Toward Improving Short-Lead Monthly Forecast

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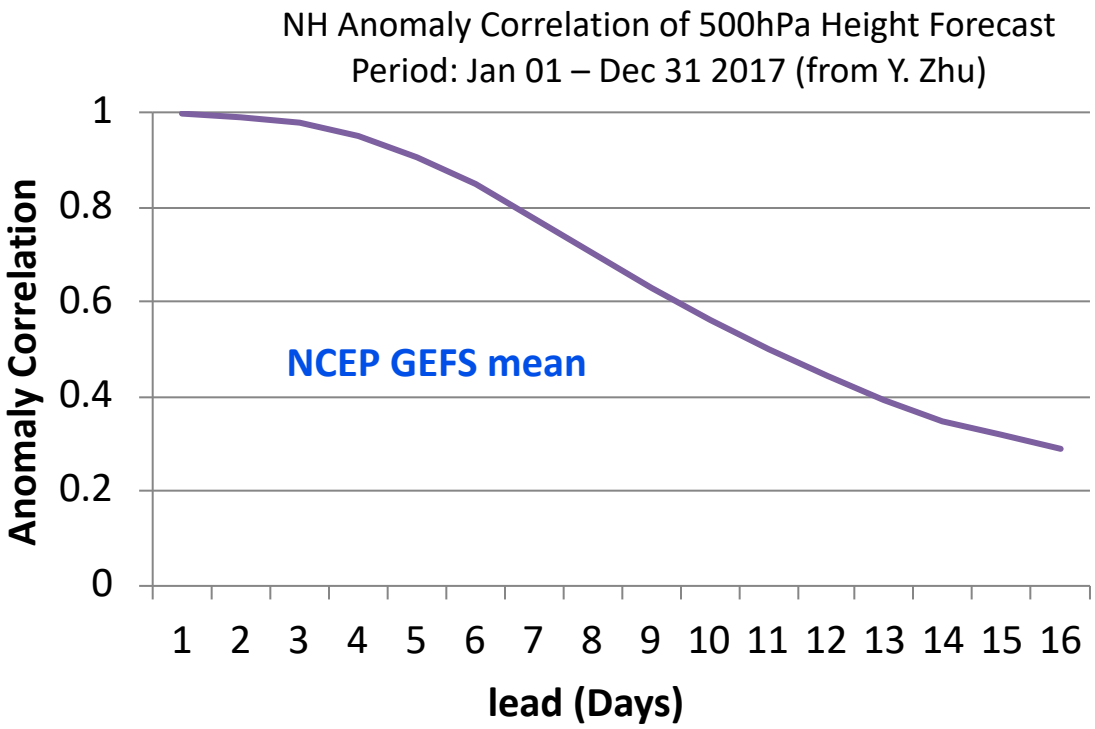
Rational



Weather forecast skill decays fast with lead time, meanwhile, big anomalies of variables occurred in early period of a month could have big impact to their monthly mean values, thus for a short-lead monthly forecast, its skill could be improved by counting the skill decay from the initial state through the forecast period.

Procedure

1. Calculate hindcast skill (temporal AC) for the 4 sub-monthly periods : a)Days 1-3, b)Days 4-7, c)Days 8-14, d)Days 15-30

2. Construct 30-day weighted mean forecast by weighting the 4 sub-monthly forecasts with their hindcast AC skill:

$$f_w = \frac{1}{30}\sum_{n=1}^{4} d_n f_n \, AC_n$$

Where d is the day number, f the forecast, AC the temporal anomaly correlation skill in hindcast.

Data:

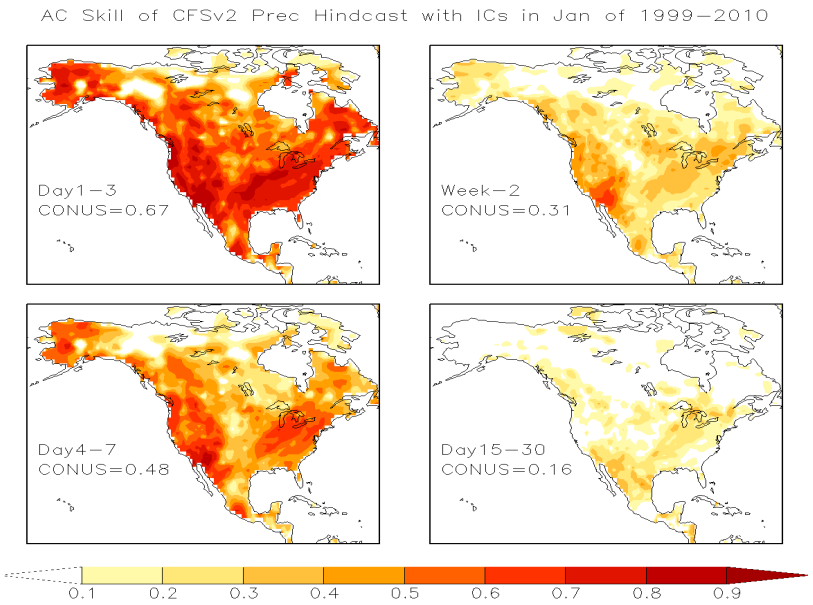
1. CFS 45-day hindcast (1999-2010), forecast (2011-2017)
2. Surface air temperature (SAT): CPC analyses
3. Precipitation (Prec): CPC's gauge-based unified dataset (Xie)

Hindcast skill (AC) comparison for the 4 sub-periods for Initial Conditions in January and July

