In this manuscript the authors present the analysis of an extensive dataset of Lagrangian trajectories simulated using modelled velocity fields across the Pacific Ocean. The authors also propose a connection between simulations and real dispersion of FADs across the basin. Overall the work is interesting but I believe that some critical points should be addressed before publication. Please find below my argumentations that hopefully will be useful for the authors:

We thank the reviewer for their careful and useful comments. Below, we detail how we address all of them.

Main points:

1) The FADs dataset is mentioned several times across the paper but it is indeed poorly described and characterized. It is not even clear if and how the authors really use FADs observed trajectories or not. How the simulations presented can be tested against real FADs pathways?

Perhaps it was unclear in the initial manuscript that our analysis is based purely on trajectories obtained from numerical simulations. We did not employ actual dFAD data, which is not openly available in the Tropical Pacific. In the introduction, we use FADs to frame our research question as a motivation to assess hydrodynamic connectivity in the Tropical Pacific. We have now clarified this by specifically referring to '*virtual dFAD particles*' throughout the manuscript. We have also clarified that dFAD trajectories, while highly informative, have a very limited availability.

2) A key point is that a FAD is a large floating object with a significant mass and complex hydrodynamical proprieties. However the authors claim that simulated numerical passive tracers (i.e. ideal point-like, massless particles) can effectively describe the dynamics of FADs. This is a very difficult to support assumption. More generally, I would say that the connection with FADs dynamics is pretty weak. Either the authors provide more elements to support the relevance of their simulation for addressing real FADs dynamics or they shift the focus on general Lagrangian dispersion patterns in the region.

The reviewer is right that dFADs are large floating objects and thus their hydrodynamic properties are different from other objects. On the scale of the global ocean, the FADs do not have their own inertia (the Stokes number is very low), see also Van Sebille et al (2020). Furthermore, it is not true that we consider the dFADs as point-particles. In our simulations, we integrate the velocity over the full depth range (50m) of a dFAD.

In lines 117-120, of the method section, we have added the following:

"This means we do not account for the mass and small-scale hydrodynamic properties of dFADs in this study. On the scale of the global ocean this assumption holds, as the dFADs have a very low Stokes number and as such do not have their own inertia (Van Sebille et al, 2020)."

A section has also been added in the introduction, to lines 78-81 of the revised manuscript, to highlight the relevance of the Lagrangian simulations used in this study to address real FADs dynamics:

"However the access to such real trajectories remains limited in the Pacific Ocean (Lopez et al., 2020; Escalle et al., 2021b). In this context, Lagrangian simulations, can be a useful tool to explore drift of virtual particles with characteristics similar to dFADs (Escalle et al., 2019; Scutt Phillips et al., 2019; Imzilen et al., 2019; Amenou et al., 2020; Curnick et al., 2021)."

[1]Amenou, H., Koné, V., Aman, A., & Lett, C. (2020). Assessment of a Lagrangian model using trajectories of oceanographic drifters and fishing devices in the Tropical Atlantic Ocean. *Progress in Oceanography*, *188*, 102426.

[2]Curnick, D. J., Feary, D. A., & Cavalcante, G. H. (2021). Risks to large marine protected areas posed by drifting fish aggregation devices. *Conservation Biology*, *35*(4), 1222-1232.

3) The authors present some interesting statistical patterns of the loopiness metric across space and time. However they do not discuss in depth how such patterns could be related to studies of eddies polarity statistics in the same basin present in the literature (e.g. Abernathey, R., & Haller, G. (2018). Transport by lagrangian vortices in the eastern pacific. J. Physical Oceanography, 48, 667–685).

Literature indicates that Tropical Instability Waves (TIW) are a cause of eddies in the South Equatorial Current (SEC), because TIWs are characterized by large scale meandering of the SEC (as observed originally by Düing et al.: 1975). TIWs are stronger during a la Niña event (Imada and Kimoto 2012; Yu et al 2003), and are not as pronounced south of the equator (Xue et al., 2020).

