

## ***Interactive comment on “Long-term variability of storm surge frequency in the Venice Lagoon: an update thanks to eighteenth century sea level observations” by F. Raicich***

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R: Reviewer's remark

A: Answer (pages, lines of the 'difference' manuscript, attached as Supplement).

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R: 7466, 23 -associated with

A: Corrected (page 2, line 22).

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C3391

R: 26 -... Adriatic can result in a north-easterly ..

A: Corrected (page 2, line 25 – page 3, line 1).

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7467, 12 13 -middle of the Lagoon

A: Corrected (page 3, line 13).

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R: 7468, 4 -discussion of storm surge frequency and interannual variability of monthly means of sea level. Concluding remarks ..

A: Corrected (page 4, lines 3-5).

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R: 7468, section 2.1 -if I understand right it would be worth having a sentence saying these Venice numbers are only one overall flux and one reflux number per day and not two as for Chioggia and as one would expect for a semidiurnal tidal location. (This brings into question whether the measurements were really made over 24 hours or only in daytime.)

A: The text has been modified to clarify the number of observations per day (page 4, lines 17-19; page 5, line 15-16). However, there is no information to understand whether measurements were only made in daytime.

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R: 7469, 2 -is 'segment' the right word? Chiseling?

A: The reviewer is right, the word is incorrect. It has been replaced by “short horizontal mark” (page 5, line 4).

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C3392

R: 7469, 11 -like the comment above, the word 'daily' is used which implies one number a day but I think in this case there are two, as shown in Figure 2. It would be good to make that clear.

A: "Daily" has been removed (page 6, line 11); now the text should be more clear after the correction at page 4, lines 17-19, mentioned above.

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R: 7470, 10 -what about more recent air pressure data that must have been used in the inverse barometer calculations lower down?

A: Regressions with recent data only involves observations up to 1997. This point has been clarified in the text (page 9, line 8).

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R: around line 20 -it is a feature of many historical high and low water records like this (e.g. Liverpool and London) that it is not clear how the times were measured. Measuring heights is relatively easy because of the 'flat top' of the tidal curve but that makes measuring times uncertain. No doubt in some places the reversal of flows was used for the time, rather than changes in the heights themselves.

A: I do not have information that can help clarify this point. Times at Chioggia are known with a 15-minute precision, however, they are not crucial for the analysis. My doubt is whether the measured height of a sea level peak might have been significantly affected by wind waves. Perhaps, if the observations were made in small canals, this should not have been a big problem because at that time there were no motor boats. No changes have been made to the text.

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R: 22 -I would say 'Times at Chioggia' to make it clear.

A: Corrected. Moreover, the reference to "both stations" (line 24) was wrong, because  
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times are not available for Venice: this has been corrected too (page 6, lines 22 and 24).

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R: 7470, 23 -surely it is not just a question of applying a longitude correction. The times in the Chioggia archives must have been in apparent time and not a local mean time, so an equation-of-time correction is needed. The fact that the times start after sunset (7469, 21) makes it messier. Anyway, I gather that the times are not used in detail, although they must have been used for Figure 2 for example.

A: Times were converted to UTC+1 taking into account the changing sunset time, not only longitude. The text has been modified to clarify this point (page 6, lines 23-24). Moreover, the information that times are apparent and that sunset is local has been included at page 5, lines 22-24.

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R: 7471, 6 -I would mention that the storm clearly lasts for a couple of days.

A: Done (page 7, line 7).

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R: 8 -.. changes that have occurred ..

A: Corrected (page 7, line 9).

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R: 11-14 -this sentence relates to my comments above. The sentence will be more understandable if the information on whether one number or two a day is archived at Venice and Chioggia is given. I would also drop 'normally'.

A: The text has been modified to respond to comment 7468, Section 2.1 (page 4, line 17-19). "Normally" dropped (page 7, line 14).

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R: 21 -standard errors (STDs).

A: The text has been slightly modified. The acronym was only used twice in the paper (the second time at page 10, line 18) and has been replaced by full words (page 7, line 23).

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R: 29 -I would add that these small errors are quite tolerable for the study of storm surges.

A: Done (page 7, line 29 – page 8, line 2).

