Hydrometric Networks – Catchments and Data Series

Abstract
Switzerland's hydrometric networks include water level and discharge gauging stations run by various operators. This interactive map shows the development of Swiss hydrometric networks since 1856, and provides information about gauging stations, their catchments, and digitally available data series.

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1 Introduction

Historical and current hydrometric data on water levels and discharge are important for many areas of human activity. Sustainable water management and adequate sizing of flood control infrastructure, for example, would be impossible without suitable discharge data series covering multiple years. Today, many gauging stations are technically capable of sending their data to a central database shortly after measurements are made. These real-time data support the detection and assessment of flood risks and thereby help to prevent damage.

Switzerland's hydrometric networks include water level and discharge gauging stations run by various operators. The federal measuring network consists of around 260 active stations and is today run by the Hydrology Division of the Federal Office for the Environment FOEN. In addition to the federal government, numerous cantonal governments, research institutions, and operators of hydropower plants run their own measuring networks.

The Hydrological Atlas of Switzerland shows gauging stations whose data are available in digital form and accessible to third parties. This is why the present edition of the data set on gauging stations contains fewer stations run by "private" operators than the last printed atlas plate on this topic, Plate 5.1[2] [1].

2 Data and methods

The metadata on hydrometric stations were taken from [1] where possible, and subsequently checked and completed. Each station record includes its location, information about the corresponding catchment, and selected metadata on digitally available data series. Major data sources are listed in Table 1.

A new numbering system ensures unequivocal identification of all stations in the Hydrological Atlas. Numbers of national stations consist of the two-digit ISO country code, a hyphen, and a four-digit number. For cantonal stations, the country code is followed by the ISO canton code, a hyphen, and a three-digit number. All stations run by other institutions are numbered according to the system for cantonal stations, but with the canton code replaced by an X and an additional letter signifying the operating institution. To facilitate communication with station operators, each record also includes the operator's specific identification code for the given station. This code needs to be used when ordering data from an operator, for example.

The catchments of the monitoring sites were generally combined from the data set on the catchment classification of Switzerland (EZGG-2015 [2]) and corrected in the area of the catchment outlet to ensure that the catchment boundary more or less runs through the measuring site. The catchment areas of the currently active measuring stations of the FOEN and those of the Canton of Geneva were taken from existing geospatial data sets [3], [4]. All catchments of measuring stations were derived from topography, without considering hydrogeological phenomena (underground watersheds, karst, etc.) or technical infrastructure (diversions, urban drainage, etc.). Therefore, the real catchment boundaries may differ from the ones shown in the Hydrological Atlas.

The metadata on data series indicate which parameters a station measured over which period, and in which temporal resolution data are available. Information about the beginning and the end of measuring periods were recorded in terms of the exact dates whenever the data source provided this information. The data set includes information about relocations, changes of name, and changes of operator, so that each measuring site record shows the entire period for which digital data series are available, including from earlier stations nearby. However, users should assess in each individual case whether it is possible to extend a given data series with data from a previous station.

Finally, both the FOEN and the cantons were asked in the autumn of 2019 to provide their discharge data to the Hydrological Atlas of Switzerland for visualisation (cf. Chapter 4). In Table 1, a ✓ denotes agencies from which discharge data series are available.

3 Results

The present data set currently contains a total of 985 hydrometric stations, of which around two-thirds are in operation. Figure 1 shows the development of hydrometric networks since 1863, the year in which the Swiss Hydrometric Committee was founded. The creation of this committee of the Swiss Academy of Natural Sciences (Schweizerische Naturforschende

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Table 1. Sources of data and information included in metadata on hydrometric stations. Additionally, discharge measurement series are available from agencies marked with a ✓ (current as of spring 2020).

