Geophysical Research Abstracts
Vol. 20, EGU2018-19662, 2018
EGU General Assembly 2018

Dealing with uncertainty in an integrated water management model

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Integrated Water Assessment and Modelling (IWAM) considers the environment, economic and social aspects, which have their own uncertainties. Uncertainty is a pervasive concern and its criticalities must be identified and managed to further support decision-making processes. Integrated models that couple representations of system domains have different types and sources of uncertainty which then propagate through the model.

In this study, we have developed an integrated and component-based model for the lower Campaspe catchment, which is part of Murray-Darling Basin, Australia. The Campaspe system is highly developed, regulated, and supports extensive irrigation infrastructure. Water is predominantly diverted for agricultural purposes and is the primary consideration herein. However, it is acknowledged that there are other key water users in the basin, including industry, stock and domestic, water for recreational purposes, and the environment.

The integrated model is component based comprising models that represent farm, ecology, surface water, and groundwater systems. A climate component provides the necessary climatic data. The models, and the interfacing framework, has been developed in Python with the exception of the ground and surface water hydrology models which were implemented with MODFLOW and in Fortran respectively. The challenges were to understand and, where possible, quantify the trade-offs and uncertainties involved with water resource management options and opportunities under plausible futures. This requires the behaviour of model components and their linkages and interactions to be understood.

Therefore we conducted sensitivity and uncertainty analysis (SA/UA) for individual components as well as the integrated model as a whole. Conducting SA/UA in this parallel approach produces the range of outputs under uncertainty and additionally shows the influence of individual parameter factors on model results. Identification of uncertain and sensitive parameter factors through this assessment process allows model components to be simplified whilst also being as complex as necessary for the model purpose.