What it takes to Build a Weather-Ready Nation

NOAA

March 10, 2020

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NOAA Environmental Leadership Seminar

What We Do

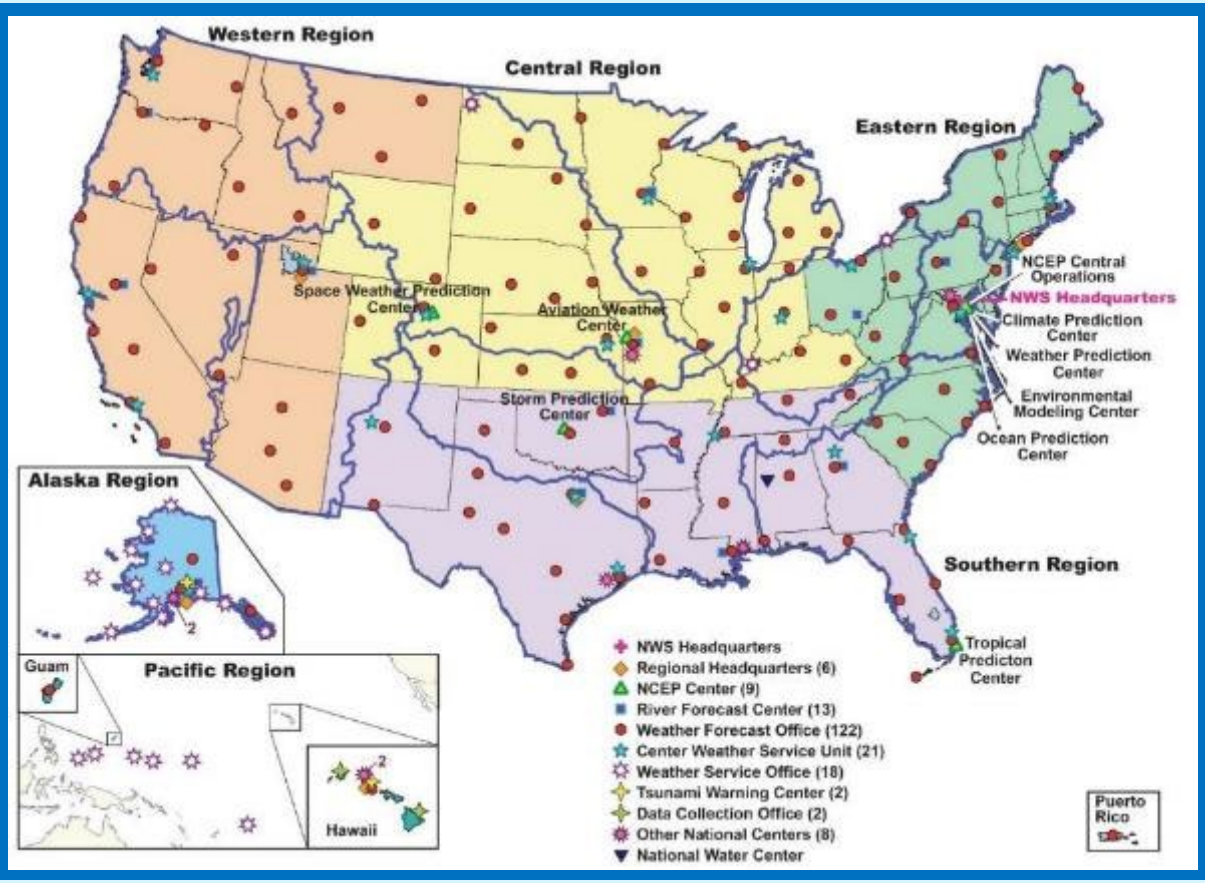
The Mission:
Providing weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy

The Vision:
A Weather-Ready Nation
Society is prepared for and responds to weather, water, and climate-dependent events

The Outcome: Ready, Responsive, and Resilient Communities

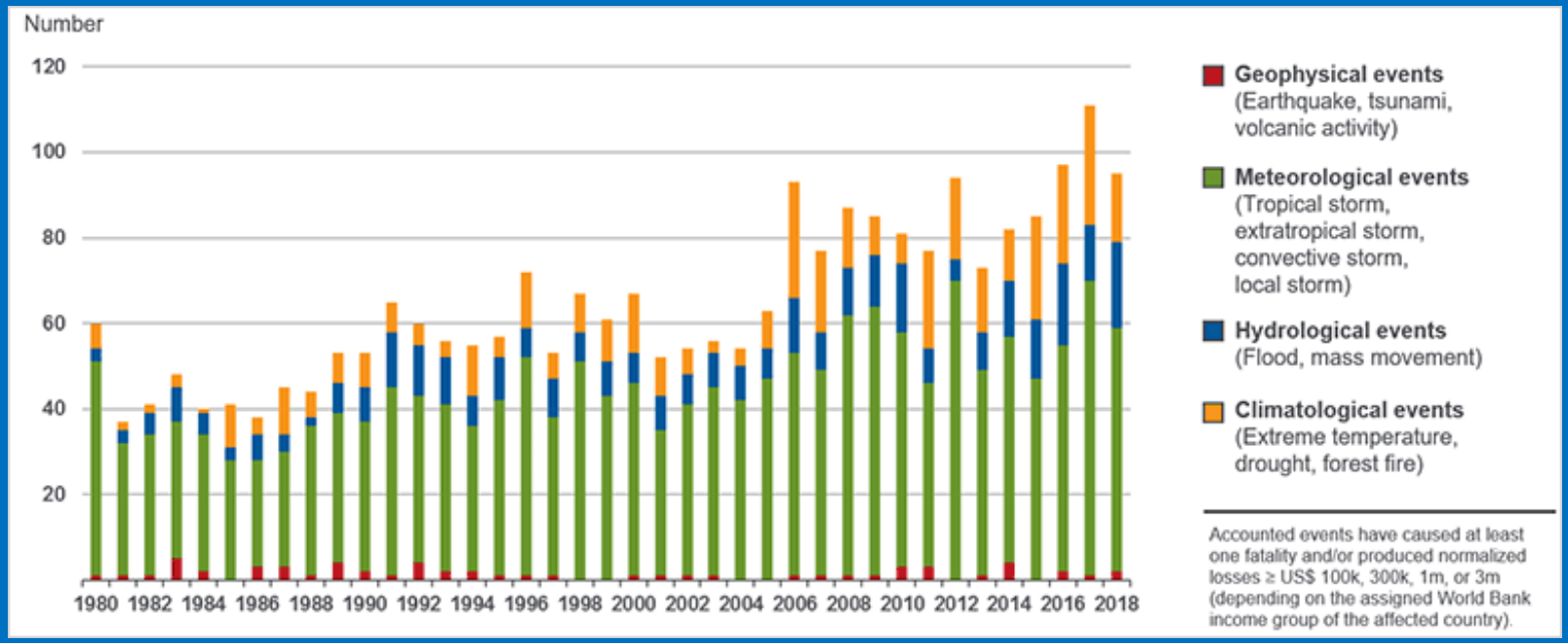
NWS Operations: Guam to Puerto Rico
Sun to the Sea

