



The spatiotemporal pattern of the mid-Holocene Bond 4 event (5.2 ka) : a global data-based review

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The Bond 4 event starting at 7000 yr BP and culminating around 5300 yr BP is the largest (in magnitude and duration) invasion of drifting ice across the subpolar North Atlantic of the Holocene (Bond et al., 2001). While several studies have focused on other events of the Holocene, such as the 8.2 ka, the 4.2 ka and the Little Ice Age, little is known about the mid-Holocene 5.2 ka event.

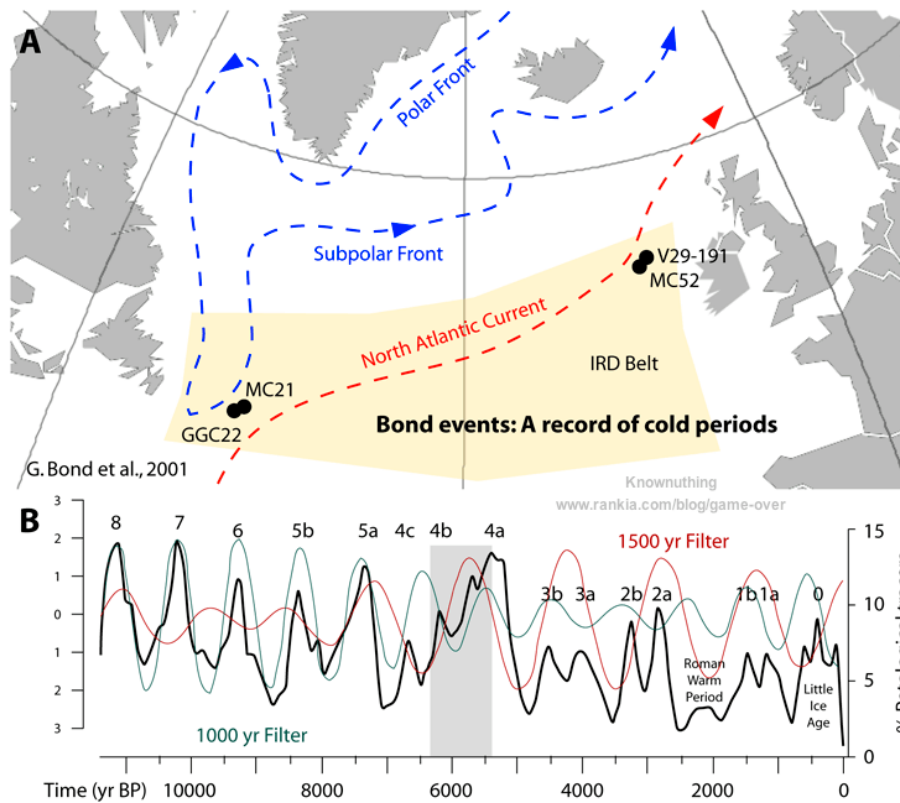


Figure 1: A) Map showing the location of cores used in Bond et al. (2001) and B) stacked record of the percent hematite stained grains and number of each Bond event. Grey band indicates the Bond 4 event. Source: Debret et al., 2007

Data and methods

Here we present a global synthesis of 75 SST/surface temperature and 65 $\delta^{18}\text{O}$ speleothem records that have been selected from the most recent global compilations of Kaufman et al. (2020) (1339 records from 679 sites) and Comas-Bru et al. (2020) (691 speleothem records from 294 cave sites), respectively. The selected records meet strict quality control criteria of: 1/ temporal resolution (at least one measurement in every 200-year period), 2/ chronology (records must have at least two ages, within error, between 7000 and 4000 yr BP) and time interval (records must cover at least the period between 6500-5000 yr BP). Each time-series has been averaged into 200 yr bins then standardized by subtracting the mean and dividing by the standard deviation (of the bins). Data showing cooling /warming or dryness/wetness trends following the Bond 4 event (~7000-5300 yr BP) are stacked to a single composite (see following slides). Sensitivity test of the records to bin centering is also carried out.

