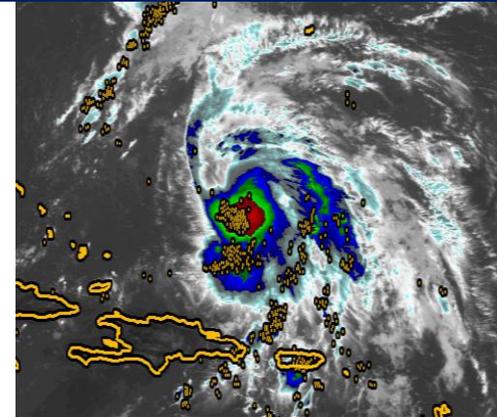
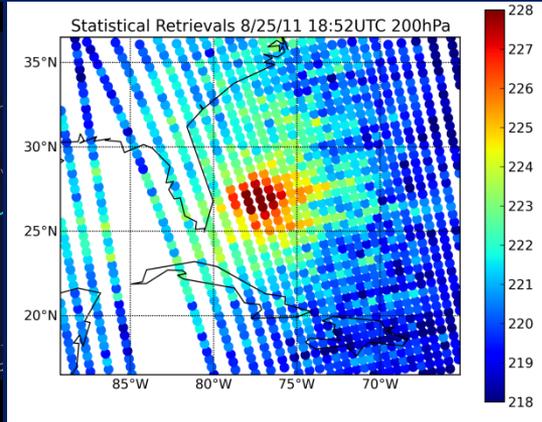
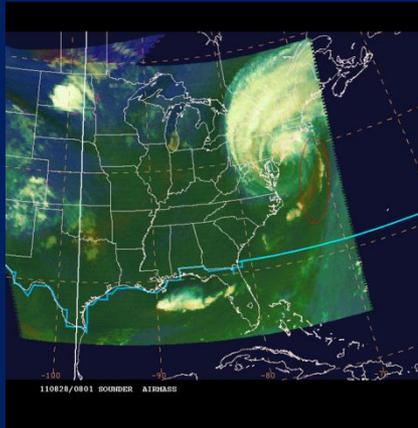


# New Tropical Cyclone Products from GOES-R and JPSS



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Mark DeMaria, NOAA/NESDIS, Fort Collins, CO

Collaborative Effort with CSU/CIRA, UW/CIMSS, NASA/SPoRT,  
OAR/HRD and UM/CIMAS



# Outline

- **Potential uses of GOES-R and JPSS for tropical cyclone analysis and forecasting**
- **Summary of the NHC GOES-R Proving Ground**
- **New GOES-R and JPSS tropical cyclone products under development**

# TC Applications of GOES-R

- Only one official AWG baseline hurricane product
  - Hurricane Intensity Estimate
- *Risk reduction, proving ground, JCSDA activities essential to fully exploit GOES-R for TC forecasting*
- Other applications
  - Improved track and intensity forecasts through assimilation of ABI radiances, GLM, and advanced feature track wind
  - Improved statistical model intensity and structure forecasts through inclusion of GLM and ABI
  - Super rapid scan data for center fixing, intensity estimates
  - Multi-spectral cloud products for convective analysis
    - Overshooting tops, particle size, cloud thickness, phase
  - Red, Green, Blue products for environmental analysis
    - Air mass, dust, Saharan air layer, etc.
  - Natural color for feature identification, public outreach

# TC Applications of JPSS

- Only one official JPSS hurricane product
  - Conversion of AMSU intensity/structure estimation to ATMS
- *Risk reduction, proving ground and JCSDA activities essential to fully exploit JPSS for TC forecasting*
- Other applications
  - Improved track and intensity forecasts through assimilation of ATMS/CrIS radiances, VIIRS imagery
  - Improved statistical model intensity and structure forecasts through inclusion of ATMS/CrIS retrievals
  - Improved center fixing using high resolution VIIRS, especially low-light nighttime imagery
  - Multi-spectral cloud products for convective analysis
    - Overshooting tops, particle size, cloud thickness, phase
  - True color for feature identification, public outreach

