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Long-term measurements of volatile organic compounds highlight the importance of sesquiterpenes for the atmospheric chemistry of a boreal forest

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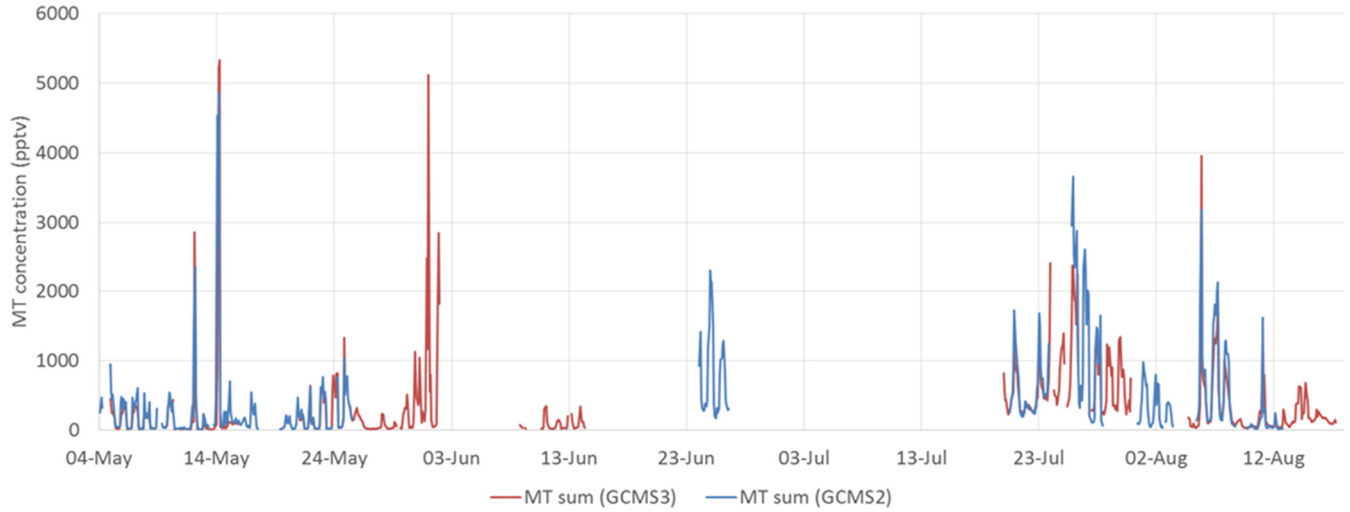

Figure S1. Comparison of GC-MS2 and GC-MS3 measurements of MTs.

