Overview:

This paper describes the evolution process of the river bulge through satellite remote sensing images and model simulation results. Two numerical sensitivity tests were also carried out to study the wind-driven and density-driven current in the evolution of the river bulge. Term balance is utilized to understand the mid-field dynamics of the bulge, which shows different results with previous work.

The research topic of this manuscript is interesting to readers of the Ocean Science, however, a significant revision is required to address the following issues before this manuscript could be accepted for publication.

Comments:

1. *The paper describes many details of the observation and simulation that without enough explanation of why these features occur. It should be more concise and deliver a more focused "story" the readers.*

2. *It is mentioned in the paper that the tidal oscillation is small in the study region, thus tide forcing is not considered, however an additional case with tide forcing should be considered to approve that the tidal influence on the river bulge is negligible, as many studies show that tide-induced mixing have significant effect on the structure of the river plume (Chao, 1990; MacCready et al., 2009; Zu et al., 2014)*

3. *By using the term balance on a certain time, the paper concludes that geostrophic balance is valid for the entire mid-field of the bulge, which is different with previous results. However, time series of the term balance should be presented to approve that the conclusion is universal here, and is not an occasional event.*

4. *As many results are based on the model simulation, more detailed description of the model set up is needed, (i.e. numerical scheme, physical forcing, open boundary conditions ...)*

5. *On page 4, at line 20-28, the author should add some short statement about the circulation in the Baltic Sea. The observed representative T/S profile should be plotted in Figure 1.*

6. *On page 6, at line 20-21, the Baltic Sea has two large straits(Irbe Strait and Virtsu Strait) and these strait has important effects on the circulation in the Baltic Sea, why the model use the closed boundaries?*

7. *On page 7, at line 5-6, the spin-up time of the model only 3 days. It seems too short?*

8. *On page 12, at line 5, 'the pulsation of the actual bulge' should be 'the pulsation of the real bulge'*

9. *On page 12, at line 5-10(shown in Figure 5). For ideal bulge, when bulge diameter increased, bulge mean depth increased. The statement "when bulge diameter increased, bulge mean depth decreased and vice versa." why?*

10. *On page 14, at line 5-15, The real simulation gave* $r_b \sim t^{0.50\pm0.04}$ *while the ideal simulation gave* $r_b \sim t^{0.28\pm0.01}$*. And the satellite remote sensing gave* $r_b \sim t^{0.31\pm0.23}$*. Why is the evolution of the bulge in the ideal simulation more similar to that in the satellite remote sensing?*

11. *On page 15, at line 24, " one km" should be "1km"*

12. *On page 16, at line 24, the bulge centre should be defined using geometric mean position of the distribution of the tracer concentration .The reason is that when ambient current overrode bulge circulation, the bulge centre was not defined using with closed streamlines, although the bulge still existed if we look at the distribution of the tracer concentration.*

13. *On page 18, at line 20-22, why the bulge centre was closer to the coast in the case of the ideal bulge than in the case of the real bulge?*

14. *On page 30,what is the meaning of whine blank area in the bulge in Figure 6((left column)?*

Reference

Chao, S.-Y., 1990. Tidal modulation of estuarine plumes. J. Phys. Oceanogr. 20, 1115 –1123.

MacCready, P., Banas, N.S., Hickey, B.M., Dever, E.P., Liu, Y., 2009.Amodel study of tide- and wind-induced mixing in the Columbia River estuary and plume. Cont. Shelf Res. 29,278 –291.

Zu, T., D. Wang, J. Gan, W. Guan, 2014. On the role of wind and tide in generating variability of Pearl River plume during summer in a coupled wide estuary and shelf system, Journal of Marine System, 136: 65-79.