# Comparison of Two Different Ceilometers (CT 12 and CL 31)

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## Abstract

Ceilometer is not only a device that can measure cloud base heights but it is a very powerful tool that can provide quantitative aerosol information. During the last decade, atmospheric profiling from ground-based remote sensing instruments has reached a level of maturity that makes easier to get information about the atmosphere state. However, most of the current lidar activities are research oriented and different systems are in use. In this research activity, we are focused on the intercomparison of two different types of ceilometers which are CT 12 and CL 31 located close together at Howard University Beltsville (HUBV) lab. We discuss their methodology, investigate their effectiveness and measure their backscatter coefficient profiles.

## Introduction

As an instrument that employs the LIDAR technology, the ceilometer is placed in the category of the "simple one-wavelength backscatter" (Weigner, Geib 2012). The improvement made in this instrument gives the opportunity to entities responsible for air traffic control and weather service to gather solid information about the atmospheric state. Thus, this exercise of comparison of the CT 12 with Cl 31 will benefit the BCCSO in order to create a backscatter profile for the CT 12 and build up a sub-regional network of CT 12.

## The strength of the return signal

The instantaneous power received from a certain distance (h) is calculated by using the LIDAR equation:

$$Pr\,(h) = E_o * \frac{C}{2} * \frac{A}{h^2} * \beta\,(h) * e^{-2\int_0^z \sigma\,(z)dz}$$

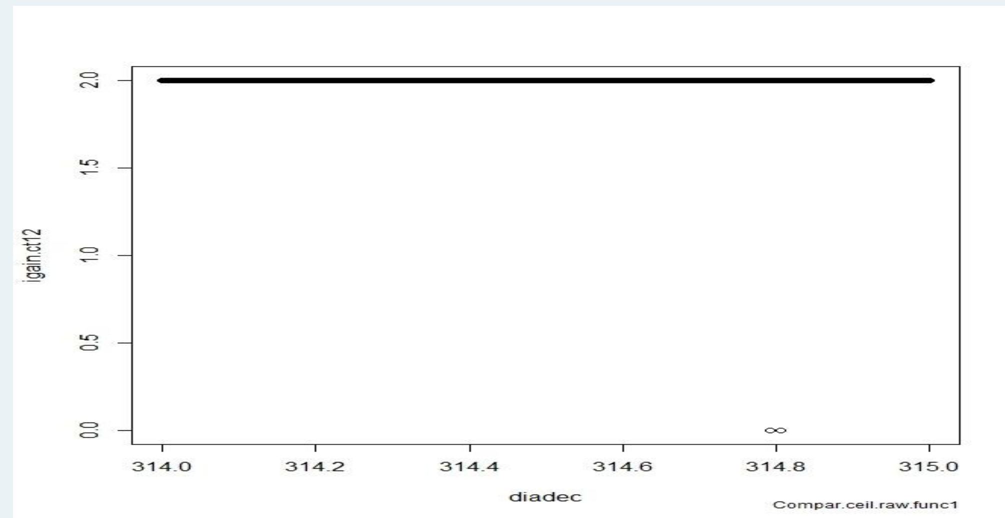
Aperture; CT 12; CL 31; Atmospheric transmittance

## Table of Comparison

| | CT 12 | CL 31 |
|---|---|---|
| Sample the return signal every | 100 ns from 0 to 25.4 μs | 33 or 67 ns from 0 to 50 μs |
| Spatial Resolution | 15 m | 5 or 10 m |
| Temporal Resolution | 30 seconds | 15 seconds |
| Maximum distance | 3,810 m | 7,460 m |
| Output | Return Power | Backscatter |

