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Analysis of the diurnal evolution of atmospheric ammonia over the Paris megacity from ground-based and satellite remote sensing

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Ecosystems and human health are directly affected by atmospheric ammonia, by unbalancing the vegetation nutrient cycle and causing respiratory troubles both directly and through the formation of fine particles. In Europe, agricultural practices are the dominant source of atmospheric ammonia. It is released to the atmosphere by volatilization of fertilizer applied to soils and decay of organic matter. Then, it reacts with acids (such as sulphuric, nitric and chlorine acids) or nitrogen oxides (all produced in high concentrations from anthropogenic activities) to produce ammonium aerosols, whose concentrations over Europe and Paris megacity are particularly high during springtime pollution events, as occurred in 2014 and 2015.

Difficulties for measuring ammonia by in situ techniques are induced by its polarity, which causes accumulation in inlets and sampling tubes. Remote sensing is therefore a valuable alternative method to measure ammonia, without direct interaction with the sample. Measurements of ammonia total atmospheric columns using the OASIS observatory are routinely made in the Paris suburbs since 2009 using a medium spectral resolution BRUKER Fourier transform infrared spectrometer. Spectra of radiation emitted by the sun and absorbed by the atmosphere were recorded every 10 minutes, under clear sky conditions, enabling the observation of the diurnal evolution of ammonia concentrations.

Our work provides a new analyse of the diurnal evolution of ammonia over the Paris megacity during springtime pollution events. For this, we use measurements of total atmospheric columns of ammonia derived from the ground-based OASIS observatory for the first time and from satellite approaches, such as that from IASI and other available satellites. Furthermore, this study takes into account the influence of meteorological conditions and atmospheric chemical composition, of gaseous and particulate phases, from surface measurements simultaneously performed at Palaiseau, in the Paris region.