First, we would like to thank the reviewer for providing constructive comments that were taken into account in order to improve the manuscript. Please find below a point-by-point answer. The reviewer comments are in bold.

Reply to reviewer #1

The work presented by Carret et al compares SARAL and Jason 2 altimetry data with HF radar, vessel-mounted ADCP and glider data in the North Western Mediterranean Sea. Dataset are well presented, and a complete Section describes similitudes and differences between the dataset. Yet some important physical differences between the dataset are missing in that section. Most of the results presented are not new: it is well known that seasonal and mean average of the altimetry currents are trustable. Also, little is learnt in terms of description of the currents. On the other hand, it is presented a very interesting description of six cases where a detailed comparison between the datasets is made. I encourage the authors to push forward the analysis of the higher frequency and to clearly show when satellite altimetry works well and when does not. I hope that the below specific comments will help in that sense.

Thank you for these comments. First, we improved the description of the differences between the datasets by adding in Section 2 more informations and/or precisions on their respective physical content (details below). We also used high resolution SLA altimetry data (i.e. 20Hz for Jason-2, 40-Hz for SARAL) and added a section (new section 3.4) to compare and discuss the corresponding results with the results obtained from 1-Hz SLA data. We then insisted on the individual cases as suggested by the reviewer. However we believe that the results presented in this manuscript, even in its first submitted version, are really new. If different studies have already shown that altimetry is able to capture seasonal and mean currents, they did not (or poorly) show until what point this is true and what part of the seasonal and mean current components is missing. Past studies on coastal currents derived from altimetry are generally qualitative (as in Birol et al., 2010-2014-2015; Jébri et al, 2016) and/or based on individual case studies. Here we take advantage of a large number of data (as much as we found) and relatively long time series in order to quantify (as much as we can) what part of the current can/can't be captured by altimetry. We used a multi-platform approach in order to learn more on the causes of the differences between currents derived from altimetry and from in situ data. To our knowledge, this is not common at all since we do not know coastal altimetry studies based on such degree of integrated observation system.

P3, L 13, add a comma after "swaths"

It has been corrected.

P3, L29-30, the list of articles is non-exhaustive. Please add "eg" at the beginning of the list. → Right. It has been done.

P4, L 14: "associated to important mesoscale and sub-mesoscale variability at all time scales".Meso and sub-mesoscale have time scales associated as well. Please re-phrase.

We have removed these words. Now : "To study the contribution of altimetry amongst other types

of coastal ocean measurements, the North-Western Mediterranean Sea (NWMed) represents a laboratory area. First, with a Rossby radius of only ~10 km, the region is associated to a variety of mesoscale and sub-mesoscale dynamical signals (see below)."

P6, L3-5: could you comment why the optimal spatial filtering scale that you obtained is so different for tracks that are relatively close to each other ?

We agree and have added the following sentences at the end of the paragraph: "The lower values obtained for SARAL are due to the better signal-over-noise ratio of the AltiKa altimeter, compared to Jason-2. The differences obtained between the three SARAL tracks are explained by their respective geographical locations: they represent different mesoscale features.".

P6, L7: Please justify the values used (for SARAL in the precedent paragraph you obtained values that ranged between 34km and 49km). Why you selected a fixed value? →

We have added the following sentence: "Note that we have chosen a single value for the different SARAL tracks in order to have the same data processing and facilitate the comparison between the different datasets".

P6, L13: please add a short discussion (with references) to justify that the selection of the MDT. An inaccurate MDT can largely bias your results.

We agree. We chose to work with the regional MDT from Rio et al., 2014 which was validated against in situ datasets. Compared to the previous MDT from Rio et al., 2007, it has a better resolution (1/16° vs 1/8 °) and the regional circulation is better resolved (see Rio et al, 2014 but we have also done our own diagnostics). We have added the following sentences:

"The MDT product used is a regional product with an horizontal resolution of 1/16° (lower than the altimetry resolution in the along-track direction). Compared to other products, it allows a better representation of the NC in the Ligurian Sea (Rio et al., 2014)."

P6, eq 1: it should be noted that this is the across-track component of the geostrophic velocities

It has been written.

