Overview of

Localized Aviation MOS Program

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Meteorological Development Laboratory

Presentation to Coastal WFOs (SR, WR) and
Great Lake WFO SOOS

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Outline

- LAMP background
- Gridded LAMP
- Known deficiencies and proposed solutions
- Future upgrades
- Questions and discussion

Localized Aviation MOS Program (LAMP) Background

- LAMP is a system of objective analyses, simple models, regression equations, and related thresholds which together provide guidance for sensible weather forecasts
- LAMP acts as an update to GFS MOS guidance
- Guidance is both probabilistic and non-probabilistic
- LAMP provides guidance for aviation elements
- LAMP bridges the gap between the observations and the MOS forecast
- 2006-2008: Implemented LAMP at stations and gridded thunderstorm guidance
- 2010: Implemented experimental version of Gridded LAMP centrally at NCEP

LAMP Guidance Details

- LAMP guidance is in the range of 1- 25 hours in 1 hour projections
- Runs 24 times a day (every hour) in NWS operations
- LAMP provides station-oriented guidance for:
  - all LAMP forecast elements
  - ~1600 stations
  - CONUS, Alaska, Hawaii, Puerto Rico
- LAMP provides grid-oriented guidance for:
  - Thunderstorms (at least one CTG ltg strike):
    - Probability of thunderstorm occurrence/best category of an occurrence (yes/no) in a 2 hour period in a 20-km grid box
  - Temperature
  - Dewpoint
  - Ceiling Height
  - Visibility
  - Convection (new, experimental)

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

New “Gridded LAMP” elements

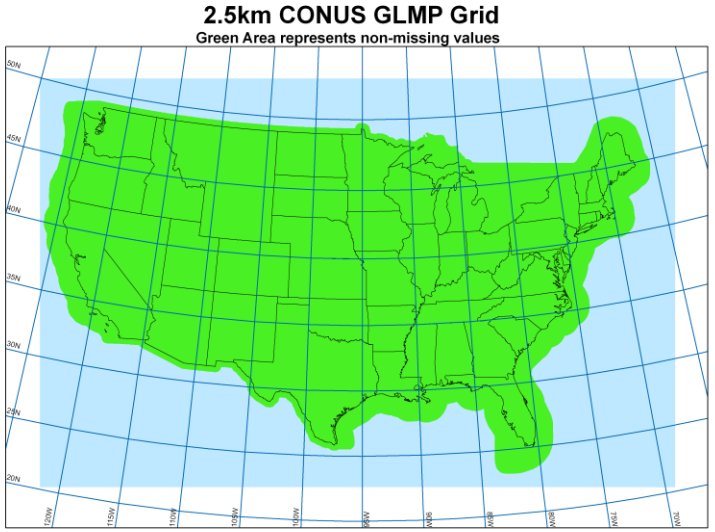
LAMP Current Status: Available Products

- At NWS WFOs:
  - Currently operational guidance viewable at WFOs
  - Gridded LAMP grids can be brought into GFE via the LDM data feed
- Website products:
  - Text bulletins
  - Station plots
  - Meteograms
  - Probability/Threshold images
  - Gridded Thunderstorm images
  - Gridded LAMP images (Temperature, Dewpoint, Ceiling, Visibility)
  - Experimental Gridded Convection images
- Via FTP, in the National Digital Guidance Database:
  - Station-based LAMP bulletins (ASCII)
  - Station-based LAMP forecasts (BUFR)
  - Gridded LAMP thunderstorm guidance (GRIB2)
  - Gridded LAMP products (GRIB2)

LAMP/Gridded LAMP (GLMP)

- LAMP:
  - Guidance of sensible weather at stations
  - Guidance of thunderstorms (≥ 1 CTG lightning strike) on grid

- GLMP: Gridded observations and Gridded LAMP forecasts of:
  - Temperature
  - Dewpoint
  - Ceiling Height (100's of ft)
  - Visibility (miles)
  - Other elements later



- Status:
  - GLMP grids on the 2.5km NDFD grid
  - GLMP in NWS jobstream at NCEP
  - Data available in Experimental NDGD
  - Available in MDL's test Web Coverage Service
  - GLMP grids can be brought into AWIPS via the LDM data feed (no SBN activation yet)
  - Can be used in the creation of NWS digital aviation products
  - Images available on LAMP web page
  - Will be available via the NextGen 4-D Data Cube

Gridded LAMP Details

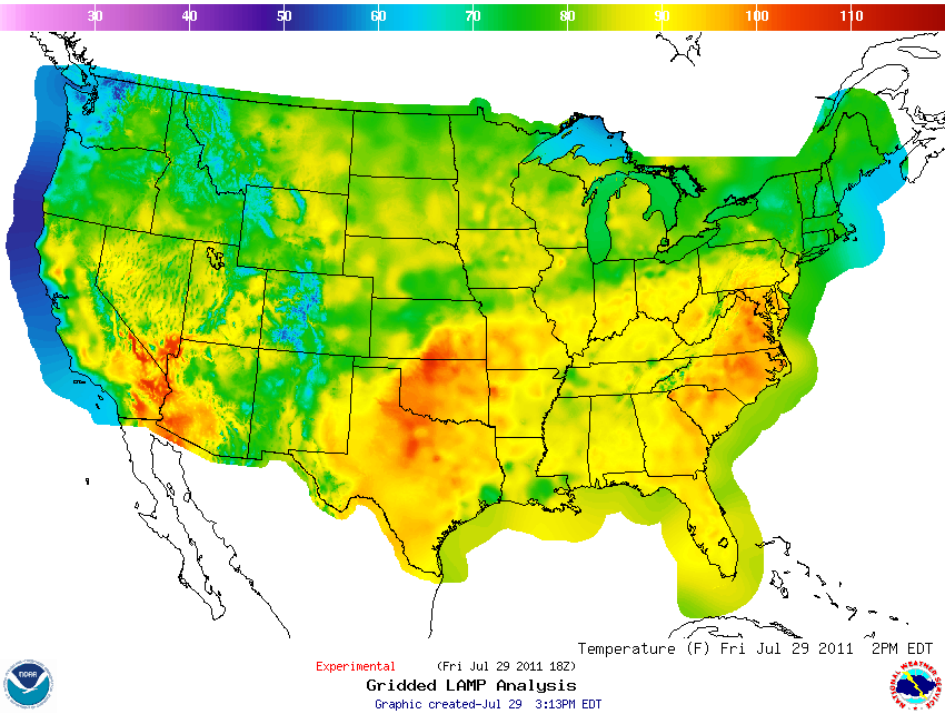
- Gridded LAMP analyses of **observations** – for checkout and verification
  - Temperature and Dewpoint:
    - Observations from METAR, Mesonet, synoptic stations, C-MAN, tide gauges, and moored buoys (Roughly 10,000 – 12,000 observations per hour)
    - Error estimates of temperature and dewpoint available in gridded format
  - Ceiling Height and Visibility:
    - Observations from METAR

- Gridded Analysis of LAMP **forecasts**
  - Temperature and dewpoint:
    - Continuous values are analyzed
    - < 1500 LAMP stations (input points) in CONUS, so SREF forecasts are used to augment LAMP forecasts
  - Ceiling Height and Visibility:
    - Categorical values are converted to continuous values
    - No augmentation

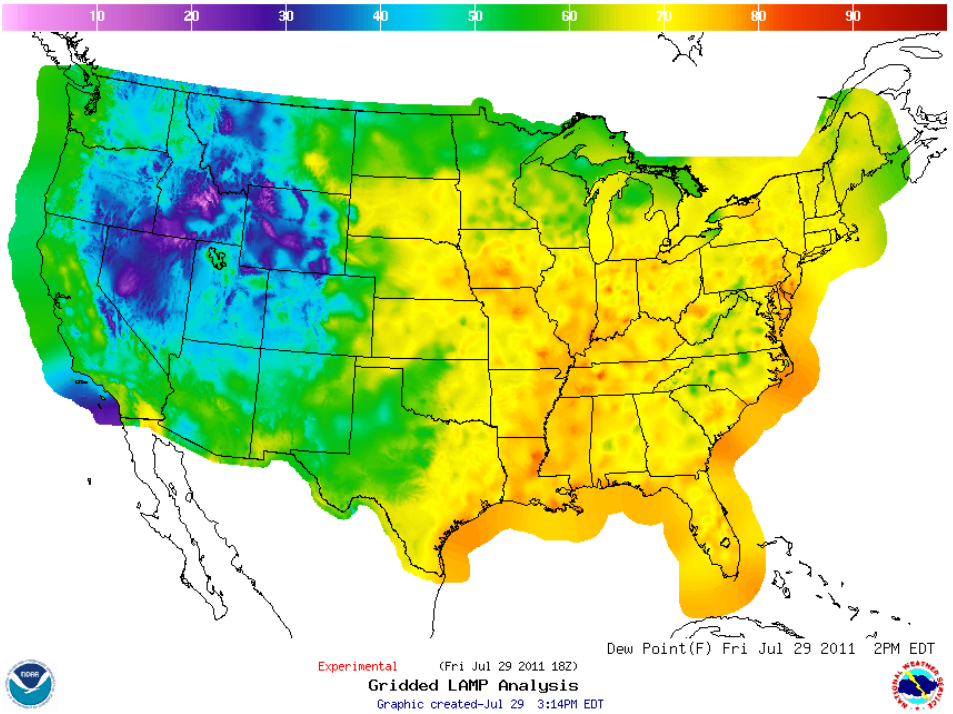
Technique: MDL Gridding Technique used in Gridded MOS, with modifications

