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Source apportionment and air quality impact assessment studies in Beijing/China

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More than 15 million people in the greater area of Beijing are still suffering from severe air pollution levels caused by sources within the city itself but also from external impacts like severe dust storms and long range advection from the southern and central part of China.

Within this context particulate matter (PM) is the major air pollutant in the greater area of Beijing (Garland et al., 2009). PM did not serve only as lead substance for air quality levels and therefore for adverse health impact effects but also for a strong influence on the climate system by changing e.g. the radiative balance. Investigations on emission reductions during the Olympic Summer Games in 2008 have caused a strong reduction on coarser particles (PM10) but not on smaller particles (PM2.5).

In order to discriminate the composition of the particulate matter levels, the different behavior of coarser and smaller particles investigations on source attribution, particle characteristics and external impacts on the PM levels of the city of Beijing by measurements and modeling are performed:

Examples of long term measurements of PM2.5 filter sampling in 2005 with the objectives of detailed chemical (source attribution, carbon fraction, organic speciation and inorganic composition) and isotopic analyses as well as toxicological assessment in cooperation with several institutions (Karlsruhe Institute of Technology (IfGG/IMG), Helmholtz Zentrum München (HMGU), University Rostock (UR), Chinese University of Mining and Technology Beijing, CUMTB) will be discussed.

Further experimental studies include the operation of remote sensing systems to determine continuously the MLH (by a ceilometer) and gaseous air pollutants near the ground (by DOAS systems) as well as at the 320 m measurement tower (adhesive plates at different heights for passive particle collection) in cooperation with the Institute of Atmospheric Physics (IAP) of the Chinese Academy of Sciences (CAS). The influence of the MLH on the air pollution concentration could be demonstrated and will be discussed.

The impact of dust storm events on the overall pollution level of particulate matter in the greater area of Beijing is being assessed by the online coupled comprehensive model system COSMO-ART. First results of the dust storm modeling in northern China (2006, April 3rd until 12th) demonstrates very well the general behavior of the meteorological parameters temperature and humidity as well as a good agreement between modeled and measured dust storm concentration variability at Beijing in the course of time.

The results show the importance of intertwine investigations of measurements and modeling, the analysis of local air pollution levels as well as the impact and analysis of advective process in the greater region of Beijing. Comprehensive investigations on particulate matter are a prerequisite for the knowledge of the source strengths and source attribution to the overall air pollution level. Only this knowledge can help to formulate and to introduce specific reduction measures to reduce coarser as well as finer particulates.