



Precipitation-Measuring Networks

Abstract

This map shows the development of precipitation measurement networks in Switzerland from the start of systematic measurements in 1863 right up to the present day. A wealth of information about the measuring stations and the available data series can be accessed interactively. Links in the tooltips point to further information and, for selected stations, to supplementary products such as the extreme value analyses of MeteoSwiss. In addition, historical precipitation measurement series can be visualised for some of the stations.

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1 Introduction

Historical and current precipitation data provide an important basis for addressing numerous issues in our society. For example, information on precipitation is used for warning purposes, numerical climate models, hydrological modelling, and climatological purposes (grid data sets, extreme value analyses), as well as to address agricultural and economic issues [1]. Many of the maps in the data and analysis platform of the Hydrological Atlas of Switzerland are based directly or indirectly on precipitation measurement series.

Precipitation has been measured in Switzerland for more than 150 years. The systematic recording of precipitation and other meteorological parameters began in 1863, on the initiative of the Swiss Academy of Sciences. By 1864, the measurement network already comprised 88 climate stations. In the years up to 1880 it was supplemented by 50 precipitation measuring stations, so as to better take into account the high spatial variability of precipitation. Once the Central Meteorological Institute was founded, this organisation (which today is called the Federal Office of Meteorology and Climatology MeteoSwiss) assumed responsibility for all measuring stations [1].

From its beginnings right up to the present day, the precipitation measurement network has been subject to constant change. Over time, both the number of measuring stations and the types of instruments used to measure precipitation have changed. For a very good overview of the development of the precipitation measurement networks, data processing, and measuring technology, please refer to [1] and [2].

The purpose of this map is to present information on precipitation stations and data series available in Switzerland in one central depository, and to provide easy access to additional information by means of links.

2 Data and Methods

This map is based on metadata on meteorological measuring stations from numerous publicly accessible sources (cf. Table 1). It builds on the tables for plate 2.1² published in the printed issue of the Hydrological Atlas [2] and the first four geodata sets men-

tioned in Table 1 and published by MeteoSwiss on opendata.swiss. These geodata sets contain daily information on active meteorological measuring stations. For this map, the geodata sets were last retrieved in May 2022. The metadata of these MeteoSwiss data sets were used almost unchanged. Some station locations are contained in several of the four data sets, because the corresponding stations belong to several measurement networks. Each of these stations was included only once in the data set for map A08, as part of the “highest-quality” measurement network among the ones it belongs to. For example, all stations of the Swiss National Basic Climatological Network are a subset of the automatic meteorological ground-level measuring stations. In this map, they are only shown as stations of the Swiss National Basic Climatological Network. Furthermore, all stations that do not measure precipitation were removed.

Automated access to the web application for the measuring station networks¹ was used in order to determine whether precipitation is measured at the respective station and at what time the manual or automatic measurement of precipitation began. In addition, the web application for the extreme value analyses was used to determine the stations for which these analyses are available.

The data set containing the summarised information from MeteoSwiss was compared with the station lists from plate 2.1² of the printed issue of the Hydrological Atlas, as per Figure 1. Using station names and station locations (coordinates and altitude), it was possible to identify all stations from plate 2.1² that are included in the MeteoSwiss data sets. All other stations were additionally included in the data set for map A08. As per Figure 1, the period for which measurement data are available was updated for these stations whenever this was possible on the basis of digital and publicly accessible information. In addition, metadata and data series from the Data Portal for Teaching and Research (IDAwEB) were used to update the information on measurement periods.

