



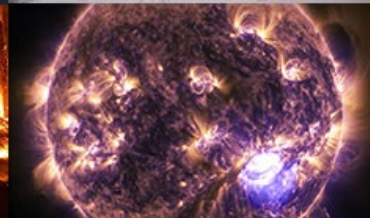
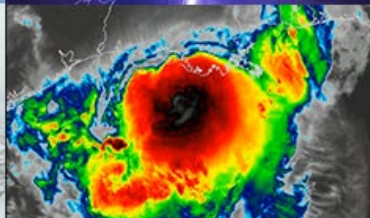
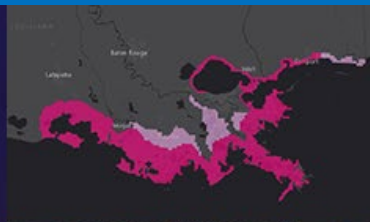
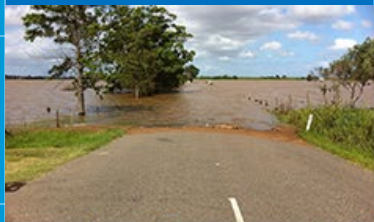
**NATIONAL
WEATHER
SERVICE**

User Evaluation Information for LAMP/GLMP v2.6* and Proposed Termination of LAMP Station Plot Webpage

FEBRUARY 23, 2024

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Meteorological Development Laboratory

* Disclaimer: Portions of this research is in response to requirements and funding by the Federal Aviation Administration (FAA). The views expressed are those of the authors and do not necessarily represent the official policy or position of the FAA.





Outline

- LAMP Background
- Summary of v2.6 upgrades
- Product changes
- Real-time experimental products
- Feedback and Schedule



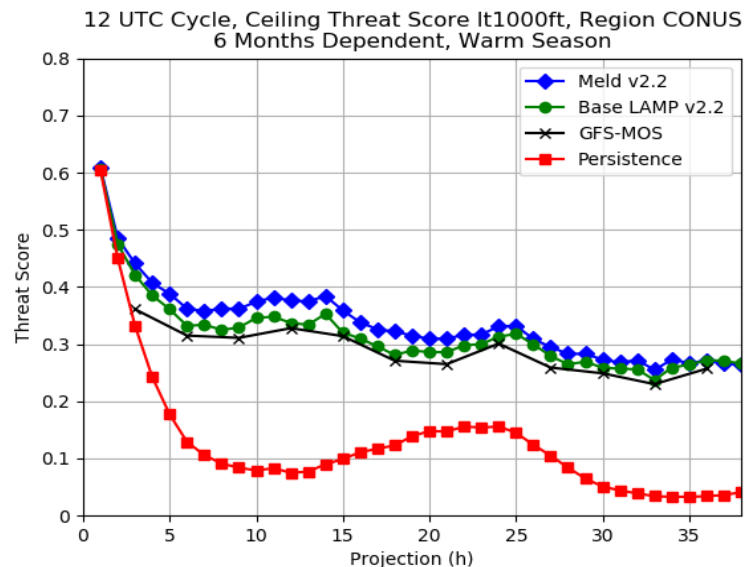


LAMP Background



LAMP Background

- What is LAMP? LAMP is a statistical system that uses observations, MOS output, and model output to provide guidance for aviation forecasting.
- LAMP acts as an update to MOS guidance.
- LAMP bridges the gap between the observations and the MOS forecast.
- LAMP guidance covers the short-range period of 1-25 hours (1-38 hours for some elements).
- Runs every hour in NWS operations (every 15 minutes out to 3 hours for ceiling and visibility).
- LAMP supports the National Blend of models (NBM).



LAMP Background: Guidance Details

- LAMP provides station-oriented guidance for:
 - 2313 stations (as of v2.5)
 - CONUS, Alaska, Hawaii, Puerto Rico
- Gridded LAMP provides gridded guidance for:
 - Lightning & Convection
 - Temperature & Dewpoint
 - Wind Speed / Gusts / Direction
 - Ceiling Height & Visibility
 - Sky Cover
 - Probability of Precipitation
- Available:
 - At NWS WFOs in AWIPS
 - Via NCEP NOMADS
 - Via website: <https://vlab.noaa.gov/mdl/lamp>

- Temperature and dewpoint
- Wind speed, direction, and gusts
- Probability of precipitation (on hr)
- Probability of measurable precipitation (1-, 6- and 12-h)
- Precipitation type
- Precipitation characteristics
- Lightning/Convection
- Ceiling height
- Conditional ceiling height
- Opaque sky cover
- Visibility
- Conditional visibility
- Obstruction to vision

LAMP Background: Meld Technique

- Step 1: Base LAMP:
 - Station-based **Base LAMP** = Observations + locally-run models + GFS MOS
 - Technique = Linear Regression where predictors are statistically related to predictands via regression equations
 - **Gridded Base LAMP** = Station-based **Base LAMP** analyzed to a grid
- Step 2: Meld LAMP:
 - Station-based Meld LAMP = Obs + **Base LAMP** + HRRR MOS
 - Gridded Meld LAMP = Gridded Obs **Base LAMP** + Gridded forecasts **Base LAMP** + Gridded HRRR MOS
 - Combining HRRR information with Base LAMP results in increased skill

MOS = Model Output Statistics, GFS = Global Forecast System, HRRR = High Resolution Rapid Refresh

LAMP Background

- LAMP supports the National Blend of Models:
 - The National Blend of Models (NBM) provides a skillful and spatially consistent gridded starting point for making National Digital Forecast Database (NDFD) forecasts.
 - NBM is key component to NWS efforts to evolve and build a Weather Ready Nation.

Increasing Temporal Resolution of GLMP

- Current Gridded LAMP forecast projections are hourly, valid at the top of the hour.
- MDL was tasked by the Federal Aviation Administration Aviation Weather Research Program (FAA AWRP) to increase the temporal resolution of Gridded LAMP ceiling height and visibility guidance from 1 hour to 15 minutes in the first six hours of the forecast period.
 - Aviation decision-making operators, including the Helicopter Air Ambulance operators, use the NWS Aviation Weather Center (AWC) Graphical Forecasts for Aviation - Low Altitude (GFA-LA) platform which currently uses GLMP data to update every 15 minutes with the latest observational and hourly forecast data.
 - GFA-LA users requested a higher temporal resolution C&V forecast to support decision making.
 - Providing updated GLMP guidance for C&V every 15 minutes for 15-minute periods (instead of valid at the top of the hour) will help fill the gap in the GFA-LA tool.



