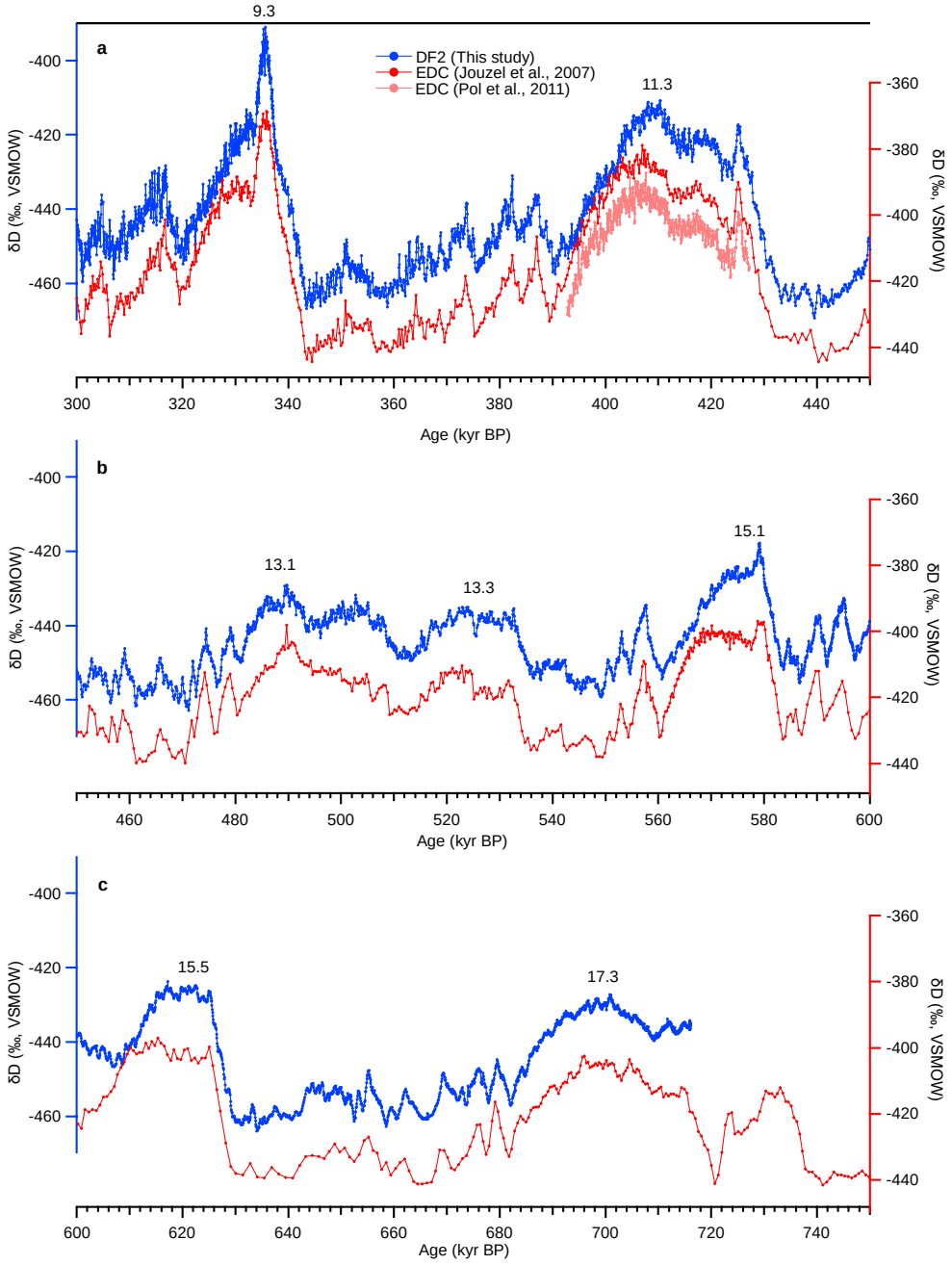
Supplementary Information

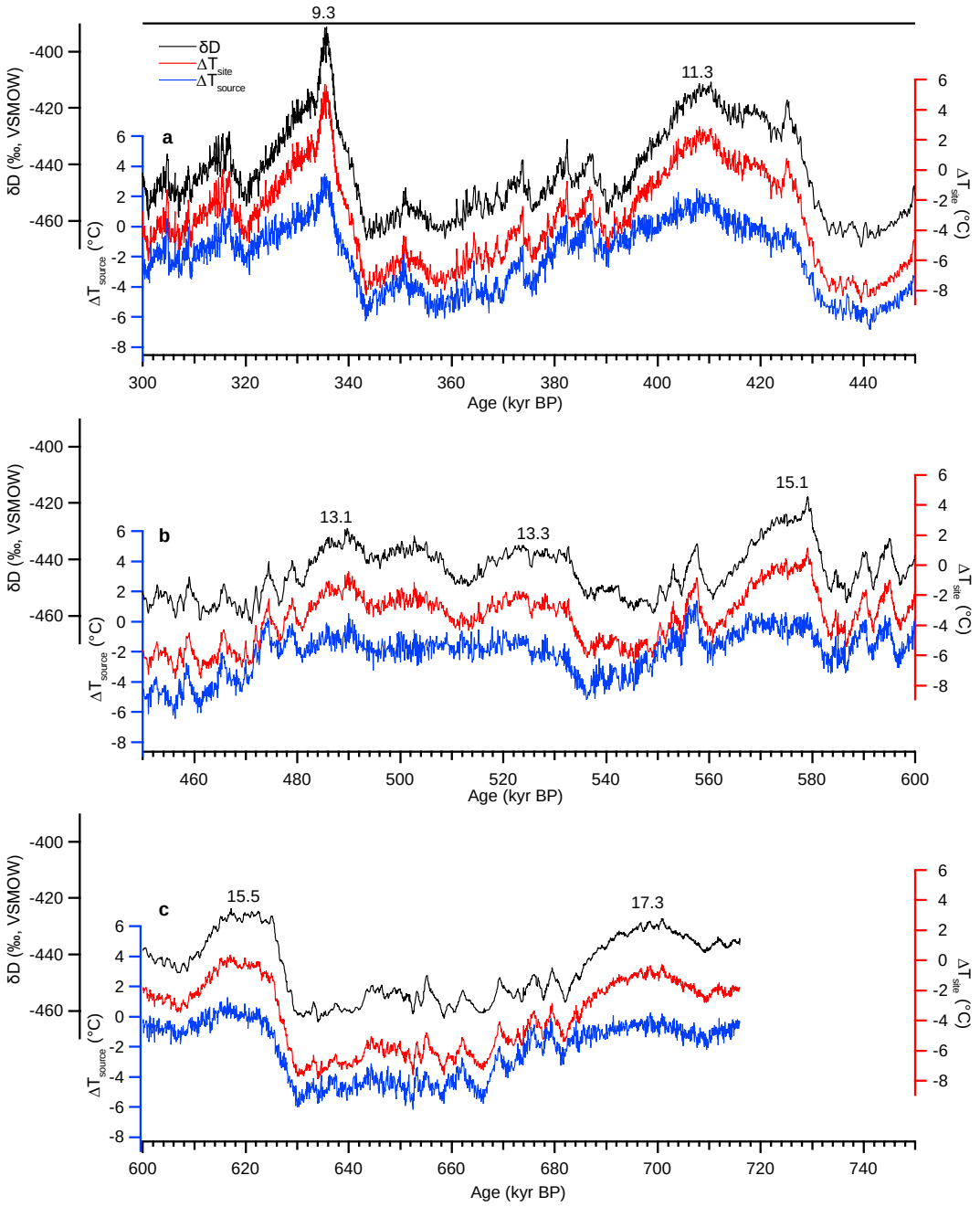
Asynchrony between Antarctic temperature and CO_2 associated with obliquity over the past 720,000 years

Uemura et al.



