

First, I noticed the title might be a bit misleading. Could you please clarify where the temporal scales of NIOs are presented in the paper? It seems like only estimates of spatial scales are shown in Figure 5. Apart from the intrinsic time scales of NIOs determined by the inertial frequency, I haven't found any results about their decay temporal time scales or any other time scales. By analyzing single trajectories, this is a topic I explored in my own study from 2010 (Elipot et al. 2010 doi: 10.1029/2009JC005679). In this study, I also demonstrate the significant influence of the mesoscale on the characteristics of NIOs, which you seem to dismiss as "certainly not dominant". Could you please provide the basis for this statement?

Your right, title is misleading and has been changed to "Spatial scales of Near-Inertial Oscillations inferred from surface drifters." The comment on the relation between NIO and mesoscale has been removed.

Second, I'm curious about the method you're using to interpolate model velocities onto the position and time (of year?) of the drifters. Is this really a way to validate the model (LLC2160-C1440) for simulating NIOs? Because the displacements of the true drifters don't match the velocity field of the model, their pair separation distances don't either. In fact, you're sampling the model in a way that's pretty limited. Alternatively, you could use all the data points from the model to calculate the spatial decorrelation scale of NIOs from filtered model velocities. That way, I think the studies by Yu et al. 2019 and Arbic et al. 2022 (doi: 10.1029/2022JC018551) are a more straightforward comparison of NIOs in drifter data and in model data. Even though these studies are only concerned with the energy of NIOs, not their temporal or spatial scales, which is what you're interested in.

The idea here is not only to estimate the spatial correlation of the NIO, but also to assess the LLC. We want to estimate the correlation scales of the NIOs and show that the LLC can be used with confidence to estimate them. In this way, it will be possible to use the surface currents from the LLC as a tool to support the ODYSEA mission performance. LLC could be used to simulate data during the preparation phases of ODYSEA.

After demonstrating that the LLC accurately reproduced the statistical characteristics of NIOs, we could have repeated the study on the grided model data. This would have avoided restrictions related to the spatial and temporal sampling of drifting buoys. However, we have chosen to present the results comparing drifters and LLC.

Third, the main results in Figure 5 might be reliable, but they're not presented in a robust way. It's important to include uncertainty estimates for these results. How can we be sure that the spatial scales are different between NIO and low-frequency motions without any uncertainty estimates? Also, the paper should mention how many pairs of data are actually used in the calculations. Since the size of your boxes and the distribution of the data change depending on latitude, I think the uncertainty estimates in Figure 5b would also vary a lot. Additionally, I think some of the choices of the analyses aren't explained well. Why would a correlation threshold of 0.5 give us a meaningful decorrelation scale estimate? How dependent are the results in Figure 5b to this choice? Other metrics could be used, like the x-axis intercept of the slope at distance zero, or fitting parametric models of the decorrelation or cross-covariance function to your results.

The decorrelation length scale result is highly depends on the threshold or method used to define the decorrelation value. We have investigated different criteria. As can be seen on the figure 5 below, a threshold of 0.2 could double the value of the decorrelation scale. But based on Ballarotta and al; 2019¹ study, we choose the 0.5 treshhold which is close to a signal to noise ratio close to 1.

Indeed, an estimation of uncertainties on decorrelation scales is necessary. Therefore, we used a bootstrapping method. After convergence tests, for each distance box, 50 simulations were performed with a random selection of 70% of the selected data. Moreover, all the statistics have been made using complex velocities $U + iV$, with similar global results as previously. We ensure that in each distance box a minimum of 50 pairs are available.

Figure 5b (below) now shows the uncertainties on the decorrelation scales.