LAMP/GLMP V2.6 Upgrades: Highlights



LMP/GLMP V2.6 Upgrade Highlights

1. Addition of station-based guidance for ceiling height and visibility valid for **15-minute periods** out to six hours, **updated every 15 minutes** (96 cycles per day):
 - a. Guidance for the **lowest** ceiling height category and **lowest** visibility category that is forecast to occur during each **15-minute period** (this differs from the traditional hourly guidance where forecast projections are valid for a snapshot in time at the top of the hour).
 - b. Will be produced in a text bulletin format that displays ceiling height and visibility categories valid for 15-minute periods out to six hours for **1841 CONUS stations**.
 - c. When implemented the text bulletins will be available on NCEP Web Services / NOMADS.
2. Addition of Gridded LAMP guidance for ceiling height and visibility valid for **15-minute periods** out to six hours, updated every 15 minutes (96 cycles per day):
 - a. Probabilistic and deterministic guidance for the **lowest** ceiling height and **lowest** visibility condition that is forecast to occur during each **15-minute period**.
 - b. Produced in GRIB2 format on NBM CONUS domain.
 - c. When implemented the GRIB2 data will be available on NCEP Web Services / NOMADS.

LMP/GLMP V2.6 Upgrade Highlights

3. Minor bug fixes:

- a. Addition of a post-processing check for GLMP wind gusts to prevent negative values from occurring on the grid.
- b. Removal of a problematic mesonet station (TRJHS) from the GLMP temperature analysis.
- c. An adjustment to the LAMP advection model (used as a predictor in LAMP guidance) to prevent missing visibility values from advecting over the station in rare cases of high winds.



LAMP/GLMP V2.6 Upgrades: LAMP High Impact Weather (HIW) C&V

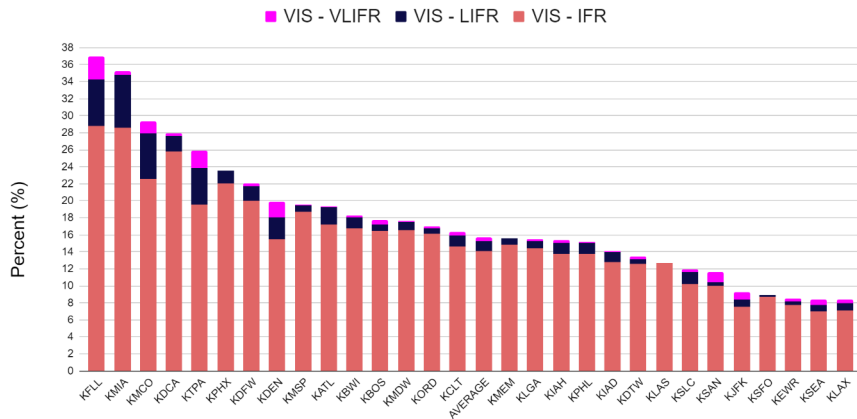


Subhourly High Impact Weather

How often do top of hour observations miss impactful events during the hour?

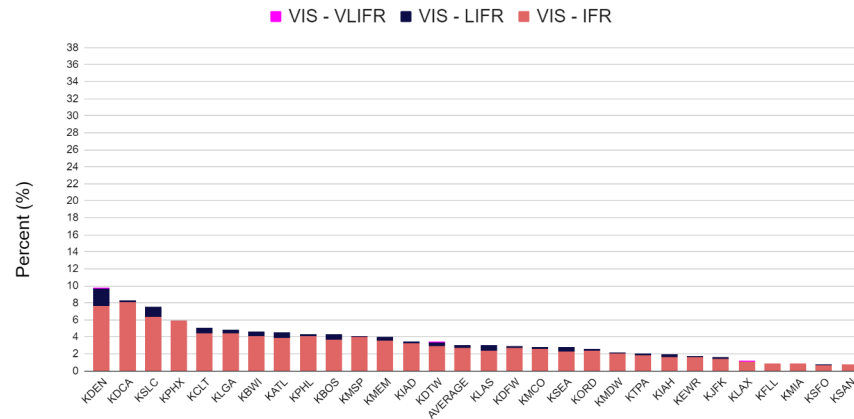
Visibility

Percent of time the intra-hour visibility is lower than the top-of-hour visibility of MVFR



Ceiling

Percent of time the intra-hour ceiling is lower than the top-of-hour ceiling of MVFR



- Forecasts focused on predicting C&V at the top of the hour miss impactful C&V that occur between the hours.
- Intra-hour variability higher for visibility than for ceiling.

High Impact Weather C&V Development

- High Impact Weather (HIW) C/V predictand is defined as the **lowest C/V observed over a 15-minute period** ending at 14, 29, 44, and 59 minutes past the hour.
 - Most recent observation is persisted into the period unless a new observation indicates a worse condition.
 - Furthest lookback is 15-minute period prior to the previous hour.
- 3-step regression approach (similar to hourly C&V):
 1. 15-min Base LAMP = GFS MOS + 15-min Advection + Observations
 2. 15-min HRRR MOS = Sub-hourly HRRR predictors
 3. 15-min Meld LAMP = 15-min Base LAMP + 15-min HRRR MOS
- Predictors include:
 - 15-min advected radar composite reflectivity (MRMS)
 - HRRR-based proxy C&V climatology



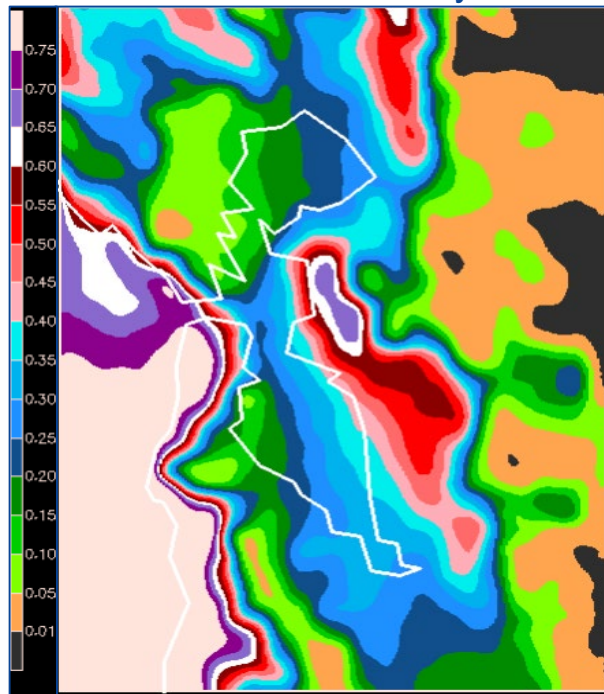
High Impact Weather C&V Development

- Base LAMP and Meld equations and thresholds were developed for each 15-minute period out to six hours (total of 24 projections)
- Will run for **96 cycles per day** - output out to six hours will be available every 15 minutes at nominal times of **HH:00, HH:15, HH:30, and HH:45**



