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Refinements to an Error Model Based Algorithm for Passive Microwave Retrievals of Oceanic Rain

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The validation of oceanic precipitation retrievals is somewhat problematic. Suitable data are very sparse. Thus we are forced to resort to error models to estimate the uncertainty; in the TRMM/GPM community this has become known as "Physical Validation".

Error models for the principal sources of uncertainty (NEDT, Calibration, Drop Size Distribution, Beam Filling) have been reported previously. All of these models have been integrated into Level-3 algorithms for TMI and AMSR-E that compute rain totals and associated uncertainties for one month intervals over 5° x 5° boxes. Recently, the Beam Filling model has been updated. The previous model had overcorrected for beam filling at low rain rates and undercorrected at high rain rates. Since the bulk of the contribution to the monthly rain total comes from low rain rates, this results in a net decrease and brings the estimates closer to other estimates of monthly rainfall.

The algorithm computes rain rates and uncertainties for each pixel for both polarizations at 3 frequencies (11, 19 and 37 GHz). These are, in turn, reduced to a single rain rate for each pixel with weights based on the computed uncertainties. The algorithm is structured on a two-pass basis. In the first pass, histograms of rain rate are accumulated for the month for each 5° box. These are used to compute zero-rain offsets. Using the computed offset reduces the calibration error to zero near zero rain rate but substitutes the uncertainty of the offset correction which can be measured by partitioning the data into even and odd days of the month. We also average the reliably retrieved freezing levels and average them by latitude (and month) to serve as a default freezing level for those pixels for which no freezing level can be reliably retrieved nor obtained by reasonable interpolations.

In the second pass, the (offset corrected) rain rates and the components of the uncertainty are computed for each oceanic pixel in each data granule (orbit). The uncertainties are partitioned into random and correlated parts. The correlated parts are combined to compute the weights of the various channels. The two polarizations for each frequency are combined based on the weights. After the rain rates and uncertainties for a granule (orbit for TMI, half orbit for AMSR-E) have been computed, the data are smoothed to a common resolution (that of the lowest frequency channel) and reduced to a single rain rate by weighted averaging of the three frequencies. These rain rates are summed for each box along with the correlated uncertainty.

The net uncertainty is the RSS of the correlated uncertainty and a random uncertainty determined by partitioning the data into even and odd days of the month. This results in a rain total and uncertainty for each box.

While these estimates are useful in their own right, they also help in system design for the satellite missions. An example is specifying the allowable mission lifetime orbital altitude drift for the GPM satellites.