



# An Introduction to the National Blend of Global Models Project

**Kathryn Gilbert, Project Manager**  
**David Myrick, Deputy Project Manager**

**Wednesday, February 18, 2015**

**Co-Authors: Jeff Craven, Dave Novak, Tom Hamill,  
Jim Sieveking, and David Ruth**  
**Many additional contributors**

# Overview

- Introduction
- Project Goals & Scope
- Activities and Progress
- Schedule
- Summary of Issues and Challenges
- How VLab is being used

# The Growing Challenge: Consistency

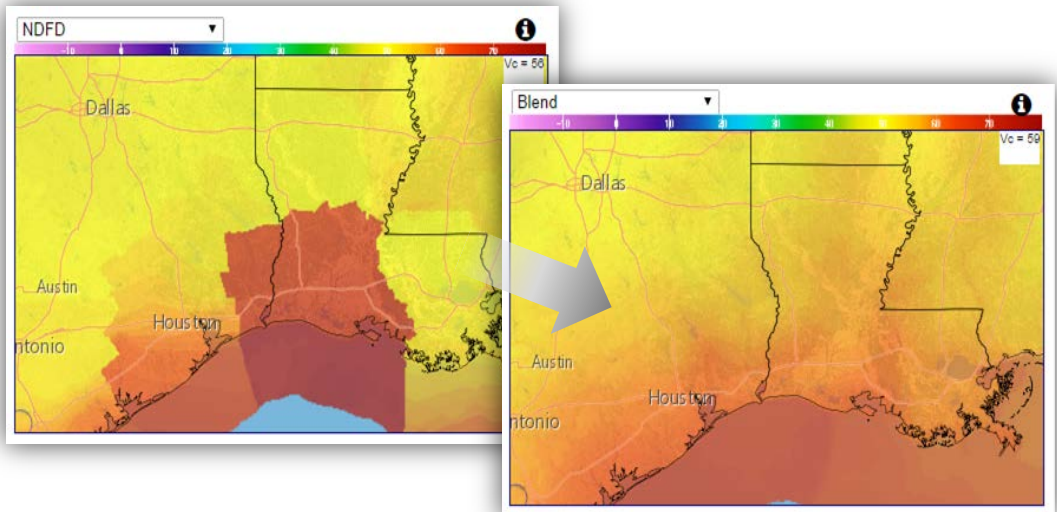
**Issue:** Local forecast offices work primarily to serve local user requirements.  
How are state, regional, and national needs being addressed?

**Consequence:** Inconsistencies across CWA or Regional lines can lead to challenges for Impact-based Decision Support Services on the state, regional & national scale.

*What do our partners think when they see sharp changes in our forecast grids?*

*It impacts their confidence in our forecasts*

**Need:** To develop nationally consistent methodologies



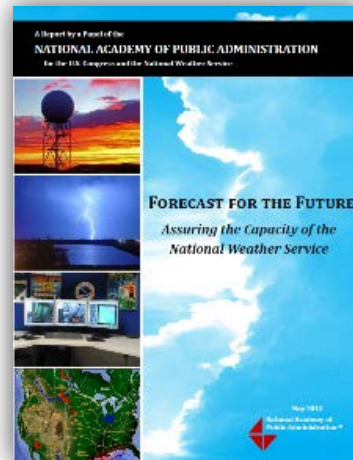
# Origins of the National Blend

## REASONING

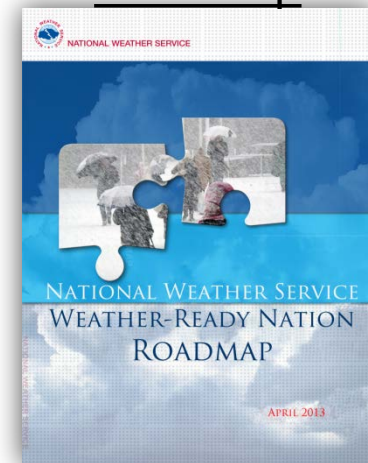
### Local / Regional Model Blend Initiatives



### NAPA Report



### WRN Roadmap



## FUNDING



Sandy Supplemental  
JPSS Gap Mitigation:  
*projects that make better  
use of existing model data*

# The National Blend Project Team

- **Former Technical Advisor – Stephen Lord (ret. as of Jan 3)**
- **Project Manager – Kathryn Gilbert**
- **Deputy Project Manager – David Myrick**
- **Plenary Team: NWS HQ, NCEP, NWS Regions, NWSEO, OAR/ESRL**

## Project ‘Working Level’ Teams:

- Analysis and Verification
- Post Processing
- Testing and Training
- Dissemination
- Outreach

Over 70 contributors on this one project!



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# Project Goals & Requirements

## Objective:

- **Improve quality and consistency of the NWS National Digital Forecast**

## Project Goals

- Through an integrated and structured approach:
  - Develop a set of foundational gridded guidance products for National Digital Forecast Database (NDFD) weather elements based on NWS and non-NWS model information
  - Create a methodology for a national blend (“best”) product from multiple models, beginning with the Day 3 - 8 time frame and extensible to a full set of deterministic and probabilistic products covering days 1-10

## Project Requirements:

- NWS Enterprise Solution
  - Nationally uniform product, with spatial and temporal consistency
  - Extensible methodologies (models, elements, lead times...)
- Meet R2O criteria
  - Implementable and Sustainable
- No degradation of service

# The National Blend Project

## What this *IS*:

- Recognition of the need to get the most out of the data we have and use it to improve consistency in our products on a state, regional, and national scale
- A scientifically sound approach to extract consistent weather information from all models, especially ensembles

## What this *IS NOT*:

- A way to reduce NWS staff
- A way to remove the human completely from grid editing



# Project Development Scope

National Digital Forecast Database (NDFD) elements will be part of the National Blend package

