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Interannual Variability of Tropical Ocean Evaporation: A Comparison of Microwave Satellite and Assimilation Results

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Remote sensing methodologies for turbulent heat fluxes over oceans depend on driving bulk formulations of fluxes with measured surface winds and estimated near surface thermodynamics from microwave sensors of the Special Sensor Microwave Imager (SSM/I) heritage. We will review recent work with a number of SSM/I-based algorithms and investigate the ability of current data sets to document global, tropical ocean-averaged evaporation changes in association with El Nino and La Nina SST changes. We show that in addition to interannual signals, latent heat flux increases over the period since late 1987 range from~ .1 to .6 mm day^{-1} are present; these represent trends 2 to 3 times larger than the NCEP Reanalysis. Since atmospheric storage cannot account for the difference, and since compensating evapotranspiration changes over land are highly unlikely to be this large, these evaporation estimates cannot be reconciled with ocean precipitation records such as those produced by the Global Precipitation Climatology Project, GPCP. The reasons for the disagreement include less than adequate intercalibration between SSM/I sensors providing winds and water vapor for driving the algorithms, biases due to the assumption that column integrated water vapor mirrors near surface water vapor variations, and other factors as well. The reanalyses have their own problems with spin-up during assimilation, lack of constraining input data at the ocean surface, and amplitude of synoptic transients.

We will also discuss the potential for improving retrievals of the near-surface specific humidity (q_a) and air temperature (T_a) needed for flux calculations through the addition of moisture and temperature profile data from the SSM/T-2 and AMSU-A and –B sounders. In particular, an improved satellite-based algorithm for q_a has been developed through the combined use of SSM/I and SSM/T-2 data. The current algorithm uses the combination of the SSM/I 19V, 22V, 37V, and SSM/T-2 183±3 brightness temperature channels. This algorithm enabled a reduction in the rms error in q_a to 0.97 g/kg from a value of 1.20 for an algorithm of the form used by Schulz et al. (1997) that incorporates only the SSM/I 19V, 19H, 22V, and 37V channels.

We will assess the current ability to quantify regional and global ocean evaporation changes, examine promising improvements afforded by additional microwave channels, and put these in the context of similar challenges to precipitation measurement and the global water cycle in general.