Processes controlling the aerosol chemical composition in the Western Mediterranean Sea

M. Chrit[1], K. K. Sartelet[1], J. Sciare[2,3], J. Pey[4*], N. Marchand [4], L. DeWitt[4], and K. Sellegri[5]

[1]CEREA, joint laboratory Ecole des Ponts ParisTech - EDF R&D, Université Paris-Est, 77455 Champs sur Marne, France.
[2]LSCE, CNRS-CEA-UVSQ, Gif-sur-Yvette, France
[3]EEWRC, The Cyprus Institute, Nicosia, Cyprus
[4]Aix Marseille University, CNRS, LCE UMR 7376, Marseille, France
[5]LAMP, Aubière, France
[*]Now at the Spanish Geological Survey, IGME, 50006 Zaragoza, Spain

This work aims at evaluating the chemical transport model (CTM) Polair3d of the air-quality modelling platform Polyphemus during the ChArMex summer campaign of 2013, using ground-based measurements performed at ERSA (Cape Corsica, France), and at determining the processes controlling organic aerosol concentrations at ERSA. Simulations are compared to measurements for concentrations of both organic and inorganic species, PM_{10}, PM_1, as well as the ratio of biogenic versus anthropogenic particles, and organic aerosol properties (oxidation state).

For inorganics, the concentrations of sulphate, sodium, chloride, ammonium and nitrate are compared to measurements. Different parameterizations of sea-salt emissions are compared and the parameterization of Jaeglé et al. (2011) leads the best agreement to sodium measurements. The dynamics of formation of semi-volatile inorganic species is studied.

For submicron organics, the concentrations are well modelled when compared to experimental values. Moreover, an important organic mass fraction is noted in small-size sea spray emissions. Anthropogenic species are influenced by emission of semi-volatile organic compounds (SVOC). Measurements allow us to refine the estimation of those emissions, which are currently missing in emission inventories. Although concentrations of organics are well simulated, they are not enough oxidised in the model. The observed oxidation state of organics shows that the oligomerisation of monoterpenes oxidation products was overestimated in Polyphemus. To improve the oxidation property of organics, the formation of extremely low volatile organic compounds (ELVOCs) from autoxidation of monoterpenes is added to Polyphemus, using the recently published data from chamber experiments of Ehn et al. (2014). These chemical compounds are highly oxygenated and are formed rapidly. This process may explain some of the discrepancies between measurements and modelling of organic oxidation properties.

References

Ehn, M., Thornton, J. A., Kleist, E., and SipilaX, M. (2014). A large source of low-volatility secondary organic aerosol. 506:476–479.

Jaeglé, L., Quinn, P. K., Bates, T. S., Alexander, B., and Lin, J.-T. (2011). Global distribution of sea salt aerosols: new constraints from in situ and remote sensing observations. *Atmos. Chem. Phys.*, 11:3137–3157.