



# **WAVE**

## **Weather Archive and Visualization Environment**

**Travis Wilson - WFO Phoenix**  
**William Rasch - WFO Sacramento**



# Video Testimonials



Click  
image to  
view  
video.

A video player interface showing a video of a large wave crashing. The text "Introducing: Weather Archive & Visualization Environment" is overlaid on the video. The NOAA and National Weather Service logos are in the top right corner. The video player controls at the bottom show a play button, a progress bar at 0:02 / 6:14, and icons for closed captions, settings, HD, and full screen.

**Introducing:**

**Weather**

**Archive &**

**Visualization**

**Environment**

0:02 / 6:14

Click  
image to  
view  
video.



# What is WAVE?

Multi-Purpose system that effectively manages and visualizes data

Accessible via Web Browser

Various archived datasets (mainly grib)

Hosted on Server at WRH

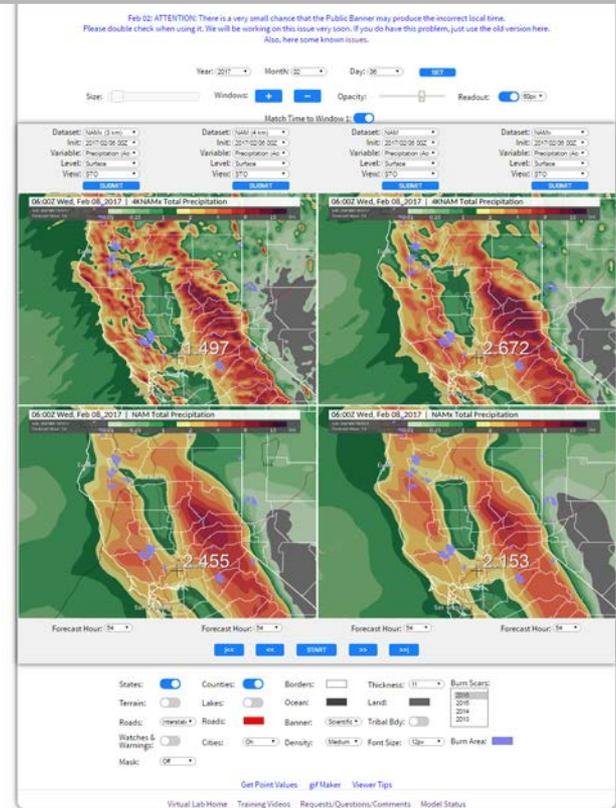
Only 2 CPUs atm

Limited space

Several GrADS / BASH / php scripts

Data obtained from AWIPS SBN / LDAD / FTP

PNG images/animations generated on the fly





# Why Wave?

## Data management Challenge

Gets arms around all data  
 Support Ops, O2R, and R2O  
 Increase overall Efficiency  
 Consistent IDSS Content Source

NCAR Ensemble Forecast  
 00 UTC Tue 16 Jan 2017

Ensemble Summary

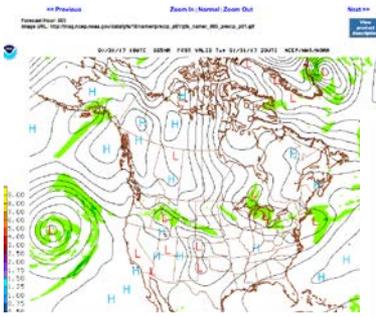
Ensemble Member Viewer

- Ensemble Plots
- Ensemble Soundings
- NCAR Ensemble WRF archive

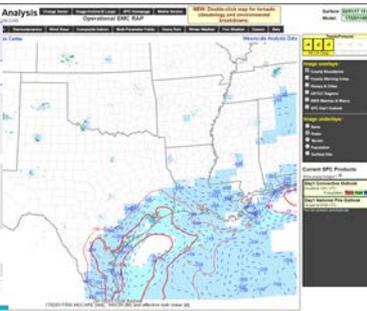
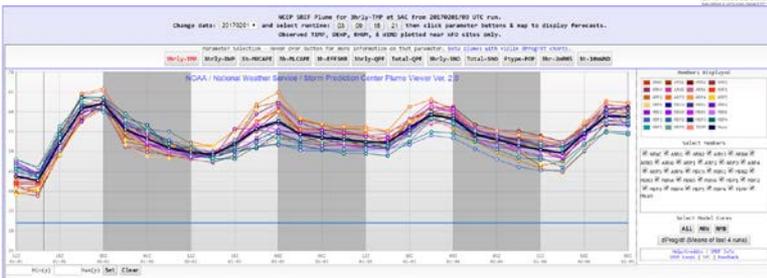


Cooperative Institute for Precipitation Systems  
 CIPS Historical Analog Guidance  
 Analog Run: 2017020112

Threat Guidance

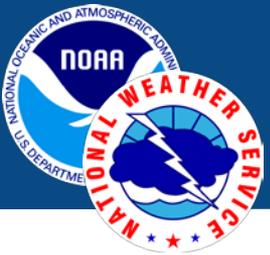


Data Set	freq	grib filter	http	gds-alt
<b>Global Models</b>				
GDAS	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-alt</a>
GFS 0.25 Degree	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-alt</a>
GFS 0.25 Degree Hourly	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-alt</a>
GFS 0.25 Degree (Secondary Params)	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	-
GFS 0.50 Degree	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-alt</a>
GFS 1.00 Degree	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-alt</a>
GFS Ensemble 1.00 Degree	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-alt</a>
GFS Ensemble 0.50 Degree	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	-
GFS Ensemble Precip Bias-Corrected	daily	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-alt</a>
GFS Ensemble 1.00 Degree Bias-Corrected	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-alt</a>
GFS Ensemble NDGD resolution Bias-Corrected	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-alt</a>
NAEFS high resolution Bias-Corrected	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-alt</a>
NAEFS NDGD resolution Bias-Corrected	6 hours	<a href="#">grib filter</a>	<a href="#">http</a>	<a href="#">OpenDAP-alt</a>
NGAC 2D Products	daily	<a href="#">grib filter</a>	<a href="#">http</a>	-
NGAC 3D Products	daily	<a href="#">grib filter</a>	<a href="#">http</a>	-
NGAC Aerosol Optical Depth Products	daily	<a href="#">grib filter</a>	<a href="#">http</a>	-



WRF GFS Table - Jan 22, 2017 00Z Run

	Z	T	U	V	WSP	SLP	Q	PW	IVT		
0	Sun	00Z	-2.2	1.9	3.2	2.6	3.3	-2.1	2.6	1.6	3.8
6		06Z	-3.3	1.7	3.2	3.8	4.6	-3.3	3.1	2.5	6.5
12		12Z	-3.1	2.1	3.3	4.0	4.6	-3.0	3.2	2.8	6.9
18		18Z	-2.7	-2.7	3.6	4.2	5.2	-2.8	3.1	2.9	7.3
24	Mon	00Z	-3.0	-3.1	3.2	3.2	4.0	-3.1	2.3	2.4	4.9



# WAVE - Meets this Challenge

## Data management

- Hosts wide array of datasets
- Archived and cloud based

## Greatly increases R2O and O2R efficiency

- Improve collaboration and feedback between NWS ops and research branches
- Consistency

## Ease of use

- Greatly reduces technical support

## **BONUS: IDSS training/content** (Rest of the Field)

- Already widely used by WFOs for IDSS content
- Opportunity for a consistent one source solution



