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Warm summers during Younger Dryas cold reversal over Eurasia

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The Younger Dryas cold reversal (GS-1) sticks out as a major stadial interrupting the mid to late deglaciation with a sharp temperature drop of several degrees around the North Atlantic with global teleconnections. The abrupt return to a very cold glacial-like ocean state introduces a strong temperature anomaly to the climate system contrasting the high solar radiation received by northern summers.

Here we show that, in contrast to earlier coarse resolution climate simulations of the Younger Dryas, these competing factors result in rather warm summer conditions over Eurasia comparable to the preceding warm period of the late Allerød (GI-1a). Despite up to 10 K colder sea-surface-temperatures in summer, our high resolution simulation with the Community Earth System Model 1 (CESM1.0.5) suggests that the presence of large ice sheets over Scandinavia, Spitsbergen and the Kara Sea significantly modifies atmospheric flow in summer preventing cold westerly winds from the Atlantic to impact the continent. Instead, fluid dynamics around ice sheets deflect winds to the north or south along the coasts supported by divergent flow from ice domes, stratification and increased tendency to high pressure and atmospheric blocking.

Consistent with our model simulation, we show that temperature reconstructions derived from an extended compilation of multi-proxy lake records (chironomids, aquatic pollen, macrofossils) suggest warm July conditions of 13-17° C for continental Europe with exception of coastal and high elevation sites. The analysis of simulated growing degree days, season length and first results from paleo lake modelling driven by climate model output suggests that severe winter to spring conditions significantly delay and shorten the vegetation season but do not produce cold summers as previously simulated.