

# Improving Gridded Localized Aviation MOS Program (LAMP) Guidance by Using Emerging Forecast and Observation Systems

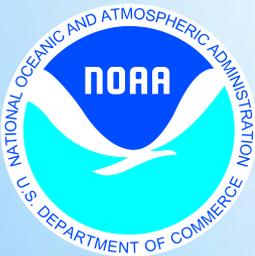
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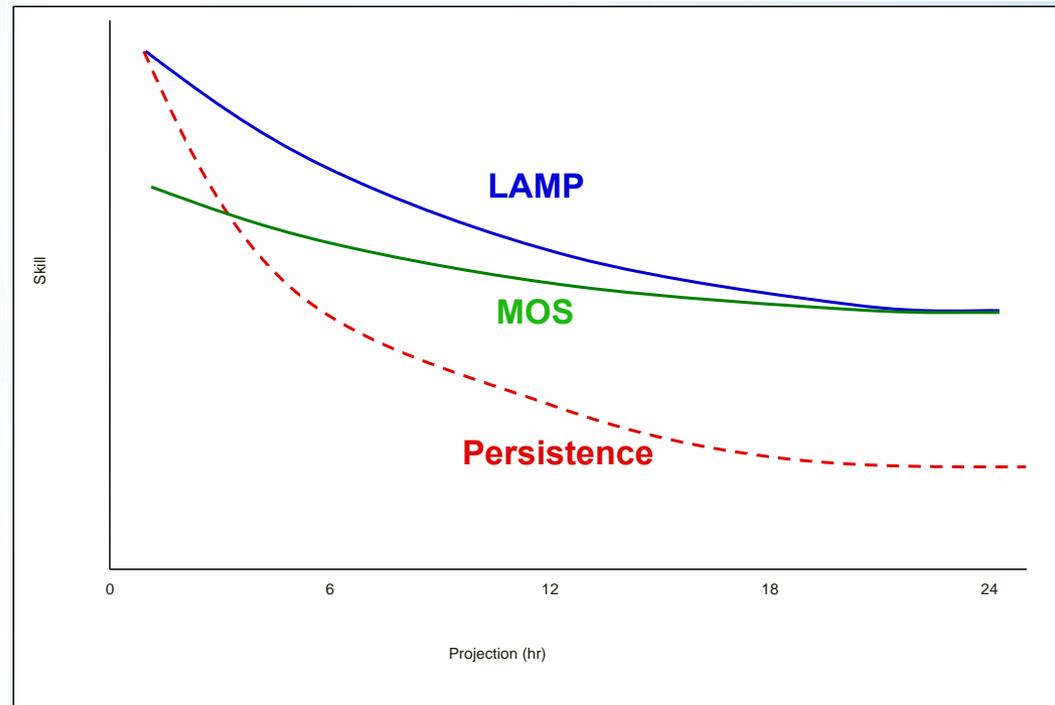


# Outline

- LAMP Convection, Lightning, Ceiling Height and Visibility: Background and Challenges
- Newly available datasets available to meet the challenges
- Preliminary verification of merging LAMP with HRRR for visibility
- Future work

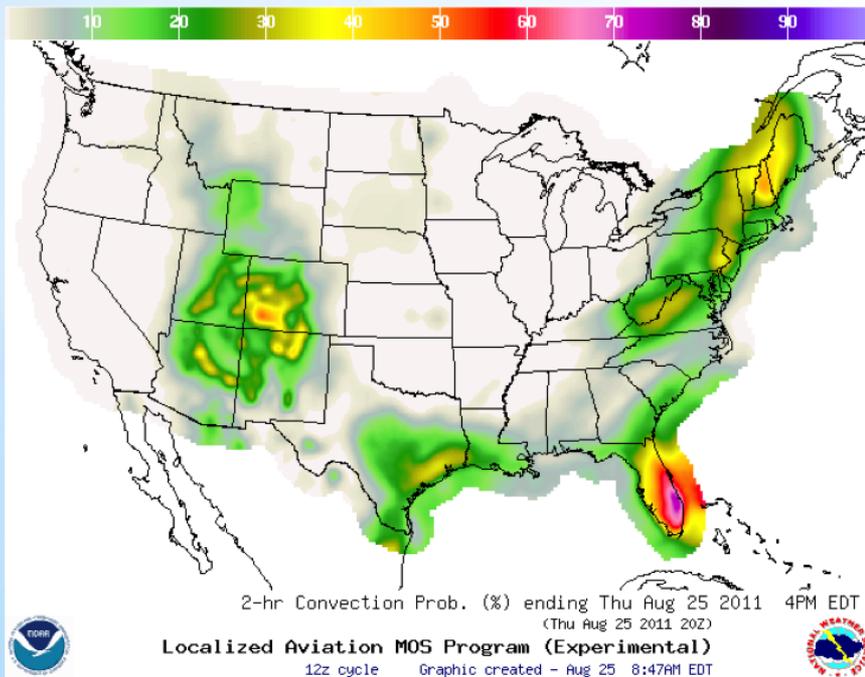
# Localized Aviation MOS Program (LAMP) Background

- 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 MOS guidance
- LAMP bridges the gap between the observations and the MOS forecast
- LAMP outperforms persistence in the early period and trends towards MOS at the end of the period
- LAMP guidance covers the short-range period of 1- 25 hours
- Runs every hour in NWS operations

