Comparisons of airborne HSRL and ECMWF Aerosol Profiles

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Aerosol-related products from the European Center for Medium-range Weather Forecasts (ECMWF) Integrated Forecasting System (IFS) model, produced in the Monitoring Atmospheric Composition and Climate (MACC) project, are used in a number of applications such as studies of air quality and climate forcing. These products are also important for providing the spatial and temporal context for interpreting satellite measurements such as those provided by CALIPSO. Aerosol amounts and vertical distributions derived from the ECMWF model are examined using aerosol profiles acquired by the NASA Langley Research Center (LaRC) airborne High Spectral Resolution Lidar (HSRL). The ECMWF/MACC model analyses include assimilation of MODIS aerosol optical thickness (AOT) measurements. The airborne HSRL has been deployed from the NASA LaRC King Air aircraft and measures profiles of aerosol extinction (532 nm), backscatter (532 and 1064 nm), and depolarization (532 and 1064 nm) between the surface and about 7 km. Airborne HSRL measurements acquired during 16 field experiments conducted by NASA, DOE, NOAA, and EPA over North America between 2006-2011 are used to examine the ECMWF model profiles. Included in these measurements are numerous underflights of CALIPSO. Initial comparisons show considerable variability in the agreement between the ECMWF and HSRL 0-7 km layer AOT values and aerosol extinction profiles. Over the Caribbean where the majority of aerosols were associated with the long range transport of Saharan dust, initial comparisons show generally good agreement between 0-7 km layer AOT and aerosol extinction profiles. In contrast, over the Los Angeles basin and central California, where there was extensive small scale spatial variability in AOT and much of the aerosol was produced locally, there were considerable differences between the HSRL and ECMWF layer AOT values and extinction profiles. This variability in model performance is expected to be associated at least in part with the accuracy and availability of MODIS AOT values assimilated by the model. The relationship between the measured and modeled aerosol profiles with aerosol type is also examined using aerosol types inferred from the HSRL measurements.