



Supplement of

Sensitivity of polar stratospheric cloud formation to changes in water vapour and temperature

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Supplement

Result of the trajectory ensemble statistic for T_{NAT} :

Table 1: Total time where the temperature along the back trajectory is below the NAT existence threshold temperature (sum over all 738 back trajectories) for a stratospheric H₂O mixing ratios of 4.75, 5.0, 5.25, 5.5 and 6.0 ppmv. The calculation was performed assuming an HNO₃ mixing ratio of 3, 5 and 7 ppbv. Note: The total trajectory ensemble time is 107010 h (738 trajectories × 145 h)

		T	T-0.5	T-1
HNO ₃ (ppbv)	H ₂ O (ppmv)	T<T _{NAT} (h)	T<T _{NAT} (h)	T<T _{NAT} (h)
3	4.75	32960	36776	40584
3	5	34486	38301	42171
3	5.25	36024	39782	43779
3	5.5	37476	41310	45210
3	5.75	38802	42709	46533
3	6	40128	44080	47869
5	4.75	38275	42133	45951
5	5	39824	43810	47568
5	5.25	41430	45319	49051
5	5.5	42893	46711	50560
5	5.75	44331	48126	51994
5	6	45667	49460	53447
7	4.75	41849	45746	49513
7	5	43512	47312	51179
7	5.25	45062	48811	52750
7	5.5	46463	50298	54262
7	5.75	47870	51735	55580
7	6	49196	53180	56787

Table 2: Increase in time where the temperature along the back trajectory is below the threshold temperature (sum over all 738 back trajectories) for a stratospheric H₂O increase of 0.25, 0.5, 0.75 and 1.0 ppmv, respectively, and for a stratospheric H₂O decrease of 0.25 ppmv. The calculation was performed assuming an HNO₃ mixing ratio of 3, 5 and 7 ppbv.

HNO ₃ (ppbv)	H ₂ O increase (ppmv)	T	T-0.5	T-1
		Δt for T < T _{NAT} (h)	Δt for T < T _{NAT} (h)	Δt for T < T _{NAT} (h)
3	-0.25	-1526	2290	6098
3	0.25	1538	5296	9293
3	0.5	2990	6824	10727
3	0.75	4136	8223	12047
3	1.0	5642	9594	13383
5	-0.25	-1459	2309	6127
5	0.25	1606	5495	9227
5	0.5	3069	6887	10736
5	0.75	4507	8302	12170
5	1.0	5843	9326	13623
7	-0.25	-1663	2234	6001
7	0.25	1550	5299	9238
7	0.5	2951	6786	10750
7	0.75	4358	8223	12068
7	1.0	5684	9668	13275

Result of the trajectory ensemble statistic for T_{ice} :

Table 3: Total time where the temperature along the back trajectory is below the ice formation threshold temperature (sum over all 738 back trajectories) for a stratospheric H₂O increase of 4.75, 5.0, 5.25, 5.5, 5.75 and 6.0 ppmv. Note: The total trajectory ensemble time is 107010 h (738 trajectories \times 145 h).

	T	T-0.5	T-1
H ₂ O (ppmv)	T < T _{ice} (h)	T < T _{ice} (h)	T < T _{ice} (h)
4.75	340	771	1530
5	571	1159	2152
5.25	870	1685	3030
5.5	1240	2286	4270
5.75	1738	3133	5523
6	2299	4296	6789

Table 4: Increase in time where the temperature along the back trajectory is below the ice formation threshold temperature (sum over all 738 back trajectories) for a stratospheric H₂O increase of 0.25, 0.5, 0.75 and 1.0 ppmv, respectively, and for a stratospheric H₂O decrease of 0.25 ppmv.

	T	T-0.5	T-1
H ₂ O increase (ppmv)	Δt for T < T _{ice} (h)	Δt for T < T _{ice} (h)	Δt for T < T _{ice} (h)
-0.25	231	200	959
0.25	299	1114	2459
0.5	669	1715	3699
0.75	1167	2562	4952
1	1728	3725	6218

Correlation of water vapour and temperature (525-825 K):

Correlations of temperature and water vapour anomalies were derived for different time scales (all seasons, specific season, single months). The time series are based on data within 70° and 90°N equivalent latitude. A large majority of these calculations indicate an anti-correlation between these two parameters in the altitude range between 475 and 525 K (see main paper). The correlations are strong in winter and very weak in summer. The figures below show some examples for different data sets for the potential temperature range 525-825 K: (top) T, H₂O: Envisat/MIPAS and (bottom) T, H₂O: Aura/MLS (Figure 1). The data are averaged over the months January, February and March. The derivation of the anomalies considers the entire time series. The correlation is not as strong as at 475-525 K, but still negative. The weak correlation in the Envisat/MIPAS data is caused by a positive correlation at the begin of the time period considered.

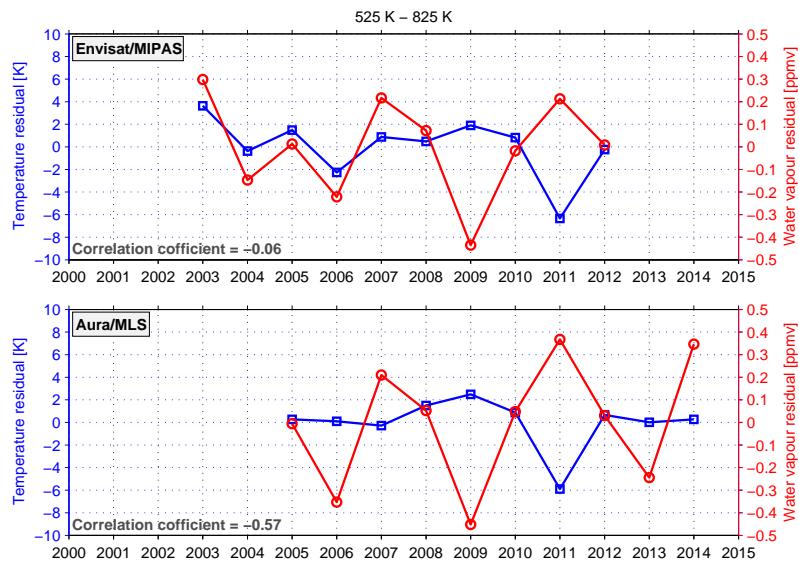


Figure 1: Correlation of temperature (blue) and water vapour (red) anomaly derived from Envisat/MIPAS (top) and Aura/MLS (bottom) for the potential temperature range 525-825 K (3-month average consisting of the months January, February and March; MIPAS: 2002-2012, MLS: 2005-2014).