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Ocean Science Discussions

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

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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

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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? Reponse: 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.

Added text in the revised manuscript: "An update of the results presented in this paper has been recently performed extending the SLA time series with Jason-3 data up to June 2018 (coastal trends based on Jason-1, 2 and 3 over 2002-2018 at several

hundreds of coastal sites located in six different regions worldwide will be presented elsewhere; The Coastal Sea Level Team, 2020). Although the coastal trends within the 2-3 km to the coast are slightly lower than those reported above, exactly the same behavior is found, as shown in Fig.20 that compares coastal trends over 2002-2016 and 2002-2018. Thus the trend increase close to the coast observed at Senetosa is not due to the limited length of the time series, although its amplitude decreases as the record length increases. Similarly the geophysical correction trends present the same behavior on both time spans. It is worth to mention that in the extended study (2002-2018), among the 400+ studied coastal sites, computed coastal trends do not in general differ from open ocean trends (within 1 mm/yr), except at a few sites. Senetosa is one of them. This is why we made a focus on that particular site." Added figure: "Fig.20. Altimetry-based sea level trends at Senetosa, over two periods: (1) July 2002-June 2016, green curve and (2) June 2002-May 2018, red curve. Black vertical bars correspond to trend uncertainties."

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.

Response: In the revised version, we have added a long paragraph discussing the

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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. Added text in the revised manuscript: "The new X-TRACK/ALES processing system first downloads from the altimetry database hosted by the French National Observations Service for altimetry called CTOH (http://ctoh.legos.obs-mip.fr/), all parameters needed to compute the sea level anomaly (orbit solution, altimeter ranges, instrumental, environmental and geophysical corrections). These parameters come from the Geophysical Data Records (GDRs) data sets distributed by the space agencies for the different altimetry missions. ALES range and SSB products come from TUM. Additional geophysical corrections are provided by the RADS altimeter database (http://rads.tudelft.nl/rads/rads.shtml) and the University of Porto (for the GPD+ wet tropospheric correction, Fernandes et al., 2015). Concerning the geophysical corrections, we used the standards defined in the ESA CCI sea level project (http://www.esa-sealevel-cci.org/). These are summarized in Table 1." Added table : "Table 1" Added text (continued): "A dedicated editing strategy was further applied to eliminate noisy data. For each orbit cycle, the temporal behavior of each geophysical correction was analyzed along the satellite track. Abrupt changes were considered as spurious and removed (Birol el al., 2017). This strategy has proved to be very efficient in recovering a significant amount of valid altimeter measurements that were otherwise flagged in the standard GDR products (Jebri et al., 2016). In a second step, all corrections were recomputed at the 20-Hz high-rate using only the valid data, through interpolation/extrapolation method. The sea level data of each cycle were further projected onto fixed points along a nominal ground track and converted into SLAs by subtracting a reference mean sea surface. At this stage of the processing, a regional dataset of SLA time series with a spatio-temporal resolution of 10 days and 20Hz ($\sim$0.3 km) was produced for each Jason mission. To obtain a single multi-mission product, an inter-mission bias was estimated and removed. This was done at regional level by computing the mean sea level differences between the two missions over their overlapping period (calibration phase). The resulting SLAs were further averaged on a

monthly basis at every 20 Hz point and an additional editing was performed to remove outliers (details in Marti et al., 2019). "

Fig. 2: The grey square is hardly visible. Please improve. Response: The figure has been improved as requested

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

Section 4.2.1 – “waves could has a” replace by “waves could have a” Response: Corrected

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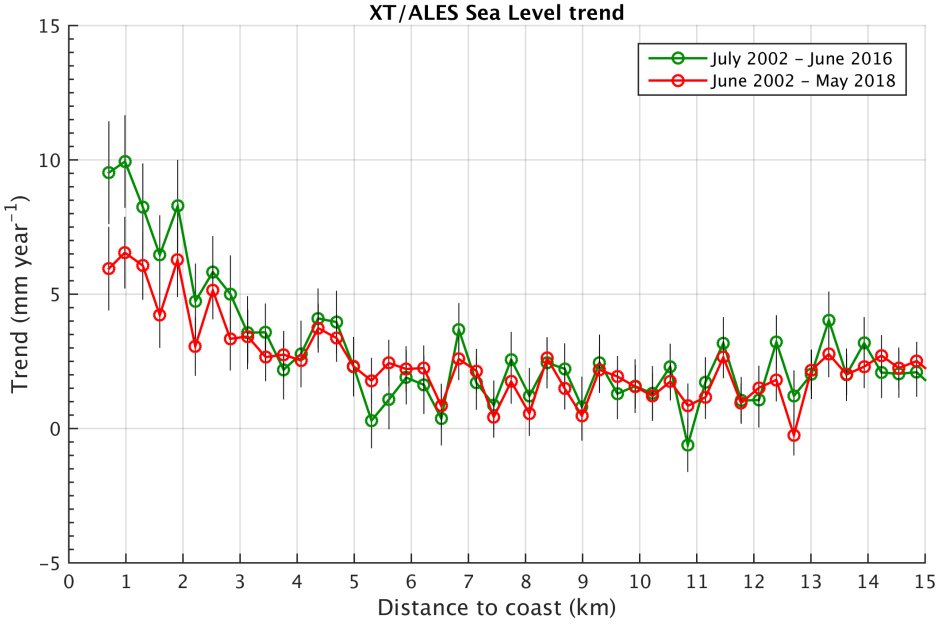

Fig. 1. New Figure 20

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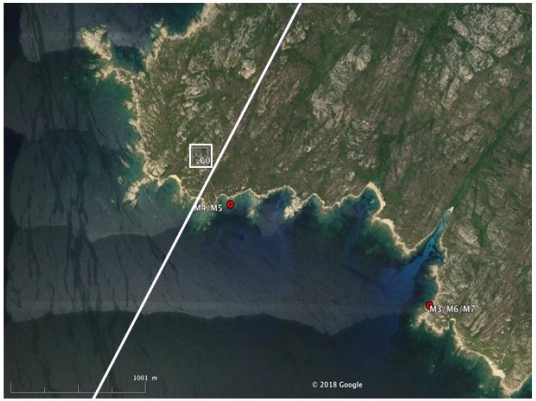

Fig. 2. New Figure 2

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