S1 Introduction

For each flight, Table S1, lists (for the entire flight) the cold point temperature, the altitude, the potential temperature and the pressure at the cold point. The range of the potential temperature at the cold point is 370.3 K to 402.5 K. The mean cold point temperature for the StratoClim flights is 191.2 K, the mean altitude of the cold point is 17.1 km and 384.7 K and 87.3 hPa for potential temperature and pressure, respectively.

For the last part of each StratoClim flight (e.g. the last hour, which is the descent into Kathmandu), Table S2, lists the cold point temperature measured by the aircraft, the altitude, the potential temperature and the pressure at the cold point. The range of the potential temperature for the descent flight segments at the cold point is 315.0 K to 369.5 K. The mean cold point temperature for the flights is 197.2 K, the mean altitude of the cold point is 17.3 km and 349.0 K and 85.1 hPa for potential temperature and pressure, respectively. Similarly, Table S3, lists the location of the lapse rate tropopause for the same segment of each flight. The mean lapse rate tropopause is located at 15.9 km (or 373.0 K, pressure 104.4 hPa); the mean temperature at the lapse rate tropopause is 195.6 K.

Table S1: Overview of the StratoClim science flights 2017 from Kathmandu. Shown is information on the cold point (CP) tropopause deduced considering the entire flight. (Note that F6 did not cross the tropopause.) Mean potential temperature at the CP is 384.7 K.

Flight No.	Date	Cold point (K)	Alt. at CP (km)	Theta at CP (K)	Press. at CP (hPa)
F1	27.07.2017	193.4	17.0	388.7	87.1
F2	29.07.2017	194.1	17.7	402.5	78.1
F3	31.07.2017	192.7	17.0	386.6	87.7
F4	02.08.2017	191.7	17.9	399.9	76.5
F5	04.08.2017	191.5	16.2	370.3	99.7
F6	06.08.2017	191.8	16.2	370.9	99.6
F7	08.08.2017	187.5	17.4	382.6	82.6
F8	10.08.2017	186.7	17.1	375.8	86.7
mean	–	191.2	17.1	384.7	87.3

Table S2: Overview of the StratoClim science flights 2017 from Kathmandu. Shown is information on the cold point (CP) tropopause, but for the flight segments that also the lapse rate (LR) tropopause was selected; i.e. the descent of the aircraft into Kathmadu. (Note that F6 did not substantially cross the tropopause and is therefore not listed.)

Flight No.	Date	Cold point (K)	Alt. at CP (km)	Theta at CP (K)	Press. at CP (hPa)
F1	27.07.2017	194.6	17.4	336.0	82.2
F2	29.07.2017	194.1	17.7	369.5	78.1
F3	31.07.2017	195.2	17.1	359.1	85.7
F4	02.08.2017	191.7	17.9	315.0	76.5
F5	04.08.2017	191.9	16.3	360.1	97.3
F7	08.08.2017	189.8	17.2	349.2	85.7
F8	10.08.2017	191.6	16.8	353.6	90.1
mean	–	192.7	17.3	349.0	85.1

Table S3: Overview of the StratoClim science flights 2017 from Kathmandu. Shown is information on the lapse rate (LR) tropopause for selected part of the flight (i.e. the descent of the aircraft into Kathmadu). The mean lapse rate tropopause is located at 373.0 K. (Note that F6 did not substantially cross the tropopause and is therefore not listed.)

Flight No.	Date	Cold point (K)	Alt. at CP (km)	Theta at CP (K)	Press. at CP (hPa)
F1	27.07.2017	198.2	15.6	372.7	109.6
F2	29.07.2017	196.8	15.6	370.8	108.9
F3	31.07.2017	197.5	15.9	376.2	104.9
F4	02.08.2017	197.6	15.7	373.8	107.4
F5	04.08.2017	192.3	16.3	373.1	98.2
F7	08.08.2017	192.3	16.4	374.5	97.0
F8	10.08.2017	194.3	15.9	369.8	105.2
mean	–	195.6	15.9	373.0	104.4

