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Interactive comment on "Influence of hydrodynamic mixing on the distribution of dissolved organic carbon in the East China Sea and the northwest Pacific" *by* Ling Ding et al.

Anonymous Referee #2

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This manuscript provided the DOC concentrations and distribution in the East China Sea (ECS) and Kuroshio Extension (KE) region in the northwestern North Pacific. Through the comparison of DOC concentrations among different stations that located under the influence of Kuroshio current and Oyashio current and the DOC distribution superimposed on top of the other parameters such as temperature, salinity, DIC, △14C-DIC, and AOU, it was concluded that the observed DOC patterns were most likely attributed to the hydrodynamic mixing by Kuroshio current and/or Oyashio current water. Since there is scarce data on the DOC distribution in the ECS and KE regions, this study can help to establish a valuable database on the DOC values in those areas. However, the discussion of linking DOC distribution to physical mixing is

not thoroughly developed in the manuscript. For example, (1) the authors discussed the linear regression between DOC value and temperature or DIC (Fig. 4) and used this as an evidence to support the important role of physical mixing in shaping DOC distribution, this data and discussion should be reprocessed and readdressed as this correlation is mainly due to the co-variation of those DOC, DIC values with depth. And DOC decrease with depth is more likely to be controlled by biological processes. The authors need to tease out the effects of physical mixing after filtering out the depth effects first in those discussion. The salinity depth profile patterns could be potential evidence to support physical mixing and intrusion of currents to certain depths in ECS and KE (for instance, the high salinity around 200m in ECS may from intrusion of saline Kuroshio current, and the low salinity around 300-700m in KE may result from intrusion of fresh Oyashio current), but this is not fully discussed in the discussion or result section. Discussion around the Fig.5 and Fig.8 is more convincing to show the physical mixing, which should be emphasized. (2) While the authors mentioned the mixing of Kuroshio and Oyashio water in the KE, they touched a little on the mixing model but did not provide well-developed discussion on the relative contribution of these two currents in terms of DOC on the surveyed stations. Also there is not enough comparison of the role of biological processes vs. physical mixing in shaping DOC distribution. Since one main conclusion from this study is to show the important role of physical mixing, some direct comparison or estimated percentage of each process that contributed to DOC would be helpful to support the conclusion. (3) In addition, the discussion of DOC and AOU seems to be kind of random. The authors should lay out better what is the purpose of introducing the AOU in the manuscript here, is it to state the refractory quality of DOC or to show that dissolved oxygen is also more affected by mixing rather than biological process? If the authors want to include AOU to evaluate the DOC oxidization, then more discussion is needed regarding what it really means and relating that to the DOC quality. Also the DOC vs AOU relationship should be evaluated on specific isopycnal layers to filter out the depth effects, rather than on pooled DOC data over different depth. Overall, major revision is needed for this manuscript especially in its results and discussion sections.

Specific comments:

Abstract: The abstract should include some information of the DIC and Δ14C-DIC information, as those are important pieces of evidence in this manuscript to derive the role of hydrodynamic mixing.

Line 24: Any more details on what relative percentage of biological process vs. hydrodynamic mixing each contributes to the distribution of DOC?

Line 28: the sentence is not finished yet, so what doe the 18% means, this suggesting of other processes (e.g. mixing) controlling AOU?

Line 30: add below how much meters is defined as deep waters, “deep waters (below xxx m)”

Line 34: The manuscript doesn’t talk about any nutrient, it is a little bit stretching here to say it is the important role of nutrient.

Line 38: Ocean is not the largest carbon reservoir on earth, crust is the biggest, and ocean is the second largest.

Line 39: not all DOC are active, delete “active”

Line 41: The FTICR analysis only capture the Solid phase extracted proportion of DOM and doesn’t include isomers as well, so the actual individual compounds should be more than 20,000. To be safe, just say “over 20,000 individual compounds”.

Line 46: Talk more specifically on the biological processes, such as microbial respiration.

Line 53-72: Here it talks about different processes (biological and physical) in shaping DOC distribution. Since this study will show physical mixing, rather than biological processes, dominated the role in shaping DOC distribution in the ECS and KE region.

Would be helpful to provide some background on the relative role between biological processes vs. physical mixing in other different ocean regions. Any literature on this comparison before?

Line 89: What does “reduce the very old DOC 14C-age” mean? The export of DOC makes it younger or older?

Line 156: Samples were analyzed in duplicate sample from different vial or duplicate draws from same vial? Clarify.

Section 3.1: Should provide some information of the temperature and salinity on the end members of Kuroshio current and Oyashio current. It would help readers to compare these end member values with observed values in the studied stations.

Line 202-206: Interesting “S” shape, can develop some discussion on why salinity profile is in “S” shape. As mentioned above, it seems to me that the high salinity around 200m in ECS may come from intrusion of saline Kuroshio current, and the low salinity around 300-700m in KE may result from intrusion of fresh Oyashio current. This could be another evidence to show the important role of physical mixing in the studied regions.

