

## ***Interactive comment on “The Stochastic Calculus Reformulation of Data Assimilation: on Scale” by Feng Liu and Xin Li***

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Although this is a potentially interesting paper I found it extremely hard to read. I realise that this is partly true because it stretches my knowledge of mathematics, but, as mentioned by others, the language is also not standard. A major revision is needed to make this readable for the interested NPG audience.

There are several recent works that describe the filtering problem for stochastic processes, and I'm not sure the results of the authors are new in this respect. An example is the book by Bain and Crisan, *Fundamentals of Stochastic Filtering*, doi:10.1007/978-0-387-76896-0. See also the articles by e.g. Stuart, at [http://www2.warwick.ac.uk/fac/sci/math/people/staff/andrew\\_stuart/cv/](http://www2.warwick.ac.uk/fac/sci/math/people/staff/andrew_stuart/cv/).

On the scale issue, it is not entirely clear to me what the issue is. (I apologise to the

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authors.) Is the main issue that observations and numerical models represent reality at different scales? That would make sense. However, since point observations do not exist that problem can be treated directly via the likelihood in Bayes Theorem, and I don't see the need for the measure theory developed here. Furthermore, much work has been done in the data-assimilation community on this issue, called representation error. References that might be useful are Hodyss and Nichols Tellus A 2015, 67, 24822, <http://dx.doi.org/10.3402/tellusa.v67.24822>, and perhaps Van Leeuwen (2015), Representation errors and retrievals in linear and nonlinear data assimilation. Q.J.R. Meteorol. Soc., 141: 1612–1623. doi:10.1002/qj.2464. See also the excellent work by Bocquet et al. 2011. Bayesian control space for optimal assimilation of observations, I: Consistent multiscale formalism. Q. J. R. Meteorol. Soc. 137: 1340–1356.

My suggestion is that the authors consider these references and reconsider their findings in light of those works. What has been missed by the examples of papers referred above? Why is the new framework needed, using language that the average NPG reader interested in data assimilation can understand?

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