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What have we learned from HaChi (HAZE IN CHINA) project?

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HaChi (Haze in China) project, a joint research between Chinese NSFC and German DFG, focuses on investigating the aerosol hygroscopic properties in the North China Plain and their relationships to aerosol optics, radiation, cloud physics and ozone photochemistry. As we know, Eastern China has suffered from severe pollution caused by large concentrations of aerosol particles resulting from emissions from fossil fuel and biomass burning, transportation and some other combustion sources. Low visibility events are frequently encountered and mainly accompanied with haze as a result of either high aerosol loading or the strong hygroscopic growth of the aerosol particles. Especially at relative humidities between 90 and 99%, the aerosol particles grow exponentially. The hygroscopic behaviors at relative humidities close to 100% are also strongly linked to the particles ability to grow into cloud droplets at supersaturation. In my talk, I will present an overview of the up to date results from a serial of intensive and comprehensive field campaigns conducted at the sites of Wuqing and Xianghe, China, between 2009 and 2014. The measurements of the ambient aerosol hygroscopic properties at high RH between 90 and 98.5% are reported first. These in situ field measurements of atmospheric aerosol are unique with respect to their high RH range and especially of importance to better understand the widespread anthropogenic haze over the North China Plain. Then I will introduce the methods for calculating of aerosol hygroscopicity and their parameterization schemes derived from size-segregated chemical composition and the light scattering enhancement factor measurements in the North China Plain. A new method was proposed to retrieve the ratio of the externally mixed light absorbing carbon mass to the total mass of light absorbing carbon. A new parameterization scheme of light extinction for low visibilities on hazy days is proposed based on visibility, relative humidity, aerosol hygroscopic growth factors and particle number size distributions measured. Cloud Condensation Nuclei (CCN) closure study is conducted with bulk CCN number concentration and calculated CCN number concentration based on the aerosol number size distribution and size-resolved activation properties. An evaluation of various methods for CCN parameterization is presented based on in situ measurements of aerosol activation properties within HaChi project. Hygroscopic growth of aerosol particles can significantly affect their single-scattering albedo, and consequently alters the aerosol effect on tropospheric photochemistry. At last, I will introduce the results on the relationship between aerosol hygroscopic properties and aerosol radiation including impacts of aerosol hygroscopic growth on the NO_2 photolysis rate coefficient and the estimation of direct aerosol radiative effect in the North China Plan.