6TH GOES Users' Conference
Conference Report

November 3-5, 2009
Madison, Wisconsin

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Environmental Satellite, Data, and Information Service

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FOREWORD

The Geostationary Operational Environmental Satellite - "R" Series (GOES-R) is a major, collaborative development and acquisition effort between the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA). The GOES-R series acquisition includes five different environmental instrument suites; spacecraft launch services; ground systems; and the end-to-end systems integration to support GOES-R's design, fabrication, testing, launch, and operations. GOES-R is planned to be launch ready in 2015.

NOAA is conducting a number of important outreach efforts to exchange information with the user community to ensure user readiness when GOES-R becomes operational. To further this user coordination, NOAA held the Sixth GOES Users' Conference in Madison, Wisconsin, in November 2009.

The conference was a key event that brought together industry, academia, international partners, and users. The conference enabled NOAA to show users where we are and how we plan to continue preparations for the next generation of geostationary satellites.

The goals of the conference were to:

- Continue to improve communication between NOAA and the GOES user communities
- Inform users on the status of the GOES-R constellation, instruments, and operations
- Seek ways/define methodologies to ensure user readiness for GOES-R
- Promote understanding of the various applications of data and products from the GOES-R series.

We would like to thank all conference participants, especially the invited speakers, the program committee, and all those who provided valuable suggestions for improving the future GOES program. We appreciate everyone's support of this critical satellite program.

Mary E. Kicza
Assistant Administrator for
Satellite and Information Services

EXECUTIVE SUMMARY

About 250 satellite data users gathered in Madison, Wisconsin, November 3-5, 2009, for the Sixth Geostationary Operational Environmental Satellite (GOES) Users' Conference. The conference began one day after the 50th anniversary celebration of the first successful meteorological satellite experiment that was launched aboard Explorer 7.

The GOES conference focused on current, near-term, and future capabilities. It was designed to: continue to improve communication between NOAA and the GOES user communities; inform users on the status of the GOES-R constellation, instruments, and operations; seek ways and define methodologies to ensure user readiness, and promote understanding of the various applications of data and products from the GOES-R series.

GOES-R, slated to be launch-ready in 2015, will provide critical atmospheric, oceanic, climatic, solar, and space data. These new satellites will provide the user community with significantly more data, including noteworthy improvements in temporal and spatial resolutions over data currently provided.

Attendees at the GOES conference represented government, academia, the international community, and industry. The conference featured informational briefings, oral presentations, a panel discussion, a town hall meeting, and a poster session that consisted of 85 posters representing applications from the ocean, through the atmosphere, to the stars. Posters were arranged by topic area: Atmosphere, Hazards, Imagery, Readiness/Training, Transitions, Space, Synergy, Processing, and Distribution.

The information briefings were presented in three sessions: Current Constellation, GOES-13, GOES-N Series; and EMWIN/LRIT; GOES-R Program and Earth-observing Instruments; and Solar and Space, Ground Systems and Products. A GOES-R User Readiness session featured recommendations from past GOES users' conferences, current perspectives, and education and training.

Don Berchoff, NWS/OST, gave a stimulating keynote address on "Leveraging GOES Capabilities to Maximize Response to User Needs." He said that in order to realize the full potential benefits of GOES-R, we have many challenges to overcome, including dealing with an explosion in data volume. As the data volume is increasing, the time to digest the information and make critical decisions is decreasing. Thus, the demand for decision support tools is increasing.

The lunch panel discussion featured the Status and Plans for GEO and HEO Satellites in the International Community. Items of note from this session include the international plans for geostationary high spectral resolution infrared sounders, China's exemplary satellite development program that starts with demonstrations of new instrument capabilities followed by operational implementation on subsequent satellites, and the growing interest and plans for highly elliptical orbiting (HEO) satellites complementary to geostationary (GEO) orbiting platforms. Speakers included: Jerome Lafeuille, from the World Meteorological Organization (WMO) Space Program Office; Carlos Frederico Angelis, from INPE/CPTEC; Louis Garand, from Environment Canada; Yang Jun, Director General of the Chinese National Satellite Meteorological Center; Johannes Schmetz of EUMETSAT; Dr. Devi Prasad Karnik, the Space Counsellor at the Indian Embassy; Yoshinori Yoshimura from the Japan Aerospace Exploration Agency; Ae-Sook Suh from the Korea Meteorological Administration; and Paul Menzel for Alexander Uspensky from SRC Planeta of the Russian Federal Service for Hydrometeorology and Environmental Monitoring.

The Wednesday sessions started with a comprehensive look at GOES-R User Readiness. James Gurka, NOAA/NESDIS/(OSD) kicked off the morning session with a look back at important recommendations from previous GUC conferences together with accomplishments and progress made to date. Talks on Proving Ground Activities by three producers of GOES-R proving ground pseudo-products: NOAA's Cooperative Institute for Meteorological Satellite Studies (CIMSS), and Cooperative Institute for Research in the Atmosphere (CIRA) and NASA's Short-term Prediction research and Transition Center (SPoRT) were followed by talks on CLASS, Direct Readout, and HRIT/EMWIN. Tony Mostek, NOAA/NWS/OCWWS, wrapped up the session with an Education and Training talk.

Following this session, a lunchtime town hall-style meeting was held. The idea was conceived by Chris Velden, CIMSS, who was a member of the National Research Council's Decadal Study, and chaired the session. The panel consisted of five members broadly representing the potential advanced sounder user community, along with an introduction and summary given by Abby Harper, the NOAA/NESDIS Deputy Assistant Administrator for Systems. Tim Schmit, NOAA/NESDIS/ORA, served as the session moderator.

The subject, The Need for an Advanced Sounder on GOES, was briefly introduced by Mr. Schmit, and followed with a few comments by Ms. Harper. An overview of hyperspectral sounding opportunities was given by Dr. Hank Revercomb, Director of UW/SSEC. The NWP perspectives were covered by Robert Aune, NOAA/NESDIS/ORA. NWS forecasting perspectives were given by Jeff Craven, NOAA/NWS/MKE SOO. Hurricane forecasting perspectives were covered by Jack Beven, Lead Hurricane Forecaster, and satellite focal point, NWS/TPC. International perspectives were presented by Johannes Schmetz, EUMETSAT. About 30 minutes was available after the presentations for audience discussion time. In general, the comments strongly advocated for the United States' need to have advanced geostationary sounders.

Breakout Sessions were conducted with all conference participants on Wednesday afternoon. Each participant selected and attended one theme-area group during the Breakout Session.

Theme-area groups were: Atmosphere (2 sub-groups); GOES Transition 11-R series (2 sub-groups); ABI; Training; Product Distribution, Implementation and Processing; and Ocean/Land/Solar & GLM/SEISS. Each group was asked to consider two common questions on GOES-R user readiness in addition to other pertinent theme-related questions. Pre-assigned facilitators, technical experts and scribes assisted each group during the sessions. A presenter was selected from each group to summarize the group's discussions and recommendations during the Breakout Summary Session on Thursday morning.

Important recommendations from the Breakout Sessions that centered on user-readiness included: increasing the level of communication, education and demonstration by taking GOES directly to the users — utilizing various methods and opportunities; providing simulated data products and proxy datasets for local decision aid development; and ensuring reliable program status information including launch, dates for data availability and data transition timelines.

Other important suggestions and recommendations from the groups were: better use of the current GOES series, developing COMET training modules on the GOES R ground segment and the 65 products; use of integrated and blended products, providing low-cost transition solutions to new services like EMWIN and HRIT, exploring a new concepts of operations, requiring matching formats for real-time and archived data, improving information about GOES-R Access Systems (GAS), developing a readiness plan, defining early routine scanning and special event procedures, determining how non-AWIPS users get products and services, improving outreach to NWS Offices and National Centers, and finally ensuring that the user communities are ready!

After the conclusion of the conference, the GOES-R Program Office developed responses to many of the excellent ideas and suggestions offered by the conference participants. These suggestions and recommendations, along with the NOAA responses can be found in the appendixes at the end of this report.

Plans call for the important communication with the user community to continue; the next GOES Users' Conference is tentatively scheduled for October 19-21, 2011, at the Wynfrey Hotel in Birmingham, Alabama in conjunction with the National Weather Association's Annual Meeting.

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APPENDICES

OVERVIEW

The Sixth Geostationary Operational Environmental Satellite (GOES) Users' Conference was held in Madison, Wisconsin, November 3-5, 2009. There were over 260 participants, from Government, private industry, academia, and the international community, including representatives from EUMETSAT, the World Meteorological Organization, China, Japan, Korea, India, Brazil, and Canada. The conference consisted of oral presentations, poster sessions, panel discussions, a town hall meeting, and breakout sessions, giving an overview of the current, near-term, and future GOES systems.

1. SESSION 1 — WELCOME AND KEYNOTE

1.1 Introduction – James Gurka, NOAA/NESDIS/GOES-R Program Office

The Program Committee co-chair, James Gurka, kicked off the session, welcoming the participants, and providing a brief summary of the conference logistics and events planned for the week. He reminded the participants that NOAA considers their feedback to be an essential component of the conference.

1.2 Welcome/Conference Overview/Goals – Greg Mandt, GOES-R System Program Director

The GOES-R System Program Director, Greg Mandt, welcomed and thanked the participants for joining the GOES-R team in GUC-6 to ensure that the user communities will continue to reap the benefits from the current GOES and will be ready for the transition to the GOES-R Series. Mr. Mandt reminded the audience that past GUC recommendations have had a significant impact on shaping the plans for the GOES-R instruments, spacecraft, and ground system. He said, however, we still face the daunting task of ensuring user readiness for the tremendous improvements in observational capability in the GOES-R era. Improved observations provide tremendous potential to improve environmental services to our Nation and the world. However, this potential can be realized only if our primary users, including weather forecasters, climatologists, hydrologists, NWP modelers, air quality forecasters, and space weather forecasters are prepared to receive and understand the information so that they can better serve the Nation, improving public safety and providing substantial economic benefits. Mr. Mandt said that during the conference, the GOES-R Program Office would provide the latest information on the current GOES Series and on the capabilities and acquisition status of GOES-R. He likewise requested the active participation of everyone present, providing information on how we can work together to ensure that the user communities will be ready for GOES-R on the first day of operations.

He finished by reading a proclamation from Wisconsin Governor Jim Doyle, declaring the week of November 2, 2009, Geostationary Satellite Week in the State of Wisconsin.

1.3 NESDIS/NOAA Overview and Satellite Acquisition Status – Gary Davis, Director, NOAA/NESDIS/OSD

Gary Davis, the Director of NESDIS' Office of Systems Development, provided an update on the upcoming polar orbiting and geostationary satellites and an informative history on the evolution of GOES. Included in his topics were news items from the National Polar-orbiting Environmental Satellite System (NPOESS): 1) Potential NPOESS management restructuring continues to be evaluated, including possibility of oversight by the Office of Science and Technology Policy (OSTP). 2) The Visible Infrared Imager Radiometer Suite (VIIRS) will come out of thermal vacuum and be shipped to the NPP spacecraft in November 2009. 3) The Cross-track Infrared Sounder (CrIS) is back in thermal vacuum, and will not be ready for delivery until June 2010. 4) NPP launch will be in the summer of 2012, slipping from January 2011.

Scatterometers: NOAA is negotiating with the Japanese Aerospace Exploration Agency's (JAXA) Global Change Observation Mission (GCOM) on potential for the GCOM W2 satellite to host a scatterometer as follow-on to the QuikSCAT mission.

Radio Occultation: For Taiwan's follow-on to COSMIC, NOAA will build its own GPS receivers and provide to Taiwan, as part of a 2011 budget initiative. For the follow-on to Jason2: a 50/50 split with EUMETSAT has been approved in the U.S. Federal budget.

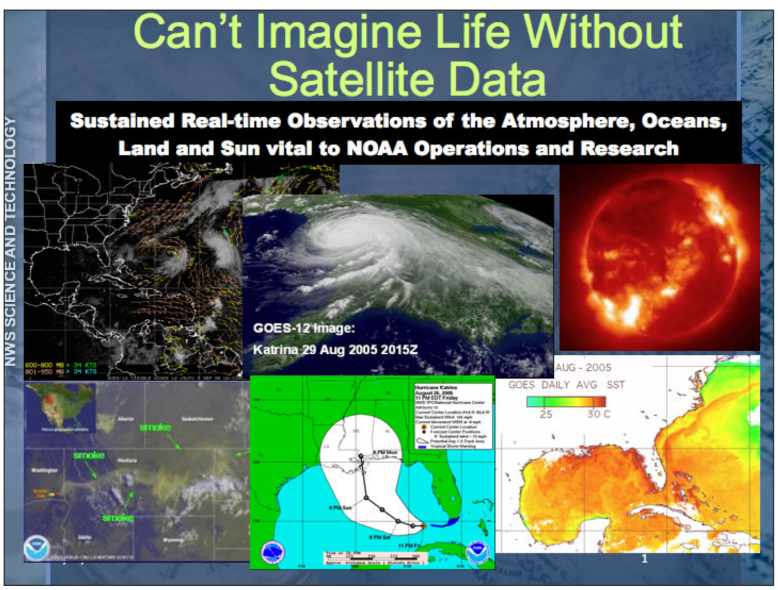
GOES Satellites: The success of the meteorological experiments carried aboard the Applications Technology Satellites (ATS) led to NASA's development of a satellite specifically designed to make atmospheric observations in a geostationary orbit, 35,786 km above the equator. NOAA's GOES program began in this cooperative period when NASA designed, built, and launched the first two geosynchronous meteorological satellites: Synchronous Meteorological Satellite-1 (SMS-1) in May 1974 and SMS-2 in February 1975. These two spacecraft were the prototypes for the NOAA GOES program. GOES-1 was launched on October 16, 1975, followed by GOES-2 and 3, which were similar and provided continuity of service. The primary instrument on the SMS 1-2 and GOES 1-3 spacecraft was the Visible/IR Spin Scan Radiometer (VISSR), Professor Vern Suomi's conceptual design. The VISSR, a true radiometer, provided day and night observations of cloud and surface temperatures, cloud heights, and wind fields.

GOES-4, launched in 1980, advanced meteorologists' capabilities by continuously profiling vertical temperature and water vapor. This major advancement permitted for the first time, the monitoring of frame-to-frame movement of water vapor concentrations, a technique introduced by the European Meteosat-1 satellite. Meteosat-1 did not have profiling capability, but pioneered water vapor imaging in 1977. This new capability led to a greatly improved knowledge of global atmospheric circulation by revealing motions in clear areas where no visible clouds were present.

GOES-8, the first 3-axis body-stabilized geostationary environmental satellite, was launched in April 1994, with the first fully independent sounder along with a newly designed imager. The GOES system has continued to improve with new technological innovations and sensors. To date there have been 16 U.S. geostationary weather/environmental satellite launches: two SMS (1974-75) and 14 GOES (1975-present, with one launch failure).

Mr. Davis also discussed the deactivation of GOES-10 and the likelihood of replacing GOES-12 with GOES-13, and moving GOES-12 to replace GOES-10 for South American coverage. He stressed the need for dialogue between NESDIS and the user communities on the pros and cons of plans for GOES-R following the checkout period. The decision to be made is whether GOES-R should be employed directly into operations, or whether it should go into storage mode. In the context of discussing the lunch panel topic on hyperspectral sounding in geostationary orbit, Mr. Davis stated that some of our international partners, including EUMETSAT and China, are catching us and passing us in geostationary satellite capabilities.

1.4 Keynote Address: "Leveraging GOES Capabilities to Maximize Response to User Needs" – Don Berchoff, NWS/OST Director



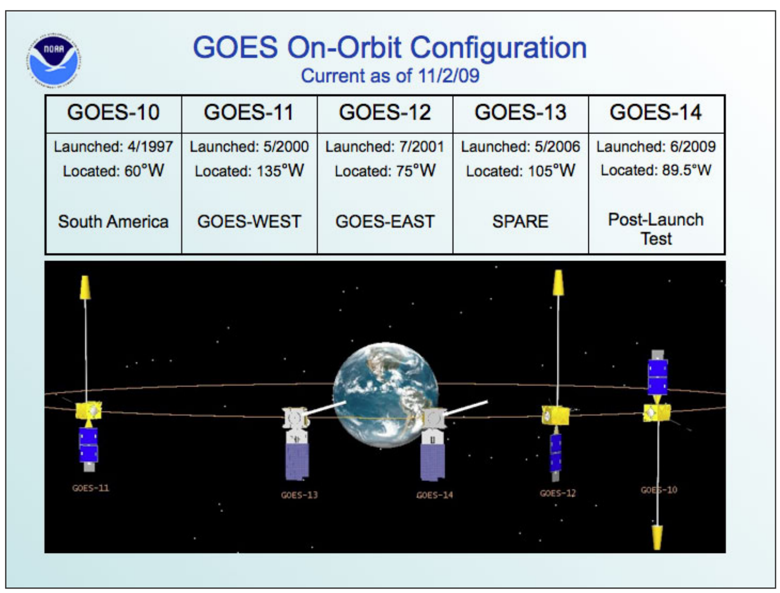
Don Berchoff, Director of the NWS Office of Science and Technology, presented the keynote address, titled: "Leveraging GOES Capabilities to Maximize Response to User Needs." He started with a review of the progress made in improving the capabilities of GOES from the launch of GOES-1 in 1975 to the present. GOES observations are a critical part of NWS operations, providing essential information on hurricanes, severe convective storms, flash flood potential, climate variability, space weather and input to numerical weather prediction.

He noted that the exciting possibilities for GOES-R include: greater high impact event warning lead times to reduce loss of life and property; contribution to storm scale modeling and forecasts, critical to enhancing people's lives and the Nation's economy; and improved solar/space monitoring and forecasts to mitigate impacts to vital national infrastructure assets. In order to fully realize the potential benefits of GOES-R, we have many challenges to overcome, including dealing with an explosion in data volume. As the data volume is increasing, the time to digest the information and make critical decisions is decreasing. Thus, the demand for decision support tools is increasing. U.S. industry needs the most accurate, accessible, timely and reliable weather data to make critical decisions that impact our national economy. Weather impacts on aviation alone in 2007 amounted to $41 billion. In order to mitigate this impact, one of the major challenges for the NWS is to enable "warn-on-forecast" for severe weather, including severe thunderstorms, tornados, and convective initiation, with the target of a 60-minute lead time for the first two events and a 30-minute lead time for convective initiation. Another challenge is to overcome observational stovepipes and to integrate development efforts based on the unique strengths inherent to each observing system. Mr. Berchoff outlined the strategic goal as taking observations from a variety of sources and combining all observations into a single merged source, the "weather cube," whether the data be from radiosondes, polar orbiting satellites, geostationary satellites, radar, or Numerical Weather Prediction. Mr. Berchoff summarized by saying that GOES has proven its operational value, and GOES-R will provide exciting new capabilities. He closed by challenging the group to translate these improved observations into societal benefits by building enabling technologies and architectures and by forging strong partnerships.

2. SESSION 2 — INFORMATION BRIEFINGS I – Current Constellation, GOES-13, GOES-N Series and EMWIN/LRIT

2.1 GOES Satellite Constellation Status Update – Chris Wheeler, NESDIS/OSO

Chris Wheeler, the Office of Satellite Operations' GOES Team Lead, gave a talk presenting the current status and near term future of GOES satellites. His topics included: GOES On-Orbit Configuration, GOES Spacecraft Overview, GOES Spacecraft Status, GOES-10 Decommission Plan, GOES East Transition, Imager Stray Light Effects and GOES Variable Data (GVAR) changes for GOES-14 and GOES-15.



He announced the draft plan for NOAA to replace GOES-12 with GOES-13 in April 2010, which will have minimum impact to GOES constellation fly-out scenarios. The goal is to complete transition prior to the 2010 hurricane season. This will be a similar sequence to the GOES-8/12 transition and provides significant test periods for the Office of Satellite Data Processing and Distribution and direct users to evaluate ingest systems. The proposed plan will not require users to re-point antenna systems during drift period. It also incorporates a single GVAR switch from GOES-12 to GOES-13.

Mr. Wheeler also reported that the GOES-10 instruments and communication services will be de-activated Dec. 1, 2009, due to end of fuel life, and that there will be some interruptions in South American imaging operations for at least a few months. If the plan is approved, GOES-12 would be available for South America coverage beginning in May 2010.

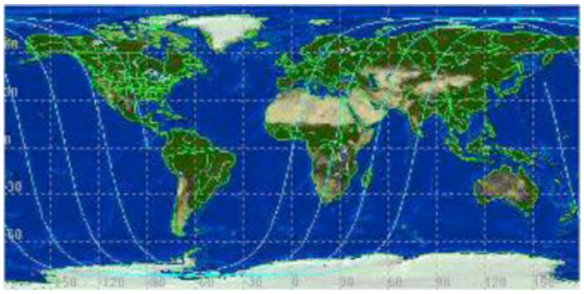
It was also noted that the new GOES N-P design allows for continuous imaging operations through eclipse, and this has been verified through post-launch testing and GOES-13 operational periods. However, solar stray light contamination is observed when the sun is <10-15 degrees from the image frame. A software fix has shown promise in resolving this issue.

Mr. Wheeler also reported GVAR format changes for GOES-O/P including that GOES-O/P imagers have an additional 8th IR detector, and important calibration changes could be found at: http://www.oso.noaa.gov/goes/GOES-calibration/index.htm The changes to the GVAR format on GOES-O (GOES-14) and GOES-P require users (or their ingest manufacturer supplier) to adjust their ingest hardware/software to accommodate for these changes.

2.2 GOES User Services Overview – Brian Hughes, NESDIS/OSDPD

Brian Hughes, from the Satellite Services Division, reported on the Polar-Orbiting Operational Environmental Satellite (POES) and GOES programs. NOAA has a two-polar satellite constellation; one in a morning orbit and one in an afternoon orbit. New polar satellites are launched upon failure of an imager or sounder. This continuity of operations has been maintained since early 1960s. Since May 2007, NOAA has been using a EUMETSAT satellite operationally for mid-morning orbit through a NOAA/EUMETSAT partnership.

Using GOES, NOAA operates two geostationary satellites with an on-orbit spare. GOES has maintained a continuity of operations since 1974.



2 p.m. Orbit

10 a.m. Orbit

Within OSDPD, the Satellite Services Division serves as the primary interface with the user community of environmental satellite data and products as they:

- Work alongside research in the development of products and services from NOAA's satellites
- Evaluate new products for operational usefulness
- Solicit feedback from users on the performance and usefulness of operational satellite products and services
- Provide analysis and interpretation of satellite products; natural hazard mitigation
- Manage the data collection and Search and Rescue missions on board the NOAA satellites
- Provide unique services such as OSEI, Web Pages, GIS, Google Earth.

The Satellite Services Division further:

- *Provides* real-time notifications to users and stakeholders of any type of activity affecting product ingest, processing or distribution
- *Maintains* "One Stop Shop" Help Desk responsible for the monitoring of many operational OSDPD products and services, and serves as the "first line" information portal for users with problems or questions about products
- *Serves* as the conduit of information between users and the Product Area Leads (PALs), concerning inquiries about product or dissemination specifics
- *Enhances* the knowledge transfer between OSDPD and stakeholders, concerning new or enhanced products or services, changes to operational or experimental satellite systems, and facilitates the transition of products from research to operations (R2O).

Major worldwide users include: the National Weather Service, private industry, universities and cooperative institutes, international meteorological services: Central and South America, New Zealand, France among other countries; research institutions, Volcanic Ash Advisory Centers, the media, private users, the Direct Broadcast community, NOAAPORT, GeoNetcast, the general public, and the Internet.

2.3 Current Use and Benefit of GOES data within NWS – Louis Uccellini, NWS/NCEP Director

Dr. Louis W. Uccellini, Director of the National Centers for Environmental Prediction (NCEP), presented a talk on the current use of GOES data in NCEP Numerical Forecast Models. He reported that use is rather limited because in the short-range models (RUC perspective), the relative accuracy of Derived Product Images is an issue, and in the longer range models (GFS perspective) the limited domain precludes wider use.

NCEP has recently studied the utility of conventional satellite and aircraft observations, as well as non-conventional satellite radiance observation types, with respect to "model dropouts" where the GFS models under perform at a certain threshold. The preliminary findings are:

- May not be a model issue; remedial action includes using ECMWF analysis in GFS with very positive results within existing model system
- Analysis to date has focused on conventional satellite, and aircraft observations
- Could be bias issues in various data
  - Warm bias in aircraft data
  - Bias, altitude assignment and QC issues with satellite winds
  - Potential impact compounded by over sampling (aircraft and satellite)
- Could have analysis issue with respect to how the observation biases are handled, especially in the tropics and the Southern Hemisphere
  - Size of analysis window (2.5 of the GFS vs. 6 or 12 hr for NCEP models) could be an important issue
  - Bias can influence the background guess causing deviations from truth that are perpetuated by the cycling
- Specific data sets appear to contribute: Satellite Winds, Aircraft

In summary, Dr. Uccellini noted that the combined use of GOES/POES continues to provide a foundation for NWS warnings and forecasts, with overall satellite data providing more than 99% of input into the models, but that the current use of GOES data in models is limited due to quality-control issues, coverage and the inability to take full advantage of improved temporal resolution. The future use of GOES-R Advanced Baseline Imager (ABI) expanded coverage and more rapid updates of full disc are critical advancements that should lead to improved model outputs.

2.4 Operational GOES Hazard Overview in the Satellite Analysis Branch – Jamie Kibler, NESDIS/OSDPD

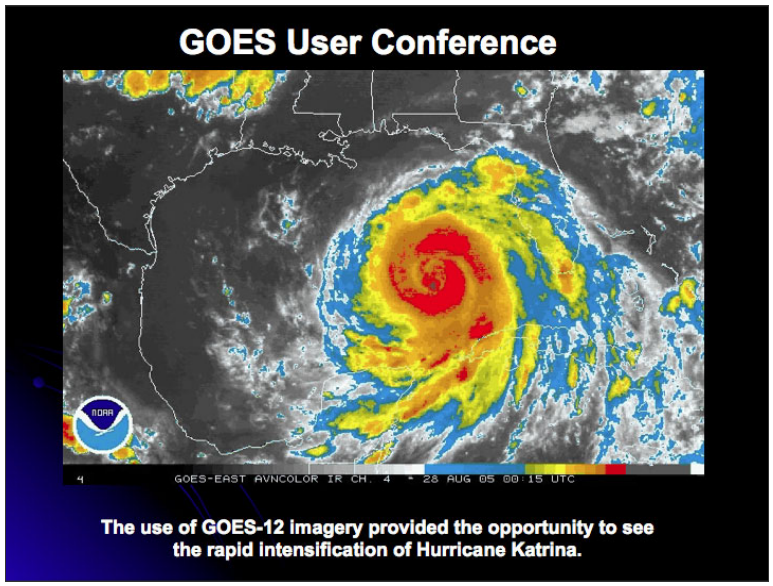
Jamie Kibler, from the Satellite Services Division, reported on the scope and impact of several key operational satellite programs to the hazards community. These are:

The Smoke, Fire, and Air Quality Program: The Satellite Analysis Branch (SAB) performs a smoke and fire analysis in which GOES satellite imagery plays a large role in the overall operations. A smoke and fire analysis is done across the continental United States, Hawaii throughout the year, and also Alaska and Canada from May through October. The SAB product is merged with the analysis from the Servicio Meteorologico Nacional (SMN) in Mexico and the Water Center for the Humid Tropics of Latin America and the Caribbean (CATHALAC) in Panama for a full North America smoke and fire product.

The Precipitation Program: The Satellite Analysis Branch (SAB) Precipitation Program plays an important role in monitoring areas of potential flash flooding and heavy snowfall. Their main focus is on short term trends and rainfall estimates. They provide support to the National Weather Service (NWS) Weather Forecast Offices (WFOs), River Forecast Centers (RFCs) and the Hydrometeorlogical Prediction Center (HPC). GOES satellite imagery plays an important role in these operations due to the high temporal resolution.

The Volcanic Ash Program: As one of the worldwide Volcanic Ash Advisory Centers (VAAC), the Volcanic Ash Program at the Satellite Analysis Branch (SAB) monitors volcanic activity across North America, northern South America and large areas of the Pacific and Atlantic Oceans basins. The main objective of the program is to monitor volcanic eruptions using satellite imagery and to issue advisories providing ash locations and forecasts. GOES satellite imagery plays an important role due to the high temporal refresh. The primary customer of the volcanic ash program is the aviation community.

The Tropical Program: The Tropical Program at the Satellite Analysis Branch (SAB) monitors tropical systems across the entire world. Geostationary satellite imagery plays an important role, especially GOES which is primarily used in the Atlantic and Pacific Ocean basins. Analysts apply a technique called the Dvorak technique, which uses enhanced infrared and/or visible satellite imagery to quantitatively estimate the intensity of a tropical system. One of the main customers of the Tropical program is the National Hurricane Center (NHC).



2.5 Current GOES Direct Readout Overview – Paul Seymour, NESDIS/OSDPD

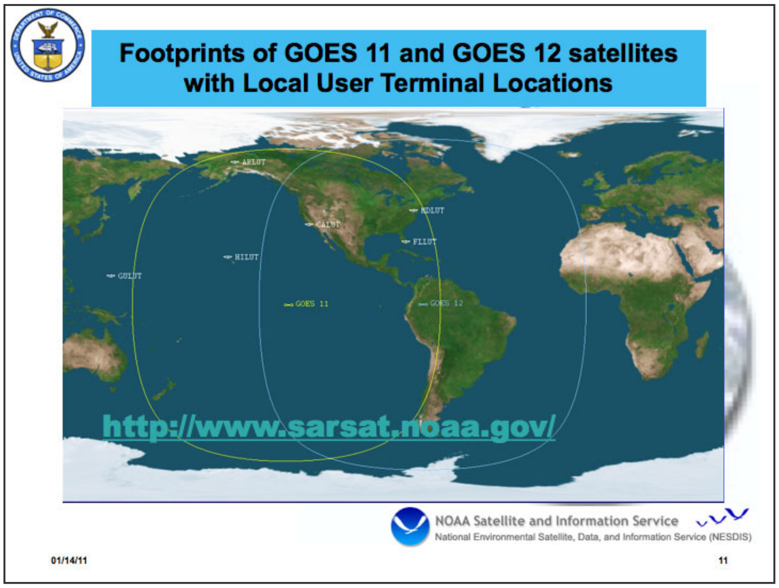
Paul Seymour from the Satellite Services Division reported on several Satellite Direct Services. He discussed how GVAR formatted data is used primarily to transmit Imager/Sounder data from GOES Satellites and what type of changes are expected in the GOES-R era. The Direct Services mentioned were: Direct Collection Services (DCS), the Search and Rescue Satellite Aided Tracking (SARSAT) System, the Low Rate Information Transmission (LRIT), and the Emergency Managers Weather Information Network (EMWIN).

GOES DCS is the data services for the collection of environmental data in real-time from more than 30,000 remote data collection platforms located across the GOES footprint. http://www.noaasis.noaa.gov/DCS/

DCS improvements underway are:

- New ground system (DADDS) in operation
- New transmitters to cut channels in half, double capacity coming soon

- Finishing conversion to faster transmitters, eliminating slower (100 bps) transmitters
- Future implementation of available 2-way communication capability
- Allowing more frequent observations (1 hour instead of 3 or 4 hour repeat cycle)



As an integral part of the worldwide search and rescue program, NOAA operates the Search and Rescue Satellite Aided Tracking (SARSAT) System to detect and locate mariners, aviators and recreational enthusiasts in distress anywhere in the world at anytime and in almost any condition. http://www.sarsat.noaa.gov

The Low-Rate information Transmission (LRIT) system is the delivery of imagery products to comparably low cost receive systems. http://www.noaasis.noaa.gov/LRIT Products include:

- GOES images: Visible, Infrared and Water Vapor
- Environmental products including tropical storms
- Graphic images of MTSAT/MSG in JPEG
- Copy of DCS and EMWIN Stream, Administrative Text Messages

Upcoming changes include:

- Advances in LRIT system / Reliability increased
- New DCS delivery application from LRGS's at Wallops Island
- New Imagery Processing Hardware
- New Domain 4 communications module hardware and updated application
- Redundant system in place by December 2009
- Upgrades at the CDA Wallops Island

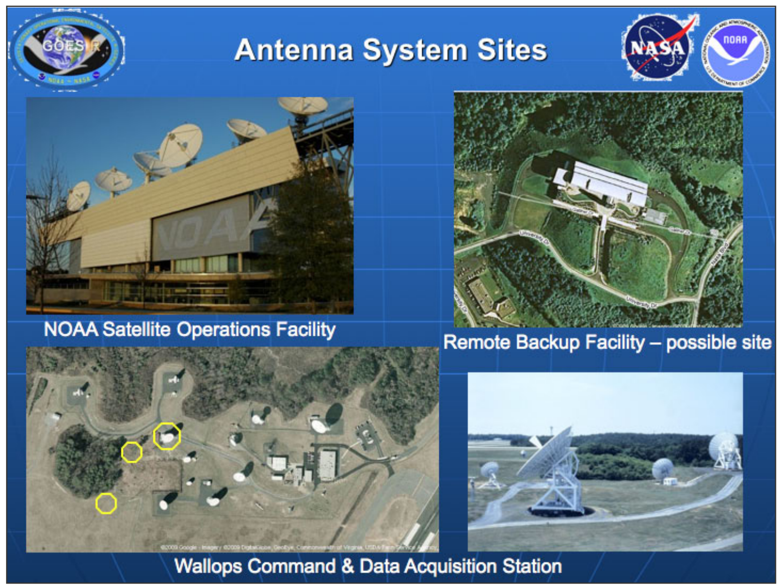
EMWIN is a reliable, low cost, weather warning and data broadcast system providing free and rapid dissemination of warnings, forecasts, graphics and imagery in the Americas, the Caribbean and Pacific Rim that has been in operation for over 14 years.

The goal of EMWIN is to inform emergency managers and the public as quickly as possible of pending weather threats, increasing the likelihood of saving lives and property. EMWIN is a National Weather Service Network, disseminated via GOES and the Internet. http://www.weather.gov/emwin/index.htm

3. SESSION 3 — INFORMATION BRIEFINGS II — GOES-R Program and Earth-Observing Instruments

Chairpersons: Chris Velden and Jaime Daniels

3.1 GOES-R Program Status – Greg Mandt, NOAA/NESDIS/OSD, GOES-R System Program Director, Greenbelt, Maryland



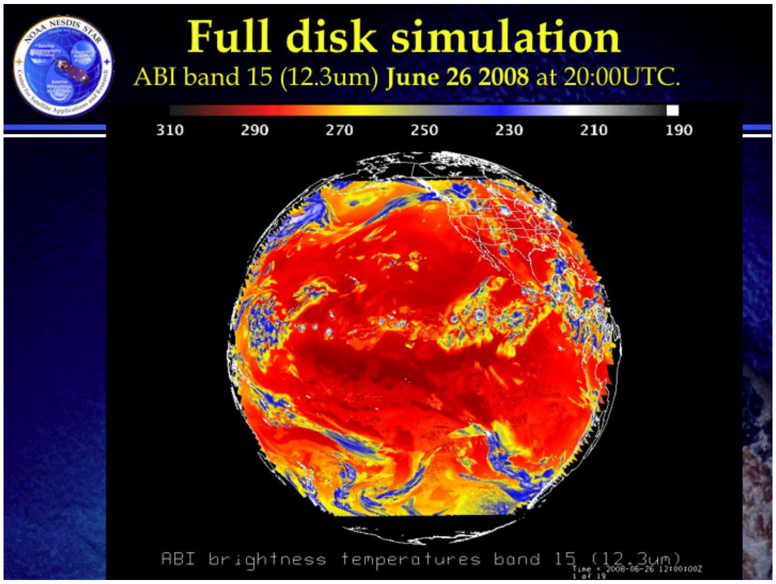
The session began with a presentation by Greg Mandt who provided the status of the GOES-R program. He reported that the GOES-R sensor design and development activities are well underway and making great progress. The Advanced Baseline Imager (ABI) model was currently in testing; the Geostationary Lightning Mapper (GLM), Extreme Ultraviolet and X-ray Irradiance Sensor (EXIS), Solar Ultraviolet Imager (SUVI), and Space Environment In-Situ Suite (SEISS) instruments were headed toward Critical Design Review (CDR). GOES-R spacecraft development was progressing well as it moves toward System Design Review (SDR). Significant progress was reported on the GOES-R Ground Segment (GS) development. Harris was selected as the ground segment contractor and is now onboard and working toward its Integrated Baseline Review (IBR) and preliminary design. The Government's Algorithm Working Group (AWG) is making significant progress in developing the GOES-R Level-2 product algorithms and Algorithm Theoretical Basis Documents (ATBD) for the baseline Level-2 products. Finally, Mr. Mandt reported that the GOES-R Proving Ground activities are well underway and stressed that these activities will help ensure GOES-R user readiness.

3.2 GOES-R Spacecraft – Jamison Hawkins, Lockheed Martin

Jamison Hawkins discussed the A2100-Based GOES-R spacecraft bus design and highlighted several of its notable elements. First, it will allow for instrument operation through daily station-keeping and momentum adjusting maneuvers. Second, the yaw flip operation is expected to improve radiometric response. Third, the ABI and GLM instruments are mounted on a stiff optical bench that is expected to lead to high fidelity instrument navigation and registration performance. Mr. Hawkins also noted the development was on schedule.

3.3 The ABI (Advanced Baseline Imager) on the GOES-R Series – Tim Schmit, NESDIS/ORA, Madison, Wisconsin

Tim Schmit's presentation highlighted the temporal, spatial, and spectral advances of the GOES-R ABI instrument over today's GOES imager instruments. The GOES-R ABI's 16 bands offer improved spectral coverage, and will be available at 2km resolution IR, while the visible bands will be available at either 0.5km or 1km. The faster imaging capability of the ABI will enable the collection of significantly more observations in a shorter amount of time. The instrument will support flexible scanning scenarios that include the collection of observations over full disk, CONUS, and mesoscale sectors with temporal refreshes that are dependent on the scanning mode. Mr. Schmit showed numerous examples of how these advanced attributes will be used and leveraged in a wide range of qualitative and quantitative weather, oceanographic, climate, and environmental applications aimed at meeting a broad spectrum of user needs. He also showed examples of simulated GOES-R ABI imagery that cover the full-disk, CONUS, and mesoscale domains. As part of GOES-R Proving Ground work being done at CIMSS, Mr. Schmit showed what this imagery looks like in the legacy AWIPS system. He also showed examples of simulated GOES-R imagery centered over Hurricane Katrina.



