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Significant concentrations of nitryl chloride observed in rural continental Europe associated with the influence of sea salt chloride and anthropogenic emissions

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Recent observations of significant concentrations of nitryl chloride ($ClNO_2$) over the North American continent, far from coastal regions, have highlighted a potentially important source of reactive halogens in the continental lower troposphere. Nitryl chloride, formed nocturnally by the heterogeneous reaction of N_2O_5 with aqueous-phase chloride, is readily photolysed producing NO_2 and chlorine radical. We report measurement of significant quantities of nitryl chloride, up to 800 pptv, during the Particles and Radicals: Diel observations of the impact of urban and biogenic Emissions (PARADE) measurement campaign at a mountaintop field site in Hessen Germany, 350 km from the nearest coastline, using chemical ionization mass spectrometry (CIMS). $ClNO_2$ was detected during the majority of nights between the 15^{th} August and 16^{th} September 2011, the largest mixing fractions of $ClNO_2$ being associated with air masses influenced by sea salt and anthropogenic emissions. $ClNO_2$ persisted in measurable quantities until early afternoons on days with foggy conditions and low photolysis frequencies.