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Combining datasets of satellite retrieved products: application to the Mississippi and Niger basins

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This study addresses in general terms the problem of the optimal combination of multiple observation datasets. It focuses on the terrestrial water cycle and presents methodologies to obtain a coherent dataset of four water cycle key components: precipitation (P), evapotranspiration (E), runoff (R) and terrestrial water storage (S). Various innovative "integration" methodologies based on the datasets uncertainties are introduced: Simple Weighting (SW), Constrained Linear (CL) and Optimal Interpolation (OI). A simple Post-processing Filtering (PF) step can be used to impose the water cycle budget closure after the integration step. The integration techniques are tested using multiple real observation datasets over the Mississippi and the Niger basins from satellite (P, E and S) and in situ (R) measurements. The merged P and E are then validated against independant in situ observations. It is shown that the PF step actually improves the estimation of the water cycle components and that the three techniques have equivalent accuracies when the PF is applied. The need for this type of methodologies should increase in the future since multiple observation datasets are now available and the climate and hydrology communities need to combine them into a unique, optimal and coherent dataset of multiple parameters at the global scale.