3.4 The ABI Instrument Development – James Gurka, NOAA/NESDIS, GOES-R Program Office, Greenbelt, Maryland

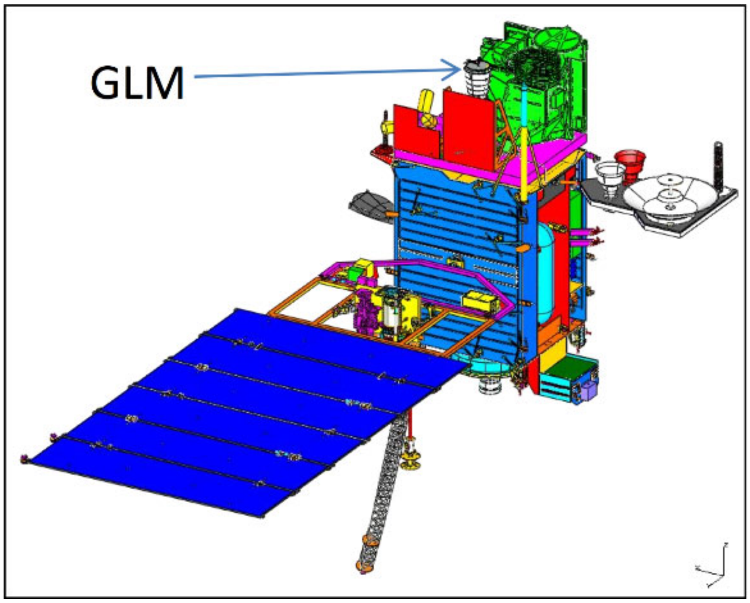
James Gurka's presentation highlighted the strengths of the ABI and provided a status of the ABI instrument development activities. The strengths of the ABI are:

- Its scans are parallel to the equator with no image plane rotation which greatly simplifies the ground processing
- It does not require a yaw flip
- Its scan patterns and rates are fully configurable on orbit
- Its optimized system delivers data with no gaps and little overlap
- INR performance will be achieved for all image scans, not just the full disk scan
- Its rapid slews will generate little spacecraft disturbance.

It was reported that the ABI development activities are well underway and progressing well. Most notably, the ABI Prototype Model (PTM) has been built, integrated, and is currently in the midst of instrument level testing that is demonstrating the fidelity of the ABI design. This testing has demonstrated that scan Modes 3 and 4 work, custom timelines work, the mechanisms for collecting data and adjusting instrument performance are working well, and data collection efforts are providing real data to analysis teams and software. With respect to the Protoflight Model (PFM), it was reported that many of its components and some of its assemblies are currently in production.

3.5 The GLM (Geostationary Lightning Mapper) on the GOES-R Series – Steve Goodman, GOES-R Program Senior Scientist, Greenbelt, Maryland

Steve Goodmans's presentation provided an overview and update of the GOES Lightning Mapper (GLM) instrument. He reviewed the GLM instrument characteristics and clarified the Level-1 and Level-2 requirements for lightning detection. The Level-1 component includes events; the Level-2 components include groups and flashes. He presented an overview of the Level-2 components of the lightning detection algorithm and presented examples of the TRMM Lightning Imaging Sensor (LIS) data and products noting the synergies between natural hazards and lightning. The LIS data are serving as an excellent source of GLM proxy data for use in ongoing GOES-R lightning detection algorithm development and validation activities. Mr. Goodman also showed use of VHF Lightning Mapping Array (LMA) data as a GLM proxy data source for testing and validation of lightning detection algorithm. He then highlighted GOES-R Proving Ground activities aimed at preparing users for the new GLM data and products. GLM Testbeds are located in Huntsville, AL; Norman, OK; Sterling, VA; and Cape Canaveral, FL, where GLM algorithm developers and forecasters are involved in demonstrations and training activities that utilize GLM proxy datasets. He discussed user readiness from the perspective of data assimilation and summarized a Joint Center for Satellite Data Assimilation (JCSDA) 2010 Data Assimilation Initiative that solicits proposals for model impact studies that involve the use of future advanced satellite-based instruments to improve forecasting of severe weather events (hurricanes, flash flooding, etc) at both global and regional scales. Mr. Goodman concluded his presentation by summarizing some new risk reduction and advanced product initiatives involving the use of data from combined sensors/platforms to better understand the lightning connection to thunderstorm updraft, storm growth, and storm decay.



3.6 GLM instrument Development – Hugh Christian, Lockheed Martin/University of Alabama at Huntsville, Huntsville, Alabama

In the final presentation of the session, Hugh Christian discussed the overall GLM system concept and the design and expected performance of the GLM instrument. As part of this discussion, he provided a review of the Low Earth Orbit (LEO) optical lightning detection instrument heritage that included the Optical Transient Detector (OTD) and LIS technology. He went on to review the GOES-R GLM mission objectives that include: providing continuous full-disk lightning measurements for storm warning and nowcasting; providing sufficient temporal resolution to allow tracking of each lightning flash within a specific storm cell and calculation of its optical center over time; providing longer warnings of tornadic activity; and accumulating a long-term database to track decadal changes in lightning activity. He then discussed the key instrument design parameters for being able to detect lightning over the full disk and followed this with descriptions of the GLM sensor unit components. Given that peak lightning activity occurs during the daytime, one of the challenges for the GLM instrument is to be able to detect a weak lightning signal against a bright cloud background. This challenge has been met by a GLM instrument with high SNR and sensitivity that allows for lightning events to be detected. He noted that experience with LIS data provides insight and methodology for efficient GLM false event removal that should ensure compliance with the PORD75 False Event Rate requirement. He concluded his talk with a brief description of the numerous ground processing algorithms needed to process the raw GLM data into a scientifically meaningful product.

4. SESSION 4 — Information Briefings III — Solar and Space, Ground Systems and Products

4.1 GOES-R Solar and Space Environment Data Products: Benefiting Users – Joe Kunches, NOAA/NWS/STIB, Boulder, Colorado

Joe Kunches' presentation highlighted how GOES data serves space weather users, past, present, and future. NOAA's priority is continuity with earlier GOES measurements in a cost effective manner. At the same time, we must satisfy the needs of our customers. So, while there are changes in the instrument suite for GOES-R, the changes are essentially incremental adjustments to better meet those needs. Mr. Kunches emphasized that GOES data are the bedrock for space weather products and services, on which two of three widely used NOAA scales are built.

Mr. Kunches noted that many space weather observations are made from Earth's surface. The Space Weather Prediction Center (SWPC) uses data from ground-based magnetometers, solar telescopes, ionosondes, and Global Positioning System receivers. There are also non-NOAA space assets. While these spacecraft are not operational in the NOAA sense, they provide substantial and in some cases huge improvements in forecasts. For example, the Advanced Composition Explorer (http://www.srl.caltech.edu/ACE/) makes in situ measurements of particles and fields and provides crucial short term warnings – with very high confidence – for the onset of major solar geomagnetic and radiation storms. The Solar and Heliospheric Observatory (http://sohowww.nascom.nasa.gov/) provides observations of coronal mass ejections that give 1-3 day warning of geomagnetic storms.

Space weather observations are used to protect life and property of those adversely impacted by space weather conditions. Space weather consists of complex phenomena with significant societal and economic impacts such as rerouting polar air traffic, delaying deep-sea drilling operations as well as surveying activity, and affecting electric power distribution. In addition, other key impact areas are communications (HF, VHF, and SatComm), human exposure, effects on Global Navigation Satellite Systems, and avionics. The key to mitigating environmental hazards is the integration of the terrestrial weather and the space weather products and services. In partnership with the Aviation Weather Program, the new space weather products serving our GPS and aviation customers will be incorporated into the NextGen 4D Database of aviation weather data. This will provide a seamless interface to the full information needed by decision makers to mitigate the impacts of terrestrial and space weather storms.

As space weather users grow and diversify in the coming decade, space weather data and products from GOES provide the foundation for support to new systems, products and services.

4.2 GOES-R Ground Systems – Your Portal to the Future – Robin Pfister, Deputy GOES-R Ground System Project Lead, Greenbelt, Maryland

Richard Reynolds from the GOES-R Ground Segment Project (GSP) presented on Robin Pfister's behalf. He provided an overview of the GOES-R concept of operations that included requirements development, operational scenarios to be defined by the "core ground segment contractor" (Harris Corporation of Melbourne, FL), and that operational details would be refined during testing conducted by the Mission Operations Support Team and Data Operations Support Team. Mr. Reynolds also highlighted a GOES-R notional functional overview that includes the following elements: Mission Management, Product Generation, Product Distribution, and Enterprise Management.

Mr. Reynolds provided a detailed list of roles and responsibilities for both the Government as well as the contractor, and described the execution of the contract, project schedule and major project milestones. The GOES-R GSP and the contractor have established several mechanisms to ensure the GOES-R program stays on track, and to support the primary mission operations goals to safely launch and operate the GOES-R series spacecraft, to design, develop, integrate, and test the ground segment in a manner that minimizes costs, and to provide cost-effective ground segment sustainment and maintenance once transitioned to Government operations.

4.3 GOES-R Ground System – Denny Hansen, Harris Corporation, Melbourne, Florida

Denny Hansen provided a comprehensive overview of the GOES-R ground segment, describing the flexible architecture, operating system and commercial off the shelf (COTS) software tools that will be employed to maximize user benefit. He noted that the products generation and distribution architecture being developed resolves several challenges, including processing of a continuous data stream, interdependence of data and products to create the final output product set, finite limitations of available computers and software, and architecture obsolescence in the face of evolving COTS computer hardware/software products.

Mr. Hansen depicted a products and user dashboard showing the health and status of products and the ability of users to receive them. This will allow restoral activities to be initiated and identification of the root causes of any problems affecting generation or distribution of products and services. A key feature of the ground segment is use of a COTS-based solution for the satellite command, telemetry, and mission planning functions using components proven on other missions. The GOES-R architecture has been designed for flexibility, scalability, expandability and availability, and the service-based architecture eases the introduction and deletion of product services.

4.4 GOES-R Access System (GAS) – Reginald Lawrence, NOAA/NESDIS, Silver Spring, Maryland

Reginald Lawrence described the GOES-R Access Subsystem (GAS), a subsystem of the GOES-R ground segment system. He noted that GAS is responsible for receiving and storing GOES-R data and products in 7-day temporary storage and making them available to authorized users. GAS will be developed and integrated as a part of an enterprise NESDIS data processing and distribution operational capability, such as the NESDIS Environmental Satellite Processing Center (ESPC).

Mr. Lawrence provided details on the NESDIS functional architecture, to include the ESPC products processing and distribution, and GOES-R notional architecture and technical boundaries. He also briefly outlined the standards and formats (e.g., McIDAS, NetCDF, FITS) that will be employed, and closed his presentation with GAS milestones that included a projected delivery of a GAS capability in December 2012.

4.5 GOES-R Products and Their Algorithms – Jaime Daniels, NOAA/NESDIS, Camp Springs, Maryland

Mr. Jaime Daniels provided a brief introduction of the Algorithm Working Group (AWG), AWG progress in GOES-R Level-2 product development and validation, gave examples of products and operational applications, and closed with future work.

The purpose of the AWG is to select, develop, test, validate and demonstrate Level-2 algorithms that meet the GOES-R F&PS requirements and provide them to the GOES-R ground segment, and provide sustained life cycle validation and Level-2 product enhancements. The AWG is composed of four major teams, and leverages nearly 100 scientists from NOAA, EPA, DoD, and NOAA's Cooperative Institutes. The AWG adherence to its established processes and standards in its algorithm development activity reduces risk associated with the development of the Level-

2 product algorithms and their delivery to the GOES-R program. The outcome of the algorithm selection process is a suite of algorithms for GOES-R instruments that are expected to be computationally efficient, robust, easy to implement and maintain, and meet their respective requirement specifications.

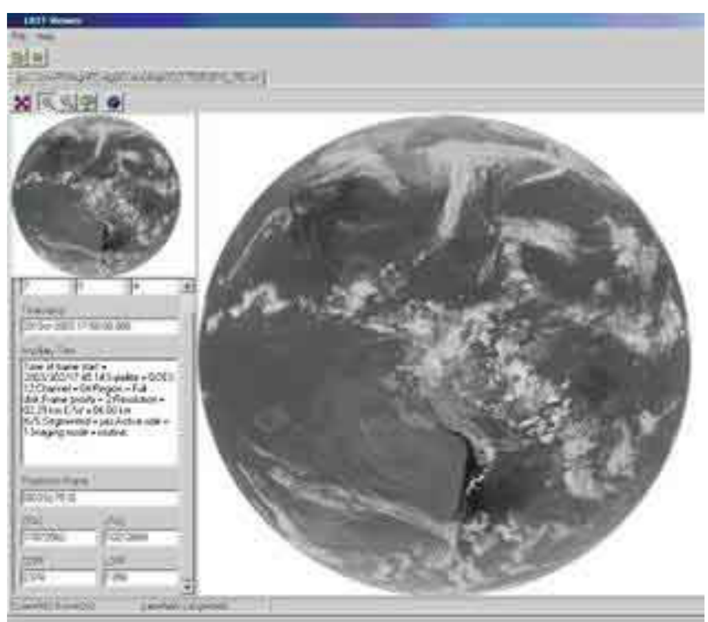
Mr. Daniels provided examples of GOES-R ABI Level-2 products and the related algorithm highlights. Cloud products discussed included cloud phase, height and sky mask. Land products presented included land surface temperature and fire/hot spot characterization. Other examples described included sea surface temperature, derived motion winds, solar insolation, snow cover, and aerosol detection.

Mr. Daniels closed his presentation by indicating that the AWG has made significant progress, establishing and executing processes and standards, and that they will continue to support user readiness and training activities.

4.6 HRIT/EMWIN – Santos Rodriguez, NOAA/NWS, Silver Spring, Maryland

Santos Rodriguez described the Emergency Managers Weather Information Network (EMWIN) as a low cost, priority-driven weather data broadcast service that provided one of the most robust NWS systems for public weather dissemination. EMWIN provides rapid satellite, VHF radio and internet dissemination of alerts/watches/warnings (longer than 1 minute), forecasts, and graphics and imagery. To learn more about EMWIN, Mr. Rodriguez requested everyone go to http://www.weather.gov/emwin/index.htm.

Mr. Rodriguez next described the Low Rate Information Transmission (LRIT), a rebroadcast of environmental data through GOES East and West. LRIT is in a digital format and is a relatively lower cost option. After GVAR imagery is collected and processed, the imagery is combined with other data sets, encapsulated into LRIT packets, and the information is sent to Wallops Island CDA for up-link to GOES 11 and GOES 12. To learn more about LRIT, Mr. Rodriguez requested everyone go to http://www.noaasis.noaa.gov/LRIT.



For the transition to GOES-R/S, Mr. Rodriguez indicated there will be a merger of EMWIN and LRIT to a new High Rate Information Transmission (HRIT)/EMWIN, with accompanying changes to the frequency, EMWIN modulation, and data rate (increase to 400 kbps). The goal is to minimize the transition impact on users, and keep user costs low while striving to improve services. He encouraged conference participants to join the demonstration of the proof of concept receiver at the poster session, and reminded everyone that documentation and software releases are available at http://www.GOES-r.gov/.

4.7 Poster Preview, Tim Schmit, NOAA/NESDIS, Madison, Wisconsin

Tim Schmit described the wide variety of GOES posters onsite, with over 80 posters available for review and discussion. Posters were arranged loosely by topic areas such as atmosphere, hazards, imagery, readiness, training, transitions, synergy, processing and distribution. Mr. Schmit then highlighted a number of specific posters available, to include GOES-R ground segment architecture, research to operations transition processes, intercalibration of GOES imagers, blended and legacy GOES products, GOES variable (GVAR) data and examples, to short and longer-range forecasts using GOES data and products.

5. SESSION 5 — GOES-R User Readiness

5.1 GOES-R Recommendations from Past GOES Users' Conferences — James Gurka, NOAA/GOES-R Program Office, Greenbelt, Maryland

James Gurka, gave a short talk about GOES-R recommendations from past GOES Users' Conferences. He touched on several recurring messages from those conferences including: user readiness on Day-1; using a proving ground - test-bed approach; using proxy and simulated data sets to test and validate data processing and distribution systems; the need for decision aids; and the importance of user education and ongoing user input.

He discussed how recommendations from past conferences have impacted GOES-R baseline instruments and plans for user readiness. He concluded by stating that NOAA and the GOES-R Program Office continue to be committed to keeping lines of communication open with the user communities using the GOES-R Web site and future GOES User meetings — with the next meeting scheduled for 2011.

5.2 GOES-R Proving Ground Activities

5.21 GOES-R Proving Ground Activities Introduction — James Gurka, NOAA/GOES-R Program Office, Greenbelt, Maryland

James Gurka described the Proving Ground mission to engage the National Weather Service in pre-operational demonstrations of selected capabilities of next generation GOES. The mission objective is to bridge the gap between research and operations by:

- Using current systems (satellite, terrestrial, or model/synthetic) to emulate future GOES-R capabilities
- Infusing GOES-R products and techniques into NWS operations with emphasis on AWIPS and transitioning to AWIPS-II.

- Engaging in a dialogue to provide feedback to developers from users

Mr. Gurka emphasized the importance of Day-1 user readiness and maximum utilization of GOES-R products and effective transition of products and decision aids to operations. He also described the rationale for proving ground activities originating from program risk reduction activities addressing user readiness. He gave some examples of the utility of user feedback into product development demonstrated at Proving Grounds. One of these was convective initiation and cloud-top cooling and the forecasters' desire to better assess storm severity by being able to monitor cloud top cooling after convection initiates with better resolution data.

Finally, he highlighted an important Proving Ground goal — to ensure a pathway into operations by developing GOES-R proxy products for the AWIPS2 environment.

5.22 GOES-R Proving Ground Activities at CIMSS — Wayne Feltz, CIMSS, Madison, Wisconsin

Wayne Feltz, NOAA's (CIMSS), provided an overview of GOES-R product demonstrations at the WFO-level (MODIS, AVHRR, AIRS derived proxy products) and at NCEP Centers Test beds (convective initiation), AWIPS Weather Event Simulations and near real-time NWP simulated ABI radiances (and introduction to forecasters of GOES-R era-like products).

Proving Ground goals were listed as: provide pre-launch satellite simulated and real-time proxy data and products to stakeholders; make data available with end-user decision support systems (AWIPS, N-AWIPS, AWIPS-2, Google Earth); and provide strength and weaknesses documentation along with training (in-field) and collaborative feedback. Mr. Feltz then showed numerous examples of simulated GOES-R data and their applications to various physical science analyses and forecasting fields.

He concluded by stating that there is vested interest in providing GOES-R like products to end-users such as NWS forecasters and FAA decision support personnel. To this end, the GOES-R AWG teams are working toward algorithms ready to produce decision support information. This GOES-R algorithm development effort has fostered new decision support applications with current imager technology (with further improvements expected with the launch of GOES-R in 2015). These areas are: Convective Initiation, Overshooting-tops, and Turbulence.

5.23 GOES-R Proving Ground Activities at CIRA — Dr. Mark DeMaria, NESDIS/ORA

Dr. Mark DeMaria, NOAA's Cooperative Institute for Research in the Atmosphere (CIRA), described a re-focused and expanded Proving Ground (PG) effort at CIRA including: remote interaction with additional WFOs, Product dissemination through NWS regions to local AWIPS, National Centers SPC, and NHC.

This also includes interactions with the Alaska Region and SPoRT (lightning applications) leveraging parallel efforts to demo NASA Earth Observing System products.

Dr. DeMaria described the CIRA efforts to expand interactions with other PG components, WFOs, and NCEP Centers, as well as leveraging ongoing CIRA/RAMMB activities. Next he gave an overview of Day-2 WFO products (e.g., Simulated Tru-Color, Low-Cloud, Volcanic Ash, snow-cover, statistical hail); he also outlined NHC demonstrations (e.g., air mass, tropical cyclone rapid intensity).

Plans call for: expanded WFO/National Center demos in coordination with CIMSS; SPoRT continues with AWIPS/AWIPS-II developments; expanding coordination with wider Proving Grounds members to demo selected AWG products; standardizing product documentation/feedback, multi-platform applications and product training.

5.24 GOES-R Proving Ground Activities at SPoRT — Dr. Gary Jedlovec, NASA

Dr. Gary Jedlovec, NASA, gave a talk describing the Short-term Prediction research and Transition Center (SPoRT) Proving Ground mission at NASA as applying NASA measurement systems and unique Earth science research to improve the accuracy of short-term (0-24 hr) weather prediction at the regional and local scale by conducting focused research, evaluating in "testbed" mode, and transitioning priority products to WFOs (end user decision support systems/tools).

He outlined the keys to success as: linking data / products to forecast problems; integrating capabilities into AWIPS / other DSS; and providing training / forecaster interaction and feedback.

A primary goal of this Proving Ground activity is technology infusion into short term weather forecasting. Dr. Jedlovec described the customer interface as 13 WFOs in Southern Region. He also described an overview of research products transitioned into operations (derived products from MODIS, AMSR-E, total lightning, combined instruments products, GOES, and GOES-R products (GLM proxy, ABI proxy) and other SPoRT Proving Ground activities related to ABI-proxy, GLM-proxy, and WRF-based lightning forecasts.

He concluded by announcing that ABI proxy imagery and products and pseudo GLM data will be disseminated to selected WFOs (early 2010) and to the Proving Ground test-bed as part of the Hazardous Weather Testbed (HWT) and 2010 NSSL Spring Program.

5.3 GOES-R and CLASS — Bob Lutz, GOES-R Ground Segment Project

Bob Lutz, GOES-R GSP, presented an overview of the Comprehensive Large Array-Data Stewardship System (CLASS), which is the information technology (IT) component of the NOAA National Data Centers: National Climatic Data Center (NCDC), National Geophysical Data Center (NGDC) and National Oceanographic Data Center (NODC). He also described how CLASS will serve as the permanent archive and provide retrospective access services for GOES-R products and the type of enhancements planned for GOES-R.

Requirements for GOES-R to CLASS data transfer were established in the Ground System-to-CLASS Interface Requirements Document (IRD). These were signed by CLASS and GOES-R Ground System managers in the summer of 2009. Enhancements of CLASS include implementation of CLASS Ingest Portals (routing capabilities) at all three GOES-R productions sites, with failover scenarios supported. Upgrades to CLASS network infrastructures are also planned.

5.4 GOES-R Direct Readout Implications — Richard G. Reynolds, SGT, Inc.

Richard G. Reynolds, SGT, Inc., gave a talk presenting upcoming changes expected with GOES-R, for user preparation both before and after operational implementation.

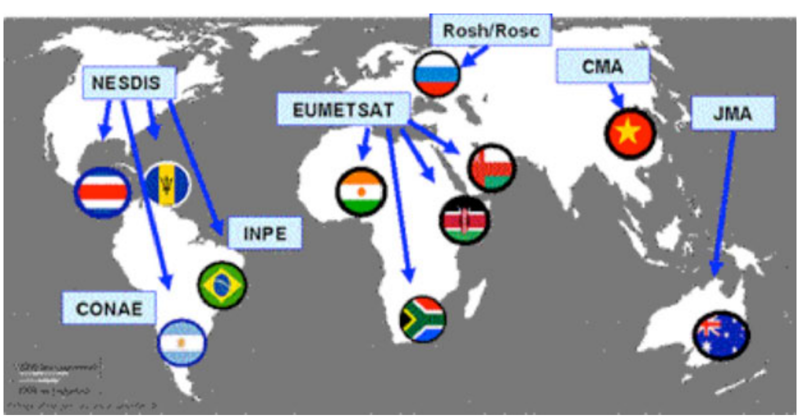
The GOES-R system requirements, communications requirements, and the Ground Segment architecture have now been defined for the entire system, including Direct Readout Services. The detailed definition of communication link characteristics are not fully finalized; they will be refined through the Spacecraft and Ground Segment contract design processes. He described the GOES-R baseline as: GRB will replace all current forms of instrument data broadcast, full resolution, geo-located and calibrated in essentially real-time.

EMWIN and LRIT will be combined and enhanced to a higher data rate on a new downlink frequency called HRIT/EMWIN. DCS will remain largely the same; however, DCPR downlink in L-Band will have a frequency shift. SARSAT will be essentially unchanged.

Documentation for the Direct Readout User community will be produced by the GOES-R Ground System contractor as CDRLs. Of particular note, the Ground System Contractor (Harris Corporation) will be developing a Product User's Guide (PUG) that will include a section on building a GRB receive system.

5.5 Education and Training — Tony Mostek, NWS

Tony Mostek gave a talk presenting the current status and overview of the major training initiatives in the National Weather Service. He also described training programs in NOAA with its international partners and the interaction between VISIT, COMET, NWS Training Division, WMO, and EUMETSAT Bilateral Programs.



He further outlined an overview of: training program needs assessment; a description of the Satellite Hydromet Course (tracks for interns, forecasters, tropics, and hydrologists); an overview of Learning Management System (LMS); and feedback from satellite training workshops.

He also presented some of the challenges for the GOES-R era, including increased data flow and data integration issues and the opportunities to make improvements before launch. He also asked some probing questions for the community to consider related to rapid changes in technology and operations: How can NOAA improve how it prepares for new satellites? How to get Products and Services to more NOAA Users? How can Training Programs work most effectively with Proving Ground to connect Development and Operations?

Lastly, he reported that management support for future training is continuing to increase with new budget support for training from Assistant Administrators, Office Directors, and stakeholders from all the NOAA Offices.

6. SESSION 6 — Breakout Questions/Issues/Logistics — Co-chairs: Tim Schmit and Tom Renkevens

Session 6 introduced the break-out sessions. This included the questions, issues, and logistics. The issue of user readiness was introduced by Mike W. Johnson, NWS Office of Science and Technology. In addition, the "Rules of Engagement" were discussed by Kathleen Paris, the lead professional facilitator.

6.1/6.2 Introductions to the various breakout groups with issues they will discuss and Logistics. Overview of break-out sessions and questions

Tim Schmit and Tom Renkevens presented the overview of the Breakout Sessions. This Breakout Session was conducted with all conference participants on Wednesday afternoon. Each participant selected and attended one theme-area group during the Breakout Session. The theme area groups were: Atmosphere Session A & B, GOES Transition – 11 through R series Session A & B, ABI, Training, Product Distribution, Implementation & Processing, and Ocean/Land/Solar & GLM/SEISS. Tim and Tom outlined the issues for the groups to consider and the questions that needed to be answered by each group, including the two common questions that each group was being asked to answer.

6.3 Development of NWS Satellite User Readiness – Mike W. Johnson, NWS Office of Science and Technology

Mike Johnson presented a talk on the Development of the NWS's Satellite User Readiness. He organized his presentation around three areas: 1) Satellite products in context of the broader strategic goal, 2) Preparing NWS for future satellite products, and 3) NWS user-system readiness for GOES-R.

He began with the NWS strategic goal to develop a fully integrated observation system along with analysis tools to fully exploit data and enable strategic warn-on-forecast stretch goals. Since forecasters won't have time to analyze the growing amounts of observational and model data, there is a need to assimilate observations from multiple platforms into products that directly address forecast and warning needs. The end-state objective will be that the system automatically analyzes the data and determines when the forecaster needs to react – the main strategic goal.

Since the NWS will not fully realize this goal on Day-1 GOES-R, there are many activities the satellite community can and should be doing to lead the way. Some of these areas are:

- How and what satellite products will be available to users
- Push-Pull, Product integration, AWIPS development – details of GAS
- How do requirements differ regionally, seasonally, how to handle localized products
- Training – preparation and implications to warning processes near term (Day 1)
- How do we systematically progress toward our strategic goal
- GOES-R Proving Ground (PG) Activities guided by Proving Ground Plan
- NWS User-Readiness and Infrastructure Planning Studies

To address these activities, a NWS User Readiness Working Group has been formed to develop user-readiness and feedback to PG activities. Initially, this will be a small internal NWS member group which will grow incrementally as topics mature and users require more detailed information.

Finally, he stated that the GOES Users' Conference offers a great opportunity to obtain user feedback on the transition to the GOES-R era. The Breakout Sessions have been designed to specifically focus on this. The NWS plans to take the results of these breakout sessions to help define the framework and milestones for the way ahead.

6.4 "Rules of Engagement"

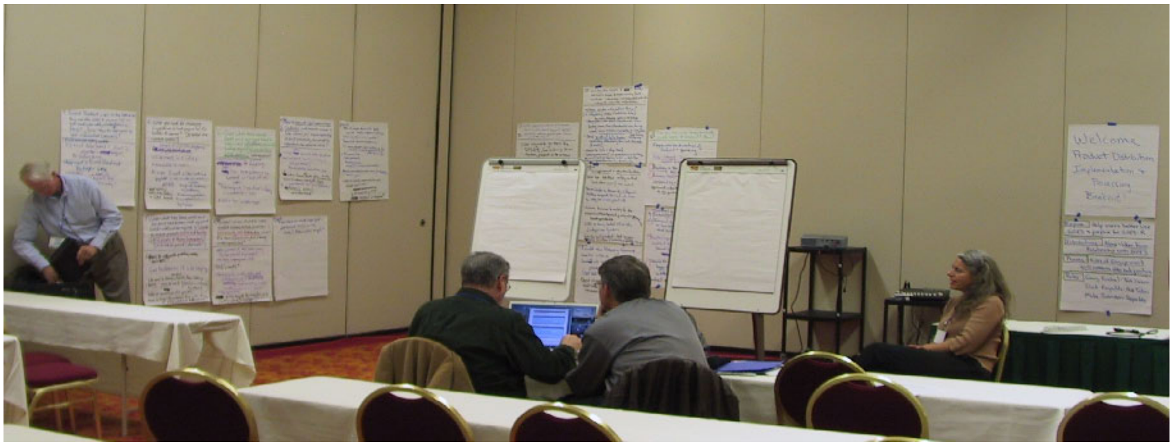
Kathleen Paris, lead facilitator went over the ground rules to be followed by each group during the breakout sessions**.** She explained how pre-assigned facilitators, technical experts and scribes would assist each group during the sessions. She further asked the group to select a presenter to summarize the group's discussions and recommendations during the Breakout Summary Session on Thursday morning.

6.5 Logistics and locations

Tim Schmit went over the different groups. These theme-area groups were: Atmosphere (2 sub-groups); GOES Transition 11-R series (2 sub-groups); ABI; Training; Product Distribution, Implementation and Processing; and Ocean/Land/Solar & GLM/SEISS.

Each group was asked to consider two common questions on GOES-R user readiness in addition to other pertinent theme-related questions. Room number assignments were given to each group as well as the time allotted to accomplish the assigned task.

7. SESSION 7 — Breakout Sessions



The results of the Product Distribution and Implementation breakout session.

8. SESSION 8 — Breakout Session Results and Wrap-up

Chair Session 8: Shanna Pitter – (See Appendices 3, 4, and 5)

This session consisted of the breakout sessions, led by a professional facilitator. The session topics were:

- Atmosphere Session (Sessions A and B)
- GOES Transition – 11 through R series Session A and B
- ABI
- Training
- Product Distribution, Implementation & Processing
- Ocean/Land/Solar & GLM/SEISS

Important ideas and recommendations from the Breakout Sessions that centered on user-readiness included: increasing the level of communication, education and demonstration by taking GOES directly to the users — utilizing various methods and opportunities; providing simulated data products and proxy datasets for local decision aid development; and ensuring reliable program status information including launch, dates for data availability and data transition timelines.

Other important suggestions and recommendations from the groups were: better use of the current GOES series, developing COMET training modules on the GOES R ground segment and the 65 products; use of integrated and blended products, providing low-cost transition solutions to new services like EMWIN and HRIT, exploring a new concepts of operations, requiring matching formats for real-time and archived data, improving information about GAS, developing a readiness plan, defining early routine scanning and special event procedures, determining how non-AWIPS users get products and services, improving outreach to NWS Offices and National Centers, and finally ensuring that the user communities are ready!

9. SESSION 9 — A Look into the Future

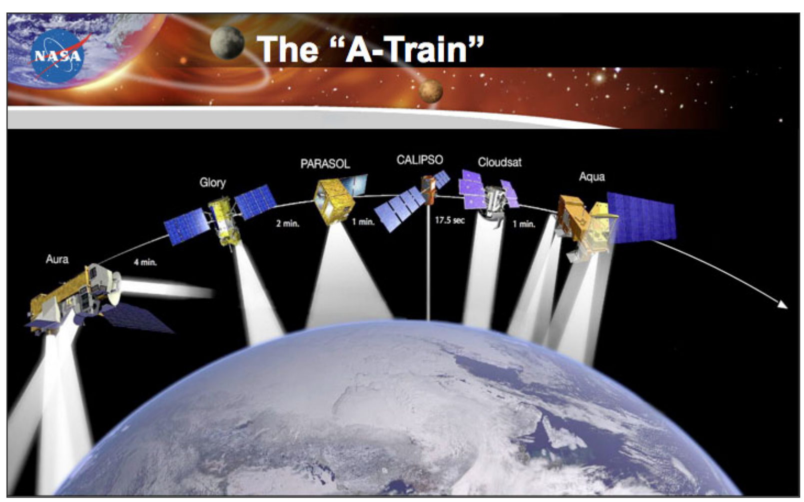
Chair: Steve Goodman

9.1 NASA Earth Science Program: From Innovative Observations to Solutions — Dr. Jack Kaye, NASA, Earth Science Division

Dr. Jack Kaye, NASA's Earth Science Division (ESD), presented a talk describing NASA's environmental satellite constellations and supporting infrastructure of airborne assets, surface observation networks and high-end computing resources. He reported on significant ESD accomplishments, such as: TRMM data providing climatology of tropical precipitation, ICESat data showing changes in ice sheet thickness, Topex/Poseidon and Jason-1 data showing an increase in global sea level, and GRACE data showing a draw-down of ground water in India.

He outlined how NASA partnerships continue to play a significant role in advancing earth sciences. Some of these are: NASA and USGS providing Mid-Decadal data set from Landsat; NASA and EPA partnering to provide air quality (particulate) information for the United States; NASA partnering with UNESCO to provide African drought monitoring and forecasting; and NASA and USAID implementing SERVIR to provide data for disaster support in Central America and now East Africa.

Research to Operations initiatives include: 1) the Joint Center for Satellite Data Assimilation's (JCSDA) work on assimilation of OMI TO3 NRT product that has been implemented within the NCEP GSI, improving assimilation of AIRS water vapor channels in the NCEP GSI and assimilation of MODIS aerosol optical depth at FNMOC; 2) Short-Term Prediction Regional Transition Center (SPoRT) MODIS/AMSR-E composite SSTs used as lower boundary forcing for weather forecast at AOML; and 3) accelerating Operational Use of Research Data (AOURD) SST High Resolution Composite Data Sets used at NWS Southern Region WFOs; Altimeter significant wave heights (SWH) used in NCEP/OPC Operations; and MLS NRT evaluated at NCEP, ECMWF, UK MetO, Environment Canada, and GMAO.



The Earth Science technology portfolio of over 550 science-focused, competitively selected projects is helping NASA realize its Decadal Survey mission goals. Dr. Kaye reported on the latest developments in Climate and Radiation Balance, Weather, the Earth's surface and Ice Sheets.

He concluded his remarks by summarizing how: 1) NASA's satellites and aircraft are providing new views of the Earth system, enabling scientific discovery by a large and diverse community of researchers; 2) NASA's investments and partnerships are facilitating use of NASA data to support forecasting, management, and policy development; 3) Satellite programs in formulation, development, and planning will significantly expand national capability in Earth observation and be implemented into global enterprise with partnerships and coordination; 4) NASA-developed technology will facilitate improved performance of future observing systems; and 5) the NASA-NOAA partnership is central to the Nation's ability to advance scientific knowledge and support advances in climate research, adaptation, services, and technology.

9.2 NASA Geostationary Coastal and Air Pollution Events (GEO-CAPE) Mission — Jay Al-Saadi, NASA

Jay Al-Saadi, NASA, presented a talk on the GEO-Cape Mission. He described how NASA is implementing missions within three groups of "Tiers" in accordance with the sequencing of the 2007 Space Decadal Survey and that GEO-CAPE is one of five missions in the 2nd Tier.

He reported how the GEO-Cape Mission represents the next generation of environmental science: High-time-resolved (~hourly) observations of atmospheric composition and coastal ocean biochemistry/physics. Air Quality goals include: satisfy basic research and operational needs related to air-quality assessment and forecasting; emission of O3 and aerosol precursors, including human and natural sources. Coastal Ocean goals include: quantify response of marine ecosystems to short-term physical events; and monitor biotic and abiotic material in transient surface features. Measurements of aerosols from the air-quality instrument can also be used to correct aerosol contamination of the high-resolution coastal ocean imager. Mr. Al-Saadi suggested that instrumentation has a strong low-Earth-orbit space heritage and a high level of technology readiness.

A 2015 launch would be feasible in geosynchronous orbit near 80W with notional payload of three instruments. These would be:

- a Wide area UV-Visible spectrometer, <10km nadir resolution, hourly, 45S to 50N (O3, NO2, CH2O, SO2, aerosol),

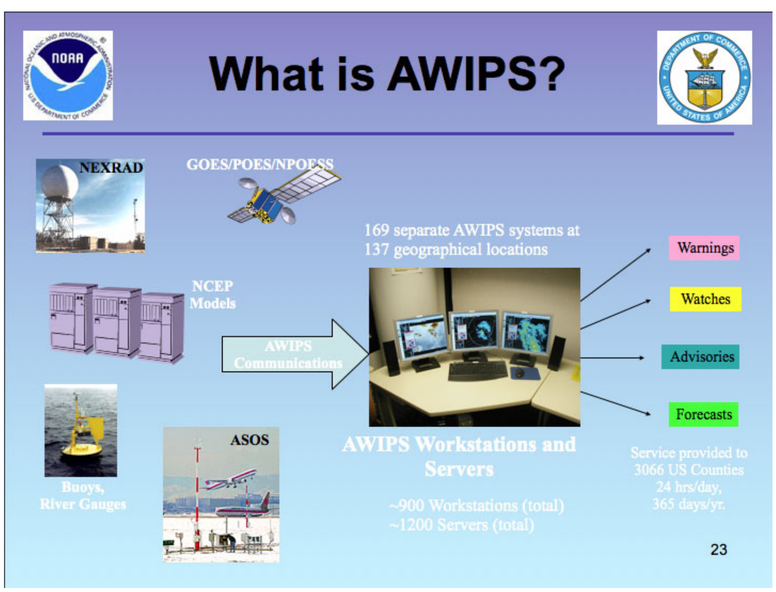
- a Wide area IR correlation radiometer for CO mapping with capability to distinguish between near-surface and free-troposphere,
- a High spatial resolution (250m) steerable event-imaging spectrometer.

The two wide-area instruments together provide systematic/continuous air quality observations. The high-resolution event imager provides targetable/episodic Observations – a coastal ocean color instrument but also capable of atmospheric observations. Estimated mission cost is ~$550M (NRC) ~$1.1B (NASA).

Finally, he summarized the talk by making the following points:

1. GEO-CAPE and the GOES-R System are highly complementary for the next generation of atmospheric and coastal ocean observations.
2. NASA is supporting advanced technology development and science working groups to refine GEO-CAPE mission concepts. *NOAA scientists involved; expanded involvement is welcomed!*
3. GEO-CAPE phased implementation concepts, including launches of opportunity for individual instruments, may offer a timely, systematic, cost- and risk-effective approach. *This fiscal year, NASA plans to conduct instrument accommodation studies for commercial and future GOES-R (S, T) platforms.*
4. A specific concept that leverages NASA and NOAA investments while enabling an integrated global observing system for air/water quality: *Launch mature high-heritage wide field-of-view UV-Vis and IR (2-4 micron) instrumentation as soon as possible. Continue to develop compact pan-chromatic FTS instrumentation with initial focus on high-resolution.*

9.3 Roadmap for Satellite Data in the Advanced Weather Interactive Processing System (AWIPS) — Deirdre Jones, National Weather Service



Deirdre Jones, National Weather Service, presented a talk on the future of satellite data in the Weather Service's AWIPS system. She outlined the agenda for her talk by addressing: challenges meeting new customer weather needs, the architectural vision, AWIPS plan to achieve architecture, and next steps.

