Reduced El Niño variability in the PlioMIP2 model ensemble

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The mid-Piacenzian or mid-Pliocene warm period (mPWP, 3.264 – 3.025 Ma) is the most recent geological period to see atmospheric CO$_2$ levels similar to the present-day values (~400 ppm). Some proxy reconstructions for the mPWP show reduced zonal SST gradients in the tropical Pacific Ocean, possibly indicating an El Niño-like mean state in the mid-Pliocene. However, past modelling studies do not show the same results. Efforts to understand mPWP climate dynamics have led to the Pliocene Model Intercomparison Project (PlioMIP). Results from the first phase (PlioMIP1) showed clear El Niño variability (albeit significantly reduced) and did not show the greatly reduced time-mean zonal SST gradient suggested by some of the proxies.

In this work, we study ENSO variability in the PlioMIP2 ensemble, which consists of additional global coupled climate models and updated boundary conditions compared to PlioMIP1. We quantify ENSO amplitude, period and spatial structure as well as the tropical Pacific annual mean state in a mid-Pliocene and pre-industrial reference simulation. Results show a reduced El Niño amplitude in the model-ensemble mean, with 11 out of 13 individual models showing such a reduction. Furthermore, the spectral power of this variability considerably decreases in the 3–7-year band and shifts to higher frequencies compared to pre-industrial. The spatial structure of the dominant EOF shows no particular change in the patterns of tropical Pacific variability in the model-ensemble mean, compared to the pre-industrial. Further analyses that will be presented include the correlation of the zonal SST gradient with the El Niño amplitude, investigation of shift in El Niño flavour, and a discussion of the coupled feedbacks at play in the mid-Pliocene tropical Pacific Ocean.