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Global Scale Evapotranspiration: Comparison and Sensitivity Analysis of three Retrieval Algorithms

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Quantifying reliable estimates of evapotranspiration (ET) over land is an important part of the larger effort to develop long-term Earth System Data Records (ESDRs) for the major components (fluxes and storages) of the terrestrial water cycle and is a particular focus of the GEWEX Landflux project. Recent progress has involved the development of global ET datasets using a variety of sources: objective interpolation of Fluxnet tower data, land surface model estimates and remote sensing approaches that allows for the evaluation of uncertainties across these datasets. However, uncertainties in the inputs along with the surface resistance parameterizations in the different models result in a wide range of estimates, thus leading one to question the confidence levels of individual ET datasets.

In the current study, a long-term global ET dataset has been developed for the period 1984-2007 using three process-based, remote sensing models forced using a combination of input from remote sensing and reanalysis models. Radiation data was obtained from the Surface Radiation Budget (SRB) project; meteorology from the MERRA reanalysis output; and the vegetation distribution using data from AVHRR GIMMS data. The models considered are a modified Penman-Monteith (PM-Mu), Priestley-Taylor (PT-Fi), and the Surface Energy Balance System (SEBS). The three models adjust the surface resistances using aerodynamic principles or provide ecophysiological constraints to account for changing environmental factors; thus scaling ET from its potential value to the actual estimate. Initial results show considerable differences among the model estimates. Uncertainties in the input forcings, coupled with the sensitivity of the algorithms to input (forcing) uncertainty, results in significant uncertainty in the derived ET products. Understanding the sensitivity of the algorithms is a critical need. For example, for air temperature, a 1° bias in Tair leads to differences of up to 50 W/m^2 in latent heat flux (LE) on the annual scale. The presentation focuses on three aspects: (1) Evaluation of the input forcings and a check of consistency across the variables and time period considered in this study, (2) Inter-comparisons of the surface resistance parameterizations and estimates across the three process models, and their consistency, and (3) Sensitivity analysis of the three models to the various input forcings.