Customers are demanding improved services as the U.S. industry needs the most accurate, accessible, timely and reliable weather data to make critical decisions that impact our national economy. This includes the speed at which decisions are made as demand for decision support services is increasing at the same time Federal deficits are soaring and resource constraints are the watchword. Faced with huge data explosions, plans must also address: rapid data assimilation requirements, demands on data management architecture, and data access on-demand within resource constraints while challenged with integrating all observing data sources to achieve the desired effect. This leads to the conclusion that mangers must develop a strategic enterprise infrastructure plan and roadmap for building infrastructure capability over the next 10 to 15 years.

She then looked at the specific need for advances in the AWIPS program in the GOES-R Era. Key points raised were: SEC leading the effort to prepare the enterprise as well as planning AWIPS improvements to support future data, robust infrastructure with capacity and throughput for larger volume/higher resolution data, flexible software infrastructure, communications bandwidth — satellite broadcast and terrestrial networks, and the data distribution paradigm — push and pull.

She summarized her remarks by stating how NOAA is working on the enterprise infrastructure to accept, manipulate, and use data from new capabilities. NOAA is also working to ensure all NWS systems are on track for user readiness, addressing a complete assessment, design solution, building toward NOAA target architecture, and requiring efficiencies to reduce cost needed; and seeking out new technologies for computing and data integration architectures.

10. LUNCH PANEL — Status and Plans for GEO and HEO Satellites in the International Community

Co-Chairs: Paul Menzel and Martin Medina

Items of note from this session include the international plans for geostationary high spectral resolution infrared sounders, China's exemplary satellite development program that starts with demonstrations of new instrument capabilities followed by operational implementation on subsequent satellites, and the growing interest and plans for highly elliptical orbiting (HEO) complementary to geostationary (GEO) orbiting platforms.

Jerome Lafeuille, from the World Meteorological Organization (WMO) Space Program Office, presented the WMO Space Programme activities and plans regarding geostationary and highly elliptical orbiting (HEO) satellites. He noted that HEO coverage above 60/70 degrees supplements GEO coverage. The WMO Vision for the Global Observing System (GOS) in 2025 includes operational high spectral resolution IR GEO-sounders and pathfinder visible / Near-IR HEO-imagers. He stressed that the challenge is to realize these new capabilities and to integrate GEO, LEO, and HEO observations through intercalibration, data standardization, and composite products.

Carlos Frederico Angelis, from INPE/CPTEC, discussed current and planned satellite activities. Brazil currently uses satellite data / products from NOAA, NASA, China, EUMETCast and GEONETCast. He thanked NOAA for moving GOES-10 to 600 West to cover the Southern Hemisphere with both the imager and the sounder. The Brazilian Space Agency (AEB) is discussing the launching of a GEO satellite in the near future, which would likely have an infrared sounder and a visible and infrared imager.

Louis Garand, from Environment Canada emphasized the complementarity of GEO and HEO orbits. He presented Canada's Polar Communications and Weather (PCW) Program that is planning two highly elliptical (Molniya) orbit satellites that will provide continuous, GEO-like coverage over Canada's polar region. The first PCW satellite is scheduled for launch in 2016.

The geo plans for China were summarized by Yang Jun, Director General of the Chinese National Satellite Meteorological Center. The second Chinese geostationary meteorological satellite, FY-2C, was launched in October 2004 carrying GOES Imager-like spectral bands at 1 km (visible) and 5 km (IR) resolution. The satellite is spin stabilized and stationed at 1050E. FY-2D, launched in December 2006, continued this imaging capability. FY-2E, an in-orbit spare, was launched in December 2008. FY-4 (the second generation of Chinese geostationary meteorological satellite series) is being planned; several changes are under consideration including (a) three-axis stabilization, (b) VIS/IR satellite (A series: 2014) and microwave satellite (B series: 2017), (c) more powerful imager and lightning mapper, (d) sounding capability (spectrometer?), (e) enhanced ground control capability, and (f) enhanced application and services systems. FY-4 is in definition and pre-configuration stages; the first FY-4 is a demonstration mission with the following two considered operational.

Johannes Schmetz of EUMETSAT noted that two Meteosat Second Generation spacecraft are in geostationary orbit – Meteosat-8 since August 2002 and Meteosat-9 since December 2005. Both carry the 12-channel imager SEVIRI and an earth radiation budget GERB. Two more MSGs will follow. He also summarized the approved version of the plans for Meteosat Third Generation (MTG). Observation missions include (1) a Flexible Combined Imager that supports nowcasting and very short term forecasting with high resolution fast imagery supplanting the MSG SEVIRI mission, (2) an Infrared Sounder (IRS) with 1700 channels of 0.6 cm-1 resolution sampling 700 to 2175 cm-1 focused on atmospheric dynamics, (3) a Lightning Imager (LI), and (4) an Ultraviolet Near Infrared (UVN) instrument that supports atmospheric chemistry and air quality monitoring over Europe.

Dr. Devi Prasad Karnik, the Space Counselor at the Indian Embassy, presented India's plans for the Indian National Satellite System (INSAT), India's geostationary environmental satellites. This is a multi-purpose system for telecommunications, radio and TV broadcasting, meteorology, search and rescue operations, and disaster warning. India launched INSAT-3A in April 2003. Kalpana, a geo dedicated to meteorological applications, was launched in September 2002 carrying an imager with visible (2 km), IRW (8 km), and WV (8 km) channels and a 1 km CCD array at 0.7, 0.8, and 1.6 micrometers. Both of these satellites are operational for India. INSAT-3D launch is planned for 2010; the payload will include a 6-channel imager and a 19-channel sounder.

Yoshinori Yoshimura discussed Japan Aerospace Exploration Agency's (JAXA's) current and planned satellite activities, including the Global Change Observation Mission and cooperation with NPOESS and MetOp. JAXA currently has satellites for disasters and resources, greenhouse gases, water cycle, and plans to launch satellites to monitor climate change. In an update on the geostationary Multi-functional Transport Satellite (MTSAT), it was noted that MTSAT-1R was launched in February 2005 and was followed by MTSAT-2 in February 2006. MTSAT-1R and MTSAT-2 are multi-purpose satellites with both aeronautical and meteorological missions that are planned to serve Japan's needs through the rest of the decade. The MTSAT series have four infrared channels including a 3.7 micrometer channel and one visible channel. A follow-on to MTSAT-2 that includes a SEVIRI-like imager and a hyper-spectral sounder is being planned for 2013 launch.

Ae-Sook Suh spoke about Korea's plans for a geostationary Communication, Ocean, and Meteorological Satellite (COMS). COMS would have satellite communication, ocean monitoring, and weather monitoring missions. The last two missions include (a) monitoring of marine environments around the Korean peninsula, (b) production of fishery information (chlorophyll, etc.), (c) monitoring of long-term/short-term change of marine ecosystems, (d) continuous monitoring of imagery and extracting of meteorological products with high-resolution and multi-spectral imager, (e) early detection of special weather such as storms, floods, yellow sands, dust, etc., and (f) extraction of data on long-term change of sea surface temperature and cloud. COMS will carry a 5 channel meteorological imager (visible, 4, 6.7, 11, and 12 micrometers) and an 8 channel ocean imager (visible and NIR channels). She noted that COMS will be launched in 2010.

Paul Menzel (for Alexander Uspensky from SRC Planeta of the Russian Federal Service for Hydrometeorology and Environmental Monitoring presented an update of the Russian geo-plans for GOMS Electro L1 launch to geostationary orbit at 760E in 2010. Electro L1 will carry on a three axis stable platform the Multi-Scanning Unit (MSU-G), a scanning radiometer-imager with 10 channels in visible and IR similar to MSG SEVIRI (spectral bands include 0.5-0.65; 0.65-0.80;0.8-0.9; 3.5-4.0; 5.7-7.0; 7.5-8.5; 8.2-9.2; 9.2-10.2; 10.2-11.2; 11.2-12.5 micrometers). The spatial resolution in sub-satellite point will be about 1 km (VIS) and 4 km (IR). The primary mission objectives for GOMS Electro are (a) continuous observation of the Earth within a radius of 55-60 degrees centered at the sub-satellite point; providing simultaneous images of cloud cover and the Earth's surface, (b) collection and retransmission the hydro-meteorological data from national and international platforms (DCPs) to the main and regional forecasting centers, (c) helio-geophysical measurements at geostationary orbital altitude, and (d) dissemination through the satellite various information products (image fragments, charts and numerical data) from the main and regional centers to national and foreign users' receiving stations.

The session concluded with the observation that the Global Observing System is truly an international enterprise and that evolution of the geostationary component as outlined in the presentations represents a significant increase in observing capability.

11. TOWN HALL MEETING — "The Need for an Advanced Sounder on GOES"

Chair: Chris Velden; Moderator: Abby Harper

Overview of Hyperspectral Sounding Opportunities: Hank Revercomb, UW/SSEC

NWP Perspectives: Robert Aune, NESDIS/STAR

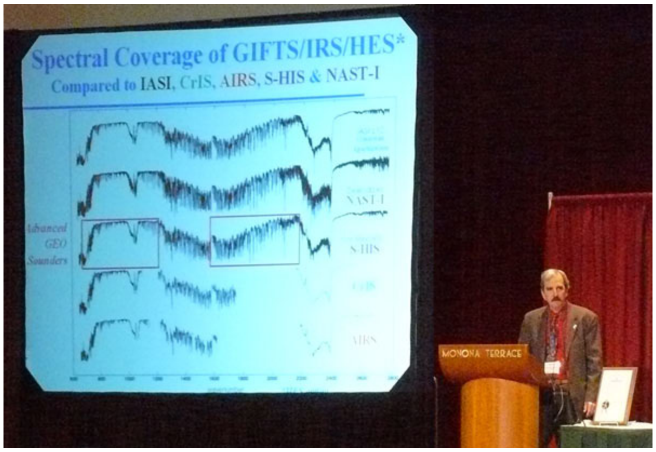
NWS Perspectives: Jeff Craven, SOO, NWS/MKE

NHC Perspectives: Jack Beven, Hurricane Forecaster, NWS/NHC

International Perspectives: Jo Schmetz, EUMETSAT

A lunchtime town hall-style meeting was held on Wednesday. The idea was conceived by Chris Velden (CIMSS), who was a member of the National Research Council's Decadal Study, and chaired the session. The panel consisted of five members broadly representing the potential advanced sounder user community, along with an introduction and summary given by Abby Harper, the NOAA/NESDIS Deputy Assistant Administrator for Systems. Tim Schmit, NOAA/NESDIS, served as the session moderator.

The subject was briefly introduced by Mr. Schmit, and followed with a few comments by Ms. Harper. The first point she made was that government decision makers don't really understand the need for hyperspectral sounders, so that scientists must make a better effort to define the potential value of the information. In addition, the current situation is a bit of an unfortunate one, in that almost all focus and efforts (and resources) are being applied to the NPOESS/VIIRS and GOES-R/ABI programs, which will naturally limit the development and deployment of an advanced geostationary sounder.

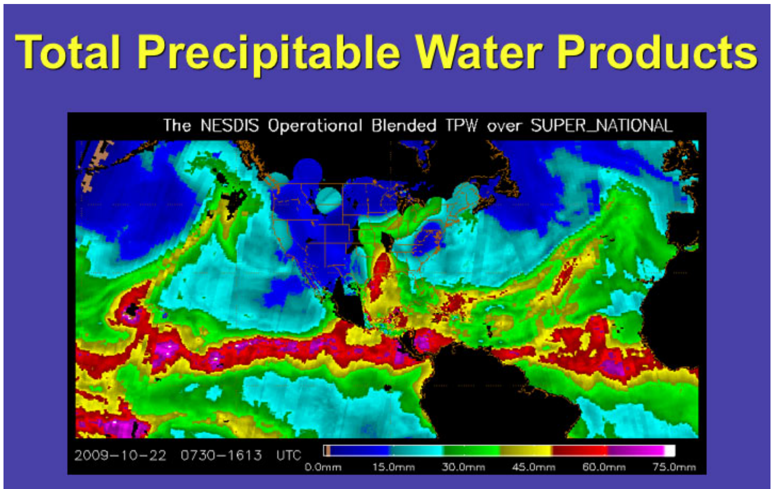


An overview of hyperspectral sounding opportunities was given by Dr. Hank Revercomb, Director of UW/SSEC. He showed how the advanced GEO sounder concept represents a dramatic new capability to provide longer lead times for severe weather. An important point that he made was to recall the NRC Decadal Survey recommendation to "Develop a strategy to restore the previously planned capability to make high-temporal- and high-vertical-resolution measurements of temperature and water vapor from geosynchronous orbit," and suggested this was the "forgotten" recommendation. In addition, Dr. Revercomb pointed out that this strategy is supported by the Congressional view of NASA and NOAA roles expressed in the 2008 NASA Authorization Act. So based on this, together with the fact that implementation is proceeding in Europe and Asia, and that the United States has the proven technological capability, it was strongly suggested that the United States' plans for the advanced geostationary sounder need a fresh look.

The NWP perspectives were covered by Robert Aune, NESDIS/STAR. He suggested that advanced GEO sounder data would be useful for both "nearcasting" and short-term forecasting. Nearcasting severe weather up to 6 hours in advance fills the gap between nowcasting observations and regular numerical weather prediction. The improved vertical resolution offered by the advanced sounder would be the key contributing factor to the data. Mr. Aune also noted previous OSSE experiments that suggested both high-spectral and high-temporal are needed for regional scale models. This is supported by more recent results (QJRMS, Oct, 2009) that show the top three observing systems that contribute to ECMWF forecast error reduction are AMSU-A (4 satellites) [17.2%], IASI (one satellite) [12.0%] and AIRS (one satellite) [11.8%]. Finally, Mr. Aune noted that a geostationary hyper-spectral sounder located upstream of North America will provide a significant improvement in mesoscale model 24-48 hour forecast accuracy for the United States.

NWS forecasting perspectives were given by Jeff Craven, SOO, NWS/MKE. Mr. Craven was a strong advocate, and noted that a GEO sounder could help to "Warn on Forecast" by providing a better analysis and prediction of convective initiation, which could also be used as input to high resolution NWP models. An advanced GEO sounder would also help populate the planned NextGEN – 4D data Cube.

Hurricane forecasting perspectives were covered by Dr. Jack Beven, Lead Hurricane Forecaster, NWS/NHC. He pointed out that low-earth-orbiting sounders at best provide data over an area of interest once every few hours and that evolving/translating meteorological features such as hurricanes can easily slip through the swath gaps in LEO sounder coverage. A GEO sounder would produce higher temporal resolution data and cover the swath gaps over the tropics. Dr. Beven thought that the NHC could significantly benefit from an advanced sounder on the GOES-R satellite series, but that the greatest benefit might result indirectly from assimilation of the data into NWP models that forecast hurricane track and intensity. Sounder data could also be used more directly in hurricane-specific products such as eye sounding intensity estimates, and in other derived environmental products such as TPW.



GOES-R sounder data could temporally enhance the microwave-based TPW product over the oceans, making it easier for the NHC to detect and track important moist and dry features.

International perspectives were articulated by Johannes Schmetz, EUMETSAT. One of his many points was to adhere to international agreements to fly sounders on GEO platforms. Examples are: the 2003 CGMS report prescribed that all international geostationary meteorological satellites should have sounders by 2015; the 2007 decadal survey indicated the high priority for GEO hyperspectral sounders; and the 2008 GEO partners meeting in Geneva specifying that all met GEO satellites should have sounders as part of the global observation system. EUMETSAT has started phase-A studies to implement an advanced sounder on the MTG series late in this coming decade.

About 30 minutes was available after the presentations for audience discussion time. In general, the comments strongly advocated for the United States' need to have advanced geostationary sounders. At the very least, a demonstrable prototype needs to be flown to clearly show the importance to impacts on U.S. forecasts. In addition, it was mentioned that recent findings from the international climate community indicate that water vapor data is one of the most important parameters in climate forecasting and assessment. It was stated that the GEO sounder data would accurately measure water vapor in four dimensions, including the motion that could be used to better describe the transport.

A final (very good) question was asked about how the community can better champion this cause. Whom do we advocate to, and what is the best approach to do so? The session was adjourned by Abby Harper, who attempted to address these questions, and also noted that she had learned much from this session about the potential benefits of an advanced GEO sounder. She ended with an optimistic, but also realistic tone: that NOAA/NESDIS is very focused on getting the currently planned instrumentation into space as soon as possible, and that new or higher-risk options are much lower on the radar screen. She noted that if the science and user communities feel strongly about the GEO sounder, then the push should continue.

12. NOAA's POST-CONFERENCE RESPONSES TO USER QUESTIONS AND RECOMMENDATIONS (See Appendix 5)

13. POSTER ABSTRACTS

The posters covered a wide range of topics — from the ocean, through the atmosphere, to the stars. Posters were arranged loosely by topic area: Atmosphere, Hazards, Imagery, Readiness/Training, Transitions, Space, Synergy, Processing, and Distribution.

Atmosphere

1. Satellite Use in the NWS Eastern Region

Authors: Frank Alsheimer, Dave Radell, and Jon Jelsema

The Eastern Region of the National Weather Service is composed of 23 Weather Forecast Offices, 3 River Forecast Centers, and 4 Central Weather Service Units. All offices use geostationary and polar orbiting satellite data in near real-time, as a crucial component of the forecast processes. Besides routine use in the preparation of daily forecast products, satellite data are also critical in assessing and forecasting aviation weather, marine weather, severe weather, fire weather, and small scale weather that is vital for decision support services. These data provide critical coverage for the forecaster in areas where in-situ data either is not available or is sparsely located, such as over open bodies of water or mountainous regions. Additionally, a large amount of satellite data goes into the operational numerical models, which forecasters at all offices use on a daily basis. This poster shows specific examples of some of these uses in Eastern Region Weather Forecast Offices.

2. Applications of the Geostationary Lightning Mapper to Tropical Cyclone Intensity Forecasting

Authors: Mark DeMaria, John A. Knaff, Robert T. DeMaria

The next generation NOAA Geostationary Operational Environmental Satellite (GOES) system starting with GOES-R will include a Geostationary Lighting Mapper (GLM). The GLM will provide near continuous monitoring of the timing and location of total lighting (cloud to ground and intra-cloud) activity. The coverage of GOES-East and –West will include nearly the entire region where tropical cyclones form and move in the Atlantic and Eastern North Pacific oceans. Lighting data from the ground-based World-Wide Lightning Location Network (WWLLN) are being used as a proxy for the GLM. The WWLLN data detects only a fraction of the cloud to ground lightning, so a crude correction factor is applied by comparison with annual lightning climatologies from the Optical Transient Detector (OTD) and Lighting Imaging Sensor (LIS) from polar satellites. The OTD and LIS have detection characteristics similar to what will be available from the GLM. The relationships between lightning activity from the corrected WWLLN data and tropical cyclone intensity changes is examined in detail. The relationships with other storm characteristics such as the vertical shear of the environmental wind and the sea surface temperature are also examined. Results show that the relationship between lightning density (strikes per unit area and time) and intensity changes is complicated by the influence of vertical wind shear. Once that factor is taken into account, there is a significant correlation between increased lighting and tropical cyclone intensification. The lightning activity in tropical cyclones in the Atlantic and Eastern North Pacific are compared. Atlantic storms tend to have greater lightning activity than those in the Eastern North Pacific. Preliminary intensity forecast algorithms that utilize the lighting data are under development. Preliminary real-time tests of these algorithms are planned for the GOES-R Proving Ground at the National Hurricane Center during the 2010 hurricane season.

3. Satellite Data for Human Spaceflight Operations

Author: Doris A. Hood

The National Weather Service Spaceflight Meteorology Group (SMG) supports NASA's human spaceflight program at Johnson Space Center. Currently, the main operational function is support of the Space Shuttle program by providing landing forecasts for the launch intact abort sites, on-orbit primary landing site selection, and end-of-mission landings. Detailed forecasts are required for cloud cover, winds, visibility and turbulence as well as rain shower and thunderstorm proximity with respect to a specific runway. The main landing sites are located in the United States, Spain and France, but the emergency landing sites cover the globe, requiring worldwide data sets.

SMG has local downlink capability for GOES East, GOES West and Meteosat Second Generation (MSG) data. All bands of the GOES and MSG data are ingested, in real time, into SMG's customized version of the Man-computer Interactive Data Access System (McIDAS). The data can be displayed as individual bands, multi-channel differencing imagery or as multi-channel color combinations. Digital imagery from several polar orbiting satellites is also available on McIDAS from various NESDIS and NASA servers.

The high resolution visible, infrared and water vapor MSG channels are put into a netCDF format on McIDAS and then sent via the Local Data Acquisition and Display (LDAD) system for display in the Advanced Weather Information Processing System (AWIPS). SMG also receives Moderate Resolution Imaging Spectroradiometer (MODIS) data from the University of Wisconsin Cooperative Institute for Meteorological Satellite Studies, which is displayed in both AWIPS and McIDAS. Additional imagery and imagery products are also received from NASA's Short-term Prediction Research and Transition Center (SPoRT) for display in AWIPS. Each SMG forecast console provides access to both McIDAS and AWIPS displays.

In the GOES-R era, SMG will be supporting NASA's new Constellation Program where both the abort and nominal end-of-mission landing sites for the crew capsule will be in the ocean. This will require SMG to access and evaluate a new suite of satellite products applicable to meteorological and oceanographic analysis and forecasting in these data sparse regions.

4. Roadmap for Satellite Data in AWIPS

Authors: Deirdre Jones, Brian Gockel

The Advanced Weather Interactive Processing System (AWIPS) is the integrating element of NOAA's National Weather Service (NWS) IT infrastructure, and is the primary tool in NWS forecast offices for producing forecasts and warnings. The NWS' Office of Science and Technology manages the AWIPS Program, and Raytheon Technical Services is the AWIPS prime contractor. The AWIPS Program is undergoing substantial software re-architecture to enable NWS to leverage the GOES-R for the warning and forecast mission. This paper describes the role AWIPS plays in delivery of satellite observations to NWS forecasters, how these data are delivered today, and how AWIPS is evolving to accommodate GOES-R era observations.

5. High impact weather study using advanced IR sounding product

Authors: Jun Li, Jinlong Li, Jason Otkin, Hui Liu, and Timothy J. Schmit

A high spectral resolution Infrared (IR) sounder in the geostationary orbit will provide unique high temporal and high spatial resolution 3-dimensional temperature and water vapor profiles. This will help monitor and forecast severe thunderstorms. In this study, a case from the International H2O Project (IHOP) field experiment was used to demonstrate the benefit of advanced IR geo-sounder in nowcasting severe storms. Atmospheric profiles from the output of the high resolution Weather and Research Forecasting (WRF) model were used to simulate the Hyperspectral Environmental Suite (HES) like and Advanced Baseline Imager (ABI) like radiances. Temperature and moisture profiles were further retrieved from these radiances. The derived atmospheric stability parameters (e.g., lifted index) show that the ABI or current GOES sounder provides only limited instability information before the storm development due to the limited spectral information for temperature and water vapor profiling, while the advanced IR sounder (HES like) can provide the critical unstable information well earlier than ABI or current GOES sounder. In the second part of this study, the high spatial resolution of single field of view (SFOV) atmospheric soundings from AIRS, a research product from CIMSS/UW-Madison, have been applied in the hurricane track and intensity assimilation and forecast by using NCAR WRF Data Assimilation Test Bed (DART) system. The results show that the track errors for Hurricane Ike (2008) and Typhoon Sinlaku (2008) are greatly reduced when AIRS full spatial resolution soundings are assimilated. The forecast of rapid intensification of Typhoon Sinlaku is also significantly improved if AIRS data are added.

6. Improvements and Applications of Atmospheric Soundings from GOES Sounder

Authors: Zhenglong Li, Jun Li and Paul Menzel

A unique feature of the Geostationary Operational Environmental Satellite (GOES) Sounder over the polar orbiting sounders is that it observes the atmosphere and the surface on an hourly basis with a nominal spatial resolution of 10 km. The temporally and spatially dense observations are of great importance for improving short-term weather forecasting or nowcasting. To further demonstrate how the GOES clear-sky sounding products can help nowcasting, an improved clear-sky physical retrieval algorithm for atmospheric temperature and moisture is developed. The use of the GOES Sounder is usually limited to clear skies to avoid cloud contamination of the derived profiles. However, the chance for a GOES Sounder field-of-view (FOV) to be clear is only about 34 %. Until the advent of a microwave sounder in geostationary orbit, the search for viable soundings in cloudy conditions will continue. This study extends the sounding retrievals from clear sky to cloudy regions, by developing a synthetic regression-based cloudy sounding retrieval algorithm. A comparison with the microwave radiometer measured total precipitable water (TPW) at the Southern Great Plains (SGP) Cloud and Radiation Testbed

(CART) site from June 2003 to May 2005 shows that the clear sky TPW retrievals are improved by 0.4 mm over the legacy GOES Sounder TPW product. Comparisons against radiosondes at SGP CART site from August 2006 to May 2007 and the conventional radiosonde network over the Continental United States (CONUS) from January 2007 to November 2008 both show that the retrievals of moisture under thin cloud conditions perform as well as those with the clear sky conditions. The largest improvement to the Global Forecast System (GFS) first guess is found in the upper level (roughly 300 – 700 hPa) integrated precipitable water vapor (PW) or PW3; the RMS is reduced by 0.4 mm. In the case of low thick clouds, PW3 is significantly improved; the improvement of RMS is about 0.21 mm. The new GOES algorithms are applied to three severe storm cases, demonstrating that the new soundings provide additional information that can lead to better short term severe storm forecasting.

7. Monitoring South America and Environs from GOES

Authors: James P. Nelson III, A. J. Scheiner, J. Li, Z.Li, M. M Gunshor, T.J.Schmit, G.S. Wade

For more than two years, NOAA/NESDIS has been operating the Geostationary Operational Environmental Satellite (GOES)-10 at 60 degrees West longitude, and providing data from both the Imager and (until February 8, 2009) Sounder instruments to interested parties, in particular to users in South America. In fact, the GOES-10 Sounder was the first operational geostationary Sounder to routinely provide data over South America. The impetus for providing these GOES data to the South Americans can be traced to the Global Earth Observation System of Systems (GEOSS) project (http://www.ssd.noaa.gov/PS/SATS/GOES/TEN/), which is a collaborative effort between NOAA and international partners.

Within the Space Science and Engineering Center (SSEC) at the University of Wisconsin-Madison, GOES-10 Imager and Sounder data have been archived routinely since 1998, when GOES-10 was used to service North America, and has continued throughout the satellite's service station at 60W. In addition, for most of the period while GOES-10 was at 60W, the Cooperative Institute for Meteorological Satellite Studies (CIMSS) has generated remapped, enhanced imagery from all 5 bands of the Imager, and the Sounder data has been utilized to generate several experimental value-added products (http://cimss.ssec.wisc.edu/goes/rt/goes10.php). The Sounder products available from GOES-10 over South America consist of Derived Product Images (DPI) of Cloud Top Pressure (CTP), Total Precipitable Water (TPW) and Lifted Index (LI). Animations of these DPIs are also available, as well as other displays of single and multiple Sounder bands. At the conference, examples of the imagery and products produced at CIMSS from GOES-10 Imager and Sounder data will be presented.

Due to end-of-life spacecraft fuel issues, the GOES-10 satellite is due to be decommissioned in December 2009 (http://www.oso.noaa.gov/goesstatus/). However, discussions are ongoing concerning perhaps replacing GOES-10 with one of the GOES satellites currently servicing North America. Given their history of successfully ingesting the data and providing meteorological products from GOES-10, SSEC/CIMSS is uniquely positioned to generate and provide the same (and indeed expanded) imagery and meteorological products over South America when the next suitable GOES satellite becomes available.

8. AWIPS Tracking Point Meteogram Tool

Author: Ken Sperow

With the launch of GOES-R, forecasters will have higher temporal and spatial resolution satellite data and exciting new products at their disposal. Forecaster tools to analyze this ever increasing volume of meteorological data are more important today than ever. Simple tools that help the forecasters focus on signals within the data rather than being overwhelmed by the volume of data are crucial. The Meteorological Development Laboratory (MDL) within the National Weather Service (NWS) is developing such a tool for use within AWIPS Migration.

MDL is developing a tool within AWIPS to create "data following" tracking points and subsequently display data values at the points for various time steps. This tool will allow forecasters to assign a "centroid/center point" and motion to any feature of interest displayed within D-2D, and then generate a meteogram of the data underneath the associated centroids. A meteogram is a graphical depiction of trends in meteorological variables, such as temperature, dew point, wind speed and direction, or pressure.

The addition of this tool will allow for "on the fly" plotting of values from gridded model or diagnostics fields, satellite data, or radar data while following a feature in an animation. This tool will have a multitude of operational applications that will benefit NWS forecasters both from a warning and decision making, and forecast and threat assessment standpoint.

The application of this tool to satellite remote sensing is of particular interest. With additional satellite datasets and channels being added to the AWIPS data stream with each upgrade, the forecaster has access to more high resolution satellite data than ever before. To make optimal use of this data, the "tracking point" tool could be utilized to more efficiently query and analyze the satellite fields. For instance, this tool will allow a forecaster to determine cloud top cooling rates for an approaching cluster of convection or analyze total cloud lightning data from the Geostationary Lightning Mapper (GLM) to make assessments of storm strength and growth rates. This tool could also be utilized in conjunction with channel difference fields to analyze a variety of trends including the potential for aircraft icing and fog and stratus development. The tool could also see particular utility in the areas of convective initiation, terminal area forecast (TAF) forecasting, and Aviation Weather Center (AWC) route planning and forecasting. With the NWS developing more user specific products, including graphical and derived applications, this type of cross-cutting concept would have obvious benefits to both the local forecast offices and to national centers.

9. Estimating PM2.5 using MODIS and GOES Aerosol Optical Depth Retrievals in IDEA

Authors: Hai Zhang, Raymond M. Hoff, Shobha Kondragunta

Aerosol optical depth (AOD) acquired from satellite measurements demonstrates good correlation with particulate matter with diameters less than 2.5 um (PM2.5) in the Eastern United States so that it can be used to estimate PM2.5 in areas where in situ measurements are not available. We investigated the relationship between AOD and PM2.5 over ten regions defined by the Environmental Protection Agency (EPA) in different seasons and developed a look-up-table based on the seasonal and regional varied linear regression relationship for estimating PM2.5 from AOD. We applied this LUT in the IDEA (Infusing satellite Data into Environmental Applications) product currently running at NOAA (http://www.star.nesdis.noaa.gov/smcd/spb/aq/), and combined the AOD retrievals from MODIS Terra and Aqua and from GOES East imager to generate daily PM2.5 estimations. The PM2.5 estimations from AOD using this LUT were found to be more accurate than those using a fixed ratio between AOD and PM2.5.

10. A Multi-angle Aerosol Optical Depth Retrieval Algorithm for GOES

Authors: Hai Zhang, Alexei Lyapustin, Yujie Wang, Shobha Kondragunta and Istvan Laszlo

Aerosol retrieval from a geostationary satellite has high temporal resolution compared to a polar orbiting satellite, which enables us to monitor aerosol motion. However, the current GOES imager has only one visible channel for retrieving aerosol, and hence its accuracy is low compared to polar-orbiting satellites that carry the Moderate Resolution Imaging Spectroradiometer (MODIS). The operational GOES aerosol optical depth (AOD) retrieval algorithm (GOES Aerosol/Smoke Product, GASP) uses 28-day composite images from the visible channel to derive surface reflectance. In this work, we investigate a new AOD retrieval algorithm from the GOES imager. The algorithm assumes the surface Bidirectional Reflectance Distribution Function (BRDF) at channel 1 of GOES is proportional to the BRDF at 2.1 μm from MODIS. The ratios between them are derived through timeseries analysis of visible channel images. The results of the AOD and surface reflectance retrievals are compared against Aerosol Robotic Network (AERONET), GASP, and MODIS retrievals. The benefit of the new algorithm is that the time period for the surface reflectance retrieval is much shorter than GASP algorithm so that it can capture the rapid change in the surface reflectance. Compared to GASP algorithm, the new algorithm has significantly better retrievals during early spring at some of the AERONET sites, and similar retrievals during summer and fall.

11. Version 2 of the GOES Surface and Insolation Products: An improved Solar Radiation and Cloud Resource for Coral Bleaching and NWP Modeling

Authors: William C. Straka III, Istvan Laszlo, Andrew Heidinger

Measured radiative fluxes are important inputs into hydrological models that evaluate water budgets. This is due to their direct influence on the climate. In addition, radiative fluxes combined with other cloud properties and surface temperature, can be used in a variety of other operational products. Examples of these include: the NOAA Coral Reef Watch (CRW) program, which combines photosynthetically active radiation (PAR) with operational thermal stress products to help determine coral bleaching; the Woods Hole Oceanographic Institute (WHOI), which uses radiation data in estimating heat flux components over the coastal ocean to drive ocean circulation models and the PAR data to drive coupled ocean biophysical models. Finally, radiative fluxes, land surface temperature as well as cloud properties are used to validate and as model initializations for numerical weather prediction (NWP) models. The second version of the GOES Surface and Insolation Products (GSIP) processing system is a near real-time operational system for generating several different radiative properties from the shortwave, longwave, and visible portions of the electromagnetic spectrum, as well as cloud properties and surface temperature, using data from the GOES satellite system. This study will discuss the products as well as the usage of the products in an operational capacity.

Hazards

12. An Object-Based Nighttime Fog/Low Cloud Detection Algorithm

Authors: Corey G. Calvert and Michael J. Pavolonis

The current GOES operational nighttime fog detection algorithm relies on the pixel brightness temperature difference (BTD) between the 3.9 and 11 micron channels. While large areas of distinct fog and low cloud are usually detected using this method, local fog events (e.g., valley fog) are harder to discern without dramatically raising the false alarm rate. Here we introduce an object-based fog/low cloud detection algorithm that uses the 3.9-11 micron BTD as well as a 3.9 micron pseudo emissivity to categorize connecting pixels with similar radiometric properties into objects. Once the objects are formed, the probability that the object is fog or low cloud can be assigned through predetermined look-up tables established using surface observations.

13. GOES Convective and Turbulence Aviation Applications

Authors: Wayne Feltz, Kristopher Bedka, Justin Seiglaff, Lee Cronce, and Jordan Gerth

As satellite infrared imager/sounder sensor spectral, spatial, and temporal resolutions become higher, satellite data will be a primary driver for aviation decision support, especially for over-ocean route turbulence, atmospheric stability, convective initiation, and volcanic ash decision support. A decade ago the perspective of using satellite infrared and microwave data to help the aviation community was primarily dismissed due to lack of instrument temporal and spatial resolution on the 0-6 hour nowcasting time frame. This has changed dramatically, and with the United States government agencies behind the Joint Program Development Office NextGen endeavor (http://www.jpdo.gov/nextgen.asp), satellite data will be used extensively to drive air traffic control routes, general flight planning, and weather hazard avoidance. New imager and sounder technology planned for the next ten years will be a fruitful area of research and has direct cost-benefit metrics. Current and Future GOES convective and turbulence decision support applications will be presented.

14. Recent Wild Fire Automated Biomass Burning Algorithm activities at CIMSS

Authors: Jay P. Hoffman, Christopher C. Schmidt, Elaine M. Prins, Jason C. Brunner, Joleen M. Feltz, Scott S. Lindstrom

Efforts are underway at the Cooperative Institute for Meteorological Satellite Studies (CIMSS) to enhance the Wild Fire Automated Biomass Burning Algorithm (WF_ABBA) and expand its coverage to the entire globe. Active fire detection and characterization from geostationary satellites provides the hazard mapping user community, emissions and air quality modeling and applications, and land use / land change applications with hotspot detection and characterization in near real-time, as well as over a decade of archival fire detections. With a legacy dating back to the GOES VAS instrument, continuous development has led to the current operational version of the WF_ABBA that processes data from all GOES from GOES-8 through GOES-14, with plans to continue support for future GOES. The WF_ABBA has been adapted to the Met-8/-9 SEVIRI and MTSAT JAMI instruments, allowing for near-global fire product coverage from a suite of geostationary platforms. Development work for GOES-R ABI has also been underway. Fire product development at CIMSS focuses on active fire detection and sub pixel characterization, including analysis of fire radiative power (FRP) and the calculation of instantaneous fire size and temperature. Product improvement efforts involve inter-comparison of the WF_ABBA fire product with other satellite fire products such as MODIS, case study analysis of fire detection and characterization from scenes of MODIS data projected to ABI resolution, and collaboration with CIRA (Cooperative Institute for Research in the Atmosphere) on the development and application of modeled ABI proxy data containing fires. Additional research efforts have focused on understanding the impact of the satellite navigation variations, surface emissivity determination, atmospheric attenuation correction, diffraction considerations, and correction for solar radiance contamination in the 4 micron band.

15. Introducing a GOES Convective Initiation Nowcasting Decision Support Tool

Authors: Justin Sieglaff, Lee Cronce, Wayne Feltz, Kristospher Bedka

A newly developed satellite-based convective initiation nowcasting decision support tool has been developed at the Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin. The decision support tool known as UWCI (University of Wisconsin Convective Initiation) uses GOES infrared window cloud-top cooling rate combined with the GOES-R ABI/GOES cloud mask/type algorithms to make convective initiation nowcasts. The UWCI algorithm has shown lead-times ahead of radar-based convective initiation (35dBZ echo or greater) by as much as 45 minutes.

As part of the GOES-R Proving Ground, the UWCI algorithms are being provided to NOAA operational centers for evaluation and feedback. The Storm Prediction Center (SPC) began receiving and evaluating the products for the Spring 2009 Hazardous Weather Testbed Experiment. In addition to the SPC, NOAA's Satellite Analysis Branch (SAB) and the National Weather Service Milwaukee/Sullivan Forecast Office have been evaluating the product since Spring 2009. The feedback from operations is crucial to making UWCI algorithm product improvements.

Ongoing work includes algorithm improvement based upon operational feedback. In addition algorithm validation work is underway to determine the UWCI probability of detection (POD) of convective initiation and probability of false alarm (POF). The poster presentation will provide a high-level algorithm description and examples of the UWCI algorithm over the Central Plains from the Spring/Summer 2009.

16. Sea and Lake Ice Concentration, Extent, and Motion with GOES-R ABI

Authors: Yinghui Liu, Jeffrey R. Key, and Xuanji Wang

The cryosphere exists at all latitudes and in about one hundred countries. It has profound socio-economic value due to its role in water resources and its impact on transportation, fisheries, hunting, herding, and agriculture. Not only does the cryosphere play a significant role in climate, but also its characterization and distribution are critical for accurate weather forecasts. A number of ice characterization algorithms have been improved and/or developed for the next generation Geostationary Operational Environmental Satellite (GOES-R) Advanced Baseline Imager (ABI), including ice identification and concentration, ice extent, ice thickness and age, and ice motion. An overview of the ice concentration, extent, and motion algorithms will be provided and their preliminary results will be shown here with applications to SEVIRI, and MODIS data.

Mature algorithms exist for ice identification and ice surface temperature, but others such as ice concentration, ice thickness and age, and ice motion are experimental or under development. Errors in existing algorithms must be determined by inter-comparing products from other sensors and comparing those products to numerical model simulation, submarine sonar measurements, and surface-based observations. Potential solutions to problems have been sought and new algorithms for estimating ice concentration, ice thickness/age, and ice motion have been developed and validated against a variety of realistic data sources. This work will serve as a testbed of the current and developing algorithms for sea and lake ice products.

