NCAR | EARTH OBSERVING LABORATORY

SWEX
NCAR/EOL ISS Ceilometer Products Data Report

Prepared by Jacquelyn Witte - Data Manager

Dr. William Brown - ISS Lead Scientist

Earth Observing Laboratory
In situ Sensing Facility

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH
P.O. Box 3000
BOULDER, COLORADO 80307-3000

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SWEX Principal Investigators

Leila Carvalho, University of California, Santa Barbara
Charles Jones, University of California, Santa Barbara
Gert-Jan Duine, University of California, Santa Barbara
Craig Clements, San Jose State University
Stephan De Wekker, University of Virginia
Joe Fernando, University of North Dakota
David Fitzjarrald, SUNY - Albany
Robert Fovell, SUNY - Albany
Zhien Wang, University of Colorado, Boulder
Loren White, Jackson State University

EOL ISS Staff

ISS Lead Scientist: William Brown - wbrown@ucar.edu
Engineers: John Sobtzak, Gary Granger, Isabel Suhr, David Ortigoza
Technicians: Lou Verstraete, Elizabeth Bernhardt
Data Managers: Jacquelyn Witte <jwitte@ucar.edu>, Matt Paulus

Web References

SWEX Homepage: https://www.eol.ucar.edu/field_projects/swex
SWEX Field Catalog: https://catalog.eol.ucar.edu/swex
ISS Operations during SWEX: https://www.eol.ucar.edu/content/iss-operations-swex
ISS Homepage: https://www.eol.ucar.edu/observing_facilities/iss

Citations

If these data are used for research resulting in publications or presentations, please acknowledge EOL and NSF by including the following citations, as appropriate:

Ceilometer C31 Data Set

NCAR/EOL ISS Team. 2023. SWEX: ISS Ceilometer CL31 Data Products. Version 1.0. UCAR/NCAR - Earth Observing Laboratory. https://doi.org/10.26023/RB11-0HZ1-QV0F. Accessed 14 Mar 2023.

Ceilometer C51 Data Set

NCAR/EOL ISS Team. 2023. SWEX: ISS Ceilometer CL51 Data Products. Version 1.0. UCAR/NCAR - Earth Observing Laboratory. https://doi.org/10.26023/VY3V-71AR-150A. Accessed 14 Mar 2023.

Ceilometer C61 Data Set

NCAR/EOL ISS Team. 2023. SWEX: ISS Ceilometer CL61 Data Products. Version 1.0. UCAR/NCAR - Earth Observing Laboratory. https://doi.org/10.26023/AP30-C79D-6T0G. Accessed 14 Mar 2023.

The ISS Platform

UCAR/NCAR - Earth Observing Laboratory. (1997). NCAR Integrated Sounding System (ISS). UCAR/NCAR - Earth Observing Laboratory. https://doi.org/10.5065/D6348HF9

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Users of EOL data are expected to add the following acknowledgement to all of their publications, reports and conference papers that use those data:

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In the event that information from this document are used for publication or presentation purposes, please provide the above acknowledgement to NSF and NCAR/EOL and make reference to *Witte, J., (2023): SWEX 2022 NCAR/EOL ISS Ceilometer Products Data Report.*

Overview

The Sundowner Wind Experiment (SWEX) was conducted in the Santa Ynez Mountains in Santa Barbara County, California for the period 01 April - 15 May 2022. The Integrated Sounding System (ISS) operated three Vaisala ceilometers at three sites located near-coastal (Santa Barbara Fire Department Headquarters) and the interior mountain region (Rancho Alegre and UCSB Sedgwick Reserve).

Project time period: 01 April - 15 May 2022

Site Description

ISS operated three trailers of instrumentation at the Santa Barbara Fire Department Headquarters (SB Fire Dept), Rancho Alegre near Lake Cachuma, and the University of California, Santa Barbara (UCSB) Sedgwick Reserve. Refer to **Figure 1** and **Table 1** for a map and coordinates of the sites.

Ceilometer	Site	Latitude	Longitude	Elevation
CL61	SB Fire Dept (ISS1)	34.4527°N	119.7712°W	90.99 m
CL51	Rancho Alegre (ISS2)	34.5624°N	119.9505°W	284.45 m
CL31	Sedgwick Reserve (ISS3)	34.6874°N	120.0384°W	322.81 m

Table 1. General location and elevation of the ISS sites and ceilometer version.

