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Interactive comment on "Effect of winds and waves on salt intrusion in the Pearl River Estuary" *by* Wenping Gong et al.

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Comment (1) from referee #1 This study investigated effects of winds and waves on salt intrusion in the Pearl River Estuary by conducting a series of numerical experiments. The topic is of interest and the results are reliable. Therefore, I recommend publication this manuscript in Marine Science after moderate revision.

Response:

We are grateful for the reviewer's encouragement and providing us constructive comments.

Comment (2) from referee #1

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Discussion paper

The numerical model was validated using two observation data sets. Generally the model skills are low, particularly for the data set from Dec. 9 to 26, 2009. I understand that the bathymetry of Pearl River Estuary is rather complicated and to obtain a good performance of model simulation is not easy. However, the conclusion of "well performance" (see page 6, line 12 and line 29) is beyond the truth.

Response:

We totally agree with the reviewer's comment. The dataset from Dec. 9 to 26, 2009 were obtained in the Modaomen Estuary, another estuary in the Pearl River Delta, which has very complex geometry and bathymetry, and a much small size. The model's spatial resolution is not fine enough to resolve the small scale variations of geometry and bathymetry, thus the model performance is not good enough. We revise this statement to be "performs satisfactorily" and "agree reasonably", respectively.

Comment (3) from referee #1

In the experiment without winds, the higher surface salinity during the spring was attributed to "lower freshwater inflow during the spring tide than during the neap tide (page 7, line 27-28). However, the fact is that the river discharge of the Pearl River was higher during the spring than neap tides (see Fig. 3b).

Response:

This is a confusion caused by our insufficient explanation. The river discharge data shown in Fig. 3b are those from the upstream of the West, North and East Rivers. These freshwater takes approximately 3-5 days to reach the head of the PRE. Thus the river inflow into the PRE lags the variations of upstream river discharge. Therefore, the neap tide coincides to a higher inflow, while the spring tide to a lower inflow. Another fact is that under the similar river discharge, more freshwater is detained in the Pearl River Network during the spring tide by strengthened bottom friction, thereby smaller amount of river inflow into the estuary is expected, and vice versa. Above explanation are added into the revised manuscript in the end of the third paragraph of section 5.1. To further confirm our statement, we select the cross-section at the HumenOutlet, and calculate the freshwater flux during our study period. More information can be seen in the supplement pdf file.

Comment (4) from referee #1

Page 8, line 27 states “Generally, the local wind causes the landward salt flux to decrease”, while line 29 states “overall, the total salt transport flux is seaward and decreased considerably under the local wind”. Did local winds cause decrease in both landward and seaward salt flux? The two conclusions look contradictory.

Response:

This is a misunderstanding. In the manuscript, we state that "Generally, the local wind causes the landward tidal flux to decrease", not the "salt flux to decrease". The tidal flux is "the tidal oscillatory flux", one component of "the salt flux". Our statement is to say that the tidal oscillatory flux is decreased while the total salt flux is increased by the local wind. We correct this by replacing “the tidal flux” with “the tidal oscillatory flux” in the revised manuscript.

Comment (5) from referee #1

In the experiment with remote wind, the subtidal water level increased across the entire domain (page 9 line 15). Does this mean the model failed to keep mass balance?

Response:

This does not mean the model failed to keep mass balance. As we impose a water level setup at the open boundary, more saline water is pumped into the estuary. In the meantime, freshwater is discharged into the estuary. These water inflows elevate the water level in the estuary, and keep the mass in balance. The water level setup occurs in our study period. However, when the water level at the open boundary recedes, the accumulated water in the estuary will flow out.

Comment (6) from referee #1

Sea level rise fills saltwater into the estuary and enhances salt intrusion. Does this filling effect affect the conclusion drawn from the wind experiment?

Response:

Sea level rise fills saltwater into the estuary and enhances salt intrusion. It definitely sets a different background for the wind effects. However, the conclusions drawn from the wind experiments still hold true. The local NE wind drives more landward salt transport flux and pushes the river plume against the western shore, the remote wind mixes the river plume water near the estuary mouth and pump saltier water into the estuary by Ekman transport. These conclusions will not change under sea level rise, though the magnitudes may change more or less. As seen in our simulation scenarios, Case 4 is a combination of cases 2 and 3, and the salt intrusion in case 4 is simply a summation of those in case 2 and 3. Note that in case 3, we include a water level setup, similar to sea level rise. We can postulate that the integrated results of winds and sea level rise can be a summation of their effects.

Comment (7) from referee #1

The study found that the wind-induced water flux is larger during the spring (Day 46-48) than neap (Day 41-43) tides (page 9 line 25-26), and attributed this to tidal argument. I noticed that the winds were much stronger during the spring than neap tides (see Fig.3a). That accurately explains the change in wind-induced water flux from the spring to neap tides.

Response: Of course, the wind is stronger during the spring tide than during the neap tide, and drives more saltier water into the estuary in the spring tide. In the meantime, the spring tide induces more Stokes inflow flux, and thus augment the wind-induced flux. So the tidal effect is an extra, but may not dominate. We did not distinguish these two effects.

Comment (8) from referee #1

Figure 10, “T4” should be “T3”.

Response:

We correct the error by replacing “T4” with “T3” in the caption of Fig. 10.

Comment (9) from referee #1

Figure 15, Adding the contour of “0” might help identify landward and seaward flows.

Response: We redraw this Fig. 15 with the contour of "0" and revised the caption accordingly.

Please also note the supplement to this comment:
https://www.ocean-sci-discuss.net/os-2017-73/os-2017-73-AC1-supplement.pdf

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