Flux Stations 101

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Tuesday 2nd February 2010

Overview

What is a flux station?

Instruments

Installation

Day to day running

What is a flux station?

A flux station comprises a core collection of instruments that measure:

- CO_2 and H_2O concentrations in air (10 or 20Hz)
- 3-D wind vector (10 or 20Hz)
- Net radiation (15 min average)
- Incoming and reflected longwave & shortwave radiation (15 minute average)
- RH and air temperature (15 minute average)
- 2-D wind speed and direction (15 minute average)
- Soil temperature (15 minute average)
- Soil heat flux (15 minute average)
- Rainfall

What is a flux station?

Optional instrumentation:

- Soil moisture profile (TDR, capacitance)
- CO_2 and H_2O concentration profiles through & above canopy
- Temperature profile through & above canopy
- Spectrometer (plant canopy reflectance spectra)
- Particle counter (VOC's, dust)
- Gas isotope measurements
- Etc., etc., etc.

The primary limitations on adding instrumentation are:

- Power requirements
- Sanity of those looking after the instruments and collected data

What is a flux station?

A flux station measures the surface flux of CO_2 and H_2O using eddy correlation.

Fluxes are calculated by correlating 3-dimensional air movement with changing concentrations of CO_2 and H_2O.

OzFlux "standard" flux stations use a CSAT 3-D sonic anemometer to measure wind vector and a Licor 7500 open path IRGA to measure CO_2 and H_2O concentrations (10Hz).

Fluxes of CO_2 and H_2O calculated using software developed for the Campbell CR3000 data logger.

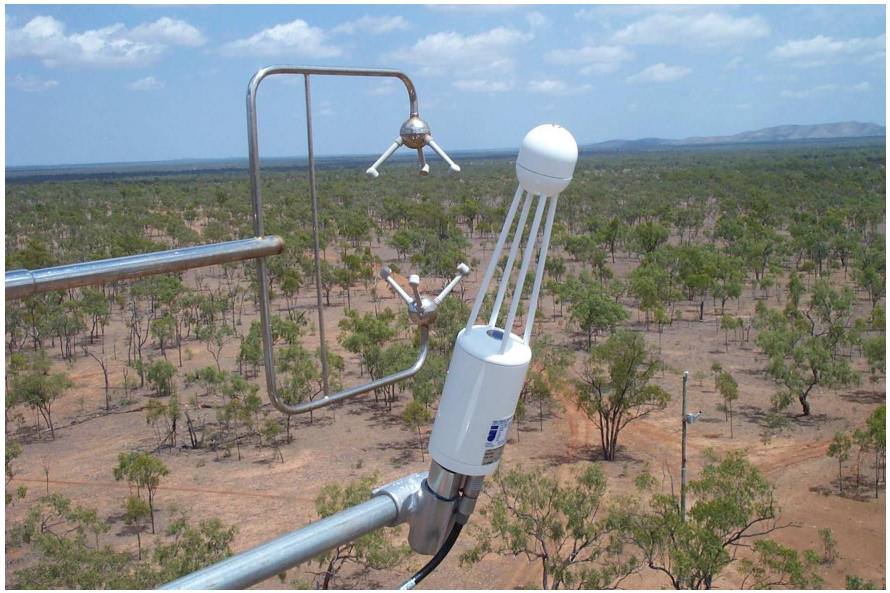
Core Instruments (10 Hz data stream)

Campbell CSAT-3 sonic anemometer (3-D wind speed)

- Mounted at top of mast
- Mount to minimise wind flow obstructions (point upwind to predominant wind direction at site)

Licor 7500 IRGA (H_2O and CO_2 concentrations)

- Mount adjacent to CSAT-3



Core Instruments (met data 1)

Radiation sensors

- Net radiometer (Kipp & Zonen CNR1)
- Net radiometer (Kipp & Zonen NR Lite)

CNR1 data stream includes both longwave and shortwave components

Use second net radiometer (NR Lite) as quality control and backup

Mount radiometers high to avoid shadows, orient towards north

Core Instruments (met data 2)

Wind

- Gill WindSonic - 2D wind speed and direction
- Quality control of CSAT-3 data

Mount at top of mast – minimise wind flow interference

Wind vane and cup anemometer as alternatives

WindSonic in our experience is very robust – no moving parts to wear, and does not require calibration

Core Instruments (met data 3)

Relative Humidity, Air Temperature & Rainfall

- Vaisala RH & T sensor
- Tipping bucket rain gauge

Ideally RH & T sensor should be aspirated

Rain gauge ground mounted and positioned to minimise rain shadowing

Core Instruments (soil)