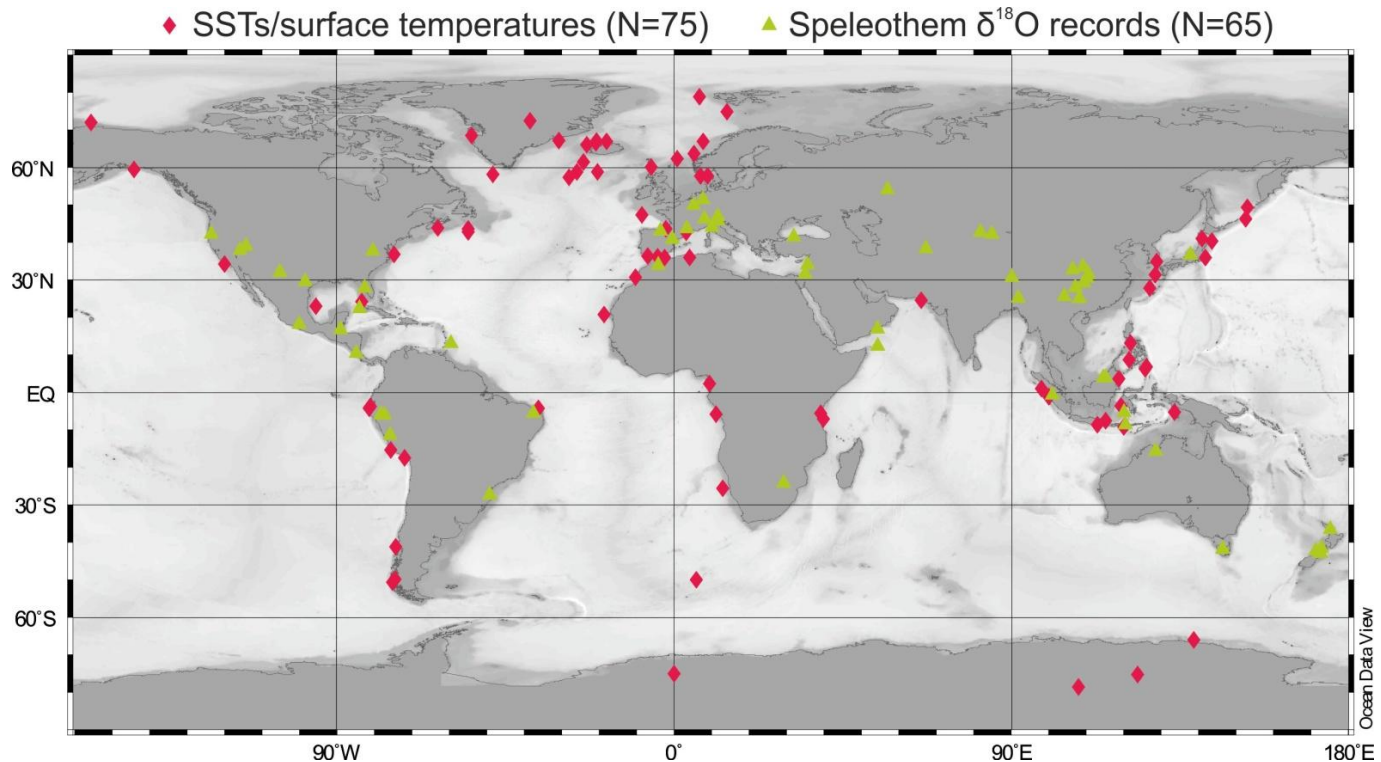


Figure 2: Map showing the location of selected records

Surface temperature trends (between 6400-5400 yr BP)

