# Probabilistic Forecasting of Ceiling and Visibility:
## Skill Improvement through Blending of NWP, LAMP and Regression

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Photo Credit: AOPA Air Safety Foundatio


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# Motivation – Ceiling and Visibility Forecasting

## Traffic delays

*1/3 of Wx-rel. delays due to impacted C&V in the terminal area*

## GA Safety

*- VFR to IMC hazard*
*- Accidents 90% fatal*
*- Avg 2 deaths/accident*

## HEMS Safety


*- 9 min go/no-go, IFR*
*- 3 hr ops window*

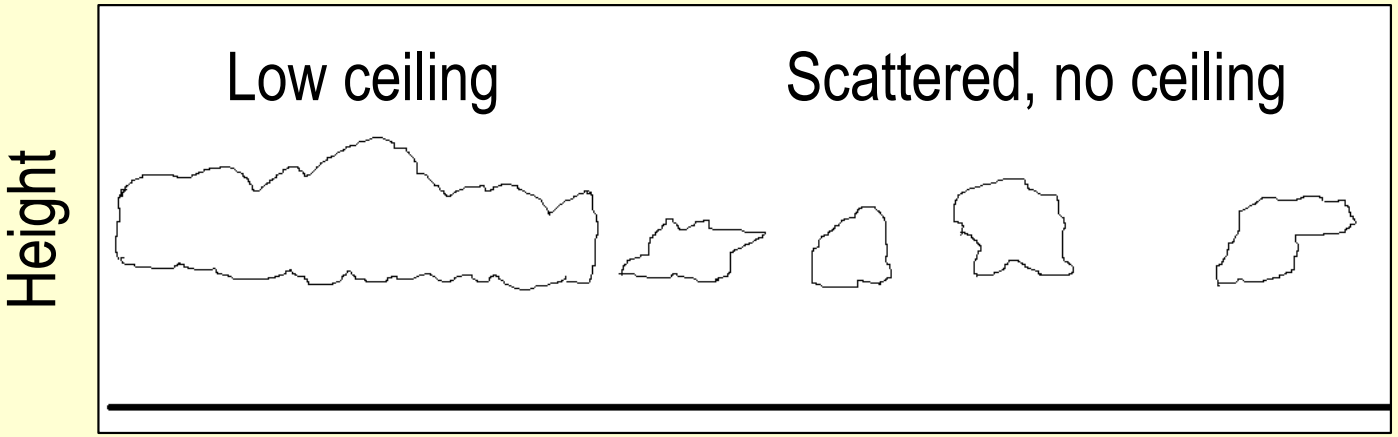
***CVF:*** probabilistic 1-10 hr forecast

***Method:*** Complementary blend of WRF-RR, LAMP & obs-based forecasts.

***Status:*** In development
- Testing in FY12.

# Scientific & Practical Challenges

- C&V impacts arise from diverse phenomena:
  (aerosols, haze, fog, cloud, precipitation)
- Ceiling: Frequently discontinuous in space and time
  Dependent on fractional cloud coverage.




- Need both airport and en route fcsts. Must be consistent.