17. Quantitative Volcanic Ash Monitoring from GOES and GOES-R

Authors: Michael Pavolonis, Justin Sieglaff, and Andrew Parker

Suspended volcanic ash poses significant threats to the aviation community. These threats include loss of life and severe damage to aircraft. Current operational volcanic ash detection techniques used at the various Volcanic Ash Advisory Centers (VAACs) are generally qualitative and require manual analysis. Reliable satellite-based automated ash detection techniques are few and far between due to the difficult nature of separating volcanic clouds from meteorological clouds and other non-volcanic features using reflectance or brightness temperature measurements alone. In addition, to forecast the dispersion of volcanic ash clouds, an estimate of the cloud height, effective particle size, and mass loading is needed. We will present results from automated algorithms designed to reliably detect volcanic ash clouds and retrieve their macro and micro-physical properties using the current GOES Imagers and the future GOES Imager (GOES-R).

18. Optimizing the Impact of Geostationary Satellite Products in Very-short-range Forecasts – Recent Results and Future Plans

Authors: Ralph Petersen and Robert Aune

Instruments aboard the future GOES-R satellite series will resolve atmospheric features at extremely high resolution both in time and space. Although one measure of the utility of these data will be their impact on NWP guidance at 12 hours and beyond, a greater benefit from these detailed and frequently refreshed data may come through objective tools that assist forecasters in identifying rapidly developing, extreme weather events 1-6 hours into the future. These "NearCasting" systems must be able to detect and retain extreme variations in the atmosphere, incorporate large volumes of high-resolution asynoptic data, and provide guidance products within minutes of when updated satellite observations become available. Because of the detail and perishable nature of these very-short-range forecast products, numerical approaches are needed that are notably different from those used in numerical weather prediction, where the forecast objectives cover longer time periods and take substantially longer to run using many more computer resources.

At previous meetings, a new Lagrangian approach was introduced that optimizes the impact and retention of information provided by satellites, specifically detecting and preserving intense vertical and horizontal variations observed in the various data fields observed over time. To test the system, full resolution (10 km) moisture products from current GOES sounders have been used to update and enhance longer-range guidance from very-short-range NWP forecasts.

Results show that the Lagrangian system captures and retains details (maxima, minima and extreme gradients) important to the development of vertical moisture structures critical to the development of convection 3-6 hours in advance, even after IR observations are no longer available due to obscuration by the developing convection itself. Early results also point to the need to control the growth of convergence in the show-range wind forecasts. To accomplish this, both components of the deformation as well as the convergence itself must be minimized in the initial wind fields.

Although previous tests provided prototype examples of NearCast products that can be available at higher resolution using existing GOES or SEVIRI data, additional experiments have been conducted to further expand the utility of both existing and future geostationary observations. Key to these NearCasting experiments is choosing parameters whose forecasts are both 1) critical in identify the pre-convective environment and 2) observed well by GOES. To accomplish this, 2 or 3 layers of moisture data and 6 to 8 layers of temperature data can be projected forward in time and then combined to determine areas where a variety of stability indices are undergoing substantial changes. Candidate indices include the Lifted Index, Totals Index, CAPE, CIN, and Convective Instability, as well as scaled ensembles of these individual indicators. Because of the desire to reduce false alarms and increase probability of detection, both destabilization and stabilization must be studied.

Details of recent NearCasting enhancement results, as well as assessments the products within NWS WFOs and NCEP Service Centers, will be presented. Examples will include cases of severe convection over the United States using sounder products from the current GOES satellites and over Europe using SEVIRI temperature and moisture data as a surrogate for future GOES-R ABI data. Efforts to limit the growth of convergence and deformation within the NearCasting model will also be discussed.

19. Objective Day/Night Overshooting Top and Enhanced-V Detections Using MODIS, AVHRR, and MSG SEVIRI Imagery in Preparation for GOES-R ABI

Authors: Kristopher Bedka, Jason Brunner, Wayne Feltz, Rich Dworak, and Lee Cronce

An overshooting convective cloud top is defined by the American Meteorological Society as "a domelike protrusion above a cumulonimbus anvil, representing the intrusion of an updraft through its equilibrium level." A single overshooting top (OT) exists for less than 30 mins and has a maximum diameter of ~15 km. Despite their relatively small size and short duration, storms with OTs often produce hazardous weather conditions such as aviation turbulence, frequent lightning, heavy rainfall, large hail, damaging wind, and tornadoes. Though it is commonly understood that a small cluster of very cold IRW brightness temperatures from satellite data relates well with the presence of an OT, this characteristic has yet to be exploited in any operational objective OT detection technique. Spatial IRW BT gradients (IRW-texture technique) can be combined with NWP-based tropopause temperature information and knowledge of the characteristic size of an OT to objectively identify them at their proper scale. OTs found in combination with a U or V shaped region of cold infrared window brightness temperatures (BTs) are often indicative of an especially severe thunderstorm. Once OTs have been identified by the IRW-texture technique, the focus can be directed toward the objective detection of the enhanced-V signature. While the enhanced-V is often highly variable in infrared imagery, one aspect of the enhanced-V remains fairly constant in that the "arms" of the V signature enclose a warm region downwind of the overshooting top to form an "anvil thermal couplet." UW-CIMSS and Kristopher Bedka (SSAI/NASA LaRC) have developed a pattern recognition technique with IRW imagery to objectively detect anvil thermal couplets associated with the enhanced-V signature.

These IRW-texture OT and enhanced-V/anvil thermal couplet detection algorithms are currently being developed for future operations with the Geostationary Operational Environmental Satellite Advanced Baseline Imager (GOES-R ABI) within the GOES-R Aviation Algorithm Working Group. As GOES-R ABI will offer 2 km spatial resolution in the infrared channels, we can use current satellite instruments to emulate the imagery that will be available in the future with GOES-R ABI. This work provides some examples of algorithm output and validation using MODIS, AVHRR, MSG SEVIRI, CloudSat, and CALIPSO data.

20. An overview of the Improvements with the Version 6.5 WF_ABBA and Trend Analyses of Fires from 1995 to Present over the Western Hemisphere

Authors: Jason C. Brunner, Christopher C. Schmidt, Elaine M. Prins, Joleen M. Feltz, Jay P. Hoffman, and Scott S. Lindstrom

The UW-Madison Cooperative Institute for Meteorological Satellite Studies (CIMSS) is reprocessing the GOES-East archive with an updated version 6.5 of the WildFire Automated Biomass Burning Algorithm (WF_ABBA) to generate fire summary statistics and locations of fires throughout the Western Hemisphere from 1995 to present. Trend analyses of fires have been generated for this time period. The 14-year diurnal fire climatology will have applications in emissions and air quality modeling, climate change studies, land-use/land-cover change, fire dynamics modeling, fire weather analyses, and socio-economic studies. The WF_ABBA is a dynamic, multispectral, thresholding, contextual algorithm that uses the visible (when available), 3.9 μm, and 10.7 μm infrared bands to locate and characterize hot spot pixels. The algorithm is based on the sensitivity of the 3.9 μm band to high temperature subpixel anomalies and is derived from a technique originally developed by Matson and Dozier (1981). It incorporates statistical techniques to automatically identify hot spot pixels in the GOES imagery. Once the WF_ABBA locates a hot spot pixel, it incorporates ancillary data in the process of screening for false alarms and correcting for water vapor attenuation, surface emissivity, solar reflectivity, and semi-transparent clouds. Version 6.5 of the WF_ABBA provides additional parameters and metadata as requested by the international user community. Improvements include an opaque cloud product to indicate regions where fire detection is not possible; a fire radiative power (FRP) product in addition to Dozier output of instantaneous estimates of fire size and temperature; metadata on processing region and block-out zones due to solar reflectance, clouds, extreme view angles, saturation, and biome type; and fire metadata mask imagery.

21. Operational Hazard Detection and Monitoring in the Satellite Analysis Branch

Authors: Jamie Kibler and Brian Hughes

The National Environmental Satellite Data and Information Service (NESDIS) is a line office within the National Oceanic and Atmospheric Administration (NOAA) charged with the development and operation of the Nation's environmental satellites and the creation of associated data and products. These satellite derived products support all of NOAA's core missions, including ensuring safe and efficient commerce and transportation, monitoring of weather and water, ecosystem management, and climate services. As such, NOAA's satellites enjoy a unique perspective of the Earth to allow scientists to detect and monitor significant environmental and man-made hazards that pose a threat to life and property.

This presentation will focus on the hazard and disaster detection, product generation and product distribution of the Satellite Analysis Branch (SAB) of NESDIS. The SAB is staffed 24/7 to monitor and distribute products related to volcanic eruptions, ash extent and movement, global tropical cyclone analysis, wildfire detection and smoke emissions monitoring, and heavy precipitation nowcasting and analysis. SAB also participates as an operation test-bed for new satellite product algorithms, before products are placed into routine operations. An overview of SAB operations, satellite data used, how these data and derived products are used in operations, and linkage to users will be presented.

22. The Satellite Analysis Branch Hazard Mitigation Programs

Author: Jamie Kibler

The Satellite Analysis Branch (SAB) provides and distributes a wide variety of operational hazard mitigation products to the user community for use in operations, research, validation and verification. The programs associated with these products are many; including a precipitation analysis and estimation, tropical position and intensity classification, volcanic ash tracking and a smoke and fire detection.

This presentation will focus on hazard and disaster detection and product generation. Hazard mitigation analysts of SAB have an expertise in satellite meteorology. They use a variety of satellite data including NOAA's Geostationary Operational Environmental Satellites (GOES), Polar Orbiting Environmental Satellites (POES), also, NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) and other satellite constellations to provide hazard mitigation products on a 24/7 daily basis. These products are time sensitive and our users depend on the information provided to be of highest quality. SAB continues to improve each program and associated product with the help of user input and new satellite technology.

Imagery

23. GOES Stray Light Intrusion and Remedies

Author: Hyre Bysal

There is no longer a health and safety risk of imaging close to the sun with the improvements incorporated into GOES N-P imagers and sounders. However, NOAA has discovered significant product degradation due to sun intrusion when scanning within 10 degrees of the sun. The sun intrusion is more detectable on lower wavelength IR channels (especially Channel 2) of the imager with the effect increasing as the scan angle gets closer to the sun. NOAA and ITT are still characterizing the effect of the sun intrusion and working on two potential remedies to maximize scanning around satellite midnight during the eclipse season. The easier and more immediate one of these remedies is the replacement of regular frames with same size frames shifted away from the sun when sun is near the edge of the frame. The longer-term remedy is to remove the stray light effect from the affected areas of the image through an algorithm in the Sensor Processing System (SPS) and send the corrected image through GVAR.

24. The Legacy Products from GOES-R Atmospheric Sounding

Authors: Xin Jin, Jun Li, Timothy J. Schmit, Graeme Martin, Jinlong Li, and Mitchell D. Goldberg

The legacy products from GOES-R atmospheric profile sounding are compared with the European Centre for Medium-Range Weather Forecasts (ECMWF) forecast and reanalysis products using the SEVIRI onboard the Meteosat Second Generation (MSG) as proxy. It is found that the quality of these legacy products is solidly improved over cold areas, and in warm areas, the improvement is less significant.

25. NOAA'S Geostationary Operational Sea Surface Temperature Product suite

Authors: Eileen Maturi, John Sapper, Andy Harris, Jon Mittaz, Wen Meng, Robert Potash, Meizhu Fan

NOAA's National Environmental Satellite, Data, and Information Service (NESDIS) have generated Sea Surface Temperature (SST) products from geostationary (GOES) East and West satellites on an operational basis since December 2000. Since that time, a process of continual development has produced steady improvements in product accuracy. Recent improvements extended the capability to permit generation of operational SST retrievals from the Japanese Multi-function Transport Satellite (MTSAT-1R) and the European Meteosat Second Generation (MSG-2) satellite, thereby extending spatial coverage. The four geostationary satellites (longitudes 75ºW, 135ºW, 140ºE, and 0º) provide high temporal SST retrievals for most of the tropics and mid-latitudes, with the exception of a region between ~60ºE and ~80ºE. Due to ongoing development, the quality of these retrievals now approaches that of SST products from the polar orbiting Advanced Very High Resolution Radiometer (AVHRR). The suite of products consists of gridded, NetCDF imagery and HDF blended SST analysis. Gridded products generated from the four geostationary satellites provide hourly regional imagery, 3-hourly hemispheric imagery, 24 hour merged composites, along with a buoy matchup data set. NetCDF Level 2 preprocessed products are generated for every satellite image. This consists of a pixel level SST and additional parameters which are generated for GOES-E/W every 30 minutes for each N and S hemispheric sectors; MTSAT-1R every 60 minutes for each full disk sector; and MSG-2 every 15 minutes for each full disk sector. The blended SST is daily 11KM analysis generated from blending geostationary and polar-orbiting satellite SST retrievals. These products provide to the user community a reliable source of SST observations, with improved accuracy and increased coverage in important oceanographic, meteorological, and climatic regions.

26. Status of the Advanced Dvorak Technique (ADT)

Authors: Tim Olander and Chris Velden

The Advanced Dvorak Technique, an objective algorithm developed at UW-CIMSS designed to estimate tropical cyclone intensity from geostationary IR imagery, has undergone several important recent upgrades and modifications. These upgrades range from functionality changes to accommodate operational ADT user requirements, to coding modifications to adapt and adhere the algorithm to GOES-R guidelines and objectives. In addition, new innovations continue to improve the performance and accuracy of the ADT in estimating tropical cyclone intensity. These modifications and upgrades will be summarized in the poster to brief current and future ADT users on the algorithm's status.

27. Diurnal Frequencies of the GOES Derived Cloud Product

Authors: Anthony J. Schreiner and James P. Nelson III

One of the primary strengths for the Geostationary Operational Environmental Satellite (GOES) series of Imager- and Sounder-derived products is the opportunity to examine and compare the diurnal cycle for specific atmospheric components (e.g. frequency of cloudiness) for varying time lengths. Comparisons of this type may show changes in seasonal trends with respect to the diurnal cycle within a given year, or comparisons from year to year. In addition to examining diurnal characteristics at a particular location, one can also investigate diurnal differences due to land/sea conditions or orographic differences, for example.

Routine processing of the GOES Sounder and Imager Cloud Product at the University of Wisconsin–Madison Cooperative Institute for Meteorological Satellite Studies (UW-CIMSS) has been ongoing for the past fourteen and eight years, respectively. These data are available in near-real time on the CIMSS Real-time web page (http://cimss.ssec.wisc.edu/goes/rt/). A technique for generating monthly frequencies of all-cloud, high-level, mid-level, and low-level cloud at hourly intervals has been developed using the GOES Sounder Cloud Product. To date this technique has only been applied for the months July through September 2009 and is limited to the Continental United States (CONUS) plus the immediate surrounding waters of the Atlantic and Pacific Oceans and the Gulf of Mexico.

A demonstration of this product will be presented. Plans include the reprocessing of historical Sounder derived Cloud Product data and expanding this technique to include the derived Cloud Product from the GOES-12 Imager.

Readiness / Training

28. McIDAS-V Support for the GOES-R Program

Authors: Thomas Achtor, Thomas Rink, Thomas Whittaker

The fifth generation of the Man-computer Interactive Data Access System (McIDAS-V) is a Java-based, open-source, freely available software package. It provides powerful new capabilities to analyze and visualize data from the next generation of remote sensing instruments under development for the GOES-R and NPOESS programs. Working through the GOES-R AWG Imagery team, McIDAS-V will provide visualization and analysis capabilities for the GOES-R algorithm development teams. We are developing data analysis and visualization tools for ABI simulated imagery and AWG development products. SEVIRI data can also be displayed and manipulated. We will provide an intuitive user interface to the GOES-R routine processing framework to bring AWG products into the McIDAS-V data model. This will allow GOES-R scientists and algorithm developers to analyze and visualize their products, enable algorithm evaluation, monitoring and support iterative development.

29. Operational Uses of Bands on the GOES-R Advanced Baseline Imager (ABI)

Authors: Kaba Bah, T. J. Schmit, T. Achtor, T. Rink, W. Wolf, J. Otkin, J. Sieglaff, and J. Feltz

The capabilities of the Advanced Baseline Imager (ABI) that will be onboard the GOES-R satellite are being demonstrated by using McIDAS-V as a tool to visualize and analyze simulated GOES-R ABI data. These simulated images were created by the GOES-R Algorithm Working Group (AWG) who used super computers to run high resolution numerical models, which were then input into the Cooperative Institute for Meteorological Satellite Studies (CIMSS) advance radiative transfer models. The simulated datasets include 2km sampling full disk images showing GOES-R ABI in the "west" projection, 2km resolution Continental United States(CONUS) images, and higher resolution mesoscale images for the convective outbreak on June 4-5 2005 at 1-minute time intervals. McIDAS-V is a free Java based open source software package designed for easy visualization and analysis of different satellite datasets. By ingesting these simulated ABI datasets into McIDAS-V for visualization, we were also able to analyze multiple bands in many different ways, which includes Normalized Difference Vegetation Index (NDVI), simple band differences, scatter analysis and data transacts.

30. Interpretation of Total Lightning Density Patterns in the GOES-R Proving Ground

Author: Eric C. Bruning

Described is a framework for explaining total lightning density patterns using charge conservation and simple electrostatic criteria for lightning initiation and propagation. It is proposed that cellular maxima in lightning density maps are tied to frequent, local flash initiation driven by local updraft conditions supportive of non-inductive charging, while extensive regions of lower-density activity are tied to lower-frequency propagation of lightning channels through regions of charge carried to those regions by advection. Lightning imagery possibilities from the GOES-R Geostationary Lightning Mapper will be shown, focusing on different combinations of event, group, and flash centroids, extents, and radiances, and the different physical processes implied by each.

31. Education Resources: GOES Satellite-related Web Modules and the Environmental Satellite Resource Center (ESRC)

Authors: Patrick Dills and Wendy Schreiber-Abshire

The COMET® Program (www.comet.ucar.edu) receives funding from NESDIS and the NPOESS Integrated Program Office (IPO), with additional contributions from the GOES-R Program Office and EUMETSAT, to directly support education and training efforts in the area of satellite meteorology. This partnership enables COMET to create educational materials of global interest on the products and operational applications from geostationary and polar-orbiting remote sensing platforms.

Since the mid 1990s, COMET's satellite education programs have focused on the capabilities and applications of operational GOES and POES systems and their relevance to operational forecasters and other user communities. Several years ago, COMET introduced educational materials on the upcoming NPP/NPOESS system, and then in 2008 expanded its activities to include training on the future GOES-R satellites. By partnering with experts from various scientific and user communities, and applying cutting edge Web-based learning and teaching technologies, COMET is able to stimulate greater utilization of both current and future satellite data observations and products. COMET has also recently broadened the scope of its online training to include materials on the EUMETSAT Polar-orbiting System (EPS) and Meteosat geostationary satellites. EPS represents an important contribution to the Initial Joint Polar System (IJPS) between NOAA and EUMETSAT, while Meteosat imaging capabilities provide an important proving ground for the next generation GOES-R imager. This presentation provides an overview of COMET's recent satellite education efforts and publications, highlighting new materials relevant to the GOES satellite series. In addition to being available via the MetEd Web site (www.meted.ucar.edu/topics_satellite.php), COMET's satellite modules can also be found among a growing body of satellite information and training resources within the Environmental Satellite Resource Center (ESRC) Web site (www.meted.ucar.edu/esrc). The ESRC, developed and supported by COMET, provides search capabilities and free access to both geostationary and low Earth orbiting satellite information and education from multiple trusted sources. The ESRC site is a community-driven resource and is sponsored by the NPOESS IPO, NOAA, and NESDIS.

32. New Course: Satellite Hydrology and Meteorology for Forecasters

Authors: B. Connell, J. Braun, D. Bikos, R. Van Til, S. Lindstrom, S. Bachmeier, T. Mostek, and M. DeMaria

The Forecaster track of the Satellite Hydrology and Meteorology (SHyMet) Course will cover satellite imagery interpretation, including feature identification, water vapor channels and what to expect on GOES-R. There is a session on remote sensing applications for hydrometeorology that includes uses of remote sensing data for operational hydrology; there is also a session on aviation hazards. Other topics include an understanding of the Dvorak method in tropical cyclone analysis and the utility of cloud composites in forecasting. This course will be administered through web-based instruction and will be the equivalent of 16 hours of training.

33. New Training: GOES-R 101

Authors: B. Connell, T. Schmit, J. Gurka, S. Goodman, D. Hillger, and S. Hill

What information would you select to present to forecasters to introduce them to GOES-R – and do it in under 2 hours? We address 3 W's: Why, when, and what sensors and provide examples and information links. Come find out what is in the module.

GOES-R/S Transition

34. Validation of Nighttime Cloud Optical and Microphysical Properties for GOES-R

Authors: S. Bedka, P. Minnis, P. W. Heck, Y. Yi, M. M. Khaiyer, D. A. Spngenberg, and S. J. Abel

The determination of nighttime cloud microphysical properties from satellite-based radiometers remains a relatively unexplored area, particularly in comparison to daytime methods. While nighttime multi-spectral algorithms are routinely used for cloud masking, cloud typing and determining cloud height, techniques for deriving optical properties and microphysics are less prevalent due to the lack of shortwave information from which scattering and absorption properties of hydrometeors can be inferred. The GOES-R Cloud Algorithm Working Group (AWG) is employing a modified version of NASA Langley's Solar infrared-Infrared-Split window Technique (SIST) to retrieve cloud optical depth, particle size and liquid/ice water path. This modified technique, the Nighttime Optical and Microphysical Properties (NCOMP) algorithm, currently utilizes 3.9, 10.8 and 12 -µm channels and has been applied to Advanced Baseline Imager (ABI) proxy datasets, Spinning Enhanced Visible InfraRed Imager (SEVIRI) imagery. NCOMP is a streamlined version of SIST in that it uses both cloud phase and cloud temperature that are pre-determined by upstream GOES-R algorithms rather than deriving those quantities as part of its retrieval technique. This paper will present validation and comparisons of NCOMP results from a 10-week period during which other Cloud AWG products are also being validated. Performance and accuracy will be assessed with respect to the GOES-R Function and Performance Specifications (F&PS). Particular emphasis will be placed on Cloud Liquid Water Path (LWP) and Ice Water Path (IWP) comparisons as these quantities are readily available from Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO), Advanced Microwave Scanning Radiometer - Earth Observing System (AMSR-E) and surface-based retrievals. Consistencies between SIST and NCOMP results will also be shown in order to expand validation opportunities given the relative lack of well-tested nighttime optical and microphysical property retrievals from other instruments. SIST is used in near-real time over a variety of domains using imagery from additional geostationary and polar-orbiting orbiting satellites, so validation results from non-SEVIRI field programs such as the Tropical Composition, Cloud and Climate Coupling (TC4) mission will be shown.

35. GOES-R EXIS: Providing Solar EUV and X-Ray Irradiances for Space Weather

Author: Francis G. Eparvier

The variable solar EUV and soft X-ray radiation is a primary energy source for the upper atmosphere, heating the thermosphere, creating the ionosphere, changing the environment in which low earth orbit satellites fly, and affecting telecommunications and navigation systems. Part of the GOES-R solar instrumentation will be the EUV and X-Ray Irradiance Sensors (EXIS). The EXIS consists of two instruments, the EUV Sensor (EUVS) and the X-Ray Sensor (XRS), both designed to measure the solar spectral irradiance in different geo-effective wavelength ranges. An XRS has been included in the GOES manifest since the beginning of the program and has become the standard, real-time monitor of solar flares. The new XRS design will continue that long history, measuring the solar irradiance in the 0.05-0.4 nm and 0.1-0.8 nm bands, but will have a larger dynamic range, capturing both the lowest solar minimum and brightest flaring irradiances. An EUVS was first added to the program with the launch of GOES-13 in 2006. Completely redesigned for GOES-R, the new EUVS will use a combination of measurements of specific solar emissions and empirical modeling to produce a realtime solar irradiance product spanning the entire 5-127 nm wavelength range. This paper will introduce the concept designs for the GOES-R EXIS and the utility of the EXIS data products for space weather monitoring and modeling.

36. An Air Quality Proving Ground (AQPG) for GOES-R

Authors: M. Green, R. Hoff, S. Christopher, F. Moshary, S. Kondragunta, R. Pierce

A consortium of universities has been awarded an Air Quality Proving Ground for the GOES-R ABI instrument. Led by UMBC and University of Alabama Huntsville, the Proving Ground will provide the first steps to building a user community who will be prepared to use the ABI data in near-real time for air quality forecasting and analysis needs. Based on the currently successful, IDEA product, the AQPG will evolve a product delivery system so that regional air quality forecasters have access to measurements from GOES-R, from ground based sites, and from models to better predict particulate air quality in the US. The Year 1 activities of the Proving Ground will be to gather user driven ("pull") guidance on the understanding of the ABI product and how it would be used in such a forecast system. To that end, an AQPG User Group will be formed that will advise the project in the future. Evolving from the current Three-Dimensional Air Quality System User Group and adding members from the NWS Forecast Guidance User community, these advisers will assess ABI proxy data that has been and will be processed in the future. Using known data sets from existing satellite, ground based remote sensing, ground based air quality and models, at least ten case studies will be created which exercise the ABI algorithm and allow the User Group to comment on how those data would be used in their forecast tasks.

37. Convective Initiation Algorithm for GOES-R

Authors: Wayne M. MacKenzie, John R. Walker, John R. Mecikalski

This algorithm, first developed for the current GOES satellite series (Mecikalski and Bedka 2006), is being evolved to take advantage of the improvements in spectral, spatial and temporal resolution. A recent study by Mecikalski et al. (2009) and Siewert et al. (2009) outlines the uses of additional spectral bands on convective initiation events using Meteosat Second Generation (MSG). Since MSG contains similar spectral bands as GOES-R will contain, these results apply to the GOES-R Convective initiation (CI) algorithm. The results from that study have been used tested in a framework to include within the (CI) algorithm.

The components of the algorithm include an object tracking component, and spectral channel tests to determine a high probability for which cloud objects will CI. The validation has been performed on the algorithm itself (independent of an objective tracking system), and current work includes object-tracking validation. This will allow for an analysis of which components contribute to the algorithm error.

38. Development of a Visibility Retrieval for the GOES-R Advance Baseline Imager

Authors: R. Bradley Pierce and Allen Lenzen

This poster presents a comparison between GOES-R Advanced Baseline Imager (ABI) visibility retrievals, under development within the GOES-R Aviation Algorithm Working Group, with model based estimates from the NCEP North American Model (NAM) and observations Automated Surface Observing Systems (ASOS) visibility reports for the period May-July 2008. Visibility is proportional to extinction-1, which is a measure of attenuation of the light passing through the atmosphere due to the scattering and absorption by aerosol particles. The integrated extinction coefficient over a vertical column is called aerosol optical depth (AOD). Conversion from AOD and Low Cloud/Fog optical depth (COT) to extinction requires knowledge of the depth of the aerosol/cloud layer, which is assumed to be determined by the depth of the planetary boundary layer (PBL) in the ABI visibility algorithm. The ABI visibility retrieval combines ABI clear sky Aerosol Optical Depth (AOD) retrievals (using MODIS L1 radiances as ABI proxy data) with ABI Cloud Optical Depth (COT) retrievals (using GOES-12 L1 radiances as ABI Proxy data) and meteorological analyses from the NCEP Global Forecasting System (GFS). Assessment of visibility product measurement accuracy is presented. The results of this feasibility study show systematic biases in classification for Low and Moderate visibility that point to the need to perform seasonal and/or regionally dependent bias corrections to meet ABI design specifications.

39. The History and Evolution of the ABI (Advanced Baseline Imager) on the GOES-R Series

Author: Timothy J. Schmit

The evolution of the next generation GOES-R Advanced Baseline Imager (ABI) will be covered. As with any instrument, the ABI leverages heritage instruments and the input from many. The ABI began as a proposed eight-channel imager, all with fairly wide instrument spectral responses. Over time, eight more bands were added to better meet the stated requirements. In general, the bands were made more narrow spectrally. The next generation geostationary satellite series will offer a continuation of current products and services and enable improved and new capabilities. The ABI on the GOES-R series has been designed to meet user requirements covering a wide range of phenomena. This includes applications related to weather, oceans, climate, and the environment. The ABI will improve upon the current GOES Imager with more spectral bands, faster imaging, higher spatial resolution, improved navigation and registration, and more accurate calibration. The ABI expands from five spectral bands on the current GOES imagers to a total of 16 spectral bands in the visible, near-infrared and infrared spectral regions. The ABI will also offer an increase of the coverage rate leading to full disk scans at least every 15 minutes. ABI spatial resolution at the satellite sub-point will be 2 km for the infrared bands and 0.5 km for the 0.64 um visible band.

40. The GOES-R Proving Ground at NOAA's Storm Prediction Center and Hazardous Weather Testbed

Authors: Christopher Siewert, Eric Bruning, Russell Schneider, Steve Goodman, James Gurka, Robert Rabin

The GOES-R Proving Ground's activities at NOAA's Hazardous Weather Testbed (HWT) in the Storm Prediction Center (SPC) in Norman, OK provide a unique opportunity to interact with and study new products available on the next generation GOES-R satellite in an operational framework. The overall goal of the proving ground is to provide forecasters with the knowledge and experience needed to effectively use the products in day to day operations once they become available. This past year, the GOES-R Proving Ground's Spring Experiment at the SPC met this goal through constant interaction with the products in real-time forecasting situations by both forecasters and product developers. Constructive feedback given by forecasters during the Spring Experiment and throughout the year is provided to product developers in order to facilitate required improvements to the products.

GOES-R proxy products focusing on detecting and forecasting convection, lightning and severe weather were studied this year in a broad range of forecasting strategies, from short term convective outlooks to real-time nowcasting exercises. The products available currently at the SPC include a 15-minute cloud-top cooling and 0-1 hour convective nowcast product from the University of Wisconsin – Cooperative Institute for Meteorological Satellite Studies (UW-CIMSS), a 10-km total lightning GLM proxy from NASA's Short-term Prediction Research Transition (SPoRT) and the National Severe Storms Laboratory (NSSL), and a 0-1 hour severe hail probability forecast from the Cooperative Institute for Research in the Atmosphere (CIRA).

The presentation will focus on the GOES-R Proving Ground's activities at the SPC, preliminary findings from this past year's experiment, product improvements and case examples, forecaster interactions, and goals for the GOES-R Proving Ground's activities in years to come including additional experiment activities throughout the year.

41. Sea and Lake Ice Thickness and Age for Use with GOES-R ABI

Authors: Xuanji Wang, Jeffrey R. Key, Yinghui Liu

Sea and lake ice concentration and thickness affect the exchange of heat, energy, mass, and momentum between the atmosphere and the underlying water body. Ice and snow, commonly called the cryosphere, exist at all latitudes and in about one hundred countries. Not only does the cryosphere and its characterization and distribution play a significant role in weather forecast and climate, it also has profound socio-economic value due to its role in water resources and its impact on transportation, hazards, recreation, fisheries, hunting, herding, and agriculture. Current remote sensing techniques provide an unprecedented opportunity to estimate and monitor the cryosphere routinely with relatively high spatial and temporal resolutions. In this study, a thermodynamic model, called One-dimensional Thermodynamic Ice Model (OTIM), is developed and introduced here to estimate sea and lake ice thickness and age with optical (visible, near-infrared, and infrared) satellite data for the next generation Geostationary Operational Environmental Satellite (GOES-R) Advanced Baseline Imager (ABI).

The comparison in ice thickness between the OTIM retrievals and submarine upward-looking sonar measurements during the 1999 Scientific Ice Expedition (SCICEX) shows that the OTIM is capable of retrieving ice thickness up to 3 meters. The mean absolute error is 0.31 m for the samples with a mean ice thickness of 1.80 m, i.e., a 17% mean absolute bias. Sensitivity studies indicate that the largest errors in the model ice thickness estimates come from uncertainties in surface albedo and downward solar radiation flux estimates from satellites, followed by uncertainties in snow depth and cloud fractional coverage. Based on the ice thickness, eight categories of ice "age" are defined: new, nilas (0.00~0.10 m), grey (0.10~0.15 m), grey-white (0.15~0.30 m), first-year thin (0.30~0.70 m), first-year medium (0.70~1.20 m), first-year thick (1.20~1.80 m), and old ice including second-year and multi-year ice (> 1.80 m). The thicker categories are for sea ice only. The current version of the OTIM was also compared with the ice thickness data measured by Canadian meteorological stations over 2002~2004, and the simulated ice thickness data from Pan-Arctic Ice-Ocean Modeling and Assimilation System (PIOMAS). Due to the uncertainties in current satellite retrievals of surface albedo and surface downward shortwave radiation flux, the model is not recommended for use with daytime data. Preliminary testing results with the proxy data from AVHRR, MODIS, and SEVIRI are promising.

42. Exploring the Behavior of Atmospheric Motion Vector (AMV) Errors Through Simulation Studies

Authors: Steve Wanzong, Chris Velden, Jaime Daniels and Wayne Bresky

The Cooperative Institute for Meteorological Satellite Studies (CIMSS), in cooperation with NOAA's GOES-R Algorithm Working Group (AWG), has been using simulated Advanced Baseline Imager (ABI) radiances to evaluate potential instrument effects on atmospheric motion vector (AMV) errors.

Simulated GOES-R ABI Top of Atmosphere (TOA) radiances derived from the Weather Research and Forecasting (WRF) model, and the CIMSS fast solar/infrared forward model are used within a new framework to produce AMVs. The use of this framework is a departure from the current operationally derived GOES AMVs, but is employed in this study since this framework will mimic what will be in place for the GOES-R ground system data processing. Adaptive changes to the operational feature-tracking algorithms were necessitated for inclusion into this system. For example, pixel-level cloud heights derived from the AWG cloud team algorithms are used in the AMV height assignment routine.

As a first step, unaltered TOA radiances (no noise) are used to derive a baseline set of AMVs. The TOA radiances are then altered at 1- and 3-times the ABI threshold specifications with several different induced noise effects: calibration offsets, navigation shifts, degraded sensor signal-to-noise, image striping, and all the effects combined.

AMV datasets are derived with the above instrument effects for a selected case study time period. They are then compared to the WRF model U and V wind fields ("truth") to assess which effects are most sensitive to the AMV processing software within the framework. The results will provide important tolerance guidance to the GOES-R Program Office in the selection of instrument specification thresholds.

43. GOES-R AWG Product Processing System Framework

Authors: Walter Wolf, S. Sampson, Z. Cheng, P. Keehn, Q. Guo, S. Qiu, and M. Goldberg

NOAA/NESDIS/STAR has designed, developed, and implemented the GOES-R Algorithm Working Group (AWG) Product Processing System Framework. The framework enabled the development and testing of the Level 2 Advance Baseline Imager (ABI) and the GOES-R Lightning Mapper products within a single system. The development of one program was possible because most main programs for operational Level 2 satellite product processing systems perform similar functions. Although the concept of a unified framework seems simple, many issues had to be taken into consideration to accomplish this task due to the intricacies inherent in each algorithm. One concern involved maintaining algorithm compatibility with outside research systems. To address this, algorithms were integrated into the framework using a plug and play interface allowing for backwards compatibility with other systems. To prevent redundant code, commonalities between different algorithms were identified, consolidated into a single place, and the duplicate code removed. Other considerations addressed in developing this system include: the coordination of the input data for the multiple algorithms, unified data structures, common data formats for all the products, common software libraries, input file configurations, interface between the main program framework and the algorithms, product precedence, hardware, programming languages, and the software used to both check and compile the code. The framework also has the ability to process both polar and geostationary data. These design features and the current algorithms integrated into the framework will be discussed.

44. Emulated GVAR from GOES-R ABI Data

Authors: Shu Yang and Mike Jamieson

Advanced Baseline Imager (ABI) is a next-generation imaging instrument onboard of GOES R-series. Its design has no backward compatibility consideration for the current GOES I-P Imager, and its operation is significantly different from the current Imager in scenario, scan pattern, number of spectral bands, image shape, size and resolution, and pixel bit-widths. Therefore an emulated GVAR product (eGVAR) is to be created to facilitate the current GOES Imager users to continue utilization of their heritage downloading hardware, ingesting software, as well as various GVAR data application software modules they have developed over years.

The eGVAR will contain ABI's L1b image data (i.e., images after radiometric and geometric calibrations) but formatted to the same GOES VARiable (GVAR) format as the current GOES payload data. Since there is no counterpart of the current GOES Sounder onboard GOES-R, there are no corresponding sounding data to be generated in the eGVAR.

Five of ABI's 16 spectral bands, whose central wavelengths are 0.64, 3.90, 6.19, 11.2, and 13.3 µm respectively, are chosen to be the eGVAR spectral bands. These wavelengths are very close to those of GOES I-P Imager's spectral bands. For example, GOES-P Imager's five spectral bands have central wavelengths of 0.625, 3.885, 6.517, 10.70 and 13.28 µm.

The resolution of Imager's one IR band has been changed from 8 km in GOES I-M to 4 km in GOES O-P; hence the eGVAR product is going to be compliant with the GVAR format of GOES O-P, i.e., 1-km resolution for the visible band and 4-km for all four IR bands. The scenario of the eGVAR will be scheduled to create one full-disk image frame in every half hour. In order to create a backward compatible eGVAR product, the following three emulations have to be achieved:

1. Fit the ABI's range of albedo in the specified visible band and the ranges of brightness temperature in the specified IR bands into the corresponding ranges of the current GOES Imager. Then re-digitize the radiometric values of the ABI image pixels in all specified bands to match the bit widths to that of the GOES O-P Imager by using linear interpolation, and extrapolation if necessary.
2. Transform the elevation and azimuth angles from ABI scanner to that of the current Imager scanner if their scan angle definitions are different. Then transform the image resolution from ABI to the current Imager. Both transformations will be carried out by resampling, sub-sampling and/or binning of image pixels.
3. Design and implement a virtual yet sophisticated GOES O-P Imager simulator to correctly create the scenario, scanner, pixel calibration and image frame related metadata in GVAR block 0 and 11's as well as the document portion of GVAR block 1 to block 10 so that GVAR users can process the eGVAR imagery pixel data in block 1 to 10 in the same fashion as they did for a GOES O-P GVAR downlink stream.

The created eGVAR data will be sent via a modulated IF signal from GOES R Ground Segment (GRGS) to the current GOES Satellite Support Ground System (SSGS).

45. High-resolution Simulated ABI datasets Used for GOES-R Research and Demonstration Activities

Authors: Jason Otkin, Tom Greenwald, Justin Sieglaff, Mat Gunshor, Kaba Bah, Tim Schmit, Allen Huang, and Steve Wanzong

The next generation of Geostationary Operational Environmental Satellites (GOES), beginning with GOES-R in a few years, will contain improved spacecraft and instrument technologies capable of observing the earth's atmosphere with greater accuracy and at higher resolutions than current GOES satellites. The Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin-Madison is heavily involved in GOES-R satellite algorithm development, risk reduction, data processing, and measurement capability demonstration activities. To support this work, an end-to-end processing system that utilizes proxy top of atmosphere radiance datasets has been developed. High-resolution numerical model simulations are used to generate simulated atmospheric profile datasets that are subsequently passed through a sophisticated forward radiative transfer model to generate proxy top of atmosphere radiances for the GOES-R Advanced Baseline Imager (ABI) spectral bands.

In this paper, results from several large-scale, high-resolution Weather Research and Forecasting (WRF) model simulations will be presented. Proxy ABI radiances generated from the model-simulated data are a critical component of the GOES-R Proving Ground and GRAFIIR projects that are used to demonstrate future ABI-derived cloud and stability products for the operational community and to test the sensitivity of various retrieval algorithms to potential errors in the ABI radiances. Representative examples of how these projects use the proxy radiance data will be shown.