Gridded LAMP: 0-25 hours

Temperature

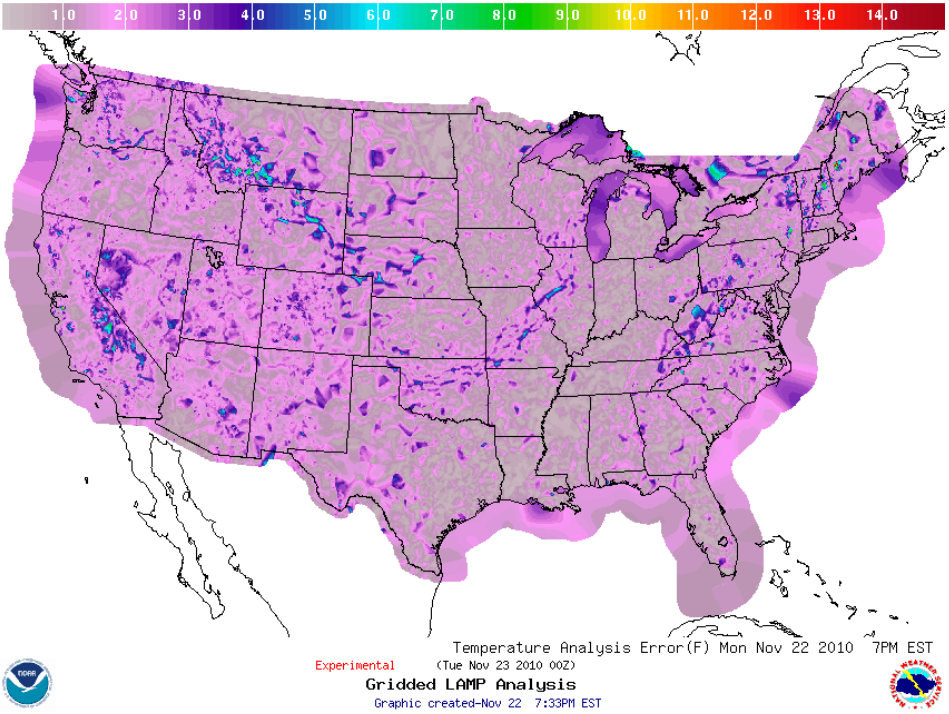


Dewpoint

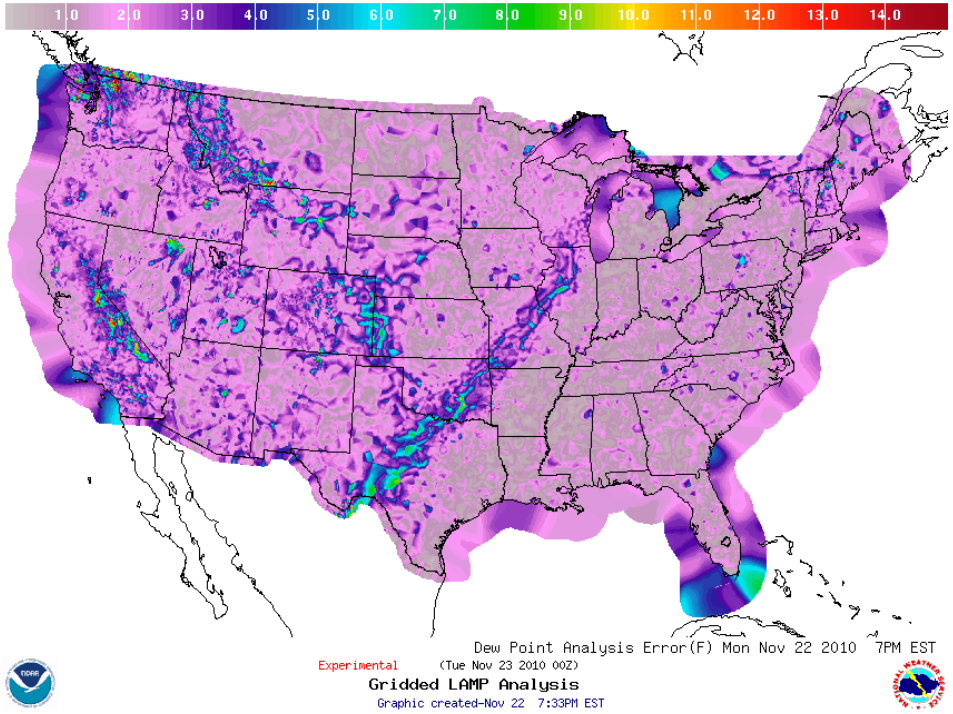


Observation Analysis
Error Estimates

Temperature Error Estimate



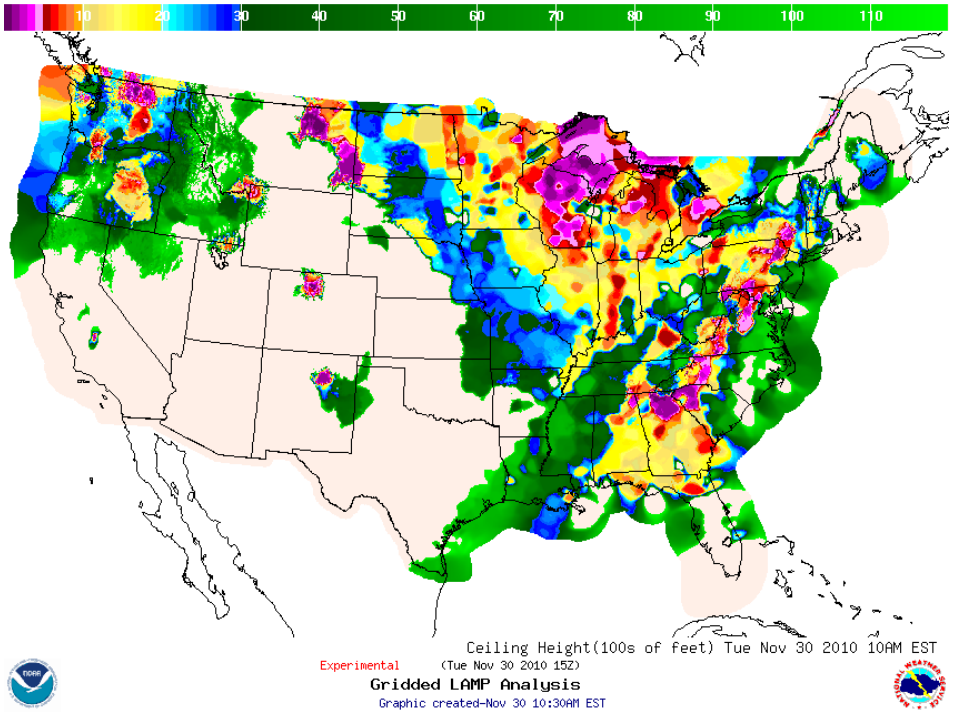
Dewpoint Error Estimate



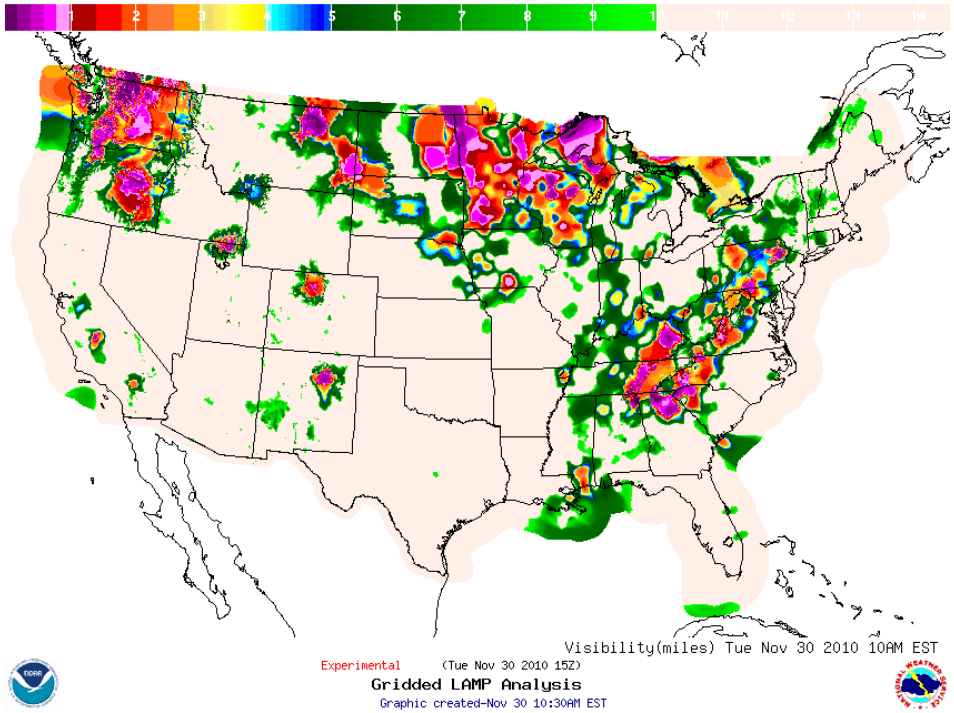
Error Estimate: “a measure of the inability to recover the data values on which the analysis is based from the gridded analysis by linear interpolation anywhere within the extent of the grid.” (Glahn and Im, 2010)

