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Supplement of

Air Control Toolbox (ACT_v1.0): a flexible surrogate model to explore mitigation scenarios in air quality forecasts

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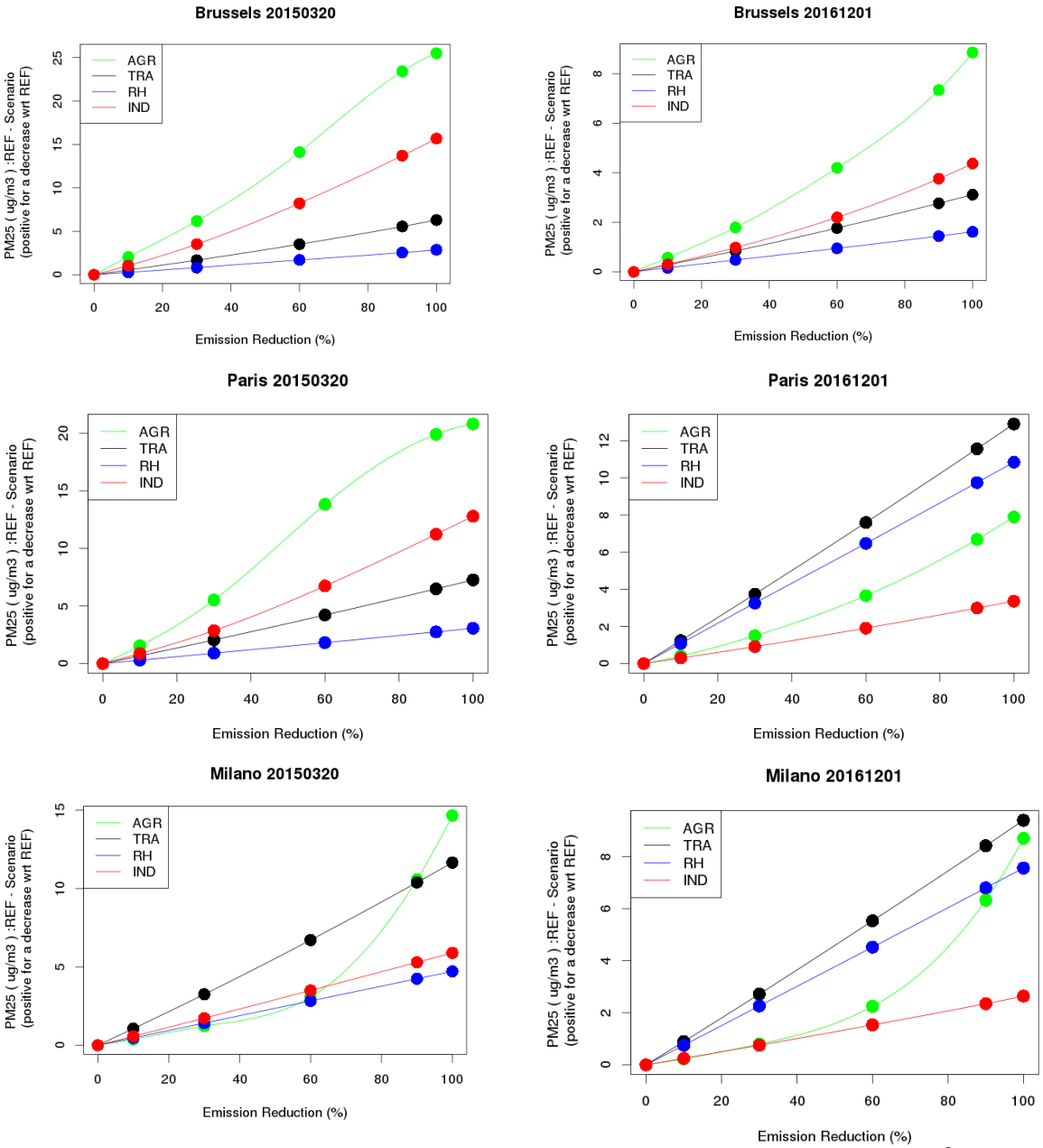


Figure S1 : Modelled $PM_{2.5}$ reduction (y-axis : positive for a decrease with respect to the reference, $\mu g/m^3$) for a given reduction in Agriculture (green), Industrial (red), Residential Heating (blue), and Traffic (black) emissions (x-axis: in %) in Brussels, Paris and Milano (top to bottom) and for 20150320 (left) and 20161201 (right).

