Reconstructing Australian environments of the last glacial cycle through quantitative modelling

Richard Wardle and Ian Simmonds

School of Earth Sciences
The University of Melbourne
Parkville, Victoria
Australia, 3052
Email: rwardle@unimelb.edu.au

Our work involves the systematic study of large-scale changes in global climate and regional changes for the Australian continent that have occurred over the last 130,000 years. There currently exists a need for the interpretation of the data based reconstructions within a dynamical framework. Our modelling approach will provide simulated climate and hydrological model data sets with which to compare the reconstructed climates, identifying consistencies and inconsistencies that may exist with the dynamics.

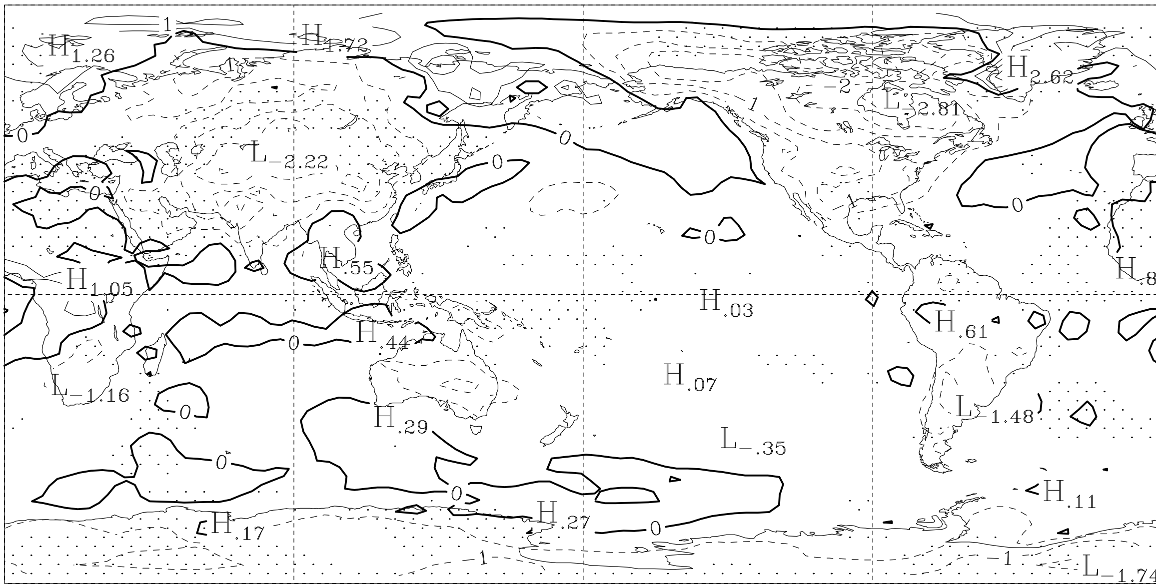
The global simulations are performed with a sophisticated atmospheric GCM which successfully replicates the present day (PD) climatology. Focus will then turn to smaller scales within Australia, where limited area models and hydrological models will be used to understand processes down to the catchment level. We focus initially on the mid-Holocene (6 ka), an epoch for which relatively large amounts of paleo data exist and for which there is a clear understanding of the climate forcings. Boundary conditions are consistent with the Paleoclimate Modelling Intercomparison Project (PMIP) with only the orbital forcings and atmospheric CO_2 concentrations differing from those of today.

The model simulated DJF surface air temperature anomalies (6ka - PD) shows cooler temperatures for most of the land masses over the globe (Fig. 1a). Statistical significance at the 95% level is indicated by stippling. Fig. 1b shows the corresponding JJA distribution. Australia is marked by reduced seasonality, in contrast to the northern hemisphere where summers are warmer and winters colder. Reconstructed paleo vegetation maps through proxy methods yield a mid-Holocene Australian climate that, with a few notable exceptions, is similar to today [Dodson (1992)]. The palynological data [Kershaw *et al.* (1991), Kershaw *et al.* (2000), among others] suggest that the conditions in Australia at that time were up to 25% wetter than today with warmer annual mean temperatures of about 1^{o}C concurrent with reduced seasonality, in agreement with the climate simulated by the model.

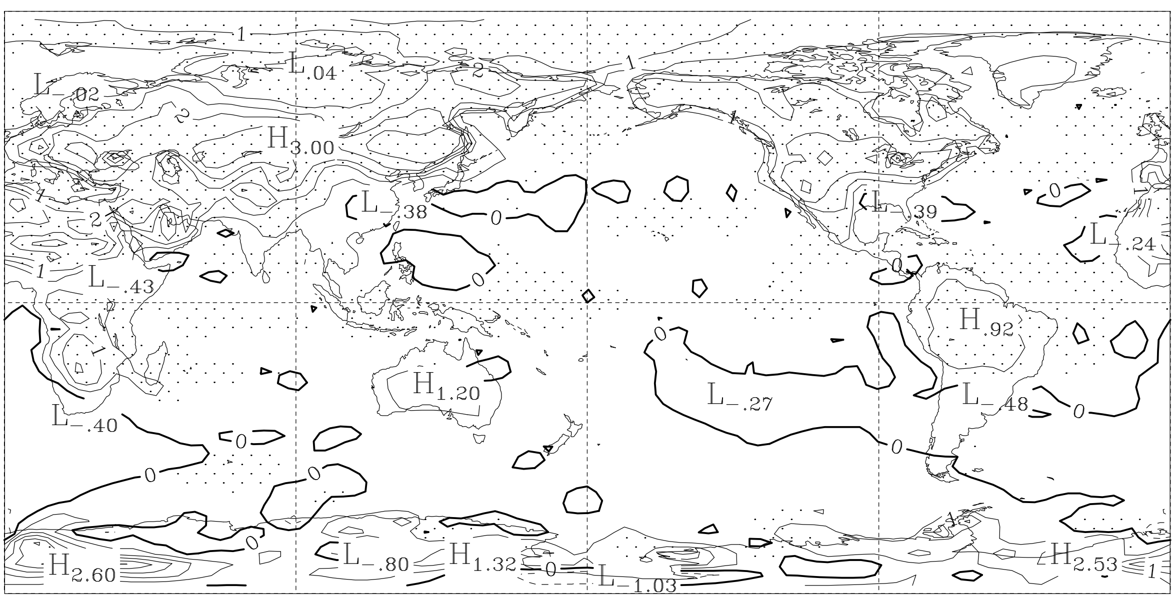
Dodson J.R. (ed.), 1992: The Naive lands: prehistory and environmental change in Australia and the south-west Pacific. *Longman Cheshire*. 258p.

Kershaw A.P., D'Costa D.M., McEwan Mason J.R.C. and Wagstaff B.E., 1991: Palynological evidence for Quaternary vegetation and environments of mainland south-eastern Australia. *Quaternary Science Reviews*, **10**, 391-404.

Kershaw P., Quilty P.G., David B., Van Huet S. and McMinn A., 2000: Paleobiogeography of the Quaternary of Australia. *Memoir of the Association of Australasian Paleontologists*, **23**, 471-516.



(a) DJF Surface air temperature anomaly (6ka - PD)



(b) JJA Surface air temperature anomaly (6ka - PD)

Figure 1: The distribution of the difference in the surface air temperature between the 6 ka simulation and that of the present day; a) DJF and b) JJA. Regions of statistical significance at the 95% level are stippled.