Gridded LAMP Work: Gridded Observations

Ceiling Height Observations

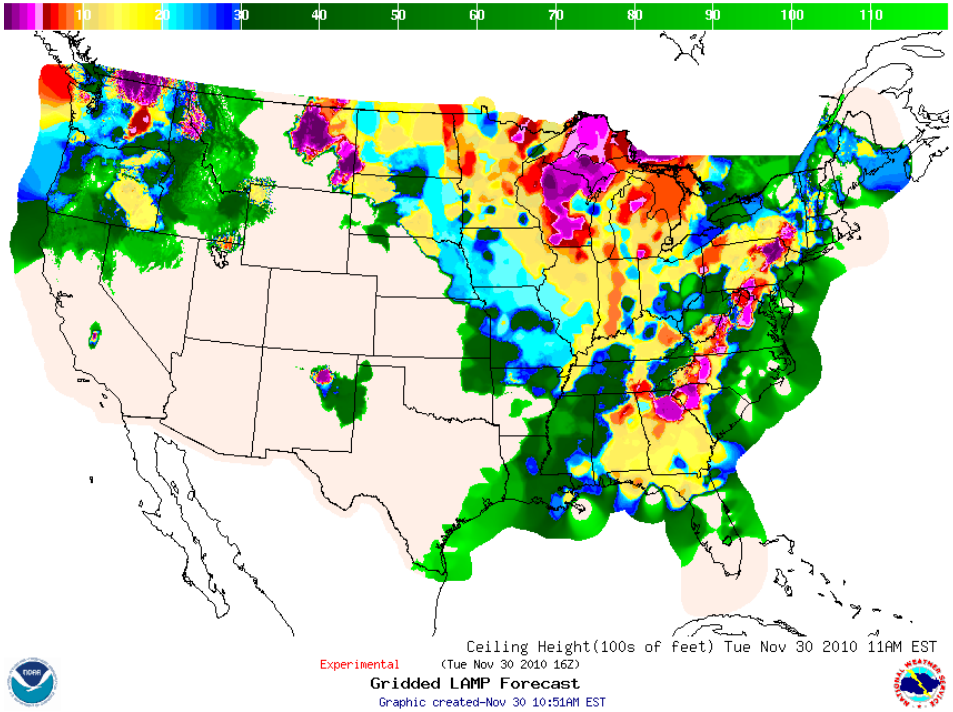


Visibility Observations

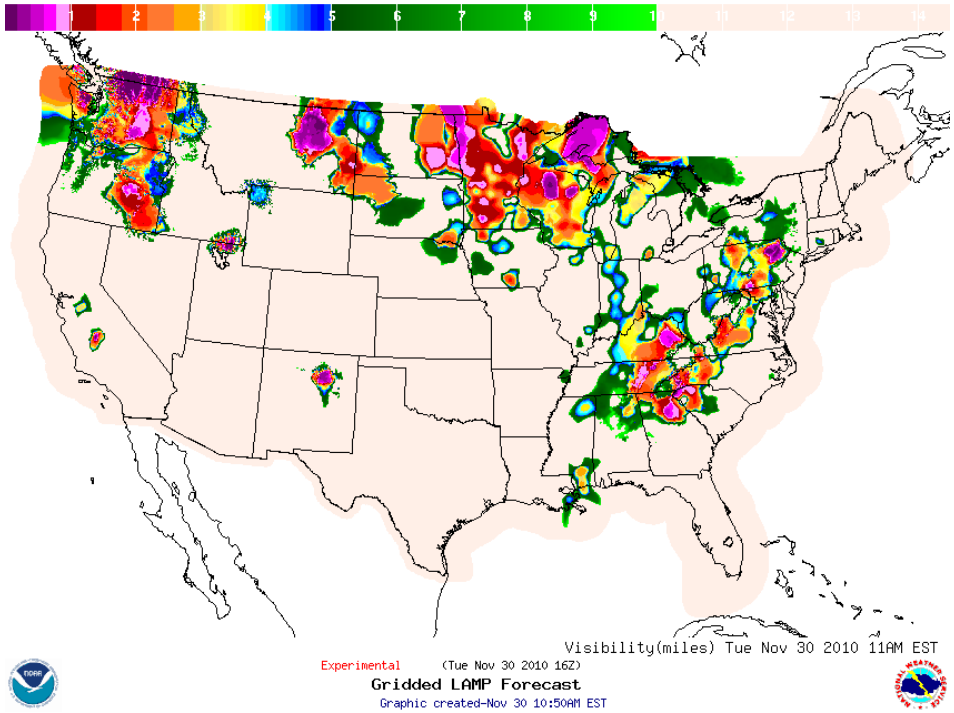


Gridded LAMP Work: Gridded Forecasts

Ceiling Ht Forecasts 1-25 hours



Visibility Forecasts 1-25 hours

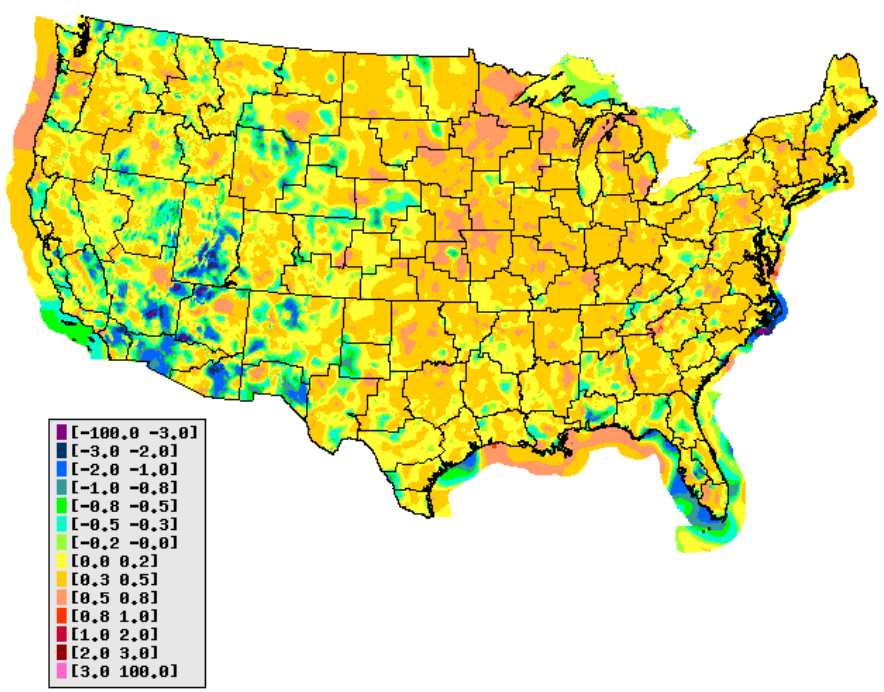


Temperature and Dewpoint Gridded Verification

- Compared GLMP vs. GMOS
  - 0600 UTC GLMP vs 0000 UTC GMOS
  - 1800 UTC GLMP vs 1200 UTC GMOS
- Data Sample: November-December 2010
- Area: CONUS, 2.5-km grid
- Variables: Temperature and Dewpoint
- Verification using two methods:
  - GLMP 0-hr gridded observations
  - RTMA
- Computed:
  - MAE over all gridpoints
  - Fractional Improvement in MAE of GLMP over GMOS at each gridpoint
- Purpose: to determine if GLMP improves on GMOS as LAMP improves on MOS

GLMP T and Td Gridded Verification Summary

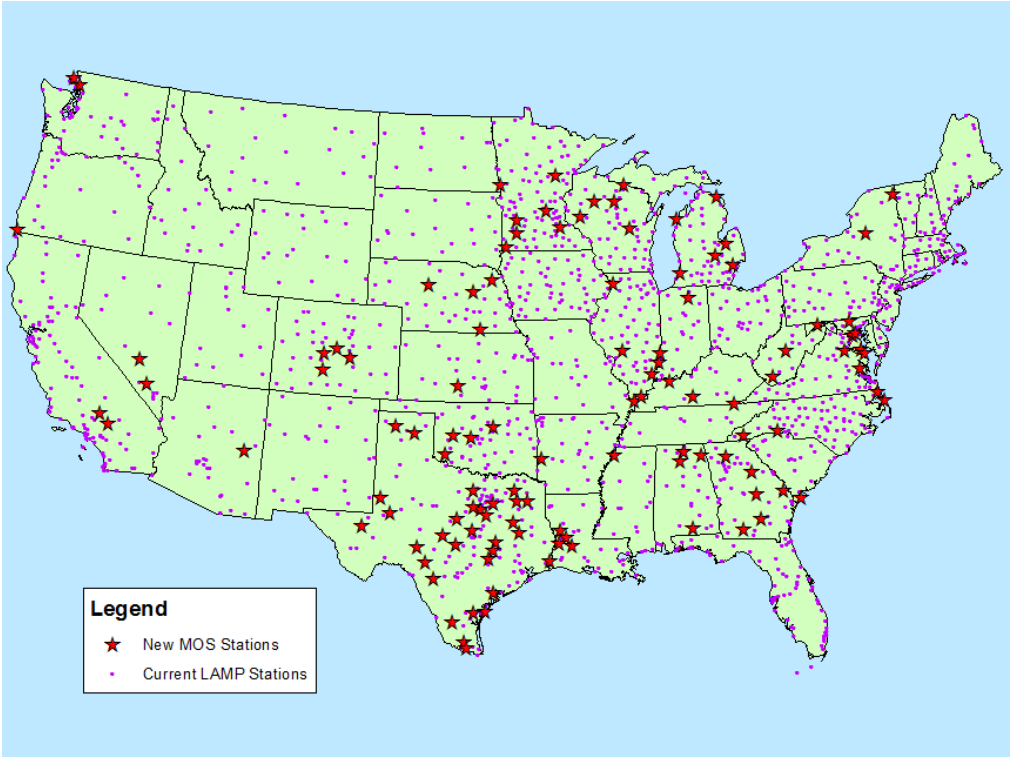
- Overall, GLMP shows improvement over GMOS, as expected
  - Result independent of verifying data (GLMP gridded obs or RTMA)
- By gridpoint, GMOS temperature is better than GLMP temperature in Western Region for some gridpoints, some projections, and for some marine areas



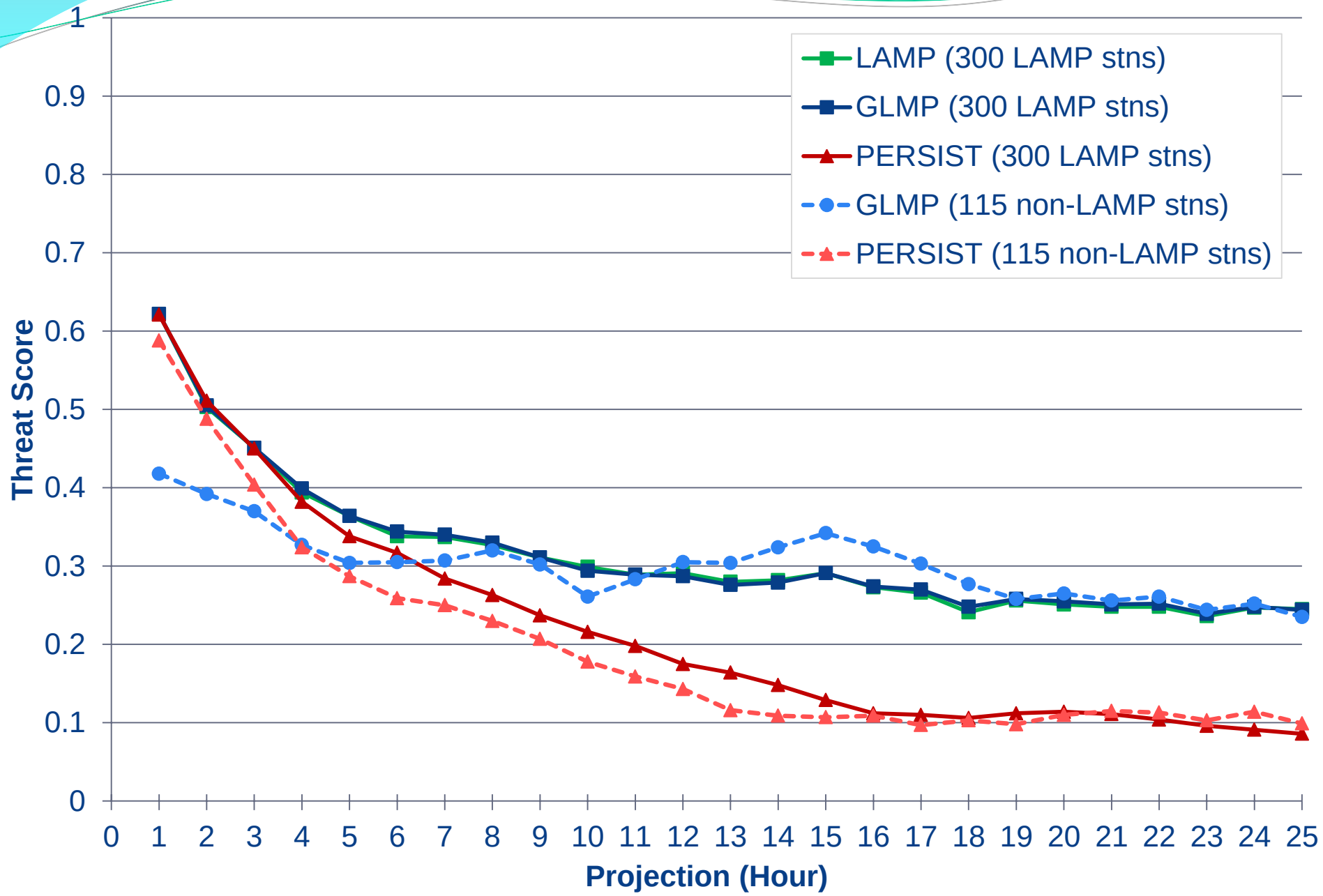
0600 UTC GLMP – 03 HR Projection Temperature

