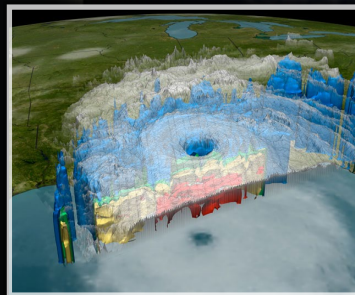
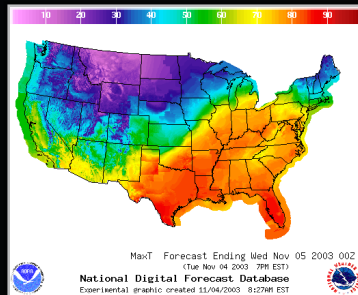
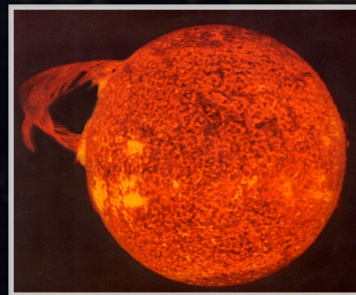
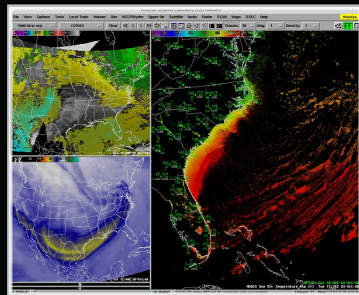
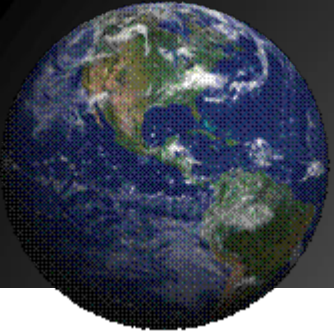


# The National Centers for Environmental Prediction (NCEP): Enabling a Weather Ready Nation

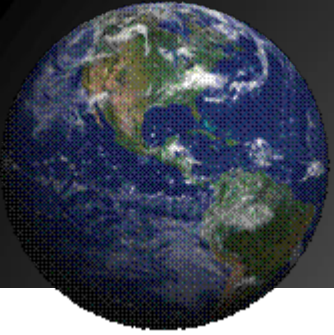


**Jim Yoe, Transitions Manager**  
National Centers for Environmental Prediction  
NOAA National Weather Service  
December 5, 2019



# Overview

- **Background and Motivation**
- **NWS Strategic Outcome**
- **NCEP Centers -**
  - **Specialized Services – Common Mission**
  - **(Some) Use of Satellites Observations**
  - **IDSS**
- **Discussion (Collaboration)**
- **Summary**



# Background and Motivation

- **My NCEP perspective as...**
  - **Research Transition Manager**
  - **Coordination with NWS STI & Obs**
  - **JCSDA Administration**
- **... and formerly NESDIS**
  - **STAR (1993-2007) and OSD (2007-2010)**
- **Slides drawn from**
  - **NCEP 101 (Dr. Bill Lapenta)**
  - **Leveraging Sat Obs @ NCEP (NSC2013)**



# NWS Strategic Outcome: *A Weather- and Water-Ready Nation*



<https://www.facebook.com/NWS/videos>



***“Ready, Responsive, Resilient”***

Becoming a Weather-Ready Nation is about **building community resiliency in the face of increasing vulnerability** to extreme weather, water and climate events

*Better forecasts and warnings*

*Consistent products and services*

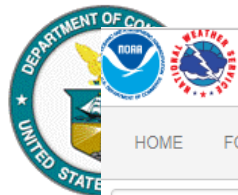
*Actionable environmental intelligence*

*Connecting forecasts to decisions*

***Involves the entire US Weather, Water and Climate Enterprise WORKING TOGETHER***

**We have 7000+ WRN Ambassadors**





# NATIONAL WEATHER SERVICE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

- HOME
- FORECAST ▾
- PAST WEATHER ▾
- SAFETY ▾
- INFORMATION ▾
- EDUCATION ▾
- NEWS ▾
- SEARCH ▾
- ABOUT ▾



### News Headlines

- [SKYWARN class schedule for April & May - both Basics and Flood](#)

[View Location Examples](#)

[Additional Headlines](#)

Your local forecast office is

**[Baltimore, MD/Washington, D.C.](#)**

### Hazardous Weather Conditions

- [Coastal Flood Advisory until April 17, 01:00 AM EDT](#)
- [Flood Warning until April 16, 11:45 AM EDT](#)
- [Hazardous Weather Outlook](#)

[En Español](#)



Current conditions at

### Washington/Reagan National Airport, DC (KDCA)

Lat: 38.85°N Lon: 77.03°W Elev: 13ft.



Heavy Rain Fog/Mist

**51°F**  
11°C

Humidity 89%  
 Wind Speed NW 13 mph  
 Barometer 29.46 in (997.7 mb)  
 Dewpoint 48°F (9°C)  
 Visibility 2.00 mi  
 Wind Chill 46°F (8°C)  
 Last update 16 Apr 8:52 am EDT

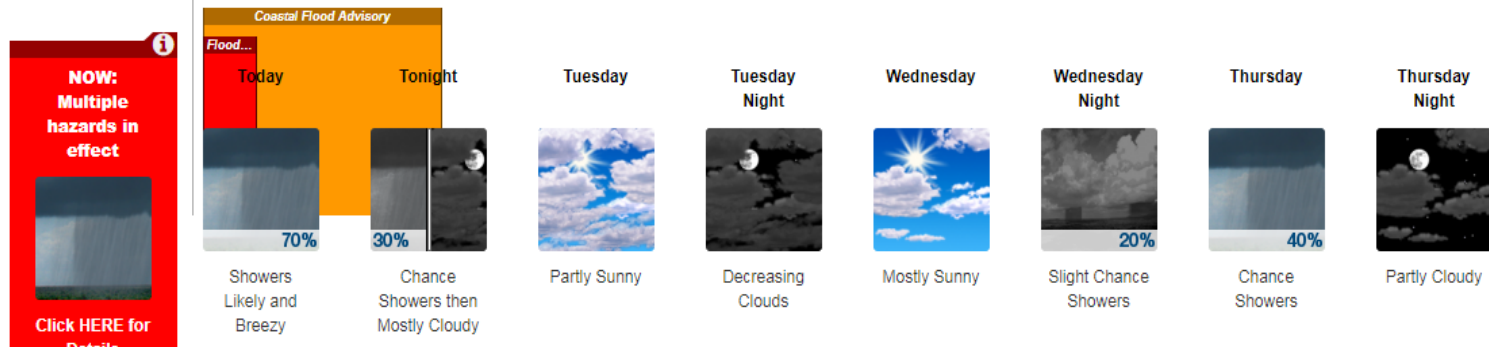
#### More Information:

- [Local Forecast Office](#)
- [More Local Wx](#)
- [3 Day History](#)
- [Mobile Weather](#)
- [Hourly Weather Forecast](#)

Extended Forecast for

### Washington DC, Reagan National Airport VA

[Click here for hazard details and duration](#)





# Realizing the Full Value of Forecasts: Connecting Forecasts to Critical Decisions



Generating forecasts and warnings

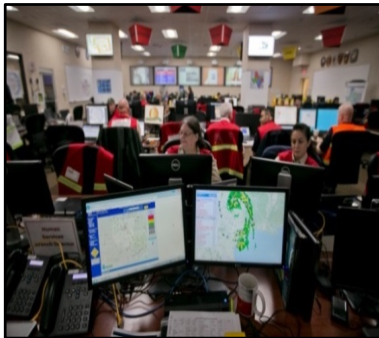


Connecting those forecasts & warnings with impacts (IDSS)



Realizing Intrinsic Value and Mission Success

*“Impact-based Decision Support Services”*



Provide the best hydrological and meteorological forecasting in the world

Develop relationships and know partner needs



Explain uncertainty



Support partner decision making before, during, and after events

Embed when needed



Build trust



Practice, Practice, Practice

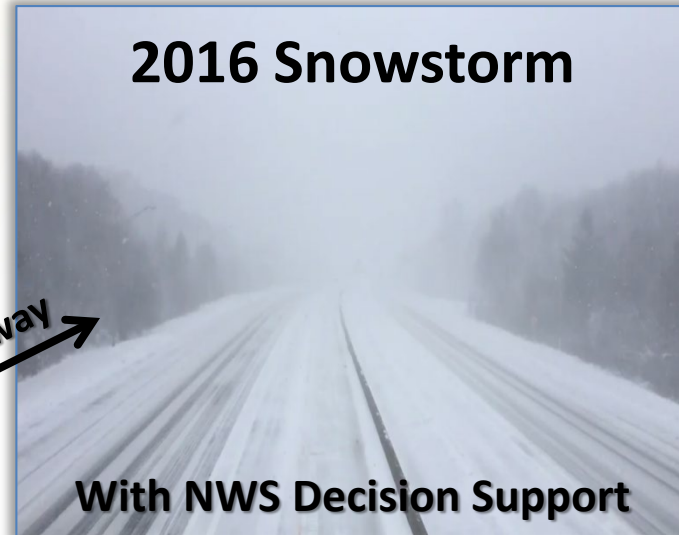
# January 2016 IDSS Example: Long Island Expressway comparison to 2013

