Plate 7.1[2] Measuring Sites for Chemical and Physical Parameters

Introduction

In the field of water protection, changing issues and approaches give rise to analogous changes in the corresponding investigations. This results in modification of the parameters measured, as well as the measuring networks themselves and the methods used to collect data. These modifications in the measuring networks, involving qualitative aspects of hydrology, are documented in the new edition of plate 7.1. This plate was originally published in 1992.

The condition of rivers and lakes in Switzerland can be assessed using various chemical, physical and biological parameters. The majority of routine investigations focus on only one specific aspect, however. While most monitoring projects cover general chemical parameters, other projects involve the regular measurement of water temperature, certain isotopes and radionuclides, suspended sediments and bed load. Rivers and lakes are monitored by both federal and cantonal authorities.

In comparison with the original edition of plate 7.1, the new version includes additional information regarding the beginning and duration of measurements. Most measuring sites indicated are used to record chemical parameters.

Chemical parameters

Basically, data is collected by both federal stations that are part of the NADUF (National Long-term Surveillance of Swiss Rivers) programme and cantonal measuring networks. Data sources are indicated in the tables. The markers on the map do not differentiate between NADUF stations and cantonal measuring sites. All NADUF stations and some of the cantonal measuring sites regularly take cumulative samples throughout the year.

The NADUF programme is a joint project involving the Swiss Agency for Environment, Forests and Landscape (SAEFL), the Federal Office for Water and Geology (FOWG), the Swiss Federal Institute for Environmental Science and Technology (EAWAG), and the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL). Cumulative samples taken in proportion to discharge, usually over a period of two weeks, are examined for several chemical components. In addition, most measuring stations continually record pH, electrical conductivity, temperature and dissolved oxygen concentration. The measuring programme has been described in detail [2]. The results of the measurements are published [4] and can also be obtained direct from the FOWG or downloaded from the internet [7].

Most chemical analyses of Swiss rivers and lakes are carried out by the cantonal water protection agencies. The type and frequency of analyses vary considerably from canton to canton both in terms of location and time resolution. In the case of rivers, 4, 12 or more random samples, or, in some cases, between 12 and 365 24-hour cumulative samples are taken per year, while series of random samples at different depths are collected 2 to 12 times per year from lakes. In some cases measuring probes are used to obtain high-resolution depth profiles for individual parameters such as dissolved oxygen, temperature, electrical conductivity and light transmissivity.

The present map of measuring sites is based on the Database on Water Status (DBGZ), which is run by the FOWG [6], as well as on additional information provided by the cantonal agencies. The DBGZ contains the results of the regular examination of rivers and lakes. For reasons of clarity, measuring sites have been included in the map only if they meet the following minimum requirements:

rivers and streams:

- two consecutive annual cycles with samples taken once a month, or
- three non-consecutive annual cycles with samples taken once a month, or
- four consecutive or five non-consecutive annual cycles with samples taken less frequently but regularly;

lakes:

- regular profile sampling over a period of at least three years.

Owing to these criteria, many measuring sites run by monitoring programmes that focus on specific aspects have not been included in the map and project-based investigations by various research institutions have likewise not been taken into account.

As far as concerns the choice of parameters measured there are marked differences both between and, to a certain extent, within the individual cantons. The same applies to the NADUF programme, where the set of parameters measured varies according to the purpose of each measuring station, depending on whether it is a permanently operated basic station or a test area station that is operated intermittently but regularly.

The numbers used in the plate correspond to the identification numbers given in the DBGZ. According to the arrangements made with the agencies that carry out the measurements, the data are available either from the FOWG or direct from the relevant cantonal agency or water protection laboratory.

Temperature

The majority of the measuring stations included in the map are part of the FOWG network. The new edition of plate 7.1 also includes cantonal measuring stations that are equipped with thermographs and data loggers, however. The numbers used in the plate correspond to the identification numbers used by the various agencies and are not standardised. As a consequence of temperature changes observed since the late 1980s, the FOWG measuring network has been substantially expanded since 2001 to include stations on mostly small rivers and streams that are influenced as little as possible. The results can be obtained from the FOWG or from the relevant cantonal agencies. The monthly and annual means as well as the extreme values observed by the FOWG network are published regularly [4].