HRRR-Based Proxy Climatology

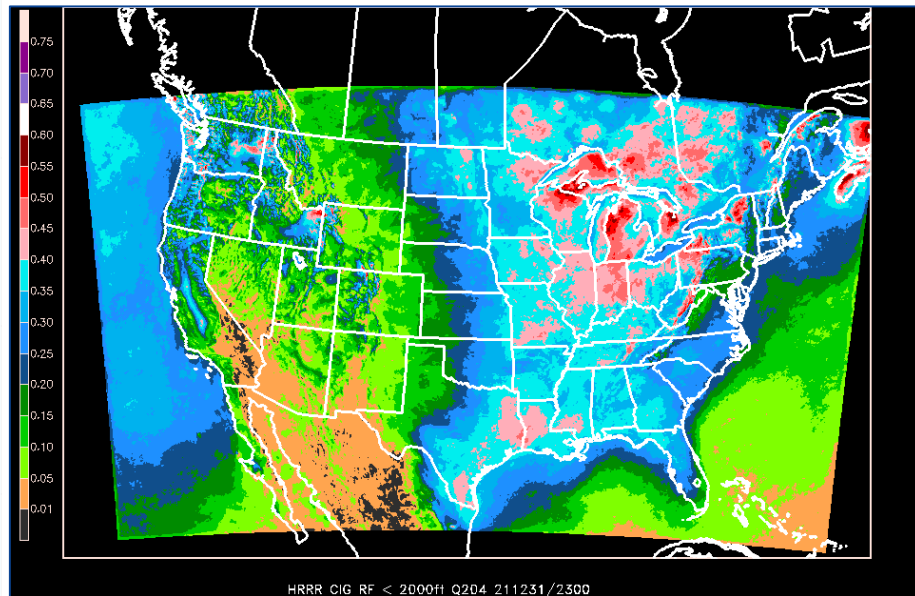
San Francisco Bay



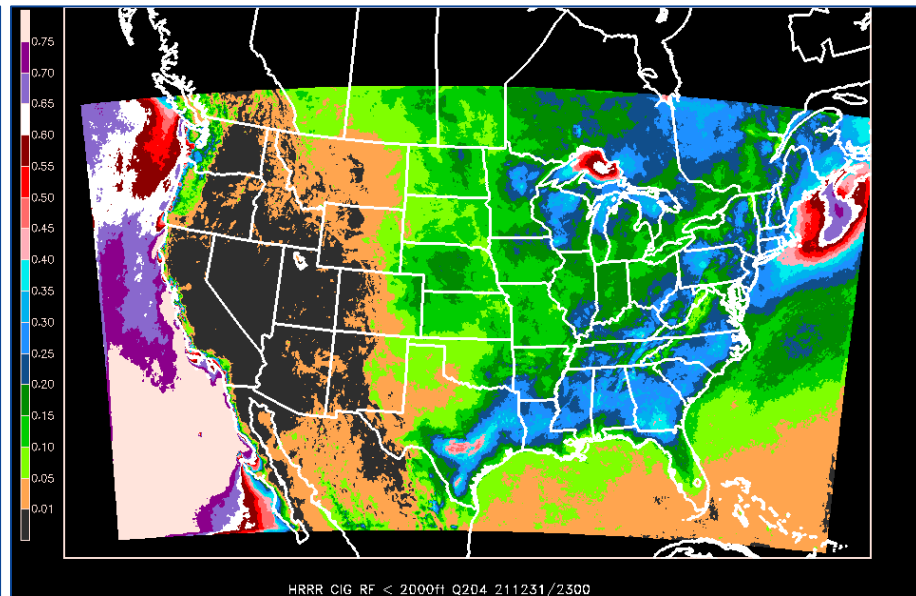
HRRR CIG RF < 1700 ft, July, 1200 UTC

- HRRR-based ceiling height and visibility relative frequencies (RFs) were calculated for all grid points over the HRRR CONUS domain for each month, time of day, and several C&V thresholds.
- Serves as proxy climatology predictor in 15-min C&V HRRR MOS equations.

