Interactive comment on "A near-surface sea temperature time series from Trieste, north Adriatic Sea (1899–2015)" *by* Fabio Raicich and Renato R. Colucci

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Pages and lines of the edited manuscript, unless otherwise stated (To make reading easier, the pdf version of this document and of the edited article, with revisions, are attached as supplement1.zip.)

SPECIFIC COMMENTS

–Page 1

–Line 12: "1.1+/-0.3 C per century was estimated": Could you mention here also the 1946-2015 1.3+/-0.5C per century trend, as that is a more continuous and thus robust

trend? Answer: The relevant sentence was completed as follows: "... was estimated, while in 1946-2015 it is 1.3 ± 0.5 °C per century." (Page 1, lines 12-13)

–Line 26: "Even though these data are coastal": What is meant by this? That coastal data may not be most useful for climate change indicators? Why? Please explain in manuscript. A: The sentence was completed as follows: "... coastal and, therefore, sensitive to local natural and anthropogenic processes, the considerable ...". (Page 1, lines 26-27)

–Page 3

–Lines 1-10: How were the Pinsel thermometer measurements taken? Were they affected by sea level change similar to how the thermographs were affected? A: The text was modified in two places, as follows: 1) Page 2, lines 24-26: "In order to measure temperature, the instrument was manually deployed to the prescribed depth and kept there until thermal equilibrium was reached. Its bulb was wrapped in a sort of brush which could absorb water and keep it insulated from the surrounding environment while the thermometer was being extracted from water and read.". 2) Page 3, lines 3-4: "While manual measurements were performed at prescribed depths below the sea surface, the thermograph bulbs were at fixed heights, therefore their depths would change according to sea level variations."

–Line 14: "Usually, ocean temperature should be measured to the 0.01 C accuracy": can you provide a reference for this? Seems to me that this accuracy would change based on the end user. A: We agree that the concept was too strong. The sentence was modified as: "Usually, ocean temperature is reported with the precision of 0.01 °C, i.e. ..." (Page 3, line 17)

–Lines 28-31: Are the time (9 am to 10:30 am to 8 am to 9 am) and space (300 m apart) changes too large to produce a sufficiently homogeneous dataset here? Please comment in the manuscript. A: As several changes occurred in observation times, depths, sites and sampling frequencies, we could not assume the time series to be

homogeneous. The only way to say if time and space changes introduced significant biases or not, was to estimate them, and this is what we did. The reviewer's question, which we believe concerns the time and space changes in general, is answered in three places: 1) At page 4, line 17 (original manuscript), where differences are shown to be negligible between sites inside and outside the Sacchetta basin. 2) At page 6, lines 6-12 (original manuscript), where the influence of time sampling turns out to be small but not negligible in summer (relative to a daily mean obtained from 24 observations per day). 3) At page 7, line 18 (original manuscript), where differences are shown to be negligible also between the manual measurements at Porto Lido and the digital records at Molo Bandiera. In order to assess the possible effect of the biases, we also computed the long-term trends of the time series without any normalization. The text in section 4 was rewritten as: "The effect of the biases induced by poor time samplings, discussed in Sect. 3.1, can be estimated by analysing the time series of the original observations; in this case, the trend is 1.0±0.5 °C per century. Because of the many missing years in the first part of the time series, this result should be taken with caution. The trend over the continuous 1946–2015 period is 1.3±0.5 °C per century, both using the normalized and the original data." (Page 8, lines 14-17)

–Page 4:

–Lines 1-12: This is very difficult to follow along with Table 1. Suggest somehow adding "Data set A" and "Data set B" to Table 1 to make it clearer what is indicated by what in Table 1. A: Unfortunately, Table 1 was affected by errors and we are sorry for that. The table was rewritten accepting the reviewer's remarks. (Page 15)

–Line 8: "Manual observations continued until 2008" where is 2008 in Table 1? I only see dates after 1990 on the last row of Table 1, and nowhere else. A: Corrected. (Page 15)

–Line 10: "From 1964 to 1970": isn't it 1968 in Table 1 row 2? A: Corrected. (Page 4, line 14)

