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Influence of sea breeze dynamics on aerosols physicochemical properties and toxicity in an industrialized city

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Sea breeze phenomena may strongly influence the air quality and lead to important effects on human health. In order to study the impact of sea breeze dynamics on aerosols properties and toxicity, an Atmospheric Mobile Unit (AMU) has been implemented and deployed during a field campaign performed in summer 2017, at different receptor sites in an industrialized coastal area in Northern France. This system combines in situ aerosol samplers, two scanning lidars (Doppler and elastic) and an Air-Liquid Interface (ALI, Vitrocell®) in vitro cell exposure device.

We will present a typical case of a well-developed North Westerly Sea-Breeze (NWSB) passing through an industrial zone and carrying a polluted air mass towards a residential area. After the Sea-Breeze Front (SBF) passage, the Atmospheric Boundary Layer (ABL) top collapses as the Thermal Internal Boundary Layer (TIBL) develops, associated with an increase of precursor gas and aerosol mass concentration, in addition to a change in the size and nature of the fine particles (PM1, PM 2.5). The meteorological characteristics (wind run and resultant transport distance) of the Sea-Breeze Gravity Current (SBGC) air mass, indicate high recirculation conditions, which induce an increase of the pollutant concentrations. During this sea breeze event, an increase of the oxidative stress and inflammation processes in exposed lung cells versus the unexposed ones, is also noted. Two hours after the SBF passage, the lower troposphere structure changes significantly. The Doppler scanning lidar reveals the intrusion of a North Easterly Sea-Breeze (NESB) gravity current, located just below the NWSB. This double SBGC structure consists in two adjacent gravity currents where the NWSB is superimposed to the NESB. The NESB occurrence, with a short lifetime of about one hour, induces a substantial decrease of aerosol mass concentrations associated with an important increase of the TIBL top, favoring the pollutants dispersion. At the end of the NESB intrusion, the double SBGC vanishes and the NWSB reaches the ground, resulting in a second increase of aerosol mass concentrations.