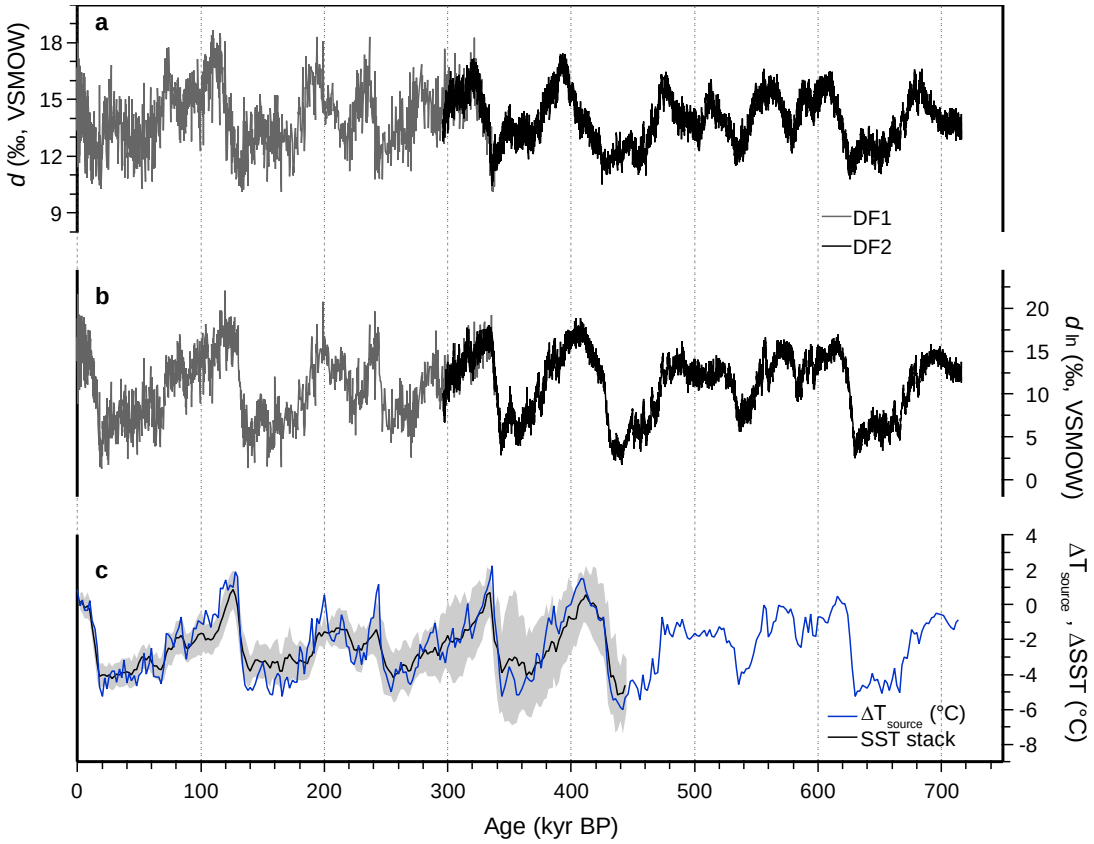
Supplementary Figure 1. δD records from the DF2 and EDC ice cores

The δD records of the DF2 (10-cm sampling, blue) and EDC cores (55-cm sampling, red)[1] for (**a**) 300-450 kyr BP, (**b**) 450-600 kyr BP and (**c**) 600-750 kyr BP. The light-red line indicates high-resolution (11-cm sampling) data[2] covering MIS 11 (these δD values are shifted by 10‰ for clarity). Numbers indicate Marine Isotope Stages. Dots represent raw data.



