Supplement to

Version 8 IMK/IAA MIPAS temperatures from 12–15 μm spectra: Middle and Upper Atmosphere modes

Maya Garcia-Comas et al.

Correspondence: Maya Garcia-Comas (maya@iaa.es)

This supplement contains the temperature error budget collection for MIPAS MA/UA RR data (2005-2012) for daytime (SZA<90°) and nighttime (SZA>95°), estimated using the representative atmospheres listed in Table S0.

Table S0. Labels and definitions of the representative atmospheric conditions used to estimate MIPAS temperature errors.

Atmosphere label	Months used	Latitude range
Northern polar winter	Jan, Feb	65°N−90°N
Northern polar spring	Apr	65°N−90°N
Northern polar summer	Jul, Aug	65°N−90°N
Northern polar autumn	Oct	65°N−90°N
Northern midlatitude winter	Jan, Feb	40°N−60°N
Northern midlatitude spring	Apr	40°N−60°N
Northern midlatitude summer	Jul, Aug	40°N−60°N
Northern midlatitude autumn	Oct	40°N−60°N
Tropics	Apr	20°S−20°N
Southern midlatitude winter	Jul, Aug	40°S−60°S
Southern midlatitude spring	Oct	40°S−60°S
Southern midlatitude summer	Jan, Feb	40°S−60°S
Southern midlatitude autumn	Apr	40°S−60°S
Southern polar winter	Jul, Aug	65°S−90°S
Southern polar spring	Oct	65°S−90°S
Southern polar summer	Jan, Feb	65°S−90°S
Southern polar autumn	Apr	65°S−90°S

Table S1. Temperature error budget for Northern polar winter day. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	226.0	<0.1	<0.1	0.1	0.5	0.4	<0.1	0.3	0.5	0.5
30	219.6	<0.1	<0.1	0.4	0.4	0.3	<0.1	0.3	0.4	0.6
40	219.2	<0.1	<0.1	0.1	0.4	0.2	0.1	0.3	0.4	0.5
50	226.8	<0.1	<0.1	0.4	0.4	0.2	0.1	0.5	0.6	0.6
60	224.0	<0.1	<0.1	0.4	0.3	0.6	0.2	1.0	1.1	0.7
70	226.6	0.7	0.3	0.3	0.2	0.7	0.7	2.5	2.6	1.1
80	232.1	2.9	<0.1	0.3	0.4	0.7	1.2	4.4	4.8	2.7
90	219.7	3.3	2.0	0.6	0.4	0.5	1.3	5.3	5.7	3.6
100	199.7	4.6	1.0	0.7	0.8	0.4	1.6	7.3	7.8	4.3
110	254.2	21.4	7.7	1.9	0.9	0.5	4.8	19.3	22.9	19.8
115	320.4	26.7	10.9	2.7	0.9	0.7	6.7	26.9	31.0	25.5

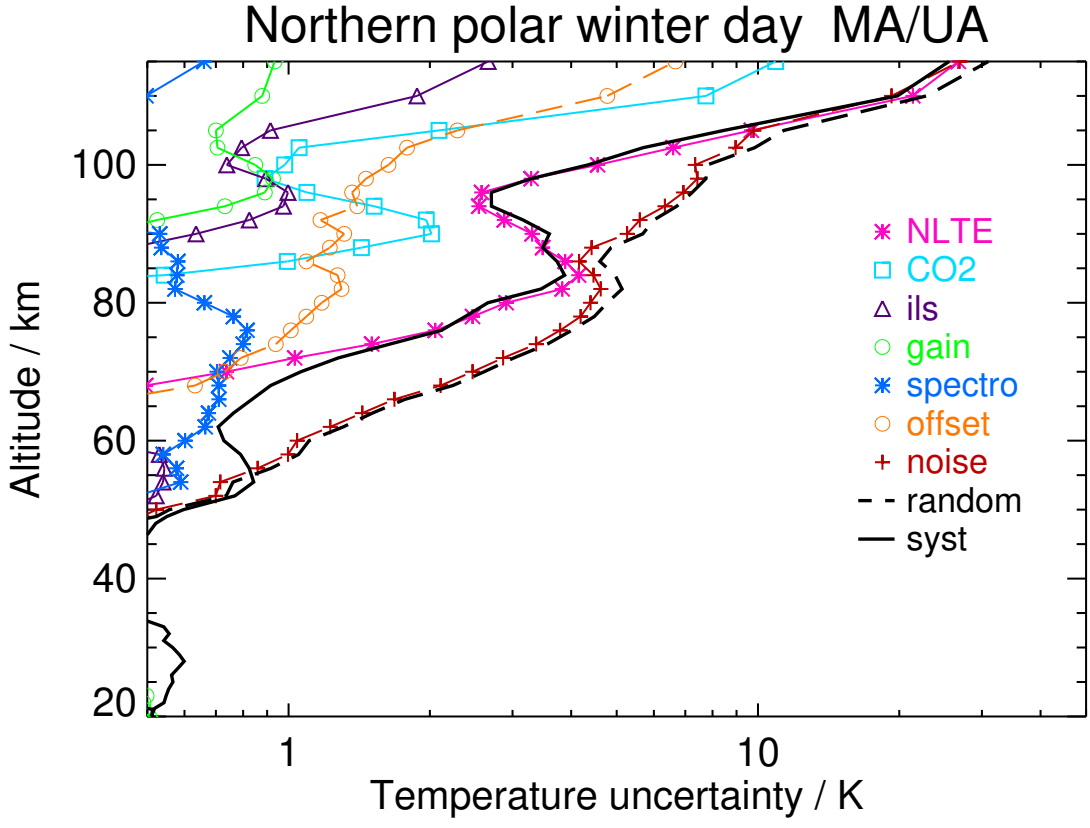

Figure S1. Temperature uncertainties for Northern polar winter daytime conditions.

Table S2. Temperature error budget for Northern polar winter night. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	208.1	<0.1	<0.1	0.2	0.4	0.4	<0.1	0.3	0.4	0.6
30	208.7	<0.1	<0.1	0.4	0.4	0.6	<0.1	0.3	0.6	0.6
40	225.3	<0.1	<0.1	0.1	0.4	0.5	0.1	0.4	0.6	0.6
50	253.9	<0.1	<0.1	0.5	0.4	0.3	0.1	0.5	0.6	0.6
60	246.3	0.2	<0.1	0.3	0.3	0.8	0.2	0.9	1.0	0.9
70	230.2	0.7	0.3	0.3	0.2	0.9	0.8	2.3	2.5	1.2
80	218.4	2.1	<0.1	0.5	0.3	0.7	1.1	4.4	4.8	1.7
90	207.3	2.8	1.8	1.0	0.5	0.3	1.4	5.5	6.0	2.9
100	195.7	5.8	1.2	0.9	0.9	0.3	1.8	7.6	8.3	5.3
110	247.2	19.1	8.5	1.6	0.7	0.5	5.6	21.7	24.4	18.6
115	301.0	22.7	11.0	2.2	0.8	0.6	7.1	28.3	31.5	22.5

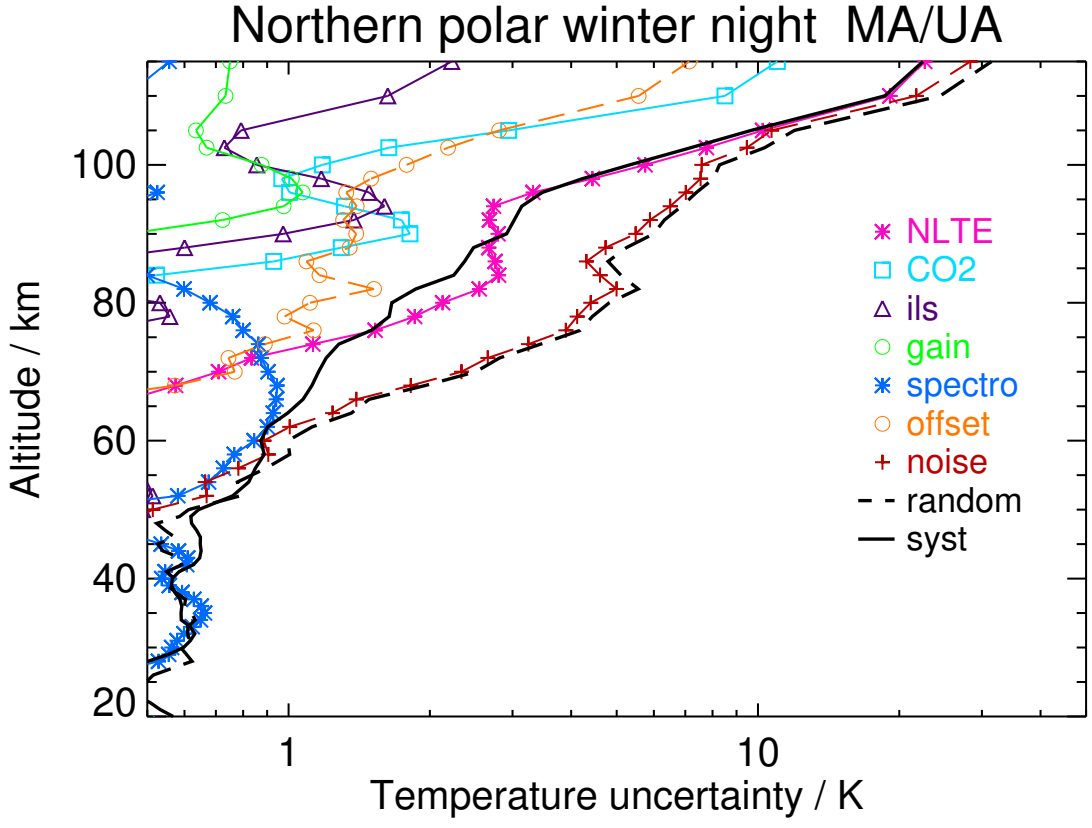

Figure S2. Temperature uncertainties for Northern polar winter nighttime conditions.

Table S3. Temperature error budget for Northern polar spring day. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	215.4	<0.1	<0.1	0.2	0.4	0.2	<0.1	0.4	0.4	0.4
30	216.9	<0.1	<0.1	0.5	0.3	0.5	<0.1	0.3	0.4	0.7
40	248.1	<0.1	<0.1	0.2	0.4	0.7	<0.1	0.3	0.5	0.8
50	270.1	<0.1	<0.1	0.5	0.3	0.4	0.1	0.4	0.5	0.7
60	254.7	0.1	<0.1	0.3	0.2	1.0	0.2	0.7	0.8	1.0
70	222.2	0.2	0.2	0.4	0.2	0.9	0.8	2.2	2.4	1.0
80	199.6	0.5	<0.1	0.6	0.2	0.6	0.9	4.4	4.6	0.7
90	179.9	1.0	1.2	0.9	0.4	0.2	1.4	5.8	6.0	1.6
100	181.4	7.6	1.7	0.8	1.3	0.8	2.4	8.2	8.9	7.5
110	283.4	31.1	7.6	4.1	1.2	0.8	5.7	20.7	23.0	31.2
115	354.7	37.8	10.0	5.8	1.2	0.9	7.8	27.7	30.4	38.4

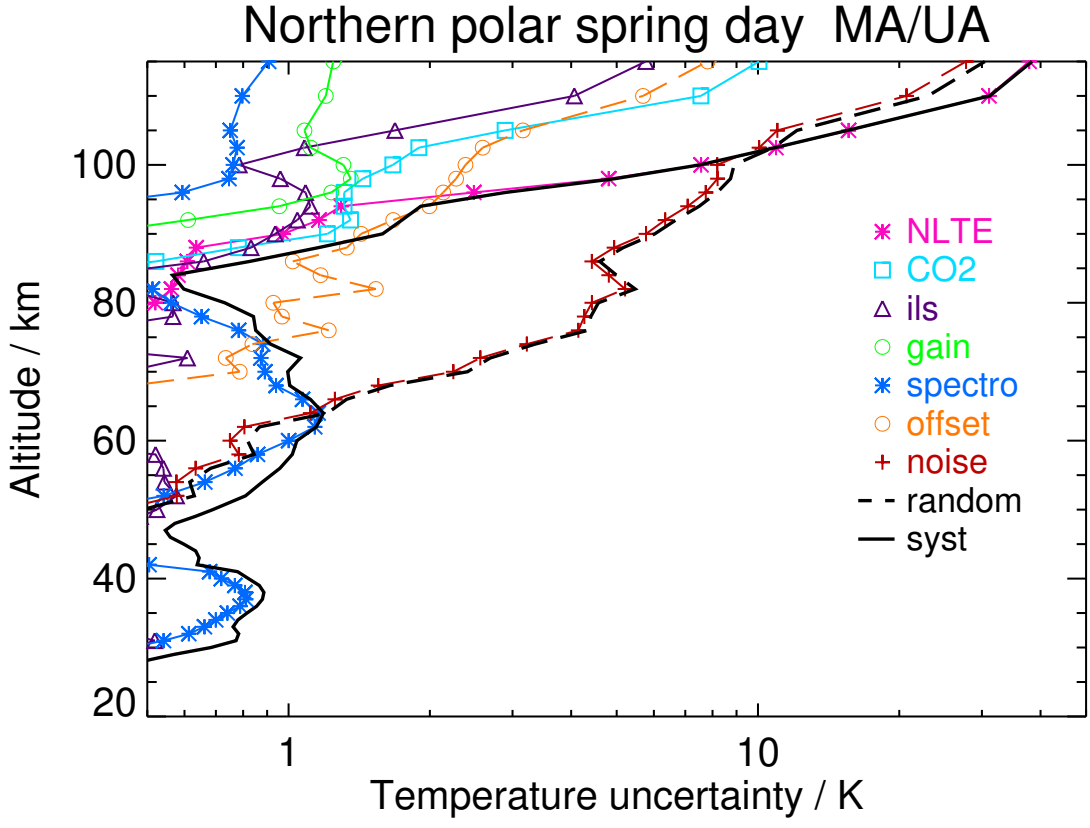

Figure S3. Temperature uncertainties for Northern polar spring daytime conditions.

Table S4. Temperature error budget for Northern polar spring night. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	215.8	<0.1	<0.1	0.2	0.4	0.2	<0.1	0.3	0.4	0.4
30	218.0	<0.1	<0.1	0.5	0.3	0.5	<0.1	0.3	0.4	0.7
40	247.8	<0.1	<0.1	0.2	0.4	0.7	<0.1	0.3	0.4	0.8
50	265.9	<0.1	<0.1	0.5	0.3	0.4	0.1	0.4	0.5	0.7
60	249.5	0.1	<0.1	0.2	0.2	1.0	0.3	0.8	0.8	1.0
70	221.4	0.2	0.2	0.5	0.2	1.0	0.8	2.3	2.4	1.1
80	200.3	0.6	<0.1	0.6	0.2	0.7	1.0	4.5	4.7	0.9
90	189.5	1.6	1.2	1.2	0.4	0.2	1.5	5.8	6.1	2.1
100	189.7	8.4	1.3	0.7	1.3	0.7	2.0	7.9	8.6	8.2
110	271.8	30.6	6.7	2.8	0.9	0.6	4.7	18.4	22.1	29.4
115	332.6	38.1	9.6	4.2	0.9	0.7	6.8	26.5	30.7	37.0

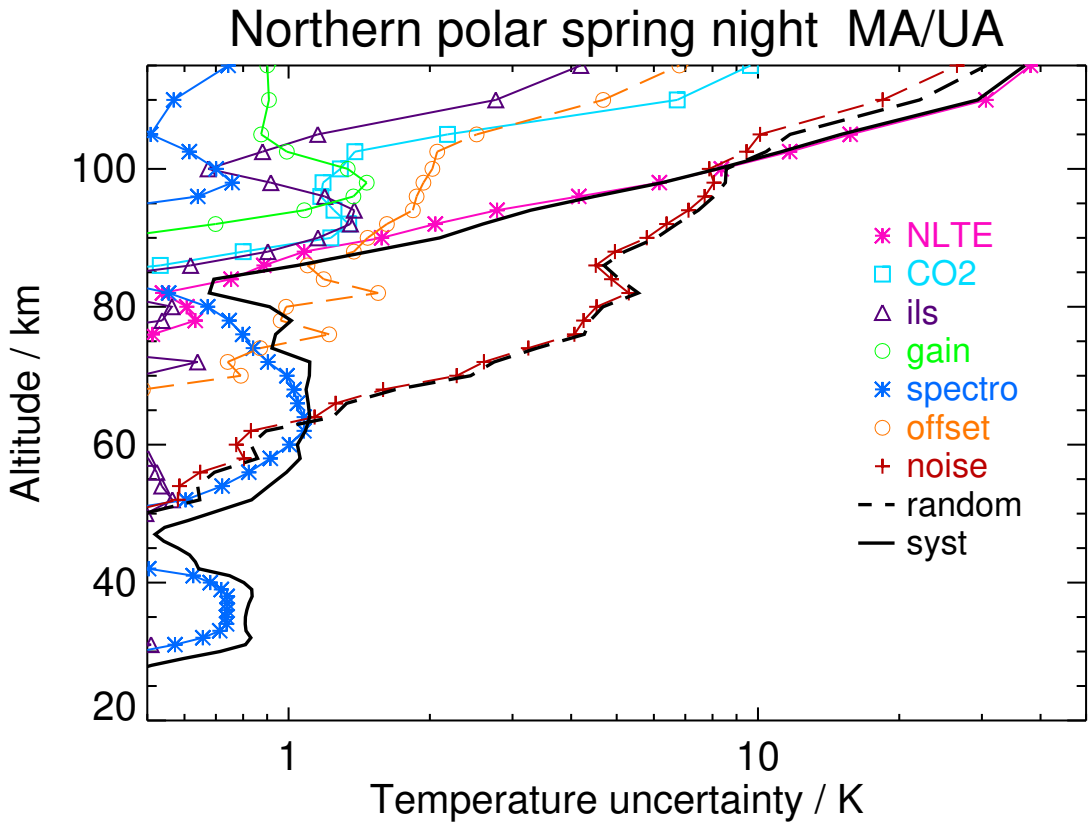

Figure S4. Temperature uncertainties for Northern polar spring nighttime conditions.

