Task Team 5 (Ancillary Measurements, TT-AM)
2014 Report

Tony Reale (NOAA)

Martine De Maziere (IASB)

Thierry Leblanc (JPL)

Annual Refresher: TT-AM Terms of Reference

1. *Interface with other expert teams (such as NDACC, TCCON, MWRnet, etc.)*
2. *Evaluate the data products (uncertainty budget etc.) and bring in missing knowledge*
3. *Inventory potential instruments (and interface with other GRUAN-Task Teams if needed)*
4. *Establish campaign rationales for the validation of data from multiple platforms*
5. *Establish a system for the routine collection and display of data from multiple platforms*
6. *Guidance on the type and amount of data and associated metadata needed to be stored from the instruments, as needed*
7. *Draw conclusions on the suitability of the deployed equipment and advise accordingly to GRUAN Task Team on Site Assessment*
8. *Report on all above duties to (WG-GRUAN?)*

Updated (2014) List of TT-AM Members

Name	***Affiliation***	***AM***	***Community***
J. Hannigan	*NCAR*	*FTIR*	*NDACC, TCCON*
M. De Mazière	*IASB/BIRA*	*FTIR*	*NDACC, TCCON*
M. Schneider	*IMK-ASF*	*FTIR*	*NDACC, TCCON*
N. Cimini	*IMAA/CNR*	*Microwave*	*MWRNet*
N. Kämpfer	*Univ. Bern*	*Microwave*	*NDACC, MWRNet*
A. Haefele	*MeteoSwiss*	*Microwave, Lidar*	*NDACC, MWRNet*
A. Apituley	*KNMI*	*Lidar*	*EARLINET*
T. Leblanc	*JPL/Caltech*	*Lidar*	*NDACC, TOLNet*
D. Whiteman	*NASA/GSFC*	*Lidar*	*NDACC*
T. Reale	*NOAA/NESDIS*	*Satellite*	
M. Schröder	*DWD*	*Satellite*	*GEWEX*
D. Tobin	*Univ. Wisconsin*	*Radiance*	
New 2014:			
J. Gero	*Univ. Wisconsin*	*AERI*	*ARM*

Review/Update of TT-AM Action Items

Next 4 slides

Following Task number according to
the GRUAN Master Action Item List available here:

https://docs.google.com/spreadsheet/
ccc?key=0Aq9hAcrcg9GtdEJDZkRWdGtUQXZ1YjZQNjJTLUUyYUE&usp=sharing

Microwave

(contributors: Cimini, Kämpfer, Haefele)

Task (43): Microwave Radiometer Guidelines

Status: *Ongoing*

Progress: *First draft delivered Feb 2013 (V0.4). Other material (MWRnet reports, TOPROF activities) to be compiled. Next draft expected for late 2014.*

Task (44): Inventories of operating Microwave Radiometers (MWRnet)

Status: *Ongoing*

Progress: *Six new unit-members have joined MWRnet since last update*

Russia, Norway, Germany, China, France

Task (45): Validation Strategies and Results (Microwave)

Status: *Ongoing*

Progress: *Validation statistics are available for some GRUAN sites (will be reported on GRUAN MWR guidelines). Other activities are planned within the EU COST Action TOPROF*

- Review of instrument and retrieval accuracy

- Observation minus model background (O-B) statistics

*- First TOPROF WG meeting: 18-20 March 2014 (**next week!**).*

TOPROF

http://www.toprof.imaa.cnr.it/

COST Action ES1303

Towards operational ground based profiling with ceilometers, Doppler lidars and microwave radiometers for improving weather forecasts

Period: Oct. 2013 – Dec. 2017.

WG 3: Microwave radiometers

Co-Chairs: Ulrich Loehnert (DE) and Nico Cimini (IT)

Objectives:

- *pursue the establishment of a sustainable network of MWR*
- *summary of current status of "core" MWR*
- *assessment of procedures for calibration, operation, and maintenance*
- *development of harmonized QC data processing*
- *develop common error characteristics*

GRUAN-related

Lidar

(Contributors: Apituley, Leblanc)

Task 53 (Leblanc): Report on lidar products and uncertainty budgets developed by the ISSI Team on NDACC lidar algorithm

Main Report under revision by ISSI team and 3 AMT papers in preparation (presented Monday)

Task 55 (Apituley): Interface with other expert teams: EARLINET Centralized Algorithm (lidars)

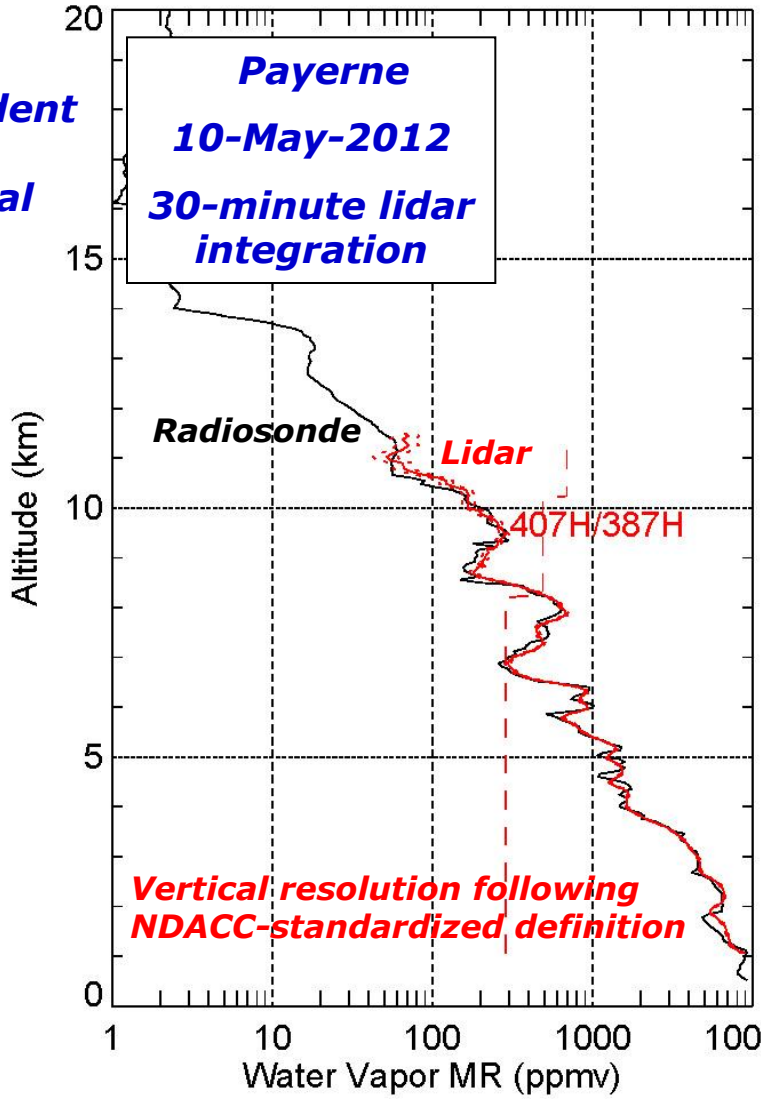
EARLINET single calculus chain (SCC) now upgraded to near operational level.

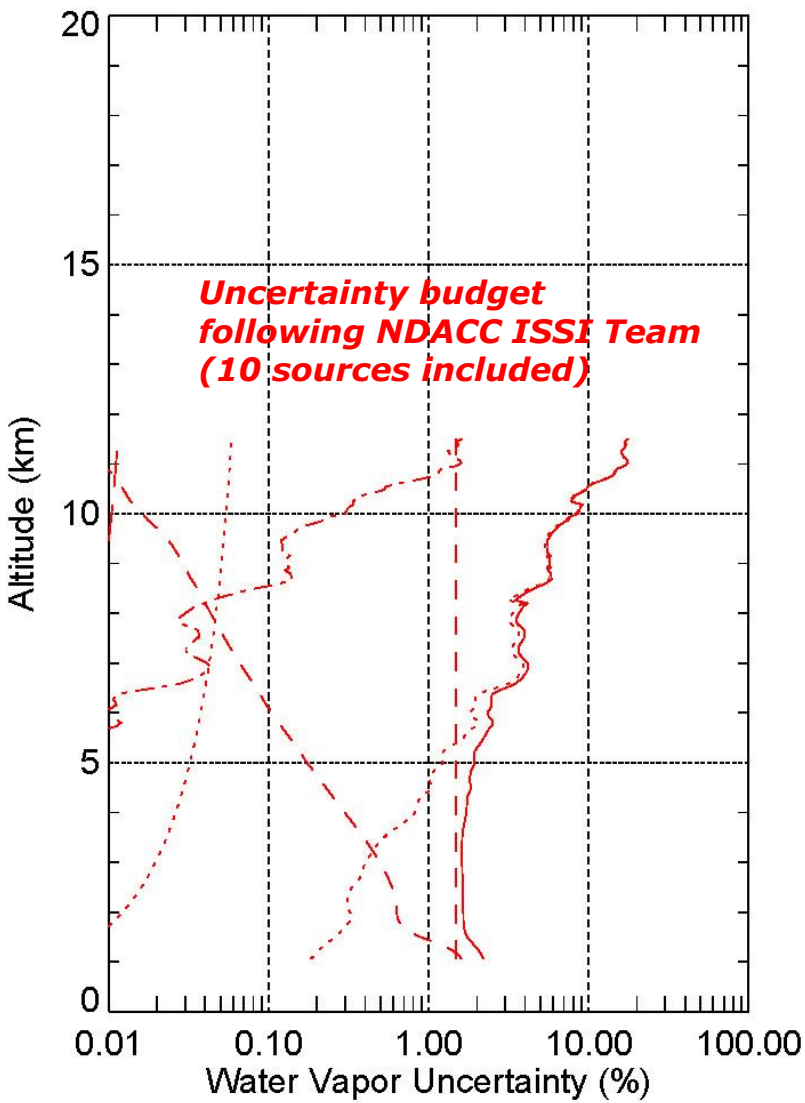
All EARLINET groups can now upload data.

