S1 Statistical analysis of simulated warm season MDA8 O₃ and annual mean PM₂.₅ compared to measurements

Table S1: Warm season (April-September) mean of daily maximum 8-hour running mean O₃ concentrations (MDA8 O₃) and annual mean PM₂.₅ concentrations at the global and regional resolutions compared to observations from 52 and 25 stations within the EMEP network, respectively.

Season		Obs.	140 km	50 km
MDA8 O₃ (Apr - Sept)	Mean (μg m^{-3})	86.3	95.6	94.8
	NMB (%)		10.9	8.9
	SD (μg m^{-3})	9.2	14.7	14.2
	Difference (%)		1	
PM₂.₅ (Annual)	Mean (μg m^{-3})	11.4	12.6	13.7
	NMB (%)		10.5	20.2
	SD (μg m^{-3})	5.1	2.8	5.0
	Difference (%)		-9	

S2 Seasonal and country level evaluation for O$_3$

We further analyse how the seasonality in O$_3$ concentrations simulated at the two resolutions varies seasonally and also geographically at the country level (Fig. S1). During winter, O$_3$ concentrations at southerly locations in Greece and Italy (Fig. S1 red box) show the largest differences between the two resolutions, with an overestimate of ~ 50 µg m^{-3} at the global resolution compared to EMEP measurements. In contrast to the majority of the sites during winter, simulated O$_3$ concentrations at the regional resolution are higher compared to the global resolution for several locations in Austria, Hungary and Slovakia (red circle). Similar to winter, O$_3$ concentrations at the same locations in Italy are also largely overestimated by both model resolutions in summer (~50 µg m^{-3}, Fig. S1c). In autumn, the largest overestimates of low O$_3$ concentrations at the regional resolution occur at northern European locations in the Netherlands and Belgium, (Fig. S1d - red box).

In spring, summer and autumn, O$_3$ concentrations simulated at both resolutions in Malta are much higher compared to measurements (~ 40 µgm^{-3}; Fig. S1b, c and d -red circle). This is due to the fact that at both resolutions, the grid box covering the Maltese Islands is represented as ocean and not land. Deposition of O$_3$ is typically less over the sea than compared to over land, potentially leading to an overestimation in simulated O$_3$ concentration compared to measurements at this location.
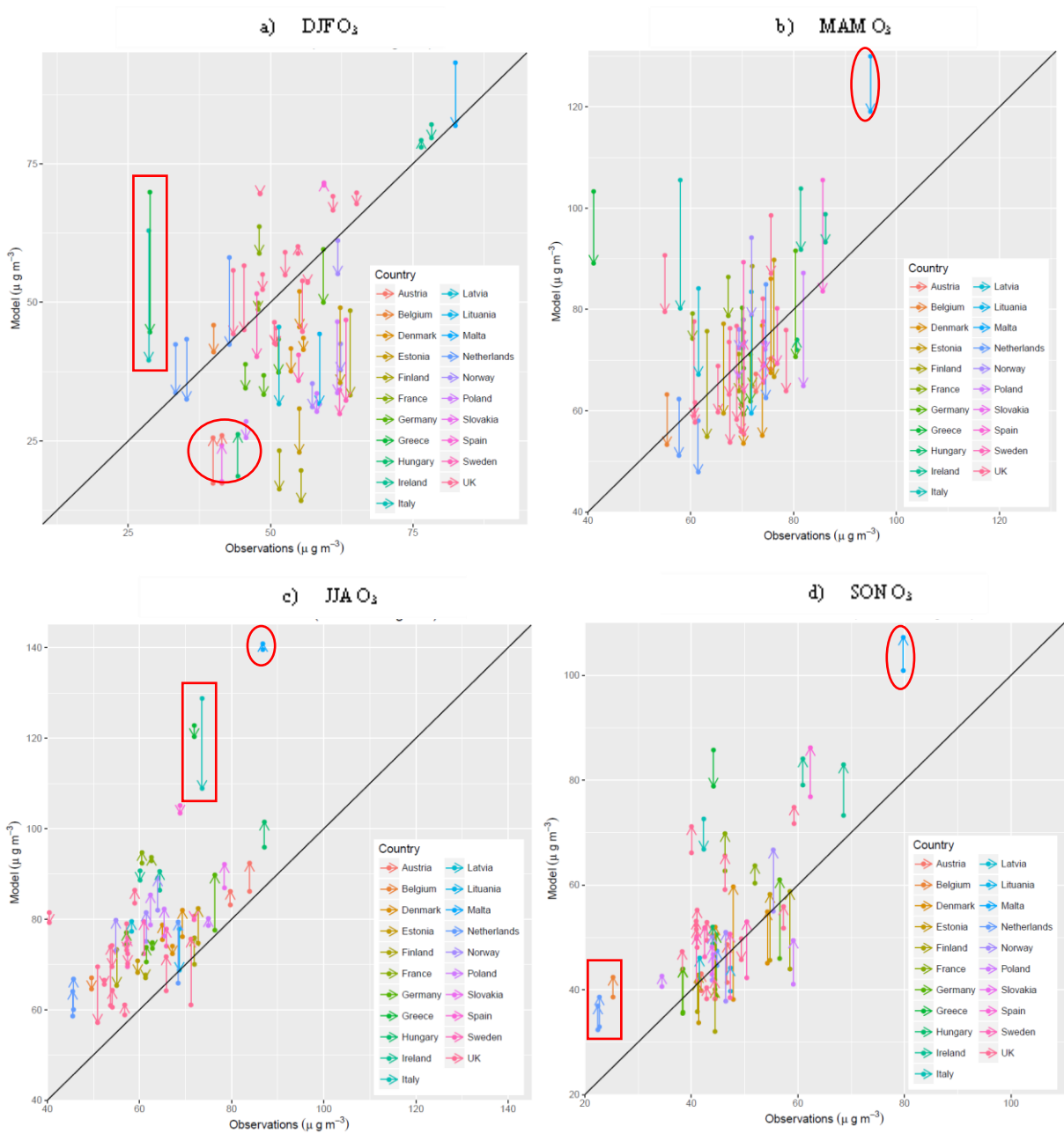
Figure S1: Modelled versus observed seasonal mean O₃ for a) DJF b) MAM c) JJA d) SON 2007 over a subset of 52 sites across the EMEP network as shown in Fig. 1. The arrow tails mark O₃ concentrations at the global resolution while the arrow heads represent the corresponding O₃ concentrations at the regional resolution.

