INVESTIGATING THE VERTICAL DISTRIBUTION OF THE MANAUS POLLUTION PLUME DURING GOAMAZON IOP1 (FEBRUARY-MARCH 2014) FROM THE MEASUREMENTS OF A CEILOMETER

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Introduction

The aerosol concentration in the Amazon region is under constant change. The area suffers the impact of urban pollution from nearby cities, such as Manaus, and from deforestation and biomass burning. The GoAmazon2014/15 project aimed at studying how anthropic pollution changes the natural aerosol and cloud life-cycles. The experiment made continuous observations with high temporal and spatial resolution and aimed to provide a rich database to help solve some of the physical processes that control clouds.

In this study, one of our main goals was to investigate the vertical distribution of aerosols in the central Amazon region in a period when there was no contribution from biomass burning, classifying the data according to the origin of the air masses and comparing the average vertical distribution of aerosol for clean air masses (from the forest) and polluted air masses (from the city).

Method

Instrument: Vaisala CL31 Laser Ceilometer

Maximum vertical range: 7700 m

Vertical resolution and reporting interval: 10 m

Wavelength: 910 nm at 25 °C

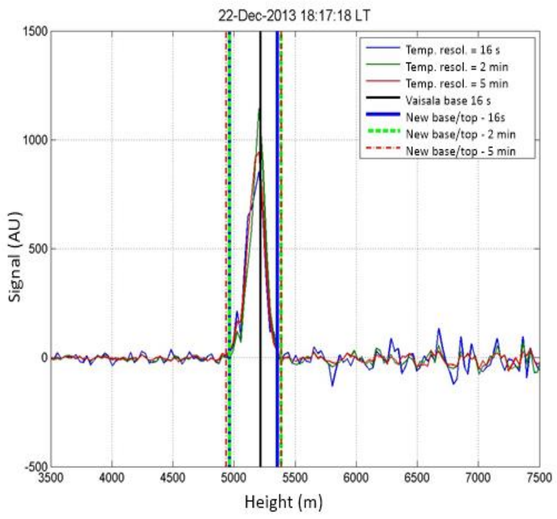
Location: T3 experimental site of the GoAmazon experiment located downwind of the city of Manaus

Cloud height detection: Adaptation of method by Gouveia et al., (2017)[1]

Aerosol backscatter: Klett (1981)[2] method applied to 60-min averaged profiles

Aerosol classification: Classification developed by Cirino (2015)[3]

Cloud screening the profiles

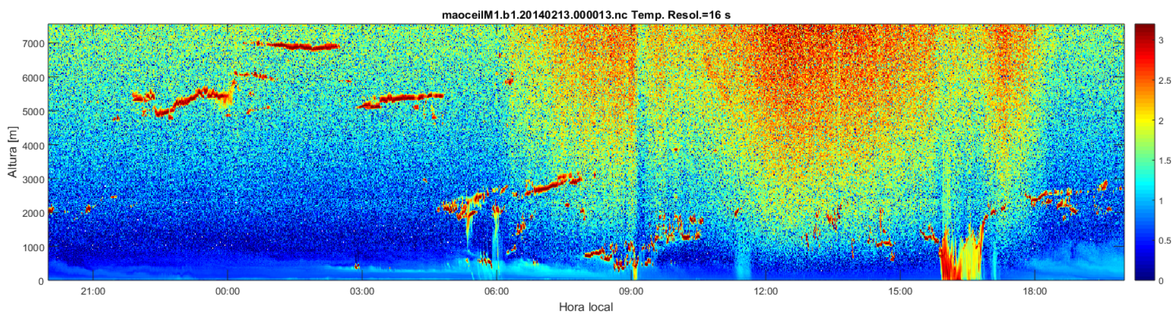


The cloud base heights are obtained through the use of an algorithm developed in our laboratory.

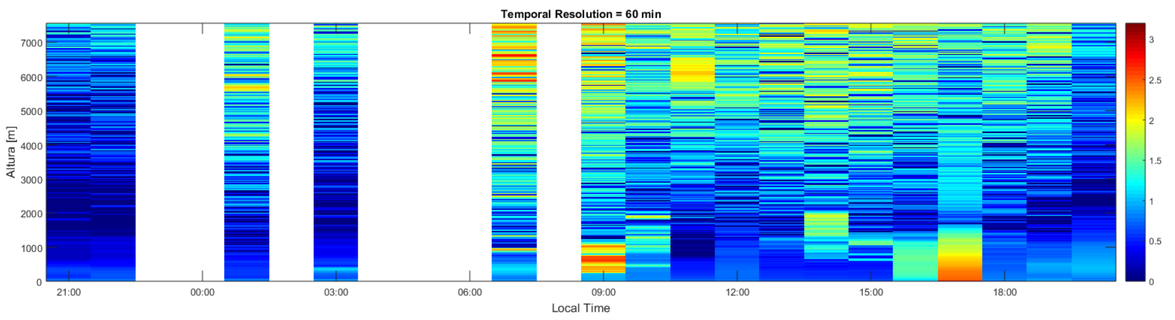
In order to choose the best temporal resolution, we tested the algorithm by using different time averages. It is easier to detect clouds with higher temporal resolutions, since it improves the signal-noise ratio.

