TRMM and its connection to the Global Water Cycle

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The importance of quantitative knowledge of tropical rainfall, its associated latent heating and variability is summarized in the context of the global hydrologic cycle. Much of the tropics is covered by oceans. What land exists, is covered largely by rainforests that are only thinly populated. The only way to adequately measure the global tropical rainfall for climate and general circulation models is from space. The TRMM orbit is inclined 35° leading to good sampling in the tropics and a rapid precession to study the diurnal cycle of precipitation. The precipitation instrument complement consists of the first rain radar to be flown in space (PR), a multi-channel passive microwave sensor (TMI) and a five-channel VIS/IR (VIRS) sensor. The precipitation radar operates at a frequency of 13.6 GHz. The swath width is 220 km, with a horizontal resolution of 4 km and the vertical resolution of 250 m. The minimum detectable signal from the precipitation radar has been measured at 17 dBZ. The TMI instrument is designed similar to the SSM/I with two important changes. The 22.235 GHz water vapor absorption channel of the SSM/I was moved to 21.3 GHz in order to avoid saturation in the tropics and 10.7 GHz V&H polarized channels were added to expand the dynamic range of rainfall estimates. The resolution of the TMI varies from 4.6 km at 85 GHz to 36 km at 10.7 GHz. The visible and infrared sensor (VIRS) measures radiation at 0.63, 1.6, 3.75, 10.8 and 12.0 microns. The spatial resolution of all five VIRS channels is 2 km at nadir. In addition to the three primary rainfall instruments, TRMM will also carry a Lightning Imaging Sensor (LIS) and a Clouds and the Earth's Radiant Energy System (CERES) instrument.

This presentation will focus primarily on the advances in our understanding of tropical rain systems needed to interpret the TRMM data. Global averages, as well as case studies from TRMM radar (PR), the TRMM Microwave Imager (TMI) and Visible and Infrared Sensor (VIRS) will be presented. Comparisons and contrasts among the different sensors will be drawn. Results will also be compared to previous rainfall climatologies generated from the SSM/I instrument. In particular this paper will focus on the synergy between the TRMM radar and passive microwave radiometer and what we have leraned from is synergy.