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Interactive comment on "Modelling survival and connectivity of <i>Mnemiopsis leidyi<i> in the southern North Sea and Scheldt estuaries" *by* J. van der Molen et al.

Anonymous Referee #1

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General comments

Introduction In this paper is van der Molen with co-authors modeling the reproduction, survival and dispersal of the invasive ctenophore Mnemiopsis leidyi in the Scheldt estuaries and the southern North Sea. By taking use of three different models with varying resolution and complexity, they are able to estimate the potential dispersal patterns of Mnemiopsis in the southern North Sea and surrounding estuaries, and perhaps more importantly, to explore potential factors effecting the dispersal patterns. In their hand, except for the models, they have field observations from several field campaigns in Dutch waters, and they are partly using model parameters previously defined in published work.

Merits It is a highly relevant topic within its research field. Since the introduction of Mnemiopsis in European waters, the scientific community has questioned if, how and where Mnemiopsis may be transported and if this will result in further spreading through European waters. Since Mnemiopsis have the potential of affecting the whole ecosystem, this is of high relevance not only for "jellyfish researchers". The authors' use of different models to explore different aspect of the dispersal potential, it allows them to draw conclusions about potential important factors influencing Mnemiopsis spread. This is certainly one of the better drift-modeling papers involving this species. The paper is well structured and written, and understanding the limitations of the models, the authors have managed to write a nicely balanced discussion.

Critique Because it is a very ambitious work with several models it demands a long and technical method section, and the result section contains a lot of figures. To make the manuscript slightly less heavy, it would be to their advantage to at least reduce the total number of figures. I have included some suggestions below. The manuscript is generally well structured and written, but certain sections will need clarifications. For example, the authors are using different names (or parts of the full name) for the same model throughout the text. Because there are many models used in this study it is particularly important to simplify it for the reader by consistently using the same name. Suggestively, after writing out the full model name once (e.g. here in abbreviation, GETM-ERSEM-BFM model with particle tracking GITM), a short-name can be used (e.g. the GETM-model or similar). The DEB model is the least well written part, and the method and result section are sometimes difficult to follow, sometimes due to lack of information. In the method and discussion section the authors are also referring to the original article (Augustine et al. 2014/in press) for details. At this stage it is problematic, since as far as I know, it is not publicly available yet. The authors must therefore make sure all parts are clearly explained independent on Augustine et al. Several comments on this can be found below.

Specific and technical comments

Page 1562 Line 20: Change “East” to “east”

Line 20: Only Parcell et al. 2001 is a paper concerning the American Mnemiopsis population. I would suggest the authors to go back to the original articles, since Boersma et al. 2007, Gesamp et al. 1997, and Lehtiniemi et al. 2011 only cite papers from the US (see for example Costello, Kremer, Reeve, etc.).

Line 21: The full species name is sometimes fully spelled out (Mnemiopsis leidyi) in the beginning of a sentence, and sometimes not (see for example pp. 1563 line 1 vs. line 9, page 1576: line 14 and 17). Maybe the journal has a standard way for this, if so follow this. Either way, be consistent throughout the manuscript.

Page 1563 Introduction section generally: If the ambition is to shortly review the distribution and spread of Mnemiopsis in new habitats, they should also include the Baltic Sea are with surrounding waters (see for example Javidpour et al. 2006,Tendal et al. 2007 or Riisgård et al. 2012 etc.). I would also like to see some more background information about Mnemiopsis in the Scheldt estuaries and close surrounding. When where they first observed, have they been observed year after year etc.?

Line 18: Change “M. Leidyi” to “M. leidyi”

Line 18-19: Again, these are not the primary references. I find it more suitable to refer to for example Daskalov 2002, Kidey 2002, or Mutlu 2009.

Line 27-28: Just a note. In previous description of the study you mention “Transport, survival and reproduction”, while only “transport and reproduction” here.

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Line 8: The names used for the models: Make sure the same name is used for the same model through the whole manuscript.

Line 8 and onwards: I would suggest numbering the models mentioned here. For a reader unfamiliar with these models, and/or when reading the paper for the first time, I

suspect it may be hard to separate the different models, particularly since some consists of several coupled models.

Line 9-10: “with limited adaptations”, the authors can be more direct with what they mean.

Line 11-12: Logically, it seems like “deploying the strengths of the individual models” should be written out before “intercomparison of the results”?

Line 16..: Although the language flow is very nice here, I still believe enumerating the different models will make it “crystal clear” also for the first time reader.

Line 24: “(dramatically)”, this is an interpretation and should not be included here.

Page 1568 Particle tracking: I would appreciate more information about the vertical movement, and information about what parameterization was used for the vertical movement: Is there a vertical movement, and what decides it (behavior, random walk, turbulence)? Also, are the final outputs summed over all depth intervals?

