# Chapter 2
# Observational Method


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**Abstract** Observations introduced into this book include current and wave observations mainly using WavesADCP, meteorological observation using an anemometer, and water quality observation using a portable multi-item water quality meter. This chapter presents a description of these observational methods.

**Keywords** Field observation · Ocean current · Temperature · Wave · Wind

## 2.1 Current Velocity and Wave Observation

WavesADCP was used for observation of current velocity and waves in studies introduced in this book. An Acoustic Doppler Current Profiler (ADCP), an ultrasonic current meter using the Doppler effect is upgraded to WavesADCP by augmentation with simultaneous observations of waves.

The WavesADCP employed for this study (Workhorse Sentinel; Teledyne RD Instruments Inc.). This WavesADCP operates at a frequency of 600 kHz and simultaneously emits four beams at beam angles of 20°. It has measurement accuracy of ±0.3% or ±0.3 cm/s, resolution of 0.1 cm/s, a current measurement range of ±5 m/s (standard) and ±20 m/s (maximum), and maximum measurement range of 66 m. A WavesADCP can also measure water temperature with an equipped water thermometer.

Layer thickness was set to 50 cm. The ensemble interval was set to 10 min (100 measurements during this period) for the acquisition of high-resolution data. The error of measurement of current velocity assumed from this setting was 0.01 m/s.

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**Fig. 2.1** Observation sites

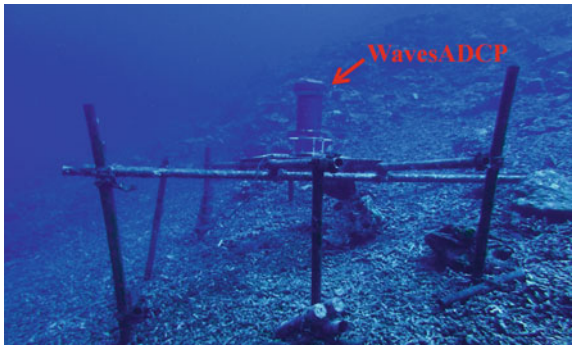


**Fig. 2.2** Installation of WavesADCP

We constructed a solid frame that maintains a level necessary for high-precision observation and which can bear a strong current at the time of a typhoon on the sea bottom (12.4 m average water depth) of observation site A, as presented in Fig. 2.1. We installed WavesADCP described in Fig. 2.2.

## 2.2 Meteorological Observation

Meteorological observations were conducted at point B shown in Fig. 2.1 using an analog weather signal recording system (CR1000; Campbell Scientific Inc.), a humidity and temperature probe (1CVS-HMP155D-JM; Vaisala), a rain gauge (CTK-15 PC-JM; Climatec Inc.), and a marine wind monitor (CYG-5106; R. M. Young Co.) (Fig. 2.3). The anemometer is 4.2 m above the top plate of the landing bridge shown in Fig. 2.4 to the center of the windmill. The data logging interval of these observation instruments is 10 min.

**Fig. 2.3** Analog weather signal recording system (CR1000), Hygrothermograph (1CVS-HMP155D-JM) and Rain gauge (CTK-15PC-JM)

**Fig. 2.4** Anemometer (CYG-5106)

## 2.3 Water Quality Observation

A portable multi-item water quality meter (RINKO-Profiler ASTD102; JFE Advantech Co. Ltd.) (Fig. 2.5) was used in this study for water quality observations, which can simultaneously measure DO, turbidity, and chlorophyll as well as the water depth, water temperature, and salinity according to the specifications presented in Table 2.1.

**Fig. 2.5** Portable multi-item water quality meter

**Table 2.1** Profiler specifications (RINKO-Profiler ASTD102)

| Measurement items | Depth | Water temperature | Electric conductivity | Salinity | DO | Chlorophyll | Turbidity |
|---|---|---|---|---|---|---|---|
| Sensor type | Semiconductor pressure sensor | Thermistor | Electrode | Practical salinity | Phosphorescence | Fluorometer | Backscattering |
| Measurement range | 0–600 m | −5 to 40 °C | 0–70 ms/cm | 0–40 | 0–20 mg/l (0–200%) | 0–400 ppb (Uranine reference) | 0–1,000 FTU (Formazin reference) |
| Resolution | 0.01 m | 0.001 °C | 0.001 ms/cm | 0.001 | 0.001 mg/l (0.01%) | 0.01 ppb | 0.03 FTU |
| Accuracy | ±0.3% FS | ±0.01 °C | ±0.01 ms/cm (2–65 ms/cm) | ±0.01 | ±2% FS (± 2% FS) | ±1% FS zero drift ±0.1 ppb | ±0.3 FTU or ±2% of the measured value |
| Time constant (s) | 0.2 | 0.2 | 0.2 | 0.2 | 0.4 | 0.2 | 0.2 |

Water quality is visible with 0.1 m resolution along the vertical direction by going to an observation point by ship and dropping it into the sea.

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