S2 StratoClim 2017: measured temperature profiles

S2.1 Temperature vs. altitude
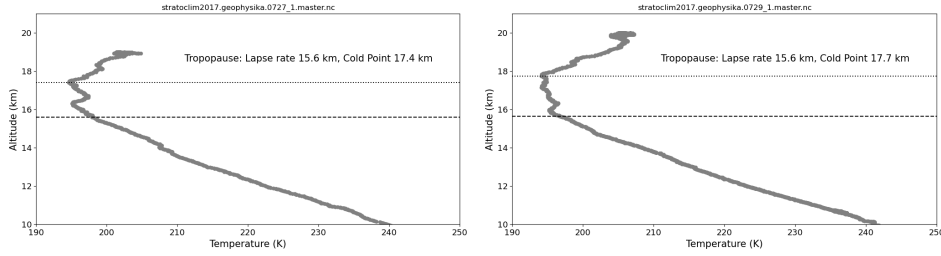
Figure S1: The temperature profile versus altitude in the vicinity of the tropopause for the scientific flight on 27 and 29 July 2017. The dashed line shows the altitude of the lapse rate tropopause and the dotted line the altitude of the cold point tropopause on this day (for the decent into Kathmandu, see Tables S2 and S3). The duration of the flight on 27 July 2017 was 2.7 hours on 29 July 4.4 hours.
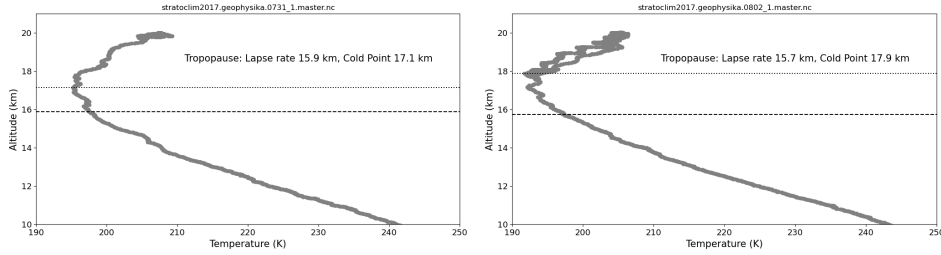
Figure S2: The temperature profile versus altitude in the vicinity of the tropopause for the scientific flight on 31 July and 2 August 2017. The dashed line shows the altitude of the lapse rate tropopause and the dotted line the altitude of the cold point tropopause on this day (for the decent into Kathmandu, see Tables S2 and S3). The duration of the flight on 31 July 2017 was 4.5 hours on 2 August 4.0 hours.
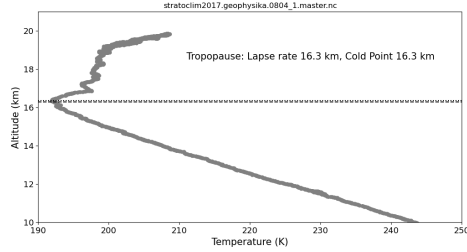
Figure S3: The temperature profile versus altitude in the vicinity of the tropopause for the scientific flight on 4 August 2017. The dashed line shows the altitude of the lapse rate tropopause and the dotted line the altitude of the cold point tropopause on this day (for the decent into Kathmandu, see Tables S2 and S3). The duration of the flight on 4 August 2017 was 4.1 hours.
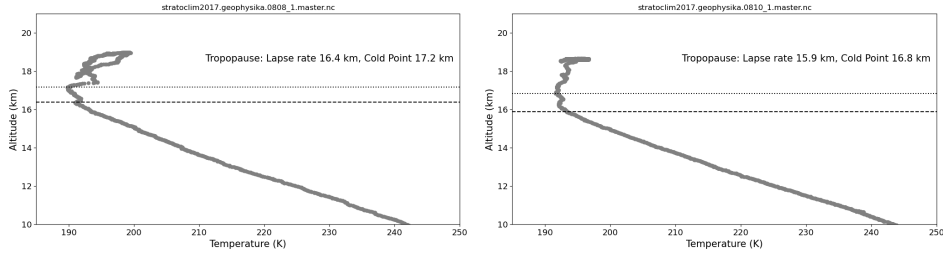
Figure S4: The temperature profile versus altitude in the vicinity of the tropopause for the scientific flight on 8 and 10 August 2017. The dashed line shows the altitude of the lapse rate tropopause and the dotted line the altitude of the cold point tropopause on this day (for the decent into Kathmandu, see Tables S2 and S3). The duration of the flight on 8 August 2017 was 3.5 hours, on 10 August 2017 3.7 hours.

