MBL Aerosol Properties and Their Impact on CCN at the Azores-AMF Site

Research Highlight

A multi-platform data set from the Clouds, Aerosol, and Precipitation in the Marine Boundary Layer (CAP-MBL) Graciosa, Azores, 2009–2010 field campaign was used to investigate how continental aerosols influence MBL cloud condensation nuclei (CCN) number concentration (NCCN).

Figure 1 shows the yearly and seasonal aerosol particle volume and number size distributions, aerosol optical depth (AOD), and Angström exponent (AEAOD) during the CAP-MBL campaign. A low overall mean AOD_{440} of 0.12 denoted a clean environment, though this region typically contains MBL sea salt. In terms of aerosol volume, a bimodal signal was prominent where the coarse mode influence (r # 1 µm) dominated that of the fine mode (r < 1 µm) throughout the year. In the case of the yearly number size distribution, the fine mode was nearly the same magnitude as the coarse mode due to continental aerosol influences during the spring and summer seasons. The coarse mode aerosols (e.g., sea salt) dominated the volume and number size distributions during the winter and spring months. However, weather patterns over the Azores region begin to advect continental aerosols during the spring months as evidenced by the larger fine mode number concentration. Notably, the summer season had the lowest coarse mode volume influence as well as the highest fine mode number concentration. This is primarily due to a combination of the low surface winds and an influx of pollution aerosols from the Americas.

Using the HYSPLIT backward trajectories, Logan et al. (2014) identified considerable continental fine mode aerosols advected to the Azores region during summer months, including Saharan mineral dust, volcanic ash, biomass smoke, and pollution from North America. These polluted aerosols have different properties than the locally generated coarse model aerosols (e.g., sea salt), which will certainly have different effects on cloud microphysical properties. The combination of dominant clean air masses, with periodic episodes of polluted air masses, will provide a substantial change in aerosol properties during the summer, providing a great opportunity to investigate the interactions between aerosol and cloud properties, or the aerosol indirect effect.

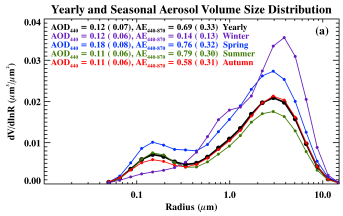

Figure 1a. Retrieved yearly and seasonal mean aerosol volume size distributions at the Azores.

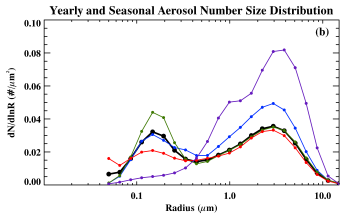

Figure 1b. Retrieved yearly and seasonal mean aerosol number size distributions at the Azores. The mean (standard deviation) AOD and AEAOD are also included (Figure 3 of Logan 2014).

Reference(s)

Logan T, B Xi, and X Dong. 2014. "Aerosol properties and their influences on marine boundary layer cloud condensation nuclei at the ARM mobile facility over the Azores." Journal of Geophysical Research – Atmospheres, 119(8), doi:10.1002/2013JD021288.

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Working Group(s)

Cloud-Aerosol-Precipitation Interactions