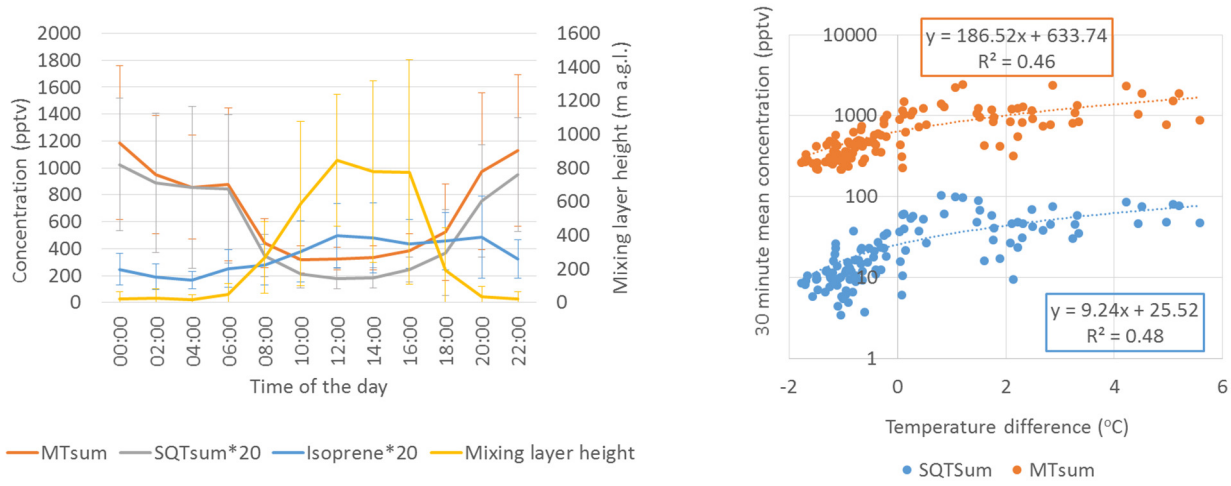

Figure S2. a) Mean diurnal variation (local winter time UTC+2) in the MT sum, SQT sum and isoprene concentrations (SQT sum and isoprene values were multiplied by 20 to get them into the same range as MT sum) and the mean mixing layer height with standard deviations (error bars) and b) correlation of the MT and SQT concentrations measured (N=115) with the temperature difference between heights of 125 m and 4.2m at SMEAR II in July 2016. Note: the y-axis in the figure b) is in a logarithmic scale.

