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

NOAA 2013 Satellite Science Week Virtual Meeting Summary Report

March 18-22, 2013

Virtual and Boulder, CO

Final Report

FOREWORD

The second NOAA Satellite Science Week Meeting was held March 18-22, 2013, facilitated by the Cooperative Program for Operational Meteorology Education and Training (COMET) in Boulder, CO. The goal of this meeting was to continue promoting interchange between product developers and the user communities; ensuring a path for the transition of research to operations and user readiness. The interaction during Science Week is part of an ongoing effort to ensure effective communications among program managers, product developers, and end users, review the progress of on-going risk reduction research projects, and address the best approach to transition high priority research into operations.
This was the first time this meeting was held as an entirely web-based virtual event. There were 120 people registered for virtual attendance with an average of 85 in attendance per session. In addition, most of the Science and Demonstration Executive Board (SDEB) and the chairs of the Independent Advisory Committee (IAC) and NWS Operational Advisory Team (NOAT) were on site during the week.

We acknowledge the many people who helped to make this, our first virtual meeting, a success. We would like to especially acknowledge the work of the Planning Committee: Lon Goldstein and Wendy Abshire of COMET; Jim Gurka from the GOES-R Program Office; Mitch Goldberg from the JPSS Program Office; Jaime Daniels, Ingrid Guch and Mark DeMaria from NESDIS/STAR; Tony Mostek, NWS/Training Div; Mike Johnson, NWS/OST; Kathryn Miretzky, AS&D; Dick Reynolds, M2 Strategy, and Bill Sjoberg, Global Science and Technology. This report relied on the help of Jim Gurka, many hands at Omitron: Christopher Daughtrey, Janel Thomas, and Kathryn Miretzky (AS&D); and Dick Reynolds of M2 Strategy.

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1 Introduction

The agenda for the week featured live online presentations in each of eight session topic areas as well as "virtual posters" which were available for viewing on the website. In addition, there were also a selection of posters chosen for presentation and discussion during "live" virtual poster sessions within each of the eight topic areas which are listed below:

1. **AWIPS II** focused on use of AWIPS-II and development of plug-ins to display and integrate satellite data for operational forecasting applications.
2. **Tropical Storms/Hurricanes** focused on use of GOES-R and SNPP/JPSS data for tropical storm and hurricane forecast and warning applications.
3. **Severe Weather and Lightning** focused on use of GOES-R and SNPP/JPSS data for severe storms and high-impact convective weather forecast and warning applications.
4. **Exploitation of Satellites for Data Sparse Regions** focused on satellite-related applications for regions and centers that are satellite-centric or have significant gaps in radar and other observational coverage.
5. **Non-Convective Forecast Applications** focused on all satellite-based forecast and warning services that were not covered in the "Severe Weather and Lightning" session.
6. **Hydrology** focused on satellite contributions to hydrology from short term (flash flood) event predictions to climate (water cycle) studies.
7. **Exploratory Science** focused on new ideas and areas of interest that scientists think will be able to address the needs of the operational community in the longer term (next 3-7 years). These operational needs were described by the NOAT (NWS operational advisory team) in the 2012 NOAA Satellite Science Week Meeting which outlined a strategic vision for operational weather analysis and forecasting and posed several challenges to the research community e.g., boundary layer, state of the atmosphere, etc.
8. **Numerical Weather Prediction** focused on applications of satellite data assimilated into NOAA's current and planned operational numerical weather models for use in forecast and warning.

For each of the eight sessions, the goal was to address the following questions:

- Where are we now?
- What have the demonstrations to date shown us with respect to product value and applicability?
- Are product modifications needed?
- Do we need to improve product display techniques? Is there a need for product integration?
- What training is available and what training is still needed?
- What operational forecaster decision aids need to be developed?

And with respect to the above questions:

- Where do we need to be by the end of the calendar year 2013?
- Where do we need to be by launch?
- How do we get there?

The diverse audience including operational forecasters and international scientists, provided the opportunity for interesting discussions and, in some areas, closed the gap between product developers, operators, and trainers. This meeting continued the synergetic approach with open discussion to solve rising issues with the transition to future satellites and products.

A summary from the general session is given in Section 2. The Advisory Committee Meetings are covered in Section 3. Section 4 sums up the results of the meeting, including action items.

2 General Session Summaries

This section summarizes the major topics of interest covered during the eight topic sessions. Copies of the presentations and posters are available from the GOES-R web site.

Louis Uccellini, Director NWS, opened with a presentation on "Weather Ready Nation - A Challenge for Proving Ground Participants". The focus centered on the need for increased resiliency of communities, states, and sections of the country, to prepare and take action in the face of extreme events. The only way this can happen is to continually improve the forecast and warning process so that people have confidence to take action. The important elements for a successful forecast include: a Global Observing System; computers (supercomputers and work stations); data assimilation; modeling; and science; and a trained work force." The challenge for the modeling community is how to better plug both Low-Earth Orbiting (LEO) and Geostationary (GEO) satellite observing systems into the numerical models. An evolutionary distinction between the uses of the two systems has become blurred (traditionally LEO used by numerical models and GEO used by human forecasters) and it is clear that there is a need for integration.

