Dear Authors,

thanks for the revised version. You have addressed the referee comments very well!

I have few additional minor comments for the manuscript at this stage. Please see the list below.

Tuukka Petäjä

We would like to thank the editor for valuable and constructive comments and suggestions. Our point-by-point responses to the editor's comments have been provided below.

Editor comments to Park et al. (2023) New particle formation leads to enhanced cloud condensation nuclei concentrations in Antarctic Peninsula

Abstract:

line 23: Regarding the the spatial scale, please shortly describe, how you reacted the value of 155 km for the scale.

Response: As suggested by editor, we described the information on how to estimate the value of 155 km to the abstract.

Page 1, Line 22: "We estimated the spatial scale of NPF by multiplying the time during which a distinct nucleation mode can be observed at the sampling site by the locally measured wind speed."

Sect 2.2:

line 194 onwards. BC concentration represented with a maximum of 6 significant figures. Not realistic. Please correct the mean concentrations and standard deviations to a reasonable accuracy.

Response: We corrected the mean concentrations and standard deviations as follows.

Page 8, Line 195: "Of the total time period assessed, pristine air conditions represented 30% (mean value of BC: 6 ± 6 ng m^{-3}), clean for 44% (mean value of BC: 30 ± 10 ng m^{-3}), lightly polluted 19% (mean value of BC: 69 ± 14 ng m^{-3}), moderately polluted 6% (mean value of BC: 150 ± 47 ng m^{-3}), polluted 1% (mean value of BC: 499 ± 174 ng m^{-3}), and extremely polluted less than 1% (mean value of BC: 1537 ± 595 ng m^{-3})."

Sect 2.3:

The size distribution is measured until 300 nm. Do you consider the larger sizes to contribute to the CS? How about the supermicron aerosol particles?

Response: We did not consider the contribution of particles larger than 300 nm to the CS. In the future, we will investigate the impact of larger size particles on CS by measuring the number size distribution of supermicron aerosol particles.

Sect 3.2.3:

line 428: ... observed grown mode... Please improve the sentence.

Response: Thank you for pointing this out. Based on the editor's comments, the sentence was rewritten as given below.

Page 17, Line 432: "This suggests that the actual formation and growth occurred during daylight hours upwind from measurement location, but very slow growth continued over the Antarctic Peninsula allowing the detection of observed grown mode at ~ 7 nm after the sunset."

Sect 3.3.1:
line 463 .. were the highest...

Response: Based on the editor's comments, the sentence was modified as given below.

Page 18, Line 469: "There was no difference in the median value in solar radiation, while the median values for chlorophyll exposure and DMSP exposure were higher in air masses originating from the ocean than in air masses originating from the sea ice."

Sect 3.3.2:

line 469: ... were the highest...

Response: Based on the editor's comments, the sentence was modified as given below.

Page 19, Line 477: "The chlorophyll exposure and DMSP exposure during marine NPF events were higher than those during sea ice NPF events"

line 480: Please clarify the sentence starting "Although sea-ice algae...". I don't see the connection between the satellite not being able to detect the biological activity and the fact that the exposure (based on trajectories?) was lower.

Response: Sea ice algae are microscopic algae that grow within and beneath sea ice in polar regions. These organisms are an essential part of the polar marine ecosystem and play a crucial role in the food web. However, satellites are not typically used to directly measure the biomass of sea ice algae because satellite sensors cannot penetrate through thick layers of sea ice to directly measure the biomass of algae beneath it (Lee et al., 2015; Lange et al., 2017). Thus, calculated chlorophyll exposures (i.e., satellite-estimates of biological activity) cannot account for the biological activities thriving within and beneath of the sea ice. To clarify this issue, we added the information in experimental section (section 2.4) and the sentence was modified as given below.