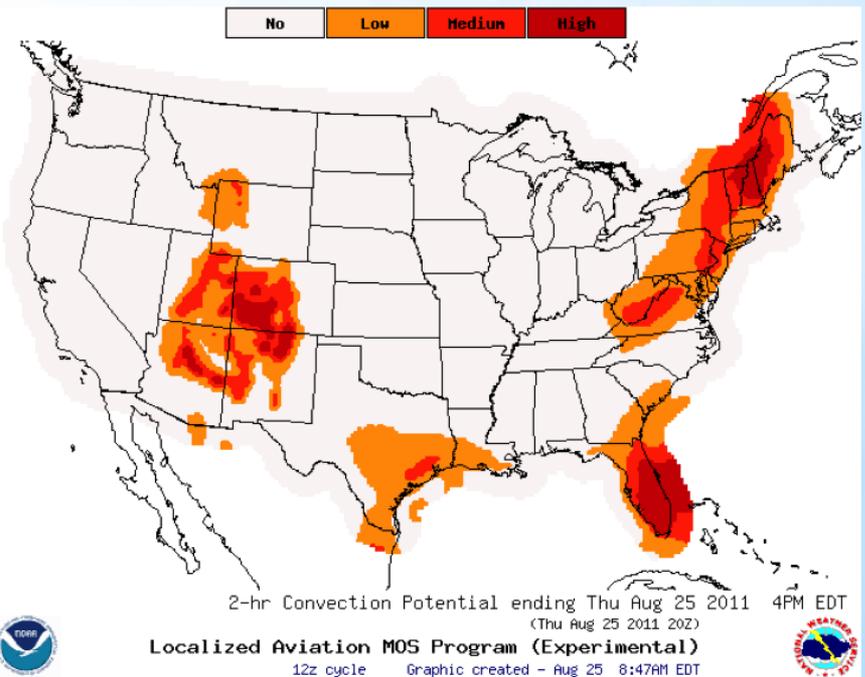


# LAMP: Convection and Lightning Guidance

- Lightning Predictand: at least 1 Cloud to Ground (CG) lightning strike in a 2-hr period
- Convection Predictand: at least 1 CG lightning strike in a 2-h period **and/or** radar reflectivity of  $\geq 40$  dBZ
- Equations are developed on a grid
- The guidance is **produced on a grid** and interpolated to stations for inclusion in LAMP text bulletin