In the future it will be important to generate more interaction between the GOES-R and JPSS Proving Grounds (PG) and the Joint Center for Satellite Data Assimilation (JCSDA) to move the whole enterprise forward whether it is for impact decision aids or for use of the data in numerical models. The second challenge lies in the dissemination of the data. We have to have a clear path to be able to move data around (to forecasters and to models). Need to work with NESDIS and NASA on this. It doesn't pay to do all of this and not be able to get the info out to the user community. The National Weather Service will focus activities into new budget categories representing the forecast process: Observations, Central Processing, Forecast and Analysis, Dissemination, and Science & Technology Integration. This must work for both satellite programs.

A presentation on "Working to Meet the Challenge" was given, summarizing the JPSS and GOES-R science, training and proving ground programs. The JPSS Proving Ground and Risk Reduction Program portion was given by Mitch Goldberg, Program Scientist NESDIS/JPSSO. Some of the challenges for JPSS are how to move from products to end user applications and ensure that users are ready for NPP/JPSS data. An understanding of how JPSS data is used throughout NOAA is pivotal to evolving and maintaining a robust satellite mission that serves the needs of all line offices. Guidance from the NWS Operational Advisory Team (NOAT) is important to prioritize how best to use JPSS data in combination with other data to improve critical products and services. To meet this challenge, the JPSS Proving Ground and Risk Reduction Programs were established. The Proving Ground and Risk Reduction Application areas are: Weather Forecasting, Ocean/Coastal, Land, Hazards, Hydrological, Climate, Education and Training, and Infrastructure. JPSS continues to engage the NOAA user community, ensuring that both the best current product and any new or enhanced products (via the Proving Ground) are made available in a timely manner.

Steve Goodman, Senior Scientist NESDIS/GOESRPO, presented the GOES-R Science Office update portion of "Working to Meet the Challenge." The GOES-R Science Office continues to apply lessons learned to incorporate new improvements each year. Pre-launch demonstrations with proxy data are important and benefit users and prepare them to fully exploit all GOES-R instruments and capabilities. Products and decision aids have been demonstrated in NOAA Testbeds, NCEP Centers, select WFO's, and the NWS Operations Proving Ground. A transition has begun from warning related products to remaining baseline products, day 2 future capability, fused products, decision support services, and impact-based decision aids. The GOES-R Science Office, with enhanced collaboration with JPSS,

international, and broadcaster communities, will continue to develop, demonstrate, and test GOES-R products intended for use as part of NWS decision support services.

Within the eight topic sessions there were many highlights throughout the week. The development of synergistic processing for LEO and GEO data is an important step and the use of common software and an Enterprise approach will aid this process. Together with the use of models and data assimilation, the polar and geo-satellite applications and products are entering a new era. There has been increased attention given to satellite data assimilation, and potential gains demonstrated in a number of cases for this activity; however this work in many cases still requires a planned transition to operations to ensure the community benefits from these activities. Multichannel RGB image enhancement has made significant advances since the last meeting. RGB images, however, need to be complemented by radiances. RGB enhancements can always benefit from fine-tuning for local advantage and may also benefit from accompanying quantitative data. There is a need to optimize generation and assimilation of Atmospheric Motion Vectors. This includes improved error characterization and data assimilation methodologies. There is also a need for direct assimilation of geostationary radiances in operational numerical weather prediction (NWP). These observations can be assimilated in a way that takes advantage of their almost time-continuous nature. The development of Cal/Val plans continue and need to be accompanied by a post-launch data plan and related data stewardship and access recommendations.

Proving Ground activities are increasing dialogue between forecasters and researchers in a very positive way. Everyone agreed that these exercises should be sustained and expanded as much as possible. While baseline product software development is well underway, it is important to note that the delivery of the highest priority GOES-R Future Capability products is continuing with five priority capabilities funded. Among Future Capability products for example, the Low Cloud and Fog and SO2 detection products are needed for aviation safety. It is important that the benefits available from the highest priority Future Capability products are not lost to the community. Quantitative Derived Product Images (DPIs) of satellite products can be inspected along with or in favor of qualitative RGBs in the proving ground exercises. Fog/Low Stratus work is impressive; again continuing proving ground exercises are desirable. Convective Initiation work is progressing; additional proving ground work will be helpful. Merging of GEO (Advanced Baseline Imager (ABI) and Lightning Mapper (LM)), radar, and modeling are receiving positive attention. Overshooting Tops and Clear Air Turbulence (CAT) progress is encouraging; an impressive list of publications is available. Cloud Height algorithm (ACHA) work is impressive; a uniform product from LEO and GEO is emerging and the Independent Advisory Committee (IAC) is recommending making it operational now with current GOES and VIIRS. GOES-R lightning mapper work also has made significant advances since the last meeting and real time application of lightning data is underway.

2.1 Session 1 AWIPS II / RGB

Session co-chair Ed Mandel, Branch Chief NWS/OST/SEC/DB, opened the session by presenting an overview of AWIPS II deployment status, program developments, the virtual lab and the development community, including governance and training. Mr. Mandel reported that deployment is on schedule for completion by mid-2015. Session co-chair Mike Johnson, Physical Scientist NWS/OST/PPD/MOBI, then presented a proving ground perspective. He presented a vision of a path to operations after the product demonstration is completed and challenged the science community to explore the potential for fusion processing within the AWIPS system. Part of this vision of path to operations includes Virtual Lab (VLab) which is a repository for AWIPS software products; a means for inter-team collaboration; a coordination mechanism for applications testing; facilitates the migration path to operations and organizes training and reference material.