18 National Centers	122 Weather Forecast Offices
7 National/Regional Headquarters	13 River Forecast Centers
2 Tsunami Warning Centers	21 Center Weather Service Units



Increasing Societal Vulnerability to Environmental Hazards

Loss Events in the U.S. 1980-2018



Source: © 2019 Munich Re, Geo Risks Research, NatCatSERVICE.

4 out of 5 Americans live in counties that have been declared weather-related disaster areas in the past six years*

*Source: Environment America

Factors contributing to increased risk

- ☑ Increasing population in extreme weather prone areas
- ☑ Increasing vulnerability (older population along coasts…)
- ☑ More infrastructure at risk
- ☑ Influence of climate change (heavier precip, sea-level rise…)

Internalize the Need for Change: Comparing Severe Weather Outbreaks

Super Outbreak:	April 3-4, 1974	April 27-28, 2011
Summary:	150 tornadoes across 13 states	~200 tornadoes across 16 states
Number and Strength:	6 F-5 tornadoes, 24 F-4	4 EF-5 tornadoes, 11 EF-4
Tornado Track Length:	2500 miles	2500 miles
Tornado Time:	50 hours	50 hours
Outbreak forecast :	"Indications" provided night before	4-6 days prior
Warning lead time:		~24 minutes
Fatalities:	**314**	**316**

"Ready, Responsive, Resilient"

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

Touching every county every day.
Supporting national security and public safety.

This requires:

Better forecasts and warnings

Consistent products and services

Actionable environmental intelligence

Revolutionary change connecting forecasts to decisions through ***impact-based decision support services***

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

Defining Impact-Based Decision Support Services

Our forecasts and warnings	+	Connecting to your decision-making process	=	Impact-based Decision Support Services