Table S5. Temperature error budget for Northern polar summer day. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	228.5	<0.1	<0.1	0.2	0.4	0.1	<0.1	0.3	0.4	0.4
30	236.0	<0.1	<0.1	0.5	0.3	0.3	<0.1	0.2	0.3	0.7
40	260.9	<0.1	<0.1	0.3	0.4	0.5	<0.1	0.3	0.3	0.7
50	278.0	<0.1	<0.1	0.5	0.3	0.2	0.1	0.4	0.4	0.6
60	262.4	<0.1	<0.1	0.3	0.2	1.0	0.2	0.7	0.7	1.1
70	218.3	<0.1	0.1	0.6	0.2	1.2	0.8	2.0	2.2	1.3
80	157.9	1.2	0.4	0.8	0.2	0.6	1.0	5.2	5.4	1.5
90	141.0	1.1	1.0	0.5	0.3	0.1	2.3	6.2	6.7	1.4
100	228.8	22.5	6.5	1.5	1.3	0.7	2.4	8.4	11.2	22.4
110	323.6	43.0	17.5	6.0	1.6	0.9	6.3	23.1	25.6	46.0
115	368.9	46.8	20.4	7.5	1.7	1.0	8.1	28.8	31.2	50.8

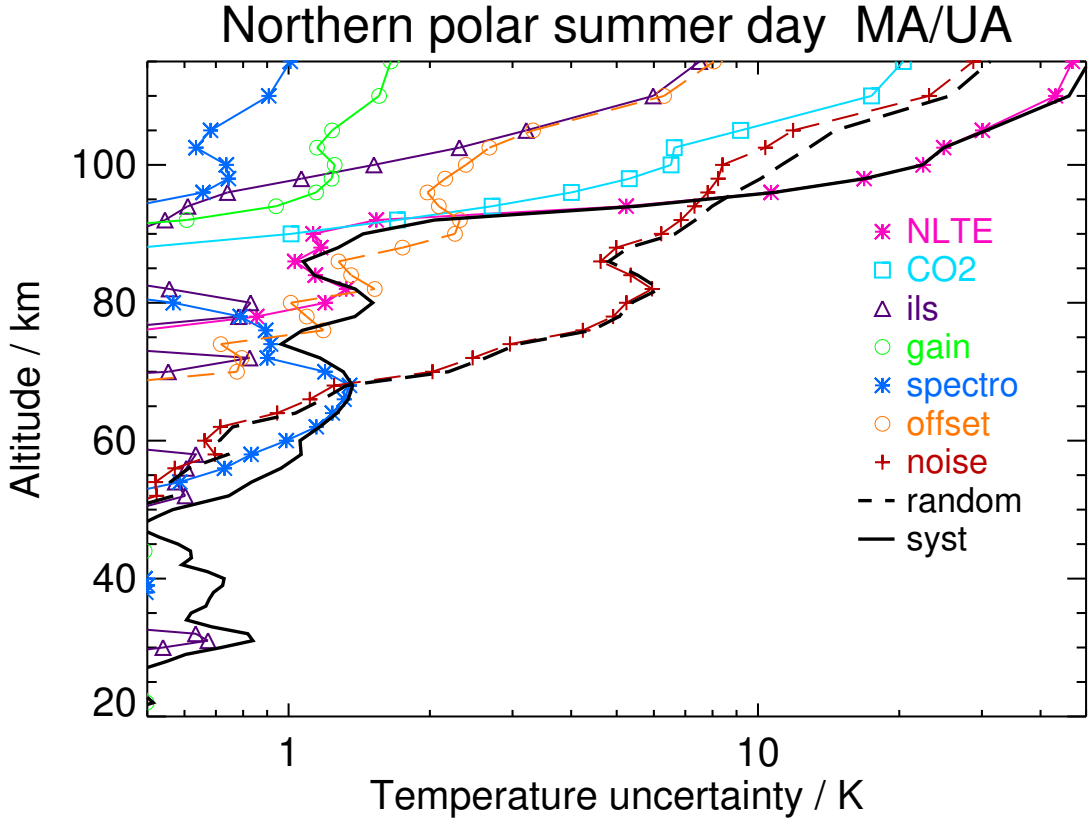

Figure S5. Temperature uncertainties for Northern polar summer daytime conditions.

Table S6. Temperature error budget for Northern polar summer night. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	223.4	<0.1	<0.1	0.1	0.4	0.2	<0.1	0.3	0.4	0.4
30	229.0	<0.1	<0.1	0.5	0.4	0.3	<0.1	0.3	0.3	0.7
40	250.7	<0.1	<0.1	0.3	0.4	0.5	<0.1	0.3	0.3	0.7
50	266.2	<0.1	<0.1	0.5	0.3	0.3	0.1	0.4	0.5	0.6
60	249.4	<0.1	<0.1	0.3	0.2	1.1	0.2	0.7	0.8	1.1
70	210.1	<0.1	0.1	0.6	0.1	1.0	0.8	2.4	2.5	1.2
80	171.6	0.7	0.2	0.4	0.2	0.5	1.2	5.3	5.4	0.8
90	172.5	1.0	1.1	1.5	0.7	0.2	1.9	6.3	6.6	2.0
100	210.5	13.2	2.5	0.4	0.9	0.4	1.9	7.7	8.4	13.2
110	290.9	35.4	12.7	3.4	1.1	0.7	5.2	21.3	23.7	36.6
115	350.6	40.8	16.3	4.9	1.1	0.8	7.0	28.1	30.8	42.9

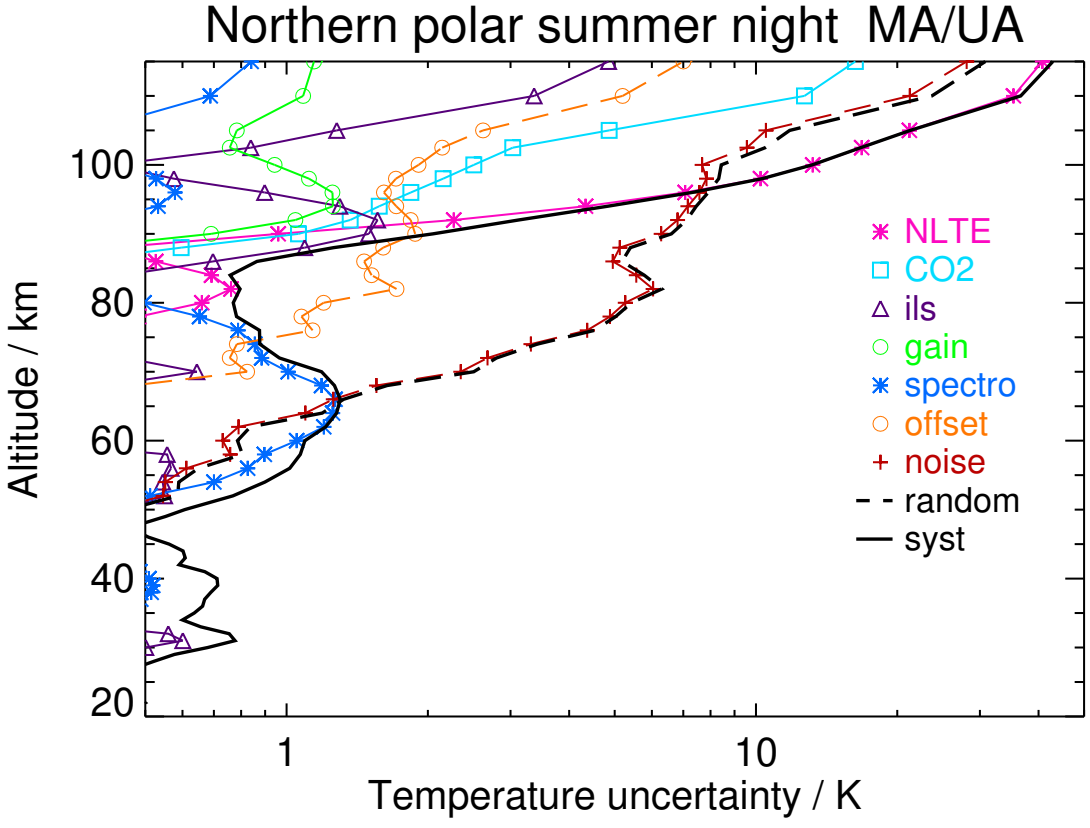

Figure S6. Temperature uncertainties for Northern polar summer nighttime conditions.

Table S7. Temperature error budget for Northern polar autumn day. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	215.0	<0.1	<0.1	0.2	0.4	0.4	<0.1	0.4	0.4	0.5
30	214.3	<0.1	<0.1	0.4	0.4	0.2	<0.1	0.3	0.4	0.6
40	233.1	<0.1	<0.1	0.2	0.4	0.5	0.1	0.3	0.4	0.6
50	252.7	<0.1	<0.1	0.5	0.4	0.3	0.1	0.5	0.5	0.6
60	244.4	0.1	<0.1	0.3	0.3	0.9	0.3	0.8	0.9	1.0
70	224.7	0.4	0.3	0.4	0.2	0.9	0.8	2.4	2.5	1.0
80	204.5	0.7	<0.1	0.4	0.2	0.6	0.9	4.4	4.5	0.9
90	192.8	1.1	1.4	0.8	0.3	0.2	1.4	5.8	6.0	1.7
100	187.9	5.6	1.0	1.1	1.2	0.7	1.9	7.5	8.0	5.6
110	243.2	20.2	5.4	2.0	0.8	0.5	5.4	20.8	23.4	18.9
115	301.5	24.7	7.2	2.9	0.8	0.6	7.0	28.0	31.0	23.2

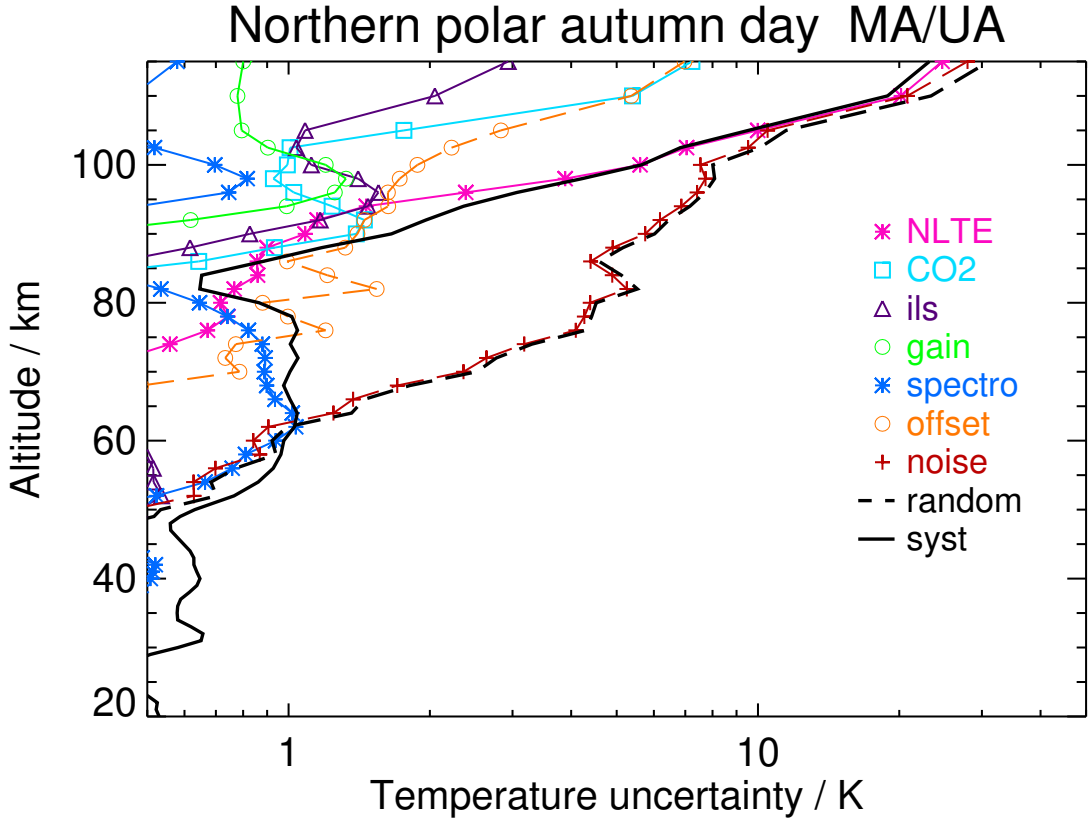

Figure S7. Temperature uncertainties for Northern polar autumn daytime conditions.

Table S8. Temperature error budget for Northern polar autumn night. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	212.9	<0.1	<0.1	0.2	0.4	0.4	<0.1	0.3	0.4	0.6
30	211.0	<0.1	<0.1	0.4	0.4	0.2	<0.1	0.3	0.3	0.6
40	229.1	<0.1	<0.1	0.1	0.4	0.6	0.1	0.4	0.5	0.7
50	252.4	<0.1	<0.1	0.5	0.4	0.3	0.1	0.5	0.6	0.6
60	249.4	0.2	<0.1	0.2	0.3	0.9	0.2	0.8	0.9	1.0
70	228.4	0.5	0.3	0.4	0.2	1.0	0.8	2.3	2.5	1.1
80	206.8	1.0	<0.1	0.5	0.2	0.7	1.1	4.6	4.8	1.1
90	196.4	1.4	1.4	0.9	0.4	0.2	1.4	5.6	5.9	2.0
100	191.1	6.2	1.0	0.9	1.1	0.5	1.8	7.6	8.1	6.1
110	244.4	19.1	5.9	1.4	0.7	0.4	5.0	20.3	22.3	18.5
115	301.2	23.7	8.3	2.2	0.7	0.5	6.6	27.7	30.1	23.3

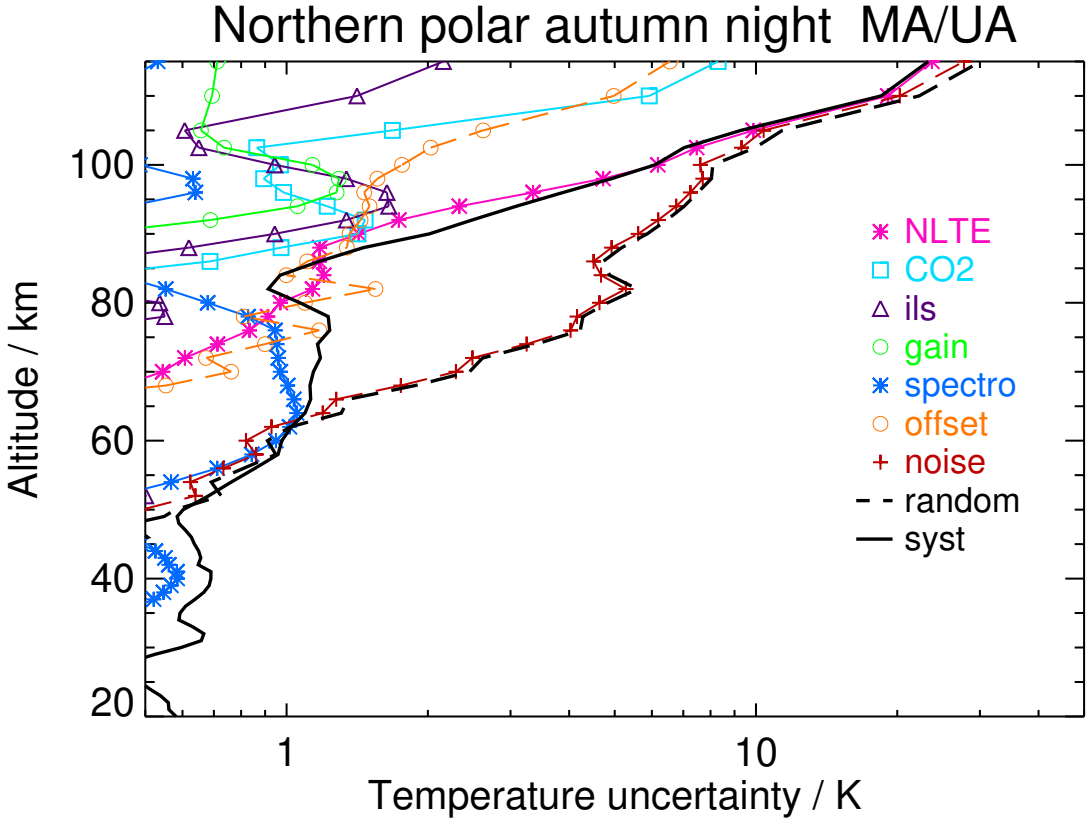

Figure S8. Temperature uncertainties for Northern polar autumn nighttime conditions.

