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Multi-decadal air and sea surface temperature records for the last 2000 years from a marine core in the Skagerrak, offshore southern Norway.

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Sediments strongly influenced by the North Atlantic Current accumulate at high rates in the northeastern Skagerrak (off southern Norway) Here, we report sea surface and continental air temperature records obtained at decadal resolution from core MD99-2286 in the north-eastern Skagerrak, where the relative sedimentation rate is higher than 1cm/year. The site location is key for regional estimations and provide unique insights on the paleoceanographic development of the eastern North Sea and climate patterns in southern Scandinavian region over the last 2000 years.

A variety of proxies can provide estimates of past sea surface temperatures (SST), of which the UK37’ ratio is one of the most commonly applied. In 2002 a new proxy to reconstruct SST was introduced, based on the membrane lipids produced by nonthermophilic Crenarchaeota, the so-called TEX86, which estimates the integrated temperature of approximately the first 100m of the water column. Furthermore, in 2006 a new tool to reconstruct Mean Annual Air Temperature (MAAT) was proposed, which estimates terrestrial air temperature also from archaeal lipids in soils. These are novel tools which offer, potentially, the chance to obtain from a single sediment core both quantitative sea and land temperature records.

We have tested this approach in a high resolution marine record from the Skagerrak. The aim was to decipher decadal climate patterns and assess the influence of oceanic circulation in continental northern Europe. In this communication we focus on the temperature record obtained that span the last 2000 years, derived from UK37', TEX86 and the MAAT indices.

We have validated the proxies by comparing them to an instrumental air temperature record (AD 1870-1996) from Oksoy station (Kristiansand, Norway) and an instrumental SST record (AD 1951-1996) from Faerder station (Tjome, Norway). Results suggest that the temperature signal obtained from TEX86 reflect the spring SST, whereas the temperature signal obtained from MAAT and the SST derived from UK37' correspond to the summer air and sea temperature of the study area.

The SST record from UK37' is approximately 6ºC higher than SST record from TEX86. This may be attributed to water column stratification in the Skagerrak, as both proxies presumably differ in the water column depth at which the temperature signal is originated. This supports the idea that both proxies could be used together to estimate past thermocline changes. Both proxies register a warm period around AD 1200, followed by a SST decrease until AD 1600 approximately. Interestingly, from AD 1885 to 1996 the trends registered by both proxies differ. Whereas SST from UK37' tends to increase sharply, SST from TEX86 tends to decrease. Again, this suggests changes in water column stratification in the study area. The air temperature record from MAAT shows a general air temperature increase during the last 2000 years. We interpret the MAAT estimates as relating to changes in air temperature in southern Norway. This record shows also an air temperature peak between AD 630 and 1140 which may correspond to the so-called Medieval Warm Period, an air temperature decrease for the period AD 1140 to 1650 which could be attributed to the Little Ice Age and a trend to a MAAT increase between AD 1650 and 1885, that may be divided into two parts. (I) The increase between AD 1650 and 1885 might correspond to a natural climate warming after the previous cold period. (II) The sharp increase from AD 1885 to 1996 which could be attributed to anthropogenic climate change. The record estimates that the air temperature for the period AD 1885-1996 is 2.5ºC higher than the air temperature for the whole period AD 0-1885. We interpret, at this stage, much of the multi-decadal variability in temperature in the area as related to thermohaline circulation cycles in the North Atlantic.