

Integrating Weather Forecasts into Transportation Decision Making



Dr. David Green,
NOAA National Weather Service

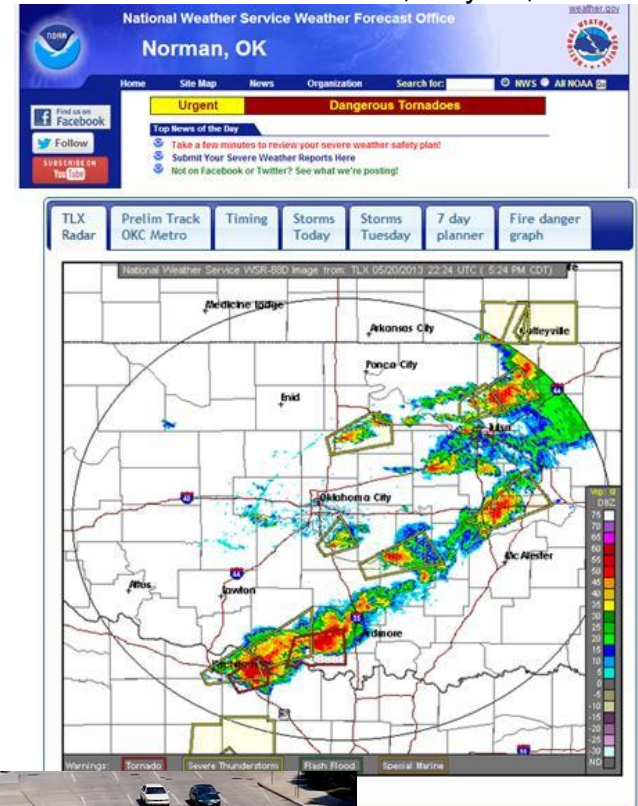
Washington D.C. June 11, 2013

Transportation Research Board: When Extreme Weather Strikes Transportation Systems – Implications and opportunities for Data Before, During, and After.

Outline

- Toward a common vision for research and application
- National Weather Service partnership policy and support for State/Local DOTs
- Resources and Emerging Services

Moore OK, May 20, 2013



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...



Marine and Coastal Weather

High Impact Events

- Coastal flooding
- Storm surge
- Hurricane
- Tsunami



Key Research Interdependencies

- Big data science
- Climate modeling/assessment
- Infrastructure and network design, management and adaptation planning
- Communication

Toward a Common Vision

A Weather Ready Nation

Its about better decisions!



The image shows the header and navigation menu of the Weather-Ready Nation website. The header is blue with the WRN logo on the left, the text "Weather-Ready Nation" in large white font, and "National Oceanic and Atmospheric Administration" in smaller white font below it. To the right of the header is a search bar with the text "Forecast by 'City, St' or Zipcode" and a "Go" button. Below the header is a navigation menu with buttons for "Home", "News", "Events", "Resources", "FAQS", "About", "Are you Weather-Ready?", and "Be a Force of Nature".

<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, maintain and deliver a suite of data and proactive products (forecasts, advisories, analysis, maps, outlooks, tools...)

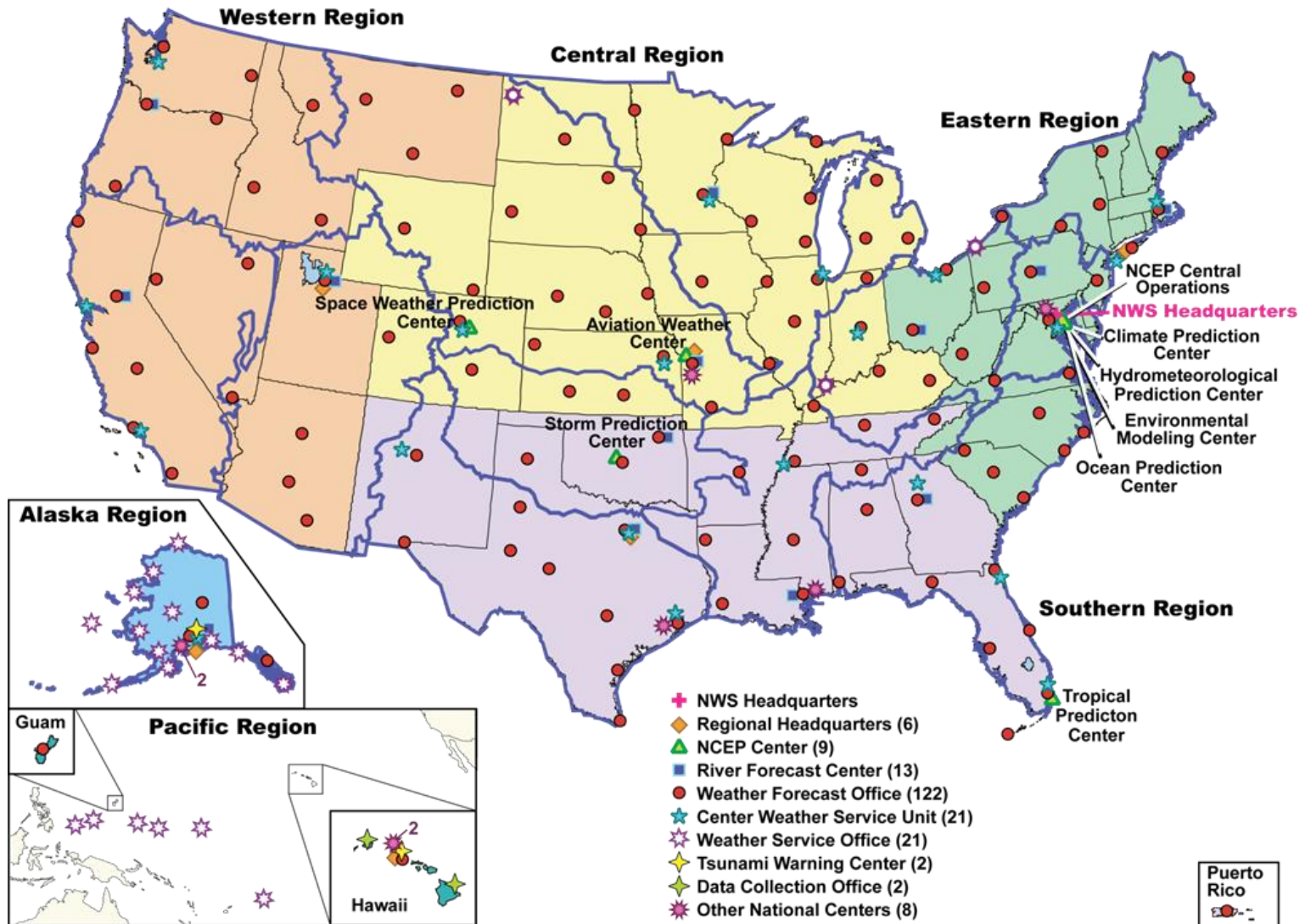
Tangible Outcomes

Research results and service enable decisions



- **Safe transportation systems;**
- **Minimized road restrictions;**
- **Efficient traffic flow, movement of goods and services,**

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

Enter location ...