HRRR-Based Proxy Climatology

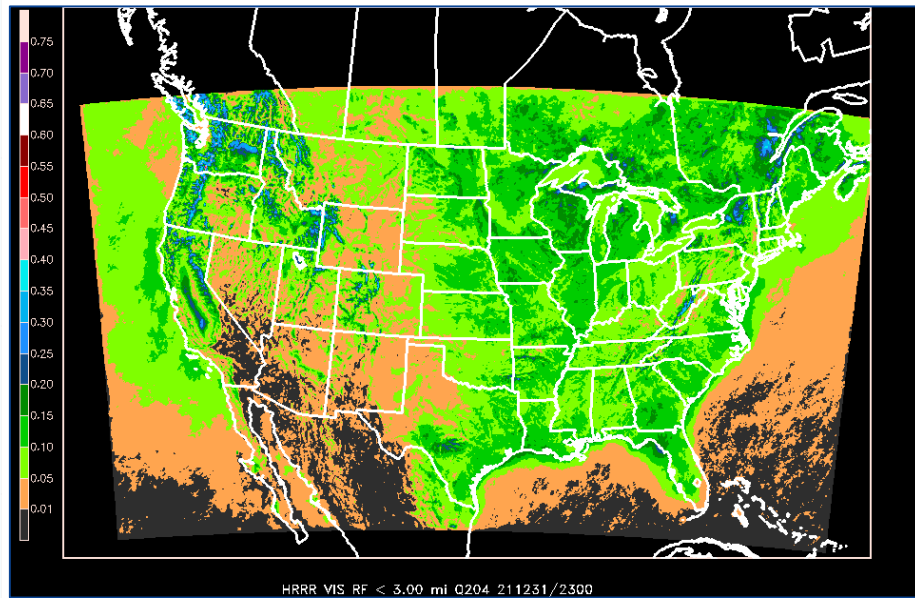


HRRR CIG RF < 2000 ft, Jan, 1200 UTC

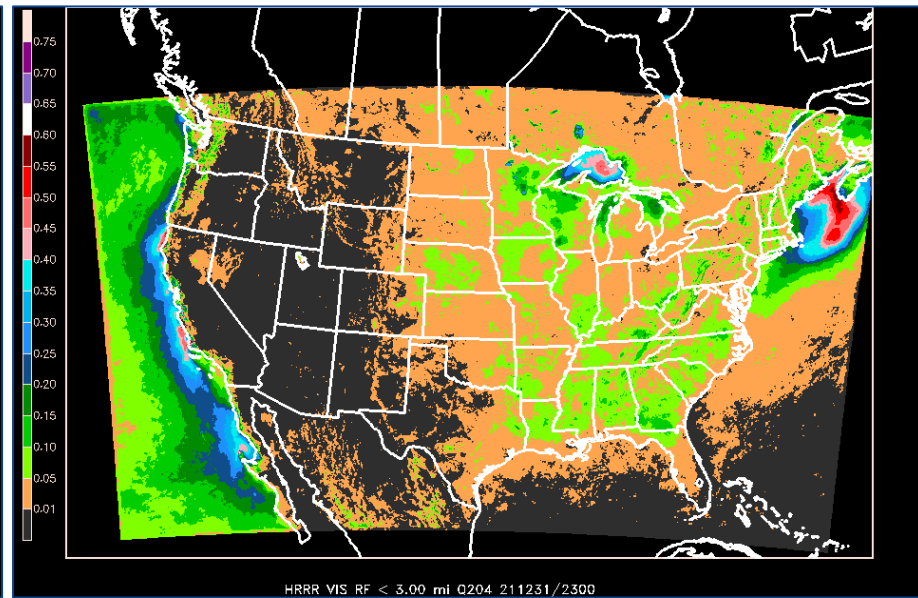


HRRR CIG RF < 2000 ft, July, 1200 UTC

HRRR-Based Proxy Climatology



HRRR VIS RF < 3 mi, Jan, 1200 UTC



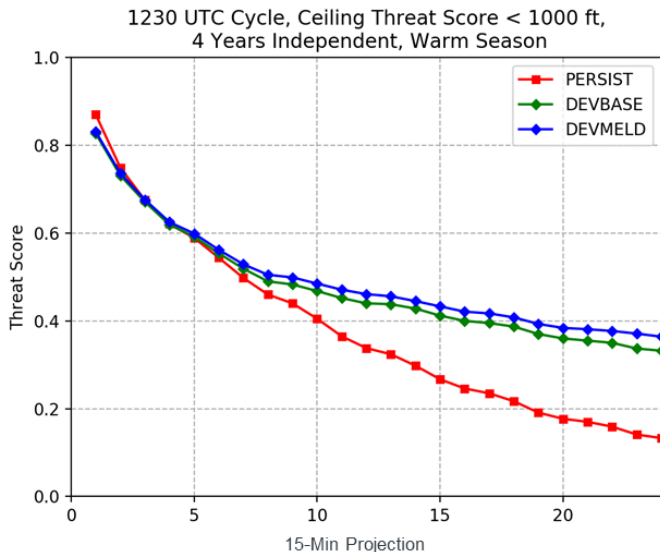
HRRR VIS RF < 3 mi, July, 1200 UTC

15-Minute HIW Verification

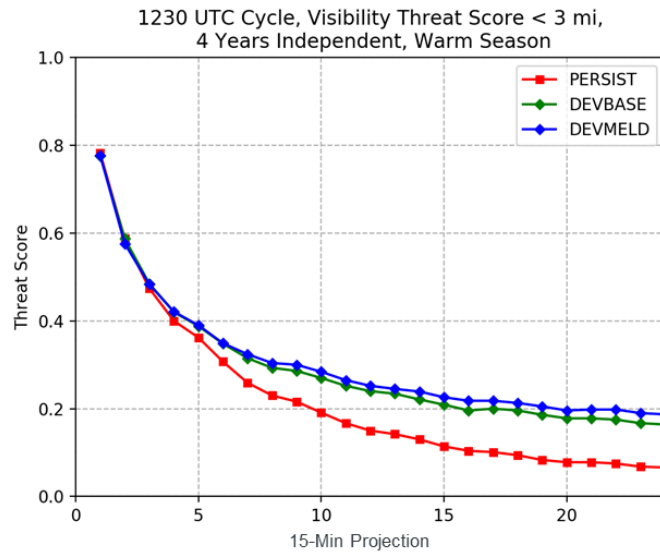
- Development period:
 - 4 years of warm season data (Apr to Sep of 2017 – 2020)
 - 4 years of cool season data (Jan to Mar/Oct to Dec of 2017 – 2020)
- Independent 4-fold cross validation:
 - Four developments were completed by withholding a different year from each of the development periods above
 - Much better than using single developmental and test samples
 - Results presented are for all 4 independent years combined
- ~1,850 CONUS stations verified
- Only IFR thresholds shown for 1230 UTC cycle - results for other thresholds and cycles available upon request. (Note - these independent results are from an initial/preliminary development that did not include the HRRR-based climatology.)

15-min HIW Verification: Warm Season

Ceiling < 1,000 feet



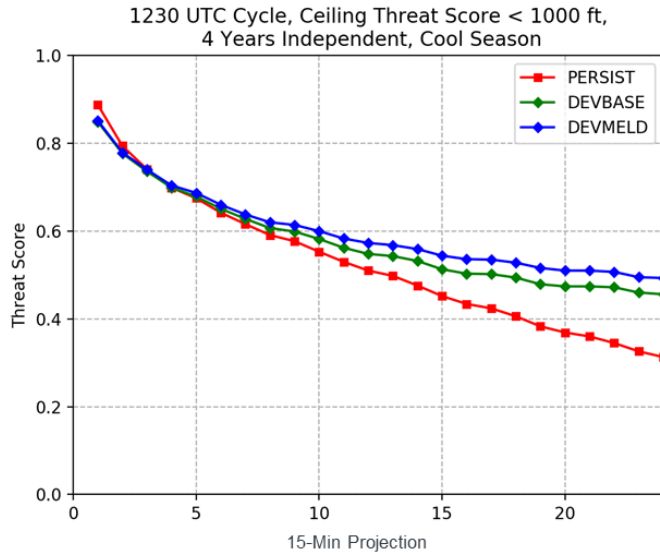
Visibility < 3 miles



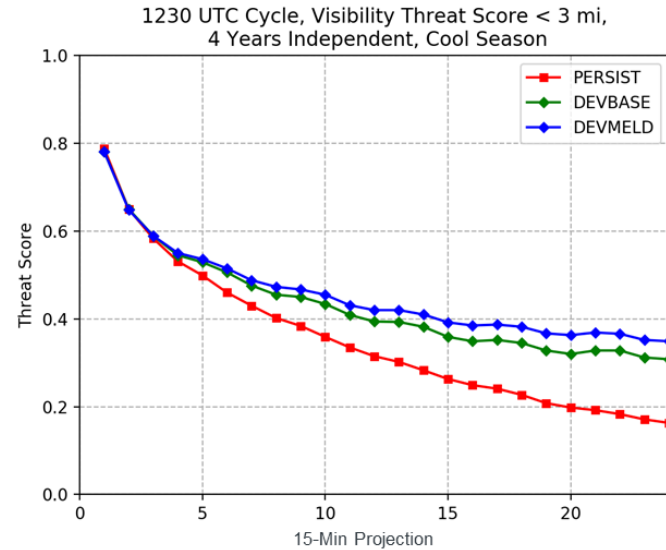
15-min Meld LAMP (blue) shows improvement over 15-min Base LAMP (green) at later projections due to the decreased predictive strength of the observation and the increasing predictive strength of the HRRR

15-min HIW Verification: Cool Season

Ceiling < 1,000 feet



Visibility < 3 miles



15-min Meld LAMP (blue) shows improvement over 15-min Base LAMP (green) at later projections due to the decreased predictive strength of the observation and the increasing predictive strength of the HRRR

15-Minute Text Bulletin

KBWI	BALTIMORE										GFS LAMP 1930 UTC										2/13/2024			
UTC	19	20	20	20	20	21	21	21	21	22	22	22	22	23	23	23	23	00	00	00	00	01	01	01
MIN	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30
CIG	6	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
VIS	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7

UTC: Ending hour of the 15-minute valid period

LAV Ceiling Height (CIG) Categories

- 1 < 200 feet
- 2 200 - 400 feet
- 3 500 - 900 feet
- 4 1000 - 1900 feet
- 5 2000 - 3000 feet
- 6 3100 - 6500 feet
- 7 6600 - 12,000 feet
- 8 > 12,000 feet or unlimited ceiling

