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Global Climatology of Precipitation-State of Knowledge and Issues

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An attempt is made to summarize the state of knowledge of the climatology of global and regional surface precipitation by examining a number of satellite and satellite-gauge analyses. The goal is to produce best estimates of global precipitation values, monthly climatological maps and estimates of bias errors. The approach uses two analyses as starting points. The first is the Global Precipitation Climatology Project (GPCP) monthly data set, which is a globally complete satellite and gauge combination analysis. The second primary data set is the new TRMM Composite Climatology (TCC) based on ten years of multiple (both radar and passive microwave) TRMM products. The time period chosen for the exercise is 1998-2007 in order to overlap with TRMM period. This activity is also part of a larger effort with other investigators to estimate balanced global and regional water cycle means and variations with the help of estimated errors of the various fluxes.

With the GPCP data as the base, a zonal-averaged analysis (land and ocean separately) is carried out using a number of included data sets, which were selected by being within +/- 50% of GPCP zonal means. For the global total precipitation during this period the GPCP number is 2.64 mm/d, with an estimated error of +/- 9%. This is probably an upper bound of the error estimate, due to inclusion of some questionable estimates. Regionally, the error maps indicate relatively large errors as expected in higher latitudes (up to $\tilde{5}0\%$), indicating serious questions at these latitudes even as to the total precipitation. Mountainous areas are also regions with larger uncertainty, as well as areas with poor gauge coverage.

A second exercise uses a set of TRMM-based estimates (different over ocean and land) to estimate the mean tropical rainfall to provide a seasonal climatology. Over both the ocean and land the Precipitation Radar (PR) “near surface” estimates (2A25-NS) are used, after the bulk estimates are adjusted for the effect of the orbit boost in 2001. The passive microwave estimates (2A12) based on data from the TRMM Microwave Imager (TMI) are included over ocean and the combined TMI/PR-based product (2B31) is used over both land and ocean. Over land the TRMM Multi-satellite Precipitation Analysis (TMPA) monthly product (3B43) is used to include passive microwave estimates, but with their overall bias restrained using raingauge information. The TRMM Composite Climatology (TCC) is simply produced by taking a mean of the three products (different by one product over ocean and land). The range of estimates provides a measure of uncertainty for the mean value. The mean tropical rain (25N-25S) is 3.0 mm/d (combined land and ocean) with an estimated error of +/- 3%. This error value is probably a lower bound, but comes about partially due to most of the TRMM products used having nearly exactly the same sampling. TRMM sampling the diurnal cycle also should result in a better estimate. Although the total estimated error is $\tilde{3}\%$, zonal mean values have errors in the 5-7 % level and areas in the eastern Pacific Ocean have 15% estimated errors.

The TCC is also compared to the GPCP in terms of total tropical values and geographic distributions. The 3.0 mm/d for TCC compares to a value of 3.1 mm/d for the same years from the GPCP (25N-25S). However, when regional values are examined, significant differences are noted over the ocean in the deep tropics (e.g., eastern Pacific) and in the sub-tropics and middle latitudes where TCC mean values are significantly lower than GPCP.

These results will be summarized, issues and regions needing further research and improved observations or analysis will be identified, and these issues will be placed in the context of current and future observing systems (e.g., GPM).