Supplementary material

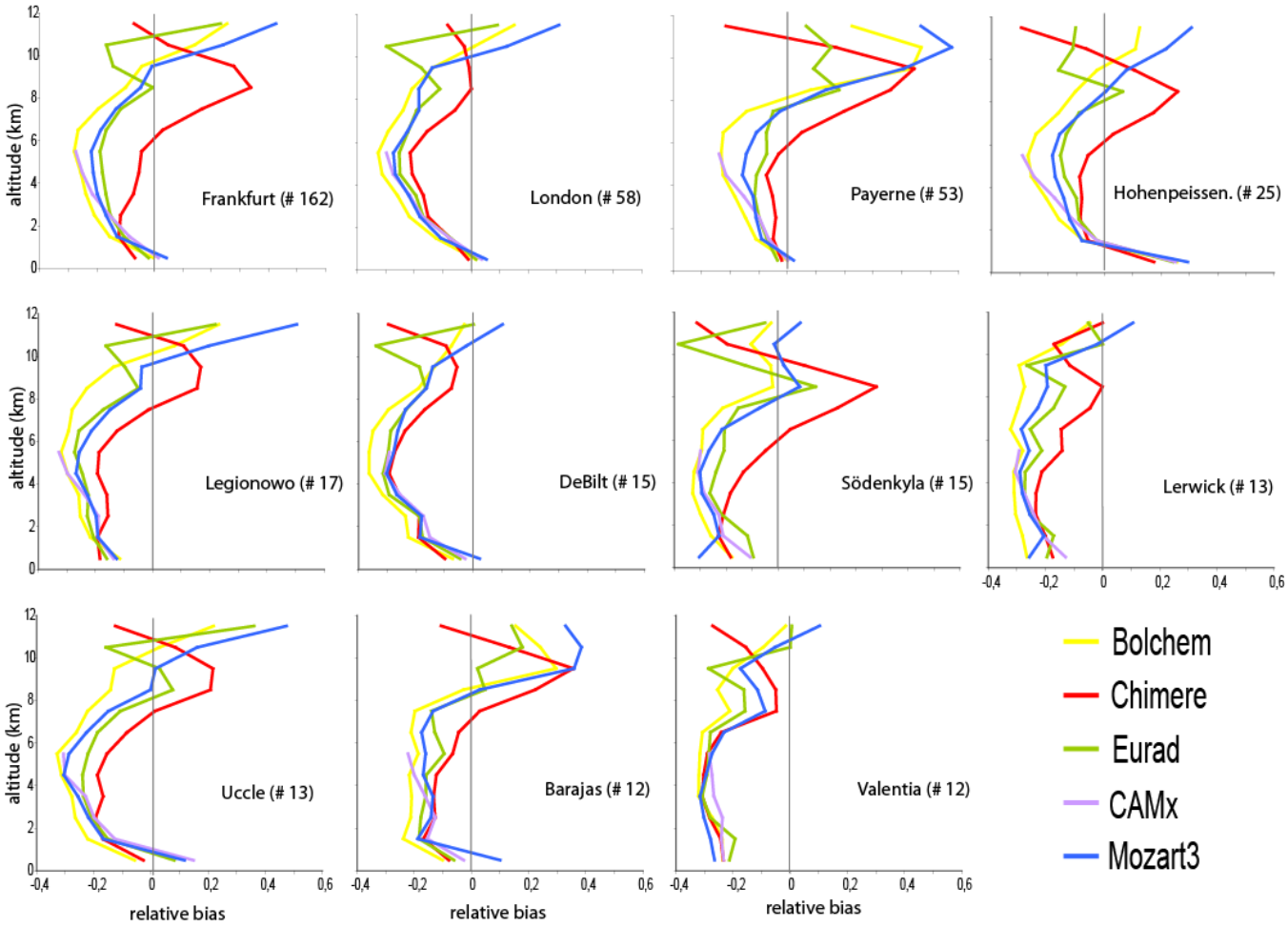

Figure S1. Vertical profiles (y-axis in km) of normalized ozone bias calculated at each sounding site (or along aircraft flights from/to London and Frankfurt) for models forced by IFS-MOZART (BOLCHEM, CAMX, CHIMERE, EURAD, IFS-MOZART). The number of profiles used for each site is also indicated.

