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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "A review of approaches to estimate wildfire plume injection height within large scale atmospheric chemical transport models – Part 1" *by* R. Paugam et al.

**Anonymous Referee #2**

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This paper provides an excellent review of techniques used to estimate smoke plume injection height. The advantages and disadvantages of each method are well described. The narrative is also well organized. I therefore find this paper appropriate for publication in ACP. However, several minor errors and omissions must first be addressed (see comments below).

General comments:

Minor grammar mistakes are found in all sections of the document. I have noted several of these errors in my specific comments below. Please preform a detailed check over



the entire document.

The pyroCb is the most extreme form of a high-altitude injection, and the most troubling situation for smoke transport modeling. I recommend adding a figure showing an active pyroCb (e.g. satellite image) and the resulting high-altitude smoke (e.g. CALIOP curtain). There is also a great deal of uncertainty surrounding the conditions that result in pyroCb development.

Studies like Kahn et al. (2007) note that smoke above the boundary layer will concentrate at levels where there is increased stability. This should be mentioned in the text in an appropriate location. Also, can models accurately represent these small, weak layers of stability? Or would the smoke have to be mixed above the boundary layer?

Are there any studies that discuss smoke plume altitude at night? Certain meteorological conditions may allow a fire to remain active during the nighttime (e.g. Santa Ana driven fires in southern California). Therefore, while rare, there is at least some potential for higher-altitude smoke at night. I believe Fromm et al., (2010) also mention pyroCb occurrence at night.

A brief description of potential improvements from the next generation of satellite sensors should be included, possibly in the last paragraph. For example, GOES-R and Himawari-8 will provide capabilities similar to MODIS, with a temporal frequency potentially as high as one minute (please check exact specifications). This will allow for detailed observations of pyroconvection during peak burning hours.

Specific comments:

Abstract, line 8: change "This characteristics" to "the characteristics"

Abstract, lines 17-19: This sentence is disjointed and confusing. Please modify.

Intro, p3, lines: 7-10: You mention the acronyms of four global inventories. You should give the full name of each inventory and possibly where it was developed. Some readers may be unfamiliar with these. Also, you only give 3 references for the 4 inventories.

Intro, p3, line 19: “transports the fire emissions”. Should it be “transports the smoke emissions”? It might be worth changing the terminology within the whole document.

Intro, p4, lines 12-14: What resolution would be required to resolve plume dynamics? Perhaps you should give the reader some idea of the typical resolutions used by current CTMs.

Section 2: This is the primary background section. It might be beneficial to give a brief history, starting with the earliest known studies on smoke injection height characterization and modeling. Give the reader some idea of how long the injection height topic has been discussed in the literature.

Section 3, p8, lines 6-19: Remember that many fires produce pyroCu, but only a few events produce a full pyroCb. This should be clarified. Also, a very recent study by Peterson et al. (2014) provides more insight on these three types of plumes, especially the dynamics driving pyroCb development, including the potential role of mid-level moisture entrainment. Peterson, D. A., Hyer, E. J., Campbell, J. R., Fromm, M. D., Hair, J. W., Butler, C. F., and Fenn, M. A.: The 2013 Rim Fire: Implications for Predicting Extreme Fire Spread, Pyroconvection, and Smoke Emissions, Bulletin of the American Meteorological Society, 10.1175/bams-d-14-00060.1, 2014.

Section 4: FRP is better described as an instantaneous measure (or proxy) of fire intensity. It is usually calculated using a middle infrared (e.g. 4 micron) channel. However, the Dozier-derived FRP does incorporate the thermal IR (e.g. 11 um) channel.

Section 4.1.1, p9, lines 25-26: I believe the full name for CALIOP is “Cloud-Aerosol Lidar with Orthogonal Polarization”. Please check.

Section 4.2, paragraph 1, “can be trigger” should be “can be triggered”

Section 4.2, p14, line 12: I think “infra red” should be “infrared” or “infra-red”

Section 5, paragraph 1: change “it also have effects on” to “it may also affect”



Section 5.2.1, paragraph 1: CMAQ has not been defined. Also, “originally build” should be “originally built”.

Page 5.2.1: Rio et al. description: Many small grammar errors within.

Section 5.2.2: WF-ABBA has not been defined. Perhaps it should be mentioned in section 4, along with the fire detection and the FRP discussion.

Section 5.2.2: last sentence: “MSIR” should be “MISR”

Section 5.2.3: second sentence: this is confusing and disjointed.

Section 5.3: I think the overall message here is that statistical models for plume height would require two equally weighted components: (1) accurate fire characterization from satellite, likely aided by the Dozier technique and (2) accurate meteorology, especially in the vertical (e.g. stability profile). This section could be streamlined to get those points across.

Section 6: There are many grammar errors within. The last paragraph is actually a single, very long sentence that should be broken into at least two sentences.

Section 6, discussion of Figure 11: An FRP of 6 GW? That’s 6000 MW, which is a large FRP value. Please see the Giglio et al., Peterson et al., Schroeder et al, and Ichoku et al. papers. Additional information is required here. For example, how many pixels were used in that calculation? Where are they located in the figure? Is this high smoke plume actually a pyroCu. . .it looks like it might be? Is there an estimate of how many plumes in the MISR dataset may have pyroCu?

Figure 4: The color bar text is hard to read. Also, it might be worth cropping the images to zoom in on the plumes.

Figure 7: Can you use the same scale on the x and y axes? Also, panel b might be more informative as a density (shaded) plot. There are too many data points for a standard scatter plot.

Figure 9: The land cover types should be defined. For example, the reader probably doesn't know what "SA" and "EF" stand for.

Figure 10: Perhaps you should label and reference the four panels as a, b, c, d?

Figure 11: Same comments as Figure 4. Is this a pyroCu? The extreme altitude and overall appearance suggests it's some form of pyroconvection.

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Interactive comment on Atmos. Chem. Phys. Discuss., 15, 9767, 2015.