Supplementary Material

for

Assessment and economic valuation of air pollution impacts on human health over Europe and the United States as calculated by a multi-model ensemble in the framework of AQMEII3

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The effect of pollution concentrations (EVA input) on health impacts (EVA output) is investigated by means of regression analysis. The input dataset consists of the simulated pollutant by each model, averaged over all stations. The output dataset consists of the 14 health impact indices (HII) for each model.

The Pearson Correlation Coefficient (CC) between the simulated pollutant levels and the health impacts are presented in Table S1. For the particular input-output configuration, the results show that the strength of the linear relationship between the pollutants and the HIIs is strongest for $PM_{2.5}$, with CC in the range 0.77-0.85. All correlations are statistically significant. The 2nd most important factor is CO, with CC varying between 0.60 and 0.69. The correlations are significant only for three out of fourteen HIIs. For the other pollutants (O_3 and SO_2), the correlations are statistically non-significant.

The Partial Correlation Coefficients (PCC) are evaluated from regression analysis and provide a measure of the strength of the linear relationship between two variables after a correction has been made for the linear effects of the other variables in the analysis. For example, the PCC gives the strength between the HII and a given pollutant (e.g. O_3), after adjustment for any effect due to correlation between O_3 and the other pollutants. If we exclude the effects of the other pollutants, the importance of O_3 is augmented (Table S1), with PCC that closely follow the PCC of CO. Using CC, the importance of O_3 is masked, mainly by CO. For the other pollutants, the PCC results are similar with the CC ranking.

More quantitative measures of sensitivity are evaluated from the standardized regression coefficients (SRCs). Assume b_j is the linear regression coefficient of the dependent input x_j (O_3, $PM_{2.5}$, SO_2, CO) and the independent variable y (health indices) using a multiple linear regression model. If σx_j and σy represent the standard deviations of the dependent input x_j and the independent variable y respectively, the SRCs are defined as $b_j \sigma x_j / \sigma y$. The SRCs offer a measure of sensitivity that is multi-dimensionally averaged and hence represent a global measure of sensitivity. The effectiveness of the standardized regression coefficients is conditional on the value of the model coefficient of determination (R^2). The fit of the regression (Table S1) is high (0.81-0.86), implying that the linear regression model is able to represent the majority of the variation of the HII. This also means that at least 81% of the variation of the health indices is explained by sole variations in the pollutants (i.e. without interactions). The most important contribution to the HIIs is from $PM_{2.5}$, followed by CO and O_3 (with much smaller influence though). The effect on the HII of perturbing PM2.5 by a fixed fraction of its standard deviation if roughly double compared to CO and O_3. The order of variable importance based on SRC and PCC is the same.

Table S1. Univariate and Multivariate analysis of the relationship between concentration inputs and health impact indices in the EVA system by means of the Pearson Correlation Coefficient (CC), the Partial Correlation Coefficient (PCC) and the Standardized Regression Coefficient (SRC). R^2 stands for the coefficient of model determination. Values in bold denote significant correlations.

HII	CC				PCC				SRC				
	O_3	$PM_{2.5}$	SO_2	CO	O_3	$PM_{2.5}$	SO_2	CO	O_3	$PM_{2.5}$	SO_2	CO	R^2
CB	0.09	**0.84**	0.23	0.60	0.52	**0.79**	-0.13	0.54	0.32	0.66	-0.06	0.40	0.81
RAD	0.09	**0.84**	0.23	0.60	0.52	**0.79**	-0.13	0.54	0.32	0.66	-0.06	0.40	0.81
RHA	0.06	**0.77**	0.14	**0.68**	0.63	**0.71**	-0.44	**0.74**	0.41	0.50	-0.23	0.66	0.83
CHA	0.09	**0.84**	0.23	0.60	0.52	**0.79**	-0.13	0.54	0.32	0.66	-0.06	0.40	0.81
CHF	0.02	**0.85**	0.26	**0.69**	0.55	**0.82**	-0.15	**0.70**	0.29	0.62	-0.07	0.51	0.86
LC	0.09	**0.84**	0.23	0.60	0.52	**0.79**	-0.13	0.54	0.32	0.66	-0.06	0.40	0.81
BUC	0.09	**0.84**	0.23	0.60	0.52	**0.79**	-0.13	0.54	0.32	0.66	-0.06	0.40	0.81
BUA	0.09	**0.84**	0.23	0.60	0.52	**0.79**	-0.13	0.54	0.32	0.66	-0.06	0.40	0.81
COUC	0.09	**0.84**	0.23	0.60	0.52	**0.79**	-0.13	0.54	0.32	0.66	-0.06	0.40	0.81
COUA	0.09	**0.84**	0.23	0.60	0.52	**0.79**	-0.13	0.54	0.32	0.66	-0.06	0.40	0.81
LRSC	0.09	**0.84**	0.23	0.60	0.52	**0.79**	-0.13	0.54	0.32	0.66	-0.06	0.40	0.81
LRSA	0.09	**0.84**	0.23	0.60	0.52	**0.79**	-0.13	0.54	0.32	0.66	-0.06	0.40	0.81
PD	0.09	**0.83**	0.20	**0.63**	0.61	**0.80**	-0.28	0.66	0.37	0.62	-0.13	0.50	0.84
IM*	0.09	**0.84**	0.23	0.60	0.52	**0.79**	-0.13	0.54	0.32	0.66	-0.07	0.40	0.81

Table S2. Health impacts as calculated by the individual models over Europe and the United States (×10^3, except for IM) in response to a 20% reduction of global anthropogenic emissions (GLO). See Table 2 for the definitions of health impacts.

