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# Nineteenth century meteorological records from Vevey, Einsiedeln, Bellinzona, Lucerne, Fribourg, and Zug

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## Abstract

This paper briefly describes seven early instrumental series from Switzerland from the 19th century. This concerns records from Vevey (1805-1840), Einsiedeln (1818-1864), Bellinzona (1826-1832), Lucerne (1826-1832 and 1844-1864), Fribourg (1829-1847) and Zug (1843-1873). We describe observers and observations and present the digitized data. Together with the already described series in this volume, they will substantially increase data coverage in the decades before the start of the official Swiss network in 1863. Of particular value are the series of Vevey and Zug, both of which are 30 years or longer and of sufficient quality to produce long time series, although they are not without inhomogeneities. The series from Lucerne, Bellinzona and Fribourg are of high quality, albeit short, while the record from Einsiedeln, though long, is of historical more than climatological value as it is sparse and observation times often unknown. However, it contains valuable descriptive weather information.

## 1. Introduction

In this volume, we provide descriptions of a number of Swiss early instrumental series in some detail. However, we have digitized, processed, and re-evaluated many more series, and although detailed descriptions could be given for each of them, some of the series received a somewhat lower priority. Here we provide a summary description and assessment of seven series; the concluding Chapter of this book will then give a complete list also of those series that cannot be presented in detail due to space.

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The seven series shown in this Chapter could help to back-extend the post-1864 series, and together they provide detailed insights into the Swiss weather in the 19th century, which includes momentous climatic events such as the "Year Without a Summer" of 1816 or the extremely cold winter of 1829/30. We provide descriptions of series from Vevey (1805-1840), Einsiedeln (1818-1864), Bellinzona (1826-1832), Lucerne (1826-1832 and 1844-1864), Fribourg (1829-1847), and Zug (1843-1873). From several of these locations, additional series could possibly be found to further complete the records and merge them with post-1864 data. The corresponding metadata are included in this paper (see also Pfister et al., 2019). The imaged data sheets are available from Zenodo and further descriptions of the data can be found in Brugnara et al. (2020b). The digitised and processed data from the seven series can be obtained from MeteoSwiss, PANGAEA (Brugnara, 2020), from the EURO-CLIMHIST data base (Pfister et al., 2017) and the Copernicus Climate Change Service (C3S) Global Land and Marine Observations Database (Noone et al., 2021).

The paper is organised as follows. Section 2 provides a historical overview of the observers and the measurements of all seven series. Section 3 presents the results of the quality assurance, followed by mutual comparisons of the series. Conclusions are drawn in Section 4.

## 2. Observers and observations

### *2.1. Overview of observations*

The seven series cover different areas of Switzerland and a large portion of the 19th century. Most notably, with the series from Bellinzona, this paper provides the earliest Swiss meteorological series south of the main Alpine ridge. An overview of all locations is shown in Figure 1; Table 1 provides more details on the seven series as well as further series from the same locations (see Pfister et al., 2019).

**Table 1.** Overview of the series at the six locations discussed in this paper. * series presented in this paper. T = temperature, p = pressure, Pr = precipitation, rh = relative humidity, Wn = wind speed, wdir = wind direction.

| Station | Time period | Observer | Variables |
|---|---|---|---|
| Vevey | 1761-1766 | Alexandre Perdonnet | p, T, wdir, Pr, Wn, 3x daily |
| Vevey* | 1805-1840 | Jean-Samuel Nicod-Delon | p, T, wdir, rh, Wn, 2x daily |
| Vevey | 1855-1859 | Albert Davall | T |
| Einsiedeln* | 1817-1850, 1859, 1864 | Bernhard Foresti, Pius Regli, Raphael Kuhn | p, T, wdir, rh, Wn, 2-9x daily |
| Bellinzona* | 1826-1832 | Thomas Inderbitzin, Plazidus Gmeinder | p, T, wdir, Wn, 3x daily |
| Lucerne* | 1826-1832 | Josef Ineichen | p, T, wdir, Wn, 3x daily |
| Lucerne* | 1844-1864 | Franz Xaver Schwytzer | p, T, wdir, Wn, 2x daily |
| Lucerne | 1860-1861 | Ernst Grossbach | P, T 2x daily |
| Fribourg* | 1822-1847 | Jean Baptiste Wière | p, T, rh, 2-3x daily |
| Fribourg | 1830-1859 | Joseph-Victor Daguet | T, Wn, 2x daily |
| Fribourg | 1856-1861 | Francois(?) Moret | p, T |
| Zug* | 1843-1873 | Michael Müller, unknown observer | T, 2x daily |
| Zug | 1810s-1820s | Franz Karl Stadlin | T |

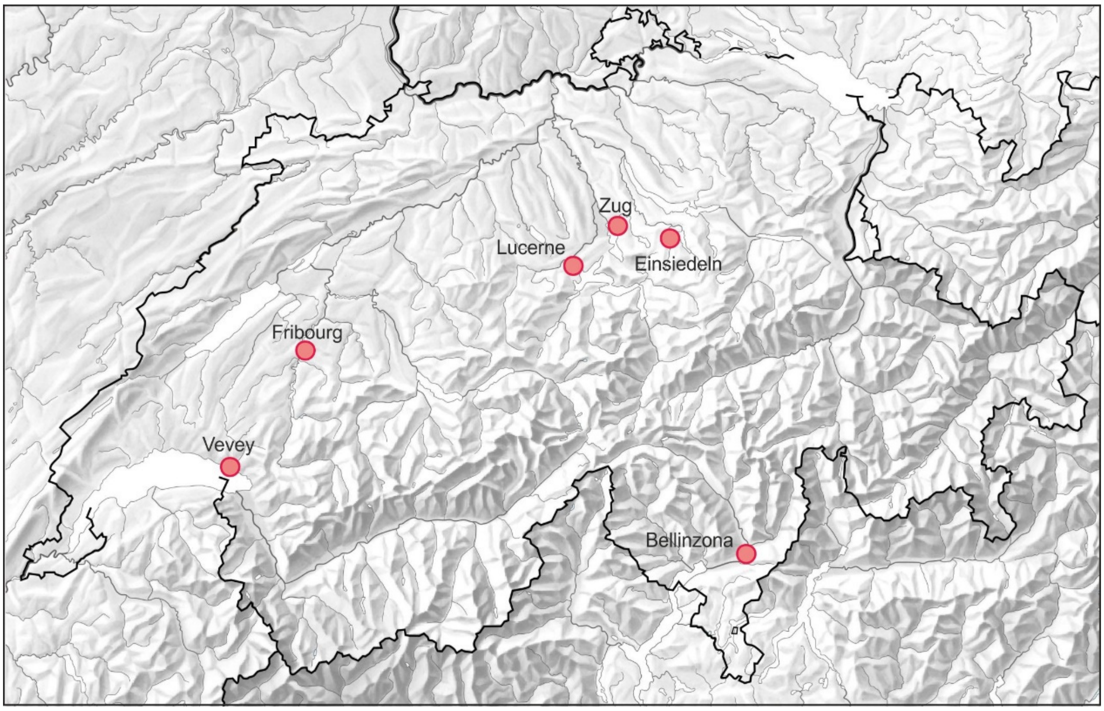


**Figure 1.** Location of the seven series presented in this paper (two series are from Lucerne).

*2.2. Vevey*

The longest and earliest of the seven series is that of Vevey, covering 1805 to 1840. In fact, this is only the longest segment of a potentially even longer series. The first short measurement series covers the years 1761 to 1766. Probably measurements were made by Alexandre Perdonnet (1736-1807), lieutenant in the military, in the context of the network of the Oekonomische Gesellschaft Bern (Wyer et al., 2021). Some monthly statistics were published in 1765 in the society's journal "Abhandlungen und Beobachtungen durch die Ökonomische Gesellschaft zu Bern gesammelt". A later temperature record by D. Doret and forestry inspector Albert Davall, 1855-1859, is only available as monthly means (Davall, 1860). Vevey was not part of the first national network 1864, but measurements were performed in the neighbouring city of Montreux.

