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

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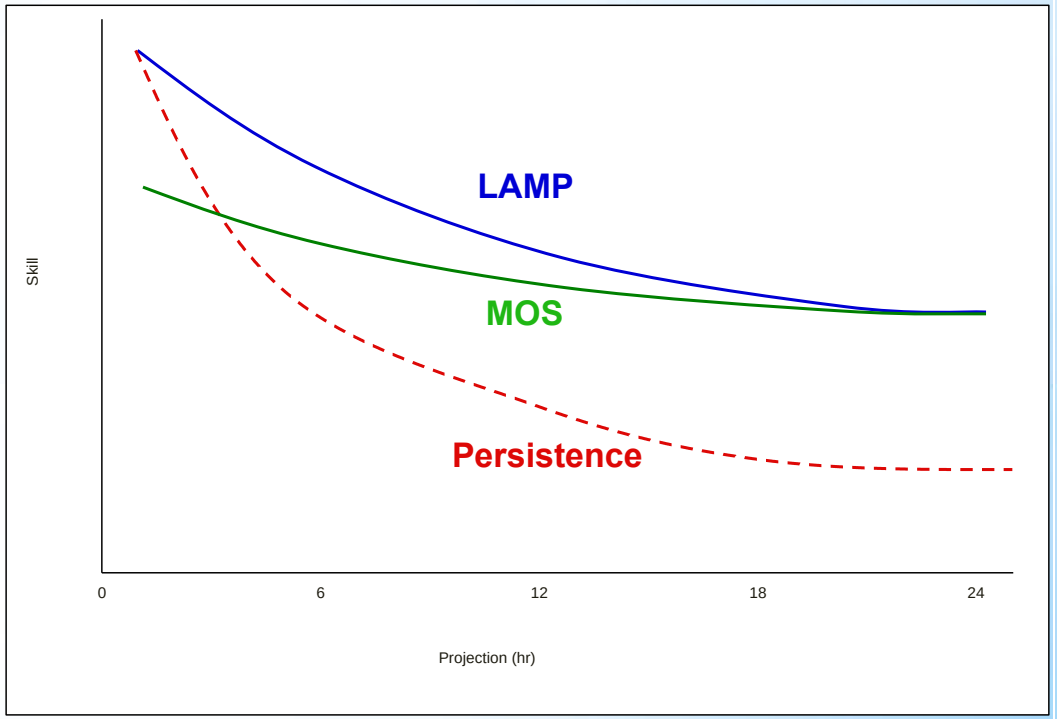
Outline

- 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

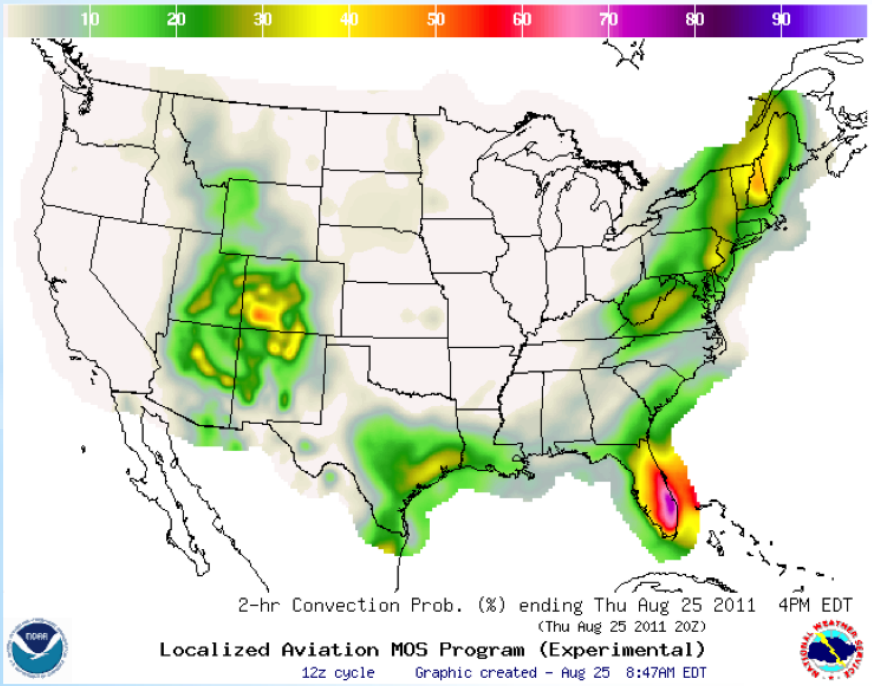
Localized Aviation MOS Program (LAMP) Background