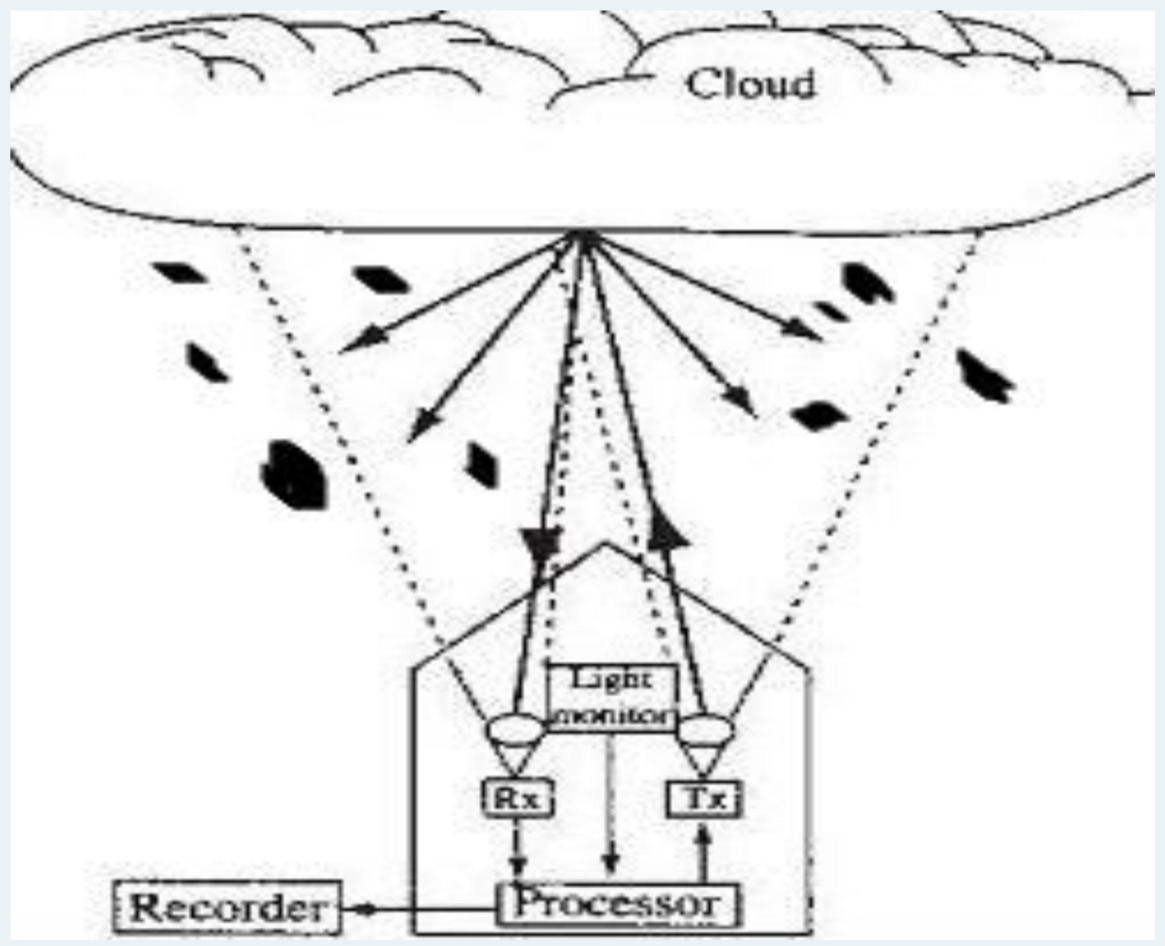
## Gain of CT 12

Gain is crucial for a ceilometer. The CT 12 has a gain equals to 0 for a bright and cloudy daytime and a gain equals to 2 in darkness and twilight with no clouds (Vaisala, 1989).



