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Level 2 Algorithm Performance Assessment: Oxford Activities

Anu Dudhia, Chiara Piccolo & Vivienne Payne

- Anu Dudhia
  - Jitter residuals
  - NRT monitoring
- Chiara Piccolo
  - OFL-NRT Comparisons
- Vivienne Payne
  - Long Term trends

Jitter Signatures

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- Last meeting - ghost spectra at ±13.5cm^{-1} due to pointing jitter

- Any evidence in residual spectra?
  - Random amplitude each sweep, so cannot use averaged residuals
  - Use residual spectra from single sweeps @30km selected arbitrarily from NRT data, one per month
  - Simple least squares fit, converted to jitter pointing amplitude
  - Also fit ghosts at ±13.0cm^{-1} as a control

Jitter Signatures

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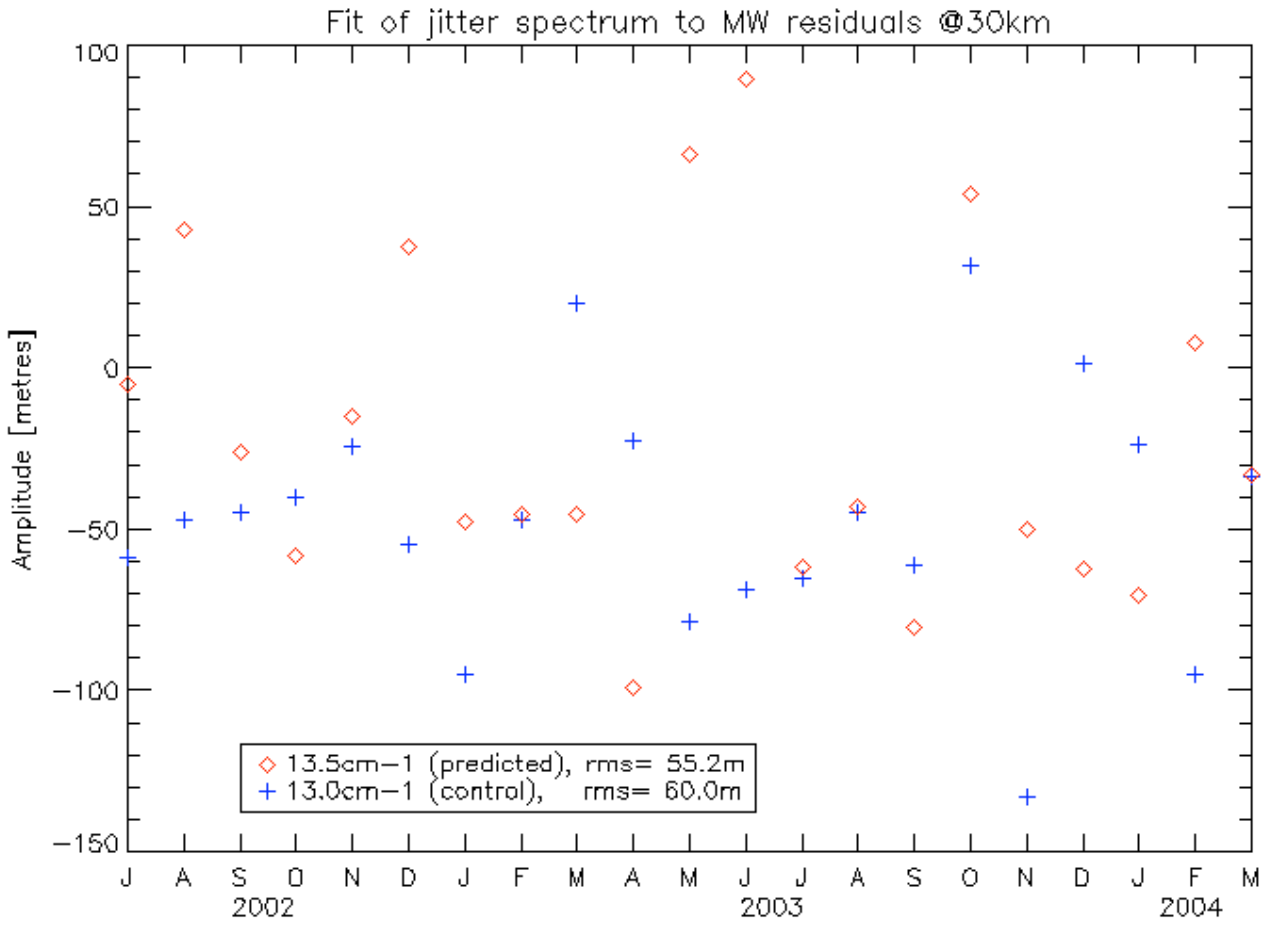

Jitter Signatures

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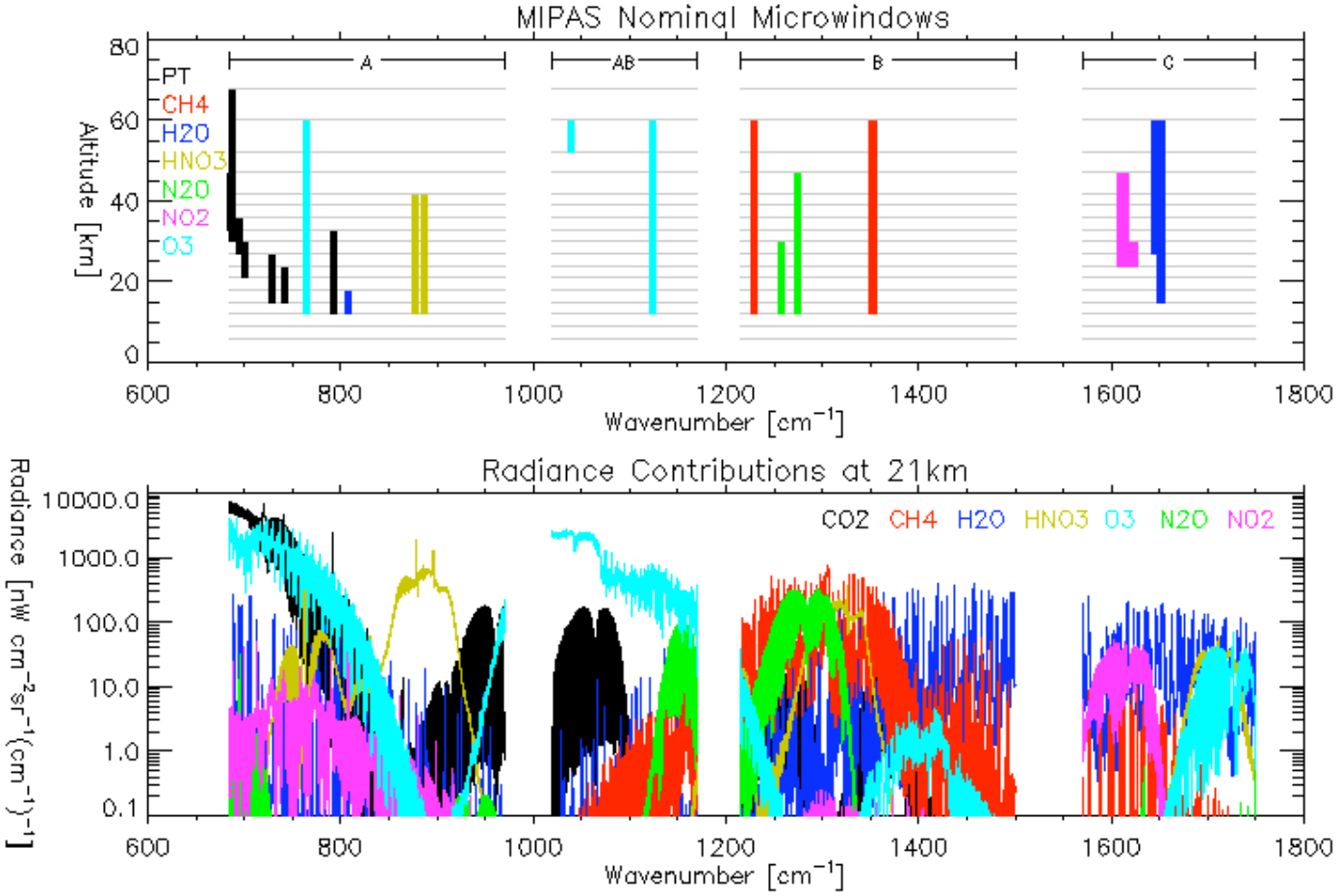

Jitter Signatures

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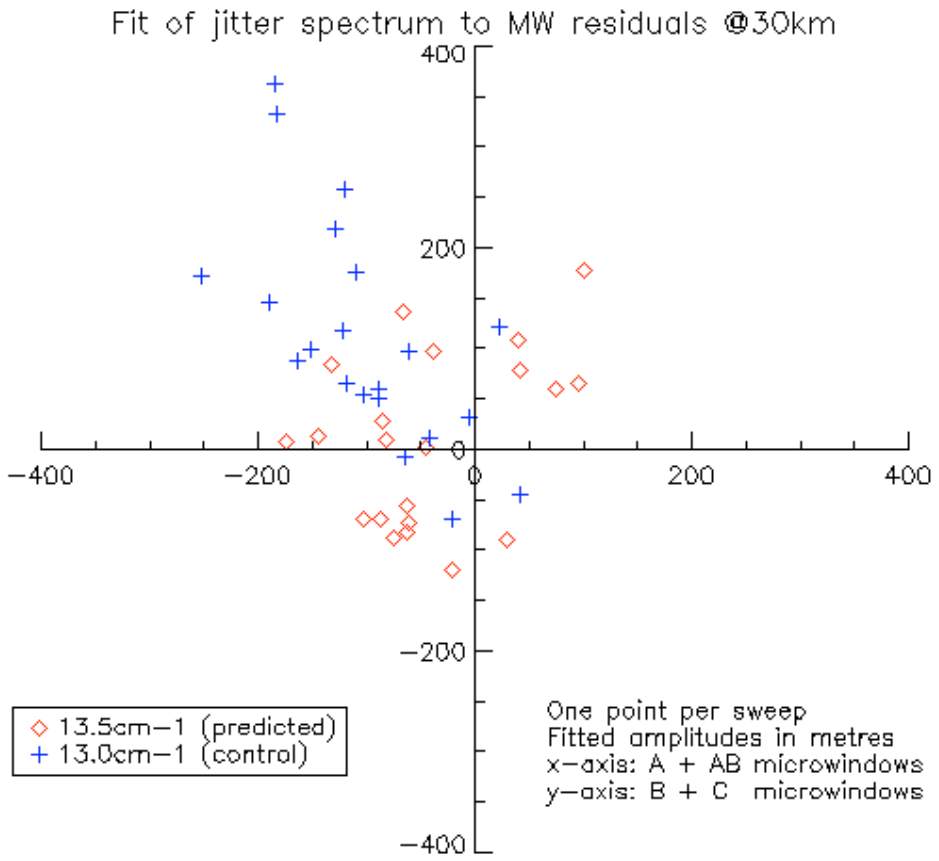

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Conclusion

No evidence of ±13.5cm^{-1} ghost spectra in NRT residuals

MIPAS Monitoring at Oxford

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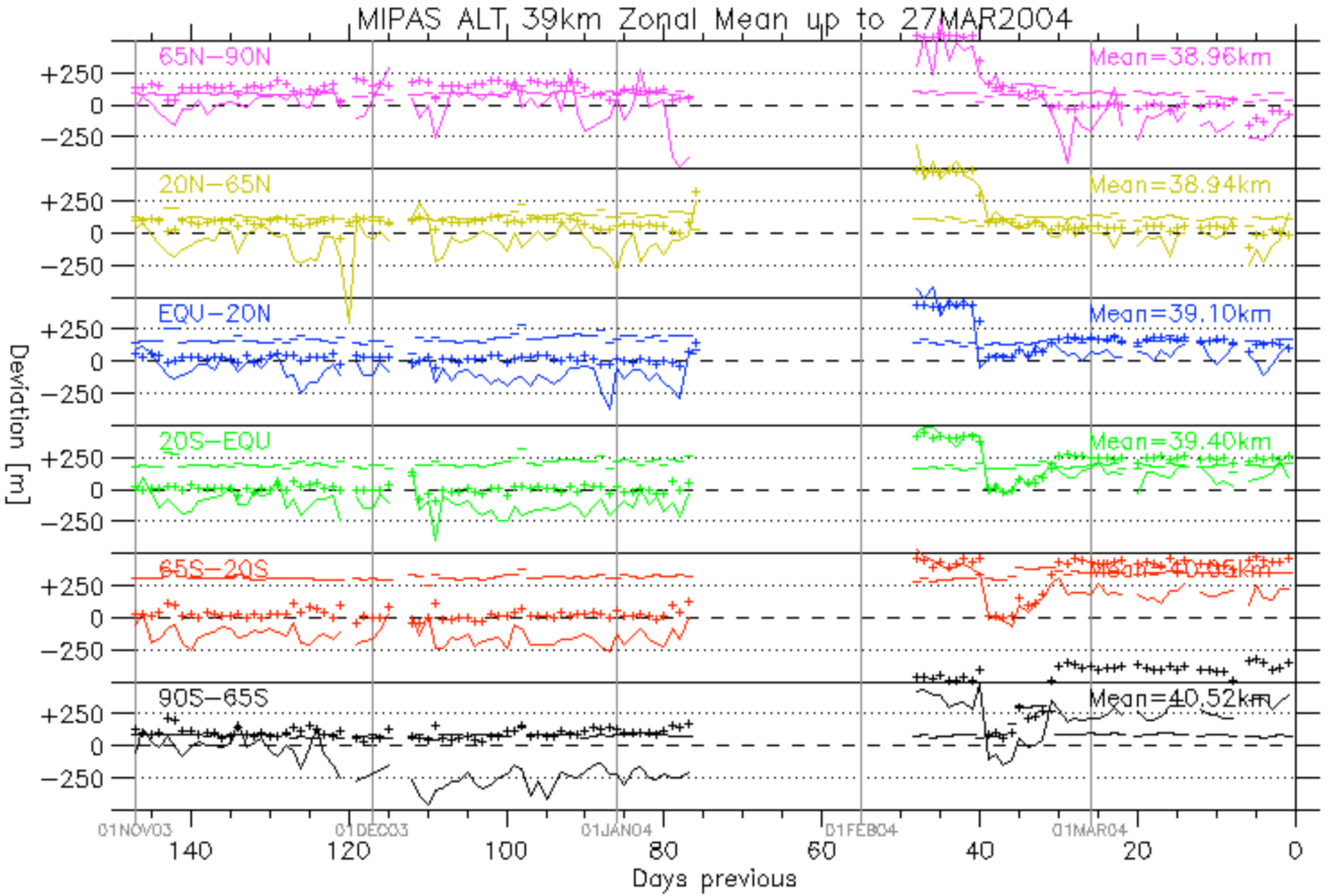
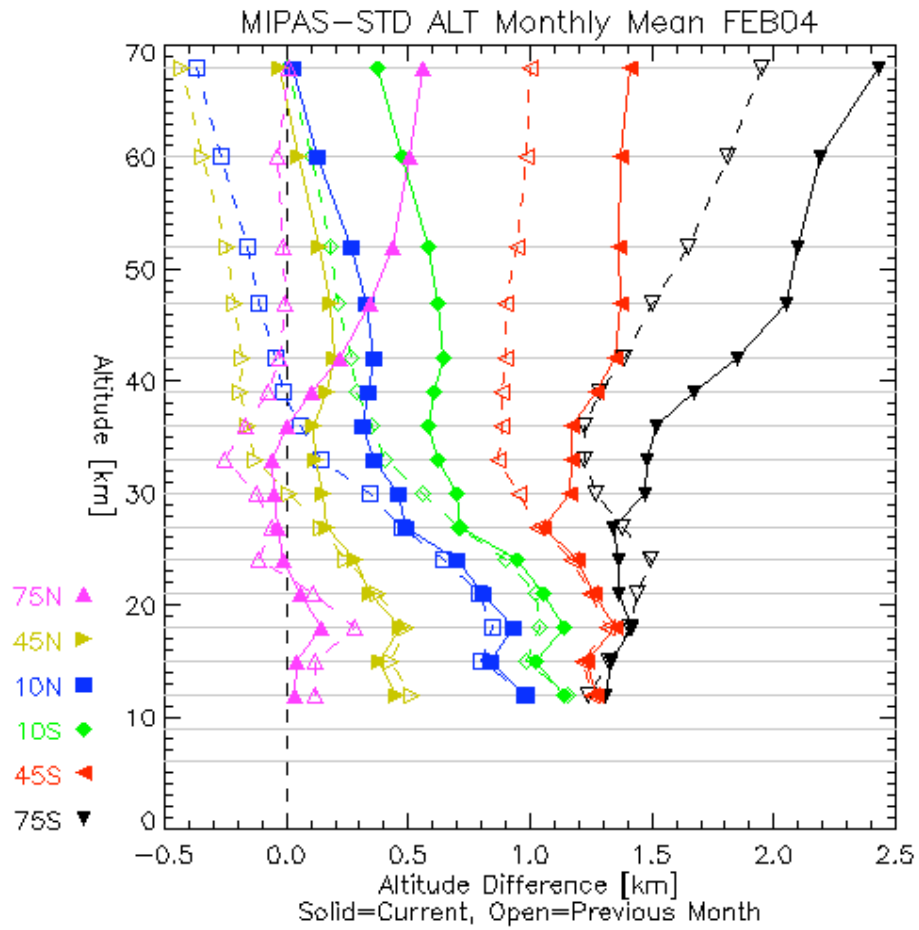
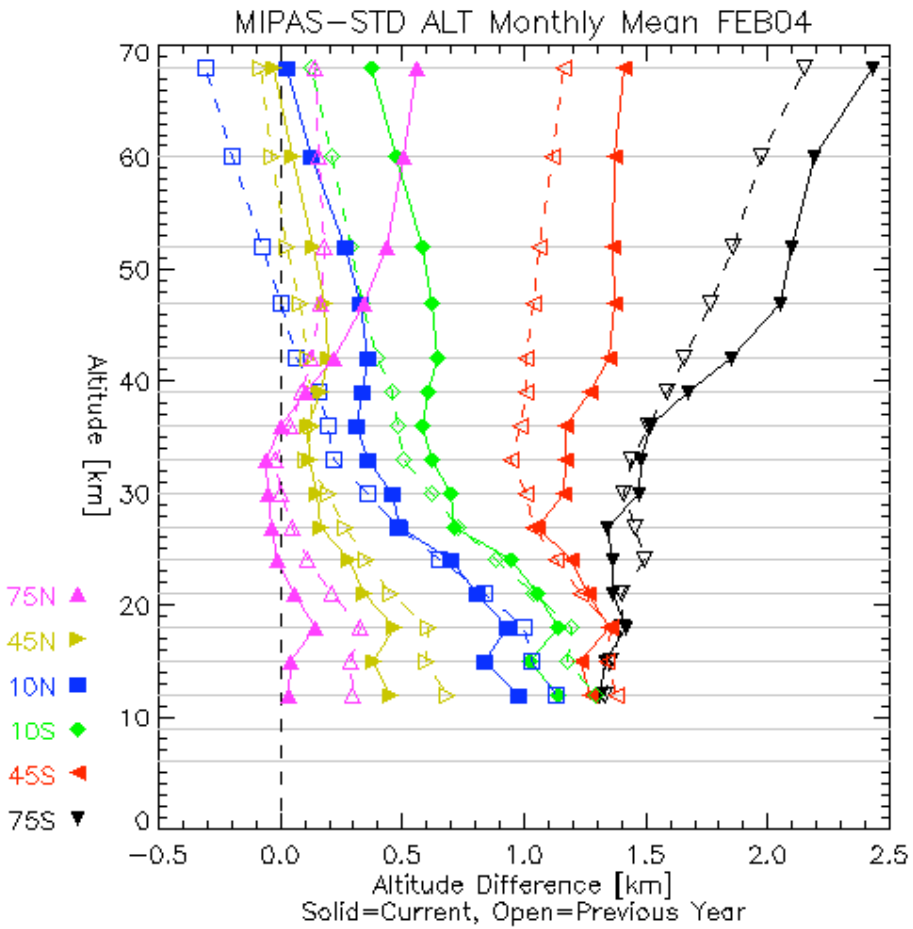
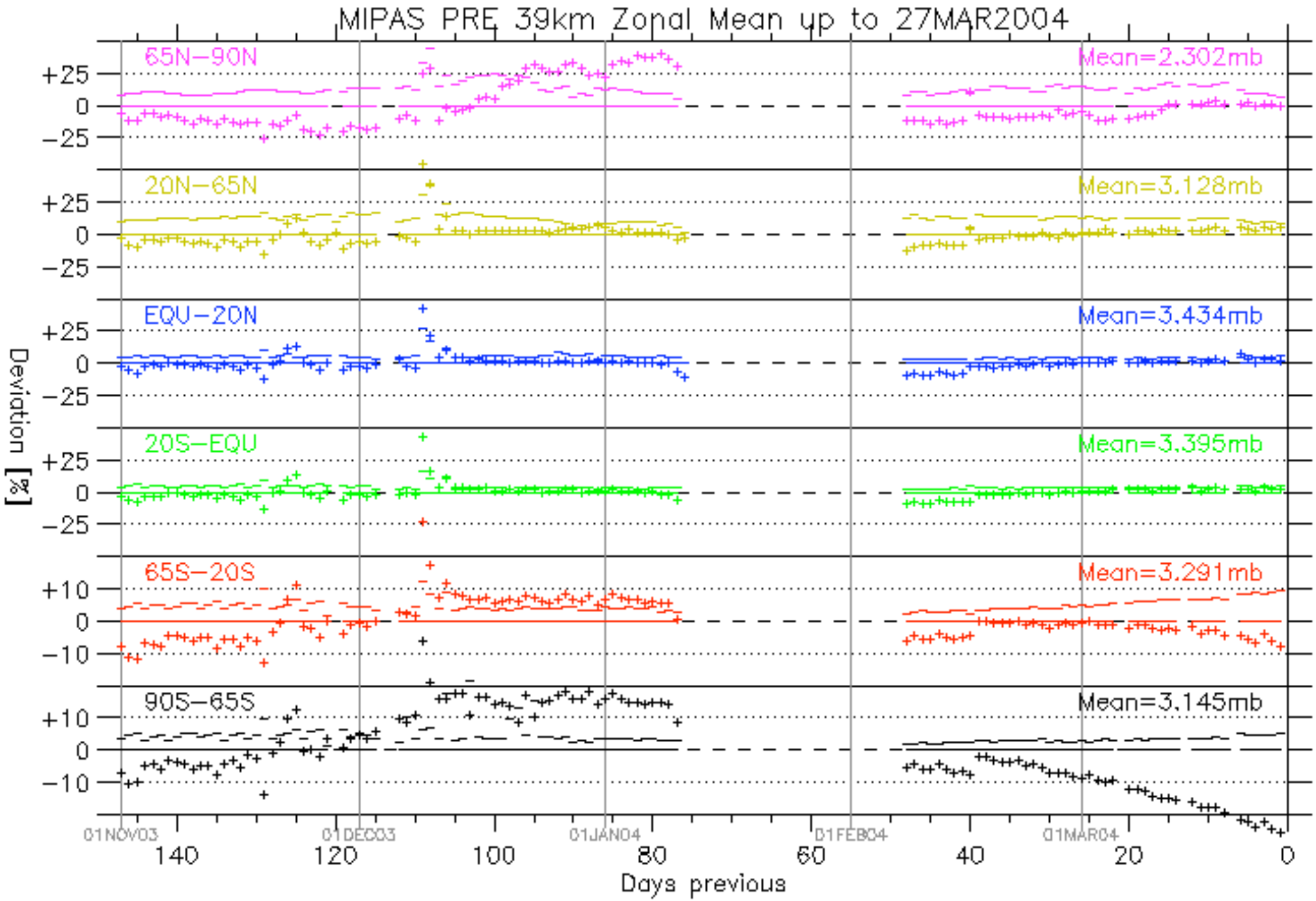
- Daily Means
- Profile Location Maps
- Monthly Means
- Occupation Matrix Statistics (monthly)
- REC Analyses (monthly)

