Brönnimann, S., Y. Brugnara, and L. Pfister (2022) Several little-known meteorological series from Basel, 1766-1802. In: Brönnimann, S. (Ed.) *Swiss Early Instrumental Meteorological Series.* Geographica Bernensia G96, p. 213–224, DOI: 10.4480/GB2020.G96.17.

Several little-known meteorological series from Basel, 1766-1802

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Abstract

The meteorological series from Basel, reaching back to 1755, is one of the two long Swiss climate series. The data from 1755 to 1805 in this series are based on observations by D'Annone. Here we present additional series from Basel that cover almost the same period and thus allow an assessment of the D'Annone data and eventually a reassessment of a new Basel series. These series comprise measurements by Johann Heinrich Ryhiner (covering 1766-1772), Daniel Wolleb (1777-1785) and Abel Socin (1783-1802) in the city of Basel and by Ambrosius Bavier (1776-1790) in Waldenburg. An additional series from Werner de Lachenal (1766-1795) was imaged but was very incomplete and hard to digitise. Here we provide information on the locations, observers, and instruments (where available), as well as quality control procedures.

1. Introduction

The series from Basel is one of two prominent long Swiss series (the second being Geneva) and reaches back to 1755. In the currently available Basel series, which dates back to Bider et al. (1958) and Bider and Schüepp (1961), the first 50 years are from one single observer: Johann Jakob D'Annone. Bider and Schüepp provided daily data that already included many corrections. In the framework of the MeteoSwiss project DIGIHOM III (Füllemann et al., 2011) and the MeteoSwiss GCOS project "Long instrumental series", the original subdaily data from D'Annone were re-digitised (Brönnimann and Brugnara, 2020) to allow a complete re-assessment of the Basel series. During the same 50 years, several other observers measured pressure and temperature in the city of Basel and its vicinity (Pfister et al., 2019;

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see also Riggenbach, 1892), as was the case also elsewhere in Europe, leading to a peak in the number of series during the Enlightenment (Brönnimann et al., 2019). These data have not been consulted by Bider et al. (1958). However, some of them seem to be of good quality (Riggenbach, 1892) and could support the re-assessment of the Basel series.

In this paper we present several records which together span the period 1766-1802. These include the series by Johann Heinrich Ryhiner (covering 1766-1772), Daniel Wolleb (1777-1785) and Abel Socin (1783-1802) in Basel as well as a series by Ambrosius Bavier (1776-1790) from Waldenburg, Basel-Landschaft. An additional series by Werner de Lachenal (1766-1795) was imaged, but the data are very incomplete and difficult to digitise and hence were not digitised. We present the compiled metadata on the series such as information on observers, locations, and instruments (Section 2). Then we describe processing and quality control of the data series as well as results of mutual comparisons (Section 3). Conclusions are then drawn in Section 4. Metadata can be found in the inventory of Pfister et al. (2019); the data can be obtained from MeteoSwiss or from EURO-CLIMHIST (Pfister et al., 2017).

2. The 18th century Basel series

This section summarizes the metadata for each of the four series, based mostly on archival material. Table 1 gives an overview of the series; measurement locations are shown in Figure 1 on a contemporary map. Table and Figure also list two very short series by Zwinger (1755)

Figure 1. Locations of meteorological observations in Basel, 1755-1805, on a contemporary map. (Grundriss der Stadt Basel = Plan de la ville de Basle / aufgenommen im Jahr 1784 von Samuel Ryhiner; herausgegeben von Christian von Mechel, source: UB Basel Maps, Wikimedia Commons).

Table 1. Meteorological observations in Basel, 1766-1802. Sources: Riggenbach (1892), Pfister et al. (2019).

Period	Location	Observer
1755	Unknown (Basel)	Friedrich Zwinger
1755-1805	Heuberg 16 (Basel)	Johann Jakob D'Annone
1766-1772	Schönauerhof/Rittergasse (Basel)	Johann Heinrich Ryhiner
1766-1795	Botanical Garden (Basel)	Werner de Lachenal
1776-1790	Pfarrhaus, Waldenburg	Ambrosius Bavier
1777-1785	Eisengasse (Basel)	Daniel Wolleb
1783-1805	Offenburger Hof (Petersgasse 40), 1st floor (Basel)	Abel Socin
1786	Unknown (Basel)	Johann Kaspar Scholer

and Scholer (1786) as well as the long series by D'Annone (Brönnimann and Brugnara, 2020), which covers the entire period. The Zwinger series was copied by D'Annone to backward extend his own record by five months to January 1755. The Scholer series covers only seven months in 1786 and is listed only for completeness.

The manuscript sources of all series discussed in this paper are kept at the University Library of Basel. In the following we discuss the individual series. Note that the series from Lachenal and Scholer were imaged but not keyed. A short description of the Lachenal series is nevertheless provided.

