Supplementary Materials

Ice core 17O reveals past changes in surface air temperatures and stratosphere to troposphere mass exchange

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A diagram of a graph

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**Figure S1.** Schematic representation of the Brewer-Dobson Circulation with upwelling in the tropics, poleward transport by the “extratropical pump”, and downwelling in the high latitudes. Re-drawn after Holton et al. (1995) and Stohl et al. (2003).

A black background with arrows and arrows

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**Figure S2.** Schematic representation of moisture transport in the troposphere (re-drawn after Stohl et al. (2003). Water vapor from surface evaporation in the tropics and subtropics is transported upwards in convective clouds. Moisture from detrainment of cloud condensate and saturated air mass is transported to other regions by large scale circulation.

A. B.

A graph of a distance from coast

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C. D.

A graph of a graph

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**Figure S3.** Tritium and oxygen isotopes in Antarctic surface snow from Terra Nova Bay to Dome C. Tritium and distance data are from (55, 56) and d18O is from (57). *A*. Tritium with distance from the coast. *B*. d18O versus tritium. Correlation of d18O with tritium suggests that some of the decreasing d18O may be attributed to an increasing contribution of upper tropospheric moisture containing stratospheric input. *C.* D'17O versus tritium with l = 0.516. D*.* D'17O versus tritium with l = 0.528.

A graph of a graph showing the number of snow in different colors

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A graph with numbers and symbols

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**Figure S4.** The effect of the value of MDF coefficient on D'17O. For MDF coefficient values less than 0.521, the D'17O and d'18O are positively correlated and the magnitude of D'17O has negative values (less than zero) owing to MDF coefficient value being less than the effective d17O/d18O ratio in stratospheric input. For values of 0.534 or higher, the correlation becomes negative and D'17O values mostly are greater than zero. For intermedite values of MDF, the correlation and D'17O values are variable.

A graph of different types of temperature

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**Figure S5.** Calibration of the D'17O paleothermometer using an MDF coefficient of 0.521. Compare with Figure 3 in text.

A graph of different types of dryers

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A graph of different colored lines

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**Figure S6.** Reconstructed surface air temperatures for multiple ice cores using a value of 0.521 for the MDF coefficient.