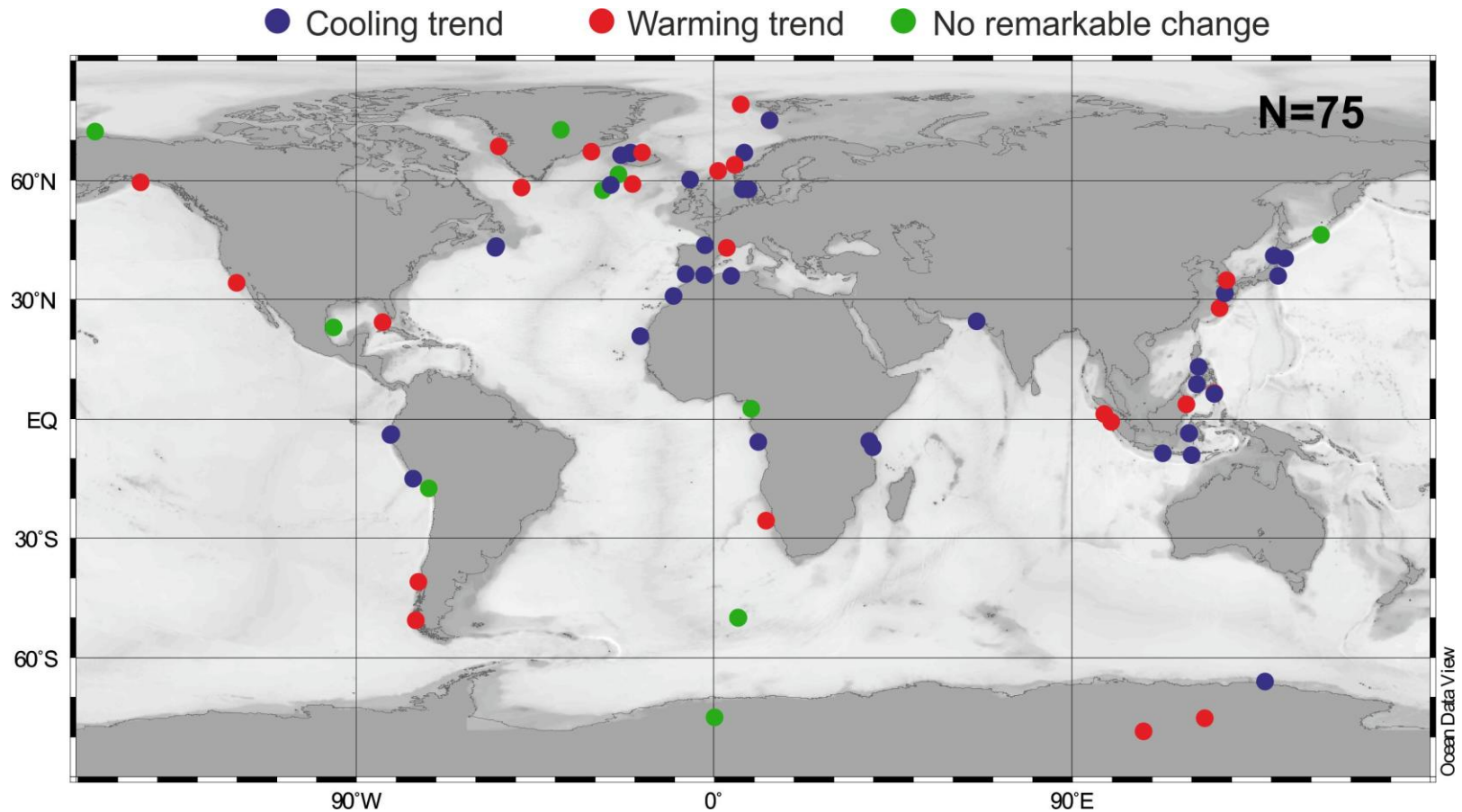


Figure 3: Map showing the trend of each SST/surface temperature record determined by linear regression of the bins between 6400-5400 yr BP

- The analyzed records show cold conditions in the North Atlantic (low and mid latitudes), the Mediterranean as well as in the western Pacific Ocean.
- They indicate warming in the high latitudes North Atlantic and eastern Pacific Ocean