2.1. The series by Johann Heinrich Ryhiner

The first series discussed here is that of Johann Heinrich Ryhiner (1732-1802, Fig. 2). He was the son of a theology professor and thus grew up in an academic environment. Ryhiner studied philosophy in Basel, then medicine in Strasbourg. In 1753 he returned to Basel and in 1760 became professor of ethics and law at the University of Basel. Furhtermore, he served as the University's librarian and multiple times as dean and rector (Staehelin, 1957; Marti-Weissenbach, 2012). He is also known for his interests in chemistry.

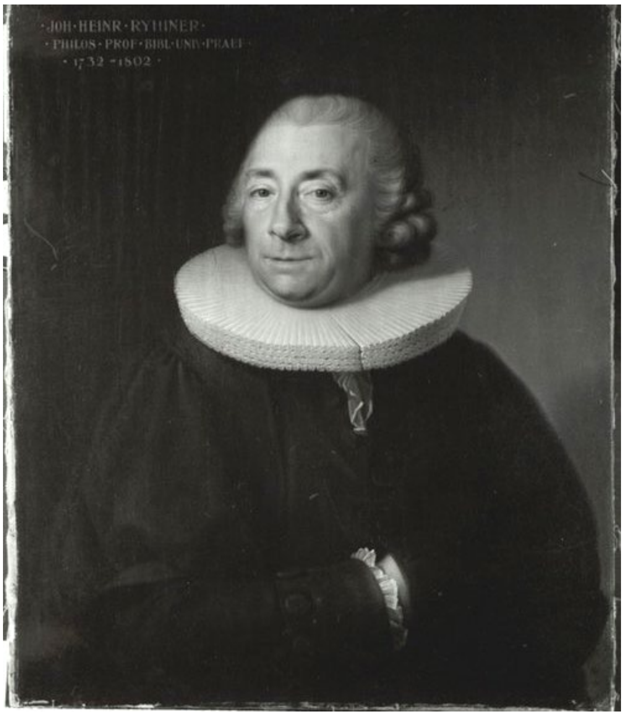


Figure 2. Johann Heinrich Ryhiner (painting by Anton Hickel, 1785, portrait collection of the University of Basel, UBH Portr BS Ryhiner JH 1732, 1).

