Supplementary Materials

Table S.1a Comparison of modelled O_3 with observations at Northern sites.

Site	Lat	Lon	Mn-obs (ppbv)	Mn-mod (ppbv)	MB (ppbv)	NMB (%)	URMSE (ppbv)	nURMSE (%)	r
Alert, NU	82.4508	-62.508	24.5	23.6	-0.9	-3.7	3.9	16.6	0.80
Little Fox Lake, YK	61.2067	-149.82	26.5	25.5	-1.0	-3.6	6.7	26.2	0.21
Norman Wells, NT	65.2791	-126.81	17.6	21.6	4.0	23.0	5.8	27.0	0.55
Snare Rapids, NT	63.5086	-116.01	21.8	22.2	0.5	2.1	5.3	23.8	0.61
Yellowknife, NT	62.4521	-114.36	20.1	21.9	0.8	4.1	7.1	34.0	0.43
Fort Chipewyan, AB	58.7088	-111.18	22.6	23.0	0.4	2.0	7.2	31.3	0.48
Fort McKay, AB	57.1894	-111.64	17.8	23.3	5.5	30.8	8.7	37.3	0.69
Syncrude UE1, AB	57.1492	-111.64	16.3	22.1	5.8	35.9	9.1	41.2	0.68
Patricia McInnes, AB	56.7522	-111.48	21.4	24.7	3.3	15.2	8.2	33.2	0.70
Athabasca Valley, AB	56.7328	-111.39	15.8	24.5	8.7	54.9	7.8	31.7	0.68
Goose Bay, NL	53.3111	-60.367	20.7	21.8	1.1	5.11	5.6	25.8	0.58
Barrow, AK	71.3200	-156.60	22.6	23.0	0.6	2.7	5.0	21.7	0.50
Denali, AK	63.7253	-148.97	22.9	25..5	2.6	11.2	7.6	29.8	0.09
Anchorage Borough, AK	61.3219	-149.57	13.0	23.1	10.1	77.1	8.5	36.8	0.10
Anchorage, AK	61.2067	-149.82	11.7	16.1	4.4	37.8	8.0	49.5	0.48

Table S.1b Comparison of modelled $PM_{2.5}$ with observations at Northern sites.

Site	Lat	Lon	Mn-obs ($\mu g\ m^{-3}$)	Mn-mod ($\mu g\ m^{-3}$)	MB ($\mu g\ m^{-3}$)	NMB (%)	URMSE ($\mu g\ m^{-3}$)	nURMSE (%)	r
Inuvik, NT	68.3601	-133.73	5.41	0.98	-4.43	-81.9	5.62	104.0	0.27
Norman Wells, NT	65.2791	-126.81	6.07	1.93	-4.14	-68.2	5.26	86.6	0.14
Yellowknife, NT	62.4521	-114.36	4.64	6.83	2.18	47.0	9.41	203.0	0.16
Fort Liard, NT	60.2358	-123.47	4.06	0.72	-3.35	-82.4	3.16	77.7	0.35
AIRSUSAK6MAT, AK	61.5989	-149.11	3.55	3.95	0.40	11.2	4.24	119.0	-0.04
Anchorage Borough, AK	61.3219	-149.57	3.65	3.43	-0.22	-5.9	3.65	100.0	0.03
AIRUSAKWANC, AK	61.2150	-149.90	4.65	7.89	3.24	69.7	5.35	115.0	0.18
Anchorage, AK	61.2067	-149.82	4.58	7.93	3.35	73.2	5.12	112.0	0.25
Juneau, AK	58.3885	-134.57	6.19	1.91	-4.28	-69.2	6.04	97.7	0.30

Table S.1c Comparison of modelled NO_2 with observations at Northern sites.