Table S9. Temperature error budget for Northern midlatitude winter day. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	215.0	<0.1	<0.1	0.1	0.5	0.2	<0.1	0.3	0.4	0.5
30	221.0	<0.1	<0.1	0.4	0.3	0.4	<0.1	0.3	0.4	0.6
40	236.2	<0.1	<0.1	0.1	0.4	0.4	<0.1	0.3	0.4	0.5
50	251.7	<0.1	<0.1	0.5	0.3	0.4	0.1	0.5	0.5	0.7
60	238.0	<0.1	<0.1	0.3	0.2	1.0	0.2	0.8	0.9	1.0
70	218.0	0.2	0.2	0.5	0.2	0.9	0.7	2.4	2.5	1.0
80	207.6	0.9	0.1	0.6	0.2	0.7	1.3	4.7	4.9	1.0
90	198.0	1.8	1.6	0.9	0.4	0.3	1.4	5.6	6.0	2.0
100	199.7	6.9	1.4	0.6	1.0	0.5	1.9	7.3	8.0	6.6
110	250.2	24.0	7.7	2.5	1.0	0.6	5.1	19.9	23.8	22.3
115	313.1	29.0	10.3	3.7	1.0	0.8	7.0	27.4	31.6	27.6

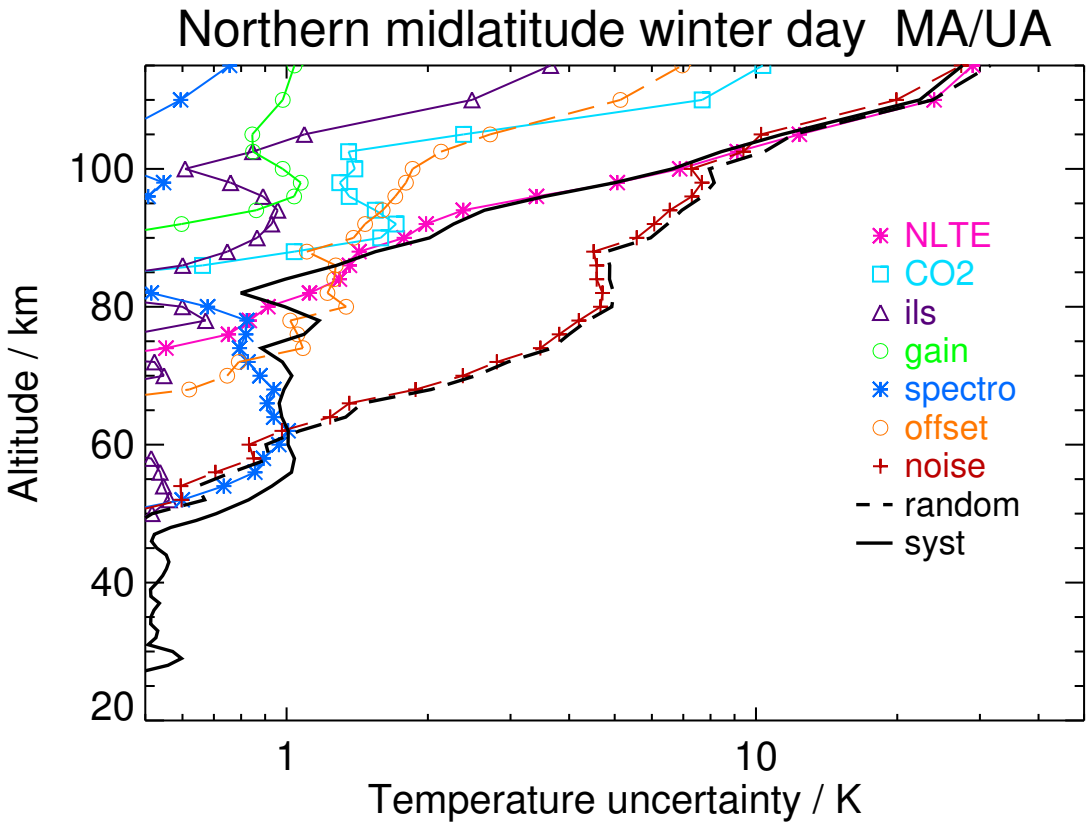

Figure S9. Temperature uncertainties for Northern midlatitude winter daytime conditions.

Table S10. Temperature error budget for Northern midlatitude winter night. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	216.8	<0.1	<0.1	0.2	0.4	0.3	<0.1	0.2	0.4	0.5
30	221.4	<0.1	<0.1	0.5	0.4	0.4	<0.1	0.3	0.4	0.7
40	240.2	<0.1	<0.1	0.2	0.4	0.6	<0.1	0.3	0.4	0.7
50	251.1	<0.1	<0.1	0.5	0.3	0.5	0.1	0.5	0.6	0.7
60	234.4	0.1	<0.1	0.4	0.3	0.9	0.2	0.9	1.0	1.0
70	221.3	0.4	0.3	0.5	0.2	0.8	0.7	2.3	2.4	1.0
80	215.1	1.7	<0.1	0.5	0.3	0.7	1.1	4.4	4.7	1.6
90	197.3	2.1	1.5	1.0	0.4	0.3	1.5	5.7	6.1	2.4
100	195.4	6.9	1.3	0.5	0.9	0.5	1.8	7.4	8.1	6.5
110	241.6	19.9	8.3	1.6	0.6	0.5	5.4	21.0	24.5	18.3
115	304.3	24.5	11.1	2.5	0.6	0.6	7.0	27.9	32.1	23.1

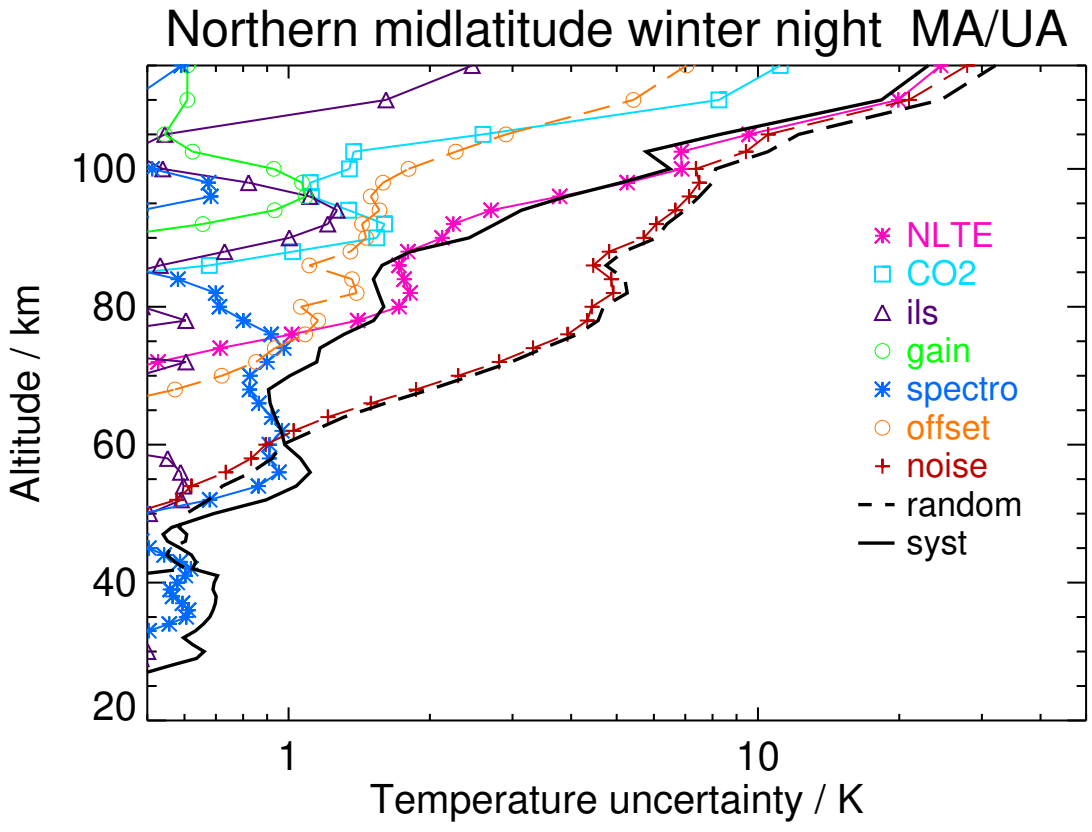

Figure S10. Temperature uncertainties for Northern midlatitude winter nighttime conditions.

Table S11. Temperature error budget for Northern midlatitude spring day. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	215.4	<0.1	<0.1	0.2	0.3	0.2	<0.1	0.3	0.4	0.4
30	226.6	<0.1	<0.1	0.5	0.3	0.4	<0.1	0.3	0.4	0.7
40	252.6	<0.1	<0.1	0.3	0.4	0.5	<0.1	0.3	0.4	0.7
50	262.3	<0.1	<0.1	0.5	0.3	0.4	0.1	0.4	0.5	0.7
60	243.2	<0.1	<0.1	0.3	0.2	1.0	0.3	0.8	0.9	1.1
70	216.1	0.1	0.2	0.5	0.2	0.9	0.7	2.3	2.4	1.0
80	187.7	0.6	0.1	0.6	0.2	0.6	0.9	4.7	4.8	0.9
90	182.2	1.2	1.2	1.0	0.4	0.2	1.5	5.9	6.2	1.6
100	191.9	9.3	1.7	0.5	1.1	0.7	2.3	7.8	8.7	9.0
110	260.4	27.1	5.4	3.0	1.1	0.7	5.2	19.5	22.3	26.1
115	315.5	32.5	7.3	4.5	1.2	0.8	6.9	27.1	30.3	31.5

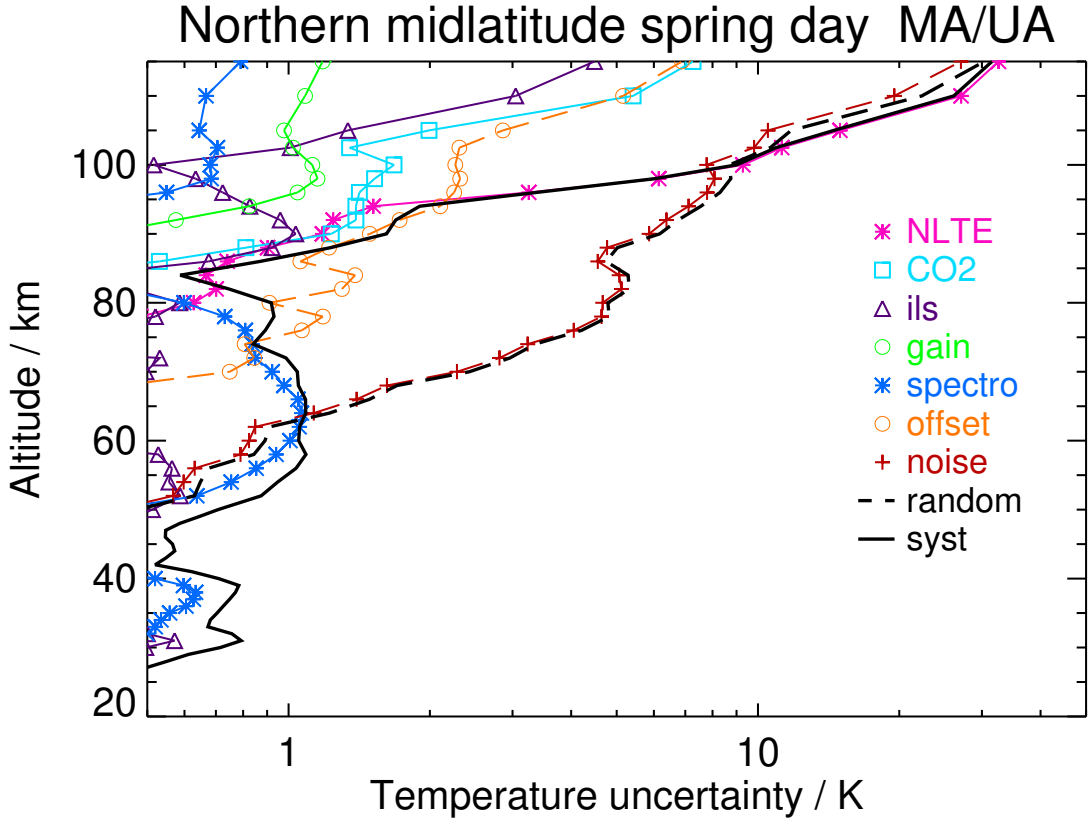

Figure S11. Temperature uncertainties for Northern midlatitude spring daytime conditions.

Table S12. Temperature error budget for Northern midlatitude spring night. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	215.8	<0.1	<0.1	0.2	0.3	0.2	<0.1	0.3	0.4	0.4
30	222.6	<0.1	<0.1	0.5	0.3	0.5	<0.1	0.3	0.4	0.7
40	249.8	<0.1	<0.1	0.2	0.4	0.6	<0.1	0.3	0.4	0.7
50	263.7	<0.1	<0.1	0.5	0.3	0.4	0.1	0.4	0.5	0.7
60	243.8	<0.1	<0.1	0.3	0.2	1.0	0.3	0.8	0.9	1.1
70	216.2	0.2	0.2	0.5	0.2	0.9	0.8	2.3	2.5	1.1
80	195.5	0.6	<0.1	0.4	0.2	0.6	1.0	4.6	4.8	0.7
90	182.4	1.4	1.2	1.0	0.4	0.2	1.7	6.1	6.4	1.8
100	195.1	9.6	1.4	0.6	1.2	0.7	2.0	7.9	8.6	9.5
110	265.2	28.4	5.7	2.7	0.9	0.5	4.4	17.9	20.7	27.5
115	311.7	34.1	8.1	4.1	1.0	0.7	6.2	26.2	29.2	33.5

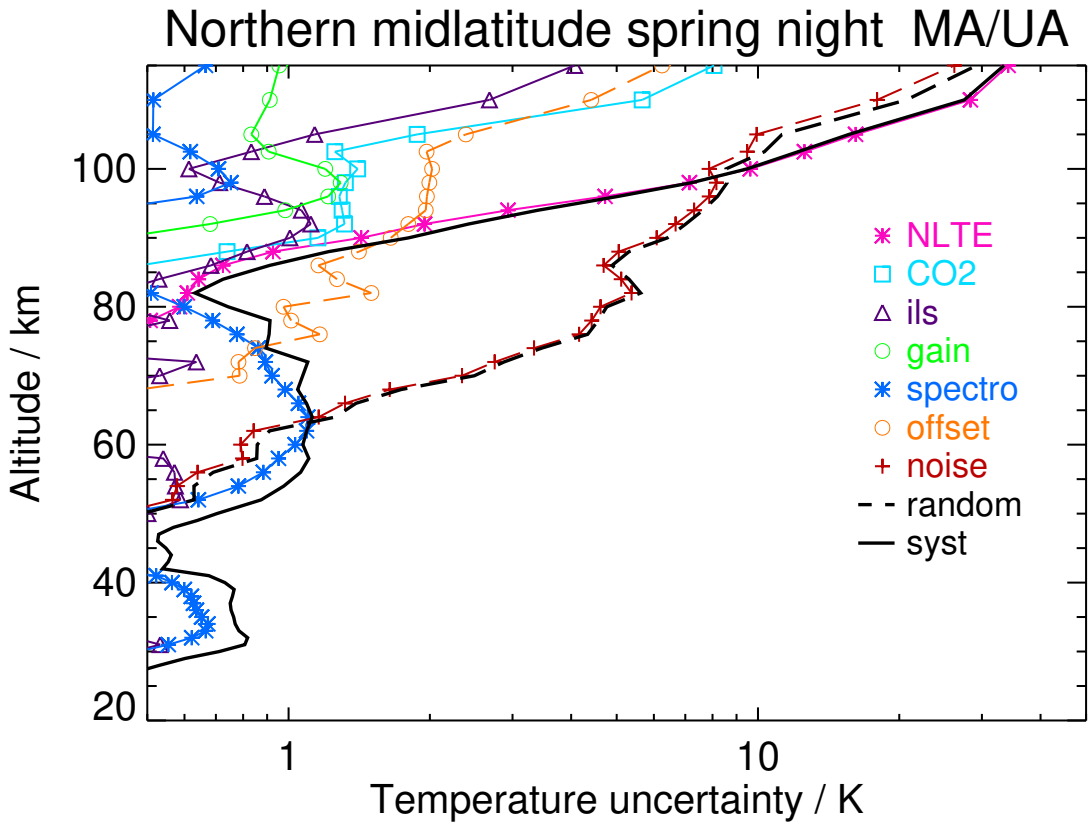

Figure S12. Temperature uncertainties for Northern midlatitude spring nighttime conditions.

Table S13. Temperature error budget for Northern midlatitude summer day. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	221.5	<0.1	<0.1	0.2	0.4	0.1	<0.1	0.3	0.4	0.4
30	232.7	<0.1	<0.1	0.5	0.4	0.4	<0.1	0.3	0.3	0.7
40	256.0	<0.1	<0.1	0.3	0.5	0.5	<0.1	0.3	0.3	0.7
50	267.0	<0.1	<0.1	0.5	0.3	0.3	0.1	0.4	0.5	0.7
60	246.1	<0.1	<0.1	0.3	0.2	1.1	0.3	0.8	0.8	1.2
70	204.8	0.2	0.1	0.6	0.2	0.9	0.8	2.4	2.5	1.1
80	165.0	1.1	0.2	0.5	0.2	0.4	1.0	5.1	5.2	1.1
90	169.3	1.0	1.1	1.3	0.6	0.2	1.8	6.1	6.5	1.8
100	210.3	14.0	3.8	0.5	0.8	0.4	2.0	7.6	8.9	14.0
110	311.4	39.1	16.9	4.0	1.2	0.8	5.6	21.9	25.5	41.1
115	374.8	43.7	20.2	5.4	1.3	0.9	7.5	27.8	31.4	46.8

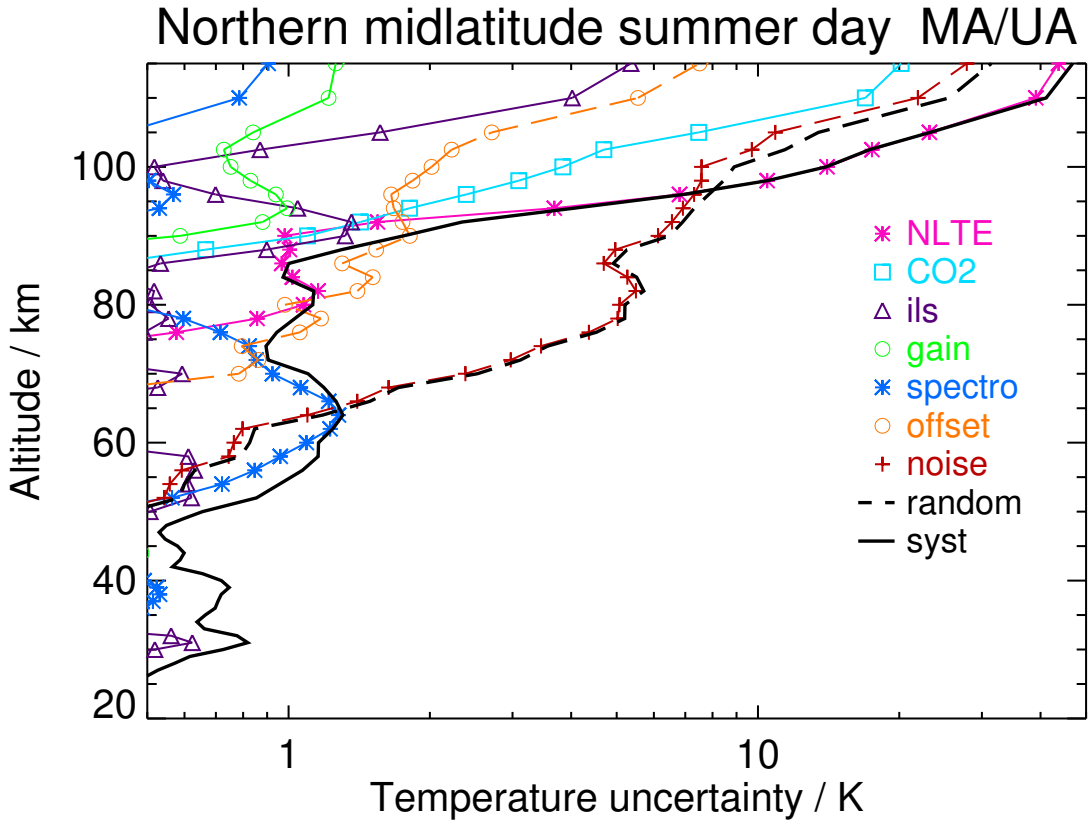

Figure S13. Temperature uncertainties for Northern midlatitude summer daytime conditions.

