**Satellite Proving Ground Demonstration Plan:**
**Aviation Weather Center Proving Ground – 2015 Demonstrations**

1. **Project Title:** 2015 Satellite Proving Ground – Aviation Weather Testbed

2. **Organization:**
   - **a.** Aviation Weather Center Proving Ground, Kansas City, MO
   - **b.** Air Traffic Control Systems Command Center, Warrenton, VA
   - **c.** Center Weather Service Units

3. **Products to be Demonstrated as a GOES-R Proving Ground activity at the AWT**
   - **a.** Satellite Derived Motion Winds
   - **b.** GOES GeoColor imagery
   - **c.** Synthetic Cloud and Moisture Imagery
   - **d.** Flight Icing Threat
   - **e.** ACHA Cloud Top Altitudes
   - **f.** JPSS AIRS Ozone Retrievals
   - **g.** NearCast Model Theta-E
   - **h.** Convective Toolkit
     - **i.** Pseudo Geostationary Lightning Mapper
     - **ii.** GOES-R Convective Initiation
     - **iii.** Cloud-Top Cooling
     - **iv.** Overshooting Top Detection
     - **v.** HRRR Lightning Threat Forecast
   - **i.** VIIRS Imagery
     - **i.** Day/Night band
     - **ii.** VIIRS/MODIS Cloud Layers & Snow Cover Discriminator
     - **iii.** VIIRS/MODIS Dust Enhancement
     - **iv.** VIIRS/MODIS Nighttime Microphysics
   - **j.** GOES-14 SRSOR 1-minute imagery

4. **Demonstration Project Summary**

   a. **Overview**: The Satellite PG has provided aviation-related products to the Aviation Weather Center (AWC) and Aviation Weather Testbed (AWT). Pre-operational demonstrations of these products, which will provide aviation forecasters the opportunity to critique and improve the products relatively early in their development, will occur throughout the coming year. Amanda Terborg, the GOES-R liaison at the AWC, will be handling all logistics and coordination of the new satellite datasets within the demonstration period.

   **b. Plan, Purpose, and Scope:** The AWC 2015 demonstrations will provide the Satellite Proving Ground (PG) with a pre-operational environment in which to deploy and demonstrate algorithms associated with weather-related aviation hazards while in addition familiarizing end users with its next generation geostationary and polar satellite systems. The demonstration will consist of two ongoing long-term evaluations as well as one two-week long, intensive experiment period in late summer. Products will be evaluated based on the operational desk structure of the AWC.

   **c. Goals:** The activities within the Satellite Proving Ground at the AWT will focus on demonstrating and evaluating the baseline and future capabilities products as identified below, and more extensively on integrating them within AWC operations. The 2015

demonstrations will include forecasters from each desk within AWC operations, and this will not only provide a wide variety of feedback, but will also aid in building relationships within a very diverse aviation user community. Both of these things will be vital part in furthering the GOES-R/JPSS PG Research to Operations effort within the AWT.

5. **Participants Involved:**
    a. **Providers:**
        i. Satellite Derived Motion Winds (Daniels – NESDIS STAR)
        ii. GOES GeoColor imagery (Szoke/Lindsey – CIRA/NRL)
        iii. Synthetic Cloud and Moisture Imagery (Sieglaff/Lindesy – CIMSS/CIRA)
        iv. Flight Icing Threat (Smith Jr./Heidinger – NASA LaRC/CIMSS)
        v. ACHA Cloud Height Algorithms (Heidinger/Wanzong – CIMSS)
        vi. JPSS AIRS Ozone Retrievals (Berndt/Zavodsky – SPoRT)
        vii. NearCast Model (Petersen/Line – CIMSS/CIMMS)
        viii. Pseudo Geostationary Lightning Mapper gridded version (Stano – SPoRT)
        ix. GOES-R Convective Initiation (Mecikalski – UAH/SPoRT)
        x. Cloud-Top Cooling (Feltz/Sieglaff – CIMSS)
        xi. Overshooting Top Detection (Feltz/Bedka/Monette – CIMSS)
        xii. HRRR Lightning Threat Forecast (McCaul, Chronis, Alexander – USRA, UAH, ESRL-GSD)
        xiii. VIIRS Day/Night band (Fuell/Strabala/Miller – SPoRT/CIMSS/CIRA)
        xiv. MODIS/VIIRS Cloud Layers & Snow Discriminator (Miller – CIRA)
        xv. MODIS/VIIRS Dust Enhancement (Miller – CIRA)
        xvi. MODIS/VIIRS Nighttime Microphysics (Fuell/Knaff – SpoRT/NESDIS STAR)
        xvii. GOES-14 SRSOR 1-minute imagery (Schmit/Knaff - CIMSS)
    b. **Consumers:**
        i. Aviation Weather Center forecast operations
        ii. AWC Air Traffic Control Systems Command Center forecast operations
        iii. Center Weather Service Units

