Airborne measurements of different trace gases during the AROMAT-2 campaign with an Avantes spectrometer.

Tim Bösch[1], Andreas Meier[1], Anja Schönhardt[1], Enno Peters[1], Andreas Richter[1], Thomas Ruhtz[2] and John P. Burrows[1]
[1] Institute of Environmental Physics (IUP), University of Bremen, Bremen, Germany
[2] Institute for Space Science, FU Berlin, German
tim.boesch@iup.physik.uni-bremen.de

1. Campaign

- AROMAT-2 (**A**irborne **RO**manian **M**easurements of **A**erosols and **T**race gases)
  is a follow-up campaign of AROMAT-1 in 2014
- Flights with a Cessna (FU Berlin), within the second half of August 2015
- Targets:
  - Turceni power plant (localized plume with high SO_2 & NO_2 emission)
  - Bucharest (Traffic and Industry emissions of several trace gases)

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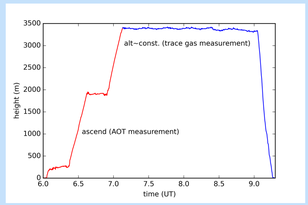
On this poster: VC of NO_2 & HCHO over Bucharest and VC of NO_2 and SO_2 over the Turceni power plant.

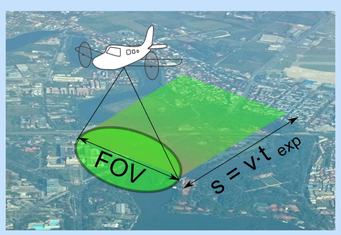
Typical altitude profile for flights



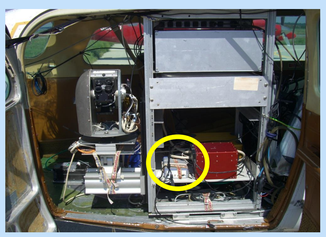
Bucharest flight pattern (afternoon)

2. Instrument

	AvaSpec-ULS2048x64
Optical Bench	Symmetrical Czerny-Turner with 75mm focal length
Wavelength range	287 – 551nm
Resolution	2,3nm
Straylight	< 0.2%
Signal/ Noise	500 : 1
Integration time	2.4ms – 60s
FOV	8.1° → ~ 430m (@ altitude ~ 3km)



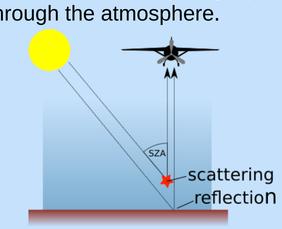
Viewing direction: Nadir



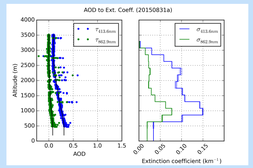
Avantes spectrometer mounted on a Cessna airplane

3. Data preparation

Measured slant columns contain information of multiple light paths through the atmosphere.



1. Aerosol information
(Extinction coeff. via AOT measurem.)



Asumptions: SSA = 0.9
Asymmetry factor = 0.7

2. Albedo information

Comparison of intensities over reference regions (e.g. forest, lake) with simulated intensities.

Intensity calculation with RTM SCIATRAN

3. AMF calculation

With aerosol info (step 1), albedo infos (step 2), and trace gas profile asumptions (500m box)

AMF calculation with RTM SCIATRAN

4. Vertical columns

Slant column with stratospheric trace gas amount (NO_2)

Tropospheric AMF (step 3)

Stratospheric column (B3dCTM)