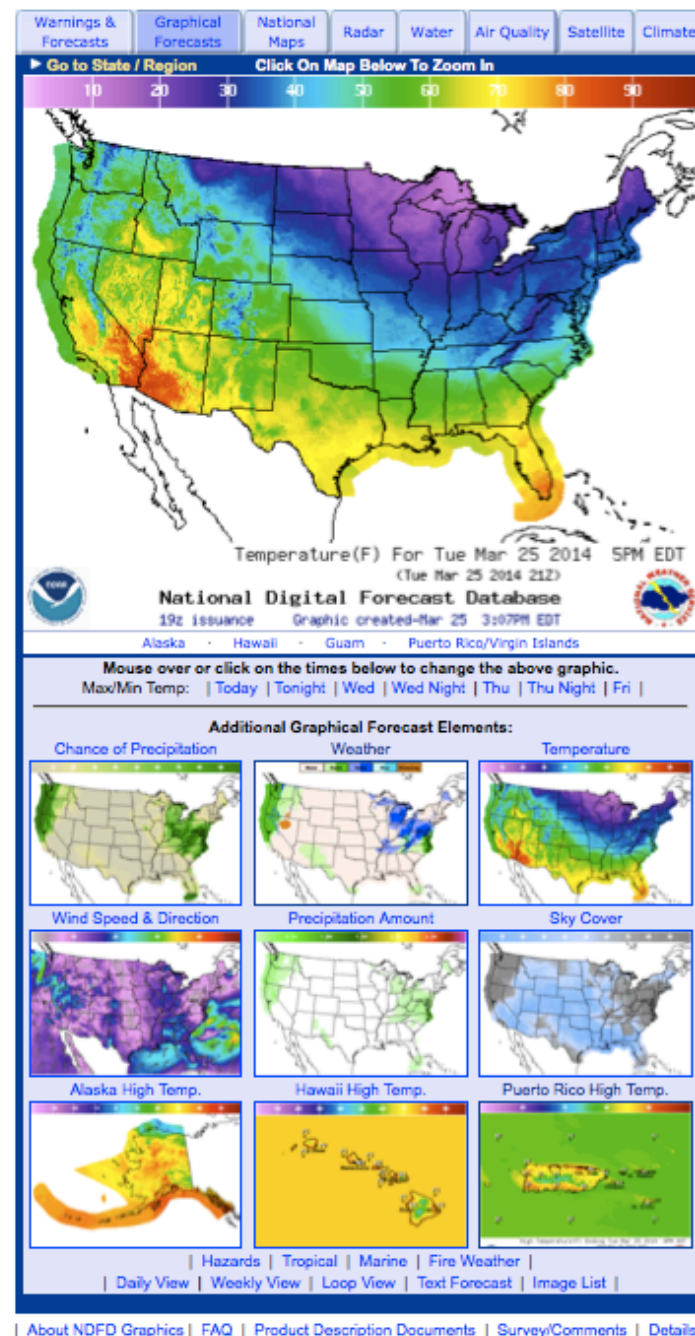
Version 1, December 2015 weather elements:

- 2-m Temperature
- 2-m Dewpoint
- Daytime Max T and Nighttime Min T
- Sky Cover (%)
- 10-m Wind speed/direction
- 12-h Probability of Precipitation (%)

Version 2, FY16Q3, adds:

- Snowfall Amount
- QPF
- Wind Gusts
- Precipitation Type
- Predominant Weather

Derive where it makes sense to ensure consistency, efficiency: i.e. Relative Humidity, Apparent Temperature

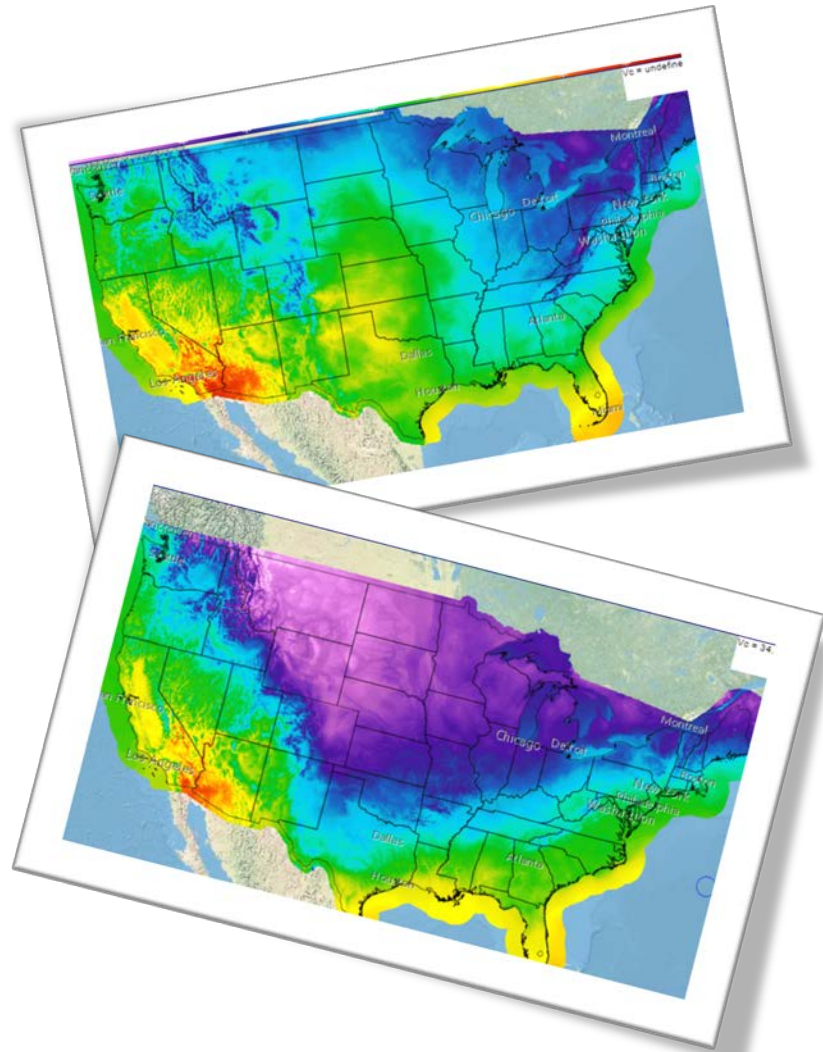


# Project Development Scope (cont.)

Products will be generated on NOAA's Weather and Climate Operational Supercomputer System (WCOSS)

Initial efforts focused on blending global models

- Global Model inputs
  - ECMWF, ECMWF Ensembles
  - GFS, GFS Ensembles
  - CMC Ensembles
  - CMC, FNMOC - NAVGEM, UKMET

