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Research paper

Groundwater fluxes in the global hydrologic cycle: past, present and future

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Abstract

A quantification of groundwater fluxes in the hydrologic cycle for large river basins and on a global scale is reported in this paper. Groundwater contributions to river runoff (i.e. baseflow), direct submarine groundwater discharge to the ocean floor, and salt throughput to oceans and seas are analyzed. The baseflow/precipitation and baseflow/river runoff ratios are found to be approximately 10% and 30% on a world-wide basis, showing great geographical variability across the major continents of the Earth. Direct groundwater discharge to the ocean floor is only 6% of the total water influx to oceans and seas, yet, it contributes a salt load to oceans and seas that is approximately 50% of the salt loading by rivers. Factors and uncertainties germane to global groundwater balancing, recent anthropogenic modifications of groundwater contributions to runoff, and the likely role of potential global warming in groundwater

circulation are discussed. Over the last 300 years baseflow contribution to river runoff has slightly increased, whereas the river runoff has declined as a result of anthropogenic modifications to the natural environment. Assuming a 10% increase in global annual precipitation from potential greenhouse warming, the associated increases in baseflow contribution to river runoff and direct groundwater discharge to oceans would amount to 1200 km^3 $year^{â^'1}$ and 260 km^3 $year^{â^'1}$, respectively. The additional salt load to oceans and seas by direct groundwater flow is estimated at 140 000 000 t $year^{â^'1}$. Salinity of oceans and seas could rise if their water volumes do not increase enough to offset the larger salt load.

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