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Aerosol-Cloud Interactions
Spring 2012

| # | Paper | Summary |
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| 1 | Lohmann and Feichter 1997: Impact of sulfate aerosols on albedo and lifetime of clouds: sensitivity study with ECHAM4 GCM. | ECHAM4 GCM. 1st, 2nd, and both indirect effect estimates: -1.00, -0.40, -1.40 W/m$^2$. Parameterizing cloud cover in terms of LWC rather than RH increases the forcing, but lowering the sensitivity of autoconversion to CDNC reduces the lifetime effect. |
| 2 | Rotstayn 1999: Indirect forcing by anthropogenic aerosols: A GCM calculation of the effective-radius & cloud-lifetime effects. | CSIRO GCM. 1st, 2nd, and both indirect effect estimates: -1.20, -1.00, -2.10 W/m$^2$. Results are sensitivite to autoconversion, sulfate-CDNC relation, and vertical distribution of sulfate. Lifetime effect is at least 25% of total indirect forcing. |
| 3 | Rotstayn and Penner 2001: Indirect aerosol forcing, quasi forcing, and climate response. | CSIRO GCM. 1st, 2nd, and both indirect effect estimates: -1.35, -1.32, -2.57 W/m$^2$. Calculated pure (everything fixed) and quasi (can vary) forcings for 1st indirect effect (less than 10% difference), determined that its OK to treat the 2nd as a quasi forcing. |
| 4 | Jones et al. 2001: Indirect sulphate aerosol forcing in a climate model with an interactive sulphur cycle. | Hadley Centre GCM. 1st, 2nd, and both indirect effect estimates: -1.30, -0.50, -1.90 W/m$^2$. Found that alternative assumptions about natural sulfur (DMS) sources reduce the forcing by over 25%, and different parameterizations of autoconversion can double it. |
| 5 | Takemura et al. 2005: Simulation of climate response to aerosol direct and indirect effects with aerosol transport-radiation model. | CCSR/NIES/FRCGC GCM. 1st, 2nd, and both indirect effect estimates: -0.52, -0.42, -0.94 W/m$^2$. Included a parameterization of droplet nucleation, rather than empirical relation. Aerosol effects reduce the greenhouse gas warming by 40%. |
| 6 | Hansen et al. 2005: Efficacy of climate forcings. | GISS GCM. 1st, 2nd, and both indirect effect estimates: -0.77, -1.01, -1.78 W/m$^2$. Evaluated the impact of different forcing agents on temperature, aerosol effects cool -0.45°C. Individual species contribute: 36% SO4, 36% OC, 23% NO3, and 5% BC. |
| 7 | Ming et al. 2005: GFDL general circulation model investigation of the indirect radiative effects of anthropogenic sulfate aerosol. | GFDL GCM. 1st, 2nd, and both indirect effect estimates: -1.40, -0.90, -2.30 W/m$^2$. Separates forcing from flux change, which includes long wave effects. Evaluated statistical significance of zonal mean forcing, most significant in northern hemisphere. |
| 8 | Rotstayn and Liu 2009: Cloud droplet spectral dispersion and the indirect aerosol effect: comparison of two treatments in a GCM. | CSIRO GCM. 1st, 2nd, and both indirect effect estimates: -0.38, -0.24, -0.62 W/m$^2$. Represented droplet spectral dispersion as a change in the effective/volume radius ratio. Treating the ratio as a function of CDNC and LWC significantly reduced indirect effects. |
| 9 | Isaksen et al. 2009: Atmospheric composition change: climate–chemistry interactions. | Literature review (multi-model). 1st, 2nd, and both indirect effect estimates: -0.90, -0.35, -1.25 W/m$^2$. Summary of climate–chemistry interactions and contributions to changes in atmospheric composition and forcing, identified major remaining areas of uncertainty. |
| 10 | Wang et al. 2010: Modeling study of aerosol indirect effects on global climate with an AGCM. | BCC GCM. 1st, 2nd, and both indirect effect estimates: -1.14, -1.03, -1.93 W/m$^2$. Forcing is largest in mid/high lats of northern hemisphere summer. Global temperature change of -0.12°C is mostly in the northern hemisphere, which leads to broadening of ITCZ precip. |

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# Aerosol indirect effects: comparing the magnitude of cloud-albedo and cloud-lifetime effects and cloud cover change.