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The 'Sticky' ITCZ: Ocean-Moderated ITCZ Shifts

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By transporting heat across the equator, the ocean circulation is capable of affecting the positions of the Intertropical Convergence Zone (ITCZ) and the ascending branch of the Hadley cells, both of which are tied to the atmosphere's hemispheric energy balance. To study the importance of the ocean's cross-equatorial heat transport in these dynamics, we induce ITCZ shifts in an aqua-planet coupled atmosphere-ocean climate model by imposing an interhemispheric heating contrast, increasing the albedo in one hemisphere and reducing it in the other. First, we find that ITCZ shifts are always damped relative to simulations in which the ocean circulation is held fixed, irrespective of the heating distribution or its amplitude, keeping the ITCZ "stuck" to latitudes near the equator. The damping is primarily due to the ocean's anomalous cross-equatorial heat transport associated with the coupling of the trade winds to an oceanic cross-equatorial cell (CEC). Second, we find that the damping effect is strongest when the forcing distribution is polar-amplified, which enhances the gross stability of the CEC and maximizes the efficiency of its cross-equatorial heat transport. Third, we argue that the ocean's heat transport can have secondary impacts on ITCZ shifts through its interaction with climate feedbacks. Finally, we discuss the implications of our study for our understanding of the role of CECs in damping ITCZ and Hadley cell shifts on Earth.