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European air quality and climate change: a numerical modeling study

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In the context of climate change, the evolution of air quality in Europe is a challenging scientific question, despite the political measures taken to limit and reduce anthropogenic emissions. Heat waves, changes in transport pathways or synoptic patterns, increase of emissions in other areas in the world (in particular in Asia), or for instance possible increase of biogenic emissions may affect adversely future Air Quality levels in Europe. In the context of a project co-funded by the French environment agency ADEME, a numerical modeling study has begun relying on the tools used by MÈtÈo-France for its contribution to the 5th IPCC assessment report, to GMES atmospheric services (MACC FP7 project) and to the French national operational Air Quality platform PrÈv'Air (http://www.prevair.org). In particular, the MOCAGE 3-D chemical transport model (CTM) is used with a configuration comprising a global (2^o) and a European domain (0.2^o), allowing representation of both long-range transport of pollutants and European Air Quality at relevant resolutions and with a two-ways coupling. MOCAGE includes 47 layers from the surface to 5hPa. The first step of this project is to assess the impact of meteorological forcings, either analyses ("best" meteorology available for the recent past) or climate runs for the current atmosphere, on air quality hindcasts with MOCAGE over Europe. For these climate runs, we rely on Météo-France Earth-System model CNRM-CM, and particularly the ARPEGE-climate general circulation model for the atmosphere. By studying several key variables for Air Quality (surface and low troposphere concentrations of ozone, nitrogen oxides, volatile organic compounds, radicals, PM,. . .) we aim at investigating the indicators that are robust or not (monthly averages, frequency of exceedances, AOTs, . . .) for a given climate when using climatological forcings instead of analyses, which constitutes the reference. Obviously, daily Air Quality for a given year cannot be represented with climatological forcings, but it is expected that averages over several years could be sufficiently realistic. Both simulations are evaluated against validated surface data in France (Banque de Données de la Qualité de l'Air) and in Europe (EMEP network). These preliminary results are the basis for studying future projections (2030 and 2050 timeframes), for which indeed only climatological forcings are available.