S3 Additional figures on the impact of model resolution on pollutant concentrations
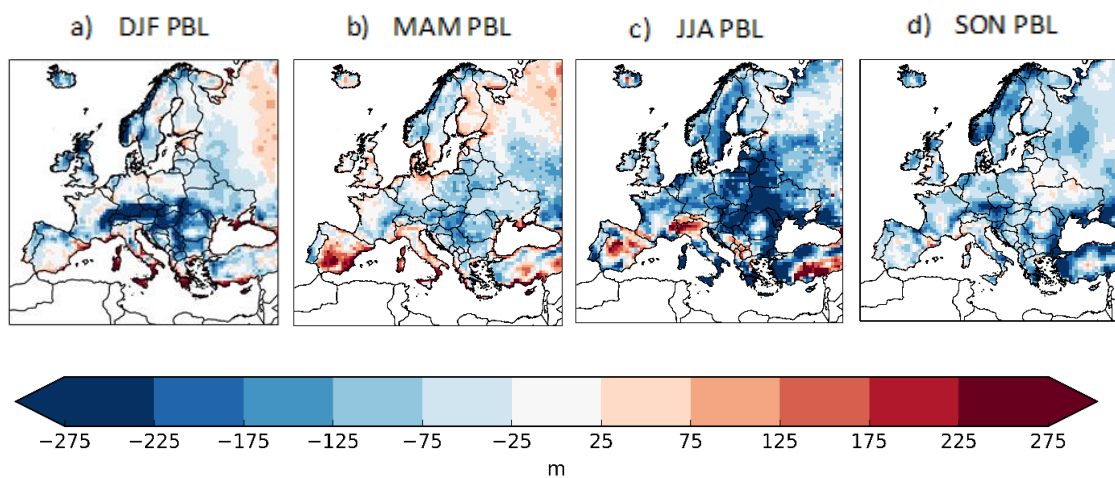
Figure S2: Difference between global and regional seasonal mean boundary layer height (PBL global resolution – PBL regional resolution) for a) DJF b) MAM c) JJA and d) SON for 2007
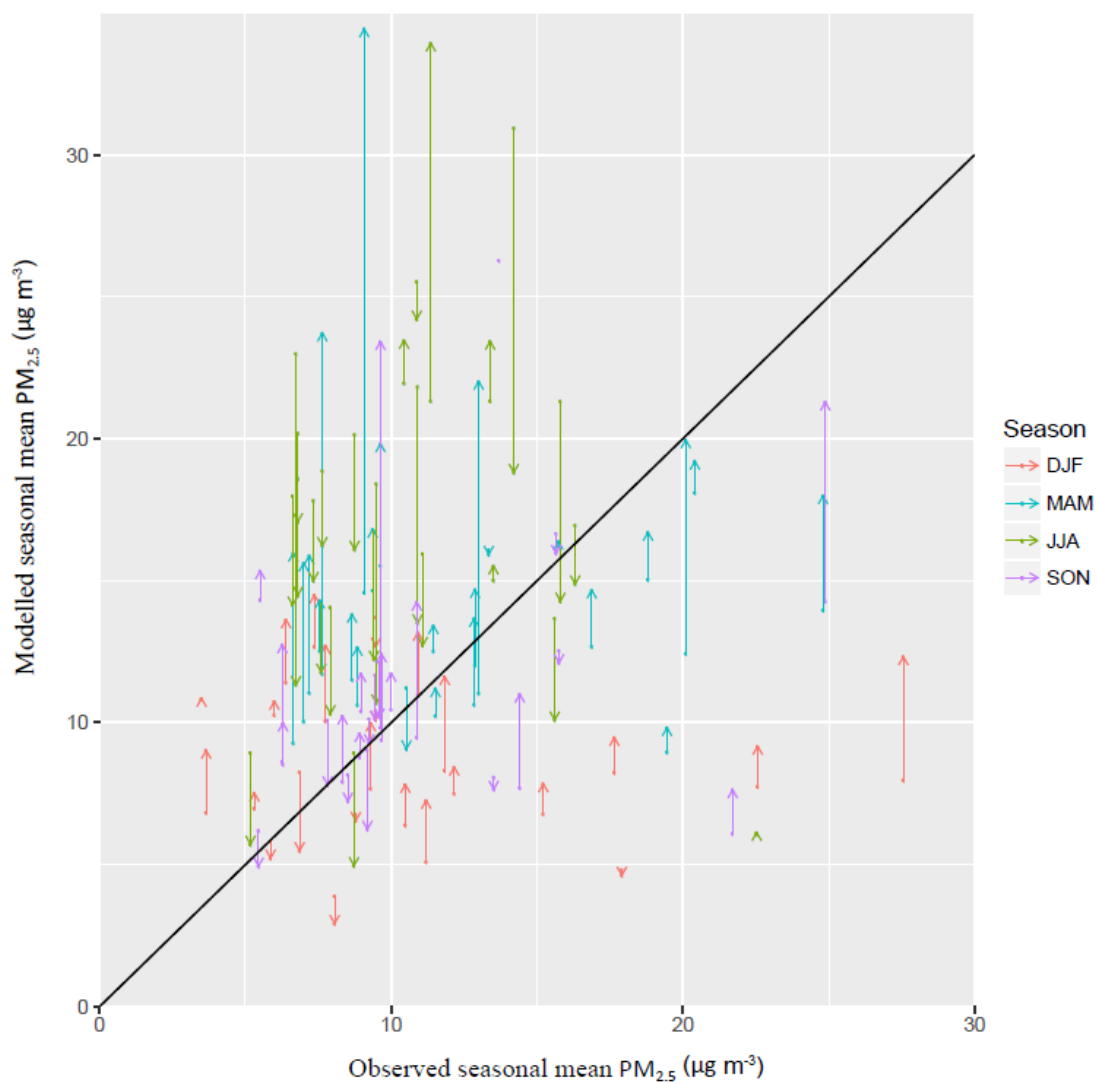
Figure S3 Seasonal mean modelled vs observed PM₂.