Answers to the comments of the reviewer

Here are on the behalf of all authors, the replies (text in Italic) to the comments of Reviewer#2 (text in bold characters)

I generally would like to follow Referee #1 and thus do not need to repeat the summary or the overall intention of the paper by Lionello et al.; as Referee #1, I also do not have major comments but would like to provide some more specific comments/questions as follows:

We thank the reviewer for these constructive and useful comments. Please, see below our detailed answers to each specific comment.

Line 49: It would be nice to get more information on the average number of flooding events nowadays against a selected period from the past. After reading the entire paper, one could also just point to the following sections (and/or to Fig 4, which then becomes Fig 1: : :) where this is discussed/presented.

Thanks for suggesting this.
In fact, this information is shown in Figure 4, but it was not highlighted in the text. Figure 4 shows that the number of floods above the 120 cm threshold has increased from 1.6/decade (average frequency during the first half of the 20th century) to 40/decade in the period 2010-2019. Considering the lower 110 cm threshold the number of events has increased from 4.2/decade to 95/decade during the same time spans. This information will be added to the text of this manuscript (hereafter Editorial) and to section 4.1 of the review paper on Extreme floods of Venice in this special issue (hereafter L2020), where discussing the past evolution and recent trends of floods and extreme sea levels in.

Line 55: In my understanding, the event of 1966 should be described as storm surge, "reaching the highest ever recorded extreme sea levels (ESL)"; the term RSL refers to just on component of the entire ESL, consisting of tide, surge, RSL. I often find it difficult to read papers on storm surges, ESL or MSL changes as the terms used to describe these phenomena differ from author to author. I like the using the terminology proposed by Gregory et al. (2019).
Gregory, J.M., Griffies, S.M., Hughes, C.W. et al. Concepts and Terminology for Sea Level: Mean, Variability and Change, Both Local and Global. Surv Geophys 40, 1251–1289 (2019).
https://doi.org/10.1007/s10712-019-09525-z
Line 62: Following the suggestion above, I would use ESL instead of sea levels; if considered relevant, more adjustments are needed throughout the manuscript but these are no longer highlighted here

We consider together these two comments, because they are related.
First, thanks for pointing at the Gregory et al. (2019) paper (hereafter G2019). We agree it provides an excellent reference for the terminology to be used when discussing sea level. However, two issues prevent us following strictly G2019 in our special issue.
The first issue is the proper characterization of extremes for the Venice sea level, which are actually extremes of the local instantaneous thickness of the ocean, $\tilde{\boldsymbol{H}} = \tilde{\eta} - \tilde{F}$, where $\tilde{\eta}$ and $\tilde{F}$ are the instantaneous sea surface and bottom level, respectively (here the meaning of the symbols is the same as in G2019). Both $\tilde{\eta}$ and $\tilde{F}$ are measured with respect to a common reference (which could be the reference ellipsoid, the geoid G, or a geocentric reference frame). On the contrary, in G2019 sea surface height extremes are defined as exceptionally high values of the geodetic height of the sea surface above the reference ellipsoid $\tilde{\eta} - G$. Therefore, the characteristics of the extremes practically relevant for the flood of Venice do not correspond to the definition of sea surface height extremes in G2019. We could refer to the extremes of $\tilde{\boldsymbol{H}}$ using the term "extreme thickness", but this sounds to us a clumsy and not effective terminology. We suggest to use the terminology "water height" extremes or high-end values.

We note that a similar issue on terminology arose also for the review article on mean sea level trends (Zanchettin et al., 2020, this special issue, hereafter Z2020), and further discussion is available in our responses to the reviewers in the open discussion of that manuscript (see: https://nhess.copernicus.org/preprints/nhess-2020-351/). In short, as Z2020 deals mainly with mean and relative sea level issues, we could adopt there the G2019 terminology with a few exceptions related to the Earth's gravity, rotation and deformation components, which are clarified in the text.
We agree with the reviewer that a general revision of the terminology is needed in this introduction and L2020, and we will implement it in the revised versions, with an explanation of the terms used and how they differ from G2019.

The second issue is the definition of surge that according to G2019 is "The elevation or depression of the sea surface with respect to the predicted tide during a storm". Actually, as it is discussed in L2020, the sea surface elevation with respect to the tide results from contributions with different time scale. Some contributions have a time scale that is much longer than the typical duration of a storm, O(24 hours), some shorter, namely the meteo-tsunamis whose duration is O(1hour), and basin wide seiches have their own periods of approximately 11 and 22 hours. Therefore, the G2019's definition of surge is not the best option for the analysis of sea level extremes in the North Adriatic and Venice, though we acknowledge that it is applicable to a wide range of situations that are simpler than the North Adriatic Sea. This discussion will be added to this Editorial and will be further expanded in the review article L2020.
Considering specifically the November 1966 event, the surge component (as defined in L2020) is the main contribution to the extreme water height value, but in other cases (e.g. the event of November 2019) other contributions have had comparable magnitude.

Line 105: Comma after Century
Thanks

Line 132: Mixed tidal-regime, semi- or diurnal? Would be nice to know, especially as you refer to the diurnal frequency of tides hereafter.

The tidal regime is a mixed semidiurnal cycle with two high and two low tide levels of different height every day. There are 7 components with amplitude above 1 centimeter and only 3 above 10 centimeters, with semidiurnal M2 and S2, and diurnal K1 providing the largest contributions. The values of M2, S2 and K1 are approximately 23, 14, 16 centimeters, respectively, both outside the lagoon and at the Venice historical tide gauge station. This information will be added below line 132.

Line 159: ": : :of the compound event that led to the exceptional sea level maximum". Compound events (and a specific one) have not been discussed before, somehow confusing the reader. Maybe write "a compound event (discussed in/see XXXX)" and maybe also give some short explanation as e.g. "the joint occurrence of two or more individual hazards:

We will swap the order of paragraphs beginning at line 159 and 165. The latter describes the relevance of compound events. Extreme water heights are the result of different factors, often playing comparable roles. The review article L2020 lists and describes them: astronomical tides, seiches, storm surges, meteo-tsunamis, long planetary atmospheric waves, with a background trend produced by relative sea-level rise. Compound events occurs when their superposition produce an extreme water height, though individual factors have a non-exceptional height. This discussion will be added to the paragraph.

Line 231: Still difficult to assess, as all scenarios develop side by side. Based on the article of Hausfather and Peters (2020) I would add " the world seems heading".

We agree and have changed the text accordingly.

Fig. 2: Nice, but really small and thus difficult to read. Maybe put the aerial above the two sea level graphs and extend all slightly

Thanks for the suggestion.