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The importance of alkyl nitrates and sea ice emissions to atmospheric NO_x sources and cycling in the summertime Southern Ocean marine boundary layer

Jessica M. Burger et al.

Correspondence to: Jessica M. Burger (brgjes006@uct.ac.za)

Table S1: The starting and ending date, latitude (°S), and longitude(°E) are presented for each aerosol filter deployment. The wind speed (WS; m s^{-1}), atmospheric temperature (Atm T; °C), relative humidity (RH; %), and the number of daylight hours (h) were calculated as an average (Avg) over the duration of each filter deployment. For WS, Atm T and RH the standard deviations (SD) are also shown. Filter deployments are separated into early Summer (ES), Weddell Sea (WS) and late Summer (LS) depending on the location and time of sampling.

Cruise	Collection Dates		Latitude (°S)		Longitude (°E)		WS (m s^{-1})		Atm T (°C)		RH (%)		[1]Sample duration (h)
Leg ID	Start Date	End Date	Start	End	Start	End	Avg	SD	Avg	SD	Avg	SD	
ES 1	2018-12-07	2018-12-08	34.5	37.0	14.8	12.7	5.2	1.8	15.7	0.6	73.4	4.8	24.8
ES 2	2018-12-08	2018-12-09	37.1	41.8	12.6	8.8	5.0	3.3	14.7	1.1	65.9	10.9	13.5
ES 3	2018-12-09	2018-12-10	41.8	44.1	8.8	6.8	9.8	2.3	10.7	0.7	100.3	2.7	14.2
ES 4	2018-12-10	2018-12-12	45.0	50.8	6.1	0.6	13.3	3.1	3.6	1.9	76.6	9.2	15.6
ES 5	2018-12-14	2018-12-16	59.7	68.3	0.0	0.0	6.1	2.0	-2.6	0.6	76.1	8.8	29.5
ES 6	2018-12-16	2018-12-19	68.5	70.1	0.0	-2.1	8.8	4.8	-2.4	1.8	78.3	8.3	27.1
ES 7	2018-12-19	2018-12-21	70.1	70.2	-2.1	-2.1	11.7	1.8	-3.4	1.9	69.5	12.3	39.8
WS 8	2019-01-04	2019-01-06	67.4	64.0	-16.0	-37.0	8.3	4.4	-2.2	0.5	77.4	5.8	42.4
WS 9	2019-01-06	2019-01-08	63.9	62.5	-37.8	-49.2	6.4	3.2	-2.0	0.7	82.9	7.3	34.9
WS 10	2019-01-08	2019-01-10	62.5	65.7	-49.2	-60.2	6.9	3.9	-2.8	0.6	74.3	7.4	28.6
WS 11	2019-01-10	2019-01-12	65.7	66.6	-60.2	-59.6	5.3	1.4	-2.7	1.0	69.2	5.1	25.2
WS 12	2019-01-12	2019-01-14	66.6	66.1	-59.6	-60.4	4.6	1.2	-1.7	0.9	84.0	6.8	37.4
WS 13	2019-01-14	2019-01-16	66.1	65.8	-60.4	-60.5	8.4	2.4	-3.9	1.2	78.7	4.9	26.2
WS 14	2019-01-16	2019-01-18	65.8	65.8	-60.5	-60.7	4.6	0.7	-3.2	1.6	76.4	8.5	22.7
WS 15	2019-01-18	2019-01-20	65.8	66.4	-60.7	-60.3	5.4	1.1	-3.9	0.6	83.8	5.3	32.2
WS 16	2019-01-20	2019-01-22	66.4	66.4	-60.3	-59.9	3.7	1.9	-2.8	0.6	82.5	3.2	33.1
WS 17	2019-01-22	2019-01-26	66.4	64.7	-59.9	-57.2	5.1	2.6	-2.9	0.6	83.4	5.7	37.1
WS 18	2019-01-26	2019-01-28	64.7	63.9	-57.2	-52.0	8.2	1.8	-0.9	0.9	87.4	4.4	29.6
WS 19	2019-01-28	2019-01-31	63.9	62.1	-52.0	-49.9	10.5	4.8	-1.6	0.9	87.8	5.0	35.3
WS 20	2019-01-31	2019-02-01	62.1	62.2	-50.1	-58.9	7.0	3.6	-1.0	2.2	79.8	5.7	39.4
WS 21	2019-02-01	2019-02-06	62.2	61.9	-58.9	-48.7	10.4	3.1	1.5	0.9	89.4	5.0	88.4
WS 22	2019-02-06	2019-02-09	62.0	69.0	-48.2	-52.0	7.7	4.1	-3.6	3.1	87.6	4.1	48.6
WS 23	2019-02-09	2019-02-11	69.0	68.6	-52.0	-52.4	5.6	1.8	-6.2	1.8	80.7	3.3	34.4
WS 24	2019-02-11	2019-02-13	68.6	68.8	-52.4	-51.8	3.3	2.0	-7.8	1.1	82.6	3.8	23.6
WS 25	2019-02-13	2019-02-16	68.8	68.9	-51.8	-41.3	6.9	3.9	-5.2	1.5	81.7	6.5	37.7
WS 26	2019-02-16	2019-02-19	68.9	69.5	-41.3	-8.6	11.9	4.5	-0.6	0.5	90.3	5.5	75.8
WS 27	2019-02-19	2019-02-21	69.6	70.3	-8.2	-2.7	8.2	2.9	-5.3	2.3	76.1	8.1	38.9
LS 28	2019-02-27	2019-03-01	69.3	60.0	-4.0	-2.3	8.6	2.4	-0.7	1.4	74.1	6.5	40.6
LS 29	2019-03-01	2019-03-03	60.0	59.5	-2.8	-26.1	10.1	4.3	-0.2	0.6	80.8	5.3	38.8
LS 30	2019-03-03	2019-03-04	59.5	55.9	-26.1	-33.8	13.0	3.7	0.2	0.9	71.4	5.8	26.2
LS 31	2019-03-04	2019-03-10	55.8	49.5	-34.0	4.1	16.4	7.5	4.2	1.4	88.8	6.6	33.1
LS 32	2019-03-10	2019-03-12	49.5	43.1	4.1	7.8	11.9	2.4	8.6	2.5	90.0	4.7	34.1
LS 33	2019-03-12	2019-03-13	43.1	36.3	7.8	13.3	11.5	1.0	17.5	2.6	84.3	4.0	34.9
LS 34	2019-03-13	2019-03-14	36.1	34.4	13.4	17.8	10.2	2.3	20.0	0.4	82.1	5.0	18.1

