Gridded Localized Aviation Model Output Statistics Program (GLMP)

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Outline

- LAMP background
- Current status and products
- Verification
- Gridded LAMP
- New LAMP Convection Product
- NextGen Airport Forecast System (NGAFS)
- Future work
- Plans

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

  - 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

- 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

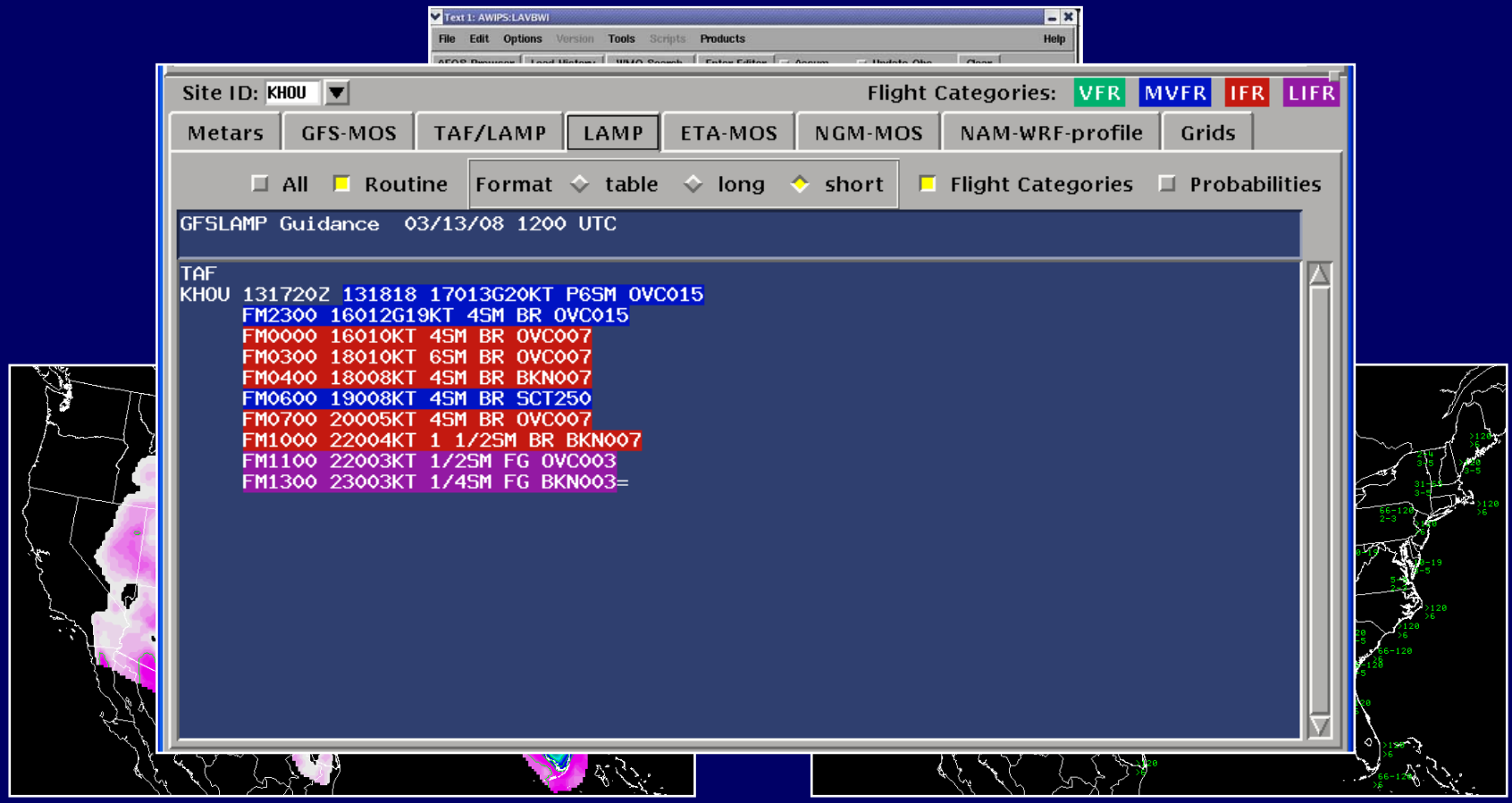
New “Gridded LAMP” elements

LAMP Current Status: Available Products

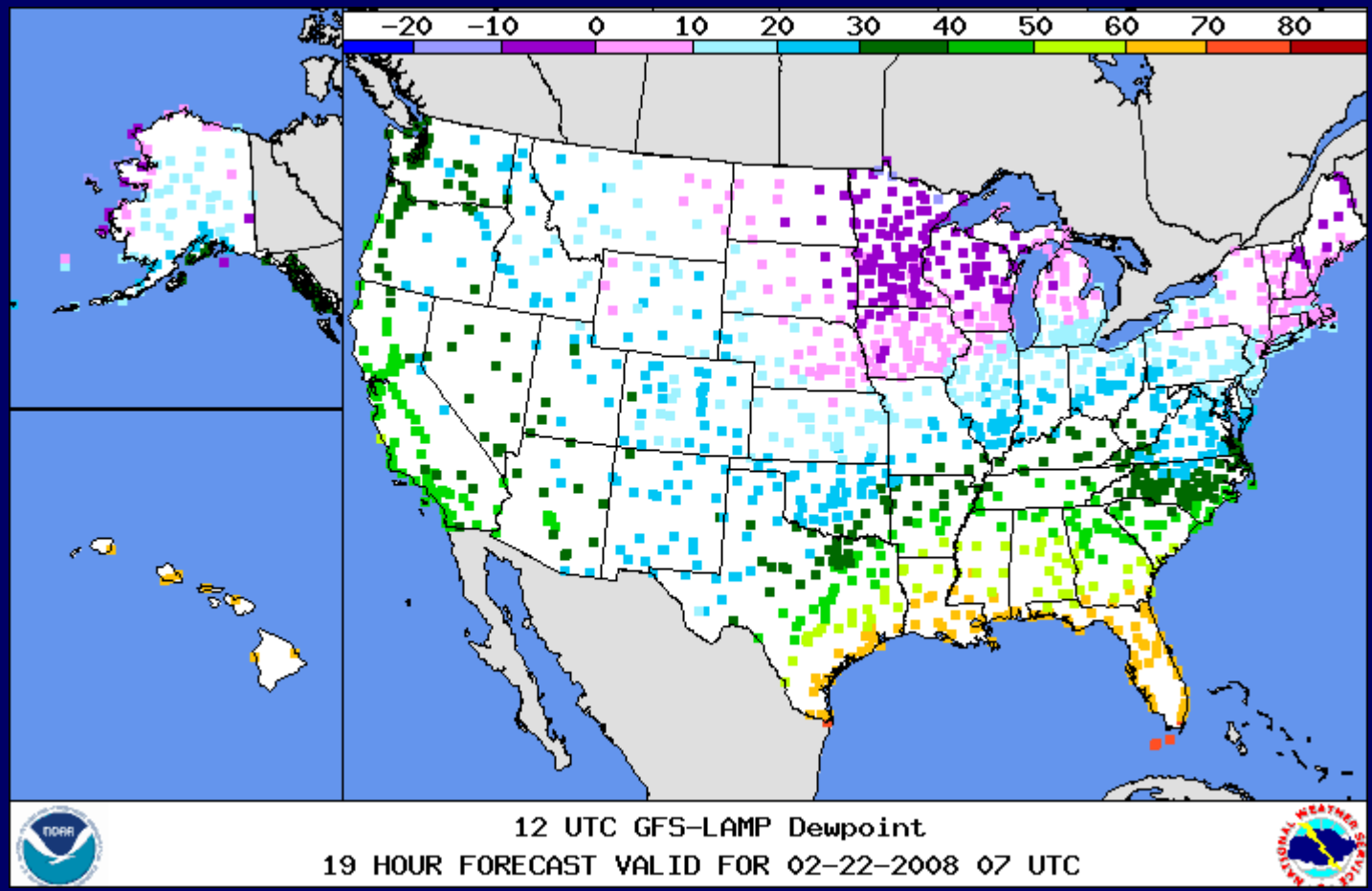
- At NWS WFOs:
  - Currently operational guidance viewable at WFOs
  - Experimental Gridded LAMP grids can be brought into GFE via the LDM data feed (contact Eastern Region for more information)
- Website products:
  - Text bulletins
  - Station plots
  - Meteograms
  - Probability/Threshold images
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

Overview of Available Products

- Available to NWS forecasters via AWIPS
  - Guidance is viewed as text or graphically by forecasters
  - Guidance is input into software for preparing TAFs



Website: LAMP Station Plots



Elements

- Flight Category
- Ceiling Height
- Visibility
- Obstruction to Vision
- Total Sky Cover
- Precipitation Type
- Probability of Precipitation
- Wind Speed
- Wind Gust
- Wind Direction
- Temperature
- Dewpoint

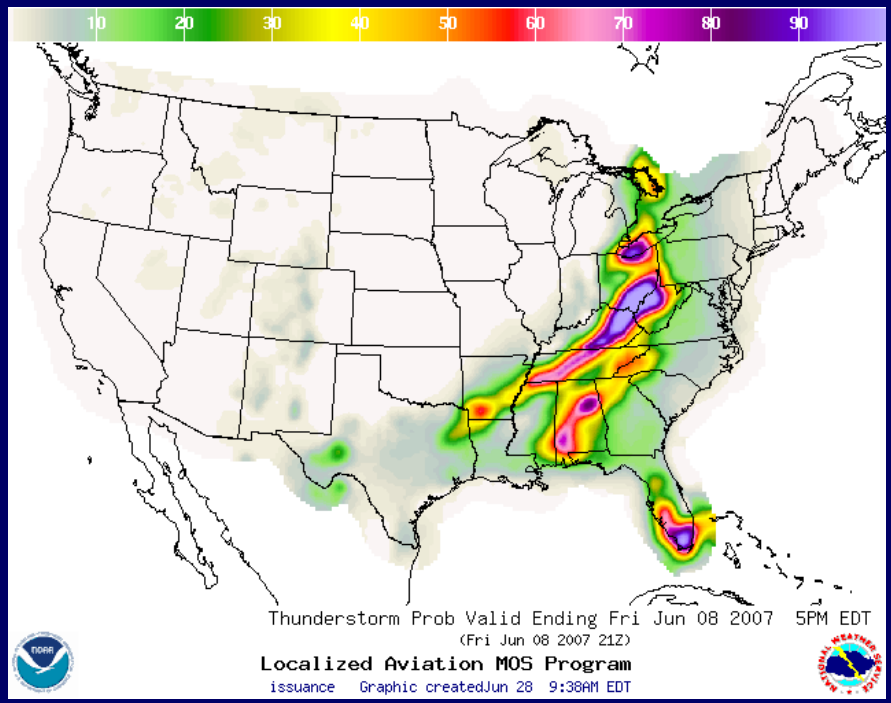
Click an element name on this slide to see its plot

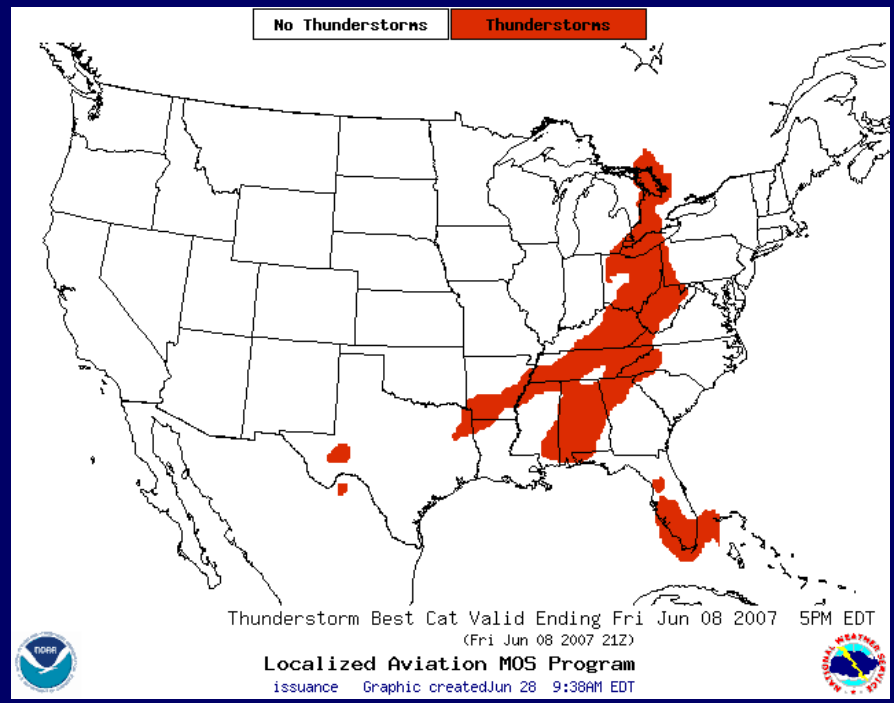
Website: LAMP Station Meteograms

Features

- Up to 12 displayable LAMP forecast elements
- Real-time verification of current and past cycles
- Verification of completed past cycles including the corresponding GFS MOS forecast

Website: LAMP Thunderstorms Probabilities and Best Category (Y/N) All Projections



