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The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

TECHNICAL BRIEF

Climate change

WRC-funded research investigated methodological approaches to assessing eco-hydrological responses to climate change in South Africa.

Assessment tools

South Africa typically has two groups of researchers using two different climate scenario modelling downscaling approaches; namely statistical downscaling and dynamic downscaling techniques. For this project, a statistical downscaling technique was used for generation of likely scenarios for the primary and higher order impacts of climate change on water resources, in order to support the development of policy responses and coping strategies.

Climate scenarios

Daily time series of key climate variables for hydrology were generated from observations and Global Climate Models (GCMs) data. The technique enabled a number of GCMs to be downscaled and therefore a wide range of possible future climates were also sampled. Estimates of daily rainfall, minimum and maximum temperatures were downscaled for more than 3000 stations across South Africa, for 9 GCMs under an assumed A2 SRES scenario (all used as part of the IPCC 4th assessment report). This has been completed for the three periods: 1960-2000, 2046-2065 and 2081-2100; and daily rainfall grids at 0.25° resolution have been produced for the same 9 GCMs and 3 periods.

Benefits and the new higher resolution scale

The spatial scale at which the local hydrology was previously modeled was identified as being inadequate. Hence, a further subdivision of existing quaternary catchments into 5 838 quinary catchments covering South Africa, Lesotho and Swaziland was then undertaken. This allows, for example, the distinction between high mountainous and lower riparian zones within each quaternary, each of which have different characteristics with respect to hydrology and land use. New water temperature indicators were developed for the Thukela catchment, as primary indicators of water quality, and these represent the first attempt at doing this under conditions of climate change.

Implications for sustaining current and future research

Supporting and maintaining requisite skills and capacity in southern Africa to update and refine scenarios and trajectories on an ongoing basis is essential, in order to ensure refinement and further development of policy responses and coping strategies. Identify specific aspects of water resources that should be addressed in long-term monitoring programmes, in order to provide information and feedback on:

- The rates of change and possible thresholds of change; and
- Effects of policy and implementation of coping strategies.

Recommendations for future work

Given the dynamic nature of the climate science and the projections the scenarios used to make an assessment should be periodically updated;

- Hydrological assessments should be reiterated when either regional climate model (RCM) data becomes available such as through the coordinated regional climate downscaling experiment (CORDEX) program.
- Given the complexity of simulating future climate systems and to reduce resultant uncertainties incurred in using only one model (i.e. ECHAM5 GCM was the only

one used in the projections in this project), and to assign levels of confidence to results; output from a series of GCMs should be used in order to obtain a probability distribution of, and a level of confidence on, the climate impacts being modelled;

- In this research project only a subset of all the available flow indicators was applied with the three climate scenarios. In order to fully describe a South African river's flow regime, climate change responses from all 67 indices should be modelled. Therefore, in future projects investigating the likely impacts of climate change on flow regimes it is recommended that methods and techniques be developed to assess all 67 indices;
- The Thukela Catchment was used as the test catchment for the water temperature related analysis in this research project. The techniques developed to assess the impact of projected climate change on the water temperature parameters produced workable results and thus it is recommended that a study covering southern Africa be performed.

Further reading:
To obtain the report, *Methodological Approaches to Assessing Eco-Hydrological Responses to Climate Change in South Africa.* (**Report No. 1562/1/10**), contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.