Table S14. Temperature error budget for Northern midlatitude summer night. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	221.4	<0.1	<0.1	0.2	0.3	0.1	<0.1	0.3	0.4	0.4
30	233.6	<0.1	<0.1	0.5	0.3	0.4	<0.1	0.3	0.3	0.7
40	257.7	<0.1	<0.1	0.3	0.5	0.5	<0.1	0.3	0.3	0.7
50	267.5	<0.1	<0.1	0.5	0.3	0.4	0.1	0.4	0.5	0.6
60	245.9	<0.1	<0.1	0.3	0.2	1.1	0.3	0.7	0.8	1.1
70	205.9	<0.1	0.1	0.7	0.2	0.9	0.8	2.4	2.6	1.1
80	171.0	0.7	0.2	0.5	0.2	0.5	1.2	5.3	5.5	0.8
90	172.6	1.4	1.1	1.1	0.5	0.2	1.9	6.3	6.7	1.9
100	204.7	12.3	3.1	0.4	0.8	0.4	2.0	7.6	8.4	12.4
110	274.8	29.7	11.2	3.2	1.0	0.6	5.1	21.1	23.2	30.9
115	330.4	34.6	14.4	4.6	1.1	0.7	6.6	28.0	30.4	36.5

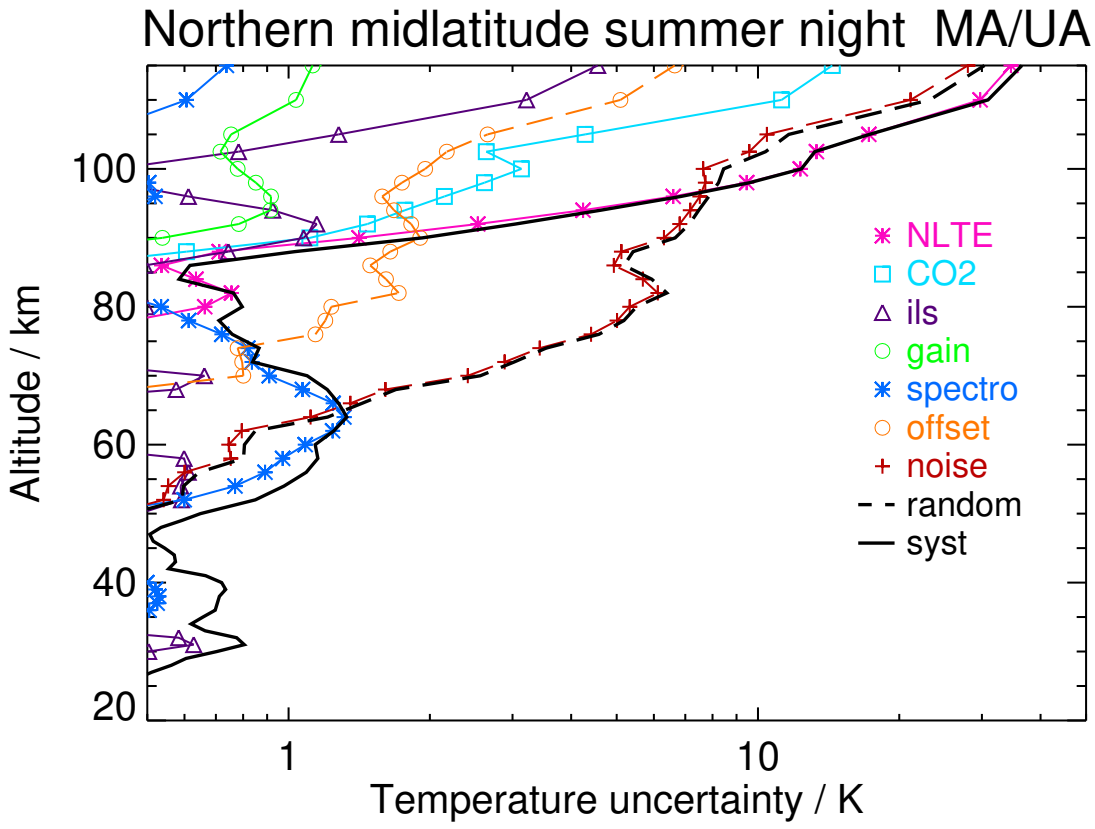

Figure S14. Temperature uncertainties for Northern midlatitude summer nighttime conditions.

Table S15. Temperature error budget for Northern midlatitude autumn day. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	215.7	<0.1	<0.1	0.2	0.4	0.2	<0.1	0.3	0.4	0.4
30	222.2	<0.1	<0.1	0.4	0.3	0.4	<0.1	0.3	0.4	0.6
40	242.2	<0.1	<0.1	0.2	0.4	0.5	<0.1	0.3	0.4	0.6
50	254.4	<0.1	<0.1	0.5	0.3	0.4	0.1	0.4	0.5	0.7
60	238.3	<0.1	<0.1	0.3	0.2	1.0	0.3	0.9	0.9	1.0
70	215.9	0.2	0.2	0.4	0.2	0.9	0.8	2.4	2.6	1.0
80	194.3	0.6	<0.1	0.6	0.2	0.5	0.9	4.6	4.7	0.7
90	191.1	1.3	1.4	0.9	0.4	0.2	1.5	5.9	6.2	1.7
100	195.7	7.8	1.4	0.6	1.0	0.6	1.9	7.4	8.3	7.4
110	252.2	23.4	5.9	2.1	0.9	0.5	4.4	18.4	20.6	22.8
115	310.1	28.5	8.2	3.4	1.0	0.6	6.1	26.3	28.9	28.1

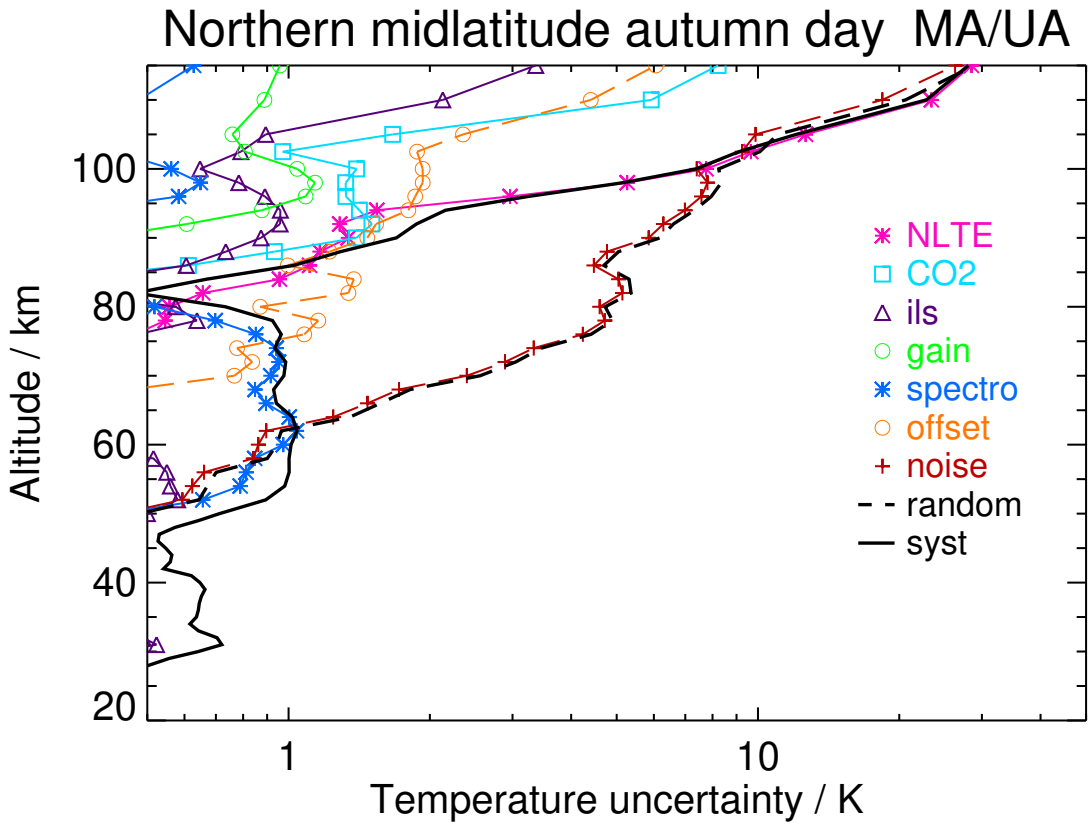

Figure S15. Temperature uncertainties for Northern midlatitude autumn daytime conditions.

Table S16. Temperature error budget for Northern midlatitude autumn night. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	216.5	<0.1	<0.1	0.2	0.4	0.2	<0.1	0.3	0.4	0.4
30	222.8	<0.1	<0.1	0.4	0.4	0.3	<0.1	0.3	0.3	0.6
40	241.3	<0.1	<0.1	0.2	0.4	0.5	<0.1	0.3	0.4	0.7
50	253.4	<0.1	<0.1	0.5	0.3	0.4	0.1	0.4	0.5	0.7
60	237.3	<0.1	<0.1	0.3	0.2	1.0	0.3	0.9	0.9	1.0
70	216.3	0.3	0.2	0.5	0.2	1.0	0.8	2.4	2.6	1.1
80	196.7	0.8	<0.1	0.6	0.2	0.7	1.0	4.8	4.9	0.9
90	197.0	2.5	1.4	1.1	0.4	0.2	1.4	5.8	6.1	2.6
100	191.2	6.7	1.0	0.6	1.0	0.5	1.8	7.5	8.1	6.5
110	231.5	18.8	4.8	1.6	0.7	0.4	4.7	19.1	21.5	17.5
115	286.9	23.1	6.8	2.5	0.8	0.5	6.3	27.0	29.7	21.7

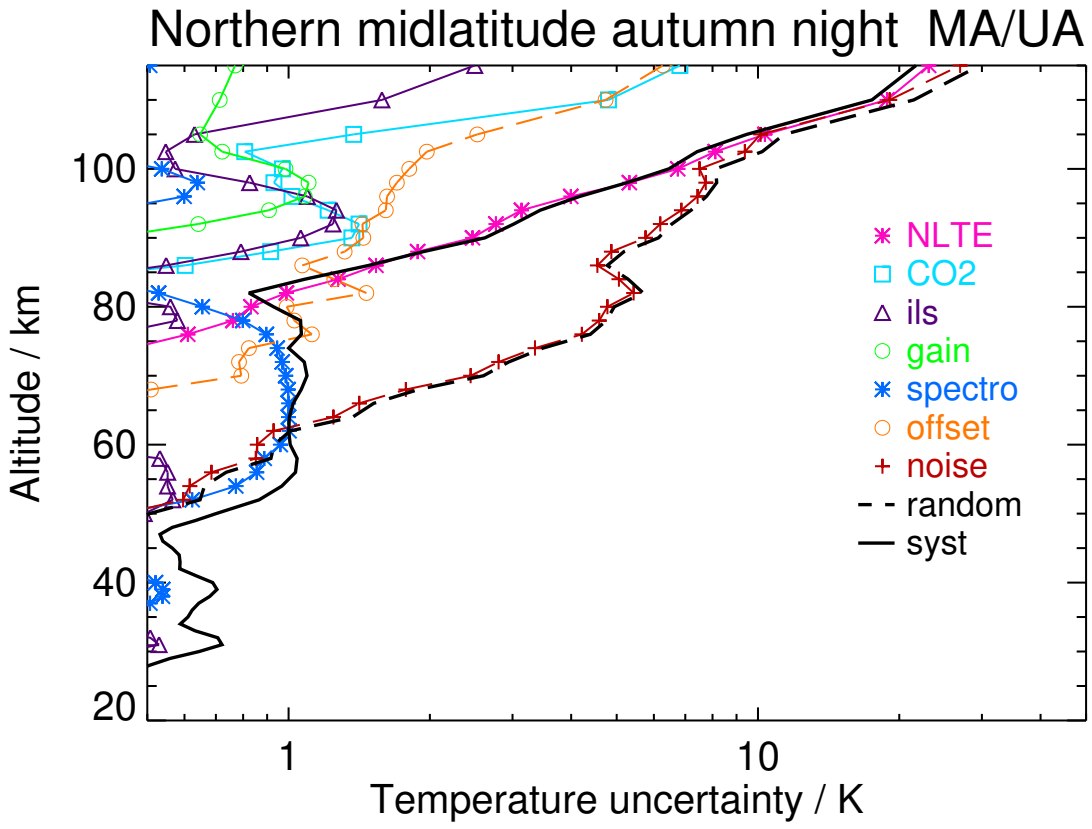

Figure S16. Temperature uncertainties for Northern midlatitude autumn nighttime conditions.

Table S17. Temperature error budget for Tropics day. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	203.2	<0.1	<0.1	<0.1	0.2	0.8	<0.1	0.2	0.3	0.8
30	230.1	<0.1	<0.1	0.5	0.3	0.5	<0.1	0.3	0.3	0.7
40	254.4	<0.1	<0.1	0.3	0.4	0.6	<0.1	0.3	0.4	0.7
50	263.7	<0.1	<0.1	0.5	0.3	0.4	0.1	0.4	0.5	0.7
60	241.9	<0.1	<0.1	0.4	0.2	1.1	0.3	0.8	0.9	1.2
70	207.7	0.2	0.2	0.6	0.2	1.0	0.7	2.3	2.5	1.1
80	190.0	0.6	0.1	0.7	0.2	0.5	1.1	4.8	4.9	0.8
90	193.4	1.6	1.5	1.1	0.4	0.2	1.4	5.7	6.1	2.0
100	190.8	5.7	1.3	0.5	0.7	0.3	1.8	7.0	7.6	5.4
110	239.9	19.1	7.6	1.9	0.8	0.4	4.5	18.7	21.3	18.6
115	295.7	23.8	10.4	3.2	0.9	0.6	6.1	26.5	29.5	23.6

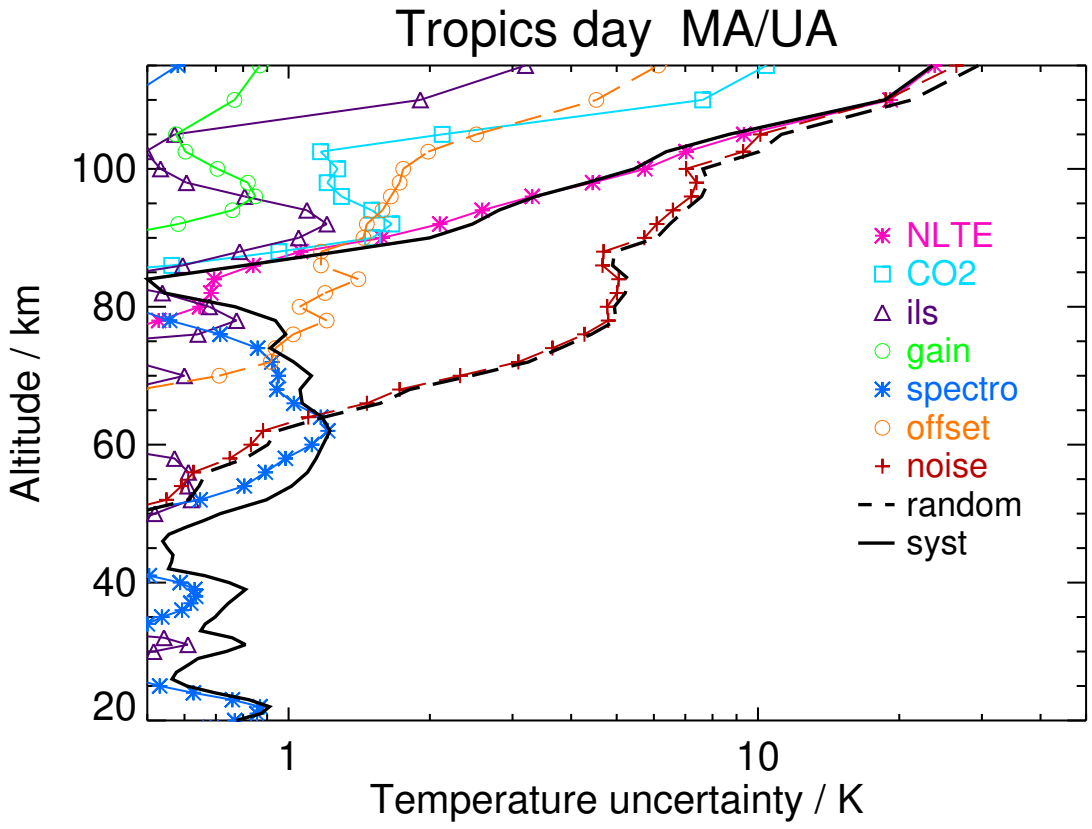

Figure S17. Temperature uncertainties for Tropics daytime conditions.