2013 Snowstorm



The Past

2016 Snowstorm



With NWS Decision Support

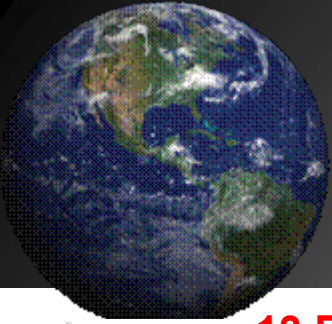
Long Island Expressway



Without NWS Decision Support

Pennsylvania Turnpike

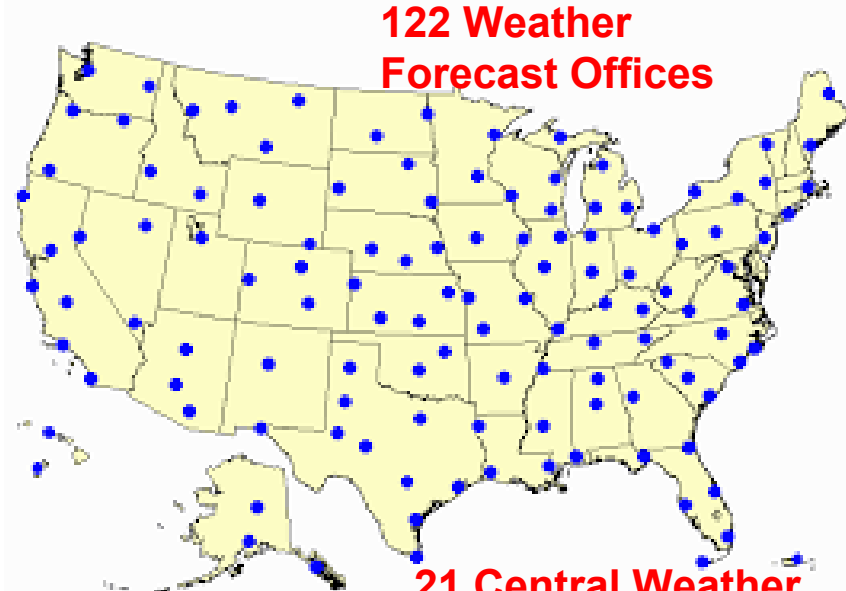




# Connecting the NWS Organization to Deliver Accurate and Consistent Products and Services



**13 River Forecast Centers**



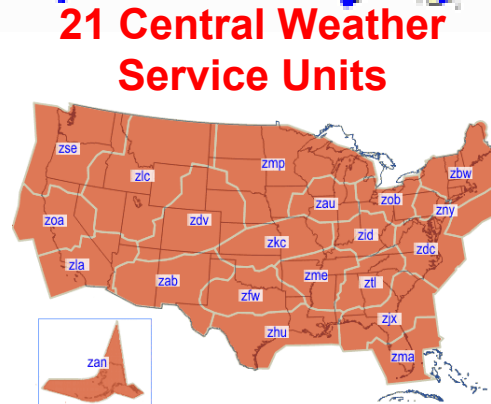
**122 Weather Forecast Offices**



**National Water Center**

**9 National Centers**

- 59  
Aviation Weather Center  
Kansas City, MO
- 48  
Climate Prediction Center  
College Park, MD
- 54  
Environmental Modeling Center  
College Park, MD
- 48  
National Hurricane Center  
Miami, FL
- 121  
NCEP Central Operations  
College Park, MD  
(Supercomputers in Reston & Orlando)
- 25  
Ocean Prediction Center  
College Park, MD
- 47  
Space Weather Prediction Center  
Boulder, CO
- 34  
Storm Prediction Center  
Norman, OK
- 47  
Weather Prediction Center  
College Park, MD

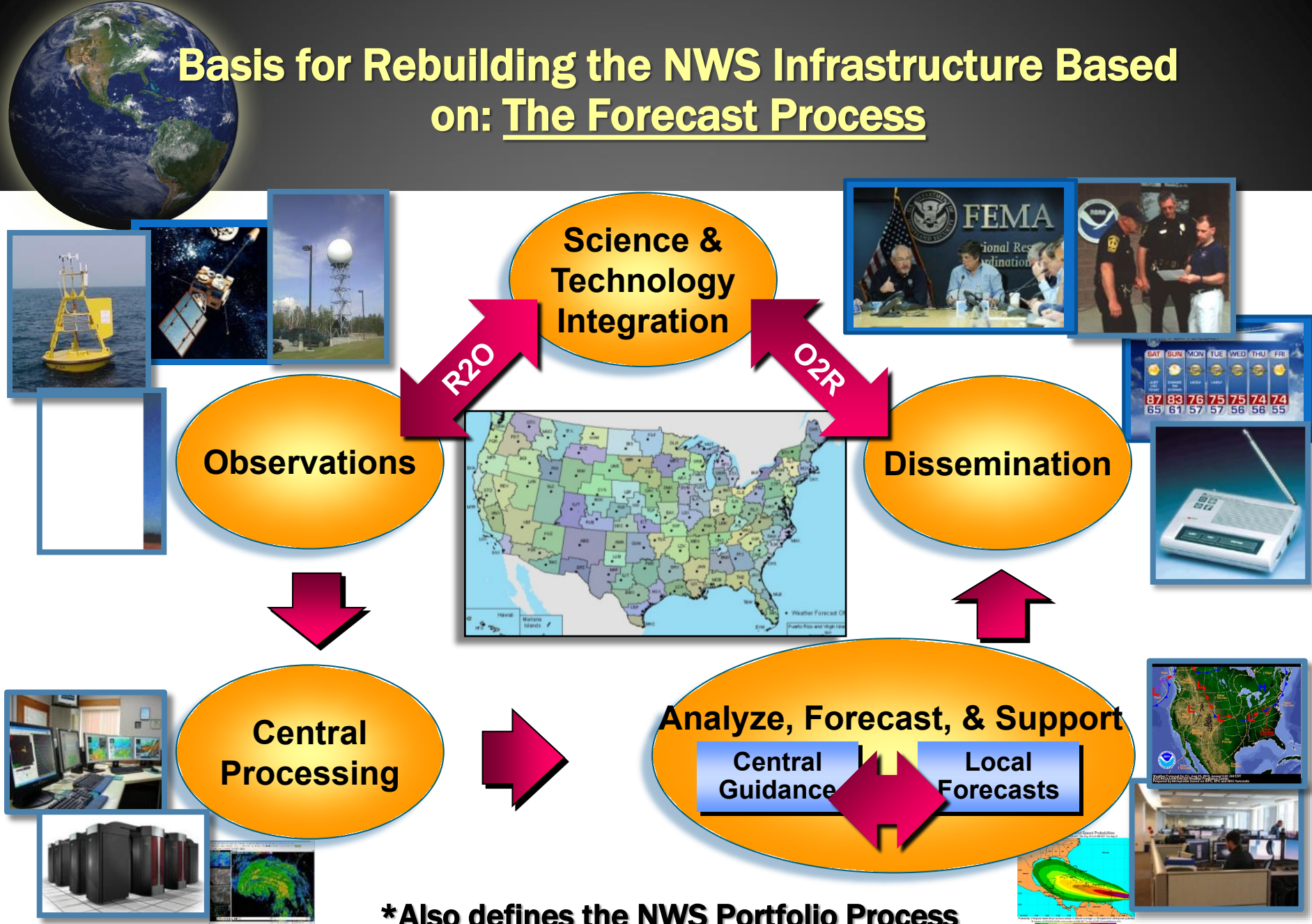


**21 Central Weather Service Units**





# Basis for Rebuilding the NWS Infrastructure Based on: The Forecast Process



**\*Also defines the NWS Portfolio Process**



# NWS National Centers for Environmental Prediction

## Specialized Services – Common Mission

- **490 FTE**
- **237 Contractors**
- **20 visitors**
- **5 NOAA Corps Officers**
- **\$137M Budget**



**Aviation Weather Center**  
Kansas City, MO



**Space Weather Prediction Center**  
Boulder, CO



**Storm Prediction Center**  
Norman, OK



**National Hurricane Center**  
Miami, FL



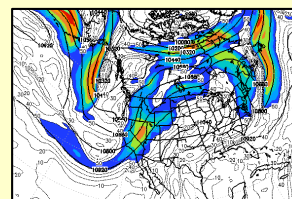
**NCEP Central Operations**  
College Park, MD  
(Supercomputers in Reston & Orlando)



**Ocean Prediction Center**  
College Park, MD



**Climate Prediction Center**  
College Park, MD



**Environmental Modeling Center**  
College Park, MD



**Weather Prediction Center**  
College Park, MD

### Mission

NCEP delivers national and global operational weather, water and climate products and services essential to protecting life, property and economic well-being.

### Vision

The trusted source for environmental predictions from the sun to the sea, when it matters most.



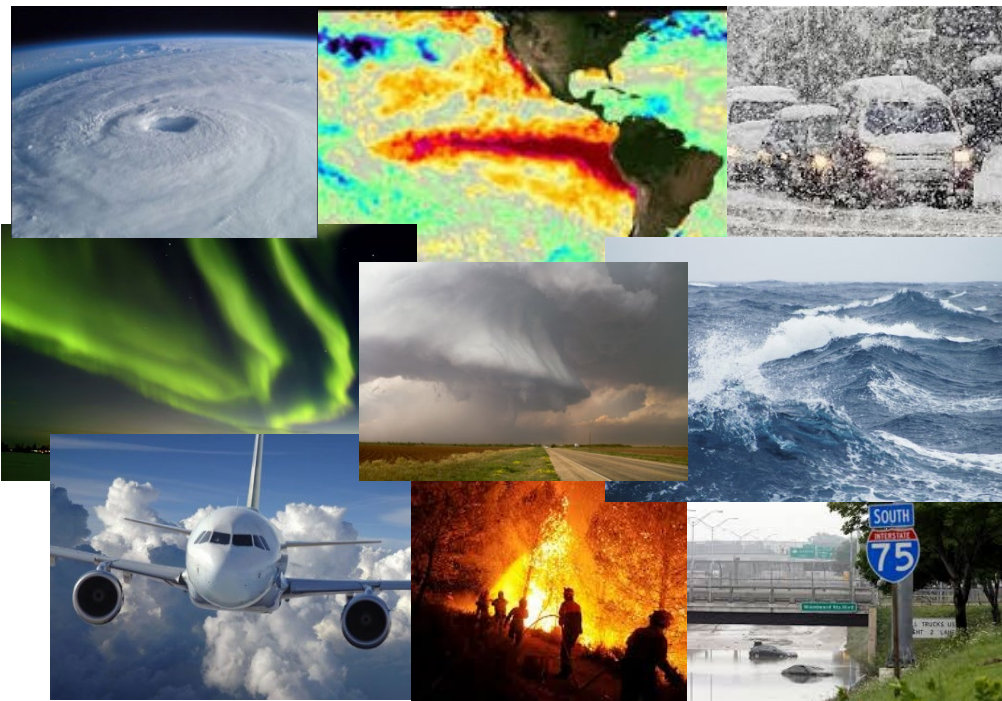


# NCEP is a Critical Component of the NWS Collaborative Forecast Process

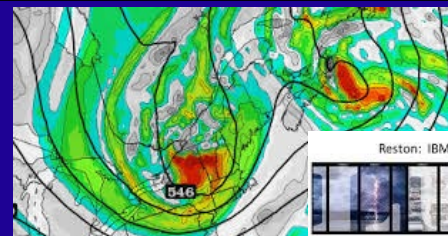


## *“Provision of Services from the Sun to the Sea”*

- Solar Monitoring, Warnings and Forecasts (SWPC)
- Aviation Forecasts and Warnings (AWC)
- Extreme Events (Hurricanes, snowstorms, excessive rain; severe & fire weather) (NHC, WPC, SPC)
- High Seas Forecasts and Warnings to day-5 (OPC)
- Week 3 & 4; Seasonal Outlooks; El Nino – La Nina Forecasts (CPC)