Page 10, Line 253: "However, satellites are not typically used to directly measure the biomass of sea ice algae because satellite sensors cannot penetrate through thick layers of sea ice to directly measure the biomass of algae beneath it (Lee et al., 2015; Lange et al., 2017). Thus, calculated chlorophyll exposures (i.e., satellite-estimates of biological activity) cannot account for the biological activities thriving within and beneath of the sea ice."

Page 19, Line 488: "The air mass exposure to chlorophyll and DMSP for sea-ice NPF events were 1.8 and 2.7 times lower than those of marine NPF events."

line 503: Please clarify the connection between the higher halogen concentrations and the frozen iodine containing solutions. The last sentence is not well connected to the rest of the paragraph.

Response: We agree with editor's comments. The sentence was removed in the manuscript.

line 513: ... sources of precursor gases leading to NPF.

Response: According to the editor's comments, the sentence was improved as given below.

Page 20, Line 519: "seabird colony emissions are the likely sources of precursor gases to NPF (e.g., ammonia and amine) (Quéléver et al., 2022)."

Sect 3.3.3:

line 553: We newly calculated... Please refrase.

Response: We provided percentage values for the increase of CCN concentrations during NPF event and compared them between each air mass origin in Line 555. The CCN increase rate is not relevant to the scope of the present study. Thus, the sentence was removed.

line 555: CCN rate?

Response: As mentioned above, the sentence was removed.

line 578: No need to have the color indicated in the main text.

Response: It was removed.

line 580-583: The percentage with 4 significant figures is too much. Please round the percentages to more reasonable values.

Response: It was corrected.

Table 1: please add the information of the measurement location and the time to the table caption.

Response: We added the information according to the editor's comments.

Table 1 and elsewhere: The SI abbreviation for second is s. Please correct here and throughout the paper

Response: It was corrected throughout the manuscript.

Figures 6,7,8: please label the subplots a,b,c,d, etc and refer in the figure caption.
Selecting a different color palette to the size distribution data would allow better readability.

Response: We added the subplots for the Figures and changed the color palette to the size distribution data.