Ceiling Height and Visibility Station Verification

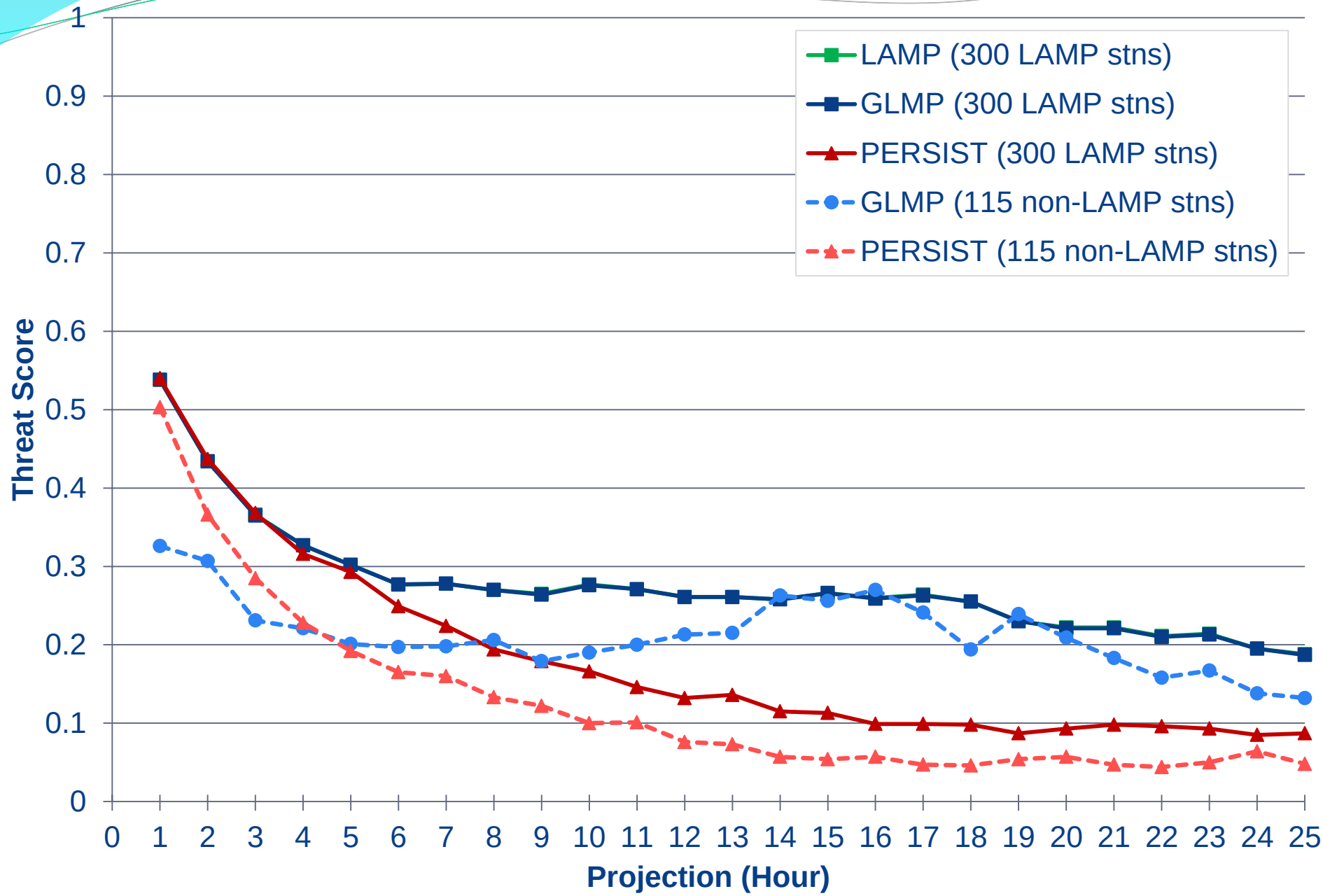
- No Gridded ceiling/visibility verifying observations other than from Gridded LAMP → verification done at stations only
- Two cycle times: 0600 and 1800 UTC
- Verified for Nov-Dec, 2010
- Verifying at stations
  - At LAMP 300 stations
    - Purpose: to see if GLMP inter-polated to the stations is as good as actual LAMP at the stations.
  - At 115 non-LAMP stations
    - 115 stations where LAMP station forecasts were not available, but obs were available
    - Mimics with-held data testing



Threat Scores 0600 UTC Ceiling Height < 1000 FT
(At LAMP and NON-LAMP stations)



Threat Scores 0600 UTC Visibility < 3 MILES
(At LAMP and NON-LAMP stations)



GLMP Cig and Vis Station Verification Summary

- Overall, GLMP interpolated to LAMP stations shows no degradation compared to LAMP guidance at stations, as expected
- GLMP interpolated to non-LAMP stations potentially worse than GLMP interpolated to LAMP stations, as expected
  - More difficult to objectively quantify given small sample

User Comments regarding Visibility:

- Initial Feedback from the Charleston (WV) WFO :
  - Favorable feedback
  - Specific comments included:
    - Visibility was not restricted to just the valleys - it was spread out to the mountains. While this is not realistic, they can easily correct it in the grids via AWIPS tools.
- Feedback from the Boston WFO:
  - “So far the forecasters here like the Ceiling (PredHgt) and Vsby fields the best, especially in the first 6 hours. We have seen far fewer "bulls eyes" than we did with the point LAMP data.”

User Comments regarding Visibility:

- Later (March 2011) Feedback from the Charleston (WV) WFO :
  - “The gridded LAMP has been a great improvement for use in GFE over the point data. Before the gridded LAMP we had to SERP in the point data which greatly smoothed over detail and removed, rather then adjusted, detail in the mountains.”
  - “Visibility grids for systems moving in and out have been an improvement over the point data for constructing our visibility grids. They are still noisy during fog situations.”
  - “With the resolution improvements as a result of grids, first guess fields are much improved assisting in the forecast creation process.”

User Comments regarding Visibility:

- Feedback from the Caribou WFO:
  - Small study of a station that was distant from stations that had ceiling height and visibility observations, and distant from LAMP stations that had ceiling height and visibility guidance.
  - The object of the study was to see how GLMP (observations and forecasts) verified away from data points by using a web camera as validation.
  - Their results were favorable.

Known deficiencies
and
future improvements

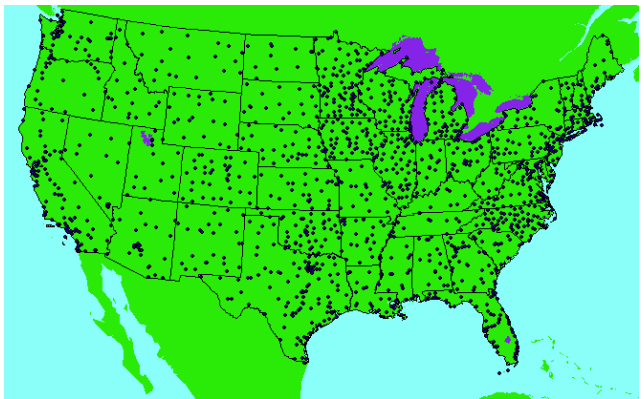
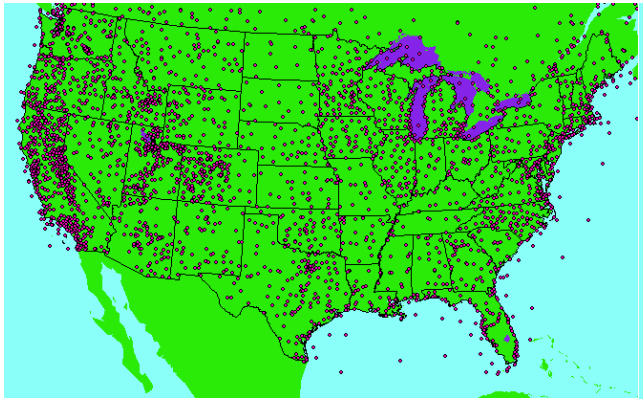
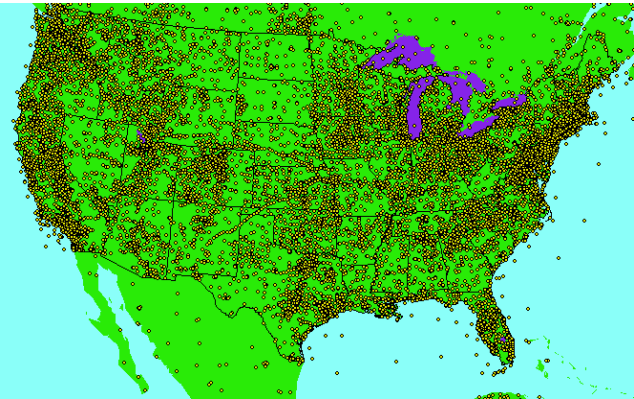
Temperature and Dewpoint

- GLMP worse than GMOS in some areas in WR and in the marine areas. Likely due to larger number of better input points used in GMOS compared to GLMP, especially in WR and marine areas, and GLMP's use of coarser resolution SREF data.

- More spatial detail seen in the 0-h Gridded LAMP analysis than in the 1-25-h Gridded LAMP forecasts due to much larger number of inputs for observation analysis vs. forecast analysis.

- Solution: Use additional MOS input points as well as 0-hr GLMP observations (10,000-12,000 input points) instead of SREF data to provide more spatial detail in GLMP forecast analyses.

