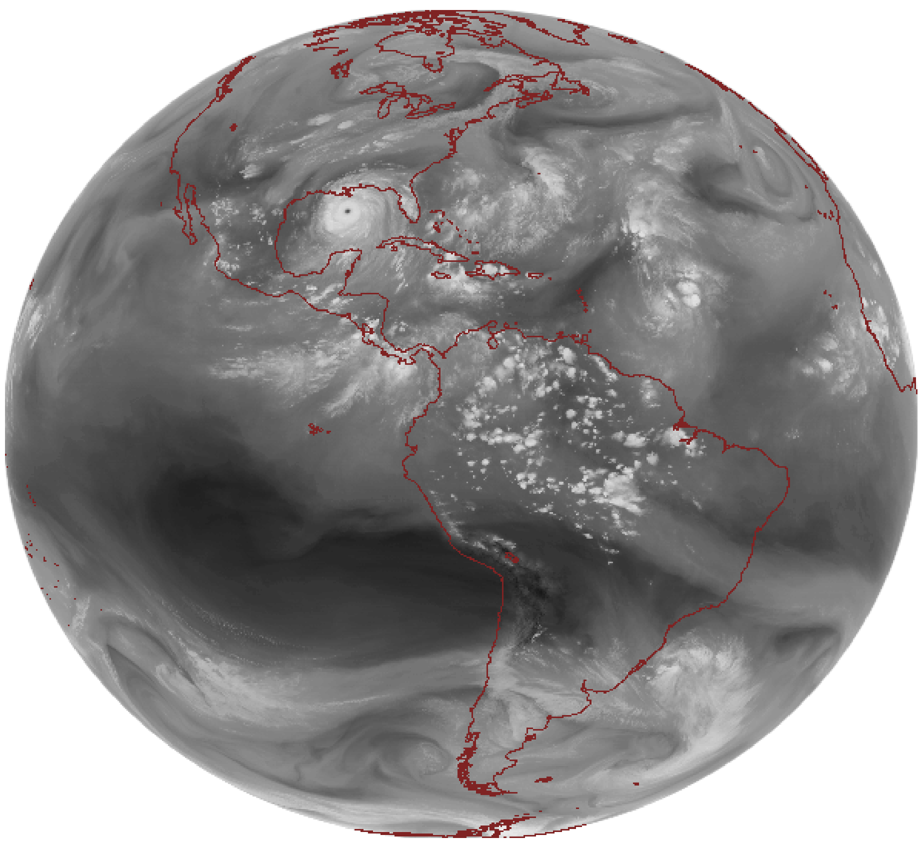
5TH GOES Users' Conference
Conference Report

January 23-24, 2008
New Orleans, Louisiana



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

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Foreword

The National Oceanic and Atmospheric Administration's (NOAA's) Geostationary Operational Environmental Satellite Series R (GOES-R) is in the early stage of development—with GOES-R planned to be launch-ready in 2015. NOAA is conducting outreach efforts to ensure user readiness when GOES-R becomes operational. To advance user coordination, NOAA held the 6th GOES Users' Conference in New Orleans, Louisiana at the American Meteorological Society's (AMS's) 88th Annual Meeting in January 2008.

The conference brought together industry leaders, academic professionals, international partners, and users. It 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:

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

NOAA and AMS co-organized the conference with support from the National Weather Association (NWA). We would like to thank all conference participants, especially the invited speakers, AMS, NWA, the program committee, and all those who provided valuable suggestions for improving the GOES program.

The GOES-R team has worked very hard to move from the initial risk reduction into the full acquisition phase. NOAA has identified the appropriate scope, budget, and schedule to ensure the success of the GOES-R program. We appreciate everyone's support of this critical satellite program and commit to building an even stronger relationship with our user community.

Mary E. Kicza
Mary E.Kicza
Assistant Administrator for
Satellite and Information Services

Executive Summary

Over 350 satellite data users gathered in New Orleans, Louisiana, January 23-25, 2008, for the Fifth Geostationary Operational Environmental Satellite (GOES) Users' Conference. The conference was held in conjunction with the 88th Annual Meeting of the American Meteorological Society. The broad theme of the AMS meeting was "Enhancing the Connectivity Between Research and Applications for the Benefit of Society." The GOES conference enhanced this theme nicely.

The GOES conference is an example of many people working together to inform a large group of users about current, near-term, and future capabilities. It was designed to seek ways and define methodologies to ensure user readiness, continue to improve communication between NOAA and the GOES user communities, inform users on the status of the GOES-R constellation, instruments, and operations, and promote understanding of the various applications of data and products from the GOES-R series.

Attendees at the GOES conference represented government, academia, and industry. The conference featured informational briefings, oral presentations, panel discussions, two users forums, and a poster session that consisted of almost 100 posters representing applications "from the stars to the sea." Applications included weather, ocean, climate, cryosphere, land, hazards, and others. Over 20 oral presentations included topics such as baseline instruments, geostationary satellites as a part of the Global Earth Observation System of Systems (GEOSS), GOES data products and instrument operations.

Attendees were excited to hear a keynote address by Dr. William H. Hooke, American Meteorological Society, and a lunchtime presentation by Dr. John L. Beven II, a hurricane specialist at NOAA's National Hurricane Center/Tropical Prediction Center, Miami, Florida. Dr. Hooke discussed "GOES End Users: Who They Are, How They Matter, What They Need, Why They'll Pay." Dr. Hooke said that the end users contribute to public health and safety, economic growth, protection of the environment and ecosystems, and geopolitical stability. Dr. Beven gave a presentation that focused on GOES-R and the increases in capabilities dealing with tropical cyclones, as well as the larger meteorological issues that overlap with observations of tropical cyclones.

People from many countries participated in the GOES conference including India, Korea, Brazil, Argentina, China, Russia, as well as representatives from the World Meteorological Organization (WMO) and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT). Jerome Lafeuille, Chief of the Space-based Observing System Division of the WMO's Space Program, provided an update on geostationary satellites in a WMO perspective. Ernst Koenemann, EUMETSAT, said that the European commitment to environmental and climate observations is evolving. He provided a status report of the Meteosat program. Toro Hashimoto, from the Meteorological Satellite Center (MSC) of the Japan Meteorological Agency (JMA), gave a presentation on the current status and plans of JMA's satellites, including follow-up on its preparatory activities for the follow-on satellite to MTSAT. Dr. P.C. Joshi, Space Applications Center, Indian Space Research Organization, Ahmedabad, India, described India's meteorological missions. He said many ongoing Indian satellite meteorological missions are useful for the specific observational needs over the tropics. Dr. Ae-Sook Suh, Director of Meteorological Satellite Division, Korea Meteorological Administration, gave an overview of KMA's current status of Korea's first meteorological satellite, the Communication, Ocean, Meteorological Satellite (COMS), which is scheduled to be launched in June 2009.

Two panel discussions were held at the conference. A Future Operations Panel, moderated by Thomas M. Renkevens, NOAA/NESDIS/GOES-R, Greenbelt, Maryland, featured panelists who described their use of GOES data, challenges and opportunities of GOES-R. An International User Panel, moderated by Dr. Donald E. Hinsman, WMO, Geneva, discussed Lessons Learned from Current GOES and Implications for GOES-R.

Two GOES-R Users' Forums were held. Topics and presenters included:

- Hurricane intensity changes associated with the Gulf of Mexico Loop Current and Eddies using GOES sea surface temperatures and satellite altimetry, Nan D. Walker, Louisiana State University
- Potential Socio-Economic Benefits of GOES-R, Sharon K. Bard, Centrec Consulting Group, LLC, Savoy, Illinois
- Preparing for GOES-R+ User Training and Education, Anthony Mostek, NOAA National Weather Service, Boulder, Colorado
- United Airlines Polar Operations, Michael Stills, United Airlines, Chicago, Illinois
- Use of Satellite Data at National Weather Service Forecast Offices, Donald M. Moore, NOAA National Weather Service, Billings, Montana
- GOES imagery applications at the Aviation Weather Center, Steven Silberberg, AWC/NCEP, Kansas City, Missouri
- U.S. Environmental Protection Agency -- Future use of GOES-R in Air Quality Assessments, James Szykman, USEPA, Hampton, Virginia
- Multi-Spectral Data for Space Shuttle Landing Operations, Doris A. Hood, NWS Spaceflight Meteorology Group, Houston, Texas

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 (television meteorologists, private weather companies, aviation and agriculture communities, and national and international government agencies) with significantly more data, containing noteworthy improvements in temporal and spatial resolutions over data currently provided. The need for an advanced satellite for weather forecasting, and the need for the Advanced Baseline Imager have been well documented and publicized. Attendees not only heard more details about the weather forecasting applications of satellite data, but also about the crucial need for advanced instruments for other applications, including fisheries, space weather, and aviation applications. Users stressed the need for making their requirements known in a timely fashion in order to solidify GOES-R requirements.

The conference was co-organized by the National Oceanic and Atmospheric Administration (NOAA) and the American Meteorological Society (AMS), with support from the National

Weather Association (NWA). Plans call for the important communication with the user community to continue, and for the next GOES Users' Conference to be held November 3-5, 2009, at the Monona Terrace Conference Center (MTCC) in Madison, Wisconsin. Tours of the University of Wisconsin-Madison Space Science and Engineering Center, Cooperative Institute for Meteorological Satellite Studies will be offered before and after the conference.

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1. OVERVIEW

Over 350 satellite data users gathered in New Orleans, Louisiana, January 23-25, 2008, for the Fifth Geostationary Operational Environmental Satellites (GOES) Users' Conference. The conference was held in conjunction with the 88th Annual Meeting of the American Meteorological Society. The GOES conference was designed to seek ways and define methodologies to ensure user readiness, continue to improve communication between NOAA and the GOES user communities, inform users on the status of the GOES-R constellation, instruments, and operations, and promote understanding of the various applications of data and products from the GOES-R series.

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2. SESSION 1 – Welcome and Keynote

2.1 Introduction, James Gurka, Acting GOES-R chief scientist, NOAA Satellite and Information Service

James Gurka, acting GOES-R chief scientist, NOAA Satellite and Information Service, welcomed the attendees to the 5th GOES Users' Conference. He welcomed feedback, encouraged the attendees to provide input, and stated that users' input is one of the most important aspects of the conference. Mr. Gurka introduced Gary Davis, director of the Office of Systems Development at NOAA Satellite and Information Service. Mr. Davis also encouraged feedback and questions, and emphasized that the conference is a users' conference; he emphasized the desire for communication. Mr. Davis introduced Ms. Abigail Harper, NOAA, Deputy Assistant Administrator for Systems, coordinating acquisition for satellites and ground systems.

2.2 Conference Goals, Abigail Harper, NOAA, Deputy Assistant Administrator for Systems

Abigail Harper, Deputy Assistant Administrator for Systems, NOAA Satellite and Information Service, said that the conference is a key event, bringing together industry, academia, international partners, and users. The conference enables NOAA to show users where we are and to continue preparations for the next generation of geostationary satellites. The GOES-R team has worked very hard to successfully progress from the initial risk reduction to the eve of moving into the full acquisition phase. NOAA has identified the appropriate scope, budget, and schedule to ensure the success of the GOES-R program. Ms. Harper thanked all of the team members, including the design and risk reduction contractors, and the independent review team.

She said she is pleased to hear from our international partners. "Geostationary Satellites over the Western Hemisphere are not enough," she said. "We rely on our partners for access to the data from their satellites to provide the global geostationary coverage." She described "partnership" as a key word – partnership with NASA, the user community, and international agencies, and said that no one agency alone can provide satellite coverage.

2.3 GOES, a Key Component of GEOSS, Mary E. Kizca, NOAA Assistant Administrator for Satellite and Information Services

Mary E. Kizca, NOAA Assistant Administrator for Satellite and Information Services, spoke on "Geostationary Satellites: Contributing to GEOSS." She said that when we think of NOAA's Geostationary Operational Environmental Satellites, we tend to think of NOAA's weather sentinels constantly monitoring the hemisphere and being vital to severe weather monitoring and forecasting. GOES is an important link to the broader GEOSS effort. It is especially important to view GOES as part of the international constellation as we move into the GOES-R era. We need to weave the GOES-R into the broader global capability of earth observations. "GOES is much more than weather," she said. GOES focuses on the broader set of capabilities of earth observations that GOESS supports.

Ms. Kizca described the Global Combined Sea Surface Temperature (SST) product as an example. Typically, in the past, NOAA has used Polar-orbiting Operational Environmental Satellite (POES) data for the SST product. NOAA has made incredible progress over the past several years in developing the application of a dynamic data-fusion scheme to generate a global, operational SST analysis from NOAA POES and GOES SST data. This dynamic scheme is an optimal assimilation technique combining multi-satellite retrievals of POES and GOES sea surface temperatures into a single analysis of SST. The methodology will replace the current POES SST/aerosol analysis software, which is an algorithm form the late 1970s. Plans call for this new SST analysis to become operational in NOAA in the next month.

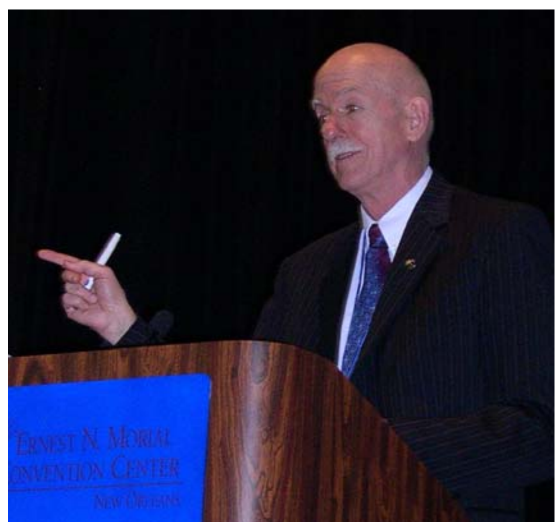
Ms. Kizca said this demonstrates the utility for a broader set of products. The future will bring together geostationary and polar satellite data from foreign partners around the world to continue to improve usefulness of the analysis. The analysis is set to take in a variety of data types and sets from various sensors.

This new analysis will be a key part of understanding the state of our oceans. It will be used by NOAA's Ocean Prediction Center in its ocean forecast and high seas forecast models. NOAA's CoastWatch and OceanWatch programs will use this to provide better information about our coasts so that our coastal resources can be managed better. The Coral Reef Watch program will be replacing its current SST analysis using this new data to provide better information on how ocean temperatures affect the coral reef ecosystems and can help predict coral reef bleaching.

In the future, we will need to describe how GOES information can contribute to improved products that benefit society. We need to know: How does GOES contribute to the broader environmental data? How are we using GOES products to improve fisheries management? Can improved ocean frontal products, which affect ocean fisheries, be used to improve how we manage fishing resources? How are we going to use GOES-R with other future satellite programs, like NPOESS, to provide information to help make ecological forecasts or to provide coastal managers and officials with better information that can help with tourism and human health issues? We need to communicate this information to the public; we need to describe how GOES data will be used to contribute to societal goals.

In closing, Ms. Kicza said GOES-R will present technical challenges, but results will be immense. Great strides have been made in the program over the past year. We will need to translate the improved capability into improved environmental products, and community, industry, and government will need to work together to convey the message.

2.4 Keynote Address: "GOES End Users: Who They Are, How They Matter, What They Need, Why They'll Pay," Dr. William H. Hooke, American Meteorological Society



Dr. Hooke, American Meteorological Society, discussed "GOES End Users: Who They Are, How They Matter, What They Need, Why They'll Pay." He did an informal demographic survey of the room, which was divided between providers and users. The users were defined as front-line users, an important and valuable group.

Dr. Hooke said that the end users contribute to public health and safety, economic growth, protection of the environment and ecosystems, and geopolitical stability. They identify with the national agenda.

The end users matter because the way in which they use, misuse, or fail to use the data determines the value proposition for GOES. Dr. Hooke said the end users are currently losing the battle in each of the four arenas above. Disaster losses are rising; economic pricing has yet to internalize environmental costs; the world's sixth mass extinction is underway; and complex emergencies are on the rise. As a community, we are silent on these subjects. We want the society that we serve to do these things right. Then the community will realize that they have been under-valuing the satellite systems.

On the input side, the user community needs more accuracy, parameters, spatial/ temporal resolution, and accessibility/ flexibility/ continuity, Dr. Hooke said. The GOES providers and users are excellent in this regard. On the output side, the community needs the right policy framework – one that makes their GOES-based decisions and actions valuable.

The gap between the advance of our science and technology and society's ability to use it is widening. The key to closing the gap is getting the policies right. The benefits of science are not fundamental constants, but vary considerably, depending on the prevailing policy framework at all levels of government. We are currently under-investing in this science and technology.

Dr. Hooke said we are under-investing because:

- The benefits are hard to measure
- Many benefits are "non-monetizable"
- Many benefits are public goods
- Policies constrain benefits
- We frame benefits in ways that downplay their value

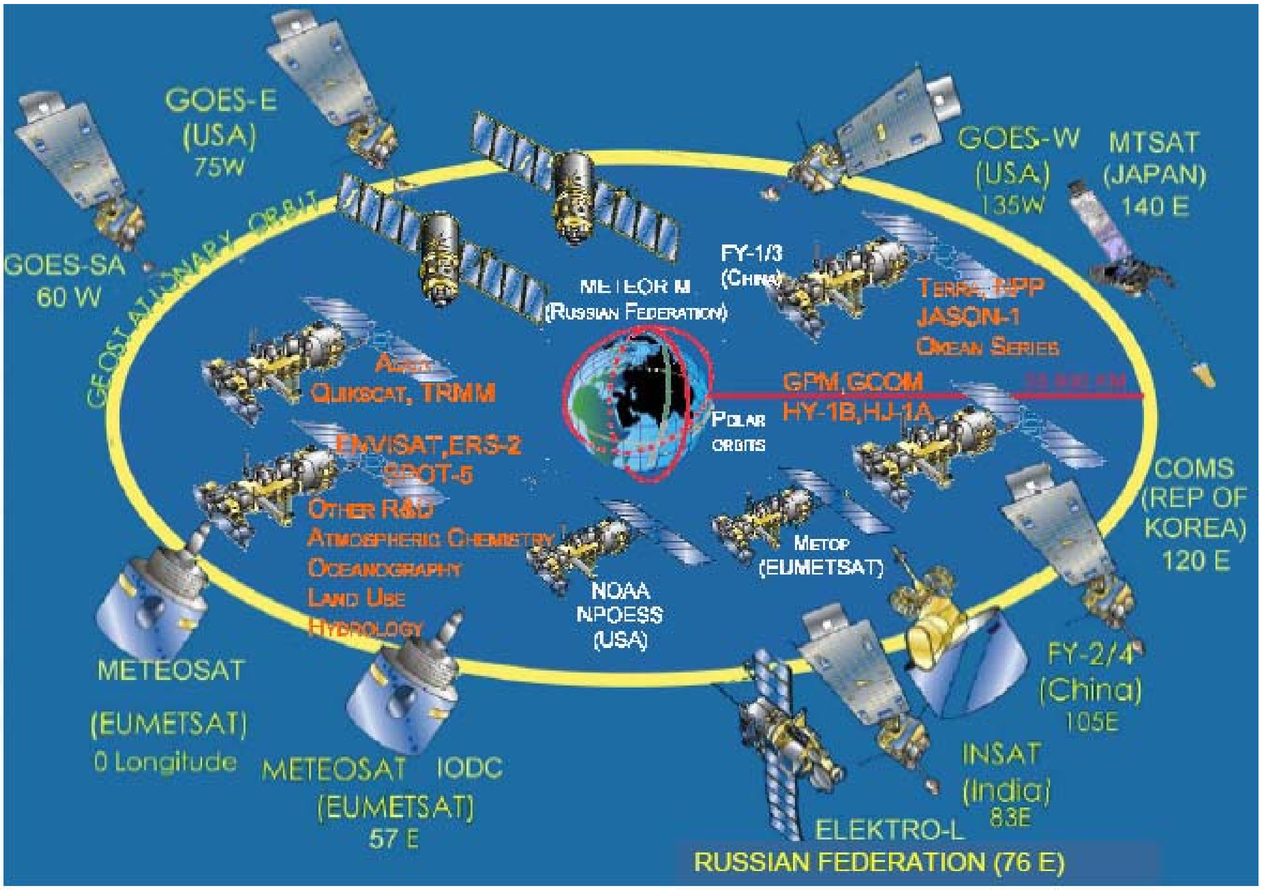
The forecast is that GOES end users will pay because the stakes and urgency are rising; and the dysfunctional outcomes are becoming increasingly more visible. Society is waking up to the problem, he said. We are seeing this with respect to the climate change issue. The AMS is trying to help people see the dysfunction. "We are trying to have a more robust framework for valuation studies," he said. "We are providing transition documents to improve the infrastructure and quality of science and services. We are also providing Hill briefings. We are also getting ready to start a new journal on socio-economic impacts and society."

In this regard, the AMS is working with five corporations who were present in the room: Raytheon, ITT, Lockheed Martin, SAIC, and Northrup Grumman. Dr. Hooke encouraged other corporations to become involved.

2.5 Geostationary Satellites in a WMO Perspective, Jerome Lafeuille, World Meteorological Organization, Space Program, Geneva, Switzerland

Jerome Lafeuille, Chief of the Space-based Observing System Division of the WMO's Space Program, provided an update on geostationary satellites in a WMO perspective. The WMO Global Observing System (GOS) is becoming more important in space observations.

Traditionally, there have been three elements in global observations: geostationary satellites, polar-orbiting satellites, and research and development satellites. Currently the design is evolving. The requirements are reviewed and updated. Gap analysis is performed; implementation requirements are identified and provided to member agencies' space programs. Subsequently, the WMO is updating its long-term vision of the GOS. In 2006 the WMO initiated a re-design of the GOS baseline system to look ahead to 2025. Operational weather forecasting remains the core of the system, but it shall respond to climate requirements with an equal priority. In 2007 the 15th WMO Congress agreed on the principle of the WMO Integrated Global Observing Systems (WIGOS) addressing the needs of all WMO programmes including weather forecasting, climate monitoring, and atmospheric chemistry and hydrology.



Space-based component of the Global Observing System

The new vision of the GOS to 2025 includes operational observations from geostationary, polar orbiting, and other inclinations and orbits when relevant. Mr. Lafeuille said that we need a transition of advanced observations from research and development to operations; improved calibration; improved data access and data timeliness; consideration of the possibility of targeted observations; and increased cooperation among satellite providers.

The new vision is being refined. Elements of the new vision include:

- Optimized/enhanced geostationary constellation
- Sounding missions on three sun-synchronous orbital planes
- Operational radio-occultation sounding constellation
- Updated strategy for altimetry and sea surface winds
- Continuity of other essential climate variables, e.g., radiation budget, precipitation and chemistry
- Lightning detection is encouraged
- Possible highly elliptical orbit missions for polar regions

Geostationary satellites have a unique role in the system, Mr. Lafeuille said. They monitor rapidly evolving weather patterns. They detect events such as lightning, wild fires, wind and pollutant transfer. Geostationary satellites are in six locations over the Equator, providing global coverage of our planet.

The new vision for the geostationary component of the GOS includes:

- Near global coverage with at least six spacecraft separated by not more than 60 degrees longitude
- Multipurpose VIS/IR imagery (revisit time less than 15 minutes for full disc)
- IR Hyperspectral sounding
- Contribution to Earth radiation budget
- Contribution to atmospheric chemistry
- Lightning detection complementing ground systems

The GOES is a key player in the global constellation, providing 33 years of continuous service. GOES covers two of six WMO regions; two oceans, with hurricane watch over the Caribbean and Pacific, and has been a pioneer in geostationary sounding.

The WMO is looking forward to the GOES-R series. The ABI is an excellent response to the imagery requirement. It will allow breakthrough in nowcasting applications and numerical weather prediction; it will lead the new generation of imagers. Lightning detection will serve nowcasting and climate requirements. There is also a growing interest in space weather observations. The Hyperspectral IR sounder is considered essential in the new vision of the GOS to 2015. The WMO is strongly encouraging the Hyperspectral IR sounder for GOES-S and beyond.

In conclusion, Mr. Lafeuille said that as the new GOS is expanded and diversified, geostationary satellites remain the backbone of meteorological observation for which operational continuity is mandatory. The GOES system has been a major component of the WMO GOS since its origin. Improved spatial, temporal and spectral resolution allows major improvements on products and benefits in applications. The WMO is looking forward to the GOES-R series, which should allow unprecedented geostationary imaging performance. The WMO is encouraging NOAA to consider Hyperspectral sounding on future satellites when possible.

3. SESSION 2 – Information Briefings: Baseline Instruments I

3.1 GOES-R Program Status, Greg Mandt, NOAA/NESDIS, System Program Director, GOES-R

Greg Mandt, System Program Director, NOAA Satellite and Information Service, GOES-R, gave an update on the GOES program, with a focus on GOES-R. GOES satellites are a mainstay of weather forecasts and environmental monitoring in the United States. Their images of the clouds are seen daily on television weather forecasts. The next generation GOES will provide critical atmospheric, hydrologic, oceanic, climatic, solar, and space data. Additional capabilities include improved direct services, such as GOES-R Re-Broadcast (GRB), Search and Rescue (SAR), Data Collection System (DCS), Emergency Managers Weather Information Network (EMWIN) and Low Rate Information Transmission (LRIT).

Mr. Mandt said that GOES provides a vital asset to the Nation. GOES is our sentinel in the sky; it keeps an eye on hurricanes, severe storms, and flash floods. It covers a much broader spectrum. It provides input to weather models, forecasts, and warnings. Fire and smoke products are provided for air quality monitoring and forecasting and fire fighting. GOES provides sea surface temperature products for fisheries and climate, winds for aviation, solar imagery for communications satellites, environmental data, data for river gauges, and search and rescue data. GOES data are shared with other countries.

Currently GOES-11 and 12 are the operational satellites; GOES-13 is in on-orbit storage; GOES-10 is in routine operations over South America. GOES-12 also provides data to South America, and is used for rapid scan operations. The demands for rapid scans have increased as its value has become more understood.

The satellites will provide the user communities, including the general public, television meteorologists, private weather companies, the aviation and agricultural communities, oceanographers, hydrologists, climatologists, and national and international government agencies with about 30 times the amount of data currently provided.

The annual estimated economic benefit of Advanced Baseline Imager on GOES-R beyond the current system exceeds $4.6 billion. GOES-R is truly a great investment for the country. User needs include: improve hurricane track and intensity forecast; improve thunderstorm and tornado lead time; improve aviation flight route planning; improve solar flare warnings; improve power blackout forecasts due to solar flares; and improve energetic particle forecasts.

The GOES program has started many tasks for success:

- Conduct a program definition and risk reduction phase
- Include satellite operations and support organizations early in architecture design and development teams
- Consider security early
- Stringent latency requirements drive architecture and costs

- Consider government expertise in user product generation options (thus an Algorithm Working Group was formed within NOAA/NESDIS)
- Be cognizant of pushing technology limits

In developing the GOES-R series, NOAA and NASA are striving to maintain a balance between affordable costs and evolving user needs. Complete life cycle end-to-end costs must be included in upfront planning to ensure decision makers have a full understanding of the system cost. Architectures, including ground systems, must be developed to effectively handle large volumes of data required by users.

To reach the goal of an optimal balance between benefits and cost, the GOES program has adopted various strategies. Trade studies have been performed against requirements. Multiple architecture options have been and are being evaluated. End-to-end system architecture is being defined. The planned GOES-R program life cycle is structured as follows: 1) Pre-Study Phase; 2) Concept/ Architecture Development Phase; 3) Program Definition and Risk Reduction Phase (began 9/05, extended to 4/07); and 4) Acquisition and Operations (A&O) Phase (May 2008). Formulation phase has been completed for all the baseline instruments.

The new instruments will allow for a host of new environmental products and services, while improving most of the products and services that are currently provided, Mr. Mandt said. The new observations will contribute to dramatically improved weather, water, and space environmental services in the next decades, enhancing public safety and providing economic benefits to the United States and our international partners.

A lot of work has gone into developing the acquisition activity. Twelve architecture study contracts were awarded November 2003 to evaluate end-to-end architecture approaches. Program Definition and Risk Reduction have taken place. Three firm fixed-price contracts have been awarded. The flight and ground segments have been split, providing more of an opportunity to industry leaders. NOAA is to retain overall program responsibility and procure the ground segment. NASA is to procure the space segment. The government is to perform System Engineering and Integration activities required to integrate the space and ground segments. Mr. Mandt showed a slide of the GOES-R organization and explained the organization.

The notional system will include a GOES East and GOES West, GOES-R ground segment, mission management, product generation, and product distribution. Over the past year, key program documents have been signed. NOAA and NASA signed a Memorandum of Understanding, and a Level 1 Requirements document was signed. A draft request for proposals for spacecraft acquisition was released in August 2007. RFP documents are in final development for ground acquisition.

The first satellite of the GOES-R series, scheduled to be launch-ready in 2015, will usher in a new era in geostationary environmental satellites, providing vastly improved spatial, spectral and temporal resolutions. This timeframe is required to maintain mission data continuity. Increased performance will take place with GOES-R. There will be an increase of channels from the current five to the 16 with the GOES-R imager. Lightning detection capability will be new. The

Advanced Baseline Imager (ABI) will scan the Earth nearly five times faster than the current GOES, and will have improved resolution. ITT Corporation will provide the ABI. The Space Environmental In-Situ Suite will be provided by Assurance Technology Corporation. The Solar Ultra Violet Imager will be provided by Lockheed Martin Advanced Technology Center. The Extreme Ultra Violet/X-ray Irradiance Sensor will be provided by the Laboratory for Atmospheric and Space Physics. The magnetometer will be procured as part of the spacecraft contract. The Geostationary Lightning Mapper will be provided by Lockheed Martin Space Systems Company. It will detect total strikes: in cloud; cloud-to-cloud; and cloud-to-ground. Today's land based systems measure only cloud to ground.

The Hyperspectral Environmental Suite was removed from the GOES-R program in August 2006. NOAA continues to have strong requirements for measurements from advanced hyperspectral sounder in geostationary orbit. The ABI can approximate the current GOES sounder capabilities. A geostationary advanced sounder demonstration mission should be funded as soon as possible.

The communications payload on GOES-R will include: GOES Rebroadcast; Low Rate Information Transmission; Emergency Managers Weather Information Network; Search and Rescue; Data Collection System; and EVGAR (Emulated GVAR).

3.2 The Advanced Baseline Imager on the GOES-R Series, Timothy J. Schmit, NOAA Satellite and Information Service, Madison, Wisconsin; and J. J. Gurka, M. M. Gunshor, and J. Li

Timothy J. Schmit, NOAA Satellite and Information Service, Madison, Wisconsin, said the next generation geostationary satellite series will offer a continuation of current products and services and enable improved and new capabilities. The Advanced Baseline Imager on the GOES-R series has been designed to meet user requirements covering a wide range of phenomena. As with the current GOES Imager, the ABI will be used for a wide range of weather, oceanographic, climate, and environmental applications. The ABI will improve upon the current GOES Imager with more spectral bands, faster imaging, higher spatial resolution, better navigation, 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. There will be an increase of the coverage rate leading to full disk scans at least every 15 minutes. ABI spatial resolution will be 2 km for the infrared bands and 0.5 km for the 0.64 um visible band.

ABI will improve every product from the current GOES Imager and will introduce a host of new products. Current products include: retrieved Atmospheric Motion Vectors (AMVs), Quantitative Precipitation Estimates (QPEs), cloud parameters, clear-sky radiances, Sea Surface Temperature (SST), surface (skin) temperature, detection and characterization of fires, volcanic ash, fog, and cloud-top information. ABI will also provide cloud-top phase/particle size information and improved snow/ice detection, total column ozone, aerosol and smoke detection for air quality monitoring and forecasts. Other new products include vegetation monitoring and upper-level SO_2 detection. In addition, the ABI will be used to generate "pseudo-soundings" to continue the sounder legacy products such as Total Precipitable Water (TPW) and atmospheric stability parameters. The ABI "pseudo-soundings" do not fulfill the need for advanced high-spectral resolution sounders. To prepare for the on-orbit ABI data, simulations from a mix of synthetic (derived via forward models) and actual satellite observations are being used.

