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Original sounding and drifting balloon-borne measurements in the western Mediterranean with the aerosol counter/sizer LOAC during summer ChArMEx campaigns, with a focus on desert dust events

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LOAC (Light Optical Aerosol Counter) is a new small optical particle counter/sizer of ~250 grams designed to fly under all kinds of balloons. The measurements are conducted at two scattering angles (12° and 60°), allowing the determination of the aerosol particle concentrations in 19 size classes within a diameter range of ~0.2-100 μm and some identification of the nature of particles dominating different size classes. Following laboratory calibration, the sensor particularly discriminates wet or liquid particles, mineral dust, soot carbon particles and salts. Comparisons with other in situ sensors at the surface and with remote sensing measurements on the vertical were performed to give confidence in measurements. The instrument has been operated at the surface, under all kinds of balloons up to more than 35 km in altitude, including tethered, sounding, open stratospheric and new boundary-layer pressurized drifting balloons (BLPB) from CNES, and was tested on board a small UAV. Operations encompass a variety of environments including the Arctic (Reykjavik, Island, and Kiruna, Sweden), Brazil (Sao Paolo), the western Mediterranean Basin, southwestern France, peri-urban (Ile de France) and urban areas (Paris and Vienna).

Presented results are focused on the LOAC balloon-borne measurements performed in the western Mediterranean basin during MISTRALS/ChArMEx campaigns (Mediterranean Integrated Studies aT Regional And Local Scales/the Chemistry-Aerosol Mediterranean Experiment; http://www.mistrals-hjome.org; http://charmex.lsce.ipsl.fr), with a focus on African dust events. Two test flights with a first version of LOAC under sounding balloons were first successfully performed in late June 2012 near Marseille during an intense dust event. In 2013, 19 LOAC flights have been performed under meteorological balloons and 12 under low altitude drifting balloons, most of them from Minorca Island (Spain) in June and early July and others from Levant Island (south of France) in late July and early August . A number of the 2013 flights were coupled with ozone concentration measurements (see presentation of Gheusi et al. in the same session). LOAC balloons were especially, but not only, dedicated to study the various Saharan dust events that occurred during the campaign. In particular, a series of flights were conducted every 12 hours during the 15-19 June dust event. Forest fire smoke from North America was also sampled in late June over Minorca, as well as anthropogenic polluted layers in various occasions.

LOAC data (available from ChArMEx database http://mistrals.sedoo.fr/ChArMEx) are interpreted with the help of coincident lidar, sun photometer remote sensing measurements available in Menorca, and satellite products and air mass trajectories. The sounding flights allow us to determine the vertical extent of the various aerosol layers, and to follow the particle size distribution and the concentration evolution along the vertical. The low altitude drifting balloons, which stayed roughly at constant altitude between 350 and 3330 m up to more than 25 h, allow us to study the time-evolution of the aerosol concentrations in the same air mass. Under both balloon types, LOAC has detected larges particles up to ~30 μm in diameter. The flights drifting within dust layers indicate that there is a relatively stable particle size distribution during transport over the sea, with no clear sedimentation loss of large particles. Aerosol simulations with the CHIMERE and NMMB/§BSC chemistry-transport models are compared to LOAC measurements.

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