



## Supplement of

## Influence of temperature and humidity on contrail formation regions in the general circulation model EMAC: a spring case study

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Figure S1: Same as Fig.2 but for the Asian region (50°E-160°E, 80°N-20°N).



Figure S2: Same as Fig.2 but for the entire northern hemisphere (80°N-20°N).



Figure S3: Same as Fig.2, but for a specific time (26 March 2014, 12 UTC).



Figure S4: 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 S5: 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 S6: Same as Fig.3 but for the Asian region (50°E-160°E, 80°N-20°N).



Figure S7: Same as Fig.3 but for the entire northern hemisphere (80°N-20°N).



Figure S8: Same as Fig.3, but for a specific time (26 March 2014, 12 UTC).



Figure S9: 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 S10: 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 S11: Same as Fig.4, but for the Asian region (50°E-160°E).



Figure S12: Same as Fig.4, but for the entire northern hemisphere.



Figure S13: Same as Fig. 4, but for a specific time (26 March 2014, 12 UTC).



Figure S14: Same as Fig.4, but for the Asian region (50°E-160°E) and for a specific time (26 March 2014, 12 UTC).



*Figure S15: Same as Fig.4, but for the entire northern hemisphere and for a specific time (26 March 2014, 12 UTC).* 



Figure S16: Probability distributions of relative humidity over ice (%) for the different model setups and ERA5 at four specific pressure levels (200 hPa, 250 hPa, 300 hPa, and 350 hPa) in the extended NAFC region for March and April 2014. The black histograms at the top show ERA5 data, while the colored histograms correspond to various EMAC configurations (T42L31, T63L31, T42L41, and T42L90) with standard (STN) and mean (MTN) temperature nudging. The ERA5 data exhibit a bimodal distribution with a pronounced peak near 0–5% RH and a secondary peak around 50%. By contrast, the EMAC simulations tend to shift toward higher RH values, especially at the lower pressure levels, although the magnitude of this shift varies among the different EMAC setups. Such systematic differences in upper-tropospheric humidity can impact contrail formation, underlining the importance of accurately capturing these distributions in global models.



Figure S17: Same as Fig.16 but for the Asian region (50°E-160°E, 80°N-20°N).



Figure S18: Same as Fig.16 but for the entire northern hemisphere (80°N-20°N).



Figure S19: Same as Fig.S16, for a specific time (26 March 2014, 12 UTC).



Figure S20: Same as Fig.16, but for the Asian region (50°E-160°E, 80°N-20°N) and for a specific time (26 March 2014, 12 UTC).



Figure S21: Same as Fig.S16, but for the entire northern hemisphere (80°N-20°N) and for a specific time (26 March 2014, 12 UTC).



Figure S22: 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 S23: Same as Fig.S22, but for 250 hPa.



Figure S24: Same as Fig.S22, but for 200 hPa.

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	

*Table S1:* Same as Table 1, but for the Asian region (50°E-160°E, 80°N-20°N).



Figure S25: Same as Fig.S22, but for the Asian region (50°E-160°E, 80°N-20°N), Table S1.



Figure S26: Same as Fig.S22, but for 250 hPa.



Figure S27: Same as Fig.S22, but for 200 hPa.

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)							
$\mathrm{RH}_{ice} > 90  /  95  /  100  [\%]$	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	

Table S2: Same as Table 1, but for the entire northern hemisphere (80°N-20°N).



Figure S28: Same as Fig.8, but for March 27 2014.



Figure S29: Same as Fig.8, but for March 29 2014.



Figure S30: Same as Fig.8, but for April 01 2014.



Figure S31: Same as Fig.8, but for April 03 2014.



Figure S32: Same as Fig.8, but for April 04 2014.



Figure S33: Same as Fig.8, but for April 07 2014.



Figure S34: Same as Fig.8, but for April 11 2014.



Figure S35: Same as Fig.8, but for April 11 2014.



Figure S36: Same as Fig.8, but for April 13 2014.