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Model-data comparison in a strongly eddying Eocene ocean

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Simulations of the geological past using General Circulation Models (GCMs) are computationally expensive. Mainly because of the long equilibration time scales, most of these GCMs have ocean components with a horizontal resolution of 1° or coarser. Such models are non-eddying and the effects of mesoscale ocean eddies on the transport of heat and salt are parameterized. However, from present-day ocean modeling studies, it is known that eddying ocean models better represent regional and time-mean ocean flows compared to non-eddying models. At the same time, proxy data from sediment sample sites represent climate at specific locations. Hence, the coarse ocean resolution of typical palaeo-GCMs lead to a challenge for model-data comparison in past climates.

Here we present the first simulations of a global eddying Eocene ocean with a 0.1° (horizontal) resolution model, which are initialized and forced with data from a coarser resolution (1° horizontally) equilibrated coupled ocean-atmosphere GCM. We investigate the response of the model equilibrium state to the change in ocean resolution and the consequences this has for model-data comparison in the middle-late Eocene (38Ma). We find that, compared to the non-eddying model, the eddying ocean resolution of palaeomodels reduce the biases in both sea surface temperatures and biogeographic patterns which are derived from proxy data.