



The 2013 Satellite Proving Ground at the National Hurricane Center

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Outline

- **Overview the NHC GOES-R Proving Ground**
- **Summary of 2013 products**
- **Forecaster feedback and examples**
- **Plans for 2014**

Overview of GOES-R

- **Next generation of GOES satellites**
- **Planned launch in late 2015 or early 2016**
 - **Advanced Baseline Imager (ABI)**
 - 16 channels, improved spatial and temporal resolution
 - **Geostationary Lightning Mapper (GLM)**
 - Near continuous monitoring of total lightning
 - **Space Weather Instruments**
 - **Communications Capabilities**



Goals of NHC PG Experiment

- Demonstrate GOES-R surrogate products in real-time at NHC during the 2013 hurricane season
 - Product set determined by coordination between NHC forecasters, developers and GOES-R Program Office
 - Proxy GOES-R ABI data from MSG, current GOES
 - Proxy GOES-R GLM data from ground-based WWLLN
- Ensure that NHC forecasters can use and get familiar with GOES-R products using proxy data
- Evaluate products and provide valuable feedback to GOES-R Program Office and developers

2013 NHC Proving Ground Products

Phase 1 (Started Aug 1, 2013)

1. Hurricane Intensity Estimate (HIE)
2. Super Rapid Scan Imagery (SRSO)
3. Tropical Overshooting Tops (TOT)
4. GOES-R Natural Color Imagery
5. Red-Green-Blue (RGB) Air Mass Product*
6. RGB Dust Product*
7. Saharan Air Layer (SAL) Product*
8. Rapid Intensification Index (RII)
9. Pseudo Natural Color Imagery *

Phase 2 (Started Sep 1, 2013)

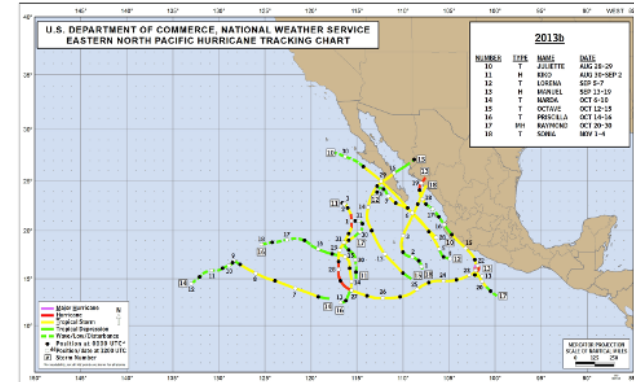
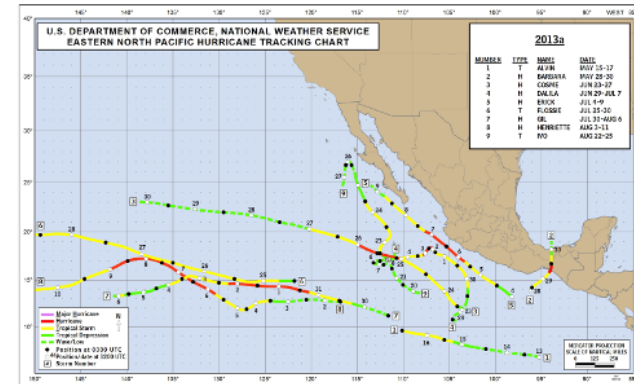
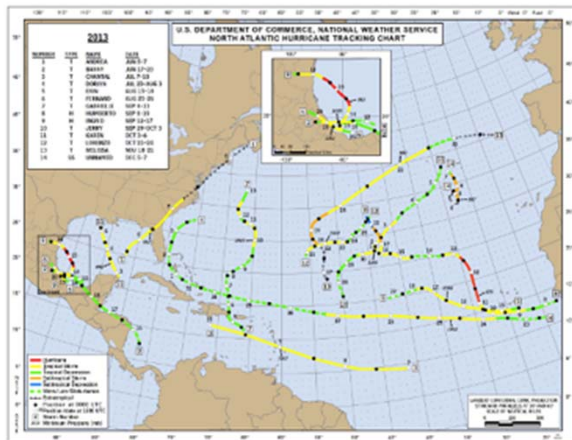
10. RGB Cloud Top Microphysics Product
11. RGB Convective Storms Product
12. VIIRS Day/Night Band (S-NPP Product)

