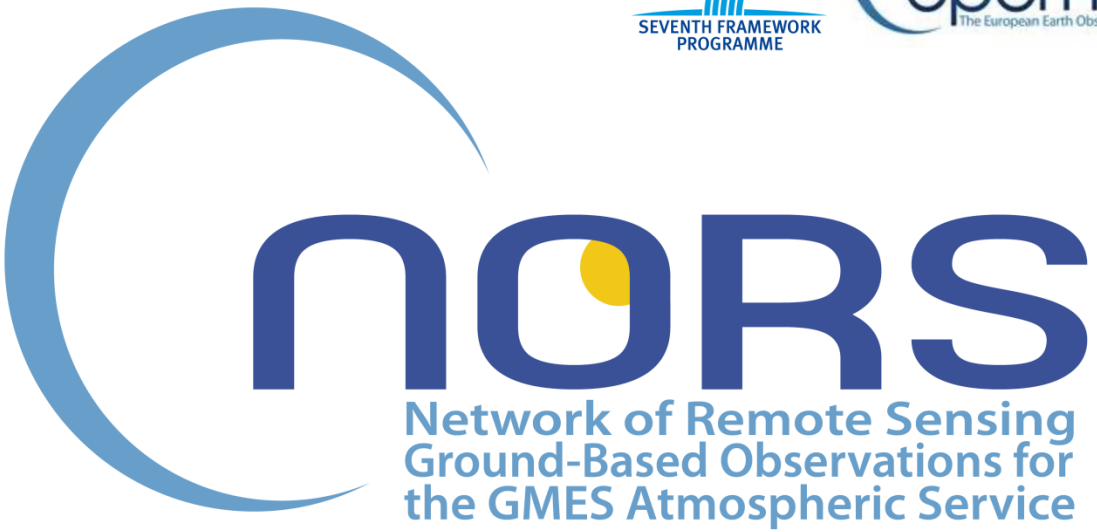


Project full title:

" Demonstration Network Of ground-based Remote Sensing Observations in support of the Copernicus Atmospheric Service "

http://nors.aeronomie.be

NORS Objectives

Final Goals:

1. To deliver ***in situ*** monitoring data from ***ground-based remote sensing*** instruments ***with minimal delays*** to the Copernicus Atmospheric Service (CAS) for the purpose of ***assessing the quality of the CAS products***

2. To establish ***remote sensing monitoring capabilities outside of W-Europe***

3. To develop and provide ***integrated products*** for validation

4. To build a ***Web-based validation server for CAS products – providing automatic default validation reports***

5. To become a ***sustainable validation service*** for ***many CAS products*** on the ***quasi-global scale***

NORS Objectives

NORS is a demonstration project (Nov. 2011-June 2014):

⇒ It will start with data from **4 pilot stations of NDACC** (Network for the Detection of Atmospheric Composition Change)

⇒ It will focus on a limited set of target products:

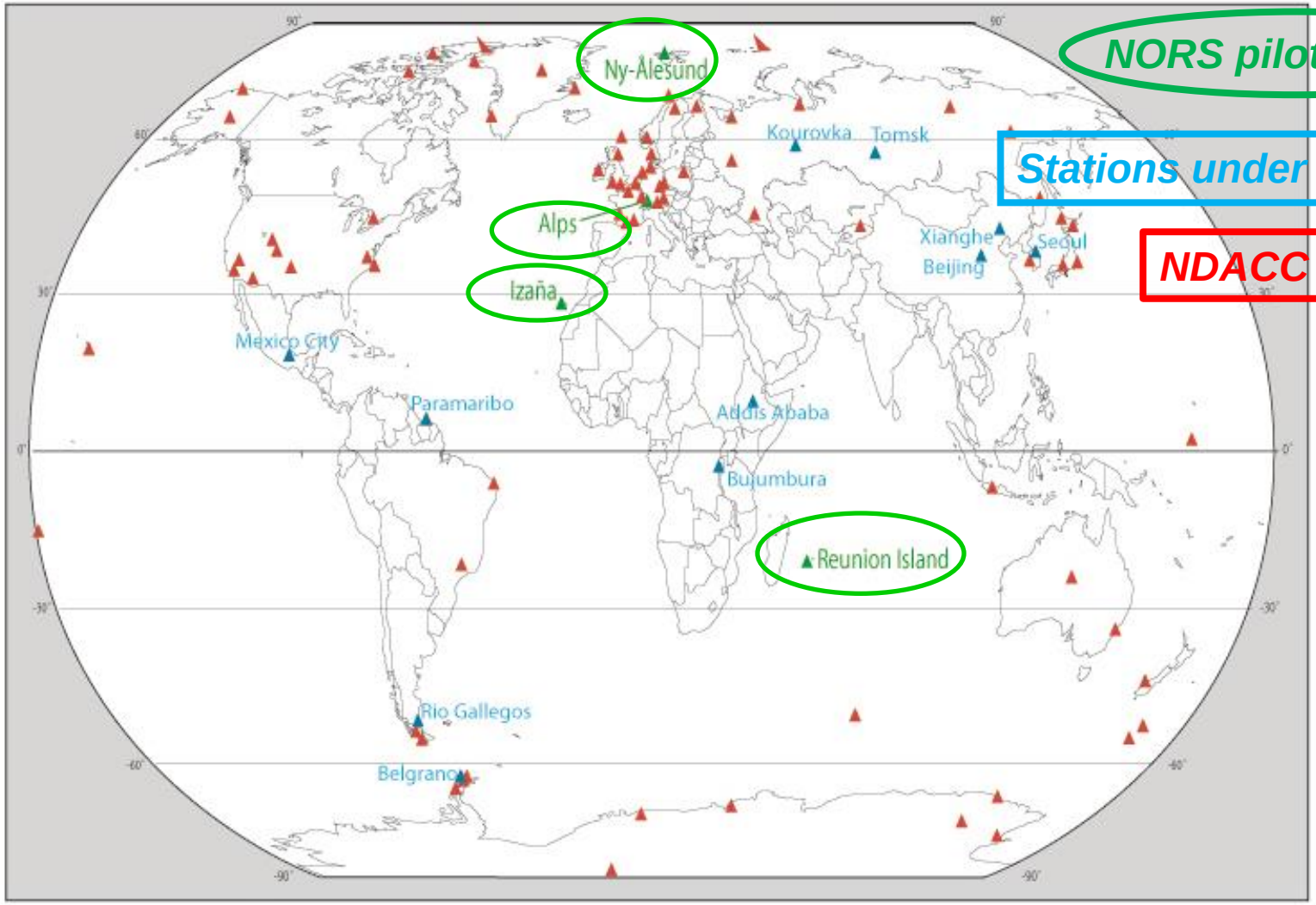
O_3, NO_2, HCHO, CO, CH_4, aerosol extinction

total and tropospheric and stratospheric columns,

vertical profiles

provided by ***LIDAR (DIAL), Microwave radiometer, Fourier-Transform IR (FTIR) and (MAX-)DOAS UV-VIS*** spectrometers

NORS/NDACC map



NORS pilot stations

Stations under development

NDACC stations

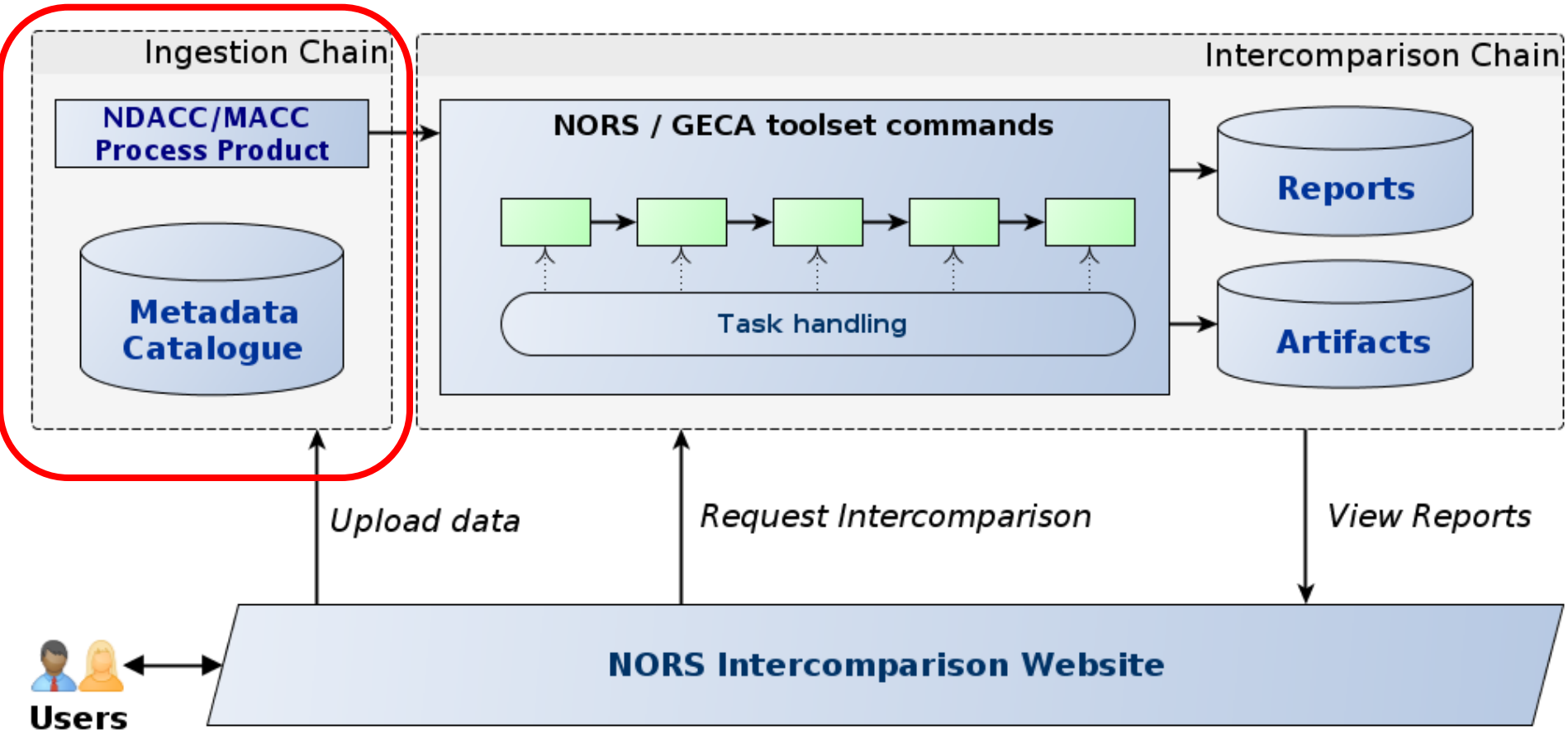
- Operational NDACC stations
- NDACC stations selected as pilot stations in NORS
- Stations to be developed in NORS to potentially become NDACC stations

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

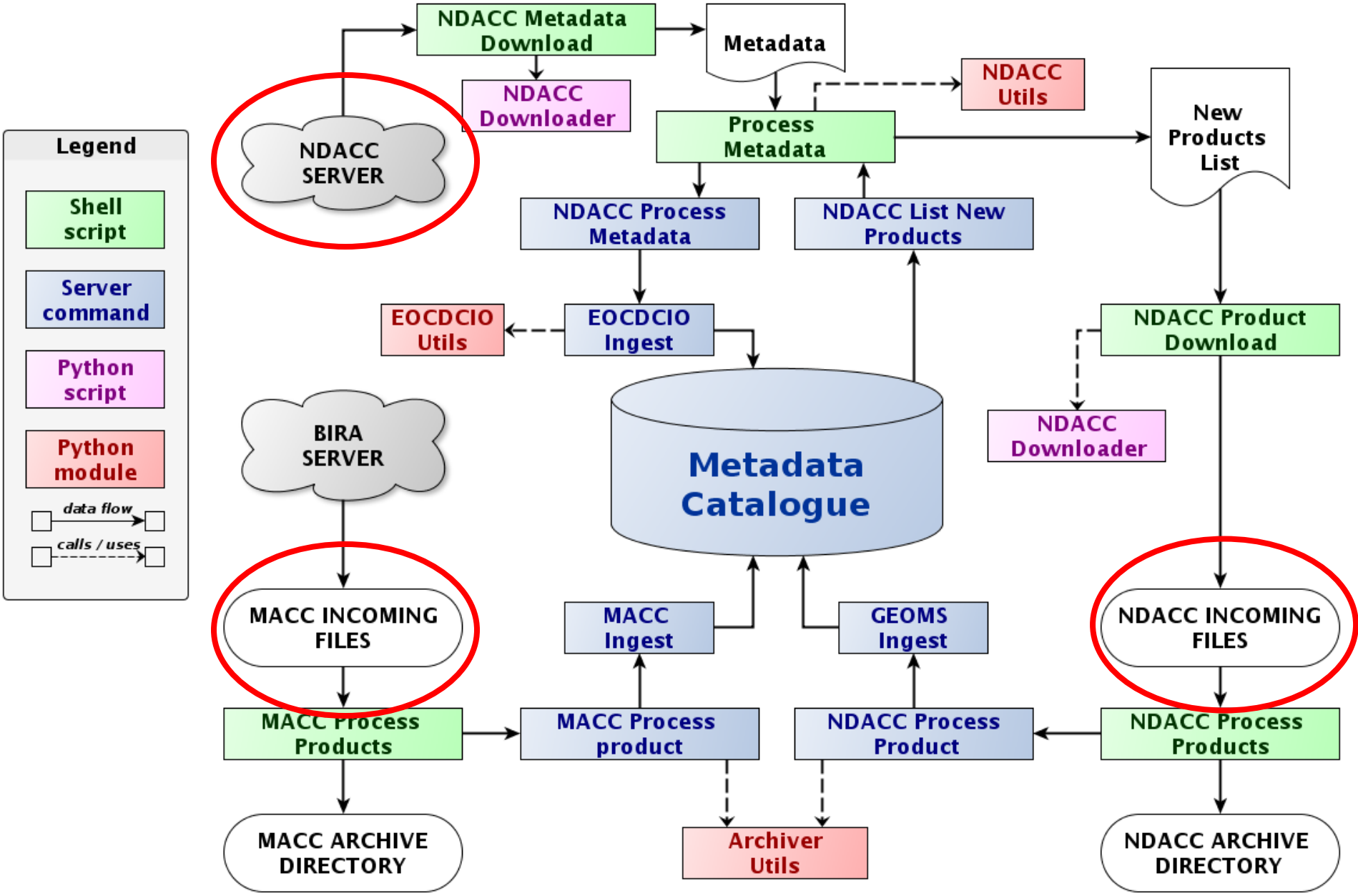
NORS VALIDATION SERVER:

