4.6.2 NO

NO emissions have a strong non-LTE influence, similar to CO, but the retrieval of NO from MIPAS spectra has two additional problems: the nighttime concentration is small, preventing a nighttime-only, LTE retrieval; and there is a large, but poorly-determined, concentration at high-altitudes which significantly contributes to radiation from the nominal range of tangent paths.

Microwindows have been selected for LTE and non-LTE retrievals (i.e., jointly with vibrational temperature), as with CO, but here both cases are for a mid-latitude day-time atmosphere. Variations in the high altitude column are ignored, effectively assuming that the high altitude column is fixed. The selected microwindows are listed in Tables 31 and 32 and plotted in Figs. 62 and 63. For the LTE case the maximum of 10 microwindows was reached, while for the non-LTE case the maximum of 10 000 measurements was reached, the non-LTE microwindows being significantly wider than the LTE microwindows.

Table 31: NO LTE Microwindows

MW	Waveno. Range		Alt.		NPts	NUse
1	1860.375	1860.850	12	52	260	259
2	1874.825	1876.100	12	33	416	381
3	1887.450	1887.725	12	52	156	156
4	1923.350	1924.600	18	52	561	560
5	1850.050	1850.300	12	39	110	110
6	1928.625	1929.225	9	52	350	350
7	1857.225	1857.850	36	52	130	122
8	1931.525	1931.900	9	52	224	224
9	1830.275	1832.450	47	60	264	181
10	1870.000	1871.950	9	47	1027	434
				Total:	3498	2777

Table 32: Joint NO,T_{vib} (non-LTE) Microwindows

MW	Waveno. Range		Alt.		NPts	NUse
1	1847.650	1850.650	9	68	1936	1234
2	1873.775	1876.350	9	68	1664	1662
3	1852.250	1855.250	9	68	1936	1586
4	1855.575	1858.575	9	52	1694	1524
5	1844.625	1847.625	9	68	1936	1260
6	1897.650	1900.650	9	52	1694	1178
				Total:	10860	8444

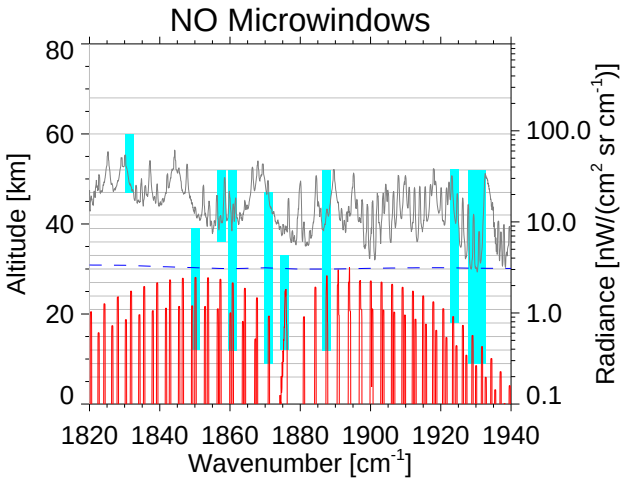

Figure 62: NO LTE microwindows and the NO spectrum.

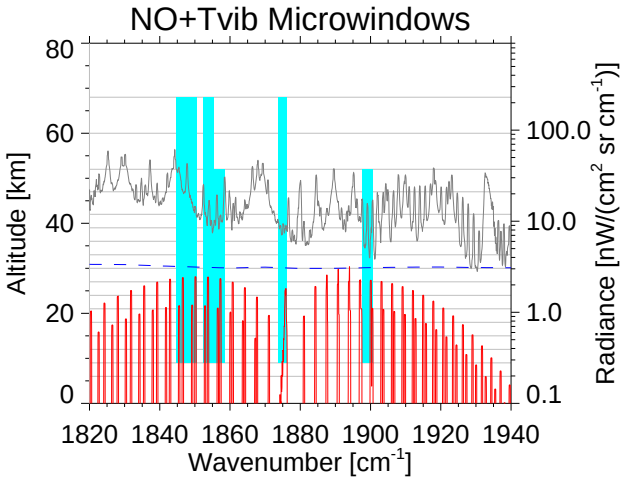

Figure 63: Joint NO,T_{vib} (non-LTE) microwindows and the NO spectrum.

Fig. 64 shows the NO profile and expected accuracy for the LTE case, and Fig. 65 the (kinetic−vibrational) temperature profile and expected accuracy for the non-LTE case. Results are summarised in Fig. 66.