Provide the Best Forecasts in the World

Establish Relationships, Know Partner Needs

Practice, Practice, Practice

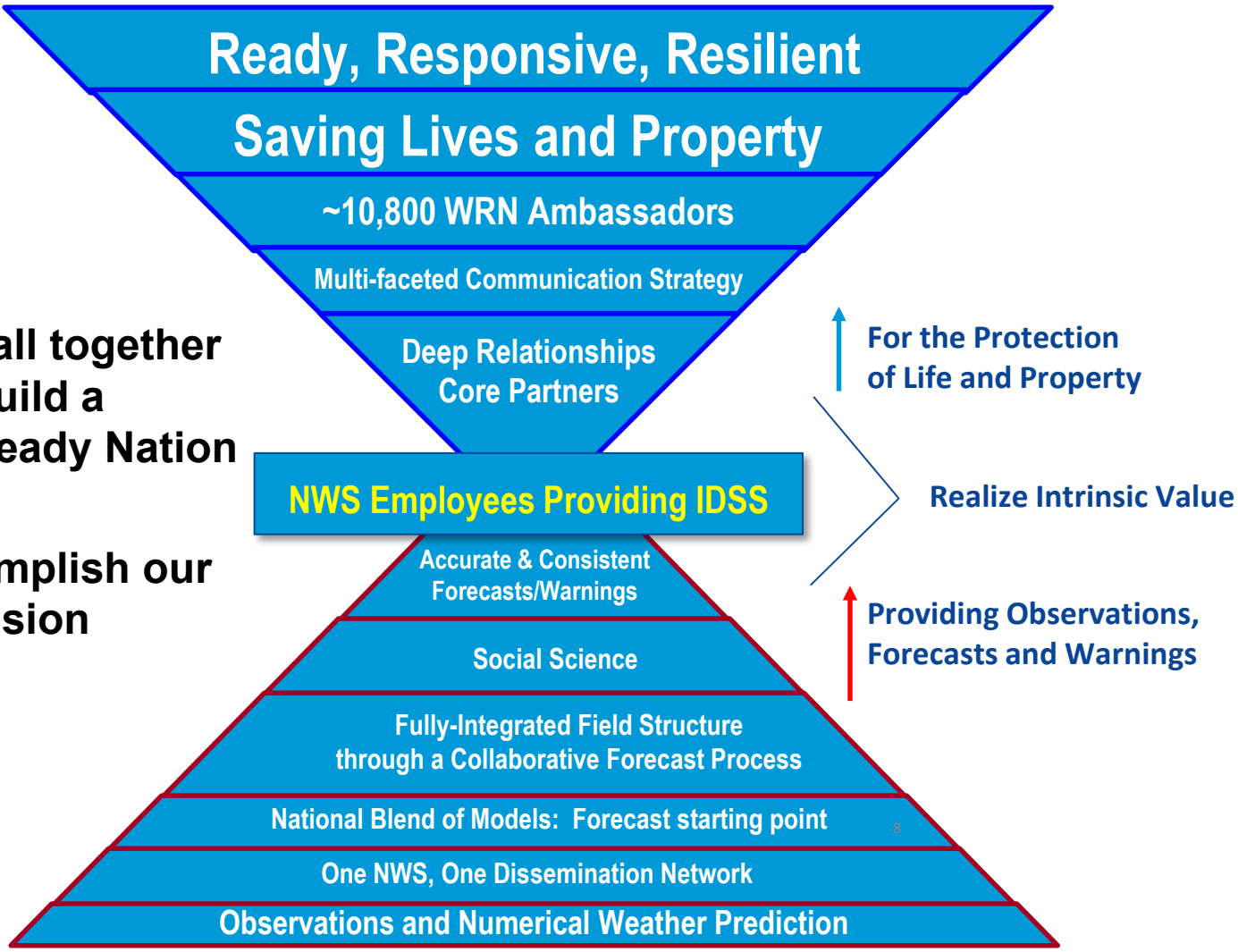
Work Together

Build TRUST

Ensuring Ready, Responsive, and Resilient Communities

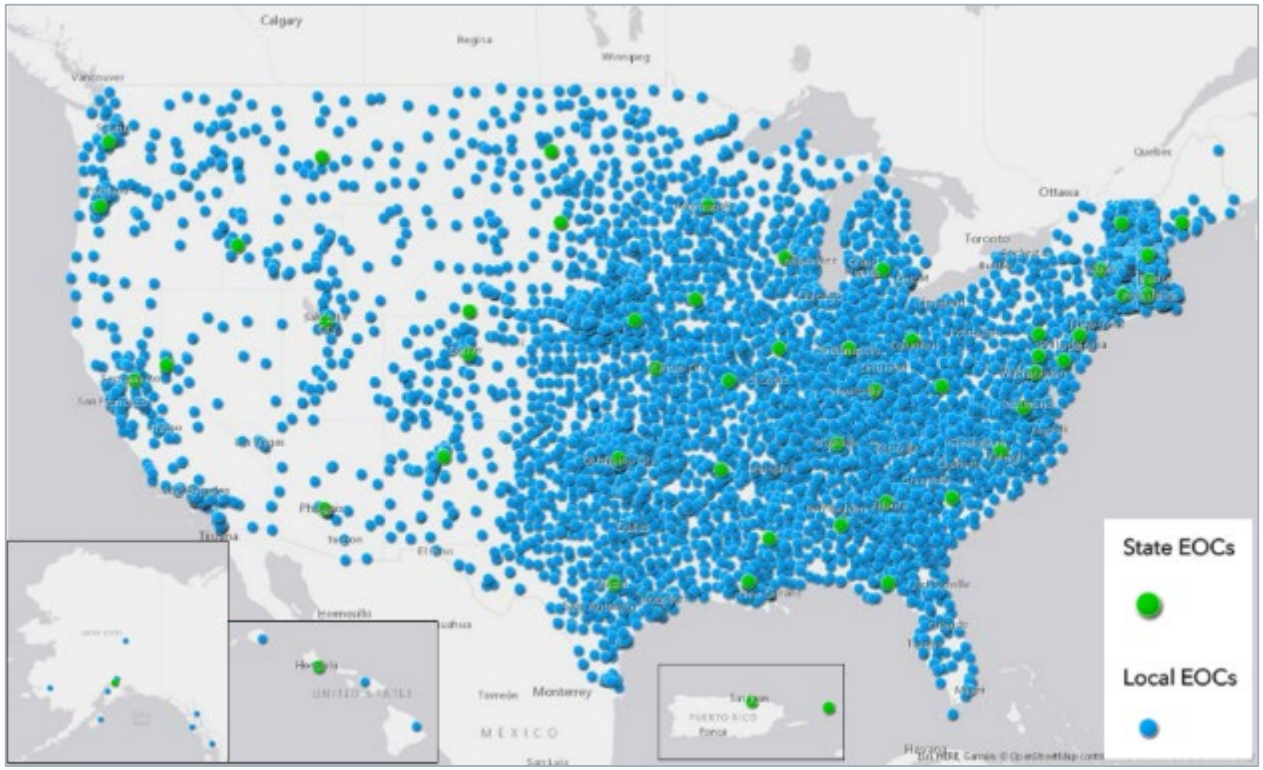
Pulling it all together to build a Weather-Ready Nation

and accomplish our mission



2017 Weather Act: Address the “increase IDSS” at the Federal, State, Tribal Nation and local levels

Emergency Operations Centers



Reflections on de Tocqueville 1838:

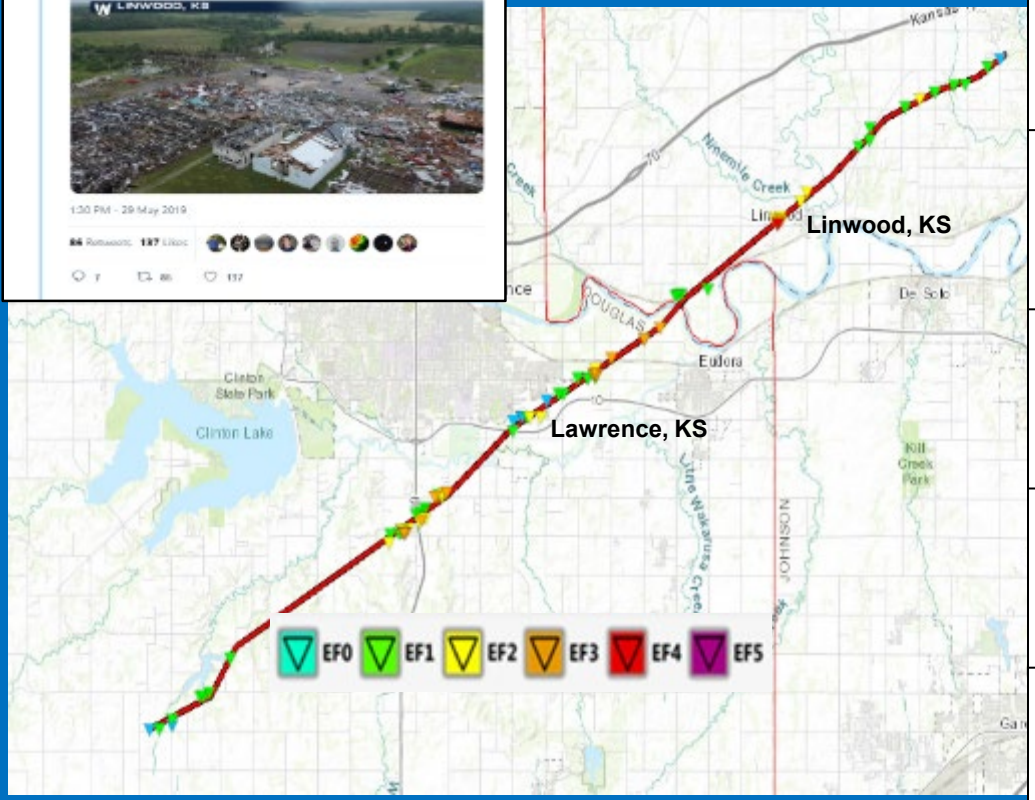
Decisions related to public good, especially public safety, are made through the “complex mechanisms” at the local level.

Building a Weather-Ready Nation

NWS has committed itself to serving the "complex mechanism" of local decision makers who save lives

Rhode Island "Storm Ready State" Celebration: 39 Townships Make the Decisions (February 2, 2018)

May 28, 2019
NE Kansas EF-4 Tornado



6 Days Before	NWS SPC outlooks Kansas City as having a risk of severe weather on 5/28.
4 Days Before	NWS SPC upgrades Kansas City's risk to Enhanced.
3 Days Before	SPC places Kansas City under a hatched area for significant severe weather potential.
9 Hours Before	SPC update features a moderate risk near Kansas City, emphasizing the tornado potential.
4 Hours Before	SPC issues a Tornado Watch for Kansas City, predicting a couple intense tornadoes possible.
1.5 Hours Before	NWS Topeka issues first Tornado Warning for Osage County as cell begins to intensify.
27 Minutes Before	NWS Kansas City issues a Tornado Warning for Linwood, calling it a "Particularly Dangerous Situation".
10 Minutes Before	NWS Kansas City issues a Tornado Emergency for Linwood and areas downward.

EF-4 on the Ground for 30+ Miles
No Fatalities!

Memorial Day 2019 Ohio Tornado Outbreak

Tornado Warnings Issued: 37 Tornado

Probability of Detection: 100%Tornado

Touchdown Lead Time: 6 to 34 minutes

Lead Time for Dayton EF4 Damage: 34 minutes

"Thanks for the collaborative effort in saving lives that night…" - Brian Davis, Chief Meteorologist WDTN Dayton Channel 2

"You all did an AMAZING job on Memorial Day and the days that followed…" - McCall Vrydaghs, Chief Meteorologist WHIO Dayton Channel 7

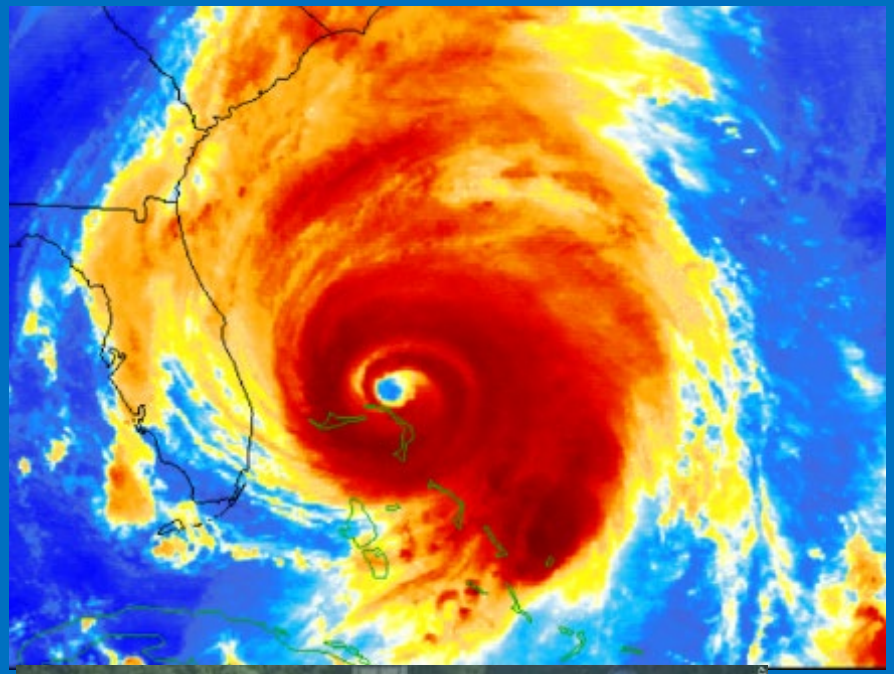
Courtesy: Andy Hatzos (NWS Wilmington, OH)

The Washington Post

Article Regarding May 27-28, 2019 NE Kansas and Dayton, OH Tornadoes

‘Something incredible happened last week’: Forecasters credited with saving lives in outbreak with 434 tornado reports