Future interaction between GRUAN and EARLINET expected for GRUAN H2O (and aerosol) lidars (LidarRunClient, GLASS and SCC areas).

Lidar

First Independent (~GRUAN) H2O Retrieval





FTIR

(contributors: Schneider, Hannigan, and De Mazière)

Task 36 (Hannigan): FTIR best measurement practices and suitability of equipment (FTIR Guidelines)

TT5 FTIR experts will work on a first draft following principles applied in Lidar Guidelines doc. De Maziere, Schneider & Hannigan met and created an outline but no further action to date. Action is still in process

Task 39 (Schneider): Examine FTIR and IASI Retrievals and Products long-term consistency (2007-2012)

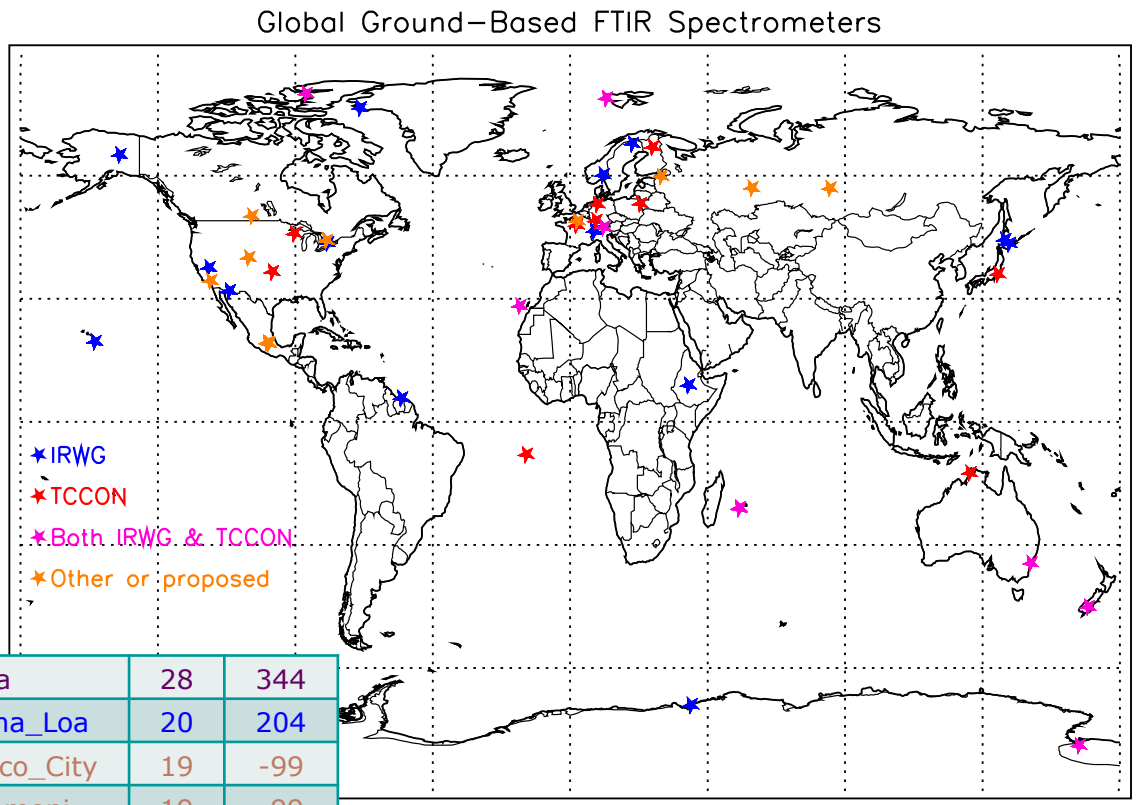
Examine long-term consistency (the whole IASI period: 2007-2012*).*

FTS Error Analysis & Budgeting

Summary

- *First IRWG / NORS Error Analysis Workshop held in Boulder USA February 2012,*
- *Second Error Analysis Workshop associated with IRWG meeting Tsukuba Japan June 2013*
- *Current Activities:*
- *Implementation of derivative calculations (Kb) for many new possible error sources*
- *Ongoing testing by several groups within IRWG*
- *Implementation into dataset operational processing schemes*
- *Upload of this analysis into NDACC archive has begun*
- *Third workshop planned for Bremen Germany after 2014 IRWG in May*

Global FTS Stations



Izana	28	344
Mauna_Loa	20	204
Mexico_City	19	-99
Altzomoni	19	-99
Addis_Ababa	9	39
Paramaribo	6	305
Ascension	-8	-14
Darwin	-12	131
Reu_Maido	-21	55
Reu_St_Denis	-21	55
Wollongong	-34	151
Lauder	-45	170

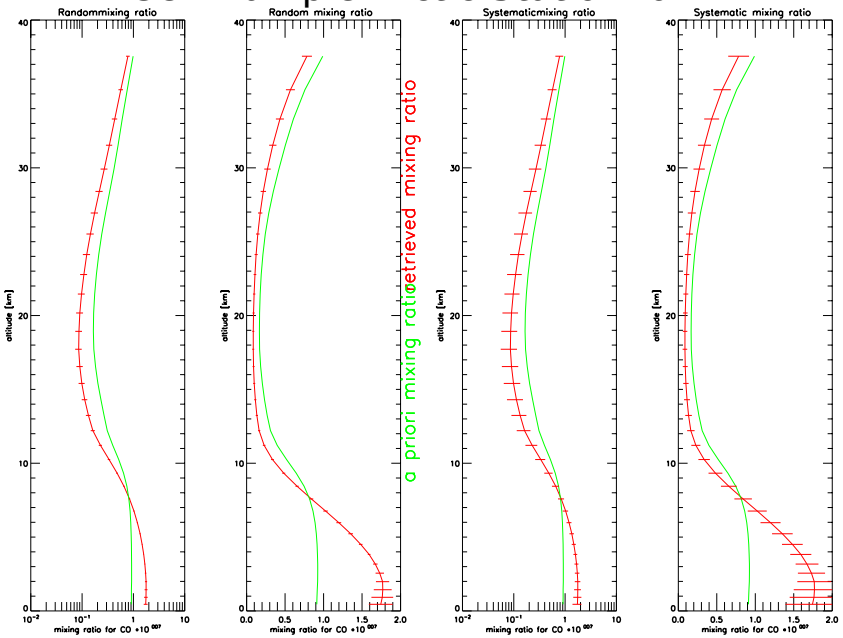
Eureka	80	274
Ny_Alesund	79	12
Thule	77	291
Kiruna	68	20
Sodankyla	67	27
Poker_Flat	65	213

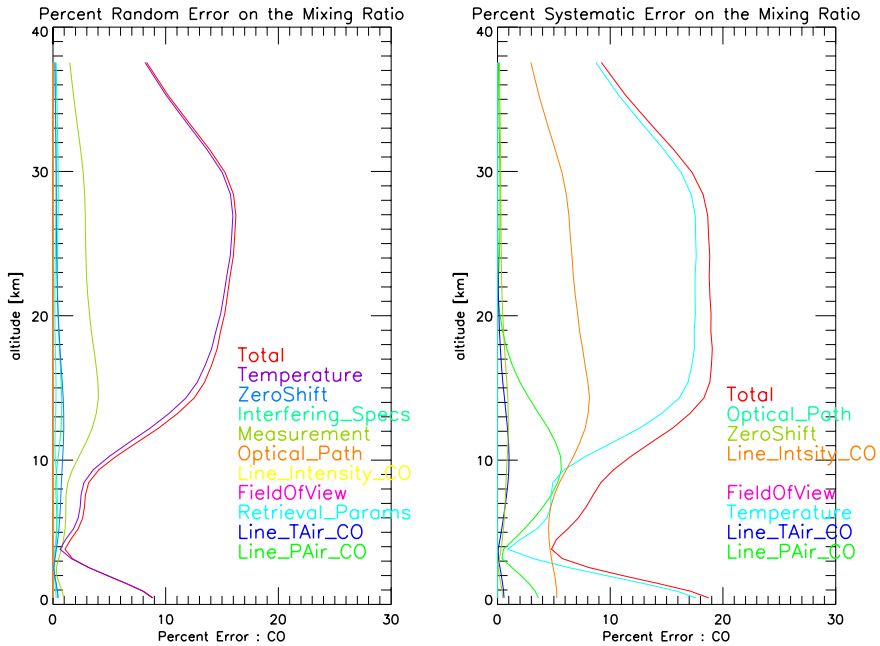
Syowa_Station	-69	40
Arrival_Heights	-79	167

Harestua	60	11
St_Petersburg	60	30
Yekaterinburg	57	60
Tomsk	57	85
Bialystok	53	23
Bremen	53	9
Bratts_Lake	50	-104
Karlsruhe	49	8
Paris	49	2
Orleans	48	2
Garmisch	47	11
Zugspitze	47	11
Jungfraujoch	47	8
Park_Falls	46	270
Moshiri	44	142
Egbert	44	280
Rikubetsu	44	144
Toronto	44	281
Boulder	40	255
Barcroft	38	242
Lamont	37	263
Tsukuba	36	140
Table_Mtn	34	242
Kitt_Peak	32	248

FTS Error Analysis & Budgeting

CO Example Arctic Station76ºN





A priori and retrieved profiles + random uncertainty estimates on the retrieval grid (graduated but spacing ~1km in the troposphere.)