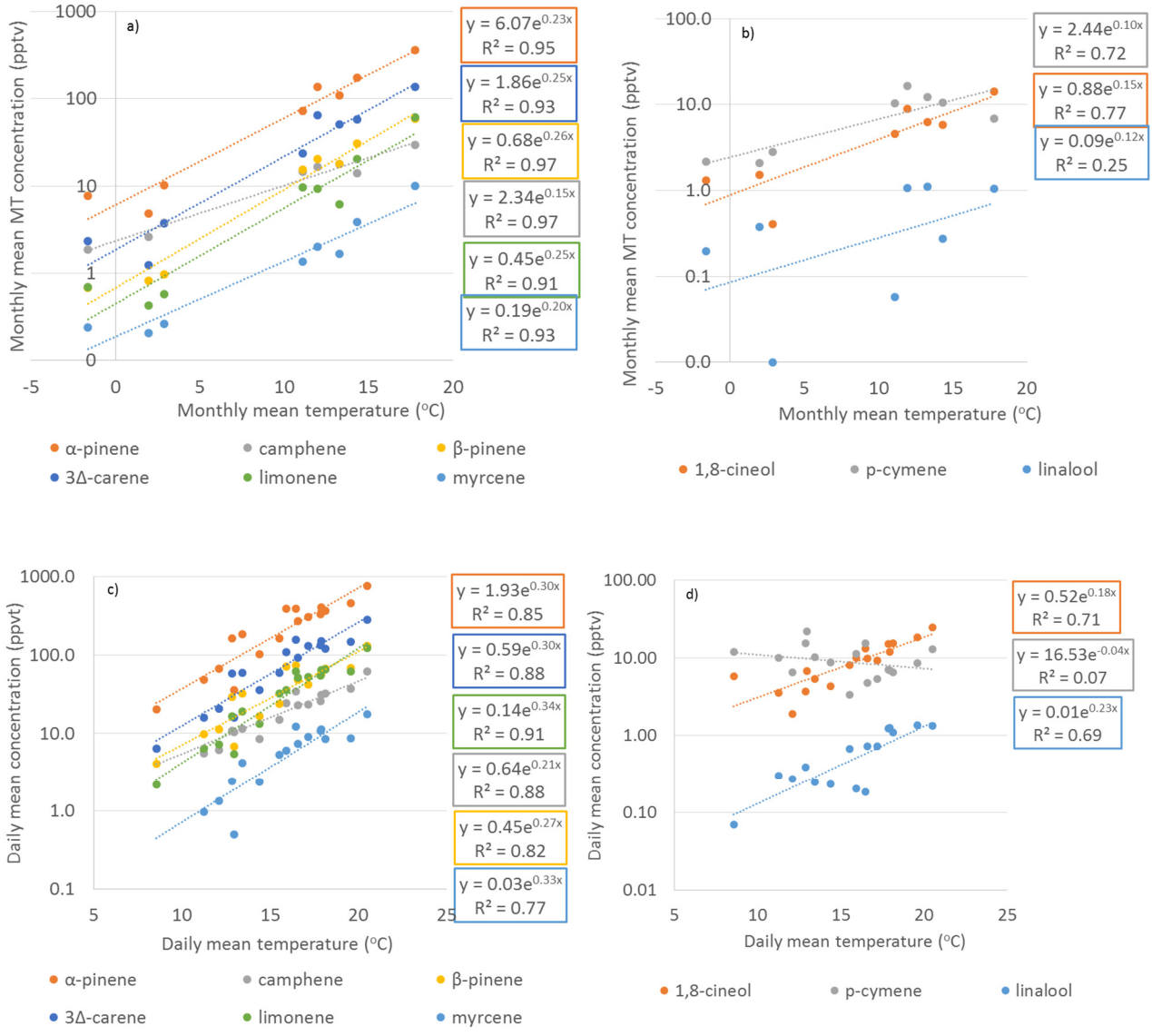

Figure S3. Exponential correlation of the temperature with the monthly means of the individual MTs measured (April-November, a and b) and with the daily means of the individual MT concentrations in summer (June-August, c and d) in 2016 at SMEAR. Note: the y-axes are in a logarithmic scale.

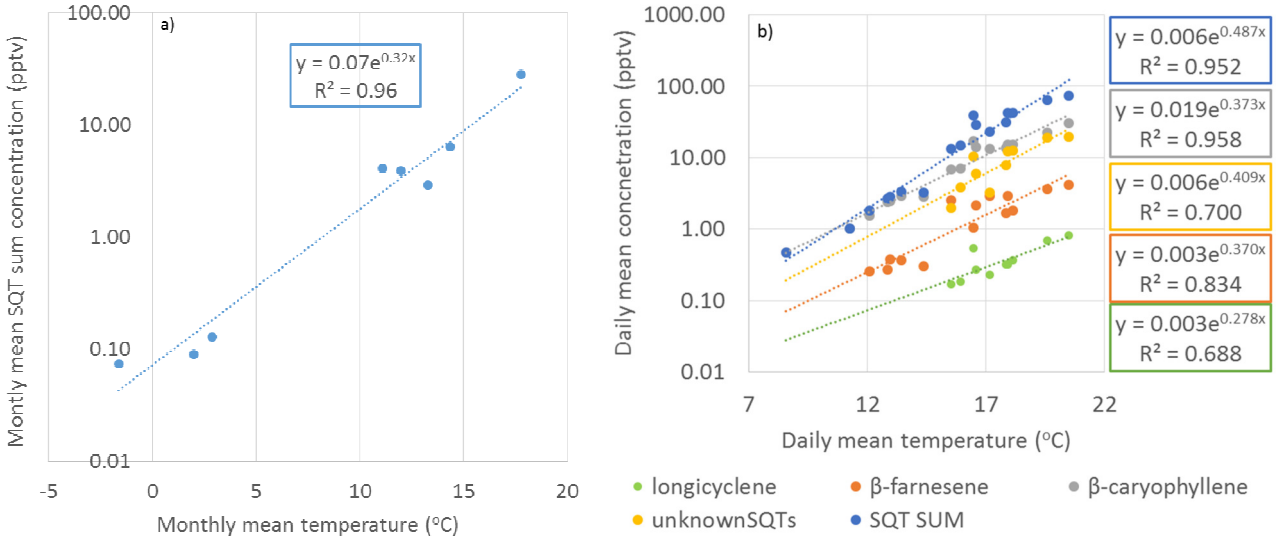

Figure S4. Exponential correlation of temperature with a) the monthly mean (April-November) of the SQT sum and b) the daily means (June-August) of the individual SQT concentrations at SMEAR II measured in 2016. Note: the y-axes are in a logarithmic scale.

