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Impact of land cover data on modeling groundwater recharge and role of different data sources

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Groundwater is an indispensable base of human life and economics. The European Water Frame Directive takes this into account and regulates water protection and management. For this, political actors in water administration will need more and detailed information about larger areas in shorter time steps. For quantification of groundwater recharge, a large number of models are operational, which include themselves different layers of information, such as geology, soils and land cover. The latest one is the most variable in short time steps. Remote sensing is an effective tool for providing this kind of data. But now, it has to be evaluated, if these models are able to reflect the changes in the land cover, when provided with quantitative and qualitative details.

To respond to this challenge, a small investigation project was established to evaluate the impact of land use information on the modeling of ground water recharge. As a testing area the lower Kylltal, situated north of Trier (Germany) was chosen. For this region already processed data for land cover and geology, hydro-metrological data and calculated ground water recharge rates (based on hydrograph analysis) are available. Seven different model concepts were chosen according to the criteria established by Scanlon et al.[1]. We analyzed in which modules land cover data is used and how sensitive these components are for land cover or derivated parameters e.g. (Leave area index, density of vegetation cover). Due to the complexity of the model implementation, investigations were limited to the variation of the single modules.

[1] Scanlon, B., Healy, R., Cook, P., 2002: Choosing appropriated techniques for quantifying groundwater recharge. Hydrogeological Journal, 10, pp 18-39.

Results show, that best performance for deep seeping estimation was driven by distributed complex water balances models. These types of models show simultaneously the highest sensitiveness to detailed land cover information, taking into account land cover types and spatial distribution. According to this, these models need input data of high complexity. Unfortunately, they are focused on surfaces water fluxes, and for this seem to underestimate the influence of pedological and geological parameters.

In a second step we analyzed the possible data sources for detailed land cover information. Classification results from remote sensing data (Landsat TM-data) were compared with those from other sources like topographical maps, ATKIS and ground checks. For the accuracy assessment we chose 10 parameters, e. g. cover ratio, spatial resolution, time and financial amount or the possibility to create sub classes. For meso scale to macro scale areas results are best using models with the possibility for high resolution input data generated by remote sensing.