¹<https://www.meteoswiss.admin.ch/services-and-publications/applications/measurement-values-and-measuring-networks.html#param=messwerte-niederschlag-1d&lang=en>



Table 1. Data sources and dates of retrieval

Source of information and data	Status/Call-off
MeteoSwiss: Stations of the Swiss National Basic Climatological Network (Swiss NBCN)	05.2022
MeteoSwiss: Weather stations of the automatic monitoring network (SwissMetNet)	05.2022
MeteoSwiss: Manual snow- and precipitation stations	05.2022
MeteoSwiss: Weather stations of MeteoSwiss partner networks	05.2022
Hydrological Atlas: Plate 2.1 ² Precipitation-Measuring Networks	
– Table “Eidgenössische Stationen”	12.2005
– Table “Kantonale Stationen”	12.2005
– Table “Private Stationen”	12.2005
MeteoSwiss: Web presence on measurement values and measuring networks	05.2022
MeteoSwiss: Extreme value analyses (version 2020)	05.2022
Kanton Aargau, Kartenportal HydroWeb	05.2022
Kanton Bern, Bau und Verkehrsdirektion, Amt für Wasser und Abfall	05.2022
République et Canton de Genève, Office cantonal de l'eau (Veille Hydro-météorologique)	05.2022
Kanton Luzern, Bau-, Umwelt- und Wirtschaftsdepartement, Umwelt und Energie	05.2022
République et Canton de Neuchâtel, Département du développement territorial et de l'environnement (Veille Hydrologique)	05.2022
Kanton Solothurn, Bau- und Justizdepartement, Amt für Umwelt	05.2022
Kanton St. Gallen, Amt für Wasser und Energie	05.2022
Kantone Thurgau und Schaffhausen, Wasserportal Thurgau – Schaffhausen (Hrsg. Amt für Umwelt, Kanton Thurgau)	05.2022
Canton de Vaud, Direction générale de l'environnement (Veille Hydro-météorologique)	05.2022
Kanton Zürich, Baudirektion, Amt für Abfall, Wasser, Energie und Luft	05.2022

To keep future updates of the data set as simple as possible, the four measurement network categories from MeteoSwiss were adopted for the map display and supplemented by a fifth category containing all stations that are not included in the MeteoSwiss data sets. The station ID is generally that of MeteoSwiss. If no such ID is available, the ID of plate 2.1² of the print version of the Hydrological Atlas is used.

Station locations consist of the most recent location available for each respective station. The map does not reflect changes of location. For example, precipitation in Bern is shown as having been measured at the Bern/Zollikofen site throughout the measurement period, even though this location has only existed since August 2006. Until then, precipitation and other parameters were measured in Bern-Liebelfeld.

3 Results

The present map provides both a comprehensive overview of the precipitation measurement networks in Switzerland and the available data series, as well as easy access to detailed information on the individual stations. Information is currently available for a total of 2390 precipitation measuring stations, of which around two thirds are in operation. Of these stations, 74 belong to the Swiss National Basic Climatological Network (depicted as red dots on the map). These stations, all of which are operated by MeteoSwiss, offer particularly long and high-quality homogeneous measurement series of precipitation and other meteorological parameters. Data collection and transmission at these stations is now fully automatic and virtually in real time, just as it is for the approximately 200 auto-

matic weather and precipitation stations (blue dots). For all these locations, very up-to-date values are thus available for numerous applications.

The automatic measuring stations are supplemented by a manual precipitation measurement network comprising 246 measurement points (brown dots). At 189 of these sites, precipitation and, in some cases, snow depth are recorded manually for MeteoSwiss, usually every morning at 7:30 a.m., and sent to the database system by SMS. The remaining 57 measuring stations in this category are totalisers in the high mountains, which are read at least once a year at the end of the “hydrological year” (end of September).

The MeteoSwiss partner stations category (green dots) includes 96 weather stations with precipitation measurement, 116 precipitation measuring stations, 218 road weather stations with mostly optical precipitation measurement, and 35 so-called agrometeorological stations with precipitation measurement. These 465 stations are operated by cantonal offices and other institutions and are used by MeteoSwiss to expand the information from its own measurement networks as required.

A total of 1404 measuring stations were assigned to the most extensive category, “Other precipitation stations” (black dots). These are measuring stations that were listed in plate 2.1² of the print version of HADES and are not included in any of the more recent data sets. For 549 of these stations, it was possible to update the information on the measurement periods from plate 2.1². The date of the available data is shown for all stations in the graph on data availability (cf. Fig. 3).