P6, L29-30: how much is "too far away" and "too short" ?

Right. Now: "The ones being too short (<60 km) or moving too far away (>15 km) from an average trajectory computed from the individual ones were discarded. "

P6, L31-P7L1: please improve sentences (for instance obs have the potential.)

We have rephrased. Now: "It represents a huge amount of observations and a large number of cases available for the comparisons with altimetry or with the other in-situ observations. "

P7, L6, a word is missing (end of the line)

We have added the word "horizontal" in the text.

P7, L8-9: Here and all over the document: Try to avoid parenthesis as much as possible

We removed these parenthesis and some others.

P7, L13, "of the second order" - > "of second order"

Done.

P7, L15, add "data" after "salinity"

Done.

P7: 15-18: please clarify that these geostrophic velocities do not represent the same physical quantity that the ones obtained from satellite altimetry

We have added the following sentence: "The difference with altimetry-derived currents is then that the barotropic component and the baroclinic component below 500m are missing."

P8: HF-radar: please add a sentence explaining the error associated to this dataset (ie explaining where velocity components are better solved in the spatial domain covered by the antennas)

We have added the following sentence : "An assesment of this HF Radar site can be found in Sentchev et al. (2017) who found an overall good agreement between derived radial velocities and in situ ADCP, with relative errors of 1 and 9 % and root mean square (RMS) differences of 0.02 and 0.04 m/s, slightly increased, in velocity and direction, for the reconstructed total velocities, but mainly in conditions of unstationnary wind forcing. »

P9, L24: altimetry currents are not "located at the surface". They are computed from the SSH, but the SSH topography is the result of several process, including the density changes in the whole water column. Comparison of currents from different instruments elsewhere show that satellite altimetry represents better sub-surface than surface currents. Depth of best matching depends on time and space.

It has been reworded. Now: " We then decided to use the glider data at 34 m depth (to be coherent with the ADCP observations) and consider that it should not be a significant source of differences with altimetry currents, representing near-surface currents"

P9, L33-34: gliders provide density sections from where you can extract only the baroclinic component of the velocities. Altimeters provide SLA. When adding MDT, altimetry provides barotropic and baroclinic components. Depending on the accuracy of the geophysical corrections, altimetry data might be more or less biased by ageostrophic components. Please state more clearly the differences between gliders and altimetry data.

Done. Now: "After the addition of the MDT, the gliders and altimeters are clearly the closest in terms of current information derived. However, the glider currents are computed from hydrographic measurement profiles with a reference level of 500 m. They miss the barotropic and the deeper baroclinic geostrophic current components when altimetry and MDT allow to estimate absolute geostrophic currents representative of the horizontal density gradients integrated over the whole water column. In this study, in order to minimize (as far as possible) the differences between the current data sets, we performed a projection of the ADCP velocities to obtain the current component perpendicular to the ship transects. Concerning the gliders, estimates of depth-average currents computed following *Testor et al*., 2018 approach were added to the velocity data as an approximation of the barotropic component."

P10, L1-4: exactly what I expressed above for comment in P9, L24.

Figure 2: representation of mean velocities for the HF radar could be improved. There, you can solve two directions. The large blue spot is not very meaningful.

We have chosen to represent only the zonal component to be closer to the information which can be derived from the other data sets. However in this area the NC is known to be almost zonal. These informations were missing in the text and have been added: "Concerning the HF radars, only the zonal current component is taken into account. Note however that in this area, since the NC is almost zonal, most of its mean and variability are captured in the corresponding statistics." The representation of the two direction overload the figure and we have then decided not to change.

P10, L31-32: this information should be included in the legend of the Figure

This sentence has been moved in the legend of Figure 2.

Figure 4: please add monthly ticks in the x axis. Please describe how HF radar data were treated. You averaged them along the coast? If so, please discuss how much variability is lost, as the distance along the coast is not so short. →

We have added monthly ticks in the x axis and we have added the following sentence: "The HF radar data correspond to a meridional section of the zonal current component located at 6.2°E." See also answer to the comment on Figure 2.

