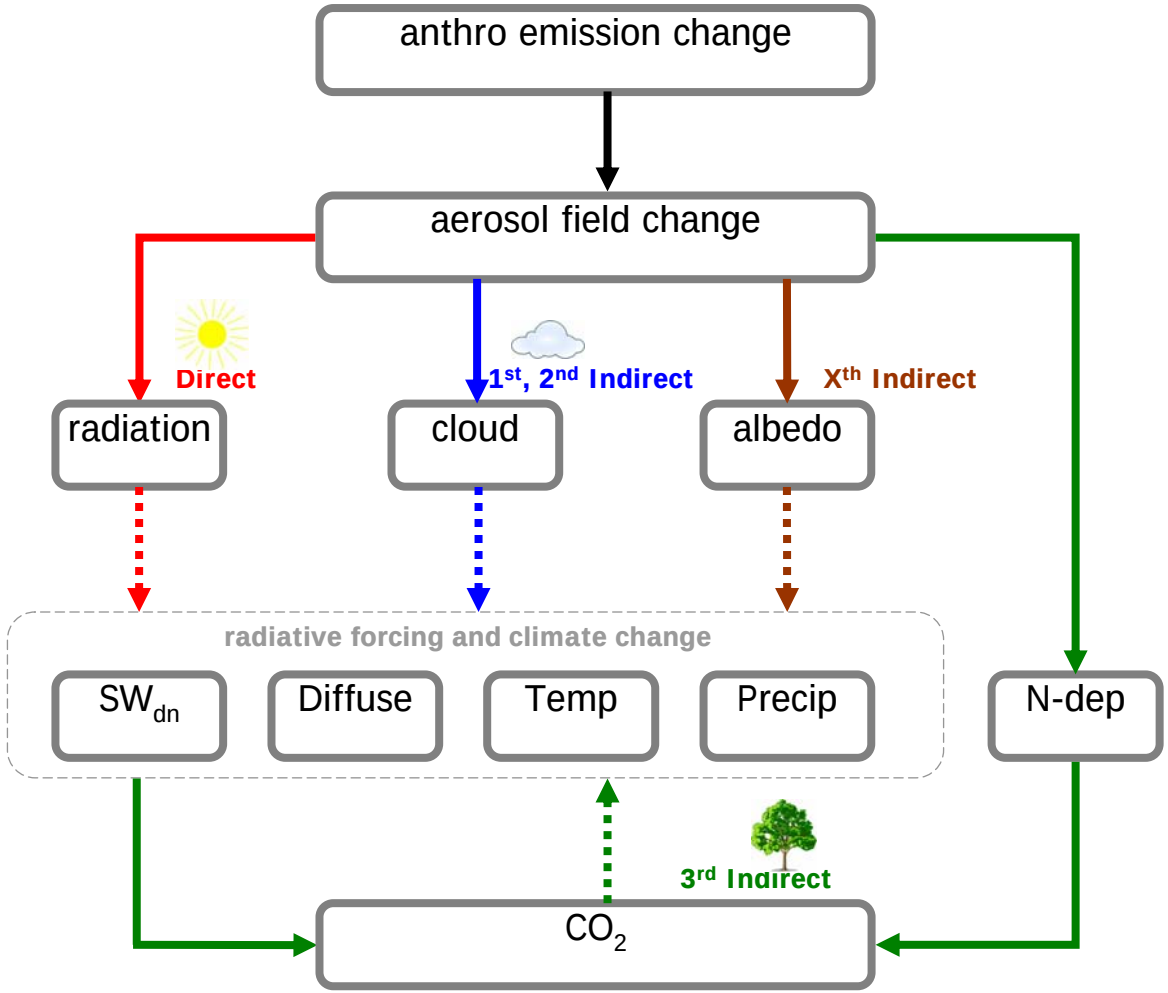
Evaluating the Third Indirect Effect of Aerosols on Climate

The second visio-conference

September 15, 2011

Aerosols' direct and indirect effects



Topics

- Aerosol → temperature → C sink
- Aerosol → SWdn → C sink
- Aerosol → diffuse light → C sink
- Aerosol → N-deposition → C sink

Back-of-the-envelop calculations

- Based on Koch 2011 (J Climate), the cooling effects of sulfate aerosols are **0.2-0.5K** over North America and Eurasia, and **0.1-0.2K** elsewhere.

- Assuming **-0.2K** everywhere, the net gain in carbon storage due to the cooling effect of sulfate is 15.8GtC or 57.9GtCO_2, equivalent to **7.4ppm** (1ppmCO_2= 7.81GtCO_2) decrease in terms of ambient CO_2 concentration

- The corresponding RF is approximately **-0.12 W m^{-2}** (calculated as 7.4ppm/100ppm*1.66Wm^{-2}, 1750-2005), ranging from -0.06 to -0.3 W m^{-2} (if the uncertainties of Δ Tc range from -0.1K to -0.5K).

Calculation based on CMIP5 results

Expt 3.1 Pre-Industrial Control	Impose non-evolving, pre-industrial conditions, which may include: Prescribed atmospheric concentrations of • all well-mixed gases (including CO2) • some short-lived (reactive) species Prescribed non-evolving emissions or concentrations of • natural aerosols or their precursors • some short-lived (reactive) species. Unperturbed land use.
Expt 6.2a PI (prescribed SST)	Baseline climatology
Expt 6.4a: PI + 2000 anthro. Aerosols Expt 6.4b: PI + 2000 anthro. sulfate	An atmosphere-only run driven by prescribed SST and sea ice consistent with the climatology of the pre-industrial control run (expt. 3.1), but with aerosols consistent with conditions in year 2000 of the historical run

Norwegian Climate Centre (NCC), **NorESM1-M**

Canadian Centre for Climate Modeling, **CanESM2**

Commonwealth Scientific and Industrial Research Organization/ Queensland Climate Change Centre of Excellence (CSIRO-QCCCE), **CSIRO-Mk3.6**

N-deposition on C sink

- Which aerosol species are important for C-sink? (ammonium, nitrate, and …?).
- What types of deposition should we use (i.e., dry deposition or wet deposition)?
- How to conduct the calculation (ORCHIDEE)?
- Any suggestions …