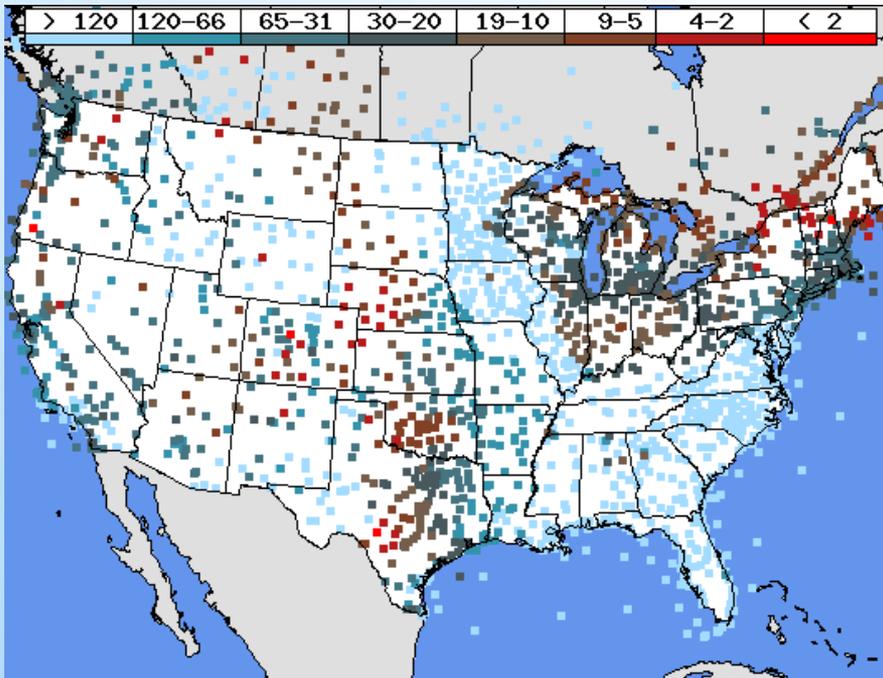
Convection Probabilities



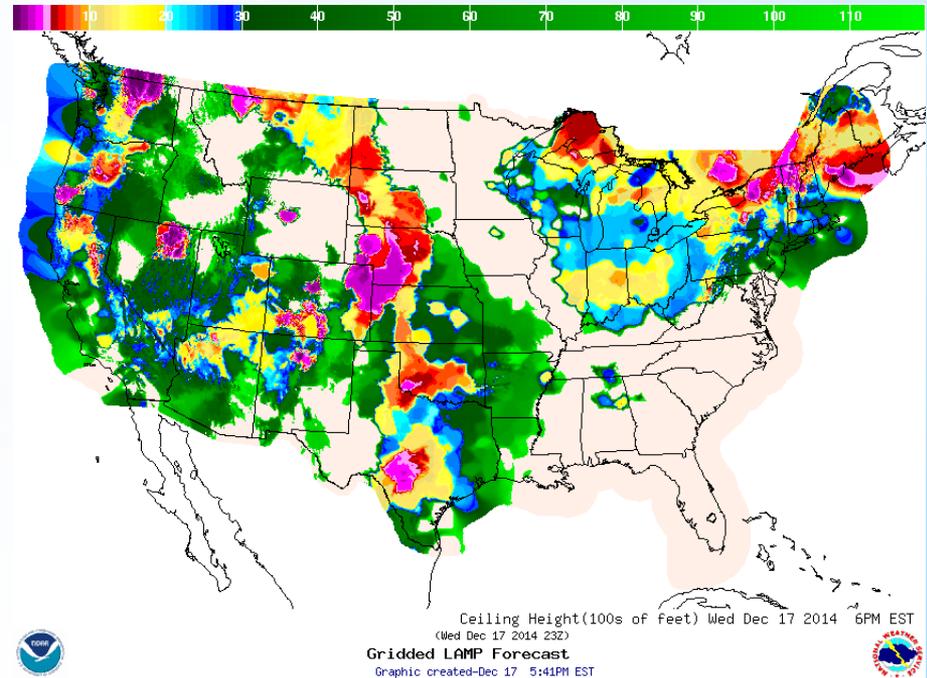
Convection Potential

# LAMP: Ceiling Height and Visibility Guidance

- The LAMP Ceiling and Visibility predictands are METAR observations, valid at stations
- The equations are developed at stations
- The guidance is **produced at stations** and analyzed to a grid



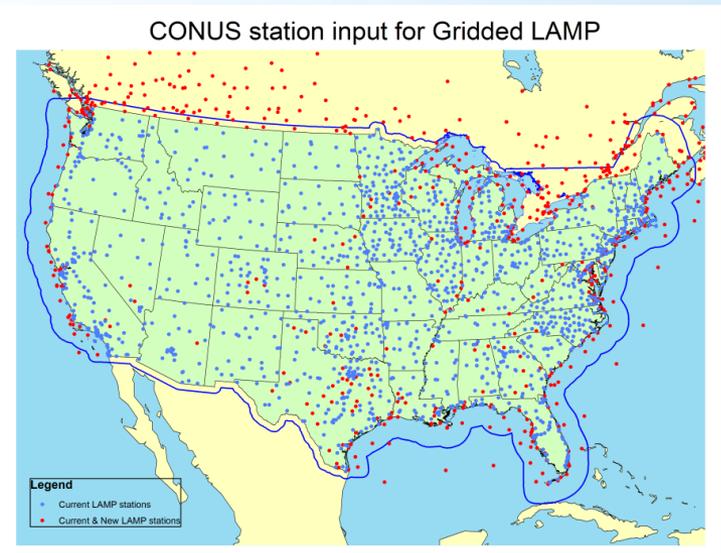
Developed and produced at stations



Analyzed to a 2.5km grid

# Current Challenges

- LAMP Convection and Lightning:
  - Aviation community needs increased spatial and temporal resolution in the very short term
  - LAMP has no development/dissipation except via NAM/GFS predictors
  - LAMP can be slow to pick up on Convection Initiation
- LAMP Ceiling Height and Visibility:
  - Aviation community needs good gridded ceiling and visibility guidance for: NWS forecasters - Digital Aviation Services; FAA – NextGen
  - Too few (< 3,000) METAR station observations to adequately cover the CONUS grid; no mesonet data
  - No observations of ceiling and visibility in the Atlantic or Pacific, some observations in the Gulf of Mexico
  - Ceiling height and visibility are very discontinuous fields