Site	Lat	Lon	Mn-obs (ppbv)	Mn-mod (ppbv)	MB (ppbv)	NMB (%)	URMSE (ppbv)	nURMSE (%)	r
Inuvik, NT	68.3601	-133.73	2.84	0.10	-2.73	-96.3	2.11	74.2	0.11
Norman Wells, NT	65.2791	-126.81	1.31	0.92	-0.40	-30.2	1.24	94.6	0.07
Yellowknife, NT	62.4521	-114.36	4.03	3.03	-1.00	-24.9	3.26	80.9	0.17
Fort Liard, NT	60.2358	-123.47	0.65	0.11	-0.54	-82.7	0.77	119.0	-0.02
Fort Chipewyan, AB	58.7088	-111.18	0.83	0.30	-0.53	-64.2	0.70	85.1	0.54
Fort McKay, AB	57.1894	-111.64	3.12	4.80	1.69	54.1	4.74	152.0	0.39
Syncrude UE1, AB	57.1492	-111.64	2.70	6.56	3.86	142.0	6.12	226.0	0.32
Millenium, AB	56.8889	-111.38	10.70	16.70	6.07	58.60	11.3	106.0	0.35
Patricia McInnes, AB	56.7522	-111.48	3.00	2.80	-0.20	-6.8	3.49	116.0	0.26
Athabasca Valley, AB	56.7328	-111.39	6.04	2.76	-3.27	-54.2	4.53	75.1	0.27

Table S.1d Comparison of modelled SO_2 with observations at Northern sites.

Site	Lat	Lon	Mn-obs ($\mu g\ m^{-3}$)	Mn-mod ($\mu g\ m^{-3}$)	MB ($\mu g\ m^{-3}$)	NMB (%)	URMSE ($\mu g\ m^{-3}$)	nURMSE (%)	r
Norman Wells, NT	65.2791	-126.81	1.92	0.03	-1.89	-98.4	2.32	70.3	-0.06
Yellowknife, NT	62.4521	-114.36	2.29	0.61	-1.67	-73.2	2.50	81.3	0.07
Fort Liard, NT	60.2358	-123.47	0.19	0.21	0.02	10.7	0.98	522.0	-0.01
Fort Chipewyan, AB	58.7088	-111.18	0.43	1.19	0.76	174.0	2.43	533.0	0.54
Fort McKay, AB	57.1894	-111.64	3.55	7.81	4.26	120.0	14.20	382.0	0.20
Syncrude UE1, AB	57.1492	-111.64	3.40	17.60	14.20	417.0	21.10	457.0	0.20
Mildred Lake, AB	57.0500	-111.56	4.61	12.40	7.83	170.0	20.20	405.0	0.13
Lower Camp, AB	57.0269	-111.50	3.71	18.50	14.80	398.0	20.30	374.0	0.14
Buffalo Viewpoint, AB	56.9967	-111.59	3.27	18.50	15.20	466.0	22.20	495.0	0.18
MANNIX, AB	56.9678	-111.48	5.36	18.50	13.20	246.0	25.10	399.0	0.11
Millenium, AB	56.8889	-111.38	2.72	18.50	15.78	579.0	21.10	517.0	0.13
Patricia McInnes, AB	56.7522	-111.48	1.95	6.29	4.34	222.0	12.40	595.0	0.16
Athabasca Valley, AB	56.7328	-111.39	1.78	6.29	4.51	254.0	12.20	639.0	0.14
Taylor Town site, BC	56.1508	-120.69	6.20	49.4	43.20	696.0	73.8.00	966.0	0.01
Pine River Hassler, BC	55.6056	-121.97	1.10	3.11	2.01	182.0	9.70	861.0	0.03
Pine River Gas Plant, BC	55.5750	-121.92	10.90	51.30	40.40	372.0	88.60	726.0	-0.15
Smokey Height, AB	55.4050	-118.28	0.47	0.81	0.34	72.1	1.64	340.0	0.18
Evergreen Park, AB	55.1191	-118.73	0.74	0.96	0.22	29.6	3.07	412.0	-0.07