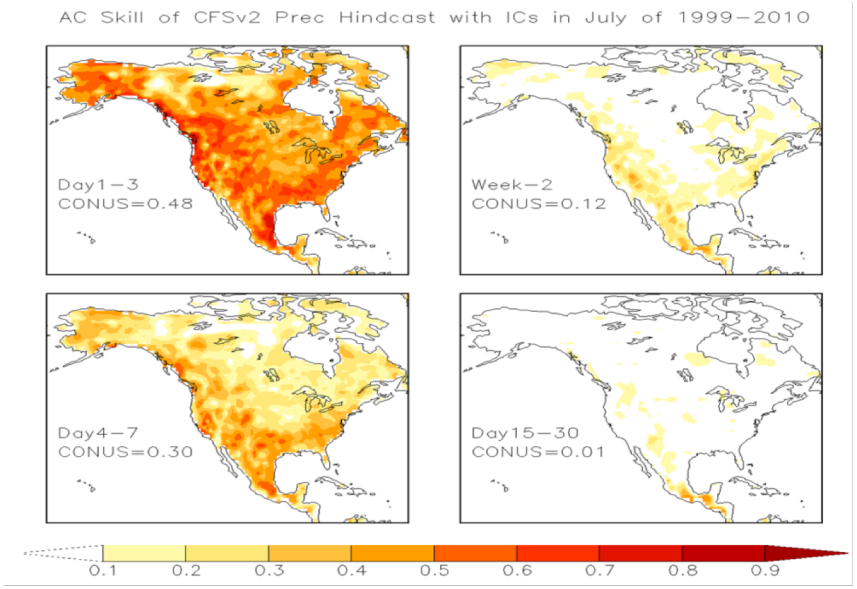
Hindcast AC Skill of Prec

ICs in Januanry

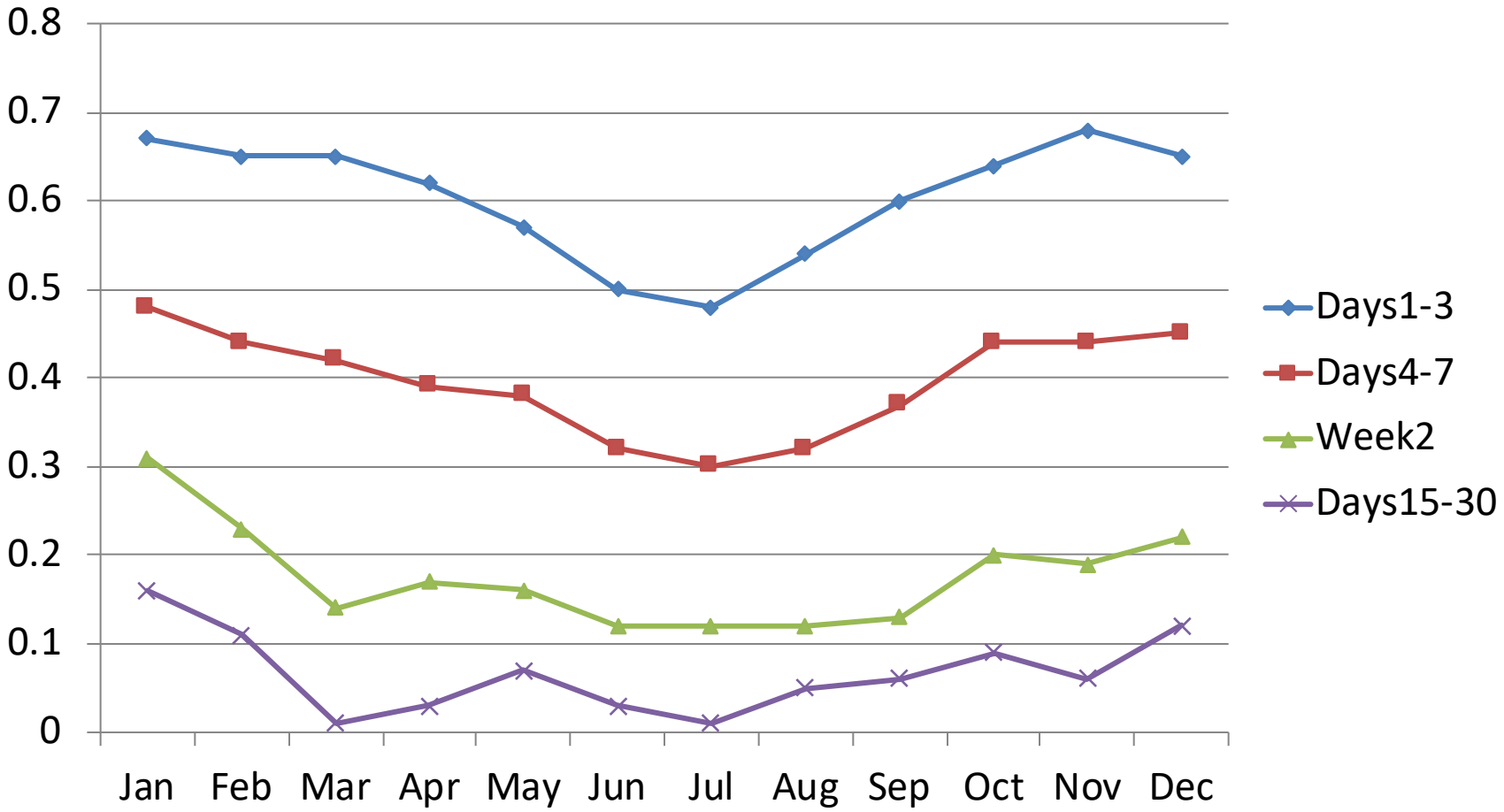
Skill decays fast from early to Late periods



