Simulation of water sources and precipitation recycling in the MacKenzie, Mississippi and Amazon river basins

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An atmospheric general circulation model simulation for 1948-1997 of the water budgets for the MacKenzie, Mississippi and Amazon River basins is presented. In addition to the water budget, we include passive tracers to identify the geographic sources of water for the basins, and the analysis focuses on the mechanisms contributing to precipitation recycling in each basin. While each basin's precipitation recycling has a strong dependency on evaporation during the mean annual cycle, the interannual variability of the recycling shows important relationships with the atmospheric circulation. The MacKenzie River basin recycling has only a weak interannual correspondence with evaporation, where the variations in zonal moisture transport from the Pacific Ocean can affect the basin water cycle. The Mississippi River basin precipitation and recycling have strong interannual correlation on evaporation. The evaporation is related to moist and shallow planetary boundary layer that provides moisture for convection at the cloud base. At global scales, high precipitation recycling is also found to be partly correlated to warm SSTs in the tropical Pacific Ocean. The Amazon River basin evaporation exhibits small interannual variations, so that the interannual variations of precipitation recycling are related to atmospheric moisture transport from the tropical south Atlantic Ocean. Increasing SSTs over the 50-year period are causing increased easterly transport across the basin. As moisture transport increases, the Amazon precipitation recycling decreases (without real time varying vegetation changes). In addition, precipitation recycling from a bulk diagnostic method is compared to the passive tracer method used in the analysis. While the mean values of the different recycling methods are different, the interannual variations are comparable between methods. The methods also exhibit similar relationships to the terms of the basin scale water budgets. Additional basins (e.g. Baltic Sea Exp., BALTEX) were included in the model simulation and are presently under investigation.