[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

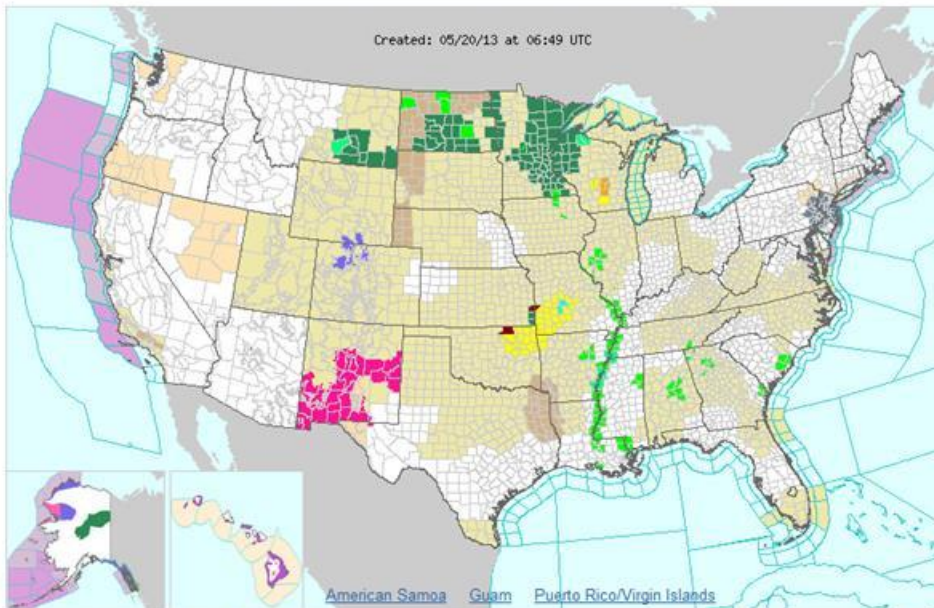
City, ST

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 [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](#)

Customize Your Weather.gov

City, ST

Enter Your City, ST or ZIP Code

Remember Me

[Privacy Policy](#)

National Forecast Maps National Weather Service National Headquarters

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

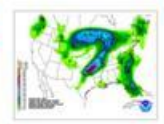
Short range forecast products depicting pressure patterns, circulation centers and fronts, and types and extent of precipitation.

[12 Hour](#) | [24 Hour](#) | [36 Hour](#) | [48 Hour](#)

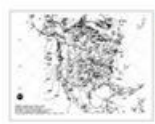
Medium Range Forecasts

Medium range forecast products depicting pressure patterns and circulation centers and fronts.

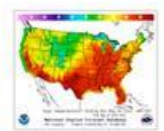
[Day 3](#) | [Day 4](#) | [Day 5](#) | [Day 6](#)



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



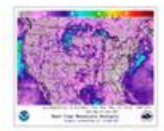
Surface Analysis
 Highs, lows, fronts, troughs, outflow boundaries, squall lines, drylines for much of North America, the Western Atlantic and Eastern Pacific oceans, and the Gulf of Mexico.
[Standard Size](#) | [High Resolution](#)



Temperature
 Maximum daytime or minimum overnight temperature in degrees Fahrenheit.



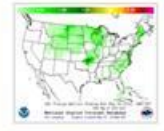
Predominant Weather
 Expected weather (precipitating or non-precipitating) valid at the indicated hour. The weather element includes type, probability, and intensity information.



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



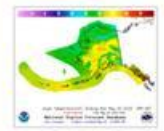
Chance of Precipitation
 Likelihood, expressed as a percent, of a measurable precipitation event (1/100th of an inch).



Precipitation Amount
 Total amount of expected liquid precipitation.



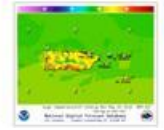
Sky Cover
 Expected amount of opaque clouds (in percent) covering the sky.



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.

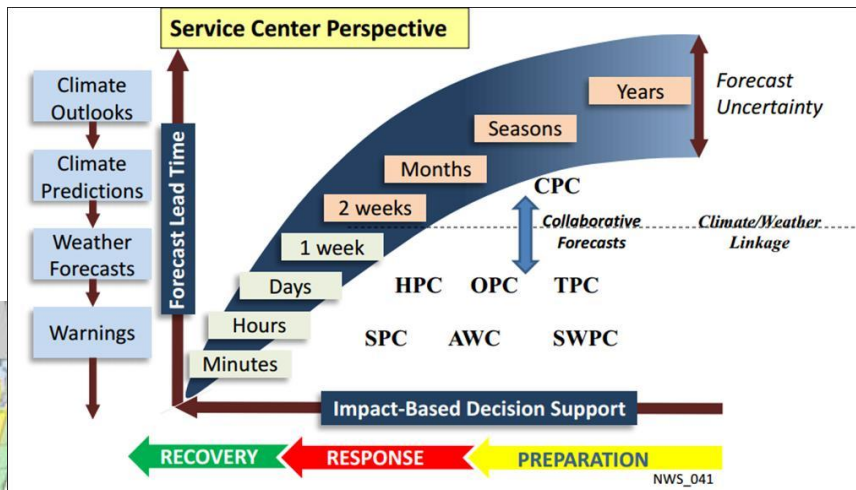


Puerto Rico Graphical Forecasts
 Graphical forecasts from the National Digital Forecast Database for Puerto Rico and Virgin Islands.

NWS Seamless Suite

Products and Services

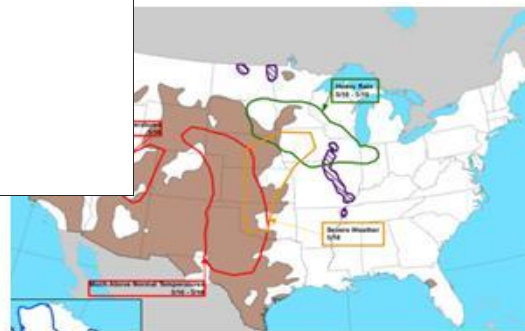
Spanning Climate, Water and Weather Scales



Severe Weather

www.spc.ncep.noaa.gov

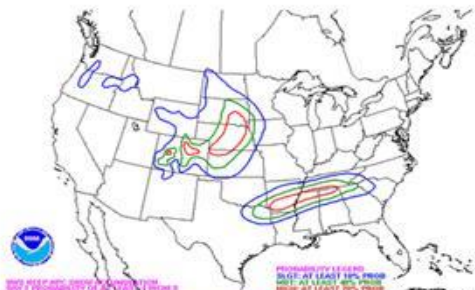
Storm Prediction Center (SPC)



3-7 and 8-14 Day Hazards

www.cpc.ncep.noaa.gov

Climate Prediction Center (CPC)



Winter Weather and Heavy Precipitation

www.hpc.ncep.noaa.gov

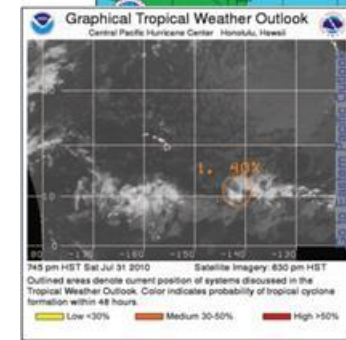
Hydrometeorological Prediction Center (HPC)