INGESTION OF DATA & ARCHITECTURE

NORS Validation Server Design



Data ingestion chain

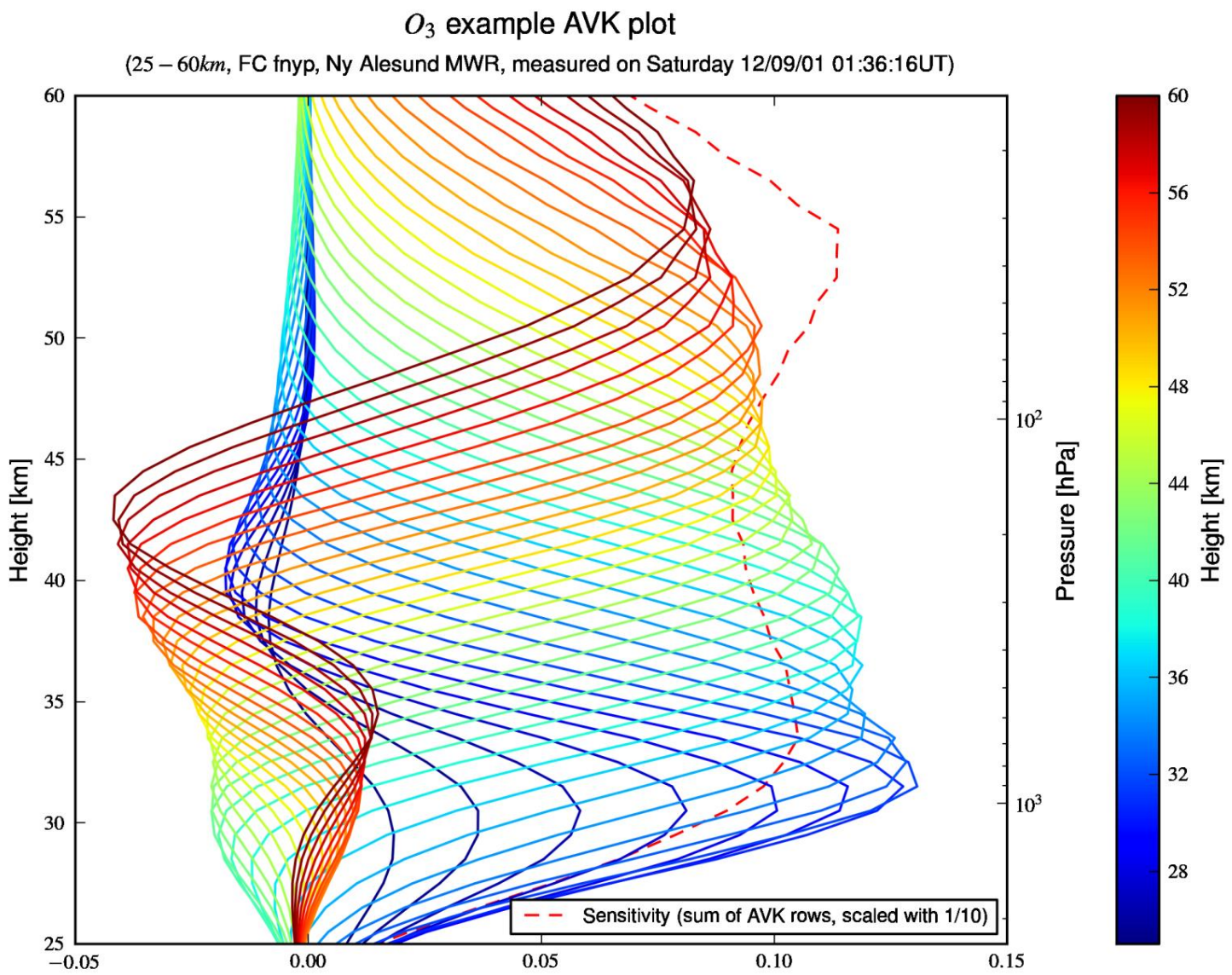


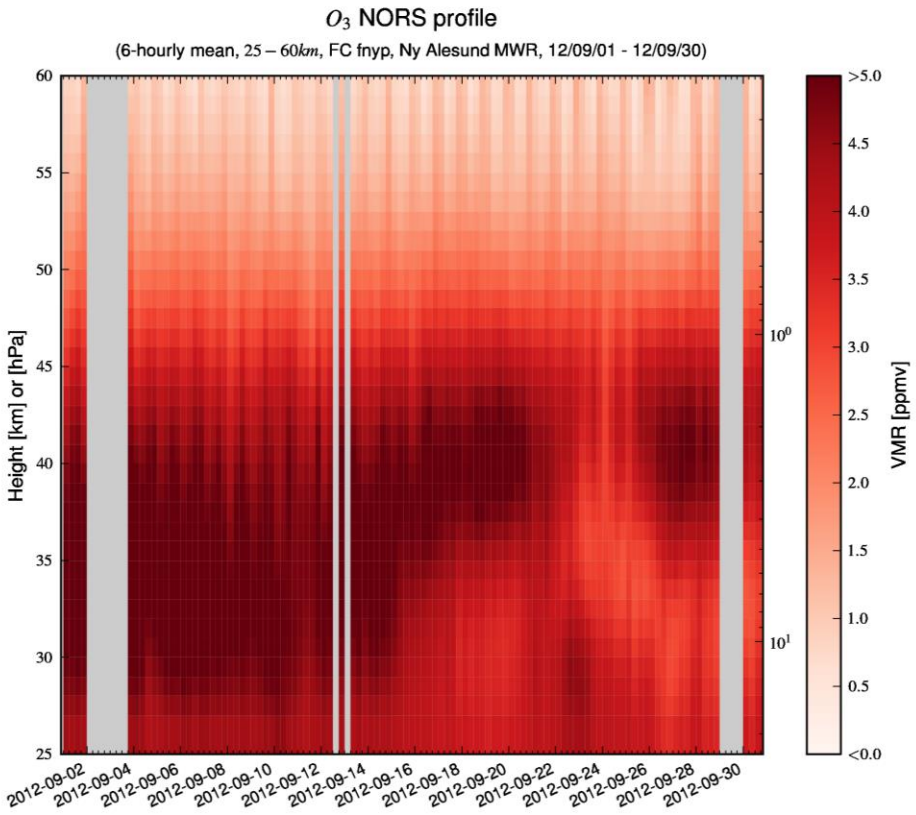
VALIDATION RESULTS ON THE NORS VALIDATION WEB SERVER:

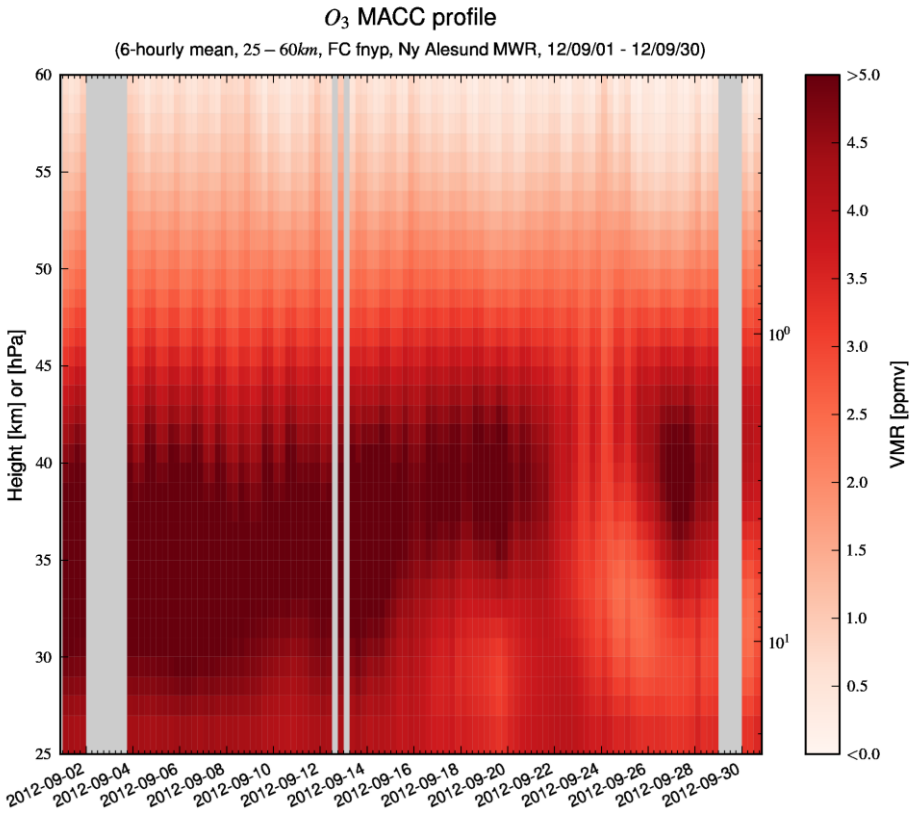
EXAMPLES

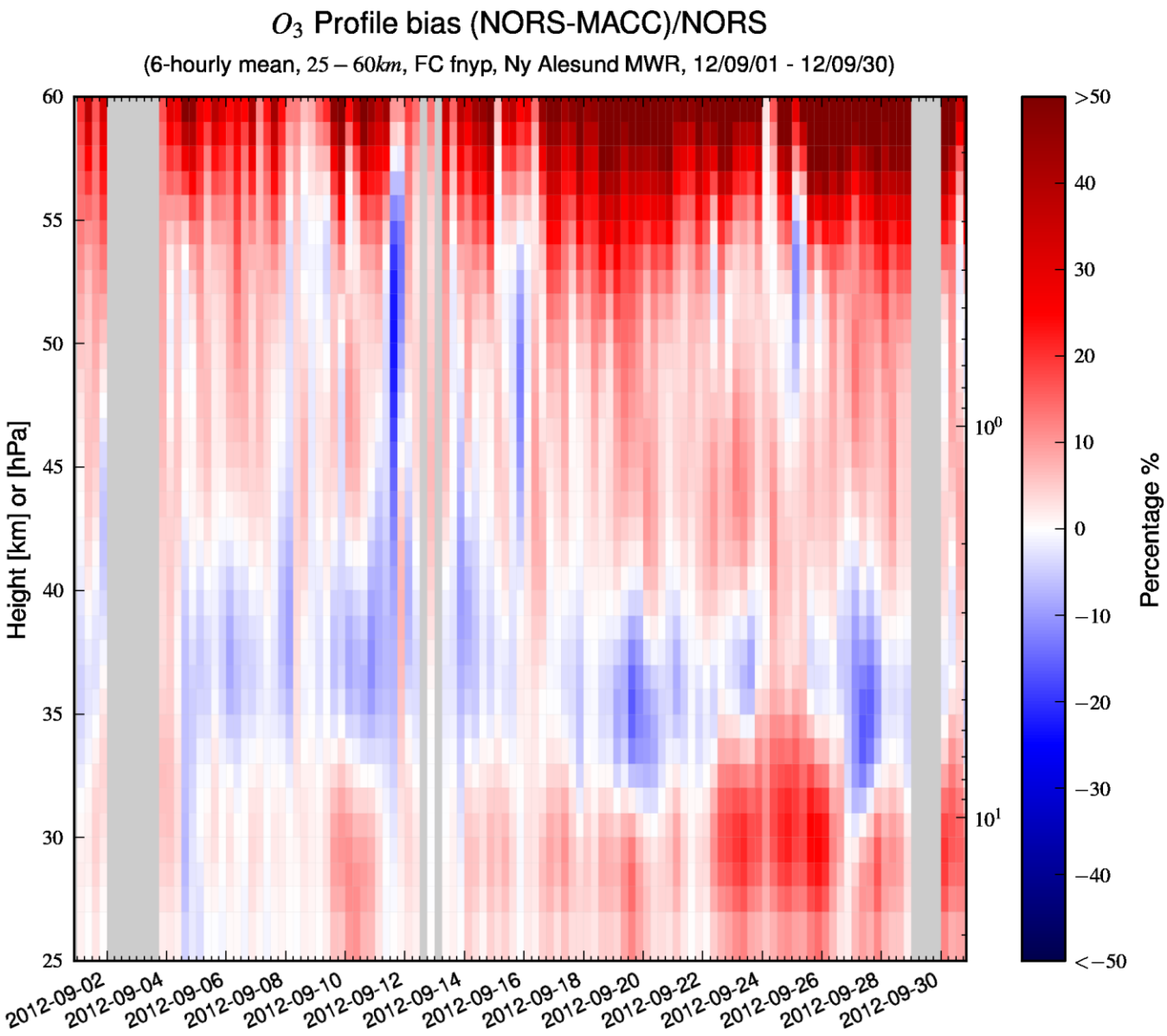
OZONE VERTICAL PROFILES ABOVE NY-ALESUND (SPITSBERGEN) IN SEPT. 2012:

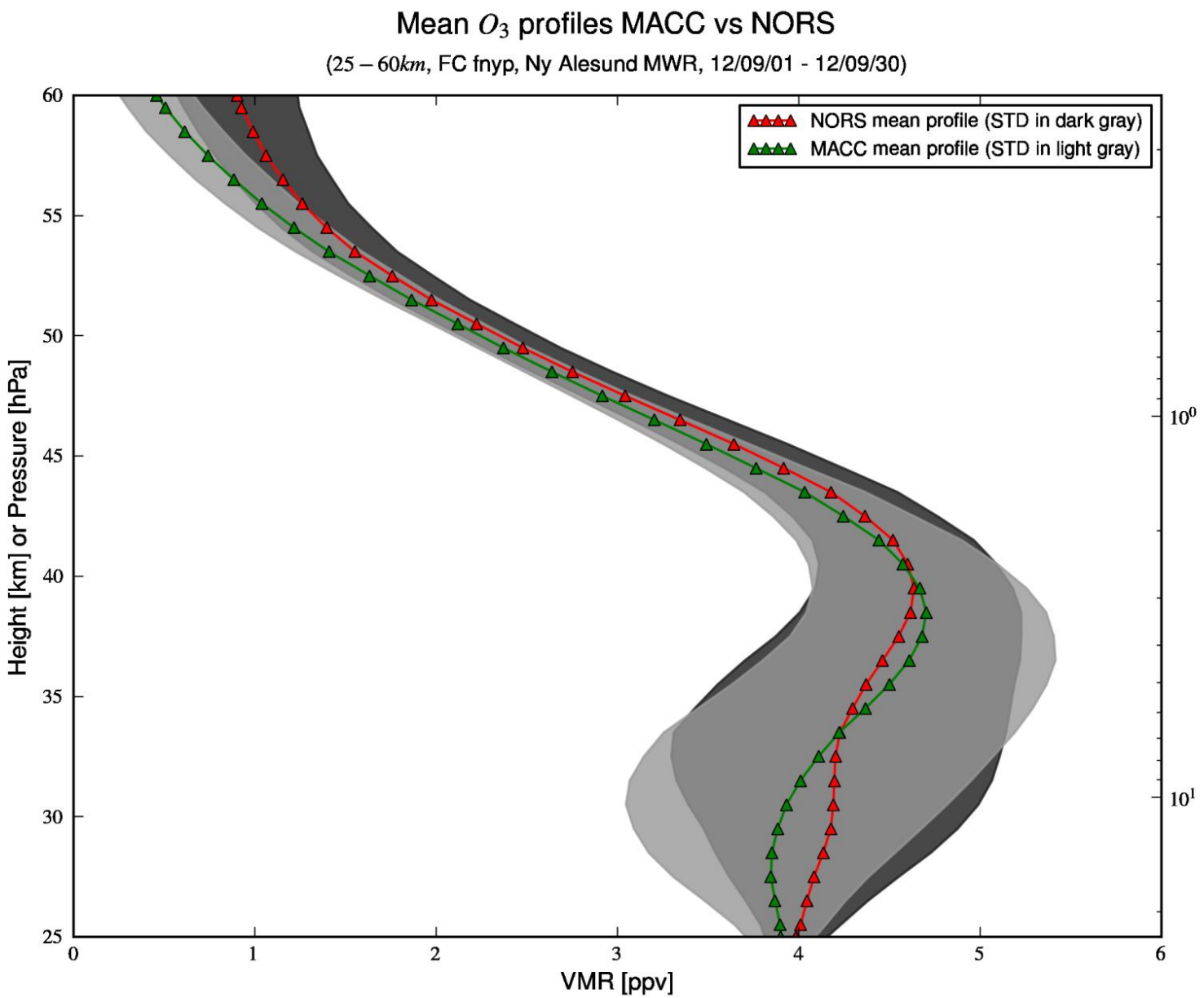
MACC-II FNYPFC PRODUCT COMPARED TO MICROWAVE RADIOMETER DATA

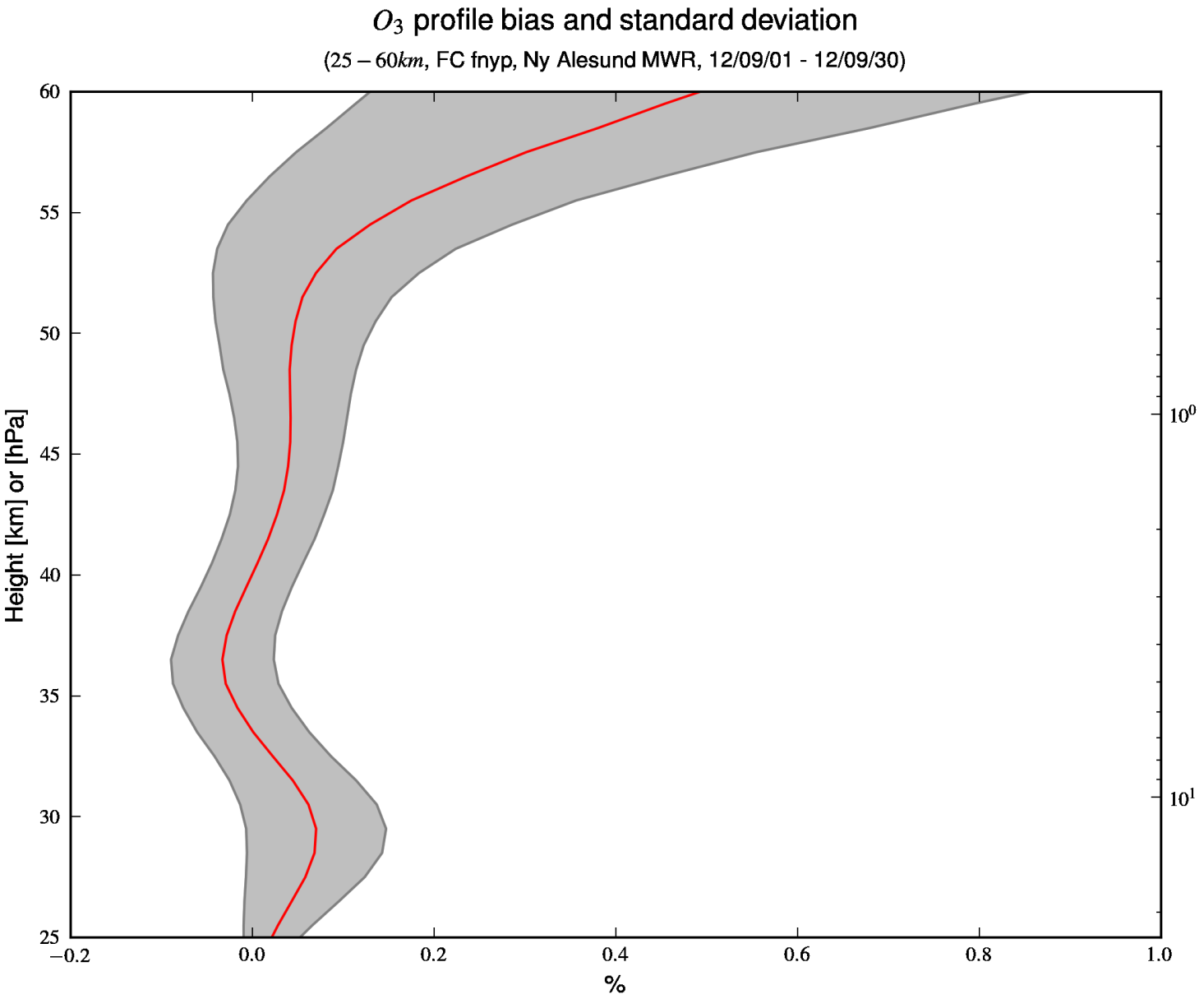

O_3 example AVK plot
(25 – 60km, FC fnyp, Ny Alesund MWR, measured on Saturday 12/09/01 01:36:16UT)
Height [km]
Pressure [hPa]
Height [km]
Sensitivity (sum of AVK rows, scaled with 1/10)
60
55
50
45
40
35
30
25
−0.05
0.00
0.05
0.10
0.15
10^2
10^3
60
56
52
48
44
40
36
32
28

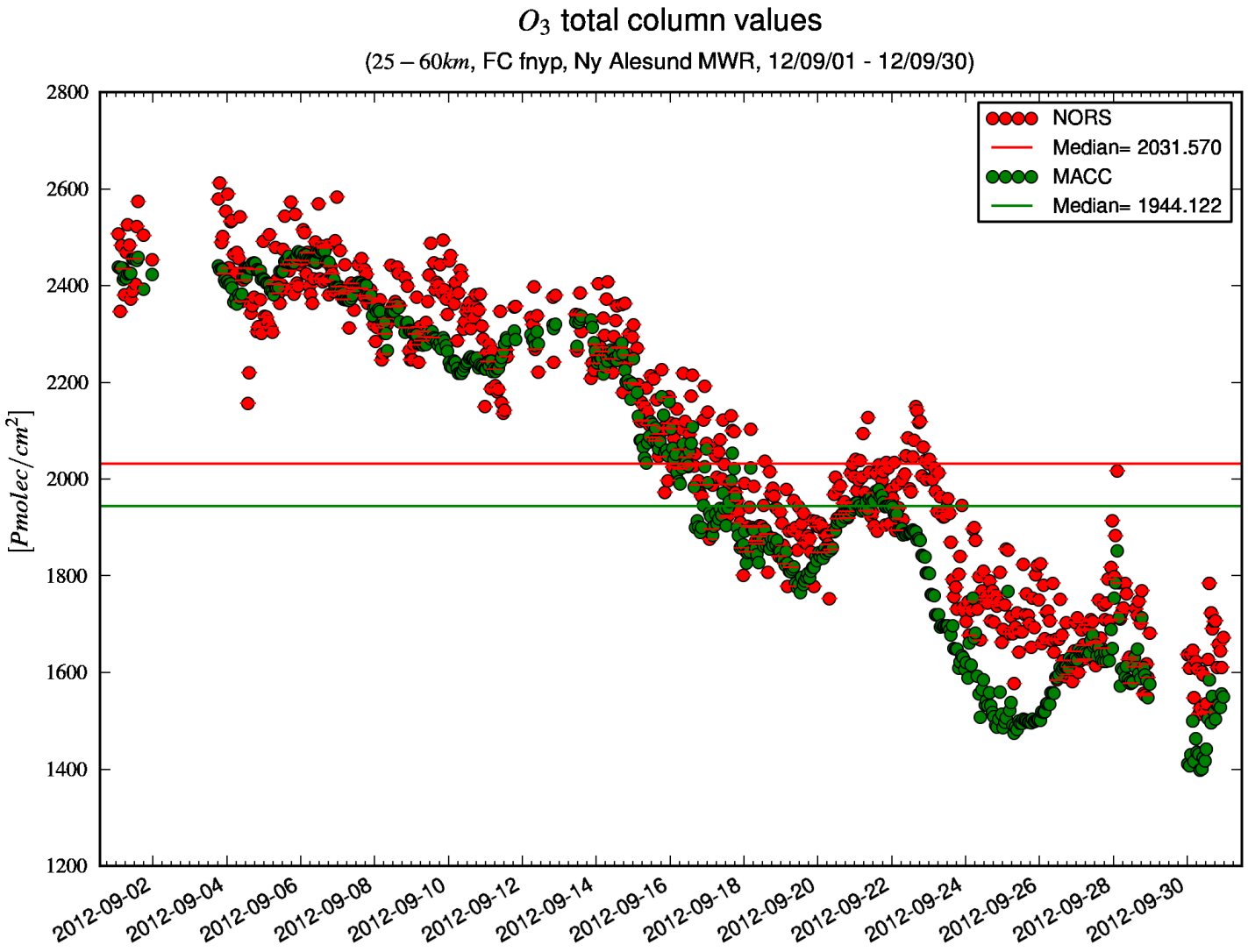

O_3 NORS profile
(6-hourly mean, 25 – 60km, FC fnyp, Ny Alesund MWR, 12/09/01 - 12/09/30)
Height [km] or [hPa]
60
55
50
45
40
35
30
25
10^0
10^1
2012-09-02
2012-09-04
2012-09-06
2012-09-08
2012-09-10
2012-09-12
2012-09-14
2012-09-16
2012-09-18
2012-09-20
2012-09-22
2012-09-24
2012-09-26
2012-09-28
2012-09-30
VMR [ppmv]
>5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
<0.0