Green A priori Red Retrieved

Two left panels log/linear in volume mixing ratio
Two left panels log/linear in column (molec/cm^2)

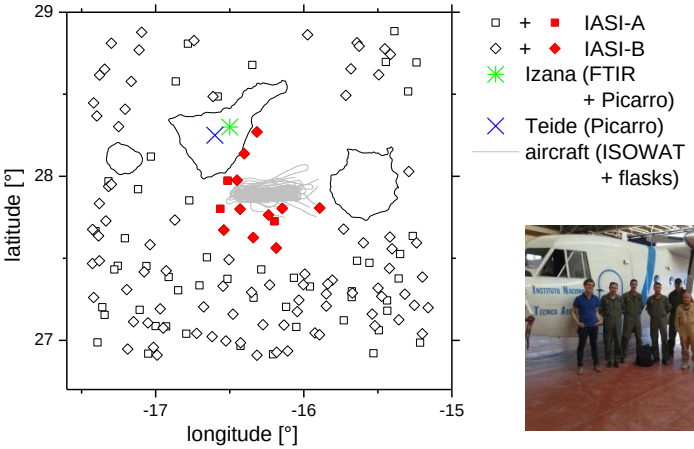
Components of random (left) and systematic (right).

Temperature uncertainty dominates the total uncertainty budget. Use of local daily sondes should improve this.

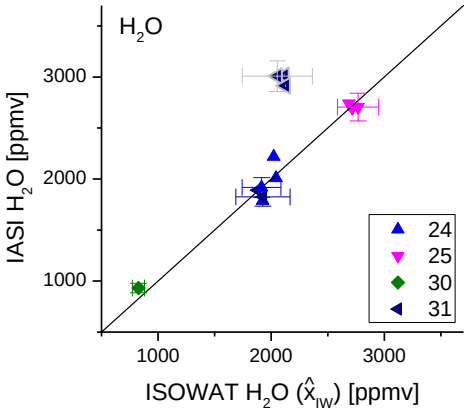
Estimates of the ranD. & sys. parameter uncertainty remains to be harmonized within the network

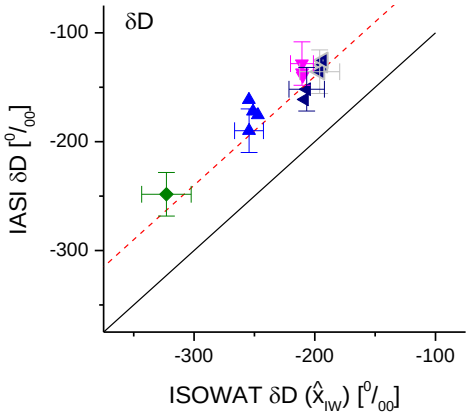
Empirical validation of the MUSICA remote sensing products with respect to in-situ references

Example, MUSICA campaign summer 2013:



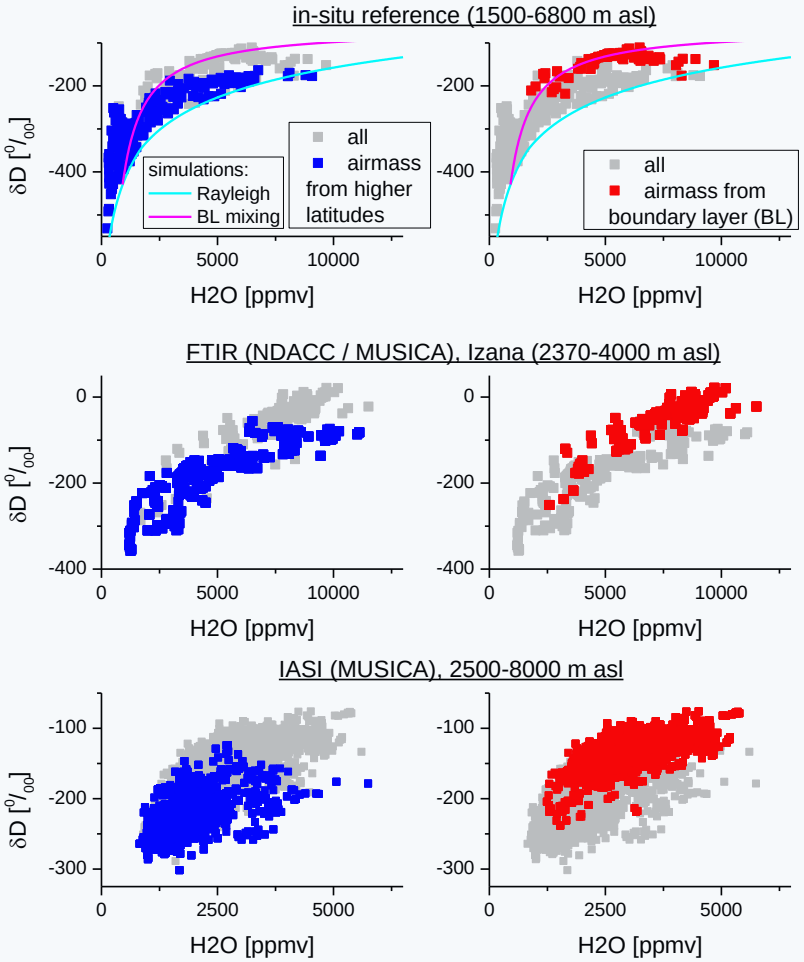
Extensive efforts with different in-situ references: Vaisala RS90, Picarro, ISOWAT, flask sampler, GAW





Schneider et al., submitted to AMT; Gonzalez et al., in preparation; Dyroff et al., in preparation

The isotopologues' complementary value: e.g., investigating the moistening processes of the subtropical FT:



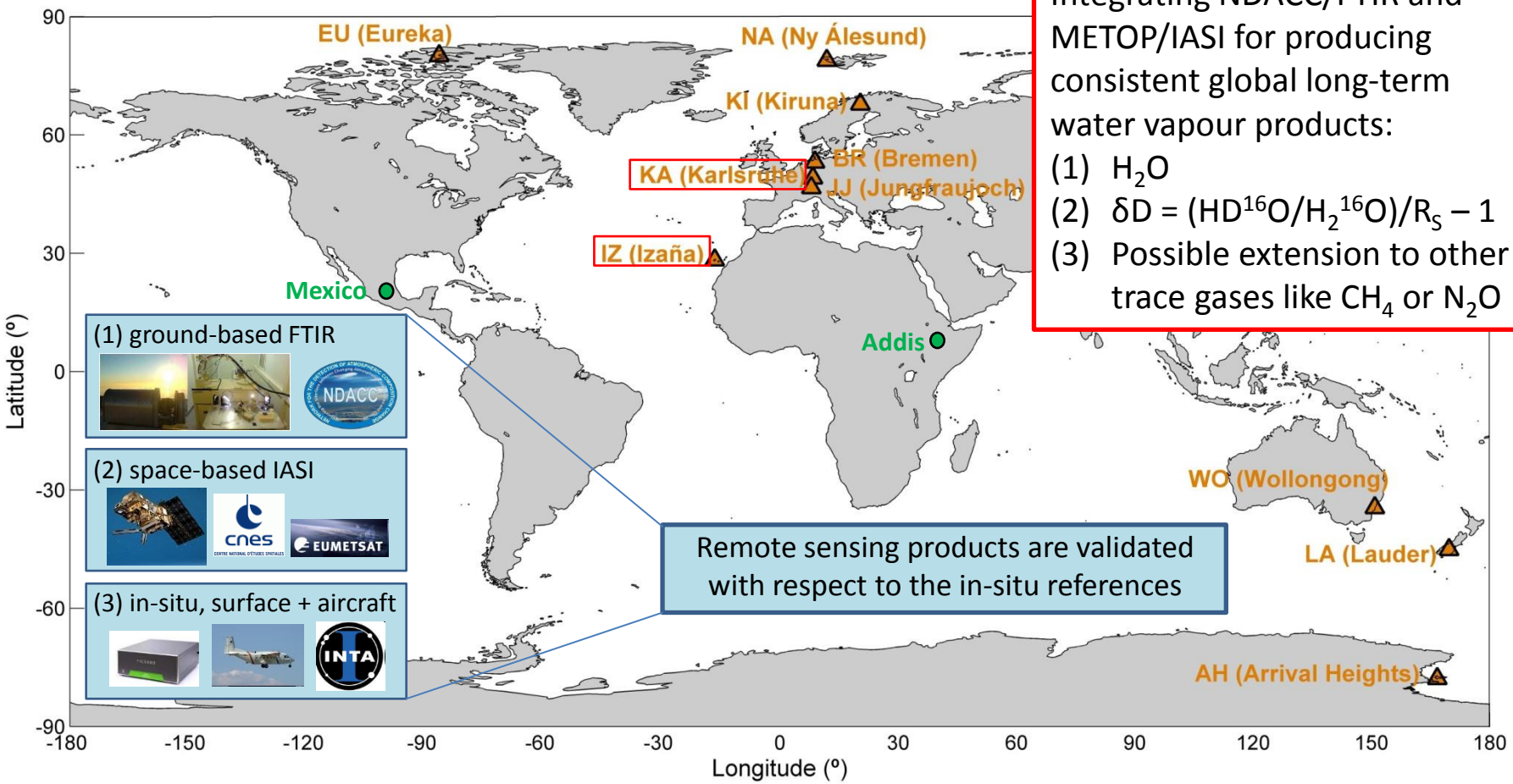
ERC project **MUSICA:** **MU**lti-platform remote **S**ensing of **I**sotopologues for investigating the **C**ycle of **A**tmospheric water