- 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 per-sistence 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

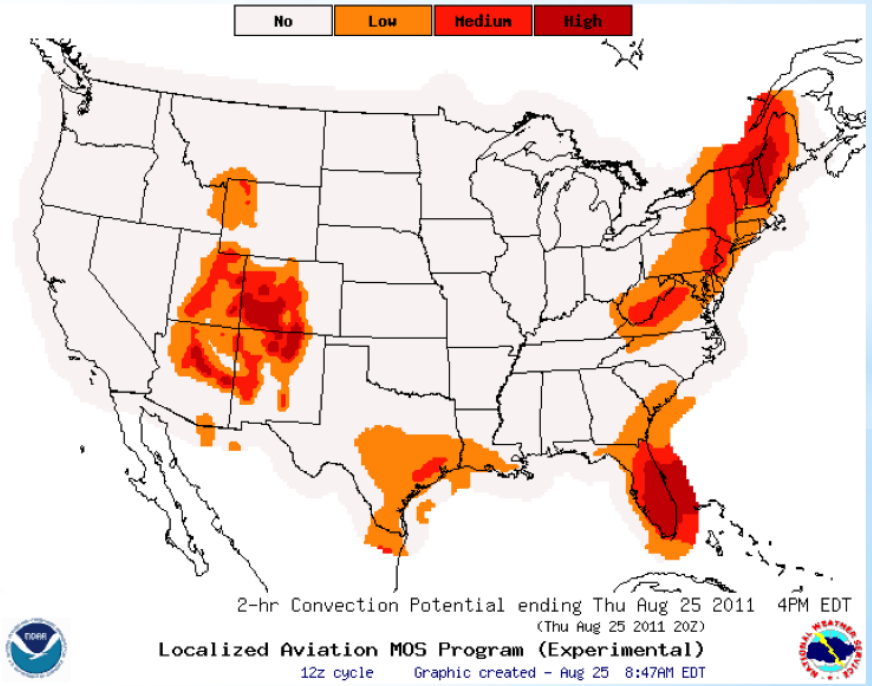


LAMP: Convection and Lightning Guidance

- 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 ≥ 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

