

Supplemental Material

Supplemental Material, Equation 1. Equation for the regional background concentration, $C_{\text{bkg}}(z)$, for the year 2000 at elevation z in meters above sea level, is expressed as the sum of the primary and secondary (nitrate, sulfate, and ammonium) background concentrations and the additional background for Southern Switzerland.

$$C_{\text{bkg}}(z) = C_{\text{bkg}}(0) \frac{a + \ln z}{a + \ln z_o} + \delta_1 \left(C_{\text{Ticino}}(0) \frac{\ln\left(\frac{z}{1200}\right)}{\ln\left(\frac{z_{\text{Ticino}}}{1200}\right)} \right) + \delta_2 C_{\text{Sottoceneri}}$$

Where $C_{\text{bkg}}(0) = 9.2282$, $a = -8.6146$, $z_o = 440\text{m}$, $z_{\text{Ticino}} = 200\text{m}$, δ_1 is unity for Southern Switzerland (Ticino including Lugano and Sottoceneri) at altitudes lower than 1200 m a.s.l. and zero elsewhere. $C_{\text{Ticino}}(0) = 9.5$, δ_2 is unity for the Sottoceneri region and zero elsewhere, and $C_{\text{Sottoceneri}} = 4.4$. The terrain height, z , in each grid cell, is averaged over a circle with a total area of 1 km^2 in Southern Switzerland and 5 km^2 elsewhere.

Supplemental Material, Table 1. Fixed monitoring sites used for model evaluation.

City, Station	Traffic site		Alpine site	PM10		NO2		NOx	
	1990	2000		1990	2000	1990	2000	1990	2000
Aarau LES	1	0	0	1	1	1	0	0	0
Aesch	0	0	0	0	0	0	1	0	0
Altdorf	0	1	1	0	1	0	1	0	0
Anières	0	0	0	0	1	1	1	0	0
Arbon, Stadthaus	0	1	0	0	0	1	1	0	0
Aéroport de Genève	0	0	0	0	0	0	1	0	0
BRIGERBAD	0	1	1	0	1	1	1	0	0
Baar, Inwil	0	0	0	0	0	1	0	0	0
Bachtel	0	0	0	0	0	1	1	0	0
Baden, Schulhausplatz	0	1	0	0	0	0	1	0	0
Basel - Binningen	0	0	0	1	1	1	1	1	1
Basel, Feldbergstr.	0	1	0	0	0	0	1	0	1
Basel, St. Johann	0	0	0	1	1	1	1	0	1
Bern Bollwerk, NABEL	0	1	0	0	1	0	1	0	1
Bern, Brunneggshalde	1	1	0	1	1	1	1	0	0
Bettlachstock	0	0	0	0	0	0	1	0	0
Biberist, Ost	0	0	0	1	1	0	0	0	0
Biberist, West	0	0	0	0	1	0	0	0	0
Biel	0	0	0	0	1	1	1	0	0
Bioggio	0	0	0	0	0	0	1	0	0
Bodio	0	1	0	0	1	1	1	0	0
Brione/Minusio	0	0	0	0	1	1	1	0	0
Chablais	0	0	0	0	0	0	1	0	0
Chaumont, NABEL	0	0	0	0	1	0	1	0	0
Chiasso	0	1	0	0	1	1	1	0	0
Chur, RhB Verw.-Geb.	0	1	0	1	0	1	1	0	0
Davos	0	0	1	0	0	1	1	1	1
Davos	0	0	1	1	1	1	1	1	1
Delémont	0	1	0	0	0	0	1	0	0
Dornach, Schulh. Brühl	0	1	0	1	0	1	1	0	0
Dübendorf, NABEL	0	0	0	1	1	1	1	0	0
Ebikon Sedel	0	1	0	0	0	1	1	0	0
Eggerberg	0	0	1	0	1	1	1	0	0
Epalinges	0	1	0	0	1	1	1	0	0
Evionnaz	0	1	0	0	0	1	1	0	0
Flughafen Zuerich	0	0	0	0	1	0	1	0	0
Flüelen	1	0	0	0	0	1	0	0	0
Frauenfeld	0	1	0	1	1	1	1	0	0
Fribourg, Pérolles	0	1	0	0	0	1	1	0	0
Genf St. Clotilde	1	1	0	1	1	1	1	0	0
Genève, Foron	0	0	0	0	0	1	1	0	0
Genève, L'île	0	1	0	0	0	1	1	0	0
Glarus Feuerwehrtstützpunkt	0	0	0	0	0	1	1	0	0
Grabs	0	0	0	0	1	0	1	0	1
Grenchen Stadt	0	1	0	0	0	1	1	0	0
Härkingen, NABEL	0	1	0	0	1	0	1	0	0
Interlaken	0	0	0	0	0	0	1	0	0
Ittigen	0	0	0	0	0	0	1	0	0
Jungfrauoch, NABEL	0	0	0	1	0	0	1	0	0
Jussy	0	0	0	0	0	1	1	0	0
Kreuzlingen Löwenstrasse	1	1	0	0	0	1	1	0	0
La Chaux-de-Fonds	0	1	0	0	0	0	1	0	0
Langenthal	0	0	0	0	0	1	1	0	0
Langnau i.E.	0	0	0	0	1	0	0	0	0