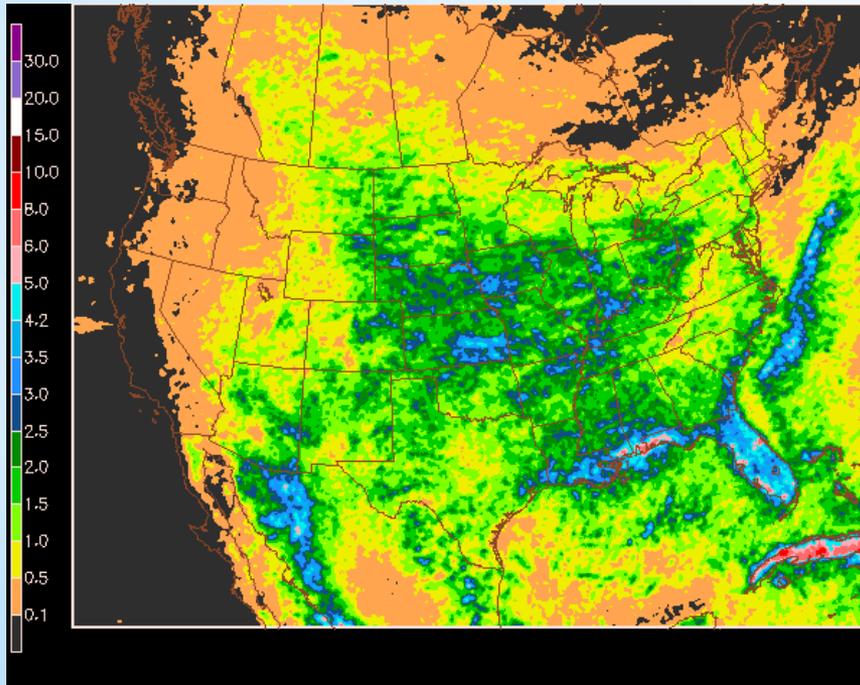


# New Datasets

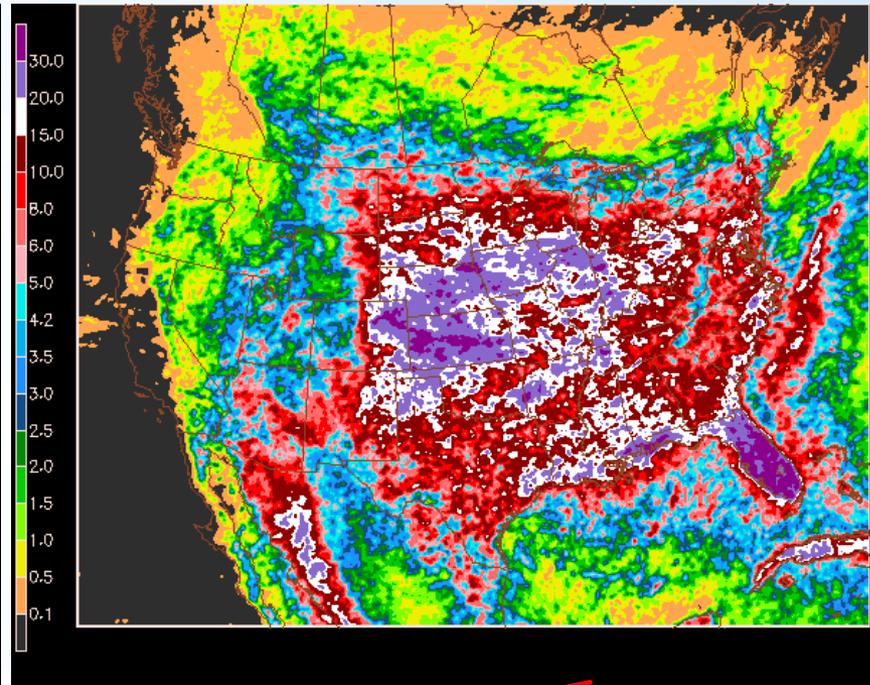
- Total Lightning (TL) data:
  - TL archive consists of in-cloud (IC) and cloud-to-ground (CG) flashes
  - Data provided by Earth Networks, Inc. (ENI)
  - Expect TL data to become operationally available to NWS in 2015
- Multi-Radar/Multi-Sensor System (MRMS) radar data:
  - Data provided by National Severe Storms Laboratory (NSSL)
  - Raw data has resolution ~ 1 km every 2 min
  - Operational in the NOAA/NWS Integrated Dissemination Program (IDP) - September 2014
- High Resolution Rapid Refresh (HRRR) model data:
  - Available on a 3 km grid, produced hourly in 1-hr time steps to 15 hours
  - Data provided by NOAA/ESRL/Global Systems Division
  - Operational on the NOAA/NWS Weather and Climate Operational Supercomputing System (WCOSS) - September 2014