The 1805-1840 segment was measured by Jean-Samuel Nicod-Delon [Nicod de Lom]. He was a member of the Swiss Natural Sciences Society (SNSS) since 1820 and was active in the society meetings, e.g., presenting work on thunderstorms. He also measured, and published about, the level of Lake Geneva and its regulation by Geneva (Nicod-Delom, 1817). We do not know the exact location, nor the instruments used by Nicod-Delon.

The data comprise twice daily measurements of pressure, temperature, and humidity as well as wind observations. The data sheets are kept at the Swiss Federal Archive. An excerpt of a data sheet is given in Figure 2.

**Figure 2.** Example sheet of the observations performed at Vevey (source: Swiss Federal Archive).

## *2.3. Einsiedeln*

At the monastery of Einsiedeln, meteorological observations began in 1817. Over the next half century, measurements were made by Bernhard Foresti (1774-1851), Pius Regli (1792-1882), and Raphael Kuhn (1826-1909), all of which were padres at the monastery. The series from the monastery continues until 1949. The data comprise measurements of pressure, temperature, relative humidity, and wind, two to nine times per day. The original data sheets are kept at the archive of the monastery of Einsiedeln.

Bernhard Foresti wrote down observations from 1817 to 1850. An example data sheet is shown in Figure 3. At first these were mostly qualitative descriptions of the weather, written in latin, with (form 1818 on) some scattered measurements, though without the measurement time. The qualitative descriptions are important sources for historical climatology in their own right. For instance, Rössler and Brönnimann (2018) used observations for Einsiedeln to address the causes for the early summer flood event of 1817. However, in this paper we focus on the instrumental observations, which started on a more regular basis only in 1834.

After 1850 the series has a long gap. Later, Pius Regli made observations in 1859 and again in 1864. No data are available for the years in between. Some monthly data from 1818 to 1842 (1829 missing) comprising wind and rain days as well as, from 1834 to 1842, daily minimum and maximum temperature were published in Wolf (1866). Einsiedeln was a station in the Swiss national meteorological network from December 1863 onwards, with Pius Regli as observer.

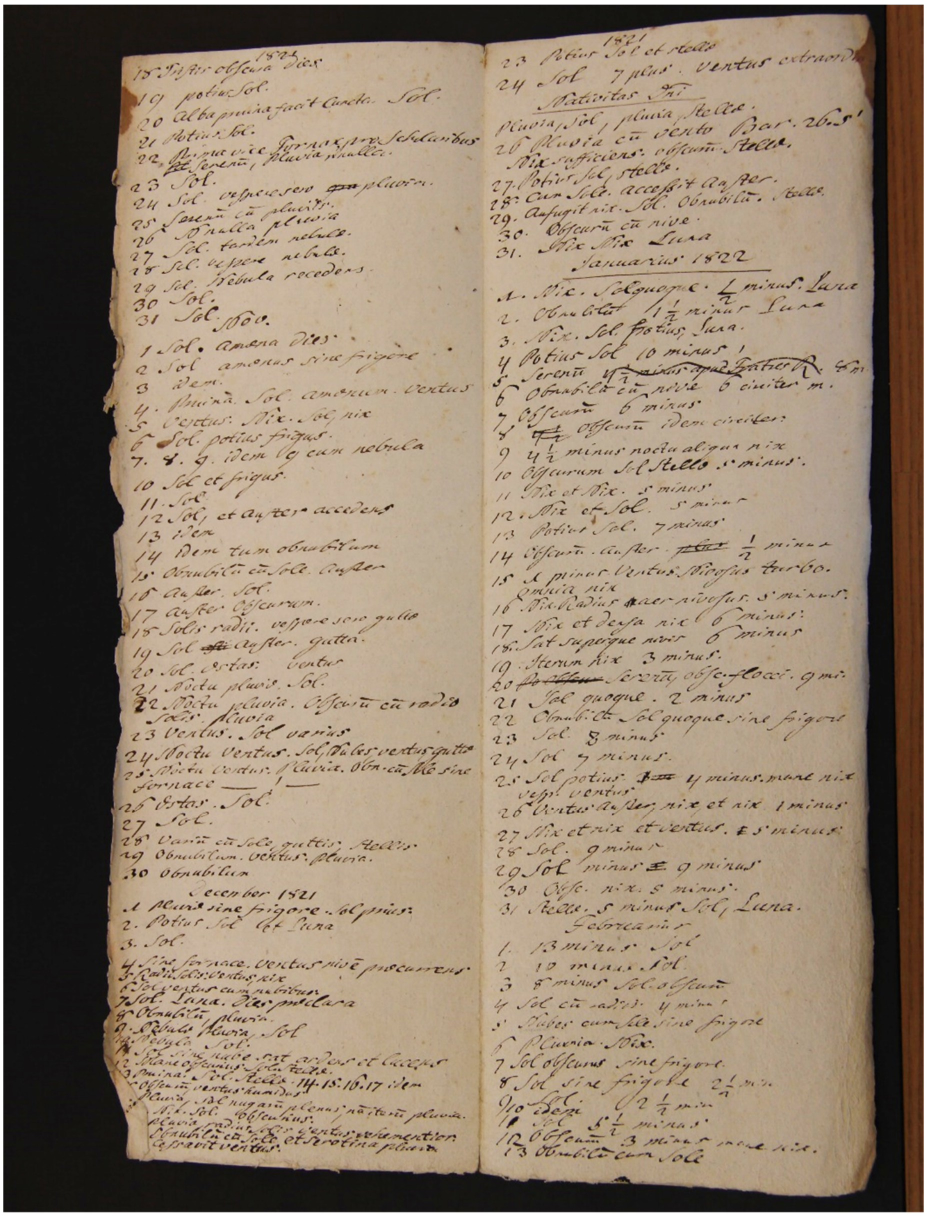

**Figure 3.** Weather observations in Einsiedeln in the winter 1821/22 by Bernhard Foresti (Klosterachive Einsiedeln).

### *2.4. Bellinzona*

The measurements in Bellinzona cover the period 1826-1832. They were started by Padre Thomas Inderbitzin [Tomaso in der Bitzen] (1791-1856). Inderbitzin came to Bellinzona as a teacher in 1824, but stayed there only until 1828. From November 1829 onward, Padre Plazidus [Placido] Gmeinder (1795-1869) performed the measurements. As there are no gaps in the record, it remains unclear who actually performed the measurements inbetween. Likewise, Plazidus Gmeinder was in Bellinzona only until 1831 and it is not clear who performed the measurements afterwards. Nothing is known about the instruments used and the exact location.

The data from Bellinzona comprise three times daily pressure, temperature, and wind. They are archived at the Burgerbibliothek Bern. Bellinzona was a station in the Swiss national meteorological network after 1864.

### *2.5. Lucerne*

Two records are discussed for Lucerne. The first of these records, covering 1826-1832, was performed by Josef Ineichen (1792-1881). Ineichen studied natural sciences in Göttingen and Paris. During 1823-1870 he was professor of mathematics and physics at the "Kantonsschule" Lucerne and an active politician (Ineichen, 2008). The data comprise three times daily pressure and temperature measurements as well as wind observations. Observation sheets can be found at the Burgerbibliothek Bern.