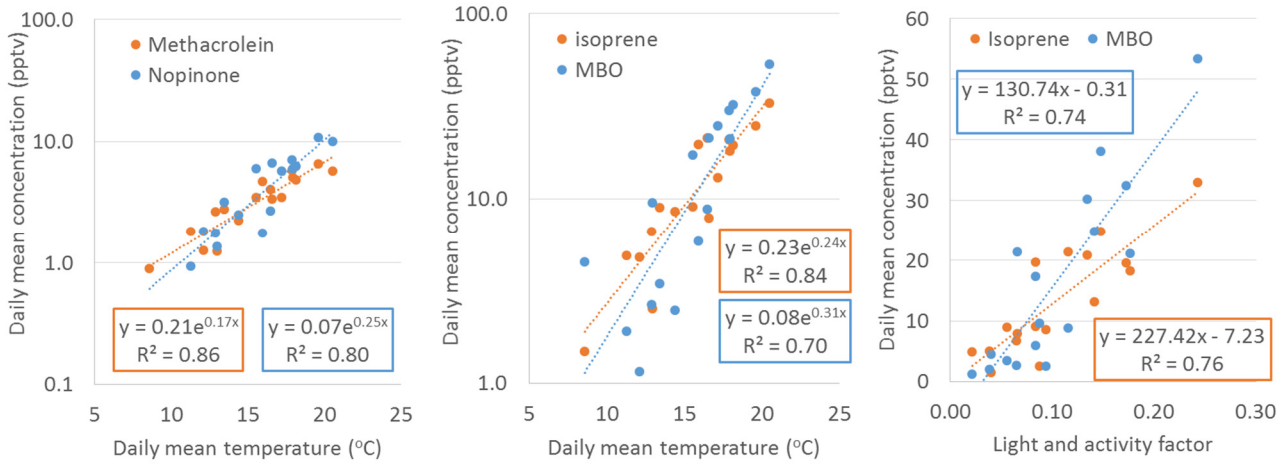

Figure S5. Exponential correlation of the temperature with the daily means of a) nopinone and methacrolein and b) isoprene and MBO concentrations. c) an exponential correlation of isoprene and MBO daily mean concentrations with light and activity factor in summer (June-August) 2016 at SMEAR II. Note: the y-axes are in a logarithmic scale.

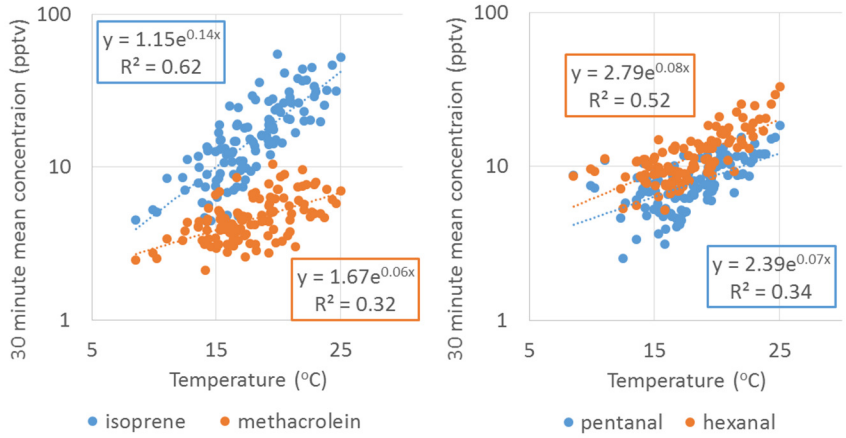

Figure S6. The temperature dependence of measured 30 min mean concentrations of the isoprene, methacrolein, pentanal and hexanal in July 2016. Note: the y-axes are in a logarithmic scale.

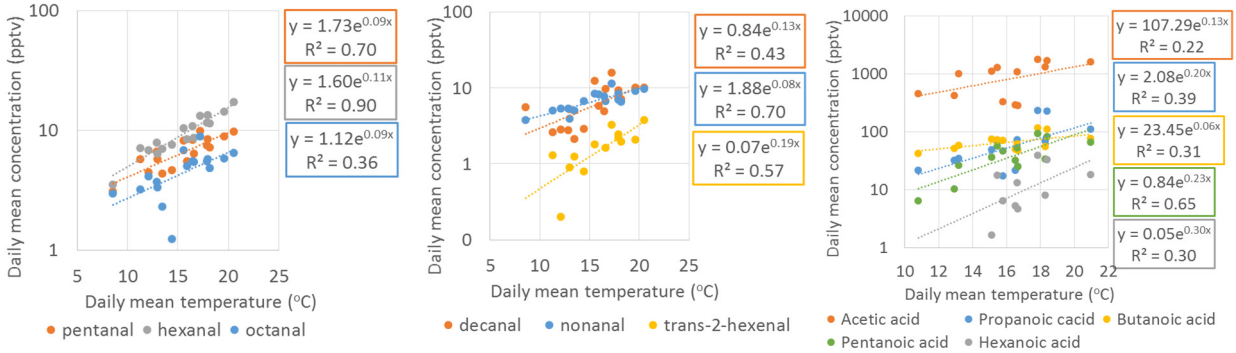

Figure S7. Exponential correlation of the daily means of aldehyde and the VOA concentrations with the temperature in summer (June-August) 2016 at SMEAR II. Note: the y-axes are in a logarithmic scale.