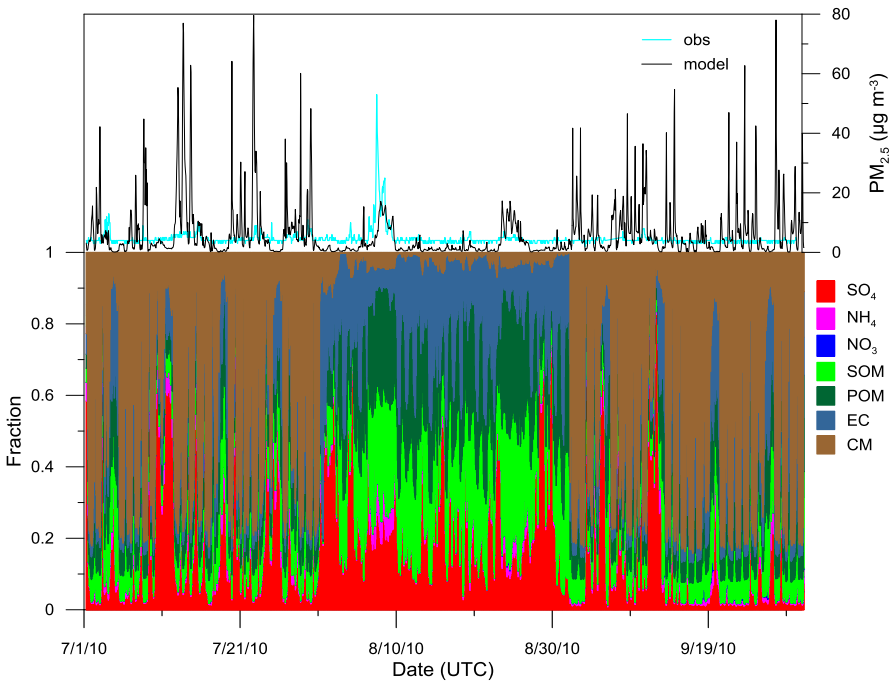

Figure S.1 $PM_{2.5}$ at Yellowknife, NT: top panel – ambient $PM_{2.5}$ time series at Yellowknife monitoring site (light blue – observation; black line – model); lower panel shows the modelled fractional $PM_{2.5}$ components at Yellowknife site.

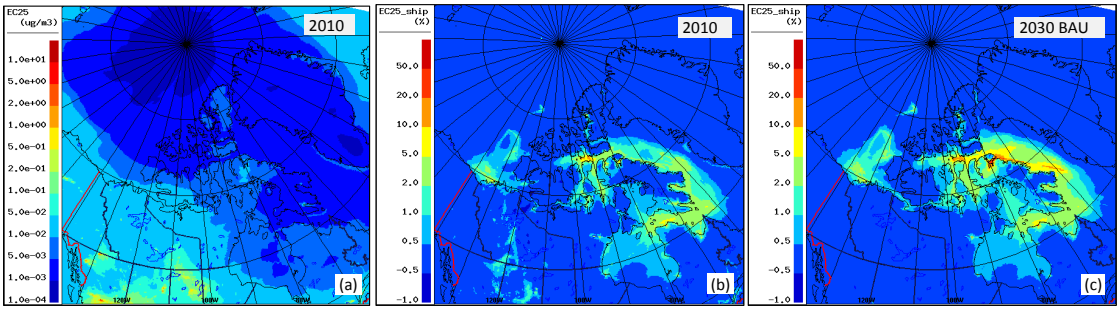

Figure S.2. (a) modelled ambient $EC_{2.5}$ averaged over the July-to-September period (base year 2010); (b) Arctic shipping contribution to the July-to-September averaged $EC_{2.5}$ concentration at the current level (2010); (c) contribution from the projected Arctic shipping at 2030 (BAU scenario).

