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**Interactive
comment**

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 #3

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This interesting paper represents a large amount of coordinated work with the aim of tracking plume evolution from the vent to downwind areas. It reports observed plume characteristics as measured by multiple techniques. This information will contribute to our understanding of plume dynamics and has relevance for local forecasts and global models.

General and specific comments:

1. This paper would benefit from reorganization with an aim toward concise communication of the study objectives, methods, results, and interpretation. Study objectives are stated a few times throughout the paper with slightly different levels of detail and emphasis (e.g. p.,3 L19-25, p.2 L31-33, P. 17 L17-19). A careful content and english

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[Discussion paper]

language edit would help cut down on redundancy, and tighten up the narrative. Attention to consistent use of language, terms, and nomenclatures through the different sections would help the readability. Decide on one spelling for sulfur versus Sulphur, for a single date format, etc. The paper is interesting and exciting, but is hard to digest in its current format. The introduction could be condensed, as there is extraneous information.

2. Gas section (section 5) and references to gas measurements. The plots and interpretation in this section could use some revision and clarification.

a. In plot 6, I don't see the pulse of SO2 observed at the end of phase 1 (noted in the section text and conclusions). Since Novac data can have strong anomalies due to atmospheric effects, wind, etc., it would be good to corroborate the novac data with emission rates from the mobile DOAS from Sept. 7, 11, 18 to confirm your observation. Plotting all the mobile data on figure 6 seems important.

b. It seems that the data in fig. 6 plot would be much easier to see if it were a scatter plot rather than column plot. E.g. in conclusions "During most of the eruption, SO2 fluxes have been lower than 1.5-2 kt day-1." It is actually hard to see that the red columns are in that range because of the error bars, which focus your eye on the max error bar value rather than the data points. Or is there some other reason you have it as a column plot?

c. Figure 6. caption: 'The uncertainty comes from the spectroscopic retrieval, radiative transfer, wind direction and speed, and plume height. This uncertainty is used in the computation of the daily mean values as presented in Figure 5.' Can you explain how this was done? Both the calculation of the uncertainty, and how it is used to calculate the daily mean values? Or send readers to a reference, if it is published elsewhere?

d. Fig. 7 –

i. The labeling/notations on the 2 FLIR images are inconsistent with each other, and

would be better if they were similar (e.g. you might have a single box for the max pixels in the image like for the bottom left image)

ii. Can you say something about the FLIR images, rather than just present them? Are they included to emphasize the less vigorous eruption during May as compared to august? Or is there another point you are wanting them to demonstrate?

iii. The Photo beneath the multi-gas plots detracts from the data plot, and should either stand on its own if you feel it is showing something of importance, or remove it. The plot axis labels cannot be read easily on the multigas plots, and need to be increased in size, and the plots presented in a larger format. Can you explain the trend in the different species, and if you think the concentrations make sense based on the plume traverse? e.g. Should the SO_2 and CO_2 anomalies be better correlated if they are from the plume, or are the instrument response times contributing to the lack of coincidence of peaks? Might you plot the C/S and H_2O/CO_2 that are described in the text? It is hard to take away anything from these plots in the current presentation.

iv. Are there some interesting differences in the multi-gas data for the 2 different eruption regimes (may versus august-oct)? might you show the data more clearly and completely since the text emphasizes this gas data?

v. Important to add emission rate for the SO_2 column amount profile plot. While this profile is interesting for people familiar with the technique, a plot of the mobile doas emission rates for the long eruption seems important in addition to this column amount plot.

3. Conclusions

a. The discussion of the preliminary data, and the relationship of the various data sets to each other, deserves its own section.

b. The emission rates for CO_2 and H_2O are not reported in the paper, although it is referred to in the conclusion. It seems a table with the reported values scattered through-

out the paper, and repeated in the conclusions could help the reader (gas emission rate data, Lidar coefficients, LR, particle numbers, etc.). I think such a table could be useful for others looking into plume dispersion and chemistry at their own volcanoes.

4. References – since you refer to radiative transfer a couple of times in the paper, it would be good to add a reference. Kern, C. et. al, 2012 (or other).

Minor comments:

1. It would be helpful for the maps to have a N arrow and a scale

2. Since you are reporting SO_2 to 1 ppb, you might want to state the sensitivity and resolution of the pulse fluorescence SO_2 analyzer.

3. p. 14 L 16-18. Your use of the terms 'course' and 'fine' to describe your particle size cut is unconventional for most of us who think of fine particles as PM2.5. Could you quality your description with a caveat like 'course particles as defined in this study'? Or use some other term to refer to the two size fractions you are discussing?

4. P. 14 L22. Figure 10 suggests SO_2 is west of the vent, so the text is confusing since it states 'east'.

5. P. 14, L33. Do you mean 'volcanic aerosol-free air masses'? Otherwise, it is confusing – since particle size distribution in aerosol-free air masses doesn't make sense.

6. The red text on figure 1 is not legible. Can you use a color that more strongly contrasts, and with better resolution?

7. P. 16 L 7-8. Can you reorganize this sentence so that it is clearer? You could start the sentence with 'Examples of the evolution. . . .' And omit the first 5 words.

8. Figure 2. Might you Label the contour lines with elevation, for people not familiar with the topography? Fig.1 helps, but you could help your reader out by labeling it in fig. 2.

9. P. 16 L21-22. The wording of this sentence is unclear as you seem to be calling the sulphuric acid the precursor gas.

10. Can you mention the double maxima modeled in fig 9 bottom left in the final sentence of section 6? Or is it explained somewhere else? What might cause that?

11. For plots, state in captions or axis label if altitude is agl or asl

12. Is the 6.8 kt/d SO2 data point noted in the conclusion (and in the earlier text) on the plot?

Technical comments:

1. Identify acronyms with first use. While some sections do a good job of this, the Introduction needs attention. The subsequent sections don't have to repeat it, but watch for how the different authors use the acronyms so there is consistency throughout the paper. P. 15: ASQUA, ACTRIS – are these defined somewhere?

2. L26 p.3 –Do you mean topography rather than morphology?

3. L14-15 p. 4 – suggest revision of sentence: The Observatoire Volcanologique du Piton de la Fournaise (OVPF/IPGP) manages the monitoring networks on the island, allowing the observatory to follow eruptive and specific volcanic events, and to describe their time and space evolution.

4. L 17 p. 4- replace Internationals with International

5. P. 12-13, look carefully at the use of the word 'aerosols' versus 'aerosol' in this section.

6. P. 13 – both UTC and local time are provided in the discussion which is helpful. Consider doing this in key sections where you are describing a process that is dependent on diurnal orographic meteorology.

7. Global replace of 'pick up' with pick-up or 'pick-up truck'

8. Caption for fig. 10 – recommend clarifying sentence 2. "The flight path is coloured as a function of the measured..."

9. P.16 L26. This sentence needs to be clarified. '...because it depends whether the volcanic plume arrives at the station.' Do you mean it depends on 'when' it arrives? Or 'when and if' it arrives?

10. P. 16 L33-34. This sentence needs reorganization and grammar corrections.

11. P. 17 L2-4. This sentence needs to be rewritten, as it is very hard to follow.

12. Global replace 'researches' with 'research'

13. Figure 14. It would be kind to your readers to label the DMPS and AIS panels more clearly. Also, might want to make scale label and caption consistent (chose either cm-3 or #/cm)

14. Alternate wording suggestions have been included in a pdf version of the manuscript for many technical issues, but will not take the place of a thorough English language edit.

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/acp-2016-865/acp-2016-865-RC3-supplement.pdf

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-865, 2016.