MIPAS Predicted Retrieval Accuracy
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This report summarises the MIPAS error analysis from the microwindow/occupation matrix selection program `mwmake`, applicable to the 'jul01' delivery of nominal occupation matrices (12km lower limit).

The selection uses five different atmospheres

`day` mid-latitude daytime

`ngt` mid-latitude nighttime

`sum` polar summer (day)

`win` polar winter (night)

`equ` equatorial daytime

A 'global' figure of merit is based on summing the figures of merit for each individual atmosphere, with double weight assigned to the polar winter atmosphere ('glw' weighting). However, while the individual MWs and the OMs were selected using old versions of profile variabilities (Jun99) and HITRAN uncertainties, the error analyses have been performed with updated versions (Jul01), so these are not necessarily the optimum OMs/MWs that could be selected given the new error estimates.

Figures 1–8 show the profiles and expected errors for each species for all 5 atmospheres. Also included on these plots are the glw-weighted profiles and error bars although it should be empahasised that the MW/OM selection considers each of the five atmospheres individually, not just the glw-weighted atmosphere.

Tables 1–8 show the glw-weighted error analyses, the Random, Systematic and Total errors corresponding to the 'glw' curves in the figures, but also including the leading systematic error terms. Error analyses for each individual atmosphere can be found in anonymous ftp site `florence.atm.ox.ac.uk`, directory `/pub/mipas/error/`, together with this report.

List of systematic errors considered:

`nonlte` Error due to neglecting non-LTE effects

`ctmerr` 25% uncertainties in modelling gaseous continua (H_2O, O_2, CO_2, N_2)

`hitran` Uncertainties in HITRAN line data (assume uncorrelated between microwindows)

`gain` 1% uncertainty in radiometric gain calibration (assume uncorrleated between microwindows)

`ils` Uncertainties in ILS shapes (assume uncorrelated between microwindows)

`tem` 1K uncertainty in temperature retrieval (assume uncorrelated between tangent altitudes)

`los` 2% uncertainty in pressure retrieval, or 150m in pointing (assume uncorrelated between tangent altitudes)

`shift` 0.001 cm^{-1} uncertainty in spectral calibration

`co2mix` 100% uncertainty in modelling CO_2 line-mixing effects

`gra` Error due to neglecting 1K/100km horizontal temperature gradient

Other errors are due to climatological assumptions about contaminant species. All errors are assumed fully correlated except where stated.

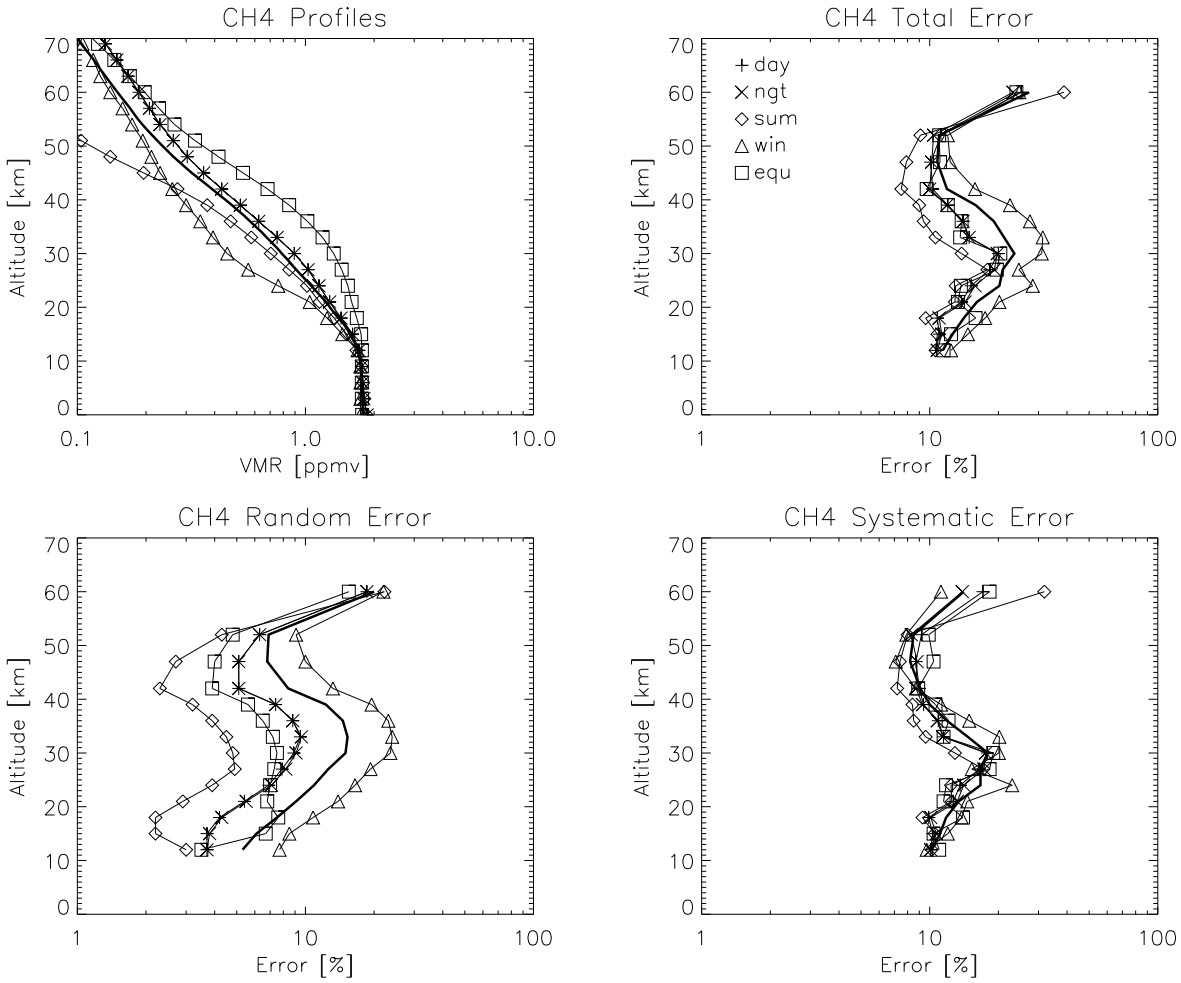

Figure 1: CH_4 profiles.

