How NORS is enhancing the value of NDACC, especially for validation purposes.

De Mazière Martine,
on behalf of NORS consortium

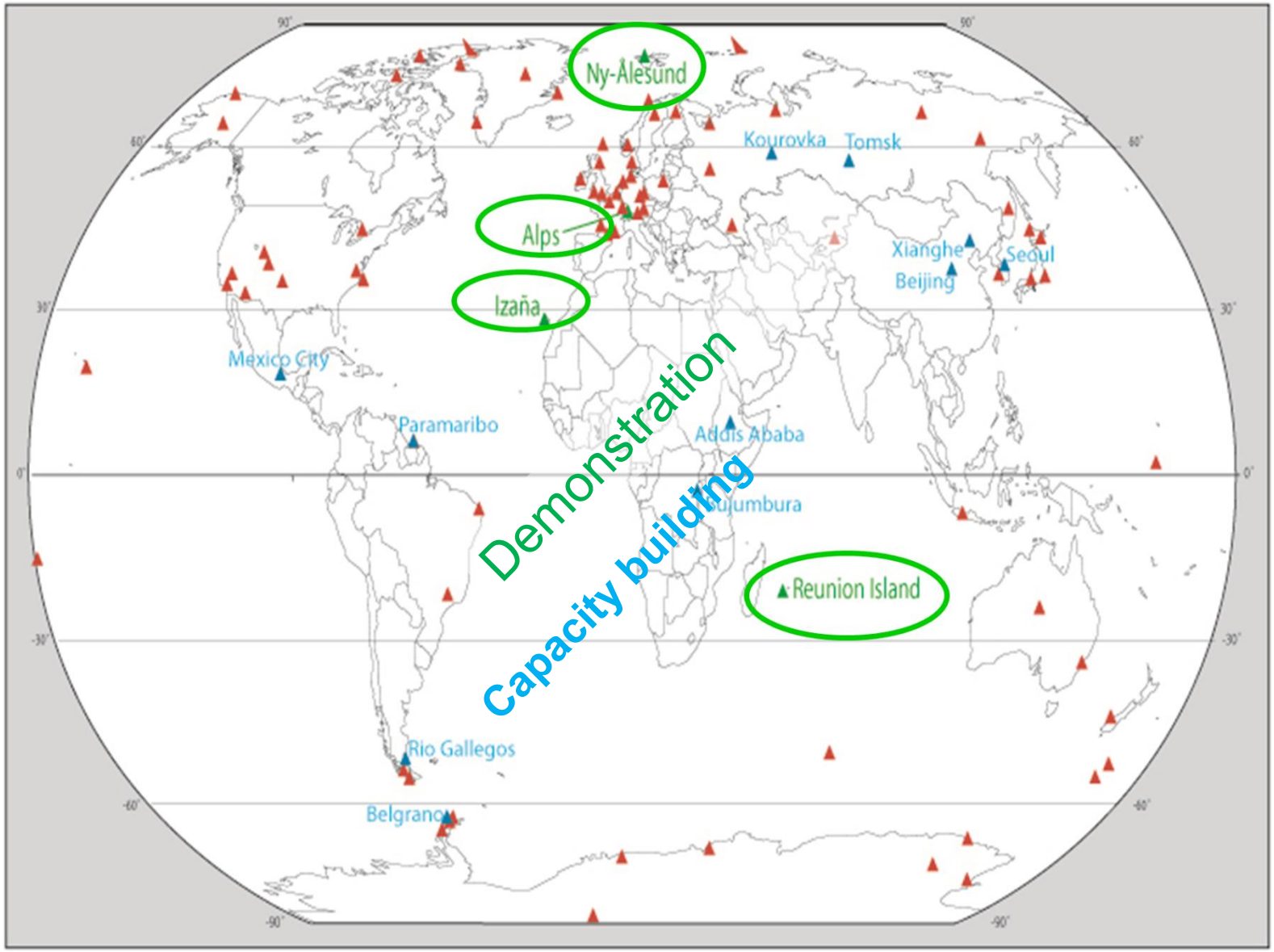
Partner	Participant organisation name / Short name in the proposal	Country
1	Belgian Institute for Space Aeronomy	BE
2	Eidgenoessische Materialpruefungs- und Forschungsanstalt	CH
3	Instituto Nacional de Tecnica Aeroespacial	ES
4	Universitaet Bern	CH
5	Karlsruher Institut fuer Technologie	DE
6	Centre National de La Recherche Scientifique	FR
7	Universitaet Bremen	DE
8	Université de Liège	BE
9	Max Planck Gesellschaft zur Foerderung der Wissenschaften	DE
10	Ruprecht-Karls-Universitaet Heidelberg	DE
11	Science and Technology B.V.	NL

Reminder about NORS

- **EU FP7 project**
- **Start**: Nov. 1, 2011
- **Duration**: 33 months, i;e., up to July 2014 (+ extension?)
- **Objective:**
  - **To perform the required research and developments for optimizing the NDACC data for the purpose of supporting the quality assessments of the Copernicus Atmospheric Service (CAS) i.e., MACC-II for now**

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

    ⇒ ***Operational part***



- Operational NDACC stations
- NDACC stations selected as pilot stations in NORS
- Stations to be developed in NORS to potentially become NDACC stations

NORS data products & techniques

- Target NORS data products
  - tropospheric and stratospheric ozone columns and vertical profiles up to 70 km altitude
  - tropospheric and stratospheric NO_2 columns and profiles
  - lower tropospheric profiles of NO_2, HCHO, aerosol extinction
  - tropospheric and stratospheric columns of CO
  - tropospheric and stratospheric columns of CH_4

- 4 NDACC observation techniques + in-situ surface monitoring:

  Lidar, MicroWave, FTIR, UV-VIS DOAS

  + in-situ surface monitoring

Research (1)

- Development of a methodology for integrating ground-based data sources to provide consistent ozone vertical distribution time series as well as tropospheric and stratospheric ozone columns
- integration of surface in-situ, gb remote-sensing and satellite data (lead by EMPA)