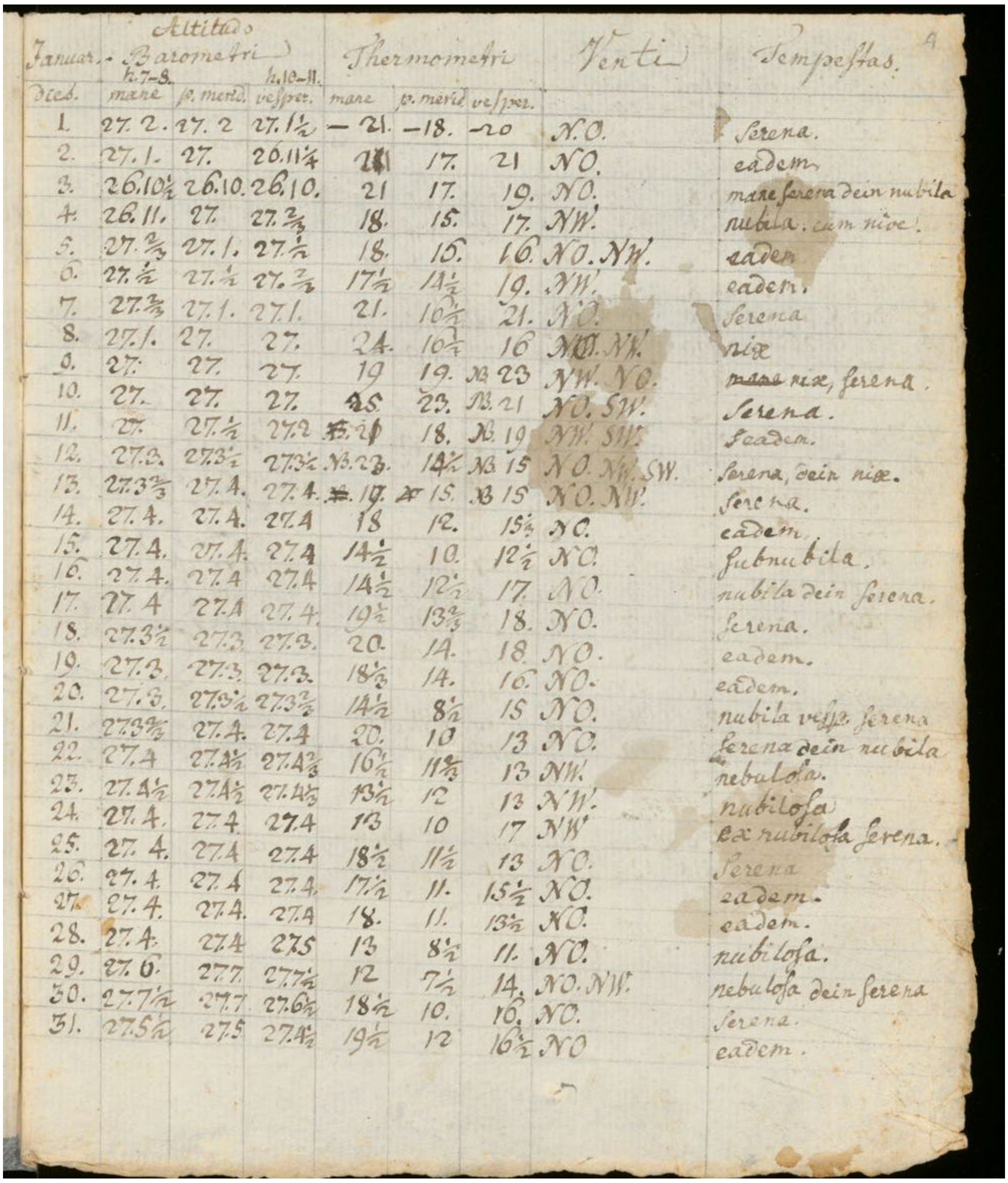


Figure 3. Data sheet from Johann Heinrich Ryhiner for the year 1766, University Library of Basel (UBH L Ib 86c).

Ryhiner measured three times daily temperature and pressure in his house at Rittergasse. The thermometer had a Du Crest scale and was mounted at a window. He also noted wind direction and weather as well as other observations (see Riggenbach, 1892). An excerpt of a data sheet is shown in Figure 3.

2.2. The series by Werner de Lachenal

Werner (Wernhard) de Lachenal (1736-1800) was the son of pharmacist, botanist and doctor Johann Lachenal and of Maria Margaretha Gottfried. He began studying pharmacy, but then graduated in philosophy and studied medicine, finishing with a doctorate in Basel in 1763. From 1776 to 1798 he was professor of anatomy and botany in Basel. He redesigned the botanical garden and enlarged the library and herbarium and also promoted anatomy at the university. He had a wide scholarly network, which included scientists such as Albrecht von Haller (Marti-Weissenbach, 2008).

Werner de Lachenal measured one to eight times daily, but very irregularly (only a few days per year in 1766, 1775-1791, 1795; see also Riggenbach, 1892). The data proved to be too demanding to digitise because of the irregular structure and were considered of little value given that no monthly means could have been obtained.

2.3. The series by Daniel Wolleb

Daniel Wolleb (1757-1822) was a scientist from Basel. He studied medicine in the 1770s and, after a stay in Strasbourg, returned to Basel to obtain his doctoral degree. He joined the medical faculty of the University and in 1789 became professor of eloquence (Staehelin, 1957).

Wolleb measured temperature three times per day using a Du Crest thermometer, and pressure once or twice per day. According to Riggenbach (1892) the measurements were performed with utmost care. An excerpt of a data sheet is shown in Figure 4.

