GOES-R Proving Ground Demonstration Proposal:
NWS Operations Proving Ground – 2013 WFO Demonstrations

1. **Project Title:** 2013 GOES-R Proving Ground – NWS WFO Product Demonstrations

2. **Organization**: NWS Operations Proving Ground, Kansas City, MO

3. **Products to be Demonstrated as a GOES-R Proving Ground activity in NWS WFOs:**
   - **a.** GOES-R Fog and Low Stratus
   - **b.** Orographic Rain Index
   - **c.** Convective Toolkit
     - **i.** GOES-R Convective Initiation
     - **ii.** Cloud-Top Cooling
   - **d.** NSSL-WRF Simulated Satellite Forecasts
   - **e.** GOES Sounder RGB Airmass

4. **Demonstration Project Summary:**
   - **a. Overview:** The GOES-R PG will provide demonstration products to National Weather Service Forecast Offices. Pre-operational demonstrations of these products will give forecasters across the country the opportunity to provide feedback to algorithm developers on the performance and usefulness of the products in forecast operations. The GOES-R Proving Ground and product developers can use this information to potentially improve the GOES-R algorithms during the GOES-R pre-launch phase. Due to the diverse climate, weather, and topography across the U.S., it is important for the demonstration products to be evaluated across different geographic regions. Therefore, the product demonstrations included in Section 6 are NWS Region centric. Chad Gravelle, the GOES-R Liaison at the NWS Operations Proving Ground, will be handling all logistics and coordination of the product demonstrations within this proposal. The demonstration and report deadline dates are not finalized and should only be considered as temporary.

   - **b. Plan, Purpose, and Scope:** The NWS Operations Proving Ground will provide the GOES-R Proving Ground with pre-operational environments in which to deploy and demonstrate algorithms within NWS Forecast Offices in Eastern, Central, Southern, Western, and Alaska Regions. These product demonstrations will familiarize end users with the next generation GOES-R geostationary satellite system.

   - **c. Goals:** The main objective of the GOES-R product demonstrations proposed therein is to integrate products into NWS Forecast Office operations and have forecasters evaluate and provide feedback through Area Forecast Discussions, online surveys, and/or email correspondence. This feedback will be gathered during each demonstration by the Satellite Liaison (i.e., Chad Gravelle) and a final report will be submitted to the GOES-R Proving Ground. The majority of the proposed demonstration products have been evaluated in NCEP National Centers or testbeds, including the Hazardous Weather Testbed and/or the Aviation Weather Testbed. Therefore, these demonstrations will allow numerous NWS Forecast Offices within the specified NWS Regions to evaluate the products for their readiness in providing both forecaster and partner decision support.

5. Participants Involved:

a. Providers:

i. GOES-R Fog and Low Stratus (Pavolonis – CIMSS)
ii. Orographic Rain Index (Miller/Szoke – CIRA)
iii. GOES-R Convective Initiation (Mecikalski – UAH/SPoRT)
iv. Cloud-Top Cooling (Feltz/Sieglaff – CIMSS)
v. NSSL-WRF Simulated Satellite Forecasts (Lindesy/Bikos – CIRA)
vi. GOES Sounder RGB Airmass (Knaff/Fuell – CIRA/SPoRT)

b. Consumers:

i. NWS Western Region (FLS, ORI, WRF)
ii. NWS Southern Region (FLS, CI Toolkit, WRF)
iii. NWS Alaska Region (FLS)
iv. NWS Central Region (CI Toolkit, RGB Airmass, WRF)
v. NWS Eastern Region (FLS, CI Toolkit, WRF)

6. Project Schedule/Duration (some dates are preliminary and subject to change):

FLS – Future Capability

	WFOs	**Product Ingest Date**	**AWIPS, AWIPS II, or NAWIPS**	**Training Period**	**Evaluation Period**	**Mid-term Report**	**Final Evaluation Report**
AK Region	TBD	1 May 2013	AWIPS	May 2013	1 May – 1 Oct 2013	1 Aug 2013	15 Nov 2013
Western Region	SEA, EKA, LOX, MTR	1 May 2013	AWIPS and AWIPS II	April 2013	1 May – 1 Sep 2013	15 Jul 2013	15 Oct 2013

ORI – Decision Aid

	WFOs	**Product Ingest Date**	**AWIPS, AWIPS II, or NAWIPS**	**Training Period**	**Evaluation Period**	**Mid-term Report**	**Final Evaluation Report**
AK Region	TBD	1 Oct 2013	AWIPS	Sept 2013	1 Oct 2013 – 1 Apr 2014	1 Feb 2014	15 May 2014

