

Integrating Weather Forecasts into Transportation Decision Making

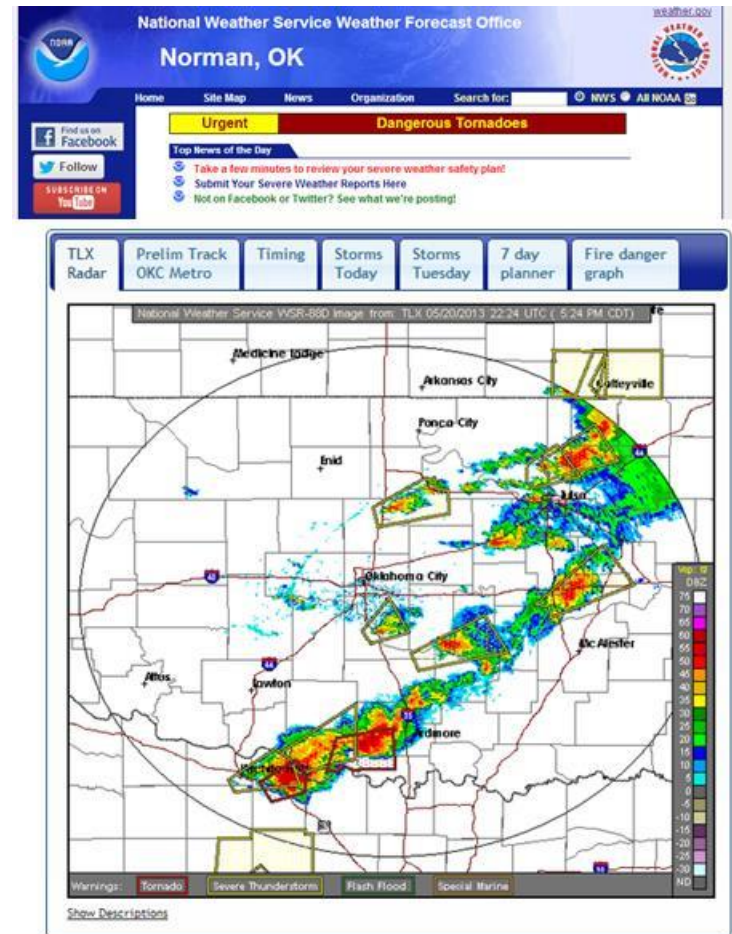


Dr. David Green,
NOAA National Weather Service

Washington D.C. May 21, 2013

Outline

- Common concern and goal
- National Weather Service
- Partnerships & DOT Support
- Resources



Our Common Concern

Extreme Weather

- Includes...
 - severe and unseasonable weather
 - heavy precipitation
 - hurricanes
 - storm surges
 - tornadoes, other windstorms (including derechos)
 - extreme heat, extreme cold
 - and many other qualifying weather events...



Our Common Goal

A Weather Ready Nation

Its about better decisions!



<http://www.nws.noaa.gov/com/weatherreadynation/>



Traffic Operations Center . Photo courtesy UDOT

Your National Weather Service

Protecting Lives and Property

Mission

Protect life and property and enhance the national economy

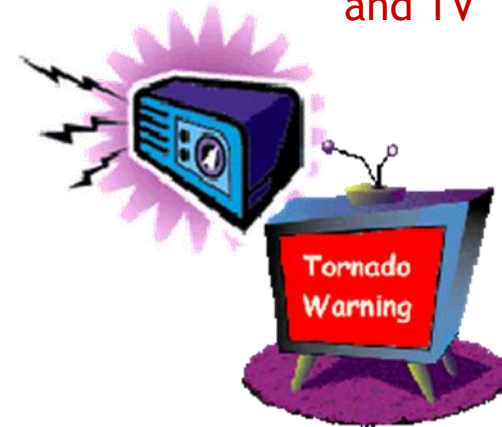


What we do!

Create a suite of data and products (forecasts, analysis, maps, outlooks, tools...)

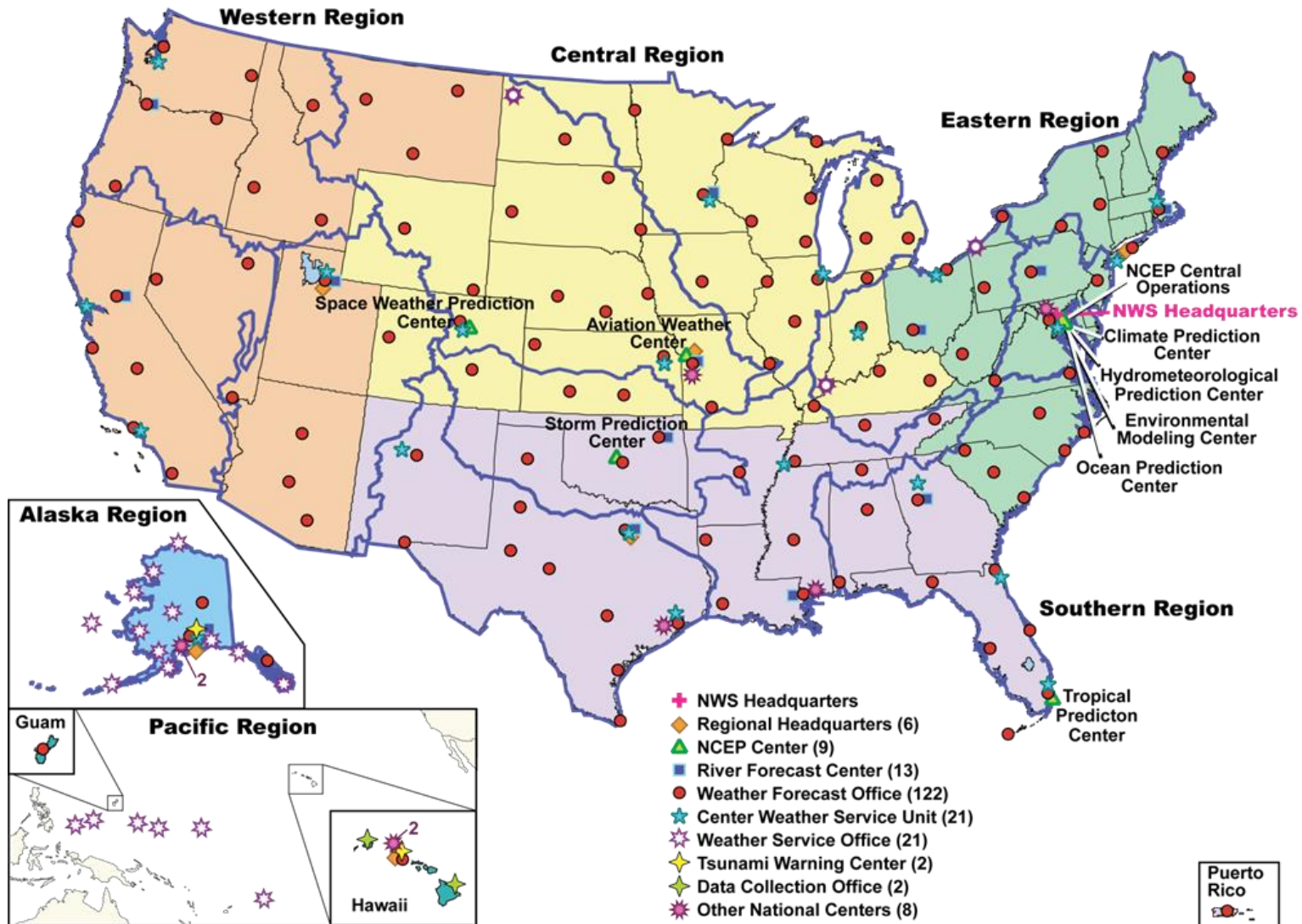
Enable decisions of other governmental agencies, the private sector, the public, and the global community