Soil Temperature

- Averaging soil thermocouples

Soil Heat Flux

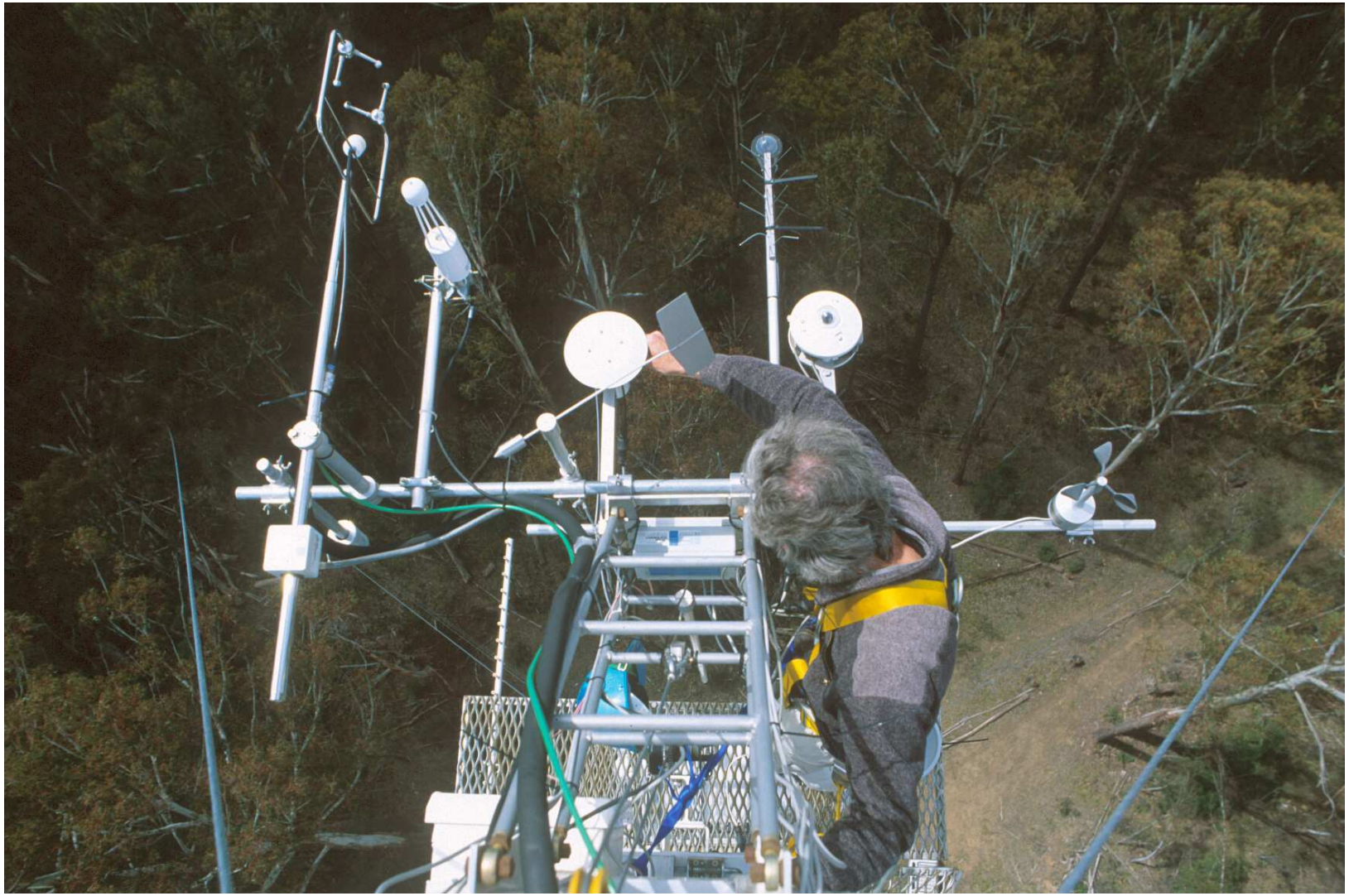
- Soil heat flux plate

Soil Water Content

- Campbell CS616 3-wire probe

Position all probes to exclude shadows from sun and rainfall shadowing

Mounting mast instruments



Mounting mast instruments

Compromise between minimising unwanted interference and maximising serviceability