6. **Project Schedule/Duration (timeline):**
    a. AWC Testbed Schedule:
        i. Long-term evaluation (6 January – 30 April 2015)
            1. ACHA Cloud Altitudes
            2. Synthetic Cloud and Moisture imagery
            3. VIIRS/MODIS Imagery
            4. Flight Icing Threat
            5. Fog and Low Stratus
            6. Satellite Derived Motion Winds
        ii. Evaluation Period II (1 May – 1 September 2015) and the 2015 AWT Summer Experiment (10-22 August 2015)
            1. GeoColor Imagery
            2. Synthetic Cloud and Moisture imagery
            3. Convective Toolkit
            4. NearCast Model
            5. GOES-14 SRSOR 1-minute imagery
            6. Ozone
    b. First Products in AWC Testbed: May 2012
    c. Deadline for all product availability: 6 January 2015
    d. Training Period: 13 January – 30 September 2015

e. Center Responsibilities: AWC Operations is responsible for delivering accurate, consistent, and timely weather information for safe and efficient flight across the world airspace system. The main met-watch responsibilities range from small areas of the CONUS (West, Central, East) out to large portions of both the Pacific and Atlantic Oceans. In addition, they are also responsible for a smaller number of global aviation products. Satellite is used within operations to determine areal extent and intensity trends of in-flight weather hazards along aviator's routes of flight. The products demonstrated within the AWC will be evaluated on their usefulness in forecasting the various aviation hazards.

**f.** Mid-term Evaluation Report: 29 May 2015

**g.** Final Evaluation Report: 1 October 2015

| GOES-R/JPSS Proving Ground Product | Category | Acquisition into Testbed | Training | Formal Evaluation |
|---|---|---|---|---|
| ACHA Cloud Height Algorithms | Baseline | Already Acquired | Spring 2014 | 6 January – 30 April 2015 |
| Aircraft Flight Icing Threat | Future Capability/ NOAT Priority (3) | Already Acquired | Spring 2014 | 6 January – 30 April 2015 |
| GeoColor Imagery | Future Capability | Already Acquired | Spring 2014 | 6 January – 30 April 2015 |
| Satellite Derived Motion Winds | Baseline | Winter 2015 | Winter 2015 | 6 January – 30 April 2015 |
| VIIRS Day/Night Band | Baseline | Already Acquired | Spring 2014 | 6 January – 30 April 2015 |
| VIIRS/MODIS Nighttime Microphysics | Future Capability | Already Acquired | Winter 2015 | 6 January – 30 April 2015 |
| VIIRS/MODIS Cloud Layers and Snow Discriminator | Future Capability | Winter 2015 | Winter 2015 | 6 January – 30 April 2015 |
| VIIRS/MODIS Dust Enhancement | Future Capability | Already Acquired | Fall 2014 | 6 January – 1 September 2015 |
| JPSS AIRS Ozone Retrievals | Future Capability | Winter 2015 | Winter 2015 | 6 January – 1 September 2015 |
| Convective Initiation | Future Capability/ NOAT Priority (1) | Already Acquired | October 2013 | 1 May – 1 September 2015 |
| Cloud Top Cooling/OTD | Future Capability | Already Acquired | October 2012 | 1 May – 1 September 2015 |
| NearCasting Model Theta-E | GOES-R Risk Reduction | Already Acquired | Summer 2014 | 1 May – 1 September 2015 |
| Pseudo Geostationary Lightning Mapper | Baseline | Already Acquired | October 2013 | 1 May – 1 September 2015 |
| HRRR Lightning Threat Forecast | Future Capability | Already Acquired | Summer 2013 | 1 May – 1 September 2015 |
| Synthetic Cloud and Moisture Imagery | Baseline | Already Acquired | May 2013 | 6 January – 1 September 2015 |
| GOES SRSOR 1-minute Imagery | Baseline | Already Acquired | Winter 2013 | When available in operations |

7. **Project Deliverables**
    - **a.** Proving Ground Operations Plan – First Draft: 7 November 2014
    - **b.** Proving Ground Operations Plan – Final Draft: TBD
    - **c.** Proving Ground 2015 Demonstration Mid-term Report: 29 May 2015
    - **d.** Proving Ground 2015 Demonstration Final Report: 1 October 2015

8. **Responsibilities and Coordination:**
    - **a.** Amanda Terborg, UW-CIMSS/AWC – Satellite Liaison
    - **b.** David Bright, NOAA/NCEP AWC – ASB Chief
    - **c.** Bruce Entwistle, NOAA/NCEP AWC - SOO
    - **d.** Kathryn Miretzky, AS&D for GOES-R Program Office – PG Coordinator

9. **Budget and Resources Estimate:** Funded through the GOES-R Science Office as part of the Omnibus Proving Ground funding to CIRA, CIMSS, UAH, and NASA/SPoRT