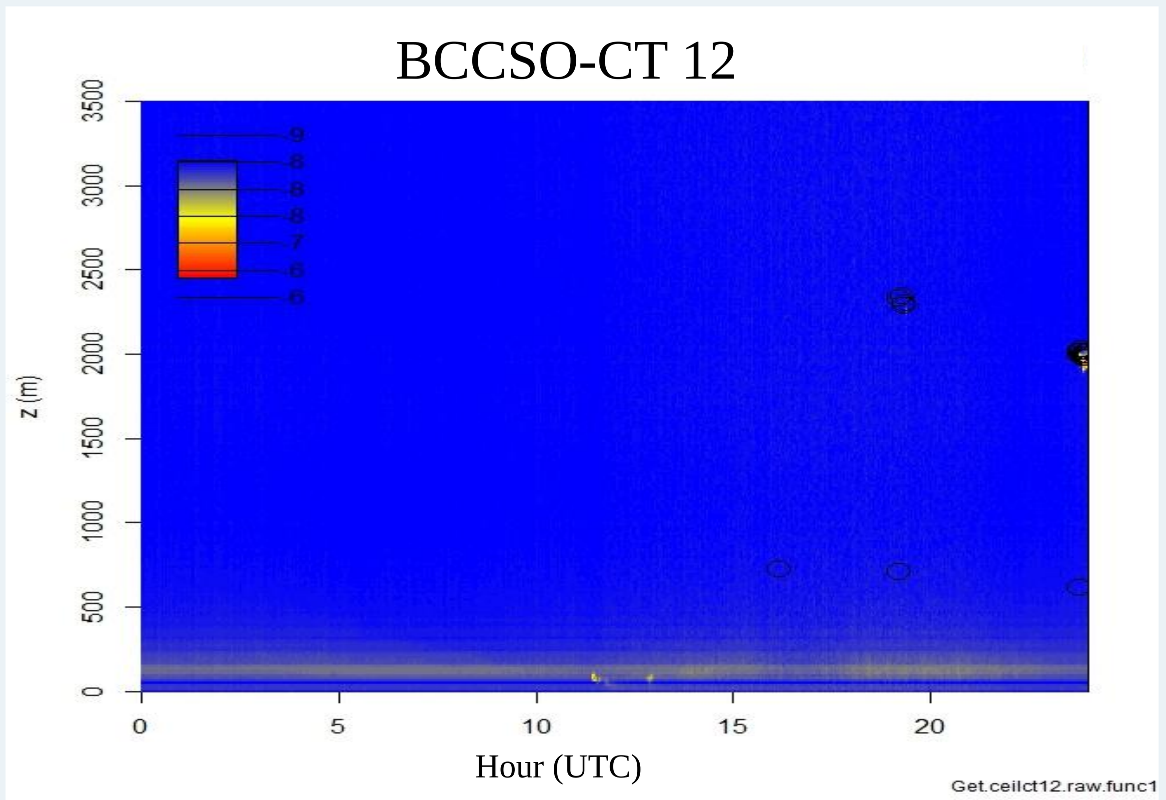

## Principle of Operation of the Ceilometer

Since we set up the ceilometer, its operation becomes fully automatic and measure continuously. The operating principle of the ceilometer (CT 12 and CL 31) is base on the measurement of time required for a laser beam that sends from the transmitter to traverse the atmosphere to hit the backscattering cloud base and return to the receiver of the ceilometer (Vaisala, 2004).

