Geophysical Research Abstracts
Vol. 12, EGU2010-9958, 2010
EGU General Assembly 2010

Responses of the low latitude hydrological cycle to orbital forcing over the last glacial cycle using HadCM3

Joy Singarayer and Paul Valdes

BRIDGE (Bristol Research Initiative for the Dynamic Global Environment), University of Bristol, Geographical Sciences, Bristol, United Kingdom (joy.singarayer@bris.ac.uk, +44 117 9287878)

Proxy records of low latitude precipitation (such as speleothem delta-18O) suggest that the Inter-Tropical Convergence Zone (ITCZ) northerly position varies with boreal summer insolation. On astronomical time-scales, the effect of precession ($\sim$23 kyr period) on seasonality is particularly important at low latitudes. Numerous palaeo-records demonstrate this periodicity. The orbitally-driven variation in low latitude hydrological processes is amplified by feedbacks from oceans and vegetation. Modelling studies have demonstrated that the ITCZ mean position responds to changes in the inter-hemispheric temperature contrast and atmospheric heat exchange between the tropics and mid-latitudes. This implies that the asymmetric temperature distribution caused by high latitude Northern Hemisphere glacial ice-sheets may impact low latitude precipitation patterns. In addition to astronomical variability, there is also a high degree of correlation between tropical proxies for precipitation and Greenland ice core delta-18O records on millennial time-scales. This suggests significant teleconnections exist between the tropics and high latitudes.

The relative influences of astronomical, ice-sheet, and continental configuration at glacial-interglacial time-scales on the low latitude hydrological cycle are still to be examined using climate models. In this study we use the Hadley centre coupled ocean-atmosphere model (HadCM3) to investigate variations in ITCZ and monsoon intensities during the last glacial cycle. The last 130 kyr have been simulated in a number of snap-shot simulations at up to 1 kyr temporal resolution. In three separate experiments, varying boundary conditions of orbital configuration were progressively added to with atmospheric greenhouse gases and ice-sheets. Our findings suggest that continental configuration is a large factor setting the phase of response of regional movement of the ITCZ to changes in orbital configuration. Northern Hemisphere ice-sheets also influence the apparent phase lag with insolation. The lag between monsoon intensities and insolation varies between regions. For example, the East Asian and Indian monsoons demonstrate different lags due to differing moisture source regions. Such modelling studies can add considerably to current debates concerning the phase lag and mechanisms of orbital-scale changes in these regions.