Geophysical Research Abstracts
Vol. 17, EGU2015-3226, 2015
EGU General Assembly 2015

Interaction of Volcanic Forcing and El Nino: Sensitivity to the Eruption Magnitude and El Nino Intensity

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Volcanic aerosols formed in the stratosphere after strong explosive eruptions influence Earth's radiative balance, affecting atmospheric and oceanic temperatures and circulation. It was observed that the recent volcanic eruptions frequently occurred in El Nino years. Analysis of the paleo data confirms that the probability of a sequent El Nino occurrence after the eruption increases. To better understand the physical mechanism of this interaction we employed ocean-atmosphere coupled climate model CM2.1, developed in the Geophysical Fluid Dynamics Laboratory, and conducted a series of numerical experiments using initial conditions with different El Nino Southern Oscillation (ENSO) strengths forced by volcanic eruptions of different magnitudes, Pinatubo of June 1991 and Tambora of April 1815: (i) strong ENSO/Pinatubo, (ii) weak ENSO/Pinatubo, (iii) strong ENSO/Tambora. The amount of ejected material from the Tambora eruption was about three times greater than that of the Pinatubo eruption. The initial conditions with El Nino were sampled from the CM2.1 long control run. Our simulations show the enhancement of El Nino in the second year after an eruption. We found that the spatial-temporal structure of model responses is sensitive to both the magnitude of an eruption and the strength of El Nino. We analyzed the ocean dynamic in the tropical Pacific for all cases to uncover the physical mechanism, resulting in the enhanced and/or prolonged El Nino.