Geophysical Research Abstracts
Vol. 15, EGU2013-3284-1, 2013
EGU General Assembly 2013

Global scale groundwater flow model

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As the world's largest accessible source of freshwater, groundwater plays vital role in satisfying the basic needs of human society. It serves as a primary source of drinking water and supplies water for agricultural and industrial activities. During times of drought, groundwater sustains water flows in streams, rivers, lakes and wetlands, and thus supports ecosystem habitat and biodiversity, while its large natural storage provides a buffer against water shortages. Yet, the current generation of global scale hydrological models does not include a groundwater flow component that is a crucial part of the hydrological cycle and allows the simulation of groundwater head dynamics.

In this study we present a steady-state MODFLOW (McDonald and Harbaugh, 1988) groundwater model on the global scale at 5 arc-minutes resolution. Aquifer schematization and properties of this groundwater model were developed from available global lithological model (e.g. Dürr et al., 2005; Gleeson et al., 2010; Hartmann and Moorsdorff, in press). We force the groundwtaer model with the output from the large-scale hydrological model PCR-GLOBWB (van Beek et al., 2011), specifically the long term net groundwater recharge and average surface water levels derived from routed channel discharge. We validated calculated groundwater heads and depths with available head observations, from different regions, including the North and South America and Western Europe. Our results show that it is feasible to build a relatively simple global scale groundwater model using existing information, and estimate water table depths within acceptable accuracy in many parts of the world.