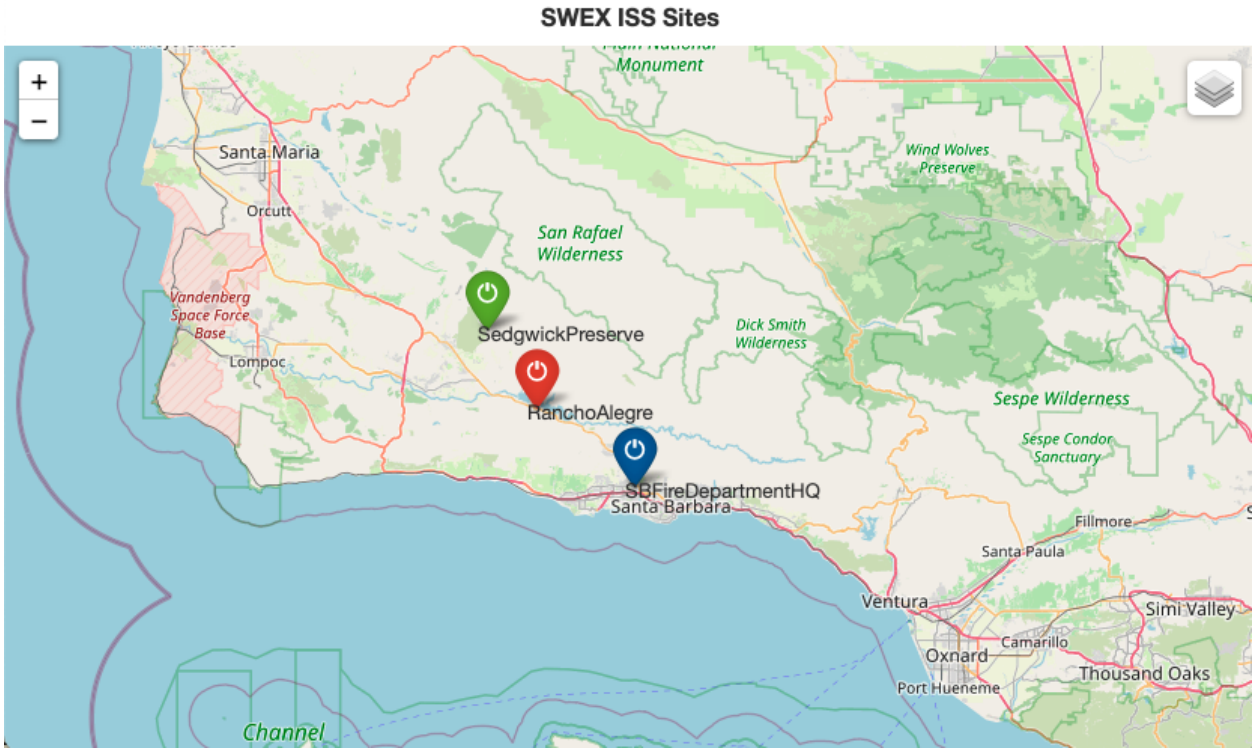

Figure 1. Map of the ISS sites relative to Santa Barbara, CA.

Instrument Description

Vaisala Ceilometers are commercial instruments designed to measure high-range cirrus cloud heights without surpassing the low and middle layer clouds, or vertical visibility in harsh conditions. In addition to basic ceilometer data reporting, the CL61 offers depolarization measurement that enables differentiation between solid, liquid, or mixed-phase clouds and precipitation. The CL61 is approximately 5 times more sensitive than the CL51. Refer to the instrument specifications for each version.

CL31 Instrument Fact Sheet:
https://www.vaisala.com/sites/default/files/documents/CL31-Datasheet-B210415EN.pdf

CL51 Instrument Fact Sheet:
https://www.vaisala.com/sites/default/files/documents/CL51-Datasheet-B210861EN.pdf

CL61 Instrument Fact Sheet:
https://www.vaisala.com/sites/default/files/documents/WEA-MET-WhitePaper-CL61-Applications-B212377EN-B.pdf

Photo 1. SB Fire Dept site where the Vaisala CL61 was deployed.

Photo 2. Rancho Alegre site where the Vaisala CL51 was deployed.

Photo 3. Sedgwick site where the Vaisala CL31 was deployed.

Data Set Description

	CL31		CL51		CL61
Site	Sedgwick		Rancho Alegre		SB Fire Dept
Format	raw ascii DAT	netCDF4	raw ascii DAT	netCDF4	netCDF4
File Frequency	6 hourly	Daily	6 hourly	Daily	5 minutes
Resolution	16 min		16 min		5 seconds

Table 2. Metadata for final, public data sets.

Data Collection and Processing

Data were stored directly to disk drives at the ISS base trailers and transmitted to servers at EOL for local storage and added back-up.

Ceilometer CL31 Data Processing

CL31 data was collected using CL-View software (version 2.0) which generates ascii formatted files (DAT) every 6 hours. These are also downloadable as a single tar file containing raw DAT files. The ascii DAT files are processed in near real-time by software known as MLH (Mixed Layer Height, version 2.2) to produce png plots and identify significant layers in the gradient of the backscatter profile (Eresmaa et.al., 2006). These png plots are 4-hourly plots of backscatter density and backscatter gradient and appear on the SWEX field catalog and ISS web page. Text files (txt) are also produced and report the average height of significant layers every 10 minutes.

The original ascii DAT files have been converted to netCDF4 daily files using the cl2nc python program converter. Access to the tool can be found at Github site: https://github.com/peterkuma/cl2nc. Refer to the Vaisala CL51 User's Guide for a complete description of the variables. The global attribute for the netCDF and hdf version are below. Refer to Appendix A for a complete list of netCDF metadata contents.

```
// global attributes:
            :_NCProperties =
"version=1|netcdflibversion=4.6.1|hdf5libversion=1.10.6" ;
            :software = "cl2nc (https://github.com/peterkuma/cl2nc)" ;
            :version = "3.3.1" ;
            :created = "2023-02-23T16:54:56Z" ;
```

The CL31 ceilometer functioned as expected with a few notable data gaps due to Windows operating system errors. Data gaps occurred for the following dates and time:

09 Apr 0700 - 1800 UT
19 Apr 0000 - 1700 UT
26 Apr 0000 - 2000 UT
03 May 0300 - 2300 UT

The time range coincided with local overnight hours when staff could not get to the site. When possible, ISS staff visited the Sedgwick site and performed a hard reboot on the computer and a manual restarts of CL-View MLH software.

netCDF daily plots are provided as previews on the cl31 data archive (see citations above). **Figure 2** is a daily plot during IOP1 (eastern sundowner event).

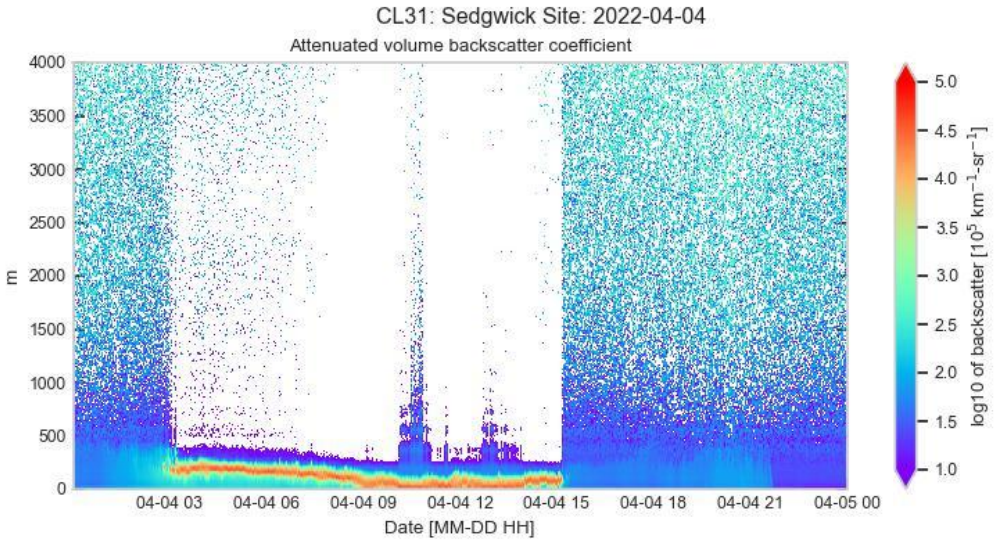

Figure 2. Daily plot of CL31 measurements during IOP01 (4 April 2022). Time is in UTC.

