

Review of manuscript “Mode-1 N2 internal tides observed by satellite altimetry” by Zhongxiang Zhao.

Manuscript reviewed by Clément Vic on 14<sup>th</sup> November 2022

The manuscript reports on a method that allows to map the global mode-1 N2 internal tides from sea surface height (SSH) measured by satellite altimetry. Results are presented and discussed in light of a similar product for the well-described mode-1 M2 internal tides. The model’s predictive skill is tested vis-à-vis of an independent global time series of SSH, and it proves to be good. The manuscript is clearly written and well presented, and the science looks robust to me. The scientific interest of mapping internal tides is emphasized in the context of the new SWOT satellite mission. I recommend this manuscript for publication after some minor revisions that I hope can help to clarify some points.

Minor comments:

- Line 6 and elsewhere: “1993 through 2019” replace “through” with “to”?
- Line 10: “Both features mimic their barotropic counterparts” is unclear to me. This could be rephrased and developed a bit, including considerations on the energy conversion etc.
- Line 20: the acronym should be expanded first and put into parentheses afterward, i.e., “Surface Water and Ocean Topography (SWOT)”
- Line 20: The SWOT mission has not been designed to strictly study the submesoscales only I think, but to have a wider picture of entangled motions and waves that have a signature in SSH.
- Line 27: remove “(Section 2)” and stick it to where the plan is announced?
- Line 31: I think it would be useful for the reader to be introduced to the semidiurnal tide components in general, before getting into the details of N2 and L2.
- Line 37: insert “see their Figure 4” within the previous parentheses?
- Line 39: “can better parameterize” is not very clear. I think you mean more than just parameterize, i.e., increase our understanding?
- Line 70: why is the fitting window size not varying geographically? I thought it would take into account mode-1 wavelength.
- Line 75: add “horizontal” before “wavenumber”
- Line 98 (and perhaps before): It would be good to stress out that only the coherent internal tides are mapped.
- Line 112: rephrase “they have same generations over rough topography” to be more specific (amplitude, phase, etc.)
- Line 114: add “energy” before “conversion”
- Line 115: “in the causative chain” is unclear. If I understood correctly, you mean that the similar M2 and N2 barotropic tides generate similar baroclinic tides and that the ratio between barotropic tides is also observed in baroclinic tides.
- Line 120: I assume 0 degree is East? It should be mentioned.
- Line 137: typo? “prone to” be?
- Line 146: remove “percentage”
- Line 157: I do not understand the sentence “Thus, ...”

- Figure 4 and line 173: I think it would be good to give globally integrated numbers for all terms, and perhaps the integrated contribution of all negative and positive terms to make sure that the variance is indeed reduced.
- Line 198: add "mode-1"
- Line 201: I do not understand how one can do "parameterizing the temporal variation" with the elements provided. It could be developed.
- Line 208: typo (sub and not sum). And perhaps rephrase into something that reminds the reader on the fast (waves) and slow (balanced motions) manifolds?