Figure S2a: Same as Fig.2 but for the Asian region (50°E-160°E, 80°N-20°N).
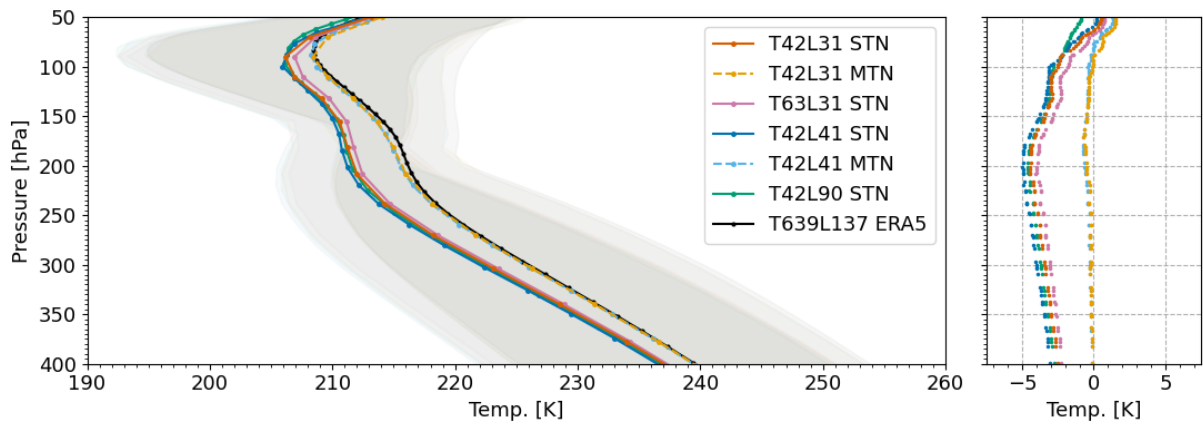
Figure S2b: Same as Fig.2 but for the entire northern hemisphere (80°N-20°N).
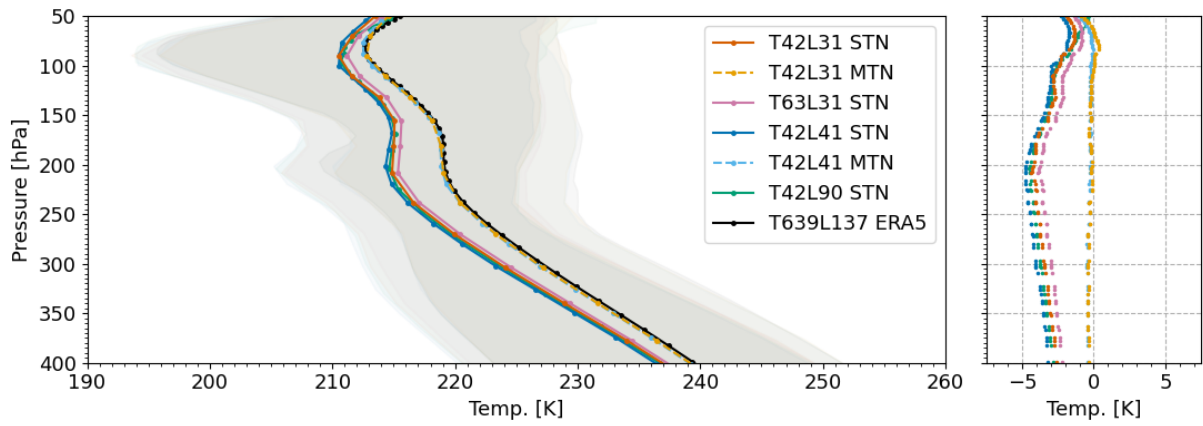
Figure S2c: Same as Fig.2, but for a specific time (26 March 2014, 12 UTC).
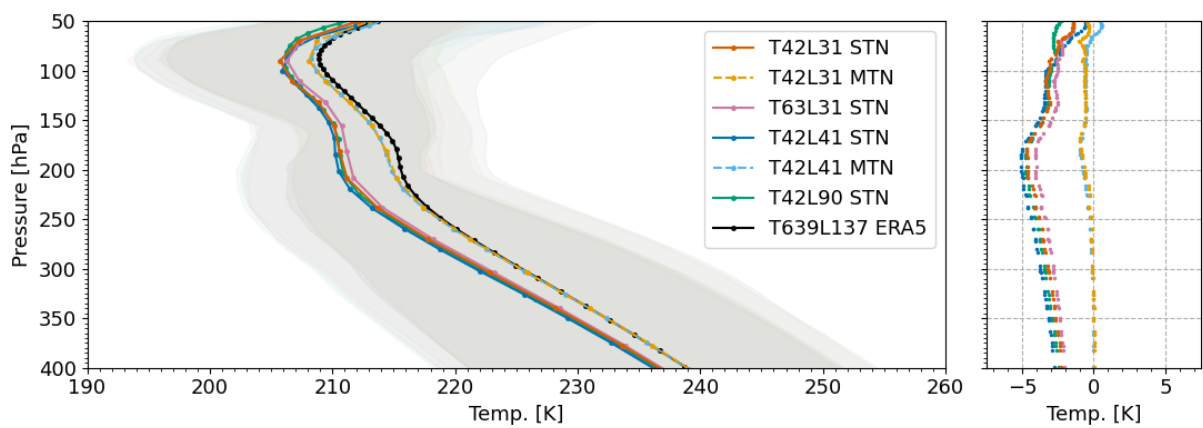
Figure S2d: Same as Fig.2, but for the Asian region (50°E-160°E, 80°N-20°N) and for a specific time (26 March 2014, 12 UTC).
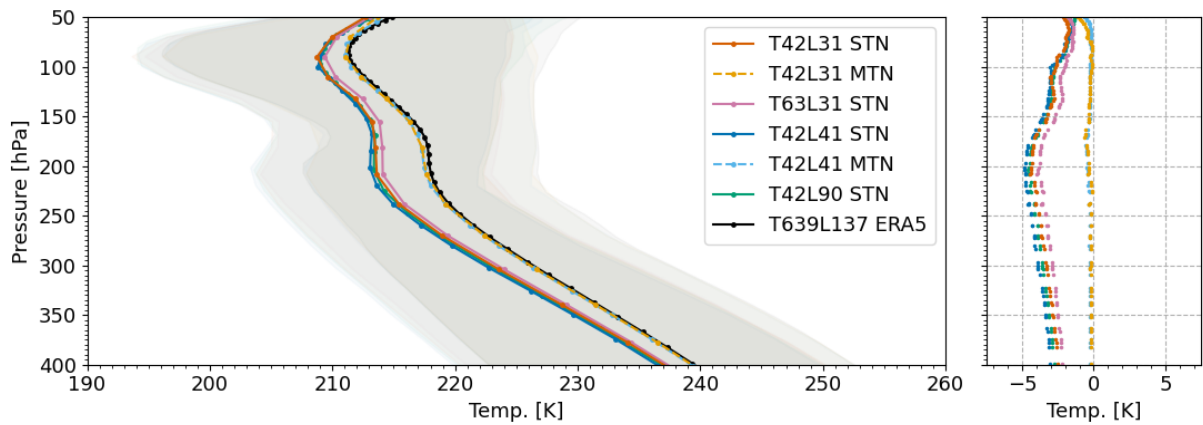
Figure S2e: Same as Fig.2, but for the entire northern hemisphere (80°N-20°N) and for a specific time (26 March 2014, 12 UTC).
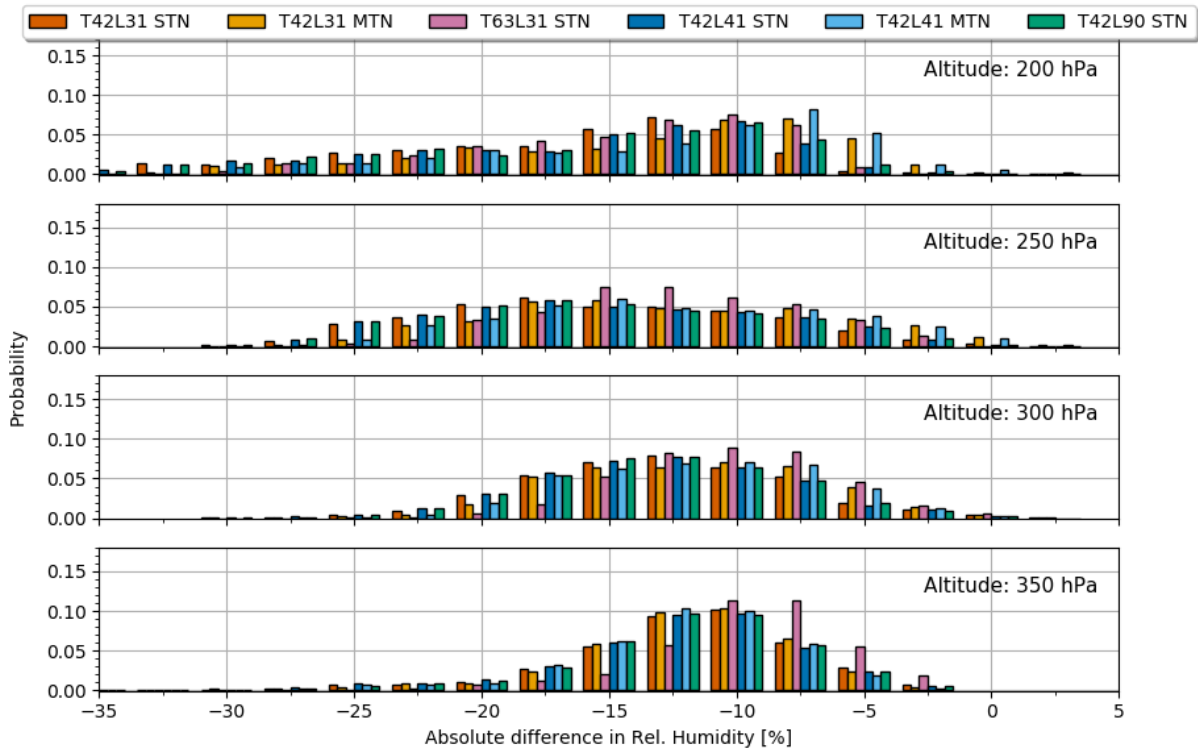
Figure S3a: Same as Fig.3 but for the Asian region (50°E-160°E, 80°N-20°N).
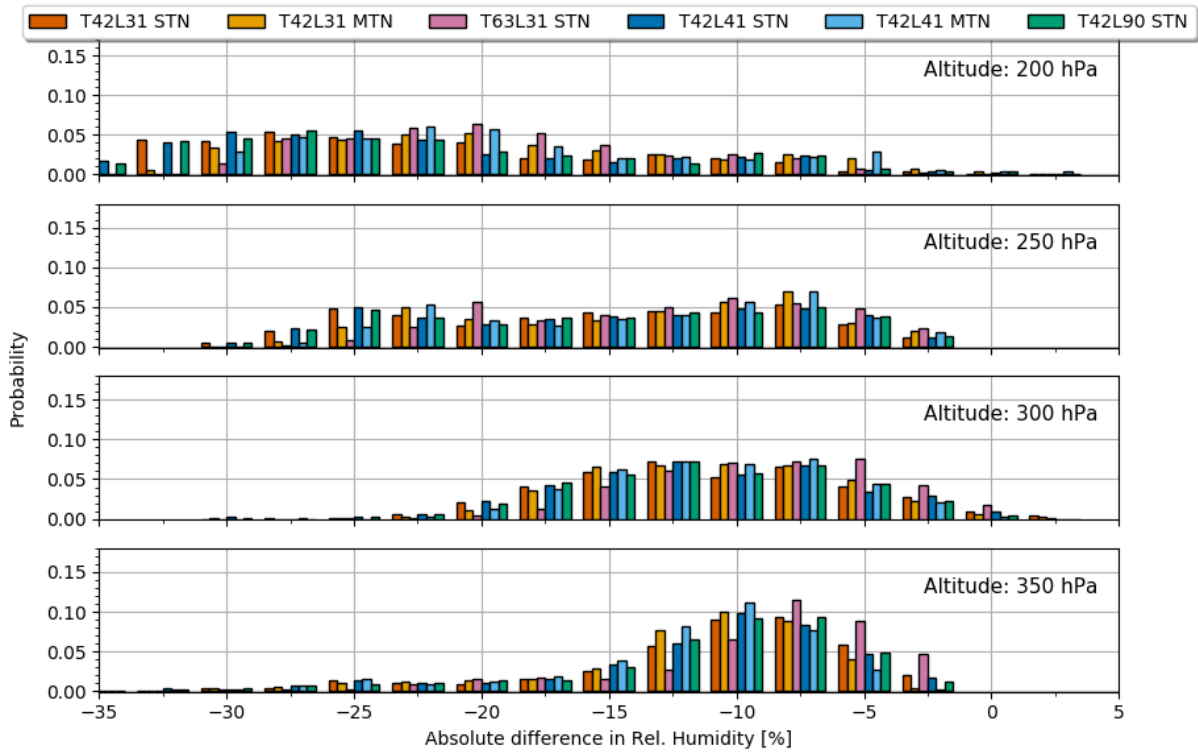
Figure S3b: Same as Fig.3 but for the entire northern hemisphere (80°N-20°N).