Figure 4f: some interannual variability is also observed. And during 2014 some noisy(?) data close to the coast are also observed. Why it is observed only during that period of time?

We have no clear explanation for the presence of the noisy HF radar data located close to the coast in 2014 (these data are processed and distributed by MOOSE) and have decided to remove these points.

Track 302 of SARAL is particularly suited to compare with the HF Radar dataset. Did you try different re-tracking procedures (ALES for example) to analyze how close to the coast the altimetry data can be improved?

No we did not try yet but it will be done in the near future. We wait for the new 20-Hz L3 ALES/X-TRACK product which should be distributed soon.

P13, L35 & P14, L1-2: please provide a clearer explanation on the criterium adopted.

Now: "The maximum NC current amplitude is defined as the average of the first decile of the velocity values for each transect and time (remember that the NC corresponds to negative current values). These values must be close in space. This strategy allows to filter large isolated current values which may not correspond to the NC. In altimetry, only a distance spanning 60 km to the coast is considered. The number of data in the first decile varies according to the data set and to the number of data in the section considered (because of the lower resolution, it always corresponds to one point in altimetry). As we can see in Figure 4d, data gaps exist in Jason 2 for some cycles. When more than 3 points are missing, the corresponding cycle is discarded from the analysis."

P14, L2-4: which velocity is seasonally averaged? Legend of Figure 5 says "maximum current amplitude" but form the text I understand that all velocities have been averaged →

It has been reworded. Now: "Finally, all the maximum NC current values collected are averaged ..."

P14, L4-6, please improve sentences. →

Now: "The results derived from in-situ data are in Figure 5a and the results derived from altimetry are in Figure 5b. The glider results are on both figures because this instrument provides the currents which are the closest to altimetry in terms of physical content."

P14, L18: South of Toulon only SARAL data can be compared to HF radar data. Please add Toulon position in Figure 1

Done.

P16, L11-13. Please justify the window time scales selected. I suggest to repeat the calculation as a function of the time window. In the coastal region time scales are shorter than 22 days.

Please see the answer to the comment below (p 20, L 2-4).

P16, L19-22. Figure 6a. I wonder how the distance to the coast is measured. Figure 1 clearly shows that there are no measures of the altimeter inside the 1000m isobath, while gliders and ADCP do show measures up to the 200m isobath. Thus, I am suggesting that in Figure 6 Saral and J2 lines are not correctly placed. Orientation of J2_0009 track is quite different from Saral_887 (with respect to main direction of the isobaths).

Right. The figures are not represented as a function of the distance to the coast but of the distance to the transect-shoreline intersection point. The new sentence is: "The corresponding cross-track currents are shown in Figure 6 (by season) as a function of the distance to the point where the corresponding transect intersects the coastline."

P16, L34 to P17, L4: data are "very close in time" but then you argue that differences may be due to "one-week difference". Please say precisely what is the difference in time for each case.

All the dates are provided in Table 3 for each case and each instrument. We have added this information in the corresponding sentence. Now: "It could be due either to the differences in the dates of observations (one week from Table 3, temporal scale at which meanders develop) or to an important ageostrophic NC component."

Figure 7 looks strange: double colorbars? Double x-axis?

The figure was inserted twice. It has been corrected.

P20, L2-4 "but a quantification of the high frequency component of the coastal ocean dynamics that altimetry is able to capture would require data that are colocalized in both space and time." Completely agree. But with the dataset that you already have, you do have the possibility to quantify this quite precisely: how much is the bias that is introduced in the comparison because of non-colocalized data? Just compare, more precisely than what you have done so far, the "very close" space & time datasets with the "not very close".

Thank you for this suggestion. We have tried to investigate the bias introduced by non-colocalized data in more details and have computed the diagnostics shown below. Using all the data available, we represent in Figure 1 and in Figure 2 the differences between the maximum NC amplitudes derived from in situ datasets (gliders and ADCP) and from altimetry (J2 and SARAL) as a function of the number of days which separates two measurements. In Figure 3 and 4 we represent the

differences obtained as a function of the distance of the NC core to the coast. As you can see, unfortunately, these results don't allow to draw any conclusion because there are no clear rule that appears. The explanation is not really obvious. Is it because of the high level of short scale variability in this area? Difficult to say. A high resolution numerical model would probably help to understand but it is beyond the scope of this study.

