

**A proposed model intercomparison
study to quantify uncertainties
associated with indirect aerosol
radiative forcing**

Models: Japan, LMDZ, ECHAM,
CCM-Norway, GISS

Prescribed experiments

- 1. Prescribed aerosol mass; no effect of aerosols on precipitation efficiency; common treatment of precipitation efficiency; common treatment of cloud droplet number parameterization; does not include aerosol direct effects on the heating profile
- 2. Prescribed aerosol mass and size distribution; no effect on precipitation by aerosols; common treatment of precipitation efficiency; no common cloud droplet number parameterization; does not include aerosol direct effects on the heating profile
- 3. Prescribed aerosol mass and size distribution; common treatment of effect of aerosols on precipitation efficiency; no common cloud droplet number parameterization; does not include aerosol direct effects on the heating profile

Prescribed experiments

- 4. Prescribed aerosol mass and size distribution; **NO** common treatment of effect of aerosols on precipitation efficiency; no common cloud droplet number parameterization; does not include aerosol direct effects on the heating profile
- 5. Prescribed aerosol sources; no common treatment of effect of aerosols on precipitation efficiency; no common cloud droplet number parameterization; does not include aerosol direct effects on the heating profile
- 6. Prescribed aerosol sources; no common treatment of effect of aerosols on precipitation efficiency; no common cloud droplet number parameterization; includes aerosol direct effects on the heating profile
- 7. Prescribed aerosol sources; prescribed aerosol primary emissions and size; no common treatment of effect of aerosols on precipitation efficiency; no common cloud droplet number parameterization; includes aerosol direct effects on the heating profile

stratiform cloud frac: 3D time-avg (range 0 to 1)

stratiform in cloud LWP: 3D in-cloud, avg when there are clouds (kg/m²)

stratiform in cloud IWP: 3D in-cloud, avg when there are clouds (kg/m²)

stratiform cloud LWP: 3D grid-avg, time-avg (kg/m²)

stratiform cloud IWP: 3D grid-avg, time-avg (kg/m²)

stratiform water cloud freq: 3D n/a (range 0 to 1)

stratiform ice cloud freq: 3D n/a (range 0 to 1)

stratiform in-cloud droplet number concentration: 3D in-cloud, avg when there are clouds (cm⁻³)

stratiform in-cloud droplet effective radius: 3D in-cloud time-ave of $\text{SUM}(\text{snd} \cdot \text{sre}) / \text{SUM}(\text{snd})$ (mm)

convective cloud frac: 3D time-avg (range 0 to 1)

convective in cloud LWP: 3D in-cloud, avg when there are clouds (kg/m²)

convective in cloud IWP: 3D in-cloud, avg when there are clouds (kg/m²)

convective cloud LWP: 3D grid-avg, time-avg (kg/m²)

convective cloud IWP: 3D grid-avg, time-avg

convective water cloud freq: 3D n/a (range 0 to 1)

convective ice cloud freq: 3D n/a (range 0 to 1)

convective in-cloud droplet number concentration: 3D in-cloud, avg when there are clouds (cm⁻³)

convective in-cloud droplet effective radius: 3D in-cloud, time-ave of $\text{SUM}(\text{cnd} \cdot \text{cre}) / \text{SUM}(\text{cnd})$ (mm)

Analysis of effects of model assumptions on cloud albedo

$$S_{\Delta\alpha_p}^2 = \frac{\partial\alpha_p}{\partial x_i} S_{x_i}^2 + 2 \text{cov}(x_i, x_j) \frac{\partial\Delta\alpha_p}{\partial x_i} \frac{\partial\Delta\alpha_p}{\partial x_j}$$

Variables in analysis:

- treatment of cloud droplet number concentration
- treatment of precipitation efficiency
- treatment of aerosol transport/removal
- treatment of aerosol heating effects on clouds

Comparison of model results of experiment 6 with satellite obs:

- Analysis of spatial correlation of cloud optical depth, LWP, Re and Nd with satellite observations
- Analysis of spatial correlation of predicted and observed low cloud albedo with satellite observations
- Analysis of correlation of aerosol optical depth and cloud albedo for a fixed LWP with satellite observations

Comparison of model results and satellite obs for correlation with aerosol optical depth:

- Analysis of spatial correlation of cloud optical depth, LWP, Re and Nd with optical depth of aerosol
- Analysis of spatial correlation of predicted and observed low cloud albedo with optical depth of aerosol
- Analysis of correlation of aerosol optical depth and cloud albedo for a fixed LWP with optical depth of aerosol