[1] The difference in the pump's hour meter reading before and after a filter sample deployment. A sector collector was used to restrict HV-AS activity to avoid contamination from ship stack emissions (Campbell Scientific Africa). The HV-AS only began operating if the wind was blowing at an angle less than 75° or greater than 180° from the bow of the ship for a minimum of ten minutes at a speed of at least 1 m s^{-1}.

Table S2: Accepted reference values for $\delta^{15}N$ vs. N_2 in air and $\delta^{18}O$ vs. VSMOW in ‰ for the calibration standards used. The pooled standard deviation in ‰ and sample size (1 SD_p, n = x) is also reported.

Standard	**IAEA-N3**	**USGS34**	**USGS35**	**Citation**
$\delta^{15}N$	4.7 (0.12, n = 61)	-1.8 (0.09, n = 61)		Böhlke et al., 2003
$\delta^{18}O$	25.6 (0.57, n = 61)	-27.9 (0.54, n = 61)	57.5 (0.44, n = 65)	Böhlke et al., 2003

Table S3: The mass weighted average N and O isotopic composition of atmospheric coarse mode NO_3^- (> 1μm) are shown ($\delta^{15}N$-NO_3^- and $\delta^{18}O$-NO_3^-; ‰), along with total coarse-mode nitrate concentration ([NO_3^-]; ng m^{-3}). The average (Avg) and standard deviation (SD) for the duration of each filter deployment are shown. Filter deployments are separated into early summer (ES), Weddell Sea (WS) and late summer (LS) depending on the location and time of sampling.

