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Sensitivity of aerosol indirect forcing and autoconversion to cloud formation parameterization, meteorological field and emission scenarios: An assessment with the NASA Global Modeling Initiative (GMI)

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The aerosol indirect effect (AIE) is one of the largest sources of uncertainty in assessments of anthropogenic climate change [*IPCC*, 2001]. An important step towards constraining the AIE is to quantify important sources of uncertainty. The objective of this study is to assess the uncertainties in indirect forcing and autoconversion of cloud water to rain from differences in meteorological fields, emission scenarios, and parameterizations of cloud droplet formation. The uncertainty in indirect forcing and autoconversion rate is assessed with the NASA Global Modeling Initiative (GMI). The GMI allows easy interchange of meteorological fields, chemical mechanisms, aerosol microphysical and aerosol-cloud interaction packages.

"Present day" and "preindustrial" simulations were carried out using the University of Michigan and AEROCOM emission inventories. Three different meteorological fields were used: the NASA Data Assimilation Office (DAO), the NASA GEOS4 finite volume GCM (FVGCM) and the Goddard Institute for Space Studies version II' (GISS

II') GCM. Cloud droplet number concentration is computed with the empirical correlations of *Boucher and Lohmann* [1995] and *Segal and Khain* [2006], and the mechanistic parameterizations of *Abdul-Razzak and Ghan* [2000], *Feingold and Heymsfield* [1992], and *Fountoukis and Nenes* [2005]. Computed CDNC is used to calculate the cloud optical depth, the autoconversion rate and the mean top-of-the-atmosphere (TOA) short-wave radiative forcing using modified FAST-J algorithm [*Meskhidze et al.*, 2006]. Autoconversion of cloud water to precipitation is parameterized following the formulations of *Khairoutdinov and Kogan* [2000] and *Rotstayn* [1997].

Our results suggest that differences in meteorological fields, cloud droplet activation parameterizations and emission scenarios could account for up to 30% discrepancies in forcing estimates for the first indirect effect and up to 50% in autoconversion rates.

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