Convective Toolkit Products – Future Capability/Decision Aid

	WFOs	**Product Ingest Date**	**AWIPS, AWIPS II, or NAWIPS**	**Training Period**	**Evaluation Period**	**Mid-term Report**	**Final Evaluation Report**
Central Region	TBD	1 May 2013	AWIPS	Apr 2013	1 May – 1 Oct 2013	1 Aug 2013	15 Nov 2013
Eastern Region	RNK, RLX	1 May 2013	AWIPS and AWIPS II	Apr 2013	1 May – 1 Oct 2013	1 Aug 2013	15 Nov 2013

NSSL-WRF Simulated Satellite Forecasts – Baseline

	WFOs	Product Ingest Date	AWIPS, AWIPS II, or NAWIPS	Training Period	Evaluation Period	Mid-term Report	Final Evaluation Report
All CONUS Regions	TBD	1 Jul 2013	AWIPS	Jun 2013	1 Jul 2013 – 1 Apr 2014	1 Dec 2013	1 May 2014

GOES Sounder RGB Airmass – Decision Aid

	WFOs	Product Ingest Date	AWIPS, AWIPS II, or NAWIPS	Training Period	Evaluation Period	Mid-term Report	Final Evaluation Report
Central Region	TBD	1 Oct 2013	AWIPS	Sep 2013	1 Oct 2013 – 1 Apr 2013	1 Feb 2014	15 May 2014

7. Project Decision Points and Deliverables:

- **a.** Proving Ground Operations Plan – First Draft: 1 March 2013
- **b.** Proving Ground Operations Plan – Final Draft: 1 May 2013
- **c.** Proving Ground Mid-Term Report: TBD
- **d.** Proving Ground Final Report: TBD

8. Coordination:

- **a.** Chad Gravelle, UW-CIMSS/NWS OPG – Satellite Liaison
- **b.** Carven Scott, NOAA/NWS AKRH – Acting SSD
- **c.** Andy Edman, NOAA/NWS WRH – SSD Chief
- **d.** Pete Browning, NOAA/NWS CRH – SSD Chief
- **e.** Ken Johnson, NOAA/NWS ERH – SSD Chief
- **f.** Bernard Meisner, NOAA/NWS SRH – Acting SSD Chief
- **g.** Kathryn Miretzky, AS&D for GOES-R Program Office – PG Coordinator

9. Budget and Resource 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 Fog and Low Stratus

Primary Investigator: Mike Pavolonis (NOAA/NESDIS/STAR)

NWS Center/Office Relevance:
• Provides decision support and tactical decision aids for NWS forecasters when identifying the presence and location of fog and low stratus.

• Products can be used during the day and when high cirrus or ice clouds are present.

• Comparisons to surface observations indicate the IFR probability product outperforms (almost twice as much skill) the traditional 3.9–11 μm brightness temperature difference.

• Fused product that incorporates GOES satellite observations and Rapid Refresh model output.

• Addresses one of the top future-capability priorities of the NOAT.

Product Overview:
• GOES-R Fog and Low Stratus detection products are designed to quantitatively (expressed as a probability) identify clouds that produce MVFR, IFR, and LIFR conditions.

• Physical thickness of water cloud layers is estimated in the Water Cloud Thickness product.

• Primary limitation is that some discontinuity will be associated with the transition from sunlit to non-sunlit conditions and vice-versa.

Product Methodology:
• Satellite and NWP model data are used as predictors and ceilometer based surface observations of cloud ceiling are used to train the algorithm.

• During the day, the 0.65, 3.9, and 11 μm channels (in various ways) along with boundary layer relative humidity information from the NWP model are used as predictors (similar approach is utilized at night without the 0.65 μm channel).

GOES-R Fog and Low Stratus Products:
• MVFR, IFR, and LIFR Probabilities
• Water Cloud Thickness (Fog Depth)

• The products are available using GOES-13, GOES-15, and MODIS data as proxies in ABI.

Concept for Pre-Operational Demonstration:
• Fog and Low Stratus product will be delivered to NWS Central, Western, and Alaska Regional HQ via the University of Wisconsin LDM and on to local NWS Weather Service Offices where they are converted to a format suitable for display in AWIPS and AWIPS 2.

Concept for Operations:
• A proposal has been submitted for the Fog and Low Stratus Products to be centrally produced at OSPO/ESPC and delivered by SBN or PDA.

Product Name: Orographic Rain Index (ORI)

Primary Investigator: Steve Miller and Ed Szoke (CIRA)

NWS Center/Office Relevance:
• Provides decision support and a strategic decision aid for NWS forecasters to identify locations where the potential for heavy orographic rainfall may occur in the following 3 hours.