1999: Hurricane Floyd



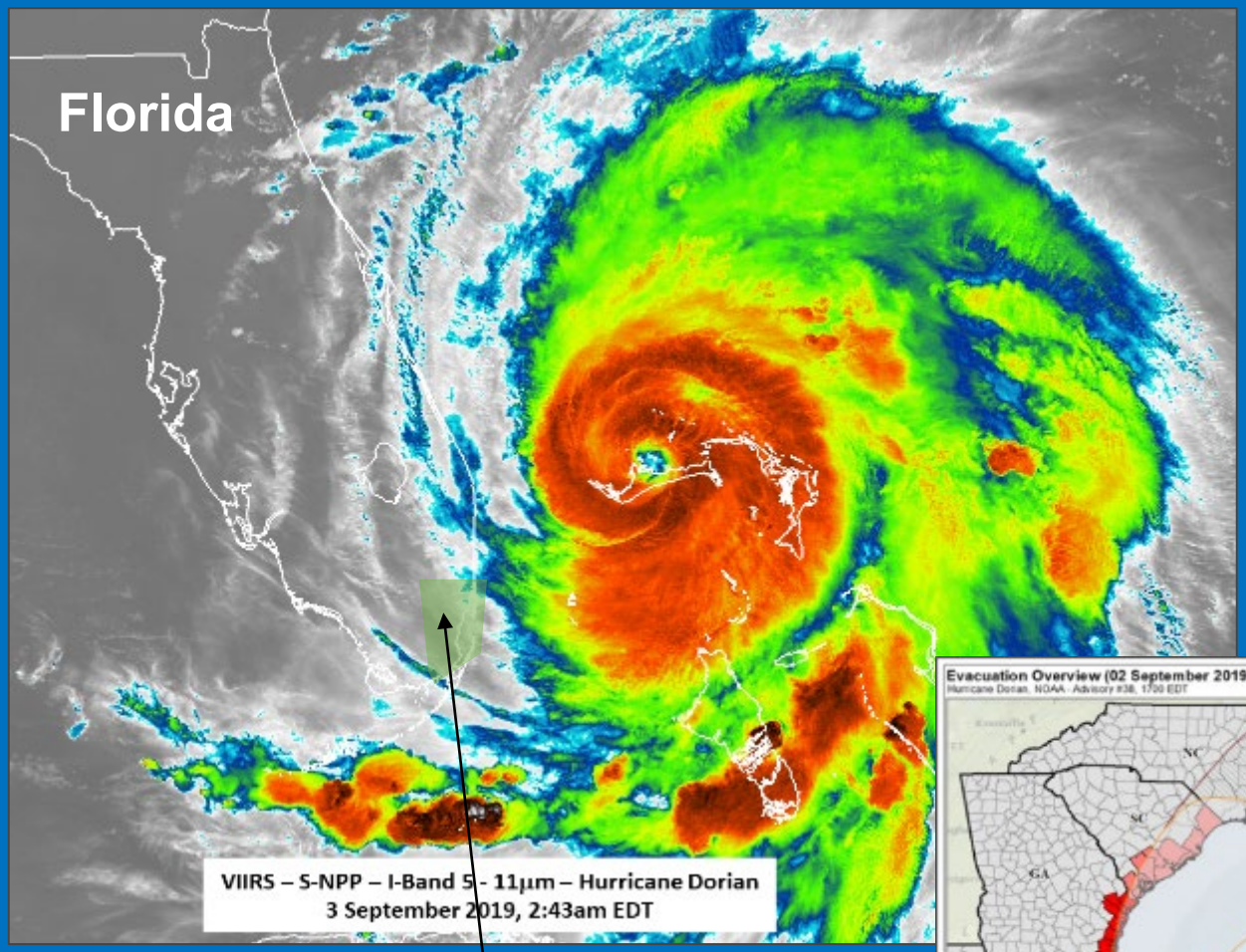
Traffic in all four lanes of I-16 as people evacuate the coast outside Savannah, GA, on 9/14/1999, ahead of Hurricane Floyd.

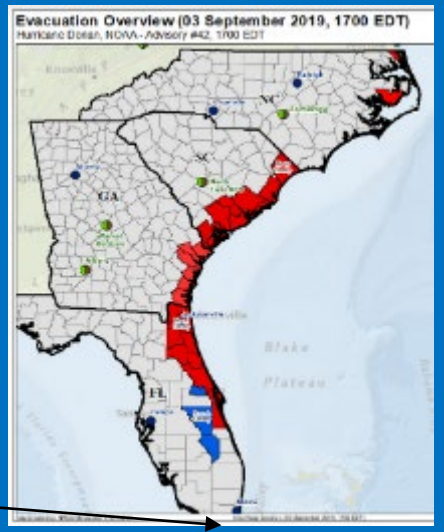
CNN **Thousands in Florida told to evacuate September 13, 1999**

