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Responses of Atmospheric General Circulation to Groundwater

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Recently, the more frequent extreme events and overused groundwater result in high variations of land water storage. The land water variations can affect not only streamflow but also evapotranspiration, thus the atmospheric general circulation. In this study, we conducted a series of experiments with different water table depth (WTD) over the global continents by AMIP-type simulations in Community Earth System Model (CESM). When the WTD becomes shallower, the land evapotranspiration increases. That induces more surface cooling over the sub-tropics, and leads to stronger Hadley Circulation because of increased meridional surface temperature gradient. Meanwhile, stronger circulation and more surface evapotranspiration cause more southward (northward) latent heat energy (dry static energy) transportation. The shallower WTD also makes the world in simulation be similar to aquaplanet, the reduced land-sea heat contrast leading to a weaker South-Asia monsoon circulation. Although more surface latent heat flux to the atmosphere, the stationary eddy associated with monsoon circulation shows less northward latent heat energy transportation because of compensation by much weaker South-Asia monsoon circulation. That also indicates the world in these experiments become more zonal symmetric – stronger Hadley Circulation and weaker monsoon circulation.