



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F510

Weather Monitoring and Field Meteorology

Standard Operating Procedure

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1. Purpose

This SOP describes procedures for recording weather and meteorological conditions during field activities. Documenting weather conditions at the time of sampling is essential for interpreting environmental data, identifying storm-driven events, establishing baseline climate conditions, and ensuring field safety. This SOP covers manual weather observations, use of portable weather instruments, and deployment of unattended data loggers for continuous monitoring (World Meteorological Organization, 2018).

2. Scope

- **Applies to:** All EA Program field activities where weather conditions may affect data interpretation, sample quality, or personnel safety; deployment and retrieval of portable weather stations and data loggers
- **Does not apply to:** Climate modeling or historical meteorological analysis; operation of fixed, permanently installed weather stations managed by other departments; air quality monitoring (see [SOP-F502](#))
- **Location:** All EA Program field sites

3. Responsibilities

Role	Responsibility
PI / Field Lead	Identify which weather variables are required for the project; approve deployment of data loggers
Trained Personnel	Record weather observations, deploy and retrieve loggers, download data
New Students	Complete training before independent use

4. Definitions

- **Beaufort scale:** A standardized scale (0–12) relating wind speed to observable effects on land or water; allows wind speed estimation without instruments; developed by Admiral Beaufort in 1805 and adopted as the international standard by the WMO (World Meteorological Organization, 2018).
- **Cloud cover:** The fraction of the sky obscured by clouds, expressed in tenths (0–10) or oktas (0–8); recorded with each manual weather observation (World Meteorological Organization, 2018).
- **Dew point:** The temperature to which air must be cooled at constant pressure for condensation to occur; a direct measure of absolute humidity; can be derived from wet-bulb temperature measurements (World Meteorological Organization, 2018).
- **HOBOnnect:** The Onset smartphone app used to program and download data from Bluetooth-enabled MX-series HOBO loggers (Onset Computer Corporation, 2021).
- **Kestrel meter:** A handheld weather meter (Kestrel 3000 or similar) that simultaneously measures air temperature, relative humidity, wind speed, barometric pressure, and derived quantities (dew point, wet-bulb temperature, heat index); the standard portable weather instrument for EA Program field use.
- **Radiation shield:** A ventilated white housing that surrounds a temperature or humidity sensor to prevent direct solar radiation from inflating measured air temperatures; mandatory for any sensor exposed to sunlight (World Meteorological Organization, 2018).
- **Relative humidity (RH):** The ratio of actual water vapor pressure to saturation vapor pressure at the same temperature, expressed as a percentage; affects evapotranspiration,

dew deposition, and physical and biological processes at field sites (World Meteorological Organization, 2018).

- **Screen height:** The standard height of 1.5 m above ground level for air temperature and humidity measurements; specified by the WMO to ensure comparability between stations and with published meteorological data (World Meteorological Organization, 2018).
- **Sling psychrometer:** A pair of wet-bulb and dry-bulb thermometers mounted on a frame that is swung to ventilate the sensors; used to determine relative humidity from the wet-bulb depression; a reliable low-cost alternative to electronic sensors.
- **WMO (World Meteorological Organization):** The United Nations agency responsible for international meteorological and hydrological standards; its Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8) is the authoritative reference for field measurement practice (World Meteorological Organization, 2018).

5. Safety and Hazards

Hazards

- **Lightning:** Cease all field activities and seek shelter in a vehicle or enclosed structure when lightning is observed. Wait at least 30 minutes after the last lightning strike before resuming.
- **Heat:** Southern California field sites can exceed 40 °C. Carry adequate water, take shade breaks, and monitor for heat-related illness.
- **Wind:** High winds can topple tripod-mounted instruments and create hazardous conditions near exposed ridgelines or water bodies.
- **Flooding:** Rapidly changing weather can cause flash flooding in Southern California canyons and channels. Monitor upstream conditions and have an evacuation route planned.

5.1. Required PPE

- ☐ Closed-toed shoes or field boots
- ☐ Sun protection (hat, sunscreen)

5.2. Emergency Procedures

Refer to [SOP-F001 Field Safety](#).

6. Equipment and Materials

Item	Notes
Kestrel 3000 or equivalent meter	For air temperature, RH, wind speed
Sling psychrometer	Backup for RH measurement

Item	Notes
Rain gauge (manual graduated cylinder)	For precipitation measurement
HOBO MX-series data logger	For unattended monitoring per SOP-F204
Radiation shield (RS3 or similar)	Required for any temperature sensor exposed to sunlight (World Meteorological Organization, 2018)
Compass	For wind direction measurement
Field notebook	Per SOP-F003

7. Procedure

7.1. Manual Weather Observations

Record weather conditions at the start and end of each field session, and at any time conditions change notably. Enter all observations in the field notebook per [SOP-F003](#) (World Meteorological Organization, 2018).