Supplemental Material, Table 1 (continued).

City, Station	Traffic site		Alpine site	PM10		NO2		NOx	
	1990	2000		1990	2000	1990	2000	1990	2000
Lausanne, NABEL	0	1	0	0	1	0	1	0	0
Lausanne, Rumine	0	1	0	0	0	0	1	0	0
Le Landeron	0	0	0	0	0	0	1	0	0
Les Agettes	0	0	0	0	0	1	1	0	0
Les Giettes	0	0	0	0	1	1	1	0	0
Liestal	0	1	0	0	0	1	1	0	0
Locarno	0	1	0	1	1	1	1	0	0
Lugano	0	1	0	1	1	1	1	1	1
LuzernMuseggstrasse	0	0	0	0	1	0	1	0	0
Magadino, NABEL	0	0	0	0	1	0	1	0	0
Massongex	0	1	0	0	1	1	1	0	0
Mauren Pünt	0	0	0	1	0	1	1	0	0
Meyrin	0	0	0	0	0	1	1	0	0
Montana	0	0	1	0	1	0	0	0	0
Montreux	0	1	0	0	0	0	1	0	0
Morges	0	1	0	0	0	0	1	0	0
Neuchâtel	0	1	0	0	0	0	1	0	0
Neuhausen	0	0	0	0	0	1	1	0	0
Nyon	0	1	0	0	0	0	1	0	0
Olten, Frohheim	0	0	0	0	1	0	1	0	0
Opfikon	1	1	0	0	0	1	1	0	0
Opfikon Tenniscenter	1	0	0	0	0	1	1	1	1
Ottoberg	0	0	0	0	0	0	1	0	0
Passeiry	0	0	0	1	1	1	1	0	0
Payerne	0	0	0	1	1	1	1	1	1
Porrentruy	0	1	0	0	0	0	1	0	0
Pratteln	0	0	0	0	0	1	1	0	0
Rapperswil	0	0	0	0	0	1	1	0	0
Rigi, NABEL	0	0	1	0	1	0	1	0	0
Roggwil	0	1	0	0	0	1	1	0	0
Roveredo	0	1	0	1	1	1	1	0	0
Saxon	0	1	1	0	1	1	1	0	0
Schwyz	0	1	1	0	1	0	1	0	0
Sion	1	1	1	0	1	1	1	0	0
Sion, NABEL	1	1	1	1	1	1	1	0	0
Sisseln	0	1	0	0	1	1	1	0	0
Solothurn, Altwyberhüsli	0	1	0	0	0	0	1	0	0
Solothurn, Werkhofstr.	0	1	0	0	1	0	0	0	0
St.GallenVolksbadstrasse	0	0	0	0	1	1	1	0	0
Stans,Engelbergstrasse	0	1	1	0	1	0	1	0	0
StationWilson	1	1	0	0	0	1	1	0	0
Suhr, Distelmatte	1	1	0	1	1	1	1	1	1
Suhr, Zentrum	0	1	0	0	1	0	1	0	1
TURTMANN	0	1	0	0	0	0	1	0	0
Thun	0	0	0	0	0	1	1	0	0
Tänikon, NABEL	0	0	0	1	1	1	1	0	0
Wald	0	0	0	0	1	0	1	0	1
Wallisellen	0	0	0	0	1	1	1	1	1
Winterthur, Obertor	0	0	0	0	1	1	1	0	0
Yverdon	0	1	0	0	0	0	1	0	0
Zizers	0	0	0	1	0	1	1	0	0
Zollikofen	0	0	0	0	0	1	1	0	0
Zug	0	1	0	0	1	0	1	0	0
Zürich, NABEL	0	0	0	1	1	1	1	1	1
Zürich, Schimmelstr.	1	1	0	1	1	1	1	1	1
Zürich, Schwamendingen	0	0	0	0	1	0	0	0	0
Zürich, Stampfenbachstr.	1	1	0	1	1	1	1	1	1