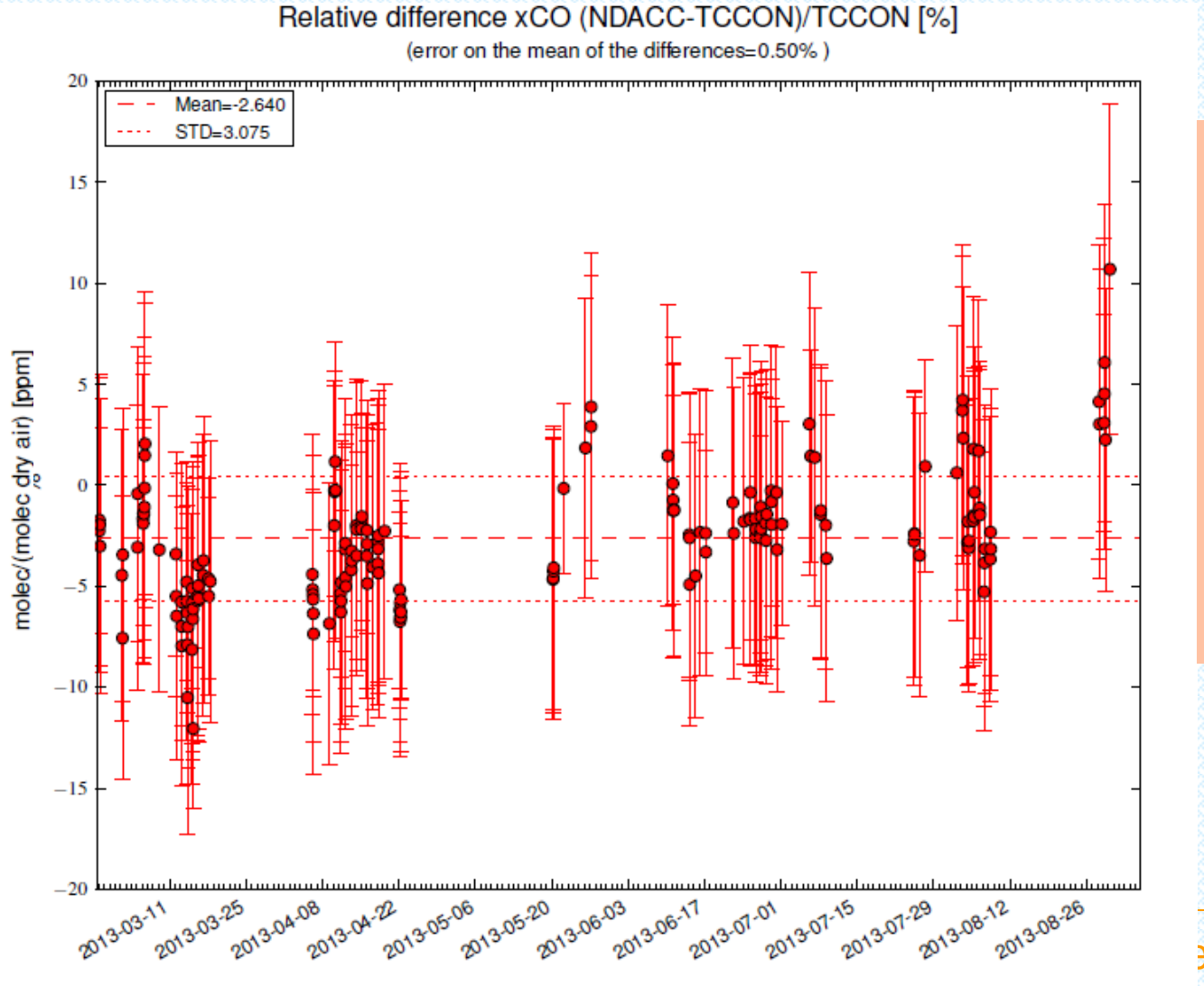
- (MAX)DOAS technique:
  - Advances in cloud detection and filtering techniques
  - Advances in aerosol measurements
  - …

- Consistency checks between DOAS and FTIR data for NO2 (see talk by E. Mahieu) end HCHO (in progress)

- Advances in uncertainty budget evaluations

Research (2)

- Consistency checks between CO from NDACC (MIR) and TCCON (NIR) observations



Prelimlinary direct comparison without accounting for AVK

Very good agreement

Research (3)

- **Documentation**
  - Data User guide
  - Uncertainties budgets
  - Data 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.

Horizontal distance [km]

To be made available also on NDACC database or Website ?

Operational part (1)

- ***Rapid delivery*** – within < 1 month after data acquisition) of the NORS (NDACC) data to the RD directory on the NDACC DHF

- Requirement: ***GEOMS HDF format*** according to templates (including uncertainties preferably)

- Consolidated data and reanalysis data are submitted to usual station directories on NDACC DHF

Operational part (2)

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 by S&T in Nors Validation Server (NVS)

This development started from GECA tools but advanced and improved them significantly; they could be re-used in "GECA-2" for satellite validation

Operational Part (3)

NORS Validation Server

⇒ Actual status

Prototype validation server

http://nors.stcorp.nl

available for testing and verification

⇒ Final status:

implemented at BIRA

linked to the MACC-II Webpages

⇒ completely **automatic reports generation**

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

⇒ Gives direct feedback to data providers and users

Operational Part (4)

Automatic means what ?

As soon as MWR, LIDAR, FTIR or UV/VIS DOAS data are archived

in NDACC station directories or RD directory,

in GEOMS HDF,

⇒ they will show up on the Validation Server

and intercomparison reports will be available on NVS

dation

PARAMETER

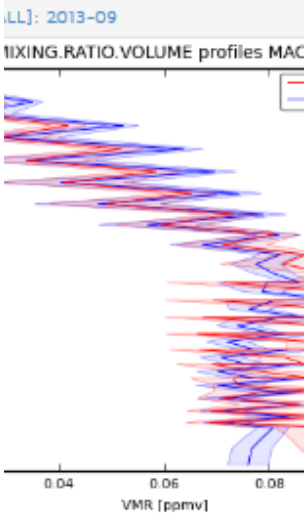
AEROSOL	1
CH2O	3
CH4	1
CO	3
NO2	1
O3	12

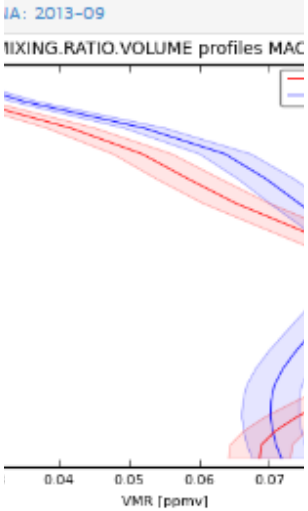
MODEL TYPE

fkya	6
fnyp	7
fsd7	8

INSTRUMENT TYPE

FTIR	7
LIDAR	3
MWR	3
UVVIS	8





LOCATION

[ALL]	63
BERN	9
IZANA	48
JUNGFRAUJOCH	80
LA.REUNION	49
LAUDER	10
MAUNA.LOA.HI	9
NY.ALESUND	9
ZUGSPITZE	7

AFFILIATION

[ALL]	61
BIRA.IASB	49
IUP	9
KIT	48
KIT.IMK.IFU	7
NIWA.ERI	6
UBERN	9
ULG	80
UMASS	15

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NORS Validation Server

Currently viewing

REPORT PROPERTIES

Intercomparison	O3-fnyp-MWR
Period	MONTHS
Start	01 Mar 2013
End	31 Mar 2013
Location	NY.ALESUND
Affiliation	IUP
Generated	30 Sep 2013, 14:09h

