

Responses to Referee #2:

General comments:

The paper cannot be published in its present form. Major corrections are required.

The paper presents a valuable review of the state of the art of two different topics: A) Retrieval of non-coastal ocean current information derived from satellite data; B) Assimilation of HF coastal current in operational ocean models

The contents are generally well explained, and demonstrate a very good knowledge of the authors in the topics. Furthermore, given the importance of the problems treated, and the difficulty to obtain this kind of updated information on the state of the art, the idea behind the paper is valuable.

Nevertheless, the paper has some important problems that should be tackled to fully unleash its potential.

Specific comments:

1) There is a clear lack of connection between the two main sections of the paper. One is dealing with global non-coastal currents derived from altimeter, while the other is dealing with data assimilation, but only from coastal HF radar currents. These two topics could be perfectly in separated papers. It is necessary to provide more coherence to the paper to avoid the feeling of two different papers pasted together. The easiest way would be to review the state of the art of assimilation from global currents into numerical models. . . but unfortunately, that authors already claimed that there is no successful exercise in this line. Another possible link is to review any possible work comparing altimeter derived data with HF currents, providing a link between these two worlds. If all the previous fails, the authors should reflect this dual nature of the paper both in the title and in the introduction, or split in two the paper.

The aim of this manuscript has always been to focus on reviewing two aspects of remote sensing of ocean surface currents. On the one hand, we are reviewing the different approaches that can be used to produce estimates of sea surface currents from remote sensing data (Sections 2 and 3). On the other hand, to review the advances in assimilation of sea surface currents, specifically centered on HF radar in coastal regions which is, up to now, the only source of direct remote sensing current measurements (Section 4). It is expected that gained experience and the lessons learned from assimilating currents from HF radars can be translated, and applied, to global data assimilation systems if real-time, quasi-synoptic maps of ocean currents were available either from incoming satellite missions or derived from the methods reviewed in section 2. To avoid the false expectations from potential readers we have changed the title of the manuscript and we have rewritten completely the Introduction section to better reflect the dual nature of the review.

2) Section 2 is failing to provide a pragmatic and consistent overview of the usefulness and validity of the techniques that are being described. For example, for some techniques the limitations are explained in much more detail than for others. It would be highly valuable to define, in a systematic way, the expectations of each technique, as well as its limitations in terms of accuracy, capability of deliver timeliness information, spatial resolution, etc. . .

In this sense, and being a review paper, it is obvious than additional information should be included on the pros and cons of these techniques when compared to the other main source of current information, the operational forecast models.

Finally, given the nature of the paper (a review by experts) some insight should be included on the value of the present techniques to address different specific problems, that at the end are linked with different spatial and temporal scales. Maybe some of the techniques are not valid for some uses like, for example, oils spill forecast, but could be very useful to derive a climatology. This is never addressed, and is vital. A possible solution to most of these problems could consist on a table explaining, for each one of these techniques, the status of development, limitations and possible uses.

In the new version we have been careful to provide a balanced account of details for each of the techniques reviewed. Note however that these products are not yet been used in global operational forecasting models.

We have followed your suggestions and we have now added some new material in the sense you mention. Now, a new figure illustrates (figure 3) the current status in terms of spatial and temporal scales of sea surface currents observations according to the GOOS panel. We have also included in the summary section a table listing some key parameters for future use in operational assimilation systems (latency, resolution,...)

3) Inertial currents are in some occasions and during given time windows the main contribution to ocean currents. Nevertheless, seem like the different retrieval methods are not able to deal with this component. If this is the case, additional assessment should be included.

Inertial currents are the ocean response to the range of atmosphere-ocean interaction processes excited when winds are intermittent. Most of the remote sensing satellite systems are not able to satisfy this requirement because the time resolution needed is not high enough to capture this variability. In fact, that is the main reason why equations 7 and 11, which are the base for many retrieval approaches of sea surface currents, lack the temporal term looking only for steady solutions.

Note however that HF radars are the only systems that attain such high temporal sampling and, in fact, they observe and can resolve both tidal flows (semidiurnal and diurnal) and inertial currents which are within the same range of time scales. In the paper it is mentioned the resolution of the data assimilation of such systems. There are systems that average current data daily, over the inertial period and even assimilate data every 20 minutes. However we did not found specific literature centered on resolving inertial variability.

4) The mathematical formulation in section 2 seems to be in some occasion excessive and unjustified by the text (i.e. reference to Rossby number to define what is geostrophic and ageotropic contributions. Another point where this can be observed is in the description of ageostrophic velocities that lead to expression 16. This formula is obtained just to inform the reader some lines further than the connection is done in practice by adjusting with surface drifters.

In the new version we have simplified the mathematical notation and rewritten section 2: reference to Rossby number has been simplified and clarified but, for the wind and waves section, we have rewritten the text while keeping the logical structure. The reason is that surface currents are very complex and recent advances in trying to infer sea surface currents are now including more and more processes. The situation is similar to the evolution of ocean numerical models that only lately start to implement waves effects, Langmuir circulations and so on in new versions of numerical codes. In our case we opted to first describe classical solutions and then look at the algorithms and procedures able to exploit present observational systems to unveil the complexity of these processes.

5) Section 2.3 seems disconnected with the rest of the chapter. It is not retrieving currents, but providing streamlines. I recommend to move it to the end of section 2, including it as a part of section 2.4 (that would be converted in 2.3), and be treated as a bonus derived from analysis of data imagery (not a as a current retrieval method with its own section)

We have followed your suggestion and made changes accordingly.

6) Section 3 should improve the information on how much improvement is expected from the different data assimilation methods. For example, it is stated that some methods improve the position of the fronts, but it is no explained properly how much. In this sense, selected figures with results should be include in a paper of this nature, providing both a more pleasant reading experience and a better insight of the benefits derived from data assimilation.

In the new version we have included three new figures illustrating the impact of assimilating ocean current data in coastal applications.