Title: Flow Structure and Mixing Near a Small River Plume Front: Winyah Bay, SC, USA
Author(s): Christopher Papageorgiou et al.
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Authors Response to Reviewer Comments

My co-authors and I would like to express our sincere gratitude to Dr Spicer (Reviewer 1) and the anonymous Reviewer 2 for their thoughtful and constructive review. We revised the manuscript following their recommendations. We believe we have responded adequately to all suggestions / requests. Although a thorough re-reading of the revised manuscript would be required, we also provide a summary of the changes we made in this document. by first listing each reviewer's comment and then our response using blue fonts.

A general suggestion by both reviewers was to focus more on what is new and highlight the new science / ideas that the manuscript has to offer. As both reviewers acknowledge the data set collected is of high quality. Our primary objective in the original submission was to present the data to the community without "biases" from our own interpretation. In retrospect this might have been a naïve approach, and we thank the reviewers for pointing this out and providing us with an opportunity to rectify. Major new topics we expand on the revised manuscript are: return flow under the plume, divergence of vertical flow at the interface of the counteracting flows, limited if any mixing behind the plume, potentially due to straining etc. We hope that this manuscript inspires our modeler colleagues to look at these processes in more detail.

We hope that this revised version is acceptable for publication in EGU Oceans.

Sincerely

George Voulgaris

Specific Responses to Reviewer 2

Reviewer 2 Comments

The manuscript presents field measurements of water-column mean and turbulent statistics during a passing river plume. The topic falls in the scope of the journal Ocean Science. The presentation could be improved to more effectively emphasize the novelty of the study and the

science behind these unique measurements. I would recommend publication provided that my suggestions are considered.

Major suggestions:

Introduction: Suggest more explicitly highlighting the novelty of this study. Currently, the authors provided a review of relevant existing studies. Still, it is vague what the knowledge gaps are left in those studies and how this new set of measurements will address any unresolved questions.

Section 4.4: While the Figs. 12 to 16 are adequately described, how each variable is calculated, how its value changes, etc., the implied dynamics and physics are not discussed in detail. Suggest strengthening the discussion. Also, Figures 14 and 15 seem very noisy, and the scattering of the data is not addressed. I suggest the authors improve the clarity of the figures.

Conclusion: Suggest better highlighting the most important findings of the paper. Please also consider discussing possible future work.

As we indicated in response to Reviewer 1, the manuscript has undergone major revision and we have attempted to better highlight the most important findings as suggested. With regards to the figures, we have referenced Smith (2020) for the calculations (we actually used the code supplied by the author as supplementary documents) we provided only a brief description of the principle behind the calculations. The noise in the data is real and as we mentioned in our response to Reviewer 1 the objective in here is to look at the grouping and emerging patterns and not on individual points..

Minor suggestions:

Fig. 1(b): what is the variable shown in the image?

Not clear what "variable" the reviewer refers to as this is a satellite image of the study site showing the plume. We speculate the reviewer might be referring to TS2, which is the station location.

Fig. 3(c): The unit of dT/dz is missing.

This has been corrected now.

Fig. 6(c) and Line 220: the vertical current ~ cm/s is quite strong. It also indicates horizontal divergence above the depth of maximum w and convergence below. I would suggest the authors more clearly explain the circulation.

We have updated the figure to now show both the vertical velocity from the 4 beams (broad band) and the more accurate vertical velocity from the 5th beam of the ADCP. The 5th beam velocity is less sensitive to conversions of the radial, along-beam velocity to ENU coordinates. The signs remain the same although the magnitude is slightly reduced. Also the circulation is better explained in this version, after we elected to present the currents in a coordinate system aligned with the direction of front propagation. See updated figure and text for details.

Fig. 8(c): suggest using a different colormap to better highlight positive and negative, for example, lowbluehighred.

Done as suggested.

Line 262: the sentence is not clear to me. Suggest clarifying.

In the revised manuscript this sentence has been removed.

Line 273: suggest deleting “As presented earlier,”

Done

Fig. 9: what does the purple arrow in Layer 2 mean?

Indicates propagation direction of the front / new plume, it has been removed in the revised manuscript to avoid confusion.

Fig. 10: suggest changing the order of the panels so that panel a is at the top and panel d is at the bottom.

Done as suggested.

Table 3: in the caption, please define \epsilon_k.

Corrected

Fig. 14: the unit for K_\{rho} is wrong.

Corrected.