



Supplement of

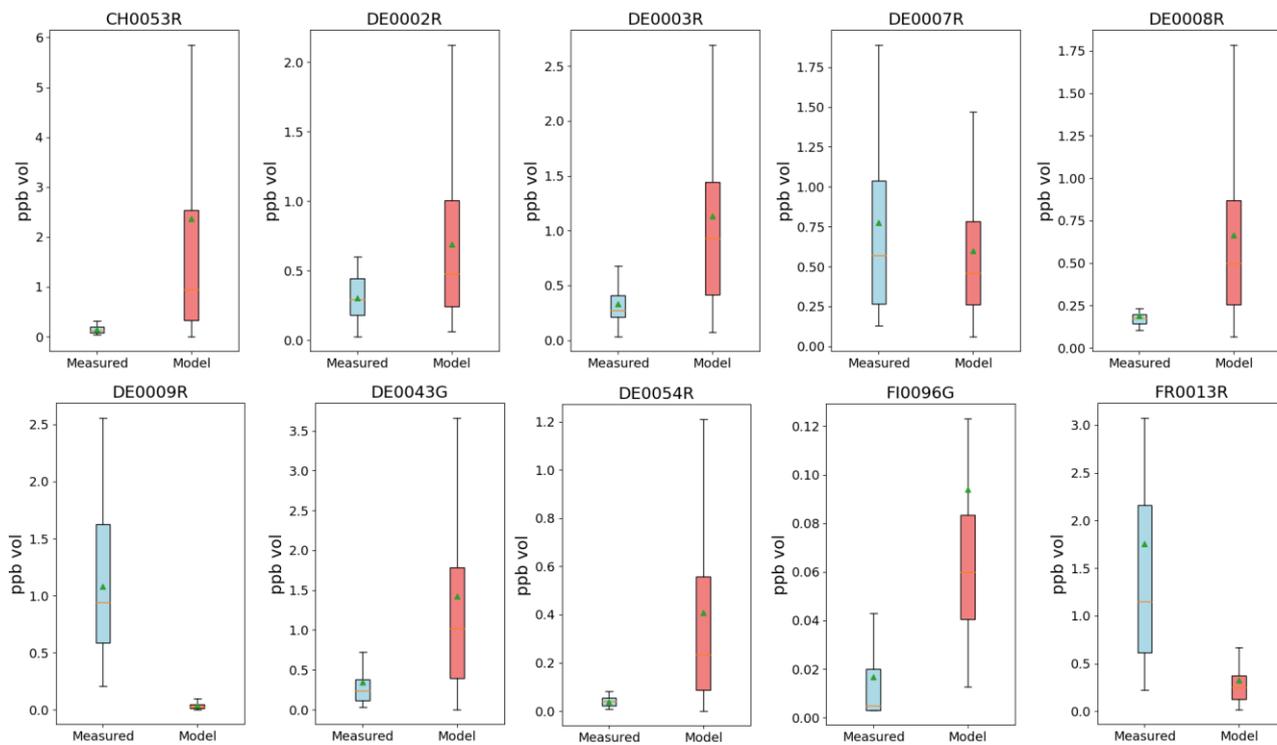
On the formation of biogenic secondary organic aerosol in chemical transport models: an evaluation of the WRF-CHIMERE (v2020r2) model with a focus over the Finnish boreal forest

Giancarlo Ciarelli et al.

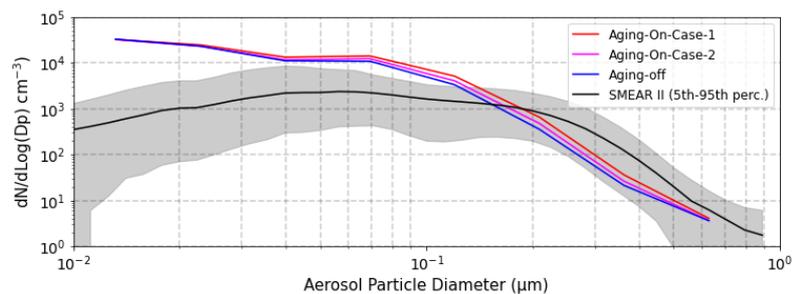
Correspondence to: Giancarlo Ciarelli (giancarlo.ciarelli@helsinki.fi)

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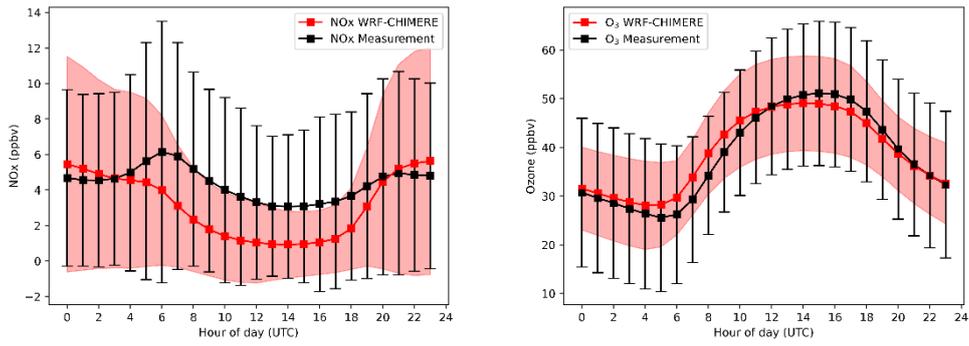
Supplement



