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The Mediterranean aerosol and its climate interactions, and the AerMEx initiative

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This presentation will (i) review our present knowledge of the Mediterranean aerosol including the control that weather and climate has on its variability, (ii) examine aerosol potential feedbacks on weather and climate, and (iii) describe a new French initiative for an extensive study of the Mediterranean aerosol.

In the early 1980s, the first aerosol measurements performed during oceanographic cruises showed that the aerosol load over the remote Mediterranean is controlled by a variety of continental sources and is subject to a very high variability the overview of which requires continuous monitoring. Subsequent surface and satellite-based monitoring of aerosol composition and column optical properties in the Mediterranean yielded a good picture of the aerosol variability in time and space. On average the continental-derived Mediterranean aerosol load is controlled by the precipitation frequency and shows a high background during the dry season and a low background during the wet season, with short term variations of one order of magnitude or more due to the succession of turbid episodes and rains. The average South-North decreasing gradient in aerosol optical depth indicates that African dust dominates. Desert dust is essentially lifted over the basin by Atlantic or North African low pressure systems, and different seasonal patterns of the aerosol load are found in the different parts of the basin. Lidar data have further provided an insight on the complex vertical distribution of the Mediterranean aerosol with turbid layers often found over the atmospheric mixed layer at altitudes of several kilometres.

The control of the Mediterranean weather and climate on the aerosol load is therefore clear, but in turn the Mediterranean aerosol has likely feedbacks on the regional weather and climate, which are yet poorly quantified but generally dominate greenhouse gas effects in terms of regional radiative forcing. Direct aerosol radiative effects cause a significant deficit in surface heating and evaporation. Light-absorbing aerosol particles (e.g. soot found every summer in large scale plumes from biomass burning) further enhance the surface radiation deficit and impact the tropospheric thermal vertical gradient with a possible contribution to heat waves. Evaporation during sea salt formation also contributes to heat exchange over the sea surface. Acting as CCN, pollution aerosols are known to impact cloud properties in the northern hemisphere. In addition, ice nucleation properties of dust particles seem to impact the cirrus cloud cover in the Mediterranean as well as the precipitation from convective events.

Since several years, aerosol-climate interactions are being studied worldwide through regional intensive experimental campaigns, but the Mediterranean region has been relatively neglected. In order to address such questions as well as other large-scale aerosols impacts in the Mediterranean region (e.g. on marine biogeochemistry and air quality), the French atmospheric aerosol and chemistry scientific community has initiated an integrated multiyear project entitled AerMEx (Aerosol Mediterranean Experiment). AerMEx aims at an unprecedented synergetic use of the most recent techniques for aerosol in situ observations, surface-based and space-borne remote sensing, chemistry-transport and climate modelling. Emphasis is put on the western Mediterranean region with the set-up of a new observatory in Corsica and observation periods including research aircrafts. International collaborations will be sought to enhance AerMEx.