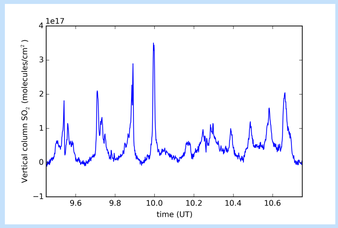
→ **Vertical tropospheric column**

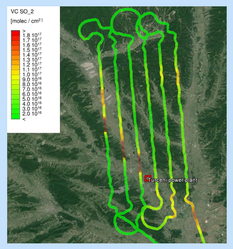
4. Fit settings

Parameter / Molecule	Value	Value	Value	Reference
Species:	**NO_2**	**HCHO**	**SO_2**	
Fit windows	425 – 490 nm	336.5 – 359 nm	307.5 – 328 nm	
Polynomial degree	3	3	4	
Ozone, O_3	223 K	223 K	223 K	Serdyuchenko et al. 2014
Oxygen-dymer, O_4	293 K	293 K	--------	Thalman and Volkamer 2013
Nitrogen dioxide, NO_2	298 K	298 K	298 K	Vandaele et al. 1998
Formaldehyde, HCHO	--------	297 K	--------	Meller, MPI Mainz, 1992
Sulfur dioxide, SO_2	--------	--------	294 K	Vandaele et al. 1994
Water vapor, H_2O	293 K	--------	--------	HITRAN 2012
Ring effect, Const. Offset	Yes, Yes	Yes, Yes	Yes, Yes	Calc. with SCIATRAN (Rozanov et al. 2014)

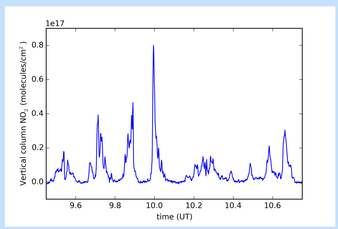
5. Flight above Turceni power plant (28.08.2015)

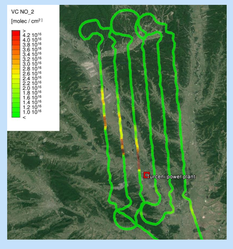
SO_2 t_{int} = 5s





NO_2 t_{int} = 5s

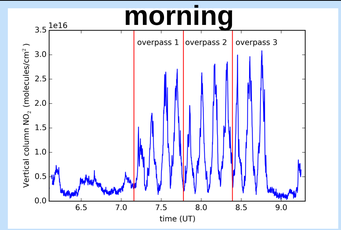


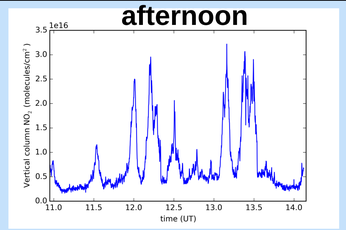


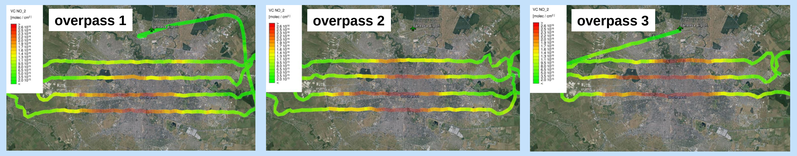
! No aerosol information included in AMF calculation.

6. Flights above Bucharest (31.08.2015)

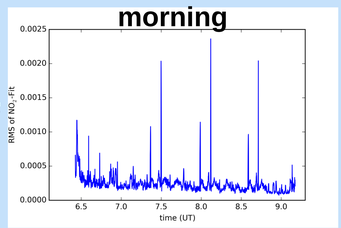
NO_2 t_{int} = 5s





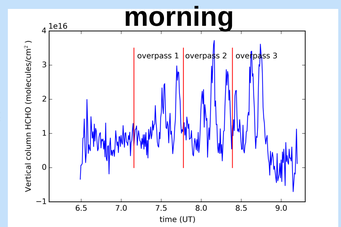


RMS NO_2 t_{int} = 5s

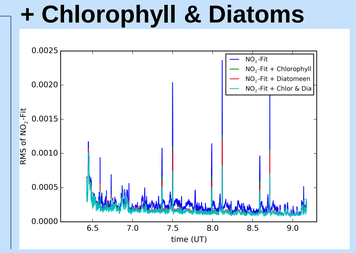


Algae in Lacul Morii Lacul Cernica and other lakes around the city.

HCHO t_{int} = 30s



RMS NO_2 + Chlorophyll & Diatoms



7. Conclusion / Outlook

- We found NO_2 vertical columns up to $3x10^{16}$ molecules/cm^2 over Bucharest with a strong temporal variation (mostly due to changes in trafifc emission)
- HCHO vertical columns match the peaks of nitrogen dioxide and show again strong variation in time and location
- Additional spectral features during the Bucharest flight were found as algae within lakes around the city
- High emissions of **NO_2** and **SO_2** could be found during the flight above the Turceni power plant with a strong lateral movement of the emission plume

8. Acknowledgement & Selected References

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