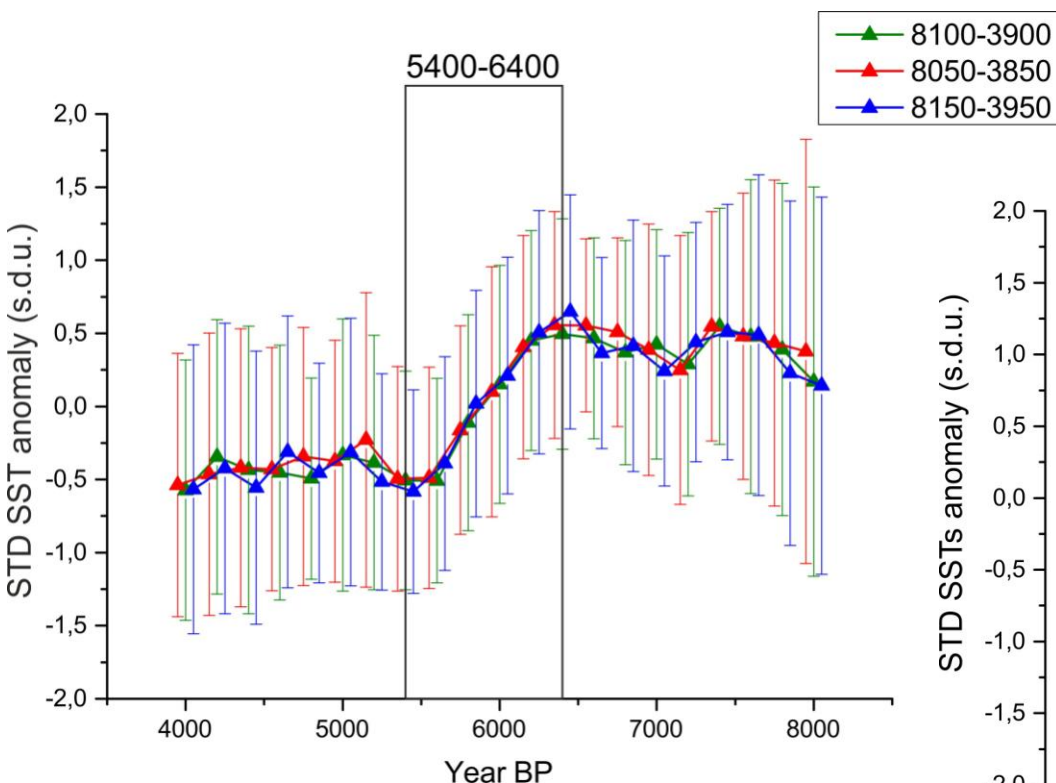


Figure 4: Global composite of data (N=47) showing cooling trend Following the Bond 4 event between 6400-5400 yr BP

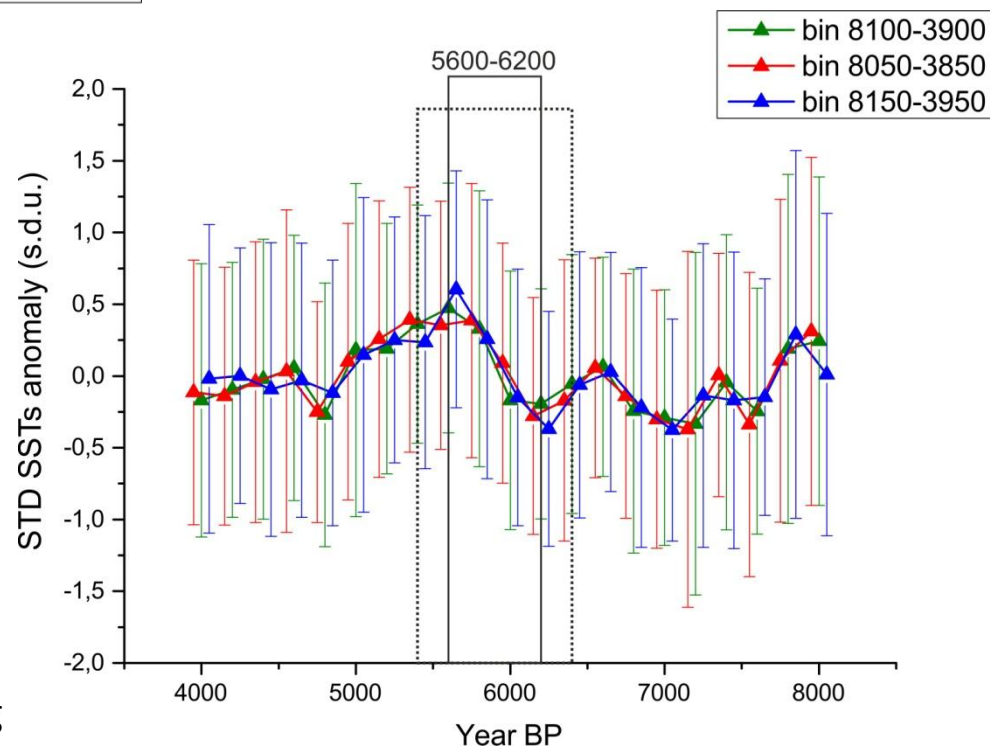


Figure 5: Global composite of data (N=27) showing warming trend following the Bond 4 event between 6200-5600 yr BP.

The sensitivity test indicates that the trends are not sensitive to changing of the bin centering.

