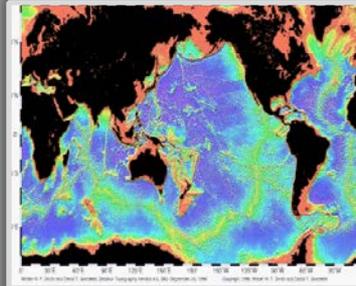
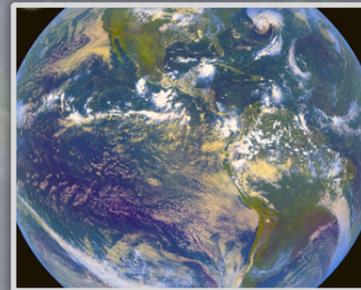


# Joint Polar Satellite System (JPSS) Proving Ground

*Mitch Goldberg,  
JPSS Program Scientist  
NOAA/NESDIS*

*Co-authors - Ingrid Guch, Bill Sjoberg*



**93<sup>rd</sup> AMS Annual Meeting**  
**Taking Predictions to the Next Level:**  
**Expanding Beyond Today's Weather, Water, and Climate Forecasting and Projections.**



# Challenge

## Move from Products to End User Applications

Ensure users are ready for NPP/JPSS data and improve their key operational and research product and services

- ✓ Severe weather forecasts and warnings
- ✓ Aviation weather forecasts and warnings
- ✓ Improve fire and air quality forecasts and warnings
- ✓ Improve warnings and prediction of poor water quality in coastal regions
- ✓ Improve drought, precipitation, snow and ice assessments and predictions

Periodic feedback from keys users on the impact of NPP/JPSS data and to identify improvements needed for products and applications

To meet this challenge, the NOAA JPSS Office has established a JPSS Proving Ground and Risk Reduction Program



# SUOMI NPP and JPSS ENVIRONMENTAL DATA RECORDS (RED - NOAA-LEGACY PRODUCTS)



## VIIRS (22 > 25)

ALBEDO (SURFACE)  
CLOUD BASE HEIGHT  
CLOUD COVER/LAYERS  
CLOUD EFFECTIVE PART SIZE  
CLOUD OPTICAL THICKNESS  
CLOUD TOP HEIGHT  
CLOUD TOP PRESSURE  
CLOUD TOP TEMPERATURE  
ICE SURFACE TEMPERATURE  
OCEAN COLOR/CHLOROPHYLL  
NET HEAT FLUX\*  
SURFACE REFLECTANCE

SUSPENDED MATTER  
VEGETATION INDEX. FRACTION, HEALTH  
AEROSOL OPTICAL THICKNESS  
AEROSOL PARTICLE SIZE  
ACTIVE FIRES  
POLAR WINDS  
  
IMAGERY  
SEA ICE CHARACTERIZATION (AGE AND CONCENTRATION)  
SNOW COVER  
SEA SURFACE TEMPERATURE  
LAND SURFACE TEMP  
SURFACE TYPE

## GCOM AMSR-2 (11)

CLOUD LIQUID WATER  
PRECIPITATION TYPE/RATE  
PRECIPITABLE WATER  
SEA SURFACE WINDS SPEED  
SOIL MOISTURE  
SNOW WATER EQUIVALENT

IMAGERY  
SEA ICE CHARACTERIZATION  
SNOW COVER/DEPTH  
SEA SURFACE TEMPERATURE  
SURFACE TYPE

## OMPS (2)

O<sub>3</sub> TOTAL COLUMN  
O<sub>3</sub> NADIR PROFILE  
SO<sub>2</sub>, AEROSOL INDEX

## CERES (2)

REFLECTED SOLAR RADIATION (TOA)  
OUTGOING LW RADIATION (TOA)

## CrIS/ATMS (3 > 5)

ATM VERT MOIST PROFILE  
ATM VERT TEMP PROFILE  
PRESSURE (SURFACE/PROFILE)  
TRACE GASES (CO<sub>2</sub>, CH<sub>4</sub>, CO)  
IR OZONE PROFILE (CRIS)

## ATMS (11)

CLOUD LIQUID WATER  
PRECIPITATION RATE  
PRECIPITABLE WATER  
LAND SURFACE EMISSIVITY  
ICE WATER PATH

LAND SURFACE TEMPERATURE  
SEA ICE CONCENTRATION  
SNOW COVER  
SNOW WATER EQUIVALENT  
TEMPERATURE PROFILE  
MOISTURE PROFILE

A-DCS

## TSIS (1)

SOLAR IRRADIANCE

SARR & SARP

BLACK – ORIGINAL NPOESS LEVEL 1 REQUIREMENTS EDRS  
BLACK PLUS RED – JPSS LEVEL1 REQUIREMENT EDRS  
\* NET HEAT FLUX is removed as EDR.



# PGRR Application Areas

**Weather Forecasting (Improving Global, Regional forecasts)**

Tropical Cyclones

Severe Weather (Nowcasting)

**Ocean/Coastal (Coral Bleaching, Harmful Algal Bloom alerts)**

**Land (Droughts, Agriculture)**

**Hazards (Smoke, Fire, Volcanic Ash, Air Quality)**

**Hydrological (Precipitation, Floods, Soil Moisture, Snow/Ice, River Ice)**

**Climate (integrated products, real-time anomaly products)**

**Education and Training**

**Infrastructure (Direct Readout and Software (CSPP), Airborne campaigns)**

CSPP is a critical component of the JPSS Proving Ground !

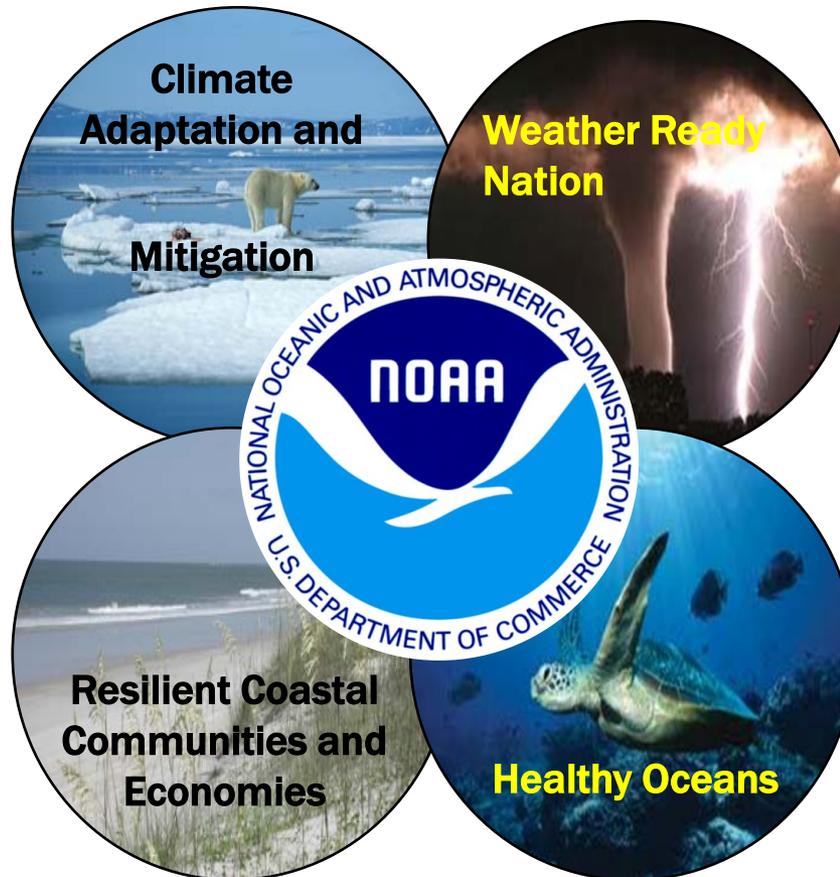


# Supporting the NOAA Mission

## JPSS data supports all four NOAA mission areas

- Assessments of **current and future states of the climate** system that identify potential impacts and inform science, service and stewardship decisions.
- **Mitigation and adaptation efforts** supported by sustainable, reliable and timely climate services.
- Improved scientific **understanding of the changing climate system.**

- Improved **coastal water quality** supporting human health and coastal ecosystem services.
- Safe, environmentally sound **Arctic access** and resource management.
- **Coastal communities that can adapt** to the impacts of hazards and climate change



- **Reduced loss of life, property and disruption** from high-impact events.
- More productive and efficient economy through relevant **environmental information.**
- Healthy people and communities due to improved **air and water quality services.**
- Improved **transportation** efficiency and safety.

- Improved **understanding of ecosystems** to inform resource management decisions.

# NOAT

## NWS Operational Advisory Team

---

Best state of the atmosphere and boundary conditions (3-d analysis of the current state)

**Challenge** – boundary layer and integration of various datasets

**Basis for:**

- Initial zero hour of the forecast database
- Initial conditions to next generation modeling systems
- Assisting the forecaster for monitoring /QCing the forecast database
- Situational awareness
- Verification

*How do you fit?*

Smoke and dust  
Moisture/clouds  
Derived winds  
Fire hot spots  
QPE  
SST  
TPW  
Snow/ice cover  
Sea ice  
Volcanic ash  
Low clouds/fog  
Visibility

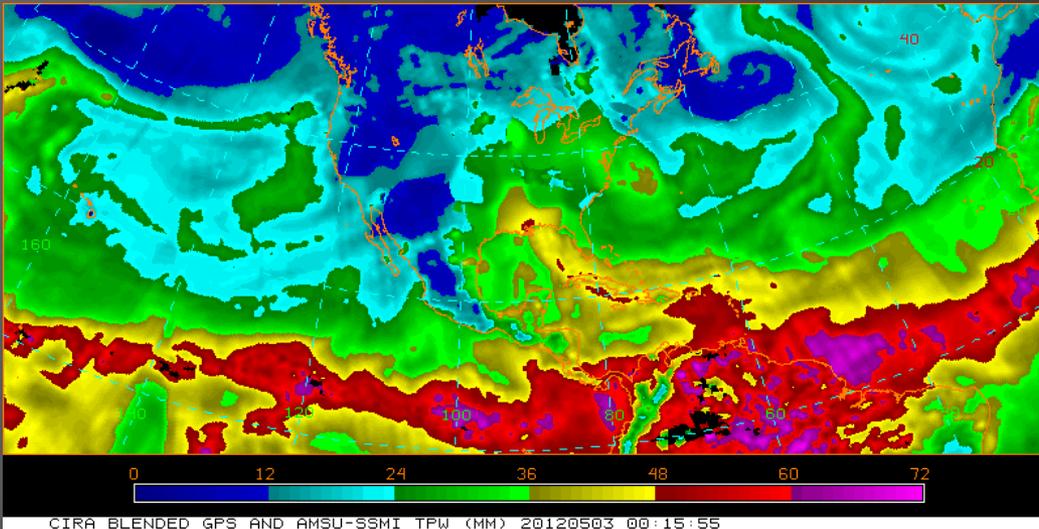
# NOAT

## NWS Operational Advisory Team

---

### An Operational Example: Blended TPW

Multisensor (GPS, AMSU-SSMI) product well used by forecasters because it dealt with a significant issue: moisture distribution



Why we need this?