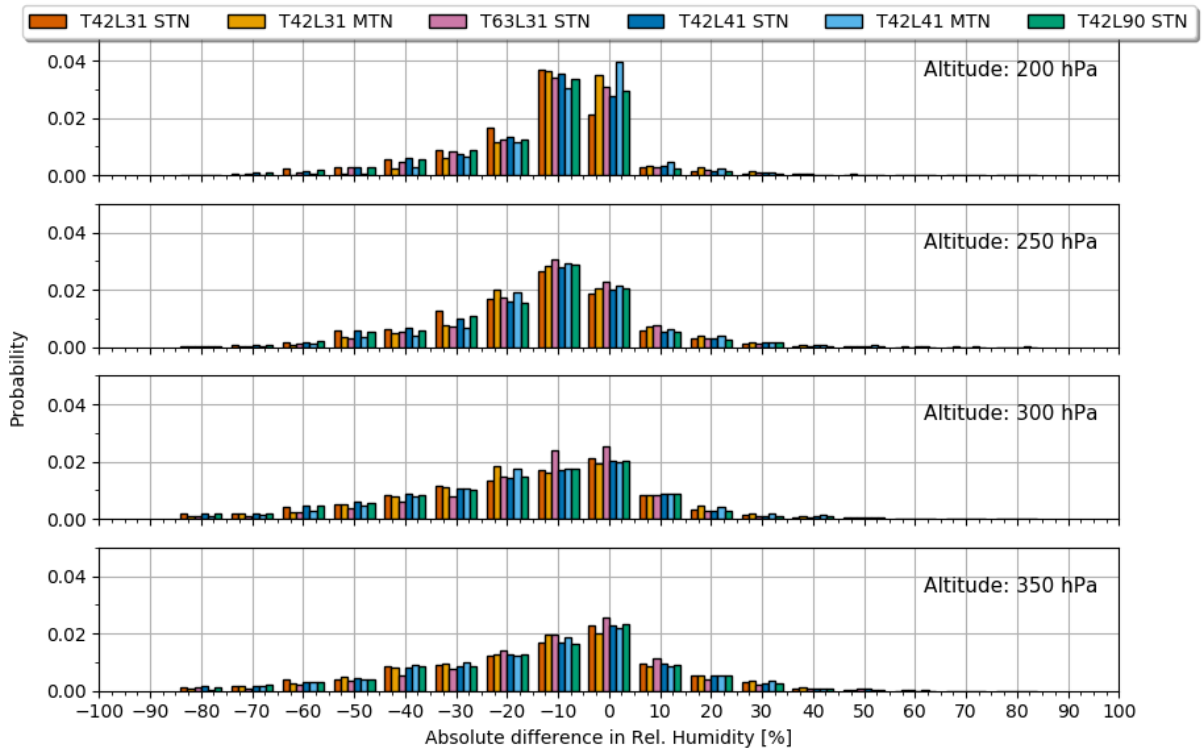
Figure S3c: Same as Fig.3, but for a specific time (26 March 2014, 12 UTC).
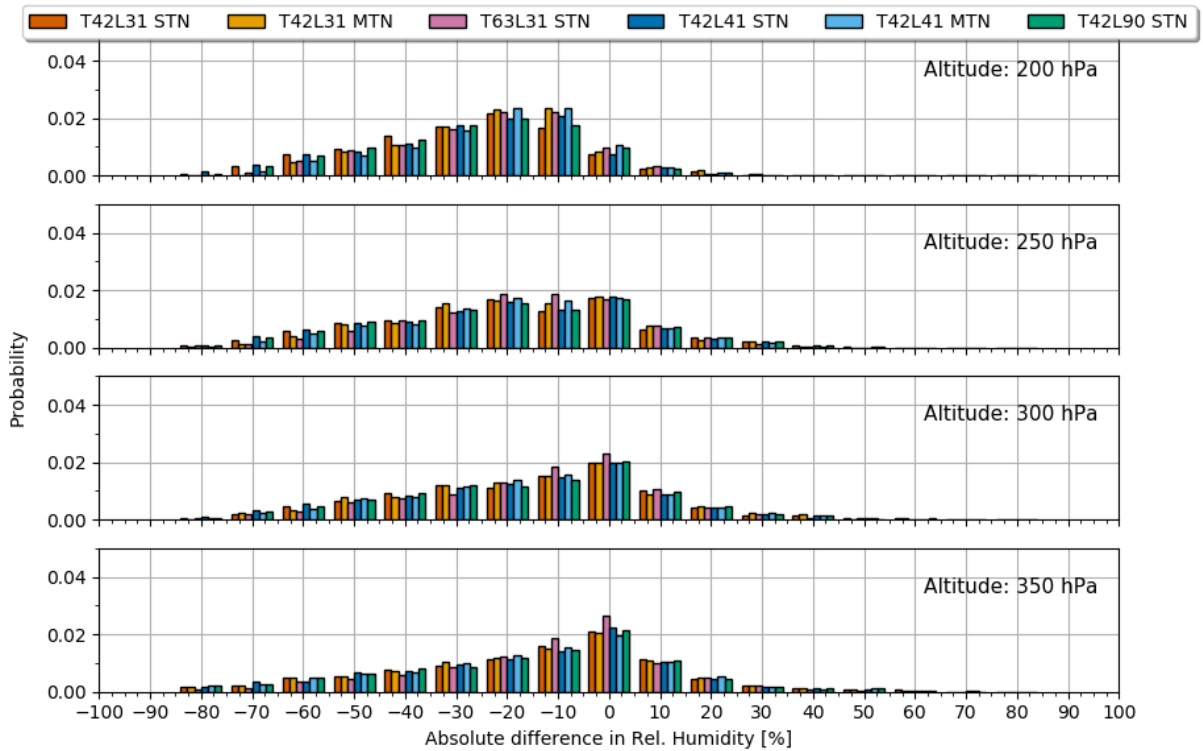
Figure S3d: Same as Fig.3, but for the Asian region (50°E-160°E, 80°N-20°N) and for a specific time (26 March 2014, 12 UTC).
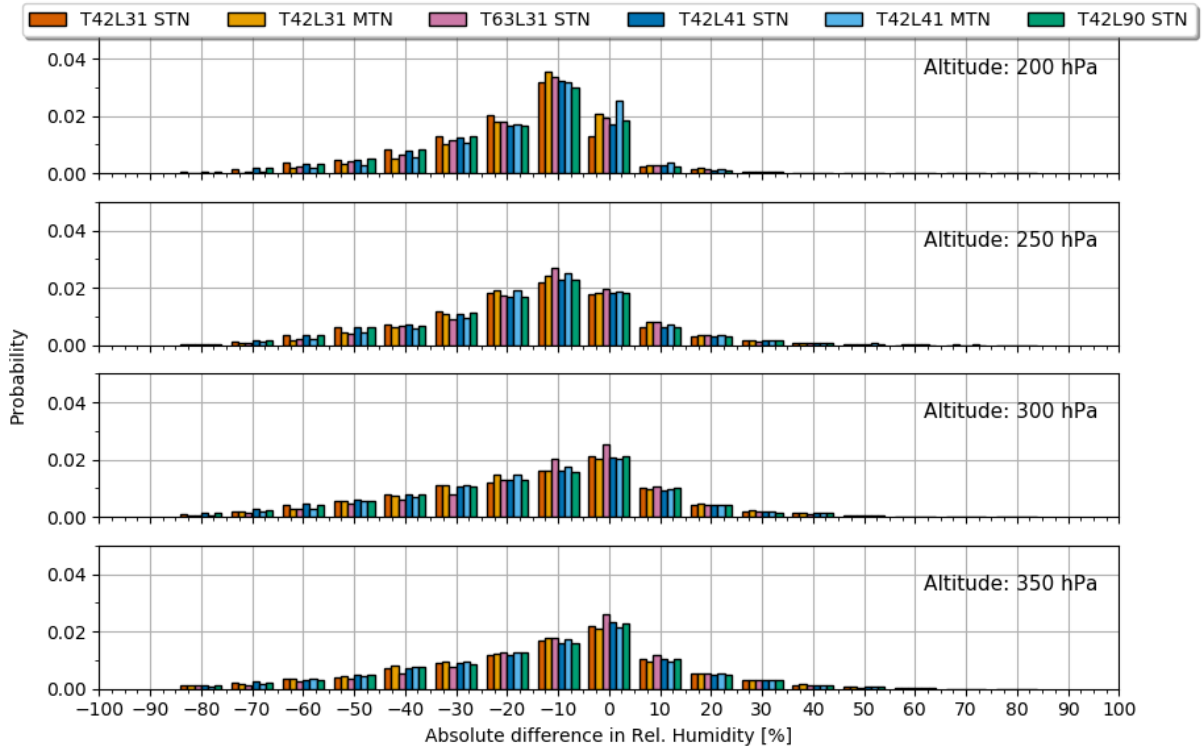
Figure S3e: Same as Fig.3, but for the entire northern hemisphere (80°N-20°N) and for a specific time (26 March 2014, 12 UTC).