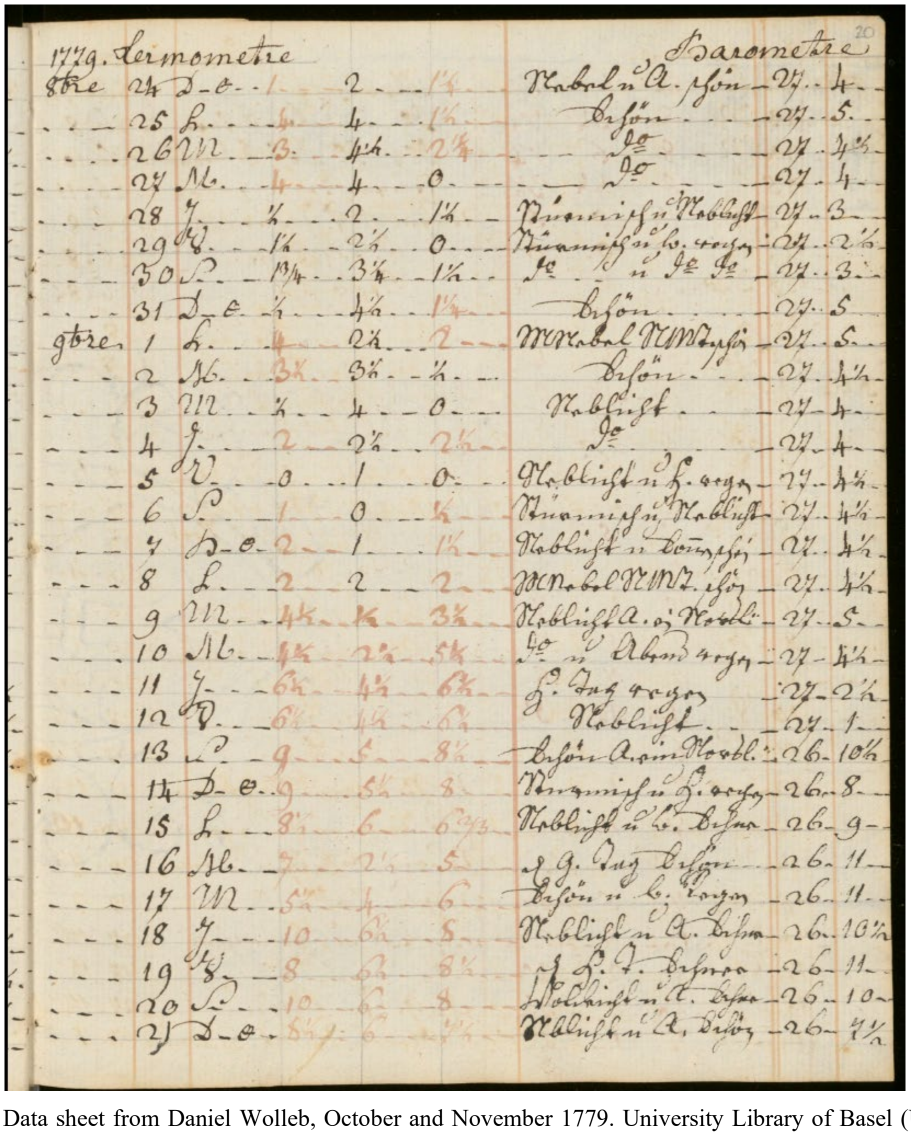
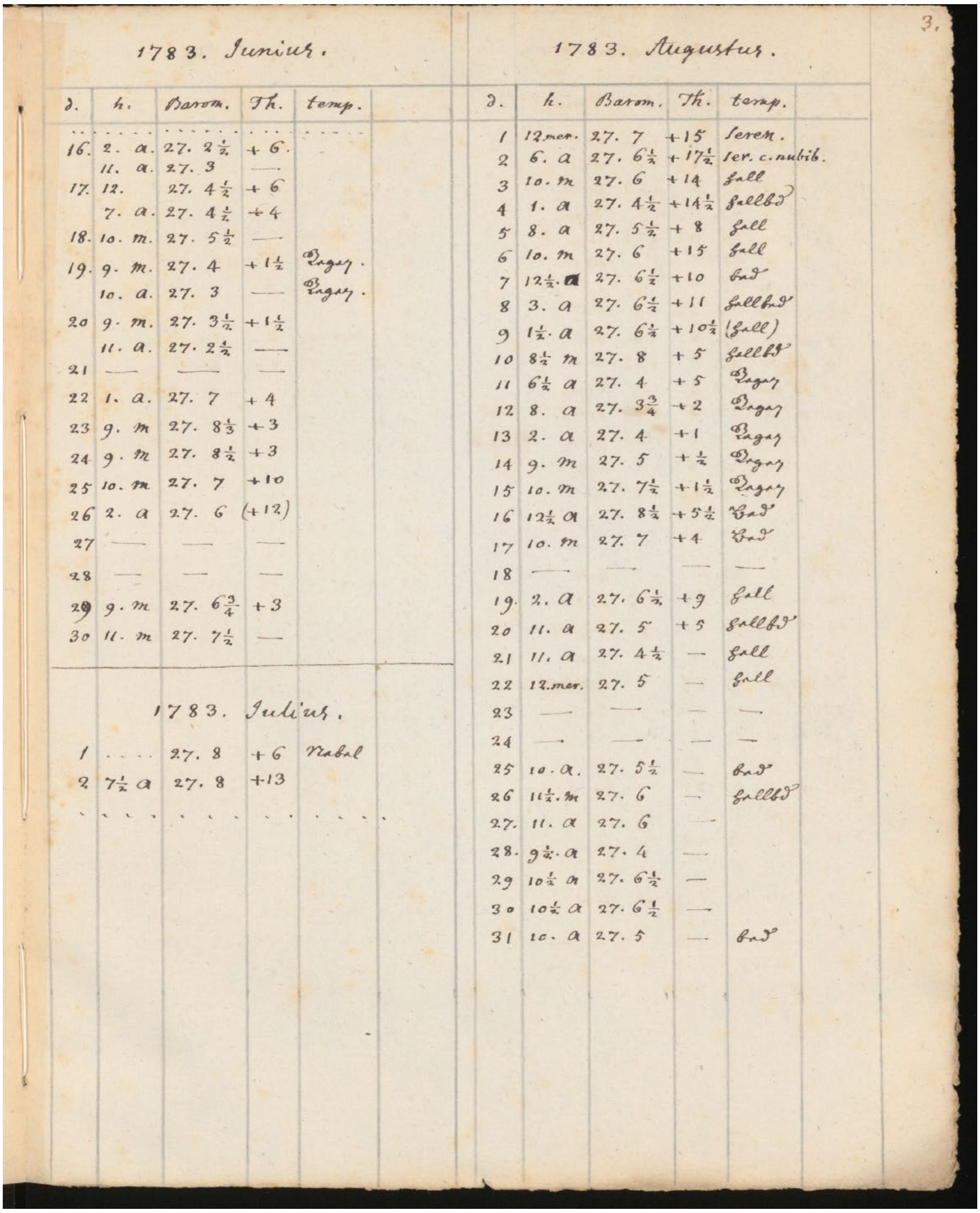


Figure 4. Data sheet from Daniel Wolleb, October and November 1779. University Library of Basel (UBH L Ib 86d).