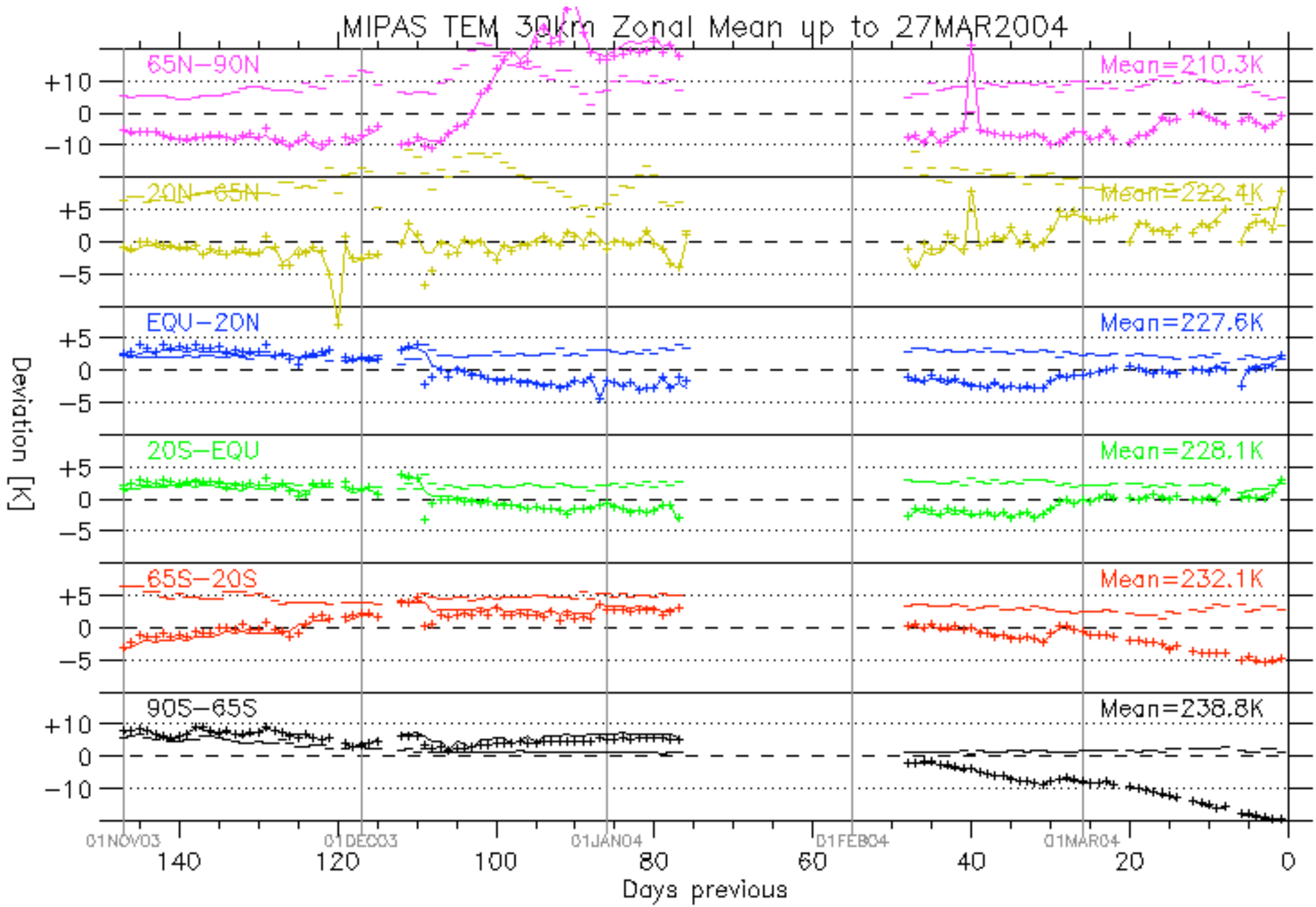
Results on web http://www.atm.ox.ac.uk/group/mipas/
and selected results provided for monthly reports

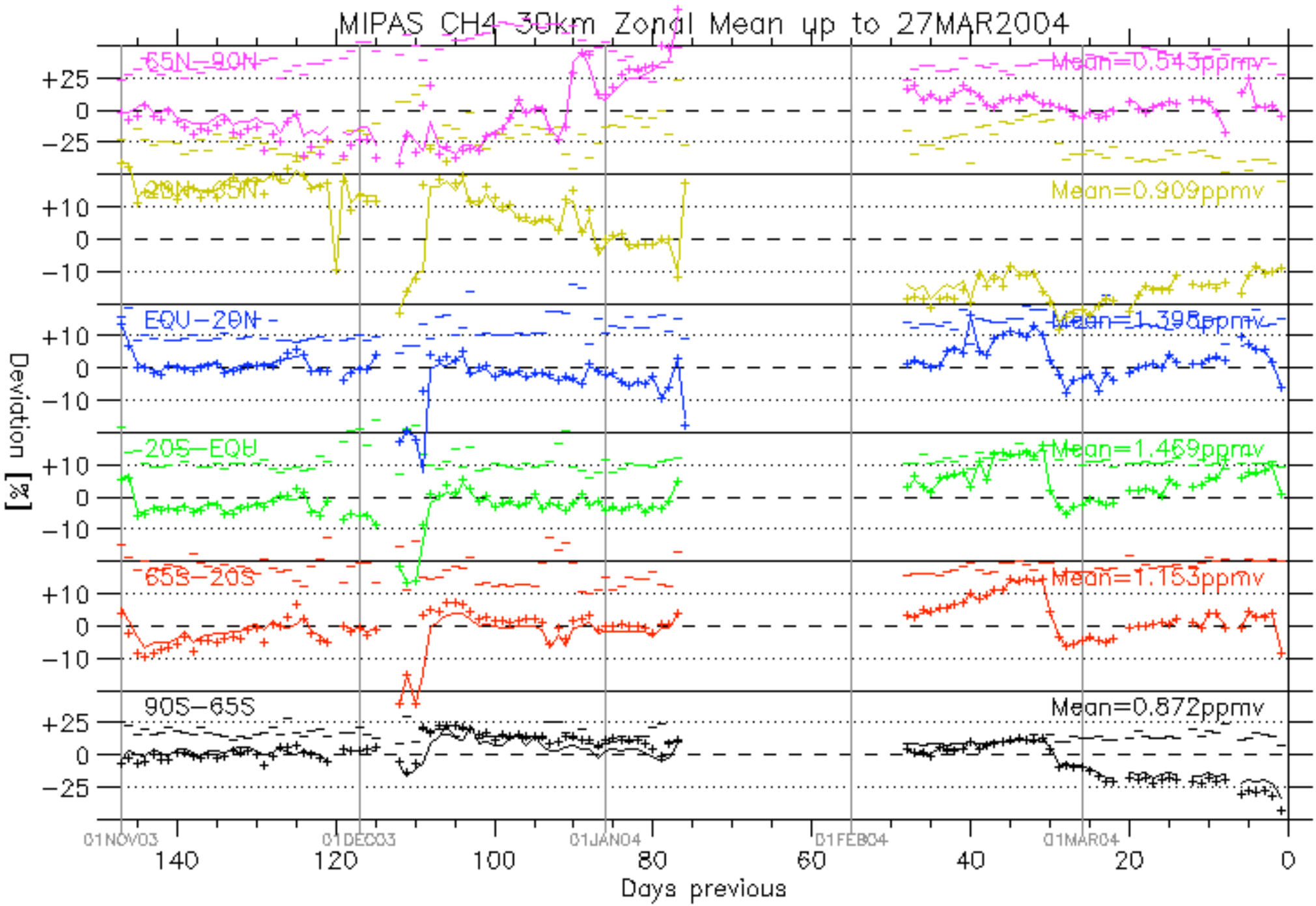

MIPAS ALT 39km Zonal Mean up to 27MAR2004
65N–90N
Mean=38.96km
20N–65N
Mean=38.94km
EQU–20N
Mean=39.10km
20S–EQU
Mean=39.40km
65S–20S
90S–65S
Mean=40.52km
+250
0
−250
Deviation [m]
01NOV03
01DEC03
01JAN04
01FEB04
01MAR04
140
120
100
80
60
40
20
0
Days previous

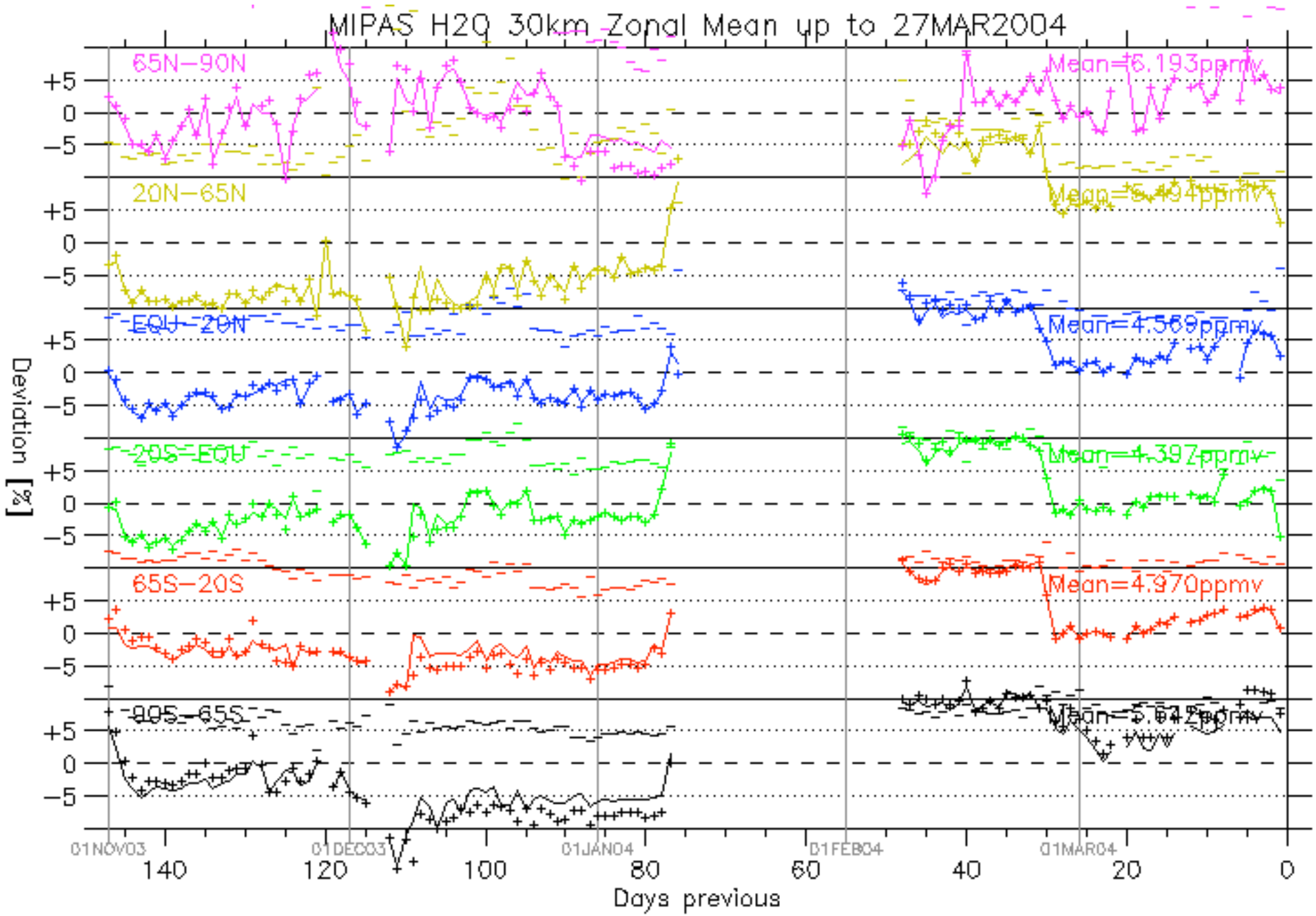

MIPAS−STD ALT Monthly Mean FEB04
Altitude [km]
Altitude Difference [km]
Solid=Current, Open=Previous Month
75N
45N
10N
10S
45S
75S

