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## ***Interactive comment on “Seasonal renewal time variability in the Curonian Lagoon caused by atmospheric and hydrographical forcing” by G. Umgiesser et al.***

**Anonymous Referee #2**

Received and published: 15 December 2015

The authors have applied their well-known 3-D finite element model SHYFEM developed at ISMAR, CNR, to the Curonian Lagoon to explore the factors that influence the water renewal times (WRTs) in the lagoon. The study is interesting and a straightforward application of a numerical model, although the conclusions are quite obvious a priori. The lagoon is very shallow (3.8 m average depth) and is connected to the Baltic Sea via a very narrow strait that restricts the water mass exchanges between the lagoon and the sea. In addition, the tides in eastern Baltic are negligible and so tidal variations in the sea level in the Baltic are unimportant as far as the lagoon is concerned. However, wind-induced sea level changes in the Baltic Sea might be significant and that is where the Baltic Sea could influence the lagoon, albeit with the

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Strait restricting the exchange. The authors should have investigated this scenario as thoroughly as they have done the obviously influential river discharge. The Namunas river discharges a significant volume of fresh water into the very small lagoon, making it, as the authors point out, nearly a fresh water lagoon and hence plays a dominant role in WRT.

As an exercise in numerical model application, the study is fine. But it does not shed any light on physical processes underpinning the WRT. For example, I find it hard to understand why not even a single plot of the circulation in the lagoon is presented. Obviously, the prevailing circulation must affect WRT in various parts of the basin. And the restricted exchange through the Strait must affect the entire basin. Without a clear picture of what the circulation in various sections looks like, it is very hard to understand why the model is producing the results it is producing. The discussion of various energies is interesting but not illuminative. The emphasis should have been on circulation. So I urge the authors to include currents in their analysis of the model results. It would also be nice to see a plot of the flow volume through the Strait over the 10 years of model simulation. It should be included in Figure 8.

The model does a decent job on sensitivity studies but is woefully brief on the 10 year reference simulation (e.g. Figure 8). I would like to see more discussion of the 10-year simulations as presented in Figure 8 but supplemented with maps of currents and water mass properties.

Overall, Major revisions addressing my concerns are in order before the manuscript can be accepted for publication in OS.

Detailed Comments:

Page 2: Line 11-12: are mostly depended should be depend mostly Line 15: are only marginally determining should be only marginally determine Line 21: remove due

The manuscript needs a thorough going through to improve the language and gram-

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mar. Especially bothersome is use of continuing tense such as that pointed out in Line 15 above, throughout the manuscript. There are too many language fixes needed and so it is impossible to point them all out. So I will not and instead will concentrate on the technical content. The authors should ask an English-knowledge person to go through the manuscript and correct the language deficiencies, before it can be accepted for publication in OS. However, that can be done during their response to reviewers and resulting revision of the paper.

The figures are very poor. The different colors and lines are very difficult to see. Please re-plot ALL the figures with thicker lines, better color distinctions and bigger fonts. In their current form, they are not fit for publication.

Page 4, Line 1: Replace importance by magnitude.

Figure 1: I could not see the gray lines without expanding the figure a lot. Re-plot with a suitable color and thickness. Change the color of the thick line also. It merges with the FEM cell boundaries.

Page 5: List the average discharges of all rivers, even if Nemunas river dominates. A plot of the change in Nemunas discharge with time is necessary to understand its seasonal influence.

Page 6: Explain how data from different sources for different years affects the results. How reliable are the data from the “forecast” models?

Page 6: Ice cover is characterized by two quantities: fractional area covered and the ice thickness. Looks like only the fractional area covered is available. You also say you ignore ice cover. Explain why.

Page 10, Line 7: Replace Energy by Lagoon energy

Page 10, Line 26: Are these fluxes across the gray lines in Figure 1? If so, state it and refer to the figure.

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Figure 3: Change the vertical scale of the bottom panel to  $2500 \text{ m}^3/\text{s}$  also, so that the strait discharge can be compared visually to the river discharge.

Page 11, Line 19: How much of the results are affected by model discretization of the Strait? Comment.

Page 11, Line 26: Reason for “reinitialization?”

Page 12: A plot of the temporal variability of various (especially Namunas) river discharges is essential to understand the results in Figures 4 and 5.

Page 15: Discuss the dynamical reasons why the ice cover influence is small and why the influence of how the ice cover was taken into account in the model might or might not have affected the results. If the lagoon is completely covered by ice, as happened during 2009 and 2010, and if the ice is land locked, the wind stress is NOT transmitted to the water underneath. Has that been taken into account? Does that affect WRT or doesn't it? Explain.

Figure 7: Once again, the plots are too poor and hard to understand. Thicker lines, better color selections to highlight different situations in a particular lagoon etc. are needed.

Page 15: The paper draws obvious conclusions re WRT. The presence of the narrow Strait, which forms its outlet to the Baltic Sea and hence restricts exchange of water masses between the lagoon and the sea, must play an important role. And of course river discharge into such a small volume must also play an important role in WRT.

Page 16: I do not understand why the lack of influence of ice cover is “astonishing.” All it does is mediate between the wind stress and the water column. So it affects vertical mixing in the water column mostly. WRT cannot be not sensitive to vertical mixing in such a shallow basin (3.8 m average depth), since even small winds mix up the water column, if the estuarine exchange through the very narrow Strait is highly restricted and so more saline water intruding along the bottom cannot be a major factor, at least in

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the southern section. A plot of the salinity in the basin would be very helpful. Actually, I would start the paper with a plot of the salinity and temperature (seasonal or average) in the lagoon immediately after Figure 1 showing the topography and the model cells.

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Interactive comment on Ocean Sci. Discuss., 12, 2043, 2015.

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