Integrating NDACC/FTIR and METOP/IASI for producing consistent global long-term water vapour products:

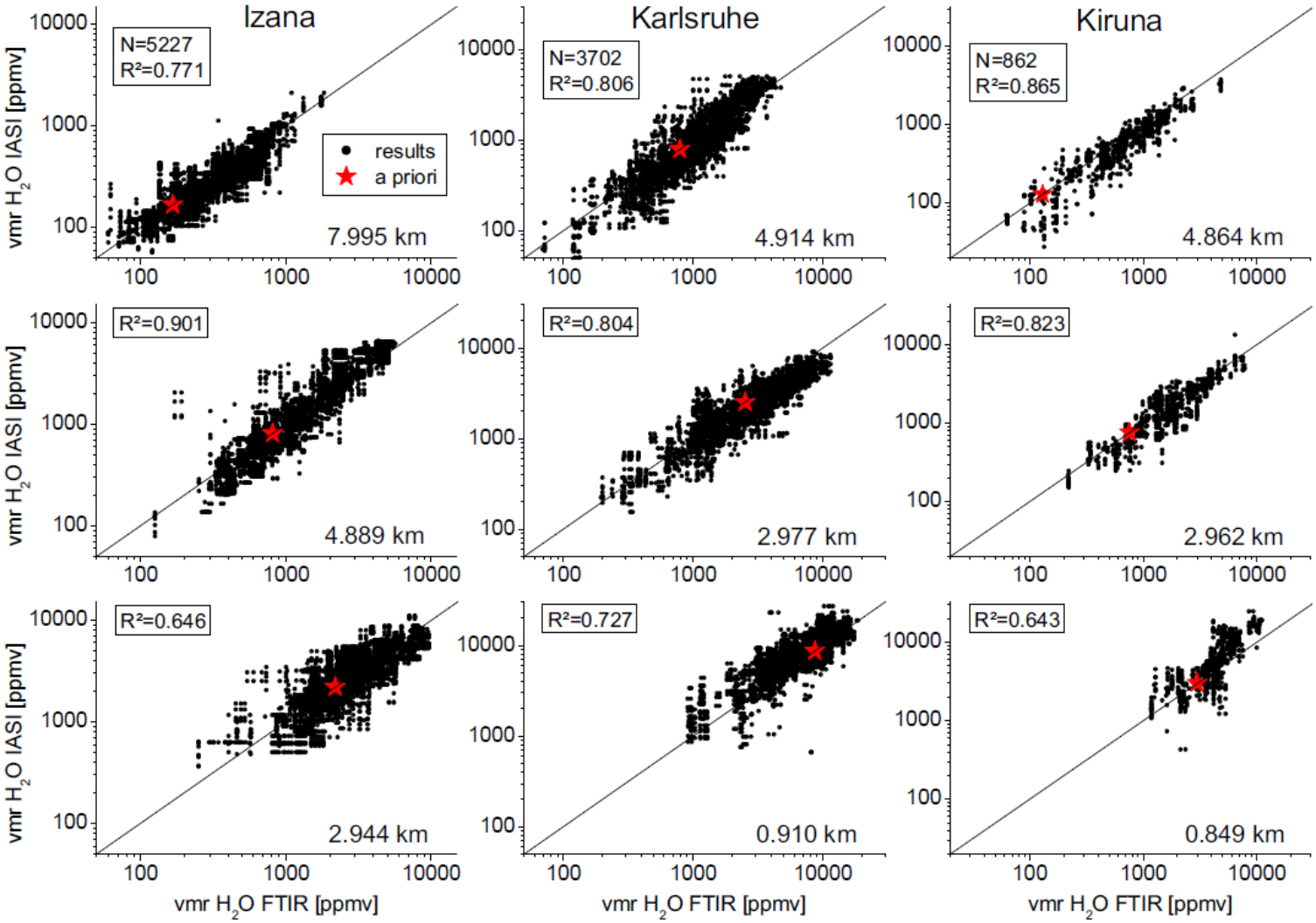
(1) H_2O

(2) $\delta D = (HD^{16}O/H_2{}^{16}O)/R_S - 1$

(3) Possible extension to other trace gases like CH_4 or N_2O



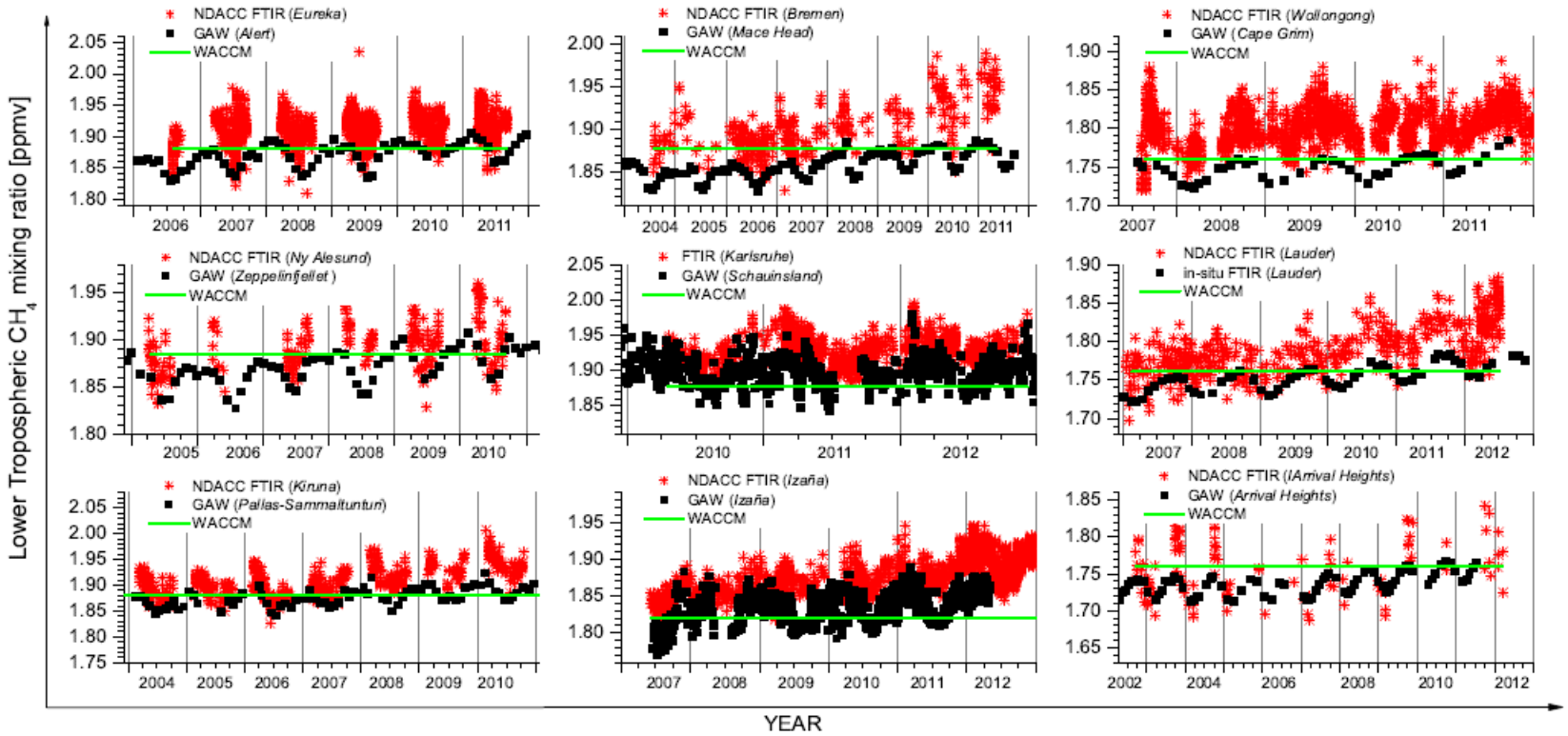
Long-term consistency for MUSICA H_2O profiles from IASI/METOP and NDACC/FTIR



Wiegele et al., submitted to AMT

Possible extension to other trace gases, example NDACC/FTIR CH_4

Extensive long-term comparison of NDACC/FTIR and GAW regional scale lower tropospheric CH_4 data (Sepúlveda et al, AMTD, www.atmos-meas-tech-discuss.net/7/633/2014/):



NORS

NORS : Demonstration Network Of ground-based Remote Sensing Observations (of NDACC) in support of the Copernicus Atmospheric Service (CAS or MACC-II at present)

EU FP7 project, coordinator: M. De Mazière

- **Start**: Nov. 1, 2011
- **Duration**: 33 months, i.e., up to July 2014
- **Objective:**
  - **To perform the required research and developments for optimizing the <u>NDACC</u> data for the purpose of supporting the quality assessments of the CAS**

