Supplementary Material

Measurements of BC using the Aethalometer AE31

The aerosol BC mass concentration $C_{BC}(wl)$ (in units of g m^{-3}) is related to the attenuation coefficient ($b_{ATN} = \frac{A}{V}\frac{dATN}{dt}$), attenuation cross-section ($\sigma(wl)=\sigma_{abs} \cdot C_{cor}$), and $R(ATN)$ by:

$$C_{BC}(wl) = \frac{b_{ATN}}{\sigma(wl) \cdot R(ATN)}, \quad \text{(S1)}$$

where σ_{abs} is the mass specific absorption cross-section, and C_{cor} is the calibration factor. In this work, a value of $\sigma(wl)$ =16.6 m^2 g^{-1} at 880 nm was used, as supplied by the manufacturer. $R(ATN)$ was calculated by:

$$R(ATN) = (\frac{1}{f} - 1) \cdot \left(\frac{\log_e(ATN) - \log_e(10\%)}{\log_e(50\%) - \log_e(10\%)} \right) + 1 \quad \text{(S2)}$$

In this work we used a value of f = 1.08 by taking into account values at the maritime sites: Cabauw (51°N, 4°E) and Mace Head (53°N, 10°W) reported in Collaud Coen et al., (2010).

Atmospheric CO measured at 1-min interval during high BC event

As mentioned in the text, if BC, CO, and other gas concentrations are affected by the local sources on Rishiri Island, they would vary largely within a short time interval. During high BC events, atmospheric CO and CO_2 concentrations measured at 1-min intervals varied smoothly (Figure S1), suggestive of an air mass affected by remote sources.

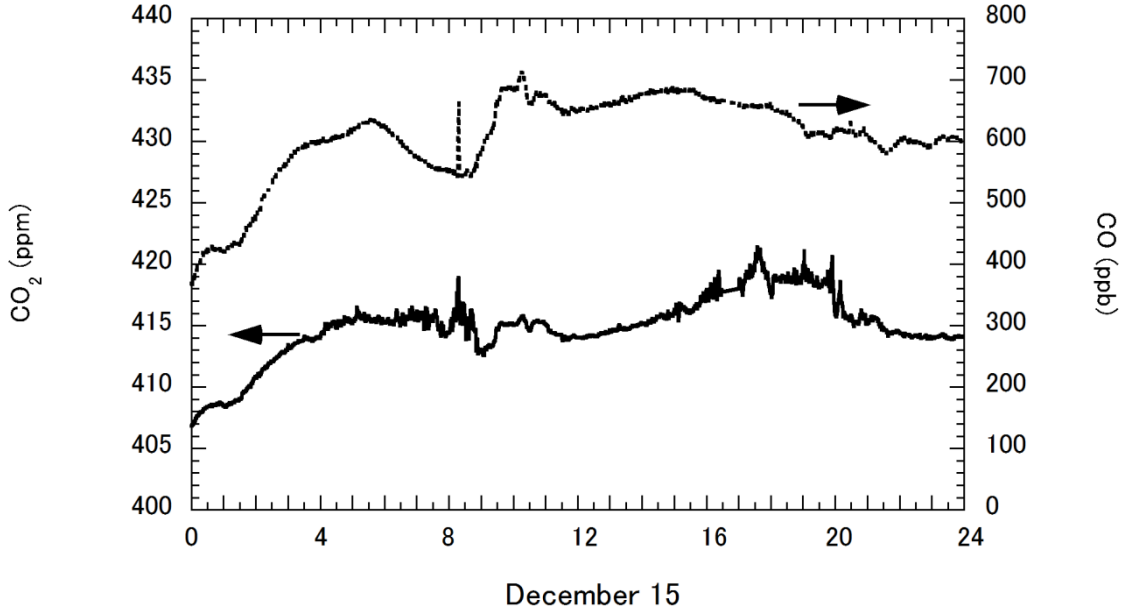

Figure S1. Atmospheric CO_2 and CO measured at 1-min intervals on December 15, 2012.

Supplementary Table S1. Air temperature (T), wind speed (WS), and wind direction (WD) observed at Kutsukata station on Rishiri Island during high BC events occurring between December 2012 and April 2013. The wind direction is reported using the 16 points of a compass.