Data rich ……**But**…... Data poor at airports elsewhere

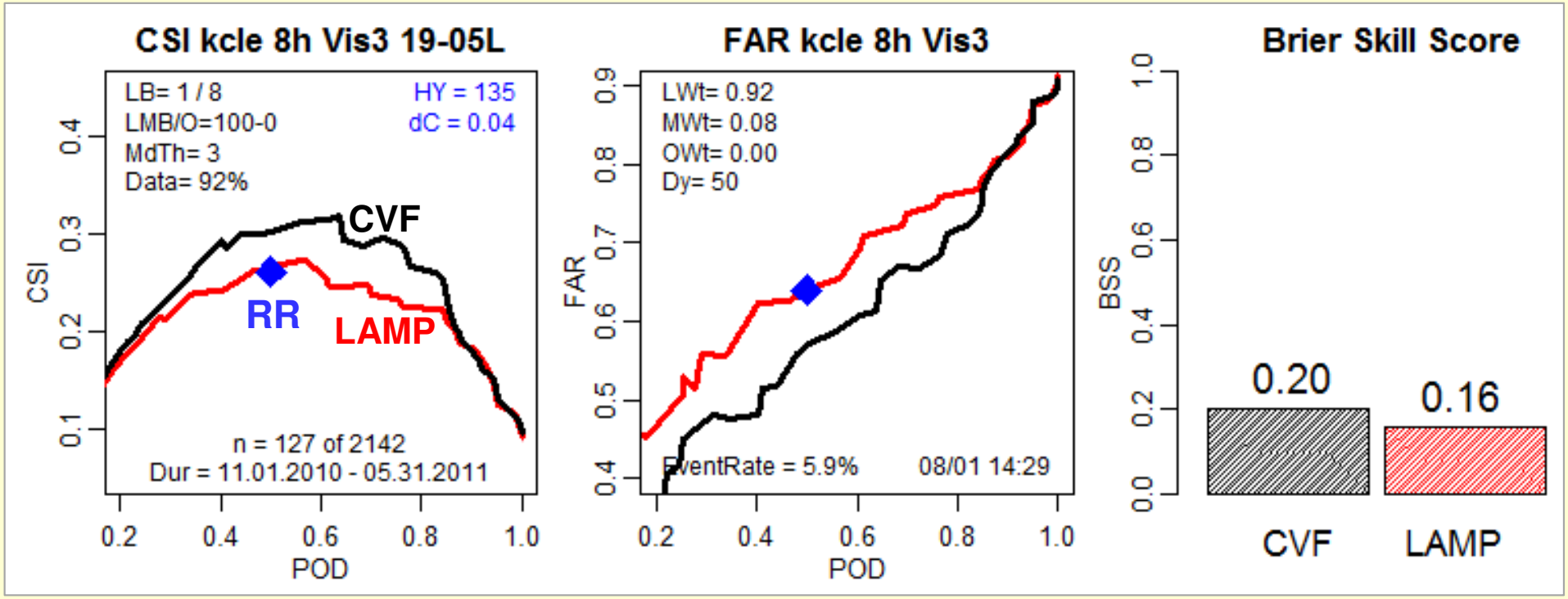
# Approach – blend multiple probabilistic forecast inputs

**Rapid Refresh**
- Time-lagged ens.
- Ceiling bias corr'n
- Latency used (2hr)

**LAMP**
- MOS/Regr. blend
- Probabilistic
- Latency used (1hr)

**NCAR Obcast**
- Obs-based fcst.
- Logistic regression
- Length 1 to 5 hr

Form a weighted average (or blend) of the three inputs.