We issue the
warnings you
hear on radio
and TV



Your National Weather Service

Strong Community Presence



www.weather.gov



NATIONAL WEATHER SERVICE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

[HOME](#)[FORECAST](#)[PAST WEATHER](#)[WEATHER SAFETY](#)[INFORMATION CENTER](#)[NEWS](#)[SEARCH](#)[ABOUT](#)

Local forecast by
"City, St" or ZIP code

[Location Help](#)

Severe Weather Possible Across Parts of Northern Plains, Southern Plains, Southeast

The NWS Storm Prediction Center is forecasting a possibility of severe thunderstorms Friday afternoon and evening for parts of northeast Wyoming, western South Dakota and northwestern Nebraska, parts of west-central Texas, as well as parts of northern Mississippi and Alabama and southern middle Tennessee. The primary threats will be damaging wind and large hail.

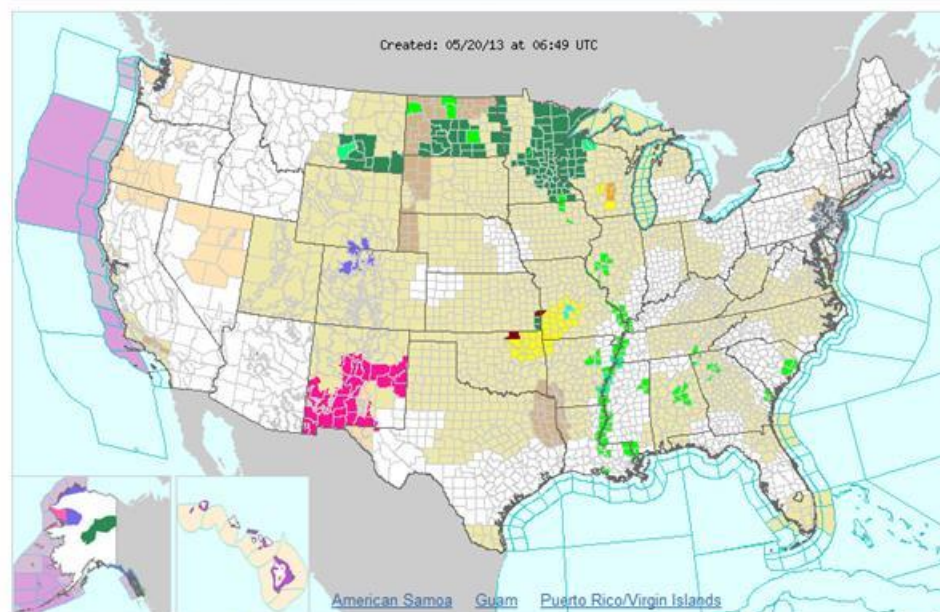
[Read More...](#)

Customize Your Weather.gov

Enter Your City, ST or
ZIP Code

☐ Remember Me[Privacy Policy](#)

[ACTIVE ALERTS](#) [FORECAST MAPS](#) [RADAR](#) [RIVERS, LAKES, RAINFALL](#) [AIR QUALITY](#) [SATELLITE](#) [PAST WEATHER](#)



Click on the map above for detailed alerts or

Warnings By State

Public Alerts in XML/CAP v1.1 and ATOM Formats

☐ [Severe Thunderstorm
Warning](#)

☐ [Flash Flood Warning](#)

☐ [Severe Weather
Statement](#)

☐ [Winter Storm Warning](#)

☐ [Flood Warning](#)

☐ [Tornado Watch](#)

☐ [Flash Flood Watch](#)

☐ [Small Craft Advisory
For Winds](#)

☐ [Small Craft Advisory](#)

☐ [Brisk Wind Advisory](#)

☐ [Hazardous Seas
Warning](#)

☐ [Lake Wind Advisory](#)

☐ [Wind Advisory](#)

☐ [Frost Advisory](#)

☐ [Gale Warning](#)

☐ [Red Flag Warning](#)

☐ [Winter Weather
Advisory](#)

☐ [Flood Advisory](#)

☐ [High Surf Advisory](#)

☐ [Dense Fog Advisory](#)

☐ [Small Craft Advisory
For Hazardous Seas](#)

☐ [Flood Watch](#)

☐ [Fire Weather Watch](#)

☐ [Special Weather
Statement](#)


☐ [Marine Weather
Statement](#)

☐ [Hazardous Weather
Outlook](#)

☐ [Hydrologic Outlook](#)

NWS Forecast Maps

<http://www.weather.gov/forecastmaps>

**NATIONAL WEATHER SERVICE**
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

HOME FORECAST PAST WEATHER WEATHER SAFETY INFORMATION CENTER NEWS SEARCH ABOUT

Local forecast by "City, ST" or ZIP code
 Enter location
[Location Help](#)


Severe Weather Threat to Continue Through Monday Across the Central States
After over 300 reports of severe weather on Sunday, another round of dangerous severe weather is expected Monday with the greatest threat once again in the southern Plains targeting Oklahoma and parts of Kansas, Missouri and Arkansas. However, severe weather is possible much further north towards Chicago and Madison as well.
[Read More](#)

National Forecast Maps
[Weather.gov](#) > National Forecast Maps


National Weather Service
National Headquarters

Customize Your Weather.gov
City, ST
Enter Your City, ST or ZIP Code
☐ Remember Me

[Privacy Policy](#)





National Forecast Chart
High Resolution Version | Previous Days Weather Maps
Animated Forecast Maps | Alaska Maps | Pacific Islands Map
Ocean Maps | Legend | About These Maps





National Temperature
Alaska | Hawaii | Guam | Puerto Rico/Virgin Islands
More from the National Digital Forecast Database


Short Range Forecasts
Short range forecast products depicting pressure patterns, circulation centers and fronts, and types and extent of precipitation.
[12 Hour](#) | [24 Hour](#) | [36 Hour](#) | [48 Hour](#)

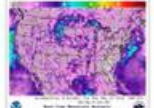
**Medium Range Forecasts**
Medium range forecast products depicting pressure patterns and circulation centers and fronts.
[Day 3](#) | [Day 4](#) | [Day 5](#) | [Day 6](#)


**Precipitation Amounts**
Quantitative precipitation forecasts.
[Day 1](#) | [Day 2](#) | [Day 3](#)


**Surface Analysis**
Highs, lows, fronts, troughs, outflow boundaries, squall lines, drylines for much of North America, the Western Atlantic and Eastern Pacific oceans, and the Gulf of Mexico.
[Standard Size](#) | [High Resolution](#)


**Temperature**
Maximum daytime or minimum overnight temperature in degrees Fahrenheit.

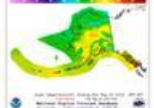
**Predominant Weather**
Expected weather (precipitating or non-precipitating) valid at the indicated hour. The weather element includes type, probability, and intensity information.


**Wind Speed and Direction**
Sustained wind speed (in knots) and expected wind direction (using 36 points of a compass) forecasts.

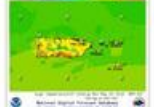
**Chance of Precipitation**
Likelihood, expressed as a percent, of a measurable precipitation event (1/100th of an inch).