# The NHC Proving Ground at NHC

- **Two years of experience so far**
  - Aug 1-Nov 30, 2010
  - Aug 1-Nov 30, 2011
- **6 products in 2010**
- **9 products in 2011**
- **ABI proxy data**
  - SEVIRI, current GOES, MODIS, AVHRR
- **GLM proxy data**
  - Ground based lightning networks
    - WWLLN and Vaisala GLD360

# 2011 NHC Proving Ground Products

- **Baseline**
  1. Hurricane Intensity Estimate (HIE)
  2. Super Rapid Scan Imagery
- **Future capabilities**
  3. Tropical Overshooting Top (TOT) Detection Algorithm **(new in 2011)**
- **GOES-R Risk Reduction**
  4. Red-Green-Blue (RGB) Air Mass Product
  5. RGB Dust Product
  6. Saharan Air Layer (SAL) Product
  7. Pseudo Natural Color Imagery **(new in 2011)**
  8. GOES-R Natural Color Imagery **(new in 2011)**
  9. Rapid Intensification Index (RII)

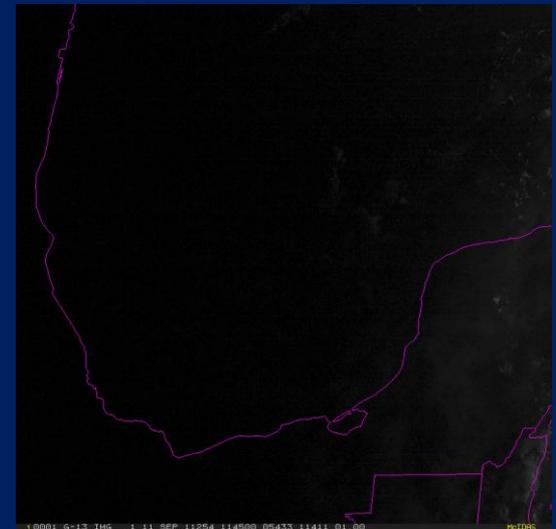
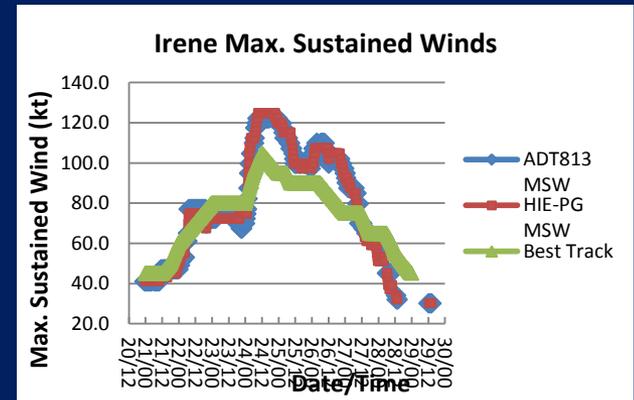
# Feedback Summary

## 1. HIE

- Some differences from ADT noted
- Pressure-wind problems identified and fixed by developers
- Influenced operational TC estimates in some cases

## 2. SRSO

- Many good cases in 2010 due to GOES-15 science test
- Most useful during sunrise
  - Used to reposition Nate (2011)
  - Useful for aircraft deployment decisions



First light SRSO Images for Nate on 11 Sept 2011

# Feedback Summary

## 3. Tropical overshooting tops

- More evaluation needed for hurricane applications
- May have utility for TAFB marine applications

## 4. and 5. RGB air mass and dust products

- Many applications for genesis, intensity, structure forecasts
- SPoRT provided N-AWIPS versions in 2011
- Examples to be shown Friday

## 6. and 7. Saharan Air Layer and Pseudo Natural Color

- Experience with multi-spectral image combinations
- N-AWIPS versions needed to improve utility

# Feedback Summary

## 8. GOES-R Natural Color algorithm

- Routine product generation revealed algorithm deficiencies (too much green at high viewing angles)
- Algorithm developers made correction on 20 Oct 2011