The Washington Post **Floyd Prompts Huge Flight From Coast**

AP **Clinton rushes home ahead of Hurricane Floyd**

2019: Hurricane Dorian

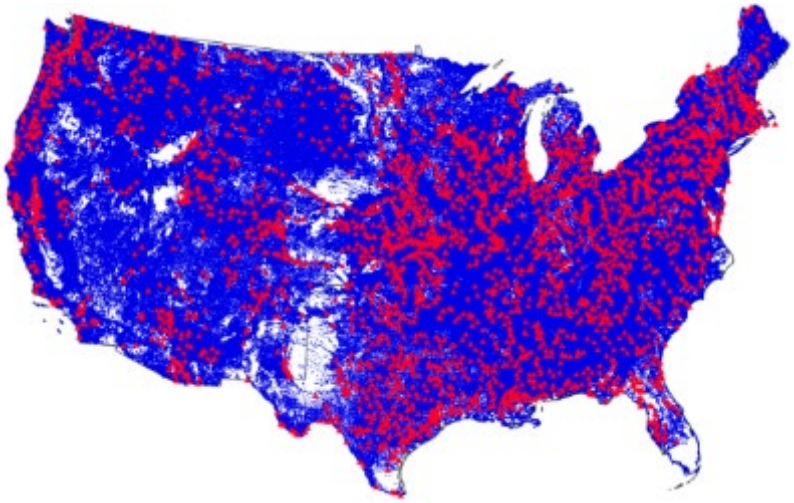


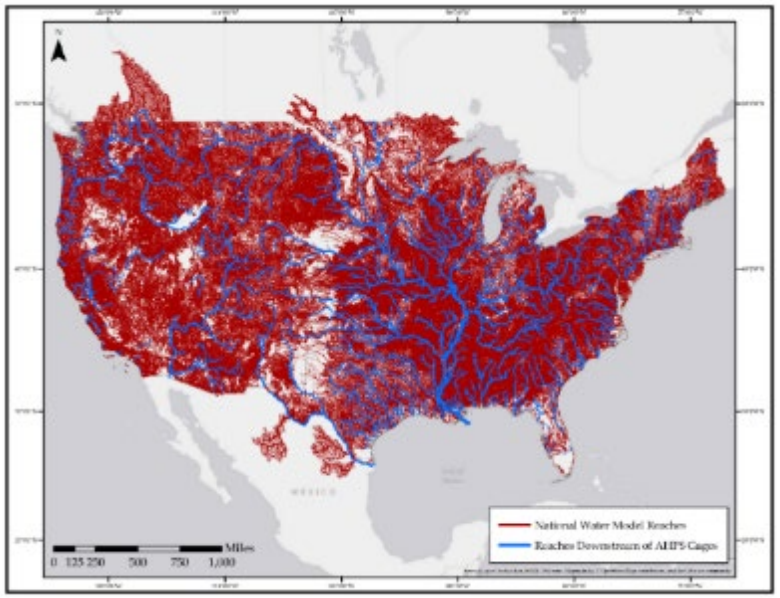


Miami-Dade County

National Water Model

Current Operational Predictions





NWS AHPS points (red)
NWM Output Points (blue)

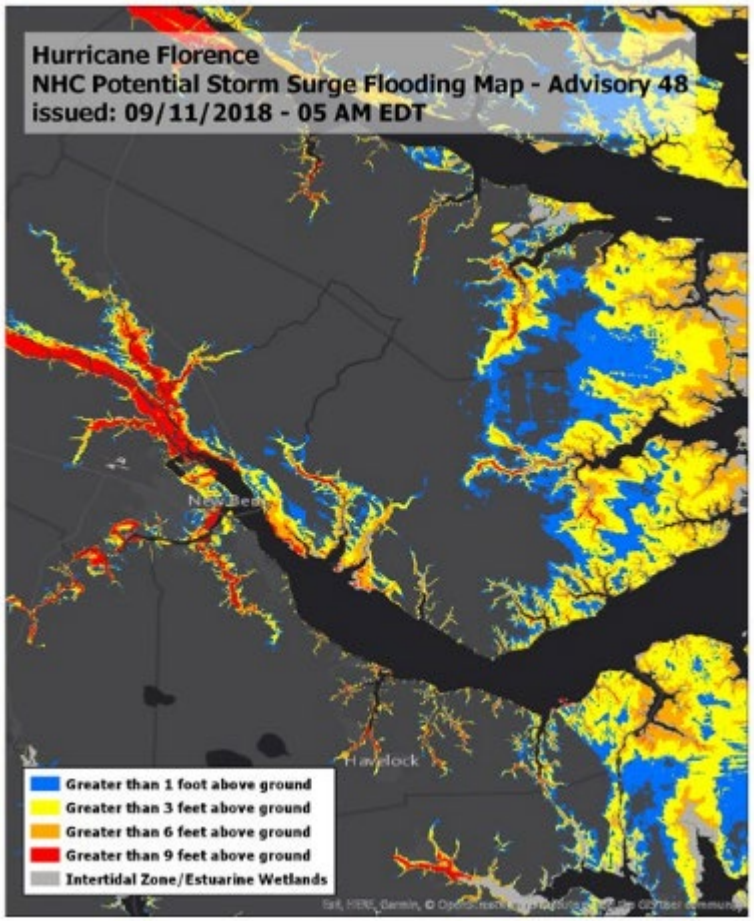
~ 4000 Advanced Hydrologic Prediction Service River Forecast Points

