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Variability of the North Atlantic during Past Climate Change: Inference from Scarce and Inaccurate Data

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The role of North Atlantic variability in climate change remains poorly understood due in large part to the limited span of instrumental records. This situation invites researchers to consult other sources of information, in particular records of sea surface temperature (SST) estimated from the analysis of marine sediments. Interpreting SST records from deep-sea sediment cores, however, is a delicate problem, as the SST estimates are generally scarce, inaccurate, and sometimes inconsistent. Here we discuss the interpretation of a small number of North Atlantic SST records characterized by (generally) centennial resolution and spanning the past 15,000 years, i.e., part of the last glacial-interglacial transition and episodes of more abrupt climate change, such as the Younger Dryas. An attempt is made to infer the time-evolving SST field in the North Atlantic from the quantitative combination of the SST records with an advective mixed layer model using methods of optimal estimation theory (an extended Kalman filter and a fixed-interval smoother). The error covariance of the time-evolving SST field is evaluated from the model dynamics, the reduced availability and accuracy of the SST estimates, and estimates of the model errors. We find that the climatologic position of the 10°C surface isotherm, which today coincides approximately with the North Atlantic Current and the Subpolar Front, pivoted recurrently around a region near the Tail of the Grand Banks: during cold climate intervals, the isotherm assumed a more zonal and southern position compared to today, whereas during warm climate intervals it was generally oriented SW-NE, such as today. In our presentation, emphasis will be placed on the statistical and oceanographic significance of this interesting result.