Table 1: CH_4 error contributions.

Alt	12km	15km	18km	21km	24km	27km	30km	33km	36km	39km	42km	47km	52km	60km
Rnd	5.3	6.1	7.5	9.1	10.9	12.6	15.0	15.3	14.6	12.3	8.4	6.8	6.9	20.0
Sys	10.2	11.1	11.8	13.4	16.7	16.7	18.0	14.7	11.9	10.0	9.1	8.2	8.5	14.1
Tot	11.4	12.6	14.1	16.1	20.2	20.9	23.5	21.2	19.1	15.9	11.9	10.8	11.0	27.3
Significant systematic error sources (largest at each altitude in **bold**).														
so2	0.9	−6.1	−3.2	−3.0	−0.4	1.4	−1.5	−4.4	1.5	−0.2	−0.5	1.4	0.8	4.2
hitran	5.5	4.1	5.9	6.0	5.8	4.7	6.9	4.0	5.1	3.3	3.6	3.2	3.9	6.6
ils	0.3	0.5	0.8	1.1	1.7	2.5	2.5	2.4	1.5	3.4	3.7	3.0	**4.9**	**13.5**
shift	0.6	0.1	3.4	−2.9	−0.1	−1.1	1.9	1.9	1.1	−2.3	0.0	−0.5	0.9	−1.8
gra	−3.2	2.2	−1.6	3.4	**10.1**	**10.9**	**12.0**	3.3	**6.9**	4.8	2.8	**4.4**	0.8	0.6
tem	**5.6**	**6.4**	**6.8**	**6.6**	7.3	6.4	6.5	**5.8**	5.9	**5.4**	**4.9**	4.3	3.6	3.4
los	2.8	3.1	3.4	3.2	3.3	2.9	2.7	2.4	2.3	2.0	1.9	1.9	1.9	1.5

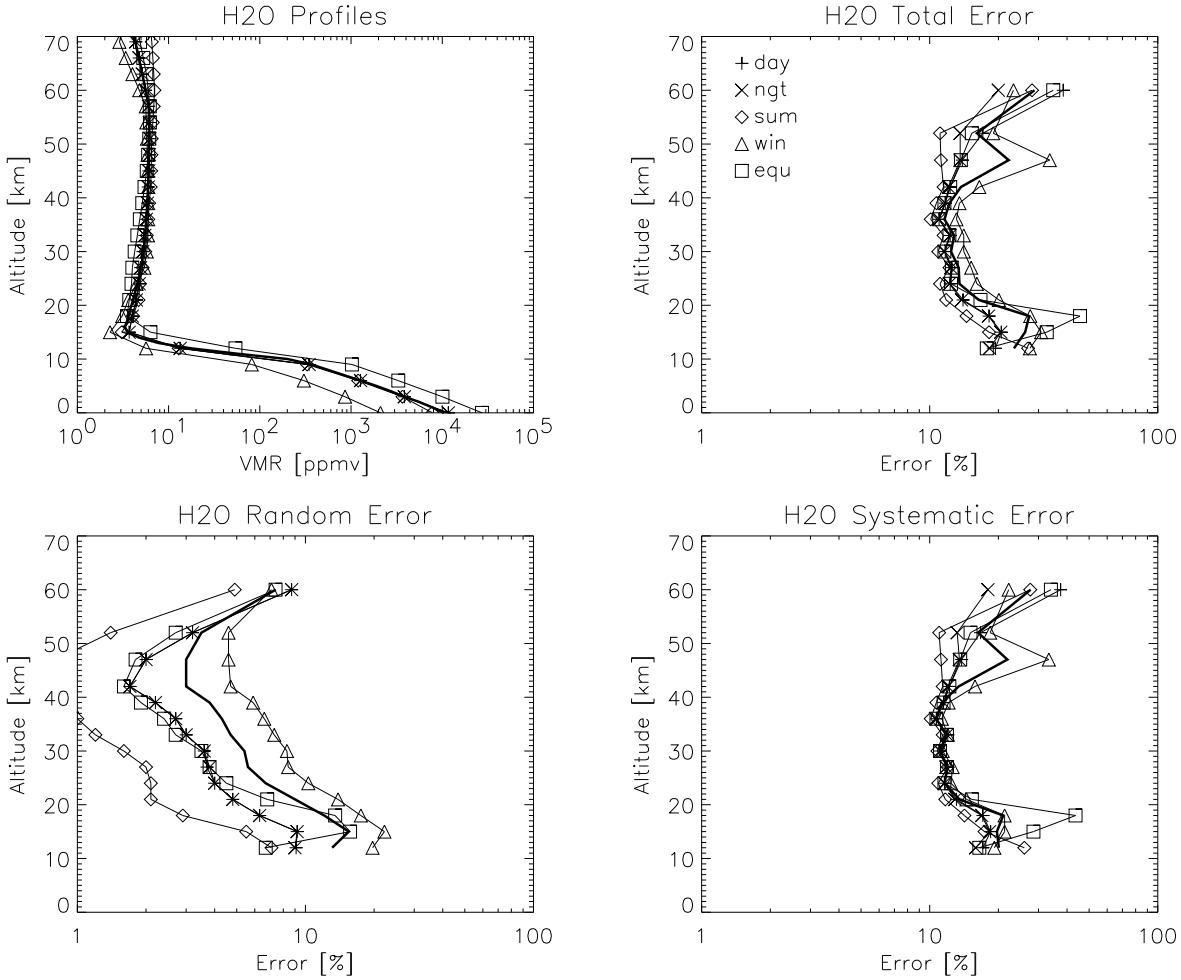

Figure 2: H_2O profiles.