Removing the cloudy profiles

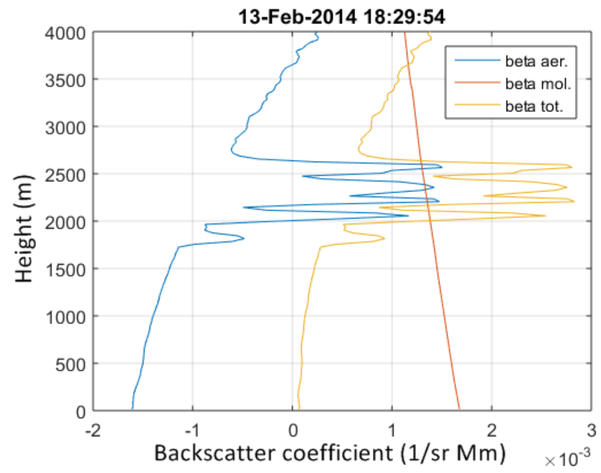
Temporal resolution: 16 seconds



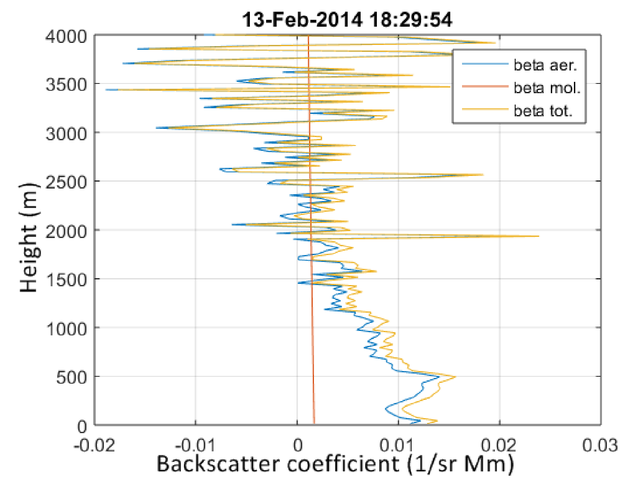
Temporal resolution: 60 minutes



Obtaining the backscatter coefficient



It is not possible to find the aerosol backscatter coefficient when the cloudy profiles are not properly removed from the analysis.



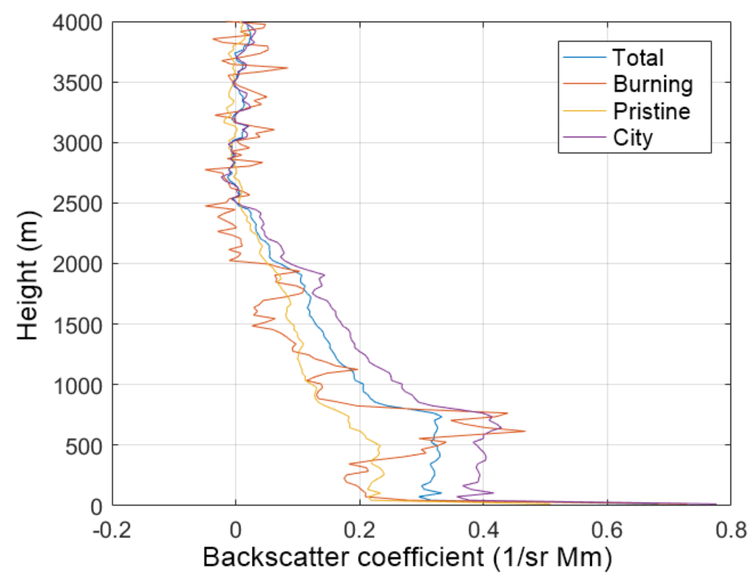
We can use the algorithm to identify the profiles that contain clouds, and remove these profiles from the data in order to apply the Klett method (1981)[2] to obtain the vertical distribution of aerosols.

Grouping according to air mass origin

Profiles that contained clouds or had negative values for the backscatter coefficient were removed from the analysis. A 60-minute average was applied to the remaining data and the vertical backscatter coefficient profiles were grouped according to air mass origin.

Number of 1-hour profiles used for the analysis for each classification (Feb-Mar 2014)

City plume	Biomass burning	Clean air masses	No classification	Total
235	10	31	227	503



Average vertical distribution of the aerosol backscatter coefficient according to air mass origin.

Conclusion

We can obtain the backscatter coefficient for 60-minute averaged data if the profiles are correctly cloud screened. By grouping the vertical profiles according to air mass origin, we can see a clear difference between the profiles for clean air masses and polluted air masses coming from the city.

References

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[3] Cirino, G., G.: Caracterização fisico-química de aerossóis no experimento Goamazon2014/15: a interação entre emissões urbanas de Manaus com emissões naturais da floresta, Tese de Doutorado, CLIAMB, UEA-INPA, Manaus, 187 f., 2015.

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