# Archived Data Already Available



## Model Datasets

Operational - NAM, GFS, ECMWF, NMM, ARW, GEM, NARR

Experimental - NAMX, NAMX Nest, GFSx, HRRRExp, HRRR-TLE

## Observational:

NLDN, **NoRHSC**, NLDN, MRMS

**Soon: NBMv3, URMA, RTMA, FLASH, ProbSvr**

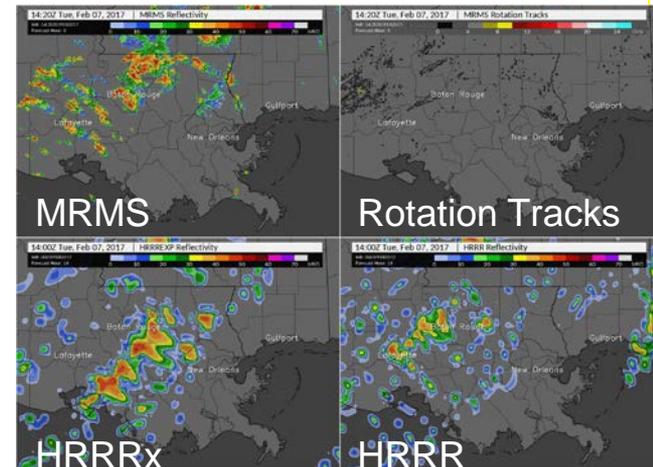
## National Centers

**WPC QPF, WPC PQPF, WPC PWPf**

## Other:

NOAA Atlas 14 ARI

**Pacific Region and Alaska Region**





# What more can WAVE do?



## Expand access

IMETs, EOCs, Working from home

## Additional Datasets

Post-processed ensemble data  
(SPC SSEO or SPC meso-analysis)  
(NCAR Hi-Res Ensemble)

Anomaly and Analog, Wof, More Radar, GOES-16

Expand and add functions for NDFD

## Non-Traditional Datasets

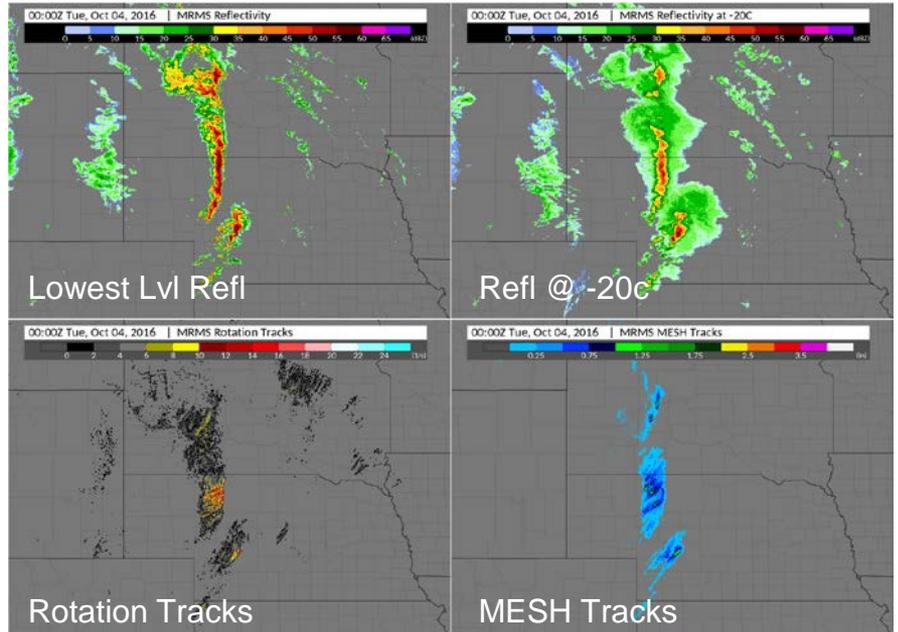
FEMA Risk Data, GIS  
Forest Service Flash Flood Guidance (BAER)

## More functionality

Expand Mapping abilities

## Verification Ability

## MRMS

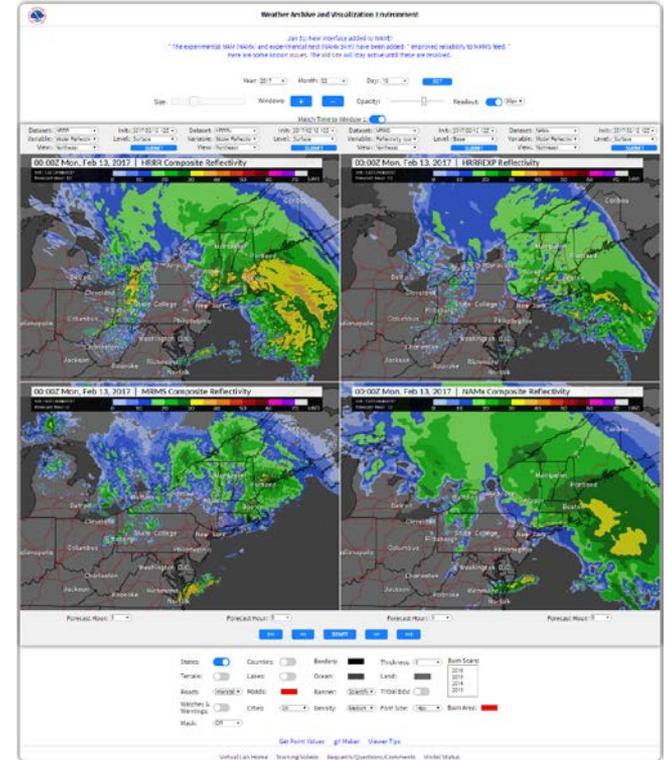
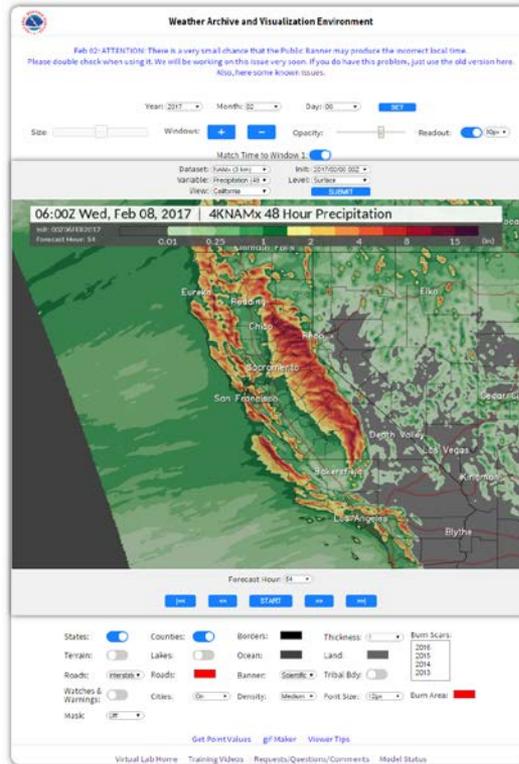




# Some Examples of WAVE Output



Examples  
of WAVE  
output...