Raw ascii DAT plots at 4 hour intervals can be previewed online for:

- 4 hour AttenuatedBackscatter
- 4 hour Negative Gradients

Ceilometer CL51 Data Processing

CL51 data processing was performed by Boundary Layer View 2.0 Software (BL-VIEW) proprietary to Vaisala. BL-View generates an online visual representation of the mixing layer height (MLH, Eresmaa et.al., 2006). BL-View also uses an all-weather algorithm that takes into account possible precipitation and cloud events. The ceilometer and communication status is permanently displayed on the main screen so that possible operational warnings and alarms can be investigated. Link to Vaisala BL-View Data Sheet. The global attribute for the netCDF and hdf version are below.

```
// global attributes:
           :_NCProperties =
"version=1|netcdflibversion=4.4.1-rc2|hdf5libversion=1.8.17" ;
```

Raw CL-View ascii formatted data are also downloadable as a single tar file containing raw DAT files.

The CL51 ceilometer functioned as expected. There was a significant data gap from April 18 16:30 UT to April 19 16:00 UT. Comparisons with the 31 which operated nearby showed similar overlapping back-scatter properties in height and time. The BL-View algorithm reports cloud heights (to the base of the clouds), backscatter, and “boundary layer” heights, identified from gradients in the backscatter profile. Caution should be exercised in interpreting this data as the

actual planetary boundary layer, however comparisons with soundings do indicate that these layers do frequently coincide with potential temperature inversions and other significant levels in the atmosphere.

- Click here to preview CL51 daily plots
- Click here to preview CL51 4 hourly daily plots

An example of CL51 daily plot is in **Figure 3** during IOP1 (4 April 2022) defined as an eastern sundowner event.

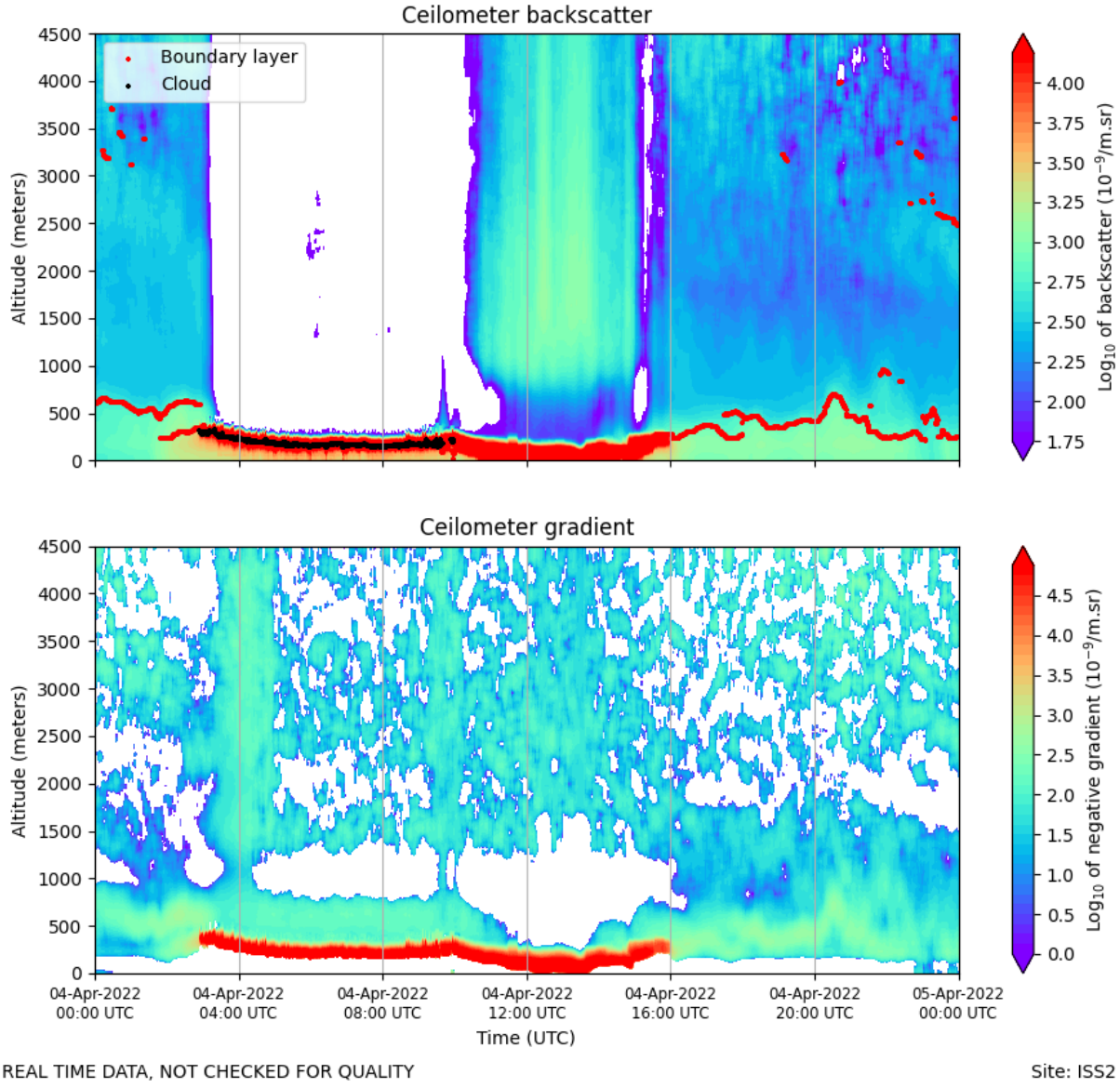

Figure 3. Daily plot of CL51 measurements during IOP1 (4 April 2022). The bold black dots indicate cloud bases, the bold red the mixing-layer height derived from Vaisala's automated algorithm.