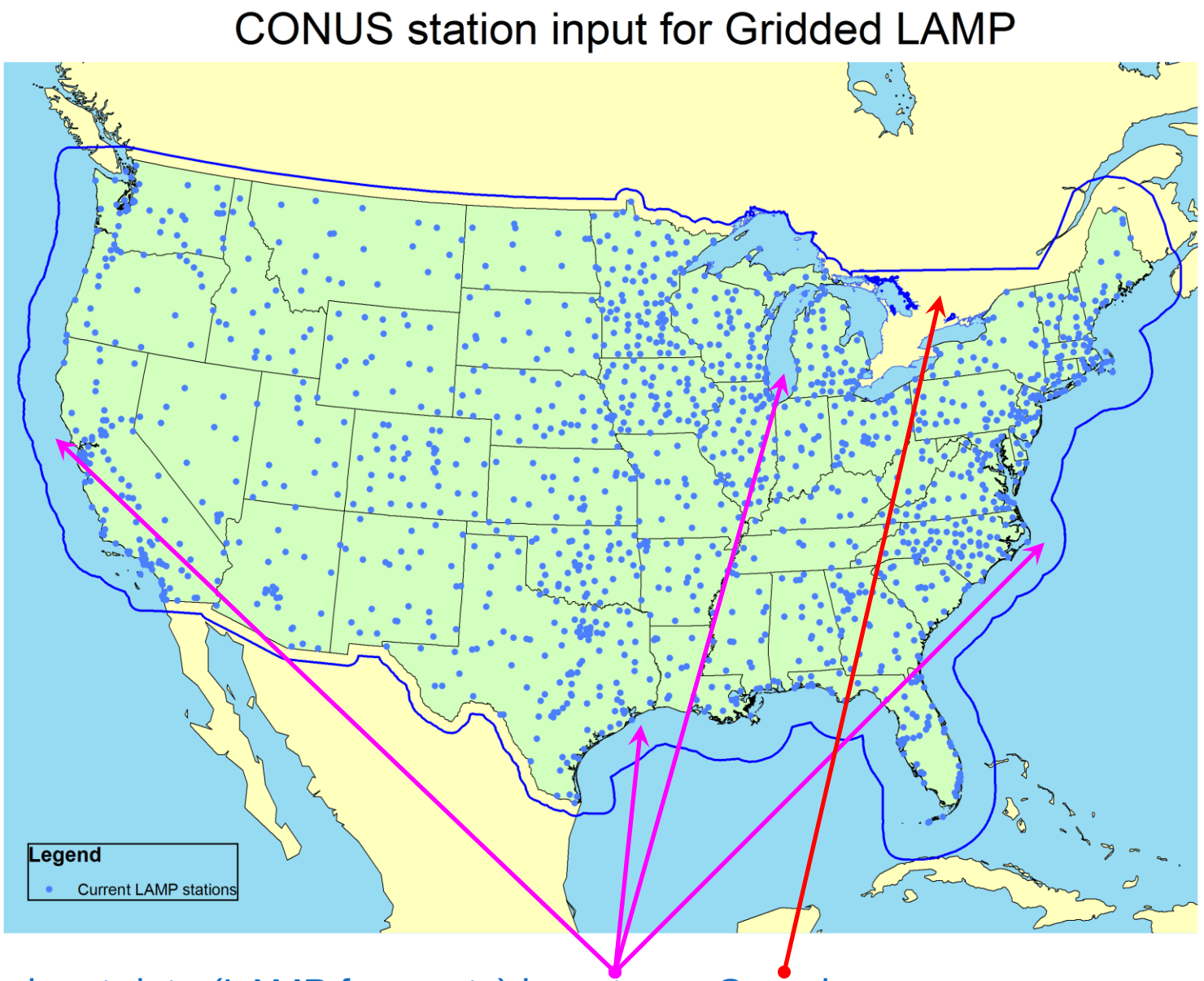
LAMP (1445 stns)	MOS (3288 stns)	OBS (17925 stns)

Ceiling and Visibility Known Issues

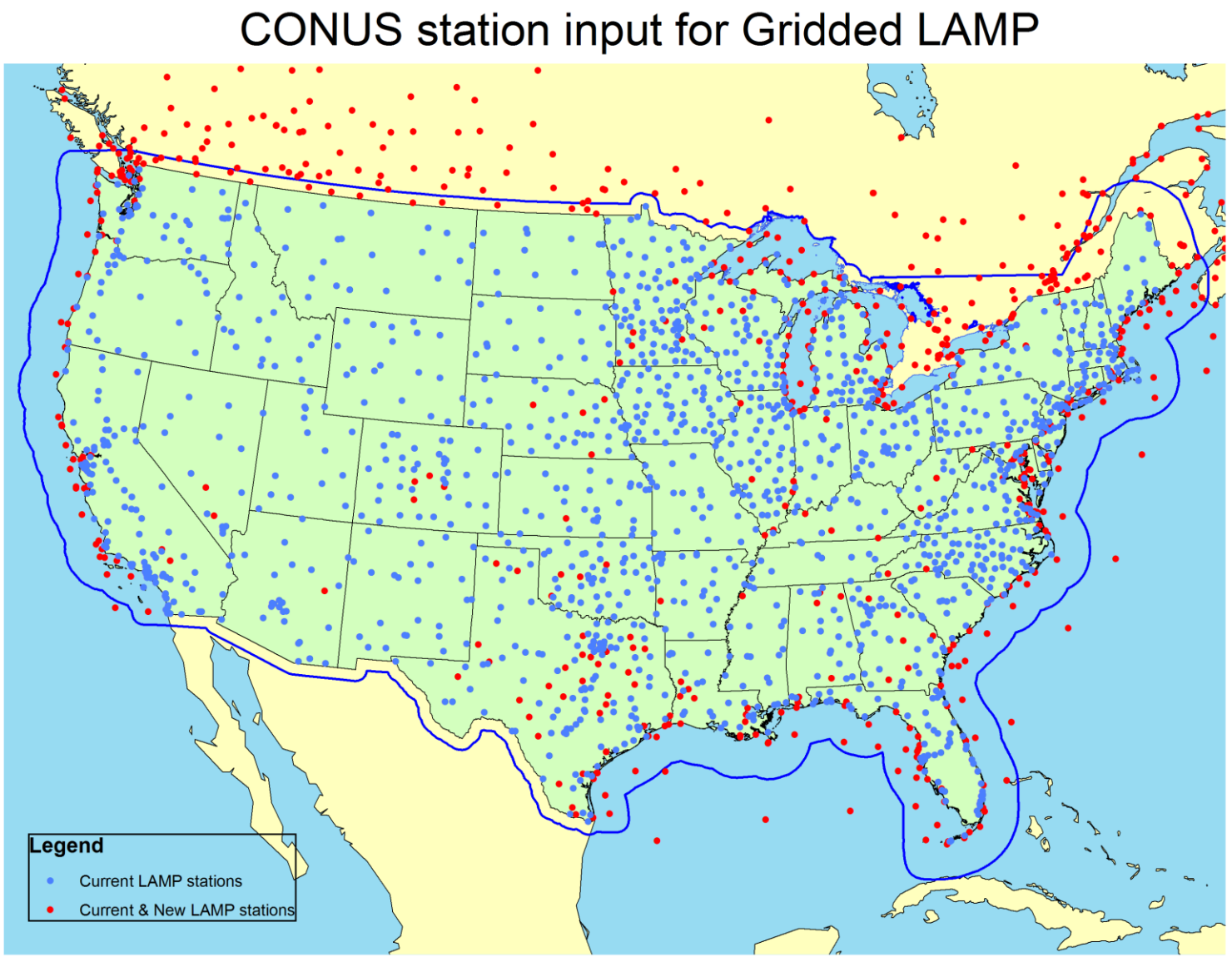
- Can sometimes lack consistency between 0-h Gridded LAMP analysis of observations and early hour projections of Gridded LAMP forecasts.
- Currently no LAMP station forecasts in the marine or Canadian areas. There are no marine stations with visibility observations (if you know of any, please let us know their call letters).
- Temporal inconsistences can occur.
- Solution: 1) Modified codes to increase consistency between grids of 0-h analysis of observations and early projections of analysis of forecasts, and 2) adding 718 new stations (306 in marine areas) to LAMP station forecasts for C&V.
- Longer term solution: 3) codes will be modified to minimize temporal inconsistencies in GLMP C&V.

Improving Gridded LAMP Ceiling and Visibility Forecasts



No input data (LAMP forecasts) in water or Canada

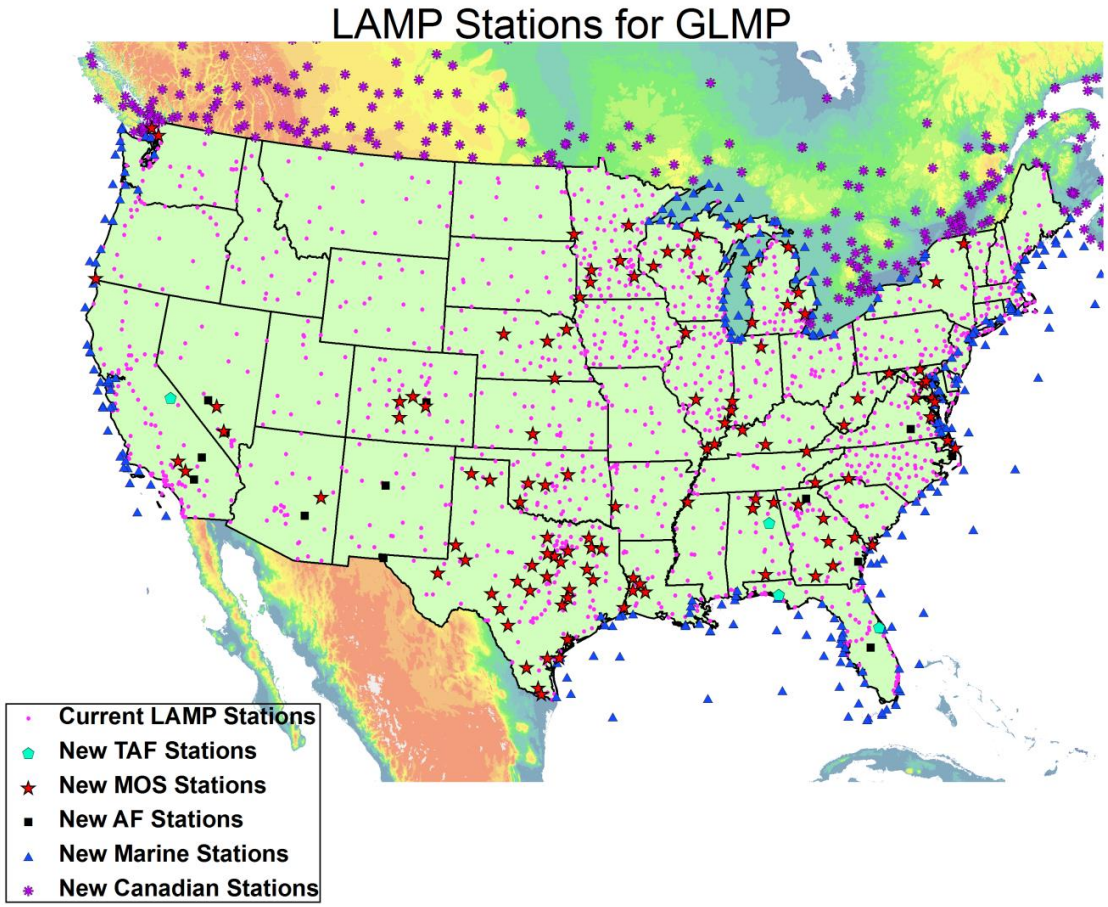
Improving Gridded LAMP Ceiling and Visibility Forecasts