Atmospheric Rivers  
Heavy rain/snow  
Flood/Blizzard  
Drought  
Convective Storms



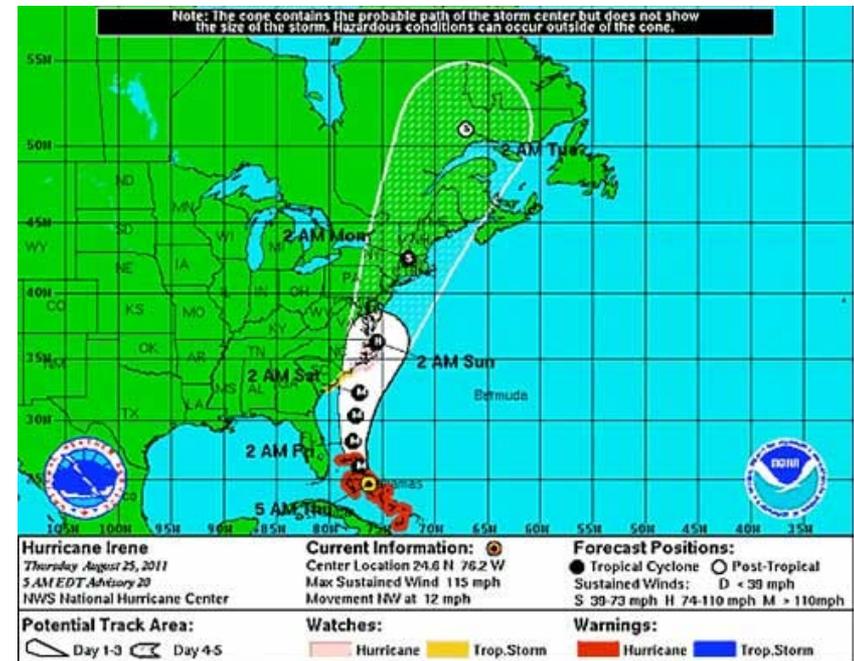
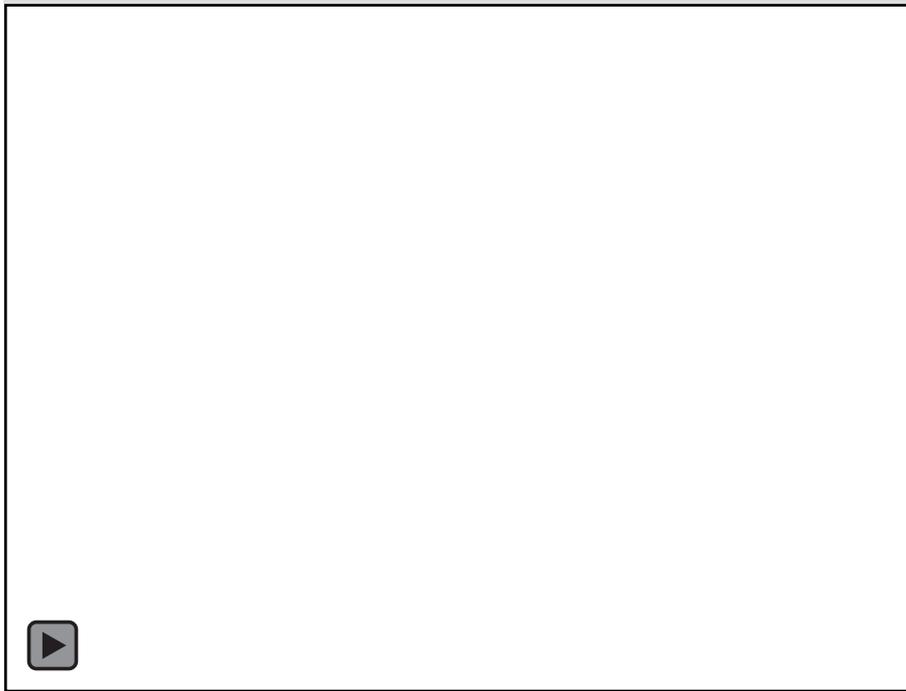
# Reduced loss of life, property and disruption from high-impact events.

- **Tropical Storm Track and Intensity**
- **Forest Fire Detection and Monitoring**
- **Blended precipitation/TPW products and applications**
- **Nowcasting applications (Imagery, soundings)**
- **Numerical Weather Prediction Data Assimilation**



# Reduced loss of life, property and disruption from high-impact events.

Operational geostationary satellites provide continuous surveillance, while sounders on polar orbiting satellites provide the key observations needed to forecast weather out to 5 days

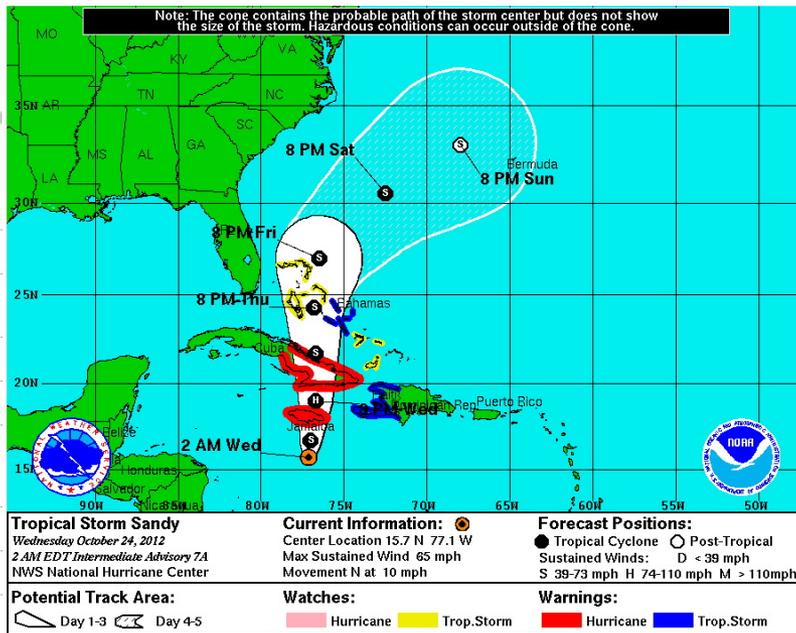


Track errors have reduced over the past two decades due to satellite sounders and numerical weather prediction model improvements



# Hurricane Sandy

Wednesday 2AM EDT



Thursday 11AM EDT



# Forecasts of Hurricane Sandy without polar satellites

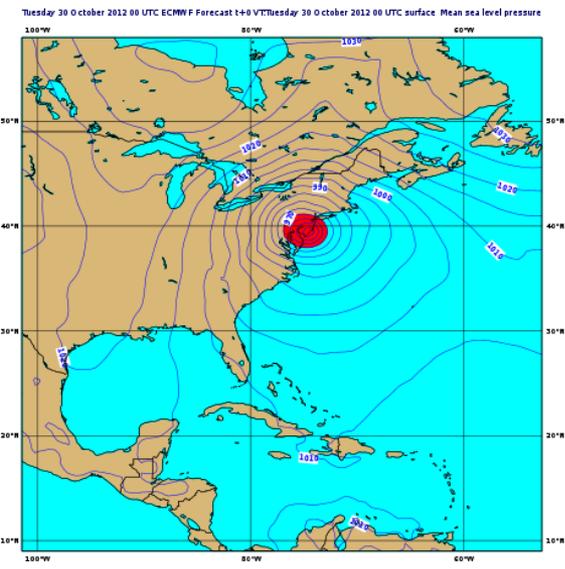
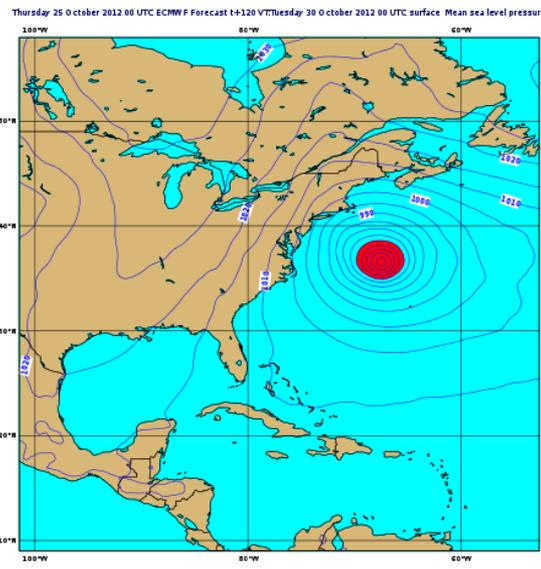
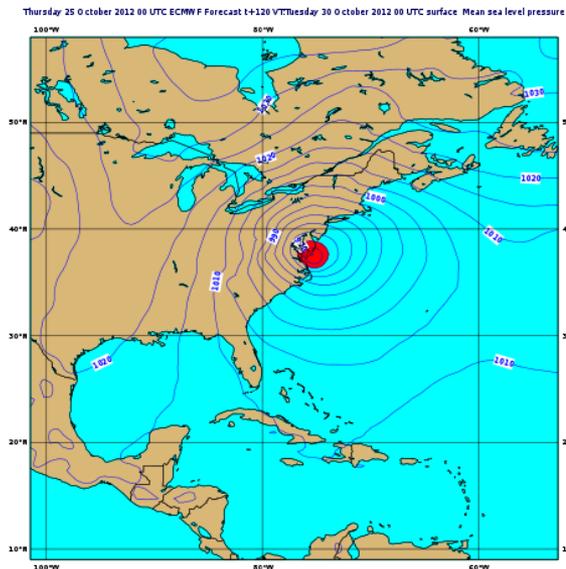


ECMWF forecasts of Mean Sea Level Pressure, **5 days in advance** of the 30<sup>th</sup> October 2012 for the landfall of Hurricane Sandy. Forecasts from an assimilation system **with no polar satellites** fail to predict the landfall of the storm on the US east coast.