# ENI Mean Daily Flash Counts

Flash counts in 10-km grid boxes  
Warm season\* (Apr – Sep) 2013-2014



CG Lightning

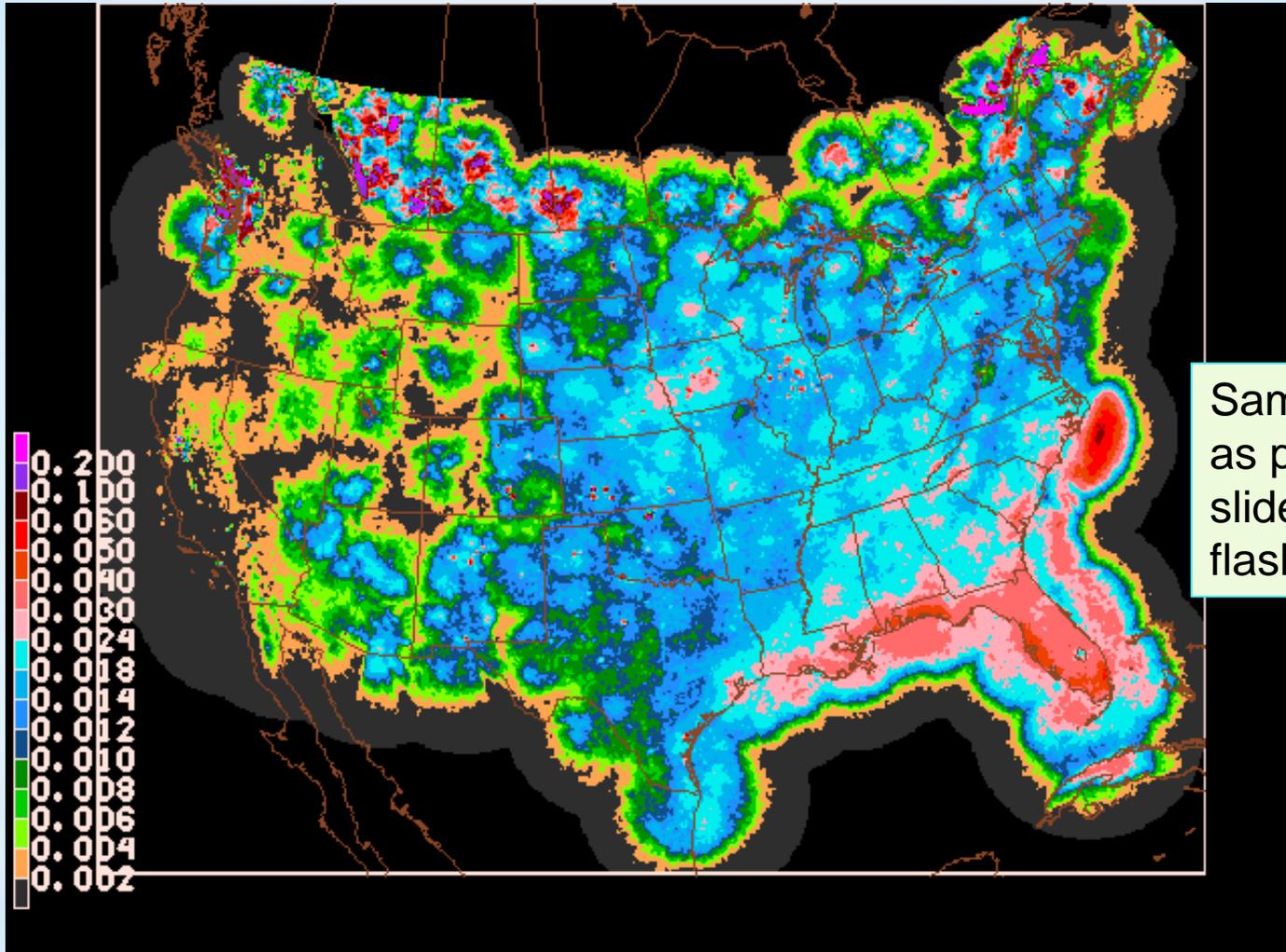


Total Lightning

~6.2 times  
more TL  
than CG  
lightning

\* Warm seasons: 6/4/2013 – 9/30/2013; 4/1/2014 – 9/30/2014

# MRMS Relative Frequencies\* (RF) $\geq 40$ dBZ Warm season\* (Apr – Sep) 2013-2014



- RF of maximum Composite Reflectivity  $\geq 40$  dBZ in a 10-km gridbox at HH:00, where HH = 00, 01, 02, ..., 23 UTC (combining all hours of each day)
- Additional Quality Control needed and in progress

\* Warm seasons: 6/4/2013 – 9/30/2013; 4/1/2014 – 9/30/2014

# Approaches to improve Gridded LAMP guidance

- LAMP Convection and Lightning:

|         | Current predictand/predictors | New predictand/predictors        |
|---------|-------------------------------|----------------------------------|
| Replace | RCM radar data                | MRMS radar data                  |
| Replace | CG lighting                   | Total Lightning                  |
| Add     |                               | HRRR model output as a predictor |

- LAMP Ceiling Height (CIG) and Visibility (VIS):

- Develop regression equations to statistically merge: LAMP + HRRR

# Improving LAMP CIG & VIS: HRRR Verification

- Initial Verification:

- Verified at:

- 1562 CONUS LAMP stations; 314 CONUS non-LAMP stations
    - Warm season (April – Sept. 2013) and cool season (Oct. 2013–Mar. 2014 ).
    - 00 UTC LAMP vs 23 UTC HRRR;
    - 12 UTC LAMP vs 11 UTC HRRR

- Results:

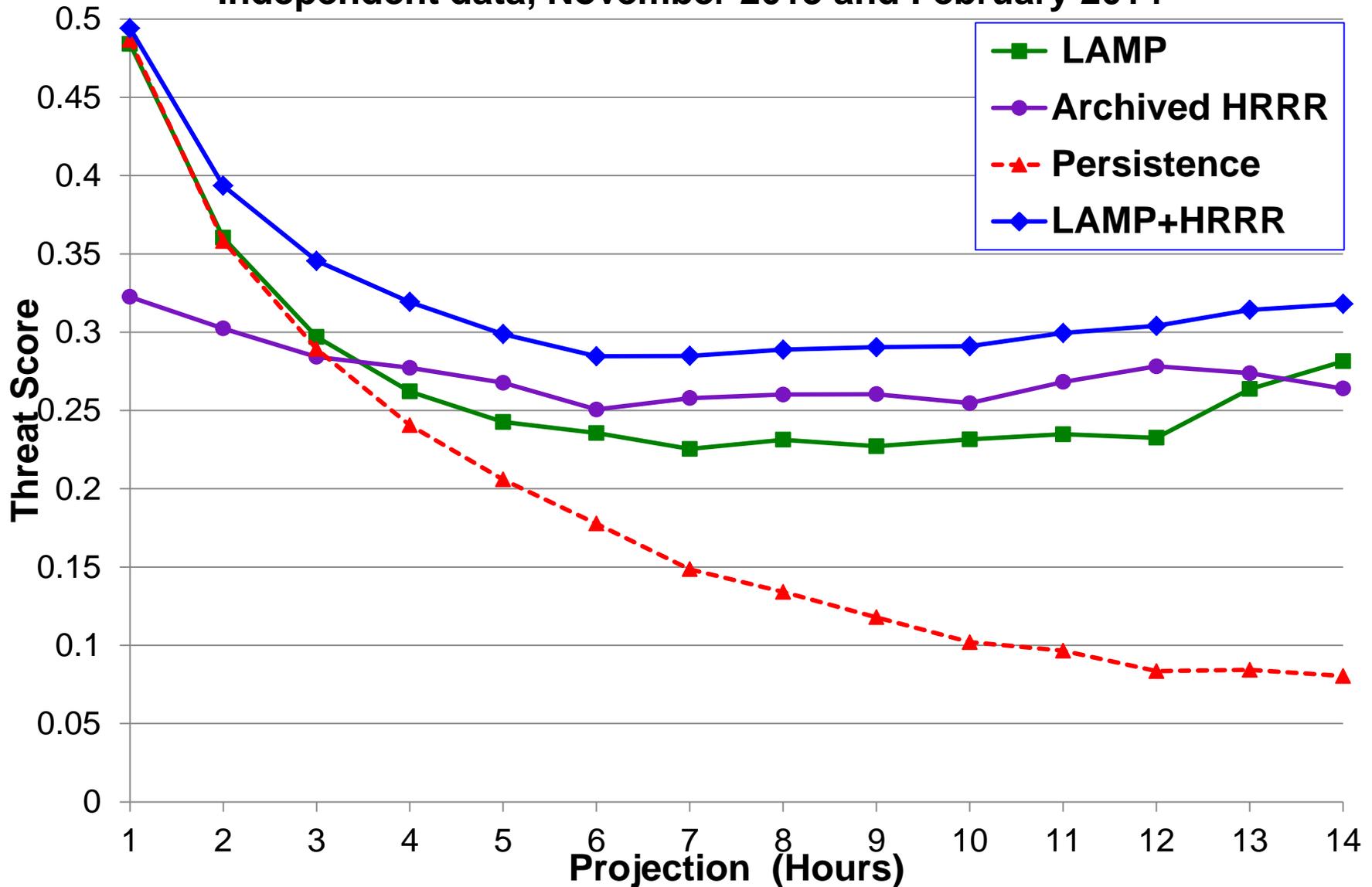
- HRRR had better Threat Scores (TS) than LAMP for VIS after the beginning period at LAMP stations at 00 UTC, and in general, **much better scores at non-LAMP stations**
    - HRRR showed less improvement over LAMP for CIG and in the 12 UTC comparison, even at non-LAMP stations
    - HRRR had higher biases than LAMP at the lower visibility categories

# Improving LAMP CIG & VIS: Regression Equation Development

- Regression Analysis:
  - First focus on visibility
  - Predictand Data: METAR Observations
  - Predictor Data: LAMP and HRRR VIS forecasts
  - Data Sample: Cool season development Oct. 2013 – Mar. 2014
    - 4 months for dependent data
    - 2 months for independent data
  - Generalized Operator Approach → many cases
  - Equations developed for 00 UTC:
    - LAMP+HRRR Regression:
      - Using LAMP Cumulative Probabilities + HRRR Cumulative Binaries only

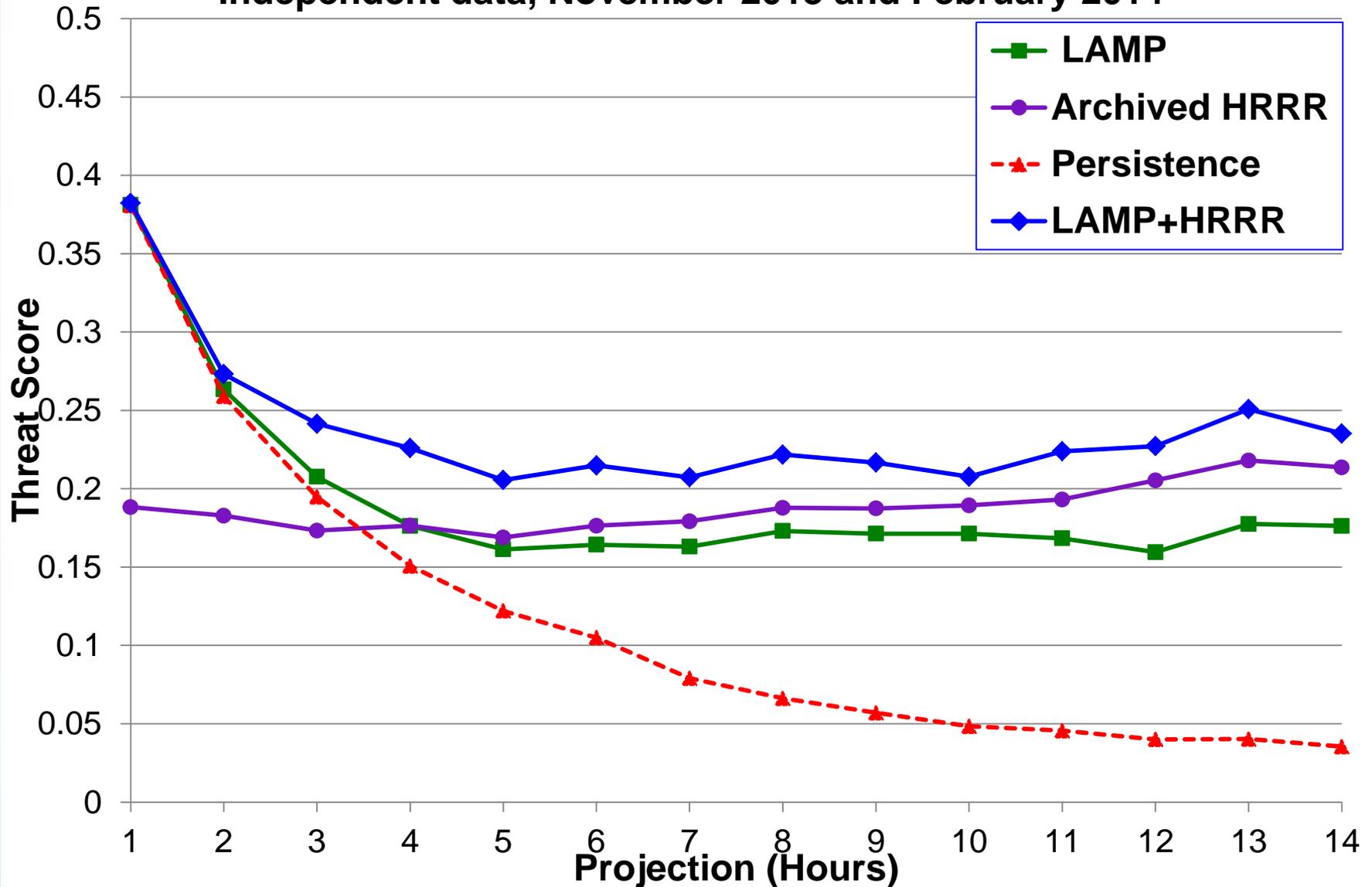
# LAMP + HRRR Development: Preliminary Results