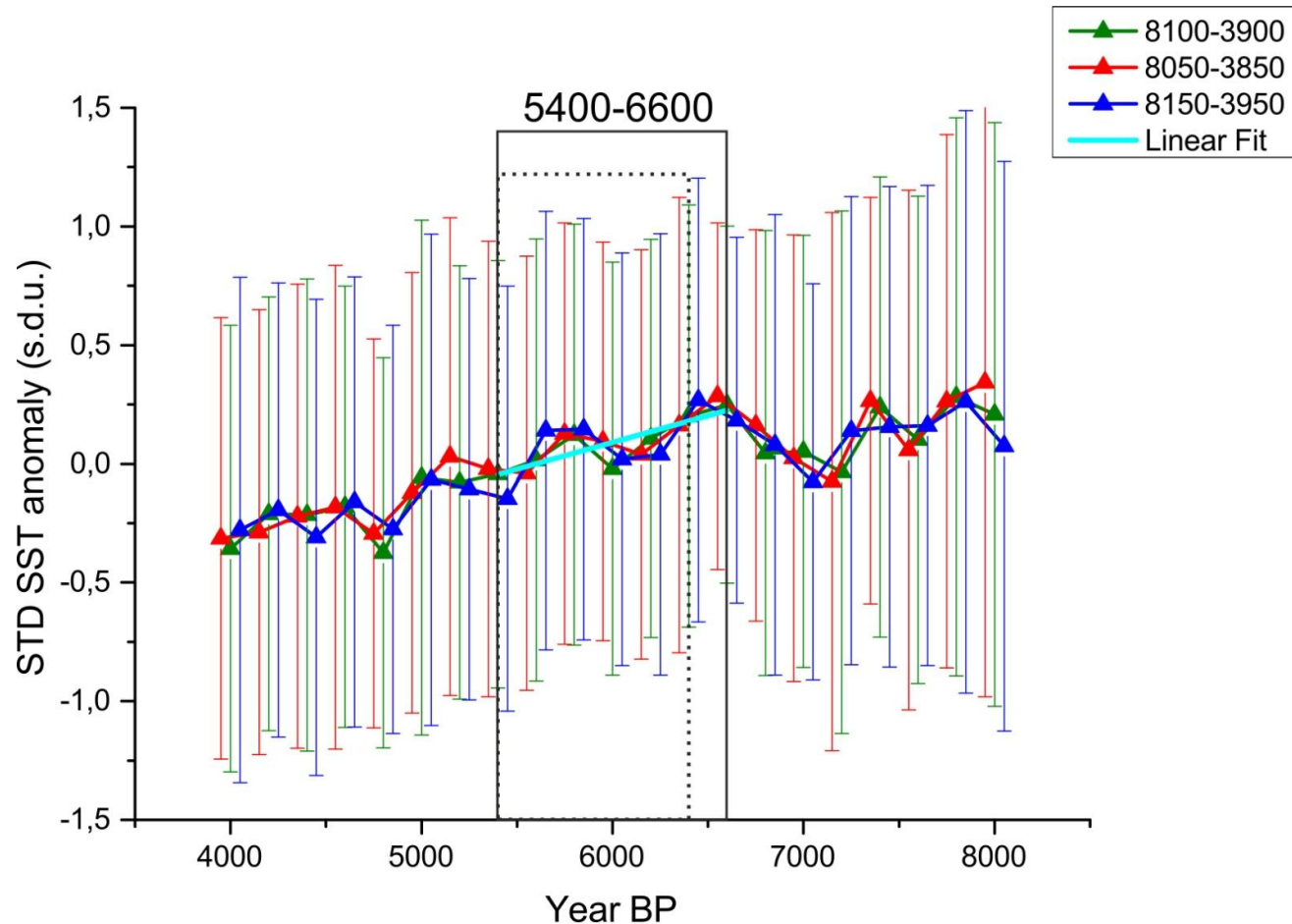


Figure 6: Global composite of all SST/surface temperature data

- The composite of all data indicates a global cooling trend between 6600-5400 yr BP coeval with the Bond 4 event.

$\delta^{18}\text{O}$ trends (between 6400-5400 yr BP)

