

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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This paper describes TROPOMI satellite retrievals of glyoxal (CHO.CHO) and formaldehyde (HCHO) over Western Canada during the wildfire-intensive month of August 2018. Enhanced VCDs of $\sim 14 \times 10^{14}$ molec cm^{-2} CHO.CHO and $\sim 50 \times 10^{15}$ molec cm^{-2} HCHO are observed at wildfire locations and these enhancements appear to persist over long distances of up to 1500 km. FLEXPART tracer transport simulations using GFAS emission locations are able to reproduce the spatial distribution of enhancements if a lifetime of 20 hours or more is used.

My general suggestion for the paper is to articulate more clearly the usage of lifetimes in FLEXPART to avoid confusion. Since a full chemical transport model is not being used, (1) the model is not producing CHO.CHO and HCHO columns that can be directly compared to the observations and (2) the ‘effective lifetime’ does not represent the chemical/physical production/loss processes that are occurring within the large wildfire plume. Rather, the ‘effective lifetime’ in FLEXPART simply allows tracer particles to persist from their origin and continue to be transported. This provides a general spatial comparison to the observations. Hence the ‘effective lifetime’ here is a simple and useful computational proxy – but not a representation of – complex plume processes. The authors have clarified this in the Methods but it should be made more obvious to readers in other sections.

For example, the wording in the abstract suggests >24 hour lifetimes during nighttime or at high latitudes (does this refer to Canadian latitudes?) and presents 20+ hours as the FLEXPART lifetime; these are referring to the different usages described above and can be confusing.

The authors discuss the far downwind CHO.CHO and HCHO observations and suggest continued production from precursors as the likely cause, and not a physical increase in the lifetimes. It is worth noting that British Columbia is a coastal province and the presence of chlorine-initiated oxidation adds to the skepticism of >20 hr lifetimes.

This is a relevant paper for ACP. The paper is well written and the results are presented in an organized manner. The satellite retrievals of CHO.CHO and HCHO from the recently launched TROPOMI instrument are highly valuable and provide improved insight into Canadian wildfires as presented in this work. I recommend acceptance to ACP after addressing the above comments and the minor corrections below:

Line 05 – ‘lifetimes’

Line 24 – order of CHO and HCHO is awkwardly changed in this sentence

Line 51 – remove comma after ‘Spectroscopy’

Line 57 – remove comma after ‘07’

Line 73 – ‘and/or’

Line 81 – capitalize ‘Precursor’ and remove ‘of’

Line 85 – remove ‘of’

Line 86 – keep formatting of dates consistent (e.g. 13 October 2017 vs. August 07 2018 in Line 57 vs. 10th of August 2018 in Line 140, etc.)

Line 89 – 13:30 LT

Line 92 – again consider removing ‘of’

Line 94/95 – keep formatting of in-text citations consistent

Line 106 – How many CHO.CHO peaks are within this range?

Line 110 – What is meant by a ‘row-dependant’ spectrum? Explain. Is it one background spectrum per line of latitude? The author states that a daily mean is used but if the background spectrum changes throughout the day, will this introduce significant error?

Line 110 – ‘...as a background spectrum (Alvarado, 2016).’

Table 1 – remove ‘de’ in title

Line 127 – heading should state ‘HCHO retrieval from TROPOMI measurements’ to match Line 93

Line 133 – ‘consists’

Line 161 – full citation in brackets

Line 206 – remove comma

Line 211 – ‘HCHO’

Line 220 – reword to ‘...which are discussed in detail in Section 3.2.’

Line 229 – reword to ‘Figure 7 presents...’

Line 231 – ‘However, on the 20th...’

Line 233 – ‘from’

Line 252 – ‘references’

Figure 8 caption – ‘...for the 10th of August 2018.’

Line 286 – misspelling of ‘conclusions’ in heading