Cruise	**[NO_3^-] (ng m^{-3})**		**$\delta^{15}N$-NO_3^- (‰)**		**$\delta^{18}O$-NO_3^- (‰)**	
Leg ID	**Avg**	**SD**	**Avg**	**SD**	**Avg**	**SD**
ES 1	75.5	27.1	-5.0	0.9	36.7	3.7
ES 2	124.0	37.3	-5.7	0.2	40.5	1.7
ES 3	264.0	45.6	-2.7	0.3	51.7	1.8
ES 4	23.9	19.2	-14.5	1.7	16.5	3.2
ES 5	77.6	9.7	-32.2	0.2	70.0	0.5
ES 6	51.9	7.1	-42.9	0.8	62.8	1.4
ES 7	80.7	7.7	-33.5	1.4	52.3	0.6
WS 8	18.8	1.1	-30.9	0.4	53.1	1.0
WS 9	37.6	1.2	-30.1	0.2	53.1	0.4
WS 10	31.0	3.8	-21.0	1.3	48.4	0.6
WS 11	35.0	17.6	-20.1	2.2	23.7	9.5
WS 12	24.8	3.7	-38.1	0.8	60.3	1.9
WS 13	23.4	6.3	-15.9	0.9	23.4	1.4
WS 14	24.4	14.8	-17.1	0.8	20.1	0.7
WS 15	25.6	10.5	-19.6	2.2	28.7	7.2
WS 16	29.6	5.2	-23.9	0.6	30.6	1.9
WS 17	51.4	13.9	-18.2	0.7	29.2	2.7
WS 18	67.3	6.6	-11.6	0.3	42.0	1.4
WS 19	42.9	12.8	-23.5	1.2	18.8	2.0
WS 20	39.9	4.8	-25.0	0.4	51.3	2.1
WS 21	17.3	1.2	-24.2	0.2	52.3	0.6
WS 22	21.1	6.2	-15.5	1.5	45.0	0.7
WS 23	20.7	4.9	-37.8	1.4	50.5	3.8
WS 24	57.7	10.8	-18.7	0.2	28.6	2.0
WS 25	40.2	10.9	-27.7	3.0	34.8	2.0
WS 26	25.8	6.7	-18.4	0.9	43.6	5.8
WS 27	40.8	10.1	-17.0	0.3	30.3	1.8
LS 28	28.3	3.8	-25.6	0.6	50.5	2.8
LS 29	19.9	3.9	-20.8	1.2	51.2	3.7
LS 30	21.9	5.4	-22.4	1.1	43.1	4.24
LS 31	33.0	6.9	-14.0	0.2	44.9	1.6
LS 32	59.1	7.4	-11.2	0.1	45.3	1.4
LS 33	111.3	6.6	-6.6	0.1	57.9	0.8
LS 34	199.0	20.1	-4.6	0.1	58.9	0.9

Table S4: The average (Avg) and standard deviation (SD) sea surface nitrite concentration ([NO_2^-] (μmol L^{-1})) measured during the early summer (ES) and late summer (LS) cruise transects. The date (dd/mm/yyyy), time (GMT), latitude (ºS) and longitude (ºE) of each sample is also given.

Leg	**Date**	**Time**	**Latitude**	**Longitude**	**[NO_2^-] (μmol L^{-1})**	
	(dd/mm/yyyy)	**(GMT)**	**(°S)**	**(°E)**	**Avg**	**SD**
ES	07/12/2018	10:00:00	34.23	17.85	0.13	0.03
ES	07/12/2018	14:00:00	34.50	17.09	0.11	0.01
ES	07/12/2018	18:00:00	34.50	16.17	0.07	0.01
ES	07/12/2018	22:00:00	34.50	15.19	0.09	0.03
ES	08/12/2018	02:00:00	34.77	14.44	0.15	0.00
ES	08/12/2018	06:00:00	35.43	13.93	0.07	0.00
ES	08/12/2018	10:00:00	36.06	13.44	0.13	0.05
ES	08/12/2018	14:00:00	36.64	12.99	0.11	0.04
ES	08/12/2018	18:00:00	37.22	12.54	0.21	0.09
ES	08/12/2018	22:00:00	37.84	12.04	0.16	0.00
ES	09/12/2018	02:00:00	38.57	11.46	0.10	0.02
ES	09/12/2018	06:00:00	39.30	10.88	0.15	0.02
ES	09/12/2018	10:00:00	39.98	10.32	0.21	0.01
ES	09/12/2018	14:00:00	40.70	9.73	0.20	0.02
ES	09/12/2018	18:00:00	41.41	9.14	0.16	0.01
ES	09/12/2018	22:00:00	42.10	8.56	0.14	0.00
ES	10/12/2018	02:00:00	42.82	7.95	0.20	0.02
ES	10/12/2018	06:00:00	43.00	7.79	0.15	0.01
ES	10/12/2018	10:00:00	43.31	7.53	0.30	0.12
ES	10/12/2018	14:00:00	44.00	6.92	0.29	0.03
ES	10/12/2018	18:00:00	44.73	6.29	0.39	0.04
ES	10/12/2018	22:00:00	45.30	5.78	0.37	0.03
ES	11/12/2018	02:00:00	45.80	5.33	0.30	0.00
ES	11/12/2018	06:00:00	46.29	4.90	0.31	0.01
ES	11/12/2018	10:00:00	46.77	4.45	0.33	0.03
ES	11/12/2018	14:00:00	47.32	3.94	0.32	0.02
ES	11/12/2018	18:00:00	47.86	3.44	0.30	0.01
ES	11/12/2018	22:00:00	48.35	2.99	0.31	0.02
ES	12/12/2018	02:00:00	48.82	2.54	0.31	0.02
ES	12/12/2018	06:00:00	49.24	2.14	0.25	0.00
ES	12/12/2018	10:00:00	49.69	1.71	0.31	0.01
ES	12/12/2018	14:00:00	50.09	1.31	0.29	0.05
ES	12/12/2018	18:00:00	50.60	0.82	0.24	0.01
ES	12/12/2018	22:00:00	51.12	0.30	0.33	0.03
ES	13/12/2018	02:00:00	51.73	0.00	0.23	0.04
ES	13/12/2018	06:00:00	52.50	0.00	0.22	0.02
ES	13/12/2018	10:00:00	53.30	0.00	0.24	0.03
ES	13/12/2018	14:00:00	54.00	0.00	0.32	0.01
ES	13/12/2018	18:00:00	54.48	0.00	0.31	0.01
ES	13/12/2018	22:00:00	55.28	-0.06	0.25	0.00
ES	14/12/2018	02:00:00	56.06	0.00	0.21	0.02
ES	14/12/2018	06:00:00	56.89	0.00	0.30	0.01
ES	14/12/2018	10:00:00	57.70	-0.01	0.32	0.02
ES	14/12/2018	14:00:00	58.52	0.00	0.30	0.00
ES	14/12/2018	18:00:00	59.35	-0.01	0.29	0.00
ES	14/12/2018	22:00:00	59.83	-0.01	0.34	0.00