Indeed, the negative correlation between ENSO and loopiness in the EPO indicates increased eddy-like behaviour during la Niña. To clarify this, we now added lines 205-208 (results):

"These observations are in agreement with the theories that tropical instability waves are stronger in this region during a la Niña event (Yu et al., 2003; Imada and Kimoto, 2012) and that the associated tropical instability vortices (which grow between 3ºN and 8ºN in the East Pacific Ocean) are less active during el Niño years (Yu et al., 2003)."

In the Western and Central Pacific SEC region, however, we observe increased loopiness and decreased distance ratios in the negatively correlated loopiness area. We could not find literature which links ENSO and eddy dynamics in this region. For example, the research of Abernathey et al. (2018) shows that in the tropics of the eastern Pacific few eddies appear per square degree of latitude/longitude per year, but do not offer much insight with respect to the spatial and temporal distribution of eddies in the tropics; the paper focusses more on the subtropics, which is the case for most studies related to eddy polarity statistics in this region. As such, we changed the following to the discussion in lines 266-273:

"In the EPO, stronger loopiness and lower distance ratios between the NECC and SEC (north of the equator) were observed during colder conditions. This coincides with the region where during la Niña, stronger generation of tropical instability vortices takes place, due to higher velocity shear between the eastward and westward currents (Yu et al., 2003; Imada and Kimoto, 2012). In the WCPO, a region of stronger eddy-like behaviour was found in the SEC, that became stronger during warm conditions, with decreased distance ratios and increased loopiness. South of the equator, weak TIW patterns exist (Xue et al., 2020) but they should have an opposite effect on our eddy statistics, compared to our observations, which suggests TIWs are not the driving mechanism behind these patterns in the WCPO SEC. The mechanisms behind this behaviour require further research, as most research on eddy polarity statistics in this region do not focus on the tropics."

Zhao et al. (2013), states that during the 2009-2010 el Niño event, the North Equatorial Counter Current (NECC) was displaced southwards during the warming stages and that its intensity (flow velocities) increased. Zhou et al. (2021) shows that the same happened during the strong 2014-2016 el Niño event, though this study focused mainly on the origin of the NECC in the far west (outside our region of interest). Both argue that the increased velocity shear somewhat leads to increased meandering and recirculation in this region. In our data, the flow of the NECC intensifies and particle trajectories follow straighter trajectories during positive ENSO events in the NECC. In our response to the specific comment on line 156 below, we discuss how we implement this in the manuscript.

[3]Düing, W., Hisard, P., Katz, E., Meincke, J., Miller, L., Moroshkin, K. V., ... & Weisberg, R. (1975). Meanders and long waves in the equatorial Atlantic. *Nature*, *257*(5524), 280-284.

[4]Zhao, J., Li, Y., & Wang, F. (2013). Dynamical responses of the west Pacific North Equatorial Countercurrent (NECC) system to El Niño events. *Journal of Geophysical Research: Oceans*, *118*(6), 2828-2844.

[5]Zhou, H., H. Liu, S. Tan, W. Yang, Y. Li, X. Liu, Q. Ren, and W. K. Dewar, 2021: The Observed North Equatorial Countercurrent in the Far Western Pacific Ocean during the 2014–16 El Niño. *J. Phys. Oceanogr.*, **51**, 2003–2020.

[6]Xue, A., Jin, F. F., Zhang, W., Boucharel, J., Zhao, S., & Yuan, X. (2020). Delineating the seasonally modulated nonlinear feedback onto ENSO from tropical instability waves. *Geophysical Research Letters*, *47*(7), e2019GL085863.

Specific comments on the manuscript:

line 80-81 : not really clear how the authors compare FADs drift and virtual particles trajectories

In this research, the FADs are virtual as well, which we have clarified now by referring to 'virtual dFAD particles' throughout the manuscript. We compared the virtual FAD drift and virtual particles advected only due to surface currents by comparing in both cases the statistics of our metrics (averages, correlations and linear regression coefficients). In lines 195-207 of the old manuscript, we describe the comparison of some of these metrics. However, the main result here is that the virtual FAD drift and the drift of virtual particles advected only due to surface currents, were quite similar in their spatial structure, but mainly showed differences amplitude-wise.

line 111-112 : Why particle are removed? It seems that the number of particles is far smaller than numbers that can be numerical unfeasible.. Which is the real numerical limitation here? A few thousands of particles can be advected for a month in seconds.. Maybe I am missing something?