S2.2 Temperature vs. potential temperature
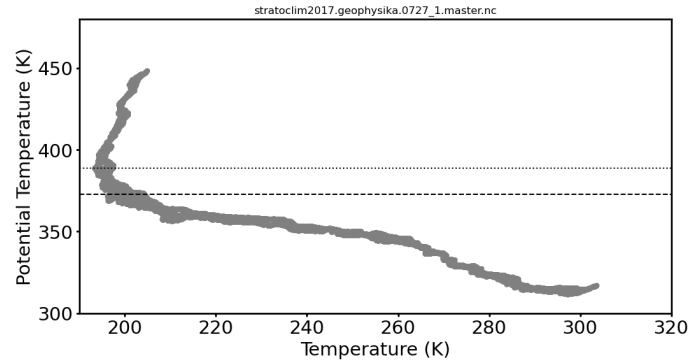
Figure S5: The temperature profile versus potential temperature for the scientific flight on 27 July 2017. The dotted line shows the potential temperature of the cold point tropopause (considering the entire flight) on 27 July 2017 (388.7 K) and the dashed line shows the potential temperature at the lapse rate tropopoause (for the descent into Kathmandu; 372.7 K). The entire altitude range covered by the aircraft is shown; flight duration was 2.7 hours.
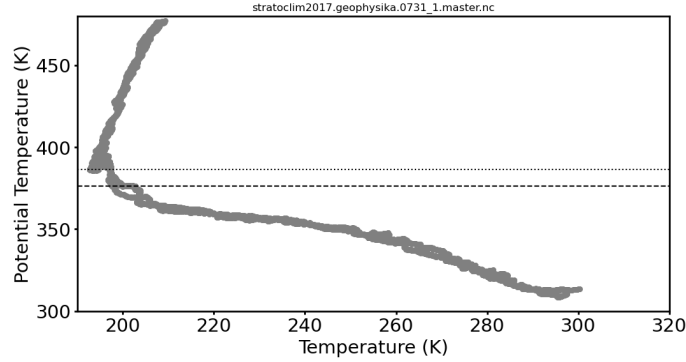
Figure S6: The temperature profile versus potential temperature for the scientific flight on 31 July 2017. The dotted line shows the potential temperature of the cold point tropopause (considering the entire flight) on 31 July 2017 (386.6 K) and the dashed line shows the potential temperature at the lapse rate tropopoause (for the descent into Kathmandu; 376.2 K). The entire altitude range covered by the aircraft is shown; flight duration was 4.5 hours.
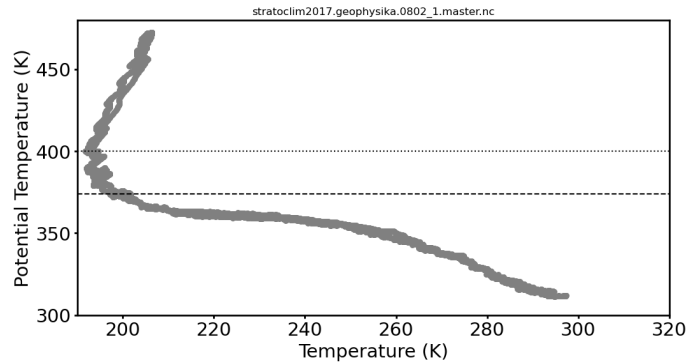
Figure S7: The temperature profile versus potential temperature for the scientific flight on 2 August. The dotted line shows the potential temperature of the cold point tropopause (considering the entire flight) on 2 August 2017 (399.9 K) and the dashed line shows the potential temperature at the lapse rate tropopoause (for the descent into Kathmandu; 373.8 K). The entire altitude range covered by the aircraft is shown; flight duration was 4.0 hours.
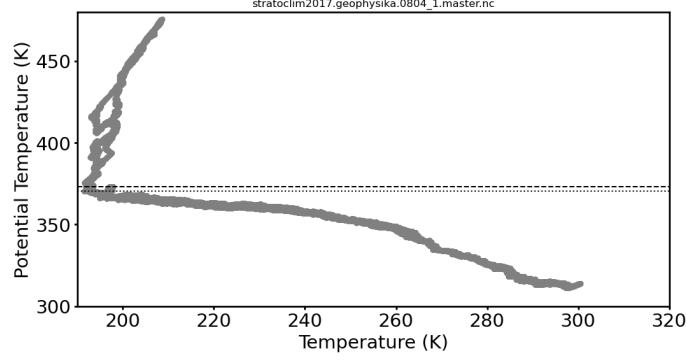
