Revision of

"Rescue and quality control of sub-daily meteorological data collected at Montevergine Observatory (Southern Apennines), 1884–1963"

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RC (X) = Referee comment (number X)
AR (X) = Authors' reply (number X)

Referee #1 (Maria Carmen Beltrano)

RC: The article is well structured. Methods and materials are well characterized and clearly describe the data set. Formal metadata are appropriate. The quality control procedures adopted are well described and ensure the high data quality. On the whole, the article is good, original and useful, appropriate to supporting the publication of the related data set. Considering the location of the meteorological observatory, the data set can be assessed very helpful in studying the climate of the central Mediterranean mountain area. Data set is correctly accessible via the given identifier, at. https://data.nodc.noaa.gov/cgi-bin/iso?id=gov.noaa.nodc:0205785#

AR: Dear Ms. Beltrano, we are very grateful for your positive comments and relevant suggestions, which helped us improving our manuscript. The replies to your remarks are set out below. Moreover, we have modified the paper according to your recommendations.

RC (1): Page 3: row 73 and next ones: please, indicate here the four stations names (move from page 16 rows 499-500). However they are not the only ones: the auditor is aware of the existence of at least two other stations in Southern Italy which have functioned as observatories (three multiparametric observations per day), located in Foggia (Nigri Observatory, from the end of the 19th century to the 1970 and more), Taranto (Ferrajolo Observatory, still functioning).

AR (1): We have listed in the introduction the historical southern-Italy stations providing digitized data extending back prior 1960s, which can be found on the ISPDv4 database (rda.ucar.edu/datasets/ds132.2/index.html?sstn=17606&spart=exact#stationViewer).
The main text has been modified as follows:
"In accordance with the ISPDv4 database, there are only five other historical weather stations in southern Italy extending back several decades prior 1960s that had performed sub-daily multi-parametric observations and that may supply digitized data: Naples Capodimonte (40.88°N, 14.25°E), Foggia Nigri (41.46°N, 15.54°E), Taranto Ferrajolo, (40.47°N, 17.23°E), Palermo (38.10°N, 13.35°E) and Cagliari (39.20°N, 9.15°E). They are all located in coastal or near-coastal areas and only provide atmospheric pressure data with a temporal resolution of one observation per day (rda.ucar.edu/datasets/ds132.2/index.html?sstn=17606&spart=exact#stationViewer, last access: 29 January 2020). The digitized records available for these stations cover the period 1895-1940, except for the Taranto observatory whose time series spans a very limited time interval (1931-1939): for this reason, it has not been included in Fig. 1a.
In light of the above, the sub-daily data rescue activities carried out until now in southern Italy are incomplete. Furthermore, these datasets available in a digital format are only a small part of the larger amount of meteorological information stored in the original paper archives, both in terms of data temporal resolution and number of measured atmospheric parameters."
Regarding the two old observatories cited by the reviewer, the first one (Foggia Nigri) was already mentioned in the previous manuscript version (page 16, line 500); now we have also mentioned

Taranto Ferrajolo. However, we have decided not to include it in Fig. 1a due to the short record of available data (1931-1939), as shown in the ISPDv4 database.

RC (2): Page 4 row 103 data can (shade) light
row 114 drawn (is) section
row 123-124 e 126 please, titles translated in English enclosed in brackets

AR (2): We have modified the text according to the referee suggestions.

RC (3): Page 5 The (tower measured) . .. The)square-based tower measures(. .
row 143 in the observatory (situation) room
row 154 (suppressed))interrupted(

AR (3): We have modified the text according to the referee recommendations.

RC (4): Page 6 formatted)in tables(according to . . ..
row 187-188 Please, review description: e.i. : Each table is related to a month; it is composed of two pages, the first column of each one lists the days, the first row the name of the parameters and observation time.). Each box((On) of each column contains the value of. . .

AR (4): We have modified the description of handwritten meteorological registers stored in Montevergine Observatory.

RC (5): Page 7 Row 204-207 please, add a figure of the more recent model of register.
Row 220 please, add the reference for relationship formula.

AR (5): In Fig. 3, we have added two panels (c) and (d) to show a more recent register reporting the meteorological measurements collected in the second decade of January 1946 (see page 6 of this document). By comparing the added panels with a and b of Fig. 3, it can be observed that there are some differences with older register models. From 1944, a slightly different format was adopted in accordance with the new standards suggested by the Italian Central Office in Rome. A description of the January 1946 register structure has been added in the main text and is provided below for referee convenience:
"The meteorological registers of 1944-1961 period contain additional columns dedicated to other (sporadically measured) variables, such as snow depth, visibility and low-level clouds base height and quantity. Those registers have a different structure from the standard format described previously. Indeed, a single register consists of 72 pages (i.e. two pages for every decade of each month) and each page contains two tables. Panels (c) and (d) in Fig. 3 show the register structure for the decade of January 1946. In particular, the upper table on the left page (Fig. 3c) includes three-daily observations of atmospheric pressure, wind direction and force and cloud direction performed from day 11 to 20. The bottom table shows daily maximum and minimum temperature, three-daily observations of dry and wet bulb temperature, vapour pressure, relative humidity and finally the sum and average of thermometric measurements. The upper table on the right page (Fig. 3d), instead, contains sub-daily records of the sky conditions (cloud cover and type), accumulated rainfall, snow

depth and accumulated snowfall. In addition, daily summaries related to cloud cover, accumulated rainfall and snowfall, maximum 1-hour rainfall amount and precipitation duration (hours and minutes), are reported. The bottom table is dedicated to special notes concerning observed hydrometeors and meteorological phenomena."