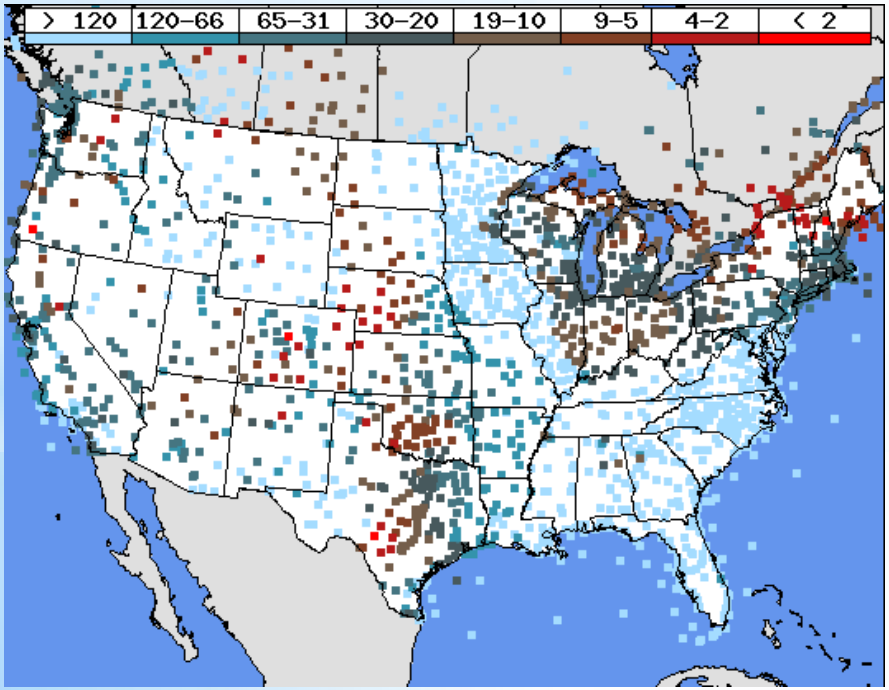


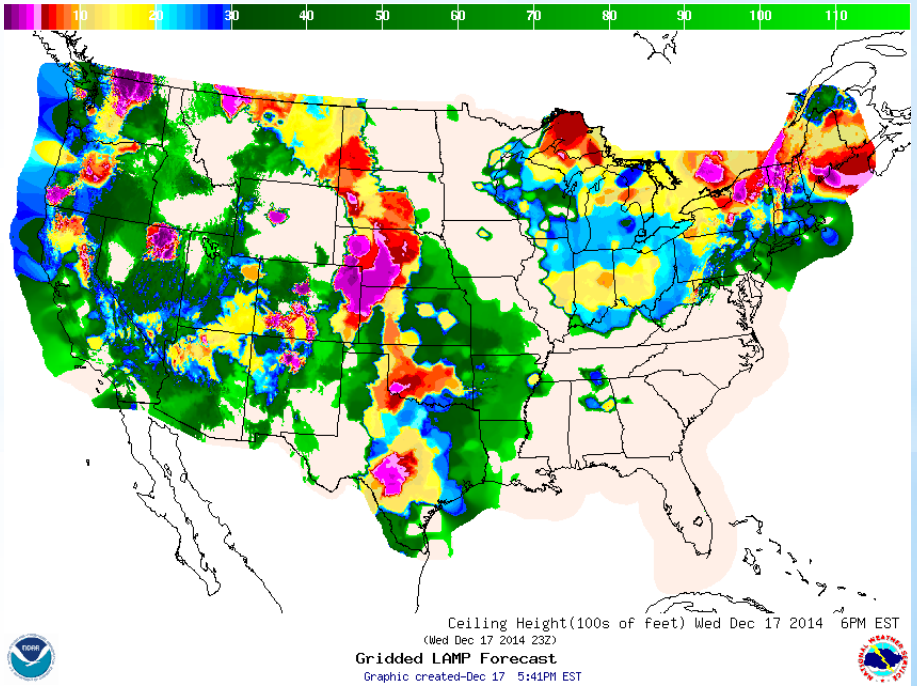
Convection Potential

* Archives obtained from Global Hydrology Resource Center (GHRC)