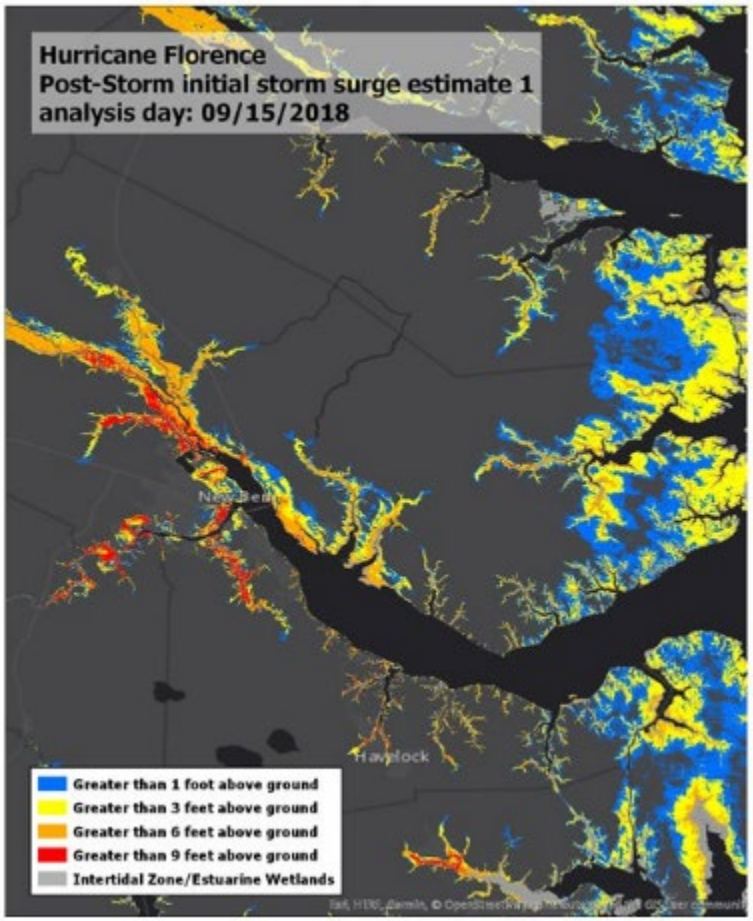
~ 110,000 River Miles

NWM Streamflow Output Points ~2.7 million

~5,000,000 River Miles

Florence: Storm Surge

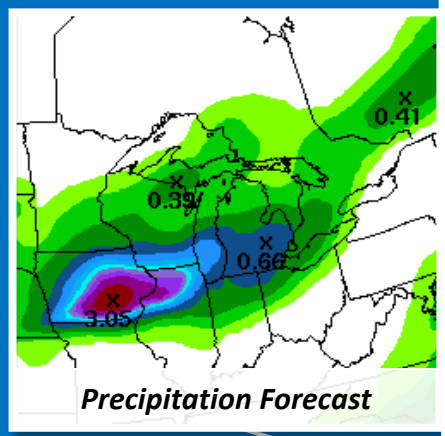




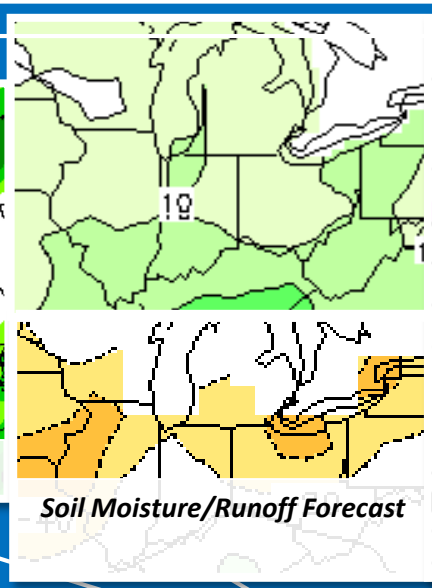
Initial issuance of the potential storm surge flooding map on September 11, 2018 at 5am EDT (left) versus the initial post-landfall analysis of storm surge flooding from Hurricane Florence (right) near New Bern, NC

Taking Prediction to the Next Level
with NOS, OAR, NMFS, NESDIS

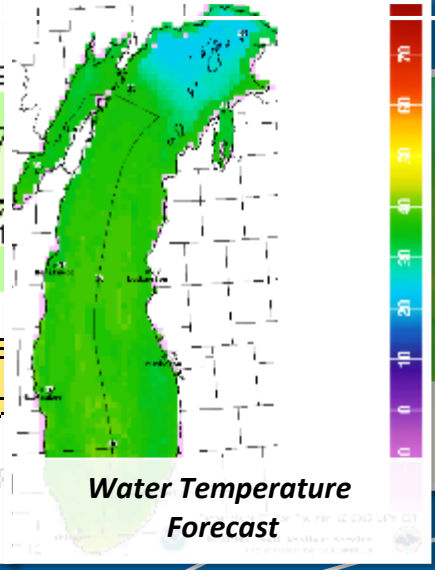
Existing Products

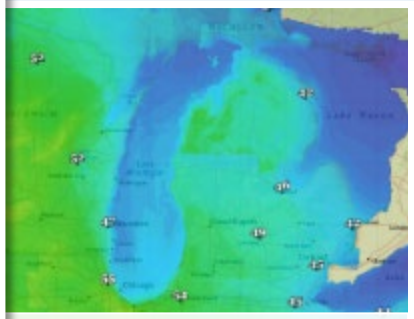


Precipitation Forecast



Soil Moisture/Runoff Forecast


Water Temperature Forecast


Air Temperature Forecast

HAB **Hypoxia** **Vibrio** **Beach**

Quality

Health Vectors

“One NOAA” Ecological Forecasting Collaborating with NOS, NMFS, OAR

Harmful Algal Bloom, Hypoxia (low oxygen in the water), Pathogens, and Habitat Science prediction led by NOS, NMFS

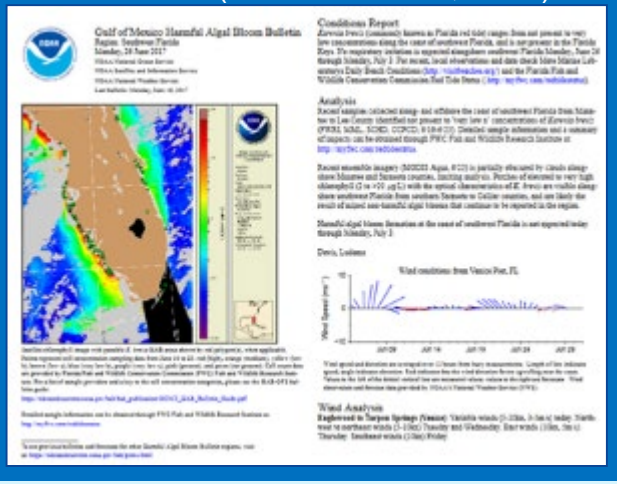
Examples of NWS *IDSS* for eco forecasting:

- NOS’ Lake Erie Daily HAB Bulletin (Operational July 3, 2017)
- WFO CLE provides a decision support dashboard to NOS’ HAB analysts to use in preparing the HAB Bulletin.
- OHRFC provides CFS 45-day flow forecasts for 2 points on Maumee River to NOS’ HAB analysts

- WFOs Tampa, Miami, and Key West wind obs and forecasts input into the HAB forecast (Summer-Fall 2018)
- WFOs Tampa and Miami have issued Beach Hazard Statements for high respiratory irritation from HAB, connecting NOS products to local decision makers through IDSS