- Model Development, Implementation and Applications for Global and Regional Weather, Climate, Oceans and Space Weather (EMC)
- Super Computer, Workstation and Network Operations (NCO)

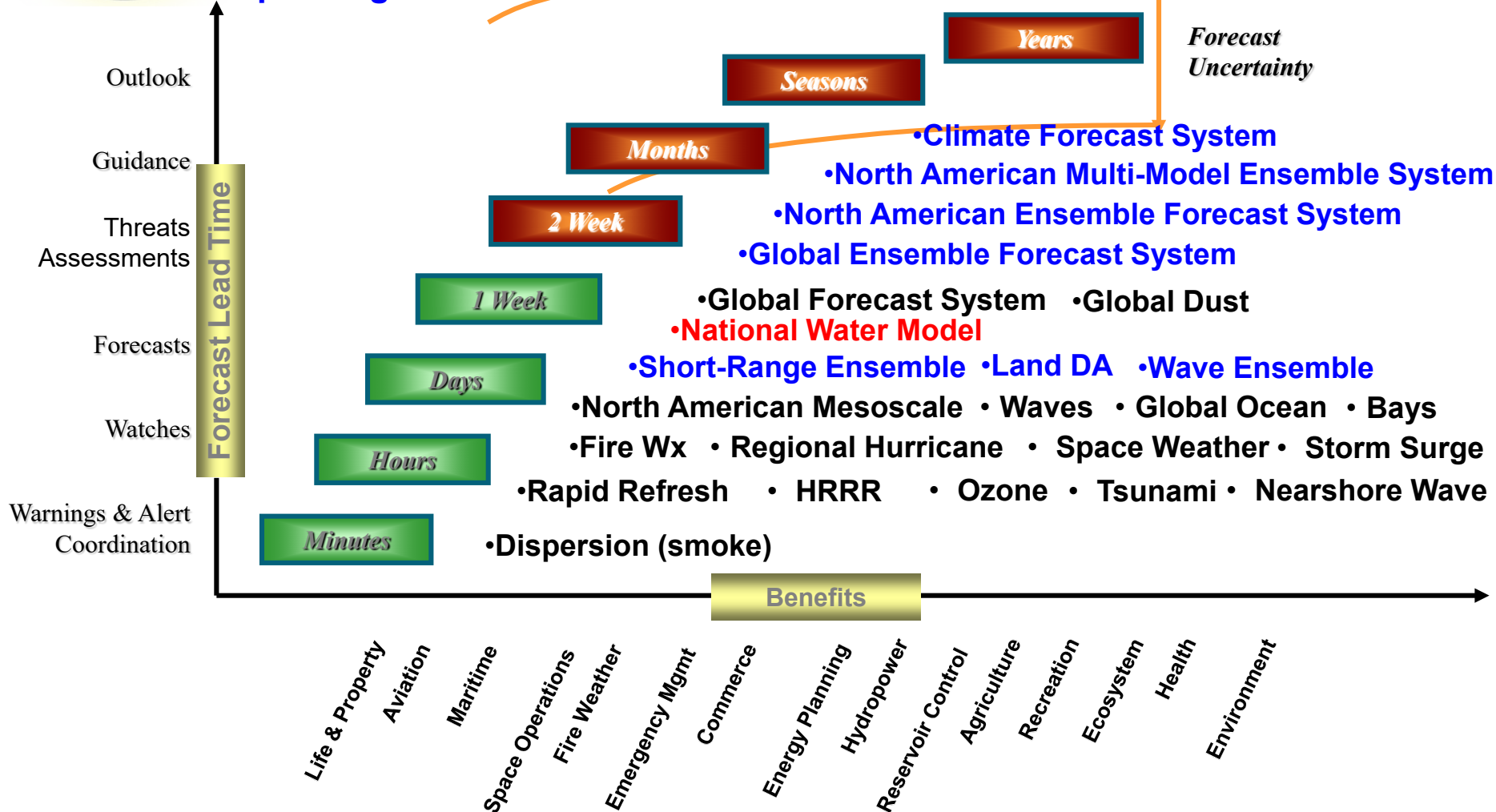


The Cray Systems will include graphics on the front panels of the systems as shown in these two images.



# Seamless Suite of Operational Numerical Guidance Systems

Spanning Weather and Climate



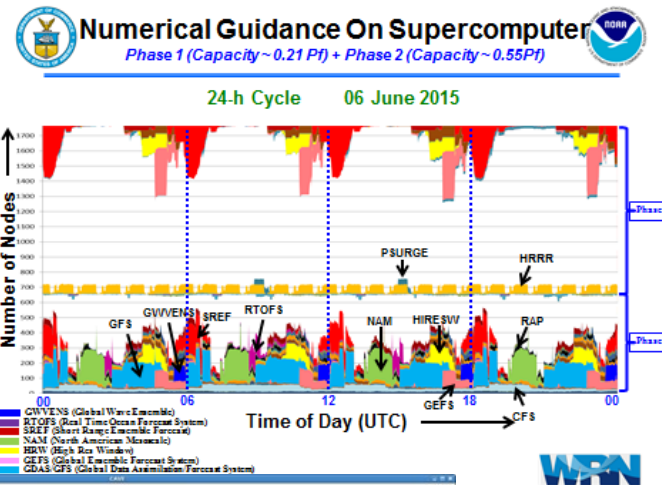
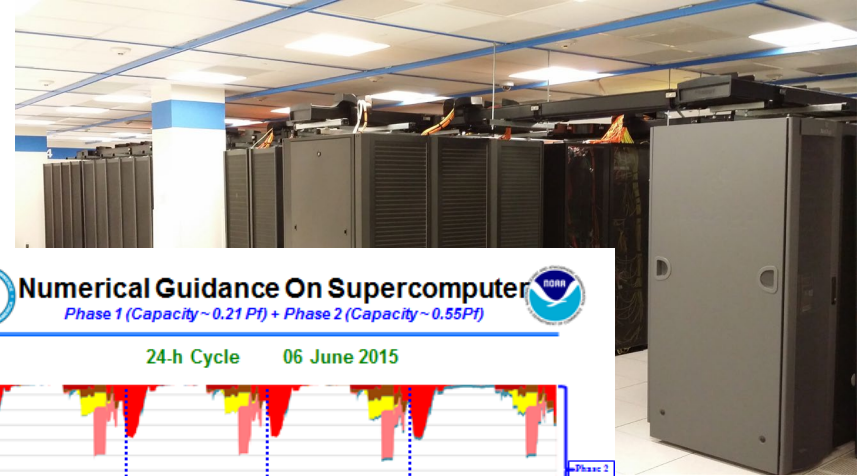




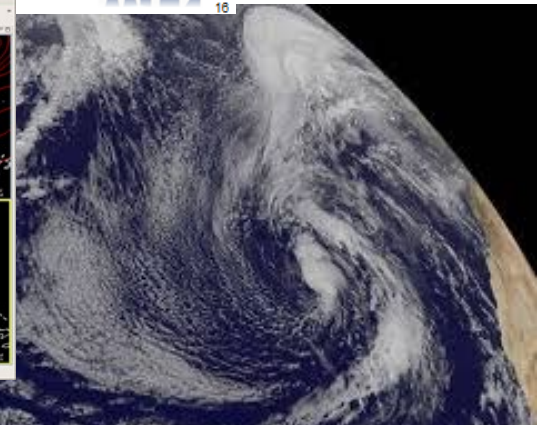
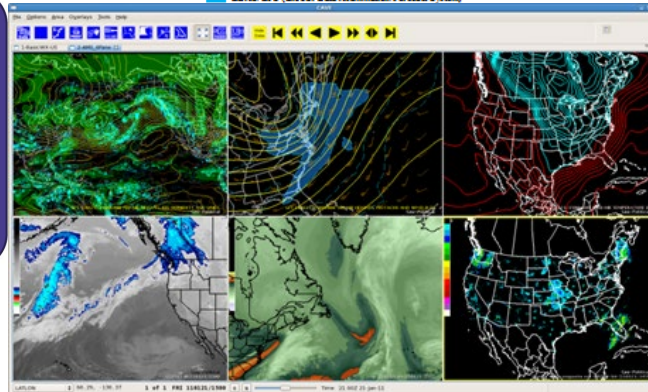
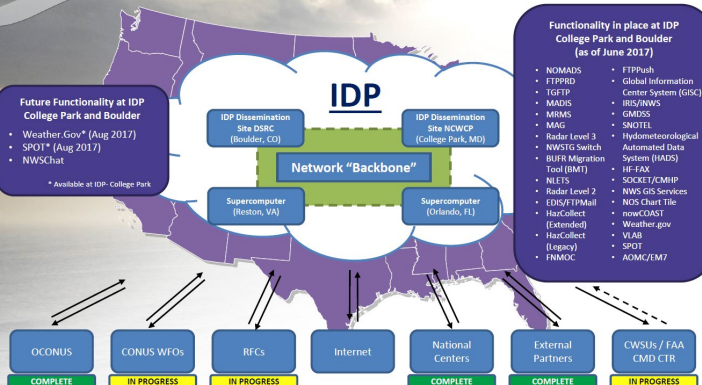
# NCEP Central Operations (NCO) Foundational Products and Services



- High Performance Computing
- 24x7 Systems and Monitoring Support
- Telecoms Support: AOMC, NEXRAD, One-NWSnet
- NOAA's IDP: MRMS, MADIS, VLab, NOMADS, MAG, NIDS
- Operational Data Exchange
- AWIPS Software Development



## Integrated Dissemination Program (IDP) Long-Term Sustainable Solution



**"OneNWS" Network**  
The future OneNWS network will consolidate all operational networks (OPSnet, Regional, etc.) as a single managed network under NCEP Central Operations (NCO).