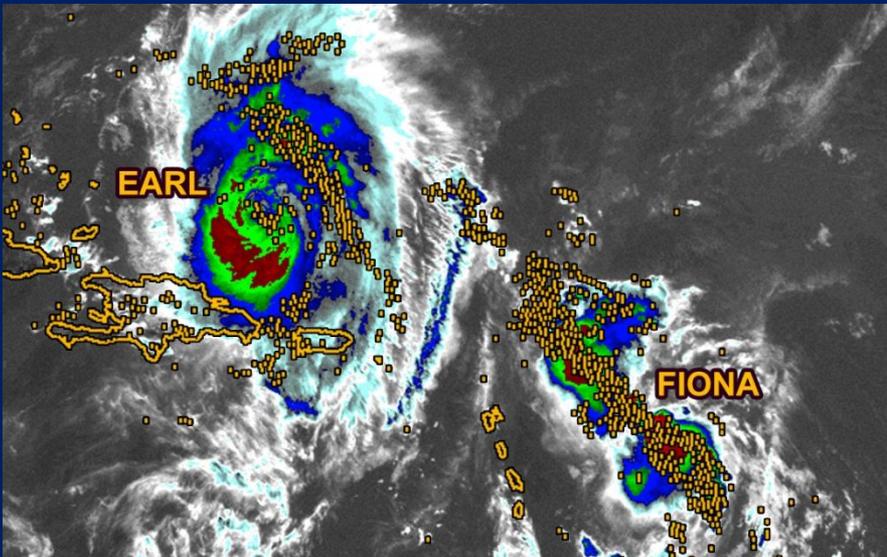
Old Algorithm



New Algorithm

# Feedback Summary

9. Lightning based rapid intensification index (RII)
  - Inner core lightning does not imply rapid intensification
    - Rain band lightning better correlated with intensification
  - Lightning input provides modest changes to RII ( $\leq 10\%$ )
    - Several season sample needed to show statistical significance



*Six hour lightning locations for Earl and Fiona (2010). Fiona had more inner core lightning but Earl intensified more*

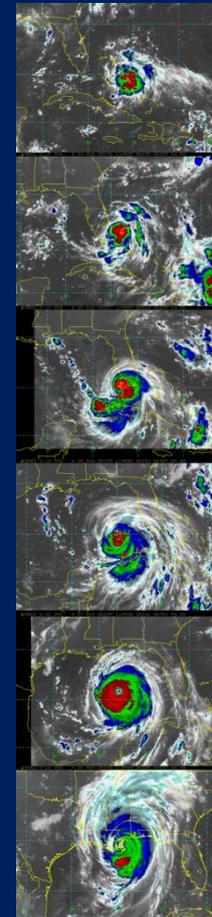
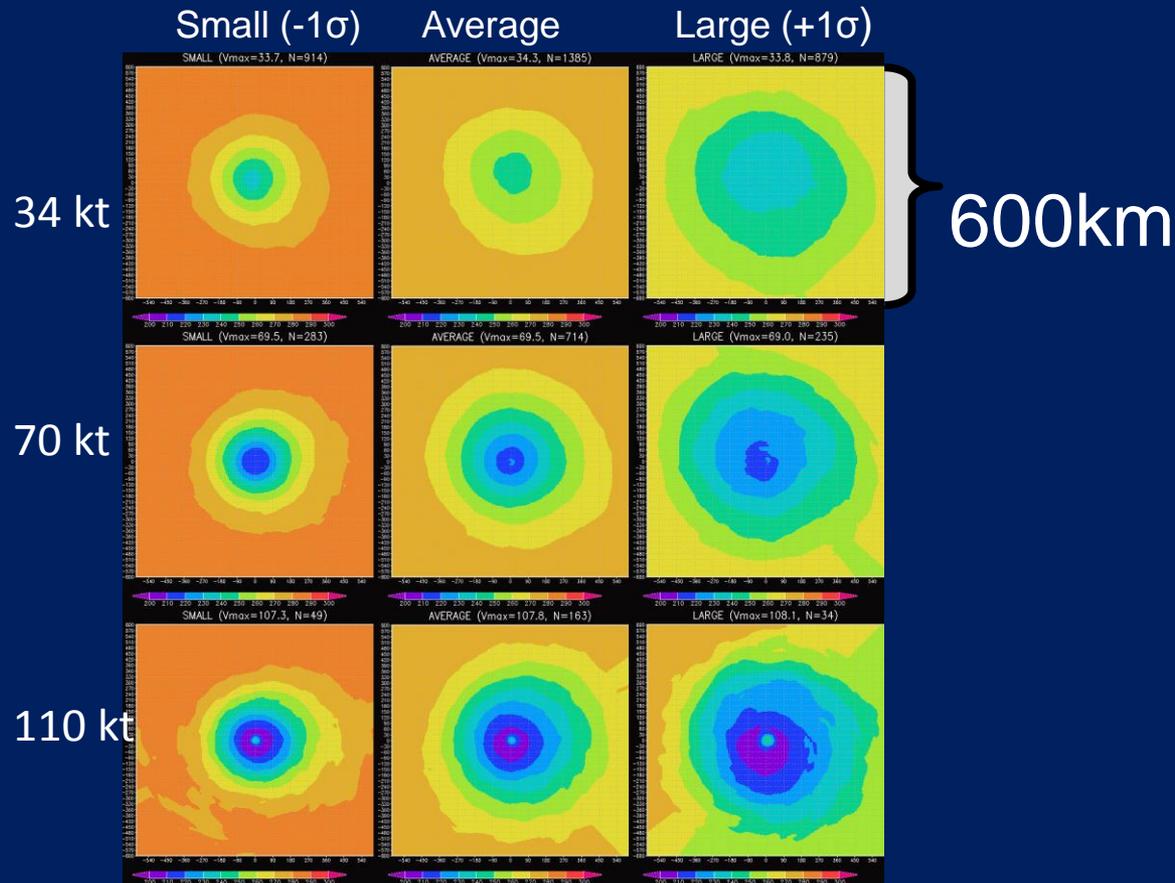
# Plans for 2012 NHC Proving Ground