LAV Visibility (VIS) Categories

- 1 < 1/2 miles
- 2 1/2 - < 1 miles
- 3 1 - < 2 miles
- 4 2 - < 3 miles
- 5 3 - 5 miles
- 6 6 miles
- 7 > 6 miles

15-Minute Text Bulletin

KBWI	BALTIMORE										GFS LAMP 1930 UTC										2/13/2024					
UTC	19	20	20	20	20	21	21	21	21	21	22	22	22	22	22	23	23	23	23	00	00	00	00	01	01	01
MIN	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00
CIG	6	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
VIS	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7

MIN: Ending minute of the valid period

LAV Ceiling Height (CIG) Categories

- 1 < 200 feet
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- 3 500 - 900 feet
- 4 1000 - 1900 feet
- 5 2000 - 3000 feet
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LAV Visibility (VIS) Categories

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15-Minute Text Bulletin

KBWI	BALTIMORE										GFS LAMP 1930 UTC										2/13/2024					
UTC	19	20	20	20	20	21	21	21	21	21	22	22	22	22	22	23	23	23	23	00	00	00	00	01	01	01
MIN	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00
CIG	6	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
VIS	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7

CIG: Lowest forecasted LAMP categorical ceiling height during the 15-minute period

LAV Ceiling Height (CIG) Categories

- 1 < 200 feet
- 2 200 - 400 feet
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- 5 2000 - 3000 feet
- 6 3100 - 6500 feet
- 7 6600 - 12,000 feet
- 8 > 12,000 feet or unlimited ceiling

LAV Visibility (VIS) Categories

- 1 < 1/2 miles
- 2 1/2 - < 1 miles
- 3 1 - < 2 miles
- 4 2 - < 3 miles
- 5 3 - 5 miles
- 6 6 miles
- 7 > 6 miles

15-Minute Text Bulletin

KBWI	BALTIMORE										GFS LAMP 1930 UTC										2/13/2024				
UTC	19	20	20	20	20	21	21	21	21	21	22	22	22	22	23	23	23	23	00	00	00	00	01	01	01
MIN	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	
CIG	6	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
VIS	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	

VIS: Lowest forecasted LAMP categorical visibility during the 15-minute period



LAV Ceiling Height (CIG) Categories

- 1 < 200 feet
- 2 200 - 400 feet
- 3 500 - 900 feet
- 4 1000 - 1900 feet
- 5 2000 - 3000 feet
- 6 3100 - 6500 feet
- 7 6600 - 12,000 feet
- 8 > 12,000 feet or unlimited ceiling

LAV Visibility (VIS) Categories

- 1 < 1/2 miles
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- 6 6 miles
- 7 > 6 miles



LAMP/GLMP V2.6 Upgrades: Gridded LAMP HIW C&V

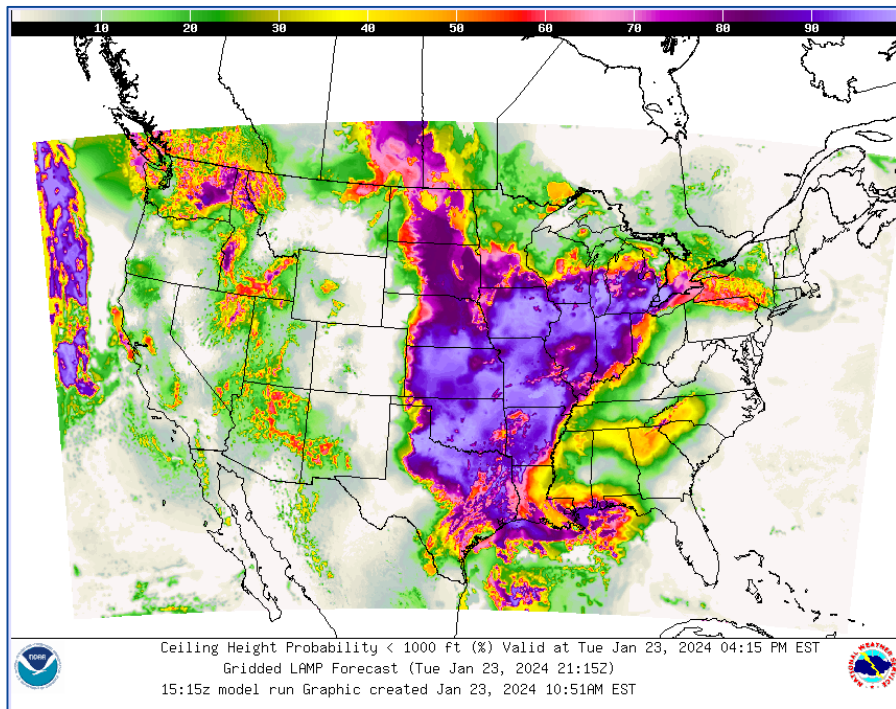


Gridded LAMP 15-min HIW C&V

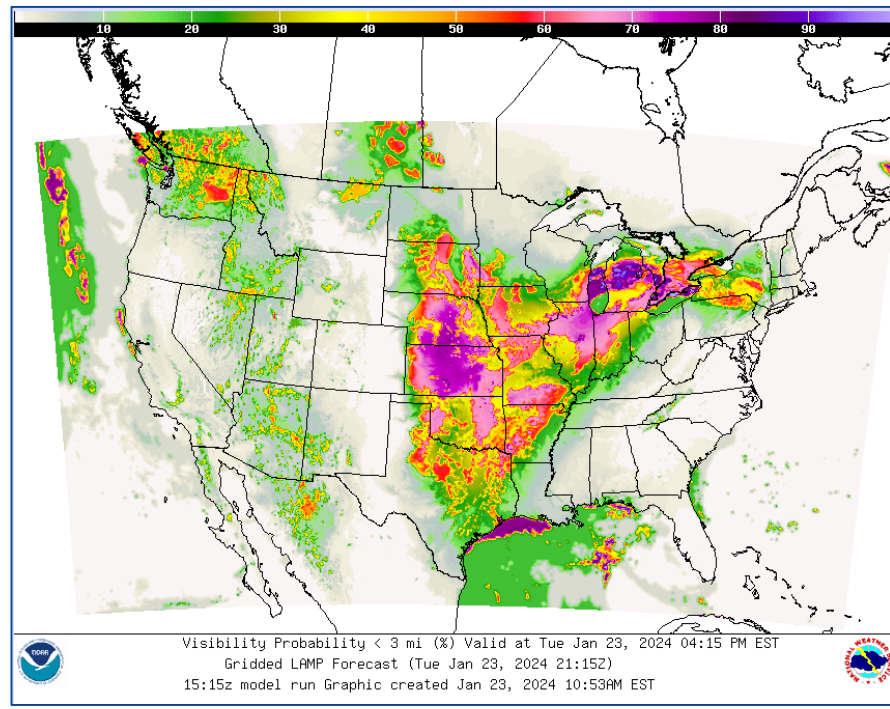
- Gridded 15-min Meld = Gridded 15-min Base LAMP + Gridded HRRR MOS + Gridded Observations
- 3-step process to make Gridded 15-min Meld C&V:
 1. 15-min Base LAMP C&V probabilities at stations are analyzed to 2.5-km NBM CONUS grid
 2. 15-min HRRR MOS equations are evaluated at each 2.5-km grid point
 3. 15-min Meld equations (which use observations, Base LAMP and HRRR MOS as predictors) are evaluated at each 2.5-km grid point
- National Blend of Models (NBM) CONUS grid - **note that extent of guidance will be limited to the extent of the sub-hourly HRRR.**
- Will run for **96 cycles per day** - output out to six hours will be available every 15 minutes at nominal times of **HH:00, HH:15, HH:30, and HH:45**