Table S18. Temperature error budget for Tropics night. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	203.0	<0.1	<0.1	<0.1	0.2	0.7	<0.1	0.2	0.3	0.7
30	230.5	<0.1	<0.1	0.5	0.3	0.4	<0.1	0.3	0.3	0.7
40	253.5	<0.1	<0.1	0.3	0.4	0.6	<0.1	0.3	0.4	0.8
50	264.1	<0.1	<0.1	0.5	0.3	0.5	0.1	0.4	0.5	0.7
60	243.7	<0.1	<0.1	0.3	0.2	1.1	0.3	0.8	0.8	1.2
70	203.3	<0.1	<0.1	0.6	0.2	1.0	0.8	2.5	2.6	1.2
80	190.5	0.8	<0.1	1.4	0.1	0.3	1.2	5.1	5.3	1.4
90	191.9	1.9	1.2	1.2	0.5	0.4	1.5	5.8	6.1	2.3
100	184.1	5.9	1.5	0.5	0.7	0.4	1.9	7.4	7.9	5.8
110	261.8	23.2	9.5	2.3	0.8	0.5	4.6	18.9	21.4	23.6
115	308.2	28.6	13.1	3.5	1.0	0.7	6.2	26.7	29.6	29.6

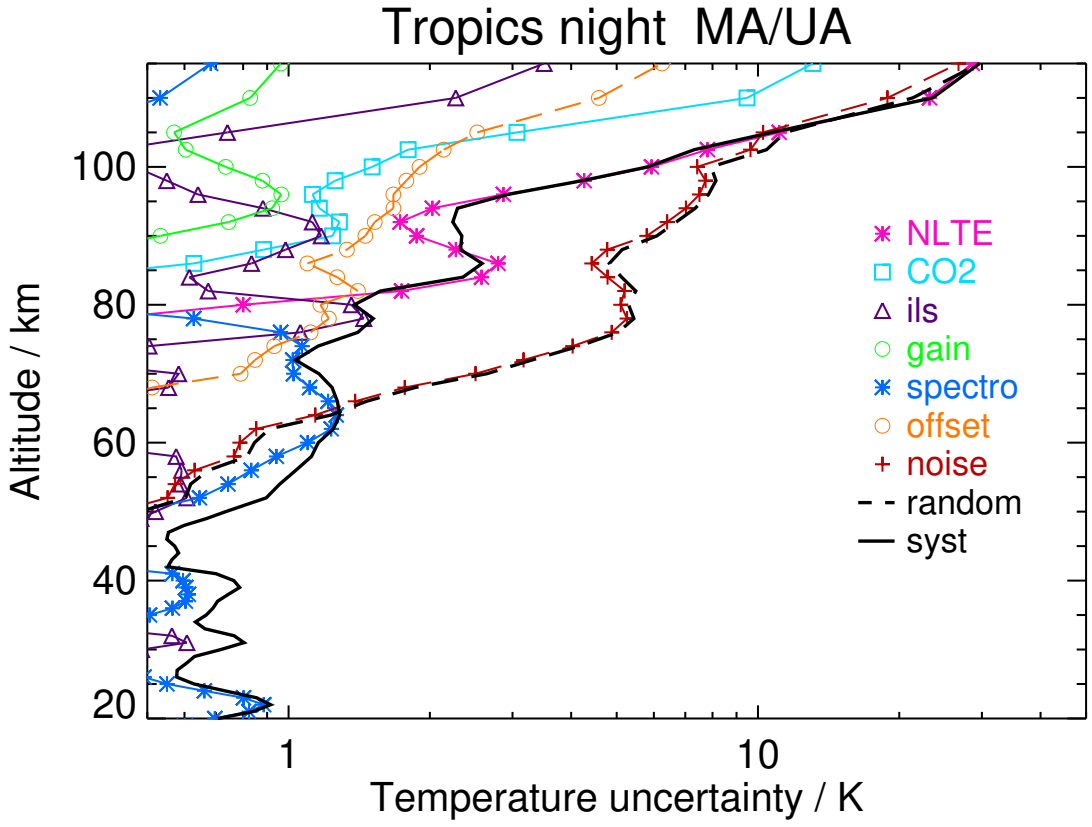

Figure S18. Temperature uncertainties for Tropics nighttime conditions.

Table S19. Temperature error budget for Southern midlatitude winter day. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	216.7	<0.1	<0.1	0.1	0.4	0.2	<0.1	0.3	0.3	0.4
30	220.2	<0.1	<0.1	0.4	0.4	0.6	<0.1	0.3	0.5	0.6
40	242.3	<0.1	<0.1	0.3	0.4	0.6	<0.1	0.3	0.6	0.7
50	257.2	<0.1	<0.1	0.5	0.3	0.6	0.1	0.5	0.7	0.8
60	238.2	<0.1	<0.1	0.4	0.3	1.0	0.2	0.9	1.0	1.0
70	211.9	0.2	0.2	0.4	0.2	1.0	0.7	2.5	2.6	1.0
80	203.4	0.9	<0.1	0.5	0.2	0.5	1.4	5.0	5.2	0.9
90	191.5	1.3	1.3	1.1	0.5	0.2	1.3	5.6	5.9	1.9
100	183.5	7.1	1.9	0.7	0.9	0.5	2.3	8.4	9.2	6.8
110	267.3	21.5	10.6	2.1	0.7	0.5	6.5	23.7	26.3	22.1
115	323.7	24.8	13.0	2.8	0.7	0.6	7.9	29.1	32.1	25.9

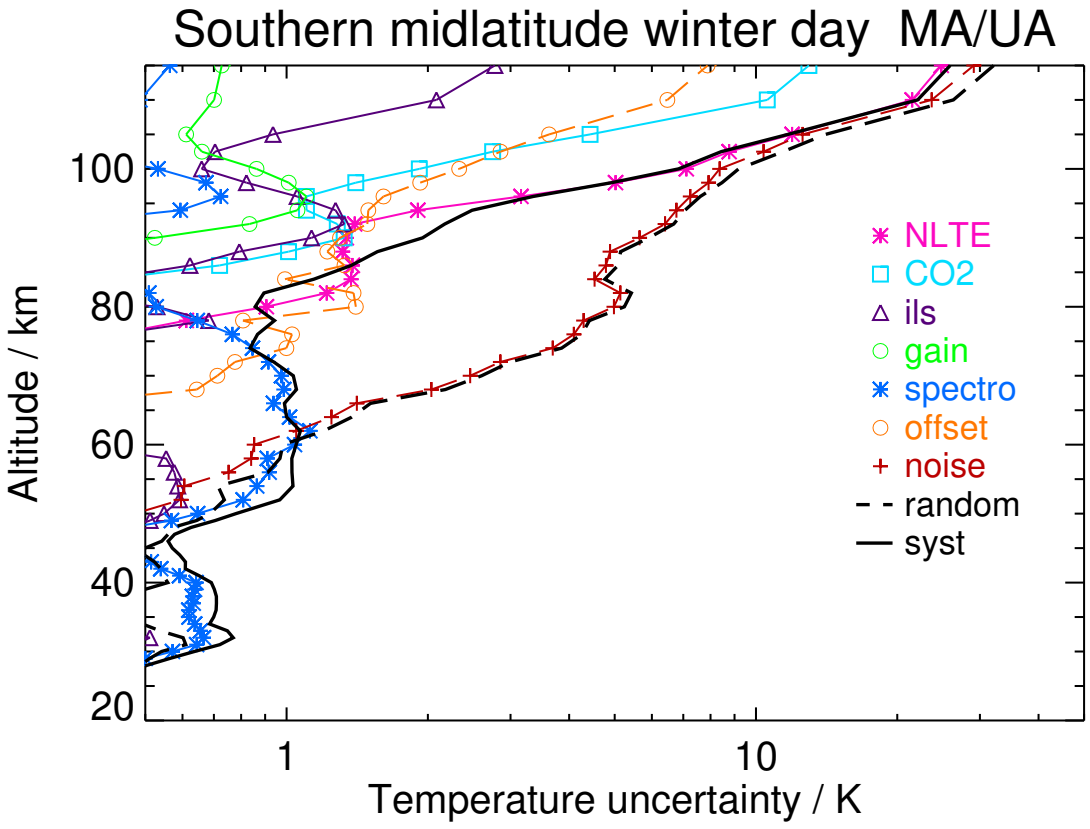

Figure S19. Temperature uncertainties for Southern midlatitude winter daytime conditions.

Table S20. Temperature error budget for Southern midlatitude winter night. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	211.9	<0.1	<0.1	0.2	0.4	0.3	<0.1	0.3	0.4	0.5
30	213.0	<0.1	<0.1	0.4	0.4	0.5	<0.1	0.3	0.5	0.6
40	239.7	<0.1	<0.1	0.2	0.5	0.8	<0.1	0.3	0.6	0.8
50	261.1	<0.1	<0.1	0.6	0.4	0.6	0.1	0.5	0.7	0.7
60	244.0	0.1	<0.1	0.4	0.3	1.0	0.2	0.8	0.9	1.1
70	216.8	0.3	0.2	0.4	0.2	0.9	0.7	2.4	2.6	1.0
80	200.8	1.0	<0.1	0.4	0.2	0.6	1.3	5.0	5.2	0.9
90	188.3	1.8	1.2	1.3	0.6	0.2	1.4	5.8	6.1	2.4
100	189.6	8.6	2.1	0.9	1.0	0.6	2.3	8.4	9.2	8.5
110	270.3	24.4	11.8	2.4	0.9	0.6	6.2	23.4	26.4	25.1
115	324.4	27.8	14.7	3.2	0.9	0.7	7.8	29.1	32.6	29.1

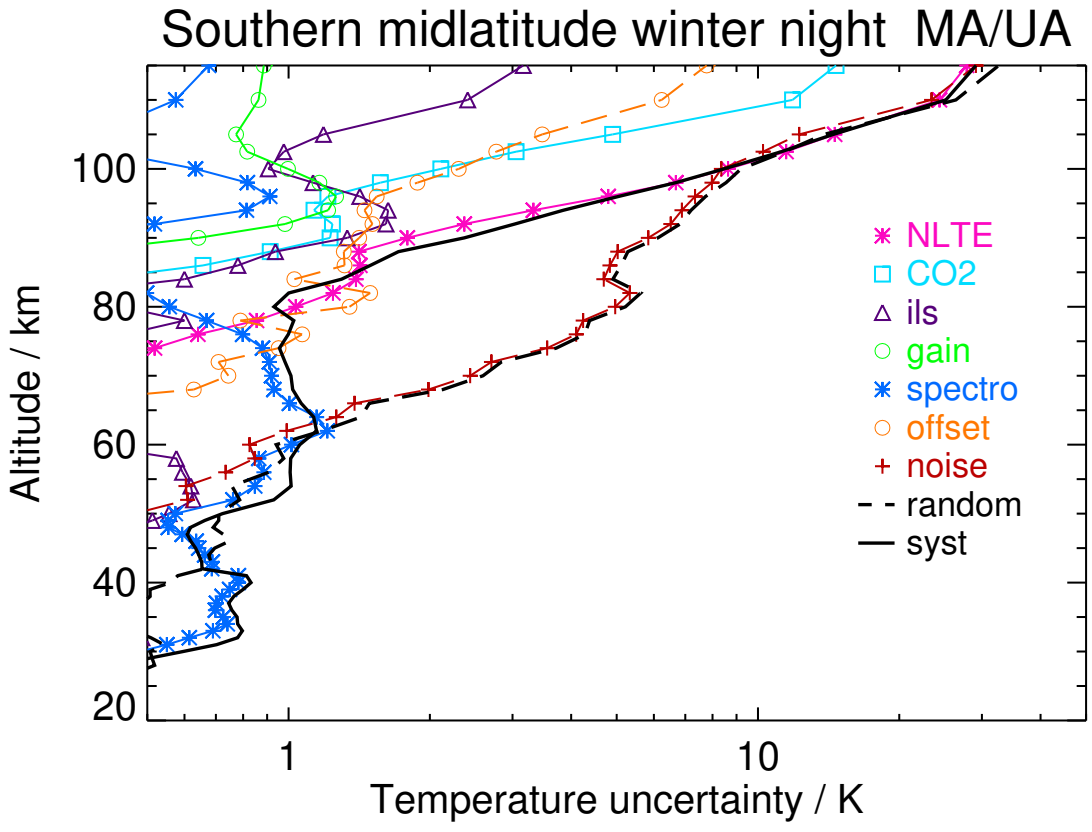

Figure S20. Temperature uncertainties for Southern midlatitude winter nighttime conditions.

Table S21. Temperature error budget for Southern midlatitude spring day. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	223.1	<0.1	<0.1	0.1	0.4	0.2	<0.1	0.2	0.4	0.4
30	229.7	<0.1	<0.1	0.4	0.4	0.3	<0.1	0.3	0.4	0.6
40	246.1	<0.1	<0.1	0.3	0.4	0.5	<0.1	0.3	0.4	0.7
50	261.4	<0.1	<0.1	0.5	0.3	0.4	0.1	0.4	0.5	0.7
60	243.3	<0.1	<0.1	0.3	0.2	1.1	0.2	0.8	0.8	1.1
70	212.7	0.1	0.2	0.5	0.2	0.9	0.7	2.3	2.4	1.0
80	193.9	0.6	0.1	0.4	0.2	0.6	1.4	5.0	5.2	0.7
90	183.9	1.3	1.4	0.9	0.4	0.2	1.4	5.7	6.0	1.7
100	188.4	8.5	2.2	0.6	1.0	0.6	2.2	8.4	9.3	8.3
110	271.4	27.0	10.0	3.3	1.1	0.7	5.7	21.5	23.7	27.8
115	341.9	32.7	13.4	4.7	1.2	0.9	7.5	28.3	30.8	34.3

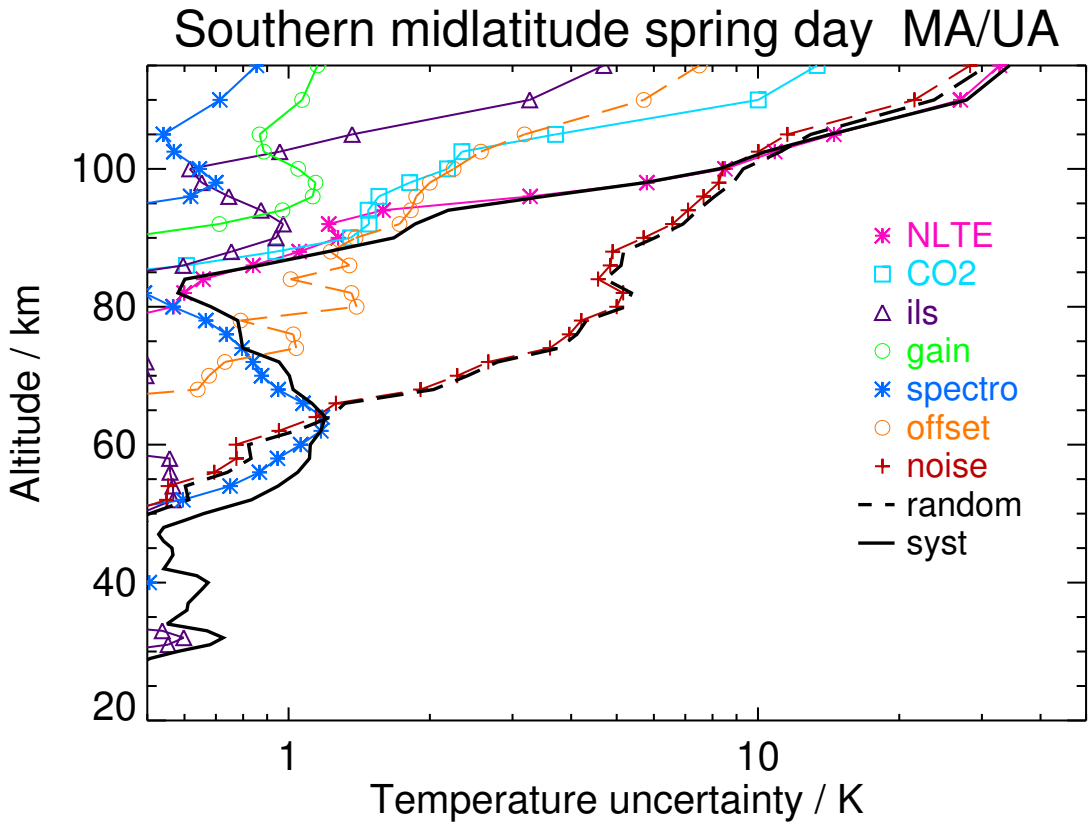

Figure S21. Temperature uncertainties for Southern midlatitude spring daytime conditions.