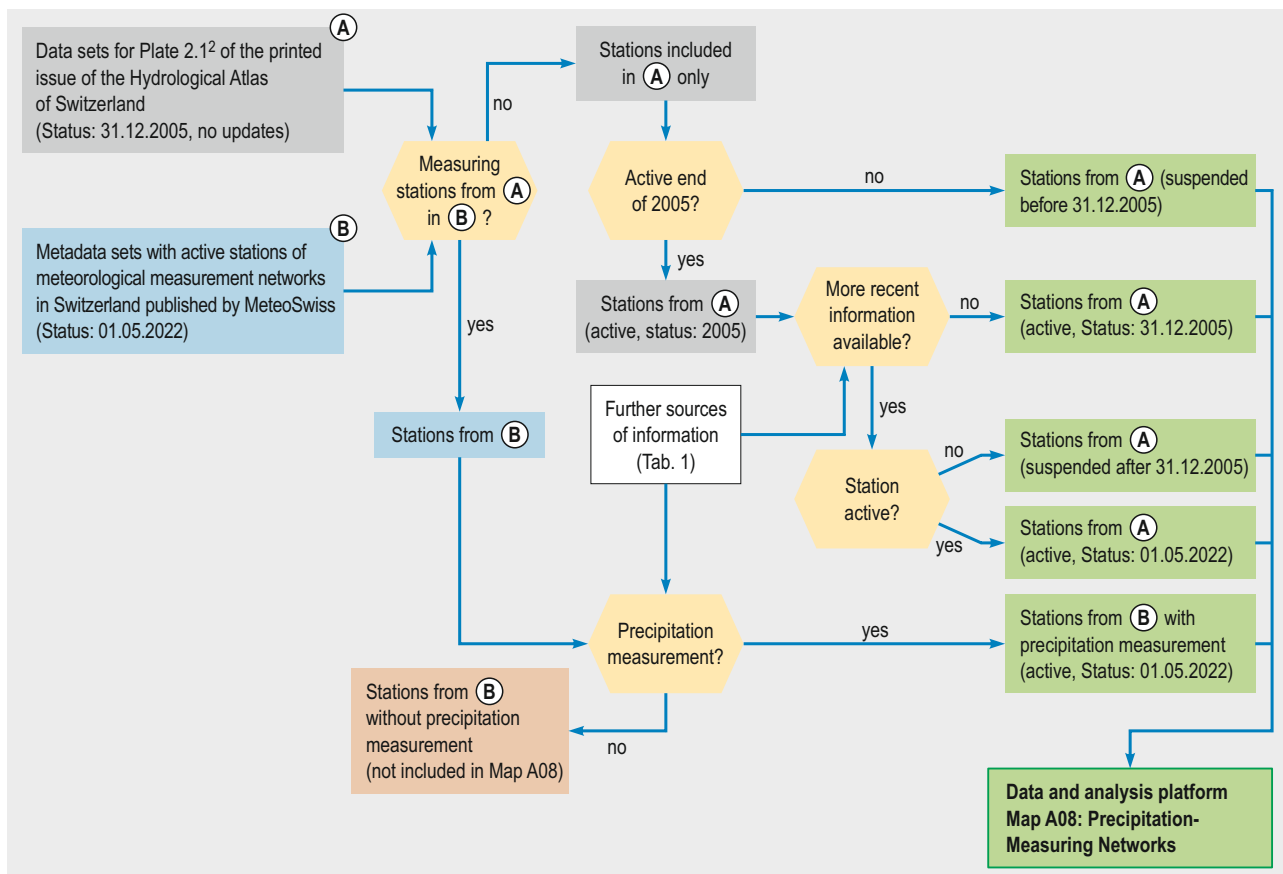


Figure 1. Schematic representation of the procedure for preparing the metadata

4 Example of application

Clicking on a measuring station dot opens up a tooltip showing the metadata for the respective station (Fig. 2). If extreme value analyses are available for the data series of a MeteoSwiss measuring station, the tooltip provides the corresponding links.

