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Geoscientific Model Development Discussions

Interactive comment on "One-dimensional simulation of fire injection heights in contrasted meteorological scenarios with PRM and Meso-NH models" *by* S. Strada et al.

Anonymous Referee #2

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General Comments

This paper presents a comparison of smoke plume injection heights obtained with a meteorological model (Meso-NH), which uses an Eddy-Diffusivity/Mass-Flux approach, and the Freitas et al., [2010] 1-D plume-rise model. For this comparison exercise, the Authors use three fire examples (one Mediterranean and two Amazonian fires) and focus on models' sensitivities to meteorological conditions using input observations from radiosondes and ECMW near the location of the fires.

The problem of parameterizing the injection height of smoke fire emissions in CTMs is a challenging task. In the last years, a few 1-D plume rise models have been incorporated

into CTMs. However, the current knowledge on how these parameterizations actually work is still very uncertain. This paper studies the sensitivity of two plume-rise models to meteorological conditions as well as to different meteorological inputs (radiosondes versus ECMW) that provide insights on their performance.

In my opinion, the topics of this work are of relevant interest for the readers of the GMD. However, I found some substantial limitations in the paper that should be addressed before it can be considered for publication. First, I found the paper too long. The Authors provide an extensive, detailed comparison of the results given by the two models, which seems quite excessive. These detailed descriptions make the reader lose track of the main points in each section of the paper. Second, I am not sure why the Authors compare two models and try to understand the differences between them. I think one would learn much more from the two models (i.e., advantages and limitations) if the results were also compared to real observations. It is worth noting that the three fires considered by the Authors are well studied and measurements of injection heights and smoke layer thickness have been reported in the literature. Third, I found rather unclear what the main objective of this paper is meant to be. Are the Authors going to improve the injection height scheme in the Meso-NH model based on what they learned from the 1D plume-rise model comparison? If so, do the Authors believe that the Freitas et al., [2010] plume-rise model estimates accurate smoke fire injection heights?

Below, I have added some specific comments, which I hope may help the Authors go through the review process. Please, note that I have not made any specific comments on the English grammar and typos since this does not seems of primary importance at this stage.

Specific comments

Title

The title is not clear as the reader does not know yet what PRM and Meso-NH mean.

Abstract

I think the abstract should be more specific and tell what the Authors did and what they learned from the models' comparison. What are the main conclusions of their analysis?

Section 2

I think this section is too long and provides too much detail. For example, sections 2.1 and 2.2 can be shortened; section 2.3 can be compressed and embedded within 2.1 and 2.2. A brief information of the actual plume height observed for those three fires could be added here, and a summary in Table 1.

Page 730 Line 2- What is $\partial z\theta$?

Page 730 Line 4- CBL has not been defined yet

Page 731 Line 6- rv has not been defined yet

What is the spatial and temporal resolution of the ECMWF reanalysis observations? Where those observations extracted at the time and location of the fires?

Do the Authors think that the disagreement between the radiosondes and ECMWF observation can be due to different spatial resolutions?

Section 3

I think this section can be significantly shortened. I suggest focusing on the main differences between the two models without presenting all the equations that drive the models. For example, section 3.2 was mainly shown in Strada et al. [2012] and section 3.2 was presented in Freitas et al. [2007, 2010].

Page 740 Line 1- Φs is the nominal value, of what?

Page 744 Line 17- What is Wp?

Section 4

Section 4.1- This section can be shortened. I also think it will fit better in a methodology section (e.g. section 3)

Page 746 Line 1- The sentence "Meso-NH/EDMF burnt 100 ha in 1 h, while PRM burnt 100 ha for 1 h." is not clear to me. I do not understand how the two models treat temporally the area burned in a different way.

Page 746 Line 12. The Authors should be consistent. Figure 6 cannot be introduced before Figure 5.

Section 4.2- This section seems out of place here.

Page 749 Line 22. The Authors described the vertical profiles obtained with PRM after 10 min simulation and at the steady state solution. In what figures do these vertical profiles appear?

Page 749 Line 24. For the Meso-NH model, the Authors show the temporal session of the PRM model steady state solution and the end of the simulation (after 60 min). I do not understand what the Authors really mean. In the Figures, they show results from different solutions. For example, 20 min and 60 min (Fig. 8), 40 min and 60 min simulations (Fig. 12), 10 min and 50 min (Fig. 13), 50 min and 60 min (Fig. 15), etc. Why are there such a variety of time solutions?

Sections 4.3-4.5- I think these sections can be significantly reduced. The Authors may want to consider describing only 1-2 examples of all the sensitivity tests performed, and showing Figure 17 as a summary. In Figure 17, the Authors could include the observed plume height and thickness for those three fire plumes based on measurements, and comment what they learn from a model-observation comparison perspective.

Sections 5 and 6

I think these two sections can be joined. I suggest focusing on what the Authors really learned from the models: advantages, caveats, limitations, etc. Do they have any recommendations for the modeling community on the application of these plume rise

models into CTMs?

Page 757 Line 5. The Authors mentioned that the Mediterranean fire has a higher fire-induced heat flux than the Amazonian fires (100 versus 80 Kw/m2). However, the model predicts a lower injection height for the Mediterranean fire. They attribute this lower injection height to the meteorological conditions. Although I agree with this statement, the Authors should notice that the PRM sensitivity to heat fluxes is small (Figure 4 in Freitas et al, [2007]), in particular for the heat flux ranges (80-100 Kw/m2) they consider in the simulations.

Figures and Tables

Figures 1, 2 and 3 can be combined in a single panel figure.

Figure 4. What is the squared shaded area (from 2.5 to 4.5 km) mean? What the 10 min and 20 min mean? (Questions for Fig. 4 also apply for Figures 5-16).

Figure 16. Only one simulation time (60 min)?

Figure 17. I do not understand why for the "Rodonia Windy-Wet" fire, the Meso-NH/EDMF Final case shows two solutions (i.e., two red triangles).

Interactive comment on Geosci. Model Dev. Discuss., 6, 721, 2013.