German campaign activities for the uncertainty characterization of trace gas products from Sentinel-5p

S5PVT Workshop 13

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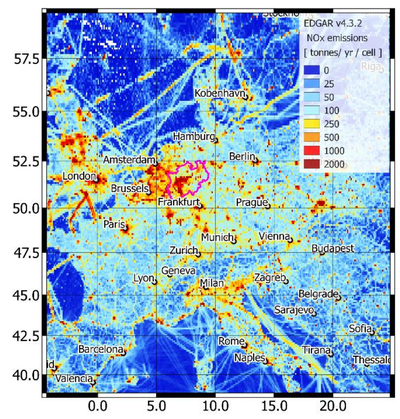
1. Introduction

- Sentinel-5 precursor (S5p) with the TROPOMI payload was launched in October 2017, operational data since July 2018
- Uncertainty characterization of trace gas products important for usage in other products, such as model assimilation, risk assessment etc.
- Uncertainties can be estimated by retrieving the S5p trace gas products from different instruments and observation geometries
- A set of different dedicated field studies are planned in the period 2019 – 2020 in the frame of the ESA funded QA4EO Atmospheric Composition Uncertainty Field Studies project taking place in Belgium, the Netherlands, Romania, France and Germany

2. German campaign & target site

- German activities take place in North Rhine-Westphalia – a pollution hotspot in Europe
  - Urban character & large industrial emitters
- Instrumentation includes:
  - An airborne imaging DOAS instrument
  - Mobile car-DOAS instruments
  - Stationary ground-based instruments
- A first part of the German activities took place from 2019-09-25 – 2019-10-23
  - No flights due to bad weather conditions
- A second phase is planned for 2020



Annual average NO_x emissions from the EDGAR inventory on a 0.1° x 0.1° grid for the year 2012. The administrative boundary of North Rhine Westphalia is shown as a pink outline.

Stationary component

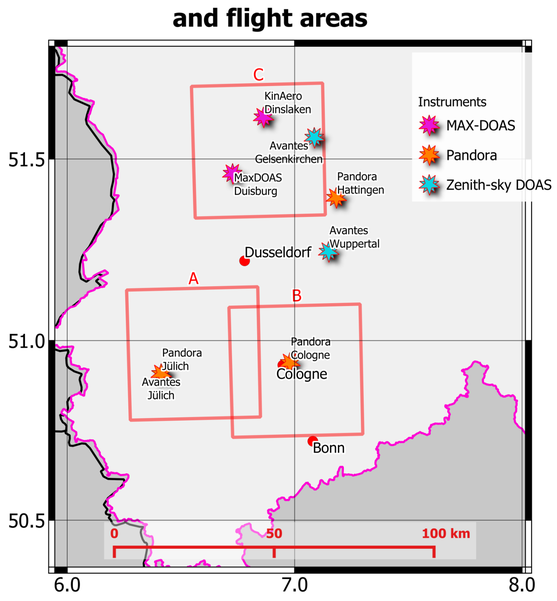
Overview of ground-based campaign instruments

Instrument Ground-based	Type	Location	Owner / Operator
Avantes	Zenith-sky	Gelsenkirchen, Wuppertal Jülich	IUP-Bremen
Pandora	Direct-sun	Hattingen (FUB), Cologne, Jülich (Bremen)	NASA FUB
KinAero	MAX-DOAS	Dinslaken	BIRA
IUP-UB Truck	MAX-DOAS	Duisburg	IUP-Bremen

Pandora system and Avantes zenith-sky system installed in Jülich, next to routinely operated instruments

- Eight ground-based instruments installed at the premises of local cooperators (Jülich Research Center, University of Wuppertal, Environmental Agency of Cologne and private individuals)
- Stationary measurements useful for time series longer than actual campaign period
  - Pandoras stay installed for ~ 6 months
  - Other sites may be reactivated in 2020

Ground-based instrument locations and flight areas



Locations of stationary ground-based instruments and focus areas for mobile measurements

Mobile component

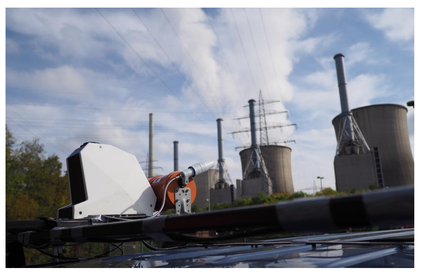
Airborne instruments installed on FUB Cessna

Instrument airborne	Type	Owner / Operator
AirMAP	Imaging-DOAS	IUP-Bremen
Avantes	Nadir-only	IUP-Bremen

AirMAP on FUB Cessna

Mobile car-DOAS instruments

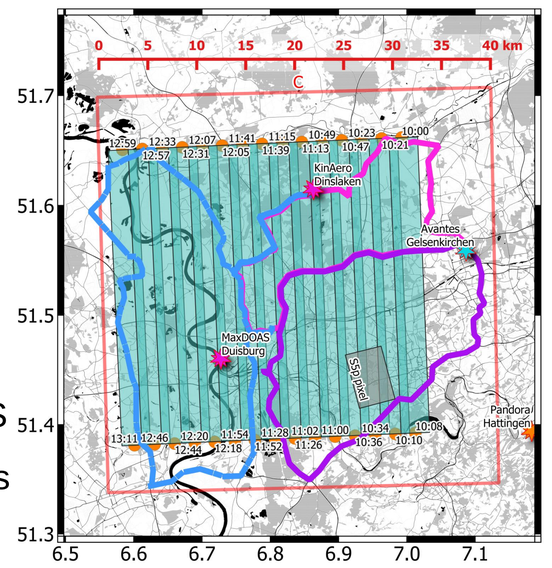
Instrument mobile car	Type	Owner / Operator
IUB-Bremen car-DOAS	Zenith-sky	IUP-Bremen
MPIC car-DOAS	MAX-DOAS	MPIC
BIRA car-DOAS	MAX-DOAS	BIRA



The MPIC mobile car-DOAS system in front of a power plant

- Flight boxes of 40 x 40 km² registered for flight permits
- Shifting of flight pattern within box according to wind direction
- Flight times optimized for S5p overpass
- Mobile car-DOAS measurements within area mapped by aircraft
- Co-locations between different car-DOAS instruments as well as stationary systems

Example of mobile deployments in a focus area



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5. Summary & Outlook

- A campaign to estimate uncertainties in S5p trace gas products was planned and carried out with a duration of 4 weeks
- Due to bad weather and clouds no research flights could be performed
- Car-DOAS measurements could be performed on 3 days in broken cloud conditions
- A second phase of the campaign is currently planned for 2020
- Contacts established for the first phase enabled the setup of a ground-based measurement network. Sites may be reactivated during a second phase.

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