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Disentangling the major climate forcings since Eocene: large decrease of pCO_2 and Tibetan Plateau uplift

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Since the Eocene, atmospheric CO_2 concentration decreased from about 4 to 1 PAL. This long-term decay is associated with major orographic changes due to India/Asia collision. To disentangle both major climate forcing factors (pCO_2 and Tibetan Plateau uplift), we used a coupled atmosphere–ocean model to quantify the relative effects of each forcing factor. We present the results from warm (4PAL) and cold (1PAL) sensitivity experiments to Tibetan Plateau uplift using NCAR Community Earth System Model (CESM). Four coupled experiments were run, each one lasting more than 1000 years with and without Tibetan Plateau at 2 different pCO_2 levels (1PAL and 4PAL). For both pCO_2 values, the impact of TP on ocean dynamics shows large meridional overturning circulation (MOC) changes (Su et al. CP 2018) and a shift in deep water formation, which further results in warmer SST over North Atlantic, but cooler over Pacific. These results are consistent with several proxy data (Davies et al. Nature 2001). Indeed, data revealed a transition from a high PMOC in early Eocene (ca. 40 Ma) to a large AMOC at late Eocene (34 Ma).

Moreover, we show, using scenarios of Tibetan Plateau uplift with two different pCO_2 values that the long trend of global mean SST evolution is driven by CO_2 damping. Meanwhile, the TP uplift imprints the regional response of the different basins. This evolution of SST pattern is in good agreement with long term data reconstructions.