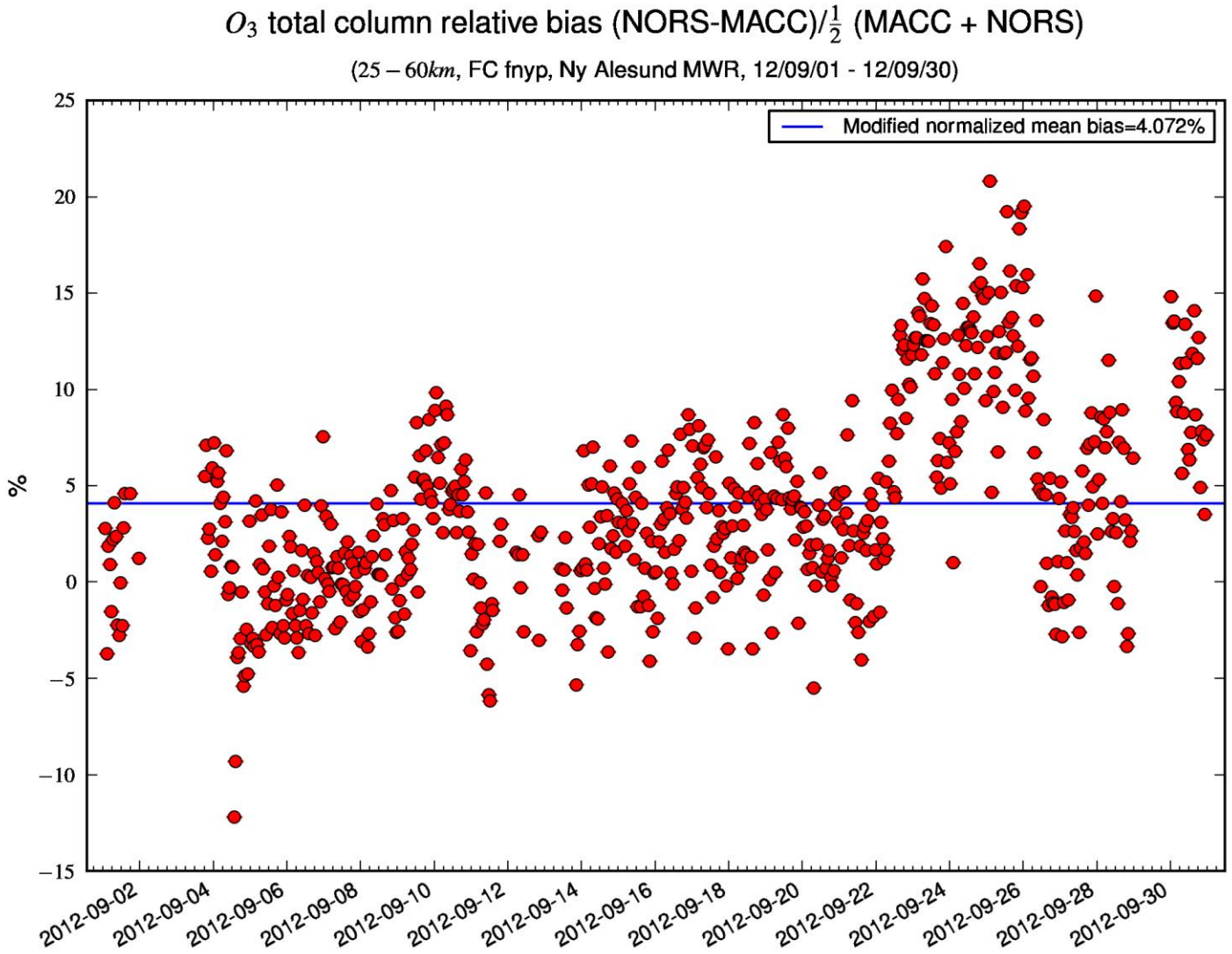

O_3 MACC profile
(6-hourly mean, 25 – 60km, FC fnyp, Ny Alesund MWR, 12/09/01 - 12/09/30)
Height [km] or [hPa]
60
55
50
45
40
35
30
25
10^0
10^1
2012-09-02
2012-09-04
2012-09-06
2012-09-08
2012-09-10
2012-09-12
2012-09-14
2012-09-16
2012-09-18
2012-09-20
2012-09-22
2012-09-24
2012-09-26
2012-09-28
2012-09-30
VMR [ppmv]
>5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
<0.0


O_3 Profile bias (NORS-MACC)/NORS
(6-hourly mean, $25-60km$, FC fnyp, Ny Alesund MWR, 12/09/01 - 12/09/30)
Height [km] or [hPa]
60
55
50
45
40
35
30
25
10^0
10^1
2012-09-02
2012-09-04
2012-09-06
2012-09-08
2012-09-10
2012-09-12
2012-09-14
2012-09-16
2012-09-18
2012-09-20
2012-09-22
2012-09-24
2012-09-26
2012-09-28
2012-09-30
>50
40
30
20
10
0
−10
−20
−30
−40
<−50
Percentage %


Mean O_3 profiles MACC vs NORS
(25 – 60km, FC fnyp, Ny Alesund MWR, 12/09/01 - 12/09/30)
NORS mean profile (STD in dark gray)
MACC mean profile (STD in light gray)
Height [km] or Pressure [hPa]
VMR [ppv]
60
55
50
45
40
35
30
25
0
1
2
3
4
5
6
10^0
10^1


O_3 profile bias and standard deviation
(25 – 60km, FC fnyp, Ny Alesund MWR, 12/09/01 - 12/09/30)
Height [km] or [hPa]
60
55
50
45
40
35
30
25
10^0
10^1
−0.2
0.0
0.2
0.4
0.6
0.8
1.0
%

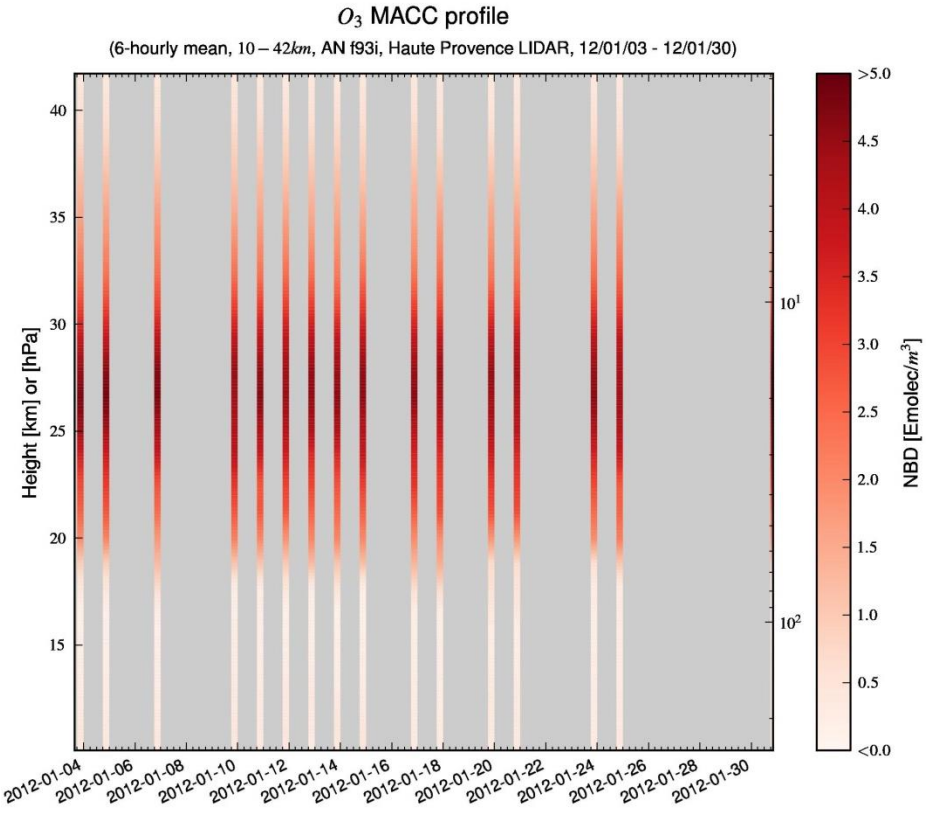

O_3 total column values
(25 – 60km, FC fnyp, Ny Alesund MWR, 12/09/01 - 12/09/30)
NORS
Median= 2031.570
MACC
Median= 1944.122
$[Pmolec/cm^2]$
2800
2600
2400
2200
2000
1800
1600
1400
1200
2012-09-02
2012-09-04
2012-09-06
2012-09-08
2012-09-10
2012-09-12
2012-09-14
2012-09-16
2012-09-18
2012-09-20
2012-09-22
2012-09-24
2012-09-26
2012-09-28
2012-09-30

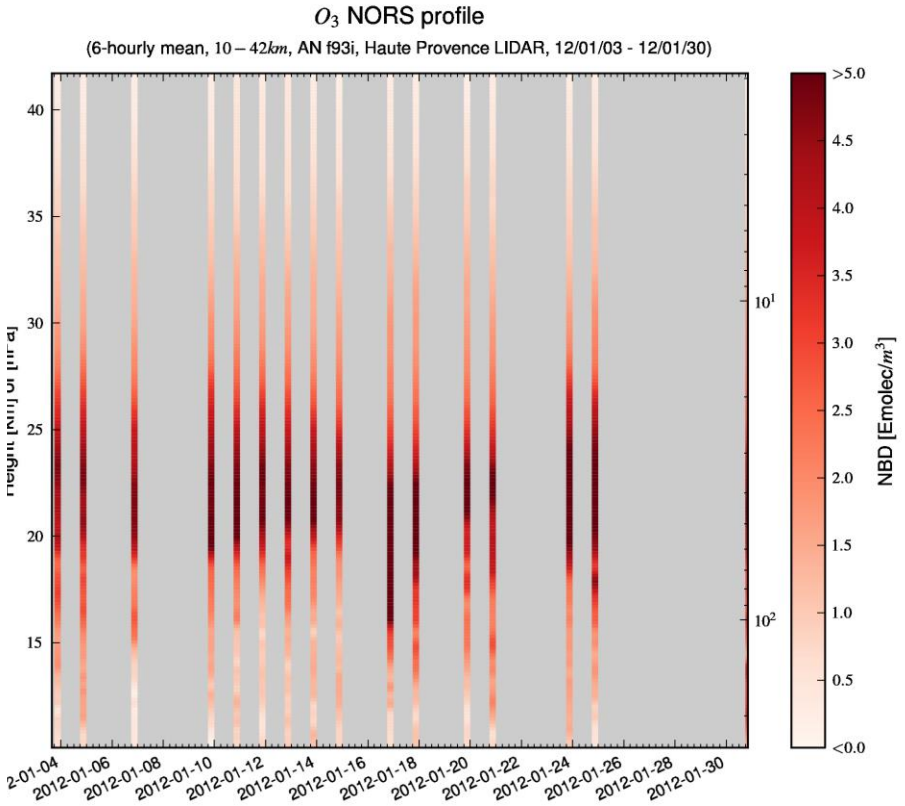

O_3 total column relative bias (NORS-MACC)/$\frac{1}{2}$ (MACC + NORS)
(25 – 60km, FC fnyp, Ny Alesund MWR, 12/09/01 - 12/09/30)
Modified normalized mean bias=4.072%
%
25
20
15
10
5
0
−5
−10
−15
2012-09-02
2012-09-04
2012-09-06
2012-09-08
2012-09-10
2012-09-12
2012-09-14
2012-09-16
2012-09-18
2012-09-20
2012-09-22
2012-09-24
2012-09-26
2012-09-28
2012-09-30

