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Ozone sensitivity study - evaluation of the efficiency of the legislations for the year 2010

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Ozone is a secondary pollutant made from photochemical reactions involving chiefly anthropogenic precursors emitted from a variety of sources such as road transport, industrial activities, energy production, distribution of fossil fuels... As it often overpasses the information and health recommendation thresholds, an action has been engaged at the international level with the ratification of the protocol of Göteborg that aims to reduce the volatile organic compounds emissions by 40% from 1999 to 2010. However, due to the complexity of atmospheric ozone chemistry, the impact of such emission reduction on ozone concentrations is difficult to determine and up to now still unknown. It is thus necessary to lead a complete analysis of the impacts of these legislations in order to answer to the main following questions:

- Quantitatively, what is the effect of emissions reduction policies on ozone regional daily maxima and 8-hour mean values? Can they efficiently reduce the number of observed ozone threshold exceeding?
- At a larger scale, do these policies efficiently reduce the quantity of ozone to be exported outside the domain of the study?
- How does the response of ozone to emission reduction vary from one type of dynamical situation to another?

Our study takes place in this context and aims to answer these problematics. The study

focused on the Berre-Marseilles region (France), chosen because of its high density of anthropogenic activities, its elevated frequency of ozone events, and the possibility to closely validate the simulations using the large 3D measurement database obtained on this site during the ESCOMPTE campaign (2001). The methodology followed was first to simulate a large number of representative pollution episodes, characterized by different meteorological situations, using the 3D chemistry-transport model CHIMERE, and to validate the simulations using specific statistical index. In a second step, we replaced the existing emission inventory by a set of 2010 emission inventories, especially designed for this study, which precisely take into account the socio-economic evolutions and the possible applications of the European legislation. We then conducted so-called "Realistic Scenario simulations". Furthermore, in order to better characterize ozone emission sensitivity on the site and evaluate the relative efficiency of the 2010 emission policies, we also conducted simulations based on a pre-defined structure of conceivable scenarios, consisting in reductions of emissions by precursor species and by category of anthropogenic emitter.

Specific statistical index have been used to quantify the simulation scenario results and to define their efficiency on the different aspects mentioned above (ozone maxima, export etc). The results have shown that there is a strong variability of the location and intensity of the impacts of emission reductions on ozone concentrations according to the type of episode, indicating that dynamics is a key parameter when setting off emergency measures. Moreover, the efficiency of a given scenario is a relative notion as it varies with the geographic scale of the problematic : in this context, we found that a combined reduction of NOx and VOCs emissions best answers the double problematic of reducing ozone concentrations at the regional scale and at a larger scale. As a consequence, we pointed out the road traffic (emitter of NOx and VOCs in quasi equal proportions) as a key sector for reducing ozone production at both scales. Our results further show that a combined reduction of emissions from both traffic and industrial sectors allows a more important reduction of 3D ozone production and maxima ozone values at the ground level than what could be obtained by adding their own impacts. We analyzed the projection of the emissions for the year 2010. They especially show strong emission reductions in the traffic and industrial sectors, and logically lead to lower ozone concentrations at both regional and larger scales. However, we noticed that even in this configuration the model still simulates a large number of thresholds exceeding for the most intensive events. This implies that the legislations act in the right way, but the addition of punctual emergency measures remains necessary. Future work will focus on that point and will be presented.