Models	CB	RAD	RHA	CHA	CHF	LC	BUC	BUA	COUC	COUA	LRSC	LRSA	PD	IM*
Europe														
DE1	153	156 353	11	20	16	23	4 571	29 929	15 793	30 809	6 095	11 113	184	171
DK1	258	263 761	15	33	23	40	7 711	50 488	26 642	51 973	10 281	18 748	297	289
FI1	345	352 263	21	44	30	53	10 298	67 429	35 581	69 412	13 731	25 038	382	386
FRES1	305	312 159	18	39	27	47	9 126	59 753	31 531	61 510	12 168	22 187	342	342
IT1	414	423 452	24	53	34	63	12 380	81 056	42 772	83 440	16 506	30 098	467	464
IT2	267	273 062	16	34	23	41	7 983	52 269	27 581	53 806	10 644	19 409	296	299
TR1	378	386 412	24	48	33	58	11 297	73 965	39 030	76 141	15 062	27 465	459	423
UK1	282	287 915	19	36	25	43	8 417	55 112	29 082	56 733	11 223	20 464	5 370	315
UK2	333	340 662	22	43	28	51	9 959	65 208	34 409	67 126	13 279	24 213	390	373
MEAN	304	310 671	19	39	27	47	9 082	59 468	31 380	61 217	12 110	22 082	910	340
MEDIAN	305	312 159	19	39	27	47	9 126	59 753	31 531	61 510	12 168	22 187	382	342
The United States														
DE1	53	53735	3	7	4	8	1679	10286	5801	10588	2239	3819	62	52
DK1	132	135058	7	17	9	20	4221	25852	14585	26612	5628	9599	153	132
US3	168	171411	9	22	11	26	5414	32809	18707	33774	7219	12183	176	171
MEAN	117	120068	6	15	8	18	3772	22982	13031	23658	5029	8534	130	118
MEDIAN	132	135058	7	17	9	20	4221	25852	14585	26612	5628	9599	153	132

Table S3. Health impacts as calculated by the individual models over Europe and the United States (×10^3, except for IM) in response to a 20% reduction of North American anthropogenic emissions (NAM). See Table 2 for the definitions of health impacts.

Models	CB	RAD	RHA	CHA	CHF	LC	BUC	BUA	COUC	COUA	LRSC	LRSA	PD	IM*
Europe														
DE1	191	194 812	13	24	19	29	5 695	37 290	19 677	38 387	7 594	13 847	231	213
DK1	290	296 847	17	37	26	44	8 678	56 822	29 984	58 493	11 571	21 099	337	325
FI1	410	419 694	25	53	35	63	12 270	80 336	42 392	82 699	16 360	29 831	457	460
FRES1	372	379 831	22	48	32	57	11 104	72 706	38 366	74 844	14 806	26 997	418	416
TR1	460	469 841	29	59	40	70	13 736	89 936	47 458	92 581	18 314	33 395	536	515
UK1	342	349 960	23	44	30	52	10 231	66 989	35 349	68 959	13 641	24 874	403	383
MEAN	344	351 831	22	44	30	53	10 286	67 346	35 538	69 327	13 714	25 007	397	385
MEDIAN	357	364 896	22	46	31	55	10 668	69 847	36 857	71 902	14 224	25 936	410	400
The United States														
DE1	52	53 382	3	7	4	8	1 667	10 218	5 760	10 518	2 223	3 794	62	52
DK1	134	137 305	7	17	9	21	4 292	26 282	14 830	27 055	5 723	9 759	158	134
US3	169	172 620	9	22	11	26	5 454	33 041	18 845	34 013	7 273	12 269	178	172
MEAN	118	121 102	6	15	8	18	3 805	23 180	13 145	23 862	5 073	8 607	133	120
MEDIAN	134	137 305	7	17	9	21	4 292	26 282	14 830	27 055	5 723	9 759	158	134

Table S4. Health impacts as calculated by the individual models over Europe and the United States (×10^3, except for IM) in response to a 20% reduction of European (EUR) and East Asian (EAS) anthropogenic emissions. See Table 2 for the definitions of health impacts.

Models	CB	RAD	RHA	CHA	CHF	LC	BUC	BUA	COUC	COUA	LRSC	LRSA	PD	IM*
							Europe							
DE1	154	157 444	11	20	16	24	4 603	30 138	15 903	31 024	6 137	11 191	187	173
DK1	270	275 740	16	35	24	41	8 061	52 781	27 852	54 333	10 748	19 599	312	302
FI1	346	353 923	21	44	30	53	10 347	67 747	35 749	69 740	13 796	25 156	384	388
FRES1	311	318 365	18	40	28	48	9 307	60 941	32 157	62 733	12 410	22 629	350	349
IT1	430	440 061	25	55	35	66	12 865	84 235	44 450	86 713	17 154	31 278	487	482
UK1	291	297 212	19	37	26	45	8 689	56 891	30 021	58 565	11 585	21 125	343	326
MEAN	300	307 124	18	39	27	46	8 979	58 789	31 022	60 518	11 972	21 830	344	336
MEDIAN	301	307 788	19	39	27	46	8 998	58 916	31 089	60 649	11 998	21 877	347	337
							The United States							
DE1	61	62 470	3	8	4	9	1 951	11 958	6 740	12 309	2 601	4 440	74	61
DK1	160	163 776	9	21	11	25	5 119	31 349	17 687	32 271	6 826	11 641	180	160
US3	204	208 377	11	27	13	31	6 583	39 885	22 746	41 058	8 778	14 810	214	208
MEAN	142	144 875	8	18	9	22	4 551	27 730	15 724	28 546	6 068	10 297	156	143
MEDIAN	160	163 776	9	21	11	25	5 119	31 349	17 687	32 271	6 826	11 641	180	160