    ⇒ ***Research part***
  - **To develop and implement a Web-based Validation Server of the MACC-II (CAS) products using the NORS data products**

    ⇒ ***Operational part***

NDACC reference data requirements

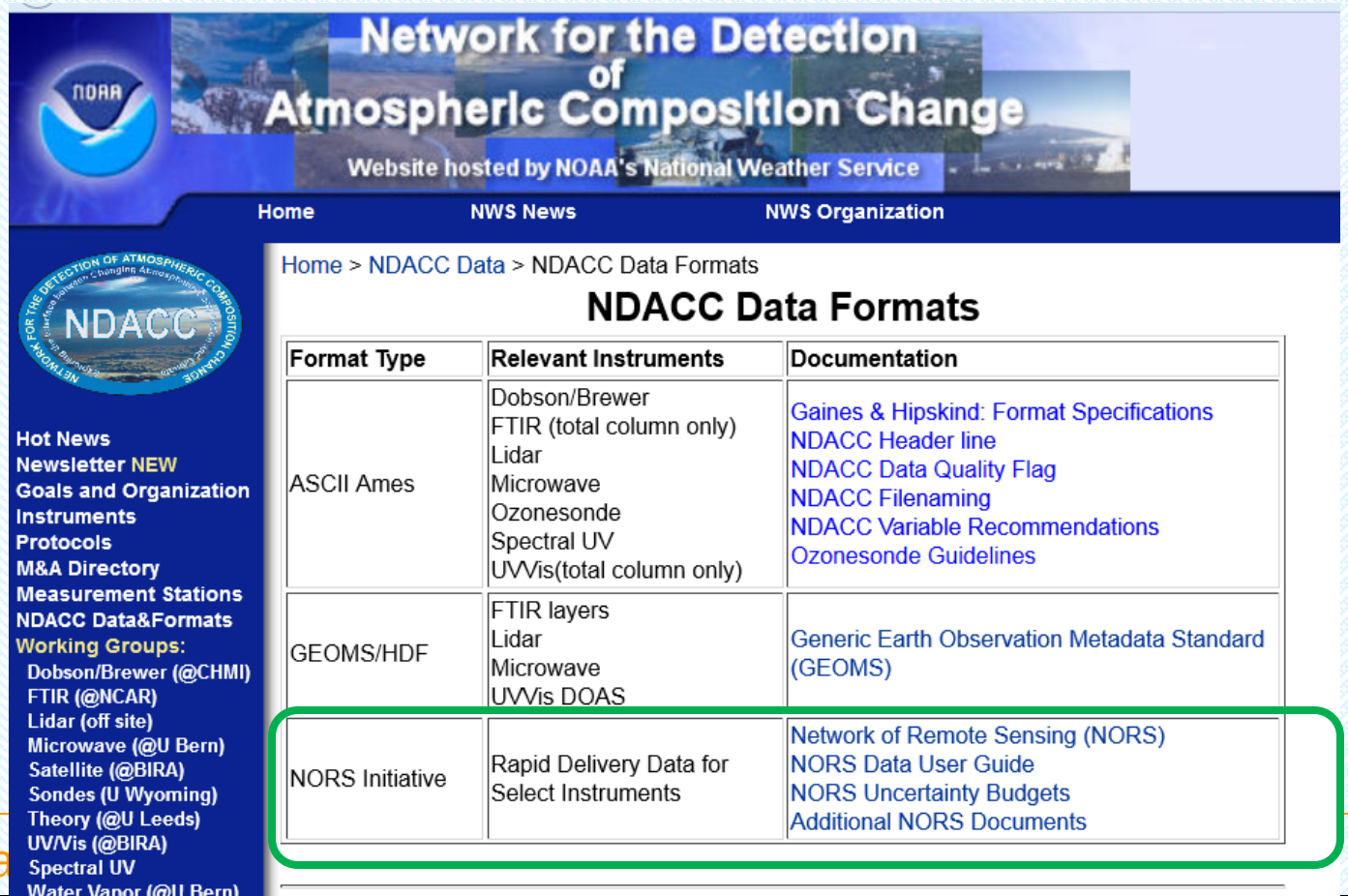
- Ensure long-term quality
  - ⇒ Quality assurance protocols
- Network consistency
- Timely data delivery
- Data documentation
  - Metadata, use guide, documented *uncertainties*

⇒ **NORS advances the NDACC data in this direction**

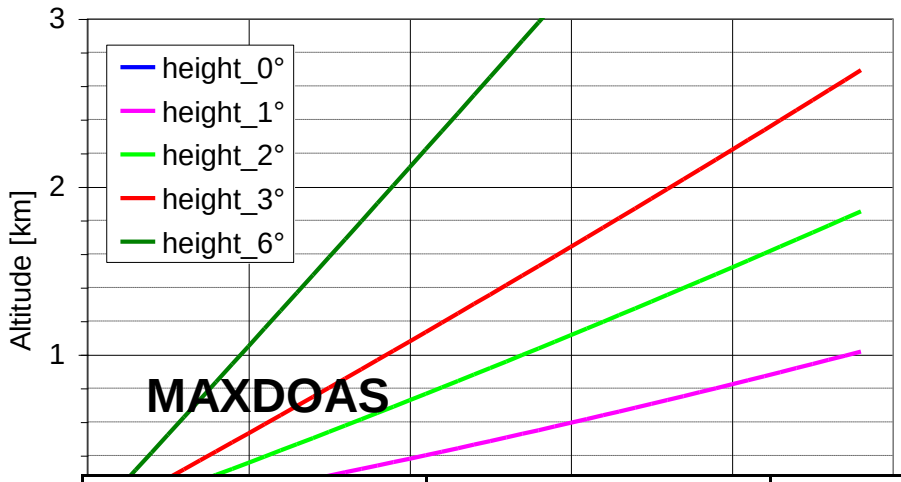
Data Documentation

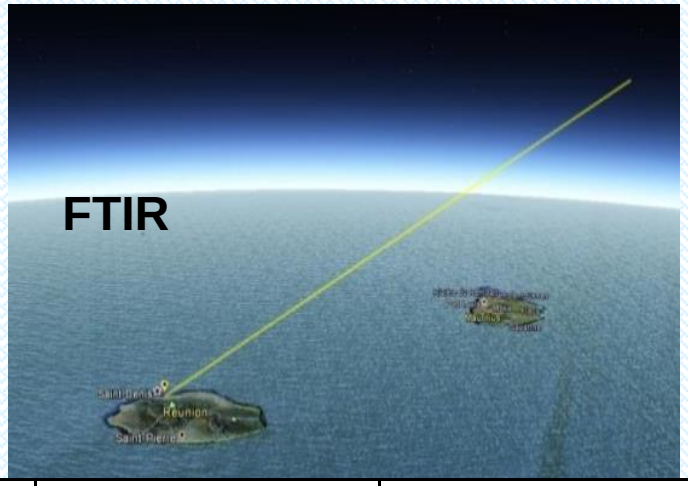
- Data User Guide
- Uncertainties budgets
- Data representativeness

www.ndacc.org & nors.aeronomie.be



Representativeness





Percentage of column	Latitude (°)	Longitude East (°)	Altitude (km)	Distance (km)
0	-20,900	55,480	0,05	0,0
20	-20,906	55,511	1,8	3,3
40	-20,912	55,546	3,8	7,0
60	-20,921	55,596	6,6	12,3
80	-20,934	55,666	10,6	19,7

Table 1. Example of a ray tracing output for an FTIR measurement of CH_4 at St Denis (-20.9°S, 55.5°E), Ile de La Réunion, on 25/1/2011 04:04 UT for a solar zenith angle of 62° and an azimuth angle of 101° measured from N (0°) to E (90°). The Table provides the geographical location of the points along the line of sight corresponding to a percentage of the total CH_4 column.

Operational Part

NORS Validation Server

http://nors-server.aeronomie.be

It takes

HDF data from the NDACC database and

& MACC-II model data from the MARS archive,

⇒ creates **automatic validation reports generation**

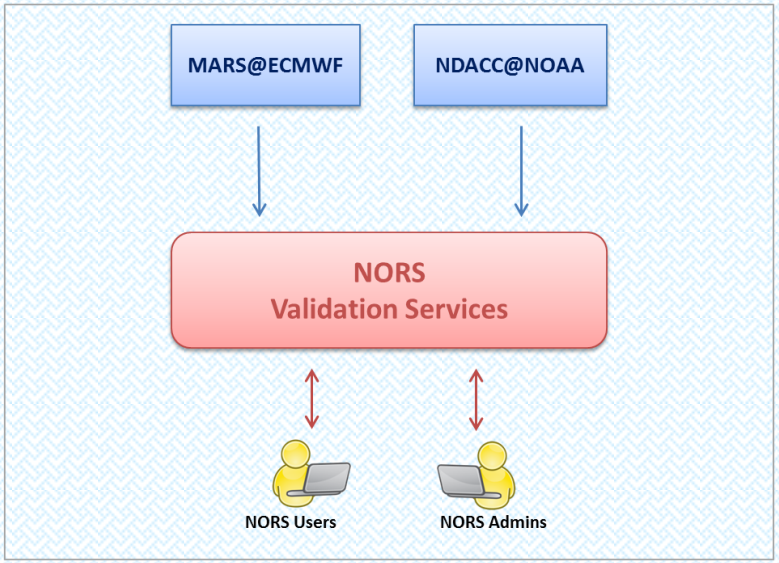
+ on-demand comparisons (other data, other models, other validation parameters, ….) and reports for VIP users