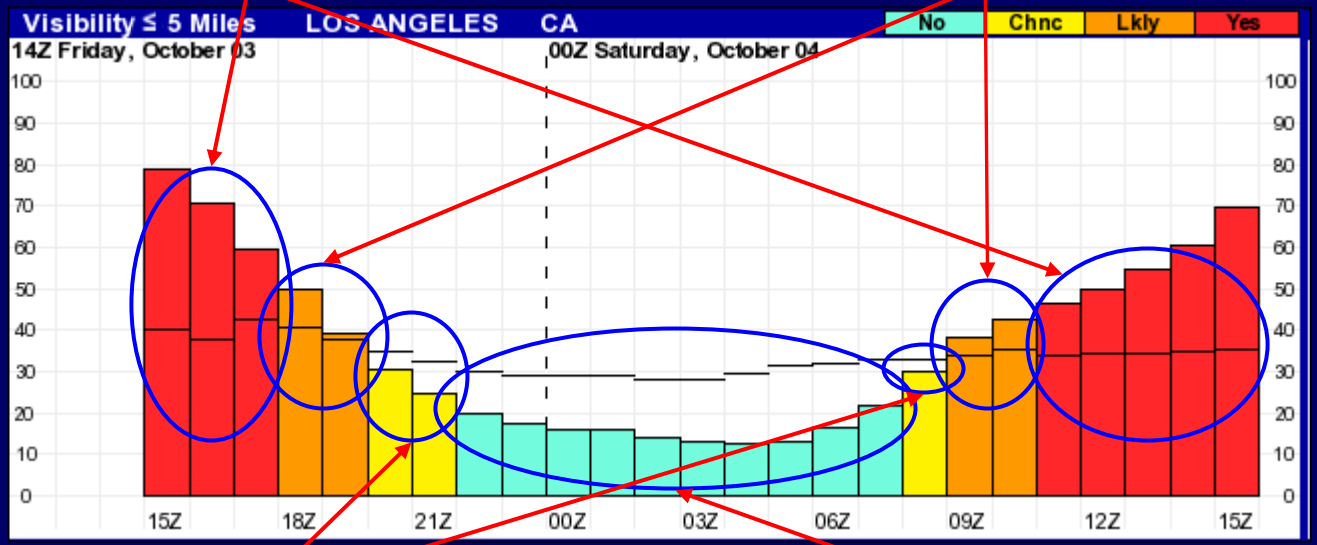


LAMP Probabilities and Thresholds for Flight Categories

Uncertainty Plot Tab – looking at vis ≤ 5 miles

Red=Yes
Probability exceeds threshold by more than 10%

Orange=Likely
Probability exceeds threshold but NOT by more than 10%

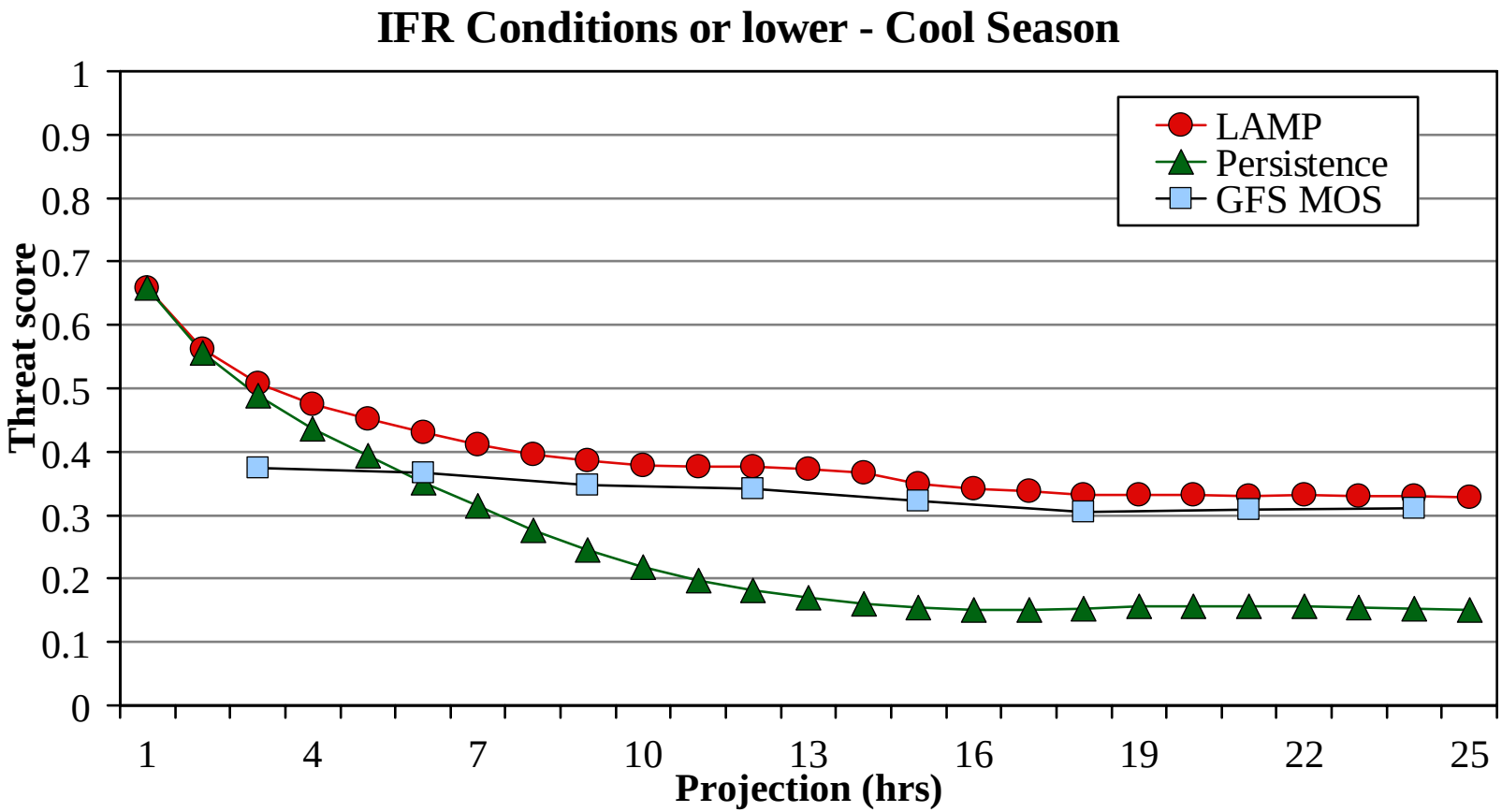


Yellow = Chance
Probability is less
than t
wi

Cyan = No
Probability is less

Note that this shows you one condition (e.g., vis ≤ 5 miles). To determine the most likely condition, you should consider rarer conditions first.

Verification

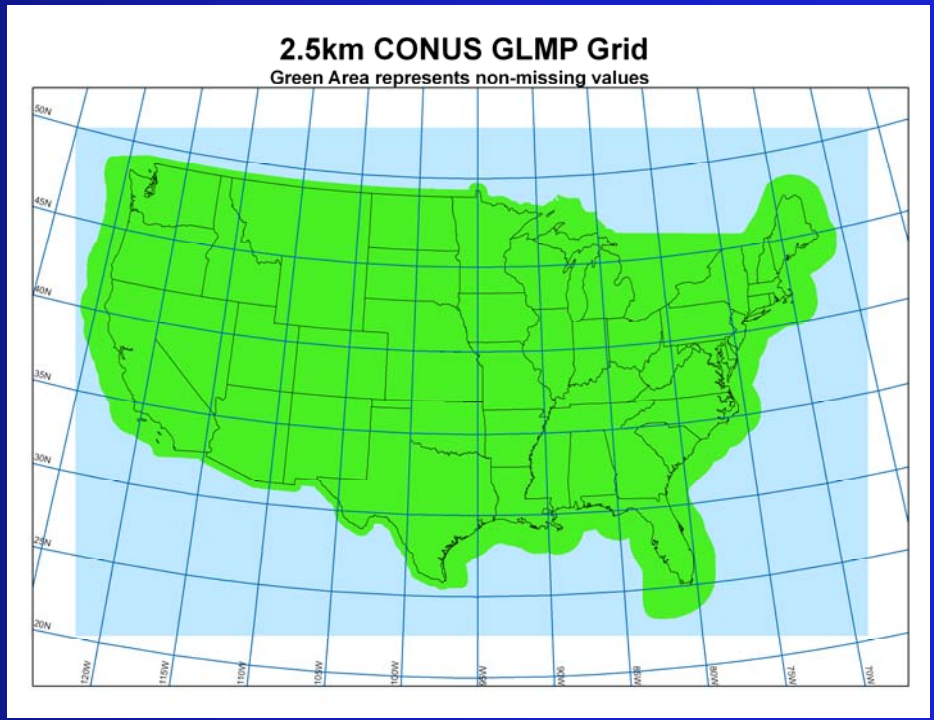


1522 stations, 0900 UTC LAMP, 0000 UTC GFS MOS

verification period: Oct 2007 – Mar 2008

Gridded LAMP Work

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



- Will be available via the NextGen 4-D Data Cube

- Status:
  - Running experimentally at NCEP as of 9/28/2010
  - Available in Experimental NDGD
  - Images available on MDL/LAMP web page

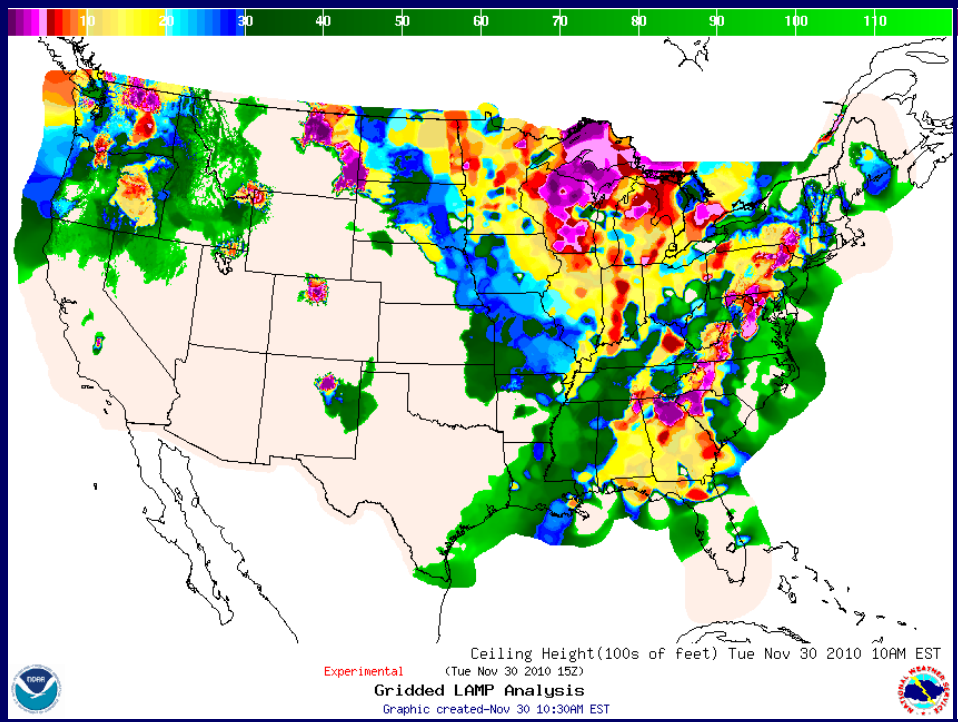
Gridded LAMP Work

- 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 and Visibility:
    - Observations from METAR
- Gridded Analysis of LAMP **forecasts**
  - Temperature and dewpoint: continuous values are analyzed
  - Ceiling Ht and Vis: categorical values are converted to continuous values

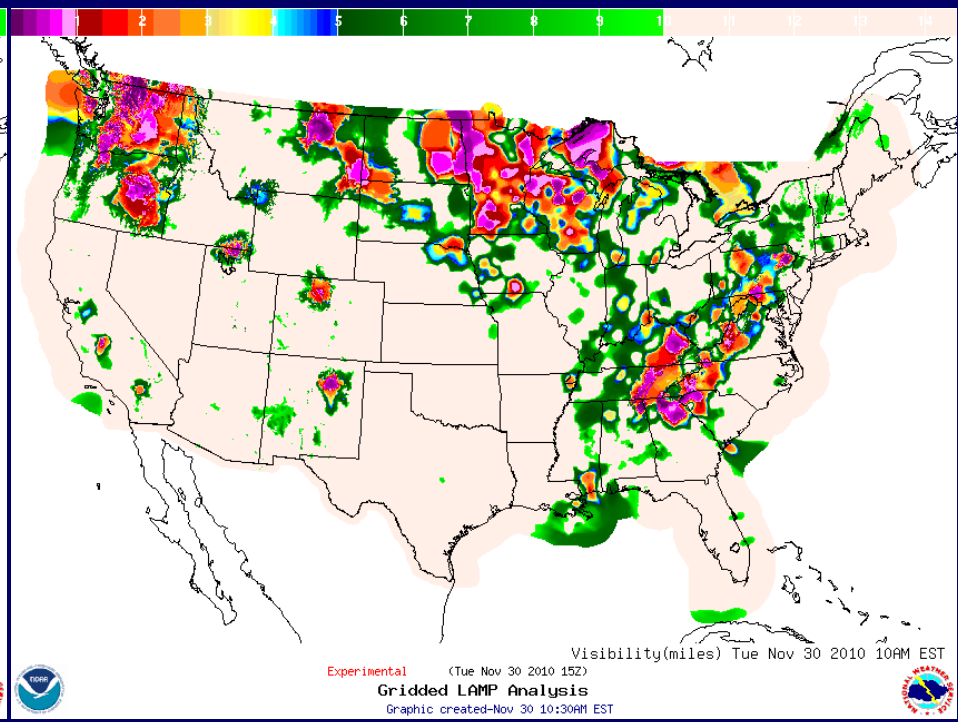
Technique: MDL Gridding Technique used in Gridded MOS, with modifications

