Atmospheric boundary layer height based on Lidar data - Determination methods

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Introduction

The atmospheric boundary layer (ABL) is the lower part of the troposphere, and by this the lowest layer of the atmosphere as a whole. In contrast to the free atmosphere above, the presence of the underlying Earth's surface has a measurable influence on the ABL.

Lidar, an acronym for Light Detection And Ranging is an active remote sensing instrument that transmits electromagnetic radiation and measures radiation after being backscattered by particles and molecules of the atmosphere.

Methodology

ABL height is defined as the height of the inversion level separating the free troposphere (FT) from the boundary layer

There are three methods for determining the PBL height:

- Logarithm gradient method;
- Inflection point method;
- Haar wavelet transform method.

Logarithm gradient method

The altitude corresponding to the minimum of *D*(*z*) is defined as the *instantaneous ABL top*.

$$D(z) = \frac{d(\log(P(z)z^2))}{dz} \approx \frac{\log(P(z_2)z_2^2) - \log(P(z_1)z_1^2)}{z_2 - z_1} \qquad h_{LGM} = \min(D(z))$$

Inflection point method

The inflexion point method is based on the estimation of the altitude corresponding to the minimum of the second derivative of the logarithm of the range-square-corrected signal.

$$h_{ip} = \min\left[\frac{d^2(\log(P(z^2))}{dz^2}\right]$$

Haar wavelet transform method

Is an application of wavelets for feature recognition, this function returns large coefficient values where a profile has large backscatter gradients

$$H\left(\frac{z-b}{a}\right) = \begin{cases} 1 & for \quad b - \frac{a}{2} \le z \le b \\ -1 & for \quad b \le z \le b + \frac{a}{2} \\ 0 & otherwise \end{cases}$$

Thank you for your attention.