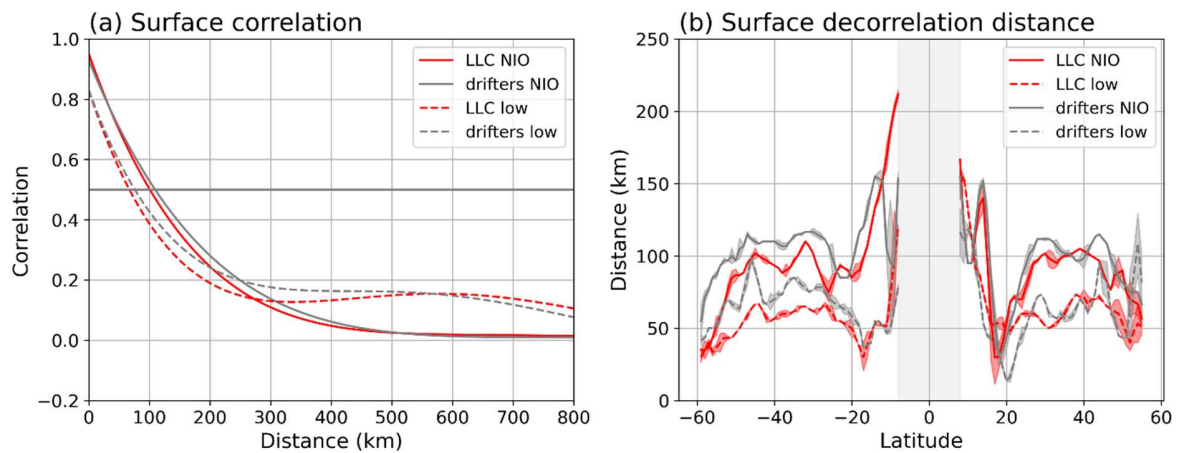


Figure 5

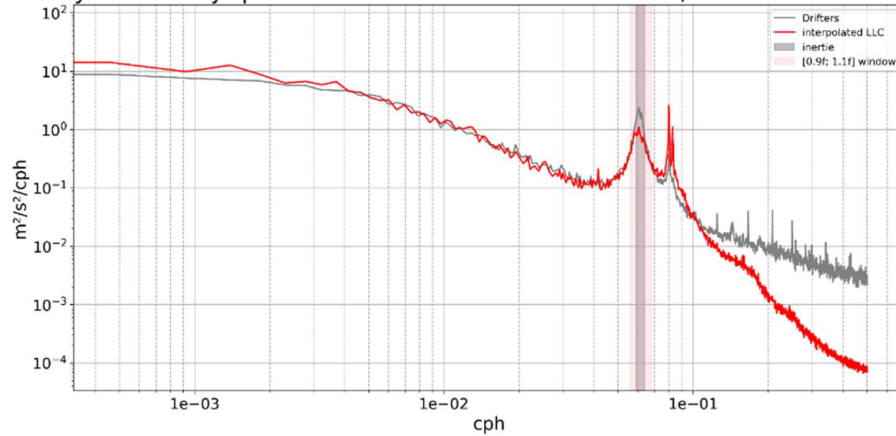
¹ Ballarotta, M., Ubelmann, C., Pujol, M.-I., Taburet, G., Fournier, F., Legeais, J.-F., Faugère, Y., Delepoulle, A., Chelton, D., Dibarboure, G., and Picot, N.: On the resolutions of ocean altimetry maps, *Ocean Sci.*, 15, 1091–1109, <https://doi.org/10.5194/os-15-1091-2019>, 2019.

Another technical comment is about the filtering method. My understanding is that you filter the velocity in the range $[0.9 f, 1.1 f]$ where f is the inertial frequency at the center latitude of each 5 degree latitudinal band. (As I understand what you mean by “ f computed for the mean latitude of the 5° bin”, or do you mean the mean value of the drifter positions in that band?). If my understanding is correct, an simple calculation shows that $[0.9 f, 1.1 f]$ covers the range of inertial frequencies in a 5 degree band only for latitudes above 22.5 degrees. Below that latitude, the range does not cover the full range of inertial frequencies and you might be underestimating the inertial velocities. Also, why presenting only the zonal velocity autocorrelation functions? If you considered the phase and amplitude of the complex-valued velocity autocovariance function you would disentangle the decay of the covariance due to phase on one hand, and due to amplitude on the other hand.