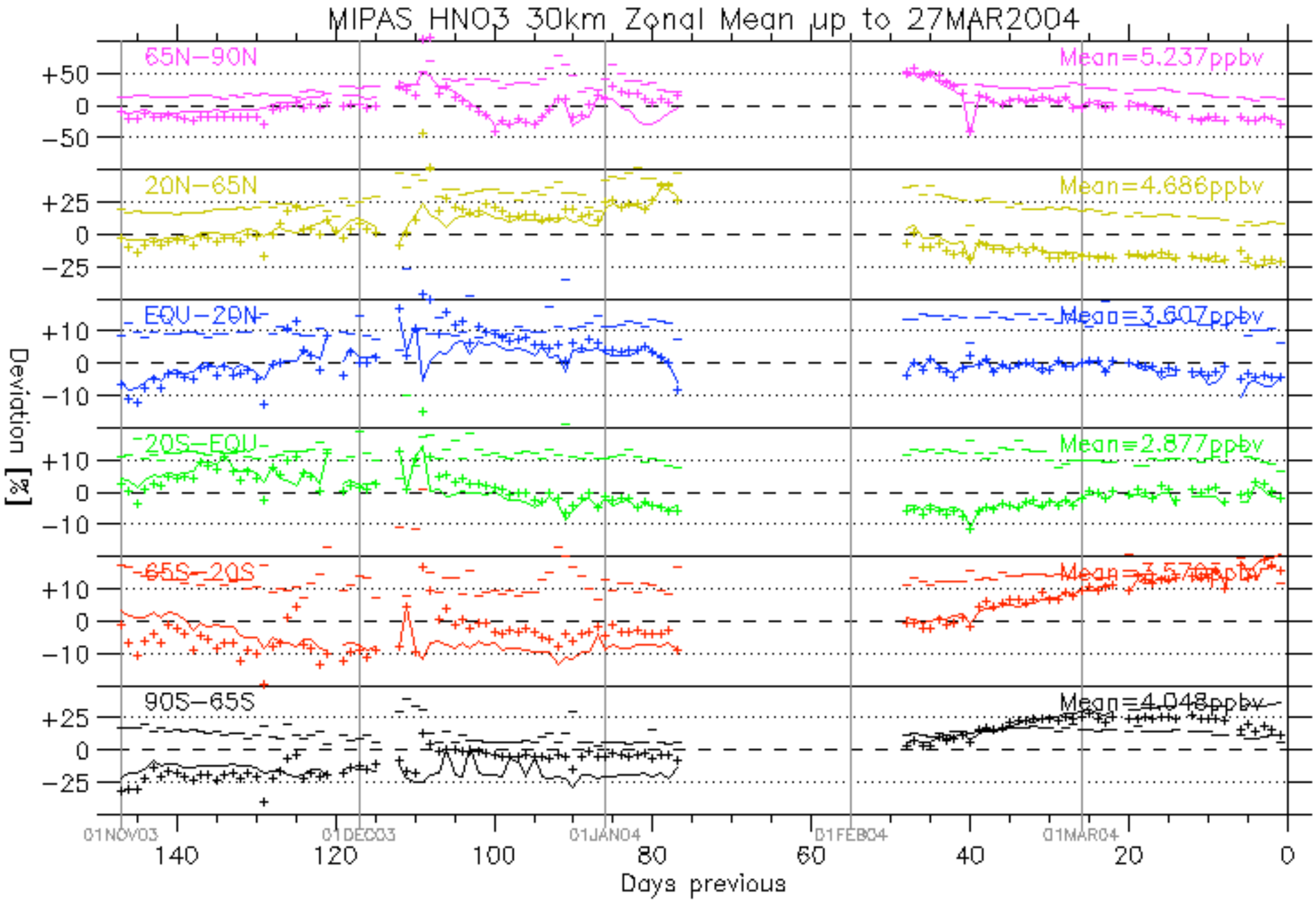

MIPAS−STD ALT Monthly Mean FEB04
Altitude [km]
Altitude Difference [km]
Solid=Current, Open=Previous Year
75N
45N
10N
10S
45S
75S

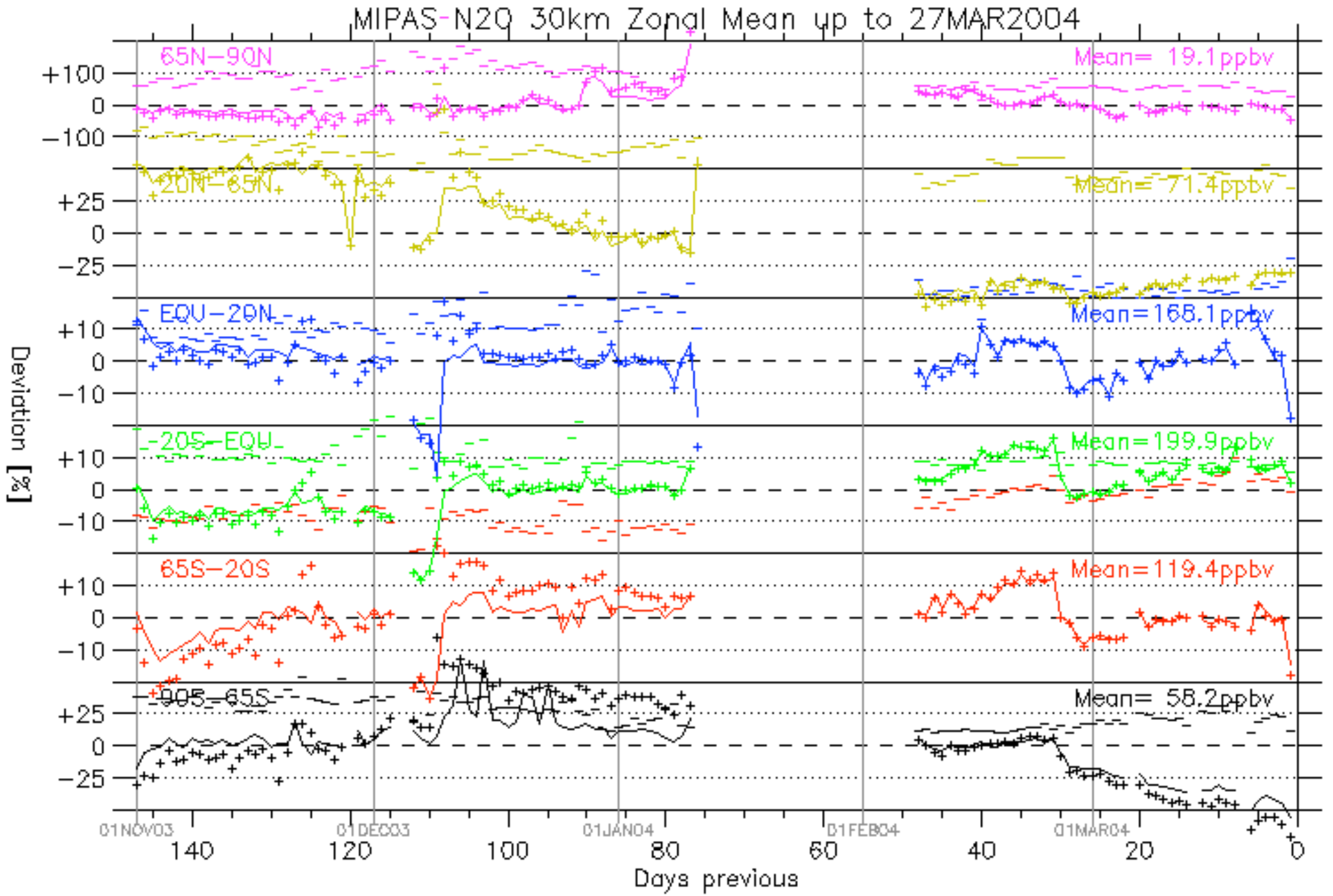

MIPAS PRE 39km Zonal Mean up to 27MAR2004
65N–90N
Mean=2.302mb
20N–65N
Mean=3.128mb
EQU–20N
Mean=3.434mb
20S–EQU
Mean=3.395mb
65S–20S
Mean=3.291mb
90S–65S
Mean=3.145mb
+25
0
−25
+10
−10
Deviation [%]
01NOV03
01DEC03
01JAN04
01FEB04
01MAR04
140
120
100
80
60
40
20
0
Days previous

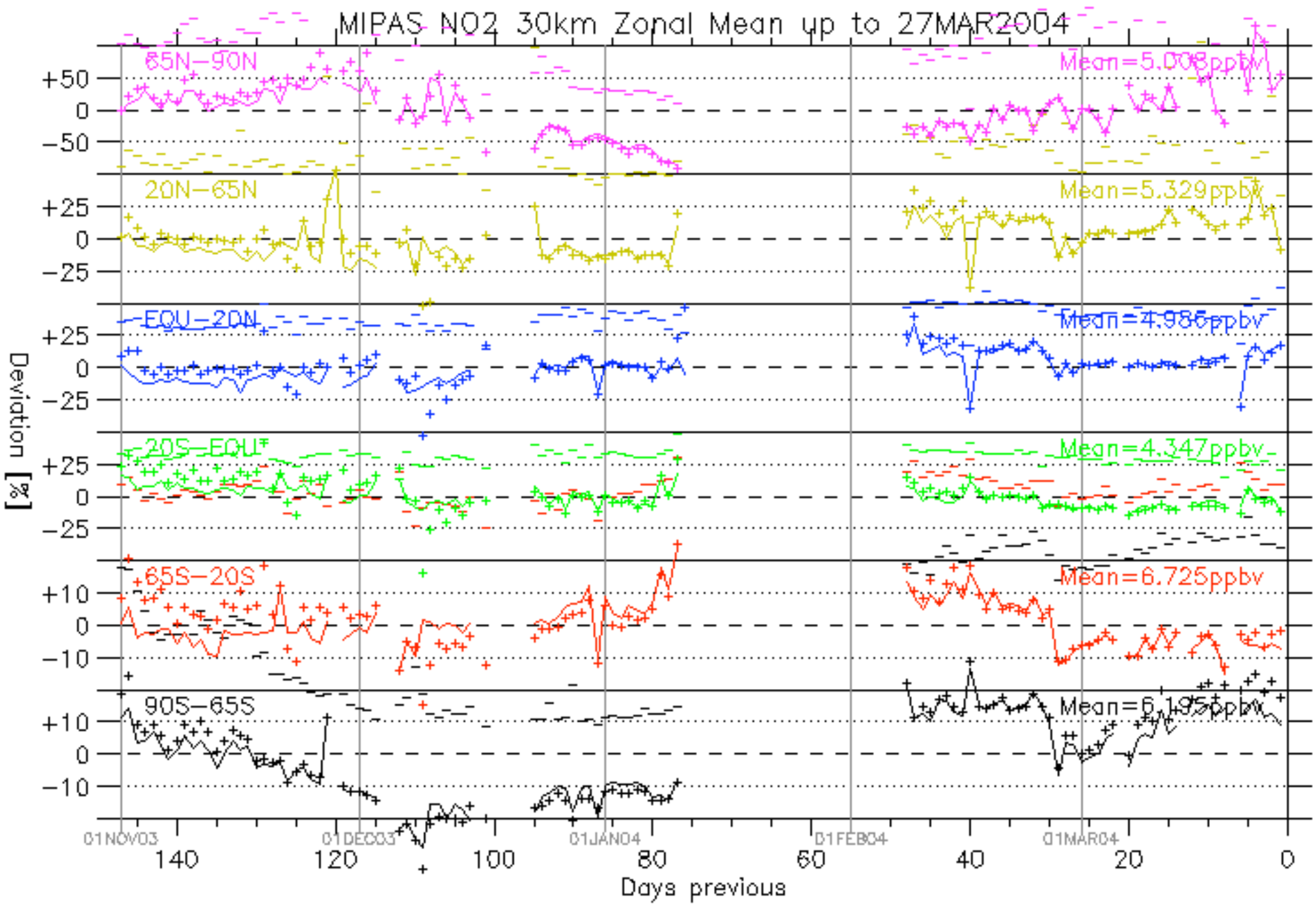

MIPAS TEM 30km Zonal Mean up to 27MAR2004
65N–90N
Mean=210.3K
20N–65N
Mean=222.4K
EQU–20N
Mean=227.6K
20S–EQU
Mean=228.1K
65S–20S
Mean=232.1K
90S–65S
Mean=238.8K
+10
0
–10
+5
0
–5
Deviation [K]
01NOV03
01DEC03
01JAN04
01FEB04
01MAR04
140
120
100
80
60
40
20
0
Days previous

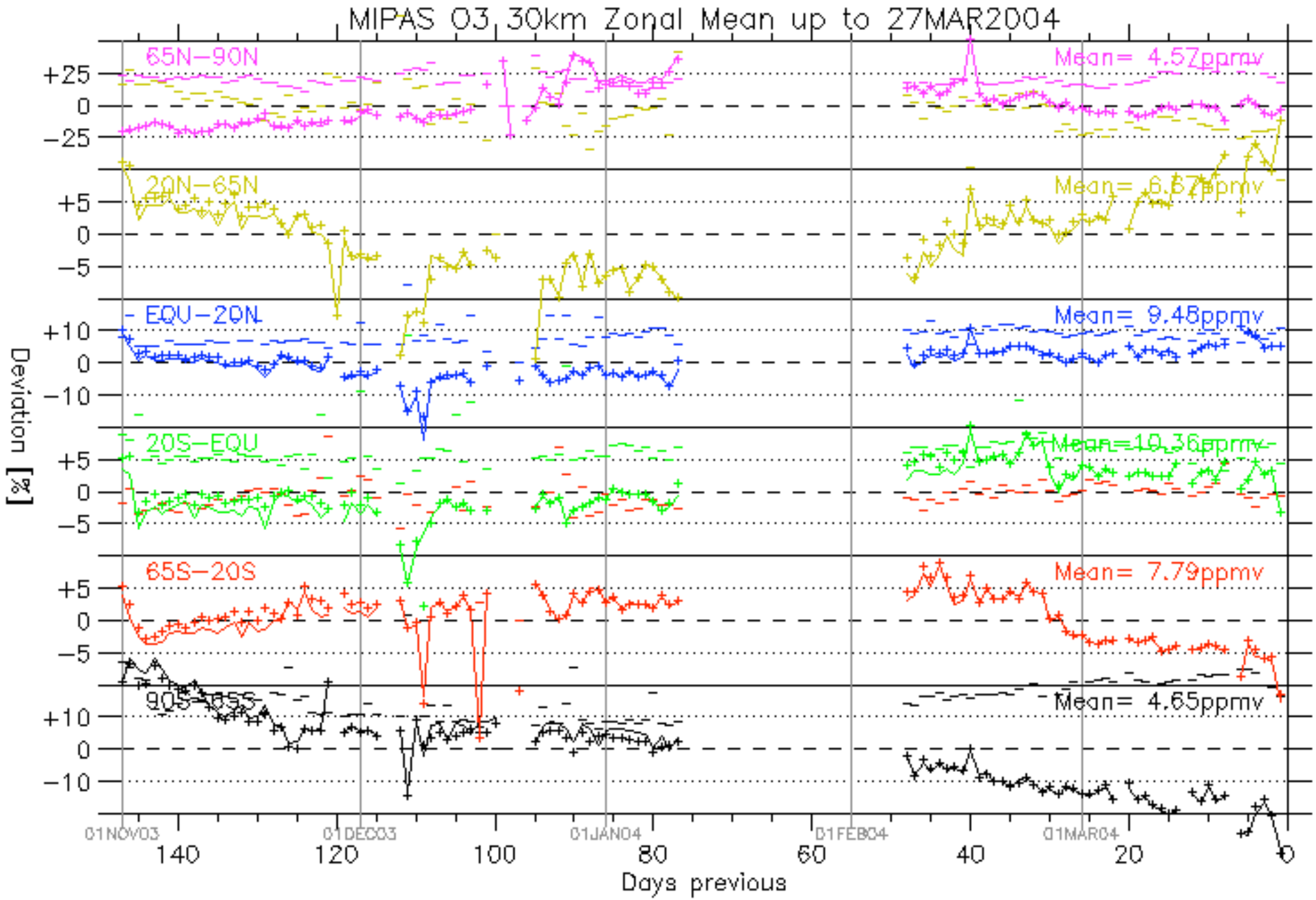

MIPAS CH4 30km Zonal Mean up to 27MAR2004
65N–90N
Mean=0.543ppmv
20N–65N
Mean=0.909ppmv
EQU–20N
Mean=1.398ppmv
20S–EQU
Mean=1.469ppmv
65S–20S
Mean=1.153ppmv
90S–65S
Mean=0.872ppmv
+25
0
−25
+10
0
−10
Deviation [%]
01NOV03
01DEC03
01JAN04
01FEB04
01MAR04
140
120
100
80
60
40
20
0
Days previous


MIPAS H2O 30km Zonal Mean up to 27MAR2004
65N–90N
Mean=6.193ppmv
20N–65N
Mean=5.494ppmv
EQU–20N
Mean=4.569ppmv
20S–EQU
Mean=4.397ppmv
65S–20S
Mean=4.970ppmv
90S–65S
Mean=5.642ppmv
+5
0
–5
Deviation [%]
01NOV03
01DEC03
01JAN04
01FEB04
01MAR04
140
120
100
80
60
40
20
0
Days previous


MIPAS HNO3 30km Zonal Mean up to 27MAR2004
65N–90N
Mean=5.237ppbv
20N–65N
Mean=4.686ppbv
EQU–20N
Mean=3.607ppbv
20S–EQU
Mean=2.877ppbv
65S–20S
90S–65S
Mean=4.048ppbv
+50
0
−50
+25
−25
+10
−10
Deviation [%]
01NOV03
01DEC03
01JAN04
01FEB04
01MAR04
140
120
100
80
60
40
20
0
Days previous