2.4. The series by Abel Socin

Abel Socin (1729-1808) was the son of a merchant and politician. He studied mathematics, physics and medicine in Basel and Strasbourg, where he promoted in medicine. He returned as a doctor and private teacher to Basel, became a member of the medical faculty of the university and held lectures in physics (as an assistant of Daniel Bernoulli). In 1762 he became professor in medicine and physics at the Gymnasium Hanau (Germany). He stayed in Hessen for 16 years, during which he was rector of the Gymnasium, doctor and at the same time engaged as a scientist. He returned to Basel in 1778. Socin was well known for his lively presentations on topics pf physics, including electricity (Marti-Weissenbach, 2011). He is also known for his meteorological measurements and for his publications about the barometer.



3.

1783. Junius.

d.	h.	Barom.	Th.	temp.
16.	2. a.	27. 2½	+ 6.	
	11. a.	27. 3	—	
17.	12.	27. 4½	+ 6	
	7. a.	27. 4½	+ 4	
18.	10. m.	27. 5½	—	
19.	9. m.	27. 4	+ 1½	Regen.
	10. a.	27. 3	—	Regen.
20	9. m.	27. 3½	+ 1½	
	11. a.	27. 2½	—	
21	—	—	—	
22	1. a.	27. 7	+ 4	
23	9. m	27. 8⅓	+ 3	
24	9. m	27. 8½	+ 3	
25	10. m	27. 7	+ 10	
26	2. a	27. 6	(+12)	
27	—	—	—	
28	—	—	—	
29	9. m	27. 6¾	+ 3	
30	11. m	27. 7½	—	

1783. Julius.

d.	h.	Barom.	Th.	temp.
1	....	27. 8	+ 6	Nebel
2	7½ a	27. 8	+13	

1783. Augustus.

d.	h.	Barom.	Th.	temp.
1	12.mer.	27. 7	+15	seren.
2	6. a	27. 6½	+17½	ser. c. nubib.
3	10. m	27. 6	+14	fall
4	1. a	27. 4½	+14½	fallbd
5	8. a	27. 5½	+ 8	fall
6	10. m	27. 6	+15	fall
7	12½. a	27. 6½	+10	bad
8	3. a	27. 6½	+11	fallbad
9	1½. a	27. 6½	+10½	(fall)
10	8½ m	27. 8	+ 5	fallbd
11	6½ a	27. 4	+ 5	Regen
12	8. a	27. 3¾	+ 2	Regen
13	2. a	27. 4	+ 1	Regen
14	9. m	27. 5	+ ½	Regen
15	10. m	27. 7½	+ 1½	Regen
16	12½ a	27. 8½	+ 5½	Bad
17	10. m	27. 7	+ 4	Bad
18	—	—	—	—
19	2. a	27. 6½	+ 9	fall
20	11. a	27. 5	+ 5	fallbd
21	11. a	27. 4½	—	fall
22	12.mer.	27. 5	—	fall
23	—	—	—	—
24	—	—	—	—
25	10. a.	27. 5½	—	bad
26	11½. m	27. 6	—	fallbd
27	11. a	27. 6	—	
28	9½. a	27. 4	—	
29	10½ a	27. 6½	—	
30	10½ a	27. 6½	—	
31	10. a	27. 5	—	bad

Figure 5. Data sheet from Abel Socin, June to August 1783. University Library of Basel (UBH L Ib 81).

Abel Socin measured mostly once per day, temperature and pressure. According to Riggenbach (1892) his measurements are the best among the observers discussed in this paper because Socin was a physicist (and not a medical doctor as the other observers) and because he used better instruments. . An excerpt is shown in Figure 5. It is interesting to note that Abel Socin was the grandfather of Peter Merian, the main observer in the 19th century and a leading figure in the attempts by the Natural Sciences Society to coordinate a Swiss meteorological network in the 19th century (Brönnimann and Brugnara, 2021).

2.4. The series by Ambrosius Bavier

Ambrosius Bavier (1726-1796) studied philosophy and theology in Basel in the 1740s. From 1761 to 1764 he worked as priest in Markirch (Alsace), then as a "Gemeindehelfer" in Basel. In 1769 he took on a position as pastor in Waldenburg, Basel-Landschaft, ca. 20 km south of Basel (Triet et al., 1980). Ambrosius Bavier was married to Margaretha Bruckner.

Figure 6. Data sheet from Ambrosius Bavier, January 1776. University Library of Basel (UBH L Ib 87b).

Not much is known about the measurement series. Starting in 1776, the record from Bavier encompasses three times daily pressure and temperature measurements, as well as information on wind, measured at his house.However, the series has long gaps and quality issues; according to Riggenbach (1892), the barometer was not completely free of air, and the thermometer (with a Du Crest scale) was sometimes no protected from the sun. An example measurement sheet is given in Figure 6. Measurements stop in 1790, one year before he resigned as a pastor.

3. Processing and Quality Assessment

In this section we present the results from the quality control procedure, similar as described in Brugnara et al. (2020a). We present results on the internal consistency of the series (comparing measurements at different times of the day) and of the outlier screening. Additionally, as all series overlap with the D'Annone series (Brönnimann and Brugnara, 2020), we also present results from comparing all series with D'Annone as well as results from mutually comparing the shorter series.