Gridded LAMP 15-min HIW C&V

Prob Cig < 1,000 ft



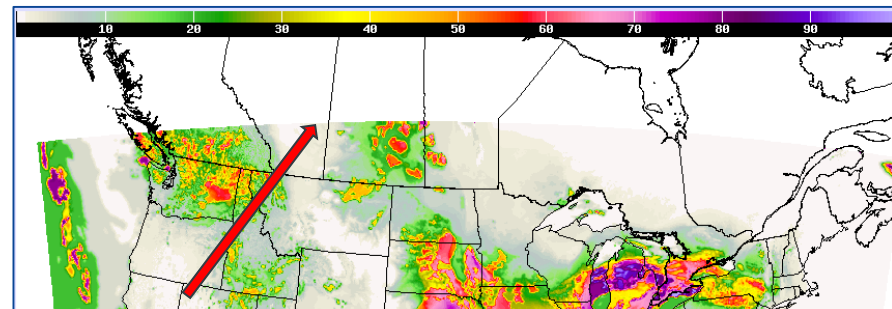
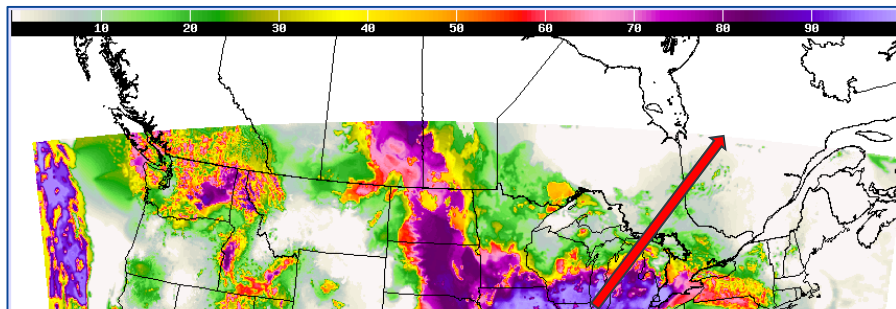
Prob Vis < 3 miles



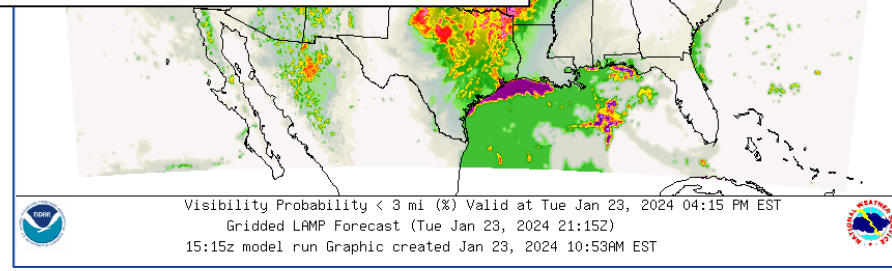
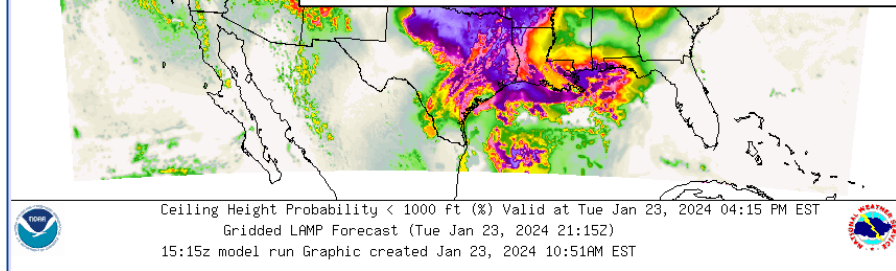
Gridded LAMP 15-min HIW C&V

Prob Cig < 1,000 ft

Prob Vis < 3 miles

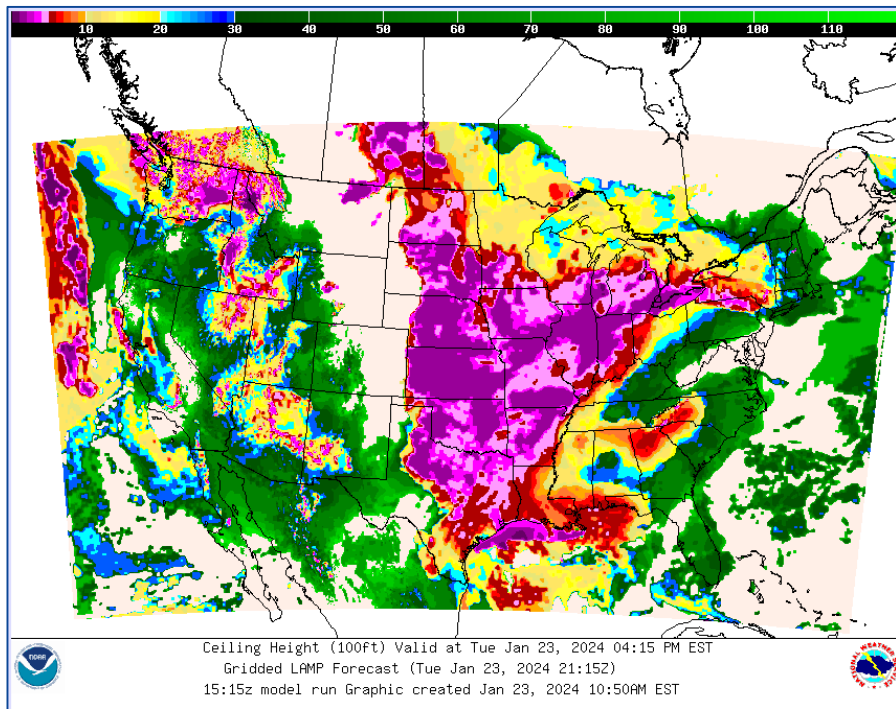


The 15-minute GLMP guidance will be available out to the extent of the sub-hourly HRRR domain and missing outside this area