Gridded LAMP Work: Gridded Observations

Ceiling Height Observations

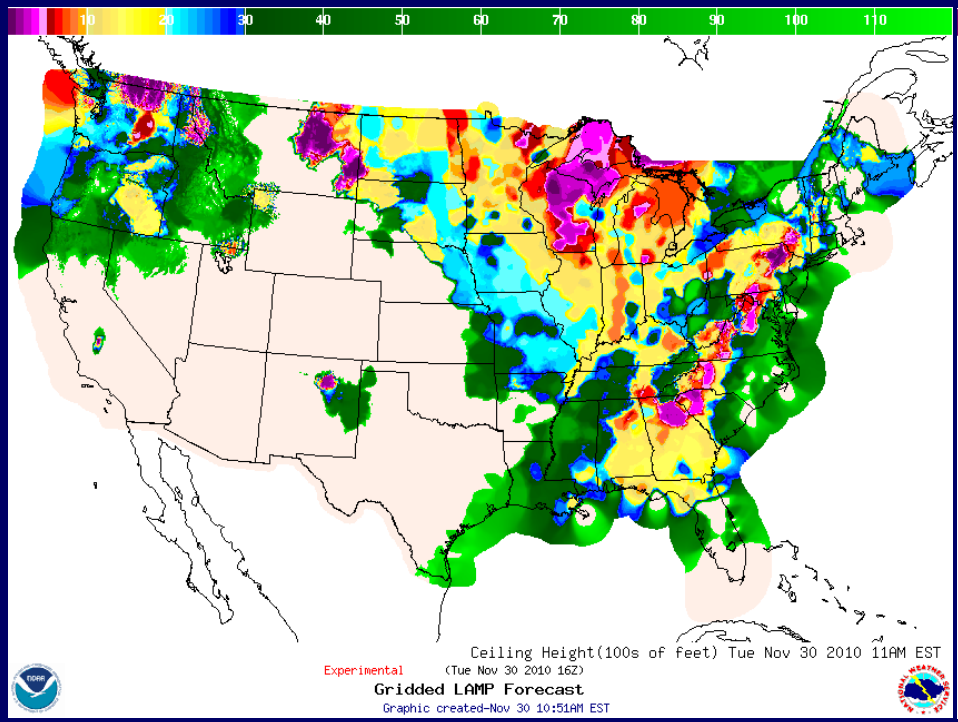


Visibility Observations

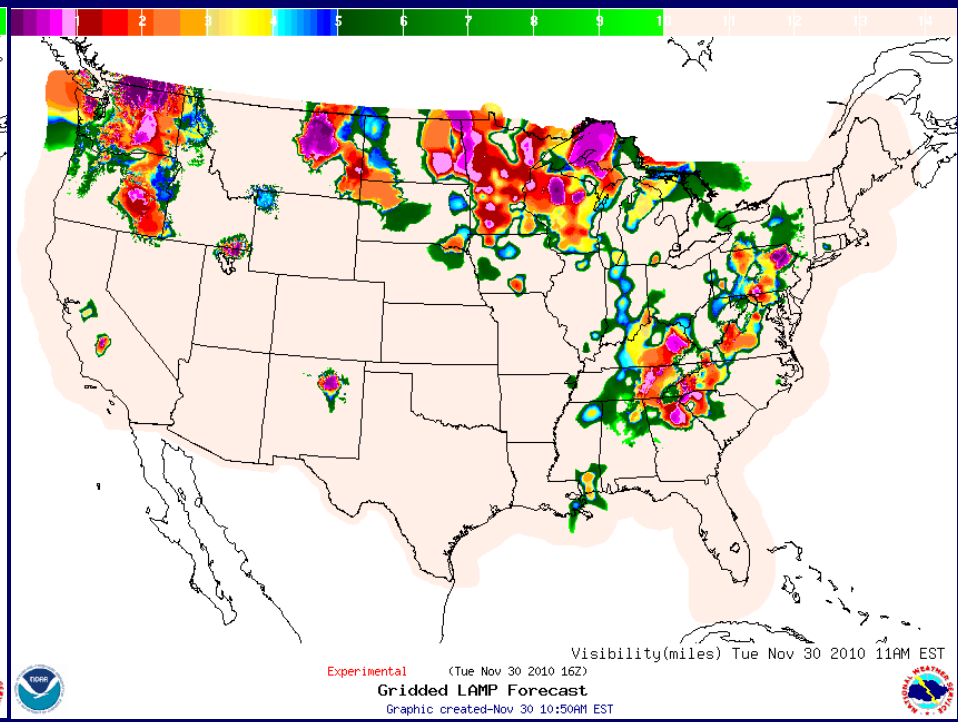


Gridded LAMP Work: Gridded Forecasts

Ceiling Ht Forecasts 1-25 hours



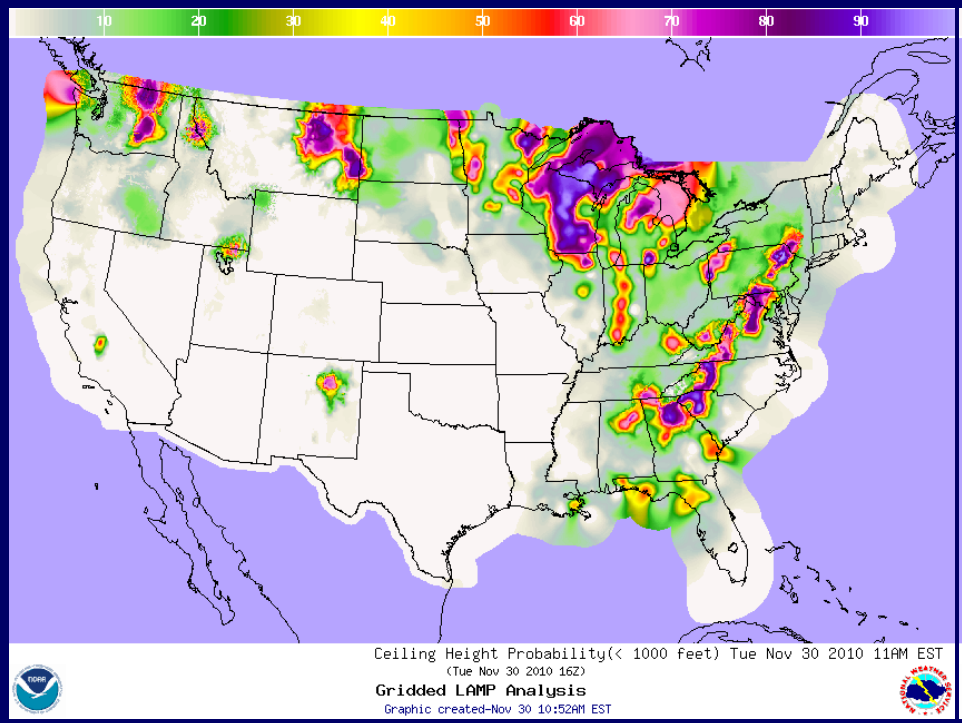
Visibility Forecasts 1-25 hours



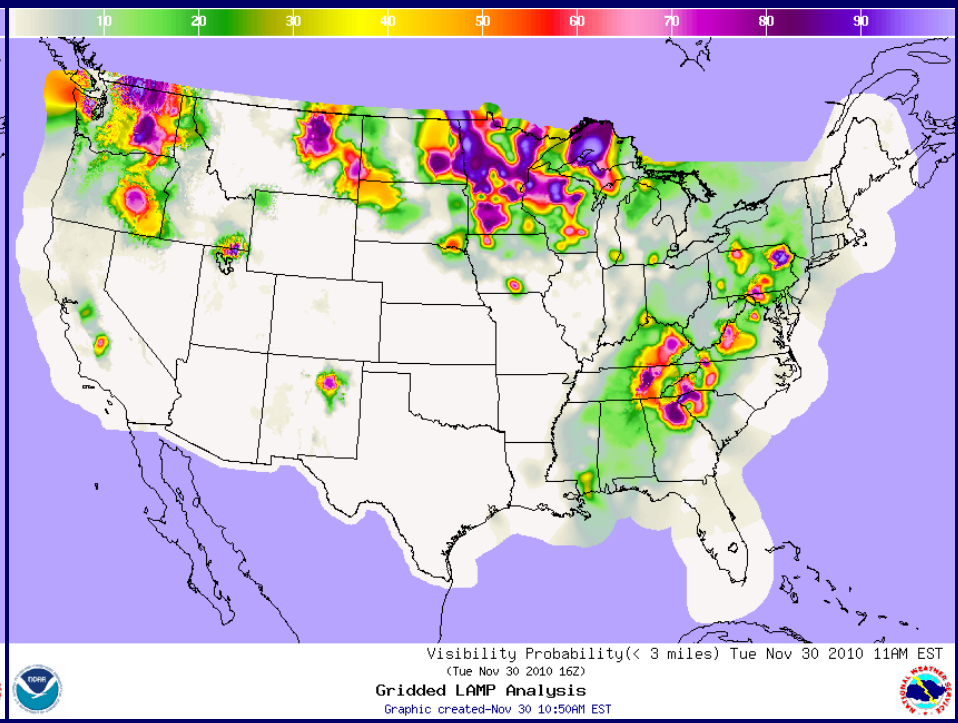
Gridded LAMP Work: Gridded Probability Forecasts

Not yet implemented

Ceiling Ht Prob. Forecasts 1-25 hrs



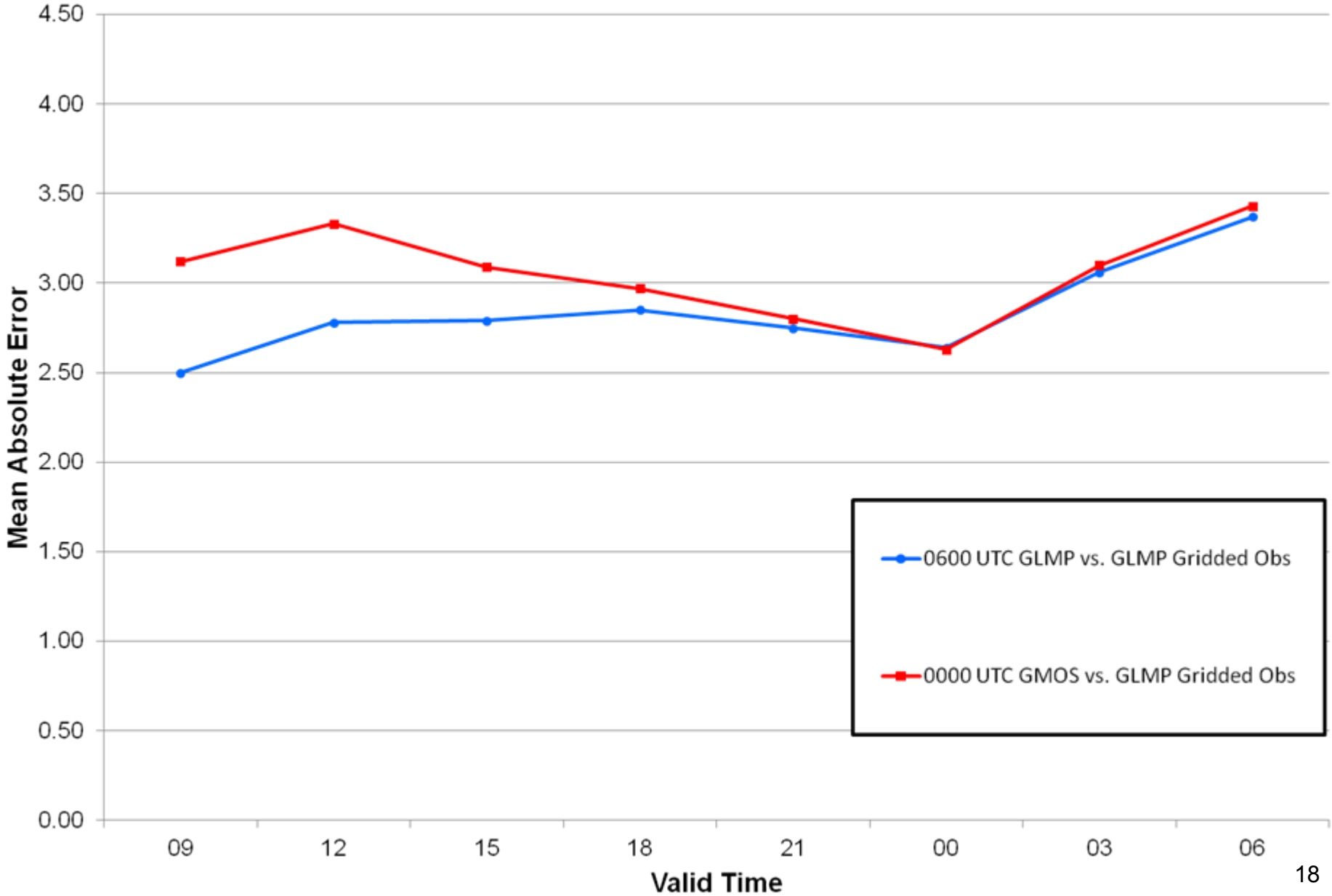
Visibility Prob. Forecasts 1-25 hrs



Gridded LAMP Verification Study

- Compared GLMP vs. GMOS
  - 0600 UTC GLMP vs 0000 UTC GMOS
  - 1800 UTC GLMP vs 1200 UTC GMOS
- Data Sample: November-December 2010 (53/54 days)
- Area: CONUS, 2.5-km grid
- Variables: Temperature and Dew Point
- Verifications using two methods:
  1) GLMP 00-hr gridded observations
  2) RTMA