ES	15/12/2018	02:00:00	60.38	-0.05	0.32	0.01
ES	15/12/2018	06:00:00	61.10	0.00	0.28	0.00
ES	15/12/2018	10:00:00	61.58	-0.01	0.29	0.04
ES	15/12/2018	14:00:00	62.30	0.00	0.28	0.02
ES	15/12/2018	18:00:00	62.93	0.00	0.27	0.00
ES	15/12/2018	22:00:00	63.43	-0.02	0.28	0.02
ES	16/12/2018	02:00:00	63.94	0.00	0.25	0.00
ES	16/12/2018	06:00:00	64.50	0.00	0.22	0.02
ES	16/12/2018	10:00:00	65.40	-0.04	0.20	0.01
ES	16/12/2018	14:00:00	66.20	-0.01	0.24	0.01
ES	16/12/2018	18:00:00	66.99	0.00	0.22	0.02
ES	16/12/2018	22:00:00	67.92	-0.05	0.27	0.01
ES	17/12/2018	02:00:00	68.81	0.02	0.27	0.03
LS	27/2/2019	10:00:00	-70.26	-2.72	0.16	0.00
LS	27/2/2019	14:00:00	-69.99	-3.82	0.18	0.01
LS	27/2/2019	18:00:00	-69.64	-3.76	0.17	0.01
LS	27/2/2019	22:00:00	-68.84	-3.76	0.20	0.01
LS	28/2/2019	02:00:00	-67.99	-2.96	0.30	0.01
LS	28/2/2019	06:00:00	-67.04	-2.32	0.20	0.01
LS	28/2/2019	10:00:00	-65.04	-1.44	0.24	0.02
LS	28/2/2019	14:00:00	-64.94	-0.66	0.16	0.02
LS	28/2/2019	18:00:00	-63.90	0.00	0.19	0.00
LS	28/2/2019	22:00:00	-62.82	0.00	0.16	0.02
LS	1/3/2019	02:00:00	-62.18	0.00	0.18	0.00
LS	1/3/2019	06:00:00	-61.27	0.00	0.31	0.01
LS	1/3/2019	10:00:00	-60.16	-0.01	0.39	0.05
LS	1/3/2019	14:00:00	-60.01	-0.86	0.28	0.02
LS	1/3/2019	18:00:00	-59.97	-3.11	0.31	0.01
LS	1/3/2019	22:00:00	-59.88	-5.24	0.26	0.02
LS	2/3/2019	02:00:00	-59.86	-7.35	0.36	0.02
LS	2/3/2019	06:00:00	-59.79	-9.49	0.34	0.02
LS	2/3/2019	10:00:00	-59.73	-11.58	0.34	0.00
LS	2/3/2019	14:00:00	-59.74	-13.69	0.35	0.02
LS	2/3/2019	18:00:00	-59.70	-15.84	0.18	0.02
LS	2/3/2019	22:00:00	-59.64	-17.96	0.39	0.02
LS	3/3/2019	02:00:00	-59.62	-20.08	0.25	0.01
LS	3/3/2019	06:00:00	-59.58	-22.17	0.27	0.01
LS	3/3/2019	10:00:00	-59.54	-24.33	0.29	0.02
LS	3/3/2019	14:00:00	-59.48	-26.34	0.30	0.01
LS	3/3/2019	22:00:00	-59.00	-28.37	0.33	0.02
LS	4/3/2019	02:00:00	-58.32	-29.59	0.40	0.02
LS	4/3/2019	06:00:00	-57.62	-30.83	0.30	0.03
LS	4/3/2019	10:00:00	-56.99	-31.92	0.31	0.02
LS	4/3/2019	14:00:00	-56.48	-32.78	0.28	0.02
LS	4/3/2019	18:00:00	-55.96	-33.65	0.31	0.01
LS	4/3/2019	22:00:00	-55.43	-34.53	0.27	0.03
LS	5/3/2019	02:00:00	-54.89	-35.39	0.24	0.01
LS	5/3/2019	22:00:00	-54.18	-35.46	0.34	0.02
LS	6/3/2019	02:00:00	-54.17	-33.59	0.31	0.02
LS	6/3/2019	06:00:00	-54.16	-31.71	0.37	0.00
LS	6/3/2019	10:00:00	-54.15	-29.83	0.38	0.01