- **Product set same as 2011**
- **Provide more imagery in N-AWIPS**
  - **Transition to AWIPS-2 for 2013 season**
- **Increased involvement of the Tropical Analysis and Forecast Branch (TAFB)**
  - **Coordination with OPC/HPC/SAB Proving Ground**
- **Quantitative evaluations when possible**
- **Formalize forecaster feedback procedure**
- **Possible inclusion of JPSS products in 2013**

# New GOES-R Hurricane Products

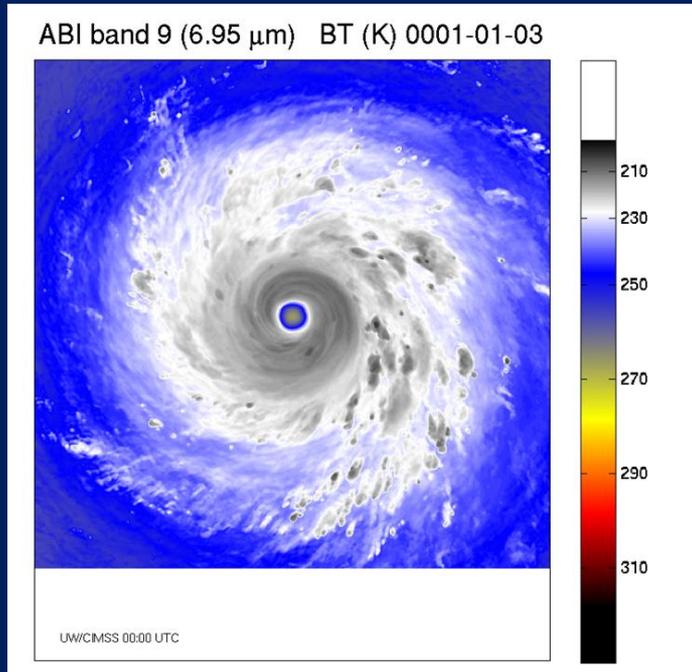
- **Completed CIRA/CIMSS/OAR R3 project**
  - Better use of GOES IR and TPW input in the RII
  - Transitioning to NHC operations under the Joint Hurricane Testbed for 2012
- **Current CIRA/CIMSS R3 project**
  - Automated center fixing using lightning and multi-spectral imagery (also NPP data)
  - Wind structure estimation and forecasting
    - Includes modeling studies for better understanding
    - Generalize operational SHIPS model to include wind radii
      - Planned year 3 demonstration
  - Further details on the poster

