Geophysical Research Abstracts, Vol. 7, 00896, 2005
SRef-ID: 1607-7962/gra/EGU05-A-00896

An extended bipolar seesaw concept explaining North-South climate connections

R. Knutti (1), J. Flückiger (2), T.F. Stocker (3), A. Timmermann (4)

(1) National Center for Atmospheric Research, Boulder, CO, USA, (2) Institute of Arctic and Alpine Research, University of Colorado, Boulder, CO, USA, (3) Climate and Environmental Physics, University of Bern, Switzerland, (4) University of Hawaii, HI, USA

The last glacial period was punctuated by large and abrupt shifts in temperature in the North Atlantic region, accompanied by more gradual changes in Antarctica. Some of the long lasting Dansgaard-Oeschger events were preceded by massive ice surges from the northern hemisphere ice sheets, documented as thick layers of ice rafted debris (Heinrich layers) in marine sediments in the North Atlantic. Climate model simulations have shown that collapses and rapid onsets of the Atlantic thermohaline circulation explain many features of abrupt change found in different paleoclimatic archives. The concept of the thermal bipolar seesaw, in which the Southern Ocean integrates the North Atlantic signal, has solved the controversy of lead and lag between climate signals in the northern and southern hemispheres. However, its major shortcoming was that the southern damping time scale, derived from high-resolution, synchronised ice core records from both hemispheres, was much longer than the typical adjustment times of the Southern Ocean of about 100 years. Using a coupled model of reduced complexity, but including a comprehensive ocean circulation component, we show that the major north-south response to a shut down of the thermohaline circulation is well described by an extended bipolar seesaw concept with physically plausible time scales. Changes in the density structure, caused by the freshwater discharges, induce anomalous ocean circulations in the Atlantic and modify the heat change with the Southern Ocean. This thermal freshwater seesaw, in which both temperature and freshwater anomalies contribute to the changes in southern temperature, is able to reconcile the timing and amplitude of Greenland and Antarctic temperature changes, and explains the slow changes in Antarctic temperature and its similarity to sea level, as well as a possible time lag of sea level with respect to Antarctic temperature during

Marine Isotope Stage 3.