2013 Summer GOES-R Proving Ground Demonstration Proposal:
Satellite Proving Ground for Marine, Precipitation, and Hazardous Weather Applications

1. **Project Title:** 2013 Summer GOES-R Demonstrations for Marine, Precipitation, and Hazardous Weather Applications (MPHWPG)

2. **Organizations**: The Weather Prediction Center (WPC), the Ocean Prediction Center (OPC), the NESDIS Satellite Analysis Branch (SAB)

3. **Products to be Demonstrated as a GOES-R Proving Ground Activity in the MPHWPG:**
   - **a.** NSSLWRF & NAM Simulated Satellite Imagery
   - **b.** Overshooting Top Detection (OTD)
   - **c.** Total Lightning Detection
   - **d.** RGB Air Mass
   - **e.** RGB Dust
   - **f.** Hurricane Intensity Estimate (HIE)
   - **g.** Tropical Overshooting Tops (TOT)
   - **h.** Super Rapid Scan Operations for GOES-R (SRSOR)

4. **Demonstration Project Summary:**
   - **a. Overview:** The GOES-R PG will provide demonstration products to the WPC, OPC, and SAB. 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 pre-launch phase. Due to the diverse range of focus in each of these national centers, it is necessary to demonstrate these products for an extended period to allow forecasters the opportunity to evaluate the products in various weather regimes. Michael Folmer, the GOES-R Satellite Liaison at the Satellite Proving Ground for Marine, Precipitation, and Hazardous Weather Applications (MPHWPG), 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 WPC, OPC, and SAB will provide the GOES-R Proving Ground with pre-operational environments in which to deploy and demonstrate algorithms within the operational centers. These product demonstrations will familiarize end users with the next generation of geostationary satellite products prior to launch.
   - **c. Goals:** The main objective of the GOES-R product demonstrations proposed herein is to integrate products into WPC, OPC, and SAB operations and have forecasters evaluate and provide feedback through text products, a feedback form, online

surveys, and/or email correspondence. This feedback will be gathered during each demonstration by the Satellite Liaison and a final report will be submitted to the GOES-R Proving Ground. These demonstrations will allow forecasters in WPC, OPC, and SAB the opportunity to evaluate the products for their readiness in providing both forecaster and partner decision support.

5. Participants Involved:

a. Providers:

i. NSSL-WRF/NAM Simulated Imagery (Lindsey/Bikos - CIRA, Sieglaff - CIMSS)
ii. Overshooting Top Detection (Bedka - SSAI/CIMSS)
ii. Total Lightning Detection (Sienkiewicz - OPC, Rudlosky - NESDIS/STAR)
iii. RGB Air Mass (Molthan/Fuell - SPoRT)
iv. RGB Dust (Molthan/Fuell - SPoRT)
v. HIE (Velden - CIMSS)
vi. TOT (Velden/Monette - CIMSS)
vii. GOES-14 SRSOR (Schmit - NESDIS/ASPB, Robaidek - CIMSS)

b. End Users:

i. Weather Prediction Center (WPC)
ii. Ocean Prediction Center (OPC)
iii. NESDIS Satellite Analysis Branch (SAB)

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

WRF & NAM Simulated Imagery – Situational Awareness

	Product Ingest Date	Display	Training Period	Evaluation Period	Final Evaluation Report
WPC	1 Apr 2013	N-AWIPS	1 May – 1 Sep 2013	1 Jun – 31 Oct 2013	31 Dec 2013
OPC	1 Apr 2013	N-AWIPS	1 May – 1 Sep 2013	1 Jun – 31 Oct 2013	31 Dec 2013
SAB	1 Apr 2013	N-AWIPS	1 May – 1 Sep 2013	1 Jun – 31 Oct 2013	31 Dec 2013

Overshooting Top Detection – Future Capability

	Product Ingest Date	Display	Training Period	Evaluation Period	Final Evaluation Report
WPC	1 Apr 2013	N-AWIPS	1 May – 1 Sep 2013	1 Jun – 31 Oct 2013	31 Dec 2013
OPC	1 Apr 2013	N-AWIPS	1 May – 1 Sep 2013	1 Jun – 31 Oct 2013	31 Dec 2013
SAB	1 Apr 2013	N-AWIPS	1 May – 1 Sep 2013	1 Jun – 31 Oct 2013	31 Dec 2013