46. New Large-scale Model-derived Proxy ABI datasets Available for GOES-R Research and Demonstration Activities

Authors: Jason Otkin, Justin Sieglaff, Tom Greenwald, and Allen Huang

The Cooperative Institute for Meteorological Satellite Studies at the University of Wisconsin-Madison is heavily involved in GOES-R satellite algorithm development, risk reduction, data processing, and measurement capability demonstration activities. In support of this work, an end-to-end processing system that utilizes proxy top of atmosphere radiance datasets derived from numerical model output has been developed. The first step in the end-to-end system is to use the Weather Research and Forecasting (WRF) model to perform a high-resolution simulation covering a large geographic domain with high spatial and temporal resolution. Model-simulated temperature, moisture, and cloud data are subsequently passed through a forward radiative transfer model to produce proxy ABI radiances.

In this paper, we will describe our recent simulation activities, which includes performing two large-scale, high-resolution model simulations at the Pittsburgh Supercomputing Center during 2009. The first simulation contained a single 3950 x 3420 grid point domain with 5-km horizontal resolution centered at -137º W while the second simulation contained two nested domains with the inner domain covering a 1000 x 1000 km area with 500-m resolution. These two simulations were configured to represent the potential western viewing area of GOES-R and a representative special mesoscale viewing area, respectively. Proxy radiance datasets generated from these simulations provide an important opportunity to realistically demonstrate ABI measurement capabilities.

47. Processed Sensor Data Rebroadcast for the GOES-R Weather Satellite System

Author: William Callicott

GOES Rebroadcast (GRB) will provide ground-processed sensor data from the GOES-R System to weather operations, research, and Earth sciences communities on a free and open basis. In addition, GRB will deliver processed instrument data to the NOAA product generation facility, enabling creation of higher-level weather products at low latency. The GOES-R satellite instruments will collect about 50 times more data than the current NOAA geostationary operational satellites with advanced temporal, spatial and spectral performance. Compared with previous generation of GOES satellites, broadcast rates for processed data from GOES-R series will increase from 2.6 Mbps to 31 Mbps. The poster describes the GOES R data flow and content of GRB to direct readout users. A dual circular polarization approach will be used to accommodate the 31 Mbps data rate within a band frequency of 12MHz using a standard modulation at 1690 MHz (L-band). The GRB processed instrument data will be packetized using CCSDS Space Packet standards and will include lossless data compression to fit within bandwidth constraints. Data blocking and accompanying header metadata will be used to minimize risk of loss due to link errors and allow for user verification of data integrity.

48. Commercial Sounder Options in the GOES-R Era

Author: David Crain

Advanced Geostationary Sounding remains an unmet requirement since the HES cancellation on GOES-R. Recent NOAA solicitations for commercial options have resulted in several alternatives for making Hyperspectral Sounding Observations during the GOES-R Era. These options do not require any accommodation within the GOES-R mission, but can be accomplished using existing commercial architectures and leveraging existing sensor development programs. The proposed options do not require upfront investment, but rather rely on a fee-for-service procurement model to make timely hyperspectral sounding data available for weather forecast and climate observations. Details of these options and timelines are presented.

49. Commercial Ocean Color Options in the GOES-R Era

Authors: David Crain and Loren Woody

The original ocean color mission requirement for GOES-R was lost with the cancellation of HES. Recent NOAA solicitations for commercial options have resulted in several mission concepts to achieve a U.S. Ocean color observation capability including LEO (Low Earth Orbit) and GEO options. Details for some of these options are presented.

50. GOES-R ABI True-Color Capability

Authors: Don Hillger, Louie Grasso, Renate Brummer and Robert DeMaria

The 16-band GOES-R Advanced Baseline Imager (ABI) does not contain a "Green" (0.55 μm) band; however the Green band is needed to generate RGB (true-color) imagery from ABI. The CIRA-RAMMB Team in Fort Collins is developing forward model simulations of ABI reflective band imagery in order to test the production of ABI Green band and RGB products. Using 16-day albedos from MODIS for the land background, forward model simulations of the Red (0.64 μm), Near-IR (0.86 μm), and Blue (0.47 μm) images are made. Those three bands are used as input into a look-up-table (LUT) generation of the Green band, which we refer to as "synthetic Green" band. The LUT, created by Steve Miller, was trained on MODIS imagery which contains all three: Red, Near-IR, and Blue images, as well as a Green band.

The ABI Green band can also be simulated directly using the same forward model calculations used to produce the other ABI bands. This allows for the "simulated Green band" to be used as ground truth for the "synthetic Green band." In addition, the direct simulation of the Green band allows the possibility of Green band generation through regression on the other (Red, near-IR, and Blue) ABI bands. Results of both methods of Green band generation will be presented and compared. The synthetic-Green and synthetic-RGB ABI products have application for use in detection and retrieval of smoke plumes, volcanic ash, and other aerosols. Example of synthetic-RGB imagery with added smoke will be presented. Such simulations, with known aerosol properties, may be useful as proxy datasets for testing of algorithms for detection of such aerosols.

51. GOES Science Testing

Authors: Don Hillger and Tim Schmit

Two out of three of the Geostationary Operational Environmental Satellites (GOES) in the current series (GOES-13/14) have been launched. Only GOES-P remains to launch before the GOES-R series. An important aspect of the Post Launch Testing (PLT) of each satellite is the NOAA Science Test. That Science Test occurs at the end of the 5-month PLT, and allows scientists a chance to check out the satellite capabilities, especially the new and improved capabilities as the satellites evolve. Unique to the Science Test is the focus on products, as well as the imagery. Science Testing will be especially important when GOES-R is launched. The entirely new series of spacecraft will provide many new capabilities and challenges. Improvements are expected in the following four areas: spectrally (increased number of bands), radiometrically (lower noise), spatially (better spatial resolution), and temporally (increased temporal resolution).

Examples were shown of the types of tests that take place during the NOAA Science Tests. These tests are complete for GOES-13 and currently taking place for GOES-14 and will be completed in December 2009. Details of the current Science Test are being gathered on the GOES-14 Science Test page at http://rammb.cira.colostate.edu/projects/GOES-o/ and will appear in a NOAA Technical Report to appear in 2010.

For all GOES checkouts, the goals of the Science Tests include: 1) To assess the quality of the GOES radiance data. This was accomplished by comparison to other satellite measurements or by calculating the signal-to-noise ratio compared to specifications, as well as assess the striping in the imagery due to multiple detectors. 2) To generate products from the GOES data stream and compare to those produced from other satellites. These included several Imager and Sounder products currently used in operations. In addition, rapid-scan imagery of interesting weather cases are collected with temporal resolutions as fine as every 30 seconds, a capability of rapid-scan imagery from GOES-R that is not implemented operationally on current GOES.

GOES-R Space

52. SURF/NIST Calibration Capabilities for Solar Extreme Ultraviolet Missions

Authors: Uwe Arp, Alex Farrell, Mitch Furst, Steven Grantham, Edward Hagley, Ping-Shine Shaw, Charles Tarrio, Robert Vest

The Synchrotron Ultraviolet Radiation Facility SURF III maintains several experimental stations, which are used to support solar observations in the ultraviolet, extreme ultraviolet, and even soft X-ray range. Recently several instruments for the Extreme Ultraviolet Variability Experiment (EVE) on the Solar Dynamics Observatory (SDO) were calibrated at SURF III. In addition, the twin instruments used for rocket underflight experiments that ensure the stability of the EVE instruments are also calibrated at SURF before and after each sounding rocket experiment. Several, very different, experimental stations can be used to perform calibrations at SURF. For many solar observations the calculability of synchrotron radiation is used to calibrate instruments on beamline 2. SURF can be operated at electron energies between 100 MeV and 420 MeV, which allows us to custom-tailor the output spectrum. The storage ring can also be operated with electron ring currents from a few micro-amperes to about one 1 ampere, which allows us to change the output intensity over several decades, to match the expected intensity in space.

On beamlines 4, 7, and 9, we have the capability to calibrate photodectors in the extreme ultraviolet and ultraviolet spectral ranges by comparing them against absolute cryogenic radiometers. Beamline 7 is equipped with a grazing incidence monochromator and a large sample chamber that allows us to measure optical properties in the extreme ultraviolet spectral range, like multilayer reflectivities. Beamline 7 can also be used to calibrate CCD cameras. Recently we have calibrated vacuum ultraviolet sources as transfer standards on beamline 3, again using the calculability of synchrotron radiation. Overall, SURF III is available to the heliophysics and astrophysics communities to perform a multitude of calibration tasks for future solar and earth observing missions.

53. GOES-R Solar and Space Environment Data Products: Benefiting Users

Author: Joe Kunches

Space weather data from GOES are the cornerstone of valuable products and services to the user community. The data are the basis of the widely used NOAA Space Weather Scales, as well as the premier input to another class of users, the duty forecasters at the Space Weather Prediction Center. The growing user base, both external and internal, is the focus for planned product improvement activities at SWPC. These activities include better products derived directly from GOES data, i.e., the D-Region Absorption Model, used by commercial airlines as they plan and fly polar routes, to the envisioned ENLIL/Cone interplanetary coronal mass ejection model that will enable better predictions of the most threatening geomagnetic storms. The external user segment is varied and broad; examples of the key role of the GOES data, now and in the future, will be the focus of the presentation.

54. Space Environment In-Situ Suite (SEISS)

Authors: Kevin P. Ray, E. Gary Mullen, Gary E. Galica, Bronek K. Dichter

The Space Environment In-Situ Suite (SEISS) is a suite of five instruments and a Data Processing Unit (DPU) that will provide real-time measurements of electrons, protons, and heavy ions in geosynchronous orbit while operating on-board the GOES-R series spacecraft. The SEISS suite is composed of the following instruments: Magnetospheric Particle Sensor – Low (MPS-LO) which measures both electrons and ions from 30 eV to 30 keV; Magnetospheric Particle Sensor – High (MPS-HI), which measures electrons from 50 keV to 4 MeV and protons from 80 keV to 12 MeV; Two Solar and Galactic Proton Sensors (SGPS), which measure protons from 1 to greater than 500 MeV and alpha particles from 4 to 500 MeV; Energetic Heavy Ion Sensor (EHIS) which measures solar and galactic heavy ions in five mass groups (H, He, CNO, Ne-S, Fe-group). All five instruments are controlled by the DPU, which serves as the main power and telemetry interface with the spacecraft. The paper will present an overview of the instruments, initial modeling results and preliminary results from testing in particle beam accelerators showing the expected on-orbit performance of the SEISS instruments.

Synergy

55. Life Stage of Deep Convection Defined by Split Window and Rainfall Rate Observed by TRMM/PR

Author: Toshiro Inoue

The life stage of deep convective system over the Eastern tropical Pacific (30N-30S, 180-90W) was studied in terms of cloud type classified by the split window (11 micron and 12 micron). Hourly split window image data of Geostationary Operational Environmental Satellite (GOES-W) from January 2001 to December 2002 was used in this study. Deep convection mostly consists of optically thick cumulus type cloud in the earlier stage and cirrus type cloud area increasing with time in the later stage. In this analysis period and over the analysis area, life stage of deep convection, to a large extent, identified by computing the percentage of cirrus type cloud within deep convection from the single snap shot of split window image. Coincident Tropical Rainfall Measuring Mission (TRMM) Precipitation Radar (PR) observation was used to study the relationship between the percentage of cirrus type cloud within deep convection (life stage) and rainfall rate from TRMM PR. It is found that the rainfall rate tends to be larger at the earlier stage of the lifecycle when smaller percentage of cirrus type cloud is present within deep convection. Calibration is essential to classify cold cloud type by split window. We desperately need the best quality of calibration for 11 micron and 12 micron data, especially for colder brightness temperature in GOES-R system.

56. CLASS Presentation

Author: Bob Lutz

GOES-R data will be permanently archived at two NOAA data centers - the National Climatic Data Center (NCDC) and the National Geophysical Data Center (NGDC). The Comprehensive Large Array-Data Center (CLASS) is the informational technology (IT) component of the data centers and provides the archive and access services for this data. Enhancements of CLASS are planned for the GOES-R era.

57. The NASA Geostationary Coastal and Air Pollution Events (GEO-CAPE) Mission

Authors: Jay Al-Saadi, Paula Bontempi, Ernest Hilsenrath, and Lawrence Friedl

The Geostationary Coastal and Air Pollution Events (GEO-CAPE) mission was recommended for launch in the second tier of missions by the 2007 U.S. National Research Council Earth Science Decadal Survey, "Earth Science and Applications from Space." The mission's purpose is to identify human versus natural sources of aerosols and ozone precursors, track air pollution transport, and understand the short-term dynamics of coastal ecosystems. Instrument concepts covering the wavelength range from UV through thermal IR are being considered to meet these objectives. We will summarize the current status of GEO-CAPE including mission study activities and instrument technology investments. The potential role of GEO-CAPE within integrated U.S. and global observing strategies will be discussed, focusing on synergies with the GOES-R Series.

58. Satellite Composites in the Polar Regions: Development, Evolution and Applications

Authors: Matthew Lazzara, Linda Keller, Shelley Knuth, Rick Kohrs, Rich Dworak, and Jerry Robaidek

Research investigations and operational needs in the data sparse polar-regions and adjacent high latitudes have called for satellite observations to complement limited in situ observation systems. For over 17 years, the combination of geostationary and polar orbiting satellite imagery into a single composite view over the Antarctic and Southern Ocean has been captured in three hourly mosaics. A review of the history of satellite composites in the Antarctic and their evolution will be followed by a report on applications and extended uses. Some examples include storm tracking, atmospheric motion vectors, and cloud mass transport. Recent improvements in temporal resolution will be introduced, as well as changes in the processing methodology. Multi-spectral compositing and recent development of Arctic composites will also be presented. Future efforts with polar satellite composites will be outlined.

59. The Blended Total Precipitable Water (BTPW) Product

Authors: B. Motta, R. VanTil

The National Weather Service (NWS), NOAA Oceanic and Atmospheric Research (OAR), and National Environmental Satellite Data and Information Service (NESDIS) have deployed an operational version of the Blended Total Precipitable Water product for operational use on the Advanced Weather Interactive Processing System (AWIPS). The data are flowing to National Weather Service (NWS) field offices and are available for display in the operational AWIPS systems used by weather forecasters to issue warnings and forecast products. A number of issues have arisen with the operational implementation of this blended product and the poster will identify and explain them.

60. Intercalibration of the World's Geostationary Imagers with High Spectral Resolution Data

Authors: Mathew Gunshor, Tim Schmit, W. Paul Menzel and Dave Tobin

High spectral resolution polar-orbiting satellite instruments, such as AIRS and IASI, can be used to intercalibrate the global system of operational geostationary imagers. The international community of satellite operators, through the WMO, has recognized a need for an improved quantitative assessment of satellite calibration for applications such as climate monitoring and has formed an international committee to coordinate a Global Satellite-Based Intercalibration System (GSICS). In addition to climate monitoring, intercalibration provides satellite operators with near real time feedback on instrument operation and response to changes implemented from the ground. Comparisons between geostationary imagers and the high spectral-resolution Atmospheric InfraRed Sounder (AIRS), polar-orbiting on Aqua, have provided an accurate estimate of calibration performance of the world's geostationary imagers. AIRS has been proven to have absolute calibration accuracies of 0.1K in most bands. However, AIRS does not have complete spectral coverage. The channels on geostationary imagers where AIRS has spectral gaps, such as the water-vapor absorption region, are difficult to compare accurately. IASI, which does not have spectral gaps, offers another opportunity for geostationary satellite intercalibration as well as validation of spectral interpolation techniques being used for AIRS where necessary. Both AIRS and IASI are being used to intercalibrate the world's geostationary imagers.

61. GRAFIIR – An Efficient End-to-End Semi Automated GOES-R ABI Algorithm Performance Analysis and Implementation Verification System

Authors: Allen Huang, Hong Zhang, William Straka and Mathew Gunshor

The NOAA GOES-R mission is the first of the next generation of national geostationary operational environmental satellites. The Advanced Baseline Imager (ABI) on GOES-R represents a technological leap in the nation's satellite sensing capabilities. In support of this mission, CIMSS at the University of Wisconsin-Madison is contributing to the critical role of performing tasks for risk reduction, data processing system framework, proving ground, sensor tradeoff, sensor impacts on algorithm performance, and calibration/validation for the ABI. This work is being done in concert with other major ongoing efforts, such as the GOES-R Algorithm Working Group (AWG).

This presentation will overview the updated capability of GOES-R Analysis Facility for Instrument Impacts on Requirements (GRAFIIR). GRAFIIR is a system facility established to leverage a host of projects including AWG proxy, AWG algorithms, AWG McIDAS visualization, GOES-R Risk Reduction, sensor tradeoff and calibration/validation. GRAFIIR is to support GOES-R analysis of instrument impacts on meeting user and product requirements. GRAFIIR is for "connecting the dots," the components that have been built and/or are under development, to provide a flexible framework to effectively adopt component algorithms toward analyzing the sensor measurements with different elements of sensor characteristics (e.g., noise, navigation, band to band co-registration, diffraction, etc.) and their impact on products.

One of the newly developed components called GLANCE is a comparison tool built to assess and evaluate many of the GOES-R data and products (e.g., imagery, clouds, derived products, soundings, winds, etc.) in a consistent and semi-automated way. This tool can be used to help characterize the effects of changes in sensor characteristics on product performance. It can also be used to quickly test proper product algorithm implementation as various product algorithms are transferred from developers to operators. Furthermore, the concept and build details of GLANCE will also be highlighted to demonstrate that a truly functional and effective end-to-end system is being built to support NOAA's GOES-R ABI project.

62. Blended POES and GOES Real-time and Climate Cloud Products

Authors: Andrew Heidinger, Corey Calvert and William Straka III

NOAA/NESDIS and CIMSS are pursuing several concepts to blend the cloud products from the VIS/IR imagers on the current POES and GOES platforms. One of these efforts is a blended POES/GOES cloud height analysis for Alaska; the other is a blended POES/GOES cloud climatology over the GOES/West domain. This poster will provide examples and discuss the benefits and challenges of these efforts.

63. Overview of NOAA's Satellite Operations including Data, Products, and Services

Authors: Brian Hughes, Thomas Renkevens

The mission of the National Oceanic and Atmospheric Administration (NOAA) National Environmental Data Information Service (NESDIS) is to provide timely access to global environmental data from satellites and other sources to promote, protect, and enhance the Nation's economy, security, environment, and quality of life. To fulfill its responsibilities, NESDIS:

- acquires and manages the Nation's operational environmental satellites
- operates the NOAA National Data Centers
- provides data and information services including Earth system monitoring
- performs official assessments of the environment
- conducts related research

This presentation will provide an overview of NESDIS satellite operations, data processing and product generation, data and product distribution, unique satellite services, and customer services. A schedule of current and future satellite activities will be presented. Satellite data and product access will be covered including distribution through the Man-computer Data Analysis System (McIDAS) and the Advanced Weather Interactive Processing System (AWIPS). Several examples of how satellite data and products are used for weather analysis and forecasting will be shown. Finally, we will discuss how NESDIS manages these many streams of satellite data and processing systems, and the management of user services.

Processing

64. The UTLS Signatures from Advanced Infrared Sounder Retrievals

Authors: Chian-Yi Liu, Jun Li, Timothy J. Schmit and Steven A. Ackerman

The atmospheric sounding retrieval methods from satellite infrared (IR) radiance measurements have been developed over decades. The sounding retrieval accuracy is much improved with the hyperspectral IR radiances compared with to those from the broadband IR radiances, and to be indispensable in achieving the 1K/1km and 10%/1km requirements for tropospheric temperature and humidity, respectively. The retrieval accuracy is better in the upper troposphere lower stratosphere (UTLS) than the atmospheric boundary layer, which provides an opportunity to explore the UTLS structure. We employ both clear and cloudy skies sounding retrievals from satellite-based hyperspectral IR radiance measurements to investigate the UTLS stability associated with storm-scale weather phenomenon. The case study shows the atmospheric thermodynamic stability (e.g., Lifted Index) may be flawed in certain circumstances, while a relative low UTLS stability in terms of the buoyancy frequency is found in the storm vicinity. The paper demonstrates the advantage of using the clear and cloudy hyperspectral IR sounding retrievals for supporting the short-term forecasting or nowcasting.

65. Exception Handling for GOES-R Ancillary Data

Authors: Robert Woodward, Laurie Rokke, Donald Gray, August Ryberg

The GOES-R Advanced Baseline Imager (ABI) algorithms require ancillary data to generate the suite of proposed output data products. For a variety of reasons, these ancillary inputs may not always be available in a timely manner requiring the use of exception handling techniques. These techniques generally employ programming language constructs designed to manage the occurrence of special conditions, known as exceptions, which change the normal flow or execution of a program. With regard to ancillary data, exception handling techniques involve substituting alternate ancillary or climatological data when the primary sources are unavailable. As a means of gauging requirements for GOES-R, this poster presents a compilation of ancillary data exception handling techniques for algorithms from the Moderate Resolution Imaging Spectroradiometer (MODIS), the Sea-Wide Field-of-view Sensor (SeaWiFS), the NPOESS Preparatory Project (NPP), and GOES-R.

66. GOES Constellation Status Update

Author: Chris Wheeler

Significant changes to the GOES constellation have taken place since the last GOES Users' Conference including the launch of GOES-14 and an emergency operational period for GOES-13. Additionally, the upcoming year will see a de-commission of GOES-10, a transition of GOES-13 as the operational GOES-East, and a transition of GOES-12 to provide operational support for South America. This presentation will cover the status of the on-orbit GOES spacecraft and instruments as well as present the timeline and schedule for the upcoming operational transitions. Also presented will be status of the GOES-14 post-launch testing, GOES Imager stray light performance, and changes to the GVAR format for GOES-14 and GOES-15.

67. Improved Observations of Earth and Space Weather from GOES-R

Authors: Mary M. Hopkins, Dr. Satyanarayan Kalluri

The National Oceanic and Atmospheric Administration (NOAA) has been operating a system of Geostationary Operational Environmental Satellites (GOES) since 1975 to provide nearly continuous monitoring of the earth's environment, including ocean, land, atmosphere and the solar/ space environment to protect life and property across the United States and the Western Hemisphere. GOES satellites series from 1994 through 2010 share the same generation primary instrument payload. The next generation GOES-R series represents a generational change in both spacecraft and instrument capability. Upon launch in 2015, the GOES-R series will carry into orbit a new suite of instruments that will provide improved observations of earth and space weather:

- the Advanced Baseline Imager (ABI) will collect imagery in 16 spectral bands within 0.45 μm to 13.6 μm., The spatial resolution varies from 0.5km to 2 km with the 0.59-0.69 μm band having the highest spatial resolution.
- the Extreme ultraviolet and X-ray Irradiance Sensor (EXIS) will measure the magnitude of solar X-ray irradiance and determine the solar EUV irradiance from 5 to 127 nm
- Solar Ultraviolet Imager (SUVI) will image the full disk in the following six wavelengths every five minutes: 93.9 Å, 132.8 Å, 171.1 Å, 195.1 Å, 284.3 Å, and 303.8 Å at high cadence around the clock
- Space Environment In-Situ Suite (SEISS) has a set of particle sensors that measure the proton, electron, and heavy ion fluxes
- Magnetometer (MAG) will provide information on geomagnetic activity in Earth's magnetosphere such as monitoring of magnetopause crossings and shock that permit the detection of space plasma storms and substorms
- Geostationary Lightning Mapper (GLM) will capture at least 70% of the global lightning flashes with a false alarm rate less than 5%.

Additionally, GOES-R will provide a set of communications services (Unique Payload Services) in support of the Data Collection System (DCS), Low-Rate Information Transmission (LRIT), Search-and-Rescue Satellite Aided Tracking (SARSAT), and Emergency Managers Weather Information Network (EMWIN).

The new instrument suite covers a wider spectral range, with increased frequency, and with observations in areas not covered by heritage instruments. This combination produces dramatically more data than any previous GOES series, along with significantly enhanced nowcasting and forecasting capability

68. Insuring Incorporation of Improvements to the GOES Sounder Vertical Profile Retrieval Algorithm into NOAA/NESDIS Operations.

Authors: Gary S. Wade, Zhenglong Li, James P. Nelson III, Jun Li, and Timothy J. Schmit

Recently, Li et al. (2008) reported on improvements to the Geostationary Operational Environmental Satellite (GOES) Sounder vertical profile retrieval algorithm. These changes in the retrieval methodology marked the first successful attempts to significantly improve upon the established GOES physical retrieval algorithm currently in use (Ma et al. 1999). The Ma approach has been employed for several years by the NOAA/NESDIS Office of Satellite Data Production and Distribution (OSDPD) to provide GOES Sounder products to the National Weather Service (NWS).

A moist and unstable bias near cloud edges has historically plagued the Ma et al. (1999) retrievals. The Li et al. (2008) algorithm has made improvements with respect to this deficiency, and is currently being moved through the research-to-operations process. Both retrieval algorithms are implemented as Man-computer Interactive Data Access System (McIDAS) applications on hardware at the University of Wisconsin (UW)-Madison Space Science and Engineering Center (SSEC). The current goal is to port the Li et al. (2008) algorithm to the NOAA/NESDIS/Center for Satellite Applications and Research (StAR)/Satellite Meteorology and Climatology Division (SMC)/Operational Products Development Branch (OPDB), who in turn will provide operationally ready, locally run code to NOAA/NESDIS/OSDPD.

As this transfer of technology is progressing, scientists at the Cooperative Institute for Meteorological Satellite Studies (CIMSS), housed within SSEC, continue (1) to assess how successfully the McIDAS implementation of Li et al. (2008) is being completed, and (2) to evaluate how much the Li et al. (2008) algorithm routinely improves upon the Ma et al. (1999) algorithm. The current status and methods used to compare the retrieval products from both algorithms will be described. This work is relevant to future GOES-R data processing, as these current GOES Sounder products are to be approximated as the required GOES-R "GOES Sounder legacy" products (for profiles, stability, and moisture), which are to be derived with the non-sounder, but multi-spectral GOES-R Advanced Baseline Imager (ABI).

69. A Single-Antenna Field Deployable Polar/Geostationary Direct Readout System

Author: Michael Guberek

Global Imaging's new Mark X portable, tactical earth station is capable of receiving, processing, and displaying digital LRIT data from the latest GOES, MSG and MTSAT-1R next-generation geostationary satellites and NOAA HRPT and DMSP polar imagery using a single antenna and workstation. The Mark X system contains all the electronics, computers and software necessary for an autonomous field meteorological operation.

70. A New Nested Tracking Approach For Reducing The Slow Speed Bias Associated With Atmospheric Motion Vectors (AMVS)

Authors: Wayne Bresky and Jaime Daniels

The GOES-R Algorithm Working Group (AWG) Winds team is working on the development and validation of algorithms for the generation of Atmospheric Motion Vectors (AMVs) from the future GOES-R Advanced Baseline Imager (ABI). Meteosat SEVIRI imagery is currently serving as an important GOES-R ABI proxy data source for the development, testing, and validation of the GOES-R AMV algorithms.

Statistics comparing satellite-derived motion estimates to collocated radiosonde observations often show a pronounced slow speed bias at mid and upper levels of the atmosphere. One possible explanation for this slow bias is a poorly assigned height (too high). Recent work by

Sohn and Borde (2008), however, suggested a link between the size of the target box used and the magnitude of the slow bias. Specifically, they found that a smaller target box leads to both a faster wind estimate and a lower height assignment. Both of these factors will contribute to a smaller slow bias. Independent tests performed by the authors of this poster, that involved varying target size (5 to 21 pixels) and temporal intervals (5 to 30 minutes), have confirmed these earlier findings. This testing, as well as subsequent analysis of individual case studies, have led the authors to develop a new approach to tracking that relies on a smaller target box "nested" within a larger one to derive a field of vectors for each pixel location in the larger window. Statistical comparisons of AMVs derived via this new approach show a significant improvement in the overall quality of the derived AMVs characterized by significant reductions in the slow speed bias without a corresponding increase in spatial variability. In addition, results from case studies involving use of Meteosat-8 rapid-scan SEVIRI imagery will be shown.

71. GOES-R Image Navigation and Registration (INR)

Authors: James L. Carr and Houria Madani

The GOES-R series offers enhanced imagery with better spatial, spectral, and temporal resolution and introduces a new instrument, the GOES Lightning Mapper (GLM), for detection and monitoring of lightning. Processing and monitoring the data generated by a GOES-R satellite are challenging in terms of product quality and latency. The subject of this paper is image navigation and registration (INR) of GOES-R earth viewing instruments with a special focus on the Advanced Baseline Imager (ABI).

Image navigation provides the relationship between image coordinates and earth coordinates (latitude and longitude). Image registration ensures that the pixel earth locations remain aligned to a predetermined fixed grid. INR on the GOES I-M and NOP series is achieved through application of Image Motion Compensation (IMC) to the instrument's servo mechanism to control its scanning. The GOES-R Advanced Baseline Imager (ABI) will use a mechanism akin to IMC to ensure the geographical coverage but the geometric correction and registration to a fixed grid are achieved by resampling. The GOES-R INR concept and its main differences with the current GOES INR process will be presented.

Another important activity performed in the GOES ground system is product monitoring, which consists of inspecting the data quality, such as INR performance, as it is distributed to the user community. Monitoring the INR performance is provided by the Replacement Product Monitor (RPM) for the current GOES series. Information about the RPM can be obtained from the RPM User's Manual or the RPM Software Maintenance Manual. Although some re-use of the RPM algorithms is expected, the GOES-R PM capability is expected to be more complex than the RPM. The main features of the GOES-R PM will be presented with a special focus on monitoring the GOES-R INR performance.

72. Overview of the GOES-R ground system architecture

Authors: Denny Hansen

The next generation GOES, designated the GOES-R Series, provides continuity of the GOES mission and improvement of its remotely sensed environmental data. The GOES-R system consists of the Space and Ground Segments. The Space Segment comprises the spacecraft bus, and its remote-sensing instruments and communications payloads. The Ground Segment, comprising all Earth-based functions, provides satellite operations and instrument product generation and distribution. The GOES-R Ground Segment operates from three sites. The NOAA Satellite Operations Facility (NSOF) in Suitland, MD, houses the primary Mission Management (MM), and selected Enterprise Management (EM), Product Generation (PG), and Product Distribution (PD) functions. The Wallops Command and Data Acquisition Station (WCDAS), located in Wallops, VA, provides the primary space communications services, EM and MM functions, and selected PG and PD functions. The third site is a geographically diverse remote backup facility (RBU), located at Fairmont, WV. It functions as a completely independent backup for the MM and selected PG and PD functions for the production of Key Performance Parameters (KPPs) and GOES Rebroadcast (GRB) data, and is capable of concurrent and remote operations from the NSOF and the WCDAS. The RBU has visibility to all operational and on-orbit spare satellites.

73. Process for Transitioning Algorithms from Research to Operations

Author: Allan Weiner

The GOES-R Algorithm Transition to Operations Process is a low-risk methodology to translate algorithm definitions into operational code that aligns with the iterative delivery of Algorithm Packages. This process encompasses the full algorithm software development lifecycle (SDLC) from requirements analysis through qualification testing for science and operational code development. It is composed of the following process flows: First, the Ground Segment Project Office (GSP) Algorithm Package is delivered with subsequent Systems Engineering Audit/Analysis/Examination of GSP Material; next, the Science Implementation is performed by the Algorithm Engineering Team, which develops and tests the implemented algorithm; and finally the Algorithm Code Operationalization is performed by the Product Generation (PG) Algorithm Software Team. The entire process is completed by independent PG IPT Integration and Test.

74. Development of GOES-R Algorithms using Common Framework and Data Model Design Approach

Authors: T. Scott Zaccheo, Craig Richard, David B. Hogan and Edward Kennelly

The development of a common/robust algorithm framework and data model(s) are two key elements of Harris GOES-R Team ground system infrastructure design. These modern software design elements will facilitate the transition of Government provided algorithms packages to operational Level 1 and 2+ software. The Harris Team GOES-R GS algorithm framework provide general design principles and standardized methods for initializing general algorithm services, interfacing to external data, generating intermediate and L1b and L2 products and implementing common algorithm features such as meta-data generation and error handling. The data model interface is an essential part of this framework, and provides abstract classes/methods for reading external data and writing output products and meta-data. The data model design provides a seamless mechanism for transition core algorithm software between algorithm engineering and operational environment. Algorithms developed and tested in an engineering environment will not need significant, if any, interface re-work as they are transitioned to the production facility, since data model classes and methods employed in the development environment will mimic those in the operation system. This modular design approach not only enables a smooth transition from development to operations, but also enables "buy-back" from the production to the development environment. This work described the basis Harris GOES-R GS team's algorithm architecture and engineering approach, and demonstrates how the algorithm framework and data model are an integral part of this process. It also provides a preliminary implementation road map for the development of the GOES-R GS software infrastructure, and view into how the framework and data model will be integrated into the final design.

75. GOES-R GS Product Generation Infrastructure Operations

Author: Mike Blanton

GOES-R GS Product Generation Infrastructure Operations: The GOES-R Ground System (GS) will produce a much larger set of products with higher data density than previous GOES systems. This requires considerably greater compute and memory resources to achieve the necessary latency and availability for these products. Over time, new algorithms could be added and existing ones removed or updated, but the GOES-R GS cannot go down during this time. To meet these GOES-R GS processing needs, the Harris Corporation will implement a Product Generation (PG) infrastructure that is scalable, extensible, extendable, modular and reliable. The primary parts of the PG infrastructure are the Service Based Architecture (SBA) and the Distributed Data Fabric (DDF). The SBA is the middleware that encapsulates and manages science algorithms that generate products. The SBA is divided into three parts: the Executive, which manages and configures the algorithm as a service; the Dispatcher, which provides data to the algorithm; and the Strategy, which determines when the algorithm can execute with the available data. The SBA is a distributed architecture, with services connected to each other over a compute grid and is highly scalable. This plug-and-play architecture allows algorithms to be added, removed, or updated without affecting any other services or software currently running and producing data. Algorithms require product data from other algorithms, so a scalable and reliable messaging is necessary. The SBA uses the DDF to provide this data communication layer between algorithms. The DDF provides an abstract interface over a distributed and persistent multi-layered storage system (memory based caching above disk-based storage) and an event system that allows algorithm services to know when data is available and to get the data that they need to begin processing when they need it. Together, the SBA and the DDF provide a flexible, high performance architecture that can meet the needs of product processing now and as they grow in the future.

76. Integrated Requirements and Design Model for GOES-R

Author: Mike Blanton

The Harris Team is using an advanced set of integrated requirements and design tools to ensure that the GOES-R Ground Segment meets the Government's requirements. Our toolset maintains a single baseline of requirements and design that is accessible by all contractor and Government personnel regardless of where they are geographically located. All Government requirements are linked to contractor requirements and then to the design and implementation of the Ground Segment. This allows the implementation of each Government requirement to be followed to its implementation in the Ground Segment. Our approach provides a very high level of visibility into how Government requirements are met and how the Ground Segment is designed and tested, while minimizing manual efforts.

77. How GOES-R Will Limit Outages and Breaks In Continuity

Author: Les Spain

The GOES-R Series with new spacecraft and a new ground system contains a number of features designed to limit outages and breaks in continuity. The GOES-R spacecraft will make use of GPS based navigation to maintain position and operate for up to 14 days without command contact with the ground and lower outage time during and following maneuvers. The use of Consultative Committee for Space Data Systems (CCSDS) standards and Low Density Parity Check (LDPC) code permits improved communications packet handling and error detection and correction. The ground system contains a geographically isolated back-up facility that mimics the ability of the primary site to command the spacecraft, produce and uplink GRB and generate KPPs. The spacecraft and ground system both contain features designed to meet stringent availability requirements. The spacecraft contain autonomous fault detection and correction capabilities that contribute to successful recovery from component failures. The ground system uses an Enterprise Management capability to enable operators to supervise their local site and distributed GS components, infrastructure, and interfaces. The Ground Product Processing Infrastructure uses mainstream, standards-based hardware technology based on mature, vendor-neutral, commodity hardware components, reducing risk during upgrades. Hardware processing capacity can be increased by adding commodity blade servers to a high-performance computing grid. The Product Processing Software allows changes to algorithm complements and precedence dependencies and the addition of new sensors, without adversely affecting the generation of other executing algorithms.

78. GOES-R Command and Control

Author: Les Spain

The GOES-R Command and Control System ensures continuity of services by incorporating centralized management of space and ground assets, a backup site, redundant equipment, automated recovery, and workflow-enabled contingency procedures. Mission Management and Enterprise Management functions are integrated to ensure that operations and maintenance activities align with mission priorities. Scheduling of satellite and ground segment activities is consolidated to prevent operational errors that could result in a loss of operations continuity or interruption in service. The capability to monitor the satellite and GS assets together is provided to minimize staff and enhance well-informed coordinated responses when anomalies occur. An integrated approach to automation provides an efficient system that can be operated with minimal staff, while maintaining high availability. Centralized control and monitoring of the satellites, GS equipment and processing across three sites, and lights-out operations at the RBU minimize staff and expedite problem resolution.

79. GOES-R Algorithm Architecture: Ensuring Product Quality and System Performance

Authors: Bobby (Rob) Braswell, Peter Finocchio, Richard Lynch, William Gallery and Edward Kennelly

The Harris GOES-R Ground Segment team will provide the algorithm and engineering infrastructure for production and distribution of next-generation GOES-R data products. The team will implement, verify, and test software corresponding to government-supplied algorithms that will yield a variety of products that describe the state of the atmosphere, land, oceans, and solar/ space environment. The GOES-R end-product performance parameters (EPPs) (i.e., the characteristics and quality of the data products) are unprecedented in terms of spatial resolution, temporal frequency, precision, and thematic focus. This poster presents the suite of GOES-R products, their properties and the process by which the related requirements are maintained during the design/development life-cycle. It also describes the means by which the system will maintain the integrity of the EPPs, and monitor the quality and accuracy of the products.

GOES Distribution

80. Current GOES Variable (GVAR) Data and Examples

Authors: Tom Renkevens, Brian Hughes, Paul Seymour

The GOES Variable (GVAR) data stream is a service from the current series of Geostationary Operational Environmental Satellites (GOES) that broadcast 10-bit scaled radiances to a broad community of users. This poster will display the capabilities of the current GOES I-M and N-P series, by showing imager and sounder examples that can be generated in real time from the GVAR data stream. Changes to the GVAR format beginning with GOES-O (GOES-14) will be highlighted as well.

81. Current GOES Direct Readout Overview

Authors: Paul Seymour, Marlin O. Perkins, Kay Metcalf, Rob Wagner, Santos Rodriguez

NOAA provides data and information through several GOES direct readout and broadcast services. They include imagery in the GOES VARiable (GVAR) format, the Data Collection Service (DCS), the Low Rate Information Transmission (LRIT) broadcast and the Emergency Managers Weather Information Network (EMWIN) broadcast. This presentation will discuss the current status of these services and changes due in the near future including changes required for reception from the new GOES-14 broadcasts.

82. Low Rate Information Transmission (LRIT)

Author: Paul Seymour

NOAA's GOES Low Rate Information Transmission (LRIT) broadcasts transmit reduced resolution GOES Imagery from both the East and West GOES along with a copy of the GOES Data Collection System (DCS) and Emergency Managers Weather Information Network (EMWIN) data streams, environmental data and administrative information. The service is broadcast at 1691.0 MHz and at 128 kilobits per second.