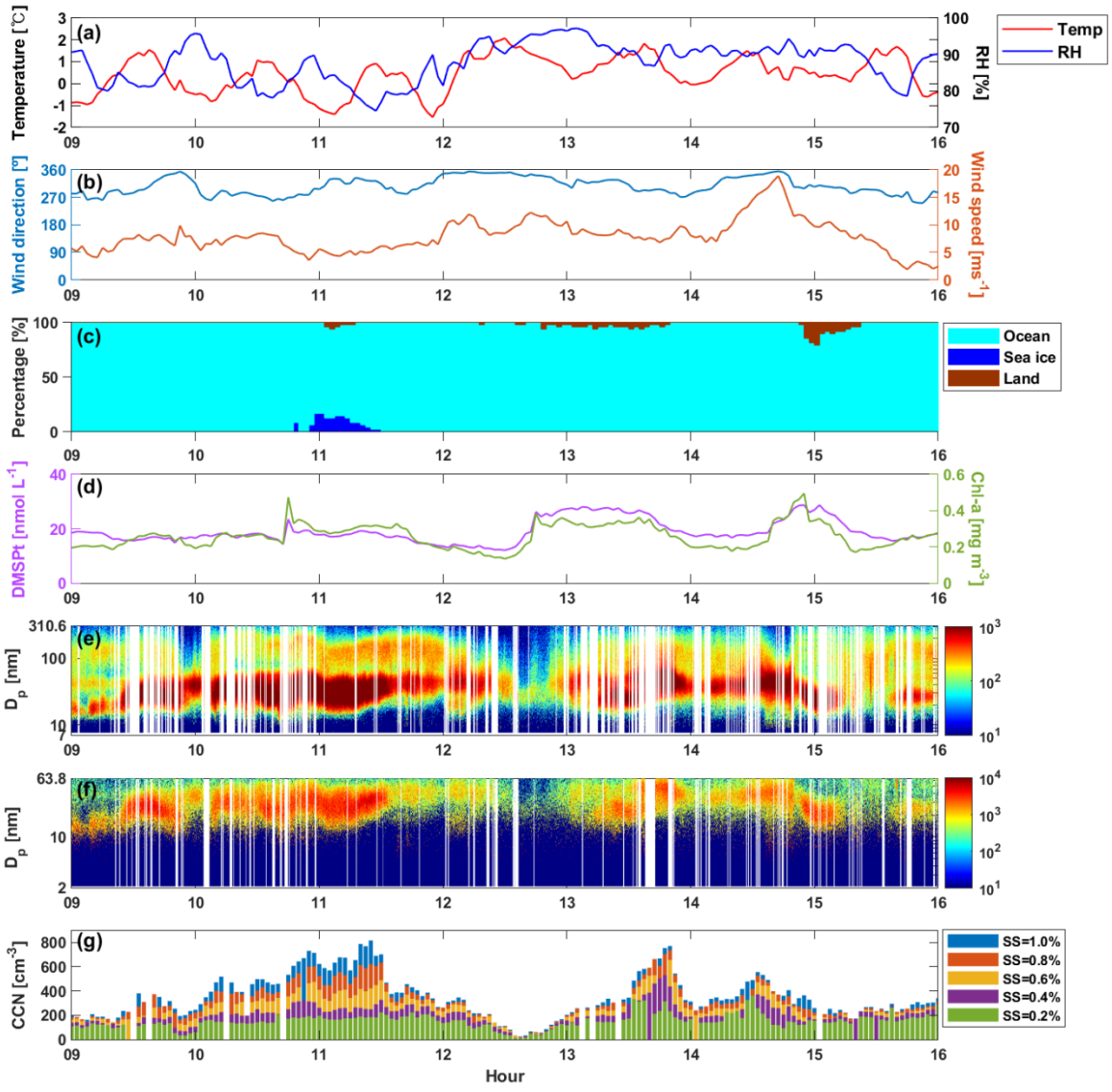

Figure 6. Marine NPF event observed from December 9–15, 2018. (a–b) meteorological variables, (c) the residence time of air masses that passed over the ocean, sea ice and land areas, (d) total DMSP and chlorophyll exposures, (e–f) number size distribution with the standard-SMPS and nano-SMPS, and (g) CCN number concentration. The x-axis represents local time.