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



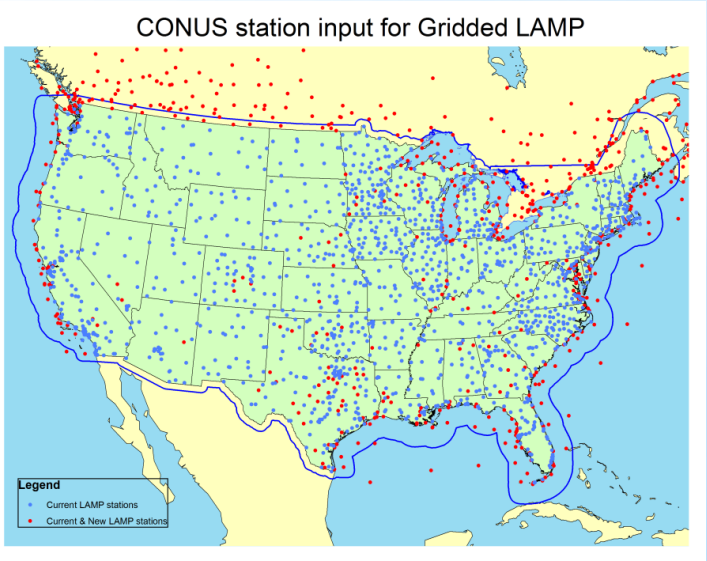


Developed and produced at stations

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



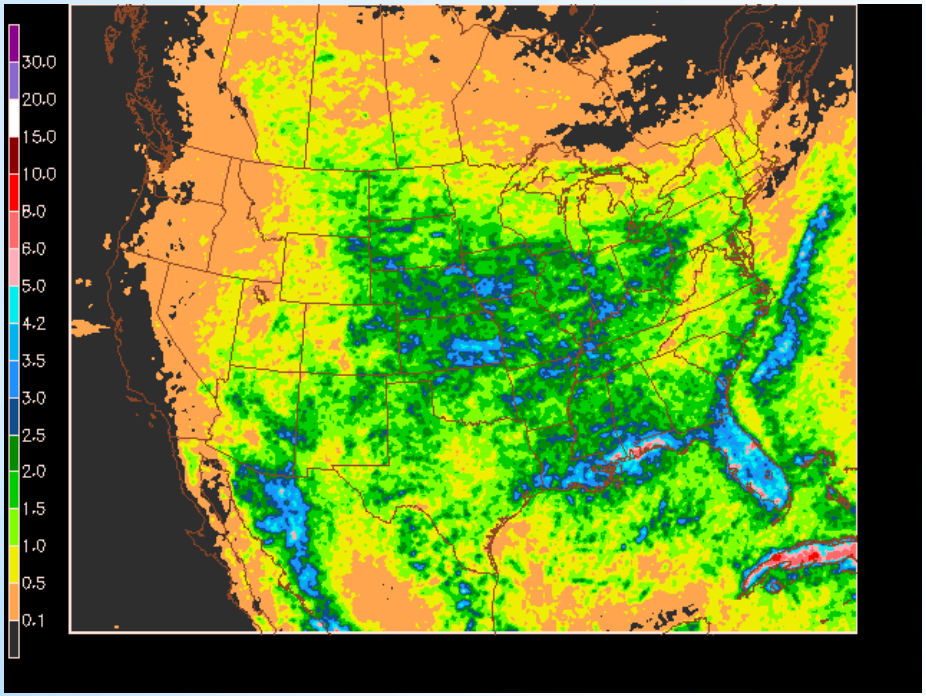
New Datasets

- 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

