HaChi –Size- and time-resolved measurements of submicron winter and summer haze particles from the Beijing area

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Clearly visible from satellite observations the Beijing area is frequently plagued with heavy air pollution caused by significantly increased particle emissions. The aerosol affects the regional air quality and impairs the visibility by the formation of haze. This process strongly depends on the chemical, optical, and microphysical properties of particles governing the ability to take up water. Furthermore, these particles play an important role for cloud formation processes, precipitation, and the radiative balance of the atmosphere by subsequently acting as Cloud Condensation Nuclei. The HaChi project (Haze in China) targets to study chemical parameters of submicron aerosol in order to associate the chemical composition with the ability to act as condensation nuclei during the formation of haze.
For this purpose, two measurement campaigns were performed at a background site located between Beijing and Tianjin on different meteorological conditions, respectively. The winter campaign was carried out in March 2009 and the summer campaign took place from mid July 2009 to mid August 2009. PM_1 samples were continuously sampled every 24 hours using a DIGITEL high volume sampler and size- and time-resolved aerosol samples were collected using a 10-stage Berner impactor in a 6 hours day/night regime.
This study presents the results of the chemical characterization of submicron particles from winter haze and summer haze measurements in comparison to clear and dusty day measurements. All samples were analyzed for the mass concentration, inorganic ions and carbon sum parameters such as elemental (EC), organic (OC) and water soluble organic carbon (WSOC). The WSOC fraction of filter samples was analyzed for polar substances such as dicarboxylic acids and saccharides. Fatty acids were determined to investigate surface-active substances and metals from the impactor measurements for crust material.
Usually, highest PM_1 concentrations are observed during haze periods, while the particle load was lower on clear days. Probably, the formation of haze depends utmost on wind direction and wind speed. The main components of the varied submicron particles are inorganic ions and carbonaceous material (CM). A higher concentration of ions was found from samples collected on haze days compared to clear day aerosol during the summer campaign due to the secondary formed sulfate, ammonium, and nitrate. No such a distinction was determined during the winter time measurements. A significant higher CM content was observed in the aerosol collected on clear days compared to hazy days caused by higher OC and EC concentrations during the winter and the summer period, respectively. The OC fractions are mostly dominated by WSOC. Higher WSOC and higher therein-enclosed dicarboxylic acid concentrations are determined on hazy conditions than during clear sky measurements. The chemical composition of particles collected during a dust event was characterized by a significantly decreased amount of the secondary formed ions, an increased content of sodium, magnesium and calcium, and of a remaining unidentified fraction containing most likely crust material such as silicates as well as water.