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–Line 12: "From 1980 to 2008" where is 2008 in Table 1 besides at the bottom? A: The line starting with "LID-Porto Lido" was corrected. (Page 15)

–Line 16: Where is 1983-1986 in Molo Sartorio in Table 1? A: This information was actually missing; it was inserted before the line starting with "TER-Molo S. Teresa". (Page 15)

–Line 19: Where is 1919 in Molo Sartorio in Table 1? A: In order to clarify the point, the text was modified as follows: "... duty in offices close to the observation sites at Molo Sartorio (in 1899-1908) and at Molo Santa Teresa (in 1915-1917 and, probably, in 1920), thus ...". (Page 4, lines 24-25)

–Line 25: "2.3 Data set B (1986-2015)": Is this all in just the last row of Table 1? If so, how is Data set A going to 2008? (can't find this in Table 1). A: The line starting with "LID-Porto Lido" was corrected. (Page 15)

–Line 27: "In 1992" What about 1989-1992? A: The text was modified to clarify that there was an interruption of the observations: "Observations were interrupted until 1992, when the depth was changed ..." (Page 4, line 32)

–Page 5

–Lines 3-4: How was 2-m temperature estimated from the observations at other depths? Please briefly explain in manuscript.

A: Sect. 3.1 describes the method. In particular, eq. 4 and 5 show how 2-m temperature was estimated. The sentence was completed as: "... other depths, as explained in Sect. 3.1.". (Page 5, line 10)

–Line 7: "Although the mean daily temperature range is generally within 0.5 C" What does this mean? How is "mean daily temperature range generally within 0.5 C"? and –Line 8: "24 hourly data" what is this? Hourly data (24 per day)? Please clarify in text. Also, what does "which can be regarded as a standard" mean? Awkwardly worded. A: The text was unclear and the whole sentence was modified as: "Although the mean

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daily temperature range is generally less than 0.5 °C, a daily mean computed with few observations may be significantly differ from a mean accounting for the full daily cycle, which is well represented by 24 hourly observations." (Page 5, line 13-16)

–Page 7:

–Line 4: Is rounding occurring here to get +/- 0.25 C (0.5 C band) and +/- 0.1 C (0.2 C band)? What about using the maximum range, e.g. 0.54 and 0.23 C bands? A: We can only provide representative errors and we believe that precisions of 0.01 °C could suggest an unrealistically high accuracy. For clarity, we changed the start of the sentence at line 4 as: "Representative errors of . . .". (Page 7, line 15)

–Line 9: Where is 0.18 C in Table 2? Please clarify as there are several within the 4th column. and –Line 13: Where are the overall errors between 0.2 and 0.4 C for data set A and 0.1 and 0.2 C for data set B in Table 2? A: The table was redesigned and, to clarify both points, its caption was rewritten as: "Table 2: Errors on estimated mean daily temperature. σI is the instrumental error, σE is the environmental error, σT is the time-related error, σo is the observational error, n. obs. is the number of observations per day, σ is the error on the estimated daily mean. Labels a) and b) correspond to zero and non-zero uncertainties on time, respectively. When n.obs. is characterized by a range, the corresponding σ range is shown. See Sect. 3.2 for detailed explanations." (Pages 15-16)

–Line 15: "1986-2008" again, where is this for data set A in Table 1? A: As explained in the answer to the remarks to page 4, lines 12 and 25, this was corrected. (Page 15)

TECHNICAL CORRECTIONS

Abstract –Line 8: "The measurements compose two data set": suggest changing to "The measurements are comprised of two data sets" A: We corrected using "consist of" instead of the suggested "are comprised of". (Page 1, line 8)

Short Summary -"We described" should be "We describe" and -"variability on different

time scale" should be "variability on different time scales" A: Both corrections will have to be made online.