Daniel Nietfeld, Science Operations Officer NWS/CR/WFO/Omaha (Valley) Nebraska, presented a local office perspective on AWIPS II. Mr. Nietfeld reported that his office has been coordinating with Raytheon since 2005 and switched over to AWIPS II permanently in November 2011. WFO OAX continues to be an AWIPS II R2O/O2R testbed. He presented examples of many interests including day/night band, low clouds and fog, convective initiation, RGB and simulated WRF imagery.

Matt Smith, UA/Huntsville, reported on the initiation and activities of the Experimental Products Development Team (EPDT). Mr. Smith described who is on the team, what the team does, and provided a commentary on the recent workshop. He said NWS/OST will coordinate with members on next steps and continue biweekly teleconferences to support further planning and use of VLab. He also listed some recent brainstorming ideas.

Jordan Gerth, Research Assistant UW/CIMSS, presented a comparison of AWIPS I and II and described on-going work at CIMSS. Mr. Gerth's comparison of the two systems clearly showed many advantages of the new system. He also described new satellite plug-ins and their usage. He pointed out some challenges for the new system including training, length of deployment and various issues that preclude using AWIPS I capabilities. He also described current efforts to improve AWIPS II. In summary, Mr. Gerth pointed out that there is still a lot of work to be done and that we must begin to consider the data delivery strategy to maximize utility of imagery and products from day one.

2.2 Session 2 Tropical Storms/Hurricanes

Co-chair Michael Brennan, Senior Hurricane Specialist NWS/NCEP/NHC, presented an overview and description of operational needs for forecasting tropical storms and hurricanes. He began by showing the NHC areas of responsibility and then illustrated the importance of satellite imagery for analysis and forecasting and then showed many illuminating examples of the process/analysis of these storms and presented a list of forecast challenges. Forecasting rapid intensity change is the biggest challenge, but advances in satellite meteorology could help improve the models. Another challenge he discussed is storm structure, including wind radii and storm surge magnitude, location, timing and extent.

Co-chair Mark DeMaria, Supervisory Meteorologist NESDIS/STAR/CRPD/RMMB, presented a discussion of science achievement, including: assimilating satellite data into numerical forecast models, improving analysis and statistical post-processing forecast products, and development of satellite imagery and products for situational awareness. He presented examples of recent progress in each area. He said that JPSS and GOES-R will provide new observations to improve regional and global models through data assimilation and new satellite products for analysis and situational awareness.

Hugh Cobb, Tropical Analysis and Forecast Branch Chief NCEP /NHC/TAFB, described the 2012 Satellite Proving Ground at the NHC. After providing an overview of the proving ground, Mr. Cobb then summarized the GOES-R products demonstrated. These included Hurricane Intensity Estimate, super rapid scan imagery, tropical overshooting tops, Saharan air layer, and several RGB products. Next, Mr. Cobb presented forecaster feedback with examples and then discussed plans for 2013 including use of AWIPS II and a number of JPSS products.

2.3 Session 3 Severe Weather and Lightning

Co-chairs Dr. Steve Goodman and Steven Weiss, Science Support Branch Chief NWS/SPC/SSB, introduced three speakers.

Brian Carcione, Science Operations Officer NWS/SR/WFO Huntsville, provided an operational perspective on severe weather/lightning. He introduced the topic by pointing out that there have been many improvements in short/medium range prediction of severe convective storms but that bigger challenges still exist in the "near" term (0-6 hour). He said local severe weather operations boil down to anticipation-how things will change, and validation- are the expected/current conditions valid/reasonable. The main questions during severe weather are: 1) where and when will storms develop; 2) how will the storm(s) evolve, and 3) which storms have the greatest chance of threatening life and property. He said that the WFO is using a number of products to answer these questions including; CIMSS NearCast, UA/Huntsville SATCAST, CIMSS Cloud Top Cooling, MODIS/VIIRS Air Mass RGB, assimilation of ABI data into NWP/analyses, and total lightning information from the pseudo-Geostationary Lightning Mapper proxy derived from ground-based total lightning mapping arrays. He illustrated the use of these products with many examples. He said the biggest challenge the operational meteorologist will face is the "fire hose" of data, requiring more use of decision aids and suggested use of an overarching algorithm to combine many decision aids into one package.

Wayne Feltz, UW/CIMSS, spoke about current and future scientific advances. He reviewed NOAT priorities and showed how they are being addressed. Among those discussed were pre-convective environment, the optimization of GEO/LEO atmospheric stability, and NearCast. He then addressed future plans for further development in these areas, including convection initiation nowcasting, GLM lightning, and utilizing data fusion to probabilistic forecast severe convection. Mr. Feltz concluded his talk with a summary of an "operations toolkit."

