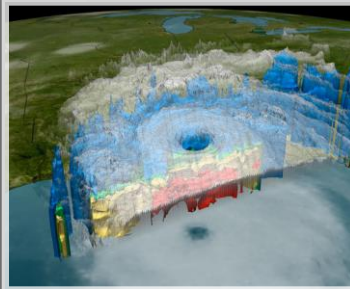
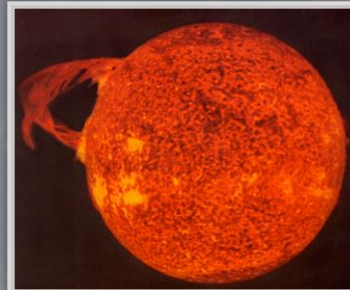
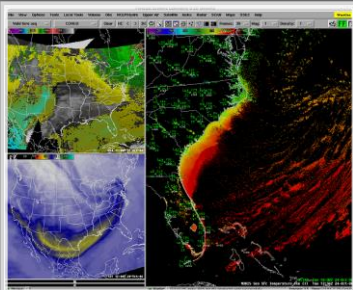


# A Weather-Ready Nation: Ready, Responsive, Resilient



**John D. Murphy**

**Chief Operating Officer**

**National Weather Service**

**October 27, 2016 – Multi-State Fleet Response Working Group**



# Increase in Extreme Events

## “Average” Year and Trends in the U.S.



**650 Deaths**  
**\$15B in Losses**



**26,000 Severe**  
**Thunderstorms**



**6 Atlantic Basin**  
**Hurricanes**



**1,300 Tornadoes**



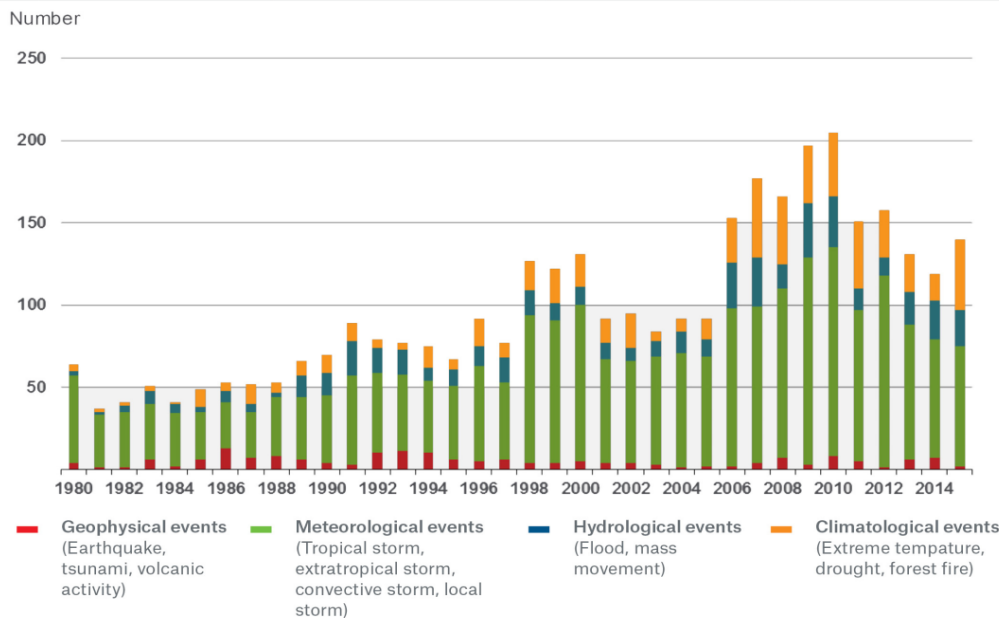
**5,000 Floods**

Munich Re NatCatSERVICE

### Loss events in the U.S. 1980 - 2015

Number of events\* \*Excludes last week of December 2015

Munich RE



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### Increasing Vulnerability

- Increasing population
  - More infrastructure at risk
  - Signs of sea level rise
- 
- Improved forecasts of extreme events 4-8 days in advance
  - Connecting forecasts to decision-makers is basis for building a Weather-Ready Nation





# Comparing 1974 and 2011 Severe Weather Outbreaks



## April 3-4, 1974 Super Outbreak

- 150 tornadoes across 13 states
- 6 F-5 tornadoes, 24 F-4
- Tornado Track Length: 2500 mi
- Tornado Time: 50 hours
- “Indications” provided night before
- Fatalities: 310-319

## April 27-28, 2011 Super Outbreak

- ~200 tornadoes across 16 states
- 4 EF-5 tornadoes; 11 EF-4
- Tornado Track Length: 2500 mi
- Tornado Time: 50 hours
- Outbreak forecast 4-6 days prior
- Warning lead time ~ 24mins
- Fatalities: 316





