



Supplement of

A phenomenology of new particle formation (NPF) at 13 European sites

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14 **Table S1:** Data availability per season.

Sites	Winter	Spring	Summer	Autumn	Total
DENRU	80.4%	70.0%	55.2%	56.5%	65.4%
DENUB	67.3%	78.0%	46.6%	44.3%	59.0%
DENRO	69.8%	80.1%	53.7%	57.5%	65.0%
GERRU	84.1%	82.1%	91.1%	91.3%	87.1%
GERUB	77.8%	83.2%	94.3%	96.6%	88.0%
GERRO	67.1%	33.3%	78.7%	78.7%	64.4%
FINRU	98.6%	99.1%	98.4%	98.7%	98.7%
FINUB	97.4%	97.9%	88.5%	92.4%	94.0%
FINRO	87.4%	73.2%	99.7%	99.3%	90.0%
SPARU	42.3%	40.6%	55.4%	53.2%	47.7%
SPAUB	62.6%	58.5%	55.6%	80.7%	64.2%
GRERU	83.1%	85.4%	99.8%	99.2%	92.4%
GREUB	70.0%	72.5%	77.1%	89.3%	77.2%

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18 **Table S2:** Meteorological conditions and condensation sink on average (upper) and NPF event days
 19 (lower).

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Site	Temperature (°C)	Solar radiation (W m ⁻²)	Wind speed (m s ⁻¹)	Relative humidity (%)	Condensation sink (s ⁻¹)
DENRU	9.80 ± 6.75	115 ± 98.0	4.17 ± 1.49	75.7 ± 11.7	9.46E-03 ± 6.56E-03
DENUB	9.82 ± 6.76	115 ± 98.0	4.17 ± 1.49	75.7 ± 11.7	1.42E-02 ± 8.80E-03
DENRO	10.0 ± 6.68	117 ± 98.5	4.16 ± 1.48	75.7 ± 11.4	3.10E-02 ± 1.79E-02
GERRU	10.3 ± 7.83	130 ± 94.0	2.58 ± 1.32	81.9 ± 10.4	7.02E-03 ± 3.54E-03
GERUB	11.1 ± 8.37	114 ± 86.3	2.33 ± 0.84	78.7 ± 14.7	9.11E-03 ± 4.48E-03
GERRO	11.1 ± 8.37	114 ± 86.3	2.33 ± 0.84	78.7 ± 14.7	1.20E-02 ± 5.58E-03
FINRU	4.79 ± 8.79	91 ± 89.0	1.31 ± 0.86	80.1 ± 15.7	2.32E-03 ± 1.25E-03
FINUB	6.52 ± 8.34	111 ± 110	3.43 ± 1.53	76.5 ± 13.9	6.34E-03 ± 3.20E-02
FINRO	7.72 ± 7.55	114 ± 103	4.26 ± 1.44	71.1 ± 11.4	8.96E-03 ± 3.70E-02
SPARU	13.9 ± 6.27	162 ± 82.3	0.94 ± 0.56	66.4 ± 15.6	5.49E-03 ± 2.70E-03
SPAUB	18.2 ± 5.68	180 ± 93.3	2.05 ± 0.99	69.2 ± 11.7	1.00E-02 ± 4.00E-03
GRERU	18.2 ± 6.01	201 ± 104	6.06 ± 3.38	70.0 ± 8.59	4.66E-03 ± 2.08E-03
GREUB	17.6 ± 7.37	183 ± 92.3	1.87 ± 0.74	60.5 ± 15.5	7.55E-03 ± 3.23E-03

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Site	Temperature (°C)	Solar radiation (W m ⁻²)	Wind speed (m s ⁻¹)	Relative humidity (%)	Condensation sink (s ⁻¹)
DENRU	13.5 ± 4.61	218 ± 71.0	4.29 ± 1.31	65.1 ± 9.38	8.67E-03 ± 5.46E-03
DENUB	13.4 ± 5.17	206 ± 76.4	4.59 ± 1.43	64.6 ± 9.96	1.12E-02 ± 5.80E-03
DENRO	13.6 ± 4.82	226 ± 78.5	4.49 ± 1.33	66.2 ± 8.48	2.66E-02 ± 1.41E-02
GERRU	15.4 ± 5.90	229 ± 68.3	2.05 ± 0.98	71.2 ± 7.75	8.61E-03 ± 2.98E-03
GERUB	17.6 ± 5.66	215 ± 60.6	2.08 ± 0.71	62.0 ± 10.5	9.96E-03 ± 3.86E-03
GERRO	18.7 ± 6.44	217 ± 65.70	1.96 ± 0.62	60.6 ± 11.1	1.42E-02 ± 4.51E-03
FINRU	3.48 ± 6.74	149 ± 80.8	1.44 ± 0.93	64.8 ± 14.6	2.15E-03 ± 9.52E-03
FINUB	5.32 ± 5.44	150 ± 85.5	3.28 ± 1.42	62.0 ± 13.3	4.33E-03 ± 2.01E-03
FINRO	11.6 ± 6.28	169 ± 91.9	4.47 ± 1.46	64.2 ± 14.0	6.89E-03 ± 2.62E-03
SPARU	12.0 ± 4.71	169 ± 67.3	1.00 ± 0.47	59.2 ± 13.4	4.68E-03 ± 2.34E-03
SPAUB	17.7 ± 5.29	196 ± 76.2	2.58 ± 1.04	57.9 ± 10.3	8.45E-03 ± 3.57E-03
GRERU	18.1 ± 4.99	233 ± 91.5	6.49 ± 3.33	67.6 ± 7.98	4.80E-03 ± 1.73E-03
GREUB	16.8 ± 7.50	192 ± 74.9	1.79 ± 0.72	54.6 ± 12.0	9.31E-03 ± 3.49E-03

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24 **Table S3:** Average (top panel) and NPF event day (lower panel) concentrations of chemical
 25 components (*refers to NO₂, +refers to Organic Mass in PM₁ measurements, *refers to measurements
 26 at the Kalio site).

