EGU2020-18685, updated on 28 Oct 2021
https://doi.org/10.5194/egusphere-egu2020-18685
EGU General Assembly 2020


# Stochastic hydrogeological parameterisation and modelling of the Chalk of England

**Marco Bianchi**, Andrew Hughes, Majdi Mansour, Johanna Michaela Scheidegger, and Christopher Jackson
British Geological Survey (BGS), Environmental Science Centre, Keyworth (Nottinghamshire), United Kingdom of Great Britain and Northern Ireland (marcob@bgs.ac.uk)

The Chalk is the most important regional aquifer in England supplying the majority of the groundwater used in the country. Traditionally, the Chalk has been interpreted as a dual-porosity aquifer consisting of a low-permeability, high-porosity matrix and a fracture component with associated relatively high secondary permeability, allowing groundwater flow. However, these two components alone cannot fully explain the groundwater flow regime and aquifer productivity indicating that the distribution of the hydrogeological properties is the result of more complex interplay of several regional and local factors. For instance, transmissivity generally exhibits a non-linear decline with depth controlled by variations in the spacing and aperture of the primary and secondary (solution) fractures. Topography is another important regional factor determining a spatial distribution of transmissivity (T) and storage coefficient (S) with generally higher values within valleys and lower values in the interfluves. The topographic factor is widely recognised, and it has been applied in several previous numerical modelling studies. However, these studies do not consider the local variability exhibited within an extensive dataset of more than 1000 pumping tests, while local adjustments of the initial topography-based T and S distributions are considered during the calibration step of the model. In this work, a hybrid geostatistical approach has been developed and applied for modelling the distribution of the hydrogeological properties of the Chalk. The approach combines, for the first time for the Chalk, local hard data from pumping tests with soft data accounting for the regional topographic trend. In particular, similar to the classic regression kriging approach, stochastic realisations of the T distribution in the unconfined region of the Chalk are generated from the combination of two components: 1) a non-linear deterministic model of the relationship between measured T values and the distance to valleys; 2) a sequential Gaussian simulation (SGS) component generating equally probable realizations of the residuals conditioned to the local data. Traditional conditional sequential Gaussian simulation was used instead to generate T and S spatial distributions in the confined region. To test the representativeness of the generated distributions, realisations of the hydrogeological parameters were considered for groundwater flow simulations based on a transient 2-D finite difference model coupled to a regional recharge model. Comparison between observed and simulated values for groundwater levels and river flows at reference locations showed a generally good agreement. The model was then used to quantify the importance of local hydrogeological data for improving model predictions versus alternative conceptualisations solely based on regional trends and

model calibration.