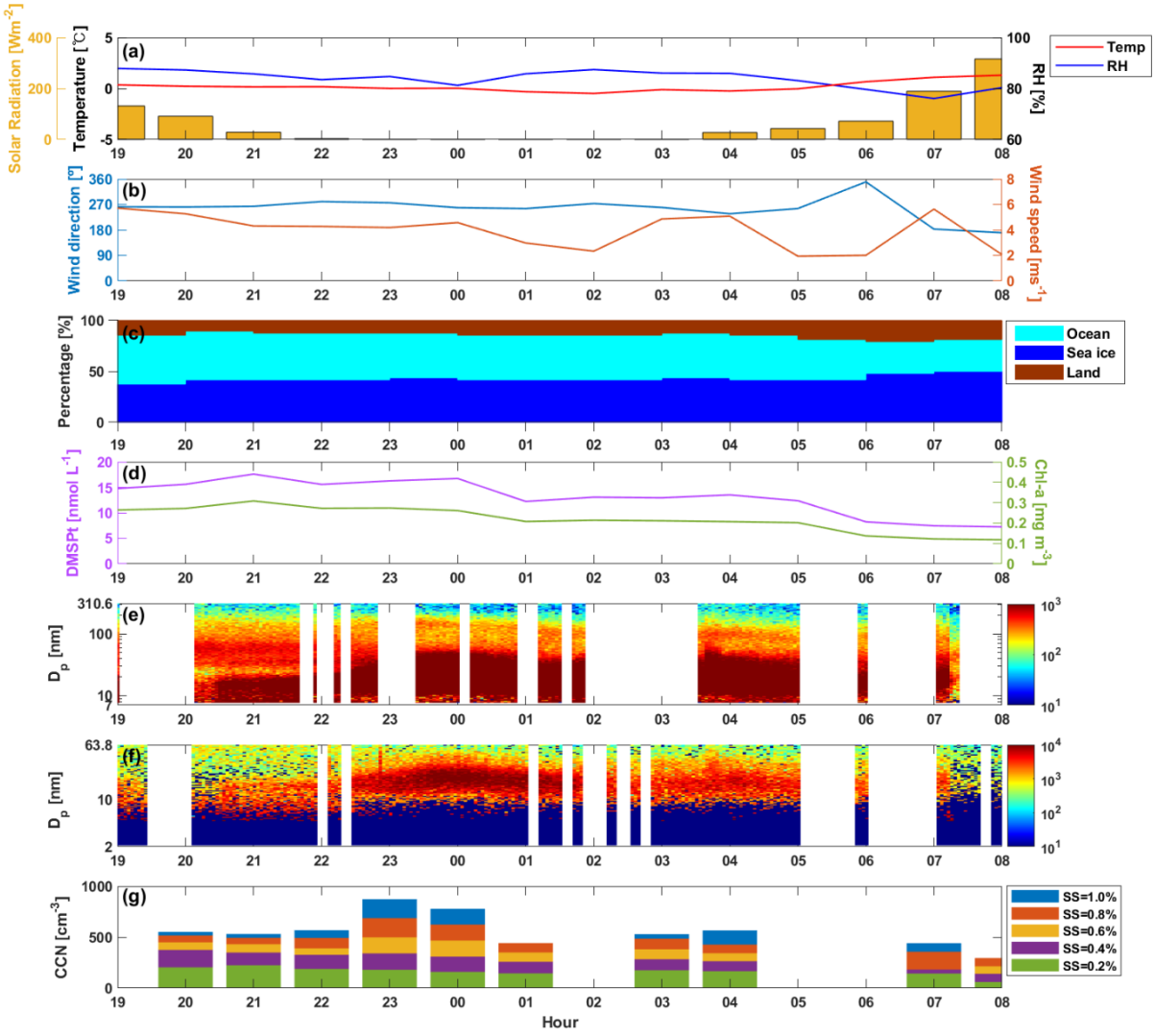

Figure 7. Sea ice NPF event observed from January 13–14, 2018. (a–b) meteorological variables, (c) the residence time of air masses that passed over the ocean, sea ice and land areas, (d) total DMSP and chlorophyll exposures, (e–f) number size distribution with the standard-SMPS and nano-SMPS, and (g) CCN number concentration. The x-axis represents local time.

