Geophysical Research Abstracts
Vol. 12, EGU2010-6517, 2010
EGU General Assembly 2010

Testing a parsimonious ground water model in the Silberleite catchment, Moxa Germany

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The Geodynamic Observatory Moxa is located 30 kilometres south of Jena, Thuringia Germany in the narrow valley of the Silberleite. A superconducting gravimeter, which measures changes in the earth's gravit field, is located in the observatory. The gravitational field is not only influenced by tectonic activity, but also by the hydrological situation in the vicinity of the gravimeter. In a Previous study, a steady state 3D-model of the area directly around the observatory was constructed. The objective of this study was to gain an understanding of water storage and water flow on the hill slopes around the observatory and to create a dynamic linear reservoir model for the hill slopes. This reservoir model is used to transform the steady state 3D-model into a transient model.

A short, intensive field campaign was conducted with the aim of obtaining information on the spatial variability of the area (vegetation, geology, hydrogeology) and the response times. This was done on the relatively steep slope east of the gravimeter – which is closest to the gravimeter – and on the less steep slope west of the gravimeter. No distinct spatial variability of the upper soil layer was found. An infiltration experiment was performed, in order to test the transmissivity of the parent material (shales). On this small plot, the cracks were able to transport 0.3 l/s during 20 hours towards the valley. The water level below the gravimeter – downstream of the experiment – showed a quick rise after the start of the experiment with a maximum water level rise five hours after the start of the experiment of 0.53 m over a distance of approximately 50 m.

A linear reservoir model was constructed to enable predictions of the amount of water flowing into the valley. The model consists of different reservoirs that represent layers on both the eastern and western slope. Not all model parameters could be quantified in the field, therefore calibration was carried out. The canopy is an important reservoir in the model as it has the capacity to store a large amount of precipitation. The western slope reacts faster to the onset of precipitation than the eastern slope, because of the different geological profiles that occur on both slopes. Base flow is not yet included in this model. As a result, the modelled outflow from the parent material in the valley can stop during long dry periods. Discharge measurements in the Silberleite show that also during longer lasting dry periods water is discharged, indicating at least some base flow conditions. The calibration in this study was done for the eastern slope and shows promising results. The groundwater model constructed in this study is an important next step in linking gravity measurements with the hydrological situation in the field.