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Arctic Chlorine Chemistry Influenced by NO_x Pollution from Villages and Oil Fields

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Atomic chlorine (Cl) is a strong atmospheric oxidant that shortens the lifetimes of atmospheric pollutants and methane in the springtime Arctic, where the molecular halogens Cl_2 and BrCl are known Cl precursors that are emitted from photochemical reactions occurring in the surface snowpack. During March – May 2016 near Utqiaġvik, Alaska, we quantified the contributions of a suite of reactive chlorine trace gases, including Cl_2, ClO, BrCl, and $ClNO_2$, using chemical ionization mass spectrometry. To our knowledge, $ClNO_2$, N_2O_5, and HO_2NO_2 were quantified for the first time in the Arctic. Using these data, we evaluated the relative importance of these species as chlorine atom precursors. Notably, elevated levels of $ClNO_2$, N_2O_5, Cl_2, and HO_2NO_2 coincided with polluted NO_x periods from local stagnant wind conditions (Utqiaġvik town influence) and air mass transport from the Prudhoe Bay oilfields. The connections between NO_x pollution emissions, chlorine chemistry, and snowpack photochemistry will be discussed, with an emphasis on interconnected chemical mechanisms. This NO_x influenced halogen chemistry is important when evaluating changing Arctic atmospheric composition and are important given increasing shipping and fossil fuel extraction across the Arctic with sea ice loss.