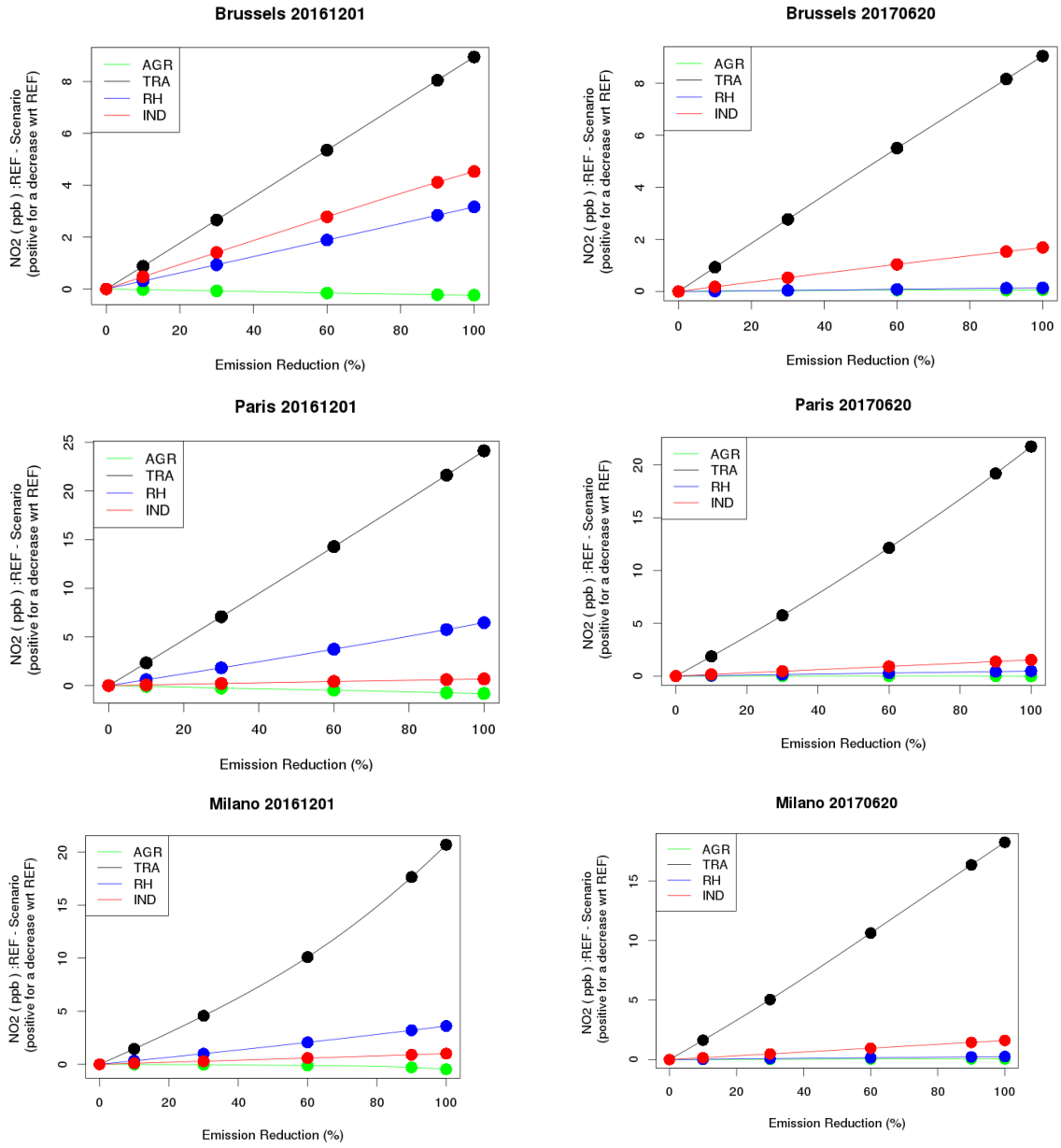


Figure S2 : Same as Figure S1 for NO_2 20161201 and 20170620

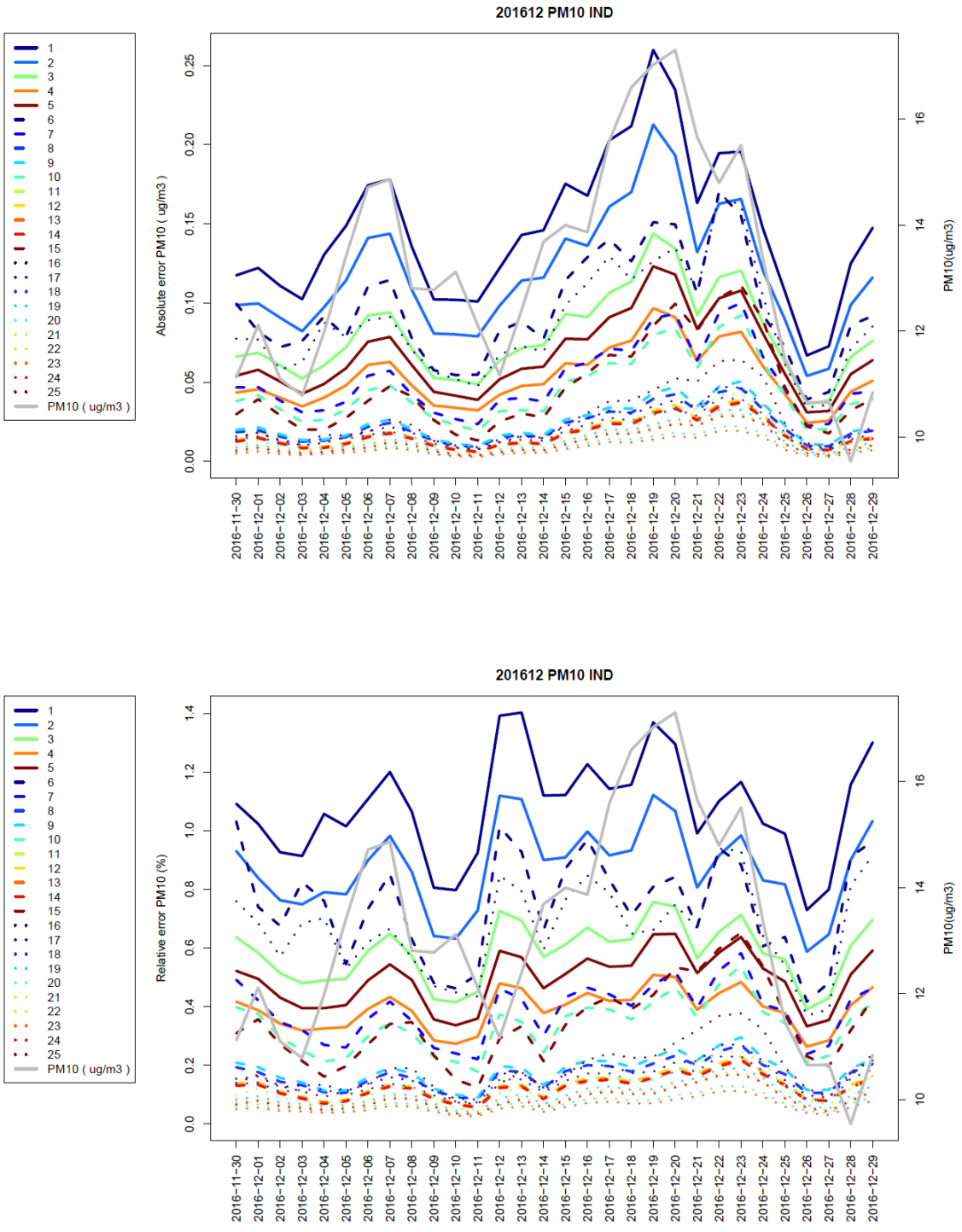


Figure S3 : Absolute (top, µg/m^3) and relative (bottom, %) error over Western Europe of the