3.3 Geostationary Lightning Mapper for GOES-R and Beyond, Steven J. Goodman, NOAA/NESDIS/ORA, Camp Springs, MD; and R. J. Blakeslee and W. Koshak

Dr. Steven Goodman, NOAA's Satellite and Information Service, Center for Satellite Applications and Research (STAR), reported on the Geostationary Lightning Mapper (GLM) planned instrument performance, algorithms, advanced applications, and user readiness. (Note from editor: Dr. Goodman has since become Chief Scientist for the GOES-R Program Office.) The GLM is a single channel, near-IR imager/optical transient event detector, used to detect, locate and measure total lightning activity with near uniform spatial resolution of 10 km. The GLM will provide continuous day and night observations of lightning from the west coast of Africa (GOES-E) to New Zealand (GOES-W) when the constellation is fully operational.

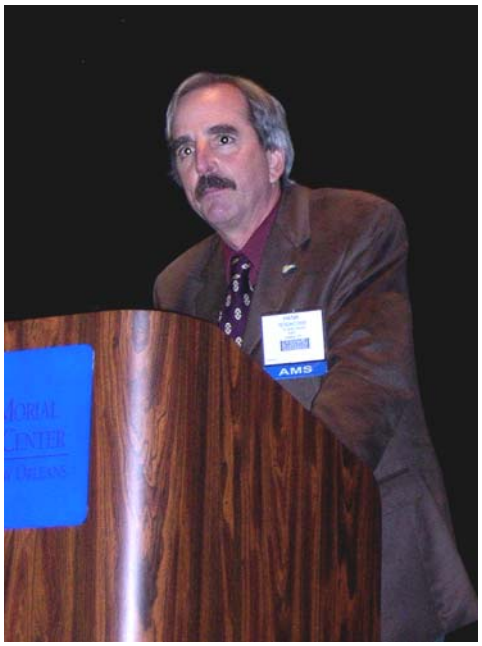
The mission objectives for the GLM are to: 1) provide continuous, full-disk lightning measurements for storm warning and nowcasting, 2) provide early warning of tornadic activity, and 3) accumulate a long-term database to track decadal changes of lightning. The GLM owes its heritage to the NASA Lightning Imaging Sensor (1997-Present) and the Optical Transient Detector (1995-2000), which were developed for the Earth Observing System and have produced a combined 13 year data record of global lightning activity.

The implementation phase award to develop a prototype and four flight units was underway in December 2007. In parallel with the instrument development, a GOES-R Risk Reduction Team and Algorithm Working Group Lightning Applications Team have begun to develop the Level 2 algorithms and applications. Proxy total lightning data from the NASA Lightning Imaging Sensor on the Tropical Rainfall Measuring Mission (TRMM) satellite and regional test beds (e.g., Lightning Mapping Arrays in North Alabama, Oklahoma, and the Washington, D.C. metropolitan area) are being used to develop the pre-launch algorithms and applications, and also improve our knowledge of thunderstorm initiation and evolution. Real time lightning mapping data are being provided in an experimental mode to selected National Weather Service (NWS) forecast offices in the Southern and Eastern Regions. This effort is designed to help improve our understanding of the application of these data in operational settings.

4. SESSION 3 – Information Briefings: Baseline Instruments II

4.1 High Spectral and Temporal Resolution Imaging Sounders for GOES, Henry E. Revercomb, University of Wisconsin, Madison, Wisconsin

Henry. E. Revercomb, University of Wisconsin, Madison, Wisconsin, said the benefits of high spectral and temporal resolution imaging sounders for the operational systems of the future have been widely recognized by NOAA and the weather satellite community for many years. This recognition of the importance of sounder data for improving nowcasts and forecasts of severe weather events of all kinds led to the successful development of the GIFTS (Geosynchronous Imaging Fourier Transform Spectrometer) advanced sounder under the NASA New Millennium Program and to the initial commitment of NOAA to a similar advanced sounder for GOES-R. Cost-Benefit studies showed that the sounder would contribute about half of the large societal benefit of the new GOES-R system. Unfortunately, perceptions of system development and resource risks have led to decisions delaying implementation of the operational sounder until GOES-T. Unless other actions are taken to acquire advanced sounding data, much of the benefit of the new system for protecting the populace would be delayed for a decade. However, it is not too late; there are options under consideration, Mr. Revercomb said.



Both GIFTS and the sounders designed by three competing industries for GOES-R under the Hyperspectral Environmental Suite (HES) program are capable of providing huge advances over the current GOES sounder. Like the Advanced Baseline Imager (ABI), increases in overall information content by factors of 10 to 100 will be captured. For ABI, the horizontal detail is increased over the current GOES imager by a factor of 4, and temporal coverage rates are increased by a factor of 5, yielding an overall factor of 20 in spatial/temporal resolution. ABI also increases the spectral information content by increasing the number of channels from 5 to 16. However, ABI is still not able to resolve the vertical dimension, even as well as the current GOES system. Vertical resolution is crucial to characterizing atmospheric stability and severe weather. The advanced sounder options would provide a vertical resolution that is three times higher than the current GOES sounder, an advance needed to meet future national and WMO observing requirements. In addition, the sounder options would provide major spatial and temporal advances as needed for compatibility with the new high resolution imaging capabilities of ABI. For example, the GIFTS design offers an overall factor of 100 improvement in spatial and temporal sampling over the current sounder, including its improved vertical resolution. And these sounder options can be provided without inordinate technological or cost risk.

An attractive approach for providing timely sounding data prior to an expected operational implementation on GOES-T is to fly demonstration sounders, Mr. Revercomb said. This option has been recommended by the National Research Council "Decadal Survey" released in January and by the NOAA Analysis of Alternatives following the cancellation of the sounder program for GOES-R. The payoffs of proceeding with sounding as early as possible include: (1) societal benefits that significantly exceed the cost, (2) reduced technical, data handling, and cost risks for the future operational system, and (3) fulfillment of a key U.S. leadership role in the international Global Earth Observations System of Systems (GEOSS). The accomplishments of the GIFTS program under joint NASA and NOAA support make it possible to plan for the first demonstration by as early as 2012. In addition, progress under the HES program lays the groundwork needed to proceed with a prototype of the ultimate operational sounder. Serious priority should be given to planning for demonstrations as soon as possible.

4.2 GOES-R Solar and Space Environment Data Products: Benefiting Users, Steven Hill, NOAA National Weather Service, Boulder, Colorado; and H. J. Singer, T. Onsager, R. Viereck, and D. Biesecker

Steven Hill, NOAA National Weather Service, Boulder, Colorado, said instrumentation on GOES-R to monitor the highly-variable solar and near-Earth space environment continues a long history of space weather observations from the GOES program. These 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.

As space weather users grow and diversify in the coming decade, GOES measurements will provide the critical information enabling progress to be made on new products and services. The emphasis for GOES-R is to maintain continuity with previous observations, but there are also improvements and changes in the measurements. In the presentation Mr. Hill provided an update on the space weather instruments for GOES-R, the products and services that depend on these instruments, and the preparation for new products and services to better support our users.

The GOES-R instruments contributing to forecast services and research data include: the Solar Ultraviolet Imager (SUVI), the Extreme ultraviolet and X-ray Irradiance Suite (EXIS) that will measure solar x-rays and solar EUV radiation; and the energetic particle instruments, called the SEISS (Space Environment In-Situ Suite), which will provide multiple measurements characterizing the charged particle population, including measurements of the electron, proton, and heavy ion fluxes. Finally, Earth's magnetic field will be measured by a magnetometer (MAG) that is part of the spacecraft procurement. The measurements made by these instruments will contribute to the global Earth and Solar observations that are used in NOAA's operations and will provide direct support of users of space weather forecasts.

5. SESSION 4 – Geostationary Satellites as a Part of GEOSS

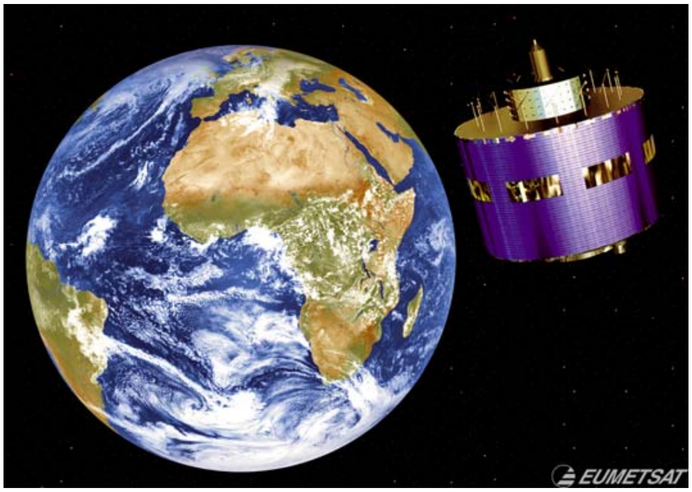
5.1 EUMETSAT's Geostationary Satellites as a Part of GEOSS, Ernst Koenemann, EUMETSAT, Darmstadt, Germany

Mr. Ernst Koenemann, EUMETSAT, said that the European commitment to environmental and climate observations is evolving. The development of the European initiative of Global Monitoring for Environment and Security (GMES) places space-based observations at the heart of future European activities for managing the European environment. GMES is identified as the main European contribution to international initiatives such as the Global Earth Observation System of Systems (GEOSS). EUMETSAT operational satellite systems are key elements of established Space-based observing system coordinated by WMO. EUMETSAT programmes are an essential part or sine-qua-non for a global space-based observing system.

Mr. Koenemann provided the status of the Meteosat program:

- Since February 2007, Meteosat-7 has taken over the IODC (Indian Ocean Data Coverage) Mission from Meteosat-5
- Since April 2007 Meteosat-6 is placed at 67.5° E to support Meteosat-7 during eclipse periods and as a back-up satellite
- Meteosat-7 also supports an International Data Collection System (IDCS)
- In the Indian Ocean and Western Pacific regions the IDCS is used for the relay of Tsunami warning information from currently 30 remotely located Data Collection Platforms
- Meteosat-9 (MSG-2) provides primary service at 0°
- Meteosat-8 (currently at 3.4°) is prepared for rapid scanning service from 9.5°E (starting in 2008)
- The new Rapid Scanning service has a basic repeat cycle of 5 minutes for 1/3 of a full earth scan (15 deg N -> 70 deg N)

Meteosat Second Generation (MSG) is a breakthrough for meteorology. The MSG SEVERI is a 12-channel instrument with 3km sampling distance and 15-minute repeat cycle (5 minutes in rapid scan). Mr. Koenemann showed samples of winds from tracking atmospheric motions, monitoring the onset of convection, better spatial resolution and clearer depiction of cloud tops, and distinguishing snow and clouds. *(Photo shows Meteosat Second Generation satellite)*



For future generation missions, Meteosat Third Generation (MTG), the focus is on numerical weather prediction and nowcasting. Candidate missions are:

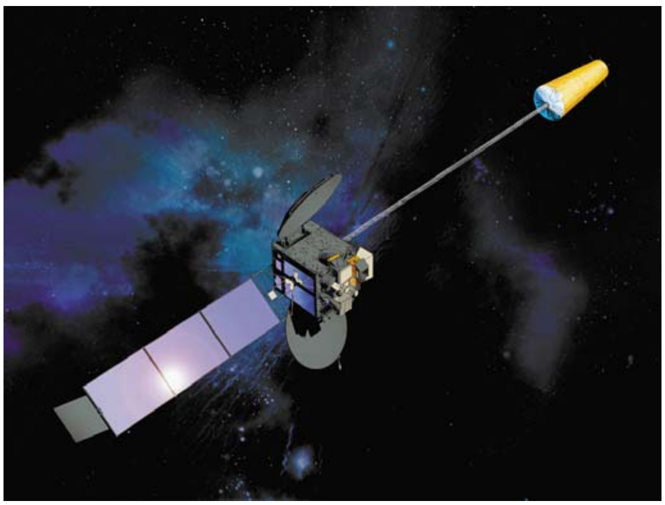
- High Resolution Fast Imagery (HRFI)
- Full Disk High Spectral Imagery (FDHSI) => combined with HRFI
- Infrared Sounding (IRS)
- Lightning Imagery (LI)
- UV-VIS Sounding (UVS)

MTG will provide continuity of EUMETSAT services and innovative observations. For the MTG preparatory program, the following actions have been completed:

- EUMETSAT Council in December 2007 approved MTG Preparatory Programme
- Eighteen Member States voted in favour
- Two countries voted in favour ad referendum (one has lifted the ad ref)
- Entry into Force of the Meteosat Third Generation Preparatory Programme

In conclusion, Mr. Koenemann said, EUMETSAT satellite systems (Meteosat and Metop) are a key element of the operational space-based meteorological observing system in Europe. Continuity and serving the evolving needs of our Member States has highest priority; this will satisfy basic aspirations of the GEOSS. EUMETSAT's Meteosat systems (as the other operational systems) are coordinated within WMO and CGMS (Coordination Group for Meteorological Satellites). International partnership (such as the Joint Polar System of NOAA and EUMETSAT) ensures European contributions to the GOS and GEOSS that are mutually consistent and also cost-effective. Coordination of the planning of geostationary meteorological satellites would be a major leap toward enhanced satisfaction of user needs. Hyperspectral sounders on more than one geo satellite would serve global NWP.

5.2 Plans for Japan's Satellite Program, Toru Hashimoto, Meteorological Satellite Center, Japan Meteorological Agency (MSC/JMA), Tokyo, Japan



Toro Hashimoto, from the Meteorological Satellite Center (MSC) of the Japan Meteorological Agency (JMA), gave a presentation on the current status and future plan of JMA's satellites, including follow-up on its preparatory activities for the follow-on satellite to MTSAT. He discussed the plan on reprocessing the historical data of the GMS series for climate monitoring and diagnostics.

JMA has been operating geostationary satellites at 140 E since 1977. MTSAT-1 has been in operations since 2005; MTSAT-2 is expected to become operational in 2010. HiRiD and WEFAX will be discontinued in 2008. After that, Low Rate Information Transmission (LRIT) and High Rate Information Transmission (HRIT) will be provided for direct broadcast services. The imager on MTSAT-1 has one visible and four infrared channels. Images are provided by the Internet and direct broadcast. The imager on MTSAT-2 will be almost the same as the current imager. (*Photo shows MTSAT-1R.)*

MTSAT provides products that are in four categories: for numerical weather prediction; for cloud monitoring; for ocean/land monitoring; and for environmental monitoring. MTSAT-2 will contribute to HORPEX Pacific Asian Regional Campaign using the rapid scan function. Plans call for MTSAT Follow-on to be launched in 2014 and put into operations in 2015; follow-on #2 is planned for operations in 2022. Sixteen channels are planned; the lifetime of the meteorological mission is seven years.

JMA also plans to reprocess the historical data of the previous geostationary satellite series (GMS series) for use in climate monitoring and diagnosis. The products are: aerosol optical thickness over the sea; land surface albedo; cloud optical thickness; and downward solar flux at surface.

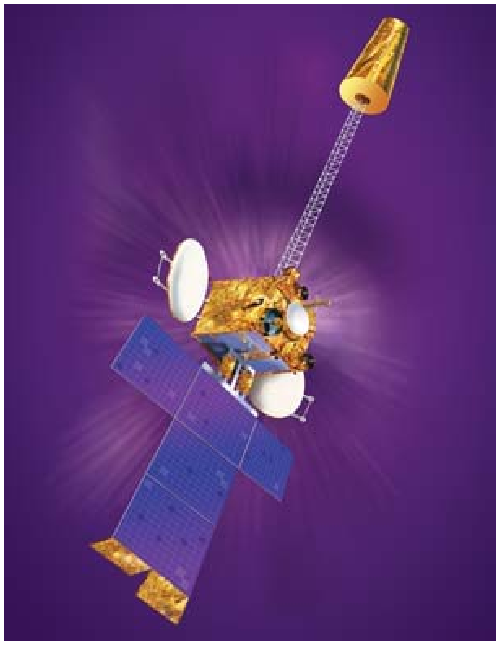
5.3 Indian Meteorological Satellite Missions: Current and Planned, P.C. Joshi, Indian Space Research Organisation, Ahmedabad, India

Dr. P.C. Joshi, Space Applications Center, Indian Space Research Organization, Ahmedabad, India, said many ongoing Indian satellite meteorological missions are useful for the specific observational needs over the tropics. Geostationary missions carry optical sensors, imager and sounder operating in thermal region. Polar orbiters instruments include a microwave radiometer, scatterometer and altimeter.

Two geostationary satellites, Kalpana-1 (74 E) and INSAT-3A (93.5 E), are in orbit. Kalpana -1 and INSAT-3A have a VHRR sensor. INSAT-3A in addition carries a CCD camera with a resolution of 1kmx1km. The meteorological products are being routinely generated from these satellites. The data from METEOSAT-7 over the Indian Ocean region is very useful for validation and inter calibration of the products. The utilization of these products in numerical modeling and regular weather forecasting is significant. (*Photo shows INSAT-3A.)*

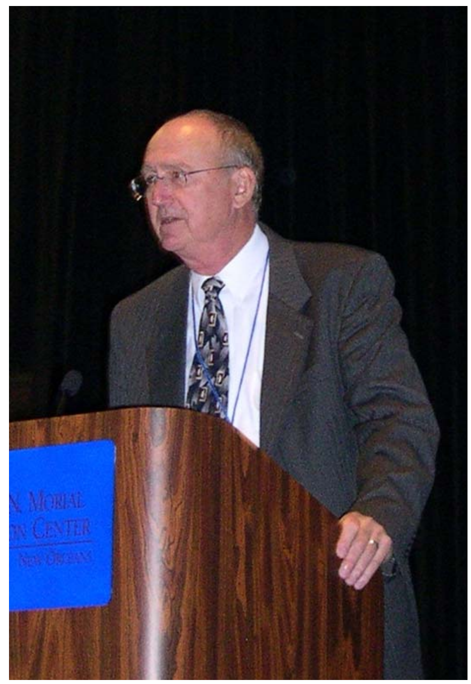
INSAT-3D, to be launched into orbit at 83 E this year, will have a six-channel imager and nineteen-channel sounder for retrieving temperature and humidity profiles over high humidity regions. Suitable algorithms for the retrieval are under investigation. The experience gained with the sounder onboard GOES would be helpful in developing retrieval algorithm. The validation of the retrieved products from the imager along with METEOSAT, GMS, and other satellites is desirable. The accurate parameter retrieval either from the imager or from the sounder essentially depends upon the extent of radiometric and geometric correction applied, calibration, normalization, navigation and earth location of basic pixel data. INSAT-3D is well equipped for these. Follow up satellites of INSAT-3D are being examined. The possibility of the hyper-spectral sounder in particular is being studied.

In the time frame of INSAT-3D, three additional Indian polar orbiting satellites will be available: Oceansat-II (follow up of Oceansat-1), Megha-Tropiques and SARAL. The OCEANSAT-2 satellite will be carrying a Ku-band scatterometer similar to Quikscat and an Ocean Colour Monitor (OCM). The retrieval algorithms for OCEANSAT-II are at advanced stages of development. The Megha-Tropiques (MT) satellite (a joint Indo-French mission) is designed to study how the water cycle affects atmospheric climate processes over the tropics. It will carry three payloads: MADRAS, a microwave imager operating in the frequency range from 19 to 85 GHz for measuring rain, atmospheric water vapor content, liquid water content and ocean surface wind speed; SAPHIR, a multi-channel microwave sounder operating at 183 GHz to measure vertical profiles of atmospheric humidity over land and ocean and; ScaRab, operating in the optical region for estimating earth radiation budget over tropical convective region. Both Oceansat-II and Megha-



Tropiques will additionally be equipped for GPS based radio-occultation measurements. SARAL, a polar-orbiting satellite, will carry a Ka band altimeter. The satellite is slated for launch in 2009. Other Indian Earth Observing Satellites for resources (called the IRS-series) operationally provide many land surface parameters useful for weather/climate modeling. All the missions have strong operational and research and development components.

5.4 Plans for China's Satellite Program, James F.W. Purdom, PhD, Senior Research Scientist, CIRA, Colorado State University, and Chair, Open Program Area Group on Integrated Observing Systems, World Meteorological Organization, Geneva



Plans for China's satellite program were described by Dr. James F. W. Purdom, Senior Research Scientist, CIRA, Colorado State University, and Chair, Open Program Area Group on Integrated Observing Systems, World Meteorological Organization, Geneva. Dr. Purdom spoke on behalf of Wenjian Zhang, and Jun Yang, both of the China Meteorological Administration.

FY 2 is at 86.5 E, and another FY 2 is at 105 E. Future geostationary satellites will carry an imager, sounder lightning sensor, and a high resolution CCD. With FY2, the Chinese have gone into dual operation. Two geostationary satellites take 96 images daily during the flooding season. Movies are made over China at 15-minute intervals.

A totally new ground segment has been established and put into operation since the FY-2C launch. More than 20 products for FY-2C have been developed, validated, and tested. Major products include: rainfall estimation, OLR, TBB, cloud motion vector, cloud amount, total precipitation water, moisture profile, cloud classification, fog, fire, sea ice, snow wetness, and snow cover. The products are delivered to 2441 Very Small Aperture Terminal (VSAT) users, which can acquire near real time FY-2C data by re-transmitting through the communications satellite. The FENGYUN broadcast system is being developed to send out data to a wide area.

FY-2E is planned for launch in November 2008; FY-2F in October 2010; and FY-2G in October 2012. There is a two-satellite configuration. This will enhance the observation capability and meet the WMO contingency strategy requirements. The next generation of geostationary satellites is the FY-4. These satellites will be used for research and development, then enter into operations in 2016 and beyond. The main payloads are: imaging radiometer; CCD imager; infrared sounder; lightning mapper; solar X-ray imager; and space environment monitor suite.

Various products are used for typhoon monitoring, and various visualization tools are available. Dr. Purdom showed various examples of these and said that a large part of the future is GEO microwave. Dr. Purdom showed a slide of the various satellites serving the Eastern Hemisphere and noted that geostationary satellites offer a marvelous chance for international cooperation and special imaging.

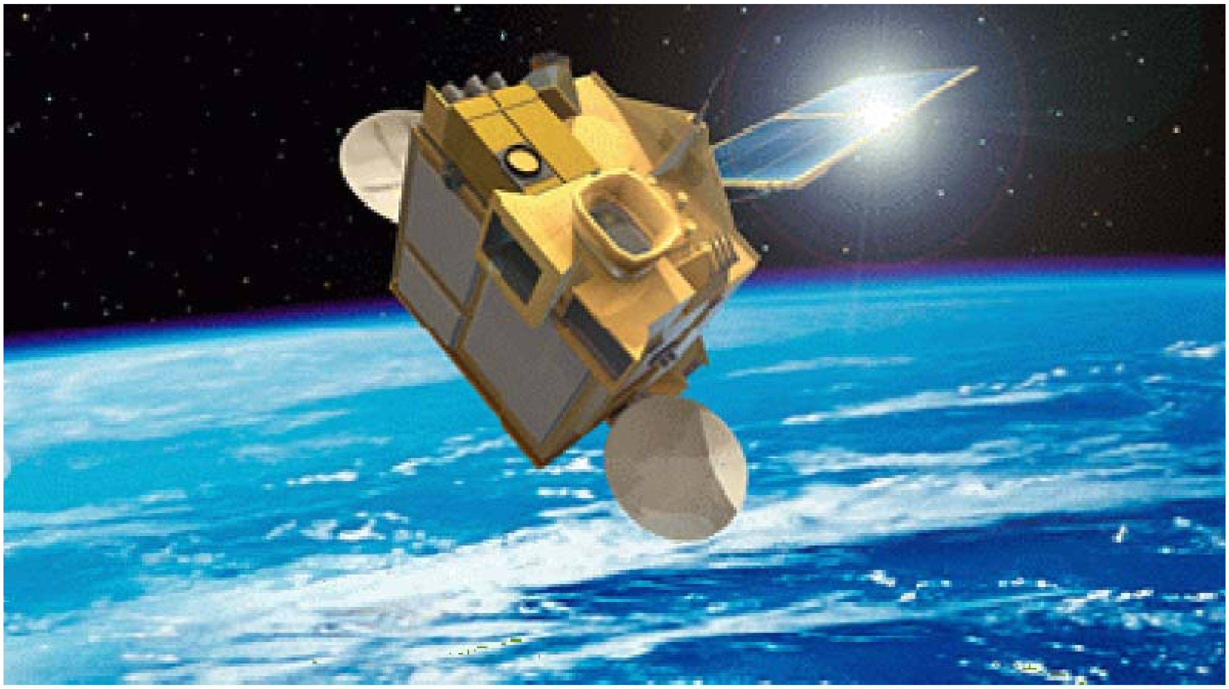
5.5 Plans for Russia's Satellite Program, James F.W. Purdom, PhD, Senior Research Scientist, CIRA, Colorado State University, and Chair, Open Program Area Group on Integrated Observing Systems, World Meteorological Organization, Geneva

Dr. James F.W. Purdom, Senior Research Scientist, CIRA, Colorado State University, and Chair, Open Program Area Group on Integrated Observing Systems, World Meteorological Organization, Geneva, discussed plans for Russia's satellite program. The Russian Federation's missions to the future include Hyperspectral IR, synthetic aperture radar, and new initiatives. The Russian Federation is planning launch the Electro satellite. Electro-L, to be launched in 2010, will have a five-channel imager. It will be placed into goestationary orbit at 76 East. A second GOMS satellite is planned for 2012. The satellite will be three-axis stabilized.

The Molniya orbit possibility is being studied. This is a highly elliptical orbit and would provide monitoring of the Arctic region. The satellite would move low and fast over the Southern Hemisphere, then slow as it moves across apogee in the Northern Hemisphere, allowing for about eight hours of good viewing per orbit. The WMO is planning workshops to study this orbit.

5.6 Plans for Korea's Satellite Program, Dr. Ae-Sook Suh, Director of Meteorological Satellite Division, Korea Meteorological Administration, Seoul, South Korea

Dr. Ae-Sook Suh, Director of Meteorological Satellite Division, Korea Meteorological Administration, gave an overview of KMA's current status of Korea's first meteorological satellite, the Communication, Ocean, Meteorological Satellite (COMS), which is scheduled to be launched in June 2009. COMS is being developed by the Korean government agencies based on the National Long-term Space Development Plan of Korea: Ministry of Science and Technology, Ministry of Information and Communication, Ministry of Maritime Affairs and Fisheries; and the Korean Meteorological Administration.



COMS 2009, Korea's first meteorological satellite

COMS will have three missions: weather monitoring, ocean monitoring, and satellite communications. COMS is a geostationary satellite with a design life time of 10 years, and an operational life time of 7.7 years after launch. It will carry a meteorological imager, a geostationary ocean color imager, and an infrared earth sensor, and communications equipment. It will be launched on an Ariane rocket from Guiana Space Center, Kourou, into an orbit at 128.2E. It will provide full disc imagery every three hours, Northern Hemisphere every 30 minutes, and East Asia every 15 minutes. In cases of severe weather, it will image the Korean Peninsula every eight minutes. Products from the MI imager will be provided free of charge to end-users around the world.

In addition to COMS, the COMS follow-on satellite program is scheduled to begin in 2010, and to be launched in 2015. The preliminary study for meteorological mission of the follow-on satellite was finished in the end of 2007 and will have a high performance meteorological payload of the next generation satellite.

The first COMS training course was held in 2007. Thirteen persons from 13 countries in the Asian-Pacific area attended. The training course will be offered every year, and this year will be open in October. The First COMS International Users' Conference is planned for late 2010.

6. SESSION 5 – GOES Data Products and Instrument Operations I

6.1 Recommendations from the Fourth GOES Users' Conference, James J. Gurka, NOAA Satellite and Information Service, GOES-R Program Office, Greenbelt, MD; and T. J. Schmit, T. Mostek, T. Renkevens, and D. Reynolds

James J. Gurka, NOAA Satellite and Information Service, GOES-R Program Office, said there has been much input for the GOES- R program, and it has helped in the evolution of GOES-R. He encouraged attendees to continue to provide input and feedback. Before society can reap the benefits of the improved capabilities of the GOES-R series, NOAA first faces the challenge to ensure that the user communities are ready to receive and use the information immediately following the start of operations. Issues to be resolved include: the processing and distribution of vast amounts of data and products; algorithm development and refinement for producing and analyzing products; development of automated decision aids to help users sort through the vast amount of information available for each specific analysis or forecast problem; user education on the use of data and products much more complex than from the current GOES series; and data and product archiving.

Users must be ready to use the data on Day 1. NOAA has received recommendations to make this happen. Mr. Gurka described the recommendations from previous conferences, and provided updates on the recommendations. NOAA has been following the path to user readiness through the GOES Users' Conferences. The most recent user conference was held in May of 2006 in Broomfield, Colorado. The more than 350 participants provided numerous valuable recommendations on how to ensure that the user communities will be ready at the start of GOES-R operations.

One recurring recommendation is for the development of at least three GOES-R Proving Grounds at National Weather Service Forecast Offices (WFOs). NOAA's Satellite and Information Service plans to follow through with this recommendation by providing experts at each of these (to be determined) sites to test and apply algorithms and decision aid tools for present generation GOES products, simulated GOES-R products and proxy GOES-R products. Algorithms will be tested in real time and post event, with data from available operational and research satellites. Input will be provided by the WFO staffs to refine requirements for algorithms, decision aids, display techniques, and concept of operations. Mr. Gurka described the proving ground concept along with numerous additional user recommendations for user readiness, including user education and training, decision aids, and data archiving.

Mr. Gurka provided information on the impact of GOES Users' conferences. Before the conferences, the notional baseline included an 8-channel imager, 15 minute full disk coverage, no lightning mapper, and no onboard VIS calibration. In May 2004, the notional baseline was a 16-channel imager, 5-minute full disk coverage, lightning mapper, and VIS calibration. He gave an update on other recommendations and explained actions that have taken place in response to the recommendations.

6.2 GOES-R User Requirements Change Process, Barbara B. Pfarr, W. Mazur and M. Todirita representing GOES-R Program Systems Engineering, Greenbelt, Maryland

Barbara B. Pfarr, the NASA Lead for GOES-R Program Systems Engineering, said NOAA is in final preparations for the procurement of the next-generation GOES satellites and Ground system. The fundamental requirements for GOES-R have evolved and been refined since the process of mission definition began in 1999 with the issuance of NWS's Operational Requirements Document. Since that time, Government contracted studies, four previous GOES User Conferences, and most recently a comprehensive "Program Development and Risk Reduction" effort with industry, has led to the current requirements baseline that is the foundation of the new system to be procured.

The most fundamental requirements for the system are now defined in the GOES-R Level 1 Requirements Document (LIRD). The LIRD is a selected subset of NOAA's Consolidated Observational Requirements List (CORL). Changes to the LIRD are reviewed by the NOAA Program Management Council, the NOAA Observing System Council (NOSC), and the GOES-R Operational Requirements Working Group (GORWG). Changes to the LIRD must ultimately be approved by the NOAA Deputy Under Secretary, who must ensure that the system is in tune with NOAA's priorities and at the same time must ensure the system remains affordable.

While the LIRD defines "what" the system should do, the Level-2 requirements document, the "Mission Requirements Document (MRD)," defines the "how". It allocates functions between the Flight Segment and the Ground Segment and specifies performance requirements needed to meet the LIRD objectives. The requirements are further broken down into detailed functional and performance specifications ("Level-3") which are issued to industry to propose and implement solutions for the various elements of the system.

