

Atmos. Chem. Phys. Discuss., referee comment RC1
<https://doi.org/10.5194/acp-2021-994-RC1>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on acp-2021-994

Anonymous Referee #1

Referee comment on "Diurnal evolution of negative atmospheric ions above the boreal forest: from ground level to the free troposphere" by Lisa J. Beck et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-994-RC1>, 2022

Summary:

The authors measured negative atmospheric ions above the SMEAR II boreal forest site from a novel aircraft platform. Level flight legs were performed in the stable boundary layer, residual layer, mixed layer, and free troposphere at various times of day across several weeks. The measurements illustrate the evolution of negative ions in the atmosphere as the boundary layer rises. Ion composition is variable between different layers on each day, and variable within each layer across different days due to changes in air mass history. I found this paper to be very clearly written and depicted, and it is a useful contribution to the knowledge of atmospheric ions and their impacts on new particle formation. I have just a few minor comments below, and recommend publication in ACP.

Comments:

Line 176: Can you provide more details here for readers who may be unfamiliar with sampling with an API-TOF, e.g., are ion transmission rates of ~1% normal? How do your transmission rates compare with previous field measurements of ions, or with the ground measurements at the SMEAR II site?

Line 220: When the flight setup was operated in the tower, did it include the same sliding inlet system to see if the inlet contributed to any differences between instruments?

Line 374: You are saying the FT air had marine origin in both morning and afternoon flights on 2 May 2017. You justify this as the reason for measuring halogenated compounds in the morning and MSA in the afternoon. Do you have any thoughts on why the halogenated compounds were not present in the afternoon and MSA was not present in the morning? Is this a result of charge transfer, as you discuss later on (e.g. line 438), or something else?

Line 478: I wonder if you find any correlation between ground level monoterpene concentrations and/or ozone concentrations with HOM in the SBL. Maybe there is a way to explain some of the slight variations in HOM across different days. Were there monoterpene measurements at SMEAR II during these times?

Fig S2: Can you color by altitude? That would help make the plot clearer I think.

General comment: This paper focuses mainly on presenting the data, and it would be even more useful if you could expand upon what these results mean for atmospheric processes that depend on ions. For instance, what does the variable distribution of negative ions mean for the likelihood of NPF in each different layer of the atmosphere? Is NPF favored by the ions found in the boundary layer and mixed layer, or disfavored by the lack of HOM in the free troposphere? Please expand somewhere, perhaps in the conclusions section, even if it is to clarify that not enough is known yet about what role each subclass of ions ultimately plays in NPF.