NORS final meeting
Brussels, 07.11.2014

NORS WP4

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Main Objectives of WP4

"Ensure that the products provided by NORS are tailored so that the data can be used directly as validation data in the GMES atmospheric service (= GAS = MACC-II)."

1. Harmonization of data in terms of format and contents
2. Full characterisation of data with respect to integration volume, resolution, and sensitivity
3. Full description of uncertainties
4. Comparison to satellite data used for assimilation in GAS

Deliverables of WP4

No	Title	Lead	Due
D4.1	Data format definitions	**ULg**	04.2012
D4.2	Data user guide	**BIRA-IASB**	04.2013
D4.3	Error budgets	**KIT**	04.2013
D4.4	Data representativeness	**UBremen**	07.2013
D4.5	NORS data consistency	**BIRA-IASB**	10.2013
D4.6	Methane data assessment	**UBremen**	10.2013
D4.7	Consistency with satellite data	**INTA**	04.2014

D4.1 Data format definitions

Aim:

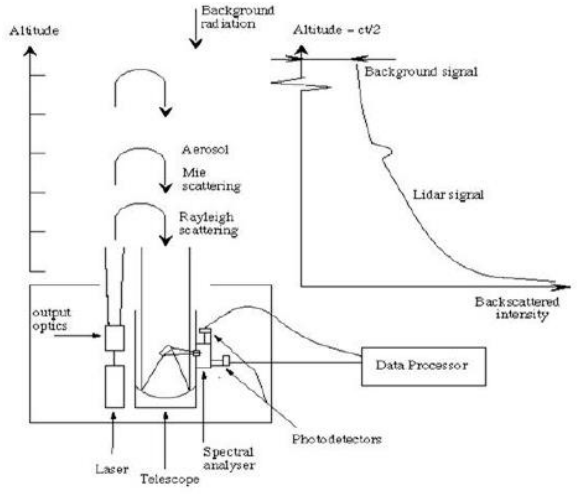
- To ensure that all needed data including meta data on uncertainties and vertical and horizontal resolution is included in the files submitted to NDACC
- To ensure highest possible consistency between different NDACC products
- To ensure compliancy with all relevant data format protocols
- To move to HDF to enable automated use and checking of NDACC files
- To provide thorough testing of the proposed new formats through delivery of data from many stations and instruments and through automated ingestion into the validation server

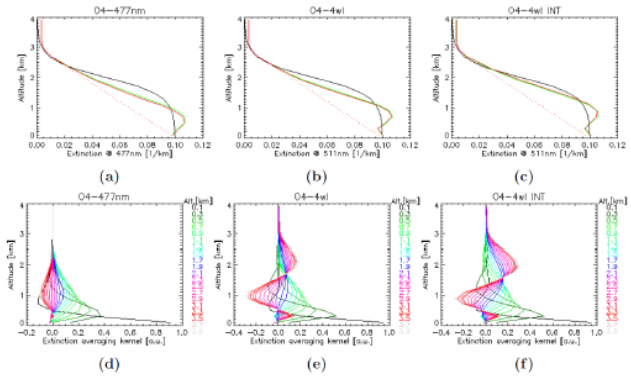
D4.2 Data user guide

Aim:

- To collect all necessary information on the data, but also on the instruments and data analysis in a concise document for all NDACC techniques
- To provide data users with a starting point on learning how the data is created and what needs to be taken into account when using the data

Instrument	Fourier transform infrared spectrometer (Michelson-type interferometer)
Platform	ground-based
Measuring technique	Solar (or lunar) absorption spectrometry
Observation geometry	Looking directly at the center of the sun (or the moon)
Units	Total columns (mol/cm2) and volume mixing ratio per atmospheric layer (vmr) and partial column per atmospheric layer (mol/cm2)
Vertical resolution	A few km to 10 km
Horizontal resolution	Depending on solar zenith angle of measurement and vertical profile of the target species: the horizontal resolution decreases as the SZA increases and if the target gas is located higher in the atmosphere.
Temporal resolution	Depending on the spectral resolution and number of interferometer scans per spectrum (the higher the spectral resolution and the number of scans per spectrum, the worse the temporal resolution)
Vertical range	0-70 km
Horizontal range	about 5x5km at 50 km
Stability/drift	avoided by instrument line shape verifications with a known cell measurement (typically HBr or N2O)
Precision	
Systematic uncertainty	Mainly determined by spectroscopic uncertainties (5 – 20%)
Daytime/ nighttime	Only daytime for solar absorption; nighttime data with lunar absorption are generally less precise
Weather conditions	Stable optical depth is required in FOV; essentially clear sky is required
Interferences/ contamination (payload, spectral)	Minor contaminations due to spectroscopic interferences with other species, like H2O, CH4, …. In general they are minimized.
Bottlenecks, limitations	Large, heavy and expensive instrument; limited or no transportability; open view to the sun is required all day; air-conditioned room is





