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A speleothem-based trace element reconstruction of westerly wind strength during the Younger Dryas in northern Iberia

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The latitude of North Atlantic westerlies during the Younger Dryas (YD) is constrained using precisely-dated, high-resolution stable isotope and trace element data from a La Garma Cave stalagmite, Northern Spain. In situ laser techniques yield a biennial-scale isotope and subannual-scale trace element record of the YD providing crucial information about the mechanisms that led to the onset, stabilisation, and termination of this important abrupt climate change event. We present high resolution Mg data as a novel proxy of sea spray contributions and therefore wind strength at this coastal cave site. Decadal-scale meridional oscillations in westerly storm tracks during the early YD (12.85 – 12. 15 kyr) resemble the modern NAO. Our records support a northward repositioning of westerlies between 12.15 and 12.10 kyr that persisted until the YD termination consistent with existing central and northern European wind reconstructions (Bakke et al. 2009; Brauer et al., 2008). A correlation between inferred westerly wind position and the low latitude Intertropical Convergence Zone (ITCZ) suggests that a strengthen Atlantic Meridional Overturning Circulation (AMOC) resulted in northward migration of the ITCZ and associated atmospheric circulation, including westerlies over Europe. This eventually resulted in break-up of sea ice initially proximal to Scandinavia, followed by the NW European Atlantic margin, and finally along NE North America. Our data further detail the nature of North Atlantic sea ice loss during the YD and the subsequent atmospheric reorganization. The mid-Younger Dryas shift provides an example of substantial atmospheric circulation reorganization that occurred over just a few decades leading to a stormier northern Europe but a warmer Mediterranean.