Threat Score Visibility < 3.0 MI, 0000 UTC cycle  
Independent data, November 2013 and February 2014



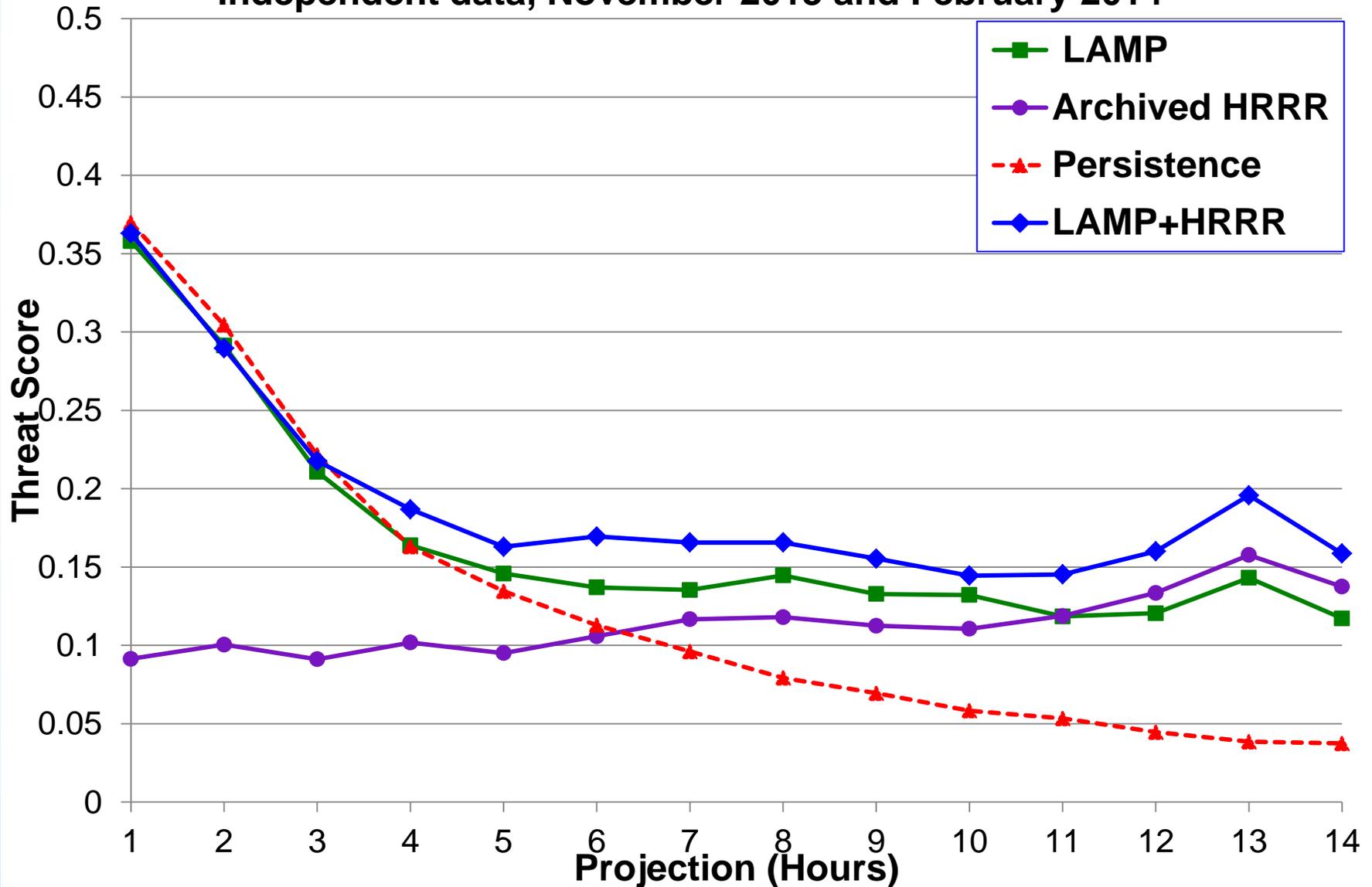
# LAMP + HRRR Development: Preliminary Results