ICs in July



Hindcast Prec AC Skill Averaged over CONUS

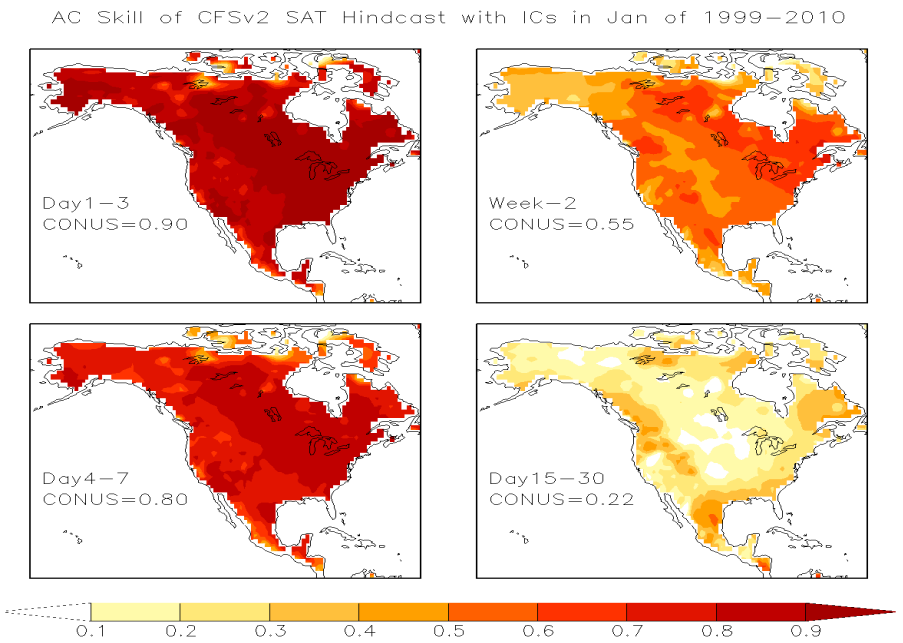


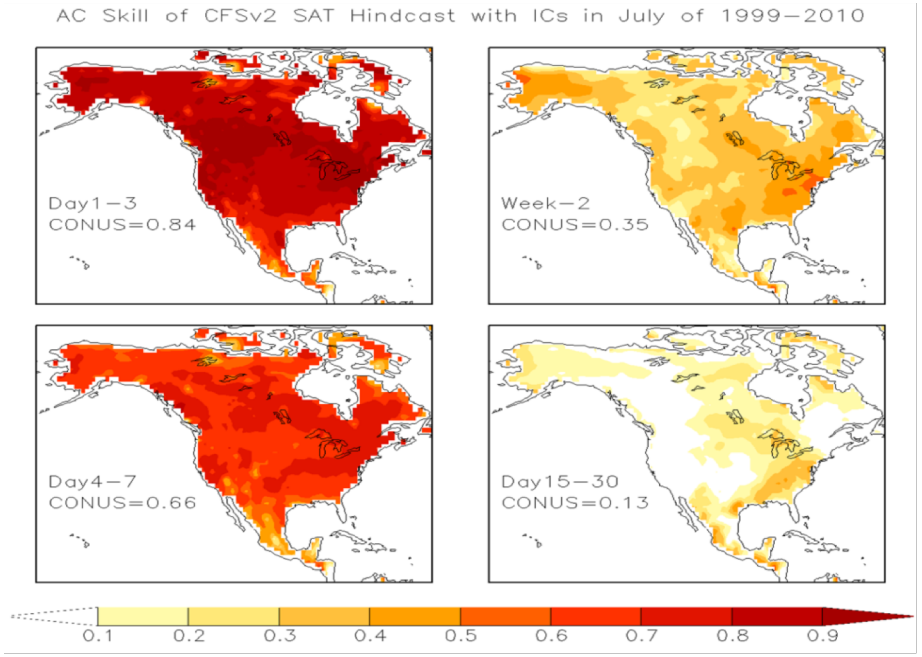
Hindcast AC Skill of SAT

ICs in Januanry

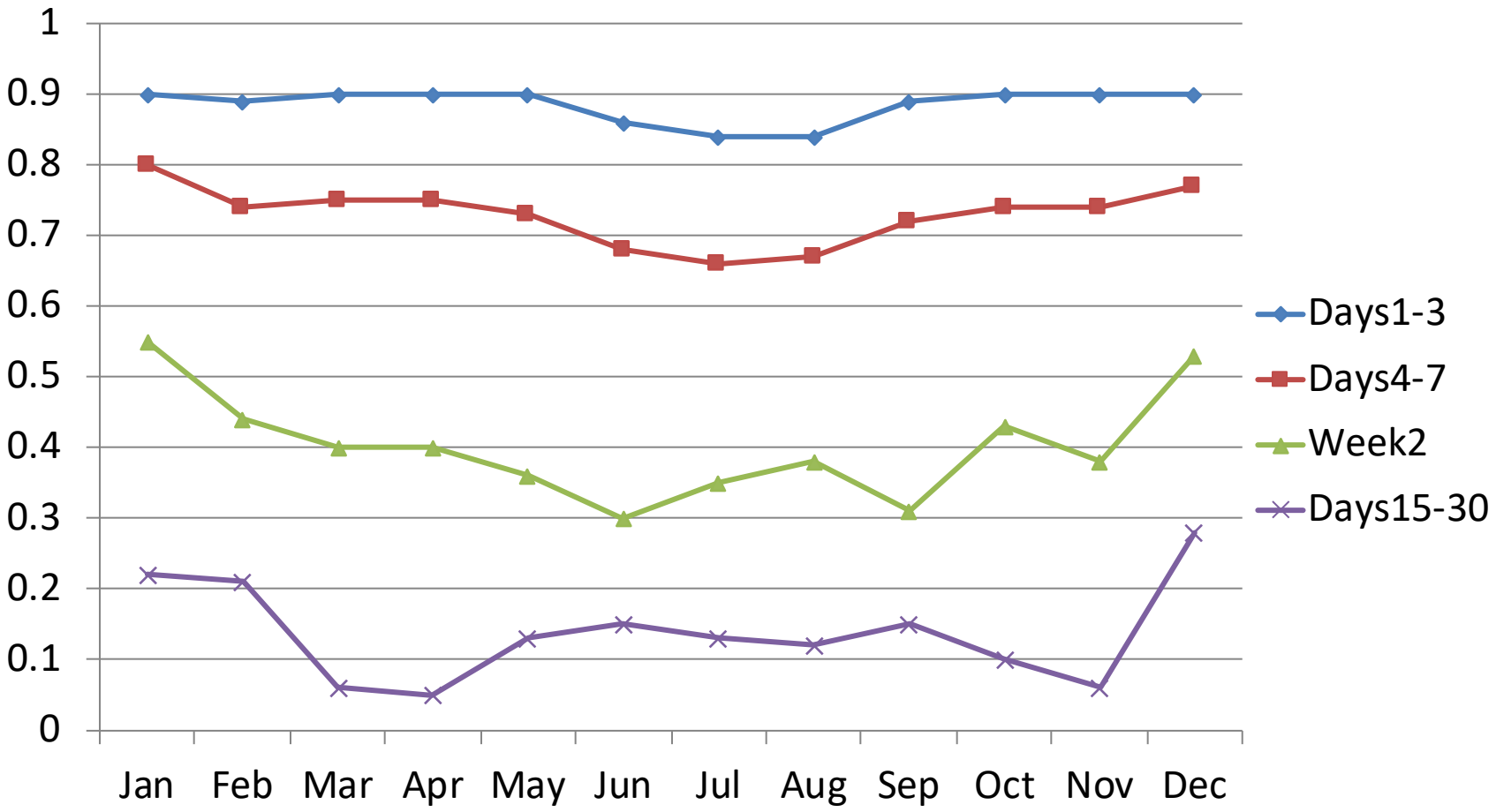
Skill decays fast from early to Late periods

ICs in July





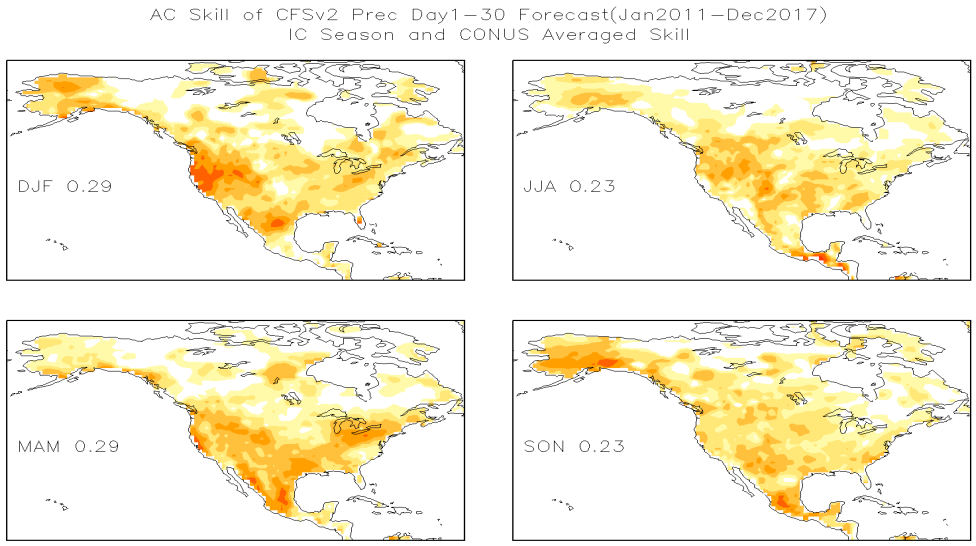
Hindcast SAT AC Skill Averaged Over CONUS



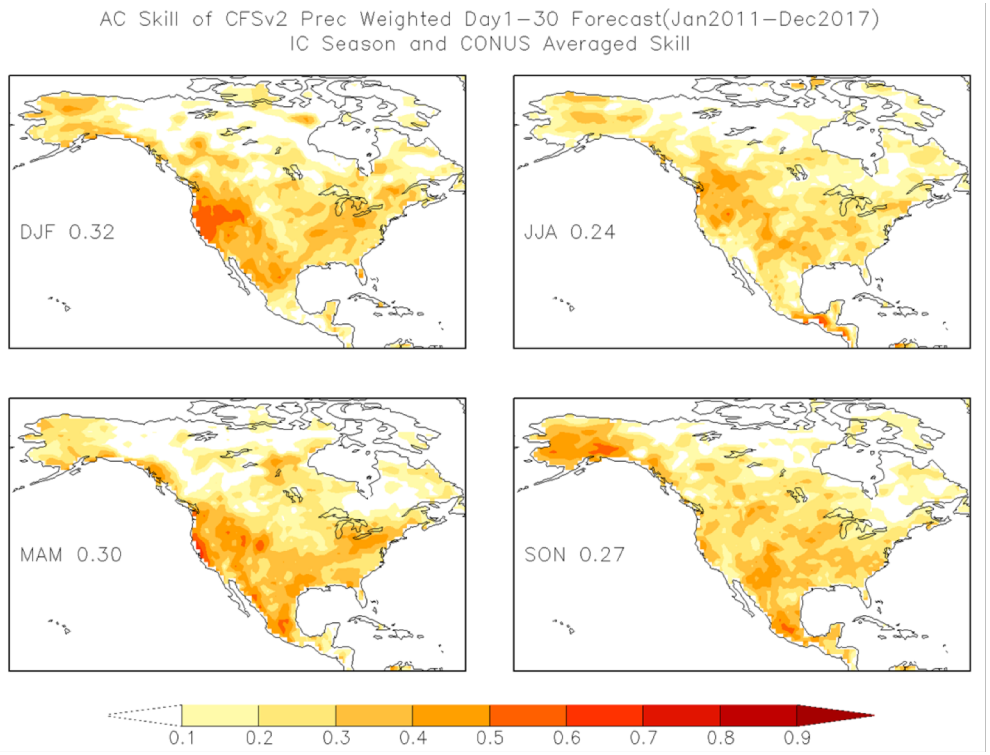
Skill comparison of 30-day mean forecast over 2011-2017: simple average vs. skill-weighted average