Report actions

DOWNLOAD ACTIONS

Download report as PDF file

Download report as zip archive

Related reports

OTHER MODELS

fsd7

OTHER PERIODS

previous month

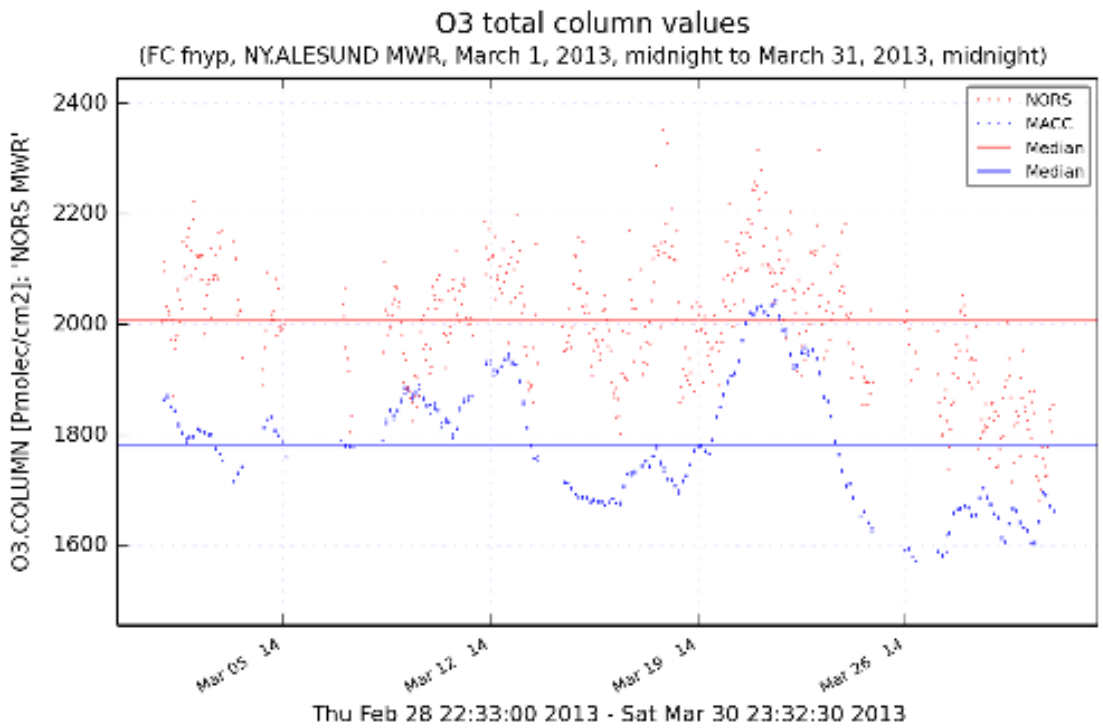
next month

Intercomparison Report

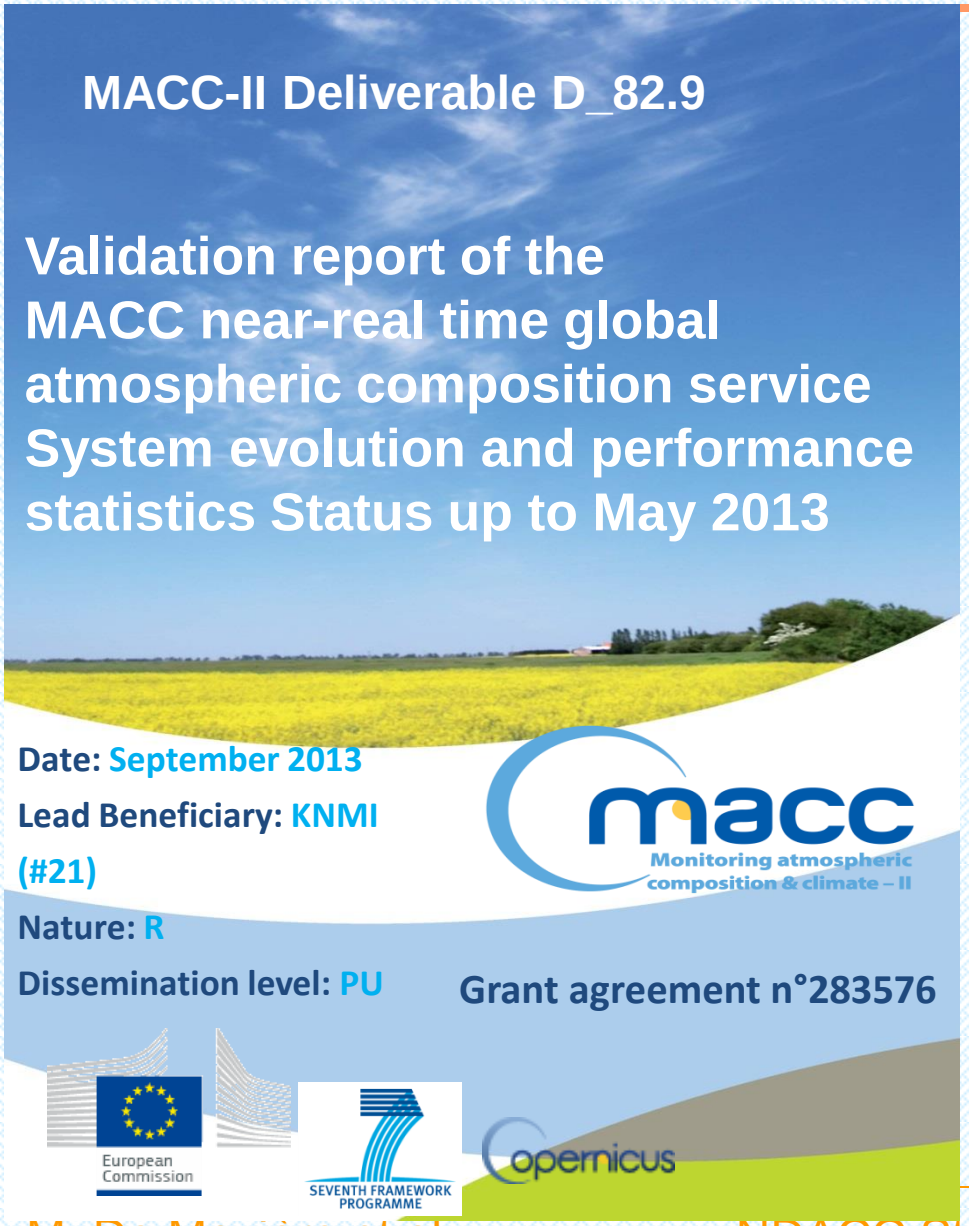
NORS Report: MACC fnyp vs NORS MWR - O3

MACC vs NORS O3 Intercomparison Statistics

f (predicted variable)	O3.COLUMN [Pmolec/cm2]: 'MACC fnyp'
o (observed variable)	O3.COLUMN [Pmolec/cm2]: 'NORS MWR'
# measurements	543
median bias	-204.051
B (mean bias)	-212.975
RMSE (root mean square error)	107.092
MNMB (modified normalized mean bias)	-0.11271
FGE (fractional gross error)	0.113095
R (correlation coefficient)	0.571567
RS (Spearman rank correlation coefficient)	0.56853

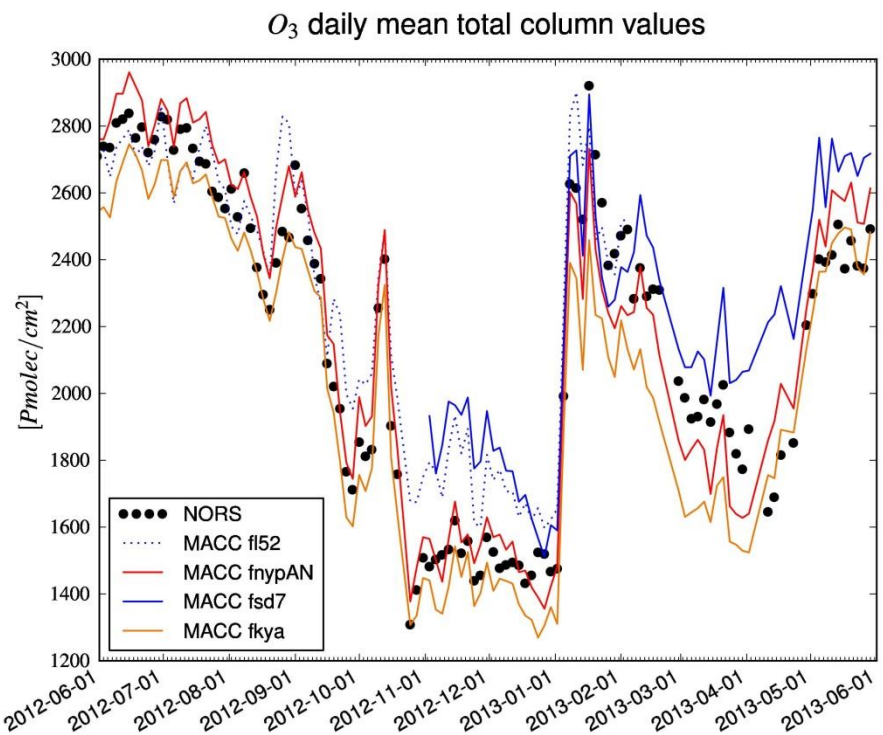


NVS is of direct use to MACC-II



- Every 3 months, MACC-II produces a Validation Report.
- The September 2013 report includes results from NVS for the 1st time. This use of NORS results will be enhanced from now onwards.