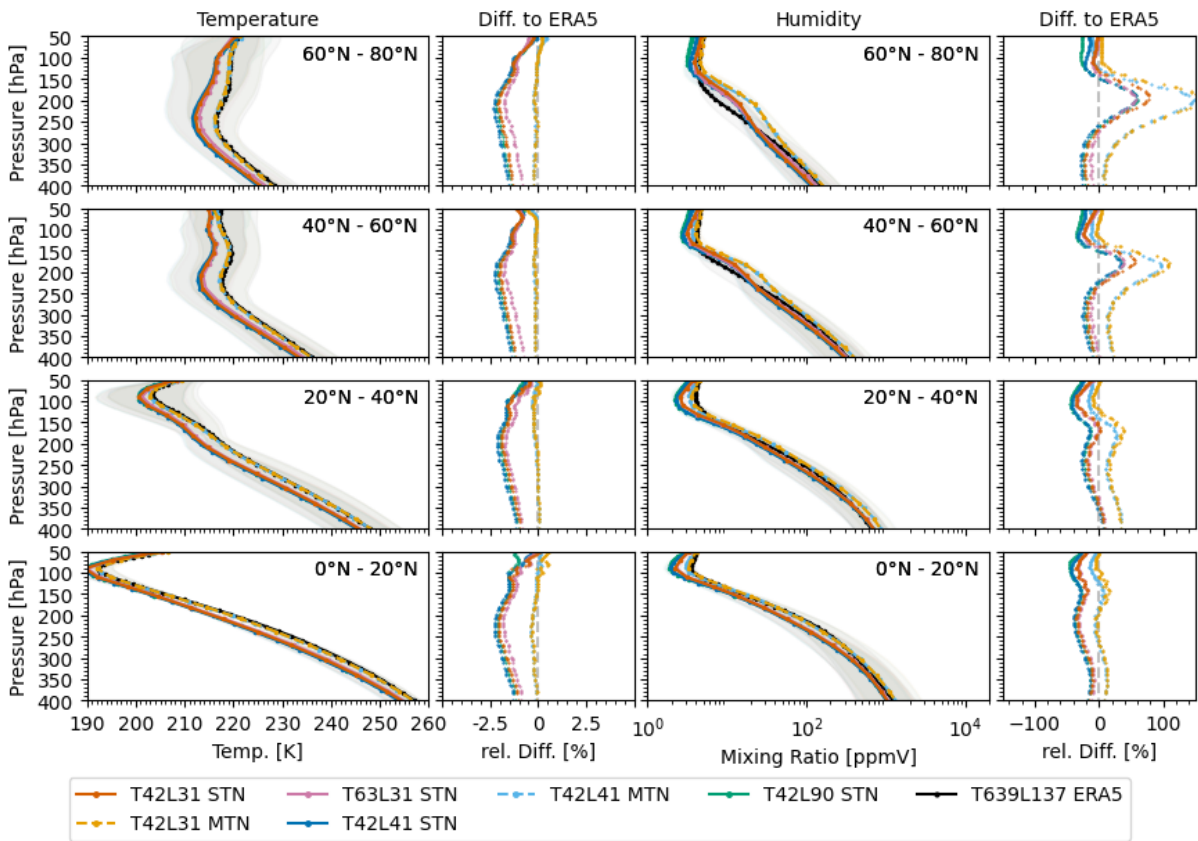
Figure S4a: Same as Fig.4, but for the Asian region (50°E-160°E).
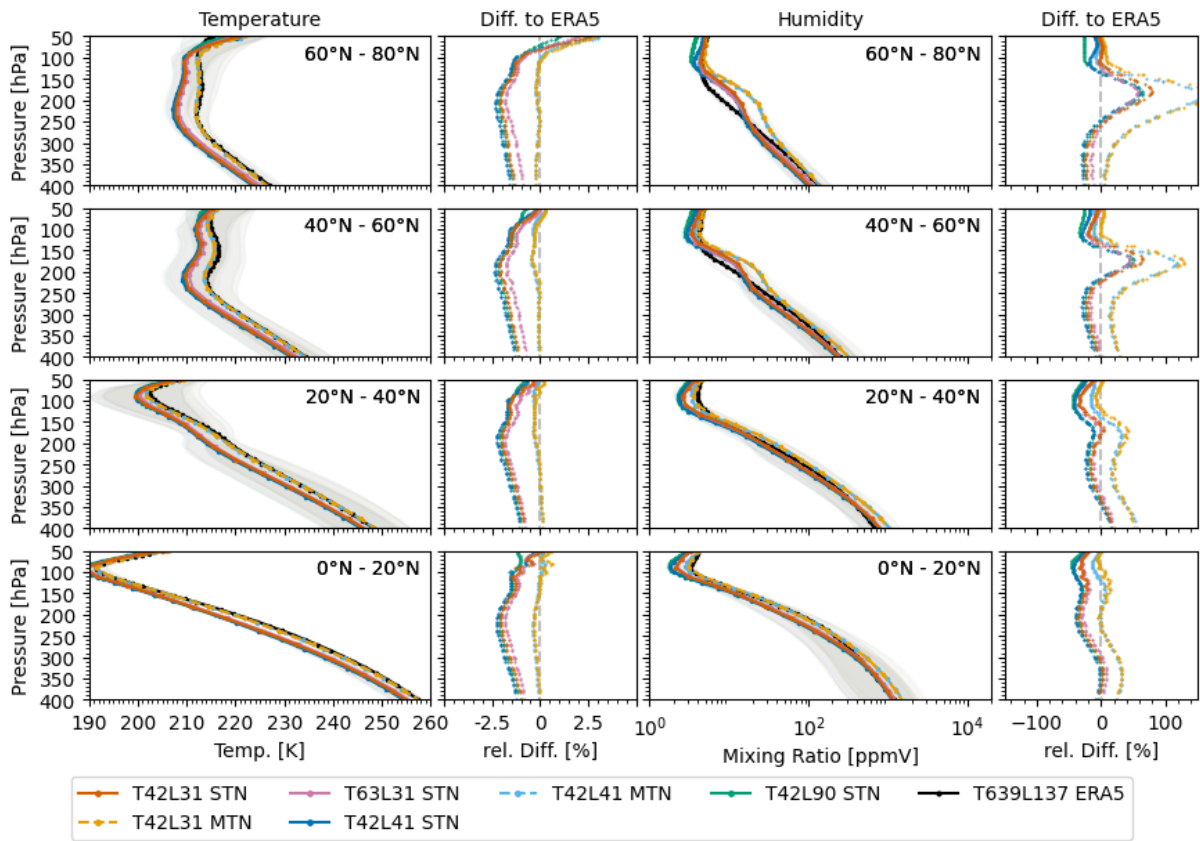
Figure S4b: Same as Fig.4, but for the entire northern hemisphere.
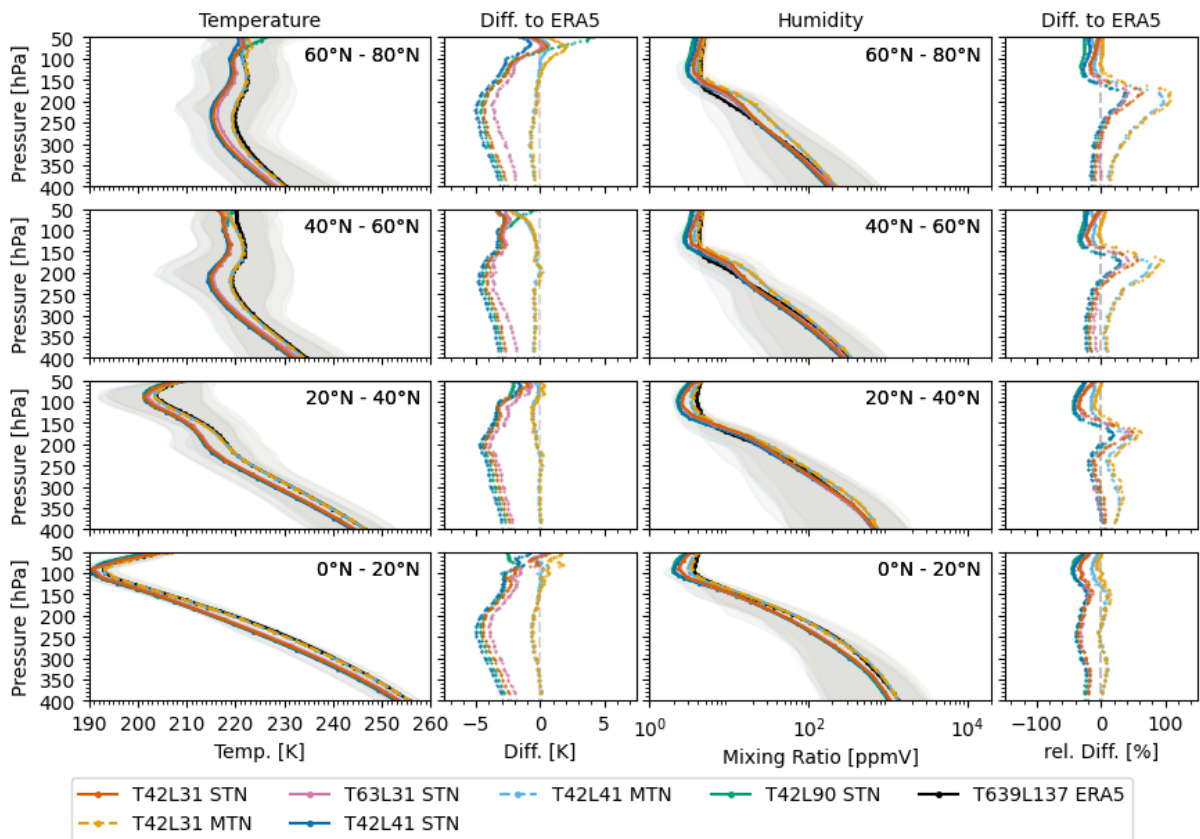
Figure S4c: Same as Fig. 4, but for a specific time (26 March 2014, 12 UTC).
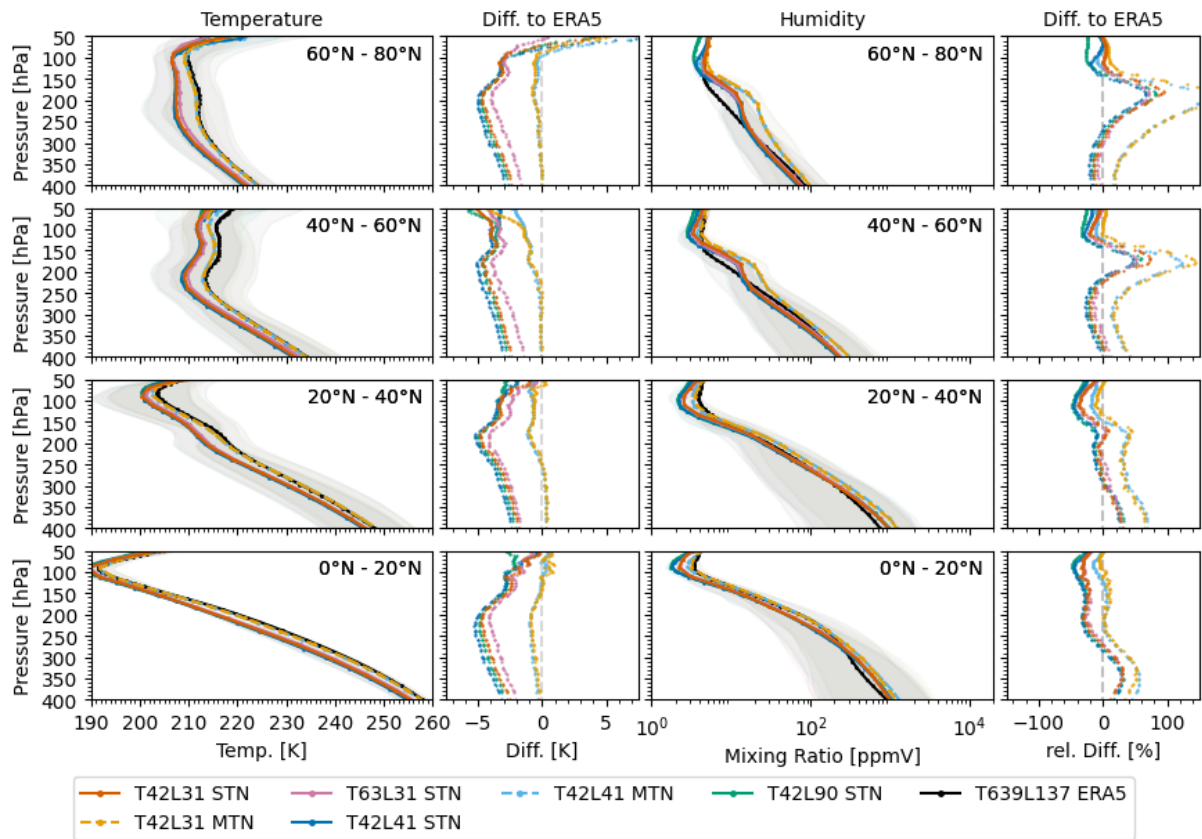
Figure S4d: Same as Fig.4, but for the Asian region (50°E-160°E) and for a specific time (26 March 2014, 12 UTC).