**Product Name:** GOES-R Flight Icing Threat

**Primary Investigator:** Bill Smith Jr. (NASA LaRC), Andy Heidinger (CIMSS)

**National Center/WFO Relevance:**

- The GOES-R Flight Icing Threat integrates various cloud properties from the GOES-R baseline DCOMP algorithm to generate a probability and intensity of icing and provides a forecasting tool for aviation operations.
- This product attempts to address one of the future-capabilities of the NOAT and will aid in further guidance regarding a more integrated, NWP-like approach in the future.
- Provides situational awareness for the issuance of icing AIRMETs at the AWC

**Product Overview:**

- Utilizes various satellite-derived cloud properties and provides information on icing conditions.
- Composed of three components including (1) an icing mask available day and night, which discriminates regions of possible icing, (2) an icing probability, estimated during the daytime only, and (3) a two-category intensity index which is also derived during the daytime only.
- The skill of the algorithm in detecting icing conditions (POD) reported by pilots (via PIREPs) is better than 90%

**Product Methodology:**

- The icing mask is developed using GOES-R derived cloud thermodynamic phase, cloud top temperature, and cloud optical thickness products to identify which cloudy pixels are most likely to contain significant super-cooled liquid water.
- During the daytime, the probability (low, medium, or high) of encountering icing and the intensity category [light (LGT), or moderate or greater (MOG)] are determined using the liquid water path and effective droplet size products.
- The GOES-R Flight Icing Threat product will assist in resolving small-scale areas of intense icing often missed in other products.

**GOES-R Flight Icing Threat Products:**

- Flight Icing Threat

**Concept for Pre-Operational Demonstration:**

- The Flight Icing Threat product was delivered to the Aviation Weather Testbed in February 2013 via the University of Wisconsin LDM and converted to a format suitable for display in N-AWIPS.

**Concept for Operations:**

- The hope is that the FIT will be centrally produced at OSPO and delivered via SBN or PDA.

**Product Name:** VIIRS Day-Night Band Reflectance

**Primary Investigators:** Kevin Fuell (SPoRT), Kathy Strabala (CIMSS), Steve Miller (CIRA)

**NWS Center/Office Relevance:**

- The VIIRS Day-Night Band (DNB) on S-NPP is a new low light sensing capabilities that has numerous NWS applications, including nighttime tropical cyclone center fixing, and cloud, fog and smoke detection.

**Product Overview:**

- The DNB senses reflected moonlight at night. It can be used in similar ways to the visible channel during the day.

**Product Methodology:**

- The DNB measures reflected moonlight and emitted light from surface sources such as city lights and fires. To provide a more uniform image as the moon phase changes, a reflectance product is generated using the moonlight algorithm from CIRA.

**Pseudo Natural Color Imagery Products:**

- The reflectance product is available twice per day from the ascending and descending passes of S-NPP

**Recent Product Modifications:**

- None

**Concept for Pre-Operational Demonstration:**

- The DNB is obtained from servers at CIMSS and provided via a SPoRT ftp server. The CIRA moonlight code is applied at SPoRT to create the reflectance product before the data is posted for distribution.

**Concept for Operations:**

- The DNB and other VIIRS channels will be part of the operational satellite data stream for the NWS.

**Product Name:** Synthetic Cloud and Moisture Imagery

**Primary Investigator:** Dan Lindsey (STAR/RAMMB), Justin Sieglaff (CIMSS), and Dan Bikos (CIRA)

**National Center/WFO Relevance:**

- Synthetic satellite cloud and moisture imagery forecasts allow forecasters to become familiar with the different bands associated with the GOES-R Advanced Baseline Imager (ABI).
- Realistic satellite bands using the model output allow forecasters to easily identify features that may be difficult to determine using standard and derived model output fields.
- Comparisons of synthetic satellite imagery with actual satellite imagery provide a method for NWP model performance evaluation.

**Product Overview:**

- Synthetic cloud and moisture imagery from the ABI replicates how atmospheric features will appear in the GOES-R ABI bands.

**Product Methodology:**

- After the NSSL runs their 0000 UTC 4-km WRF-ARW, several variables including temperature, water vapor, and other physical and microphysical parameters are obtained.
- When all variables have been received, a radiative transfer model (RTM) is run to generate the synthetic imagery bands.
- Hourly output of NSSL WRF data between 0900 UTC of Day 1 and 1200 UTC of Day 2 (F009-F036) is processed daily.
- Resolution of the output is 4-km to match the input resolution of the NSSL-WRF model; the GOES-R ABI IR bands will have 2-km resolution.