# **“A Vital Conversation”**

## ***Dec 2011 Workshop in Norman***

Focus on the “last mile”  
& warnings to decision-making:

Connecting forecasts

- Assess and update warning dissemination strategy
- Integrate social and physical science to address:
  - Is the message delivered equal to the message received?
  - Impact-based forecast & warnings for wide range of decision makers
- Improved outreach and education







# NWS Mission Doesn't End with Forecasts & Warnings



***“First, it should be understood that forecasts possess no intrinsic value. They acquire value through their ability to influence the decisions made by users of the forecasts.”***

**“What is a Good Forecast? An Essay on the Nature of Goodness in Weather Forecasting”**

*– by Allan H. Murphy; Weather and Forecasting (June 1993)*





# NWS Strategic Outcome: A Weather-Ready Nation

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

## ***"Ready, Responsive, Resilient"***

- Requires NWS to:
  - Fully integrate our field structure to produce:
    - *Better forecasts and warnings*
    - *Consistent products and services*
    - *Actionable environmental intelligence*
  - Address "last mile" that connects forecast to critical national, state and local decisions
    - *Provide Impact-based Decision Support Services (IDSS)*
    - *Deliver through multiple and reliable dissemination pathways*
    - *Work with partners to gain needed response; includes embedding NWS in Emergency Operations Centers and incorporating Social Sciences*



***Involves entire US Weather, Water and Climate Enterprise WORKING TOGETHER  
to achieve far-reaching national preparedness for weather events***





# Realizing Intrinsic Value

*Intrinsic Value is realized through the provision of Impact-Based Decision Support Services (IDSS)*

Generating forecasts and warnings + Connecting those forecasts/warnings with impacts = **IDSS**



The best hydrometeorological forecasting in the world

Practice, practice, practice!



Develop relationships / know partner needs



**Embed**



**Trust**



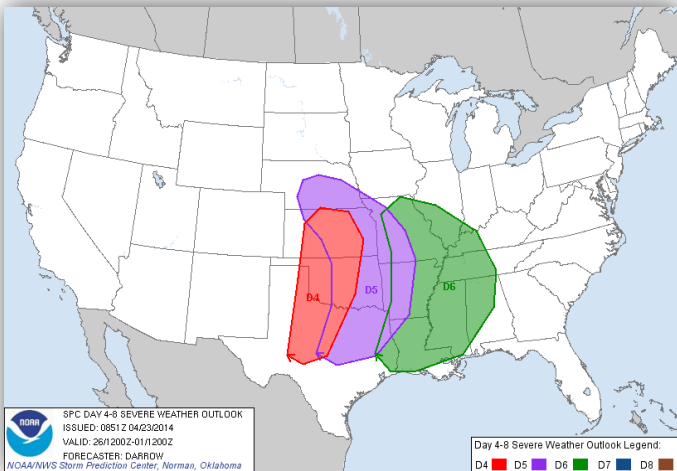
**“Ready, Responsive, Resilient”**



# Extending Impact-based Decision Support Services

## Severe Weather General Timeline

### Severe Weather Preparedness and Forging Effective Partnerships



**NWS briefs partners as confidence increases; EMs maintain awareness**

**Preparation:**  
NWS works closely with EM at all levels who are identifying personnel and assessing availability of interagency resources

**Enhanced Collaboration:**  
Partner briefings more frequent to discuss risks and identify any shortfalls  
+  
Review/Execute All-Hazard Emergency Operation Plans

8 - 4

3

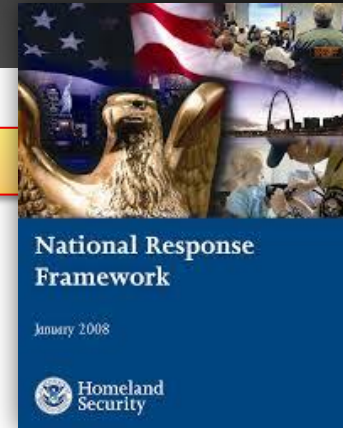
2

1

Outbreak

Days to Outbreak

National, state and local emergency managers need *consistent* and more accurate forecasts from Days 1-8 for planning and preparation decisions







# Extending Impact-based Decision Support Services

## Severe Weather General Timeline

### IDSS and Real-Time Situational Awareness:

NWS deploys to EOCs and Coordination Centers;  
FEMA and States deploy response assets and teams

