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# Climatology of aerosol optical properties with a synergy of remote sensing/altitude in situ measurements.

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Understanding spatial and temporal variability of aerosol particles in the atmosphere is important to characterize their contribution to health, visibility and climate. The aerosol vertical distribution is less documented than the horizontal variability because of the difficulty to make continuous altitude measurements compared to ground-based platforms. Moreover, there are still large uncertainties for key parameters like the single scattering albedo, the refractive index, the asymmetry coefficient and the hygroscopicity. It also contributes to the uncertainties in radiative forcing assessments and climate change projection.
For the first time to our knowledge, a long term in situ and co-located remote sensing study of optical aerosol properties has been realized at an elevated research station. The Puy de Dôme (1465m above sea level) is ideally situated to investigate aerosols vertical variability in both Planetary Boundary Layer and Free Troposphere.
We used a combination of in-situ (Nephelometer, MAAP, HTDMA, SMPS, OPC, AMS, TEOM) and remote sensing (LIDAR, Sun Photometer) instruments to realize a climatology of the optical aerosol properties. Mie calculations were computed from the size distribution measured by the SMPS and the OPC, grown at the ambient relative humidity from the HTDMA measurements. The synergy between the different instruments sampling in-situ allowed us to calculate a refractive index. During intensive field campaigns we also performed a complete optical closure to test the routine methodology of calculation of this refractive index. Aerosol mass vertical profile retrievals algorithms were then applied using the in-situ information.
Using the Lagragian model HYSPLIT we performed a classification of the air masses arriving at the Puy de Dôme and their corresponding aerosol properties. We found significant differences in the Angstrom coefficient, the single scattering albedo and the LIDAR ratio between, local, oceanic and Saharan air masses. We highlight the importance of a correct mass-extinction ratio and a well-known hygroscopicity to compute vertically resolved mass distribution from LIDAR extinction.