univariate surrogate model for the Industry activity sector in December 2016. The colored lines are for individual polynomial surrogate models and training scenarios (x-axis: 5 linear, 10 quadratic and 10 cubic forms with indices of the x-axis matching the rows of Table 1). The grey curve gives the day-to-day variation of PM_{10} (µg/m^3) averaged over the region (displayed on the right-hand-side y-axis)

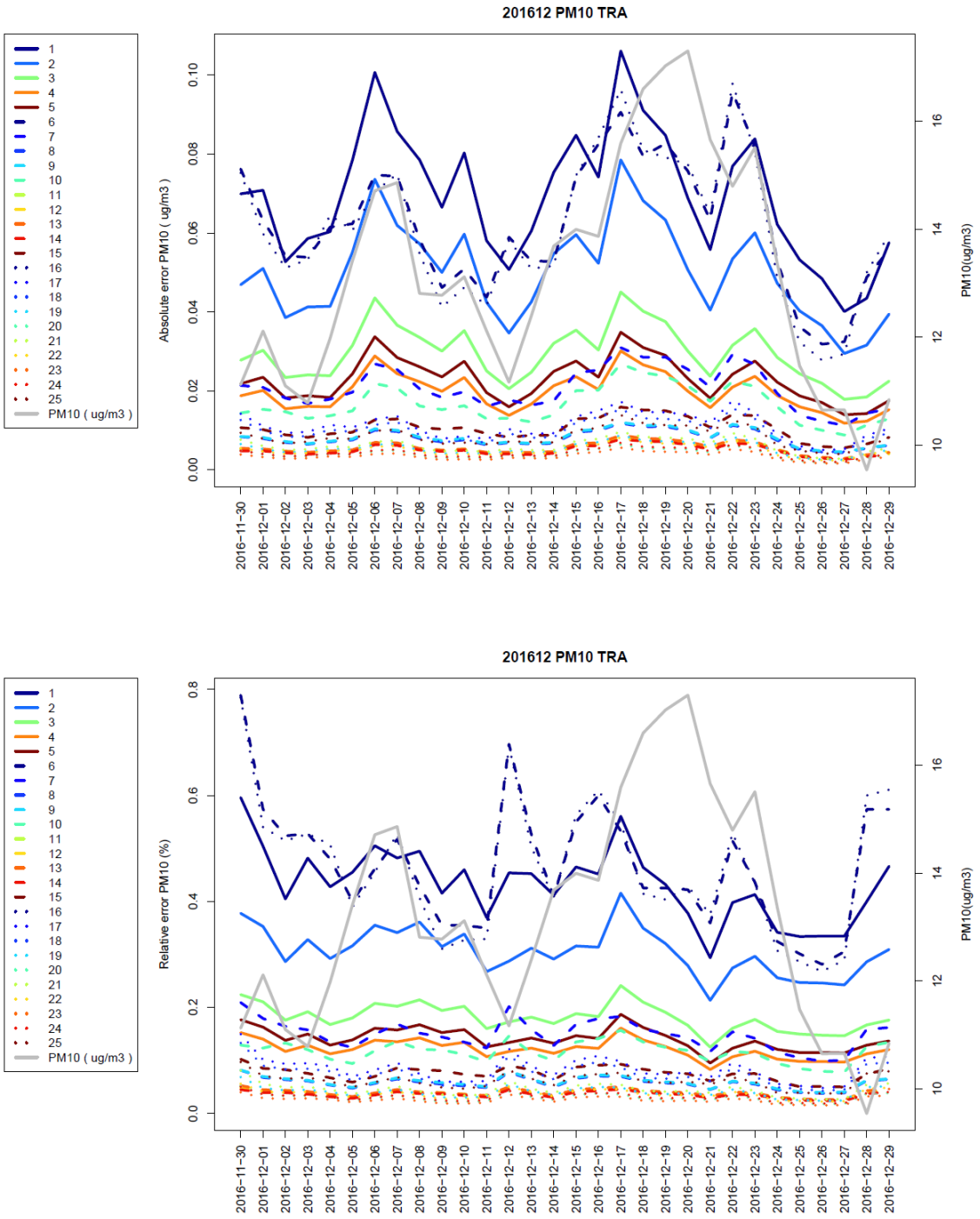
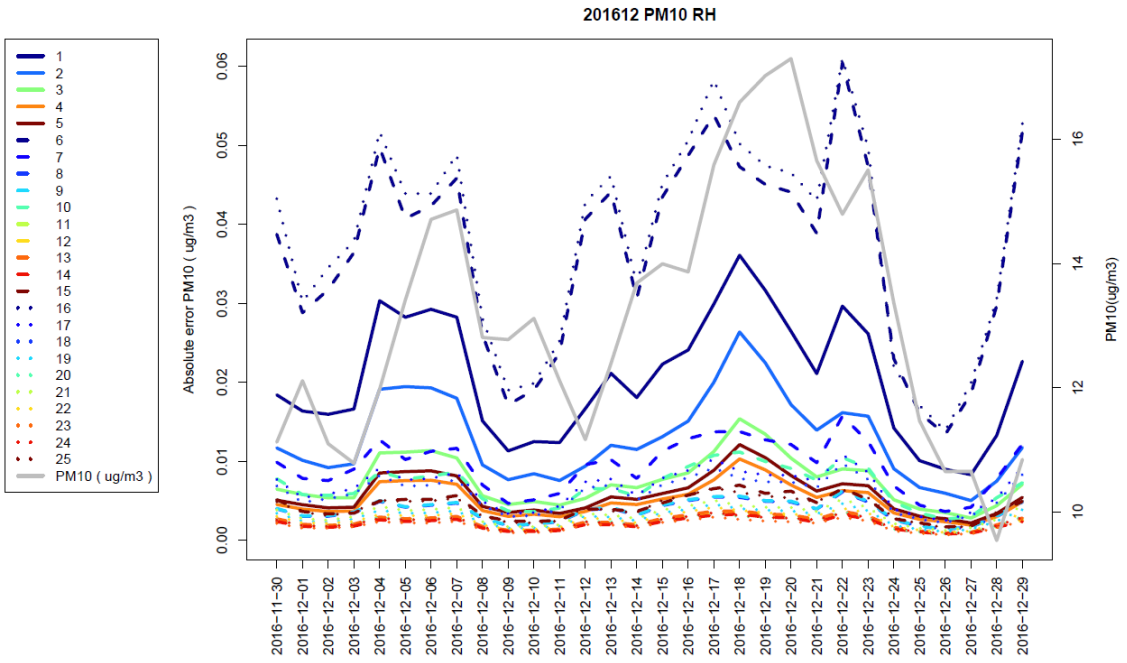