*Provided in N-AWIPS format through SPoRT

Collection of NHC Forecaster Feedback

- NHC feedback form
- Mid-project review
- Blogs
 - http://rammb.cira.colostate.edu/research/goes-r/proving_ground/blog
 - <http://nasasport.wordpress.com>
- Informal communications with developers

The 2013 Hurricane Season



- Very quiet season in the Atlantic
 - No rapid intensification cases
 - No major hurricanes

- East Pacific also quiet
 - Only one major hurricane

No SRSO cases from GOES-14 due to slow season and satellite availability

Hurricane Intensity Estimate (HIE)

- Provides TC analysts with an objective and operationally-proven TC intensity estimation tool using GOES-R ABI IR imagery.
- Has been demonstrated to NHC/TAFB specialists within the GOES-R Proving Ground since the 2010 Atlantic TC season.
 - As proxy data for GOES-R, employs 15-minute IR imagery from Meteosat-9/10 and GOES-East (CONUS sector)
 - 15 min imagery frequency increases responsiveness
- Algorithm heritage based on the Advanced Dvorak Technique (ADT)
 - Developed by UW-CIMSS, used operationally by NHC
- Systematic verification is underway as part of PG feedback
- Feedback in 2013
 - Higher refresh rate useful during Humberto...

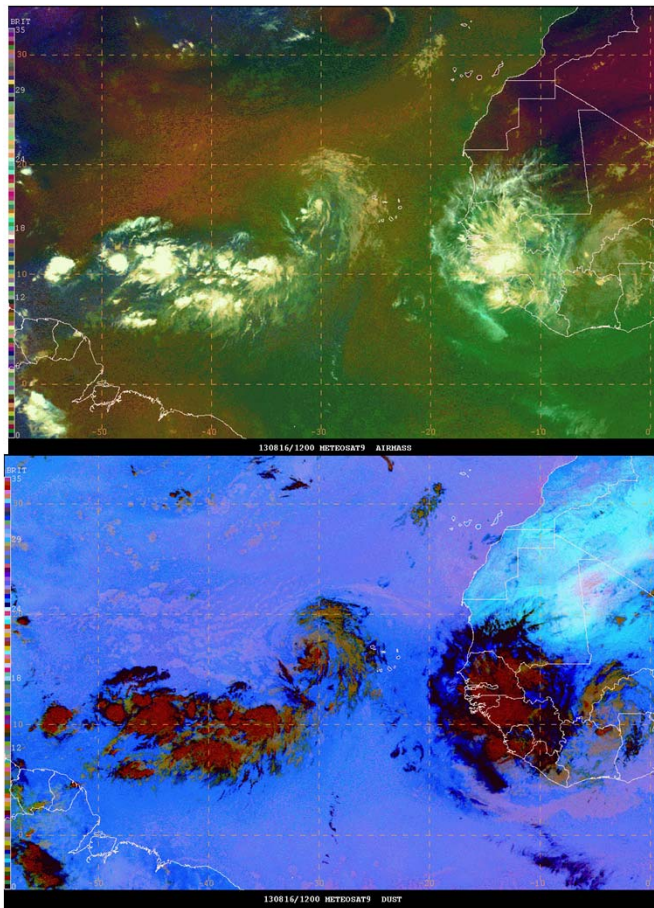
“Higher refresh rate of RPG HIE allowed for quicker identification of developing eye scene with Humberto, and thus a higher CI than AODT.”

