Algorithm to determine the aerosol pollution layers from ceilometer / lidar profiles

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Objectives

❑Calculate aerosol pollution layers (FT)

Input

- CHM 15k 'Nimbus' ceilometer: RCS data (signal)
- Multiwavelength Raman lidar: β_p@355 (signal)

Methodology

- Profiles are averaged (1 h, 60 m)
- Additional smoothing over 9 bins
- Signal with SNR < 3 dismissed
- Calculate variance of the cumulative signal (VCS)
- Define: NV=VCS(1:2:end-1).*VCS(2:2:end)
- Calculate NV's local maxima[1)] (inflection points in signal)
- Calculate NV's local minima[2)] (minima and maxima in signal)
- The data for which the prominence of the inflection points and the corresponding NV values are smaller than 0.01 is dismissed
- Few other criteria involved to retain the optimum number of inflection points and local minima / maxima
- Layer's first / last 60 m are dismissed.

[1)]islocalmax [2)] islocalmin in Matlab

The new algorithm is an improved version of that used in [1].

Challenges

❖layer definition

❖multiple adjacent thin layers

❖low SNR in ceilometer profiles

Results

❖ E.g. layers ceilometer 20210410

❖ E.g. layers lidar 20140807 and 20160530

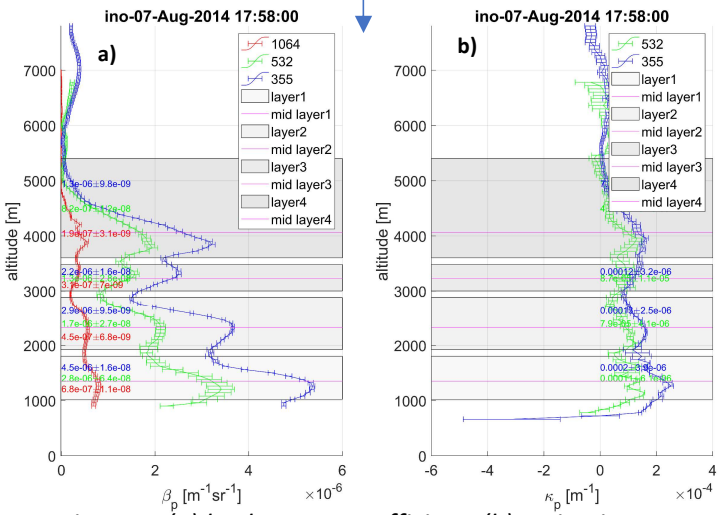

Figure 4. (a) backscatter coefficient, (b) extinction coefficient and superimposed layers. 20140807.

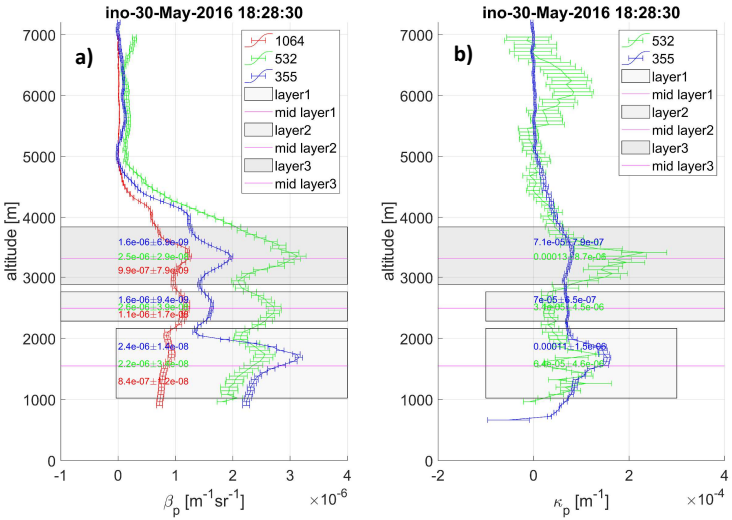

Figure 5. (a) backscatter coefficient, (b) extinction coefficient and superimposed layers. 20160530.

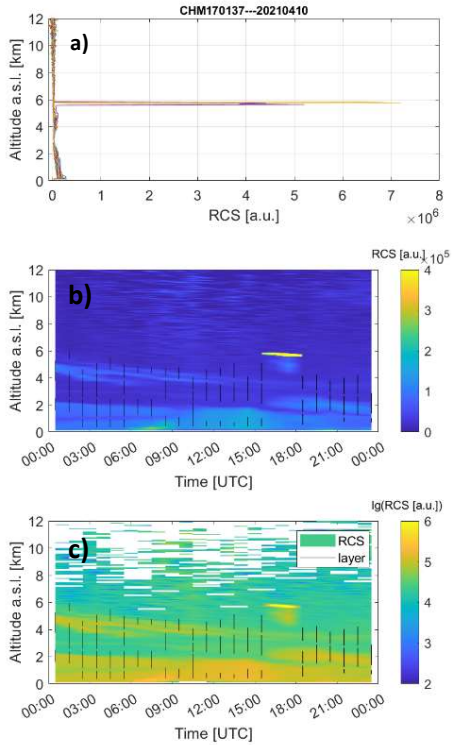

Figure 1. (a) RCS versus altitude, (b) RCS versus time and altitude and superimposed layers, (c) same as b) with RCS in log scale.

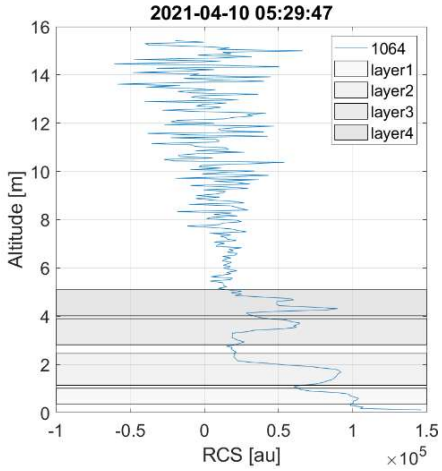

Figure 2. RCS profile and layers for 05:00-06:00 UTC.

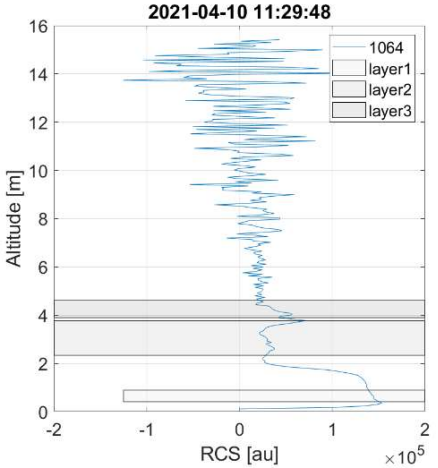

Figure 3. RCS profile and layers for 11:00-12:00 UTC.

Summary

- Algorithm reliable ~95%
- Applied on both ceilometer and lidar

Reference

1) Adam et al., https://acp.copernicus.org/preprints/acp-2020-320/

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