Page 1571 Line 26: Is the temperature taken from the GETM-ERSEM-BFM model? (the same on page 1572 Line 27)

Page 1574 Line 1: Does mortality below 2 degrees C apply only to the adults, and not to the juveniles? This could be written out.

Page 1575 Line 10: Write out the previously used model name here (particle tracking IBM), particularly since a particle tracking unit were used also in the Delft3D model.

Line 11: It is not clear from which depth the particles were released (random depth, specified depth), please precise.

Line 20: Perhaps shortly clarify why the sensitivity of juvenile mortality in particular are tested (and not other parameters).

Page 1576 DEB model generally This is the least well explained part in the manuscript,

and since the original article (Augustine et al. 2014) is not accessible yet, it is extra important that the description of the model is clear. I have made some comments and I further recommend the authors to carefully work through this part again.

Line 4-5: This sentence sounds a bit strange to me, particularly “all organisms” and later “applies to all animals” (which organisms and animals). Do the authors mean “any organism”, or “all organisms under conditions in which food densities and temperatures vary”? Please clarify the sentence.

Line 8: The article is referred to as both (in press, the reference list and table 1) and (2014, all the text), please be consistent.

Line 10: Here EH is defined as “maturity level”, and in Fig. 3 as the “cumulated energy invested in maturation”. If these can be considered the same (maturity level = cumulated energy invested in maturation), I would advice to specify this at the same place in the text. I would also include the definition of ER here.

Line 12: The definitions of the life stages are not very clear, this can be improved. (Maybe include egg, juvenile, adult etc.). Section starting on line 25: Puberty (maturation?) seems to be an important moment described by the model where the allocation of energy is significantly changed. I would suggest explaining with one or two lines what the “puberty” refers to in the model.

Page 1577 Line 4: Since I cannot access Augustine et al., it is not clear to me how the analyses in this manuscript are differing from the once about to be published in the original article. I would like the authors to be more precise about this.

Line 8-10: Which is the second simulations experiment: If you write out “the first”, write out “the second” as well.

Line 16: Should it be “L d-1 cm-2”, with capital L, perhaps?

Equation 13: What food concentration (X) is used?

Page 1578 Line 18: For clarity, perhaps specify which of the model runs from the Eastern Scheldt you refer to, e.g. “the results of the Eastern Scheldt model runs using a uniform initial distribution of particles are presented in. . .”.

Line 10: Which sensitivity test: as far as I can see, this has not been explained in the method section.

Line 14: Perhaps introduce this name, the “realistic run”, already in the method section (just as the authors have done with the “standard run” for the GETM-ERSEM-BFM model)

Line 14: I suggest changing to: “. . . of the realistic runs for the Western and Eastern Scheldt are presented. . .”, then the authors don’t need to repeat this again on line 23. Later, delete sentence 22-23 and go straight to the results.

Line 16: Change to “observational measurements” or similar.

Line 16: Make sure to consistently use “Figure” or “Fig.” throughout the manuscript.

Page 1580 Line 11-12: “West” and “North” don’t need to be spelled with capital letters

Line 21: Take away one “in”, in front of “in December. . .”

Page 1581 Line 6: Fig. 12, red lines are in the figure referring to the run assuming 10% temperature increase, not the 2/3 juvenile mortality. The legend does not seem to agree with the text (see also line 10). Check this carefully.

Line 9: Where is the value 8.6 coming from (I assume it is the same value/factor given in table 1)? Please clarify this information.

Line 10-12: It is not clear from Fig. 13a where these values comes from. Please clarify.

Line 12: Change “at libitum” to “ad libitum”.

Line 13-15: As far as I can see, it is only Fig 13a which is showing the carbon weight of Mnemiopsis at different transition stages. Therefore, it is not clear to me where the

authors get these other carbon masses from? Please clarify.

Line 21: At the end of the sentence "...reach puberty", I would suggest including a reference to the figure (Fig. 13b).

Line 23: This reference does not belong in the result section (also, the authors are returning to this in the discussion), please delete.

Line 24-26: This is also more of a discussion point and can be moved.

Page 1583 Line 12: "... response to changes in reproduction as function of food level." - and temperature?

Line 8-11: This is a very long and a bit confusing sentence and should suggestively be split up, at least with some commas.

First two paragraphs: Something that may be worth considering in this section of the discussion is that the model is not including potential influence of behavior of Mnemiopsis. This can for example involve predator avoidance (e.g. Titelman et al. 2012), or prey search including diel vertical migration (e.g. Haraldsson et al. 2014). Both behaviors often result in a vertical movement, and the vertical position may in turn have a significant influence on the transportation. This potential discussion point may be more or less relevant depending on how the vertical movement was accounted for in the models (see previous comment in method section).

Page 1584 Line 15: Perhaps indicate what the salinity levels are.

Page 1585 Line 3: Delete "in the chain", or reformulate this part.