The second series covers the years 1844-1864 and was measured by Franz Xaver Schwytzer, architect and cantonal engineer. The data encompass twice daily measurements of temperature and pressure, weather observations, and measurements of the lake level. Schwytzer's original data are kept at the Swiss Federal Archive. An example data sheet from the year 1844 is shown in Figure 4. Both Ineichen and Schwytzer were active members of the Lucerne Natural Sciences Society (Suidter-Langenstein, 1895).

A third, short record by Ernst Grossbach (1803-1878), teacher of philosophy at the "höhere Lehranstalt" in Lucerne, covering 16 months (1860/1) has not been digitised. His twice daily temperature and pressure measurement are kept at the Swiss Federal Archive. Lucerne was not a station in the Swiss network of 1864, but Rathausen, ca. 3 km from the city centre of Lucerne, was part of the network. The Lucerne series could therefore potentially be merged.

### *2.6. Fribourg*

The series from Fribourg was measured at Collège Saint-Michel by Jean Baptiste Wière (1793-1850). Wière was a Jesuit padre and professor of physics and natural sciences at the college

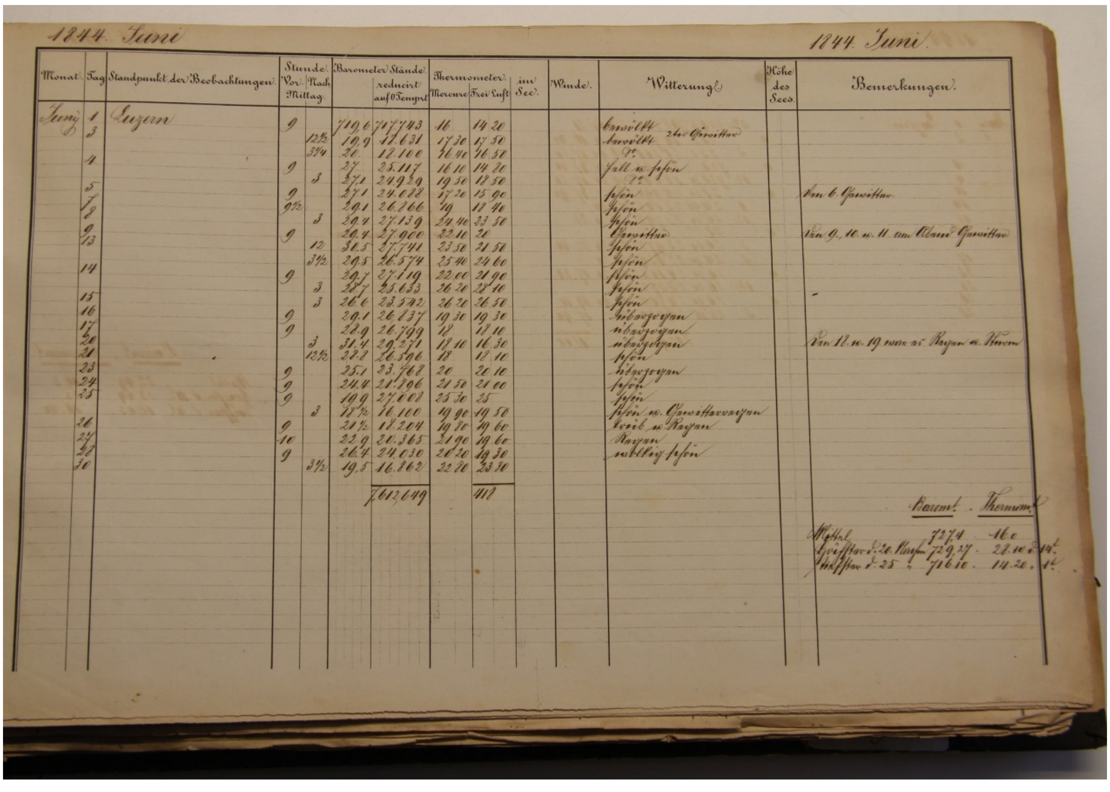


**Figure 4.** Example sheet of meteorological measurements from Lucerne, 1844.

("Kollegium", see Maggetti, 2019). His instruments included a barometer, several thermometers, a hair hygrometer (all of which were produced by Gourdon), and an anemometer. The barometer (the exact location is unknown) was calibrated against the instrument in Paris. The three thermometers were mounted outside a north-facing window at the second floor of the college. According to Maggetti (2019), Wière read the thermometers since 1822, whereas the full suite of 2-3 times daily meteorological observations started only in 1829. The data can be found at the Bibliothèque Cantonale et Universitaire Fribourg, but covering only 1829-1847, as the first volume of the series is missing.

Two more series from Fribourg could possibly be used. State archivist Joseph-Victor Daguet (1786-1860) made meteorological measurements from 1830 to 1859. The data are kept at the Burgerbibliothek Bern. Another record by Francois Moret, professor of mathematics at the Collège, covering 1856-1861, could not be found.

### *2.7. Zug*

The series from Zug provides a relatively complete temperature record covering the period 1843 to 1873. Bieler (1959) indicates Michael Müller (1813-1851) as observer from 1844 to 1851; the observer from 1851 to 1873 remains unknown. Twice daily temperature data can be found at the Swiss Federal archive, but probably more data exist. According to Bieler (1959), also pressure was measured, which is not in the sources kept at the Swiss Federal archive. The data from 1844 to 1851 were analysed by Prof. F[riedrich] Müller and his students (Bieler, 1959). The Zug series could perhaps be extended backward by a record from physician and pharmacist Franz Karl Stadlin (1777-1829), covering parts of the 1810s and 1820s. However, these data could not be found (see Pfister et al., 2019).

## 3. Processing and quality control

All series described in this paper were processed as detailed in Brugnara et al. (2020a). In addition to comparing measurements at different times of the day and flagging outliers, we also compared series with neighbouring cities. The comparisons of Vevey and Fribourg revealed a problem in some of the pressure data. As it was impossible to state, which of the two series was wrong, we also compared against the series from Bern made by Trechsel (Flückiger et al., 2020). This clearly indicated the erroneous series to be that of Fribourg. Correspondingly, for this study we flagged the pressure measurements at Friboug between 16 Dec. 1833 and 27 Jan. 1834. Some digitisation errors were flagged for Vevey.

In the following, before showing comparisons between different times of day or between different series, we show the time series of the three longest records. Figure 5 presents the long series from Vevey together with corresponding monthly or seasonal data from the reconstruction EKF400v2 (Valler et al., 2021). The monthly pressure series from the observations shows a high correlation with sea-level pressure in EKF400v2, though visually clear inhomogeneities are present that require further homogenization. Temperature shows a good agreement between the two data sets on a seasonal scale. The correlations are high, and some clear anomalies are found in both series such as the cold summer of 1816 (Brönnimann, 2015) or the particularly cold winter 1829/1830 (Pfister and Wanner, 2021); both features were already discussed for the Schaffhausen series (Brönnimann et al., 2022).