# Composite IR Imagery as a Function of Storm Size and Intensity

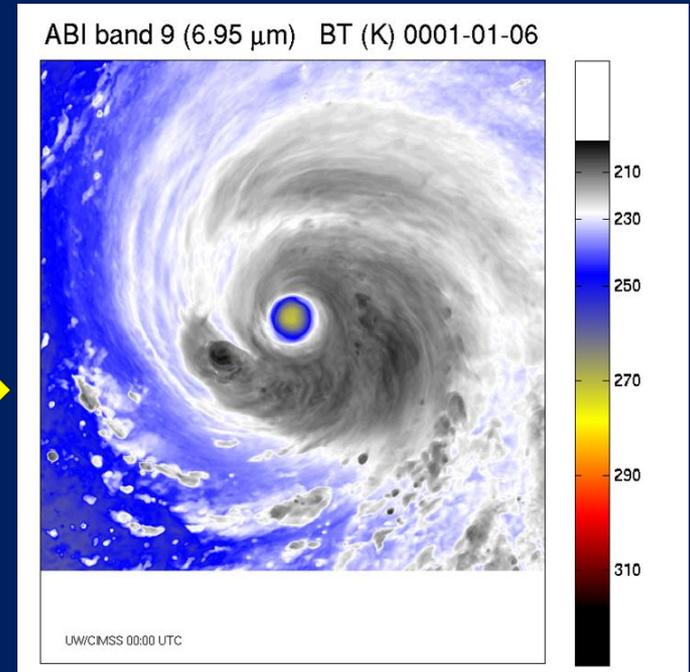


Katrina (2005) example

# WRF Modeling Studies to Understand Structure Changes



Three days of growth from internal processes as viewed in WRF-based ABI water vapor imagery



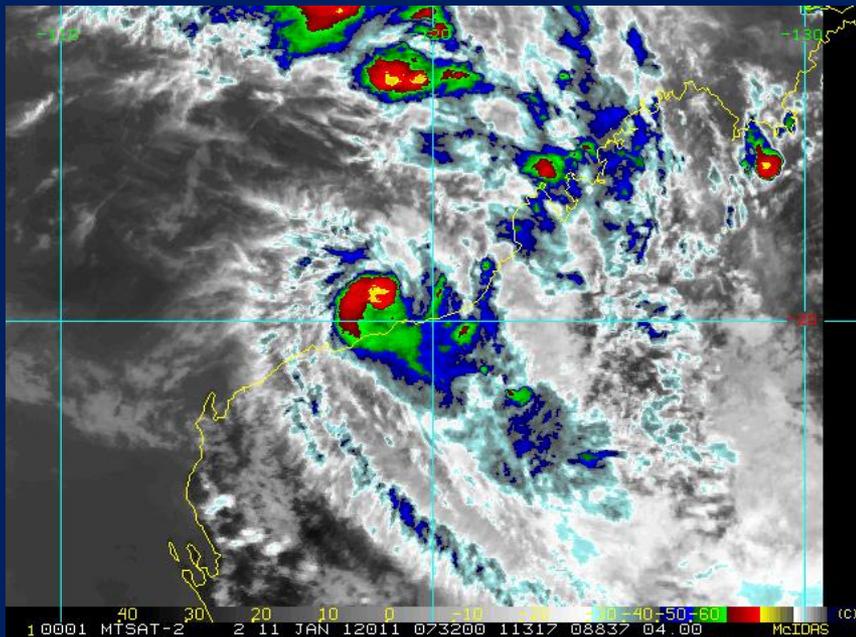
- Convection outside of inner core leads to growth
- SEVIRI cloud ice product useful for diagnosing size changes
- Size analysis and forecast algorithm combines ABI and model forecast input