Total Lightning Detection - Baseline

	Product Ingest Date	Display	Training Period	Evaluation Period	Final Evaluation Report
WPC	1 Apr 2013	N-AWIPS	1 Jul – 30 Sep 2013	1 Jul – 31 Oct 2013	31 Dec 2013
OPC	1 Apr 2013	N-AWIPS	1 Jul – 30 Sep 2013	1 Jul – 31 Oct 2013	31 Dec 2013
SAB	1 Apr 2013	N-AWIPS	1 Jul – 30 Sep 2013	1 Jul – 31 Oct 2013	31 Dec 2013

RGB Air Mass – Decision Aid

	Product Ingest Date	Display	Training Period	Evaluation Period	Final Evaluation Report
SAB (Tropical Desk)	1 Aug 2013	McIDAS	N/A	1 Aug – 30 Nov 2013	31 Dec 2013

RGB Dust – Decision Aid

	Product Ingest Date	Display	Training Period	Evaluation Period	Final Evaluation Report
SAB (Fire and Volcano Desks)	1 Aug 2013	McIDAS	1 Aug – 31 Aug 2013	1 Aug – 30 Nov 2013	31 Dec 2013

Hurricane Intensity Estimate – Future Capability

	Product Ingest Date	Display	Training Period	Evaluation Period	Final Evaluation Report
SAB (Tropical Desk)	1 Aug 2013	Website	1 Aug – 31 Aug 2013	1 Aug – 30 Nov 2013	31 Dec 2013

Tropical Overshooting Tops – Future Capability

	Product Ingest Date	Display	Training Period	Evaluation Period	Final Evaluation Report
SAB (Tropical Desk)	1 Aug 2013	Website	1 Aug – 31 Aug 2013	1 Aug – 30 Nov 2013	31 Dec 2013

GOES-14 SRSOR – Baseline

	Product Ingest Date	Display	Training Period	Evaluation Period	Final Evaluation Report
WPC	11 Jun 2013	N-AWIPS, McIDAS	N/A	12 Aug – 30 Aug 2013	31 Dec 2013
OPC	11 Jun 2013	N-AWIPS, McIDAS	N/A	12 Aug – 30 Aug 2013	31 Dec 2013
SAB	11 Jun 2013	N-AWIPS, McIDAS	N/A	12 Aug – 30 Aug 2013	31 Dec 2013

7. **Project Decision Points and Deliverables:**
   - **a.** Proving Ground Operations Plan – First Draft: 15 August 2013
   - **b.** Proving Ground Operations Plan – Final Draft: 31 August 2013
   - **c.** Proving Ground Final Report: 31 December 2013

8. **Responsibilities and Coordination:**
   - **a.** Michael Folmer, UMCP/ESSIC/CICS – Satellite Liaison
   - **b.** Joseph Sienkiewicz, NOAA/NWS/NCEP/OPC – OAB Branch Chief
   - **c.** David Novak, NOAA/NWS/NCEP/WPC – DTB Branch Chief
   - **d.** Hugh Cobb, NOAA/NWS/NCEP/NHC/TAFB – Branch Chief
   - **e.** Jamie Kibler, NOAA/NESDIS/OSPO/SAB – GOES-R Lead
   - **f.** 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: NSSL-WRF and Simulated Satellite Forecasts

Primary Investigator: Dan Lindsey and Dan Bikos (CIRA)

MPHWPG 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 N-AWIPS compatible AREA format and provided to the MPHWPG via the LDM and FTP for use in operations at WPC, OPC, and SAB.

Concept for Operations:

- Since the NSSL-WRF is considered non-operational, CIRA/CIMSS will continue to produce the imagery and deliver it to the NWS for the foreseeable future.

Product Name: Overshooting Top Detection

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

MPHWPG 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 especially in OCONUS and radar poor regions (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, such as the intermountain west.