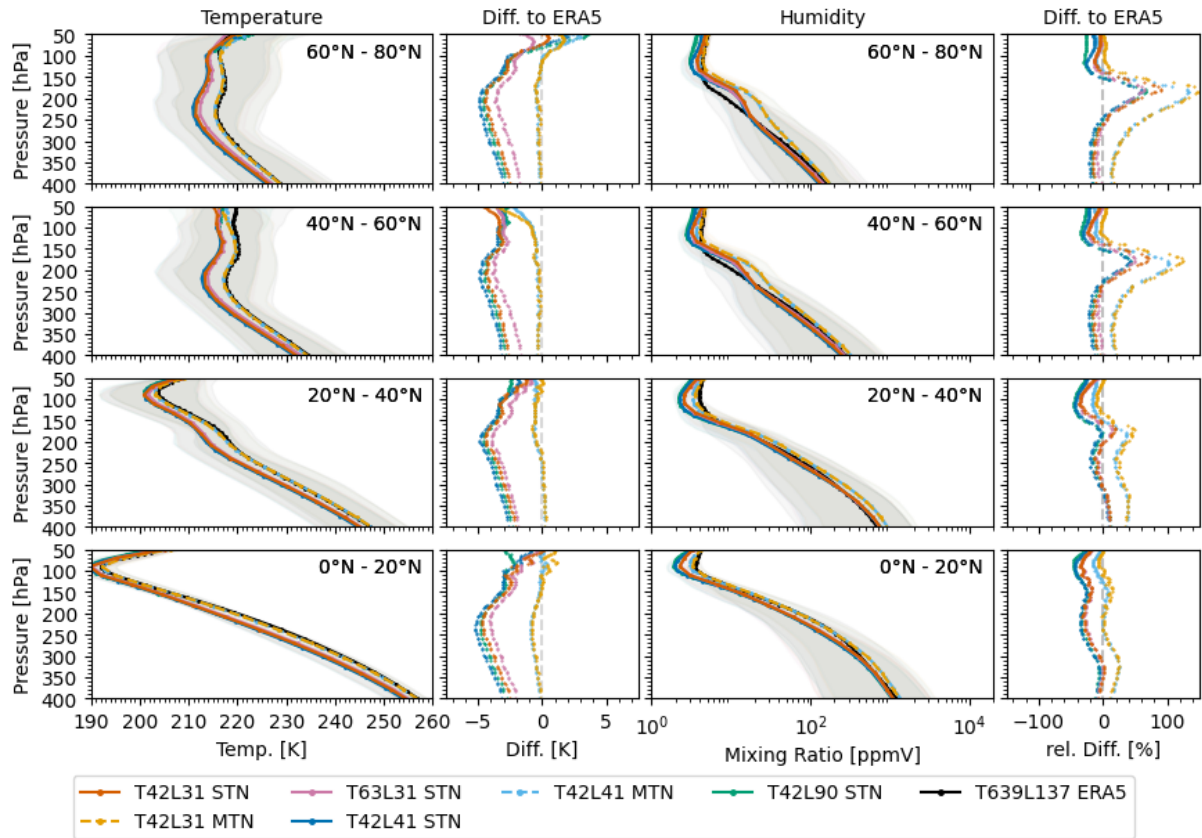
Figure S4e: Same as Fig.4, but for the entire northern hemisphere and for a specific time (26 March 2014, 12 UTC).
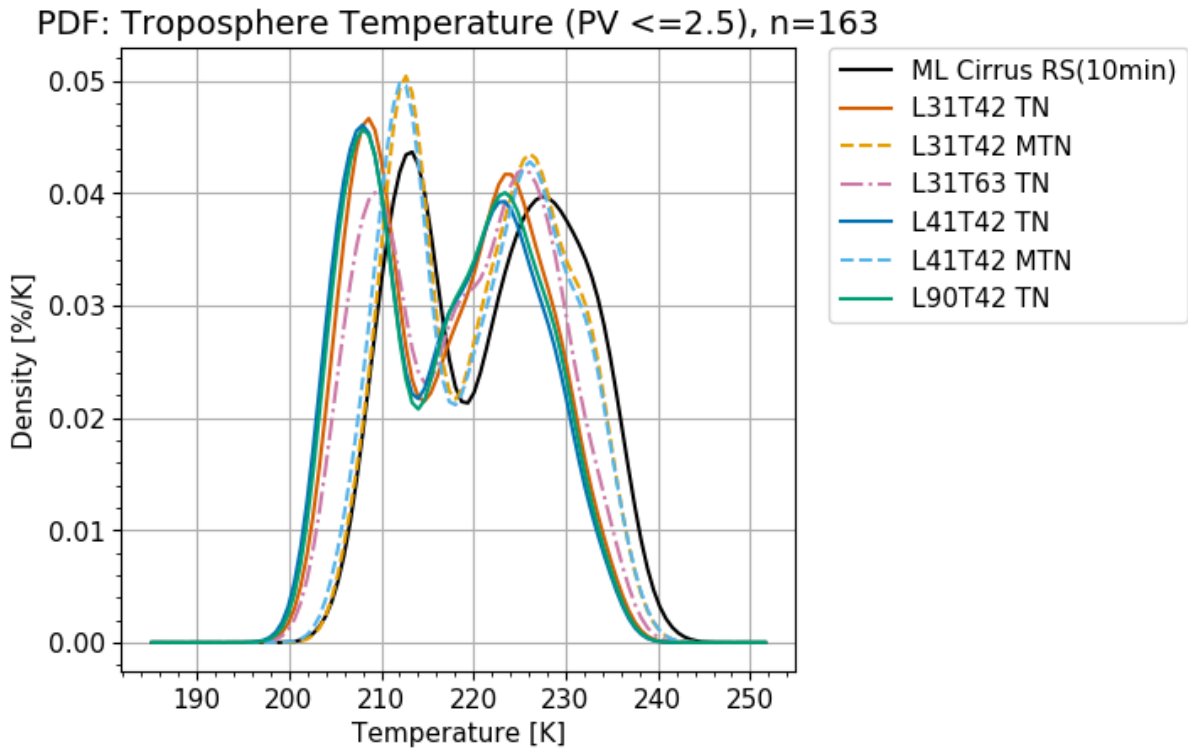
Figure S5a: This figure presents the probability density function (PDF) of tropospheric temperature for potential vorticity (PV) equal to or less than 2.5, with a sample size (n) of 163. The different line styles and colors correspond to various model setups such as resampled ML Cirrus measurement data (10min) and L31T42 (S)TN, L31T42 MTN, L31T63 (S)TN, L41T42 (S)TN, L41T42 MTN, and L90T42 (S)TN EMAC model setups. This plot illustrates the temperature distribution within the stratosphere under the specified conditions during the ML-Cirrus period.
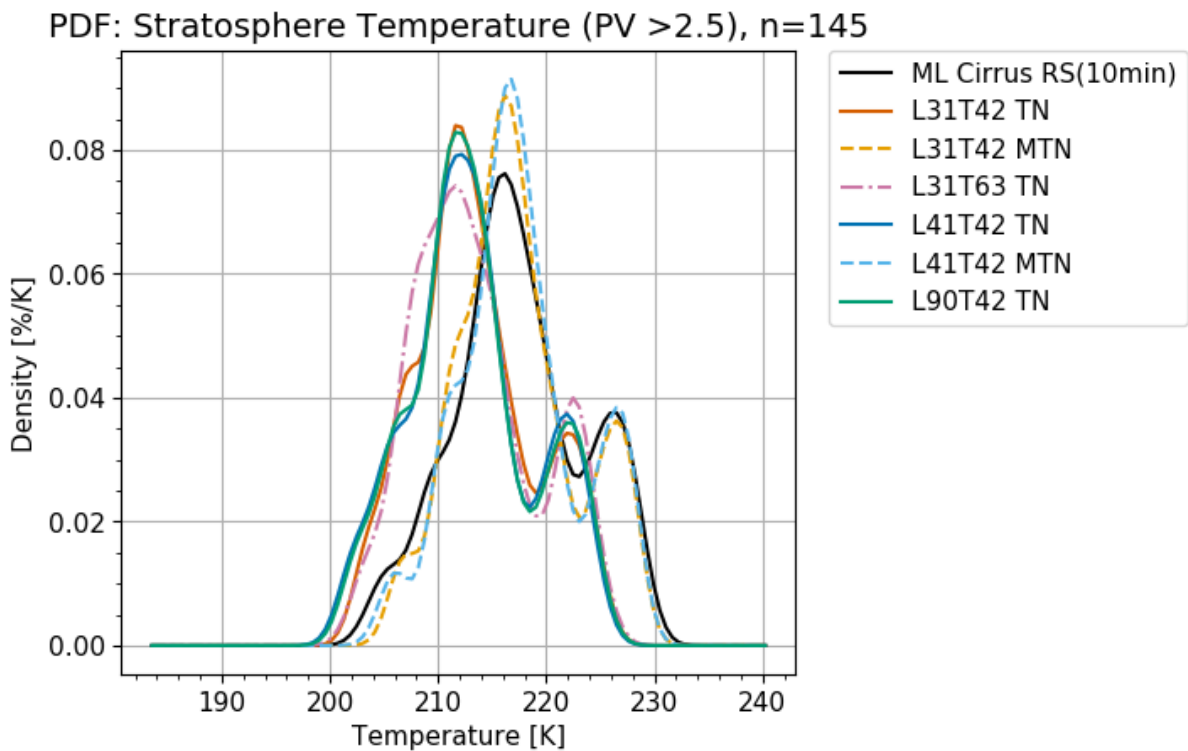
Figure S5b: Same as Fig.S5a, but for the stratosphere (PV greater than 2.5).
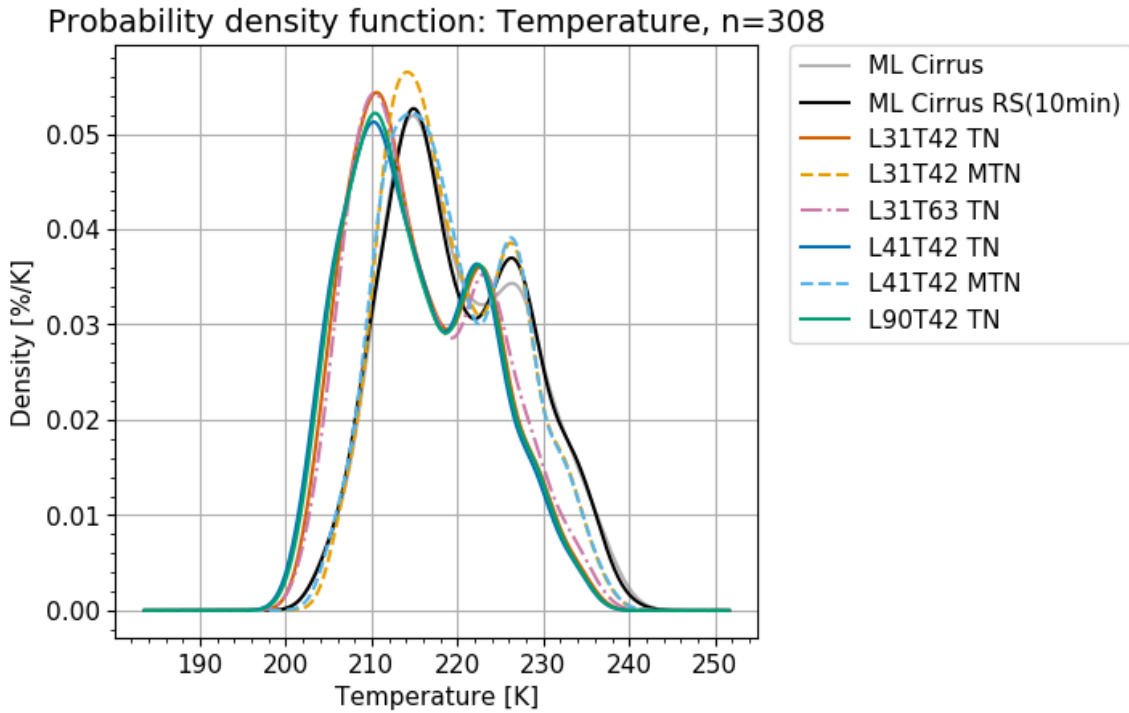
Figure S5c: This plot shows the probability density function (PDF) of temperature with a sample size (n) of 308. Different line styles and colors represent various model setups, including ML Cirrus measurement data, ML Cirrus resampled data (on 10min), as well as EMAC model setups L31T42 (S)TN, L31T42 MTN, L31T63 (S)TN, L41T42 (S)TN, L41T42 MTN, and L90T42 (S)TN. The plot highlights the density distribution of temperatures in different model setups in comparison to observations (ML-Cirrus period).