Site	NO _x /NO ₂ (µg m ⁻³)	SO ₂ (µg m ⁻³)	O ₃ (µg m ⁻³)	Organic carbon (PM _{2.5}) (µg m ⁻³)	Sulphate (PM _{2.5}) (µg m ⁻³)
DENRU	5.42 ± 4.55	0.26 ± 0.37	30.1 ± 9.32	1.48 ± 1.37	0.52 ± 0.46
DENUB	10.5 ± 6.24	-	28.2 ± 9.36	-	-
DENRO	68.5 ± 30.4	0.97 ± 0.78	31.1 ± 7.13	2.59 ± 1.81	0.55 ± 0.50
GERRU	-	-	-	2.18 ± 2.08	0.83 ± 0.12
GERUB	-	-	-	-	-
GERRO	-	-	-	-	-
FINRU	0.72 ± 0.55	0.09 ± 0.16	27.4 ± 8.07	1.78 ± 1.24 ⁺	1.02 ± 0.82
FINUB	-	-	-	-	-
FINRO	88.1 ± 54.4	0.93 ± 1.27*	37.1 ± 14.0	-	-
SPARU	3.26 ± 2.46*	0.95 ± 0.57	75.9 ± 20.0	2.69 ± 1.34	1.21 ± 0.97
SPAUB	31.4 ± 14.2*	1.99 ± 0.88	54.9 ± 19.0	-	-
GRERU	0.52 ± 0.22*	-	49.5 ± 8.61	1.58 ± 0.97	-
GREUB	-	-	-	-	-

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Site	NO _x /NO ₂ (µg m ⁻³)	SO ₂ (µg m ⁻³)	O ₃ (µg m ⁻³)	Organic carbon (PM _{2.5}) (µg m ⁻³)	Sulphate (PM _{2.5}) (µg m ⁻³)
DENRU	2.59 ± 1.64	0.18 ± 0.19	37.0 ± 6.10	0.74 ± 0.45	0.33 ± 0.15
DENUB	6.55 ± 2.77	-	35.5 ± 5.54	-	-
DENRO	53.9 ± 22.7	0.66 ± 0.54	36.3 ± 4.09	2.13 ± 0.87	0.34 ± 0.18
GERRU	-	-	-	1.83 ± 0.98	0.69 ± 0.28
GERUB	-	-	-	-	-
GERRO	-	-	-	-	-
FINRU	0.50 ± 0.42	0.13 ± 0.20	33.8 ± 7.12	1.21 ± 0.63 ⁺	0.66 ± 0.45
FINUB	-	-	-	-	-
FINRO	52.9 ± 31.6	0.66 ± 0.60*	45.1 ± 16.0	-	-
SPARU	3.27 ± 3.39*	0.96 ± 0.71	78.1 ± 15.0	1.47 ± 0.76	0.53 ± 0.68
SPAUB	25.4 ± 12.7*	1.95 ± 0.81	59.6 ± 16.2	-	-
GRERU	0.56 ± 0.28*	-	50.8 ± 7.48	1.46 ± 0.74	-
GREUB	-	-	-	-	-

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31 **Table S4:** Seasonal meteorological conditions and chemical compound concentrations.

DENRU	Solar radiation (W m ⁻²)	Wind speed (m s ⁻¹)	Temperature (°C)	Relative humidity (%)	NO _x (µg m ⁻³)	O ₃ (µg m ⁻³)	Organic carbon (PM _{2.5}) (µg m ⁻³)	Condensation sink (s ⁻¹)
Winter	24	4.60	2.26	82.2	7.29	25.5	1.99	8.34E-03
Spring	163	4.06	8.69	69.4	5.07	36.3	1.43	1.09E-02
Summer	210	3.80	17.8	70.7	3.16	34.9	1.10	1.07E-02
Autumn	68	4.21	10.8	80.0	6.09	24.2	1.43	8.03E-03

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DENUB	Solar radiation (W m ⁻²)	Wind speed (m s ⁻¹)	Temperature (°C)	Relative humidity (%)	NO _x (µg m ⁻³)	O ₃ (µg m ⁻³)	Condensation sink (s ⁻¹)
Winter	24	4.62	2.19	82.2	12.08	22.7	1.37E-02
Spring	163	4.06	8.69	69.4	10.12	34.1	1.45E-02
Summer	210	3.80	17.8	70.7	8.25	33.5	1.61E-02
Autumn	68	4.21	10.8	80.0	11.71	22.2	1.25E-02

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DENRO	Solar radiation (W m ⁻²)	Wind speed (m s ⁻¹)	Temperature (°C)	Relative humidity (%)	SO ₂ (µg m ⁻³)	NO _x (µg m ⁻³)	O ₃ (µg m ⁻³)	Organic carbon (PM _{2.5}) (µg m ⁻³)	Condensation sink (s ⁻¹)
Winter	23	4.61	2.40	82.6	0.90	68.99	32.4	2.84	3.19E-02
Spring	166	4.04	8.91	69.4	0.79	65.07	28.8	2.44	2.96E-02
Summer	210	3.80	17.8	70.7	0.94	61.40	31.2	2.19	3.08E-02
Autumn	68	4.21	10.8	80.0	1.24	78.45	32.0	2.89	3.21E-02

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GERRU	Solar radiation (W m ⁻²)	Wind speed (m s ⁻¹)	Temperature (°C)	Relative humidity (%)	Organic carbon (PM _{2.5}) (µg m ⁻³)	Condensation sink (s ⁻¹)
Winter	39	2.94	0.69	89.6	3.37	7.94E-03
Spring	164	2.68	9.83	79.1	2.01	7.03E-03
Summer	215	2.12	19.0	74.8	1.44	6.92E-03
Autumn	85	2.62	10.3	85.3	1.81	6.28E-03

