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Letter

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A large atomic chlorine source inferred from mid-continental reactive nitrogen chemistry

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Halogen atoms and oxides are highly reactive and can profoundly affect atmospheric composition. Chlorine atoms can decrease the lifetimes of gaseous elemental mercury¹ and hydrocarbons such as the greenhouse gas methane². Chlorine atoms also influence cycles that catalytically destroy or produce tropospheric ozone³, a greenhouse gas potentially toxic to plant and animal life. Conversion of inorganic chloride into gaseous chlorine atom precursors within

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the troposphere is generally considered a coastal or marine air phenomenon⁴. Here we report mid-continental observations of the chlorine atom precursor nitryl chloride at a distance of 1,400 km from the nearest coastline. We observe persistent and significant nitryl chloride production relative to the consumption of its nitrogen oxide precursors. Comparison of these findings to model predictions based on aerosol and precipitation composition data from long-term monitoring networks suggests nitryl chloride production in the contiguous USA alone is at a level similar to previous global estimates for coastal and marine regions⁵. We also suggest that a significant fraction of tropospheric chlorine atoms⁶ may arise directly from anthropogenic pollutants.

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