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Estimating Uncertainties in Satellite-based Global Precipitation Measurements

Yudong Tian (1) and Christa Peters-Lidard (2)

(1) University of Maryland at Baltimore County (yudong.tian@nasa.gov), (2) NASA Goddard Space Flight Center (Christa.Peters@nasa.gov)

Quantifying the uncertainties in global precipitation measurements by satellite remote sensing is of fundamental importance to a wide range of applications. However, due to the lack of "ground-truth" on the global scale, it is difficult to quantify the uncertainties in the satellite-based measurements. In this work, we estimated these uncertainties by studying the measurement spread from an ensemble of six different TRMM-era precipitation products (3B42, 3B42RT, CMORPH, PERSIANN, NRL and GSMaP). Our results show that each of the products, as well as the ensemble mean, captured the major features of global precipitation distribution well, such as the ITCZ and the Indian summer Monsoon. This illustrates the promise of satellite-based global retrievals. On the other hand, the uncertainties among these different measurements exhibit systematic regional and seasonal variations. They are relatively small (40-60%) over the oceans, especially in the tropics, and over the continents in the Southern Hemisphere lower latitudes. The southeastern U. S. also enjoys similarly lower uncertainties. However, large uncertainties (100-140%) exist over high latitude (> 30N) land surfaces, especially during the cold season. Such areas include the northern U. S., most of Europe, and the Tibetan Plateau. The high uncertainties over the Tibetan Plateau also persist through the Northern Hemisphere warm season. In addition, high uncertainties (> 100%) are also associated with the Andes Mountains through all seasons. These results highlight both the advantages and achievements of satellite remote sensing of precipitation over the global ocean, and the challenges of accurate measurement of precipitation over land surfaces, especially over higher latitudes or over complex terrain.