



Supplement of

The $\Delta^{17}\text{O}$ and $\delta^{18}\text{O}$ values of atmospheric nitrates simultaneously collected downwind of anthropogenic sources – implications for polluted air masses

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Table S1. Sampling sites, duration of sampling, average results obtained for the parallel sampling with the CAPMoN systems.

#	Site	Deployment	Collection	Days	Sampling hours	Mean (total for pooled) air volume (m ³)	<i>p</i> NO ₃ ⁻					HNO ₃				Daylight fraction (sunrise to sunset)	NO ₂ in sample train* (ug/m ³ as N equivalents)	
							Mean (total for pooled) loading (ug of N)	Air conc(ug/m ³ as N equivalents)	δ ¹⁸ O (‰)	δ ¹⁷ O (‰)	Δ ¹⁷ O (‰)	Mean (total for pooled) loading (ug of N)	Air conc (ug/m ³ as N equivalents)	δ ¹⁸ O (‰)	δ ¹⁷ O (‰)			Δ ¹⁷ O (‰)
1	Genesee	2010-09-30	2010-10-05	5	23	59	8.0	0.14	70.3	63.8	26.9	8.4	0.15	66.9	59.4	24.3	0.49	
2	Genesee	2010-10-08	2010-10-18	10	42	99						6.6	0.07	63.3	56.1	22.9	0.65	
3	Genesee	2010-10-18	2010-11-08	21	39	87	13.4	0.15	62.1	55.9	23.3	10.2	0.12	69.2	61.1	24.8	0.33	
4	Genesee	2010-11-08	2011-01-31	84	360	517	181.6	0.35	83.2	74.2	30.5	40.2	0.08	81.7	71.9	29.0	0.31	
5	Genesee	2011-02-22	2011-04-28	65														
6	Genesee	2011-04-28	2011-06-20	53	144	189	19.4	0.10	67.3	60.9	25.6	24.9	0.13	67.6	60.2	24.7	0.71	0.82
7	Vauxhall	2011-10-25	2011-11-17	23	152	255	22.1	0.09	64.8	61.3	27.3	6.9	0.03	68.3	61.4	25.5	0.35	0.05
8	Vauxhall	2011-11-17	2011-12-01	14	89	176	15.9	0.09	60.7	57.0	25.1	4.8	0.03	61.7	55.9	23.5	0.28	0.12
9	Vauxhall	2011-12-01	2011-12-13	12	128	235	31.1	0.13	63.9	60.2	26.7						0.34	
10	Terrace Heights	2012-07-24	2012-08-12	19	213	112	3.2	0.03	56.6	50.6	20.9	3.7	0.03	62.4	52.9	20.2	0.73	
11	Terrace Heights	2012-08-23	2012-09-10	18	288	103	2.5	0.02	62.9	56.6	23.6	1.4	0.01	68.7	57.5	21.4	0.64	1.1
12	Terrace Heights	2012-10-01	2012-10-10	9	128	39	1.4	0.04	59.3	54.1	23.0	0.8	0.02	65.9	56.5	21.9	0.51	1.2
13	Terrace Heights	2012-10-19	2012-10-25	6														1.8
14	Fort Saskatchewan	2013-04-14	2013-04-28	15	115	37	4.3	0.11	51.8	46.0	18.8	3.0	0.09	67.7	60.1	24.6	0.75	5.2
15	Fort Saskatchewan	2013-05-02	2013-06-03	32	108	39	9.6	0.26	58.0	53.2	22.8	4.8	0.13	64.9	56.8	22.8	0.84	14.9
16	Fort Saskatchewan	2013-06-14	2013-07-11	27	151	44	1.9	0.06	48.4	39.2	13.8	2.4	0.07	64.4	53.2	19.4	0.74	9.1
17	Fort Saskatchewan	2013-07-19	2013-09-06	49	223	76	4.4	0.06	60.2	50.6	19.0	4.5	0.06	65.8	55.0	20.5	0.74	4.4
18	Fort Saskatchewan	2013-09-29	2014-01-19	113	107	31	7.3	0.24	69.5	60.3	23.8	3.3	0.05	63.2	52.5	19.3	0.33	1.1

*Sum of upstream and downstream NO₂ filters where breakthrough <15%. Sum of NO₂ and NO filters where there was no downstream filter to check for breakthrough (samples in italics).

