EMS Annual Meeting Abstracts
Vol. 15, EMS2018-580, 2018
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Cloud cover climatology in the High Arctic investigated by a ceilometer

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Five year of measurements of cloud cover estimated from attenuated backscatter profiles from a Vaisala CL51 ceilometer are presented. The measurements are performed in the High Arctic (latitude 81.3°; longitude -16.4°) at Villum Research Station, Station Nord in Greenland. The site is at present going through the approval process to become an ICOS atmospheric site labelled SNO. The area around Station Nord is covered by snow/ice from September-July, in some years the snow does not disappear. Here we define winter as the period with sun down all day and summer as sun up all day.

The CL51 outputs attenuated backscatter profiles up to 7.7 km every 15 s with a vertical resolution of 10 m. The profiles are used to determine whether a cloud is present by applying a threshold value of the attenuated backscatter. If the attenuated backscatter somewhere in the profile exceeds the threshold value, it is taken as an indication of a cloud layer. It is clear that the estimated cloud cover when determined in this way becomes a function of the chosen threshold value.

The cloud cover is also determined from the Vaisala cloud cover algorithm. It is based on visibility criteria for aviation purposes and is proprietary and here provided without details.

The analysis shows that for a threshold value of 10^{-5} sr^{-1} m^{-1} the cloud cover at Station North systematically decreases from being 0.63 in 2012 to 0.53 in 2017. These numbers and the general trend are in very good agreement with the estimated cloud cover based on the Vaisala proprietary algorithm.

When only considering the seasonal variation a clear decrease in the cloud cover can be noticed during spring time. Looking at the distribution of the attenuated backscatter there is a clear difference between winter-spring and summer-autumn. The 50% percentile of the attenuated backscatter is reached by a threshold value of $\sim$6 10^{-5} sr^{-1} m^{-1} during winter and spring, during the summer and autumn the 50% thresholds value is shifted towards more dense clouds corresponding to a threshold value of $\sim$10-4 sr^{-1} m^{-1}.

In conclusion:

1. The overall cloud cover has decreased by 20% from 2012 to 2017. The change can mainly be attributed to a decrease in the cloud cover during spring.
2. There are relatively more thin transparent clouds during winter and spring than during summer and autumn.