# Observation Planning and the Selection of Flux Observation Sites

# 1.1 The observation site

This section describes how to select appropriate sites for performing long-term, continuous observations of energy and CO<sub>2</sub> fluxes.

# **Basic concept**

When selecting a site, you must clarify the purpose of your proposed observation by answering the question: In what type of ecosystems will these flux measurements be taken? Specifically, you must determine the following required conditions beforehand: vegetation type (dominant species), density, height, and age; climatic conditions; soil characteristics; potential disruptions in the ecosystem due to natural causes; and potential disruptions in the ecosystem because of man-made changes such as tree trimming or land development. Then, search for an appropriate observation site based on these variables. Careful site selection is important as it can profoundly affect the validity of your observational data; preliminary studies on possible observation sites are worthwhile.

Flux measurements performed using the eddy covariance method postulate fewer atmospheric or land-surface condition as compared to those performed using other micrometeorological methods. However, the eddy covariance method does require that there is a flat terrain and homogeneous vegetation in the windward side of the observation point (Schmid, 1997).

### **Preparation**

Select candidate observation sites based on information collected from the following: topographic maps, vegetation maps, aerial photography, satellite images, land use maps, forest management maps, data on climate and hydrological conditions, and history of land use and management. With respect to climatic conditions, studying the speed and direction of prevailing winds and changes in their daily and seasonal patterns helps to determine the most appropriate site for flux measurements and sensor positioning. Practically, it is necessary to collect information on land ownership, land-use rights, and building restrictions. It is also important to find out the social structure and security of the area from people who are familiar with the surrounding region. At the same time, draw up an observation plan that specifies the observation period, methods for managing vegetation, manpower requirement, methods employed for data collection, data usage, and procedures for making the data publically available, as well as any relation between your study and other flux observation studies.

# Tips!

Flux measurement studies require two full-time staff members for each observation site (Baldocchi *et al.*, 1996). Additional staff members are required for the measurement of other items such as micrometeorological variables. Advances in measurement equipment have reduced the need of maintenance, and thus number of staff. Even then, it is better to avoid working alone in high places on a tower.

Tips 1.1-1

# Selecting a flux measurement point

When candidate sites have been identified, you should reconnoiter them, and if possible, view them from above. Select an appropriate observation point (to set up a tower or pole) and ensure that there is a vast expanse of flat terrain and homogeneous vegetation on its windward side. It is desirable to set the flux measurement height at least twice as the vegetation height. However, due to technical limitations and micrometeological-footprint restrictions (see section that contributes to the observed flux: 1.2.2, "Tower construction and maintenance"), the height of the flux measurement might be lowered in some instances.

Avoid areas that have artificial facilities, such as buildings and power transmission lines or areas that have cars and other traffic facilities nearby. This is because gas emissions from traffic and electrical noise can invalidate your observational data. It is ideal to have an areal allowance of the same ecosystem for conducting ecological and pedological surveys, which would disturb vegetation and soil but without affecting flux observation. In most of the Asian countries, it is not rare that agricultural areas other than permanent grasslands are managed in sections of one hectare or less. Each section may use a different management method, and this can have an adverse effect on the observation results. It is important to take this factor into consideration when conducting a preliminary survey on an observation site.

### Access

It is desirable that there is a road leading to the observation tower so that heavy equipment can be carried into the tower for maintenance. Where there is no road, one should be built, or if it is difficult to build a road because of strict restrictions on the use of roads or due to steep slopes, installing a monorail is a good option. However, since emissions from vehicles can adversely affect observation results, it is necessary to have some restrictions on traffic.

# Remote site

There are some areas that are difficult for people to access, but they must be observed as they are considered important ecosystems. We call an observation site installed in such an area as a "remote site". What steps must be taken to conduct a long-term survey at such remote sites? It is impossible to install commercial power lines in such locations. Access is also extremely inconvenient. To enable observational

studies in such an area, we should first plan how to address problems with the living environment, such as problems relating to transportation and accommodation.

Obtaining the cooperation of local residents is also essential for conducting a successful study. Prior preparation is ideal as it ensures that many obstacles are removed before the study begins. Continuous year-round observation is ideal in principle, in many cases however, that is not always possible due to limited budgets, human resources and electric power supply. In such case, we should reduce the number of



Photo 1.1-1 A supportive year-round weather station. (Tura, Russia)

observation items and the duration of observation to secure the indispensable data. Moreover, it is desirable to set up an additional weather station in a readily accessible location where security and electric power for collecting supportive meteorological data throughout the year (Photo 1.1-1).