RESPONSES TO THE REVIEWERS' COMMENTS

Reponses to Reviewer 1's comments (in italics)

Interactive comment on "Coastal Sea Level rise at Senetosa (Corsica) during the Jason altimetry missions" by Yvan Gouzenes et al.

Anonymous Referee #1

Received and published: 27 March 2020

Review of the paper: os-2020-3 Title: Coastal Sea Level rise at Senetosa (Corsica) during the Jason altimetry missions

General assessment

This paper addresses a relevant topic of research, the determination of local coastal sea level trends from satellite altimetry. The study focuses on a Jason track crossing Corsica Island at the Senetosa site. The analysed period spans 14-years (from July 2002 to June 2016). Altimeter data used include Jason-1 and Jason-2 20Hz measurements, ranges from the ALES retracker and corrections from the X-TRACK system. The main conclusion of the paper is that, provided altimeter-derived coastal sea level trends are reliable, these trends can be significantly different from the corresponding open ocean trends. Most effort is put in justifying that the results are not due to e.g., spurious trends in the geophysical corrections, imperfect intermission bias estimate, decrease of valid data close to the coast and errors in waveform retracking. The paper is scientifically sound, generally well written and structured. The paper can be accepted subject to minor revision. A few suggestions are given to improve paper clarity.

Detailed comments:

1) My major suggestion to authors is to include a discussion about the connection (or not) between the results in this particular site with the global results of the CCI project. Did they find many sites where coastal sea level is significantly different from that offshore? Is this a representative site or an exceptional result?

This is the objective of another article to be submitted in 2 or 3 weeks to Nature Scientific Data where we present coastal sea level anomalies and coastal sea level trends from the Jason-1, 2 and 3 missions at 429 selected sites (among several thousand studied sites) located in 6 different regions (Northeast Atlantic, Mediterranean Sea, Western Africa, North Indian Ocean, Southeast Asia and Australia) that gives robust coastal trends. It is found that in general, coastal trends do not differ from open ocean trends except at a few sites. Senetosa in the Mediterranean Sea is one of them. We decided to write a separate article on the Senetosa results in which we examine in many details potential errors in the data processing (including spurious geophysical correction) to assess the validity of the observed coastal trend. This kind of detailed analysis is not presented in the Nature Scientific Data paper (impossible to do this at 429 sites in a single article!)

In the present revised version, we have added a paragraph in the conclusion section to explain our strategy, mentioning that Senetosa counts among the very few coastal sites where coastal sea level trends differ from open ocean trends.

2) Since the main focus of the paper is trying to discard causes that might explain

the observed trends, it is important to give enough detail on the altimeter data used and adopted processing, so that the reader can follow the discussion with enough information. For example, saying that that corrections are those adopted in the XTRACK system is not enough. At least the corrections that most affect coastal sea level, in addition to the SSB, the wet tropospheric correction and ocean tides should be discussed in more detail. Information should be given, with appropriate references, on: i) models used (e.g., original wet tropospheric correction from the Jason GDRs (MPA algorithm from Brown ,TGARS 2010) or from GPD (Fernandes, RSE 2015)?; ii) tide model from FES2014 or any other model? How big are tides in this site?; iii) rate at which each of these corrections is provided (1Hz or 20Hz)? In case of 1Hz corrections interpolated to 20Hz, they don't have enough detail to cause differences in trends at scales of few km, discussed in this paper.

In the revised version, we have added a long paragraph discussing the processing approach and the source of chosen geophysical corrections, explaining why these have been selected for this study. A table dedicated to the geophysical corrections and associated references has been added.

Fig. 2: The grey square is hardly visible. Please improve.

The figure has been improved as requested

Section 4.1: please explain how the standard deviation of trends is computed.

Done

Section 4.2. A more recent reference on coastal altimetry than that by Vignudelli et al., 2011 is the book chapter "Satellite altimetry in coastal regions" by Cipollini et al., 2017 in the CRC Press book. Please include.

Done

Section 4.2.1 – "waves could has a" replace by "waves could have a"

Corrected

Responses to Reviewer 2's Comments (in italics)

Comments :

Jason-1&2 satellite altimetry data, reprocessed (with ALES and X-TRACK) to give fineresolution along-track sea level time series, including closer to the coast and spanning July 2002 to June 2016, are used to compute coastal sea level trends, specifically where the Jason track crosses Senetosa, southern Corsica. The estimated rate of sea level rise increases in the last 4-5 km to the coast, compared with further offshore; it amounts to about 10 cm extra rise near the coast over the 14 years. Potential altimetry errors are considered. I am not expert in these but the manuscript consideration is convincing. An extra 10 cm rise in such a short distance near the coast appears a lot to attribute to error, despite the extra near-coast trend being absent from coastal tide gauges. The possible contribution of wave set up is also convincingly assessed as too small. The remaining identified possibilities are: the sea-state bias correction degrades somewhat near the coast – certainly SLA difference (near-coast minus 15 km offshore) is correlated with SWH; an effect of coastal currents suggested by distribution of winter currents but no mechanism is proposed and the possibility is left for further

investigation.
It is rather disappointing that resolution of the origin of the extra near-coast trend is left to further work. It occurs to me to speculate that the nearshore flow might be affecting the surface waves which could give a systematic effect since it is suggested that both occur more strongly in winter, i.e. they are correlated. Even then, there would need to be a trend in intensity of waves and/or current to produce the differential trend in altimetric signal.
The authors might have considered the momentum equation to look at what might cause a trend in differential sea level. My "back of envelope" calculation for geostrophic balance across a flow of strength 0.2 m/s and width 5 km (rather more than considered in the manuscript) gives a difference of only 1 cm. The very narrow shelf suggests that wind-forced set-up will be very small.
Ultimately, there is a question still unanswered but thereby needing publicity in order to make scientific progress, especially as there might yet be serious implications for near-coast altimetry.
In general the work is well presented and the intended meaning is expressed clearly.

Response :
We thank Reviewer 2 for his/her comments. Indeed the main purpose of this study was to assess all sources of potential errors of the data processing able to explain the sea level trend increase as the distance to the coast decreases. From the numerous tests performed in this study, none is able to explain the reported trend behavior. We further examined the wave set up mechanism but this process occurs too close to the coast to explain our results. We made the hypothesis that trends in coastal currents could be the process we are looking for. Unfortunately, there is a crucial lack of small scale coastal data, especially in this region, to go farther. Thus we decided to leave the process assessment for further studies, either by our team or by other scientists from the coastal oceanography community. High resolution hydrodynamical models -if available- may provide some answer.

Comment :
On this count, one "technical" matter concerns lines 111-112; Senetosa is "southern Corsica" rather than "south of Corsica" and nearer 9E ? Some explanation of the different colours of the sea in figure 2 might be useful.

Response :
Corrected