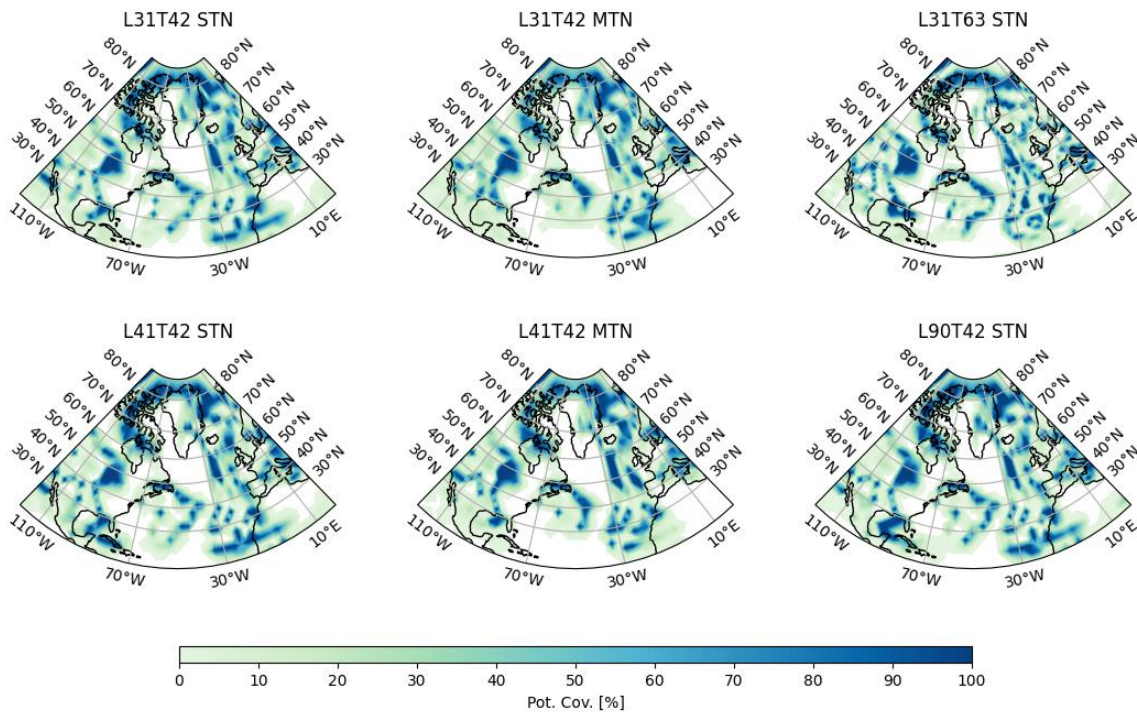
Figure S6a: This figure presents a series of polar plots illustrating the potential coverage percentage across various model setups. Each subplot represents a different setup. The color bar at the bottom indicates the potential coverage percentage, ranging from 0% (light green) to 100% (dark blue), providing a visual representation of coverage density. The maps highlight the differences in potential coverage, as also shown in Table 1, for the NAFC at 300 hPa on 26 March 2014 at 12:00 UTC, revealing significant variations in model outputs.
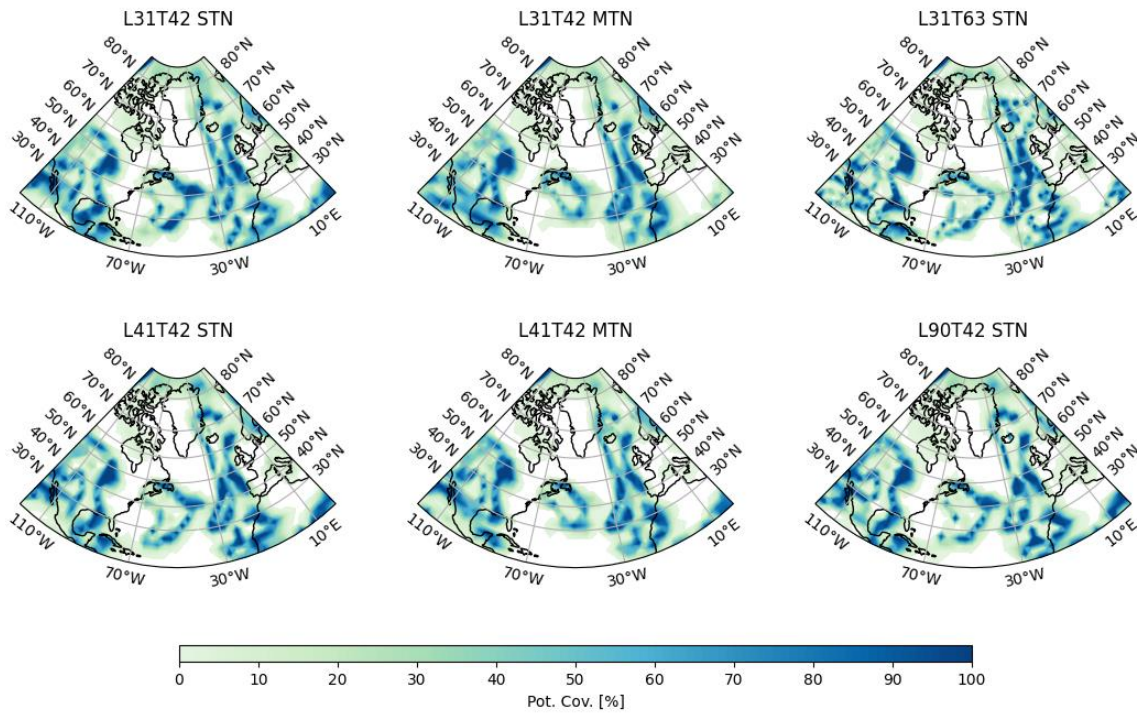
Figure S6b: Same as Fig.S6a, but for 250 hPa.
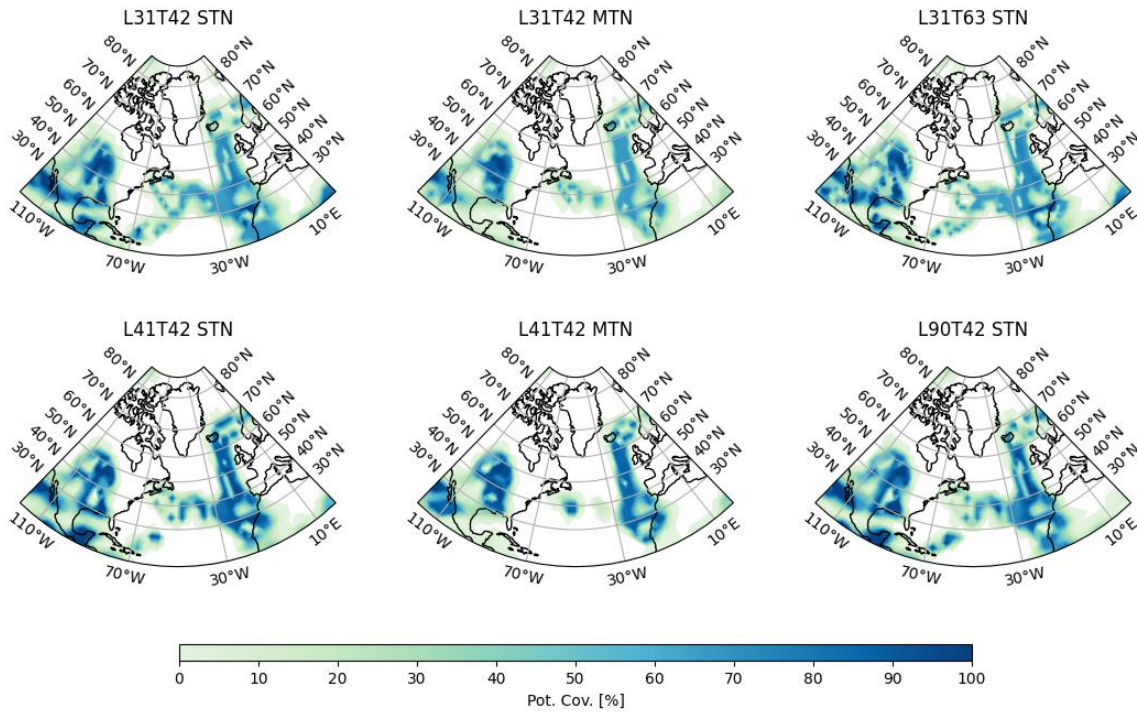
Figure S6c: Same as Fig.S6a, but for 200 hPa.

Table S1a: Same as Table 1, but for the Asian region (50°E-160°E, 80°N-20°N).

Region: 50°E 160°E 80°N 20°N	T42L31 STN	T42L31 MTN	T63L31 STN	T42L41 STN	T42L41 MTN	T42L90 STN	ERA5
Height: 250 hPa							
Cov. Area (ISSR)							
RH_{ice} > 90 / 95 / 100 [%]	30 / 26 / 14	27 / 22 / 9	30 / 25 / 13	32 / 27 / 15	29 / 24 / 11	32 / 27 / 15	16 / 13 / 7
Cov. Area (PotCov)							
GBA (total) [%]	24 (59)	23 (61)	23 (61)	25 (58)	25 (60)	25 (60)	
AWM PotCov [frac]	0.42	0.39	0.39	0.45	0.43	0.44	
Height: 300 hPa							
Cov. Area (ISSR)							
RH_{ice} > 90 / 95 / 100 [%]	37 / 31 / 18	32 / 27 / 15	35 / 30 / 17	39 / 34 / 19	32 / 28 / 16	38 / 33 / 20	19 / 15 / 8
Cov. Area (PotCov)							
GBA (total) [%]	22 (55)	21 (57)	21 (55)	23 (55)	21 (52)	22 (57)	
AWM PotCov [frac]	0.42	0.40	0.41	0.44	0.43	0.42	
Height: 350 hPa							
Cov. Area (ISSR)							
RH_{ice} > 90 / 95 / 100 [%]	24 / 21 / 12	20 / 16 / 9	23 / 19 / 11	24 / 21 / 13	19 / 16 / 9	24 / 21 / 12	14 / 11 / 7
Cov. Area (PotCov)							
GBA (total) [%]	15 (40)	15 (37)	16 (39)	16 (43)	14 (40)	15 (42)	
AWM PotCov [frac]	0.41	0.42	0.43	0.41	0.40	0.39	
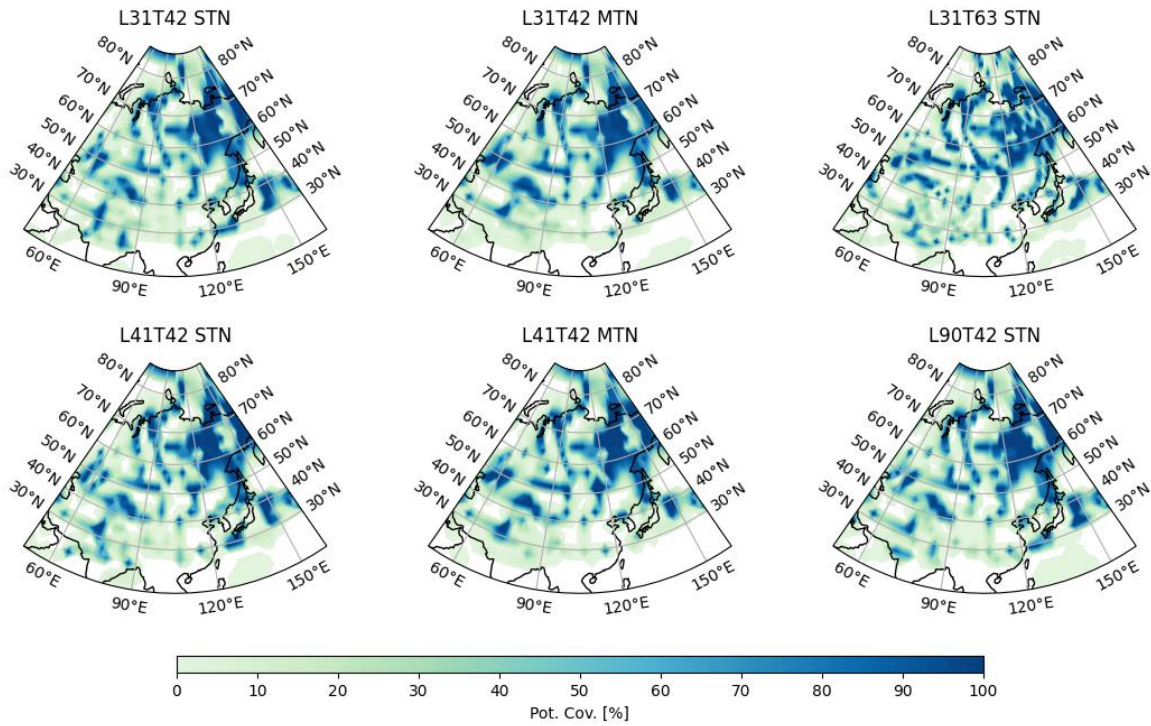
Figure S6d: Same as Fig.S6a, but for the Asian region (50°E-160°E, 80°N-20°N), Table S1a.