Most of the top priorities from 1999 are still in existence: operation of sensors through eclipse; removing conflicts among climatic, synoptic, and mesoscale imaging requirements; and improved time and spatial resolution for the imaging sensor.

Although the requirements are temporarily frozen, while the procurements are underway, changes to the requirements will still be necessary in the future. One obvious reason will be the continuing development of new and better products that use the current satellite series, which must be continued in the GOES-R era. These are called "new legacy products."

Ms. Pfarr then described the process by which Users identify and request changes to the GOES-R requirements. Formal requests are validated by at least one NOAA Line or Program office and entered into the NOAA CORL. The value and feasibility of producing the products is evaluated by the GORWG. The NOSC is responsible for ultimately approving the change to the LIRD and also for finding the money necessary to implement it.

Bill Mazur then walked the group through one representative change that is currently in progress--the proposed growth in the capacity for the EMWIN and LRIT communication services. Currently both services use dedicated transponders on both the East and West satellites. Both communities want to increase their data rate. The proposed solution is to combine the data streams for both services to share a single transponder at a combined data rate that satisfies both communities' growth needs. Mr. Mazur presented the benefits and challenges of this change. Since a new user receiver will be necessary, the GOES-R program plans to demonstrate a prototype very low cost combined-EMWIN/LRIT receiver based on Software Defined Radio techniques.

Mr. Mazur indicated that additional details on the EMWIN/LRIT receiver and other GOES-R Direct Broadcast services will be available at the next NOAA-sponsored Direct Readout Users Conference scheduled for December 2008 in Miami.

6.3 GOES-R Products and Implementation Schedule, Thomas Renkevens, NOAA Satellite and Information Service, GOES-R Program Office, Greenbelt, Maryland

Thomas Renkevens, NOAA Satellite and Information Service, GOES-R Program Office, Greenbelt, Maryland, provided an overview of the new and improved GOES-R product suite and the planned operational implementation schedule. He provided an update on current GOES operations. GOES-13 is currently on orbit standby. Slides depicted the GOES-13 improved navigation and radiometrics; and GOES-O improved spatial resolution of the 13.3 µm band. GOES-O is planned for launch in late 2008.

Significant improvements are planned for the current suite of GOES-I/M re-broadcast data (GVAR), cloud and moisture imagery and quantitative products.

The launch of the first in a series of next generation GOES-R geostationary satellites is planned for 2015. New instruments include the Advanced Baseline Imager (ABI), a Geostationary Lightning Mapper (GLM) and various space and solar instruments. These will provide increased accuracy at higher spatial and temporal resolution of the atmosphere, land, ocean, climate, space and solar environments.

The ABI is capable of providing full disk coverage at five minute intervals, and increased spatial resolution of 2km for the infrared bands and 0.5km for the visible band. The GLM will monitor global lightning strikes, while the solar and space environments will be observed by the Solar Ultra Violet Imagery (SUVI), Extreme Ultra Violet Sensor / X-Ray Sensor (EXIS), the Space Environment In-Situ Suite (SEISS) and the GOES-R Magnetometer (MAG).

The GOES-R products will include aerosol detection (including smoke and dust), geomagnetic field, and surface albedo. Although there will be no sounder onboard GOES-R, there will be much improved spatial coverage with ABI.

Mr. Renkevens showed product demonstrations of the ABI scan loop. Total precipitation water and lifted index were shown. In summary, Mr. Renkevens said that the great amount of information from the GOES-R will offer a continuation of current products and new products. The ABI along with the GLM will enable much improved monitoring of Earth compared with current capabilities. The space and solar instruments will improve monitoring of the Earth and solar environments.

6.4 NOAA/NESDIS GOES-R Algorithm Working Group (AWG) and its Role in the Development and Readiness of GOES-R Product Algorithms, Mitchell D. Goldberg, NOAA's Satellite and Information Service, Office of Research, Camp Springs, MD; and J. Daniels

Mitchell D. Goldberg, NOAA's Satellite and Information Service, Office of Research, said that for the next-generation of GOES-R instruments to meet stated performance requirements, state-of-the-art algorithms will be needed to convert raw instrument data to calibrated radiances and derived geophysical parameters (atmosphere, land, ocean, and space weather). The GOES-R Program Office (GPO) assigned the NOAA/NESDIS Center for Satellite Research and Applications (STAR) the responsibility for technical leadership and management of GOES-R algorithm development, and calibration and validation. STAR responded with the creation of the GOES-R Algorithm Working Group (AWG) to manage and coordinate development and calibration/validation activities for GOES-R proxy data and geophysical product algorithms. The AWG consists of 15 application teams that bring expertise in product algorithms that span atmospheric, land, oceanic, and space weather disciplines. There are about 100 scientists from NOAA, NASA, DoD, EPA, and the cooperative institutes working together. Each AWG team will leverage science developments from the GOES-R Risk Reduction Program, potential scientific algorithms from other communities (other government agencies, universities and industry), and heritage approaches from current operational GOES and POES product systems. All algorithms will be demonstrated and validated in a scalable operational demonstration environment. All software developed by the AWG will adhere to new standards established within NOAA/NESDIS. The AWG Algorithm Integration Team (AIT) has the responsibility for establishing the system framework, integrating the product software from each team into this framework, enforcing the established software development standards, and preparing system deliveries to the GOES-R Ground System contractor.

The AWG will deliver an Algorithm Theoretical Basis Document (ATBD) for each GOES-R geophysical product as well as Delivered Algorithm Packages (DAPs) to the GPO. The DAPs will include pre-operational algorithm source code, related software development files such as program scripts, make files, and process control files; software and installation documentation, software tool kits required for compilation (NetCDF, HDF, etc.); proxy (simulated input/output) test data sets; coefficient files; and test programs/test information including test descriptions, plans and procedures, and performance testing results.

Mr. Goldberg said, in summary, the team has extensive experience. They have developed the algorithms for NOAA's satellite programs since their inception over 40 years ago. They are knowledgeable. They understand how to calibrate, validate and verify algorithms using techniques appropriate for instrument, product, and spectral characteristics. The system is efficient – capable of generating proxy data sets for all GOES-R instruments for use in program activities. The team is coordinated: they will develop, host, demonstrate, document, and deliver algorithms to meet program specifications. They are consistent and on track.

6.5 GOES-R Ground Segment Overview, Robin Pfister, NASA, GOES-R Program Office, Greenbelt, MD

The next generation GOES-R geostationary satellite series first launch is planned for 2015. GOES-R will host a multispectral imager, a lightning mapper and various space and solar instruments, all directed at acquiring significantly more information on the atmosphere, land, ocean, space and solar environments. The time scales for the products and applications include nowcasting, forecasting, and climatic regimes.

The GOES-R Ground Segment organization continues to work with various partners within NOAA to develop the ground solution for the next generation GOES-R series mission. The approach involves inputs from the groups who will operate and use the GOES-R systems and data to ensure a timely and smooth transition to operations. Over the past year, the ground segment team has analyzed trade studies and made decisions that will guide NOAA's partnerships, including the eventual selected acquisition and operations vendor, to a successful system that will meet end user needs.

Ms. Pfister described GOES-R improvements, and said that the large increase in spatial, spectral, and temporal resolution of the ABI increases the data volume and drives a large increase in ground system processing requirements for product generation and for distribution of products to users.

The ground segment objectives are to:

- Support the primary mission operations goals to safely launch and operate the GOES-R series spacecraft.
- Design, develop, integrate, and test the ground segment in a manner that minimizes costs.
- Minimize the impact to existing users during the transition to GOES-R services.
- Provide cost-effective ground segment sustainment and maintenance once transitioned to government operations.
- Provide cost-effective and timely solutions to meet GOES-R evolving ground segment requirements through the application of open standards, modular, scalable, flexible system design and development and the application of industry standard system and software engineering practices.
- Maintain compatibility with existing and enhanced versions of NOAA institutional systems required to support the GOES-R series spacecraft.

Ms. Pfister showed a notional functional overview of the GOES-R ground segment. Additional capabilities include improved user services for direct readout users. The user impacts involve GVAR to GRB changes; LRIT and EMWIN data rate increases; OSDPD access will be similar; AWIPS and NOAAPORT will need to change in order to accept and disseminate higher data rates; and Web sites will need to change in order to display higher temporal, spatial, and spectral data. The GOES-R ground segment is developing a user readiness plan. The final RFP is planned for April 2008.

7. SESSION 6 – GOES Data Products and Instrument Operations II

7.1 Rapid Scan Operations for GOES, Cynthia Hampton and Christopher Wheeler, NOAA Satellite and Information Service, Office of Satellite Operations, Suitland, Maryland, and Brian Hughes, Office of Satellite Data Processing and Distribution

Christopher Wheeler, NOAA Satellite and Information Service, Office of Satellite Operations, Suitland, Maryland, discussed GOES rapid scan operations. When severe weather conditions develop the need to monitor changes in weather patterns and make real-time decisions intensify, the GOES spacecraft provides the ability to monitor these critical conditions. Rapid Scan Operations (RSO) and Super Rapid Scan Operations (SRSO) are special GOES imaging schedules that can be requested by National Weather Service (NWS) office and other government agencies to monitor and track mesoscale phenomena such as hurricanes, severe storms, smoke tracking from large wildfires or explosions, tracking of hazardous airborne materials and volcanic ash eruptions. RSO and SRSO also provide input into derived level 2 products such as mesoscale wind analysis and hurricane eyewall development. RSO and SRSO schedules provide images at 7.5-minute intervals (RSO) and at 1-minute intervals (SRSO).

GOES N-P feature an on-board schedule that allows for execution of multiple, unrelated functions. A ground schedule runs on the ground in "shadow" mode to verify on-board command execution. The schedule can be executed from the ground, similar to GOES-I-M. There are four types of schedules: routine, rapid scan, super-rapid scan, and full-disk. Schedules consist of commands for imaging, image navigation, and special operations.

Mr. Wheeler discussed the behind the scenes operations concept for requesting and implementing RSO/SRSO requests within GOES satellite operations from the NWS to the satellite operators sending the commands to the spacecraft. He provided a comparison between the GOES-I-M series RSO operations concept and GOES NOP. Mr. Wheeler provided examples of the scientific value of RSO coverage along with the tradeoffs of getting a reduced imaged area while in RSO.

7.2 Future GOES-R Instrument Operations – Capabilities and Constraints, Tim Walsh, NOAA Satellite and Information Service, GOES-R Program Office, Greenbelt, Maryland; and T. J. Schmit

Tim Walsh, NOAA Satellite and Information Service, GOES-R Program Office, Greenbelt, Maryland, described the GOES-R instrument suite, changes since the last GOES Users' Conference, ABI imaging scenarios, other instrument operations, and instrument interface outages.

The GOES-R satellite instrument payload will include the Advanced Baseline Imager (ABI), Geostationary Lightning Mapper (GLM), Solar extreme UV Imager (SUVI), EUVS/XRS Irradiance Sensors (EXIS), Space Environment In-Situ Suite (SEISS), and Magnetometers. Together, these instruments will monitor a wide range of phenomena, including measurements of the earth, solar and geostationary-orbit in-situ environments.

The Geostationary Lightning Mapper (GLM) will complement today's operational ground based lightning detection systems, which only provide information on cloud to ground strikes over land, with information on total lightning flash rate (including both cloud to cloud and cloud to ground), over both land and adjacent oceans. The GLM will provide nearly continuous information on lightning flash rates, leading to improved severe thunderstorm forecasts and warnings, aviation weather services, and lightning climatology.

The solar pointed instruments (SUVI and EXIS) and geostationary-orbit in-situ measurement instruments (SEISS and Magnetometer), will monitor the highly-variable solar and near-Earth space environment. These observations are used to protect life and property of those sensitive to solar and space weather fluctuations.

The Advanced Baseline Imager (ABI) is a state of the art, 16-band imager covering 6 visible (VIS) to near-infrared (NIR) bands, and 10 infrared (IR) bands. Spatial resolutions are band dependent, 0.5 km at nadir for broadband VIS, 1.0 km for NIR and 2.0 km for IR. The ABI will be capable of scanning the Full Disk (FD) in approximately 5 minutes. ABI will improve every product from the current GOES Imager and will introduce a host of new products. The atmospheric sounding capability for GOES-R and -S satellites will be one of continuity-only, provided by the ABI instrument.

Since the last GOES Users' Conference, the following changes have taken place:

- Five instruments are in implementation
- ABI is a year past CDR
- HES is no longer a part of the instrument manifest
- Instrument interfaces are mature
- The spacecraft implementation RFP release is imminent.

Mr. Walsh presented an ABI data collection summary that described scene definitions (what to collect) and timelines (when and how to collect scenes) in the context of anticipated GOES-R operations. The current GOES-I-P imager was compared to the next generation ABI, including spectral, spatial and temporal differences, operational complexity, and scene targeting. SUVI, GLM, EXIS and SEISS normal operational activities were also briefly discussed. Future targeting and operational plans for the GOES-R instruments will be discussed with the user community via the GOES-R Operational Requirements Working Group.

8. Panel Discussions

8.1 Future Operations Panel

Panelists: Joseph T. Schaefer, NOAA/NWS/NCEP/SPC, Norman, Oklahoma; Christopher B. Darden, NOAA/NWS, Huntsville, Alabama; Bob Breck, WVUE-TV, New Orleans, Louisiana; Christopher Velden, CIMSS/Univ. of Wisconsin, Madison, Wisconsin; Lars Peter Riishojgaard, Director of the Joint Center for Satellite Data Assimilation, Camp Springs,Maryland; John McMillen, AFWA/A5RS, Offutt AFB, Nebraska

Moderator: Thomas M. Renkevens, NOAA/NESDIS/GOES-R, Greenbelt, Maryland

Moderator Thomas M. Renkevens introduced the panelists. Each panelist described his use of GOES data, challenges and opportunities of GOES-R.

Future Operations Panel

Joseph T. Schaefer, NOAA/NWS/NCEP/SPC, Norman, Oklahoma, said that the Storm Prediction Center (SPC) relies heavily on GOES imagery – water vapor, IR, and visible. They view the imagery as loops ranging from several hours of data to about 24 hours in length. Current rapid scan is not used all that much because the breaks in coverage make looping the imagery impossible. Similarly, cloud contamination limits the availability of sounder data in on-going weather episodes. Hence satellite derived soundings are not relied on by SPC forecasters. In contrast, blended spectral products such as fog, low clouds (i.e., black stratus), fire monitoring (ABBA), volcanic ash, and total precipitable water are used widely. The future will see SPC forecasters running up to four or five loops made from one-minute data. Derived products such as cloud particles, multispectral images will be analyzed. The GLM, which has potential for increasing lead time for watches, will receive heavy use from the SPC forecasters.

The Hazardous Weather Test-bed will continue looking at new ways to use GOES data in operations. For instance this summer, we will be working with Danny Rosenfeld from the Hebrew University of Jerusalem and his colleagues in using GOES spectral data to identify the vertical distribution of mean droplet size in growing clouds. It is postulated that vertical profiles featuring droplet sizes that are nearly constant with height identify areas capable of producing storms with strong updrafts and thus identify areas with high severe weather potential. In response to a question, Mr. Schaefer said it is beneficial to make forecasters familiar with new datasets, so that they know that the data has value for them before it becomes part of the operational data stream. The key is to get new data types available to the forecasters as early as possible. This can be done with forecast test beds, or proving grounds.

Christopher B. Darden, NOAA/NWS, Huntsville, Alabama, said that the mission of the NWS is to protect lives and property. Key to this is lead time and accurate warnings. We have seen an explosion of technology with computers and modeling. Doppler radars and other diagnostic tools provided additional data. Mr. Darden's group has worked with various colleagues at NASA and other agencies to study satellite and other unique remote sensing data from various sources. The forecasters like MODIS data as more details are available. Data from ground based lightning sensors also provide valuable input to the warning decision making process. The next generation of GOES is very exciting.

Bob Breck, WVUE-TV, New Orleans, Lousiana, said he issues warnings when he receives them from the NWS. The majority of the people in his audience have a sixth grade science education. When they see color enhanced imagery, they are interested, but don't know exactly what the data mean. He sees himself as a story teller, to interpret the data. He tries to stay current, but has some apprehension about the future. He said the ability to animate satellite imagery now greatly enhances the public's understanding of how the weather moves plus, thanks to color enhancement, clearly indicates increasing or decreasing storm intensity. He remembers Hurricane Camille, and the perception that the public had was that the danger was not that great. When Camille was rapidly intensifying, it wasn't readily visible. In contrast, when Katrina was coming, the perception that we gave of the danger is so much better. Yet, over 1000 people died. What went wrong? Ninety-two percent of the people evacuated; eight percent did not. One or two percent could not get out. We need to reach the people who did not evacuate. Mr. Breck is excited about the future, but will retire before GOES-R is launched. In response to a question, he said that he gets five minutes for his late weather forecast. He has time to explain the imagery; therefore, his viewers understand what water vapor imagery is, for example. Other weather forecasters may not have as much time to explain the imagery. Mr. Breck said that satellite imagery has come a long way during his nearly 40 year broadcasting career, and he is excited to see where the future takes us.

Lars Peter Riishojgaard, Director of the Joint Center for Satellite Data Assimilation, Camp Springs, Maryland, is at the interface between the data and the weather prediction. Satellite data is now well incorporated into the numerical weather prediction, and is largely responsible for its success. The center is using the polar data well. The visible and infrared imagery of GOES are absolutely compelling. He said that the paradox is that we have not been able to translate that into NWP benefits as well as we have the polar data. We expect great things from GOES-R, especially from the ABI, with better calibration, and better temporal resolution. A big part of the challenge is with R&D in the NWP community – to make use of the geostationary data to the same extent as we have with the polar data. In response to a question, he said that we in the NWP community would like to have access to the data as soon as possible after launch.

Christopher Velden, Senior Research Scientist, CIMSS/University of Wisconsin, Madison, Wisconsin, focused on GOES-R algorithm development. Mr. Velden's group creates derived products from imagery, with a focus on applications, and getting research products into operations. "We are hitting a plateau with the current GOES products; it is getting harder and harder to extract something novel and new. We look forward to the GOES-R data so that we can be innovative again." Mr. Velden said he is a strong proponent of rapid scans, and is very eager to see the routine 5-min data from GOES-R. He also stressed there should be no delay from the time GOES-R is launched to the time the data are made available to users and researchers (after the normal cal/val checkout period). In response to an audience question, he said there will be overlap with the old and new satellites, and they will use that overlap to tune and validate newly developed algorithms/products.

Captain John McMillen, AFWA/A5RS, Offutt AFB, Nebraska, described Air Force Weather, which is charged with global environmental characterization for the U.S. Air Force, Army, and the intelligence agency. Air Force Weather Agency's First Weather Group is responsible for Air Force weather forecasting for the continental United States. The Second Weather Group provides numerical weather prediction, intelligence community support, and space weather forecasting. AFWA provides backup operations for several NOAA operations, including the Storm Prediction Center, Aviation Weather Center, National Volcanic Ash Advisory Center, Environmental Modeling Center, and the Space Environment Center.

AFWA's mission is focused on combat decision makers and deployed forces. The forecasts are mission-specific rather than wide-area, general forecasts. The main concern is the impact to the mission. AFWA expects significant improvement in Numerical Weather Prediction accuracy with dramatic increase in available vertical channel data AFWA will use the planned GOES-R Environmental Data Records: GOES Lightning Mapper; Space Weather: Space Environment In-Situ Suite; Solar Instrument Suite; Magnetometer; Rapid Scan Winds – Improved tropical storm fixing. In response to a question, he said we are moving into an NPP, NPOESS, and GOES-R era. It would be beneficial to receive the data products and the new formats with some lead time.

8.2 International User Panel on Lessons Learned from Current GOES Including GOES-10 and Implications for GOES-R Preparations

Panelists: Luiz Machado, National Space Research Institute, São José dos Campos, Brazil; Marcelo Colazo, National Commission for Space Activities (CONAE), Buenos Aires, Argentina; David Grimes, MSC, Ottawa, Canada; Paulo Manso, National Meteorological Institute, San José, Costa Rica

Moderator: Dr. Donald E. Hinsman, WMO, Geneva Switzerland

Moderator Dr. Donald E. Hinsman, WMO, Geneva, Switzerland, introduced the panelists. He said countries in the Western Hemisphere are using GOES data to the maximum.

Luiz Machado, National Space Research Institute, São José dos Campos, Brazil, presented information on how Brazil is using GOES-10. After GOES-10 was moved to 60 W, there are images each 15 minutes. Facilities in Brazil include the Center for Weather Forecast and Climatic Studies of the National Institute of Space Research, and numerous satellite reception stations. At Cuiaba there is a NOAA HRPT reception station, as well as Aqua and Terra stations. At Cachoeira Paulista, there are NOAA HRPT stations, GOES GVAR, EumetCast/MSG-HRIT SEVIRI stations. Mr. Machado showed the Institute's Website, which features imagery from GOES-10, as well as GOES-10 imagery combined with imager from Meteosat MSG. The Website is accessed around 300,000 times per month. The site features a wide variety of GOES-10 products, including precipitation, winds, visible, water vapor, infrared imagery, fire products, lightning, and sounding data and products. All these products are available on line in real time. GOERS-R future products include the vegetation index Continental surface temperature and cloud microphysics. GOES-R will improve all of the products.

Marcelo Colazo, National Commission for Space Activities (CONAE), Buenos Aires, Argentina, spoke about GOES-10 reception and processing. In December 2006, there was a transition from GOES-12 to GOES-10. Standard products from GOES-10 are available on CONAE's Website. Level 2 products are generated and catalogued. More than 1000 specific products are generated and delivered to the Argentine Meteorological Service daily. In July 2007, the reception was moved to a tracking antenna. In January 2008 two new tracking antennas were installed at the ground station for a redundant GOES-10 and GOES-12 reception system. Mr. Colazo showed various images, including visible, infrared, CTT and water vapor.

David Grimes, Assistant Deputy Minister, Meteorological Service of Canada, Environment Canada, Ottawa, Canada, said there is training in place for weather users of GOES-R data, as well as non-weather users. Users are key and must be engaged early in the process. Interdisciplinary workshops have been held and various applications have been developed. In some cases, scientists from diverse disciplines are trained in the use of these data, for example, wetlands scientists. In some cases, derived products are developed and used. Canada also has established a close collaborative working relationship with the COMET program. To ingest GOES data, Canada has developed a diagnostic tool that also enables users to access, process and quality assure meteorological data. Canada has passed onto NOAA some questions about the calibration of the GOES sounder.

Paulo Manso, National Meteorological Institute, San José, Costa Rica, said WMO's training center in Costa Rica has pioneered a virtual laboratory for education and training in the use of satellite information for meteorological applications. WMO has capitalized on this and other centers to "train the trainers" and maximize the use of satellite data, products and services. Linked together through the Internet and a virtual resource library, the virtual laboratory provides WMO Members with the possibility of continuous education and training.

9. GOES-R Users' Forum I

9.1 Hurricane intensity changes associated with the Gulf of Mexico Loop Current and Eddies using GOES sea surface temperatures and satellite altimetry, Dr. Nan D. Walker, Louisiana State University, Baton Rouge, Louisiana; and R. R. Leben, S. Balasubramanian, C. Pilley, and A. Haag

Dr. Nan D. Walker, Louisiana State University, Baton Rouge, Louisiana, said that hurricane track forecasting has improved steadily over the past three decades whereas the forecasting of hurricane intensity changes has not, due mainly to insufficient real-time oceanic and atmospheric information. Dr. Walker and her team investigated the intensity changes of recent hurricanes (Ivan, Katrina and Rita) during crossings of the Gulf of Mexico and relationships with the Loop Current, detached warm core rings, and cold core eddies. Their primary goal was to assess the role that real-time satellite measurements can play in providing better predictor variables for hurricane intensity changes.

GOES-E satellite measurements were used to quantify sea surface temperature changes resulting from ocean to atmosphere heat and moisture fluxes, caused mainly by hurricane winds. Sea surface height measurements were used to identify distinct water masses as the surface temperature structure can be quite uniform across the Gulf during summer, reducing ocean feature detection before hurricane passages. Sea surface temperatures (SSTs) were computed from the mid-infrared channel (3.5-3.9 micron) of GOES GVAR using night-time data only. The major advantage of using GOES GVAR data in oceanography is its high frequency repeat coverage (every 15 minutes over the Gulf) which enables removal of much water vapor and cloud contamination through the use of the warmest pixel compositing technique on a series of night-time images. Satellite altimetry measurements provide the only remote sensing technique that directly measures a dynamic variable of ocean state - the sea surface height (SSH).

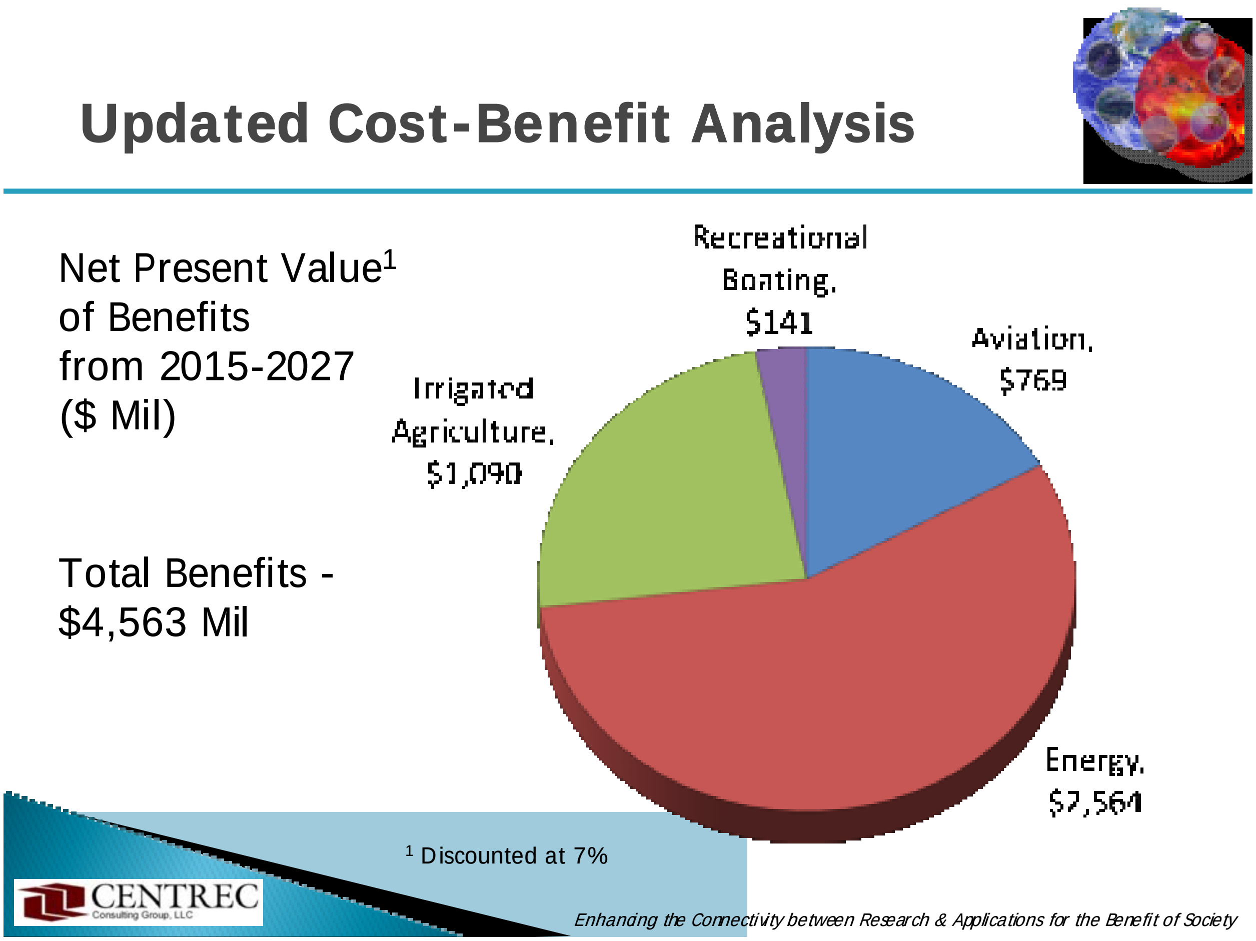
Dr. Walker said detection of mesoscale eddies has been improved by combining multi-mission measurements from TOPEX-Poseidon, ERS-2, GFO, Jason-1 and Envisat into a gridded product, updated daily (http://argo.colorado.edu/~realtime/welcome). Integration of GOES SST and SSH data can be found at http://www.esl.lsu.edu.

The cyclonic winds within Hurricane Ivan in September 2004 enhanced the cyclonic circulation in two large areas north and south of a detached warm core ring of the Loop Current. Cooling of 3-7 C was measured over 39,000 km^2 producing SSTs below 26 C, a known lower limit for hurricane maintenance. NHC wind data showed a decrease in sustained maximum wind speeds as Hurricane Ivan interacted immediately with the cool water as it crossed the Gulf.

The following year, Hurricanes Katrina and Rita exhibited rapid intensification from category 1 to category 5 in close proximity to the high heat content Loop Current and detached warm core rings, however both hurricanes experienced weakening before landfall in close proximity to self-generated cool wakes within cold-core ocean cyclones adjacent to warm core rings. These results demonstrate the importance of both cyclonic and anticyclonic eddies in producing hurricane intensity changes. A focused effort to incorporate more accurate information on mesoscale cyclonic eddies and cool wake predictions could benefit hurricane intensity modeling efforts.

9.2 Potential Socio-Economic Benefits of GOES-R, Sharon K. Bard, Centrec Consulting Group, LLC, Savoy, Illinois; and T. A. Doehring and S. T. Sonka

Sharon K. Bard, Centrec Consulting Group, LLC, Savoy, Illinois, presented information on the potential social-economic benefits of GOES-R. The Centrec team prepared a study for NCDC titled, "An Investigation of the Economic and Social Value of Selected NOAA Data and Products for GOES." She said that in modern society, information is one of the first lines of defense employed to protect citizens' health and well-being and to optimize the effectiveness of economic and social systems responding to dynamic weather conditions. Information from earth-observing satellites, including the current Geostationary Environmental Satellite System (GOES), forms a critical component of today's capabilities. The planned GOES-R set of satellite innovations would further enhance this system when it moves into its operational phase.



Information from the GOES-R system has the potential to affect a vast array of human activities in the United States. Centrec studied potential socio-economic benefits from the GOES-R system and provided estimates for improved tropical cyclone forecasts along the Gulf and Atlantic coastlines and for the application of improved information in four specific sectors of the economy – aviation, energy (both electricity and natural gas), irrigated agriculture, and recreational boating.

Tropical cyclones clearly have massive social and economic impact. Existing analyses of tropical cyclone damages tend to be event specific. However, improved hurricane forecasts would not be event specific, but available on a continual basis, both in terms of time and geographic coverage. Therefore, a methodology was developed and employed that assesses the potential value of improved tropical cyclone forecast capabilities and is not limited to the analysis of individual tropical storm or hurricane events. Several scenarios were considered as part of the analysis. For the Base Case scenario, the study focused on the proposed GOES-R Advanced Baseline Imager (ABI) instrument. The annual non-discounted net benefits estimated for improved tropical cyclone forecasts exceed $450 million for the year 2015. This benefit would average about $130,000 for each mile of the more than 3,000 coastline miles along the Gulf and Atlantic coastlines. Using a 7% discount rate (and with no inflation), the present value of sum of benefits from 2015 to 2027 would be almost $2.4 billion, averaging more than $690 K per coastline mile.