Loading the global daily velocity fields substantially increased the computational costs of simulations. Hence, we load in the data between latitudes of 31ºN and 31ºS, to decrease the computational time of a simulation. After the particles travel for longer timescales, however, more particles pass these boundaries, giving the trajectories NaN values, in turn making the statistical analysis around the edges of the domain less robust as more trajectories become invalid. In the simulations, the particles were initially actually advected for 6 months, but for the reason above, we did not account for the data past the first month.

line 150 : Not clear how the correlation is calculated, please provide statistical details of the approach used. Moreover, why some metrics are correlated only with el Niño event and not la Niña?

Following also the comments from reviewer 2, we have decided to clarify the methods section as a whole. The metrics are now provided with a mathematical expression and graphic example, shown below in Fig. 1:

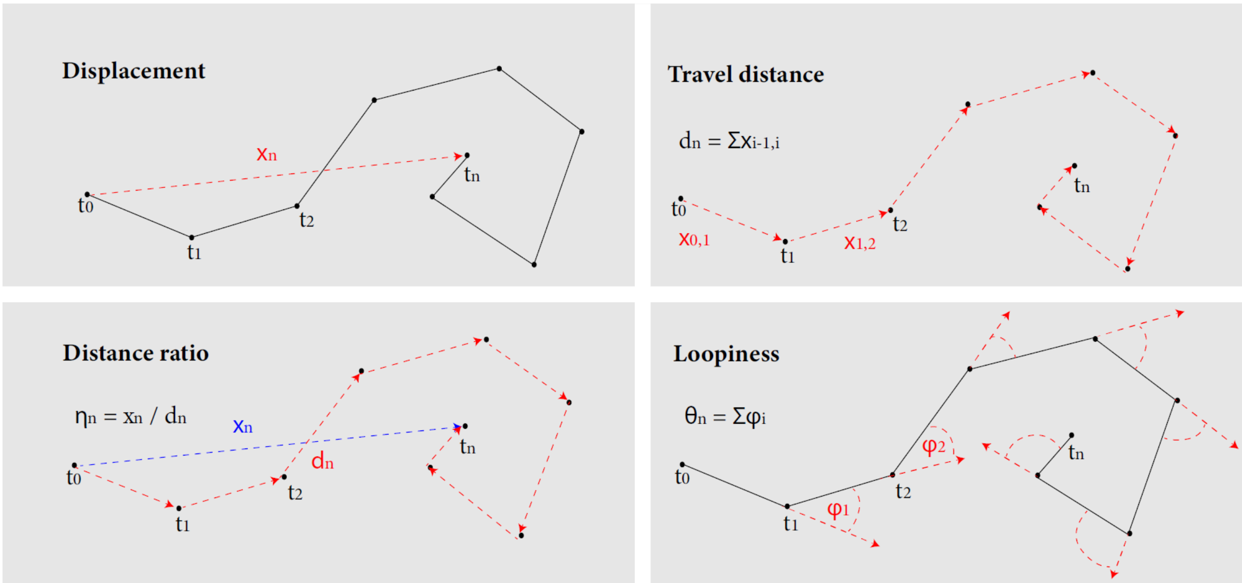


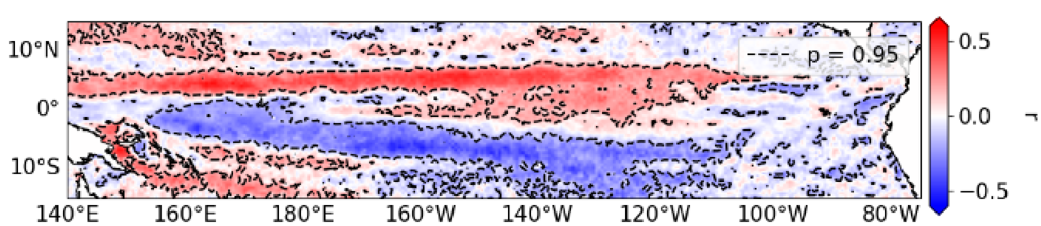
Fig. 1 Conceptual visualisation of the metrics used in this study: displacement (top left), travel distance (top right), distance ratio (bottom left) and loopiness (bottom right)