Moreover, we have added the reference (Brombacher et al., 1960) for the relationship formula.

RC (6): Page 8 Row 247-256 please, add reference about snow/water conversion criteria.

AR (6): In the revised version of the manuscript, we added three references for the snow to equivalent liquid water conversion (Winiger, 2005; Egli, 2008; Egli et al., 2009).

RC (7): Page 9 Row 288 please indicate which are remaining parameters.

AR (7): In the revised version of our manuscript, we have indicated the meteorological parameters that only underwent through a basic manual inspection within the quality control procedure. These parameters are listed below: clouds direction, wind direction, wind speed, cloud type, visibility, low-level cloud base height and quantity, snow depth, precipitation duration and precipitation type.

RC (8): Page 11 Row 335 please, indicate that cloud cover parameter underwent only to gross error control and explain why.

AR (8): We have added the following sentence: "It should be noted that cloud cover data did not undergo tolerance and temporal coherence tests. The cloud amount was estimated by visual observations using a fixed reference scale. Due to the specific nature of this parameter and to its strong hour-to-hour variability, it is not possible to define climatological limits for outlier and anomalous jumps detection. Therefore, quality control for cloud cover includes only manual inspection and gross error test and it aims to assess the data plausibility and their consistency with other related meteorological parameters, such as cloud type and, when available, low-level clouds base height and quantity".

RC (9): Page 14 Row 443 reference: Brunet a or b?

AR (9): We apologize for the mistake. The correct reference is Brunet et al., 2014b.

RC (10): Page 17 Row 538 (precepts)

AR (10): We have modified the text according to referee's comment.

RC (11): Table 3: please indicate, below each QC code, the description: bad value, suspicious data, tolerance test, temporal incoherence, good value.

AR (11): In the first row of Table 3, and more clearly in the text, we have included a description for each QC flag (see page 5 of this document):

- bad data (QC = 8);
- suspicious data (QC = 9);
- good data, lower quality level (QC = 1), i.e. data that passed only gross error test
- good data, medium quality level (QC = 2), i.e. data that passed gross error and tolerance tests;
- good data, higher quality level (QC = 3), i.e. data that passed all statistical tests.

RC (12): Figure 6: there aren't blue dots (outliers, QC=1).

AR (12): In Figure 6, we show an application of QC procedure to relative humidity sub-daily observations collected in March 1901, where no data are flagged as QC = 1 (i.e. there aren't outliers). Therefore, we have deleted the phrase "blue dots (outliers, QC=1)" from the caption.

List of new cited references

Brombacher W. G., Johnson D. P., and Cross J. L.: Mercury Barometers and Manometers, NBS Mono.8, U.S. Govt. Printing Office, Washington, 1960.

Egli, L.: Spatial variability of new snow amounts derived from a dense network of Alpine automatic stations, Annals of Glaciology, 49, 51-55, https://doi.org/10.3189/172756408787814843, 2008.

Egli, L., Jonas, T., and Meister, R.: Comparison of different automatic methods for estimating snow water equivalent, Cold Regions Science and Technology, 57, Issues 2–3, 107-115, https://doi.org/10.1016/j.coldregions.2009.02.008, 2009.

The International Surfance Pressure Databank version 4, Interactive Station Viewer: https://rda.ucar.edu/datasets/ds132.2/index.html?sstn=17606&spart=exact#stationViewer, last access: 29 January 2020.

Winiger, M., Gumpert, M., and Yamout, H.: Karakorum–Hindukush–western Himalaya: assessing high-altitude water resources, Hydrol. Process. 19, 2329–2338, https://doi.org/10.1002/hyp.5887, 2005.

List of modified tables according to referee suggestion. We highlighted our changes in yellow.

Table 3. Results of quality control tests applied to MVOBS sub-daily meteorological data. Each column show the percentage of data flagged as QC = 8, QC =9, QC = 1, QC = 2 and QC = 3. It should be noted that cloud cover data underwent only manual inspection and gross error test, whereas rainfall and snowfall measurements quality was evaluated according to manual inspection, gross error and tolerance tests.

