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SEARCH FOR CLIMATE RESPONSE TO AEROSOL FORCING IN TEMPERATURE ANOLMALY TRENDS

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Shortwave radiative forcing of climate by anthropogenic tropospheric aerosols is thought to have substantially contributed to radiative forcing over the industrial period, albeit with considerable uncertainty in magnitude. Determining the magnitude of this forcing and any differences in climate response to aerosol and greenhouse gas (GHG) forcing is crucial for empirical inference of climate sensitivity, i.e., change in temperature per change in radiative forcing. Differences in sensitivity might arise from the different nature of the forcing (shortwave vs. longwave) and the different geographical and seasonal distribution. The different geographical distribution of the forcing raises the possibility of empirical inference of climate response to aerosol forcing, and by extension, to any forcing, from interhemispheric differences in temperature anomaly trend. Previous examination of Northern and Southern Hemisphere annual mean temperature anomaly trend have indicated no significant difference indicative of a NH aerosol signal (S. E. Schwartz, Nature, 1988; T. M. L. Wigley, Nature, 1989). However, zonal and seasonal patterns of temperature anomaly trend are spatially coherent with aerosol forcing and exhibit secular trends consistent with the history of anthropogenic SO_2 emissions (D. E. Hunter et al., GRL, 1993). Two recent general circulation model studies indicate the same global and annual mean climate sensitivity for GHGs and for GHGs plus sulfate aerosols (J. F. B. Mitchell et al., Nature, 1995; S. J. Cox et al., GRL, 1995). Substantially less warming in the NH compared to the SH in response to combined GHG plus sulfate forcing is indicative of a local and seasonal signature to the response. However substantial cross-hemisphere response indicates that climate sensitivity cannot be simply inferred from the interhemispheric difference in aerosol radiative forcing and temperature anomaly trend.

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