LS	6/3/2019	14:00:00	-54.11	-27.89	0.24	0.01
LS	6/3/2019	18:00:00	-54.12	-26.02	0.28	0.00
LS	6/3/2019	22:00:00	-54.01	-24.19	0.32	0.02
LS	7/3/2019	02:00:00	-54.12	-22.83	0.32	0.04
LS	7/3/2019	06:00:00	-54.12	-21.44	0.23	0.01
LS	7/3/2019	10:00:00	-54.09	-19.56	0.28	0.03
LS	7/3/2019	14:00:00	-54.09	-17.59	0.29	0.01
LS	7/3/2019	18:00:00	-54.09	-15.65	0.30	0.03
LS	7/3/2019	22:00:00	-54.09	-13.72	0.21	0.01
LS	8/3/2019	02:00:00	-54.06	-12.25	0.21	0.04
LS	8/3/2019	06:00:00	-54.06	-10.90	0.29	0.05
LS	8/3/2019	10:00:00	-54.04	-8.79	0.31	0.04
LS	8/3/2019	14:00:00	-54.04	-7.01	0.49	0.02
LS	8/3/2019	18:00:00	-54.03	-5.09	0.27	0.04
LS	8/3/2019	22:00:00	-54.02	-3.46	0.42	0.01
LS	9/3/2019	02:00:00	-54.01	-1.82	0.32	0.01
LS	9/3/2019	06:00:00	-54.00	-0.16	0.35	0.01
LS	9/3/2019	10:00:00	-53.56	-0.02	0.36	0.03
LS	9/3/2019	14:00:00	-52.78	0.00	0.26	0.01
LS	9/3/2019	18:00:00	-52.05	0.00	0.24	0.02
LS	9/3/2019	22:00:00	-51.45	0.00	0.32	0.09
LS	10/3/2019	02:00:00	-51.01	-0.22	0.27	0.03
LS	10/3/2019	06:00:00	-50.68	0.08	0.22	0.01
LS	10/3/2019	10:00:00	-50.40	1.43	0.32	0.08
LS	10/3/2019	14:00:00	-50.15	2.85	0.25	0.02
LS	10/3/2019	18:00:00	-49.61	3.95	0.32	0.03
LS	10/3/2019	22:00:00	-48.95	4.90	0.26	0.01
LS	11/3/2019	02:00:00	-48.23	5.82	0.36	0.09
LS	11/3/2019	06:00:00	-47.56	6.75	0.30	0.01
LS	11/3/2019	10:00:00	-46.76	7.00	0.27	0.01
LS	11/3/2019	14:00:00	-45.87	7.06	0.34	0.04
LS	11/3/2019	18:00:00	-44.99	7.36	0.28	0.01
LS	11/3/2019	22:00:00	-44.13	7.36	0.33	
LS	12/3/2019	00:00:00	-43.79	7.69	0.00	0.05
LS	12/3/2019	04:00:00	-43.18	7.81	0.15	0.04
LS	12/3/2019	08:00:00	-42.89	7.01	0.22	0.00
LS	12/3/2019	12:00:00	-42.12	8.01	0.25	0.11
LS	12/3/2019	16:00:00	-41.34	9.28	0.10	0.00
LS	12/3/2019	20:00:00	-40.54	9.94	0.02	0.01
LS	13/3/2019	00:00:00	-39.72	10.60	0.05	0.07
LS	13/3/2019	04:00:00	-38.89	11.25	0.01	0.01
LS	13/3/2019	08:00:00	-38.06	11.92	0.01	0.01
LS	13/3/2019	12:00:00	-37.24	12.56	0.01	0.01
LS	13/3/2019	16:00:00	-36.42	13.19	0.02	0.01
LS	13/3/2019	20:00:00	-35.58	13.83	0.01	0.01
LS	14/3/2019	00:00:00	-34.92	14.32	0.00	0.00
LS	14/3/2019	04:00:00	-34.50	14.87	0.01	0.01

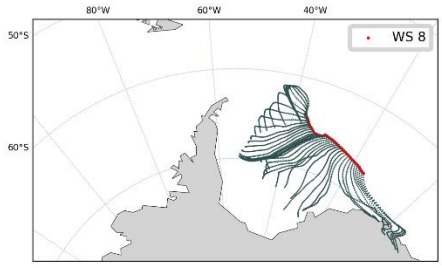
Table S5: The average (Avg) and standard deviation (SD) for atmospheric nitrate concentration ([NO_3^-] (ng m^{-3})) and nitrogen isotopic composition ($\delta^{15}N\text{-}NO_3^-$) in each aerosol size range: >7 µm, 3 to 7 µm, 1.5 to 3 µm and 1 to 1.5 µm, separated by cruise leg: early summer (ES), Weddell Sea (WS) and late summer (LS).