**Precipitation Amount**
Total amount of expected liquid precipitation.

**Sky Cover**
Expected amount of opaque clouds (in percent) covering the sky.

**Alaska Graphical Forecasts**
Graphical forecasts from the National Digital Forecast Database for Alaska.

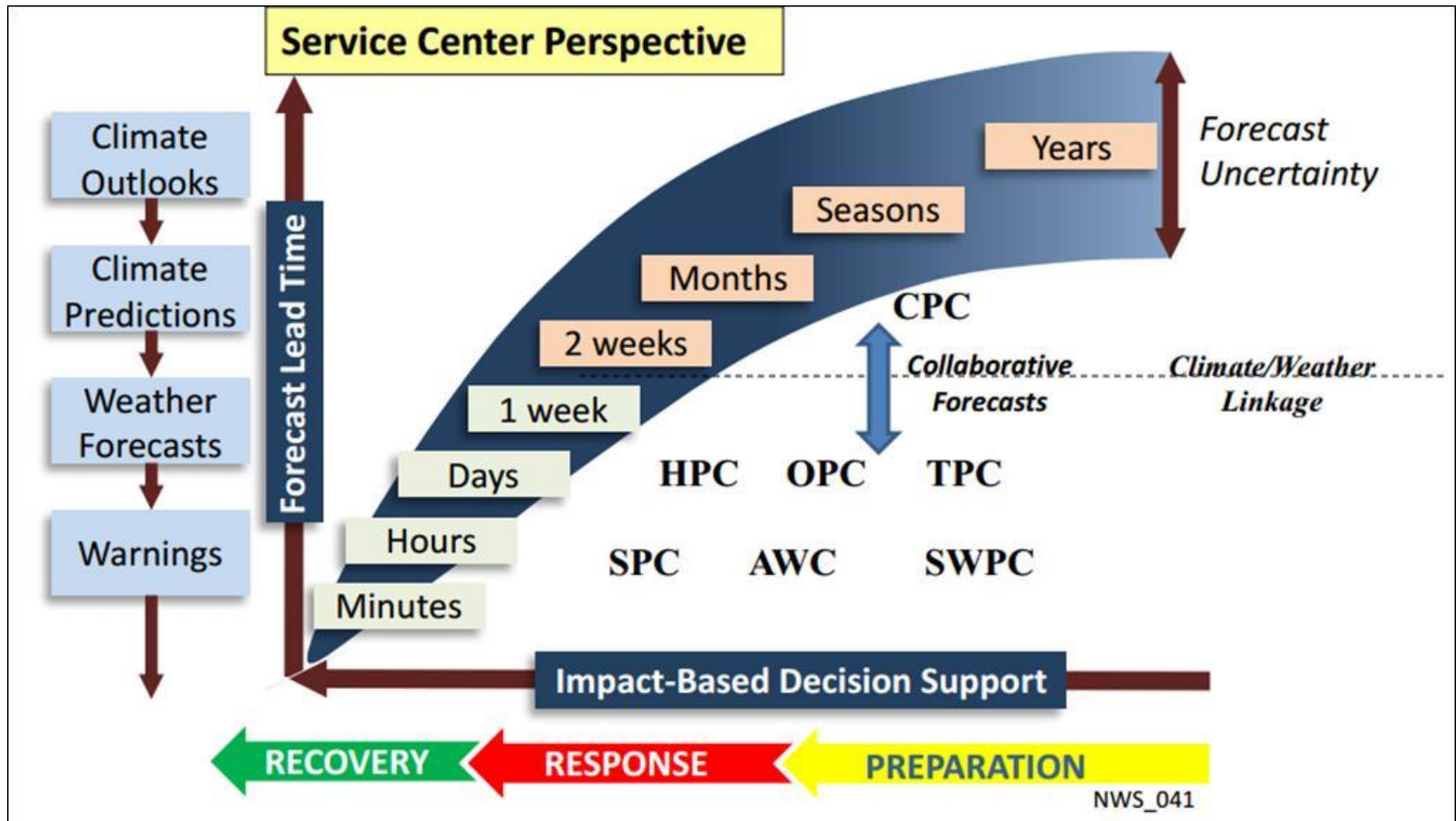
**Hawaii Graphical Forecasts**
Graphical forecasts from the National Digital Forecast Database for Hawaii.

**Puerto Rico Graphical Forecasts**
Graphical forecasts from the National Digital Forecast Database for Puerto Rico and Virgin Islands.

NWS Seamless Suite

Products and Services

Spanning Climate, Water and Weather Scales



Seamless Suite

National Outlooks for Hazardous Weather



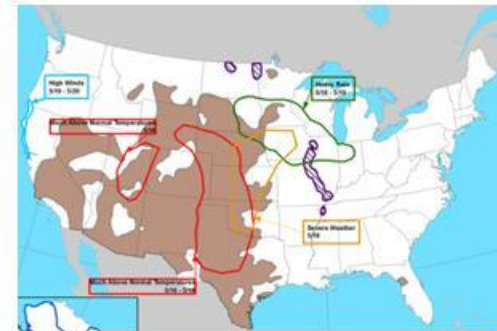
Severe Weather

www.spc.ncep.noaa.gov



Winter Weather and Heavy Precipitation

www.hpc.ncep.noaa.gov



3-7 and 8-14 Day Hazards

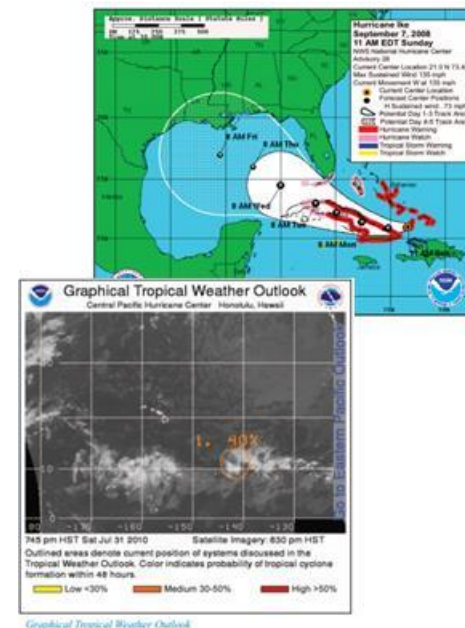
www.cpc.ncep.noaa.gov

NWS Seamless Suite

Non-Routine Products and Services

Watch/warning/advisory

- Convective Weather
- Tropical Weather
- Winter Weather
- Hydrology
- Coastal Flood
- Marine Weather
- Non-Precipitation
- Fire Weather
- Statements
- Storm Data
- Other Non-Routine Products.
- Information Requests
- Extreme Weather Wording
- Verification and Performance Goals
- Impact-Based Decision Support Services
- Requesting a Spot Fire Weather Forecast
- Hazardous Materials Emergency Support
- Interactive Warning Team
- HazCollect
- Damage Surveys



NWS Seamless Suite

Routine Products and Services

- Public Forecasts
- Data
- Radar Services
- Hydrologic Services
- Marine Services
- Fire Weather Services
- Aviation Services
- Climate Services



NWS Support for State DOTs

Partnership Policy

- **What we do!** NWS provides weather information through standard dissemination mechanisms
- **What we don't do!** NWS does not provide specialized forecasts or comprehensive services

NOTE:

NWS partners with the America's Weather Industry to provide specialized weather support to DOTs

NWS Support for State DOTs

In Practice

- **Collaboration cross all extreme weather concerns...**
 - *NWS Centers and Offices may respond to questions from (or initiate contact with) with state DOTs for the purpose of ensuring motorist safety, and for protecting life and property*
 - *NWS/DOT interaction will occur in certain non-routine situations that may be critical to public safety, such as fires, hazardous material incidents, heavy fog, and dangerous conditions that fall outside standard products*