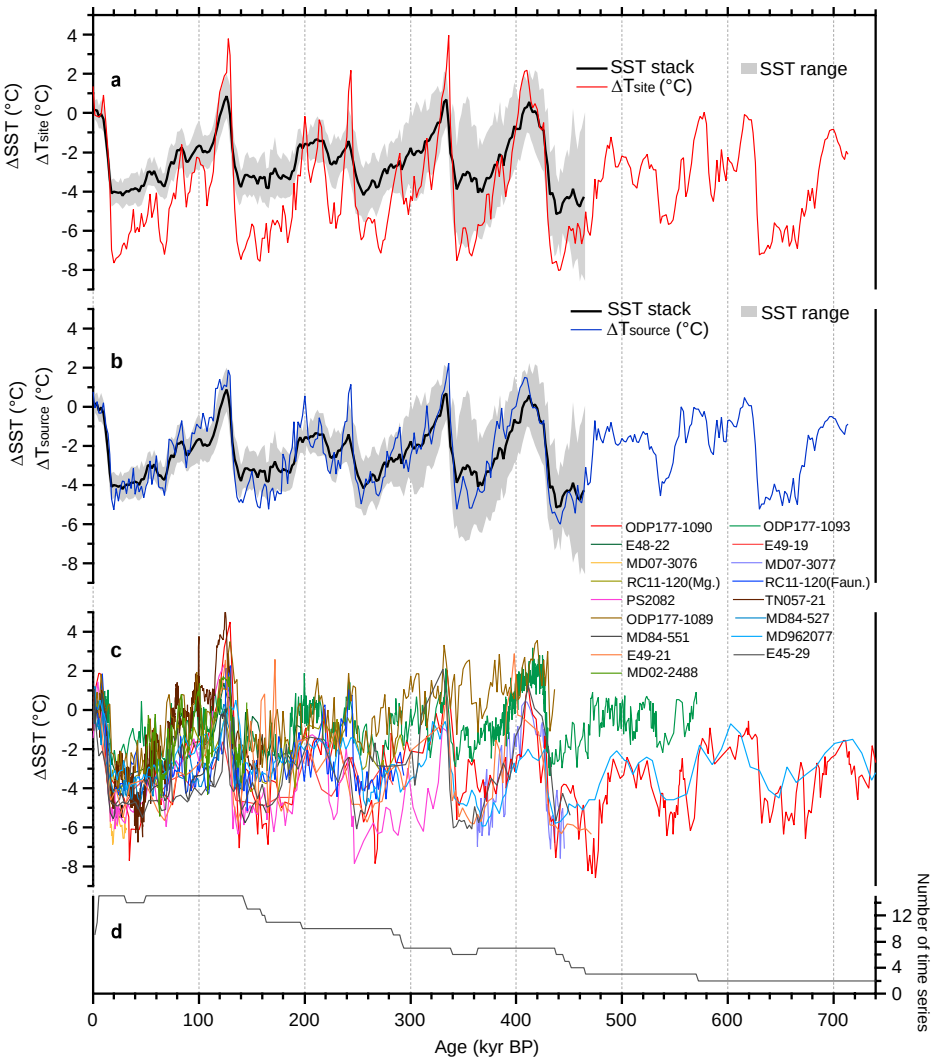
Supplementary Figure 2. Enlarged profiles of the δD, ΔT_{site} and ΔT_{source} records from the DF2 core

Records of δD (black), ΔT_{site} (red) and ΔT_{source} (blue) from the DF2 core for (**a**) 300-450 kyr BP, (**b**) 450-600 kyr BP and (**c**) 600-750 kyr BP. Numbers indicate Marine Isotope Stages.