LT	T (°C)	WS (m s^{-1})	WD	T (°C)	WS (m s^{-1})	WD	T (°C)	WS (m s^{-1})	WD	T (°C)	WS (m s^{-1})	WD	T (°C)	WS (m s^{-1})	WD
	December 14, 2012*			December 31			January 5			January 12			January 31		
0	0.3	4.4	SW	1.2*	3.9*	W*	-8.6*	3.6*	W*	-6.3*	3.0*	W*	-0.8*	2.3*	N*
3	1.6	4.8	SW	0*	6.1*	WNW*	-7.1*	3.6*	WSW*	-6.4*	4.9*	WNW*	-1.1*	1.0*	E*
6	1.3	3.2	WSW	-0.5	5.5	WNW	-6.5*	3.2*	WNW*	-6.2*	3.6*	WNW*	-0.9*	1.1*	ENE*
9	0.5	6.4	WNW	-1.9	5.5	NW	-5.3*	3.4*	WSW*	-5.2*	3.8*	SW*	-0.8*	0.8*	NE*
12	-1.1	5.1	W	-3.8	11.6	SW	-2.5*	6.5*	SW*	-4.7	3.5	WSW	-0.2*	2.7*	SW*
15	-0.1	5.5	WNW	-5.5	8.2	SW	-1.9*	6.9*	SW*	-3.7	3.4	W	-0.2*	4.1*	SW*
18	-0.2	3.3	NW	-5.5	6.7	W	-0.8*	4.1*	WSW*	-3.6	3.1	WNW	0.4*	4.8*	SSW*
21	-1.4	4.4	N	-6.5	6.5	W	-2.6	3.3	NW	-4.6	3.6	NNE	0.9	6.0	SW
	December 15			January 1, 2013			January 6			January 13			February 1		
0	-2.0	2.3	NE	-7.4	6.5	W	-4.6	3.4	NNW	-5.2	5.2	NNE	1.7	6.3	SSW
3	-1.7	1.6	ENE	-8.1	6.5	W	-6.5	6.1	NNW	-5.7	4.3	NNE	2.2	6.0	SSW
6	-2.9	1.6	E	-7.4	6.6	W	-6.6	7.0	WNW	-5.8	5.2	NNW	2.7	6.3	SSW
9	-1.5	0.9	SE	-6.7	5.3	W	-7.8	7.5	WNW	-6.3#	4.9#	NW#	3.2	6.0	SSW
12	-0.2	1.5	NE	-6.1	5.1	W	-9	7.0	WNW	-6.6#	4.1#	NW#	3.8	6.5	S
15	-0.7	0.7	E	-5.7	5.2	WSW	-9.2	6.3	NW	-6.6#	3.0#	NW#	4.1	5.6	S
18	-0.9	2.0	ENE	-6	4.8	WSW	-9.1	5.6	WNW	-7.1#	3.7#	WNW#	4.4	7.4	S
21	-0.8	1.2	NE	-5.4	5.2	WSW	-8.9	6.7	NW	-6.4#	4.3#	WNW#	3.9	8.2	S
	December 16			January 2			January 7						February 2		
0	-0.9	1.4	E	-5.6	3.8	WSW	-9.5	5.2	NW				3.7	8.1	S
3	0.3	3.3	NE	-6	4.0	W	-10.2#	5.2#	NW#				2.9	5.8	S
6	0.8	4.9	NE	-5.9	4.1	WNW	-9.9#	4.1#	NW#				2.7	4.5	S
9	0.1	4.2	NE	-6	1.9	W	-9.6#	4.9#	WNW#				4.2	8.6	SSW
12	0.2	4.9	NNE	-5.1	2.2	NNW	-9.9#	4.0#	NW#				-1.0	4.5	NW
15	-0.7#	6.7#	NNE#	-5.8	4.1	NNE	-9.2#	3.9#	WNW#				-2.7	7.2	WNW
18	-0.8#	6.2#	NNE#	-5.5	3.6	NE	-8.9#	3.5#	WNW#				-4.9	9.2	WNW
21	-1.1#	4.6#	NNE#	-5.9	6.9	NNE	-8.4#	2.7#	NW#				-5.9#	10.1#	WNW#
	December 17#			January 3											
0	-0.9	1.7	NE	-5.7	6.5	NNE									
3	-1.6	1.1	ENE	-6.4#	10.1#	NNE#									
6	0.1	2.2	WSW	-7.2#	7.6#	NNE#									
9	-0.9	5.7	NW	-7.1#	6.4#	N#									
12	-1.5	4.4	W	-7.2#	7.1#	N#									
15	-2.4	2.7	WSW	-7.5#	5.8#	NNW#									
18	-2.6	2.6	W	-7.3#	3.8#	NW#									
21	-2.4	1.7	W	-7.8#	4.1#	NW#									

* Prior to high BC event

After high BC event

Supplementary Table 1. Continued.

