Fourth International Conference on Earth System Modelling
4ICESM-36, 2017
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Impact of SST diurnal cycle on ENSO asymmetry

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The dominant mode of inter-annual variability in the tropical Pacific is El Niño-Southern Oscillation (ENSO). ENSO is not symmetric in the sense that El Niño is generally stronger than La Niña. However, many CMIP5 models, including the Max Planck Institute Earth System Model (MPI-ESM), produce an almost symmetric ENSO. This paper shows that, when resolving the intra-daily air-sea interactions by coupling the atmospheric and oceanic model components once per hour, the simulated ENSO asymmetry is improved.

The improvement is closely related to the simulated diurnal cycle of SST. In the central tropical Pacific, the simulated diurnal range of SST is about 0.2°C, up to 10% of the typical SST anomalies of the simulated ENSO events. During El Niño events, the simulated diurnal cycle of SST enhances the atmospheric moist instability, whereby triggering more convection in the central tropical Pacific. During La Niña and normal years, however, the mean convection is not changed by the included diurnal cycle of SST. As a result, the anomalies of the trades, which are directly related to the convection, are stronger during El Niño years than that during La Niña years, making El Niño to be stronger than La Niña via Bjerknes feedback.

These results obtained with a low resolution MPI-ESM are further confirmed by simulation with the same model at higher spatial resolutions, suggesting that the role of the intra-daily air-sea interactions for the ENSO asymmetry is independent of model resolutions.