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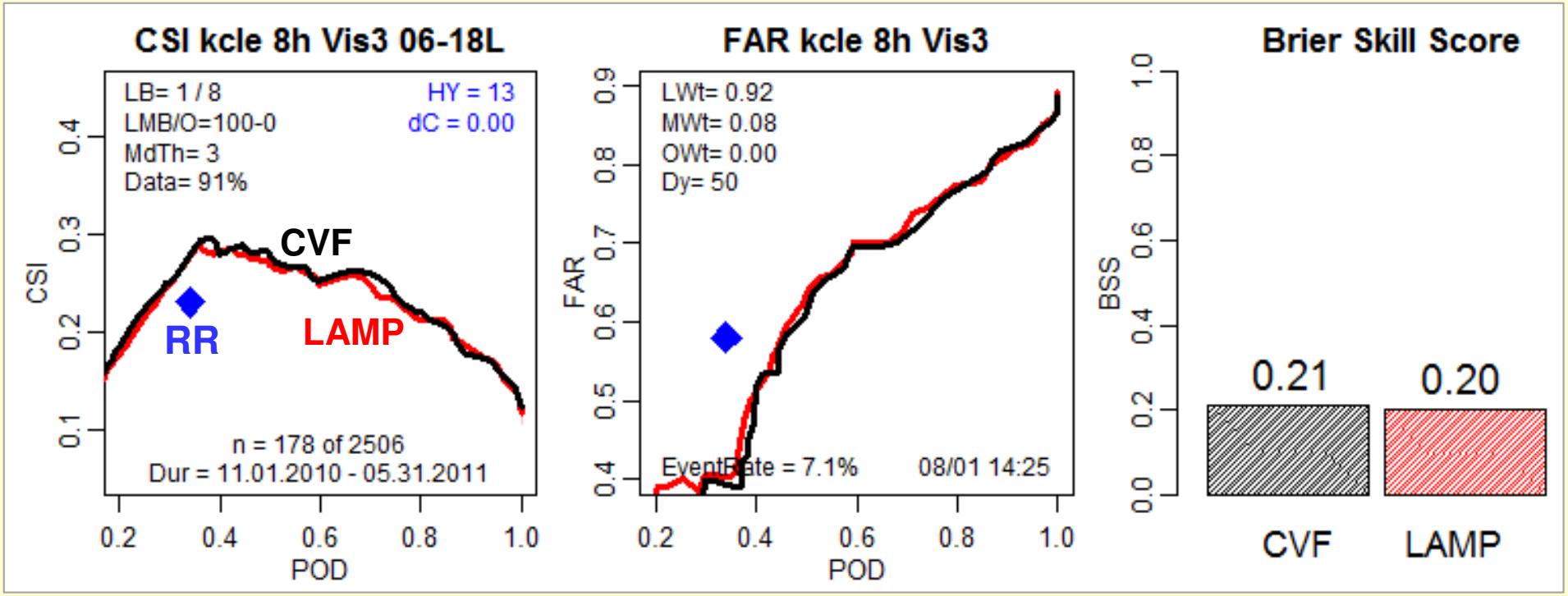

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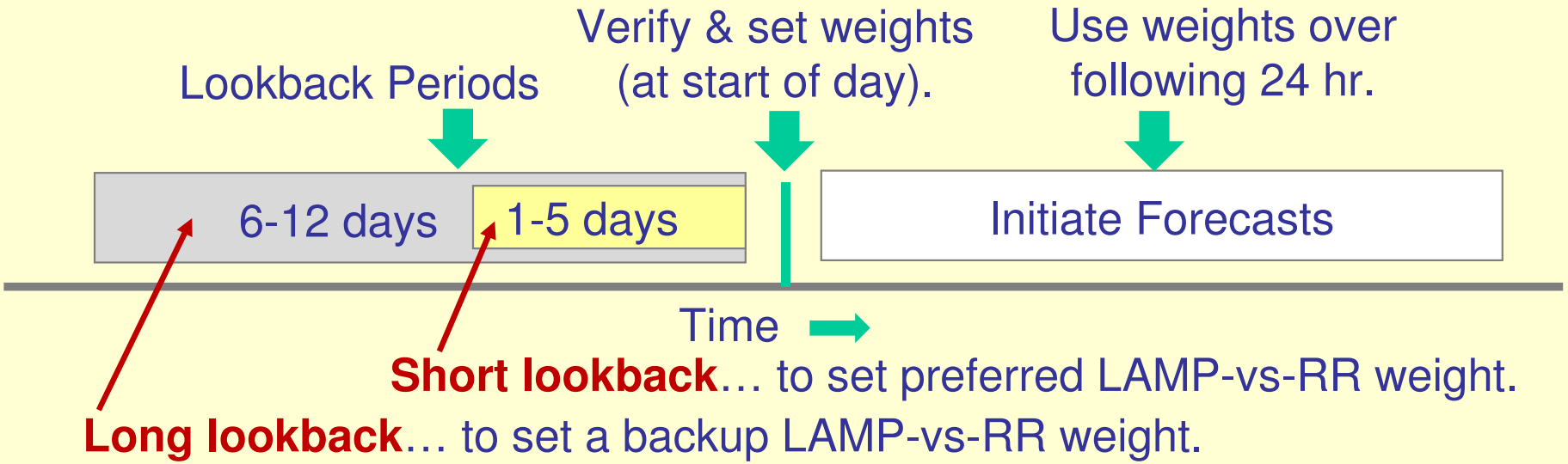


