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Beyond EPICA - a climate modeling perspective

Content

Understanding past climate change in and around Antarctica may provide new insights into the coupling mechanisms between climate and the carbon cycle on orbital timescales. However, our knowledge of how the atmosphere and the Southern Ocean have responded to Milanković forcing is very much limited by the time periods covered by Antarctic ice cores (< 800 ka). Looking beyond this horizon into events such as the Mid-Pleistocene transition has become the main motivation for the paleoclimate research community and projects such as Beyond EPICA-Oldest Ice. In this presentation, we present results from an unprecedented transient climate simulation conducted with NCAR's realistic Community Earth System Model version 1.2, which covers the climate history of the past 3 million years (the longest CGCM simulation to date). The simulation was forced by orbital variations and estimates of time-varying greenhouse gasses and northern hemisphere ice-sheet extent and height. Previously [1], we have documented the fidelity of this simulation in capturing the Pliocene/Pleistocene time evolution of reconstructed variations in tropical sea surface temperature, rainfall in central Africa, the Mediterranean, and the Asian summer monsoon system. Here we will provide a more detailed view of simulated shifts in the Southern Hemisphere polar climate. We will focus on the precessional modulation of the atmospheric westerlies and their potential role in pacemaking ocean upwelling and the release of deep ocean carbon during glacial terminations. We will also share model "predictions" for some of the climatic parameters that will be reconstructed in near future using the Beyond-EPICA ice core. Several key datasets from this simulation can already be accessed through: https://climatedata.ibs.re.kr/data/hominin-habitats/2ma-transient-climate-simulation-data.

[1] Timmermann et al. (2022), Nature, 604, https://doi.org/10.1038/s41586-022-04600-9

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