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Climatic teleconnections during the last ice age: postcards and text messages from the North Atlantic

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Climatic anomalies in widely separated regions of our globe can show very strong correlations. Wave propagation and heat transport in both the ocean and atmosphere are responsible for these climatic teleconnections. One such teleconnection, commonly referred to as the bipolar seesaw, occurred repeatedly during the last ice age. During this time, the circum-North Atlantic experienced a rapid succession of cold (stadial) and warm (interstadial) periods, that is linked to variations in cross-equatorial heat transport by the Atlantic Meridional Overturning Circulation (AMOC). Each phase had a duration of hundreds to thousands of years. Climate anomalies in the southern hemisphere (SH) oppose those in the north, with a warming trend seen during the cold NH stadials, and a cooling trend during the warm NH interstadials.

In this talk we will address the question of how the North Atlantic climate anomalies are propagated to the southern hemisphere high-latitudes. Using accurately synchronized ice core records from both Greenland and Antarctica, we can clearly distinguish the operation of both a slow oceanic teleconnection (200-year propagation time), and a fast atmospheric one (synchronous within dating precision). The temperature response of Antarctic can be understood as the superposition of these two distinct modes. Using deuterium excess, a second-order water isotope parameter, we further show that the atmospheric mode is associated with meridional movement of the SH westerly winds. This effect is analogous to the modern-day Southern Annular Mode that dominates atmospheric variability of the SH extratropical atmospheric circulation.

The presented work can help us understand climate dynamics and coupling on timescales that are much longer than observational records from weather stations.