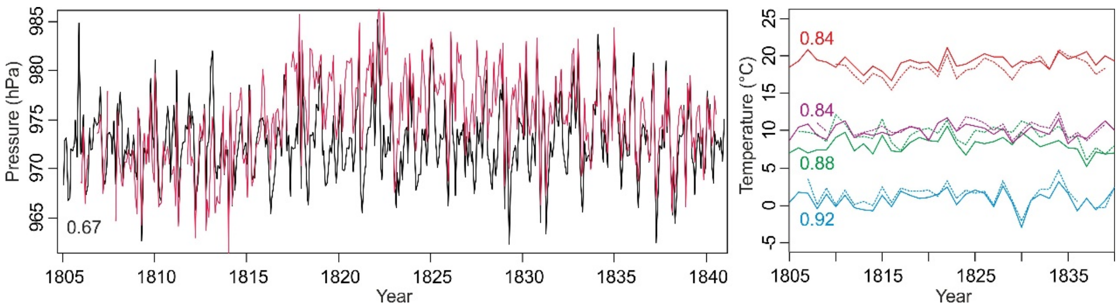


**Figure 5.** (left) Monthly mean pressure in the observations from Vevey (red) and sea-level pressure in EKF400v2 (black, offset by 45 hPa). (right) Seasonal temperature observations from Vevey (dashed) and EKF400v2 (solid, increased by 2 °C) in Dec.-Feb. (blue), Mar.-May (green), Jun.-Aug (red) and Sep.-Nov. (purple). Numbers indicate Pearson correlations.

For temperature in Einsiedeln (Fig. 6) we plot the individual values, as the data are often too sparse to plot monthly mean values. The plot clearly shows that prior to 1834, the record is sporadic, in particular, there are few summer measurements. After 1851 there are only two individual years of measurements, with long gaps in-between. Furthermore, the record could be affected by inhomogeneities. Finally, daily temperature for Zug is shown in Figure 7. The series is almost complete and its seasonal means fit well with the data from EKF400v2. Correlations are between 0.92 and 0.96.

We further analysed the correlation between measurements at the same location at different times of the day. For Vevey (temperature and pressure), we find high correlations between morning and evening. Even a higher correlation is found for Zug (Fig. 8).

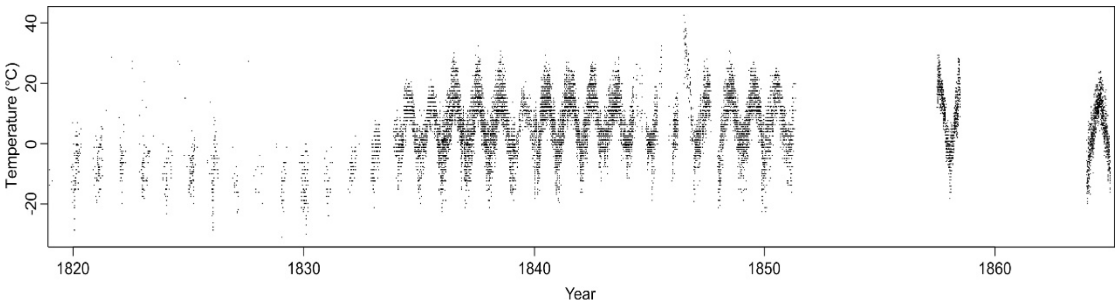


**Figure 6.** All available temperature measurements from Einsiedeln, 1818-1864.

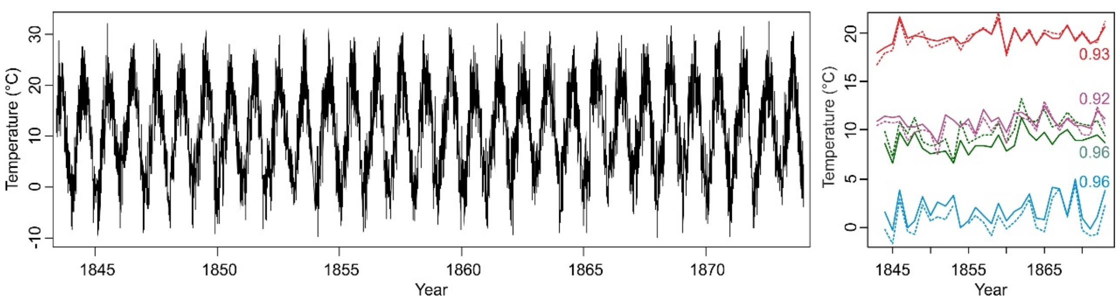


**Figure 7.** (left) Individual temperature observations from Zug. (right) Seasonal temperature observations from Zug (dashed) and EKF400v2 (solid, increased by 4 °C) in Dec.-Feb. (blue), Mar.-May (green), Jun.-Aug (red) and Sep.-Nov. (purple). Numbers indicate Pearson correlations.

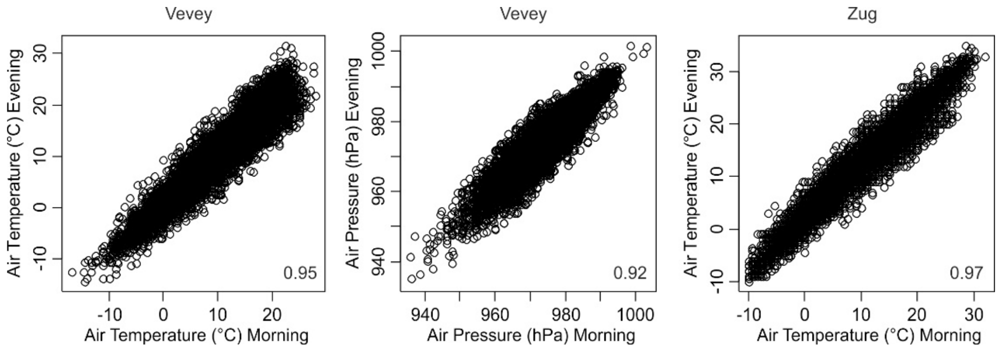


**Figure 8.** Comparison of morning and evening temperature and pressure in Vevey and Zug (temperature only). The number indicates the Pearson correlation coefficient.

The same figure for Bellinzona shows even higher correlations (Fig. 9). This is not suprising given that the measurements were taken at 3-hour intervals (9 AM, 12 PM, 3 PM). These observation times had been recommended by the SNSS and were followed by many observers during the 1820s and the 1830s (see e.g., Faden et al., 2020; Weber et al., 2020; Brugnara et al., 2021), including Ineichen in Lucerne and Wière in Fribourg. However, in the temperature record of Bellinzona there are some obvious outliers, which are grouped in specific months. Several individual months, namely December 1827, March 1828, and September/October 1828, are marked in the figure, but there are others. The highlighted months correspond to the end of the Inderbitzin segment of the records. This suggests that the record of Bellinzona needs a closer look.

A similar plot for the Ineichen series in Lucerne shows a high level of agreement for temperature, even higher for pressure (Fig. 10). Conversely, the plot for the Schwytzer series (Fig. 11) reveals a lower internal consistency. This might partly be due to outliers but certainly also to the different observation times, which were usually much farther apart than those of the SNSS.