First we compared morning and evening measurements (or morning, noon and evening measurements) within a series. As Abel Socin measured mostly only daily, the comparison cold not be performed for this series. The Ryhiner series (Fig. 7) generally shows a good agreement for temperature and pressure, although the correlation between morning and noon temperature is only 0.9. Corresponding plots for Wolleb (Fig. 8) show slightly lower correlations for temperature. Pressure was measured mostly only daily, for this reason the corresponding plot for pressure is based on relatively few data points. Finally, for Waldenburg (Fig. 9) we find an excellent agreement both for temperature and pressure.

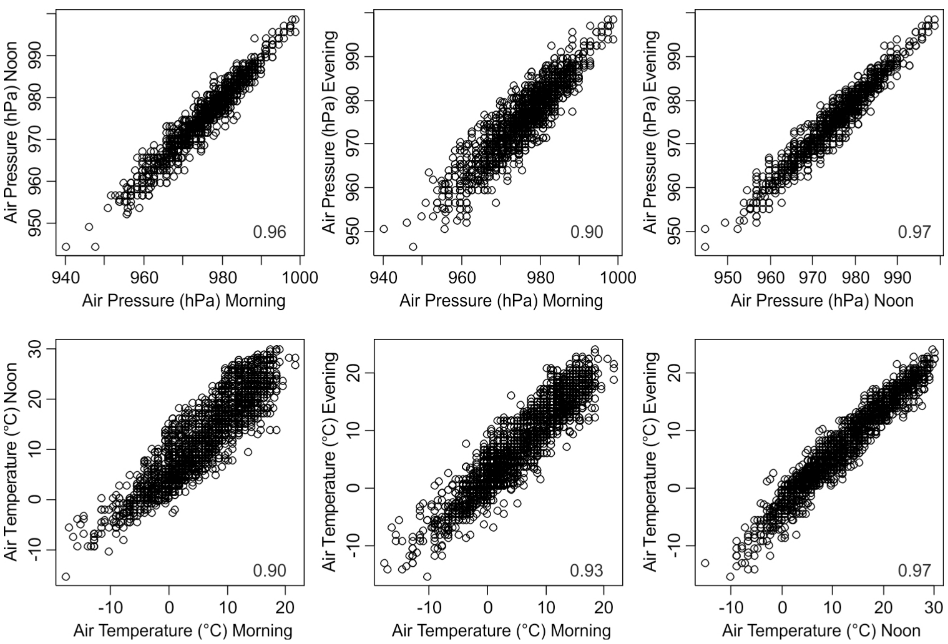


Figure 7. Mutual comparisons of morning, noon, and evening measurements in the series of Ryhiner. Top: pressure, bottom: temperature. Numbers indicate the Pearson correlation coefficient.

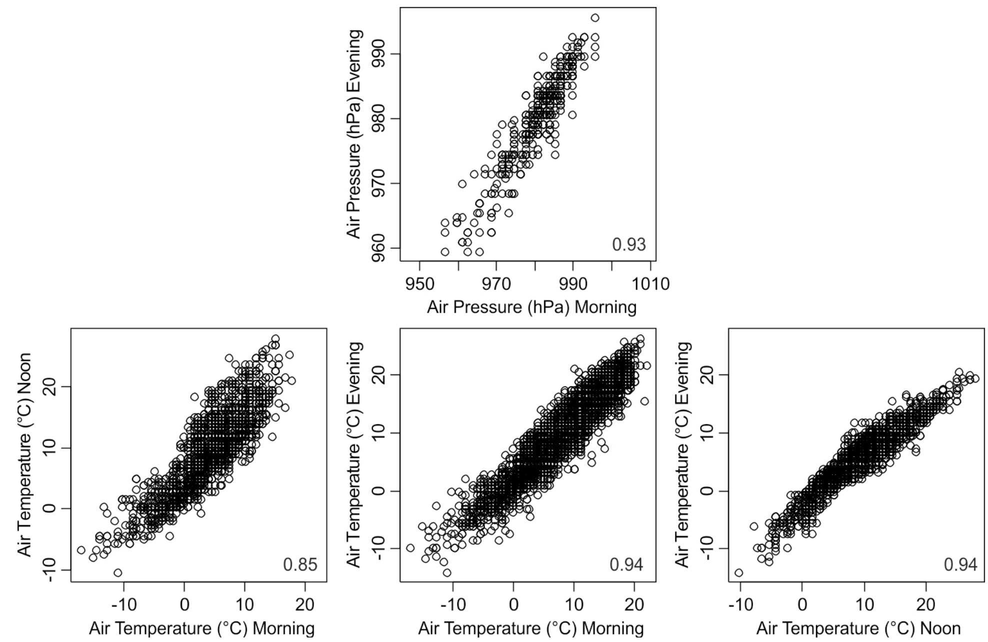


Figure 8. Mutual comparisons of morning, noon, and evening measurements in the series of Wolleb. Top: pressure, bottom: temperature. Numbers indicate the Pearson correlation coefficient.