# Some Examples of WAVE Output

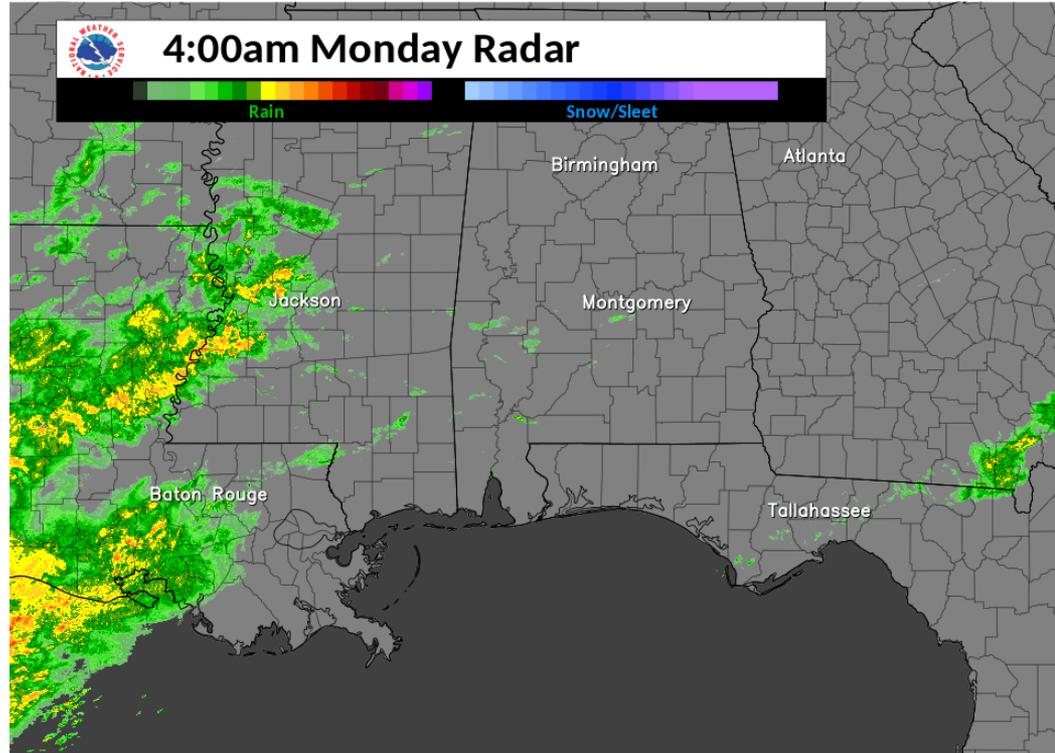


December 5th - 2016

MRMS Lowest Level  
Reflectivity

Adaptive Resolution for  
efficiency.

Higher zoom closer to  
native resolution





# Some Examples of WAVE Output



2017 Feb 07 - New Orleans Tor

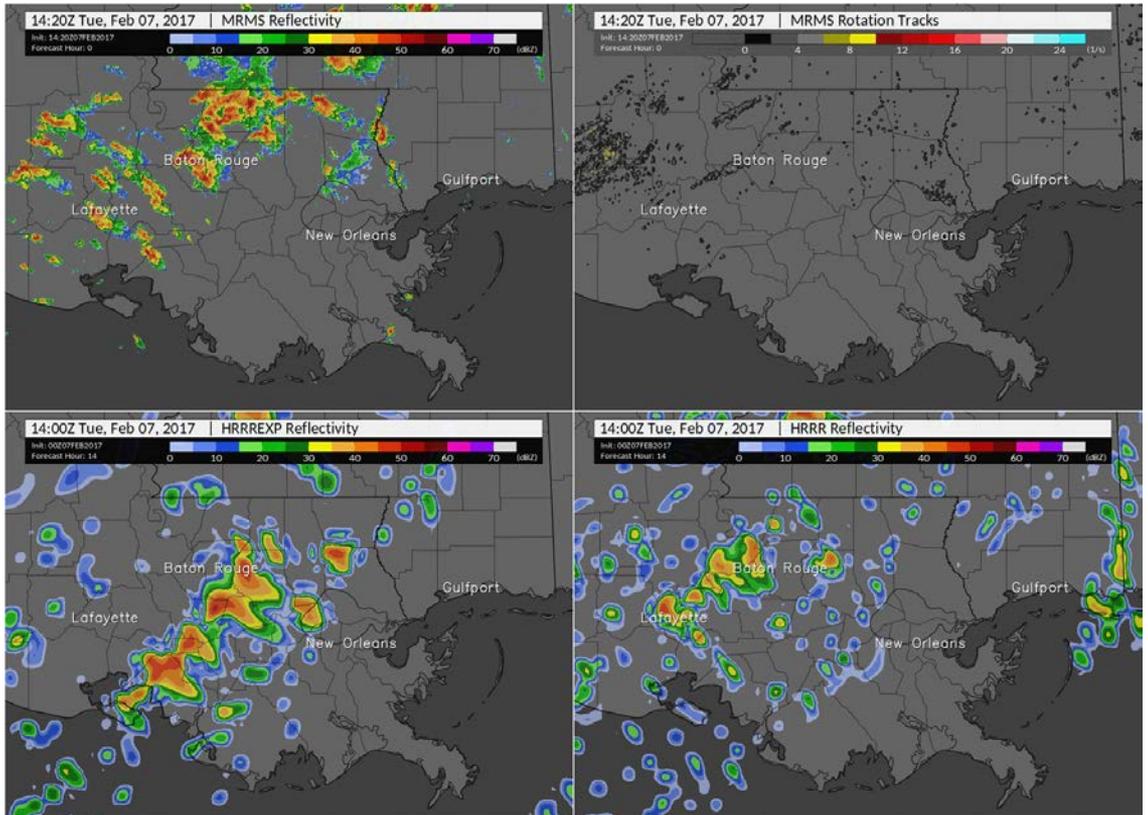
MRMS Lowest Level Reflectivity

MRMS Rotation Tracks

HRRR-Exp Reflectivity

HRRR Reflectivity

Easily compare time synced data sets with observational data.