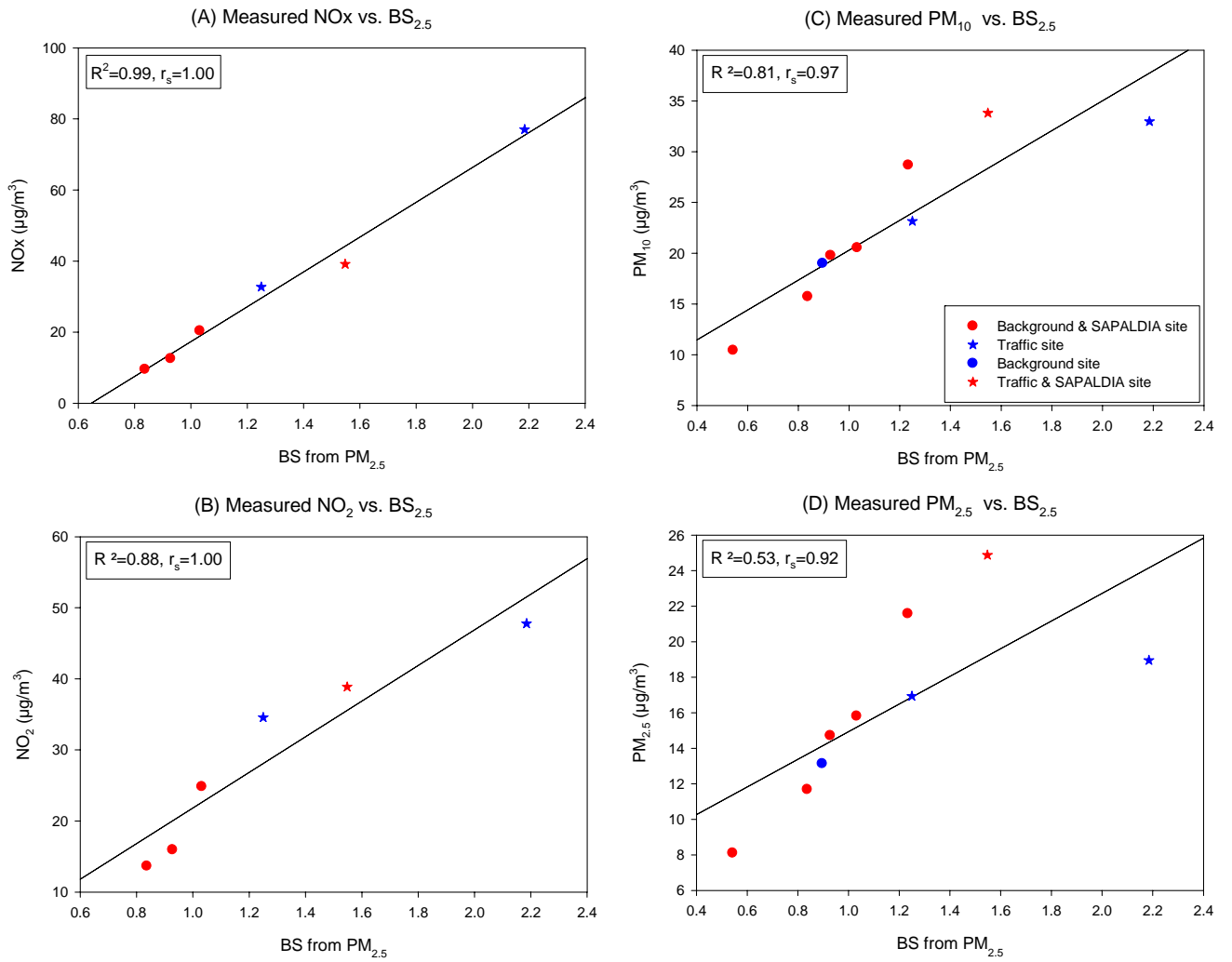
Supplemental Material, Table 2. PM₁₀ emission by source (kg/ha) in 1990 and 2000.