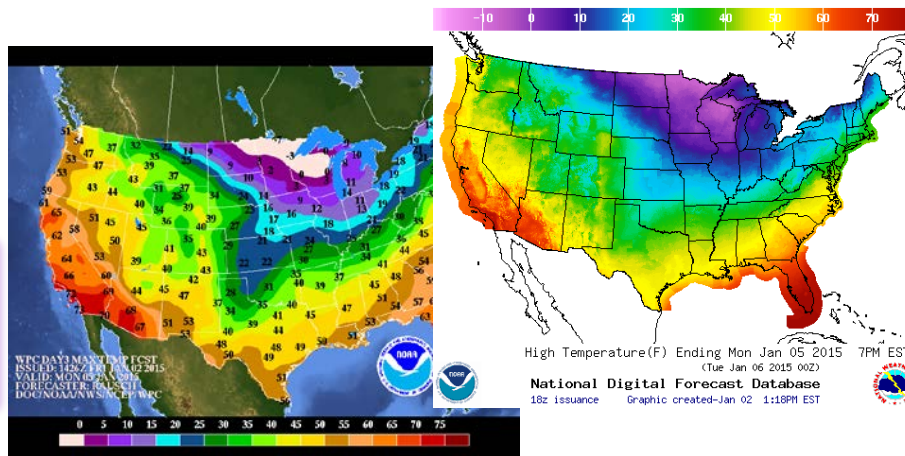


# The National Blend Plan

Objective blended products will be generated on WCROSS from calibrated post-processed model output

- Two cycles per day (0000 and 1200 UTC)
  - Initially limited to Deterministic and Ensemble **Global** models
  - Disseminated to NCEP Centers and WFOs
- Weather Prediction Center (WPC) will provide oversight of the National Blend for Days 3-8 to ensure meteorological and spatial consistency
  - WFOs will receive both objective (WCROSS-generated) and WPC (edited) grids
  - WFOs retain the final gridded forecast responsibility for the full Day 1 – 8 period to populate NDFD.

Example:  
WPC and NDFD  
Day 3 Max T



# Activities & Progress

## Analysis and Verification – David Ruth, NWS/MDL

- MDL developed a viewer to compare performance of candidate analyses and prototype blends in real-time with NDFD
- The team reviewed candidate analysis packages, identifying strengths and weaknesses
- Real-Time Mesoscale Analysis (RTMA)/UnRestricted Mesoscale Analysis (URMA) identified as the best candidate analysis for verification and post-processing:
  - Running centrally on WCOSS
  - Covering all NDFD domains
  - Validated products for most NDFD elements
  - **Goal: Improve the RTMA/URMA to be the “Analysis of Record”**
- The viewer enabled enhanced NWS field participation in a recent parallel URMA evaluation (RTMA/URMA upgrade scheduled for March 2015)

# Comparison Viewer

## URMA evaluation - wind, arctic front 11/11/2014

Forecast View  
[Daily Forecast Review](#)  
[Daily Analysis Review](#)  
[Monthly Forecast Review](#)  
[Monthly Analysis Review](#)

WFO:

Element  
 Wind Speed

Year-Month-Day  
 14-11-11-Tuesday

Analysis Hour (UTC)

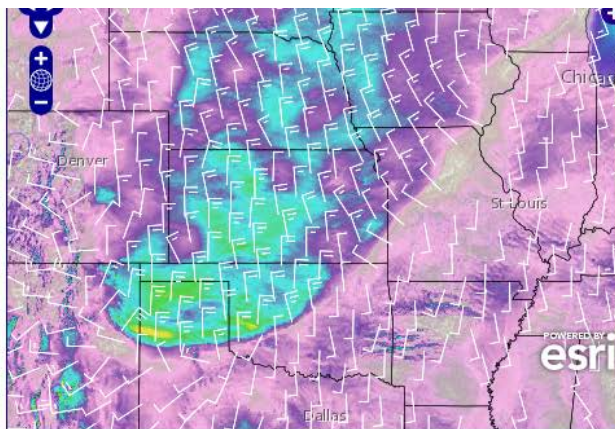
00	01	02	03	04	05
06	07	08	09	10	11
12	13	14	15	16	17
18	19	20	21	22	23

Opacity: 65%

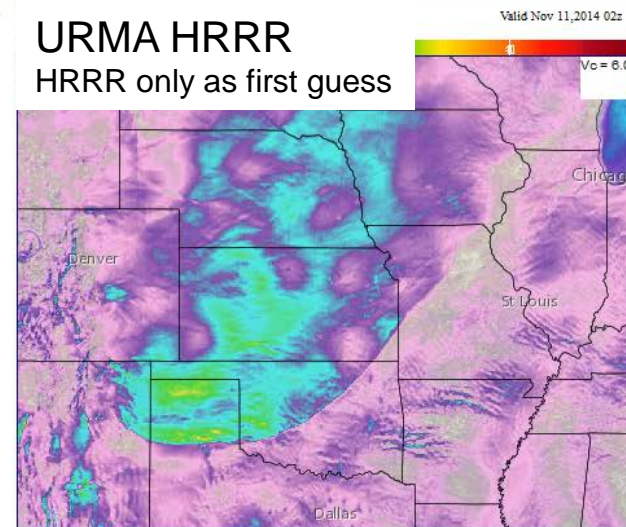
Annotation  
 Navigate

[User Documentation](#)

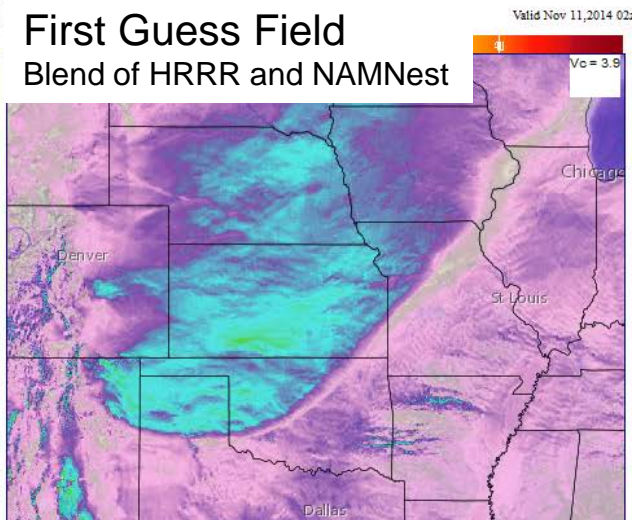
**URMA Blend**  
 blends HRRR and NAMNest as first guess