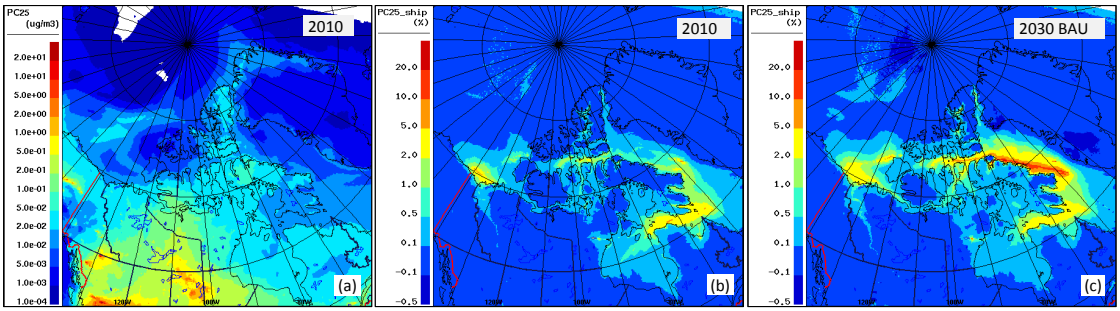

Figure S.3. (a) modelled ambient $PC_{2.5}$ averaged over the July-to-September period (base year 2010); (b) Arctic shipping contribution to the July-to-September averaged $PC_{2.5}$ concentration at the current level (2010); (c) contribution from the projected Arctic shipping at 2030 (BAU scenario).

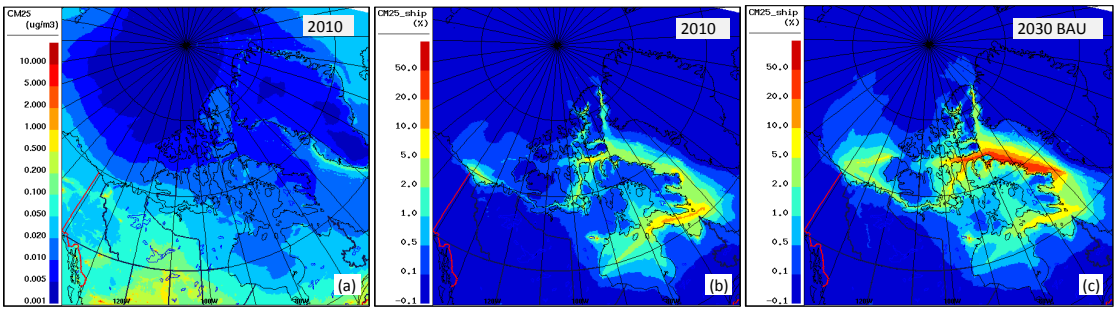

Figure S.4. (a) modelled ambient $CM_{2.5}$ averaged over the July-to-September period (base year 2010); (b) Arctic shipping contribution to the July-to-September averaged $CM_{2.5}$ concentration at the current level (2010); (c) contribution from the projected Arctic shipping at 2030 (BAU scenario).

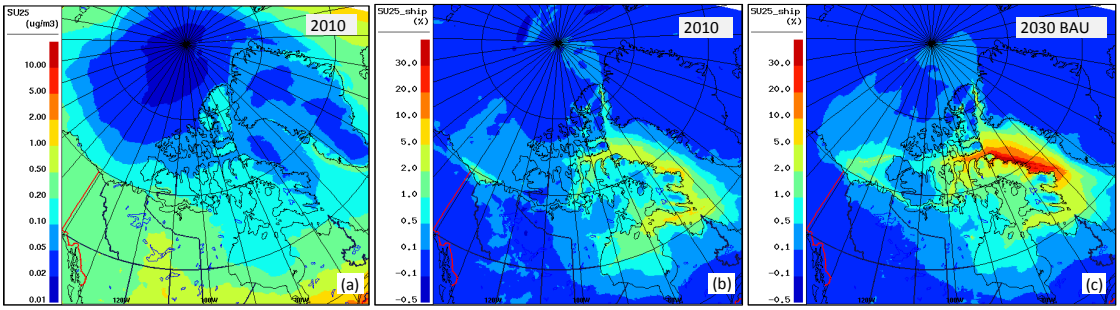

Figure S.5. (a) modelled ambient $SU_{2.5}$ averaged over the July-to-September period (base year 2010); (b) Arctic shipping contribution to the July-to-September averaged $SU_{2.5}$ concentration at the current level (2010); (c) contribution from the projected Arctic shipping at 2030 (BAU scenario).

