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Where does atmospheric moisture come from for Antarctic ice cores?

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An ice core is a cylindrical section of a naturally occurring medium consistent enough to hold a layered structure resulting from the accumulation of snow and ice over many years that have recrystallized and have trapped air bubbles from previous time periods. Typical ice cores are removed from an ice sheet, most commonly from the polar ice caps, confined to Antarctica and Greenland, or from high mountain glaciers elsewhere. Inclusions in the snow of each year remain in the ice, such as wind-blown dust, ash, bubbles of atmospheric gas and radioactive substances. Thus, it would be of undeniable interest to evaluate the origin of the air that is trapped annually in these ice cores with all the climate information associated.

Therefore, the main objective of this study is to locate the main sources of moisture over the Antarctica using a Lagrangian method (Stohl and James, 2004). The method computes budgets of evaporation minus precipitation (E-P) by calculating changes in the specific humidity along 3-D back-trajectories. The trajectories were calculated for the previous 10 days, which is the average time that water vapour resides in the atmosphere. The areas analyzed (final point of the moisture) correspond to four stations with well-known extensive ice cores [Vostok (-78.5ºS, 106.8ºE), EPICA Dome C (-73ºS, 120ºE), Byrd (-80ºS, 119.6ºW) and EPICA DML (-75ºS, 0.04ºE)]. We tracked the origin of air-masses residing over small areas centred in these 4 ice core locations and for a period of five years (2000–2004). We should stress that this methodology has been recently applied by the authors to detect the humidity sources for different geographical realms, such as the Sahel (Nieto et al., 2006) and Iceland (Nieto et al.,

2007). The analysis of (E-P) values tells us where and when the moisture over the ice cores was received.

The 10 days averages of the back-trajectories for the Vostok and EPICA Dome C ice cores show that the main source area of moisture corresponds to the latitudinal band located over the Pacific Ocean between 30ºS and 50ºS. Similarly, the main source area of moisture for the Bird ice core is located over the Indic Ocean at roughly the same latitudinal band, and for EPICA DML ice core the most important source of moisture is located over the Atlantic Ocean between 30ºS and 45ºS and slightly shifted towards the American continent. These results show clearly that the main sources of moisture can vary considerably for these selected Antarctic ice core stations located over the same continent (although at different longitudes).

References:

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