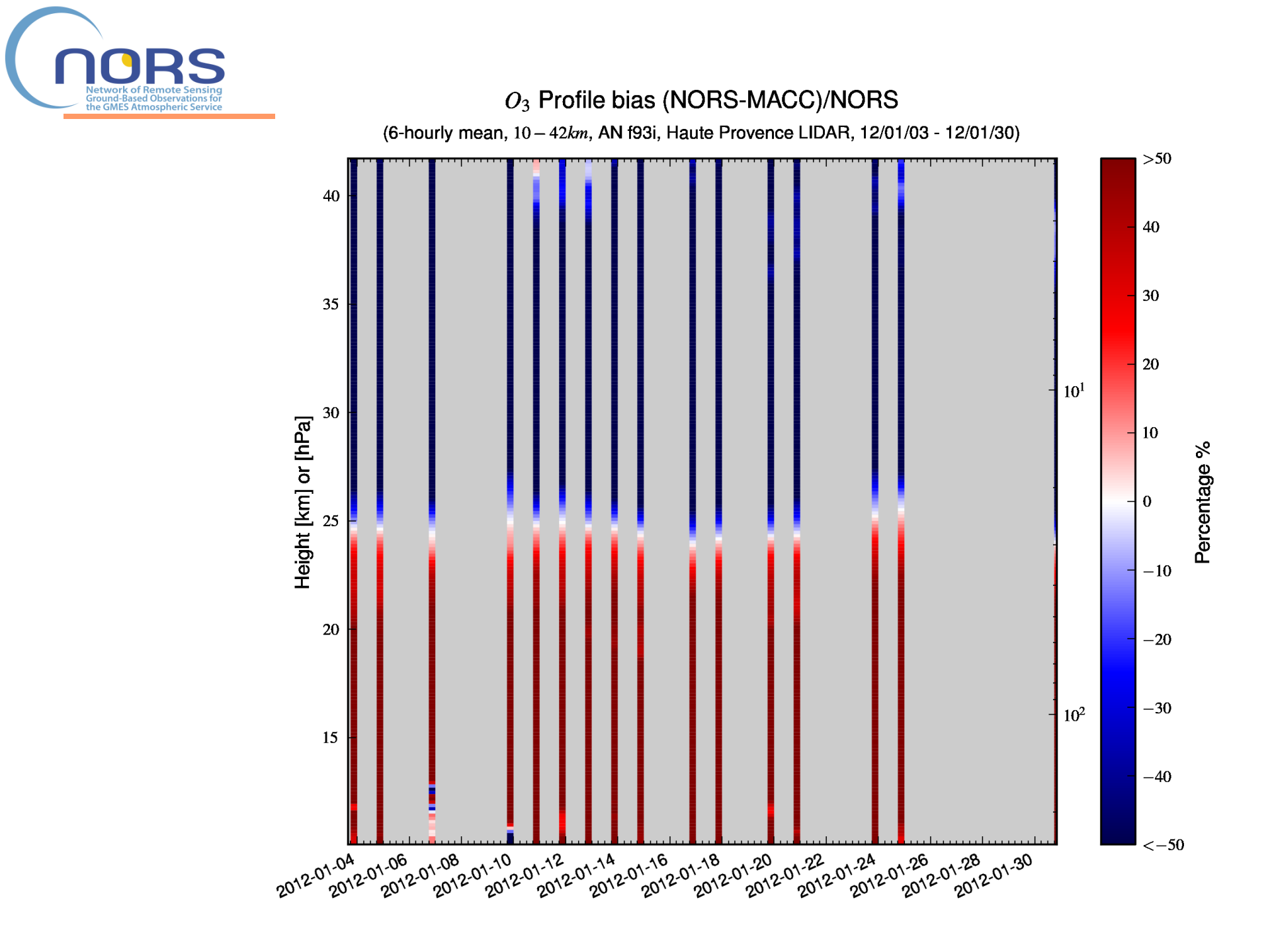
NORS
Network of Remote Sensing Ground-Based Observations for the GMES Atmospheric Service

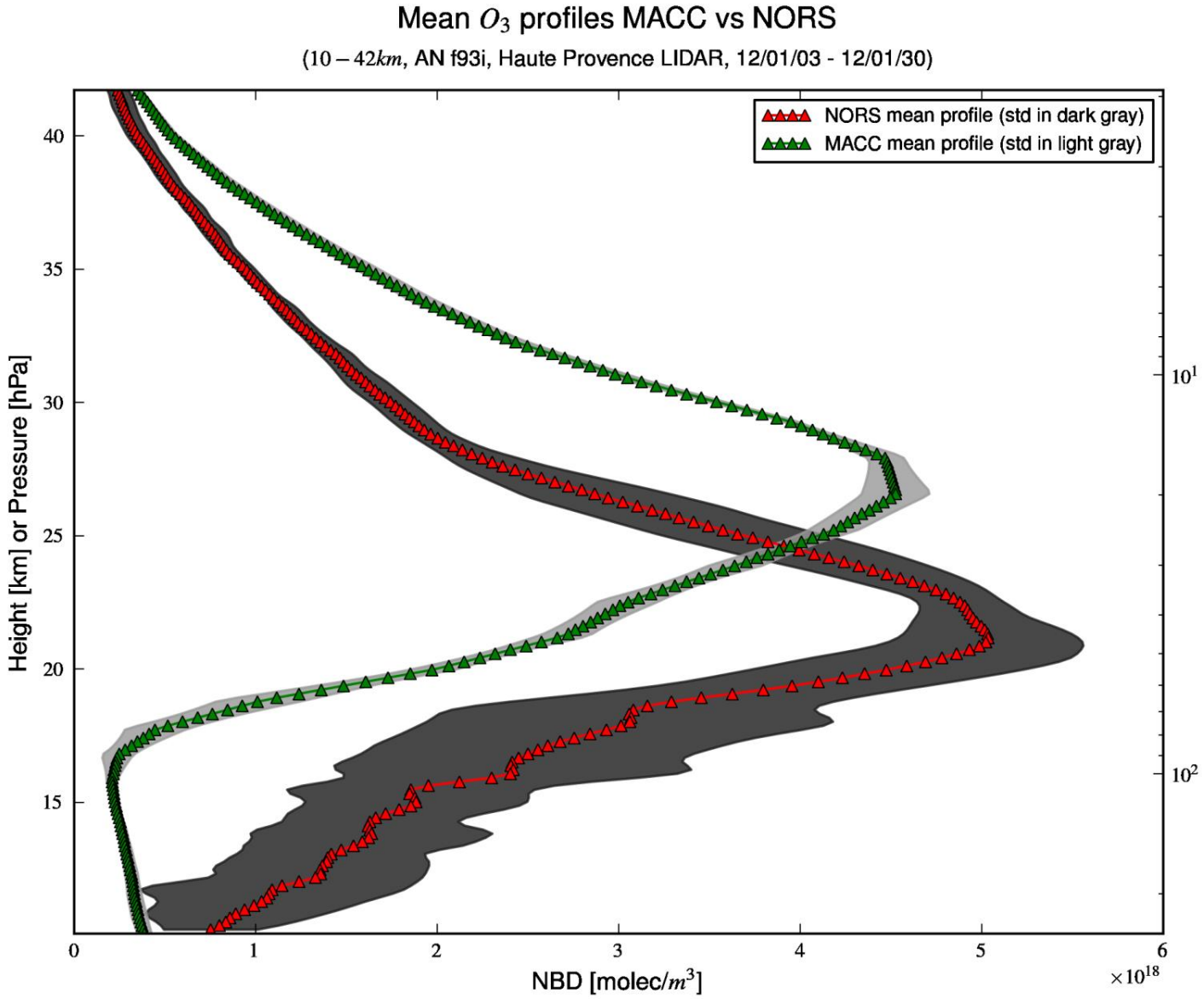
OZONE VERTICAL PROFILES ABOVE OHP (FRANCE) IN JAN. 2012:

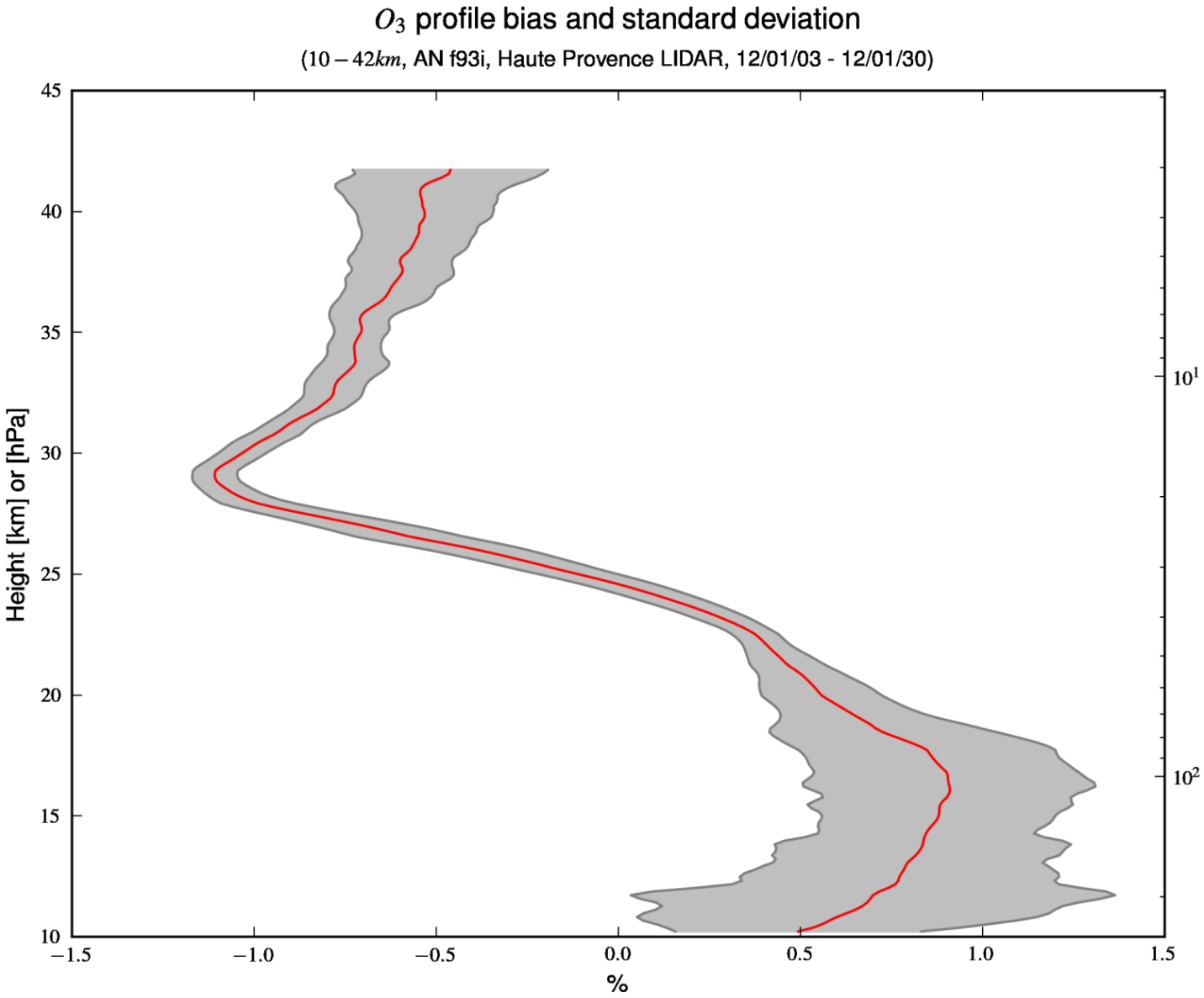
MACC-II F93YI PRODUCT COMPARED TO LIDAR DATA


O_3 MACC profile
(6-hourly mean, $10-42km$, AN f93i, Haute Provence LIDAR, 12/01/03 - 12/01/30)
Height [km] or [hPa]
NBD [Emolec/m^3]
>5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
<0.0
10^1
10^2
2012-01-04
2012-01-06
2012-01-08
2012-01-10
2012-01-12
2012-01-14
2012-01-16
2012-01-18
2012-01-20
2012-01-22
2012-01-24
2012-01-26
2012-01-28
2012-01-30


O_3 NORS profile
(6-hourly mean, $10-42km$, AN f93i, Haute Provence LIDAR, 12/01/03 - 12/01/30)
NBD [Emolec/m^3]
>5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
<0.0
10^1
10^2
2012-01-06
2012-01-08
2012-01-10
2012-01-12
2012-01-14
2012-01-16
2012-01-18
2012-01-20
2012-01-22
2012-01-24
2012-01-26
2012-01-28
2012-01-30

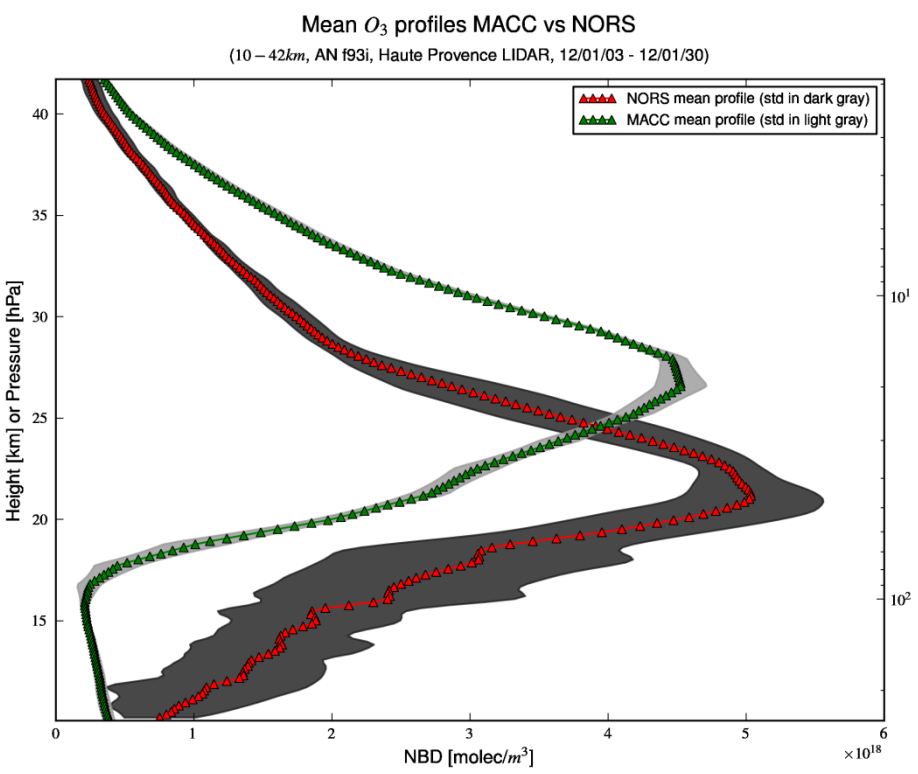

O_3 Profile bias (NORS-MACC)/NORS
(6-hourly mean, $10-42km$, AN f93i, Haute Provence LIDAR, 12/01/03 - 12/01/30)
Height [km] or [hPa]
40
35
30
25
20
15
10^1
10^2
2012-01-04
2012-01-06
2012-01-08
2012-01-10
2012-01-12
2012-01-14
2012-01-16
2012-01-18
2012-01-20
2012-01-22
2012-01-24
2012-01-26
2012-01-28
2012-01-30
>50
40
30
20
10
0
−10
−20
−30
−40
<−50
Percentage %