Bed load

In a joint programme, the Group for Operational Hydrology (GHO) and the cantonal agencies are endeavouring to determine bed-material loads over the long term using standardised recording and evaluation methods. The concept for this project has been published by the GHO [1]. The data collected by the cantonal authorities are stored in the FOWG's DB-Solid Database and are available to those interested. The numbers used in this plate correspond to the identification numbers given in the DB-Solid Database.

Suspended sediments

The map shows FOWG measuring sites for suspended sediments. As a rule, samples are taken twice a week to measure the concentration of suspended sediments; the load is then calculated. A new calculation method has been used since 2001 [5]. Suspended sediment concentration and calculated suspended sediment load data are published on an annual basis [4]. Plate 7.4 includes a comprehensive overview of results. The numbers used in the plate correspond to the DBGZ identification numbers.

Isotopes and radioactivity

Analysing radioactivity in rivers and lakes is one component of the Swiss radioactivity-monitoring system. In the early years of the monitoring programme, samples were taken at random. Over time, this practice developed into continual sampling at almost all measuring sites. The results are published once a year [3]. In 1992 the FOWG set up an additional isotope-measuring network (NISOT); the results obtained and their interpretation are published separately [8]. The sites indicated where radioactivity and isotopes are measured meet the same criteria with regard to sampling as those that where chemical parameters are measured. The numbers used in the plate correspond to those used in plate 6.2, which shows the principal results obtained from the isotope-measuring networks.

Development of measuring networks

The reverse side of the plate shows how the chemico-physical measurement networks have expanded over the past 50 years. This chronological illustration is again based on data stored in the DBGZ. Together with chemical parameters it also includes information on suspended sediment content as well as individual data on temperature and electrical conductivity. Measuring sites on rivers and lakes where at least one measurement was taken during the 10-year-period in question have been included in a map. Some sites do not meet the criteria for inclusion in the 1:500 000 map and are therefore indicated in the small maps only. These clearly show that comprehensive water analyses have been carried out only since the early 1970s, when the second Water Protection Act came into force. It is interesting to note that, for many measuring sites, the beginning of the measurement series coincides with the highest level of water pollution. For most sites there are no long-term series of regularly obtained data.

The chronological overview is complemented by documentation of various sampling techniques, such as the complicated equipment used for NADUF sampling and continual measurement as well as a smaller device for automatic random and cumulative sampling. In lakes, samples are taken at various depths using a flask which is lowered to the desired depth on a winch and sealed by remote control from the boat before being retrieved.

References

[1] **Arbeitsgruppe für operationelle Hydrologie (1987):** Die mengenmässige Erfassung von Schwebstoffen und Geschiebefrachten. Mitteilung der GHO Nr. 2, Bern.

[2] **Binderheim-Bankay, E., Jakob, A., Liechti, P. (2000):** NADUF – Messresultate 1977–1998. Schriftenreihe Umwelt Nr. 319, Bern.

[3] **Bundesamt für Gesundheit (BAG):** Umweltradioaktivität und Strahlendosen in der Schweiz. Jahresberichte des BAG, Bern.

[4] **Bundesamt für Wasser und Geologie:** Hydrologisches Jahrbuch der Schweiz. Bern.

[5] **Grasso, A., Jakob, A. (2003):** Charge de sédiments en suspension – Comparaison entre deux méthodes de calcul. In: Gaz–Eaux–Eaux usées 12/03:898–905, Zürich.

[6] **Jakob, A. (1998):** Datenbank Gewässerzustand (DBGZ) – Überblick, Datentransfer, Auswertungsmöglichkeiten. Hydrologische Mitteilungen der Landeshydrologie und -geologie Nr. 25, Bern.

[7] **Nationale Daueruntersuchung der schweizerischen Fliessgewässer:** www.naduf.ch (Stand 26.03.2003).

[8] **Schotterer, U. et al. (2000):** Das Schweizer Isotopen-Messnetz: Trends 1992–1999. In: Gas–Wasser–Abwasser 10/2000:733–741, Zürich.