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The Role of Atmospheric Feedbacks in simulated ENSO and their influence on the Pacific OMZ

Simulated ENSO in climate models of the CMIP5 data base is still too divers to allow reliable predictions, how ENSO will change under global warming (Stocker et al. 2013). The atmospheric component of CGCMs was identified as major source of diversity (Lloyd et al. 2011). In many state-of-the-art CGCMs the positive (amplifying) atmospheric Bjerknes feedback and the negative (damping) heat flux feedback are both underestimated, leading to an error compensation (Bellenger et al. 2014, Bayr et al. 2018). Therefore, many CGCMs have biased ENSO dynamics, which hamper the simulation of strong El Niño events.

During El Niño events the upwelling in the eastern Pacific is reduced and the thermocline is deeper than normal. Especially during strong El Niño events oxygen rich water is brought from the top into the OMZ (up to 300m depth), as observed during the strong El Niño in 1997 close to cost of Peru (Levin et al. 2002). As climate models with weak atmospheric feedbacks have problems in simulating strong El Niño events, this leads to a much weaker inflow of oxygen rich water into the OMZ from top in models with weak atmospheric feedbacks.

We were able to produce in a series of perturbed physics experiments with the Kiel Climate Model (KCM) the same spread in ENSO atmospheric feedbacks then seen in the CMIP5 data base, due to different mean state climates in the tropical Pacific. In these KCM experiments we want to show the influence of the underestimated ENSO atmospheric feedbacks and biased ENSO dynamics on the simulation of the mean ocean circulation, the variability of the tropical ocean currents and the Pacific OMZ in coupled climate models.

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