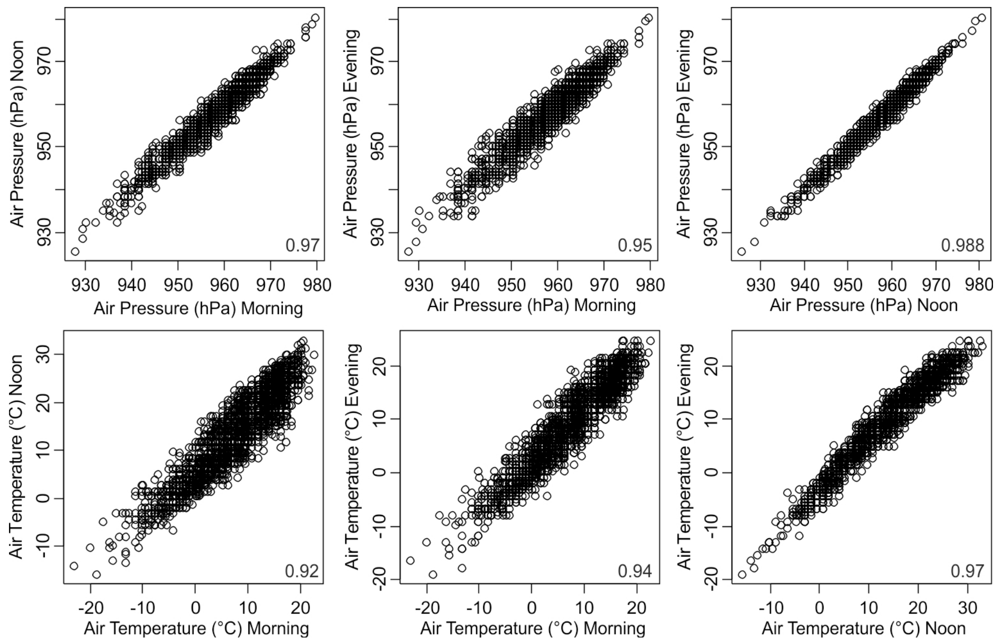


Figure 9. Mutual comparisons of morning, noon, and evening measurements in the series of Bavier. Top: pressure, bottom: temperature. Numbers indicate the Pearson correlation coefficient.

After comparing the internal consistency within each series, we compared each of the series with the measurements of D'Annone, quality-controlled in the same way. Results are shown in Figure 10 for morning and evening (note that Socin has very few evening measurements only). Most of the correlations are very high. Slightly lower correlations are found for pressure for the series of Socin (which is arguably mainly due to remaining outliers) and Wolleb. Note that extremely high correlations are also suspicious, as the observers arguably knew each other and might have exchanged data to fill gaps in their own records, as we have found in other cities.