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 are delivered to the MPHWPG via the CIMSS LDM and are 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: Total Lightning Detection

Primary Investigator: Scott Rudlosky (NESDIS/STAR), Joseph Sienkiewicz (OPC), Geoffrey Stano (SPoRT)

MPHWPG Relevance:

- The Vaisala GLD-360 is primarily used at the MPHWPG and a lightning density product has been created locally that can be used to identify convection that may contain a significant amount of mainly cloud-to-ground (CG) lightning strikes.
- Will prepare forecasters to receive data from the GLM, baseline GOES-R instrumentation designed to measure total lightning.

Product Overview:

- Provides an 8x8 km boxed average estimation of CG lightning activity within the Vaisala GLD-360 network (covers the entire OPC and WPC domain).

- Designed to give forecasters the opportunity to use and critique a demonstration of GLM type data to help improve future visualizations of these data.
- Serves as reference for comparison with full GLM proxies and derived products.

Product Methodology:

- Takes the raw lightning observations from the Vaisala GLD-360 network 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 2, 5, 15, and 30-minute refresh rate.

Concept for Pre-Operational Demonstration:

- The GLD-360 lightning feed is used to create the 8x8 density grids at OPC. These grids are then made available to WPC, OPC, and SAB through the NCEP network for use in N-AWIPS.

Concept for Operations:

- Lightning Density is a Level 3 gridded product. The GLM Lightning Detection – event, group, flash – is the Level 2 product and will be distributed by ESPC from central processing.

Product Name: MSG RGB Air Mass

Primary Investigators: Kevin Fuell (SPoRT) and John Knaff (NESDIS/STAR/RAMMB)

MPHWPG 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 SEVIRI channels 12 (WV6.51), 10 (WV7.43), 9 (IR9.71), and 8 (IR11.03).

- 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) (Red)

- Differencing the ozone channels (i.e., 9.71 µm and 11.03 µm). (Green)
- Uses the 6.51 µm channel to indicate gross air mass temperature differences. (Blue)

MSG Air Mass Products:

- MSG-based RGB Air Mass imagery will be generated every 15 minutes.
- Sounder-based RGB Air Mass imagery will be generated once per hour.

Recent Product Modifications:

- None

Concept for Pre-Operational Demonstration:

- Product is generated at SPoRT and then provided to the MPHWPG in AREA format for use in N-AWIPS and provided via an ftp server or the LDM.

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.

Document last updated: 31 July 2013

Product Name: RGB Dust

Primary Investigator: Kevin Fuell (SPoRT) and John Knaff (NESDIS/STAR/RAMMB)

MPHWPG Relevance:

- The dust product will allow for the monitoring of dust storms over the African continent and tracking of dust plumes into the tropical Atlantic waters where easterly waves move and sometimes develop into tropical cyclones. This will be of value to NWS National Centers that have marine forecast responsibilities.

Product Overview:

- Product designed to monitor the evolution of dust storms during both day and night.

Product Methodology:

- The dust product is an RGB composite based upon infrared channel data from the Meteosat Second Generation satellite. The resulting product depicts dust in magenta and purple colors over land during day and night, respectively. Over the ocean the dust also shows up as magenta, although with a little less contrast than over the land.
- Product is generated from Meteosat Second Generation SEVIRI channels 7 (IR8.7), 9 (IR10.8), and 10 (IR12.0).

- Highlights dusty regions, which is accomplished by:
    - Differencing two IR channels related to optical thickness (i.e., at 12.0 µm and 10.8 µm) (Red)
    - Differencing two IR channels related to particle phase (i.e., 9.71 µm and 11.03 µm). (Green)
    - Uses the IR window channel (10.8 µm) to indicate surface temperature. (Blue)

MSG Dust Products:

- MSG-based RGB Dust imagery will be generated every 15 minutes.

Recent Product Modifications:

- None

Concept for Pre-Operational Demonstration:

- Product is generated at SPoRT, converted to a format suitable for N-AWIPS and provided via an ftp server or the LDM to the MPHWPG.

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.