83. HRIT/EMWIN

Authors: Robert Wagner and Santos Rodriguez

EMWIN and LRIT are NOAA data broadcast services from the GOES satellites that provide users a variety of weather forecasts, warnings, and imagery. The transition to the GOES N-P satellites and later to the GOES R-T satellites will affect these services and their users. This presentation will describe the EMWIN and LRIT services and the changes that will take place with each transition, culminating in a merged 400 kbps broadcast in the GOES-R era. It will also discuss the proof of concept system that was developed to be backward compatible and transition ready. This design takes advantage of software defined radio techniques for greater flexibility and reduced user cost.

84. EMWIN Poster and Demonstration

Authors: Robert Wagner and Santos Rodriguez

EMWIN is a low cost service that allows users to obtain weather forecasts, warnings, watches, graphics, imagery and other information directly from the National Weather Service (NWS) in near real time and broadcast from the GOES satellites. EMWIN is intended to be used primarily by emergency managers and public safety officials who need timely weather information to make critical decisions. The demonstration will highlight the HRIT/EMWIN proof of concept receiver developed by the GOES-R Program, Aerospace Corporation, NESDIS and the NWS.

GOES-R Metadata

85. The GOES-R Metadata Model

Author: Ted Habermann

A group of metadata experts from NOAA, NASA, and other groups associated with the GOES-R Program worked together during the early part of 2009 to create a Strawman Metadata Model for GOES-R based on the ISO 19115-2 Metadata Standard for Geographic Data. I will describe the model and use it as a starting point for discussion of capabilities that might be developed using metadata provided with the GOES-R products.

14. The 50th Anniversary of the 1st successful meteorological satellite experiment (on Explorer 7)

The 50 year anniversary of the first successful meteorological satellite experiment on Explorer 7 was commemorated on Monday, November 2, 2009. The program consisted of presentations, followed by a reception at the Monona Terrace. The experiment, flown on Explorer 7, measured the radiative energy balance of Earth. The architects of the radiometer were the University of Wisconsin's Verner Suomi (http://library.ssec.wisc.edu/SuomiWebsite/index.html) and Robert Parent. Invited speakers, representing the University of Wisconsin, NASA, NOAA, the WMO, the AMS and Suomi students, reflected and provided perspective on the event's key players and its historical significance. After the symposium, Paul Menzel invited attendees to an open microphone to relate anecdotes of Verner Suomi and to discuss their participation in the Explorer 7 project.

Jim Doyle, Governor of the State of Wisconsin, proclaimed October 13, 2009, Explorer 7 Day. Senator Herb Kohl issued a statement that said, in part: "For fifty years, the space industry has benefited from the experiments that Verner Suomi and his colleagues at UW-Madison first performed on meteorological satellites. Their research was the foundation of understanding the forces that govern the environment in which we live. The innovative ideas of the Space Science and Engineering Center have transformed the way we study the Earth's climate. I applaud the center's dedication to research on important environmental issues that continue to affect our planet. You should be proud of your accomplishments. I know we can expect even greater things from you in the future."

An Oral History: "Remembering Verner Edward Suomi, the Father of Satellite Meteorology," Panel members: Larry Sromovsky, Dan Johnson, Tom Haig, Bob Fox (moderator), Chuck Stearns, Tom Vonder Haar, Bill Smith.

The program was as follows:

Opening remarks and speaker introductions — Hank Revercomb, Director, Space Science and Engineering Center, University of Wisconsin-Madison
(http://www.ssec.wisc.edu/50thmetsat/agenda/talks/Revercomb_50th.ppt)

Welcome to Wisconsin — Congresswoman Tammy Baldwin

Congresswoman Tammy Baldwin wrote, "Although I am not able to be with you personally this evening, I want to recognize and honor the 50th anniversary of the first successful satellite meteorology experiment.

"On October 13, 1959, Verner Suomi and colleague, Robert Parent, from the University of Wisconsin-Madison measured the radiative energy balance of earth via satellite. This groundbreaking experiment began a new age of satellite meteorology, and represented the culmination of a vision to utilize rocket technology to increase our understanding of earth and our climate. Suomi, the "Father of Satellite Meteorology," began the University of Wisconsin-Madison's historic legacy in the development of satellite meteorology. Over the past fifty years, UW-Madison has continued to build upon this legacy through close research collaboration with the National Oceanic and Atmospheric Administration and the National Aeronautics and Space Administration.

"Professors Suomi and Parent typify the Wisconsin Idea that the application of university research should be used to better the global community as a whole. I salute the efforts of past, present and future satellite researchers and am deeply grateful for their contributions to our community."

NOAA's Environmental Satellite Program: Past, Present, and Future — Gary Davis, Director, Office of Systems Development, NOAA/NESDIS
(http://www.ssec.wisc.edu/50thmetsat/agenda/talks/Davis_50th.ppt)

Gary Davis described the birth of the U.S. weather satellite program:

- Traces back to the Department of Defense (DoD) rocket, sensor, and satellite development projects beginning the decade following World War II
- With little theory and very little experience available to guide these projects, DoD development teams learned their space trade on the job, often resulting from analyses of catastrophic failures
- DoD developed instruments to measure atmospheric conditions that the rockets were encountering as they were propelled to then extraordinary altitudes
- Measurements recovered from salvaged recorders or from radio transmissions were the basis for meteorological satellites research
- Still cameras became part of the payload and recovered film depicted images of the Earth's surface and cloud cover from space

50 Years of Meteorological Satellite Experiments – The NASA Perspective — Dr. Franco Einaudi, Director, Earth Sciences Division, NASA GSFC
(http://www.ssec.wisc.edu/50thmetsat/agenda/talks/Einaudi_50th.pptx)

Dr. Franco Einaudi described some historical events in the area of meteorological satellites. The first TIROS was launched on April 1, 1960, and provided the first picture from space. It is here where NASA began its mission of observing the Earth's weather. Scientists recognized the need for a major research effort for an effective use of these new observations. They recognized that a battle for resources was inevitable. They also recognized the important role that our science can play and the responsibility we have to provide reliable information to the policy makers.

Half a century later, the battle for resources is on-going. Our responsibility to provide reliable information to policy makers remains. We have a stronger realization of the potential global economic impact of our science. In general, we have an even stronger realization that our problems and challenges are global. The role of satellites is to provide the global view of the Earth System.

Dr. Einaudi described the Earth's energy balance, and the ways in which it can change. He discussed NASA's operating research missions, and described those in development, including Aquarius, Glory, Landsat Data Continuity Mission (LDCM), Global Precipitation Measurement (GPM), the NPOESS Preparatory Project, GOES, and POES.

He described the next generation of decadal survey missions including near-term missions ICESat-II, SMAP, DESDynl, the NASA portion of the CLARREO mission; mid-term missions ACE, ASCENDS, GEOCAPE HyspIRI, SWOT; and long-term missions 3D-Winds, GRACE-II, LIST, GACM, SCLP, and PATH.

Fifty Years of Innovation and Cooperation in Satellite Meteorology — Jérôme Lafeuille, Chief, Space Programme Office, World Meteorological Organization
(http://www.ssec.wisc.edu/50thmetsat/agenda/talks/Lafeuille_50th.pdf)

Jerome Lafeuille described international cooperation in satellite technology and provided the following chronology:

1961: Launch of Tiros2 with FPR on board
UN Resol.1721 on cooperation in satellite meteorology
1963: WMO establishes World Weather Watch and the GOS
Launch of Tiros 8 with APT
1966-73: Launch of scanning camera aboard geostationary ATS1
Global Atmospheric Research programme (GARP)
Coordination of Geostationary satellites: CGMS
1978: First Global GARP Experiment (FGGE) involves 5 GEO
First contingency relocation of a satellite (Indian Ocean)
1979-2009: India (79), China (89), Korea (05) joined CGMS

Satellite backup operations in 84, 91, 92, 98, 03

1998: USA and Europe sign Initial Joint Polar System agreement

2006: Response to GCOS by CGMS and & CEOS (virtual constellations)

The challenges ahead include:

- Continuity and improvement of operational constellations
- Sustained observation of ALL Essential Climate Variables observable from space
- Transition Research to Operations for priority, mature observations
- Generation of QC products
- Integration : network optimization, composite products, system interoperability

Introducing Satellite Data to the Public — Terry Kelly, Chairman and CEO, Weather Central, Inc. (http://www.ssec.wisc.edu/50thmetsat/agenda/talks/Kelly_50th.ppt)

Terry Kelly described innovative video applications in meteorology. The goal was to:

- Make ground-breaking satellite imagery available to markets worldwide
- Develop a production system for television weather: 30 FPS, NTSC standards, full color, automatic updates
- National Distribution of "NowCasting": Detailed, accurate weather for 0 to 12 hours; address specific needs of farmers, pilots, fishermen, agriculture, the public; real time updates using McIDAS; severe weather alerting

In 1978, the first McIDAS-generated weathercast took place at 6 p.m. in Washington, D.C.

Suomi: Pragmatic Visionary — John Lewis, Adjunct Research Professor, Desert Research Institute (http://www.ssec.wisc.edu/50thmetsat/agenda/talks/Lewis_50th.ppt)

John Lewis presented a talk on Verner Suomi that included historic photographs. The basis of his talk was a paper **by** John M. Lewis, David W. Martin, Robert M. Rabin[v], and Hans Moosmüller destined for publication in the AMS Bulletin, March 2010:

Article: http://journals.ametsoc.org/doi/pdf/10.1175/2009BAMS2897.1

Abstract:
http://journals.ametsoc.org/doi/abs/10.1175/2009BAMS2897.1?prevSearch=&searchHistoryKey=

The authors examined the steps on Verner Suomi's path to becoming a research scientist. They argued that his research style — natural interests in science and engineering and his methodology in pursuit of answers to scientific questions — were developed in his youth on the Iron Range of Northeastern Minnesota, as an Instructor in the Cadet Program at the University of Chicago (U of C) during WWII, and as a fledgling academician at University of Wisconsin-Madison. They examined several of his early experiments that serve to identify his style. The principal results of this study are: 1) Despite austere living conditions on the Iron Range during the Great Depression, Suomi benefited from excellent industrial arts courses at Eveleth High School, 2) With his gift for designing instruments, his more-practical approach to scientific investigation flourished in the company of world-class scientific thinkers at U of C, 3) His dissertation on the heat budget over a cornfield in the mid-1950s served as a springboard for study of the earth-atmosphere energy balances in the space-age environment of the late 1950s, and 4) His design of radiometers, the so-called Ping-Pong radiometer and its sequel, the hemispheric bolometer, flew aboard Explorer VI and VII in the late 1950s, and analysis of the radiances from these instruments led to the first accurate estimate of the earth's mean albedo.

Verner Edward Suomi (1915-1995) was born and raised in Eveleth, Minnesota, one of the prominent mining towns on the Mesabi Range. Much of the world's supply of iron ore came from the cavernous open-pit mines along this 100-mile stretch of land in northeastern Minnesota. His mother and father emigrated from Finland to the Iron Range in 1902 where Vern's father found work as a carpenter for the mines. Vern was the sixth of seven children in the Suomi family — five girls and two boys. In his unique way of viewing life, he said "I always complained that my sisters had two brothers and I only had one" (Suomi 1994). And, indeed, his brother Anard, nine years older than Vern, became his guiding light.

Although Vern showed promise in industrial arts and mathematics, his future was uncertain upon graduation from Eveleth High School in 1933. The family's economic state suffered after Vern's father lost his job in the late-1920's. Anard dropped out of school and became the family's breadwinner. Somehow Anard scraped up money to send Vern to Eveleth Junior College. The tuition was $14/semester.

Although Vern never aspired to be a teacher, the bachelor of education (B. E.) degree, granted in 1938, set him off on a career as a junior high school and high school science teacher in southern Minnesota —teaching chemistry in high school. He taught for three years in three different cities (New York Mills, Sleepy Eye, and Faribault). While at Faribault, he received his pilot's license as part of the Civilian Aviation Authority's (CAA) Pilot Training Program. With the likelihood of the United States' entry into WWII in early 1941, Vern had the draft board "breathing down my neck" (Suomi 1994). Then he heard a half-hour radio broadcast where Carl Rossby, professor at U of C, announced a 9-month Cadet Program for college graduates who were interested in becoming meteorologists (Rabson 1998). This program was aimed at increasing the number of weather forecasters in the military and civilian communities.

Verner Suomi executed a tight small-scale trajectory on his journey to becoming a research scientist —from the Iron Range to Winona to the lakeshore in Chicago and back north to Madison. The odds of finding a path out of Eveleth were slim, and when you include the chances of a college education during the Great Depression, the product of these probabilities approaches a miniscule fraction. Without his brother's altruistic support, Vern would never have made this journey. As recalled by Vern, "To a large extent, he [Anard] took my father's place and gave a lot of guidance…much of my philosophy of life stems from him…" And when Vern graduated from Winona Teachers College with a sense of guilt because of his brother's sacrifice, the wise Anard said, "Don't worry about that Vern, when they honor you, they honor us" (Suomi 1994).

Without great expectations upon his entry into meteorology, Suomi found himself in the company of world-class scientists —Rossby, Ference, Wulf, Starr, and Bergeron. Through interactions with these scientists, he learned to embrace all aspects of a problem —theoretical underpinning, observations needed, and instrument design. And beyond that, he could latch onto a fundamental principle as espoused by the theoreticians and devise a "gadget" as he liked to call his instruments, and make observations that could be used to verify or refute theory. His path to development of the Ping-Pong radiometers is a case in point. At Suomi's dissertation defense, Riehl asked the key question, he was further inspired by Houghton's comprehensive investigation of the earth's heat budget, Wexler (and Riehl) supported his idea at the administrative level, and the painstaking analysis of the observations by Suomi and his doctoral students led to the critically important estimate of the earth's albedo.

To his final days, Vern used his ingenuity to design gadgets — the last being a flux meter that would measure the heat balance at the sea/air interface. He jokingly called it his "Frisbee flux meter" since he envisioned it being flung from the deck of a ship much like a Frisbee would be tossed in the park. This study had the earmarks of his earlier research —scientific/engineering investigation at the machinist's workbench and stages of development under his control and free from consensus or democratically determined project goals. This last study was to take place over the ocean whereas his first took place over a cornfield. In between, his budget-measuring instruments flew on satellites that circled the earth and probed the atmospheres of the other planets. Without doubt, Suomi's efforts to obtain radiation data from his innovatively designed radiometers aboard Explorer VII awakened the meteorological community to the advantages of making measurements from space. He served as our pathfinder on this journey —an extraordinary journey that continues as we seek to more thoroughly understand the heat budget of our complex earth-atmosphere system.

Suomi's ERB Experiments on Explorer 7 and TIROS Satellites — Fred House, Professor, Drexel University (http://www.ssec.wisc.edu/50thmetsat/agenda/talks/House_50th.ppt)

Professor House presented slides showing:

- Vanguard Satellite at Launch Pad 1958
- Preparing Explorer 7 for launch
- A postcard from 1959 showing when it all began "Operation Kitchen Sink"
- Explorer 7 Termistor Bolometers
- New York Times article on the TIROS I launch on April 1, 1960
- TIROS Satellite Model with Suomi Radiometers

Keynote Address: Science Investigations: The Legacy of Explorer 7 — Tom Vonder Haar, Distinguished Professor of Atmospheric Science and Emeritus Director, CIRA Colorado State University (http://www.ssec.wisc.edu/50thmetsat/agenda/talks/Vonder_Haar_50th.ppt)

Professor Tom Vonder Haar said the thermal radiation experiment on board Explorer 7 was proposed by Dr. Verner Suomi of the University of Wisconsin and Dr. Harry Wexler of the US

Weather Bureau. The experiment was designed to measure solar, reflected and terrestrial radiation to gain a better understanding of Earth's Energy Budget.

The primary instrumentation for the thermal radiation experiment consisted of bolometers in the form of hollow silver Hemispheres. Instruments included two black hemispheres that responded to solar and terrestrial radiation, one white hemisphere that was more sensitive to terrestrial radiation and one gold hemisphere designed to absorb short-wave radiation. Explorer made 4000 radiation observations daily and 400 to 1000 readings were collected for analysis. Observations were made every 30 seconds and recorded at a low rate to a tape recorder. The data was transmitted at a high rate to 1 of 21 ground stations.

With concepts and science objectives developed for the International Geophysical Year in the late 1950's, Vern Suomi's Explorer-VII experiment launched the era of Earth Observing Systems. With his students and colleagues in the new space programs of NASA, the U.S. Weather Bureau, the U.S. Air Force and aerospace industries, new lines of science inquiry and global observations were embarked.

The early Earth Radiation Budget measurements from the first three decades following Explorer-VII had great scientific impact. The science legacy of Explorer-VII continues in successive, larger space observing programs related to Earth's Energy, Water and Carbon Cycles.

Today, it is the knowledge of intersections among these three cycles and budgets which provides us so much promise for new scientific understanding.

The following information is from the University of Wisconsin-Madison, Space Science and Engineering Center. The information is online at:
http://www.ssec.wisc.edu/media/spotlight/explorer7.html

On October 13, 1959, Verner Suomi and Robert Parent crouched in a bunker at Cape Canaveral, sweating through the countdown for the Juno II rocket perched on its launching pad 150 yards away. Would the rocket burst into a cloud of flaming debris, as had so many previous attempts, or would it survive and shoot skyward on a pillar of smoke and fire?

Sitting atop the missile was the Explorer 7 satellite, bristling with several experimental devices from some of the top researchers in the country. Suomi and Parent, professors from the University of Wisconsin-Madison, had conceived, designed, and built the innovative radiometer nestled into the body of the satellite. If their instrument made it into orbit, and operated properly once it got there, it would open the world to satellite meteorology. It would be the first successful satellite measure of the Earth's climate – if it survived the launch.

There was absolutely no guarantee that it would. Suomi and Parent, only three months before, had watched Explorer 7x, containing another of their radiometers, explode just after launch, intentionally detonated as its guidance systems failed and it veered dangerously off-course. And before that their instruments on the Vanguard TV3 were vaporized when a fuel leak immolated the rocket just after launch.

In the first years of the "Space Race," nothing was certain. In 1959, the competition between the United States and the Soviet Union to orbit satellites was on the front page worldwide. Only two years before, the Russians had rocked the world with its launch of Sputnik, the first artificial satellite to orbit the planet. Within months the United States responded with Vanguard 1. Both countries had successes and failures. Some satellites made it into orbit; many disintegrated into fire and explosion.

Though these first steps off the planet were difficult, no one doubted the possible worth of satellite observations.

UW Professor Verner Suomi realized earlier than most the importance of understanding the intricacies of the Earth's climate. His 1953 dissertation measuring the difference between the amount of energy absorbed from the sun in a cornfield and the amount of energy radiated back into the atmosphere served as a springboard for ongoing studies of Earth-atmosphere energy balances. He became one of the first professors at the UW's new Department of Meteorology, but it was when he partnered with a professor of electrical engineering, Robert Parent, that the pieces of satellite meteorology began to fall into place.

With Suomi's conceptions and designs, and Parent's technical wizardry, a new chapter in the study of the Earth's climate was born. They knew that if they could get their radiometer into orbit it would lead to the first successful measurements of the vital balance between the heat received from the sun and the heat exiting the atmosphere as a result of reflection and emission processes. They could measure the primary driving force of atmospheric circulation on a planetary scale

Modest in size by today's standards, Explorer 7 weighed 41.5 kg (91.5 pounds) and was 75 cm (29.5 inches) high and 75 cm wide. Solar cells and 15 nickel-cadmium batteries powered instruments measuring solar proton radiation and cosmic rays. However, Explorer 7's most important potential was its capability of making the first satellite observations of the Earth's heat balance.

If it could be launched successfully, that is. At 10:36, Eastern Standard Time, the countdown reached zero and the Juno II rocket was ignited. The rocket seemed to pause briefly as the thundering engine came to full power and then, shaking the earth beneath it, it rose into the sky. Verner Suomi and Robert Parent watched unblinking as it flew higher and higher. The launch was successful and Explorer 7 entered its orbit moments later.

Augmenting the satellite's observations with ground based measurements, Suomi and his team discovered that the Earth absorbed more of the Sun's energy than originally thought and demonstrated that it was possible to measure and quantify seasonal changes in the global heat budget.

Explorer 7 was the first step in a fifty-year journey toward understanding the forces that govern the environment in which we live. Suomi and Parent went on to design and build increasingly more sophisticated instruments over the next two decades: the flat-plate radiometer that rode in the TIROS satellite and the spin-scan camera that made Earth observations from a geostationary orbit possible. Suomi also conceived of and led the team that created the McIDAS (Man-Computer Interactive Data Access System) software, a suite of sophisticated software packages that perform a wide variety of functions with satellite imagery, observational reports, numerical forecasts, and other geophysical data.

Climate studies have proven their vital importance to humanity again and again, and will continue to do so far into the future. And it all started with a pair of nervous scientists hunkered down in a bunker, hoping for a successful launch.

Explorer 7 faithfully transmitted continuous data through February of 1961 and finally went silent in August of 1961. Verner Suomi and Robert Parent, with their radiometer on Explorer 7, began the era of satellite-based climate studies that have continually grown in importance and will continue to supply us with vital data far into the future.

APPENDIX A CONFERENCE AGENDA

AGENDA
6TH GOES USERS' CONFERENCE

3-5 NOVEMBER 2009

MONONA TERRACE COMMUNITY & CONVENTION CENTER

MADISON, WISCONSIN

"Bringing Environmental Benefits to a Society of Users"

Conference Goal: Improve the use of current **G**eostationary **O**perational **E**nvironmental **S**atellites and prepare for GOES-R series

Conference Objectives:

1) Continue to improve communication between NOAA and the GOES user communities;
2) Inform users on the status of the GOES-N and -R series constellation, instruments, and operations;
3) Seek ways/define methodologies to ensure user readiness for GOES-N and -R series;
4) Promote understanding for the various applications of data and products from the GOES-R series.

NOVEMBER 2ND (MONDAY)

5:00 pm The 50th Anniversary of the 1st successful meteorological satellite experiment (on Explorer VII) will be commemorated at the Monona Terrace. The program will consist of presentations in the Lecture Hall, followed by a reception in the Grand Terrace.

NOVEMBER 3RD (TUESDAY): Monona Terrace Exhibit Hall

Session 1: Welcome and Keynote

Co-Chairs: Greg Mandt and Jim Gurka

9:00 am Introductions (logistics, conference format, etc) – Jim Gurka, NESDIS/GOES-R Program Office
9:05 am Welcome/Conference Overview/Goals – Greg Mandt, GOES-R System Program Director
9:10 am NESDIS/NOAA Overview and Satellite Acquisition Status – Gary Davis, Director, NOAA/NESDIS/OSD
9:30 am

Keynote Address: "Leveraging GOES Capabilities to Maximize Response to User Needs"

Don Berchoff, NWS/OST Director

10:00 – 10:30 am Coffee Break

Session 2: Information Briefings I — Current GOES Constellation and GOES-N/O/P Series Update

Co-Chairs: Gary Davis and Tom Renkevens

10:30 am GOES Satellite Constellation Status Update – Chris Wheeler, NESDIS/OSO
10:45 am GOES User Services Overview – Brian Hughes, NESDIS/OSDPD
11:00 am Current Use and Benefit of GOES data within NWS – Louis Uccellini, NWS/NCEP Director
11:15 am Operational GOES Hazard Overview in the Satellite Analysis Branch – Jamie Kibler, NESDIS/OSDPD
11:30 am Current GOES Direct Readout Overview – Paul Seymour, NESDIS/OSDPD
11:45 am Short Break

12:00 – 1:30 pm

Lunch Panel: Status and Plans for GEO and HEO Satellites in the International Community

Co-Chairs: Paul Menzel and Martin Medina

WMO: Jerome LaFeuille
Brazil: Dr. Carlos Federico Angelis, INPE/CPTEC
Canada: Dr. Louis Garand, Environment Canada
China: Dr. Jun Yang, China Meteorological Agency
EUMETSAT: Dr. Johannes Schmetz, Head, Meteorological Division
India: Devi Prasad Karnik, Space Counselor, Embassy of India in DC
Japan: Yoshinori Yoshimura, JAXA
South Korea: Dr. Ae-Sook Suh, Korea Meteorological Administration
Russia: Presented by Dr. W. Paul Menzel

Session 3: Information Briefings II — GOES-R Program and Earth-Observing Instruments

Co-Chairs: Chris Velden and Jaime Daniels

1:30 pm GOES-R Program Status – Greg Mandt, GOES-R System Program Director
1:45 pm GOES-R Spacecraft – Jamison Hawkins, Lockheed Martin
2:00 pm The ABI (Advanced Baseline Imager) on the GOES-R series – Tim Schmit, NESDIS/STAR
2:15 pm The ABI Instrument Development – Jim Gurka, NESDIS/GOES-R Program Office

2:30 pm The GLM (Geostationary Lightning Mapper) on the GOES-R series – Steve Goodman, GOES-R Program Scientist

2:45 pm GLM instrument development – Hugh Christian, University of Alabama at Huntsville

3:00 – 3:30 pm Coffee and Poster Break

Session 4: Information Briefings III — Solar and Space, Ground Systems and Products

Co-Chairs: Hal Bloom and Ken Carey

3:30 pm GOES-R solar and space environment data products: benefiting users – Joe Kunches, NWS

3:45 pm GOES-R Ground Systems – your portal to the future – Robin Pfister, Deputy GOES-R GS Project Lead

4:00 pm GOES-R Ground System – Denny Hansen, Harris Corporation

4:15 pm GOES-R Access System (GAS) – Reginald Lawrence, NESDIS/OSD

4:30 pm GOES-R Products and their algorithms – Jaime Daniels, NESDIS/STAR

4:45 pm HRIT/EMWIN – Santos Rodriguez, NWS/EMWIN

5:00 pm Poster Summary – Tim Schmit, NESDIS/STAR

5:30 – 7:30 pm

Reception — Poster Reviews and HRIT/EMWIN Demonstration

Poster Topics:

Hazards, Readiness/Training, Hydrology, Atmosphere, Ocean, Land, Space/Solar, Imagery, Instruments, Processing, Distribution, Climate Applications

NOVEMBER 4TH (WEDNESDAY): Monona Terrace Exhibit Hall

Session 5: GOES-R User Readiness

Co-Chairs: Steve Goodman and Mike Johnson

8:30 am Welcome/Administration/Previous GOES–R Users' Conference recommendations – Jim Gurka

8:35 am GOES-R Proving Ground Activities
- Introduction – Jim Gurka
- CIMSS – Wayne Feltz
- CIRA – Mark DeMaria
- SPoRT – Gary Jedlovec

9:30 am GOES-R and CLASS – Bob Lutz, GOES-R GSP

9:45 am GOES-R Direct Readout Systems – Richard G. Reynolds, SGT, Inc.

10:00 am Education & Training – Tony Mostek, NWS

10:15 – 10:45 am Coffee and Poster Break / Facilitators and technical advisors meeting

Session 6: Breakout Questions/Issues/Logistics

Co-Chairs: Tim Schmit and Tom Renkevens

10:45 am Introductions to the various breakout groups with issues they will discuss and Logistics
- Overview of break-out sessions and questions – Tim Schmit and Tom Renkevens
- Development of NWS satellite user readiness – Mike W. Johnson, NWS Office of Science and Technology
- "Rules of Engagement" – Kathleen Paris, lead facilitator
- Logistics and locations – Tim Schmit

11:45 am Short Break

12:00 – 2:00 pm (meal provided)

GOES-R Town Hall Meeting: "The Need for an Advanced Sounder on GOES"

Chair: Chris Velden / Moderator: Abby Harper

12:15 pm Panelist Presentations
- Overview of Hyperspectral Sounding Opportunities – Hank Revercomb, UW/SSEC

NWP Perspectives – Robert Aune, NESDIS/STAR
NWS Perspectives – Jeff Craven, SOO, NWS/MKE
NHC Perspectives – Jack Beven, Hurricane Forecaster, NWS/NHC
International Perspectives – Jo Schmetz, EUMETSAT
1:15 pm Audience Q/A and Discussion
1:45 pm Wrap-up and Adjourn – Abby Harper, NESDIS Deputy AA

2:00 – 5:30 pm

Session 7: Breakouts

Atmosphere Session A in Meeting Rooms MNQR
Atmosphere Session B in Hall of Ideas E
GOES Transition – 11 through R series Session A in Hall of Ideas F
GOES Transition – 11 through R series Session B in Hall of Ideas G
ABI in Meeting Rooms KLOP
Training in Hall of Ideas H
Product Distribution, Implementation & Processing in Hall of Ideas I
Ocean/Land/Solar & GLM/SEISS in Hall of Ideas J
3:30 – 4:00 pm Coffee Break (Posters taken down)

6:30 – 8:00 pm

Banquet – The Concourse Hotel

Speakers: "The Weather Guys" – Jon Martin & Steve Ackerman

NOVEMBER 5TH (THURSDAY): Monona Terrace Lecture Hall

8:30 am

Session 8: Breakout Session Results and Wrap-Up

Chair: Shanna Pitter

Atmosphere Session A
Atmosphere Session B
GOES Transition – 11 through R series Session A & B
ABI
Training
Product Distribution, Implementation & Processing
Ocean/Land/Solar & GLM/SEISS
Common Questions

10:00 – 10:30 am Coffee Break

Session 9: A Look into the Future

Chair: Steve Goodman

10:30 am Future NASA Earth Observation Missions – Jack Kaye, NASA
10:50 am NASA Geostationary Coastal and Air Pollution Events (GEO-CAPE) Mission – Jay Al-Saadi, NASA
11:10 am Roadmap for Satellite Data in AWIPS – Deirdre Jones, NWS

11:30 am

Luncheon – Hall of Ideas
"Imagining the Future" – Steve Ackerman

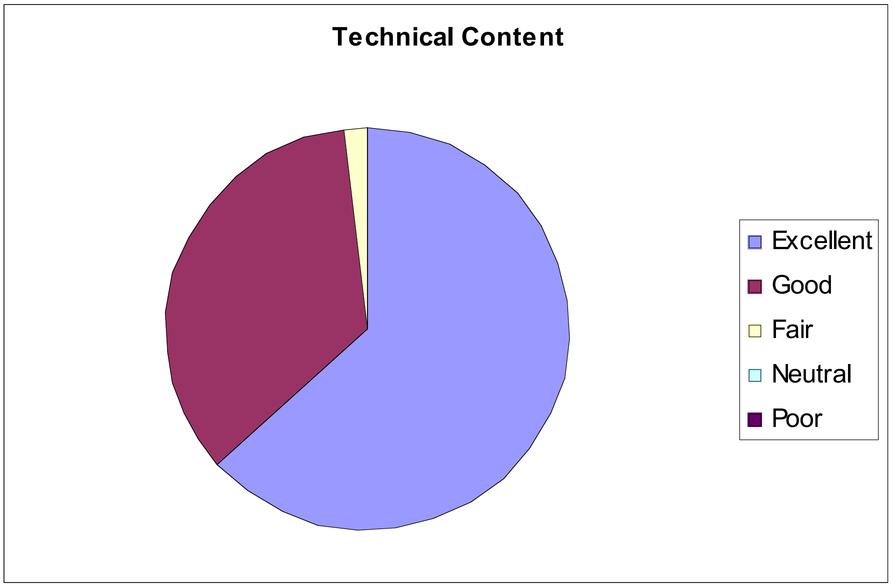
(Box Lunches available)

1:00 – 3:00 pm

McIDAS V Demonstration – Tom Whittaker

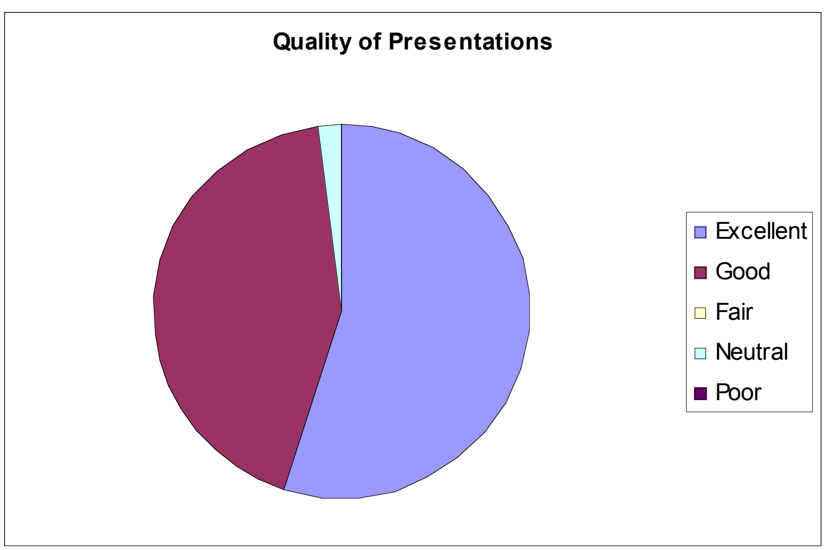
APPENDIX B SUMMARY OF ELECTRONIC SURVEY FORMS

Although it varied slightly by question, there were just over 50 responses to the on-line survey.



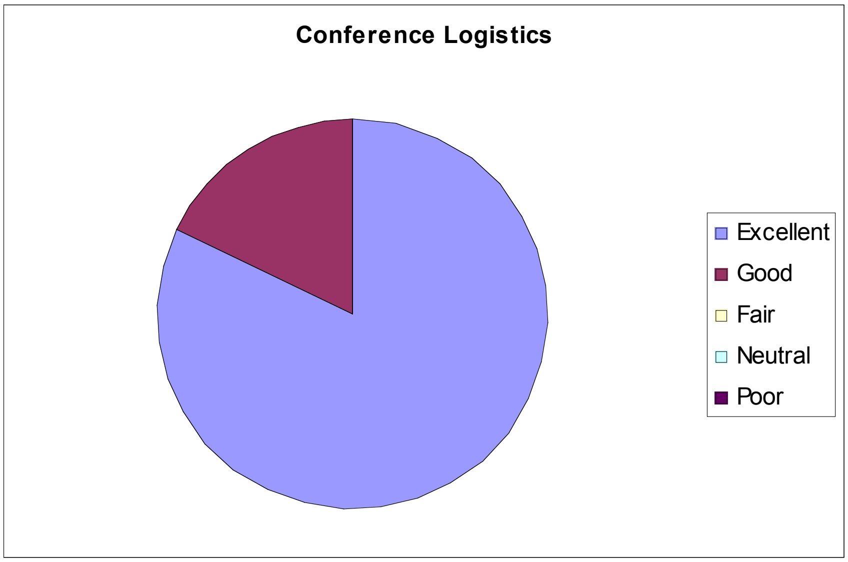
COMMENT: Technical Content (breadth, depth, relevance, practical utility, state-of-the-art and recent developments)

- Good to excellent. More input/feedback needed from more users, especially NWS forecasters and EMC modelers.



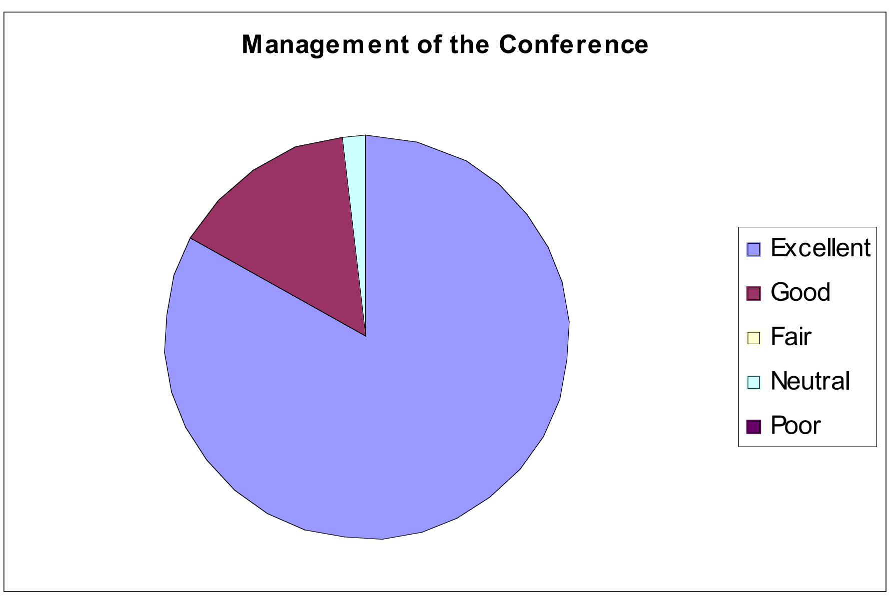
COMMENT: Quality of Presentations (expertise of presenters, quality of slides, manner of delivery, interaction with audience)

- The presentations were very informative, but perhaps there were too many squeezed into the conference period. Perhaps using more of Thursday for presentations would have helped. Not having 'mindless' lunches caused a bit of mental strain by the end of each day.

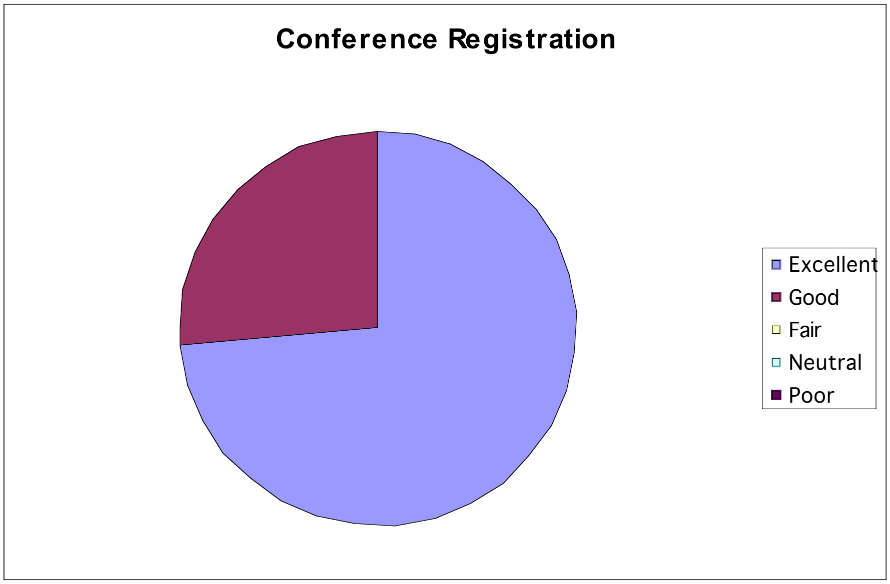


COMMENTS: Conference Logistics (location, facilities, food)

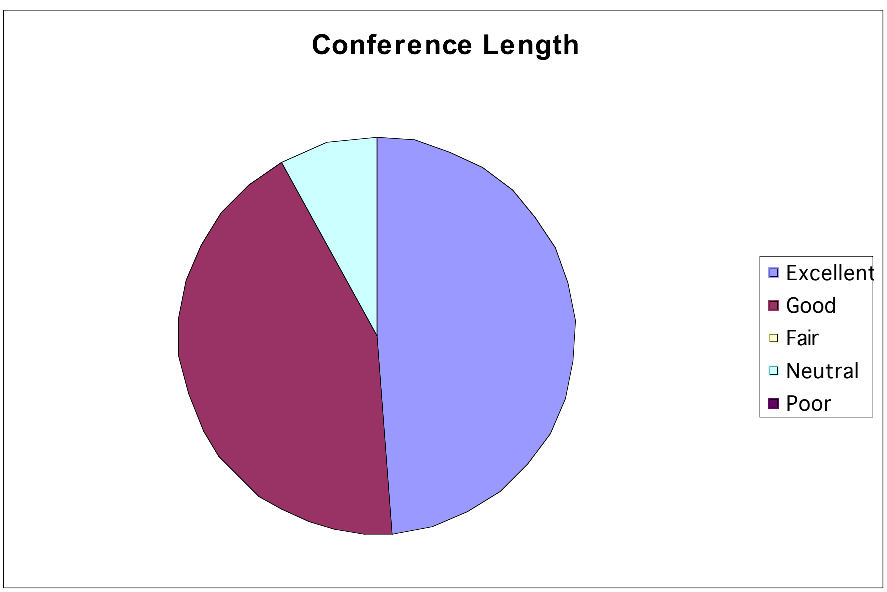
- Not excellent only because of the spread-out nature of the main meeting room.
- This was beyond excellent. Best food of any conference I've ever been to. Seems like a lot of attention was paid to detail and it showed.