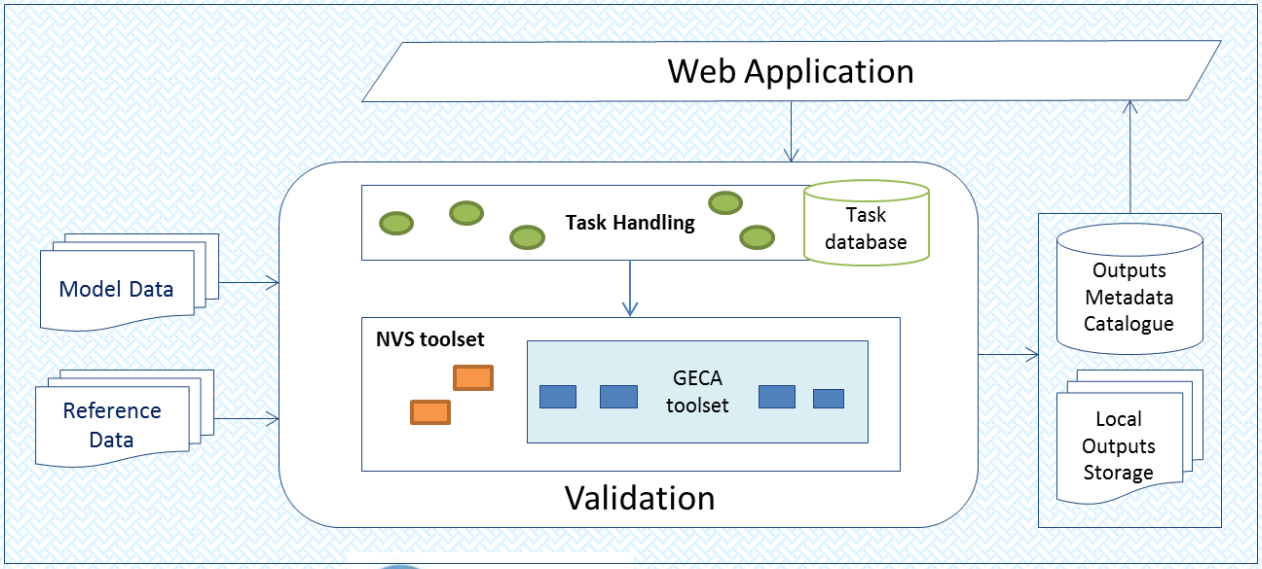
- Publicly available
- linked to the MACC-II Webpages

http://www.copernicusatmosphere.eu/services/aqac/global_verification

⇒ Gives direct feedback to data providers and users

NVS Design


MARS@ECMWF
NDACC@NOAA
NORS
Validation Services
NORS Users
NORS Admins


Web Application
Task Handling
Task database
Model Data
Reference Data
NVS toolset
GECA toolset
Validation
Outputs Metadata Catalogue
Local Outputs Storage

NORS Validation server

Development of generic, advanced and consistent ***intercomparison tools*** for NDACC versus model data

e.g., Accounting for vertical averaging (AVK)

e.g., accounting for data representativeness

e.g., accounting for diurnal variation of strato- NO2

e.g., consistent interpolation and regridding methods

e.g., consistent reporting

e.g., uncertainties included

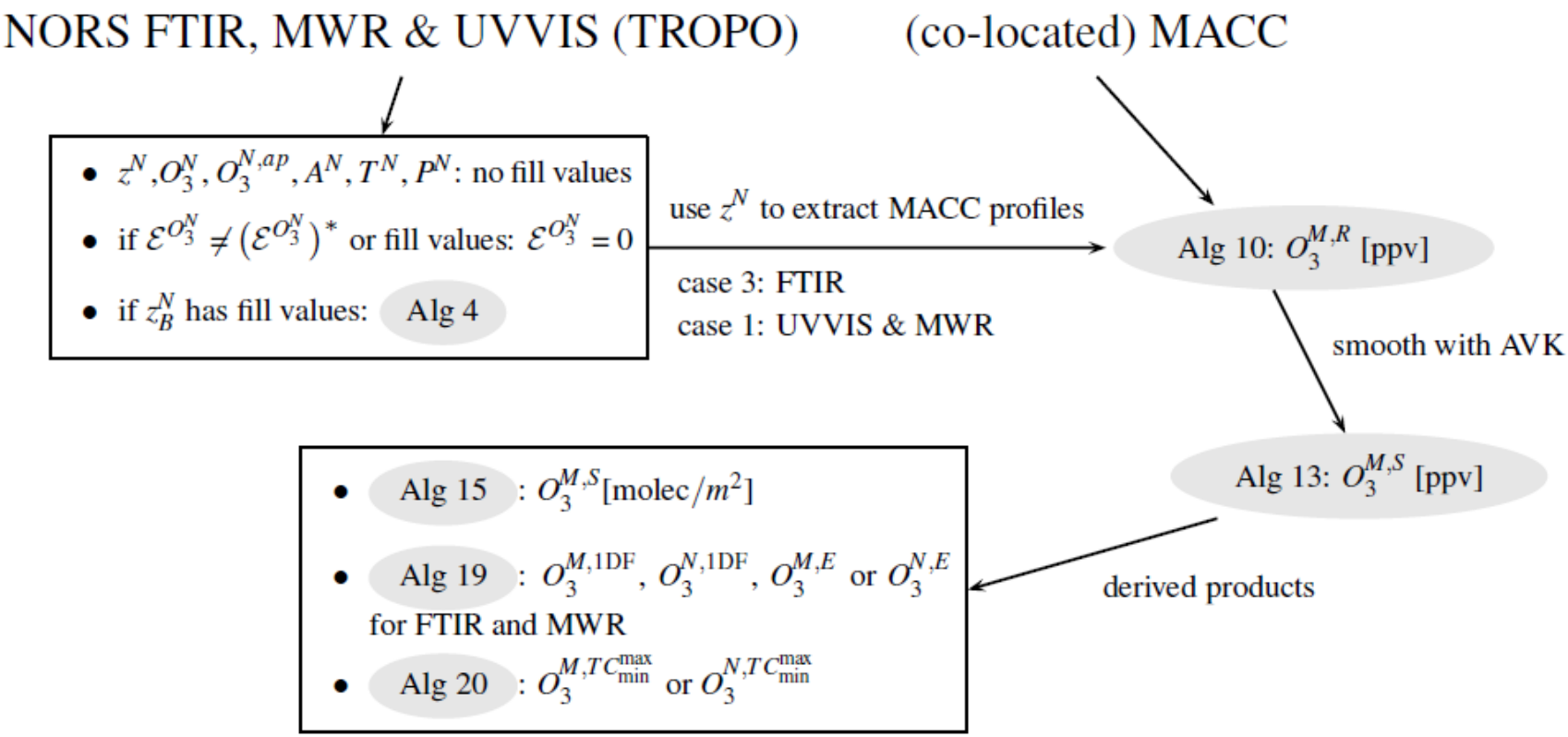
…..

- Described in ***"Description of algorithms for the NORS Validation server"*** *(to be published)*
- Available as python routines
- Implemented in **NORS Validation Server (NVS)**

This development can easily be re-used for development of a generic tool for satellite validation

Example

Validation scheme for NORS products with AVK



RS Validation
VS)

Intercomparison Selection

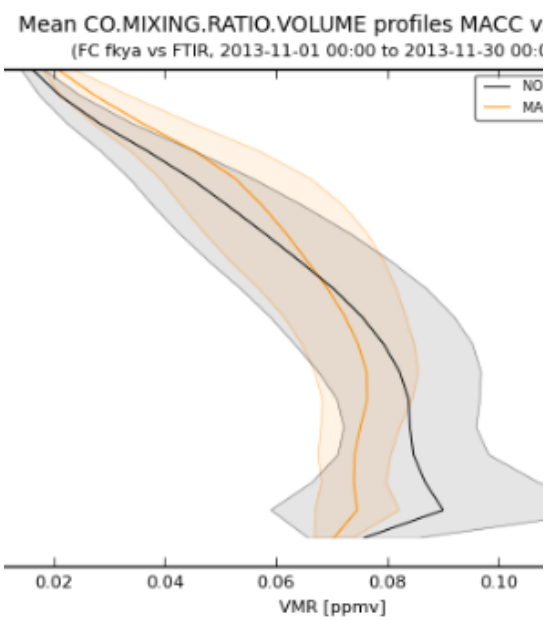
PARAMETER	
AEROSOL	2
CH2O	3
CH4	1
CO	3
NO2	3
O3	13

MODEL TYPE	
fkya	6
fnyp	9
fsd7	10

INSTRUMENT TYPE	
FTIR	10
LIDAR	3
MWR	3
UVVIS.DOAS	5
UVVIS.DOAS.OFFAXIS	2
UVVIS.DOAS.ZENITH	2

oduct files

R, [ALL]@[ALL]: 2013-11



R, KIT@IZANA: 2013-11

opernicus
The European Earth Observation Programme

MACC

Filter Options

LOCATION	
[ALL]	38
BERN	6
EUREKA	6
HAUTE.PROVENCE	6
IZANA	64
JUNGFRAUJOCH	22
LA.REUNION	6
LA.REUNION.MAIDO	9
LAUDER	25
MAUNA.LOA.HI	22
NY.ALESUND	31
XIANGHE	12
ZUGSPITZE	30

