In this study, the authors implement a diagnostic model for surface flows in the Yellow Sea, using a time-dependent model that includes both low-frequency geostrophic and Ekman velocities, and high frequency flows such as tides and inertial oscillations. The model in this setting, appears to substantially improve on earlier work using a steady Ekman model.

The authors do a good job demonstrating the advantage of incorporating the inertial terms in the diagnostic velocity field and comparing it to the steady Ekman theory model.

We appreciate the reviewer’s insightful comments and are grateful for the positive assessment. We address each point below and explain the revisions made to improve the manuscript.

I would recommend accepting the manuscript with minor revisions:

My main reservation is about the geostrophic component obtained from altimetry, and I believe the authors would improve the manuscript by attempting to address some of these concerns:

(1) What kind of geostrophic circulation features are recurring in the Yellow Sea? It may be mentioned in past studies, but it would help to add a figure or two in the introduction or in section 3.2.1, documenting mesoscale motions and their variability.

We thank the reviewer for this helpful suggestion. Following the reviewer’s comment, we added statements reviewing the current pattern of the Yellow Sea discussed in Choi et al. (2018). In addition, temporal-mean geostrophic current fields are added in Figure 1. Because Choi et al. (2018) already showed and discussed the low-frequency velocity component fields of the Yellow Sea, including the geostrophic circulation features and its dominance relative to the Ekman current (e.g., Fig. 4 in Choi et al., 2018), we would like to avoid profound discussions about the low-frequency components to focus on the high-frequency signals, such as tides and near-inertial oscillations, that are main modeling subject of this study.

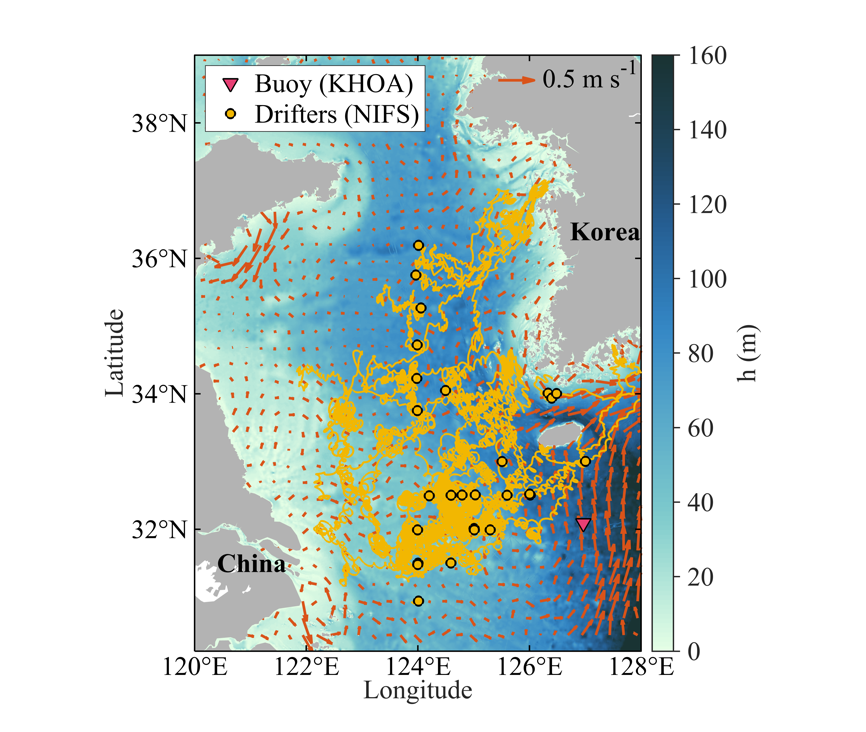


Figure 1 (revised). Climatological mean geostrophic velocity fields are added.

(2) What is the contribution of the geostrophic component for the surface velocities in the Yellow Sea, with respect to the tidal and Ekman velocities?

We strongly agree with the importance of the contribution of each velocity component. This is one of the reasons we provided the correlation (Fig. 6), whose squared value represents the variance of the observation explained by the component. We revised the manuscript (L313-327 in revised manuscript) to clarify relative contribution of each velocity components with additional discussion below.