Figure S4 : Same as Figure S3 for Traffic



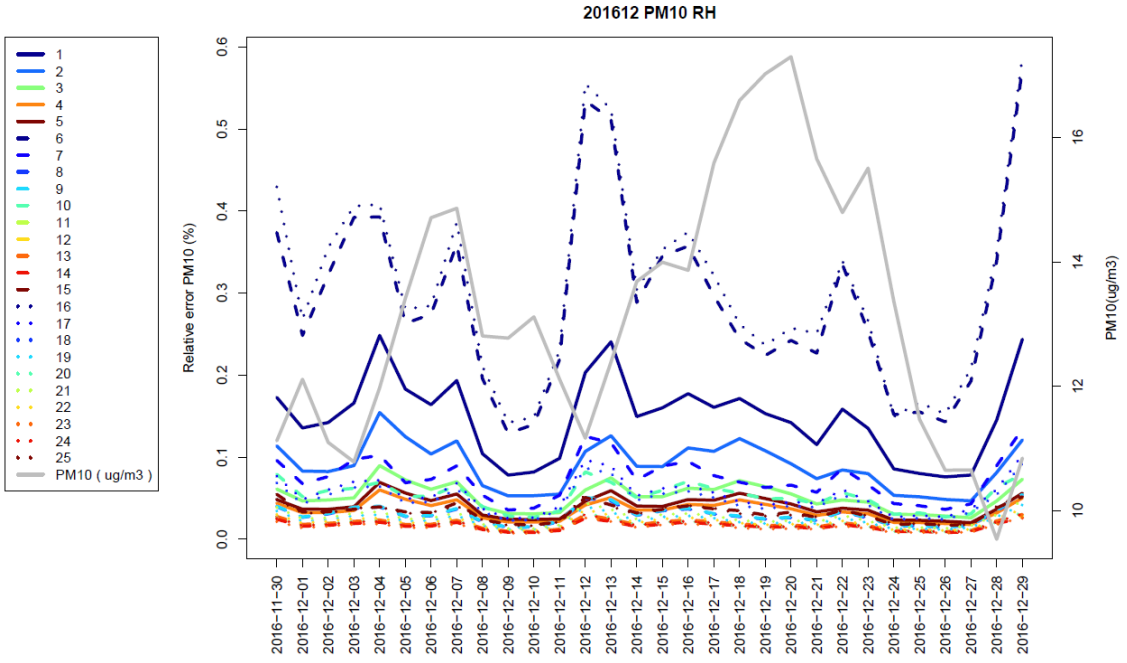


Figure S5 : Same as Figure S3 for Residential Heating

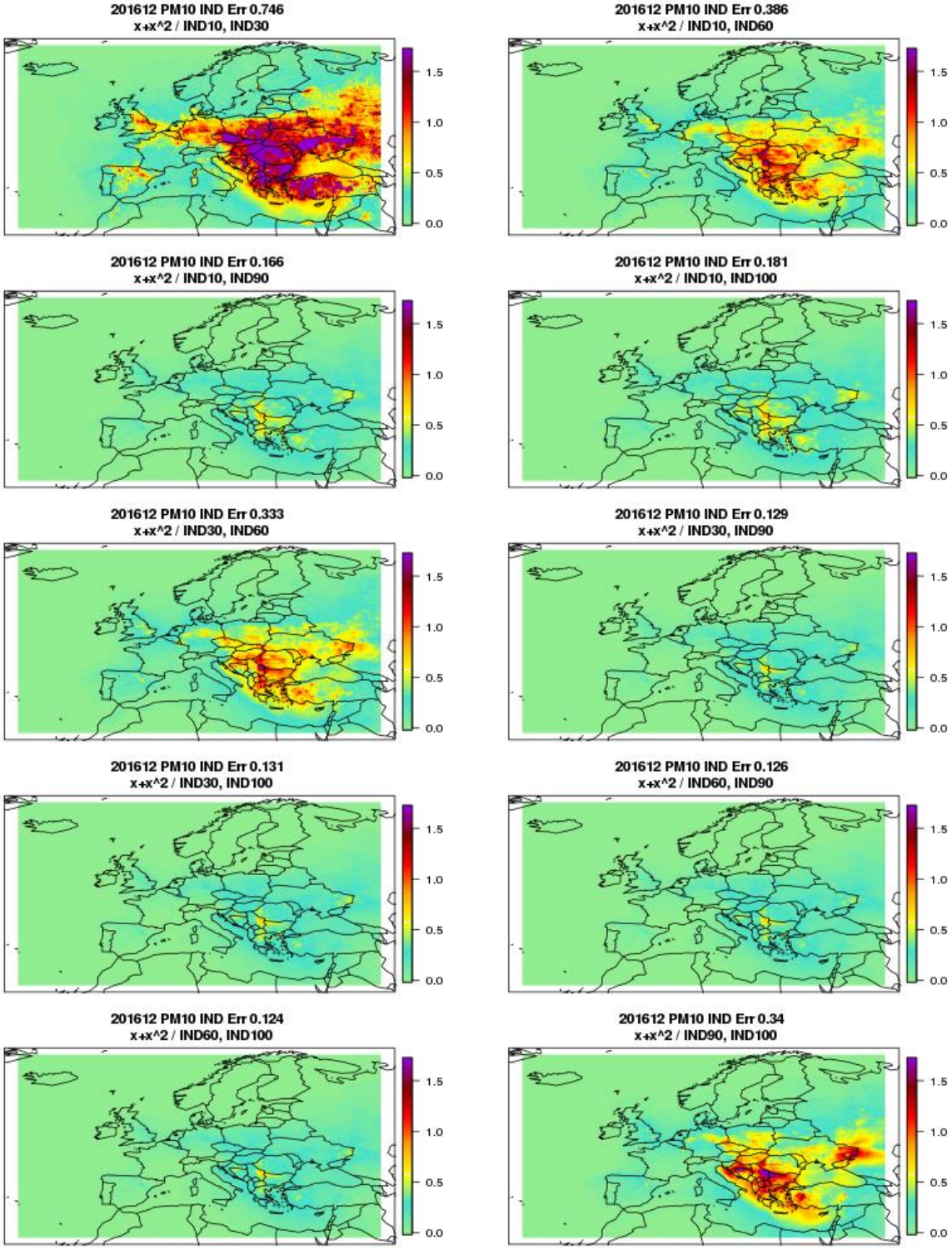


Figure S6 : Relative error (%) averaged over the month of December 2016 for the quadratic univariate PM_{10} models with respect to the industry activity sector. The sensitivity scenarios used to train the individual models are indicated in the title of each panel, as well as the average error.