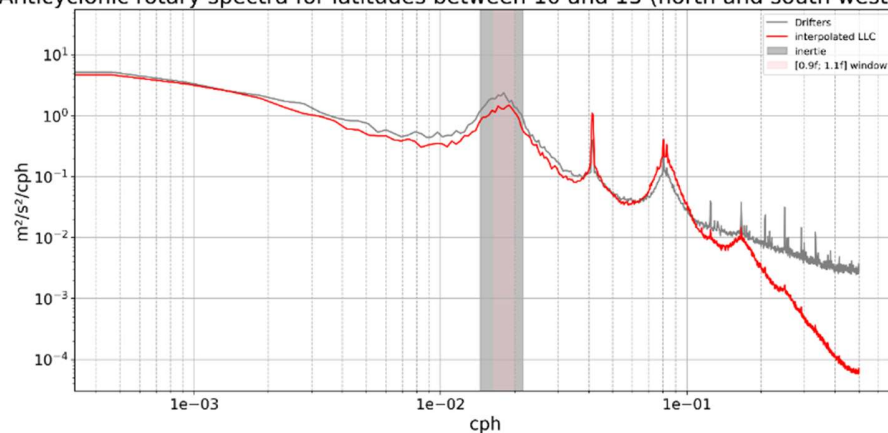
In our filtering method, In each box of 5° latitude, the mid-latitude of the box is used to calculate f . This will be better explained in the text. You are right, this filtering method does not cover the full range of inertia frequencies in the tropical area and slightly overestimate the inertia at high latitudes. Two examples of anticyclonic rotary spectrum are provided below. We probably should have varied the size of the boxes in latitude according to latitude, but in the case of the equatorial region, the small

number of pairs available (see Figure 1) is a significant constraint. As said in answer of the previous comment, statistics have been reprocessed using complex velocities.

Anticyclonic rotary spectra for latitudes between 45 and 50 (north and south Atlantic)



Anticyclonic rotary spectra for latitudes between 10 and 15 (north and south west Pacific)



Finally, I noticed that there hasn't been much discussion about the meaning and importance of your results. I'm curious to know how these results can be explicitly applied to the potential data from the upcoming ODYSEA satellite mission.

Conclusion has been changed and completed to highlight the application of these results in the ODYSEA mission:

The spatial scales of Near Inertial surface current have been analyzed in this study and compared to the spatial scales of the low-frequency surface current. The methodology was based on drifter pair analysis, allowing us to compare the Near Inertial Oscillation amplitudes and phases at different distances, through spectral analysis. The diagnostics have also been applied on the surface current from a

coupled Ocean/Atmosphere numerical model for comparison. The main result regarding the spatial scales is the relatively large decorrelation scales of the near-inertial surface current at all latitudes, ranging from 50km at high latitudes to more than 150km at low latitudes. Everywhere, these decorrelation scales are larger than that of the low frequency surface current (including the geostrophy in particular). This result could be explained by the large atmospheric patterns (the atmospheric Rossby radius being much larger than the Oceanic Rossby radius) that force the inertial current. Despite the expected interactions between the inertial current and the ocean mesoscales, the spatial scales of NIOs would remain larger at first order.

This result has interesting implications for the perspective of spaceborne Doppler radar to observe total surface current in the future. In particular, it suggests that large spatial averaging should be possible to capture near inertial signal, allowing to significantly reduce the impact of instrument noise. It also suggests that the temporal revisit is certainly of higher importance than the spatial resolution, at least for the inertial component. Indeed, the design of ODYSEA with a 1,500km wide swath would allow daily revisits over large patterns which seem particularly suited. The low frequency of the surface current, principally observed by altimetry, has shorter spatial correlation scales requiring higher spatial resolution, which is now well addressed by the flying SWOT mission.

The second important result is the very good statistical agreement between the drifters and the surface current from the LLC2160 numerical simulation. Although the periods of analysis were not coincident (LLC2160 one climatological year), the spectral characteristics and in particular the spatial decorrelation scales of both the near-inertial current and the low frequencies are similar at all latitudes. This suggests that such numerical simulation could be used with good confidence for simulation experiments during the design of ODYSEA. Many parameters such as the exact orbit impacting the revisit and the instrument characteristics can be tested in simulation on surface current scenes from numerical coupled Atmosphere/Ocean models with good confidence. In particular, the mapping of the total surface current will be a key challenge that requires testing and tuning the algorithms on simulated data during the preparation phases of ODYSEA (S. Jousset personal communication). The possibility of using numerical models for this exercise is extremely valuable. It also opens the door to AI-based reconstruction algorithms trained on digital models, enabling more efficient and accurate mapping of future ODYSEA data.