Ceilometer CL61 Data Processing

CL61 data processing software is developed by Vaisala or third parties. The CL61 reports measurements in NetCDF format using CF-1.8 conventions. Refer to the global metadata attributes below:

```
// global attributes:
           :_NCProperties =
"version=1|netcdflibversion=4.4.1.1|hdf5libversion=1.8.18" ;
           :title = "CL61-D, Profiling Ceilometer, rev A" ;
           :conventions = "CF-1.8" ;
           :history = "1.0.0-rc1" ;
           :featureType = "profile" ;
           :unit = "m" ;
           :temporal span of this file in minutes = 5. ;
           :time between consecutive profiles in seconds = 5 ;
```

The CL61 ceilometer data is not currently processed by BL-View, so cloud and boundary layer data are not available. The CL61 data does include a depolarization channel which enables some determination of the nature of the particles the scattering occurred from.

An example of CL61 measurements from IOP01 is shown in **Figure 4**. Cloud base can be seen collapsing around 1200 UTC. Backscatter from spherical particles such as water cloud droplets, mist, fog and drizzle is not generally polarized so the depolarization ratio from these particles is close to zero. Rain, dust, smoke, snow, ice pellets, and graupel are non-spherical and thus have an increasingly polarized backscatter (see **Figure 5**).

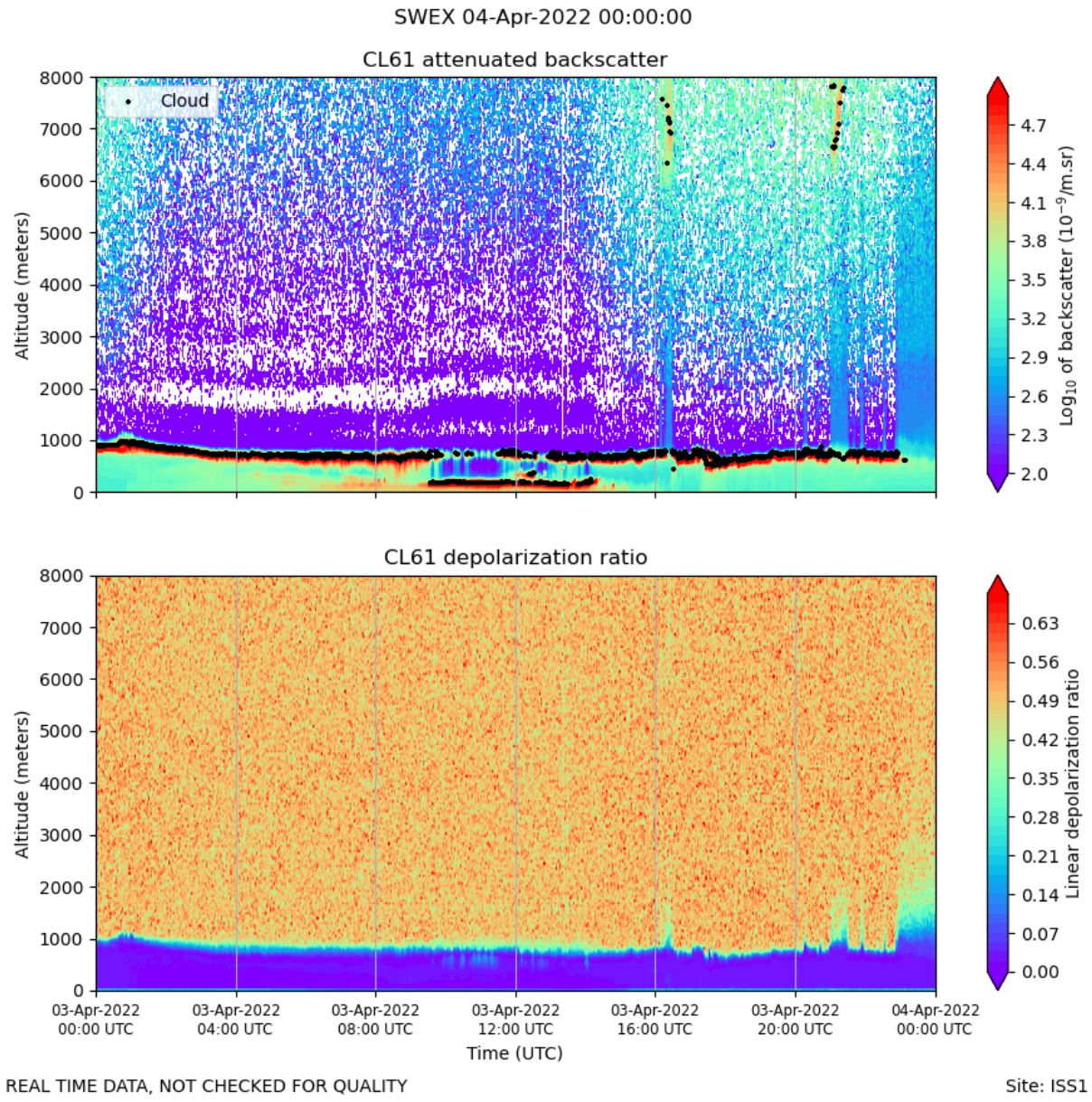

Figure 4: ISS CL61 measurements during IOP01.

