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Aircraft observations of NO₂ and NH₃ over selected locations in Germany

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Anthropogenic atmospheric emissions of the reactive nitrogen components nitrogen dioxide (NO₂) and ammonia (NH₃) have majorly altered the global nitrogen cycle in the past 100 years, with devastating consequences to biodiversity, soil, water and air quality. Thanks to effective legislation, NO₂ emissions are declining worldwide. Unfortunately, this is not the case for NH₃ for which a recent study reports yearly increases of around 2% in Europe and the U.S. and up to 6% in East Asia.

Both species are currently actively monitored with several satellite sounders, which provide daily global measurements. Yet, the spatial resolution of current sounders is inadequate for resolving the highly heterogenous spatial distributions of both species. This is particularly the case for point source emitters, for which satellites are currently only able to quantify the largest and most isolated ones. To fill the important gap in the monitoring landscape, a satellite called Nitrosat has been proposed in answer to ESA's Earth Explorer call. The satellite would allow making simultaneous measurements of NO₂ and NH₃ at a spatial resolution of 500 meter. In support to the Nitrosat proposal, ESA has funded a project called NITRO-CAM (Nitrogen cycle airborne measurements), which aims at mapping simultaneously NO₂ and NH₃ in the Greater Berlin area using aircraft measurements. It is the results of this campaign that are presented here. These can be seen as proof-of-concept for Nitrosat, but are also interesting in their own right. A larger focus is given to NH₃, for which the presented measurements are the first of their kind.

Campaign flights were performed in the surroundings of Berlin in the autumn of 2020. A follow-up campaign is foreseen in early spring. Measurements are performed with BIRA's UV-VIS spectrometer newly-developed SWING instrument for NO₂ and TELOPS thermal infrared HYPER-CAM for NH₃. Surveying gapless areas of at least 10 by 10 km, the measurements enable capturing the emissions of both point and area sources, and are suitable for degrading at various hypothetical satellite instrument footprints. For NO₂ specifically, Berlin and nearby power plants are targeted, while for NH₃ the Piesteritz fertilizer factory is targeted, as well as rural areas in the surroundings of Berlin.

