Response to Referee 2- Anonymous

General comments

The manuscript entitled “Evolution of an extreme Pyrocumulonimbus-driven wildfire event in Tasmania, Australia” provides an analysis of the extreme fire event in Tasmania of 4 January 2013. The temporal evolution of the PyroCb is assessed using weather radar data and is then analyzed together with the McArthur Forest Fire Danger Index (FFDI), the Continuous Haines Index (C-Haines) and fire severity maps. Overall, the presentation quality is good, the results are well described and discussed, and the manuscript covers a relevant topic that has been gaining increasing attention over the last years. As such I believe that a revised version of the manuscript will present a good contribution to the fire community.

My main concern is regarding section 3.2.1 analysis of large wildfires (>500 ha) in the context of FFDI and C-Haines. Reasoning only about the number of large fires in the FFDI/C-Haines domain (Figure 5) can be misleading since, for example, when comparing the number of large fires for FFDI >25 or <25, as the number of days with FFDI < 25 is much higher, the interpretation of the figure may be biased. I would suggest plotting the smaller fires in other colour and computing for each of the 4 regions (delimited by the dashed lines) in Figure 5, the fraction of fires exceeding 500 ha. Reasoning about the fraction of large fires may be more insightful for the discussion.

All the fires in the plot are >500 ha in size, irrespective of which region (of the 4) in the graph they fall. We have now differentiated the fires into different fire-size classes and represented them as different-sized dots, with larger dots in the graph corresponding to large fires sizes.

Fire size is used as a proxy for intensity, based on the assumption a large fire will contain some high intensity areas likely to spawn a pyroCb. There is evidence to suggest that pyroCb development is more likely when expansive flaming takes place (Badlan et al., 2017), so fire size will also relate to this aspect of development.

Badlan, R. L., Sharples, J. J., Evans, J. P., and McRae, R. H. D.: The role of deep flaming in violent pyroconvection, in: MODSIM 2017, 22nd International Congress on Modelling and Simulation. December 2017, edited by: Syme, G., Hatton MacDonald, D., Fulton, B. and Piantadosi, J. , Modelling and Simulation Society of Australia and New Zealand, 1090-1096, 2017.

Specific comments

L65: Is the range 0-13 correct? In Figure 4 the last class has a range of 12-14 and

Theoretically, there is no upper bound on C-Haines, but realistic values of the input variables restrict its range. Mills & McCaw (2010) have reported the maximum as ~13; Yeo *et al*., 2015 quote the upper bounds as 13.5 while Di Virgilio *et al.,* 2019 report values such as 13.7. In this study, gridded CH for the period 2007-2016 reached 12.63.

The text now reads: "The C-Haines index provides a measure of the potential for erratic fire behaviour, based on air temperature lapse and moisture content between two lower-tropospheric levels, and typically ranges from 0-13, although values above 13 are possible (Yeo et al., 2015; Di Virgilio et al., 2019)".

Yeo, C. S., J. D. Kepert, and R. Hicks. 2015. Fire danger indices: current limitations and a pathway to better indices., Bushfire & Natural Hazards CRC, Australia.

Di Virgilio, G., J. P. Evans, S. A. P. Blake, M. Armstrong, A. J. Dowdy, J. Sharples, and R. McRae. 2019. Climate Change Increases the Potential for Extreme Wildfires. *Geophys. Res. Lett.* **46**:8517-8526.

L367 refers values up to 13.7. See the above explanation.

L165: 2.3? Also, a few sentences explaining the intuition of the VLS could be helpful.
We have added the following sentence in that section:
"VLS is an atypical fire spread arising from the interaction between strong winds and terrain which creates lee-slope eddies that interact with the fire to cause lateral fire propagation, an increase in fire intensity and mass spotting downwind of the lateral spread zone".

Figure 3: What are the units for Max.height? It is in km. See the y-axis label that has perimeter, length and height in km.

L255: What is the actual proportion for the 3 groups? It's hard to tell just from the image.
The first isochrone contributed 10% of total area burnt across all vegetation types within the entire fire perimeter, while the peak fire period accounted for 46%, with the last period on 4 January contributing 9%. We have now included the following sentence:

"The isochrone leading up to the peak in fire behaviour accounted for 10 % of total area burnt across all vegetation types within the entire fire perimeter, the peak period contributed 46%, while the last isochrone on 4 January contributed 9 % of total area burnt (Fig. 3c)".

L265: The 0.5 correlation is for 1-day lag? No. Correlation has been computed without considering the lag between the two variables.

L282: It may be relevant to also comment on how extreme are these values regarding all days, for example, what percentile they correspond, 95, 99?
From the reanalysis data for the period 2007-2016, the Forcett-Dunalley fire represents 99th percentile of daily C-Haines and FFDI of all the days within that specific cell in Dunalley which had the highest daily FFDI. We have not computed the percentile of all days within the entire island of Tasmania because the climate is different all over the island.

The sentence now reads:
“The Forcett-Dunalley fire had amongst the highest levels of elevated fire weather (gridded FFDI and C-Haines of 68 and 11.5, respectively) of all the 77 large (>500 ha) Tasmanian fires that occurred between 2007-2016 (Fig. 5). These values represent the 99th percentile of daily FFDI and C-Haines for the grid cell in Dunalley that had the highest daily FFDI during the fire”.

L363: Is this true for all fires or for all large fires (>500 ha)? Yes. The Forcett-Dunalley fire had amongst the highest levels of elevated fire weather of all the large (>500 ha) Tasmanian fires (shown in Figure 3) between 2007-2016 and was the only event to have produced a pyroCb.