COMMENTS: No comments



COMMENTS: No comments



COMMENTS: Conference Length

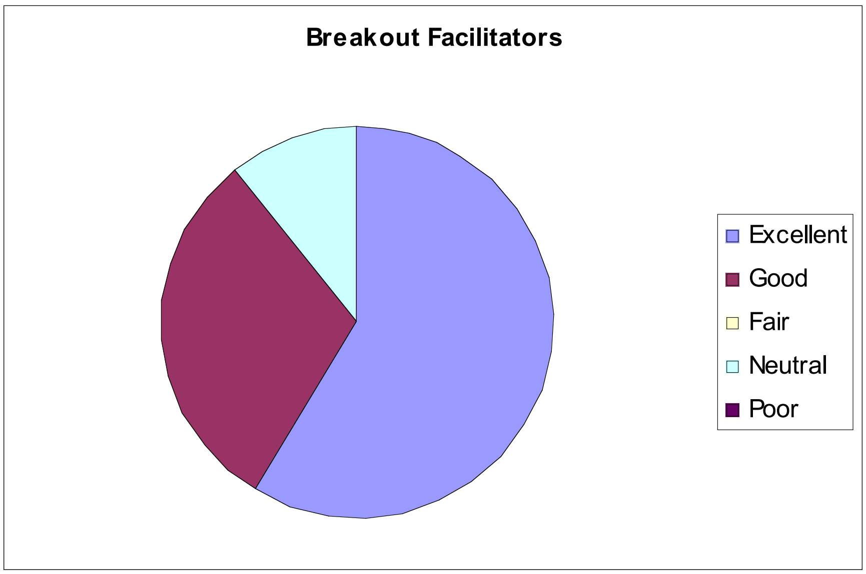
- With the amount of content, perhaps the conference should have been a day longer.
- The length seemed just about right, but filling the lunches with speakers really made each day seem 'long.'

- The length of the conference was great. However, I think it could be extended one more day or half a day, and avoid the seminars during lunch and dinner, which are overwhelming, not healthy, and did not allow scientific networking.
- Another day would have been helpful in order to allow presenters just a little more than the typical 15-minute allocations. Some of the more detailed, technically specific talks could have been given 20-25 minutes

Recommendations for Attendees to Stay to the End (What are your recommendations to ensure that most of the conference participants stay until the end of the conference and provide their feedback in the breakout sessions?)

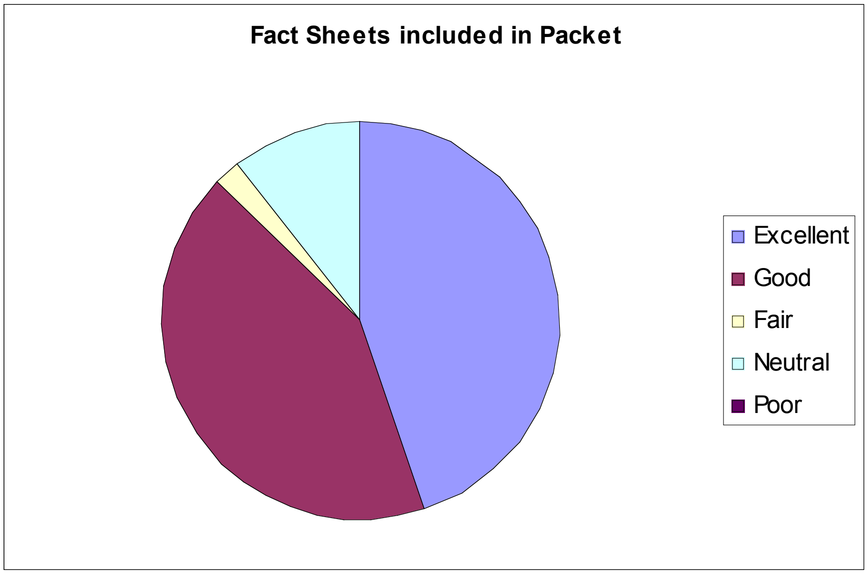
- Commitment by NESDIS senior leadership to stay for more of conference and to participate in process.
- This will always be a challenge. It appeared you did all you could this year.
- Provide food and continue to have reporters
- Move the conference around; so that it can be attended more easily by more people in particular parts of the country.
- Only if they are interested in the topics. Otherwise, even if they stay, they are silent.
- I agree that there was an issue with attendance at the break out sessions and during the main poster viewing time. Unfortunately I don't know how folks can be convinced to stick around.
- You have to save some of the most interesting talks all the way to the last day. If you keep the breakout sessions small, which you did, then most of the attendees will participate. That was not a problem in our breakout session.
- I believe everyone stayed for the whole breakout session in our group. If they did leave, it was because there was a break in between and they took that time to leave or talk with others.
- Breakouts in mid-day, sandwiched between presentations in morning and afternoon
- (1) Provide (named) certificates to those who stay for the entire conference (similar to those provided through NOAA e-learning courses). (2) Withhold one of the "mementos" (i.e. travel mugs) until distribution in the break-out groups.
- Providing lunch on the last day was a great idea.
- I thought you did a great job in setting up the Lunch Panel sessions for this purpose.
- I don't think much can be done to keep participants until the end, given the demands on schedules.
- Keep the conference about the same length.
- Hold breakout sessions each day. Get attendees involved right from the get-go.
- I left early because of my own workload, not due to any problems with the conference.
- Have the breakout sessions in the morning instead of the late afternoon. I thought most people DID stay through the end of the meeting??

- If you continue to provide such excellent meals the word will spread that it's worth sticking around for things like the banquet.
- Good mix of presentations and breakouts through the last day.
- I think we lost quite a few people in the breakout sessions since they were near the end of the day of talks and people were getting tired. I would have put the breakout sessions in the middle, with a few more interesting talks afterwards to encourage people to stay.
- Allow a bit more time for discussion on the conclusions of the breakout sessions.
- May want to place the breakout sessions in the middle of the conference instead of the end.



COMMENT: Breakout Facilitators

- Our group was very small. The facilitator did a fine job, no complaints at all, but she probably wasn't needed in our particular case. She may have felt the same way and adjusted accordingly by letting things go as they went.



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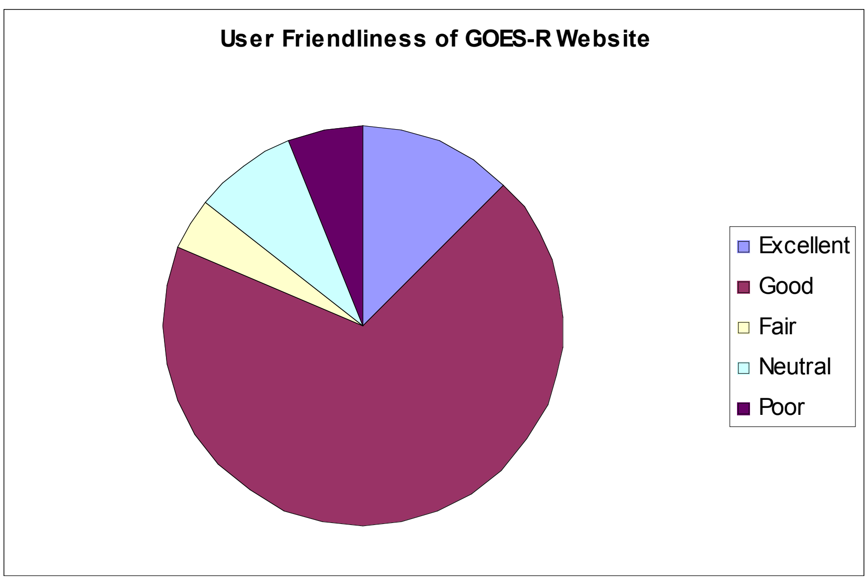


COMMENTS: GOES-R Web site Info (What additional information would you like to see on the GOES-R Program Web site?)

- Better linking to relevant material esp. on non-NOAA sites
- More information for direct broadcast users
- GOES Users Readiness Guide, GAC system-priorities
- Links to "all" relevant information for GOES-R, one stop shopping so to speak
- Educational sessions to bridge between the research community and the general public
- Talk/poster slides, participant list

- That they are going to add a HES…
- Actually, looked at for first time in while just now, and see that there is much more content than before. To remain pertinent the site must continue to be updated with schedules, news, conferences etc… suggest a subscription service to notify users of news updates.
- (1) Link (on main homepage) for official timeline for best estimates of GOES-R, -S launches and operational use and location. (With dates according to ISO 8601 standards. NASA typically requires use of SI ("metric") units, as noted in procurement documentation. Dates should be internationally friendly as well.) (2) Actual names of individuals serving, added to the organization charts (on the "inter-agency team" page). (3) printer-friendly (clean spreadsheet format for hard-copy) versions provided for "option-1" and "option-2" products lists. (4) Lists of all AWG teams and members (unless I just couldn't find them easily enough). (5) Description of GOES-R Proving Ground program and link to its web page.
- MORE! Needs more content, needs to be more relevant, etc, etc.
- Legislative update on funding status of GOES-R and a visit from NOAA leadership would have been nice.
- Plan for scan schedules and precedence chart of weather hazards in relation to scan schedules. Who makes these decisions, who has more say in scan schedule plan in severe weather situations?
- None that I can think of. Looks good.
- It came out in the ABI breakout session that there are a lot of basic questions people have that are not answered there. I know there's a lot of confusion about what is really ITAR and was is really NDA material but there can certainly be a lot more information out there. It's difficult to even find a listing of instruments and finding basic facts on instrument characteristics is practically impossible.
- Would like to see some simulated data (actual displays)
- More education material. More overview information. More sample images, sample products.
- Information about the products, a search feature, more fact sheets.
- Up to date schedules of Ground Segment and Flight acquisition milestones.
- Easy access to the basic ABI channels and resolutions without having to dig through one of the requirements documents.
- Transition scenario for GOES-R users.

GOES-R Web site Improvements

- Too thin. Looks almost like a placeholder site.
- Actually, I don't know if this is already available, but have a place to submit questions, and then have someone forward those questions to those who can answer them, and follow up.
- Have an interface through which "visitors" can make comments and suggestions, such as raising the concerns for the missing HES.

- Perhaps you could develop a Web page for non-specialists with descriptive information but no acronyms or technical jargon.
- More CURRENT information. Manage the content more frequently.
- A redesign is needed with more content and relevant info to its respective audiences (among other ideas).
- The Web site looks really nice and I can't think of any suggestions at this time.
- Need to add a cascading level of information. This should range from the "why GOES-R", to "what's GOES-R" to any number of details. Plus, a host of previously presented material by GOES-R folks should be available. Not just the GOES user conferences.
- Better navigation, search feature, more content.

Information Can't Find Online (What information from current GOES do you wish to see online but can't find?)

- Satellite status and/or distribution issues in a "dashboard" form, also on www.goes.noaa.gov (see also comment for q14).
- Launch information that is up-to-date, and not different answers at different sites.
- GOES is absolutely important. But, need to put it in a broad picture in terms of other satellites.
- It can be hard to navigate through NESDIS Web pages to find GOES information. I think the information is out there and often I can be directed where I need to go by others.
- Real-time statistical comparisons of current GOES Sounder products (e.g. total precipitable water vapor; Lifted Index; cloud heights), compared to other available independent sources (radiosondes, Raman lidars, GPS, etc.).
- Budget profiles and breakouts.
- Information on non-operational GOES (e.g., GOES-13 and -14).
- The NESDIS Web site is actually quite good regarding GOES, its products and schedules.

GOES Data with Better Access to Online (What GOES data / products do you wish to have better access to online?)

- GOES products are spread out on too many Web servers, even within NESDIS. All NOAA GOES products (incl. those on coop institute sites) should be available easily through www.goes.noaa.gov. I shouldn't have to know the line office creating the product to find it. Most images too small to be terribly useful.
- Packages serve as examples of how the data flow from stage to stage.
- It can be hard to navigate through NESDIS Web pages to find GOES information.
- AWIPS pipe to GOES
- I wish I knew how to order radiance data online... I currently only know how to get it through McIDAS.
- DCP data would be great....

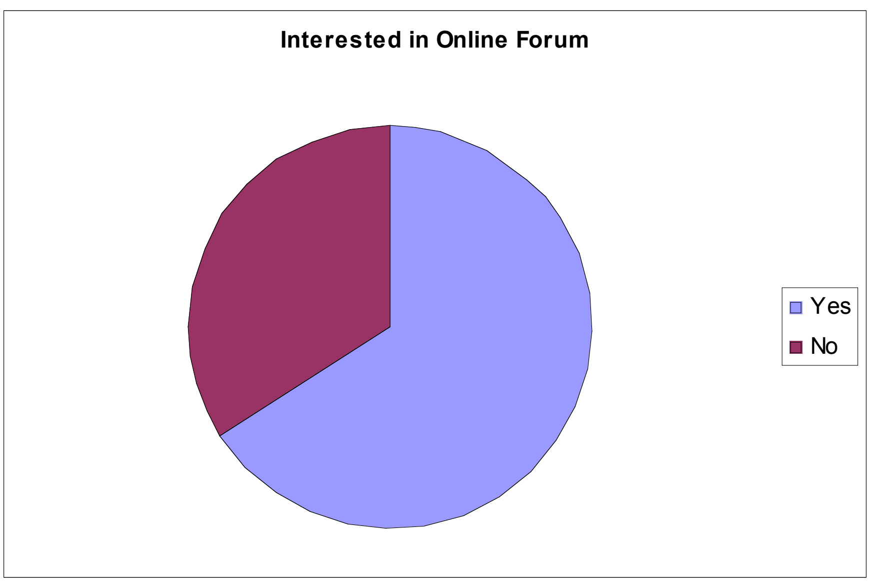
- All products should have a (at least) and consistent format and location for access point. Some products are binary, some BUFR, some other on the Web, some aren't.
- Movie loops that can be easily saved and played in Power Point.

Data Formats Desired for GOES Data (What formats do you wish to receive GOES data in that you currently do not get?)

- HDF, esp. archive data
- NCDF
- DCP data....
- NETCDF

Distribution Methods for GOES Data

- Internet
- I work at SSEC and have excellent access to GOES products now, but I think we're somewhat a special case in this regard.
- FTP Push.
- Public access. Not just to WFOs.
- Via ADDE servers.
- Already have direct read out
- Online ordering would be nice, something like the NASA DAC.
- Streaming via Internet would be great....perhaps a system like LDM that would allow even folks with limited bandwidth to get some products and displays.
- Sample GVAR data should be posted and accessible.
- More data and products on an integrated dissemination means such as NOAAPORT (or GEONETCast-Am if fully operational). [Speaking for the Latin-American user community, along with WMO recommendations]



Suggestions to make Conference more Valuable (Do you have any additional suggestions to make future conferences more valuable to you and the GOES and GOES-R Programs?)

- Have more representation from NOAA upper management so our concerns don't fall on deaf ears or "get lost in the shuffle."
- Hands-on, interactive presentation/displays
- More external users.
- Not really. You did an outstanding job overall.
- The "users", in fact, were the NWS forecasters to receive and use the GOES data. Fair enough. But they are only a layer that is detached from the true end users, i.e., agriculture, airlines, even commercial weather providers. Suggest the next conference really focus on them.
- Just about every minute of the conference was filled with presentations. If possible, it would be good to allow a little more time for one on one interaction. For example, at least one lunch with no speaker might have been nice, even though the lunch speakers were very good.
- Perhaps a little less talking at and more talking with.
- It did not seem like there was a lot of interaction during the poster sessions, I think it would be good to broadcast about the posters more during the breaks for more interaction. The lectures and whole conference in general was outstanding though. I learned a lot.
- More applications talks, fewer overview talks. It would be nice to see some new faces at the podium (though I noticed some this time around and that was nice). Also, it would be nice to have more time for posters (on the second day). I had a poster and was so busy talking to others about it, that I didn't get a chance to look at many other posters myself. Poster presenters seemed to leave the reception early? Perhaps it just went a little bit too late. People didn't seem to stand by their posters during the coffee breaks much either.
- There was not enough "face time" since every lunch was spent listening to someone talk; the main poster session was at the end of a long day and many people left and did not stick around to wander among the posters. When people spend the entire day in the same chair in the same room without any type of break from that room, I think they're dying to get away when they can.
- Continue to update the community on developments.
- The head of NESDIS should attend at least part of this conference.
- Get more users involved. These conferences are usually attended more by industry and GOES R program reps (which is good since they have the answers to many questions) but also need to be attended by more users since it is their feedback you are trying to get.

Under Represented Groups at GUC (If you think a group was under-represented at the GUC, what venue or alternate meeting would you suggest to reach out to these individuals?)

- DoD not well represented, but may have been due to budget issues (under a CR, lots of travel in early Nov cancelled). Focused meeting with direct readout users (esp. for

Government users) once distribution methods better defined (or, perhaps before so that DRO users are more into the process).

- Private forecasters
- The Direct Broadcast users were not addressed as much as will be needed as 2015 gets nearer. We would welcome speakers from the GOES and GOES-R programs at the SeaSpace Conference which takes place every other year. Also they should continue to have Direct Broadcast user meetings.
- Operational forecasters were underrepresented. I think you mostly have to go to them given the nature of their jobs. They are also most present at NWA meetings.
- A speaker representing GOES-R-cubed research should have been included. DoD speakers should have been included.
- Except the established breakout sessions, have one for discussions without a bound. Of course, it is still related to our weather services.
- State and Local Governments; commercial users
- Direct Readout Conferences better represents GVAR users, of which I am one.
- The meeting should be held in conjunction with a meeting of the National Weather Service Science Operations Officers.
- GOES-R needs to go to decision support topical meetings (Western and Eastern Fire Conference, National Air Quality conference, emergency managers....)
- Perhaps a "mini" (1 day) GUC meeting held in conjunction with an NWA (Nat'l Weather Assoc) Annual Meeting.
- It's always hard to get a large number of real users. Still, the conferences must go on in hopes that more users will show up as launch gets closer.
- Begin with attending the smaller trade meetings that draw the end users with presentations or a display; then approach key reps to be involved in the GOES organizing committee and, if need be, fund the travel for a representative group of end users.
- The Users' Conference seems a little low on users. Perhaps having a session where users can submit ideas for presentations, rather than having everything by "invitation only" might help. Sometimes it is easier for a person to travel to a conference if they are presenting something.
- Perhaps a few more NWS and other true "user" attendees, including from industry, would have been good.
- Air Quality Group; AMS Annual Conference and AGU Conference.
- A GOES-R launch press conference might work.
- Users were under represented.
- Someone should talk about GOES-R at meetings like the AGU.
- Not sure there were enough users....
- DOD, broadcasters, school teachers, UNIDATA college folks
- I think the vendors who will eventually create ingest systems were underrepresented. A Webinar to get them up to speed might be good in addition to a separate session at the

AMS Annual meeting where many vendors participate. I would think they would need a longer lead time to design systems.

- I haven't seen many South-American users. May be the Direct Readout conferences are more convenient and appropriate for them.

General Comments

- There was a lot of finger pointing of who would have the money to educate the Direct Broadcast Community. Before GOES-R goes operational, they should probably do it, but were they funded for that?
- It was a fantastic conference. I learned a lot and met lots of wonderful professional contacts.
- Appreciate the excellent work done by UW. UW indeed provided a platform for various GOES-R participants and many others.
- What a great conference. Run smoothly. Great program. Lots of VIP speakers. The facilities were outstanding.
- I am uncertain about the effectiveness of facilitators from outside the field. That said, if we desire a clean slate, it may not be a good idea to use contacts internal to the GOES-R Program. One idea is to bring it collaborators from a related endeavor, such as NEXRAD, to facilitate the break-out sessions.
- The poster session might start a short time (15-20 minutes) after the availability of food, following the last session of talks. The food was too distracting at the "start" of the poster session.
- Kudos to the GUC organizers! You all did a great job and should be very proud of your efforts! Huzzah!!
- It is my recommendation that Sheraton Madison be removed from the list of future conference hotels. Despite their Web site saying they had an airport shuttle, I arrived at Madison Airport to find that no shuttle was available, necessitating a taxicab. Throughout the week, they played a game of "yes there's a shuttle today," "no there's not a shuttle this evening," etc., ending with another taxicab ride to the airport. Concerning the latter, the said they would call a cab to be ready for me at 5:30 the morning of my departure, which turned out not to be true when 5:30 came and went with no cab present or even having been called. I should also mention that the hotel did not offer to reimburse me for the cab fares to/from the airport. {*Hotel has apologized and given a free night's stay*}
- Excellent meeting, bravo to the organizers.
- Very good job. Thanks for your great support.

APPENDIX C BREAKOUT SUMMARY

App C-1. Common Question 1

How can the GOES-R Program ensure that the user communities are ready for the dramatic increase in data volume from GOES-R, including receive capabilities, display and processing, and a new concept of operations to optimize the value of the information to society?

Themes Shared Across Several Groups

1. Take GOES to users rather than bringing users to GOES (booths, town meetings, presence at annual conferences like NSW, AMS, AGU).
2. Use a variety of methods for communicating, educating and demonstrating—road shows, working groups, publications, quarterly customer forums.
3. Provide proxy data/code to users early, showing the exponential increase in data.

Ideas from Individual Groups

1. Revitalize current GOES products and calibration information for more effective use now and to contribute to and get ready for GOES-R.
2. Training (e.g. COMET, including documentation).
3. Better outreach to NWS offices and National Centers—Outreach Office to identify and work with diverse user community.
4. Invest in outreach to smaller communities (fire, state government, hydrology, etc.).
5. Separate forums for direct readout users.
6. Provide legacy data in new distribution format early for testing.
7. Select products pushed to users based on user requests using consistent metadata.
8. Provide low cost transition solutions for new services like EMWIN and HRIT.
9. Provide sufficient lead time for preparation.
10. Explore new concept of operations.
11. Explore whether GOES-R should adopt IMAAP paradigm for direct broadcast users.

App C-2. Common Question 2

What information do you need from GOES-R to aid in user readiness? For example, data formats, rebroadcast formats/specification, data distribution methods and options, manufacturer information, individual product volumes, timeline for data access.

Themes Shared Across Several Groups

1. Simulated data products and descriptions of coming products in advance.
2. Proxy datasets for local decision aid development.
3. Reliable program status information including launch date, when data will be available (or stored), data transition timelines, and milestones (E.g. data flow in NWS offices).

Information Needs From Individual Groups

1. Synergies among GOES-R instrumentation.
2. Software tools to manage and display data/products.
3. Matching formats for real-time and archive data.
4. Easily accessible information on rebroadcast format.
5. Information on Integrated and blended products.
6. What will NOAAPORT deliver and will it exist?
7. Long lead time for engaging partners in CAL/VAL.

Information Needs Related Specifically to GAS

1. Need interface specs for GAS (protocols, authorization, process, registration, prioritization).
2. Back-up for GAS – only source for some products used operationally.
3. Need GAS products available for testing.
4. Smart generation of products by geographic location on the fly (issue is control load shedding, prioritization of users would be important).
5. Schedule specifics for ground system testing and GAS testing for users that are critical to end-to-end test success (NWS offices).
6. How will mitigate data loss be mitigated?
7. How many simultaneous users can GAS handle?
8. What data volume will users be allowed to draw from GAS?

APPENDIX D — RESPONSES FROM THEME GROUPS

(specific theme group questions)

App D-1. Advanced Baseline Imager (ABI)

GOES-R checkout

- Define a cascading group of users/engineers/cal/val/NWS AWIPS/modelers/products involved through the checkout phase.
- Need an early engagement strategy.
- Need to extended commissioning phase at least one year, possibly two.
- Post ongoing progress and data on the Web.
- NOAA Airborne Programs in validation - there will be new products – need to conduct science tests.
- Private Industry that reformats (different ways to format the data), can they connect the plumbing.
- All GOES Users need to use it at end of checkout stage (involvement issue). Need a campaign to reach all that neeed to be involved.
- Readiness plan needed — some elements can be ready early, but others may take time.

ABI concept of operations

- Need to define routine scanning schedules and special event scans.
- Need to engage other users and structure an approach (a plan) for users to react to proposed GOES-R operations plans.
- Actively seek others who should be involved in future GOES R users meetings.
- Engage other users: DOD, US, EPA, State, FAA, etc.
- Will GOES East and West be in Sync?
- What additional information
- Need open-access source of information where a user can find specific information cascading various levels of detail.
- Need someone to sort through sensitive information and provide information to users on-line.
- Need talks/handouts for what different channels do.
- Need updates on products lists.
- What will NWS offices get? What subset? Bandwidth limitations/politics?
- Calibration issues.
- Access to process data and saturation flags.
- Need fact sheet for users.
- How will ITAR be addressed?
- CD with simulated data needed.

- How will users without AWIPS get data and products?
- What scan mode will users need? Build FAQ.
- Procedure table – hazards for scan mode determination.
- Stray light – how well it affects channels.
- Co-registrations issues (how well co-registered).
- GOES R web page improved (wiki).
- ABI simulator data availability — vendors would fine it useful.

Most challenging aspect

- Challenge: Ensuring end-to-end capabilities (building, training, user access).
- Improvements: Synergies of spatial, temporal and spectral data.
- Climate: Diurnally resolved regional products.
- Display systems, i.e. AWIPS II.
- Combining data with other channels and other data to maximize utility. Who should take the lead?
- Training.
- Algorithm development planning.
- Bridge the data communities.
- User community w/o AWIPS (data display system – private sector vendor) e.g., McIDAS V, Google earth.
- Assuring end-to-end capabilities.
- Will there be processing packages so users can do their own processing?

Ensure that the user communities are ready

- Training
- FAQs
- GOES WEB Site
- Sample/simulated data, CD's
- Visualization
- Alternate data distribution
- Collected set of documentation (1-stop shopping).
- Provide information on the algorithm descriptions.
- Documentation kept up-to-date.
- Define other users and communicate with them.
- Engage international users.

App D-2. GOES Transition (both groups)

Integrated products

- Searchable and consistent metadata used throughout data processing pipeline. Documented with training provided.
- Streamline process for getting algorithm from research to operations and available on AWIPS.
- Need to define fusion point and operations concept.
- Define where the producer/consumer demarcation point is.
- Will there be a "GDE" (GOES Data Exploitation) / NOAA Satellite Data Exploitation (NSDE)?

Direct Readout user

- Funding for GRB antenna upgrades.
- LM - not so worried about antenna – but about back-end problems for their users (DOD). This depends on what data/product/algorithms will be requested by their end users.
- Continuous communication on requirements (proactively in case of changes). This needs to be on the website.
- Canada concerned about GRB (no need for eGVAR). Cost to change algorithm.
- Customers will demand GRB on day 1, not eGVAR, what is the cutoff for eGVAR?
- Canada worried about not being able to take advantage of the GRB data stream beyond imagery. Can they make products w/o official algorithms? Will algorithms be made available to commercial entities for free?
- Want direct land line link for GRB (no antenna) — they already have a line into NESDIS.
- Need two year lead time on antenna/GRB system acquisition.
- Technical specs need to be available at least 1 year for industry to cost/build.
- Might do 4 GRB receivers then send products to their centers
- Communicate with users at: DRO Conference, AMS broadcast conferences, NWA conferences, etc.
- FAQs on website (continuously updated).
- Need more information to decide on data access methodology and products and channel selection.
- Algorithm availability?
- eGVAR – how long available?
- Direct land-line link for GRB?
- Web Updates
- Twitter / social networking media

Activation

- Benefits: Higher resolution data, Allows algorithm testing / refinement, Improved space weather data, Lessons learned in time to apply / correct future spacecraft (GOES-S/T/U), Allows testing of ingest systems / issue resolution, Political benefit of seeing the new satellite up and working (program confidence), Lot more data, Reduced outage time (120 min/year), Begin validation right away, identify new users / products, Activating GOES-R early would allow for GOES N-P availability to international uses (South America)
- Major issues: Impacts constellation / instrument lifetime and continuity, Budget, Operational and user resource availability, X-band transmission at 105W not authorized.

Group that is being under-represented

- Commercial sector value-added is not represented at this conference (that group isn't concerned yet, GOES-R is to far away).
- Users not present: DOD, AFWA, FNMOC, NRL.
- Broadcasters
- Climate community as new users.
- DRO Transition
- Canadian forecaster training/education, lack of knowledge.
- Maintenance of old/new systems of N-Series and R-Series overlap.
- AWIPS merged East/West data/products won't be done yet.
- Policy for GAS user access (priorities/types of access). Who are the high priority authorized user? Impacts value added operators who might be lower priority than their customer who will no longer want the services, since they can get it first/easier.
- Lack of detailed information for intelligent decision making.
- Maintaining two systems simultaneously GOES-N and GOES-R.
- Large data volume preparation.
- GAS priority policy on data access.
- What happens if GOES-R spacecraft or instrument fails and we have to revert back to GOES-N series?

Ensure that the user communities are ready

- Provide proxy data/code to users early.
- Select products pushed to users based on user requests using consistent metadata.
- Provide legacy data in new distribution format early for testing.
- Increase communication with end-users via road shows, working groups, publications, etc.
- Provide low-cost transition solutions for new services like EMWIN and HRIT.
- Industry day – timeline needs to have sufficient lead time for preparation.
- What information do you need

- Need interface specs for GAS (protocols, authorization, process, registration, prioritization).
- Back-up for GAS – only source for some products used operationally.
- Need GAS products available for testing.
- Smart generation of products by geographic location on the fly (issue is control load shedding, prioritization of users would be important).
- Schedule specifics for ground system testing and GAS testing for users that are critical to end-to-end test success (NWS offices).
- How will we mitigate data loss?
- How many simultaneous users can GAS handle?
- What will NOAAPORT deliver and will it exist?
- What data volume will users be allowed to draw from GAS?

App D-3. Atmosphere (both groups)

Integrated products & blended products

- Discussion to include integration of all meteorological observations. How should it be done?
- Blending should include both multi-satellite and multi-programs (e.g., GOES-R and Phased Array).
- Importance of satellite data as part of an integrated data system to produce integrated products.
- Visualization tools are of the utmost importance, web/GIS availability, enhanced AWIPS capabilities.
- Automated decision assistance tools, situational awareness.
- Ultimate objective is an integrated observing system, specifically an automated process. There will be too much data to consider without automated intervention.
- Forecasters will need a tool for providing an automated 'heads up' to an event (fog, volcanic ash, etc.) allowing them to provide consideration without having to monitor everything coming their way.
- How many new products can be used as is? What products need to be integrated into an automated 'system'?
- Can users (like the Air Force Weather Agency) still get the standard products or would they have to get some kind of integrated product system.
- Some users will want to get web (GIS) friendly products and use them as they need and want.
- AWIPS not quite up to the task of blending/combining/overlaying all the products that are available at present, advancement is needed. There should be a mechanism for getting products into the hands of forecasters.
- USAF system may be headed toward a Google Earth approach. Products from IDPS.

- Users beyond forecasters exist. Some will have needs on a weekly (monthly, yearly) basis.
- Blending of products is even more important with the loss of HES.

GOES-R checkout

- Use various ways ranging from user readiness, calibration, product validation, and so on.
- Involves all parts of either engineering or scientific checkouts.
- Question as to whether Solar Forecasters will have access to data. Are there other data sources other than direct readout?

Most challenging aspect of the GOES-R product suite

- Good news – lots of information. Bad news – lots of information! Risk that information will not be fully utilized.
- Importance of having real-time and archive data formats match.
- Training for all users – Education of users, new paradigm with decisions aids, etc. – Training to help manage/decide what is useful.
- Manage volume of data to help forecasters/users – How to deal with data volume – Data/product volume and latency.
- Determine optimal data viewing rates for different forecast problems and applications – Display.
- using the data
- Lack of vertical resolution.
- Use of data/products in NWP.

About current GOES products, status, access

- Revitalize current GOES for more effective use right now and to help folks get ready for the future of GOES-R.
- Advances of GOES-R AWG get back to enhance current GOES products.
- Advances with current GOES work their way into GOES-R development.
- More effective organization of currently available GOES products and calibration information.
- Include HES in future GOES launches as soon as possible,
- Common and easy to use data formats.
- Improved navigation.
- Better bandwidth to forecast offices.
- Quantitative validation of sounder products.
- Start using N-O-P series operationally.
- Seamless integration of GOES-E and –W (intercalibration).
- Not a lot of quantitative use of current GOES. Prototype use of current GOES for future use of GOES-R.

- Current graphics products readily available our fairly basic, 'goodies' are hidden away deeper on web sites.
- Derived products not available in CLASS, hard to get products for case studies.
- CLASS includes images, clouds, surface temp. (GSIP). No sounder products.
- Revitalize current GOES products and how they are disseminated.
- Hard to find calibration information.
- Let's put into practice some GOES-R mandates with current GOES.
- A central location for grabbing NOAA GOES derived products would be very useful and help make current GOES products more visible.
- GOES information is spread out all over the web (POES is similar).
- Dissemination of products, archiving, calibration is disorganized.
- Continue looking at new ways to use current GOES.
- Money is all going to GOES-R at present (evidenced by these questions) and there is less 'motivation' for current GOES related tasks.
- GOES-R work has lead to some current GOES development.
- More GIS compatible files would help build a user base of current products.
- Updating the web dissemination might conflict with commercial interests.
- If we can't maximize the use of current GOES, there's now way we should expect we'll be able to even remotely maximize the use of future GOES products.
- Proving ground is helpful in getting some products to users.
- Should GOES-R program adopt IMAP paradigm for direct broadcast users?
- More accurate and unbiased data.
- Send Status massages only when there is a problem.
- Better low cloud and fog products.
- LMA as an example of needed new sensors.
- Pursue greater interagency collaboration.
- Use best available satellite – Stereo sounder products (e.g., CI).

User communities ready

- Train (e.g., COMET – including documentation).
- Better outreach to NWS offices and National Centers – Outreach Office to identify and work with diverse user community.
- Facilitate data distribution for wide range of users.
- Educate users on data and products, volume, access.
- Continue user conferences
- Need user readiness plan
- More budget dollars
- Satellite User Hotline
- Expert systems

GOES-R to aid in user readiness

- Provide simulated data streams in advance.
- Reliable program status information (when will GOES-R be available, etc.) – Data transition timelines – Schedule with milestones (e.g., data flow in NWS Offices).
- Software tools to manage and display data/products.
- Proxy data for local decision aid development.
- How will CLASS archive work beyond NOAA users?
- Have broad community involvement in formats – allow or seek user input.
- Need standard package of products, some users will want at least level 1b products. Is there a need for direct readout processing systems? Commercial concerns also.

App D-4. Other Instruments

GOES-R checkout

- Instrument providers will be intimately involved, as will product generators.
- Algorithm Working Group will be involved in checking out and validating products (in particular for the attendees are lightning products).
- Checkout phase isn't really that important for end-users.
- Users were not well represented in this breakout session. The participants were primarily instrument providers, product generators, and project representatives.
- Getting requirements from users is difficult, as is making them familiar with what will be available and how it will be useful to them. Educating customers is important.

Integrated products and blended products

- It appears that the GOES-R project has created stovepipes, inhibiting integration of information and synergies between products developers, instrument builders, and users. These barriers exist for reasons of security, cost containment, and configuration management, but are detrimental to achieving the GOES-R hope of moving away from stovepipes.
- SWPC wants to be part of the proving ground, using models with test data, and generating new test products, but funding is in question. May need to get industry and the research community more involved.
- There is interest in blended products, but there seems to be no process for achieving them.
- Who will create blended products? Currently GOES-R program does not plan on creating blended products. Who will do it, where will it reside, what data will it be, what products can be blended together to make it more useful.
- Blended data can include data from other sources than just satellites, such as radar plus a satellite product.
- Not every user wants or needs blended products. Those users are primarily NWS users, but others really do want Level 1b data. Not all products are given to blending very well. It all depends on the end-user. Not all need blended products.

- Product improvements are desired like: lightning igniting fires, not even sure if this can be done, possibly looking at correlations between currents in cloudtops with fires starting,
- New sensor needed: white light coronagraph for forecasting geoeffective CMEs and space weather events. Currently use SOHO and STEREO, but their lifetime is very limited. No coronagraph is planned for GOES or future NASA missions
- Potential new products: There is a possibility that the new and improved sensors on GOES-R (such as GLM looking at upward lightning products like sprites and blue jets, or any of the solar imaging or irradiance instruments) will enable new products that will be useful, but are not envisioned yet. Discussions about potential new products need to be discussed now to be prepared to create them when GOES-R is operational. Need to know what the customers are going to want or need in the future (e.g. NextGen era). It's up to the scientists and instrument people to help envision those future products.

Concept of operations

- What are the CONOPS for GOES-R? Users are hazy about what happens after GOES-R becomes operational. The new distributed contractor model makes it unclear what will happen with the data products.
- There is confusion about what the ground system contractor will do for data production, since they aren't required to use the code delivered by the instrument contractors and the AWG (Algorithm Working Group), but are indicating they will only code from the ATBDs (Algorithm Theoretical Basis Documents).
- Question: if the instrument provider requests a waiver for their instrument performance, does the AWG study and approve/disprove of the waiver because of impacts on the data products? Some specific details about GLM and lightning strikes in quick succession. There is an Integrated Modeling Working Group at GOES-R project that looks at waivers and studies impacts of waivers on data products, but they don't have everything they need from all the instrument vendors. Problem of traceability of data through algorithms to L1b and higher data products.
- There appear to be many barriers between instruments, spacecraft, AWG, NASA, NOAA, users, etc. that hinder information transfer. There is a project wide lack of communication, particularly how the project is organized, who is responsible for what, what is the process of information flow.
- More information is needed on instrument performance, product improvements, and impacts of waivers or deviations from requirements.

Most challenging aspect

- Creating the proxy data and algorithm test plans to validate the data products. Disseminating that to users to test systems. What do the products look like and how do they fit in existing systems?
- When are the products going to be available? Immediately after start of operations? After some time? Having a good plan for what state products are in, when they'll be available, and when will tests be done?
- User education about the instruments. In particular other instruments besides ABI.

- GOES-R has many new instruments that haven't been on GOES before. Will they work as expected? How long until the data is understood? What will the data look like, both in format and content?
- User education about the instruments. In particular other instruments besides ABI.

User communities are ready

- With the broad spectrum of users, there have to be many different methods of communicating, educating, and demonstrating.
- Different venues for information dissemination beyond the GOES Users' Conference are needed, e.g. NWS conference, booths at other meetings where the majority of users will really be in attendance. Bring GOES to the users, rather than the users to GOES.
- Encourage algorithm developers to invite the users to actually attend this conference.