Document last updated: 31 July 2013

Product Name: Hurricane Intensity Estimate (HIE)

Primary Investigator: Chris Velden, UW/CIMSS

MPHWPG Relevance:

- Infrared estimates of tropical cyclone intensity have been the cornerstone of operational tropical cyclone forecast agencies for several decades. The HIE is the next generation version of the Automated Dvorak Technique (ADT) for GOES-R.

Product Overview:

- The HIE GOES-R algorithm will estimate hurricane intensity (mean sea level pressure (MSLP) and max surface wind) from ABI IR-window channel imagery.
- Product will also be run using 15 min GOES-East CONUS (MSG) IR imagery for those systems west (east) of 60^{o}W

- The code for the product was derived from the current Advanced Dvorak Technique (ADT).

Product Methodology:

- Product will be run in real-time at UW/CIMSS in Madison, WI, during Atlantic tropical cyclone events.
- It will be automatically activated upon NHC declaring any such system a Tropical Depression or greater strength.

Hurricane Intensity Estimate Products:

- Maximum wind, minimum sea-level pressure estimates

Recent Product Modifications:

- June 2013, HIE now run using ADT version 8.1.4 (SAB operational version)

Concept for Pre-Operational Demonstration:

- The HIE will be generated at CIMSS and provided using the mechanisms as the current Advanced Dvorak Technique (ADT)

Concept for Operations:

- The HIE is a baseline GOES-R product and will be provided as part of the operational processing system

Document last updated: 31 July 2013

Product Name: Tropical Overshooting Tops

Primary Investigator: Sarah Monette and Chris Velden (CIMSS)

MPHWPG Relevance:

- The product can help to identify vortical hot towers, which are related to tropical cyclone formation and intensification.
- NHC forecasters will provide feedback on the utility of the TOT in the preparation of their operational products.

Product Overview:

- Real time OT timing and location over the tropical and subtropical Atlantic east (west) of 55^{o}W based on 15-min Meteosat (GOES-east) imagery.

Product Methodology:

- Uses infrared window channel imagery to identify dome-like protrusions above cumulonimbus anvils associated with very strong updrafts.

Tropical Overshooting Tops Products:

- Lat/Lon and time of tropical overshoots updated every 15 min

Recent Product Modifications:

- July 2013 – ADT used to identify CDO pattern, TOT threshold reduced from 9K to 5K in cold CDO region as defined by IR brightness temperatures

Concept for Pre-Operational Demonstration:

- The TOT product is generated at CIMSS and made available through a web page (http://cimss.ssec.wisc.edu/goes_r/proving-ground/nhc/ot/) and are also distributed in N-AWIPS format

Concept for Operations:

- The TOT product is a variation on the GOES-R Overshooting Tops algorithm. The TOT product could be generated on a central system at NESDIS and distributed along with the OT product.

Document last updated: 31 July 2013

Product Name: Super Rapid Scan Imagery for GOES-R

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. The 1-min imagery is not routinely utilized by NHC for tropical cyclone applications, so special datasets are being collected to provide experience the higher time resolution imagery.
- Will provide super rapid scan operations (SRSO) data during hurricane events to better document convective evolution, and provide research datasets for improving atmospheric motion vectors

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 (SRSOR) from GOES-14.

Product Methodology:

- Short periods of SRSO data may be collected for landfalling cases, although this ability is constrained by the operational RSO scanning mode that is triggered when tropical storm operations are in place. Typically RSO is called for GOES-east, so SRSO will be called for GOES-west if the storm is far enough west.
- The GOES-14 satellite will be available during the main part of the 2013 Hurricane Season (Aug-Oct) and will be centered at 105^{o}W. Extended periods of 1 minute imagery will be available (SRSO-R), and will be called for cases of interest. With SRSO-R, 26 images can be collected every ½ hour.

Super Rapid Scan Imagery Products:

- Full resolution 1 minute visible imagery

Recent Product Modifications:

- None

Concept for Pre-Operational Demonstration:

- The current satellite systems at NHC are not set up to ingest the 1 min imagery, so these will be ingested at CIMSS and CIRA and made available via web pages.

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.

Document last updated: 31 July 2013