

**Contaminant emissions as indicators of chemical elements in the snow along a
latitudinal gradient in southern Andes**

Jaime Pizarro^{*1}, Pablo M. Vergara¹, Sergio Cerda¹, Raúl R. Cordero¹, Ximena Castillo¹,
Penny M. Rowe^{1,2}, Gino Casassa³, Jorge Carrasco³, Alessandro Damiani^{1,4}, Pedro J.
Llanillo¹, Fabrice Lambert⁵, Roberto Rondanelli^{6,7}, Nicolas Huneeus^{6,7}, Francisco
Fernandoy⁸, Juan Alfonso⁹ and Steven Neshyba¹⁰

¹Universidad de Santiago de Chile, Av. Bernardo O'Higgins 3363, Santiago, Chile

²NorthWest Research Associates, Redmond, WA, USA

³Universidad de Magallanes, Punta Arenas, Chile.

⁴Center for Environmental Remote Sensing, Chiba University, Chiba, Japan

⁵Department of Physical Geography, Pontificia Universidad Católica de Chile, Santiago, Chile

⁶Universidad de Chile, Blanco Encalada 2002, Santiago, Chile

⁷Center for Climate and Resilience Research CR2, Blanco Encalada 2002, Santiago, Chile

⁸Universidad Nacional Andrés Bello, Viña del Mar 2531015, Chile.

⁹Instituto Venezolano de Investigaciones Científicas (IVIC), Carretera Panamericana, Km 11, Altos de Pipe, Venezuela.

¹⁰University of Puget Sound, Dept. of Chemistry, Tacoma, WA, USA

*jaime.pizarro@usach.cl

Table S1. Andean mountain sites where now sampling campaigns were carried out, including data taken during 2015 (july 4-27), from Nevados de Tarapacá (S18°06'8.5") to Valle Nevado (S 33°21.58'35.03"), and 2016 (July 13-21 and August 19 and September 1) from the Maipo Valley (33°29.8'48.6") to Osorno Volcano (S 41°07'12.0"). Some sites had two snow samples with different depth (see sample ID).

Site	Sample ID	Altitude (m)	depth (cm)
Nevados de Tarapacá	1	5318	0-5
San Pedro: Cerro Toco	1	5370	10-15
La Ola Tranque (Copiapo)	1	3624	10-15
Valle del Elqui (El Indio)	1	2341	0-5
La Ramada (Limarí)	1	1757	0-4
Valle Choapa	1	1919	0-3
Portillo	1	2800	10-15
Los Hornos: El Juncal	1	2322	0-5
Valle Nevado	1	2802	0-5
Valle Maipo- Rio Colorado	1	2302	0-5
Valle Maipo	1	2236	0-5
Curico	1	1860	0-10
Curico	2	1860	20-30
Laguna del Maule	1	1860	20-30
Laguna del Maule	2	1860	40-50
Chillan	1	1963	30-40
Chillan	2	1963	20-30
Antuco	1	1494	5-10
Antuco	2	1494	10-15
Volcan Collaqui	1	1142	0-5
Volcan Collaqui	2	1142	5-10
Lonquimay	1	1652	5-10
Lonquimay	2	1652	10-20
Centro de ski Corralco	1	1601	50-60
Centro de ski Corralco	2	1601	70-80
Volcán Llaima	1	1830	10-20
Volcán Llaima	2	1830	20-30
Volcán Villarrica	1	1450	0-5
Volcán Villarrica	2	1450	80-90
Volcán Antillanca	1	1349	30-40
Volcán Antillanca	2	1349	50-60
Volcán Osorno	1	1326	5-10
Volcán Osorno	2	1326	20-30

Table S2. Best-supported GLM showing the additive effects of atmospheric pollutants on chemical elements found in snow samples from Andean mountains

