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Parameterization of a hydrological model using magnetic resonance sounding measurements application to the Strengbach mid-mountain catchment, France

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Mid-mountain catchments may show significant dynamic groundwater storage to supply freshwater resources. Physically based models coupling surface and subsurface flows are promising tools for understanding how water resources are influenced by the hydro-climatic regime. However, the strong heterogeneity of the subsurface together with a difficult access to drillings of observation boreholes render arduous the model parameterization. We applied the coupled surface-subsurface hydrological model NIHM (normally integrated hydrological model) to physically simulate flows and heads both in the surface and the subsurface of a mid-mountain catchment. In NIHM, the complexity of the physical processes simulated is reduced by assuming that flow in the vadose and the saturated zones of the aquifer is mainly parallel to the substratum. The computation time is thus substantially reduced allowing us for the use of stochastic approaches to determine the model parameters. The model is applied to the Strengbach watershed, located in the Vosges mountain and site of the Hydro-Geochemical Observatory (OHGE http://ohge.unistra.fr). Magnetic resonance soundings (MRS) acquisitions cover the entire catchment and are used here to parameterize the NIHM model. MRS measurements are directly sensitive to the subsurface water content, so that NIHM outputs are straight converted to estimate MRS data. The most sensitive parameters of NIHM (the aquifer thickness, the porosity, and the saturated hydraulic conductivity) are sought by fitting the MRS data and the stream flow rates at the outlet of the watershed. This work highlights the pertinence of MRS data to drastically reduce equifinalities when seeking model parameters.