AC Skill of Prec

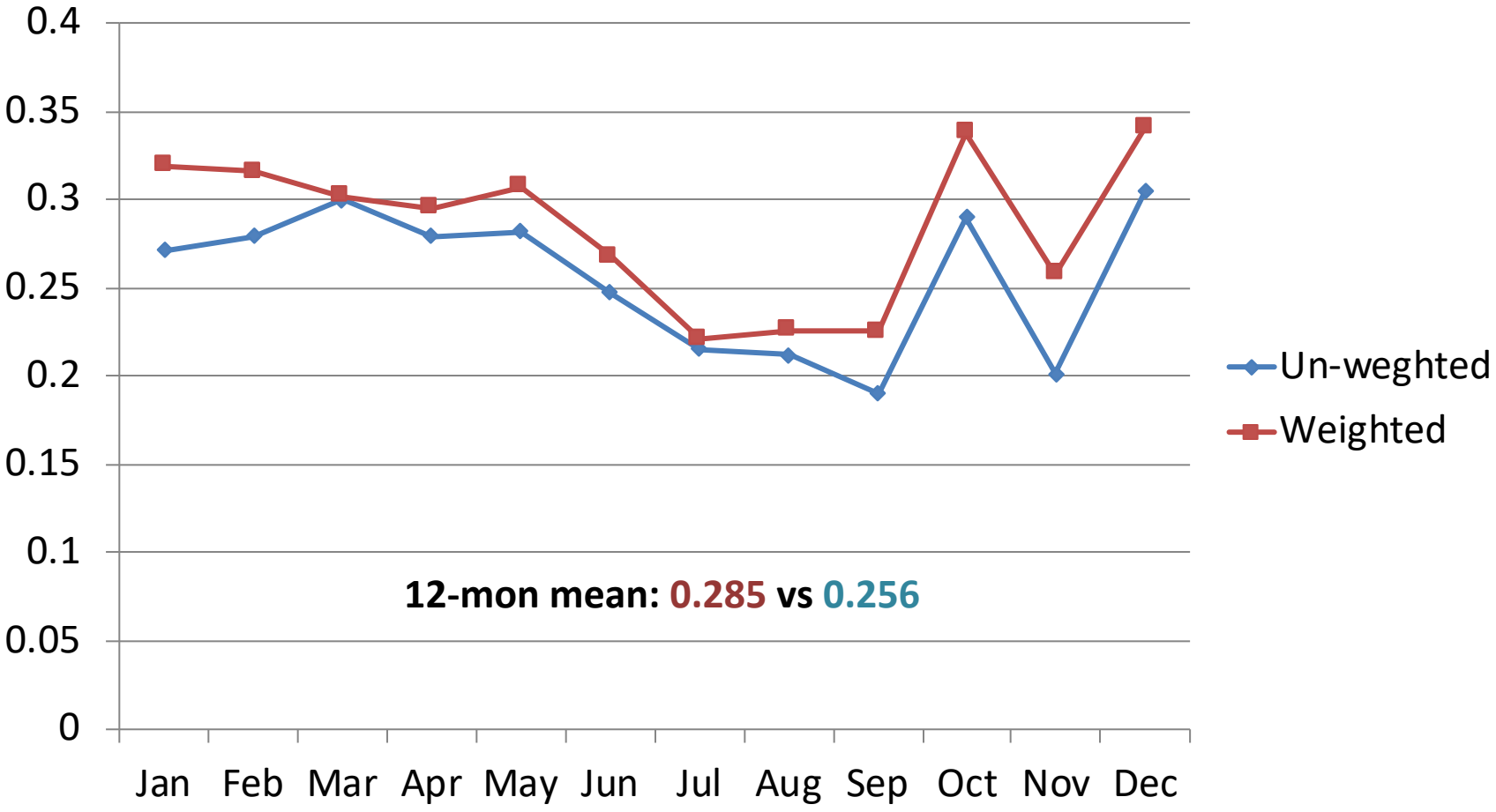
Simple 30-day average



Weighted average of the 4-sub periods



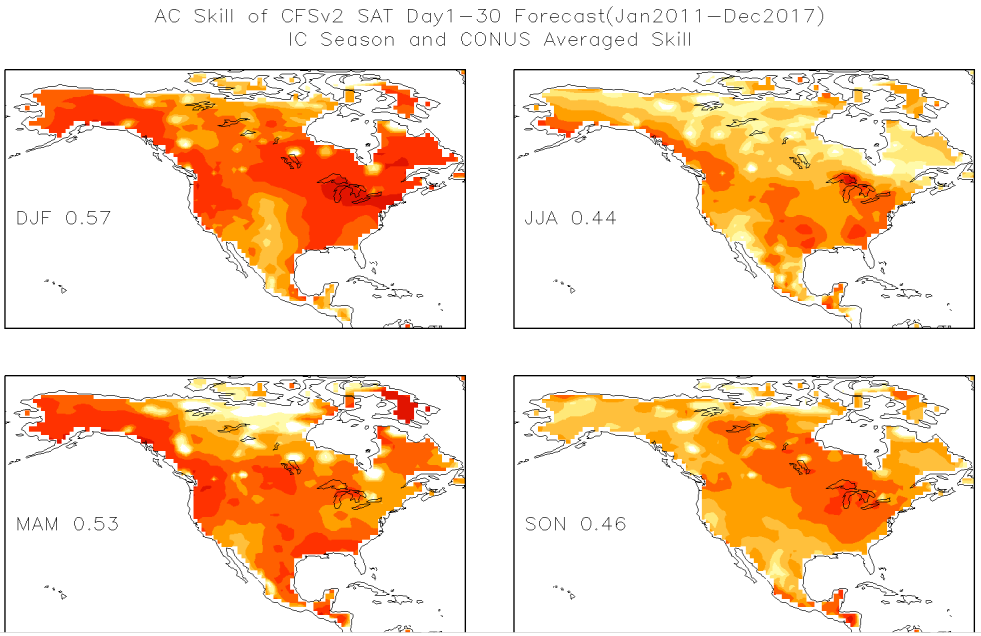
Prec AC Skill of Days1-30 Forecast over CONUS



