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El Niño Southern Oscillation and Tropical Basin Interaction in Idealized Worlds

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In this study we discuss a set of fully coupled general circulation model simulations with idealised geometries of the tropical ocean basins and land with a focus on important characteristics of El Niño Southern Oscillation (ENSO) type of variability and tropical basin interaction. In a series of 15 simulations we first vary the zonal width of a single tropical ocean basin from 50^o to 360^o, while the rest of the tropical zone is set as land. Further we discuss different simplified configurations of two or three tropical ocean basins. The results show remarkable changes in ENSO characteristics as function of basin width and due to the interaction with other basins that challenge our current understanding of ENSO dynamics. A single basin ENSO has an optimal basin width of about 150^o at which ENSO preferred period is the longest, the wind stress feedback is the strongest and variability is stronger than in all other basin widths, expect for the 350^o basin. Tropical basin interactions substantially affect ENSO strength, periodicity, feedbacks, non-linearity, spatial scale and pattern. In experiments with two or three identical ocean basins we find highly synchronized ENSO modes that are identical between basins and far more energetic and oscillatory then the single basin modes. The results suggest that tropical basin interaction is an essential part of ENSO. The framework of these experiments can help to better understand the atmospheric dynamics of ENSO and should help to formulate an ENSO theory that incorporates tropical basin interactions as a core element.