

Aerosol versus greenhouse gas impacts on Southern Hemisphere general circulation changes

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This study re-examines the possible impacts of anthropogenic aerosols (AERs), which are primarily concentrated in the Northern Hemisphere extratropics, on the atmospheric general circulation changes in the Southern Hemisphere (SH). The long-term trends of the SH Hadley Cell edge and Southern Annular Mode (SAM) index are particularly evaluated for the historical and single forcing experiments of eight models archived for the Fifth Coupled Model Inter-comparison Project (CMIP5). The AER-induced temperature changes are typically opposite in sign to that of the greenhouse gas (GHG)-induced ones. However, the zonal-mean circulation changes driven by the AERs are not simply opposite to those due to the GHGs. They are instead highly sensitive to the choice of analysis period. Depending on the analysis period, the AER-induced circulation changes exhibit the same sign as the GHG-induced ones. It is also found that the inter-model spread of AER-driven circulation changes is primarily dependent on the uncertainty of tropospheric temperature changes, particularly static stability changes in the subtropics, whereas that of GHG-induced changes in the austral summer is influenced by the uncertainty of both the tropospheric and polar lower-stratospheric temperature changes. This accentuates that the AER-induced SH circulation changes are not simply mirroring the GHG-induced ones.