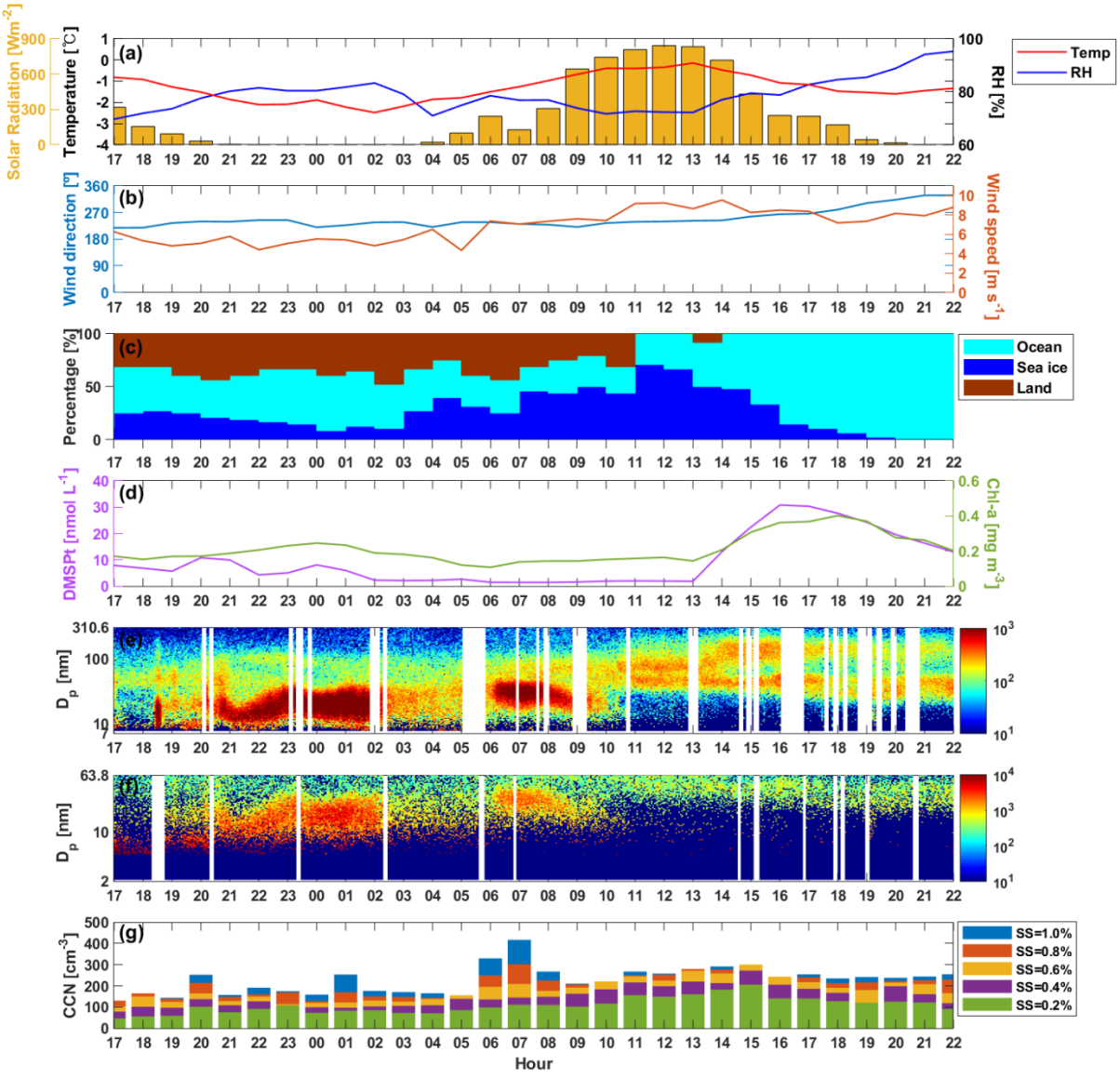

Figure 8. Multiple NPF event observed from November 16–17, 2018. (a–b) meteorological variables, (c) the residence time of air masses that passed over the ocean, sea ice and land areas, (d) total DMSP and chlorophyll exposures, (e–f) number size distribution with the standard-SMPS and nano-SMPS, and (g) CCN number concentration. The x-axis represents local time.

References

Lee, Y.J., Matrai, P.A., Friedrichs, M.A., Saba, V.S., Antoine, D., Ardyna, M., Asanuma, I., Babin, M., Bélanger, S., and Benoît-Gagné, M.: An assessment of phytoplankton primary productivity in the Arctic Ocean from satellite ocean color/in situ chlorophyll-a based models, J. Geophys. Res., 120, 6508–6541, doi: 10.1002/2015JC011018, 2015.

Lange, B. A., Katlein, C., Castellani, G., Fernández-Méndez, M., Nicolaus, M., Peeken, I., and Flores, H.: Characterizing spatial variability of ice algal chlorophyll a and net primary production between sea ice habitats using horizontal profiling platforms, Front. in Mar. Sci., 4, 349, 2017.