**NSSL-WRF Synthetic Cloud and Moisture Imagery Products:**

- ABI Bands 7-16, including wavelengths from 3.9 to 13.3 μm
- 10.35-3.9 μm Difference (to identify liquid water clouds)
- 10.35-12.3 μm Longwave Difference (to identify low-level moisture convergence)

**Concept for Operational Demonstration**:

- The NSSL-WRF product will be converted into AWIPS, AWIPS-II, and NAWIPS formats and sent to the National Centers and WFOs

**Concept for Operations:**

- GOES-R Cloud and Moisture Imagery is expected to be centrally produced at OSPO/ESPC and delivered by SBN or PDA. Synthetic imagery expected to be generated and displayed via plug-in on AWIPS-II.

**Product Name:** Pseudo Geostationary Lightning Mapper

**Primary Investigator:** Geoffrey Stano (SPoRT)

**National Center/WFO Relevance:**

- Can be used to identify convection that may contain significant lightning, both cloud-to-ground and intra-cloud lightning, that can affect enroute air traffic
- Will prepare forecasters to receive data from the GLM, baseline GOES-R instrumentation designed to measure total lightning.

**Product Overview:**

- Provides an 8km boxed average estimation of total lightning activity within the LMA networks.
- Designed to give forecasters the opportunity to use and critique a demonstration of GLM type data to help improve future visualizations of these data and its trends.
- Serves as reference for comparison with full GLM proxies and derived products.

**Product Methodology:**

- Takes the raw total lightning observations, or sources, from any of the ground-based LMA available and recombines them into a flash extent gridded field.
- These data are then mapped to a GLM resolution of 8 km and are available at a 1 to 2 minute refresh rate, depending on the ground-based network being used.
- With the flash data, when a flash enters a grid box, the flash count will be increased by one and no flash is counted more than once for a give grid box.

**GOES-R PGLM Products:**

- Current LMA networks: Oklahoma (OKLMA), Northern Alabama (NALMA), D.C. LMA (DCLMA), Colorado (COLMA), New Mexico (NMLMA), West Texas (WTLMA), and Houston (HGLMA)
- Expected LMA networks by summer 2014: Central Florida and Atlanta?
- GLD360 OCONUS proxy – limited NWS data feed from Vaisala

**Concept for Pre-Operational Demonstration:**

- The PGLM data, including the NALMA, OKLMA, and DCLMA networks, were delivered to the Aviation Weather Center in May 2012 and the COLMA and HGLMA in April 2013 via the SPoRT LDM. Additionally, the WTLMA, and NMLMA network data are expected in spring 2013. The files have been converted to a format suitable for display in N-AWIPS.

**Concept for Operations:**

- GLM data are expected to be centrally produced at OSPO/ESPC and delivered by SBN or PDA

**Product Name:** GOES-R Convective Initiation

**Primary Investigator:** John Mecikalski (SPoRT)

**National Center/WFO Relevance:**

- Provides 0-2 h probabilistic forecasts that highlight where convective initiation is likely.
- Attempts to address a difficult short-term forecast challenge with a fused NWP-satellite approach and the top future-capability priority of the NOAT.
- Provides additional situational awareness for the issuance of Convective SIGMETs.

**Product Overview:**

- NWP-satellite fused probabilistic product that serves as a strategic aid for convective initiation.
- True probabilistic product (unlike previous versions of the convective initiation algorithm) because the algorithm incorporates information about the local atmospheric environment.

**Product Methodology:**

- Convective initiation probabilistic product is produced using a logistic regression framework.
- Convective cloud properties and 20 fields from the Rapid Refresh model are used to create 0-2 h probabilistic forecasts.
- Early verification statistics have much improved skill scores when the environmental data is included.
- GOES ABI proxies are 10.7µm T 0°C, 10.7µm T time trend, 6.5-10.7µm difference, 13.3-10.7µm difference, 6.5-10.7µm time trend, and 13.3-10.7µm time trend.

**GOES-R Convective Initiation Products:**

- 0-2 h Probabilistic Forecasts of Convective Initiation

**Concept for Operational Demonstration:**

- The GOES-R Convective Initiation product was delivered to the AWC testbed via the SPoRT LDM in May 2012 and was formatted for display in N-AWIPS.

**Concept for Operations:**

- Convective Initiation is expected to be centrally produced at OSPO/ESPC and delivered by SBN or PDA.

**Product Name:** Cloud-Top Cooling

**Primary Investigator:** Wayne Feltz and Justin Sieglaff (CIMSS)

**National Center/WFO Relevance:**

- Product determines which convective clouds are growing vertically particularly those in data sparse regions (radar void areas over the CONUS as well as oceanic areas).
- Stronger cloud-top cooling rate is directly correlated to larger hail when compared to maximum hail size.
- 15-min satellite data is available everywhere over CONUS, including areas where lightning and radar data are either insufficient or unavailable.
- Product assists in addressing a future-capability priority of the NOAT.
- Provides additional situational awareness in the issuance of Convective SIGMETs

**Product Overview:**

- Product can be used to objectively determine where convective clouds are and are not growing vertically.
- Cloud-top cooling is a satellite indicator used in the GOES-R Convective Initiation product and is considered a compliment and tactical decision aid for convective initiation.