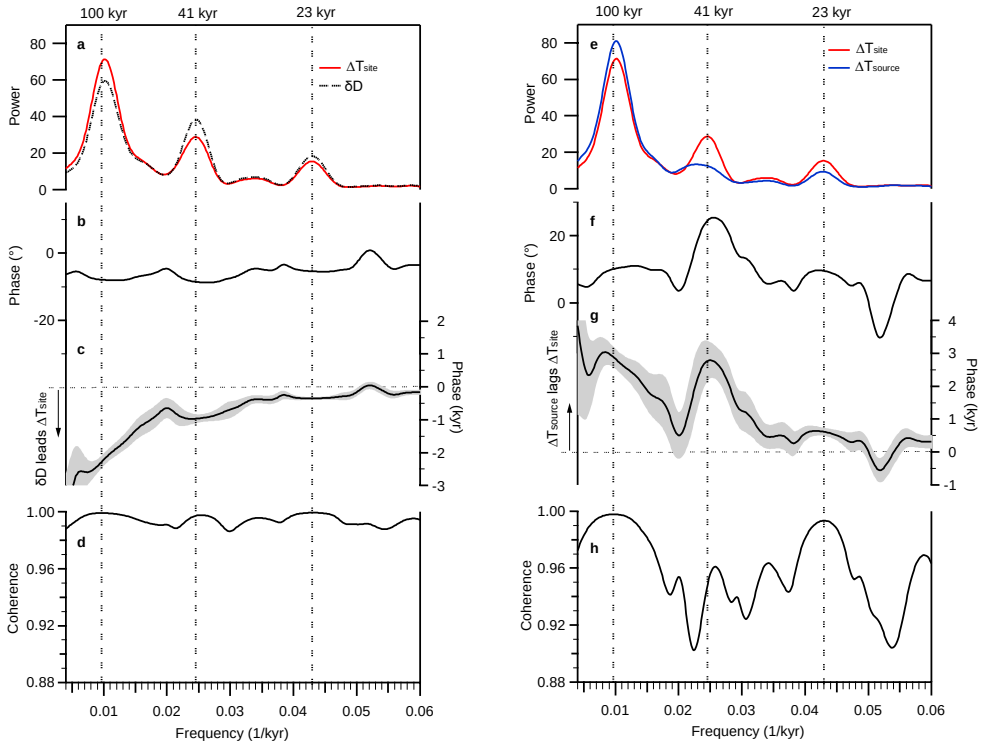


Supplementary Figure 3. Deuterium excess and ΔT_{source} records from the DF1 and DF2 ice cores

(**a**) The *d* record using the traditional linear definition[3] of the DF1 (grey) and DF2 (black). (**b**) Same as (**a**), but for the logarithmic definition of *d*, d_{ln}. (**c**) DF ΔT_{source} record (blue) shown with the stacked SST record (black) with its uncertainty interval (area shaded grey).



Supplementary Figure 4. DF ΔT_{source} and SST records from the moisture source region (**a**) ΔT_{site} (red) record from the DF cores. The black line indicates the stacked SST record from the moisture source region with its uncertainty interval (area shaded grey). Data were resampled at a 2-kyr interval. (**b**) Same as (**a**), but for the ΔT_{source} (blue) record from the DF cores. (**c**) Individual SST records used to produce the stacked SST record (Methods). (**d**) Number of SST data series.



Supplementary Figure 5. Cross-spectral analyses of ΔT_{site} vs. δD and ΔT_{site} vs. ΔT_{source}

(**a**) Power spectrum of ΔT_{site} (red) and δD (black dotted). (**b**) Phase shown in units of degrees. (**c**) Same as (**a**) but shown using units of kyr. Negative values indicate that δD leads ΔT_{site}. (**d**) Coherence between ΔT_{site} and δD. (**e**)-(**h**), same as (**a**)-(**d**) but for ΔT_{site} (red) and ΔT_{source} (blue). Positive values indicate that ΔT_{source} lags ΔT_{site}. The spectral analyses were conducted using 100-yr resampled data.

Supplementary References

1. Jouzel, J. *et al.* Orbital and Millennial Antarctic Climate Variability over the Past 800,000 Years. *Science* **317**, 793-796, doi:10.1126/science.1141038 (2007).
2. Pol, K. et al. Links between MIS 11 millennial to sub-millennial climate variability and long term trends as revealed by new high resolution EPICA Dome C deuterium data - A comparison with the Holocene. *Climate of the Past*, **7**, 437-450, doi:10.5194/cp-7-437-2011 (2011).
3. Dansgaard, W. Stable isotopes in precipitation. *Tellus*, **16**, 436-468 (1964).