BL-View User Guide

Document code : M211185EN | Revision : E | Language : English | Product : BLVIEW, CL31, CL51
Document type : User guide

About This Document

Version Information

This document provides information for installing, configuring, and using Vaisala Boundary Layer View Software BL-View.

Table 1. Document Versions (English)

Document Code	Date	Description
M211185EN-E	June 2019	Release 2.1.2 contains the following new features: • File Viewer • Altitude, longitude, and latitude information added to L1 files • NetCDF variables and dimensions renamed
M211185EN-D	November 2018	Release 2.1.1 contains the following new features: • Full ceilometer profile up to 15 400 meters (50 520 feet) • Language selection for English/Chinese • Scheduled snapshot
M211185EN-C	June 2018	Release 2.1 contains the following new features: • Support for multiple ceilometers • Embedded CL-VIEW functions • Mixing-layer height information added to HIS files • User interface update

This *Vaisala Boundary Layer View Software BL-View User Guide* is available as follows:
- BL-View software contains the online help (from 2.0 onwards).
- USB drive contains the online and PDF help.

The help content is identical in the PDF and online.

Related Manuals

Table 1. Related Manuals

Document Code	Name
M210482EN	*Vaisala Ceilometer CL31 User Guide*
M210801EN	*Vaisala Ceilometer CL51 User Guide*
M212160EN	*BL-View NetCDF Example File Technical Reference*

Documentation Conventions

WARNING! Warning alerts you to a serious hazard. If you do not read and follow instructions carefully at this point, there is a risk of injury or even death.

CAUTION! Caution warns you of a potential hazard. If you do not read and follow instructions carefully at this point, the product could be damaged or important data could be lost.

Note highlights important information on using the product.

Tip gives information for using the product more efficiently.

Lists tools needed to perform the task.

Indicates that you need to take some notes during the task.

Trademarks

AviMet® is a registered trademark of Vaisala Oyj.

Vaisala® is a registered trademark of Vaisala Oyj.

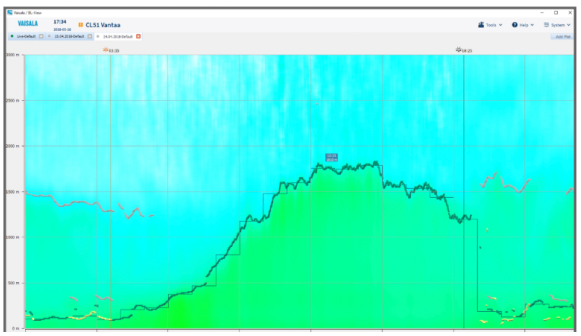
Microsoft® and Windows® are either registered trademarks or trademarks of Microsoft Corporation in the United States and other countries.

All other product or company names that may be mentioned in this publication are trade names, trademarks, or registered trademarks of their respective owners.

Vaisala Boundary Layer View Software BL-View

Vaisala BL-View is an application software for the data collection, analysis, and visualization of the planetary boundary layer. It provides an understanding of the current conditions to support faster and more reliable decision-making.

Figure 1. Vaisala Boundary Layer View Software BL-View



Improved Decision-making with Accurate Boundary Layer Visualization

BL-View generates an online visual representation of the mixing layer height (MLH), which provides you with an immediate understanding of the local conditions. You can view and analyze logged data while continuing to display online data. BL-View helps to improve your air quality monitoring and forecasting.

Reliable Data in All Weather

Vaisala Ceilometer measures the backscatter profile of the atmosphere and provides it for analysis in BL-View. The analysis uses an automatic algorithm for the online reporting of the boundary layer depth and additional residual structures. BL-View calculation is based on the combined gradient and idealized backscatter methods and enables reliable automatic reporting of the convective MLH.

To ensure reliable reporting in all weather conditions, BL-View uses an all-weather algorithm that takes into account precipitation and cloud events. The algorithm also uses the time of day and the location to improve automatic reporting in all conditions.