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

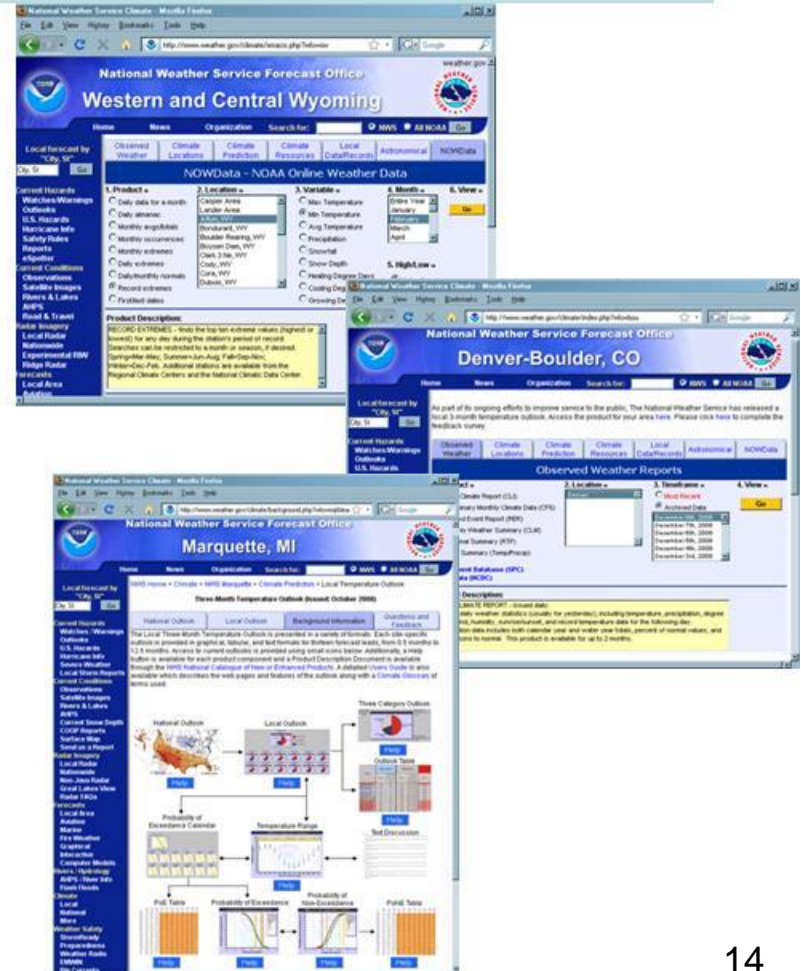


Climate Services

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>



Hydrologic Services

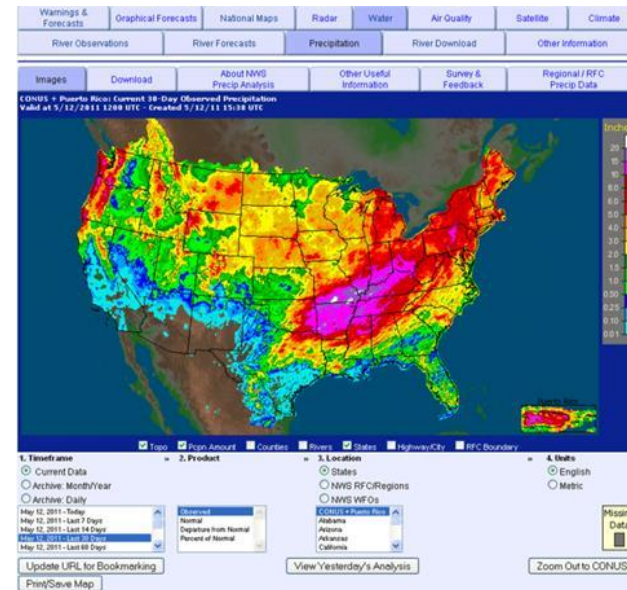
- **Advanced Hydrologic Prediction Service AHPS**

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*

- **Precipitation Frequency Atlas 14**

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



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

**National Weather Service
partnership policy and support
for State/Local DOTs**

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 America's Weather Industry to provide specialized weather support to DOTs



NWS Support for State DOTs

Messaging and Forecasting

- ***Coordinated*** DOT and NWS public notices
 - Variable-message signs
 - Common **wording**
 - Press releases
- ***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

- **NWSChat** 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

- **GIS Data Portal**

GIS Data Portal – Geo-referenced images and standardized web services

<http://www.nws.noaa.gov/gis/>

- **Graphical Weather Summaries**

- Graphical Travel Pages

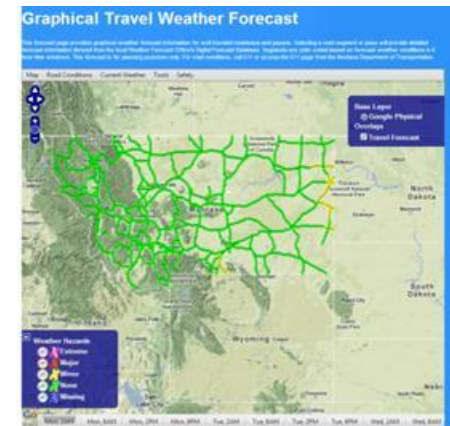
- *Single Slide Graphics*

- **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"



Today's Thunderstorm Hazards
Severe Thunderstorms Likely Later Today
 National Weather Service Raleigh, NC – 10 AM Friday June 1, 2012

These are the types of impacts that we are likely to see later today:

- Wind gusts to 65 MPH resulting in downed trees and power lines, and other minor structural damage.
- Large hail
- Reduced visibility in heavy downpours

Stay up to date by frequently checking <http://weather.gov/Raleigh> throughout the day today

- Here is what the radar MAY look like by the mid to late afternoon
- High confidence that a line of strong to severe storms will move across central NC later today.
 - The severe weather threat appears to be highest between 6 pm and 11 pm.
 - Be sure to have a way to stay informed of the weather today. Make sure your NOAA Weather Radio is turned on, or have some other way to receive weather warnings.
 - Plan the rest of your day with the knowledge that severe weather is expected later today.
- Here is what the radar MAY look like later this evening

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.

The screenshot shows the NCDOT website interface. At the top, there's a navigation bar with links for Home, About, Contact, and Search. Below that, a main content area features a large graphic titled "Today's Thunderstorm Hazards" which is the same graphic shown in the previous block. To the right of this graphic, there's a section titled "Severe Weather This Week May Cause Dangerous Travel Conditions in North Carolina - NCDOT Reminds Motorists about Dangers...". Below the main content, there are several service links: DMV Services (License Registration, Other Permits, License Plates, DMV Locations), Traveler Services (I-85 Recovery, Live Traffic Updates, State Travel Map, Park Reservations), and Project Search. The footer contains various organizational logos and contact information.

