

Response to Reviewer

Comments to the author:

Dear Dr. Guo,

Thank you for your thorough revision of the previous version of the manuscript. The reviewers have returned only minor comments and seem satisfied with your revision. Before we take the manuscript further, however, I must request some changes.

This is not a climate-change effect study. If the intention was so, the entire study must be redesigned and is not acceptable in its present form. I would strongly recommend you carefully go through the manuscript and edit any part relating to climate change effects. Some statements can be retained as speculative comments, but please tone down in the discussion, abstract, results and conclusions. The final statement of the abstract “These findings will help to predict bottom water temperatures and improve the current understanding of ecosystem changes in shelf seas under global climate change” must be removed or revised as I cannot see how your results will improve the current understanding of ecosystem changes in shelf seas.

A careful reading/edit is necessary. In some parts, the language is not clear. Below are some line-by-line comments, not separated minor/major.

Thanks for your careful reading and comments. This study investigates the interannual variation of INCWM and its response to air-sea heat flux change. We have carefully gone through the manuscript and edited the part relating to climate change effects. The final statement of the abstract changed to “These findings will help us to understand the response of bottom cold water mass in coastal seas to sea surface forcing change”. Following your comments and suggestions, we have finished a comprehensive revision on the original manuscript. Below is a point-to-point response.

Li14: [its] influencing factors- clarify ambiguity

Thanks for your comment. We changed the statement to “its response to air-sea heat flux change”.

Li 15: [t]he lower case

Changed as your suggestion.

Li16: [Their] internannual variation- clarify ambiguity

Thanks for your comment. We changed the statement to “The interannual variation of average water temperature of INCWM”

Li36: dissipating: wrong word (water mass does not dissipate). You mean disappearing?

Thanks for your careful reading. We changed the word to “disappearing”.

Li46: [T]hey, upper case

Thanks and changed as your suggestion.

Li 51: Kii Channel is not marked in fig 1

Thanks and we have marked the “Kii Channel” in new Fig. 1a.

Li 53-54: only one of these place names are marked in fig 1

Thanks for your comment. We have marked the location of Suo-Nada, Iyo-Nada, Hiuchi-Nada and Harima-Nada in new Fig. 1a.

Li 54: we focus[es]: delete “es”

We have deleted “es” as your suggestion.

Li 64: “changes under climate change”: this motivation is good but not addressed thoroughly in your study. Please consider removing altogether.

Thanks for your comment. We have removed “under climate change”.

Li81: no need to give the URL for a research institute.

We have deleted the URL as your suggestion.

Li83: use oC, degree

We have changed the word “degree” to “°C”.

Li 88-100: This part is not method. It belongs to a subsection in results (e.g., call it Seasonal variability)

Thanks for your comment. We have moved this part to a new section “Section 3.1 Seasonal variability of the INCWM”.

Li 95-100, and throughout, “deep” must be “depth” when referring to measurements from XX m depth.

Thanks for your comment. We have changed “deep” to “depth” when referring to measurements from XX m depth in the revised manuscript.

Colormap: please use a better-suited colormap than “rainbow/jet” for temperature in Fig 2 & 3. For Fig 9 consider a blue-white-red colormap. One suggestion is to use the cmocean package available for Matlab and other common softwares.

Thanks for your suggestion. We have changed the colormap in Fig.2 and Fig. 3 using the cmocean package available for Matlab. For Fig.9, we consider that you said is Fig. 8, and we have replotted with a blue-white-red colormap.

Fig 2 caption: bars in (m) not (b). 50 m depth.

Thanks and changed as your suggestion.

Li 118: were used to force the model

Thanks and changed as your suggestion.

Li140: delete obvious

We have deleted “obvious”.

Li 132 to 150: these are also “results”, not methods. Please restructure.

Thanks for your comment. We have moved this part to a new section “Section 3.1 Seasonal variability of the INCWM” which compare the observed and simulated seasonal variability of the INCWM. Meanwhile, we changed the title of Section 2.2 to “Model configuration”.

Li 173: choice of 18°C isotherm: seems arbitrary. Please discuss the sensitivity to this choice.