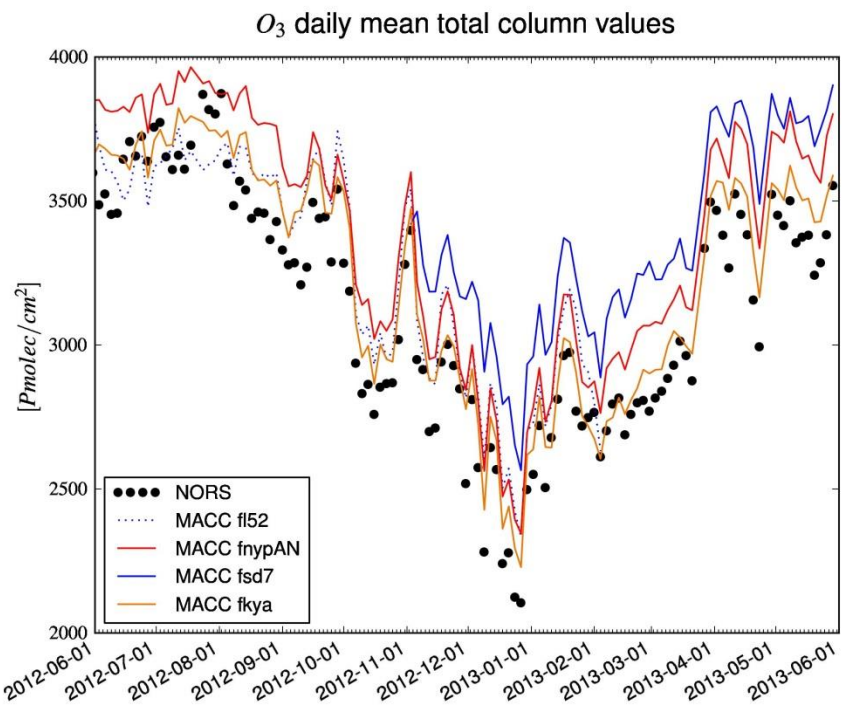
NORS Validation Server & MACC



O3 columns 25-60 km: NORS microwave data versus different MACC models

Ny-Alesund ↑

Bern→

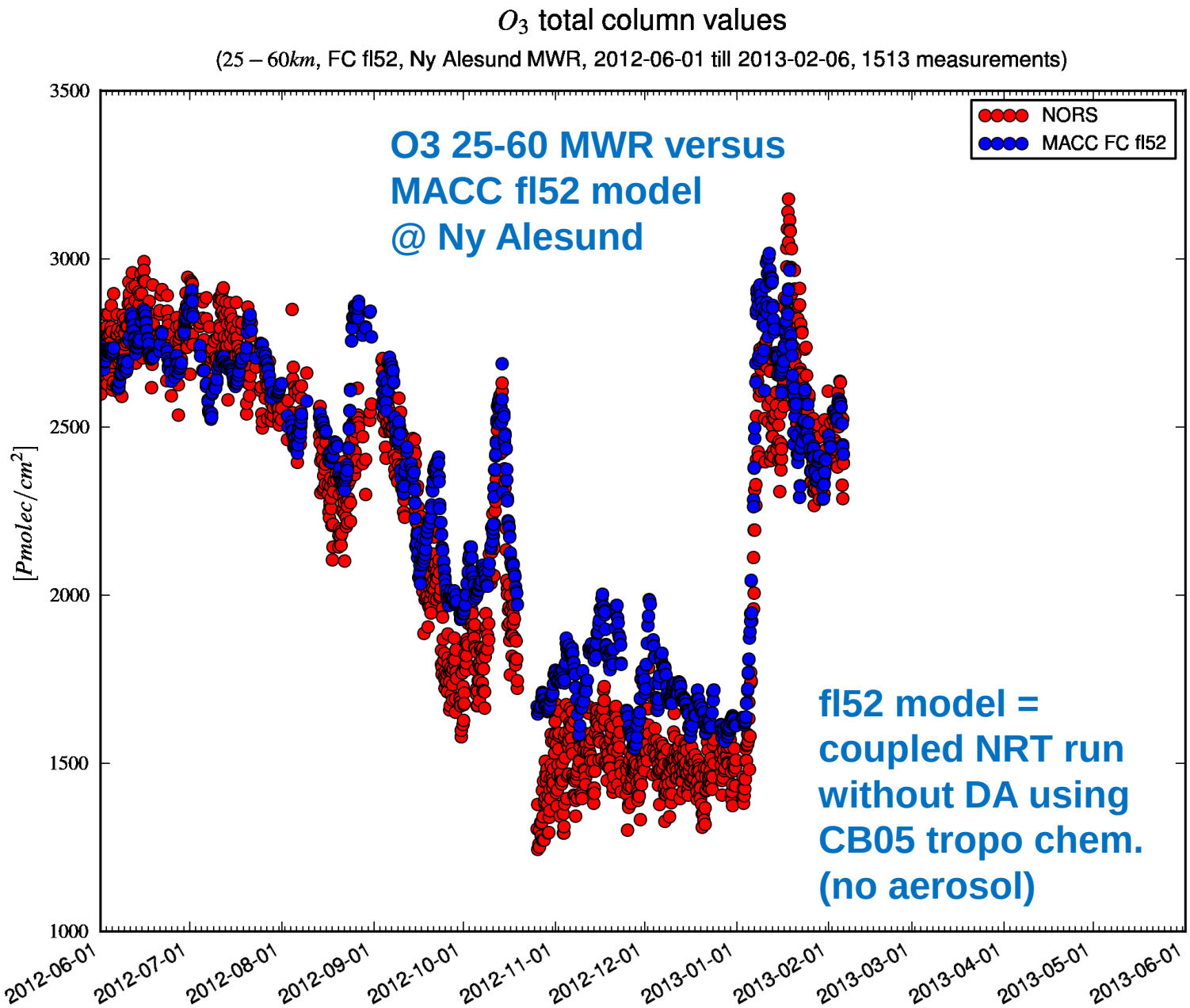


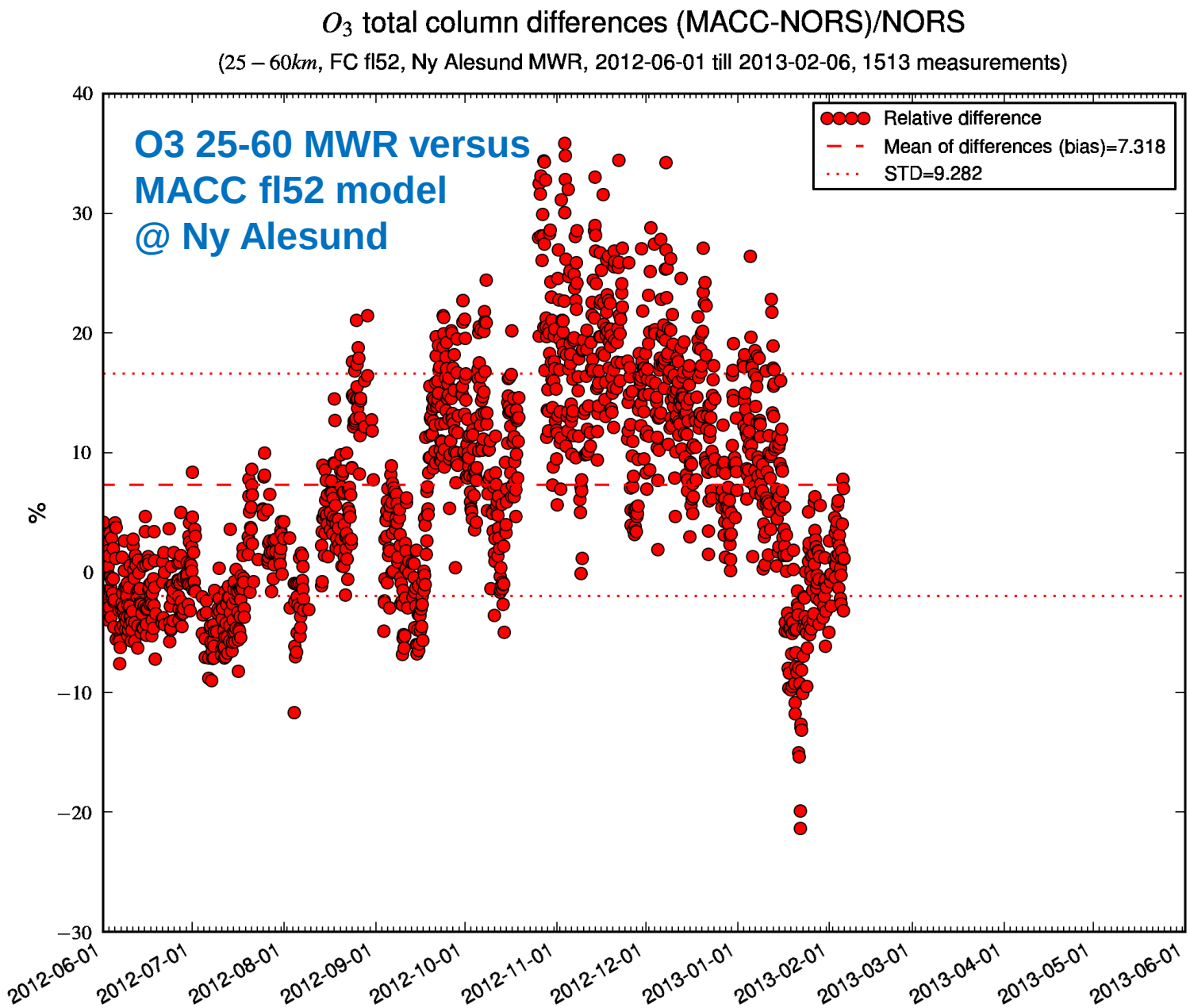
NVS reporting examples

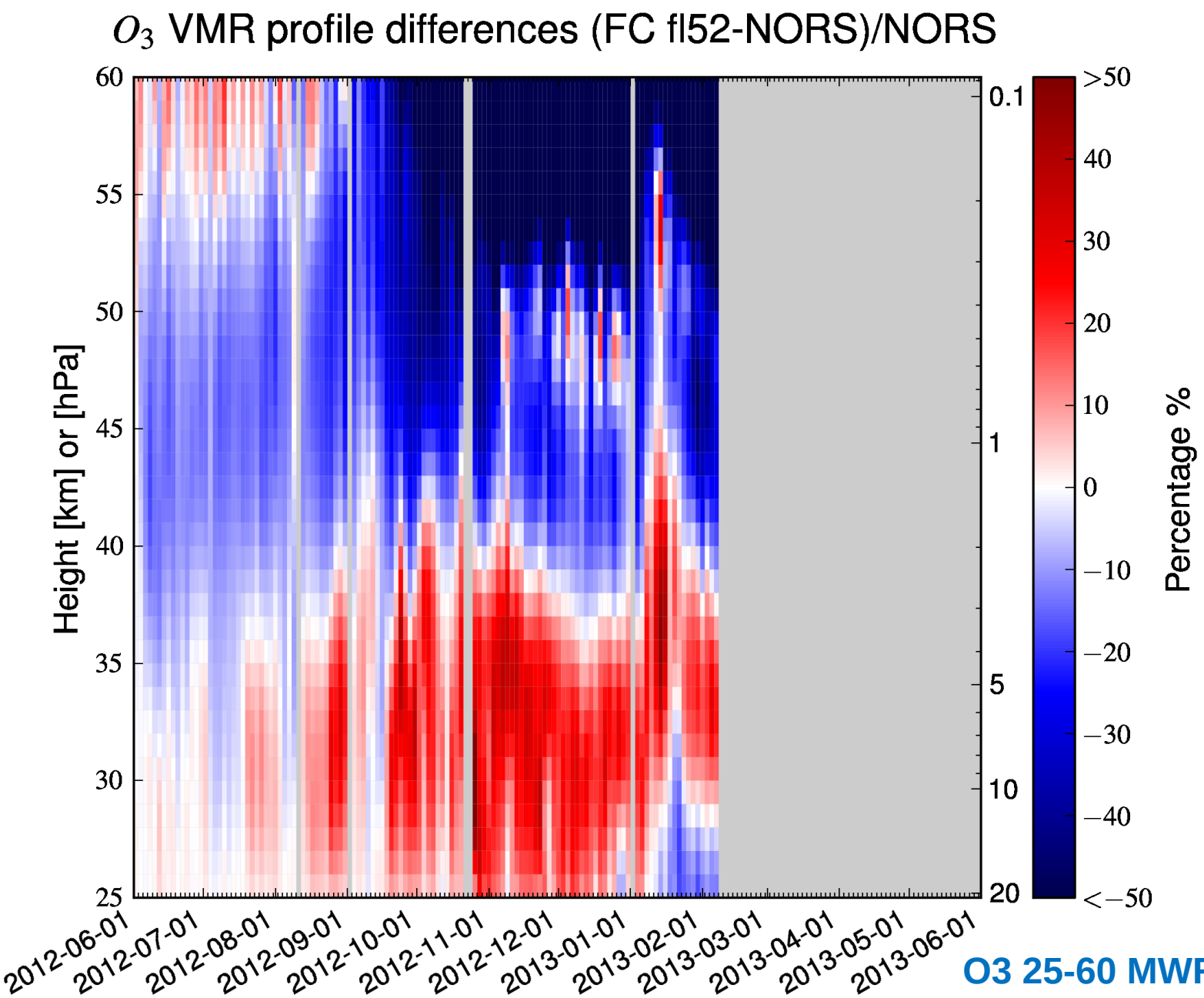
⇒ Profile, partial column and total column intercomparisons always limited to sensitive altitude range

⇒ +report including statistics

⇒ Care for traceability


O_3 total column values
(25 – 60km, FC fl52, Ny Alesund MWR, 2012-06-01 till 2013-02-06, 1513 measurements)
NORS
MACC FC fl52
O3 25-60 MWR versus
MACC fl52 model
@ Ny Alesund
fl52 model =
coupled NRT run
without DA using
CB05 tropo chem.
(no aerosol)
[Pmolec/cm2]
3500
3000
2500
2000
1500
1000
2012-06-01
2012-07-01
2012-08-01
2012-09-01
2012-10-01
2012-11-01
2012-12-01
2013-01-01
2013-02-01
2013-03-01
2013-04-01
2013-05-01
2013-06-01

