

Preface

The papers in this publication were presented at the ModelCARE 2011 conference held in Leipzig, Germany. The ModelCARE series, always centred around the calibration of groundwater models, how to deal with inherent uncertainties and how to judge reliability, has been a regular international conference series. It has offered the opportunity to meet experts deeply involved with analytical and numerical modelling of groundwater flow and transport processes. Measured data and experimental methods are mainly seen in the context of input and output of models, with a crucial link to reality and carrying the challenge the models have to cope with. Though not named groundwater, this has always been the central topic of the ModelCARE conferences. However, times and key people involved are regrettably changing, but there is also a chance for new developments. The role of groundwater is now combined with other environmental compartments and related processes. This is to a larger extent driven by questions of global and climate change, but is also related to energy resources, as well as the required waste deposition. Therefore, this ModelCARE has stressed the boundaries of groundwater, which are the interfaces to the atmosphere, surface waters and deeper formations that are potentially used for geothermal energy and CO₂ storage. We believe this extended scope is the way forward to maintain ModelCARE as a model-centric conference of subsurface hydrology and its related disciplines.

This development is clearly reflected in the broader range of topics in an environmental hydrological context represented in this book. Still, models play an important role in the protection of groundwater as a freshwater resource. The subsurface heterogeneity is a key challenge still, but has to be handled not only in respect to groundwater flow and conservative transport, but also in respect to salinization, biogeochemical processes and exchange with surface waters and the atmosphere. Coupled processes in the subsurface still lack rigorous understanding, e.g. unsaturated flow, density-effects, multiphase flow including CO₂ sequestration, exchange of solutes with solid phases and biomass, or transfer between streams and groundwater. At the same time, new developments in remote sensing and geophysical exploration provide more and different input to constrain, calibrate and validate models needing further development of existing standard approaches. More than ever, models are the mechanism to integrate information from different and manifold sources, allowing a better conceptual view of the system as a whole and the knowledge that may be retrieved on studying this system. That is, models are, in the best case, *repositories of knowledge*. This was the special title of the ModelCARE 2011. However, in the worst case scenario, models can end up as the opposite, as heaps of inconsistent data carry wrong conclusions. That is why we continuously have to take special care of conceptual models, numerical developments and integration of experimental data into models, to achieve the deeper, quantitative insight only models can provide. As a result, the community will profit from continuing the ModelCARE series.

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