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GERUB	Solar radiation (W m ⁻²)	Wind speed (m s ⁻¹)	Temperature (°C)	Relative humidity (%)	Condensation sink (s ⁻¹)
Winter	39	2.94	0.69	89.6	1.12E-02
Spring	164	2.68	9.83	79.1	7.63E-03
Summer	215	2.12	19.0	74.8	8.58E-03
Autumn	85	2.62	10.3	85.3	9.19E-03

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GERRO	Solar radiation (W m ⁻²)	Wind speed (m s ⁻¹)	Temperature (°C)	Relative humidity (%)	Condensation sink (s ⁻¹)
Winter	30	2.45	0.52	92.3	1.42E-02
Spring	150	2.42	11.1	74.2	1.16E-02
Summer	194	2.19	20.2	66.1	1.16E-02
Autumn	70	2.27	11.0	83.5	1.11E-02

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FINRU	Solar radiation (W m ⁻²)	Wind speed (m s ⁻¹)	Temperature (°C)	Relative humidity (%)	SO ₂ (µg m ⁻³)	NO _x (µg m ⁻³)	O ₃ (µg m ⁻³)	Organic carbon (PM ₁) (µg m ⁻³)	Condensation sink (s ⁻¹)
Winter	12	1.34	-5.56	93.1	0.14	1.14	27.3	NA	1.84E-03
Spring	131	1.34	3.74	72.0	0.12	0.69	35.5	1.52	2.52E-03
Summer	179	1.24	14.5	71.4	0.05	0.37	26.0	4.69	2.94E-03
Autumn	43	1.31	4.36	86.8	0.05	0.81	20.7	1.81	1.85E-03

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FINUB	Solar radiation (W m ⁻²)	Wind speed (m s ⁻¹)	Temperature (°C)	Relative humidity (%)	Condensation sink (s ⁻¹)
Winter	17	3.76	-2.54	84.5	5.97E-03
Spring	158	3.25	5.35	70.0	8.59E-03
Summer	213	3.18	16.2	70.0	5.79E-03
Autumn	55	3.52	6.94	81.7	4.84E-03

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FINRO	Solar radiation (W m ⁻²)	Wind speed (m s ⁻¹)	Temperature (°C)	Relative humidity (%)	SO ₂ * (µg m ⁻³)	NO _x (µg m ⁻³)	O ₃ (µg m ⁻³)	Condensation sink (s ⁻¹)
Winter	17	4.65	-0.68	77.2	1.35	102.34	32.9	8.67E-03
Spring	156	4.10	6.16	65.1	1.11	85.28	46.6	8.94E-03
Summer	212	3.98	16.3	67.2	0.69	77.13	39.6	9.39E-03
Autumn	56	4.37	7.53	76.0	0.64	89.79	28.4	8.76E-03

42 *SO₂ data are from the nearby Kalio station

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SPARU	Solar radiation (W m ⁻²)	Wind speed (m s ⁻¹)	Temperature (°C)	Relative humidity (%)	SO ₂ (µg m ⁻³)	NO _x (µg m ⁻³)	O ₃ (µg m ⁻³)	Condensation sink (s ⁻¹)
Winter	94	0.83	6.87	62.3	0.86	3.89	61.5	3.60E-03
Spring	179	1.03	11.6	68.6	1.06	3.21	83.1	5.04E-03
Summer	234	0.97	20.6	63.2	0.89	2.86	91.2	7.67E-03
Autumn	129	0.90	15.3	71.4	1.02	2.99	66.9	5.00E-03

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SPAUB	Solar radiation (W m ⁻²)	Wind speed (m s ⁻¹)	Temperature (°C)	Relative humidity (%)	SO ₂ (µg m ⁻³)	NO _x (µg m ⁻³)	O ₃ (µg m ⁻³)	Organic carbon (PM _{2.5}) (µg m ⁻³)	Condensation sink (s ⁻¹)
Winter	96	2.32	11.6	65.7	1.50	35.05	39.9	4.23	9.29E-03
Spring	220	2.22	15.9	69.5	1.86	30.73	63.0	3.67	1.00E-02
Summer	277	1.81	24.8	68.6	2.67	26.07	70.6	4.05	9.91E-03
Autumn	143	1.93	20.0	72.3	1.91	33.27	48.4	3.96	1.06E-02

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GRERU	Solar radiation (W m ⁻²)	Wind speed (m s ⁻¹)	Temperature (°C)	Relative humidity (%)	NO _x (µg m ⁻³)	O ₃ (µg m ⁻³)	Organic carbon (PM _{2.5}) (µg m ⁻³)	Condensation sink (s ⁻¹)
Winter	100	6.29	13.2	71.9	0.59	40.8	1.36	2.95E-03
Spring	239	5.21	17.1	69.5	0.58	51.6	1.53	4.04E-03
Summer	301	7.33	23.9	67.4	0.48	58.0	2.16	6.38E-03
Autumn	161	5.67	19.7	71.4	0.50	46.5	1.51	4.33E-03

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GREUB	Solar radiation (W m ⁻²)	Wind speed (m s ⁻¹)	Temperature (°C)	Relative humidity (%)	Condensation sink (s ⁻¹)
Winter	88	1.86	9.30	71.9	8.81E-03
Spring	215	1.96	15.9	59.2	8.02E-03
Summer	282	2.00	26.5	46.0	6.93E-03
Autumn	144	1.68	18.5	65.2	6.73E-03

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50 **Table S5:** NPF probability (and number of NPF events) per season.