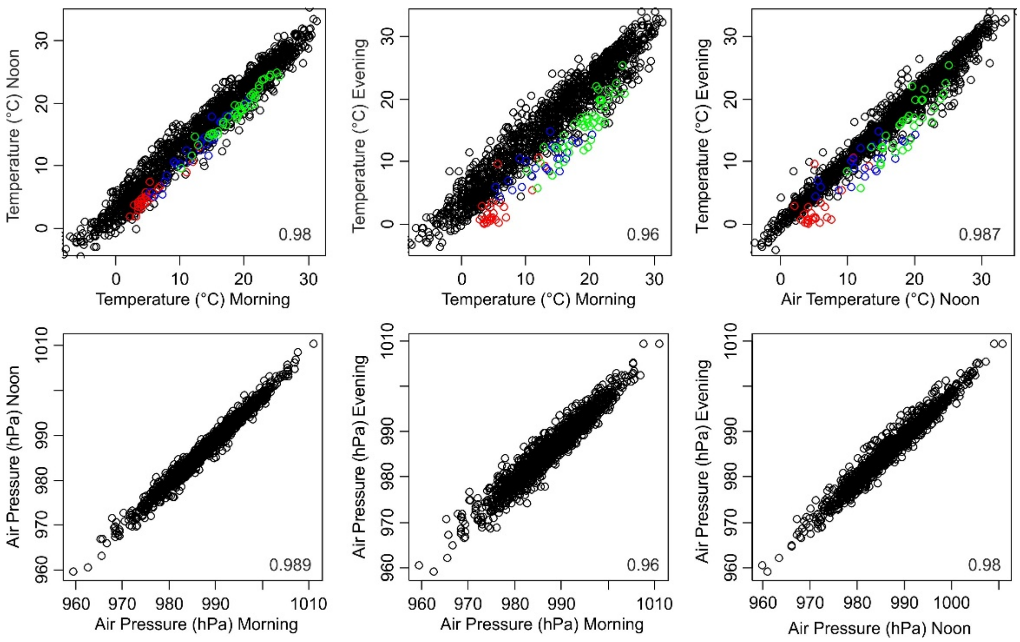


**Figure 9.** Mutual comparison of temperature and pressure at different times of the day for Bellinzona. The number in the lower right corner indicates the Pearson correlation coefficient (red: Dec. 1827, blue: Mar. 1828, green: Sep./Oct. 1828, not included in the correlation).

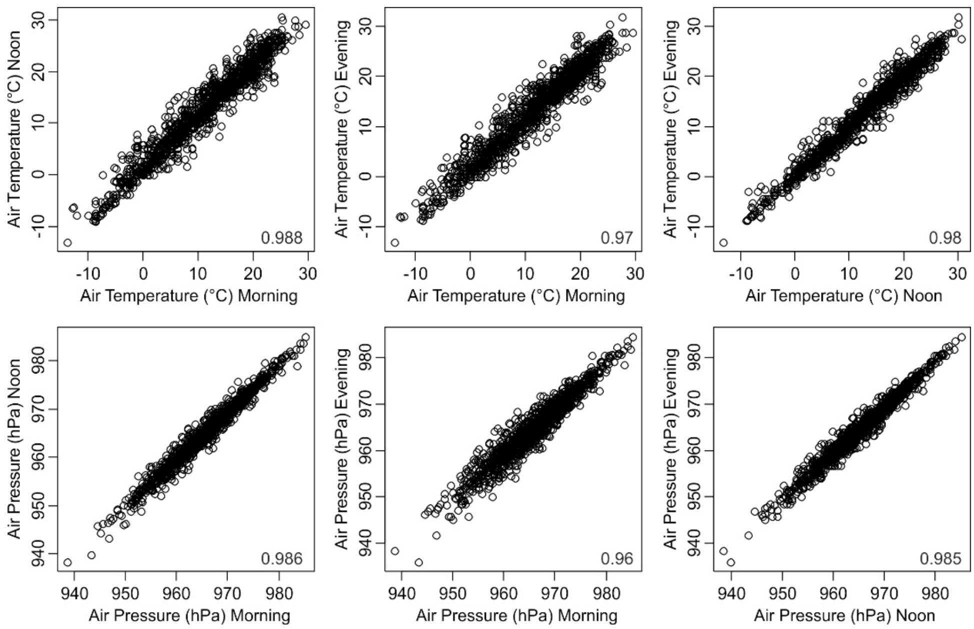


**Figure 10.** Mutual comparison of temperature and pressure at different times of the day for Lucerne (Ineichen series). The number in the lower right corner indicates the Pearson correlation coefficient.

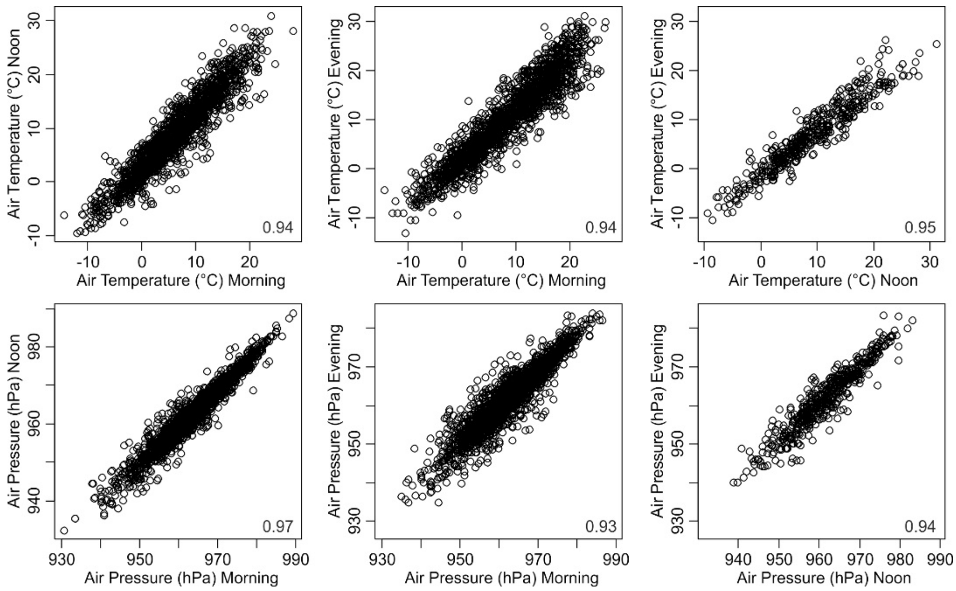


**Figure 11.** Mutual comparison of temperature and pressure at different times of the day for Lucerne (Schwytzer series). The number in the lower right corner indicates the Pearson correlation coefficient.

The comparison of temperature in Zug against temperature in Lucerne in the Schwytzer series (Fig. 12) shows correlations of 0.95 and 0.94 for morning and evening measurements, respectively, which is not particularly high given their proximity (the distance is 21 km). The numbers are lower than the corresponding correlations for Vevey and Fribourg (the distance here is 44 km). Pressure also agrees well between Fribourg and Vevey.

We also compared pressure and temperature in Bellinzona and in Lucerne (Ineichen series). Correlations here are clearly lower. Since the two sites are at opposite sides of the Alps, this is expected. In particular, Föhn situations will have opposite effects on both sides, and strong pressure gradients across the Alps are possible. The temperature correlations (0.90-0.91) are therefore in the expected range.

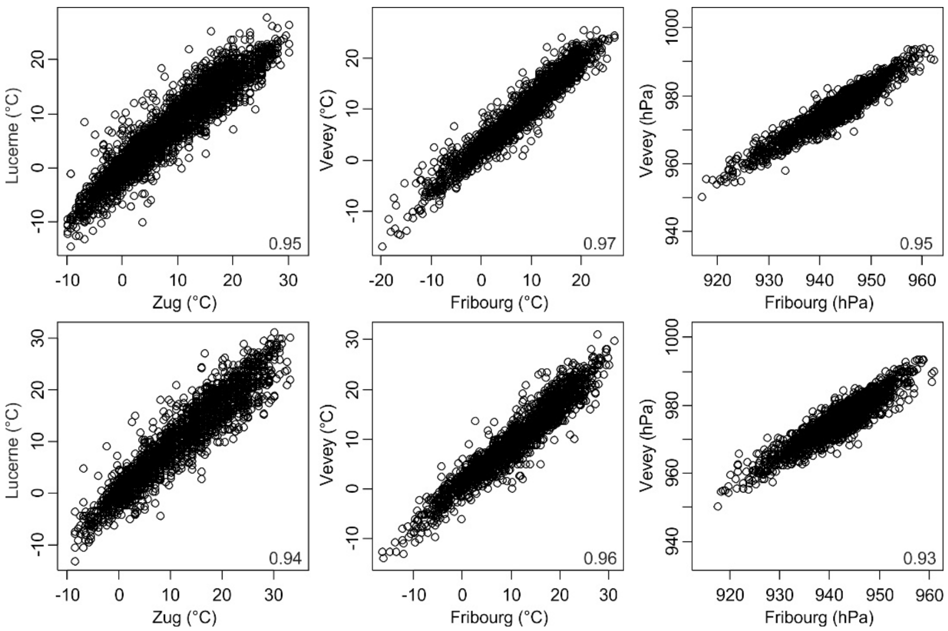


**Figure 12.** Comparison of temperature and pressure in (top) morning and (bottom) evening between (left) Zug and Lucerne (Schwytzer), (middle) Fribourg and Vevey and (right) pressure at Fribourg and Vevey. The number in the lower right corner indicates the Pearson correlation coefficient.

