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Changes in potential intensity and humidity under stratospheric sulphate geoengineering and its impact on tropical storms

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Variation in tropical cyclone (TC) intensity is driven in part by changes in the distributions of meteorological variables that are known to influence their genesis and intensity under the current climate. Genesis Potential Index (GPI) and ventilation index are combinations of vertical wind shear, relative humidity, midlevel entropy deficit, and absolute vorticity to quantify thermodynamic forcing of TC activity under changed climates and can be calculated from climate model output. Here we use five CMIP5 models running the RCP45 experiment the Geoengineering Model Intercomparison Project (GeoMIP) stratospheric aerosol injection G4 experiment to calculate the two indices over the 2020 to 2069 period. Globally, GPI under G4 is lower than under RCP45, though both they have a slight increasing trend. Spatial patterns in the effectiveness of geoengineering can be expressed in the differences G4-rcp45. These show reductions in TC in all model in the North Atlantic basin, and for the northern Indian Ocean in all except NorESM1-M. In the North Pacific, most models also show relative reductions under G4. Ventilation index results generally coincide with the GPI patterns. Most models project a decrease in the potential intensity and relative humidity but the relative humidity change is less than for potential intensity. Changes in vertical wind shear and vorticity are small with scatter across different models and ocean basins. Thus stratospheric aerosol geoengineering impacts on potential intensity and hence TC intensity are reasonably consistent with statistical forecasts of Tropical North Atlantic hurricane activity driven by sea surface temperatures. However the impacts of geoengineering on other ocean basins are more difficult to assess, and require more complete understanding of their driving parameters under present day climates. Furthermore, the possible effects of stratospheric injection on chemical reactions in the stratosphere, such as ozone, are not well rendered in the models used so far.