**Reviewer Comment #1:**

This manuscript employs a diagnostic model to derive the surface velocity fields in the Yellow Sea. It presents many comparisons between the steady state Ekman model and the time-dependent Ekman model, showing that the time-dependent Ekman model has a great improvement. This seems to be quite simple since we must use the time-dependent one when considering the velocity of higher frequencies, such as tide and inertial. And the same feeling for including the inertial term, which is absolutely important at the period of strong wind change as it generates significant near-inertial currents. And including the time-dependent and inertial parts is easy, and not new. Overall, there are little novel insight in this work, and its scientific significance is low.

**Author Response #1:**

We appreciate the reviewer’s comments and efforts for our study. As the reviewer mentioned, inertial term is essential for resolving high-frequency processes such as tides and near-inertial oscillations and previous studies have already addressed this importance of inertia term, that was acknowledged in our manuscript (Line 48 in original manuscript).

Nevertheless, it has not been considered in previous studies on diagnostic velocity fields (Bonjean and Lagerloef, 2002; Rio et al., 2014; Dohan, 2017; Choi et al., 2023; cited in the manuscript). It is worth noting that OSCAR and GlobCurrent (currently provided by the most famous agencies, NASA and CMEMS) are still based on steady-state formulations ignoring the inertial term. To the best of our knowledge, our study is the first study applying the time-dependent Ekman theory to the diagnostic surface current reconstruction, which represents the novel contribution of our work. We kindly argue that, even though the theory and dynamics are not new, the application testing its surface current reconstruction ability is new and scientifically significant.

Furthermore, we generalized the analytical solution used in the theory to account for the pressure gradient, which may be regarded as progress in theory, and it enables the diagnostic velocity field to resolve tidal component. The fact that method is easy is what we intended, so many other researchers can easily adopt the method proposed in this study for their study areas and own dataset.

**Reviewer Comment #4:**

Line 25: ‘coastal oceans’ is not propriate.

**Author Response #4:**

We have revised the wording to “marginal sea” to more accurately describe the Yellow Sea.

**Reviewer Comment #5:**

Line 155: The time range of drifter data should be noted, as the comparison probably has a seasonal difference.

**Author Response #5:**

In the revised manuscript, the explicit time range of the drifter dataset have been added in the Data section. We appreciate this valuable suggestion about the seasonal comparison. Unfortunately, as we mentioned in manuscript, drifter observations are not available in winter, so we examined buoy observation for both summer and winter (Figures. S1). There are not significant differences between summer and winter in terms of skill scores. The seasonality of the surface current system of the study area, governed by low-frequency Ekman-geostrophic balances, were well discussed by Choi et al. (2023). In this study, we would like to focus on high frequency dynamics.

