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Short-lived high-amplitude cooling on Svalbard during the Dark Ages

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As the paradigm of a stable Holocene climate has shifted, an increasing number of high-resolution proxy time-series reveal dynamic conditions, characterized by high-amplitude climate shifts. Some of these events occurred during historical times and allow us to study the interaction between environmental and cultural change, providing valuable lessons for the near future. These include the Dark Ages Cold Period (DACP) between 300 and 800 AD, a period marked by political upheaval and climate instability that remains poorly investigated. Here, we present two temperature reconstructions from the High Arctic Svalbard Archipelago. To this end, we applied the established alkenone-based UK37 paleothermometer on sediments from two lakes on western Spitsbergen, Lake Hajeren and Lake Hakluyt. The Arctic is presently warming twice as fast as the global average and proxy data as well as model simulations suggest that this amplified response is characteristic for regional climate. The Arctic therefore provides a uniquely sensitive environment to study relatively modest climate shifts, like the DACP, that may not be adequately captured at lower-latitude sites. Owing to undisturbed sediments, a high sampling resolution and robust chronological control, the presented reconstructions resolve the attendant sub-centennial-scale climate shifts. Our findings suggest that the DACP marks a cold spell within the cool Neoglacial period, which started some 4 ka BP on Svalbard. Close investigation reveals a distinct temperature minimum around 500 AD that is reproduced in another alkenone-based temperature reconstruction from a nearby lake. At $\pm$ 1.75 °C, cooling underlines the sensitivity of Arctic climate as well as the magnitude of the DACP.