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Comment

## ***Interactive comment on “Linking local wildfire dynamics to pyroCb development” by R. H. D. McRae et al.***

**R. H. D. McRae et al.**

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Anonymous Reviewer #3

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REPLY

General comments:

Anonymous Reviewer #3 (AR3): The manuscript entitled “Linking local wildfire dynam-

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ics to pyroCb development” by McRae et al. describes an attempt to associate the development of deep pyrocumulonimbus clouds with identifiable types of fire behavior in two Australian wildfires. I find the paper to be interesting, concise, and well-written. The scientific concepts are clearly presented, the methodology is described completely, and the conclusions are justified by the results. When the authors have addressed the mostly quite minor points details below, I feel the manuscript will be ready for publication.

Reply: We thank the AR for these comments. The reviewer has clearly cross-referenced our arguments with other literature, producing valuable feedback.

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Minor Points:

(We note that some of the details in our replies will need to vary when we incorporate the comments of all of the reviewers.)

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AR3: 1) Page 7272, line 6: First, it is not entirely clear which events are being referred to in this sentence. I can accept that events impacting the stratosphere are likely to be among the most extreme. However, I am not as certain that all “cases where interactions between strong winds and rugged topography resulted in rapid wildfire development” (from the previous paragraph) fall into this category. Please clarify.

AR3: Additionally, I’m not comfortable with the reference to a pyroconvective scale in this sentence. It could be interpreted as suggesting that a formal scale for pyroconvective activity exists in the literature, which is not the case.

Reply to both points: We acknowledge the ambiguity of the sentence and propose amending it. We also feel that in the absence of a formal scale, the second concern could be addressed by switching to “spectrum”.

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“PyroCb events such as those near Canberra in 2003 are at the most extreme end of the pyroconvective spectrum.”

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AR3: 2) Page 7272, line 15: I don’t agree that it is surprising, without a better defined context for the surprise. Strong Cb routinely penetrate the stratosphere, why should strong pyroCb be any different?

Reply: The reviewer has a perspective that we did not anticipate. We will amend and re-focus the sentence to read:

“While there is the possibility that additional pyroCbs have occurred in the past in association with significant bushfires that predate the technology necessary to formally detect them, this tabulation of pyroCb occurrence is informative both for the satellite and pre-satellite era. The recent frequency of pyroCb occurrence in Australia necessitates on-going monitoring and study.”

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AR3: 3) Page 7272, line 29: I question whether “blew up” is the appropriate terminology here. The discussion later in the manuscript indicates that the authors are well-acquainted with the imprecision associated with the use of “blow-up” both in the field and in the literature. For this reason, I feel the authors should be more precise here in how they echo Fromm et al.’s use of “blow-up” in reference to the development of a pyroCb (i.e. that Fromm et al. uses it in reference to the development of a very deep plume, without any direct discussion of associated fire behavior or changes in fire behavior).

Reply: We accept the reviewer’s concern. To address this we will amend the sentence to read:

“The so-called Grose Valley and Wollemi fires were notable due to the fact that their behaviour escalated quasi-simultaneously in the late morning, rather than in the late

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afternoon when this typically occurs (Fromm et al., 2010)."

To avoid confusion, we note that this refers to 7272L19.

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AR3: 4) Page 7272, line 26: I do not see where Fromm et al. 2012 stated that "the extreme fire behavior" in these two events needs to be further scrutinized. My reading suggests they proposed that the predictors of extreme fire behavior in general receive additional scrutiny. At several points in the discussion they indicated that extreme conditions occurred, but Fromm et al. 2012 never stated explicitly that these fires exhibited extreme fire behavior. As with "blow-up" above, "extreme fire behavior" is terminology that has been used very loosely in the past. Considering the recent efforts to more clearly define the criteria for "extreme fire behavior", I would prefer that the authors avoid this terminology when discussing these specific fires unless they wish to refer explicitly to the developing definition (see e.g. Synthesis of Knowledge of Extreme Fire Behavior: Volume I for Fire Managers by Werth et al.) and then establish that those conditions occurred in these events.

Reply: Again we value the reviewer's fresh perspective on our text. We proposed removing the ambiguity noted with the following changes to the text:

1) Amend the sentence beginning at 7272L24 to:

"They also noted that neither factor alone was deterministic, reflecting a general need to further scrutinise the local drivers of the extreme fire behaviour."

2) In the sentence beginning on 7271L10 replace "extreme" with "elevated".

3) The sentence starting at 7274L10 should end: "...predictor of raised fire intensity and energy release."

4) The sentence starting on 7277L21 will be amended to read: "The relative intensity of the spectral signals indicates that this lateral spread produced higher rates of energy

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release rates compared to those inferred from Fig. 3c, two and a half hours earlier.”

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AR3: 5) Page 7278, line 11-13: I do not see the “quantitative connection” here. Can we say from this data that a certain value or threshold indicative of “violent pyroconvective activity” is associated with a certain value or threshold indicative of “intense, lateral spread”? I don’t believe these results establish that association, and without it I don’t see how one can claim that a “quantitative connection” has been established.

Reply: Our responses to the previous reviewers on this sentence came up with:

“This establishes a compelling spatial and temporal connection between the intense, lateral spread associated with fire channelling and the violent pyroconvective activity detected by the radar. As stated by Finney and McAllister (2011), a large fire source will produce a plume which experiences less entrainment and is thus able to reach greater heights. This is consistent with the GV-N situation.”

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AR3: 6) Page 7278, line 17-18: I do not think “fully” or “certainly” are necessary in this sentence.

Reply: We will accept the reviewer’s point here and remove the two qualifiers from the sentence. It will read:

“The pattern of fire propagation depicted here is consistent with fire channelling and the terrain in this vicinity meets the criteria necessary for fire channelling occurrence (Sharples et al., 2012).”

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Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 2, 7269, 2014.

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