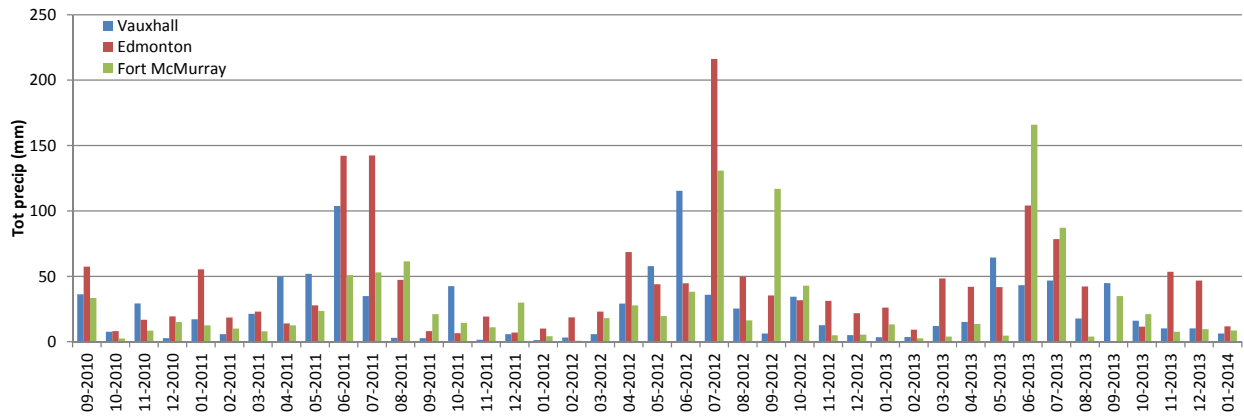
Table S2. Sampling sites, duration of sampling, and results obtained for precipitation.

#	Site	Sampling duration			wNO_3			
		Deployment	End	Days	Concentration (mg/L as N equivalents)	$\delta^{18}O$ (‰)	$\delta^{17}O$ (‰)	$\Delta^{17}O$ (‰)
4	Genesee	2010-11-14	2011-01-06	49	0.18	69.2	64.3	28.0
4	Genesee	2011-01-06	2011-01-24	19	0.27	74.4	69.2	30.1
5	Genesee	2011-02-04	2011-04-28	79	0.48	57.4	49.3	19.2
6	Genesee	2011-04-28	2011-06-21	58	0.17	63.3	57.4	24.2
10	Terr. Heights	2012-07-24	2012-08-12	19	0.28	66.8	59.4	24.3
11	Terr. Heights	2012-08-23	2012-09-10	18	0.15	67.6	59.9	24.4
15	F. Saskatchewan	2013-05-02	2013-06-05	33	0.46	60.0	55.1	23.6
16	F. Saskatchewan	2013-06-14	2013-07-11	27	0.30	63.8	52.7	19.2
18	F. Saskatchewan	2013-09-20	2014-01-20	122		71.4	63.1	25.6

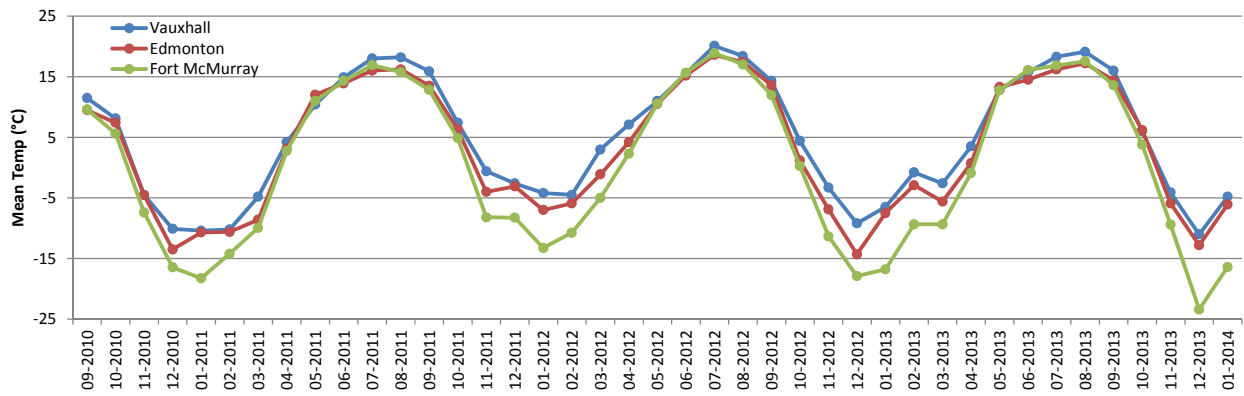
Table S3. Sampling sites and other measured parameters.