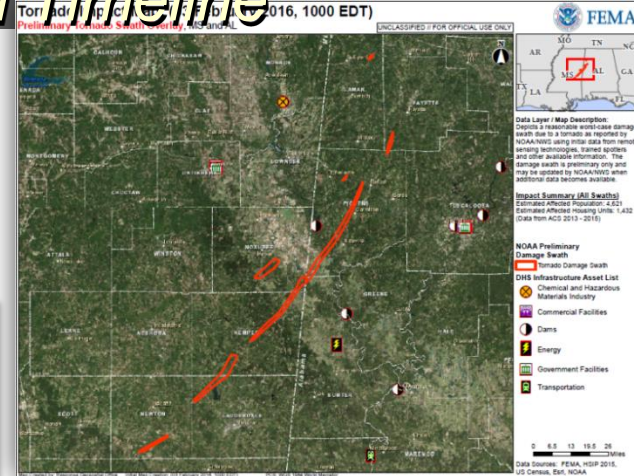


Photo: FEMA



### Event Characterization:

NWS provides GIS tracks within  
1-hr; FEMA analyzes impacts



### Federal Assistance:

FEMA and States define response and recovery needs



### Declaration Requests:

NWS provides analysis; FEMA and  
States conduct damage assessments

24 Hrs Prior

24 Hrs After

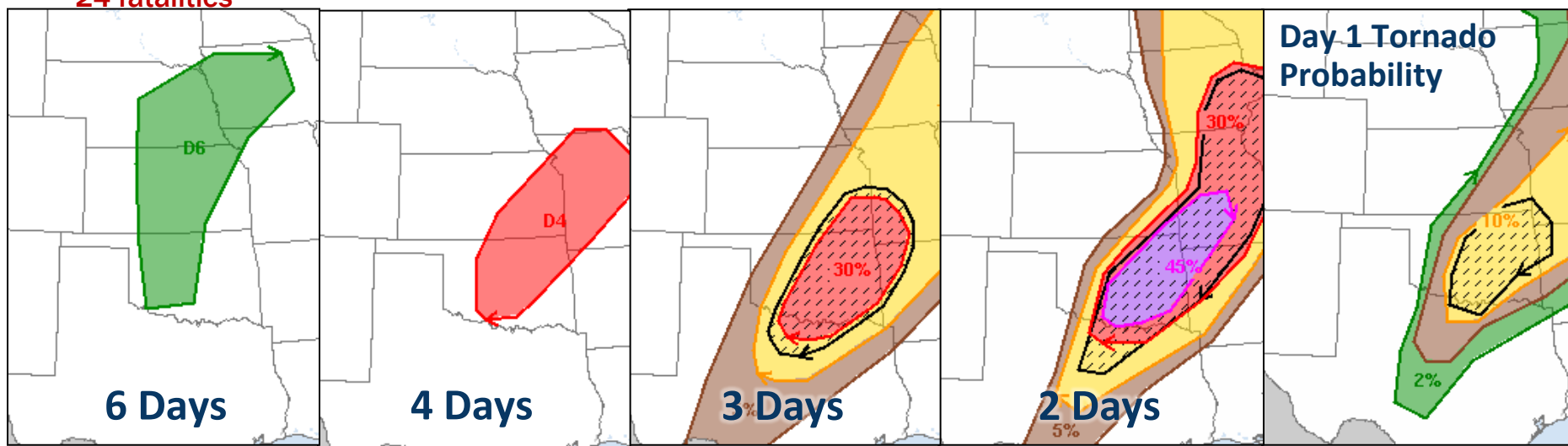
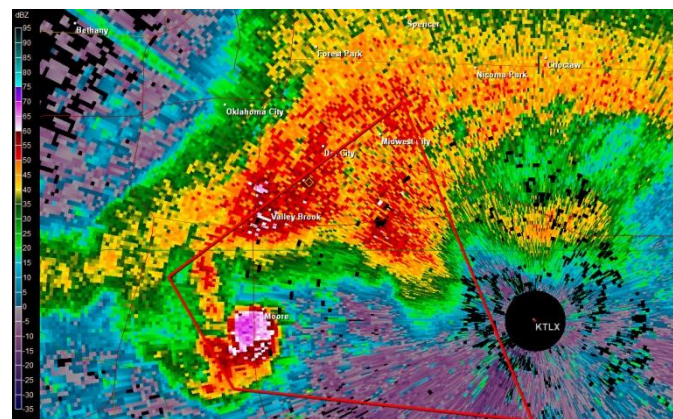
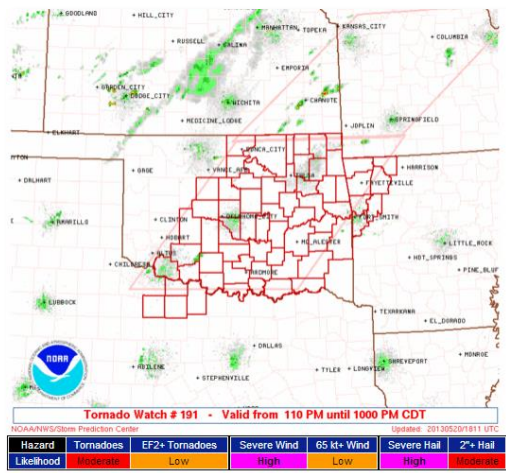
2+ Days