**Short lookback**… to set preferred LAMP-vs-RR weight.

**Long lookback**… to set a backup LAMP-vs-RR weight.

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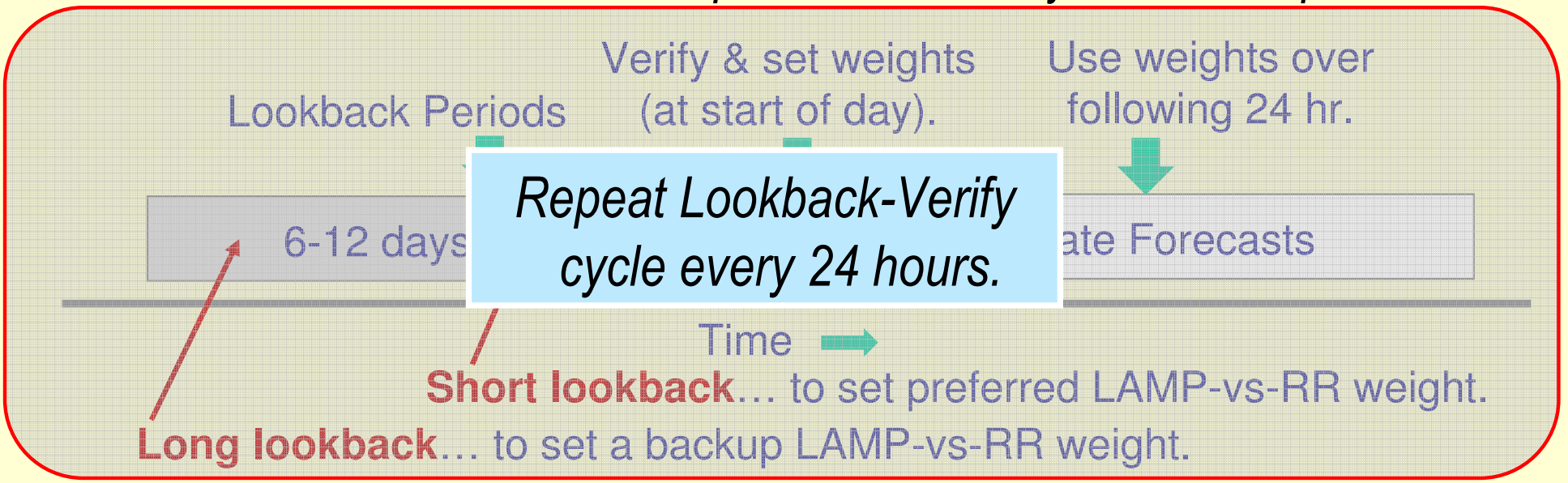
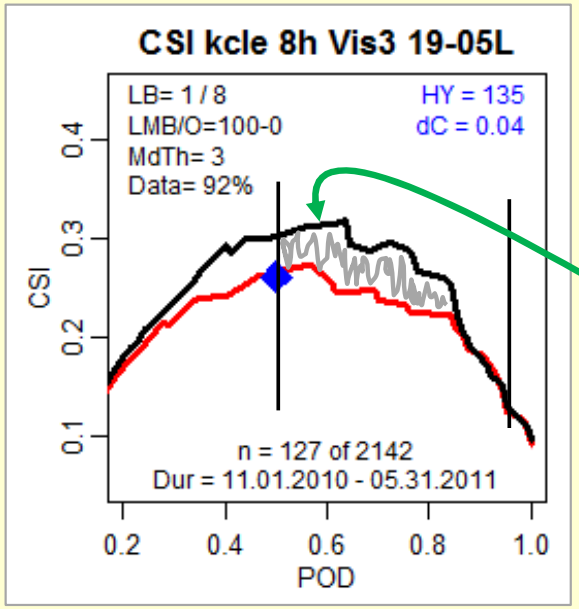
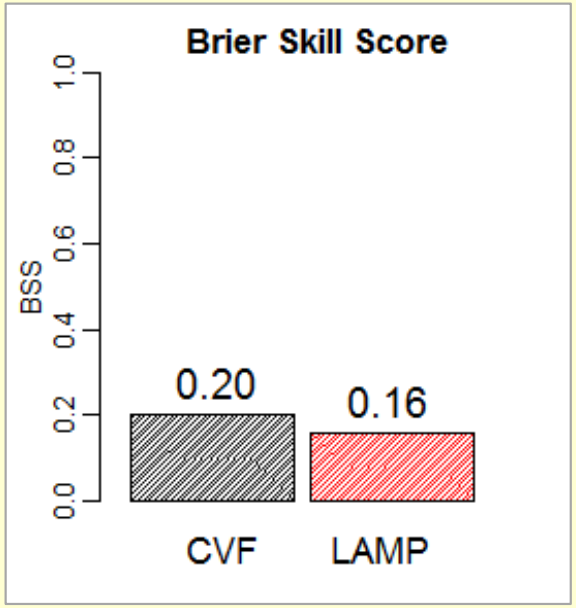