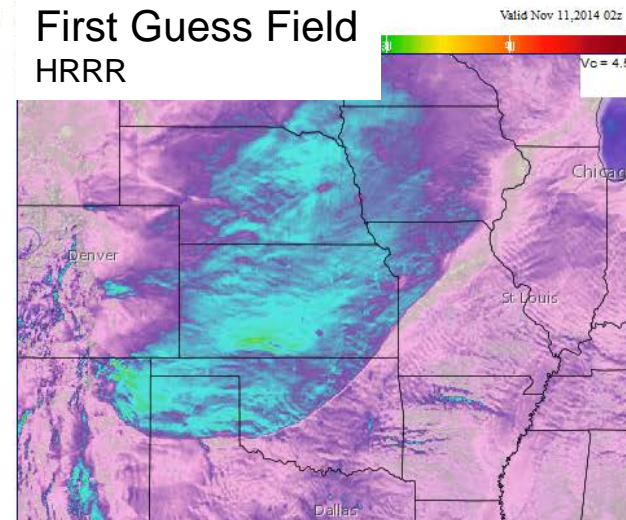
**URMA HRRR**  
 HRRR only as first guess



**First Guess Field**  
 Blend of HRRR and NAMNest



**First Guess Field**  
 HRRR



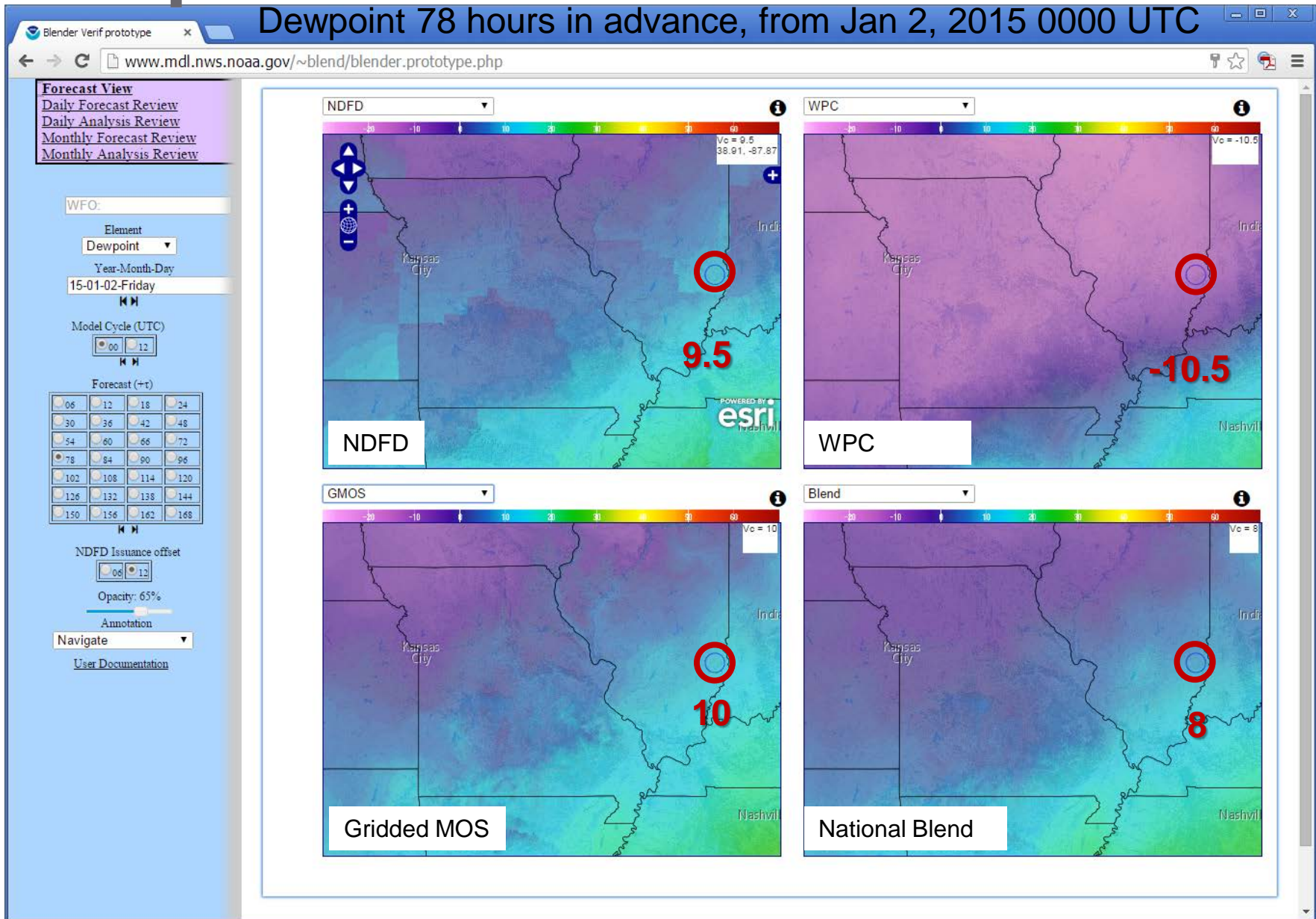
# Activities & Progress (cont.)

## Post-Processing – Tom Hamill, OAR/ESRL/PSD

- NWS and OAR scientists conducted sample-size studies, results used for white paper recommendations on reforecasts and reanalyses (<http://www.esrl.noaa.gov/psd/people/tom.hamill/White-paper-reforecast-configuration.pdf>)
- Team conducted comparisons of methods for post-processing (OAR, EMC, MDL)
- OAR/PSD developing calibrated precipitation guidance (lead: Tom Hamill)
  - 12-h PoP code handed over to MDL in September
  - CDF-based bias correction using past 60 days
  - Statistically downscale – find past coarse-resolution precipitation analyses most similar to today's forecast, differences applied to each member to increase resolution
  - Compute probability from ensemble relative frequency
- MDL developing non-precipitation guidance (lead: Bruce Veenhuis)
  - Temperature and Dewpoint now ready for limited evaluation
  - Statistically post-processed at observing sights
  - Downscaled to NDFD grids
  - Bias-corrected to the RTMA/URMA
  - Blended using MAE-based weights, trained on ~ 20 days