Sites	Winter	Spring	Summer	Autumn	Total
DENRU	0% (0)	10.3% (62)	20.5% (100)	2.9% (14)	176
DENUB	0% (0)	9.9% (67)	9.6% (39)	2.6% (10)	116
DENRO	0.2% (1)	5.9% (39)	13.9% (65)	2.4% (12)	117
GERRU	2.1% (5)	24.3% (57)	31.4% (81)	8.2% (21)	164
GERUB	0% (0)	27.6% (64)	30.7% (82)	8.6% (23)	169
GERRO	1.1% (2)	9.8% (9)	18.0% (40)	5.0% (11)	62
FINRU	2.8% (15)	21.2% (113)	4.4% (24)	7.1% (38)	190
FINUB	1.5% (8)	10.9% (60)	1.3% (7)	6.2% (34)	109
FINRO	2.0% (4)	4.8% (10)	8.3% (23)	4.4% (12)	49
SPARU	14.0% (19)	22.8% (34)	5.6% (9)	4.2% (6)	68
SPAUB	9.1% (19)	12.5% (23)	8.0% (17)	15.5% (38)	97
GRERU	5.6% (18)	11.6% (54)	4.2% (23)	4.7% (21)	116
GREUB	8.1% (18)	10.6% (26)	5.5% (13)	9.6% (25)	82

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53 **Table S6:** Annual number of NPF events, growth rate and formation rate.
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	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
DENRU	11	15	22	16	18	24	19	27	24	NA
DEBUB	10	7	11	6	34	15	17	11	5	NA
DENRO	14	13	7	12	16	11	16	22	6	NA
GERRU	63	55	46	NA	NA	NA	NA	NA	NA	NA
GERUB	50	63	56	NA	NA	NA	NA	NA	NA	NA
GERRO	15	17	30	NA	NA	NA	NA	NA	NA	NA
FINRU	33	41	27	NA	NA	NA	NA	34	27	28
FINUB	21	34	12	NA	NA	NA	NA	19	8	15
FINRO	NA	NA	NA	NA	NA	NA	NA	21	15	13
SPARU	NA	NA	NA	NA	35	3	30	NA	NA	NA
SPAUB	NA	NA	NA	NA	23	43	31	NA	NA	NA
GRERU	NA	NA	NA	NA	13	17	14	11	23	38
GREUB	NA	NA	NA	NA	NA	NA	NA	37	27	18

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	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
DENRU	3.03	3.47	3.9	2.79	3.04	3.45	2.93	2.97	2.98	NA
DEBUB	3.51	3.25	2.7	2.46	3.44	3.2	3.39	2.82	2.96	NA
DENRO	4.2	4.68	3.49	4.16	3.91	5.88	4.66	4.48	4.36	NA
GERRU	4.08	4.5	4.5	NA	NA	NA	NA	NA	NA	NA
GERUB	4.39	4.04	4.34	NA	NA	NA	NA	NA	NA	NA
GERRO	4.68	5.95	4.96	NA	NA	NA	NA	NA	NA	NA
FINRU	3.13	3.05	2.72	NA	NA	NA	NA	3.34	2.52	2.5
FINUB	3.21	2.89	2.94	NA	NA	NA	NA	2.63	2.83	2.65
FINRO	NA	NA	NA	NA	NA	NA	NA	3.56	3.89	3.86
SPARU	NA	NA	NA	NA	3.37	2.41	4.05	NA	NA	NA
SPAUB	NA	NA	NA	NA	4.03	3.55	2.69	NA	NA	NA
GRERU	NA	NA	NA	NA	4.92	2.97	3.16	3.04	4.76	3.61
GREUB	NA	NA	NA	NA	NA	NA	NA	3.61	3.56	3.98

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	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
DENRU	2.15E-02	3.39E-02	2.34E-02	1.48E-02	1.89E-02	2.80E-02	1.76E-02	2.26E-02	3.25E-02	NA
DEBUB	2.16E-02	2.62E-02	1.94E-02	1.00E-02	2.98E-02	1.77E-02	1.62E-02	1.94E-02	1.08E-02	NA
DENRO	1.12E-01	9.07E-02	5.80E-02	7.48E-02	6.66E-02	8.81E-02	6.89E-02	8.07E-02	5.28E-02	NA
GERRU	8.46E-02	1.03E-01	8.85E-02	NA	NA	NA	NA	NA	NA	NA
GERUB	1.13E-01	8.30E-02	1.14E-01	NA	NA	NA	NA	NA	NA	NA
GERRO	9.17E-02	1.63E-01	1.46E-01	NA	NA	NA	NA	NA	NA	NA
FINRU	7.85E-03	1.29E-02	7.19E-03	NA	NA	NA	NA	1.48E-02	9.38E-03	1.24E-02
FINUB	1.99E-02	1.91E-02	2.53E-02	NA	NA	NA	NA	2.99E-02	1.82E-02	2.75E-02
FINRO	NA	NA	NA	NA	NA	NA	NA	6.83E-02	5.82E-02	8.35E-02
SPARU	NA	NA	NA	NA	1.69E-02	7.33E-03	1.46E-02	NA	NA	NA
SPAUB	NA	NA	NA	NA	1.12E-02	2.65E-02	2.12E-02	NA	NA	NA
GRERU	NA	NA	NA	NA	2.18E-03	4.01E-03	5.30E-03	3.43E-03	7.67E-03	4.85E-03
GREUB	NA	NA	NA	NA	NA	NA	NA	3.06E-02	5.15E-02	6.09E-02

59 **Table S7:** Average conditions as a function of incoming wind direction at each site.

