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Modelling agricultural ammonia emissions: impact on particulate matter formation

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Abstract

Agricultural ammonia (NH_3) emissions provide a large amount of aerosol precursors in the lower troposphere, leading to the formation of ammonium nitrate in the atmosphere. This compound can be responsible for high concentrations of particulate matter ($PM_{10}$and $PM_{2.5}$) in the boundary layer.

In March and April 2007, the forecasts delivered by the chemical transport model (CTM) Chimere, within the operational platform for air quality monitoring and forecasting Prev'Air, exhibited a large underestimation of PM_{10} levels in the boundary layer.

To improve the ability of the model at forecasting PM_{10} and $PM_{2.5}$ in spring, we started implementing an online NH_3 emission computation within CHIMERE with the goal to substitute the basic time-constant parameterisation by a coupled approach between the CTM and the mechanistic model Volt'Air (INRA).

The new method takes into account climatic environmental conditions to accurately assess the ammonia surface fluxes after manure and synthetic fertilizer spreading.

Several spatially and temporally resolved input data are required to run the Volt'air model: meteorological variables such as temperature and moisture, crop practices such as fertilizer types, rates and dates of fertilizer applications, and soil properties such as pH and soil texture.

Data about crop and grassland areas, fertilization rates and dates are available at cantonal and regional scale in France, and they are delivered through annual crop statistics and agricultural practices survey. These data are then intersected with the corresponding land cover types using the Corine Land Cover database (2006).

The spatial and temporal distributions of meteorological data are provided by the meso-scale model WRF with high resolution in time (hour) and space (typically less than 25 km) using GFS data.

We will present the set-up of this new modelling approach, with details about the input data and the modelling tools, and will present first results from a preliminary study carried out over France between September 2005 and June 2006. In particular, first results on ammonia concentrations simulated with the new scheme will be highlighted. Its potential role for inorganic aerosol formation will be shown.