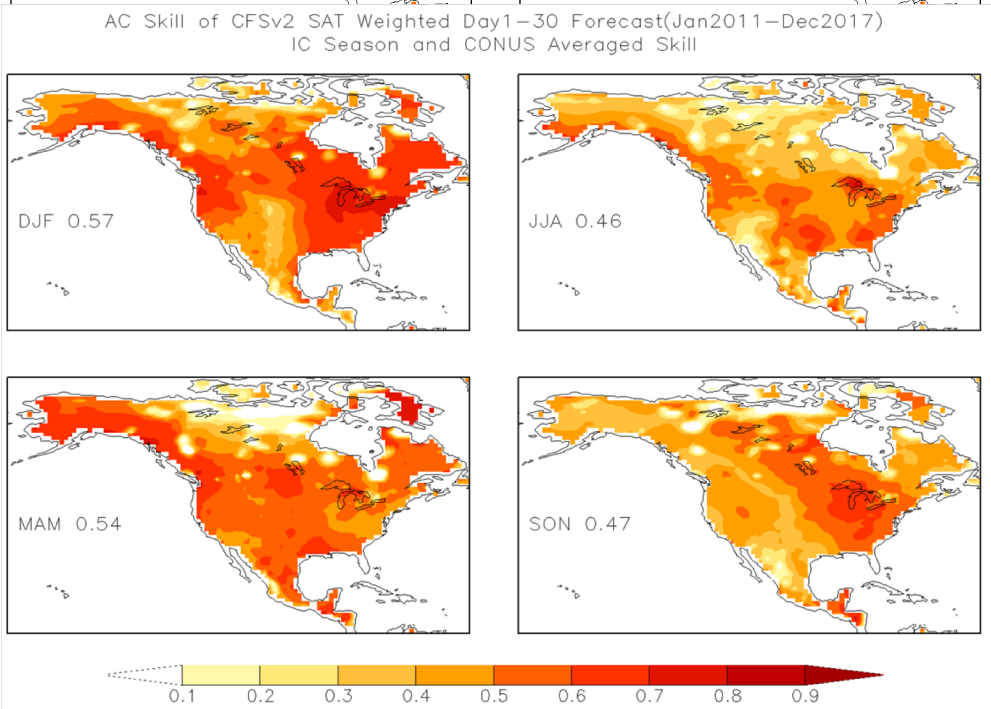
Skill improvement of the weighted mean for PREC is marginal but consistent

AC Skill of SAT

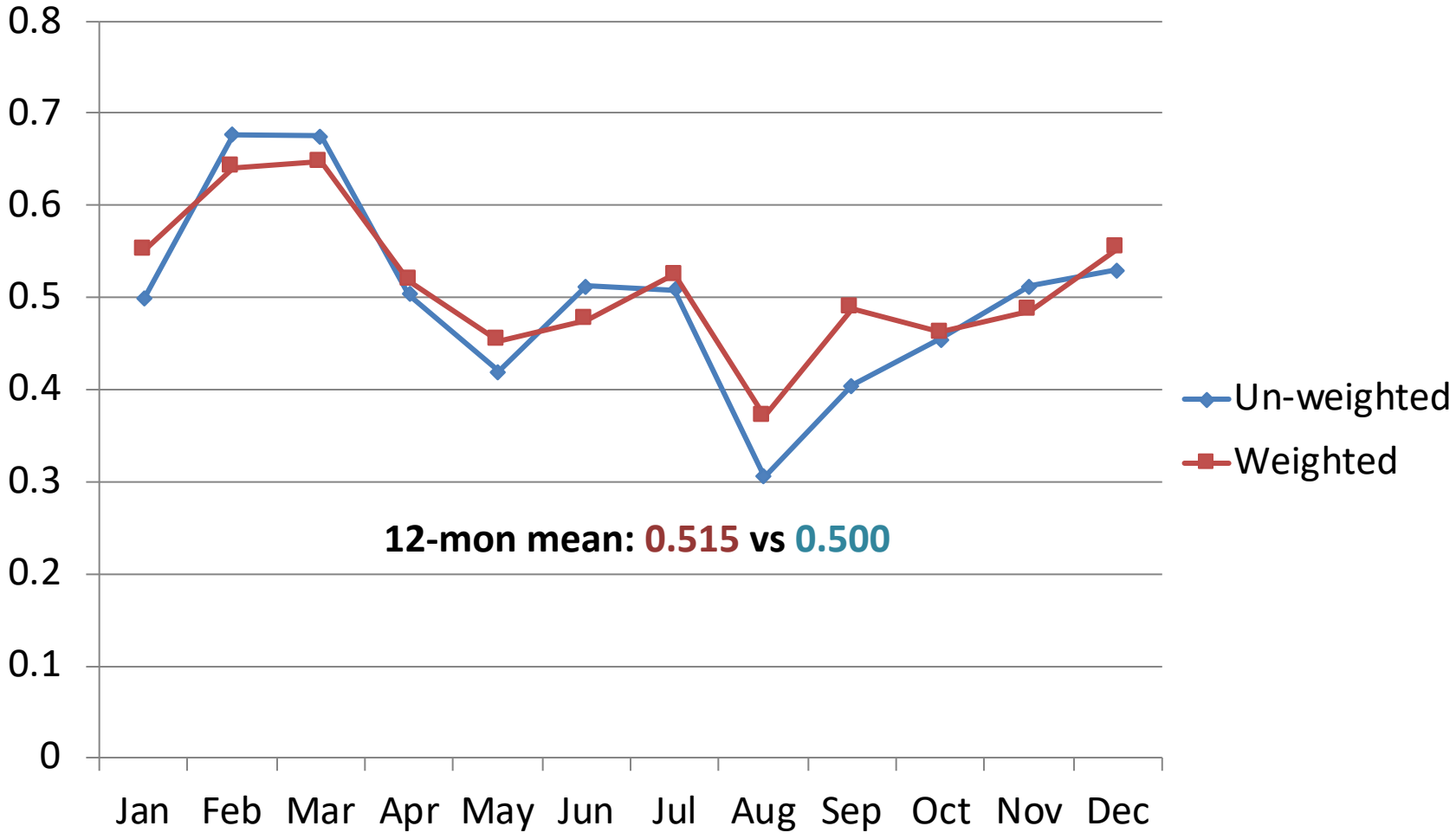
Simple 30-day average



Weighted average of the 4-sub periods



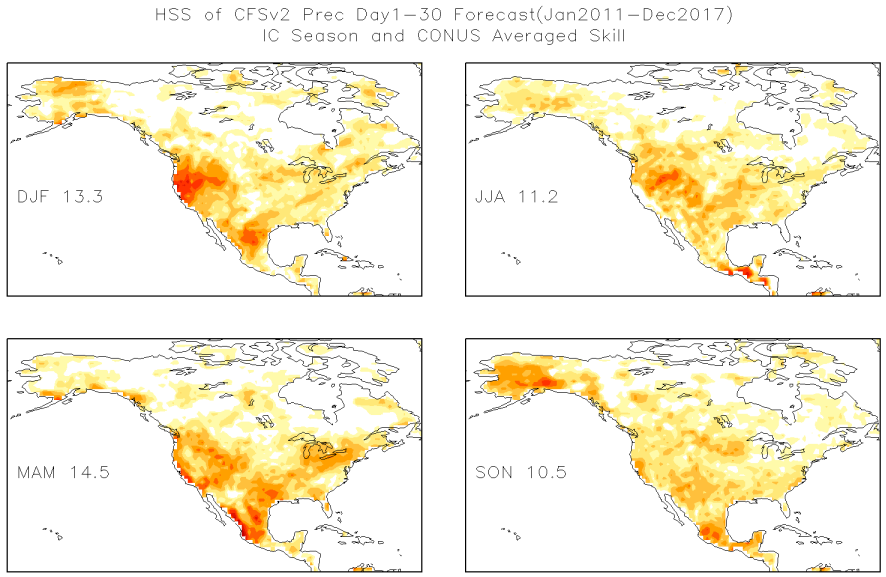
SAT AC Skill of Days1-30 Forecast over CONUS