In terms of the squared correlation () based on the hourly velocity fields, the variance explained by the tidal component () is predominant () relative to that explained by geostrophic () and Ekman () current components ( and , respectively). However, when the velocity fields are daily averaged (Fig. 7 in revised manuscript; also shown below), this pattern reverses: the tidal current contribution (red downward-pointing triangles) becomes negligible (in Fig. 7), whereas the geostrophic (yellow upward-pointing triangles) and Ekman components (red squares) becomes considerable ( and , respectively; Fig. 7). This attenuation of the tidal signal is not surprising, since the tidal currents are purely periodic (sinusoidal functions) and their temporal means over the tidal periods are intrinsically zero.

Consequently, if research interests are the floating materials crossing the Yellow Sea (Choi et al., 2018 and 2023), their time scales are order of a month, much longer than periods of tides, so geostrophic and Ekman currents become more dominant than tides (mentioned in L250-254). On the other hand, if we need to forecast positions of subjects as quickly as possible on short time scales (e.g., search and rescue; SAR), tides become considerably important. Those contents are added in discussions (L313-327) and conclusion (L434-441) sections.

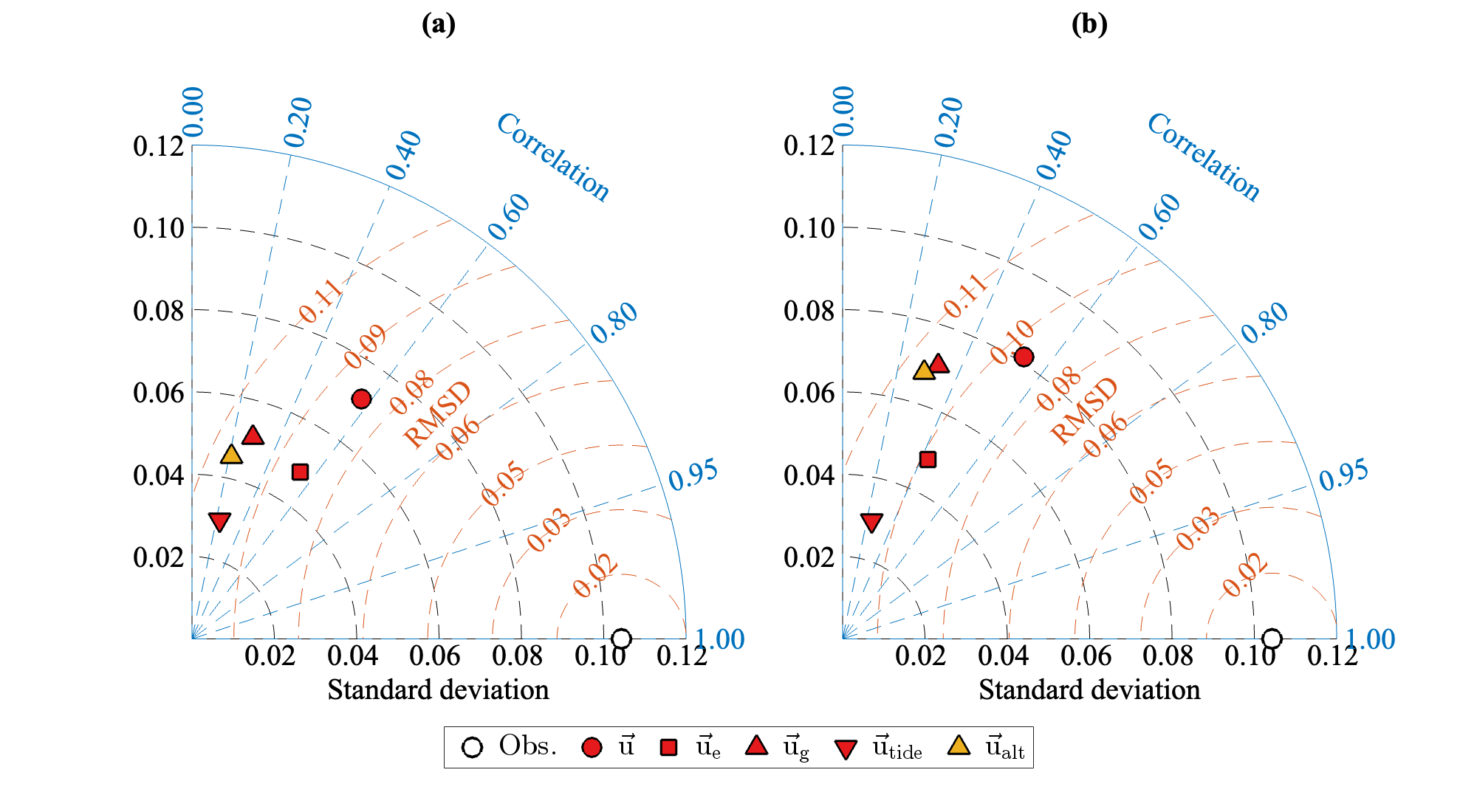


Figure 7. Taylor diagram comparing observed daily-averaged surface velocities (drifters and buoy, black-lined circles) with time-dependent Ekman model components (red markers) for (a) zonal and (b) meridional. (red circles) represent the time-dependent Ekman total velocity. (red squares) indicates wind-driven component, (red upward-pointing triangles) indicates the pressure-gradient component, (red downward-pointing triangles) indicates tidal component. (yellow upward-pointing triangles) indicates the geostrophic current component derived from altimetry ().

(3) More specifically regarding the altimetry product: how close is the altimetry-derived geostrophic component to the in-situ velocities? Are the (CMEMS) velocity field errors (due to spatiotemporal interpolations, and quite shallow depth of the Yellow Sea) distinct from the high frequency motion errors, which are the main focus of this study? For instance, if you were to remove the geostrophic component in the diagnostic model, how much would it affect the correlations and RMS errors?