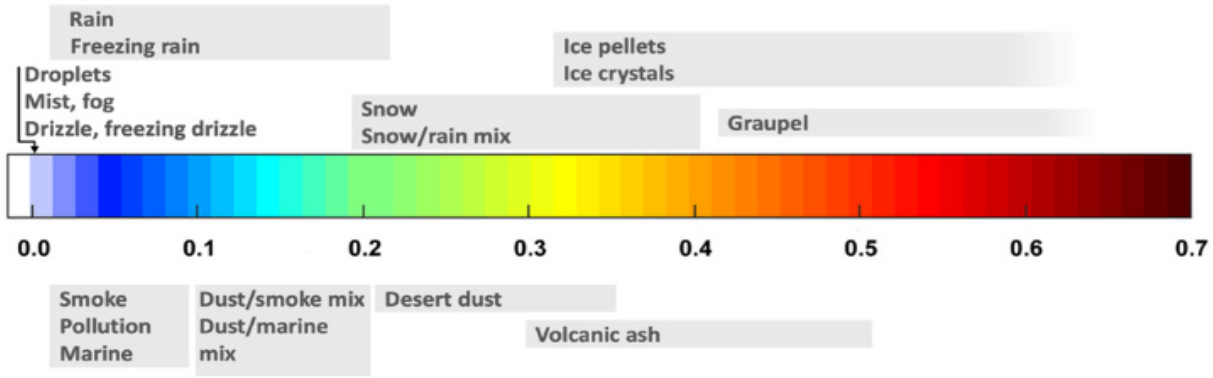

Figure 5: Typical depolarization ratios for a variety of atmospheric scattering conditions. Note that the color scale differs slightly to that in **Figure 4**. (Vaisala CL61 whitepaper).

Otherwise, the ceilometer functioned as expected. Minor data gaps of 5 minutes occurred for a few dates (April 2, 8, 13, 26, and May 13). There was a major data gap of about 2 hours on May 1st (**Figure 6**) that coincided with network issues. Fortunately, this data gap does not coincide with an IOP.

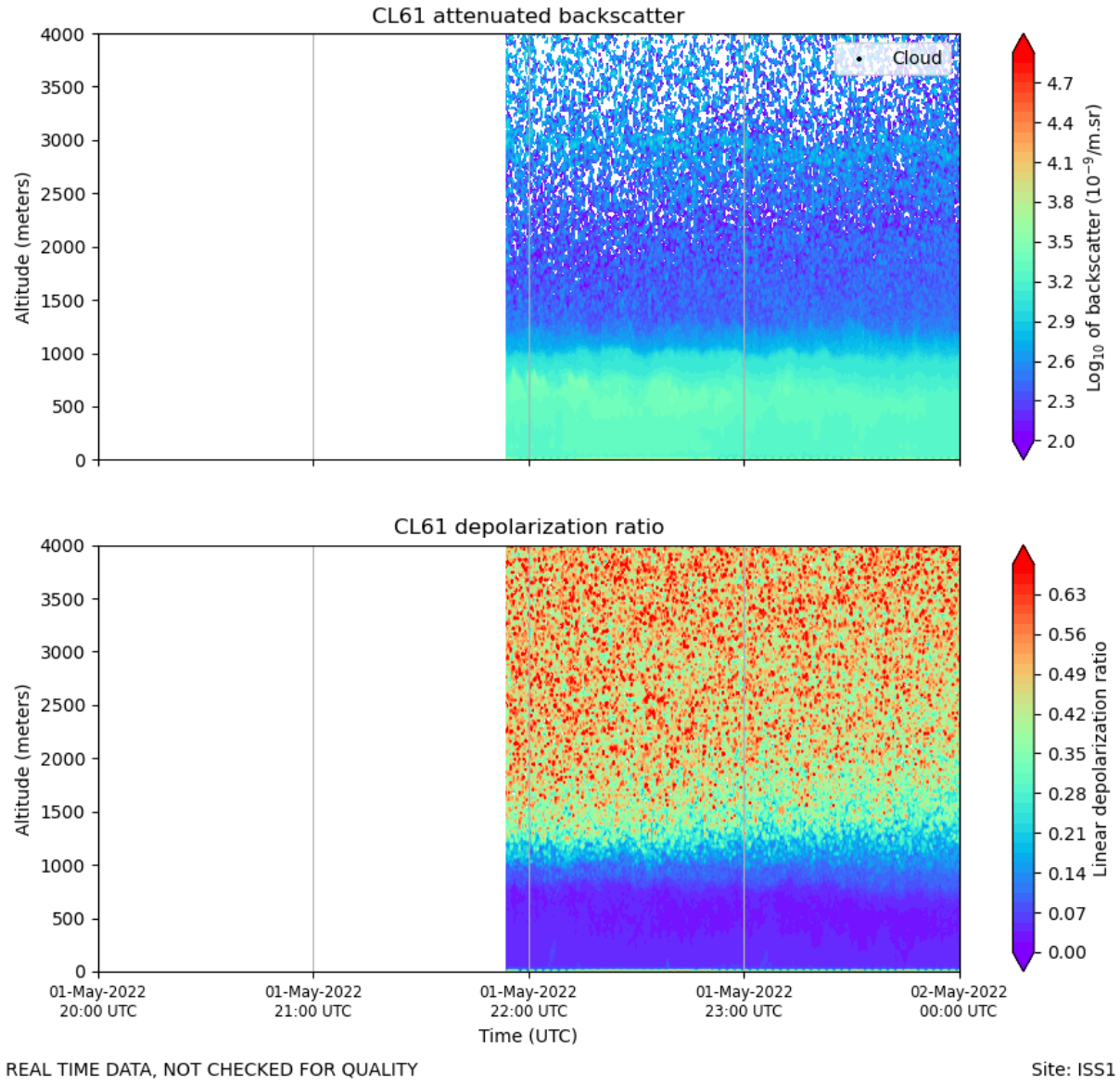

Figure 6. CL61 image for 1 May 2023 showing a significant data gap.

Qualitative comparisons with the CL51 which operated nearby showed similar overlapping back-scatter properties in height and time.

- Click here to preview CL61 daily plots
- Click here to preview CL61 4 hourly daily plots

Intensive Operating Periods (IOP)/Extended Operating Periods (EOP)

IOP1 - April 4-5 - Eastern Sundowner

IOP2 - April 6-7 - Eastern Sundowner occurring during hot/dry conditions preceding a weak Santa Ana.

IOP3 - April 13-14 - Western Sundowner

EOP1 - April 17 - Western Sundowner

IOP4 - April 18-19 - Western Sundowner

IOP5 - April 23-24 - Eastern Sundowner hybrid with strong winds in the east and west.