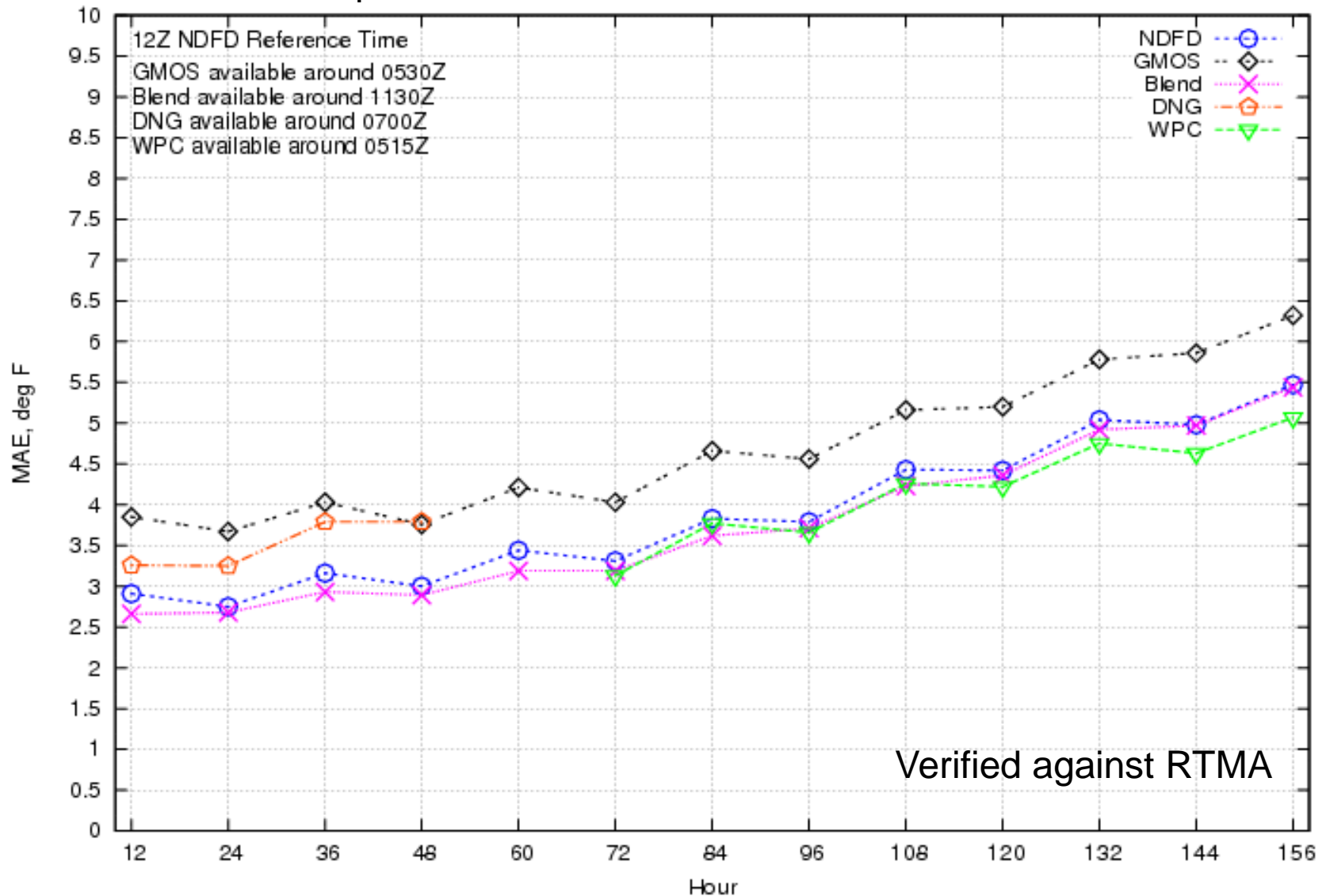
# Comparison Viewer – National Blend

Dewpoint 78 hours in advance, from Jan 2, 2015 0000 UTC



# Early Verification of the National Blend

201410 Dewpoint MAE: **NDFD**, **Gridded MOS**, **Blend**, **DNG**, **WPC**





# Temperature MAE – MKE CWA – Feb. 2-17, 2015

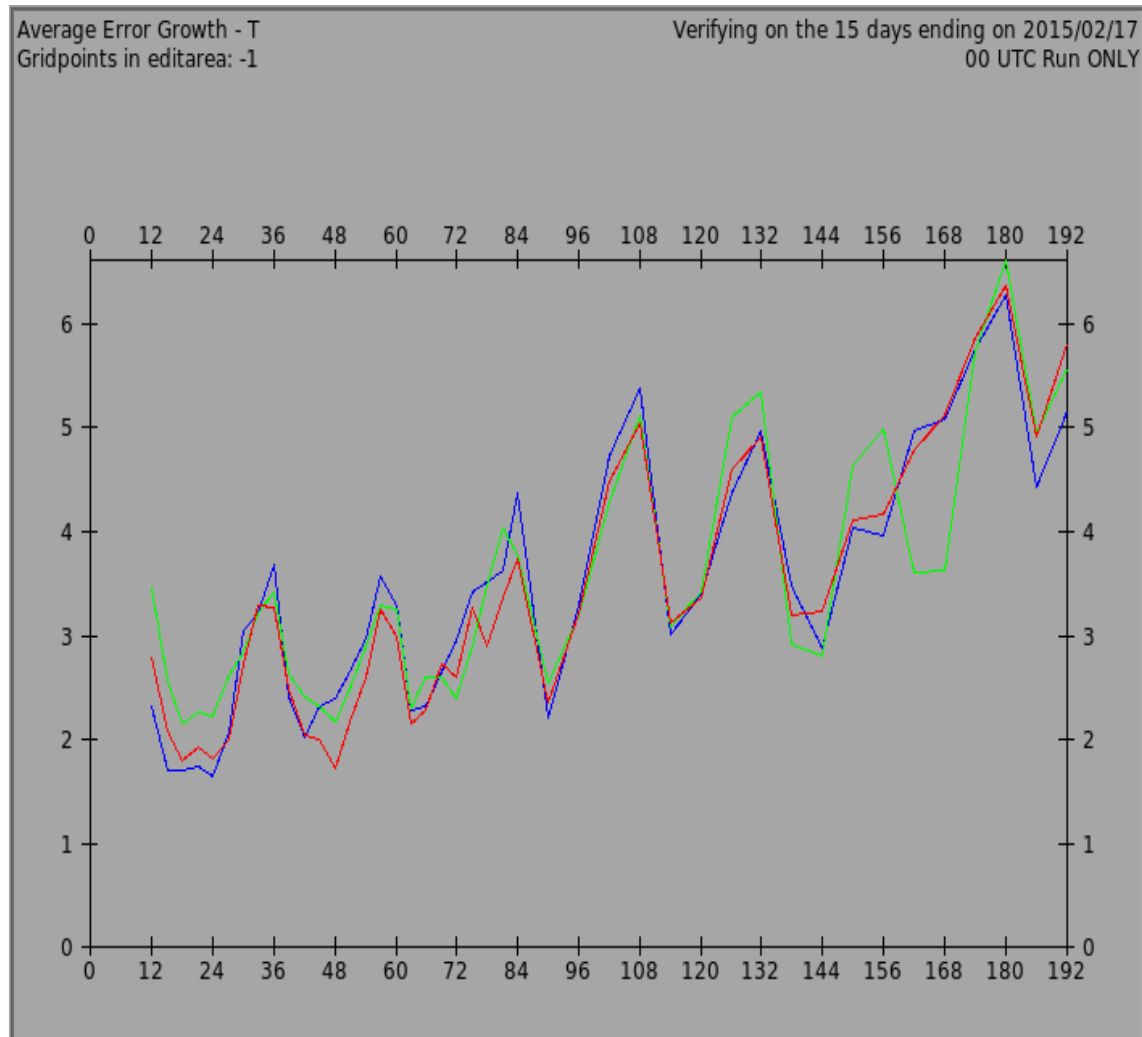
**NBM**

**Official**

**SuperBlend**

**Verified against  
CONSOBS**