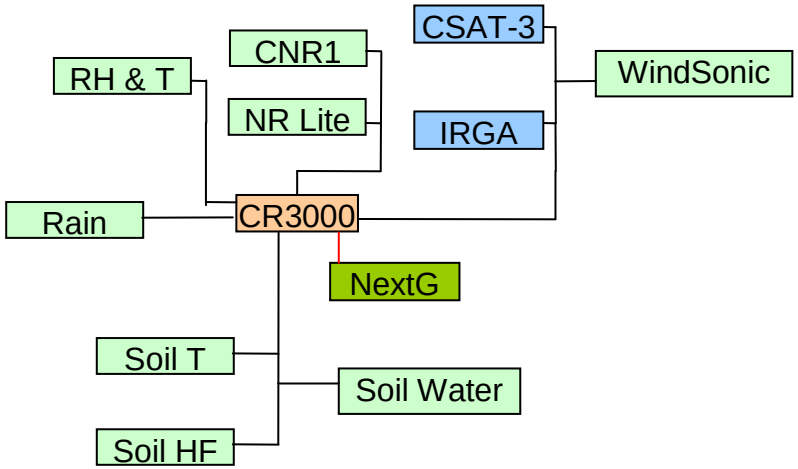
Instrument mounting must be secure

Regularly serviced/replaced instruments must be easily mountable – including data & power connections

Corrosion, weathering, and flux predators (any lifeforms with teeth or beak and a predilection to chew) are the primary concerns for long term maintenance

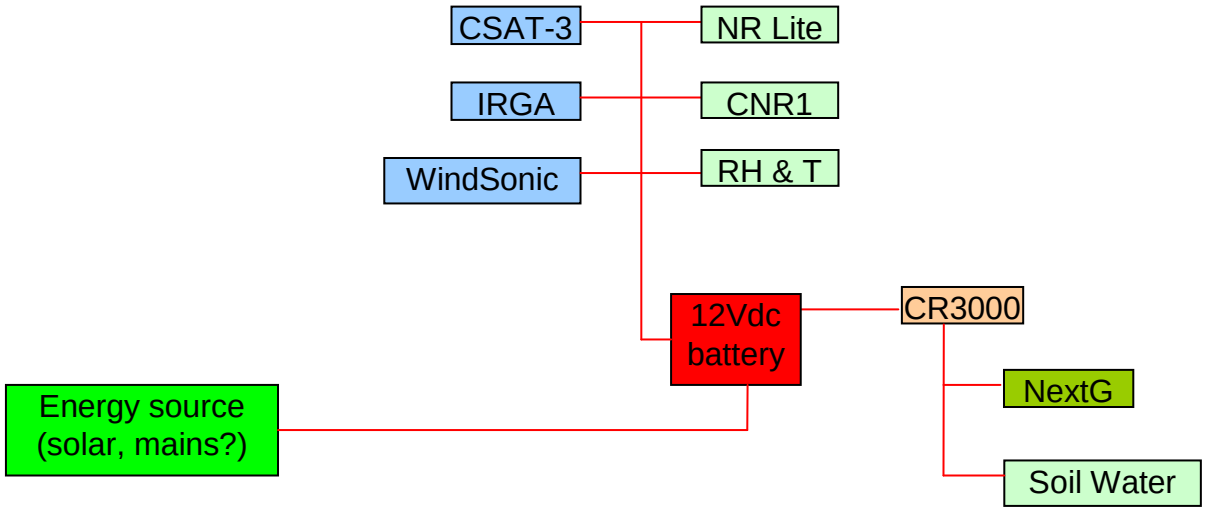
OzFlux flux station instrument schematics 1

Data stream



OzFlux flux station instrument schematics 2

Power



Typical flux station power consumption ~ 15 to 35 Watts

Communications

Mobile phone

- Most common solution
- Requires cell coverage – high gain antenna may be necessary
- Use CR3000 to schedule modem power to conserve energy

Satellite

- Expensive and slow
- Coverage Australia wide (problems under dense canopies)

Land-line

- If available may provide best speeds and reliability

Day to day operation

Data downloads

- Schedule regularly – daily is optimal
- Basic processing to determine status of instruments

Regular maintenance

- Instrument calibrations
- Mast inspections (every visit)
- Data & power cabling – check for damage and weathering
- Rain gauge cleaning
- Clean radiation sensor lenses

Conclusion

This is a very brief introduction to the science & art of flux stations. Major points are:

- Flux stations require constant attention
- An ounce of prevention (well planned setup and installation) will prevent a ton of problems and difficulties down the track

Use the flux community to help with problems and difficulties – there are very willing and experienced users who will wax lyrical on all things flux-y