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DENRU	WS (m s ⁻¹)	RH (%)	T (°C)	CS (s ⁻¹)	OC (µg m ⁻³)	NPF probability (%)	GR (nm h ⁻¹)	J ₁₀ (N cm ⁻³ s ⁻¹)
N	3.45	72.8	7.85	6.62E-03	1.35	2.88%	3.47	9.58E-03
NE	3.92	74.2	8.35	9.57E-03	1.81	3.19%	3.30	2.21E-02
E	3.93	74.2	9.19	1.20E-02	2.41	2.33%	3.27	2.24E-02
SE	3.92	74.1	10.5	1.35E-02	2.39	1.36%	3.52	1.69E-02
S	4.15	77.9	10.5	1.16E-02	1.40	3.54%	3.47	2.50E-02
SW	4.34	80.1	9.64	7.61E-03	0.96	6.54%	3.07	3.19E-02
W	4.87	75.1	10.1	6.21E-03	0.94	10.4%	3.05	2.97E-02
NW	3.71	70.2	9.06	6.65E-03	1.06	8.01%	3.26	1.84E-02

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DENUB	WS (m s ⁻¹)	RH (%)	T (°C)	CS (s ⁻¹)	NPF probability (%)	GR (nm h ⁻¹)	J ₁₀ (N cm ⁻³ s ⁻¹)
N	3.45	72.8	7.86	1.07E-02	3.14%	3.28	1.95E-02
NE	3.92	74.2	8.36	1.32E-02	1.81%	3.36	2.74E-02
E	3.93	74.2	9.19	1.67E-02	1.85%	3.21	2.63E-02
SE	3.93	74.1	10.5	2.06E-02	2.05%	3.31	2.52E-02
S	4.16	77.9	10.6	1.70E-02	2.01%	3.22	2.45E-02
SW	4.34	80.0	9.69	1.27E-02	3.04%	3.02	1.69E-02
W	4.87	75.0	10.1	1.04E-02	7.76%	2.94	2.27E-02
NW	3.71	70.2	9.10	1.04E-02	5.20%	3.47	2.90E-02

62

DENRO	WS (m s ⁻¹)	RH (%)	T (°C)	CS (s ⁻¹)	OC (µg m ⁻³)	NPF probability (%)	GR (nm h ⁻¹)	J ₁₀ (N cm ⁻³ s ⁻¹)
N	3.47	72.7	8.02	2.46E-02	2.42	1.92%	4.33	5.46E-02
NE	3.92	74.3	8.56	3.62E-02	2.91	2.41%	5.27	1.04E-01
E	3.92	74.4	9.50	3.46E-02	3.43	2.95%	5.02	1.07E-01
SE	3.90	74.3	10.9	3.53E-02	3.30	2.16%	5.16	1.23E-01
S	4.15	77.9	10.7	3.18E-02	2.51	2.57%	4.56	7.35E-02
SW	4.34	80.2	9.91	3.08E-02	2.17	2.81%	4.00	5.76E-02
W	4.84	75.0	10.3	2.36E-02	2.12	7.44%	3.95	7.09E-02
NW	3.72	70.2	9.36	2.79E-02	2.20	3.49%	5.02	8.74E-02

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GERRU	WS (m s ⁻¹)	RH (%)	T (°C)	CS (s ⁻¹)	OC (µg m ⁻³)	NPF probability (%)	GR (nm h ⁻¹)	J ₁₀ (N cm ⁻³ s ⁻¹)
N	2.00	84.5	9.08	7.47E-03	2.68	13.0%	4.40	7.21E-02
NE	2.19	81.9	8.86	9.30E-03	3.47	21.6%	4.47	8.48E-02
E	2.08	77.5	10.3	9.30E-03	3.34	25.0%	4.61	1.17E-01
SE	1.64	81.3	11.2	7.90E-03	2.18	21.9%	4.41	1.08E-01
S	2.45	81.6	10.8	6.48E-03	1.89	13.8%	4.33	1.23E-01
SW	3.24	82.7	10.3	6.49E-03	1.66	10.9%	4.29	1.02E-01
W	3.23	81.7	10.5	5.05E-03	1.38	12.5%	3.81	4.81E-02
NW	2.35	79.7	11.8	5.28E-03	1.55	10.3%	4.27	3.53E-02

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GERUB	WS (m s⁻¹)	RH (%)	T (°C)	CS (s⁻¹)	NPF probability (%)	GR (nm h⁻¹)	J₁₀(N cm⁻³ s⁻¹)
N	1.99	84.3	9.18	8.67E-03	13.8%	4.21	7.86E-02
NE	2.19	82.1	8.73	1.00E-02	26.7%	4.58	6.74E-02
E	2.07	77.3	10.4	1.14E-02	28.4%	4.67	1.05E-01
SE	1.64	81.1	11.3	1.12E-02	22.9%	4.04	1.31E-01
S	2.45	81.4	10.9	9.99E-03	11.4%	3.96	1.87E-01
SW	3.22	82.8	10.3	8.64E-03	8.7%	3.97	1.35E-01
W	3.21	81.6	10.6	6.82E-03	12.5%	3.66	6.84E-02
NW	2.38	79.8	11.7	6.72E-03	11.1%	4.08	3.76E-02

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GERRO	WS (m s⁻¹)	RH (%)	T (°C)	CS (s⁻¹)	NPF probability (%)	GR (nm h⁻¹)	J₁₀(N cm⁻³ s⁻¹)
N	2.10	81.6	9.84	1.55E-02	2.69%	4.94	6.71E-02
NE	2.09	79.8	9.10	1.59E-02	7.32%	4.97	1.30E-01
E	1.75	72.6	12.4	1.54E-02	15.5%	4.92	1.23E-01
SE	1.62	77.1	11.9	1.40E-02	10.4%	5.05	1.73E-01
S	2.05	80.1	10.9	8.95E-03	3.36%	5.36	1.90E-01
SW	2.99	78.7	11.3	8.41E-03	3.17%	5.53	1.24E-01
W	2.85	77.5	12.0	1.17E-02	5.72%	5.31	1.04E-01
NW	2.70	79.9	11.5	1.32E-02	4.50%	5.12	1.25E-01

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FINRU	WS (m s⁻¹)	RH (%)	T (°C)	CS (s⁻¹)	NPF probability (%)	GR (nm h⁻¹)	J₁₀(N cm⁻³ s⁻¹)
N	1.96	73.7	3.20	1.82E-03	14.6%	2.98	7.20E-03
NE	1.37	80.0	1.84	1.95E-03	10.9%	3.21	1.54E-02
E	0.98	81.8	3.21	2.49E-03	7.10%	3.09	1.41E-02
SE	1.19	83.4	4.66	2.97E-03	4.49%	3.08	1.47E-02
S	1.19	82.8	6.11	2.60E-03	5.20%	2.93	9.35E-03
SW	1.39	78.5	6.99	2.23E-03	8.42%	2.97	1.39E-02
W	1.26	78.0	4.75	1.75E-03	12.3%	2.61	1.23E-02
NW	1.88	73.9	3.41	1.78E-03	18.5%	2.91	9.58E-03