RGB Products

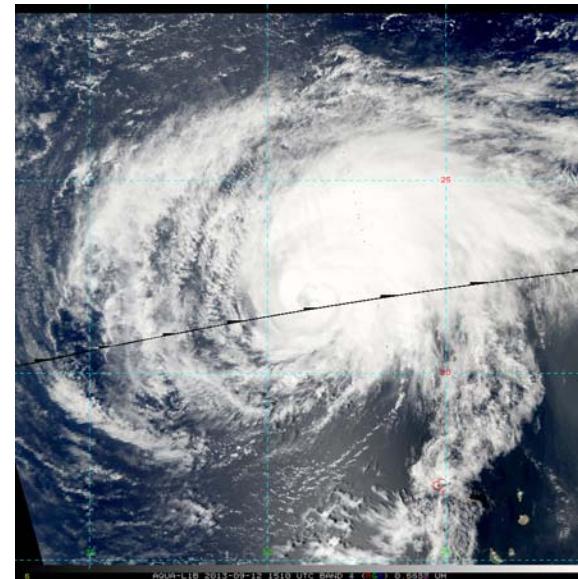
- Forecasters will not have time to view all 16 ABI channels
- Red-Green-Blue (RGB) image combination products being developed to highlight features of interest
- 7 RGB and related image products in 2013 PG
 - Air Mass (MSG, GOES Sounder)
 - Dust (MSG)
 - Saharan Air Layer (MSG)
 - Pseudo Natural Color (MSG)
 - Natural Color (MODIS)
 - *Cloud-top Microphysics (MSG)
 - *Convective Storms (MSG)

**New products for 2013*

RGB Product Examples



Air Mass (top) and Dust (bottom)
TS Erin, 16 Aug 2013



Natural Color
Hurricane Humberto, 12 Sep 2013
(MODIS example, GOES-R will loop)

New RGB for 2013

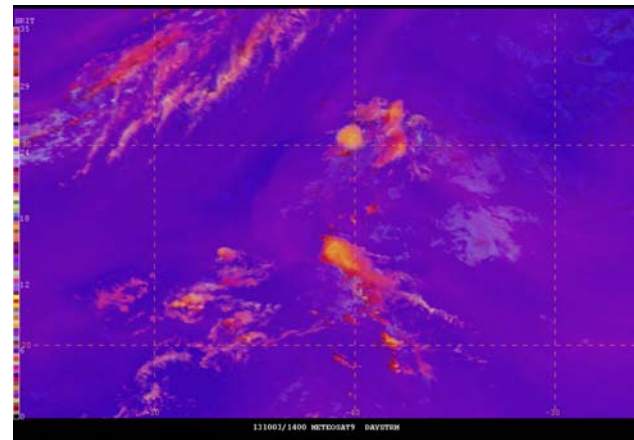
Cloud-Top Microphysics Product

- Provides information about cloud-top particle, cloud-top phase, and precipitation
- Tropical applications
 - Intensity forecasting (cloud-top particle size related to updraft strength)
 - Monitoring marine environment
- Generated from MSG Seviri channels VIS0.8, IR3.9, IR10.8
- Highlights differences in cloud top particle size and phase
 - Cloud top structure (Red)
 - Particle size (Green)
 - Cloud top temperature and phase (Blue)

New RGB for 2013

Daytime Convective Storms Product

- Provides information about
 - Cloud top particle size (related to updraft strength)
 - Cloud top phase
 - Precipitation
- Tropical applications
 - Cloud discrimination (convective, stratiform)
 - Genesis and intensity forecasting
- Generated from MSG Seviri channels WV6.2, WV73, IR3.9, IR10.8, NIR1.6, VIS0.6
- Highlights differences between dry, tropical, and cold air masses



