Reply on CC3
Yves Quilfen et al.

Author comment on "Towards improved analysis of short mesoscale sea level signals from satellite altimetry" by Yves Quilfen et al., Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2021-352-AC4, 2022

The authors are grateful for the positive feedback and are pleased to respond to the two main points raised:

- We understand that our description of the denoising process may be not that clear, as described lines 246-257. We can try to summarize as follows. For a given data segment typically covering several hundreds km along the satellite track, denoising is performed in several steps, the first being an initial EMD expansion of the signal, $SGN(x)$, into a series of IMF. The first IMF, IMF1(x), derived from this EMD expansion is the high-frequency component of the signal along the track, mainly associated with the high-frequency noise $HFN(x)$. $HFN(x)$ is estimated in a second step by a wavelet analysis of IMF1(x). As $HFN(x)$ is only a particular realisation of the noise, to make the full denoising scheme more robust, a third step is to generate a set of $N=20$ new realisations of the noisy signal, $SGN(x,1:20)$, by random perturbation of $HFN(x)$, $HFN(x,1:20)$. Each new noisy signal, $SGN(x,i=1:20)= SGN(x) - HFN(x) + HFN(x,i=1:20)$, is then denoised separately using the thresholding process to provide a set, or an ensemble, of $N$ denoised signals. Finally, the result is the average of the ensemble of denoised signals and the standard deviation provides an estimate of the uncertainty which is function to the actual signal to noise ratio. Note that random noise perturbation, to provide new noise series, is performed in windows of about 140 km width, as the noise statistics are unlikely to be stationary along-track, mainly due to their dependence on the significant wave height. Hope this makes things clearer.

- Improving the regularity of sea surface height estimates will certainly help the determination of along-track gradients. It shall then serve to better estimate the across-track geostrophic balance. It will also provide more reliable statistics, e.g. occurrences of large along-track SSH gradients. The impacts of these large SSH gradients can then be possibly traced, and more reliably related to sea state SWH gradients. At high latitudes, where the altimeter tracks intersect, these more regular SSH estimates can be combined to map 2D field, leading to better resolved geostrophic surface currents. However, the proposed technique will improve the observation of both balanced and unbalanced motions.