sample	Site	Nearest air quality data site(s)	Distance from sampler (km)	Bearing from sampler	Mean T (°C)	Wind speed (km/h)	Wind direction (°)	RH (%)	O ₃ (nmol mol ⁻¹)	SO ₂ (nmol mol ⁻¹)	PM _{2.5} (µg/m ³)	Nearest source (km)
1	Genesee				11.7	15.8	316	62.9	15.5	4.3	4.9	7
2	Genesee				12.2	16.2	304	43.5	26.1	1.8	3.3	7
3	Genesee	Genesee	5	W	5.5	9.4	308	64.3	18.7	1.5	2.9	7
4	Genesee				-9.8	13.9	313	76.1	16.3	1.0	4.7	7
5	Genesee				-0.9	7.7	298	62.6	36.6			7
6	Genesee				12.2	16.3	312	64.8	27.4	2.2	5.0	7
7	Vauxhall				2.6							n/a
8	Vauxhall	Lethbridge	65	SW	-0.7	-	-	-	-	-	-	n/a
9	Vauxhall				-3.5							n/a
10	Terrace Heights				20.3	11.0	276	60.3	25.5	1.1	7.5	4
11	Terrace Heights	Edmonton East	4.5	E	15.6	13.9	277	60.6	19.7	1.1	7.2	4
12	Terrace Heights				7.9	11.3	313	63.3	21.1	0.4	1.6	4
13	Terrace Heights				-1.8	10.2	309	66.3	15.2	0.8	0.9	4
14	Fort Saskatchewan				4.3	10.8	298		42.5	0.2	2.3	3
15	Fort Saskatchewan	Ross Creek; Fort Saskatchewan	4.3; 6.1	W	15.7	8.8	300		37.8	0.3	4.0	3
16	Fort Saskatchewan	(O3)			16.3	8.6	293		25.5	0.4	5.7	3
17	Fort Saskatchewan				17.7	6.3	302		22.1	0.5	5.2	3
18	Fort Saskatchewan	Range Rd 220	4.0	N	-8.1	10.3	351		18.6	0.8	5.8	9

A



B



5 Figure S1. Monthly total precipitation (A) and mean temperature (B) for the Vauxhall region (feedlots and gas compressors), great Edmonton area (CFPP, chemical and metal industries, city traffic, fertilizers and oil refinery), and oil sands mining lower Athabasca region, recorded over the period of sampling. The Edmonton area and Vauxhall meteorological conditions only differ from the oil sands ones by having higher winter temperature.

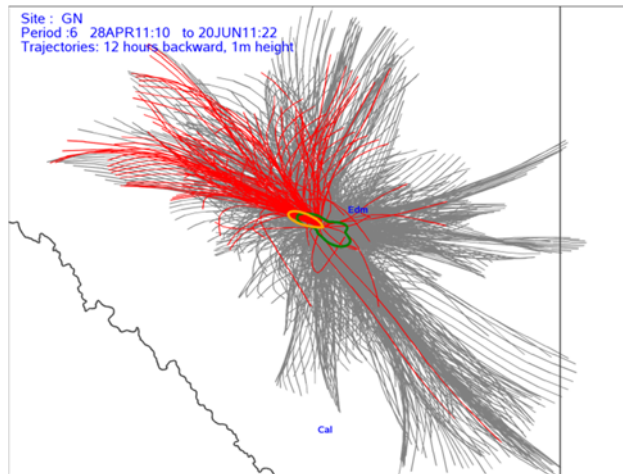


Figure S2. Twelve-hour HYSPLIT back trajectories during sample 6 (at Genesee), with red trajectories showing the times when winds were from the sampled sector.