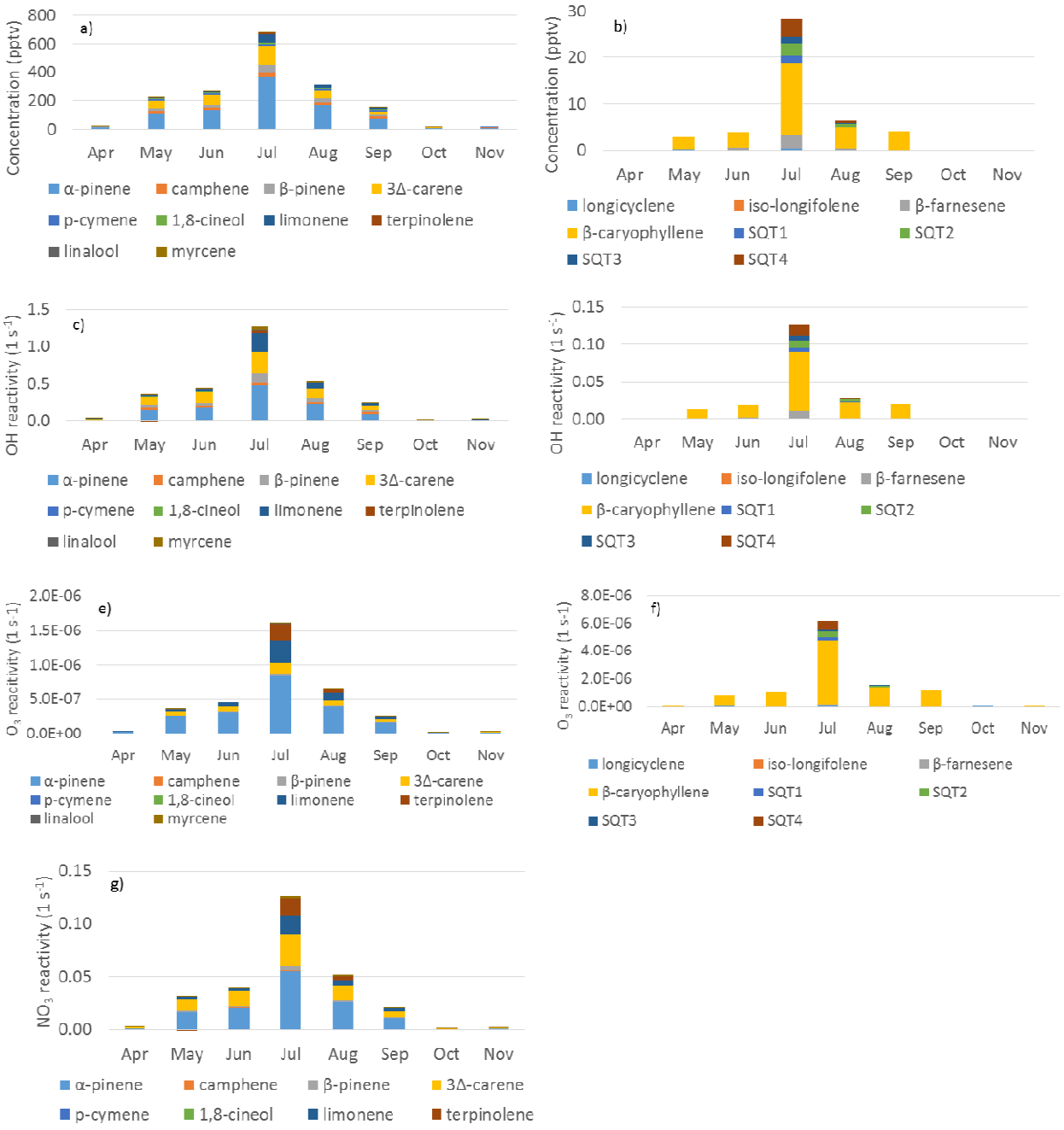

Figure S8. a) Concentrations of MTs, b) concentrations of SQTs, c) OH reactivity of MTs, d) OH reactivity of SQTs, e) O_3 reactivity of MTs, f) O_3 reactivity of SQTs and g) NO_3 reactivity of MTs

