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A model-data comparison of the Holocene global ocean temperature evolution

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In order to test the ability of climate models to simulate future climate change, they must be tried under the influence of different main climate conditions. This preferably should be done independent of the last century as information from that period was partly used in constructing the climate model itself. The climate evolution from the mid-Holocene to preindustrial times is an ideal test bed as here the climate forcing is well known and a large number of high resolution proxy data are available. In this study, we use a multimodel, multiproxy approach to analyze the mid-Holocene to preindustrial evolution of the ocean's temperature. This allows us to determine the cause for model-data discrepancies: either deficiencies within the climate model or a misinterpretation of the proxy data. For our analysis, we make use of atmosphere ocean general circulation model (AOGCM) simulations of the Paleoclimate Modelling Intercomparison Project Phase II (PMIP II) as well as of a transient simulation (ECHO-G), which covers the mid-Holocene to preindustrial time span. The proxy record comprises marine alkenone and Mg/Ca-derived temperature data available for most regions of the ocean. In the comparison process, we consider the effects of seasonality and habitat depth of the proxy recorder. Even accounting for this uncertainty, we find a systematic deviation between the proxy-based ocean temperature reconstructions and model simulations. This study raises a series of questions concerning the quantitative comparison of model results and proxy data.