Manage Your Ceilometer Network

BL-View provides a centralized view of the ceilometer data in the network, facilitating concentrated data analysis. The status information of the network is available in one place.

For a network with more than 10 ceilometers, Vaisala recommends using BL-View with Vaisala Observation Network Manager NM10.

Fast Data Analysis

The ceilometer messages are stored in the netCDF format on the computer hard drive for fast data analysis and easy sharing. The automatically analyzed boundary layer data can be easily transferred to other applications, for example, as inputs to numerical weather prediction models.

File Viewer enables a simple and convenient way to analyze any netCDF files logged with BL-View.

Flexible User Interface

You can run simultaneous operator-specific analyses with user-set algorithm parameters for both logged and online data without disturbing online data analysis.

The ceilometer and communication status is displayed on the main screen enabling easy investigation of possible operational alerts. The warnings and alarms are stored automatically to log files for easy retrieval.

Supported Ceilometers

BL-View supports up to 10 ceilometers. Vaisala Ceilometers CL31 and CL51 can be connected to BL-View.

Related tasks

Adding Ceilometers to BL-View

Minimum System Requirements

Table 1. Minimum System Requirements

Component	Minimum Requirement
Computer	Ethernet port, serial port, or USB serial converter
Operating system	Windows 10 Pro Windows 10 Pro Enterprise Windows 7 Ultimate (32-bit or 64-bit) Windows 7 Professional (32-bit or 64-bit)
Memory	2 GB RAM
Hard disk space	For BL-View installation: 600 MB For BL-View data files: 40 GB / year / ceilometer (typically) Required total hard disk space depends on the number of ceilometers

Do not use BL-View on the same computer as AviMet Automated Weather Observing System or Vaisala Observation Network Manager NM10.

Licensing

BL-View requires a software license to run. To activate the license, you need a product key.

Vaisala delivers the product key when you purchase the software. If you have purchased the software and you have not received the product key, contact Vaisala.

The license is mapped to the hardware. If your hardware changes and you need to re-install BL-View, you must request a replacement license from your Vaisala representative.

The license can include one or several devices. After license activation, you can add devices in BL-View.

For license updates and new licenses, contact Vaisala.

Vaisala License Manager is used for activating the Vaisala software license. The license allows one activation.

Operating Principle

The planetary boundary layer (or atmospheric boundary layer) is the lowest part of the Earth's atmosphere. It is directly influenced by its contact with the Earth's surface. The planetary boundary layer responds to heat transfer, pollutant emission, and other surface forcings in a timescale of an hour or less.

The depth of the planetary boundary layer depends on, for example, the location, season, time of day, and weather. Typically, the planetary boundary layer extends 50 ... 3000 m (164 ... 9840 ft) from the Earth's surface. Fog, haze, mist, smog, and air pollution are typical phenomena in the planetary boundary layer.

The planetary boundary layer contains several layer types:

- **Convective boundary layer**: Layer of air in which particles mix well due to mechanical and thermal forces. The depth of the convective boundary layer is called the mixing height.
- **Nocturnal boundary layer**: Stable layer of air that forms around sunset. Its top is often marked by a temperature inversion. The layer usually dissolves by convection in the morning hours, but it can also stay during daytime when solar heating is not sufficient to disperse the nocturnal boundary layer.
- **Residual layer**: Layer of air containing the particles left from the previous convective boundary layer after sunset or from long-range transportation by winds.
- **Surface layer**: Layer of air that is situated closest to the ground. Its thickness is typically 50 ... 100 m (164 ... 328 ft), about 10 % of the boundary layer height.

Diurnal Variation in Planetary Boundary Layer

Variations that occur during the day in the planetary boundary layer are called diurnal variation.