NWS
 Products on
 DOT Webpage

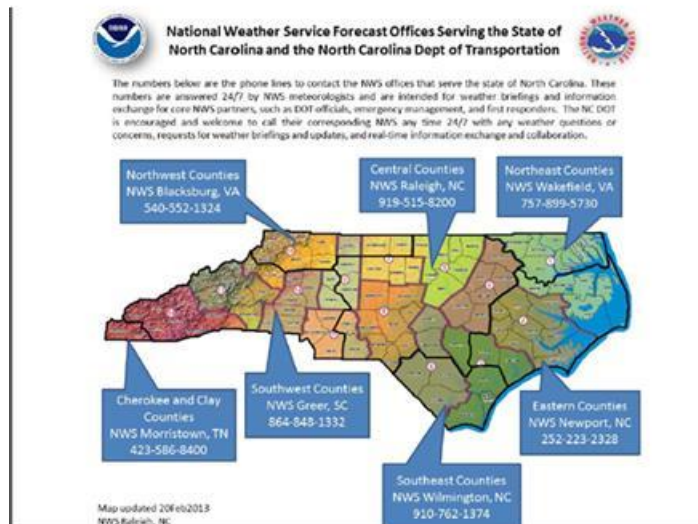
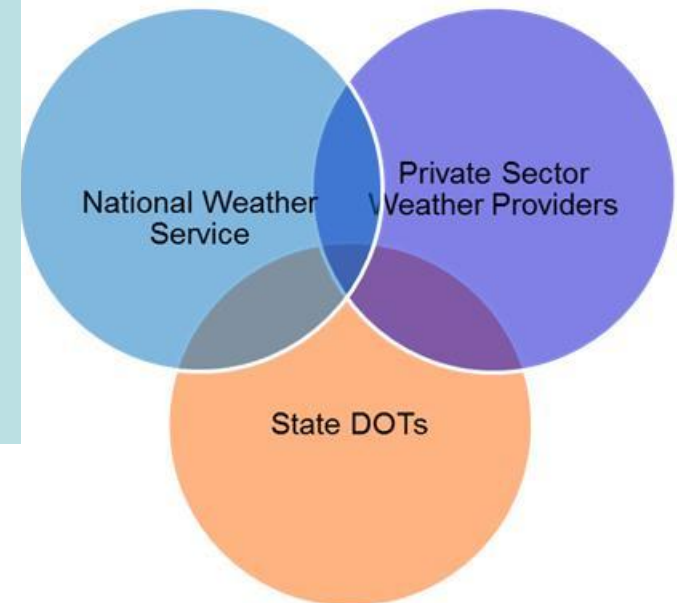
Courtesy of WFO Raleigh

Enterprise Support to State DOTs

Enterprise Partnership Study

Project Description and Goals

- *NWS with FHWA to Evaluate Current DOT/Weather Enterprise Practices in the exchange of data and information*
- Document Effective Interactions Provide Guidance



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

Enterprise Support to State DOTs

Case Studies

1. State Dot Meteorologist/NWS

Private Sector Embedded in TMC

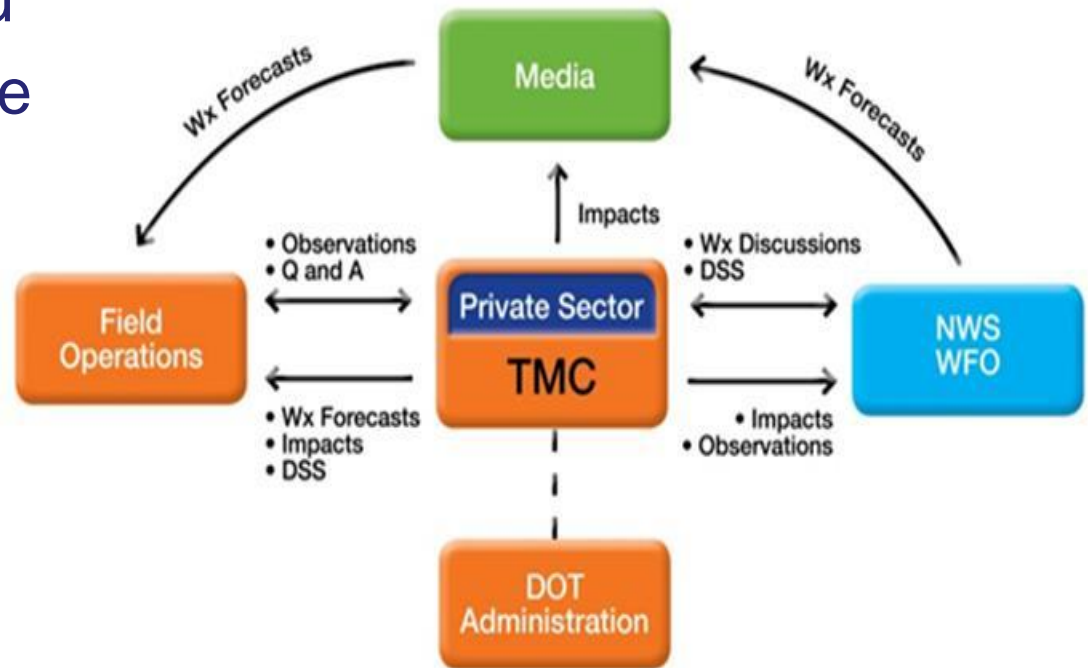
- Private Sector in-situ
- Private Sector off site

2. Private Sector/NWS

- Private Sector in-situ
- Private Sector off site

3. NWS Only

- No Private Sector



Case Study: Utah 10 January 2013

Partnership in Action

Leading up to Event

- Strong cold front brought a heavy band of snow to the Wasatch Front just ahead of the evening commute
- Snow accumulated on area roads during the late afternoon and evening resulting in a hazardous commute
- Event was well forecast and collaborated between NWS and UDOT meteorologists