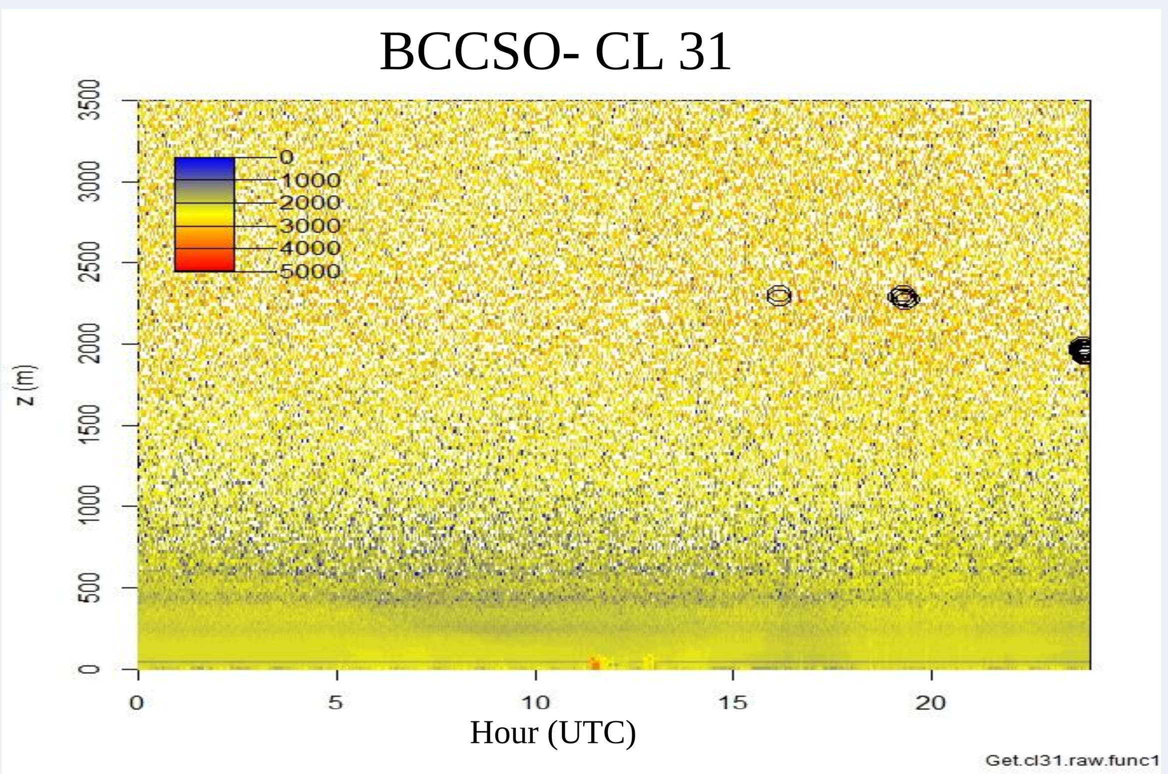



The return signal will provide information on the backscatter profile of the atmosphere

