Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2019-100-RC2, 2019

Atmospheric Chemistry and Physics Discussions

Interactive comment on "New particle formation in the active volcanic plume of the Piton de la Fournaise: specific features from a long-term dataset" *by* Clémence Rose et al.

Anonymous Referee #2

Received and published: 24 April 2019

This paper deals with an important, yet very little-studied, topic: new particle formation (NPF) in a volcanic plume. Therefore, the paper can be considered highly relevant and also original. The conducted analysis is mostly scientifically sound, and text is relatively well written. I have a few comments that should be addressed before I can recommend the acceptance of this paper for publication.

Main scientific issues

Section 2.2. The authors should discuss briefly the uncertainties and limitations of the equations 1 to 4 in calculating the particle formation (J) and growth (GR) rates in their data. First, these equations have been developed originally for regional NPF, in which

formation and growth of particles is assumed to take place relatively homogeneously over large spatial scales. This is apparently not the case in plumes where, among other things, various transport effects on J and GR should be taken into account. Second, experimental limitations cause further uncertainties in determining J and GR. For example, using coagulation sink at 12 nm for all particles in the size range 12-19 nm in equation 1 causes some overestimation of coagulation losses, which results in underestimating J12. Also, Calculating J2 from J12 would require knowing GR in the size range 2-12 nm rather than that in the size range 12-19 nm. While it is impossible to take into account the above issues to correct the data, the authors should at the very least discuss these issues briefly in section 2.2. If possible, the authors could also estimate whether resulting uncertainties are important or not with respect to their results.

Section 3.2.2. In this work, neither J2 nor H2SO4 concentration were measured directly, but were derived from other measured quantities, resulting in potentially large uncertainties in their values. This has implications which are not mentioned in the paper. First, how reliable is the observed relation between J2 and H2SO4 concentration, and how meaningful is it to compare this relation with those observed in studies were J and H2SO4 concentration were measured directly? Second, how meaningful is it compare J obtained here with parameterized J due to binary water-sulfuric acid nucleation as a function of H2SO4 concentration? Does this comparison tell anything about nucleation mechanism?

There are a few issues related to the particle growth that need some clarifications. First, did the authors consider particle growth from one mode to another when estimating the relative contributions of primary and secondary particles in each mode? This remains a bit unclear when reading the results. Second, the authors do not tell what were the typical air mass transport times from the volcano to the measurement site. This is important because for the reported particle growth rates (Fig. 2a), it takes a while before particles formed in the plume are able to growth into the Aitken mode, and for several hours before they can reach the minimum CCN size (assumed >50 nm here) or the accumulation mode. Is it feasible that particle formed by NPF in the volcanic plume reach these sizes by the time measurements were conducted? Third, while I agree with the authors that volcanic emissions are able to boost particle growth by e.g. heterogenous reactions of SO2 on particle surfaces, there seems to be some inconsistences in the storyline: on one hand the authors state that the plume appear not to influence the particle growth (section 3.1.3), and on the other hand they state that particle growth in the plume increased both modal (section 3.3.1) and CCN (section 3.3.2) concentrations.

Minor/technical issues

Page 7, line 4: "...when global radiation >50 ...". Something is missing from here (was?).

The format of providing the time difference (i.e. 2h10) in section 3.1.2 seems strange to me. Is this a correct way of expressing the time difference?

Page 10, line 2: "GR12-19 showed an important variability, ...". What do the authors mean by "important" here?

Exclusing the last paragraph of section 4, the text in that section mainly summarizes the results discussed eaerlier in the paper. As a results, an appropriate title of this section would be "4. Summary and Conclusions".

Would it be possible to change the lines and marks with yellow color in Figures into some other, more easily visible color?

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