Threat Score Visibility < 1.0 MI, 0000 UTC cycle  
Independent data, November 2013 and February 2014



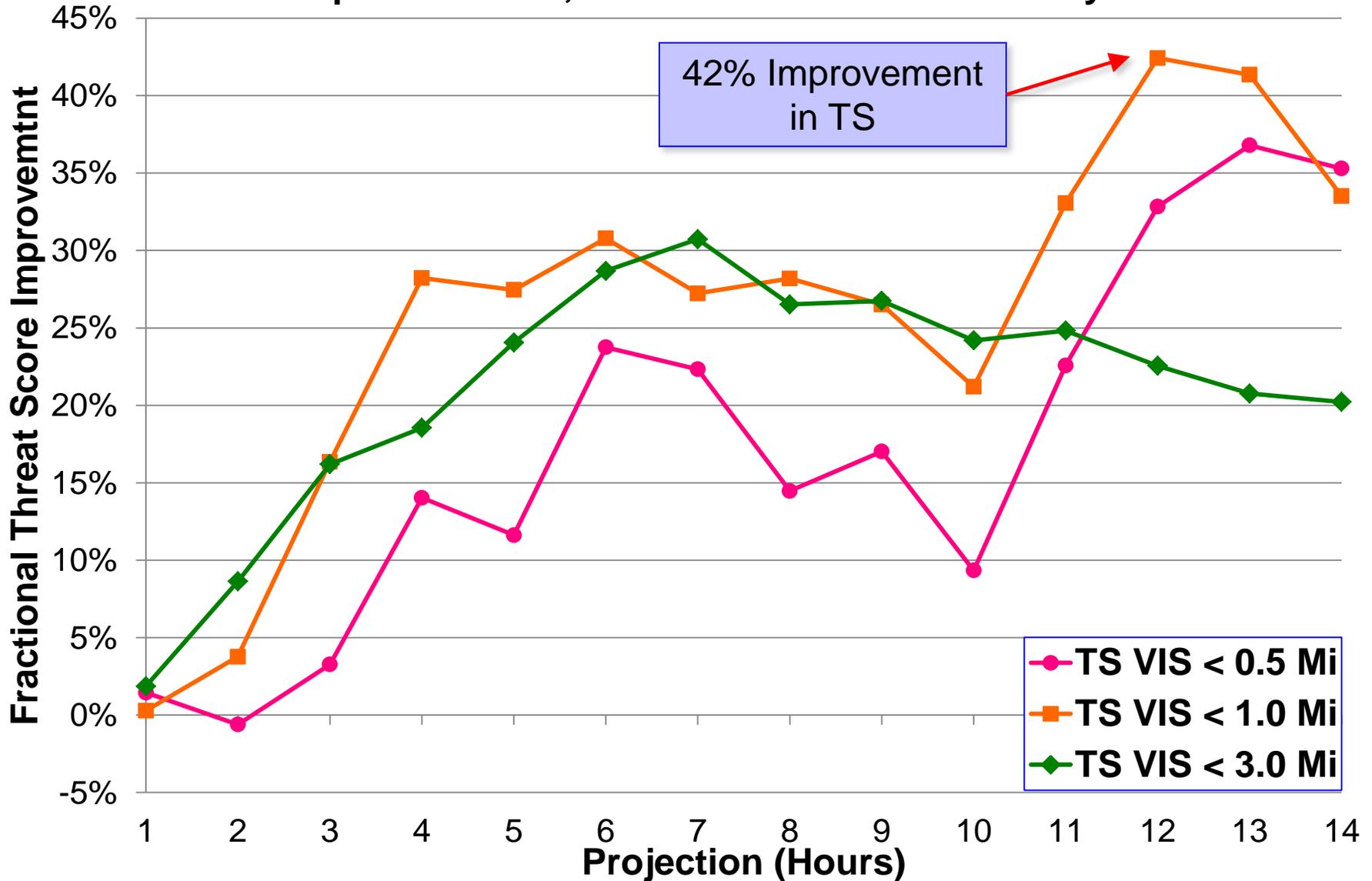
# LAMP + HRRR Development: Preliminary Results

Threat Score: Visibility < 0.5 MI, 0000 UTC cycle  
Independent data, November 2013 and February 2014



# LAMP + HRRR Development: Preliminary Results

Improvement of LAMP+HRRR over LAMP  
Independent data, November 2013 and February 2014



# Improving LAMP Guidance: Summary

- Challenges still to overcome:
  - Only one season and cycle tested; short sample
  - Need to grid the regressed LAMP+HRRR forecasts and look at cases
  - Need to blend 1-14-hr Regressed LAMP+HRRR with LAMP/Gridded LAMP after 14 hours
- Plans:
  - Convection & Lightning: Redevelopment using new datasets of TL, MRMS radar, and HRRR (**FY15**)
  - Storm Tops: New Gridded Storm Top guidance using new datasets (**FY16**)
  - Ceiling and Visibility:
    - **Preliminary results show that post-processing HRRR and LAMP together yields very encouraging results** (see forthcoming AMS extended abstract for more information).
    - Improvement expected at stations and on the grid from developing second order LAMP+HRRR Regression equations (visibility: **FY15**; ceiling height: **FY16**)

# Questions?

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