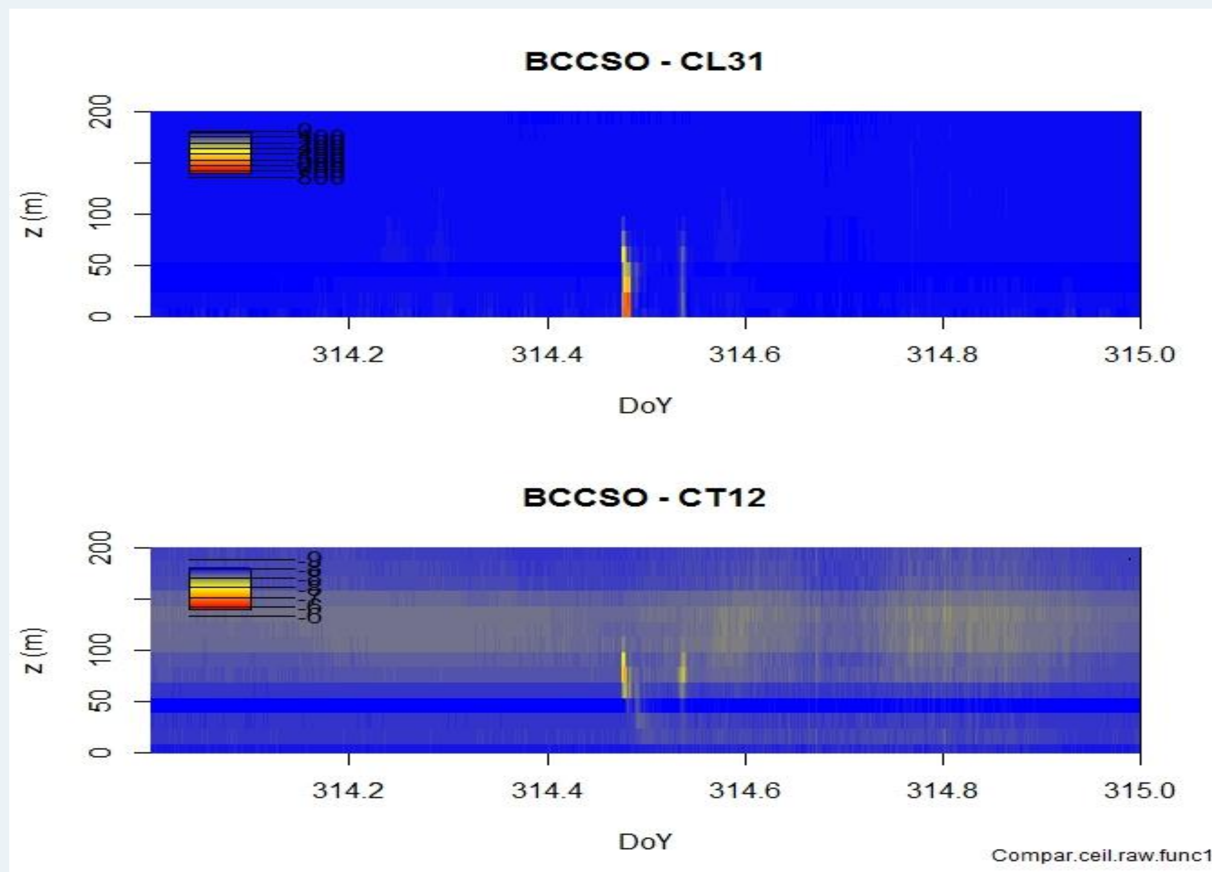
## Example of the Return Signal




The image above is an example of the power return signal of the CT 12 . It's an almost clear day with a few clouds represented by the black dots. The below image is the same day but the backscatter return signal of the CL31.

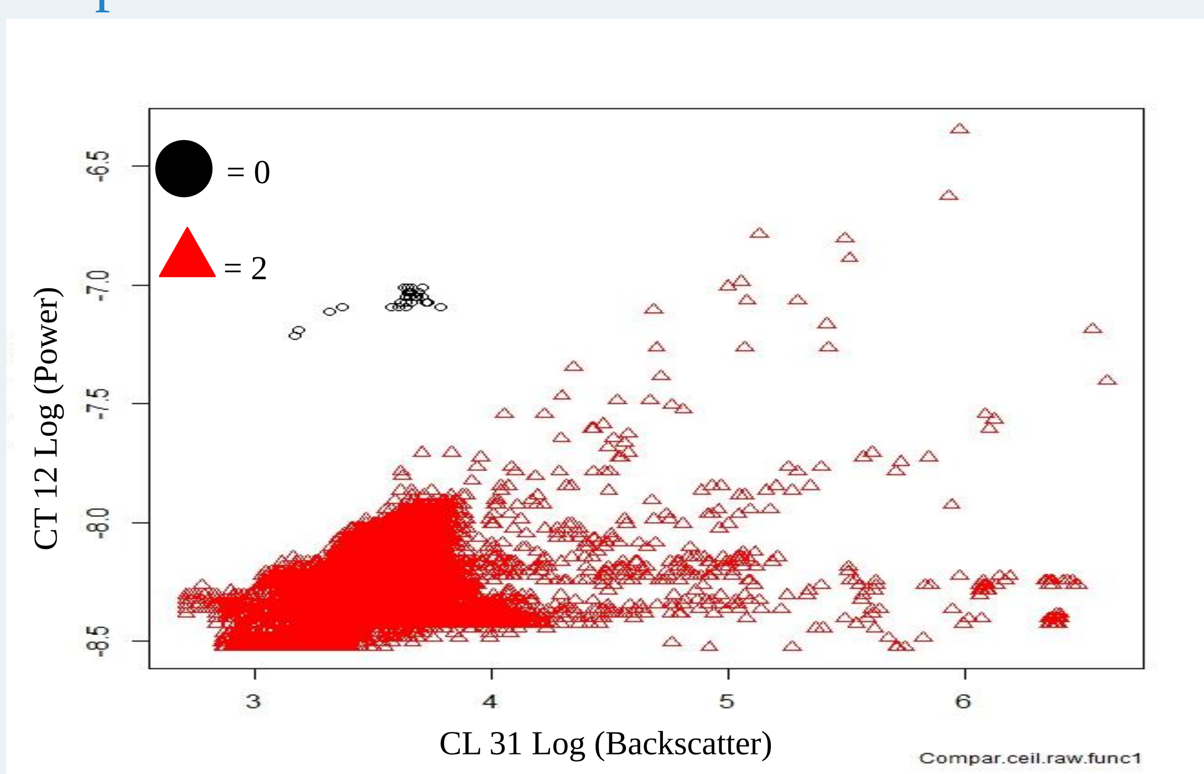



## Intercomparison of CT 12 and CL 31




In this comparison the height region is restricted to 200 m to have a stronger signal because the power is inversely proportional to the square of the height. The compared profile was taken within the same time.

## Comparison of CT 12 Power and CL31 Backscatter




## Conclusion / Future Study

It seems the newer ceilometer CL 31 is better than the older one, CT 12; but more studies are needed in order to conclude. That is why our future work will be to analyze some single profile and try to find a conversion factor between them.

## Acknowledgements

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## Reference

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