

Earth Syst. Sci. Data Discuss., referee comment RC1  
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## **Comment on essd-2021-297**

Anonymous Referee #1

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Referee comment on "An extensive data set for in situ microphysical characterization of low-level clouds in a Finnish sub-Arctic site" by Konstantinos Matthaios Doulgeris et al., Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2021-297-RC1>, 2021

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Review of the manuscript: **In-situ microphysical characterization of low-level clouds in the Finnish sub-Arctic, extensive dataset**

The authors produced and summarized data obtained from two cloud ground based spectrometers (CAPS and FSSP-100 ground setups) and accompanying meteorological instruments during eight years of cloud measurements in field campaigns conducted in the Finnish sub-arctic region, during autumns from 2004 until 2019.

### **Major comments:**

The authors state multiple times that the provided datasets are significant and very important for cloud microphysics, but don't provide any evidence or specific examples of how their datasets can be used. Instead, the authors highlight that these data can't be used for trend analysis and that different campaigns shouldn't be combined into one analysis (L227-232). I'd highly recommend to include at least one specific example in this manuscript where these datasets are used.

The figures, particularly figures 4-9, are barely discussed in the main text.

The grammar needs to be revised, I provided some recommendations in the minor comments below.

**Minor comments:**

L1: I'd suggest to change the title to: In-situ microphysical characterization of low-level clouds in the Finnish sub-Arctic site, in the years 2004-2019.

L15: cloud parameter along with the air temperature

L16: horizontal wind speed I suppose?

L18: remove: "includes cloud cases with temperature from"

L19: The data are available in the FMI...

L25: cloud microphysical

L26: development of the clouds, more

L28: Despite the fact that cloud...

L31: size distribution of cloud droplets

L33: cloud lifetime and radiative effects as well as precipitation (e.g....

L34: McFarquhar

L35: Three general approaches were used in previous studies of cloud microphysical...

L36: (e.g. Heymsfield et al., 2011; Craig et al., 2014; Petäjä et al., 2016; Nguyen et al., 2021)

*Nguyen, C. M., Wolde, M., Battaglia, A., Nichman, L., Bliankinshtein, N., Haimov, S., Bala, K., and Schuettmeyer, D.: Coincident In-situ and Triple-Frequency Radar Airborne Observations in the Arctic, Atmos. Meas. Tech. Discuss. [preprint], <https://doi.org/10.5194/amt-2021-148>, in review, 2021*

L41: access to individual hydrometeors within a sampling volume. Unfortunately, each of the aforementioned approaches has inherent limitations.

L43: Data sets that have been obtained from measurements in sub-Arctic clouds are of high value since cloud processes are considered as an important component of climate change in the Arctic...

L45: The main objective during PaCE...

L46: In this work, we present a unique dataset – in other places you use 'data sets', please use dataset. Also it's not clear throughout the text which dataset/datasets you are referring to in each sentence e.g. dataset of a single instruments or the whole dataset

L48: This dataset can be used in studies of cloud microphysics, climate change in the sub-Arctic, and performance evaluation and improvement of existing models, in particular at higher latitudes.

L49: In the next section, we provide a description of the sampling location, instrumentation, and the methodology we used for sampling, data processing, and quality control.

L55: The Sammaltunturi station (67°58'24''N, 24°06'58''E) is hosted by the Finnish...

L58: an excellent location for the monitoring of background...

L59: The station is about 100 m above the tree canopy line and the vegetation...

L60: (see Lohila et al. 2015).

L66: The predominant origin of air masses arriving at Sammaltunturi is from...

L68: The main motivation to perform in-situ cloud measurements at the Sammaltunturi was that the station is occasionally immersed in a cloud.

L69: measurements was autumn when the horizontal visibility drops bellows...

L70: Once the preferable time of the year was identified, we started to conduct...

L71: The "Pallas Cloud Experiments" were, usually, 6-8 weeks...

L72: occasionally extended to the beginning of December.

L73: attempt of measuring in situ cloud properties – throughout the text, you sometimes use 'in situ', 'in-situ', '*in-situ*', choose one

L76: remove (includes two instruments; the cloud and aerosol spectrometer (CAS) and the cloud imaging probe (CIP)) – you will mention this in L113.

L76: was added.

L76: In January and February 2012, it was tested for the first time for two short periods...

L94: sensors can be found in Hatakka...

L99: The CAPS was fixed and...

L100: was installed on a rotating platform...

L101: The CAPS had a total height of 0.6 m above the roof where...

L102: 0.6 m above...

L104: was often blocked by freezing of supercooled...

L105: it was cleaned every hour if occurrence of supercooled water was detected.

L107: However, even without placing the laminator, the Reynolds number indicated that the...

L109: were more extensive and the number of cases when the FSSP would have been blocked was significantly reduced.

L111: documented in Doulgeris et al. (2020).

