Geophysical Research Abstracts
Vol. 19, EGU2017-11091, 2017
EGU General Assembly 2017

Sensitivity of quantitative groundwater recharge estimates to volumetric and distribution uncertainty in rainfall forcing products

Micha Werner (1), Rogier Westerhoff (2), and Catherine Moore (3)

(1) UNESCO-IHE, Delft, the Netherlands (m.werner@unesco-ihe.org), (2) Deltares, Delft, the Netherlands, (3) GNS Science, New Zealand

Quantitative estimates of recharge due to precipitation excess are an important input to determining sustainable abstraction of groundwater resources, as well providing one of the boundary conditions required for numerical groundwater modelling. Simple water balance models are widely applied for calculating recharge. In these models, precipitation is partitioned between different processes and stores; including surface runoff and infiltration, storage in the unsaturated zone, evaporation, capillary processes, and recharge to groundwater. Clearly the estimation of recharge amounts will depend on the estimation of precipitation volumes, which may vary, depending on the source of precipitation data used. However, the partitioning between the different processes is in many cases governed by (variable) intensity thresholds. This means that the estimates of recharge will not only be sensitive to input parameters such as soil type, texture, land use, potential evaporation; but mainly to the precipitation volume and intensity distribution.

In this paper we explore the sensitivity of recharge estimates due to difference in precipitation volumes and intensity distribution in the rainfall forcing over the Canterbury region in New Zealand. We compare recharge rates and volumes using a simple water balance model that is forced using rainfall and evaporation data from; the NIWA Virtual Climate Station Network (VCSN) data (which is considered as the reference dataset); the ERA-Interim/WATCH dataset at 0.25 degrees and 0.5 degrees resolution; the TRMM-3B42 dataset; the CHIRPS dataset; and the recently releases MSWEP dataset. Recharge rates are calculated at a daily time step over the 14 year period from the 2000 to 2013 for the full Canterbury region, as well as at eight selected points distributed over the region. Lysimeter data with observed estimates of recharge are available at four of these points, as well as recharge estimates from the NGRM model, an independent model constructed using the same base data and forced with the VCSN precipitation dataset.

Results of the comparison of the rainfall products show that there are significant differences in precipitation volume between the forcing products; in the order of 20% at most points. Even more significant differences can be seen, however, in the distribution of precipitation. For the VCSN data wet days (defined as >0.1mm precipitation) occur on some 20-30% of days (depending on location). This is reasonably reflected in the TRMM and CHIRPS data, while for the re-analysis based products some 60%to 80% of days are wet, albeit at lower intensities. These differences are amplified in the recharge estimates. At most points, volumetric differences are in the order of 40-60%, though difference may range into several orders of magnitude. The frequency distributions of recharge also differ significantly, with recharge over 0.1 mm occurring on 4-6% of days for the VCNS, CHIRPS, and TRMM datasets, but up to the order of 12% of days for the re-analysis data. Comparison against the lysimeter data show estimates to be reasonable, in particular for the reference datasets. Surprisingly some estimates of the lower resolution re-analysis datasets are reasonable, though this does seem to be due to lower recharge being compensated by recharge occurring more frequently. These results underline the importance of correct representation of rainfall volumes, as well as of distribution, particularly when evaluating possible changes to for example changes in precipitation intensity and volume. This holds for precipitation data derived from satellite based and re-analysis products, but also for interpolated data from gauges, where the distribution of intensities is strongly influenced by the interpolation process.