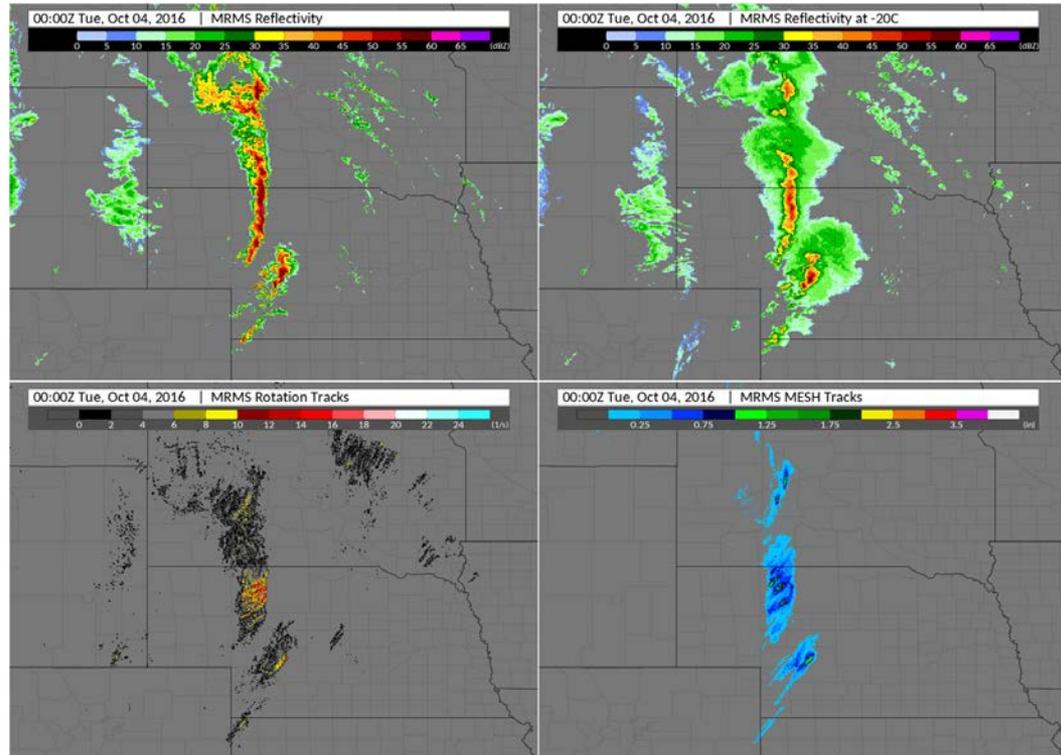


# Some Examples of WAVE Output



Oct 4th - 2016

- MRMS Reflectivity
- MRMS Ref at -20C
- MRMS Rotation Tracks
- MRMS MESH Tracks





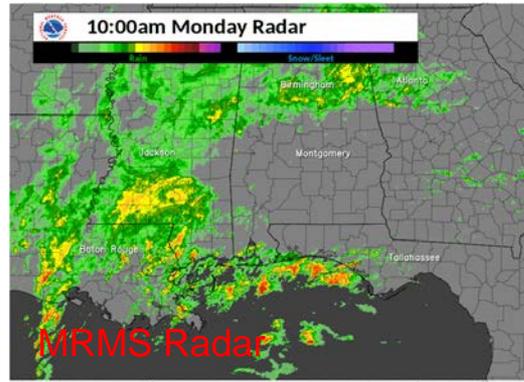
# Some Examples of WAVE Output



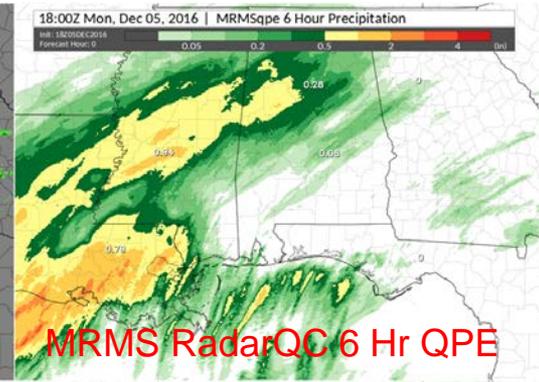
December 5th - 2016

Atlas 14 ARI allows us to put model and observed output into climatological perspective.

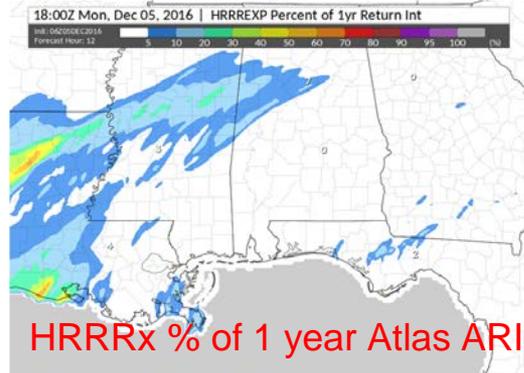
Great for IDSS and training.



MRMS Radar



MRMS RadarQC 6 Hr QPE



HRRRx % of 1 year Atlas ARI



HRRR 6 Hr Precip



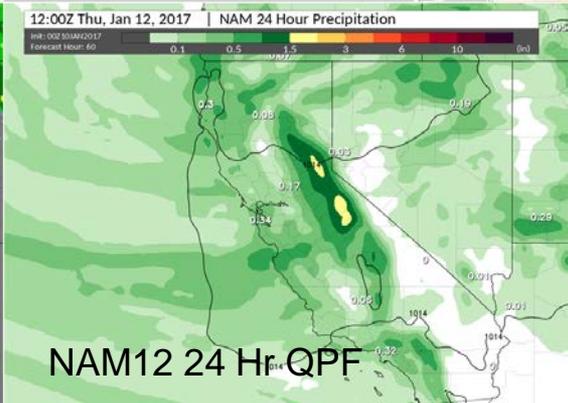
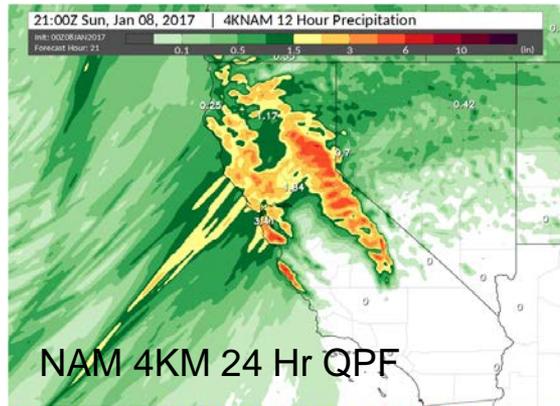
# Some Examples of WAVE Output



Jan 9/10 - 2017

Puts all QPF/QPE datasets in Atlas 14 perspective.

As percent of 1 year ARI or also showing the actual ARI year.