AFFILIATION	
[ALL]	16
BIRA.IASB	31
CNRS.LATMOS	6
IUP	31
KIT	64

NORS Validation Server

Currently viewing

REPORT PROPERTIES

Intercomparison	CO-fkya-FTIR
Period	MONTHS
Start	01 Nov 2013
End	30 Nov 2013
Location	LA.REUNION.MAIDO
Affiliation	BIRA.IASB
Generated	19 Dec 2013, 17:28h

Report actions

DOWNLOAD ACTIONS

- Download report as PDF file
- Download report as zip archive

Related reports

OTHER MODELS

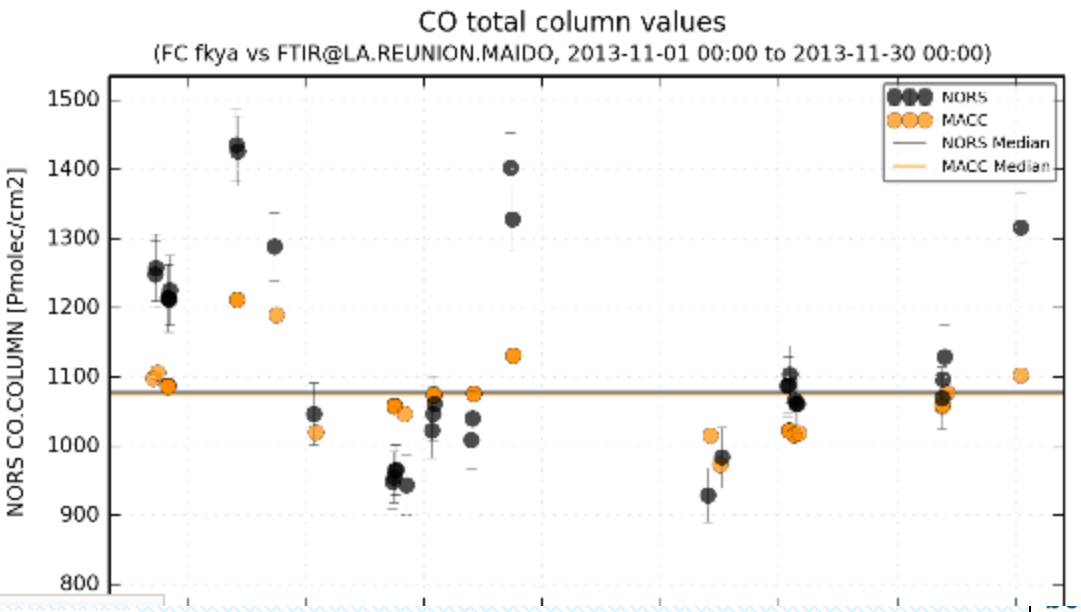
- fsd7

Intercomparison Report

NORS Report: MACC fkya vs NORS FTIR - CO

MACC vs NORS CO - Intercomparison Statistics

f (predicted variable)	MACC CO.COLUMN [Pmolec/cm2]
o (observed variable)	NORS CO.COLUMN [Pmolec/cm2]
# measurements	34
median bias	-46.895
B (mean bias)	-51.262
RMSE (root mean square error)	105.817
MNMB (modified normalized mean bias)	-0.0398903
FGE (fractional gross error)	0.0852018
R (correlation coefficient)	0.802744
RS (Spearman rank correlation coefficient)	0.734759



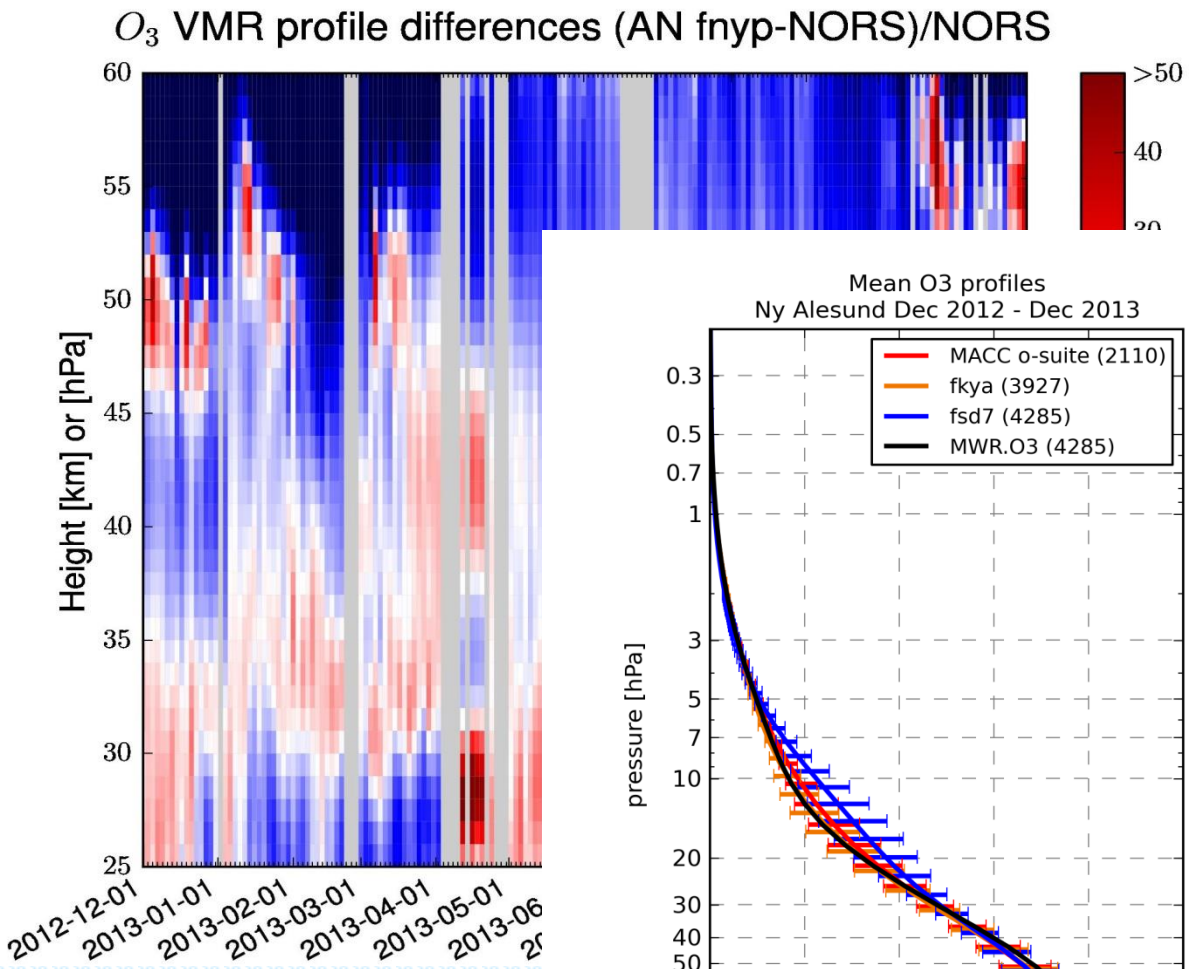
NVS reporting examples

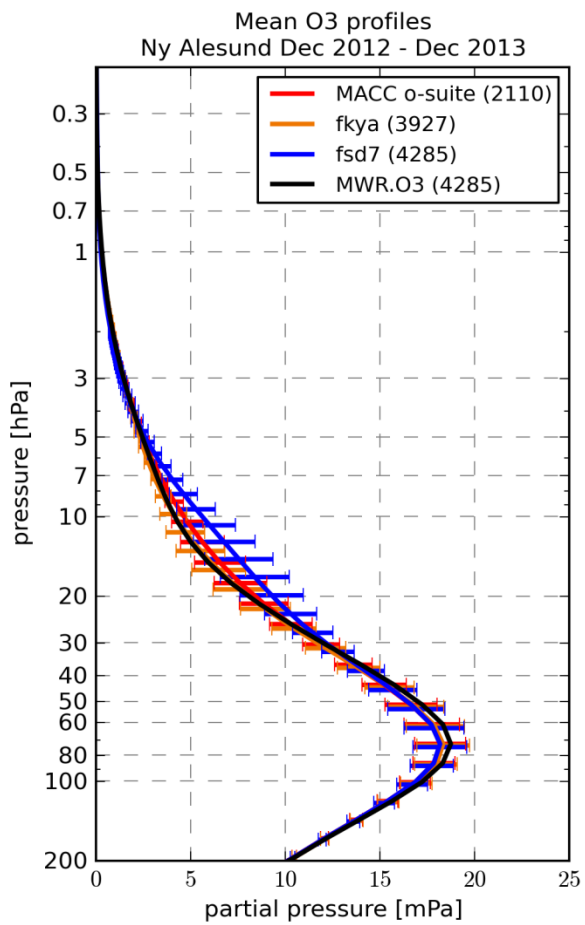
Profile, partial column and total column intercomparisons