Line 209: somewhere in this section, the authors should introduce the temperature and salinity of the end members from Kuroshio and Oyashio currents.

Line 215: Define your surface water? Top how much meters?

Line 217: Why sub-maximum? Related to subsurface chlorophyll max?

Line 226: Where is your DIC, 14C-DIC, AOU data? They are important component to support your physical mixing conclusion, should be included in the main text rather than the supplemental table. If this data have already been published in previous papers, just redraw the figures or tables to fit into this manuscript and state that it is adapted from previous papers.

Line 234: Again, the correlation between DOC and temperature is mainly just due to covariation with depth. Should filter out the depth effect first, for example, compare DOC vs temperature at the same depth across stations.

Line 241-243: Why this correlation indicates physical mixing? Not convincing.

Line 263: In line 261, it just said there are little effects of upwelling intrusion to <100m in the shelf stations. Z4 not included as a shelf station? But Line 213 said Z4 is defined as shelf-edge station. Need clarification here.

Line 275-277: As mentioned above, provide some quantitative percentage to compare the relative role of biological processes vs. physical mixing in shaping DOC distribution. More well-developed discussion related to the dominant role of physical mixing and its comparison with biological processes are needed overall. Also should include some literature comparisons here.

Line 281: DOC vs. AOU regression should filter out the depth effects as well. For example, should be reprocessed on specific isopycnal layers.

Line 292: What is the dissolved oxygen value of the end member from the Kuroshio current? Any way to build a conservative mixing model to estimate what percentage of AOU pattern is attributed to the physical mixing? Is it just the rest of 18% (i.e., 82%)?

Line 310: Any chlorophyll data from CTD to get some idea on primary production in the region?

Line 312: "around the axis", what axis?

Line 315: Modify this part to say more clearly. You mean primary productivity should be high in the north stations like Sta B2 And A4 and result in higher DOC concentration there, but in reality, DOC is low at Sta B2 and A4, indicating it is due to physical mixing, right?

Line 320-325: Again, need to filter out the co-variation (with depth) factor, reprocess

the correlation data here.

Line 329-335 and Fig.7: Need to related back those water masses to your studied stations, thus can further evaluate the effects of physical mixing. For example, are the dots of water mass C with higher densities in Fig.7 the stations in the north that is more affected by Oyashio current? Otherwise it would still be the effects of water masses from different depths.

Line 370: Where is the ratio data? I cannot tell which dot is which station on Fig. 9. Need better way to show the exact ratio data for each station. The mixing of two currents is touched upon a little here, but not well developed. This should be discussed more thoroughly.

Line 376: Can you use this to derive the percentage of biological process vs. physical mixing?

Line 394: After the separate discussion for ECS and KE, somehow the authors should connect the ECS and KE data together to derive some general pattern or their contribution to form the overall current that enters into North Pacific. Otherwise it is just like put two separate survey studies together side by side without any connection.

Fig.3: Hard to look at the data since all lines are pretty close to each other. Need a better way to present this data. Maybe using color in ODV plots? Can leave this figure as a supplemental figure if needed.

Fig.7: What about the leftover dots not in water mass A, B,C? How did you decide the grouping of those different water mass? Is it statistically different?

Technical comments:

Line 21: Add "the" before ECS

Line 29: should be "lower in surface waters than that in the ECS"

Line 40: Clarify as "DOC in the ocean is. . ."

Line 42: Delete “therefore”, not a result caused by previous sentence.

Line 80: “exiting”, not “existing”

Line 85: restructure this sentence

Line 92: change to “have been collected. . .”

Line 97: delete “a”

Line 112: add “that” after “branch”

Line 113: “higher primary productivity” higher compared to where?

Table 1: Sampling data for ECS not clear, Stn.1,7 both on 12 July? Z1,Z2,Z4 all on 14 July?

Line 143: change to “rinsed with seawater three times”

Line 151: change to “standards”

Line 154: delete “before”, just “every five samples”. What does the content in parenthesis mean? The blank is also run before each deep station sample?

Line 164: Change “was” to “were”.

Line 173: Add “the” before “DOC and DIC analyses”.

Line 210: Change to “Concentrations”

Line 214: “fewer variation” than what? Compared to KE?

Line 222: Is 36-53uM the DOC value for Sta A4 and B2?

Line 228: Change to “Processes controlling the DOC distribution. . .”

Line 237: delete “depth”

Line 258: Change to “high concentrations of DIC and. . .”

Line 259: restructure this sentence

Line 262: Change to “the well mixed shelf water not only contributed to . . ..”

Line 292: Change to “statistically significant”

Line 295: Change to “Processes”

Line 205: “among these stations” means “spatially”, right?

Line 307: ‘significantly lower than other stations”

Line 310: “with values that are 28% higher”

Line 318: delete “most”

Line 375: change “modulated” to “modulating”

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