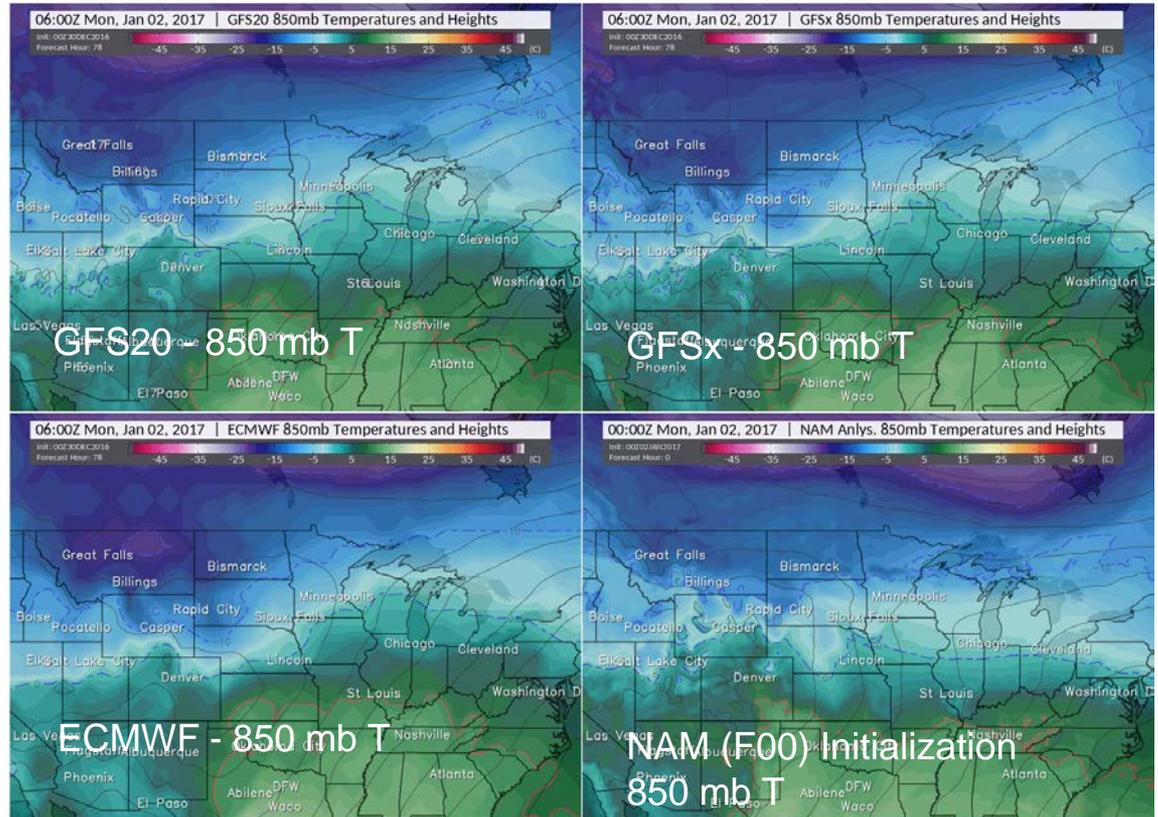


# Some Examples of WAVE Output



Early Jan 2017 - Cold Snap

Quick verification by using NAM or RAP time synced initialization (F00) data.



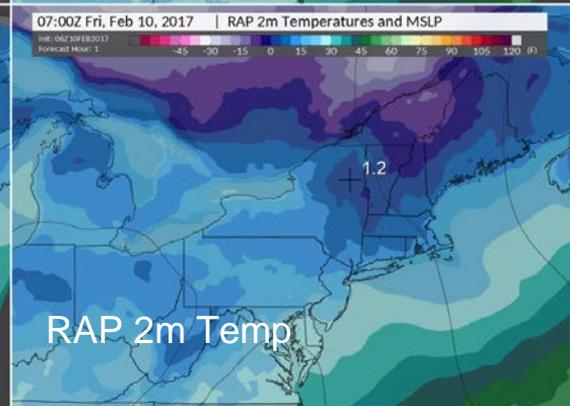
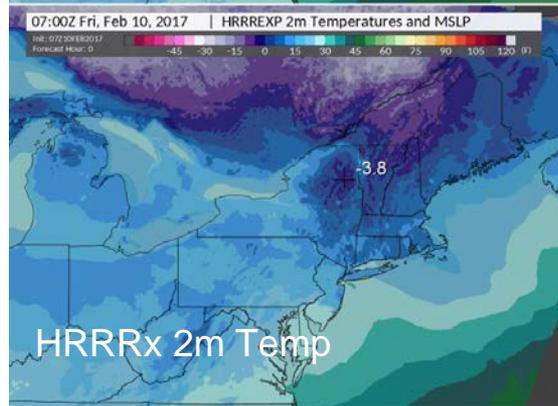
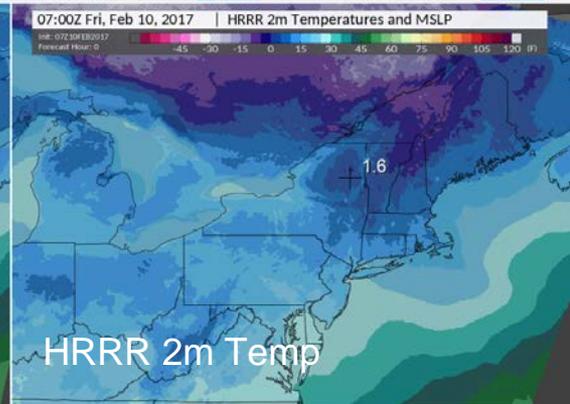
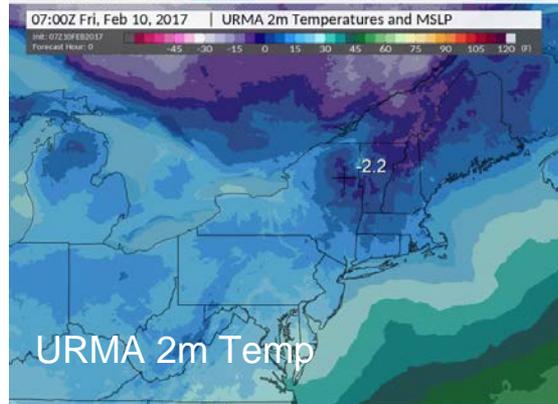


# Some Examples of WAVE Output



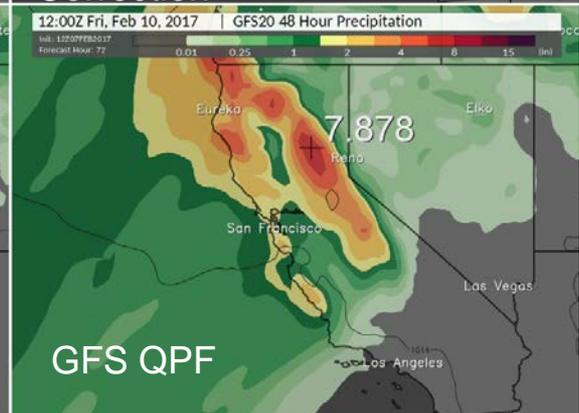
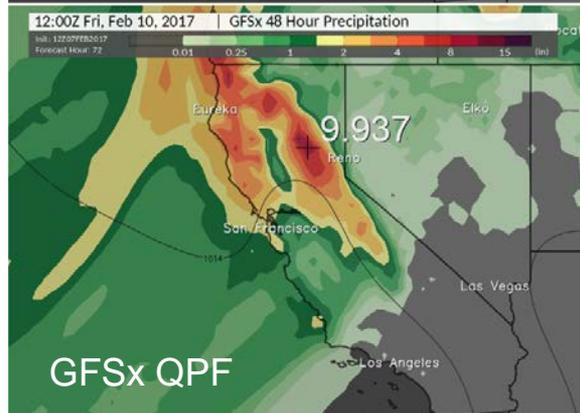
Sampling allows you to interrogate data.

Puts all datasets in one place with consistent look for better communication for R2O / O2R.