0600 UTC Gridded LAMP Temperature MAE for All Regions



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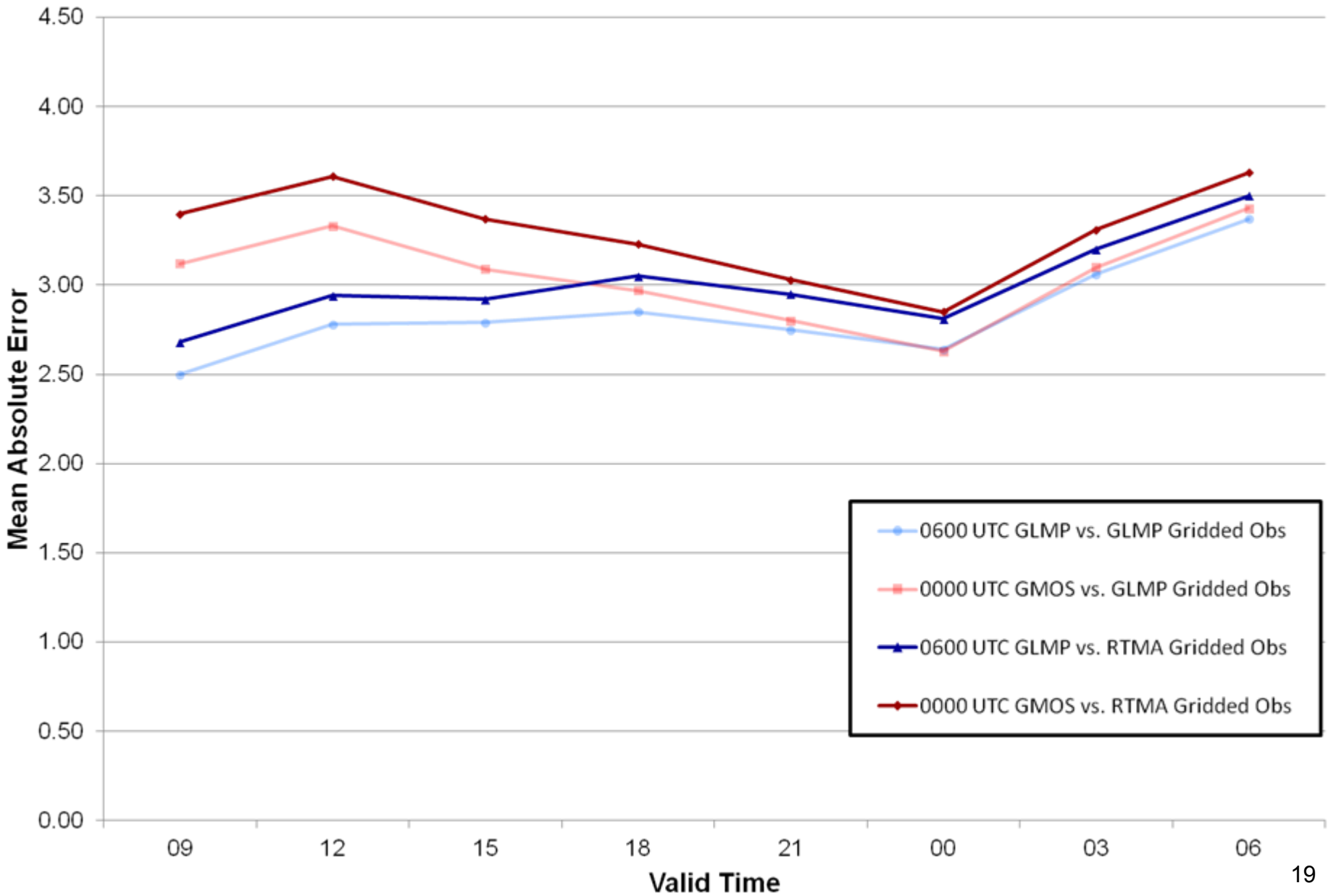

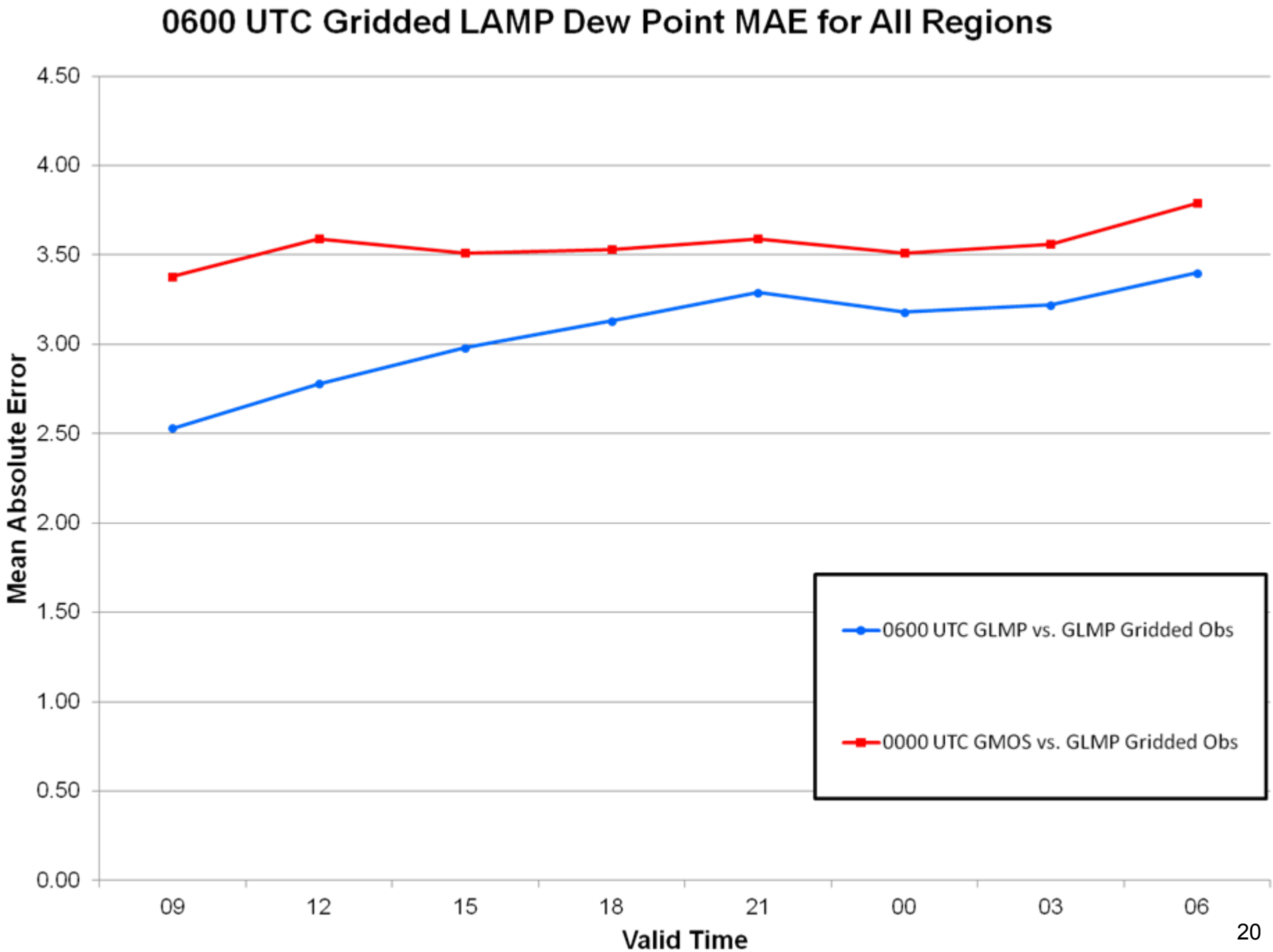
0600 UTC Gridded LAMP Dew Point MAE for All Regions
Mean Absolute Error
4.50
4.00
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3.00
2.50
2.00
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1.00
0.50
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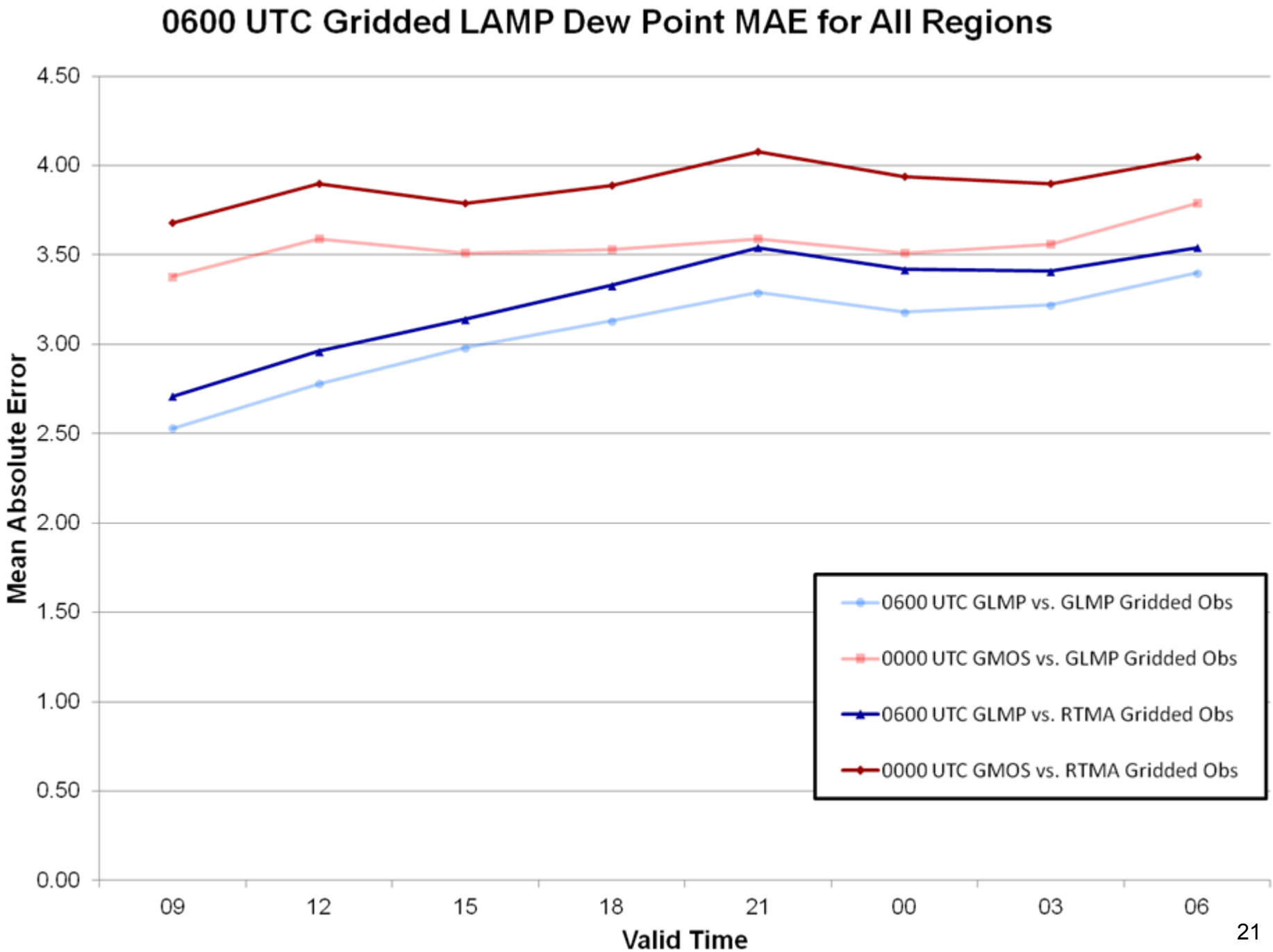
Valid Time
0600 UTC GLMP vs. GLMP Gridded Obs
0000 UTC GMOS vs. GLMP Gridded Obs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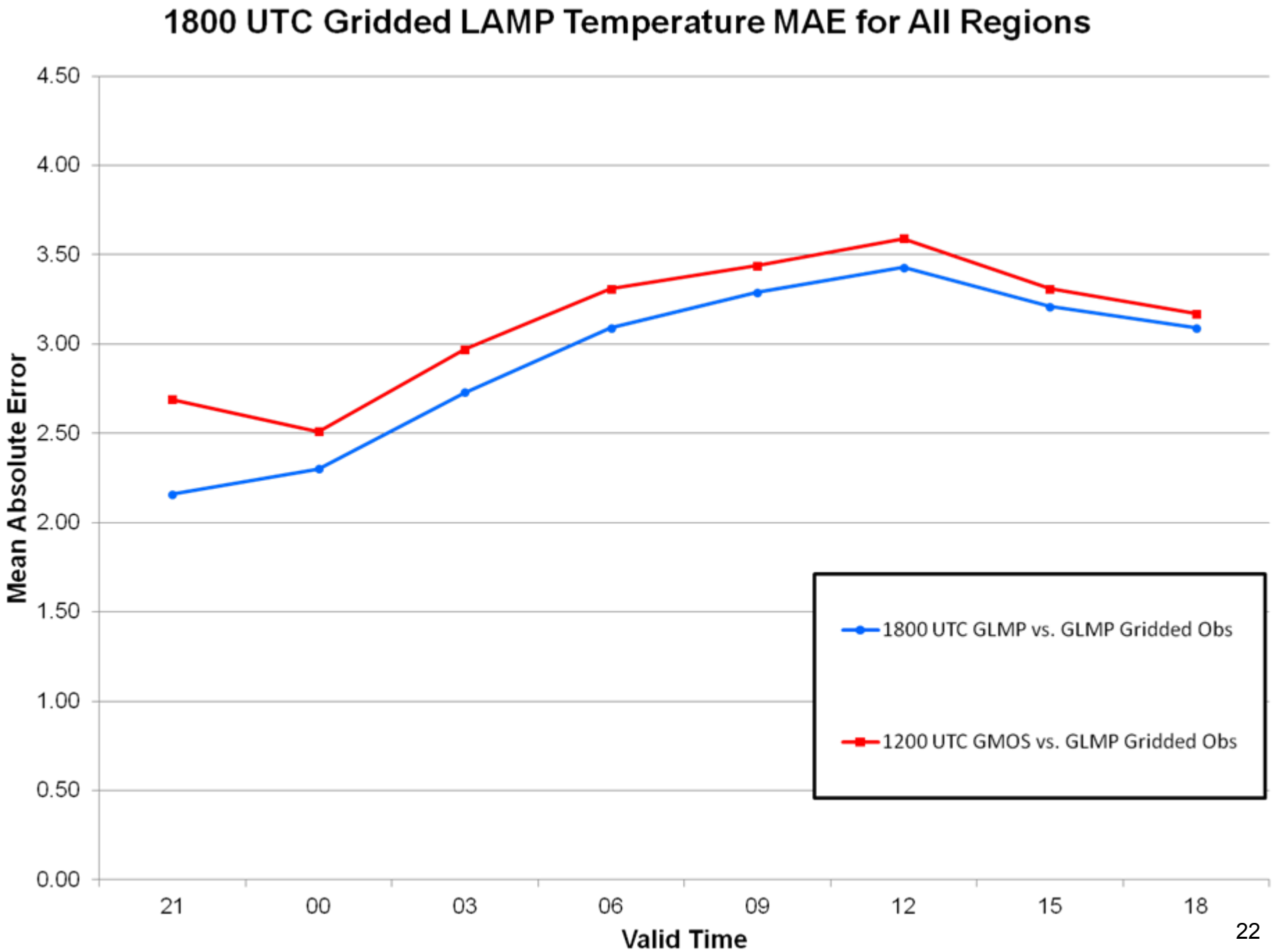
0600 UTC GLMP vs. RTMA Gridded Obs
0000 UTC GMOS vs. RTMA Gridded Obs