Table S22. Temperature error budget for Southern midlatitude spring night. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	222.8	<0.1	<0.1	0.2	0.4	0.1	<0.1	0.3	0.4	0.4
30	229.9	<0.1	<0.1	0.5	0.4	0.4	<0.1	0.3	0.4	0.7
40	247.2	<0.1	<0.1	0.3	0.5	0.6	<0.1	0.3	0.4	0.7
50	262.4	<0.1	<0.1	0.5	0.3	0.4	0.1	0.4	0.5	0.7
60	243.1	<0.1	<0.1	0.3	0.2	1.1	0.2	0.8	0.8	1.1
70	215.2	0.2	0.2	0.5	0.2	0.9	0.8	2.3	2.5	1.0
80	192.2	0.5	0.1	0.5	0.2	0.6	1.3	5.0	5.2	0.8
90	185.4	1.5	1.2	1.6	0.6	0.2	1.5	5.9	6.1	2.4
100	192.8	8.8	1.8	0.5	1.0	0.7	2.0	8.0	8.7	8.6
110	262.8	25.4	9.6	2.0	0.8	0.5	4.8	20.0	21.7	26.3
115	311.7	30.6	13.1	3.2	0.9	0.7	6.5	27.7	29.7	32.3

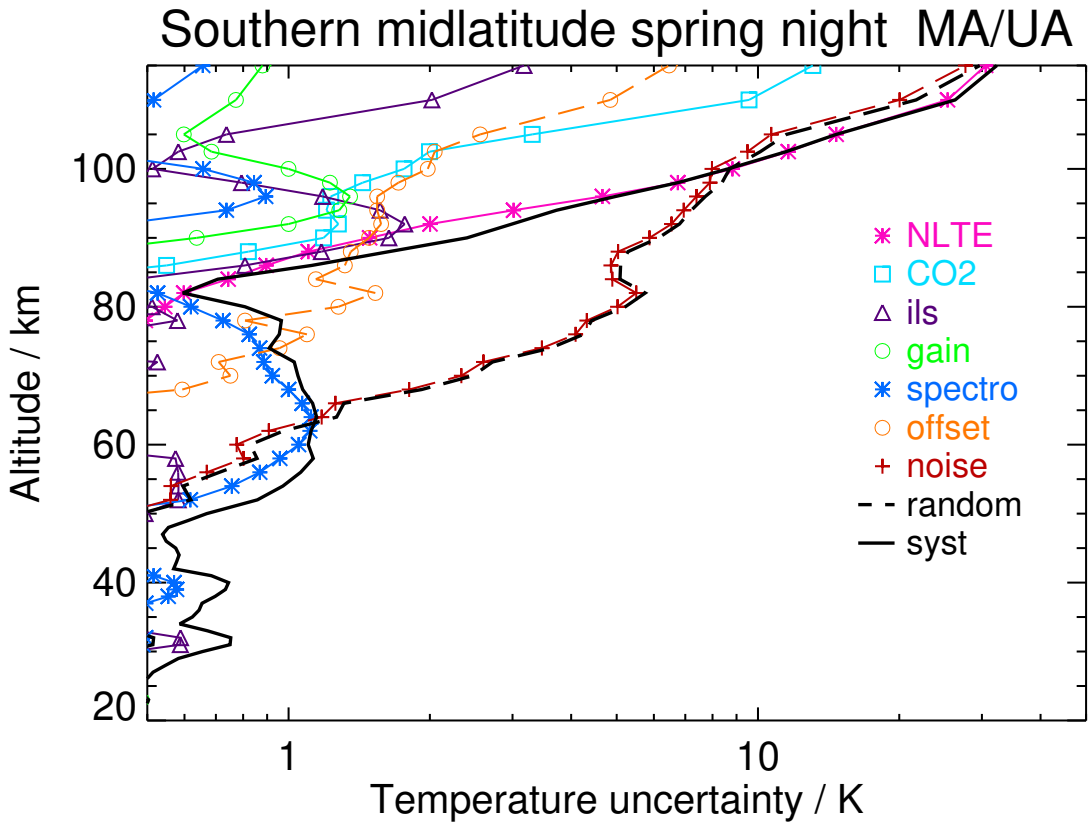

Figure S22. Temperature uncertainties for Southern midlatitude spring nighttime conditions.

Table S23. Temperature error budget for Southern midlatitude summer day. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	218.1	<0.1	<0.1	0.2	0.3	0.2	<0.1	0.3	0.4	0.4
30	233.3	<0.1	<0.1	0.6	0.3	0.4	<0.1	0.3	0.3	0.7
40	256.4	<0.1	<0.1	0.2	0.4	0.4	<0.1	0.3	0.4	0.7
50	267.4	<0.1	<0.1	0.5	0.3	0.4	0.1	0.4	0.5	0.6
60	246.3	<0.1	<0.1	0.3	0.2	1.1	0.2	0.8	0.8	1.2
70	209.9	0.2	0.1	0.6	0.1	0.9	0.8	2.2	2.4	1.1
80	175.3	0.9	0.2	0.5	0.2	0.5	1.3	5.1	5.3	0.9
90	181.1	1.1	1.4	1.1	0.5	0.2	1.6	5.8	6.1	1.8
100	200.0	11.3	3.5	0.5	0.8	0.4	2.0	8.0	9.1	11.3
110	305.7	37.3	20.3	4.2	1.3	0.8	5.7	21.7	25.3	41.0
115	356.3	43.2	25.4	5.8	1.4	0.9	7.8	28.5	32.4	48.7

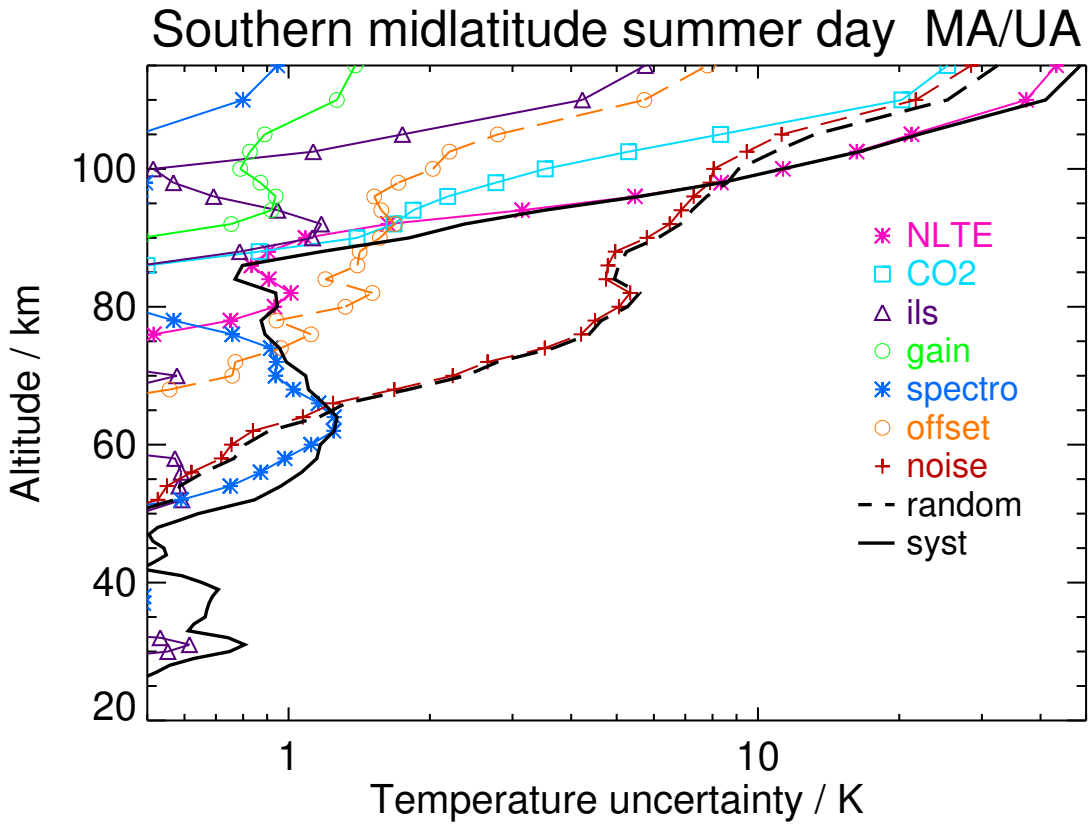

Figure S23. Temperature uncertainties for Southern midlatitude summer daytime conditions.

Table S24. Temperature error budget for Southern midlatitude summer night. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	219.8	<0.1	<0.1	0.2	0.3	0.2	<0.1	0.3	0.4	0.4
30	234.2	<0.1	<0.1	0.5	0.3	0.4	<0.1	0.3	0.3	0.8
40	259.8	<0.1	<0.1	0.3	0.5	0.5	<0.1	0.3	0.3	0.8
50	268.7	<0.1	<0.1	0.5	0.3	0.5	0.1	0.4	0.5	0.7
60	247.5	<0.1	<0.1	0.4	0.2	1.1	0.2	0.7	0.8	1.2
70	210.7	<0.1	0.2	0.6	0.2	1.0	0.8	2.3	2.4	1.2
80	182.0	0.5	0.2	0.7	0.2	0.7	1.4	5.3	5.5	0.9
90	182.7	1.7	1.1	2.0	0.7	0.2	1.4	5.8	6.1	2.7
100	194.4	9.4	2.8	0.5	0.6	0.5	2.0	8.1	9.2	9.1
110	262.0	26.0	12.0	2.2	0.8	0.5	5.6	21.4	23.7	27.4
115	322.7	31.3	15.9	3.4	0.9	0.7	7.3	28.4	31.1	33.8

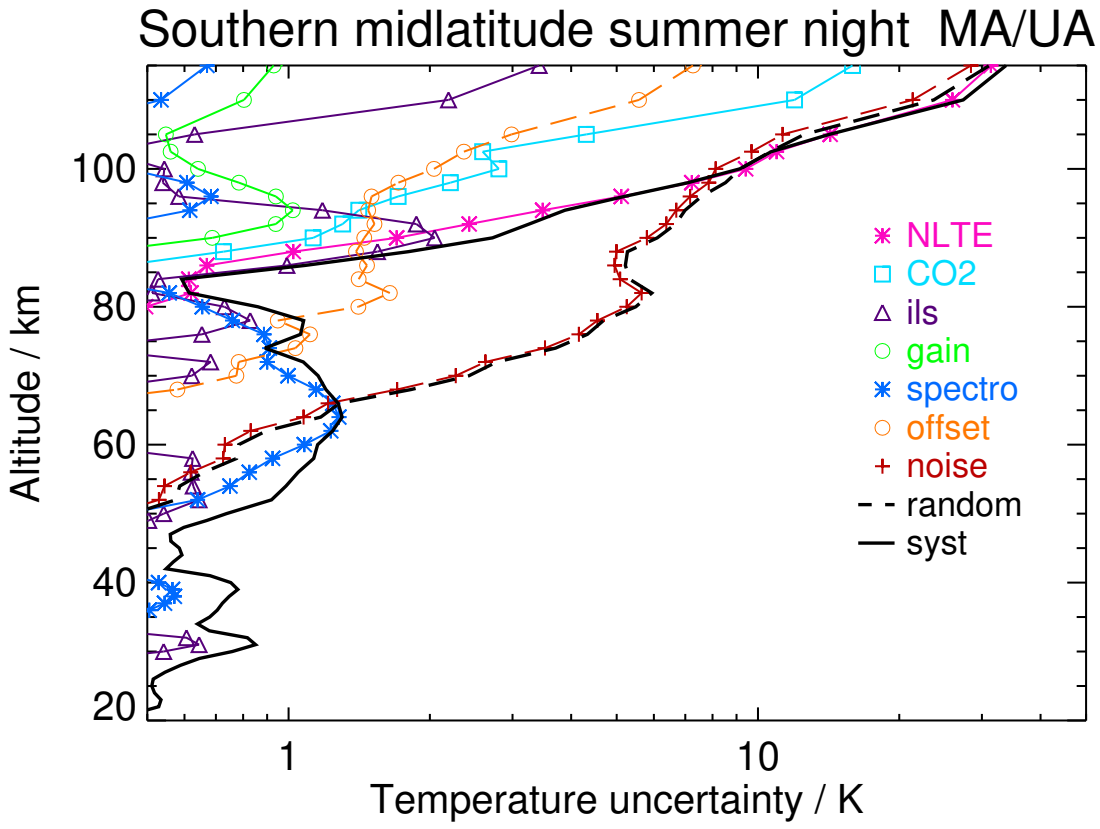

Figure S24. Temperature uncertainties for Southern midlatitude summer nighttime conditions.

Table S25. Temperature error budget for Southern midlatitude autumn day. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	214.4	<0.1	<0.1	0.2	0.4	0.2	<0.1	0.3	0.3	0.4
30	223.8	<0.1	<0.1	0.4	0.4	0.3	<0.1	0.3	0.3	0.6
40	242.4	<0.1	<0.1	0.3	0.4	0.4	<0.1	0.3	0.4	0.6
50	251.3	<0.1	<0.1	0.5	0.3	0.5	0.1	0.5	0.6	0.7
60	232.3	<0.1	<0.1	0.4	0.3	0.9	0.2	0.9	1.0	1.0
70	221.5	0.3	0.3	0.4	0.2	0.9	0.7	2.2	2.4	1.0
80	193.2	0.7	<0.1	0.5	0.2	0.7	1.4	5.1	5.3	0.9
90	187.8	1.1	1.3	1.0	0.4	0.2	1.3	5.7	6.0	1.7
100	194.9	8.4	1.5	0.6	0.9	0.6	1.9	8.1	8.8	8.1
110	258.6	25.6	7.6	2.1	0.9	0.5	5.3	20.8	23.2	25.3
115	315.8	30.9	10.4	3.0	0.9	0.6	7.0	28.0	30.8	30.9

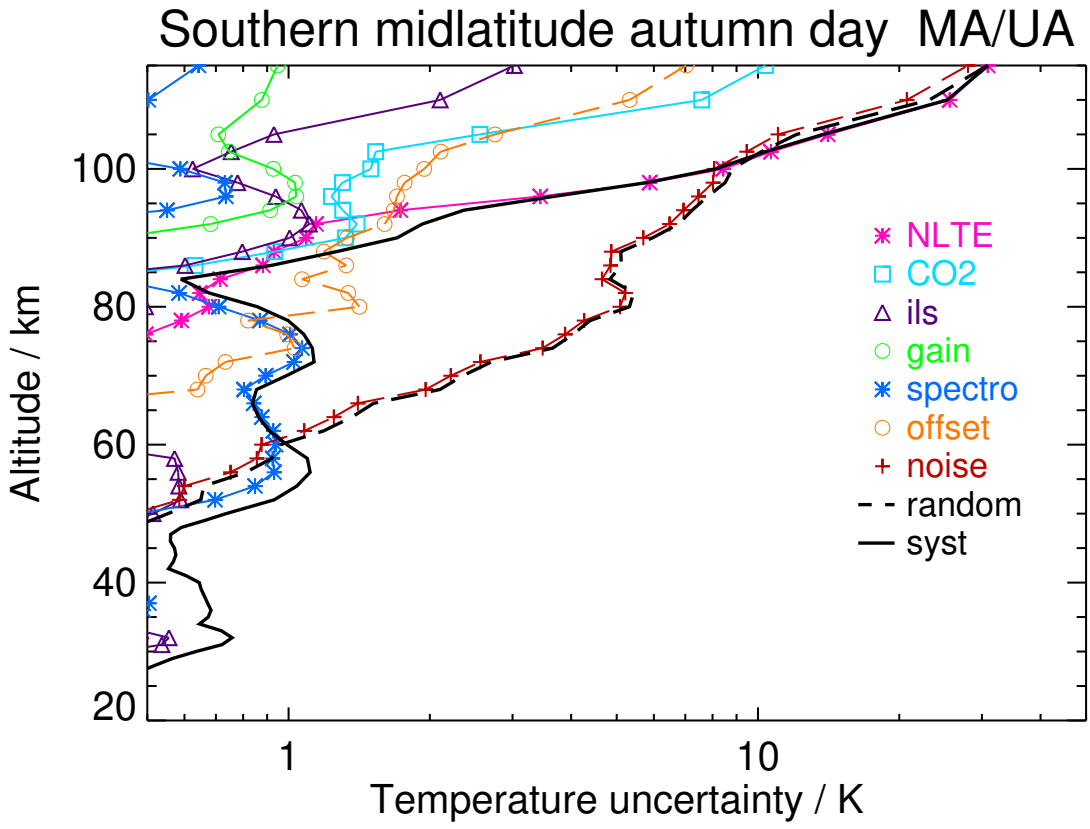

Figure S25. Temperature uncertainties for Southern midlatitude autumn daytime conditions.

