GOES-R Proving Ground Demonstration Proposal:
Aviation Weather Center Proving Ground – 2013 Summer Experiment

1. **Project Title:** 2013 GOES-R Proving Ground – Aviation Weather Testbed Summer Experiment

2. **Organization:** Aviation Weather Center Proving Ground, Kansas City, MO

3. **Products to be Demonstrated as a GOES-R Proving Ground activity at the AWT**
   - **a.** NSSL-WRF/NAM Nest Simulated Satellite Forecasts
   - **b.** Convective Toolkit
     - **i.** GOES-R Convective Initiation
     - **ii.** Cloud-Top Cooling
     - **iii.** Overshooting Top Detection
     - **iv.** Pseudo Geostationary Lightning Mapper
     - **v.** GLD360 GLM Proxy Decision Aid – OCONUS use of lightning
   - **c.** NearCasting Model
   - **d.** ACHA Cloud Height Algorithms
     - **i.** Cloud Top Height
     - **ii.** Cloud Top Temperature
   - **e.** GOES_14 SRSOR 1-minute imagery

4. **Demonstration Project Summary**

   a. **Overview**: The GOES-R 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 within the within the Summer Experiment from 12 – 23 August 2013. Participants within the Summer Experiment will be similar to that run in 2012, including participants from all aspects of the aviation community such as visiting scientists and developers working on aviation related products, traffic flow managers and airline operators, general aviation operators, and forecasters from the AWC and NWS. Amanda Terborg, the GOES-R liaison at the AWC, will be handling all logistics and coordination of the new satellite datasets within the experiment.

   b. Plan, Purpose, and Scope: The AWC Summer Experiment will provide the GOES-R Proving Ground (PG) with a pre-operational environment in which to deploy and demonstrate algorithms associated with summer season aviation hazards while in addition familiarizing end users with its next generation GOES-R geostationary satellite systems. The structure will consist of four 'mock' operational desks and one Situational Awareness desk, descriptions of each listed below:

   <u>Convective SIGMET (CSIG)</u>: Participants at the CSIG desk will focus on using experimental products to generate 2-hour CSIG snapshots, working to fill the gap between nowcasting forecast products and CCFP. For these two-hour forecasts they will also be collaborating with the CCFP desk. Additionally participants will be exploring other potential ways in which CSIG forecasts could be improved.

   <u>Collaborative Convective Forecast Product</u>: The CCFP desk generally focuses on the evolution of convection from growth to propagation to decay. The operational CCFP issues 4, 6, and 8-hour forecasts, and the experiment will focus on this as well as a 2hr

snapshot. As it is a collaborative product one of the main goal is to stimulate discussion with the other desks including CSIG, NAM, and the Situational Awareness desk.

National Aviation Meteorologist: The continuing focus at the NAM desk will be the issuance and evolution of the Aviation Weather Statement. This year the goal will be to evaluate the timeliness of issuing the AWS for the entire CONUS (as currently it is limited to the Northeast U.S.) and also experiment with multi-variable AWS's (i.e. ceilings along with convection). Additionally, participants will be exploring the benefits and/or drawbacks to issuing a longer term AWS for potential hazards.

Global Graphics (International): As a desk unique to the rest, the international desk will focus on mid-level significant weather graphics, focusing on global data sets such as lightning, various model fields, experimental satellite products, etc. Additionally, participants will explore experimental products for potential use in the validation of the global graphics convection forecasts.

Situational Awareness: The SA desk has been designed to accommodate those experimental products, both model and real-time, that can be used to provide additional situational awareness in an operational environment. By-in-large participants will focus on exploring lightning datasets (PGLM, ENTLN, and GLD360) as well as a series of GOES-R derived satellite products that will provide forecasters with a pre-launch glimpse of the capabilities of future satellite technology. The main goal will be to provide additional information to the above listed desks, exploring the potential ways in which each dataset could be used to monitor the onset, evolution, and cessation of convection.

c. Goals: The activities within the GOES-R Proving Ground at the AWT will focus on demonstrating and evaluating the baseline and future capabilities products as identified below, and integrating them within AWC operations. The Summer Experiment will, as mentioned above, include participants from throughout the aviation community, and this will not only provide a wide variety of feedback, but will also aid in building relationships within this very diverse user community. Both of these things will be vital part in furthering the GOES-R PG Research to Operations effort within the AWT.

5. Participants Involved:

a. Providers:

i. NSSL-WRF/NAM Nest Simulated Satellite Forecasts (Sieglaff/Lindesy/Bikos – CIMSS/CIRA)
ii. Pseudo Geostationary Lightning Mapper (Stano – SPoRT)
iii. GLD360 GLM proxy decision aid (Pettegrew/Solomon – AWC)
iv. GOES-R Convective Initiation (Mecikalski – UAH/SPoRT)
v. Cloud-Top Cooling (Feltz/Sieglaff – CIMSS)
vi. Overshooting Top Detection (Feltz/Bedka/Monette – CIMSS)
vii. NearCasting Model (Petersen – CIMSS)
viii. ACHA Cloud Height Algorithms (Heidinger/Wanzong – CIMSS)
ix. GOES-14 SRSOR 1-minute imagery (Schmit/Knaff

b. Consumers:

i. Aviation Weather Center forecast operations
ii. Alaska Aviation Weather Unit forecast operations

