

Interactive comment on “First results of the Piton de la Fournaise STRAP 2015 experiment: multidisciplinary tracking of a volcanic gas and aerosol plume” by Pierre Tulet et al.

Anonymous Referee #2

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This article presents results from multi-disciplinary observation of volcanic plumes during five eruptive episodes in 2014-2015. There is no doubt that this is an excellent dataset with the potential to aid our understanding of plume development. In particular, the potential of the distant (Maido station) measurements for parameterising nucleation in the plume is exciting.

My main comment about this study is that I found it hard to follow – the introduction to the paper is verbose and discusses the motivation for the whole STRAP project rather than that specifically relevant to the results presented here. The results are separated out into separate sections that also describe methodological considerations for each method. Synthesis and comparison of the different results is not introduced until the

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conclusions, and is then very brief.

On page 17, line 16 (conclusions) the authors write that “The purpose of this article was twofold: (i) to present the methodological approach developed to track plume evolution from source to the distal area, and (ii) to summarize the preliminary observations of gaseous emissions, plume location, height and dispersion and gas-particle conversion” This would be a much clearer structure than the outline followed from page 3 lines 19-32 and currently followed. My suggestion is that the article is restructured on the following basis:

- 1) The introduction could be shortened and made more relevant to the results presented here, e.g., on page 3 lines 9 -19 are dominated by affiliations of the co-authors and some other information that could be in the acknowledgements; section 3.1 is long and could be condensed into an introduction to the more relevant material in section 3.2.
- 2) The methods of the STRAP experiment, for which results are presented in this article, should be outlined in a methods sections. This should include a clear account of the temporal coverage of the observations that are being presented here (e.g., in a table or figure) It would help the article’s readability if methods were clearly linked to the stated goal of tracking plume evolution from source to distal area.
- 3) The results should be described in a separate section and could be subdivided into (1) a presentation of preliminary observations of plume properties with clear reference to figures and (2) a synthesis of measurements relevant to understanding plume evolution. At present some of the results are well represented by figures, while others are described but not shown.
- 4) Discussion and conclusions should place the new observations made from measurements presented in this paper into context of past studies at Piton de la Fournaise and other volcanoes.

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Line by line comments:

Abstract: line 5 – do measurements span 85 days in total? Does this include gaps in activity? Line 11 – 'a particular emphasis is placed on...' this is an ambiguous phrase. Do you mean that this is a particularly interesting result? How do the SO₂, CO₂ & H₂O levels compare to past measurements/periods of activity. What are the implications for plume interaction with the atmosphere? Are there implications for understanding the development of the eruption (e.g., from increase in SO₂ at end of phase referred to later?)

I understand from Section 3.2 that observations from 20th June 2014 to October 2015 are presented in the paper, but from the Figures (Especially 12 and 13) it looks like data were only acquired in 2015 (the abstract refers to 85 days of measurements and from page 3 line 28 (and figures) it sounds like only the climatology for two eruptions is described). Overall I found it difficult to get my head around the differences in temporal coverage of all the different measurement types – I suggest that the authors include a table, or perhaps a figure, to compare the duration and temporal coverage of each type of observation.

Page 2 line 7-8. Use of 'on one side', 'on the other side' is confusing – these are not opposing ideas? Page 2 line 18. Please add reference for impossibility of obtaining source parameters at Eyja? Page 2 line 31: 'an objective' - is this the particular aim of this work? The following sentence refers to real-time measurement, which I think is not necessary for these goals. page 3, line 5: I don't think this is true. The Boulon 2011 paper does not include measurements made within a volcanic plume. And there are certainly other earlier studies that present measurements of aerosol within volcanic plumes (e.g., Mather et al., 2004; Rose et al., 2006; Martin et al., 2008). Although it provides no information about nucleation mechanism Ebmeier et al., 2014 also shows that there is elevated aerosol and depressed cloud droplet size downwind of PdIF in satellite retrievals averaged over a decade (and a greater effect for periods of eruption). It would be interesting to know how these course observations compare to your much

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more detailed multi-sensor measurements. Page 4, line 2: 'unique and craggy' is uninformative, 'benefits from a tropical climate softened by the breezes of the Indian Ocean' is also rather informal in style. Section 2.2 title: 'means'=methods? Page 4 line 19: what kind of imagery? Photographs? Figure 1: Resolution appears to be quite low for the size of Figure. Caption: Page 5 line 20 range of dates is surprisingly precise page 10 line 10: I'm not sure that this is an acceleration? Page 17 line 21 – where are these geometries shown? Page 18 line 10 → rugged? Conclusions: Comparison to the previous level of knowledge about the PdIF plume would be useful here - both to place your results in context and help the reader appreciate the level of advance in knowledge offered by such an integrated multi-methodological approach.

Through the article there are English phrases that are ambiguous and some rather awkward constructions. I suggest that English language proof reading would help the final version of this article.

References:

Martin, R. S., et al. "Composition resolved size distributions of volcanic aerosols in the Mt. Etna plumes." *Journal of Geophysical Research: Atmospheres* 113.D17 (2008).

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