



*Supplement of*

## **Summer aerosol measurements over the East Antarctic seasonal ice zone**

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## S1. Uncertainty in mode size locations

To estimate the uncertainty in the size of the aerosol modes, each aerosol size distribution measurement was split into two halves, with the split point being the observed Hoppel minimum size for the dataset in question.

- 5 For each split distribution, the diameter of the maximum was retrieved. This produces a dataset of the sizes where maxima were observed. The median of this dataset and the CI was then determined using bootstrap resampling ( $R = 10\,000$ ).

Grouping size distribution measurements before applying this process results in the modal bin sizes and confidence intervals reported in Table S4.

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**Table S1:** Sensitivity testing of selected wind windows. “f\_plus” etc. refers to the adjusted sector. “f” and “p” stand for Ferrel and Polar respectively. “plus” and “minus” refer to the sector shifted closer to  $0^\circ$  and  $360^\circ$  respectively. “wide” and “narrow” refer to the sectors being symmetrically widened or narrowed by  $10^\circ$  on each side.

	Ferrel cell sector				Polar cell sector			
Window ( $^\circ$ )	f_plus	f_minus	f_wide	f_narrow	p_plus	p_minus	p_wide	p_narrow
<b>Median CN<sub>3</sub></b>	259	246	265	229	613	578	534	620
<b>Concentration (cm<sup>-3</sup>)</b> <b>(95% CI)</b>	(246-272)	(230-262)	(253-278)	(213-245)	(592-634)	(556-600)	(515-554)	(596-643)
<b>% available CN<sub>3</sub> measurements</b>	19	17	22	13	24	29	32	21
<b>n</b>	823	742	979	586	1067	1282	1426	923
<b>Median CCN<sub>0.55</sub> (cm<sup>-3</sup>)</b> <b>(95% CI)</b>	120	115	117	122	227	202	200	236
<b>Median Rn (mBq m<sup>-3</sup>)</b> <b>(95% CI)</b>	59	64	61	60	74	77	76	80
	(54-64)	(58-69)	(57-66)	(54-66)	(69-79)	(72-82)	(72-81)	(73-87)

**Table S2: Cross-tabulation of measurements present in wind and absolute humidity categories. Integers represent measurement numbers, with percentage of total measurements indicated in parentheses.**

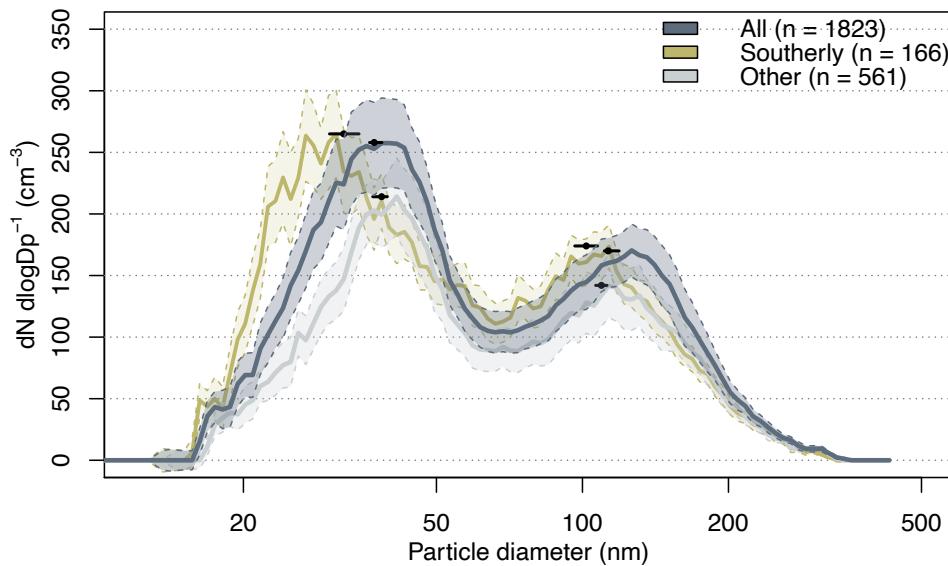
<b>Absolute humidity category</b>	<b>Wind category</b>						<b>Total</b>
	<b>Polar</b>	<b>Ferrel</b>	<b>Transit</b>	<b>Southerly</b>	<b>Other</b>		
<b>Low</b>	1501 (19.7)	868 (11.4)	0	840 (11.0)	265 (3.4)	3474 (45.5)	
<b>Mid</b>	710 (9.3)	575 (7.5)	68 (0.9)	435 (5.7)	1240 (16.3)	3028 (39.7)	
<b>High</b>	0	1 (0.1)	1124 (14.7)	0	0	1125 (14.8)	
<b>Total</b>	2211 (29.0)	1444 (18.9)	1192 (15.6)	1275 (16.7)	1505 (19.7)	7627 (100)	