We added lines 153-158, to address how we calculate the correlations:

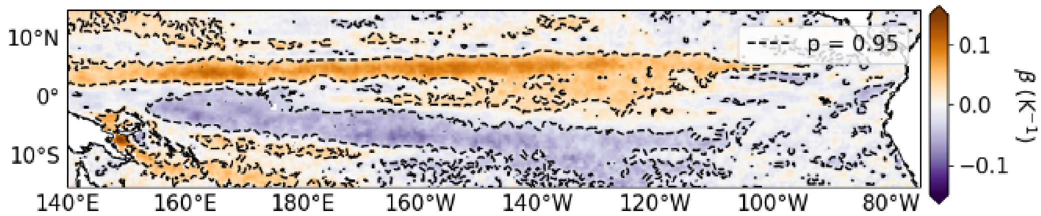
"First, values from each metric (i.e., virtual particle's displacement, distance ratio, and loopiness) are grouped by the month in which the virtual particles were released. Second, a monthly average is calculated for each metric. Then, the correlation between the monthly average and the monthly Nino3.4 index is assessed using Pearson correlation statistics. Two-sided p-values are calculated under the assumption that the metrics and the Nino3.4 index are drawn from independent normal distributions."

These p-values are used to indicate the areas where the calculated correlation values are not only high, but also statistically significant. As such, our metrics are correlated to the full Nino3.4 index, during both positive and negative ENSO events.

Following the feedback from reviewer 2, we revisited the method of the composite images (original manuscript Fig 2b, 2c), and replaced them with the same correlation analysis as the displacement and loopiness, shown below in Fig. 2a and 2b. The (a) correlation and (b) linear regression coefficient of the distance ratio of the depth-integrated virtual particles with the Niño3.4 index is shown below.



(a)



(b)

*Fig 2 **(a)** Correlation between virtual dFAD distance ratio after 1 month and the monthly Niño3.4 index. Positive correlation are shown in red, whereas blue colours show a negative correlation. The dotted black lines mark regions where correlations are significant (probability values larger than 95%). **(b)** Linear regression coefficient between virtual dFAD distance ratio after 1 month and the monthly Niño3.4 index. Units are in* K^{-1}.

line 156 : This mechanisms could be checked explicitly

Following our response to point (3), we changed lines 156-158 (old version of the manuscript) to lines 172-176 (new version):

"The pattern of alternating positive and negative correlations surrounding the NECC is likely due to the southward shift in the NECC during the 2009-2010 (Zhao et al., 2013) and 2015-2016 (Zhou et al., 2021) el Niño and the northward shift during la Niña. However, this latitudinal shift of the NECC does not occur during every ENSO event. Our analysis shows no significant correlations of distance ratio and loopiness in Fig. 3 and 4 in the NECC to explain these patterns with eddy-like behaviour."

In the literature, we found that the latitudinal shift of the NECC occurs both during the 2009-2010 and 2015-2016 el Niño event, and we found that the MOi velocity data also captured this behaviour. We think stronger eddies near the NECC are less likely to be the cause, as this behaviour is not found in the distance ratio and loopiness analyses.

Line 170 : Also here, this hypothesis could be tested more explicitly

Especially the strongly (anti-)correlated part in the western and central SEC is not a well-defined area in literature. We back our hypothesis that there is increased eddy-like behaviour in this region during el Niño compared to la Niña events, with the correlation analyses of the distance ratio and loopiness. Both metrics support the idea that eddy-like behaviour is enhanced in this region, though the underlying physical mechanisms are best suited for a separate study.