# Satellite Data Used in Global NWP Models

Sensors/ Satellites Data Assimilated (from Uccellini September 2019)

- HIRS sounder radiances
- AMSU-A & B sounder radiances
- ATMS sounder radiances
- MHS sounder radiances
- AIRS\* sounder radiances
- IASI sounder radiances
- CrIS sounder radiances
- GOES sounder radiances
- GOES, Meteosat, GMS winds
- GOES precipitation rate
- SSM/I precipitation rates
- TRMM\* precipitation rates
- SSM/I ocean surface wind speeds
- Quikscat\* ocean surface wind vectors
- MT SAPHIR\*
- JASON ocean surface altimetry
- AVHRR SST
- AVHRR vegetation fraction
- AVHRR surface type
- Multi-satellite snow cover
- Multi-satellite sea ice
- SBUV/2 ozone profile & total ozone
- MODIS\* polar winds
- GPS Radio Occultation
  - COSMIC, METOP/GRAS, CNOFS, GRACE,\* SAC-C\*, TerraSAR-X\*, KOMPSAT5, COSMIC2 (soon)
- SSMIS sounder radiances
- Aura/OMI\*
- AMSR/E\*
- MSG SEVIRI
- GOES—R/S, Himawari winds
- VIIRS Polar Winds
- In Development
  - VIIRS SST radiances
  - GOES-R ABI radiances
  - GPM/GMI\*
  - SMAP\*
  - ADM/Aeolus\*
  - SSMIS imaging channels
  - ASCAT OSWV

Denotes Research Satellites \*

Enhanced through the Joint Center for Satellite Data Assimilation. Accelerated the use of research and operational satellite data in operational numerical weather predict modeling systems.





# Aviation Weather Center (AWC)

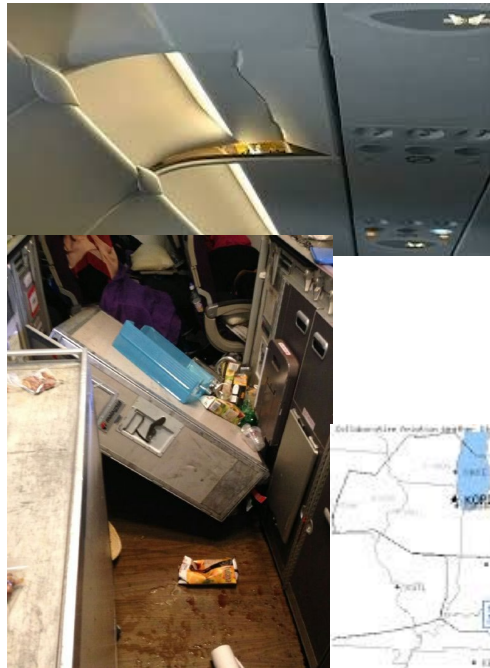
Kansas City, MO



*The AWC delivers consistent, timely and accurate weather information for the world airspace system*

## In Flight Forecasts, Advisories and Warnings:

### Turbulence



### Convection



### Icing





# Satellite Data at AWC

- AWC is a **global** forecast center
- Imagery vital to operations
- GOES-R and NPP data improve operations:
  - Mosaic and global imagery
    - VIIRS and GOES-R integration
  - Overlays with other aviation tools
    - ASDI (flight tracking) and EDR (turbulence reports)
- Research to support new applications
  - Collaborative projects involving both developers and forecasters, for example, turbulence detection

## AWC Testbed Tools

1. Fog and Low Stratus
2. ABI
3. Flight Icing Threat
4. PGLM
5. CI toolbox
6. NearCasting Model
7. ACHA algorithms
8. VIIRS Imagery - CONUS

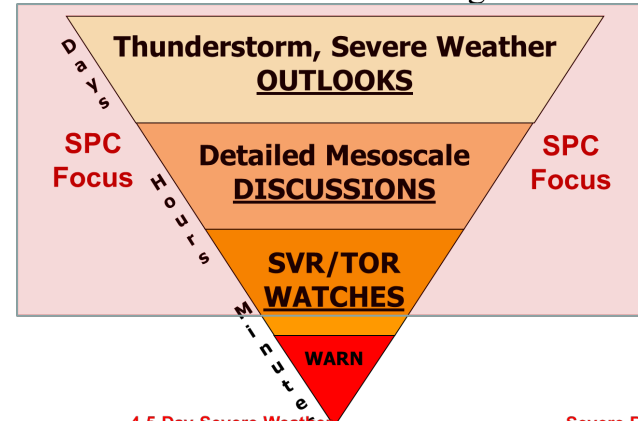


# Storm Prediction Center (SPC)

## Norman, OK

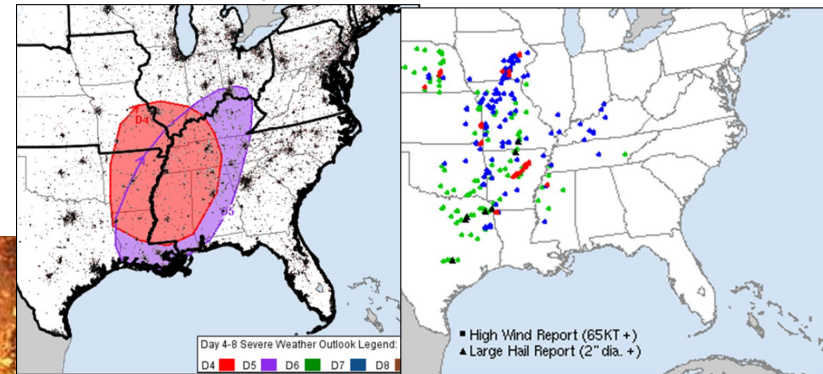
- Convective (Severe Thunderstorm) Outlooks for Day 1, 2, 3, and Days 4-8
- Severe Thunderstorm and Tornado Watches
- Thunderstorm Outlooks
- Mesoscale Convective discussions (MD)
- Watch Status Messages
- Fire Weather Outlooks (Day 1, 2, 3-8)

### Severe Thunderstorm and Tornado Watches and Warnings



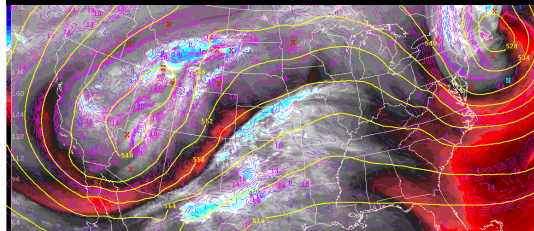
4-5 Day Severe Weather Outlook Valid 27-28 April

Severe Reports 27 April 2014

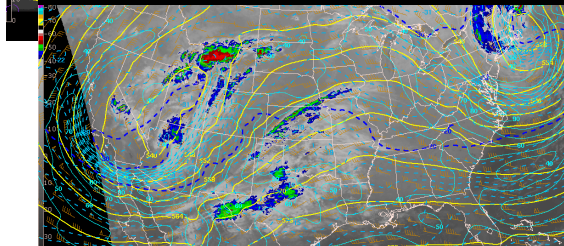


# SPC Use of Satellite Data – Current and Future

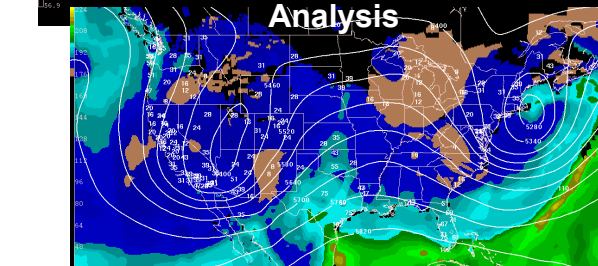
### WV and RAP Analysis



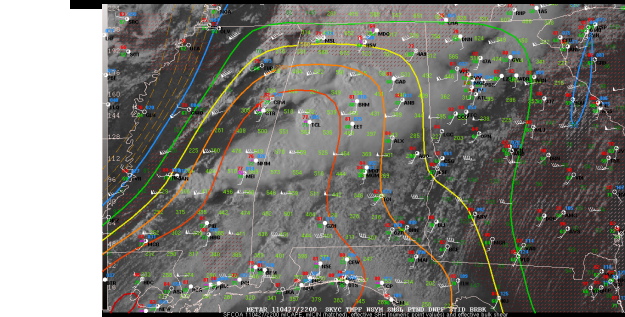
### IR and RAP Analysis



### Blended TPW, GPS, GFS Analysis



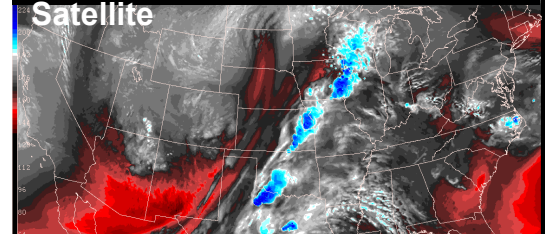
### Visible and Mesoanalysis Fields



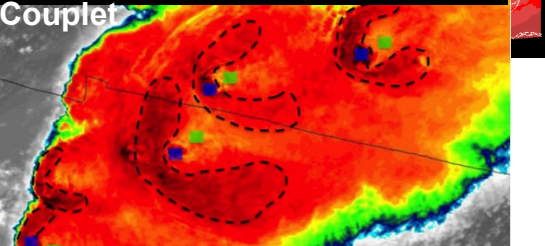
2013 - Blending satellite imagery with NWP and environment data helps diagnose current environment

Current and Future - New satellite products will improve ability to predict convective storms in advance, and to diagnose intensity and evolution of existing storms

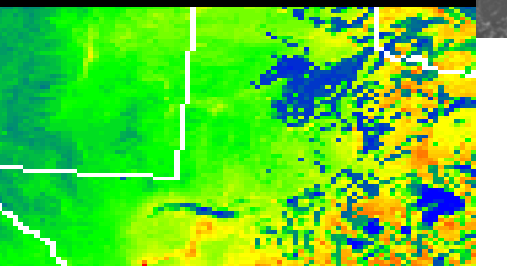
### Stormscale NWP Simulated Satellite



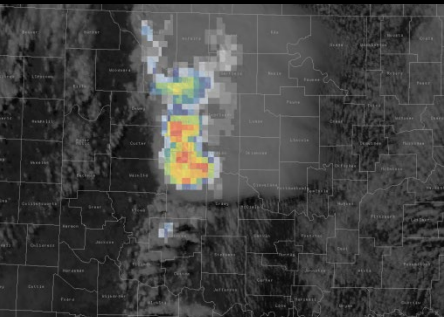
### Overshooting Top/Thermal Coupler



### ABI Split Window Difference



### GLM Total Lightning





# Space Weather Prediction Center

Established 1946 as part of Central Radio Propagation Laboratory

Aurora Forecast  
OWATION-Prime Model

Forecast For: 2017-07-17 01:00 UT  
Hemispheric Power: 44.48 GW  
Typical Range 0 to 150 GW

## Operations – Space Weather Forecast Office



Daily forecast since 1965.

