Impact of the SST on the 5-day Average Weather Variables in the Extended Forecast using the NCEP Global Ensemble Forecast System

Wei Li[1], Yuejian Zhu, Malaquias Peña[1], Xiaqiong Zhou[1] , Dingchen Hou
Environmental Modeling Center (EMC), NCEP/NWS, [1] IMSG at EMC/NCEP
5830 University Research Court, College Park, MD 20740

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Introduction

For weather forecast beyond two weeks, the influence of the boundary conditions (underlying SST) is found to be more dominant with the increase of lead time. To explore the impact of SST on weather forecast up to monthly time scale, we examined the forecast error from three retrospective experiments initialized during fall-winter season of 2013-2014 that forced by different prescribed SST. The different SST conditions include a 90-day e-folding SST towards observed climatology (control), the observed SST (AMIP-style) and SSTs forecasted from the CFSv2 (two-tiered). For each experiment, the ensemble forecast system is integrated for 35 days with 20 members involved in the forecast system.

The weather forecast on monthly time scale is subject to much larger error and noise than the short range due to the growth of the error with forecast time. As such, one way to improve the forecast skill for longer lead time is to perform the time-average on the forecast result to remove the short term noise. In this work, we compared the forecast error for 5-day mean weather variables from three retrospective experiments. The results indicate that over the North America, the observed and CFS SST both helped reduce the forecast errors for near surface temperature and precipitable water over different latitude after two weeks, with more significant improvement for observed SST case. Comparison between the daily verification with the 5-day running mean shows that the forecast error is reduced after taking time mean, indicating a smooth of the signal.

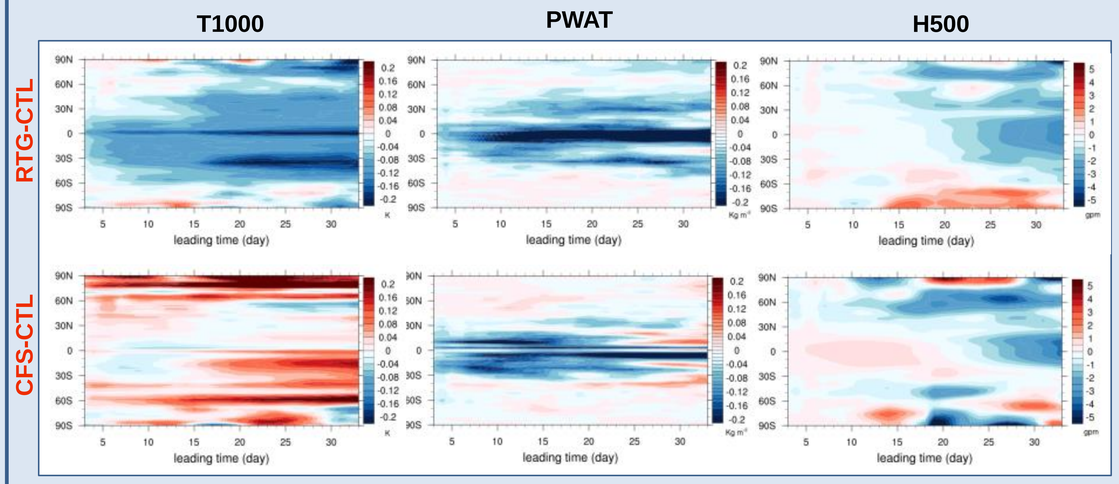
A modified CFS SST scheme (removed SST forecast errors) is ongoing. Based on all these results, we will investigate a GEFS scheme suitable for extended forecasts especially over the North American continent.

Experimental Design

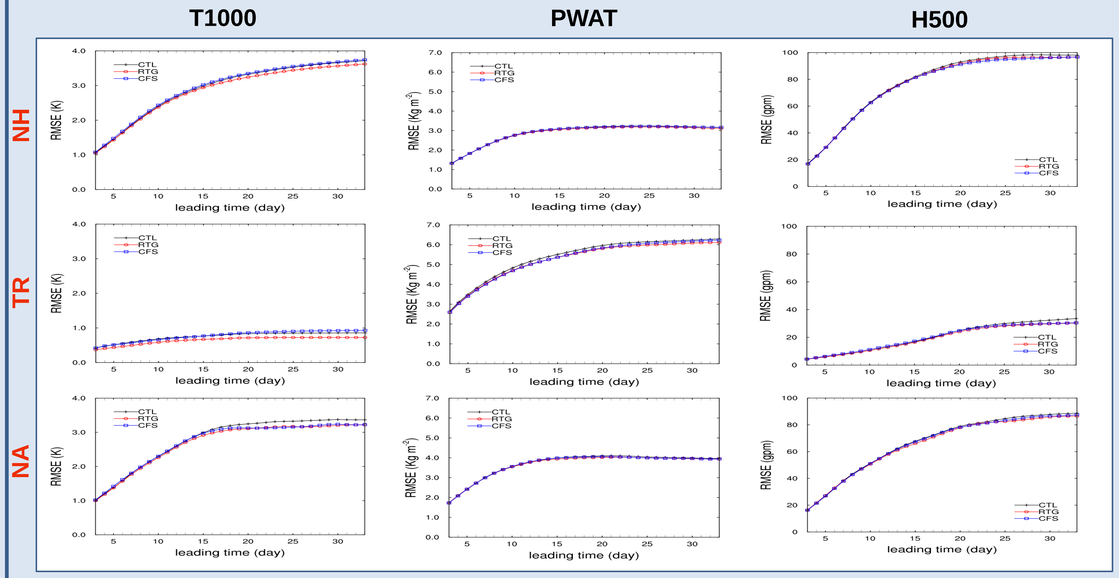
- **Forecast System:** GEFS, 20 members, integrated to 35 days
- **Resolution:** T574L64 (33 km); 0-8 days; T382L64 (55 km); 8 to 16 days; T254L64 (73 km); 16 to 35 days
- **Initialization:** September 1, 2013 - February 28, 2014, 00Z
- Prescribed SST
  - **Scheme 1 (CTL):** Initial SST anomaly damped (90 days e-folding) towards observed climatology, which is same as the operational GEFS.
  - **Scheme 2 (RTG):** Using NCEP Real Time Analysis as a time-varying SST.
  - **Scheme 3 (CFS):** Using operational CFSv2 forecast SST that changed every 24 hours. Also a time-varying SST.
- **Analysis Method:** 5-days running mean is applied to both forecast and analysis data
- **Reference used for Verification:** NCEP GFS analysis data
- **Verification Metric:** RMSE

