

Review of “**Relationships between particles, cloud condensation nuclei and cloud droplet activation during the third Pallas Cloud Experiment**”

Anttila et al. (2012) ACPD

In this article, results from the third Pallas Cloud Experiment are described including relationships between aerosol properties, cloud condensation nuclei (CCN), and cloud droplet number concentration (CDNC). During cloudy periods, the CDNC is linearly correlated with the number of particles with diameters > 100 and CCN concentration at 0.4% supersaturation. In addition to observations, a numerical model determined that measured and predicted CCN concentrations were within 30%. An air parcel model found that the variability in CDNC was driven by changes in aerosol size distribution more than changes in updraft velocity and aerosol hygroscopicity. The article is well written and contributes to ongoing research involving cloud and aerosol properties near the Arctic. I recommend publication with the following minor revisions.

General Comments:

- 1) Introduction: For readers not familiar for the first two Pallas Cloud Experiments, a more in depth description of the motivation and results of these two Experiments is needed.
- 2) Introduction: While the goals of the third Pallas Cloud Experiments are listed, additional description of the unanswered questions from the first two Experiments would be helpful. Additional discussion of how the third Experiment will answer these questions (different technologies, season, focus, etc.) would also fit well in this section.
- 3) Sect. 2.2: Inspection of Table 1 shows that the five cloud events have very different properties that are not well described. I would like to see an additional figure with back-trajectories of the five events with additional discussion to better understand the aerosol and air mass source region.
- 4) Sect. 2.2: Another figure that would be helpful in a supplement would be visible satellite images of the region during the cloud events to get an idea of the cloud coverage and synoptic conditions.
- 5) Section 6.1: “As can be seen from Fig. 5, the cloud droplet number concentrations could be reproduced accurately in this manner. Also, Table 2 shows the average values of modeled CDNC for each cloud event which are seen to compare well with the corresponding experimental values displayed in Table 1.” If I understand correctly for each case, the updraft velocity was chosen to minimize the difference between experimental and modeled cloud droplet number concentrations. Therefore, by default, modeled and measured CDNCs must agree well. Can authors report standard deviation for each averaging interval within the event? That can give some insight into the effect of updraft velocity fluctuations on CDNC.
- 6) Section 6.1: According to the paper “During the investigated cloudy periods, the inferred number of cloud droplets varied typically between 50 and 150 cm^{-3} .” Based on Fig. 9 authors argue that there is a poor correlation between CDNC and the corresponding updraft values. While this may be true, I am curious to see how Fig. 9 would change if the outliers (i.e., CDNCs with values outside 50 to 150 cm^{-3}) are removed. Please also report R^2 value as done for Fig. 10.

7) I recommend different symbols to be used for different events (i.e., A to E) on Figs. 5,7,9,10. That would help the reader to see if there are any systematic discrepancies between the measured and modeled values for a particular event.

Minor Comments:

- 1) Page 13698, line 13: In not sure what “DMPS:s” refers to.
- 2) Page 13705, line 5: Needs to be “Kammermann et al. (2010)”.