It is also possible to create customised station lists interactively, using filters in the right-hand sidebar. These lists are then available for download. Upon selection of a specific measurement period, the tool displays all stations that have data for at least 95 % of this period.

Clicking on a station provides access to different information, depending on the measurement network the station belongs to. The link “Information on this station” leads directly to the website of the institution operating the station, with further details on the station. The links to the extreme value analyses for the climate stations (red) lead to the corresponding analyses on the MeteoSwiss website.

The “Data availability” link opens a graph that gives an overview of the periods for which precipitation measurement series are available. A distinction is made between annual, monthly, daily, and hourly time series (Fig. 3).

For climate stations (red), the link is called “Data series and data availability”. For some of the climate stations, the window this opens shows – in addition to data availability – a graph that can display precipitation time series based on daily values (Fig. 4). The

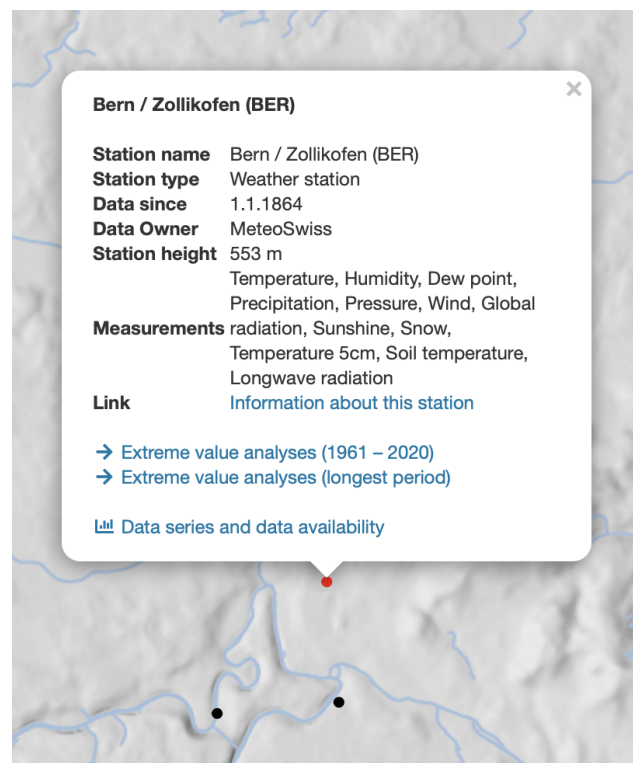


Figure 2. Tooltip containing links to the MeteoSwiss web application for measurement values and measurement networks as well as extreme value analyses

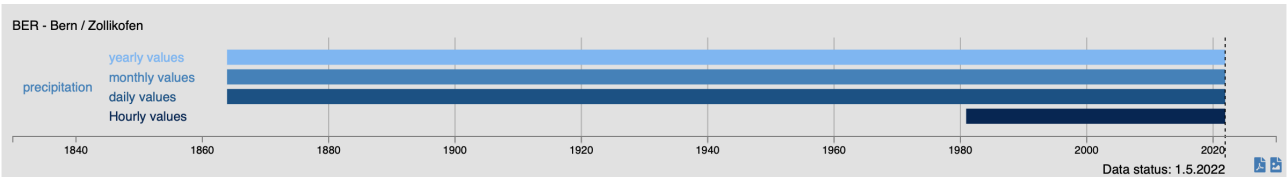


Figure 3. Available precipitation time series for the Bern/Zollikofen measuring station

