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Mid-Pliocene warming: reducing discrepancies between geological archives and climate models in the NE Atlantic and Nordic Seas

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The mid-Pliocene Warm Period (mPWP) is the most recent time slice (3.264–3.025 Ma) during which average global surface temperatures were 2–3°C warmer than preindustrial conditions, within the range estimated by the Intergovernmental Panel on Climate Change (IPCC) for the end of the 21st Century. Global mPWP sea surface temperature (SST) compilations indicate enhanced warming in the NE Atlantic and Nordic Seas, with anomalies of >6°C based on alkenone methods (Dowsett et al., 2012). However, this warming far exceeds the more conservative SST estimates (a rise of 2−3°C) predicted by the Pliocene Research, Interpretation and Synoptic Mapping (PRISM) reconstructions and leading climate models (including HadCM3). Here, we present new mid-Pliocene alkenone SST records from four regional drilling sites (IODP Site U1308, DSDP Site 552, ODP Site 642 and ODP Site 907) to further examine the magnitude of warming in the NE Atlantic and Nordic Seas, and to evaluate regional discrepancies between proxy and model SST estimates. We demonstrate mid-Pliocene SSTs peaked up to 21.5°C and 19.7°C in the NE Atlantic and Nordic Seas, respectively, consistent with existing studies (Robinson et al., 2008; Robinson, 2009). However, we reveal the majority of these SST estimates are derived from GC injections of relatively low total alkenone concentrations (<50 ng/μl), which are susceptible to warming biases caused by chromatographic irreversible adsorption (Grimalt et al., 2001). We subsequently filtered and applied a mathematical correction to our new data to rectify for these warming biases, which results in a reduction in mPWP SSTs, by up to 3.2°C, across all four sites. The corrected (and cooler) alkenone SST records indicate the magnitude of warming in the NE Atlantic and Nordic Seas may be significantly less than previously thought, helping to reduce and explain regional discrepancies between proxy- and model-based SST reconstructions.