MIPAS-N2O 30km Zonal Mean up to 27MAR2004
65N-90N
Mean= 19.1ppbv
20N-65N
Mean= 71.4ppbv
EQU-20N
Mean=168.1ppbv
20S-EQU
Mean=199.9ppbv
65S-20S
Mean=119.4ppbv
90S-65S
Mean= 58.2ppbv
+100
0
-100
+25
0
-25
+10
0
-10
+10
0
-10
+10
0
-10
+25
0
-25
Deviation [%]
01NOV03
01DEC03
01JAN04
01FEB04
01MAR04
140
120
100
80
60
40
20
0
Days previous


MIPAS NO2 30km Zonal Mean up to 27MAR2004
65N–90N
Mean=5.008ppbv
20N–65N
Mean=5.329ppbv
EQU–20N
Mean=4.986ppbv
20S–EQU
Mean=4.347ppbv
65S–20S
Mean=6.725ppbv
90S–65S
Mean=6.195ppbv
+50
0
−50
+25
0
−25
+25
0
−25
+25
0
−25
+10
0
−10
+10
0
−10
Deviation [%]
01NOV03
01DEC03
01JAN04
01FEB04
01MAR04
140
120
100
80
60
40
20
0
Days previous


MIPAS O3 30km Zonal Mean up to 27MAR2004
65N–90N
Mean= 4.57ppmv
20N–65N
Mean= 6.67ppmv
EQU–20N
Mean= 9.48ppmv
20S–EQU
Mean=10.36ppmv
65S–20S
Mean= 7.79ppmv
90S–65S
Mean= 4.65ppmv
+25
0
−25
+5
0
−5
+10
0
−10
+5
0
−5
+5
0
−5
+10
0
−10
Deviation [%]
01NOV03
01DEC03
01JAN04
01FEB04
01MAR04
140
120
100
80
60
40
20
0
Days previous

Recent Anomalies

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- +400m Altitude shift 8-16 Feb 04 for tangent points above 30km, and since 25 Feb for southern hemisphere
- Increase in retrieved temperature of a 2 K from 27-29 Feb, matched by a 10% decrease in CH4,H2O,N2O and NO2
- General upward trend in CH4 and N2O (B band), but not H2O or NO2 (C band) since 8 Feb

Comparison between L2 off-line (OFL) and L2 near-real time (NRT) data

Chiara Piccolo

Outline

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- Comparison between OFL and NRT L2 products based on times of the measured scans
  - Difference of exactly 1 second in profile times (explanation?)
- Statistics of successful retrievals for both cases
- Monthly mean of the difference between OFL and NRT L2 products (split in 6 latitude bands)
- A few examples of differences (November 2003)

2002

July							07		09	10		12	13	14	15	16	17	18	19		21	22	23	24	25	26	27	28	29	30	31	
August		02		04	05																		22	23	24		26	27	28	29		31
September	01	02	03	04	05	06	07					12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28				
October											11	12	13	14	15	16	17	18	19	20	21	22					28	29	30			
November							07	08	09												21	22	23	24	25	26	27	28	29	30		
December	01	02	03	04	05	06	07	08	09	10	11	12	13		15	16	17	18					23	24	25	26	27	28	29	30	31	

2003

January	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18		20	21	22	23	24	25	26	27	28	29	30	31
February	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19				23	24	25	26	27	28			
March	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15				19	20	21	22	23	24	25	26	27	28	29	30	31
April	01						07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
May	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18			21	22	23	24							
June					05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
July	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
August	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
September	01	02	03	04				08	09	10	11	12	13	14	15	16	17	18		20	21	22	23	24	25	26	27	28	29	30	
October	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
November	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
December	01	02	03			06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

2004

January	01	02	03	04	05	06	07	08	09	10	11	12	15	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31			
February	01	02						08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29		
March	01	02	03	04	05		07	08	09	10	11	12	13		15	16	17	18	19												

Profiles Locations

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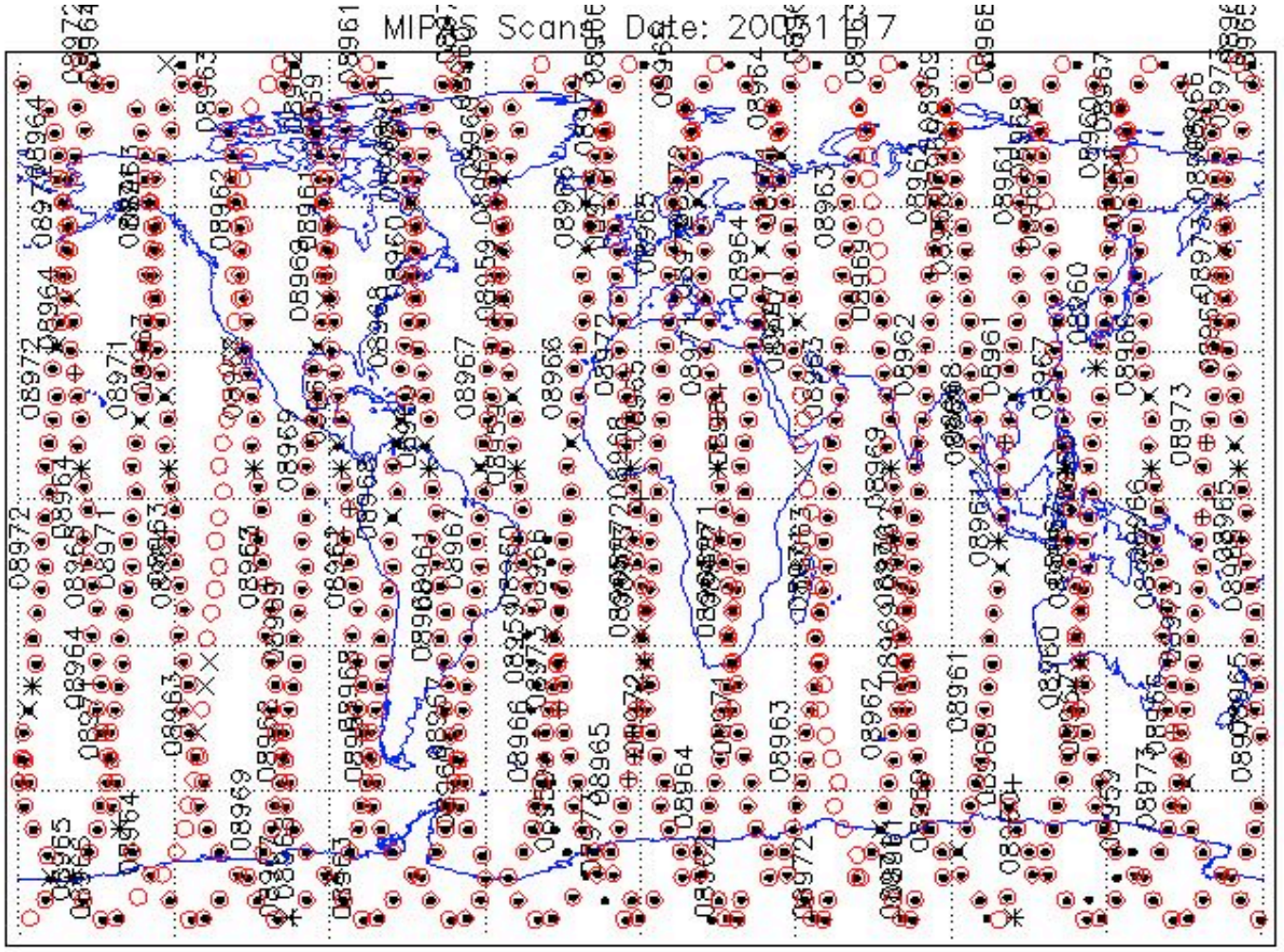

es.: 20031117

Black dots: NRT

Red circles: OFL

Profiles Locations

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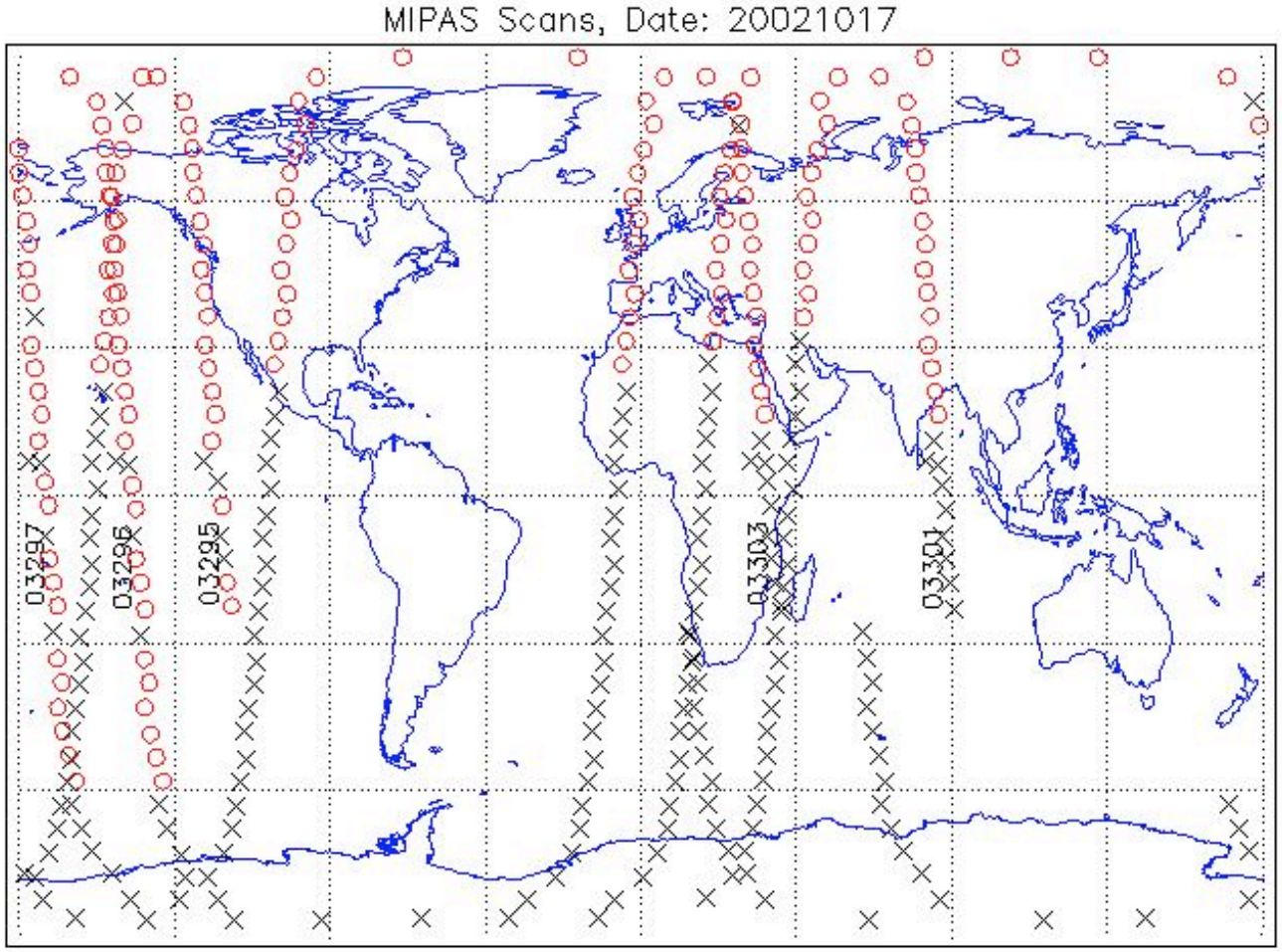

Es. NO NRT data

es.: 20021017

Red circles: OFL

Black crosses: OFL where pT and all other species are unsuccessful

Comparison

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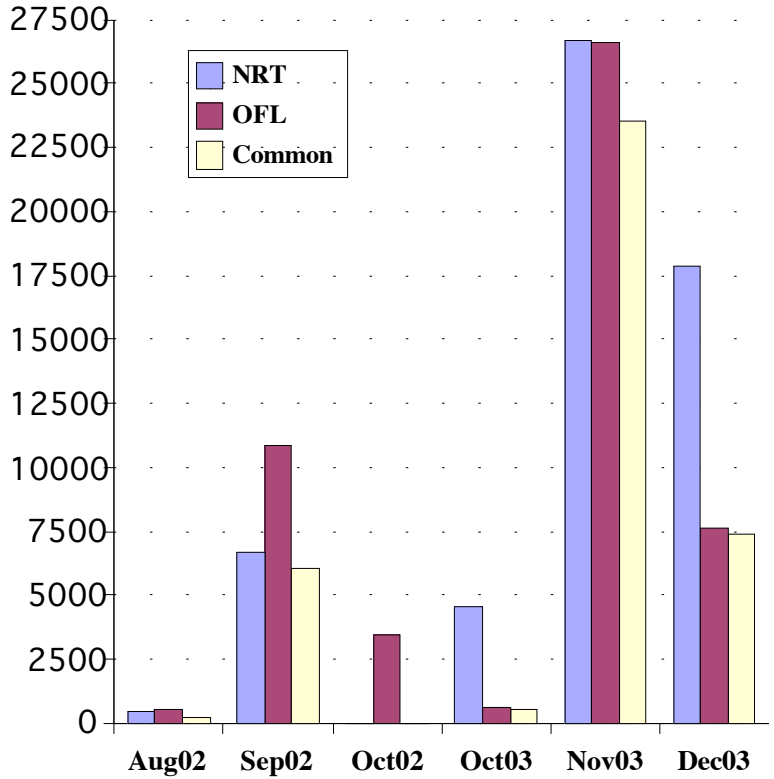
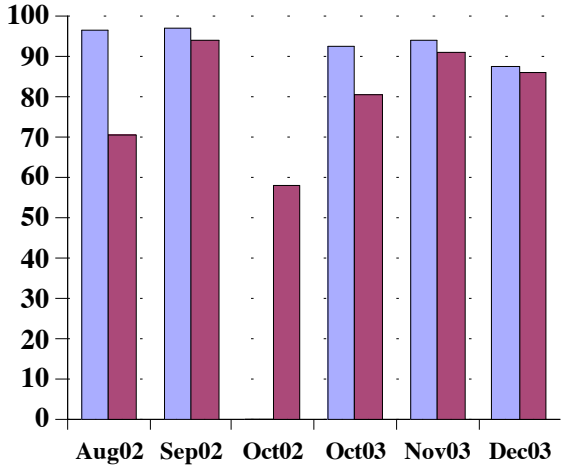
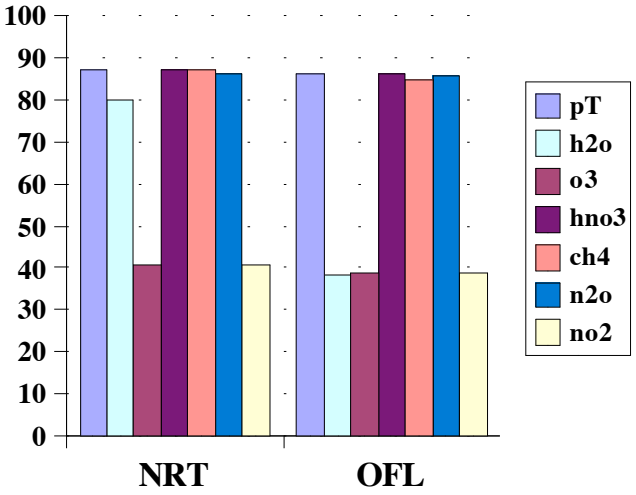
Number of NRT and OFL profiles



pT Convergence (%)



Convergence (%) December 2003



Temperature

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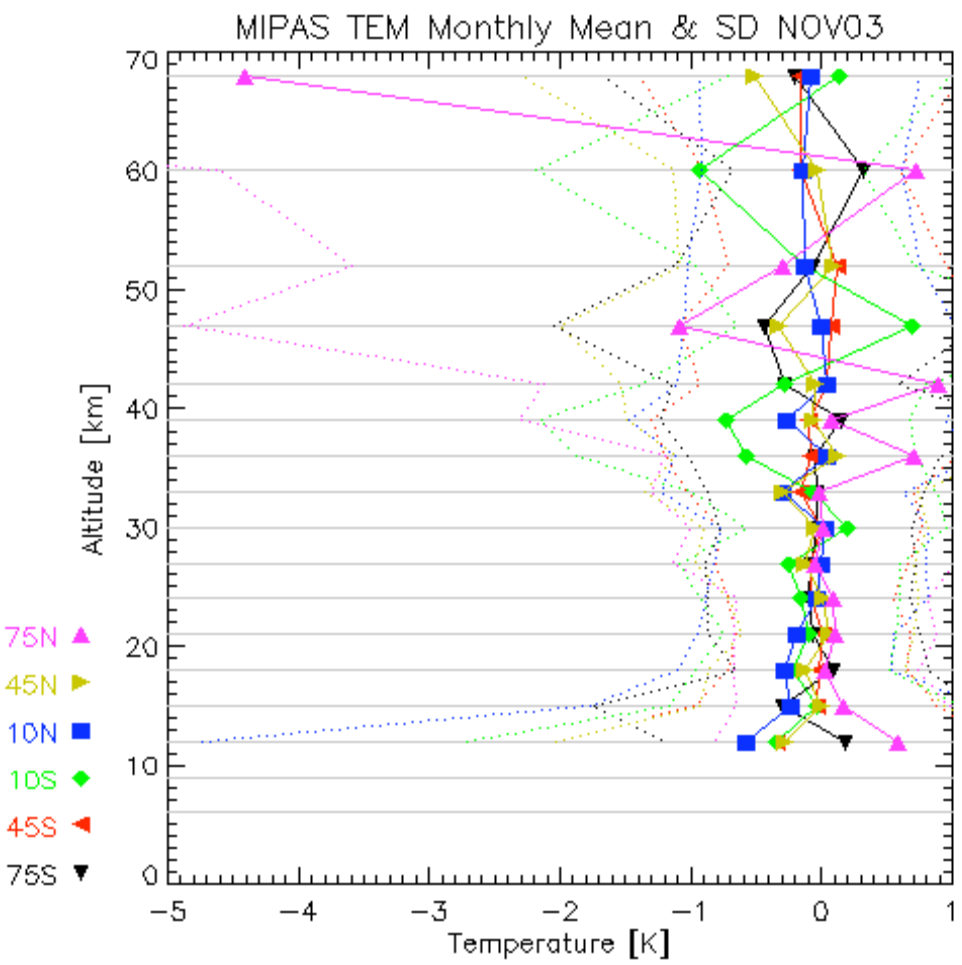