Parameter	**% of QC = 8** **bad data**	**% of QC = 9** **suspicious data**	**% of QC = 1** **good data (lower quality level)**	**% of QC = 2** **good data (medium quality level)**	**% of QC = 3** **good data (higher quality level)**
Dry bulb temperature	0.0	13.0	0.2	0.6	86.2
Wet bulb temperature	0.0	13.1	0.4	0.8	85.7
Atmospheric pressure	0.0	0.0	0.4	1.3	98.3
Vapour pressure	0.4	12.8	0.4	1.1	85.3
Relative humidity	0.3	12.8	0.4	1.6	84.8
Cloud cover	0.0	0.0	100.0	Not applied	Not applied
Rainfall	0.0	0.0	0.1	99.9	Not applied
Snowfall	0.0	0.0	0.1	99.9	Not applied

List of modified figures according to referee suggestions. We highlighted our changes in yellow.

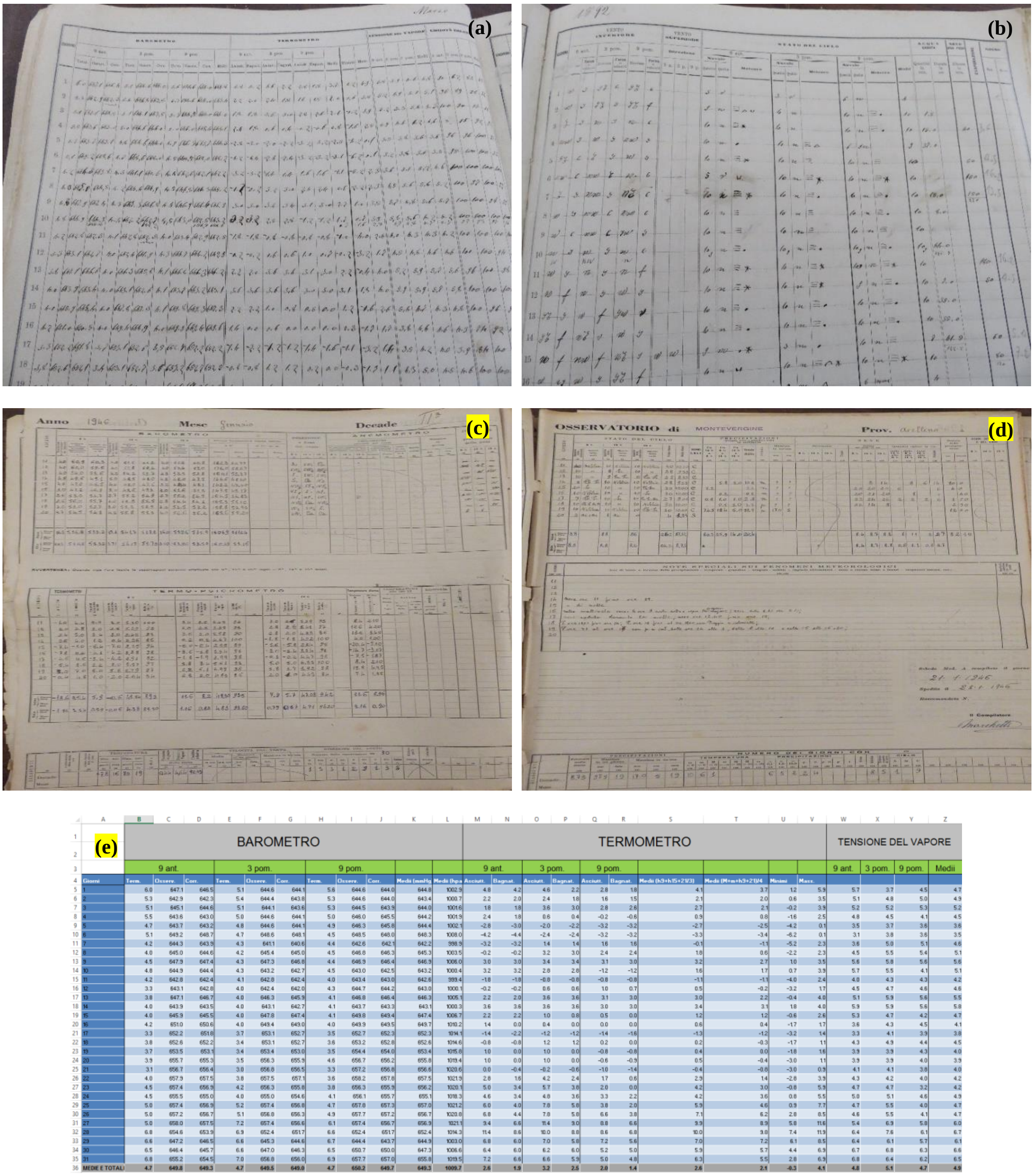

Figure 3: Upper (a, b) and middle (c, d) panels show an example of original data source (March 1892 and January 1946, respectively). Each row accounts for the observations of a specific day, including their average on decadal and monthly basis, whereas each column is devoted to the records of a determined parameter at a specific hour of the day. The bottom panel (e) is an example (referred to data collected in March 1892) of the template used in the data digitisation. The rows are designed to match the location of the data in the original source.