Model	AICc	ΔAICc	Weight	Element
CO (40 km)	63.111	0	0.332	Al
CO (40 km) + NO _x (40 km)	62.497	0.6132	0.2443	Al
CO (20 km)	61.586	1.5245	0.1549	Al
CO (20 km) + NH ₃ (20 km)	61.401	1.7093	0.1412	Al
Masl + CO (40 km)	61.196	1.9147	0.1275	Al
Masl + CO (20 km)	256.14	0	0.6779	Cu
NO _x (40 km)	254.65	1.4884	0.3221	Cu
CO (50 km)	56.65	0	0.0865	Fe
NO _x (10 km)	56.279	0.3716	0.0718	Fe
CO (10 km)	56.202	0.4482	0.0691	Fe
CO (20 km) + NH ₃ (20 km)	55.908	0.7423	0.0597	Fe
NH ₃ (30 km)	55.645	1.005	0.0523	Fe
PM10 (30 km)	55.643	1.0069	0.0523	Fe
PM2.5 (30 km)	55.643	1.0071	0.0523	Fe
CO (30 km)	55.638	1.0125	0.0521	Fe
CO (20 km)	55.605	1.0454	0.0513	Fe
NH ₃ (20 km)	55.589	1.0616	0.0509	Fe
PM2.5 (20 km)	55.489	1.1618	0.0484	Fe
PM2.5 (40 km)	55.488	1.1621	0.0484	Fe
NH ₃ (40 km)	55.488	1.1623	0.0484	Fe
PM10 (50 km)	55.487	1.1637	0.0483	Fe
PM10 (40 km)	55.485	1.1653	0.0483	Fe
VOC (30 km)	55.348	1.3029	0.0451	Fe
Masl + CO (20 km) + NH ₃ (20 km)	55.017	1.633	0.0382	Fe
PM2.5 (10 km)	55.015	1.635	0.0382	Fe
PM10 (20 km)	55.015	1.6355	0.0382	Fe
Masl + VOC (50 km) + PM10 (50 km)	93.947	0	0.0481	Li
Masl + VOC (50 km) + PM2.5 (50 km)	93.969	0.0222	0.0476	Li
Masl + NO _x (50 km) + PM10 (50 km)	94.054	0.1074	0.0456	Li
Masl + NO _x (50 km) + PM2.5 (50 km)	94.084	0.1377	0.0449	Li
Masl + PM2.5 (20 km)	94.148	0.2018	0.0435	Li
Masl + PM10 (10 km)	94.151	0.2046	0.0434	Li
Masl + PM10 (40 km)	94.162	0.215	0.0432	Li
Masl + PM2.5 (20 km)	94.183	0.2363	0.0427	Li
Masl + PM10 (50 km)	94.184	0.2376	0.0427	Li
Masl + PM2.5 (10 km)	94.187	0.2401	0.0427	Li
Masl + PM2.5 (40 km)	94.216	0.2695	0.042	Li
Masl + VOC (40 km) + PM10 (40 km)	94.228	0.2815	0.0418	Li
Masl + VOC (40 km) + PM2.5 (40 km)	94.247	0.3006	0.0414	Li

Masl + PM2.5 (50 km)	94.251	0.3046	0.0413	Li
Masl + NOx (40 km) + PM10 (40 km)	94.366	0.4193	0.039	Li
Masl + NOx (40 km) + PM2.5 (40 km)	94.389	0.4421	0.0386	Li
Masl + VOC (20 km) + PM10 (20 km)	94.589	0.6422	0.0349	Li
Masl + VOC (20 km) + PM2.5 (20 km)	94.598	0.6518	0.0347	Li
Masl + NOx (20 km) + PM10 (20 km)	94.709	0.762	0.0329	Li
Masl + NOx (20 km) + PM2.5 (20 km)	94.719	0.7728	0.0327	Li
Masl + CO (20 km) + PM10 (20 km)	95.413	1.4663	0.0231	Li
Masl + CO (20 km) + PM2.5 (20 km)	95.431	1.4843	0.0229	Li
Masl + VOC (10 km) + PM10 (10 km)	95.445	1.4983	0.0227	Li
Masl + VOC (10 km) + PM2.5 (10 km)	95.457	1.5105	0.0226	Li
Masl + NOx (10 km) + PM10 (10 km)	95.49	1.543	0.0222	Li
Masl + NOx (10 km) + PM2.5 (10 km)	95.504	1.5571	0.0221	Li
Masl + CO (10 km) + PM10 (10 km)	95.653	1.7063	0.0205	Li
Masl + CO (10 km) + PM2.5 (10 km)	95.667	1.7208	0.0203	Li
CO (20 km)	157.63	0	0.4722	Mg
CO (20 km) + NH ₃ (20 km)	156.99	0.6325	0.3442	Mg
NOx (40 km)	155.74	1.8885	0.1837	Mg
CO (20 km)	365.48	0	0.4383	Mn
CO (20 km) + NH ₃ (20 km)	365.28	0.2026	0.396	Mn
NOx (40 km)	363.54	1.9451	0.1657	Mn
NOx (40 km)	500.3	0	0.2126	Zn
CO (20 km)	499.69	0.6106	0.1567	Zn
CO (20 km) + NH ₃ (20 km)	499.47	0.8289	0.1405	Zn
NOx (50 km)	499.4	0.8926	0.1361	Zn
VOC (40 km)	498.76	1.5364	0.0986	Zn
NOx (40 km) + NH ₃ (40 km)	498.61	1.6869	0.0915	Zn
Masl + NOx (40 km)	498.4	1.8986	0.0823	Zn
Masl + CO (20 km)	498.38	1.9135	0.0817	Zn