Ber. Inst. Erdwissenschaften K.-F.-Univ. Graz	Bd. 8	ISSN 1608-8166	Isotope Workshop Volume	Graz 2004

Networking of a Rain-gauge with integrated isotope-sampling device and a spring monitoring station with automated event-sampling

Hermann Stadler[1], Paul Skritek[2]

[1]Joanneum Research, Institute of Hydrogeology and Geothermics, Graz, Austria,
e-mail: hermann.stadler@joanneum.at
[2]FH Technikum Wien, Höchstädtplatz 5, A-1200 Wien, Austria,
e-mail: paul.skritek@technikum-wien.at

The system exists of an automatic rain-gauge and a measuring station at a spring with automatic sampling units. These two parts are linked up to a network via LEO-satellites. In the described configuration it is possible to run an event triggered automatic sampling, which is also remote controlled.

The precipitation station is designed to measure the rainfall and to offer the possibility to take samples for isotopic analyses of the total discharge during one month.

Precipitation measurement: Digital tipping bucket rain-gauge with a time resolution from one minute up to some hours (free of scaling) and a quantity resolution (depending on the type of bucket) from 0.1 or 0.2 mm rainfall. The amount of rainfall within a predefined time period is used as a trigger criterion for the measuring unit at the spring. This trigger causes only the sampling of a reference sample.

Sampling application: For isotopic analyses it is necessary, that no part of the precipitation can evaporate. Therefore in this application the containers where the precipitation are stored, can be opened and closed. This procedure is working automatically. When the rainfall starts (=the moment of the first tipping), the container is opened. After the rainfall it is closed again. The time of delay can be chosen individually (for instance 1 to 10 minutes).

To get correct samples of one month, a second valve is changing the flow path between the two containers exactly at the beginning of the month.

The schematic construction of the isotope sampling device is shown in Fig. 1.

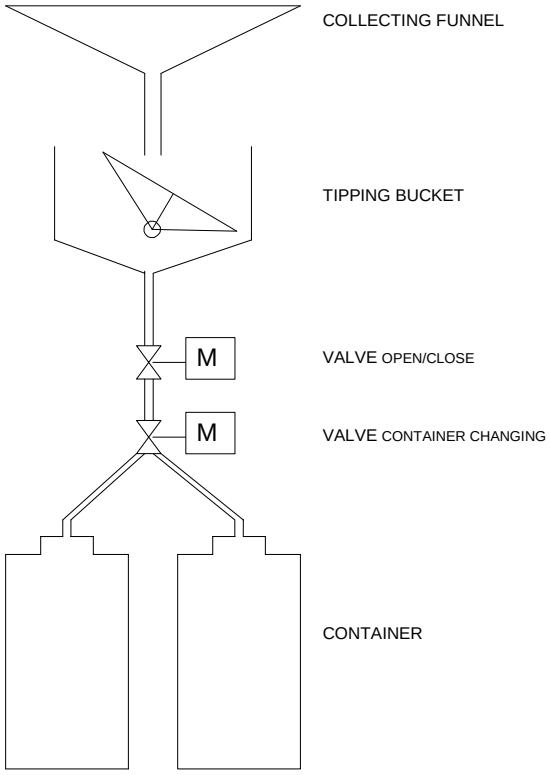

Fig. 1. Scheme of the automatic isotope-sampling device.

Both valves are controlled by the data-logger. Apart from precipitation also other parameter like temperature, wind speed, radiation, and so on can be stored.

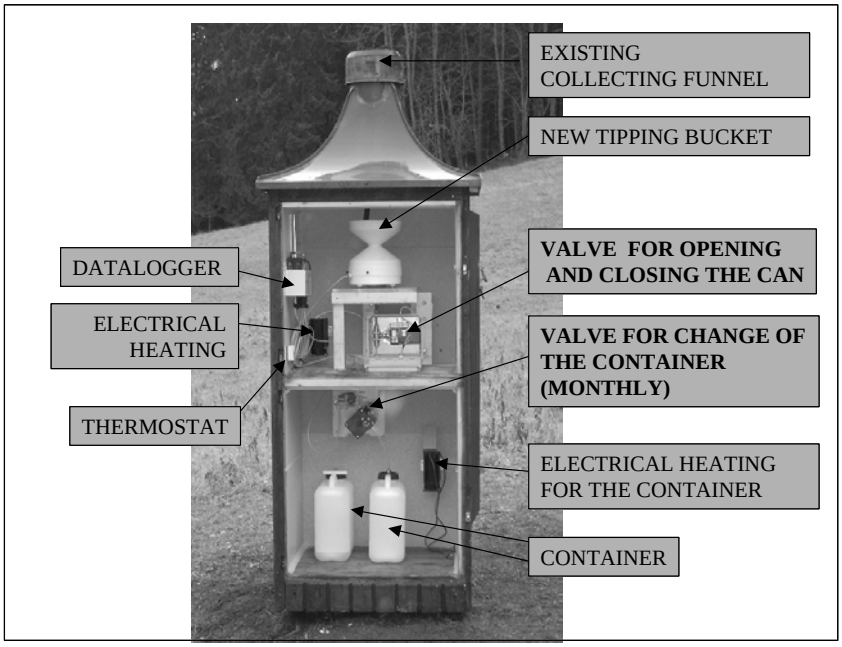

Fig. 2. Automatic precipitation station with integrated isotope-sampling device.