NWS Support for State DOTs

Messaging and Forecasting

- ***Coordinated*** DOT and NWS products
 - Variable-message signs
 - Common **wording**
- ***Collaborative forecasting***
 - DOT participation in **NWSChat**
 - Evaluation of road model (e.g. METRo) output based on NWS grids and products
 - Forecasts from NWS grids available on some
 - DOT public websites
 - DOT 511 travel information systems
 - DOT internal webpages for each mile post



NWS Support to State DOTs

Enabling Decision Support

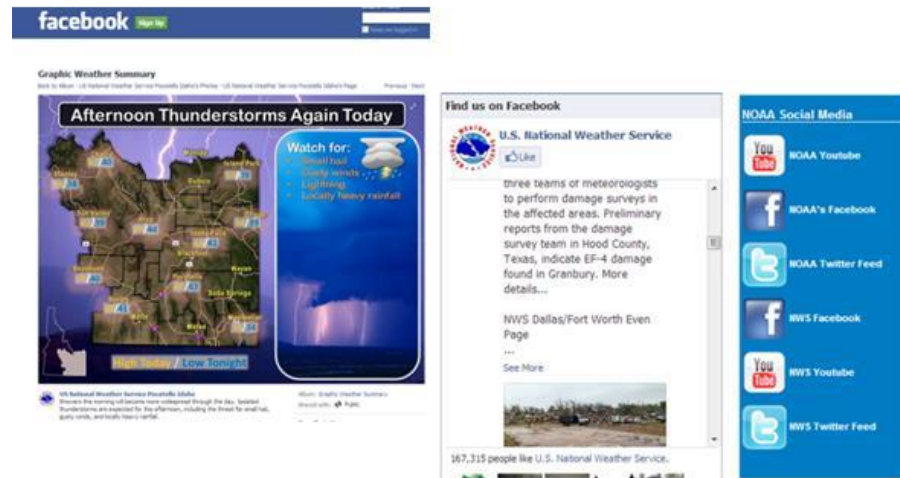
- **NWS CHAT Community**
 - Live 2-way communication with NWS, emergency managers, media... including access to DOT data and products
- *At least 91 identified DOT registered today*



DOTs and their “agents” register at:

nwschat.weather.gov

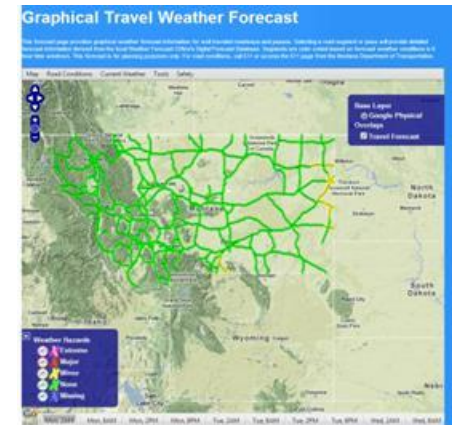
Friend Us, We are on Social Media too!



NWS Support for State DOTs

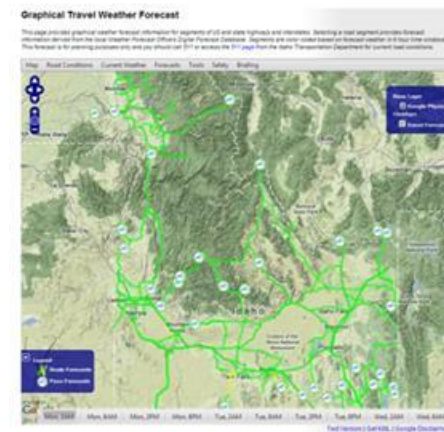
Graphics, Training & Education

- **Graphical Weather Summaries**
 - Graphical Travel Pages
 - *Single Slide Graphics*
- **NWS Outreach and Education**
 - Seasonal Training and Workshops (visits to Forecast Offices and Traffic Ops Centers)
 - COMET workforce/training modules
 - Social-science impact studies



Billings MT.

<http://www.wrh.noaa.gov/byz/state/transportation/index.php?wfo=byz>



Pocatello, ID

<http://www.wrh.noaa.gov/pih/transportation/index.php?wfo=pih>

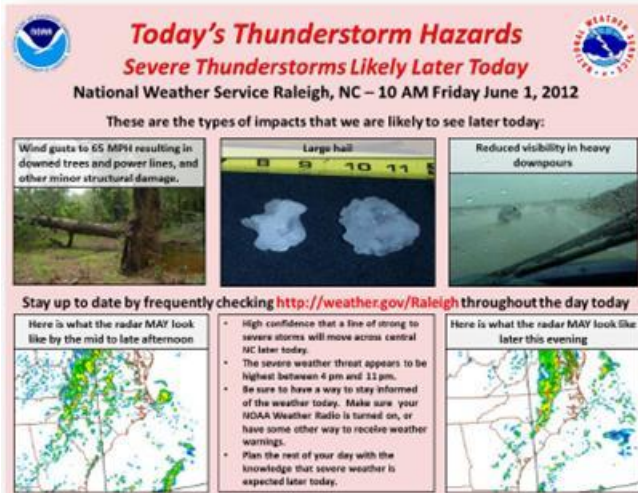
NWS Support for State DOTs

Graphics, Training & Education



Single-slide IDSS Graphics

"A picture is worth a thousand words"



Each graphic is manually created using PowerPoint and is uniquely based on the particular weather situation at hand. The finished graphics are then emailed to partners via our partner email lists.

Partners then re-distribute the single-slide graphics that they receive via email, which helps us get the word out about the impending weather hazards. Here's an example of one of our graphics being posted on the NCDOT web page.



NWS
Products on
DOT Webpage

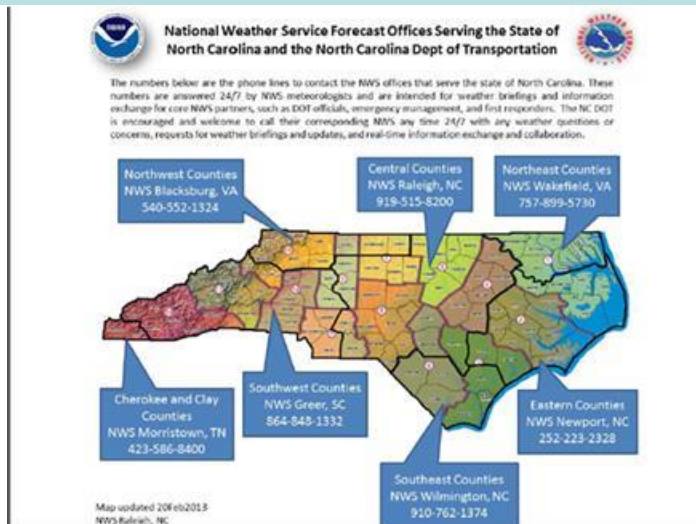
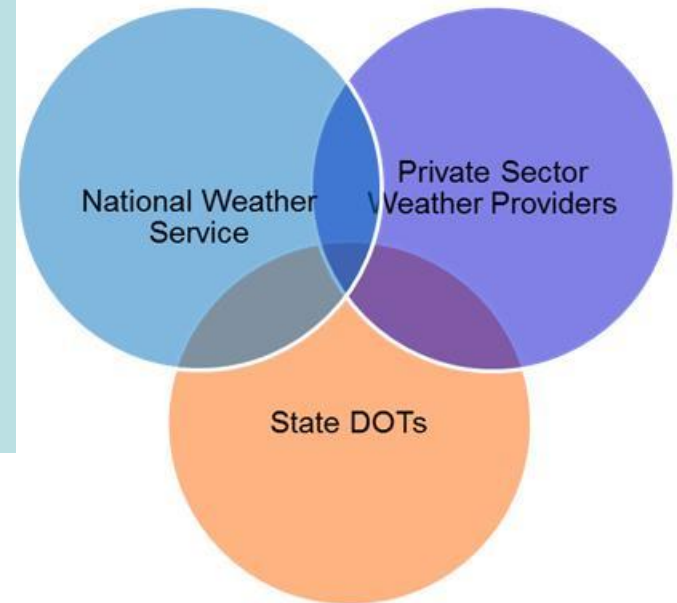
Courtesy of WFO Raleigh

