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Large scale groundwater model of the Danube Basin, an demonstrator model for the construction of global groundwater models

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Water resources will be affected by global change such as global warming or population increase. Impacts of global change processes must be assessed as a first step to mitigate them. Numerical models become essential to reach this goal. These models must cover large areas (continental or global scale models) and consider surface and subsurface hydrology. Here, we concentrate on the establishment of large scale groundwater models. A particular challenge is the lack of data to define the subsurface geometry or to calibrate them.
The large scale process-based groundwater model of the Danube basin is developed as a demonstrator to identify limitations and difficulties that arise during the construction of such large scale (global or continental) groundwater models and assess available tools and methodologies to address them. Surface water and groundwater processes are considered together by coupling off-line the hydrological model mHM and the groundwater simulation code OpenGeoSys. The main difficulty is the calibration of the model that cannot be undertaken by the classical approaches. In particular we show the very limited usefulness of the existing groundwater level measurements – even if there are hundreds of them - for parametrizing these coarsely resolved groundwater models. Therefore, we propose a new and pragmatic calibration routine that in a first step makes use of data that are often available like geophysical attributes of the area and river discharge. In a second step existing groundwater level measurements are used in a new way for further constraining the model.
Our results have tremendous implications for the establishment of large scale groundwater models in the context of global change research and for large scale groundwater monitoring strategies.