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D4.3 Error budgets

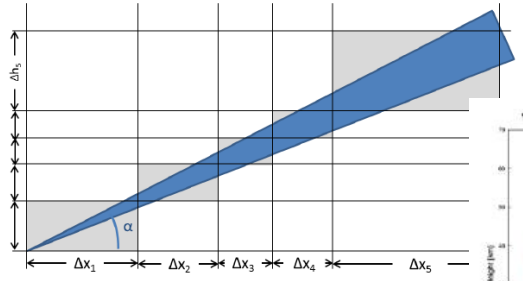
Aim:

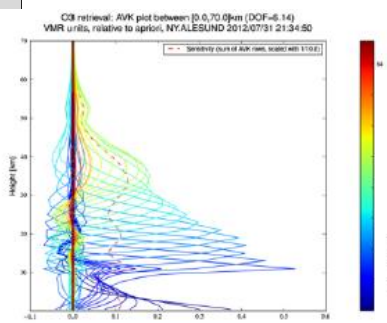
- To provide documentation for the use and interpretation of uncertainties reported in the NORS HDF files
- To provide basic information on the main error sources and their types for all the NDACC instrument types
- To ensure consistent reporting of uncertainties for all NDACC instrument types

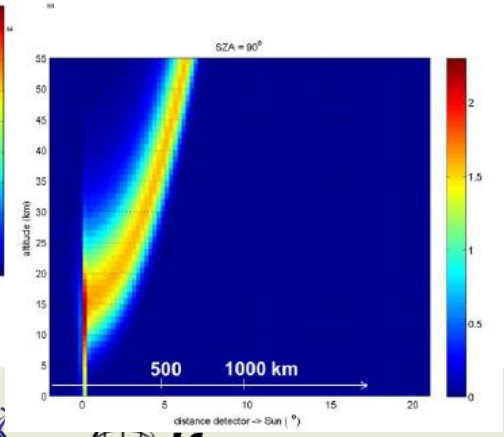
D4.4 Data representativeness

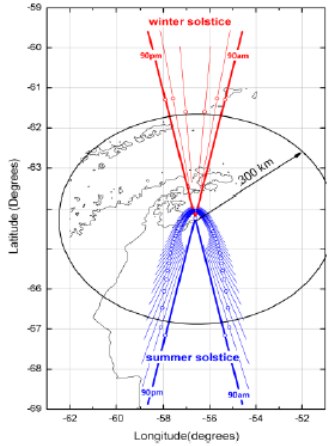
Aim:

- To evaluate and describe the volume for which a NDACC measurement is representative in the vertical as well as in the horizontal direction
- To find simple ways of including this information in the data files
- To find practical ways of making the validation server aware of the spatial smoothing / averaging / displacing needed





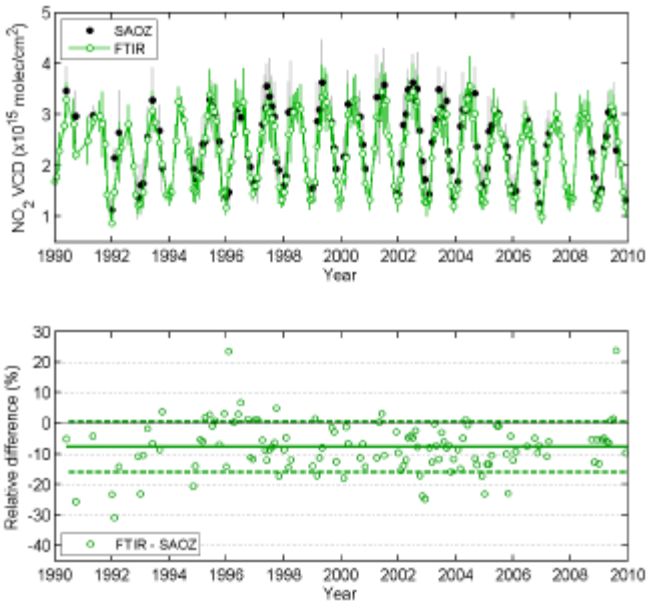


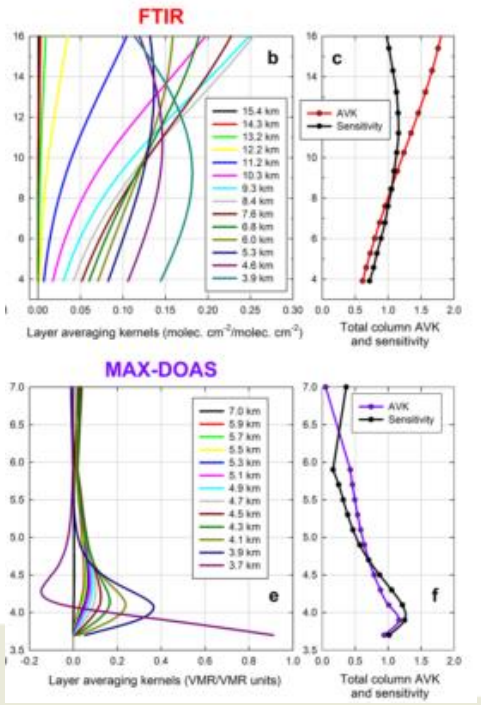


D4.5 NORS data consistency

Aim:

- To evaluate and document the agreement of measurements of the same quantity using different NDACC measurement techniques
- To understand the differences in measurement properties (horizontal and vertical averaging, a priori used, averaging kernels, …) and the resulting differences in measurement results





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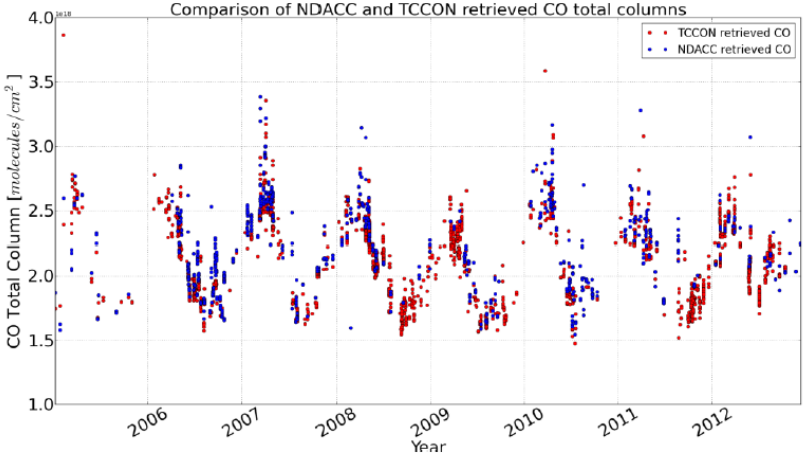
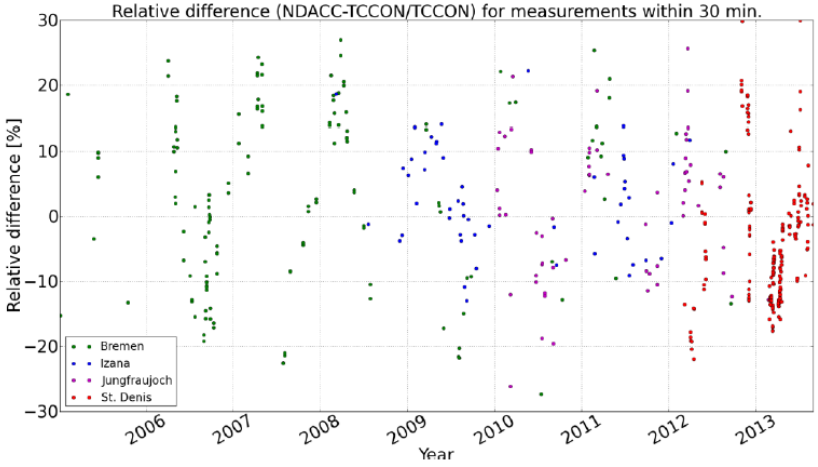
D4.6 CO mid- and near infra-red data assessment

Aim:

- To evaluate and document the consistency and differences between the two CO data products available from FTIR observations (NDACC and TCCON)
- To compare the CO products for several NORS stations





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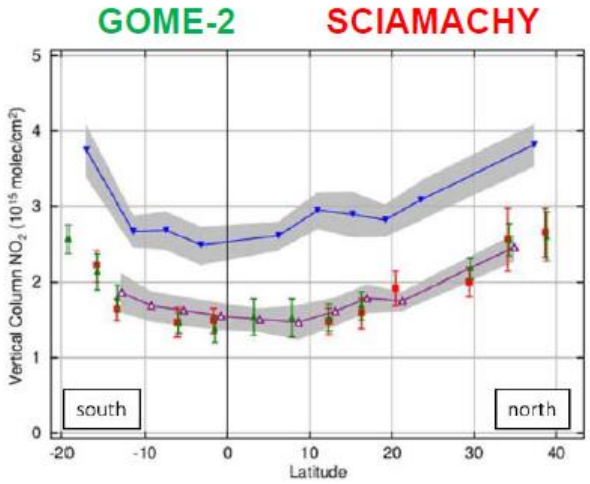
D4.7 Consistency with satellite data

Aim:

- To evaluate the consistency of satellite data products used in the Copernicus system with NDACC / NORS observations
- To collect and evaluate the existing literature on validation of satellite data and to provide an overview on validation approaches taken and uncertainties reported