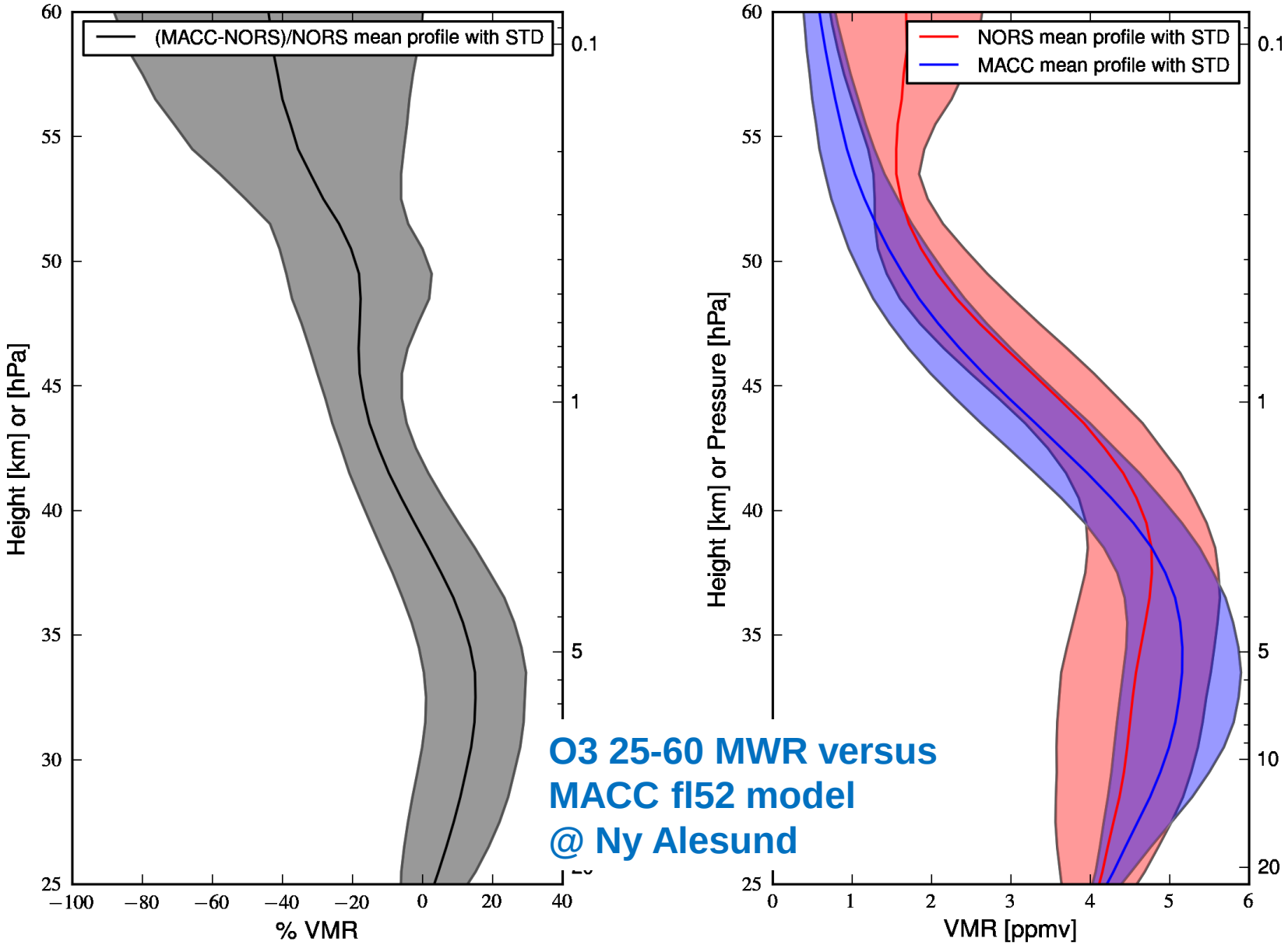

O_3 total column differences (MACC-NORS)/NORS
(25 – 60km, FC fl52, Ny Alesund MWR, 2012-06-01 till 2013-02-06, 1513 measurements)
O3 25-60 MWR versus
MACC fl52 model
@ Ny Alesund
Relative difference
Mean of differences (bias)=7.318
STD=9.282
%
40
30
20
10
0
−10
−20
−30
2012-06-01
2012-07-01
2012-08-01
2012-09-01
2012-10-01
2012-11-01
2012-12-01
2013-01-01
2013-02-01
2013-03-01
2013-04-01
2013-05-01
2013-06-01



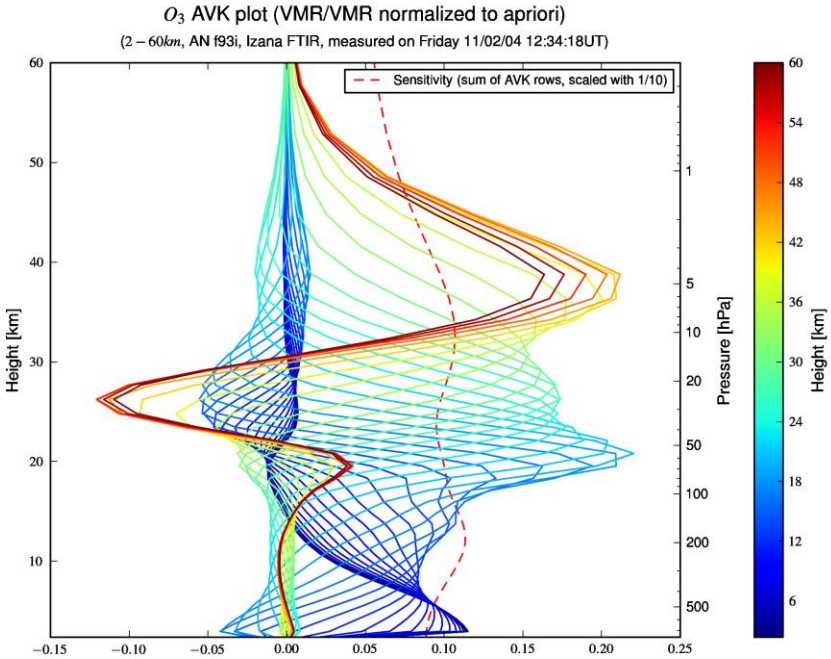
O3 25-60 MWR versus MACC fl52 model @ Ny Alesund

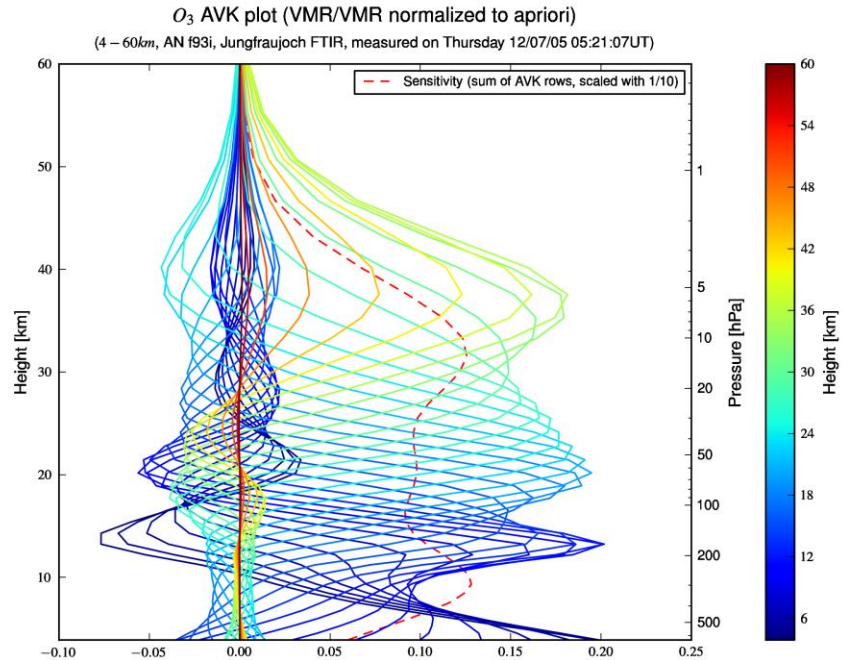
O_3 mean profile

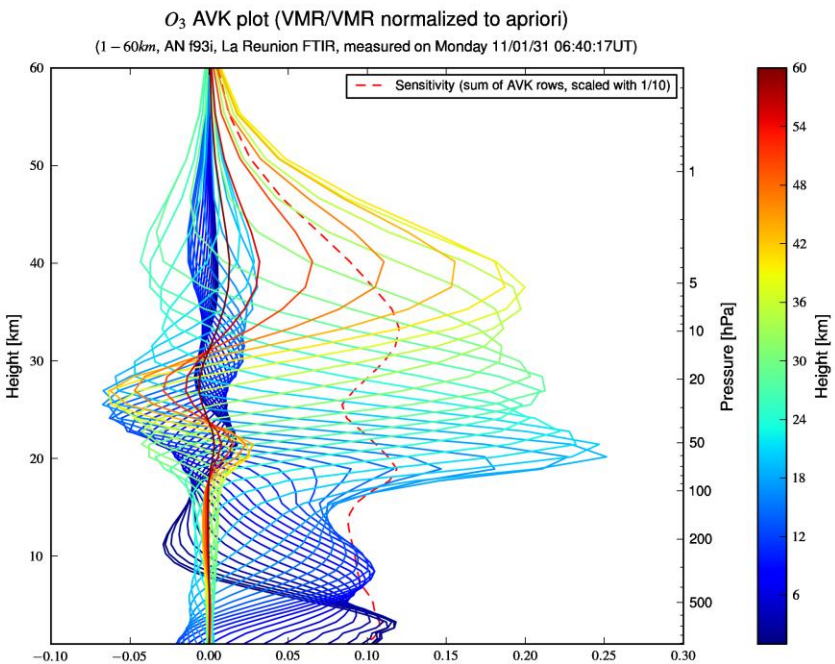
(25 – 60km, FC fl52, Ny Alesund MWR, 2012-06-01 till 2013-02-06, 1513 measurements)

