

## 3.9 Data logger

Unlike in the case of using the turbulent fluctuation method to measure flux (Chapter 2), micro-meteorological observations require no high-speed sampling data loggers. Data loggers are chosen by taking into account factors such as kinds of signal output from the sensors and power consumption.

### Types of instruments

Data loggers are roughly classified into two types: a multi-channel type that handles various output signals (e.g., voltage and pulse) sent from a sensor; and a single-function type that is equipped with a sensor or that registers one kind of signal.

Multi-channel data loggers are commercially available from many manufacturers in various styles, among which are the CR800 and CR1000 (both by Campbell Scientific Inc., US); the CADAC2 (previous model) and CADAC21 (both by Eto denki Coporation, Japan); and; GL220 and GL820 (both by GRAPHTEC Corporation, Japan). The CR1000, CADAC21 and GL-820 are introduced below.

#### CR1000

Its power consumption is quite low (0.6 mA for a 1 Hz sampling). Its memory capacity is 4 MB. With an optional compact flash (CF) module (CFM100), data can be stored on a CF card. It communicates with a PC through RS-232C or a dedicated cable (optional) to recover data, transfer control programs and adjust settings by means of specific software. The logger is able to respond to digital output sensors. Under a command of a programming language called CRBasic, the measuring interval and applied voltage are controlled at ease. The logger is so versatile and extensible as to increase the number of channels and to achieve relay control simply by adding options.

#### CADAC21

To activate the logger, a scan unit (MODEL 9220A ~ 9223A) is connected to the main unit (9201A). Through RS-232C or an Ethernet connection (optional at shipping), the logger communicates with a PC for unit control and data transmission. The memory capacity is 8MB. If there are many measuring channels, the volume of data may be excessive, in which case the data can be saved on an always connected PC. With additional scan units, up to 80 measuring channels are available. Measuring intervals can be adjusted with the help of supplementary software. Even beginners are able to handle the logger without difficulty.

#### GL820

A stand-alone logger has 20 channels and it is scalable up to 200 channels. It is competitive in price comparing to the above mentioned two loggers however its measurement accuracy can be low depending

on types of input signals.

Many handy single-function loggers are commercially available at reasonable prices. The Data Mini series (Hioki E.E. Corporation, Japan) is introduced briefly below.

#### Data Mini

There are several models of Data Mini, such as the VOLTAGE LOGGER 3635 (discontinued model), LR5041, LR5042, LR5043 and the Pulse Logger LR5061. Some are equipped with temperature and humidity sensors (TEMPERATURE LOGGER 3632, LR5011 and LR5001); thus, different loggers can be used for different tasks. Measuring intervals can be adjusted easily by the button on the face of the logger or by the software provided by the manufacturer. To recover data, however, they have to be collected from each logger; by means of a dedicated data collector, COMMUNICATION BASE 3911, 3912, COMMUNICATION ADAPTER LR5091 and DATA COLLECTOR LR5092; and fed into a PC.

#### Tips!

To carry out measurement extensively using a small output sensor such as a PAR sensor, the VOLTAGE LOGGER 3645 (discontinued model) is used. Setting the measuring range to 50 mV (indicated resolution of 0.01 mV) and turning off the preheat signal function realize cost-effective multi-point observations with a short cable.

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### Selection point

Generally the output range of pyranometers and other radio meters such as PAR sensors is as low as between 0 and 10mV. Data loggers that have accuracy to accord with them should be selected. The quantum sensor (LI-190B) produced by LI-COR, Inc., US, for example, has a voltage output range between 0 and 10 mV, which corresponds to between 0 and 3,000  $\mu\text{molm}^{-2}\text{s}^{-1}$  of photons. If a given data logger has a resolution of 1mV, its physical value is equivalent to a resolution of only 300  $\mu\text{molm}^{-2}\text{s}^{-1}$ . Thus, a data logger with a resolution of 0.01 mV or so must be chosen.

In order to take advantage of measurement precision of a sensor, its measurement accuracy as well as its resolution should be taken into consideration.

Some instruments, such as resistance thermometers, need applied voltage and preheating (to turn on the electricity for a few seconds before measurement). For these instruments, loggers capable of controlling applied voltage and preheating should be selected to facilitate measurement and reduce power consumption.