Station	Location	Institute	Latitude	Longitude	Range of monthly mean difference	Global mean difference	Global standard deviation
Ny-Ålesund	Spitsbergen	IUP/U.Bremen	78.91° N	11.93° E	-5 / +5	-1	4
Thule	Greenland	DMI	76.51° N	68.76° W	+1 / +6	+4	3
Scoresbysund	Greenland	CNRS/DMI	70.48° N	21.97° W	+4 / +5	-2	3
Kiruna	Sweden	NIWA	67.84° N	21.06° E	-5 / +4	0	3
Sodankylä	Finland	CNRS/FMI	67.37° N	26.67° E	-5 / +3	-3	4
Zhigansk	Eastern Siberia	CNRS/CAO	66.72° N	123.40° E	-3 / +1	-1	2
Harestua	Norway	BIRA-IASB	60.22° N	10.75° E	-3 / +9	+2	6
Bremen	Germany	IUP/UBremen	53.11° N	8.86° E	-7 / +9	+3	8
Jungfraujoch	Switzerland	BIRA-IASB	46.55° N	7.98° E	+3 / +10	+5	5
Moshiri	Japan	STEL/U.Tokyo	44.40° N	142.30° E	-3 / +3	-2	4
OHP	France	CNRS/LATMOS	43.94° N	5.71° E	-6 / +1	-3	5
Issyk-Kul	Kyrgyzstan	KSNU	42.63° N	76.98° E	-8 / +2	-1	5
Izaña	Tenerife	INTA	28.29°N	16.49° W	-7 / 0	-3	4
Mauna Loa	Hawaii	NIWA	19.54° N	155.58° W	-10 / -3	-7	3
Mérida	Venezuela	IUP/U.Bremen	8.60° N	71.14° W	-3 / +3	-1	3
Saint Denis	Reunion Isl.	CNRS/U.Reunion	21.07° S	55.48° E	-7 / 0	-3	3
Bauru	Brazil	CNRS/UNESP	22.35° S	49.03° W	-1 / +3	-5	9
Lauder	New Zealand	NIWA	45.03° N	169.68° E	-14 / -3	-7	4
Kerguelen	Indian Ocean	CNRS	49.36° S	70.26° E	-10 / -5	-7	3
Macquarie	Australia	NIWA	54.50° S	158.96° E	-19 / -5	-10	5
Marambio	Antarctica	INTA	64.23° S	56.72° W	-6 / +3	-3	5
Dumont d'Urville	Antarctica	CNRS	66.67° S	140.00° E	-5 / +2	-3	3
Rothera	Antarctica	BAS-NERC	67.57° S	68.13° W	-6 / -1	-4	3
Arrival Heights	Antarctica	NIWA	77.82° S	166.66° E	-5 / +2	-2	2
Belgrano	Antarctica	INTA	77.87° S	34.63° W	-6 / 0	-4	3

What about the science?

Cloud effects:

- Wagner et al., (AMT 2014): MAX-DOAS cloud classification
- Gielen et al., (AMT 2014): MAX-DOAS cloud screening
- Frieß et al., (Friday): MAX-DOAS measurements of cloud height

UV/vis progress:

- Hendrick et al., (Thursday): Progress in retrieval and interpretation
- Gill et al., (Friday): Mountain station measurements in Izana
- Gomez et al., (AMT 2014): in-situ NO2 and O3 from mountain top MAX-DOAS
- Remmers et al. (Friday): MADCAT, azimuthal dependence
- Richter et al. (Friday): Athens MAX-DOAS
- Gielen et al., (Friday): GOME-2 NO2 and HCHO and aerosol in Burundi
- Wagner et al., (Friday): Absolute calibration
- Hendrik et al., (ACP 2014): NO2 and HONO in Beijing

What about the science?

Intercomparison of techniques

- Franco et al., (AMT 2014): HCHO MAX-DOAS and FTIR
- Kiel et al., (Friday): IR and NIR comparison
- Petri et al., (Friday): CO IR and NIR intercomparison

Satellite Validation:

- Peters et al., (ACP: 2012): GOME-2 NO2 and HCHO validation
- Ma et al., (ACP 2013): NO2 validation of OMI and SCIA in China
- Pinardi et al., (Wednesday): GOME-2 NO2 validation
- Blechschmidt et al. (Thursday): NO2 validation for MACC-II

Summary

Mission accomplished:

- NDACC data are now much better accessible, documented, characterized, understood, and homogenized than before NORS
- Progress has been made in error description, in understanding of information content and in evaluating representativeness
- Change to HDF data with full meta data has been demonstrated and tested thoroughly
- A lot of interesting science has been done in the process

Still much to be done:

- Only part of the information content of the measurements is currently used
- Each solution to a problem creates a new question / challenge
- Transition from NDSC to NDACC not yet finished
- NORS was just a demonstration…