Station code	Agency/Source of data and information	
CH-	Bundesamt für Umwelt BAFU, Abteilung Hydrologie	✓
CHAG-	Kanton Aarau, Departement Bau, Verkehr und Umwelt, Abteilung Landschaft und Gewässer	✓
CHAR-	Kanton Appenzell Ausserrhoden, Departement Bau und Volkswirtschaft, Tiefbauamt	✗
CHBE-	Kanton Bern, Bau- und Verkehrsdirektion, Amt für Wasser und Abfall	✓
CHBL-	Kanton Basel-Landschaft, Tiefbauamt bzw. Amt für Umweltschutz und Energie	✓
CHFR-	Staat Freiburg, Amt für Umwelt AfU	✓
CHGE-	République et Canton de Genève, Direction générale de l'eau	✓
CHGL-	Kanton Glarus, Departement Bau und Umwelt	✓
CHGR-	Kanton Graubünden, Amt für Natur und Umwelt	✓
CHLU-	Kanton Luzern, Bau-, Umwelt- und Wirtschaftsdepartement, Umwelt und Energie	✓
CHNE-	République et Canton de Neuchâtel, Département du développement territorial et de l'environnement	✓
CHSG-	Kanton St. Gallen, Amt für Wasser und Energie	✓
CHSH-	Kanton Schaffhausen, Baudepartement, Tiefbau	✓
CHSO-	Kanton Solothurn, Bau- und Justizdepartement, Amt für Umwelt	✓
CHTG-	Kanton Thurgau, Departement für Bau und Umwelt, Amt für Umwelt	✓
CHTI-	Repubblica e Cantone Ticino, Ufficio dei corsi d'acqua	✓
CHVD-	Canton de Vaud, Direction générale de l'environnement	✓
CHVS-	Canton du Valais, Service des forêts, des cours d'eau et du paysage	✗
CHZG-	Kanton Zug, Baudirektion, Amt für Umweltschutz	✓
CHZH-	Kanton Zürich, Baudirektion, Amt für Abfall, Wasser, Energie und Luft	✓
CHXA-	EPFL Lausanne, Institut d'ingénierie de l'environnement	✗
CHXB-	Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft WSL, Birmensdorf	✗
CHXC-	Centre de recherche sur l'environnement alpin, Sion	✗
CHXD-	ETH Zürich, Institute for Atmospheric and Climate Science, Land-Climate Dynamics	✗
CHXE-	Geographisches Institut der Universität Zürich, Hydrologie und Klima	✗
CHXF-	AXPO Power AG, Baden	✗

Gesellschaft) laid the foundations for systematic monitoring of water levels on Swiss lakes and rivers [5]. At this time, a small number of water level gauges already existed along lakes and large rivers [6]. Later on, especially from the beginning of the 20th century onwards, more and more stations began to also measure discharge. Today, very nearly all stations on rivers or streams measure more than just the water level. Moreover, all stations were gradually equipped with limnigraphs, which record the water level continuously. In older data series the daily mean discharge values are often based on as little as one to three daily readings of the water level. From the middle of the 20th century onwards, the federal hydrometric network was complemented with others. Cantons increasingly installed their own networks. While the first cantonal measuring stations concentrated on the Swiss Plateau and north-western Switzerland, more recently measuring networks in the Alps have been expanded as well. Cantonal measuring networks focus mainly on small rivers and streams, a fact that clearly shows in the cantonal measuring stations' median catchment area. Considering all cantonal stations currently in operation, this value amounts to 26 km^2 – compared to 210 km^2 for federal measuring stations.

4 Uses / Examples

Clicking on one of the monitoring stations will show this station's metadata, its data series, and the catchment polygon. All of these can be downloaded. In addition, the filter function enables the creation of customised lists of measuring stations, which are downloadable as well. Selection of a specific monitoring period shows all measuring stations that offer data for at least 95% of that period.

Several sites have data series of multiple stations for successive periods owing to the relocation or renaming of stations or changes in their operators. In many cases it is possible to combine the discharge data series of two or more such monitoring stations into one long data series. This is the case, for example, on the Rhine in Basel. Taken together, the earlier stations Rhein–Basel, Schifflände and Rhein–Basel, St. Alban; as well as the station Rhein–Basel, Rheinhalle, which has been in operation since 1995; cover the entire period from 1869 to the present. For the station Rhein–Basel, Rheinhalle mean discharge data series are shown not only for the monitoring period of this station, but for the two defunct stations as well.

Discharge data for the Rhine in Basel were in fact even reconstructed back to 1807 based on gauge readings [7]. However, the Hydrological Atlas does not

