

## ***Interactive comment on “Assessing hydrological effects of human interventions on coastal systems: numerical applications to the Venice Lagoon” by C. Ferrarin et al.***

### **Anonymous Referee #1**

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#### General Comments

This paper focuses on numerical simulations of both Local and Overall Water Renewal Times for past, present, and future conditions of the Venice Lagoon. The major contributor to changes in Water Renewal Time is the construction and the frequency of closure of the mobile barriers (MoSE) at the lagoon inlets, which depends on the past, present, and anticipated future sea levels. The MoSE is the major human intervention to the Venice Lagoon. The authors addressed the effect of the MoSE properly and quantitatively for years 2002, 2012, and during the anticipated future sea level rise.

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Two more numerical applications for years 1927 and 1970 addressed the period before the construction of the MoSE in a very qualitative manner. Interventions that were very briefly mentioned included the destruction and restoration of salt marshes and the dredging of the ship channel.

The paper is very specific to the Venice Lagoon and it is very specific to the effect of its protective barrier, MoSE, on Water Renewal Time.

### Specific Comments

1. The title should be more relevant to the content. Except for the construction and operation of the MoSE, human interventions (i.e., page 13844) in the Venice Lagoon were not quantitatively analyzed in this paper. A more relevant title can be “Effects of Protective Barriers and Seal Level Rise on Water Renewal in Venice Lagoon.”
2. The reference datum for measuring vertical changes (water surface, sea level rise, MoSE, bed elevation) has to be clearly stated in the paper. Any “local datum” has to be related to the reference datum.
3. Four numerical model grids with different coastline and bathymetry were generated to cover the four simulation periods for 1927, 1970, 2002, and 2012. It should be mentioned if the calibration (page 13850) was performed for all these grids and what were the calibration parameters for both hydrodynamics and transport.
4. Baseline simulations should be included for the effect of Sealevel Rise on Water Renewal Time without any closures of the MoSE. These simulations will show the actual degree of choking these barriers are causing to the Lagoon.
5. The 4-page long Section 4.2 “Hydroecological implications” includes general information. This section should include only the implications that relate to the presented analysis of Vince Lagoon. After some cleaning, only the last 4 paragraphs may be kept in this section.
6. Figure 2: what is the datum for the shown bathymetry? Is it the same “local datum”

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mentioned in the text? If not, define the relation between the two.

7. Figures 4 and 6 are very hard to read at the presented scale. Each of these figures includes 4 maps of the spatial distribution of Water Renewal Time. It takes the reader considerable effort to compare between them and verify the explanation in the relevant text. a. All these figures should be converted to the spatial distribution of the difference (or %) in change between a reference scenario (for example 2002) and the other studied scenarios (i.e.,  $(WRT-WRT_{2002})$ , or  $(100*(WRT-WRT_{2002})/WRT_{2002})$ ); respectively). Such spatial distributions will directly point the reader to areas of change and the magnitude and trend of change (+ or -) relevant to each scenario. b. Figure 4 (A) shows year 1930. It should be consistent with the text indicating the year 1927.

8. Figure 5 and the relevant text (page 13852): a. The two figures should be separated into two independent figures because their horizontal axes are different. b. Otherwise, they should be identified as (A) Water renewal time, and (B) Bathymetry. The caption should mention these figures. c. For consistency, the word “bathymetry” should be changed to “elevation” in the caption. d. The legend for Figure (B) should not have the data for 2002. The caption for figure (B) should alert the reader that the 2002 data does not exist. e. The authors should identify the reference datum (zero elevation) for the measurements in both figures. f. To validate any quantitative comparison between the two graphs, the vertical axes should have the same scale and units [e.g., Area (km<sup>2</sup>), or Area (%)].

9. Figure 7: The horizontal axis should be changed to reflect the time from 1927 into the future. The expected times for SLR of 10, 30, and 50 cm can be estimated from relevant literature or models. A legend similar to that in Figure 8 should be added to figure 7.

10. Figure 8: a. The sketches showing leaky, restricted, and choked waterbody are very qualitative and they are not relevant to Venice Lagoon. The main cause of the restriction to the lagoon is the frequent operation of the MoSE. These sketches should

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be removed. b. Introducing the “flushing time,” which is a different time scale, is confusing. Should the vertical axis represent average water renewal time or flushing time? In addition, the curve showing flushing time does not add anything new to the analysis and it should be removed from the figure together with the relevant text (page 13855, paragraph 3). c. With the above adjustments to the figure, the eight data points should plot on a relevant vertical axis with a maximum similar to that in Figure (7) to delineate the trend with FVE, which should be similar to that in Figure 7 but reversed.

## Technical corrections

1. Abstract, sentence before last: change “increased” to “increase”.
2. Section 1.1, Study area, 4th bullet, 2nd sentence: change “inlets” to “inlet”.
3. Section 2, Material and methods, 2nd sentence: change “estimated computing” to “estimated by computing”.
4. Page 13846, Equations: a. The three equations need to be numbered (1), (2), and (3) b. Renumber equations in the following pages accordingly. c. Equation (3): use different counter than  $l$  (e.g.,  $L$ ) under the summation ( $\sum$ ) to represent number of all layers. d. Equation or explanation to define shear stress,  $\tau$ , must be added.
5. Page 13850: paragraph before last, sentence before last: change “total flux on the three inlets” to “total flux in the three inlets”.
6. Page 13851, 1927–2012 evolution, 2nd paragraph: remove text in the 2 sentences between “The variation of the relative. . . . .almost unchanged.”
7. Page 13855, paragraph 3: remove the text starting from “The inverse of FVE. . . . .” to the end of this paragraph.
8. Section 4.2, Hydroecological implications: remove the text as explained in No. 5 in the Specific Comments.

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