Hydrological Decision Support Framework (HDSF) – Initial design[#]

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Abstract

A Hydrological Decision Support Framework (HDSF) is being developed within a Water Research Commission (WRC) -funded project. The HDSF is intended as an integrated modelling tool for use by water resource managers and catchment management agencies (CMAs) in assessing and managing water resources. The HDSF will facilitate linking and running models within a common graphical user interface containing appropriate geographic information system and data analysis tools linked to a common database designed to store spatial and temporal data. Selected hydrological modelling framework applications and modelling framework development tools were reviewed. A framework for linking models was also reviewed. As a consequence of these reviews, it was apparent that no single currently available system could provide all the requirements for the HDSF. One of the modelling framework applications reviewed which met many of the requirements was selected and will be further developed. The initial design of the HDSF is presented in this document.

Keywords: modelling framework; hydrological modelling; decision support

Introduction

As demand for water resources increases in South Africa it is necessary for water to be managed and utilised with greater efficiency. The management paradigm has changed from a focus on surface water supply quantity to a more holistic approach which also considers water quality, the environment as a water user, surface water-groundwater interactions, and social and economic impacts. In recent years there has been an international trend towards this new management paradigm known as Integrated Water Resources Management (IWRM) (Havnø et al., 2002; Schulze, 2002). In South Africa this new paradigm has been captured in Section 3 of the National Water Act (NWA) of South Africa (Act 36 of 1998) as follows:

'*3. (1) As the public trustee of the nation's water resources the National Government, acting through the Minister, must ensure that water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner, for the benefit of all persons and in accordance with its constitutional mandate.*
(2) Without limiting subsection (1), the Minister is ultimately responsible to ensure that water is allocated equitably and used beneficially in the public interest, while promoting environmental values.
(3) The National Government, acting through the Minister, has the power to regulate the use, flow and control of all water in the Republic.' (NWA, 1998).

IWRM requires a greater understanding of complex hydrological systems. Since the 1980s advances in computer science combined with improved understanding of hydrological processes has resulted in the development of computer simulation models that capture and aid understanding of hydrological systems. However, many of the models were developed for a particular domain within the hydrological system, such as surface water, groundwater or ecology, by experts in that domain. IWRM requires that the models for each domain be integrated and that scientific experts collaborate in the holistic assessment and management of water resources.

The need to integrate water resource models has led to another trend, which is towards the development of modelling frameworks. Traditionally models have each been run within their own modelling systems, each consisting of similar tools to prepare model input data, write model input files and analyse model output. Modelling frameworks seek to reduce duplication of effort and ease model use and development by providing common data preparation and post-processing tools, including a Geographic Information System (GIS) and database management, for use with several models. Some modelling frameworks have progressed further than this by breaking models down into sets of modules which may be linked together to create models tailored to meet specific IWRM scenarios (Kralisch et al., 2004; Rahman et al., 2003; Argent and Rizzoli, 2004). However, there are many legacy models in existence, and as it is not financially practical to restructure all these models into a modern programming language, some other means of integration has to be developed. Such legacy models have been linked in series by running one model for a simulation period, converting the model output files to the input format of the second model, and then running the second model. This method of linking models is suitable if there are no feedback relationships between components of the two hydrological systems simulated by the models. Recent developments in computer science provide solutions to this problem and allow integration of legacy models on a time-step-by-time-step basis, which is referred to as linking models in parallel. Integrated models allow modelling at different but appropriate spatial and temporal scales. For example,

[#] This paper was originally presented at the 2005 SANCIAHS Conference, 5-7 September 2005, Midrand, South Africa.
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Received 30 September 2005; accepted in revised form 7 July 2006.