

## **Variability, trends and sensitivity to aerosol forcing of historical climate extremes in a novel single-model ensemble**

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The role of anthropogenic aerosol forcing in driving historical climate variations is currently a topic of ongoing scientific debate, owing to large uncertainties in the magnitude of historical forcing due to anthropogenic aerosol. The computational cost of running climate model simulations has steadily declined in recent years, making it possible to run a large number of ensemble members to investigate the roles of internal variability and aerosol forcing in shaping surface climate variability.

Here, we present results from a novel historical ensemble of simulations conducted with the HadGEM3-GC3.1 climate model for the period 1850-2014. In this ensemble, the anthropogenic aerosol emissions are scaled to sample a wide range in historical aerosol forcing. Multiple ensemble members sampling different ocean initial conditions are run for each scaling factor to enable the differences between the forced responses to be reliably estimated. As expected, a wide range of historical global mean temperature changes are simulated, depending on the aerosol scaling factors. For trends in temperature extremes, both the magnitude of internal variability and the sensitivity to aerosol forcing are highly dependent on the region and season. We discuss the relative importance of forcing vs. internal variability for different regions and seasons; and explore the mechanisms for these differences.