

Sky Condition Algorithm for Vaisala Ceilometer CL31



The CL31 ceilometer can be configured to report sky condition automatically and accurately.

Features/Benefits

- Produces sky condition information from a single ceilometer
- New calculation algorithm - good results compared to human observers
- Optional for the CL31 ceilometer
- Generally used in automatic surface weather stations and airport weather monitoring systems

The Vaisala Sky Condition algorithm is an easy and cost-effective way to produce more information from ceilometer data. The algorithm is included in the CL31 software as an option.

Picture of whole sky from one point

The purpose of the algorithm is to construct an image of the whole sky based on the ceilometer measurements only from one single point. The sky condition algorithm uses a time series of ceilometer data to calculate the cloud amount of different cloud layers and the corresponding layer heights. Sky Condition algorithms are generally used in automatic surface weather stations and in airport weather monitoring systems.

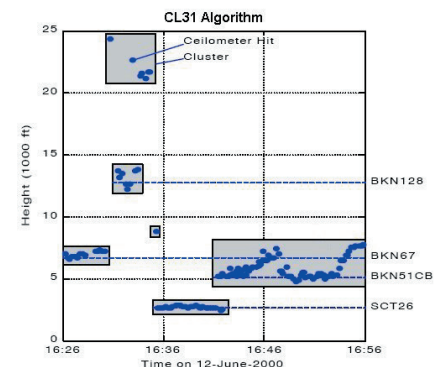
Operation principle of the algorithm

The conventional algorithms evaluate a histogram of cloud hits during the last 30 minutes. Operation of the new Sky Condition Algorithm is shown in Figure 1. Instead of forming a histogram of hit heights, the algorithm uses both height and timing information to find those hits that are close to each other. These hits are combined into clusters. After clusters have been formed a height value will be calculated for each cluster. This height gives the base height of that cloud or cloud layer which is represented by the cluster. The algorithm reports layers by combining those clusters whose heights are close to each other and then selecting those clusters that cover the greatest amount of the sky.

Figure 1. Basic operation of CL31 Sky Condition Algorithm. The new algorithm computes in 2D time-height domain.

Reliable results with automatic measurement

The new Sky Condition Algorithm has shown good results in comparison to sky condition reported by human observers⁽¹⁾. For comparison, success percentage values for the ASOS ceilometer algorithm⁽²⁾, CT25K embedded algorithm and the new Sky Condition algorithm are presented in table 1.



Technical Data

Data collection

A new sky condition message is calculated every five (5) minutes based on data collected during the last 30 minutes. The last 10 minutes are double-weighted.

Data display

The Sky Condition message line is included in the CL31 Ceilometer data message 2 and its subclass. The message output interval is the same as the ceilometer data acquisition interval.

Message line

The Sky Condition message line in data message 2 and its subclass is:

```
1 055 3 170 6 230 0 /// 0 ///
```

where:

- 1 the first number of the line: detection status as follows:
0 ... 8 Cloud amount of the first layer in oktas
9 Vertical visibility
-1 Data missing or the ceilometer is in standby mode
99 Not enough data (after start-up)
- 055 The second number of the line: Height of the 1st cloud layer (5,500 ft or 550 m depending on feet or meter selection)
- 3 The third number of the line: Cloud amount of the 2nd layer in oktas
- 170 The fourth number of the line: Height of the 2nd cloud layer (17,000 ft or 1700 m depending on feet or meter selection)
- 6 The fifth number of the line: Cloud amount of the 3rd layer in oktas
- 230 The sixth number of the line: Height of the 3rd cloud layer (23,000 ft or 2300 m depending on feet or meter selection)
- 0 The seventh number of the line: Cloud amount of the 4th layer in oktas
- /// The eighth number of the line: Height of the 4th cloud layer
- 0 The ninth number of the line: Cloud amount of the 5th layer in oktas
- /// The tenth number of the line: Height of the 5th cloud layer

Layer height resolution

Full range 100 ft or 10 m

Cloud amount

From 0 to 8 oktas (eighths), resolution 1/8, 9 vertical visibility

Compatibility

Vaisala Sky Condition algorithm is fully supported by CL-View Graphical User Interface for Ceilometers. Sky Condition message can be viewed either in the main window or in a separate window. CL-View provides cloud layer height and information in either text or symbol format.

Table 1. Ceiling height comparability to human observer. Numbers of reports compared are in parentheses.

ASOS algorithm	CT25K algorithm	CL31 algorithm
75% (2950)	89% (2313)	90% (2305)

⁽¹⁾ Ravila, Heinonen and Räsänen, 2002: Multiple Instrument Sky Condition Algorithm, 18th Conference on Interactive Information Processing Systems. American Meteorological Society.

⁽²⁾ Giles, 2000: Ceilometer Comparisons March 1998-April 1999. 16th Conference on Interactive Information Processing Systems. American Meteorological Society.