Table S1. OH, O_3 and NO_3 reaction rate coefficients and vapour pressures for various VOCs used in the calculations

	k_{OH} ($cm^3\ s^{-1}$)	k_{O3} ($cm^3\ s^{-1}$)	k_{NO3} ($cm^3\ s^{-1}$)	Vapour pressure (mmHg)
Isoprene	9.99E-11	1.27E-17	6.50E-13	551
MBO	6.30E-11	1.00E-17	1.20E-14	
α-Pinene	5.25E-11	9.4E-17	6.20E-12	4.02
Camphene	7.83E-11	6.80E-19	6.20E-13	
β-Pinene	7.43E-11	1.9E-17	2.50E-12	2.51
3Δ-Carene	8.8E-11	4.80E-17	9.10E-12	2.09
p-Cymene	1.51E-11	5.00E-20		
1,8-Cineol	1.11E-11	1.50E-19		
Limonene	1.61E-10	2.11E-16	1.20E-11	1.45
Terpinolene	2.26E-10	1.60E-15	9.70E-11	
Linalool	1.59E-10	3.15E-16	1.10E-11	
Myrcene	2.13E-10	3.74E-17	1.10E-11	
Bornylacetate	1.39E-11			
Longicyclene	9.35E-12			
β-Farnesene	1.68E-10	5.64E-16		
β-Caryophyllene	2.01E-10	1.2E-14		0.025
Nopinone	1.43E-11			
4-AMCH	1.29E-10			
MACR	2.86E-11		3.40E-14	
Pentanal	2.76E-11			26
Hexanal	2.8E-11			11.3
Octanal	3.17E-11			1.18
Nonanal	3.6E-11			0.37
Decanal	3.45E-11			0.103
trans-2-Hexenal	4.4E-11			
Acetic acid	6.93E-13			15.7
Propanoic acid	1.2E-12			3.53
Butanoic acid	1.8E-12			
Pentanoic acid	4.11E-12			0.20
Hexanoic acid	5.52E-12			0.05
Heptanoic acid	6.94E-12			

Isopropanol	5.09E-12
1-Butanol	8.48E-12
1-Pentanol	1.22E-11
1-Hexanol	1.58E-11
1-Penten-3-ol	7.42E-11
trans-3-Hexen-1-ol	1.20E-10
cis-3-Hexen-1-ol	1.08E-10
trans-2-Hexen-1-ol	1.00E-10
cis-2-Hexen-1-ol	6.23E-11
Butylacetate	5.1E-12
Hexylacetate	7.44E-12
cis-3-Hexenylacetate	7.84E-11
trans-2-Hexenylacetate	6.8E-11

Obtained from Praplan et al. (2018), Hakola et al. (2017), Ng et al. (2017) and ChemSpider database (www.ChemSpider.com)

Table S2. Halo Stream Line scanning Doppler lidar specifications.

Wavelength	1.5 μm
Pulse repetition rate	15 kHz
Nyquist velocity	20 m s^{-1}
Sampling frequency	50 MHz
Velocity resolution	0.038 m s^{-1}
Points per range gate	10
Range resolution	30 m
Pulse duration	0.2 μs
Lens diameter	8 cm
Lens divergence	33 μrad
Telescope	monostatic optic-fibre coupled

Table S3. Mean, meadian or 25th and 75th percentiles of the concentrations (ppbv) found at SMEARII site in this and previous studies.

ppbv		isoprene	MT sum	3Δ-carene	α-pinene	β-pinene	
Apr-16	mean	0.003	0.02	0.004	0.01	0.001	this study
Jul-16	mean	0.02	0.69	0.14	0.37	0.06	this study
Mar-03	25th-75th		0.19-0.40				Sellegri et al., 2005
Mar-05 *	25th-75th	0.04-0.08	0.06-0.18				Eerdekens et al., 2009
Mar-05**	25th-75th	0.05-0.10	0.17-0.64				Eerdekens et al., 2009
Mar-06	mean		0.15				Ruuskanen et al., 2009
Jul-06	mean		0.36				Ruuskanen et al., 2009
Jul-Aug -10	median	0.06		0.04	0.07	0.02	Yassaa et al., 2012
Jul 06-13	median		0.38				Kontkanen et al. 2016

*cold period, **warm period