

## ***Interactive comment on “Biomass burning emissions in north Australia during the early dry season: an overview of the 2014 SAFIRED campaign” by Marc D. Mallet et al.***

**Anonymous Referee #3**

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Review for the paper: Biomass burning in north Australia: overview of the 2014 SAFIRED campaign.

This paper gives an overview of the SAFIRED2014 campaign in Northern Australia aimed at investigating biomass burning in an area that has very frequent burning but is clearly understudied. This paper suffers from the typical issues of overview papers, where there is a long introduction of instruments and methods, but no actual results. In this paper especially the last section “Outcomes of SAFIRED” is very long, includes short literature reviews, but teases at potential results and points to other related papers without giving any results. Overview papers clearly serve a purpose and should include four major points: 1) description of the science goals and how the campaign

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was designed to answer them, 2) a systematic description of the used instrumentation, 3) a big picture overview of the results and 4) a conclusion of how the campaign results are usable for answering the science question. This overview paper here describes most of the above points, but could benefit from some improvements and in particular would benefit from summarizing the results more systematically.

Specific Comments:

I think it would be helpful to actually list the specific science questions at the end of the introduction or in a new section before the instrument descriptions.

Instruments and Measurements

- The chapter 2.2 Instruments and Measurements should be made more consistent between the individual instrument descriptions and also misses some critical information. Most of the instrument detection methods are described well, but the most important information for all the measurements are missing. For each instrument description the following needs to be added: sensitivity (precision and accuracy), limit of detection, time resolution and used inlet. A table should be added that lists all of these instrument parameters and also a reference to the technique.

- The Radon instrument description also includes a summary of how Radon measurements are used in atmospheric research. This is not appropriate here and should be moved to the results section around page 21.

- The chapter Aerosols should be numbered consistently with 2.2.2

Fires and Air Masses

- What I was mostly missing in this chapter was putting SAFIRED into the bigger picture of fire emissions in Australia, e.g.: how representative is SAFIRED, was this a typical year and what could SAFIRED potentially tell us about emission estimates in northern Australia. How many fires did you observe during SAFIRED? How many of those measured plumes were fresh (for emission ratios) and how many were aged?

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- Figure 4: The data here are split into weak moderate and strong mixing, but nothing is really done with this separation later. Also the differences are not very strong. In the next Figure and the rest of the manuscript the data get separated into different BB and costal periods. This seems a better separation. I suggest removing the mixing categories. I am also wondering how the wind direction plot looks for the Coastal Period. This would be more helpful for a separation.

- Figure 4c y-axis should go from 0-360.

- page 24 line 473: What are the criteria used to separate the data into these periods? The separation seems very arbitrary to me, especially what is the difference between BBP2 and BBP3. Also the coastal period has large CO mixing ratios and very similar O<sub>3</sub>/CO ratios as BBP3. Please explain in more detail what is difference between the periods and how you define BBP. Are these by CO or acetonitrile enhancements, back trajectories, or fire counts?

- diurnal trend e.g.: page24 line 470-471: The authors argue here and in other places that the diurnal variations are caused by the mixing height. This is probably right, but no actual evidence is presented. The wind direction changes as can be seen clearly in Figure 4. Looking only at the time series in Figures 5 and 6 one cannot judge, if the diurnal changes align with wind direction change or more with the Radon profile. A diurnal profile of some trace gases and aerosol species should be added. I would also like to see that separated for the different BBP and CP.

- Figures 5 and 8. It would be good to also show the CO data on a linear scale.

#### Close Proximity Fires versus Aged Fires

- On several places on pages 27-30 the age of fire plumes are discussed in rather vague terms sometimes using organic aerosol or size distributions as chemical indicator in addition to the fire locations. To show photochemical aging the most commonly used way is to look at ratios of a short lived tracer to an inert tracer on the time scale

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of the transport. Ratios of some of the VOC measurements versus CO or acetonitrile would be best used to show aging, most commonly used are aromatic species, benzene for longer time scales, toluene or larger aromatics for shorter time scales. Enhancement ratios of fresh fires seem to be available from the "close proximity fires" or nighttime fire plumes, although I have my doubts about how close those fires were, as I will describe below. Fires in the region are relatively similar and the emission ratios should therefore also be similar enough to distinguish between fresh plumes and plumes transported over 200-300km to the site using VOC/CO ratios. I would suggest replacing all the vague discussions about plume age with adequate VOC/CO enhancement ratios.

- O<sub>3</sub>/CO ratios: The O<sub>3</sub>/CO is used in Figures 5 and 8 and is described as giving an indication of photochemical age. Unfortunately O<sub>3</sub>/CO are much more complicated than that and depend on many different factors such as VOC/NO<sub>x</sub> ratios such that the ratio really cannot be used as "photochemical age". I think for this paper here, it is best to remove the O<sub>3</sub>/CO ratios instead of adding a proper explanation.

- The ozone enhancement shown in Figure 8 for the close proximity fire is substantial and ozone values of almost 100ppb are detected in the plume. This means that there has been significant photochemical processing of potentially several hours during plume transport. If the plume would be really fresh, ozone would actually be titrated. Again VOC/CO could be very helpful here and should be looked into. Also a comparison to a nighttime plume measurement would be very useful. Again, I doubt that this plume is very fresh.

#### Outcomes of SAFIRED

The paper is rather long in its current form and in particular this chapter is more of a literature review, of what could potentially be done with the specific measurement. I actually think this is not appropriate for an overview paper and would be more appropriately discussed in the detailed follow-up papers. I suggest deleting this whole section

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and just briefly mentioning the potential major outcomes in the “Looking Forward” section.

The picture quality of all Figures needs to be improved.

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