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FINUB	WS (m s⁻¹)	RH (%)	T (°C)	CS (s⁻¹)	NPF probability (%)	GR (nm h⁻¹)	J₁₀(N cm⁻³ s⁻¹)
N	2.95	72.1	4.31	5.49E-03	8.06%	2.61	2.85E-02
NE	2.86	77.5	3.17	6.82E-03	5.11%	2.67	3.66E-02
E	3.26	77.2	7.09	7.48E-03	1.57%	3.66	2.60E-02
SE	3.29	76.9	7.08	6.82E-03	1.73%	4.18	2.84E-02
S	3.77	81.0	6.98	6.67E-03	1.44%	4.14	3.55E-02
SW	4.14	79.0	9.34	4.86E-03	1.92%	3.21	1.39E-02
W	3.59	77.5	6.72	7.96E-03	7.53%	2.67	2.38E-02
NW	3.13	70.2	5.52	4.51E-03	13.3%	2.78	2.17E-02

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FINRO	WS (m s⁻¹)	RH (%)	T (°C)	CS (s⁻¹)	NPF probability (%)	GR (nm h⁻¹)	J₁₀(N cm⁻³ s⁻¹)
N	3.89	66.8	5.54	7.38E-03	9.31%	4.06	6.21E-02
NE	3.74	71.2	2.75	6.64E-03	8.52%	3.44	5.52E-02
E	4.21	70.3	9.30	7.87E-03	6.22%	3.75	4.29E-02
SE	4.23	72.3	7.94	9.41E-03	3.69%	4.00	6.76E-02
S	4.62	74.8	7.71	1.04E-02	1.81%	3.47	1.23E-01
SW	4.64	72.1	10.1	9.90E-03	3.22%	3.48	8.51E-02
W	4.12	72.4	8.07	9.64E-03	3.27%	3.83	8.64E-02
NW	4.23	67.0	6.61	8.44E-03	4.47%	3.99	7.07E-02

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SPARU	WS (m s⁻¹)	RH (%)	T (°C)	CS (s⁻¹)	NPF probability (%)	GR (nm h⁻¹)	J₁₀(N cm⁻³ s⁻¹)
N	0.46	72.3	13.0	4.64E-03	12.8%	3.57	2.54E-02
NE	0.26	72.1	13.1	5.00E-03	10.9%	3.67	8.75E-03
E	0.37	72.2	13.7	5.26E-03	10.8%	3.91	1.74E-02
SE	1.47	64.8	18.0	7.43E-03	9.28%	3.97	1.48E-02
S	0.93	58.7	17.1	6.46E-03	10.7%	3.68	1.67E-02
SW	0.45	60.9	13.7	4.45E-03	14.0%	3.23	2.07E-02
W	0.59	59.0	13.6	4.33E-03	17.5%	3.62	1.94E-02
NW	0.99	64.5	12.8	4.19E-03	16.7%	3.52	1.23E-02

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SPAUB	WS (m s⁻¹)	RH (%)	T (°C)	CS (s⁻¹)	NPF probability (%)	GR (nm h⁻¹)	J₁₀(N cm⁻³ s⁻¹)
N	1.24	73.8	15.9	1.14E-02	9.22%	3.02	8.62E-03
NE	2.56	79.0	17.1	9.39E-03	5.49%	3.30	2.63E-02
E	2.80	74.2	20.1	9.71E-03	6.83%	3.25	1.40E-02
SE	1.94	68.5	21.2	1.19E-02	8.42%	2.79	2.13E-02
S	1.63	63.6	22.3	1.22E-02	12.4%	3.32	3.35E-02
SW	1.60	65.9	21.6	1.13E-02	12.3%	3.91	2.59E-02
W	2.37	65.9	16.3	9.12E-03	21.5%	3.30	2.12E-02
NW	2.30	64.1	14.4	7.52E-03	22.0%	3.50	9.87E-03

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GRERU	WS (m s⁻¹)	RH (%)	T (°C)	CS (s⁻¹)	OC (µg m⁻³)	NPF probability (%)	GR (nm h⁻¹)	J₁₀(N cm⁻³ s⁻¹)
N	6.23	72.3	17.0	3.75E-03	1.39	5.51%	2.99	4.65E-03
NE	2.52	68.8	19.6	3.78E-03	1.42	5.87%	2.34	1.71E-03
E	3.36	70.6	18.7	3.82E-03	1.47	3.37%	2.68	5.41E-03
SE	8.44	65.5	18.1	3.28E-03	1.58	5.15%	3.60	2.38E-03
S	4.44	69.9	17.6	3.10E-03	1.53	5.25%	3.54	3.84E-02
SW	5.20	72.7	19.0	4.43E-03	1.79	5.56%	3.63	1.23E-02
W	6.39	69.5	21.1	5.41E-03	1.86	6.68%	3.97	2.69E-03
NW	7.08	67.9	17.7	4.51E-03	1.53	10.3%	3.42	5.25E-03

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GREUB	WS (m s⁻¹)	RH (%)	T (°C)	CS (s⁻¹)	NPF probability (%)	GR (nm h⁻¹)	J₁₀(N cm⁻³ s⁻¹)
N	1.90	48.8	7.28	7.57E-03	9.35%	3.20	3.62E-02
NE	2.54	55.2	17.6	6.29E-03	4.82%	3.30	3.86E-02
E	1.56	60.7	22.3	7.12E-03	4.73%	3.69	3.33E-02
SE	1.99	64.6	21.1	7.61E-03	7.44%	3.57	1.38E-02
S	0.88	68.5	17.3	8.23E-03	7.78%	3.62	4.53E-02
SW	1.55	65.0	17.4	7.53E-03	8.61%	3.87	4.44E-02
W	2.05	53.5	16.4	9.01E-03	10.6%	3.98	5.07E-02
NW	1.30	51.8	20.6	1.01E-02	11.8%	3.99	6.56E-02

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78 **Table S8:** Average conditions for local and region-wide events (*refers to NO₂).