AREA	1990					2000					Difference				
	Traffic	Railway	Household	Industry	Agriculture	Traffic	Railway	Household	Industry	Agriculture	Traffic	Railway	Household	Industry	Agriculture
Aarau	19.54	1.60	9.92	33.72	0.61	14.56	1.58	9.62	18.92	0.60	-25%	-1%	-3%	-44%	-1%
Basel	47.29	1.30	24.79	33.44	0.17	36.57	1.22	24.04	18.79	0.17	-23%	-6%	-3%	-44%	-1%
Davos	12.01	0.95	5.86	25.53	1.04	8.45	0.53	5.69	14.72	1.03	-30%	-44%	-3%	-42%	-1%
Geneva	55.78	0.61	42.24	32.05	0.03	42.90	0.55	40.96	18.07	0.03	-23%	-11%	-3%	-44%	-1%
Lugano	24.72	1.88	16.61	35.31	0.13	18.51	1.87	16.11	19.75	0.13	-25%	-1%	-3%	-44%	-1%
Montana	4.31	0.00	2.91	21.06	1.67	2.69	0.00	2.82	12.42	1.66	-38%	0%	-3%	-41%	-1%
Payerne	15.50	0.59	8.16	29.21	1.23	11.35	0.41	7.92	16.61	1.22	-27%	-30%	-3%	-43%	-1%
Wald	7.01	0.10	4.59	22.79	1.61	4.73	0.07	4.45	13.32	1.60	-33%	-30%	-3%	-42%	-1%
Overall	22.28	0.89	13.49	29.32	0.84	16.70	0.81	13.08	16.67	0.83	-25%	-9%	-3%	-43%	-1%

Supplemental Material, Table 3. NO_x emission by source (kg/ha) in 1990 and 2000.

Area	1990				2000				Differences			
	Traffic	Household	Industry	Agriculture	Traffic	Household	Industry	Agriculture	Traffic	Household	Industry	Agriculture
Aarau	312.9	73.5	118.0	10.6	181.9	49.9	80.7	12.6	-42%	-32%	-32%	19%
Basel	476.1	184.7	116.9	10.0	285.5	125.4	79.9	12.0	-40%	-32%	-32%	20%
Davos	52.6	47.8	85.6	10.5	29.9	32.4	58.6	12.3	-43%	-32%	-32%	18%
Geneva	656.4	350.6	111.4	10.0	359.1	238.2	76.2	12.0	-45%	-32%	-32%	20%
Lugano	543.5	137.4	124.3	10.0	296.4	93.3	85.0	11.9	-45%	-32%	-32%	20%
Montana	64.2	24.6	68.0	11.5	36.0	16.7	46.5	13.4	-44%	-32%	-32%	17%
Payerne	218.6	62.5	100.2	11.7	135.0	42.4	68.5	13.9	-38%	-32%	-32%	19%
Wald	89.1	37.4	74.8	11.4	48.7	25.3	51.1	13.3	-45%	-32%	-32%	17%
All	300.5	106.9	100.6	10.7	171.5	72.6	68.8	12.7	-43%	-32%	-32%	18%

Supplemental Material, Figure 2. Relationship between measured black smoke and measurements of (A) NO_x, (B) NO₂, (C) PM₁₀, and (D) PM_{2.5}.



Supplemental Material, Figure 3. Cumulative exposure to PM₁₀ (years* $\mu\text{g}/\text{m}^3$) vs. differences in PM₁₀ ($\mu\text{g}/\text{m}^3$) between 1990 and 2000 among non-movers.