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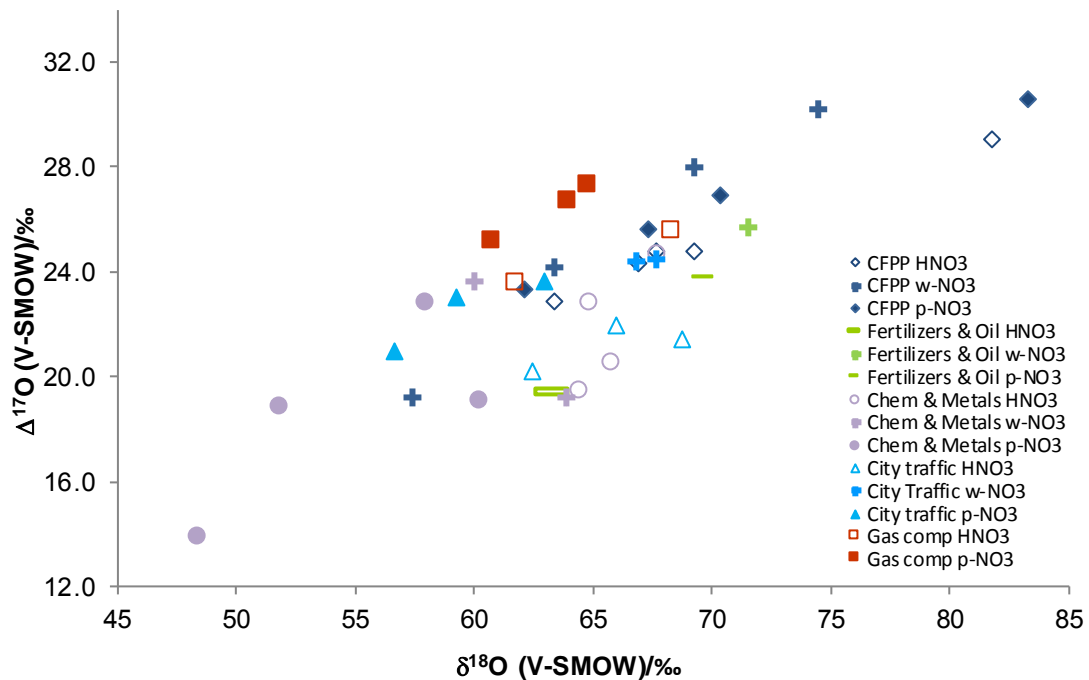


Figure S3. Triple oxygen isotopic results obtained for simultaneously sampled atmospheric HNO₃ (empty symbols), wNO₃⁻ (crosses) and pNO₃⁻ (full symbols) downwind of the various sources.