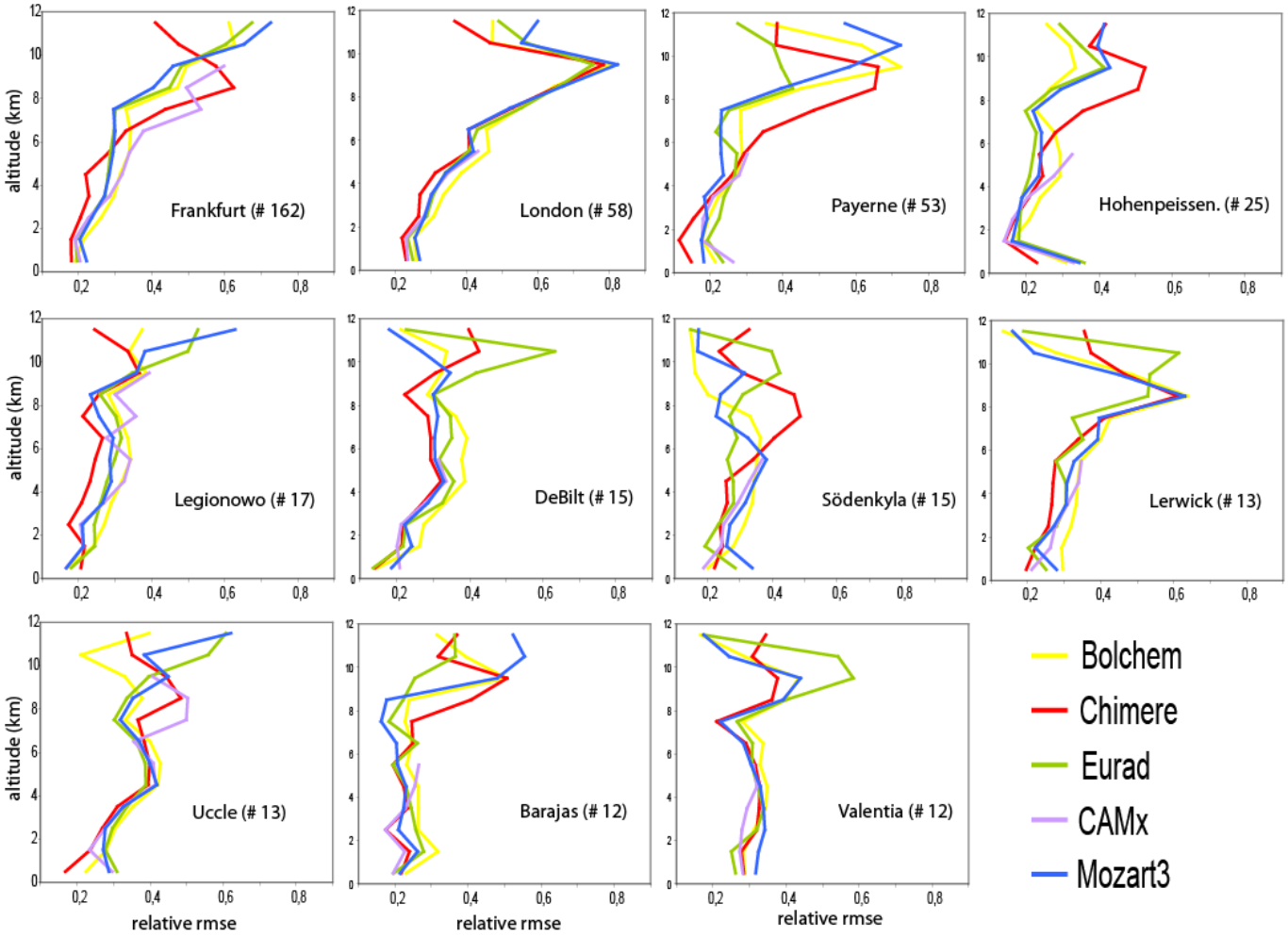

Figure S2. Vertical profiles (y-axis in km) of normalized RMSE (Root Mean Square Error) calculated at each sounding site (or along aircraft flights from/to London and Frankfurt) for models forced by IFS-MOZART (BOLCHEM, CAMX, CHIMERE, EURAD, IFS-MOZART).

