A HIGH RESOLUTION GLOBAL SCALE GROUNDWATER MODEL

Groundwater plays a vital role in satisfying human water needs. During droughts it sustains water flows in rivers and its storage provides a buffer against water shortage.

Yet, current global scale hydrological models do not include a groundwater flow component. Therefore, ultimately groundwater dynamics affected by climate or human water use cannot be studied at the global scale.

In this study we built a global scale groundwater model for an upper unconfined aquifer. We used MODFLOW[1] and forced the model with groundwater recharge and surface water levels from the land-surface model PCR-GLOBWB[2]. For the parameterization of the aquifer properties we relied entirely in available global datasets on global lithology[3] and saturated conductivity[4]. Aquifer thicknesses were estimated.

The presented map shows steady state groundwater table depths in a naturalized condition.

At the global scale, sea level poses the boundary condition to groundwater depths. Shallow groundwater tables are simulated allong the coastal ribbon, and where flat coastal plains meet the sea, including the major river basins

Deep groundwater tables are simulated for the mountain ranges. Perched water tables are not simulated

At the regional scale topography and recharge are the main controls of groundwater table depth. Topography controls the flat areas of the central Amazone and lowlands of South America which receive water from the higher elevated regions

Higher recharge rates result in higher groundwater tables, such as for the tropical swamps

Don't look at your back yard; this map is about global scale patterns

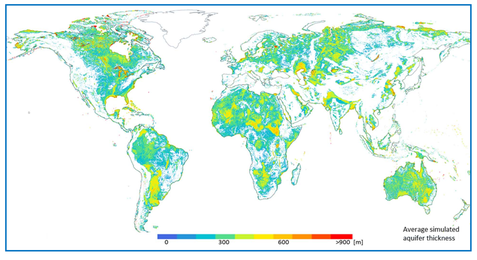
Lower recharge rates result in deep groundwater tables and the groundwater gets disconnected from the local topography.

Water table depth below land surface [m]

- < 0.25
- 0.25 – 2.5
- 2.5 - 5
- 5 - 10
- 10 - 20
- 20 - 40
- 40 - 80
- 80 - 160
- 160 - 320
- 320 - 640
- > 640

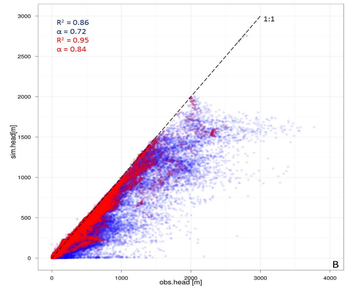
Grid resolution

6'
~ 11 km at equator



COMPARISON

Simulated groundwater depths were compared with observed groundwater depth. The model performance is good and results are better for sediment areas (red) than for mountain ranges (blue) where groundwater heads are underestimated .



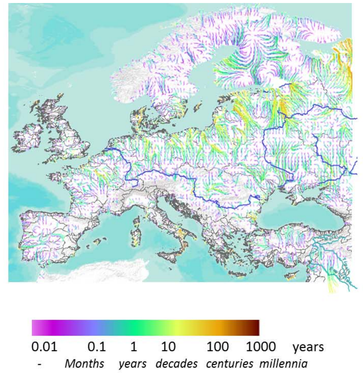
FLOWPATH SIMULATION

Flowpaths were simulated. These maps show short and long inter-basin flowpaths, that are stopped when they reach the local drainage or the ocean.

The flowpaths show that, especially for sediment areas, interbasin groundwater flow is important and significant at least at longer time scales. Long flowpaths are simulated for these sediment basins.

CONCLUSION

This study introduced a relative simple method to overcome the limited information available for aquifer schematization. The results presented confirm the relevance of taking lateral groundwater flow into account in global scale hydrological models



Find my poster here:

Inge de Graaf, Edwin Sutanudjaja, Rens van Beek, Marc Bierkens

Utrecht University, Faculty of Geosciences, Dep. of Physical Geography.. I.E.M.deGraaf@uu.nl

References: [1] McDonald and Harbaugh (2000) MODFLOW-2000, the U.S. Geological Survey modular ground-water model- User guide to modularization concepts and the ground-water flow process. U.S. geological Survey. [2] van Beek *et al.* (2011) Global monthly water stress: 1. Water balance and water availability, *Water Resource Research.* [3] Hartmann and Moosdorf (2012) The new global lithological map database GLiM: A representation of rock properties at the earth surface, *Geochemistry, Geophysisc, Geosystems.* [4] Gleeson *et al.* (2011) Mapping permeability over the surface of the Earth, *Geophysical Research Letters.*

European Geoscience Union General Assembly 2014

Universiteit Utrecht

NWO