Additional input data (LAMP forecasts) in CONUS, marine areas, Canada (red dots)

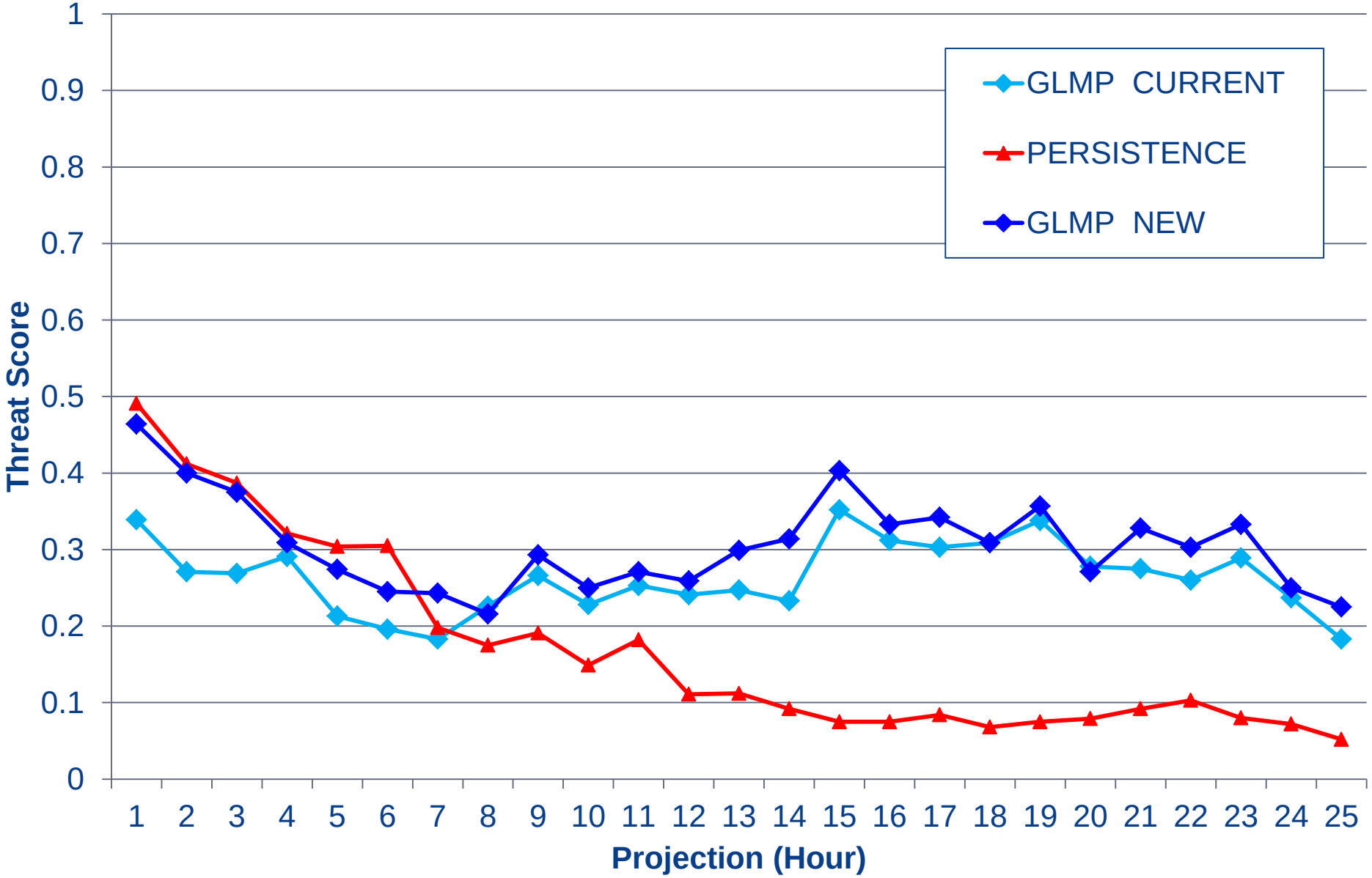
LAMP Station Implementation

- Redeveloped ceiling height and sky cover
- Adding Stations for C&V
  - 119 new MOS stns (116 in CONUS)
  - 306 Marine stns
  - 274 Canadian stns
  - 4 new TAF stns
  - 15 military stns (13 in CONUS)

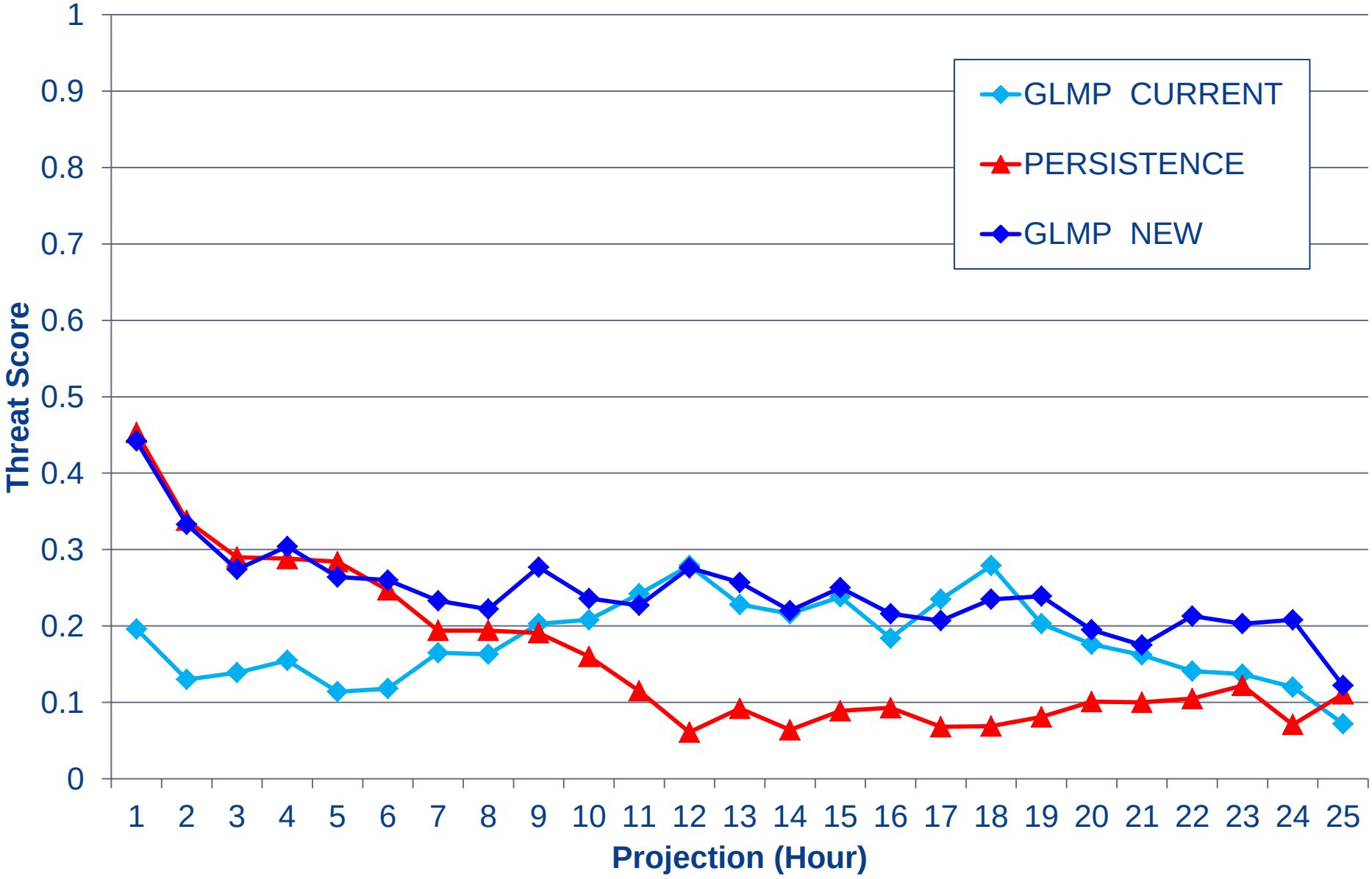


- To be implemented at NCEP 6/2012 at stations
- New station guidance will be input into grids with next GLMP implementation Q1/Q2 FY13

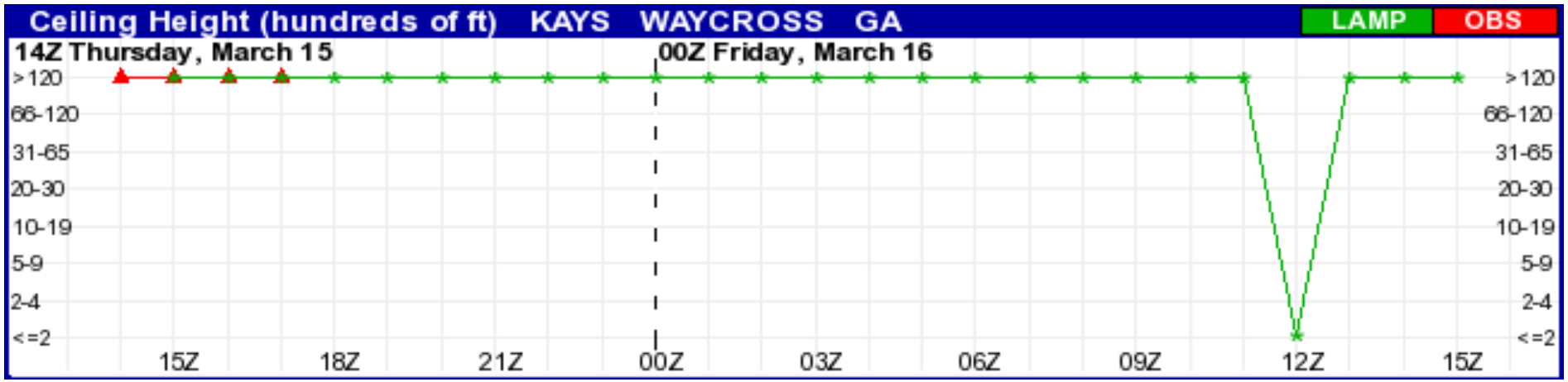
0600 UTC GLMP Verification
Ceiling Height < 1000 Feet
(11 Canadian Stations)