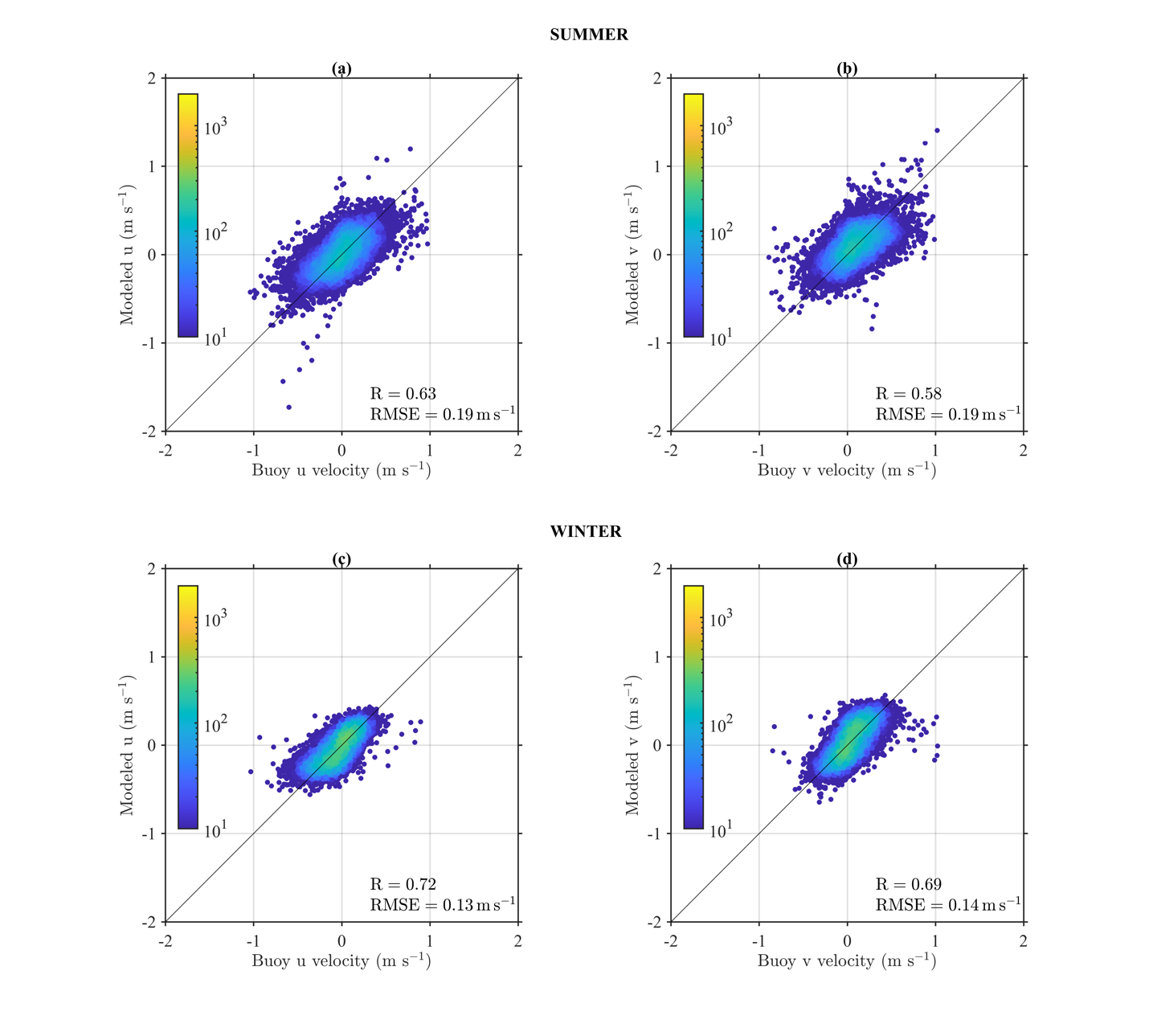


Figure S1. Comparison of buoy observations with modeled velocities for different seasons and components. (a) and (b) show summer, while (c) and (d) show winter. Zonal and meridional components are displayed in the left and right panels, respectively. The logarithmic color scale represents data density.

**Reviewer Comment #6:**

Line 216: How to obtain the velocity from drifters should have more detail. The buoy movement is affected not only by the surface current, but also by the direct wind push through a drag coefficient and the Stoke drift induced by the surface wave. Do you consider them?

**Author Response #6:**

Thank you for this helpful comment. We obtained drifter velocities from the observed positions (latitude and longitude) by calculating successive positions over next timestep, that is added in the manuscript.

The direct wind pushing (e.g., leeway drift) and Stoke drift are not considered in this study, similarly with the other diagnostic velocity field did (Bonjean and Lagerloef, 2002; Rio et al., 2014; Choi et al., 2023; cited in the manuscript). In this study, we focus on the merit of the diagnostic velocity field in considering the inertia term. We expect that the incorporating the velocity components (leeway and Stoke drifts) will enhance the diagnostic velocity field, but the results in this study (e.g., Fig. 3) elucidate that most variations in the in-situ observation can be explained by the four terms (inertial, Coriolis, pressure gradient, and vertical eddy viscosity).

**Reviewer Comment #7:**

Line 280: It is not clear what the variance ellipse stands for

**Author Response #7:**

Following the reviewer’s comment, we have added a statement explaining the variance ellipse in the revised manuscript. The following sentences will be added in Section 5.1 of the revised manuscript:

Variance ellipse represents current variability: the orientation indicates the dominant direction of variability, the length of major and minor axis corresponds to the variances in the direction, respectively.