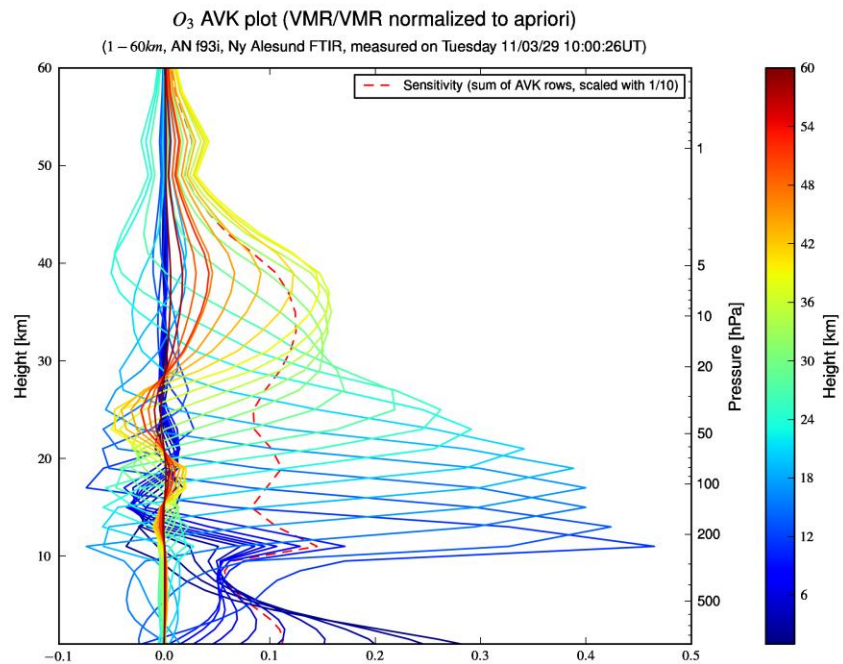


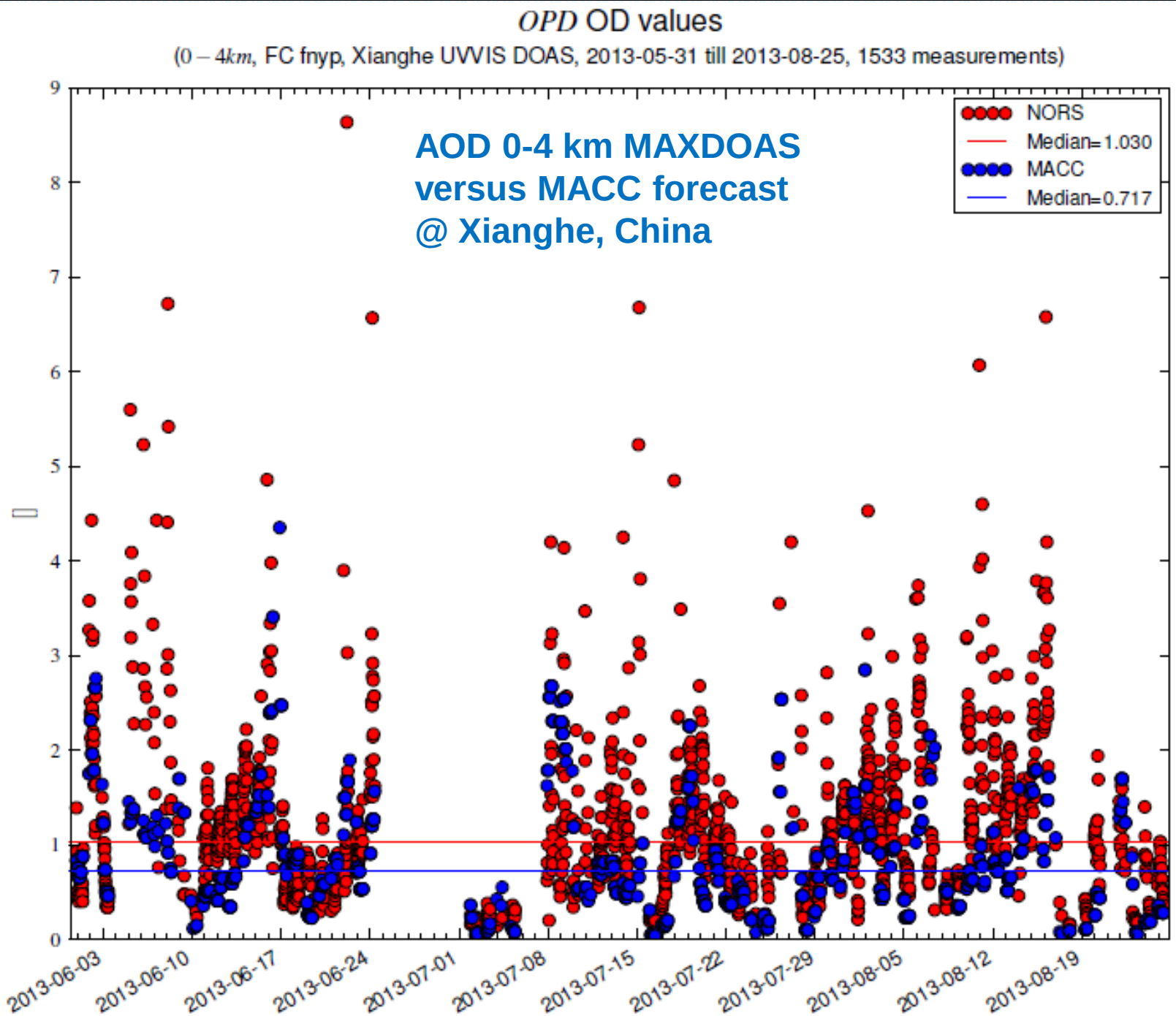
O3 25-60 MWR versus MACC fl52 model @ Ny Alesund


O_3 AVK plot (VMR/VMR normalized to apriori)
(2 – 60km, AN f93i, Izana FTIR, measured on Friday 11/02/04 12:34:18UT)
Sensitivity (sum of AVK rows, scaled with 1/10)
Height [km]
Pressure [hPa]
Height [km]


O_3 AVK plot (VMR/VMR normalized to apriori)
(4 – 60km, AN f93i, Jungfraujoch FTIR, measured on Thursday 12/07/05 05:21:07UT)
Sensitivity (sum of AVK rows, scaled with 1/10)
Height [km]
Pressure [hPa]
Height [km]


O_3 AVK plot (VMR/VMR normalized to apriori)
(1 – 60km, AN f93i, La Reunion FTIR, measured on Monday 11/01/31 06:40:17UT)
Sensitivity (sum of AVK rows, scaled with 1/10)
Height [km]
Pressure [hPa]
Height [km]


O_3 AVK plot (VMR/VMR normalized to apriori)
(1 – 60km, AN f93i, Ny Alesund FTIR, measured on Tuesday 11/03/29 10:00:26UT)
Sensitivity (sum of AVK rows, scaled with 1/10)
Height [km]
Pressure [hPa]
Height [km]


OPD OD values
(0 – 4km, FC fnyp, Xianghe UVVIS DOAS, 2013-05-31 till 2013-08-25, 1533 measurements)
AOD 0-4 km MAXDOAS
versus MACC forecast
@ Xianghe, China
NORS
Median=1.030
MACC
Median=0.717
0
1
2
3
4
5
6
7
8
9
2013-06-03
2013-06-10
2013-06-17
2013-06-24
2013-07-01
2013-07-08
2013-07-15
2013-07-22
2013-07-29
2013-08-05
2013-08-12
2013-08-19

NORS future

1. Second progress and review meeting at BIRA,
on Oct. 17-18,
attended by EU, MACC-II, ESA, CEOS, and WMO/NDACC representatives:

- to demonstrate scientific progress
- to demonstrate use of NORS (NDACC) in MACC
- to demonstrate capacity building : more and new NDACC stations joining the effort
  (e.g., Xhianghe, Mauna Loa, Zugspitze, Lauder, …

In the hope of getting sustained support through Copernicus

2. Potential spin-off: Re-viving the ESA GECA initiative for satellite validation using NDACC data, building on progress with validation toolchain and Web interface in NORS

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

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

Thanks to ESA for letting NORS use the GECA heritage

GMES
Observing our planet for a safer world

https://nors.stcorp.nl

Username: nors-guest

Passwd: {bnm-hjk-uio}

Please have a look and give feedback !