• Product can provide short-term guidance for areas susceptible for aerial and river flash flooding.

Product Overview:
• Designed to highlight locations where there is a short-term (0-3 hours) potential for heavy orographic rainfall.

• Product has a horizontal resolution of approximately 1 km.

• Radar independent, the product can provide quantitative rainfall information in areas where terrain blocking occurs.

Product Methodology:
• Satellite and NWP fused product that utilizes the following:
  • Blended TPW (i.e., indicates the strength and location of atmospheric rivers)
  • 850-mb winds (i.e., advection of water vapor to a forecast time) from the GFS model output
  • USGS Global 30 Arc-Second Elevation Data terrain elevations

• Formula for ORI is TPW * $V \cdot \nabla H$, where $V \cdot \nabla H$ is a proxy for terrain-induced "lift".

• GOES ABI proxy is Total Precipitable Water.

Orographic Rain Index Products:
• CIRA Total Precipitable Water
• Orographic Rain Index

Concept for Pre-Operational Demonstration:
• Orographic Rain Index product will be delivered to NWS Western Regional HQ via the LDM and on to local NWS Weather Service Offices where they are converted to a format suitable for display in AWIPS.

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

Product Name: GOES-R Convective Initiation

Primary Investigator: John Mecikalski

NWS Center/Office 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 twenty 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 Pre-Operational Demonstration:
• GOES-R Convective Initiation product will be delivered to NWS Regional HQ via the LDM and on to local NWS Weather Service Offices where they are converted to a format suitable for display in AWIPS and AWIPS 2.

Concept for Operations:
• Convective Initiation is expected to be centrally produced at OSPO/ESPC and delivered by SBN or PDA.

Product Name: Convective Cloud-Top Cooling

Primary Investigator: Wayne Feltz and Justin Sieglaff (UW-CIMSS)

NWS Center/Office Relevance:
• Product determines which convective clouds are growing vertically

• 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 the top future-capability priority of the NOAT.

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:
• Cloud-Top Cooling product will be delivered to NWS Regional HQ via the University of Wisconsin LDM and on to local NWS Weather Service Offices where they are converted to a format suitable for display in AWIPS and AWIPS 2.

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

Product Name: NSSL-WRF Simulated Satellite Forecasts

Primary Investigator: Dan Lindsey and Dan Bikos (CIRA)

NWS Center/Office Relevance:
• Simulated satellite forecasts allow forecasters to become familiar with the different bands associated with the GOES-R Advanced Baseline (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, 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 5 GOES-R ABI bands (6.95, 7.34, 8.5, 10.35, and 12.0 μm).

• 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 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
• 10.35 μm Clean Infrared Longwave
• 12.3 μm Dirty Infrared Longwave
• 10.35-3.9 μm Fog Difference
• 10.35-12.3 μm Longwave Difference (moisture convergence and blowing dust detection)

Concept for Pre-Operational Demonstration:
• NSSL-WRF simulated satellite output is converted to AWIPS-compatible NETCDF format and provided to NWS Regional HQ via the LDM and on to local NWS Weather Service Offices where they are converted to a format suitable for display in AWIPS.

Concept for Operations:
• Cloud and moisture forecasts are 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: GOES Sounder RGB Airmass

Primary Investigator: John Knaff (CIRA) and Kevin Fuell (SPoRT)

NWS Center/Office Relevance and Product Overview:
• Product allows for a three-dimensional assessment of the best state of the atmosphere.

• Allows for a more accurate analysis of where rapid cyclogenesis, jet streaks, and PV anomalies occur.

Product Methodology:
• Product is generated from Meteosat Second Generation channels 12 (WV6.51), 10 (WV7.43), 9 (IR9.71), and 8 (IR11.03) and applied here to the GOES sounder data.

• Highlights differences between dry, tropical and cold air masses and is accomplished by:
  • Differencing the two water vapor channels (i.e., at 6.51 μm and 7.41 μm).
  • Differencing the ozone channels (i.e., 9.71 μm and 11.03 μm).
  • Uses the 6.51 μm channel to indicate gross air mass temperature differences.

Concept for Pre-Operational Demonstration:
• GOES Sounder RGB Airmass product is generated at CIRA and then provided to NWS Regional HQ via the SPoRT LDM and on to local NWS Weather Service Offices where they are converted to a format suitable for display in AWIPS.

Concept for Operations:
• RGB Airmass products are expected to be centrally produced at OSPO/ESPC and delivered by SBN or PDA or are expected to be generated and displayed via plug-in on AWIPS.