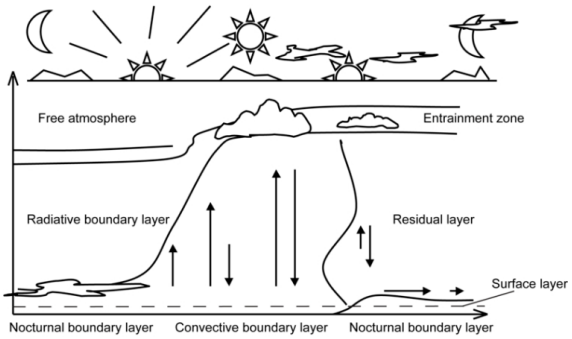
The following phenomena affect the formation of the component layers:

- Solar radiation heats the Earth's surface, causing thermals of warm air to rise from the ground.
- Radiative cooling from the clouds at the top of the planetary boundary layer creates thermals of cool air that sink down.
- Wind shear across the top of the convective boundary layer contributes to the generation of turbulence.

During the day, diurnal variation has the following effects on the planetary boundary layer:

1. The turbulence in the air is caused by solar radiation and radiative cooling, both of which occur simultaneously. At night, the radiative cooling of the surface controls the boundary layer, creating the nocturnal layer. The nocturnal layer blocks the interference between the surface layer and the residual layer. Before sunrise, the nocturnal boundary layer height is the mixing height.
2. After sunrise the solar radiation destabilizes the situation on the surface, creating thermals of warm air that rise upwards. The thermals continue to rise until their temperature has dropped to the same temperature as the surrounding air.
   At the same time thermals of cool air sink down from the top of the clouds. The resulting turbulence causes heat, moisture, and particles to mix uniformly in the convective boundary layer. The convective boundary layer reaches its maximum mixing height in the late afternoon.
   The entrainment zone acts as an interface between the convective boundary layer and free atmosphere. Turbulent air from above is mixed into the convective boundary layer in this region of the atmosphere.
   When the convective boundary layer reaches the level of the residual boundary layer, both layers are mixed together. This is an important process for air pollution transportation in time and space. The horizontal dispersion and transportation have a strong influence on the air quality.
3. When the sun sets, radiative cooling causes the convective boundary layer to collapse. A new nocturnal boundary layer is formed, and it is again replaced with a new convective boundary layer during the next day.

Figure 1. Planetary Boundary Layer Structure and Diurnal Variation



Boundary Layer Analysis

A ceilometer sends out short, powerful laser pulses in a vertical or near-vertical direction. The light reflection caused by haze, fog, mist, virga, precipitation, aerosols, and clouds, known as backscatter, is measured as the laser pulses traverse the sky.

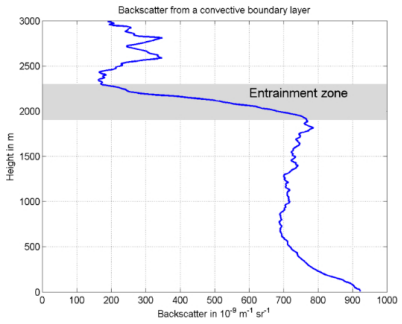
The backscatter profile, that is, the signal strength versus the height, is stored and processed, and the data is used to calculate the cloud bases and the planetary boundary layer structure.

The planetary boundary layer is the portion of the lower atmosphere where wind, temperature, and moisture are strongly influenced by the Earth's surface. The depth of this layer, also known as the mixing height layer, is important for analyzing the state of the atmosphere, for example, for air quality evaluation and aviation.

The backscatter signal is typically stronger in the planetary boundary layer where particle concentration is higher, but weaker in the free atmosphere where the atmosphere typically has fewer particles. BL-View detects the backscatter gradient between the planetary boundary layer and free atmosphere (the mixing height), as well as other atmospheric structures, such as residual boundary layers and elevated smoke or aerosol plumes that may produce strong backscatter gradients.

To reduce sensitivity to noise and transient details in atmospheric structure, BL-View performs vertical and temporal averaging on the ceilometer data.

Figure 1. Backscatter Profile from Convective Boundary Layer



Mixing Height Algorithm

BL-View uses 3 different algorithm methods:

- Gradient
- Profile fit
- Merged gradient and profile fit

Gradient Method

The gradient method can detect up to 3 aerosol layers and performs well in many situations, particularly for shallow nocturnal boundary layers at less than 500 m (1640 ft) above ground level.

