

## Preface

The ModelCARE conferences are a forum where scientists and engineers come together to demonstrate new ideas and solutions, and to address the continuing difficulties in the development of groundwater models. The models of concern represent groundwater systems, arguably the most difficult of Earth system models because the systems are inaccessible and, as they are a source of drinking water, very detailed knowledge is required. The usefulness of predictive simulations obtained by groundwater models is often hampered by the inability to indicate and quantify the reliability of model results. Uncertainty in model predictions primarily stems from a number of errors relating to the model formulation such as:

- inadequate conceptualization of processes and interactions;
- inadequate description of processes and interactions;
- inadequate description of spatial and temporal variability;
- inadequate description of the state of the system (geometry, initial and boundary conditions, system stresses);
- incorrect coefficient values (parameter values) and improper specification of error bounds.

This (postpublished) volume is an outcome of the International Conference on *Calibration and Reliability in Groundwater Modelling: From Uncertainty to Decision Making*, which was held 6–9 June 2005 in The Hague, The Netherlands. ModelCARE 2005 is a follow-up to the four previous successful conferences: ModelCARE 90 (held in The Hague, The Netherlands, 1990), ModelCARE 96 (held in Golden, Colorado, USA, 1996), ModelCARE 99 (held in Zürich, Switzerland, 1999) and ModelCARE 2002 (held in Prague, Czech Republic, 2002). As before, the conference was dedicated to providing an international forum for state-of-the-art presentations on relevant methodologies and techniques of calibration and uncertainty assessment in groundwater modelling and to identify needs for future development. The conference involved both theoretical developments and advanced case studies. In the following, a short overview of the key conference topics is given. Please note that the papers and authors mentioned herein are mere examples. It is by no means a complete account of the many other invaluable contributions to this conference.

As can be seen from the conference subtitle, extra attention was paid to how to translate uncertainty to decision making. Clearly, throughout the years that this conference series has been organized, great advances have been made on how to assess uncertainty about the outcomes of hydrological models and how to decrease this uncertainty by calibration and the incorporation of ancillary information. However, the last step of the triplet “uncertainty assessment, uncertainty reduction, uncertainty management” has not yet been properly made. In practice, policy makers still find it hard to cope with model predictions that have been enriched with measures of quantified uncertainty. For this conference we therefore solicited papers that dealt with decision making under uncertainty. Quite a few papers were submitted on this theme, a

few of which are now part of this volume. Examples are the contributions by Vink & Schot using game theory to guide the allocation of extra resources for pollution studies, and that of Davis *et al.* who present a general framework for decision making under uncertainty.

The science of determining stochastic well head protection zones, which had already started to flourish during ModelCARE 2002, attracted even more papers for this conference. Considerable advances have been made since 2002, exemplified by the contributions of Riva & Guadagnini, Christensen *et al.*, and Indelman & Dagan. The last paper was presented by Gedeon Dagan on behalf his friend and co-author Peter Indelman, who would have attended the conference but sadly passed away a few months earlier. Another noticeable advance that became evident during this conference is the combined modelling and upscaling of spatially heterogeneous hydraulic and geochemical parameters, e.g. the papers of Gómez-Hernández *et al.* and Willmann *et al.* Further advances in the calibration of groundwater modelling were evident from the use of model reduction techniques in order to calibrate models with millions of grid nodes (Vermeulen & Heemink) and the use of remote sensing data (e.g. Hendricks Franssen *et al.*). Finally, the conference was adorned with research contributions that yielded beautiful artwork such as the transient capture zones of Vesselinov & Robinson and the spiralling groundwater whirls of Hemker & Bakker.

This volume contains 45 papers grouped into seven topics. The papers were chosen from the 70 papers pre-selected for oral and poster presentations at the conference. The selection was performed by the Editors based on two to three reviews of each paper. The reviewers consisted in general of one member of the Scientific Advisory Committee or one of the editors and one or two authors of candidate papers. The final version of the paper was again checked by the Editors. The overall procedure enabled, without doubt, a significant increase in the quality of the selected papers and therefore of the present volume. The Editors would like to thank the reviewers for their efforts.

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