Kristin Calhoun, NOAA/NSSL, described the GOES-R Proving Ground at the Hazardous Weather Testbed. She first described the HWT facilities and the operational environment. She then discussed the products demonstrated: Cloud-Top cooling rate, convection initiation SATCAST, simulated cloud and moisture imagery, NearCast, GOES sounder airmass and RGB, pseudo-GLM. For each of the products Ms. Calhoun offered examples and forecaster evaluations.

2.4 Exploitation of Satellites for Data Sparse Regions

Co-chairs David Bright, Aviation Support Branch Chief NWS/NCEP/AWC/ASB, and Tim Schmit, NESDIS/STAR/CRPD/ASPB, introduced three speakers.

Carven Scott, Environmental and Scientific Services Division Chief NWS/AR/ESSD, delivered a talk on the need for satellite data in the data sparse regions of Alaska. Mr. Scott identified a very large list of unique weather challenges and contrasted the Alaskan data paucity with the extensive data available in the contiguous US. He then described some of the physical challenges inherent to forecasting for the state. Mel Nordquist, Science Operations Officer Eureka, CA, then picked up the briefing to discuss problems in other data sparse regions such as the west coast, including near shore gale events and stratus/fog, both marine and inland valley.

Anthony Wimmers, UW/CIMSS, reported on scientific advancements in detecting turbulence within satellite image signatures. Mr. Wimmers pointed out the resolution in numerical models is insufficient for detecting turbulence and probabilistic events are misrepresented because the models tend to damp out instability. Using examples, he described the types of turbulence and showed the work being done to detect each type.

Amanda Terborg, Satellite Liaison Aviation Weather Center, reported on the impact of using satellite data on flight routes over the Gulf of Mexico. Ms. Terborg presented examples of the radar- sparse regions in the Gulf, and showed how satellite data helps the AWC provide more accurate and timely forecasts.

2.5 Non-Convective Forecast Applications

Co-chairs Dave Novak, Branch Chief NWS/NCEP/WPC, and Mike Pavolonis, NESDIS/STAR/CRPD/ASPB introduced 3 speakers.

Michael Folmer, satellite liaison WPC/OPC/TAFB/SAB, described a technique for diagnosing and forecasting high impact events. He first pointed out the broad variety of responsibilities at each of the centers he supports. He then reviewed Superstorm Sandy and showed how various proving ground products were valuable in the analysis and forecast situation. Mr. Folmer also reviewed the "Snowquester" and again showed the utility of the proving ground products. He concluded by saying that the centers have found the RGB Air Mass product to be very useful in understanding the stratospheric contributions to potential vorticity (PV) anomalies and associated cyclogenesis. Also, using model overlays on the RGB Airmass products increased confidence in model solutions.

R. Bradley Pierce, Physical Scientist NESDIS/STAR/CRPD/ASPB, reported on Aerosol Data Assimilation and Forecasting – Volcanic Ash Prediction, Severe Storm Intensification, and future TEMPO/GOES-R Synergies. He began by describing the Real-time Air Quality Modeling System Aerosol Optical Depth assimilation procedure, compared with measurements and the forecast skill score. He described the GOES-R Volcanic Ash algorithm; some examples, and some forecast uncertainties. He reported that Tropospheric Emissions: Monitoring of Pollution (TEMPO) is NASA's first Earth Venture Instrument award and it's spectrographic measurements include a tropospheric measurement suite that provides key elements of tropospheric air pollution chemistry. He said that assimilation of TEMPO together with GOES-R ABI volcanic ash will improve SO_2 forecast skill over North America.

Mike Pavolonis described a new suite of fog/low stratus (FLS) products used in the proving ground. He first defined FLS and provided an overview and the motivation for a new product suite. He then presented a Research to Operations (R2O) timeline and lessons learned. Mr. Pavolonis provided forecaster feedback from the proving ground and the operational impacts. He then proposed next steps to include merging LEO and GEO capabilities, incorporating morphometric characteristics of landforms, develop 1-3 hour prognostic IFR and LIFR probability products, develop fog formation alerting capability, and integrate results with GPS applications.

2.6 Hydrology

Co-chairs Ralph Ferraro, NESDIS/STAR/CRPD/SCSB, and David Kitzmiller, NWS/OHD/HSMB, introduced three speakers in this session.

Greg Story, Forecaster NWS/SR/RFC/West Gulf, described the use of satellite precipitation estimates by HAS forecasters at the West Gulf RFC (WGRFC). He said the problem is the forecasters need accurate mean areal precipitation in real-time from areas of Mexico that have no radar coverage and very few rain gauges. Therefore, satellite Quantitative Precipitation Estimate (QPE) must be used in such locations. He gave an example and showed how the Satellite QPE could be used to "fill in the blanks." Mr. Story urged that NESDIS meteorologists work closely with the WGRFC to improve the QPE product.

Marty Ralph, Supervisory Meteorologist OAR/ESRL/PSD, reported on satellite contributions to Hydrology. He provided a west coast event perspective of atmospheric rivers. He first described what atmospheric rivers are and then pointed out they are important because of the huge amounts of precipitation they can create and showed examples of flooding caused by this precipitation. He then described how the Orographic Rain Index (ORI) could be used to assist in predicting flash flooding. He demonstrated its use by describing another west coast event. He completed his presentation by reviewing possible paths to operations for ORI and how it can be validated in operations.