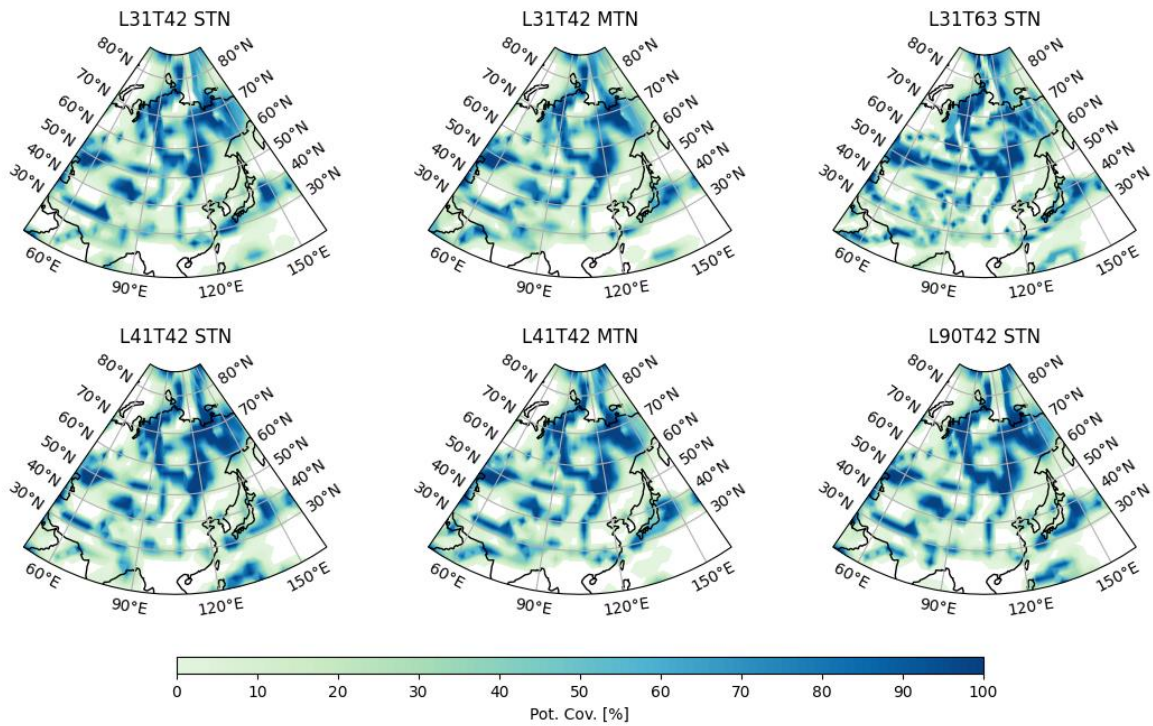
Figure S6e: Same as Fig.S6d, but for 250 hPa.
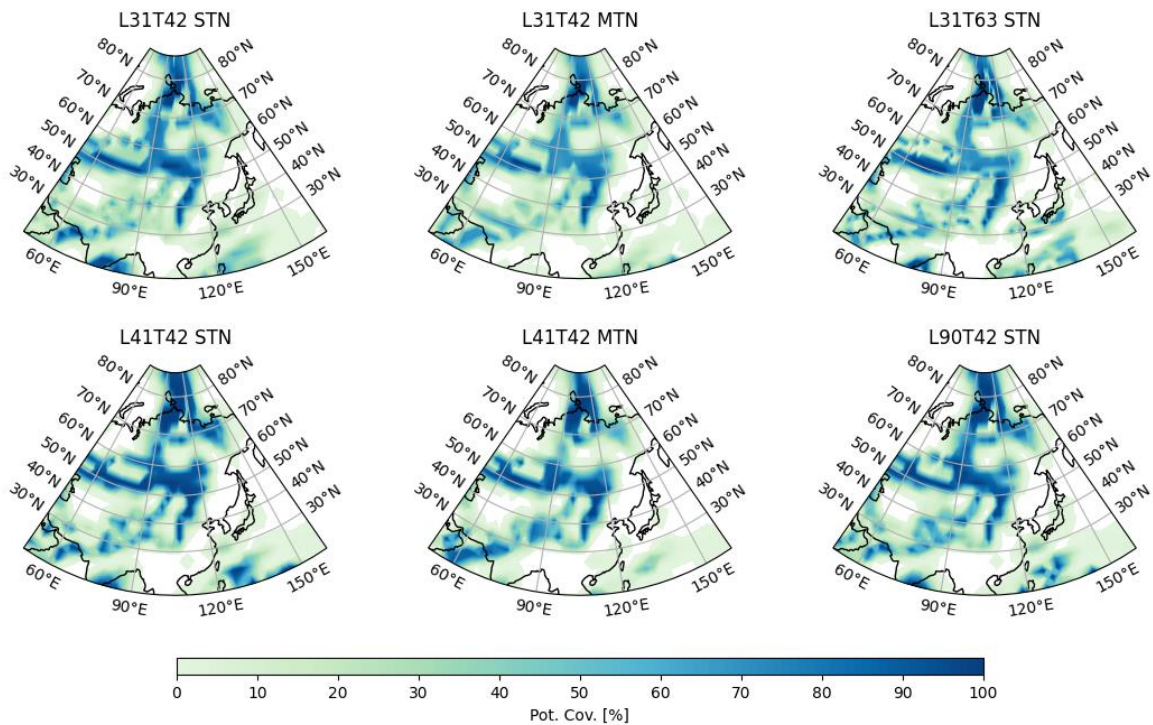
Figure S6f: Same as Fig.S6d, but for 200 hPa.

Table S1b: Same as Table 1, but for the entire northern hemisphere (80°N-20°N).

Region: 180°W 180°E 80°N 20°N	T42L31 STN	T42L31 MTN	T63L31 STN	T42L41 STN	T42L41 MTN	T42L90 STN	ERA5
Height: 250 hPa							
Cov. Area (ISSR)							
$RH_{ice} > 90 / 95 / 100$ [%]	25 / 21 / 10	20 / 16 / 6	25 / 21 / 10	27 / 22 / 11	21 / 17 / 7	27 / 23 / 12	17 / 14 / 8
Cov. Area (PotCov)							
GBA (total) [%]	23 (63)	22 (62)	21 (61)	23 (59)	22 (58)	23 (62)	
AWM PotCov [frac]	0.36	0.35	0.35	0.39	0.39	0.37	
Height: 300 hPa							
Cov. Area (ISSR)							
$RH_{ice} > 90 / 95 / 100$ [%]	33 / 27 / 15	26 / 21 / 11	31 / 26 / 14	35 / 30 / 17	26 / 22 / 12	33 / 29 / 18	17 / 14 / 8
Cov. Area (PotCov)							
GBA (total) [%]	21 (61)	19 (62)	19 (59)	22 (57)	19 (57)	22 (60)	
AWM PotCov [frac]	0.35	0.33	0.35	0.40	0.36	0.38	
Height: 350 hPa							
Cov. Area (ISSR)							
$RH_{ice} > 90 / 95 / 100$ [%]	22 / 19 / 11	17 / 14 / 8	20 / 17 / 10	22 / 19 / 12	17 / 14 / 8	22 / 19 / 12	12 / 10 / 6
Cov. Area (PotCov)							
GBA (total) [%]	14 (43)	14 (40)	14 (42)	15 (46)	14 (42)	15 (46)	
AWM PotCov [frac]	0.36	0.36	0.37	0.36	0.36	0.35	
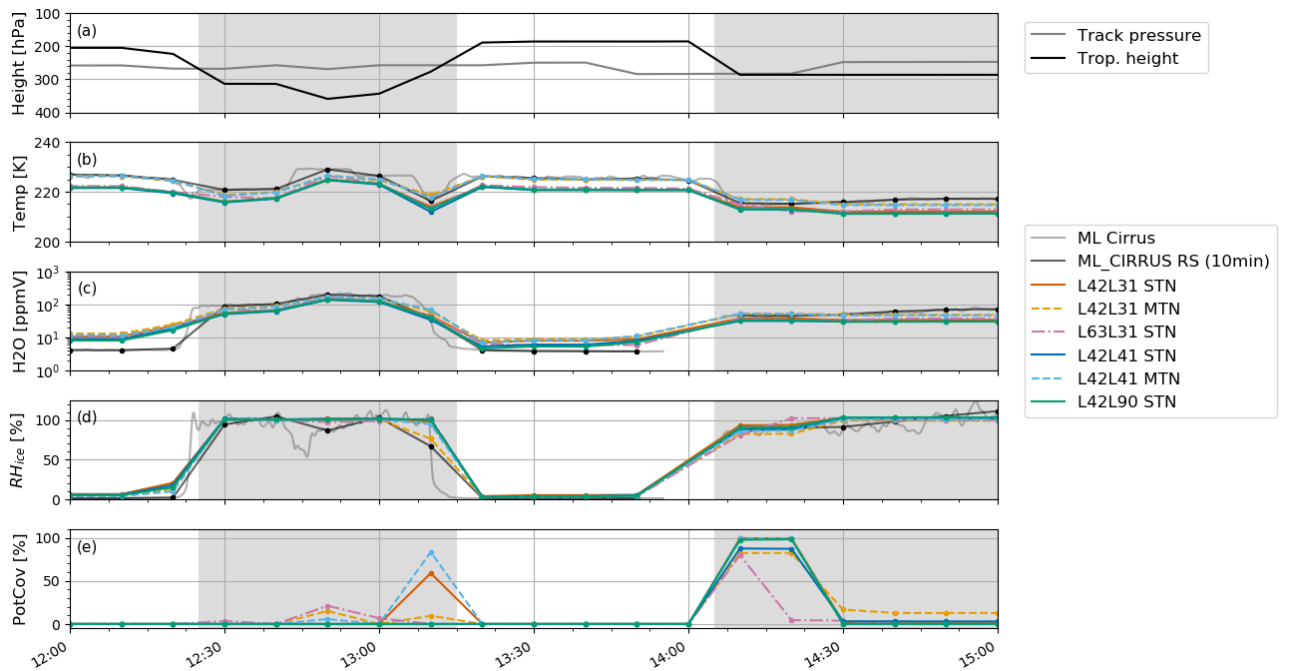
Figure S8a: Same as Fig.8, but for March 27 2014.
