

Atmos. Chem. Phys. Discuss., referee comment RC1  
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## Comment on acp-2021-282

Anonymous Referee #1

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Referee comment on "Zeppelin-led study on the onset of new particle formation in the planetary boundary layer" by Janne Lampilahti et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-282-RC1>, 2021

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This paper presents measurements of new particle formation above ground using a Zeppelin in two different environments in Europe, in northern Italy and in Finland. This is an excellent set of measurements demonstrating that these events take place uniformly in the boundary layer in both locations. The paper is well written and should be published after the authors address the following issues.

### Major issues

- (1) The major weakness of the paper is that it does not even mention the results of the other Zeppelin flights and the ground measurements during the two campaigns. I do appreciate the in depth analysis of the case studies, but it is not clear if they represent what happens most of the time in these two areas or if they are very special days. I think a section summarizing the results of all flights and their similarities (or differences) with the case studies discussed is needed.
- (2) Despite the presence of relatively high levels of sulfuric acid in the residual layer above the Po Valley there was no NPF there (Figure 4c). This is an interesting observation that deserves some discussion and discussion. I understand that the Zeppelin was not measuring the concentrations of gas-phase pollutant during this flight but my understanding is that the authors have some measurements during other flights in the campaign. What was different in the RL? They suggest that may be there was not enough ammonia there. However, the presence or lack of VOCs is probably worth some discussion using the observations of VOCs in that region during other flights in the campaign.
- (3) I was surprised by the measured spatial extent of NPF in Hyytiala. According to the measurements it is taking place in a relatively narrow area of 30-40 km around the station and not over scales of 100s of kilometers as it has been sometimes assumed. However, there is little discussion of what is happening in this relatively narrow corridor that leads to NPF and what is missing outside it and NPF is not happening. To be more provocative are all of these NPF observations over the years in Hyytiala referring to something that is quite limited in space and covers only a small fraction of the boreal forest?
- (4) There is little discussion of the measurements of the composition of the smallest particles during these flights.

**Minor points**

(5) I had some difficulty with Figure 3b (SO<sub>2</sub> in Hyytiälä) and Figure 3c (CS in Hyytiälä) until I realized that the y-axis includes negative concentrations. I strongly suggest starting these axes from zero. Also does the N axis in Figure 3c start from zero or from another value?

(6) The legend of Figure 3 should mention that these are ground measurements.