# A Hybrid Metric Guiding Weight Selection




**HY metric** – 75% CSI Area
25% ΔBrier Skill Score

**Area bounds:** Upper – *CVF*
Lower – *LAMP*
Left – *POD = 0.5 line*
Right – *POD = 0.95 line*

**Why:**

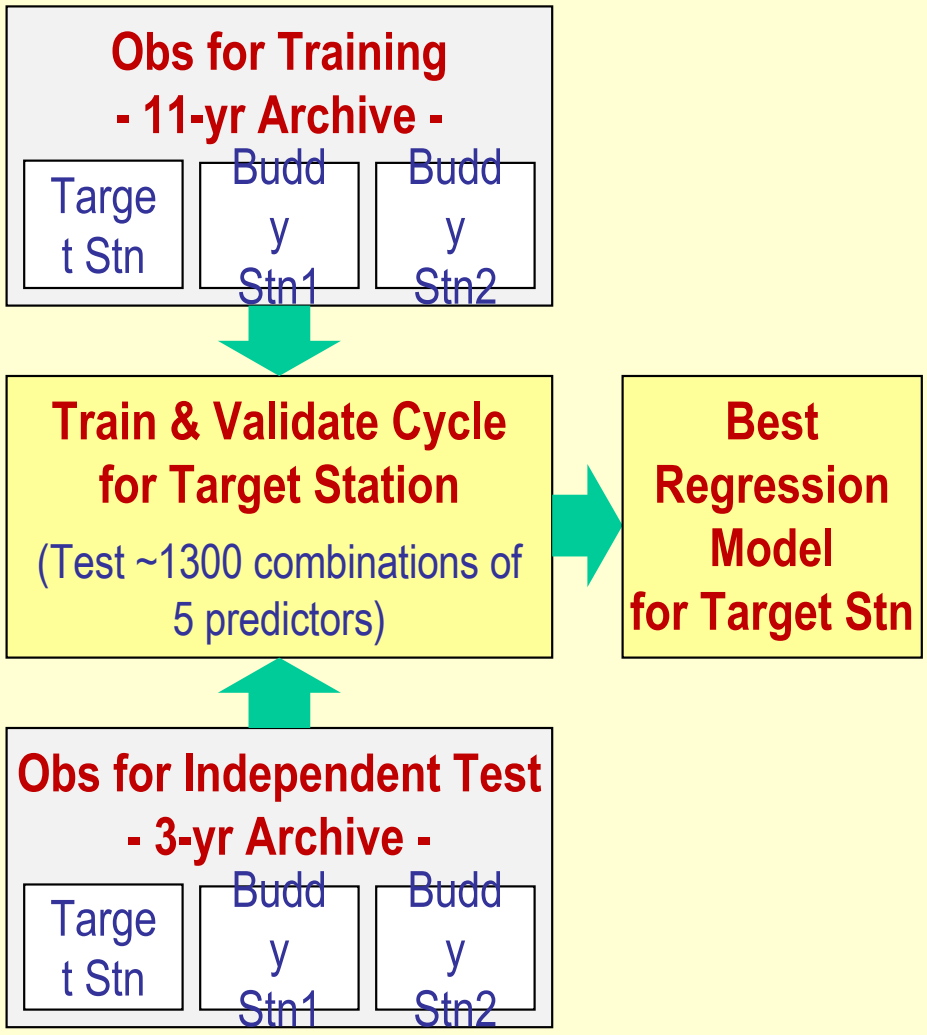
- Weights that increase area frequently decrease Brier Skill Score.
- Need to balance these tendencies.