Site		WS (m s ⁻¹)		T (°C)		RH (%)		SR (W m ⁻²)	
		Local	Regional	Local	Regional	Local	Regional	Local	Regional
DEN	RU	4.20 ± 1.29	4.72 ± 1.34	14.1 ± 4.51	10.6 ± 4.05	65 ± 9.51	65.6 ± 8.90	223 ± 69.3	197 ± 76.1
	UB	4.54 ± 1.47	4.72 ± 1.34	12.2 ± 5.49	10.6 ± 4.05	64.3 ± 10.4	65.6 ± 8.90	210 ± 76.8	197 ± 76.1
GER	RU	2.18 ± 1.59	1.97 ± 1.50	14.6 ± 8.44	15.9 ± 7.64	74.4 ± 20.2	69.2 ± 21.8	196 ± 247	251 ± 287
	UB	2.12 ± 1.55	1.97 ± 1.50	15.6 ± 8.14	15.9 ± 7.64	72.5 ± 21.3	69.2 ± 21.8	225 ± 269	251 ± 287
FIN	RU	1.37 ± 1.02	1.67 ± 1.12	4.3 ± 7.69	0.87 ± 5.93	64.7 ± 21.5	64.3 ± 19.8	153 ± 202	148 ± 197
	UB	3.38 ± 1.89	3.14 ± 1.54	6.25 ± 6.15	3.75 ± 5.24	65.4 ± 17.6	56.4 ± 17.5	142 ± 206	168 ± 224
SPA	RU	1.16 ± 0.51	1.07 ± 0.25	11.8 ± 4.76	13.6 ± 5.41	63.2 ± 12.2	55.2 ± 13.1	149 ± 66.3	167 ± 65.1
	UB	2.49 ± 1.06	3.13 ± 0.80	17.9 ± 5.41	17.5 ± 4.99	58.6 ± 9.44	54.2 ± 10.2	199 ± 77.3	194 ± 69.7

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Site		CS (s ⁻¹)		GR (nm h ⁻¹)		J ₁₀ (N cm ⁻³ s ⁻¹)	
		Local	Regional	Local	Regional	Local	Regional
DEN	RU	9.03E-03 ± 5.69E-03	6.94E-03 ± 3.84E-03	3.26 ± 1.49	2.89 ± 1.12	2.39E-02 ± 3.27E-02	2.00E-02 ± 2.45E-02
	UB	1.17E-02 ± 6.35E-03	1.01E-02 ± 3.86E-03	3.36 ± 1.59	2.78 ± 0.92	2.67E-02 ± 4.01E-02	2.16E-02 ± 2.76E-02
GER	RU	7.36E-03 ± 3.42E-03	9.42E-03 ± 4.22E-03	4.11 ± 1.71	4.48 ± 1.71	7.58E-02 ± 3.76E-02	1.02E-01 ± 1.65E-01
	UB	9.63E-03 ± 1.03E-02	1.01E-02 ± 5.24E-03	4.19 ± 1.71	4.27 ± 1.66	1.00E-01 ± 2.02E-01	1.03E-01 ± 2.28E-01
FIN	RU	2.26E-03 ± 1.33E-03	1.85E-03 ± 1.17E-03	2.96 ± 1.76	2.75 ± 1.37	1.03E-02 ± 1.82E-02	1.29E-02 ± 2.34E-02
	UB	4.46E-03 ± 3.16E-03	4.04E-03 ± 2.70E-03	3.06 ± 1.53	2.60 ± 0.87	2.19E-02 ± 3.33E-02	2.45E-02 ± 3.67E-02
SPA	RU	4.00E-03 ± 2.13E-03	4.30E-03 ± 1.59E-03	3.98 ± 2.22	3.38 ± 1.32	1.32E-02 ± 1.74E-02	1.32E-02 ± 1.68E-02
	UB	8.92E-03 ± 3.60E-03	6.66E-03 ± 2.12E-03	3.37 ± 1.56	3.31 ± 0.81	2.28E-02 ± 2.67E-02	1.44E-02 ± 1.42E-02