Figure S8: The temperature profile versus potential temperature for the scientific flight on 4 August. The dotted line shows the potential temperature of the cold point tropopause (considering the entire flight) on 4 August 2017 (370.3 K) and the dashed line shows the potential temperature at the lapse rate tropopoause (for the descent into Kathmandu; 373.1 K). The entire altitude range covered by the aircraft is shown; flight duration was 4.1 hours.
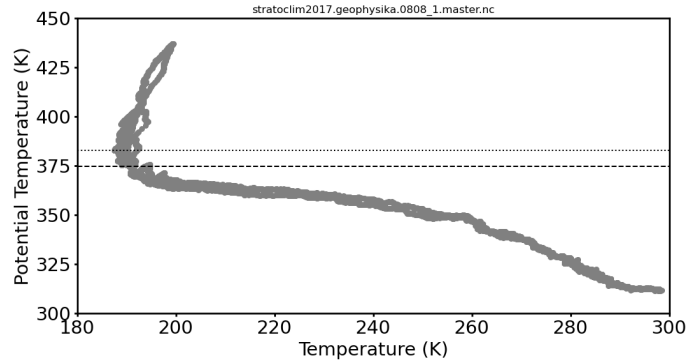
Figure S9: The temperature profile versus potential temperature for the scientific flight on 8 August. The dotted line shows the potential temperature of the cold point tropopause (considering the entire flight) on 8 August 2017 (382.6 K) and the dashed line shows the potential temperature at the lapse rate tropopoause (for the descent into Kathmandu; 374.5 K). The entire altitude range covered by the aircraft is shown; flight duration was 3.5 hours.
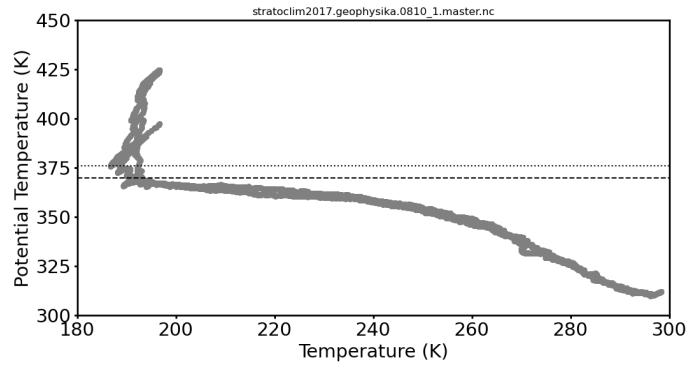
Figure S10: The temperature profile versus potential temperature for the scientific flight on 10 August. The dotted line shows the potential temperature of the cold point tropopause (considering the entire flight) on 10 August 2017 (375.8 K) and the dashed line shows the potential temperature at the lapse rate tropopoause (for the descent into Kathmandu; 369.8 K). The entire altitude range covered by the aircraft is shown; flight duration was 3.7 hours.

S3 Saturation
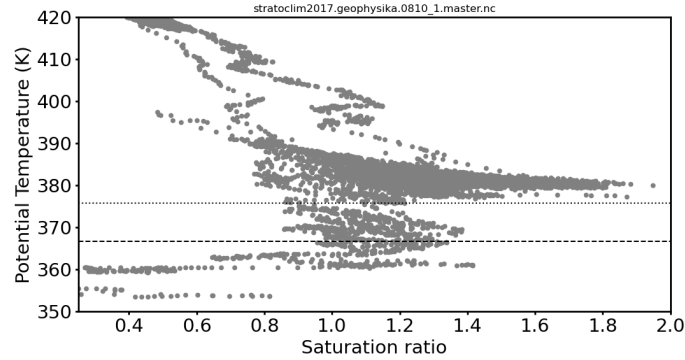
Figure S11: Saturation ratio over ice versus potential temperature for the scientific flight on 10 August 2017 in the vicinity of the cold point and the lapse rate tropopause. Saturation ratio is based on FLASH gas-phase water vapour measurements. The dotted line shows the cold point for this flight (375.8 K) and the dashed line the lapse rate tropopause (366.7 K). Tropopause information is based on data for the first three hours of the flight (see Table 1 in the main paper).