	[NO_3^-] (ng m^{-3})			**$\delta^{15}N\text{-}NO_3^-$ (‰ vs. N_2)**		
	ES Avg (SD)	**WS Avg (SD)**	**LS Avg (SD)**	**ES Avg (SD)**	**WS Avg (SD)**	**LS Avg (SD)**
>7 µm	12.1 (19.5)	4.8 (4.8)	8.0 (6.8)	-12.2 (11.2)	-14.6 (5.1)	-10.4 (2.7)
3 to 7 µm	33.7 (32.3)	8.9 (5.4)	26.2 (28.6)	-18.8 (14.9)	-25.8 (9.0)	-13.7 (6.0)
1.5 to 3 µm	30.6 (21.6)	10.7 (4.0)	20.2 (19.7)	-20.1 (16.5)	-24.5 (6.6)	-15.9 (8.3)
1 to 1.5 µm	23.1 (7.2)	9.4 (3.7)	13.1 (6.7)	-19.7 (15.5)	-23.0 (7.4)	-16.7 (9.5)

Table S6: Estimated contribution of alkyl nitrates, lightning NO_x, and snow emissions to atmospheric NO_3^- formation for early summer (ES) and late summer (LS) filter deployments. The $\delta^{15}N$ signature of NO_3^- derived from oceanic alkyl nitrates is also presented ($\delta^{15}N\text{-}NO_3^-{}_{AN}$) for samples with an alkyl nitrate source > 10%.

Cruise leg ID	**Alkyl nitrates (%)**	**Lightning (%)**	**Snow emissions (%)**	**[1]$\delta^{15}N\text{-}NO_3^-{}_{AN}$ (‰)**
ES 1	42.7	57.3	0.0	-11.7
ES 2	29.1	70.8	0.0	-19.7
ES 3	4.5	95.3	0.0	-
ES 4	97.0	3.0	0.0	-14.9
ES 5	81.3	0.0	18.7	-28.6
ES 6	35.1	0.0	64.9	-33.4
ES 7	1.9	0.0	98.1	-
LS 28	95.7	0.0	4.3	-24.7
LS 29	89.9	0.0	10.1	-17.8
LS 30	77.2	0.0	22.8	-14.8
LS 31	86.4	13.6	0.0	-16.2
LS 32	34.0	66.0	0.0	-33.0
LS 33	26.6	73.4	0.0	-24.9
LS 34	8.5	91.5	0.0	-