Another scenario is the case in which greater enhanced technologies, such as a hyperspectral sounder in addition to the ABI, could result in more credible forecasts. In this scenario, the enhanced credibility would be reflected in a smaller area for which protection warnings are issued and a greater response from citizens and decision-makers to take the appropriate action. Using a 7% discount rate (and with no inflation) for this enhanced technology scenario, the present value of sum of benefits from 2015 to 2027 would be almost $4.3 billion.

Centrec's study also updated a previous cost-benefit analysis conducted for the Department of Commerce in 2002 and 2004, when the Hyper-spectral Sounder Environmental Suite (HES) sounder was part of the proposed instrument platform. Using a 7% discount rate (with no inflation), the present value of the sum of benefits from 2015 to 2027 would be more than $4.5 billion for the four specific sectors. Based on expert judgment provided by scientists consulted during this project, the ABI estimates are estimated to be 49% of the $4.5 billion or $2.2 billion.

These estimated socio-economic benefits most likely understate the potential total benefits of the GOES-R satellite system. Conservative assumptions relative to the effect on potential value are consistently employed throughout the analysis. In addition, the four sectors analyzed, while important in their own right, do not include several other major activities of economic importance to the nation. Benefits to other users such as international, retrospective, Department of Defense, and data collection services were not included in the analysis. Nor were economic sectors such as commercial transportation, tourism, and television included. In addition, societal benefits such as human health, climate, ecological, and ocean, and other GOES-R instruments (e.g., the Geostationary Lightning Mapper (GLM) were not included in the analysis. Nonetheless, the magnitude of the economic benefits estimated for just the five economic activities included in the study provides strong evidence of the potential for societal gain when the GOES-R satellites become operational and provide improved information.

The full report can be found at www.centrec.com/climate_weather.htm.

9.3 Preparing for GOES-R+ User Training and Education, Anthony Mostek, NOAA National Weather Service, Boulder, Colorado; and M. DeMaria and J. J. Gurka

Anthony Mostek, NOAA National Weather Service, Boulder, Colorado, said that user training for NOAA staff and outreach to NOAA's many customers are critical to the success of current and future satellite programs. The needs for training and education activities are captured in NOAA's Strategic Plan as part of establishing a "World Class Workforce."

The challenge to NOAA and its partners is clear from the Strategic Plan and other planning documents: keep pace with the rapid pace of technological change and keep users informed and trained on these changes. Otherwise, NOAA and its partners face the clear possibility of being unprepared for the next environmental emergency.

The GOES program is developing a new series of satellites that will help keep NOAA at the forefront of environmental analysis, warning and prediction. There are many changes underway as part of NOAA's evolving programs. Some of these changes include:

- NOAA provides support from the Earth's surface (including sub-surface, water/land) through the atmosphere to space weather
- To support this broad array of NOAA programs, the GEOSS program now a key part of NOAA's support for an integrated global observing system.
- Major new approaches and products are provided for users to support the evolving needs of the U.S. and other countries for environmental information and services.
- The ability for users to interface with and manipulate data and products evolves rapidly. This rapid change is seen in the increase in gridded digital products produced by NOAA Offices.
- New innovations in decision aid/image processing software are developed. Examples are available with advanced radar products and in other disciplines (military image processing, medical imagery, land use, etc.)
- Merging of multiple products from multiple sensors (surface, air, space based) into a seamless system (GEOSS concept).
- Seamless merging of data/products/services is already underway with readily available systems such as Google Earth. Keys to success are common formats/reference systems (GIS) that support a wide spectrum of applications and platforms. This capability is especially critical to decision makers at all levels during crisis situations.

How can NOAA prepare its staff and partners for all these changes as satellites continue their multi-year build, launch, test, and deploy process?

- Build a NOAA Satellite Proving Ground that incorporates all new data and products.
- Prepare training, education and outreach programs with materials that reach the widest audience using a blended delivery approach.

- Use innovative distance learning approaches that include a blend of multimedia with simulations.
- Build and enhance partnerships with key stakeholders: government (at all levels); academia with Cooperative Institutes and Programs, universities and K-12; commercial sector – including the media; and international communities -- especially WMO and other satellite providers
- Engage users through monthly satellite training activities and international weather briefings

10. GOES-R Users' Forum - II

10.1 United Airlines Polar Operations, Michael Stills, United Airlines, Chicago, Illinois

Michael Stills, Manager of International Operations for Flight Dispatch, United Airlines, Chicago, Illinois, said that United Airlines operates flights daily over the top of the world. On August 30, 2007, United completed its 7000th polar flight. There have been four polar routes. A fifth route was added recently. Historically, there were 12 polar demonstration flights in 1999 and more polar flights each year in subsequent years. In 2007, there were 1832 polar flights.

There are operational concerns that must be considered. Hazards of the polar route, which is defined as north of 78 degrees North latitude, include solar activity, cold temperatures, diversion support, and communication restraints. There are many safety and regulatory requirements which must be taken into consideration when planning polar operations. All flight crews must be trained in operating in the polar environment. Operators must have SATCOM voice or HF data link. Defibrillators must be onboard the aircraft. There must be a recovery plan in the event of diversion. Two cold weather anti-exposure suits must be onboard. They must have the ability to operate in areas of magnetic unreliability. Fuel is tested for by the fuel freeze analysis program. The airlines must also have a plan for solar activity.

During adverse solar activity, United's policy restricts flights to specific routes and altitudes. United policy is in part derived from and based on the NOAA space weather scales. A polar weather package contains solar activity and Space Weather Prediction Center (SWPC) recommendations. United's onsite meteorologists also monitor the SWPC Websites and maintain contact with the SWPC, who ensures that United has timely information. Mr. Stills described some of the recent solar events and United's response to them.

Currently there are 10 carriers flying the polar route. Polar movements rose from 3731 in 2005 to 7291 in 2007. "In the airline industry anything that gives us more time to react is advantageous," Mr. Stills said in response to a question about forecasts. (*Photo shows a United Airlines 747*.)

10.2 Use of Satellite Data at National Weather Service Forecast Offices, Donald M. Moore, NOAA National Weather Service, Billings, Montana

Donald M. Moore, NOAA National Weather Service, Billings, Montana, said that satellite data, particularly from GOES, has long been an important tool for weather forecasters in the National Weather Service to better identify and track mesoscale features that play an important role in high impact weather. Also very important to forecasters is the ability to use satellite data to assess model performance, which can have implications on short term and medium range forecasts. The greater spatial and temporal resolution of future GOES, along with new channels, will provide an even greater ability to monitor mesoscale features and assess model performance. It will also allow forecasters to use GOES in ways that are not be currently done. This includes understanding the spatial distribution of temperatures in complex terrain, which is critical when providing mesoscale and microscale forecasts for wildfire support. Mr. Moore described some common ways in which GOES is being used by National Weather Service forecasters. Mr. Moore discussed the current uses of MODIS's higher resolution imagery by the National Weather Service to better understand weather conditions impacting wildfires.

Mr. Moore discussed the blizzard of December 26, 2003. Over a foot of heavy wet snow fell in the lower elevations of Southern Montana. Interstates 90 and 94 were closed. The GFS numerical model forecast a major event, while the Eta numerical model did not. That presented some challenges for forecasters. The heavy snow event of February 2006 was poorly forecast by the numerical models. This shows that satellite data are very important. In a down slope wind storm in November 2007, the models performed well, but did not clearly define the timing of the event.

There are many dense fog events at Billings Logan International Airport. The events are very localized and difficult to forecast. Nighttime detection is particularly difficult due to lower resolution of GOES IR versus GOES visible. MODIS data showed the fog.

Fire threats are always a concern to forecasters. Satellite data are used in the forecasts. MODIS data can show the coolest temperatures in the valley and warmer temperatures in the mountains. Mr. Moore showed several examples of fires and MODIS satellite data.

Satellite data can also be used in temperature forecasts and analysis, which are important for wildfire forecasting. MODIS data can be pulled into the database and be used in the analysis.

In conclusion, Mr. Moore said that the future NWS will focus more on forecasting high impact weather. Satellite data combined with other observational data sets will play a large role. The latest satellite technology has historically been slow to become part of the NWS forecast operations and the baseline operational systems. The NWS needs an operational system and infra-structure that can easily adapt and incorporate new data sets. NOAA's Satellite and Information Service should focus research efforts to operational forecast challenges associated with high impact weather. Forecasters need training to effectively use the latest satellite technology.

10.3 GOES imagery applications at the Aviation Weather Center, Steven Silberberg, AWC/NCEP, Kansas City, Missouri

Dr. Steven Silberberg, of the Aviation Weather Center (AWC) in Kansas City, Missouri, said the AWC is one of nine of the National Centers for Environmental Prediction. The AWC issues 990 forecasts each month. The AWC makes extensive use of GOES imagery in its forecast operations for both the nation and internationally. AWC forecast operations include a continuous meteorological watch world-wide for aviation weather such as: cloud type, bases, and tops; low cloud ceilings; supercooled clouds for aircraft icing; towering cumulus and thunderstorms; low visibility; blowing sand and dust; fog; smoke; volcanic ash; mountain obscuration; mountain waves; turbulence at the surface, aloft, in clear air and in clouds; strong low level wind; and low-level wind shear.

AWC acquires GOES East and West imagery via a local ground station, and worldwide geostationary and polar orbiting satellite data from NESDIS and other McIDAS-X servers. AWC's McIDAS-X server then produces customized satellite images developed by Dr. Fred Mosher, who used to work at the AWC, for aviation applications.

AWC forecast operations use 11 products from GOES-East, 10 from GOES-West, and 30 global mosaic products for its international forecasting responsibilities. An example of customized satellite imagery for aviation applications is AWC's day/night low cloud and fog image. This image uses temperature differences between the 11 and 3.9 micron bands. Particular temperature ranges for day and night are stretched into 0-255 counts to detect low cloud during the day and fog at night. Dr. Silberberg showed examples of customized aviation applications of GOES cloud images, volcanic ash images, global convective diagnostic, and global mosaics.

In conclusion, Dr. Silberberg said that the GOES imagery is critical to AWC operations. The AWC uses Dr. Fred Moser's McIDAS macros, which have resulted in the scientific advancement of aviation meteorology and aviation safety. NESDIS provides AWC with products such as the GOES sounder derived products, volcanic ash, smoke, precipitation estimates and risk, precipitable water, and QuikSCAT data.

10.4 U.S. Environmental Protection Agency -- Future use of GOES-R in Air Quality Assessments, James Szykman, USEPA, Hampton, Virginia; and J. A. Al-Saadi, T. Pace, R. Mathur, G. Pouliot, D. A. Chu, R. B. Pierce, S. Kondragunta, C. Kittaka, A. Soja, R. Scheffe, and J. Fishman

Mr. James Szykman, U.S. Environmental Protection Agency**,** said that to protect public health and welfare, EPA issues National Ambient Air Quality Standards (NAAQS) for six criteria pollutants, which include particulate matter (PM) and ozone. Exposure to PM and ozone is linked to a variety of significant health problems, ranging from aggravated asthma to premature death in people with heart and lung disease. Particle pollution also is the main cause of visibility impairment in the nation's cities and national parks.

In 2006, EPA issued new standards for the 24-hour fine particle standard from 65 micrograms per cubic meter (µg/m3) to 35 µg/m3, while retaining the annual fine particle standard at 15 µg/m3. In 2007, EPA proposed to strengthen the national ambient air quality standards for ground-level ozone, the primary component of smog, with a proposal to set the primary (health) standard to a level within the range of 0.070-0.075 ppm (70 -75 ppb) versus the current standard 8-hour primary ozone standard of 0.084 ppm. The work required to implement and attain these new standards will extend to 2020 and include the GOES-R timeframe. The EPA is developing the capabilities to use measurements from GOES-R in critical areas for assessing air quality.

Over the past several years, EPA through collaborations with NOAA, NASA, and other researchers has been using current NASA and European research and NOAA operational satellite observations within various air quality applications along with the goal to build capabilities for the next generation of satellite instruments. The GOES-R ABI sensor with next generation technology and onboard calibration systems will provide highly accurate retrievals of aerosols (optical depth, type, size) along with increase accuracy and resolution of fire detection.

Mr. Szykman discussed EPA's current efforts in three areas:

- Satellite-based air quality monitoring for aerosols (PM2.5) and the development of prototype monitoring tools
- Aerosol assimilation in regional air quality forecast models
- The use of geostationary satellite data to assist in the development of EPA's national emission inventory for biomass burning emission estimates.

GOES-R will provide improved operational air quality (AQ) related products. GOES-R will help with the temporal resolution for air quality aerosol needs, but no sounder will limit the use of any trace gas products. Fires are an important component of AQ management of aerosols, ozone, and Hazardous Air Pollutants (HAPs). Understanding where the fires are and how they contribute to the overall emissions are important for the EPA. In 2003-2006 fire emission inventories were prepared using NOAA-HMS fire activity data to generate emissions in SmartFire. GOES-R will provide improved fire characterization capabilities including characterization of fire size and temperature, and fire radiated power.

With GOES-R, the future directions include: developing an aerosol height index, increased trends analysis, and improved data delivery.

In summary, Mr. Szykman said that the air quality community is a new community now embracing the use of satellite observations. MODIS provided the first opportunity to EPA to conduct quantitative research and begin to build capacity. GOES-R will allow that effort to continue in an operational environment.

10.5 Multi-Spectral Data for Space Shuttle Landing Operations, Doris A. Hood, NWS Spaceflight Meteorology Group, Houston, Texas

The National Weather Service, Spaceflight Meteorology Group (SMG) in Houston, Texas, supports NASA's human spaceflight program at Johnson Space Center. 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 Spain, France, and the United States, but the emergency landing sites cover the globe, requiring worldwide data sets.

Spaceflight Meteorology Group. Doris Hood is in back row, second from left.

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 the SMG 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). The SMG is also working on ingesting AWIPS-compatible Moderate Resolution Imaging Spectroradiometer (MODIS) data from the University of Wisconsin.

Each SMG forecast console provides access to both McIDAS and AWIPS displays. Extensive training was conducted in 2007 to familiarize the SMG forecasters with the utility of the various bands individually and in combination. Operational use of multi-channel differencing and color combination imagery has increased. Ms. Hood showed examples from the most recently flown Space Shuttle missions.

11. Lunch Presentation

Satellite meteorology of tropical cyclones in the GOES-R era, John L. Beven II, NOAA/AOML/NHC/TPC, Miami, Florida; and M. DeMaria and C. Velden

John L. Beven II, a hurricane specialist at NOAA's National Hurricane Center/Tropical Prediction Center, Miami, Florida, gave a presentation that focused on GOES-R and the increases in capabilities dealing with tropical cyclones, as well as the larger meteorological issues that overlap with observations of tropical cyclones. His presentation also covered some other potential observations of tropical cyclones from geostationary orbit that could compliment GOES-R data.

The Hurricane Center, co-located with the NWS's Miami Weather Forecast Office, is able to withstand a Category 5 hurricane. It was designed by Herb Saffir of the Saffir-Simpson Scale, and was designed for easy media access. The National Hurricane Center has a very large area of responsibility for the Atlantic and Pacific Oceans, and has backup responsibility for four other NWS centers or offices.

The critical assets that are used for tropical cyclone monitoring and forecasting are: satellites, observational data (upper air, surface, buoys, shops and aerial reconnaissance), and numerical weather models. Geostationary satellites are vital to tropical cyclone monitoring and forecasting. At times, satellite data are the only available data. Ultimately, time is the enemy during the forecast process.

The hurricane center issues forecasts/advisories, public advisories, forecaster discussion, ICAO aviation warnings, wind probabilities, tropical cyclone updates, and tropical cyclone position estimates. The center is planning to expand its forecast capabilities in the future, including 6-7 day track forecasts, tropical cyclone genesis probabilities, and significant wave height forecasts, along with improved forecasts of intensity, wind radii, and storm surge.

With the GOES-R era, the center will make significant improvements in data processing, image display, computing capabilities, and forecast operations. The amount and quality of data from GOES-R will require changes, as the existing systems will be inadequate. NASA MODIS and EUMETSAT SEVIRI data will be used as proxy datasets for testing techniques to employ with GOES-R data. With the GOES-R era, operational tropical cyclone track, intensity, and size forecasts will likely cover periods of seven days or more. Forecast products will include elements of deterministic and probabilistic forecasts. The forecasts will require much greater data coverage of both the tropical cyclone and the environment farther from the tropical cyclone than what is available today.

The future GOES satellites, from GOES-13 on, will be able to operate through the eclipse period. This will speed up operations. The ABI imager will be a significant improvement over the current imager, with faster scan times, and improved resolution. The ABI will have better temporal observations. GOES temporal improvements will provide more capability to help with tropical cyclone analysis and forecasts. Five-minute imaging should be superior to 15-minute imaging in monitoring eyewall meso-vortices, which may help in hurricane intensification.

Intensity estimates will improve; the current method is the Dvorak technique. An automated technique has been developed, and is being refined. The potential GOES-R impacts on the Dvorak technique are:

- Increased spatial resolution will likely have minor impacts on intensity estimates due to changes in observed cloud temperatures.
- Increased temporal resolution will likely have some positive impact on automated intensity estimates.
- Unknowns: how the new channels and increased spectral resolution will affect cloud-type identification and center finding.

There will be an opportunity for enhanced satellite-derived atmospheric motion vectors. Advanced data from the ABI may help with aerosol/dust optical thickness retrieval. An advanced sounder could have major impacts on numerical weather prediction models and resulting tropical cyclone forecasts, resulting in significant social-economic benefits. The lightning mapper could be used in tropical cyclones to differentiate active convection versus cirrus debris for intensity analysis and forecasting, as well as for forecasts of tropical cyclone genesis.

In summary, Mr. Beven said there will be vast quantities of satellite data available for tropical cyclone analysis and forecasting in the GOES-R era. These high-quality data should have a considerable positive impact on tropical cyclone analysis and forecasting. Much can be learned about using GOES-R from the currently existing systems before GOES-R is launched.

12. Poster Presentations

The poster numbering below is the same numbering used for the posters at the 88th AMS Annual Meeting.

P1.1 ABI system overview (withdrawn), Paul Griffith, ITT Space Systems Division, Fort Wayne, Indiana

P1.2 ABI scan scenario capabilities, David Crain, ITT Space Systems Division, Fort Wayne, Indiana; and P. Griffith

The ABI instrument on GOES-R provides for a unique programmable scan capability in a GEO operational imager. This enables the ABI sensor to perform imaging and radiometric sampling operations rapidly over the full disk. Besides the Scan modes specified by NOAA requirements, we suggest additional scan modes and capabilities, which can offer new and unique benefits. We will examine these expected benefits for severe weather forecasting, sounding, wildfire observation, calibration/validation, etc.

P1.3 Candidate approaches for the real-time generation of cloud properties from GOES-R ABI, Andrew K. Heidinger, NOAA/NESDIS, Madison, Wisconsin

While the launch of GOES-R is years away, work is continuing on developing consensus algorithms for estimating cloud properties. The cloud application team of the GOES-R Algorithm Working Group (AWG) has recently completed an initial version of the cloud algorithms for the GOES-R Advanced Baseline Imager (ABI). This poster illustrates our current approaches and provides estimates of their performance and capabilities. Performance metrics generated via comparison with CALIPSO will be shown. In addition, this poster will discuss our current research plans to improve the performance over the coming years.

P1.4 GOES-R architecture framework, John W. Linn III, Noblis, Falls Church, Virginia; and L. Shipley

To support NESDIS' goal to develop ground system capabilities to serve current and future geostationary and polar satellite missions through incremental upgrades and consolidation of functionality, the GOES-R system requirements have been developed to be compatible with in-development NESDIS architectural concepts and "to be" architectures. These requirements were based on a GOES-R architectural framework that looked to identify elements of mission management, product generation, product distribution, and enterprise management that were consistent with the NESDIS architecture. This presentation provides an overview of the GOES-R architectural framework and describes how the NESDIS architecture concepts were used.

P1.5 Development of the GOES-R AWG product processing system framework, Walter Wolf, NOAA/NESDIS/STAR, Camp Springs, Maryland; and L. Zhou, P. Keehn, Q. Guo, S. Sampson, S. Qiu, and M. D. Goldberg

The GOES-R Algorithm Working Group (AWG) Product Processing System Framework is under development at NOAA/NESDIS/STAR. The framework has been put into place for the development of the AWG geophysical product processing systems. This development is to produce and test the scientific algorithms in a scalable operational demonstration environment -- STAR collaborate environment. The framework includes accommodations for all the Level 2 Advance Baseline Imager (ABI) products. The dependence of one product on the output of another product (product precedence) has been taken into account during the development of the framework. Data common to all the product systems have been read into the framework and passed to the appropriate product systems. These design features and the current status of the framework will be discussed.

P1.6 GOES-R Downlink Services for Users, John Schimm, Northrop Grumman, Redondo Beach, California; and J. Castellon, L. Kincaid, and L. E. Urner

The GOES-R series of satellites will continue to provide the downlink services that users are familiar with, although with some changes that users will need to prepare for. This poster reviews the downlink services for GRB (formerly GVAR), LRIT, DCPR/DCPI, EMWIN, and SAR. The poster will emphasize which services are unchanged, and which services are being modified so that users can understand how to access future downlink services.

P1.7 The GOES ABI ground processing development system, Jon Ormiston, ITT Space Systems Division, Fort Wayne, Indiana; and J. Blume, J. Ring, and J. Yoder

The GOES ABI Ground Processing Development System (GPDS) illustrates that the ABI instrument's ground processing algorithms can be implemented and perform in real time. Raw ABI instrument CCSDS packet data (Level 0) is input into GPDS where it is decompressed, calibrated, navigated, and resampled to create images (Level 1B). ITT's GPDS implementation is currently in development but initial results demonstrate specification compliant latency with at least 28% margin.

P1.8 Development of the GOES-R ABI Outgoing Longwave Radiation product, Hai-Tien Lee, University of Maryland, College Park, Maryland; and I. Laszlo and A. Gruber

The next generation of NOAA Geostationary Operational Environment Satellite, R series (GOES-R), is scheduled to launch in approximately 2015 and will provide critical support for NOAA's missions with its advanced instruments and a comprehensive suite of quantitative environmental data. Complete Earth Radiation Budget (ERB) parameters at both the top of the atmosphere and the Earth's surface will be derived from the Advanced Baseline Imager (ABI) observations. This would be the first time that such parameters are derived operationally from the NOAA geostationary satellites, whereas the top of the atmosphere ERB parameters have been derived operationally and continuously from the NOAA Polar Orbiting Operational Environmental Satellites (POES) of the TIROS-N series since 1979. This paper describes the development of the preliminary version of the Outgoing Longwave Radiation (OLR) algorithm that will be implemented for the GOES-R ABI instrument. We employed two surrogate instruments for the development purpose, including the Moderate-Resolution Imaging Spectroradiometer (MODIS) onboard NASA EOS satellites and the Spinning Enhanced Visible and Infrared Imager (SEVIRI) onboard the EUMETSAT METEOSAT satellites. The Single Scanner Footprint (SSF) OLR product derived from the broadband observations by the NASA Cloud and Earth's Radiant Energy System (CERES) was used as the validation reference. We have assessed the instantaneous OLR retrieval errors from MODIS and SEVIRI-derived OLR surrogating ABI capability that are at about 5 and 4 Wm^{-2}, over the global and over the Eumetsat-8 full-disk domain, respectively. This is very satisfying as it is within the instantaneous error of the one-sigma uncertainty of the broadband OLR observations, about 5 Wm^{-2}. Nevertheless, relatively large biases were observed over some regions, e.g., deserts. There also appeared to have view zenith angle dependent biases in the SEVIRI-derived OLR. The detailed validation results and its error analysis will be presented, and some experiment results attempting to improve the regional accuracies will be discussed.

P1.9 Applying split window technique for land surface temperature measurement from GOES-R advanced baseline imager, Yunyue Yu, NOAA/NESDIS, Camp Springs, Maryland; and D. Tarpley, M. K. Rama Varma Raja, H. Xu, and K. Y. Vinnikov

On board the GOES-R satellite, which has a planned launch-ready date 2015, the Advanced Baseline Imager (ABI) will provide a best-ever opportunity for measuring land surface temperature (LST) from geostationary orbit. The ABI sensor will have three major advantages for LST measurement. First, horizontal resolution of ABI is 2 km at nadir, fairly close to the polar-orbiting meteorology satellite sensors such as AVHRR. It allows for near simultaneous and spatially coincident LST retrievals from GOES and POES (polar-orbiting operational environmental satellites). Second, the refresh rate of ABI observation is 5 minutes, which is significantly higher than current GOES Imagers. The high refresh rate will provide more cloud-free measurements and therefore a better observation of the diurnal LST cycle, which is the greatest advantage of the geostationary satellite data. Finally, the ABI sensor noise level will be significantly lower than current GOES Imagers. At the thermal infrared band, the sensor noise equivalent temperature will be less than 0.1 K, which will allow a more accurate LST product.

This paper describes a split window (SW) algorithm being developed for LST measurement from the ABI sensor. We simulated ABI sensor data using a moderate resolution radiative transfer model (MODTRAN) and NOAA88 atmospheric profiles and ran regression analyses for the LST algorithm development. The algorithm was developed by optimizing existing SW LST algorithms published in the literature and adding a path length correction term to minimize retrieval errors due to difference in atmospheric path absorption from nadir view to the edge-of-scan. Primary evaluation of the algorithm has been performed using coincident LST values estimated from surface radiant budget dataset (SURFRAD) ground measurements. The algorithm has been applied for LST seasonal, diurnal and weather related cycles' studies using GOES-8 data (Vinnikov et al., 2007). It has also been used to produce LST data from MSG/SEVIRI data.

P1.10 Development and validation of a BRDF model for ice mapping for the future GOES-R Advanced Baseline Imager (ABI) using Artificial Neural Network, Hosni Ghedira, NOAA-CREST, New York, New York; and M. Temimi, R. Nazari, P. Romanov, and R. Khanbilvardi

Information on ice cover extent over seas is crucial for ship navigation. Ice cover can also show interannual fluctuations and reflects climate variations. Ability of satellites to provide global observations at high temporal frequency has made them the primary tool for the ice cover monitoring. This study is a part of GOES-R Cryosphere application group effort to develop new, and improve existing, applications for the future GOES-R Advanced Baseline Imager (ABI). In this paper, a new approach was developed to minimize the effect of both observation and illumination angles on the ice mapping accuracy. A Bidirectional Reflectance Distribution Function (BRDF) was developed to simulate the reflectance of ice and water over the Caspian Sea. The ultimate objective of this research is to develop a daily ice concentration map. The estimation of the reflectance of water and ice is a step toward the achievement of this goal. The Northern region of the Caspian Sea has been selected for algorithm development and calibration. Artificial Neural Networks (ANN) have been used to simulate reflectance values for both water and ice from solar, azimuth and satellite angles. Data collected by SEVIRI instrument onboard of Meteosat Second Generation (MSG) satellite have been used as a prototype. The approach used in the algorithm development includes daily cloud-clear image compositing. The simulated reflectances were compared to observed values and have shown a satisfactory agreement. This implies that the BRDF model coupled with ANN technique can be used to simulate reflectance values.

P1.11 GOES-R wind retrieval algorithm development, Iliana Genkova, CIMSS/University of Wisconsin, Madison, Wisconsin; and S. Wanzong, C. S. Velden, D. A. Santek, J. Li, E. R. Olson, and J. A. Otkin

The Cooperative Institute for Meteorological Satellite Studies (CIMSS) is conducting research on satellite-derived atmospheric motion vectors (AMVs) in preparation for the GOES-R instrument series. It integrates the use of proxy and simulated data sets, such as MSG/SEVIRI imagery, WRF model derived Top of Atmosphere (TOA) radiances, simulated hyperspectral moisture analysis fields, and current GOES Sounder data. Such a framework allows for better characterization of the expected properties of GOES-R AMVs, processing error diagnostics (risk reduction), and algorithm readiness for Day 1 processing.

Two distinct approaches using automated software are explored for the most efficient AMV derivation from the expected Advanced Baseline Imager (ABI) observations. The first uses the current version of the automated CIMSS/NESDIS AMV retrieval code, and is tested with a simulated ABI dataset from the WRF model. A 2km horizontal, 5-minute time step simulation was run for an hour over the east coast of the United States and into the western Atlantic Ocean. TOA radiances for ABI channels 8 through 16 were used to create images for the AMV retrieval algorithm. AMVs are then computed from heritage channels (3.90µm, 6.19µm, 11.2µm, and 13.3µm) and non-heritage channels (7.0 m, 7.3 m and 8.5 m). The software is being modified with a new ABI calibration module allowing AMV production from non-heritage channels, but the height assignment routines are retained. The second approach uses navigated and calibrated radiances and cloud top heights output from the GEOstationary Cloud Algorithm Testbed (GEOCAT). Adaptive changes are being made to the existing AMV derivation software to accommodate this new data type, in particular the height assignment under cloudy conditions. Validation efforts will use GOES and SEVIRI data. AMVs produced using both methods will be presented.

Another novel AMV effort involves the creation of height-resolved AMV profiles using constant pressure level moisture analyses derived from geostationary satellite retrievals in clear sky. This approach employs the existing automated AMV-tracking algorithm. The sources for retrieval moisture fields are: 1) real data from the current GOES sounder, and 2) simulated data from the proposed hyper-spectral sounder on GOES-R. For 2), simulated hyper-spectral retrievals from the Geostationary Imaging Fourier Transform Spectrometer (GIFTS), and the Hyper-spectral Environmental Suite (HES) are analyzed at 101 pressure levels. Levels that exhibit a strong water vapor signal and exhibit gradients are analyzed and converted to images for feature tracking. AMVs can be derived by tracking the advecting moisture features in an image triplet created from 3 successive analyses. As a result, a 3-dimensional wind field can be produced.

This method is also being tested with data from the GOES11/12 sounders. Near real-time height resolved AMVs are retrieved from successive moisture analyses. The quality of the AMVs is currently being monitored and assessed. Examples will be shown. Supplementary URL: http://cimss.ssec.wisc.edu/~ilianag/

P1.12 Validation of a GOES-R Broadband Shortwave Surface Transmission and TOA Albedo LUT method, Fred G. Rose, SSAI, Hampton, Virginia; and Q. Fu, I. Laszlo, and T. P. Charlock

A fast look-up-table (LUT) method to retrieve broadband surface transmission and top-of-atmosphere albedo is validated. The LUT methodology uses the LaRC modified Fu-Liou 2-stream delta-eddington, correlated-k, 18-band, shortwave radiative transfer model to produce a pseudo eleven dimension look-up-table. Narrowband retrievals of cloud properties of optical depth, phase, particle size and height are validated against in-situ surface observations from ARM, BSRN, SURFRAD and CERES TOA shortwave. Quality inputs of aerosol optical depth and single-scatter albedo, surface albedo, surface type and elevation, precipitable water, column ozone and solar zenith angle are assumed.

P1.13 Validation of the Community Radiative Transfer Model (CRTM) against AVHRR Clear-Sky Processor for Oceans (ACSPO) Nighttime Radiances for improved cloud detection and physical SST retrievals, XingMing Liang, NOAA/NESDIS, Camp Springs, Maryland; and A. Ignatov, Y. Kihai, A. K. Heidinger, Y. Han, and Y. Chen

The Advanced Very High Resolution Radiometer (AVHRR) Clear-Sky Processor for Oceans (ACSPO) is currently being developed at NESDIS. The major ASCPO products are clear-sky radiances over oceans (CSR) in all AVHRR bands, and sea surface temperature (SST) and single-channel aerosols derived from the CSRs. A fast Community Radiative Transfer Model (CRTM) has been integrated into ACSPO. It is used in conjunction with the National Centers for Environmental Prediction (NCEP) Global Forecast System (GFS) upper air fields and Reynolds-Smith version 2 weekly SST to simulate AVHRR top-of-atmosphere (TOA) clear-sky brightness temperatures (BT). Model BTs are used to improve the ACSPO cloud mask, monitor quality of AVHRR BTs, and explore physical SST retrievals.