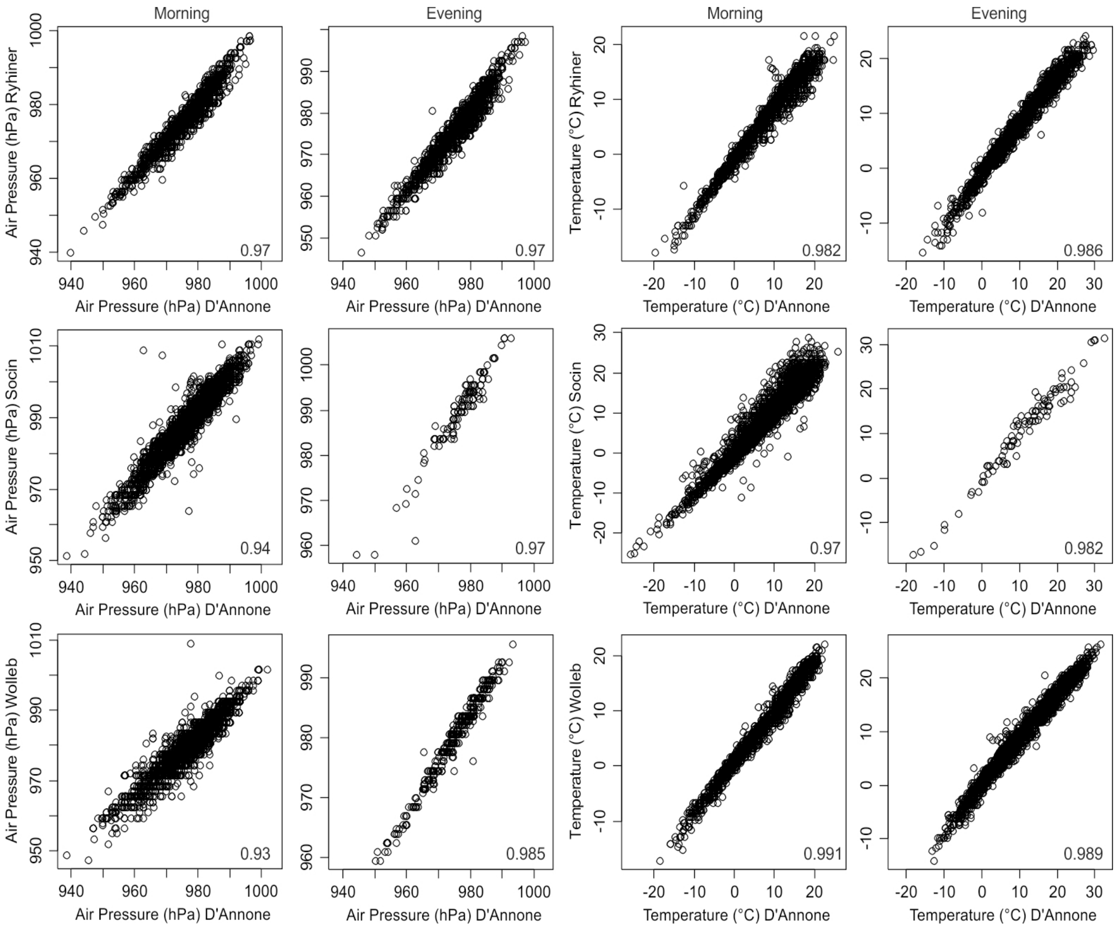


Figure 10. Comparisons of morning and evening measurements of pressure (left) and temperature (right) in all series against the series of D'Annone. Numbers indicate the Pearson correlation coefficient.

A comparison with the diurnal temperature cycle at the MeteoSwiss station of Basel-Binningen (Fig. 11) suggests a good quality in particular of the Ryhiner series, while the Wolleb data appear to be warm-biased. However, one must consider that the series are rather short and that they cover different periods. Particularly in winter, large differences can arise from true climate signals. Generally the data seem to be of quite good quality and could be used to fill gaps in the D'Annone series and to assess its homogeneity.

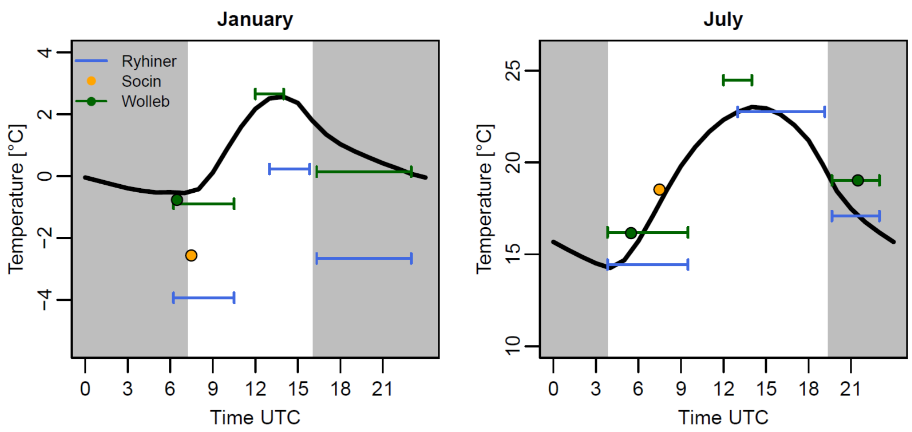


Figure 11. Diurnal temperature cycle in January (left) and July (right) in present-day (1981–2010, -1 °C to account for climate change) MeteoSwiss data from Basel-Binningen (thick black line) and in the series by Ryhiner, Socin, and Wolleb. Observation times that are not exactly known are represented with horizontal bars. Grey shading indicates nighttime.

4. Conclusions

The series from Basel is one of the longest meteorological series from Switzerland. Long segments of the current Basel series are from only two observers: D'Annone (1755-1804) and Merian (1826-1863). However, in both periods, many observers were active, and these series have never been digitised. In addition, long gaps in the current Basel series were filled with data from Delémont and Mulhouse. In this paper we present four series from the 18th century which can be used to assess and complement the D'Annone series.

Results show that series of Johann Heinrich Ryhiner (covering 1766-1772), Daniel Wolleb (1777-1785), Abel Socin (1783-1802) and Ambrosius Bavier (1776-1790, in Waldenburg) are all of generally good quality. The mutual comparisons as well as, in particular, the comparison with the D'Annone series show a good agreement. The data can therefore help to confirm or complement the data from D'Annone when generating a new, long Basel series. Additional measurements by Werner de Lachenal (1766-1795) were found, but were extremely scattered and hard to digitise.

The data will be publicly available by MeteoSwiss. They will also be available from the C3S Global Land and Marine Observations Database (Noone et al., 2021) and from EURO-CLIMHIST (Pfister et al., 2017). A further segment overlapping with D'Annone, the series by Huber, will be discussed in a subsequent paper.

Acknowledgements

We would like to express our thanks to the University Library of Basel. The archive work was affected by the COVID pandemic in 2020, when the library was closed. However, not only did the library image the data sheets for us, but they published the data sheets on their website, so that they are now all publicly available. The work was supported by the Swiss National Science Foundation (project WeaR, 188701), by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme grant agreement No 787574 (PALAEO-RA), by Copernicus Climate Change Service (C3S) 311a Lot 1, by the Federal Office of Meteorology and Climatology MeteoSwiss in the framework of GCOS Switzerland (project "Long Swiss Meteorological Series"), and by EURO-CLIMHIST.

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