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Satellite based county- to provincial-level ammonia emissions estimates

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While ammonia (NH₃) at its current levels is known to be a hazard to environmental and human health, the atmospheric budget is still quite uncertain. This can largely be attributed to the short lifetime of ammonia in combination with an overall lack of (dense) in-situ measurement networks. The capability to observe ammonia distributions with satellites has opened new ways to study the atmospheric ammonia budget. Previous studies have demonstrated the capability of current ammonia satellite sensors to resolve emissions from point like sources, biomass burning, and constraining emission sources at a regional level with methods involving the use of air quality models.

In this study, we present the first spatially resolved ammonia emission estimates across the globe using a consistent methodology based solely on ammonia satellite observations from the Cross-track Infrared Sounder (CrIS) instrument and ECMWF ERA5 wind fields. The concept was evaluated for North Western Europe and demonstrated the ability to constrain annual emissions at county- to provincial-levels with most deviations within the bounds found in the error analysis. Furthermore, we show that for some regions the spatial patterns found in the satellite observations are consistent while others do not match the current inventories. Finally, the results indicate that the absolute emission levels tend to be underestimated for parts of the globe.