This paper documents CRTM/GFS implementation in ACSPO version 1 and evaluates the "Model minus Observation" (M-O) BT biases in three bands (3.7, 11 and 12 µm) of four AVHRR/3 instruments onboard NOAA-16, -17, -18 and MetOp-A platforms using one week of global data from 16–22 February 2007. We find that if the input atmospheric and SST data are treated carefully within CRTM, then the agreement is generally good and the M-O bias shows only weak dependence on the sensor view angle and environmental parameters (water vapor, SST, sea-air temperature difference, and wind speed). Also, the CRTM and AVHRR BTs agree better if Reynolds-Smith SST is used instead of NCEP SST available from GFS files. Including Fresnel's reflection from a flat surface also reduces the M-O biases, compared to black surface. Typically, the M-O bias is positive and within a few tenths of a Kelvin, leaving some margin for future improvements in CRTM and AVHRR BTs. In particular, inclusion of aerosols and using skin SST, instead of the current Reynolds-Smith bulk SST, are expected to reduce the CRTM BTs, and the ongoing improvements to ACSPO cloud mask may increase the AVHRR BTs. Cross-platform consistency of the M-O bias is typically within ~0.1K, except for NOAA-16 channel 3B which is biased low with respect to the other three platforms by ~0.4K, likely due to a possible shift in its spectral response.

Our next step will be establishing physical SST retrievals within the available CRTM/GFS infrastructure in ACSPO. To achieve this major objective, we plan a number of steps. A web-based tool will be established to monitor the M-O bias and physical SSTs in time and to estimate the long-term performance of the CRTM and AVHRR radiances during both day and night. Adding extraterrestrial solar radiation and atmospheric scattering in the CRTM, and including global aerosols, is needed to improve the forward and inverse modeling and achieve sufficiently accurate physical SSTs. Finally, the developed system will be applied to the MSG/SEVIRI radiances to get ready for the GOES-R/ABI. The methodology described in this paper will be employed to quantitatively measure these improvements.

P1.14 Examining the MTSAT-1R solar channel calibration, Hyoung-wook Chun, Seoul National University, Seoul, South Korea; and B. J. Sohn

In this study, we propose the calibration algorithm for the solar channel (550 ~ 920 nm) Japanese geostationary satellite MTSAT 1R launched on February 26, 2005. We developed a method utilizing MODIS-derived BRDFs for the solar channel calibration over the bright desert area. Targets are selected based on the desert's brightness, spatial uniformity, temporal stability and spectral stability. The 6S model has been incorporated to account for directional effects of the surface using MODIS-derived BRDF parameters within the spectral interval in interest. Results based on the analysis for the period November 9-30, 2007, suggest that MTSAT-1R solar channel measurements have a high bias up to 8%.

P1.15 GOES-R ABI calibration approach, David S. Smith, ITT Space Systems Division, Fort Wayne, Indiana

GOES ABI's calibration approach emphasizes long term linkage between all flight instrument calibrations. Critical laboratory intercomparison of on-board Internal Calibration Targets (ICTs) and External Calibration Targets (ECTs in the test chamber) form the basis for instrument-instrument calibration stability. A description of this process, and other aspects of the calibration program are given.

P1.16 The Global Space-based Inter-Calibration System (GSICS): A status report, Xiangqian Wu, NOAA/NESDIS, Camp Springs, Maryland; and M. Goldberg

The Global Space-based Inter-Calibration System (GSICS) is an international collaboration to build an operational system for the inter-calibration of a variety of meteorological satellite instruments. GSICS is a critical thread that links individual observation system for integration into the Global Earth Observation System of Systems (GEOSS). This paper reviews the four categories of satellite instrument inter-calibration, reports on recent progress and current status of GSICS, and presents preliminary results from a prototype system.

P1.17 Inter-calibration of geostationary imagers with MetOP/IASI hyperspectral measurements, Likun Wang, QSS Group Inc, Camp Spring, Maryland; and C. Cao

Inter-calibration of the radiance measurements from geostationary imagers is important to verify the proper functioning of sensors, monitor sensor performance over time, reveal differences between sensors, and quantify measurement uncertainties. Launched in October 2006, the Infrared Atmospheric Sounding Interferometer is one of the most advanced instruments on the MetOP satellite, which measures radiation emitted from the surface and atmosphere in the 645 – 2760 cm-1 (i.e., 3.6-15.5 µm) with high spectral resolution (i.e., 8461 spectral channels with a spectral sampling of 0.25 cm-1). Preliminary comparison of the measurements between IASI and the aircraft sensor (such as the Joint Airborne IASI Validation Experiment (JAIVEx)) indicates that IASI has operated well within specifications, maintaining superb spectral and radiometric calibration accuracy. Given the high hyperspectral nature and good data quality, IASI hyperspectral measurements allow more accurate comparisons of measured radiances with other broadband instruments sharing the same spectral regions, which provide an accurate evaluation for the on-board calibration. In this presentation, we explore the use of MetOP/IASI spectra to evaluate the radiances from the geostationary imagers. We will concentrate on the nadir observations with homogeneous regions. It is found that MetOp passes over the sub-point of a geostationary satellite every seven days. We will spectrally convolve the IASI measurements with the spectral response functions of the Geostationary Imagers. The spatial collocation will be performed to match the Geostationary Imagers and IASI pixels. Specifically, we will inter-calibrate the geostationary imagers on GOES-11 and GOES-12 using IASI by analyzing several months of datasets. The potential root causes of the bias will be investigated in this study, such as spectral uncertainties and day-night time effects. Compared with the existing studies that use the High Resolution Infrared Radiation Sounder (HIRS) and Atmospheric Infrared Sounders (AIRS) for inter-calibrating GOES imagers, using the IASI measurements does not need to deal with the spectral gaps and difference in the spectral response functions. We believe that IASI can potentially serve as a baseline to inter-calibrate the future Advanced Baseline Imager (ABI) flown the GOES-R satellite to verify the calibration of the ABI thermal channels.

P1.18 Generating synthetic infrared GOES-R ABI Images with AVHRR and GOES images, William J. Emery, University of Colorado, Boulder, Colorado; and C. Roessler

In order to simulate the behavior of future Advanced Baseline Imager data planned for the future GOES-R satellite we combine 1 km resolution infrared AVHRR imagery with 4 km resolution GOES imagery. The GOES images are then oversampled to a 1 km grid. A spectral filter is designed to reduce the scan line noise that dominates the GOES imagery. Hourly GOES images are used to compute the temporal gradient between images, which is then used to interpolate features between the 6-hourly AVHRR images. A test using two sequential AVHRR images demonstrates the success of this method. Unfortunately the GOES scan lines noise continues to influence the hourly interpolated images making them less than ideal representations of what the future ABI sensor will produce. Still, the method does demonstrate what level of spatial wavenumber features must be edited out to produce the best possible hourly images for the sequence of "ABI like" thermal infrared images. An animation of 24-hours of synthetic ABI infrared images demonstrates the improvement in depicting the thermal features of the ocean off the U.S. east coast in an area including the Gulf Stream. This method could provide a good test be for future ABI image testing.

P1.19 Synthetic GOES-R Imagery Development and Uses, Lewis Grasso, CIRA/Colorado State University, Fort Collins, Colorado; and M. Sengupta and D. T. Lindsey

Synthetic GOES-R ABI imagery has been routinely generated at the Cooperative Institute for Research in the Atmosphere (CIRA). Experience has shown that brightness temperatures are quite sensitive to ice crystal size at the top of a thunderstorm at 3.9 µm. Particle size influences values of the asymmetry parameter which in turn influences values of the Legendre coefficients via the Henyey-Greenstein parameterization. Legendre coefficients are used to build a phase function. This function determines how much energy is scattered and in what direction. As a result, obtaining accurate Legendre coefficients is desirable. Legendre coefficients for seven hydrometeor types are used to produce imagery. Pristine ice has been shown to account for the brightness temperatures on tops of thunderstorms. Thus Legendre coefficients for pristine ice are obtained from light scattering calculations; Legendre coefficients for the other six hydrometeors are based on the Henyey-Greenstein formula. We have developed a method to combine Legendre coefficients from the Henyey-Greenstein parameterization and Legendre coefficients from light scattering calculations. Both values are weighted by scattering coefficients. The resulting Legendre coefficients are then used to build the phase function to produce GOES-R ABI 3.9 µm imagery. Lastly, this method may be used to generate scattering phase functions for the remaining shortwave infrared ABI channels.

P1.20 Large-scale WRF model simulations used for GOES-R research activities Jason A. Otkin, CIMSS/University of Wisconsin, Madison, Wisconsin; and A. Huang, T. Greenwald, E. R. Olson, and J. Seiglaff

The next generation of Geostationary Operational Environmental Satellites (GOES), beginning with GOES-R, 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 (TOA) radiance datasets has been developed. The Weather Research and Forecasting (WRF) model is a critical component of this system since high-resolution model simulations are used to generate simulated atmospheric profile datasets that are subsequently passed through a sophisticated forward radiative transfer model to generate proxy TOA radiances in the GOES-R spectral range.

In this paper, we will describe recent simulation activities, including a massive WRF model simulation that was performed at the National Center for Supercomputing Applications (NCSA) at the University of Illinois in Urbana-Champaign. The simulation contains 3 nested domains configured to represent the anticipated GOES-R scanning regions (i.e. full disk, CONUS, and mesoscale). The outermost domain covers the entire GOES-R viewing area (55° S – 55° N; 160° W – 5° E) with 6-km horizontal grid spacing, while the inner domains cover the CONUS and mesoscale regions with 2-km and 667-m resolution, respectively. Proxy TOA radiances generated for this case study provide an important opportunity to realistically demonstrate GOES-R measurement capabilities.

P1.21 New instrumentation for characterizing the Moon as a standard for space-based radiometry, Allan Smith, National Institute of Standards and Technology, Gaithersburg, Maryland; and S. Lorentz, H. Yoon, R. Datla, D. Pollock, T. Stone, and J. Tansock

The need to understand and monitor climate change has led to proposed radiometric accuracy requirements for space-based remote-sensing instruments that are very stringent. Many of these requirements are unmet by the current fleet of Earth-orbiting instruments. A major problem is quantifying the changes that instruments undergo during the launch and throughout the mission. While on-orbit calibrators and monitors have been developed, they too can suffer changes from the launch and harsh space environment. One potential solution is to use the moon as a calibration reference source. Already the stability of the moon has been used to remove drift and to cross-calibrate different instruments. But, at present, the uncertainty of the absolute lunar spectral irradiance is too high for absolute on-orbit calibration of climate monitoring instruments. To enable use of the moon as an absolute calibration standard, we present in this paper an Earth-based instrument to measure the lunar spectral irradiance to an uncertainty of 1 % (k=1) over the spectral range from 320 nm to 2500 nm with a spectral resolution of approximately 0.3 %. The instrument would be flown on high altitude balloons and deployed at high elevation astronomical observatories in order to mitigate the effects of the Earth's atmosphere on the lunar observations. Periodic calibrations using advanced instrumentation and techniques available from NIST would ensure SI traceability and low radiometric uncertainties for the lunar irradiance measurements.

P1.22 Preliminary study of lunar calibration for geostationary imagers Seiichiro Kigawa, Japan Meteorological Agency, Kiyose-shi, Tokyo, Japan; and K. Miyaoka

Lunar calibration technique for Imager visible channel has been studied using Japanese Multi-functional Transport SATellite-2 (MTSAT-2) Imager data. For visible channel calibration, MTSAT-2 Imager has the special device that introduces sunlight into optics, and has been calibrated during post-launch testing. The lunar images taken by MTSAT-2 could also be absolutely calibrated and enable us to propagate the absolute calibration to other geostationary imagers by comparing lunar image brightness. As a result of this process, a lunar calibration equation was established. It was used to compare the lunar brightness and obtain the absolute calibration information. The equation applies to GMS, GOES and METEOSAT, and then some of them were compared with ISCCP calibration slope. They showed good agreement, but there were partial discrepancies. Additional calibrated lunar images are required in various lunar phase angles and various wavelengths to improve the geostationary lunar calibration technique. It is proposed that GOES-R (and MTSAT-2 follow-on) will acquire these additional lunar images with the calibration mechanism for visible channel, especially during post-launch testing. Preliminary results of the lunar calibration study are shown in this poster.

P1.23 Synthesis of Angular Distribution Models (ADMs) for use in Radiative Flux Estimates from the Advanced Baseline Imager (ABI), Xiaolei Niu, University of Maryland, College Park, Maryland; and R. Pinker

Prospects for improving estimates of atmospheric radiative fluxes with the availability of the higher temporal, spatial and spectral resolution observations from GOES-R ABI, have improved. Satellites observe radiances in certain spectral intervals and specified directions. There are two critical elements in the formulation of an inference scheme for radiative flux estimates from satellite observations: 1) transformation from narrow-band observations into broadband values; b) application of Angular Distribution Models (ADMs) to correct for angular dependence. The focus of this study is to prepare up-to-date ADMs for use with ABI's shortwave observations for clear and cloudy conditions. The information for the synthesis is based on theoretical simulations with a radiative transfer model and on the Clouds and the Earth's Radiant Energy System (CERES) models. The clear sky simulations are performed with the MODTRAN model using the newly developed IGBP land use classifications; for cloudy sky conditions, cloud types (water and ice) are selected in coordination with cloud types used for the CERES ADMs. To evaluate possible improvements due to the new ADMs, they were tested with proxy data. Specifically, the University of Maryland Surface Radiation Budget Model (UMD/SRB) as implemented with the GOES series of satellites was utilized. The existing ADMs in the UMD/SRB model are based on ERBE; they were replaced with the newly synthesized ADMs. The derived surface radiative fluxes with this update have shown improvements when compared to ground observations. In progress is work related to the development of new narrow to broadband transformations as appropriate to ABI. Use will be made of SEVIRI observations as a proxy for ABI.

P1.24 Use of SEVIRI cloud properties to simulate radiative fluxes from GOES-R ABI, R. T. Pinker, University of Maryland, College Park, Maryland; and R. Hollmann and H. Wang

Two types of approaches are widely used for deriving radiative fluxes from satellite observations. In one, utilized is a relationship between the broadband reflected radiation at the top of the atmosphere (TOA) and atmospheric transmittance. Once the atmospheric transmittance is known, the surface irradiance can be computed from the incoming solar flux at the TOA and auxiliary information on the state of the atmosphere and the surface. An alternative approach is to determine first atmospheric optical parameters (aerosol optical depth from clear sky radiances, and cloud optical depth and phase, from cloudy radiances). The rationale for the latter approach is that additional channels can be utilized to learn about cloud properties that in turn, affect the radiative fluxes. It is of interest to evaluate both approaches in a given situation. In order to implement the second approach, a suitable inference scheme is needed. Such an inference scheme has been previously developed at the University of Maryland. In this study, it is implemented with cloud properties derived at the EUMETSAT Satellite Application Facility on Climate Monitoring (CM-SAF) from METEOSAT-8 SEVIRI observations. These were produced under a reprocessing effort at CM-SAF and are presently available at hourly time scale and 15 km spatial scale for the full disk for about four months of 2004. Such data will also become available from the Advanced Baseline Imager (ABI) on GOES-R which has similar channels to those of SEVIRI. It is of interest to utilize this information for deriving radiative fluxes and evaluate them against ground observations as well as against a radiative flux product of the first type as produced at CM-SAF. It is hoped that an effort of this type will provide guidelines for optimal utilization of information from ABI on GOES-R.

P1.25 Effect of GOES-R image navigation and registration errors on atmospheric motion vectors, Gary J. Jedlovec, NASA/MSFC, Huntsville, Alabama

High temporal frequency imagery from geostationary satellites allows for the continuous monitoring of rapidly changing atmospheric constituents such as smoke, dust, water vapor and clouds. The image sequences are often used to quantify the displacement of image features such as water vapor and clouds to produce atmospheric motion vectors (AMVs) which are used as diagnostic tools and also assimilated into numerical weather forecast models. The basic principle behind the determination of AMVs is the calculation of the physical displacement of features from one image (time) to the next. This process assumes that the features being tracked do not change as a function of time, usually requiring the use of short time interval imagery to minimize substantial change in size and shape of the features being tracked. High spatial resolution imagery also is required for reliable feature identification. While these image resolution and temporal sampling requirements often provide major drivers for space-based instrument design requirements, accurate image navigation and registration, INR (between a sequence of images), is also critical to the derivation of useful AMVs. In this paper and poster to be presented at the conference, the image navigation and registration (INR) accuracy expected for the Advanced Baseline Imager (ABI) on the GOES-R series of satellites will be discussed in light of its impact on AMV accuracy. Significant satellite platform and modeling enhancements are planned which should significantly improve INR performance of the GOES-R instruments. Some of these improvements have been demonstrated for the GOES-13 satellite which was launched in summer of 2006. An analysis of GOES-13 INR data, from the special satellite check out period, will be used in the assessment.

P1.26 GOES-13 End-to-End INR Performance Verification and Post Launch Testing, Christopher A. Carson, Boeing Space & Intelligence Systems, Las Cruces, New Mexico; and J. L. Carr and C. Sayal

The GOES (Geostationary Operational Environmental Satellite) system is the high altitude U.S. civilian weather satellite system, nominally comprised of an East spacecraft over the Atlantic and a West spacecraft over the eastern Pacific. GOES-13, the first of the Boeing GOES N-P series, was launched in May, 2006 from Cape Canaveral, Florida. Post-Launch Testing (PLT), executed by NASA with the support of the Boeing team, occurred from June, 2006 through GOES-13 acceptance in December, 2006. The GOES N-P series delivers improved Image Navigation and Registration (INR) performance compared to that of the previous generation. This paper describes the GOES-13 INR verification process from conceptualization through system acceptance and demonstrates the improved INR capabilities of GOES-13 that will ultimately benefit end users.

PLT preparation and execution presented formidable technical challenges. Unique analytical tools and techniques were developed for calibrating and measuring on-orbit performance of instruments and new spacecraft precision pointing technologies introduced on GOES N-P. Ground system improvements included the addition of supporting services throughout eclipse, enhanced propulsion modeling, eclipse modeling, and improvements to the Image Motion Compensation (IMC) implementation. New performance assessment statistical tools were developed for interpreting measured INR system performance during the specification testing period. PLT and system acceptance was initiated by design verification with an end-to-end high fidelity simulator, the Performance Evaluation System (PES), and a closed-loop end-to-end INR System Functional Test (SFT). PES and SFT facilitated the evolution of the INR operational concept and the PLT process.

PLT was divided into two principal phases: the bus/payload Activation & Calibration (ACT) phase and the Systems Performance and Operations Testing (SPOT) phase. The ACT phase was 30 days long, commencing with spacecraft engineering handover and ending with Imager and Sounder cooler cover deployments. The SPOT phase was approximately 150 days and ended with the in-orbit acceptance of GOES-13. Key ACT phase testing and calibration included Stellar Inertial Attitude Determination (SIAD) alignment and Dynamic Motion Compensation (DMC) filter calibration. SPOT focused on INR operations and testing and included INR startup and calibration, INR normal mode specification testing, imaging during eclipse, yaw flip operations and system preparation and performance before and after all thruster maneuver operations.

The GOES N-P INR system design represents an evolution of the INR architecture and an infusion of advanced spacecraft pointing technology. Specified improvements for the N-P series include tighter navigation and frame-frame registration requirements. The important innovations for GOES N-P include:

- Stellar Inertial Attitude Determination
- Optical Bench
- IMC Implementation Improvements
- Closed-Loop DMC
- Accommodation of Thruster Maneuvers
- Eclipse and Yaw Flip Operations

P1.27 The ABI Image and Navigation Registration, Ken Ellis, ITT Space Systems Division, Fort Wayne, Indiana; and K. Gounder, P. Griffith, D. Igli, A. Kamel, J. Ogle, and V. Virgilio

Highly accurate image navigation and registration (INR) of data collected using remote sensors is key to satisfying mission requirements for satellite observation systems. Locating image data in a specifically defined scene has become a challenge of providing sub-pixel level knowledge of the location of the raw collected samples when computed in the designated scene. The precision INR solution presented in this study is one in which the instrument is used to collect measurements as a means of estimating the instrument line of sight attitude and thermal line of sight perturbations. The approach is applied to the GOES-R Advanced Baseline Imager (ABI) mission which collects star measurements (visible and IR) and using a Kalman filter with an order of magnitude fewer states than baseline GOES, estimates line of sight attitude and thermal drift. The algorithm computes corrections to the line of sight to compensate for thermal changes as the sample data are navigated and co-registered to the specified scene. Instrument line of sight and thermal deformation effects modeling are presented and simulation results show the attitude determination accuracy for the instrument line of sight as well as the location accuracy of samples navigated to the mission-defined scene.

P1.28 The ABI star sensing and star selection, Ken Ellis, ITT Space Systems Division, Fort Wayne, Indiana; and K. Gounder, P. Griffith, E. Hoffman, D. Igli, J. Ogle, and V. Virgilio

The ABI (Advanced Baseline Imager) uses periodic star sensing to determine the absolute line of sight. Using a specifically tailored onboard star catalogue, the ABI can sense visible stars (0.64 ƒÝm) for image navigation and IR stars (3.90 ƒÝm) for coregistration purposes. The 3ƒã location accuracy for stars of magnitude 7 is expected to be better than 2.5 ƒÝrad for the visible stars and 6 ƒÝrad for the IR stars. The ABI star sense algorithm simulates the star observation with the relevant mechanical and optical effects. It employs a centroiding technique and is robust against signal geometry, background noise, clutter, jitter and degradation. The onboard ABI star catalogue is prepared using appropriate selection criteria based on the ABI field of view, star isolation, and brightness.

P1.29 ABI instrument performance simulation, Ken Ellis, ITT Space Systems Division, Fort Wayne, Indiana; and R. D. Forkert, J. Witulski, and V. N. Virgilio

The ABI Instrument Performance Simulation (AIPS) is a leap forward in both the design and use of simulation in the development of a remote sensing system. It includes many features that separately are incremental improvements but when taken together represent a significant enhancement of simulation capabilities. The new capabilities enable new uses during the ABI development process that will have significant cost and schedule benefits. AIPS is also specifically designed for extensibility, significantly reducing the effort required to modify the simulation for application to other remote sensing systems.

P1.30 GOES-R Proxy Data Management System, Tong Zhu, NOAA/NESDIS, Camp Springs, MD; and M. J. Kim, F. Weng, M. Goldberg, A. Huang, M. Sengupta, D. K. Zhou, and B. Ruston

The GOES-R Algorithm Working Group (AWG) program requests a high quality of proxy data for algorithm developments, testing and assessments. The central tasks in the proxy data management system will be the delivery of observation and simulation based GOES-R proxy data, the development of visualization tools for various proxy data, the design of a GOES-R Observing System Simulation Experiment (OSSE) framework for demonstrating the potential impacts of GOES-R data on NWP forecasts.

During the last one year, proxy data team has generated a series of datasets based on observations and NWP models. The observation datasets include measurements from SEVIRI, GOES-08/10, MODIS, SURFRAD, AERONET, NAST-I, and HIRS-X. Numerical models MM5, WRF, RAMS were used to produce atmospheric profiles. The JCSDA Community Radiative Transfer Model (CRTM) and CIMSS Fast Infrared Radiative Transfer Model have been used to simulate ABI measurements.

Recently, several new proxy datasets have been produced, including: 3 cases of ABI data derived from NAST-I with co-incident radiosondes and dropsondes; a 20-day full disk SEVIRI dataset in 2005 with NetCDF format; a 94-day hourly SEVIRI dataset during 2004, 2006 and 2007 AEROSE field campaigns; and a 16-day MODIS NDVI data across the USA in 2001. The GOES-R OSSE study is underway. This poster will give an update of all proxy datasets with focus on new proxy data activities.

P1.31 Simulation of GOES-R ABI Radiances for OSSE, Tong Zhu, NOAA/NESDIS, Camp Springs, Maryland; and F. Weng, M. Masutani, S. Lord, J. Woollen, Q. Liu, and S. A. Boukabara

The Advanced Baseline Imager (ABI) will be flown on the next generation of NOAA Geostationary Operational Environmental Satellite (GOES)-R platform. The sensor will provide enhanced spatial, temporal information for atmospheric moisture, wind and many surface properties. A joint Observation System Simulation Experiments (OSSE) project was started recently to study the impacts of GOES-R ABI measurements on numerical weather prediction.

In this poster, we will present some results of the simulation of GOES-R ABI radiances based on OSSE nature run output and the evaluation against observations. A case study will be performed to analyze ECMWF T511 natural run results. ABI instrument properties and geometry factors are simulated based on current GOES and MSG SEVIRI sensors. The JCSDA Community Radiative Transfer Model (CRTM) is used to simulate ABI radiances with the natural run atmospheric profiles. The simulated radiances are evaluated by comparing with MSG SEVIRI and current GOES observations.

P1.32 Multi-spectral precipitation estimation using Artificial Neural Networks, Ali Behrangi, Center for Hydrometeorology and Remote Sensing (CHRS), Irvine, California; and K. L. Hsu, S. Sorooshian, and R. Kuligowski

Geostationary satellite sensors have been widely applied to precipitation estimation due to their capability of providing good temporal and spatial image resolution. Although most of the current geostationary based precipitation retrieval algorithms are using single or bi-spectral channels, experiments have shown that multi-spectral imagery can benefit precipitation estimation. With the advent of the next generation of geostationary satellites (e.g., GOES-R) more spectral channels with higher temporal and spatial resolution will be provided. Meanwhile, with the increased amount of information and different embedded properties, the retrieval algorithms are required to have the capability of processing multiple channels in a computationally efficient and effective manner.

A multi-spectral precipitation retrieval algorithm using an Artificial Neural Network (ANN) model has been developed. The algorithm consists of two separate stages: (1) spectral feature classification and (2) sorting classes and multi-spectral probability matching. The classification stage relies on the unsupervised self organizing feature map (SOFM) classifier. SOFM classifies image pixels, with their associated multidimensional input features, into a number of predetermined clusters. These clusters are organized into a two dimensional discrete map which preserves the topological order. Using the observed precipitation, the SOFM clusters are ranked based on their mean rain rates. Afterwards, these ranked clusters are fitted with rain observation based on the probability matching method (PMM).

The proposed algorithm was first tested using 3 months of data from the current GOES satellites with 5 spectral channels. The next step of the experiment using 12-channel spinning imager (SEVIRI) onboard EUMETSAT's MSG satellite is ongoing. Attempts to use multi-spectral bands and their associated textural features for precipitation estimation highly increased the input space dimension. Principal component analysis (PCA) is applied to eliminate highly correlated input features. The PCA dimension compression of input spectral features also reduced the computational cost substantially. Four weeks of SEVIRI images have been evaluated and the preliminary results are encouraging. Details of the proposed algorithm, case studies, and evaluation will be presented.

P1.33 Improving Nowcasting of convective storm development using MSG SEVIRI, MODIS, and GOES-12 imagery as risk reduction for GOES-R ABI, Kristopher M. Bedka, CIMSS/University of Wisconsin, Madison, WI; and W. F. Feltz, J. Sieglaff, and J. R. Mecikalski

Research is being done at the University of Wisconsin-Madison's SSEC/CIMSS to evaluate the potential improvement in diagnosing and nowcasting convective storm development through the use of future GOES-R ABI imagery. As ABI may still be ~7 years from launch, aspects of current generation instruments must be combined to simulate what ABI imagery could provide. MSG SEVIRI and MODIS are being used to assess the benefits of improved spectral coverage from ABI. 1 km IR imagery from MODIS is being used to investigate benefits of ABI's improved spatial resolution. 1 (SRSO) to 5 (RSO) minute imagery from GOES-12 is being used to look at improvements in temporal resolution from ABI.

Results show that for 1-5 min resolution imagery, one can compute cloud top growth trends without having to explicitly track cumulus cloud pixels over time, as their movement is limited to a small area over such a short time period. Thus, IR brightness temperatures and differences can be combined with a convective cloud mask to compute "box-averaged" cumulus cloud properties which can be differenced in time to derive compute cloud top growth trends. This box-averaged product exhibits improved spatial coherency and fewer false alarms than the method from Mecikalski and Bedka (MWR, 2006) which uses mesoscale satellite winds to compute growth trends at the pixel scale.

Improved ABI spatial resolution and spectral coverage will allow for improved convective cloud classification and depiction of severe thunderstorm signatures such as overshooting tops and enhanced-V features. Also, information from the 8.5 and 12.0 micron channels can be used as a proxy to identify cloud-top phase transitions, an important indicator of the onset of precipitation at the surface over the mid-latitudes. Results show improved nowcasting of convective initiation from MSG SEVIRI through the use of better cumulus classification and cloud microphysical information during the COPS field experiment.

P1.34 GOES Winter Precipitation efficiency algorithm, Robert M. Rabin, NOAA/NSSL, Norman, OK; and J. Hanna

Recent studies have shown the importance of snow microphysics for heavy snowfall. Specifically, snow production and accumulation appears to be highly efficient when a maximum in saturated vertical ascent (level of non-divergence) is collocated within a narrow temperature range (centered at -15ºC). This temperature range is favorable for efficient snow production as a result of the preferential growth of ice crystals by deposition. In addition the dominant crystal type formed in this temperature range is dendrites which have been shown to be conducive for high snow to liquid ratios.

To highlight areas conducive for this highly efficient snowfall a GOES Winter Precipitation Efficiency Algorithm was developed by the lead author. The GOES Winter Precipitation Efficiency Algorithm uses cloud-top temperature from the Geostationary Operational Environmental Satellite (GOES) Imager combined with cloud products derived from radiance information from the GOES Sounder to create an analysis of the height of the pressure level at -15ºC. Further refinement of the analysis is conducted by including vertical velocity output from the Rapid Update Cycle to highlight areas where the -15ºC pressure level is collocated with moderate lift (defined in the algorithm as -5µb/sec).

P1.35 Proxy ABI datasets relevant for fire detection that are derived from MODIS data, Scott S. Lindstrom, CIMSS/University of Wisconsin, Madison, WI; and C. C. Schmidt, E. M. Prins, J. Hoffman, J. Brunner, and T. J. Schmit

Proxy Advanced Baseline Imager (ABI) data relevant for fire detection are computed using MODIS data from channels 1, 2, 21, 22, 31 and 32 (0.65, 0.86, 3.99, 3.97, 11 and 12 micrometers). Simulated data are produced for three fire case studies in three unique fire domains subject to different satellite angles. The three case studies represent wildfire activity in southern California, agricultural management fires in central America and deforestation/agricultural management in western Brazil.

ABI data at 2-km resolution (at the sub-satellite point, assumed to be 0 N, 75 W) are computed using full-resolution MODIS data and a point spread function (PSF) that approximates the PSF anticipated for the ABI sensors. ABI data so computed from satellite data are physically consistent and thus have inherent advantages over proxy ABI data that can be derived from numerical model output. Although these data are computed for the ABI channels relevant for fire detection, the procedure is straightforward and can be applied to any MODIS channel that has a match in the ABI sensor.

P1.36 Validating GOES active fire detection product using ASTER and ETM+ Wilfrid Schroeder, University of Maryland, College Park, Maryland; and I. Csiszar, E. M. Prins, C. C. Schmidt, and M. G. Ruminski

In this study we implemented a comprehensive analysis to validate the GOES WFABBA active fire detection product using approximately 400 ASTER and ETM+ scenes at 30 m resolution as our primary validation data. Our analyses are focused in the Conterminous United States and Brazilian Amazonia, two important areas of fire activity in the Americas. We characterize the major sources of omission and commission errors which have important implications for a large community of fire data users. We found that at the 50% detection probability mark ($p<0.001$), WFABBA requires four times more active fire area than it is necessary for MODIS Thermal Anomalies (MOD14) to achieve the same probability of detection, despite the 16× factor separating the nominal spatial resolutions of the two products. Approximately 95% of all fires sampled were omitted by the WFABBA instantaneous product whereas this omission error was reduced to 38% when considering the 30 minute interval of the GOES data. Commission errors were highly dependent on the vegetation conditions in particular across Amazonia, with the larger commission errors (approximately 35%) estimated over regions of active deforestation. Nonetheless, the vast majority (> 80%) of the commission errors were indeed associated with recent burning activity where scars could be visually confirmed in the higher resolution data. The overall non-fire related commission errors were estimated as only 3% for both the Conterminous United States and Brazilian Amazonia.

