HS02 Hydrologic Non-Stationarity and Extrapolating Models to Predict the Future
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Assessment of climate change effects on groundwater resource in transient conditions

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A sophisticated transient weather generator (WG) in combination with an integrated surface-subsurface hydrological model (HydroGeoSphere) are used for producing a stochastic generation of large numbers of equiprobable climatic time series, representing transient climate change, and assess impacts on groundwater resources in a probabilistic way.
The modelling approach, involving the catchment-scale fully integrated surface-subsurface model, is described in Goderniaux et al. [2009]. Biased-corrected climate change scenarios are applied as input of the hydrological model to quantify their impact on groundwater resources. In Goderniaux et al. [2011], the integrated model is used in combination with a stochastic daily weather generator (WG). This WG allowed generating a large number of equiprobable climate change scenarios representative of a full transient climate between 2010 and 2085. These scenarios enabled to account for the transient nature of the future climate change, and to assess the uncertainty related to the weather natural variability. The downscaling method considers changes in the climatic means, but also in the distribution of wet and dry days.
This new methodology is applied for the unconfined chalky aquifer of the Geer catchment in Belgium. A general decrease of the mean groundwater piezometric heads, has been calculated. The approach allowed also to assess different uncertainty sources: (1) the uncertainty linked to the calibration of the hydrological model, using 'UCODE_2005'; (2) the uncertainty linked to the global and regional climatic models (GCMs and RCMs), by using a multi-model ensemble; (3) the uncertainty linked to the natural variability of the weather, by using stochastic climate change scenarios. 30 equiprobable climate change scenarios from 2010 to 2085 have been generated for each of 6 different RCMs. Results show that although the 95% confidence intervals calculated around projected groundwater levels remain large, the climate change signal becomes stronger than that of natural climate variability by 2085. The WG ability to simulate transient climate change enabled the assessment of the likely timescale and associated uncertainty of a specific impact. This methodology constitutes a real improvement in the field of groundwater projections under transient climate change conditions as it enables water managers to analyse risks and take decisions with full knowledge of projected impact and their degree of confidence.

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