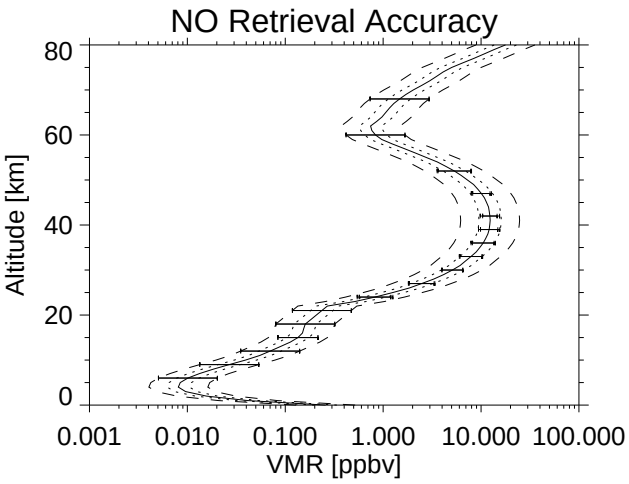

Figure 64: NO profile and retrieval errors for a mid-latitude day-time scenario assuming LTE. The dashed lines represent the ±100% *a priori* uncertainty and the dotted lines the ±30% limit of 'useful' accuracy. Inner ticks on error bars are precision, outer ticks are accuracy.

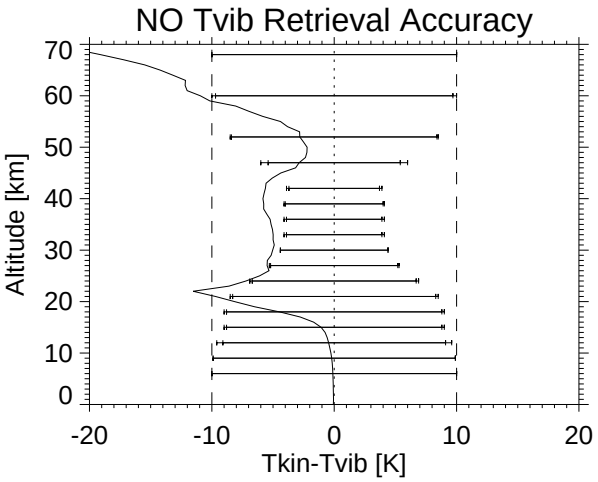

Figure 65: Difference between the kinetic and vibrational temperatures, and retrieval errors for mid-latitude day-time scenario assuming a joint NO,T_{vib} retrieval. The dashed lines represent the ±10 K *a priori* retrieval uncertainty.

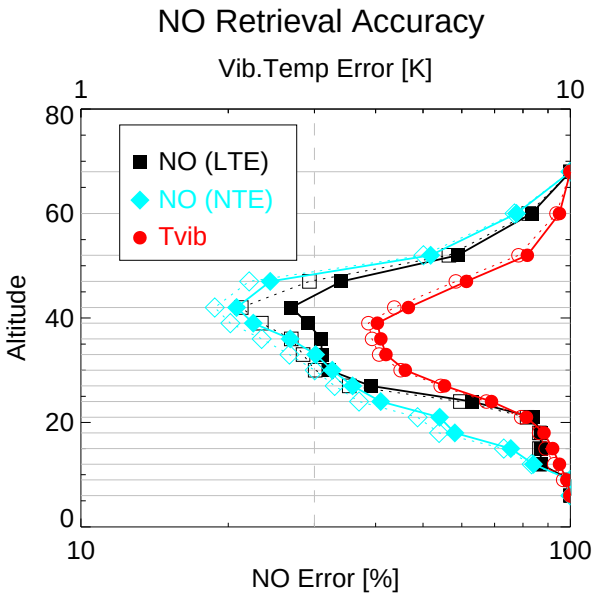

Figure 66: Retrieval accuracy profiles for NO assuming LTE, and for NO (NTE) jointly with T_{vib} (top axis), all in mid-latitude day-time conditions. Solid symbols/lines are accuracy, open symbols/dashed lines are precision.

Fig. 66 suggests that NO can be retrieved to useful accuracy in the altitude range 33–42 km, and that results are significantly improved at all altitudes if retrieved jointly with vibrational temperature. For an LTE retrieval precision is comparable with the non-LTE case but the accuracy is severely limited by non-LTE effects.

However, these represent optimistic cases. It is emphasised that the effects of the high altitude NO column and its uncertainty have not been considered in this analysis.