0600 UTC GLMP Verification
Visibility < 3 miles
(11 Canadian Stations)



Example of a Station Temporal Inconsistency

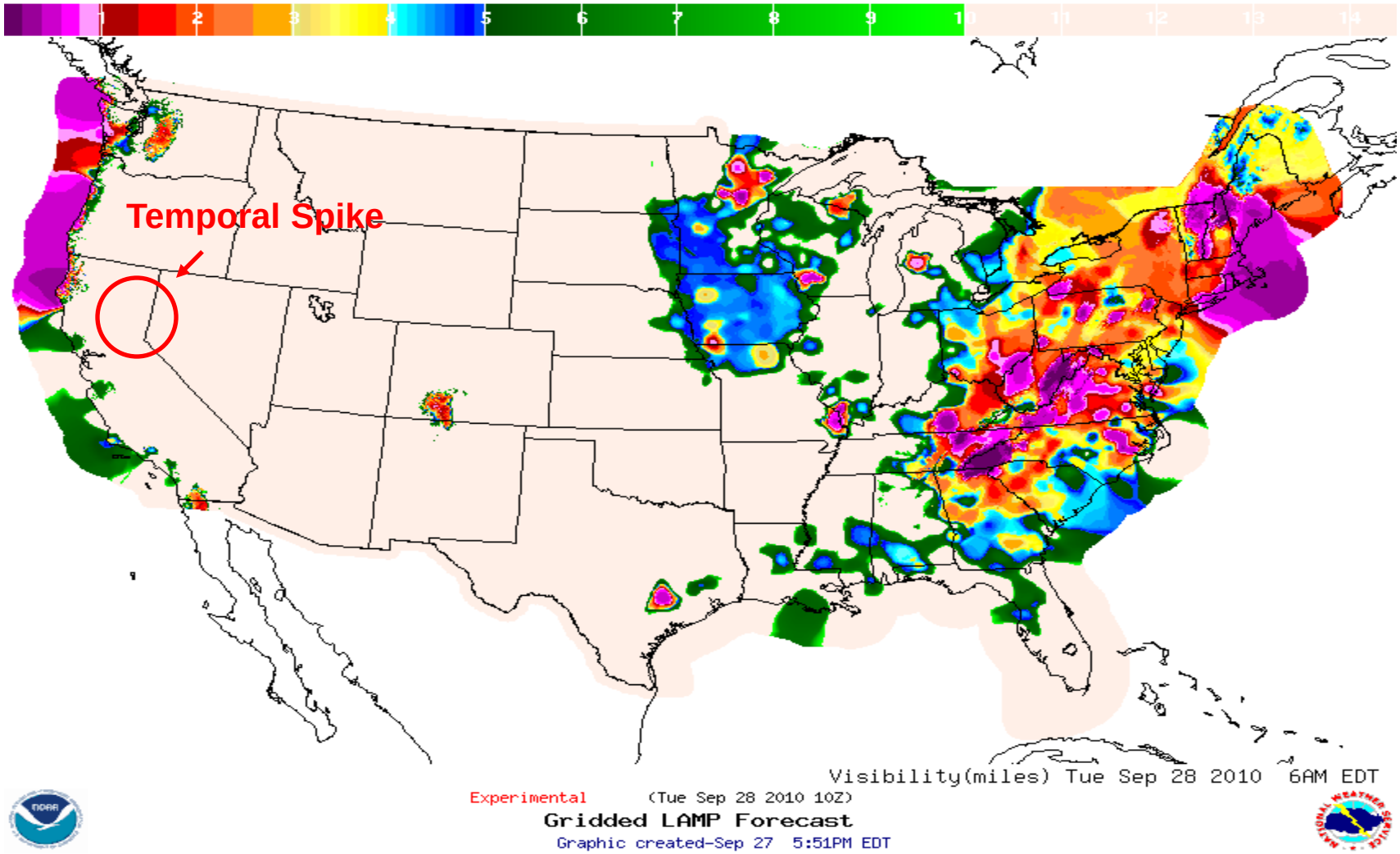


- These spikes typically occur because the probability for a rare event slightly exceeds its respective threshold. In many of these cases, the cumulative probabilities and their respective thresholds for the remaining categories actually indicate a higher category or the most common category should be chosen.

- Therefore, we believe that by attempting to understand the underlying behavior of the probability and threshold distribution we have intelligently devised a method to reduce temporal spikes.

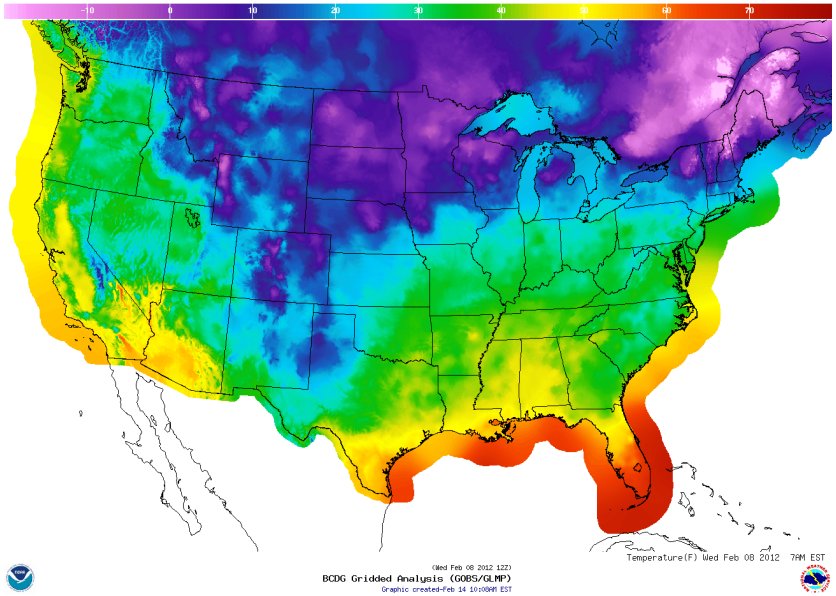
- Scheduled for a future implementation (no sooner than FY 2013).

Example of a Gridded Visibility Temporal Inconsistency



Summary of Gridded LAMP Updates

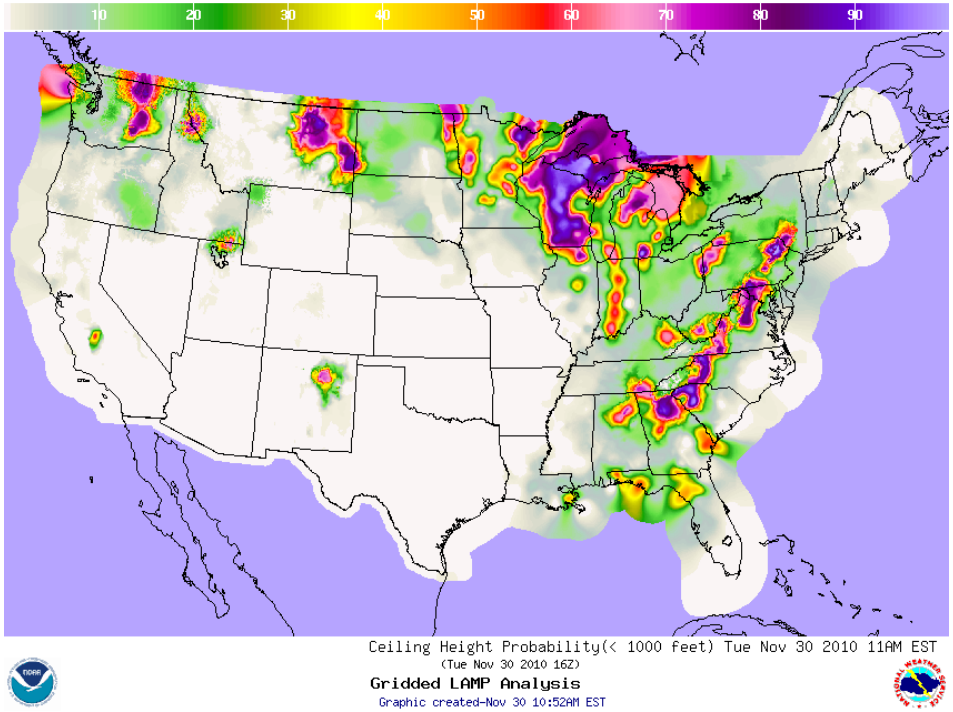
- Improvements to GLMP C&V:
  - New LAMP stations to improve C&V in marine areas and Canada
  - Improvements to consistency of 0-hr and early projections of ceiling and visibility forecasts based on observational data
  - Extension to 30 hrs
  - Minimizing C&V temporal inconsistencies
- Temperature and dewpoint:
  - Augmenting with additional MOS input points and observational data to provide improved, spatially detailed forecast grids. Will improve grids in WR and over marine areas.
- Extended grid into Canada
- Probabilities of ceiling heights, visibilities, and sky
- Additional elements:
  - Winds
  - Sky cover



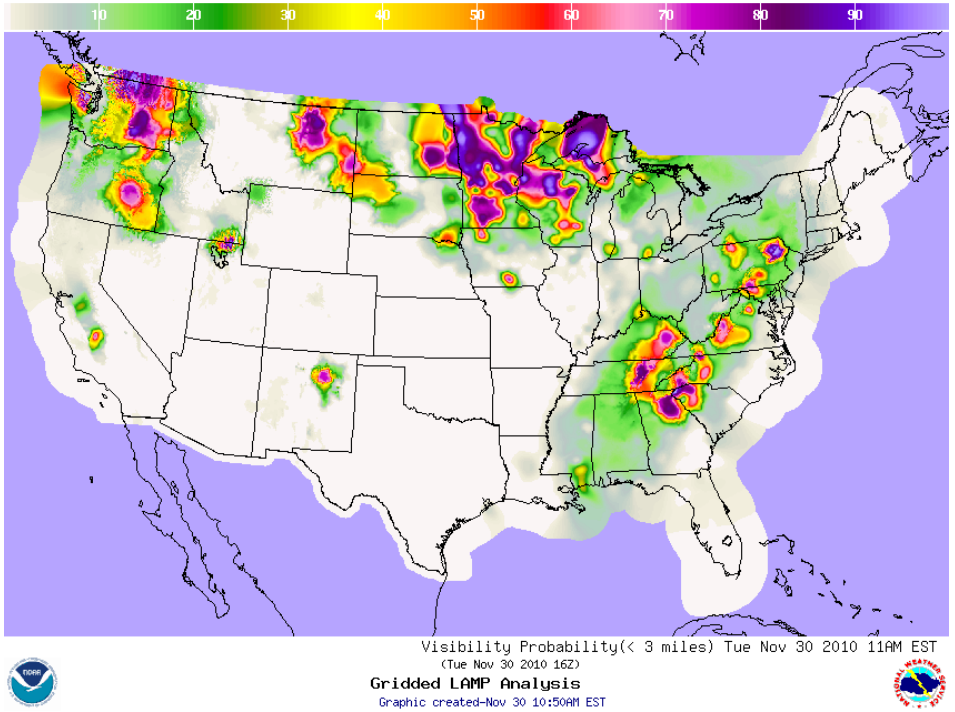
Gridded LAMP Work: Gridded Probability Forecasts

