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Evaluating aerosol-cloud-radiation interactions by combining observational data and large-scale models

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Aerosol indirect effects, the radiative forcing anthropogenic aerosols exert by acting as cloud condensation nuclei and altering cloud properties, are considered the most uncertain yet important climate forcing. A main reason for this is that general circulation models (GCMs), used to assess large-scale radiative forcings, only very crudely parameterize cloud processes and aerosol-cloud-radiation interactions. Observational data is needed to evaluate, constrain and improve such parameterizations. In the presentation, an overview is given over recent studies evaluating the parameterizations of aerosol indirect effects in GCMs using satellite and ground-based remote sensing data as a reference. Sensitivities of cloud droplet number concentrations, cloud liquid water path, cloud cover, and top-of-the-atmosphere radiation to aerosol perturbations are analysed. Recent results of extensions of these studies, investigating the sensitivity of cloud albedo to cloud property perturbations, are reported. An assessment on observational needs for better model constraints is given.