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Evaluating mid-Holocene precipitation over Australasia and the Maritime Continent in climate models

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The Australasian INTIMATE (INTegration of Ice-core, Marine and Terrestrial records) initiative (INQUA project #0809) was undertaken to develop a consistent chronological assessment of the climate of the past 30000 years over Australia, New Zealand and the Maritime Continent. Work has continued as part of SHAPE initiative (INQUA project #1302), but there has currently been little use of this comprehensive resource for evaluating the available climate model data. Therefore, this work presents the initial assessment of model simulations of the mid-Holocene over the Australasian and Maritime Continents (taken from the Paleoclimate Modelling Intercomparison Project, PMIP) in relation to those available data.

The mid-Holocene (6 ka) encompasses a period after sea level stabilisation (around 8-7.5 ka) and before the onset of strong ENSO-related variability (post 4 ka). There is some evidence of possibly drier conditions over northern Australia with increased coastal dune activity, along with slightly wetter conditions over Borneo and Papua New Guinea. Weakening of the Southern Hemisphere mid-latitude westerlies (relative to the early Holocene) is also likely to have occurred, as evidenced by drier conditions in Western Tasmania and Victoria. The modelled results from the mid-Holocene simulations indicate that conditions were approximately 1-6% drier over much of continental Australia than at present. There is also evidence of slightly wetter conditions (1-3%) over the northern tip of Australia and parts of Papua New Guinea and Borneo. The Southern Hemisphere westerlies in the mid-latitudes (around 50S) are also weaker by 1–2 m s-1 in the model simulations.

There are also differences in the seasonal cycle of precipitation and circulation in these models in response to the changes in the orbital parameters in the mid-Holocene relative to present day. The precipitation in the early half of the monsoon season (October, November and December–OND) is typically 10% higher in the mid-Holocene simulations with anomalous onshore flow onto the continent. Conversely, the precipitation is typically more than 10% lower in the late half of the monsoon period (January, February and March–JFM) with anomalous anticyclonic flow over the Australian continent. These anticyclonic anomalies are likely to be caused by reduced convection from the weaker insolation during JFM at 6 ka relative to 0 ka. The increase in OND precipitation and decrease in JFM implies that the monsoon onset and retreat may have been earlier than at present (in response to the insolation forcing), and therefore it is important to assess the changes over the whole monsoon period (October to March) instead of just the summer months (December, January and February).