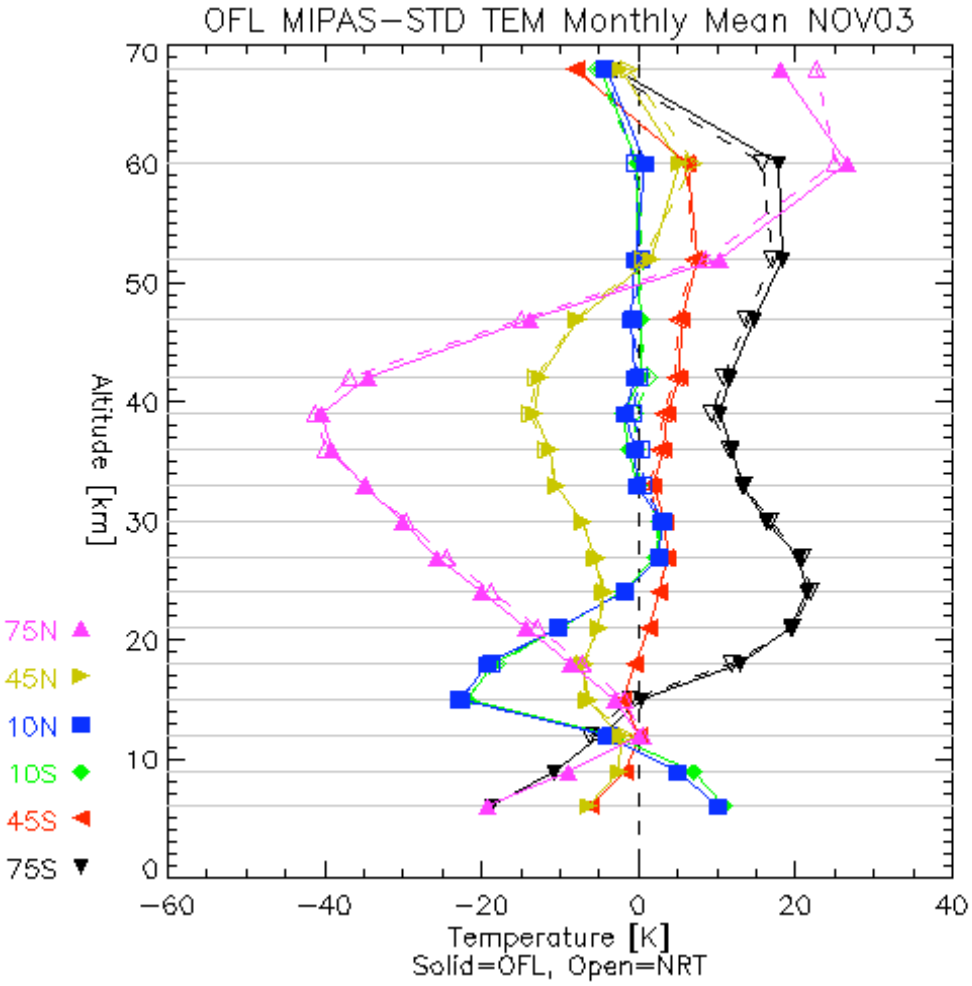

H_2O

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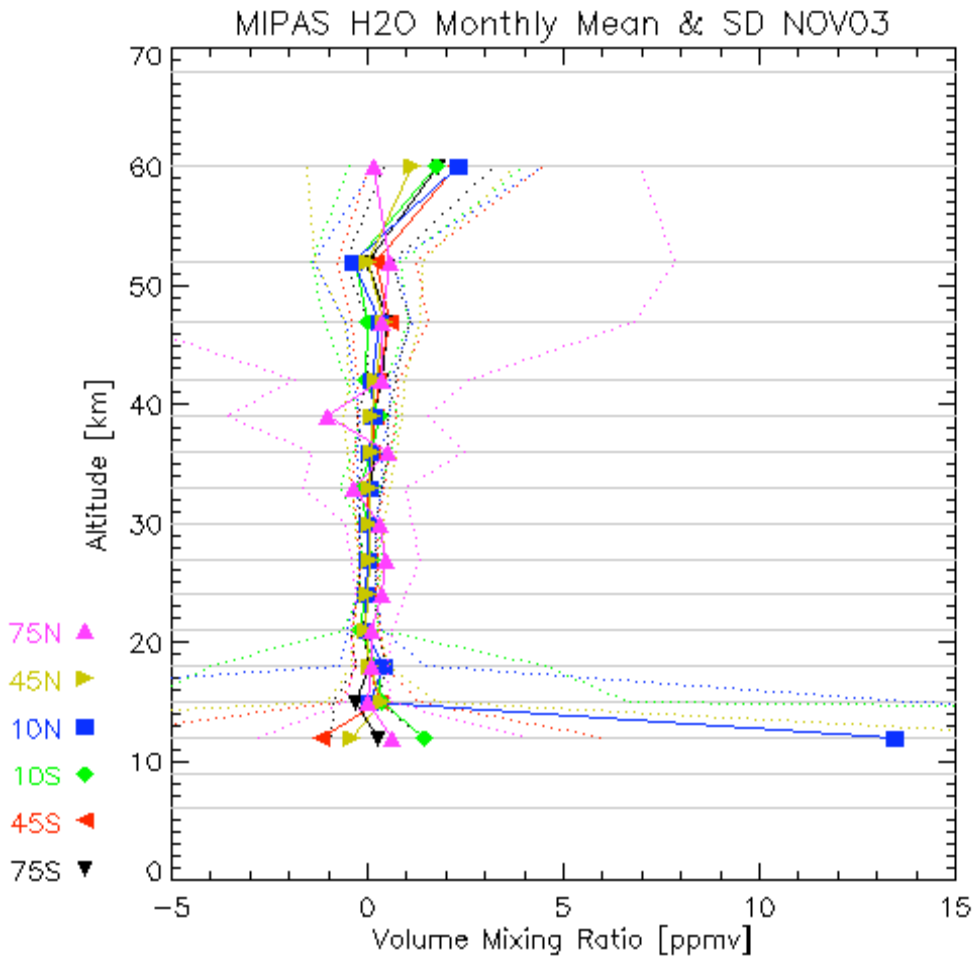

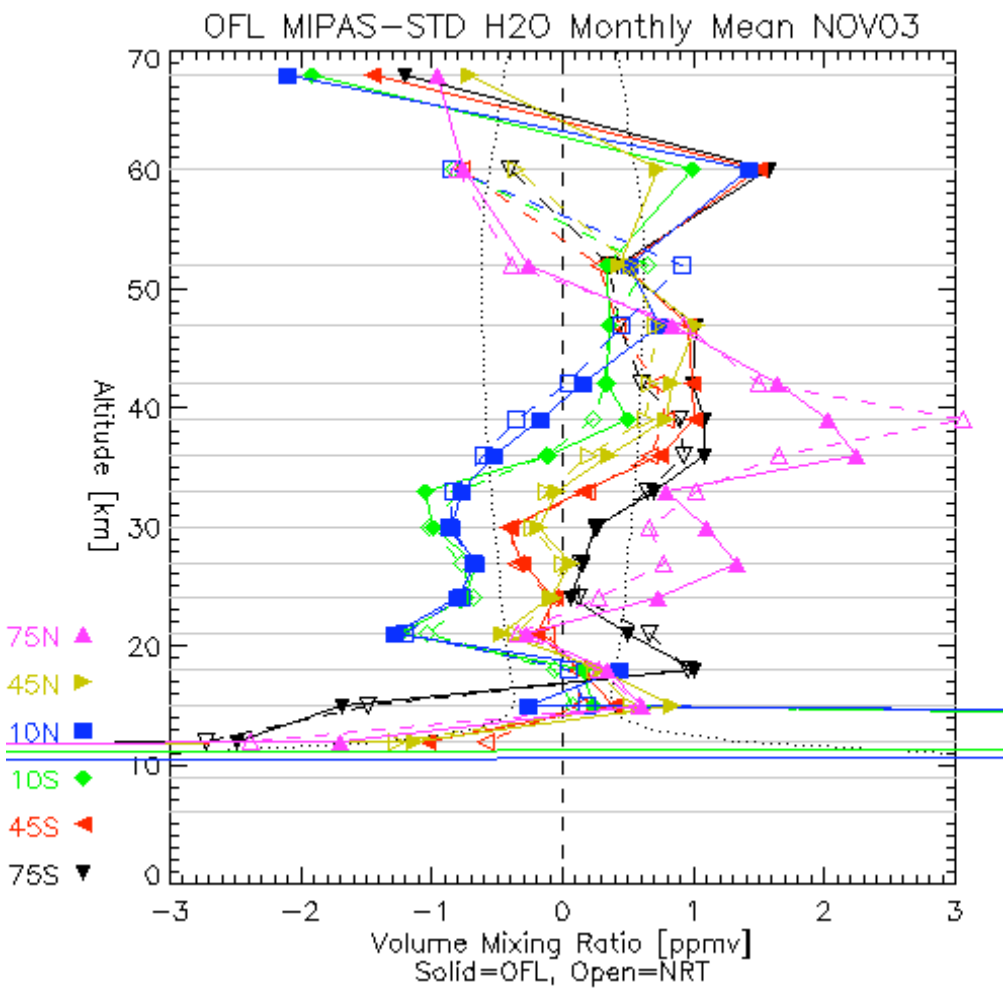

O_3

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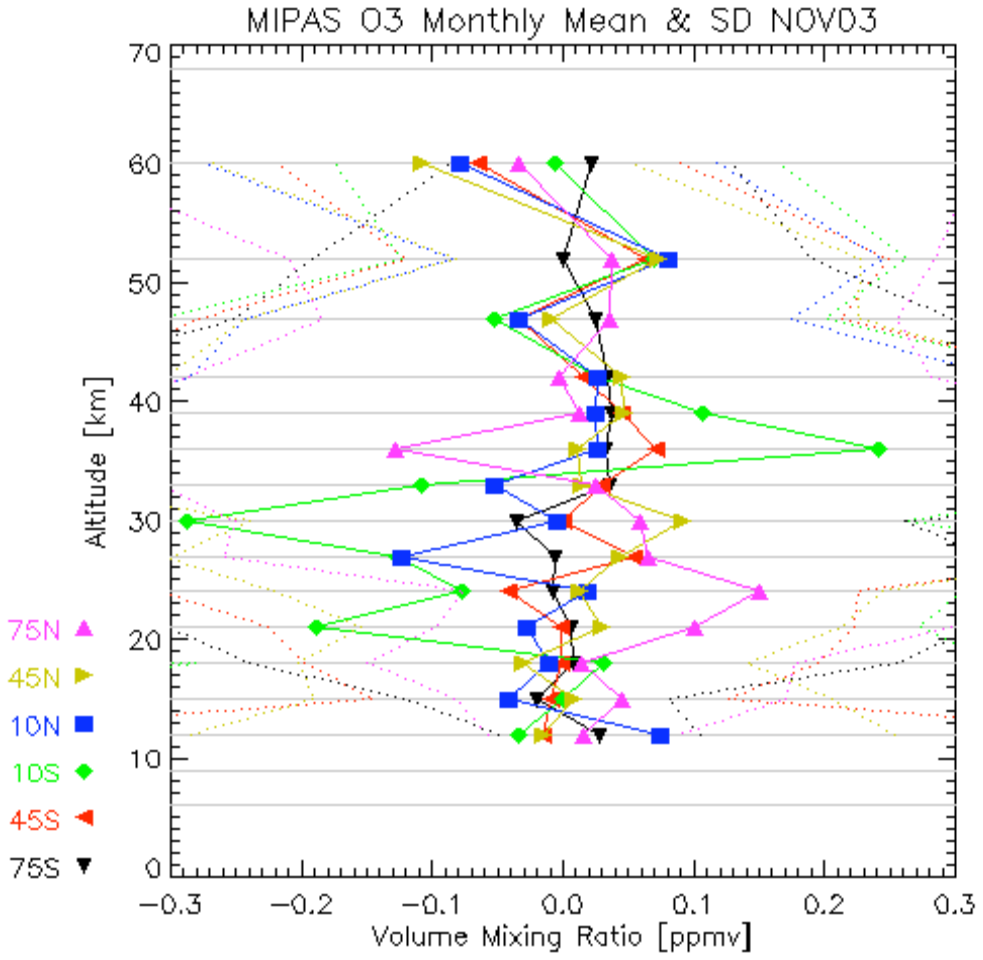

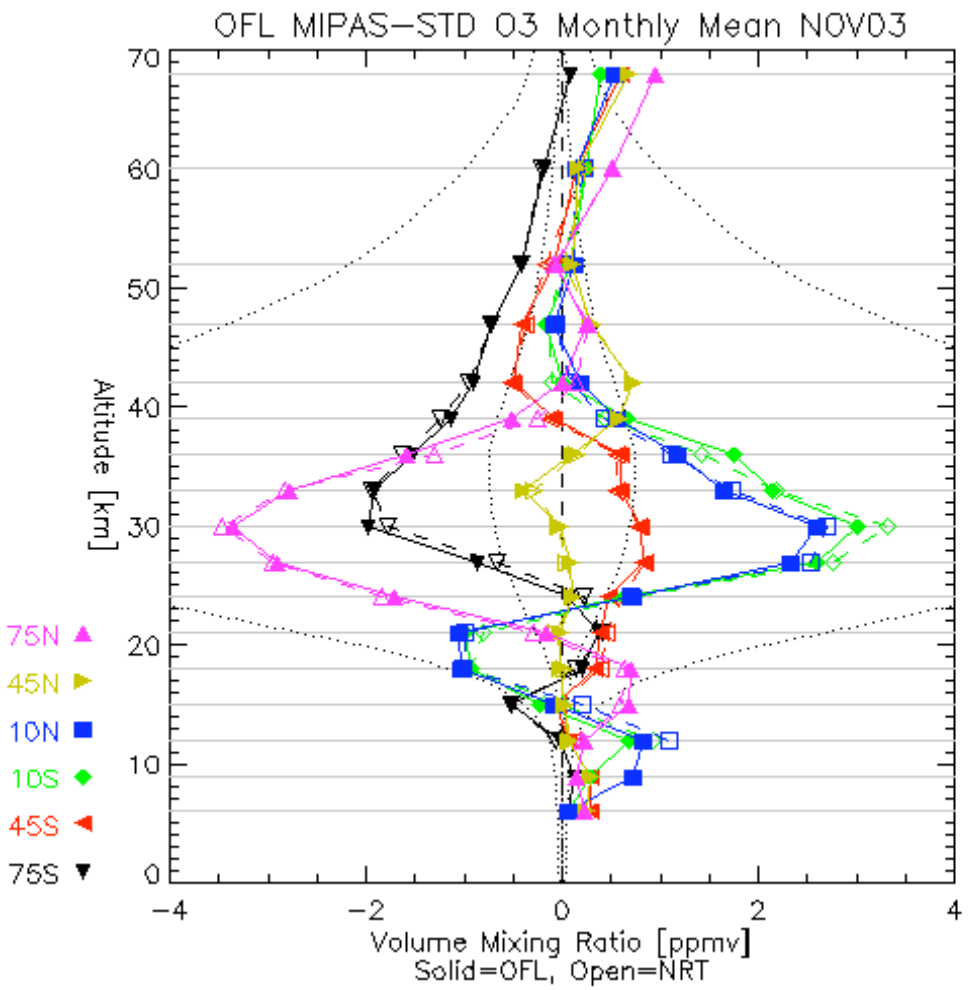

HNO_3

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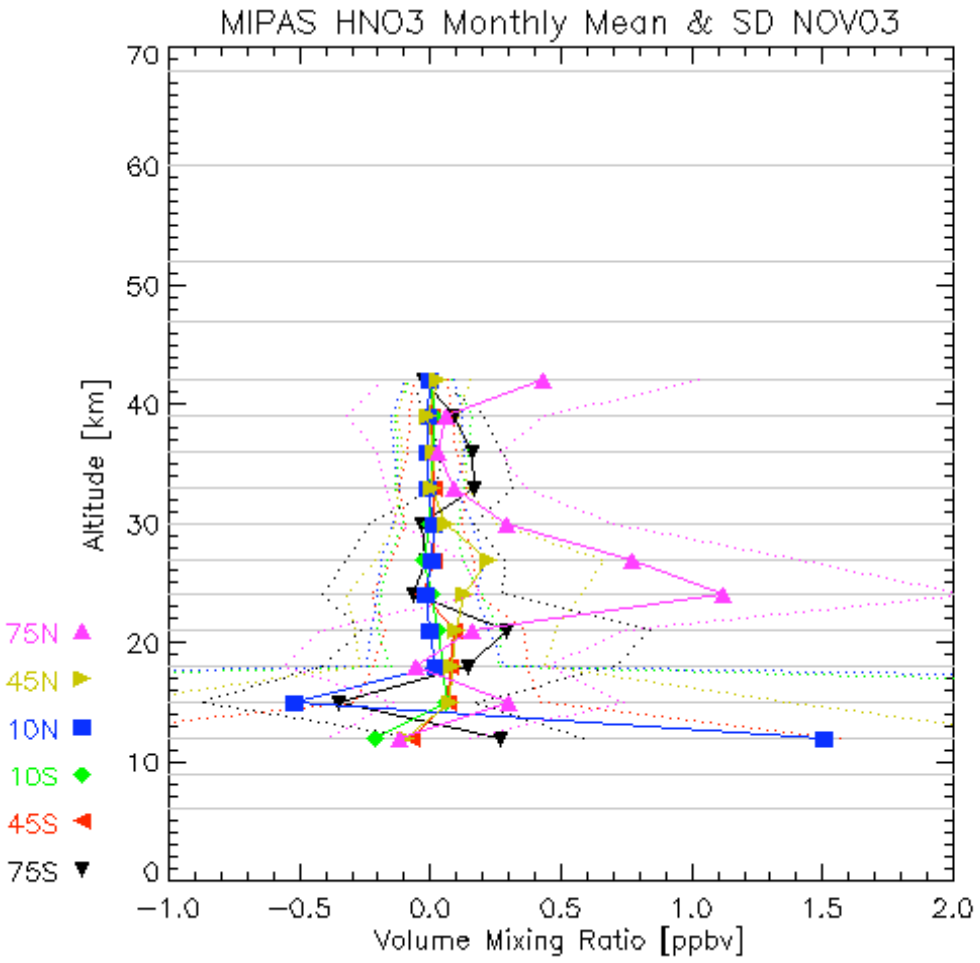