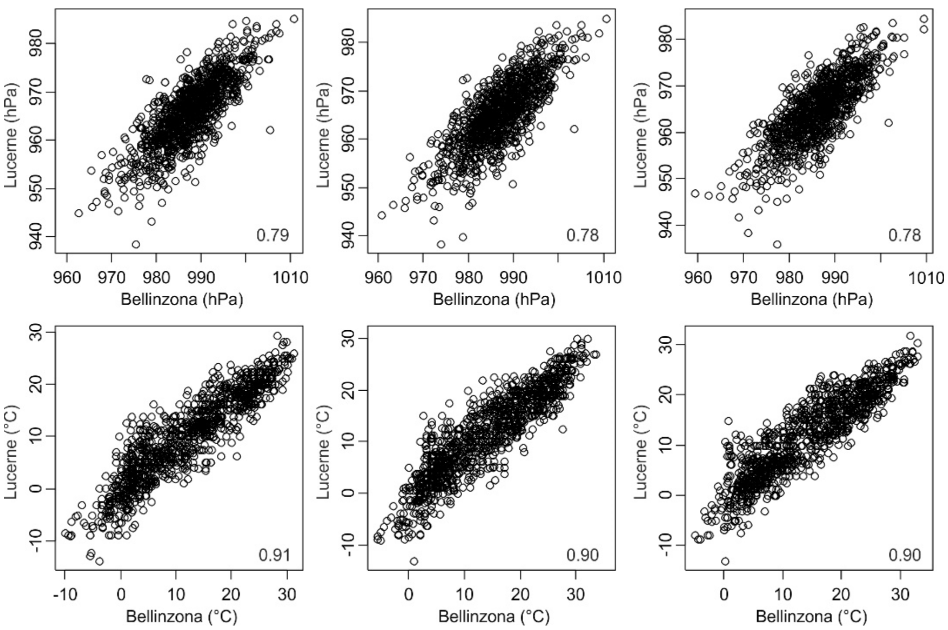


**Figure 13.** Comparison of temperature and in the morning (left), noon (middle), and evening (right) observations in Bellinzona and Lucerne (Ineichen series).

Finally, we compared the absolute temperature values in Bellinzona, Lucerne and Zug with those of the respective modern-day MeteoSwiss stations (Fig. 14; the nearby stations of Magadino/Cadenazzo and Cham are used for Bellinzona and Zug, respectively). In general the values are slightly too high, which is a common feature of early instrumental measurements (Brugnara et al., 2022). There is a better match in winter, when radiative biases are less important. For Lucerne, the measurements by Schwytzer appear to be of better quality than those of Ineichen. However, the differences might also depend on the vicinity to Lake Lucerne. Note that the observation times used by Schwytzer are better suited for calculating daily averages, because they are closer to the daily extremes.

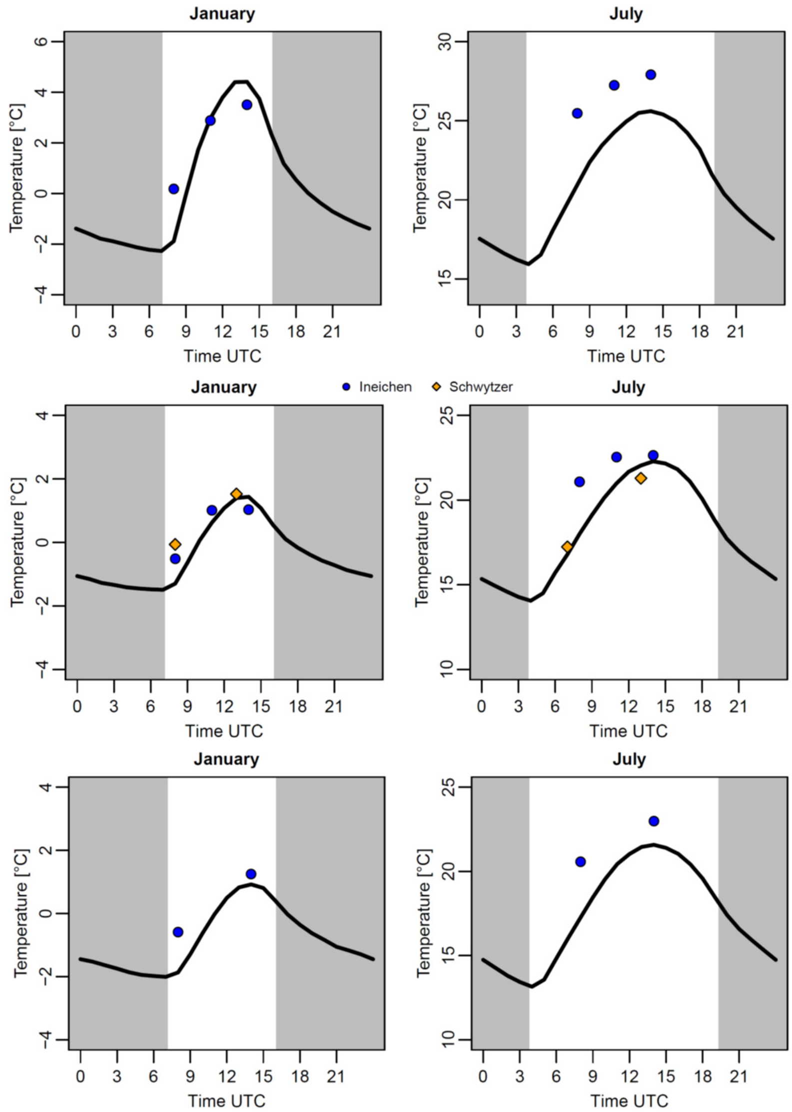


**Figure 14.** Diurnal temperature cycle (thick black line) in January (left) and July (right) in present-day MeteoSwiss data from (from top to bottom) Magadino/Cadenazzo (1981–2010, -1 °C to account for climate change), Lucerne (1981–2010, -1 °C) and Cham (1993-2020, -2°C), compared with the respective early instrumental records (points). Times have been rounded to the nearest hour, grey shading indicates nighttime.

## 5. Conclusions

In this paper we present seven Swiss meteorological series from the 19th century. The series add to the collection of series presented in this volume, which increase the number of available early Swiss meteorological series tremendously. The series exemplarily reflect the development and professionalization of meteorological measurements during this period (see Hupfer, 2019; Brönnimann et al., 2019). The series include one taken by padres in a monastery and connect to the first Swiss national network that started in 1864. In fact, several of the series could be continued to the present.

Concerning the individual series, the record from Vevey provides a long, continuous and quasi-complete series. The raw pressure series has an obvious inhomogeneous period, whereas temperature appears to be of high quality. This 35-year record is a valuable addition to the Swiss early instrumental records.