**Product Methodology:**

- Algorithm uses GOES imager data to determine immature convective clouds that are growing vertically and hence cooling in infrared satellite imagery (i.e., cloud-top cooling rate).
- Cloud phase information is utilized to deduce whether the cooling clouds are immature water clouds, mixed phase clouds, or ice-topped (glaciating) clouds.
- Final result is a prognostic value of a satellite-based measure of vertical cloud growth rate.
- GOES ABI proxies are 0.63μm, 3.9μm, 6.5μm, 10.7μm, 13.3μm, Cloud Mask, Cloud Phase, and Cloud Optical Depth.

**Cloud-Top Cooling Products:**

- Instantaneous box-averaged cloud-top cooling rate (K (15 min)$^{-1}$)
- 60-min time accumulation of box-averaged cloud-top cooling rate (K (15 min)$^{-1}$)

**Concept for Pre-Operational Demonstration:**

- The GOES-R Cloud Top Cooling was delivered to the Aviation Weather Testbed in May 2012 via the CIMSS LDM and has been formatted for display in N-AWIPS.

**Concept for Operations**:

- Cloud Top Cooling is expected to be centrally produced at OSPO/ESPC and delivered by SBN or PDA.

**Product Name:** Overshooting Top Detection

**Primary Investigator:** Kristopher Bedka (NASA LaRC) and Wayne Feltz (UW-CIMSS)

**National Center/WFO Relevance:**

- Product has been shown to assist in the diagnosis and nowcasting of hazardous convective weather because there are strong overshooting top relationships with hazardous convective weather (i.e., severe weather, total lightning, and heavy rainfall).
- Presence of a persistent overshooting top feature can signify an especially strong and long-lived storm and early recognition of an OT can raise situational awareness of impending hazardous weather.
- 15-min satellite data is available everywhere over CONUS, including areas where lightning and radar data are either insufficient or unavailable.
- Provides additional situational awareness in the issuance of Convective SIGMETs and Aviation Weather Statements.

**Product Overview:**

- Overshooting convective cloud tops are domelike bulges atop an anvil cloud that indicate a strong updraft within a convective storm system.
- Convection with either overshooting tops or enhanced-V signatures often produce hazardous weather conditions such as frequent lightning, heavy rainfall, and damaging winds.

**Product Methodology:**

- Overshooting-top product identifies clusters of 11.2 mm IR pixels significantly colder (at least 6.5K) than the surrounding anvil cloud with a diameter consistent with commonly observed overshooting tops.
- Provides a detection accuracy that exceeds that of an existing overshooting top detection technique based on the water vapor minus infrared window brightness temperature difference.
- Enhanced-V features occur when flow diverted around the OT region erodes the updraft summit and carries cloud debris downwind which is reflected in the cold brightness temperatures.
- Brightness temperature difference (at least12K) between the OT and enhanced-V feature.

**Enhanced "V" / Overshooting Top Detection Products:**

- Overshooting Top detection
- Enhanced-V (thermal couplet) detection

**Concept for Pre-Operational Demonstration:**

- The Overshooting Top Detection products were delivered to the Aviation Weather Testbed via the CIMSS LDM in May 2012 and were formatted for display in N-AWIPS.

**Concept for Operations:**

- None at this time. The idea is for it to be centrally produced at OSPO/ESPC, but for the moment the goal is to expose users to the data and collect feedback through organized demonstrations within the GOES-R Proving Ground.

**Product Name:** NearCasting Model

**Primary Investigator:** Ralph Petersen (UW-CIMSS)

**Aviation Weather Center Relevance:**

- Provides AWC forecasters with an additional decision support and situational awareness tool, particularly for the development and intensification of convection that have the potential to affect our National Airspace System and various terminals.

**Product Overview:**

- Provides 1 – 9 hour forecasts of future atmospheric moisture, equivalent potential temperature, and stability indices, and have shown skill in identifying rapidly developing, convective destabilization up to 6-9 hours in advance.
- The system fills the 1-9 hour information gap that exists between radar nowcasts and longer-range numerical forecasts.

**Product Methodology:**

- The NearCasting system uses a Lagrangian approach to optimize the impact and retention of information provided by the GOES sounder.
- Its primary data source is hourly, full resolution (10-12 km) multi-layer retrieved parameters from the GOES sounder.
- Results from the NearCasting model increases the areal coverage of single-time GOES data and enhances current operational NWP forecasts by successfully capturing and retaining details (maxima, minima, and extreme gradients) critical to the development of convective instability several hours in advance, even after subsequent infrared satellite observations become cloud contaminated.

