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Inter-hemispherically Asymmetric versus Symmetric Volcanic Forcings and the Impacts on Climate

Wenchang Yang (1), Gabriel Vecchi (1), Stephan Fueglistaler (1), Larry Horowitz (2), David Luet (1), Ángel Muñoz (3), David Paynter (2), and Seth Underwood (2)

(1) Princeton University, Princeton, United States (wenchang@princeton.edu), (2) Geophysical Fluid Dynamics Laboratory/NOAA, Princeton, United States , (3) Columbia University, Palisades, United States

In this study, we demonstrate that the spatial structure of volcanic radiative forcing, in addition to the magnitude, is also a key factor in determining its climate impact. Using a tropical-cyclone-permitting coupled climate model from GFDL, we conduct ensemble numerical experiments and compare three representative volcanic eruptions in the 20th century: Pinatubo in 1991, Agung in 1963 and Santa Maria in 1902. The radiative forcings from the three eruptions are inter-hemispherically symmetric, southern hemispherically asymmetric and northern hemispherically asymmetric, respectively. We find that the two asymmetric eruptions, although weaker than the Pinatubo eruption, can have comparable response in the hemisphere where the eruption occurs. In addition, precipitation and tropical cyclone activity are more sensitive to inter-hemispherically asymmetric than symmetric eruptions. Our findings suggest the importance of an accurate reconstruction of volcanic radiative forcing spatial structure in order to get a correct estimate of its climate impact.