1. Introduction –Page 1

–Line 15: should be "Knowledge of the processes and evolution of the Earth system. . ." A: Corrected. (Page 1, line 15)

–Line 16: "earth's" should be "Earth's" A: Corrected. (Page 1, line 16)

–Line 17: "the scientific community, and civil society" A: Corrected. (Page 1, line 17)

–Lines 20-21: "a key element in climate studies, based on both data analysis and model reconstructions, and thus the sustainability of suitable observing systems is critical" A: Corrected. (Page 1, lines 20-21)

–Page 2 –Line 3: "February to 25. . ." (not and) A: Corrected. (Page 2, line 3)

2. Data description –Line 28: "Figure 2 shows the chart for 1-8 July 1935" should this be "Figure 3"? If so, will likely want to change order of figures so they are referenced in order. A: We are sorry for the mistake. The text was correct, while Figures 2 and 3 at the end of the manuscript were swapped and identified by wrong numbers. The mistake was corrected. (Pages 12-13)

–Line 32: "linear vertical scale corresponding to 1.5 mm C-1" is this at 15 C like the first thermograph which had a vertical scale of 2.1 mm C-1 at 15 C? If so, please indicate. A: The indication "at 15 °C" was required for the first instrument which has a non-linear scale (line 28), while it is redundant for the second instrument, having a linear scale. The text was not modified.

–Page 3

–Line 3: "to a range of astronomical tide" A: Corrected. (Page 3, line 5)

–Line 15: "better; nevertheless" (change comma to semicolon) A: Corrected. (Page 3,

line 18)

–Line 16: "which is strongly influenced by atmospheric forcing" (delete "the") A: Corrected. (Page 3, line 19)

–Line 21: "2.2 Data set A (1899-2008)" where is 2008 in Table 1? A: The table was corrected (see previous answers to remarks to page 4, lines 12 and 25).

–Line 24: "The sheet for 1916 is shown in Fig. 2" (not Fig. 3âĂŤsee Line 28 comment above, may want to switch Figures 2 and 3) A: See previous answer to remark to page 2, line 28.

–Line 25: "1909-1914, and 1918-1919 are missing" A: Corrected. (Page 3, line 28)

–Page 4

–Line 7: "failure;" change comma to semicolon A: Corrected. (Page 4, line 11)

–Line 16: What are 1295 and 299 indicating? A: They are the numbers of data used for comparisons. In order to avoid confusion, we rephrased the text in brackets as: "using 1295 'surface' observations in 1964-1968" and "using 299 observations at 2-m depth in 1983-1986". (Page 4, line 20)

–Line 23: "but this was not always the case" A: The sentence was rephrased as suggested (Page 4, line 28)

–Line 24: "These analogue records were reported to 0.1 C precision, and occasionally to 0.05 C" A: Corrected. (Page 4, line 29)

–Line 33: "reported to 0.01 C precision." (remove "the") A: Corrected. (Page 5, line 6)

3. The time series at 2-m depth –Page 6

–Line 1: "the daily means are possibly estimated" "possibly" is awkwardly worded, please change A: The text was modified as follows: "… the daily means are estimated from data at other depths when possible.". (Page 6, line 10) –Line 9: "These correc-

tions concern estimates" "concern" is awkward, perhaps use "affect"? A: We replaced "concern" with "are associated to". (Page 6, lines 19-20)

–Line 17: "computed from those on the observation" is awkwardly worded, please change. Also, why do you need "respectively" here? A: The text was rephrased as follows: "The error on T, namely σ, is computed from the errors on the observation, σo, and on the climatologies, $\sigma 24c$ and σc. These errors are assessed semi-empirically as follows." (Page 6, lines 27-28)

–Line 19: "An observation is affected by" (delete "basically") A: Corrected. (Page 6, line 29)

–Line 21: "the curve thickness determine a reading error" (delete "probably") A: Corrected. (Page 7, line 1)

–Line 23: "due to turbulence and circulation. Therefore…" A: Corrected. (Page 7, line 3)

–Line 24: "representative of the hourly value" (delete "really") A: Corrected. (Page 7, line 4)

–Line 27: change to "only nominal times, and not the actual observation times, are reported." A: Corrected. (Page 7, line 7)

–Line 28: "This time uncertainty affects temperature…" A: Corrected. (Page 7, line 8)

–Line 29: "the time uncertainty until 1917" should this be 1919 or 1934 based on section 2.2? A: As stated at page 3, line 25 (original manuscript) data for 1918-1919 are missing. Uncertainty is negligible until 1917 and sometimes non-negligible from 1920 onwards. The text seems clear enough and it was not modified.