P1.37 GOES-R ABI fire detection and monitoring development activities, Christopher C. Schmidt, CIMSS/University of Wisconsin, Madison, Wisconsin; and S. Lindstrom, J. Hoffman, J. Brunner, and E. M. Prins

The international environmental monitoring and scientific research communities have stressed the importance of utilizing operational satellites to produce routine fire products for hazards applications and to ensure long-term stable records of fire activity for land-use/land-cover change analyses and global climate change research. Since the year 2000, the GOES Wildfire Automated Biomass Burning Algorithm (WF_ABBA) has been providing diurnal information on fire activity throughout the Western Hemisphere. The Advanced Baseline Imager (ABI) on GOES-R and beyond will enable continued analysis of fire activity with significant improvements in fire detection and sub-pixel fire characterization. UW-Madison CIMSS has modified the current WF_ABBA to take advantage of the enhanced fire monitoring capabilities of ABI. Modifications include updating modules that identify and characterize sub-pixel fire activity. Various GOES-R ABI proxy data sets are used to test the updates. In order to understand the impact of these modifications and to evaluate the performance of the GOES-R ABI WF_ABBA, the algorithm was applied to simulated GOES-R ABI data derived from higher spatial resolution MODIS data and model simulated ABI data. The results demonstrate the robustness of the algorithm to meet GOES-R requirements for fire monitoring.

P1.38 Quantifying uncertainties in fire size and temperature measured by GOES-R ABI, Manajit Sengupta, CIRA/Colorado State Univerdsity, Fort Collins, Colorado; and L. Grasso, D. W. Hillger, R. Brummer, and M. DeMaria

The nominal GOES-R Advanced Baseline Imager (ABI) pixel size at sub-satellite point has been specified to be 2 km X 2 km. Actual measurements though will contain information from neighboring pixels as a result of diffraction. Fires on the ground have temperatures much higher than neighboring regions and can be smaller than the GOES-R pixel size. Diffraction and pixel resolution will contribute to blurring the fire signature. Additionally observed fire size and temperature may vary because of the way GOES-R ABI will sample the ground especially for smaller fires. Our goal is to determine and quantify the sources of uncertainty in fire detection. Therefore we have simulated fires over Kansas at a resolution of 400 m X 400 m. Radiances are then computed for the 3.9, 10.35 and 11.2 ìm ABI channels, as these are the fire detection channels. Appropriate point spread functions for these GOES-R ABI channels are created and then used to generate ABI data. In this paper we show how the point spread functions were created for the various bands. We also investigate how the signatures of similar fires vary as a result of pixel sampling. It is expected that such efforts to estimate uncertainty will ultimately result in better characterization of fires from GOES-R ABI which will then lead to better characterization of emission.

P1.39 Quality Assessment of the GOES-R AWG Level 2 Product Processing System Lihang Zhou, Perot System, Fairfax, Virginia; and W. W. Wolf, S. Qu, P. Keehn, Q. Guo, S. Sampson, and M. D. Goldberg

NOAA/NESDIS/STAR is taking the lead in the activities to develop, demonstrate and recommend pre-operational algorithms for the GOES-R Level 2 product systems. Fifteen GOES-R Algorithm Working Group (AWG) teams have been formed to select the specialty area algorithms and develop the corresponding product generation systems. The Algorithm Integration Team (AIT) is building a framework that can process all the GOES-R Level 2 products. The framework being built will be used to test the algorithms individually as well as a complete system with all products. To assure the quality of the products and performance of the system meeting the requirements, tools for monitoring the system and visualizing the products are being developed based on our experience from AIRS and IASI, integrating with other existing tools for GOES products. In this presentation we will describe how AIT will evaluate AWG Level 2 Product Processing System usage, as well as how to monitor, verify, and validate the AWG products. The plan and strategy to compare and integrate products from different satellite platforms will also be addressed.

P1.40 Trade-off studies on future GOES hyperspectral infrared sounding instrument, Jinlong Li, CIMSS/University of Wisconsin, Madison, Wisconsin; and J. Li, T. J. Schmit, and J. J. Gurka

Future geostationary operational environmental satellite (GOES) sounding (suggested hyperspectral infrared (IR) sounder on GOES-T) instrument could provide the accurate three dimensional temperature and moisture distribution with high temporal and spatial resolutions. To optimize the geostationary hyperspectral IR sounding instrument that meets the users' requirement, trade-off study has been carried out to balance the spectral coverage, spectral resolution, spatial resolution, temporal resolution and signal to noise ratio (SNR) for temperature and moisture soundings. Study has showed that hyperspectral IR sounder with properly selected spectral coverage, spectral resolution and SNR can achieve the accuracy of 1K for temperature and 10% for relative humidity in troposphere. The impact of temporal and spatial resolutions on sounding product is also studied. The great advantage of future geostationary hyperspectral IR sounding system over the current GOES sounder in severe weather forecasting and nowcasting is demonstrated.

P1.41 Sounder options in the GOES-R era, David Crain, ITT Space Systems Division, Fort Wayne, Indiana

Operational Sounder Products are an essential component of the expected benefits of the GOES-R Program. Despite programmatic decisions which have led to the loss of a dedicated Sounder on the GOES-R Spacecraft, options do exist to provide a significant improvement over current GEO sounding capabilities. We will compare the cost, benefits and risks of these options to show that Advanced Operational Sounding is practical to implement and provides unique capability to improve severe weather, hurricane, aviation weather, NWP and climate change forecasting.

P1.42 Hyperspectral infrared alone cloudy sounding algorithm development, Elisabeth Weisz, University of Wisconsin/CIMSS, Madison, Wisconsin; and J. Li, C. Y. Liu, D. K. Zhou, H. L. Huang, and M. Goldberg

As a first step to combine high temporal resolution ABI (Advanced Baseline Imager on GOES-R) and hyperspectral infrared (IR) sounder (on polar orbiting satellites) data in a novel sounding approach, a retrieval algorithm has been developed to simultaneously derive atmospheric temperature, humidity and ozone profiles under all weather conditions. The methodology is based on eigenvector regression and is applied to AIRS (Atmospheric Infrared Sounder) single field-of-view radiances. Validation of the retrieval products is conducted by using the operational products of MODIS (Moderate Resolution Imaging Spectroradiometer) and AIRS, ECMWF (European Centre for Medium-Range Weather Forecasts) analysis fields and radiosonde observations. These inter-comparisons clearly demonstrate the potential of this algorithm to process the data of high-spectral infrared sounder instruments like AIRS, IASI (Infrared Atmospheric Sounding Interferometer, results are also shown) and CrIS (Cross-track Infrared Sounder).

P1.43 Improved GOES water vapor products over CONUS – planning for GOES-R, Daniel Birkenheuer, NOAA/ESRL, Boulder, Colorado; and S. Gutman, S. Sahm, and K. Holub

The NOAA Earth System Research Laboratory (ESRL) has been comparing GOES water vapor products with ground-based global positioning system (GPS) integrated water vapor estimates since 2002 (Birkenheuer and Gutman, 2005). The purpose of this work has been to assess GOES total precipitable water (TPW) retrieval performance at both synoptic and asynoptic times, assess seasonal-interannual changes in TPW retrieval performance, and develop strategies to make GOES TPW estimates more useful to NOAA forecasters and modelers. We have observed a consistent moist bias in GOES East, and no significant systematic errors in GOES West with respect to GPS. To deal with the GOES East problem, we have developed an error-correction strategy that brings GOES East measurements into close agreement with GOES West and GPS TPW over CONUS.

Using MODIS data as a proxy for GOES-R ABI observations, we have started to make routine comparisons of simulated GOES-R ABI measurements with GPS to assess the relative performance of this anticipated observing system with respect to GOES 9-13. Our initial conclusion is that the simulated ABI retrievals over the Eastern U.S. are in better agreement with GPS, but they tend to be moist biased in the Western U.S. compared with the current GOES West data.

The need for an ABI TPW correction will be explored. References:
Birkenheuer, D., and S. Gutman, 2005: A comparison of the GOES moisture-derived product and GPS-IPW during IHOP. J. Atmos. Oceanic Tech. 22, 1840-1847.

P1.44 Aerosol size density characterization for single scattering using Artificial Neural Network, Andres Bonilla, University of Puerto Rico, Mayaguez, Puerto Rico; and H. Parsiani

Climate models, in their effort to predict the weather properly, among other variables, require the aerosol size density. The determination of aerosol size density from aerosol optical depth is an ill-posed problem. A typical mathematical inversion approach consists of using a linear regularization method, which requires a smoothing operation on the penalty term associated with the regularization method. The severity of the smoothing operation itself is being optimized by a Lagrange multiplier to enable minimum error in the inversion calculations.

We propose solving this type of ill-posed problem using an artificial neural network (ANN), which will be trained with a typical pattern of Puerto Rico AOD and known size density, which will be used to take AOD data and generate size density on a continuous basis. This "typical pattern" may vary too drastically from season to season, so two networks may be used, to account for Puerto Rico's two major seasonal wind patterns. The network's reliability rests in obtaining the best training data possible that describes a relationship between AOD and aerosol size density in a given area of Puerto Rico. As a first attempt to generate size density, the training of ANN will be presented using AERONET data from nearby La Parguera for both AOD and size density.

P1.45 AER general 1D-Var retrieval infrastructure: transition from research to operations, Richard J. Lynch, AER, Inc., Lexington, Massachusetts; and J. L. Moncet, A. Lipton, D. Hogan, R. d'Entremont, and H. Snell

A general 1D-Var retrieval infrastructure has been developed with the design philosophy based on emphasizing the transition of basic research into the operational stream. The infrastructure covers each of the key components for a successful retrieval/assimilation. A fast and accurate forward radiative transfer model is essential for a robust retrieval. OSS represents the state of the art of fast RT models, under both clear and cloudy conditions, and has already been successfully incorporated into both the Community Radiative Transfer Model (CRTM) and is part of the NPOESS operational system. It is also essential to that the fast RT model is trained and validated with the most up to date LBL models. LBLRTM is the state of the art in LBL models, incorporating the most up to date line parameters and line shapes. The general infrastructure has allowed recent developments in cloud and surface parameter characterization/models to be incorporated into the general retrieval product generation routines. Retrieval technology, developed to optimize the NPOESS CrIMSS/CMIS retrievals, have been incorporated. Infrastructure has also been developed for post post-processing and validating retrieval products. The validation methods are applied operationally at AER for the data collected with the NOAA AMSU instruments. This will serve as a model for the NPOESS CrIS validation for which the METOP IASI can be used as a prototype.

P1.46 The GOES-R User Readiness Group, engaging and preparing the users for GOES-R data, Kenneth H. Lowe, Noblis, Falls Church, Virginia; and M. Goldberg and J. Daniels

The instruments on the next generation of Geostationary Environmental Operational Satellite's (GOES-R series) require the development of state-of-the-art algorithms to convert raw instrument data into calibrated radiances and derived geophysical parameters. The GOES-R Program Office has tasked the NESDIS/STAR Algorithm Working Group (AWG) to develop, demonstrate and provide recommended and preferred algorithms, end-to-end product algorithm capabilities and product algorithm enhancements. The AWG algorithms will take advantage of the improved spatial, spectral and radiometric resolutions of the GOES-R instruments to create new and enhanced products for the user community. At the 2007 AWG Annual Meeting, the need for engaging and preparing users of GOES-R products was established and a User Readiness Group was created. The user community is identified and the process for informing the users on algorithm developments and product enhancements is detailed.

P1.47 Overview of GOES-R Analysis Facility for Instrument Impacts on Requirements (GRAFIIR) Planned Activities and Recent Progress, Allen Huang, CIMSS/University of Wisconsin, Madison, Wisconsin; and M. Goldberg

GRAFIIR is a facility established to leverage existing capabilities and those under development for both current GOES and its successor in data processing and product evaluation to support GOES-R analysis of instruments 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 frame work to effectively adopt component algorithms toward analyzing the sensor measurements with different elements of sensor characteristic (i.e. noise, navigation, band to band co-registration, diffraction, etc.) and its impact on products. GRAFIIR is also built to assess and evaluate many of the GOES-R data and products (i.e. imagery, clouds, derived products, soundings, winds, etc.) in a consistent way to ensure the instrument effects on the products can be fully accounted for, characterized and product performance could be optimized.

P1.48 GOES-R Algorithm Working Group: Space weather team update, S. Hill, NOAA/NWS, Boulder, Colorado; and H. J. Singer, T. Onsager, R. Viereck, D. Biesecker, C. C. Balch, D. C. Wilkinson, M. Shouldis, P. Loto'aniu, J. Gannon, and L. Mayer

The Space Weather (SWx) Team of the Algorithm Working Group (AWG) Application Team (AT) addresses algorithm development and readiness for the Solar Ultraviolet Imager (SUVI), Extreme Ultraviolet and X-ray Irradiance Suite (EXIS), Space Environment In Situ Suite (SEISS), and magnetometer. Membership draws on NOAA's Space Weather Program and includes representation from the NCEP Space Environment Center (SEC) and from the NESDIS National Geophysical Data Center (NGDC). Significant progress has been made in the first phase of algorithm development. In the past year, the SWx AT has inventoried existing algorithms, held an algorithm design review, created algorithm flowcharts, developed proxy data, and created a product validation approach, and deployed a shared development environment. This poster presents highlights of the past year's progress as well as planned activities in the next year.

P1.49 Space weather products from the GOES-R magnetometer, Paul T.M. Loto'aniu, NOAA/NWS, Boulder, Colorado; and H. J. Singer

Since their inception in the 1970's, the GOES satellites have monitored Earth's highly variable magnetic field using magnetometers. The GOES-R magnetometer requirements are similar to the tri-axial fluxgates that have previously flown. GOES-R requires measurements of three components of the geomagnetic field with a resolution of least 0.016 nT and sampling at a 2 Hz threshold with goal of 8 Hz. This instrument will provide measurements of the space environment magnetic field that controls charged particle dynamics in the outer region of the magnetosphere. These particles can be dangerous to spacecraft and human spaceflight. The geomagnetic field measurements are important for providing alerts and warnings to many customers, including satellite operators and the power utilities. GOES magnetometer data are also important in research, being among the most widely used spacecraft data by the national and international research community. The GOES-R magnetometer products will be an integral part of the NOAA space weather operations providing, for example, information on the general level of geomagnetic activity and permitting detection of magnetopause crossings and storm sudden commencements. In addition measurements will be used to validate large-scale space environment models that are used in operations. In this presentation, in addition to briefly describing the instrument requirements and its uses, we will also describe some of the products under development through the Algorithm Working Group activities.

P1.50 Improving space weather forecasts using solar coronagraph data, Simon P. Plunkett, NRL, Washington, D.C.; and A. Vourlidas, D. R. McMullin, K. Battams, and R. C. Colaninno

As part of a risk reduction effort for the NOAA GOES program, we have conducted two research tasks aimed at improving forecasting of space weather effects caused by solar coronal mass ejections (CMEs). One of these tasks is to quantify CME morphology and its impact on forecasts of CME or shock arrival at Earth, and to determine if measures of CME asymmetry near the Sun can be used to objectively improve forecasts of geomagnetic storm activity. The second task is to determine the optimal measures of event speed to be used as inputs to models for predicting CME or shock arrival at Earth based on solar observations. We report on the results of these tasks, and we present recommendations for operational use to provide the best possible space weather forecasts.

P1.51 GOES-N EUVS observations during post-launch testing, Douglas J. Strickland, Computational Physics, Inc., Springfield, Virginia; and J. S. Evans, W. K. Woo, D. R. McMullin, S. P. Plunkett, and R. Viereck

We report initial observations by the Extreme Ultraviolet Sensor (EUVS) that is the first of four such sensors to be flown on the N-P series of GOES. The Post-Launch Test (PLT) period began in July 2006 and ended in early January 2007 during which continuous observations were made from August through November. Data will be reported from EUVS's five spectral channels designated by the letters A-E whose reporting intervals from the EUVS Calibration and Data Handbook are 5-15, 25-34, 42-63, 17-81, and 118-127 nm, respectively. The dominant contributors to Channels B and E are HeII 30.4 nm and HI 121.6 nm, respectively. Comparisons for selected months from the PLT period will be made with TIMED/SEE data for all channels and with SOHO/SEM data for Channel B. EUVS observations of the X-class flare that occurred on December 5 will also be reported, including flare to pre-flare irradiance ratios from channel to channel.

All EUVS data being reported have been processed by us using the newly developed calibration algorithm presented in the companion paper. The algorithm software enables us to examine changes to calibration factors caused by pointing offsets and to changes in spectral behavior over the spectral range of a given channel. An assessment of the PLT EUVS data being presented will be given in light of sensitivity studies that have addressed these effects

P1.52 GOES-N EUVS field of view sensitivities and modeling, Donald R. McMullin, Praxis, Inc., Alexandria, Virginia; and D. J. Strickland, J. S. Evans, W. K. Woo, S. P. Plunkett, and R. Viereck

The successful launch of the GOES-N spacecraft will provide the first series of GOES solar EUV irradiance measurements. The new measurements will provide users with detailed observations of the absolute value of solar EUV energy flux and the temporal variance on time scales as short as seconds. Each EUV sensor (EUVS) in the GOES-N series is a transmission grating based instrument, similar to the SOHO/SEM instrument. We have studied the design of the GOES-N EUVS from the EUVS Calibration and Data Handbook with a focus on the Field Of View (FOV) sensitivity to alignment and solar pointing. In this work, we have developed a new algorithm that includes changes in the instrument calibration as a function of solar pointing as well as the spatial distribution of solar intensity across the disk. The new calibration algorithm has been used to develop a new time series of GOES EUVS data collected during the GOES-N Post-Launch Test period (PLT) and these results are reported in the companion paper.

P1.53 Enhancing the Geostationary Lightning Mapper for improved performance, David B. Johnson, NCAR, Boulder, Colorado

The GOES-R Geostationary Lightning Mapper (GLM) will provide valuable new earth-observation capabilities for real-time operational applications and research. The current GLM specification calls for 10-km resolution at nadir. The progressive foreshortening of earth features away from nadir, however, will reduce the instrument's effective resolution, increasing the lightning sensor's ground sample distance (GSD) to values of 20 to 30 km over many areas of interest, including much of CONUS. While the GLM lightning observations will still be valuable, the reduced resolution will be a limiting factor for some applications.

This presentation discusses a new class of optical devices that can be used to correct for the loss in image resolution due to angle of view and earth curvature effects. The optical adapters are a hardware modification that would have to be designed into new remote sensing instruments before launch. These adapters are particularly well-suited for use with the current GLM designs, and in most cases the functionality of the adapter could be incorporated into existing optical components.

With this enhancement, the GLM should be able to provide significantly higher resolution lightning position reports over CONUS (and other areas offset from nadir), while simultaneously providing uniform GSD observations across virtually the entire earth disk. With this approach, the nadir resolution requirement could be generalized into a single resolution requirement for the entire field of view.

P1.54 A microwave sounder for geostationary orbit, Bjorn H. Lambrigtsen, JPL and California Institute of Technology, Pasadena, California

The Geostationary Synthetic Thinned Aperture Radiometer (GeoSTAR) is a new Earth remote sensing instrument concept that has been under development at the Jet Propulsion Laboratory. First conceived in 1998 as a NASA New Millennium Program mission and subsequently developed in 2003-2006 as a proof-of-concept prototype under the NASA Instrument Incubator Program, it is intended to fill a serious gap in our Earth remote sensing capabilities – namely the lack of a microwave atmospheric sounder in geostationary orbit. The importance of such observations has been recognized by the National Academy of Sciences National Research Council, which recently released its report on a "Decadal Survey" of NASA Earth Science activities. One of the recommended missions for the next decade is a geostationary microwave sounder. GeoSTAR is well positioned to meet the requirements of such a mission, and because of the substantial investment NASA has already made in GeoSTAR technology development, this concept is fast approaching the necessary maturity for implementation in the next decade. NOAA is interested in GeoSTAR as a potential payload on a future series of geostationary weather satellites, the GOES-R series and has closely monitored the technology development since 2003. GeoSTAR, with its ability to map out the three-dimensional structure of temperature, water vapor, clouds, precipitation and convective parameters on a continual basis, will significantly enhance our ability to observe hurricanes and other severe storms and would significantly improve the GOES-R capabilities in these areas. We discuss the GeoSTAR concept and basic design, the performance of the prototype, and the most important science applications that will be possible with GeoSTAR. The work reported on here was performed at the Jet Propulsion Laboratory, California Institute of Technology under a contract with the National Aeronautics and Space Administration.

P1.55 Activities of GOES-R land applications working group team, Dan Tarpley, NOAA/NESDIS, Camp Springs, Maryland; and Y. Yu, P. Romanov, E. Prins, K. Gallo, F. Kogan, H. Xu, M. K. RamaVarma Raja, K. Y. Vinnikov, M. Goldberg, S. Qiu, and J. L. Privette

The advanced baseline imager (ABI), which will be on board the GOES-R satellite planned for launch in 2015, will provide a best-ever opportunity for measuring land parameters from geostationary orbit. This instrument will provide the best-ever opportunity for measuring land parameters from the geostationary orbit. The following land surface products will be derived from GOES-R ABI data: land surface temperature (LST), normalized difference vegetation index (NDVI), green vegetation fraction (GVF), fire detection and characterization, surface albedo, and occurrence of standing water. The GOES-R land applications working group (AWG) is responsible for developing, evaluating and delivering corresponding algorithms for the above products. Currently, the land AWG team has finalized techniques needed for developing all the land surface products, except the standing water. In particular, split window techniques will be applied for the LST algorithm development and the algorithm coefficients will be stratified for dry and moist atmospheric conditions as well as for daytime and nighttime. In the NDVI algorithm development, daily NDVI will be composited from half hourly NDVI using maximum NDVI compositing technique, while weekly NDVI will be composited from the maximum daily NDVI. The fire algorithm will be heritage from the current GOES fire product. Currently, algorithms for LST, NDVI and fire identification are being tested using MSG/SERIVI data, with encouraging results. More details of these activities and achievements will be presented in this paper.

P1.56 Seasonal, Diurnal, and Weather Related Variations of Clear Sky Land Surface Temperature: A Statistical Assessment, Konstantin Y. Vinnikov, University of Maryland, College Park, Maryland; and Y. Yu, M. K. Rama Varma Raja, J. D. Tarpley, and M. D. Goldberg

Geostationary satellites provide opportunity for long-term monitoring of temporal and spatial variations of clear sky Land Surface Temperature (LST). Such monitoring is an important component of the GOES-R satellites observational program. Clear sky LST is a relatively new variable for meteorologists and needs to be studied theoretically and empirically. The results of statistical assessment of seasonal, diurnal, and weather related components in observed variations of clear sky land surface temperature will be presented in this paper.

LSTs estimated from infrared broad-band (3 to 50 microns) upwelling and downwelling irradiance measurements at six sites of Surface Radiation Network (SURFRAD) over Contiguous United States during the year 2001 are used as ground truth. GOES-8 and GOES-10 hourly observed IR brightness temperatures in atmospheric thermal split window channels for pixels closest to the site locations are used to retrieve the clear sky LSTs. The LST algorithm applied in this study is developed by Yu et al. (Yu et al., 2007). Clear sky conditions have been determined using an original manual cloud screening technique (Rama Varma Raja et al., 2007). The first two harmonics of diurnal and annual cycles are used to approximate the expected value and the variance of clear sky land surface temperature. The technique is described in (Vinnikov et al., 2004. http:/www.atmos.umd.edu/~kostya/Pdf/arbitrary.grl.pdf).

We found that the largest components in temporal variation of the clear sky LST are annual and diurnal cycles. The ranges of these variations may exceed 25K. Systematic differences, up to a few degrees K, between satellite and surface-observed clear sky LST are discussed. The weather-related components of clear sky LST variability (residuals) are much smaller than the amplitudes of seasonal and diurnal variations. These residuals estimated for SURFRAD stations and for coincident satellite observations are correlated, with correlation coefficients of about 0.9. The root mean squared difference of satellite and SURFRAD observed residuals does not exceed 1.5K. This means that GOES satellites are able to monitor satisfactorily, the weather-related temporal variations of clear sky LST.

A physical nature of weather related variation of clear sky LST and its statistical properties will be discussed.

P1.57 Enhanced Observation Capability of the New Generation Geostationary Satellites for Better Vegetation Monitoring, Peter Romanov, University of Maryland and NOAA/NESDIS, Camp Springs, Maryland; and H. Xu and D. Tarpley

GOES-R ABI will be the first GOES imaging instrument providing observations in both the visible and the near infrared spectral bands. Therefore it can be used to generate vegetation index for monitoring the state of vegetation cover as well as for identifying vegetation stress and drought. In addition to the improved spectral capability, the advantage of GOES-R ABI consists of enhanced spatial (2 km) and temporal (every 5 min.) resolutions.

This presentation demonstrates progress in the work on generating NDVI and evaluating compositing algorithms for GOES-R. Meteosat 8 SEVIRI data are used as proxy for GOES-R ABI. A set of remapped and reprojected MSG SEVIRI half-hourly images covering Europe and Africa has been analyzed since June 2006. Collection of a set of SEVIRI full-disk images started in late February 2007. Both of these datasets are used to test NDVI algorithms and assess their accuracy.

Examples of NDVI products derived from MSG SEVIRI data are presented. Diurnal variations of the derived NDVI caused by angular anisotropy of the land surface reflectance in the visible and in the near-infrared are evaluated for different land cover types and for different seasons. Seasonal changes of daily and weekly NDVI composite values over different locations with different vegetation types are also examined. NDVI retrievals from MSG SEVIRI are further compared with data from NOAA AVHRR, demonstrating the advantage of using multiple observations per day available with geostationary satellites.

P1.58 Comparison of GOES cloud classification algorithms employing explicit and implicit physics, Richard L. Bankert, NRL, Monterey, California; and C. Mitrescu, S. D. Miller, and R. H. Wade

Scene classification and/or cloud typing of GOES imagery serves many purposes depending on the user's operational or research needs. Two cloud identification algorithms are applied hourly to daytime imagery during a 1-year (approximately) period over an area in the Northeastern Pacific. One method employs pixel classification of cloud types – liquid, supercooled or mixed, glaciated, cirrus, overlapping clouds, and clear – based upon multi-spectral spatial uniformity and contrast tests (explicit physics). The second method applies supervised learning methods in which the spectral and textural characteristics (implicit physics) of historical cloud class (stratus, cirrus, cumulonimbus, etc) samples within hundreds of GOES images are extracted and stored in a database with a 1-nearest neighbor algorithm applied to new samples. While neither method can claim to be ground truth, an improved assessment and confidence of a given pixel's actual cloud type/classification can be achieved based on a comparison of the two method's output. In conjunction with that assessment, the strengths and weaknesses of each method are discovered or confirmed leading, perhaps, to improvements in the algorithms. Finally, a combination product based on the output of both methods may give the best description of the scene in any given GOES image. Statistical comparison results and examples will be presented.

P1.59 Estimation of Sea and Lake Ice Characteristics with GOES-R ABI, Xuanji Wang, CIMSS/University of Wisconsin, Madison, Wisconsin; and J. R. Key, Y. Liu, and W. Straka

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. The cryosphere not only plays a significant role in climate; 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 characterization algorithms, their accuracy, and their limitations will be provided here.

Current operational GOES imager algorithms utilize heritage channels and those from both the Advanced Very High Resolution Radiometer (AVHRR) and the Moderate Resolution Imaging Spectroradiometer (MODIS) for the estimation of sea and lake ice characteristics. Mature algorithms exist for ice identification and ice surface temperature, but others such as ice concentration, ice thickness, ice age, and ice motion are experimental or under development. Errors in existing algorithms must be determined by intercomparing products from other sensors and comparing those products to 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 as necessary. This work will serve as a test bed of the current and developing algorithms for sea and lake ice products. Preliminary tests are promising, and we expect that accuracy specifications will be met for most of the cryosphere products in the 2009-2010 timeframe.

P1.60 On the use of geostationary satellites for remote sensing in the high latitudes Yinghui Liu, CIMSS/University of Wisconsin, Madison, Wisconsin; and J. Key and X. Wang

Geostationary satellites provide continuous observations of the earth from space over tropical and mid-latitude regions, making them very useful tools for weather analysis and prediction over much of the globe. However, geostationary satellites are not traditionally used in remote sensing of the high latitudes due to larger sensor scanning angels and lower spatial resolution. The next generation of geostationary satellites will provide higher spatial resolution observations and more robust spectral information, so their use at high latitudes needs to be reconsidered.

This study demonstrates the feasibility and limitations of using geostationary satellites for remote sensing of the high latitudes. The future Geostationary Operational Environmental Satellite-R (GOES-R) is used as the primary example. The effects of sensor scan angle and pixel size on the accuracy of estimating sea ice characteristics, snow cover, cloud properties, cloud-derived winds, and atmospheric temperature and moisture profiles are examined quantitatively. Limitations are described and possible corrections for those effects are discussed.

P1.61 Operational GOES-SST and MSG-SEVIRI-SST products for GOES-R risk reduction, Eileen Maria Maturi, NOAA/NESDIS, Camp Springs, Maryland; and A. Harris, J. Mittaz, and J. Sapper

The GOES-R Advanced Baseline Imager (ABI) represents a major investment in the next-generation of U.S. geostationary weather satellites. Risk reduction activities are underway to ensure that new data are both quickly transitioned to operational status and the products themselves are of a quality commensurate with the anticipated instrument capabilities. Here we concentrate on sea surface temperature which is a key climate parameter, and can serve as a powerful diagnostic of instrument performance and various key aspects of the processing chain, including calibration, cloud detection, instrument characterization and radiative transfer modeling (RTM). The current GOES-Imager possesses a relatively small subset of the ABI capabilities and a different proxy dataset is required to develop and test various schemes. This role is best filled by the SEVIRI instrument carried onboard the Meteosat Second Generation platform. The physical SST retrieval methodology developed for the operational MSG-SEVIRI required certain tunings (mainly radiance bias correction) to perform to its full potential. Similar techniques will be employed for the ABI. The extension from 5 (GOES Imager) to 12 channels (in the case of SEVIRI) is a significant first step in refining and testing the methodologies that will be required in the GOES-R era. Methods for Radiative Transfer bias corrections include expected vs. observed brightness temperature distributions as modeled using NWP fields. RTM and cross-instrument comparisons of hyperspectral and broadband radiometer data will be outlined. The retrieval accuracy obtained by applying a probabilistic cloud screening methodology using the new Bayesian approach compared with the traditional threshold-based scheme will also be described.

Although the SEVIRI instrument is considered to be a valuable proxy for the ABI, certain aspects are not well-matched (e.g. spin-scan vs 3-axis stabilized, and the over-broad 3.9 micron channel of the former) and the current GOES-Imager remains more useful for testing certain aspects of anticipated ABI performance. The careful analysis of both proxy datasets will be used to extrapolate the findings to the best estimate of ABI performance.

