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Potential Reduction of Uncertainty in Precipitation Retrieval by the Inclusion of Dynamical, Thermodynamical, and Hydrological Constraints

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In order to achieve a better understanding in the hydrological cycle and the distribution of precipitation, the Tropical Rainfall Measuring Mission (TRMM) was launched in 1997. The TRMM Microwave Imager (TMI) and Precipitation Radar (PR) have enabled significant advances in tropical precipitation measurement through direct estimation of precipitation from microwave radiance and reflectivity observed from space. Nevertheless, ambiguities in precipitation estimation inherent with the independent use of TRMM, are known to lead to significant error. These ambiguities can be reduced with the addition of complementary data sets that until this point have not been employed in TRMM retrieval algorithms. In this paper, we investigate the potential improvements to estimating precipitation that are possible by combining TRMM measurements with other available sources of information.

Precipitation retrieval algorithms that are used are typically physically-based statistical methodologies that employ a Cloud Radiation Database (CRD) as the basis of the relationship between radiance and precipitation. The CRD is composed of vertical microphysical profiles linked to surface precipitation rates, which are produced by cloud resolving model (CRM) simulations. The brightness temperatures corresponding to the simulated microphysical profiles are estimated from a radiative transfer model.

Unfortunately, the relationship between the simulated microphysical profiles and the simulated multi-spectral brightness temperatures is not strictly unique. Therefore during precipitation retrieval, given a set of observed brightness temperatures, one can often match a set of microphysical profiles with strongly differing precipitation outcomes. To improve precipitation estimation, additional constraints are needed.

Fortunately, such constraints are virtually always available in the form of recent or short term projections of the synoptic situation**.** These constraints dramatically reduce the number of applicable profiles in the data base when the synoptic situations in effect are included in the profiles when the profiles were simulated. The Cloud Dynamics and Radiation Database (CDRD) is an attempt to include this additional information in the CRD to increase the available constraints in selecting applicable database entries used in the estimation procedure. This additional information includes the dynamical, theromodynamical, hydrological (DTH) structures of the atmosphere, which are stored as DTH tags in the CDRD. By using a Bayesian based statistical estimation method, it is expected that more appropriate microphysical profiles can be chosen and thus precipitation retrieval uncertainties can be reduced.