User readiness

- Nailing down a launch date.
- Providing sample data products and complete descriptions of the coming products.
- Communication seems to be the key missing ingredient, within the GOES program and between the program and the user community. The impediments to communication seem to be in both directions.
- Every instrument needs a responsible scientist who understands the measurements and who is in close communication with the instrument providers.
- There are other instruments on GOES-R besides ABI.

App D-5. Production, Implementation and Distribution

Improvements in information dissemination

- User requests for change go thru SPSRB. GASP, e.g., is not operational – in research phase, could be faster.
- Want nephanalysis data format compatible w/graphical forecast editor.
- KML format very useful. SDS very satisfied with many of their products.
- Need to ensure that information related to product enhancements gets into the archive. (improvements; relationships to other products – how this gets into the archives? Product history/use cases) what is the path?

Integrated products

- Integrate the building blocks (align toward standards, lower barriers to discovery of, and access to, relevant data needed for R&D of integrated products)
- Identify sponsors for cross-platform products (get the best product to the forecaster) where is the money coming from? Where is integration to be done? GDE?)
- Evolve current mechanisms (GOES-R risk reduction, proving ground expansion).
- Need a new paradigm for product life-cycle management (ensemble-like approach).
- Where is the integration done? (e.g., radar & sat data)

- Stovepipes more about standards than funding lines. The more standards are being used, the easier it is to do integration.
- Need spatial data bases – not being used very effectively thru out NOAA (& GOES).
- Need to take a step back – stovepipes exist in processing systems as well.
- Formulate a team of subject matter experts to look at how to integrate across products.
- Lower barriers to entry for research & development of integrated products.

The GOES-R checkout

- There will be low interest if we plan 2 month checkout and then park it for 2 years.
- Science quality and broadcast component equally important.
- Checkout or dual operation for at least a year.
- Two areas to checkout: 1) compatibility format, (can do before launch) 2) impact of that data to tune/optimize the use of the data (need this head start).
- People are going to want the GOES-R data as soon as possible because of the great improvements in data.

Direct Readout

- Only issue really is GRB & eGVAR
- Need data format and level 2 algorithms before the checkout period with enough time to do the coding.
- Need a direct readout package for GRB.
- Which office, GOES-R or NOAA, will support the direct readout community?

Processing algorithms

- The level 2 algorithms will be stored in CLASS and available to users – scientific and operational.
- Need standardized template so information is understandable to CLASS customers – it should be enough so algorithms can be implemented and revised by CLASS users.
- Need supporting auxiliary data interface in CLASS documents.

GRB station

- For budgeting: foreign Gov't need 3 years – 2 for funding and 1 to implement.
- Feds need 4 years – 3 for funding and 1 to implement
- DOD needs 5 years for funding

Products distributed

- Need to educate public about GAS.
- NWS needs to know ASAP for planning its architecture (to size bandwidth) (wholesale .vs. retail).
- Need to know the customer-facing functions of GAS. What is an authorized user?

GOES product implementation

- Non-government real-time users (or near real-time) are underrepresented.
- DOD needs?
- The archive community may not have good understanding.
- How are mesoscale targets to be chosen?
- How does an end-user get pertinent mesoscale data? How will they know what to get?

User communities

- Give them sample data to show how much bigger it is.
- Have a customer forum meeting quarterly dealing with formats, metadata, etc (contractors, contract managers, and all different users).
- Should have separate forum for direct readout users.
- How to reach those who don't come to GUC/AMS.
- Put money toward user outreach smaller communities (fire communities, state govt's, hydrology, …)

App D-6. Training

Training opportunities

- Better utilize current generation GOES.
- The emphasis has been on the NWS forecaster as the main user. Identifying who the other users are – for GOES training activities.
- Creating a stakeholder matrix (who are the users of this data) – NWS, International WMO (weather models), emergency manager, military, transportation industry (ground, aviation, shipping), state and local agencies, public, private sector, environmental groups, general public (citizens)
- Reverse engineering of training techniques and the ways we train the user/customer on GOES data. Learning from the rewards/mistakes of training procedures and how we trained users from the past.
- What training resources are available for users getting data from CLASS (archived data)?
- Will training activities focused for high-end users impact the medium/low-end user needs for training on current GOES information?

Kinds of training

- Training needs analysis for the GOES-R transition.
- Capture performance-based training needs.
- Establish current and future performance base metrics.
- Prepare for improvements to quantitative outputs or decisions.

Biggest concern related to current GOES training issues

- What works now – Resource support ok? Could be better?
- Were not comparable to similar agencies (people, time, money, equipment).

- Continuous improvement in training, even when the training is already good. Current level of training.
- Shrinking resources are threat.
- Testbeds - product development – casework examples. Placing product developer and product user in an operational environment for feedback on what is needed.

Biggest concern related to GOES-R training

- Making GOES-R training relevant from a time perspective as well as content.
- Use existing processes and training methods for current GOES to create an easy transition to GOES-R.
- Using current satellite datasets to emulate GOES-R capabilities.
- Broadcast meteorologists, the international community and emergency managers are the most under-represented user community.

COMET

- Great overview of the flight segment.
- The need for a Comet module on the GOES-R ground segment.
- Comet modules on the 65 products from GOES-R.
- Data fusion for decision making.

User communities are ready

- Quantitative examples of GOES-R output – visual impact.
- Education and Training involved in keeping everyone aware of GOES-R developments.
- Explore new concepts of operations.

User readiness

- Will GOES-R be put in storage or made immediately operational?
- Integrated and blended products?
- Help identify what datasets are for warnings, forecasts, and decision aids.

APPENDIX E BREAKOUT INTEGRATED RESPONSES

Bold is original question posed by GOES-R to the User Community

Indented blue text is the answer from the User Community

Yellow box is the GOES-R response to the User Community

App E-1. ABI Group

2) What questions do you have regarding the ABI concept of operations? Do you have other thoughts on ABI CONOPS in addition to the current Mode 3 ("flex mode") and Mode 4 ("continuous full disk") options?"

Actively seek others who should be involved in future GOES R users meetings.

Response: The GUC Program Committee will extend the offer of committee membership to representatives from DoD, NOS, FAA, OAR, and NWS SOOs. The committee will make a concerted effort to solicit participation from these groups/ agencies in future meetings.

4) "What do you think is the most challenging aspect of the ABI? What do you think will be the greatest improvement over current imagers? What climate applications to you foresee?"

a) Challenge: Assuring end-to-end capabilities (building, training, user access)

Response:

Building: as of Dec. 2009, there have been no show stoppers in the development of ABI. The ABI Prototype Model (PTM) is scheduled for the Pre-Environment Review (PER) in March of 2010. ITT is on track for an on-time delivery in preparation for a 2015 GOES-R launch.

Training: The primary components of user training in preparation of the ABI, are the Cooperative Program for Meteorology Education and Training (COMET); the Virtual Institute for Satellite Integration Training (VISIT); the Satellite Hydrometeorology Course (SHyMet); and the GOES-R Proving Ground. The GOES-R Program will work closely with the NWS Training Division to ensure NWS user readiness for GOES-R.

User Access: The **GRB service** is the primary space relay of Level 1b products. It is the extension of the legacy GOES-I/P series GVAR, but will include rebroadcast of Level 1b data from all GOES-R instruments in addition to the ABI (L2+ from GLM). GOES-R users must either acquire new systems to receive GRB or upgrade components of their existing GVAR systems. At a minimum, existing GVAR systems will need new receive antenna hardware, signal demodulation hardware, and computer hardware/software system resources to ingest the extended magnitude of GOES-R GRB data. This concept for GRB is based on analysis that a dual-pole circularly polarized L-band link of 12 MHz bandwidth may support up to a 31 Mbps data rate – enough to include all ABI channels in a lossless compressed format as well as data from GLM, SUVI, EXIS, SEISS, and MAG. **Network (Terrestrial) distribution** will serve a large segment of GOES-R users. Network distribution operational users will receive data through mechanisms consistent with meeting latency requirements as defined in pre-arranged agreements. Critical NWS elements will receive sectorized Key Performance Parameter (KPP) and imagery data directly via the **GOES-R AWIPS interface** with minimal latency. Authorized users of **GOES-R Access System (GAS)** will also be able to search and request data for one-time retrieval or to establish a subscription for delivery of data based on specified criteria. GAS product distribution will be controlled through the subscription manager process. Subscribed products are delivered directly from the GAS server as they become available, i.e. at the refresh rate of the particular product (including near real time for Level 1b imagery) and with the associated system latency. Users will be able to request their desired data by specific product. Subscription requests may include up to the full volume of Level 1b and higher level products. However, it is envisioned that few if any organizations will require access to all products from all GOES-R instruments via subscription. Managing GAS data distribution through a "customizable" subscription request is expected to make the process more efficient from a telecommunications standpoint. It is assumed that the subscription network distribution service will require the user to maintain a continuously open net link to the GAS**. CLASS** will supply permanent archive and retrospective access services to GOES-R as part of its mission as the single data repository for all NOAA environmental data. **CLASS** is the IT infrastructure supporting the National Climactic Data Center (NCDC) in Asheville, NC the National Geophysical Data Center (NGDC) in Boulder, CO, and the National Oceanographic Data Center (NODC) in Silver Spring, MD. CLASS operates as a distributed system with two operational sites located at NGDC and at NCDC. The facilities provide redundancy with similar hardware and identical software and are capable of assuming the overall CLASS load at any given time. During normal operations, both facilities are operational and share the processing and distribution load.

App E-2. Atmosphere Group

1) "During the GOES-R era, NOAA/NESDIS hopes to move away from system "stovepipes" and into the realm of integrated products. What are some ways to integrate information from different satellite sensors/ systems and in situ observations?"

d) Common Data formats and easy access

> Response: The products accessible from GAS will be available in NetCDF and McIDAS format, and from CLASS in NetCDF, which is common with many other systems and with other archived data in CLASS. For access information see above answer to ABI group.

4) "What do you think is the most challenging aspect of the GOES-R product suite?"

g) Importance of having real-time and archive data formats match.

> Response: The products accessible from GAS will be available in NetCDF and McIDAS format, which is common with many other systems and with the archived data in CLASS.

5) "What improvements about current GOES products, status, access, etc., do you wish to see?"

f) Advances with current GOES work their way into GOES-R development.

> Response: The GOES-R Proving Ground is using many current GOES products to demonstrate products planned for GOES-R. In addition to the Proving Ground, GOES-R risk reduction projects are testing new ways of using GOES data and ways of integrating GOES products with other data sources. The risk reduction products that demonstrate value can be further tested in the Proving Ground operational environment as a potential pre-cursor for GOES-R applications.

App E-3. GOES Production, Implementation and Distribution Group

2) "During the GOES-R era, NOAA/NESDIS hopes to move away from system "stovepipes" and into the realm of integrated products. Please provide your ideas on ways to integrate information from different satellite sensors/ systems and in situ observations."

a) Integrate the building blocks (align toward standards, lower barriers to discovery of, and access to, relevant data needed for R&D of integrated products)

> Response: Proposals are being solicited for development and application of integrated products in the GOES-R Risk Reduction funded by the GOES-R Program Office. New integrated/blended products can then be tested/demonstrated in the operational environment of the Proving Ground.

b) Identify sponsors for cross-platform products (get the best product to the forecaster! Where is the money coming from? Where is integration to be done? GDE?)

> Response: The GOES-R Program Office is funding the GOES-R Risk Reduction effort, which is soliciting proposals for the development of cross-platform products. The NOAA and NASA cooperative institutes (i.e. CIMSS, CIRA, and SPoRT) have developed and will continue to develop blended and cross-platform products. The optimal location for the operational production of blended and cross-platform products is product dependent and is to be determined. Some possibilities include OSDPD, and AWIPS. Some of the answers will be dependent on the results of the Booz Allen Hamilton study on the assessment of NWS architecture for environmental satellite information.

c) Evolve current mechanisms (GOES-R risk reduction, proving ground expansion)

> Response: GOES-R risk reduction and the Proving Ground will continue through and beyond the GOES-R launch and will be expanded as feasible.

d) Need a new paradigm for product life-cycle management (ensemble-like approach)

> Response: The Proving Ground will help determine the evolution of products and their life cycle.
>
> STAR will have the responsibility for long-term maintenance of the algorithms. The STAR Enterprise Product Lifecycle (EPL) consists of 22 process steps that take a product from initial conception through to retirement. In this lifecycle, project stakeholders work together to enable a product to predictably mature as it progresses through the lifecycle steps. Within this framework the Satellite Products and Services Review Board (SPSRB) is responsible for the oversight and guidance necessary to effectively manage the product life cycle process from product development, transition into operations, enhancements, and retirement. A revamped and more efficient version of the SPSRB will be needed to determine priorities for operational implementation and de-implementation.

4) "If you plan to be a Direct Readout user in the GOES-R era, how can the GOES-R Program help you get ready for GRB, eGVAR, EMWIN, HRIT, or DCS? What are the recommended venues for communicating information to you?"

a) Only issue really is GRB & eGVAR

The GOES-R launch is now scheduled to no earlier than December 2015, so GVAR will continue to be the GOES remote user direct image data source.

The GOES-R Program is requiring that the ground system (GS) contractor, Harris Corp, provide five GRB transportable simulators. These simulators will provide interfaces at the IF and at the Level 0 (L0) instrument source packet level. The simulators will enable users to run at full data rates, to insert anomalous data conditions and to produce proxy imagery or pattern data for full system compatibility testing. However, the number of simulators is limited and built for full level testing. The simulator interface will require that potential GRB users have sufficient resources in place to fully test their GRB functionality. It is anticipated that many users merely need to conduct feasibility testing using full fidelity GOES R data that either cannot afford nor have access to infrastructure to connect the GOES R GRB simulator. These users could best be served with access to formatted GRB data for input and processing testing in order to evaluate a return on investment for building up to the full GRB fidelity of data and rates.

b) Need data format and level 2 algorithms before checkout period with enough time to do the coding

Response: Data format will be defined in the Product Definition and Users' Guide (PUG). The initial draft of the PUG (CDRL SE-16) will be available at CDR (Dec. 2010), and the final draft in September 2011. Note that in both cases the document is referred to as a draft, since it will continue to be a living document until release 1 in the summer of 2014. Sample data sets will be available to the User Community as they are developed. Operationally, Level 2 algorithms will be in CLASS.

c) Need a direct readout package for GRB

Response: Full specifications will be available in the PUG with release dates described in 4b. GRB simulators will be available to authorized users, and sample data sets will be available to the User Community as they are developed.

d) Which office, GOES-R or NOAA, will support the direct readout community?

Response: NOAA, with support from the GOES-R Program Office.

5) "Is there information you need regarding processing algorithms to best prepare for the GOES-R series?"

a) As a user, I want a standardized template so info is understandable to CLASS customers – it should be enough so algorithms can be implemented and revised by CLASS users.

b) Need supporting auxiliary data interface in CLASS document

> Response:
>
> Accomplished via Data Submission Agreements, the final versions will be available at Release 2. Data Submission Agreements are between the data center, the producer (GOES-R), and the User Community to describe what will be archived and how to access it. For more information on data submission agreements, contact NCDC or NGDC.
>
> Complete metadata that follows the ISO 19100 series standard, or other internationally accepted content standard, will be produced for the GOES-R data. Additionally, data about how the observations were made (scan schedules, instrument health, etc.) will be acquired and made available to users via metadata and associated ancillary data (including quality indicator and algorithm code), as well as information which describes system status from when the data was collected and processed.

App E-4. GOES Transition

1) "During the GOES-R era, we hope to move away from system stovepipes and into the realm of integrated products. Please provide your ideas on ways to integrate information from different satellite sensors/ systems and in situ observations."

Define where the producer / consumer demarcation point is.

> Response: The GOES-R Ground Segment (GS) is a producer of products. The GS disseminates the products four ways: GAS, GRB, direct interface with AWIPS, and CLASS for long-term archive. Other agencies may take these products and process them and distribute them to other users, but this is beyond the scope of the GOES-R Program.

a) Searchable / consistent metadata used throughout data processing pipeline.

> Response
>
> A complete set of searchable and consistent metadata will be used throughout the processing pipeline. The Ground Segment (GS) will generate metadata: 1) that provides sufficient information at all levels of data granularity to be able to identify, evaluate, extract, employ, and manage the data and data products from GOES-R; 2) that describes the completeness of input identifying content outliers, and documenting UTC time of completion of production for each L1b and L2+ data product; 3) that supports anomaly recognition; 4) that supports operational

quality assessment; 5) that supports operational applications and decision support systems; 6) that supports scientific use including information that is necessary for discipline area and interdisciplinary studies. 7) that supports long term preservation, including information necessary to identify the data in the long-term future and to sufficiently characterize that data so that it can be used in climatological science to construct a climate record; 8) that is needed for archival and stewardship; 9) required for data processing; 10) that includes attributes that are generated by current legacy GOES products.

b) Documented with training provided

Response:

Provided via the PUG and the Data Submission Agreement for CLASS archive products.

The Cooperative Program for Meteorology Education and Training (COMET) will be the primary source of training for the GOES-R User Communities. For the NWS, the Virtual Institute for Satellite Integration Training (VISIT), and the Satellite Hydrometeorology Course will provide additional sources of education and training on GOES-R products and their applications.

2) "If you are, or plan to be, a Direct Readout user in the GOES-R era, how can the GOES-R Program help get you ready for GRB, eGVAR, EMWIN, HRIT, or DCS? What are the recommended venues for communicating information to you?

a) Funding – cost info

Response: This can be made available through NOAA

b) Back-end processing cost

Response: Will be available through NOAA

c) Information updates - Need more info to decide on Data access methodology,

Response: Will maintain the GOES-R web page with technical links as they become available.

d) Products and channel selection

Information will be provided in the PUG as it is developed.

e) Algorithm availability

Response: Algorithm software versions for GOES-R products will be archived.

e) eGVAR – how long available?

In response to an action from the IIRT this was removed...

f) Direct landline link for GRB?

Response: This is being considered along with other alternatives for data distribution beyond that already in-scope.

g) Communication Venues:

DRO Conference

NWA

Web Updates

AMS Broadcasters Conference

AMS

Twitter / social networking media

Response: All of the above.

4) "What is your biggest concern related to GOES transition issues? Is there a community or group that is being under-represented?"

d) GAS priority policy on data access

Response: From the GOES-R CONOPS (V 1.0 Oct. 2009), in order to meet latency and bandwidth requirements Data Distribution operators or a designated authority may, in real-time, prioritize the distribution of data from Data Storage to GAS users. Data Distribution operators can also restrict access to Data Storage data to authorized users, a subset of the registered users. (The actual process for determining prioritization is still to be determined). GAS can handle up to 1000 concurrent users.

App E-5. Other Instruments and Application Areas Group

6) "What do you think is the most challenging aspect of the GOES-R product suite?"

a) Creating the proxy data and algorithm test plans to validate the data products. Disseminating that to users to test systems.

Response:

Proxy data has been developed at CIMSS and CIRA, and a complete set will be developed by the Algorithm Working Group (AWG). Sample data sets should be available on the Proving Ground web page in NetCDF, McIDAS, and KMZ format by early 2010. In addition, CIMSS is developing a weather event simulator case for AWIPS. Notification of the proxy data availability will be posted on the GOES-R website.

A subset of selected algorithms will be tested in the Proving Ground. A complete set of algorithms will be tested and validated by Harris and the AWG.

Plans to disseminate products to users to test systems will be documented in the User System Readiness Plan.

App E-6. General Questions:

1) "How can the GOES-R Program ensure that the user communities are ready for the dramatic increase in data volume from GOES-R, including receive capabilities, display and processing, and a new concept of operations to optimize the value of the information to society?"

a) Take GOES to users rather than bringing users to GOES (booths, town meetings, presence at annual conferences like NWA, AMS, AGU)

Response: The GOES-R Program will continue to communicate with the user communities through conferences such as the AMS annual meeting, the National Weather Association Annual Meeting, the Direct Readout Conferences, Broadcasters Conferences, and in the future will be more active in AGU meetings. GOES-R will also actively seek opportunities to interact with specific target audiences such as NWS forecasters and Science and Operations Officers (SOOs)

b) Use a variety of methods for communicating, educating and demonstrating—road shows, working groups, publications, quarterly customer forums)

Response: GOES-R is a sponsor of COMET and will continue to fund a series of modules on GOES-R. We will provide information on the GOES-R website, and communicate with the users through the Proving Ground, GOES Users' Conferences and the conferences listed above.

c) Provide proxy data/code to users early, showing the exponential increase in data

Response: Sample data sets will be provided to the User Community as they become available.

d) Better outreach to NWS offices and National Centers—Outreach Office to identify and work with diverse user community

Response: Agreed. Over the past couple of years, the GOES-R Proving Ground has provided a major step forward in two way communication with NWS offices and the National Centers. The GOES-R Program Office will make a concerted effort to target meetings or conferences where NWS forecasters or SOOs are present. Within a couple of years of launch, more effort will be needed to reach out to emergency managers.

e) Invest in outreach to smaller communities (fire, state government, hydrology, etc.)

Response: Agreed. Outreach to science communities such as hydrology can start now, but targeting fire, state, local governments and emergency manager will be more effective closer to GOES-R launch.

f) Separate forums for direct readout users

Response: The Direct Readout Conferences are held at two-year intervals.

g/h/i) Select products pushed to users based on user requests using consistent metadata

Response: GOES-R products are disseminated via subscription through the GAS. Subscription service requests are standing data requests based upon requested conditions or criteria and consist of more than one data or product delivery, which may have an indefinite subscription time span. Subscriptions can be for a push data transfer where the requested data or product is automatically transferred to the requesting user when it is available or a pull data transfer where the requesting user is notified when a requested data or product is available for the user to initiate the transfer. For subscription service requests, users can configure the following data and product parameters:

a) Geographic Coverage Area

b) Date

c) Time

d) Time period

e) Product ID / name

f) Quality flags

g) Data format

h) Spacecraft ID

i) Channel number

j) Instrument name

k) Instrument mode

l) Data type

Reference: Ground Segment Functional & Performance Specification (F&PS)

j) Provide low cost transition solutions for new services like EMWIN and HRIT

Response: GOES-R will rely on commercial vendors for developing user terminals for the combined HRIT/EMWIN service, as is done for today's separate EMWIN and LRIT services. GOES-R will provide documentation describing product information, downlink characteristics, data formats, and decoding requirements, but will not provide software for users to view or otherwise utilize the combined EMWIN/HRIT service. This will have to be purchased from the vendor.

k) Provide sufficient lead time for preparation

Sample data sets will be provided to the User Community as they become available.

l) Explore new concept of operations

Response: The GOES-R Program Office will coordinate with the NWS to ensure that GOES-R products and services will support the future NWS concept of operations. Weather Event Simulator cases are under development to help formulate the role of future GOES-R products.

m) Explore whether GOES-R should adopt IMAAP paradigm for direct broadcast users

Response: There are no current plans for GOES-R to adopt an IMAAP type paradigm. Value added companies may have plans for an IMAAP type service.

2) "What information do you need from GOES-R to aid in user readiness? For example, data formats, rebroadcast formats/specification, data distribution methods and options, manufacturer information, individual product volumes, timeline for data access…"

a) Simulated data products and descriptions of coming products in advance

Response:

The NOAA Cooperative Institutes and the Algorithm Working Group have developed and will continue to develop proxy GOES-R products in NetCDF, Google Earth and McIDAS area formats for use by the GOES User Communities. The products and their descriptions will be made available to the user communities.

These will also be provided via the PUG, and sample data sets will be available to the User Community as they are developed.

c) Reliable program status information including launch date, when data will be available (or stored), data transition timelines, and milestones (E.g. data flow in NWS offices)

Response: This type of information will be available on the GOES-R.gov website.

f) Matching formats for real-time and archive data

Response: The products accessible from GAS will be available in NetCDF and McIDAS format, which is common with many other systems and with the archived data in CLASS.

g) Easily accessible information on rebroadcast format.

Response: The rebroadcast formats will be accessible to the user communities on the GOES-R.gov website when they are available. A link to the PUG will also be provided on the GOES-R.gov website when the PUG becomes available.

j) Long lead-time for engaging partners in CAL/VAL

Response: STAR and the CVWG have the long term responsibility of CAL/VAL and they will provide information for the user communities throughout the CAL/VAL lifecycle process.

The lifecycle phases relevant to the calibration efforts are:

1) Instrument and Level 1b algorithm development (initial pre-launch phase)
2) Satellite and Level 1b algorithm Integration and Testing (I&T) (pre-launch phase)
3) On-orbit checkout and initialization (initial post-launch phase)
4) Mission operational life (post-launch operations)

The lifecycle phases relevant to AWG product validation efforts are:

1) Level 2+ product algorithm development (initial pre-launch phase)
2) Level 2+ algorithm I&T (pre-launch phase)
3) On-orbit checkout and initialization (initial post-launch phase)
4) Mission operational life (post-launch operations)

The GOES-R Proving Ground effort will also be providing information to users throughout the lifecycle process.

k) Need interface specs for GAS (protocols, authorization, process, registration, prioritization)

Response: This will be published by the ESPDS contractor as a CDRL. Products will be described in the PUG and the access through GAS will be described in a PDA User's Guide, which will:

- Contain the information required to access data, obtain accounts, generate subscriptions, perform ad hoc queries, and search.
- Show a screen-shot of each Graphical User Interfaces (GUI) and explain the use of each GUI.
- Give detailed descriptions of major user functionality provided, including step-by-step instructions and screen-shots showing how to achieve these functionalities.
- Give a detailed description of the API and explain how to fully utilize the API.
- Provide details of the various modes of operation based on access control and show screen-shots indicating the differences in the activations based on a user input.

l) Back-up for GAS – only source for some products used operationally

Response: Early programmatic cost-based decision was made that GAS would not be backed up at the RBU.

m) Need GAS products available for testing

Response: Sample data sets will be available to the User Community as they are developed.

n) Smart generation of products by geographic location on the fly (issue is control load *shedding, prioritization of users would be important)*

Response: This is not being considered as it is out of scope for the GOES-R Program. Contact NOSC.

o) Schedule specifics for ground system testing and GAS testing for users that are critical to end-to-end test success (NWS offices).

Response: The GS Integrated Test and Validation Working Group (ITVWG) and GOES-R Program System Engineering are developing plans for end to end testing. These plans will be included in the User System Readiness Plan. A schedule for specific GS system testing will be available in the timeframe of the spring of 2012.

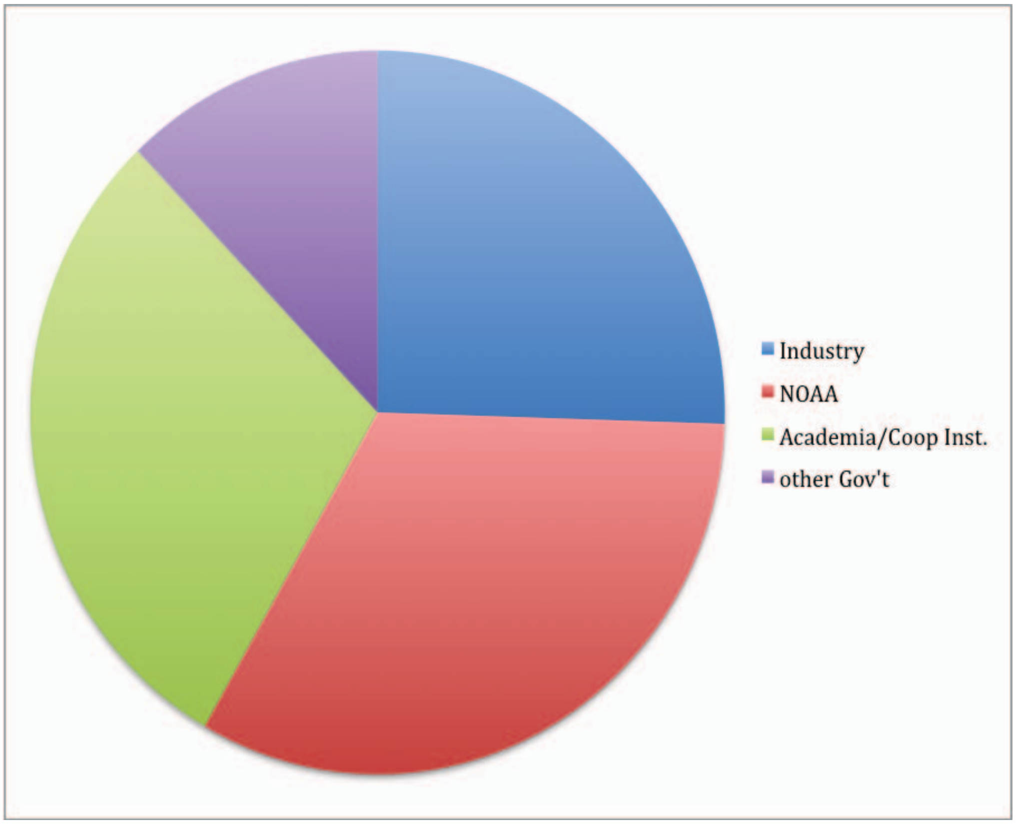
p) How will we mitigate data loss?

Response: GAS provides access to the previous 7-days worth of data via ad hoc. All GOES-R data is also available via CLASS, for the life of the mission.

q) How many simultaneous users can GAS handle?

Response: GAS will be designed to handle at least 1000 simultaneous users (subject to bandwidth limitations).

APPENDIX F ATTENDEE REPRESENTATION



247 total attendees

26% Industry
33% NOAA
30% Academia/Cooperative Institutes
12% Other Government (including foreign and U.S.)

APPENDIX G GLOSSARY

ABI ....Advanced Baseline Imager
ABS.....................Advanced Baseline Sounder
ADEOS ....Advanced Earth Observing Satellite
AFWA.................Air Force Weather Agency
AIRS ....Atmospheric Infrared Sounder
AMS....................American Meteorological Society
AMSU ....Advanced Microwave Sounding Unit
AO.......................Announcement of Opportunity
Aqua....................NASA Earth Science satellite mission named for the large amount of information that the mission will be collecting about the Earth's water cycle
ARH ....Alaska Regional Headquarters
CICS....................Cooperative Institute for Climatic Studies
CIMSS.................Cooperative Institute for Meteorological Satellite Studies
CIOSS ....Cooperative Institute for Oceanographic Satellite Studies
CIRA ....Cooperative Institute for Research in the Atmosphere
CLASS ....Comprehensive Large Array-data Stewardship System
CNMOC ....Naval Meteorology and Oceanography Command
CONUS ....CONtinental United States
CrIS.....................Cross-track Infrared Sounder
CWSA ....Commercial Weather Services Association
CWSU ....Center Weather Service Unit
DCS.....................Data Collection System
DoD.....................Department of Defense
ENVISAT...........ENVIronmental SATellite
EOS.....................Earth Observing System
ESA.....................European Space Agency
EUMETSAT........European Organisation for the Exploitation of Meteorological Satellites
GCOM.................NASDA mission
GEM....................Geostationary Microwave
GIFTS..................Geostationary Imaging Fourier Transform Spectrometer
GIFTS-IOMI........Indian Ocean METOC Imager
GOES ....Geostationary Operational Environmental Satellite
GOS.....................Global Observing System
GPS ....Global Positioning System
GVAR ....GOES Variable Format
HES ....Hyperspectral Environmental Suite
IASI.....................Infrared Atmospheric Sounding Interferometer
IOO ....Instrument of Opportunity
IR ....InfraRed

IRIS.....................Improved Resolution and Image Separation
ISCCP..................International Satellite Cloud Climatology Project
METEOR ....Russian meteorological satellite
MODIS................MODerate-resolution Imaging Spectroradiometer
MSFC..................Marshall Space Flight Center
MSG....................Meteosat Second Generation
MTG....................Meteosat Third Generation
MTSAT...............Multi-functional Transport Satellite
NASA..................National Aeronautics and Space Administration
NASDA...............Japanese Space Agency
NCAR..................National Center for Atmospheric Research
NCDC..................National Climatic Data Center
NESDIS...............National Environmental Satellite, Data, and Information Service
NGDC ....National Geophysical Data Center
NIST....................National Institute of Standards and Technology
NMFS..................National Marine Fisheries Service
NOAA.................National Oceanic and Atmospheric Administration
NOS.....................National Ocean Service
NOSA..................NOAA Observing System Architecture
NPOESS.............National Polar-orbiting Operational Environmental Satellite System
NPP.....................NPOESS Preparatory Project
NWA...................National Weather Association
NWP....................Numerical Weather Prediction
NWS....................National Weather Service
OAR....................Office of Oceanic and Atmospheric Research
OFCM.................Office of the Federal Coordinator for Meteorological Services and Supporting Research
ONR....................Office of Naval Research
PFEL...................Pacific Fisheries Environmental Laboratory
PPI.......................Office of Program Planning and Integration
SEC.....................Space Environment Center
SEVIRI................Spinning Environmental Visible and InfraRed Instrument
SST......................Sea Surface Temperature
Terra....................the EOS flagship satellite (EOS AM)
UAV....................Unmanned Aerial Vehicle
UCAR.................University Corporation for Atmospheric Research
WMO..................World Meteorological Organization

APPENDIX H GOES-R LINKS

Colorado Center for Astrodynamics Research

http://argo.colorado.edu/~realtime/welcome

Colorado State University

Cooperative Institute for Research in the Atmosphere (CIRA) http://www.cira.colostate.edu/
Regional and Mesoscale Meteorology Branch (RAMMB) http://rammb.cira.colostate.edu/

GOES

GOES-8 http://cimss.ssec.wisc.edu/goes/goes8/
UW CIMSS GOES Gallery http://cimss.ssec.wisc.edu/goes/misc/interesting_images.html
NWA Satellite Imagery list http://www.nwas.org/committees/rs/nwasat.html
SXI http://www.sec.noaa.gov/sxi/index.html http://sxi.ngdc.noaa.gov/goesr_looking_ahead.html

GOES-R Program

Official GOES-R Program Page http://www.GOES-r.gov/
GOES-R Users' Conferences http://www.osd.noaa.gov/announcement/index.htm
NASA GOES Project http://goespoes.gsfc.nasa.gov/goes/index.html
NASA GOES Project science http://goes.gsfc.nasa.gov/

Instruments

ABI Research Home page http://cimss.ssec.wisc.edu/goes/abi/

Louisiana State University http://www.esl.lsu.edu

National Centers for Environmental Prediction (NCEP)

NCEP Office of the Director http://www.ncep.noaa.gov/director/
Aviation Weather Center (AWC) http://aviationweather.gov/
Climate Prediction Center (CPC) http://www.cpc.ncep.noaa.gov/
Environmental Modeling Center (EMC) http://www.emc.ncep.noaa.gov/
Hydrometeorological Prediction Center (HPC) http://www.hpc.ncep.noaa.gov/
NCEP Central Operations http://www.nco.ncep.noaa.gov/
Ocean Prediction Center (OPC) http://www.opc.ncep.noaa.gov/
Space Environmental Center (SEC) http://www.sec.noaa.gov/index.html
Storm Prediction Center (SPC) http://www.spc.noaa.gov/
Tropical Prediction Center (TPC) http://www.nhc.noaa.gov/

National Environmental Satellite and Information Service

Office of Systems Operation (OSO) http://www.oso.noaa.gov/goes/
Office of Systems Development (OSD) http://www.osd.noaa.gov/
National Polar-orbiting Operational Environmental Satellite System (NPOESS)
http://www.ipo.noaa.gov/
NESDIS Satellite Services Division (OSDPD) http://www.ssd.noaa.gov/
Operational Significant Event Imagery http://www.osei.noaa.gov/
NESDIS Satellite Product Overview Display Control Center
http://osdacces.nesdis.noaa.gov/controlcenter.cfm
GOES Products and Services Catalogue, 4th Edition (2002)
http://www.orbit.nesdis.noaa.gov/smcd/opdb/goescat_v4/
Comprehensive Large Array-data Stewardship System (CLASS)
http://www.osd.noaa.gov/class/index.htm
STAR, formerly ORA http://www.orbit.nesdis.noaa.gov/star/index.html

National Weather Service (NWS)

National Weather Service Home http://www.nws.noaa.gov/
NOAAPORT User's Page http://www.nws.noaa.gov/noaaport/html/noaaport.shtml

Oregon State University Cooperative

CIOSS http://cioss.coas.oregonstate.edu/CIOSS/
Cooperative Program for Operational Meteorology, Education, and Training (COMET)
http://www.comet.ucar.edu/
VISITview http://www.ssec.wisc.edu/visitview/

University of Wisconsin Space Science & Engineering Center (SSEC)

SSEC http://www.ssec.wisc.edu/
Cooperative Institute for Meteorological Satellite Studies (CIMSS)
http://cimss.ssec.wisc.edu/
Man Computer Interactive Data Access System (McIDAS) http://www.ssec.wisc.edu/mcidas/
Advanced Satellite Products Branch (ASBP) http://cimss.ssec.wisc.edu/aspb/

Miscellaneous

NOAA http://www.noaa.gov/
AMS http://www.ametsoc.org/
NWA http://www.nwas.org/

APPENDIX I CONFERENCE COMMITTEE

James Gurka .... NOAA/NESDIS Office of Systems Development; **Co-chair, Conference Committee**

Dick Reynolds .... Short & Associates, Inc.; **Co-chair, Conference Committee**

Hal Bloom .... NOAA/NESDIS, Office of Systems Development

Michael Bonadonna ..... NOAA/NWS, Office of Federal Coordinator for Meteorology

William H. Campbell ... NOAA/NWS, Office of Science and Technology

Kenneth Carey .... NOAA/NESDIS, Office of Systems Development

Dennis Chesters .... NASA/Goddard Space Flight Center

Dane Clark................... Short & Associates, Inc.

Mark DeMaria .... NOAA/NESDIS, Center for Satellite Applications and Research

Gary Ellrod .... NOAA/NESDIS, Office of Research and Applications

Steve Goodman............ NOAA/NESDIS, Office of Systems Development

Don Gray .... NOAA/NESDIS Office of Systems Development

James Heil .... NOAA/NWS, Office of Climate, Water, and Weather Services

Donald Hillger .... Colorado State University

Mike Johnson............... NOAA/NWS Office of Science and Technology

Steve Kirkner............... NOAA/NESDIS, Office of Systems Development

Eric Madsen................. NOAA/NESDIS, Office of International Affairs

Michelle McMurdy ...... SESDA II

Martin Medina .... NOAA/NESDIS Office of International Affairs

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Kathleen Paris.............. Consultant, Kathleen Paris.com

Shanna Pitter................ NOAA Office of Program Planning and Integration

Thomas Renkevens ...... NOAA/NESDIS, Office of Satellite Data Processing and Distribution

Kevin Schrab .... NOAA/NWS, Office of Climate, Water, and Weather Services

Tim Schmit .... NOAA/NESDIS, Center for Satellite Applications and Research; Co-chair, Conference Committee

Howard Singer............. NOAA/NWS Space Environment Center

Bill Sjoberg.................. NOAA/NWS, Office of Science & Technology/General Dynamics

Maria Vasys................. University of Wisconsin, Space Science and Engineering Center

Patricia Viets .... Short & Associates, Inc.

Tim Walsh .... NOAA/NESDIS Office of Systems Development

APPENDIX J PHOTO CREDITS

Cover photo ....Monona Terrace by Dane Clark.

Section 1.2...........Proclamation Plaque by Tim Schmit.

Section 7..............Breakout Sessions by Matt Cullen.

Section 11............Dr. Hank Revercomb by Mark Hobson.

Section 14............50th Anniversary by Mark Hobson.