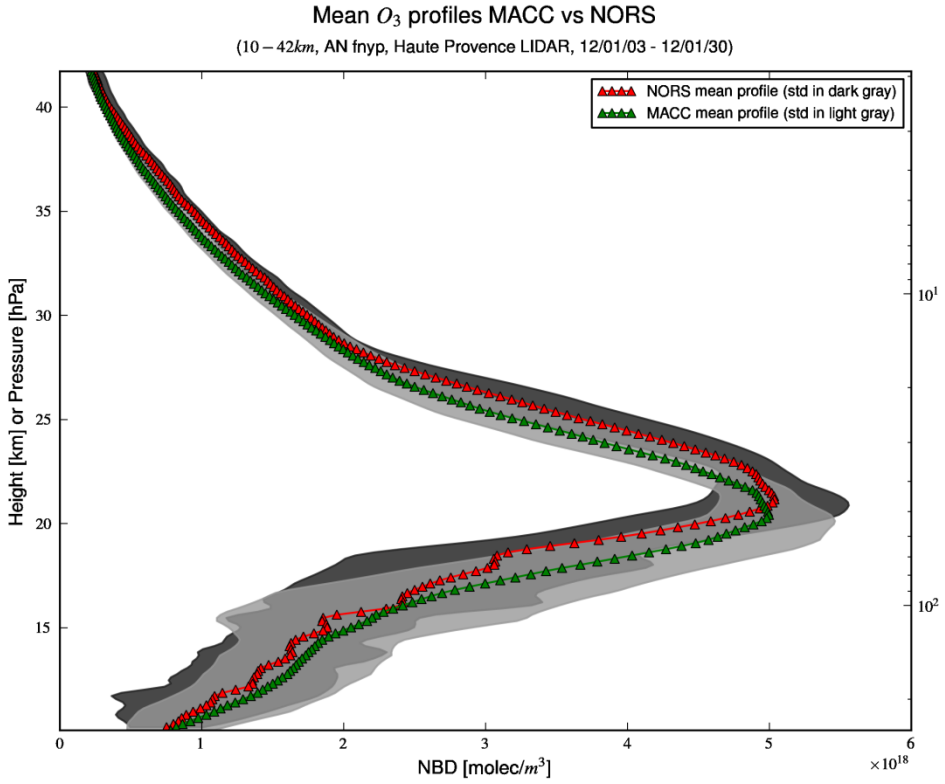

Mean O_3 profiles MACC vs NORS
(10 – 42km, AN f93i, Haute Provence LIDAR, 12/01/03 - 12/01/30)
NORS mean profile (std in dark gray)
MACC mean profile (std in light gray)
Height [km] or Pressure [hPa]
40
35
30
25
20
15
10^1
10^2
0
1
2
3
4
5
6
NBD [molec/m^3]
$\times 10^{18}$


O_3 profile bias and standard deviation
(10 – 42km, AN f93i, Haute Provence LIDAR, 12/01/03 - 12/01/30)
Height [km] or [hPa]
45
40
35
30
25
20
15
10
10^1
10^2
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
%

OZONE VERTICAL PROFILES ABOVE OHP (FRANCE) IN JAN. 2012:

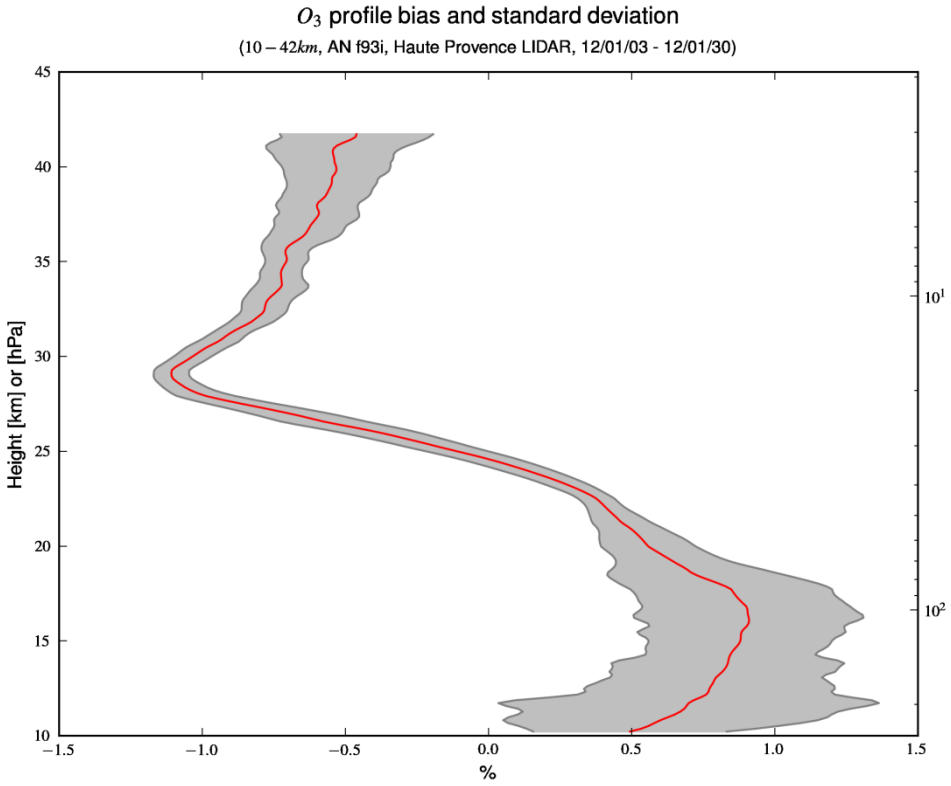
MACC-II F93YI COMPARED TO MACC-II FNYPAN2012 PRODUCT