P1.62 Overview of the NESDIS heritage AVHRR Sea Surface Temperature Calibration/Validation system, Dilkushi De Alwis, NOAA/NESDIS and CIRA/Colorado State University, Camp Springs, Maryland; and A. Ignatov, J. Sapper, P. Dash, W. G. Pichel, Y. Kihai, and X. Li

National Oceanic and Atmospheric Administration (NOAA) satellites provide repetitive daily global coverage of the Earth. Since the early 1980s, the National Environmental Satellite, Data, and Information Service (NESDIS) has been operationally generating Sea Surface Temperature (SST) products from the Advanced Very High Resolution Radiometers (AVHRR), which are onboard several NOAA platforms. Globally, AVHRR data are merged with in situ SSTs in a space and time window of 4 hr and 25 km to create monthly match-up files. Early in each satellite's mission, these match-up files are used to calibrate the SST algorithms (i.e., calculate coefficients in the SST regression equations) and then to routinely validate the SST products throughout the operational lifetime of the platform.

The primary objectives of this paper are to describe the heritage NESDIS AVHRR SST Calibration/Validation (Cal/Val) system and to document the latest validation results from NOAA -16, -17, and -18 AVHRRs from 2003 until the present. In situ SSTs are strongly contaminated due to instrument malfunction or erroneous data acquisition and relay. Quality control of the match-up dataset is critically important for ensuring proper calibration and validation of the satellite SST products. Robust identification of outliers is particularly crucial. A method for deriving robust location (mean) and scale parameters (RMSD) for outlier removal is adapted, which makes use of the entire distribution with a data-specific weighted function. The proposed scale parameter is based on the L moments, rather than conventionally used central moments, for characterizing the distribution of the match-up data about the average value. The L moment deviation (L2) is subsequently employed to exclude extreme values. The L2 approach proved to perform significantly better than the conventional approach without much loss of data.

Validation results show a typical global monthly bias within ±0.2°C and RMSD of about 0.4°C - 0.6°C. We also check the robustness and seasonal stability of the derived MC/NLSST coefficients and RMSD, and estimate their sensitivity to the quality control of the dataset. We conclude the presentation by identifying potential improvements to the heritage AVHRR SST Cal/Val system. The lessons learned from the heritage SST Cal/Val are directly applicable to the future SST products to be derived from GOES-R and NPOESS.

P1.63 Validation of Real-Time GOES Products Using GLAS and CALIPSO Data
Louis Nguyen, NASA/LaRC, Hampton, Virginia; and P. Minnis, D. A. Spangenberg, J. K. Ayers, R. Palikonda, M. L. Nordeen, and T. L. Chee

Cloud properties are currently being derived in near-real time at NASA Langley Research Center from operational geostationary satellite data for applications such as aircraft icing detection and MWP model assimilation. These include cloud amount, top height, thickness, base height, phase, effective particle size, and condensed/frozen water path among others. Data from the Geostationary Operational Environmental Satellites, GOES-11 & 12, are analyzed each half hour over a large portion of North America to provide input for the applications. When these parameters are used it is important to know their uncertainties. Cloud height is a first order parameter for weather forecasting and aircraft icing. Before the advent of lidars in space, it has been very difficult to assess the uncertainties in the cloud heights in any rigorous manner. To have a rapid and continuous evaluation of the cloud-top heights derived from the Langley products, an automated system has been developed to match the archived and near-real-time products with the cloud information determined from the lidars on the Ice Cloud and Land Elevation Satellite (ICESat) and Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) satellite. The new algorithms take the predicted paths of each satellite lidar and extract those GOES pixels that match the path most closely in time and space. The results are compared both visually by overlaying the GOES analyses and quantitatively by differencing the GOES and lidar cloud height products. By using both ICESat and CALIPSO data, it is possible to assess the GOES cloud height uncertainties over many different local times because of differences in the orbits of the two lidar satellites. This paper presents the methodology and results from the initial comparisons.

P1.64 The Manual Cloud Filtering of GOES-satellite data through combined use of satellite and ground measurements, **M. K. Rama Varma Raja, I. M. Systems Group, Inc. and NOAA/NESDIS/STAR, Camp Springs, MD; and Y. Yu, D. Tarpley, H. Xu, and K. Y. Vinnikov**

The Advanced Baseline Imager (ABI) instrument onboard the GOES-R series satellites, which is expected to be launched in the year 2015, has considerable potential for providing accurate retrievals of earth Land Surface Temperature (LST). At NOAA/NESDIS/STAR, Yu et al. (2007) have developed and refined a number of independent unique split window LST retrieval algorithms applicable for the ABI sensor. These algorithms are being evaluated through radiative transfer model simulations as well as through ground-truth data. For the ground-truth based evaluation, the LST algorithms have been applied to one year of GOES-8 and GOES-10 measurements in the year 2001, and then compared with coincident LST estimates from Surface Radiation Network (SURFRAD) irradiance measurements. This paper describes a manual cloud filtering method which we developed for the SUFRAD-GOES data comparison purpose.

The manual cloud filtering technique is applied to the spatially closest GOES pixel to the SURFRAD site, to determine if the pixel is cloudy or clear, in order to filter out the cloud-contaminated LST retrievals. This way of pixel cloud filtering employs visual determination of cloudiness based on visible channel 1 reflectance image, IR channel 4 brightness temperature image, daily time series curves of solar irradiance provided by the SURFRAD pyranometer, the broadband sky irradiance provided by the SURFRAD PIR instrument and a number of channel differences. While the solar irradiance curve provides much help during the day time, the down-welling sky irradiance curve is shown to be the most useful tool along with the channel 4 brightness temperature images in cloudiness determination irrespective of whether it is day or night. The combined use of GOES data in five different channels and the paired SURFRAD data of solar irradiance and down-welling sky radiance ensured high quality cloud filtered data during both day and night timings. The details of the manual cloud filtering criteria are discussed. The challenges in effective cloud filtering of GOES-data and how the combined use of GOES and SURFRAD data can be successfully utilized to address them in the context of this study are demonstrated with examples. A future generalized automated cloud detection scheme for satellite based multi-band passive radiometer data is discussed.

P1.65 Status update from the GOES-R Hydrology Algorithm Team, Robert J. Kuligowski, NOAA/NESDIS/ORA, Camp Springs, Maryland

The Advanced Baseline Imager (ABI) onboard the Geostationary Operational Environmental Satellite (GOES)-R platform will offer improved spatial and spectral resolution and temporal sampling, all of which should lead to enhanced capabilities for satellite-based rainfall estimation and nowcasting. The Hydrology Algorithm Team (AT), which is part of the GOES-R Algorithm Working Group (AWG), was formed to guide algorithm development and selection and to produce a recommended set of algorithms for operational production of three GOES-R Environmental Data Records: rainfall rate, rainfall potential, and probability of rainfall.

To leverage the work already done in these areas, the Hydrology AT has been supporting the modification and testing of four existing rainfall estimation algorithms and three existing nowcasting algorithms to take advantage of the new ABI capabilities. Data from the Spinning Enhanced Infrared Visible Imager (SEVIRI) onboard the Meteosat Second Generation (SEVIRI) have been provided to the algorithm developers, along with available ground validation data over Europe and Africa. This development effort is being followed by an evaluation in order to select a rainfall estimation algorithm and a rainfall nowcasting algorithm to be implemented operationally for GOES-R. This presentation will describe this work in greater detail and discuss the next steps for the Hydrology AT.

P1.66 Conditions influencing Hurricane Emily's (2005) precipitation patterns and upper tropospheric outflow, Kevin R. Quinlan, University of Alabama, Huntsville, AL; and D. Cecil and J. R. Mecikalski (withdrawn)

P1.67 Possible impacts of GOES-R temporal resolution on tropical cyclone intensity estimates, John L. Beven II, NOAA/AOML/NHC/TPC, Miami, FL; and C. S. Velden and T. L. Olander

The increased spatial and temporal resolution of GEOS-R imagery will routinely provide detailed observations of tropical cyclones at levels far beyond that available today. This poster will example the possible impacts of the GOES-R temporal resolution (5-15 minute interval routine imagery) on subjective and automated intensity estimation techniques for tropical cyclones based on results from experimental data collected from GOES-11 during Hurricane Emily of 2005.

P1.68 Verifying large-scale, high-resolution simulations of clouds for GOES-R activities, Thomas Greenwald, University of Wisconsin, Madison, Wisconsin; and J. Sieglaff, Y. K. Lee, H. L. Huang, J. Otkin, E. Olson, and M. Gunshor

Producing high quality proxy datasets from NWP simulations for the future ABI are important in developing and testing new products and algorithms. This study evaluates high-resolution simulations of top-of-atmosphere (TOA) radiances in cloudy regions using GOES-12 imager data to determine whether these proxy datasets have sufficient realism for testing cloud products and algorithms. The WRF model was used to produce retrospective forecasts on 5 June 2005 using 50 vertical levels and 6-km horizontal grid spacing that spanned nearly the entire region covered by the GOES-12 imager during full-disk mode. These simulations also provide a higher resolution (2 km) CONUS domain and a fine resolution (667 m) small domain located in the central U.S. To compute TOA radiances and reflectances for all of the imager bands, the gas absorption model in the NOAA Community Radiative Transfer Model was used together with the SOI (Successive Order of Interaction) radiative transfer model.

Our validation approach examines imager channel differences and relationships between different channels. How well the simulations reproduce observed cloud types will be determined by looking at 2D histograms of the visible reflectances from band 1 and brightness temperatures from the infrared window channel (band 4). Brightness temperature differences between the water vapor band (channel 3) and band 4 will reveal clues as to the ability of the WRF simulations to produce realistic physical properties for very cold (band 4 brightness temperature < 210 K) clouds. Comparisons of 3.9 microns (band 2) reflectance data will also be done to evaluate model-simulated cloud particle sizes. Results will be presented at the conference.

P1.69 Retrieving cloud properties for multilayered clouds using simulated GOES-R data, Fu-Lung Chang, National Institute of Aerospace, Hampton, Virginia; and P. Minnis, B. Lin, R. Palikonda, M. Khaiyer, S. Sun-Mack, and P. Yang

Geostationary satellite observations provide continuous monitoring of clouds over regional and global scales. Cloud properties retrieved from the satellite data are needed for evaluations of current climate and weather forecasting models. As operational satellite retrieval algorithms assume a single-layered cloud in their retrievals while multi-layer clouds occur frequently in nature, the retrievals based on a single-layer assumption can result in erroneous cloud properties that are unreliable for model evaluations. The GOES-R multi-spectral imager will provide unprecedented capability for monitoring clouds at high temporal and spatial resolutions. This study presents a novel satellite retrieval algorithm that takes advantage of the multi-spectral measurements for retrieving the properties of multi-layer clouds. The algorithm applies a dual-layer cloud radiative transfer technique that accounts for overlapped ice-over-water clouds and an iterative retrieval scheme that determines the overlying ice-cloud optical depth and effective particle size and the underlying water-cloud optical depth and effective droplet radius. Additionally, an enhanced CO2-absorbing technique accounting for the presence of underlying low cloud is developed to improve the retrieval of cirrus cloud-top height when the cirrus overlaps with low clouds. The cloud-top heights of cirrus clouds that overlay low clouds are commonly underestimated by the conventional CO2-retrieval techniques. This innovative retrieval algorithm is applied to the satellite observations obtained by the Spinning Enhanced Visible and Infrared Imager (SEVIRI) and by the Moderate Resolution Imaging Spectroradiometer (MODIS). The retrieved cloud properties are compared with the coincident active remote-sensing measurements from the ground and from space. Biases due to the single-layer assumption and improvements for multi-layer clouds in the satellite-retrieved cloud properties will be presented and discussed.

P1.70 Nighttime retrieval of cloud microphysical properties for GOES-R, Patrick W. Heck, CIMSS/University of Wisconsin, Madison, Wisconsin; and P. Minnis, R. Palikonda, C. R. Yost, F. L. Chang, and A. K. Heidinger

Multi-spectral algorithms are being used at NASA Langley to retrieve microphysical cloud properties from satellite imagery in near-real time over a variety of domains. Currently, the Solar infrared-Infrared-Split window Technique (SIST) is applied to night time imagery from the Geostationary Operational Environmental Satellite (GOES) over the Continental US, the Spinning Enhanced Visible InfraRed Imager (SEVIRI) over Europe, and the Multi-functional Transport Satellite (MTSAT) over the tropical western Pacific and to Moderate Resolution Imaging Spectroradiometer (MODIS) imagery over the globe. The SIST is being modified for integration into the GOES-R cloud application framework via the Geostationary Cloud Algorithm Testbed (GEOCAT), which will allow input and feedback opportunities from other cloud application team baseline algorithms. This paper will present results from new SIST retrievals conducted on 3.9, 10.8 and 12-µm SEVIRI imagery that is being used as a proxy for Advanced Baseline Imager (ABI) data. SIST-derived cloud optical depth, effective particle size and liquid/ice water path derived within the GOES-R cloud application team's developmental framework will be presented. Included will be an assessment of the impact of allowing cloud parameters, such as cloud temperature and phase that have previously been derived within SIST itself, to be determined by other cloud application team algorithms prior to the invocation of SIST. These assessments will be conducted for both case studies and larger datasets. Potential enhancements to the SIST, including the use of 8.7 and 13.3-µm data will also be examined. GEOCAT will be used to facilitate the evaluation of the strengths of both the stand-alone and modified versions of SIST, thus allowing inter-algorithm comparisons that will be used to guide the application team as they optimize the GOES-R algorithms.

P1.71 Nearcasting convective destabilization using objective tools which optimize the impact of sequences of GOES moisture products, Ralph A. Petersen, CIMSS/University of Wisconsin, Madison, Wisconsin; and R. M. Aune

Future instruments (e.g., multi-channel geostationary imagers, Wind Profilers, automated aircraft reports, etc.) will resolve atmospheric features with resolutions far beyond today's capabilities in both time and space. Although these data are expected to improve NWP guidance at 6-12 hours and beyond, a greater benefit from these detailed time/space-frequency data (i.e., GOES) may come from objective nearcasting systems that assist forecasters in identifying rapidly developing, extreme weather events by helping to fill the 1-6 hour information gap which exists between nowcasts (based primarily on extrapolation of radar data) and longer-range NWP guidance.

Nearcasting systems must detect and retain extreme variations in the atmosphere (especially moisture fields) and incorporate large volumes of high-resolution asynoptic data, while also be extremely computationally efficient. This requires numerical approaches that are notably different from those used in numerical weather prediction, where the forecast objectives cover longer time periods.

A new approach to objective nearcasting is presented that uses Lagrangian techniques (instead of Eulerean methods used in conventional NWP) to optimize the impact and retention of information provided by satellites. It is designed to detect and preserve intense vertical and horizontal variations observed in the various data fields observed over time. Analytical tests have confirmed this, as well as the computational advantages of this approach.

Real data tests have been conducted with the goals of detecting the development of atmospheric details several hours prior the onset of significant weather events. Tests using full resolution (10 km) moisture products from current GOES sounders to update and enhance current operational RUC forecasts show that the Lagrangian system captures and retains details (maxima, minima and extreme gradients) critical to the development of convective instability several hours in advance, even after subsequent satellite observations are no longer available due to cloud development. Results from case studies of hard-to-forecast isolated convective events show substantial skill in being able to define areas of convective destabilization 3-6 hours in advance using combinations of product images similar to those currently available for GOES derived product observations. These tests provide prototype examples of nearcast products that will be available at higher resolution using GOES-R ABI data and possibly with Meteosat products as well. Plans will also be discussed for assessing of these products within selected NWS WFOs.

P1.72 Transitioning GOES-based nowcasting capability into the GOES-R era, Brian L. Vant-Hull, NOAA/CREST CCNY, New York, New York; and M. Ba, B. Rabin, D. S. Mahani, R. J. Kuligowski, A. Gruber, and S. B. Smith

Nowcasting techniques continue to be of great interest for predicting rainfall in the 0-6 hour timeframe. Radar-based techniques offer significant utility; however, the limitations of radar coverage and the dependence on pre-existing rainfall make satellite-based techniques a necessary component of a nowcasting suite. In this vein two of the GOES-R Environmental Data Records (EDR's) address this need: probability of precipitation and rainfall outlook derived from GOES data.

This is a collaborative framework being pursued by personnel at NOAA/NESDIS, the NOAA/NWS Meteorological Development Laboratory (MDL), the NOAA/OAR National Severe Storms Laboratory (NSSL), and the NOAA Cooperative Remote Sensing Science and Technology Center (CREST) at the City College of New York (CCNY) to develop and test a prototype satellite-based nowcasting capability for the New York City metropolitan area and other US selected areas, and to transition that capability into the GOES-R era. In this paper we will describe how this project will be assisting in the algorithm selection process by producing output from existing nowcasting algorithms for use in the Hydrology Algorithm Team inter-comparison, and present some preliminary results of the different nowcasting algorithms using several study cases over US and Europe. Possible improvements of the existing algorithms will be included.

P1.73 Nowcasting of Thunderstorms from GOES Infrared and Visible Imagery, Valliappa Lakshmanan, CIMMS/University of Oklahoma, NOAA/NSSL, Norman, Oklahoma; and R. M. Rabin

In this paper, we describe our progress in identifying and tracking storms at multiple scales from satellite infrared (11-micron Band 4) and visible (Band 1) channels. Storms are identified by clustering the pixels in the input images using spatial-contiguity-enhanced K-means clustering. Identified clusters are then processed morphologically to yield self-consistent storms.

Identified storms (at all the scales) are tracked using a hybrid scheme that minimizes mean absolute error between frames of the input sequence of images and then smoothed temporally using Kalman filtering. This yields a grid of motion vectors at each pixel in the spatial domain.

The motion vector estimated from the sequence is used to nowcast the images. Comparison of the nowcasts with the observed values at the corresponding time gives a measure of skill of the nowcast.

Statistical properties are extracted for each cluster. The extracted properties are used as inputs to an automated decision tree training algorithm to identify regions of overshooting tops.

Results and measures of skill are demonstrated on a sequence of images from Oct. 12, 2001.

P1.74 Mission Availability Improvements for GOES-R, Larry E. Urner, Northrop Grumman, Redondo Beach, CA; and J. Castellon, M. Hanson, and S. Sawyer

The GOES-R series of satellites will offer significantly more active mission data collection time for the sensor instruments than either the GOES-I or GOES-N series of satellites. This is due to a combination of available power during eclipse, stability through maneuvers, and minimized interference between the various instruments. This poster will advise users of what they can expect for data collection continuity and estimated outage times from GOES-R vs. GOES I-M and N-P from the ABI, GLM, SIS, SUVI, EXIS, and magnetometer instruments.

P1.75 Determination of aircraft icing threat from satellite, William L. Smith Jr., NASA/LRC, Hampton, Virginia; and P. Minnis and D. A. Spangenberg

Aircraft icing is one of the most dangerous weather conditions for general aviation. Currently, model forecasts and pilot reports (PIREPS) constitute much of the database available to pilots for assessing the icing conditions in a particular area. Such data are often uncertain or sparsely available. A novel method for determining flight icing conditions from satellite data has been developed for application to current GOES satellites. The prototype algorithm is physically based, relying on the determination of satellite-derived cloud parameters and thus also applicable to MODIS and SEVIRI data. A description of the prototype algorithm, validation activities, and plans for application to GOES-R will be presented. This effort will provide improvements in the temporal and areal coverage of icing diagnoses and prognoses and will mark a substantial enhancement in aviation safety in regions susceptible to heavy super-cooled liquid water clouds.

P1.76 Cloud statistics over agricultural and mixed forest areas, Valentine Anantharaj, Mississippi State University, Starkville, Mississippi; and U. S. Nair, D. Berendes, S. Asefi, and J. G. Fairman

The Southern Bottomlands across the alluvial flood plains in Tennessee, Arkansas, Mississippi and Louisiana, along the Mississippi River, have been gradually converted to agricultural and other anthropogenic use. This region, referred to as the Lower Mississippi Alluvial Valley (LMAV, with fertile alluvial soil is characterized by intense agriculture. The distinct difference in landscape can be readily seen in satellite imagery due to the different vegetation and soil types. The differential surface temperatures are also evident in near IR imagery on clear days during spring. The main purpose of this research is to attempt to relate the current land use and land cover information to surface temperature patterns and trends and as well as via satellite-derived cloud statistics from recent years. The Geostationary Operational Environmental Satellite (GOES) data, for a time period spanning 1999-2006 are being used to analyze cloudiness patterns over the LMAV. Cloudiness analysis is focused on convective clouds, since this cloud type is the most affected by the nature of land use. Preliminary analysis of GOES-12 data indicate distinctly different cloud statistics under certain circumstances in the LMAV when compared to surrounding regions of mixed forest and wooded lands.

P1.77 Comparison of atmospheric profiles from hyperspectral and multispectral IR radiances on depicting hurricane thermodynamic structures, Hong Qiu, CIMSS/University of Wisconsin, Madison, Wisconsin; and J. Li, E. Weisz, and C. Y. Liu

An algorithm has been developed to retrieve atmospheric temperature and moisture vertical profiles from hyperspectral infrared (IR) alone radiances (Zhou et al. 2007; Weisz et al. 2007).

This study demonstrates that hyperspectral IR satellite data alone can yield important information about hurricanes. Using this type of data, high vertical and spatial resolution moisture and temperature structures within hurricane eyes and their surrounding environment can be depicted. These measurements are useful in both clear and cloudy skies. On the other hand, multispectral IR radiances provide high spatial resolution but low vertical resolution profiles, which help depict the spatial features of the moisture distribution. Data from Moderate Resolution Imaging Spectroradiometer (MODIS) and Atmospheric Infrared Sounder (AIRS) onboard the Earth Observing System (EOS) Aqua platform are used to derive the high spatial resolution (from MODIS) and high vertical resolution (from AIRS) profiles for this hurricane study. The study demonstrates the great advantage of future geostationary hyperspectral IR instrument over the current GOES Sounder on providing three dimensional atmospheric temperature and water vapor with high temporal resolution. In addition, the combination of hyperspectral IR sounding and high spatial multispectral imaging data provides better depiction of hurricane thermodynamic structures. The hyperspectral IR sounding data with high temporal resolution will be very important for hurricane track and intensity forecasts.

P1.78 Development of severe weather products for the GOES-R Advanced Baseline Imager, Daniel T. Lindsey, NOAA/NESDIS, Fort Collins, Colorado; and D. W. Hillger and L. Grasso

The Advanced Baseline Imager (ABI) aboard the GOES-R series will have a number of additional spectral channels at significantly improved spatial and temporal resolution compared to the current GOES Imager. This wealth of data likely contains some useful information about the pre-storm environment as well as active thunderstorms. In designing new algorithms to extract this information, one must find the most suitable combination of bands.

This paper describes how we take simulated ABI imagery at the proper spatial and temporal resolution and calculate Principal Component (PC) images. PC imagery highlights areas which explain the most variance in the data, and the corresponding eigenvectors can be used to determine what linear combination of spectral bands is most suitable for studying certain features. For example, in looking at low-level moisture depth, PC Analysis has revealed that a certain combination of the 11.2, 12.3, and 13.3 μm bands provides the most information. We plan to use a similar analysis to develop a number of severe weather products. Studies of this nature are important in preparation for the launch of GOES-R.

P1.79 Algorithm and Software Development of Atmospheric Motion Vector Products for the GOES-R ABI, Jaime M. Daniels, NOAA/NESDIS, Camp Springs, Maryland; and W. Bresky, C. Velden, I. Genkova, S. Wanzong, and D. Santek

Atmospheric motion vectors (AMVs), derived from the current GOES series of satellites, provide invaluable tropospheric wind information to the meteorological community. AMVs obtained from tracking features (i.e., clouds and moisture gradients) are used for: i) Improving numerical weather prediction (NWP) analyses and forecasts; ii) Supporting short term forecasting activities at National Weather Service (NWS) field offices; and iii) Generating tropical and mesoscale wind analyses.

The GOES-R Algorithm Working Group (AWG) Winds team is working on development of algorithms and software for the generation of Atmospheric Motion Vectors (AMVs) from the GOES-R Advanced Baseline Imager (ABI) to be flown on the next generation of GOES satellites. The GOES-R series of satellites offers exciting new capabilities that are expected to directly benefit and improve the derivation and quality of the AMVs. These new capabilities include: continuous scanning with no loss of imagery due to eclipse or conflicting scanning schedules, higher resolution (spatial and temporal) imagery, and improved navigation. Improved cloud-top height assignments derived from the GOES-R ABI are expected to contribute to further improvement and utilization of the AMV products.

GOES-R AMV software development and testing is being done within the Geostationary Cloud Algorithm Testbed (GEOCAT) framework. This framework supports a tiered algorithm processing approach that allows the output of lower-level algorithms to be available to subsequent higher-order algorithms while supplying needed data inputs to all algorithms through established data structures. MSG/SEVERI imagery is serving as a primary GOES-R ABI proxy data source for the development, testing, and validation of the AMV algorithms. This poster will highlight the AMV algorithms and results from recent testing.

P1.80 An enhanced IDEA product with GOES AOD, Hai Zhang, JCET/University of Maryland, Baltimore, Maryland; and R. M. Hoff, S. Kondragunta, I. Laszlo, and A. Wimmers

The University of Maryland Baltimore County, the University of Wisconsin, and NESDIS are cooperating in migrating the Infusing satellite Data into Environmental Applications (IDEA) product from UW to NESDIS for a preoperational test. IDEA was created through a NASA/EPA/NOAA cooperative effort and involves the near-real time dissemination of aerosol optical depth data from MODIS to the public using the UW direct broadcast capture of MODIS data. The product will be run at NESDIS and will be a NOAA supported product relevant to air quality decision makers.

In addition to the migration, the IDEA product will be enhanced to include GOES-R aerosol product since the ABI on GOES-R will have nearly the same capabilities as MODIS to generate multi-wavelength retrievals of AOD with high temporal and spatial resolutions. The addition of the GOES AOD product provides AOD updates on a 30-minute basis rather than the current twice-daily updates provided by MODIS. To prepare for utilizing these data in a near-real time environment, UMBC has started to install the GOES Aerosol and Smoke Product (GASP) into IDEA. This includes the development of additional trajectory and ground-based air quality data links to the IDEA product so that we have a plug-and-play application suite for the new GOES-R data stream once GOES-R in orbit.

P1.81 An initial assessment of the GOES Microburst Windspeed Potential Index, Kenneth L. Pryor, NOAA/NESDIS, Camp Springs, Maryland

A suite of products derived from the current generation of Geostationary Operational Environmental Satellite (GOES) (8-P) has been developed and evaluated to assess hazards presented by convective downbursts to aircraft in flight. The MWPI algorithm is intended for implementation in the GOES-R Advanced Baseline Imager (ABI) that has promising capability for providing legacy sounder products with greatly improved temporal and spatial resolution as compared to the existing GOES (8-P) sounders. A GOES sounder-derived wet microburst severity index (WMSI) product to assess the potential magnitude of convective downbursts, incorporating convective available potential energy (CAPE) as well as the vertical theta-e difference (TeD) between the surface and mid-troposphere has been developed and implemented. CAPE has an important role in precipitation formation due to the strong dependence of updraft strength and resultant storm precipitation content on positive buoyant energy. Intended to supplement the use of the GOES WMSI product over the United States Great Plains region, a GOES Hybrid Microburst Index (HMI) product has also evolved. The HMI product infers the presence of a convective boundary layer (CBL) by incorporating the sub-cloud temperature lapse rate as well as the dew point depression difference between the typical level of a convective cloud base and the sub-cloud layer. Thus, the WMSI algorithm is designed to parameterize updraft and downdraft instability within a convective storm, while the HMI algorithm describes the moisture stratification of the sub-cloud layer that may result in further downdraft acceleration due to evaporative cooling, eventually producing strong and potentially damaging winds when the convective downdraft impinges on the earth's surface. Large output values of the microburst index algorithms indicate that the ambient thermodynamic structure of the troposphere fits the prototypical environment for each respective microburst type (i.e. Wet, Hybrid, Dry). Accordingly, a new diagnostic nowcasting product, the Microburst Windspeed Potential Index (MWPI), is derived from merging the WMSI and HMI algorithms and designed to quantify the most relevant factors in convective downburst generation in intermediate thermodynamic environments.

This paper provides an initial assessment of the MWPI algorithm, presents case studies demonstrating effective operational use of the MWPI product, and presents validation results for the 2007 convective season. Although there is not currently an observational requirement for microburst potential for the GOES-R Advanced Baseline Imager (ABI), the ABI does have promising capability to generate a sounding profile with greatly improved temporal and spatial resolution as compared to the existing GOES (8-P) sounders. In light of this capability, the eventual implementation of a sounder-derived microburst potential algorithm is feasible. Considering that seven of the sixteen bands of the ABI are in common with the bands of the heritage sounder, the ABI should effectively produce a sounding profile comparable in quality to the current GOES. The increase in temporal resolution should greatly aid the mesoscale forecaster in the analysis of trends in thermodynamic environments.

P1.82 GOES-R Applications for the Assessment of Aviation Hazards, Kenneth L. Pryor, NOAA/NESDIS, Camp Springs, Maryland; and W. Feltz, J. R. Mecikalski, M. Pavolonis, and W. L. Smith

A suite of products has been developed and evaluated to assess meteorological hazards to aircraft in flight derived from the current generation of Geostationary Operational Environmental Satellite (GOES). The existing suite of products includes derived images to address seven major aviation hazards: fog, aircraft icing, microbursts, turbulence, volcanic ash, convective initiation, and enhanced-v and overshooting top detection. Some products have been developed for the purpose of implementation into the National Weather Service AWIPS. The fog, icing, volcanic ash, convective initiation, and enhanced-v and overshooting top detection products, derived from the GOES imager, utilize algorithms that employ temperature differencing techniques to highlight regions of elevated risk to aircraft. In contrast, the GOES microburst products employ the GOES sounder to calculate risk based on conceptual models of favorable environmental profiles for convective downburst generation. It is proposed to adapt the current suite of aviation product algorithms, with modifications and enhancements, for the GOES-R Advanced Baseline Imager (ABI). In addition, a product for nowcasting convective initiation based on the GOES imager developed at CIMSS is anticipated to be incorporated into the suite of GOES-R derived aviation products. This poster will provide a general overview of legacy candidate algorithms as well as outline proposed aviation weather applications development.

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P1.83 Application of Multi-Spectral Data to Space Shuttle Landing Operations, Doris A. Hood, NWS Spaceflight Meteorology Group, Houston, Texas; and T. Garner and T. Oram

The National Weather Service, Spaceflight Meteorology Group (SMG) supports NASA's manned spaceflight program at Johnson Space Center. One of the main operational functions is support of the Space Shuttle program by providing landing forecasts that include launch intact abort sites, on orbit primary landing site selection and end of mission landings. The United States landing sites are Kennedy Space Center, FL, White Sands Space Harbor, NM and Edwards Air Force Base, CA. The main European abort sites known as Transoceanic Abort Landing (TAL) sites include Zaragoza and Moron, Spain as well as Istres, France.

Geostationary satellite imagery ingested at the SMG includes GOES East, GOES West and Meteosat Second Generation data. The geostationary satellite imagery is displayable in a McIDAS-based system and the Advanced Weather Information Processing System (AWIPS). Digital imagery from several polar orbiting satellites is also available from NESDIS and NASA servers. The SMG is also working on ingesting AWIPS-compatible Moderate Resolution Imaging Spectroradiometer data from the University of Wisconsin.

Meteosat data have been invaluable as a forecasting tool for the TAL sites since 1987. The new Meteosat Second Generation imagery has been available at the SMG since May 2005. All bands of the Meteosat Second Generation data are ingested in real time into the SMG Man computer

Interactive Data Access System (McIDAS) including the three solar channels, eight thermal channels and a 1 km high-resolution visible channel. The data can be displayed as individual bands, multi-channel differencing imagery or as multi-channel color combinations. The multi-channel color combination imagery was initially displayable only as a single image frame, not time sequenced loops. NASA's Short-term Prediction Research and Transition Center has provided the SMG with the capability to loop multi-channel color combination imagery. The high resolution visible, infrared and water vapor imagery are also sent via the Local Data Acquisition and Display System for display in AWIPS. During Space Shuttle operations, each forecaster has access to a display for both McIDAS and AWIPS.

