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Forecasting the weather
- ensemble techniques
in probabilistic weather prediction

Megacities, air pollution and their effects on climate at different scales

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For the urban meteorology/climate or atmospheric pollution modelling studies, as a rule, urban effects (heat island, land-use, roughness, storage heat capacity, soil moisture, precipitation change, etc) and effects of urban emissions / air pollution (e.g. direct, semi-direct, first and second indirect effects of aerosols) are considered separately. However, the processes are continuously interacting with each other and hence, result in influence of megacities and large hot-spots on the atmospheric environment chemical composition and meteorology/climate on different scales. Therefore, to understand the mechanisms of interactions and their non-linearity, and correctly model the effects of megacities, online coupled/integrated models with two-way interaction of climate/meteorology and chemical/aerosol processes on different scales should be considered.

In the MEGAPOLI study (megapoli.info), such integration methodology is discussed, and the interacting processes and mechanisms responsible for the combined effects are analysed. Depending on temporal and spatial scales, the key-processes and types of their interaction are different. For micro-scale (up to 1 km) the obstacle-resolved approach is used, and the only pollutant gas density feedbacks are of importance. For the city scale (1-100 km) it includes statistical description of urban characteristics, and direct, semi-direct and second indirect aerosol feedbacks are dominated. For regional (more than 100 km) and global scale it is based on parameterised urban effects, and all the above mentioned gas and aerosol feedbacks represent the highest interest.

One of the key questions in this content is: “Are the megacities to blame for climate change/warming?” Current results of MEGAPOLI studies are giving the following preliminary answers on this scientific question:

• On city- and meso-scales definitely ‘Yes’ (both via urban heat island (UHI) and emissions),
• On regional and continental scale: urban plume extends up to thousands km, so it could effect the climate change,
• On global scale: probably ‘No’ due to UHI, but ‘Yes’ due to GHG emissions (anthropogenic CO_2, CFC, CH4, N2O and tropospheric ozone),
• Source of aerosols which have both direct and indirect cloud radiative effects (cooling or warming),

However, too early to make final conclusions: new multi-scale studies are still necessary.