Enterprise Support to State DOTs

Enterprise Partnership Study

Project Description and Goals

- *NWS with FHWA to Evaluate Current DOT/Weather Enterprise Practices*
- Document Effective Interactions
Provide Guidance



*But, Who Ya Gonna to Call?
No One Organization has all
the Solutions*

Enterprise Supporting to State DOTs

Case Studies

1. State Dot Meteorologist/NWS

Private Sector Embedded in TMC

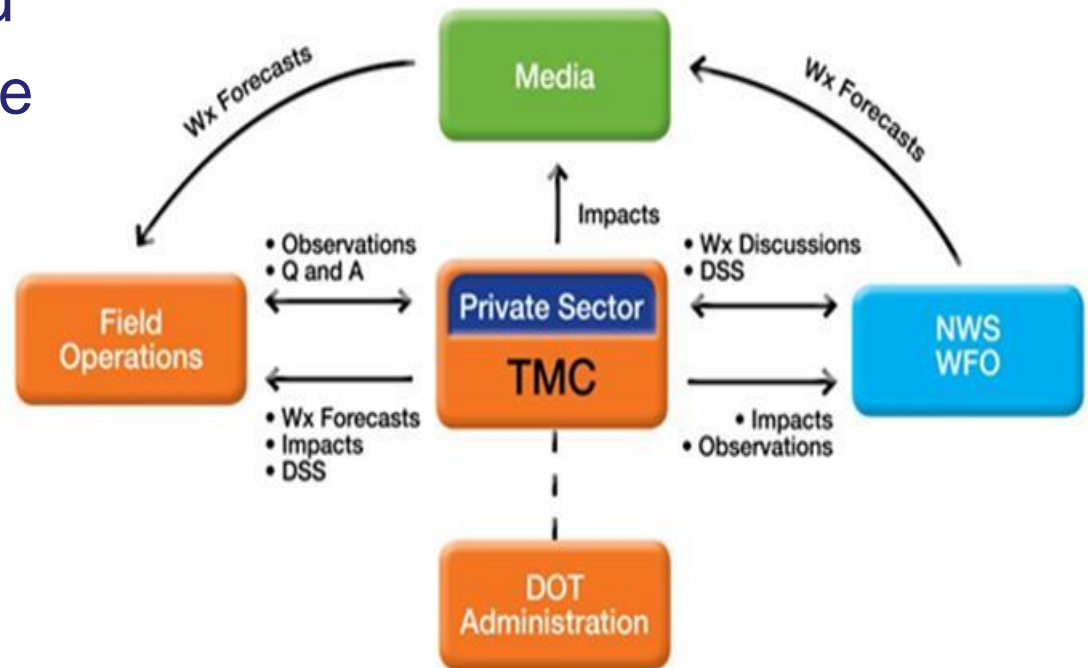
- Private Sector in-situ
- Private Sector off site

2. Private Sector/NWS

- Private Sector in-situ
- Private Sector off site

3. NWS Only

- No Private Sector



Enterprise Support to State DOTs

What Does Success Look Like?

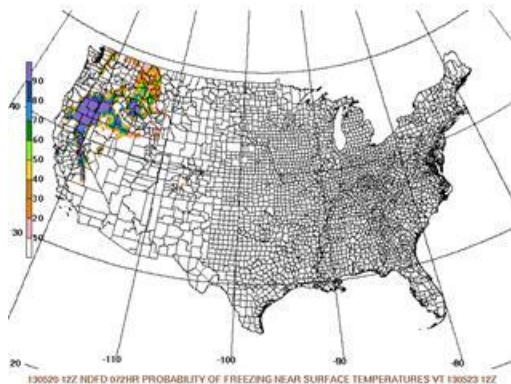
- Clearly Defined Roles
- Coordination of *Decision Support Services*
- **Consistent** Messaging
- An Engaged and Communicative



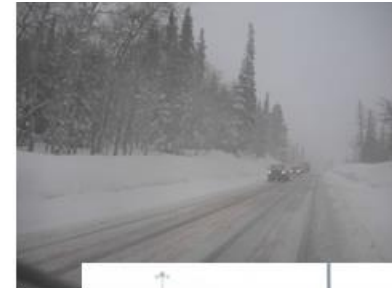
NWS Public Services

Evolution and Timing of Hazards

- Winter Weather
 - Forecast weather conditions including freezing drizzle and black ice, which makes the road slippery but is invisible to drivers.
 - Predict Icing, Snow accumulation
 - Winter and melt-related flooding
 - Data from ploughs and other equipment



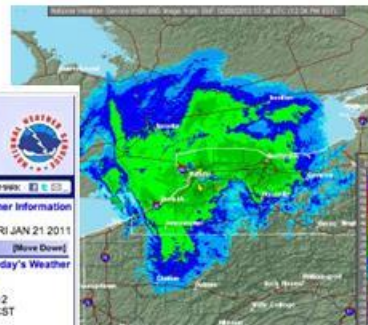
Probability of
Freezing Near
Surface



Winter Weather

Evolution and Timing of Local Impact

- Sensors in the traffic areas with high temporal and spatial resolution (1/2mi)
- Mobile Observing Networks
- Winter weather Advisories
- 7-Day Zone Forecasts



Your National Weather Service forecast
Cook County, IL

Enter Your "City, ST" or zip code Go

NWS Chicago, IL
Zone Forecast: Cook County
Last Update: 404 AM CST FRI JAN 21 2011

Detailed 7-day Forecast
Hazardous weather condition(s):
Hazardous Weather Outlook
Wind Chill Advisory

Today...Mostly sunny until late afternoon then becoming mostly cloudy. Very cold. Highs 8 to 12 above. Lowest wind chill readings 15 below to 25 below zero in the morning. West winds 10 to 15 mph until late afternoon becoming light and variable late in the afternoon.

Tonight...Cloudy. Chance of light snow or a chance of flurries in the evening...then intermittent light snow and flurries after midnight. Evening lows 3 to 7 above...then temperatures becoming steady or slowly rising. Light and variable winds until early morning becoming southwest around 10 mph during the predawn hours. Chance of measurable precipitation 40 percent.

Saturday...Cloudy. Intermittent flurries. Highs around 20. West winds 10 to 15 mph.

Saturday Night...Partly cloudy. Lows 5 to 9 above...except 10 to 14 downtown. Wind chills as low as zero to 10 below zero. North winds 10 to 15 mph.

