

Intercomparison of four airborne imaging DOAS systems for tropospheric NO₂ mapping - First results of the AROMAPEX campaign

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The AROMAPEX campaign took place in Berlin in April, 2016, co-funded by the EU (EUFAR) and ESA, with the primary objective to intercompare experimental airborne atmospheric imagers dedicated to the mapping of the spatial distribution of tropospheric nitrogen dioxide (NO₂). AROMAPEX is also a preparatory step for forthcoming intercomparison/validation campaigns of satellite air quality sensors, such as TROPOMI (TROPOspheric Monitoring Instrument). The instruments were operated from two planes, performing synchronized flights: APEX (VITO/BIRA-IASB) was operated from DLR's DO-228 D-CFFU plane at 6.1 km altitude while AirMAP (IUP Bremen), and the small, lightweight SWING (BIRA-IASB) and Spectrolite (TNO/TU Delft) instruments were operated from the FUB Cessna 207T D-EAFU at 3 km. Two synchronized flights took place on 21 April, 2016, the only cloud-free day during the campaign, in the morning from 09:34 to 12:01 LT and in the afternoon from 14:24 to 16:39 LT.

APEX, AirMAP and SWING have a comparable swath width of 3 km, while Spectrolite has a swath of 450 m due to the fact that the field-of-view had to be reduced from 40° to 8.3° for practical reasons. The spatial resolution is approximately 100 m after spatial aggregation for APEX, AirMAP and Spectrolite (pushbroom scanning), and 300 m for SWING (whiskbroom scanning). The airborne Sunphotometer FUBISS-ASA2 was installed and operated during the ascent and descent of the FUB aircraft to derive aerosol optical depth (AOD). During the overpass of the imagers, simultaneous car mobile-DOAS observations were performed with three systems covering transects from north to south and west to east. The ground-based instrumental set-up was completed by a DOAS instrument, an Aeronet station and a ceilometer installed at the rooftop of FUB, located in the southwest of Berlin. The AROMAPEX experiment builds on the experience gained during the AROMAT campaigns held in September, 2014 and August, 2015 in Romania, and the BUMBA campaigns held in April, 2015 and July, 2016 in Belgium.

We present first results of an intercomparison study of both the NO₂ slant column densities (SCDs) and vertical column densities (VCDs) retrieved from the APEX, AirMAP, SWING and Spectrolite instruments. Two large NO₂ plumes, crossing the city from west to east, were detected by all imaging systems with high consistency. Retrieved NO₂ VCDs range between 1.5 x 10¹⁵ and 2.4 x 10¹⁶ molec cm⁻². For the sake of harmonizing the different data sets, efforts are currently ongoing to agree on a common set of parameter settings, gridding algorithm and AMF LUT in the NO₂ retrieval approach. Despite these efforts, discrepancies will remain due to a combination of (1) instrumental differences, e.g. SNR, spatial and spectral resolution; (2) algorithmic differences, e.g. DOAS fitting, RTM, a priori input; and (3) observation differences, e.g. flight altitude, overpass time and viewing geometry.