*Images courtesy of Chris Rozoff UW/CIMSS*

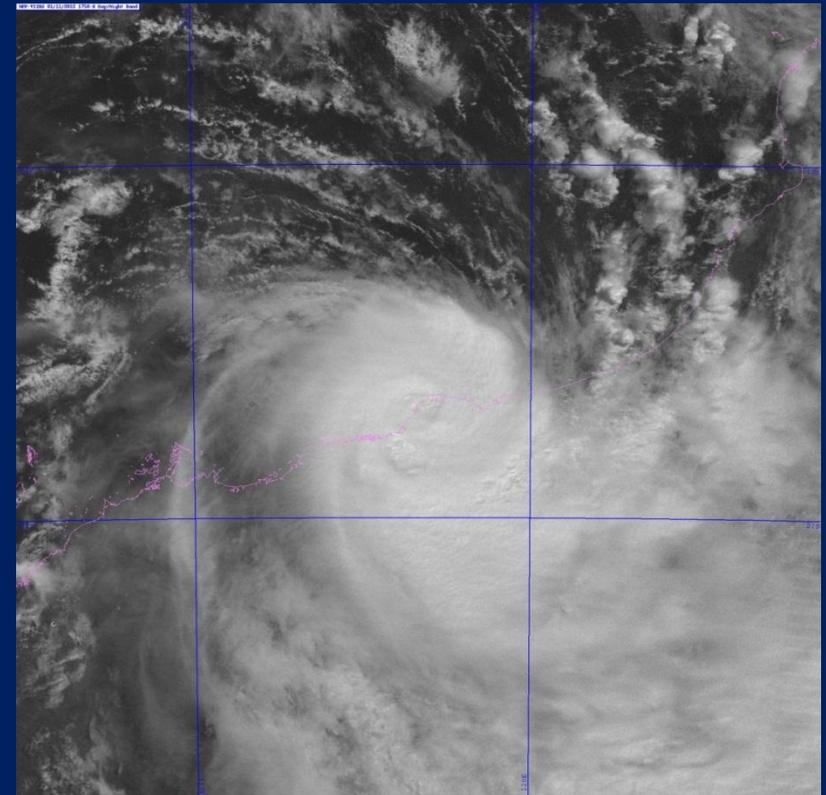
# New JPSS Hurricane Products

- **Current CIRA/CIMSS R2 project**
  - **Automated center fixing**
    - High res VIIRS “snapshots” to refine GOES algorithm
    - ATMS/CrIS retrievals also used
  - **Intensity and structure estimation algorithm**
    - Adapt operational AMSU methods to ATMS
  - **Intensity forecast improvements**
    - Use ATMS/CrIS retrievals as input to LGEM statistical intensity model
      - Better estimates of CAPE and maximum potential intensity
- **Possible demonstrations in NHC proving ground**
- **See poster for further details**