Table 2: H_2O error contributions.

Alt	12km	15km	18km	21km	24km	27km	30km	33km	36km	39km	42km	47km	52km	60km
Rnd	13.1	15.5	12.1	9.0	6.7	5.6	5.4	4.7	4.3	3.8	3.0	3.0	3.5	7.4
Sys	20.1	19.7	21.0	13.5	11.6	12.0	11.1	11.8	10.7	11.3	13.4	21.9	16.3	27.7
Tot	23.4	26.2	27.3	16.4	13.5	13.4	12.4	12.8	11.6	12.2	13.7	22.2	16.1	28.8
Significant systematic error sources (largest at each altitude in **bold**).														
o3	−6.8	−4.9	−1.7	−0.5	−0.2	−0.2	−0.1	−0.1	−0.1	0.0	0.0	−0.1	−0.1	−0.6
so2	**9.7**	−1.6	−4.3	1.4	−1.0	0.6	−0.3	0.2	−0.1	0.0	0.0	0.0	0.0	0.1
nonlte	−2.4	0.0	−1.0	−1.0	−1.0	−0.1	0.4	0.5	−0.2	0.4	0.4	0.9	3.2	**14.9**
hitran	6.5	7.6	**16.0**	6.6	6.6	**8.5**	**7.8**	**9.2**	**7.9**	**8.6**	**9.6**	8.9	7.2	5.2
shift	−4.8	−1.5	1.4	0.5	−0.5	1.2	−1.9	−1.1	−1.0	−0.8	4.0	0.7	−0.7	3.0
gra	−3.8	**−11.4**	−5.7	−1.2	0.9	−1.4	−0.4	−1.6	0.9	2.7	3.7	**15.2**	**9.1**	6.3
tem	2.3	10.6	12.3	**9.9**	**8.0**	6.9	6.1	5.6	5.6	5.3	4.8	4.7	5.6	8.4
los	1.3	3.1	3.8	4.1	4.2	4.2	4.2	4.2	4.2	4.2	4.2	3.9	3.2	2.3

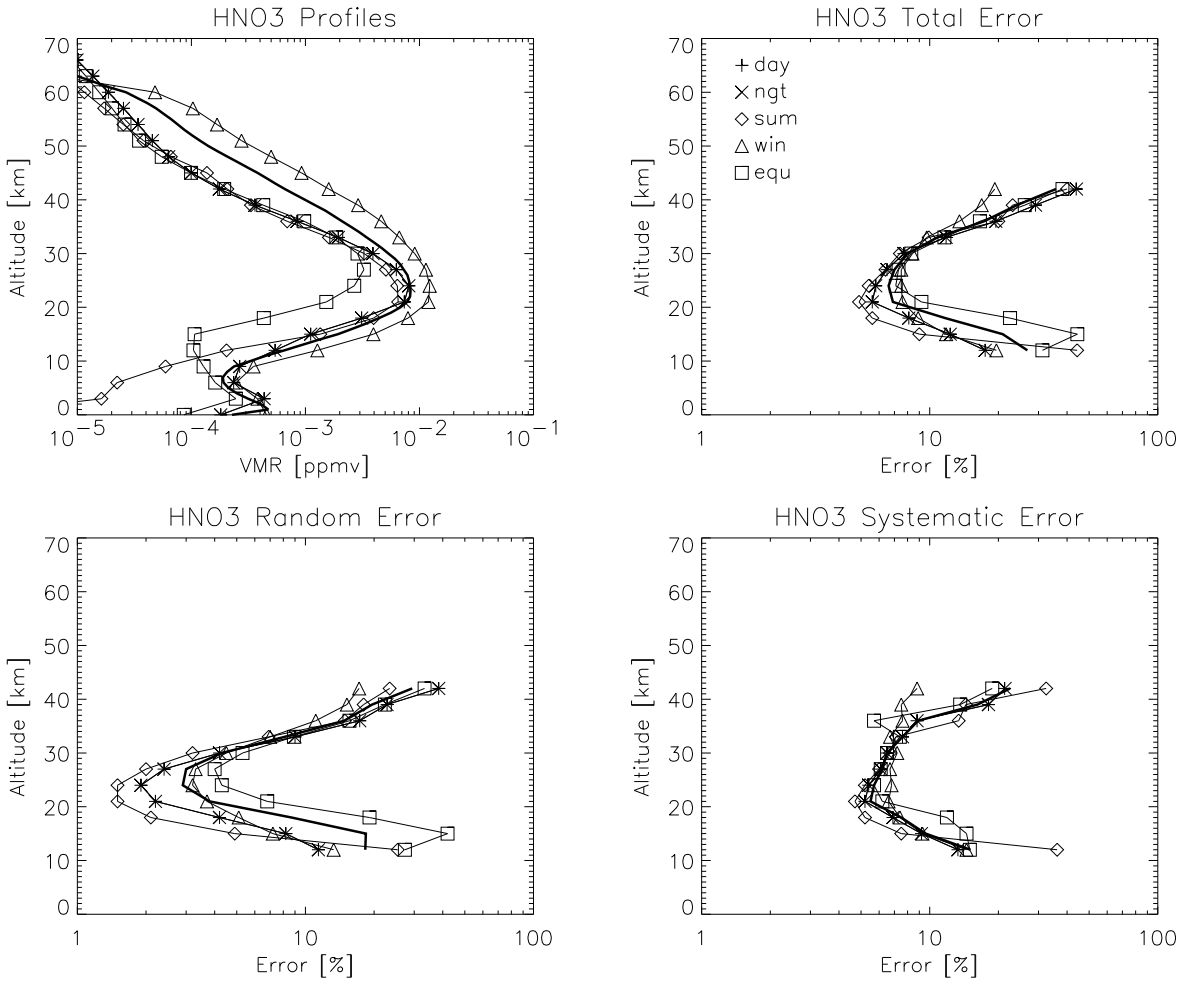

Figure 3: HNO_3 profiles.