5 **Figure S1: Comparisons of modeled (red) and measured (blue) air concentrations of isoprene as available from the EBAS database. Measurement time resolution varies from is 1 hours to 4 days depending on the specific station. Units are in ppb vol.**



10 **Figure S2: Measured (black) and modelled (various colors) median size distribution comparison at the SMEAR-II stations. The shaded areas indicated the 5th and 95th interquartile range.**



15 **Figure S3: Diurnal variation of O₃ and NO_x at available Air Quality e-Reporting rural sites (from 15 June until 30 August of 2019). Number of stations are 271 for NO_x and 350 for O₃. The extent of the bars and the shaded areas denotes the one standard deviation (1σ). Measurements data are shown in in black and model data in red. Units are in ppb vol.**

Table S1: Mass SOA yields for each SOA precursors used in the VBS version of CHIMERE. Yields are applied to all oxidants, i.e., O₃, NO₃, and OH. For isoprene, only oxidation by OH are considered for BSOA formation. The differentiation between low-NO_x and high-NO_x yield is based on the approached proposed by Cholakian et al., 2018.

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SOA precursors	Mass yield of each bin				
	C* (µg m ³)	1	10	100	1000
ALK4	0.0	0.075	0.0	0.0	0.0
ALK5	0.0	0.300	0.0	0.0	0.0
OLE1	0.0045	0.009	0.060	0.225	0.225
OLE2	0.0225	0.435	0.129	0.375	0.375
ARO1	0.075	0.225	0.375	0.525	0.525
ARO2	0.075	0.300	0.375	0.525	0.525
TERP	0.1073	0.0918	0.3587	0.6075	0.6075
ISOP	0.009	0.03	0.015	0.000	0.000
SQT	0.0750	0.1500	0.7500	0.9000	0.9000

Table S2: EBAS stations (from <https://ebas.nilu.no/>) used for the organic carbon (OC) comparison on the coarse resolution grid (30km).

Site	Latitude (deg)	Longitude (deg)
CZ0003R	49.5734	15.0803
DE002R	52.8022	10.7594
DE003R	47.9147	7.9086
DE0007R	53.1667	13.0333
DE0008R	50.6500	10.7667
DE0009R	54.4368	12.7249
DE0044R	51.5255	12.9277
FR0008R	48.5000	7.1333
FR0009R	49.9000	4.6333
FR0013R	43.6167	0.1833
FR0022R	48.5622	5.5056
FR0023R	44.5694	5.2790
FR0024R	47.8319	-1.8363
FR0025R	46.8147	2.6100
NO0002R	58.3885	8.2520
NO0039R	62.7833	8.8833
NO0056R	60.3724	11.0781
PL0005R	54.1500	22.0667
PL0009R	53.6621	17.9340

Table S3: EBAS stations (from <https://ebas.nilu.no/>) used for the isoprene air concentration comparison on the coarse resolution grid (30km).

Site	Latitude (deg)	Longitude (deg)
CH0053R	47.1896	8.1754
DE0002R	52.8022	10.7594
DE0003R	47,9147	7,9086
DE0007R	53.1666	13.0333
DE0008R	50.6500	10.7666
DE0009R	54.4368	12.7249
DE0043G	47.8014	11.0096
DE0054R	47.4165	10.9796
FI0096G	67.9733	24.1161
FR0013R	43.6166	0.1833

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Table S4: Model evaluation for organic carbon (OC) as predicted by the three BSOA schemes at the EBAS stations (from <https://ebas.nilu.no/>)

Variable	Mean	MB	MGE	RMSE	MFB	MFE
Aging-On-Case-1 ($\mu\text{g m}^{-3}$)	3	0.63	1.84	2.88	0.56	1.65
Aging-On-Case-2 ($\mu\text{g m}^{-3}$)	2.4	-0.13	1.52	1.52	-0.08	1.37
Aging-Off ($\mu\text{g m}^{-3}$)	1.3	-1.1	1.34	1.68	-0.86	1.16
Obs ($\mu\text{g m}^{-3}$)	2.4	-	-	-	-	-

35 Table S5: Model evaluation for O₃ and NO_x concentrations against measurements from the Air Quality e-Reporting rural sites. Number of stations are 271 for NO_x and 350 for O₃.

Variable	Mean measurements	Mean model	MB	MGE	r (-)
O ₃ (ppb)	38.4	39.5	1.05	7.38	0.55
NO _x (ppb)	4.4	2.5	-1.8	2.5	0.45