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Processes, observations and parameters in a coupled surface water-groundwater model

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Hydrological models of surface-water flow and infiltration allow for a process-based representation of recharge to ground water models. Recharge is a fundamental and often difficult to quantify component of a groundwater system, in part because recharge and hydraulic conductivity changes tend to similarly affect hydraulic heads, the most common kind of observations in groundwater systems. Here the goal is to analyze the importance of using recharge derived from hydrologic processes for groundwater model development and furthermore the importance of a spatially distributed value of recharge. To achieve the goal we followed this procedure: 1) independently calibrate and test the groundwater and hydrological models (accomplished as described in Foglia et al., 2007GW, 2009WRR, in press WRR); 2) for the hydrological model, we present a new sensitivity analysis and calibration obtained with a set of observations that provides more detail at low flows, which was identified as important by Foglia et al. (2009); 3) couple the two models (here, one-way coupling transfers infiltration from the surface-water model to the groundwater model after multiplying by an estimated factor); 4) identify important parameters and observations using a sensitivity analysis conducted with linear statistics for this computationally demanding model; 5) use regression in an hypothesis testing framework to explore parameter and observation importance further and also explore resulting estimates and model fit.
The analysis is carried out using s physically based models of groundwater flow (MOFLOW-2000) and surface hydrology (TOPKAPI) developed for the Maggia Valley in Southern Switzerland. Calibration and sensitivity analysis were performed using UCODE_2005. Sensitivity analysis is used to identify the most important observations for both the individual and coupled models. As expected, the observations belonging to the hydrological model play a more significant role in the coupled calibration.
Results suggest the importance of distributed recharge and allow development of new strategies for its further evaluation in the groundwater model development and calibration.