**ECMWF OPS**

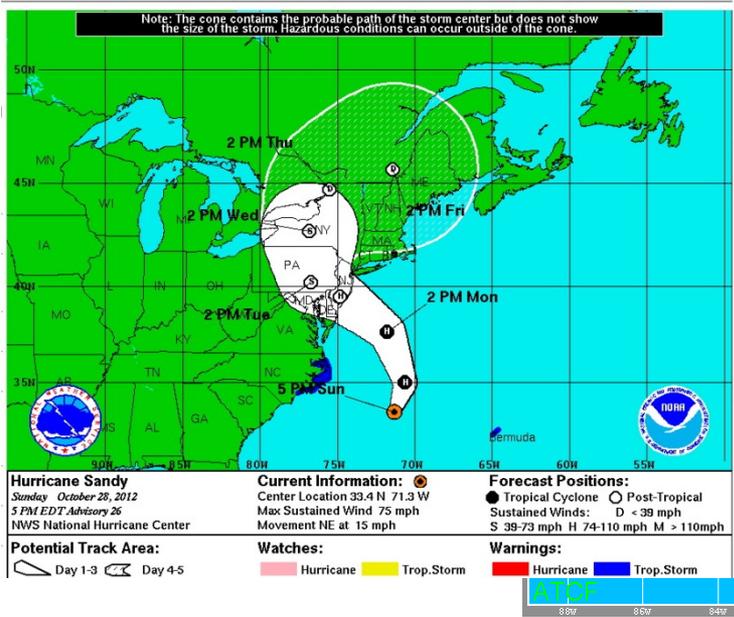
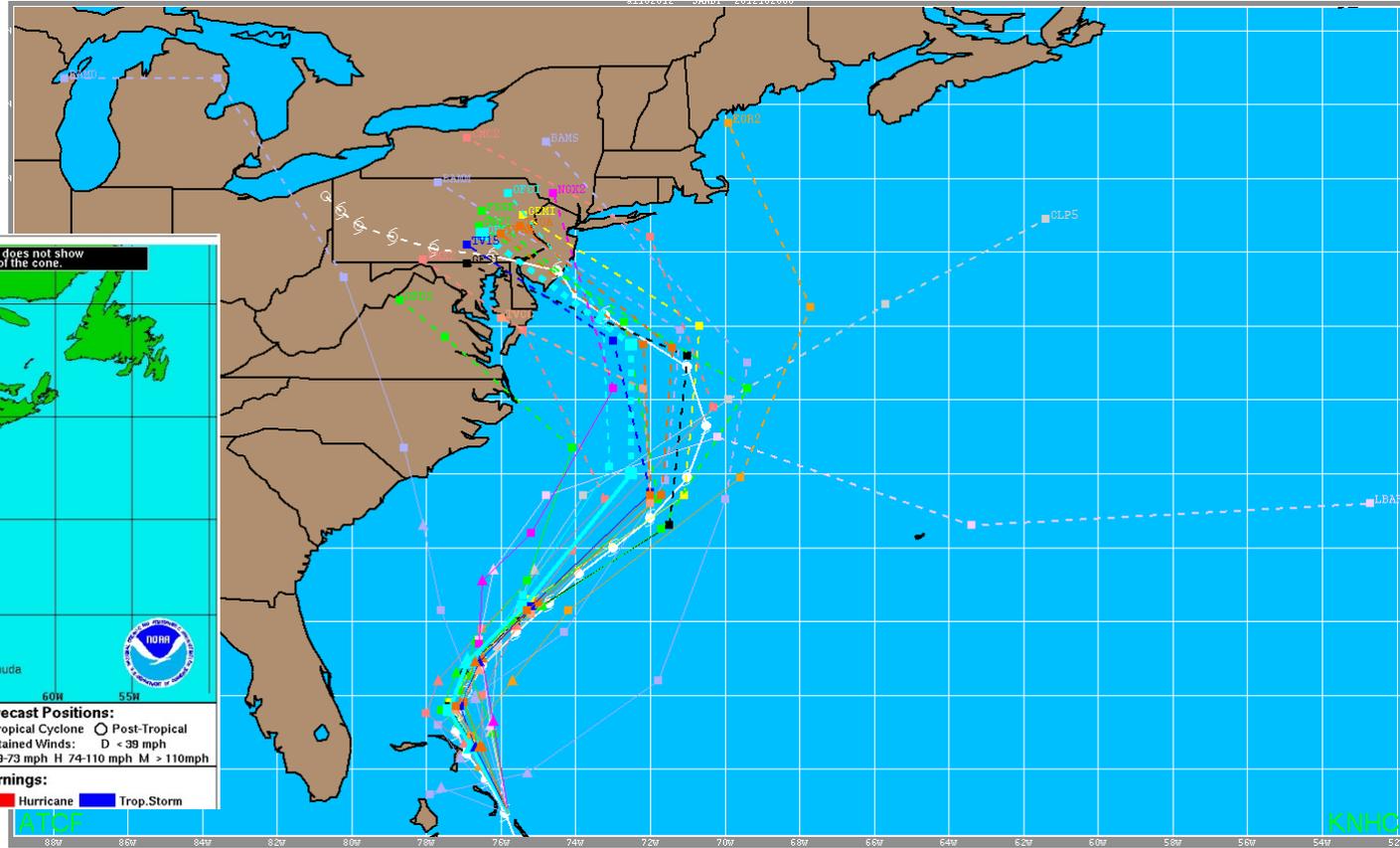
**NO POLAR SAT**

**VERIFICATION**





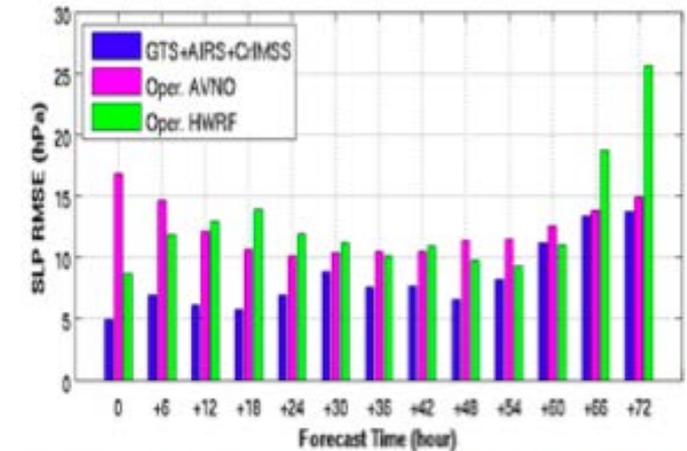
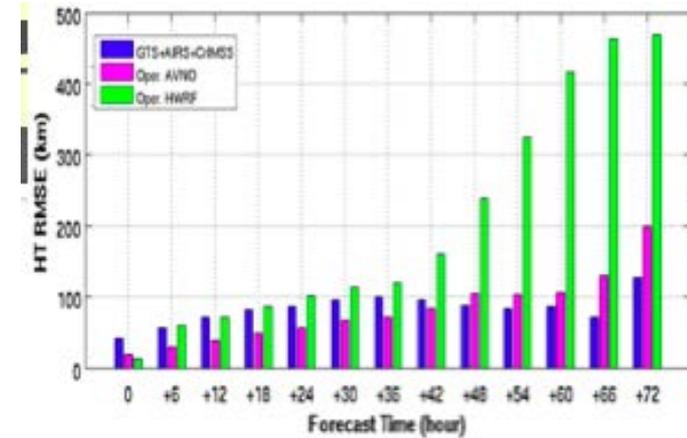
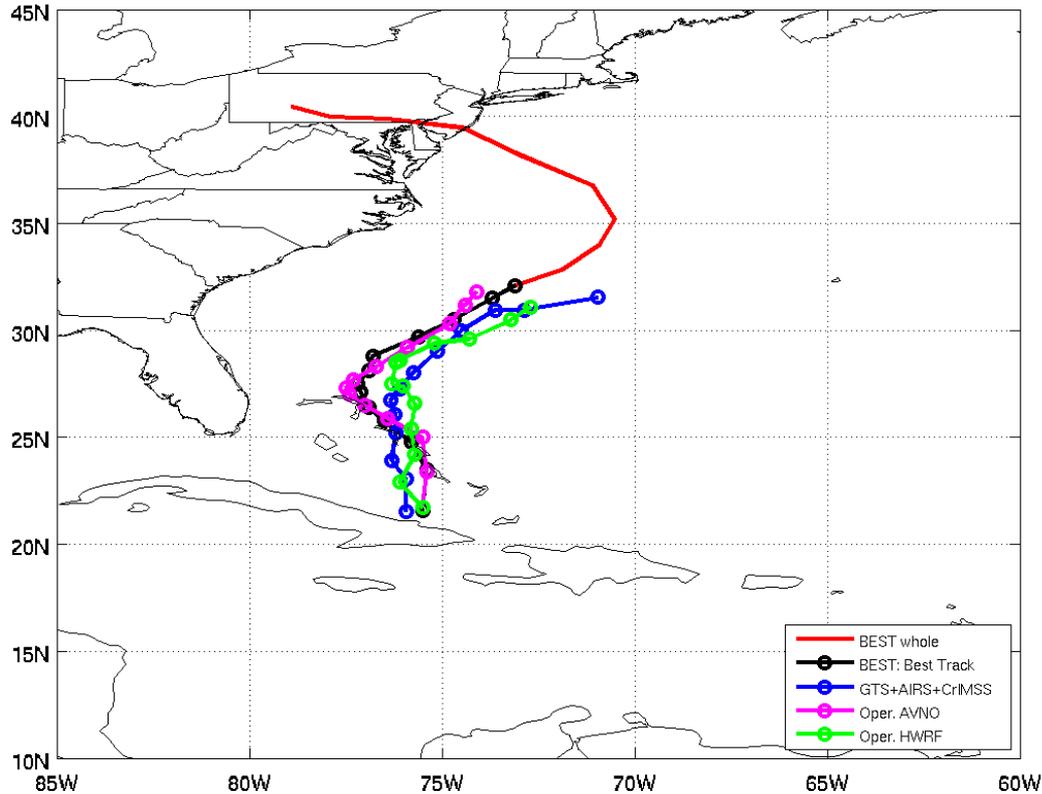
# NHC official forecast is based on studying the results from different models



# Hurricane Sandy (2012) - 72 hour track forecasts on path

(Forecasts start from 12 UTC 25 Oct, valid 18 UTC 30 Oct 2012)

From Jun Li/CIMSS



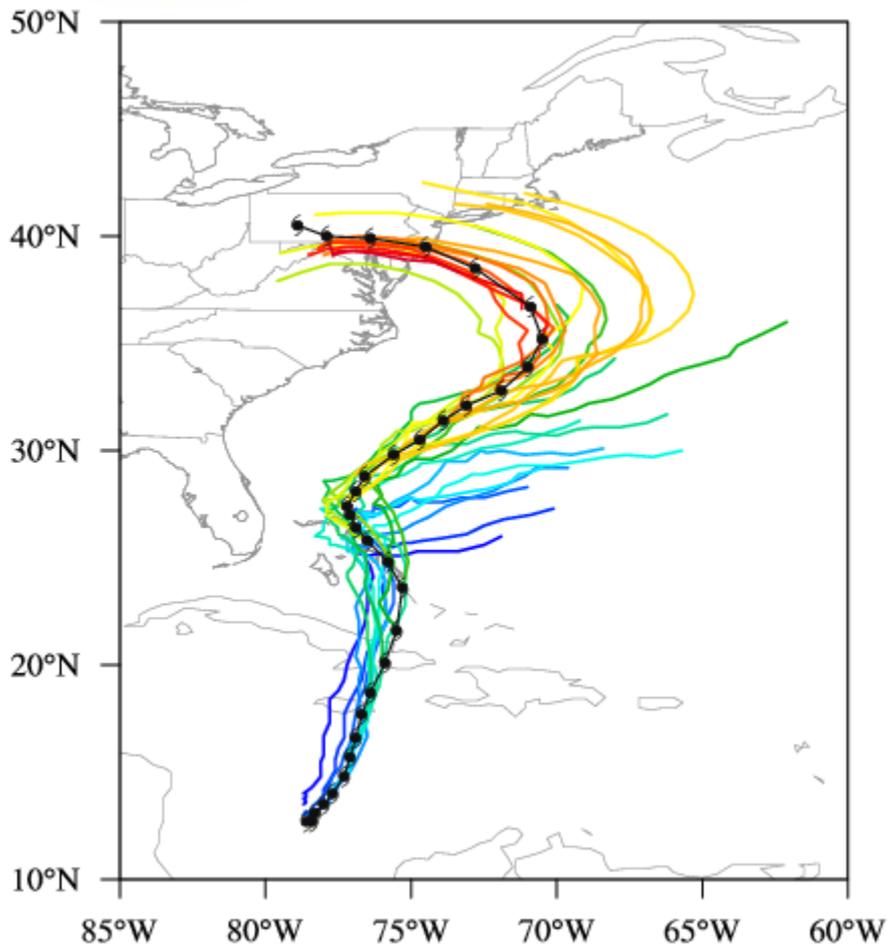
**GTS+AIRS+CrIMSS: CIMSS experimental results (WRF/GSI with 12 km resolution); AIRS and CrIMSS data are assimilated every 6 hours; assimilation window: -1 hr to +1 hr.**