Extensive training occurred during 2007 to familiarize the SMG forecasters with the utility of the various bands individually and in combination. Operational use of multi-channel differencing and color combination imagery has increased. Several examples will be shown from the June 2007 shuttle flight and the three additional flights expected to be completed by December 2007.

P1.84 Weather Information and Decision Systems (WxIDS): Looking to the future of data processing and decision support systems, Dylan Powell, Lockheed Martin, Greenbelt, Maryland; and J. A. Dutton, J. Ross, J. Sroga, C. F. Chang, R. Pickens, S. Pitter, K. Leesman, G. Young, P. G. Knight, N. L. Seaman, J. Nese, G. Haselfeld, R. Wessels, and M. Dhondt

Future geostationary and low earth orbit environmental observational systems will substantially increase the volume and timeliness of data provided to the user communities. A multitude of new and improved products will be available as a result of increases in temporal, spatial, and spectral coverage and resolution of future remote sensing systems. Combined with the evolution of numerical weather prediction (NWP) models and the resulting increase in model data, users will face unprecedented challenges to utilize all relevant data to make timely and appropriate decisions relating to severe weather events (thunderstorms, tornadoes, floods, etc.). Automation of the identification, synthesis, integration, and analysis of observations and numerical forecasts within decision support processes is critical to maximizing the societal benefits of future observational systems.

The Weather Information and Decision System (WxIDS) is a concept for implementing an automated decision support system that synthesizes observations and probabilistic forecasts with user operational experience and risk criteria designed to meet user requirements. There are four components to the WxIDS concept; the Local Data Manager manages weather information acquisition and storage; the Forecast Generation System identifies critical situations, combines NWP model predictions and observations into comprehensive probabilistic forecasts aimed at user requirements; the Decision Support System combines probabilistic forecasts with user operational experience and risk criteria for decision advice and recommendations; and the WxIDS User Interface provides interactive capabilities to users or their risk management decision system.

We present the results of a prototype of the WxIDS system focused on utilizing ensemble forecast probabilities, GOES satellite observations, and radar data to forecast and provide early warnings of severe convection. Bayesian methods coupled with the ensemble forecasts provide warnings of potential regions for severe convection 6, 12, and 24 hours prior to onset. These probabilistic forecasts identify areas with a high probability for severe convection to be monitored by GOES satellite observations for convective initiation. Radar data are used to verify both the ensemble forecasts and the GOES identified convective initiation cases (those that develop into severe convective storms). This prototype represents the initial development of the Local Data Manager and Forecast Generation System components of WxIDS.

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P1.85 Development of simulated GOES products for the GFS and the NAM, Hui-ya Chuang, NOAA/NWS/NCEP, Camp Springs, Maryland; and B. Ferrier

NCEP EMC has recently developed the capability of generating simulated satellite products for both the GFS and the NAM using model predicted moisture, cloud, and surface fields. This new capability will allow users to make direct comparisons between satellite observations and operational model output.

The first attempt was to simulate the four channels from the GOES 12 imager based on responses from several NCEP centers and NWS field offices. The preliminary results have shown reasonable, qualitative agreement between the model-derived radiances and the satellite observations. EMC is planning on generating these new simulated satellite products for both the GFS and the NAM by Winter 2007.

The purpose of this presentation is 1) to describe the methodology and assumptions used to derive these products, and 2) to show how these new products compare with observations.

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P1.86 Current GOES Sounder applications and future needs, Jun Li, University of Wisconsin, Madison, Wisconsin; and T. J. Schmit, J. J. Gurka, J. Daniels, M. D. Goldberg, and P. Menzel

The current Geostationary Operational Environmental Satellite (GOES) Sounder with 18 infrared (IR) spectral bands, ranging from approximately 3.7µm – 14.7 µm, provides clear-sky radiances, atmospheric temperature and moisture profiles, total precipitable water, cloud-top pressure, water-vapor tracked winds, etc. Products are generated operationally by NOAA/NESDIS in Washington, D.C. Some experimental GOES Sounder products, including total column ozone (TCO), are also produced at University of Wisconsin-Madison. Applications of those products include: nowcasting and forecasting of weather events, assimilation of cloud products into regional numerical forecast models, and monitoring of temperature and moisture changes in the pre-convective periods. One unique application of the current GOES Sounder products is the severe weather forecast. Hourly GOES Sounder data of typical convective storm cases, were used to illustrate the unique value of the GOES Sounder measurements in short range severe weather nowcast.

However, due to the lower spectral resolution and slow coverage rate of the current GOES Sounder, the information such as spatial coverage, lower level temperature inversion, surface emissivity, vertical resolution and accuracy is limited. There is a requirement for an operational advanced IR sounding system on future geostationary satellites. The increased spectral, temporal and spatial resolutions of the future geostationary hyperspectral sounder (GHS) will provide a substantial increase in the quantity and quality of the products. The future GOES sounder could provide high-spectral resolution Hemispheric Disk Soundings (DS) with spatial resolution better than 10 km spatial resolution and spectral resolution on the order of 1 cm-1. It is very useful when there is the potential for explosive development of severe thunderstorms, hurricanes, or severe winter storms. It can also be used over areas where the numerical forecast models have low confidence (targeted observations).

Aspects of improvement of future GOES sounders over the current GOES sounders include: spatial coverage, vertical moisture information, nowcasting, numerical weather prediction, clouds, winds, dust/aerosols, trace gases, climate, ocean/land. Current and future applications of GOES Sounder and GHS are demonstrated and compared in this paper by using the current satellite measurements such as AIRS (Atmospheric Infrared Sounder) and IASI (Infrared Atmospheric Sounding Interferometer).

P1.87 GOES-R ABI proxy data set generation at CIMSS, Mathew M. Gunshor, CIMSS/University of Wisconsin, Madison, Wisconsin; and E. Olson, J. Sieglaff, T. Greenwald, A. Huang, and J. A. Otkin

The Advanced Baseline Imager (ABI) on GOES-R will represent a technological leap in weather and environmental satellite capabilities. With 16 spectral bands, faster data rates, and improvements in resolution, signal to noise and calibration accuracy over the current imager. Preparing users for what lay ahead is a task being tackled by various research groups. At the Cooperative Institute for Meteorological Satellite Studies (CIMSS) multiple data sets are being generated in an effort to meet the needs of various GOES-R Algorithm Working Group (AWG) science teams. Parallel efforts are underway to provide simulated Advanced Baseline Imager (ABI) data from both existing satellite assets and from the Weather Research Forecast (WRF) model. Simulations from the WRF are being produced at multiple resolutions and time intervals to simulate ABI scanning scenarios such as 15 minute full disk and 5 minute Continental US (CONUS) modes. WRF model simulations are turned into ABI imagery using a forward radiative transfer model that incorporates both clear and cloudy-sky properties and a reflected component for the shortwave and visible bands. Some simulated datasets contain simulated instrument effects such as striping, random noise, and navigation shifts. A sophisticated remapping technique is being used to simulate the ABI from MODerate-resolution Imaging Spectroradiometer (MODIS) data. Most of the ABI spectral bands have similar counter-parts on MODIS and this technique involves remapping the MODIS to a presumed ABI projection, 2 km resolution at nadir (assumed to be at 75 W), and applying a point spread function. This poster will highlight the simulated datasets available so far, show what datasets are planned for the immediate future, and discuss possible avenues of future development into improving techniques.

P1.88 GOES-R mesoscale product development, Renate Brummer, CIRA/Colorado State University, Fort Collins, Colorado; and M. DeMaria, J. A. Knaff, B. H. Connell, J. F. Dostalek, and D. Zupanski

The GOES-R era will begin early in the next decade. GOES-R instruments will provide superior spatial and temporal resolution and more spectral bands than the current GOES satellites. This paper will describe the development of GOES-R products at the NESDIS Regional and Mesoscale Meteorology Branch (RAMMB) and Cooperative Institute for Research in the Atmosphere (CIRA).

Numerical simulations and existing in situ and satellite data are being used to better understand the capabilities of the advanced GOES-R instruments for mesoscale weather analysis and prediction. The emphasis of our science study is on mesoscale atmospheric phenomena that evolve on time scales faster than, and at spatial resolution greater than, those normally sampled by current GOES. These phenomena include tropical cyclones, severe weather and mesoscale aspects of winter weather, including lake-effect snowfall, as well as the detection of atmospheric hazards such as fog, dust and volcanic ash. We have produced a large dataset of proxy GOES-R data which consist of synthetic imagery and existing satellite data. Using a sophisticated cloud model and accurate radiative transfer modeling we produced synthetic imagery for several mesoscale events. Fire hotspots were embedded into these mesoscale study cases to support the development and testing of fire algorithms. AVHRR and MODIS data together with current GOES datasets of 11 tropical cyclone cases were collected as proxy GOES-R data for the tropical cyclone intensity algorithm development. A ground-based global lightning dataset and Meteosat data are also being used as a proxy for GOES-R instruments.

The prototype mesoscale product development using these datasets will be described, along with plans for the future. The development of GOES-R training material will also be summarized.

P1.89 GOES-R/ABI legacy profile algorithm evaluation with MSG/SEVIRI, Xin Jin, CIMSS/University of Wisconsin, Madison, Wisconsin; and J. Li, T. J. Schmit, J. Li, E. Weisz, and Z. Li

The algorithm to retrieve atmospheric legacy profiles from the Advanced Baseline Imager (ABI) onboard the next generation Geostationary Operational Environmental Satellite (GOES-R) is developed, forecast profile from the numerical weather prediction (NWP) model is used as the first guess. The retrieval process includes two parts: a non-linear regression followed by a physical iterative approach. Since the ABI real data is not yet available and due to the similar characteristics between ABI and the Spinning Enhanced Visible and Infrared Imager (SEVIRI) onboard the Meteosat Second Generation (MSG) satellite, the SEVIRI data is used as proxy to test the algorithm. The European Centre for Medium-Range Weather Forecasts (ECMWF) forecast (12h) profiles are used as first guess in the calculations. The ECMWF analysis data as well as the radiosonde data are used for validation.

The SEVIRI data for August 2006 is processed. The results show that both the non-linear regression and the physical retrieval lead to the better root-mean-squared error (RMSE) for humidity profile than forecast. The physical retrieval leads to better results than the regression. With information contribution from the two water vapor absorption spectral bands (6.2- and 7.2-µm), the improvement from SEVIRI is significant between 300 and 700 hPa for moisture over the forecast. Since there is only one temperature-sensitive spectral band in SEVIRI, the temperature profile does not show noticeable improvement over forecast.

P1.90 High spatial and temporal resolution retrievals obtained from the combination of GOES-R multispectral ABI and joint polar satellite ultraspectral radiances, William Smith Sr., Hampton University, Hampton, Virginia; and S. Kireev, D. Zhou, A. M. Larar, X. Liu, M. D. Goldberg, and E. M. Maturi

With the cancellation of the Hyperspectral Environmental Suite (HES) for GOES-R, mesoscale resolution vertical sounding measurements from GOES will not be possible, thereby compromising the intended storm prediction applications of the next generation geostationary satellite system. In an attempt to alleviate the consequences of this dilemma, an algorithm is being developed for achieving mesoscale resolution vertical soundings through the combination of high horizontal and temporal resolution multispectral radiances observed with the GOES Advanced Baseline Imager (ABI) and high vertical resolution ultraspectral sounding radiances observed from the Joint Polar System (JPS) of NPOESS and MetOp operational satellites. Results from trial applications of this algorithm are provided using ABI/JPS simulations based on airborne and MetOp interferometer data observed at the ARM cart-site during the April-May 2007 Joint Airborne IASI Validation Experiment (JAIVEx). The limitations of this hybrid geostationary and polar satellite radiance assimilation approach for achieving the mesoscale storm prediction objectives of GOES are discussed.

P1.91 Real-time display of simulated GOES-R experimental products, Donald W. Hillger, NOAA/NEDSIS/ORA/RAMM Team, Fort Collins, Colorado

The next generation GOES (beginning with GOES-R) is planned for launch in the 2015 time frame. This new series of satellites will include improved spatial, temporal, spectral, and radiometric resolution. The last two characteristics are manifest by an increased number of spectral bands and increased precision for measurements from those bands. Because of the long lead-time needed to design, build, and test this new and complex satellite system, preparations for GOES-R for applications to analysis and forecasting mesoscale weather events are well underway. The approach for these "Risk Reduction" activities is to use data from existing operational and experimental satellites to create new products or improve on existing products, particularly for atmospheric and surface-related phenomena, using the additional resolution capabilities that will be available.

Initial emphasis has been placed on a daytime fog product and a blowing dust product. Other possible applications include monitoring of volcanic ash clouds and smoke from fires. Image products to detect these events exist, but they can be improved with the additional spectral coverage that will be available through the GOES-R Advanced Baseline Imager (ABI). Development work on new and improved products has been focused on the ABI-equivalent bands from MODIS and MSG data in particular. Testing of these experimental products will be run in real-time mode utilizing current GOES imagery, as well as MODIS and geostationary MSG data in particular to provide the spectral bands and temporal resolution that more closely match those to be available from GOES-R ABI. Experimental products are being sent to a GOES-R ABI Experimental Products web site (http://rammb.cira.colostate.edu/products/goes-r/) so that these new products generated from simulated ABI imagery can be viewed by a wide audience and tested as analysis and forecasting tools.

P1.92 Recasting HYDRA into the next generation of McIDAS, Thomas D. Rink, CIMSS/University of Wisconsin, Madison, Wisconsin; and T. Whittaker, T. H. Achtor, B. Flynn, G. Dengel, and K. Baggett

The freely available Hyper-spectral Data Research Application (HYDRA) program has been used world-wide during the past few years for training users of hyperspectral data for the past few years. It combines easy data access with a graphical user interface that allows the user to extensively probe, compare, and combine data from spectral channels and satellites.

HYDRA is now being re-cast to work within the McIDAS-V environment (the next generation of the McIDAS software) to provide even more flexibility to work with a variety of data sources, including models and in situ data, and to enable new types of displays and analysis. This presentation will provide details of the integration process and discuss the new capabilities in depth.

P1.93 Looking Ahead to GOES-R Space Weather Data Archive, Access, and User Services, Daniel C. Wilkinson, NOAA/NESDIS, Boulder, Colorado; and W. F. Denig

The first of the GOES-R series of satellites is scheduled for launch in 2015 and will introduce three new instrument suites to the user community.

The solar instruments include a solar X-ray sensor (XRS), an extreme ultraviolet sensor (EUVS) and a Solar X-ray imager (SXI) and will detect and locate X-ray flares, measure solar EUV flux and locate coronal holes.

The Space Environment In-Situ Suite (SEISS) will provide real-time measurements of the charged particle environment in geosynchronous orbit and will monitor geomagnetically trapped electrons and protons; electrons, protons, and heavy ions of direct solar origin; and galactic background particles.

The Magnetometer (MAG) will measure the earth's geomagnetic field at geosynchronous orbit in three-axes, providing information on the general level of geomagnetic activity and current systems in space. This information facilitates the detection of magnetopause crossings and sudden magnetic storm commencements, and detection of sub storms.

The ultimate repository for the data will be NOAA's Comprehensive Large Array-data Stewardship System (CLASS). All future users of these data are encouraged to express their wishes and concerns in the areas of user interface capabilities, archive latency, archive formats, delivery formats, delivery methods, browse capabilities, quality control, visualization, products, etc. http://sxi.ngdc.noaa.gov/goesr_looking_ahead.html

P1.94 Geostationary Operational Environmental Satellites (GOES) in support of NOAA's Climate Reference Network (CRN), Debra Braun, NOAA/NESDIS/NCDC, Asheville, North Carolina

A key technology in successfully observing climate change is cost-effective, reliable, near real time transmission and data distribution. The GOES primarily supports National Weather Service requirements. However, the satellites also provide communication support to an extended interagency user community conducting scientific research and protecting lives and property in the Western Hemisphere and have done so for more than thirty years. NOAA's Climate Reference Network uses NOAA's GOES infrastructure to collect observations and to distribute them for the purpose of monitoring observing stations in the United States and Canada.

This paper presents some historical context for the role of communication in NOAA's observation of in-situ temperature and precipitation for climate purposes, several factors key to the success or failure of data communications for in-situ stations, and why the GOES and the GOES Data Collection System continues to be a very favorable alternative. The paper also describes the role of near real time communications in transitioning instrument and algorithm changes from research to operations and the role planned for GOES in the Global Climate Observing System and a modernized regional climate network. Additionally, consideration is given to the impact to GOES-R capability and ground systems of a climate network consisting of hundreds of stations with the need for near real time high data rate communications and large message windows.

P1.95 Remapping GOES Imager Instrument Data for South American Operations, Implementing the XGOHI System, Shahram Tehranian, Nortel Government Solutions, Lanham, Maryland; and J. L. Carr, S. Yang, H. Madani, S. Vasanth, K. Mckenzie, T. J. Schmit, A. Swaroop, and R. DiRosario

Operational weather forecasting depends critically on the Geostationary Operational Environmental Satellite (GOES) system. The GOES constellation consists of an eastern satellite stationed at 75°W longitude, a western satellite stationed at 135°W longitude, plus in-orbit spares. Currently, GOES-12 occupies the eastern slot while GOES-11 occupies the western slot. National Oceanic and Atmospheric Administration (NOAA) replaced GOES-10 with GOES-11 as the operational GOES-W satellite in June of 2006. The GOES-10 satellite is still functioning well, but has exhausted its north-south station-keeping fuel. The GOES-10 spacecraft completed its eastward drift from longitude 135°W to 60°W in early December 2006 where it will continue to operate in a high-inclination mission to provide coverage over South America. Other GOES satellites may also be operated in high-inclination missions when they exhaust their station-keeping fuel, extending their operational lifetimes and enhancing the return on the public investment in the GOES system. The high-inclination mission for the GOES satellite is expected to help protect lives and property in Central and South America by significantly improving satellite detection of severe storms, floods, drought, volcanic ash clouds, wildfires and other natural hazards. Without GOES-10 data, and when the GOES-East is in a rapid-scan operations mode, large regions of South America only relieved GOES imagery every three hours. The GOES-10 effort is part of the implementation of the Global Earth Observation System of Systems (GEOSS)-Americas. Repositioning GOES-10 for better satellite coverage over the southern part of the Western Hemisphere was one of the first major activities to take place under the GEOSS-Americas initiative. Implementation of Image Motion Compensation (IMC) via ground processing through resampling is an integral part of the high-inclination mission operations concept. The objective of the on-ground IMC implementation is to provide the same level of Image Navigation and Registration (INR) performance that is achieved with on-board IMC. Normally, the GOES Imager is operated in fixed-grid mode, meaning that Image Motion Compensation (IMC) is applied in space to control the Imager scan mirror to compensate for image distortion caused by deviations of the orbit and attitude from their reference values. Current GOES operational spacecrafts (east and west) operate within a 0.5 degree inclination limit that allows the on-board IMC system to scan imagery as if from a "perfect GOES projection" from a fixed point in orbit. This limitation on inclination limits the life of GOES spacecrafts in that older spacecrafts (with lower fuel reserves) cannot be maintained within the 0.5 degree inclination limit. As part of the Extended GOES High Inclination (XGOHI) mission, the current generation of GOES ground system was enhanced to accommodate on-ground IMC implementation operating on IMC OFF data received from the GOES-10 spacecraft. Considering that the GOES-10 orbital inclination has already reached the 2° saturation point, the XGOHI system will be operational in early September 2007. The GOES VARiable (GVAR) format adaptations are transparent to the users since spare words are used for XGOHI specific parameters within GVAR. Several resampling methods have been considered such as nearest-neighbor and bicubic resampling depending on the needs of the user community. Fundamentally, all high-order resampling methods such as the bicubic resampling are convolutions of raw image pixels with resampling kernel functions. The selection of horizontal and vertical resampling kernels can be done independently of the implementation of resampling. A resampling impact study is ongoing by the Advanced Satellite Products Branch (ASPB) and the Cooperative Institute for Meteorological Satellite Studies (CIMSS) at Space Science and Engineering Center (SSEC) at University of Wisconsin for evaluating and recommending appropriate kernels for the user community. As of July 2007, the XGOHI system has gone through Integration Level Testing (ILT) and is transitioning into operations at Wallops Command and Data Acquisition Station (WCDAS).

P1.96 GOES-10 @ 60 West – a Wisconsin perspective, Timothy J. Schmit, NOAA/NESDIS, Madison, Wisconsin; and J. Li, J. P. Nelson, A. J. Schreiner, G. S. Wade, and Z. Li

NOAA/NESDIS operates the Geostationary Operational Environmental Satellite (GOES)-10, which is routinely scanning the southern hemisphere with both the Imager and Sounder instruments. The satellite is located at 60 degrees West longitude. This effort is part of the Global Earth Observation System of Systems (GEOSS) project, which is a collaborative effort between NOAA and international partners. GOES-10 provides the first operational geostationary Sounder to routinely gather data over South America. The Imager scans a full disk image every three hours and scans an "extended Southern Hemisphere" sector every 15 minutes, while the Sounder (with 19 spectral bands) scans South America and its surrounding regions in four sectors over four hours.

The Cooperative Institute for Meteorological Satellite Studies (CIMSS) at University of Wisconsin-Madison is producing experimental Sounder products and posting them on a near-real time Web page (http://cimss.ssec.wisc.edu/goes/rt/goes10.php). The Sounder products include Derived Product Images (DPI) of Cloud Top Pressure (CTP), Total Precipitable Water (TPW), and Lifted Index (LI). Animations of these DPIs, as well as select Sounder and Imager spectral bands, are also available.

Regarding other uses of the GOES-10 data stream, imagery from the GOES-10 Imager is improving satellite composite imagery used for aviation concerns over Antarctica by the Antarctic Meteorological Research Center (AMRC). The GOES-10 data are also being provided to the Washington DC VAAC (Volcanic Ash Advisory Center), by the Space Science and Engineering Center (SSEC), so that volcanic ash plumes can be monitored. GOES-10 Sounder cloud information is being used to initialize a regional NWP (Numerical Weather Prediction) model. The above mentioned activities are in addition to uses of the GOES-10 Imager and Sounder data in Central and South America.

P1.97 Deep convection defined by split window, Toshiro Inoue, MRI, Tsukuba, Ibaraki, Japan

We can classify optically thin cirrus clouds using the split window (11 and 12 micron). The brightness temperature difference between the split window (BTD=TBB11-TBB12) indicates larger value because of the differential absorption for ice. Using this characteristic of the split window, we can see the evolution of deep convection by computing the percentage of cirrus clouds within deep convection (say clouds colder than 253K). We study the percentage of deep convection over the eastern tropical Pacific (180-90W, 30S-30N) using hourly GOES images during one year of 2001. The life stage of deep convection can be defined by using the percentage of cirrus cloud within the deep convection. Using the coincide observation of PR/TRMM shows the dominance of convective rain for the deep convection with anvil percentage smaller than 10%.

Further IRIS effect was studied using the cirrus cloud percentage, SST and Total water vapor from TMI/TRMM. We can see the IRIS effect when we use the data over 30S-30N data, however, no evidence of IRIS when we use the data over 20S-20N.

Thus, the split window is very effective to study the ice cloud. We stress here the importance of calibration of split window. Current GOES data generally shows noisy spots for colder TBB. However, no noisy characteristics for MSG split window. The improvement of calibration for the split window is essential for the study of cirrus cloud which is generally colder TBB.

P1.98 NOAA CLASS Project, Robert Rank, NOAA/NESDIS, Suitland, Maryland; and F. Vizbulis

NOAA's Comprehensive Large Array-data Stewardship System (CLASS) provides the IT infrastructure to support the long-term, secure storage of and access to NOAA's archived environmental datasets, preservation information, and metadata. CLASS currently stores data from Polar-orbiting Operational Environmental Satellites (POES), Geostationary Operational Environmental Satellites (GOES), Defense Meteorological Satellite Program (DMSP), and European Organisation for the Exploitation of Meteorological Satellites (MetOp).

GOES data is archived by the National Climatic Data Center (NCDC) and has been available through CLASS since December 1, 2003. The data dates back to 1974 and the total archive represents approximately 250 TB of data. The data can be searched in a variety of ways, including data type, satellite, date and time range, and spatial coverage. It can be delivered in several different formats; including McIDAS area format, NetCDF, GIF, JPEG, and raw GOES Variable format (GVAR).

APPENDIX 1. CONFERENCE AGENDA

Fifth GOES Users' Conference
January 23-24, 2008
New Orleans, Louisiana

Conference Goal: Help users prepare for GOES-R

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

Expected Outcomes:
• Promoting user education at all levels: k-high school, academia, management
• increase user understanding of GOES-R products and services
• increase NOAA understanding of user interface needs
And to provide the user community an update on GOES-R status and capabilities

January 23 (Wednesday):

Session 1: Welcome and Keynote
Co-Chairs: Gary Davis and Jim Gurka
8:30 am Introductions (logistics, conference format, etc) Jim Gurka, NOAA/NESDIS
8:45 am Welcome/Conference overview/Goals Abby Harper, NESDIS deputy AA
9:00 am GOES: a Key Component of GEOSS Mary Kicza NESDIS AA
9:15 am Keynote Address Bill Hooke
9:45 am GEOSS perspective (invited speaker)
10:15-10:30 am Coffee Break

Session 2: Information Briefings: Baseline Instruments I
Co-Chairs: Tim Walsh and Tim Schmit
10:30 am GOES-R Program Status Greg Mandt, System Program Director
11:00 am The ABI (Advanced Baseline Imager) on the GOES-R series - Tim Schmit NESDIS STAR
11:30 am Geostationary Lightning Mapper for GOES-R and Beyond - Steve Goodman NESDIS STAR
12:00 pm Lunch (on your own)

12:00-1:30 p.m. Town Hall Meeting: Joining Researchers, Forecasters, and Users to Tackle Challenges in Tropical Cyclone Prediction

Session 3: Information Briefings: Baseline Instruments II
Co-Chairs: Tim Walsh and Tim Schmit

1:30 pm High Spectral and Temporal Resolution Imaging Sounders for GOES - Hank Revercomb, Space Science and Engineering Center, UW Madison, WI
1:45 pm GOES-R solar and space environment data products: Benefiting users - Steve Hill NWS SEC
2:00 pm Poster Preview – Tim Schmit
2:30 pm Break and AMS Poster Session

Session 4: Geostationary Satellites as a part of GEOSS
Co-Chairs: Jim Purdom and Eric Madsen
Invited Speakers:
4:00 pm EUMETSAT's Geostationary Satellites as a part of GEOSS – Ernst Koenemann
4:15 pm Russia (invited speaker)
4:30 pm Japan **Toru Hashimoto**, MSC/JMA, Tokyo, Japan
4:45 pm India **P.C. Joshi**, India Space Research Division, Ahmedabad, India
5:00 pm China (invited speaker)
5:15 pm Korea - **Ae-Sook Suh**, Korea Meteorological Administration, Seoul, South Korea
5:30 pm Sessions ends

January 24 (Thursday)

Session 5: GOES Data Products & Instrument Operations I
Co-Chairs: Robin Pfister and Tom Renkevens
8:30 am Welcome/Administration/Fourth GOES–R Users' Conference recommendations - Jim Gurka
8:45 am GOES-R user end-products: requirements process overview Barbara Pfarr
9:00 am GOES-R Product List and Implementation Don Gray
9:15 am GOES-R Algorithm Working Group (AWG) and its Role in the Development and Readiness of
GOES-R Product Algorithms Mitch Goldberg
9:30 am GOES-R Ground Segment Overview – Robin Pfister
9:45 am Coffee and Poster Break

Session 6: GOES Data Products and Instrument Operations II
Co-Chairs: Vanessa Griffin and Tom Renkevens
11:00 am Rapid Scan Operations for GOES Chris Wheeler, NESDIS/OSO
11:15 am Future GOES-R Instrument Operations – Capabilities and Constraints - Tim Walsh

Panel Discussion 1: Future Operations Panel
11:30 am - Moderator Tom Renkevens
AFWA – Captain John McMillan
NCEP - Joe Schaefer (SPC)
NWS WFO - Chris Darden (Huntsville WFO)
New Orleans Weathercaster: Bob Breck - WVUE
SSEC – Chris Velden
JCSDA – Dr. Lars Peter Riishojgaard, Executive Director

12:15 – 1:30 pm Lunch Presentation: Satellite Meteorology of Tropical Cyclones in the GOES-R Era
Dr. Jack Beven, NOAA/NWS National Hurricane Center
(Box lunch provided courtesy of the GOES-R Industry Partners)

Session 7: GOES-R Users' Forum I
Co-Chairs: Mark DeMaria and Mike Bonadonna
1:30 pm Using GOES sea surface temperatures and satellite altimetry to understand hurricane intensity changes – Nan Walker, Louisiana State University
1:45 pm Economic Benefits Study Sharon Bard, Consulting Group, LLC.
2:00 pm Preparing for GOES-R+ User Training and Education - Tony Mostek, NWS

Panel Discussion 2: International User Panel on Lessons Learned from Current GOES and Implications for GOES-R Preparations
2:15 pm Moderator, Don Hinsman/WMO
Luiz Machado, National Space Research Institute, São José dos Campos, Brazil;
Marcelo Colazo, National Commission for Space Activities (CONAE), Buenos Aires, Argentina;
David Grimes, MSC, Ottawa, Canada;
Paulo Manso, National Meteorological Institute, San José, Costa Rica
3:00 pm Coffee Break
3:30 pm United Airlines Polar Operations Mike Stills, United Airlines
3:45 pm Use of Satellite Data at National Weather Service Forecast Offices Don Moore, NWS
4:00 pm GOES imagery applications at the Aviation Weather Center Steve Silberberg, NWS AWC
4:15 pm Future use of GOES-R in Air Quality Assessments Jim Szykman, EPA
4:30 pm Application of Multi-Spectral Data to Space Shuttle Landing Operations Doris Hood, NWS Spaceflight Meteorology Group
4:45 pm Final remarks, Gary Davis, NOAA/NESDIS and Greg Mandt, SPD
5:00 pm Formal Conference concludes

APPENDIX 2. 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 3. 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/**
ABI Mock Spectral Response functions ftp://ftp.ssec.wisc.edu/ABI/SRF/
The CIMSS Hyperspectral Environmental Suite (HES) Page
http://cimss.ssec.wisc.edu/goes/HES/

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**
Interface Control Document (ICD) for AWIPS - National Environmental Satellite, Data and Information Service (NESDIS) **http://www.nws.noaa.gov/noaaport/document/icd_ch4.pdf**

Oregon State University Cooperative **http://cioss.coas.oregonstate.edu/CIOSS/**

Training

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/**
Research Projects: http://cimss.ssec.wisc.edu/~ilianag/

Miscellaneous

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

APPENDIX 4. CONFERENCE COMMITTEE

Hal Bloom	NOAA/NESDIS, Office of Systems Development
Michael Bonadonna	NOAA/NWS
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 Research and Applications
Don Gray	NOAA/NESDIS Office of Systems Development
James Gurka	NOAA/NESDIS Office of Systems Development
Donald Hillger	Colorado State University
Eric Madsen	NOAA/NESDIS, Office of International Affairs
Tony Mostek	NOAA/NWS
Thomas Renkevens	NOAA/NESDIS Office of Systems Development
Dick Reynolds	Short & Associates, Inc.
Kevin Schrab	NOAA/NWS Office of Science and Technology
Tim Schmit	NOAA/NESDIS, Center for Satellite Applications and Research
Howard Singer	NOAA/NWS Space Environment Center
Bill Sjoberg	NOAA/NWS Office of Science & Technology/General Dynamics
Patricia Viets	Short & Associates, Inc.
Tim Walsh	NOAA/NESDIS Office of Systems Development