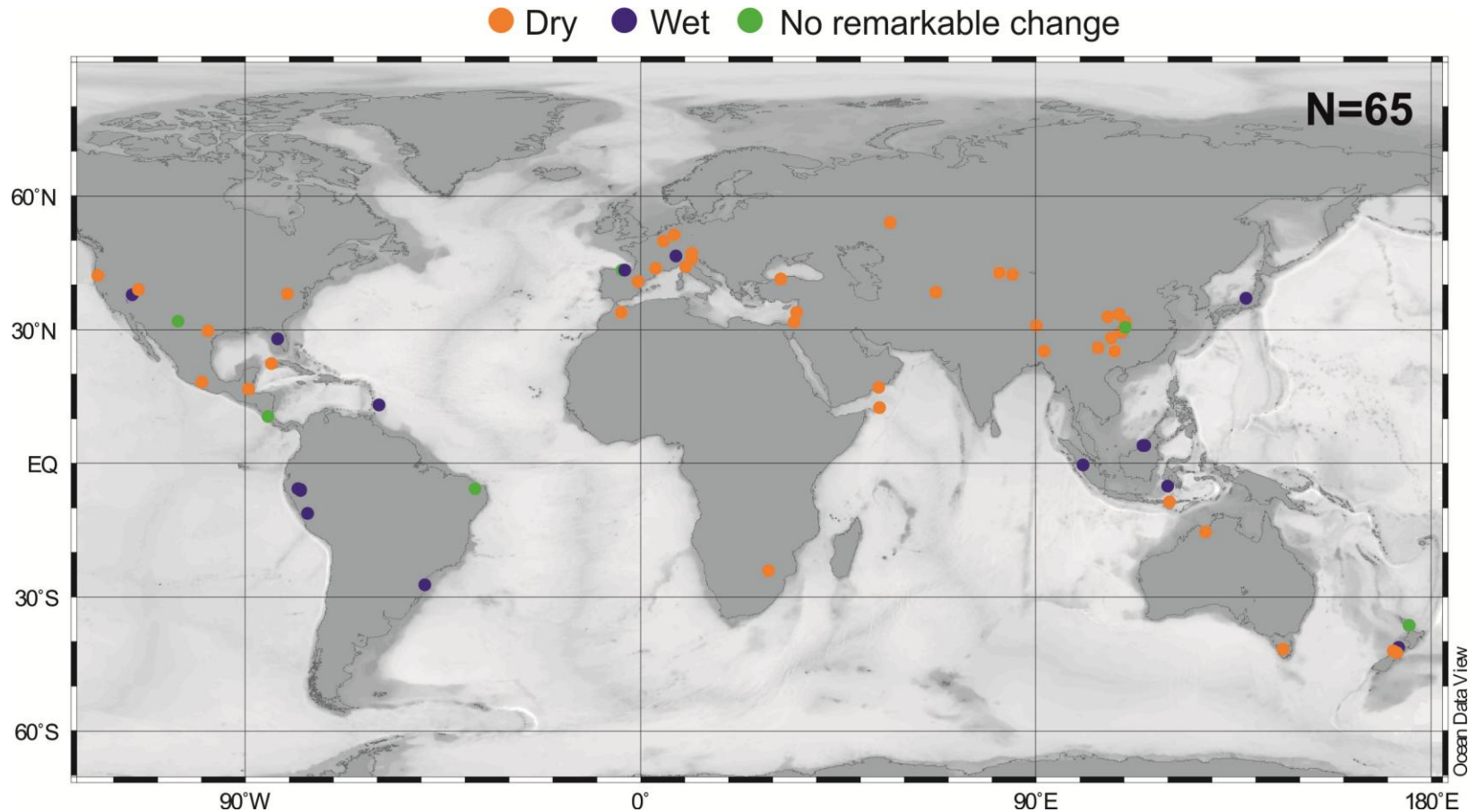


Figure 7: Map showing the trend of each $\delta^{18}\text{O}$ speleothem record determined by linear regression of the bins between 6400-5400 yr BP

- Dry conditions occurred in the northern hemisphere subtropical and mid-latitudes of all continents (except South America) between 6400-5400 yr BP.
- Data from south America and Indonesia mostly show humid conditions.