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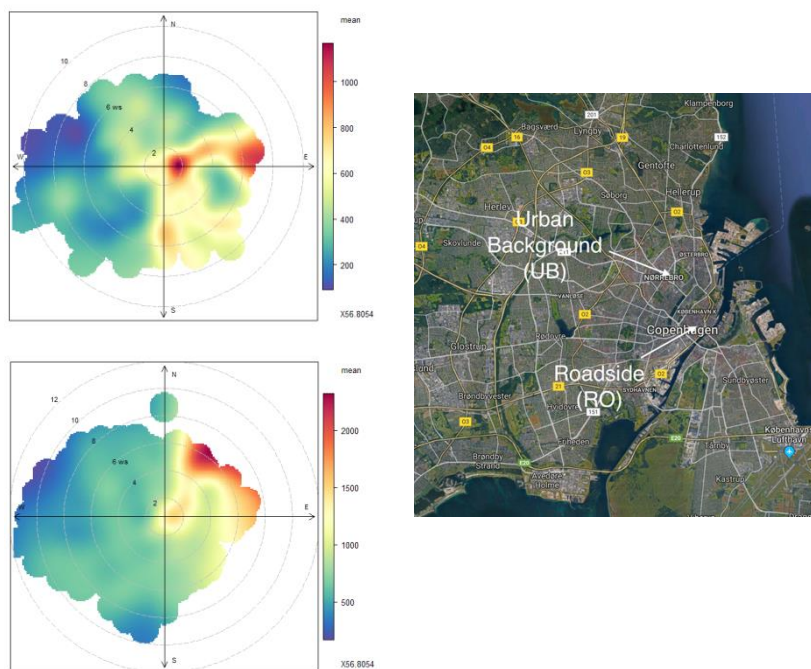
Site		NO _x / NO ₂ (μg m ⁻³)		O ₃ (μg m ⁻³)		SO ₂ (μg m ⁻³)	
		Local	Regional	Local	Regional	Local	Regional
DEN	RU	2.65 ± 1.73	2.35 ± 1.23	36.6 ± 6.37	38.3 ± 4.91	0.19 ± 0.21	0.14 ± 0.07
	UB	6.89 ± 2.96	5.89 ± 2.24	35.3 ± 5.78	35.7 ± 5.09	-	-
GER	RU	-	-	-	-	-	-
	UB	-	-	-	-	-	-
FIN	RU	0.51 ± 0.54	0.51 ± 0.59	33.4 ± 8.59	35.6 ± 6.63	0.13 ± 0.27	0.13 ± 0.19
	UB	-	-	-	-	-	-
SPA	RU	2.38 ± 1.01*	2.74 ± 0.66*	72.2 ± 8.54	81.4 ± 14.2	0.95 ± 0.89	0.90 ± 0.66
	UB	26.5 ± 13.1*	19.6 ± 7.21*	59.2 ± 15.8	67.6 ± 15.4	1.94 ± 0.81	1.94 ± 0.93

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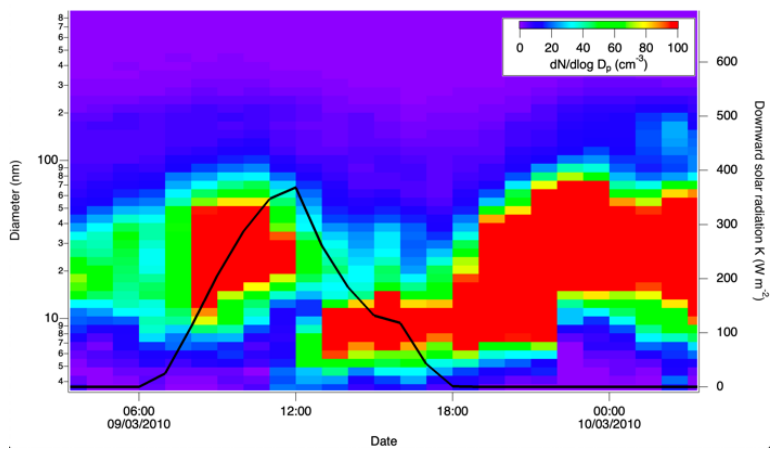
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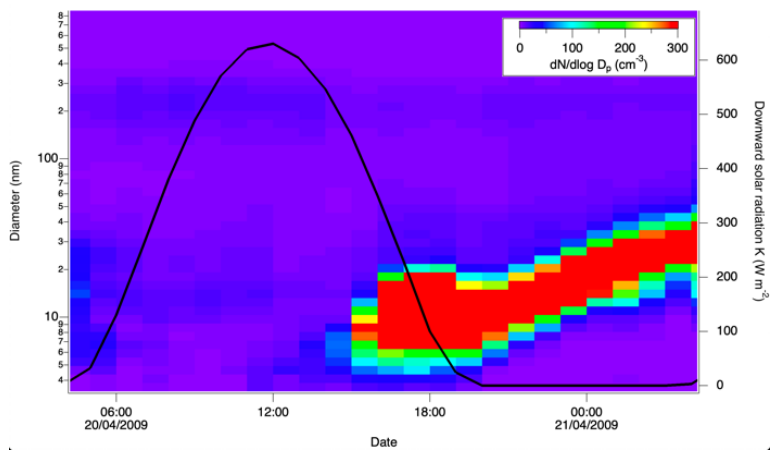
87 **Figure S1:** Sources of 56 nm particles at DENUB and DENRO (map provided by ©Google Maps).

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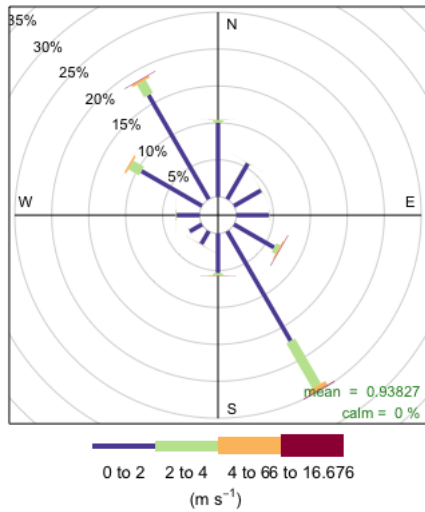
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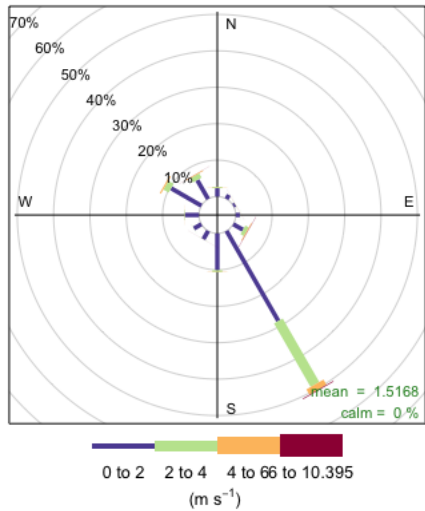
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Figure S2: Examples of NPF events with late growth of the particles at FINRU.



95 **Frequency of counts by wind direction (%)**



96 **Frequency of counts by wind direction (%)**

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 98 **Figure S3:** Average wind profile (top panel) and wind profile for the time window 9:00 to 15:00
 99 (bottom panel) for SPARU.

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