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Unexpected long-range transport of glyoxal and formaldehyde observed from the Copernicus Sentinel-5 Precursor satellite during the 2018 Canadian wildfires

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Abstract

Glyoxal (CHO.CHO) and formaldehyde (HCHO) are intermediate products in the oxidation of the majority of volatile organic compounds (VOC). CHO.CHO is also a precursor of secondary organic aerosol (SOA) formation in the atmosphere. These VOCs are released from biogenic, anthropogenic, and pyrogenic sources. CHO.CHO and HCHO tropospheric lifetimes are short during the daytime and at mid-latitudes (few hours), as they are rapidly removed from the atmosphere by their photolysis, oxidation by OH, and uptake on particles/deposition. During nighttime or at high latitudes, lifetimes can be prolonged to many hours or even days. Previous studies demonstrated that CHO.CHO and HCHO can be retrieved from space-borne observations using the DOAS method. In this study, we present CHO.CHO and HCHO columns retrieved from measurements of the TROPOMI instrument, launched recently on the Sentinel-5 Precursor (S5P) platform in October 2017. Strongly elevated amounts of CHO.CHO and HCHO are observed during the fire season in British Columbia Canada, where a large number of fires occurred in August 2018. CHO.CHO and HCHO plumes from individual fire hot-spots are observed in air masses travelling over distances of up to 1500 km, i.e. much longer than expected for the short atmospheric lifetime of CHO.CHO and HCHO. However, the temporal evolution of the plume differs for both species. Comparison with Lagrangian-based FLEXPART simulations for particles with different lifetimes shows that effective lifetimes of 20 hours and more are needed to explain the observations, indicating that CHO.CHO and HCHO are either efficiently recycled during transport or, continuously formed from the oxidation of longer-lived precursors present in the plume.