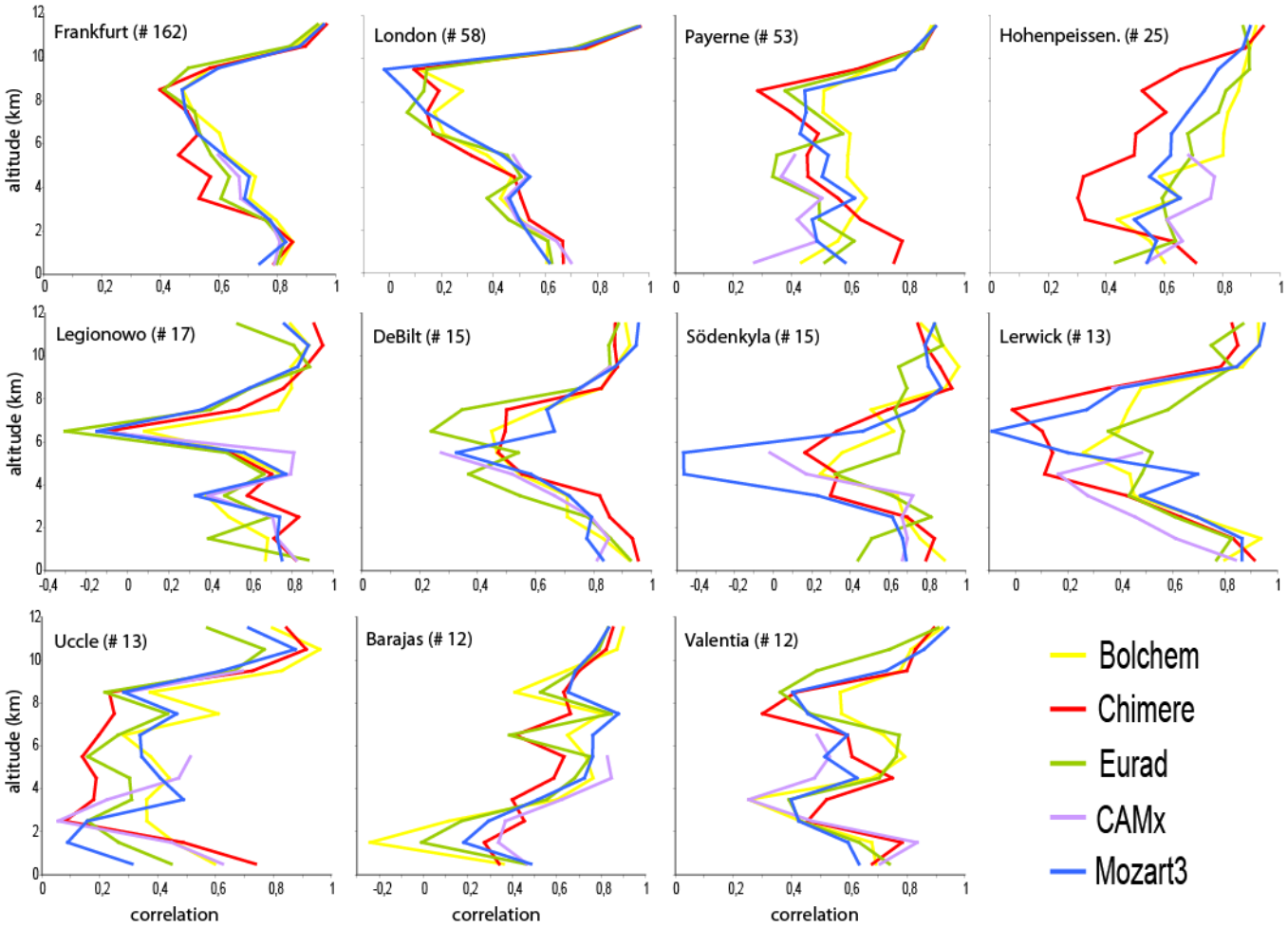

Figure S3 Vertical profiles (y-axis in km) of Pearson's correlation coefficient calculated at each sounding site (or along aircraft flights from/to London and Frankfurt) for models forced by IFS-MOZART (BOLCHEM, CAMX, CHIMERE, EURAD, IFS-MOZART).