Table 3: HNO_3 error contributions.

Alt	12km	15km	18km	21km	24km	27km	30km	33km	36km	39km	42km
Rnd	18.3	18.4	8.7	3.8	2.9	3.0	4.3	8.1	14.8	19.6	29.4
Sys	15.1	9.6	7.5	5.5	5.7	6.2	6.5	7.6	8.9	16.2	22.5
Tot	26.8	20.9	11.7	6.9	6.6	7.0	8.0	10.8	17.3	24.1	35.8
Significant systematic error sources (largest at each altitude in **bold**).											
ch4	0.9	−0.3	−0.3	−0.4	−0.4	−0.3	−0.2	−0.7	−2.0	−4.5	−2.6
hitran	**15.1**	3.3	4.4	3.2	**4.1**	**5.2**	**5.9**	**6.4**	**6.6**	7.4	**12.1**
ils	7.5	2.2	0.8	1.6	1.5	1.0	1.0	1.3	2.8	**7.8**	10.9
shift	1.0	1.4	0.2	0.5	0.2	−0.1	0.0	−0.4	−2.2	−4.4	−2.9
gra	6.1	3.2	2.6	0.8	0.4	0.3	−0.6	0.0	−2.0	−1.6	0.0
tem	4.3	**4.8**	**4.9**	**3.8**	3.2	2.5	2.0	1.8	1.4	1.2	0.6
los	2.1	1.5	2.0	1.8	1.9	1.9	1.9	1.9	1.4	0.9	0.6

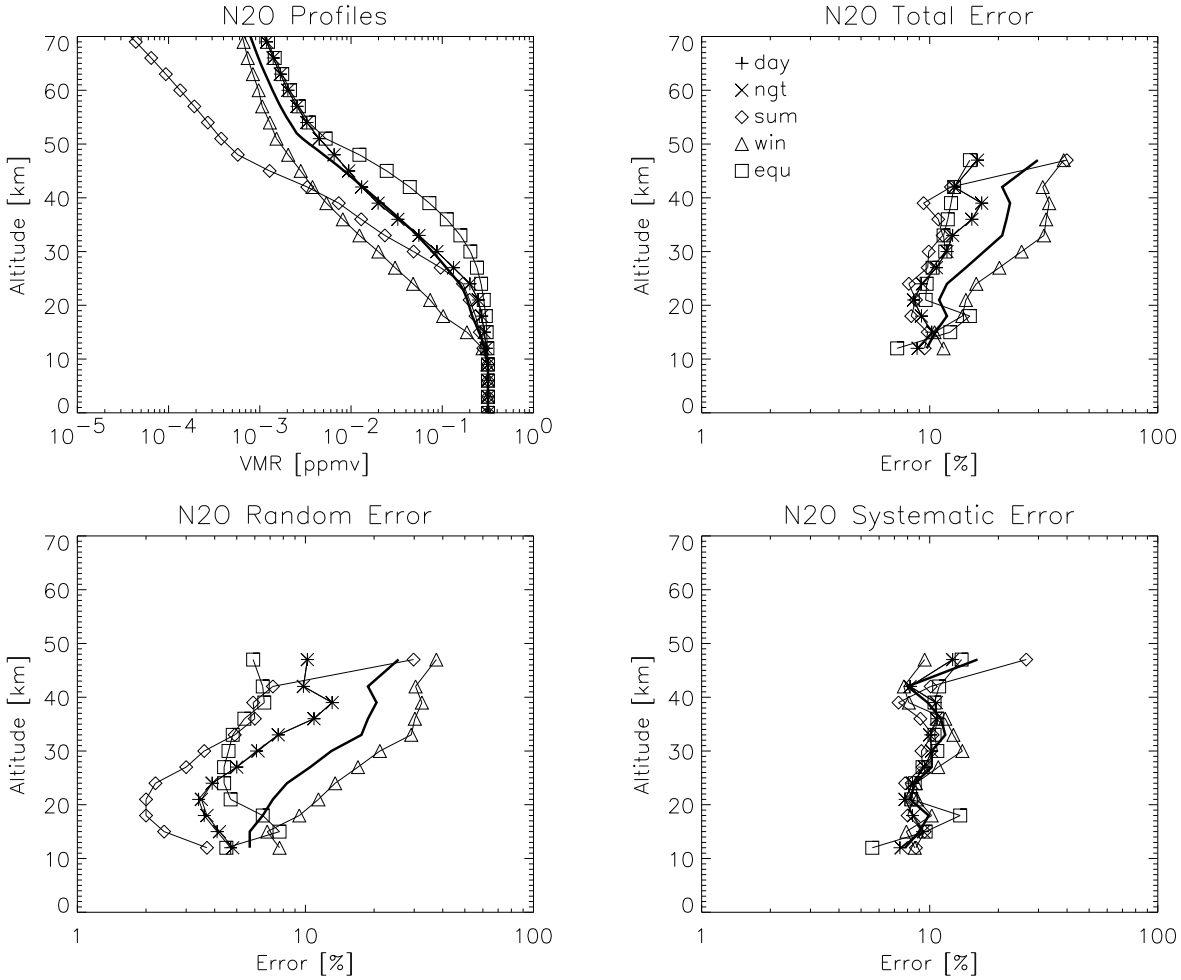

Figure 4: N_2O profiles.

Table 4: N_2O error contributions.