Sheldon Kusselson, Meteorologist NESDIS/OSPO/SPSD/SAB, reported on satellite products and applications for hydrology, now and in the future. Mr. Kusselson first discussed total precipitable water (TPW) concepts and applications and then showed use of the blended TPW in comparison to climatology to illustrate areas of below and above normal precipitation. He then showed the use of the blended rain rate product from LEO satellites and compared that with QMORPH, a technique for determining rainfall accumulation using satellite imagery that was created by NOAA's Climate Prediction Center (CPC). The National Hurricane Center has received permission from CPC to incorporate QMORPH output for tropical disturbances and tropical cyclones into their experimental satellite rainfall estimate text product and graphics. Mr. Kusselson then described the ensemble Tropical Rainfall Potential and showed an example for Hurricane Sandy.

2.7 Exploratory Science

Co-chairs Paul Menzel, retired former NESDIS Chief Scientist, and Stephan Smith, NWS/OST/MDL/DAB introduced three speakers.

Lans Rothfusz, Deputy Division Chief, OAR/NSSL, described Forecasting a Continuum of Environmental Threats (FACETS), a new warning paradigm and a framework for progress. Mr. Rothfusz pointed out that we are headed for a future warning paradigm. He showed that while just about everything (science, technology, lifestyle, etc) has changed in the last 40 years, the warning methodologies have not. He then described some evolutional trajectories to a new paradigm. Mr. Rothfusz described the seven FACETS of the paradigm: Grid-based probabilistic threats; storm-scale obs & guidance; the forecaster; threat grid tools, useful output; effective response, and verification.

William Smith Sr., UW/SSEC and HU/CAS, addressed weather and climate satellite applications. He first described several satellites with ultra-spectral sounders. He then showed how the sounding retrievals provide many useful items including quantitative interpretation of satellite imagery, 3-d structure of storm systems, and time tendency of atmospheric variables. He showed how hyperspectral sounding could improve numerical weather prediction and create altitude-resolved winds.

Carven Scott, presented a description of the NWS Operational Advisory Team (NOAT), Weather Ready Nation (WRN), and NOAT vision and priorities. Mr. Scott said that WRN was first announced in the 2011 Strategic Plan and listed its five goals. He said the SSD Chief (NOAT) Science Vision (Key Themes) come from the Science and Technology (S&T) Capstone document and that the underlying science and technology concepts are in the WRN roadmap. Mr. Scott offered some questions to ponder when developing a new product, for example, “How does your proposed project deal with a path to operations (R2O)?”

2.8 Numerical Weather Prediction

Co-chairs Sid Boukabarra, NESDIS/STAR, Geoff DiMego, Mesoscale Meteorology Branch Chief NWS/NCEP/EMC/MMB, and Jim Yoe, Chief Administrative Officer JCSDA NWS/NCEP, introduced three speakers.

John Derber, Data Assimilation NWS/NCEP/EMC/GCWMB, presented data assimilation and the use of satellite observations. He provided an overview of data assimilation basics, and showed the progress that NCEP has made in recent years in forecast accuracy. He then discussed 2 examples of the use of satellite data in data assimilation. First, he described use of clear imager data from GOES-R and showed how important it is to good forecasting. He then discussed cloudy radiance assimilation and indicated that good progress has been made in assimilating AMSU-A data but that modifications need to be made in such cases. In conclusion he said that collaboration with external groups to enhance global analysis and prediction systems is important.

Robert Gall, NCAR scientist, presented for Fred Toepfer, Physical Scientist NWS/OST, Hurricane Forecast Improvement Project (HFIP) Project Manager. He reviewed three years of work on HFIP. He began with an overview of this 10-year program focused on improving numerical weather prediction model forecast guidance. He said the goals of the project are to reduce numerical forecast errors in track and intensity by 50% in 10 years, extend forecasts to 7 days, and to increase probability of detecting rapid intensification at day 1 to 90 % and 60% at day 5. He then reviewed progress to date with some encouraging figures and examples. He concluded by saying that greater use of satellite data will help greatly toward reaching the project goals.

Lars Peter Rishojgaard, Joint Center for Satellite Data Assimilation (JCSDA) authored a briefing on JCSDA activities which was presented by Jim Yoe. He provided an overview of JCSDA, described current activities and future plans. He then summarized by saying that JCSDA activities have had a clear impact on operational activities of all partners, including NWS/NCEP, there has been increased collaboration both internally (between partners), nationally, and internationally, and preparation for new sensors is critical for NOAA and JCSDA partners.

3 Advisory Committee Summaries

3.1 NOAT: NWS Operational Advisory Team Outbrief

The NWS Operational Advisory Team (NOAT) met each day to discuss satellite needs within the NWS in the GOES-R era. Their function is to advise the GOES-R Science and Demonstration Executive Board (SDEB) by developing a yearly guidance memorandum to ensure science development and demonstration activities meet operational priorities. The group is working on revising their 2013 guidance memorandum, defining guidance for the next call for Proving Ground proposals, and defining a product's path from Proving Ground to operations. The members recognize the important role their guidance plays by providing the SDEB with thorough and consistent guidance about operational needs.

