Modelling the chemically speciated $PM_{2.5}$ over the French Northern region using the WRF-Chem system coupled to EMEP and regional emission inventories.

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Introduction The lack of information about aerosol chemical and physical properties in modelling systems is a critical step to enhance the emission reduction policies and the knowledge about aerosol impacts over radiative forcing and health.

A data processing system, the European Emission Adaptation SYstem for WRF-Chem model (EASYWRF-Chem) has been developed to generate chemical information compatible with the WRF-Chem requirements from any emission inventory based on CORINAIR. EASYWRF-Chem has been created mixing SMOKE data and CORINAIR methodologies. The emission generation system created allows the use of low (EMEP) and highly (Regional) detailed emission inventories and has been tested on the WRF-Chem model.

Methodology Using the RADM2 or RACM mechanism, we converted "emission species" into "model species" using the SAPRC methodology. An aerosol chemical speciation profile processing completes EASYWRF-Chem. Coming from the adaptation of US EPA $PM_{2.5}$ profiles (Borge et al., 2008), those data separate the unspeciated $PM_{2.5}$ emission into five chemical families: sulphate, nitrate, elemental carbon, organic aerosol and unspeciated aerosol.

The WRF-Chem has been implemented on a European area with high resolution domains. Since $PM_{2.5}$ speciation modelling has never been evaluated over Europe with detailed emission inventories and with a high resolution modelling system, we statistically compared the simulated aerosol concentrations with measurements in order to evaluate the general performance of the modelling system and the chemical speciation of anthropogenic particles at regional scale.

The five chemical families have been quantified during four measurements campaigns in two sites over the French northern region. It included winter and summer measurements using a High Resolution – Time of Flight – Aerosol Mass Spectrometer (HR-ToF-AMS). This instrument provides hourly resolved PM_1 concentrations over the same chemical families.

Meteorology, gas phase chemistry and particle phase composition has been evaluated simultaneously.

Results Finally, it reveals that EASYWRF-Chem simulations respectively overestimate the PM_{10} concentrations of +30% and +4% for summer and winter periods. The statistical analysis of $PM_{2.5}$ concentrations shows that, in summer, WRF-Chem overestimates them of +1% while, in winter, the concentrations are underestimated of -14%.

Particulate organic matter concentrations in $PM_{2.5}$ are underestimated but hourly variations of concentrations are well simulated.

Sulphates concentrations are not correlated to the observed concentrations, the average concentration is underestimated.

Nitrates concentrations are overestimated by a factor of two but variations are fairly well represented. Ammonium particulate matter is well represented.

Black Carbon (BC) measurements reveal that EASYWRF-Chem forecast performance is higher in winter than during summer when BC concentrations are very low.

Borge, R., Lumbreras, J., and Rodríguez, E.: Development of a high-resolution emission inventory for Spain using the SMOKE modelling system: A case study for the years 2000 and 2010, Environmental Modelling & Software, 23, 1026-1044, 10.1016/j.envsoft.2007.11.002, 2008.