6. Project Schedule/Duration (timeline):

a. AWC Testbed Schedule: 12 – 23 August 2013

b. First Products in AWC Testbed: May 2012
c. Deadline for all product availability: 5 July 2013
d. Training Period: 1 May – 9 August 2013
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 experiment at the AWC will be evaluated on their usefulness in forecasting the various summer season aviation hazards.
f. Final Evaluation Report: 31 October 2013

GOES-R Proving Ground Product	Category	Acquisition into Testbed	Training	Formal Evaluation
NSSL – WRF/NAM Nest Simulated Forecasts	Baseline	Already Acquired	May 2013	12 – 23 August 2013
Pseudo Geostationary Lightning Mapper	Baseline	Already Acquired	Summer 2013	12 – 23 August 2013
Convective Initiation	Future Capability/ NOAT Priority (1)	Already Acquired	Summer 2013	12 – 23 August 2013
Cloud Top Cooling/OTD	Future Capability	Already Acquired	October 2012	12 – 23 August
NearCasting Model	GOES-R Risk Reduction	Already Acquired	Summer 2013	12 – 23 August 2013
ACHA Cloud Height Algorithms	Baseline	Already Acquired	Summer 2013	12 – 23 August 2013

7. Project Deliverables
a. Proving Ground Operations Plan – First Draft: 1 November 2012
b. Proving Ground Operations Plan – Final Draft: 21 May 2013
c. Proving Ground Summer Experiment Final Report: 31 October 2013

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: NSSL-WRF and NAM Nest Simulated Satellite Forecasts

Primary Investigator: Justin Sieglaff (CIMSS) and Dan Lindsey and Dan Bikos (CIRA)

Aviation Weather Center Relevance:
• Simulated satellite forecasts allow forecasters to become familiar with the different bands associated with the GOES-R Advanced Baseline Imager (ABI) imager.

• Realistic satellite bands using the model output allow forecasters to identify features that may be difficult to determine using standard and derived fields.

Product Overview:
• Simulated 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 and after the 0000UTC NAM Nest run, several variables including temperature, water vapor, and other physical and microphysical parameters are sent to CIRA.

• When all variables have been received at CIRA, an observational operator is run to generate the synthetic imagery for GOES-R ABI bands 8-16

• Hourly output between 1200-1200 UTC (F012-F036) is processed daily.

• Resolution of the output is 4-km to match the input resolution of the cloud model; the GOES-R ABI bands will have 2-km resolution.

NSSL-WRF Simulated Satellite Forecast Products:
• 6.95 μm Upper/Mid-level Tropospheric Water Vapor
• 7.34 μm Lower/Mid-level Tropospheric Water Vapor
• 8.5 μm Cloud-top Phase
• 9.61 μm Ozone
• 10.35 μm Clean Infrared Longwave
• 12.3 μm Dirty Infrared Longwave
• 13.3 μm CO2
• 10.35-3.9 μm Fog Difference
• 10.35-12.3 μm Longwave Difference (moisture convergence)

NAM Nest Simulated Satellite Forecast Products:
• 6.95 μm Upper/Mid-level Tropospheric Water Vapor
• 10.35 μm Clean Infrared Longwave

Concept for Pre-Operational Demonstration:
• The NSSL-WRF products were delivered to the Aviation Weather Testbed in May 2012 and the NAM Nest products were delivered to the Aviation Weather Testbed in February 2013. Both were converted to a format suitable for display in N-AWIPS.

Concept for Operations:

• Cloud and moisture data expected to be centrally produced at OSPO/ESPC and delivered by SBN or PDA. Simulated imagery expected to be generated and displayed via plug-in on AWIPS.
Product Name: Pseudo Geostationary Lightning Mapper

Primary Investigator: Geoffrey Stano (SPoRT)

Aviation Weather Center Relevance:
• Can be used to identify convection that may contain significant lightning, both cloud-to-ground and intra-cloud lightning.

• 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), and Houston (HGLMA)

• Expected LMA networks by spring 2013: West Texas (WTLMA) and possibly New Mexico. (NMLMA)

• 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

Aviation Weather Center 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.

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 with a goal of better predicting CI. Future research will incorporate GOES-R data into NWP.

• Early verification statistics have much improved skill scores when the environmental data is included.

GOES- R Convective Initiation Products:
• 0-2 hour Probabilistic Forecasts of Convective Initiation

Concept for Pre-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)

Aviation Weather Center 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).

• 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 the future-capability priority of the NOAT, particularly for use in OCONUS forecasting regions.

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.

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) and Wayne Feltz (UW-CIMSS)

Aviation Weather Center 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).

• Can be used to aid in Convective SIGMET forecasting, particularly in data sparse regions such as radar void areas and oceanic areas.

• 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.

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 um 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

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.

• Exposes AWC users to the Nearcast data through organized demonstrations within the GOES-R Proving Ground in an effort to collect feedback for further improvement of the product.

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
• Vertical precipitable water difference
• 500-mb mean-layer precipitable water
• 780-mb mean-layer precipitable water

Concept for Pre-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)

Aviation Weather Center Relevance:
• Provides AWC forecasters with an additional information regarding cloud top properties which can be used for forecasting various aviation hazards.

• It is of particular use in identifying potential icing conditions

• Aids in familiarizing forecasters with tools used to build other GOES-R algorithms

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 Operations:
• Expected to be centrally produced at OSPO/ESPC and delivered by SBN or PDA.

Product Name: Super Rapid Scan Imagery

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

NWS Center/Office Relevance:
- GOES-R will provide routine 5-min imagery and better capabilities for providing 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 or NESDIS servers and displaced on AWIPS2 systems at NHC when GOES-R becomes operational.