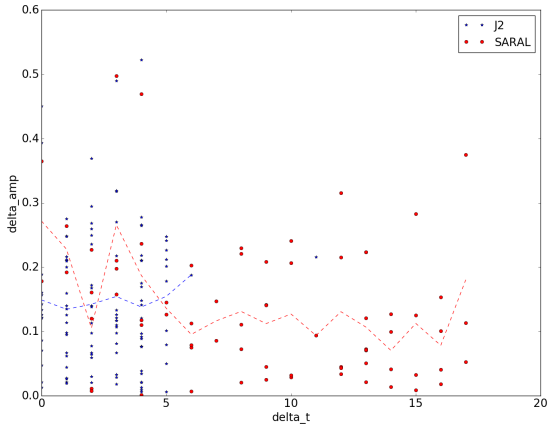

Figure 1: Differences of the maximum amplitudes of the NC between the ADCP and SARAL (in red) and between the ADCP and J2 (in black) in function of the time difference

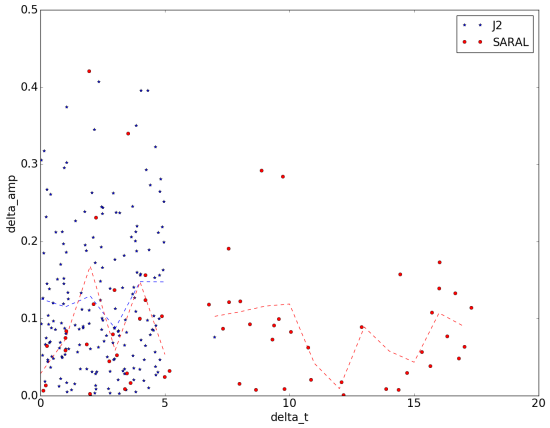

Figure 2: Differences of the maximum amplitudes of the NC between the gliders and SARAL (in red) and between the gliders and J2 (in black) in function of the time difference

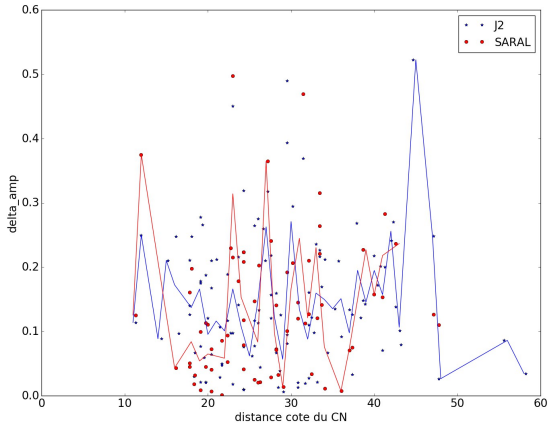

Figure 3: Differences of the maximum amplitudes of the NC between the ADCP and SARAL (in red) and between the ADCP and J2 (in black) in function of the NC distance to coast obtained from the ADCP

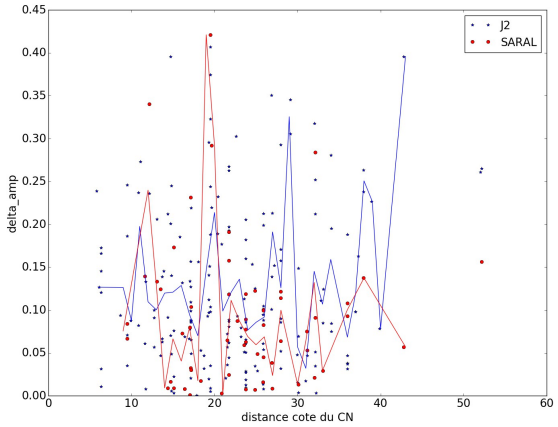

Figure 4: Differences of the maximum amplitudes of the NC between the gliders and SARAL (in red) and between the gliders and J2 (in black) in function of the NC distance to coast obtained from the gliders