Geophysical Research Abstracts
Vol. 19, EGU2017-17030, 2017
EGU General Assembly 2017
© Author(s) 2017. CC Attribution 3.0 License.

Modelling small groundwater systems – the role of targeted field investigations and observational data in reducing model uncertainty

Corinna Abesser (1), Andrew Hughes (2), and David Boon (2)

(1) British Geological Survey, Wallingford, UK, (cabe@bgs.ac.uk), (2) British Geological Survey, Keyworth, UK

Coastal dunes are delicate systems that are under threat from a variety of human and natural influences. Groundwater modelling can provide a better understanding of how these systems operate and can be a useful tool towards the effective management of a coastal dune system, e.g. through predicting impacts from climatic change, sea level rise and land use management. Because of their small size, typically 10 - 100 km2, models representing small dune aquifer systems are more sensitive to uncertainties in input data, model geometry and model parameterisation as well as to the availability of observational data.

This study describes the development of a groundwater flow model for a small (8 km2) spit dune system, Braunton Burrows, on the Southwest coast of England, UK. The system has been extensively studied and its hydrology is thought to be well understood. However, model development revealed a high degree of uncertainty relating to model structure (definition of model boundary conditions) and parameterisation (e.g., transmissivity distributions within the model domain).

An iterative approach was employed, integrating (1) sensitivity analyses, (2) targeted field investigations and (3) Monte Carlo simulations within a cycle of repeated interrogation of the model outputs, observed data and conceptual understanding. Assessment of “soft information” and targeted field investigations were an important part of this iterative modelling process. For example, a passive seismic survey (TROMINO®) provided valuable new data for the characterisation of concealed bedrock topography and thickness of superficial deposits. The data confirmed a generally inclined underlying wave cut rock shelf platform (as suggested by literature sources), revealed a buried valley, and led to a more detailed delineation of transmissivity zones within the model domain. Constructing models with increasingly more complex spatial distributions of transmissivity, resulted in considerable improvements in the fit between predicted and observed heads and reduction in overall model uncertainty.

The impact of availability of observational data on model calibration was tested as part of this study, confirming that equifinality remains an issue despite improved system characterisation and suggesting that uncertainty relating to the distribution of hydraulic conductivity (K) within the dune system must be further reduced.

This study illustrates that groundwater modelling is not linear but should be an iterative process, especially in systems where large geological uncertainties exist. It should be carried out in conjunction with field studies, i.e. not as a postscript, but as ongoing interaction. This interaction is required throughout the investigation process and is key to heuristic learning and improved system understanding. Given that the role of modelling is to raise questions as well as answer them, this study demonstrates that this applies even in small systems that are thought to be well understood.

This research is funded by the UK Natural Environmental Research Council (NERC). The work is distributed under the Creative Commons Attribution 3.0 Unported License together with an author copyright. This licence does not conflict with the regulations of the Crown Copyright.