Not yet implemented

Ceiling Ht Prob. Forecasts 1-25 hrs



Visibility Prob. Forecasts 1-25 hrs



Brainstorming ideas after 3/20/2012 Meeting with WR HQ

MDL Ideas for options on improving C&V over water:

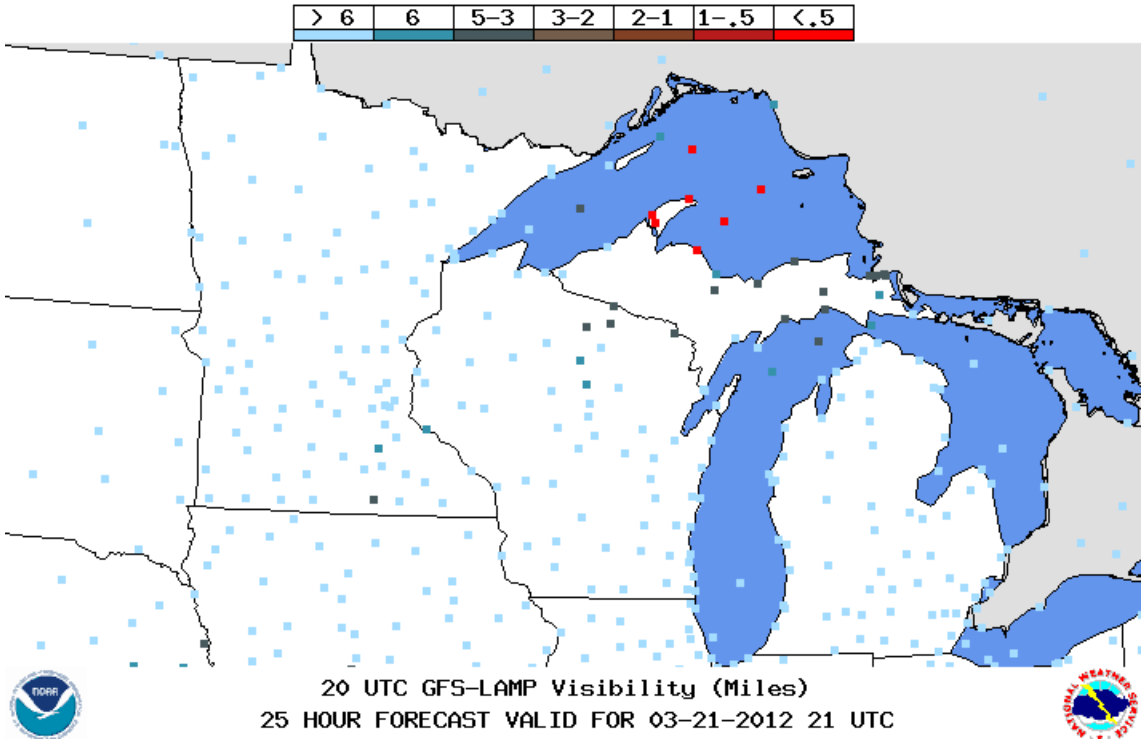
1. Use new LAMP visibility forecasts in the oceans (result of 6/2012 LAMP station implementation addition of marine LAMP stations).
2. Augment LAMP station input with Rapid Refresh interpolated to water points.

Level of effort of the above:

1. Planned for next GLMP upgrade
2. Testing, system input and code changes required

Plan to discuss further after some investigation.

Adding LAMP stations in marine areas



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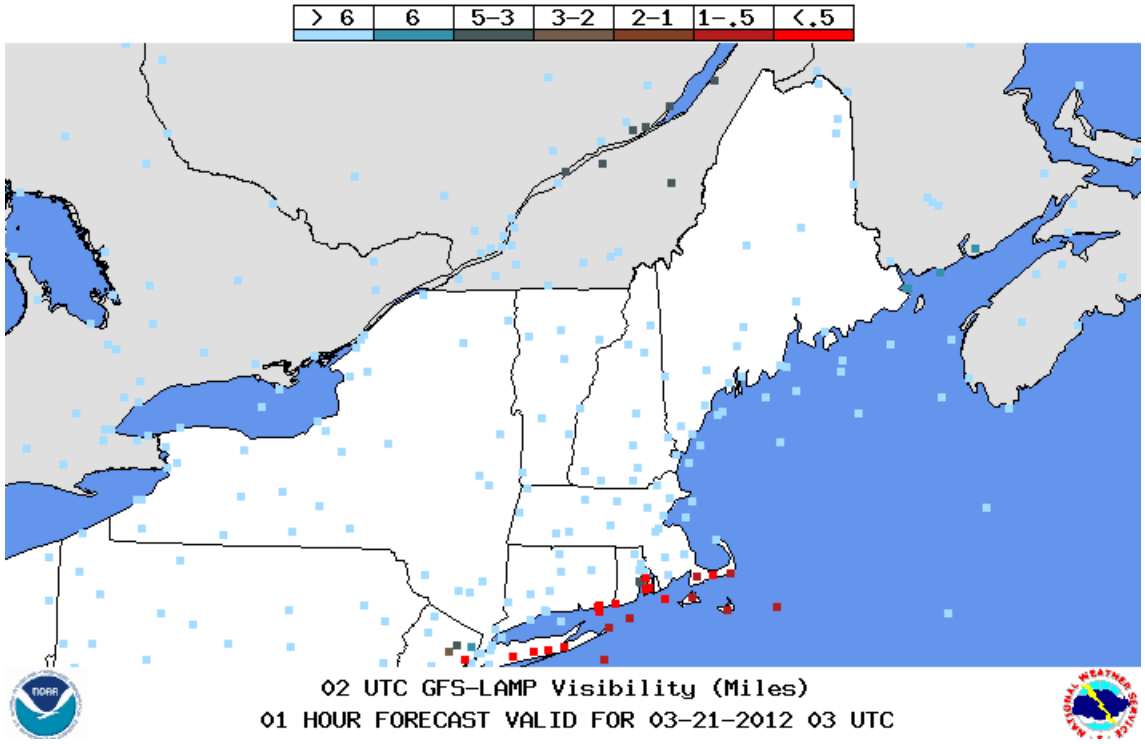
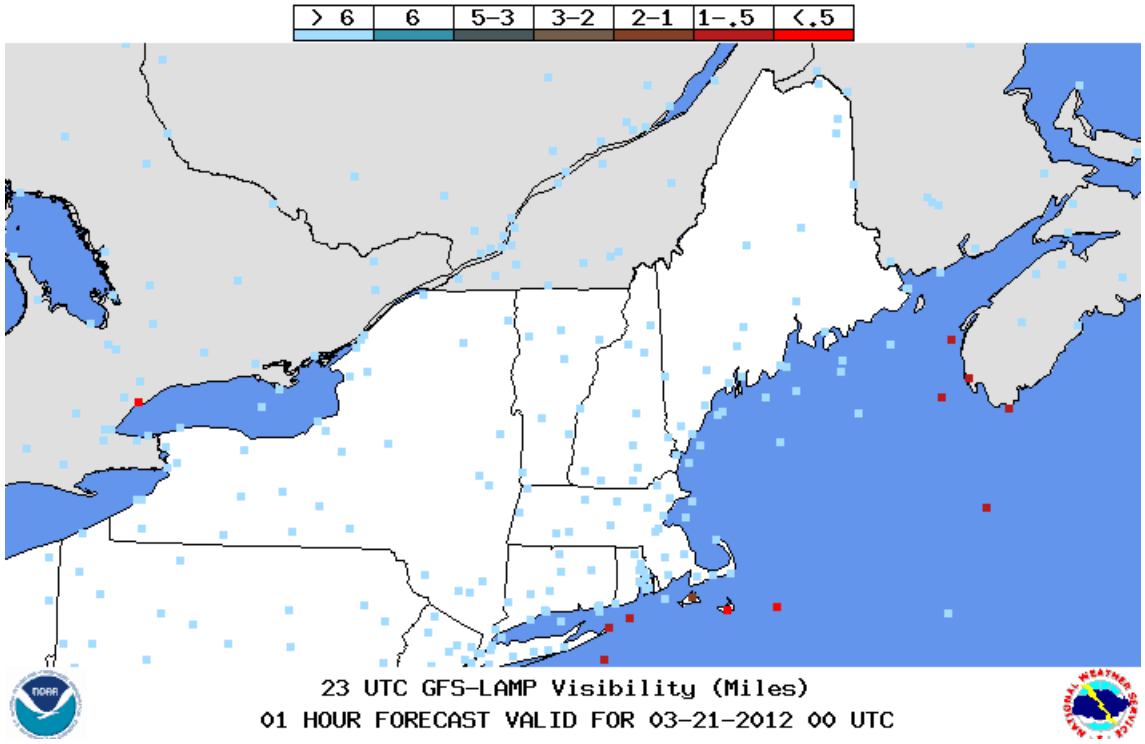


Adding LAMP stations in marine areas



Questions?

- LAMP Website:
  - http://www.nws.noaa.gov/mdl/gfslamp/gfslamp.shtml
- LAMP Mailing List for notification/announcements:
  - http://www.nws.noaa.gov/mdl/lamp/joinlist.shtml
- Training Materials:
  - http://www.nws.noaa.gov/mdl/gfslamp/docs/presentations.shtml
    - Training on LAMP Background: “An Introduction to The Localized Aviation MOS Program (LAMP)” by David Rudack.
    - Training on LAMP Products: “Accessing and Using GFS LAMP Products” by Scott Scallion.
- Contact:
  - Judy.Ghirardelli@noaa.gov