

Interactive comment on “Retrieval and assimilation of velocities at the ocean surface” by Jordi Isern-Fontanet et al.

Anonymous Referee #1

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General comments

The proposed piece of research makes an overview of the status of the retrieval and assimilation of surface ocean currents, being covered in sections 2 and 3 respectively. Section 2 discusses 5 different approaches to estimate ocean currents from satellite derived products such as SST or SSH. The techniques covered are grounded in various areas such ocean dynamics, non-linear physics or image processing. Section 3 discusses various methods to assimilate measured ocean currents, namely: nudging, ensemble Kalman Filters and 4DVAR.

The document is not suited for publication at its present form and needs major revisions.

Also, the variety of aspects covered in this paper forces it to overview each topic and,

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necessary, overlooking some specific details. I do not have any issue with this approach if the editors find it acceptable and that is within the scope of this special number.

Specific comments

1 – The document lacks coherence giving the feeling that is a collection of separated texts and not part of a structured discussion. This is partially reflected in the parts of the text used as introductions, which are vague and do not properly describe the contents that follow. Last paragraph of Section 1 can be extended to give more information about the aspects covered in the paper. Introduction for Section 2 only describes sections 2.1, 2.2 and 2.5. Section 2.4 is mention but nothing is said about the methodology described and 2.3 is omitted. Introduction for section 3 has no relation with any of the following sub-sections as there is no mention to HF radars or assimilation methods.

More importantly, the last phrase of the abstract suggests that the ocean currents obtained with the methods described in section 2 are going to be then the examples for the assimilation methods described in section 3. However, all examples from section 2 refer to large scale current estimations while section 3 describes the assimilation of HF currents, which are confined to areas close to the shore. This aspect gives the paper a feeling of disconnection between section 2 and 3 that needs to be addressed. That can be either clearly describing and justifying this approach in the appropriate sections of the text (abstract, introduction. . . etc) or providing data assimilation applications with currents obtained with the methods described in Section 2.

2 – I do acknowledge that it is simply impossible to cover all the aspects of the methods described by the paper. However, it would be good to mention which are relevant and are not possible to cover. Here I outline some examples but I encourage the authors to indicate the ones they consider more relevant based on their expertise. For example:

i) The estimation of the error of a satellite derived product is important to have a measure of the confidence on the data. This is particularly important if the data is going

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to be used for data assimilation applications, where an accurate specification of the observation error covariance matrix (R) is critical. Authors indicate which sources of information might be more prone to have high errors, but no indication on how estimate them is given.

ii) The background error covariance matrix P_f , estimated by EnKF methods usually suffers from an under sampling problem (off diagonal terms are noisy due to the fact that not enough ensemble members are used). To overcome this some localisation needs to be applied to this matrix. May be something about this can be mentioned in the text?

iii) The estimation of the B matrix for 4DVAR algorithms is a non-trivial problem. May be some methodologies can be indicated?

3- Some parts of the text have a feeling of urgency, with confusing phrases and typos, while others are well written in a language that is clear and easy to follow. May be more time can be spent in correcting this before sending the document to the next revision interaction?

I have indicated all the typos I have found in the comments section below. For some of these typos is difficult to understand how they were allowed in the presented version of the manuscript.

4 - Section 3.1 (page 20, line 8) feels more like part of the introduction for section 3. Authors may want to consider appending it to the introduction instead of having it as a separate sub-section.

5- I urge the authors to review the description of the “innovation vector” and the “ K ” matrix at page 23 (lines 2 to 6), as it seems particular non-standard. To my understanding the “innovation vector” represents the departures between the observations and the model converted to the observations space. “ K ” represents the weights of the linear combination between model and observation defined by the values of P_f and

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R. Finally, the term $K[y-Hx]$ represents the increments that applied to the background field, gives an optimal analysis provided P_f and R .

Technical comments

P1L3 – “synoptically at global scale” -> “globally at synoptic scale” perhaps more appropriate?

P1L18, P14L9, P14L15, P17L24, P19L1 – It seems awkward to use “on the other hand” without a preceding phrase with “on one hand”. May be “Conversely” or “On the contrary” can be considered?

P1L22 to L24 – I suggest to re-phrase as: “For example, coastal HF radars are able to resolve rapid changes and, although the number of HF radars has rapidly increased in the last decades, their coverage remains limited”.

P1L25 – Short statement about a new topic that is then not mentioned again. Perhaps more can be said about moorings.