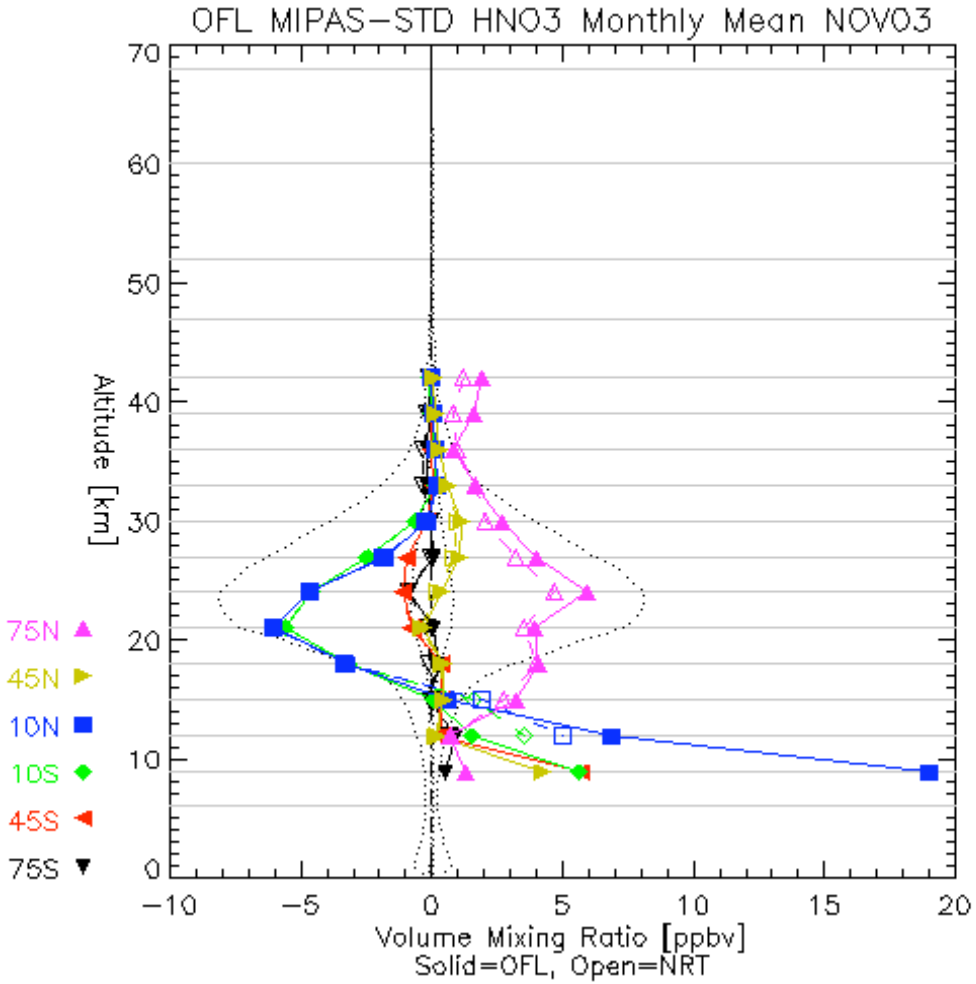

CH_4

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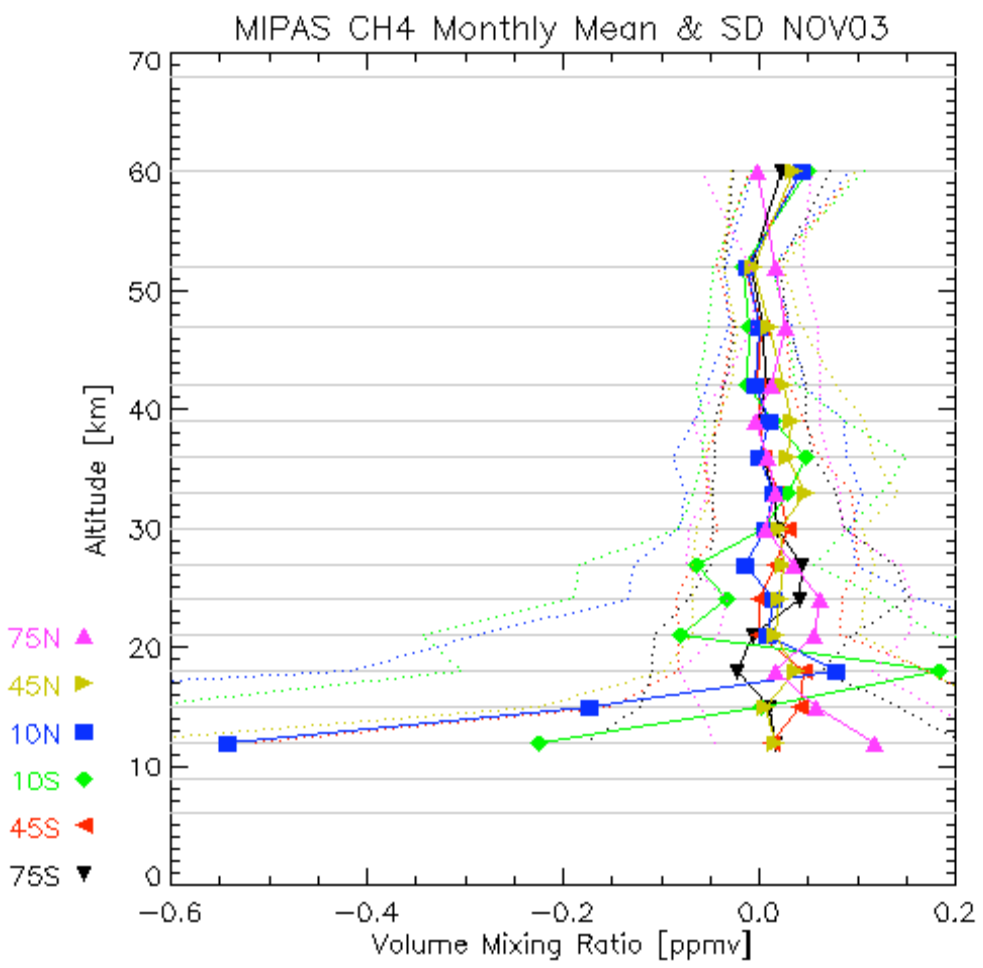

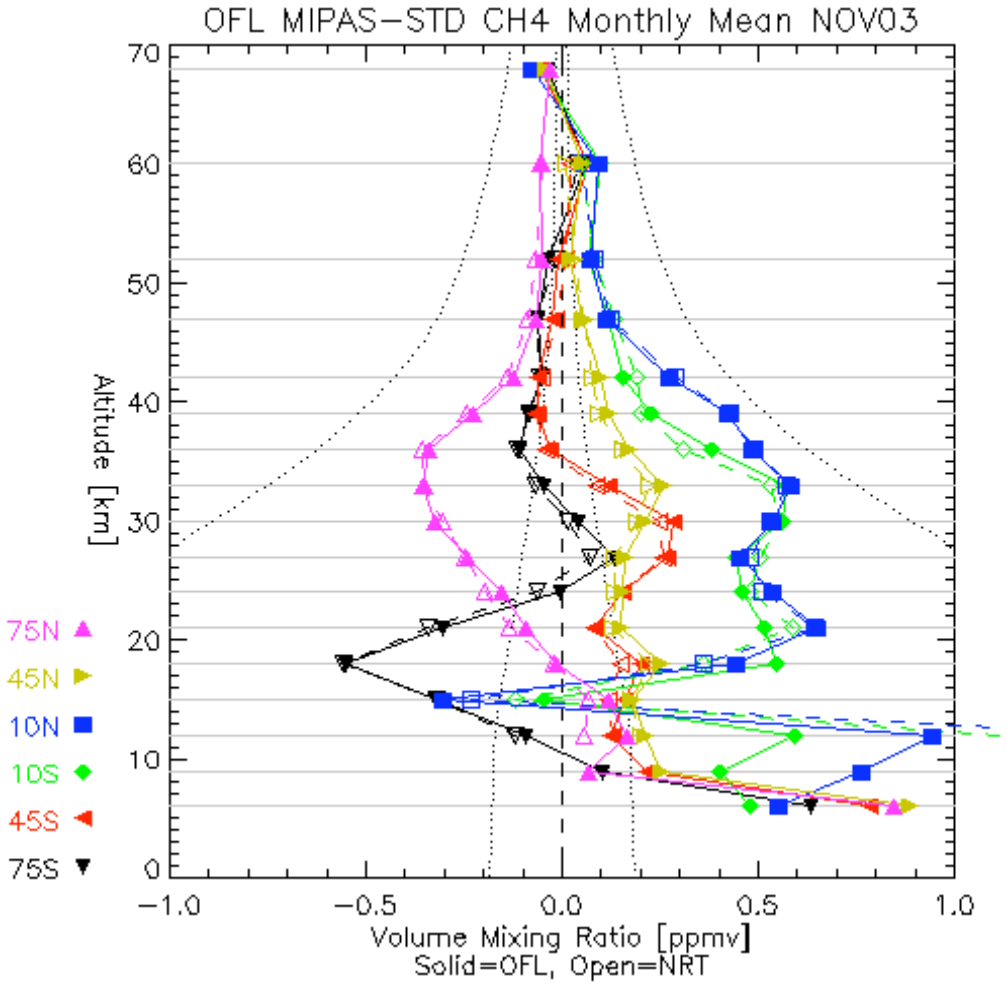

N_2O

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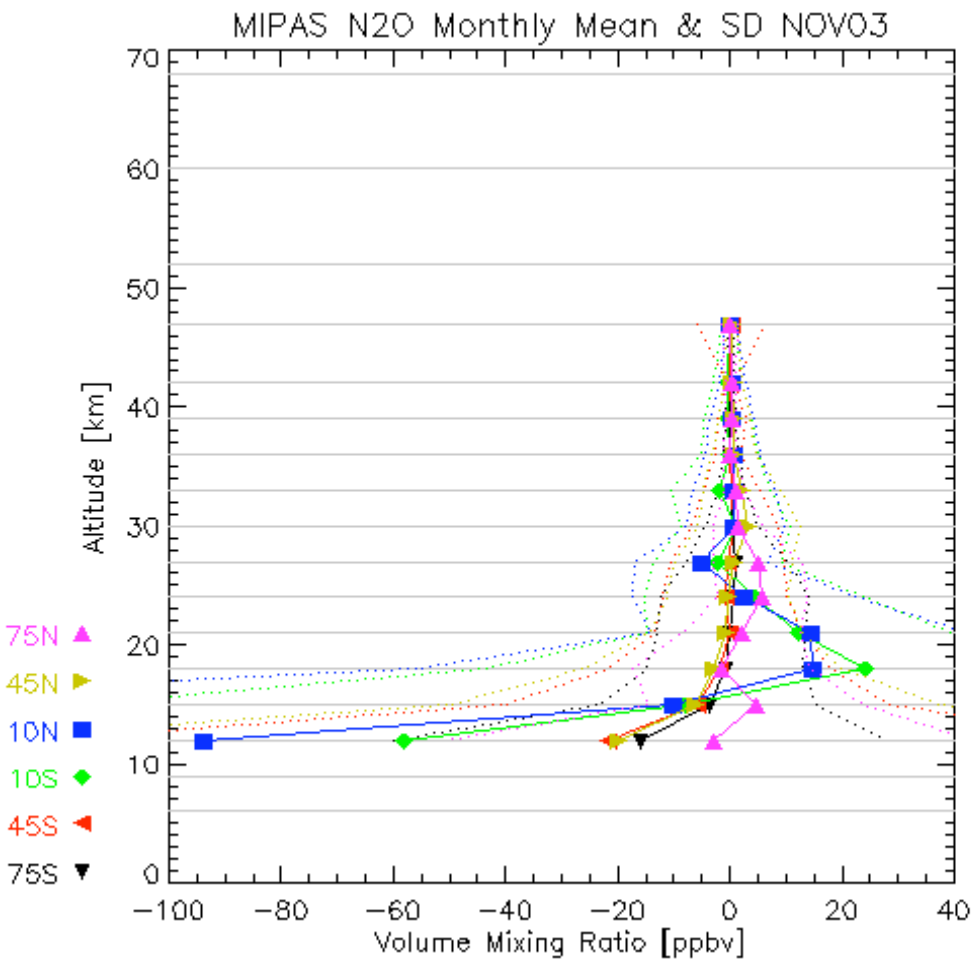

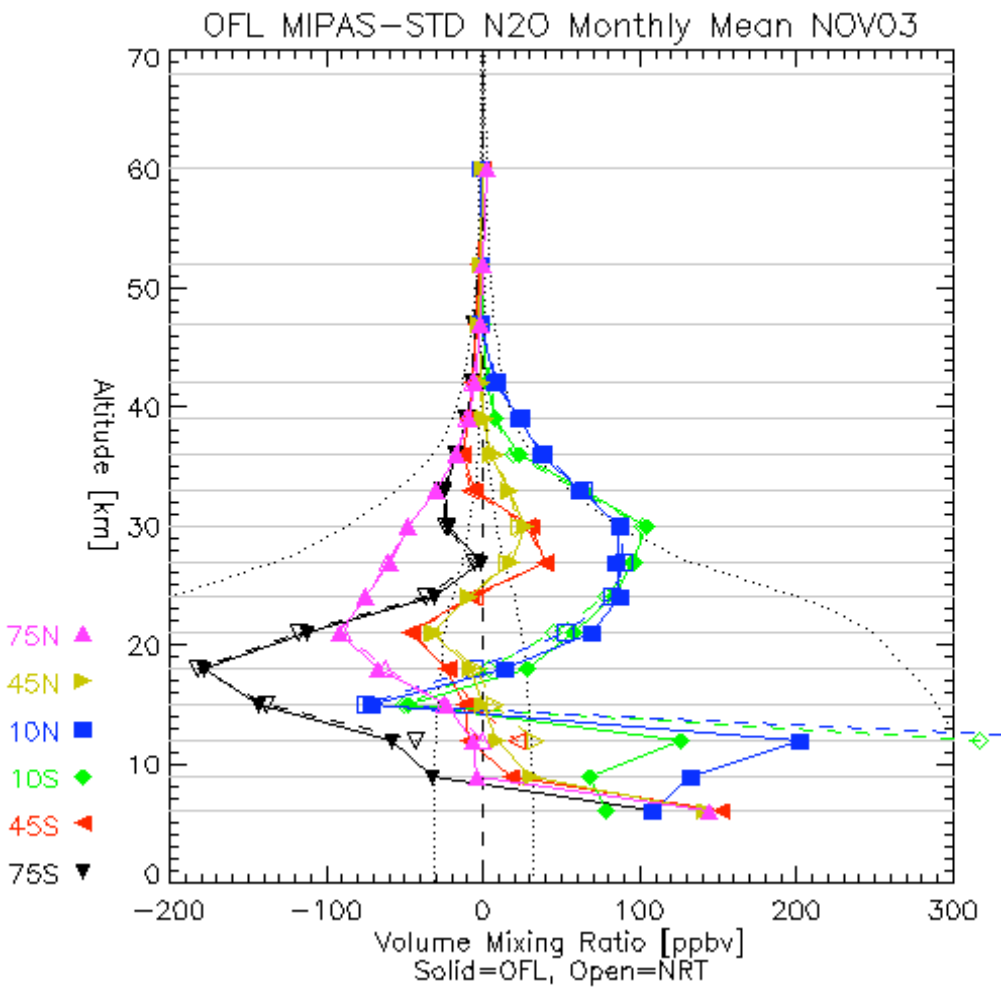

NO_2

Atmospheric, Oceanic
& Planetary Physics,
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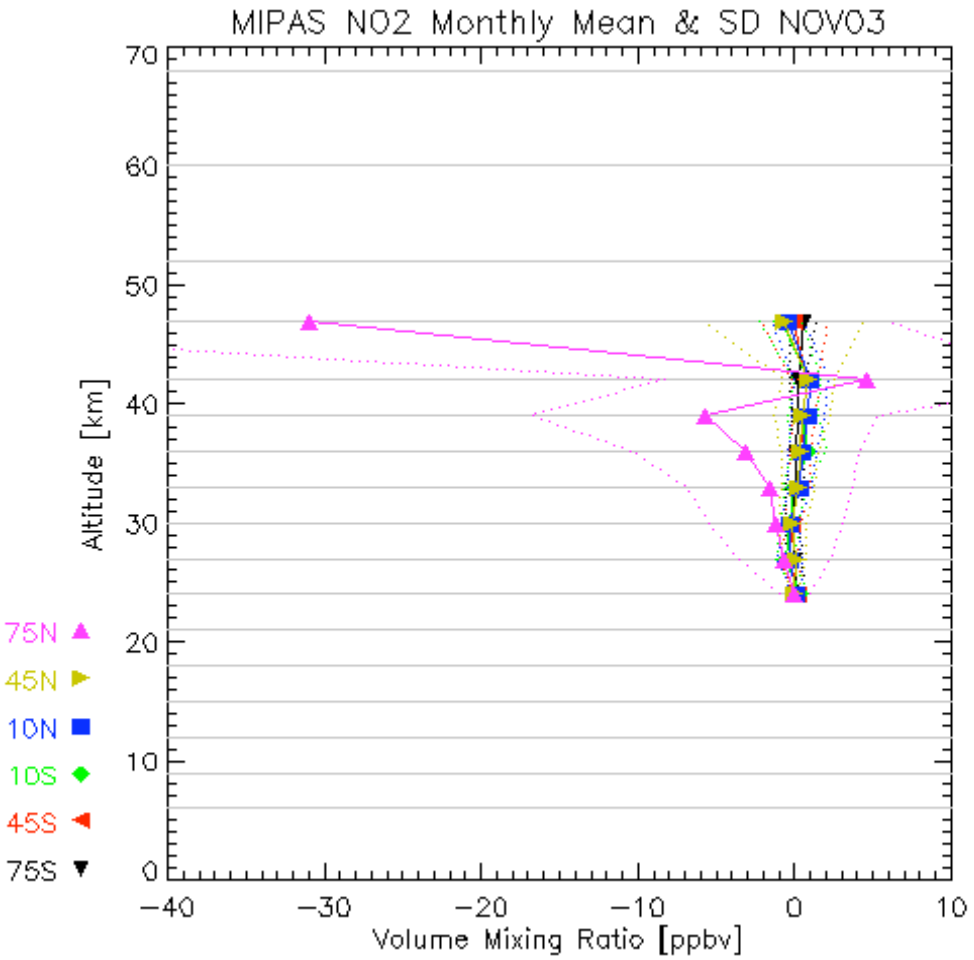

