**Quantifying the long-term changes of total water storage and their driving factors**

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**Abstract**: Changes in the total water storage (ΔTWS) with widespread consequences for humans and ecosystems are expected across the land surface under global warming. However, the long-term evolution of ΔTWS and associated environmental forcings remain relatively unexplored. For this presentation, we will analyze the spatiotemporal changes of ΔTWS and examine their driving mechanisms for the period 1902-2014. We will utilize the latest global observation-based ΔTWS reconstructions, and 36 factorial ensemble ELM simulations with and without the phosphorus dynamics driven by three different climate datasets. We will attribute the ΔTWS anomalies and cumulative ΔTWS to various external driving factors including the climate change, CO2 concentrations, nitrogen deposition, land use and land cover change, and aerosol deposition; we will investigate the sensitivities of simulated ΔTWS to the use of different climate forcings and ELM versions; we will further demonstrate how individual hydrology components (e.g., precipitation, evapotranspiration and runoff) contributed to the ΔTWS trends.