The available Fribourg record is much shorter, comprising only eight years. After flagging some implausible data, however, we find a generally high quality of the record.

The instrumental measurements from the monastery of Einsiedeln form part of a long weather diary. However, instrumental data are sparse in the first period (1818-1833) and less useful as no measurement times are given. The temperature measurements only become more frequent from 1834 to 1851 (pressure data cover only 1840-42, 1857-58, and 1864). However, the diary contains detailed descriptive weather data that could prove very valuable for weather and climate research.

The fourth record, that from Bellinzona, cover six years. Some problems were detected from December 1827 to October 1828, otherwise the quality seems good. Although the record may not seem long, we have no other series from Southern Switzerland prior to the start of the Swiss network.

Two records are available for Lucerne. The record by Ineichen is short and fragmented. The quality seems good. Scientifically it could be interesting as it covers the extremely cold winter of 1829/30 (although only to Jan 1830). The second record by Schwytzer is longer, but also fragmented, and the comparison with the record from nearby Zug indicates that the quality might not be extremely good.

Finally, we present a rather long record from Zug, covering 1843 to 1873. This record is close to complete and apparently of high quality, although it provides only twice daily temperature (further data could be available, but were not found).

In summary, this paper presents two long records of high quality (Vevey, Zug), two shorter records that also seem to be of good quality (Fribourg, Bellinzona), a more fragmented record (Lucerne) that needs mot work as well as the record from Einsiedeln, which is not useful in present form, although the descriptive weather data could be relevant. The data presented in this paper are publicly available on the PANGAEA website (Brugnara, 2020). They will also be available from MeteoSwiss, the C3S data Global Land and Marine Observations Database (Noone et al., 2021) and from EURO-CLIMHIST (Pfister et al., 2017).

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## Sources

Daguet, J.-V., Meteorological measurements 1830-1859. Burgerbibliothek Bern, Mss.h.h.XXVI.18

Foresti, B., P. Regli, and R. Kuhn, Einsiedeln Kloster Resultat der meteorologischen Beobachtungen, BAR E3180-01#2005/90#88*, https://www.swiss-archives.ch/detail.aspx?ID=4353375

Foresti, B., P. Regli, and R. Kuhn, Korrespondenz und Richtlinien der meteorologischen Station (Schweizerische meteorologische Centralstelle) Dossier: 1 Akte 1861(ca.)-1967(ca.), Meteorologische Beobachtungen 1817-1858 (Reduktionstabellen und anderes), Klosterarchiv Einsiedeln, A.39/5, A.39/6 (2), http://www.klosterarchiv.ch/earchiv_detail.php?signaturteil=KAE%2C%20A.39%2F5&start=0, http://www.klosterarchiv.ch/earchiv_detail.php?parent=90535&start=3

Foresti, B., P. Regli, and R. Kuhn, Meteorological tables 1817/4-1839/12 and 1846/1-12, Meteorologische Beobachtungen, Dossier: 1 Akte 1817-1858, Klosterarchiv Einsiedeln KAE, A.39/6 (1), http://www.klosterarchiv.ch/earchiv_detail.php?parent=90535&start=0 (mostly weather notes, single measurements).

Foresti, B., P. Regli, and R. Kuhn, Meteorological tables 1817/6-9, Meteorologische Beobachtungen, Dossier: 1 Akte, 1817-1858, Klosterarchiv Einsiedeln KAE, A.39/6 (2), http://www.klosterarchiv.ch/earchiv_detail.php?parent=90535&start=0

Foresti, B., P. Regli, and R. Kuhn, Meteorological tables 1818 and 1820/1-1839/12, incomplete data 1840-1842, subdaily January 1858, Meteorologische Beobachtungen, Dossier: 1 Heft 1820-1863, Klosterarchiv Einsiedeln KAE, A.39/8, http://www.klosterarchiv.ch/earchiv_detail.php?parent=90535&start=2

Foresti, B., P. Regli, and R. Kuhn, Meteorological tables 1840/1-1851/6, Meteorologische Beobachtungen, Dossier: 1 Akte 1817-1858, Klosterarchiv Einsiedeln KAE, A.39/6 (2), http://www.klosterarchiv.ch/earchiv_detail.php?parent=90535&start=0

Foresti, B., P. Regli, and R. Kuhn, Meteorological tables 1851/6, 1854/1-3, Meteorologische Beobachtungen, Dossier: 1 Heft 1851, Klosterarchiv Einsiedeln, KAE, A.39/9, http://www.klosterarchiv.ch/earchiv_detail.php?parent=90535&start=4

Foresti, B., P. Regli, and R. Kuhn, Meteorological tables 1857/7-1858/6, Meteorologische Beobachtungen, Dossier: 1 Akte 1817-1858, Klosterarchiv Einsiedeln, KAE, A.39/6 (2), http://www.klosterarchiv.ch/earchiv_detail.php?parent=90535&start=0

Foresti, B., P. Regli, and R. Kuhn, Meteorological tables 1864/1-12, Meteorologische Beobachtungen, Dossier: 1 Heft 1864, Klosterarchiv Einsiedeln, KAE, A.39/14, http://www.klosterarchiv.ch/earchiv_detail.php?parent=90535&start=6

Foresti, B., P. Regli, and R. Kuhn, Monthly meteorological tables 1818-1873, Meteorologische Beobachtungen, Dossier: 1 Heft 1817-1875 (ca.), Klosterarchiv Einsiedeln, KAE, A.39/10, http://www.klosterarchiv.ch/earchiv_detail.php?parent=90535&start=1

Foresti, B., P. Regli, and R. Kuhn, Monthly meteorological tables 1820-1842, Meteorologische Beobachtungen, Dossier: 1 Heft 1820-1864, Klosterarchiv Einsiedeln, KAE, A.39/7, http://www.klosterarchiv.ch/earchiv_detail.php?parent=90535&start=3

Grossbach, E., Meteorological measurements 1860-1861, Swiss Federal Archive E3180-01#2005/90#325*

Ineichen, J., Meteorological measurements 1826-1832, Burgerbibliothek Bern: Mss.h.h.XXVI.22.9.

Meteorological observations from Bellinzona, Burgerbibliothek Bern, Mss.h.h.XXVI.22.3

Meteorological observations from Zug, 1843-1873. Swiss Federal Archive E3180-01#2005/90#128*

Nicod-Delom, J.-S., Meteorological tables 1805-1812, Manuscripts Nicod, BAR E3180-01#2005/90#196*, https://www.swiss-archives.ch/detail.aspx?ID=4353519

Nicod-Delom, J.-S., Meteorological tables 1813-1819, Manuscripts Nicod, BAR E3180-01#2005/90#200*, https://www.swiss-archives.ch/detail.aspx?ID=4353524

Nicod-Delom, J.-S., Meteorological tables 1818-1826, Manuscripts Nicod, BAR E3180-01#2005/90#202*, https://www.swiss-archives.ch/detail.aspx?ID=4353527

Nicod-Delom, J.-S., Meteorological tables 1827-1840, Manuscripts Nicod, BAR E3180-01#2005/90#210*, https://www.swiss-archives.ch/detail.aspx?ID=4353537

Perdonnet, Alexandre, Meteorological measurements 1761-1766, Burgerbibliothek Bern: GA Oek.Ges.99(23-24) (1761-1762); GA Oek.Ges.100-103

Schwytzer, F. X., Meteorological observations 1844-1864, Swiss Federal Archive, E3180-01#2005/90#130*, https://www.swiss-archives.ch/detail.aspx?ID=4353431

Wière, J. B., Observations météorologiques faites au Collège [...], 1823-1847, Bibliothèque Cantonale et Universitaire Fribourg, Ref. code: ms. L 834

## References


Bieler A. 1959. Die Anfänge der Naturforschung im Zugerland. *Zuger Neujahrsblatt* **1959,** 3–19.