Thanks for your comment. We choose 18 °C isotherm based on properties of the cold water mass. First, a bottom cold water mass always shows a shape of bottom-up “bowl” that encloses a water mass there. The observed distributions of temperature (Supplementary Fig. 3) show that the water less than 18 °C always occupies the central area of Iyo-Nada below 20 m in all observed years and the form of 18 °C isotherm is similar to a bottom-up “bowl”. Second, the water temperature difference between surface and bottom layers is an important index to identify the INCWM. From May to July (Fig. 3b-d), the water temperature difference between surface and bottom layers increases faster in the area defined by 18 °C isotherm for the INCWM than in the surrounding waters. A bottom temperature front gradually separates the INCWM from the surrounding vertically mixed water. In July, INCWM can be well distinguished from surrounding waters by a water temperature difference between surface and bottom layers of 5 °C (Fig. 3d), whose location is consistent with that of 18 °C isotherm at 50 m depth (Fig. 3g). Therefore, the use of 18°C isotherm is not arbitrary. To clarify this point, we added following

sentences in the first paragraph in Section 3.2.

“Observation (Supplementary Fig. 3) shows that INCWM occupies the central area of Iyo-Nada below 20 m depth with a similar shape of bottom-up “bowl” which can be indicated by the 18 °C isotherm in almost all years. In addition, INCWM in July can be well distinguished from surrounding waters by the water temperature difference between surface and bottom layers of 5 °C (Fig. 3d) whose location is consistent with that of 18 °C isotherm at 50 m depth (Fig. 3g). Therefore, we used the 18 °C isotherm to define the boundary of INCWM in July (Fig. 2c), and calculated the average water temperature and area inside the 18 °C isotherm.”

Li 219-220: consider: “..temperature at the INCWM site was homogeneous....dome below a surface layer warmed by surface heating....”

Thanks and changed as your suggestion.

Li253: specify what you mean by stronger INCWM (colder?)

As defined by Section 3.2, a stronger INCWM has a lower water temperature and a larger area. Here, a significant negative correlation ($r = -0.44$, $p < 0.05$) was obtained for the thermocline strength in July and the average water temperature of the INCWM in July, indicating that a stronger thermocline strength corresponds to a colder INCWM. To be clear, we changed “a stronger INCWM” to “a colder INCWM”.

Li263: not all of these are “heat transfer” processes. Without loss of information, you can delete and use “by three processes”...

Thanks and we have deleted “heat transfer” in the sentence.

Li 272: However, the local vertical heat... [delete “it is noted to say that”]

Thanks and changed as your suggestion.

Fig 6. What is “gravitational circulation”? Describe or simply call it mean circulation or similar. In summer, the increase of river discharge into the Seto Inland Sea induces a density circulation which occurs as the bottom water flows from the Hayasui Strait to Iyo-Nada while the surface water flows in the opposite direction. The circulation is similar with estuarine gravitational circulation and we draw this circulation in Fig. 6. To be more accurate, we changed “gravitational circulation” to “density-driven circulation” in Fig. 6b.

Li295: consider: “q, defined as the relativeis used to quantify the response”

Thanks and changed as your suggestion.

Li305: surround[ed] by [the] 18oC isotherm

Thanks and changed as your suggestion.

Li310: delete “obviously”

Thanks and we have deleted “obviously”.

Li368: response to climate change is not studied.

We have changed “climate change” to “sea surface forcing change”.

Fig 9b: the gray arrows. I do not understand how you can link different ocean regions like this (and bypass the Irish Sea). It is confusing and must be removed.

Thanks and we have removed the gray arrows in Fig. 9(b).

Li449.451: this summary of mean temperatures etc. is not a conclusion

Thanks for your comment. We have deleted the summary of mean temperature and added the content about the intensity of INCWM as a part of conclusion.

“The INCWM was strong in the years of 1994, 1996, 2006, 2010, 2012, 2013, and 2015, while weak in the years of 1997, 2003, 2004, 2007, 2009, 2011, and 2014.”

Li466: I disagree that the used a “climatological model”

Thanks and we have changed to “a hydrodynamic model”.