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## *Supplementary Information of*

# **New particle formation in boreal forests of Siberia, Finland and Estonia**

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**Supplementary Information.** Estimates of the missing/bad data influence on the NPF frequency

Below we do the estimates of how bad quality/missing data might influence the results. Here we make an estimate of an error in event fraction for the data availability at SMEAR Estonia which is above 80%.

If  $X$  is the number of event days,  $Y$  is the number of non-event days and  $Z$  is the number of undefined days within the good quality data set, then  $X+Y+Z = 0.8N$  is the total number of days when we have good quality data ( $N$  is the total number of days).

$f=X/(0.8N)$  - fraction of events, which we get if we account only for good quality data.

Now suppose all 20% days of missing data are event days. Let  $X_1$  to be the new number of events and then  $X_1+Y+Z = N$ . Then a new fraction of events:

$$f_1=X_1/N= (X+0.2N)/N = =0.8\cdot f+0.2.$$

If the fraction of event days was  $f=13.6\%$  (SMEAR Estonia) and all missed days were events, then  $f_1=31\%$ . However, this is highly unlikely. The median annual frequency of NPF events at SMEAR Estonia is at ca 20%, not 100% (Nieminen et al., 2018). A more reasonable upper estimate (assuming 20% of all missing days were event days) results in NPF frequency  $f_2= 0.15$ .

The lower estimate, if all new days were non-event/undefined:  $f_1=X/N=0.8f=0.11$ . Thus, the 13.6% frequency of events At SMEAR Estonia can in principle vary between 11% and 15% due to 20% of missing data.

The difference with previous results from SMEAR Estonia (current 13.6% vs previous 18%) can be then explained by this uncertainty if one recalls that in Nieminen et al. (2018) study, the data availability was at the same 80% level (thus 14.4-19.4% range according to the presented estimate). However, at SMEAR II data availability is 100% (96% in Nieminen et al., 2018) and the difference between the current and previous estimates is likely due to an inter-annual variability.

**Table S1.** Results (p-values) of Wilcoxon rank sum test comparing median values of certain parameters a) between events and non-events for a given station; b) between different stations on event days.

**SO<sub>2</sub>**

Events/non-events

	Fonovaya	SMEAR II	SMEAR Estonia
p-value	7.8249e-05	0.1693	0.0297

Between stations

	Fonovaya/SMEAR II	SMEAR II/SMEAR Estonia	SMEAR Estonia/Fonovaya
p-value	5.0502e-20	5.4528e-08	3.5024e-13

**NO<sub>2</sub>**

Events/non-events

	Fonovaya	SMEAR II	SMEAR Estonia
p-value	0.0035	4.2573e-08	0.0002

Between stations

	Fonovaya/SMEAR II	SMEAR II/SMEAR Estonia	SMEAR Estonia/Fonovaya
p-value	4.7947e-22	1.1305e-11	3.1274e-16

**NO**

Events/non-events

	Fonovaya	SMEAR II	SMEAR Estonia
p-value	9.0812e-06	0.0022	0.0519

Between stations

	Fonovaya/SMEAR II	SMEAR II/SMEAR Estonia	SMEAR Estonia/Fonovaya
p-value	3.4333e-14	0.0713	1.6058e-15

**O<sub>3</sub>**

Events/non-events

	Fonovaya	SMEAR II	SMEAR Estonia
p-value	0.5162	0.0001	0.0040

Between stations

	Fonovaya/SMEAR II	SMEAR II/SMEAR Estonia	SMEAR Estonia/Fonovaya
p-value	3.4107e-16	0.1237	2.9415e-09

**Condensation sink**

Events/non-events

	Fonovaya	SMEAR II	SMEAR Estonia
P-value March	0.3637	8.3099e-09	7.1276e-05
P-value April	0.0782	0.1915	0.0018
P-value May	0.3700	0.0019	0.0004

Between stations

	Fonovaya/SMEAR II	SMEAR II/SMEAR Estonia	SMEAR Estonia/Fonovaya
P-value March	1.5598e-06	0.9210	0.0001

P-value April	0.5727	0.0096	0.1757
P-value May	0.0523	0.7251	0.1947

### Temperature

Events/non-events

	Fonovaya	SMEAR II	SMEAR Estonia
P-value March	0.0244	0.4974	0.5616
P-value April	0.0103	0.7728	0.7431
P-value May	0.5639	0.0953	0.0008

Between stations

	Fonovaya/SMEAR II	SMEAR II/SMEAR Estonia	SMEAR Estonia/Fonovaya
P-value March	0.7101	0.0083	0.0238
P-value April	0.3541	0.0140	0.0034
P-value May	0.0346	0.3367	0.2505

### RH

Events/non-events

	Fonovaya	SMEAR II	SMEAR Estonia
P-value March	0.5969	0.0001	2.6341e-06
P-value April	0.2597	0.0004	0.0392
P-value May	0.3943	0.0070	0.0977

Between stations

	Fonovaya/SMEAR II	SMEAR II/SMEAR Estonia	SMEAR Estonia/Fonovaya
P-value March	0.1238	0.6558	0.1651
P-value April	0.0196	0.3776	0.0634
P-value May	0.0102	0.6530	0.0121

### Wind speed

Events/non-events

	Fonovaya	SMEAR II	SMEAR Estonia
P-value March	0.1384	0.8315	0.0005
P-value April	0.7455	0.5181	0.1503
P-value May	0.4123	0.6607	0.0832

Between stations

	Fonovaya/SMEAR II	SMEAR II/SMEAR Estonia	SMEAR Estonia/Fonovaya
P-value March	0.0638	0.6771	0.0844
P-value April	0.0048	0.8551	0.0126
P-value May	0.0107	0.8866	0.0215