LT	T (°C)	WS (m s^{-1})	WD	T (°C)	WS (m s^{-1})	WD	T (°C)	WS (m s^{-1})	WD	T (°C)	WS (m s^{-1})	WD
	February 15			March 5			March 11			April 22		
0	-4.2*	1.7*	E*	-5.4*	0.6*	ESE*	-6.9*	10.5*	NNE*	3.9*	3.0*	NNE*
3	-5.2	3.3	NE	-3.9*	1.0*	NNW*	-5.8*	6.9*	N*	3.2	2.0	NNE
6	-5.5	4.6	NNE	-6.0*	0.7*	ESE*	-6.0*	7.1*	NNW*	3.5	2.6	NNE
9	-5.5	4.9	N	-2.5*	2.2*	SSW*	-6.3*	5.5*	NNW*	5.8	3.8	WNW
12	-4.6	4.0	N	-0.3	4.4	SSW	-4.2*	4.7*	W*	6.2	2.9	WNW
15	-5.5	4.1	NNE	0.2	4.2	SW	-3.4*	7.7*	SW*	6.2	2.1	WNW
18	-5.1	3.1	NNW	0.0	5.8	SW	-3.5*	4.7*	SW*	6	2.3	S
21	-7.5	1.7	NE	0.9	7.2	SW	-1.4	5.1	WSW	6.3	1.6	SE
	February 16			March 6			March 12			April 23		
0	-6.8	5.9	NNE	1.7	7.1	SW	0.2	7.3	W	6.7	2.3	S
3	-7.6	5.4	NNE	0.4	4.5	SW	0.6	6.8	WSW	4.4	0.9	SSE
6	-7.5	6.1	NNE	-0.8	3.1	N	1.5	8.1	SW	4.6	1.1	ESE
9	-6.9	6.5	N	-1.0	4.3	N	1.8	4.5	WSW	7.4	1.4	WNW
12	-6.6	5.9	N	-0.9	4.8	NNW	2.4	4.6	SW	8.8	3.8	SSW
15	-6.4	7.4	N	0.7	1.7	NNW	2.5	5.0	SW	10.5	4.4	S
18	-6.7	9.2	N	0.7	2.8	SW	2.9	4.6	SSW	8	3.0	S
21	-6.9#	8.2#	N#	2.5	4.6	SW	3.2	5.0	S	6.7	3.4	S
				March 7			March 13			April 24		
0				0.5	1.6	S	3.6	4	S	7.3	3.5	S
3				2.5	5.2	S	3.1	6.4	SW	7.3	3.2	SSE
6				2.8	7.0	SSW	2.4	3.1	SW	8.7	4.6	S
9				2.7	10.9	S	1.8	1.7	NW	8	2.7	SSE
12				2.1	11.8	S	-0.1	3.2	N	10.2	5.7	S
15				2.3	12.8	S	0	4.1	NNW	11.9	3.9	S
18				3.7#	8.7#	SW#	-0.9	3.4	NNW	9.8	1.8	S
21				2.8#	5.1#	W#	-0.9	5	NNW	9.4	2.8	NE
							March 14			April 25		
0							-2.5	3.9	NNW	6.8	2.3	ENE
3							-3.1#	4.0#	NW#	5.9#	0.6#	ENE#
6							-4.6#	6.6#	WNW#	6.3#	4.2#	SSW#
9							-5.2#	7.2#	WNW#	6.6#	3.0#	SSW#
12							-4.9#	5.1#	WNW#	5.5#	2.9#	W#
15							-5.1#	4.5#	WSW#	4.0#	8.8#	WNW#
18							-3.6#	3.7#	WSW#	3.7	5.2#	NW#
21							-1.9#	6.2#	SW#	4.0#	4.1#	N#

* Prior to high BC event

After high BC event