Geophysical Research Abstracts
Vol. 20, EGU2018-2813, 2018
EGU General Assembly 2018

A global assessment of the maximum depth of economically recoverable groundwater when used for irrigation

Marc F.P. Bierkens (1,2), Inge E.M de Graaf (3), Tom Gleeson (4), and L.P.H. (Rens) van Beek (1)

(1) Utrecht University, Physical Geography, Utrecht, Netherlands (m.f.p.bierkens@uu.nl), (2) Deltares, Utrecht, Netherlands, (3) Chair of Hydrology, University of Freiburg, Freiburg, Germany, (4) Department of Civil Engineering, University of Victoria, Victoria BC, Canada

Over recent decades, groundwater has become increasingly important for agriculture. Irrigation accounts for 40% of the global food production and its importance is expected to grow further in the near future. Already, about 70% of the globally abstracted water is used for irrigation, and nearly half of that is pumped groundwater. In many irrigated areas where groundwater is the primary source of irrigation water, groundwater abstraction is larger than recharge and we see massive groundwater head decline in these areas. An important question then is: to what maximum depth can groundwater be pumped for it to be still economically recoverable? The objective of this study is therefore to create a global map of the maximum depth of economically recoverable groundwater when used for irrigation. The maximum economic depth is the maximum depth at which revenues are still larger than pumping costs or the maximum depth at which initial investments become too large compared to yearly revenues. To this end we set up a simple hydro-economic model where costs of well drilling and the energy costs of pumping, which are a function of well depth and static head depth respectively, are compared with the revenues obtained for the irrigated crops. Parameters for the cost sub-model are obtained from several US-based studies and applied to other countries based on GDP/capita as an index of labour costs. The revenue sub-model is based on gross irrigation water demand calculated with a global hydrological and water resources model, areal coverage of crop types from MIRCA2000 and FAO-based statistics on crop yield and market price. We applied our method to irrigated areas in the world overlying productive aquifers. Estimated maximum economic depths range between 50 and 500 m. Most important factors explaining the maximum economic depth are the dominant crop type in the area and whether or not initial investments in well infrastructure are limiting. In subsequent research, our estimates of maximum economic depth will be combined with estimates of groundwater depth and storage coefficients to estimate economically attainable groundwater volumes worldwide.