Surface air temperature response to large-scale volcanic eruptions and its relationship with ENSO

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A volcanic eruption injects sulfate aerosols into the atmosphere, which decrease the surface air temperature (SAT). When the aerosols expand in the stratosphere, a decrease in SAT can be maintained globally during a few years, although it is generally difficult to estimate the effects of a volcanic eruption because of the existence of internal variations in the climate system. This study estimated the SAT change after large low-latitude volcanic eruptions focusing on the phase of El Niño-Southern Oscillation (ENSO) by analyzing CMIP5 historical experiments. Volcanic eruptions, as an external forcing of climate system, are prescribed based on the observational datasets. However, internal variabilities like ENSO are different in each ensemble. Thus, it is possible to analyze SAT changes in the same eruption that are different in the phase of ENSO. Results showed that global SAT changes after volcanic eruptions contain a difference in the phase of ENSO. In addition, the “combined” effect of ENSO and volcanic eruptions still was found after the eruptions globally. The contribution of the ENSO to SAT was estimated approximately 1/10 to 1/5 of the whole decrease in SAT. Furthermore, the SAT changes were different in the both hemispheres. In the northern (southern) hemisphere, the decrease in SAT was larger (smaller), and the SAT changes continued shorter (longer) periods.