TS Jerry, 3 Oct 2013

Feedback on RGB Products

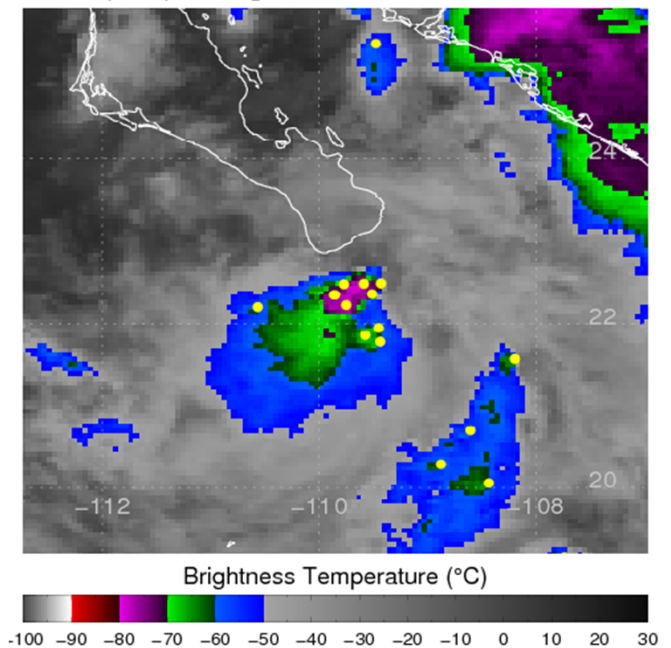
- More efficient access to products obtained through new LDM feed to NHC from SPoRT
- RGB Air Mass
 - Used often by HSU and TAFB
 - Showed dry air impinging on Erin, suggesting intensification less likely
- RGB Dust
 - Used often by HSU and TAFB
- No formal feedback on SAL, Pseudo natural color, Natural color or Cloud-top Microphysics
- Convective Storms
 - HSU noted image distorting near sunrise and sunset, developers working on issue

Tropical Overshooting Top (TOT) Detection Algorithm

- Objectively identifies overshooting top locations using cold IR pixels relative to neighbors, to isolate and quantify active vigorous tropical convection.
- As proxy data for GOES-R, the TOT algorithm employs 15-minute IR imagery from Meteosat-9/10 and GOES-East (CONUS sector).
- Research underway to associate TOT trends with TC genesis and rapid intensification, and as a potential predictor in statistical prediction models.
- Feedback in 2013
 - TOT showed signal on bursting convection near the center of Juliette

Example from 2013 NHC Proving Ground – TS Juliette

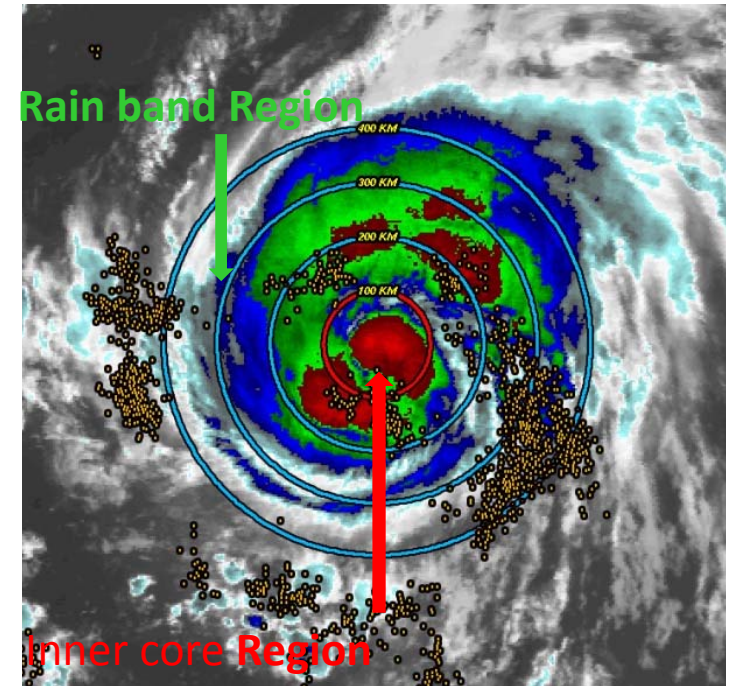
Juliette (2013) IR Image and TOTs: 20130829 at 0130 UTC



GOES-E color-enhanced IR image and identified TOTs (yellow dots) at 0615UTC on 29 Aug., 2013

Lightning-based Rapid Intensification Index

- Ground based WWLLN used as proxy for the GLM
- Rapid Intensification Index (RII) algorithm modified to include lightning predictors
 - Rain band lightning favors RI
 - Inner core lightning signals end of RI period
- Large lightning outbreaks for sheared storms
 - Consistent with rapid intensification algorithm
- Systematic verification of 2013 RII underway
- Feedback in 2013
 - Useful for continuity of convective features during GOES outage
 - Lightning outbreak in TD 11 associated with shear and reduced probability of RI
 - Inner core region definition too large for some E. Pac storms, lead to improper reduction of RI probability
 - Quantitative verification of RI with lightning input underway