Line 9-13: This is a very long sentence, and the last part, "should it be able to establish itself in East Anglia", seems out of place. Delete or reformulate.

Line 15: Change "M. Leidyi" to "M. leidyi"

Line 17: I suggest to change "But it also becomes difficult to assess..." to "At this stage

it is difficult to assess...", or similar.

Page 1586 Line 5: "mass as function of length", I haven't seen these results?

Line 7: Again I wonder how this study is differing in the analyses using the DEB model compared to the original article. If the same analyses were done in this manuscript as in Augustine et al., it would be more appropriate to only discuss their results rather than reporting them again. Please make this clearer.

Line 10-12: I am not sure what the authors want to say here. Maybe change the order on the last part of the sentence, "... BFM model, based on observations and physiology, in line with the model proposed by Salihoglu (2011)", or only write "Separate juvenile and adult food densities were extracted from the GETM-... model".

Line 16: Maybe it is appropriate to include the "discussion points" raced in the result on page 1582 here (see previous comment).

Line 17-21: I do not fully understand what the authors want to say here. Please try to rephrase and clarify.

Line 22: Perhaps change "high" to "higher"!?

Line 26: Why was this value used, a reference perhaps?

Page 1587 Line 4-5: All readers are not familiar with the fisheries literature. Please be more specific and include references.

Line 6: Delete ", as far as possible with the current results,". This is given.

Line 16: Delete ", however,".

Line 24: This is an abbreviation not defined previously. Please write out.

Line 25: Change "These results" to "Our results".

Page 1588 Line 11: Include a "than" after temperatures.

Tables Table 1: I assume you mean Fig. 3?

Table 2 and 3: I suggest including “connectivity matrix” in the table text.

Figures Figure 1 and 2: What unit is the x and y coordinate (and in all other maps)? Also, figure 1 and 2 can be combined into one figure with two panels.

Figure 3: Where are Ex and Ep included? I cannot find them either in equations, table 1 or in the text.

Figure 4, 5, 6, 7: These figures can with advantage be combined into one figure with four panels (like in Fig. 8). As it is now, these results take a “lot of space” (compared to the rest of the results) by being presented one by one. It will also be easier to compare the connectivity between the two regions if they are plotted together.

Figure 8: Change to “Observed density of M. leidyi”. The lower left panel: There are indicated observation (density circles) along the river north of the eastern estuary, was this river also covered by the model? If not, I suggest including information about this in the figure text.

Figure 8, 9, 10, 11, 12: Write out a-d/i on the respective panels.

Figure 12: Axes title is missing on the upper left panel. Check the figure legend, the figure text and the result section carefully as they do not seem to agree (see previous comment in the result section). In some of the panels all 5 simulation results are not visible (e.g. panel c). I assume this is because they are masked by the last added line. If so, mention this in the figure text.

Figure 13: It took me time to fully understand panel a. I would suggest including curled brackets on the left hand side indicating the “stage transitions”, “carbon mass” and “duration”. Why is the “puberty node” on the vertical line and not along the horizontal line? The functional response seems to have been applied at 22 degrees, while in table 1 the reference temperature seems to have been 20 degrees. Is this correct? In the figure text is says “Reproduction rate at puberty and at ultimate mass and respectively

as function of temperature”. The sentence is incomplete, and, I cannot see any figure with masses? It is not clear to me why panel (C-B) and (A-C) are combined?

Given references: Daskalov (2002) Overfishing drives a trophic cascade in the Black Sea. Mar Ecol Prog Ser 225: 53-63 Haraldsson, Bamstedt, Tiselius, Titelman, Aksnes (2014) Evidence of diel vertical migration in Mnemiopsis leidyi. Plos one e86595 Javidpour, Sommer, Shiganova (2006) First record of Mnemiopsis leidyi A. Agassiz 1865 in the Baltic Sea. Aquat Inv 1: 299-302 Kidey (2002) Fall and rise of the Black Sea ecosystem. Science 297: 1482-1484 Mutlu (2009) Recent distribution and size structure of gelatinous organisms in the southern Black Sea and their interactions with fish catches. Mar Biol 156: 935-957 Riisgård, Madsen, Barth-Jensen, Purcell (2012) Population dynamics and zooplankton-redation imact of the indigenous scyphozoan Aurelia aurita and the invasive ctenophore Mnemiopsis leidyi in Limfjorden (Denmark). Aquat Inv 7: 147-162 Tendal, Jensen, Riisgård (2007) Invasive ctenophore Mnemiopsis leidyi widely distributed in Danish waters. Aquat Inv 2: 455-460 Titelman, Hansson, Nilsen, Colin, Costello (2012) Predator-induced vertical behavior of a ctenophore. Hydrobiologia 690: 181-187

End of review

Interactive comment on Ocean Sci. Discuss., 11, 1561, 2014.