Hydrologic and climatic responses to global anthropogenic groundwater extraction

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Anthropogenic groundwater exploitation essentially changes soil moisture, land-atmosphere water and energy uxes, even climate system. In over-exploited regions, the terrestrial water storage has been rapidly depleted, causing wate unsustainability and climate change. Quantifying the hydrologic and climatic responses to anthropogenic groundwater extraction not only advances our understanding on the hydrological cycle with human intervention, but also bene ts e ective human water management. In this paper, the authors incorporated a scheme of anthropogenic groundwater exploitation into the Community Earth System Model 1.2.0, and conducted a series of simulations over globe to investigate the e ects o groundwater exploitation on the hydrological processes and climate system around the world. e framework of the coupled model are shown in Fig. 1. e model was also applied over Heihe River Basin in northwestern China for investigating the impacts of water use and groundwater lateral ow on basin-scale land processes, and the eco-hydrological e ects of stream aquifer water interaction over riverbanks. Results show that groundwater exploitation caused drying in deep soil layers but wetting in upper layers, with a rapidly declining water table in areas with the most severe groundwater extraction, including the central United States, North China Plains and the north India and Pakistan. e atmosphere also responded to groundwater extraction, with cooling at the 850 hPa level over the north India and Pakistan and a large area in North China and central Russia. Increased precipitation occurred in North China Plains. Decreased precipitation occurred in north India because the Indian monsoon and its transport of water vapor were weaker as a result of cooling induced by groundwater use. Local terrestria water storage was unsustainable at the current high extraction rate. us, a balance between reduced water withdrawal and