The NOAT is impressed with applications of synthetic imagery and suggests exploring new ways of using it. They have provided a definition of data fusion: The process of synthesizing raw data from multiple sources to generate more meaningful information that is of greater value than any single data source. A formal presentation is requested from project investigators and liaisons showing that they have completed training, identified forecast office resources, etc. so that the product can move forward to implementation into operations. The NOAT plans to provide a more accurate template for this in the near future. They also recommend that the Proving Ground ensures that funding is available to take developed training into the Commerce Learning Center.

The NOAT also acknowledged that there is a need to develop a stronger working relationship with the Satellite Liaisons. There was much discussion about the role of liaisons. The NOAT and the liaisons need better communication as new products are tested across NWS regions. The NOAT would like to formally synergize the liaisons and their activities instead of the ad hoc bond in place now. There is a sense that they all are independently steaming, often with inconsistent or duplicative guidance. The hope is this new structure will allow them to be more efficient.

3.2 IAC: Independent Advisory Committee Outbrief

Each day the Independent Advisory Committee (IAC) met to discuss the issues and impacts of the transition to GOES-R. The members of this group are not directly associated with the ground system or product development, giving them an objective point of view. Their perspectives provide an unbiased and fresh look on the challenges that may arise during the transition to GOES-R. Based on the week's meetings, recommendations were made by the committee. These recommendations will be discussed and implemented by the GOES-R Program, overseen by Steve Goodman. John LeMarshall, Bureau of Meteorology in Australia, presented the following recommendations on behalf of the IAC:

1. Scientists must remain close to their algorithms during operational implementation. Their role in product production efficiency, validation, and evolution must be facilitated by close communication/collaboration with the vendor of the ground system. However science developers should not be the principal evaluators of their own products.

2. Preparations must be made for rapid software updates, with scientist engagement, as experience with real data reveals issues (data striping, rectification issues, GEO diffraction effects, missing or saturated data). There will be situations when the algorithm change process is going from "broken to working" rather than from "adequate to

better". There is a need to draft update strategies to be used both before Day 1 and after Day 1and a pre-planned product improvement strategy must be developed for the program. **Recommendation:** Scientists need early access to the operational GOES-R C++ code and a process needs to be established for rapid software updates both before Day 1 and after.

3. The Himawari-8 satellite will carry an Imager very similar to the ABI. As a result, preoperational access to Himawari data is currently being arranged by a Memorandum of Agreement. **Recommendation:** Scientist access to Himawari data and documentation of differences from GOES-R should be arranged so that working experience with real ABI data can mitigate some issues before GOES-R launch. Interaction with Australian scientists introducing Himawari data into forecast systems is also encouraged.

4. Optimal GOES-R scanning and pre-processing scenarios still need exploration (e.g. scan south to north for more timely Northern Hemisphere data, de-striping before rectification). **Recommendation:** Undertake a study to demonstrate the difference in GOES Perfect Projection of data when de-striped then rectified (information about image construction from scanning detector array needs to be made available).

5. Effective and timely Cal/Val is essential for high quality input data for product generation. A special briefing from the Cal/Val Team has provided this valuable information. **Recommendation:** Extended post-launch Cal/Val campaigns for validation of GOES-R sensor measurements and derived products are essential and must be planned. Post-launch validation must include considerations for field experiments; leveraging and contributing to existing plans for NASA/DOE/NOAA field experiments must be undertaken. The IAC strongly supports GOES-R Science Program Office activity in relation to Cal/Val and would benefit from a briefing on plans for post-launch validation. The detailed Basis of Estimate should take into account other planned validation campaigns and assets as much as possible. Coordination with other programs requires early commitment.

6. Preparations for routine production of Option 2 (Future Capability) Products (prior to operational production) are underway as part of the Enterprise processing system. **Recommendation:** This activity should be sustained as much as possible so that affiliated scientists get an opportunity to evaluate the ABI data and the user community gets familiar with the product(s).

7. Opportunity for LEO supplement/complement to GEO measurements for product generation has been enhanced greatly by the established of the Enterprise processing system. More efforts should be encouraged for combined products where LEO benchmarks are temporally continued with GEO measurements. For example, LEO day-night band observations of fog can be extended into early morning with GEO visible composites. One caveat is that LEO and GEO must provide coherent depictions, hence physics issues need attention (e.g., viewing angle differences, diffraction issues from GEO but not LEO). For example, LEO versus GEO Vis/NIR algorithms must account for the characteristic viewing angle and solar illumination differences between the two systems.

8. Better utilization of temporal continuity for product generation and quality control (QC) is progressing. Some algorithms are now making good use of the temporal advantages

offered by geostationary measurements; all algorithm developers should re-consider ways to make better use of consistency checks and/or QC.

9. The requirements for data stewardship and access needs better articulation and planning. **Recommendation**: In relation to data stewardship there is a requirement for the development of a comprehensive data stewardship plan which includes a strategy for stewardship of level 0 data given the NESDIS decision that L0 data from the instruments will not be archived in CLASS. The Program is evaluating alternative approaches to stage L0 data, perhaps at Wallops, for use by the Calibration Working Group instrument teams.