₅ for 25 sites across the EMEP network for the year 2007. The arrow tails mark PM₂.₅ concentrations at the global resolution while the arrow heads represent the corresponding PM₂.₅ concentrations at the regional resolution. The 1:1 line shows agreement between observed and simulated PM₂.₅.
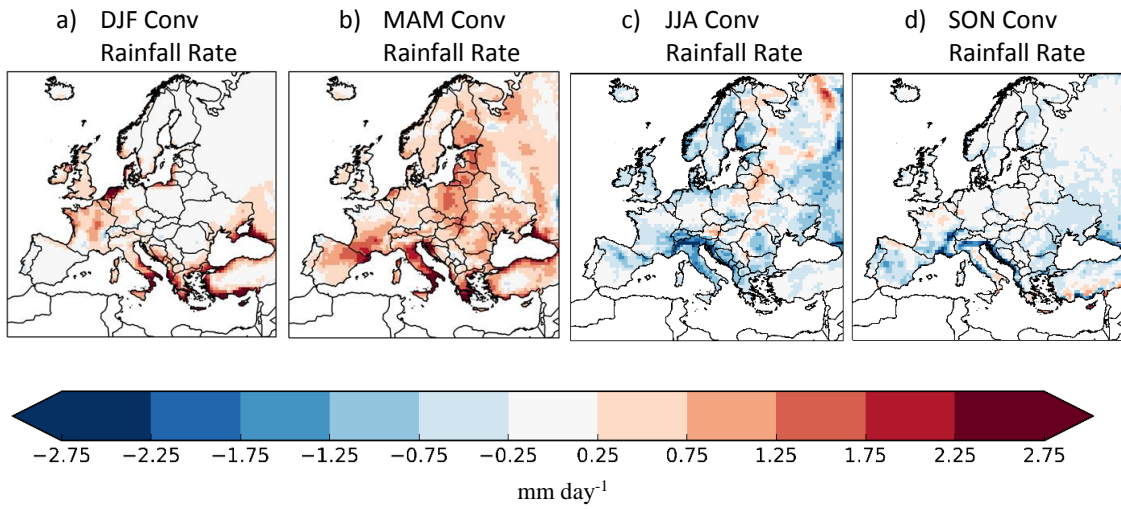
Figure S4: Difference between global and regional seasonal mean convective rainfall rate (mm day⁻¹) for a) DJF b) MAM c) JJA and d) SON for 2007