# Some Examples of WAVE Output



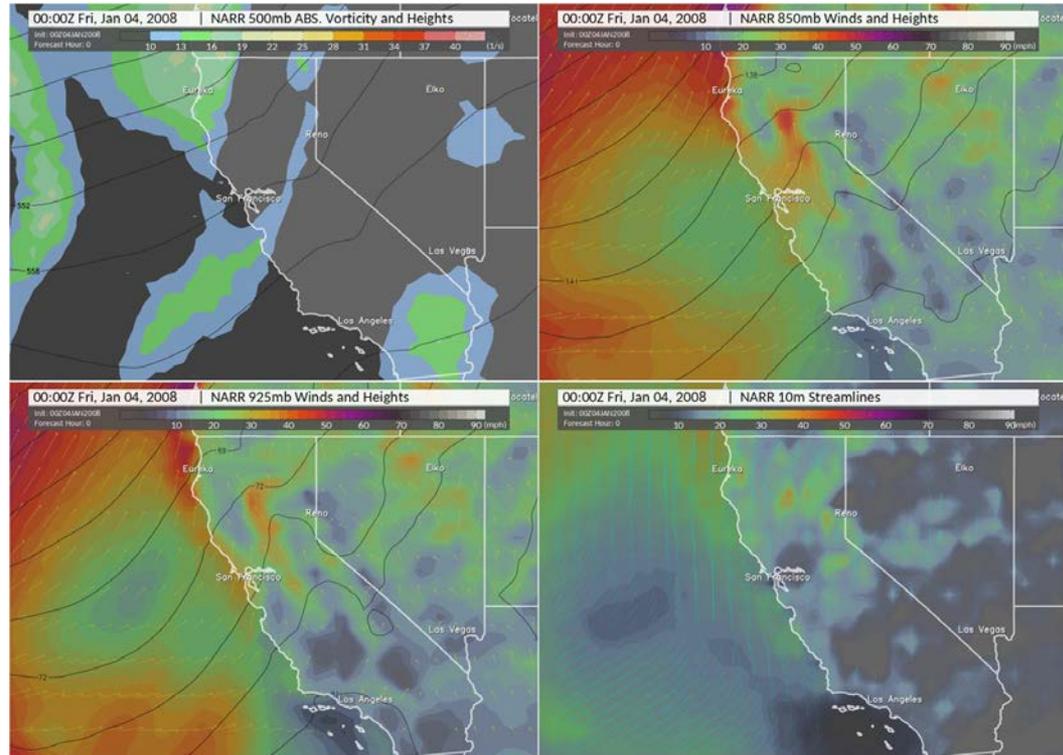
Feb Atmospheric River Event  
48 Hour QPF/QPE

Ability to verify datasets  
including experimental and  
observations datasets.

## Historical Events - NARR

Significant Wind Storm NorCal  
2008 Jan 4th

Archived model data can  
act as an analog tool for  
operational  
forecaster/SOOs and  
also for IDSS.



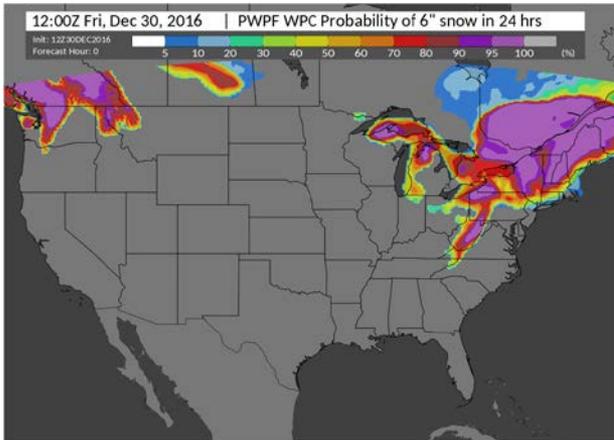


# Some Examples of WAVE Output

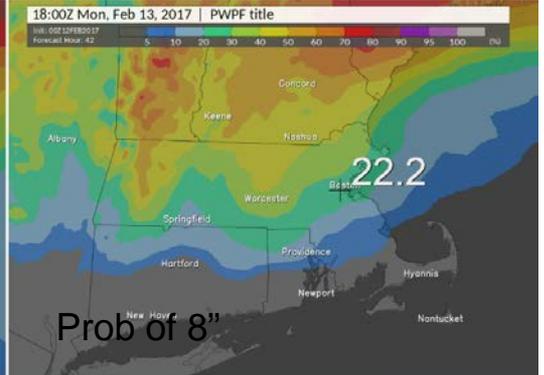
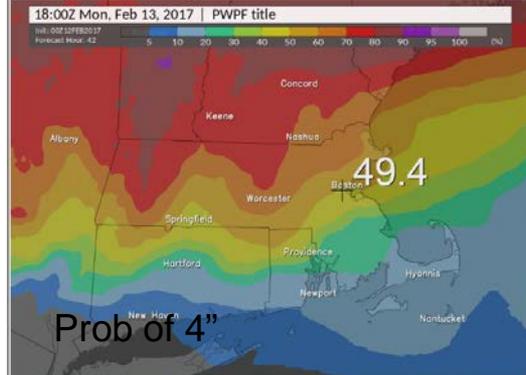
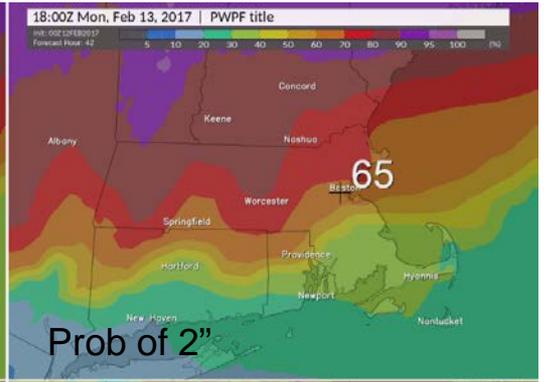
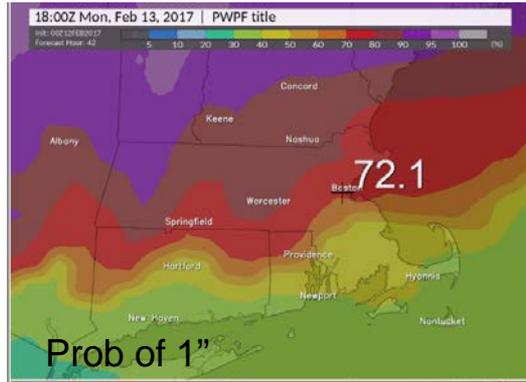


WPC - PWPF (Not in Operational WAVE yet)

Can display National Center experimental or operational datasets for R2O / O2R or IDSS.

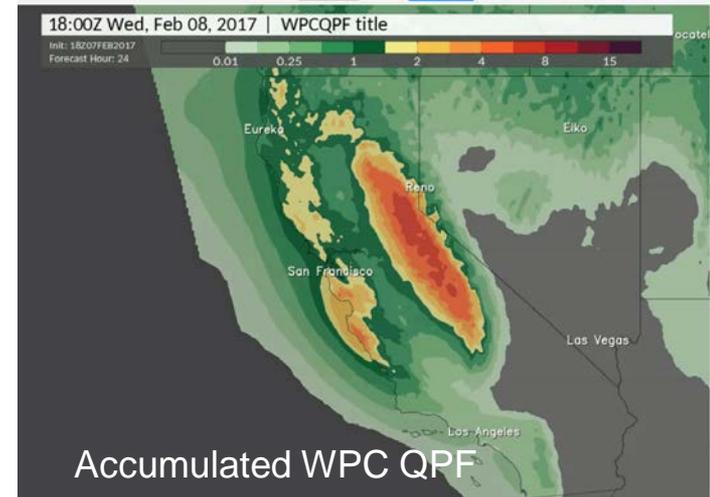
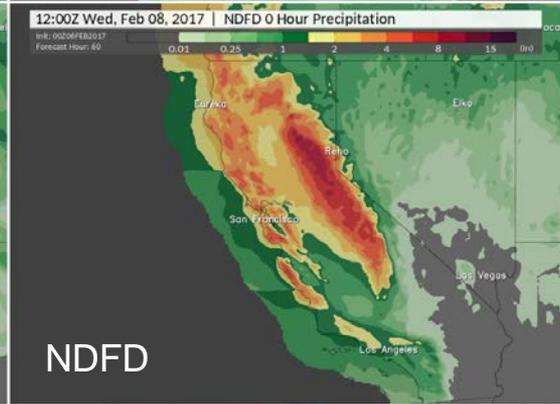
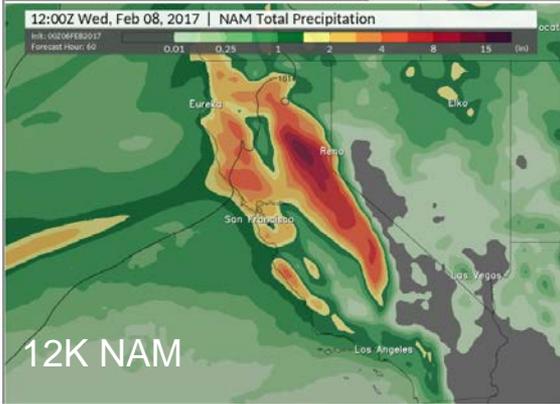
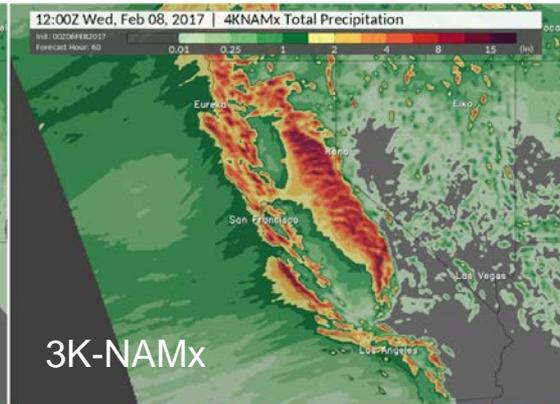