1800 UTC Gridded LAMP Temperature MAE for All Regions
Mean Absolute Error
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4.00
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2.00
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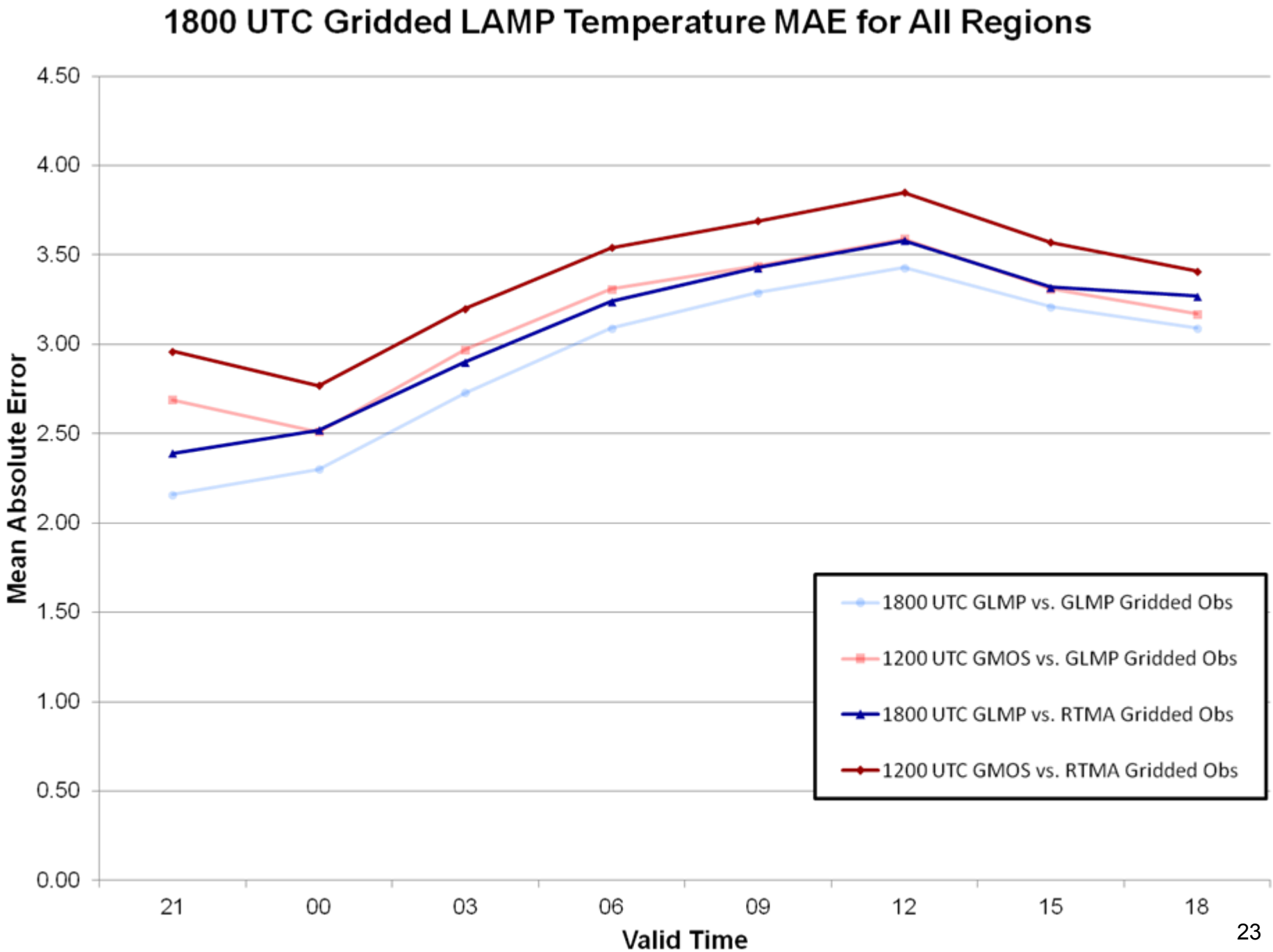
Valid Time
1800 UTC GLMP vs. GLMP Gridded Obs
1200 UTC GMOS vs. GLMP Gridded Obs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Valid Time
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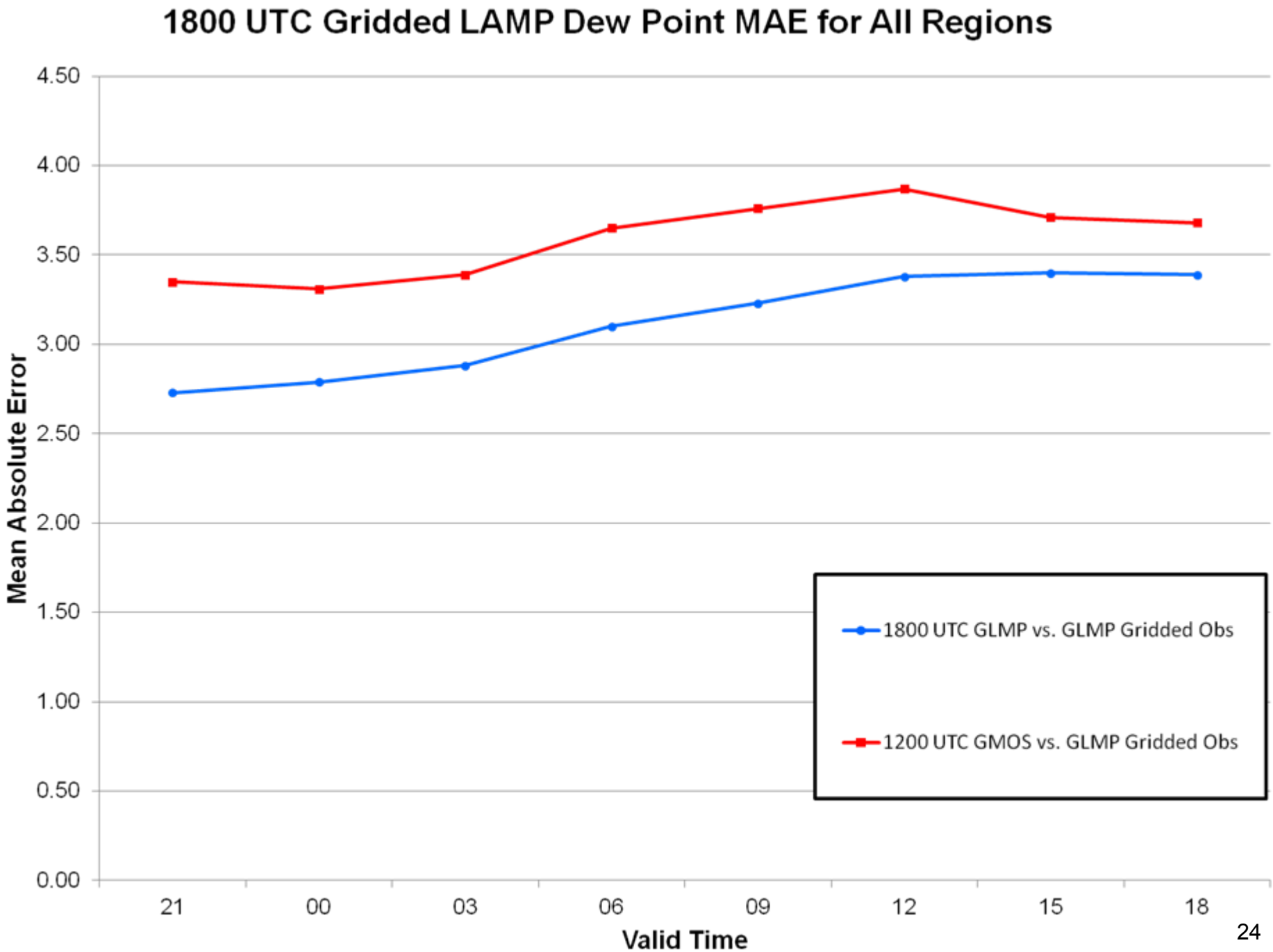
1200 UTC GMOS vs. GLMP Gridded Obs
1800 UTC GLMP vs. RTMA Gridded Obs
1200 UTC GMOS vs. RTMA Gridded Obs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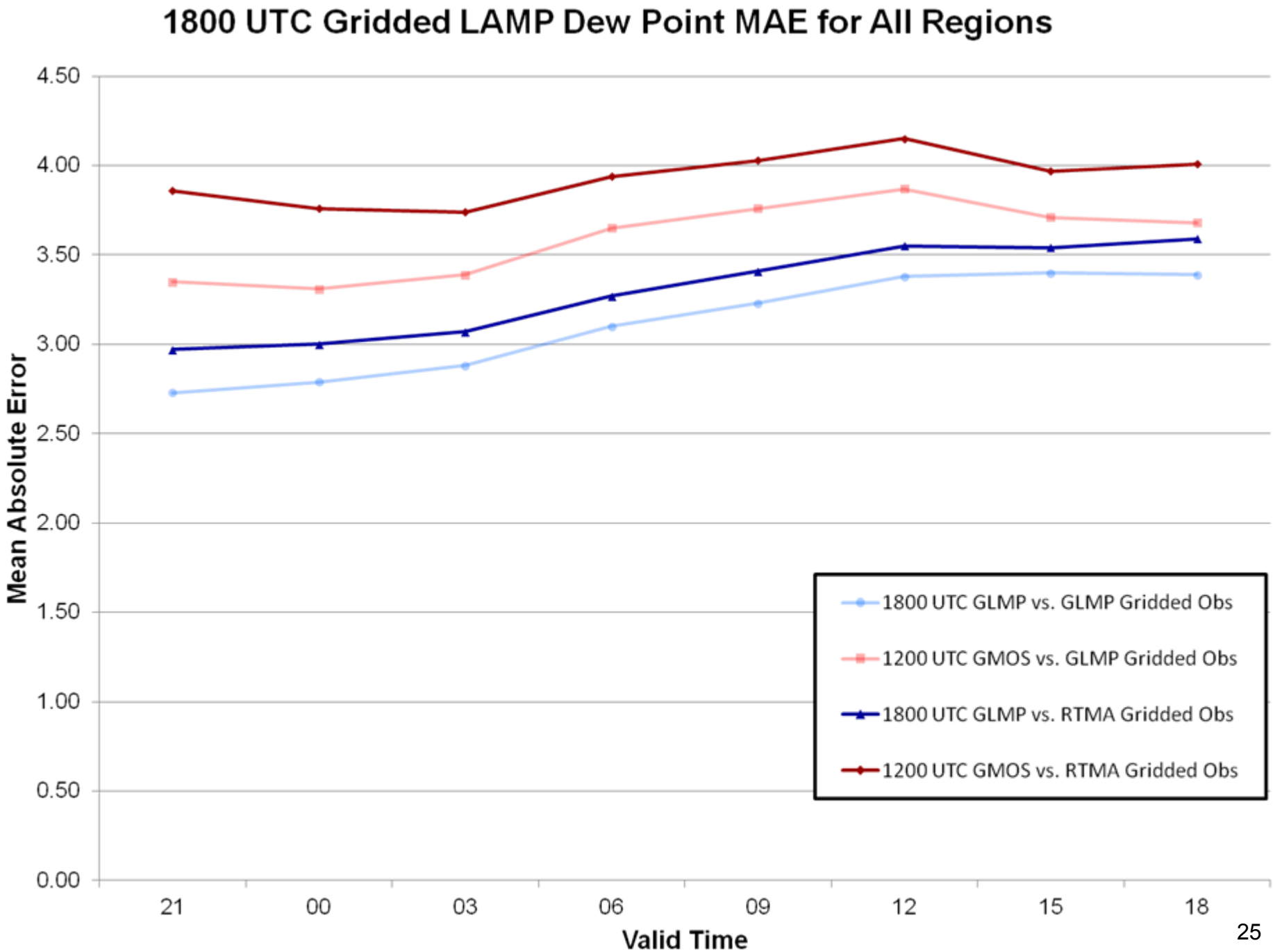
Valid Time
1800 UTC GLMP vs. GLMP Gridded Obs
1200 UTC GMOS vs. GLMP Gridded Obs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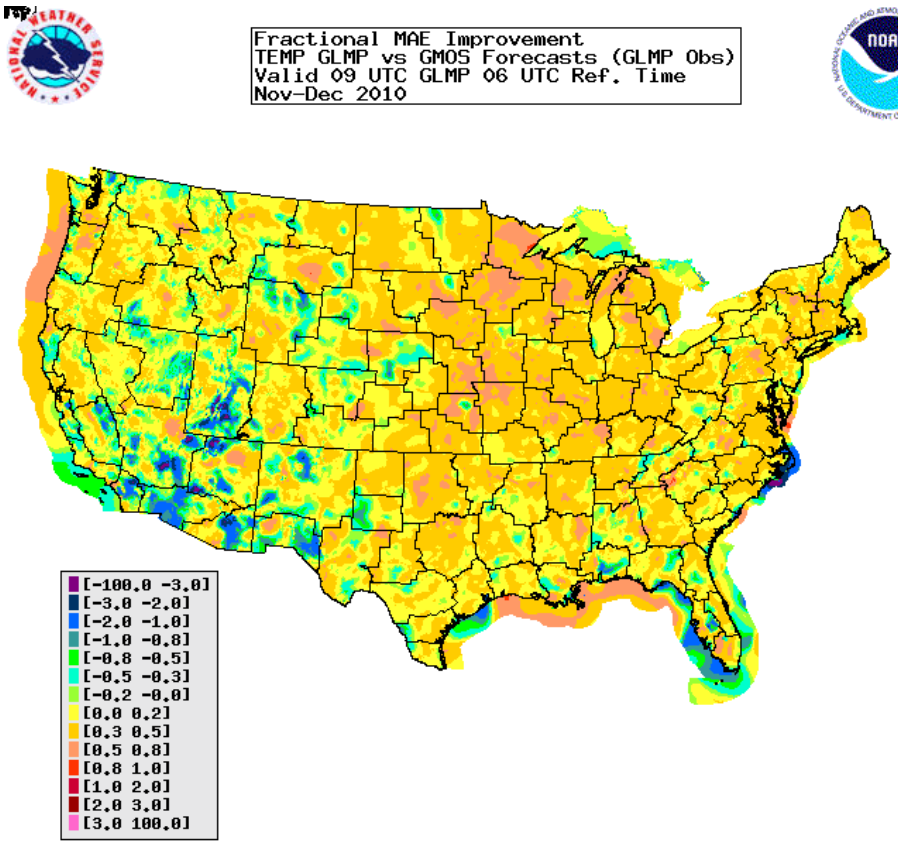
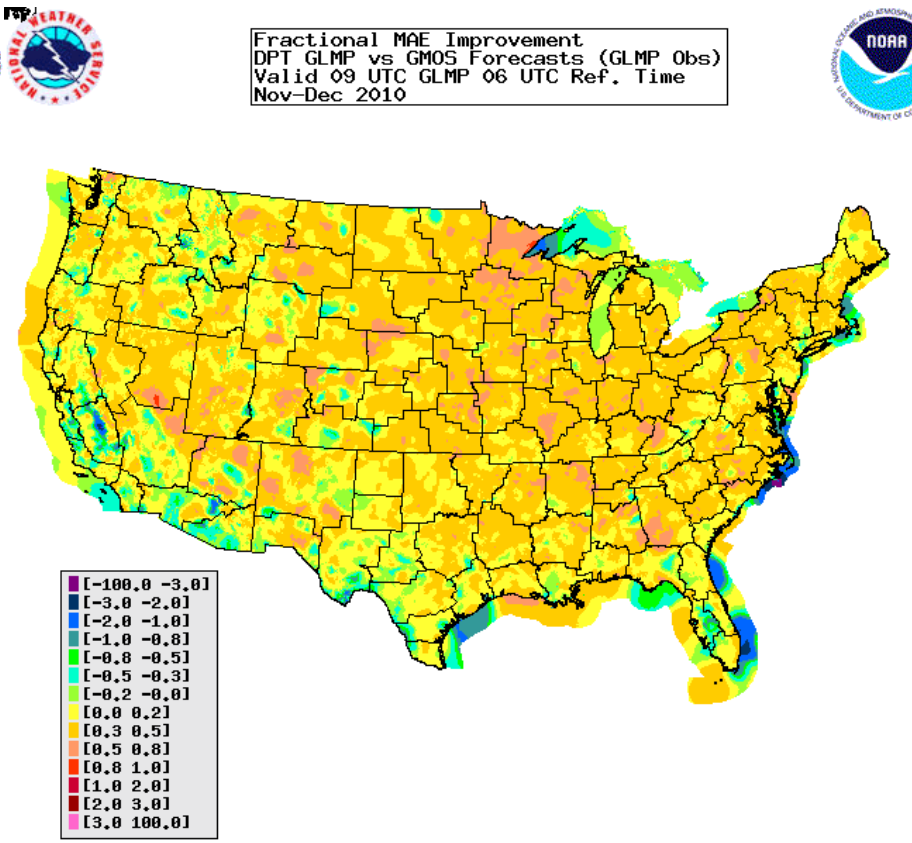
Valid Time
1800 UTC GLMP vs. GLMP Gridded Obs
1200 UTC GMOS vs. GLMP Gridded Obs
1800 UTC GLMP vs. RTMA Gridded Obs
1200 UTC GMOS vs. RTMA Gridded Obs

