NETLAKE Guidelines for automated monitoring system development

012 Station Maintenance

Objective

In this factsheet, we describe some of the considerations for maintaining an automatic monitoring station, and how to avoid the "rubbish in, rubbish out" scenario.

Considerations

The value of data collected by automatic sensors is entirely dependent on how the station is maintained, and how carefully the collected data is checked. This is especially true for longer deployments (multiple months to years), but even data from short deployments in eutrophic waters can be affected without careful maintenance.

- **How often can the station be visited?** If visits are going to be infrequent (i.e. lower frequency than monthly), then you are limited on what sensors can be used. Automatic wipers or pressured air cleaning may help here.
- **Do batteries need to be changed?** In northern latitudes, solar panels may not be able to recharge batteries – if you want measurements over winter, batteries may need to be swapped mid-winter.
- **How frequently do sensors need to be cleaned?** This depends on the sensor type, and the lake type. Sensor windows will get dirty in a matter of days or weeks, particularly in the summer. Underwater light sensors are particularly prone to biofouling. Recording of pre and post cleaning results will help define the rate of sensor fouling, and the optimal time between cleanings. Beware of bird fouling on sensors near the surface (or on the surface, such as meteorological instruments).
- **Regular calibration schedule?** It's better to calibrate sensors before problems become obvious if possible, and a routine calibration schedule will help this. E.g. calibrating multiparameter sondes, or individual sensors once a month is probably good practice. Manufacturers should be able to provide details here about regular used calibration. Maintain a log of calibration dates and results, this can be valuable for interpreting data latter on.
- **Calibration against standards:** For proxy sensors, calibration against standards serves two purposes: 1) enables quantification of the parameter of interest and 2) gives the user some idea of sensor drift. For example, calibrate chl fluorometers with serial dilutions of a spinach standard (see below), CDOM sensors with quinine sulphate, nephelometers with a turbidity standard and pH sensors with pH standards.
- **Manufacturer's calibrations:** Some sensors may need regular manufacturer's calibrations (e.g.CO_2, irradiance sensors) at a regular interval. Otherwise, a user calibration may highlight a drift issue, in which case sensors can be sent back to the factory. This can be expensive, and should be factored into your operating budget.
- **Weather conditions:** More applicable to some lakes than others. Check forecasts regularly, be conscious of the prevailing wind, and what is an ideal wind speed and direction for field work. Safety is paramount!
- **Collection of ancillary data to aid interpretation of sensor signals:** Don't rely totally

on sensor information. Use your maintenance visits to collect other data to support the monitoring effort: e.g. Secchi disk and water temperature readings, water samples for chl a extraction, grab samples for turbidity, nutrients, DOC, etc. For stream stations make independent measurements of stage height discharge and water temperature. For meteorological data make an independent measurement of air temperature and a visual check on wind direction. While these measurement may seem unnecessary at the time they can easily be incorporated into your maintenance visits, and they are invaluable for confirming and strengthening patterns shown in the sensor data.

Example

This is the maintenance schedule for the Furnace AWQMS:
http://burrishoole.marine.ie/FurnaceLake.aspx

Item	Time period
Check real time data	Once a day
Clean sensors	Every other week
Calibrate multiparameter sonde (DO, conductivity, pH)	Once a month
Take spot samples for comparison with sensor data	Once a month
Visually check moorings	Once a year
Check sensors against a standard (e.g. chl flourometer, CDOM)	Once a year
Software upgrades	Once a year
Strip winch, check and regrease all components	Once a year
Change batteries	As required
Emergency visits	As required

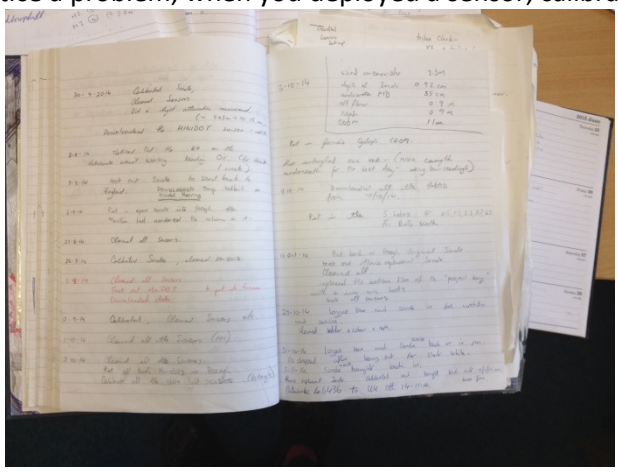
Likely Problems (and solutions)

- Power supply goes (batteries flat – especially in winter if they are charged with solar power)
  - add more solar panels, add more batteries, reduce sampling frequency, change batteries more frequently, reduce station power consumption.
- Sensor window is dirty
  - Clean more regularly with cotton buds / brushes
  - Add automatic cleaning (e.g. wipers, pressured air) to your sensors
- Sensor is drifting
  - Manual calibration if possible
  - Return to manufacturer if necessary
- Moorings break
  - Have more than one mooring to prevent total loss of equipment
  - Check mooring regularly
  - Redo moorings with stronger ropes and chains
- Wires leading from sensor to logger wear in one patch (usually when attached with cable ties)
  - Check regularly

  - Wrap wires in protective sheath (garden hose) where they are fixed
  - Look for the cause of the wear and try an fix wires in a way that prevents wear
- Bad weather means maintenance visits are limited
  - Watch weather forecasts really carefully ☺
- Sensors stop working altogether
  - Return to manufacturer
  - Check battery power – low battery is the most common reason that everything stops working

Top Tips

- Keep a maintenance log where you record EVERYTHING related to the station (maintenance visit, when you notice a problem, when you deployed a sensor, calibration notes)



- Get to know what your data should look like – minimum, maximum etc
- If cost allows, station maintenance is greatly enhanced by having remote data download.
- Take a look at summary data regularly, so that errors can be picked up, and data loss is minimized.

More information

http://www.sigmaaldrich.com/catalog/product/sigma/c5753?lang=en&region=LV (spinach standard)
http://toh.ie/paradigm/ (to manage multiple systems and sensors)

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