[1] The '-'symbol indicates samples where alkyl nitrate contributions to total NO_3^- were less than 10%, such that the $\delta^{15}N\text{-}NO_3^-$ signature derived from oceanic alkyl nitrates ($\delta^{15}N\text{-}NO_3^-{}_{AN}$) could not be determine with confidence.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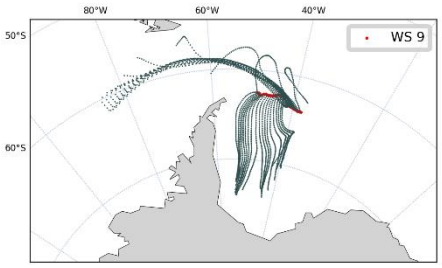
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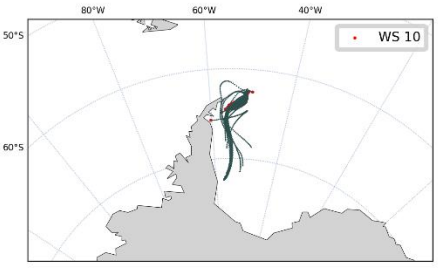
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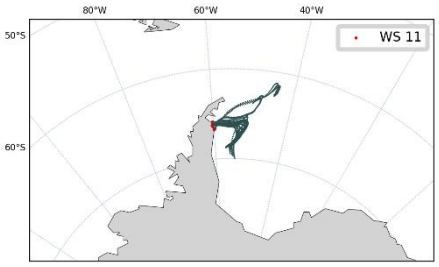
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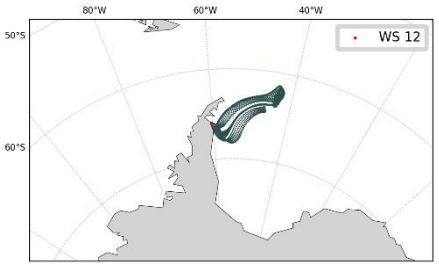
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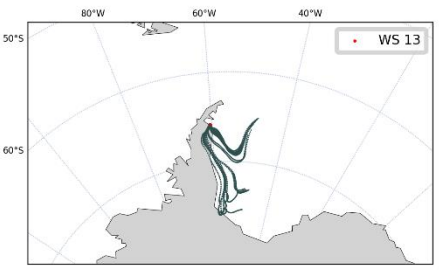
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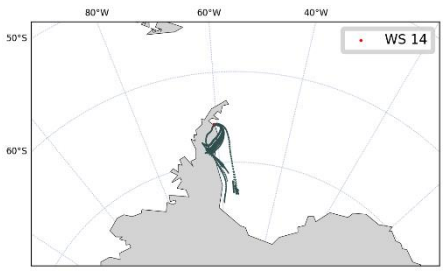
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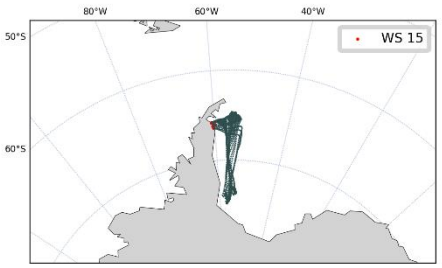
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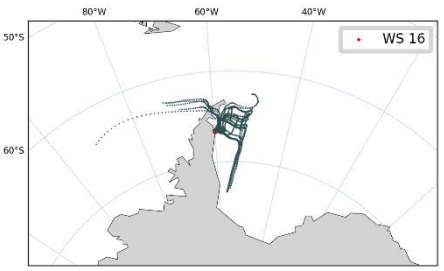
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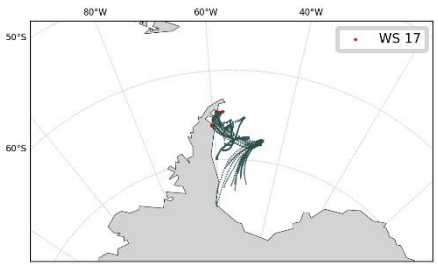
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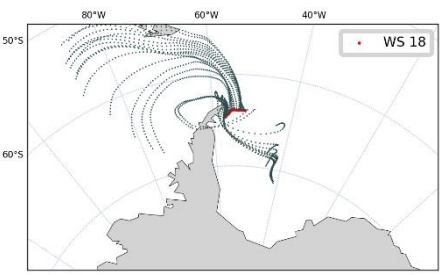
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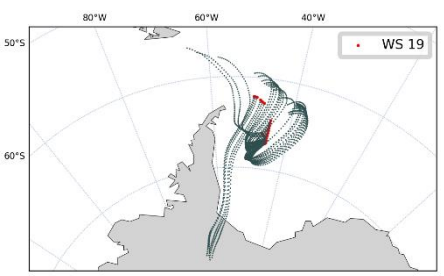
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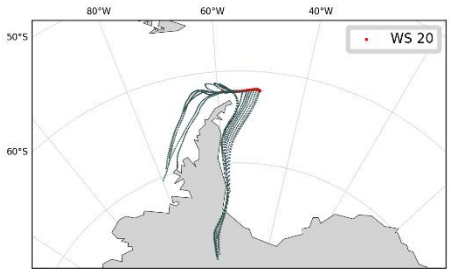
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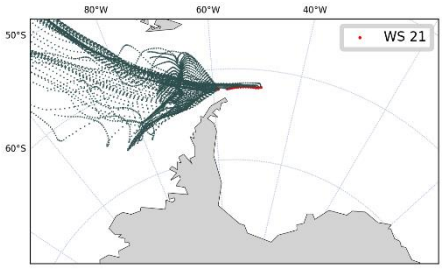
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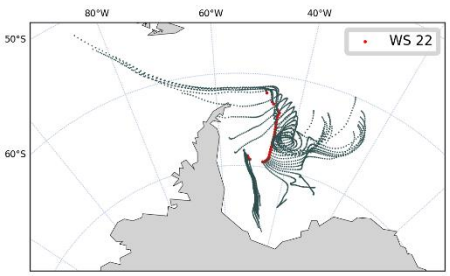
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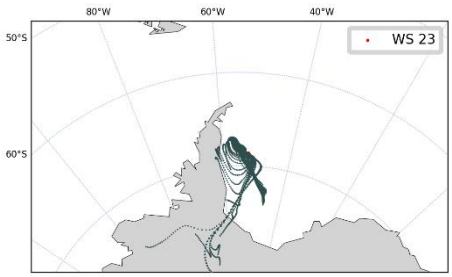
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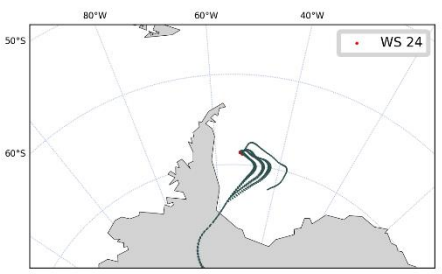
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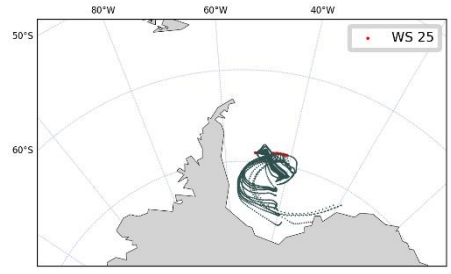
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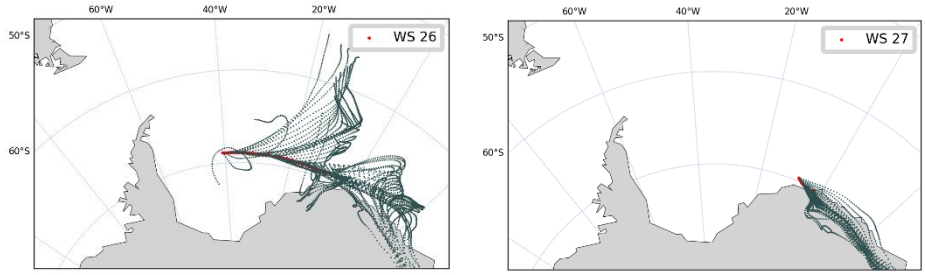