Gridded Verification
Verifying Obs: Gridded LAMP obs



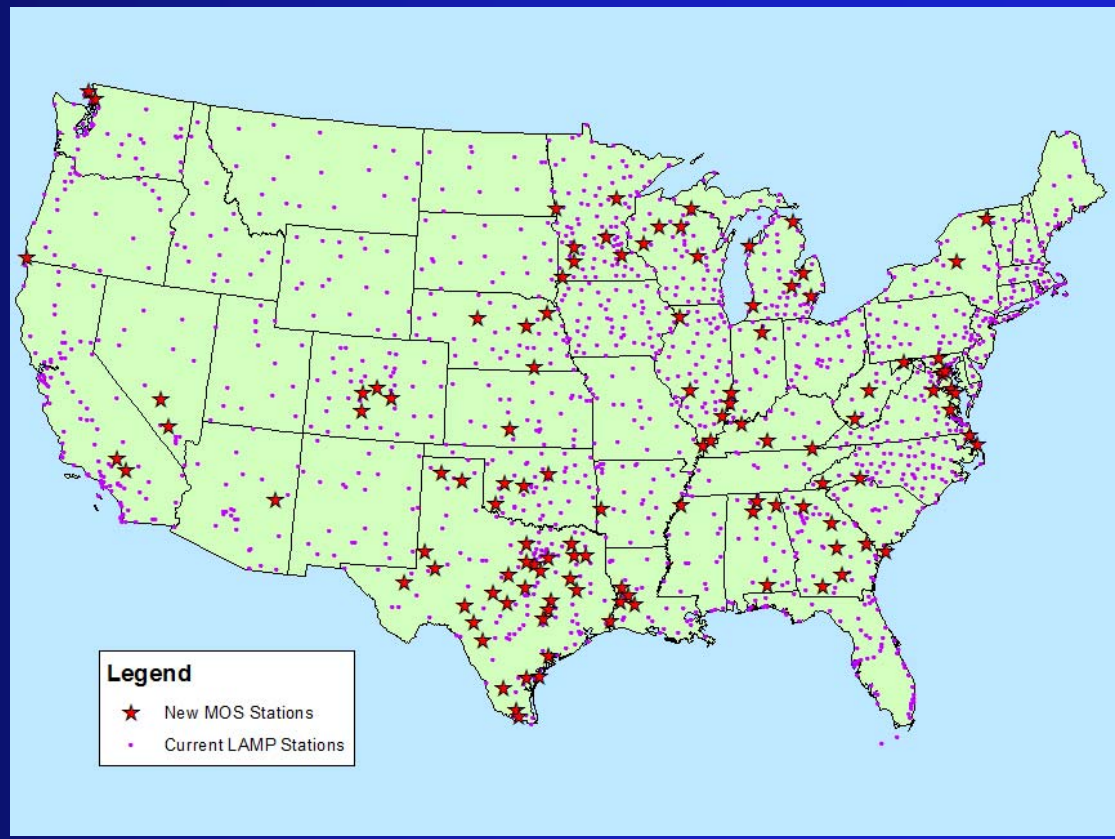
0600 UTC GLMP – 03 HR Projection
Temperature



0600 UTC GLMP – 03 HR Projection
Dewpoint

Gridded Verification
Ceiling and Visibility verified at Stations

- No Gridded ceiling/visibility verifying observations other than from Gridded LAMP
- Verifying at stations
  - At LAMP stations
  - At non-LAMP stations
- Verification study in progress



Future Work: New LAMP Convective Guidance

Thunderstorm (current)

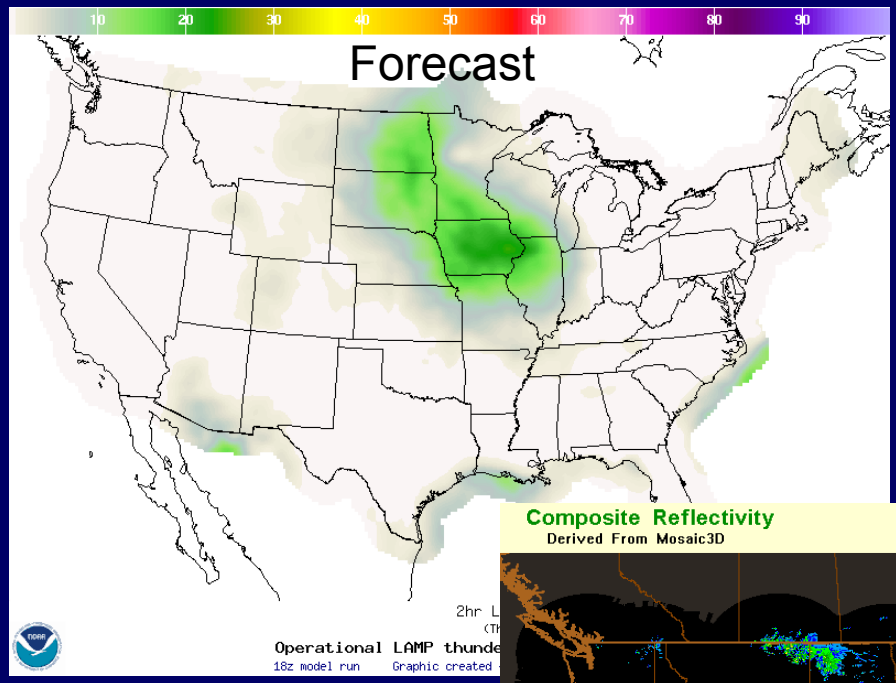
- Features:
  - Defined from Cloud-to-Ground (CTG) ltg
  - GFS MOS 3-h thunderstorm probability predictors
  - 2-h period / 20-km gridboxes
  - 1-h cycle; 3 – 25 h projections
  - Other predictors
- Criticisms:
  - Convection can occur without lightning
  - Thunderstorm probabilities lack sharpness

Convection (future)

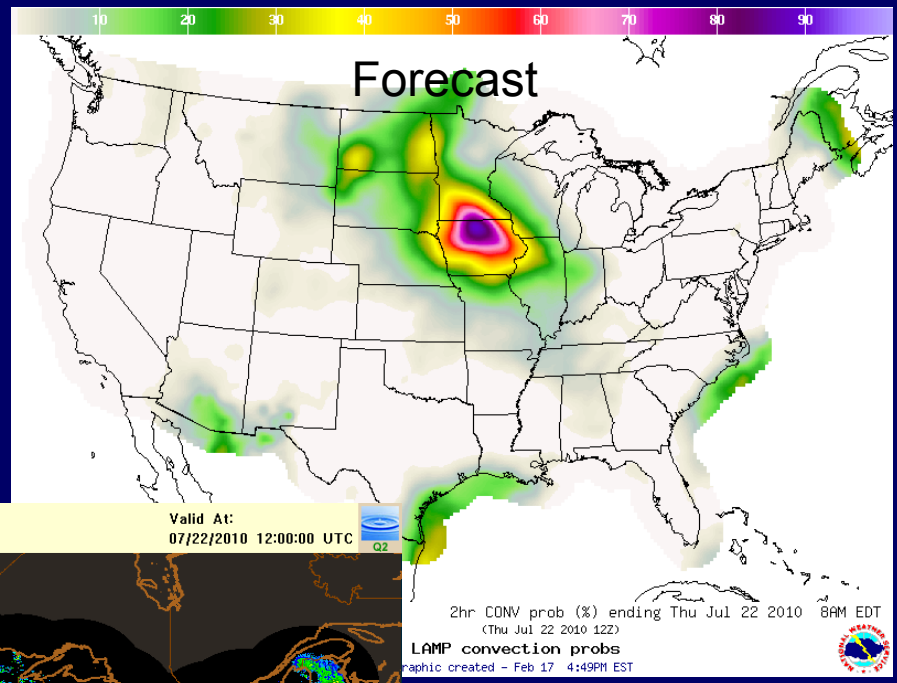
- Features:
  - Defined from CTG ltg / ≥ 40 dBZ radar reflectivity
  - GFS & NAM MOS 2-h convective probability predictors
  - 2-h period / 20-km gridboxes
  - 1-h cycle; 3 – 25 h projections
  - Other predictors
- Solution:
  - Convection can be indicated when there is little or no lightning
  - Convection probabilities exhibit good sharpness