**NearCasting Model Products:**

- Vertical theta-e difference
- 500-mb mean-layer theta-e
- 780-mb mean-layer theta-e

**Concept for Operational Demonstration:**

- The NearCasting Model products were delivered to the Aviation Weather Testbed via the CIMSS LDM in May 2012 and have been formatted for display in N-AWIPS.

**Concept for Operations:**

- Expected to be centrally produced at OSPO/ESPC.

**Product Name:** ACHA Cloud Height Algorithms

**Primary Investigator:** Andy Heidinger (UW-CIMSS)

**National Center/WFO Relevance:**

- Provides additional information regarding cloud top properties that can be used for forecasting various aviation hazards, particularly in identifying cloud tops.
- Data is also generated on a global scale, providing additional data over data sparse areas (oceans, etc.) for the AWC's international operations branch.

**Product Overview:**

- Provides information on cloud top properties (height, temperature, phase) not available via ground-based instruments.
- Provides better spatial and temporal coverage than radiosonde-collected observations.

**Product Methodology:**

- Multiple IR channels on the ABI are used to estimate cloud temperature, cloud emissivity, and particle size.
- Height and pressure are derived from the temperature and NWP profiles from the GFS
- Products are generated within minutes of receiving satellite data and are consistent through the terminator.

**ACHA Cloud Height Products:**

- Cloud Top Height
- Cloud Top Temperature

**Concept for Pre-Operational Demonstration:**

- The ACHA Cloud Height products were delivered to the Aviation Weather Testbed via the CIMSS LDM in May 2012 and have been formatted for display in N-AWIPS.

**Concept for Operatios:**

- The ACHA cloud height algorithms are expected to be centrally produced at OSPO/ESPC and delivered by SBN or PDA, and will also provide input for other AWIPS decision aids.

**Product Name:** Super Rapid Scan Imagery

**Primary Investigator:** T. Schmit (NESDIS/ASPB), J. Knaff, (NESDIS/RAMMB)

**National Center/WFO Relevance:**

- GOES-R will provide routine 5-min imagery and better capabilities for providing 30 sec and 1 min imagery than the current GOES satellites. 1-min imagery is routinely utilized at AWC when GOES-14 is out of storage.
- Will provide super rapid scan operations (SRSO) data during experimental periods and the summer demonstration to better forecast for high-impact aviation weather hazards and expose forecasters to GOES-R-like temporal resolution.

**Product Overview:**

- 1-min imagery will be provided from current GOES satellites. This will include Super Rapid Scan Operations (SRSO) data from the operational GOES-east and –west when possible and SRSO-Research (SRSO-R) from GOES-14.

**Product Methodology:**

- SRSO-R 1-minute data will be collected beginning in the middle of August and continue through the end of the month (Aug 13-28).
- During the, the GOES-14 satellite will be centered at 105 W and utilized for experimental and operational use at the AWC. With SRSO-R, 26 images can be collected every ½ hour.

**Super Rapid Scan Imagery Products:**

- Full resolution 1 minute visible imagery

**Concept for Pre-Operational Demonstration:**

- The SRSOR has been previously implement into the N-AWIPS workstations in AWC Operations and the AWT. This data will be available for demonstration during its experimental runs.

**Concept for Operations:**

- SRSO data will be available via direct readout systems and is also expected to be centrally produced at OSPO/ESPC and delivered via SBN or PDA for AWIPS-IIor NESDIS servers and displaced on AWIPS2 systems at NHC when GOES-R becomes operational.

**Product Name:** GeoColor Imagery

**Primary Investigator:** Steve Miller, Ed Szoke and Dan Bikos (CIRA)

**National Center/WFO Relevance:**

- An alternative overview type of imagery that represents some of the potential for image combination that will be available in the GOES-R era but can be replicated now.
- Provides a seamless transition between day- (visible imagery) and nighttime (IR) imagery with clouds appearing white during both day and night.

**Product Overview:**

- In addition to the basic characteristics of the imagery noted above, at night low clouds and fog are highlighted in a pinkish hue by utilizing the AWIPS fog product that uses the difference between the 10.7 and 3.9 μm channels. Also, a natural color background is provided during the day while at night city lights are used.

**Product Methodology:**

- The basic satellite imagery comes from GOES East and West visible and infrared imagery.
- The daytime background true color image comes from the NASA Blue Marble data set that is derived from MODIS imagery. It is currently a static image but could be updated using real-time MODIS and VIIRS imagery.
- The nighttime background is also a static image from the "Nighttime Lights of the World" dataset. Future versions could also use real-time Polar Orbiter satellite data.
- Opacity of the cloud layers (determining how much of the background imagery bleeds through) is determined by various transparency factors.
- Additional cloud discrimination is applied at night using the 10.7-3.9 micron difference.
- More detailed information can be found at http://rammb.cira.colostate.edu/research/goes-r/proving_ground/cira_product_list/geocolor_imagery_detailed.asp

**Image Products:**

- Images are available over the full Continental United States.
- Time resolution is 30 minutes.
- Spatial resolution is 1 km during the daytime and 4 km at night.