Profile Fit Method

The profile fit method detects only a single layer, and successfully estimates mixing heights when the aerosol backscatter signal is weak, local gradients are weak and diffuse, and the boundary layer evolves rapidly with time during morning and evening transitions.

Merged Gradient and Profile Fit Method

The merged gradient and profile fit method merges the strengths of the gradient and profile fit methods, but retains the ability to detect multiple layers in a backscatter profile. The merged method uses the following rules to select the mixing height from the gradient and profile fit retrievals:

- The gradient method's lowest retrieval for cloud profiles and shallow, high quality boundary layers.
- Profile fit retrieval in all other cases (the gradient method's lowest retrieval is not displayed unless it differs by more than 1000 m (3280 ft).
- Second and third gradient retrievals are displayed in all cases, as they may indicate residual layers or other aloft aerosol layers.

The algorithm identifies reliably the various boundary layers, such as the nocturnal, convective, marine, and residual layers, and differentiates the mixed layer from other aerosol layers detected by BL-View. It also provides an outlier removal method, cloud filter, and other changes to improve performance for evening boundary layer transitions and to increase flexibility and robustness for handling data from both CL31 and CL51 ceilometers.

The algorithm determines the mixing height by fitting an idealized backscatter profile to observed range-corrected ceilometer backscatter profiles. Clouds and precipitation produce backscattering profiles that deviate substantially from an idealized profile, which results in poor mixing height estimates. The algorithm can produce valid retrievals even if the backscatter profile deviates significantly from the idealized profile.

When a ceilometer detects multiple aerosol layers, the algorithm attributes 1 aerosol layer as the mixing height. When there are

multiple aerosol layers present, the lowest layer is a reasonable first guess for attributing one of these layers as the mixing height.

Related tasks

Creating Calculation Presets
Modifying Calculation Presets

Cloud and Precipitation Filter

Cloud filters prevent spurious mixing height retrievals caused by clouds or precipitation in the backscatter profiles, especially below 4000 m (13 123 ft) above ground level.

- In the gradient method, clouds and precipitation produce strong local gradients that may be unrelated to the mixing height.
- In the profile fit method, clouds and precipitation produce backscattering profiles that deviate substantially from an idealized profile, which result in poor mixing height estimates.

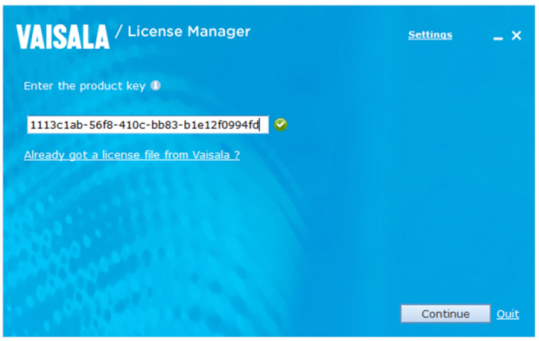
The cloud filter significantly improves the mixing height estimate, and eliminates retrievals in the morning when there are clouds and strong backscatter near the ground.

The algorithm does not report a mixing height when one or more of the following circumstances exists:

1. Clouds are present below 160 m (525 ft) above ground level.
2. Precipitation or excessively high backscatter are detected in the backscatter profile.
3. Clouds are present below 4000 m (13 123 ft) above ground level and there is excessive backscatter below 1000 m (3280 ft). Retrievals are still allowed when there are shallow, non-precipitating clouds below 4000 m (13 123 ft), but above 160 m (525 ft).

Variable Averaging

Long averaging intervals help prevent false gradient minima hits generated by signal noise. However, this approach reduces the ability of the algorithm to respond to short scale signal fluctuations in space and time. The amount of signal noise depends on the



3. A window opens with the message that there is no connection.
   a. Write down the product key and the request code shown, or select **Save codes as txt** to save the codes as a TXT file on a media that you can take with you, for example a USB drive.
   b. Do not close the License Manager window, you will later on need to upload the license file with License Manager.