Lightning Outbreak Indicated Increased Shear in NHC's TD Eleven Forecast Discussion

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WTNT41 KNHC 300840

TCDAT1

TROPICAL DEPRESSION ELEVEN DISCUSSION NUMBER 6

NWS NATIONAL HURRICANE CENTER MIAMI FL AL112013

500 AM AST MON SEP 30 2013

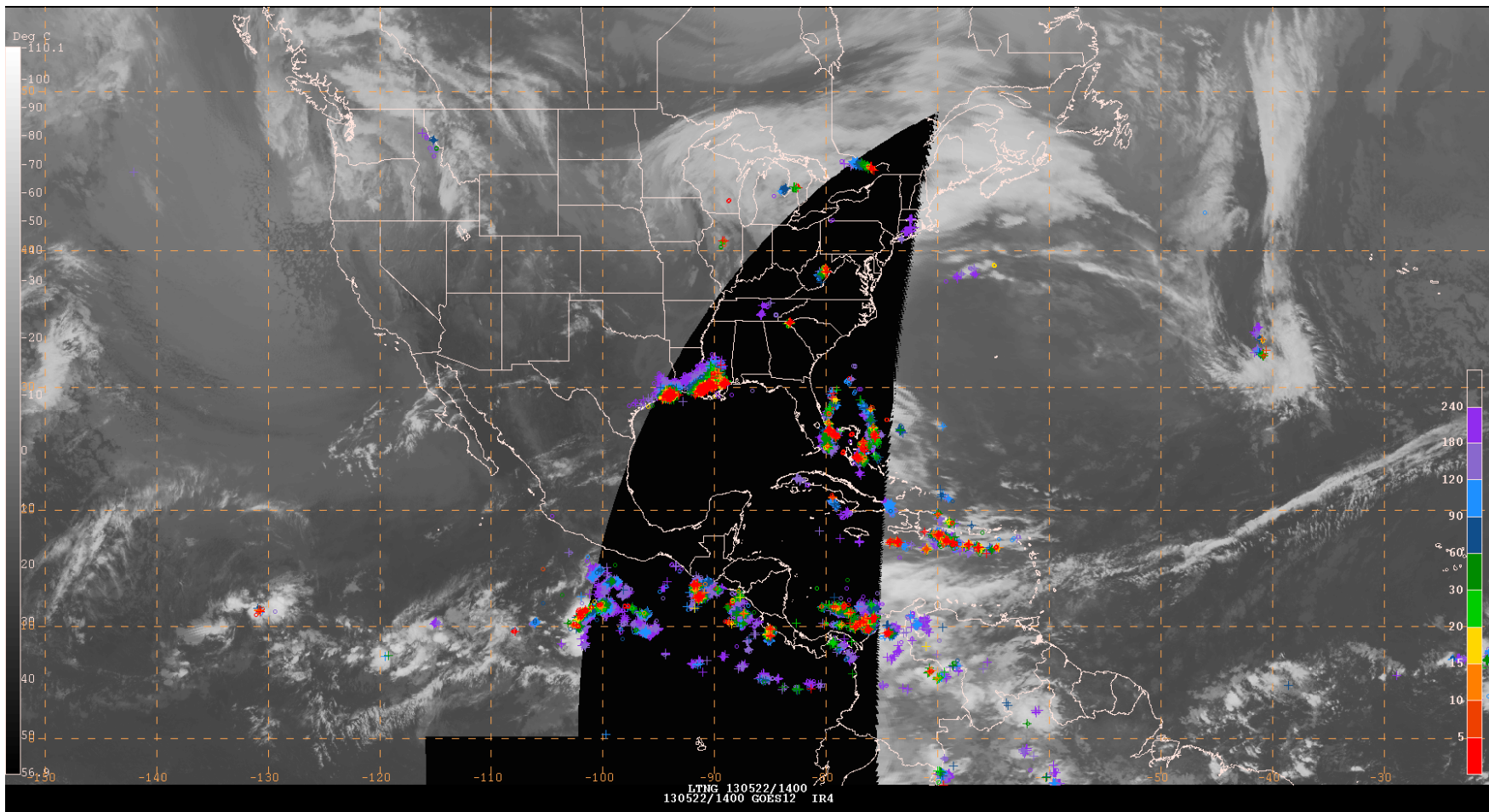
THE CONVECTIVE CLOUD SHIELD REMAINS SHEARED NORTHEAST THROUGH SOUTHEAST OF THE CENTER. THERE HAS BEEN A NOTICEABLE INCREASE IN LIGHTNING ACTIVITY DURING THE PAST COUPLE OF HOURS...WHICH IS OFTEN INDICATIVE OF INCREASING VERTICAL WIND SHEAR. ...

