Towards a better understanding of the vertical aerosol distribution in the atmosphere

Barbara Scherllin-Pirscher[1], Benjamin T. Johnson[2], and Mariusz Pagowski[3]

(1) Zentralanstalt für Meteorologie und Geodynamik (ZAMG), Vienna, Austria
(2) Joint Center for Satellite Data Assimilation (JCSDA), University Corporation for Atmospheric Research (UCAR) at National Oceanic and Atmospheric Administration (NOAA), College Park, MD, USA
(3) Earth System Research Laboratory (ESRL), National Oceanic and Atmospheric Administration (NOAA), Boulder, CO, USA and Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, USA

The presence and distribution of atmospheric aerosols have a strong impact on the Earth system. Interactions with meteorological parameters through radiative effects and cloud formation, for example, affect the Earth's weather and climate. The amount of aerosols in the atmosphere significantly increases during hazardous events such as volcanic eruptions, forest fires, and sandstorms. Those events affect not only air quality and human health, but also, e.g., aviation safety. While numerical models help to better understand the dispersion of aerosols, they heavily rely on the adequate representation of the initial aerosol distribution.
At present, there is limited information regarding the vertical distribution of aerosols since aerosol observations are mainly surface-based in-situ measurements, or vertically integrated measurements such as aerosol optical depth (AOD). Ground-based LIght Detection And Ranging (LIDAR) measurements and LIDAR measurements from satellites can be used to close this gap. The assimilation of LIDAR profiles into numerical models is expected to significantly improve the knowledge of the vertical aerosol distribution in the atmosphere and improve model forecasts.
LIDAR data assimilation is implemented in the Gridpoint Statistical Interpolation (GSI) 3DVar. Aerosol extinction and backscattering coefficient profiles are simulated with the Community Radiative Transfer Model (CRTM), which is embedded in the GSI. Since proper CRTM modeling is key for high-quality data assimilation, CRTM simulations were extensively tested and evaluated. We will discuss CRTM enhancements and show results of model-to-model comparisons as well as validations against LIDAR-based observations.