WPC PWPF - 24 Hour





# Some Examples of WAVE Output





# Some Examples of WAVE Content

From The Field



## URMA/HRRR Freckling Issues

Darren Van Cleave, SOO, WFO Salt Lake City

## 5 August 2016 Central and NE AZ Event

Andy Taylor  
WFO FGZ

View by being in presentation mode and clicking on image.



# Some Examples of WAVE Content

From The Field

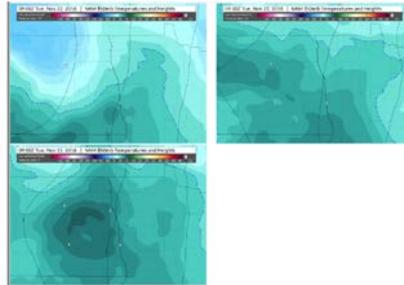


January 2-3, 2017

Messaging and Confidence

#### November 22nd - Quick Review of Model Biases with the Warm Layer Aloft

Here are the NAM forecasts of 850mb Temperature leading up to our Nov. 22nd rain-freezing rain/sleet/snow event. (Valid time is 06z Nov 22. Top Left = 06z Nov 20 Run, Top Right = 00z Nov 21 run, Bottom Left = 00z Nov 22 run).



December 5-7 Heavy Snow  
and Blizzard Event

FGF

View by being in presentation mode and clicking on image.



# Some Examples of WAVE Content

From The Field



## Light Freezing Drizzle Event at KPIR (Jan 24, 2017)

NWS Aberdeen  
Steve Fleegel

Nov 28-30, 2016  
Model Review

Steve Fleegel

Lake Effect Snow at KPIR on  
12/17/2016

Steve Fleegel  
NWS Aberdeen

View by being in presentation  
mode and clicking on image.



# Some Examples of WAVE Content

From The Field



NWS Phoenix  
@NWSPhoenix

Following

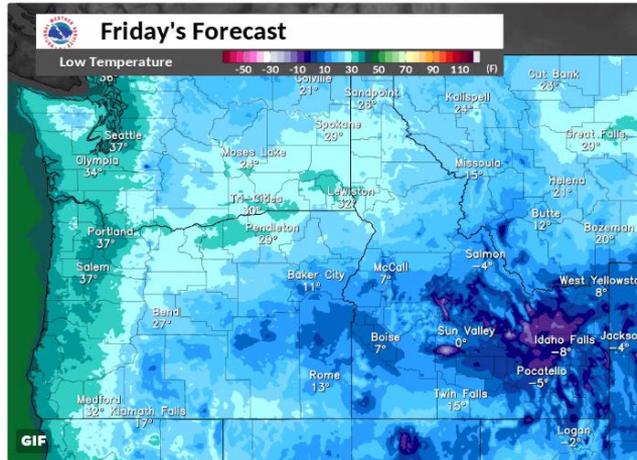
137P Rain pushing through #Phoenix metro w/ gusty winds & a few lower vsbys thru 5-6pm. Better this evening. #AZWX



NWS Boise  
@NWSBoise

Following

Below zero temperatures expected next week. Prepare now! #idwx #orwx



RETWEETS  
24

LIKES  
36



NWS Hanford  
@NWSHanford

Following

3:53 pm - Radar shows precip spreading into central CA. Snow levels are around 4,500 ft, and will rise overnight. #CAwx





# Some Examples of WAVE Content

From The Field



NWS Wakefield  
@NWSWakefieldVA



Following

Radar Update: Light to moderate rain continues across the region. Rain should begin to clear the area from west to east this afternoon.



NWS Boston  
@NWSBoston



Following

Heading out tomorrow morning? Here is a potential timeline & precipitation type. Still cannot rule out a mix across higher terrain of W MA.



RETWEETS

8

LIKES

12



NWS Gaylord  
@NWSGaylord



Following

824pm: Snow will become more widespread late this evening, exiting the area early Saturday morning. 1-2 inches of wet accumulation expected.





# Some Examples of WAVE Content

From The Field



**NWS Bay Area** ✓  
@NWSBayArea



Following

Please see the following video for the latest information about the upcoming storm. Any RT or sharing of the video is appreciated. [#caflood](#)



### Friday Afternoon Weekend Storm Update

Here is the latest information about the upcoming storm that will impact our region over the weekend. Please finalize any preparations now! [#caflood](#) [#castorm](#)

RETWEETS 235  
LIKES 96

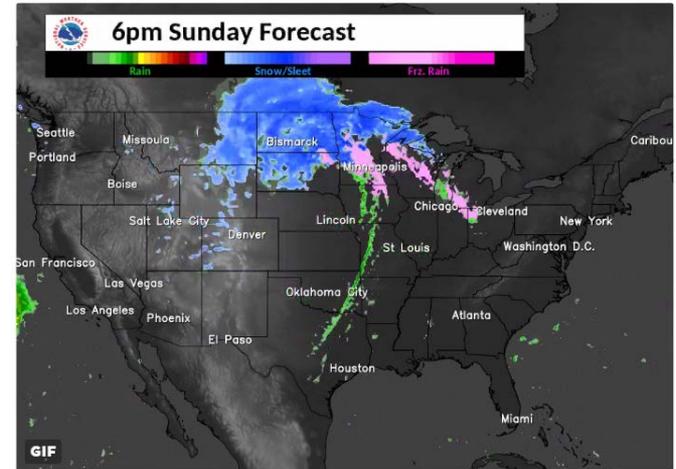


**NWS Central Region** ✓  
@NWSCentral



Following

Traveling this weekend? Here's how one of the computer models sees the storm playing out. Modify travel plans accordingly. [#holidaystorm](#)



RETWEETS 14  
LIKES 8





# Some Examples of WAVE Content

From The Field



NWS Bay Area  
@NWSBayArea

Following

Latest update from the #HRRR shows more rain today and slowly clearing north-to-south by the evening. #bayarea #castorm #caflood #cawx



RETWEETS 11  
LIKES 7



Mail ●●● LTE 2:36 PM 46%  
wrh.noaa.gov

USGS

waterdata.usgs.gov/nwis/uc?rib\_no=303474605&NWSA\_mstr\_job=0005.0000

Reno National Weather Service  
Forecasting for the Sierra and western Nevada since 1905

### Atmospheric River Landfall

Axis of heavy rains focusing on areas N of Hwy 50. Sliding south this afternoon-evening.