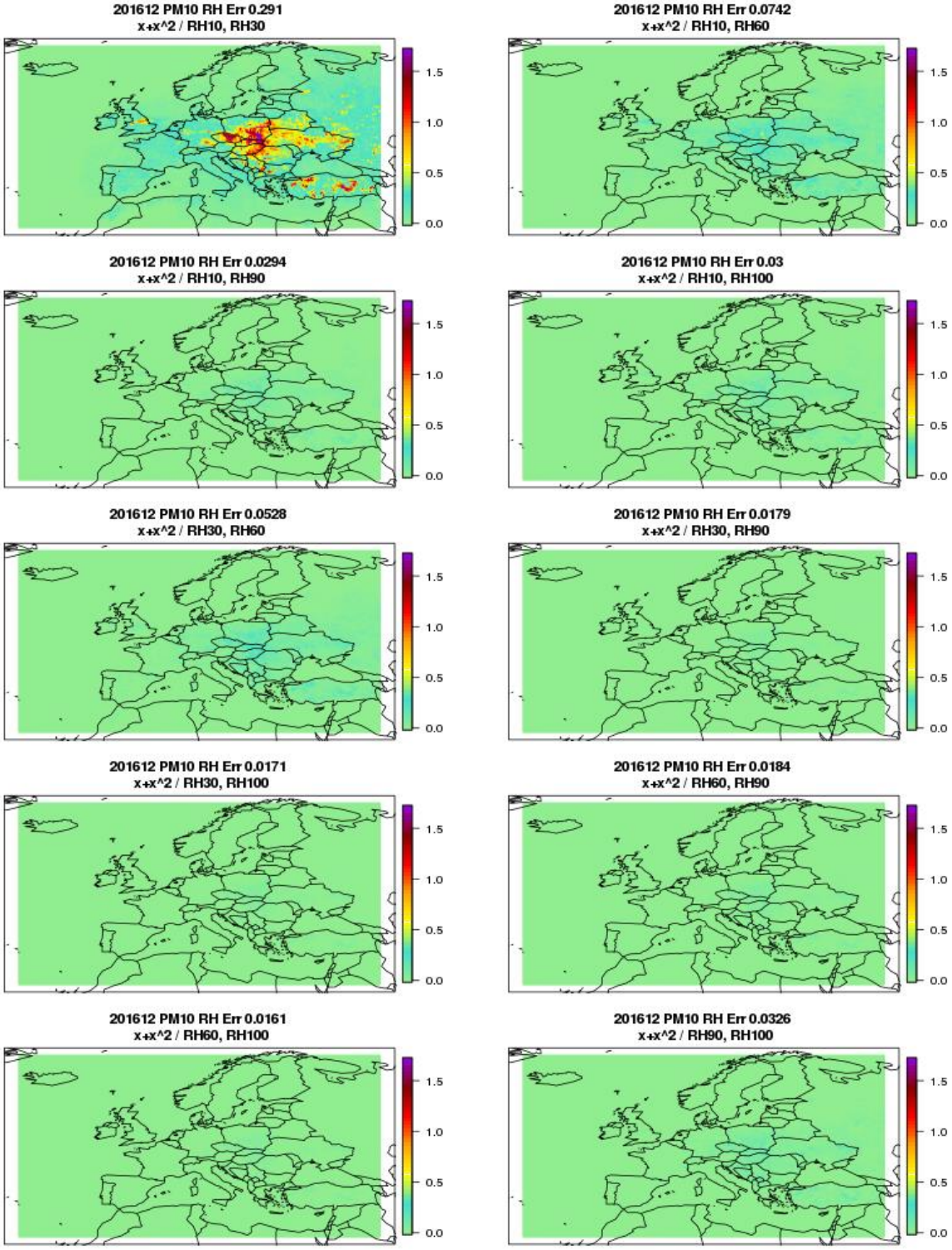


Figure S7 : Same as Figure S6 for Residential heating

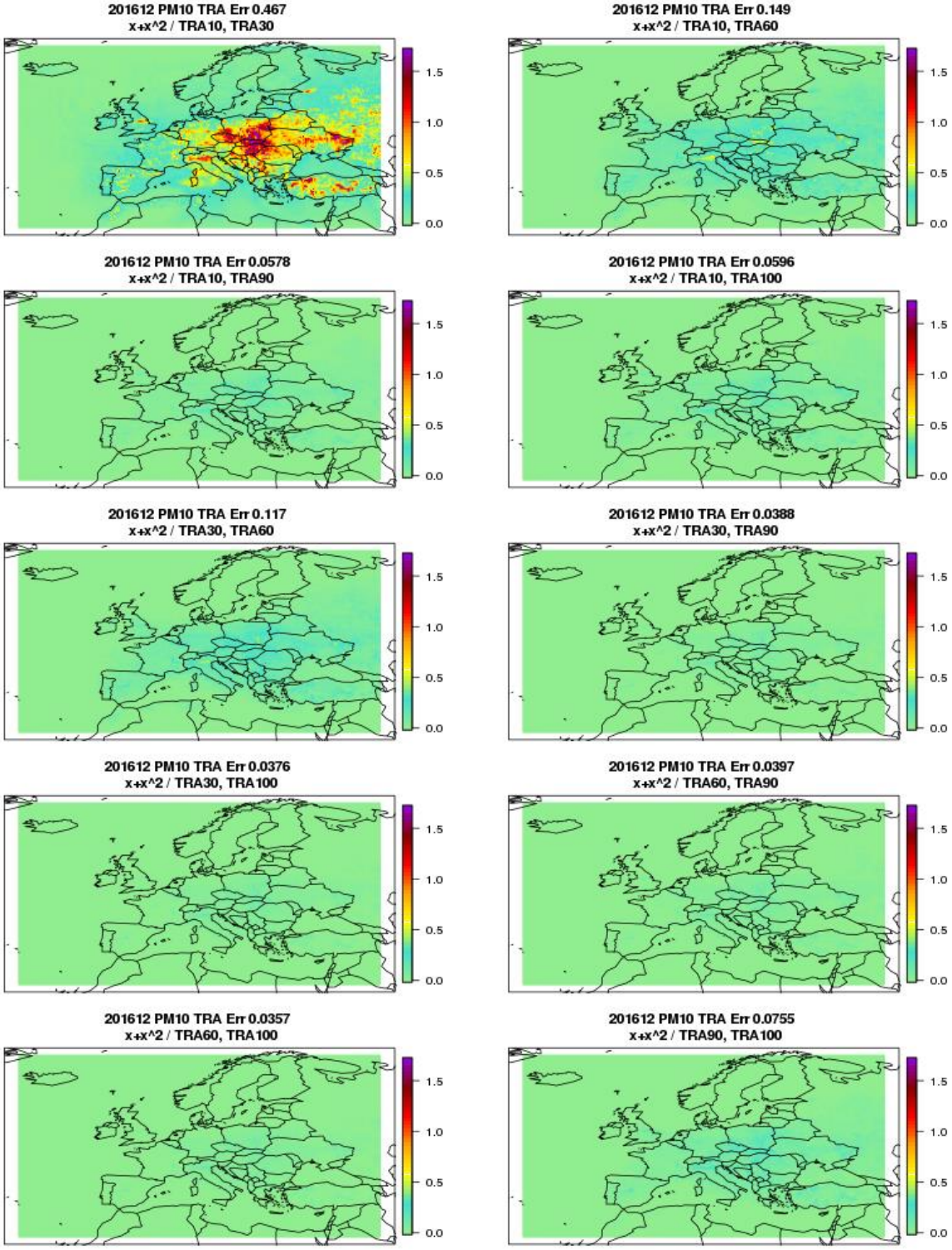


Figure S8 : Same as Figure S6 for Traffic

Polynomial	Training	AGR	IND	RH	TRA
x	10	3,933	1,133	0,130	0,339
x	30	3,123	0,894	0,082	0,236
x	60	1,983	0,573	0,047	0,137
x	90	1,310	0,382	0,032	0,092
x	100	1,463	0,471	0,036	0,106
x+x2	10 30	3,540	0,698	0,284	0,407
x+x2	10 60	2,097	0,329	0,066	0,117
x+x2	10 90	0,833	0,137	0,027	0,046
x+x2	10 100	0,856	0,147	0,027	0,047
x+x2	30 60	1,917	0,285	0,055	0,096
x+x2	30 90	0,663	0,104	0,018	0,031
x+x2	30 100	0,646	0,105	0,017	0,030
x+x2	60 90	0,697	0,101	0,017	0,032
x+x2	60 100	0,634	0,099	0,015	0,028
x+x2	90 100	1,563	0,254	0,029	0,058
x+x2+x3	10 30 60	3,437	0,634	0,315	0,428
x+x2+x3	10 30 90	0,867	0,140	0,054	0,076
x+x2+x3	10 30 100	0,736	0,122	0,049	0,068
x+x2+x3	10 60 90	0,596	0,081	0,022	0,034
x+x2+x3	10 60 100	0,407	0,057	0,017	0,026
x+x2+x3	10 90 100	0,739	0,099	0,024	0,038
x+x2+x3	30 60 90	0,560	0,074	0,020	0,032
x+x2+x3	30 60 100	0,360	0,049	0,015	0,022
x+x2+x3	30 90 100	0,514	0,068	0,017	0,027
x+x2+x3	60 90 100	1,150	0,143	0,029	0,051