Current Conditions
Chicago Midway Airport
Lat: 41.79 Lon: -87.75 Elev: 612
Last Update on Jan 21, 7:51 am CST

Partly Cloudy
Humidity: 82 %
Wind Speed: NW 10 MPH
Barometer: 30.11" (1021.9 mb)
Dewpoint: 14.65" (58.37 °F)
-1 °F (-18 °C)
Wind Chill: -17 °F (-27 °C)
Visibility: 10.00 mi
More Local Wx: 3 Day History:

Radar and Satellite Images



Wildfires

Regional Extremes

2012: destructive wildfires impact more than 9,000,000 acres across 37 States

<http://www.noaawatch.gov/themes/fire.php>



- Daily fire weather forecasts, fire weather warning products, and forecasts
- Most NWS Weather Forecast Offices provide fire forecasts twice a day and provide warnings in close partnership with local, state and Federal fire control agencies.
 - **Red Flag Warnings and Fire Weather Watches** for protection of the public and safety of officials on the ground
 - Weather Forecast Staff provide vital, **site-specific spot forecasts** for wildfire (>19,000/yr), prescribed fire projects, all-hazards incidents



Low Visibility Events

Can also be Extreme!

- High winds and dust
- Volcanic ash
- Fog
 - Dense fog advisory
 - Fog warning



Heat

Extreme Impact on Lives and Infrastructure

- July 2012 was the warmest month on record for the contiguous United States and more than 9,600 daily high temperature records broken during June, July, and August.

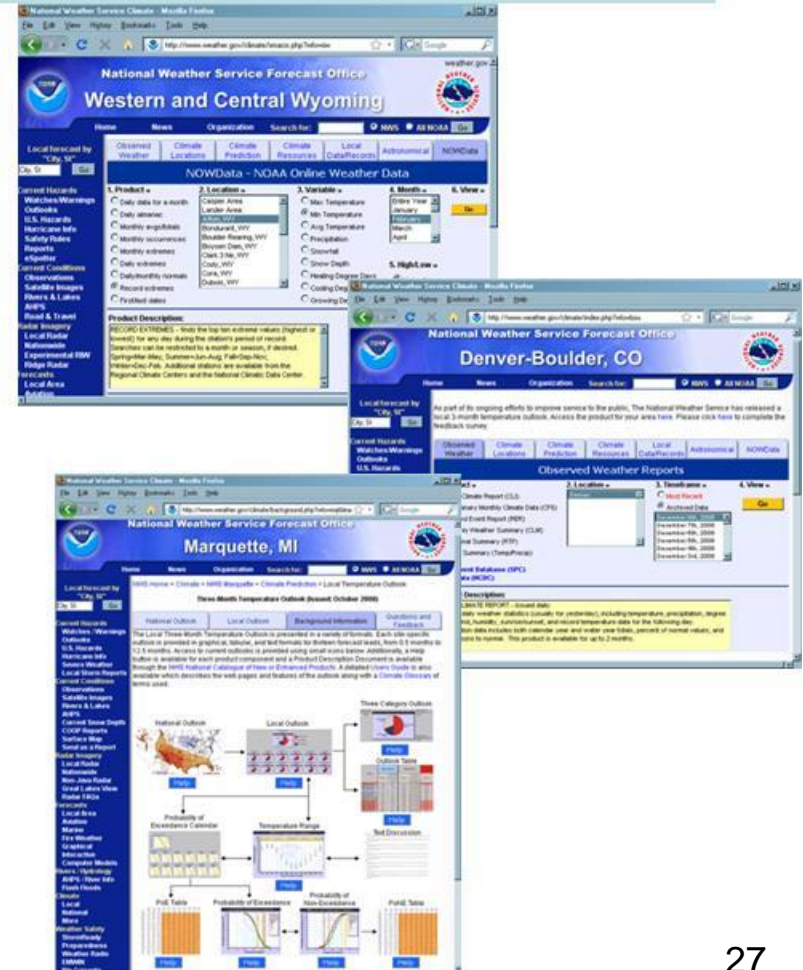


Climate Services

Data Services and Trend Analysis

- **NOAA's Online Weather Data** (NOWData) is a data query system providing basic climate statistics
 - Downscaled National Outlooks to local climate information
- Other online data products:
 - Last 3 month daily data
 - Last 5 year monthly/daily
 - This year record events
 - Last year monthly site, regional and state summaries

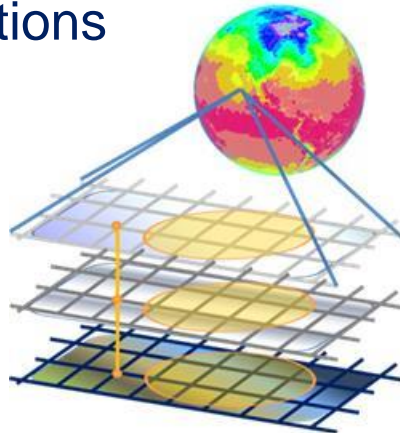
<http://www.weather.gov/climate>



Developmental Climate Services

Local Climate Analysis Tool (LCAT)

- **Pre-Operational - Online Interactive Tool for regional, local studies and analysis**
- **Future Plans**
 - Weather and Climate Extremes
 - Local information and projections



Marine and Coastal Weather

High Impact Events

- Coastal flooding
- Storm surge
- Hurricane
- Tsunami



Extreme Extremes

Superstorm Sandy

- 100 deaths,
- 100,000's of evacuations,
- 8,500,000 homes without power
- Massive flooding
- Gasoline shortages,
- Crippled regional energy and transportation infrastructure.



Ways to Stay Informed

Current Storm Information

- National Weather Service: www.weather.gov
- National Hurricane Center: www.nhc.noaa.gov
- Central Pacific Hurricane Center: www.prh.noaa.gov/cphc

Historical Storm Information

- National Climatic Data Center: www.ncdc.noaa.gov
- NOAA Coastal Services Center: www.csc.noaa.gov

Emergency/Preparedness Information

- American Red Cross: www.redcross.org
- FEMA: www.fema.gov

Mobile NHC and NWS Information

- Mobile NHC website in basic HTML: www.nhc.noaa.gov/mobile
- Mobile NWS website for smartphones: mobile.weather.gov
- Mobile NWS website in basic HTML: cell.weather.gov

Other Information

- Audio Podcasts: www.nhc.noaa.gov/audio/index.shtml
- Geographic Information System Data: www.nhc.noaa.gov/gis/
- NOAA Weather Radio All Hazards: www.weather.gov/nwr
- Hurricane Tracking Charts: www.weather.gov/os/hurricane/

Facebook

- NHC Facebook Page: www.facebook.com/US.NOAA.NationalHurricaneCenter.gov
- CPHC/ NWS Honolulu Facebook Page: www.facebook.com/US.NationalWeatherService.Honolulu.gov

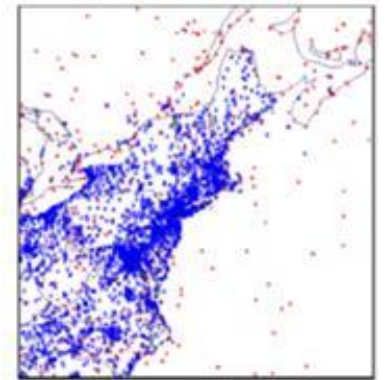
Twitter

- Atlantic: [@NHC_Atlantic](https://twitter.com/NHC_Atlantic)
- Eastern North Pacific: [@NHC_Pacific](https://twitter.com/NHC_Pacific)
- Central Pacific: [@NWSHonolulu](https://twitter.com/NWSHonolulu)
- Storm Surge: [@NHC_Surge](https://twitter.com/NHC_Surge)

Observation and Data Services - MADIS

Shared Weather Data Collection

Regional (Mesonet) Sensors (DOT and NWS, other partners)
Travel corridors
Local/traffic Cams



