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N_2O_5 measurement in Hong Kong by a chemical ionization mass spectrometry: Presence of high N_2O_5 and implications

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Dinitrogen pentoxide (N_2O_5) plays key roles in a number of nocturnal chemical processes within the troposphere, including the sink of nitrogen oxides (NO_x). However, accurate measurement of this atmospheric trace compound remains as a challenging task, especially in polluted environment like China. We initially deploy a thermal dissociation chemical ionization mass spectrometry (TD-CIMS) for N_2O_5 field measurement in Hong Kong from 2010-2012. Unusual high N_2O_5 signal measured as NO_3^- (62 amu) were frequently observed. Various interference tests and correction were conducted to verify the data, but we caution the use of 62 amu for measuring ambient N_2O_5 in a high NO_x environment like Hong Kong. Therefore, we optimized the CIMS to measure N_2O_5 as ion cluster of $I(N_2O_5)^-$ at 235 amu with some minor improvements and demonstrated to has the ability for simultaneous in situ measurements of N_2O_5 at an urban site. Then, the CIMS was deployed to another field study at a mountain-top site (Tai Mo Shan). A comparison of N_2O_5 measurement with a cavity ring-down spectrometry was performed and found to be in good correlation with the CIMS. High concentration of N_2O_5 was observed between the boundary layer and there are some occasions where N_2O_5 exceeds several ppb, which is among the highest values ever reported. These results provide deeper understanding on the chemistry of NO_x in a polluted environment. Furthermore, our first observation of nitryl chloride ($ClNO_2$) and its co-existence with N_2O_5 also implies an active heterogeneous reactivity between N_2O_5 and chloride particles in an Asian environment. Thus, N_2O_5 is an important nocturnal intermediate and has the potential in jump-starting the atmospheric photochemistry in this region