Methodology for integrating ground-based ozone profile data

Objective:

Develop a methodology for integrating ground-based data sources and provide consistent ozone vertical distribution time series as well as tropospheric and stratospheric ozone columns at 4 NDACC stations.

Methodology developped for the Alpine station

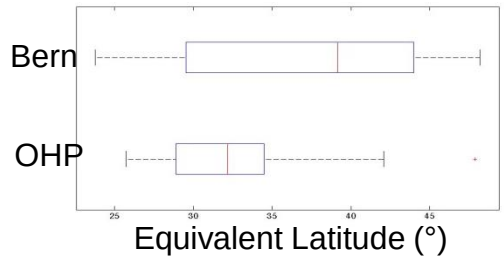
- Evaluate the validity domain of ozone profile data from the LIDAR at OHP, FTIR at Jungfraujoch and MW at Bern

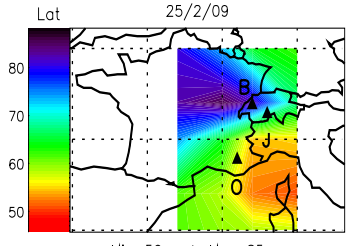
→ Altitudes, Resolution, Precision,Occurrence, Temporal resolution, Number of measurement per day or year

- Highlight O3 measurements bias between each instruments . Understand and characterize the origin of those biases

→ Bias FTIR vs MW = instrumental

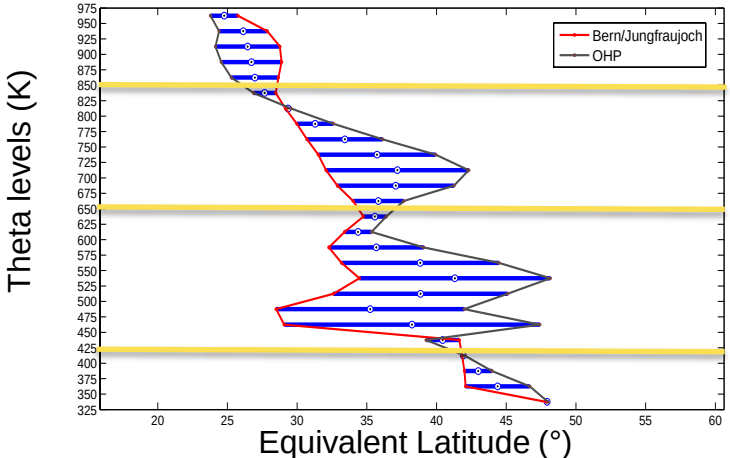
Bias MW/FTIR vs OHP = Origine of air mass





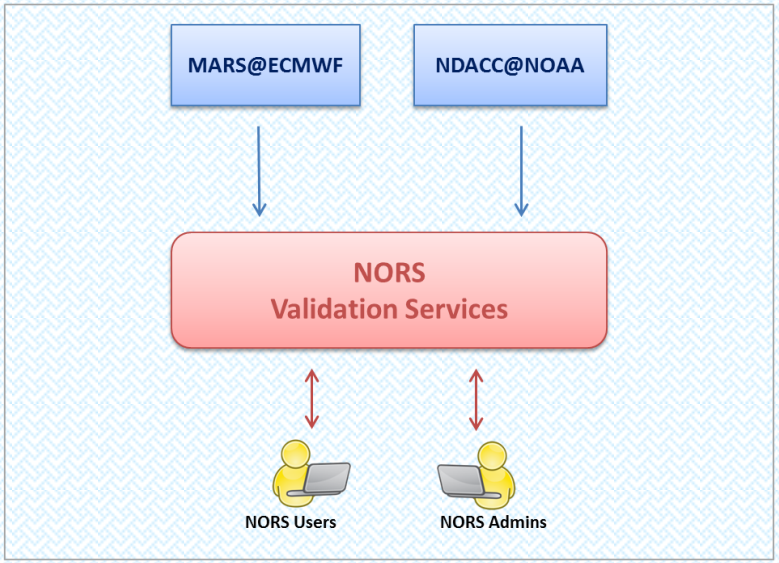
- Find the apropriate statistical tool for the profiles integration and test of the statistical tool

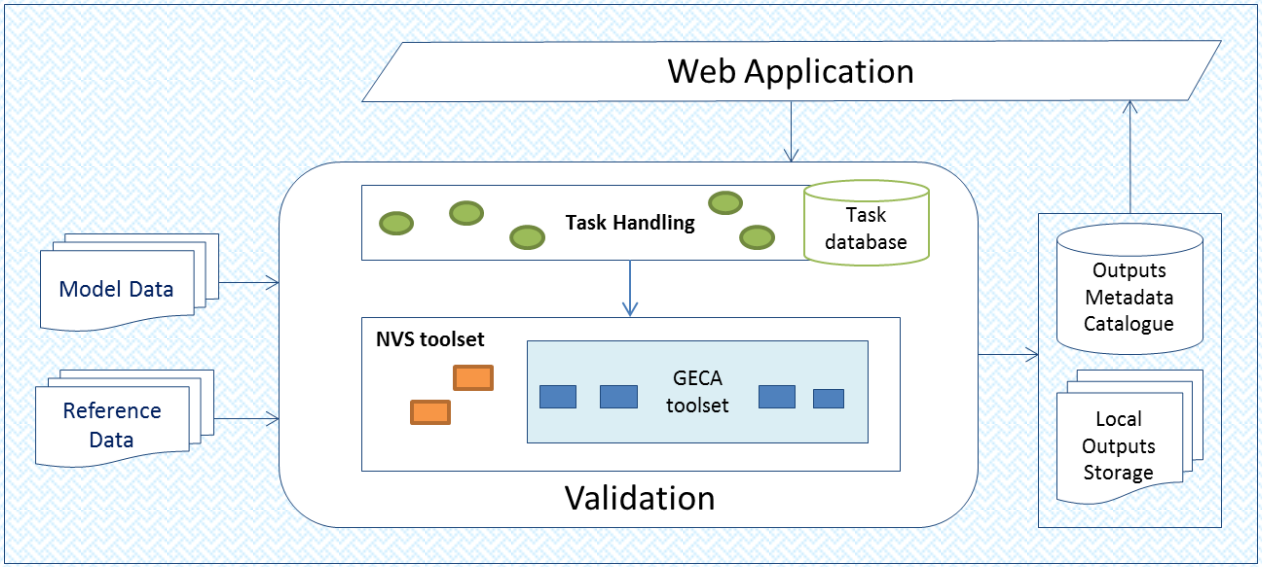
Define all the altitudes where the air mass are different by using a Principal Component Analysis



→ Use a neural network approach on the equivalent latitude at each altitude range defined by the PCA in order to obtain the predominant air mass for each altitude in the alpine region. Then assigned the corresponding weight given by this approach to O3 profiles for each individual stations to create the new integrated ground-based ozone profile

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

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