Classification of aerosol size distributions observed at a tropical high altitude station

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The tropics comprise an important source region of aerosol particles. However, long-term measurements of aerosol properties in the tropical free troposphere are sparse. Aerosol measurements were conducted between March 2007 and May 2009 at the Pico Espejo Atmospheric Research Station Alexander von Humboldt (Schmeissner et al, 2011). The Pico Espejo (8.51° N, 71.05° W, 4765 m a.s.l.) is located on the top of the mountain ridge of the Andes close to the city of Mérida, Venezuela (Figure 1).

Particle number concentration, size distribution, volatility and light absorption were observed at the high altitude research station. The aerosol instrumentation contained a Particle Soot Absorption Photometer (PSAP) and a Differential Mobility Particle Sizer (DMPS). Particle number concentrations were measured using Condensation Particle Counters (CPC). A thermodenuder was used to heat the sampled aerosol to 300°C.

The Venezuelan savannah spreads out east of the Venezuelan Andes, i.e. upwind the observation site. The savannah region comprises a wide area of potential biomass burning land during the dry season, December-April (Morales et al., 1990). The boundary layer air masses which are affected by biomass burning reach the high altitude station during daytime due to shallow convection and uplift of air masses along the mountain slope.

The special location of the observation site allows for observations of different air mass types during the wet and dry season. Air masses within the lower free troposphere (LFT) and the boundary layer (BL) were observed. The interactions and mixing at the boundary layers between the different air masses could be studied.

Observed aerosol number size distributions were grouped and classified by using cluster analysis (Dorling et al., 1992). Prior to the clustering, each observation was normalised to its maximum number concentration. Hence, the observations were clustered according to the shape of the size distribution. This procedure allows for investigating the source types and processes leading to the respective shapes rather than examining the source strength which controls the number concentration.

Figure 1 shows the resulting clusters and their average number size distributions. The size distributions are ordered clockwise according to their skewness starting from the top left corner with dominating accumulation mode towards dominating Aitken mode. Size distributions which indicate new particle formation were dominantly observed at the transition from the lower free troposphere to the boundary layer at noon time during the dry season. The dry season was also dominated by size distributions exhibiting high aerosol mass compared to the wet season.

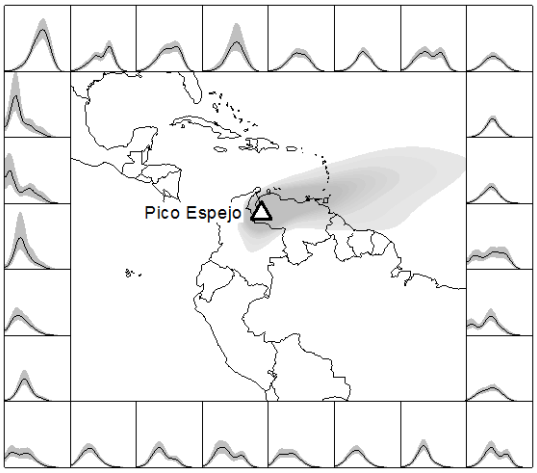

Figure 1. Clustered size distributions (25^{th}-75^{th} percentile and median). The grey shade in the map indicates possible source regions based on 5-day back trajectories.

Further analysis of statistics on observed meteorological parameters and particle properties allowed for insight into occurring aerosol processes and air mass types for each cluster.

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Dorling, S. R., et al. (1992) *Atmospheric Environment* **26A**, 2575-2581.
Morales, J. A., et al. (1990) *Atmospheric Environment* **24A**, 407-414.
Schmeissner, T, et al. (2011) *Atmos. Chem. Phys.* **11**, 3319-3332.