

Reviewer's Comments on "Severe Californian wildfires in November 2018 observed from space: the carbon monoxide perspective" by Schneising et al.

General Comments

This paper reports an analysis of TROPOMI CO observations of fire emissions over California during 2018. TROPOMI CO total column measurements are used to estimate CO concentrations in the boundary layer which are compared to air quality standards. Comparisons with the CAMS analysis, in which MOPITT and IASI CO data are assimilated, are also presented.

While this paper does not report anything fundamentally new, the results should interest many readers of ACP. The presented methods are generally reasonable with one exception. Because the TROPOMI data do not provide any information with respect to the vertical distribution of CO, a general assumption is made in the paper that the pyrogenic CO remains in the boundary layer. This assumption is the basis of the equation used to convert CO total column to CO boundary-layer concentrations, and is also important for the analysis of errors due to the radiative effects of smoke aerosol. This assumption may be reasonable near the source region at the very beginning of a fire event, but for later days CO concentrations in the free troposphere will grow as the result of boundary layer venting. Thus, for a particular TROPOMI observation, the partitioning of CO between the boundary layer and free troposphere will, to some extent, depend on the transport of CO emissions produced upwind. In fact, for regions far from the source regions, the CO enhancement in the free troposphere could greatly exceed the enhancement in the boundary layer. Thus, the method presented by the authors can really only provide an upper limit for boundary-layer CO concentration. The authors seem to acknowledge the effect of venting in Section 3.2, but propose without evidence that the associated uncertainty of this effect is 25%. With respect to errors associated with the 'shielding' effect of smoke aerosol (also in Section 3.2), the authors present results from a simulation in which the smoke aerosol was confined to the lowest 2 km or so. Thus, this analysis is also based on the premise that no venting takes place from the boundary layer to the free troposphere.

Fortunately, the authors should be able to remedy these problems with the paper using the CAMS analysis. Specifically, the CAMS model output (CO vertical profiles) should be analyzed to determine the expected spatial and temporal dependences of the partitioning of CO between the boundary layer and free troposphere. This analysis would lead to much more robust estimates of errors in boundary-layer CO concentrations derived from TROPOMI. Similarly, the simulation of errors due to the shielding effect of smoke aerosol should include a case study (guided by the CAMS output) representing a case where the free troposphere was significantly affected by upwind venting of the boundary layer.

Specific Comments

p. 1, l. 13. Replace 'in line' with 'consistent'

p. 1, l. 20. 'conflagration' does not seem like a scientific term

p. 2, l. 13. What is the exact scaling factor (or method) to convert between CO concentrations in ppm and mg/m³?

p. 2, l. 26. Replace 'Up to now' with 'Until now'

p. 3, l. 12. Add 'measurements' after 'carbon monoxide'

p. 3, l. 18. Please elaborate on validation results (e.g., what are dominant sources of random and systematic error)

p. 3, l. 29. Clarify meaning of 'similar error characteristics'

p. 3, next-to-last paragraph. Clarify how retrievals are performed over the ocean; the SICOR retrieval algorithm requires the presence of clouds in such scenes. Are retrievals over the ocean as reliable as retrievals over land?

p. 4, l. 9. Equation 1 should be moved here from Section 3.2

p. 4, l. 19. 'for days' should be more specific

p. 6, l. 3. 'obviously and 'unambiguously' are redundant

p. 7, Fig. 3 (and Fig. 4) Dotted areas in figure are not easily distinguished visually from non-dotted areas. Consider either changing size of dots or using alternative color.

p. 8, l. 4. If no reference is given, this equation needs more explanation (for example, what is the significance of the near-surface averaging kernel)

p. 9, paragraph beginning on l. 6. See general comments above.

p. 10, l. 9. replace 'entire' with 'the entire state of'

p. 11, l. 1. Justify statement that the VIIRS images show no indication of pyrocumulus

p. 12, l. 1. What are 'irradiance'?

p. 12, l. 9. This is not a realistic worst case scenario, since it does not represent effects due to the vertical distribution of smoke aerosol (see General Comments).

p. 14, l. 33. Replace 'it is the other way round' with 'the opposite is true'.