Geophysical Research Abstracts, Vol. 8, 03097, 2006
SRef-ID: 1607-7962/gra/EGU06-A-03097

Aerosol direct radiative forcing

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Our understanding of the impact by anthropogenic aerosol on climate (usually quantified by radiative forcing) is largely based on simulations with global models. Recent results based on simulations with nine different models with state of the art aerosol component modules suggest for anthropogenic aerosol an all-sky forcing at the top of the atmosphere (ToA) of -0.2W/m2, with a standard deviation of +/-0.2W/m2. This refers only to the presence of aerosol and not to 'indirect' effects via aerosol induced modifications to clouds. Although there are significant regional and seasonal variations to the aerosol 'direct' impact on the ToA energy balance, the global annual average 'ToA cooling' by -0.2W/m2 is surprisingly small (especially when compared to 'ToA warming' by anthropogenic greenhouse gases at about +2.4W/m2). Parallel to modelling, also in order to circumvent uncertainties in aerosol processing, increasingly more measurement based concepts are introduced for estimates of the aerosol impact on climate. Almost all of these approaches suggest a larger 'ToA cooling'. A cooling of -1.0W/m2 is simulated when supplying off-line simulations with data of an aerosol climatology (based on remote sensing from ground and space), satellite statistics on solar surface albedo (MODIS) and cloud properties (ISCCP). A 'cooling' of -0.8W/m2 is suggesting when linking satellite retrievals on aerosol properties (MODIS) with satellite retrievals of solar broadband fluxes (CERES). In both cases an anthropogenic fraction for the aerosol optical depth was adopted from global modelling. Detailed output of such observation-tied approaches is compared to output from global modelling, with the expectation to have answers for the aerosol forcing discrepancy. There are initial indications that the modulation of the aerosol forcing by clouds under all-sky conditions is a major contributing factor.