10. Data assimilation of hourly radiances and products (e.g. atmospheric motion vectors) in NWP models requires more attention (e.g. use of 4DVAR). JCSDA engagement in this direction needs to be strengthened. Moreover, use of satellite data over land (surface viewing as well as upper tropospheric/lower stratospheric moisture sensitive measurements) in NWP needs to be enhanced. Overall we need to be prepared for the generation and continuous assimilation of (clear) radiances and hourly winds. Surface emissivity also needs to be updated in the Community Radiative Transfer Model (CRTM).

11. Problems still exist in the treatment of the visible and visible-affected IR bands in the CRTM; these have not been adequately validated. This is becoming an increasing issue for operational implementation of all code/algorithms using these spectral bands as we get closer to launch. The CRTM team should be supported in their attempts to resolve these issues. In general NWP readiness for GOES-R needs to be pursued as a high priority activity.

12. The Satellite Programs and the JCSDA should respond to the rising need for Data Assimilation Impact metrics tailored to Forecaster/Stakeholder understanding including those for regional high impact data assimilation (DA) tests. As a result, metrics such as rainfall forecast accuracy, extreme rainfall prediction accuracy, hurricane intensity, track and wind speed forecast accuracy and storm position and timing accuracy need to be estimated. In addition all DA and other Impact studies and results should be respected; but not widely communicated until they are produced in a study of appropriate length and significance.

13. ABI does not offer a sounding product; ABI offers layer adjustments to a NWP model initial vertical profile estimate. This must be made clear in the product designation. Use of the word “sounding” is misleading. Utilization of the LEO high spectral resolution data rendering of moisture vertical and horizontal distributions needs to be encouraged. **Recommendation:** Regional forecasts and nowcasts necessary for a Weather Ready Nation will have to make better use of the information content from AIRS, CrIS, IASI data and GPS. Between LEO sounding coverage, GOES-R data should be used to monitor temporal profile (atmospheric stability, etc.) changes. **Recommendation:** To pursue the missing continuous viewing essential for capturing the rapidly changing conditions that go with severe weather, the move to a GEO high spectral resolution IR sounder should receive higher priority within NOAA. A Transition Plan and Transition Survey should be completed as soon as possible.

14. In relation to supporting operational forecasting, the value of Visible Infrared Imager Radiometer Suite (VIIRS) in Advanced Weather Interactive Processing System (AWIPS) will be dependent on the timeliness of the data. Currently the plan is to use the IDPS at

NESDIS as the source; however this will result in upwards of 2 hour latency from observation time. **Recommendation:** Make use of a network of DB sites from CONUS and OCONUS to reduce latency to within 30 minutes.

15. In relation to AWIPS II and product development, we need to bring experts in radar and NWP knowledge and skills to the product development teams. They would work with satellite experts in order to achieve the vision of fused-integrated observations with NWP. In particular, this needs to come together for the Proving Ground.

16. Because of the importance of training to ensure the success of the GOES-R program, it is recommended that the application production team subject matter experts be involved in training. This may be done in a number of ways, such as providing materials and training the trainers.

17. In relation to space weather, NOAA National Geophysical Data Center (NGDC) has now presented their part of the plan for operational processing of the Level2+ products. For software development, NGDC has taken advantage of software already developed for space weather applications. The issues related to the production of Level 2+ data from Level1 data still needs to be resolved. **Recommendation:** NWS and NESDIS should consider NGDC's proposed solution to current Level2+ processing issues noting these products are of significant operational benefit.

18. It should be noted that NGDC has an increased role in Cal/Val and is working closely with the Cal/Val Working Group planning pre- and post- launch activity. **Recommendation:** A Cal/Val team needs be formed in the short term to support the full set (4) of space weather instruments and ensure their readiness pre-launch.

3.3 Training Team Report

The training team review was given by Tony Mostek addressing training challenges and some accomplishments. Connecting to the NWS Weather Ready Nation strategic plan is an important focus for training. A major question for the Proving Ground is, “What is dynamic training and how do we make sure that we have a process that is effective, efficient, and funded?” Training is not just one place; it involves working together in a true team of users and developers in a structured process with learning objectives based on performance needs and case studies, etc. An example of a training success came from the NOAT highlighting the importance of the Fog and Low Stratus product. Initial training that was an issue a year ago was revised and enhanced because of engagement with the subject matter experts and a satellite liaison. Getting specific, regional examples was critical to having successful training and also keeping the examples current. Other important highlights and suggestions were:

- Virtual Institute for Satellite Integration Training (VISIT) chat: monthly interactive sessions are successful.
- Training completions are tracked for the number of individual regions and offices through the Learning Center.
- Lessons learned from the product developer help the trainer better understand the material.
- Future updates to training should be a less rigorous process.
- A training representative should be involved with various groups on a semi-regular basis.

- The Cooperative Institute for Meteorological Satellite Studies (CIMSS) is actively embracing AWIPS II to further demonstrate the impact of GOES-R and JPSS imagery on operational meteorology (AWIPS II offers several advantages over AWIPS I).
- The satellite and RGB-compositing capabilities of the software are increasing but need to be refined. Adequate training and testing platforms are a necessity but availability is very low.
- The data delivery strategy must be considered to maximize utility of imagery and products on the first day of operations.

