Daily Climatological Mean and Standard Deviation in NCEP Climate Forecast System Reanalysis

Bo Yang
System Research Group and Environmental Modeling Center, National Center for Environmental Prediction

Yuejian Zhu, Bo Cui and Malaquias Pena
Environmental Modeling Center, National Center for Environmental Prediction

Daily climatological mean and standard deviation on each grid point for 20 variables (geo-potential heights at 1000hPa, 700hPa, 500hPa, and 250hPa; zonal and meridional winds at 850hPa, 500hPa, and 250hPa; air temperatures at 850hPa, 500hPa, 200hPa; 2-m air temperature, maximum 2-m air temperature, minimum 2-m air temperature; mean sea-level pressure; precipitable water) from National Center for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR) were calculated with a modified analysis package originally developed for NCEP/NCAR 40-year reanalysis data (Zhu and Toth 2005). The CFSR 31-year reanalysis (1979-2009) is a global coupled atmosphere-ocean-land surface-sea ice system with more advanced data assimilation and much higher spatial (half degree) and temporal resolution (hourly) than those of NCEP/NCAR 40-year reanalysis. In the current analysis, the daily climatological mean and standard deviations for 20 variables in CFSR are generated at 00z, 06z, 12z, and 18Z, and with both the original half degree resolution and the interpolated one degree resolution, respectively. For three near-surface temperature variables, the climatology of the mean was produced using a 45-day triangular filter over the 31-year average, whereas the climatology of the standard deviation was produced using a 61-day triangular filter over the 31-year-averaged standard deviation. For other 17 variables, the first four modes of the Fourier expansion were extracted from the 31-year data to reconstruct the climatological mean. A slope of standard deviation from month to month was obtained using the monthly average of the daily standard deviation calculated with respect to the reconstructed climatological mean. Finally the climatology of standard deviation was reconstructed with the monthly mean standard deviation and the slope via linear interpolation.

Comparison of the daily climatological mean and standard deviation obtained from CFSR and those from NCEP/NCAR reanalysis suggests that only minor differences are found in the primary variables such as 500hPa geo-potential height. However, in terms of near surface temperature variables, CFSR has much finer structures than NCEP/NCAR reanalysis, especially over the land area. Considerable differences were also found between the mean and standard deviation of the wind fields in CFSR and those in NEP/NCAR reanalysis. Overall, the first four modes are enough for primary variables such as 500-hPa geo-potential heights in both CFSR and NCEP/NCAR reanalysis, whereas wind and near surface variables require more modes.

The CFSR daily climatological mean and standard deviation provide an updated probabilistic guidance for ensemble-based anomaly forecast. The operational application of the CFSR to weather and week-2 anomaly forecast in the NCEP Global Ensemble Forecast System (GEFS) will be discussed. Further study of high impact extreme weather (and/or extended) forecast will be presented in a separate abstract (Malaquias et al.).

Corresponding Author:

Name: Bo Yang
Organization: System Research Group and Environmental Modeling Center, National Center for Environmental Prediction
Address: Room 807, NOAA World Weather Building (WWB), Science Center
5200 Auth Road
Camp Springs, MD 20746-4304
USA