# Moore EF-5 Tornado (May 20, 2013)

## Convective Outlooks Highlight Threat

- Convective Outlooks highlighted threat 6 days out, SPC-FEMA coordination began 4 days in advance
- Norman WFO coordinated with EM/city managers 5 days in advance
- 31 minutes of warning lead-time for Moore, OK
- EF-5 Intensity, 200+ mph winds, 1.08 miles wide
- **24 fatalities**







# Moore EF-5 Tornado (May 20, 2013)

## Successful IDSS – Go Beyond Forecast

### Efforts to Improve Impact-Based Decision Support Services

- WFO Norman: targeted partnership development with local leaders in Moore over a 2 year period
  - Emergency managers, schools, and hospitals
- Conducted Impact-based Warning Demonstration (2012-current)
- Norman WFO established multiple dissemination outlets
- WFO connection to the Moore Medical Center; Lessons learned from Joplin
  - Medical Center took a direct hit
  - No lives lost at the hospital



**“The information you and the weather service provided us ultimately saved more lives than we could ever count”**

*--Shane Cohea, Moore Medical Center*

**Award-winning WCM Rick Smith worked with Moore Hospital months before it took a direct hit**



# Short-Term Prediction and the Rise of Now-casting Systems

Today:

Forecasters issue warnings based on observations

Near Future:

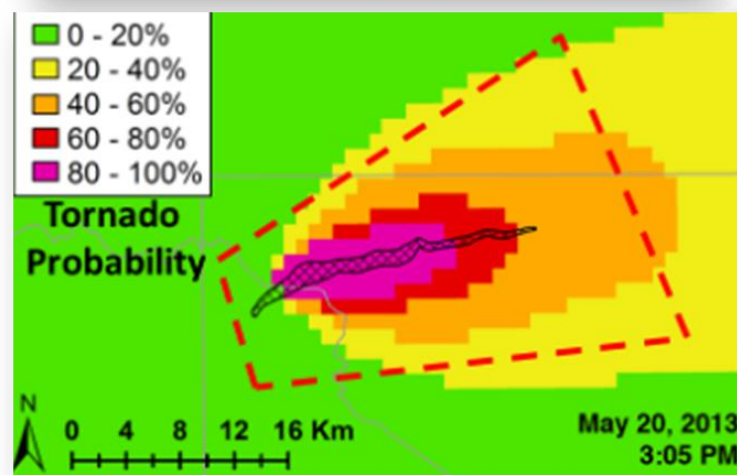
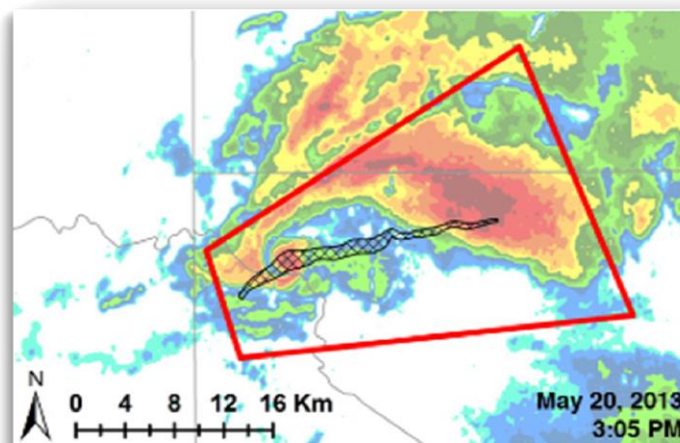
*“Warn on Forecast”*

Output from storm-scale models used to extend warning capabilities

The NWS will adopt:

Forecasting a Continuum of Environmental Threats

**FACETS**







# Summary

## WRN Vision Becoming Reality

- NWS: A science-based service organization
- Through our partnerships & embrace of Impact-based Decision Support Services, making tremendous progress **Building a Weather-Ready Nation**
- Successful IDSS requires improved forecasts/warnings with quantitative uncertainty and predictive analytics
- Emergency Management community able to pre-position resources week in advance; NWS prepared to provide support coinciding w/key decision points
- Local Emergency Managers have much greater situational awareness to anticipate and respond more quickly
- NWS committed to **Building a Weather-Ready Nation** to address increased vulnerabilities from extreme events (**We cannot do this alone**); we must work with federal, state, city, and local EM community and other key decision-makers and partners to achieve success

# Thank you