Specifications; Current conditions  
Forecast; Conditions tomorrow  
Watches; Conditions are favorable for storm  
Warnings; Storm is imminent with high probability  
Alerts; observed conditions meeting or exceeding storm thresholds

## R & D – Space Weather Prediction Testbed Transitioning models into operations

R2O

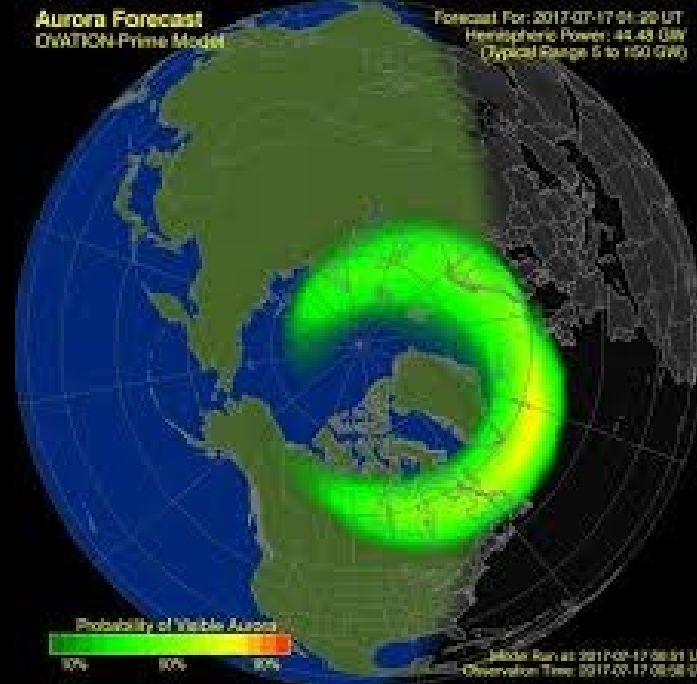
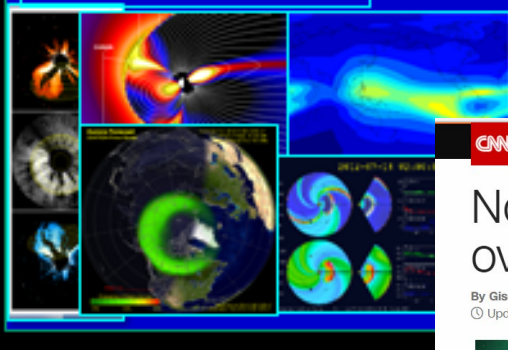
### Research-to-Operations

- Applied Research
- Model Development
- Model Test/Evaluation
- Model Transition
- Operations Support

### Operations-to-Research

- Customer Requirements
- Observation Requirements
- Research Requirements

O2R



U.S. » Northern Lights captivate crowds overnight

Live TV U.S. Edition

## Northern Lights captivate crowds overnight

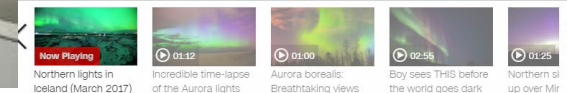
By Gisela Crespo, CNN

Updated 2:09 PM ET, Mon July 17, 2017



### Top stories

- Spicer contradicts emails, President on Trump Jr. meeting
- Former Texas officer indicted for murder



(CNN) — From Michigan to Canada, plenty of folks stayed up Sunday to watch and record the spectacle of the Northern Lights -- and it didn't disappoint.

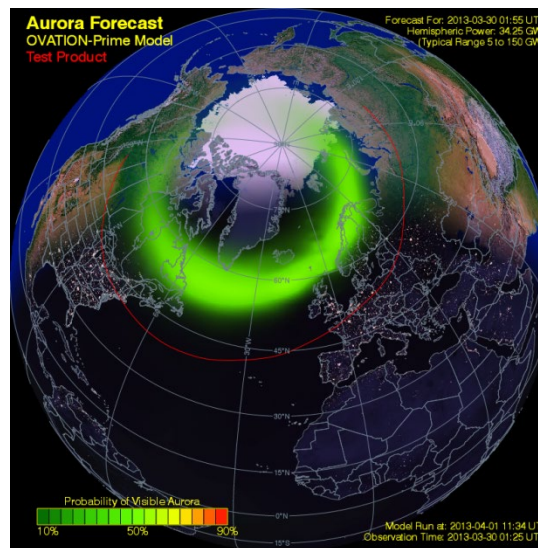
NOAA's Space Weather Prediction announced last week that there was a possibility the Aurora Borealis would be visible "as low as New York to Wisconsin to Washington State," on Sunday

Save \$464\* when you switch to State Farm® auto insurance.

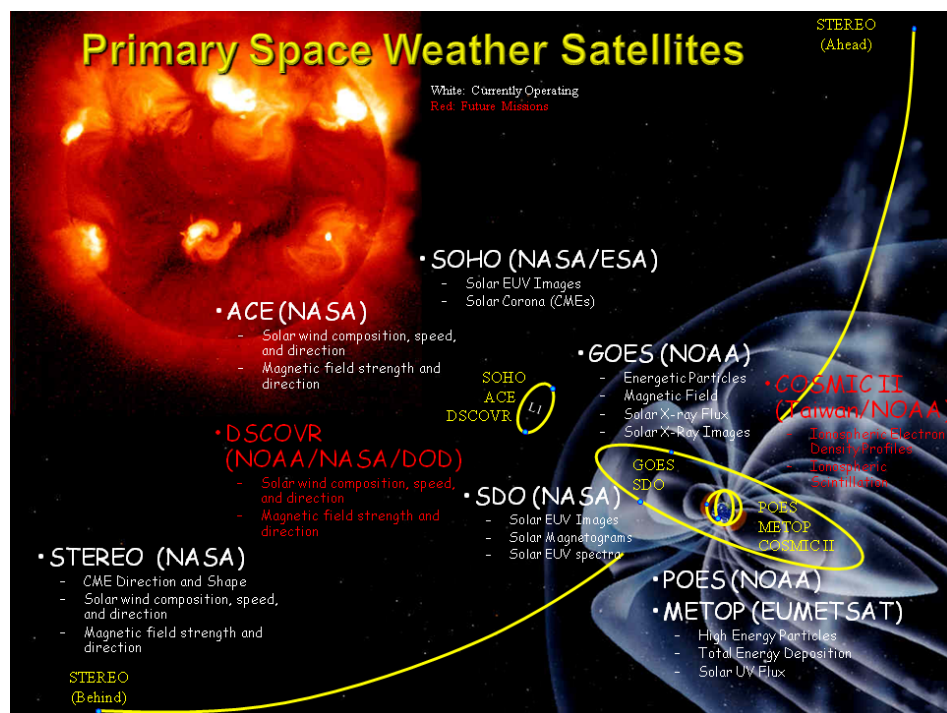
GET A QUOTE >

# SWPC Reliance on Satellites

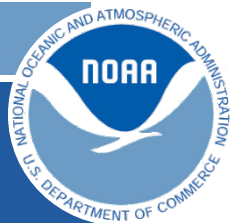
- For Accurate Space Weather Forecasts, Observations must be made from Space
  - There are no ground-based alternatives for most observations
- Most Products Require Satellite Data
  - 90% of products use satellite data
  - 75% of products require satellite data
- Two of the Three Space Weather Scales are Derived solely from Satellite Observations
- New and Future Satellite Missions are Critical
  - DSCOVR: Continuity of observations from L1; SWFO (Space Weather Follow On) Mission
  - GOES-R: Continuity of observations from GEO
  - COSMIC II: Expanding real-time observations on a global scale
  - SunJammer: Taking solar wind measurements closer to the sun for longer forecast lead-times.



Ovation – Forecasting the Location and Intensity of the Aurora:  
 Driven by ACE  
 ,DISCOVER solar wind data measured at the L1 point (1% of the distance between Earth and sun)





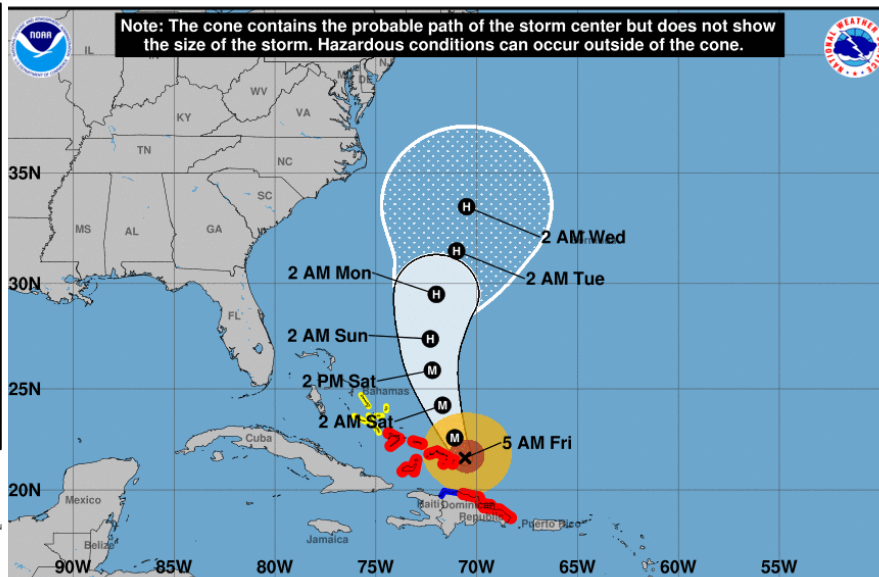
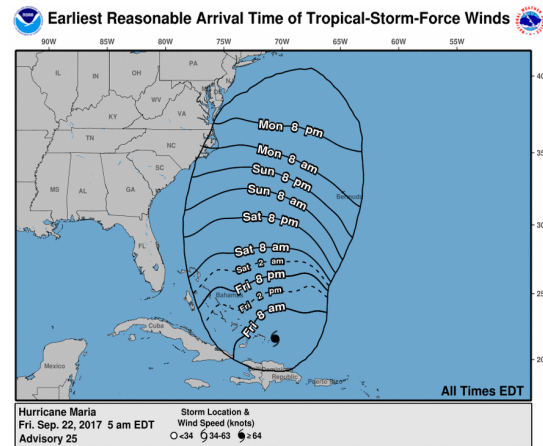
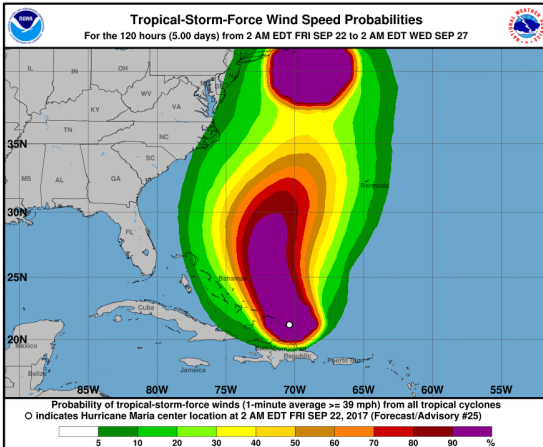
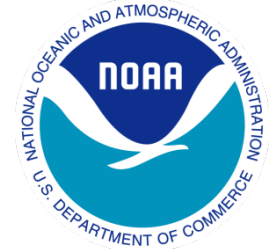


