



Standard Operating Procedures

ALCs

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

I. Site requirements

1	Operation area : environment surrounding the instrument	Secure, stable, levelled-surface (e.g. concrete base). Open view to the sky (e.g. no tree branches).
2	Specific points of attention	It is recommended (not mandatory) to install ALC pointing northward and 3° off zenith. This is to minimize solar background radiation and specular reflection from ice clouds.
3	Reliability of internet and power (UPS)	required
4	Comply with local Safety and Security Rules	ALC operate eye-safe lasers that do not require specific security clearance in most cases. Regulations applicable for the specific measurement location should be checked.

II. Operation modes

1	Stability	
2	Scanning modes	no (ALC laser points into one fixed direction)
3	Ensure collection of data	Some specific to manufacturer Vaisala (all): • set message profile noise_h2 on • set option sky_cond on Vaisala CL31: • set message type msg2_10x770 or • set message type msg1_10x770 Vaisala CL51: • set message type msg2_10x1540 Vaisala CL61: • set message type msg2_10x1540 Lufft (all): • set NetcdfMode = 2 (when updating to firmware version >=1.05)

4	Ensure collection of metadata and housekeeping data	Integrated in data message
5	Continuity	24/7
6	Ensure accurate system clock and location	Use UTC if possible (no change with “Summer Time”), use ntpd or GPS reference. Careful: Some ALC have internal clock, some take the time stamp from the computer that they are connected to for data acquisition.
7	Ancillary measurements to be performed	not required
8	Recommendations to maximize good working order of the instrument	Clean window when window condition (housekeeping data) is less than ideal. Ensure most appropriate firmware is in use. Vaisala: • Second-generation hardware (CLE321) is recommended. • Firmware version ≥ 2.51 is recommended with CLE321 hardware. Lufft: • avoid firmware versions 1.05 and 1.06 • use of version ≥ 1.07 is recommended

III. Monitoring of system parameters

1	Instrument status dashboard(s) and (automatic) alert systems (applied on data and housekeeping data)	Keep all housekeeping data and check them regularly. Take warning messages and especially error messages seriously.
2	Housekeeping data threshold and available variability	depending on manufacturer
3	Visual inspection of instrument (e.g. remotely controlled camera)	Usually not needed

IV. Data types and database connection

1	Temporal resolution of the data	15s or 30 s
2	Temporal resolution of the metadata	same as data
3	Range resolution of the data	10 - 20 m

V. Calibration

1	Retrieval of Calibration Parameters	Absolute calibration of attenuated backscatter is performed in post-processing using the liquid cloud or the Rayleigh method
2	Characterization of measurement uncertainties	Measurement uncertainties depend on optical overlap in the near range and signal-to-noise ratio in higher ranges. Also, range-dependent signal distortion has been detected for some sensors which may require correction during post-processing. Both depend on instrument specifics and can even be affected by the firmware version.
3	Calibration schedule (automatic and hands-on)	No on-site calibration
4	Detecting systematic errors during instrument operation	A failing laser can cause deterioration of signal. laser power housekeeping data should hence be monitored continuously

VI. Maintenance schedule

1	Preventive maintenance	Clean window when window condition (housekeeping data) is less than ideal. Lufft ALC require replacement of drying agent.
2	Likely component replacements	Lifespan of lasers can vary (in order of ~ 5-8 years)
3	Likely software issues, software upgrades	Ensure firmware is appropriate for specific hardware. Always follow CCRES firmware update recommendations

VII. Documentation

1	Synthesis of technical actions (e.g. on-line log book)	- record dates of hardware and firmware updates
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