The satellite training team also presented training issues:

- It is important moving forward to include training in NOAT, SDEB & PG meetings to ensure focus on top priorities at the training division, VISIT, COMET, SPoRT, Satellite Liaisons, etc.
- There needs to be a structured process with learning objectives based on performance needs and case studies/simulations where learning is applied.
- It has been a challenge to overcome reduced NWS Training Funds (~50% drop over 2 years).

Some other key topics for training include: Space Weather, High Latitude, Ocean, Climate, Decision Support/Makers, Weather Ready, Aviation, etc. A major point to take away is that NWS Science and Operations Officers (SOOs) are going to be a crucial component in developing training. They may be a resource available to fill in some of the blanks. There should be focus on improving already existing products that are in the Satellite Broadcast Network pipeline so the product does not have to go through an extended process. There was also discussion of interacting with the Australian Bureau of Meteorology Training Center as they begin using Himawari ABI data. It was expressed that an international session would be a nice addition to the next meeting.

3.4 Science and Demonstration Executive Board (SDEB)

The SDEB members convened daily to review the many excellent presentations and discussions during the course of the week. Much has been accomplished, but we are just scratching the surface in developing future capabilities with GOES-R and JPSS. The NOAT and IAC chairs were present for the daily discussions. In addition, the SDEB met with the IAC during their daily deliberations and review. The SDEB thanks the COMET Program for facilitating the logistics and conduct of the meeting, which created many challenges as a result of the virtual nature of Science Week across many time zones. It was quickly recognized on Day 1 that more time was needed for discussion after each presentation. An adjustment was made for the speakers to finish early and allow five minutes for questions. Later in the day there was a dedicated question and answer (Q&A) session that allowed for more in-depth discussion on the specific topical subject areas in the agenda. However, the poster sessions were less effective than the traditional face-to-face sessions. Each session chair selected at most 1-2 posters for an oral presentation during the Q&A wrap-up. Unfortunately, the presenters were pressed for time and the planned breakout discussions in advance of Science Week that were to allow an in-depth dialogue of all posters in each of the individual sessions did not take place. As a result, the SDEB decided that with future meetings likely to require more virtual participation and less travel, the Science Week Meeting held annually could be supplemented with monthly virtual science presentations. These presentations would be held monthly on the last Friday of the month for one hour with two speakers selected from the funded GOES-R Risk Reduction Science Program reporting their ongoing research.

Science Week and the resulting NOAT Guidance and IAC recommendations summarized above, the NOAA Satellite Conference in April, and the OCONUS meeting in June will all be helpful in developing the next call for Risk Reduction Science proposals. The Letters of Intent will be released in late July with final selections targeted for the December time frame. Training is an important consideration in the new round of research proposals. Due to NWS reductions in core funding supporting COMET and VISIT, as well as the desire by the NOAT to more closely align training with product development and the transition of the research to operations, the new starts under GOES-R Risk Reduction will request a training plan (through consultation with NWS) and an accompanying statement on the most probable path(s) to operations (e.g., centralized processing at NSOF, AWIPS-II). The satellite liaisons will also work more closely with the NOAT. More details for the Risk Reduction proposals will be sent out with the call for new starts.

4 Conclusion

The week was challenging for a meeting of this length, size, and scope to be conducted remotely for the first time. COMET was instrumental in making the week a success with maximum attendance of 130 people (119 remote). On average, the majority of attendees, in response to discussion poll sessions each day were tuned in from the Eastern time zone (40%), with an equal to lesser amount (20%) tuned in from the Central and Mountain time zones and a small percentage (10%) tuned in from the Hawaii and Alaska time zones.

Each session was evaluated by polling the attendees with the following question and possible answers: The portfolio of proving ground, operational, research and training activities for GOES-R and JPSS appear to:

A. Be on track, with only slight rebalancing if any
B. Need significant rebalancing
C. Unsure

The responses for each session were:

Session	A	B	C
Hurricane and Tropical Storms	60%	10%	30%
Severe Weather and Lightning	90%	10%	0%
Satellite Use for Data Sparse Regions	33%	29%	38%
Non-Convective Forecast applications	59%	9%	32%
Hydrology	61%	17%	22%
Exploratory Science	41%	41%	18%
Numerical Weather Prediction	50%	33%	17%

NOAA Satellite Science Week bridged gaps of communication among many groups involved in the satellite programs. This interaction is part of an ongoing effort to ensure the best approach towards resolving current and future issues and preventing redundant efforts. Future meetings will continue this synergetic approach with open discussion to solve rising issues with the transition to future satellites and products.

There were several action items from the week:

- Recommendation: Integrate satellite data more fully into forecast and warning operations.
- Action: NOAT to work with Mike Johnson and Kevin Schrab on a definition for fused product.
- Recommendation: Explore potential for fusion processing within the AWIPS-II system.
- Action: NOAT to work with Mike Johnson and Kevin Schrab on a defined product path to operations (i.e. when is a product ready to go from the Proving Ground, to SBSRB etc.).

Various recommendations from the IAC also resulted from the meeting. All actions and recommendations are being worked by their respective groups. All new information pertinent to the user will be communicated through the GOES-R website and future meetings and conferences.