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# Assessing the Importance of Lateral Groundwater Flows at the Global-Scale

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Most current global-scale hydrological models do not represent groundwater flow between grid-cells (i.e. lateral groundwater flows) as a component of the water budget, nor do they simulate groundwater heads. As such, the effect of long-distance lateral flows, transporting groundwater downstream and supporting water budgets of receiving catchments, are neglected. Also, head dependent groundwater drainage or stream infiltration and capillary rise are neglected.

Using a high resolution global-scale groundwater flow model (using MODFLOW) coupled to a hydrological model (PCR-GLOBWB), we simulated groundwater heads and groundwater flow magnitudes over 1960 to 2010 and including human interactions. First, a detailed study of spatial patterns of lateral groundwater flows showed that magnitude and significance within the water budget are primarily a function of hydrogeology, climate, terrain, and human water use. Second, we compared the results of the coupled model setup (H+GW) to the results of the hydrological model without representing lateral groundwater flows (H). Results show that shallow water tables (in H+GW), and therewith capillary rise, are supported by lateral groundwater flows. Also, groundwater depletion might be reduced in the H+GW run by supporting lateral flows and river infiltration, while in the surrounding areas negative effects increase (e.g. groundwater depletion, decreasing river flow). Our results emphasise that lateral groundwater flows are essential to include within large-scale water resources analysis. We believe our results have wide ranging implications for understanding and modelling changes in the water balance partitioning of large basins, and for informing robust future water management.