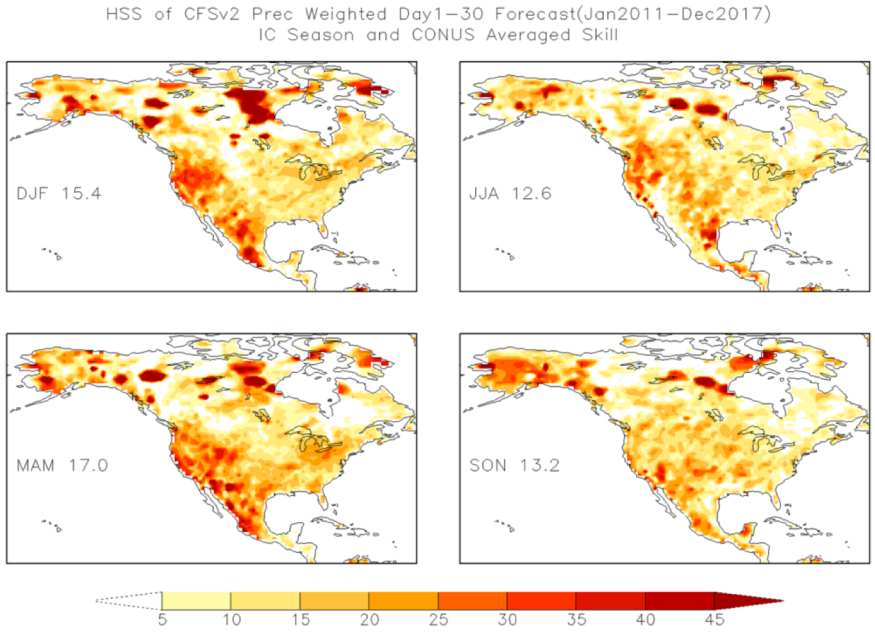
Skill improvement of the weighted mean is not obvious for SAT