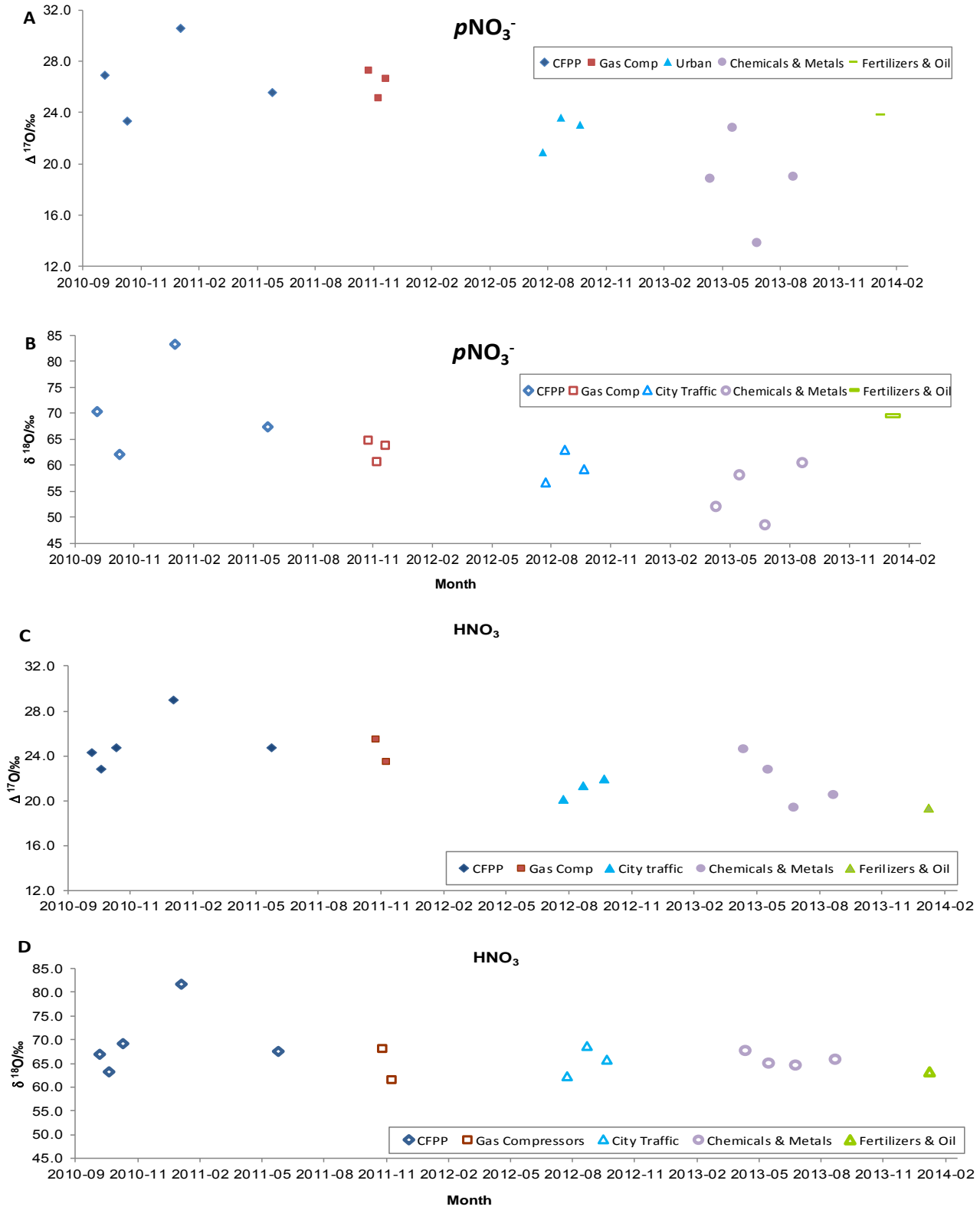


Figure S4. Oxygen isotopic variations (relative to V-SMOW) as a function of sampling period labelled by emitter types: pNO_3^- (A) $\Delta^{17}O$ and (B) $\delta^{18}O$ values; and HNO_3 (C) $\Delta^{17}O$ and (D) $\delta^{18}O$ values.

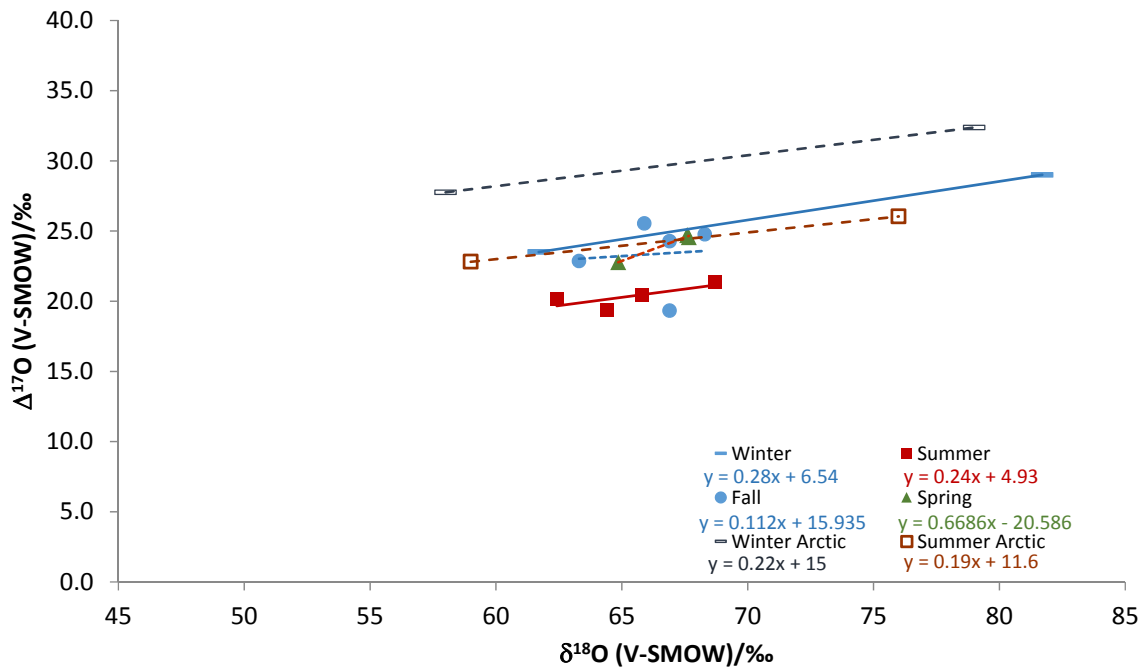


Figure S5. Triple oxygen isotopic results for HNO_3 from Southern and central Alberta (solid symbols) and pNO_3^- (empty symbols) for High Arctic (Morin et al., 2008).