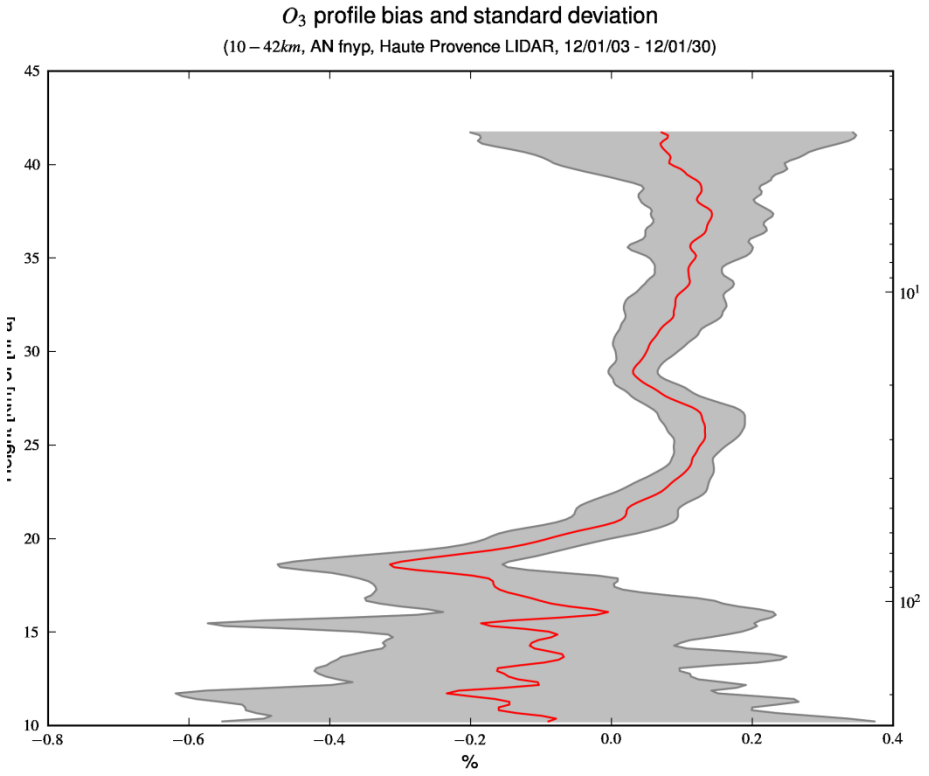




MACC-II f93i

MACC-II fnyp



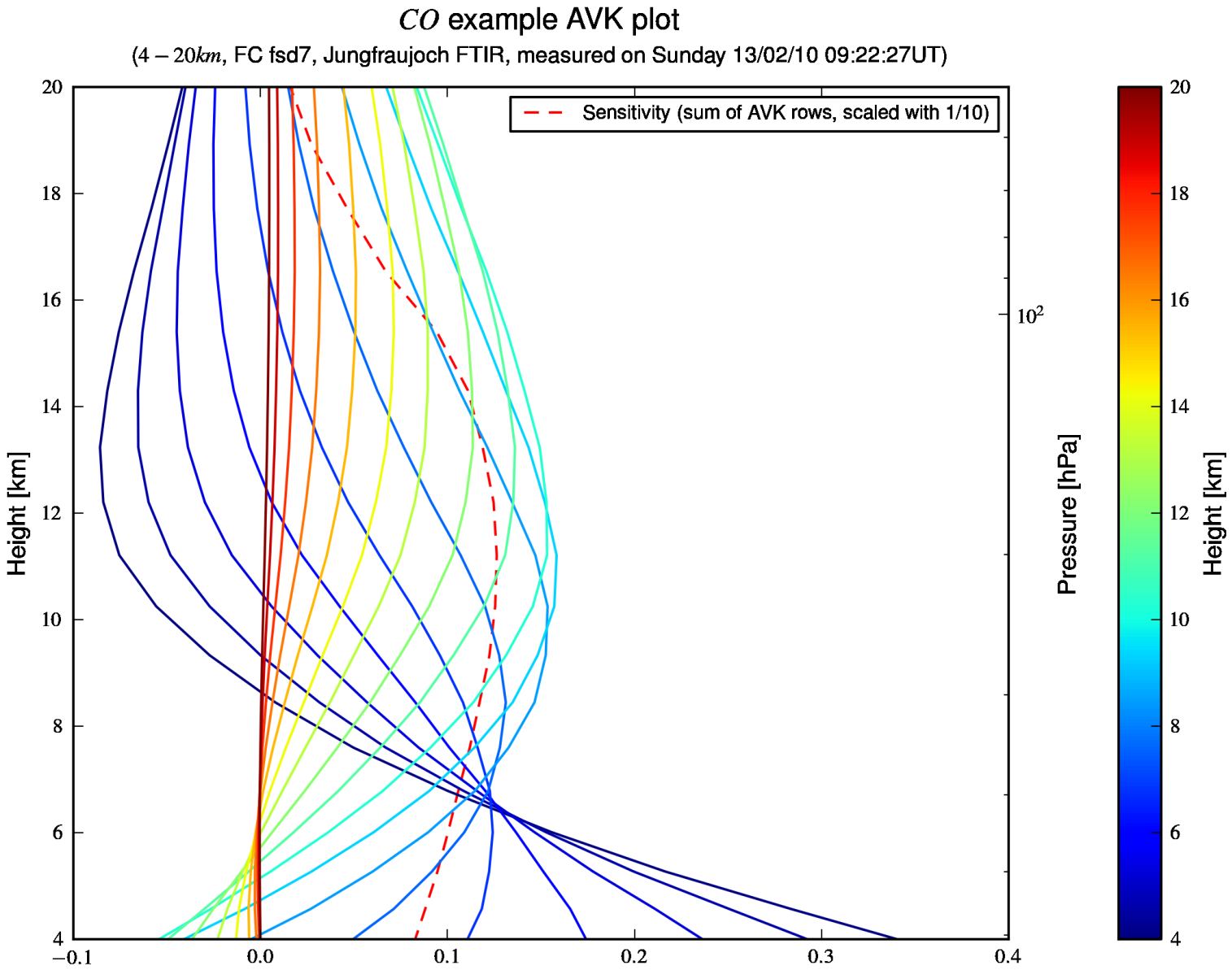


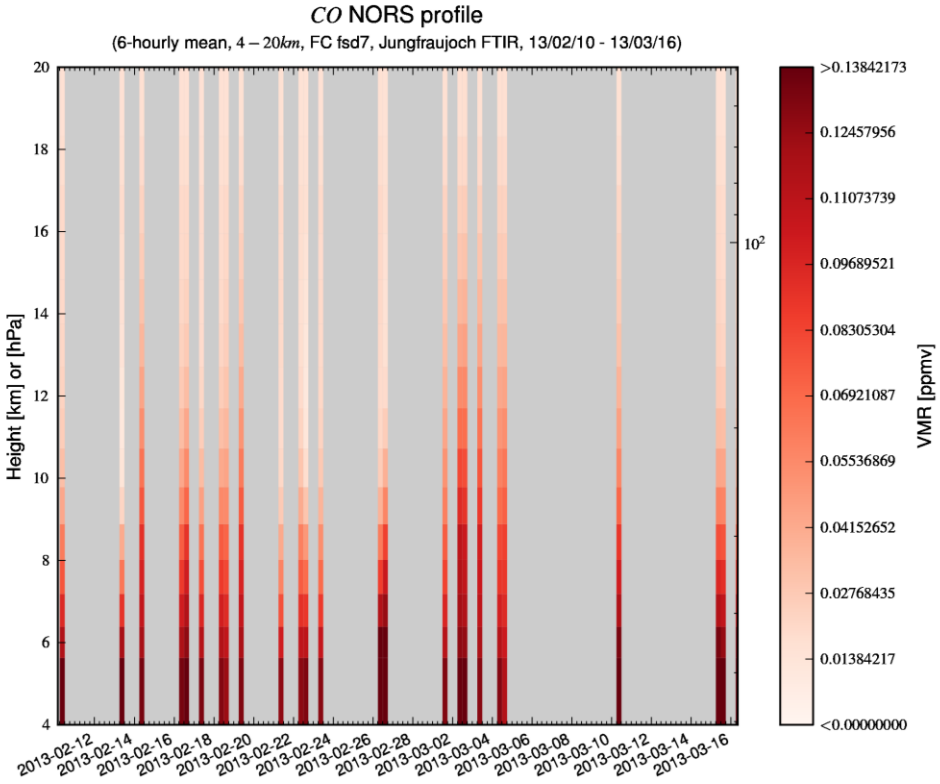
MACC-II f93i

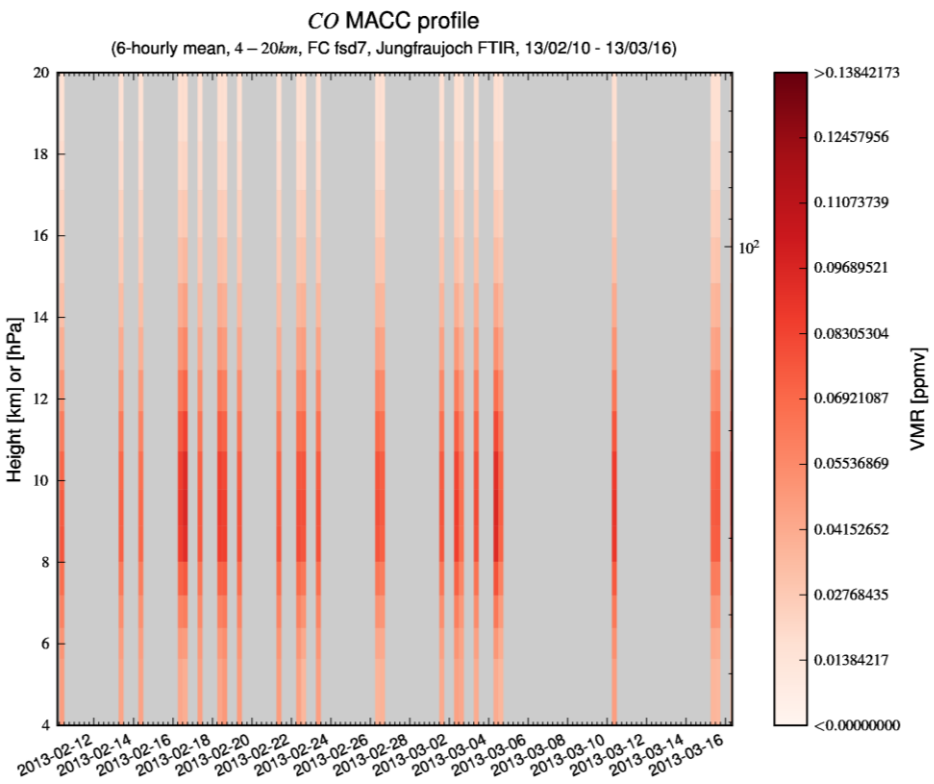
MACC-II fnyp

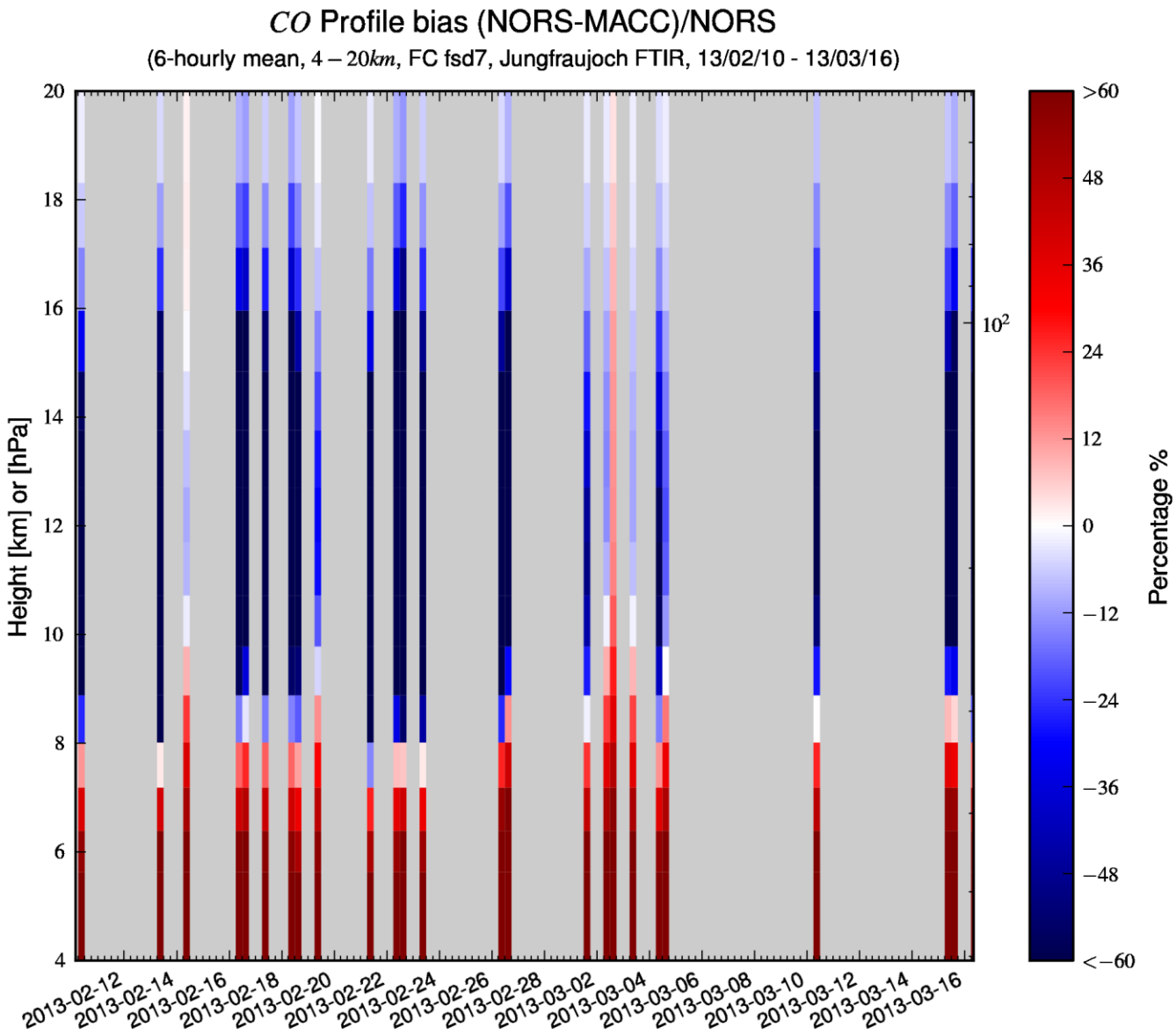
CARBON MONOXIDE (CO) (PARTIAL) COLUMNS ABOVE JUNGFRAUJOCH (SWISS ALPS) FROM MID-FEB. 2013 TO MID-MARCH 2013:

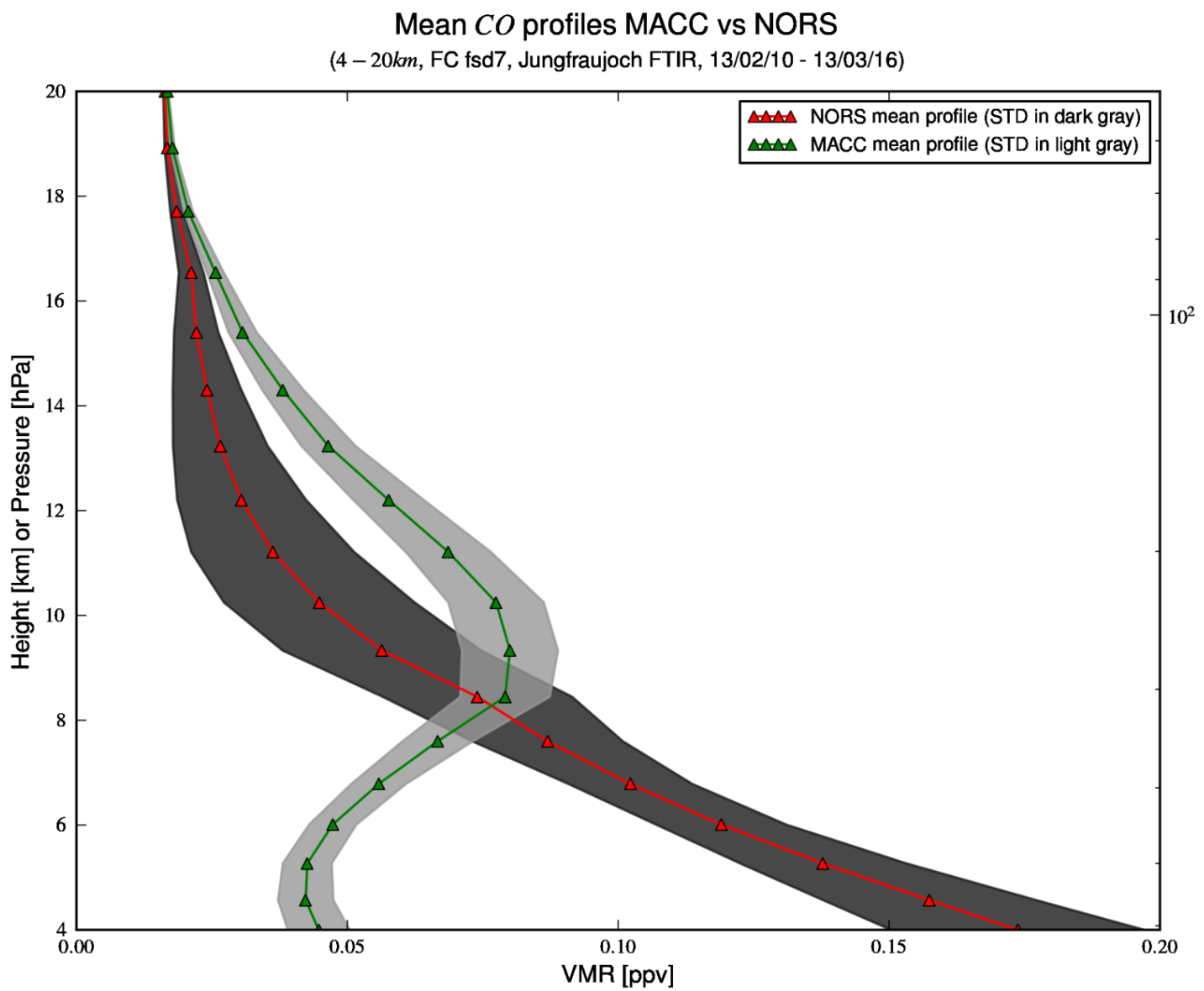
MACC-II FSD7 PRODUCT COMPARED TO FTIR DATA