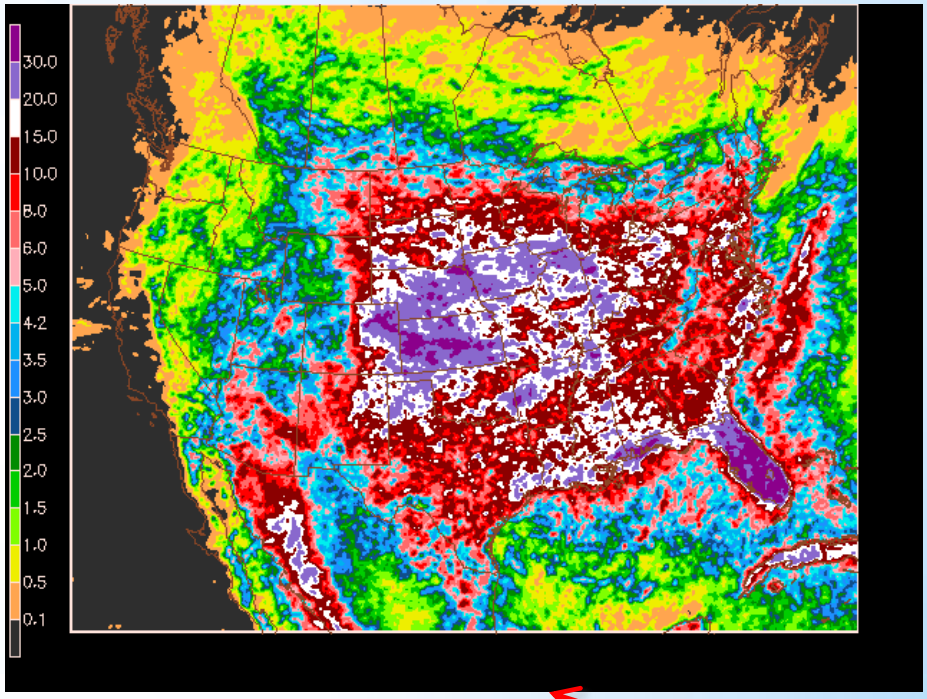
ENI Mean Daily Flash Counts

Flash counts in 10-km grid boxes

Warm season* (Apr – Sep) 2013-2014



CG Lightning

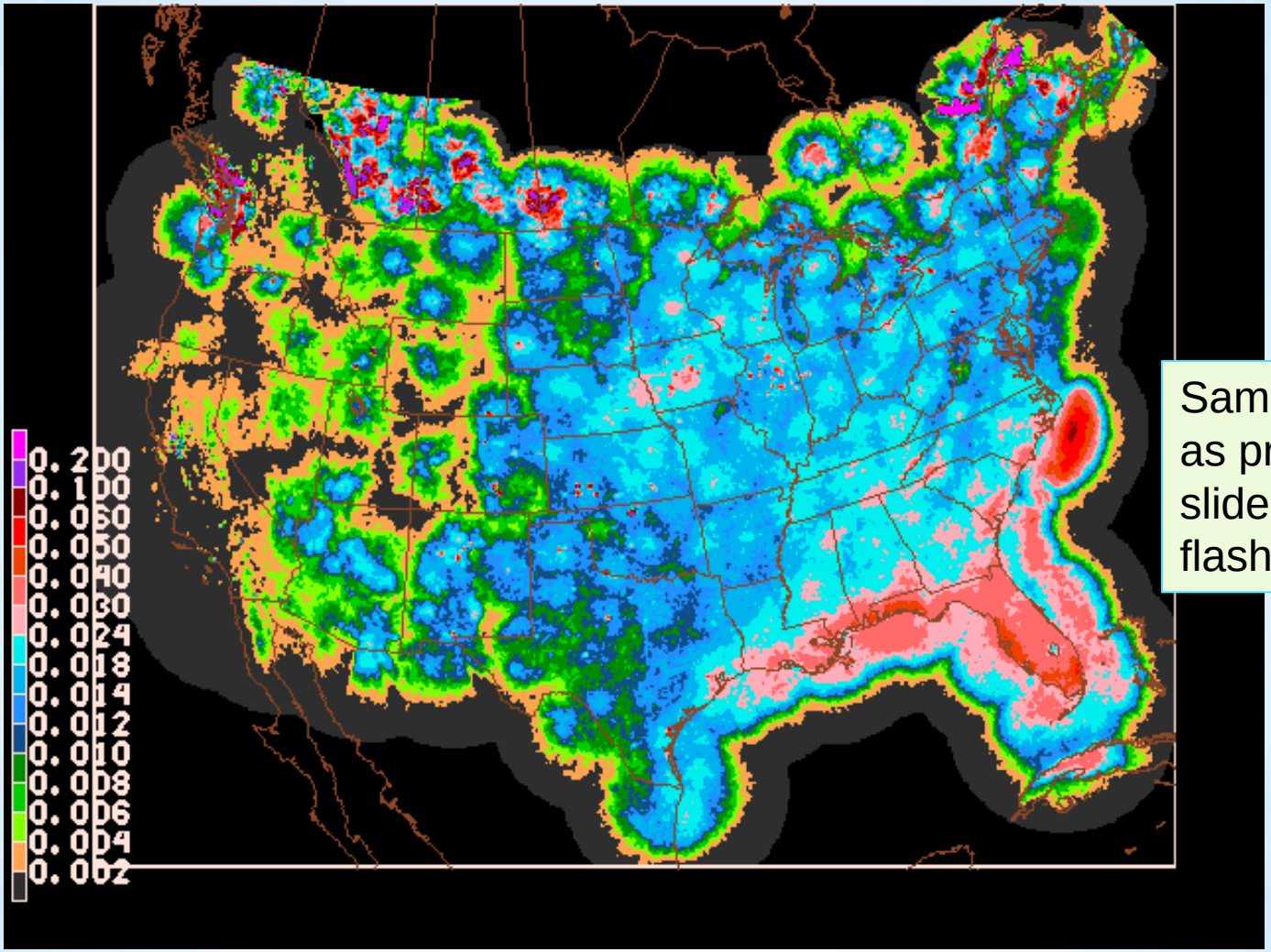


Total Lightning

~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) ≥ 40 dBZ
