The supplementary material section contains the following elements:

i. A figure showing the topography of the model domain (Figure S1)
ii. A table containing a list of all the tracers employed in our modeling study (Table S1)
iii. A table listing the performance of the model against a set of observation sites when using afternoon data only (Table S2). This table can be contrasted with table 1 in the main text, where the performance is assessed using data from all times of the day.
iv. An Excel Spreadsheet named *emission_time_profiles_liu_2017.xls* that provides the hourly, daily, and weekly time profiles for the emissions for each country and for each emission category.
v. An Excel Spreadsheet named *mapping_unfccc_carbocount_to_snap_liu_2017.xlsx* that provides the mapping of the SNAP codes to the emission categories we employ in our study here. See main text for details and source.

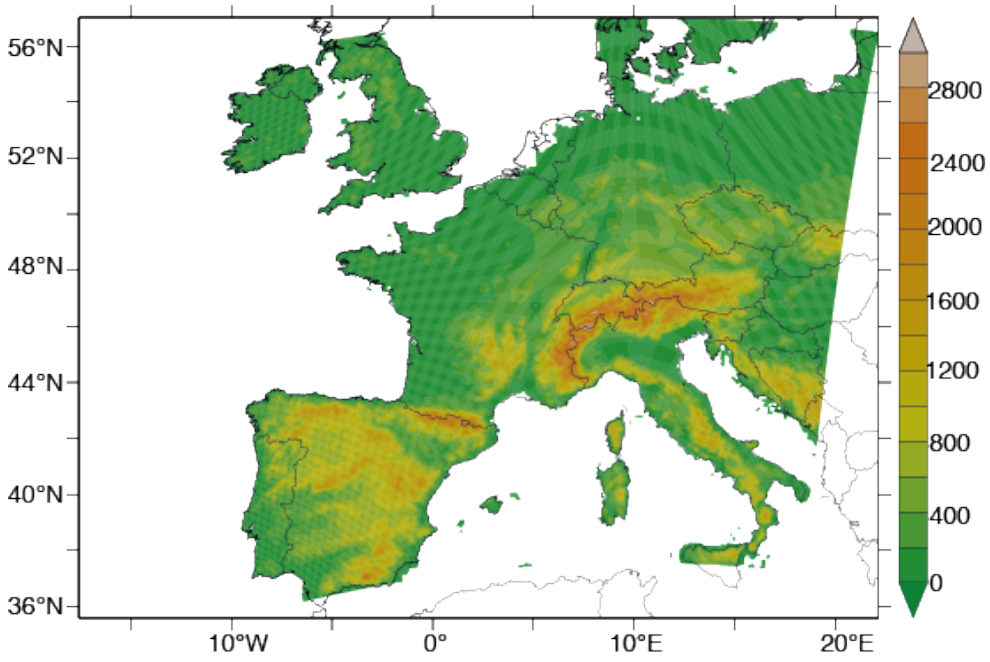

Figure S1. Topography of the model domain of COSMO, unit: m.

Table S1. List of the fossil fuel tracers used in our COSMO simulations. Listed is also whether this tracers used a constant or time-varying time function (see (2) in main text).

Name	Description	Time function
CO2_C_tot	Tracer of total emissions	constant
CO2_C_he	Tracer of emissions from heating	constant
CO2_C_in	Tracer of emissions from industry	constant
CO2_C_pp	Tracer of emissions from power plants	constant
CO2_C_ro	Tracer of emissions from road transport	constant
CO2_C_re	Tracer of emissions from other sources	constant
CO2_p_tot	Tracer from total emissions	Time varying
CO2_p_CH	Tracer of emissions from Switzerland	Time varying
CO2_p_GE	Tracer of emissions from Germany	Time varying
CO2_p_FR	Tracer of emissions from France	Time varying
CO2_p_IT	Tracer of emissions from Italy	Time varying
CO2_p_AU	Tracer of emissions from Austria	Time varying
CO2_p_NL	Tracer of emissions from the Netherlands and Belgium	Time varying
CO2_p_UK	Tracer of emissions from the United Kingdom	Time varying
CO2_p_SW	Tracer of emissions from southwestern countries (Spain and Portugal)	Time varying
CO2_p_EA	Tracer of emissions from eastern European countries	Time varying
CO2_p_other	Tracer of emissions from other regions (e.g. maritime emissions by shipping)	Time varying

Table S2. Evaluation of COSMO-7 based simulations of the atmospheric CO_2 concentration at 4 European sites. The comparison (observations minus model) are computed using afternoon average (from 12:00-18:00 PM) for the period March 27, 2008 through March 26, 2009.

Station	characteristics	height above ground (m)	S.T.D. obs (ppm)	S.T.D. mod(ppm)	Correlation	Bias (ppm)
Cabauw (CBW, Netherlands)	tower	20	11.46	11.80	0.78	-0.72
Cabauw (CBW, Netherlands)	tower	60	10.86	11.06	0.77	-0.27
Cabauw (CBW, Netherlands)	tower	200	9.35	8.19	0.74	-0.88
Puy de Dome (PUY, France)	mountain top	10	7.83	7.65	0.75	-0.85
Hegyhatsal (HUN, Hungary)	continental	10	12.08	9.42	0.8	-4.0
Hegyhatsal (HUN, Hungary)	continental	48	11.51	9.32	0.8	-4.04
Hegyhatsal (HUN, Hungary)	continental	115	10.69	8.72	0.8	-3.86
Mace Head, (MHD, Ireland)	coastal	15	6.26	3.87	0.81	0.34