Increased density through MADIS

Provides access to

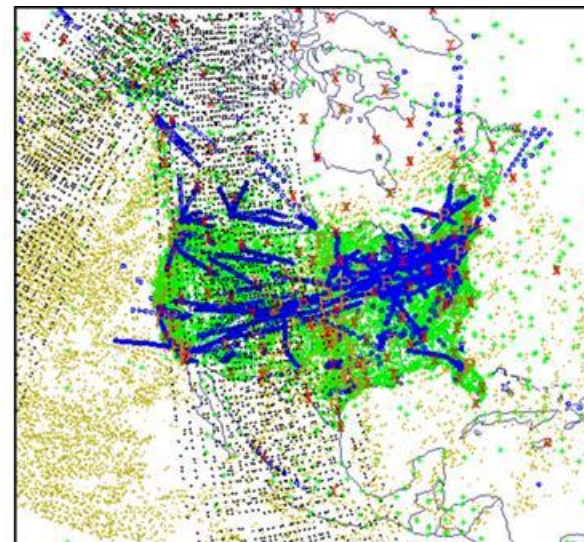
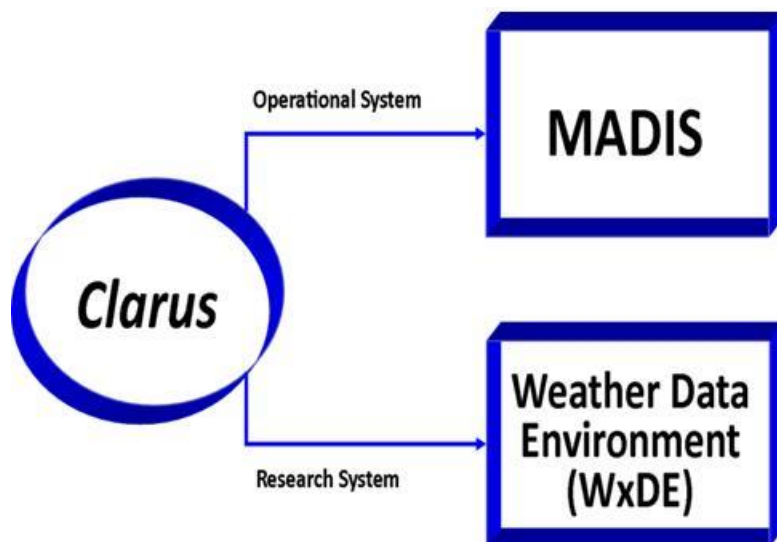
- Real-time and archived data;
- Real-time gridded surface analyses;
- User documentation and help desk

Enhanced Clarus Capabilities

Transition to Operations - MADIS

FHWA Clarus Initiative
Shares local and regional
road and rail weather
observations

***MADIS, Meteorological
Assimilation Data Ingest
System*** running operationally
within NWS



15 km grid,
updated every
15 min

MADIS

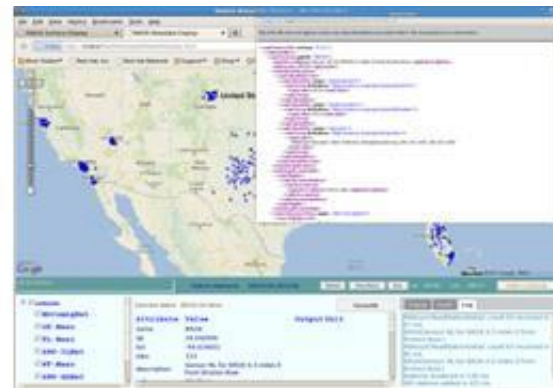
<http://www.nws.noaa.gov/ops2/ops24/madis.htm>

- Data:
 - Enhanced further by RWIS + Clarus
- Advanced data query and web services
 - MADIS Website - <http://madis.noaa.gov/>
 - Clarus / MADIS Transition Website - <http://www.esrl.noaa.gov/gsd/isb/dads/developmentefforts/clarus.html>
 - Google displays

Surface
Temperature



Metadata
SensorML



MADIS Transition Schedule

The *Clarus* transition consists of three delivery dates of MADIS enhancements

The *Clarus* transition effort will consist of three major enhancements to MADIS:

Enhancements to MADIS	Delivery Date
<ul style="list-style-type: none">• RWIS observations• RWIS contributors• RWIS data displays• RWIS metadata displays & dissemination	June 15, 2013
<ul style="list-style-type: none">• RWIS multiple observations of the same type.• <i>Clarus</i> background fields required for QC.• Enhanced subscription service capabilities.• Display enhancements for RWIS data/metadata.	December 31, 2013
<ul style="list-style-type: none">• RWIS QC implemented.• Contributor constraints.• Display enhancements for QC additions.	December 31, 2014

Water

- Data and information relevant to condition of roads and culverts
 - Precipitation Frequency
 - Runoff
 - Melts
- Signage
 - Warning and implications
- Atlas 14-9 17



CO. Alert of wet roads.

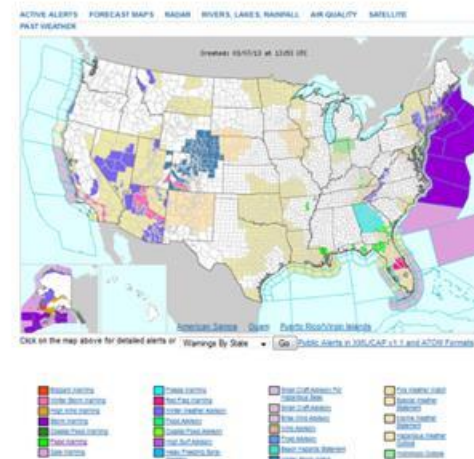


CO. RWIS Snowmass Canyon

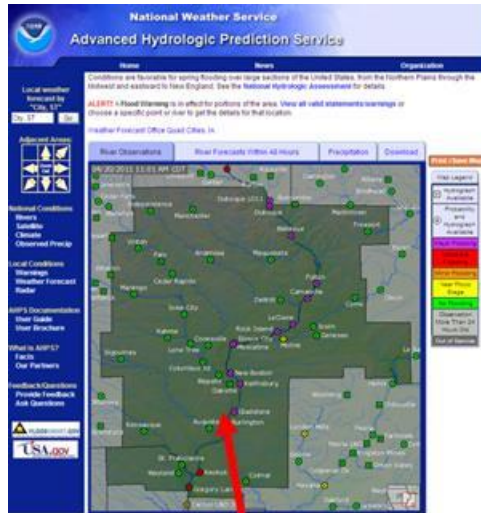
Water

- Advanced Hydrologic Prediction Service (AHPS)

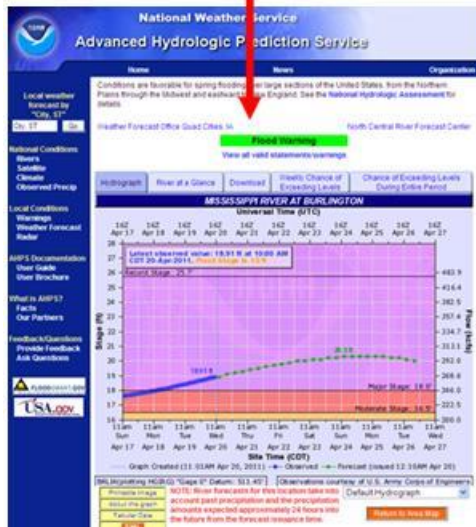
- Flash-flood to seasonal freshwater forecasts
- Quantification of forecast certainty
- Accurate and timely forecasts and warnings
- Partnered flood-forecast area mapping
- Visually-oriented products
- Consistent access to standardized graphics via web interface <http://weather.gov>