10am Sunday Radar

Reno National Weather Service  
Forecasting for the Sierra and western Nevada since 1905

### Snow Level Trends

Snow Level Radar @ Colfax  
ES&R, Physical Sciences Division  
FACR & local Snow Level Radar

Mail ●●● LTE 2:36 PM 46%  
wrh.noaa.gov

More... Open in "Chrome"

Colorado Rockies West Coast Haze - patches of weak, wispy clouds starting to clear. High to transition to mountain snow after midnight tonight. W Nev rain or snow showers possible. Heavy snow on/off mountains continuing thru Thurs. Big snow Wed AM! W Nev - rain or snow periods with strong winds. Flood risk low Tuesday onward. Heightened avalanche risk however.

Reno National Weather Service  
Forecasting for the Sierra and western Nevada since 1905

### Today's Simulation

HRRR model forecast radar - band of heavy rain pivoting back south today

Reno National Weather Service  
Forecasting for the Sierra and western Nevada since 1905

### Snow Level Trends

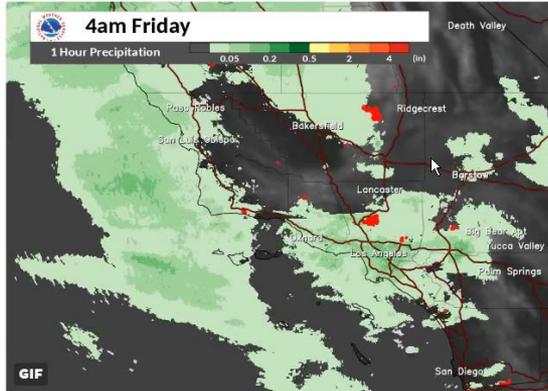


# Some Examples of WAVE Content

From The Field



NWS Los Angeles @NWSLosAngeles · 13m  
Radar-based rain rates over the last 4 hrs. The red areas are burn scars. #CASorm #LARain



NWS Columbia @NWSColumbia

Following

Quick moving storm line pushing into the eastern Midlands and lower CSRA. Wind gusts to 45 mph possible w/heavy rain. #scwx #gawx



NWS Portland @NWSPortland



Following

Forecast still on track for ice storm this weekend. Prepare for treacherous roads, falling tree limbs, and power outages #orwx #wawx #pdxst



Forecast still on track for a significant ice storm for much of the Willamette Valley, Columbia River Gorge, and foothills this weekend.



# Some Examples of WAVE Content

From The Field



NWS Memphis  
@NWSMemphis

Following

A brief period of rain & snow showers is possible overnight over portions of West TN. No accumulation is expected. #tnwx #Forecast



RETWEETS 5 LIKES 6



NWS Milwaukee  
@NWSMKX

Following

Winter wx on the way. In S WI, the heaviest will be rain; Only expecting 4" toward central WI, < 1" in the far S & E. #swiwx #wiwx #snow



RETWEETS 3 LIKES 1



10:07 AM - 23 Jan 2017

Reply to @NWSMKX



NWS Los Angeles @NWSLosAngeles - 4h

Heavy rain along the SBA South Coast will be moving east through VEN and LA Co this morning and afternoon. #CASTorm #LARain



RETWEETS 60 LIKES 45



# Some Examples of WAVE Content

From The Field



NWS Birmingham  
@NWSBirmingham

Following

Storms continue to push E across the SE Counties. Rain has ended elsewhere. [#alwx](#)



RETWEETS 5



NWS Flagstaff  
@NWSFlagstaff

Following

Radar loop to 11PM: widespread rain/snow east of I-17 with more showers developing west of I-17. Please slow down on wet & icy roads. [#azwx](#)



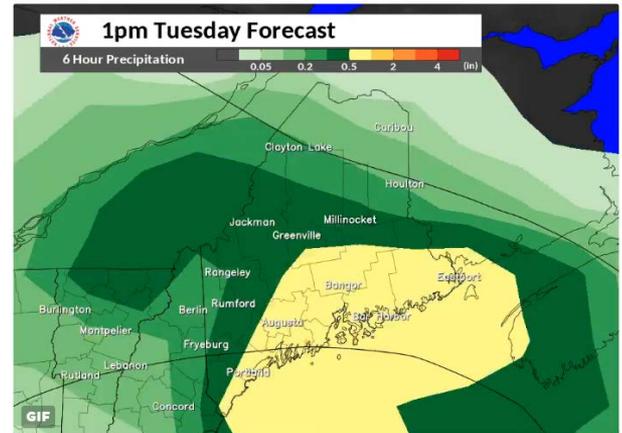
RETWEETS 7 LINES 7



NWS Caribou  
@NWSCaribou

Following

Precipitation to overspread the area late Mon night/Tue morning. [#newx](#)



2:46 PM - 22 Jan 2017

2



# Some Examples of WAVE Content

From The Field



Snow associated w/ a cold front develops by midnight over north-central MT, then spreads into SW MT late tonight through Tuesday. #mtwx



2:10pm · 30 Jan 2017 · TweetDeck



Another swath of precipitation will continue to move through the Northern Rockies this morning bringing even more #Snow. #MTwx #IDwx



8:17am · 4 Feb 2017 · TweetDeck



920 pm: Snowband moving S into S. Big Horn, S. Rosebud & Sheridan Counties. Poor visibilities; 1-2 in accumulation. Use caution! #mtwx #wywx





# Usage



VLab members 250

5th in VLab membership

Already used by SOOs for training and R2O/O2R

Widely Used by WFOs (WCMs and Mets) for IDSS and operations

Hundreds of mod requests

Daily Usage ~ 100 Unique Users/Day

Google Analytics since August 3rd, 2016

Sessions

10,586



Users

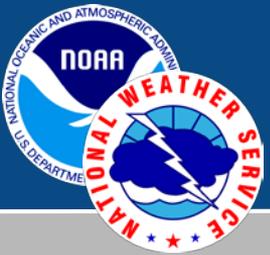
2,584



Pageviews

15,253





# Summary- What and Who does it help?

## SOOs

Greatly Increased Efficiency and Effectiveness

R2O / O2R Improvements

## Research Field

Get your datasets in front of SOOs and Forecasters

## Rest of the Field

**BONUS:** Consistent high quality clear concise IDSS content





# Thank You For The Support!



Andy Edman - WRH STID

Sean Wink - WRH SFD

Mark Loeffelbein - WRH STID

Ahmad Gorabi - WRH SFD

Clark Mercer - WRH SFD

Idamis Del Valle Martinez - NWS Sacramento

Advisory Team: Marc Singer SOO Billings MT

JJ Brost - SRH