Sandy track forecast RMSE (km) (top) and RMSE (hPa) (bottom) from CIMSS experimental forecasts with GTS, AIRS and CrIMSS data assimilated, the operational regional HWRF, and the operational global GFS forecasts (AVNO). Forecasts start from 12 UTC 25 Oct and valid 18 UTC 30 Oct 2012.

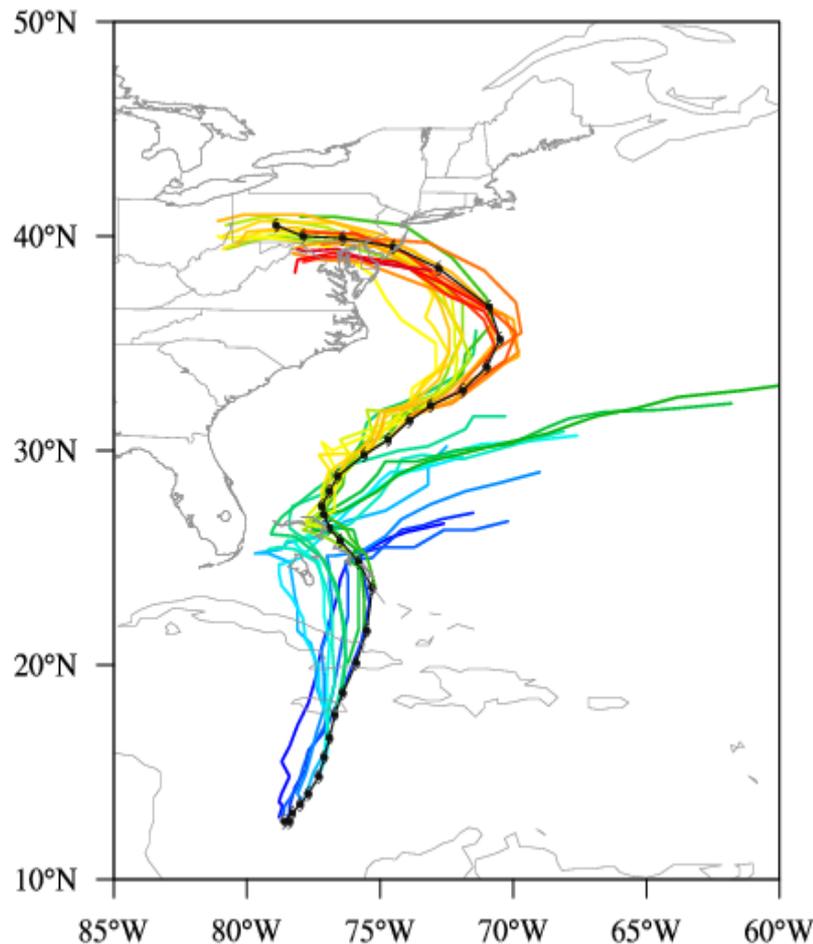


# Experimental results showing improvements in Sandy track forecasts from Hurricane Weather Research Forecast model with ATMS (Fuzhong Weng)

## HWRF-NCEP Operational



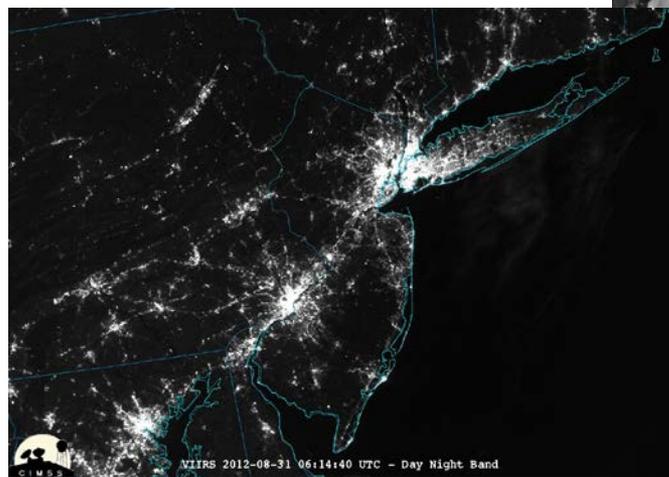
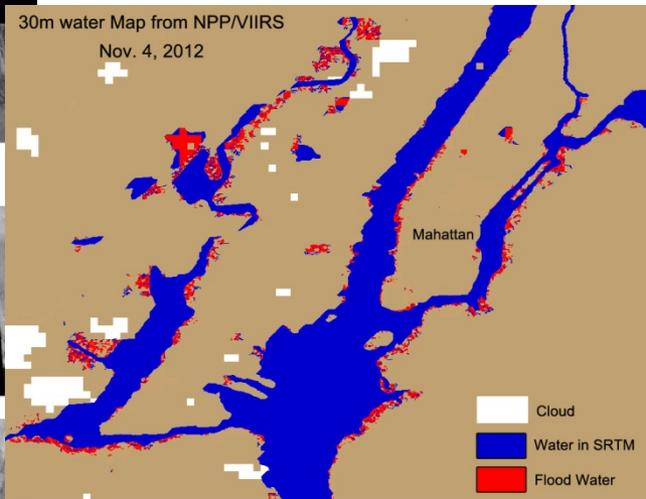
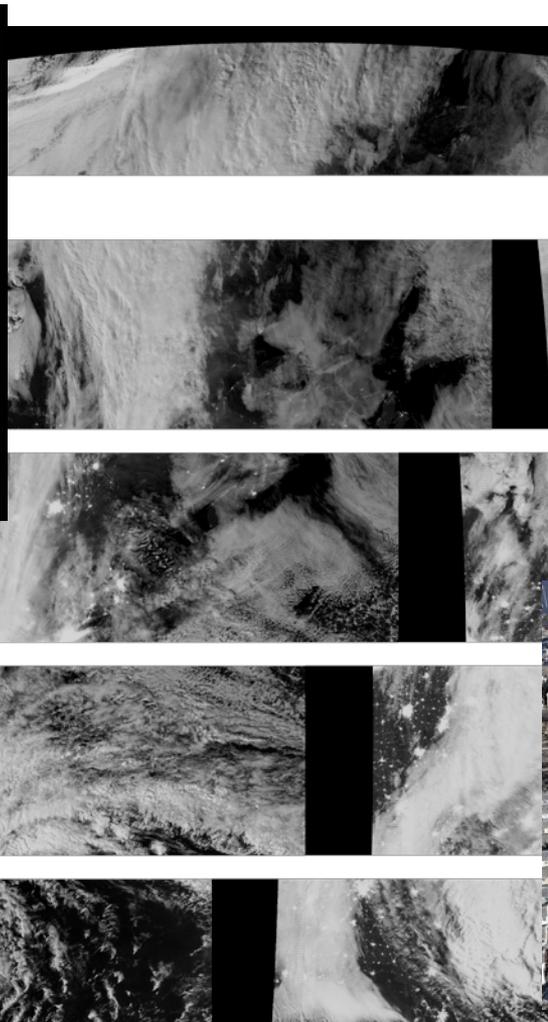
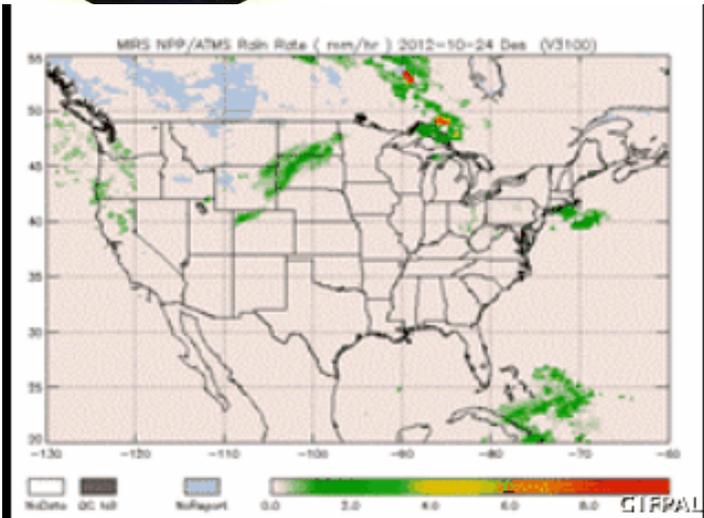
## Modified HWRF-NCEP with ATMS



- Observations
- 2012102218
- 2012102300
- 2012102306
- 2012102312
- 2012102318
- 2012102400
- 2012102406
- 2012102412
- 2012102418
- 2012102500
- 2012102506
- 2012102512
- 2012102518
- 2012102600
- 2012102606
- 2012102612
- 2012102618
- 2012102700
- 2012102706
- 2012102712
- 2012102718
- 2012102800
- 2012102806
- 2012102812
- 2012102818
- 2012102900
- 2012102906
- 2012102912
- 2012102918

