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Quantifying the Direct Radiative Effect of Absorbing Aerosols for Numerical Weather Prediction: A case study

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Aerosol feedbacks are becoming more recognized as necessary physical mechanisms for Numerical Weather Prediction Models. Here, we conceptualize aerosol radiative transfer processes in the hypothetical coupling of a global aerosol transport model and global numerical weather prediction model by applying the U.S. Naval Research Laboratory Navy Aerosol Analysis and Prediction System (NAAPS) and the Navy Global Environmental Model (NAVGEM) meteorological and surface reflectance fields. A unique experimental design during the 2013 NASA Studies of Emissions and Atmospheric Composition, Clouds and Climate Coupling by Regional Surveys (SEAC4RS) field mission, allows for collocated airborne sampling by the Langley's High Spectral Resolution Lidar (HSRL), the Airborne Multi-angle Spectro Polarimetric Imager (AirMSPI), up/down SW and broadband IR radiometers, as well as NASA A-Train support from MODIS, to perform an aerosol direct forcing closure. The results demonstrate a dramatic sensitivity of modeled fields to aerosol radiative fluxes and heating rates, specifically those associated with smoke and urban aerosols. Deficiencies associated to limitations with aerosol identification, assumed vertical distribution and choice of optical and surface polarimetry properties are discussed within the context of their influence on NWP outputs, particularly important as the community propels forward towards inline aerosol modeling.