# Climate Prediction Center: Pioneering Climate Applications of Satellite Data

- Two types of satellite data applications
  - Direct use of satellite data
  - Integrated (e.g. combine data from individual platforms / sensors into climate analyses)
- Key contributions
  - 1983: GOES Precipitation Index
  - 1985: Outgoing Longwave Radiation
  - 1988: Sea Surface Temperature Analysis
  - 1994: Ultraviolet Index
  - 1996: Gauge-Satellite Merged Precipitation Analysis
  - 1999: Full-Res Global GEO IR Images
  - 2002: Hi-Res Global Satellite Precipitation Estimates



# National Hurricane Center Miami, FL



**Hurricane Maria**  
Friday September 22, 2017  
5 AM EDT Advisory 25  
NWS National Hurricane Center

**Current information: x**  
Center location 21.6 N 70.6 W  
Maximum sustained wind 125 mph  
Movement NW at 7 mph

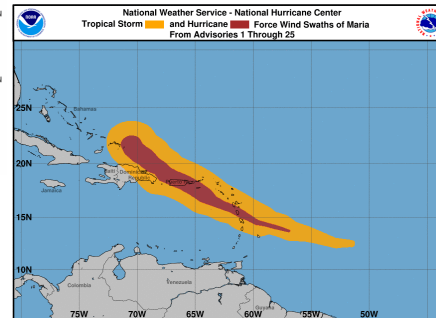
**Forecast positions:**  
● Tropical Cyclone ○ Post/Potential TC  
Sustained winds: D < 39 mph  
S 39-73 mph H 74-110 mph M > 110 mph

**Potential track area:** Day 1-3 (dotted), Day 4-5 (dashed)

**Watches:** Hurricane (red), Trop Stm (yellow)

**Warnings:** Hurricane (red), Trop Stm (blue)

**Current wind extent:** Hurricane (red), Trop Stm (yellow)



Hurricane Maria Discussion Number 25  
NWS National Hurricane Center Miami FL  
500 AM EDT Fri Sep 22 2017

AL152017

Reports from an Air Force Reserve Hurricane Hunter aircraft near 0900 UTC indicated that the central pressure of Maria had risen to 999 mb, accompanied by flight-level winds and 500hPa surface wind estimates that supported an intensity near 110 kt. Since that time, the cloud tops in the eyewall have cooled, but the eye has become less distinct in conventional satellite imagery. The initial intensity is held at 110 kt pending the arrival of the next plane near 1200 UTC, but it is possible this is a little generous. Maria is starting to be affected by 15-20 kt of southwesterly vertical wind shear, with the first sign of this being a decrease in convective banding in the western semicircle.

The large-scale models forecast some shear to persist through the forecast period, and as a result the intensity guidance predicts a gradual weakening. In addition, after 48 h the forecast track takes the center of Maria over waters that were cooled significantly by the passage of former Hurricane Jose. Based on these factors, the new intensity forecast calls for a slow weakening during the first 48 h similar to the previous forecast, then calls for more weakening than previously forecast as the cyclone reaches the colder waters.

The initial motion is 315/6. Maria will be moving between the subtropical ridge to the east and a broad trough over the southeastern United States and the adjacent Atlantic waters during the next several days. This pattern should cause the hurricane to turn north-northeastward and then northward during the next 72 h. The track guidance is tightly clustered during this part of the forecast, and the new forecast track is an update of the previous track. After 72 h, the guidance becomes a little more divergent. The Canadian and ECMWF models are on the left side of the envelope showing a generally northward motion, while the GFS is on the right side showing a north-northeastward motion. This part of the old forecast track is nudged just a little to the left of the old forecast and the consensus models to account for the ECMWF/Canadian forecasts.

**KEY MESSAGES:**

- Flash flood warnings continue in portions of Puerto Rico due to persistent heavy rainfall from Maria's trailing rainbands. Everyone in Puerto Rico should continue to follow advice from local officials to avoid these life-threatening flooding conditions.
- Swells from Maria are expected to begin reaching the coast of the southeastern United States today. These swells are likely to cause dangerous surf and life-threatening rip currents along the coast for the next several days, even with Maria forecast to remain well offshore over the western Atlantic Ocean.

**FORECAST POSITIONS AND MAX WINDS**

INIT	22/0900Z	21.6N	70.6W	110	KT	125	MPH
12h	22/1800Z	21.0N	71.0W	105	KT	120	MPH
24h	23/0600Z	24.2N	71.7W	105	KT	120	MPH
36h	23/1800Z	25.9N	72.2W	100	KT	115	MPH
48h	24/0600Z	27.4N	73.3W	95	KT	110	MPH
72h	25/0600Z	29.5N	72.0W	85	KT	100	MPH
96h	26/0600Z	31.5N	71.0W	75	KT	85	MPH
120h	27/0600Z	33.5N	70.5W	65	KT	75	MPH

55  
Forecaster Beven  
NNNN

# Forecasting Improvements Over the Past 25 Years



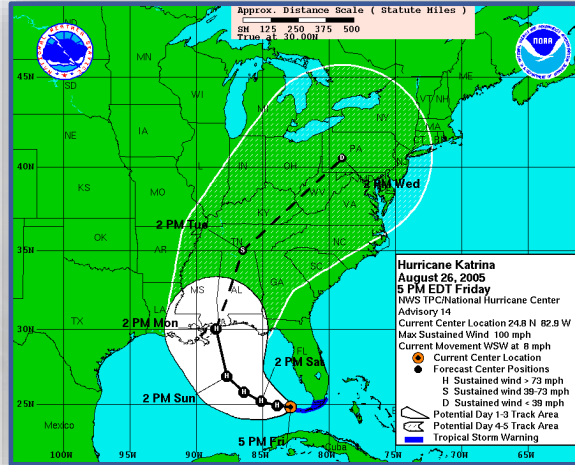
## Andrew 1992



Brian Norcross

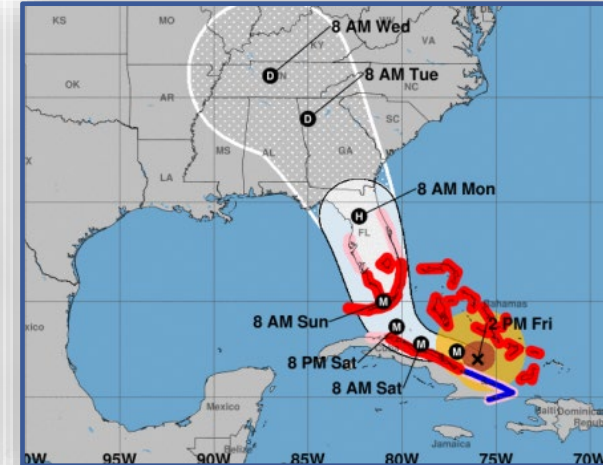
- Policy: Global models not used for official forecast
- GFS did capture an “L” with one or two closed isobars - considered a success
- Policy changed after Andrew

## Katrina 2005



- Accelerated use of models for 5-day forecasts
- Model runs captured intensification/track - broad “cone of uncertainty”
- Intensity changes advertised 1-2 days in advance – still a challenge

## Irma 2017



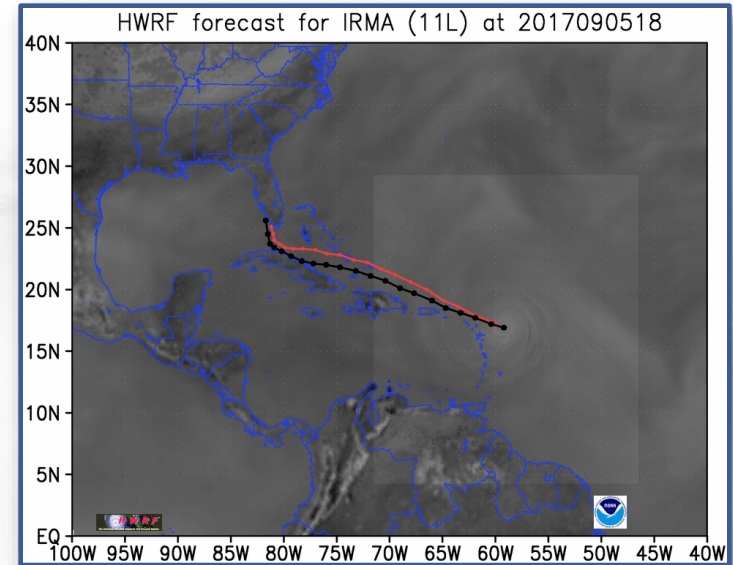
- 10-day model runs used to track Irma:
  - development of storm as a wave off Africa
  - right turn in the track
- Still have issues nailing down the details
  - Track changes
  - Rapid intensity changes still a challenge