P2L5 – “inn” -> “in”

P2L7 – “acoustic currentmeters” have not been introduced. Are the ones at L4? If so, please clarify.

P2L8 – coma missing after “zone”

P2L11 – “Rossby radius of deformation” is, may be, a more common wording?

P2L12 – Inaccurate, latitude increases from South pole to North pole. Please rephrase.

P2L16 – 1996 seems old for a reference about the past efforts in ocean data collection.

P2L20 – “resulting climatological fields” suggests that it is immediate to obtain them from observations. I would rephrase indicating that the climatological fields are calculated with the observations, sometimes using numerical models and data assimilation to provide a physical coherence for the gaps.

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P2L20 – Phrase starting with “These . . .” seems to be out of place within the ongoing discussion. Consider rephrase.

P2L24 – “Their” -> “His”

P2L27 – “current” -> “currents”

P2L32 – “such” missing after “approaches”

P3L5 – Two “gain” in the same phrase.

P3L8 – “Remote sensing techniques” -> “satellite products” seems more appropriate

P4L1 – “Dppler” -> “Doppler”

P4L2 – Phrase starting with “Some of...” is confusing, please rephrase.

P4L3 to L5 – “Measurement” is used three times in the same phrase, please rephrase.

P4L10 – “(see section 2 and 2.2)”, this is actually section 2. Please correct or rephrase (i.e. “this section”)

P4L13 – The equation is wrong (“L” should be below), please correct . Also, include in the numbering system.

P4L16 – Please, number the equation.

P4L19 – “later” -> “latter”, “include” -> “includes”

P4L20 – Phrase starting with “It is worth. . .” is confusing, please rephrase.

P6L9 – Not sure “evident” is the appropriate word. May be “depicted”?

P6L12 – “two-side effect” suggest that the two sides described oppose each other, which is not the case. Please, consider rephrasing.

P6L22 – Please, indicate what is the “fast evolving structure at the Alboran Sea”.

P9L8 – “wind-induces” -> “wind-induced”

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P12L14 – It is not clear if multifractal formalism was or was not formulated in more geometrical terms. Consider rephrasing.

P14L2 – “suggest” -> “suggests”

P14L12 – I would use “algorithms” (in plural).

P14L14 – “corrention” -> “correction”

P14L16 – “sionce Ocean” -> “since ocean”

P14L17 – “have” -> “having”

P15L14 – “the” is duplicated

P15L21 – Phrase starting with “This could. . .” sounds speculative, consider rephrasing. Perhaps it can be started with “We speculate that...” if that is what authors mean.

P17L5 – “we assume”, perhaps “it is assumed” is more appropriated?

P18L17 – “for the first time” is redundant, please remove. It is understood that cited papers indicate novel research.

P19L22 – I would remove the first “small”.

P19L23 – Is it, may be, “km” -> “m”?

P19L25 – “defotmation” -> “deformation”

P21L31 – “thei” -> “the”

P21L33 – “to” is duplicated

P22L22 – Not all the terms of the eq are described in the following paragraph. Particularly, matrices R and Pf. Please correct.

P22L25 – “vecor” -> “vector”. Actually, all the following occurrences are wrong (more than 10) which made me consult three dictionaries to ensure that “vecor” wasn’t an

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accepted variant of “vector”. Please, correct.

P22L28 – The comment about the notation seems pointless from the mathematical point of view. In any case, a different letter “y” is used to highlight the fact that “x” indicates a vector in the model space and “y” indicates a vector in the observation space.

P23L9 – “covariance matrix” -> “error covariance matrix”.

P23L12 – “covariance matrix” -> “error covariance matrices”.

P23L20 – Alpha is also known as the “inflation factor” and is needed because EnKF methods tend to be underdispersive and lose spread cycle after cycle. There for, an “inflation factor” is needed to make up for the loose of spread. Consider rephrasing.

P24L10 – “Vessel Traffic Service” case has not been introduced. Does it come from Breivik and Saetra (2001)? If so, please indicate it in the text.

P26L26 – “control variance B” -> “model error covariance B”. Also, this matrix has the same meaning as Pf in the EnKF. Please, indicate it in the text.

P27L11 – “o f” -> “of”

P28L12 – “t he” -> “the”

P29L9 – “S AR” -> “SAR”

P29L20 – “hydrograpy” -> “hydrography”

P29L20 – “i n” -> “in”

Interactive comment on Nonlin. Processes Geophys. Discuss., doi:10.5194/npg-2017-14, 2017.

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