**Table S3: Summary of statistics presented in Fig. 2 and 5.**

	<b>Wind category</b>					<b>Absolute humidity Category</b>			<b>All</b>	
	<b>Polar</b>	<b>Ferrel</b>	<b>Transit</b>	<b>Southern</b>	<b>Other</b>	<b>Low</b>	<b>Mid</b>	<b>High</b>		
<b>Median concentrations</b>	<b>Median CN<sub>3</sub> concentration</b> (95% CI) (cm <sup>-3</sup> )	594 (573-615)	265 (252-279)	366 (349-384)	354 (329-379)	250 (240-260)	507 (489-526)	284 (276-292)	363 (350-375)	354 (345-363)
	<b>Median CCN<sub>0.55</sub> concentration</b> (95% CI) (cm <sup>-3</sup> )	208 (176-240)	107 (79-134)	208 (200-217)	126 (106-146)	128 (114-143)	228 (201-255)	117 (107-128)	208 (198-218)	167 (158-176)
	<b>Median radon concentration</b> (95% CI) (mBqm <sup>-3</sup> )	78.3 (73.3-83.3)	59.1 (54.3-63.9)	72.6 (54.3-65.5)	67.8 (61.8-73.8)	57.5 (52.9-62.1)	68.1 (64.0-72.1)	63.6 (60.3-66.9)	60.1 (54.5-65.7)	64.5 (62.0-67.0)
<b>Size distribution</b>	<b>Aitken modal size bin</b> (concentration) (95% CI) (nm (cm <sup>-3</sup> ))	38.5 (291)	41.4 (198)	37.2 (421)	31.1 (265)	41.4 (214)	38.5 (230)	40.0 (221)	37.2 (422)	38.5 (258)
	<b>Hoppel minimum size bin</b> (concentration) (95% CI) (nm (cm <sup>-3</sup> ))	66.1 (153)	61.5 (116)	71.1 (73.6)	66.1 (111)	66.1 (88.4)	66.1 (151)	66.1 (95.1)	71.0 (68.9)	71.0 (104)
	<b>Accumulation modal size bin</b> (concentration) (95% CI) (nm (cm <sup>-3</sup> ))	102 (220)	109 (173)	157 (288)	113 (174)	113 (142)	106 (214)	113 (148)	157 (301)	126 (170)

**Table S4: Median modal bin sizes for wind and absolute humidity classifications from distributions fitted to each individual aerosol size distributions.**

