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Estimating aerosol emissions by assimilating observed aerosol optical depth in a global aerosol model

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The emission fluxes of a range of aerosol species and aerosol precursor are estimated at the global scale. These fluxes are estimated by assimilating daily total and fine mode aerosol optical depth (AOD) at 550 nm from the Moderate Resolution Imaging Spectroradiometer (MODIS) into a global aerosol model of intermediate complexity. Monthly emissions are fitted homogenously for each species over a set of predefined regions. The assimilation system has been applied to the entire year 2002 and its performance is evaluated by comparing the AOD after assimilation against the MODIS observations and against independent observations. The system is effective in forcing the model towards the observations, for both total and fine mode AOD. Significant improvements for the root mean square error and correlation coefficient against both the assimilated and independent datasets are observed as well as a significant decrease in the mean bias against the assimilated observations. The estimated emission flux for black carbon is 14.5 Tg/yr, 119 Tg/yr for organic matter, 17 Pg/yr for sea salt, 82.7 TgS/yr for SO_2 and 1383 Tg/yr for desert dust. They represent a difference of +45%, +40%, +26%, +13% and -39% respectively, with respect to the a priori values. The system has been applied to the year 2005 with similar performance in the reduction of the RMS and bias and increase in correlation. The study will be extended by applying it to the year 2010. The estimated fluxes corresponding to the years 2002, 2005 and 2010 will be presented and compared with different top-down and bottom-up estimates.