Stats courtesy: Jerry Wiedenfeld, WFO MKE



# Temperature MAE – MKE CWA – Feb. 2-17, 2015

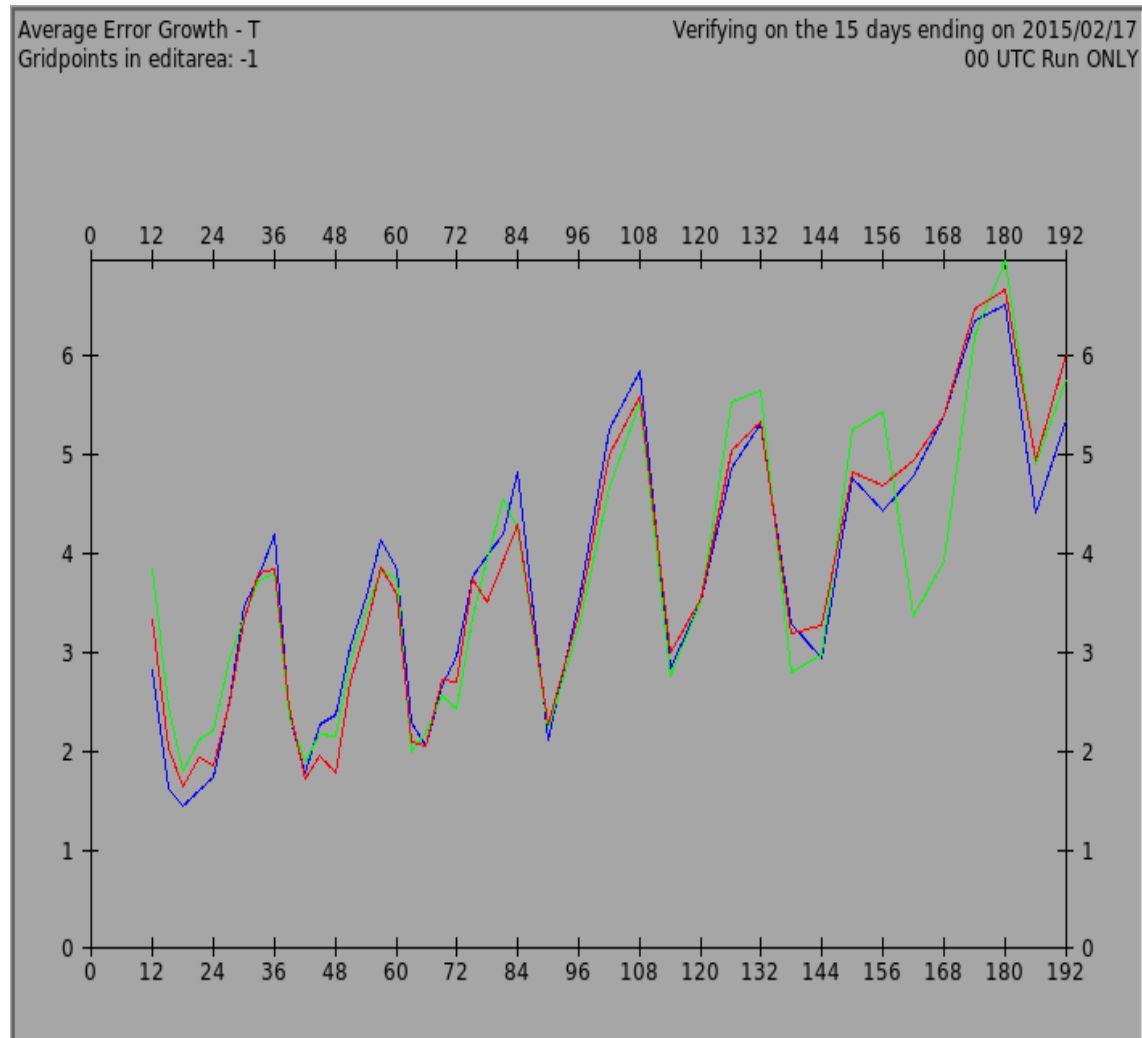
**NBM**

**Official**

**SuperBlend**

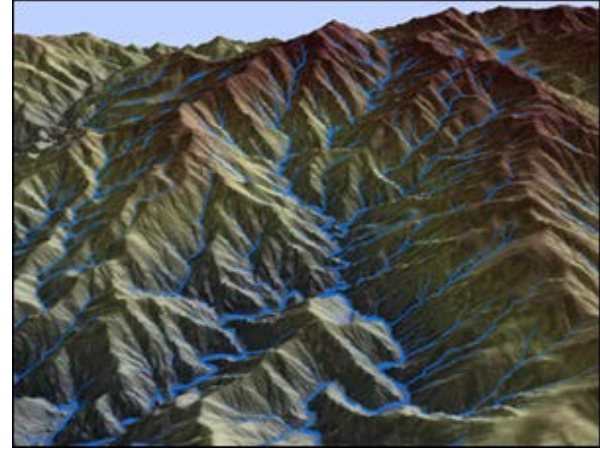
**Verified against  
Operational RTMA**

Stats courtesy: Jerry Wiedenfeld, WFO MKE



# Consistency!

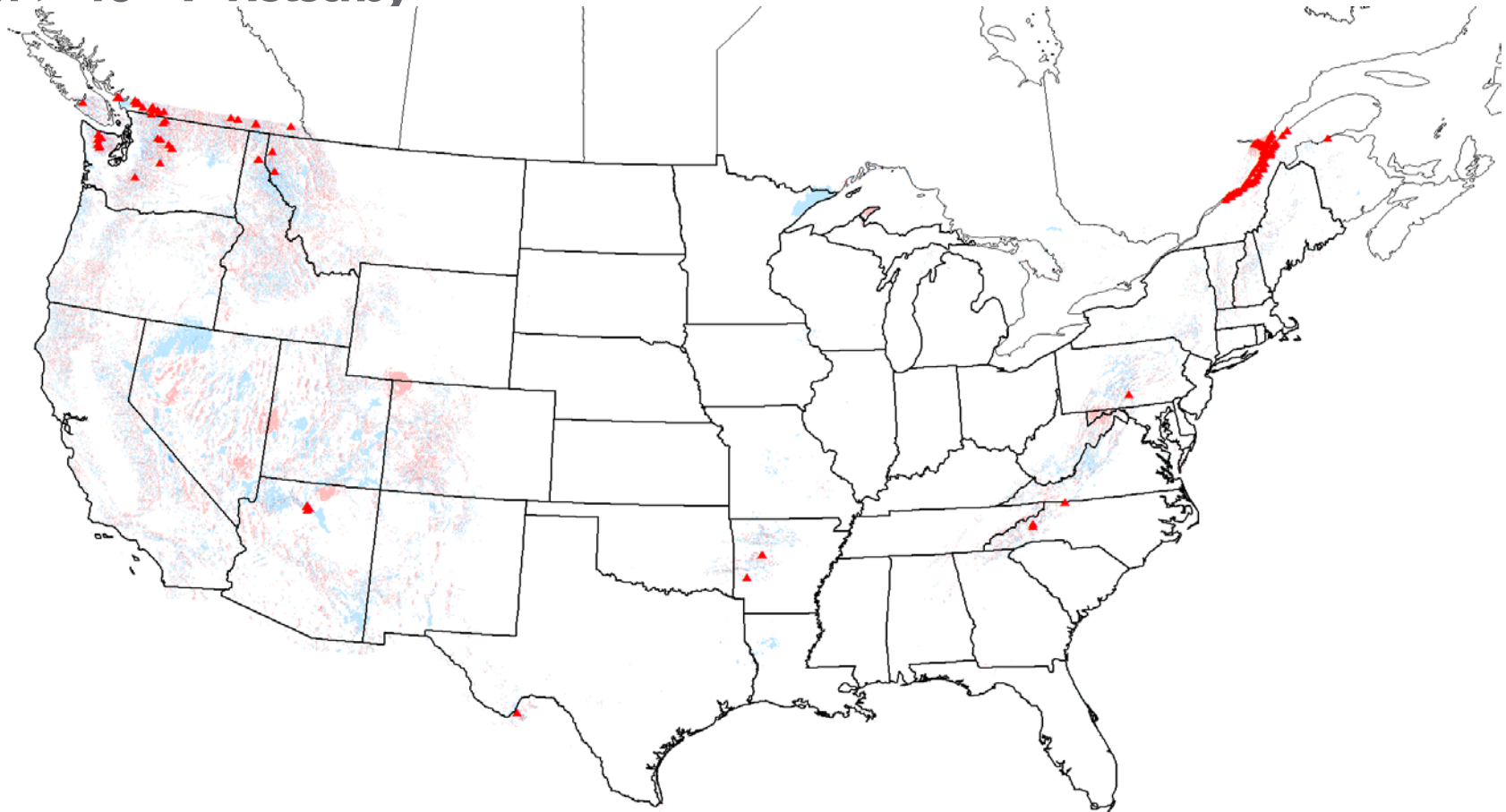
## NWS Standard Terrain



- Identified and documented the need for a common NWS terrain – credit to Brian Miretzky, Eastern Region
- NWS development groups such as those responsible for statistical post-processing and those responsible for the analysis will downscale to the same terrain in use by the WFOs.
  - Recommendation made to use GMTED2010
  - Expected to be in place at NWS by September 2015

