Standard Operating Procedures

Weather Station

This document describes the **Standard Operating Procedures (SOPs)** that must be applied to all weather station contributing measurements to the ACTRIS Cloud Remote Sensing Data Centre.

Every National Facility shall have a typical weather station including five measurements

1. 1TA : Air temperature
2. RH : Relative Humidity
3. PR : Precipitation Rate
4. WS : Wind Speed and direction

I. Site requirements

	Operation area : environment surrounding the instrument	• Surface: stable, solid and easily accessible installation area. • Open view within a cone of specified elevation angle from zenith to prevent obstacles such as buildings or trees. The objective is to have representative meteorological measurements around cloud-radar and disdrometers. • The prevailing wind direction is also important to find the optimal location of the disdrometer.
2	Instrumental set-up	To monitor precipitation rate: It should be a tipping bucket rain gauge or a weighing precipitation gauge. One heater has to be installed inside the rain gauge if negative temperature occurs at the National Facility. The rain gauge has to be installed at the same level as the cloud radar / disdrometer. For the other meteorological variables, two possibilities: • one compact weather station; • one standard weather station with different and identified sensor as recommended by met office;

		Temperature and relative humidity sensors have to be installed inside a specific multi-plate shelter at the same level as the cloud radar / disdrometer. Wind speed and wind direction should be representative of the dynamics around the cloud remote sensing instrument and disdrometer. Open field of view is very important and a set-up at several meters above the ground will be better. Anemometer and wind vane should be installed at 10m agl. The instrumental set-up concerning weather-station, disdrometer and cloud remote sensing instruments should be done in a very limited area, maximum some tens/hundreds of meters between each sensor. ● Disdrometer and rain gauge have to be very close: maximum 10-20m ● For the other meteorological variables (wind, temperature and humidity): the objective is to have a representative value around the cloud remote sensing site, some hundreds of meters can be accepted. ● Altitude difference between all the variables except for wind measurement should be smaller than 5m.
3	Internet and electrical power requirements	400W for electrical power and internet access for the datalogger (PC+software)
4	Comply with local Safety and Security Rules	

II. Operation modes

1	Intensive Observation Period or 24/7	Keep the instrument always on power.
2	Scanning modes	-
3	Data acquisition and logging	Data collection is ensured by a datalogger connected to a battery
4	Data, technical data, and metadata	Metadata and housekeeping data collection is ensured by the datalogger
5	Continuity	24/7
6	Time keeping and accuracy	Use UTC time zone (no changing with Summer Time), use ntp or GPS reference Accuracy around 1sec

III. Monitoring of system parameters

1	Instrument status dashboard(s) and (automatic) alert systems (applied on data and housekeeping data)	Objective: Quasi real time Technical data: heater OFF/ON.

		Geophysical data: min/max air temperature, relative humidity, atmospheric pressure, wind speed and precipitation rate Quality flag provided by weather station. System / data logger : free disk space
2	Housekeeping data threshold and available variability	
3	Web sites to access QLs	Time series of air temperature, relative humidity, atmospheric pressure, wind speed and precipitation rate
4	Visual inspection of instrument (e.g. remotely controlled camera)	A physical periodic check of the rain gauge is mandatory to ensure that the system is clean (especially for the rain-gauge). It should be documented and logged together with the metadata

IV. Data types and database connection

1	Measured variables	Air temperature, relative humidity, atmospheric pressure, wind speed and precipitation rate HouseKeeping data and/or status : internal quality flag, heater for rain gauge
2	Data format	Ascii file with data **and** header is OK, also the data file as Netcdf file with data and metadata is accepted. But no binary data files. See examples below to see the standard variable names that can be used
3	Temporal resolution of the data	1min to 10min
4	Temporal resolution of the metadata	1min to 10min
5	Variable accuracy	- for RH : ±3% for 0-90% RH, and ± 4% for 90-100% RH - for TA : ± 0.4°C for the range -40°C to +50°C - for wind direction : ± 2° for wind speed > 2m/s - for wind speed : ± 0.1m/s - for rain rate : resolution ≤ 0.2mm
6	Measurement range	- for TA : -40 to +80°C - for RH : 0 to 100% - for wind speed : 0 to 60 m/s - for wind direction : 0 to 360° - for rain rate : 0 to 100 mm/h
7	Raw data and metadata flow (including housekeeping data) implementation to the data center	-

V. Calibration

1	Retrieval of Calibration Parameters	Periodic evaluation of the precipitation rate and amount. Total amount of precipitation is compared to a well-known standard value with a moderate and standard precipitation rate
2	Characterization of measurement uncertainties	Yes for each tipping bucket and weighing system. Yes for the other sensors as recommended by the manufacturer (once per year for relative humidity sensor for example).
3	Calibration schedule (automatic and hands-on)	Calibration every 6 or 12 months for the rain gauge sensor made by Met-Office. Compact weather station such as Vaisala WXT has to follow the manufacturer recommendations, i.e one check up every year. The best option will be to have one spare compact weather station.
4	Detecting systematic errors during instrument operation	

VI. Maintenance schedule

1	Preventive maintenance	Cleaning the tipping bucket rain gauge or the weighing precipitation gauge every week. Cleaning the wind-speed sensor twice a year to ensure a good measurement of the flow.
2	Likely component replacements	
3	Likely software issues, software upgrades	Version numbering is crucial.

VII. Documentation

1	Synthesis of technical actions (e.g. on-line log book)	-
2	Procedure and technical documents	-
3	Web form	
4	Training guides	
5	Recording of maintenance actions	

Table 1. Minimum and optimum requirement for meteorological variables

Variables	Minimum requirement	Optimum requirement
Time resolution	*10min*	*1min*
Air temperature	*Average value*	*Minimum value*
Relative humidity	*Average value*	*Maximum value*
Wind speed	*Average value*	*Maximum value* *Average value*
Wind direction	*Average value*	*Average value*
Precipitation rate	*Sample value*	*Sample value*

Examples of raw txt file compatible with cloudnet processing available here :

- **for Palaiseau :** https://cloudnet.fmi.fi/instrument/73904193-1dac-4de5-9730-92656ab60eb9/raw-files?date=2024-09-03
- **for Granada :** https://cloudnet.fmi.fi/instrument/140918e8-99a6-47f3-bc24-67b086d81038/raw-files?date=2024-09-03
- **for Hyytiälä :** https://cloudnet.fmi.fi/instrument/80082867-c574-4f11-a8bb-d6d09e105e46/raw-files?date=2024-09-03

One example of raw netcdf file compatible with cloudnet processing is available here :

- **for Lindenberg :** https://cloudnet.fmi.fi/instrument/ffb25f43-330f-4793-bd6b-f2425cee0fd0/raw-files?date=2024-09-02