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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Wildfire smoke-plume rise: a simple energy balance parameterization" *by* Nadya Moisseeva and Roland Stull

Anonymous Referee #2

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This paper introduces updraft velocity scales that are used during daytime CBLs. The scaling was developed using a set of model-derived synthetic plumes from WRF-SFIRE. The paper is novel and well-written. This reviewer feels that the observational dataset used is not ideal compared to other wildfire plume observations available. A limitation to the study and proposed methodology is the use of fireline intensity (heat flux) as this parameter is very difficult to observe in the field and even more so for wildfires. The data used are limited to the flame zone, but not the plume base. As the authors do recognize, the data from multiple sensors, have a range of values. It may be worthwhile to use sensible heat flux values calculated from the in situ tower observations. Overall, this is an excellent paper, well written and justified. I recommend publication after Minor Revisions.

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Discussion paper

While the proposed method for estimating plume rise is somewhat novel, it is unclear why the authors don't use more observational data. The authors state that observations are limited and that is somewhat true, but given the recent publication of key wildfire plume datasets (RaDFIRE; Clements et al. 2018), the authors should really use wildfire observations verses low-intensity prescribed fires from RxCADRE. Another issue with the methodology presented in this study is that the authors use a vertical velocity scale for plume rise, but have no vertical velocity observations. Vertical velocity data are also available from the RxCADRE dataset. Additionally, a very recent paper by Rodriguez et al. (2020) show deep updraft velocities in a megafire that could be used as an extreme boundary for the parameterization. Additionally, a dataset from Lareau and Clements (2017) of a wildfire that includes plume evolution in a cross-wind is available as was also used by (Mallia et al. 2019).

Some specific comments:

Line 148: It is not clear what the authors are defining as Fireline Intensity: "... fireline intensity parameter I, which is the the kinematic heat flux into the atmosphere integratedacross the fireline depth (in units of Km2s−1),..."

I would call this the fire heat flux vs Byram's Fireline Intensity which has units of kW /m.

Line 205: Replace "lot" with "plot."

In Figure 2a, the mean plume centerline has a loop just downwind of the initial injection. Is this realistic? I would imagine that this feature represents the CBL, but would be averaged out as observed in the remainder of the downwind plume. Can the authors comment on this structure and whether this is realistic?

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-827, 2020.