Reply: comments 1st Reviewer

1. Line 301: "mean surface geostrophic EKE over this 1-year period," One year is a bit short for a mean surface geostrophic EKE here. This is why EKE pattern in Figure 3 is quite patchy. ... but I think this is the limitation of using LLC10 ?

Exactly, this is the main limitation of our 1-year simulation, whether at 1/48° or 1/10° since the region is dominated by large mesoscale events with time-scales of 1-3 months that dominate any seasonal average and can impact on the annual average. However, SWOT's fast sampling phase will only be a three-month-long temporal series. And although it occurs in Apr-June, it will not be the seasonal aspect of this time period of interest, but the large mesoscale structures to be observed during this period. Understanding SWOT capabilities is really our main focus in the paper, to be aware of the potential and the limitations of the data we will analyse.

2. Figure 5: What is the definition of the cross-terms?

The total LLC10 EKE is not simply given by the addition of the individual contributions from the residual small scales EKE and from the EKE estimated with the pseudo-DUACS data. An additional cross-term arises representing the interaction between the large scales and the smaller-scale motions. The same is true for the strain rate. The analysis shows (Figure 5 and Figure 6) that in any of the boxes, the cross terms represent a minor component of the dynamics. We have added an expanded EKE equation and the following short text after the standard EKE equation (4), inserted before line 275 (old text):

"We note that when separating our EKE analysis into larger-scales represented by CMEMS mapping, and residual smaller scales, this EKE equation needs to be expanded and important cross-terms result, see eq.4a, that mix the large and small scales. These will be analysed in our results section."

We have also added an explanation in the strain rate calculation:

Old text: lines 277-278 "Its formulation is defined from surface geostrophic velocities. "

New text: "Its formulation is defined from surface geostrophic velocities. As with the EKE analysis, an expanded version of the strain rate is needed when calculating the difference between large CMEMS scales and residual small scales, which also include cross-terms. This component is analysed in the results section."

3. Table 1: Values of strain for PseudoDUACS are quite large compared to Figure 3. Is this due to the specific locations of the boxes?

The large values for the strain rate in Table 1 in comparison with Figure 3 are due to what these two represent. Figure 3 shows the std of strain over time in a 2D geographical map. It shows that most of the strain rate variability in the Agulhas region is due to the residual small scales and that current altimetry is not able to fully represent this variability. Table 1 shows the average strain rate value over the specific box area over time. This is highlighting the fact that even though most of the strain variability is carried by the small scales, around 60% of the strain amplitude is still carried by the larger scales, which are quite constant over the year. This is also visible in Figure 6a where the orange line representing pseudo-DUACS carries most of the strain rate's strength, but the green smaller scales in Figure 6b carry most of the variability over the year. Thank you for pointing out that this is not clear, I have changed the manuscript accordingly:

Old text:
Lines 380-382: This figure and Table 1 confirm that the larger-scale pseudo-DUACS geostrophic strain rate contributes around 60% of the total mean LLC10 strain rate in Box 1 (and in boxes 3 and 4, not shown). Whereas the residual small-scale rapidly evolving geostrophic strain contributes 40% of the mean strain rate, but most of the variability.

New text:
This figure, together with Table 1 which quantifies the average strain rate values over the boxes and over one year, confirms that the larger-scale pseudo-DUACS geostrophic strain rate contributes around 60% of the total average LLC10 strain rate amplitude in Box 1 (and in boxes 3 and 4, not shown). Whereas the residual small-scale rapidly evolving geostrophic strain contributes 40% of the mean strain rate, but most of its variability as shown in (Figures 3d, 3f, 5b, 5d).

4. Figure 7: if the figure is dominated by the propagation of Natal Pulses, one possibility would be to do the statistics in absence of Natal Pulses (as in Tedesco et al., 2019).

Indeed, this would be an interesting comparison if we had a longer model simulation to derive more robust energy cascade statistics of the period between Natal Pulses. Tedesco et al (2019) used a 1-month and a 5-months high-resolution simulation with no Natal Pulses to perform a robust study of submesoscale frontal eddy generation. As shown in Figure 4, we lose around 7 months of data if we remove the Natal Pulses from Figure 4 in between box 1 and 2. The remaining data would not be enough for our monitoring of the effect of mesoscale structures over the larger scale variability, for which Schubert et al. 2020 and Contreras et al. 2023 use muli-year simulations.

It's still interesting how the direct cascade dominates from the mix of Natal Pulses and smaller-scale instabilities off Port Elisabeth, and the LLC10 shows the clear geostrophic energy cascade from the Retroflection and further west. Frankly, we were pretty happy!