Table S1 : Relative error (%) of the PM10 univariate polynomial surrogate models averaged over Western Europe for three air pollution episodes (201503, 201612, 201701) for various polynomial structures, and various set of Chimere simulations used in the training. A color shading is applied to highlight the worst (red) and best (green) performances.

Polynomial	Training	AGR	IND	RH	TRA
x	10	0,083	0,500	0,002	0,738
x	30	0,070	0,390	0,001	0,571
x	60	0,053	0,241	0,001	0,347
x	90	0,037	0,159	0,001	0,229
x	100	0,045	0,191	0,001	0,273
x+x2	10 30	0,115	0,184	0,002	0,263
x+x2	10 60	0,077	0,104	0,001	0,141
x+x2	10 90	0,034	0,040	0,000	0,053
x+x2	10 100	0,036	0,043	0,000	0,057
x+x2	30 60	0,072	0,090	0,000	0,122
x+x2	30 90	0,028	0,030	0,000	0,039
x+x2	30 100	0,028	0,030	0,000	0,039
x+x2	60 90	0,029	0,030	0,000	0,039
x+x2	60 100	0,028	0,029	0,000	0,038
x+x2	90 100	0,078	0,068	0,000	0,083
x+x2+x3	10 30 60	0,114	0,125	0,002	0,179
x+x2+x3	10 30 90	0,035	0,029	0,000	0,038
x+x2+x3	10 30 100	0,029	0,025	0,000	0,033
x+x2+x3	10 60 90	0,027	0,018	0,000	0,022
x+x2+x3	10 60 100	0,018	0,012	0,000	0,016
x+x2+x3	10 90 100	0,034	0,022	0,000	0,027
x+x2+x3	30 60 90	0,025	0,016	0,000	0,020
x+x2+x3	30 60 100	0,016	0,011	0,000	0,014
x+x2+x3	30 90 100	0,024	0,015	0,000	0,018
x+x2+x3	60 90 100	0,054	0,032	0,000	0,039

Table S.2 : Same as Table S.1 for ozone daily maximum for the month of 201706.