S4 Additional figures on the effect of applying population-weighting to pollutant concentrations
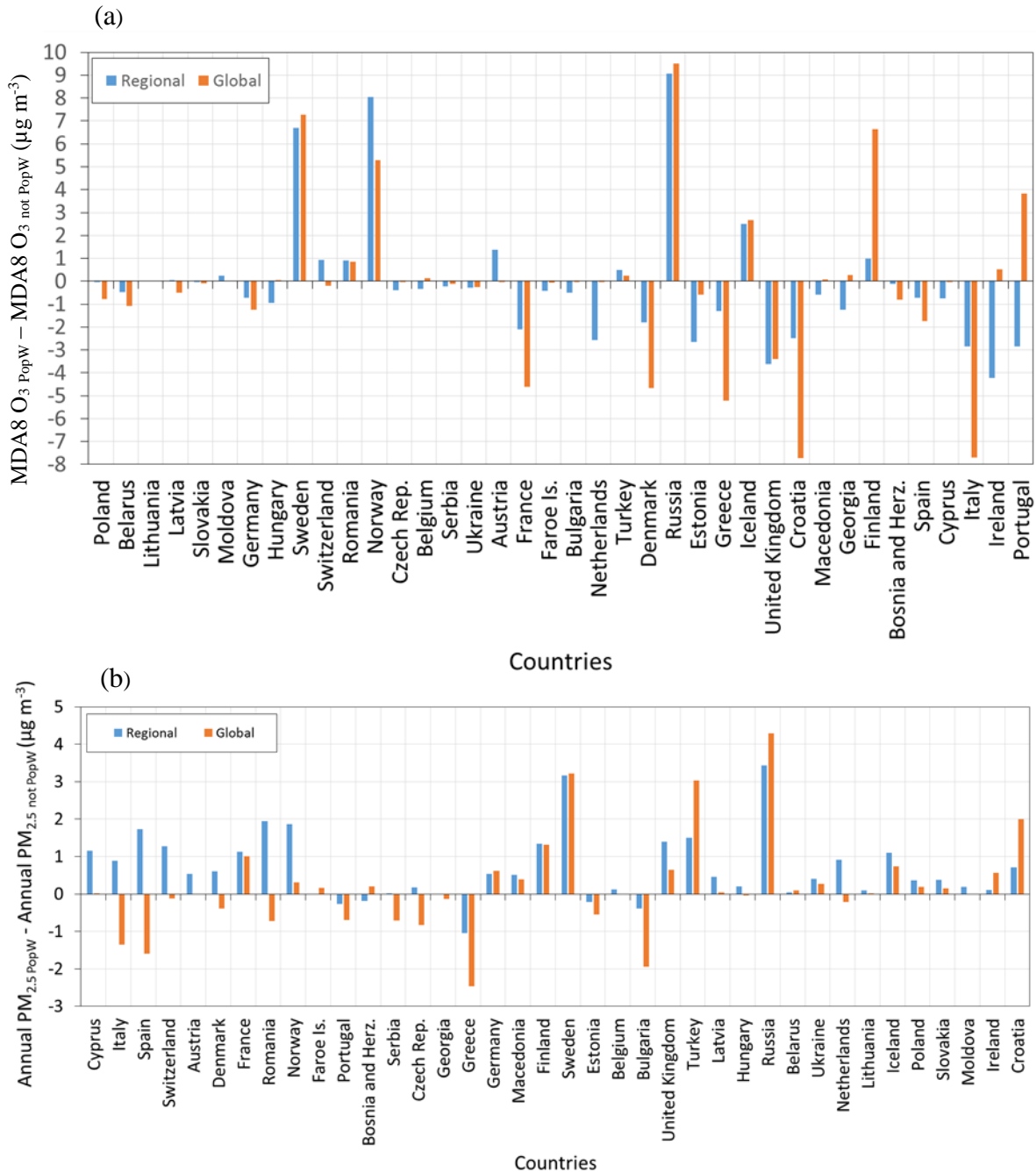
Figure S5: a) Difference between MDA8 O₃ concentrations with and without population-weighting as simulated by the global (orange bars) and regional (blue bars) resolutions b) same holds for annual mean PM₂.₅ concentrations.