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Interactions between ocean carbon cycle and climate variability in the Equatorial Pacific simulated by CMIP5 models

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Observational-based studies indicate that the interannual variability of sea-air carbon fluxes in the Equatorial Pacific is principally governed by the El-Nino Southern Oscillation (ENSO) phenomenon, with major El-Nino (warm) and La-Nina (cold) events occurring every three to seven years. In this study, we evaluate 250-years long pre-industrial control simulations from four Earth System Models (NorESM-ME, HadGEM2-ES, IPSL-CM5A-LR, and MPI-ESM-LR). When compared to the observation-based estimate, all models simulate consistent Nino3.4 SST anomaly periodicity, though the amplitude of the variations is slightly larger. All four models feature the expected temperature and dissolved inorganic carbon (DIC) vertical profile anomalies (i.e., weaker cold-water and DIC supplies from depth during El-Nino, and the opposite for La-Nina). Only two models show a robust inverse correlation between the simulated sea-to-air CO_2 fluxes and Nino3.4 indexes. One model maintains a positive correlation between sea-to-air CO_2 fluxes and Nino3.4 index throughout the 250-years period. One model shows a dominant interdecadal-like variability acting in addition to the ENSO. To address the differences between models, we will further decompose the simulated surface pCO_2 to variations due to temperature and non-temperature effects. Contributions from biological production and air-sea gas exchange to the surface DIC variability will be explored as well. Finally, the majority of models suggest weakening of ENSO variability under future global warming scenarios. We will analyse how this would implicate climate-carbon cycle feedback in the future.