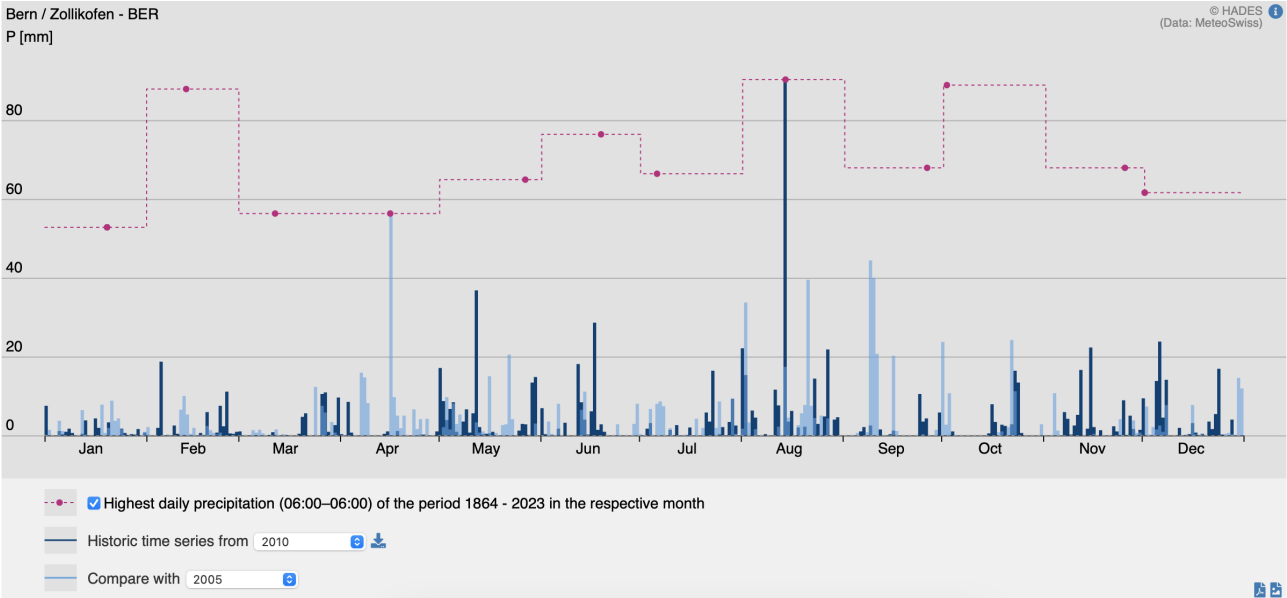


Figure 4. Comparison of precipitation time series for the years 2005 and 2010 for the Bern/Zollikofen measuring station

time series are updated daily using the data records at opendata.swiss. However, they are only available for a selection of the climate stations. The table at data.geo.admin.ch shows those locations for which data are available at the time of access. In the legend of the graph, up to two individual years can be selected in order to compare their precipitation time series. It should be noted that the precipitation is visualised in unprocessed form, as it is made available by MeteoSwiss on opendata.swiss.

5 Versions

Table 2. Versions

Version	Description
v1.0 (2022)	Overview of available gauging stations and data series

- Zürich: Willemse, S. und Furger, M. S., Hochschulverlag AG an der ETH Zürich, pp. 125–139. ISBN: 978-3-7281-3746-3. URL: https://vdf.ch/index.php?route=product/product/download&ea_id=8479&product_id=1987.
- [2] Konzelmann, T., Wehren, B. and Weingartner, R. (2007). Precipitation-Measuring Networks. In: *Hydrological Atlas of Switzerland*. Ed. by Federal Office for the Environment FOEN. Vol. 1. Tafel 2.1². <https://hydrologicalatlas.ch/products/printed-issue/precipitation/plate-2-1b>. Bern: Federal Office for the Environment FOEN. URL: <https://hydrologicalatlas.ch/products/printed-issue/precipitation/plate-2-1b>.

cf. also Table 1

References

- [1] Félix, C. and Konzelmann, T. (2016). Surface precipitation measurements. In: *From weather observations to atmospheric and climate sciences in Switzerland*. Celebrating 100 years of the Swiss Society for Meteorology. https://vdf.ch/index.php?route=product/product/download&ea_id=8479&product_id=1987.