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ITCZ shift and extratropical teleconnections drive ENSO response to volcanic eruptions

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The mechanisms through which volcanic eruptions impact the El Niño-Southern Oscillation (ENSO) state are still controversial. Previous studies have invoked direct radiative forcing, an ocean dynamical thermostat (ODT) mechanism and shifts of the Intertropical Convergence Zone (ITCZ), among others, to explain the ENSO response to tropical eruptions. Here, these mechanisms are tested using ensemble simulations with an Earth System Model in which volcanic aerosols from a Tambora-like eruption are confined either in the Northern or the Southern Hemisphere. We show that the primary drivers of the ENSO response are the shifts of the ITCZ together with extratropical circulation changes, which affect the tropics; the ODT mechanism does not operate in our simulations. Our study highlights the importance of initial conditions in the ENSO response to tropical volcanic eruptions and provides explanations for the predominance of post-eruption El Niño events and for the occasional post-eruption La Niña in observations and reconstructions.