True color image of western Lake Erie taken by the MODIS on NASA’s Aqua satellite

Recent NOS Gulf of Mexico HAB Bulletin for SW FL (issued June 26 , 2017)

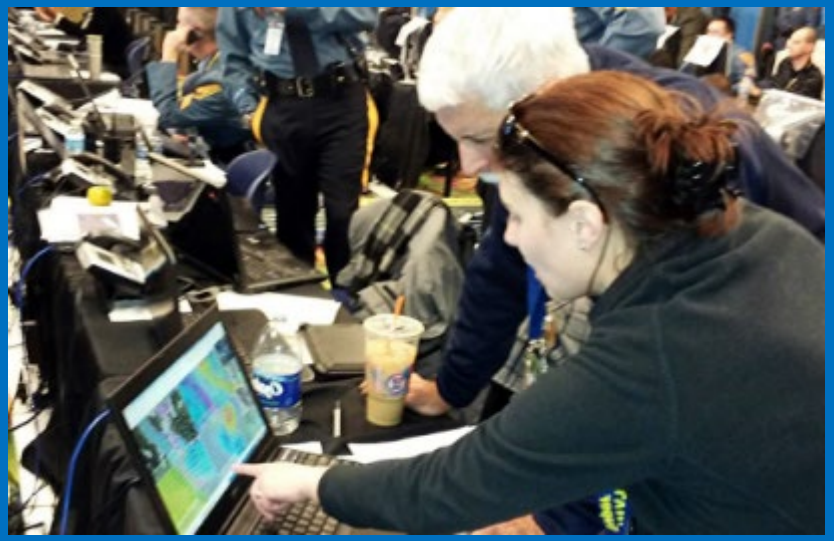


Future Needs

- A skilled, highly trained workforce is essential to build a Weather-Ready Nation

- Earth System Science:
  - Atmosphere
  - Land/Hydrology
  - Ocean
  - Cryosphere
  - Mapping/GIS

- Forecast Frontiers:
  - HAB, Hypoxia
  - Health Vectors
  - Renewable Energy
  - Arctic



- Improved Quality Control and Data Assimilation for Multi-Model Ensembles
- IT/Security; Engineers…for system reliability
- Social Sciences are crucial "KEYS to Success" for linking forecasts to Decision Support that addresses key decision points and accounts for changing risk preferences before/during/after extreme events.

Summary

- Going beyond forecasts and warnings to provide impact-based decision support services to Core Partners
- Instilling a collaborative forecast process for accuracy and consistency
- Utilizing physical and social science to connect forecasts and warnings to decision-makers to address changing risk preferences
- Lessons Learned:
  - Urban IDSS ≠ Rural IDSS
  - Weather IDSS ≠ Water IDSS
  - Decisions are being made with longer lead time
- Cannot do it alone - Team NOAA; Weather Enterprise; Core Partners; Federal/State/Local/Tribal Nations…
- Building Weather-Ready Nations: Global efforts through State Department and WMO

EVOLVING THE NATIONAL WEATHER SERVICE TO BUILD A WEATHER-READY NATION -

Connecting Observations, Forecasts, and Warnings to Decision-Makers through Impact-Based Decision Support Services

Authors: Louis W. Uccellini and John Ten Hoeve

Reference:
Uccellini, L., Ten Hoeve, J. (2019). Evolving the National Weather Service to Build a Weather-Ready Nation; Connecting Observations, Forecasts, and Warnings to Decision-Makers through Impact-Based Decision Support Services. *Bulletin of the American Meteorological Society*, (100), 10. 1924-1942.

Other Resources:
Lazo, J.K., H.R. Hosterman, J.M. Sprague-Hilderbrand, and J.E. Adkins: Impact-Based Decision Support Services and the Socioeconomic Impacts of Winter Storms. *Bulletin of the American Meteorological Society.*

Lazo, J.K., H.R. Hosterman, J.M. Sprague-Hilderbrand, and J.E. Adkins,Using the National Weather Service's Impact Based Decision Support Services to Prepare for Extreme Winter Storms. *Journal of Emergency Management.*

Thank you!

weather.gov

Follow up questions can be sent to:
nws.communications.office@noaa.gov

Planning & Budget Structure

Observations Tom Cuff	Sustains & integrates all observations to support the NWS mission and ensure continuous situational awareness
Central Processing David Michaud	Fully integrates the central and distributed computing system from central computer to AWIPS/AHPS
AFS Andrew Stern	Analyze, Forecast, Support includes all NWS forecast offices: -Works toward "fully integrated field structure" providing consistent products & services - Supports local/national IDSS, outreach, & social science integration
Dissemination Michelle Mainelli	Provides better managed, reliable, centralized, and more responsive network, especially during high impact events.
STI Russ Schneider (A)	Accelerates numerical model advances, supports forecaster training/development, provides a centralized development environment to enable Research to Operations (R2O) & a visible "catcher's mitt" for the rest of the research community interested in the R2O process (e.g., CSTAR, SOO/DOH …)
Facilities Tim Greten	Sustains all NWS facilities as a fundamental part of the NWS mission execution

October 2019 Western Wildfires

The WFOs, Western Region ROC, and 20 deployed NWS meteorologists provided collaborated and consistent NWS messaging about event significance.

With the rapid and accurate forecasts that were produced, I was able to calibrate my Fire Behavior Forecasts with a high degree of accuracy. This allowed me to give the command staff prompt and precise information that led to the safe evacuation of multiple cities and areas without incident.
- Stephen Volmer, Operations Captain, CAL FIRE, Fenner Canyon CC

Based on the predicted "Historical" wind events, by NOAA, there was no question on what the fire would do. This massive evacuation, (based on the NOAA's intel), proved accurate and validated the need. - Josh Janssen, B3511 Battalion Chief, CAL FIRE, San Bernardino Unit