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FORECASTER STEWART

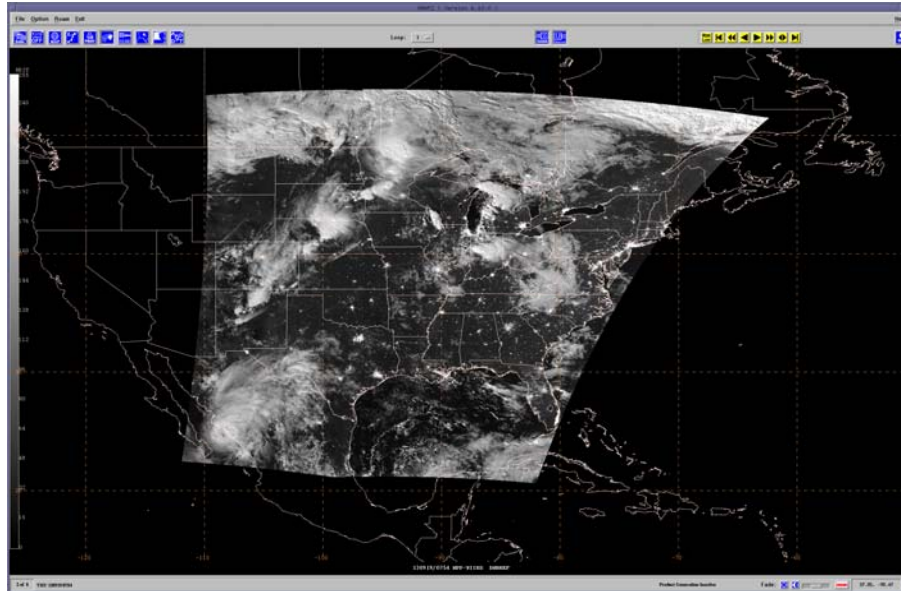
GOES-East Outage on May 22

Lightning data provided continuity of convective activity in gap between GOES-west and MSG



VIIRS Day-Night Band Reflectance

Hurricane Manuel (East Pacific) in N-AWIPS



- New low-light sensing capabilities on S-NPP
- Senses reflected moonlight at night
- Can be used in similar ways to visible channel during the day
 - Nighttime TC center fixing and structure identification
 - Cloud monitoring

Plans for the 2014 PG

- Andrea Schumacher (CIRA) new part time satellite liaison for NHC/HSU
- Continue to look for quantitative evaluations
 - HIE and Lightning RII already have quantitative evaluation methods
- Expand the domain of VIIRS using additional direct readout sites
- Too many products being evaluated
 - Maybe concentrate on a subset for specific forecast desks
 - Rotate in new products
 - ATMS temperature and moisture retrievals
 - GOES-R atmospheric motion vectors
 - Aerosol optical depth

Summary

- 11 GOES-R and 1 S-JPSS products demonstrated in 2013 NHC Proving Ground
 - Experience gained by forecasters
 - Valuable feedback obtained from forecasters
- Very quiet season in Atlantic, East Pacific also quiet, very few RI cases
- No SRSO cases from GOES-14 due to slow season
- Air Mass and Dust RGB products used often by HSU and TAFB
- Considerable feedback on lightning data
 - Useful for continuity during GOES-east outage
 - Large lightning outbreaks for sheared storms
 - Consistent with rapid intensification algorithm
 - Radial scaling may be needed for small East Pacific storms
- Hurricane Intensity Estimate higher refresh rate useful during Humberto
- More efficient access to products obtained through new LDM feed to NHC from SPoRT