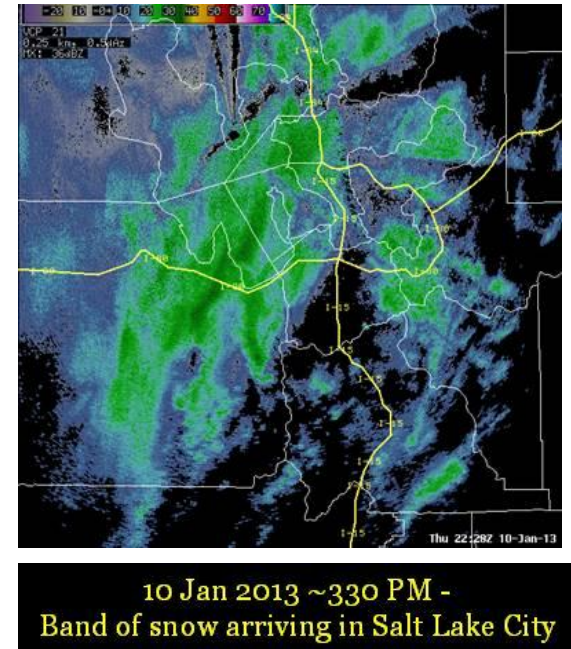
NWS/UDOT
Collaboration
via NWSChat

Mon - 7 Jan	Tue - 8 Jan	Wed - 9 Jan	Thu - 10 Jan	Fri - 11 Jan
<ul style="list-style-type: none"> Chat 1208 AM Chat 1217 AM Chat 713 AM Chat 1213 PM Chat 1213 PM Chat 1214 PM Chat 1221 PM Chat 1221 PM 	<ul style="list-style-type: none"> Chat 812 AM Chat 1115 AM Chat 1155 AM Chat 1226 PM 	<ul style="list-style-type: none"> Chat 1055 AM Chat 1141 AM Chat 1227 PM 	<ul style="list-style-type: none"> Chat 724 AM Chat 733 AM Chat 746 AM Chat 747 AM Chat 818 AM Chat 1157 AM Chat 1159 AM Chat 1260 PM 	<ul style="list-style-type: none"> Chat 602 AM * Chat 830 AM * Chat 840 AM * Chat 846 AM * Chat 858 AM * Chat 1030 AM * Chat 1053 AM * Chat 1054 AM * Chat 1145 AM *
1230 PM Conference Call	1230 PM Conference Call	1230 PM Conference Call	1245 PM Conference Call	
Chat 148 PM	Chat 301 PM	<ul style="list-style-type: none"> Chat 102 PM Chat 307 PM Chat 410 PM Chat 433 PM Chat 456 PM Chat 545 PM 	<ul style="list-style-type: none"> Chat 240 PM * Chat 246 PM * Chat 321 PM * Chat 322 PM * Chat 624 PM * Chat 630 PM * Chat 651 PM * Chat 713 PM * 	
22 Interactions 11 Alerts	12 Interactions 5 Alerts	50 Interactions 28 Alerts	85 Interactions 25 Alerts	68 Interactions 9 Alerts
Maintenance Forecast - 200 AM	Maintenance Forecast - 200 AM	Maintenance Forecast - 200 AM	Maintenance Forecast - 2 AM	Maintenance Forecast - 200 AM
		<ul style="list-style-type: none"> 4 Regional Conference Calls - 1045 to 1130 AM Road Weather Alert - 530 PM 	<ul style="list-style-type: none"> Briefed UHP - 737 AM Road Weather Alert - 9 AM TOC Wx Briefing - 10 AM 	<ul style="list-style-type: none"> Road Weather Alert - 2 AM Twitter Alert - 627 AM Statewide 511 Messages - 7 AM Snow Signal Timing plans activated - 737 AM
Maintenance Forecast - 200 PM	Maintenance Forecast - 200 PM	Maintenance Forecast - 200 PM	Briefed Incident Management - 1154 AM	Road Weather Alert - 11 AM
	TOC Weather Briefing - 395 PM	<ul style="list-style-type: none"> Twitter Alert - 352 PM UHP Alert - 395 PM Road Weather Alert - 3 PM 	<ul style="list-style-type: none"> Briefed Provo Canyon Avalanche - 1156 AM Road Weather Alert - 12 PM Twitter Alert - 124 PM 	<ul style="list-style-type: none"> Twitter Alert - 1111 AM Maintenance Forecast - 200 PM
	Road Weather Alert - 400 PM	<ul style="list-style-type: none"> Meeting with UDOT Support Leaders and Communications - 500 PM 	<ul style="list-style-type: none"> Road Weather Alert and 511 - 159 PM Briefed Part of Entries - 135 PM 	<ul style="list-style-type: none"> Briefed Communications Department - 245 PM Briefed Communications Department - 449 PM
	Statewide 511 Messages - 530 PM	<ul style="list-style-type: none"> Free alert on VMS Signs Posted - 530 PM Alerted All District Engineers - 552 PM 	<ul style="list-style-type: none"> Maintenance Forecast - 2 PM Twitter Alert - 304 PM Twitter Alert - 414 PM 	
	Road Weather Alert - 1130 PM	Statewide 511 Messages - 6 PM	<ul style="list-style-type: none"> Snow Signal Timing plans activated - 515 PM 	

UDOT
Product
Timeline

NWS/UDOT Collaborative Wording – *NWS Text Products*

- Winter Storm Warning ~3:00 PM on 9 Jan
“Accumulating snow along with blowing and drifting snow will create widespread hazardous travel conditions Thursday afternoon through Friday morning.”
- Winter Storm Warning ~4:00 AM on 10 Jan
“Widespread hazardous travel conditions will occur this afternoon through Friday morning... significantly impacting the commutes this evening and Friday morning.”
- Products also direct users to UDOT :
*“For winter road conditions from the Utah Department of Transportation visit:
<http://www.udottraffic.utah.gov/roadweatherforecast.aspx>”*



UDOT Chats to NWS

Winter Storm 400 PM

- 5:47 PM – 9 Jan 2013
<udot> FYI. **UDOT is posting VMS** (Electronic Highway Signs) stating Winter Storm XXpm Thursday on all signs statewide starting tonight.
- 7:24 AM – 10 Jan 2013
<udot>NWS, **UDOT has decided to post VMS signs reading "Winter Storm xxxx Time"**
These signs are currently indicating road impacts in Ogden at 3 PM, SLC at 4 PM, Provo/Utah County at 5 PM. We are expecting the evening commute to be impacted significantly by this storm.

NWS Non-traditional Product

Impact-Based

- **Web graphics** - 9 were created highlighting storm and its impacts
 - Many graphics referred viewers to UDOT website
- **Twitter** – 54 tweets between the 8th and the 11th
- **YouTube** **web briefings** on the storm and its potential impacts were created on 8 and 9 Jan
 - 8th – 1577 views
 - 9th – 2599 views
- **Briefings** referred viewers to UDOT webpage for additional travel information
 - Included collaborated wording on impacts and affected areas



Winter Storm Briefing
NWS SaltLakeCity · 16 videos
Subscribe < 84
2,599
12 0




NWS Web Graphics Pointed to UDOT

- NWS began issuing [web graphics](#) highlighting the potential for commute and travel impacts on Monday afternoon (7th)
- Graphics were utilized to show images of snow covered roads and potential travel impacts
- NWS also directed users to UDOT webpage for additional road weather forecasts
- Graphics often include information and graphics for impacted routes based on collaborated impacts




Winter Storm expected to break inversion Thu. & Fri.



- Storm system expected for Thursday night into Friday.
- Winds ahead of this system expected to break the inversion by Thursday afternoon.
- Widespread snow expected Statewide.
- Difficult travel at times Thursday evening through Friday morning.
- Roadways will be affected throughout the state.

Monday 7 Jan – 200 PM


Heavy Snow to Impact the Evening Commute Today



Snow, heavy at times, can be expected during the evening commute across the Wasatch Front

Snow will continue overnight into Friday morning, with additional road impacts

For updated road weather forecasts, visit:
www.udottraffic.utah.gov/roadweatherforecast.aspx