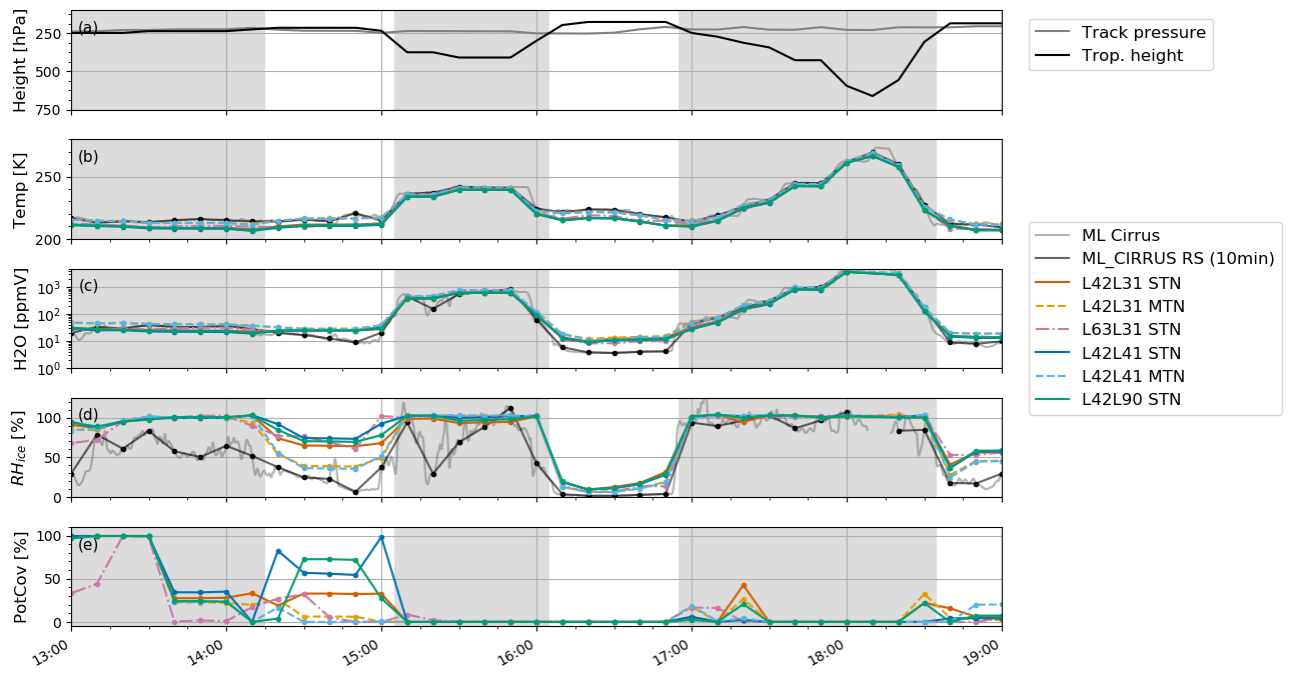
Figure S8b: Same as Fig.8, but for March 29 2014.
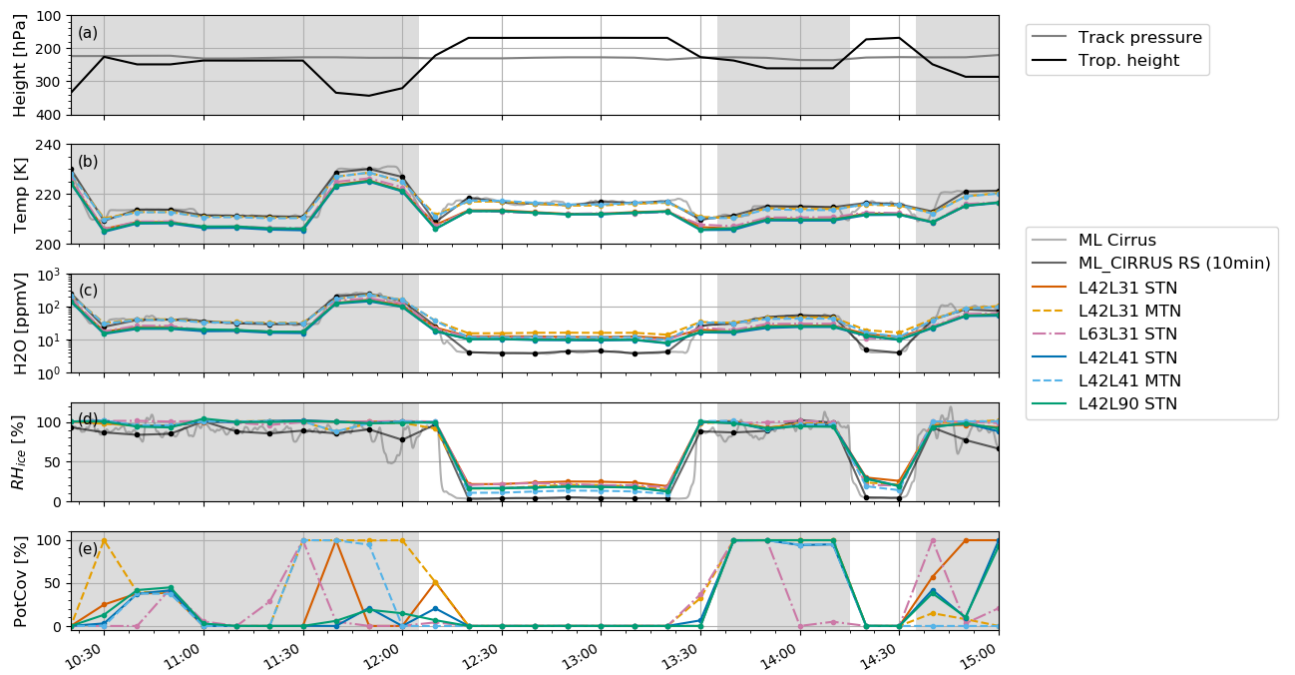
Figure S8c: Same as Fig.8, but for April 01 2014.
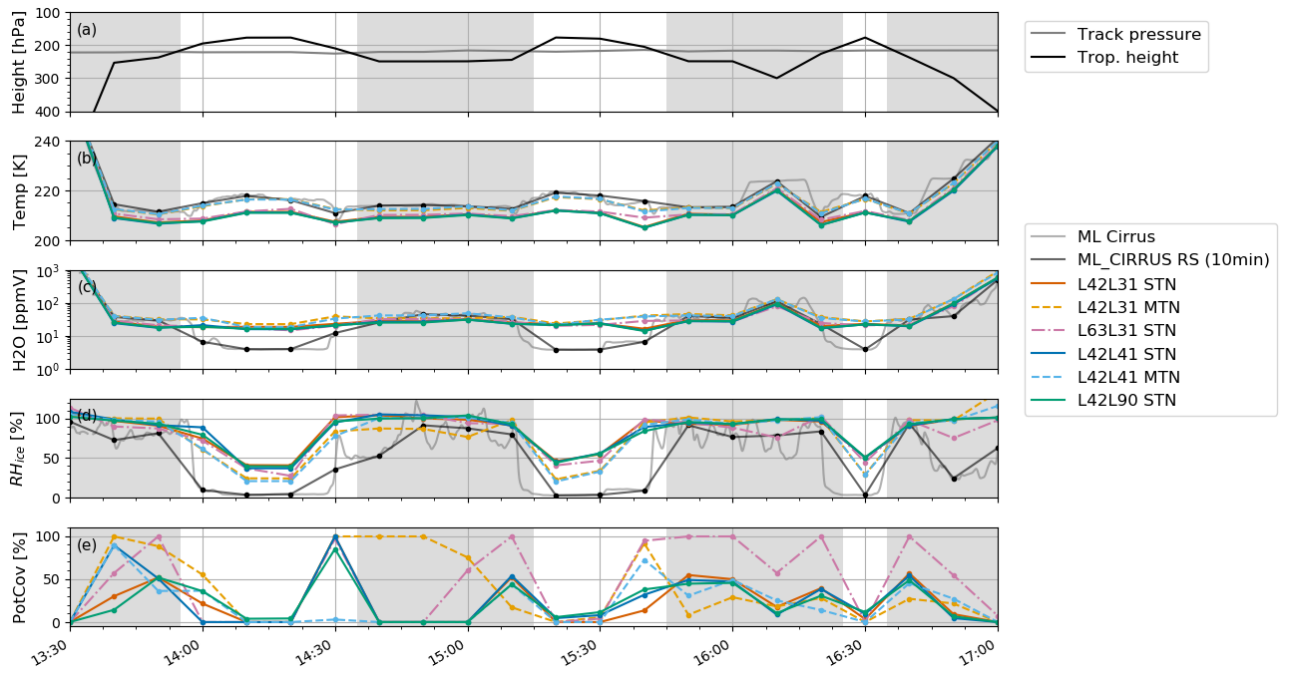
Figure S8d: Same as Fig.8, but for April 03 2014.
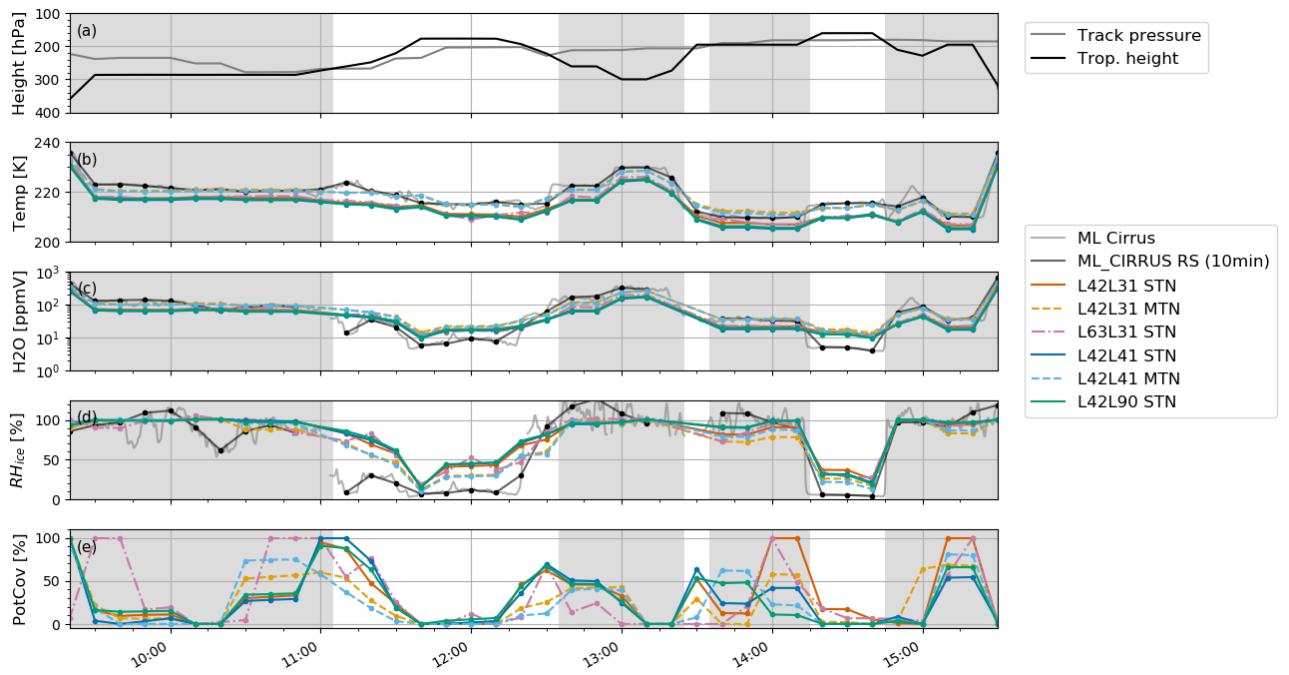
Figure S8e: Same as Fig.8, but for April 04 2014.