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Altitude range	0-2 km		2-8 km		8-12 km	
Fran kfurt (162)	**Obs.**	Model	**Obs.**	Model	**Obs.**	Model
Mean (ppb)	**47.3**	44.3	**66.0**	55.8	**107.0**	106.9
Std deviation (ppb)	**14.1**	12.6	**17.6**	16.9	**50.7**	53.8
Bias (ppb)	-3.0 (-6%)		-10.3 (-16%)		-0.1 (-0.1%)	
Rmse (ppb)	9.4 (20%)		20.3 (31%)		52.6 (50%)	
Correlation	0.81		0.57		0.5	
Variability ratio	0.89		0.96		1.06	
London (58)						
Mean (ppb)	**42.2**	40.6	**64.3**	51.4	**106.5**	94.2
Std deviation (ppb)	**11.7**	10.8	**21.0**	13.7	**71.9**	38.3
Bias (ppb)	-1.6 (-4%)		-12.9 (-20%)		-12.3 (-11%)	
Rmse (ppb)	10.2 (24%)		25.7 (40%)		79.1 (74%)	
Correlation	0.63		0.35		0.10	
Variability ratio	0.93		0.65		0.48	
Payerne (53)						
Mean (ppb)	**48.8**	46.7	**64.6**	59.0	**86.8**	113.2
Std deviation (ppb)	**9.3**	8.8	**12.4**	16.4	**34.7**	52.3
Bias (ppb)	-2.1 (4%)		-5.6 (-9%)		26.5 (30%)	
Rmse (ppb)	9.3 (19%)		17.9 (28%)		52.6. (60%)	
Correlation	0.53		0.42		0.5	
Variability ratio	0.94		1.32		1.5	
Hohenpeissen. (25)						
Mean (ppb)	**42.9**	46.2	**65.5**	57.7	**104.1**	107.4
Std deviation (ppb)	**7.7**	8.1	**12.8**	15.2	**60.2**	51.4
Bias (ppb)	3.3 (8%)		-7.7 (-12%)		3.2 (3%)	
Rmse (ppb)	9.8 (23%)		16.6 (25%)		43.7 (42%)	
Correlation	0.56		0.52		0.71	
Variability ratio	1.05		1.19		0.85	
Legionowo (17)						
Mean (ppb)	**55.1**	45.6	**72.3**	57.1	**96.3**	92.3
Std deviation (ppb)	**8.3**	6.4	**10.1**	11.7	**42.5**	33.4
Bias (ppb)	-9.5 (-17%)		-15.3 (-21%)		-4.1 (4%)	
Rmse (ppb)	11.2 (20%)		20.3 (28%)		31.3 (32%)	
Correlation	0.71		0.41		0.69	
Variability ratio	0.78		1.15		0.78	
Lerwick (15)						
Mean (ppb)	**45.9**	36.3	**69.6**	55.3	**147.5**	121.5
Std deviation (ppb)	**8.8**	8.9	**14.8**	13.6	**96.5**	48.6
Bias (ppb)	-9.6 (-21%)		-14.3 (-21%)		-26 (-18%)	
Rmse (ppb)	11.3 (25%)		25.0 (36%)		78.7 (53%)	
Correlation	0.78		0.30		0.6	
Variability ratio	1.01		0.92		0.5	
DeBilt (15)						
Mean (ppb)	**47.2**	41.6	**65.5**	49.3	**106.**	91.1
Std deviation	**13.4**	11.6	**11.9**	10.9	**53.1**	38.8
Bias (ppb)	-5.6 (-12%)		-16.2 (-25%)		-14.9 (-14%)	
Rmse (ppb)	9.4 (20%)		21.0 (32%)		34.9 (33%)	
Correlation	0.86		0.48		0.8	
Variability ratio	0.87		0.91		0.73	
Södankyla (13)						
Mean (ppb)	**39.5**	31.8	**65.0**	55.6	**133.8**	144.9
Std deviation (ppb)	**7.3**	6.86	**12.7**	17.8	**63.2**	58.3
Bias (ppb)	-7.7 (-19%)		-9.4 (-14%)		11.2 (8%)	
Rmse (ppb)	9.9 (25%)		23.8 (37%)		46.5 (35%)	

Correlation	0.63		0.34		0.78	
Variability ratio	0.94		1.40		0.92	
Uccle (13)						
Mean (ppb)	**49.0**	45.5	**71.4**	57.4	**93.3**	96.5
Std deviation (ppb)	**10.5**	10.1	**19.7**	14.0	**39.2**	41.8
Bias (ppb)	-3.5 (-7%)		-14 (-20%)		3.2 (3%)	
Rmse (ppb)	12.8 (26%)		26.1 (37%)		38.4 (41%)	
Correlation	0.42		0.25		0.47	
Variability ratio	0.97		0.71		1.06	
Barajas (12)						
Mean (ppb)	**53.0**	46.9	**67.2**	58.5	**83.9**	98.9
Std deviation (ppb)	**10.0**	6.8	**12.4**	13.1	**23.1**	33.9
Bias (ppb)	-6.1 (-12%)		-8.7 (-13%)		15 (18%)	
Rmse (ppb)	12.8 (24%)		15.8 (23%)		32.2 (38%)	
Correlation	0.24		0.50		0.55	
Variability ratio	0.68		1.06		1.46	
Valentia (12)						
Mean (ppb)	**41.4**	31.5	**67.0**	52.8	**135.4**	116.5
Std deviation (ppb)	**8.8**	5.1	**11.0**	14.6	**67.6**	49.6
Bias (ppb)	-9.8 (-24%)		-14.2 (-21%)		-18.8 (-14%)	
Rmse (ppb)	11.8 (28%)		23.5 (35%)		63.3 (44%)	
Correlation	0.68		0.46		0.53	
Variability ratio	0.58		1.33		0.73	

Table S1. Mean ozone concentrations (ppb) have been calculated (over the 3 month period of summer 2008) for observations and models (for the 5 models using MOZART-IFS boundary conditions), at each sounding/airport site, for 3 altitude ranges 1) the lower troposphere (0-2 km); 2) the free troposphere (2-8 km); the upper troposphere (8-10 km). Standard deviations are calculated in the same way. Also the absolute (ppb) and relative (%) bias, the absolute (ppb) and relative (%) RMSE, the Pearson's correlation coefficients are calculated. The ratio of modelled to observed standard deviation is also calculated.