We agree with the reviewer’s comment and expect that it is one of the significant factors influencing performance of the diagnostic velocity fields in the Yellow Sea. However, our previous studies (Choi et al., 2018 and 2023) showed that the geostrophic velocity fields work reasonably. Furthermore, this study also showed that the diagnostic velocity fields using altimetry-based geostrophic currents successfully resolve low frequency variations of the observations (Fig. 4c and d). This implies that the altimetry-based geostrophic velocity fields are good enough to resolve the true geostrophic velocity fields.

We have checked the standard error provided by CMEMS geostrophic current product. The error reported in the Yellow Sea is less than 0.05 m s⁻¹, which is much smaller than the errors we estimated (~0.2 m s⁻¹; Figs. 3 and 4). Removing the geostrophic component has little effect at the hourly scale (R slightly decrease from 0.76 to 0.74 and RMSE increase from 0.18 to 0.19). In the daily averaged velocity field, when it is removed, R decrease from 0.62 to 0.51 and RMSE increases from 0.09 to 0.10 m s⁻¹. This shows that the altimetry-based geostrophic currents are improving performance of the model.

- Typos:

We thank the reviewer for pointing out these typographical and grammatical errors. We have corrected them accordingly in the revised manuscript

line 43: "(Choi et al., 2023). Choi et al. (2023)"

The statement is modified in the revised manuscript for better readability (L43).

line 64: "trajectories of drifter"

We appreciate the reviewer’s comment. The phrase “trajectories of drifter” has been corrected to “trajectories of drifters” for grammatical accuracy (L66).

line 179:  "..which, as a result,.."?

Thank you for the suggestion. The sentence has been revised for smoother connection and improved readability (L183).

line 248-249 (rephrase?) " This explains that the reason the steady Ekman theory.." to "this explains why the steady Ekman theory.."

We agree with the reviewer’s suggestion. The phrase is revised following the reviewer’s comments (L249).

line 393: "not sufficiently" -> "not sufficient"

Thank you for pointing this out. The phrase “not sufficiently” has been corrected to “not sufficient” (L412).