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► **To cite this version:**

Camille Viatte, Nadir Guendouz, Clarisse Dufaux, Arjan Hensen, Daan Swart, et al.. Ammonia in Paris derived from ground-based open-path and satellite observations. EGU General Assembly 2024, Apr 2024, Vienna, Austria. pp. EGU24-8072, 2024, 10.5194/egusphere-egu24-8072 . insu-04517156

HAL Id: insu-04517156

<https://insu.hal.science/insu-04517156v1>

Submitted on 31 May 2024

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EGU24-8072, updated on 31 May 2024

<https://doi.org/10.5194/egusphere-egu24-8072>

EGU General Assembly 2024

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Ammonia in Paris derived from ground-based open-path and satellite observations

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Ammonia (NH₃) is an important air pollutant which, as precursor of fine particulate matter, raises public health issues. This study analyzes 2.5-years of NH₃ observations derived from ground-based (miniDOAS) and satellite (IASI) remote sensing instruments to quantify, for the first time, temporal variabilities (from interannual to diurnal) of NH₃ concentrations in Paris.

The IASI and miniDOAS datasets are found to be in relatively good agreement ($R > 0.70$) when atmospheric NH₃ concentrations are high and driven by regional agricultural activities. Over the investigated period (January 2020 – June 2022), NH₃ average concentrations in Paris measured by the miniDOAS and IASI are 2.23 $\mu\text{g}\cdot\text{m}^{-3}$ and 7.10×10^{15} molecules $\cdot\text{cm}^{-2}$, respectively, which are lower or equivalent to those documented in other urban areas. The seasonal and monthly variabilities of NH₃ concentrations in Paris are driven by sporadic agricultural emissions influenced by meteorological conditions, with NH₃ concentrations in spring up to 2 times higher than in other seasons.

The potential source contribution function (PSCF) reveals that the close (100-200km) east and northeast regions of Paris constitute the most important potential emission source areas of NH₃ in the megacity.

Weekly cycles of NH₃ derived from satellite and ground-based observations show different ammonia sources in Paris. In spring, agriculture has a major influence on ammonia concentrations and, in the other seasons, multi-platform observations suggest that ammonia is also controlled by traffic-related emissions.

In Paris, the diurnal cycle of NH₃ concentrations is very similar to the one of NO₂, with morning enhancements coincident with intensified road traffic. NH₃ evening enhancements synchronous with rush hours are also monitored in winter and fall. NH₃ concentrations measured during the weekends are consistently lower than NH₃ concentrations measured during weekdays in summer

and fall. This is a further evidence of a significant traffic source of NH_3 in Paris.