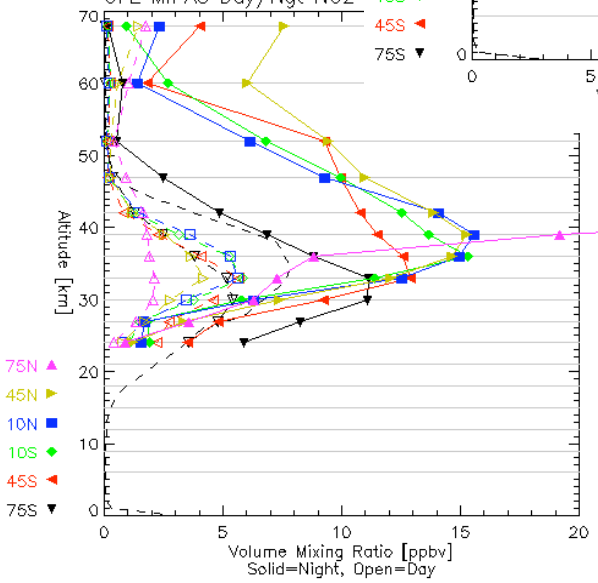

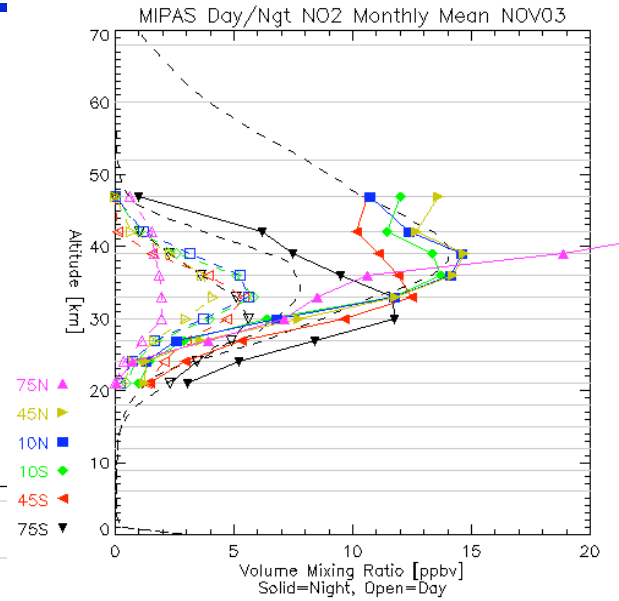

Summary

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- Difference of exactly 1 second in profile times (explanation?)
- NRT L2 products seem more robust than OFL L2 products in term of successful profiles
- Mean difference between NRT and OFL L2 data is in general not negligible
- H_2O: 60km level still problematic in OFL L2 data
- CH_4: bottom levels improvements for OFL L2 data
- N_2O: high 75N night-time mean profile in both L2 data

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MIPAS NRT Level 2 since July 2002

Vivienne Payne

- Monthly means of the NRT level 2 products
- Split into 6 latitude bands
- July 2002 - February 2004

- Comparisons with climatology
- Variations from mean profile of the whole dataset

Climatology

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- COSPAR International Reference Atmosphere (CIRA) - used for temperature comparisons
- UARS Reference Atmosphere Project (URAP) Based on HALOE/MLS/CLAES data - used for H_2O, O_3, CH_4 comparisons
- IG profiles (J. Remedios) - interpolated in time - used for HNO_3, N_2O comparisons
- Day/ngt profiles (J. Remedios) - used for NO_2 comparisons (to try to capture diurnal variation)

Temperature: MIPAS - CIRA

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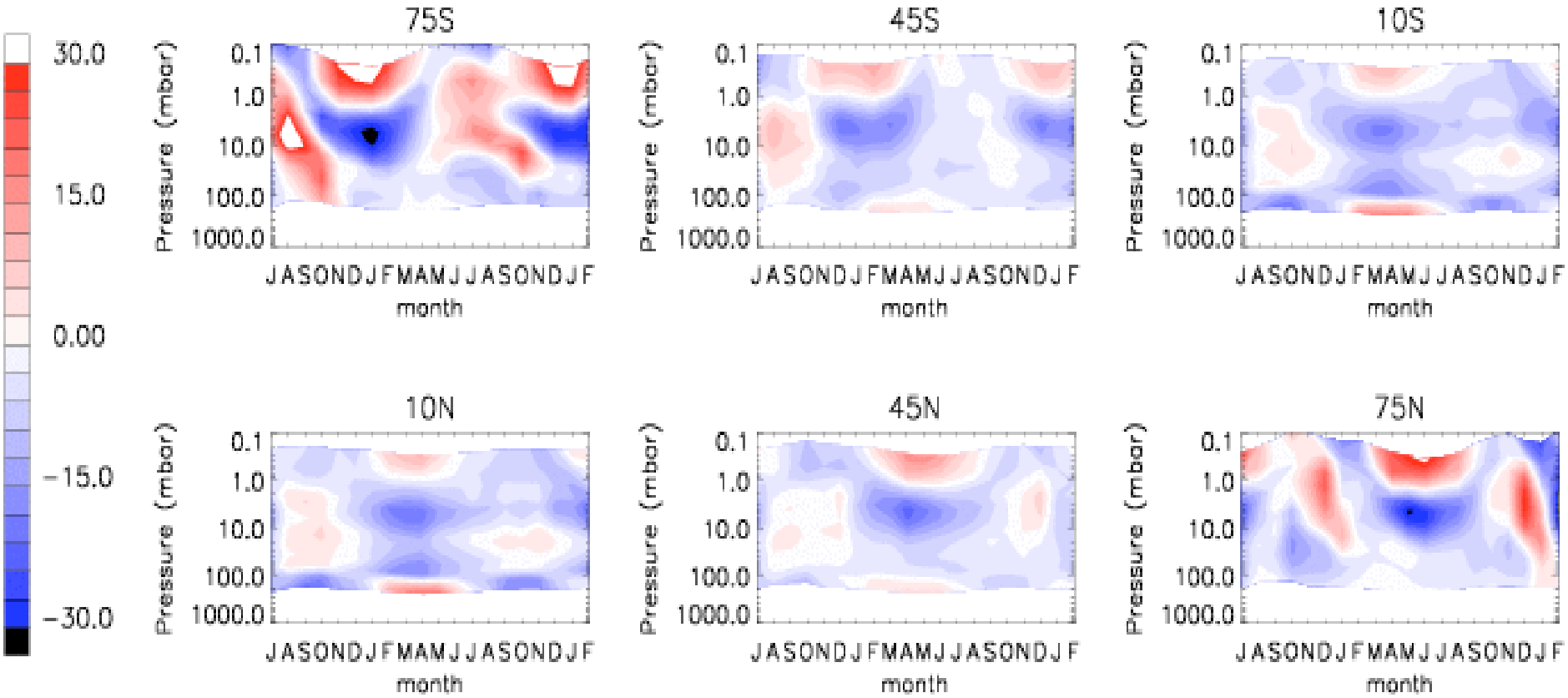

H_2O: MIPAS-URAP

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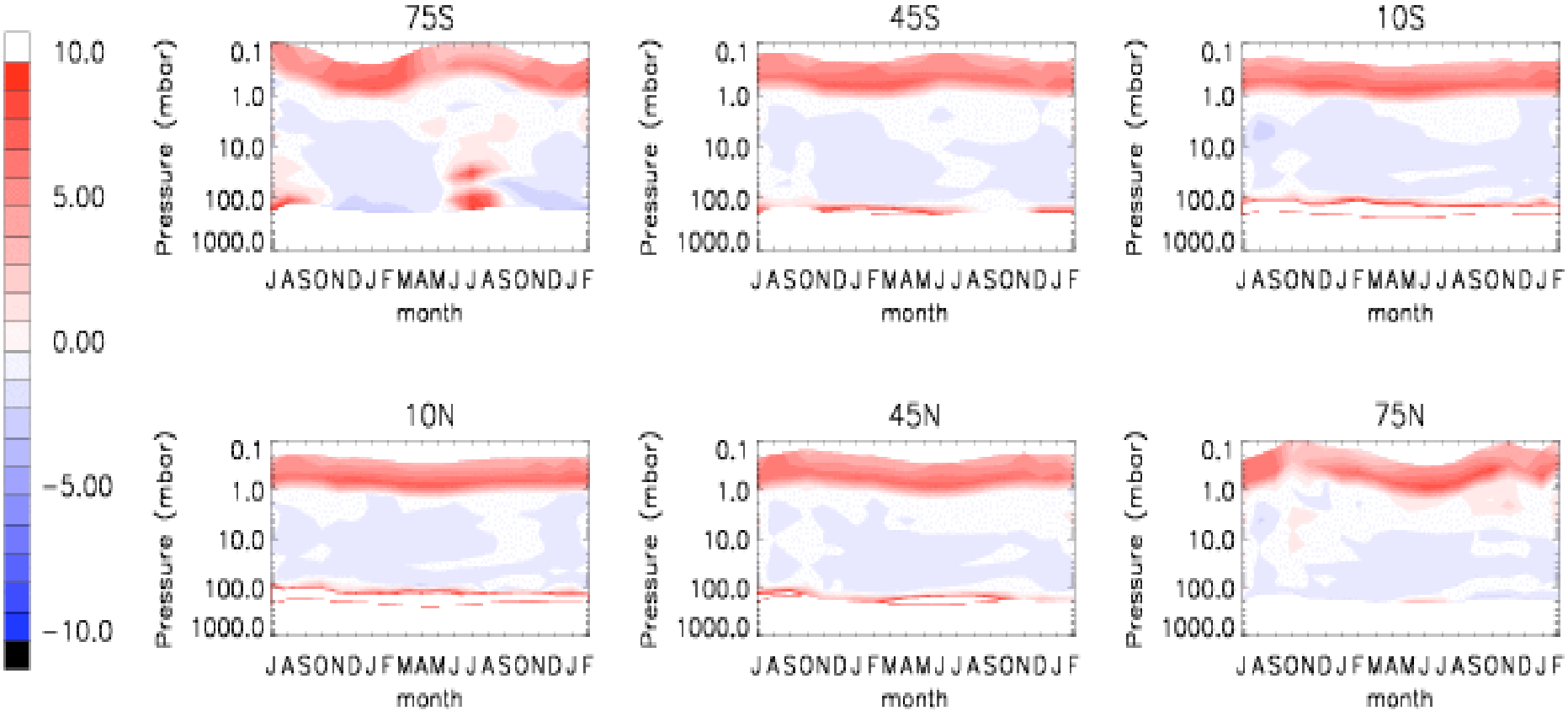

O_3: MIPAS - URAP

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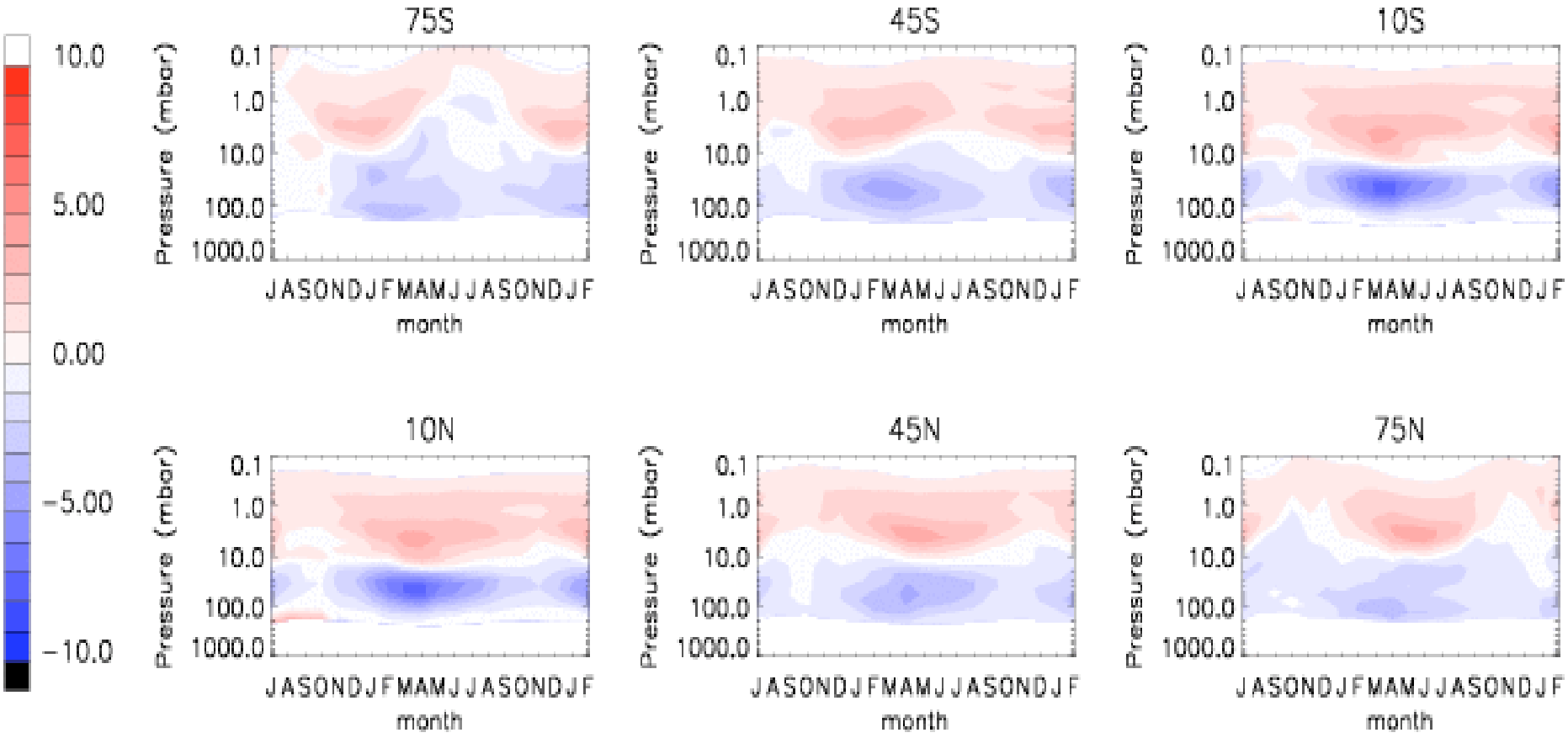

CH_4: MIPAS - URAP

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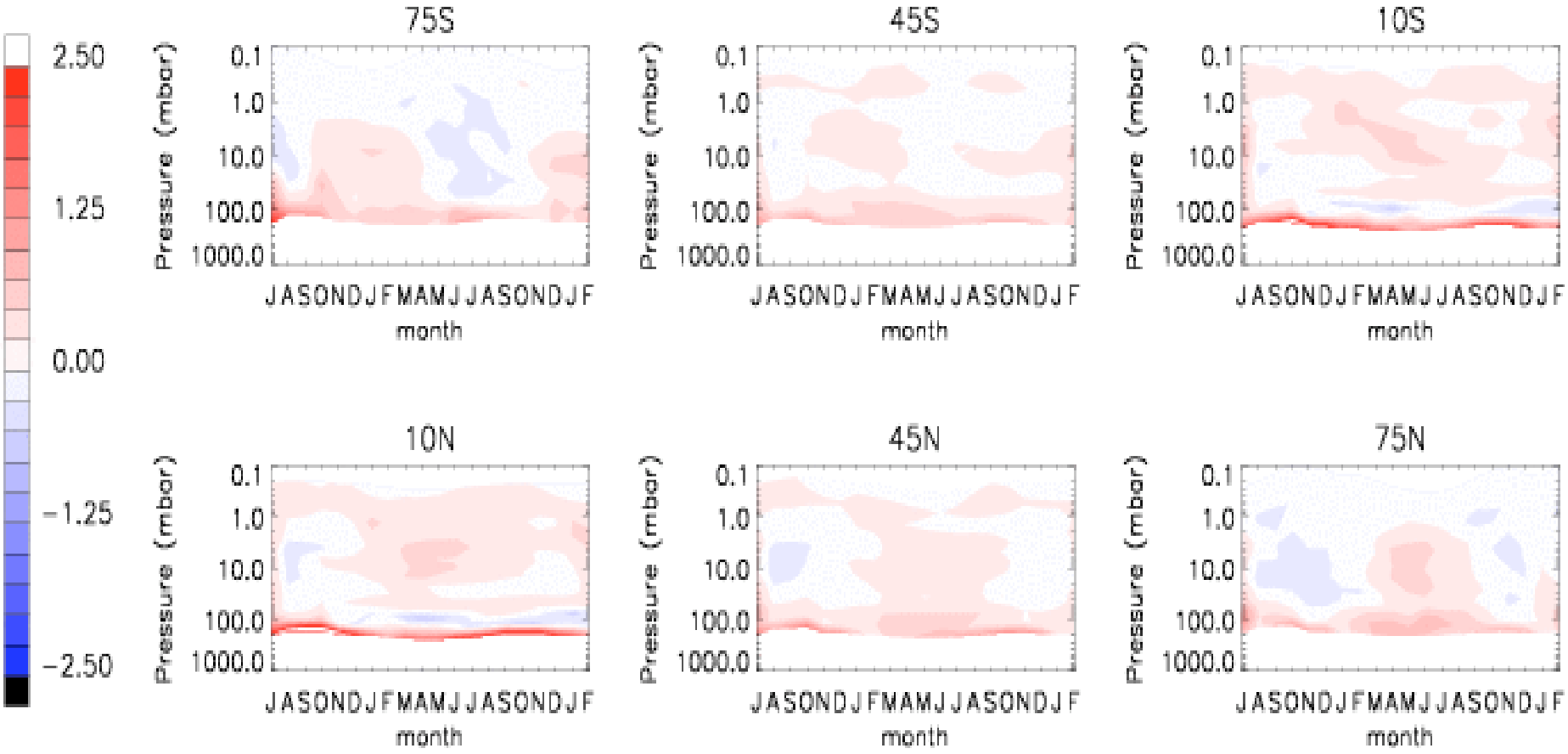