Table S26. Temperature error budget for Southern midlatitude autumn night. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	215.2	<0.1	<0.1	0.1	0.3	0.2	<0.1	0.3	0.4	0.4
30	222.8	<0.1	<0.1	0.4	0.4	0.3	<0.1	0.3	0.3	0.6
40	243.3	<0.1	<0.1	0.3	0.4	0.5	<0.1	0.3	0.4	0.7
50	253.4	<0.1	<0.1	0.5	0.3	0.5	0.1	0.5	0.5	0.8
60	232.7	<0.1	<0.1	0.4	0.3	0.9	0.2	0.9	0.9	1.0
70	220.1	0.4	0.3	0.4	0.2	0.9	0.7	2.3	2.4	1.0
80	195.1	0.7	0.1	0.3	0.3	0.7	1.4	5.1	5.4	0.8
90	188.5	1.5	1.3	1.1	0.5	0.1	1.4	5.9	6.1	2.1
100	200.1	8.7	1.1	0.9	1.0	0.7	1.7	7.8	8.4	8.5
110	249.8	23.0	6.9	1.5	0.8	0.5	4.9	19.7	21.7	22.9
115	301.3	28.5	10.0	2.4	0.9	0.6	6.5	27.5	30.0	28.6

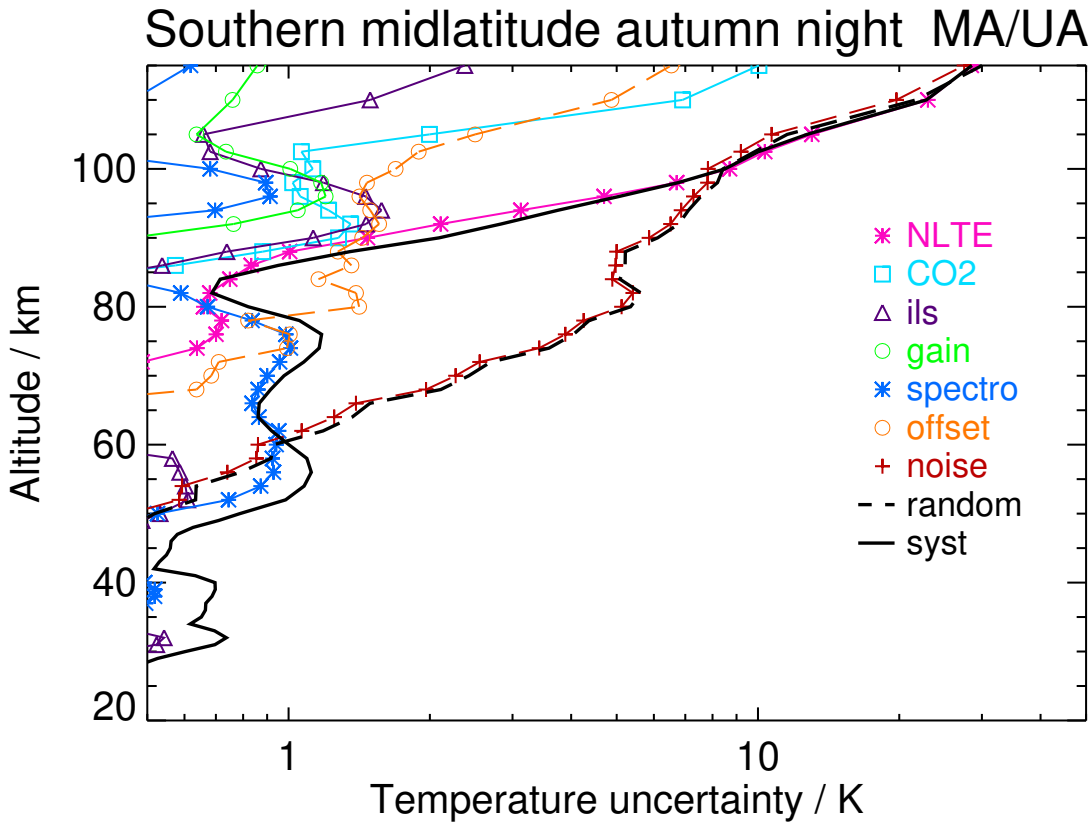

Figure S26. Temperature uncertainties for Southern midlatitude autumn nighttime conditions.

Table S27. Temperature error budget for Southern polar winter day. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	193.4	<0.1	<0.1	0.3	0.2	0.2	<0.1	0.3	0.4	0.4
30	214.6	<0.1	<0.1	0.3	0.3	1.1	<0.1	0.3	0.5	1.1
40	258.4	<0.1	<0.1	0.3	0.5	0.8	<0.1	0.3	0.6	0.8
50	274.0	<0.1	<0.1	0.6	0.4	0.6	0.1	0.5	0.7	0.7
60	252.4	0.2	<0.1	0.4	0.3	1.1	0.2	0.9	1.0	1.1
70	216.5	0.2	0.2	0.4	0.2	0.9	0.6	2.3	2.4	1.0
80	202.9	0.8	<0.1	0.6	0.2	0.5	1.5	5.0	5.3	0.8
90	192.3	1.4	1.4	1.4	0.6	0.1	1.4	5.9	6.1	2.3
100	191.1	7.4	1.7	0.8	0.8	0.4	2.2	8.5	9.1	7.2
110	267.8	21.6	10.1	2.2	0.8	0.5	6.6	23.7	25.8	22.6
115	331.0	24.9	12.5	2.9	0.9	0.6	8.1	29.0	31.5	26.4

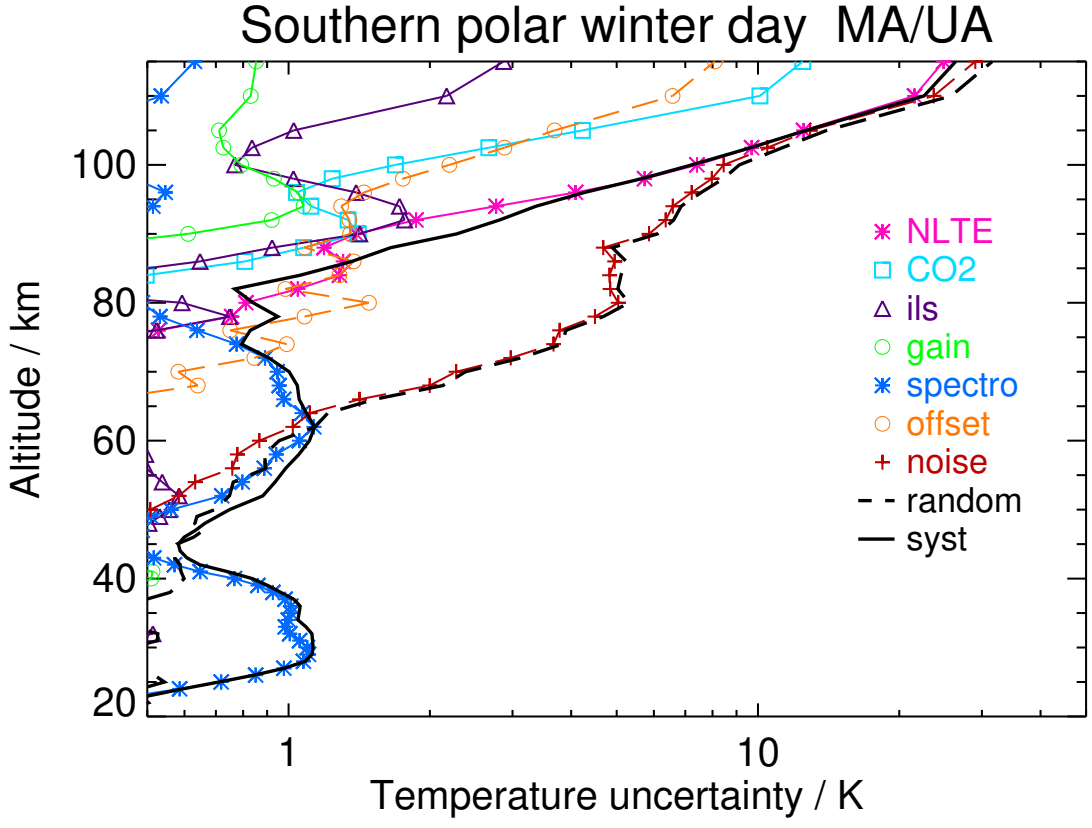

Figure S27. Temperature uncertainties for Southern polar winter daytime conditions.

Table S28. Temperature error budget for Southern polar winter night. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	194.7	<0.1	<0.1	0.3	0.2	0.3	<0.1	0.3	0.4	0.4
30	214.7	<0.1	<0.1	0.3	0.3	1.0	<0.1	0.3	0.4	1.1
40	259.8	<0.1	<0.1	0.3	0.5	0.8	<0.1	0.3	0.6	0.9
50	269.3	<0.1	<0.1	0.6	0.4	0.4	0.1	0.5	0.6	0.7
60	255.8	0.2	<0.1	0.4	0.3	1.0	0.2	0.8	0.9	1.1
70	223.6	0.5	0.2	0.4	0.3	1.0	0.6	2.2	2.3	1.1
80	201.5	0.9	<0.1	0.4	0.3	0.5	1.5	5.1	5.4	0.8
90	193.2	2.1	1.4	1.3	0.6	0.1	1.4	5.9	6.3	2.4
100	185.4	7.7	2.1	1.1	1.0	0.5	2.4	8.6	9.3	7.6
110	268.2	20.1	9.7	2.0	0.8	0.5	6.6	23.9	26.0	21.1
115	337.4	23.0	11.8	2.6	0.8	0.6	8.0	28.9	31.2	24.5

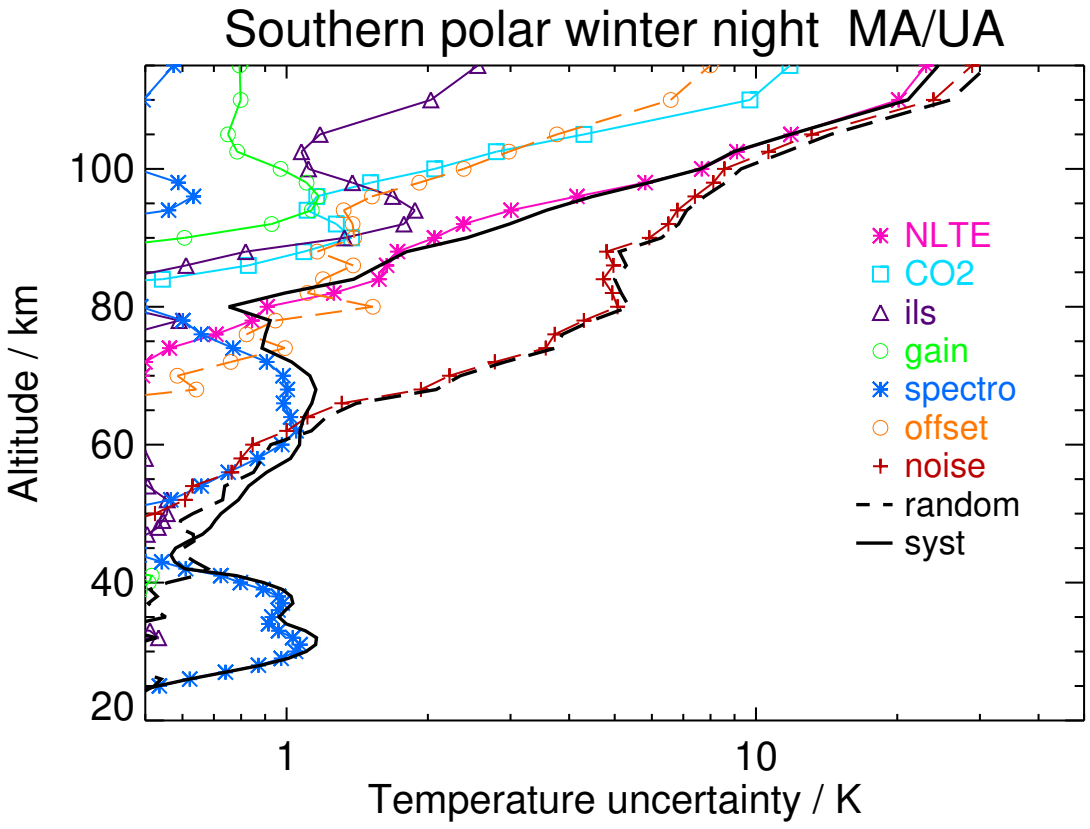

Figure S28. Temperature uncertainties for Southern polar winter nighttime conditions.

Table S29. Temperature error budget for Southern polar spring day. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	212.0	<0.1	<0.1	0.2	0.2	1.1	<0.1	0.3	0.6	1.0
30	253.8	<0.1	<0.1	0.4	0.4	0.7	<0.1	0.3	0.6	0.7
40	266.5	<0.1	<0.1	0.3	0.5	0.2	<0.1	0.3	0.4	0.6
50	272.2	<0.1	<0.1	0.5	0.3	0.4	0.1	0.4	0.5	0.7
60	251.7	<0.1	<0.1	0.3	0.2	1.1	0.2	0.8	0.8	1.1
70	215.3	<0.1	0.1	0.5	0.2	1.0	0.5	2.0	2.1	1.1
80	183.6	0.7	0.2	0.4	0.2	0.5	1.5	5.2	5.5	0.8
90	179.7	1.0	1.3	1.1	0.5	0.1	1.6	6.0	6.3	1.7
100	186.1	9.0	2.8	0.5	0.9	0.6	2.3	8.7	9.4	9.1
110	289.0	32.9	14.7	4.4	1.3	0.8	6.1	22.2	24.9	35.1
115	355.2	38.6	18.5	6.0	1.4	1.0	8.0	28.8	31.6	42.0

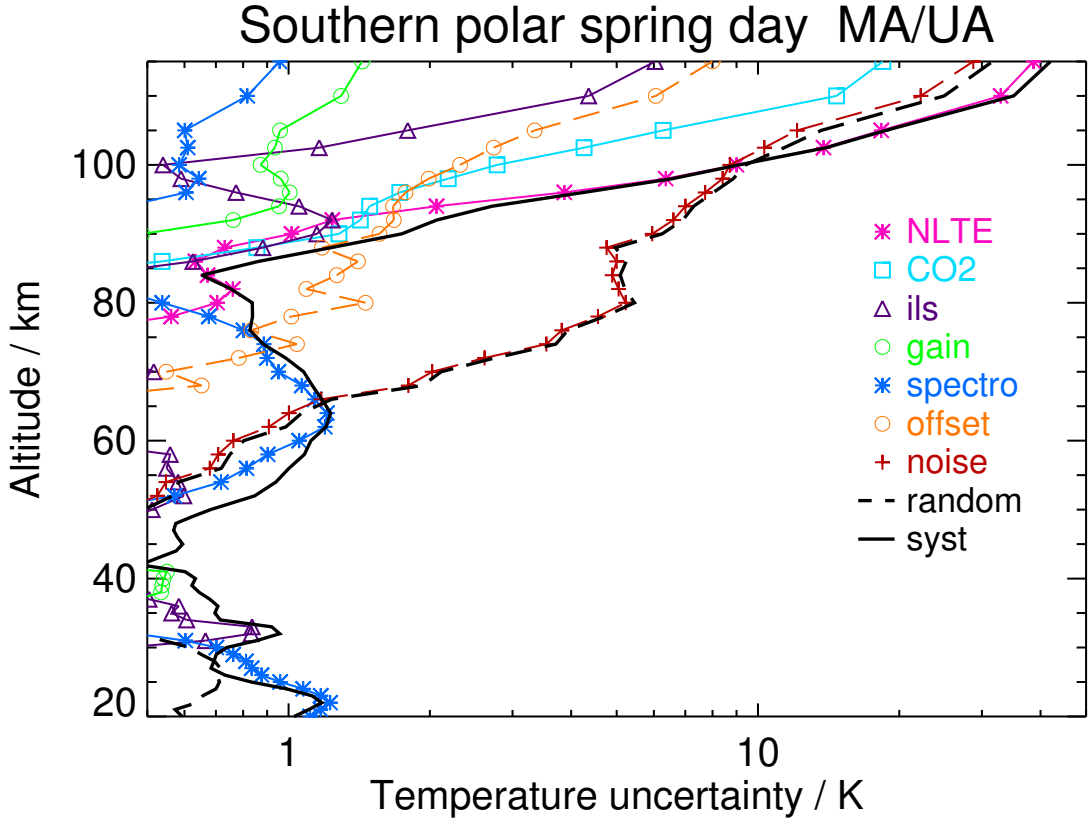

Figure S29. Temperature uncertainties for Southern polar spring daytime conditions.

Table S30. Temperature error budget for Southern polar spring night. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	215.9	<0.1	<0.1	<0.1	0.3	0.7	<0.1	0.3	0.5	0.6
30	248.1	<0.1	<0.1	0.6	0.4	0.6	<0.1	0.3	0.5	0.8
40	263.6	<0.1	<0.1	0.4	0.5	0.3	<0.1	0.3	0.4	0.7
50	267.9	<0.1	<0.1	0.6	0.3	0.5	0.1	0.4	0.5	0.7
60	244.2	<0.1	<0.1	0.4	0.2	1.1	0.2	0.8	0.8	1.2
70	212.0	0.1	0.2	0.6	0.2	0.9	0.6	2.3	2.4	1.1
80	194.2	0.5	0.1	0.4	0.2	0.5	1.5	5.2	5.4	0.7
90	186.1	1.5	1.2	1.3	0.6	0.1	1.5	5.9	6.2	2.2
100	186.3	8.1	2.0	0.5	0.9	0.7	2.2	8.3	9.0	8.0
110	268.6	26.1	11.4	2.6	0.8	0.6	5.6	21.5	24.3	26.9
115	331.6	31.7	15.1	3.8	0.9	0.7	7.4	28.4	31.7	33.3

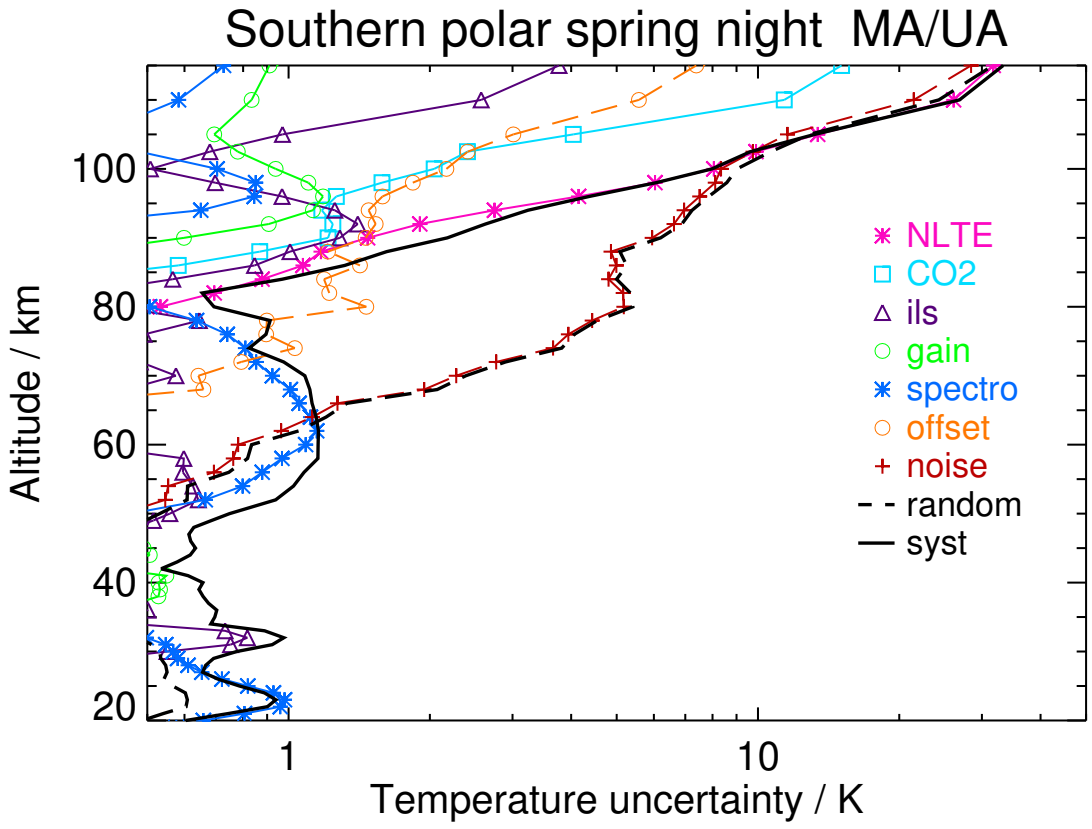

Figure S30. Temperature uncertainties for Southern polar spring nighttime conditions.