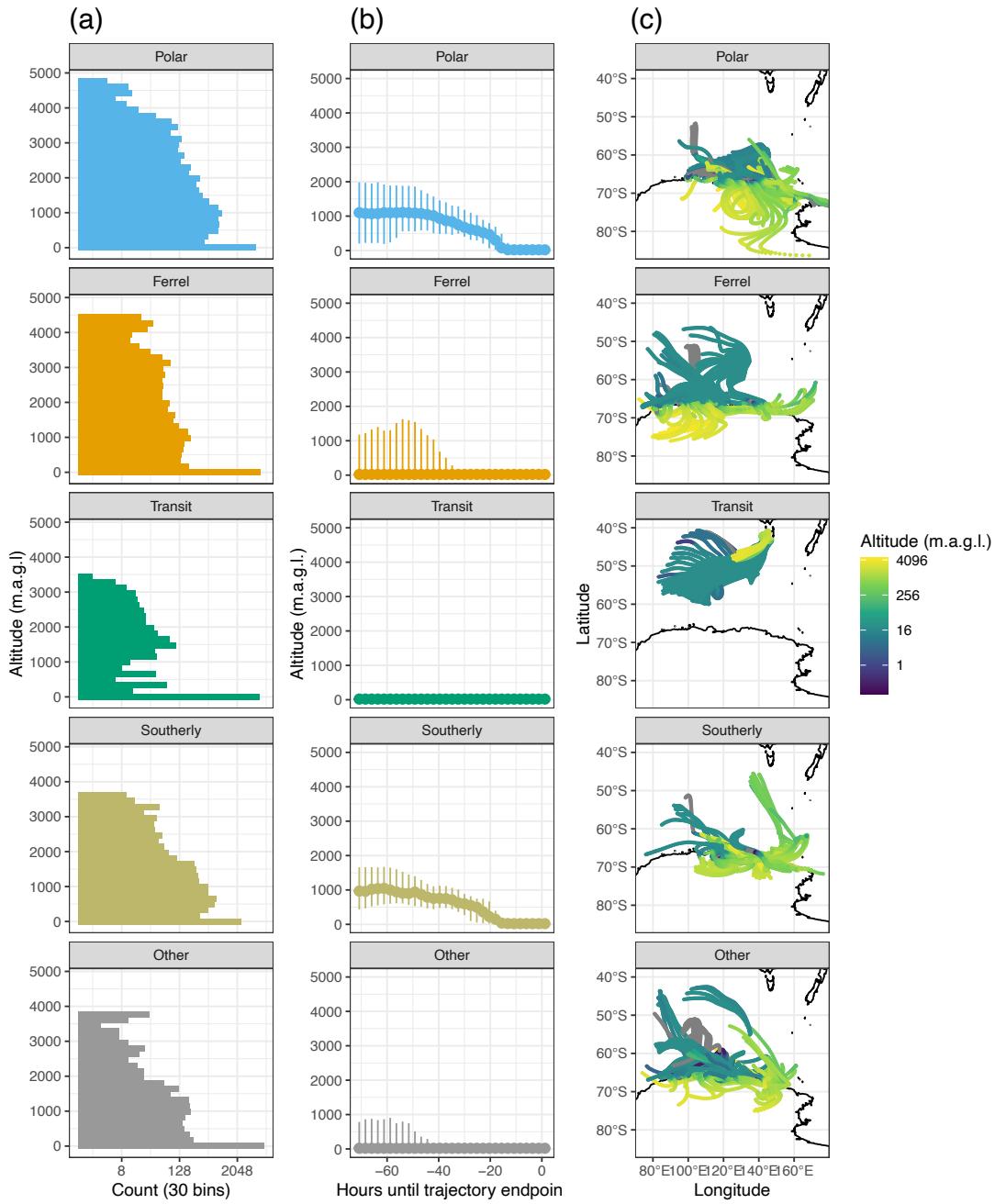
	Wind category					Absolute humidity Category			All
	Polar	Ferrel	Transit	Southern	Other	Low	Mid	High	-
<b>Aitken mode</b>	35.9	40.0	35.9	32.2	38.5	38.5	37.2	35.9	37.2
(95% CI)	(34.5-	(38.5-	(35.4-	(30.1-	(36.8-	(37.7-	(36.2-	(35.5-	(36.4-
(nm)	36.7)	41.6)	36.5)	34.5)	39.7)	40.6)	38.2)	36.2)	38.6)
<b>Accumulation mode</b>	98.2	109	146	102	109	102	106	146	113
(95% CI)	(94.9-101)	(106-116)	(143-152)	(96.6-108)	(107-112)	(98.6-104)	(103-108)	(144-148)	(111-119)
(nm)									



25 **Figure S1:** As plotted in Fig. 5, median particle size distributions for all measurements, the “Southerly” wind sector ( $148\text{--}217^\circ$ ) and measurements classified as “Other” in the wind direction classification scheme. Shaded areas represent the 95% confidence interval in the median for each bin size. Note the diameter axis is logarithmic in scale. The modal sizes and concentrations for each distribution are reported in the supplementary Table S3. Black points plotted on each distribution indicates the median Aitken and accumulation mode generated from analysis of individual size distributions. Error bars represent at 95% confidence interval.