Alt	12km	15km	18km	21km	24km	27km	30km	33km	36km	39km	42km	47km
Rnd	5.7	5.7	6.5	7.2	8.3	10.5	13.0	17.6	18.8	20.5	18.8	25.6
Sys	7.8	9.0	9.9	8.2	8.6	10.2	10.2	11.7	11.2	9.8	8.0	16.2
Tot	9.7	10.6	11.9	11.0	11.9	14.4	17.3	20.8	21.7	22.5	20.8	29.8
Significant systematic error sources (largest at each altitude in **bold**).												
o3	−3.3	−3.1	−3.0	−2.4	−2.4	−2.4	−0.8	−1.5	0.0	−0.5	−0.2	0.1
ch4	−2.3	−3.5	−3.4	−3.2	−2.6	−1.7	−1.8	−1.0	−0.9	−0.9	−0.8	−1.3
hitran	1.7	2.0	1.4	2.5	3.4	5.1	5.7	**5.8**	**5.6**	**5.6**	**5.6**	5.4
ils	0.4	0.9	1.1	1.0	0.8	2.2	4.5	2.8	4.9	4.4	4.9	**7.8**
shift	−1.0	0.1	−0.6	0.8	−0.5	0.0	0.2	−3.2	1.1	−0.2	−1.3	4.9
gra	−2.3	−0.7	−2.0	−1.6	0.2	1.2	4.9	2.9	3.2	1.9	0.1	0.8
tem	**4.3**	**6.0**	**6.9**	**5.4**	**5.4**	**5.6**	**6.0**	5.2	4.7	4.4	3.4	3.5
los	1.6	2.3	2.9	2.9	2.8	3.1	3.2	2.9	2.5	2.3	1.9	1.7

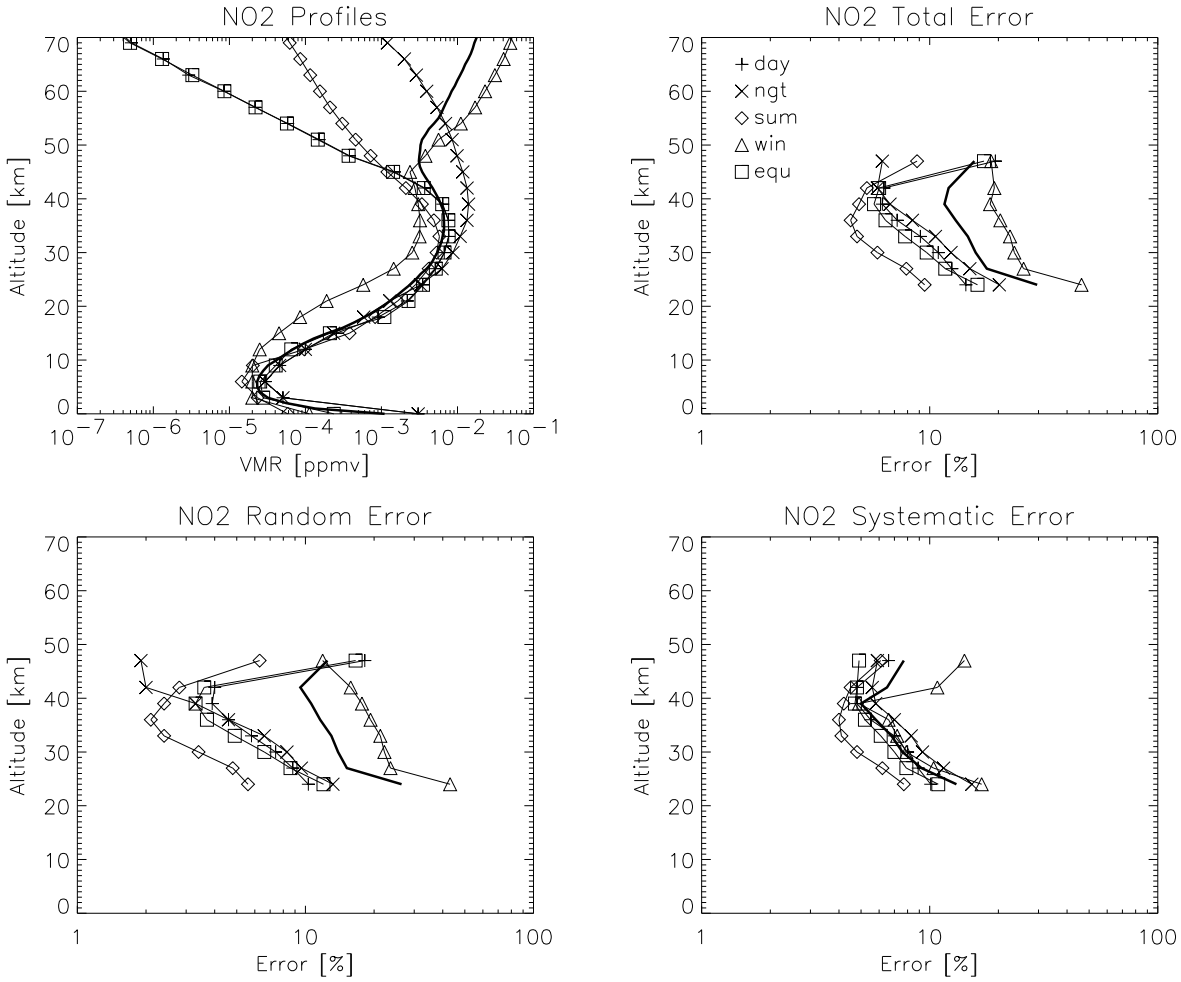

Figure 5: NO_2 profiles.

Table 5: NO_2 error contributions.

