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Analysis of Po Valley emission influence on the surrounding region air quality in winter and summer circulation regimes

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The evaluation of megacities and large conurbations emissions on the air quality and climate at regional scale is one of the main objectives of MEGAPOLI Project. The Po Valley (hereafter P-V) is one of the air pollution hot spots of major concern in Europe, where the EC air quality standards are presently not attained. Even if the P-V is not strictly a megacity, together with the Ruhr and Benelux areas is one of the most densely populated areas in Europe, with a global population of about 20 million people clustered in different urban areas, including Milan, Turin, Venice and Bologna. Moreover, the peculiar topographic features of the Po river plain, surrounded on three sides by the Alps/Apennines chain, increase the interest in understanding the influence of the P-V emissions on the air quality of the surrounding region of Europe. For those reasons the P-V is one of the main areas of investigation of MEGAPOLI.
The atmospheric physics and chemistry processes involving the pollutants emitted in the P-V have been investigated through the application of the chemical transport model FARM coupled with the meteorological model RAMS. Two nested domains have been considered: the outer one covering Central Europe, and the inner one including the whole Alpine region with an horizontal resolution (4 km) sufficient to resolve the major topographic and emission distribution features.
To describe emissions with the maximum possible detail over the target area, the MEGAPOLI European scale inventory has been integrated with high-resolution bottom-up data provided by local authorities of the administrative Regions located within the P-V.
The air pollutant export from the Po Valley region and the influence of different processes (e.g. chemistry, deposition, aerosol), under various circulation conditions, have been evaluated analyzing the full chemistry simulation results and the dispersion of additional passive tracers associated to the anthropogenic emissions and released from the P-V basin. Balances of production/removal processes within the fine computational domain have been computed for both reactive pollutants and passive tracers to identify processes potentially more influential on the exported species.
Moreover, to estimate the impact of possible emissions variation on the surrounding areas, a sensitivity analysis has been performed modulating pollutants emission within the P-V. This approach has been preferred to the "annihilation" scenario or "brute force" sensitivity analysis due to the extension of the emitting area that would have probably altered the chemical regime over the target domains. The analysis has been extended to June and December 2005 to take into account the effects of seasonal variation of both emissions and chemical processes on airborne pollutants in the investigated area.