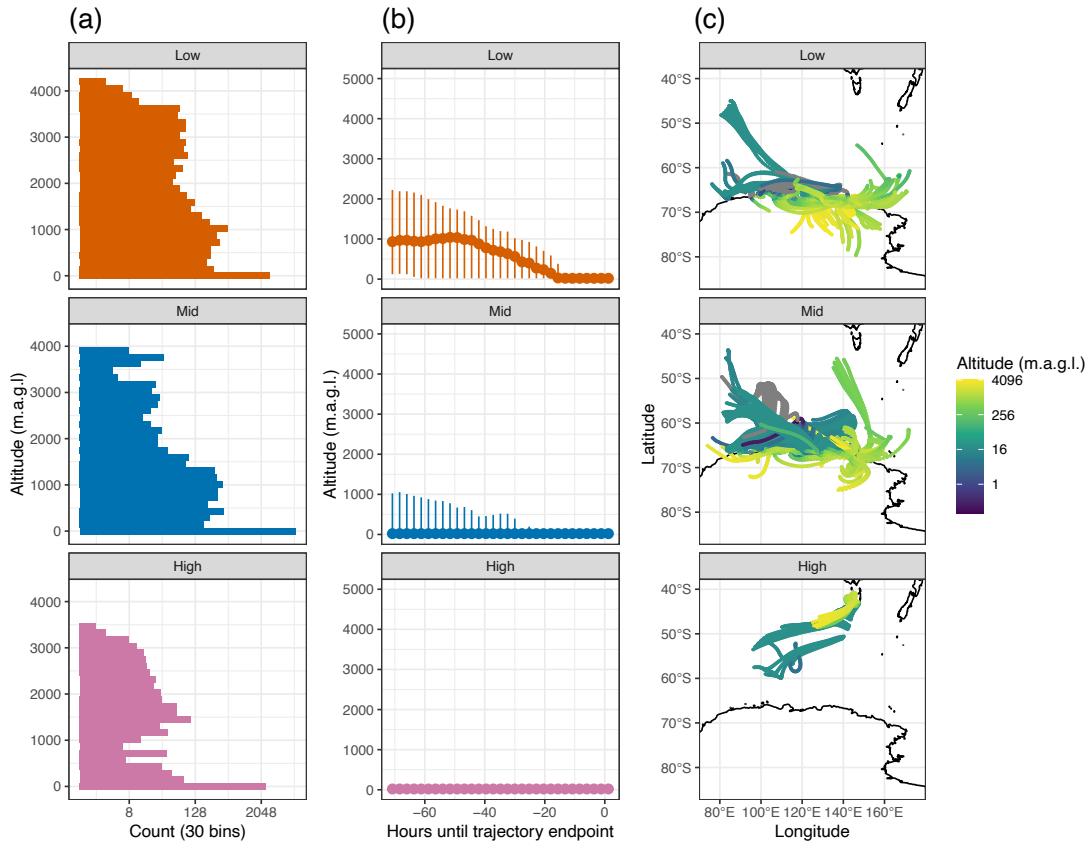
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Wind categories



**Figure S2: Trajectory plots grouped by wind category.** (a) is a frequency histogram binned by each modelled hour of the trajectory contributing one point to the plot, (b) a median vertical profile of all trajectories in each category, with vertical lines representing interquartile range and (c) a map demonstrating the spatial extent of trajectories in each category, coloured by altitude. The error bars in (b) represents interquartile range. Note the vertical development in the Polar category compared to the other categories.

Absolute humidity categories



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**Figure S3: Trajectory plots grouped by absolute humidity category.** (a) is a frequency histogram binned by altitude, (b) a median vertical profile of all trajectories in each category and (c) a map demonstrating the spatial extent of trajectories in each category, coloured by altitude. The error bars in (b) represents interquartile range. Note the vertical development in the Low category compared to the other categories.