Water



"click on" the forecast location to access local hydrograph



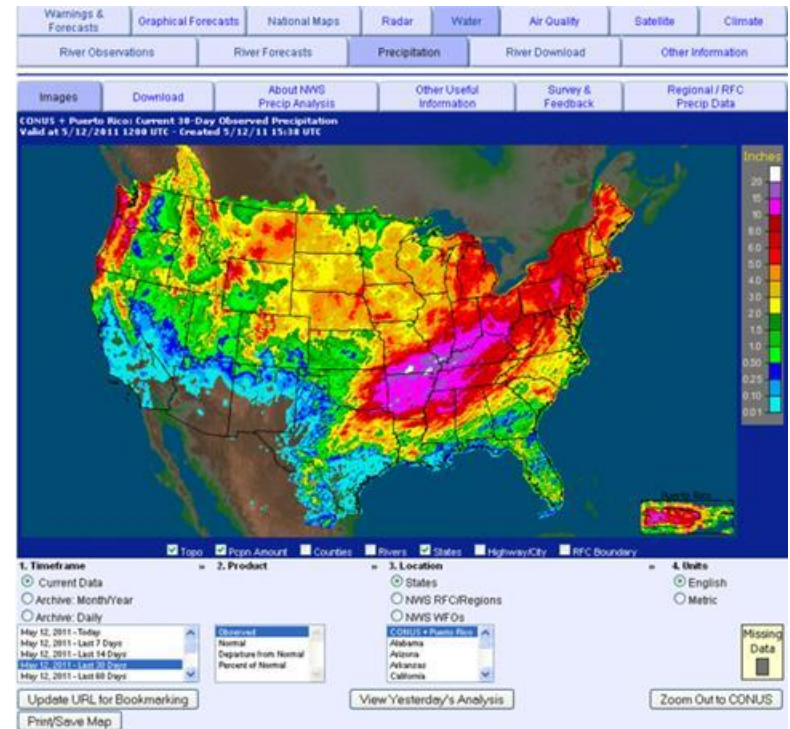
"click on" tabs for probabilistic forecasts



Currently provide probabilistic river forecasts at over 2500 locations

Water

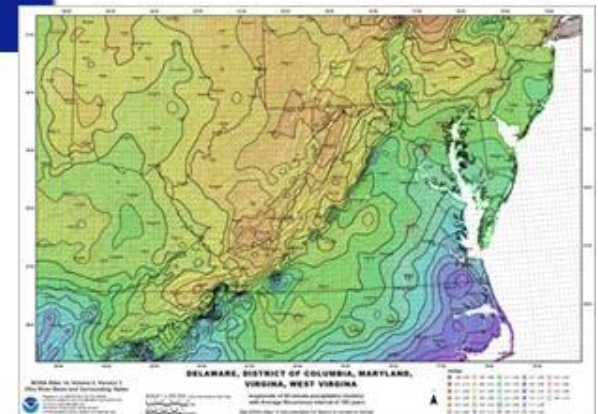
- **AHAPs Precipitation**
 - **Multi-sensor Observed Precipitation**
 - **Daily**
 - **Past 7, 14, 30 and 60 days**
 - **Year and Water Year-to-date**
 - **Historical Monthly totals**
 - **Analysis:**
 - **Period Normal**
 - **Departure from Normal**
 - **Percent of Normal**



<http://water.weather.gov/precip/>

Water

- NOAA Atlas 14 Precipitation
 - Updates precipitation frequency (PF) estimates for various areas of the U.S. as Volumes of NOAA Atlas 14.
 - PF Data Server (PFDS) provides access to data and information in many formats.
 - Publications for states not covered by Atlas 14 are also available
 - Partially funded by State Departments of Transportation



<http://www.nws.noaa.gov/oh/hdsc/>

Signage and Education



NWS Area Forecast discussion

Decision support

- Forecaster's scientific rationale (i.e., thinking) behind the forecast
- Conveys level of confidence
- Factors which could change forecast
- Updated 2-4 times daily

AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE BALTIMORE MD/WASHINGTON DC
1034 AM EDT MON MAY 13 2013

.SYNOPSIS...
AN UPPER **TROUGH** WILL CROSS THE MID-ATLANTIC REGION THURSDAY EVENING. HIGH PRESSURE WILL BUILD OVER THE REGION TUESDAY MOVE OFFSHORE EARLY WEDNESDAY AS A WARM **FRONT** ADVANCES NORTHEASTWARD ACROSS THE MID ATLANTIC. A COLD **FRONT** WILL THE REGION LATE WEDNESDAY... BUT STALL OUT THROUGH THE WEEK.

4.6
.NEAR TERM /THROUGH TONIGHT/...
AN EXPANSIVE **SFC** HIGH THAT IS CENTERED OVER THE GULF COAST MIDWEST STATES THIS **MORNING** WILL CONTINUE TO BUILD TOWARD SEABOARD. THE OTHER PROMINENT FEATURE IS A NEARLY VERTICALLY STACKED LOW OVER QUEBEC. A **SHORTWAVE** DISTURBANCE AND ULL STREAK WILL DIG SEWD AROUND THE BACKSIDE OF LARGE-SCALE THIS FEATURE WILL TRAVERSE THE **CMA** THIS **AFTER** AND EVE.

12Z IAD **RAOB** REVEALED AN ALREADY DEEP **BOUNDARY LAYER** TO KFT. EXPECT THE **MIXED LAYER** TO DEEPEN FURTHER THIS **AFTER** HEATING STEEPENS LVL LAPSE RATES AND **COLD POOL** ASSOCIATED WITH THE **TROUGH** STEEPENS HLVL LAPSE RATES. **FCST** MODEL SOUNDING... THIS **AFTER** CONTINUE TO SHOW AN THERMODYNAMIC ENVIRONMENT THAT IS FAVORABLE FOR MODEST **CONVECTION** WHILE **QC** FORCING FOR ASCENT INCREASES WITH THE APPROACH OF THE MID-LVL **TROUGH**. COVERAGE AND INTENSITY OF SHOWERS THIS **AFTER** SHOULD BE VERY LOW WITH SUCH A DRY AIRMASS OVER THE REGION. BASED ON LOCATION OF BEST LIFT/**MOISTURE** AND LATEST HIRPS **REFLECTIVITY FCST**...LOW CHANCE **POPS** COVERS THE MTS...CENTRAL VA AND **LAR** **SDN** MD. ONLY ISO SPRINKLES EXPECTED ELSEWHERE. GIVEN INVERTED V **SOUNDING**...SHOWERS CAPABLE OF TRANSPORTING 30-35 MPH GUSTS DOWN TO THE **SFC**.



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Mobile Alerts

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WEA - cell broadcast alerts

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inws.wrh.noaa.gov



NWS- DOT Shared Outcomes

- **Protecting life and property:**
 - Situational awareness (sensors, high spatial/temporal resolution, real time and retrospective)
 - Integrated decision support (health and safety)
 - Evacuations and response
 - Consistent actionable messaging/communications
 - Continuity of operations (Secure/maintained infrastructure)
- **Promoting the economy:** (minimized delays, increased mobility, enhanced productivity, ensured safety)
 - Non-recurring congestion (weather and accidents)
 - Recurring congestion (commuting)
 - Energy and fuel usage
 - Emergency response and logistics