L112: include reference to DMT Manuals please in your reference list. e.g. Droplet Measurement Technologies Manual: CAPS operator manual, DOC-0066 Revision F, DMT, Boulder, Colorado, USA, 2011.

L112: in airborne measurements of the microphysical properties in clouds...

L113: you should add Lachlan-Cope et al. 2016 to the ref list here

*Lachlan-Cope, T., Listowski, C., and O'Shea, S.: The microphysics of clouds over the Antarctic Peninsula – Part 1: Observations, Atmos. Chem. Phys., 16, 15605–15617, <https://doi.org/10.5194/acp-16-15605-2016>, 2016.*

L116: supercooled liquid clouds (even for a short time) the sensor was accreting ice.

L117: significantly shorter than the duration of the campaign. The FSSP-100 was widely used

L118: 'widely used' but you provide only one reference from 1989?

L118: CAS and FSSP-100 derive the size of the particle from the intensity of the forward scattered...

L121: whereby single particles pass through a collimated laser beam and their shadow is projected...

L122: The count of the particle is dependent on the change in the light intensity of each diode.

L124: perform calibration at the FMI, on top of manufacturer calibration, to ensure the quality of the collected?processed? data.

L125: CAS and FSSP-100, glass beads...

L128: (Baldor, Reliance, USA), which was working as an aspiration system. - please change everywhere to aspiration system.

L130: employed through FSSP-100 inlet to ensure constant flow...

L131: was used in each campaign for checks of daily cloud...

L133: In those years, a necking inside...

L136: snow or ice could accrete and affect...

L139: size distribution. The PADS software..

L140: (DMT Manual, 2011) - This manual should be cited in L112. Here you should put Droplet Measurement Technologies Manual: Particle Analysis and Display System (PADS) Image Probe Data Reference Manual DOC-0201 Rev A-2 PADS 2.5.6, DMT, Boulder, Colorado, USA, 2009.

-FSSP manual reference should also be provided where relevant.

L140: provided the number concentration...

L141: and effective diameter, (ED,  $\mu\text{m}$ ) - I don't think this parameter is used by anyone. I believe DMT also recommend not to use it since it doesn't have any physical meaning in real clouds. Unless you know any recent studies that used DMTs' ED? Please mention these when you discuss how this dataset can be used.

L143: PADS 2.2?

L144: remove: we used for cloud measurements, remove the e letter 'are summarized'

L147: In the given data set, only measurements when the station was inside a cloud were used. - I suggest to rephrase: The current dataset contains only in-cloud measurements, when the station was immersed in a cloud.

L148: format for release and further analysis.

L149: size distribution measured in both cloud spectrometers.

L155: During PaCE 2009

L157: set to sample each 1 s.

L158: sampling time was 15 s. For every year, one minute averages...

L167: horizontal wind direction...

L183: Measurements of each year were inspected to ensure a good quality of the dataset:

L184: further analysis cases when one of the cloud probes was partially...

L185: Then, we used the suggested limitations - what does it mean? Perhaps: applied suggested corrections/filtering due to limitations?

L186: Doulgeris et al. (2020) demonstrated that the CAPS (that was fixed to one direction) showed significant sampling losses...

L191: PaCE?

L192: duration are significantly higher. The amount of data in these years is excessive serving as an important source of information for Arctic studies. An overview...

L193: each campaign when the FSSP-100 and CAPS ground setups were operational.

L194: In Fig. 6, we show the percentage of the data set for each year in which the Global solar radiation was higher than 0. It was used to estimate the amount of data collected in each campaign in day light.

L196: In addition, an overview...

L196: Thus, in Figs. 7-9 - you mention three figures in one sentence, without any further discussion, this should be expanded significantly.

L198: each campaign and for FSSP-100 and CAS ground setups, respectively.

L223: Such semi long observations are difficult to obtain in similar environments due to current lack of instrumentation - this sentence should probably be elaborated further,

instead of text repetitions like in lines 224-226.

L224: remove: (size distribution as a measured parameter and additionally as derived parameters the number concentration, effective diameter, median volume diameter and the liquid water content)

L226: remove: (temperature, dew point temperature, humidity, pressure, wind speed, wind direction, (global solar) sun radiation and visibility)

L230: of observations per year and operators' experience running the ground-based...

L232: However, this data set provides a helpful contribution to cloud microphysics processes on shorter timescales. Furthermore, it can be used as complementary in model development. - Please provide examples how this data can be used? Which models, could you provide examples of models where it can be used?

Figure 1 caption: Map of Finland showing the location of the field station, and (b) map of the wider Pallas area showing the location of the Sammaltunturi station...

Figure 6 caption: The percentage of the global solar radiation that was higher than 0 during each campaign when the FSSP-100 and CAS ground setups were operational.

Figure 8: Why you use ED but no MVD figure? Did you get any images at all in the Cloud Imaging Probe that you can present here? If CIP did record images, I'd recommend to upload the raw files dataset as well. Otherwise, there should be an explanation why images are not included.