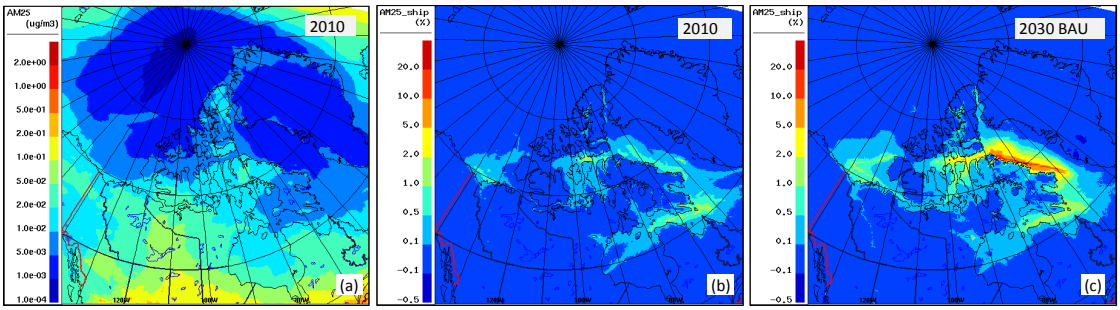

Figure S.6. (a) modelled ambient $AM_{2.5}$ averaged over the July-to-September period (base year 2010); (b) Arctic shipping contribution to the July-to-September averaged $AM_{2.5}$ concentration at the current level (2010); (c) contribution from the projected Arctic shipping at 2030 (BAU scenario).

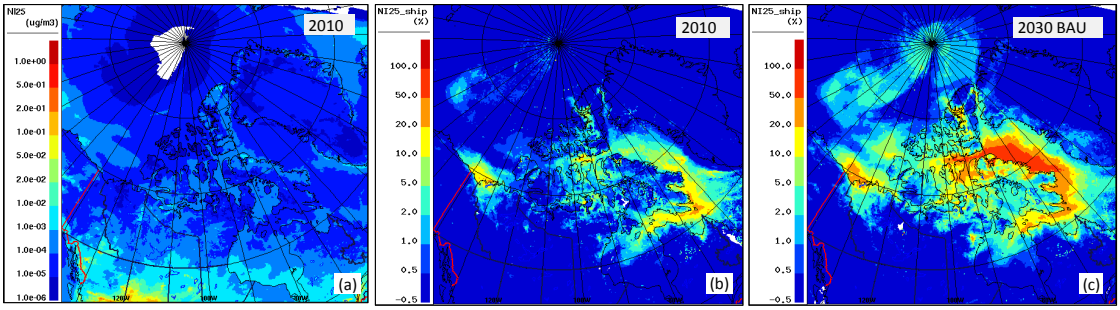

Figure S.7. (a) modelled ambient $NI_{2.5}$ averaged over the July-to-September period (base year 2010); (b) Arctic shipping contribution to the July-to-September averaged $NI_{2.5}$ concentration at the current level (2010); (c) contribution from the projected Arctic shipping at 2030 (BAU scenario).

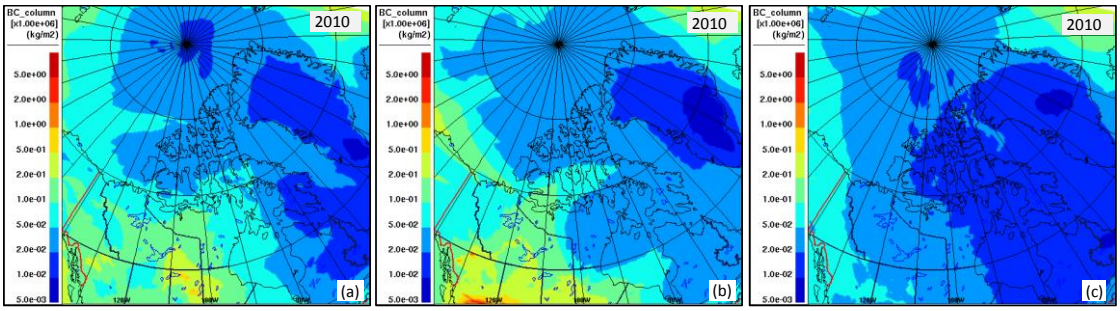

Figure S.8. Modelled BC (or EC) column loading averaged for (a) July, (b) August, and (c) September, 2010 (base year).