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R: 7473, top -this text is under-selling itself. A point that should be made here about the inverse barometer test is that if either of the sea level or barometer data were poor than you wouldn't get any correlation or reasonable regression factor at all. In fact both must be reasonable quality.

A: I thank the reviewer for this remark. The text has been modified (page 8, lines 25-27).

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R: 7474, 13 -'secular means'? You mean the long-term average means?

A: Yes, the text has been corrected (page 10, line 23).

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R: 7475, 15 -Temanza's

A: Corrected (page 11, line 25).

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R: 16 -By contrast, the Temanza ..

A: Corrected (page 11, line 26).

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R: 19 -in the Venice time series

A: Corrected (page 11, line 29).

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R: 28 -seem to report

A: Corrected (page 12, line 9).

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R: 7476,5 -homogeneously

A: Corrected (page 12, line 13).

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R: 6 -in the 18th century

A: Corrected (page 12, line 14).

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R: 7476, 21 -could you say again briefly why these values have these average values?

A: The text has been modified to clarify this point (page 13, lines 2-3).

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R: 7478, 9 -containing the Venice sea level data.

A: Corrected (page 14, line 17).

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C3396

R: I wondered at the end if you could give some references to other work e.g local work on storminess from data archaeology of met records (e.g. Padua). How does that relate to the storminess inferred from the sea levels? Also to the work in N America etc. But I do not feel strongly about this.

A: I only know of one paper where storminess in the Adriatic region is studied from old meteorological data, namely Matulla et al. (2012), "Storminess in northern Italy and the Adriatic Sea reaching back to 1760", Physics and Chemistry of the Earth 40-41, 80-85. The authors attempt to estimate storminess using large pressure variations over 24 hours and geostrophic wind (estimated from pressure gradients) as proxies, but this is only possible since about 1850. The earlier period is only represented by atmospheric pressure at Milan and Padua, the latter being already used in our inverse barometer analysis. Moreover, Matulla's study focuses on approximately decadal time scales. The gridded pressure reconstructions for the late 18th century only provide monthly values on a 5°x5° grid (Luterbacher et al., Climate Dynamics, 2002; Kuettel et al., Climate Dynamics, 2009). As a result, those papers does not seems to allow a comparison with the late 18th century data over a small area like the Adriatic Sea.

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R: 7483, Figure 3 -why doesn't the event in 1792 that you have in Figure 2 appear in Figure 3(a)? There is a spike in what looks like 1782.

A: The event is missing because it belongs to the October 1792- March 1793 period, which is incomplete because observations stop at the end of 1792. A sentence at page 10, lines 8-10 has been included to make this fact explicit.

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R: 7485, line 2 -indicates no data.

A: The figure is shown to allow the reader to know not only the monthly data availability, but also when a data source exists (dot) or not (no dot). The sentence has been

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rephrased (page 23, line 2).

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R: There are also many sentences that are too long and could be split e.g. 7466, 25 -.. uniformly. However ..

A: Corrected (page 2, line 24).

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R: 7467, 16 -... engineering). Therefore, ..

A: Corrected (page 3, lines 17-18).

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R: 7474, 5 -... 1999). Therefore, ..

A: Corrected (page 10, line 14).

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R: 7475, 27 -.. expected. However, ...

A: Corrected (page 12, line 8).

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R: 7476, 6 -cautiously. However, ..

A: Corrected (page 12, line 14).

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R: 7477, 5 -.. means. Nevertheless, ..

A: Corrected (page 13, line 13).

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C3398

R: 7477, 7 -scarcity. However, ..

A: Corrected (page 13, line 15).

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In addition:

The reference to Temanza's manuscript has been corrected, as well as that to the Padua archive that holds the manuscript (references; acknowledgements).

Because of the addition of a new Fig. 2, references to (old) Figs. 2-6 have been modified to (new) Figs. 3-7, respectively.

A few mistypes have also been corrected.

Please also note the supplement to this comment:

<http://www.nat-hazards-earth-syst-sci-discuss.net/2/C3391/2015/nhessd-2-C3391-2015-supplement.pdf>

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Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 2, 7465, 2014.