AI	AR	IR	TA	TI	TR	model
0,355	0,102	0,051	0,244	0,069	0,039	1
0,355	0,102	0,051	0,244	0,069	0,039	2
0,878	0,286	0,158	0,651	0,271	0,090	3
1,025	0,289	0,147	0,704	0,283	0,091	4

Table S.3 : Relative error (%) of the PM_{10} univariate polynomial surrogate models averaged over Western Europe for three air pollution episodes (201503, 201612, 201701) when including or excluding interaction terms. A color shading is applied to highlight the worst (red) and best (green) performances

AI	AR	IR	TA	TI	TR	model
0,011	0,001	0,003	0,008	0,032	0,005	1
0,011	0,001	0,003	0,008	0,032	0,005	2
0,017	0,001	0,012	0,022	0,317	0,019	3
0,020	0,002	0,011	0,019	0,312	0,018	4

Table S.4 : Same as Table S.3 for ozone daily maximum for the month of 201706.

AI	AR	IR	TA	TI	TR	model
1,003	0,941	0,128	0,535	0,067	0,057	1
0,638	0,558	0,072	0,614	0,074	0,028	2
0,884	0,781	0,095	0,519	0,060	0,031	3
0,996	0,832	0,127	0,353	0,128	0,054	4

Table S.5 : Relative error (%) of the PM_{10} univariate polynomial surrogate models averaged over Western Europe for three air pollution episodes (201503, 201612, 201701) when using different interaction sensitivity scenarios. A color shading is applied to highlight the worst (red) and best (green) performances

AI	AR	IR	TA	TI	TR	Model
0,047	0,037	0,045	0,065	0,049	0,060	1
0,040	0,022	0,026	0,048	0,034	0,034	2
0,047	0,030	0,036	0,062	0,037	0,047	3
0,037	0,031	0,034	0,048	0,153	0,043	4

Table S.6 : Same as Table S.5 for O_3max

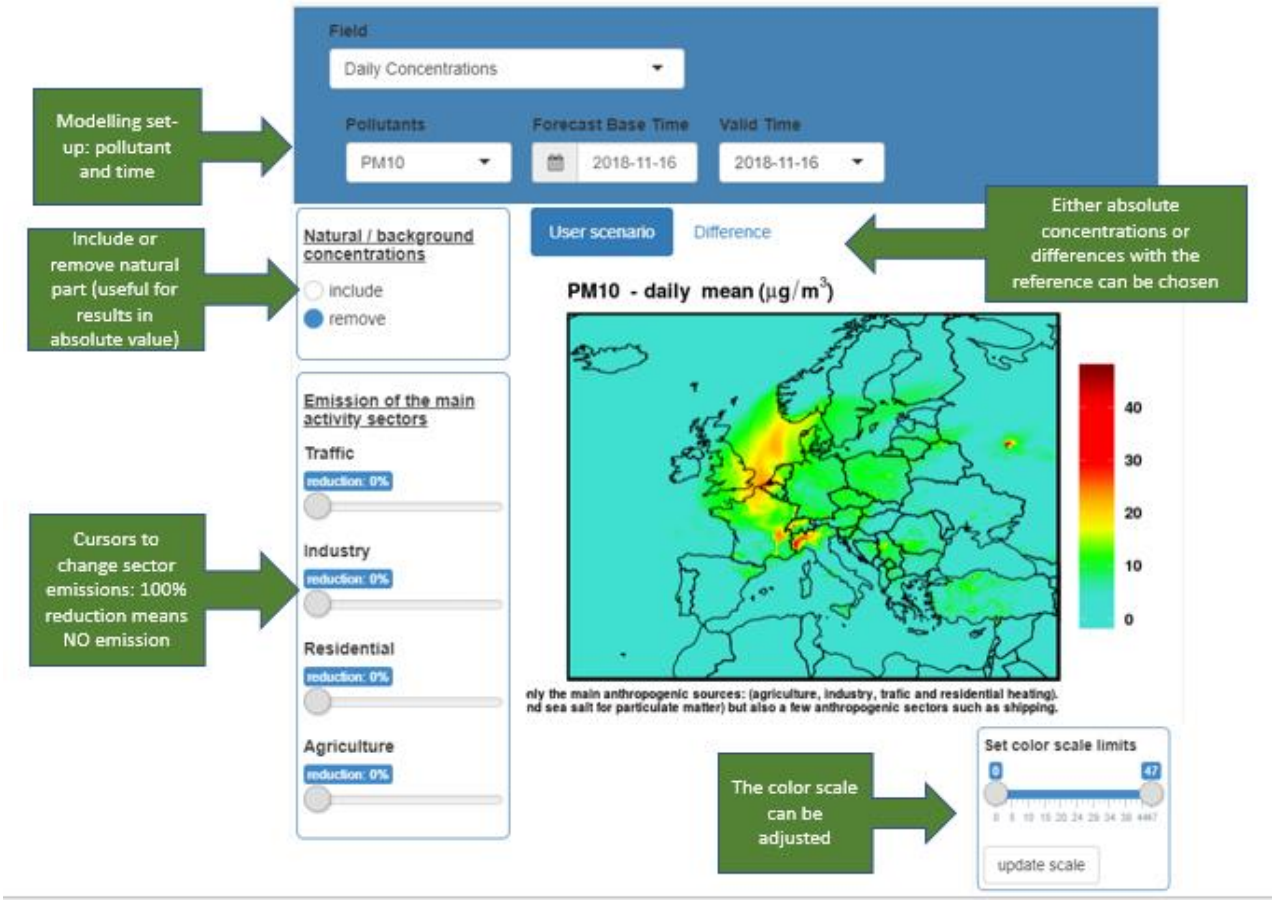


Figure S.9: Screenshot of the ACT web interface, https://policy.atmosphere.copernicus.eu/CAMS_ACT.php.