EOP2 - April 25-26 - Eastern Sundowner

IOP6 - April 28-29 - Western Sundowner

EOP3 - May 4-5 - Western Sundowner

IOP7 - May 7-8 - Western Sundowner

IOP8 - May 8-9 - Western Sundowner

IOP9 - May 10-11 - Western Sundowner

IOP10 - May 12-13 - Western Sundowner

References

Eresmaa, N., Karppinen, A., Joffre, S. M., Räsänen, J., and Talvitie, H.: Mixing height determination by ceilometer, Atmos. Chem. Phys., 6, 1485-1493, https://doi.org/10.5194/acp-6-1485-2006, 2006.

Appendix A: NetCDF metadata contents

CL31

```
netcdf iss3_swex_cl31_20220401 {
dimensions:
	time = 5400 ;
	level = 770 ;
	layer = 5 ;
	string1 = 1 ;
variables:
	string time_utc(time) ;
		time_utc:long_name = "Time (UTC)" ;
		time_utc:units = "ISO 8601" ;
	int64 time(time) ;
		time:long_name = "Time" ;
		time:units = "seconds since 2022-04-01 00:00:13" ;
		time:calendar = "proleptic_gregorian" ;
	int level(level) ;
		level:long_name = "Level number" ;
	int layer(layer) ;
		layer:long_name = "Layer number" ;
	float backscatter(time, level) ;
		backscatter:_FillValue = NaNf ;
		backscatter:long_name = "Attenuated volume backscatter coefficient"
;
		backscatter:units = "km^-1.sr^-1" ;
	char unit(time, string1) ;
		unit:long_name = "Unit identification character" ;
	int software_level(time) ;
		software_level:_FillValue = -2147483648 ;
		software_level:long_name = "Software level" ;
	int message_number(time) ;
		message_number:_FillValue = -2147483648 ;
		message_number:long_name = "Message number" ;
		message_number:flag_values = "1, 2" ;
		message_number:flag_meanings = "message_without_sky_condition_data
message_with_sky_condition_da
ta" ;
	int message_subclass(time) ;
		message_subclass:_FillValue = -2147483648 ;
		message_subclass:long_name = "Message subclass" ;
	char detection_status(time, string1) ;
		detection_status:long_name = "Detection status" ;
		detection_status:flag_values = "0, 1, 2, 3, 4, 5, /" ;
		detection_status:flag_meanings = "no_significant_backscatter
one_cloud_base_detected two_cloud_b
ases_detected three_cloud_bases_detected
full_obscuration_determined_but_no_cloud_base_detected some_obscuration
_detected_but_determined_to_be_transparent
raw_data_input_to_algorithm_missing_or_suspect" ;
```

```
      char self_check(time, string1) ;
            self_check:long_name = "Self check" ;
            self_check:flag_values = "0, W, A" ;
            self_check:flag_meanings = "self_check_ok warning_active
alarm_active" ;
      int vertical_visibility(time) ;
            vertical_visibility:_FillValue = -2147483648 ;
            vertical_visibility:long_name = "Vertical visibility" ;
            vertical_visibility:units = "m" ;
      int cbh_1(time) ;
            cbh_1:_FillValue = -2147483648 ;
            cbh_1:long_name = "Lowest cloud base height" ;
            cbh_1:units = "m" ;
      int cbh_2(time) ;
            cbh_2:_FillValue = -2147483648 ;
            cbh_2:long_name = "Second lowest cloud base height" ;
            cbh_2:units = "m" ;
      int cbh_3(time) ;
            cbh_3:_FillValue = -2147483648 ;
            cbh_3:long_name = "Highest cloud base height" ;
            cbh_3:units = "m" ;
      int highest_signal(time) ;
            highest_signal:_FillValue = -2147483648 ;
            highest_signal:long_name = "Highest signal detected" ;
      int status_alarm(time) ;
            status_alarm:_FillValue = -2147483648 ;
            status_alarm:long_name = "Status alarm" ;
      int status_warning(time) ;
            status_warning:_FillValue = -2147483648 ;
            status_warning:long_name = "Status warning" ;
            status_warning:units = "degree_Celsius" ;
      int status_internal(time) ;
            status_internal:_FillValue = -2147483648 ;
            status_internal:long_name = "Status internal" ;
      int vertical_resolution(time) ;
            vertical_resolution:_FillValue = -2147483648 ;
            vertical_resolution:long_name = "Vertical resolution" ;
            vertical_resolution:units = "m" ;
      int sky_detection_status(time) ;
            sky_detection_status:_FillValue = -2147483648 ;
            sky_detection_status:long_name = "Sky detection status" ;
            sky_detection_status:flag_values = "0, 1, 2, 3, 4, 5, 6, 7, 8, 9,
-1, 99" ;
            sky_detection_status:flag_meanings = "0_octas 1_octas 2_octas
3_octas 4_octas 5_octas 6_octas 7_
octas 8_octas vertical_visibility data_missing not_enough_data" ;
            sky_detection_status:comment = "Sky detection algorithm" ;
      int pulse_energy(time) ;
            pulse_energy:_FillValue = -2147483648 ;
            pulse_energy:long_name = "Pulse energy" ;
            pulse_energy:units = "percent" ;
            pulse_energy:comment = "Percentage of nominal factory setting" ;
```

```
      int laser_temperature(time) ;
            laser_temperature:_FillValue = -2147483648 ;
            laser_temperature:long_name = "Laser temperature" ;
            laser_temperature:units = "degree_Celsius" ;
      int window_transmission(time) ;
            window_transmission:_FillValue = -2147483648 ;
            window_transmission:long_name = "Window transmission estimate" ;
            window_transmission:units = "percent" ;
            window_transmission:comment = "90% to 100% means the window is
clean" ;
      int tilt_angle(time) ;
            tilt_angle:_FillValue = -2147483648 ;
            tilt_angle:long_name = "Tilt angle" ;
            tilt_angle:units = "degrees" ;
      int background_light(time) ;
            background_light:_FillValue = -2147483648 ;
            background_light:long_name = "Background light" ;
            background_light:units = "millivolt" ;
            background_light:comment = "Millivolts at internal ADC input" ;
      char pulse_length(time, string1) ;
            pulse_length:long_name = "Pulse length" ;
            pulse_length:flag_names = "L, S" ;
            pulse_length:flag_meanings = "long short" ;
      int pulse_count(time) ;
            pulse_count:_FillValue = -2147483648 ;
            pulse_count:long_name = "Pulse count" ;
            pulse_count:comment = "Number of pulses during a single measurement
cycle" ;
      char receiver_gain(time, string1) ;
            receiver_gain:long_name = "Receiver gain" ;
            receiver_gain:flag_values = "H, L" ;
            receiver_gain:flag_meanings = "high low" ;
            receiver_gain:comment = "High by default, may be low in fog or
heavy snow" ;
      char receiver_bandwidth(time, string1) ;
            receiver_bandwidth:long_name = "Receiver bandwidth" ;
            receiver_bandwidth:flag_values = "N, W" ;
            receiver_bandwidth:flag_meanings = "narrow wide" ;
      float backscatter_sum(time) ;
            backscatter_sum:_FillValue = NaNf ;
            backscatter_sum:long_name = "Backscatter sum" ;
            backscatter_sum:units = "sr^-1" ;
            backscatter_sum:comment = "Sum of detected and normalized
backscatter" ;
      int layer_height(time, layer) ;
            layer_height:_FillValue = -2147483648 ;
            layer_height:long_name = "Layer height" ;
            layer_height:units = "m" ;
            layer_height:comment = "Sky condition algorithm" ;
      int layer_cloud_amount(time, layer) ;
            layer_cloud_amount:_FillValue = -2147483648 ;
            layer_cloud_amount:long_name = "Layer cloud amount" ;
```

```
            layer_cloud_amount:units = "octas" ;
            layer_cloud_amount:comment = "Sky condition algorithm" ;

// global attributes:
            :_NCProperties =
"version=1|netcdflibversion=4.6.1|hdf5libversion=1.10.6" ;
            :software = "cl2nc (https://github.com/peterkuma/cl2nc)" ;
            :version = "3.3.1" ;
            :created = "2023-02-23T16:54:56Z" ;
```