**Concept for Operational Demonstration**:

- The product is created in netcdf format, converted to McIDAS AREA format, then read in and displayed by NAWIPS.

**Concept for Operations:**

- The GeoColor imagery is expected to be generated and displayed as an AWIPS-2 plug-in

**Document Last Updated:** 17 February 2014

**Product Name:** AIRS Ozone Retrievals (JPSS)

**Primary Investigators:** Emily Berndt and Bradley Zavodsky (SPoRT)

**National Center/WFO Relevance:**

- Product(s) allows identification of potential stratospheric air intrusions into the troposphere by highlighting anomalous ozone levels, which also identifies regions of increased potential vorticity.
- When used with the RGB Airmass, may allow for a more accurate analysis of where there may be increased areas of ozone due to intrusions, which may result in danger to aircraft and health risks for flight crews and passengers.

**Product Overview and Methodology:**

- Products are generated from the Atmospheric Infrared Sounder (AIRS) aboard the Aqua polar-orbiting satellite. Both a total column ozone and ozone anomaly product are available. The products are available twice a day with a latency of approximately four hours.

- The products are then made available in VGF to overlay on current satellite imagery. The total column ozone concentration is mapped in a way to easily identify areas of interest with measurements made in Dobson units. Additionally the ozone anomaly product highlights regions where the ozone values significantly deviate from climatology and are representative of stratospheric air.

**AIRS Ozone Products:**

- Total Column Ozone and Ozone Anomalies in VGF format to be overlaid on satellite imagery (works best with the RGB Air Mass product).

**Concept for Pre-Operational Demonstration:**

- Products are generated at SPoRT and then provided to the HAZMAP Proving Ground in VGF format for use in N-AWIPS and provided via LDM.

**Concept for Operations:**

- It is anticipated that this product will be created using CrIS and/or OMPS on S-NPP satellite as part of the JPSS mission. The product would be generated by NESDIS and distributed to NWS WFOs and National Centers. If the product is not adopted by NESDIS, then SPoRT would provide an operational version of these products (if global data latencies are reduced over currently available data).

**Product Name:** Lightning Threat Forecast

**Primary Investigator:** McCaul, Chronis, Alexander (USRA, UAH, ESRL-GSD)

**National Center/WFO Relevance:**

- May have utility in the generation of the Collaborative Convective Forecast Product or in the issuance of Aviation Weather Statements at the ATCSCC
- May have utility at the AWC tropical forecasting desk

**Product Overview:**

- Differentiates areas of convection in the modeled environment that are predicted to produce lightning from those that are not.
- Output displayed as lightning flash-rate density, or flashes $(5\ \text{min})^{-1}\ \text{km}^{-2}$

**Product Methodology:**

- A calibrated graupel flux at -15°C term, or Lightning Threat 1, captures the temporal variability of the lightning threat well.
- A calibrated vertically integrated ice content term, or Lightning Threat 2, captures the spatial coverage of the lightning threat well.
- Lightning Threat's 1 and 2 are blended together in a weighted average to produce the Flash Rate Density product, or Lightning Threat 3.

**GOES-R Lightning Threat Forecast Products:**

- Lightning Threat's 1, 2 and 3 from the WRF-NSSL model.
- Lightning Threats 3 from the HRRR model.

**Concept for Operational Demonstration:**

- The Lightning Threat Forecast products have been formatted for display in N-AWIPS.

**Concept for Operations:**

- This topic is still to be discussed.

**Document Last Updated:** 17 March 2014

**Product Name:** RGB Night-Time Microphysics

**Primary Investigator:** Kevin Fuell, Andrew Molthan and Kevin McGrath (NASA SPoRT)

**National Center/WFO Relevance:**

- May have utility in the generation of the Area Forecasts and issuance of graphical AIRMETs for low ceilings.
- May have utility in the issuance of the Aviation Weather Statement for low ceilings at the ATCSCC
- May have utility in issuing FA forecasts over the tropics and Caribbean

**Product Overview:**

- Takes advantage of multiple IR channels with the RGB concept to distinguish between various types of cloud physical, microphysical, and thermal characteristics. It was specifically designed to more efficiently highlight cloud types and the additional channels allow one to better distinguish between fog and low clouds at night compared to the standard "fog" imagery product.