Variable	Method	Units
Air temperature	Kestrel, sling psychrometer, or digital thermometer at 1.5 m in shade	°C
Relative humidity	Kestrel or sling psychrometer	%
Wind speed	Kestrel or Beaufort scale estimate	m/s or Beaufort number
Wind direction	Compass bearing from which wind blows	degrees or cardinal direction
Cloud cover	Visual estimate	Tenths (0–10)
Cloud type	Identify dominant type	Name (cumulus, cirrus, etc.)
Precipitation	Observation and rain gauge	mm; note type (rain, drizzle, none)
Barometric pressure	Kestrel or smartphone app	hPa

Tip

If you do not have a weather instrument, still record qualitative observations. A note such as “clear sky, calm winds, warm” is far better than no record. Note the source of any online weather data (e.g., “NWS Ontario station, 08:00 reading”).

7.2. Beaufort Wind Scale (Quick Reference)

Beaufort	Description	Speed (m/s)	Visual Indicator
0	Calm	< 0.3	Smoke rises vertically
1	Light air	0.3–1.5	Smoke drifts
2	Light breeze	1.6–3.3	Leaves rustle
3	Gentle breeze	3.4–5.4	Leaves and twigs in motion
4	Moderate breeze	5.5–7.9	Small branches move; dust rises
5	Fresh breeze	8.0–10.7	Small trees sway
6	Strong breeze	10.8–13.8	Large branches in motion

(World Meteorological Organization, 2018)

7.3. Deploying Portable Data Loggers

1. Select a deployment location representative of site conditions and unlikely to be disturbed by people, animals, or flooding.
2. Mount temperature and humidity loggers inside a radiation shield at 1.5 m above ground per WMO screen height standards (World Meteorological Organization, 2018). Secure to a tripod, post, or tree.
3. Mount rain gauges on a level surface with no overhead obstructions. The gauge orifice should be approximately 1 m above ground.
4. Program the logger using the HOBOnnect app or HOBOWare software per [SOP-F204](#) (Onset Computer Corporation, 2021):
 - Logging interval: typically 5 or 15 minutes
 - Start mode: delayed start
 - Time zone: Pacific Time
5. Record in the field notebook: logger serial number, GPS coordinates, deployment date and time, logging interval, sensor height.
6. Photograph the deployed logger with surrounding context.

7.4. Retrieving Data from Loggers

1. Connect to the logger via Bluetooth (HOBOnnect) or USB cable (Onset Computer Corporation, 2021).
2. Download the data and save using the naming convention: `YYYY-MM-DD_SiteID_LoggerSN_weather.csv`
3. Do not clear the logger memory until you have verified the file contains the expected date range.
4. Upload the raw data file to the project GitHub repository under `data/weather/` within 48 hours.

7.5. Using Online Weather Data

When on-site instruments are unavailable, supplement field observations with data from nearby weather stations. Preferred sources for Southern California:

Source	URL
NWS	https://www.weather.gov
MesoWest / SynopticData	https://synopticdata.com/mesowest
CIMIS	https://cimis.water.ca.gov
Weather Underground	https://www.wunderground.com

Record the station name, distance from field site, and retrieval date in the field notebook and data file metadata.

8. Quality Control

- Cross-check manually recorded air temperature against the nearest reliable weather station (NWS or CIMIS). Discrepancies greater than 3 °C at similar elevation and time should be investigated (World Meteorological Organization, 2018).
- Inspect data loggers for drift by deploying two loggers side by side for at least 24 hours once per year. Temperature readings should agree within 0.5 °C; humidity within 5%.
- Check rain gauge calibration at least once per year by pouring a known volume of water through the gauge and comparing the logged total to the expected value.
- Flag any suspicious data (e.g., sudden temperature jumps, constant humidity at 100% for days) during data review and note the issue in the project data log.

9. References

- World Meteorological Organization (2018)
- Onset Computer Corporation (2023)
- Onset Computer Corporation (2021)

Onset Computer Corporation. (2021). *HOBOWare user's guide*. https://www.onsetcomp.com/files/manual_pdfs/10246-K-MAN-HOBOWare.pdf

Onset Computer Corporation. (2023). *HOBO U23 Pro v2 external temperature data logger: User manual*. <https://www.onsetcomp.com/products/data-loggers/u23-004>

World Meteorological Organization. (2018). *Guide to meteorological instruments and methods of observation (WMO-no. 8)* (2018th ed.). World Meteorological Organization. <https://library.wmo.int/idurl/4/41650>

10. Related SOPs

SOP	Title	Relationship
F001	Field Safety	Lightning and heat safety
F003	Field Notebook Protocols	Weather recorded in notebook

SOP	Title	Relationship
F006	GPS and Site Navigation	Logger deployment coordinates
F204	HOBO Weather Station Deployment	Detailed logger procedures
F501	Air Temperature Monitoring	Dense sensor network SOP
L801	RStudio and GitHub	Data file version control

11. Training Record

Before recording weather observations or deploying loggers independently, personnel must:

1. Read this SOP in full
2. Demonstrate correct use of a sling psychrometer or Kestrel meter
3. Demonstrate logger programming, deployment, and data download during a supervised field visit
4. Be signed off by the PI or field lead