

MERGING PRECIPITATION OBSERVATIONS WITH PREDICTIONS TO DEVELOP A SPATIALLY AND TEMPORALLY CONTINUOUS 3-HOUR GLOBAL PRODUCT

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Precipitation is the most influential forcing to the land surface, providing moisture for processes such as runoff, biogeochemical cycling, evaporation, transpiration, groundwater recharge, and soil moisture. Therefore accurate knowledge of the history, location, and intensity of precipitation is critical for predicting all land states and fluxes on time scales ranging from minutes to years. Unfortunately, the cloud processes that generate precipitation are extremely complex, and are not well simulated in current generation atmospheric models, leading to poor precipitation prediction. Gage and satellite observations are available, but are limited by poor spatial and temporal coverage and in some cases, high uncertainty. This has motivated our development of a temporally and spatially continuous global 2x2.5 degree (latitude x longitude), 3 hour precipitation product based on a unique merging of model predictions and observations, which we designate the Goddard Merged Precipitation (GMP) product.

The GMP product is a PSAS (Physical-space Statistical Analysis System) merging or analysis of bias and cloud corrected 3-hour GEOS-1 (Goddard Earth Observing System-Version 1) DAS (Data Assimilation System) reanalysis precipitation with bias and cloud corrected 6-hour GPROF (Goddard Profiling algorithm) SSM/I (Defense Meteorological Satellite Program Special Sensor Microwave Imager) observed precipitation. The 6-hour GPROF-SSM/I observations are interpolated to 3-hour resolution to enable merging with GEOS-DAS predictions. 3-hour ISCCP (International Satellite Cloud Climatology Project) cloud observations are used to eliminate precipitation in the GEOS-DAS and GPROF-SSM/I data sets when and where the observed cloud coverage is less than 10%. To eliminate long-term bias, both data sets are also subjected to a ratio-correction to adjust their monthly-means to the GPCP (Global Precipitation Climatology Project) satellite-gage monthly precipitation climatology. Adjustments are also made to match the GPCP when the GEOS-DAS or GPROF-SSM/I monthly mean is zero, and to prevent large ratios from generating unreasonably high precipitation rates.

The GMP product has been derived for periods when GPROF-SSM/I and GPCP data is available (1987 to present, with significant gaps in 1987 and 1990). When the ISCCP cloud products are not available, the cloud correction is not performed. The 6-hour GEOS-1 STRAT (Stratospheric TRacers of Atmospheric Transport Mission) reanalysis is used after 1995.

PSAS uses a variational objective analysis approach to merge observations with forecasts. This requires a priori estimation of the observation and forecast covariance errors, which was performed using a maximum likelihood technique. We found that the observation error is consistently smaller than the forecast errors. Both observational error and forecast errors are regional dependent, in agreement with the magnitude distribution of GPCP annual mean data.

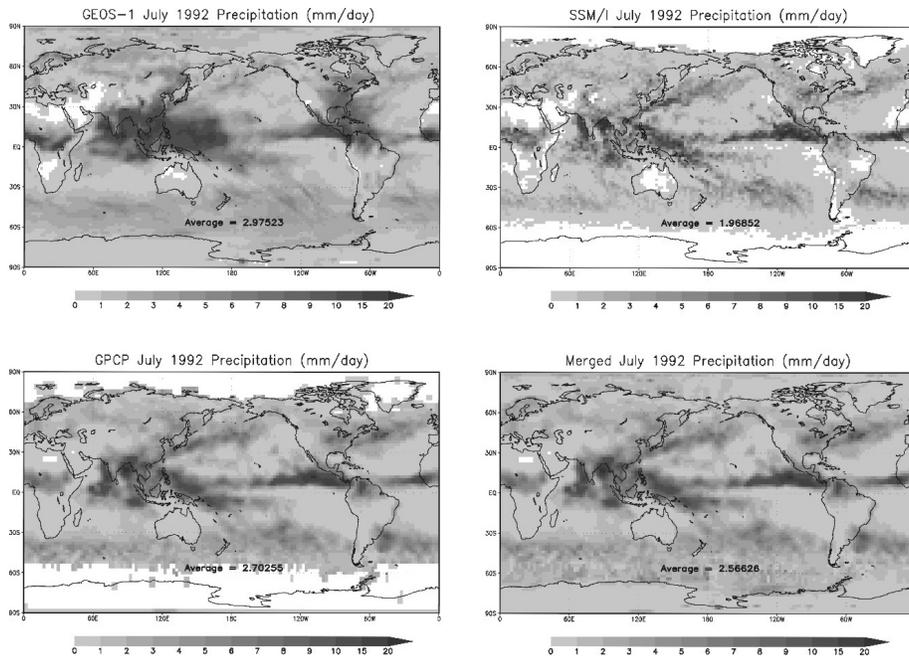


Figure 1: July 1992 monthly mean precipitation from the GEOS-1 DAS, SSM/I-GPROF, GPCP, and the merged GMP product.

The algorithms developed for the generation of the GMP precipitation product will be presented, along with a validation of the algorithm using hourly gage estimates over selected regions. Monthly and 3 hour average examples of the GMP product for July 1992 are presented in Figures 1 and 2 respectively. Access to the most recent descriptions of this research and access to the data may be obtained at the land.gsfc.nasa.gov/gmp.html internet

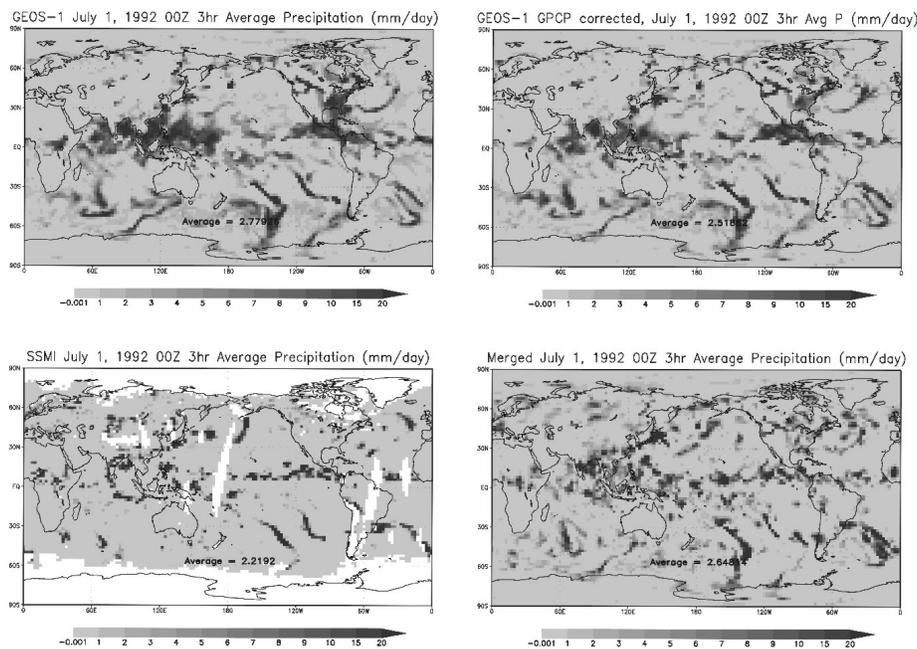


Figure 2: July 1, 1992 3 hour mean precipitation at 00Z from the GEOS-1 DAS, SSM/I-GPROF, GPCP, and the merged GMP product.