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On the Phase Relationship Between Greenland Rapid Warming Transitions and their Expression in Antarctic Ice Cores: The Bipolar Seesaw of the Dansgaard-Oeschger Oscillation

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The issue of the mechanisms involved in the transmission of the intense rapid warming transitions characteristic of the Dansgaard-Oeschger Oscillation in Greenland ice cores into their Antarctic counterparts remains outstanding. Insight into the details of this mechanism are provided by the observed phase relationship between the northern and southern hemisphere signals. Because the Dansgaard-Oeschger oscillation has now been successfully reproduced using a fully articulated model of ocean-atmosphere-sea ice interactions under glacial conditions [1] the bipolar seesaw process has become amenable to direct investigation through the diagnostic analysis of model output. A signicant result of this paper was the demonstration that it correctly predicted the coupling between the northern hemisphere and southern hemisphere ice core signals. In Vettoretti and Peltier[2] it was furthermore shown (see their Figure 3e) that the air temperature signal inferred on the basis of the EDML ice core oxygen isotopic record was perfectly correlated to sea surface temperature predictions in the southern circumpolar ocean. This means that the time delay involved in the propagation of the signal from the northern hemisphere to the southern hemisphere is being correctly predicted by the Peltier and Vettoretti (2014) model as is the magnitude of the southern hemisphere signal relative to that in the northern hemisphere. In this paper we compare the air temperature signals over a series of Dansgaard-Oeschger cycles predicted for Greenland with their counterparts in the EPICA Dronning Maudland (EDML) and WAIS Divide (WDC) ice cores. Since there have been recent attempts to infer this phase relationship directly from the ice core records themselves ([3][4]) we compare the data inferred average phase relationship with that from the model which correctly predicts both the northern and southern hemisphere signals. Our results are shown to differ from those recently inferred on the basis of the data and we discuss what may be the reasons for this discrepancy. We also comment upon the implications of these results for the understanding of the mechanism whereby the Northern Hemisphere signal is transmitted to the south.

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