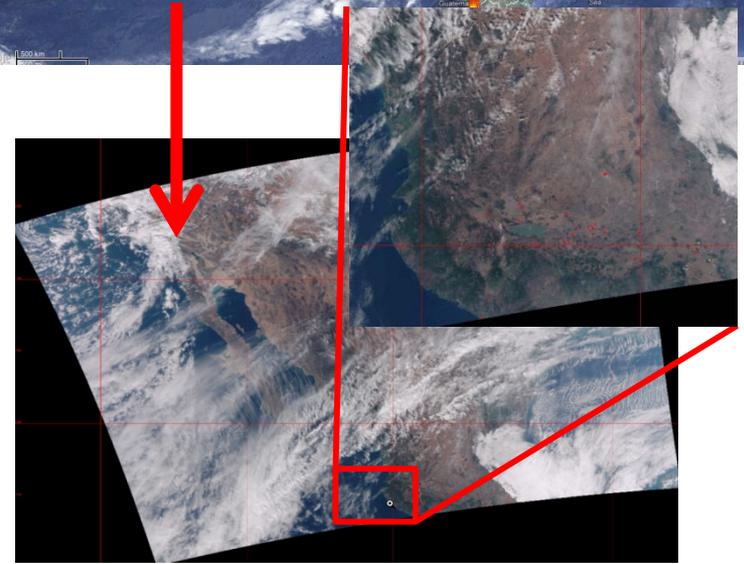
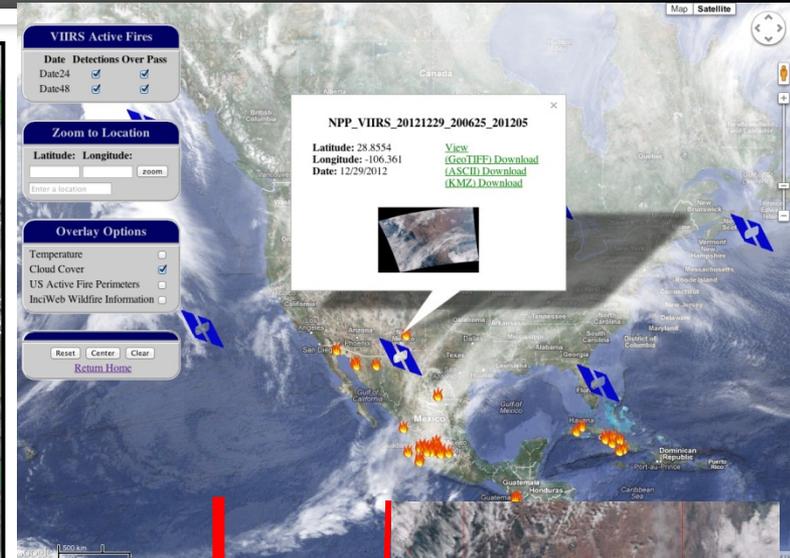
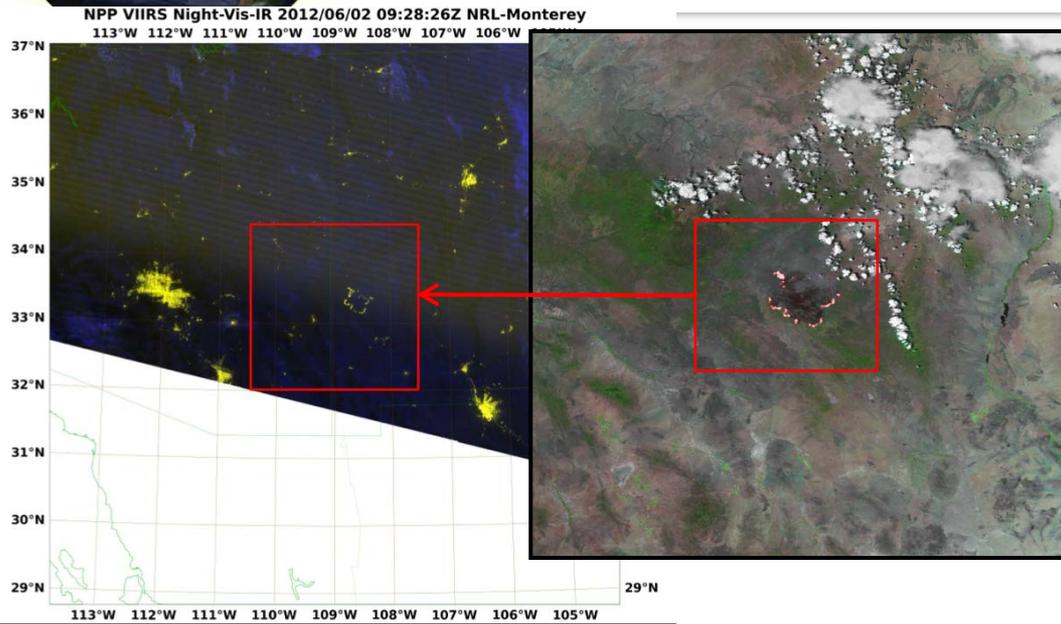


# Enhanced Products Supported Hurricane Sandy Efforts





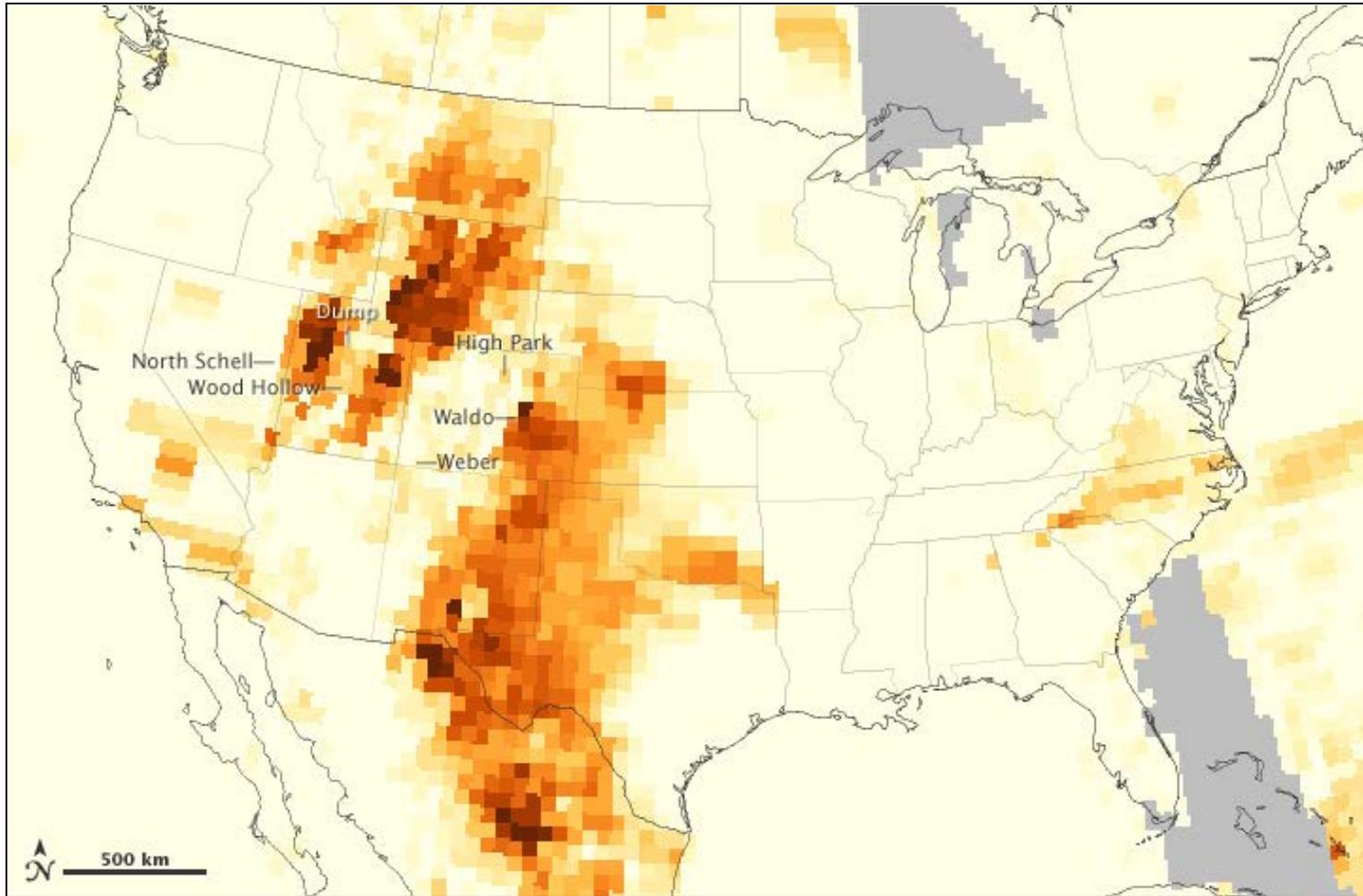
# JPSS Supporting Weather Ready Nation through VIIRS Fire Detection



The National Weather Service and US Forest Service both depend on VIIRS data to predict, identify and monitor wildfires.

JPSS has funded development and implementation of the Active Fires program through its Proving Ground.

# OMPS Monitors Smoke from Western U.S. Wildfires: June 26, 2012



Credit: NASA image by Jesse Allen, using OMPS data provided courtesy of Colin Seftor (SSAI)  
Source: <http://earthobservatory.nasa.gov/IOTD/view.php?id=78389>



National Oceanic and Atmospheric Administration's  
**National Weather Service**

Home > Products > Valid Products > RFW

000  
 WWUS82 KTAE 191842  
 RFWTAE

URGENT - FIRE WEATHER MESSAGE  
 NATIONAL WEATHER SERVICE TALLAHASSEE FL  
 142 PM EST THU JAN 19 2012

...A RED FLAG WARNING HAS BEEN ISSUED FOR PORTIONS OF SOUTH  
 CENTRAL GEORGIA UNTIL 5 PM EST THIS AFTERNOON DUE TO AROUND 4  
 HOURS OF RELATIVE HUMIDITY BELOW 25 PERCENT...

GAZ125>131-145>148-157>161-192200-  
 /O.NEW.KTAE.FW.W.0006.120119T1842Z-120119T2200Z/  
 DOUGHERTY-LEE-WORTH-TURNER-TIFT-BEN HILL-IRWIN-MITCHELL-COLQUITT-  
 COOK-BERRIEN-GRADY-THOMAS-BROOKS-LOWNDES-LANIER-  
 142 PM EST THU JAN 19 2012

...RED FLAG WARNING IN EFFECT UNTIL 5 PM EST THIS AFTERNOON...

THE NATIONAL WEATHER SERVICE IN TALLAHASSEE HAS ISSUED A RED FLAG  
 WARNING...WHICH IS IN EFFECT UNTIL 5 PM EST THIS AFTERNOON.

\* HUMIDITY...MINIMUM VALUES LESS THAN 25 PERCENT FOR FOUR HOURS.

\* IMPACTS...ANY FIRES THAT DEVELOP WILL LIKELY SPREAD RAPIDLY.  
 OUTDOOR BURNING IS NOT RECOMMENDED.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

A RED FLAG WARNING MEANS THAT CRITICAL FIRE WEATHER CONDITIONS  
 ARE EITHER OCCURRING NOW...OR WILL SHORTLY. LOW RELATIVE HUMIDITY  
 WILL ENHANCE FIRE GROWTH POTENTIAL.

