Land Surface Climatology in the NCEP Climate Forecast System Reanalysis

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The 31-year (1979-2009) NCEP Climate Forecast System Reanalysis (CFSR) was released in 2011. The CFSR land surface states, including soil moisture, soil ice and soil temperature, and snow depth and snow water equivalent, are generated by a coupled Global Land Data Assimilation System (GLDAS) using blended CFSR atmospheric model forcing and observed precipitation forcing. Compared to the previous two generations of NCEP global reanalysis, the hallmark of this CFSR GLDAS is the use of observed precipitation to drive the land surface component of the reanalysis, rather than the typical reanalysis approach of using precipitation from the assimilating background atmospheric model. It is also for the first time observed snow fields are used in the reanalysis. The NCEP CPC Merged Analysis of Precipitation (CMAP), the CPC unified global daily gauge precipitation analysis, the Air Force Weather Agency (AFWA) global daily snow depth analysis, and the NESDIS Interactive Multisensor Snow and Ice Mapping System (IMS) northern hemisphere daily snow cover analysis are used.

CFSR was produced by running 6 simultaneous streams of analyses over the 31-year period with each stream covering a period of 4-8 years. A full 1-year overlap between the streams was designed to address spin up issues concerning the deep soil, the deep ocean, and the upper atmosphere. However, there are still unanswered questions as to whether the 1-year spin up period is sufficient for the soil, whether discontinuities appear between stream boundaries, and whether the global and regional land surface climatological variability are correctly represented. To address these issues, this study will compare the soil moisture from CFSR with those from the NCEP Global Reanalysis 2 (R2), the NCEP North American Regional Reanalysis (NARR), and the NCEP North American Land Data Assimilation System (NLDAS). Furthermore, a retrospective, single stream, uncoupled GLDAS is in process to provide a baseline benchmark to better answer those questions, where special attention is paid to the initial spin-up of the land. The uncoupled retrospective GLDAS runs as a single continuous stream with identical land surface configurations as in the coupled CFSR, including the same T382 resolution, the same Noah land surface model, the same land surface characteristics, and the same blended CFSR atmospheric model forcing and observed precipitation forcing. The difference between the coupled CFSR and the uncoupled GLDAS is that, in the coupled CFSR, the Noah land surface model simulated soil moisture and soil temperature are used to simulate the energy and moisture fluxes between the land surface and the atmosphere, hence an influence on the future atmospheric forcing. On the other hand, the uncoupled GLDAS simulated soil moisture and soil temperature have no impact on its atmospheric forcing. Since the same Noah land surface model configurations and the same atmospheric forcing are used, it is expected the uncoupled GLDAS simulated land surface states will be very similar to that in CFSR until the end of the first CFSR stream. For the rest of the simulation period, the differences between GLDAS and CFSR land surface states will be investigated. This retrospective CFSR GLDAS also provides an enhanced global land surface climatology for future applications such as a proposed global drought monitor. The NCEP Land Team currently supports the U.S. National Integrated Drought Information System (NIDIS) applications such as U.S. drought monitor (drought.gov), the NCEP monthly drought briefing (www.cpc.noaa.gov/products/Drought), and NCEP seasonal drought outlook (www.cpc.noaa.gov/products/expert_assessment/seasonal_drought.html).

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