

Toward Improving Short-Lead Monthly Forecast

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1. Introduction

It is well known that 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 appropriately leveraging the decay in skill.

In this study, this idea was tested by weighting CFS forecasts of four sub-monthly periods (*i.e.*, days 1-3, days 4-7, days 8-14, and days 15-30) with their historical skill. It is found that such aggregated 30-day forecasts do have higher skill than the simple mean of the 30-day forecast.

2. Data

Model data used in this study are CFSv2 45-day hindcast for the period of 1999-2010 and forecast for the period of 2011-2017. Variables to be verified are surface air temperature (SAT) and precipitation (Prec). The verification data, both SAT and Prec are from Climate Prediction Center (CPC) analyses.

3. Procedures

We first calculated the skill of the CFS hindcast for the four sub-monthly periods, that is, days 1-3, days 4-7, days 8-14 and days 15-30, then construct 30-day mean forecast by aggregating forecast values from each of the sub-monthly periods. This was done by weighting the sub-monthly forecasts with their corresponding hindcast skill:

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

where, n is the sub-period index, d the number of days in sub-period, f the forecast, and AC the temporal anomaly correlation skill in hindcast. The earlier sub-monthly periods thus have heavier weights in the weighted forecast.

3. Results

Figure 1 shows the hindcast AC skill of SAT and Prec for the four sub-monthly periods. It is obvious that the skill decays fast with lead time, and the days 15-30 almost has no skill.

Figure 2 presents the skill of the weighted and un-weighted 30-day forecast. The improvement of the weighted forecast looks tiny for SAT, but quite obvious for Prec.

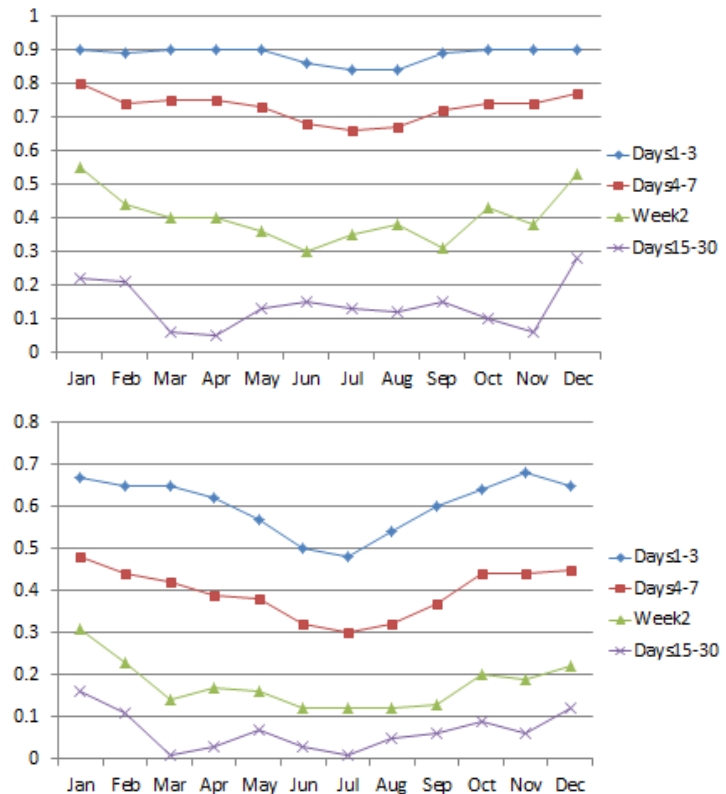


Fig. 1 Hindcast AC skill averaged over CONUS for the 4 sub-monthly periods. The upper panel is for SAT and lower panel for Prec.

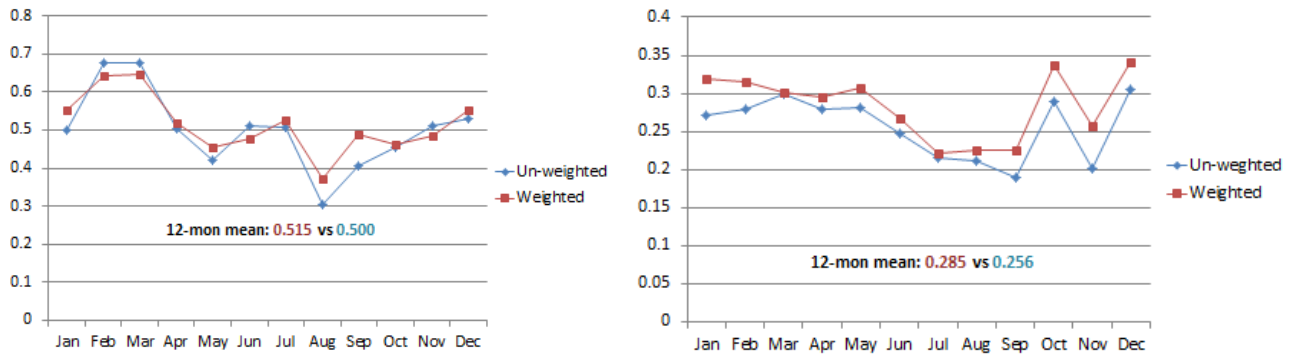


Fig. 2 Skill (AC) comparison between the weighted and un-weighted short-lead 30-day SAT (left) and Prec (right) forecast. The skill is averaged over CONUS.

4. Summary

- i. Forecast skill decays fast from early to late sub-monthly periods;
- ii. Skill weighted short-lead 30-day forecast has marginal but consistent improvement in skill for Prec, but not obvious for SAT;
- iii. As expected, big Prec anomalies in early periods are more likely to dominate monthly mean anomalies than SAT;
- iv. Possible reasons for the improvement to be limited are considered as follows.
 - a) Big anomalies don't always occur in early periods;
 - b) 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.