## Integrated Information

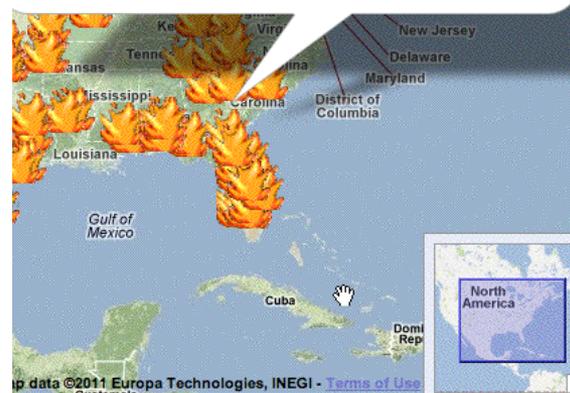
Forecast and additional information or



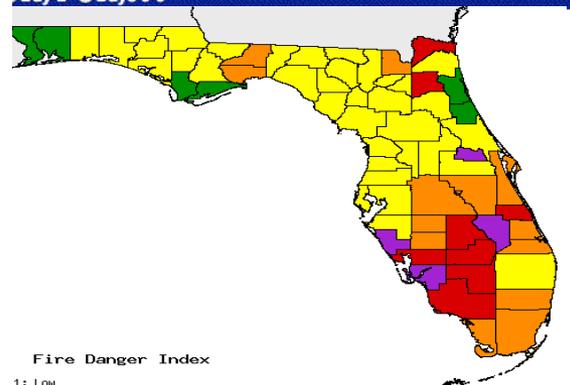
### Buskhead

Type: PRESCRIBED  
 Lat: 30.43556 Lon: -82.41278  
 Size: 300 acres

[Click here](#) for spot forecasts issued by this NWS office. You may need to go to a previous date to see this spot forecast.



Map data ©2011 Europa Technologies, INEGI - [Terms of Use](#)  
 Alerts  Spot Forecasts  Day-1 Precip  IMET Locations  
 Day-2  Days 3-8



Fire Danger Index  
 1: Low  
 2: Moderate  
 3: High  
 4: Very High  
 5: Extreme

Jan 19, 2012





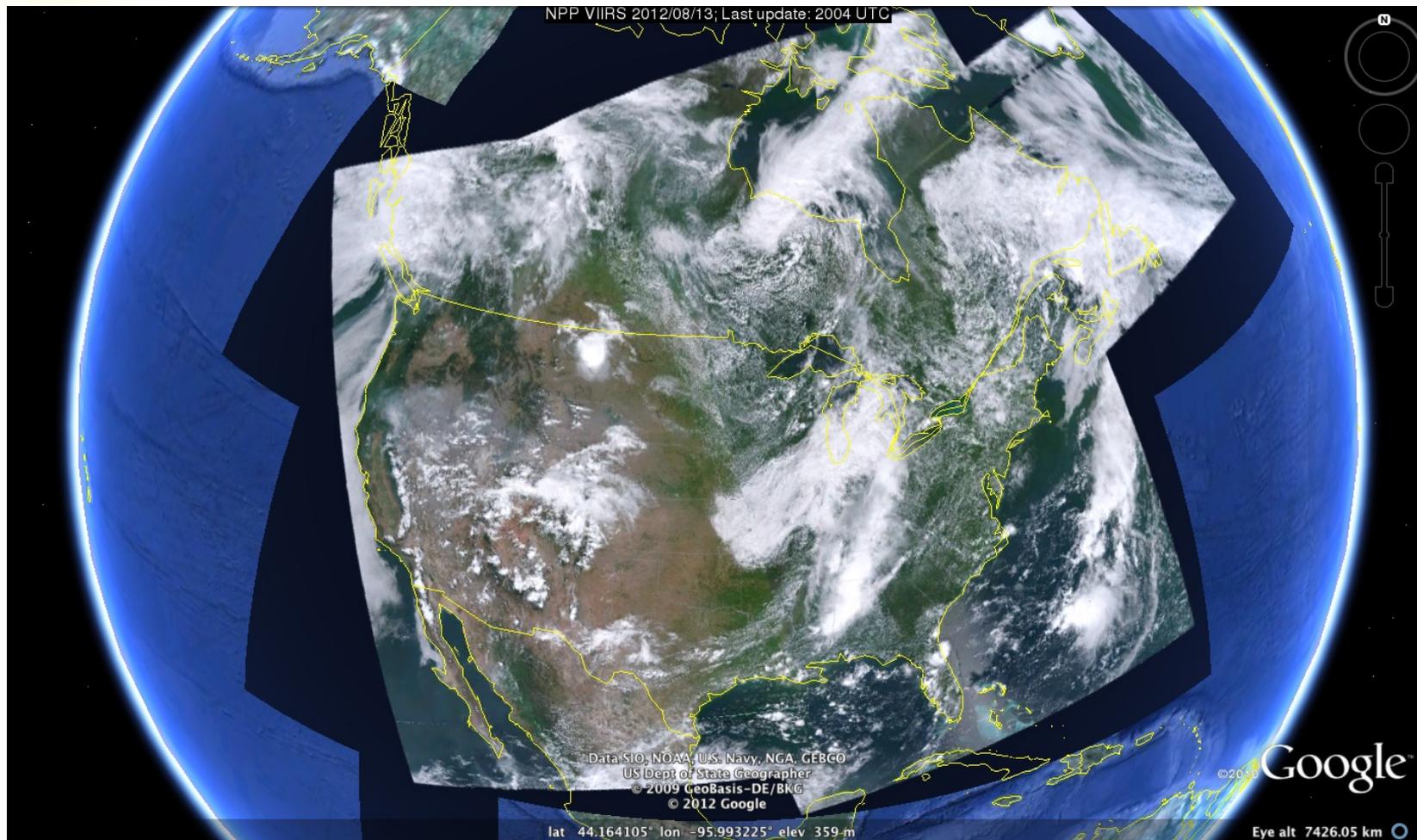
# JPSS Provides Direct Broadcast

- Started transmitting VIIRS, CrIS, and ATMS science data in real-time via X-band direct broadcast starting on 23 February 2012.
- 7812 MHz, 13 Mbps.
- No encryption, licenses, or fees.
- Downlink format is described in CDFCB External Volume VII at <http://npp.gsfc.nasa.gov/science/documents.html>
- Proving ground uses the Community Satellite Processing Package (CSPP) provided by CIMSS





# Direct Broadcast Through the CSPP Data Faster - Greater Operational Impact





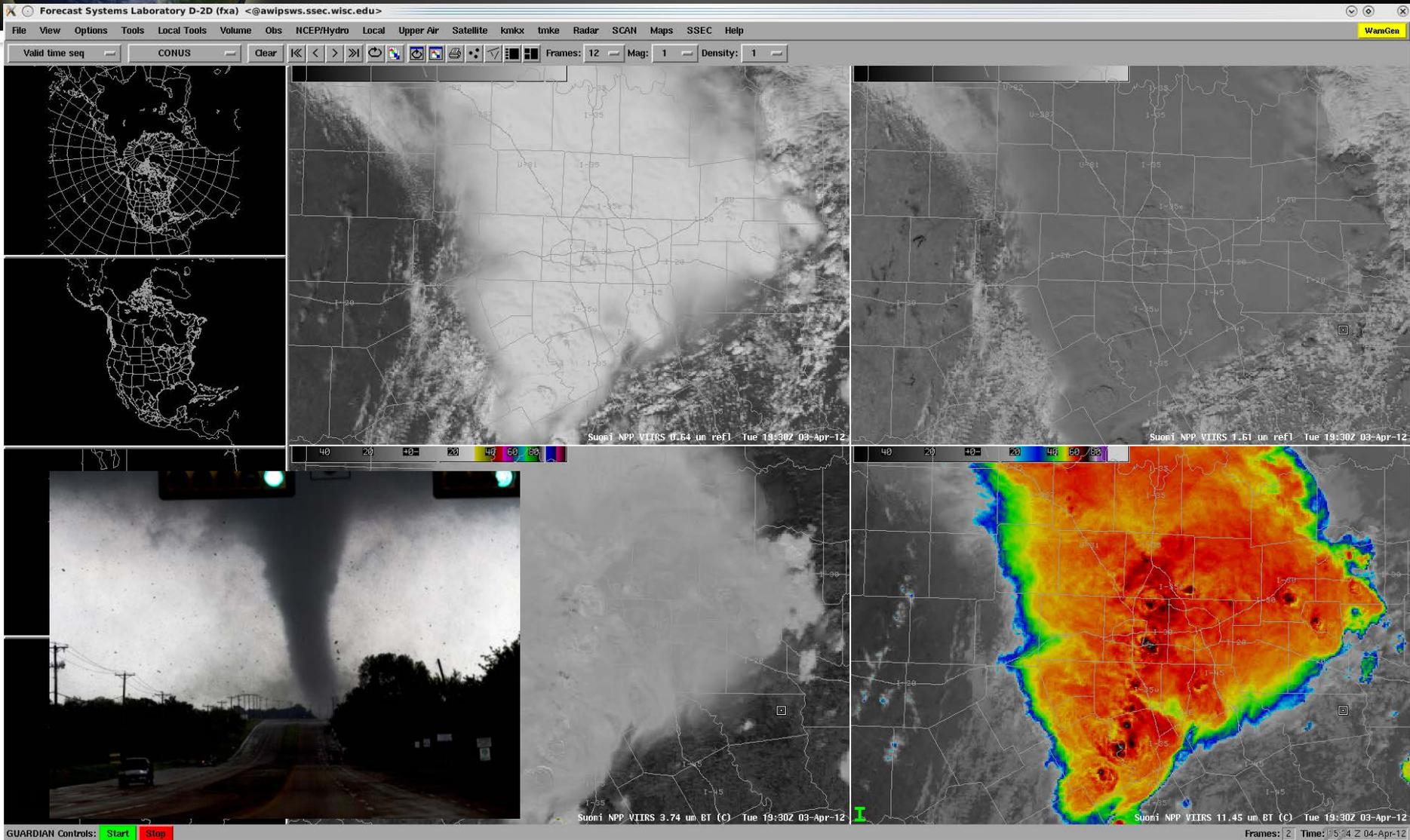
# VIIRS Direct Broadcast Data Displayed in AWIPS for Alaska NWS Operational Forecasters



Jim Nelson, Science and Operations Officer (SOO) at the NWS Forecast Office in Anchorage, Alaska, examines an image of the VIIRS Day/Night band as displayed in AWIPS. The data was captured using the DB antenna at GINA in Fairbanks, AK, automatically processed using CSPP software, converted using a portable remapping tool for display in AWIPS, and sent to Anchorage using the LDM in real-time.

