5.018 Sensitivity of dust emissions to aerosol feedback and the impact of dust loading on climate forcing with varied resolutions using FIM-Chem.

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Abstract:

Meteorological conditions directly impact aerosol loading, especially dust emissions. Variations in dust emissions on the other hand, will also impact meteorology and climate through direct and indirect aerosol forcing. To study these impacts in more detail we use the global Flow-following finite-volume Icosahedra Model (FIM, http://fim.noaa.gov/), a new global weather prediction model currently under development in the Global Systems Division of NOAA/ESRL, as it is coupled online with the aerosol modules from the Goddard Gobal Ozone Chemistry Aerosol Radiation and Transport (GOCART) model (FIM-Chem). FIM-Chem includes direct and semi direct feedback, and uses the dust schemes of GOCART and the Air Force Weather Agency (AFWA). FIM-Chem is able to investigate the contribution of climate feedbacks to simulated hyperspectral data by considering a range of simulations with different dust emissions and different levels of aerosol feedbacks enabled at four different spatial resolutions. The emitted dust flux and total emissions are highly depending on the wind, soil moisture and model resolution. We compare the dust emissions by including and excluding the aerosol radiative feedback in the simulations to quantify the sensitivity of dust emissions to aerosol feedback. The results show that all aerosol-induced dust emissions increase about 10% globally, which is mainly dominated by the contributions of anthropogenic black carbon (EC) aerosol. While the dust-induced percentage changes of dust emissions are about -5.5%, that indicates reduction effect globally. Also, the simulations based on different resolutions of 240x240 km, 120x120 km, 60x60 km and 30x30 km are performed to test the impacts of model resolution on total dust emissions. By comparing the dust emission sensitivity to aerosol feedback and model resolution, we can estimate the uncertainty of model resolution versus aerosol feedback. We also conduct FIM-Chem simulations to investigate the sensitivity of dust climate forcing to different model resolutions.