Warm season* (Apr – Sep) 2013-2014



Same sample as previous slide of mean flash counts

- RF of maximum Composite Reflectivity ≥ 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

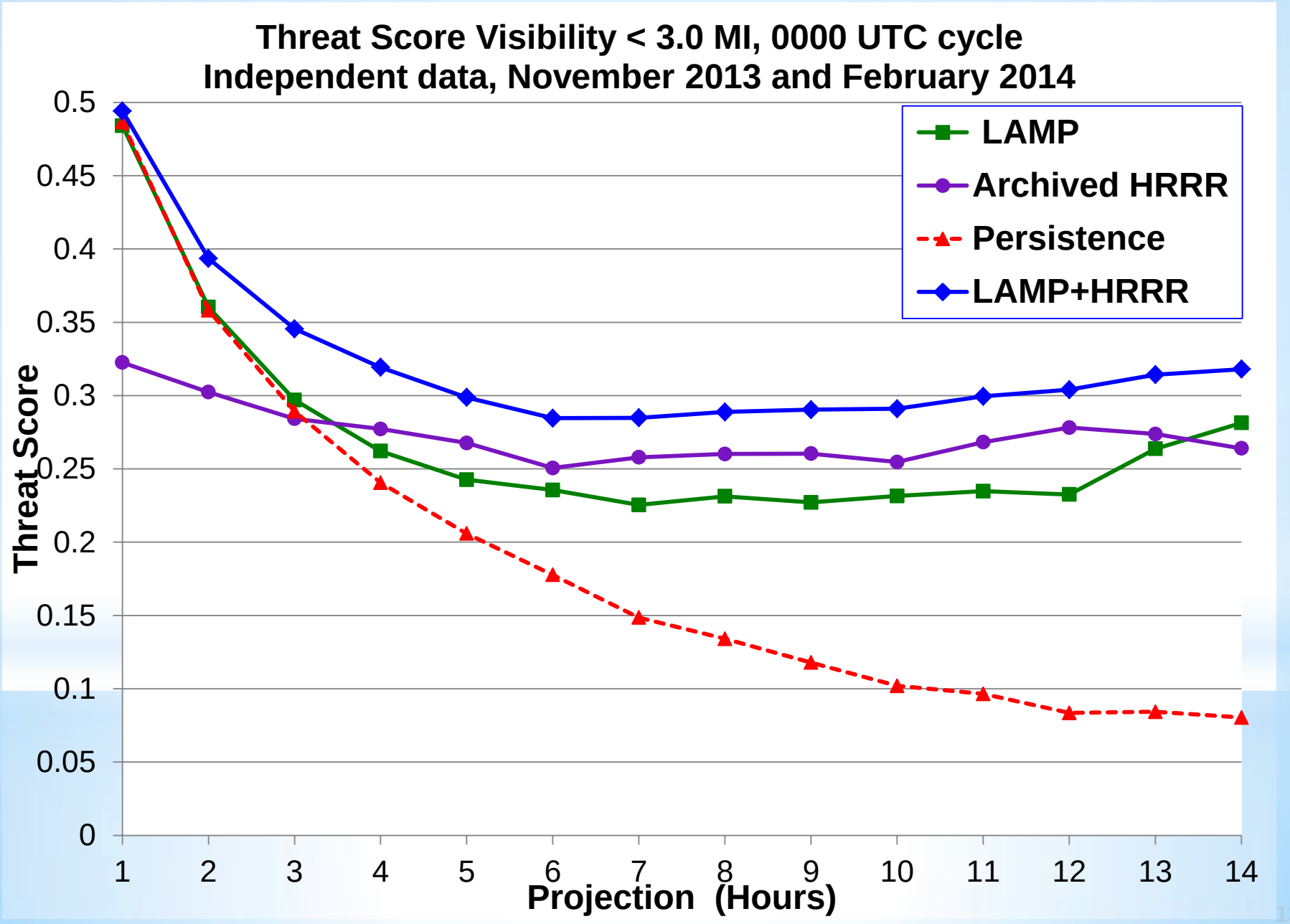
Improving LAMP CIG & VIS: HRRR Verification