# Day-Night Band VIIRS Image Cyclone Heidi Landfall NW Australia 11 Jan 2012 1750 UTC (1:50 AM local)



MT-Sat IR Window Channel

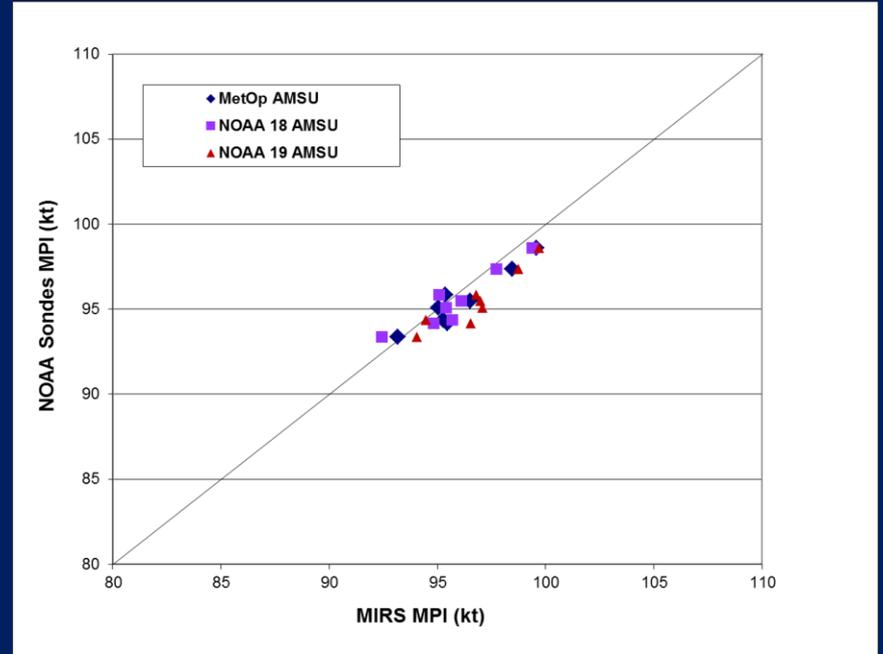
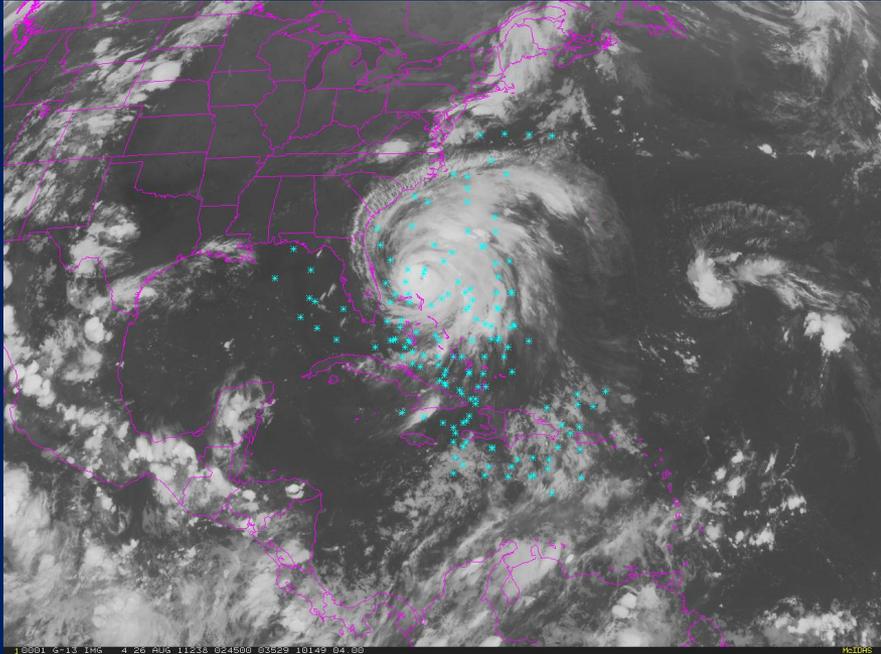


VIIRS Day-Night Band

# Intensity Forecast Improvements

- **Logistic Growth Equation Model (LGEM) has generally been most accurate in past few years**
- **Two major inputs can be estimated from soundings**
  - **Maximum potential intensity (MPI)**
  - **CAPE modified by entrainment**
- **Replace global model soundings with ATMS/CrIS at t=0 hr**
- **Improvements to short term intensity forecasts**
  - **Can also be used in the rapid intensity index (RII)**
- **Methods being tested for cases with NOAA Gulfstream Jet soundings as ground truth**

# Initial Tests with MIRS Soundings from AMSU



Locations with NOAA Jet and MIRS AMSU Sounding for Hurricane Irene (2011). The NOAA Jet flew 8 missions over the period Aug 22 to Aug 26.

MPI estimates from mission-composite NOAA Jet and MIRS AMSU soundings

# Summary

- **GOES-R and JPSS have great potential to improve tropical cyclone analysis and forecasting**
  - Assimilation, risk-reduction and proving ground studies needed to fully realize this potential
- **NHC GOES-R proving ground very successful so far**
  - Forecaster familiarity and feedback to developers
- **New GOES-R and JPSS applications under development**