–Page 7

–Line 1: "half an hour; therefore" (change comma to semicolon) A: Corrected. (Page 7, line 12)

–Line 15: "by comparing the data sets" A: Corrected. (Page 7, line 26)

–Line 23: "as discussed in the above paragraph"? A: No, it is discussed a few lines above. In order to avoid confusion, we modified the sentence as follows: "... increased by 0.5 °C on the basis of the above-mentioned temperature difference." (Page 8, lines 4-5)

4. Data availability –Line 25: "as a percentage of valid days" also, valid is awkward, maybe use "total days"? A: The text was modified as follows: "Figure 4 illustrates the monthly data availability as the percentage of the number of days with temperature estimate to the number of days per month." (Page 8, lines 9-11)

–Line 26: what is meant by 80% valid days here? Same question for "valid months"? A: Although "valid" is often used to indicate that the day or month is non-missing, we rephrased the relevant sentence as follows: "Mean annual temperatures were computed for complete years, i.e. having no missing months; a missing month has less than 80% available days (Fig. 5)." (Page 8, lines 11-12) –Line 27: better word for arbitrarily? Seems very unofficial. Also, remove the repeat "Figure 4 illustrates..." sentence. A: We do not think that another word would be better. To the authors' knowledge no official or standard percentages are generally adopted to define a monthly mean estimate reliable. It depends on the dominant time scales of variability of the specific variable. We chose 80% because it is a high percentage (corresponding to less than one week missing in a month) although not necessarily optimal. As an example, to compute reliable monthly mean sea levels, the Permanent Service for Mean Sea Level adopts 50%. The repetition was removed.

–Page 8 –Line 2: "in the first part of the period"? A: We used "of the time series". (Page 8, line 16)

5. Conclusive remarks –Line 8: "Near-surface sea temperature data" (remove the "s" in temperatures) A: Corrected. (Page 8, line 22)

–Line 9: "from 1899 to 2008, while the second consists..." A: Corrected. (Page 8, line 23)

–Lines 12-13: "study sea-temperature variability on the synoptic time scale connected to meteorological forcing, and on decadal and secular time scales related to climate changes." Also, what is meant by "secular time scales"? A: There are other time scales between the synoptic and decadal ones as, for instance, those connected to atmospheric planetary waves (10-100 days), the seasonal cycle (1 year), and those connected to the variability of large-scale atmospheric patterns like ENSO (few years). We modified the sentence as follows: "... study sea-temperature variability on time scales from the synoptic, connected to the meteorological forcing, to decadal and century-timescales related to climate changes". (Page 8, lines 26-27)

–Line 14: "The search for undiscovered data will continue, in order to possibly fill the existing gaps." A: Corrected. (Page 8, line 28)

Author contribution –Line 16: "the data sets and led" A: Corrected. (Page 9, line 2)

–Line 17: "and collaborated on the paper writing" A: Corrected. (Page 9, line 3)

Figures

Figures 2 and 3: these are somewhat difficult to read, may want to ensure very high quality images of these are included so readers can clearly read them. A: We checked that the original 300-dpi pdf images can be magnified at least to 3 times the original size without loss of definition.

Figure 5: Can you add the 1946-2015 trend line on this figure? Also, should the caption read "from 1899 to 2015"? A: Corrected accordingly. (Page 14)

Tables Table 1: several comments as indicated above A: The table was redesigned. (Page 15)

Table 2: –Line 5: "number of observations". "instrumental error" and –What are the 1st

and 2nd numbers before and after the semicolons, e.g. 0.18; 0.31? Finally, can you somehow indicate that the errors are $\frac{1}{2}$ the band (e.g. +/- 0.15 C)? A: The table was redesigned and the caption rewritten. Concerning the errors, they are always $\frac{1}{2}$ the band (see sect. 3.2), therefore there should not be any confusion. (Pages 15-16)

Please also note the supplement to this comment:
https://www.earth-syst-sci-data-discuss.net/essd-2019-15/essd-2019-15-AC1-supplement.zip