General comment by authors:

We appreciate the generally positive and encouraging feedback from the three reviewers. We also acknowledge the reviewer comments which led to improvements of the manuscript.

Below, the reviewer's comments are recalled in black, our response is given in blue, and changes to the manuscript are given green.

Anonymous Referee #2

Received and published: 23 May 2018

This manuscript presents an extensive data set of Ceilometer measurements at Ny-Alesund, Svalbard over 25 years. It explains the characteristics of the data and shows different examples what the data can be useful for. I think it is great to make this data set available to use and suggest accepting the manuscript with minor revisions.

Specific comments:

- I am missing a discussion of the uncertainty range of the presented data set (or each sub data set). It is mentioned at several places that the data can not be used for long-term trend analysis because it is very instrument dependent or different between the different instrument periods. Given that it should be mentioned what the general uncertainty range is and what the constraints are when using the data.

Lacking an internationally agreed quantitative definition of cloud base heigh (CBH) and thus absolute reference values for ceilometer instruments, we are not able to present quantitative uncertainty values.
In a report on the ceilometer intercomparison campaign CEILINEX2015, CBH differences of up to 70m were found between various ceilometer systems for liquid clouds, with even larger differences in precipitation conditions (Görsdorf et al., 2016). As there is no common definition of CBH, the instruments have been intercompared to each other to get an idea on the instrument-to-instrument variability, but uncertainties have not been presented.
As there is no absolute reference, we consider the CBH in the presented ceilometer data set a best estimate for each respective sub-period. Constraints though are given for the calculation of trends: in this respect, the data should be treated as 3 incoherent datasets, that are generally too short to retrieve significant trends.
An according statement has been added to the manuscript:

>> Page 5, lines 31 pp.

As there is no absolute reference, we consider the CBH in the presented ceilometer data set a best estimate for each respective sub-period. Constraints though are given for the calculation of long-term trends: in this respect, the data should be treated as three incoherent datasets, each of them generally too short to retrieve significant trend information.

Görsdorf, U. et al. (2016), The ceilometer inter-comparison campaign CEILINEX2015 – cloud detection and cloud base height. WMO Technical Conference on Meteorological and Environmental Instruments and Methods of Observation (CIMO TECO 2016), Madrid, Spain, 26 - 27 September 2016. https://www.wmo.int/pages/prog/www/IMOP/publications/IOM-125_TECO_2016/TECO_2016.html

- The data set presented here consists of three time periods where the data was derived with different instruments. There is no overlap between all three instruments, which makes sense in terms of having one complete consistent data set. However, in case there was an overlap between the different instruments it would be interesting to add an comparison as an aspect referring to the sensitivity/uncertainty of the overall data set.

Unfortunately, the instruments have been operated without any overlap period.

- Looking at the link how to download the data it seams that the download has to be done on a monthly basis? Please provide one data file for the whole data set presented here or some way to easily download it as a whole since it is also presented as one data set in the manuscript. In case that is available but I was not able to find it, make sure that the website is easy to navigate.

Thank you for this suggestion. The webpage for data download now provides an additional link, containing a zip file of all data files.

- page 3, line 31: Could there be a microphysical reason for the disappearance of this cloud? Whas there some precipitation or graupel or similar observed?

Indeed, precipitation was observed during the occurrence of the low level cloud. Though we add this information to the manuscript, we will not discuss any microphysical implications since the reason for the cloud's disappearance cannot unambigously be identified.

>> now page 4, line 5 pp.
The cyclonic influence ends by about 15:30 UTC, when the clouds disappear **after a period with precipitation**, the long-wave radiation drops back to the 'clear' state, and air temperature decreases.

- page 5, line 6: How often did it happen that a month had more than 20% missing data and was excluded?

The months with technical problems leading to > 20 % missing data were 02/1993, 02-05/1997, 09/1999, 01-03/2000, 08/2000. This information has been added to the manuscript accordingly.

>> now page 5, line 11 pp.
The **apportioned** months July 1998 and August 2011 have been excluded, as well as all months that had more than 20% missing data **(February 1993, February to May 1997, July 1999, January to March 2000, August 2000, respectively)**.

- page 5, line 11: You say here that the signal could be masked by the different sensitivities of the different ceilometers, but you don't really discuss how large the uncertainty of the signal and the sensitivities of the different ceilometers are. It would be good to have some information here to relate to.

We understand that the wording was misleading. Rather than the 'different sensitivity' of the instruments, we intend to point out more general instrumental differences that affect the data retrieval. We have changed the sentence accordingly, pointing out the lack of a quantitative CBH definition, and the technical issues that lead to potential differences between the ceilometers.

>> now page 5, line 17 pp.
If a change in occurrence frequency of clouds over Ny-Ålesund occurred over the 25-year period, **it may still be masked by the effects of the diverse technical parameters of the different instruments (e.g. signal-to-noise ratio), or simply by the different applied algorithms for cloud determination. As the ceilometers have been sequentially operated without any overlap period, it is impossible to quantify the variability between the used instruments.**

- Figure 1: Mark which instrument is the ceilometer in the picture.

The ceilometer is now indicated by a white arrow.

>> Figure 1: The CL-51 ceilometer **(indicated by a white arrow)** located in the vicinity of the radiation measurements of the AWIPEV station at Ny-Ålesund, in April 2013.

- Figure 2: The abbreviations of the cloud types might need to be explained.

The explanation of the abbreviations has been added to the figure caption.

>> Figure 2: A frontal passage on 15 / 16 December 2016 in Ny-Ålesund. a: Schematic diagram of the warm front (red line) and cold front (blue line), their moving direction (black arrow), and associated clouds **(Ci = cirrus, Cc = cirrocumulus, Ac = altocumulus, Sc = stratocumulus, St = stratus)**, respectively.

- Figure 2: Change to a vector graphic.

Figure 2 will be submitted as vector graphic in the final version.

- Figure 5: The shading is very light and difficult to see. It disappeared on my print-out. Check again to make sure it can be clearly seen.

In the new version of Figure 5, we have added information on the longwave net radiation for the same periods, and also adjusted the shading.

- Table 1: In the text everywhere it is mentioned that the technology got better, the vertical resolution however went down from 1998-2011 to the actual data set from 2011 ongoing. Please comment this (and change in the text accordingly).

Although the vertical resolution of the actual instrument went down due to the longer laser pulse duration (100 ns), the overall performance is better compared to the older instrument due to the higher pulse energy (3 µJ vs. 1 µJ). Other technical advantages are the lower power consumption and the possibility to retrieve backscatter profiles for the study of the boundary layer structure. The text has been changed accordingly, and more technical details have been added.

>> page 2, lines 27 pp.

Furthermore, it is likely that higher laser power and **improved** receiving hardware increased the sensitivity for cloud detection in the newer systems, potentially affecting the observed frequency of clear sky conditions. **Although the longer pulse duration of 75 ns for LD-40 compared to 100 ns for CL-51 has reduced the vertical resolution (Table 1), a higher laser pulse energy of 3 µJ instead of 1 µJ at the same pulse rate, respectively, surely increased the signal-to-noise ratio and thus the sensitivity for the detection of thin clouds.**

Small remarks,typos:

- page 1, line 22: exchange climate with global or add global to emphasize that this refers to a global mean.
- page 2, line 2: add , before which.
- page 2, line 26: replace was with were.
- page 3, line 9: avoid line break between number and unit.
- page 3, line 26: replace stably by stable.
- caption Fig. 3: replace symbols with dots.

The typos have been corrected in the revised manuscript version.