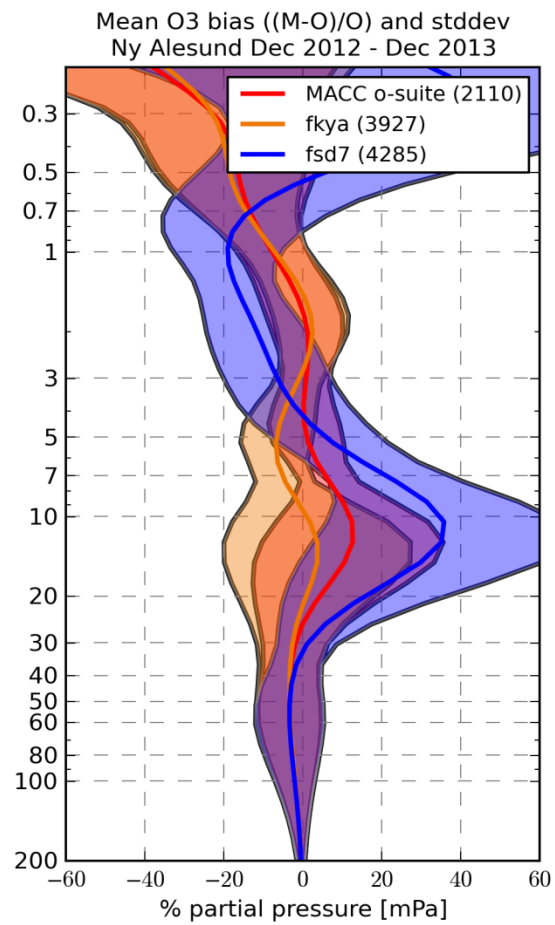
+ report including statistics

+ care for traceability

Example: O_3 from microwave spectrometer versus MACC models above Ny-Alesund

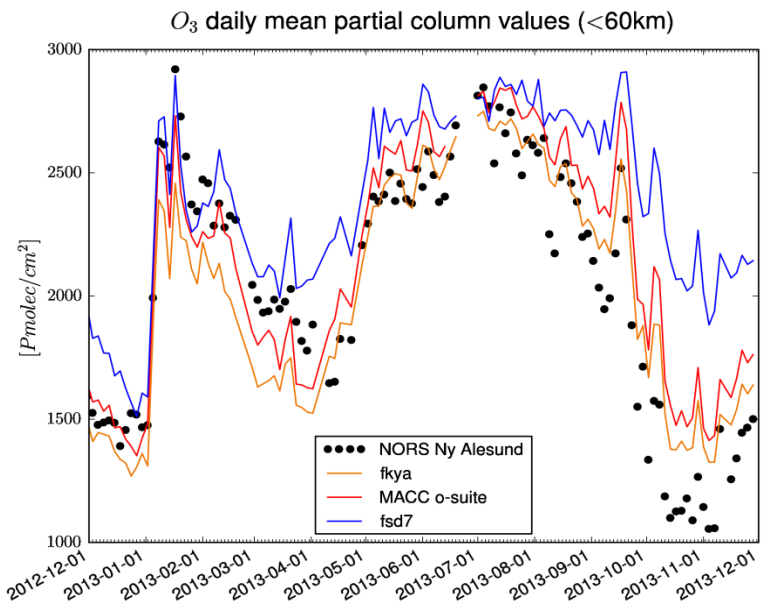


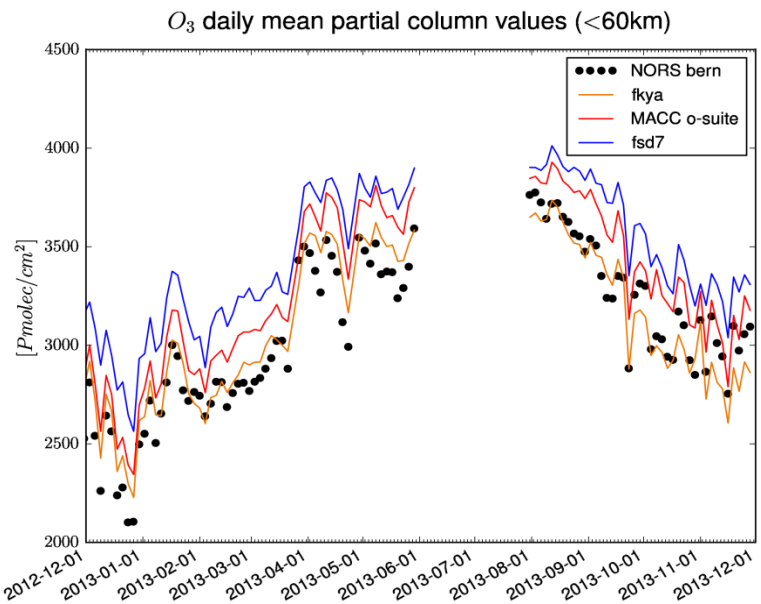


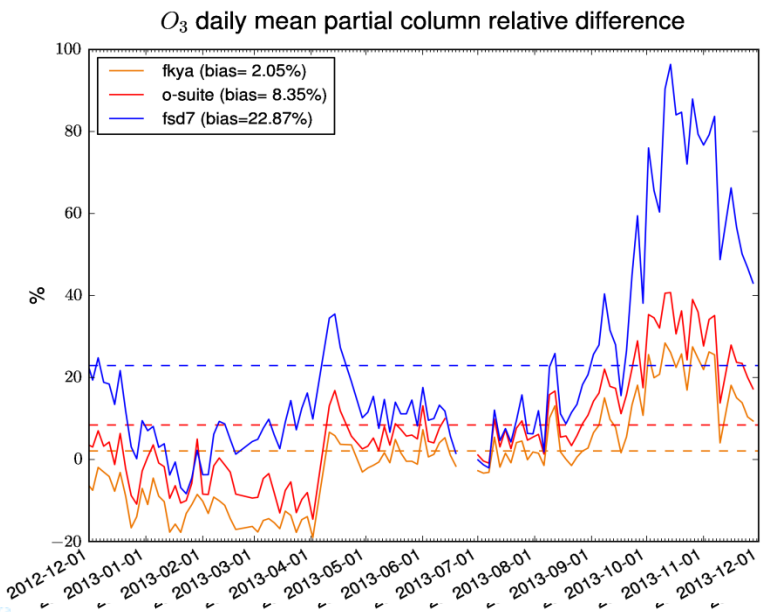


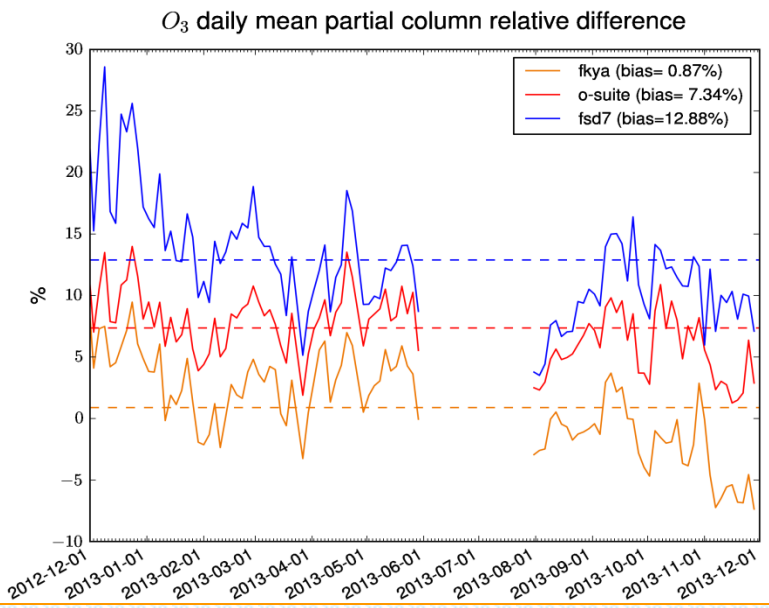
M. De Mazière

NyAlesund & Bern
MW









NORS
Network of Remote Sensing Ground-Based Observations for the GMES Atmospheric Service

- **Acknowledgements:** The NORS project has received funding from the European Community's 7th Framework Programme (2007-2013) under grant agreement 284421

SEVENTH FRAMEWORK PROGRAMME

Copernicus
The European Earth Observation Programme

Thanks to ESA for letting NORS use the ESA-GECA heritage

NVS Design (cont.)

- Server back-end retrieves model data from MACC, NORS data from NDACC; extracts and maintains metadata catalog
- Arrival of new products triggers incremental validation process that generates database of intermediate results and outputs
- Core validation chain algorithms built on top of an expanded GECA intercomparison set of command-line tools
  - Includes tools for NO_2 diurnal correction (under development) and effective airmass calculations (already available for FTIR observations)
  - And others in future….
- Server provides web application front-end that supports all use cases: user can browse outputs, generate default reports, request custom reports

AERI

Task 60 (FTIR reps.): Suitability of Equipment: AERI as a potential GRUAN FTIR instrument (FTIR)

- *Successful contacts with J. Gero in 2013*
- *TT-AM members recommend AERI representative to be added to TT-AM,*
- *J. Gero accepted invitation and will coordinate current AERI operations, and formulate reasonable plans for inclusion into GRUAN*

Conclusion (Ground-based)

GRUAN Lidar, Microwave and FTIR Products are slowly, but surely coming together

- *2014 should see the completion of GRUAN Lidar , GRUAN Microwave, and GRUAN FTIR Guides*
- *Version 1 "full scale" GRUAN Lidar Data Stream should be ready by end of 2014*
- *We are hoping that this will be followed by a "full scale" GRUAN FTIR Data Stream by end of 2015*