**Usage:**

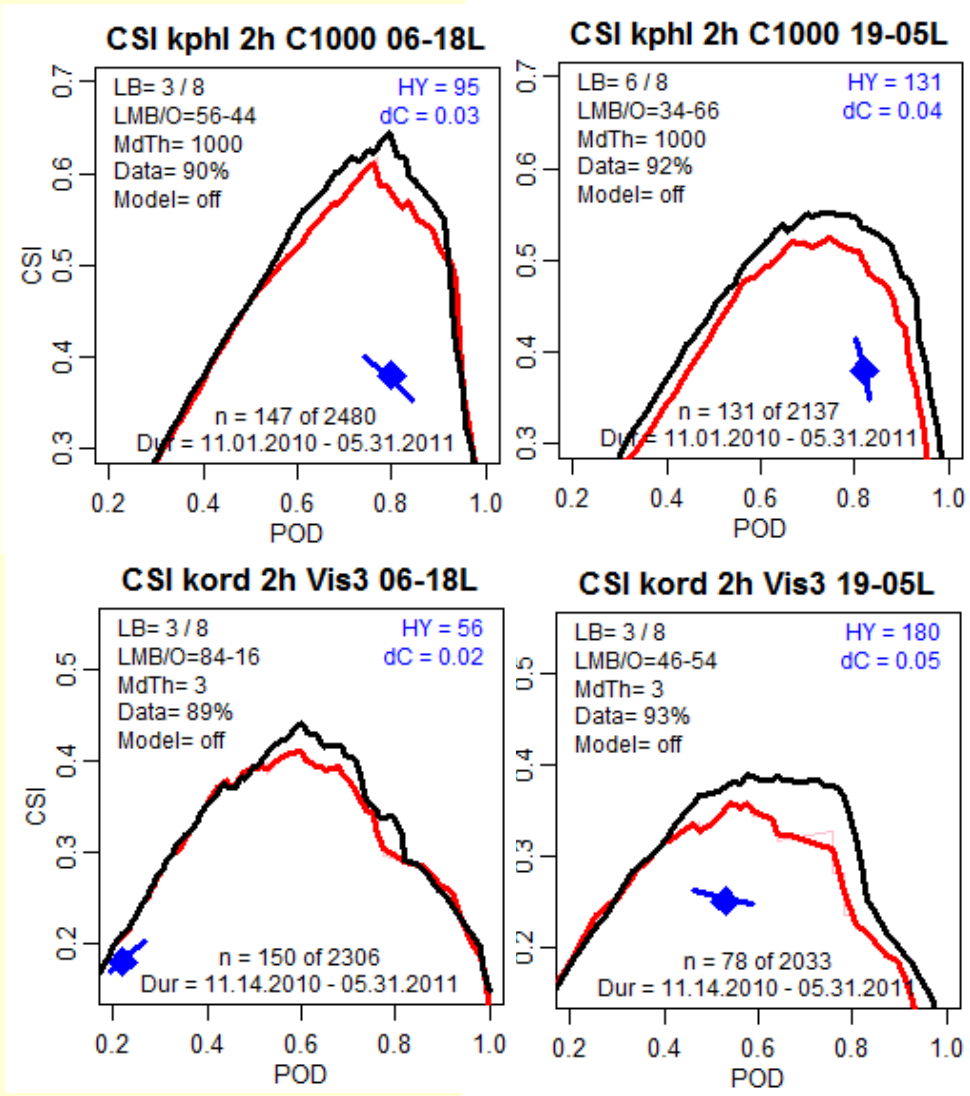
- Guides weight selection for each daily Lookback-Verify cycle.
  - Favors positive area and higher Brier SS.

