Interactive comment on "Review article: Comparison of local particle filters and new implementations" *by* Alban Farchi and Marc Bocquet

Anonymous Referee #1

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1   General comments

This paper reviews the current research on localisation in particle filters and demonstrates, with results, how some of the current ideas can be developed further. The localisation methods are split in to two types; state domain localisation and sequential-observation localisation. For each type the algorithms are summarised in a general manner, links to previous research are given and any differences noted. The different methods are then explored using the L96 and a baratropic vorticity model. This exploration not only examines the performance of the algorithms themselves but also includes an assessment of the behaviour of more general choices that can be made

with regard to particle filters.

I think this is an excellent paper. It is clearly written and very nicely categorises how localisation fits in to the general literature on solving filter degeneracy in particle filters. Just enough mathematical description and introduction is given to allow an understanding of the different algorithms without overloading the reader with unnecessary detail. I'm not always convinced that there is sufficient detail in the algorithms for someone to reproduce them based on this paper alone, but since it is a review paper and the relevant references are given, I actually think the simplification aids understanding and would be an advantage when read in conjunction with the original papers.

The paper is very long and contains a huge amount of both literature review and actual results. However, again since this is a review paper and the results are all relevant and succinctly summarised I think this is acceptable. If the paper needed to be shortened then for me the sections on the different types of regularisation could perhaps be stated, rather than evidence given, but I found the results interesting and felt they added to the paper.

I think the two slight weaknesses of the paper, the use of the perfect model (not normally used with particle filters and slightly addressed with the discussion on pre-regularisation) and RMSE as the performance indicator, are acknowledged in section 5.1 and I appreciated the inclusion of the rank histograms in the appendix to at least give some indication of the ability of the schemes to correctly represent the posterior. I think a detailed analysis on the ability of the different localisation methods to correctly represent the posterior as a whole is beyond the scope of the paper (and generally very difficult to assess anyway) and the RMSE provides at least a consistent measure of comparison between the different schemes. I would hope that if further research is to be conducted with the best performing localisation schemes then a more detailed analysis of this question would be covered.

I do have a few questions and comments that I have listed below

2 Specific comments

Do I understand correctly that your observations in the L96 setup are of every variable at every time step? So your discussion on pre-regularisation in some way is a discussion on whether to use model error or not? Perhaps this could be made more explicit in the main text. If observations are of every variable at every time step then it will strongly constrain the posterior pdfs to be Gaussian and may well be influencing the results seen. This is alluded to in the main text but I think it would add insight to explicitly state this in the discussion in section 5.1 and that it is also addressed through the use of the barotropic vorticity model (which I understand uses a more sparse observational system in space and time).

The paper outlines quite a few different extensions to existing localisation methods. This is stated in the abstract and introduction and when I read the different algorithm descriptions in detail I could find the paragraph were the differences were noted. However, in general I wasn't really left with a strong feeling of where you had introduced new elements and what benefit they had brought i.e. Section 4.4.4 is entirely new work that has the best result for L96 for the state domain localisation but this is only remarked on in the final paragraph of the algorithm description section. If it was possible to include a small summary that highlights the new work and the improvement it brings, either within an already existing concluding section or as something separate, then I think it is a chance to bring your work to the fore. It would also explicitly demonstrate how setting individual schemes in to a general context can bring benefits. This could be split between the state domain localisation and sequential-observation localisation if that was the more natural division.

3 Technical corrections

Page 4, line 97. A capital N has slipped in to representatioN
Page 15, line 386. It should be 'in order to preserve part of the spatial structure held in the prior particles'
Page 16, line 404. So E^r has discontinuities?
Page 22, line 543. The sentence doesn't really make grammatical sense.
Page 25, line 625. I assume this is 's' but it would be good to explicitly state it.