Thursday 10 Jan - 600 AM

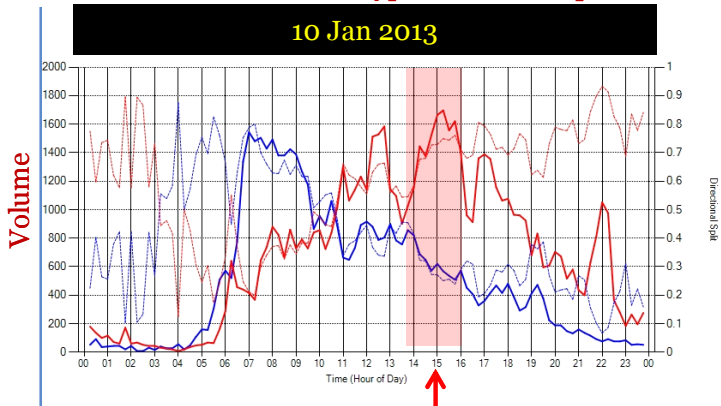
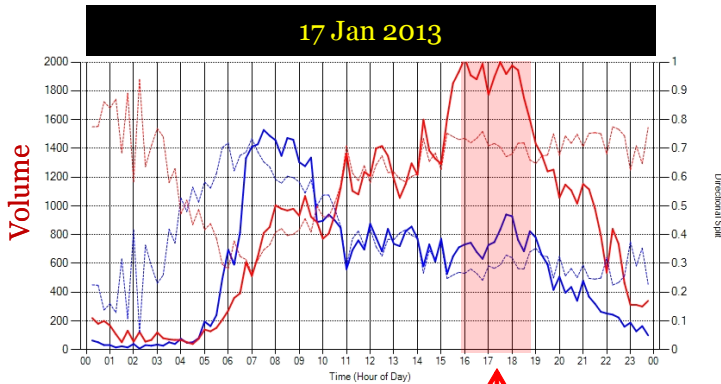
UDOT Traveler Information Products Pointed to NWS

- **Current Road Conditions**
 - Input: UDOT Plow Crews/UDOT TI Mets/Citizen Reporters
 - Updated at a goal of every 2 hours
 - 143 route segments
- **Road Conditions Forecast**
 - 18 hour forecasts in 6 hour increments
 - I-15/I-215/I-80/I-84/I-70/US-6/US-191/US-40
- **Road Weather Alert (Highlights/Route Specific)**
 - Contains a statewide Red/Yellow/Green impact Graphic
 - Available on the UDOT Traffic website/app
- **Road Weather Forecasts on 511 System**
- **UDOT Traffic Twitter**
 - Tweet road weather forecasts, restrictions, crashes, and other important information to motorists
- **Variable Message Signs (VMS)**
 - Winter Storm XXPM Tomorrow

The screenshot shows the UDOT website interface. At the top, the UDOT logo and navigation menu are visible. The 'Road Weather' section is active, showing 'Current Conditions' and 'Road Condition Forecast' tabs. A dropdown menu for 'Forecast' is open, showing options from 'Current Forecast' to '21-24 Hour Forecast'. A map displays road conditions with color-coded segments: red for hazardous, yellow for moderate concern, and green for minimal concern. A 'ROAD WEATHER ALERT' is highlighted in a red box. A table at the bottom explains the color coding.

	Degree of caution	Weather Impact on Travel	Recommended Action
GREEN	Low	Minimal	Normal Caution
YELLOW	Moderate	Minor/intermittent weather related road concerns anticipated	Monitor 511, UDOT Traffic Web page and NWS Weather Forecasts.
RED	High	Travel expected to be impaired. Be prepared for hazardous road conditions	Monitor 511, UDOT Traffic Web page and NWS weather forecasts. Be prepared to alter travel plans as necessary

Impact of a Shared Message?



— Southbound — Northbound

Major commuter route near University of Utah shows impact of messaging

Afternoon peak commute (southbound) time was shifted based on forecast

- Typical peak is 400-600 PM
- On January 10th peak was 300-400 PM

Reduced afternoon and evening (Noon-800 PM) travel based on forecast

- 17 Jan – Total Volume 17,871
- 10 Jan – Total Volume 13,540

Preliminary Driver Awareness Survey Results

- 400 drivers in the metro area were surveyed in the days after this event
 - COMET Partners Project
 - NWS/UDOT/University of Utah
- ~80-85% of respondents were 'satisfied' or 'somewhat satisfied' with forecast information
- Driver behavior modification
 - ~3% took mass transit
 - ~13% did not travel because of storm
 - ~35-40% altered their travel route or timing because of storm



Enterprise Support to State DOTs

What Does Success Look Like?

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

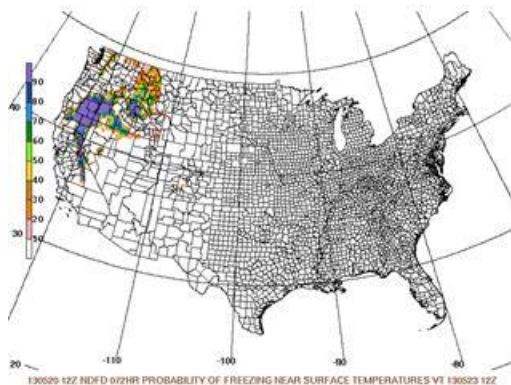
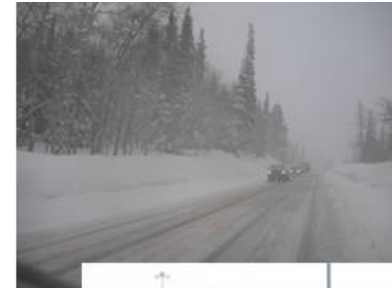


Resources & Emerging Services

NWS Public Services

Evolution and Timing of Hazards

- Winter Weather
- Forecast weather conditions including freezing drizzle and black ice.
- Predict icing, frost, thaw cycles, snow accumulation
- Winter and melt-related flooding
- Data from ploughs and other equipment



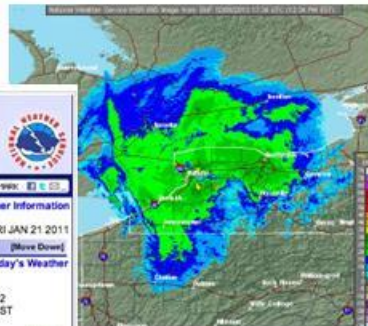
Probability of Freezing Near Surface



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

NWS Chicago, IL Mobile Weather Information

Zone Forecast: Cook County Last Update: 4:04 AM CST FRI JAN 21 2011

Detailed 7-day Forecast Current Conditions view Yesterday's Weather

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.

Partly Cloudy Humidity: 62 %
Wind Speed: NW 10 MPH
Barometer: 30.11" (1021.9 mb)
Dewpoint: 14.65 (-5.8 °C)
-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

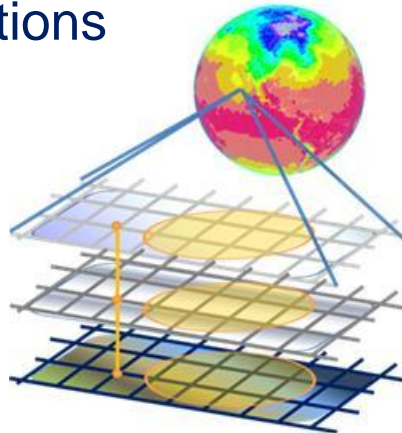
- July 2012 was the warmest month on record for the contiguous United States and more than 9,600 daily high temperature records broken during June, July, and August.