HNO_3: MIPAS - IG

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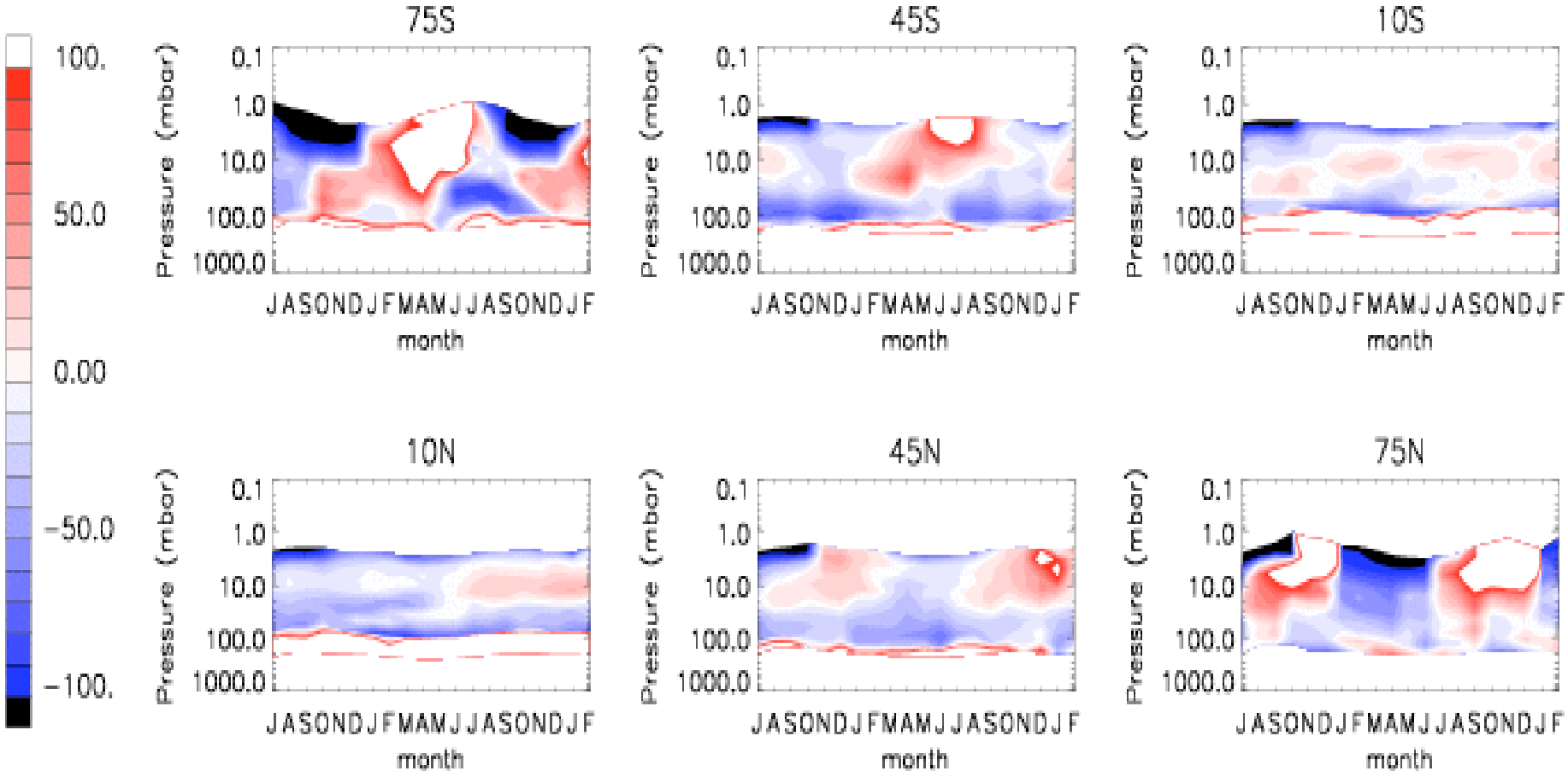

N_2O: MIPAS - IG

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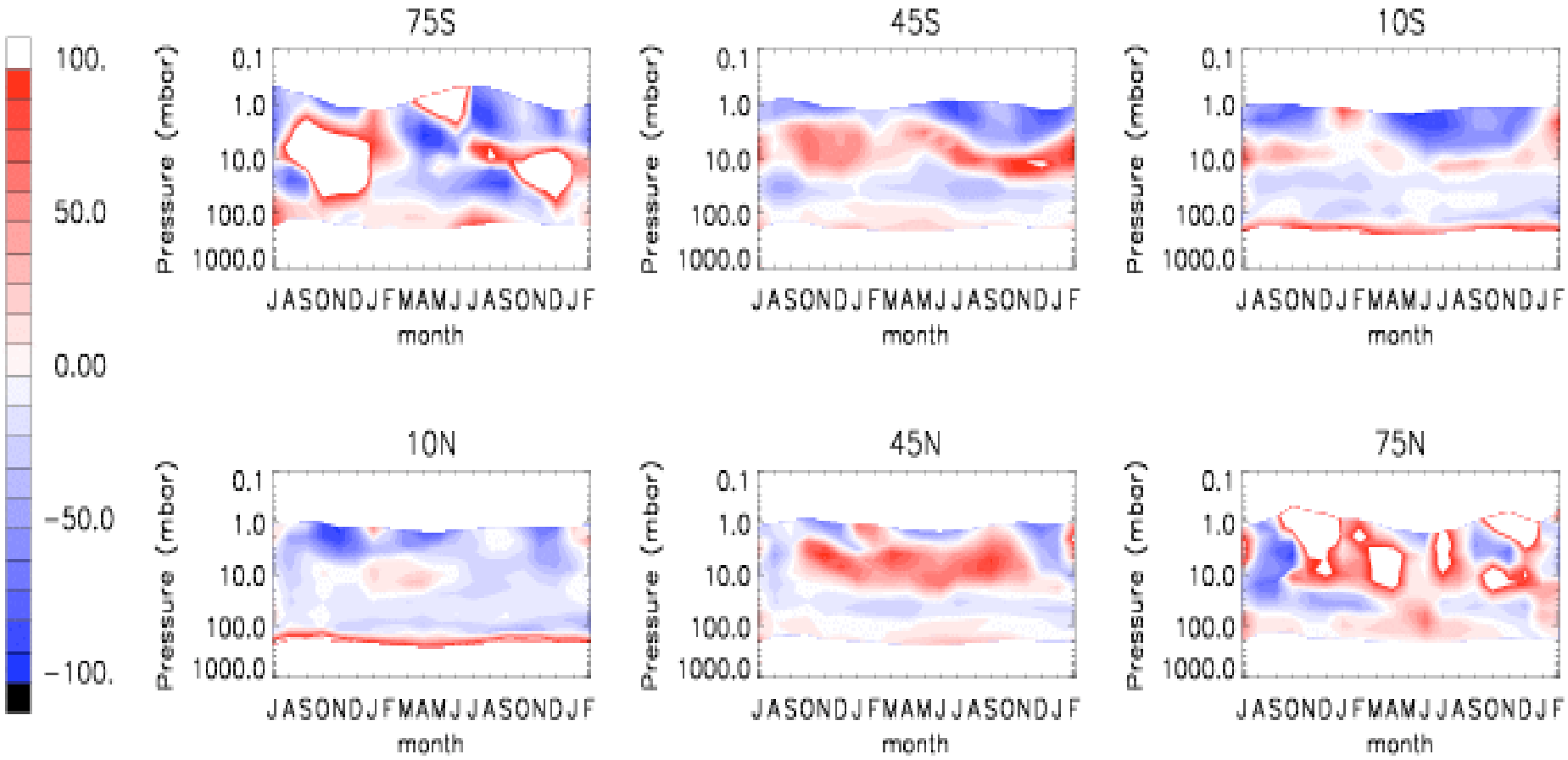

NO_2: MIPAS - day

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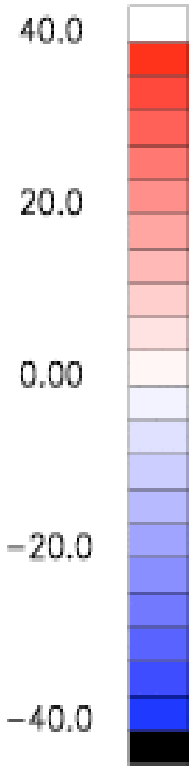

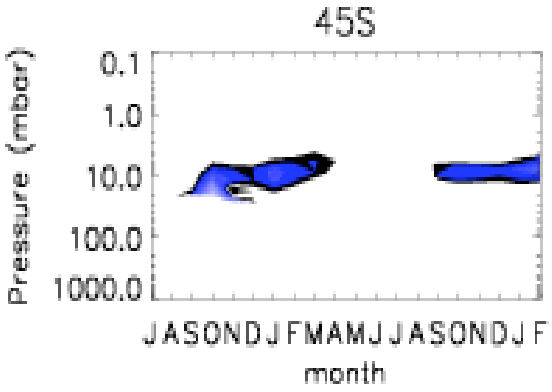

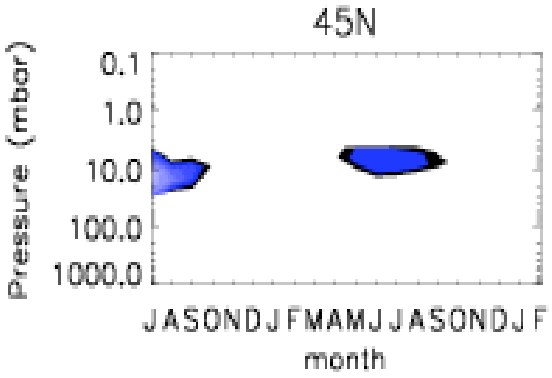

NO_2: MIPAS - ngt

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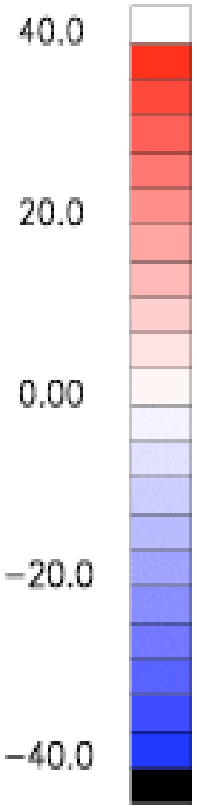

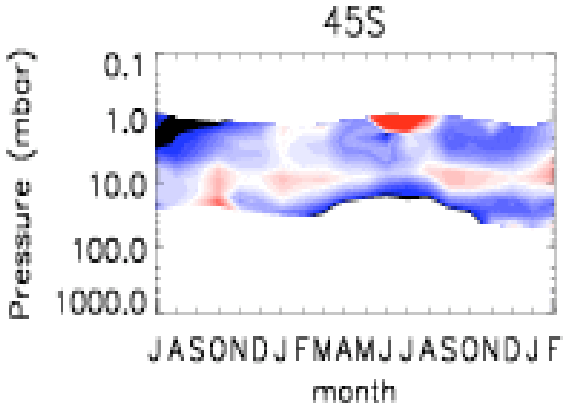

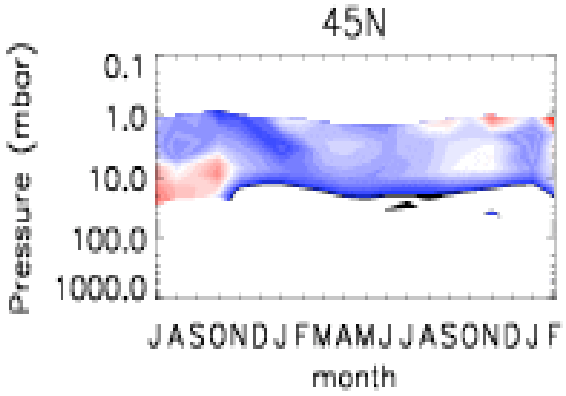

Comparison with dataset mean

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- Took mean profile from whole set of monthly means (July 2002 - Feb 2004)
- Subtracted dataset mean from monthly means (looking for sudden changes, long-term trends)
- In general, no obvious trends, only seasonal variations
- Example: H_2O

Comparison with dataset mean: H_2O

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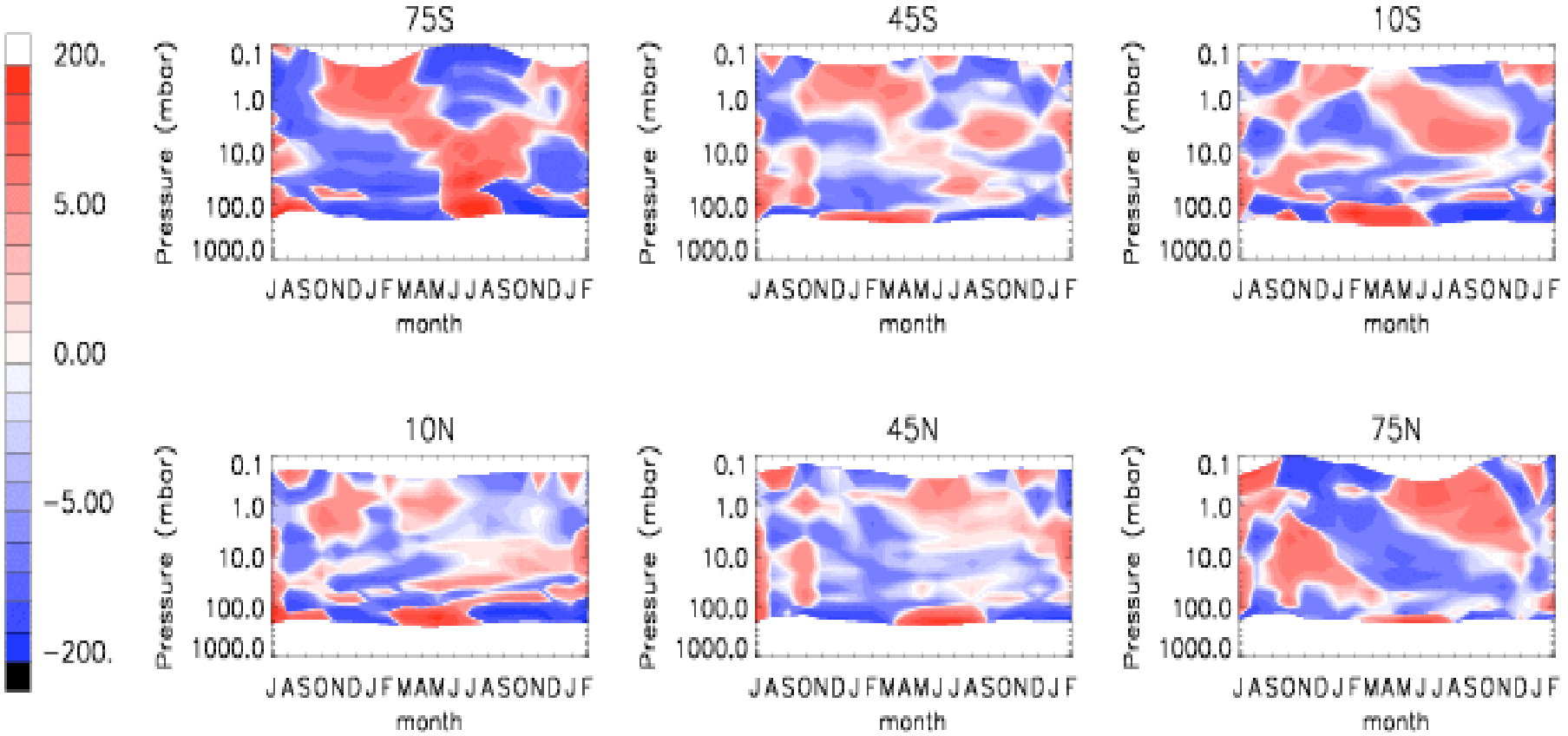

Summary

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- Temperature: large differences from CIRA reference atmosphere (up to ~30K). However, this is probably not a problem. Reference atmosphere probably cannot represent the variation from one year to the next.

- H_2O: Compared with URAP (based on HALOE/MLS). MIPAS is ~3% lower in lower/middle stratosphere. Problems with MIPAS values at lowest and highest altitudes.

- O3: Compared with URAP (based on HALOE/MLS). MIPAS lower than URAP at lower altitudes, higher than URAP at higher altitudes. Looks as though O3 peak is at a higher altitude in the MIPAS data.

Summary (contd)

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- HNO3: Compared with IG data. Differences very large, but perhaps the IG data does not represent the variations very well.
- CH4: Compared with URAP (based on HALOE/CLAES) Differences large at lowest altitudes (especially in the tropics) but small everywhere else.
- N2O: Compared with IG data. MIPAS 50-100% larger in upper stratosphere, 50-100% smaller in lower stratosphere. MIPAS too high at lowest levels.
- NO2: Compared with day/ngt atmospheres (mid-lat). Day/ngt atmospheres don't capture seasonal variation, so differences large.

Future Activities

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- Extend monthly monitoring to include OFL data
- Add long-term analyses of NRT data
- Analyse orbit intersections to verify random error
- Detailed analysis of residual spectra
- Perform full-spectral simulations:
  - Use L2 retrieved profiles plus IG to specify atmosphere
  - Run RFM calculations for full MIPAS spectrum
  - Compare with L1B spectra
  - REC analyses of residuals
  - Typically 1 orbit per month
  - Aim is to improve systematic error characterisation