**Product Methodology:**

- The Night-Time Microphysics is an RGB composite based on infrared data from the VIIRS and Terra/Aqua MODIS imagers. The resulting product depicts fog and low clouds as light blue areas in warm climates and light green in colder climates. The shades of the blues and greens will vary depending on the thickness of the fog and low clouds, and associated green and red contributions
- The product is generated using the 12.0, 10.8, and 3.9 micron IR channels
- Highlights fog and low clouds by the following:
  - Differencing two IR channels related to optical thickness (i.e., at 12.0 µm and 10.8µm) (Red)
  - Differencing two IR channels related to particle phase (i.e., 10.8 µm and 3.9 µm).
  - (Green)
  - Uses the IR window channel (10.8 µm) to indicate surface temperature. (Blue)

**RGB Night-Time Microphysics Products:**

- VIIRS Night-Time Microphysics
- Aqua and Terra MODIS Night-Time Microphysics

**Concept for Operational Demonstration:**

- The Night-Time Microphysics products have been formatted for display in N-AWIPS and pulled into the Aviation Weather Testbed via LDM from NASA SPoRT

**Concept for Operations:**

- It is anticipated that by the time GOES-R is operational, the AWIPS2 deployment will be completed, so that this RGB product can be locally generated from the individual ABI bands and used a decision aid

**Document Last Updated:** 26 March 2014

**Product Name:** VIIRS/MODIS Cloud/Snow Discriminator

**Primary Investigator:** Steve Miller (CIRA)

**National Center/WFO Relevance:**

- May have utility in the generation of the Area Forecasts and issuance of graphical AIRMETs for low ceilings, as well as icing and turbulence. It would be of particular use in the western portion of the CONUS where complex terrain is dominant and remains snow covered for at least half of the year.
- May have utility in issuing FA forecasts over the tropics and Caribbean

**Product Overview:**

- Takes advantage of multiple IR and visible channels with the RGB concept to distinguish between cloud layers and snow cover during the day. It also demonstrates the type of imagery that will become available in the GOES-R era at much higher temporal and spatial resolutions

**Product Methodology:**

- As snow cover and clouds are both highly reflective in the visible spectrum, and thus difficult to distinguish, the Cloud/Snow Discriminator takes advantages of infrared imagery and the thermal and longwave differences to better identify what is snow and what is cloud.
- The Cloud/Snow Discriminator combines information from multiple channels to create a single visual aid for distinguishing between snow and clouds, highlighting snow in white and clouds in yellow.
- The capability also exists to further distinguish specific cloud layers, highlighting both low and high clouds.

**VIIRS/MODIS Cloud/Snow Products:**

- VIIRS Cloud/Snow Discriminator
- MODIS Cloud/Snow Discriminator

**Concept for Operational Demonstration:**

- The Cloud/Snow Discriminator products will be formatted for display in N-AWIPS and pulled into the Aviation Weather Testbed via LDM from CIRA

**Concept for Operations:**

- It is anticipated that by the time GOES-R is operational, the AWIPS2 deployment will be completed, so that this RGB product can be locally generated from the individual ABI bands and used a decision aid

**Product Name:** VIIRS/MODIS Dust Enhancement

**Primary Investigator:** Steve Miller (CIRA)

**National Center/WFO Relevance:**

- Provides additional decision support on the location and extent of blowing dust for the issuance of the blowing dust SIGMETs over the CONUS
- May also have utility in the identification of dust over oceans and tropical areas. In this case, dust may not be low enough to the surface to warrant a SIGMET, but could still affect visibility, specifically in busier airspace.

**Product Overview:**

- Takes advantage of the visible distinction between dust and other surface or low level features, while also using the thermal and absorption properties of the infrared spectrum to distinguish blowing dust from surround clouds and surface features. This high resolution imagery provides a first glance into future GOES-R capabilities.

**Product Methodology:**

- The algorithm first uses the visual distinction, using True Color imagery to identify the visible color differences between dust and other features.
- Secondly, it analyzes the thermal characteristics of the lofted dust layer, looking for the temperature contrast between the cool lofted dust layer and the comparatively warmer surface or cloud features.
- Thirdly, it searches for opacity, or transparency of the dust layer, using additional IR bands to identify the scattering and absorption behavior associated with the chemical and physical properties of the dust particles.
- Tests are done for the three aforementioned variables and a confidence value between 0 and 1 is given, 0 indicating less confidence of blowing dust and 1 indicating a higher confidence.

**VIIRS/MODIS Dust Enhancement Products:**

- VIIRS Dust Enhancement (pink and yellow)
- MODIS Dust Enhancement (pink and yellow)

**Concept for Operational Demonstration:**

- The MODIS Dust Enhancement product has been formatted for display in N-AWIPS and pulled into the Aviation Weather Testbed via LDM from CIRA, and the VIIRS Dust Enhancement will be reformatted and pulled into the AWT in the same manner.

**Concept for Operations:**

- It is anticipated that by the time GOES-R is operational, the AWIPS2 deployment will be completed, so that this RGB product can be locally generated from the individual ABI bands and used a decision aid