Results

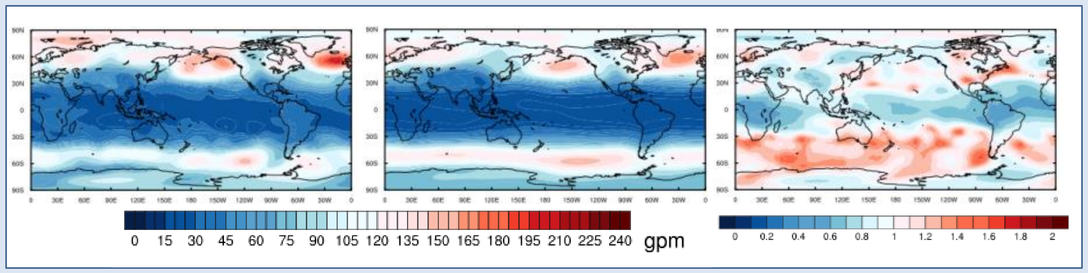
1. Zonally Average of the RMSE Difference



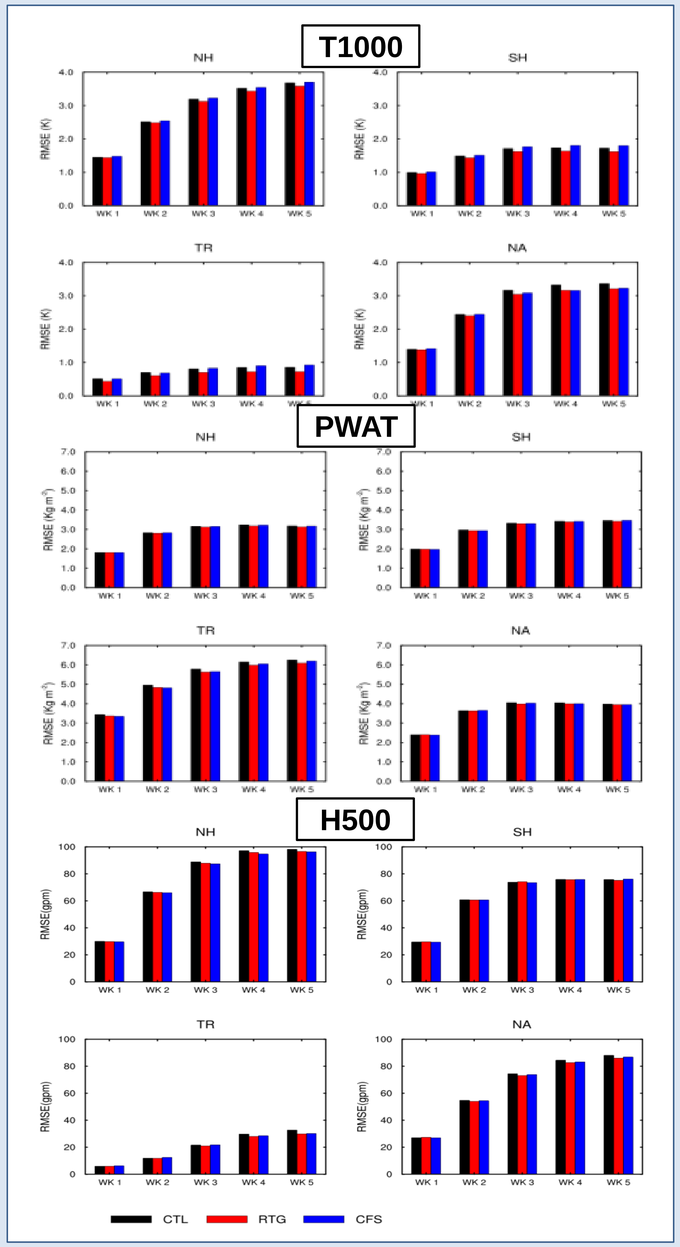
2. Evolution of RMSE for Different Domains



3. RMSE vs. Spread (H500)



Summary



- For forecast beyond two weeks, RTG and CFS SST both help reduce the forecast errors of near surface temperature, 500 hPa height and 200 hPa zonal wind (not shown) over the North America.
- More realistic (i.e. RTG) SST helps reduce the forecast error of PWAT over the tropics.
- Changing the GEFS SST has the most significant impact on the forecast of near surface temperature.
- GEFS ensemble represent the forecast error reasonably.