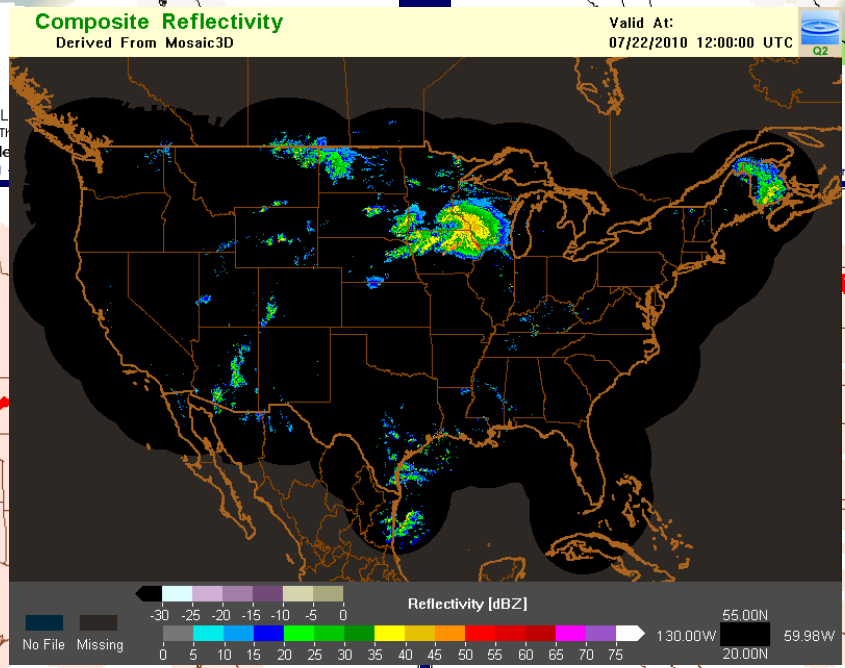
18-h LAMP probabilities and verification from 1800 UTC 21 Jul 2010

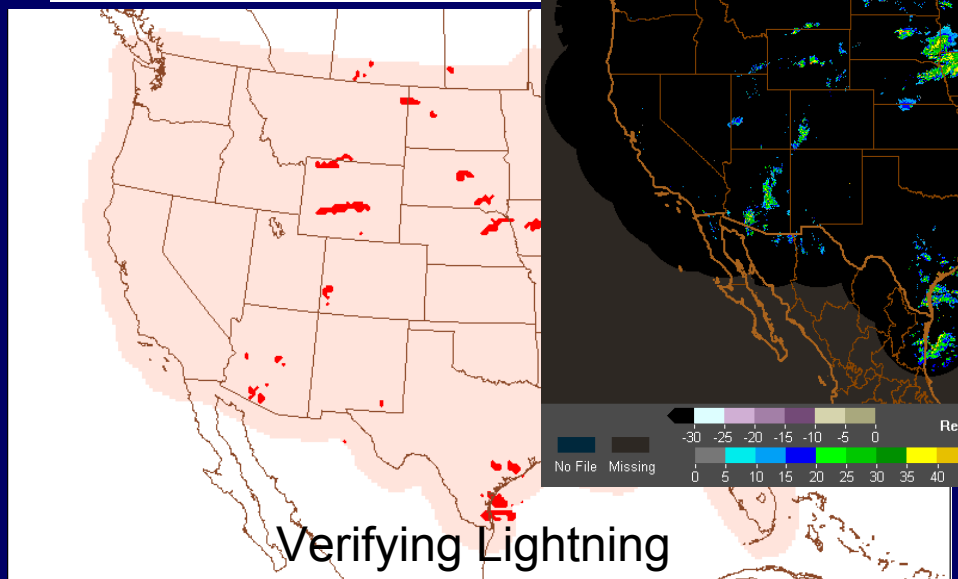
LAMP Lightning Product



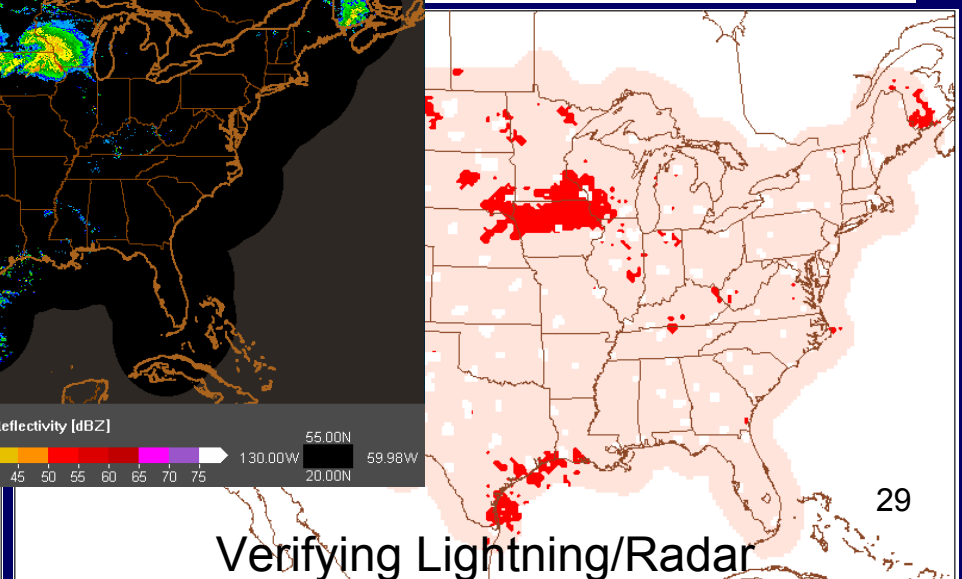
LAMP Convection Product







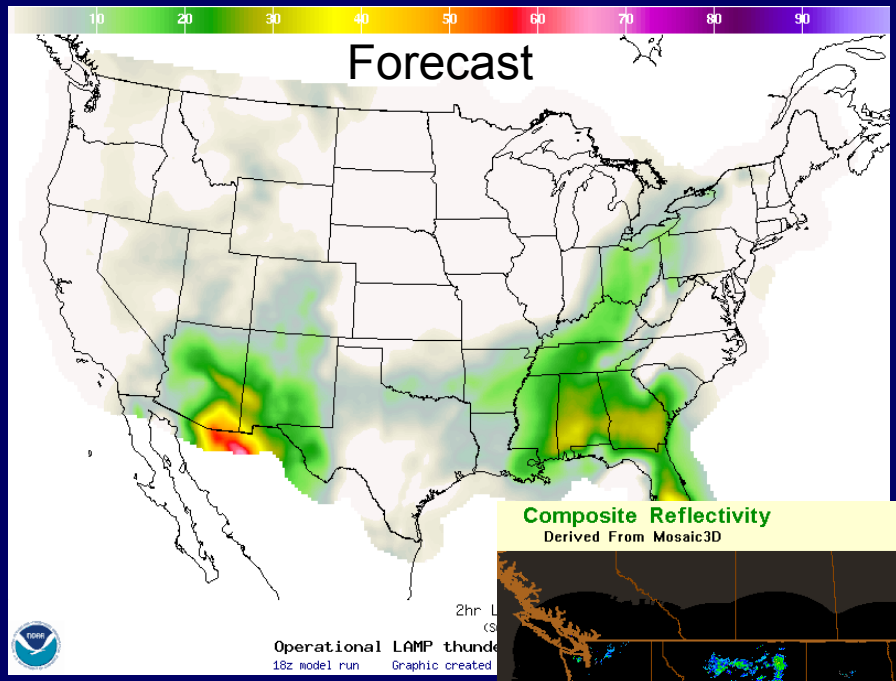
Verifying Lightning



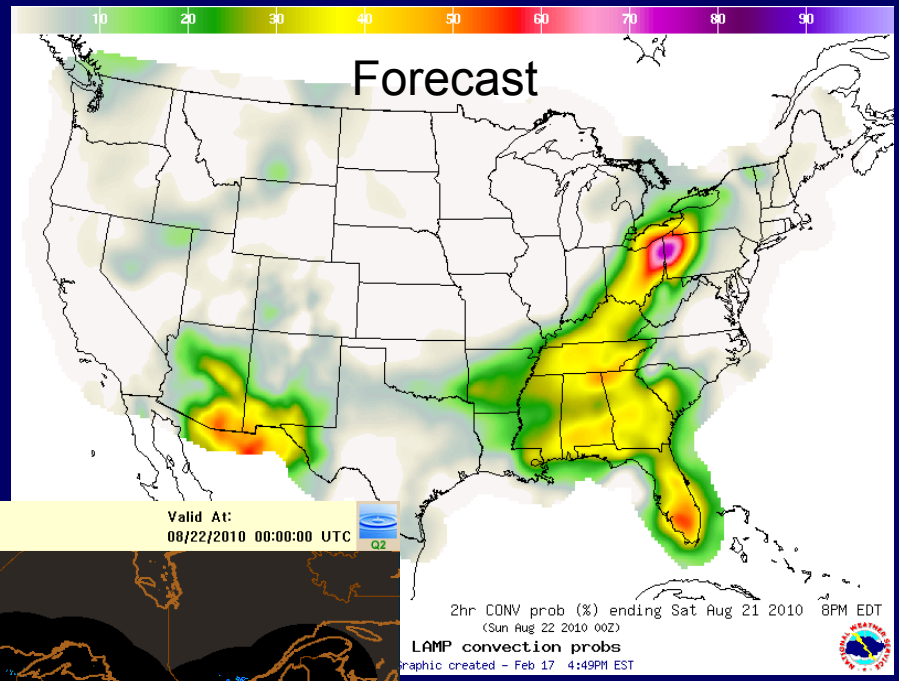
Verifying Lightning/Radar

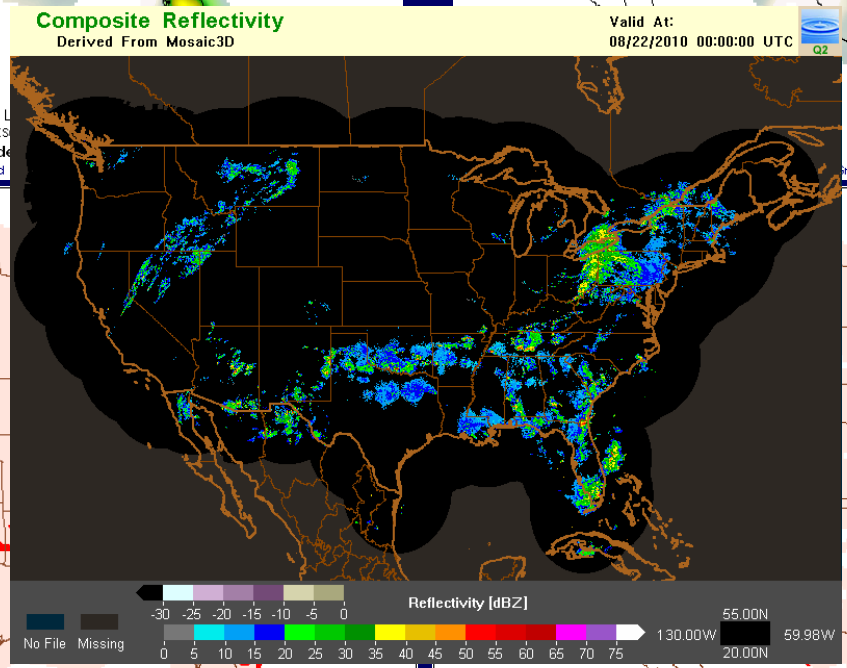
6-h LAMP probabilities and verification from 1800 UTC 21 Aug 2010