CL51

```
netcdf iss2_swex_cl51_20220511 {
dimensions:
      time = UNLIMITED ; // (5388 currently)
      name = 1 ;
      date_stamp = 1 ;
      period = 1 ;
      Mean_Layer_Height = 1 ;
      Mean_Layer_QualityIndex = 1 ;
      Mean_Layer_Calculation_Time = 1 ;
      cloud_status = 1 ;
      cloud_data = 3 ;
      bl_height_length = 1 ;
      bl_index = 3 ;
      bl_height = 3 ;
      Bs_prof_length = 1 ;
      Ng_prof_length = 1 ;
      Ec_prof_length = 1 ;
      Ec_prof_range = 1 ;
      Ec_prof_opacity = 1 ;
      vrb_height_averaging = 1 ;
      vrb_time_averaging = 1 ;
      Height_averaging_param = 1 ;
      Time_averaging_period = 1 ;
      algorithm_sensitivity = 1 ;
      boundary_layer_min = 1 ;
      boundary_layer_max = 1 ;
      number_of_boundary_layers = 1 ;
      Location_latitude = 1 ;
      Location_longitude = 1 ;
      location_utc_offset = 1 ;
      Alogrithm_Method = 1 ;
      parameter_key = 1 ;
      sunrise_utc = 1 ;
      sunset_utc = 1 ;
      LevelTwoCount = 1 ;
      range = 450 ;
variables:
      int time(time) ;
            time:Units = "days since 1970-01-01 00:00:00.000" ;
```

```
            time:Type = "double" ;
            time:Dimension = "time" ;
            time:axis = "T" ;
      string name(time, name) ;
      string date_stamp(time, date_stamp) ;
      int period(time, period) ;
      int Mean_Layer_Height(time, Mean_Layer_Height) ;
      int Mean_Layer_QualityIndex(time, Mean_Layer_QualityIndex) ;
      int Mean_Layer_Calculation_Time(time, Mean_Layer_Calculation_Time) ;
      int cloud_status(time, cloud_status) ;
      int cloud_data(time, cloud_data) ;
      int bl_height_length(time, bl_height_length) ;
      int bl_index(time, bl_index) ;
      int bl_height(time, bl_height) ;
      int Bs_prof_length(time, Bs_prof_length) ;
      int Bs_profile_data(time, range) ;
      int Ng_prof_length(time, Ng_prof_length) ;
      int Ng_profile_data(time, range) ;
      int Ec_prof_length(time, Ec_prof_length) ;
      int Ec_profile_data(time, range) ;
      int Ec_prof_range(time, Ec_prof_range) ;
      int Ec_prof_opacity(time, Ec_prof_opacity) ;
      int vrb_height_averaging(time, vrb_height_averaging) ;
      int vrb_time_averaging(time, vrb_time_averaging) ;
      int Height_averaging_param(time, Height_averaging_param) ;
      int Time_averaging_period(time, Time_averaging_period) ;
      int algorithm_sensitivity(time, algorithm_sensitivity) ;
      int boundary_layer_min(time, boundary_layer_min) ;
      int boundary_layer_max(time, boundary_layer_max) ;
      int number_of_boundary_layers(time, number_of_boundary_layers) ;
      float Location_latitude(time, Location_latitude) ;
      float Location_longitude(time, Location_longitude) ;
      float location_utc_offset(time, location_utc_offset) ;
      int Alogrithm_Method(time, Alogrithm_Method) ;
      string parameter_key(time, parameter_key) ;
      float sunrise_utc(time, sunrise_utc) ;
      float sunset_utc(time, sunset_utc) ;
      int LevelTwoCount(time, LevelTwoCount) ;
      int range(range) ;

// global attributes:
            :_NCProperties =
"version=1|netcdflibversion=4.4.1-rc2|hdf5libversion=1.8.17" ;
            :site_location = "HelsinkiNE" ;
}
```