Brönnimann, S. (2015) *Climatic changes since 1700. Springer,* Advances in Global Change Research Vol. 55, xv + 360 pp.

Brönnimann, S., R. Allan, L. Ashcroft, S. Baer, M. Barriendos, R. Brázdil, Y. Brugnara, M. Brunet, M. Brunetti, B. Chimani, R. Cornes, F. Domínguez-Castro, J. Filipiak, D. Founda, R. García Herrera, J. Gergis, S. Grab, L. Hannak, H. Huhtamaa, K. S. Jacobsen, P. Jones, S. Jourdain, A. Kiss, K. E. Lin, A. Lorrey, E. Lundstad, J. Luterbacher, F. Mauelshagen, M. Maugeri, N. Maughan, A. Moberg, R. Neukom, S. Nicholson, S. Noone, Ø. Nordli, K. B. Ólafsdóttir, P. R. Pearce, L. Pfister, K. Pribyl, R. Przybylak, C. Pudmenzky, D. Rasol, D. Reichenbach, L. Řezníčková, F. S. Rodrigo, R. Rohde, C. Rohr, O. Skrynyk, V. Slonosky, P. Thorne, M. A. Valente, J. M. Vaquero, N. E. Westcottt, F. Williamson, P. Wyszyński (2019) Unlocking pre-1850 instrumental meteorological records: A global inventory. *B. Amer. Meteorol. Soc.* **100,** ES389–ES413.

Brönnimann, S., Y. Brugnara, S. Eggenberger, L. Pfister, and C. Rohr (2022) A long meteorological series from Schaffhausen, 1794–1845. In: Brönnimann, S. (Ed.) *Swiss Early Instrumental Meteorological Series.* Geographica Bernensia G96, p. 237-244, DOI: 10.4480/GB2020.G96.21.

Brugnara, Y. (2020) Swiss Early Meteorological Observations, PANGAEA. https://doi.org/10.1594/PANGAEA.909141

Brugnara, Y., J. Flückiger, and S. Brönnimann (2020a) Instruments, procedures, processing, and analyses. In: Brönnimann, S. (Ed.) *Swiss Early Instrumental Meteorological Series.* Geographica Bernensia G96, p. 17–32, DOI: 10.4480/GB2020.G96.02.

Brugnara, Y., L. Pfister, L. Villiger, C. Rohr, F. A. Isotta, and S. Brönnimann (2020b) Early instrumental meteorological observations in Switzerland: 1708–1873. *Earth Syst. Sci. Data,* **12,** 1179–1190.

Brugnara, Y., L. Pfister, and S. Brönnimann (2021) Zurich's Many 19th Century Meteorological Records. In: Brönnimann, S. (Ed.) *Swiss Early Instrumental Meteorological Series*. Geographica Bernensia G96, p. 183-197, DOI: 10.4480/GB2020.G96.14.

Brugnara, Y., C. Hari, L. Pfister, V. Valler, and S. Brönnimann (2022) Pre-industrial Temperature Variability on the Swiss Plateau Derived from the Instrumental Daily Series of Bern and Zurich. *Clim. Past Discuss.*, https://doi.org/10.5194/cp-2022-34 (in review).

Davall A. (1860) *Climat de Vevey. Tableaux météorologiques.* Recordon, Vevey.

Faden, M., L. Villiger, Y. Brugnara, and S. Brönnimann (2020) The Meteorological Series from Aarau, 1807–1865. In: Brönnimann, S. (Ed.) *Swiss Early Instrumental Meteorological Series*. Geographica Bernensia G96, p. 61–72, DOI: 10.4480/GB2020.G96.05.

Flückiger, J., A.-M. Burgdorf, Y. Brugnara, and S. Brönnimann (2020) Two Meteorological Series from Bern from Trechsel, 1826–1849, and Benoit, 1837–1853. In: Brönnimann, S. (Ed.) *Swiss Early Instrumental Meteorological Series.* Geographica Bernensia G96, p. 97–108, DOI: 10.4480/GB2020.G96.09.

Hupfer, F. (2019) *Das Wetter der Nation. Meteorologie, Klimatologie und der schweizerische Bundesstaat, 1860–1914.* Chronos, Zürich, doi:10.33057/chronos.150.

Ineichen, R. (2008) Ineichen, Josef, in: Historisches Lexikon der Schweiz (HLS), online: https://hls-dhs-dss.ch/de/articles/046266/2008-01-22/, consulted 25 May 2022.

Maggetti, M. (2019) Jean-Baptiste Wiere SJ (1793-1850) und sein Beitrag zur Meteorologie und Höhenmessung des Kantons Freiburg. *Bull. Soc. Frib. Sc. Nat.,* **108,** 67-176.

Nicod-Delom, J.-S. (1817) *Mémoire sur les causes de l'élévation graduelle de la surface moyenne des eaux du Lac Léman et les effets nuisibles qui en sont la suite.* Lörtscher et fils, Vevey, 46 pp.

Noone, S., C. Atkinson, D. I. Berry, R. J.H. Duun, E. Freeman, I. Perez Gonzalez, J. J. Kennedy, E. C. Kent, A. Kettle, S. McNeill, M. Menne, A. Stephens, P. W. Thorne, W. Tucker, C. Voces, and K. M. Willett (2021) Progress towards a holistic land and marine surface meteorological database and a call for additional contributions. *Geosci. Data J.,* **8,** 103–120.

Pfister C. 1975. *Agrarkonjunktur und Witterungsverlauf im westlichen Schweizer Mittelland, 1755-1797.* Lang Druck AG, Liebefeld/Bern.

Pfister, C. and H. Wanner (2021) *Climate and Society in Europe. The Last Thousand Years.* Haupt, Bern, 397 pp.

Pfister, C., C. Rohr, and A. C. C. Jover (2017) Euro-Climhist: eine Datenplattform der Universität Bern zur Witterungs-, Klima- und Katastrophengeschichte. *Wasser Energie Luft,* **109,** 45–48.

Pfister, L., F. Hupfer, Y. Brugnara, L. Munz, L. Villiger, L. Meyer, M. Schwander, F. A. Isotta, C. Rohr, and S. Brönnimann (2019) Early instrumental meteorological measurements in Switzerland. *Clim. Past,* **15,** 1345–1361.

Rössler, O. K. and S. Brönnimann (2018) The effect of the Tambora eruption on Swiss flood generation in 1816/1817. *Sci. Total Environ.,* **627,** 1218-1227.

Suidter-Langenstein, O. (1895) Geschichte der Naturforschenden Gesellschaft in Luzern. *Mitteilungen der Naturforschenden Gesellschaft in Luzern,* **1,** 19-58.

Valler, V., J. Franke, Y. Brugnara, and S. Brönnimann (2021) An updated global atmospheric paleo-reanalysis covering the last 400 years. *Geosc. Data J.,* https://doi.org/10.1002/gdj3.121.

Weber, J., Y. Brugnara, and S. Brönnimann (2020) Two Meteorological Series from Herisau, 1821-1844. In: Brönnimann, S. (Ed.) *Swiss Early Instrumental Meteorological Series*. Geographica Bernensia G96, p. 73–85, DOI: 10.4480/GB2020.G96.06.

Wolf, R. (1866) Schweizerische Meteorologische Beobachtungen, Vol. 3, Zurich.