

Interactive comment on “Evaluation of vegetation fire smoke plume dynamics and aerosol load using UV scanning lidar and fire-atmosphere modelling during the Mediterranean Letia 2010 experiment” by V. Leroy-Cancellieri et al.

Anonymous Referee #1

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1. Summary

This paper examines plume dynamics with the use of observations from a scanning aerosol lidar and simulations from the Meso-NH/ForeFire coupled modeling system. The significance of this work is that there are few data sets available for coupled fire-atmosphere model evaluation and even fewer studies combining field observations and numerical modeling. The authors should highlight this in the manuscript with some description of previous work. Another key result of this work is the method based on the

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calculation of a barycenter for the plume backscatter properties and comparison with the model output. This technique provides a good estimate on model performance compared to lidar data. I feel the paper could be written a little more concise, as suggested in Minor Comments section, to highlight the results. One key result, the observed "injection" height simulated by the model to be 60 m within the observed height of 200 m is not clear. This result seems poor given 200 m is max height and model was only within 60 of that height. Overall, the paper describes a unique study with interesting and useful techniques for wildfire and hazards research. I feel the paper can be accepted after minor revision to address the comments highlighted below.

2. Major comments

(1) I think the word “vegetation” in the title should be changed to “wildland.” The term wildland will allow wildfire researchers to easily find the paper. This might be more of an American nomenclature, but should be considered by the authors.

(2) The lidar backscatter images in Figure 6 might be better supported by actual photographs of the smoke column. A group of photos presented with individual times indicated would also allow the plume behavior to be shown. This could be an additional figure with 4-6 panels.

(3) One thing missing in the experimental design is the mention of the lidar system. The specifications are provided in section 3.1, but no mention of the manufacturer is presented. Also, what are the specs of the system in terms of range gates, etc.?

(4) I think Figure 2 could be improved. I would provide an overview map showing the terrain and then show a detailed schematic / map showing the instrument layout. Maybe just show the burn plot outline on the present Figure 2.

(5) Figure 7 doesn't show much information. How does it compare to observations? I think this figure could be improved to show more plume structure.

(6) I think the major limitation to this study is the use of only five scans for comparisons.

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More scans would allow better statistics to be compiled. This limitation in data is due to the fact that the experimental fire was so small and the scanning time of the lidar was long. It would have been better to have the lidar making vertical scans on the order of 10 s rather than two minutes, and to have the active burning period occur longer in duration. However, the data are well characterized and show that the ForeFire/MesoNH coupled model can reproduce the observed plume structure to some degree. Another reference that might be of use for this paper is: Charland, A. M. and C. B. Clements, 2013 Kinematic structure of a wildland fire plume observed by Doppler lidar, *J. Geophysical Research-Atmospheres*, 118, 113, doi:10.1002/jgrd.50308.

3. Minor comments

In general, the paper is well written. I have provided a few suggested grammatical errors and some minor needed clarifications. I have not attempted to list all grammatical errors.

Pg. 3992, line 21, replace gaz with gas.

Pg. 3992, line 26: I think the term real should be changed to wildland since even a prescribed fire or experimental fire is 'real.'

Pg 3997, line 19: the authors state that the anemometer was placed at the downwind side of the burn plot to protect the instrument and measurements from being contaminated and influenced by smoke and the fire front. Do the authors mean located 'upwind' from the burn?

Pg 3998, line 10: East should be east.

Pg 3998, line 10: "High temporal/spatial resolutions continuous monitoring is performed by successive vertical scans. ." Again, what are the resolutions of the lidar? This is stated in line 15 and should be mentioned earlier when describing the lidar system. Also, vertical scans are referred to as Range Height Indicator (RHI).

Pg. 4000, line 15: "technics" should be "techniques"

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Pg. 4003, Line 9: "plan" should be "plane"

Page 4009, Line 6: Aladin is repeated.

Page 4010, line 8: "scan" should be "scans"

Page 4010, line 25: "fully smoke plume" should be changed to "full smoke plume"

Page 4011, Line 5: "During the scan 4, a transition phase between the rising smoke plume domination period and the smoke plume residual advection layer period seems to be perceptible. The smoke plume is decoupled (vertically) from the ground and the smoke injection height appears at about 200m and remains the same in the next scan (Fig. 6e)."

This paragraph is awkward and needs to be rewritten. I am not clear on what the authors mean by residual advection layer? Are you referring to the residual layer in the boundary layer? If so, that isn't correct since that occurs during nighttime. Also, I am not sure "injection height" is the correct term to use. I think it is more just plume height or max plume height rather than injection height. This especially true since the I the next sentence you state that the plume is at 300 m AGL in the next scan.

Page 4011, Line 13: "(especially horizontally)" I have a problem with this description. It is hard to observe dispersion in the horizontal using vertical scans. Generally, dispersion in the horizontal is when the plume spreads out across (perpendicular) to the mean wind direction rather than just downwind. Since the plume is only 100 m thick, it might be safer to interpret this structure as weaker plume buoyancy due to entrainment of ambient air downwind. The plume doesn't rise anymore, but is just advected downwind.

Page 4011, Line 19: hard to tell the difference in plume structure between the two domains. The simulated plume looks as one.

Page 4011, Line 22: "figure" should be changed to "determine" or better yet "estimate."

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Page 4013: line 12: "ground flows" should be "surface winds" or "surface flows"

Pg 4024: Table 2: Wind direction is labeled as degrees, but SEE is given. I would convert to degrees.

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