Comment on:
Lloyd (2010) Historical trends in the flows of the Breede River (*Water SA* 36 (3) 329-333)

by Guy Midgley
Chief Director: Climate Change and BioAdaptation, South African National Biodiversity Institute
Kirstenbosch, P/Bag x7, Claremont 7735, Cape Town, South Africa. E-mail: G.Midgley@sanbi.org.za

Philip Lloyd makes some useful points in this publication relating to recent changes in Berg River flow, but one key conclusion goes far beyond what can be claimed based on his analyses and discussion. While it is important to validate and criticize the published work of other authors, as he does in this paper, it is also important not to use this as a platform to develop unjustified overarching criticisms of a broader field of study and its policy value. I would like to draw attention to one important omission in his background discussion of General Circulation Models (GCMs), and then question his final conclusion.

As Lloyd highlights, it is well known that General Circulation Models have historically been largely unable to provide credible projections of future climate change at local scales. In the past, in order to derive finer scale projections, several methods were applied that used the outputs of GCMs as a basis for their projections. However, his blanket claim that GCMs are designed to operate only at a coarse spatial scale ignores recent advances in variable scale modeling approaches, and does not acknowledge excellent work being carried out in this country. These approaches, based on an Australian-developed (CSIRO) GCM, allow a fine-scale grid to be applied over a region of interest while modeling global climate (e.g. Park 2010). Development of the new Conformal-Cubic Atmospheric Model (CCAM) enabled simulation of the past season's major rain events (Park, 2010; Engelbrecht et al., 2009). These advances hold much promise for a better understanding of future climates at regional and local scales.

The unjustified conclusion Lloyd reaches is that: 'Above all, [GCMs] must not form the basis for any policy decisions until such time as they can reproduce known climate effects satisfactorily' (p. 329). This overarching suggestion ignores the fact that GCMs have in fact successfully reproduced many aspects of the global climate, and especially have been able to distinguish the role of greenhouse gas emissions from natural forcing factors in recent changes in the earth's global and regional temperature trends, and have even simulated fairly short-term regional changes following significant disturbances such as large volcanic eruptions. To state that no policy decisions can be based on these models is a denial of the value of such a key scientific tool. Furthermore, policy does not need to be based on certain outcomes – in fact it very rarely is! Policy can distinguish between those aspects of GCM projections that are more and less certain, and even account for large uncertainties. Future changes in Western Cape climate may well diverge from past climate trends because of the responses of large-scale circulation to global warming – this includes possible poleward displacement of westerly frontal systems that currently bring winter rainfall to this region. This is one of the most robust conclusions of GCMs for Mediterranean climate systems around the world. For policy makers to ignore the implications of such a projection would simply be irresponsible.

References

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ENGELBRECHT FA, McGREGOR JL and ENGELBRECHT CJ (2009) Dynamics of the Conformal-Cubic Atmospheric Model projected climate-change signal over South Africa. *Int. J. Climatol.* **29** (7) 1013-1033.

Response to comments made by Guy Midgley on:

by Philip Lloyd
Energy Institute, Cape Peninsula University of Technology, PO Box 532, Cape Town 8000. E-mail: plloyd@mweb.co.za

I must thank Dr Midgley for creating the opportunity to explore the predictions of General Circulation Models (GCMs)] further. There is a debate on their predictive capabilities that is probably best summed up by the latest IPCC report (IPCC, 2007: 849):

- 'Atmosphere-Ocean General Circulation Models remain the primary source of regional information on the range of possible future climates.''
- 'Advances have been made in developing probabilistic information at regional scales from the AOGCM simulations, but these methods remain in the **exploratory** phase' (emphasis added).

There have been many tests of the ability of the models to simulate historical information. One of the most thorough was that carried out by National Assessment Synthesis Team of the US Global Change Research Program in 2009 (GCRP, 2009). Over the period 1958-2008, precipitation increased by about 5% across the entire United States. However, the average of 15 different GCMs for 2080-99 did not show the same general increase as was reported over the past 50 years. "- - some areas will experience an increase in precipitation, other areas will experience a decrease, and others will see little discernible change. The difficulty arises in predicting the extent of those areas and the amount of change." Midgley claims that 'possible poleward displacement of westerly frontal systems that currently bring winter rainfall…' make the GCM predictions for such regions 'robust'. As a result, 'Future changes in Western Cape climate may well diverge from past climate trends.' With the United States example to hand, the robustness of the predictions must be questioned.

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The IPCC was clearly being conservative when it said the models were still at an exploratory stage. It needs to be recalled that the measurements of global temperatures have shown an increase for at least 100 years. If you need some guide as to what might happen during this century, then the past century is there as a basis. I can find no evidence that the precipitation in the Breede River valley has changed materially over the past century.

Midgley has suggested that there are developments in GCMs that might improve the situation. I regret I could not reference the excellent work by the CSIR in my original paper, as unfortunately the CSIR work was published well after my paper went to press. However, I question the relevance of this to climate change, because Midgley's cited Conformal-Cubic Atmospheric Model was used successfully in short-term weather prediction, not for long-term climate prediction.

Moreover, there are strong criticisms of the GCMs, which cannot be ignored. They fail, for instance, to account for clouds. Between 60°N and 60°S, they predict more rapid warming of the upper troposphere than of the surface, but measurements show that, if anything, the upper troposphere is cooling. My personal objection to GCMs stems from the observation that tropical cyclones dissipate enormous energies, yet no GCM takes cyclones into account.

I can only agree with the IPCC that GCMs are still exploratory when used to address regional aspects of climate. Midgley's conclusion, that 'For policy makers to ignore the implications of such a [GCM] projection would be simply irresponsible,' is itself irresponsible when seen in this light.

References

GCRP (United States Global Change Research Program) (2009) Global Climate Change Impacts in the US. pp30-31. ISBN 978-0-521-14407-0. URL http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf, Accessed January 2011.

IPCC (INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE) (2007) Regional Climate Projections. Chapter 11. In: *Climate Change 2007 – The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the IPCC.* Cambridge University Press, Cambridge.

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