Alt	24km	27km	30km	33km	36km	39km	42km	47km
Rnd	26.4	15.2	13.9	13.0	11.6	10.6	9.5	12.5
Sys	13.1	9.2	7.6	6.8	5.8	5.0	6.5	7.7
Tot	29.6	17.8	15.9	14.7	13.0	11.6	12.1	15.7
Significant systematic error sources (largest at each altitude in **bold**).								
h2o	**−5.7**	**−4.8**	−3.8	−3.4	−1.9	−0.9	−1.8	−0.6
hitran	2.9	2.3	1.1	0.7	1.9	1.9	**4.8**	**6.3**
gra	−3.2	−1.4	−1.6	−2.0	−1.7	−1.7	−2.9	−5.2
tem	5.3	4.7	**4.7**	**4.4**	**3.9**	**3.1**	2.3	1.6
los	1.8	1.4	1.4	1.5	1.6	1.5	1.5	1.3

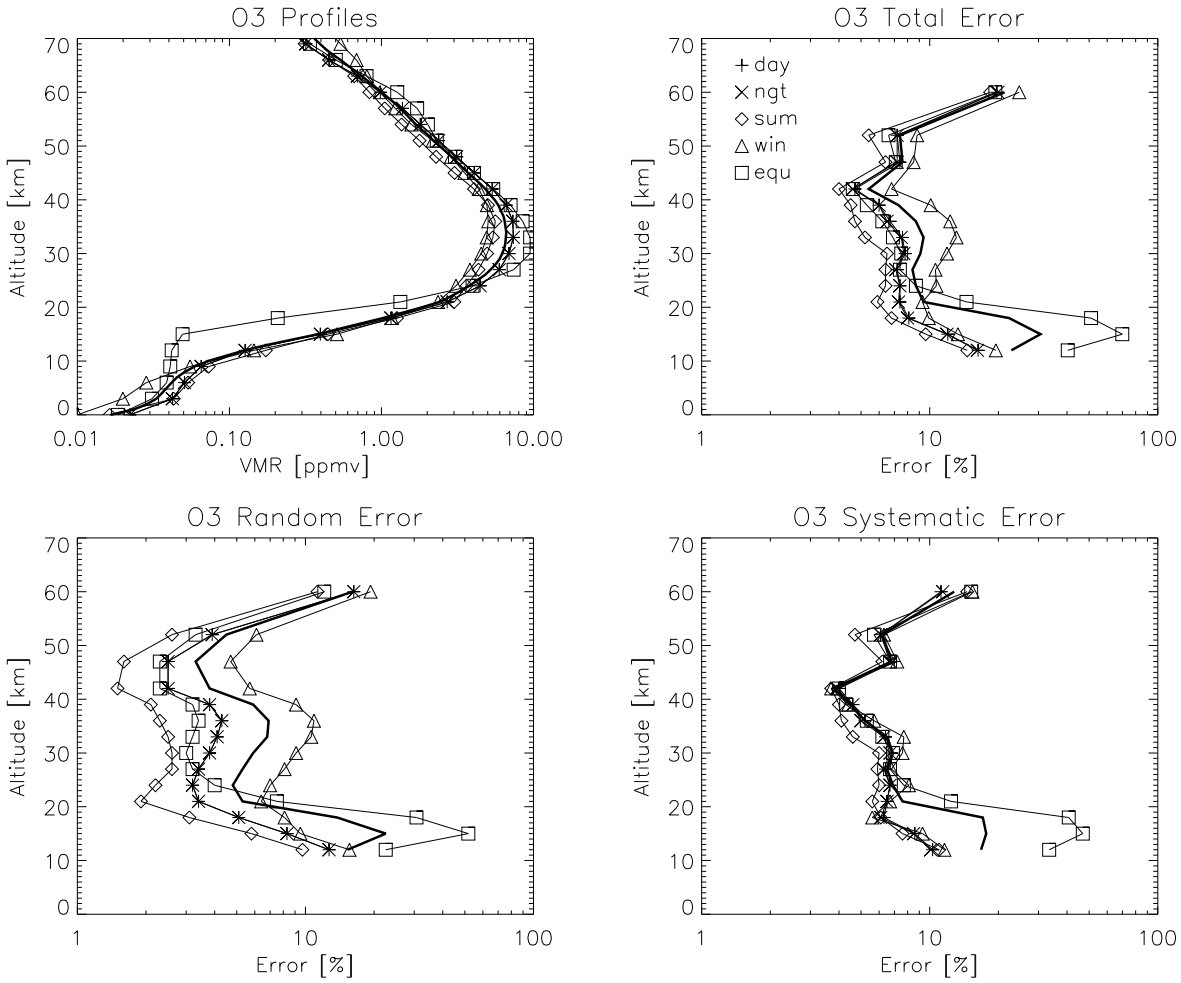

Figure 6: O_3 profiles.

Table 6: O_3 error contributions.

Alt	12km	15km	18km	21km	24km	27km	30km	33km	36km	39km	42km	47km	52km	60km
Rnd	15.3	22.5	13.8	5.3	4.8	5.3	5.9	6.8	6.9	5.9	3.8	3.3	4.5	16.1
Sys	16.8	17.7	17.1	7.6	6.9	6.5	6.9	6.5	5.2	4.5	3.8	6.8	6.2	12.8
Tot	22.8	30.6	22.3	9.4	8.7	8.4	9.1	9.4	8.7	7.3	5.4	7.6	7.4	21.3
Significant systematic error sources (largest at each altitude in **bold**).														
nonlte	−0.8	−2.9	0.8	−1.1	0.2	−0.5	−0.3	−0.2	−0.6	−0.2	−0.5	−1.4	−2.8	−3.9
hitran	4.2	**8.0**	1.8	1.6	**4.3**	2.8	**4.4**	3.2	1.8	1.8	1.8	2.1	2.0	4.3
ils	5.6	**8.0**	3.8	1.0	1.1	0.9	1.0	3.1	0.7	1.0	0.6	**5.5**	**3.4**	**8.7**
shift	0.8	4.3	1.8	−4.1	0.0	1.1	0.4	−1.6	2.0	0.6	−0.8	−0.5	−0.4	−0.2
gra	**6.4**	3.0	**−7.3**	−0.2	0.2	0.4	1.3	0.4	−1.2	−0.8	−0.3	−0.2	−0.7	0.5
tem	5.7	4.1	5.0	**4.3**	**4.3**	**4.3**	3.7	**3.3**	**3.2**	**2.9**	**2.4**	2.1	2.1	2.3
los	2.9	1.5	2.5	2.9	3.1	3.2	3.1	2.7	2.3	2.1	1.9	2.0	1.9	1.3

