eLetter

Regarding: Global Patterns of Groundwater Table Depth, Science, 339 (6122): 940-943, doi: 10.1126/science.1229881

Given the continued downloads and applications of our earlier model estimates of the global patterns in groundwater table depth (*1*), here we make available to the readers our recently revised estimates, and suggest that future applications use this new dataset, which is substantially different from the earlier estimates.

The groundwater recharge in the earlier model (*1*) was from model-estimated mean annual groundwater recharge (*2*) based on top-2m vertical soil water balance: precipitation minus evapotranspiration (P-ET). It did not account for (a) lateral convergence among grid cells, (b) plant root uptake of soil water below 2m depth or groundwater, and (c) seasonal dynamics. The consequences are several but all resulted in a biased-high estimate of the water table (too shallow). First, without lateral flow from wetter uplands to drier lowlands in the recharge model (*2*), ET cannot exceed local P, which is not true in groundwater discharge zones in dry climates; this reduced groundwater loss to ET, or over-estimated groundwater recharge, leading to biased-high water table in arid basins. Second, vegetation uptake below 2m soil, and uptake of groundwater from the capillary rise, are not accounted for, further reducing groundwater loss, over-estimating recharge, and yielding biased-high water table. Third, by using long-term mean annual recharge, our earlier model does not represent seasonal dynamics, averaging out the strong dry-season ET from groundwater, under-estimating groundwater consumption and leading to biased-high water table. Fourth, we implemented rivers which carved into the topography, providing a groundwater drainage baselevel that is lower than the land surface (base level in our earlier model) of the grid cell, thus increasing groundwater discharge and further lowering the water table.

In a recent inverse modeling study (*3*), we fully coupled the vertical soil water balance with groundwater recharge and discharge, water table rise and fall, and adaptive plant root uptake depth to meet ET demand inferred from satellite observations of leaf area index, running the model at hourly time steps over a decade (2004-2014), at the same 30" global grid. This model removed all the limitations of our earlier approach discussed above and allows for dynamic interactions between soil water, surface water (streams and floodplains), groundwater and vegetation water use.

The modeled monthly water table depth can be downloaded for each continent at the link below:
http://thredds-gfnl.usc.es/thredds/catalog/GLOBALWTDFTP/catalog.html
which contains two sub-directories:
monthlymeans/ (over 10yrs of model run)
annualmeans/ (replacing the equilibrium water table in the earlier study)
All files are organized by continents. The format is NetCDF which can be read by ArcGIS version 9 or later.

References:

1. Fan, Y., H. Li, G. Miguez-Macho (2013) Global patterns of groundwater table depth, Science, 339 (6122): 940-943, doi:10.1126/science.1229881

2. P. Döll, K. Fiedler (2008), Global-scale modeling of groundwater recharge. Hydrol. Earth Syst. Sci. 12, 863 (2008). doi:10.5194/hess-12-863-2008

3. Fan, Y., G. Miguez-Macho, E.G. Jobbágy, R.B. Jackson, C. Otero-Casal (2017) Hydrologic regulation of plant rooting depth, Proceedings of the National Academy of Sciences of the United States of America, Vol 114, No 40, 10572–10577, doi: 10.1073/pnas.1712381114.