# Statistical Forecasts Aiding CVF from 1-5 hr

## Obcast Model Development

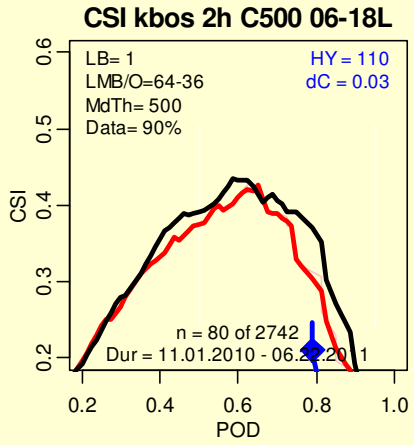


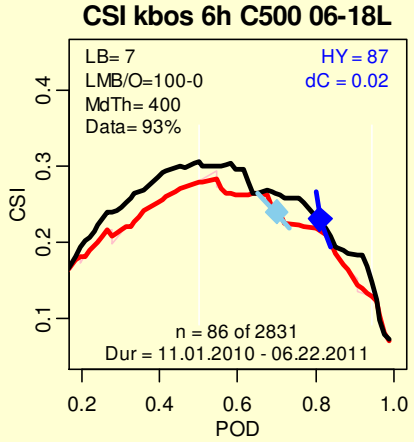

## Forecast Examples

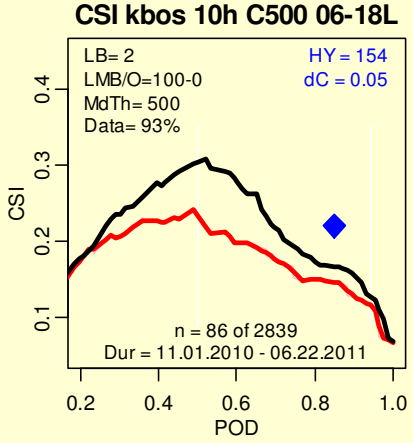


# Forecast Results for Lower Thresholds – KBOS C<500’

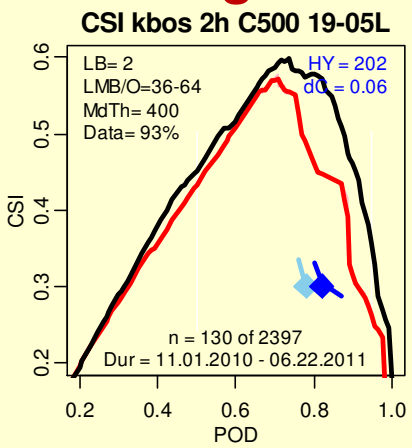
## Day

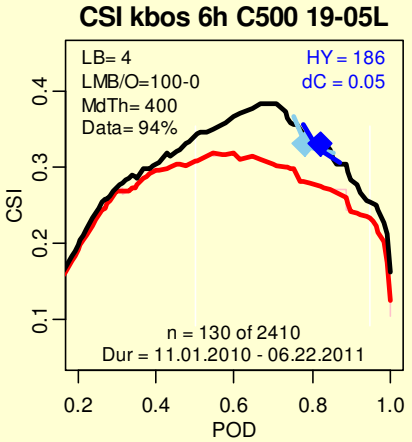


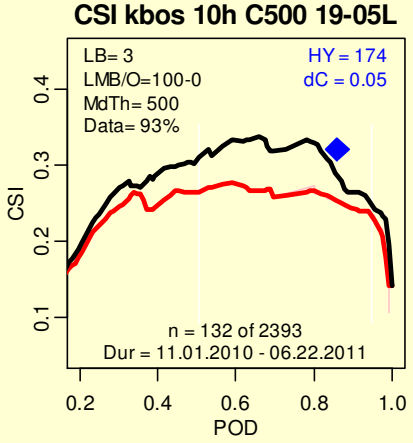




## Night



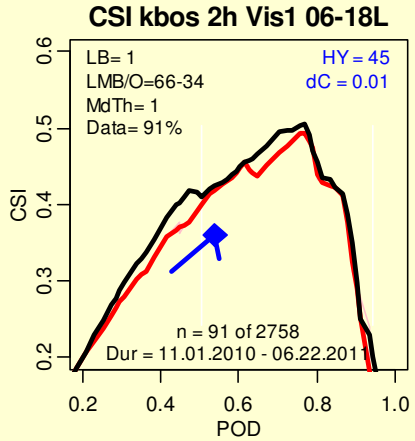

**2 hr**

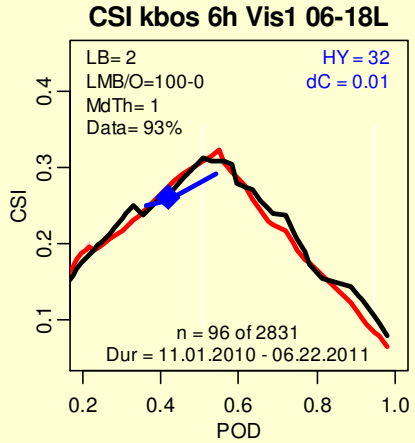
**6 hr**

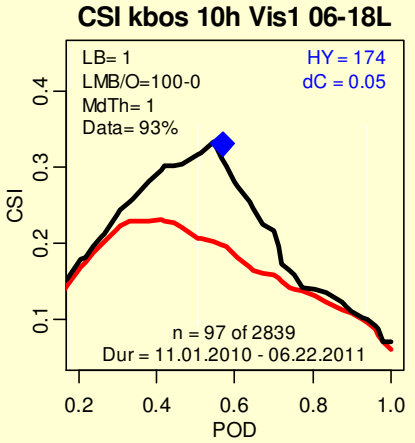
**10 hr**

# Forecast Results for Lower Thresholds – KBOS V<1mi

## Day

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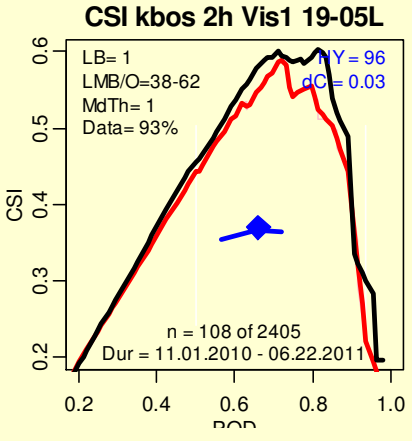