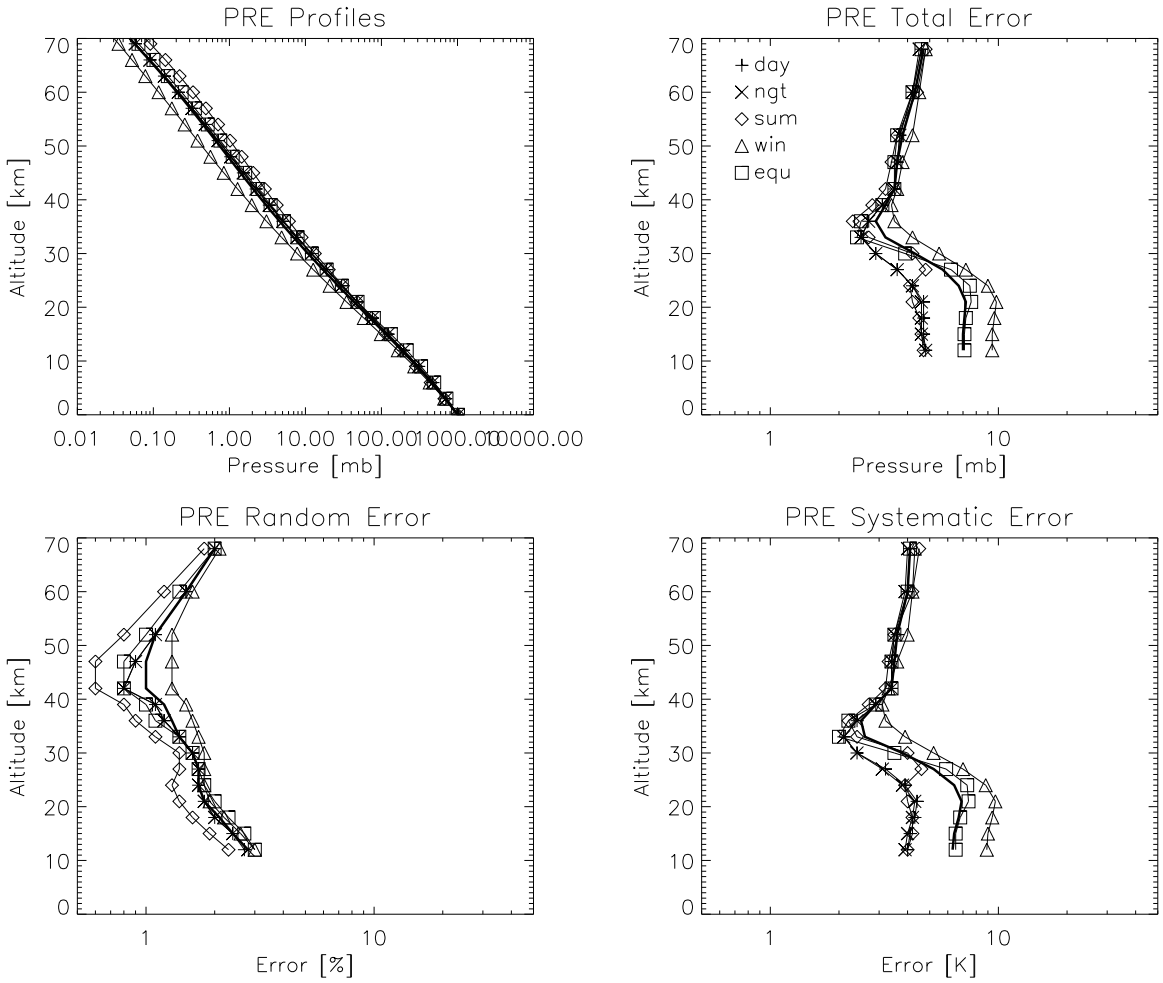

Figure 7: Pressure profiles.

Table 7: Pressure error contributions.

Alt	12km	15km	18km	21km	24km	27km	30km	33km	36km	39km	42km	47km	52km	60km	68km
Rnd	2.8	2.4	2.1	1.8	1.7	1.7	1.6	1.4	1.3	1.2	1.0	1.0	1.1	1.5	2.0
Sys	6.3	6.4	6.7	6.9	6.4	5.2	3.8	2.6	2.5	2.9	3.4	3.5	3.6	4.0	4.1
Tot	7.0	7.0	7.1	7.2	6.7	5.7	4.3	3.2	2.9	3.2	3.5	3.6	3.8	4.3	4.7
Significant systematic error sources (largest at each altitude in **bold**).															
co2	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.5	0.5	0.5
o3	**4.2**	**4.2**	**4.5**	**4.8**	**4.5**	**3.5**	**2.2**	1.0	0.0	−0.5	−0.6	−0.4	−0.1	0.0	0.0
so2	−0.6	−0.7	−0.8	−0.8	−0.8	−0.9	−0.6	−0.2	0.0	0.1	0.1	0.1	0.1	0.1	0.1
nonlte	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	−0.1	−0.4	−1.0	−1.4
hitran	2.6	2.7	2.7	2.6	2.5	2.3	1.9	**1.8**	**2.2**	**2.6**	**3.1**	**3.2**	**3.0**	**3.0**	**2.9**
gain	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.5	0.6	0.7	0.7
ils	0.7	0.8	0.8	0.7	1.0	1.1	1.0	0.6	0.5	0.6	0.5	0.5	1.0	1.4	1.4
shift	0.4	0.4	0.4	0.3	0.3	0.4	0.1	−0.3	−0.2	0.2	0.2	0.3	0.8	0.7	0.5
gra	−2.3	−2.3	−2.4	−2.4	−1.6	−0.5	0.1	0.1	0.2	0.4	0.4	0.6	1.2	1.7	1.9

