Seasonal, Interannual, intraseasonal and Diurnal Variations of Global Precipitation Depicted in the Reanalyses and Observations

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Seasonal, interannual, intraseasonal and diurnal variations of global precipitation and their representation in three sets of new generation global reanalyses are examined using the newly completed high-resolution CPC Unified Gauge-Satellite Merged Precipitation Analysis for a 14-year period from 1998 to 2011. The gauge-satellite merged precipitation analysis used here is defined by adjusting the original CMORPH high-resolution satellite estimates against two sets of long-term climate records, i.e., the CPC unified daily gauge analysis over land and the pentad GPCP over ocean, respectively. The reanalyses examined here include the NCEP CFS reanalysis (CFSR), NASA/GSFC MERRA, and ECMWF Interim. The adjusted CMORPH is integrated from its original resolution of 8kmx8km and hourly to the reanalyses grid systems to facilitate the verification.

First, quantitative agreements between the reanalysis precipitation fields and the CMORPH satellite observation are examined over the global domain. Precipitation structures associated with the large-scale topography are well reproduced when compared against the observation. Evolution of precipitation patterns with the development of transient weather systems are captured by the CFSR and two other reanalyses. The reanalyses tend to generate precipitation fields with wider raining areas and reduced intensity for heavy rainfall cases compared the observations over both land and ocean. Seasonal migration of global precipitation depicted in the 14-year CMORPH satellite observations is very well captured by the three sets of new reanalyses, although magnitude of precipitation is larger, especially in the CFSR, compared to that in the observations. In general, the three sets of new reanalyses exhibit substantial improvements in their performance to represent global precipitation distributions and variations. In particular, the new reanalyses produced precipitation variations of fine time/space scales collated in the observations.

The diurnal cycle of the precipitation is reasonably well reproduced by the reanalyses over many global oceanic and land areas. Diurnal amplitude of the reanalyses precipitation, defined as the standard deviation of the 24 hourly mean values, is smaller than that in the observations over most of the oceanic regions, attributable largely to the continuous weak precipitation throughout the diurnal cycle in all of the three reanalyses. Over ocean, the pattern of diurnal variations of precipitation in the reanalyses is quite similar to that in the observations, with the timing of maximum precipitation shifted by1-3 hours. Over land especially over Africa, the reanalyses tend to produce maximum precipitation around noon, much earlier than that in the observations. Particularly noticeable is the diurnal cycle of warm season precipitation over CONUS in association with the eastward propagation of meso-scale systems distinct in the observations. None of the three new reanalyses are capable of detecting this pattern of diurnal variations. A comprehensive description and diagnostic discussions will be given at the conference, covering the performance of the three sets of new reanalyses in producing precipitation variations of diurnal to inter-annual time scales.

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