# Example: Gridded MOS 2-m Temperature differences in analysis (WFO terrain – RTMA terrain)

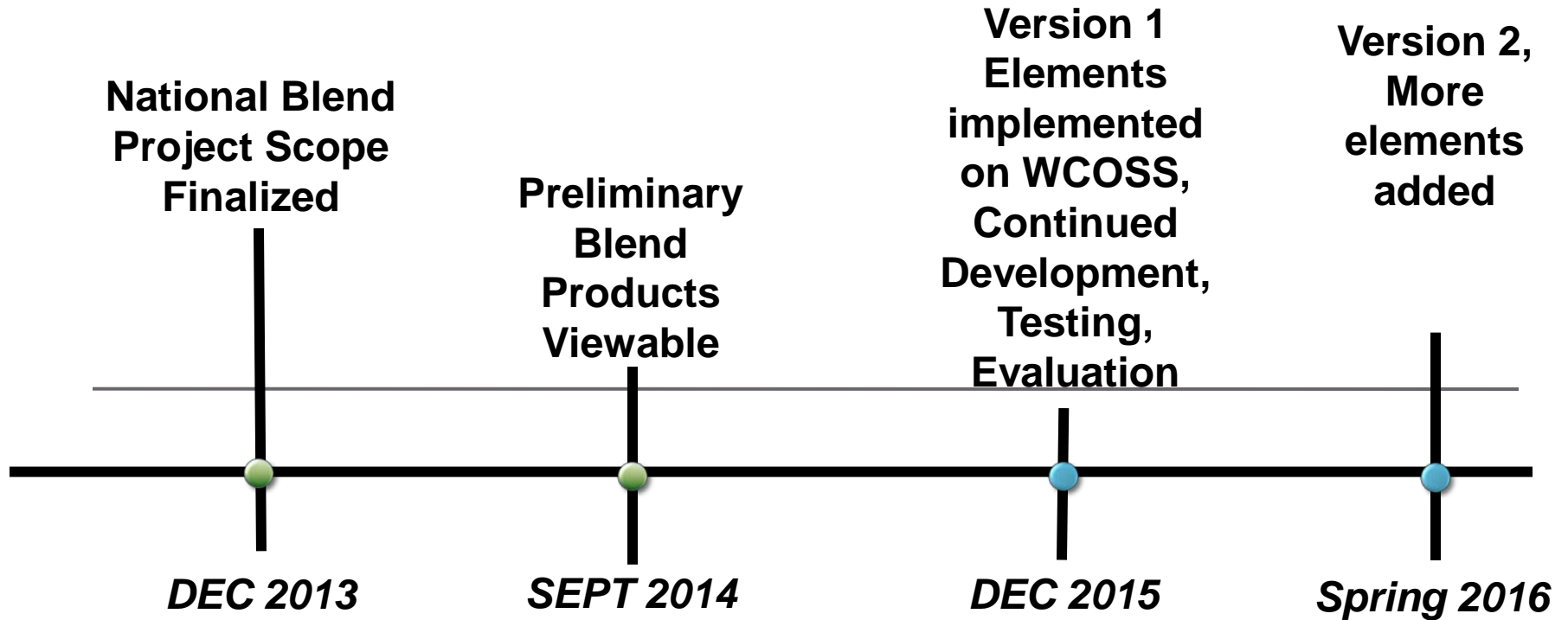
diff > 10° F noted by ▲



Differences in BCDG Analysis (GFE Terrain - RTMA Terrain) (deg F) Gridded MOS 2-m Temperature @ 12 Hours | 20140205 1200 UTC GFS

▲ ABS(Difference) >= 10 degrees F	-25.5 - -25	-19.99 - -15	-9.99 - -5	-0.99 - 0	1.01 - 5	10.01 - 15	20.01 - 25
	-24.99 - -20	-14.99 - -10	-4.99 - -1	0.01 - 1	5.01 - 10	15.01 - 20	25.01 - 50

# Project Milestones and Timeline



# NBM – VLab Community

- Open community
- Links to project folders on Google Drive and Outreach Google Site
- Forum created to share feedback with NBM development team (acts as a list-serve)
- Feedback emails post directly to the Forum
- `national.blend.feedback@noaa.gov`

The screenshot shows the NOAA Virtual Lab community page for the National Blend of Models (NBM). The page has a blue header with navigation options: '+ Add', 'Preview', 'Edit', and 'Edit Controls'. On the right of the header, there are links for 'Admin', 'My Communities', a notification badge with '11', and a user profile for 'David Myrick'. Below the header is the NOAA logo and the text 'VIRTUAL LAB Where great ideas become operational reality'. A search bar is present with the text 'Everything'. The main content area is titled 'National Blend of Models' and includes a navigation menu with 'Home', 'Forum', 'Google Drive Folders', 'FAQ', and 'Issues'. Below this is a section for 'National Blend of Models' featuring a map of the United States and a description: 'The National Blend of Models Project is an effort to develop a nationally consistent set of foundational gridded guidance products based on well-calibrated NWS and non-NWS model information. These guidance products will be made available to NCEP centers and NWS WFOs for use in their forecast process.' To the right of this section are four smaller maps labeled 'Prototype Viewer', 'WPC', 'NDFD', and 'NDGD'. Below the main content is a 'Forums' section with a search bar and a table of forum categories. The table has columns for 'Category', 'Categories', 'Threads', and 'Posts'. One category is listed: 'Feedback on National Blend of Models' with 0 categories, 17 threads, and 37 posts. There is also an 'Actions' button for this category. At the bottom right of the forums section, there are links for 'RSS' and 'Subscribe'.

# NBM – Use of VLab Development Services

- Subversion repository used for code management
- Issues tracking used by developers to track issues

Home My page Projects Help Logged in as david.myrick My account Sign out

## National Blend of Models

Search:  National Blend of Models

Overview Activity Issues New issue Gantt Calendar News Documents Wiki Files **Repository** Settings

**national-blend-of-models** Statistics | Revision:

Name	Size	Revision	Age	Author	Comment
dev		104	18 days	Bruce Veenhuis	Version 2.1.0 trains to parallel URMA feed
oper		2	6 months	Scott Scallion	Creating trunk/branches/tags directories for ea...

**Latest revisions**

#	Date	Author	Comment
104	01/26/2015 08:10 PM	Bruce Veenhuis	Version 2.1.0 trains to parallel URMA feed
103	01/26/2015 08:06 PM	Bruce Veenhuis	Removed stop from comp_mae_delta_bcfst.f. Going to make a tag from this version to implement under mdl.ens.
102	01/26/2015 07:14 PM	Bruce Veenhuis	Teset
101	01/26/2015 05:17 PM	Bruce Veenhuis	Configured to use temporary parallel urma feed.
100	01/22/2015 08:13 PM	Bruce Veenhuis	Updates to use DMO. Extended ID lists up to 240 hours and added time interpolation when needed for off hours.
99	01/12/2015 07:51 PM	Bruce Veenhuis	Code now produces identical output to version 2.0.0, but is cleaner. Removed unused files, verified correct function of model_blender code.
98	01/11/2015 06:20 PM	Bruce Veenhuis	Some bug fixes and code updates. I am getting slightly different binary output from comp_mae_delta_bcfst.f. Not sure why, but results look OK.
97	12/30/2014 06:58 PM	Bruce Veenhuis	Fixed a major bug, comp_bc_fcst.f was applying bias deltas from the GFS MOS to the ECMWF MOS products. This doesn't explain the major issues with the ECMWF GMOS Products. But it is a confounding factor.
96	12/19/2014 08:05 PM	Bruce Veenhuis	Checking in latest version before holidays.
95	12/18/2014 06:51 PM	Bruce Veenhuis	Checking in changes to handle dmo temp and dew.

[View differences](#)

[View all revisions](#)

Also available in: [Atom](#)

# Summary of Issues & Challenges

## • Issues

- Clarify dissemination restrictions on products developed with ECMWF model data
  - NWS and ECMWF have approved a Cooperative Agreement
  - Implementing Arrangements need to be vetted.
- Need nationally consistent foundational datasets: terrain, land/water masks, observation analyses
- Analysis of Record is a work in progress

## • Challenges

- Lack of High Performance Computing and human resources to generate sufficient reanalysis and reforecast samples from numerical models to provide representative samples for statistical calibration
- Not fully known how to properly blend or bias correct all needed weather variables
- High bar for success in place with blending capabilities already at WPC and WFOs



**Thank You**

