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Ozone production in summer in the megacities of Tianjin and Shanghai, China: a comparative study

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Rapid economic growth has given rise to a significant increase in ozone precursor emissions in many regions of China, especially in the densely populated North China Plain (NCP) and Yangtze River Delta (YRD). Improved understanding of ozone formation in response to different precursor emissions is imperative to address the highly nonlinear ozone problem and to provide a solid scientific basis for efficient ozone abatement in these regions. A comparative study on ozone photochemical production in summer has thus been carried out in the megacities of Tianjin (NCP) and Shanghai (YRD). Two intensive field campaigns were carried out respectively at an urban and a suburban site of Tianjin, in addition to routine monitoring of trace gases in Shanghai, providing data sets of surface ozone and its precursors including nitrogen oxides (NO_x) and various non-methane hydrocarbons (NMHCs). Ozone pollution in summer was found to be more severe in the Tianjin region than in the Shanghai region, based on either the frequency or the duration of high ozone events. High ozone concentrations (>80 ppbv) of long duration (>6h) were frequently encountered in both urban and suburban Tianjin, while the occurrence of high ozone concentrations lasted for a shorter period (usually <4h) and had a much lower frequency in Shanghai. Such differences might be attributed to the large amount of highly reactive NMHCs in Tianjin. Model simulations based on measurements also reveal similar dependence of ozone production rates upon NMHC reactivity. Industry related species like light alkenes were of particular importance in both urban and suburban Tianjin, while in Shanghai aromatics dominated. In general, the ozone problem in Shanghai is on an urban scale. Stringent control policies on local emissions would help reduce the occurrence of high ozone concentrations. By contrast, ozone pollution in Tianjin is probably a regional problem. Combined efforts to reduce ozone precursor emissions on a regional scale must be undertaken to bring the ozone problem under control.