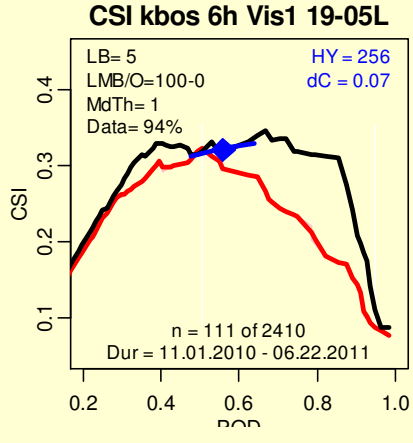


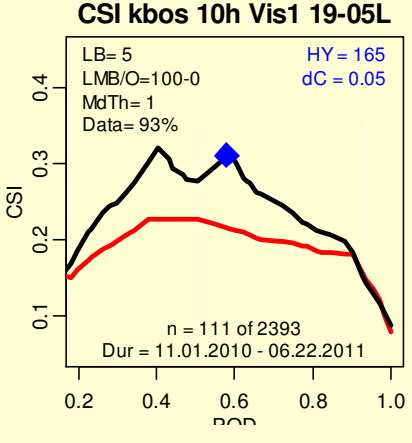


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# Wrap-Up

| | |
|---|---|
| Complementary Fcst Inputs | • NWP, LAMP & Obcast are highly complementary.<br>1+1+1 = 4<br>• Current NWP is RR. Looking at HRRR. |
| Lookbacks for Blending | • Lookback verification – basis for weight selection.<br>• Self-bootstrapping - improves handling of variability, seasonal transitions, model changes. |
| Metrics for Blending | • One size doesn't fit all.<br>• Hybrid metric joining CSI, POD & Brier skill score good. |
| Path to Ops | • NWS & FAA looking at feasibility of adding CVF process to LAMP C&V production. |