Table S31. Temperature error budget for Southern polar summer day. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	233.2	<0.1	<0.1	<0.1	0.4	0.1	<0.1	0.3	0.3	0.4
30	241.2	<0.1	<0.1	0.6	0.3	0.3	<0.1	0.3	0.3	0.7
40	264.9	<0.1	<0.1	0.3	0.5	0.4	<0.1	0.2	0.3	0.7
50	282.6	<0.1	<0.1	0.5	0.2	0.2	0.1	0.4	0.5	0.6
60	265.6	<0.1	<0.1	0.4	0.2	1.0	0.2	0.7	0.7	1.1
70	225.2	<0.1	0.2	0.3	0.2	1.2	0.5	1.7	1.8	1.3
80	167.2	1.1	0.5	0.9	0.3	0.6	1.5	5.4	5.6	1.5
90	143.3	1.1	1.2	0.7	0.4	0.2	2.1	5.9	6.4	1.5
100	216.2	15.8	8.0	1.2	1.0	0.6	2.2	8.5	9.9	17.2
110	326.3	41.7	31.5	5.9	1.6	1.0	6.2	22.2	25.8	51.3
115	369.6	46.9	37.5	7.8	1.8	1.1	8.4	28.7	32.4	59.3

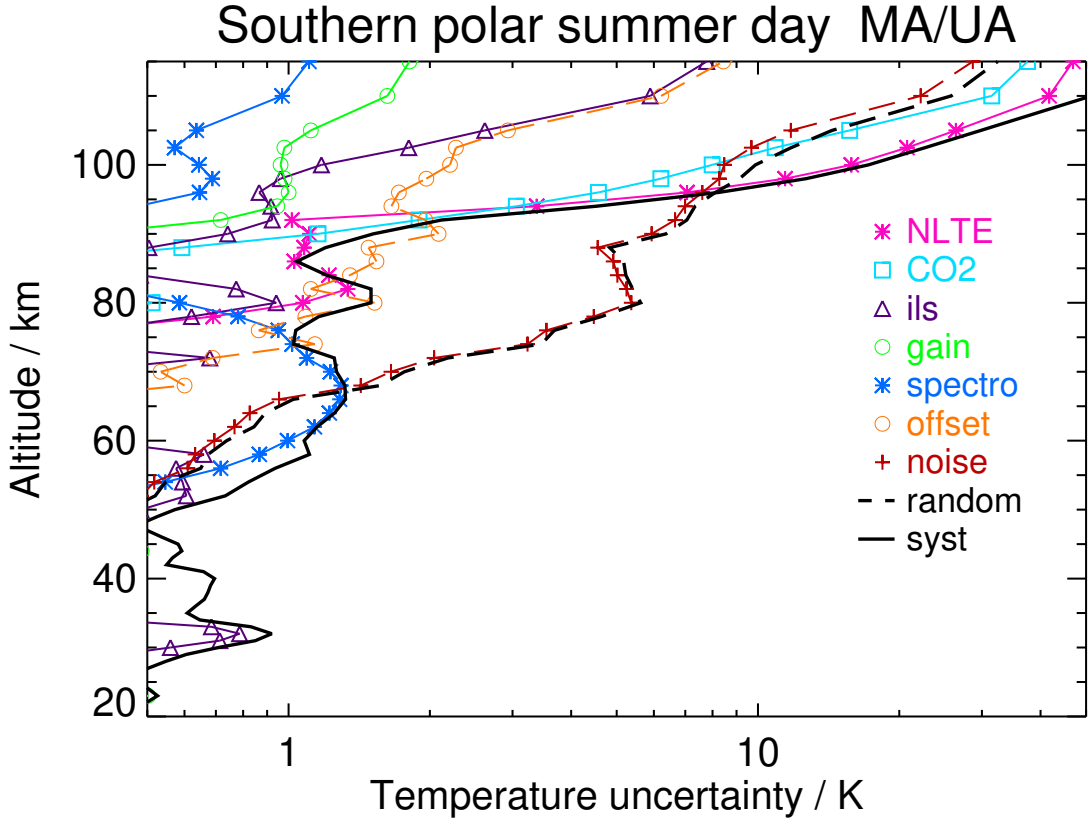

Figure S31. Temperature uncertainties for Southern polar summer daytime conditions.

Table S32. Temperature error budget for Southern polar summer night. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	226.7	<0.1	<0.1	0.1	0.4	<0.1	<0.1	0.3	0.3	0.4
30	233.2	<0.1	<0.1	0.5	0.4	0.3	<0.1	0.3	0.3	0.7
40	254.8	<0.1	<0.1	0.3	0.5	0.5	<0.1	0.3	0.3	0.7
50	268.0	<0.1	<0.1	0.5	0.3	0.4	0.1	0.4	0.5	0.7
60	249.3	<0.1	<0.1	0.3	0.2	1.1	0.2	0.7	0.8	1.1
70	214.5	0.1	0.1	0.6	0.2	1.1	0.6	2.0	2.1	1.2
80	174.8	0.6	0.2	0.5	0.2	0.6	1.5	5.5	5.8	0.8
90	177.9	1.2	1.1	1.8	0.7	0.3	1.6	6.1	6.3	2.4
100	204.2	12.1	2.9	0.5	0.8	0.5	2.0	8.3	9.0	12.1
110	286.0	33.5	15.1	3.0	1.0	0.7	5.7	21.3	25.4	34.7
115	340.5	39.1	19.2	4.3	1.1	0.8	7.7	28.4	32.7	41.4

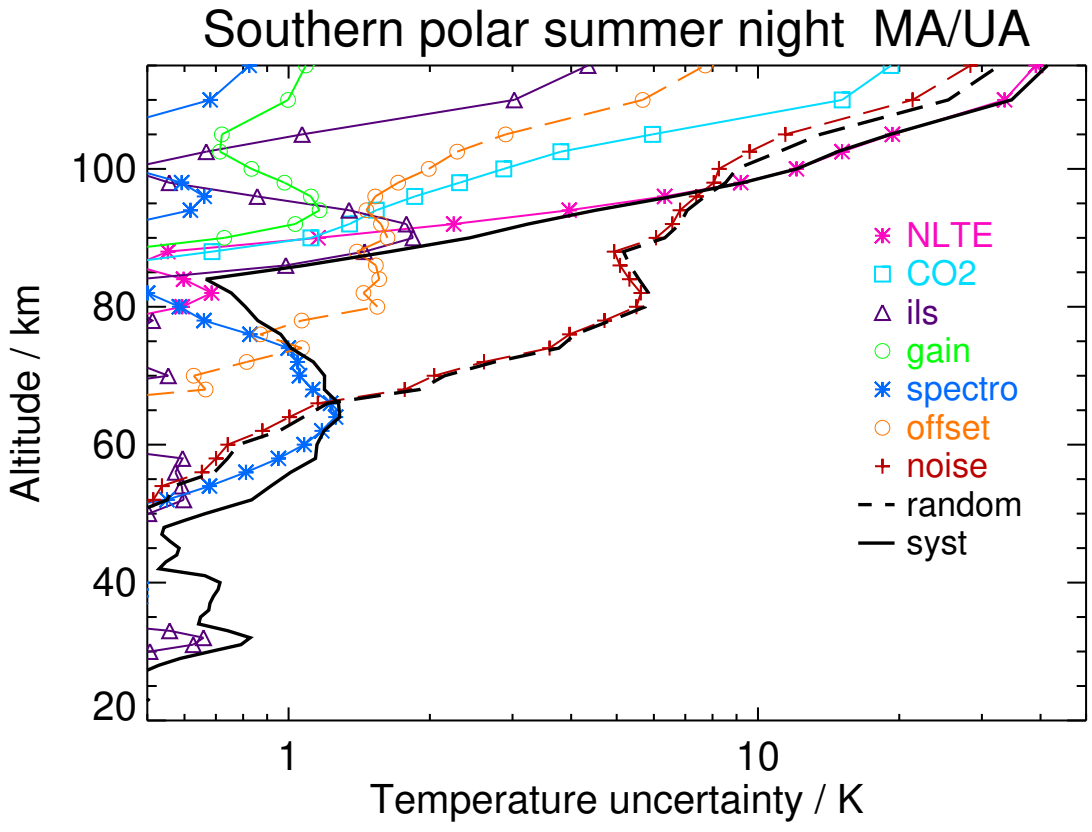

Figure S32. Temperature uncertainties for Southern polar summer nighttime conditions.

Table S33. Temperature error budget for Southern polar autumn day. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	214.0	<0.1	<0.1	0.2	0.4	0.3	<0.1	0.3	0.3	0.5
30	212.6	<0.1	<0.1	0.4	0.4	0.3	<0.1	0.3	0.4	0.6
40	230.3	<0.1	<0.1	0.2	0.4	0.5	<0.1	0.3	0.4	0.7
50	252.5	<0.1	<0.1	0.4	0.4	0.3	0.1	0.5	0.6	0.6
60	244.0	0.1	<0.1	0.3	0.2	1.1	0.2	0.9	1.0	1.1
70	220.5	0.3	0.2	0.4	0.2	0.9	0.6	2.2	2.3	1.0
80	208.3	0.9	<0.1	0.5	0.2	0.7	1.4	4.9	5.2	1.1
90	192.9	1.1	1.4	1.0	0.5	0.2	1.4	5.8	6.0	1.8
100	192.3	6.3	1.3	0.8	0.9	0.4	1.8	8.1	8.6	6.2
110	259.5	23.3	8.1	1.8	0.8	0.5	5.4	21.0	23.5	23.1
115	317.0	28.3	11.0	2.6	0.8	0.6	7.3	28.2	31.0	28.5

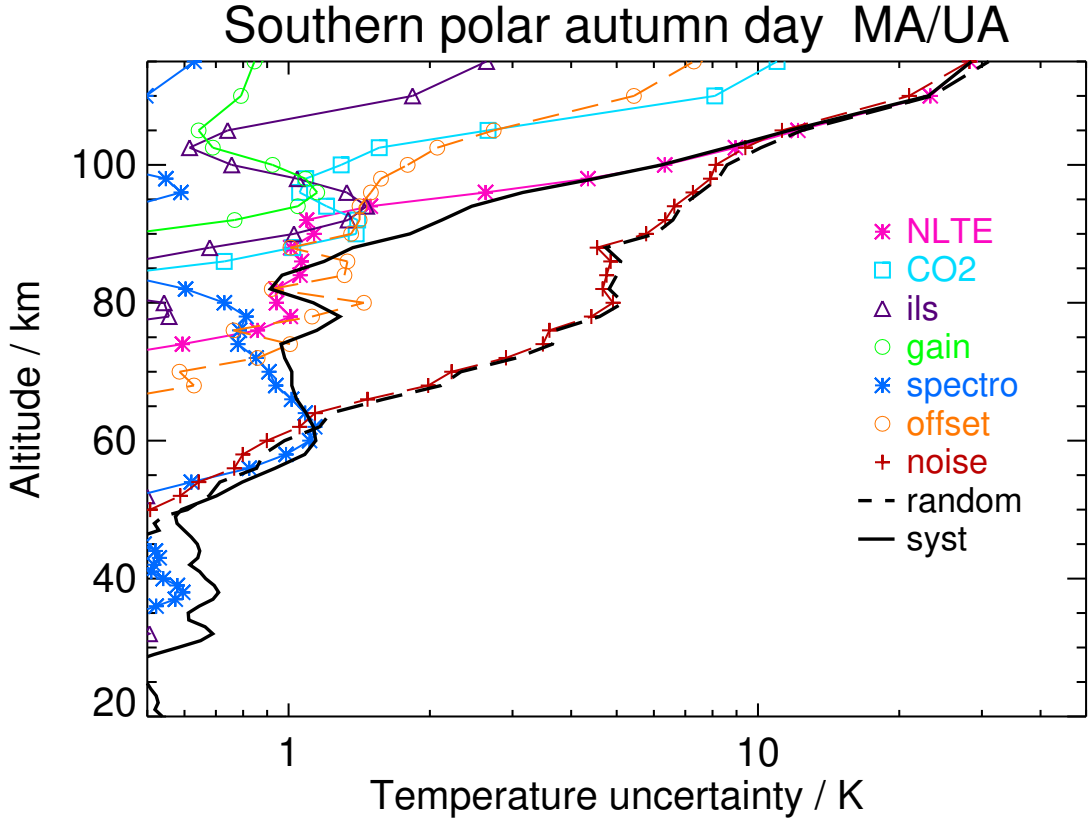

Figure S33. Temperature uncertainties for Southern polar autumn daytime conditions.

Table S34. Temperature error budget for Southern polar autumn night. All uncertainties are 1σ.

altitude (km)	mean target (K)	NLTE (K)	CO2 (K)	ils (K)	gain (K)	spectro (K)	offset (K)	noise (K)	random (K)	syst (K)
20	211.2	<0.1	<0.1	0.2	0.4	0.4	<0.1	0.3	0.3	0.6
30	211.0	<0.1	<0.1	0.4	0.4	0.2	<0.1	0.3	0.4	0.6
40	229.9	<0.1	<0.1	0.2	0.4	0.5	<0.1	0.3	0.4	0.7
50	253.4	<0.1	<0.1	0.5	0.4	0.3	0.1	0.5	0.6	0.6
60	248.3	0.2	<0.1	0.3	0.2	1.0	0.2	0.9	0.9	1.1
70	224.8	0.5	0.2	0.4	0.2	1.0	0.5	2.1	2.2	1.2
80	210.0	1.1	<0.1	0.4	0.3	0.6	1.5	4.9	5.2	1.1
90	195.9	1.5	1.4	0.9	0.4	0.3	1.4	5.8	6.1	2.1
100	191.6	6.4	1.1	1.2	1.1	0.6	1.8	8.0	8.5	6.3
110	258.4	21.3	8.5	1.6	0.7	0.5	5.3	21.1	22.7	22.0
115	316.6	26.2	11.6	2.3	0.7	0.6	7.1	28.2	30.3	27.5

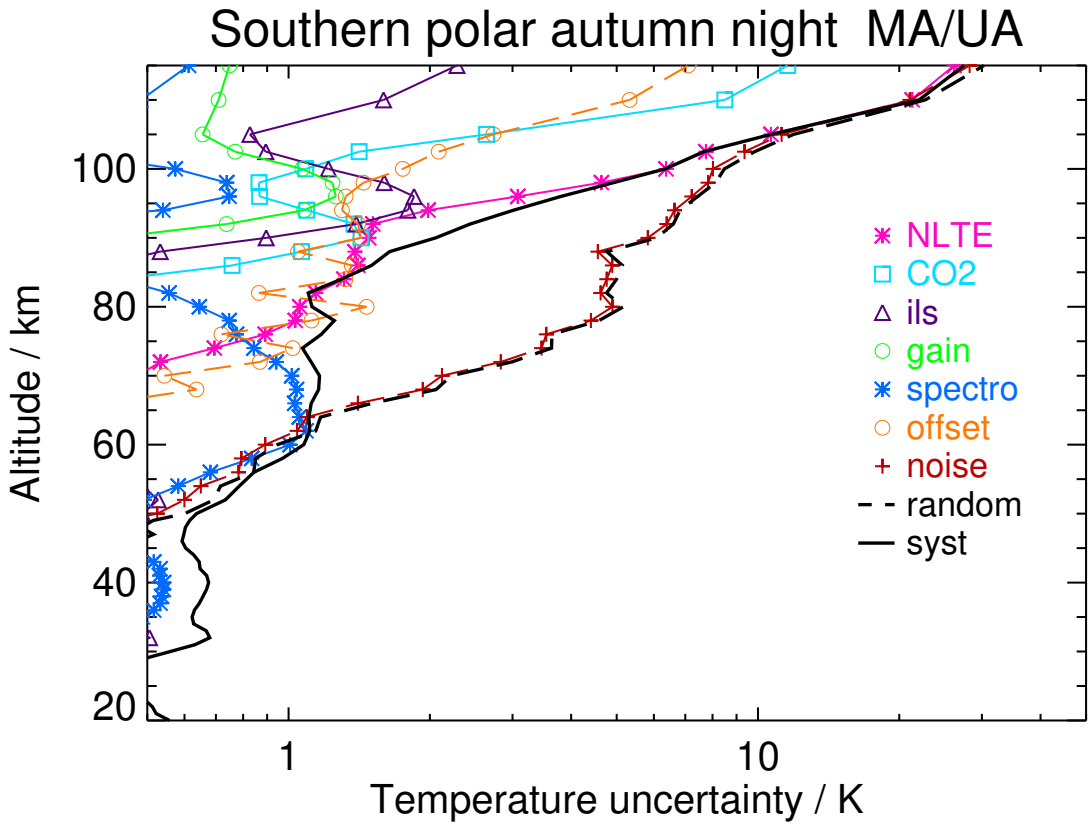

Figure S34. Temperature uncertainties for Southern polar autumn nighttime conditions.