$\delta^{18}\text{O}$ composites and sensitivity tests

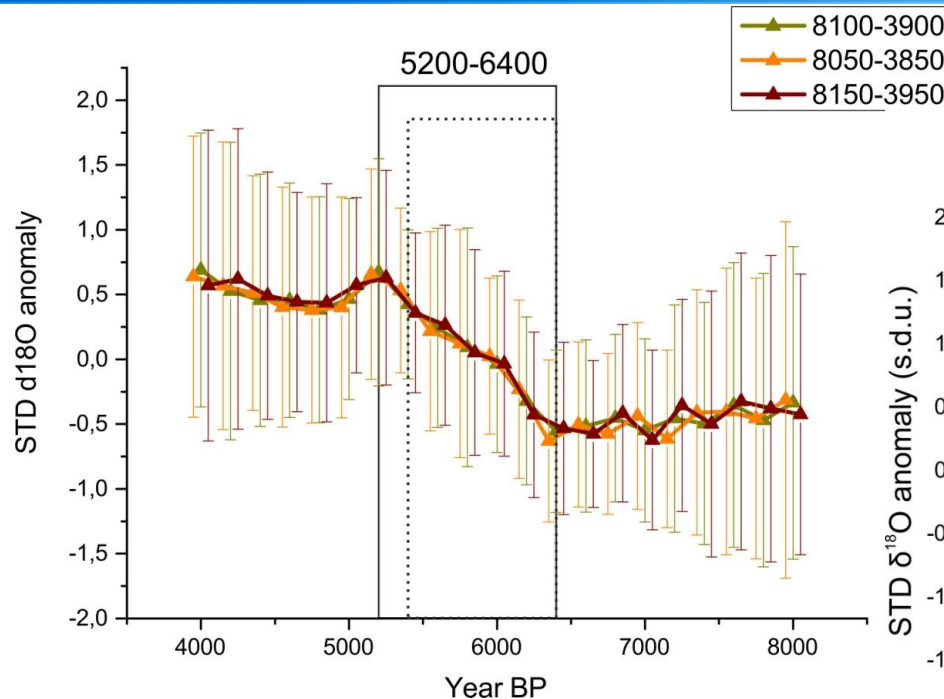


Figure 8: Global composite of $\delta^{18}\text{O}$ speleothem records (N=42) showing dry conditions following the Bond 4 event between 6400-5200 yr BP

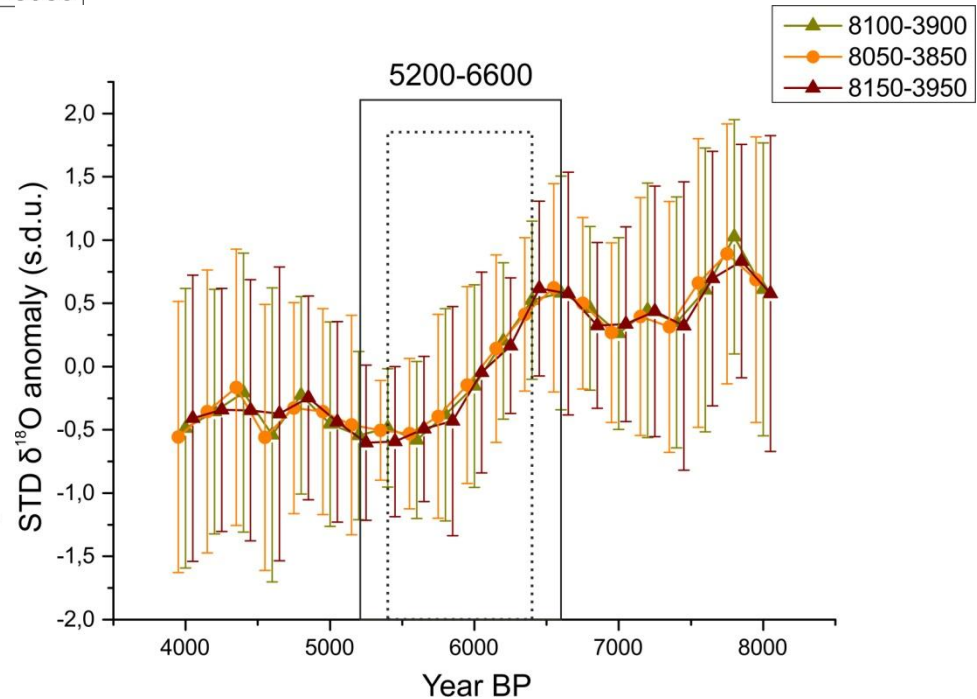


Figure 9: Global composite of $\delta^{18}\text{O}$ speleothem records (N=17) showing wet conditions following the Bond 4 event between 6600-5200 yr BP

The sensitivity test indicates that the trends are not sensitive to changing of the bin centering.