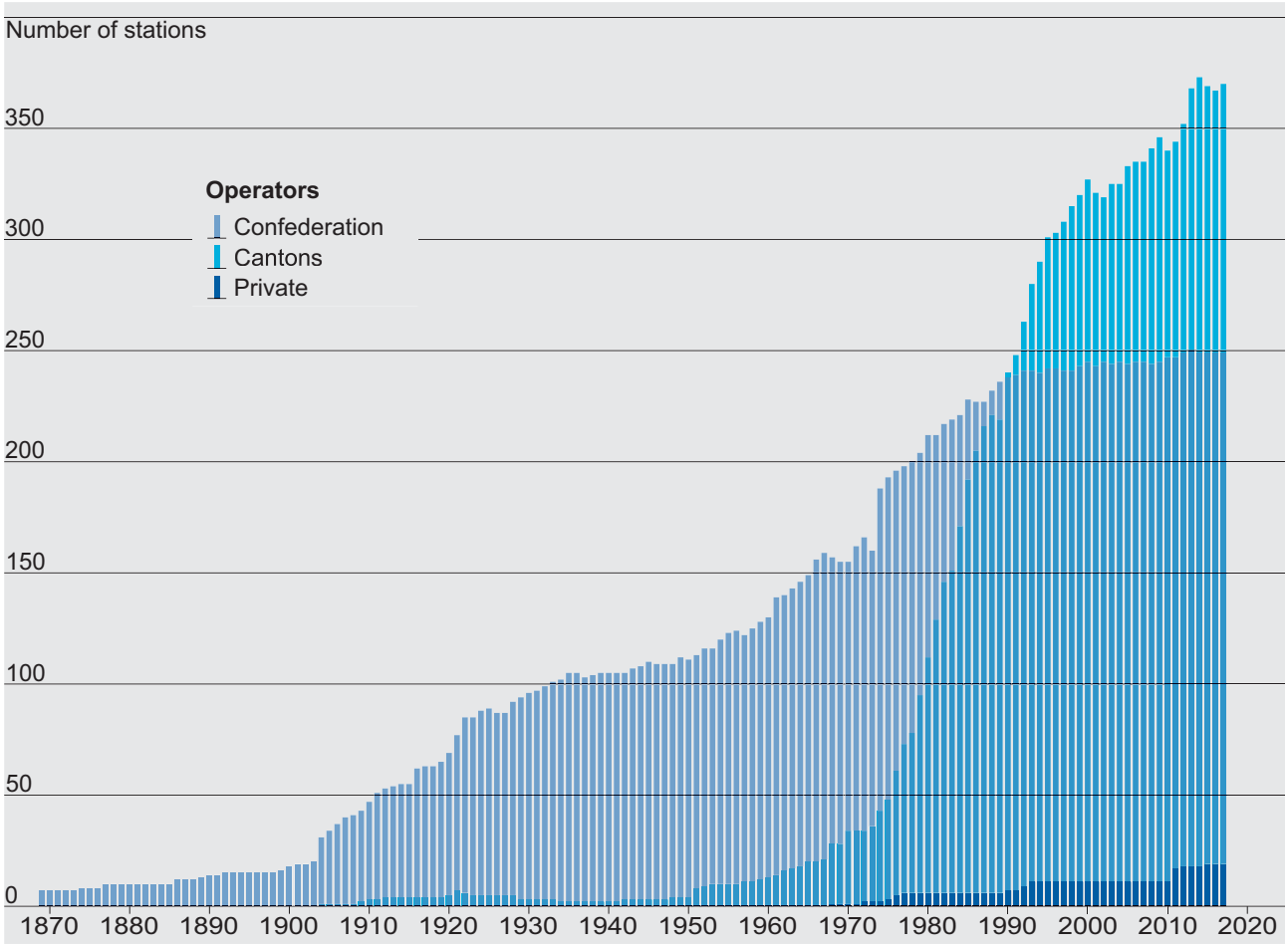


Figure 1. Development of hydrometric networks since 1869

show this reconstructed data series because it is not available in digital form.

Clicking on a station allows several pieces of information to be called up. Under “Catchment”, a comprehensive hydrogeographic portrait provides greater detail on the area. “FOEN” or “Canton XY” leads to the website of the corresponding institution, with more information on the station and, if available, on the real-time provisional discharge values for the current year. “Discharge data series and data availability” contains two graphs that visualise the available discharge data series. The first graph illustrates seasonal discharge characteristics based on daily values. For each day, long-term mean discharge and observed extreme discharge values are shown, based on the available time series (current as of autumn 2019). In addition, up to two individual years can be selected in the legend to compare discharge values and put them into a long-term context. It is important to note that the - mostly verified – hydrographs are visualised in unprocessed form, exactly as they were supplied by the agencies, who are also responsible for the accuracy of the data series.

The graph in the “Discharge data series” tab graph under topic “C02 Discharge Parameters” will provide further parameters on annual discharge and discharge patterns, as well as on flooding and low water levels.

The chart in the “Data availability” tab gives an overview of whether the selected station collects data on water level and water temperature in addition to discharge, and which periods are covered. A distinction is made between daily and hourly time series.

5 Versions

Table 2. Versions

Version	Description
v1.0 (2018)	Overview of available gauging stations and data series
v2.0 (2020)	Presentation of mean daily discharge (FOEN and cantons)

References

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