Natural Hazards
and Earth System
Sciences

Discussions

Interactive comment on "Evolution of an extreme Pyrocumulonimbus-driven wildfire event in Tasmania, Australia" *by* Mercy N. Ndalila et al.

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This article by Ndalida et al. presents the concomitant analysis of a wildfire plume, which produced a pyroCb, and surface fire behaviour. I quite enjoyed reading the paper, and I am quite familiar with the area where the fire took place. My research interests include the use of weather radar to monitor fire plumes, therefore I felt it useful to provide some comments that might help improve the paper.

Overall, I feel that the radar data, possibly making half of the paper content (the other half being fire behaviour observations) are well under-utilised by the authors. For instance, I am surprised that the authors did not show and discuss radar observations of the Doppler velocity? We have shown in Terrasson et al. (2019) that these can provide

great insights into the dynamics of the PyroCb, including convection, shear, vortices etc. Its derivative, i.e. the spectrum width as we showed in Terrasson et al. (2019) and McCarthy et al. (2017; 2018) can also give great insights. Here, the radar data is only presented as a time-series of integrated variables in one figure of the article, which gives limited information. The Figure S3 in the supplementary material shows only cross sections of the Reflectivity, without colour scale, which is really limited. Recent work by McCarthy et al. (2019) and number of papers from Lareau and Clements show that radar observations can be utilised to draw multiple quantitative and qualitative information: this richness must be utilised.

Specific comments below:

1. Title: ". . .Pyrocumulonimbus-driven. . ..." We know of the feedback loop between surface fire behaviour and pyroCb, but it reads as if the fire was influenced by the PyroCb and not the other way around. What do you mean by "Extreme PyroCb", how does it differ from a standard PyroCb? The use of more scientific rather than emotive language should be preferred.

2. L34 and other occurrences in the article. Shouldn't references listed in brackets be in chronological order?

3. L36: this seems somehow restrictive, as not only atmospheric instability but wind shear and mesoscale conditions can drive fire behaviour.

4. L44; Chronological order

5. Melnikov et al. (2008) does not present observations of PyroCb so the reference should not be cited here. Authors should also cite Terrasson et al. (2009) in which we report detailed radar observations of a PyroCb in NSW.

Terrasson, A., McCarthy, N., Dowdy, A., Richter, H., McGowan, H., & Guyot, A. (2019). Weather radar insights into the turbulent dynamics of a wildfireâĂŘtriggered supercell thunderstorm. Journal of Geophysical Research: Atmospheres, 124, 8645– 8658.

6. L57 and 58: This sentence would probably benefit from the use of a more scientific description of the radar capabilities, e.g. ..."they are "tuned" to identify" is actually incorrect. The frequency of the radar will determine which particles the radar is likely to receive a backscatter from. Post-processing analysis can be improved possibly, but it won't modify the frequency of the radar, which is a fixed hardware choice. More details on the scatterers as observed by the radar and reference to pyrometeors as described by McCarthy et al. (2019) would be appropriate here.

McCarthy, N. F., Guyot, A., Protat, A., Dowdy, A., & McGowan, H. (2019). Tracking Pyrometeors with Meteorological Radar Using Unsupervised Machine Learning. Geophysical Research Letters, 46. https://doi.org/10.1029/2019GL084305

7. L69: the authors might want to discuss here the V-shape profile as described by Peterson et al.?

8. L71: it would be useful to give here the frequency of the radar (C-band) and state that this is a Doppler radar. The reader might also want to know if this is an operational radar (thus with a given scan strategy) and by whom it is operated (BoM).

9. L83: space between "600" and "m"

10. Can you give here the time at which the pyroCb started to form?

11. Figure 1(d), the location of the weather radar is hard to see... could you possibly use another colour or/and larger font?

12. L108: This is likely to be case but how did McRae validate this? What do you mean by "violent convection"? i.e. did you compute vertical velocities?

13. L111: there is no consistency with the spelling of "Mt" and "Mt." in the paper. I think it should be "Mt"?

14. L119: Why is that threshold of 11 dBZ being used? The paper would benefit here

from more explanation on the processing of radar data (clutter removal, attenuation correction if any etc.)

15. L119 and 120: "in this paper" repeated twice

16. L162 and elsewhere: it might be good to use the terminology "air temperature" instead of "temperature".

17. L165: section title seems wrong here

18. Figure2: Wind direction? This is an important factor for fire behaviour and could help discuss the VLS aspects presented by the authors as one of the main mechanism for the increase in fire intensity? I personally prefer multiple subpanels as there is a bit of clutter on that figure with all the variables.

19. L224: "1km" above sea level?

20. Figure 3: "Smoke on subpanel (a)" is not technically correct; rather "smoke plume" should be used. That is because radar at C-Band can't get good returns from smoke as such, as the authors correctly mentioned earlier in the draft; see McCarthy et al. (2018).

21. L249 How is plume length defined?

22. Figure 5, nice

23. Maybe recall for readers unfamiliar with Tasmanian seasons when that is?

24. L315 The authors should cite Terrasson et al. here

25. L322 325 The authors should cite Terrasson et al. here as well

26. L338. The authors should discuss the findings of Terrasson et al. – the change of moisture in the lower and upper levels as brought by the cold front on the development of PyroCb and fire behaviour.

27. L348: The authors should cite Terrasson et al. here

28. L392, 394: The effect of the potential VLS on plume development is too speculative. Overall, I think that there is no justification based on the observations as shown in the current paper, for any effect of VLS.

29. The authors should cite Terrasson et al. here

30. In Terrasson et al. (2019) we did exactly that, e.g. linking fire behaviour to plume development. The authors could also cite McCarthy et al. (2018) where fire behaviour is studied against plume development for a PyroCu in Victoria (Mt Bolton fire).

McCarthy, N., H. McGowan, A. Guyot, and A. Dowdy, 2018: Mobile X-Pol Radar: A New Tool for Investigating Pyroconvection and Associated Wildfire Meteorology. Bull. Amer. Meteor. Soc., 99, 1177–1195, https://doi.org/10.1175/BAMS-D-16-0118.1

31. Fig.S3: "the orange colour represents the most intense parts of the PyroCb": it would be appropriate to use a more scientific and precise language, i.e. provide the values or range of values for the equivalent reflectivity in dBZ (colour bar), and refer to the text of the article to describe how these have to be interpreted.

Thanks and again I enjoyed reading your study. Kind regards,

A. Guyot