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# Contributions of domestic vs. foreign emission sources on major air pollutants over Europe and North America in the framework of AQMEII3 – A multi-model ensemble approach

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An international community of regional scale air quality modeling groups simulated impacts of a 20% decrease of global and regional anthropogenic emissions on surface air pollutant levels in 2010 over Europe and North America. The exercise took place in the framework of the third phase of the Air Quality Model Evaluation International Initiative (AQMEII3) and the second phase of the Hemispheric Transport of Air Pollution (HTAP2) activities.

The global Composition Integrated Forecasting System (C-IFS) model first simulated the emission perturbations at the global level, as well as over the HTAP2-defined regions of Europe, North America and East Asia, and provided these boundary conditions to the various regional CTMs. On top of these perturbed boundary conditions, the regional CTMs used the same set of perturbed emissions within the regional domain for the different perturbation scenarios that introduce a 20% reduction of anthropogenic emissions.

Results show that the largest impacts over both domains are simulated in response to the global emission perturbation. The responses of primary pollutants to a 20% percent anthropogenic emission reductions were calculated to be almost linear ($\sim$20% decrease) within the global perturbation scenario. There were large differences in the geographical distribution of the effect, in particular overt the emission hot spots. Ozone ($O_3$) levels generally decrease in all scenarios by up to $\sim$1% over Europe, with increases over the hot spot regions, in particular in the Benelux region, by an increase up to $\sim$6% due to the reduced effect of $NO_x$-titration. Daily maximum of 8-hour running average $O_3$ decreases in all scenarios over Europe, by up to $\sim$1%, with largest decreases up to $\sim$5% over North Europe.

Over the North American domain, the central-to-eastern part and the western coast of the U.S experience the largest response to emission perturbations. Similar but slightly smaller responses are found when domestic emissions are reduced. The impact of inter-continental transport on most pollutants is relatively small over both domains, however, still noticeable particularly close to the boundaries. The impact is noticeable up to a few percent, for the western parts of the North American domain in response to the emission reductions over East Asia. Daily maximum of 8-hour running average $O_3$ over the North American domain decreases in all scenarios similar to Europe, however with larger reductions compared to Europe.

We have also calculated values of the Response to Extra-Regional Emission Reductions (RERER) metric in order to quantify the differences in the strengths of non-local source contributions to different species among the different models. We found large RERER values for $O_3$ ($\sim$0.8) over both Europe and North America, indicating a large contribution from non-local sources, while for other pollutants including particles, low RERER values reflect a predominant control by local sources.