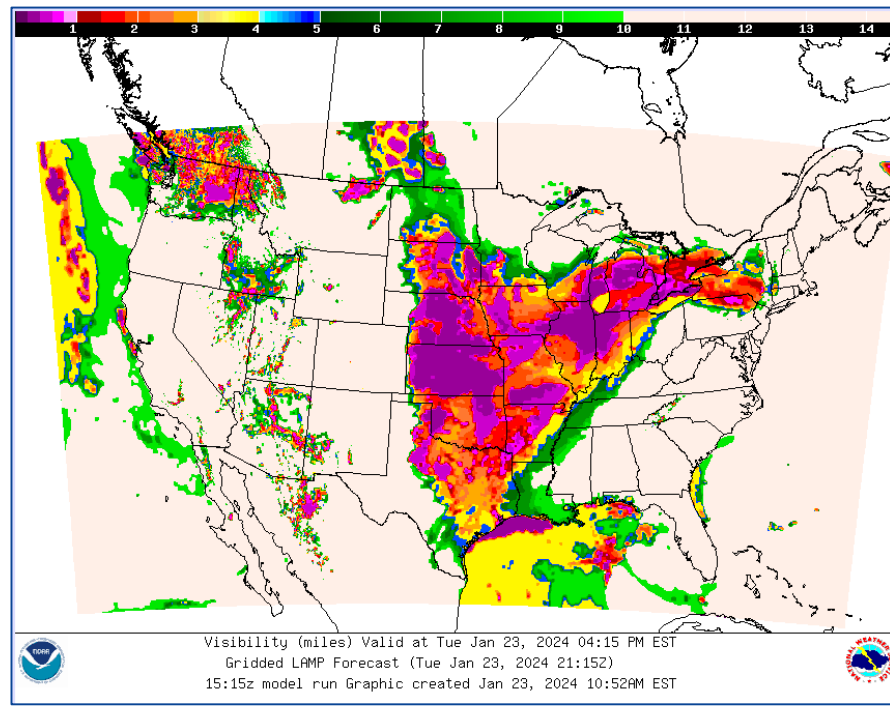


Gridded LAMP 15-min HIW C&V

Ceiling Height



Visibility





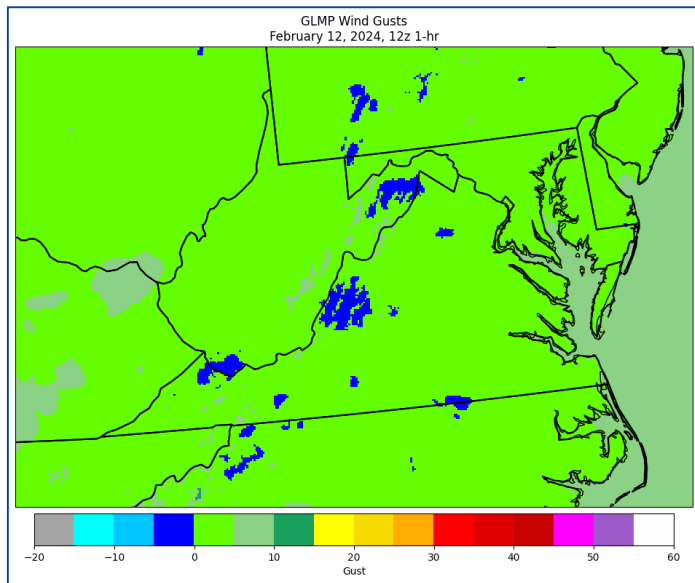
LAMP/GLMP V2.6 Upgrades: Bug Fixes



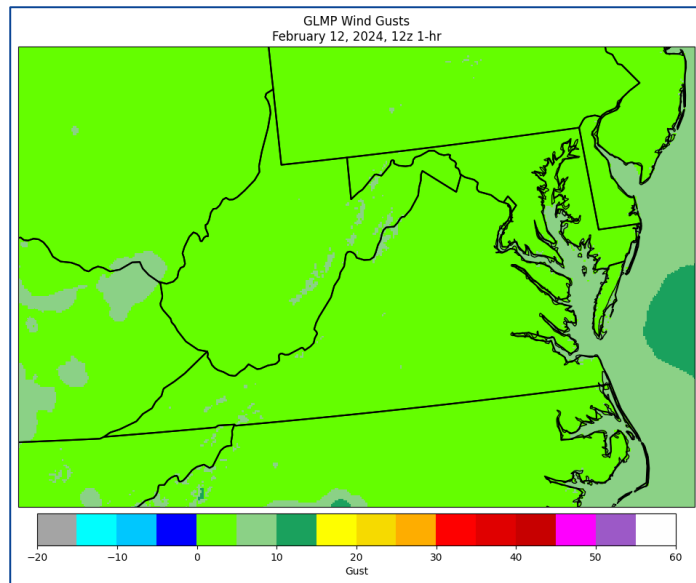
Bug Fixes

1. Addition of a post-processing check for GLMP wind gusts to prevent negative values from occurring on the grid.

v2.5



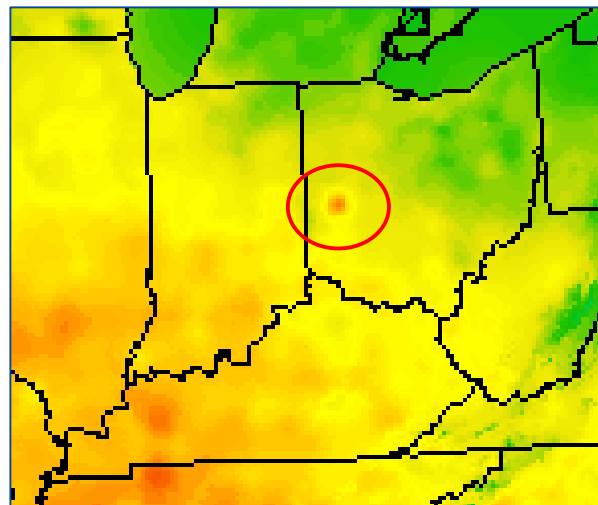
v2.6



Bug Fixes

2. Removal of a problematic mesonet station (TRJHS) from the GLMP temperature analysis.

This is an example of a bull eye in our GLMP Temperature analyses/forecasts which was caused by a bad observation at TRJHS. While the GLMP software can quality control (qc) out bad observations, at times it may be possible for a bad observation to pass the qc checks, which is what happened in this case.



Example from November 6, 2023 16:30 UTC GLMP, 3-h projection

Bug Fixes

2. Removal of a problematic mesonet station (TRJHS) from the GLMP temperature analysis.

Nov. 6, 2023 observations

TRJHS	:MESO:	40.05:	84.20:	1534:	72:	-2:
	:REG:	:	:	:	:	:
TRJHS	:MESO:	40.05:	84.20:	1539:	72:	:
	:REG:	:	:	:	:	:
TRJHS	:MESO:	40.05:	84.20:	1544:	72:	:
	:REG:	:	:	:	:	:
TRJHS	:MESO:	40.05:	84.20:	1549:	72:	:
	:REG:	:	:	:	:	:
TRJHS	:MESO:	40.05:	84.20:	1554:	72:	-2:
	:REG:	:	:	:	:	:
TRJHS	:MESO:	40.05:	84.20:	1559:	72:	:
	:REG:	:	:	:	:	:
TRJHS	:MESO:	40.05:	84.20:	1604:	72:	:
	:REG:	:	:	:	:	:
TRJHS	:MESO:	40.05:	84.20:	1609:	72:	:
	:REG:	:	:	:	:	:

Feb. 21, 2024 observations

TRJHS	:MESO:	40.05:	84.20:	1234:	32:	-31:
	:REG:	:	:	:	:	:
TRJHS	:MESO:	40.05:	84.20:	1239:	32:	:
	:REG:	:	:	:	:	:
TRJHS	:MESO:	40.05:	84.20:	1244:	32:	:
	:REG:	:	:	:	:	:
TRJHS	:MESO:	40.05:	84.20:	1249:	33:	-30:
	:REG:	:	:	:	:	:
TRJHS	:MESO:	40.05:	84.20:	1254:	33:	:
	:REG:	:	:	:	:	:
TRJHS	:MESO:	40.05:	84.20:	1259:	34:	:
	:REG:	:	:	:	:	:
TRJHS	:MESO:	40.05:	84.20:	1304:	35:	:
	:REG:	:	:	:	:	:
TRJHS	:MESO:	40.05:	84.20:	1309:	35:	:
	:REG:	:	:	:	:	:

Examples of problematic observations from TRJHS. While the GLMP software usually qc's out the bad observations, there have been some times in the past where bad obs from this station were NOT tossed when they should have been. The circled values in the observations above represent temperature:dewpoint values.

Bug Fixes

3. An adjustment to the LAMP advection model (used as a predictor in LAMP guidance) to prevent large visibility values from advecting over the station in rare cases of high winds.

- This occurred with the 2130 UTC LAMP run on August 8, 2023 (high winds due to the proximity of Hurricane Dora) which resulted in erroneous LAMP temperature forecasts for several stations in Hawaii (PHOG, PHSF, PHTO).
- This change to the advection model is intended to prevent the visibility predictor from getting out of bounds and causing an unreasonable temperature/dewpoint forecast (we plan to redevelop the T/Td equations to remove this visibility advection predictor in a future upgrade).



LAMP/GLMP V2.6 Upgrades: Product Changes



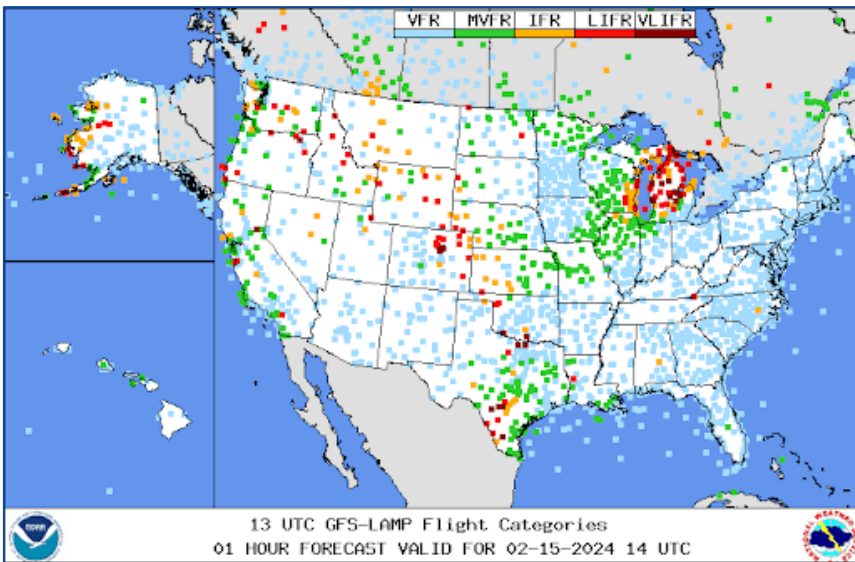
Product Availability

- When implemented, the 15-minute text bulletin containing categorical C&V guidance out to six hours will be available on NCEP Web Services / NOMADS (there are no plans to disseminate the text bulletins over the Satellite Broadcast Network at this time)
- When implemented, the 15-minute Gridded LAMP C&V guidance in GRIB2 format will be available on NCEP Web Services / NOMADS (there are no plans to disseminate the 15-minute GLMP guidance over the Satellite Broadcast Network at this time)
 - Deterministic ceiling height and visibility
 - Probability of ceiling height < 500 ft, < 1000 ft, and <= 3000 ft
 - Probability of visibility < 1 mi, < 3 mi, and <= 5 mi
- 15-minute text and gridded guidance will update every 15 minutes (96 cycles per day)

Discontinuation of Legacy Station Page

Proposed discontinuation of the legacy station forecast images web page that displays station point guidance for various LAMP elements, located at the following address:

<https://www.nws.noaa.gov/mdl/gfslamp/stnplots.php>



- Legacy webpage that was introduced before Gridded LAMP was developed and is currently hosted on a server that will soon be decommissioned.
- Most of the information provided on this page can be found elsewhere, for example LAMP meteograms at <https://www.nws.noaa.gov/mdl/gfslamp/meteoform.php> and from the GLMP image viewer at <https://www.nws.noaa.gov/mdl/gfslamp/glmp.php>

If approved, this page will be discontinued sometime prior to decommissioning of the web server.



LAMP/GLMP V2.6 Upgrades: Upgrade Benefits



LAMP/GLMP V2.6 Upgrade Benefits

1. The addition of station-based and gridded guidance for ceiling and visibility valid for 15-minute periods out to six hours, updating every 15 minutes (96 cycles per day), will provide higher temporal resolution guidance for ceiling height and visibility to aviation users.
1. The addition of a post-processing check for GLMP wind gusts and the removal of the problematic station from the GLMP temperature and dewpoint analyses will improve the quality of the gridded guidance for users.
1. The adjustment to the LAMP advection model will limit unreasonable temperature/dewpoint LAMP station forecasts, particularly for stations in Hawaii.



LAMP/GLMP V2.6 Upgrades: Real-time Experimental Products



LAMP/GLMP V2.6 Upgrades: Real-time Experimental Products

- LAMP Experimental Webpage:
<https://vlab.noaa.gov/web/mdl/experimental-lamp>
- Contains links to experimental 15-min LAMP/GLMP data:
 - 15-minute text bulletins
 - Gridded LAMP images for 15-minute C&V (deterministic and probabilities)
 - Experimental data expected to be available on or around February 23, 2024
 - Note that these experimental pages will be available through the user evaluation for feedback purposes only and will not be continued thereafter



LAMP/GLMP V2.6 Upgrades: Feedback and Schedule



LAMP/GLMP V2.6 – Feedback & Schedule

- User Evaluation: February 23, 2024 – March 25, 2024

- Public Information Statement:

https://www.weather.gov/media/notification/pdf_2023_24/pns24-11_lamp_glmp_v2.6.pdf

- Please provide comments by March 25, 2024 via this google form:

<https://forms.gle/mD4iYREyBGJSN8of8>

- Alternatively you may send feedback via email to:
 - Judy.Ghirardelli@noaa.gov , Phil.Shafer@noaa.gov

- NCEP Science Briefing: Last week of April 2024

- Code handoff: April 30, 2024

- Planned Implementation: August 2024

<https://vlab.noaa.gov/web/mdl/lamp>