Figure S1. Maps depicting the 72-hour AMBTs computed each hour for all filter deployments (dark grey dots) during the Weddell Sea leg of the research voyage. Each subplot represents one filter deployment, and the cruise leg ID (Tables S1 and S3) is shown in the legend on the upper right-hand side of each subplot. The red dots highlight the ships path.

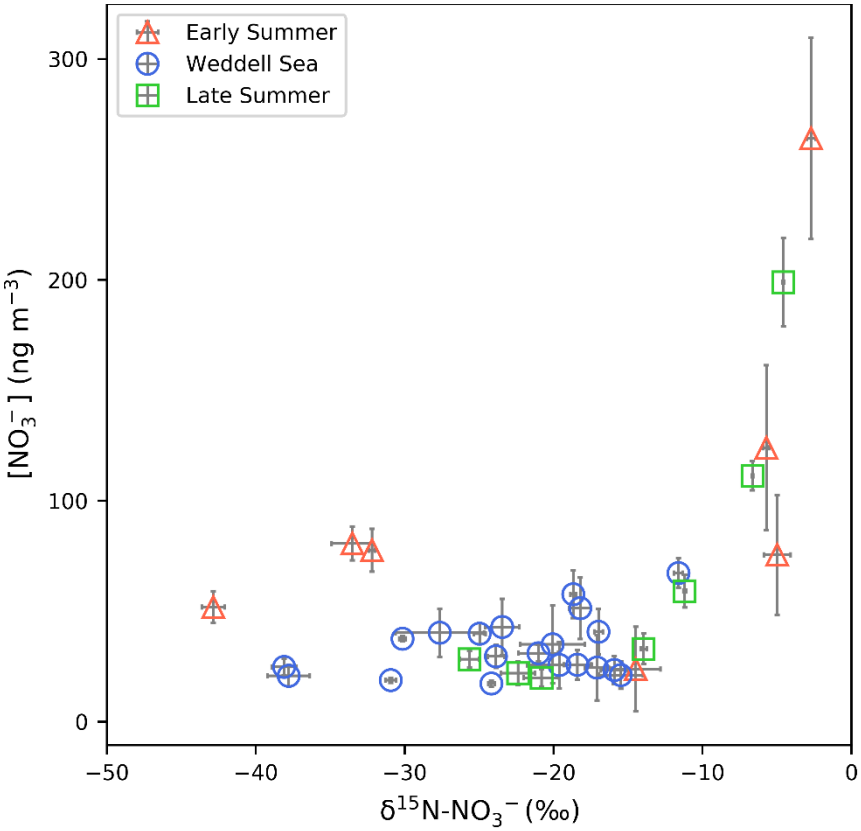

Figure S2. The average (± 1 SD) coarse mode (> 1 µm) nitrate concentration [NO_3^-] (ng m^{-3}), plotted as a function of the weighted average (± 1 SD) δ^{15}N-NO_3^- (‰ vs. N_2). Early and late summer latitudinal transects are denoted by the red triangles and green squares, respectively. Weddell Sea samples are denoted by blue circles. Where error bars (± 1 SD) are not visible, the standard deviation is smaller than the size of the marker.