# Forecast Improvements

## Irma

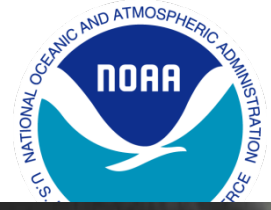
- ✓ Models picked up on Irma becoming a hurricane before the tropical depression formed in the eastern Atlantic.
- ✓ NWS indicated threat for southeastern U.S. 8-10 days in advance
- ✓ Sharp right turn to the north was expected based on strong ensemble agreement
  - Exactly turn with regard to the FL peninsula was uncertain; but confidence was high enough to alert Southeast U.S. and focus on Florida
  - **Florida Governor declared a State of Emergency on Monday, six days before landfall**
- **Forecast for the right turn verified!**



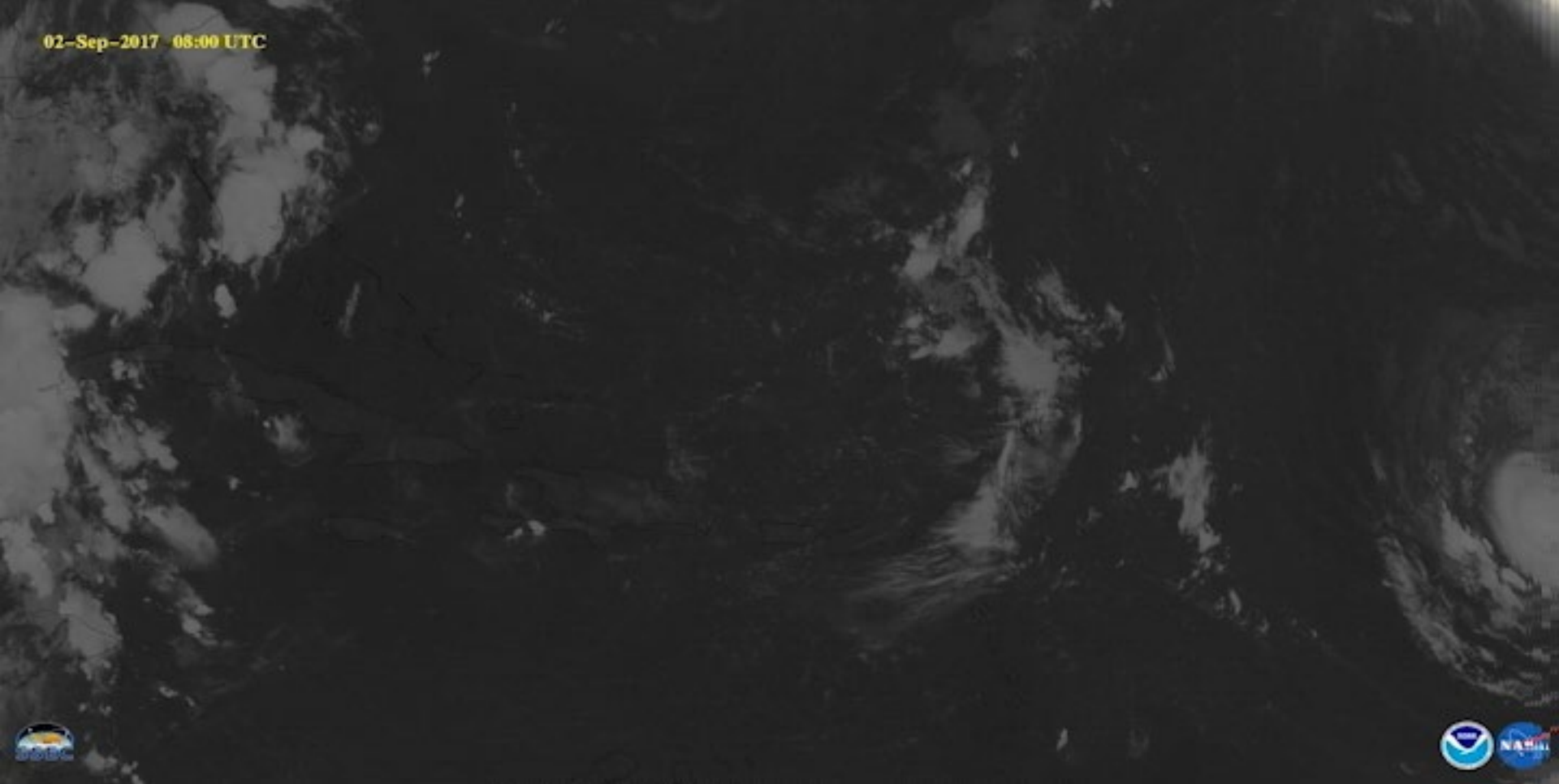


# Hurricane Irma

## Category 5 for more than 3 days



02-Sep-2017 08:00 UTC







# Hurricane Dorian

## 03 September 2019

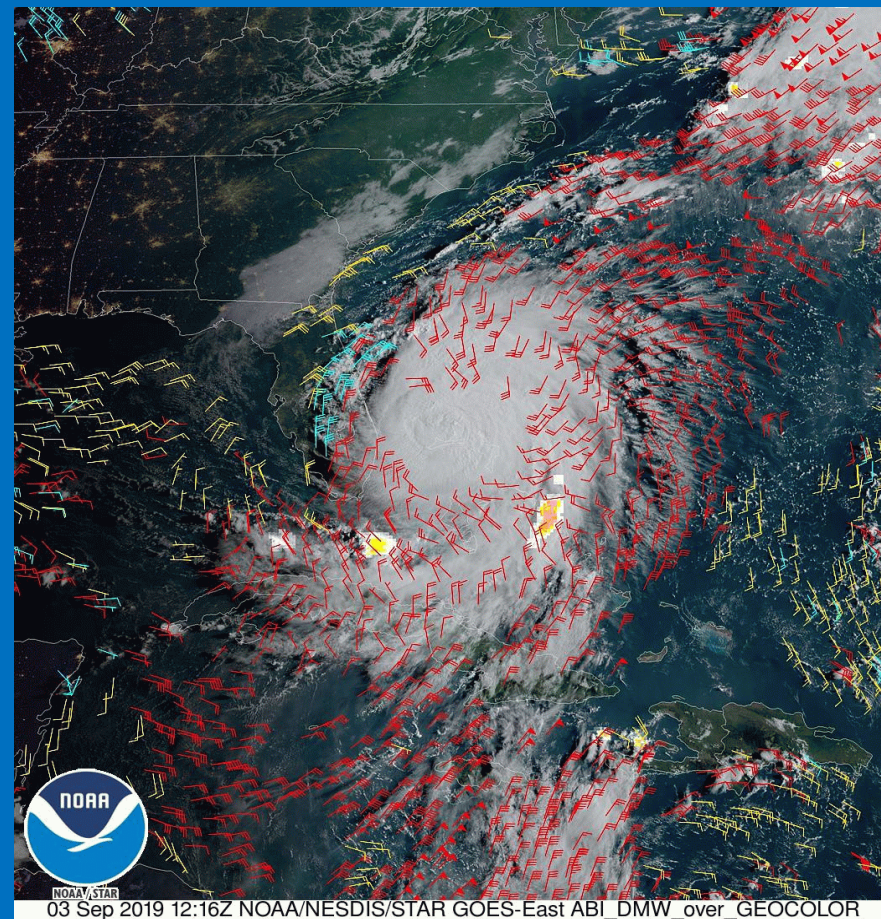
- GOES-East ABI

- Geocolor Imagery

- GLM

- Winds

- Upper level winds (100-400 hPa) shown in red
- Mid level winds (400-700 hPa) in cyan
- Low level (below 700mb) in yellow



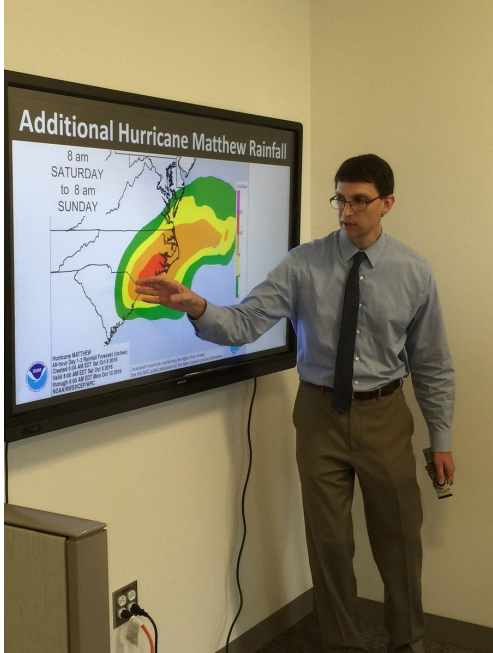
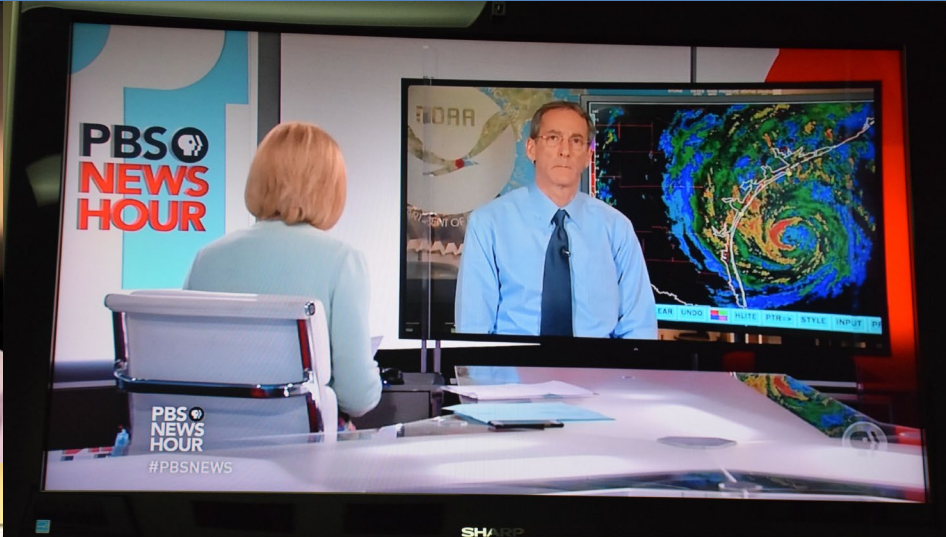
03 Sep 2019 12:16Z NOAA/NESDIS/STAR GOES-East ABI DMW over GEOCOLOR







