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Global monsoon precipitation responses to large volcanic eruptions

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Climate variation of global monsoon (GM) precipitation involves both internal feedback and external forcing. Here, we focus on strong volcanic forcing since large eruptions are known to be a dominant mechanism in natural climate change. It is not known whether large volcanoes erupted at different latitudes have distinctive effects on the monsoon in the Northern Hemisphere (NH) and the Southern Hemisphere (SH). We address this issue using a 1500-year volcanic sensitivity simulation by the Community Earth System Model version 1.0 (CESM1). Volcanoes are classified into three types based on their meridional aerosol distributions: NH volcanoes, SH volcanoes and equatorial volcanoes. Using the model simulation, we discover that the GM precipitation in one hemisphere is enhanced significantly by the remote volcanic forcing occurring in the other hemisphere. This remote volcanic forcing-induced intensification is mainly through circulation change rather than moisture content change. In addition, the NH volcanic eruptions are more efficient in reducing the NH monsoon precipitation than the equatorial ones, and so do the SH eruptions in weakening the SH monsoon, because the equatorial eruptions, despite reducing moisture content, have weaker effects in weakening the off-equatorial monsoon circulation than the subtropical-extratropical volcanoes do.