EGU24-6543, updated on 05 Apr 2024
https://doi.org/10.5194/egusphere-egu24-6543
EGU General Assembly 2024

Relative role of land and ocean in shaping tropical hydroclimate after large volcanic eruptions

Claudia Timmreck[1], Roberta D'Agostino[2], Shih-Wei Fang[3,4], Andrew Ballinger[5], Gabriele Hegerl[5], Sarah Kang[1], Dirk Olonscheck[1], and Andrew Schurer[5]
[1]Max-Planck-Institut für Meteorologie, Atmosphere in the Earth System, Hamburg, Germany (claudia.timmreck@mpimet.mpg.de)
[2]National Research Council, Institute of Atmospheric Sciences and Climate, Lecce, Italy
[3]Center for Climate Physics, Institute for Basic Science (IBS), Busan, Republic of Korea
[4]Pusan National University, Busan, Republic of Korea
[5]School of Geosciences, University of Edinburgh, Edinburgh, United Kingdom

Volcanic eruptions substantially impact tropical precipitation over the historical period but they differ in their emission strength, geographical latitude and season of the eruption, which makes it difficult to draw general conclusions. Sufficient large ensembles simulations with the same model and radiative forcing scenario but varying initial conditions have become a great tool in recent years to disentangle forced and internal variability). Here we use a suite of 100-member ensembles of the MPI-ESM-LR for idealized equatorial and extratropical eruptions of different eruption strengths and an additional 100-member ensemble without forcing. We find that precipitation reduction is primarily energetically constrained by less atmospheric net energy input (NEI). NEI decreases rapidly in the first months after the eruption due to reduced incoming solar radiation and then the circulation weaken as a consequence of less moist static energy (MSE) exported away from the intertropical convergence zone. Only afterwards, when the overturning has already weakened, the MSE, and then the gross moist stability (GMS) contribute stronger to the precipitation reduction. Tropical precipitation over land reacts immediately to forcing changes, while the precipitation response over the ocean and the temperature response have much longer response times. Altered dry-wet pattern ("wet gets drier") and the decreased monsoon precipitation are strongly tied to the weakening of the regional tropical overturning. Differences related to the geographical locations of the volcanic eruptions will be highlighted.