- 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



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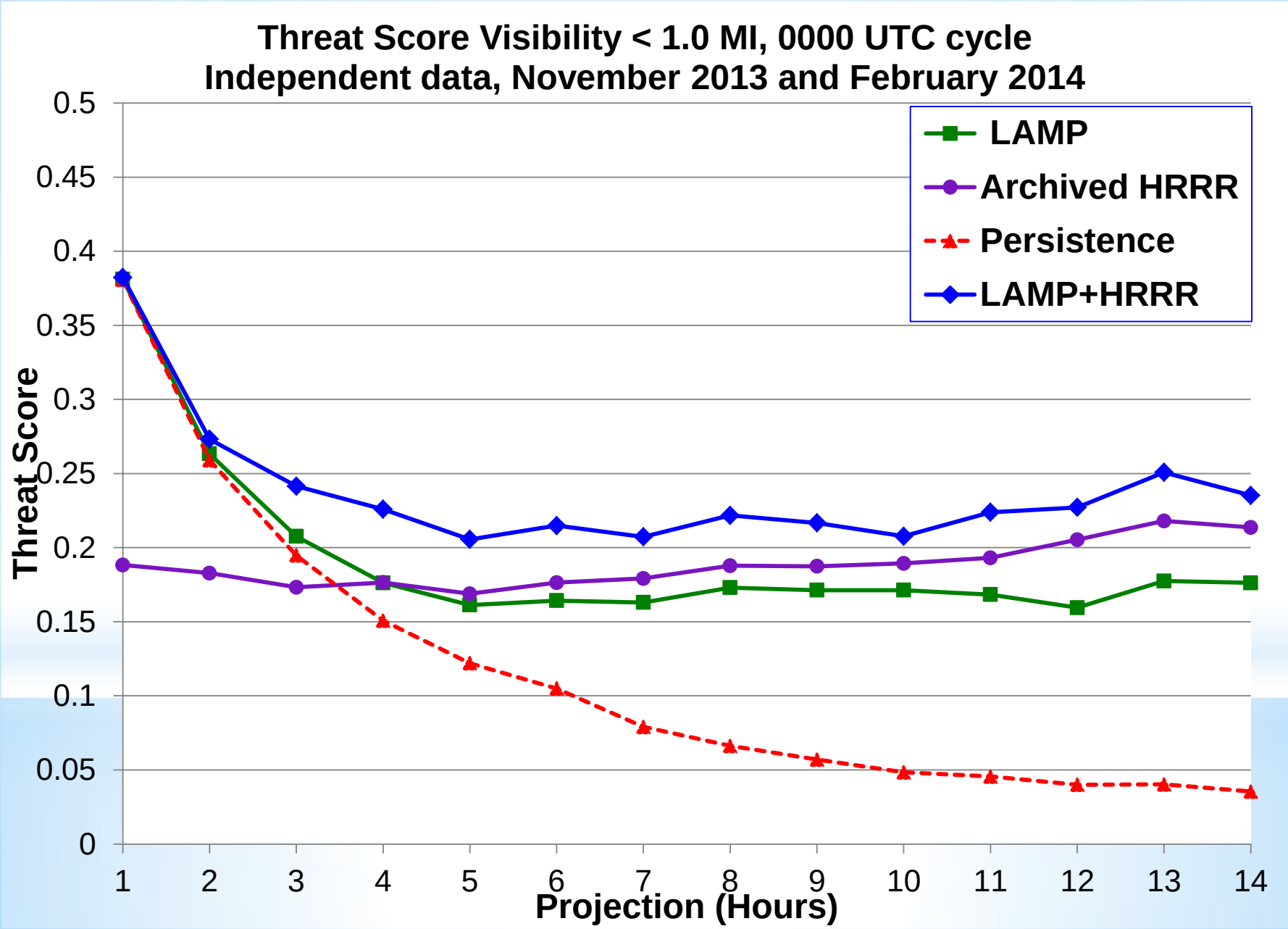
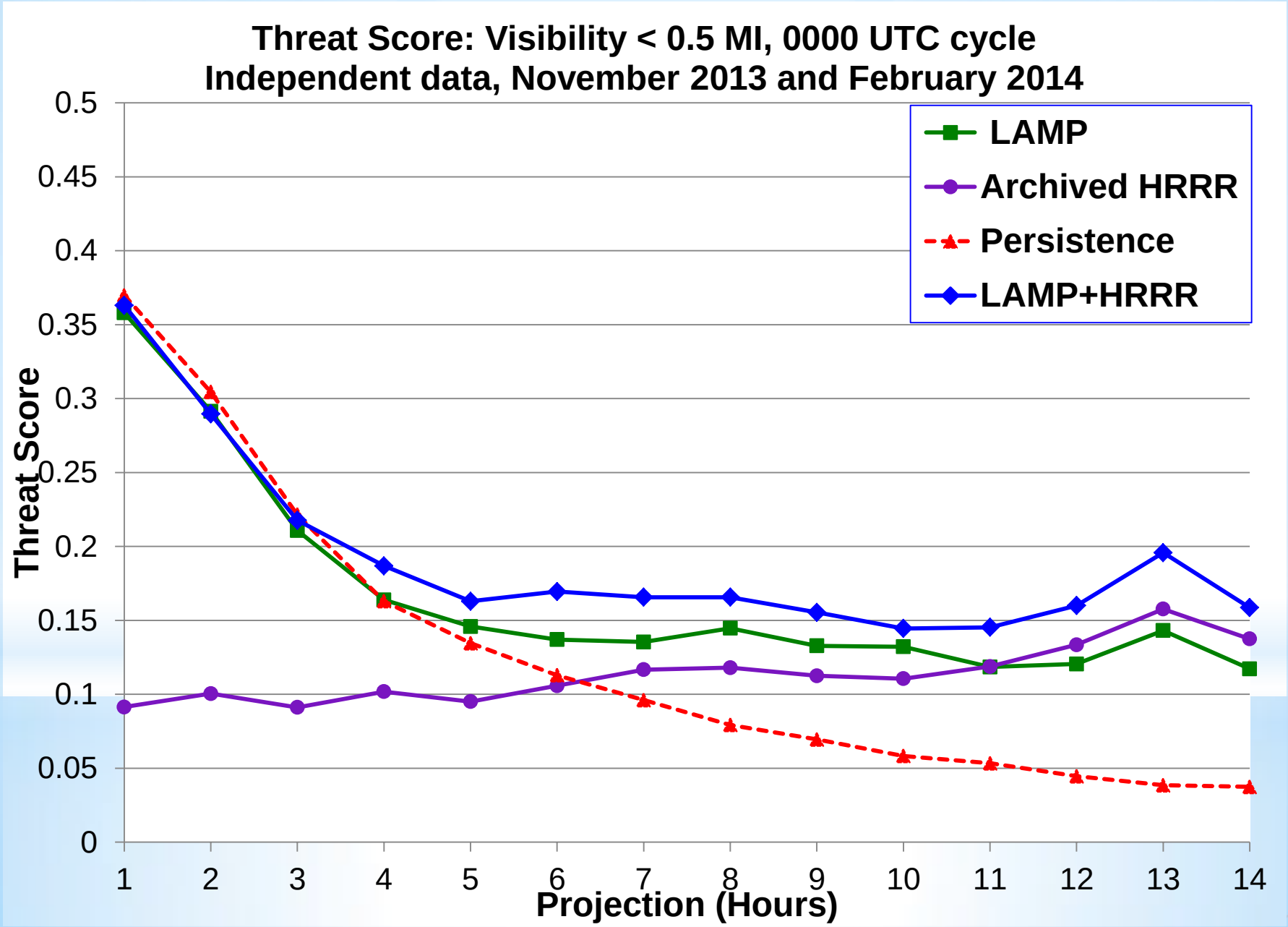
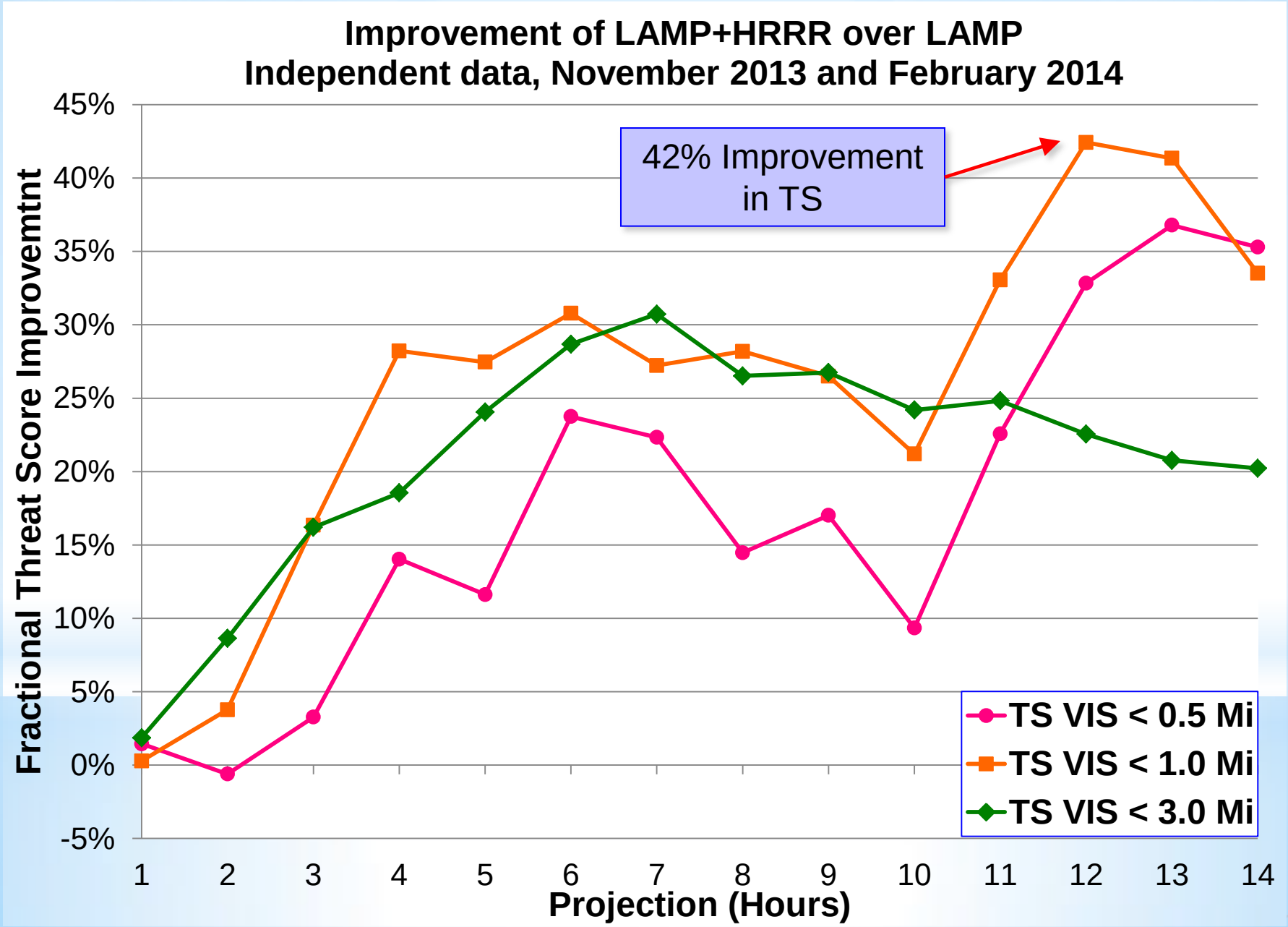


LAMP + HRRR Development: Preliminary Results



LAMP + HRRR Development: Preliminary Results



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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