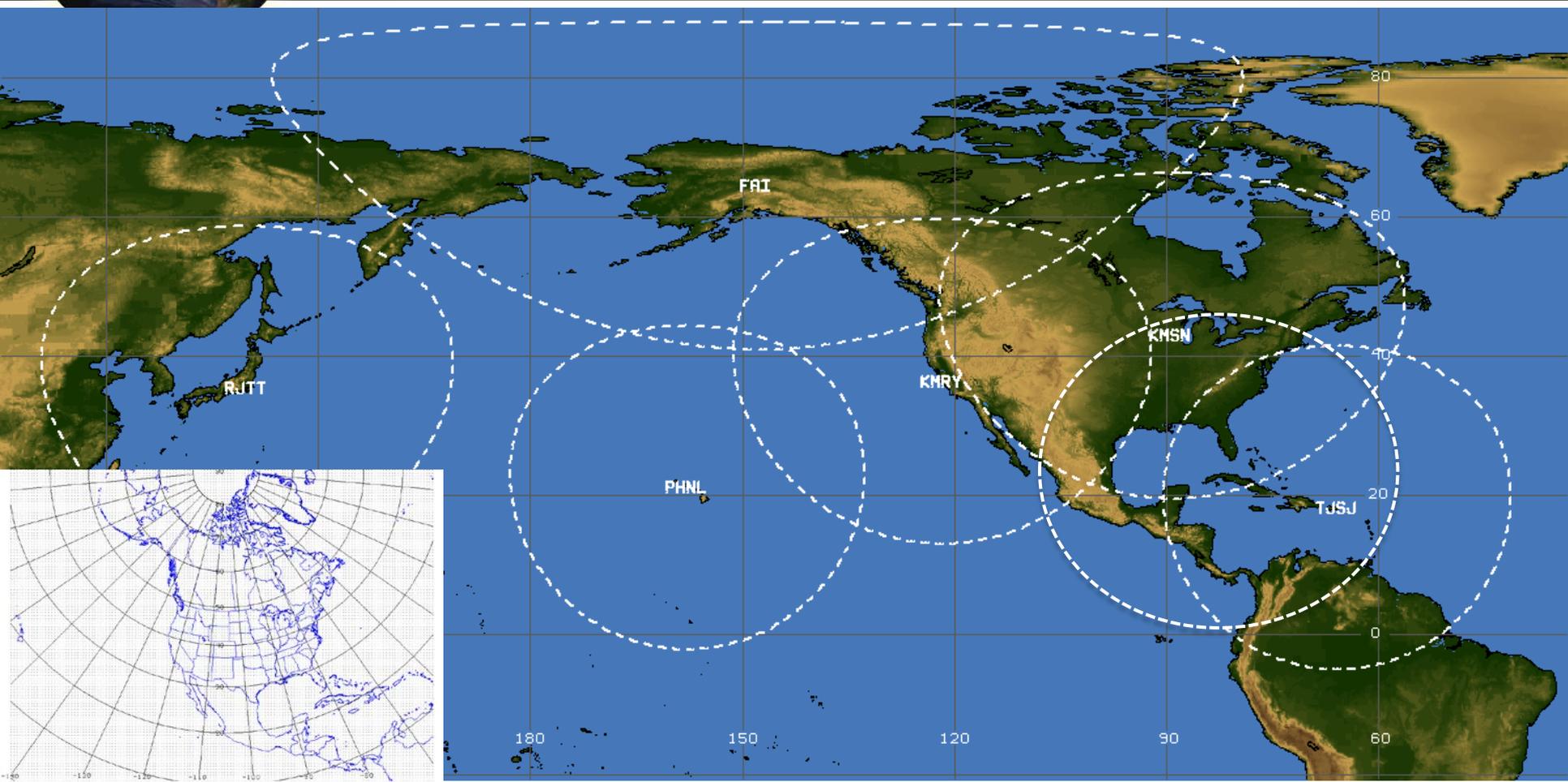


# Nowcasting Proving Ground Dallas Fort Worth storms (4/3/2012)



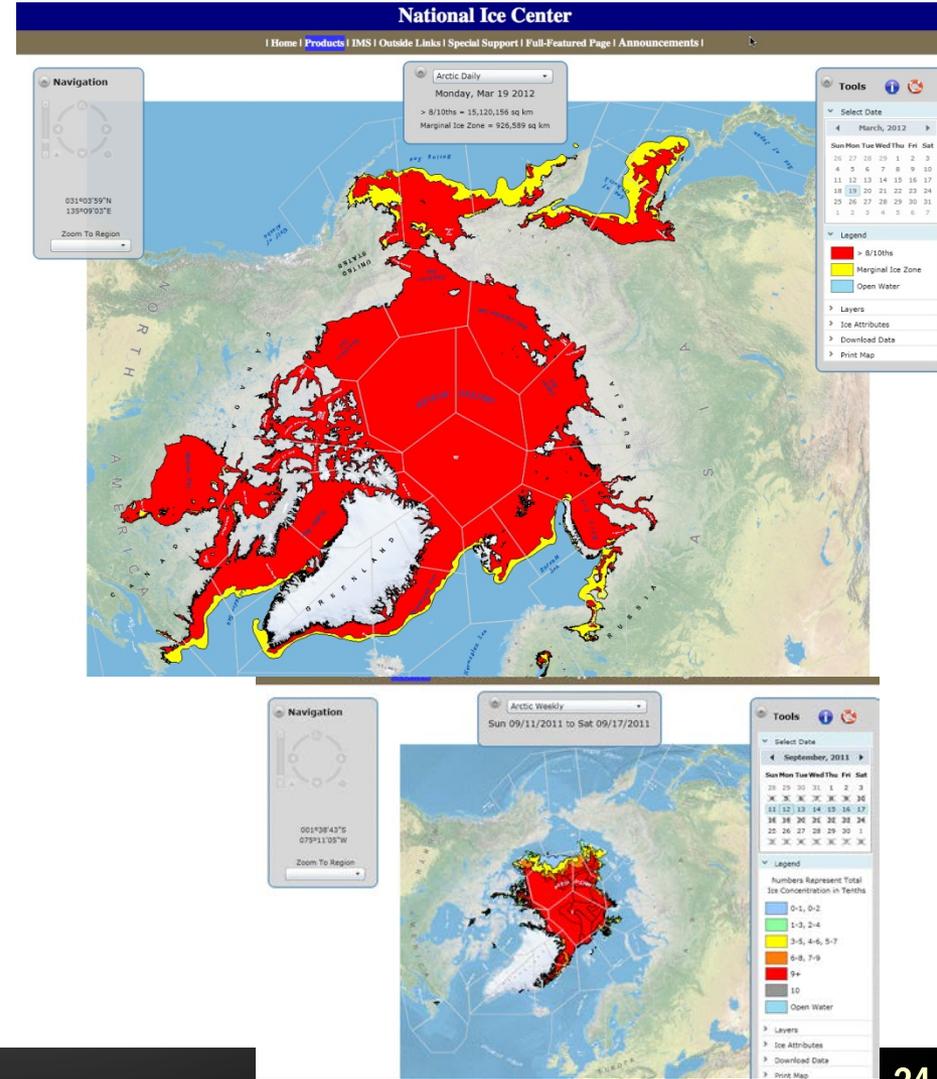


# Demonstrate the value of 30 minute latency for nowcasting and regional forecast models by establishing a network of direct readout stations





# Safe, environmentally sound Arctic access and resource management

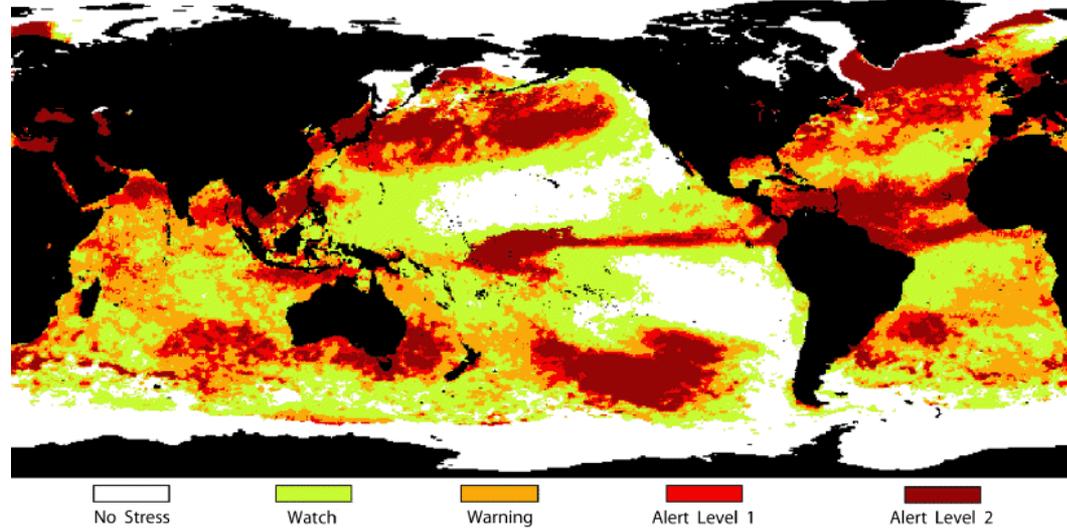




Improved **understanding of ecosystems** to inform resource management decisions.

Improved **coastal water quality** supporting human health and coastal ecosystem services.

NOAA Coral Reef Watch Annual Maximum Satellite Coral Bleaching Alert Area 2010



No Stress      Watch      Warning      Alert Level 1      Alert Level 2

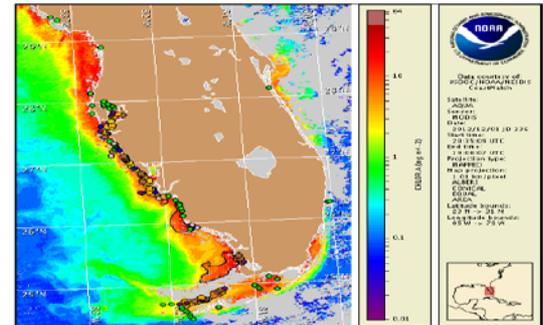
In 2010, major bleaching occurred to coral reefs throughout much of the Indian Ocean, Southeast Asia, the Coral Triangle, and the Caribbean.

Coral Reef Watch (using AVHRR) provide coral reef managers and scientists with a nowcast of current bleaching environmental conditions via the Bleaching Alert Area product.