Heidke Skill Score (HSS) of Prec

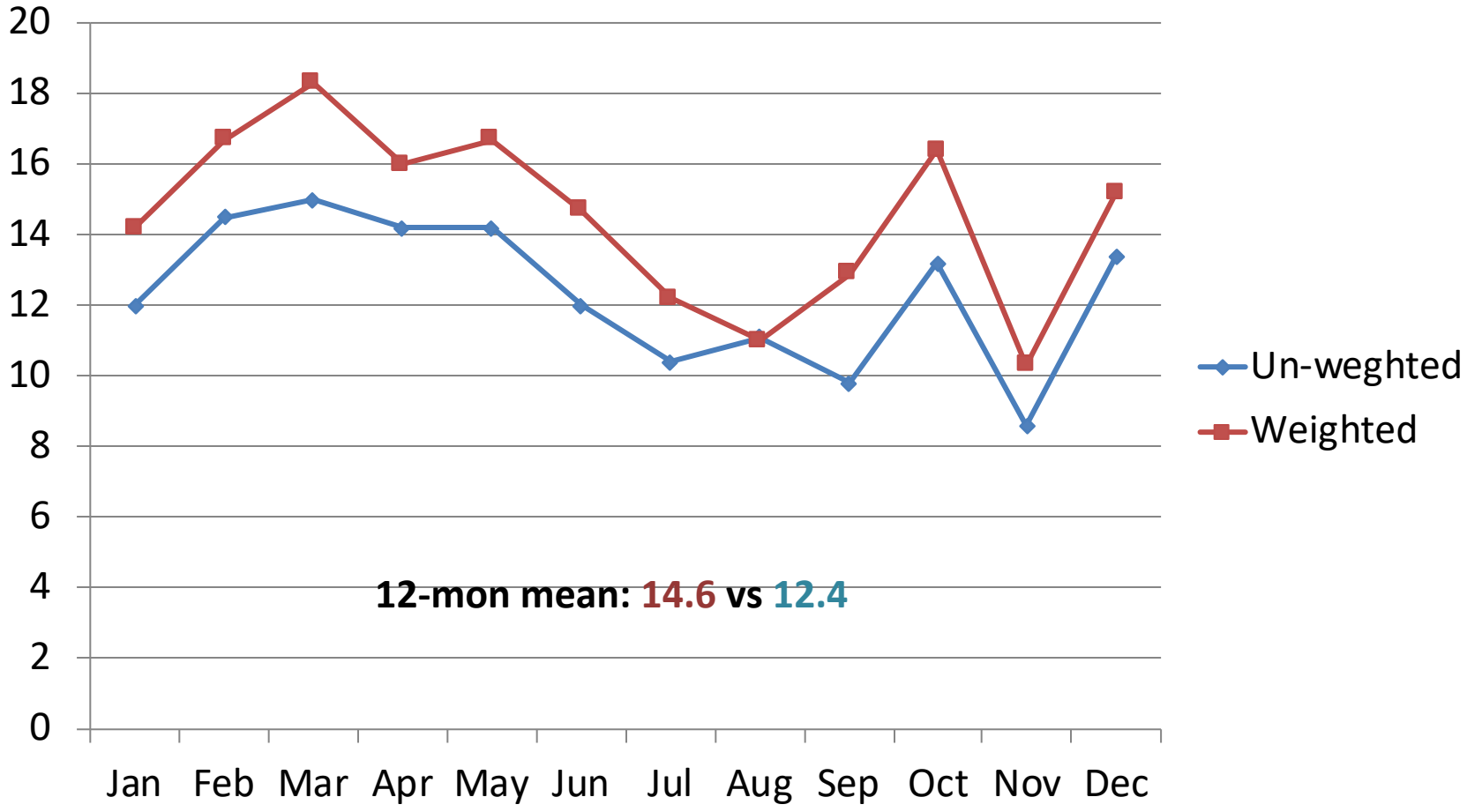
Simple 30-day average



Weighted average of the 4-sub periods

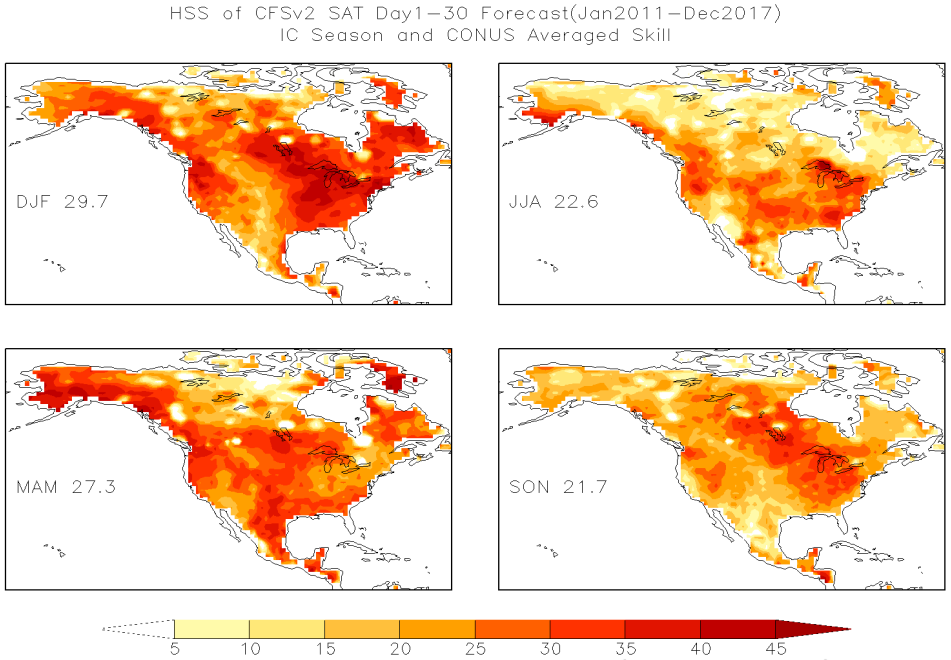


HSS of Prec Days1-30 Forecast over CONUS

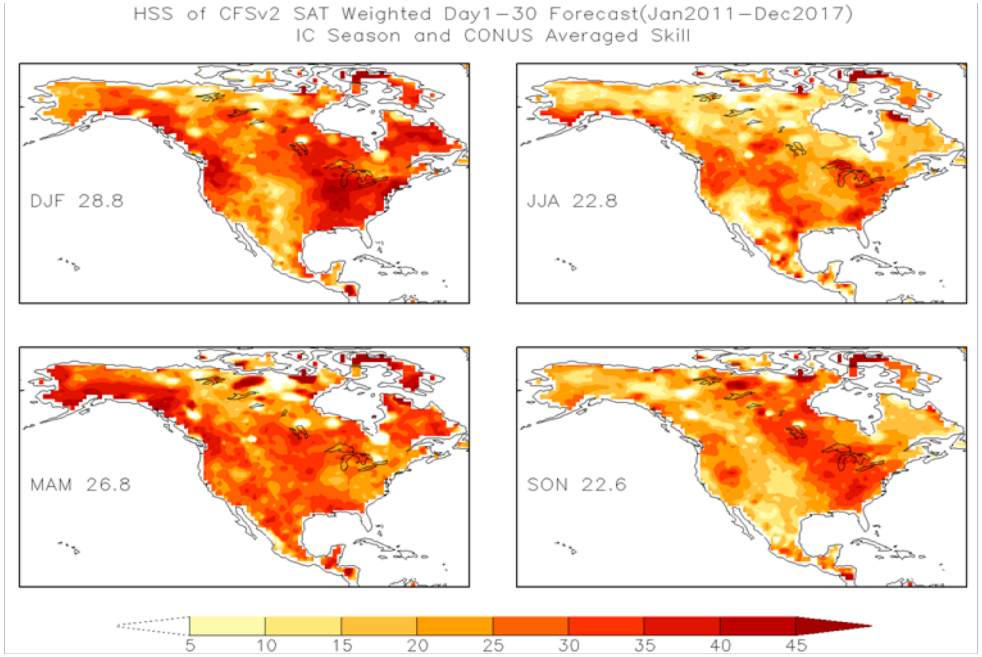


Heidke Skill Score (HSS) of SAT

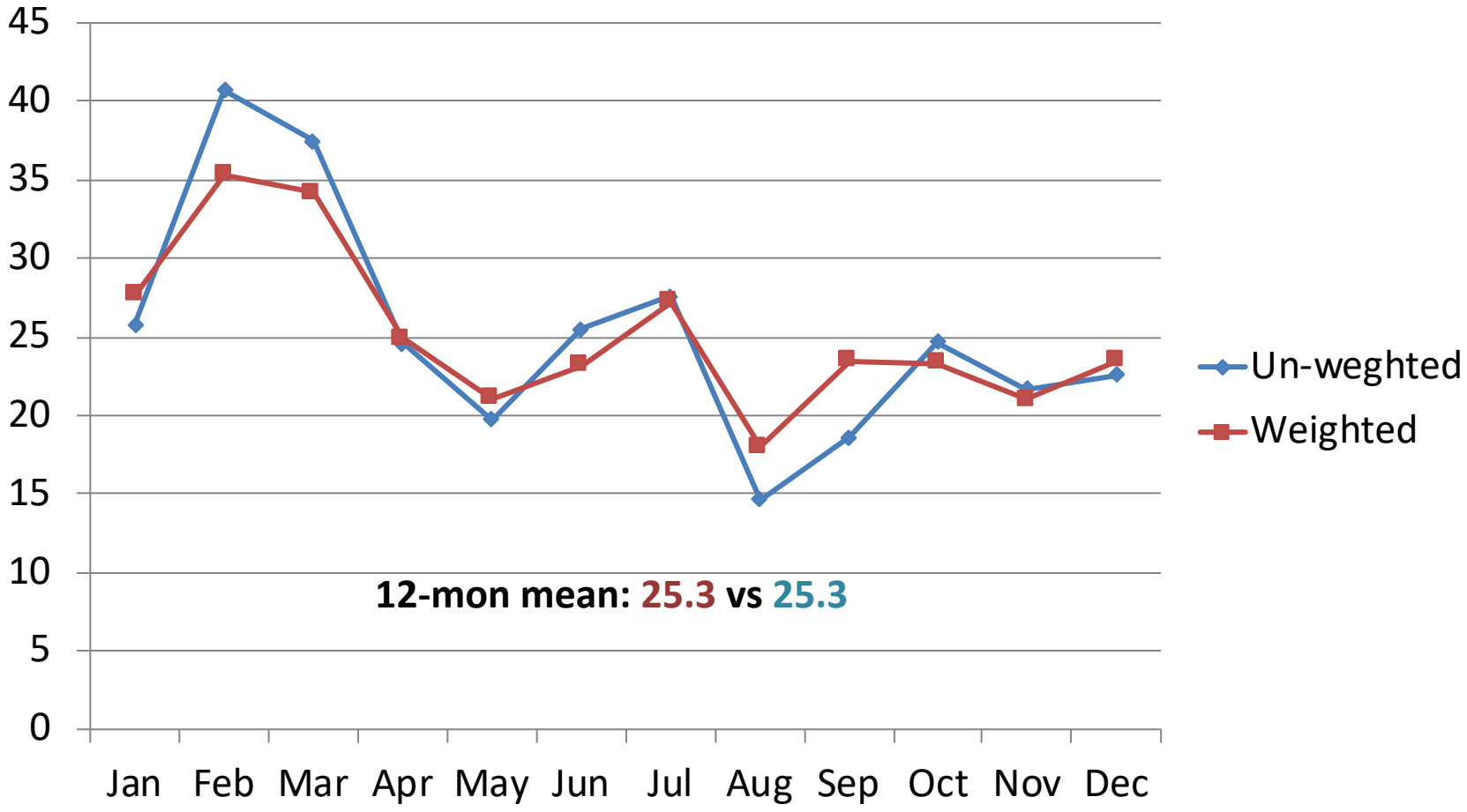
Simple 30-day average



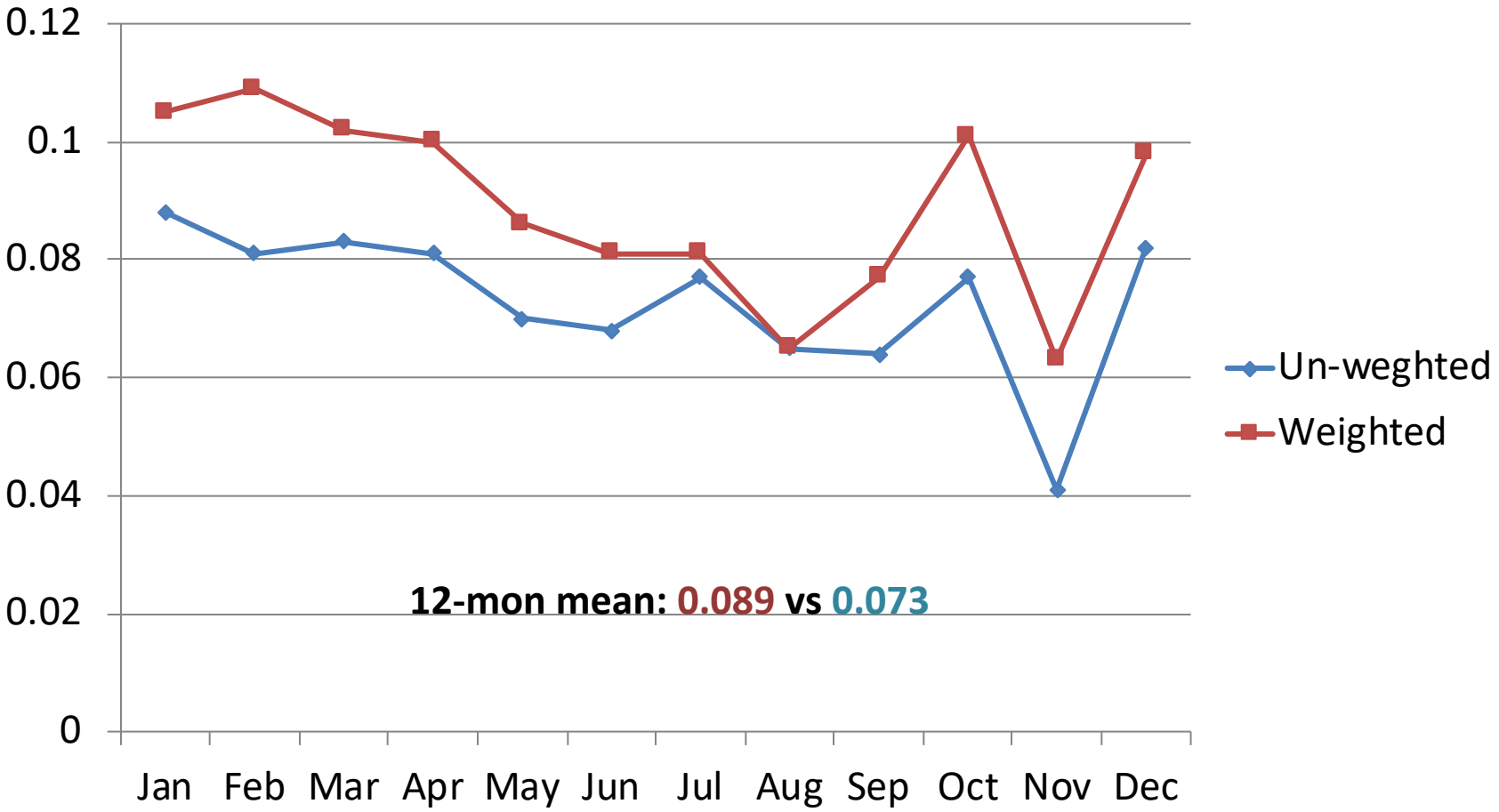
Weighted average of the 4-sub periods



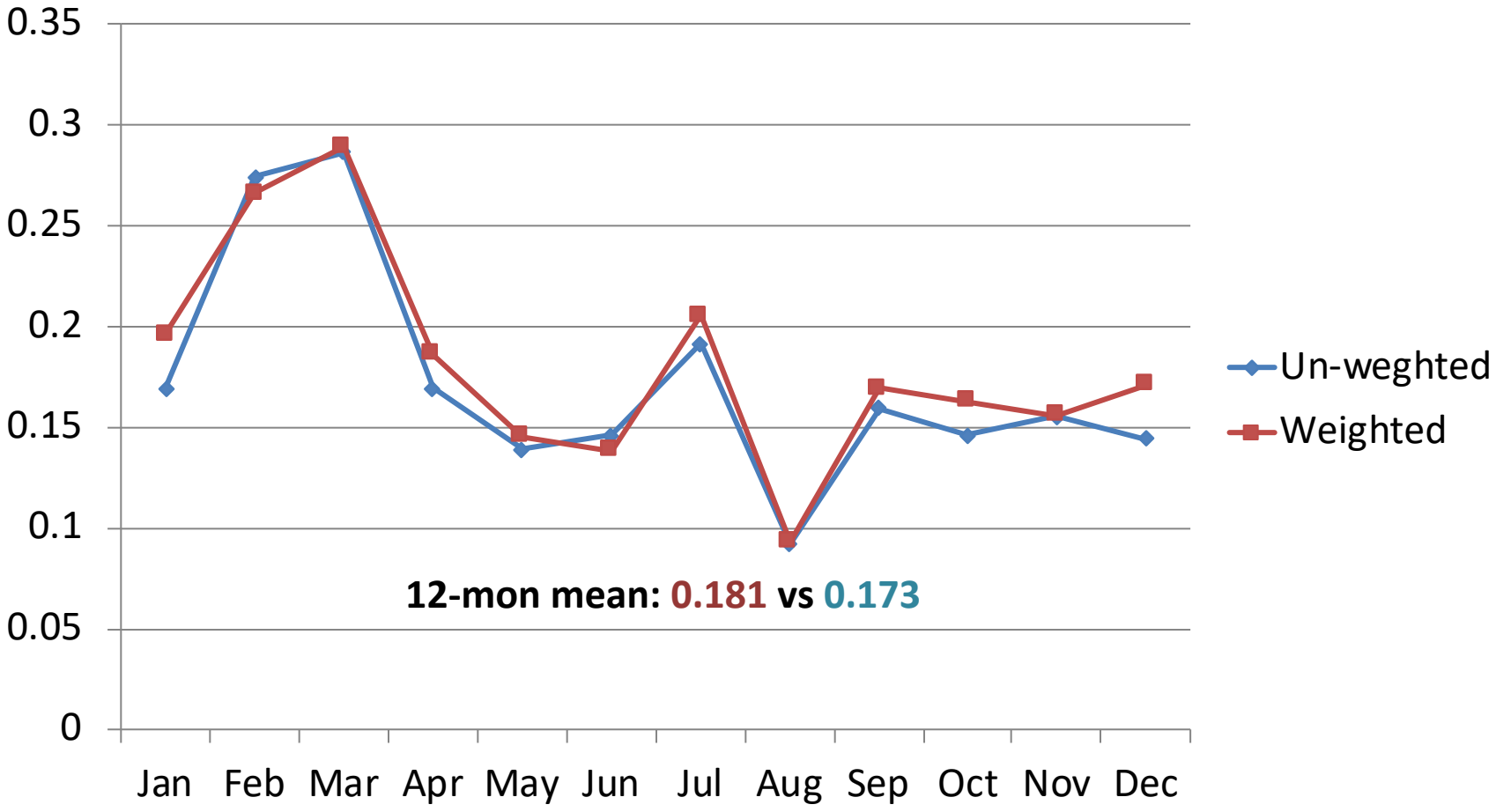
HSS of SAT Days1-30 Forecast over CONUS



RPSS of Prec Days1-30 Forecast over CONUS



RPSS of SAT Days1-30 Forecast over CONUS



Summary

- Forecast skill decays fast from early to late sub-monthly periods;
- Skill weighted short-lead 30-day forecast has marginal but consistent improvement in skill for Prec;
- As expected, SAT anomalies in early sub-monthly periods has less impact to monthly mean, as a result, skill improvement of the skill weighted forecast is not obvious;
- Possible reasons for the improvement to be limited:

  1) big anomalies don't always occur in early periods;

  2) skill dependent weighting makes the forecast skewed to higher frequency, and thus could downplay lower frequency variability, such as aliased from seasonal and inter-annual variability.