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Origin and influence of PM10 concentrations in urban and in rural environments

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In order to derive measures to effectively reduce human exposure to PM10 pollution it is vital to understand how different chemical components of particulate matter (PM) are related to distinct sources and physico-chemical processes in the atmosphere. Secondary inorganic aerosols like sulphate, nitrate and ammonium are related to emission and transformation of gaseous species, SO2 , NOx and NH3, respectively. Secondary organic aerosol is related to emission and transformation of VOC, while elemental carbon and primary organic compounds stem from direct emissions and the mineral fraction from dust entrainment. Thus, PM10 concentrations, in rural as well as in urban environments, are determined by different sources at different distances from a considered receptor site. The aim of this study is to analyse the reciprocal importance of an extended urban agglomeration like Berlin for the pollution in the rural surrounding areas and, vice versa, the relevance of remote sources for PM levels in the urban background. It could be shown that PM10 concentration levels in urban environment are heavily influenced by long range transport form remote source areas. However, the same holds for rural background concentration levels which are strongly determined by urban emissions. High resolution measurements have shown that long range transport is responsible for up to 70% of the city PM10 background. The Aerosol Chemistry Transport Model REM_Calgrid (RCG) has been used to simulate the impact of local and remote emissions on the PM10 concentration field. Berlin emissions have been switched off in order to estimate the local influence on the surroundings areas. It has been shown that 2/3 of the urban background concentration in the Berlin's centre and 1/3 of the PM10 levels in the suburbs are due to Berlin-specific PM10 and PM-precursor emissions. However, the aerosol composition , strongly determines this

ratio. Therefore, accumulation of primary and secondary aerosol components has been analysed separately. While only 10% of the secondary inorganic and organic aerosol concentrations in the suburbs as well as in the centre can be traced back to city-related emissions, more than 60% of primary particles in the centre and only 30% at the outskirts come from city sources. On the other hand, city-related emissions influence homogenously the rural air-pollution concentrations. In conclusion, while abatement measures to curb primary PM10 emissions ought to be focused on urban agglomerations, large scale coordinated emission control of precursor components of secondary PM would contribute to an essential reduction of the widespread exposure of the urban and the rural population to PM10.