MODIS and VIIRS Ocean Color observations are used for NOAA National Ocean Service (NOS) Daily Bulletins of Coastal Water Quality



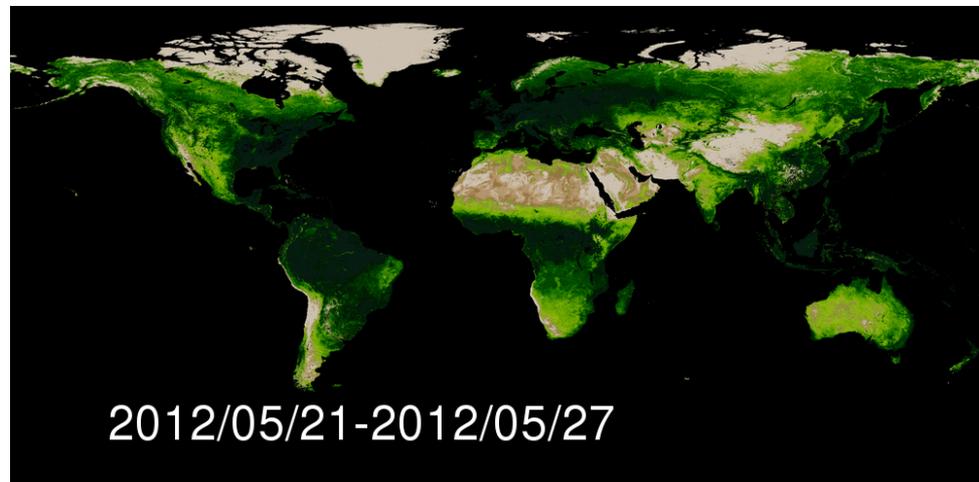
Gulf of Mexico Harmful Algal Bloom Bulletin  
Region: Southwest Florida  
Monday, 03 December 2012  
NOAA National Ocean Service  
NOAA Satellite and Information Service  
NOAA National Weather Service  
Last bulletin: Thursday, November 29, 2012



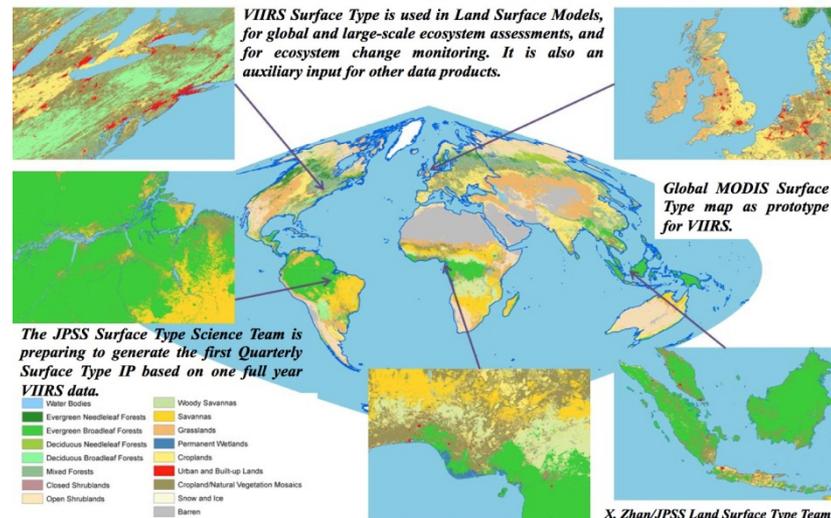
Satellite chlorophyll image with possible *J. lewisii* HAB areas shown by red polygon(s). Cell concentration sampling data from November 24 to 29 shown as red (high), orange (medium), yellow (low b), brown (low a), blue/very low b), purple (very low a), pink (present), and green (not present). Cell count data are provided by Florida FWC Fish and Wildlife Research Institute. For a list of sample providers and a key to the cell concentration categories, please see the HAB-OFS bulletin guide.

# Land Ecosystem Projects

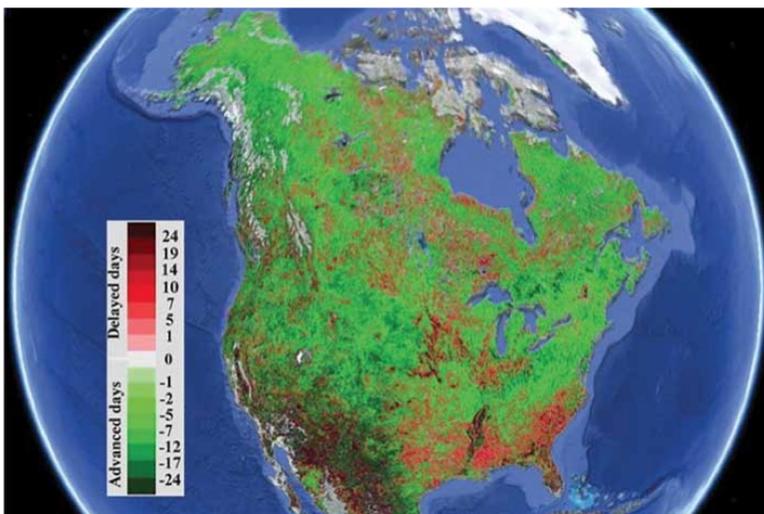
## Vegetation Fraction



## Surface Type

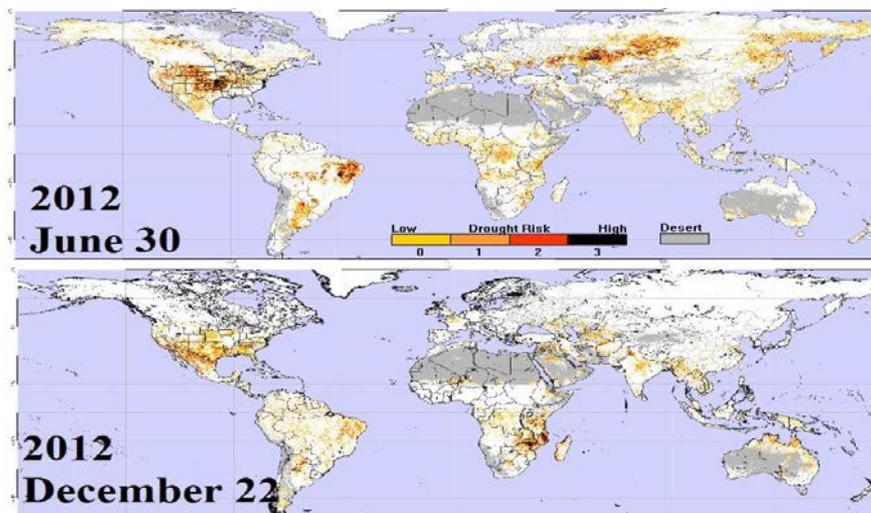


## Earlier Greening



Long-term trend of vegetation greening onset (plant budburst) is detected from weekly satellite vegetation index (1981-2005) at a spatial resolution of 4 km across North America. The trend reveals that spring greening has been accelerated by an average of 8 days in cold and temperate climate regions. In warmer subtropical regions, however, vegetation greening onset varies progressively from an earlier (north) to later (south) date because the number of winter chilling days is insufficient to fulfill vegetation chilling requirements.

## Vegetation Health



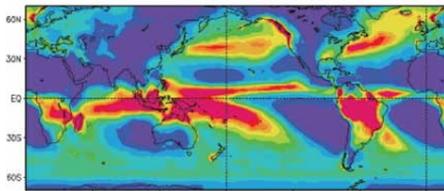


# JPSS provides critical observations to extend climate data records

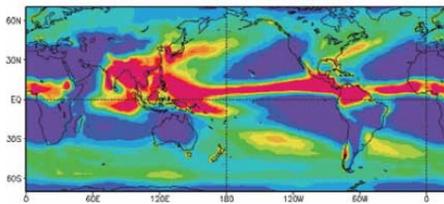


## Average Rainfall

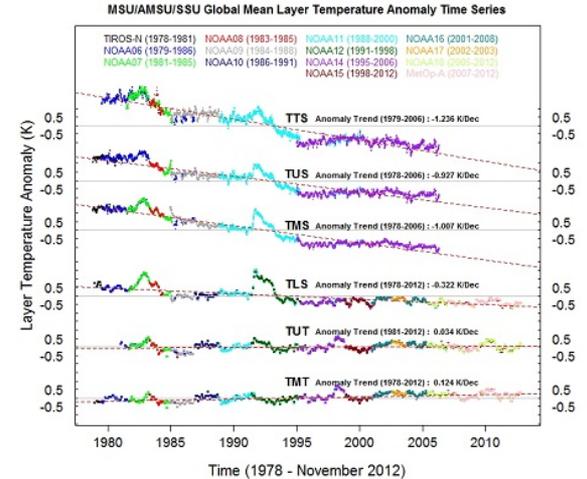
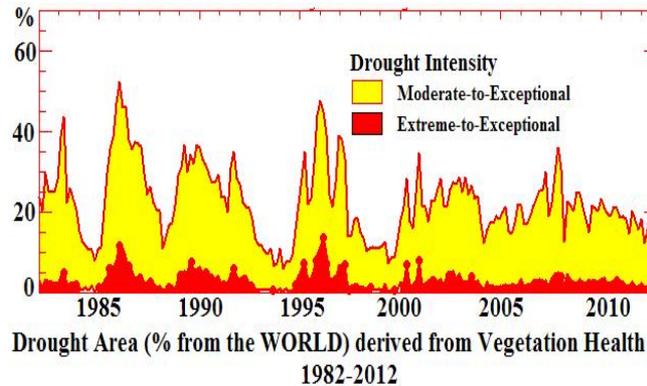
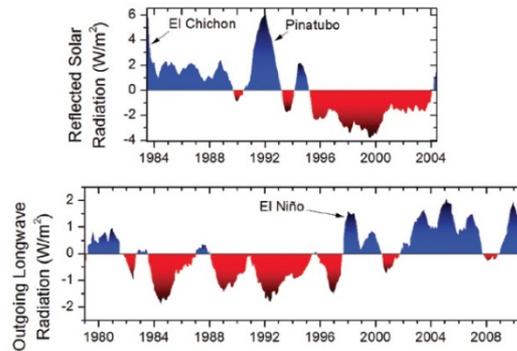
Northern Hemisphere Winter



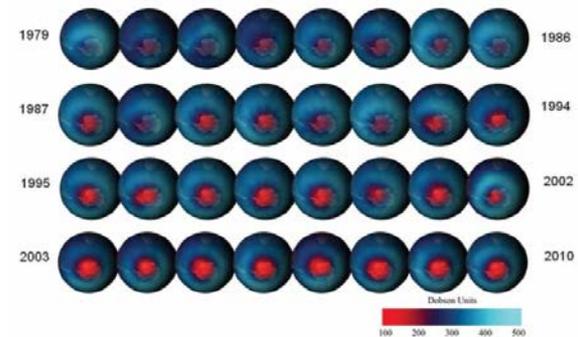
Northern Hemisphere Summer



## Changes in the Earth's Radiation Budget



## The Antarctic Ozone Hole: 1979 to 2010





# Summary

JPSS is working directly with users to increase user readiness and optimize data exploitation.

The JPSS Proving Ground and Risk Reduction Projects have demonstrated tremendous early successes and have been able to respond to real-world weather events such as Sandy

JPSS is working with GOES-R and will look for opportunities to partner with other satellite programs.



# Inaugural JPSS PGRR Projects

- ✓ Three tropical cyclone projects
- ✓ Fire detection and prediction
- ✓ Blended Precipitation
- ✓ Blended SST
- ✓ Cryosphere
- ✓ Coastal Ecosystems (ocean color)
- ✓ Marine Resources
- ✓ Three DNB/Imagery projects
- ✓ Two global data assimilation projects
- ✓ AWIPS demo projects
- ✓ Alaska Proving Ground
  - ✓ CIMSS
  - ✓ CIRA
  - ✓ SPORT
- ✓ CSPP Direct Broadcast support
- ✓ Nowcasting soundings
- ✓ Air Quality
- ✓ River Ice
- ✓ Land Ecosystems
- ✓ COMET Training

**JPSS Proving Ground Projects are precursors to further work in NOAA testbeds**