# NCEP IDSS Responsibilities: National Media

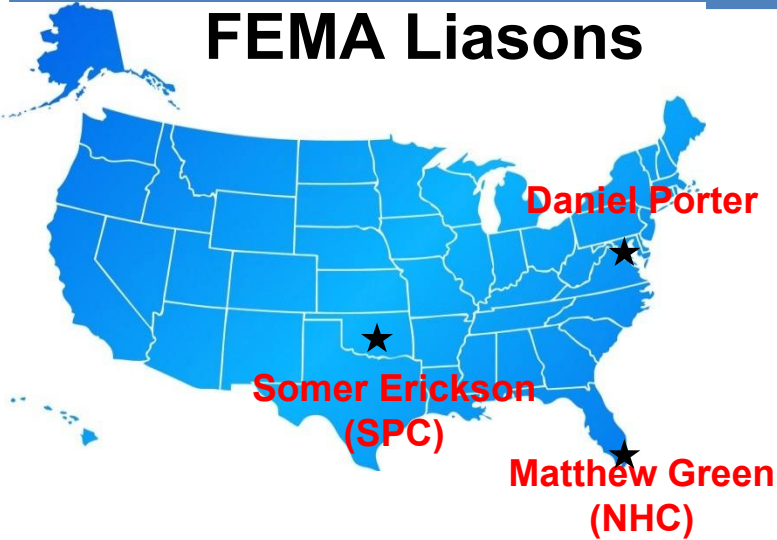




# NCEP IDSS Responsibilities: FEMA / DHS Briefings



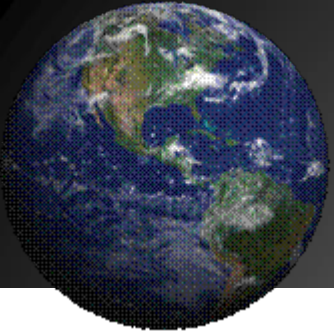
## FEMA Liasons



Monthly or Regular Basis and  
Special Partner Briefings in  
Advance of Major Events







# Discussion

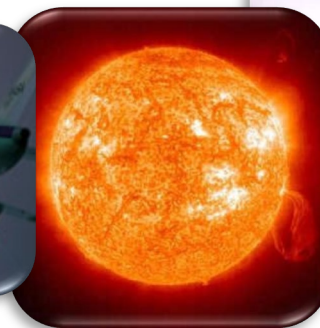
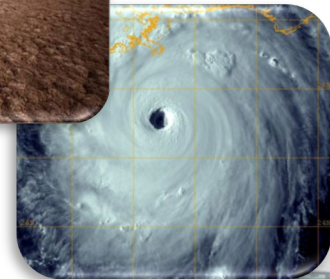
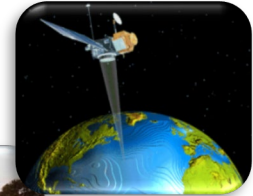
- **Toward more effective collaboration with STAR**
  - **Developing, testing, implementing new science**
  - **Exploiting new satellite data**
- **Organizational Efforts**
  - **STAR User Engagement Scientist**
  - **STAR and NCEP drafting agreement (Bayler & Yoe)**
- **Individual Efforts**
  - **Think service first**

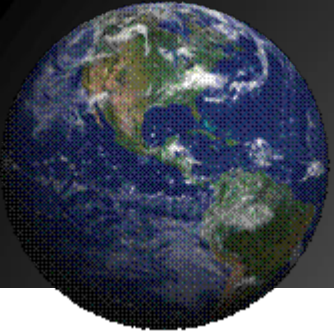


# Research to Operations - TestBeds

## Service – Science Linkage

- EMC WRF Developmental Test Center, NASA/ NOAA/DoD Joint Center for Satellite Data Assimilation
- CPC Climate Test Bed
- NHC Joint Hurricane Test Bed
- WPC Hydrometeorological Test Bed
- SPC Hazardous Weather Test Bed with NSSL
- SWPC Space Weather Prediction Test Bed with AFWA
- AWC Aviation Weather Test Bed
- OPC Linked with EMC's Marine Modeling and Analysis Branch





# To Make Impact

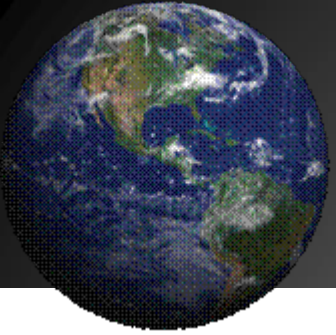
- **Focus on the mission – service to (end) users**
- **Satellite data/products integrated in forecast process and environment(s)**
- **Central Guidance (environmental modeling) biggest target**
  - **Data calibration, validation**
  - **Data characterization**
  - **Data quality control**
  - **Data assimilation**
  - **JCSDA**

# Summary

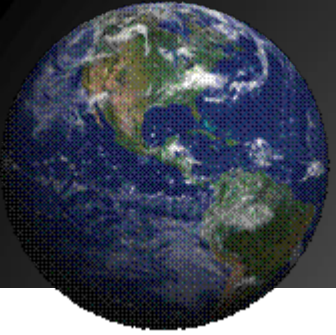
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- The “C” in NCEP is plural
  - EMC and NCO supplying Central Guidance
  - Seven Specific Service Areas
- NCEP relies on satellite data to support all of its operational environmental predictions
- NCEP needs to exploit advanced capabilities of current and future satellite sensors and data
  - Using integrated, service-focused approach
  - Emphasizing high-impact services
  - Leveraging Testbeds and Proving Grounds
  - Collaborating with partners throughout NOAA





Thank You



# Back up slides



# NCEP International Responsibilities



## NCEP executes over half of NWS International travel

- Scientific and Service Engagement
- Satellite Coordination
- Global Model Coordination

## NCEP Training Desks

South America / Tropical

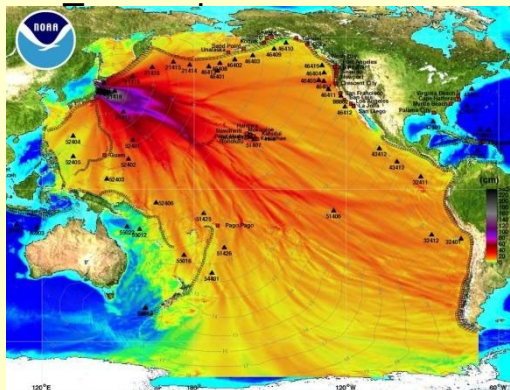


Africa / Monsoon



## Specialized Support

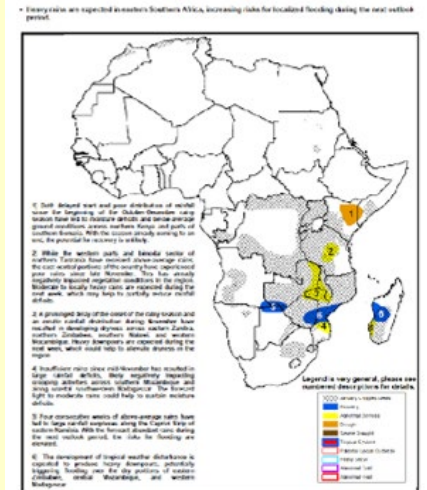
Japanese



Haiti Earthquake



Climate Prediction Center's Africa Hazards Outlook  
January 2 - January 8, 2014





# The National Hurricane Center's New Bureaucracy-Busting Forecasts Are Excellent

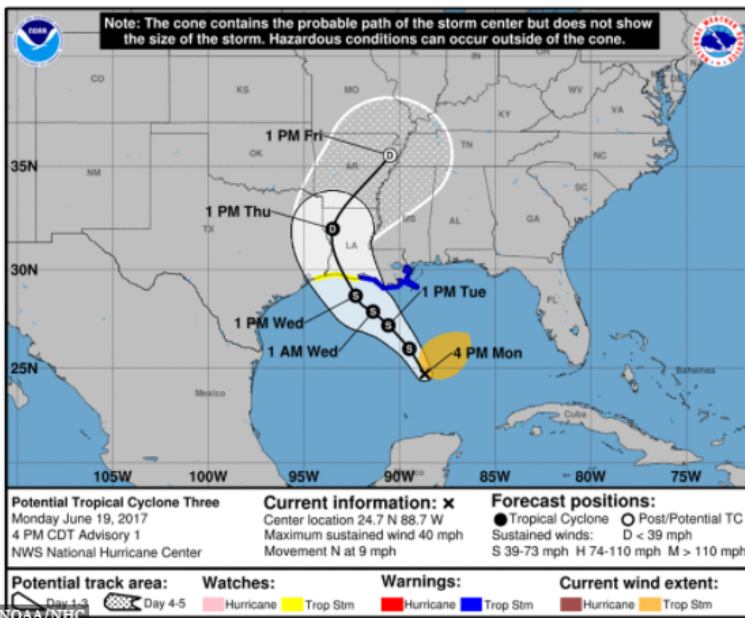


**Dennis Mersereau**, CONTRIBUTOR

*I write about the weather and all of the unique issues it creates.*

[FULL BIO](#) ▾

Opinions expressed by Forbes Contributors are their own.



The National Hurricane Center's first forecast map for Potential Tropical Cyclone Two on June 19, 2017, which would go on to become Tropical Storm Cindy one day later.

The National Hurricane Center (NHC) began issuing several new products this year, each designed to help people figure out what they need to do before a tropical cyclone reaches shore. Out of all of the products—which include storm surge alerts and maps that show the estimated arrival time of dangerous winds—their new forecasts for “potential tropical cyclones” are

# NEW NHC Product in 2017:

## Issuance of Watches, Warnings, and Advisories for Potential Tropical Cyclones

ZCZC MIATCPAT1 ALL  
TTAA00 KNHC DDHMM

### BULLETIN

Potential Tropical Cyclone Two Advisory Number 1  
NWS National Hurricane Center Miami FL AL022017  
500 PM EDT Wed Jun 05 2017

...TROPICAL STORM WARNING ISSUED FOR PORTIONS OF THE WEST COAST OF FLORIDA...  
...DISTURBANCE OVER THE EAST-CENTRAL GULF OF MEXICO EXPECTED TO BECOME A TROPICAL STORM TOMORROW...

### SUMMARY OF 500 PM EDT...2100 UTC...INFORMATION

LOCATION...25.5N 86.5W  
ABOUT 310 MI...500 KM SW OF TAMPA FLORIDA  
ABOUT 320 MI...510 KM SSW OF APALACHICOLA FLORIDA