Developmental Climate Services

Local Climate Analysis Tool (LCAT)

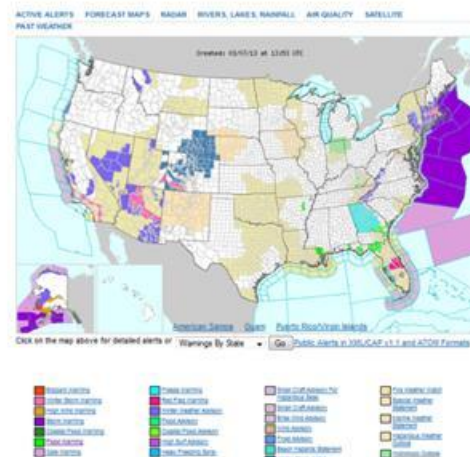
- Pre-Operational - Online Interactive Tool for regional, local studies and analysis
- Future Plans
 - Weather and Climate Extremes
 - Local information and projections



A screenshot of the LCAT website. The header includes the NOAA logo, the text 'LCAT Local Climate Analysis Tool', and a user greeting 'Welcome Maribel'. Navigation links for 'Home', 'LCAT', 'Learn', 'Logout', and 'Admin' are visible. The main content area features a large image of a desert landscape with the text 'Learn. Do. Share'. Below this are three columns: 'Learn' (with a list of bullet points), 'Do' (with a list of features), and 'Share' (with a list of features). A footer contains links for 'LCAT Help', 'LCAT News', 'Report Functionality/Posting Issue', 'Report Website Issue', and 'Subscribe to ListServ (Name: local_mex)'. A small note at the bottom left of the main content area reads: 'Please note that LCAT provides scientific guidance but not operational climate forecasts.'

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

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



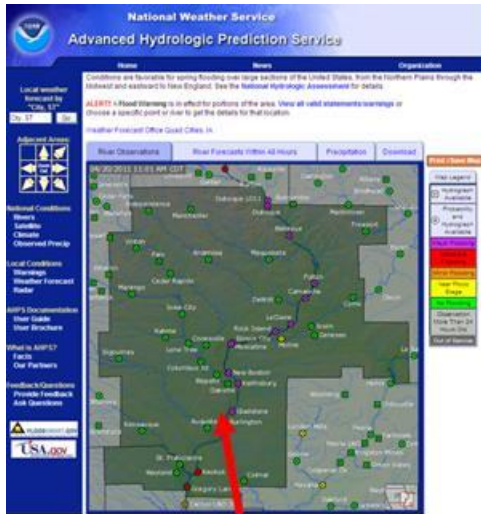
CO. Alert of wet roads.



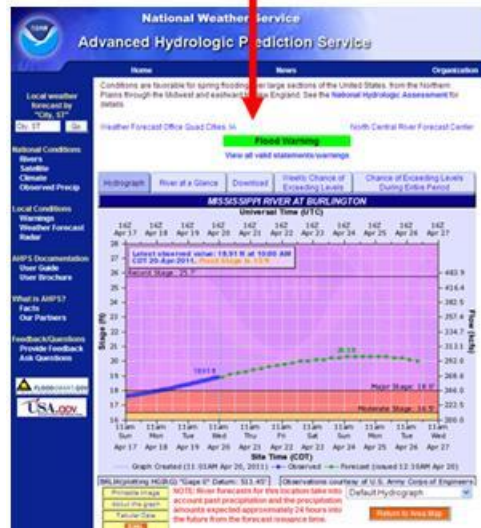
CO. RWIS
Snowmass
Canyon

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

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

- 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/>

NOAA's National Weather Service
Hydrometeorological Design Studies Center

Home Site Map News Org

General Info
Homepage
Current Projects
FAQ
Glossary

Precipitation Frequency (PF)
PF Data Server
PF Documents

Probable Maximum Precipitation (PMP)
PMP Documents

Miscellaneous
Publications
AEP Storm Analysis
Record Precipitation

Contact Us
Inquiries
List server

USA.gov

Available on PFDS for a selected location:

- Precipitation frequency estimates
- 90% confidence intervals
- Supplementary information

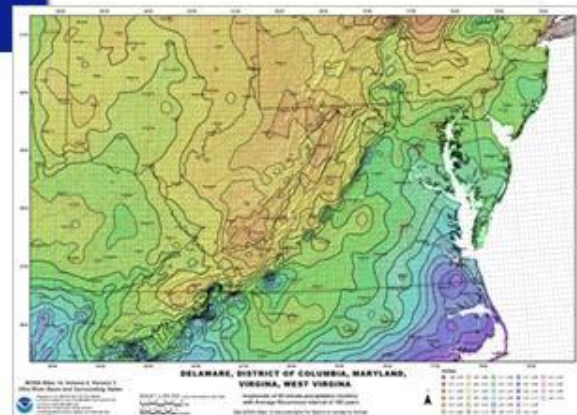
Precipitation frequency estimates

Probable maximum precipitation

Miscellaneous information

Also available on this site:

- NWS publications of interest for PF and PMP studies (NOAA Atlas 14, NOAA Atlas 2, Technical Reports, Technical Papers, Hydrometeorological Reports)
- Probability analysis for selected historical storm events
- Record point precipitation for the USA and the world



Signage and Education

Decision Support



Extreme Extremes

Superstorm Sandy

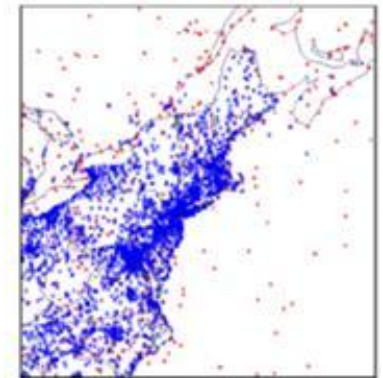
- 100 deaths,
- 100,000's of evacuations,
- 8,500,000 homes without power
- Massive flooding
- Gasoline shortages,
- Crippled regional energy and transportation infrastructure.



Observation and Data Services – Clarus and MADIS

Integrated observations and shared weather data collection and management

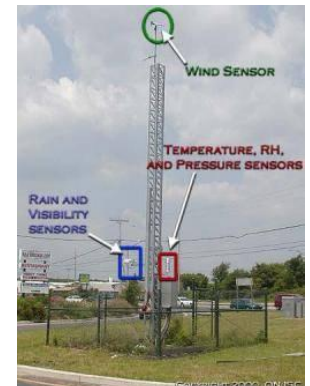
- Deployment and maintenance of regional (Mesonet) sensors (DOT and NWS, other partners)
- Real-time data for travel corridors
- Local/traffic cams