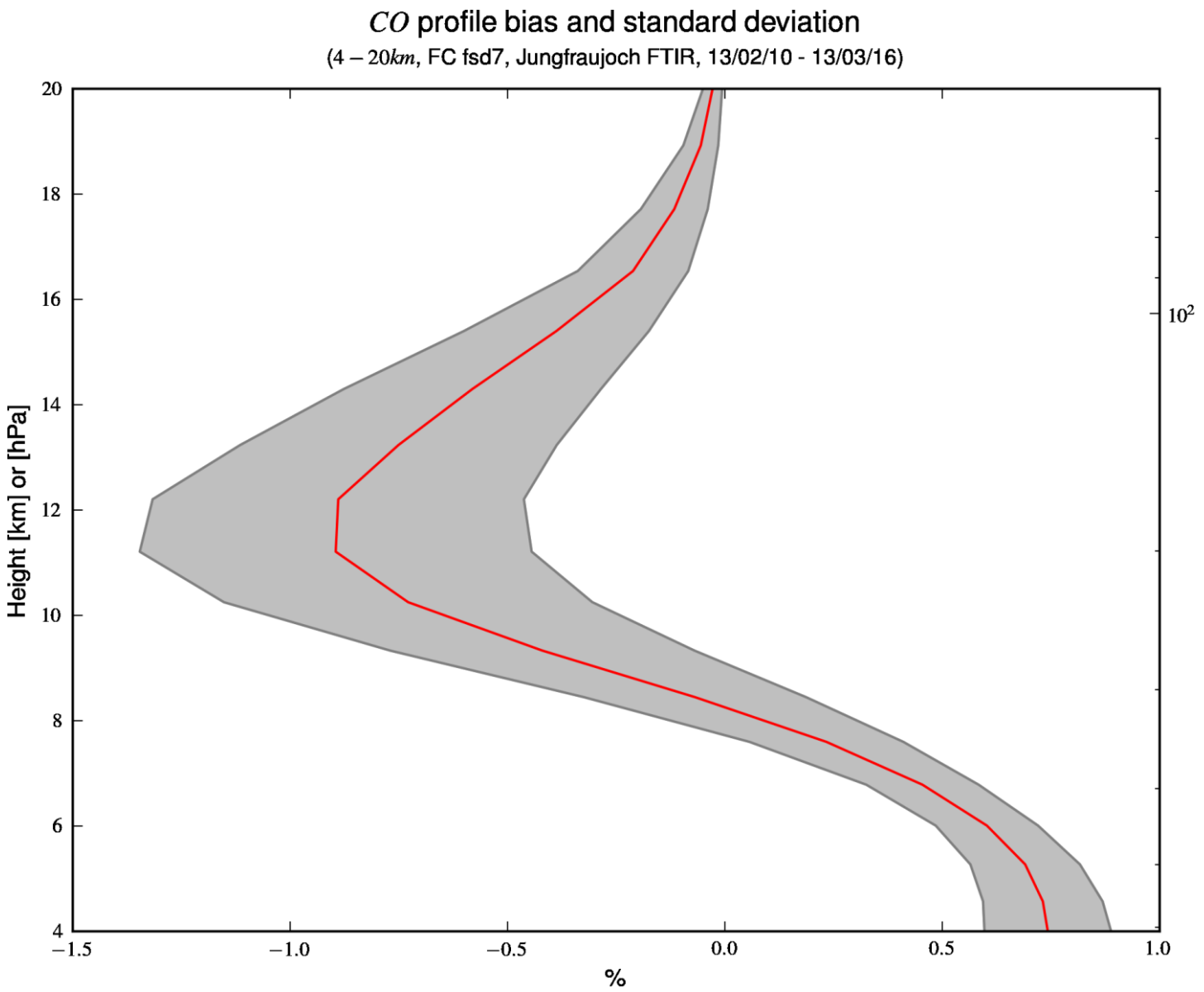

CO example AVK plot
(4 – 20km, FC fsd7, Jungfraujoch FTIR, measured on Sunday 13/02/10 09:22:27UT)
Sensitivity (sum of AVK rows, scaled with 1/10)
Height [km]
Pressure [hPa]
Height [km]
20
18
16
14
12
10
8
6
4
−0.1
0.0
0.1
0.2
0.3
0.4
10^2

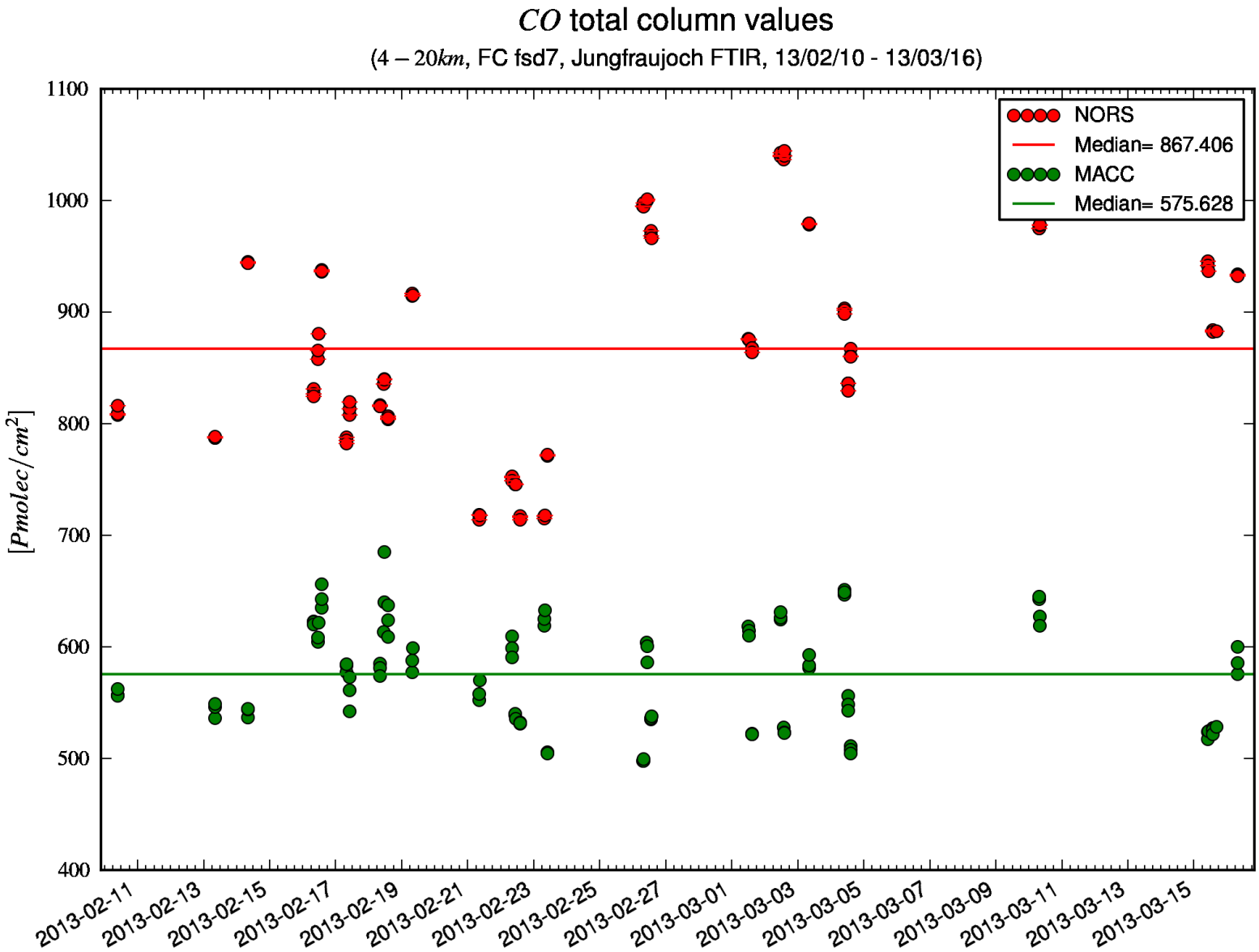

CO NORS profile
(6-hourly mean, 4 – 20km, FC fsd7, Jungfraujoch FTIR, 13/02/10 - 13/03/16)
Height [km] or [hPa]
VMR [ppmv]
>0.13842173
0.12457956
0.11073739
0.09689521
0.08305304
0.06921087
0.05536869
0.04152652
0.02768435
0.01384217
<0.00000000
10^2

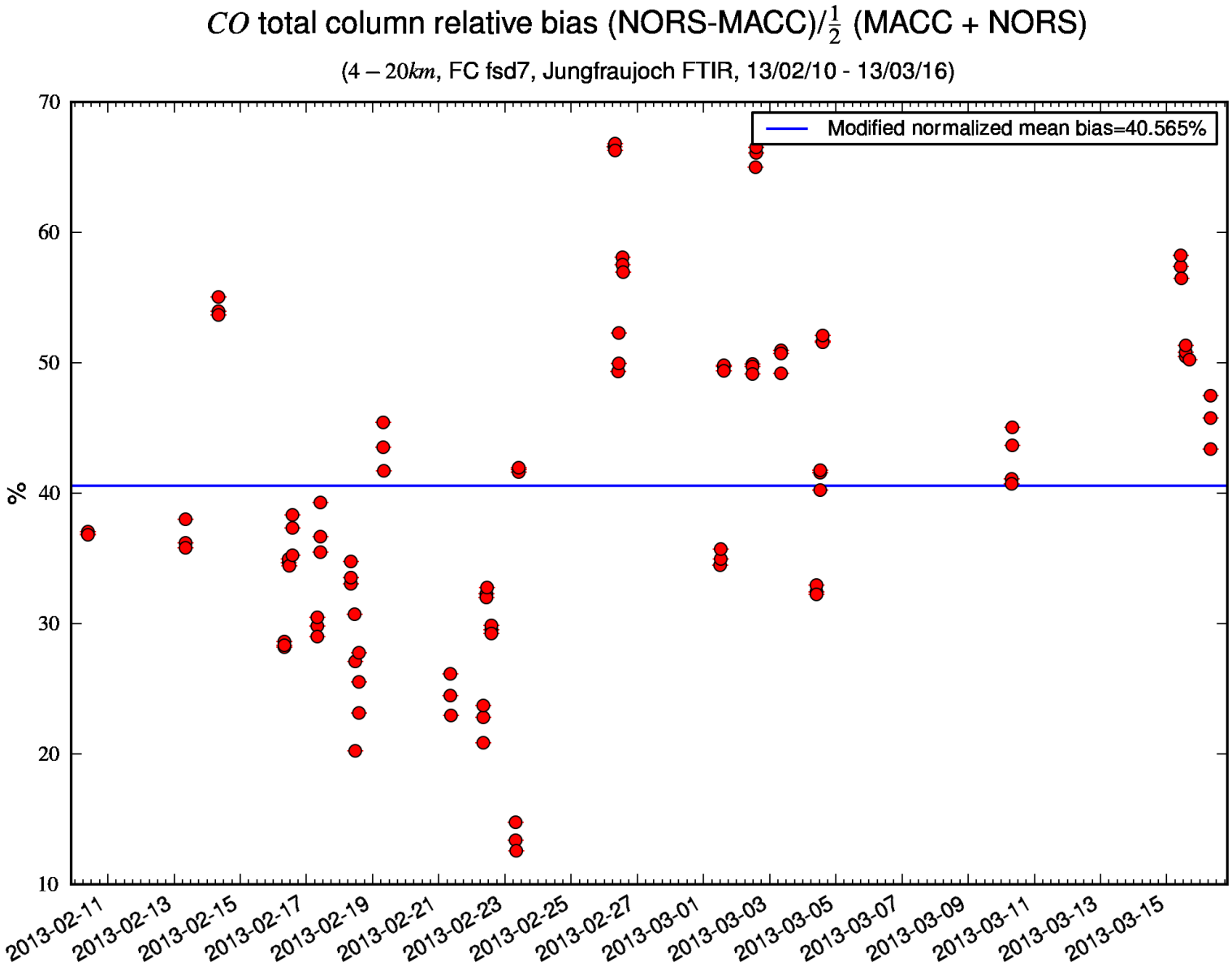

CO MACC profile
(6-hourly mean, 4 – 20km, FC fsd7, Jungfraujoch FTIR, 13/02/10 - 13/03/16)
Height [km] or [hPa]
VMR [ppmv]
>0.13842173
0.12457956
0.11073739
0.09689521
0.08305304
0.06921087
0.05536869
0.04152652
0.02768435
0.01384217
<0.00000000
10^2


CO Profile bias (NORS-MACC)/NORS
(6-hourly mean, 4 – 20km, FC fsd7, Jungfraujoch FTIR, 13/02/10 - 13/03/16)
Height [km] or [hPa]
20
18
16
14
12
10
8
6
4
10^2
2013-02-12
2013-02-14
2013-02-16
2013-02-18
2013-02-20
2013-02-22
2013-02-24
2013-02-26
2013-02-28
2013-03-02
2013-03-04
2013-03-06
2013-03-08
2013-03-10
2013-03-12
2013-03-14
2013-03-16
>60
48
36
24
12
0
−12
−24
−36
−48
<−60
Percentage %


Mean CO profiles MACC vs NORS
(4 – 20km, FC fsd7, Jungfraujoch FTIR, 13/02/10 - 13/03/16)
NORS mean profile (STD in dark gray)
MACC mean profile (STD in light gray)
Height [km] or Pressure [hPa]
20
18
16
14
12
10
8
6
4
10^2
0.00
0.05
0.10
0.15
0.20
VMR [ppv]


CO profile bias and standard deviation
(4 – 20km, FC fsd7, Jungfraujoch FTIR, 13/02/10 - 13/03/16)
Height [km] or [hPa]
20
18
16
14
12
10
8
6
4
10^2
−1.5
−1.0
−0.5
0.0
0.5
1.0
%


CO total column values
(4 – 20km, FC fsd7, Jungfraujoch FTIR, 13/02/10 - 13/03/16)
NORS
Median= 867.406
MACC
Median= 575.628
[Pmolec/cm²]
1100
1000
900
800
700
600
500
400
2013-02-11
2013-02-13
2013-02-15
2013-02-17
2013-02-19
2013-02-21
2013-02-23
2013-02-25
2013-02-27
2013-03-01
2013-03-03
2013-03-05
2013-03-07
2013-03-09
2013-03-11
2013-03-13
2013-03-15


CO total column relative bias (NORS-MACC)/$\frac{1}{2}$ (MACC + NORS)
(4 – 20km, FC fsd7, Jungfraujoch FTIR, 13/02/10 - 13/03/16)
Modified normalized mean bias=40.565%
%
70
60
50
40
30
20
10
2013-02-11
2013-02-13
2013-02-15
2013-02-17
2013-02-19
2013-02-21
2013-02-23
2013-02-25
2013-02-27
2013-03-01
2013-03-03
2013-03-05
2013-03-07
2013-03-09
2013-03-11
2013-03-13
2013-03-15

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

For more information, contact:

Martine De Mazière	Email: martine@oma.be
Bavo Langerock	Email: bavo.langerock@oma.be
Elien Raport	Email: elien.raport@oma.be