CL61

```
netcdf iss1_swex_cl61_20220428 {
dimensions:
      profile = UNLIMITED ; // (17280 currently)
      layer = 5 ;
      range = 3276 ;
```

```
variables:
      double cloud_base_heights(profile, layer) ;
            cloud_base_heights:units = "m" ;
            cloud_base_heights:long_name = "heights (range) of the detected
cloud bases" ;
            cloud_base_heights:coordinates = "time layer longitude latitutde" ;
      double vertical_visibility(profile) ;
            vertical_visibility:units = "m" ;
            vertical_visibility:long_name = "visibility in the direction of the
instrument beam" ;
      float p_pol(profile, range) ;
            p_pol:units = "m^-1.sr^-1" ;
            p_pol:long_name = "parallel-polarized component of the
backscattered light" ;
            p_pol:coordinates = "time range longitude latitutde" ;
            p_pol:averaging\ time\ in\ seconds = 5 ;
            p_pol:scaling = "linear" ;
      float x_pol(profile, range) ;
            x_pol:units = "m^-1.sr^-1" ;
            x_pol:long_name = "cross-polarized component of the backscattered
light" ;
            x_pol:coordinates = "time range longitude latitutde" ;
            x_pol:averaging\ time\ in\ seconds = 5 ;
            x_pol:scaling = "linear" ;
      float beta_att(profile, range) ;
            beta_att:units = "m^-1.sr^-1" ;
            beta_att:long_name = "attenuated volume backscatter coefficient" ;
            beta_att:coordinates = "time range longitude latitutde" ;
            beta_att:averaging\ time\ in\ seconds = 5 ;
            beta_att:scaling = "linear" ;
      float linear_depol_ratio(profile, range) ;
            linear_depol_ratio:long_name = "linear depolarisation ratio of the
backscatter volume" ;
            linear_depol_ratio:coordinates = "time range longitude latitutde" ;
            linear_depol_ratio:averaging\ time\ in\ seconds = 10 ;
      double time(profile) ;
            time:units = "seconds since 1970-01-01 00:00:00.000" ;
            time:long_name = "Time" ;
            time:axis = "T" ;
            time:standard_name = "time" ;
      double range(range) ;
            range:units = "m" ;
            range:long_name = "measurement distance from the instrument in the
direction of the transmitted
laser beam" ;
            range:axis = "Z" ;
            range:positive = "up" ;
      int layer(layer) ;
            layer:units = "layer" ;
            layer:long_name = "number of the observed cloud layer (1,2,...,5)"
;
      uint profile(profile) ;
```

```
            profile:cf_role = "profile_id" ;
            profile:long_name = "a running number which uniquely identifies the
profiles" ;
      double longitude(profile) ;
            longitude:units = "degrees_east" ;
            longitude:long_name = "longitude" ;
            longitude:standard_name = "longitude" ;
      double latitude(profile) ;
            latitude:units = "degrees_north" ;
            latitude:long_name = "latitude" ;
            latitude:standard_name = "latitude" ;
      double elevation(profile) ;
            elevation:units = "m" ;
            elevation:long_name = "elevation" ;
            elevation:standard_name = "ground_level_altitude" ;
            elevation:comment = "measurement site height above or below a fixed
reference point, most common
ly a reference geoid" ;
      double beta_att_sum(profile) ;
            beta_att_sum:units = "10^-4sr^-1" ;
            beta_att_sum:long_name = "scaled integral of the attenuated volume
backscatter coefficient" ;
      double beta_att_noise_level(profile) ;
            beta_att_noise_level:long_name = "a unitless number describing the
noise level of the attenuated
 volume backscatter coefficient" ;

// global attributes:
            :_NCProperties =
"version=1|netcdflibversion=4.4.1.1|hdf5libversion=1.8.18" ;
            :title = "CL61-D, Profiling Ceilometer, rev A" ;
            :institution = "" ;
            :source = "" ;
            :conventions = "CF-1.8" ;
            :history = "Tue Feb 21 15:14:03 2023: ncrcat … ;
            :comment = "" ;
            :featureType = "profile" ;
            :unit = "m" ;
            :temporal\ span\ of\ this\ file\ in\ minutes = 5. ;
            :time\ between\ consecutive\ profiles\ in\ seconds = 5 ;
            :NCO = "netCDF Operators version 4.7.5 (Homepage =
http://nco.sf.net, Code = http://github.com/n
co/nco)" ;
            :nco_openmp_thread_number = 1 ;

group: monitoring {

  // group attributes:
            :cl_overall = "OK: 0" ;
  } // group monitoring

group: diagnostics {
```

```
  // group attributes:
            :IsolDC_DC\(PFB\) = 1.623459f ;
            :\5V_ANALOG = 4.919252f ;
            :NC1 = 0.002f ;
            :p5VR = 5.038249f ;
            :p13VR = 13.23394f ;
            :m5VR = -5.015974f ;
            :m13VR = -13.65546f ;
            :p400V_R = 407.6786f ;
            :WINDOW_HEATER_BLW_CURRENTp = 1.105f ;
            :WINDOW_HEATER_BLW_CURRENTm = 0.684f ;
            :Window_heater_NTC = 0.46f ;
            :Laser_Tx_VCC_scaled = 21.22222f ;
            :MOTOR_VCC_SCALED = 21.44445f ;
            :TX_BLOWER_VCC_SCALED = 21.44445f ;
            :NC2 = 3.146f ;
            :NC3 = 1.715f ;
            :RX_spare = 0.f ;
            :VCC12_P = 11.92758f ;
            :APD_temperature = 0.f ;
            :TX_BLO_CUR_MEAS = 0.1774938f ;
            :MOTOR_VCC_CURRENT_DETECTION = 0.2480642f ;
            :LASER_TX_VCC_CURRENT_DETECTION = 0.0141995f ;
            :MOTOR123_VCC_12V = 11.91338f ;
            :LASER_TX_VCC_12V = 11.87788f ;
            :clomaccelerometermaccmtemperature = 32.34393f ;
            :clomaccelerometermaccmx = 0.9977778f ;
            :clomaccelerometermaccmy = -0.002407407f ;
            :clomaccelerometermaccmz = -0.05037037f ;
            :clomenvironmentalmsensormenvmhumidity = 24.398f ;
            :clomenvironmentalmsensormenvmpressure = 1003.652f ;
            :clomenvironmentalmsensormenvmtemperature = 32.78f ;
  } // group diagnostics
}
```