$\delta^{18}\text{O}$ composites and sensitivity analyses

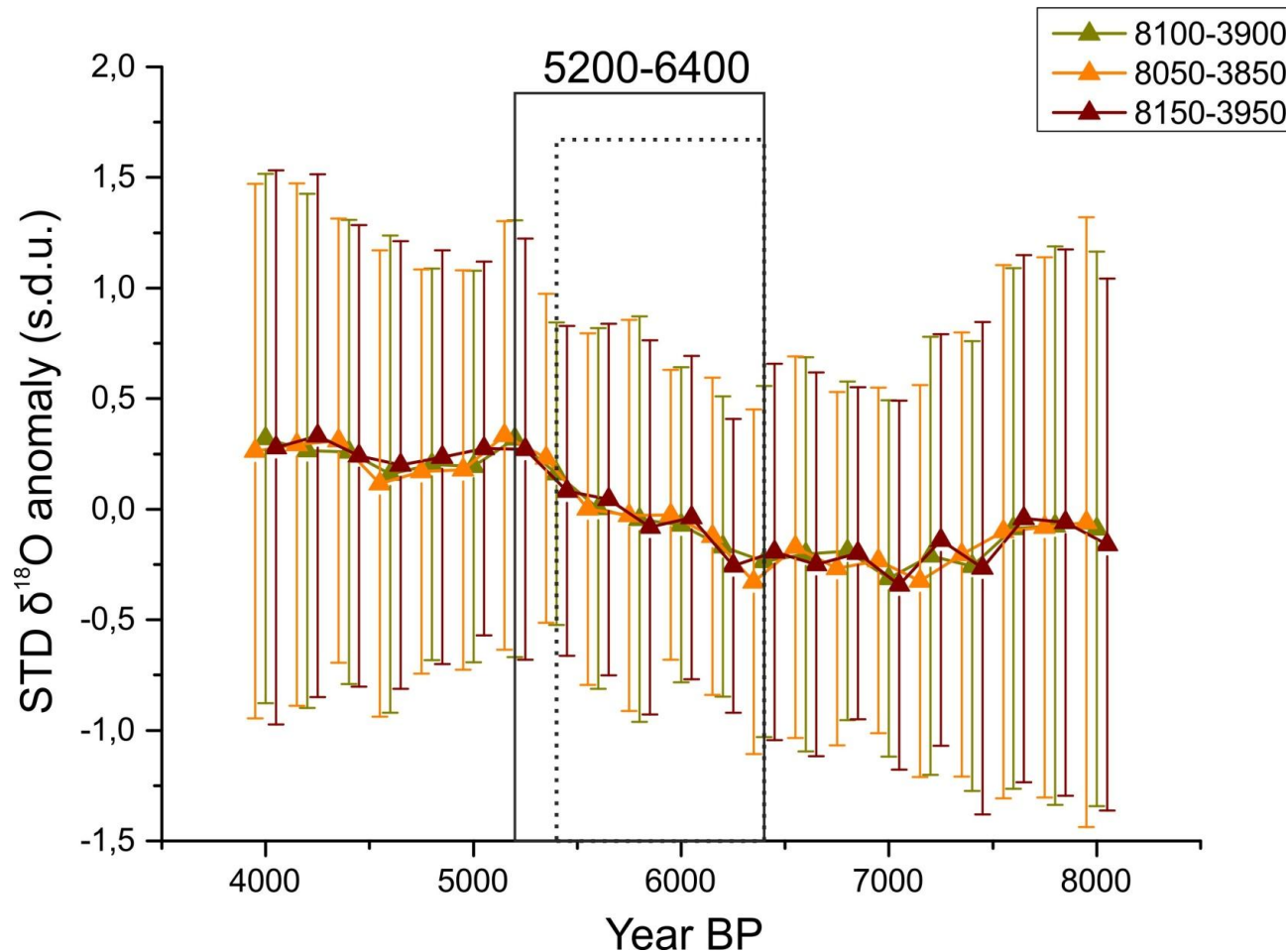


Figure 10: Global composite of all $\delta^{18}\text{O}$ speleothem records

- The global composite indicates dry conditions between 6400-5200 yr BP coeval with the Bond 4 event.

Major changes took place between 6400-5400 yr BP (± 200 years) during the mid-Holocene Bond 4 event.

- ✓ SST records show **cold conditions** in the North Atlantic, the Mediterranean as well as in the western Pacific Ocean.
- ✓ SSTs indicate **warming** mainly in the high latitude North Atlantic and eastern Pacific Ocean.
- ✓ The $\delta^{18}\text{O}$ speleothem records indicate **dry conditions** in the northern hemisphere subtropical and mid-latitude regions of all continents and **wet climate** in South America and Indonesia.
- ✓ These results suggest **weakening of monsoon systems** around the world (i.e. in Africa, North America, central and southwest Asia as well as Australia) *similar to the 9.2 kyrs associated to the southwards shift of the ITCZ (Jalali et al. 2017).*