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Dependence of global monsoon response to volcanic eruptions on the background oceanic states

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Both proxy data and climate modeling show divergent responses of global monsoon precipitation to volcanic eruptions. The reason is however unknown. Here, based on analysis of the CESM Last Millennium Ensemble simulation, we show evidences that the divergent responses are dominated by the pre-eruption background oceanic states. We found that under El Niño-Southern Oscillation (ENSO) neutral and warm phases initial conditions, the Pacific favors an El Niño-like anomaly after volcanic eruptions, while La Niña-like SST anomalies tend to occur following eruptions under ENSO cold phase initial condition, especially after southern eruptions. The cold initial condition is associated with stronger upper ocean temperature stratification and shallower thermocline over the eastern Pacific than normal. The easterly anomalies triggered by surface cooling over the tropical South America continent can generate changes in SST through anomalous advection and the ocean subsurface upwelling more efficiently, causing La Niña-like SST anomalies. Whereas under warm initial condition, the easterly anomalies fail to develop and the westerly anomalies still play a dominant role, thus forms an El Niño-like SST anomaly. Such SST response further regulates the monsoon precipitation changes through atmospheric teleconnection. The contribution of direct radiative forcing and indirect SST response to precipitation changes show regional differences, which will further affect the intensity and sign of precipitation response in submonsoon regions. Our results imply that attention should be paid to the background oceanic state when predicting the global monsoon precipitation responses to volcanic eruptions.