The picture shows a station of the Zentralwasserversorgung Hochschwab Süd, rebuilt with the digital equipment and the isotope sampling device.

The whole application can be mounted in existing measuring stations, without changing the existing collecting funnel (as shown in Fig. 2). This is important for the continuity of the measurement at an existing station.

To avoid large changes of temperature of the sampled water, the containers can be isolated. The station must be heated in such a way, that the sample is not freezing. A simple funnel heating is not enough. The heating can be done with gas or electricity. The electrical heating can be regulated by a thermostat. In stage of development are funnel-heating with Peltier-elements. This devices are also able to cool the collecting funnel during hot periods.

The system (without the heating) can be supplied with solar panels and supplemented with remote data transfer systems like LEO-satellites, GSM or telephone.

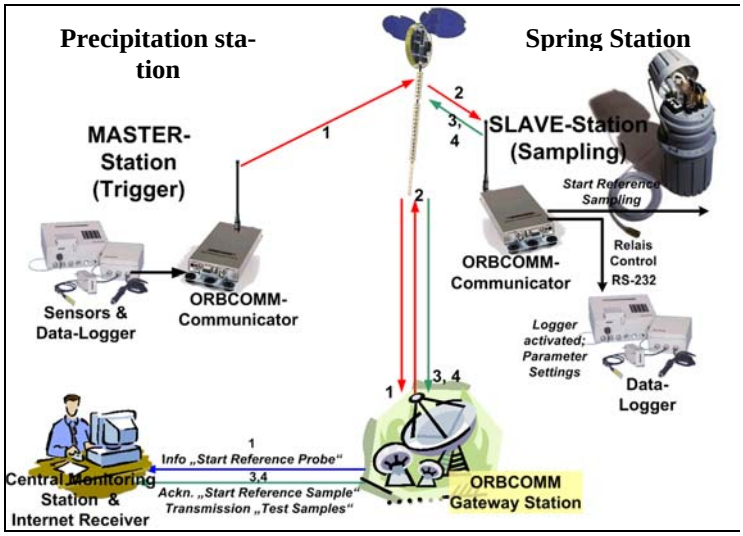

Figure 3: Prototype Block Diagram of event-triggered water sampling using satellite transmission

Spring measurement: At the spring different parameter can be recorded with a data-logger. One of these parameters can be used as second trigger criterion. In our test, the changing of the gauge height within a predefined time period is used as second trigger. If both trigger criterions are happening in a chosen time period, the periodic event sampling is started.

The schematic block diagram is shown in figure 3.

In the following, the important features and data streams are described. As it is shown, all activities of the two stations can be observed at the "Central Monitoring Station" in the office but also via GPRS somewhere outside.

- Triggering station(s): This meteorological station records e.g. rainfall with a time resolution down to one minute and sends data samples periodically (1) to a central monitoring station. Additionally, it automatically derives a trigger criterion from the recorded amount of e.g., precipitation. The station transmits via satellite activation data-set to all sampling/measuring stations (1) and to the central monitoring station.
- Sampling station(s): When the activation data-set is received, the automatic sampling unit takes the reference sample. This status is sent to the central monitoring station (2). Rainfall in the catchment area need not produce a discharge event at the monitored spring immediately, therefore, a second triggering criterion can be derived from the gauge height at the sampling station. As soon as this trigger-level is exceeded, a second automatic sampling device starts the periodical event sampling with a pre-selected time interval. This status is also sent to the central monitoring station (2).
- Central monitoring station: It comprises a specifically developed email-client to decode the com-pressed measurement data-sets which are transmitted from the gateway earth station of the satellite system as emails (1). The decoded data are stored in a central data-base, graphic visualization is be provided (2). A remote Internet access to that central monitoring station is provided so that the re-searcher can also monitor its stations from outside the laboratory, e.g. via GPRS (1,2,3).

In a next step triggering-events will also be derived from on-line measured quality parameters, which can be used as part of an early warning system or a Decision Support System (DSS). Because of data compression, satellite transmission costs for the new system can be expected to be considerably lower than manual operation. Depending from the used automatic sampling units this equipment can be used for isotope sampling.