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How do Megacity structures affect their regional and continental atmospheric impacts?

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Heavily urbanized regions emit a large part of the anthropogenic emissions of each country. The direct impact of those emissions on urban air quality, but also the subsequent alteration of atmospheric composition constitutes a serious challenge for people exposure, and for regional to global climate change. In the frame of the MEGAPOLI project, one crucial question is the way megacities impact air quality at regional and continental scales, and how their growth will increase this impact. In order to achieve the main objectives of the MEGAPOLI program and assess such impacts, simulations will thus be conducted over several cities in past and future emission configurations.

Anyway, there is an important point that first needs to be documented: how much do those megacity impacts depend on the urban emission density and on the city distribution over a define country or continent? To better characterize the atmospheric impact of megacities, and to better control their evolution, we indeed have to understand how their structure plays a role on oxidant pollution formation and export at several scales.

The work presented here is a modeling study of ozone and oxidant formation at the continental scale, made up with several emission scenarios aiming to reproduce various geographical configurations for the European urban areas. Our goal is to quantify the sensitivity of pollution formation and export to the constitution of particularly large emission spots in Europe.

The model CHIMERE was run over a continental domain including the largest cities of Europe (Paris, London, Berlin, Milan...), with horizontal resolutions of 10 to 25km,

for 2003 and 2006 summer oxidant episodes. The model was first run in the base case reproducing the real structure of the European cities. Then, modulations in the density of the urban zones were artificially created, in order to disperse or condense the urban emissions around the main cities and over the whole continent. No changes were made in the total sum of anthropogenic emissions. Instantaneous ozone production rates were included in the model calculations for all scenarios, allowing us to approach the intensity of photochemistry at several scales.

The model outputs have been extracted for the base case for ozone and primary pollutants such as NO_2. We will discuss here the different megacity scenarios relatively to the base case in terms of changes in ozone maxima, in the primary and secondary plume location and extent, and in the global intensity of the episodes, through ozone production rates. The difference of behavior between the cities will also be highlighted, in relation with their latitudinal location and original emission configuration.