Comment on egusphere-2022-1018
Anonymous Referee #1

Referee comment on "A method to enhance the detecting of geostrophic current and its temporal variations with SWOT swath data" by Jiasheng Shi et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-1018-RC1, 2022

A method to enhance the detecting of geostrophic current and its temporal variations with SWOT swath data Shi et al. (2022)

General Comments

The authors present an interesting article detailing methods and improvements for retrieval of geostrophic currents from simulated SWOT observations of the sea surface height, which are expected to contain large magnitude correlated errors.

There seem to be three aspects to the paper: the filtering of swath ADT to suppress long-wavelength (spatially-correlated) errors, testing updated space and time correlation scales in the OI, and comparing the different methods (ADT_STC, UV_STC, and UV_SC) against one another.

The methods presented demonstrate the benefit of filtering the swath ADT (which appears to remove much of the short length-scale noise), and the benefit of calculating the gradient in the ADT fields (to calculate the u/v geostrophic currents) which appears to address the limitation imposed by the large-scale correlated errors in the SWOT ADT.

However, one stated objective of the paper was to demonstrate the need to adjust the spatial and temporal scales in the OI to be more appropriate for SWOT. It was not clear how the spatial and temporal scales used were chosen and whether the two methods
(UV_SC and UV_STC) compared the currently used space/time scales with the proposed update, or not. Overall, I found the description of the methods to be somewhat confusing: it was not clear to me how the ADT was produced using the UV_STC method, nor was it clear how the UV_SC and UV_STC methods differ in terms of time-range of inputs and quantity of observations included.

I believe this work is timely and will be of interest to the community, but the description and comparison of the methods (ADT_STC, UV_STC, UV_SC) must first be clarified.

Specific Comments

Line 17: “the long wavelength error (LWE) is constant along tracks”. I don’t think this is true: the LWEs are correlated along track, but are not constant.

Line 44: “spatial resolution of…the resolution of” I think this would more correctly be “spatial sampling of…the posting of”. The expected feature resolution of SWOT is 15-30km, but the observations will sample much more frequently and the supplied product will have many observation points (every 2km) per resolution element (15-30km).

Line 61-62: “the long wavelength errors” Which of the error components due you include in this definition? Roll and phase only?

Line 62: “constant along track” Same comment as for line 17.

Line 64: “the difference step” I think here you mean that the long-wavelength errors do not affect the short-scale spatial derivatives of the ADT used in the calculation of the geostrophic velocities, but I think you could be more explicit in this at the first mention of the “difference step”.

Line 67: “swath width of 50km” I would suggest to clarify that this is only one side of the full swath.

Figure 1: The rainbow colour-scale used is hard to interpret. I’d suggest a diverging colour-scale (e.g., red to white to blue) to emphasise where the magnitude of the errors is
Figure 1: The range of the colour bar is limited to +/-5cm, but the text notes that the phase and roll errors are at the decimetre level. From my experience of these errors, +/-20cm could be necessary to show the range of the phase/roll errors.

Line 182: It’s unclear why a time window of +/-5days is chosen. While the precise choice may be arbitrary, given the timescale of 3.6 days mentioned earlier, some justification seems necessary.

Figure 3: Is the time period used for the figure to match the +/-5day window mentioned before?

Figure 3: The power spectra show that the filtering removes the excess power (and the signal) at scales shorter than ~20km, but there appears to be more small-scale structures present in Fig 3c than in Fig 3a. How is this consistent?

Line 212: The title of this section “Effect of difference” could be improved as the section discusses both the effect of deriving the u/v currents (the difference method) and Gaussian-filtering the ADT. I think it would also be clearer if the “difference method” were explicitly defined somewhere.

Line 213: Is the Gaussian filter applied two-dimensionally, or only in the along-track direction? If 2D, does this introduce artefacts at the swath edge? And if along-track, are there artefacts at the end of tracks?

Line 213: Why was a radius of 14km chosen? You stated that the correlation scale of the model was 27km and the apparent correlation scales of the observations errors is much longer.

Table 1: RRMSE is not widely used, so it would be useful to refer to equation 9 in the table caption.

Line 228: Same question as for line 182.

Line 228: Why was a 0.1degree grid chosen? If the expected limit of feature resolution is
~100km, then you would require 2-3 grid cells per resolution element to retain that resolution.

Figure 4: How was the ADT estimated using the UV_STC method?

Figure 4: The difference fields shown in panels (d) and (e) would be clearer if the colour-scale were centred on zero. This would make it easier to interpret where the bias was very small, and/or whether there is a domain-wide bias.

Line 243: It is not clear to me exactly how the UV_SC and UV_STC methods differ in terms of time-range of inputs and quantity of observations included. Is the UV_SC method equivalent to UV_STC, but with a different time window (+/-5days)?

Line 258: Related to comment on line 243: is the higher correlation between the RMSE and number of observations for UV_STC due to using many fewer observations than in UV_SC?

Technical Corrections/Suggestions

Title: suggest replacing “detecting” with “detection”

Line 15: “is different” -> “are different”

Line 26: “Satellite altimetry” -> “Satellite altimetry has”

Line 27: “Gridding method should be” -> “Gridding methods have been”

Line 41: “interferometric” -> “interferometer”
Line 65: “T/P” Perhaps expand to “TOPEX/Poseidon”

Line 67: “the globe ocean” -> “the whole global ocean”

Line 76: This first sentence could be rephrased to clarify the meaning.

Line 100: “the reality” -> “reality”

Line 106: “the other instrument error is” -> “the other instrument errors are”

Line 107 “those error is” -> “those errors are”

Line 108: “spatially structured” -> “spatial structure”

Line 108: “is constant” -> “are constant”

Line 111: “errors are…cut” -> “errors being…cuts”

Line 135: The omega symbol is used mistakenly for the meridional direction (as well as the angular velocity).

Line 187: “A Global Self-consistent” -> “the Global Self-consistent”

Figure 4: “using ADT_STC and UV_STC method” -> “using the ADT_STC and UV_STC methods”

Figure 4: “The ADT of model” -> “The ADT of the LLC4320 model”
Line 255: “on the overall” -> “overall”

Line 275: “underestimate the gridded results of model” -> “underestimate the magnitude of the gridded model ADT”

Line 280: “then” -> “than”

Figure 7: The panels references need to be updated: a,b,c,d used in figure, a,c,e,g used in caption.

Line 321: “To adapt...” This sentence should be rephrased.

Line 323: “in the swath” -> “of the swath ADT”

Line 337: C3S has not been defined.