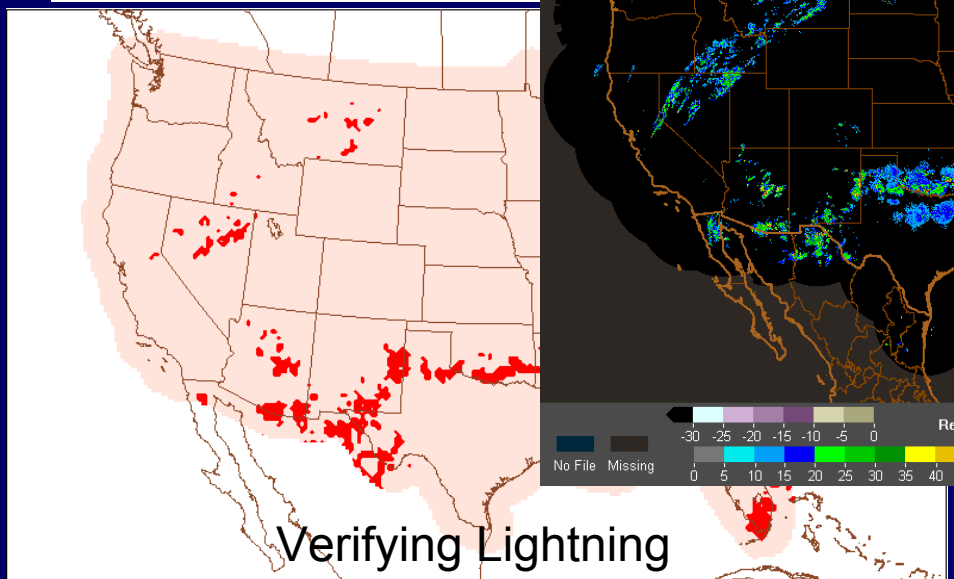
LAMP Lightning Product



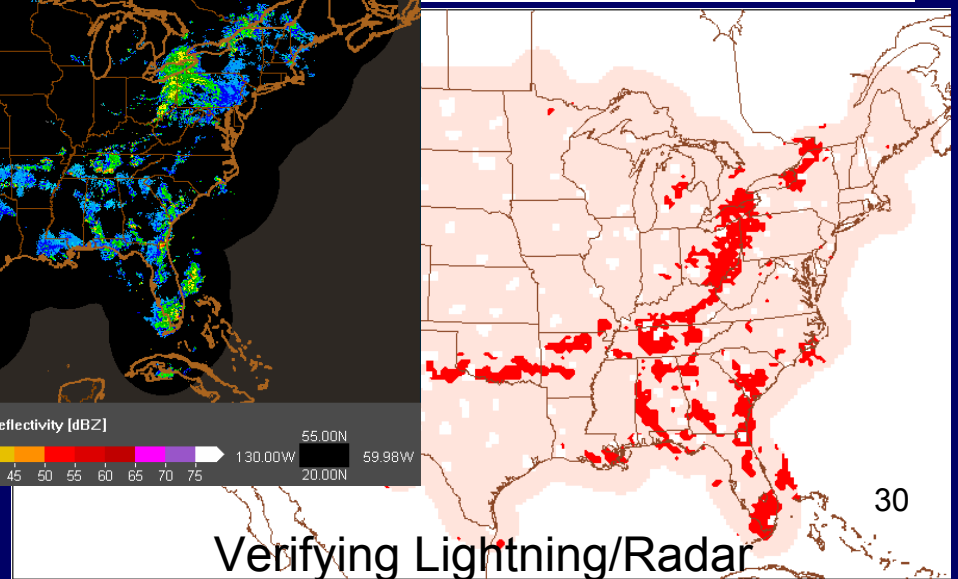
LAMP Convection Product







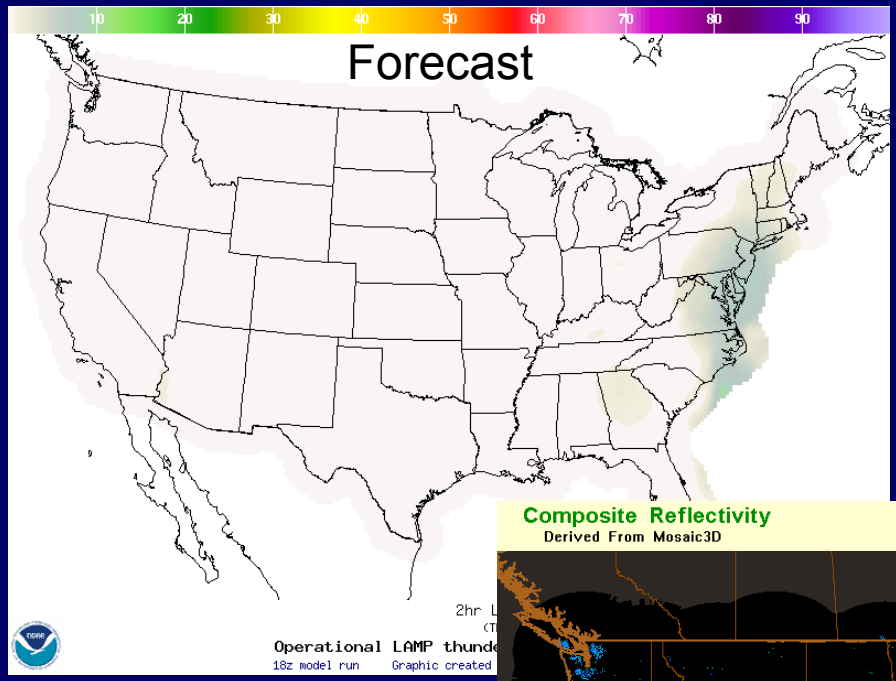
Verifying Lightning



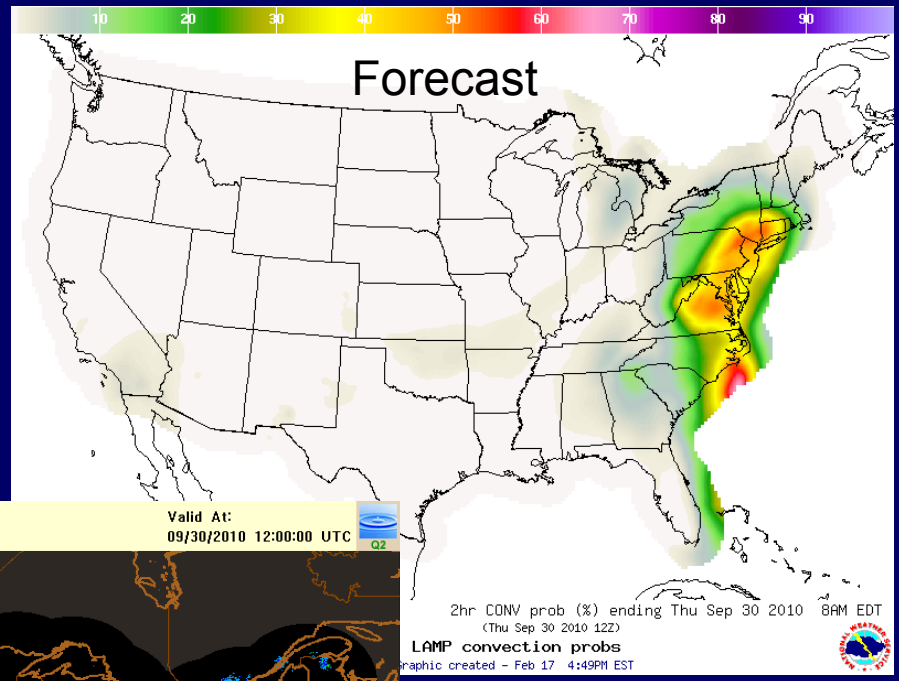
Verifying Lightning/Radar

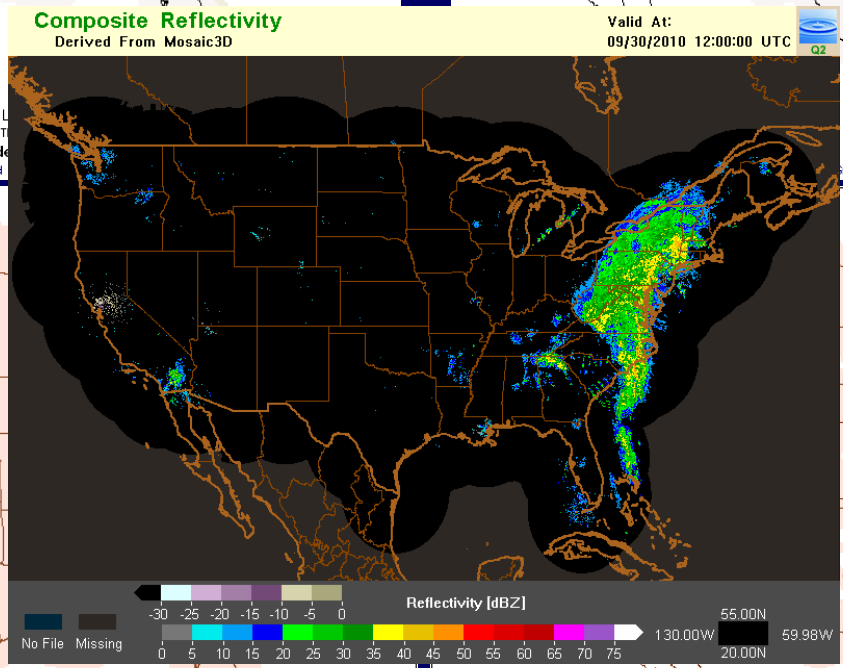
18-h LAMP probabilities and verification from 1800 UTC 29 Sep 2010

LAMP Lightning Product



LAMP Convection Product





Verifying Lightning

Verifying Lightning/Radar

Future Work: NextGen Airport Forecast System (NGAFS)

- New Grant with Pennsylvania State University to provide high resolution numerical prediction model data to produce model interpretation for aviation forecasting
- Initial target area around KLGA
- Would produce LAMP-like system forecasting 6-12 hours out
- To demonstrate that better aviation weather terminal forecasts can be produced by a judicious combination of a state-of-the-art fine scale model and appropriate postprocessing
- Develop the process such that, when successful, it can be developed for all US airports

Figure courtesy of the Proposal for a Cooperative Agreement: "A NextGen Airport Forecast System (NGAFS)" by Dr. David Stauffer, PI and Dr. Nelson Seaman, Co-PI, 2010

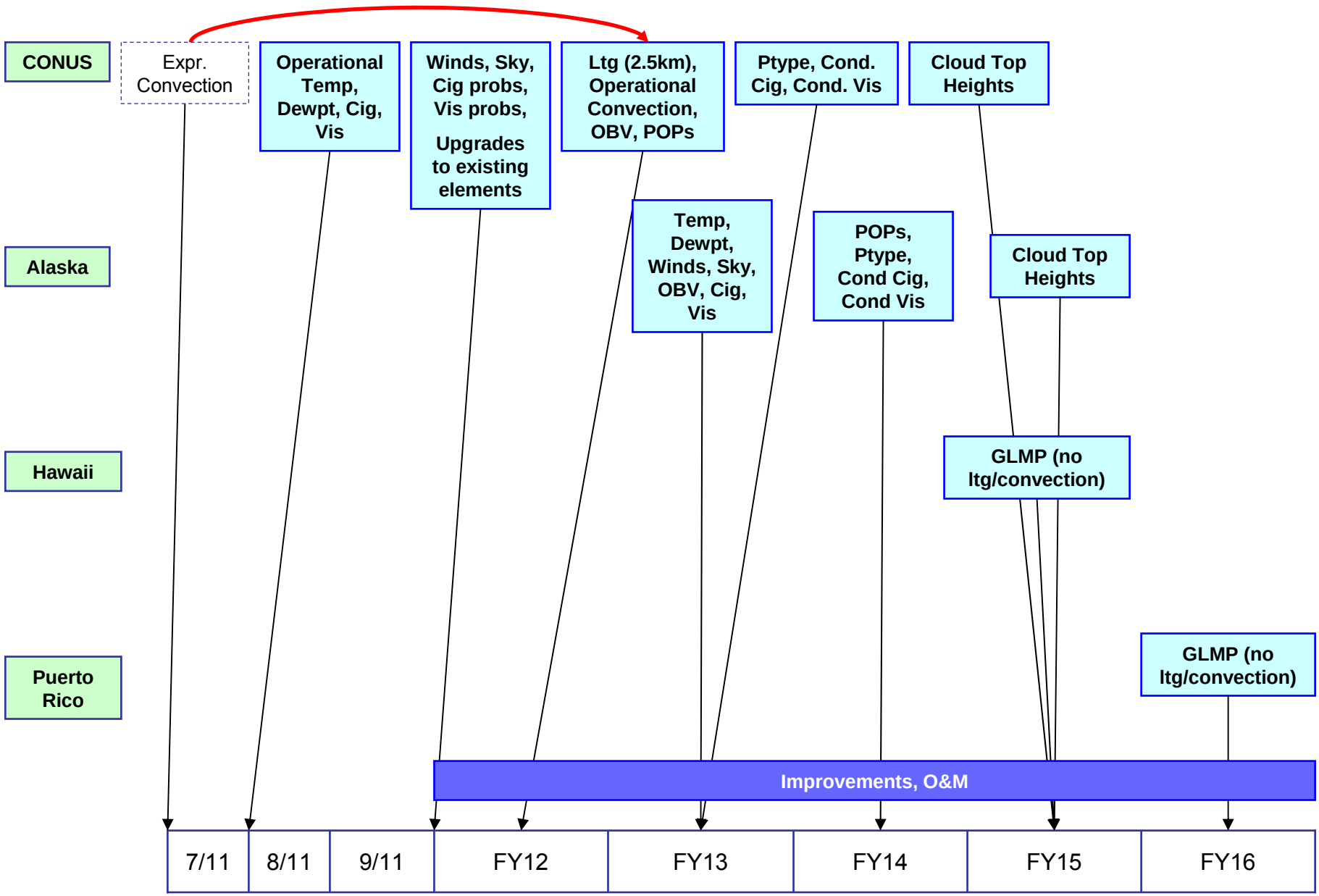
NGAFS: 5-YEAR PLAN

- Apply the WRF model at 1-km resolution over the New York area (covers 3 major airports)
- Build a multi-year sample of data
- Apply MOS and produce aviation weather variables in real time
- Coordinate with NWS Eastern Region in the production of TAFs
- Comparatively verify with other existing techniques
  - LAMP
  - TAFs

LAMP Future Plans: FY11-FY12

- Station work:
  - Add 119 stations to match those which were added to GFS MOS 03/2010
  - Test the effects of adding Canadian and marine stations to help Gridded LAMP products. (Additional stations should benefit Gridded LAMP products)
  - Redevelop LAMP station guidance of ceiling height and opaque sky cover
  - Forecast Consistency
    - Minimize temporal inconsistencies for aviation weather elements
    - Remove all inter-element inconsistencies
- Gridded Work:
  - Verify grids
  - Add ceiling height and visibility probabilities
  - Test/revise temperature and dewpoint GLMP scheme
  - Add sky cover, winds, obstruction to vision
- New LAMP Convection product

Plan: Phased-in Implementation Schedule for Gridded LAMP



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