**Ocean Science
Discussions**

Interactive
Comment

Interactive comment on "Ensemble smoother for optimizing tidal boundary conditions by assimilation of high-frequency radar surface currents – application to the German Bight" *by* A. Barth et al.

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General comments This manuscript describes an innovative technique to optimise boundary conditions by assimilation of HF radar surface currents using an ensemble smoother. Overall, this work represents a substantial contribution to scientific progress within the scope of Ocean Science. The scientific approach and applied methods are valid and results are discussed in a balanced way with appropriate references and consideration of related work. Results and conclusions are clear, concise and well-structured.

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Interactive Discussion

Discussion Paper

I recommend publication of the manuscript after minor corrections. Specific comments follow.

Specific comments

- The title could be modified to specifically mention the new "Ensemble perturbation smoother" technique. This is also suggested later in the text. - Abstract, line 1: ocean surface currents - Abstract, line 16: perturbations on what?...to improve what? This can be a little bot more specific - Page 2425, line 21: "we concentrate on the M2..." -> for the sake of simplicity? Because this is the main tidal component? Please explain and say somewhere that you will also discuss the implications. This is a very specific detail of the study within this general purpose paragraph. I would suggest starting a new paragraph on this topic. - Page 2427, line 7, line 20 and eq (1): how is the SNR calculated? Does this have any impact on the <u_r> given the temporal change in the current field within the CIT? - Page 2428, line 25: please explain impact of sea state on Bragg scattering and/or provide reference - Page 2429, lines 3 and 24: "for simplicity'. So, what is the next step in order to gain accuracy? This could be discussed in the conclusions & perspectives - Page 2429, line 14: "empirical" As these data are being assimilated, I would simply state "ocean tides', otherwise the wording sounds too much 'analytical' - Page 2430, line 2: GETM is probably a free-surface model (given the present study...), but it would be good to remind the reader about it. - Page 2430, line 6: does the North-Sea Baltic Sea model have tides? Or are the BC on GETM generated only through the perturbation eq 9-11? This becomes clear only at Page 2435, line 18 - Page 2431: B does not need to be formed explicitly. But does B^{-1}? Please complement - Page 2431, line 24: re: Rayleigh. A reference or explanation would be useful. This limit is not always known under that name. - Page 2432: dimensions of alpha and L? - Page 2432, line 2, 20: (and in general) open boundaries sometimes include the air-ocean interface (besides lateral ones). Maybe this should be clarified somewhere in the text - Page 2432: t is usually used for time. I would recommend another symbol to avoid confusion - Page 2432, eq 15-17: please

explain what these equations are - Page 2433, line 12 and page 2434, line 21: I would be more specific about what are all state variables includes in the x vector - Page 2433, line 20: I would provide more details on the construction of the H operator and maybe some other examples from the literature where this matrix is more than just an interpolator. The same goes for the model state vector, which is different from the usual 3D parameters of a dynamic ocean model. - Page 2433, line 25: some references should be added here - Page 2435, line 8 and 10: why 50, why 51: please explain - Page 2435: "random": please specify the distribution - Page 2440, line 15: the importance of this point should be further emphasized, because of its dynamical implications - Fig 6-8: Line thickness should be increased. Could this be replaced by a S_HF by S_EOT calibration matrix? - Are results sensitive to the length of assimilation period? What is the minimum length?

Technical corrections

- Page 2425, line 1: "a sometimes vigorous adjustment" - Page 2425, line 21: "assimilation OF HF radar data" - Page 2425, line 24: "to a realistic data assimilation case study" - Page 2426, line 5: "Surface current observations were..." - Page 2426, lines 12, 20: 5m vs 5.02m? - Page 2426, line 12: "thus"? Is this a consequence of the preceeding wording? - Page 2426, line 12: "surface current" I would suggest explaining at this stage the need of at least 2 RADARS to get the 2 components of velocity - Page 2435, line 13: [N+1]*N - Page 2435, line 14: "to the <identity> vector" - Page 2435, line 26 and page 2437, line 8: 60 days from which date? - Page 2436, line 17: "representative" or "representation" or "representativity". I've seen it all in the literature... - Page 2437, line 17: RMS maps <of ...> - Page 2438: "show a higher" - Page 2439, line 9: "tide gauge station" - Page 2439, line 14: remove "to us" - Page 2440: two sentences starting with "Since" - Page 2440, line 7: 'by assimilation OF HF radar...' - Page 2440, line 22: "unassimilated". Which could also be worded as "validation HF radar velocities" - Page 2442, line 21: "Alvera-Azcarate" - References: number at the end of every reference? - Table 1: RMS units? - Fig 2: crosses are not obvious - Fig 5 and others:

I would add a contour of the HF radar coverage - Fig 10 caption: left and right should probably be swapped

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