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The global climate imprint of rapid climate changes (Dansgaard-Oeschger and 8.2 kyr) centred in the North Atlantic

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Much current research is focussed on assessing whether rapid changes in thermohaline circulation strength, and consequent rapid climate changes, could occur in the future. Such a possibility would seem much more abstract if we did not have clear evidence that such changes did occur in the past. In this presentation, I will summarise the evidence about the occurrence of past rapid climate changes, and about the spatial pattern of their effects. This work draws on other efforts within the UK RAPID programme and especially the project RAPID-ISOMAP.

Dansgaard-Oeschger (DO) events are the dominant climate signal in Greenland ice cores, and indeed in many northern hemisphere climate records, during the last glacial period. In ice cores, some 25 events have been identified: in each of these, Greenland temperature increases very rapidly (typically less than 40 years) by typically 10ºC, stays in the warm state for a thousand years or more, and returns (somewhat more slowly) to the cold state. The temperature increases are accompanied by even more abrupt changes in snow accumulation rate, ice core chemical signals, and atmospheric methane concentration. Since these are all proxies for changes taking place away from Greenland, they already indicate the hemispheric significance of DO events. This is confirmed by the appearance of similar signals in a wide range of palaeorecords: in the North Atlantic, in Santa Barbara and Cariaco Basin, in Chinese stalagmites, and so on. The mechanism for DO events is still somewhat debated; however, by far the favourite candidate, that DO events result from changes in the rate and style of thermohaline circulation, is strongly supported by the existence of weak counterparts in the Antarctic temperature record, at least some of which have a phase relationship consis-

tent with this explanation. The nature and pacing of the freshwater inputs that might trigger DO cycles, and especially the relationship of Heinrich events to DO events, is not as straightforward as is often suggested.

There is now strong circumstantial evidence that DO events occurred in at least the last 4 glacial periods, and so far only one documented example of anything similar occurring in an interglacial. That one event is the famous 8.2 kyr event, seen in Greenland ice as the standout cool event of the Holocene period. Detailed examination has confirmed that the 8.2 kyr event really is a cooling, that it lasted for 100-200 years, and that it can be identified easily around the North Atlantic. Much longer climate fluctuations from beyond the North Atlantic are sometimes associated with the event, but they may be unrelated, and are certainly not part of the primary signal. The main candidate cause of this event is the drainage of Lake Agassiz, although the difference between the central the age of the drainage and the 8.2 kyr signal is uncomfortably large (though within stated uncertainties). The 8.2 kyr event is very valuable because it can be used to test the effects on climate of a presumed freshwater event on a planet not so different from that of today. However, of course, like the DO events, it also results from the freshwater impact of large ice sheets that do not exist today. Thus while, the palaeo record tells us that rapid changes can occur, and that ocean circulation can probably have different stable states, we do not yet have any observational evidence that this can occur in a world without large ice sheets around the Atlantic.