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Air quality modelling : effects of emission reductions on concentrations of particulate matter

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Atmospheric particulate matter (PM) has adverse effects on human health. PM acts primarily on respiratory and cardiovascular (due to their small size they can penetrate deep into the lungs), but they are also known effects on the skin. In France, the "Particulate Plan" - developed as part of the second National Environmental Health Plan - aims to reduce by 30% fine PM (noted $PM_{2.5}$because these particles have an aerodynamic diameter of 2.5 micrometers or less) by 2015.

A recent study by Airparif (the organization in charge of monitoring air quality in the Paris region, the Île-de-France) and LSCE (Laboratory of climate and the environmental science, France) has allowed, through a large measurement campaign conducted between 2009 and 2011, to quantify the proportion of PM produced in Île-de-France and those transported from the surrounding areas. The study by numerical modelling of air pollution presented here complements these results by investigating future emission scenarios.

The CEREA develops and uses an air quality model which simulates the concentrations of pollutants from an emission inventory, meteorological data and boundary conditions of the area studied. After an evaluation of simulation results for the year 2005, the model is used to assess the effects of various scenarios of reductions in NO_x and NH_3 emissions on the concentrations of $PM_{2.5}$in Île-de-France. The effects of the controls on the local pollution and the long-range pollution are considered separately.

For each emitted species, three scenarios of emission reductions are identified: an emission reduction at the local level (Île-de-France), a reduction at the regional scale (France) and a reduction at the continental scale (across Europe). In each case, a 15% reduction is applied. The comparison of the results allows us to assess the respective contributions of local emissions and long-range transport to $PM_{2.5}$ concentrations. For instance, the reduction of NO_x emissions in Europe leads to a weak average decrease of $PM_{2.5}$ concentrations in Île-de-France, but a decrease of NO_x emissions in Île-de-France leads to an increase in $PM_{2.5}$ concentrations due to a significant increase in oxidant concentrations in that area.