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Regional Water Budget Estimation Using Multi-sensor Remote Sensing Observations

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An integral component of NASA's Global Water and Energy Cycle (GWEC) program and the World Climate Research Programme's Global Energy and Water Experiment (GEWEX) is an improved knowledge of the land surface hydrologic states, and how they may vary spatially and temporally at continental-to-global scales. The NASA and WCRP strategy is built around the utilization of remotely sensed surface observations and land surface modeling, since characterizing the surface water and energy budgets through in-situ observations is infeasible. With NASA's Earth Observation System, and similar programs in Europe and Japan, there has been a significant increase in space-based observations that can advance our knowledge of the surface water and energy budgets. Currently, community efforts have tended to focus on the retrieval of specific budget components, like soil moisture, precipitation and evaportranspiration. These individual components, when combined with in-situ discharge measurements, usually result in non-closure of the hydrologic budget. Using standard data assimilation techniques to merge these independent estimates with land surface models (whose closure is assured through construct) results in budget estimates that have non-zero closure terms, in part because of errors in both the land surface modeling and the remote sensing retrievals. Determining the degree of closure in the terrestrial water balance is a critical step in quantifying both the current and needed accuracy of remote observations.

In this study, multi-sensor, multi-platform remote sensing observations will be combined with a land surface model to investigate the closure of terrestrial water cycle over the Red-Arkansas Basin. A combination of statistical uncertainty descriptions and data assimilation techniques, including the Particle Filter (PF), a water balance constrainer, and copula-based error models, are explored, which allows an improved

capacity to assess the utility of remote sensing observations for water and energy budget studies. The study will use two months of remote sensing data that includes estimates of precipitation from the Tropical Rainfall Measurement Mission (TRMM), soil moisture from the TRMM Microwave Imager (TMI) and evapotranspiration derived from MODIS measurements. Due to high uncertainties present in remote sensing data, determining the most appropriate methodology for merging this data with land surface models remains a difficult challenge, and the presentation will try and identify future work to overcome these.