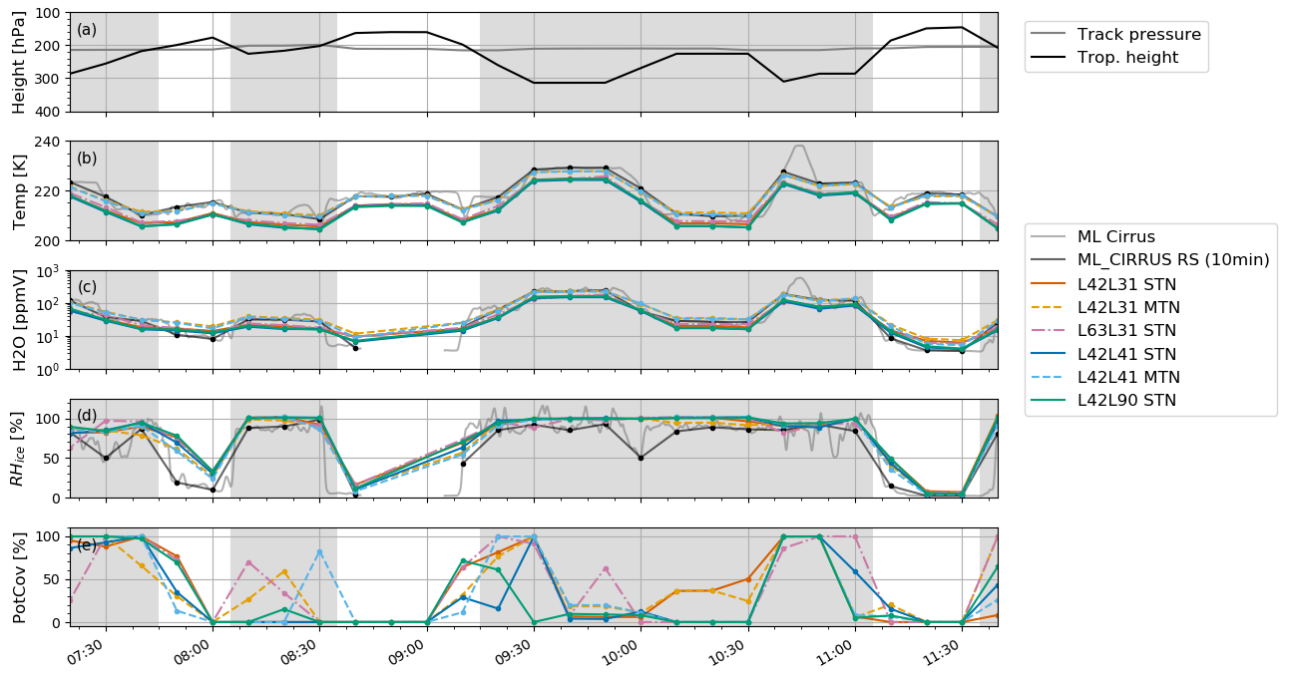
Figure S8f: Same as Fig.8, but for April 07 2014.
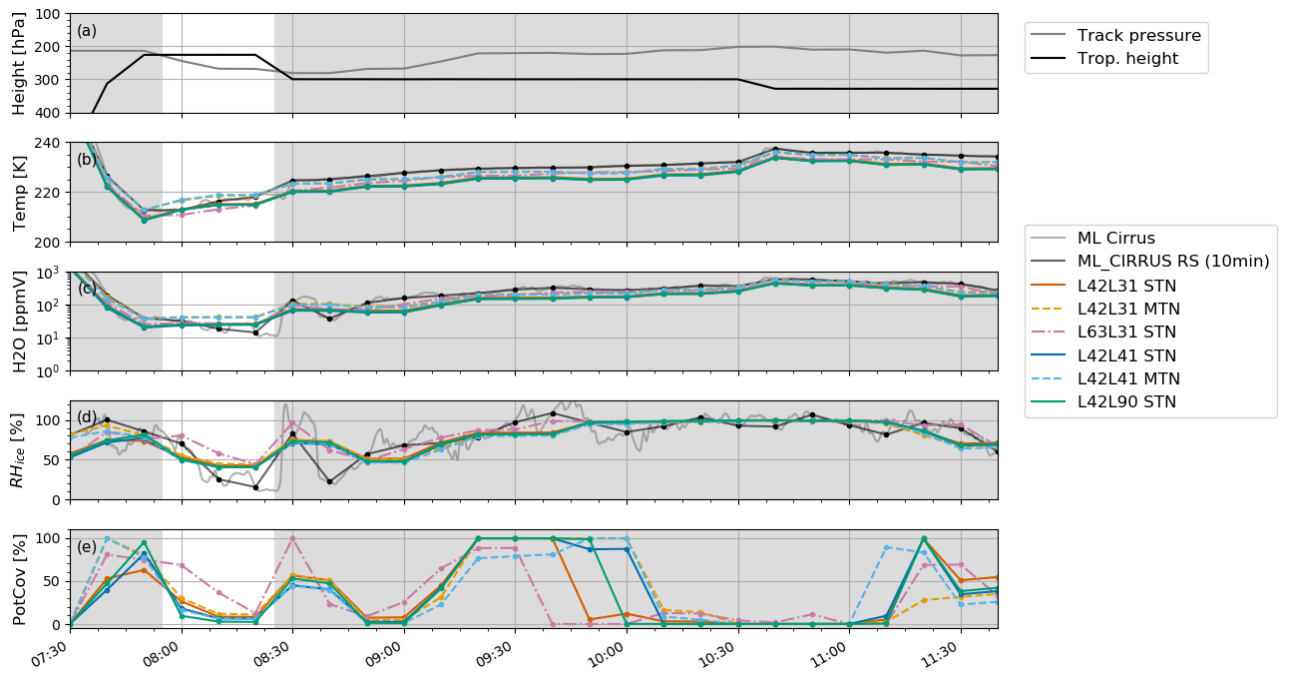
Figure S8g: Same as Fig.8, but for April 11 2014.
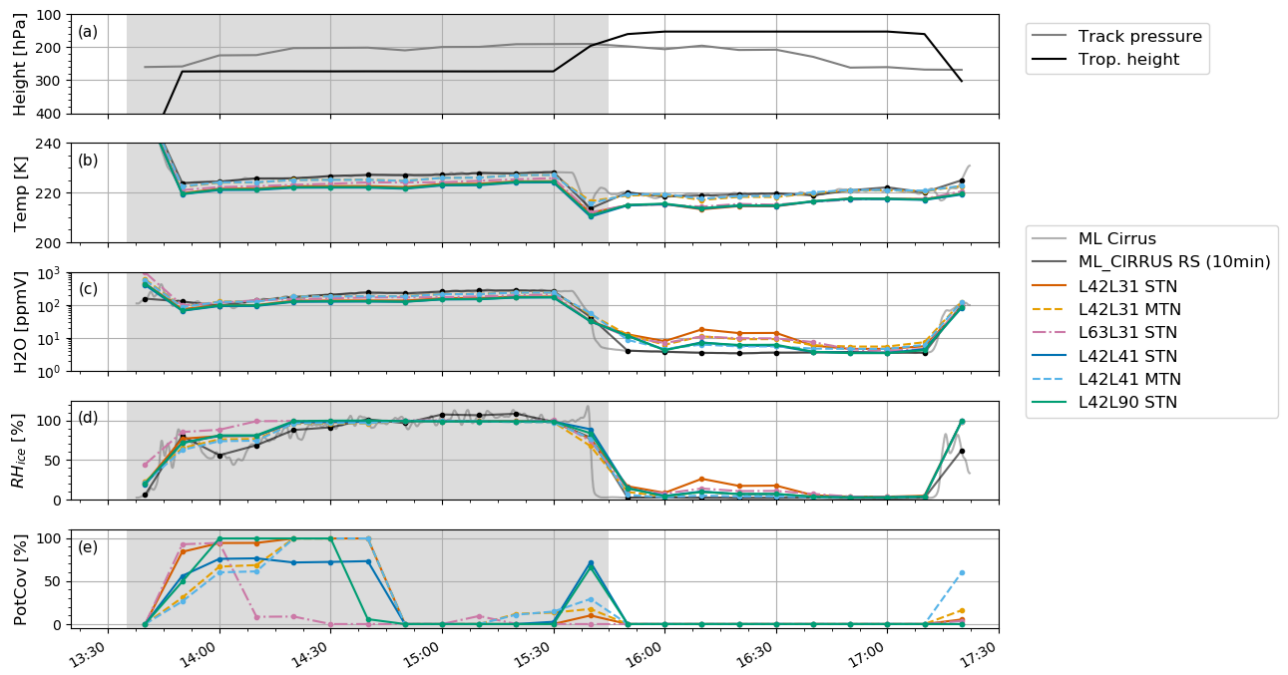
Figure S8h: Same as Fig.8, but for April 11 2014.
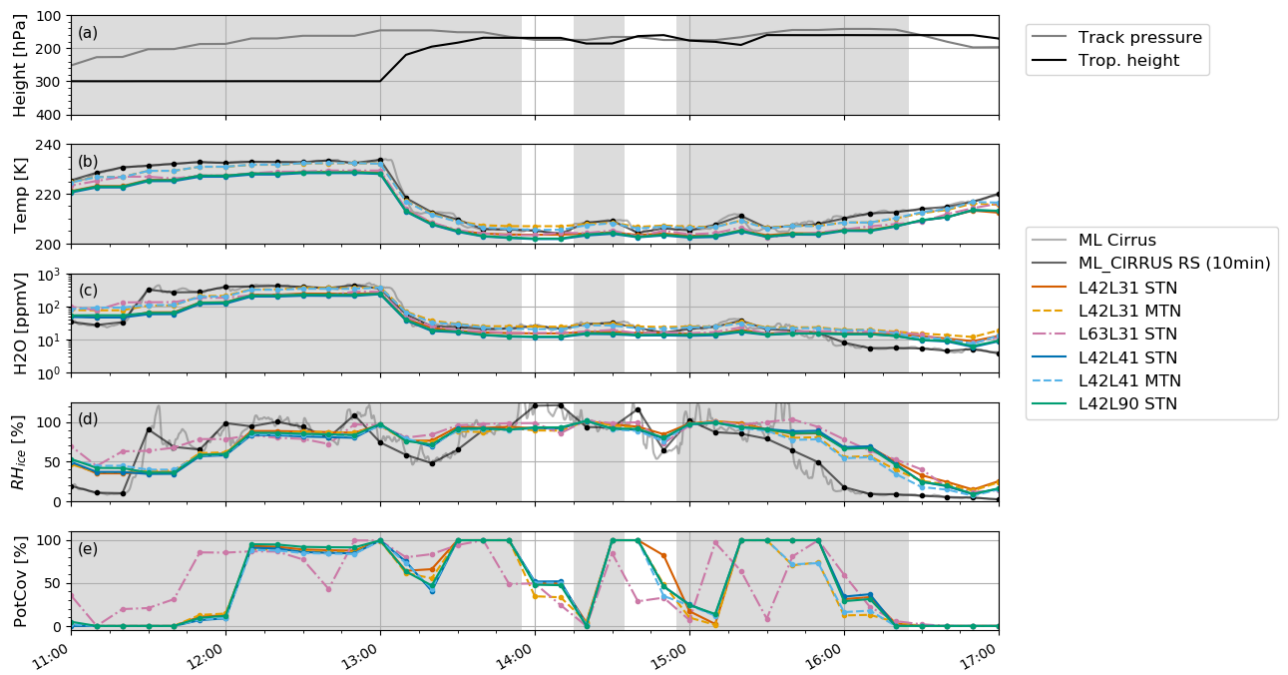
Figure S8i: Same as Fig.8, but for April 13 2014.