

EGU24-5406, updated on 15 Mar 2024

<https://doi.org/10.5194/egusphere-egu24-5406>

EGU General Assembly 2024

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Reconstructing historical ocean changes around the West Antarctic Ice Sheet over the past centuries

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Over recent decades, the West Antarctic Ice Sheet (WAIS) has witnessed a large increase in ice shelf melting. This ice loss is recognized to be associated with a response to changes in the ocean state, in particular of the Circumpolar Deep Water (CDW) on the Amundsen Sea continental shelf. It has been shown that the variability of the CDW inflow is strongly related to wind changes. While instrumental-based atmospheric reanalysis products are available since 1979, given the strong natural variability of the West Antarctic climate, this period of a few decades might be too short to identify the mechanisms driving the long-term changes in ice shelf melting, and to distinguish the relative contribution of natural and forced variability to the total changes. Therefore, there is a need to provide long-term historical changes in oceanic conditions to put the recently observed ice shelf melting into a longer context and to ultimately better constrain the future contribution of the WAIS to the global sea-level rise. Over the past few years, atmospheric reanalysis based on paleoclimate records spanning the last centuries have been released. This offers us the opportunity to assess historical changes in oceanic conditions in response to changes in the atmosphere. In this study, we propose a framework to reconstruct past ocean conditions around the WAIS over the last few centuries by using an ocean-sea-ice model (NEMO-SI3) forced by a paleo-based atmospheric reanalysis. Specifically, we use a paleo-reanalysis based on data assimilation that aims at dynamically combining information from paleoclimate records from the Southern Hemisphere (especially ice-core records) and the physics of Earth System Models. This has the advantage of guaranteeing a dynamical consistency between the reconstructed variables. Along with the methodology, we present the first reconstructed oceanic conditions from the NEMO-SI3 simulations.