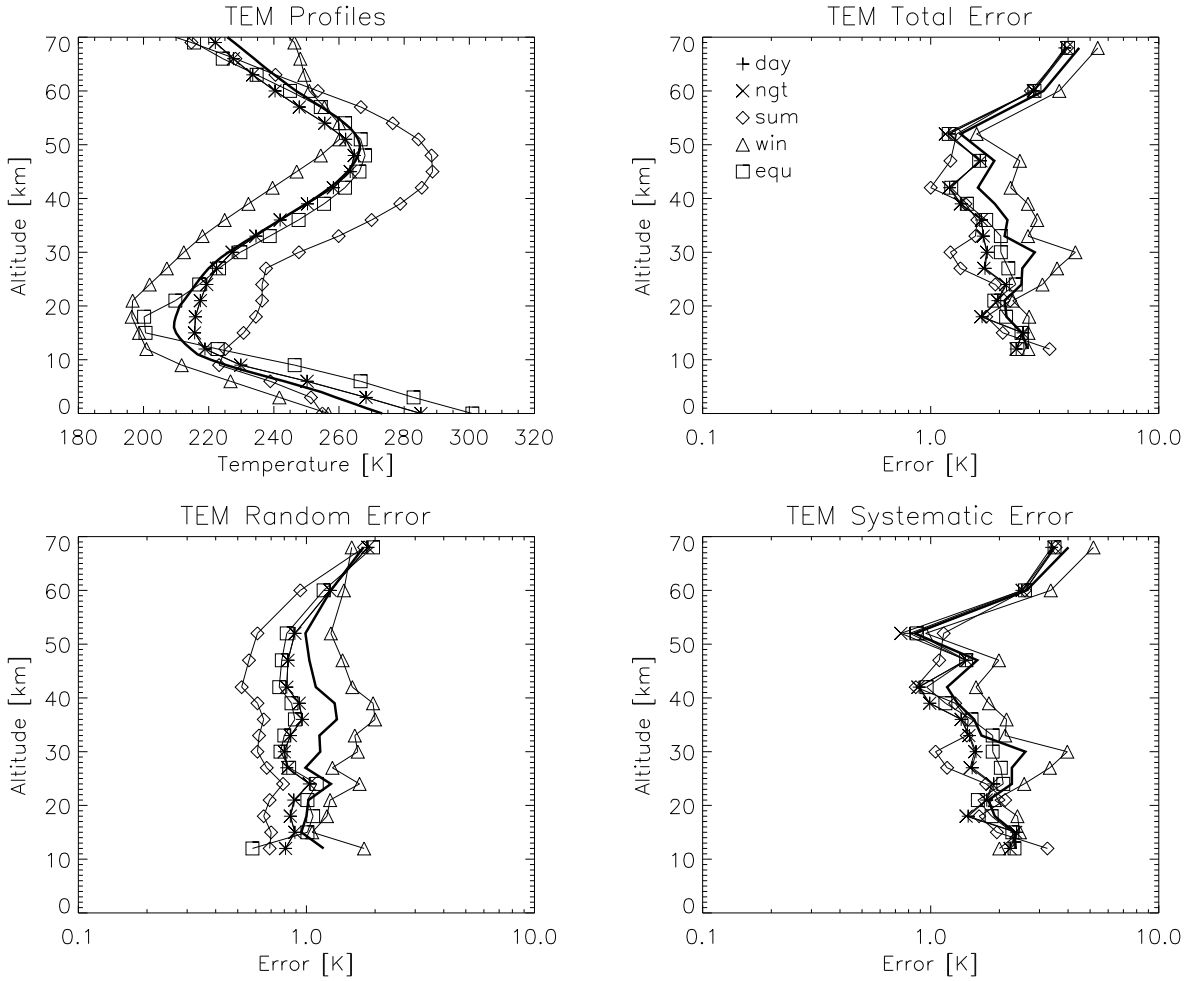

Figure 8: Temperature profiles.

Table 8: Temperature error contributions.

Alt	12km	15km	18km	21km	24km	27km	30km	33km	36km	39km	42km	47km	52km	60km	68km
Rnd	1.19	0.95	1.00	1.02	1.28	0.99	1.15	1.14	1.36	1.33	1.10	1.03	0.99	1.28	1.78
Sys	2.36	2.33	1.91	1.79	2.27	2.27	2.60	1.67	1.55	1.31	1.18	1.60	0.85	2.63	4.02
Tot	2.66	2.51	2.15	2.11	2.50	2.52	2.86	2.11	2.17	1.91	1.61	1.90	1.35	3.12	4.48
Significant systematic error sources (largest at each altitude in **bold**).															
co2	−0.07	−0.12	−0.06	−0.13	−0.03	0.02	−0.02	−0.11	−0.10	−0.09	−0.04	−0.10	−0.03	−0.03	0.13
o3	−0.66	**−1.33**	**−1.09**	−0.25	**−1.25**	**−1.65**	**−1.70**	−0.34	0.64	0.16	**0.56**	0.17	−0.03	−0.03	−0.32
so2	**−1.81**	0.94	−0.24	−0.08	0.01	−0.51	−0.48	−0.04	0.04	0.01	−0.07	−0.08	−0.08	−0.06	0.00
nonlte	0.01	0.06	−0.07	0.00	−0.04	0.05	0.06	0.00	−0.05	0.02	−0.03	−0.08	0.20	−0.24	−1.36
hitran	0.37	0.84	0.56	**1.01**	0.64	0.36	0.65	0.65	0.47	0.59	0.27	**0.79**	0.21	0.28	0.30
gain	0.12	0.06	0.06	0.06	0.06	0.13	0.13	0.23	0.20	0.11	0.13	0.34	0.18	0.22	0.27
ils	0.17	0.40	0.71	0.65	0.82	0.66	0.34	0.52	0.94	0.51	0.50	0.66	**0.62**	**2.53**	**3.15**
shift	−0.11	−0.75	−0.49	−0.80	−0.06	−0.29	−0.33	0.39	−0.34	−0.49	−0.39	0.77	0.01	−0.73	−0.31
gra	0.03	−0.58	−0.09	−0.81	0.26	0.59	0.89	**1.31**	**1.06**	**0.85**	0.43	0.60	0.28	0.84	1.18