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Water Use and Management in Semiarid Regions – A Distributed Modelling Approach in the Verlorenvlei Catchment, South Africa

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Hydrological modelling is a useful method to predict water availability and environmental impacts in a range of climate and land use change scenarios. One of the major challenges to accurate predictions using hydrological modelling in semi-arid areas is the high temporal and spatial variability of rainfall events and the associated uncertainty of related process parameters. Limited and often unreliable climate observations can cause additional problems. These particular circumstances are well documented for many catchments in the world, including semi-arid parts of South Africa. An accurate assessment of water quality and quantity is however crucial for sustainable water resource management, which is often difficult under changing environmental conditions such as climate and land use change.

This situation can be found in the Verlorenvlei catchment, a part of the Sandveld area located in the Western Cape region of South Africa. Extensive dry periods in combination with an increasing domestic water demand, expanding irrigation agriculture and expected reducing rainfall due to climate change present a challenging setup for water management in this region. The catchment is a highly sensitive area with one of the most important estuary systems in the Western Cape region, containing significant natural wetlands with high biodiversity and numerous endemic species. With very limited surface water resources, most settlements and irrigation systems in the region are mainly dependent on groundwater. As a result of the particular conditions, the use of improved management techniques, such as centre pivot irrigation and contour-bank farming, are necessary.

The distributed, process-oriented hydrological modelling system JAMS/J2000 is used and evaluated to assess water availability within the catchment under different climate and land-use change scenarios. The first phase has involved configuring the model to accurately represent the specific natural conditions of the hydrological system and anthropogenic influences that are apparent within the Verlorenvlei catchment. In this context, the model was adapted by implementing simulation routines that reflect the local conditions of the region and which show a notable impact on the hydrological conditions (e.g. irrigation and contour bank farming techniques). The first modelling results and related impacts of using different components related to management practises will be presented.