Increased density through MADIS

Provides access to

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



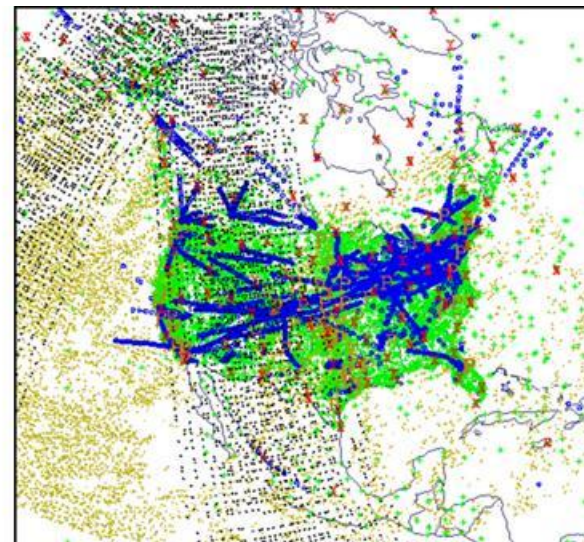
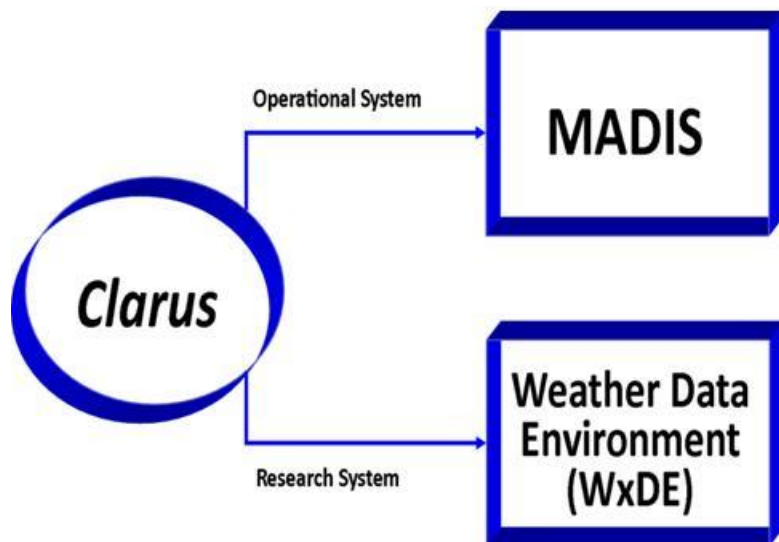
RWIS ESS

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

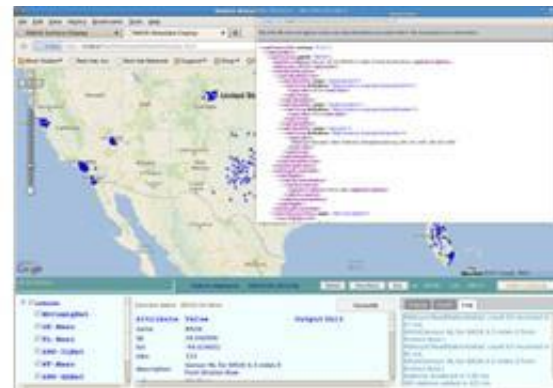
<http://www.nws.noaa.gov/ops2/ops24/madis.htm>

- 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

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 THROUGH EVENING. HIGH PRESSURE WILL BUILD OVER THE REGION THROUGH TUESDAY. A WARM **FRONT** WILL MOVE OFFSHORE EARLY WEDNESDAY AS A WARM **FRONT** ADVANCES NORTHEASTWARD ACROSS THE MID ATLANTIC. A COLD **FRONT** WILL TRAVEL THROUGH THE REGION LATE WEDNESDAY... BUT STALL OUT THROUGH THE WEEK.

NEAR TERM /THROUGH TONIGHT/...
AN EXPANSIVE **SFC** HIGH THAT IS CENTERED OVER THE GULF COAST STATES THIS **MORNING** WILL CONTINUE TO BUILD TOWARD SEABOARD. THE OTHER PROMINENT FEATURE IS A NEARLY VERTICAL **FRONT** OVER QUEBEC. A **SHORTWAVE** DISTURBANCE AND ULLC **STREAK** WILL DIG SEWARD AROUND THE BACKSIDE OF LARGE-SCALE **FEATURE** WILL TRAVERSE THE **CMA** THIS **AFTERNOON** AND **EVE**.

12Z IAD **RADAR REVEALED AN ALREADY DEEP **BOUNDARY LAYER** TO 1000 FT. EXPECT THE **MIXED LAYER** TO DEEPEN FURTHER THIS **AFTERNOON**. HEATING STEEPENS **LVL** LAPSE RATES AND **COLD POOL** ASSOCIATED WITH THE **TROUGH** STEEPENS **HLVL** LAPSE RATES. **FCST** MODEL SOUNDING... THIS **RETN** CONTINUE TO SHOW AN THERMODYNAMIC ENVIRONMENT THAT IS FAVORABLE FOR MODEST **CONVECTION** WHILE **QF** FORCING FOR ASCENT INCREASES WITH THE APPROACH OF THE MID-**LVL** **TROUGH**. COVERAGE AND INTENSITY OF SHOWERS THIS **AFTERNOON** SHOULD BE VERY LOW WITH SUCH A DRY AIRMASS OVER THE REGION. BASED ON LOCATION OF BEST LIFT/**MOISTURE** AND LATEST HIRFS **REFLECTIVITY FCST**...LOW CHANCE **POPS** COVERS THE MTS...CENTRAL VA AND **LR** **SR** MD. ONLY ISO SPRINKLES EXPECTED ELSEWHERE. GIVEN INVERTED **V SOUNDING**...SHOWERS CAPABLE OF TRANSPORTING 30-35 MPH GUSTS DOWN TO THE **SFC**.**

The screenshot shows the National Weather Service website for '2 MILES NNW NORTH POTOMAC MD'. The main forecast shows a high of 59°F and a low of 15°C. The 7-day forecast includes: Late Afternoon (Partly Sunny, High 60°F), Tonight (Frost, Low 34°F), Tuesday (Morning Frost, High 65°F), Tuesday Night (Mostly Cloudy, Low 46°F), Wednesday (Partly Sunny, High 76°F), Wednesday Night (Chance Thunderstorms, Low 60°F), Thursday (Chance Thunderstorms, High 82°F), Thursday Night (Chance Thunderstorms, Low 58°F), and Friday (Chance Thunderstorms, High 79°F).

Below the forecast, there is a 'HAZARDOUS WEATHER CONDITIONS' section and a '7-DAY FORECAST' section. The 7-day forecast details are as follows:

Time	Forecast
Late Afternoon	Partly sunny with a high near 60. Northwest wind around 15 mph, with gusts as high as 20 mph.
Tonight	Areas of frost after 2am. Otherwise, mostly cloudy, then gradually becoming clear, with a low around 34. Northwest wind 5 to 8 mph.
Tuesday	Areas of frost before 8am. Otherwise, increasing clouds, with a high near 65. North wind 5 to 8 mph becoming west in the afternoon.
Tuesday Night	Mostly cloudy, with a low around 46. South wind 3 to 6 mph.
Wednesday	Partly sunny with a high near 76. South wind 8 to 14 mph.

On the right side, there is a 'NWS Baltimore, MD/Washington, D.C.' section with a 'Peak Forecast' and a 'Click Map for Forecast' section.

weather.gov

Mobile Alerts

NOAA Weather Radio

weather.gov/nwr



WEA - cell broadcast alerts

weather.gov/wirelessalerts



iNWS – text message alerts

inws.wrh.noaa.gov



Broadcast warnings, watches, forecasts, and other hazard information 24 hours a day.

Conclusion

Hurricane Sandy and recent tornado outbreaks have highlighted the increasing need for more support to communities and integrated efforts with key partners

Hands on technical assistance and test cases linking research, social science and operations may provide much better societal benefit and increased understanding of modeling and assessments by state/local decision makers than less costly mechanisms (websites, guides, etc.) and more expensive technologic systems

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