Nonlin. Processes Geophys. Discuss., 1, C99–C102, 2014
www.nonlin-processes-geophys-discuss.net/1/C99/2014/

Nonlinear Processes in Geophysics
Discussions
Open Access

Interactive comment on "Data assimilation of two-dimensional geophysical flows with a Variational Ensemble Kalman Filter" *by* Z. Mussa et al.

Anonymous Referee #3

Received and published: 5 May 2014

1 General comments

This paper is about a recent data assimilation method called Variational Ensemble Kalman Filter (VEnKF). The paper is well written and the exposition of the method is quite interesting. But as mentionned in the paper it follows previous works : Solonen *et al.* (2012) and Amour *et al.* (2013) and it is not clear what the novelty of the paper is.

On the other hand it is not clear if the authors wanted to show that the VEnKF performs better than the Extended Kalman Filter (EKF).

So the aim of the paper needs to be clarified : what do you want to show ? what is new

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

? does this method really bring something new compared to the EnKF and why (see below) ?

2 Scientific remarks and questions

2.1 Page 404, lines 8 to 10

This is what is expected from an ensemble method but what if the EKF diverges ? It is known that the EKF may diverge but if so does the VEnKF diverge too ?

2.2 Page 406, line 16

There misses a reference about the EKF.

2.3 Page 406, line 2

Concerning the estimation or the modelling of the background error covariance matrix I recommend that you read and mention the following works : Weaver and Courtier (2001) or Pannekoucke and Massart (2008).

2.4 Page 407, line 26

There are some recent studies you seem not to know about the numerical hydrological models using data assimilation to incorporate water level measurements to improve the forecasts. You should mention here : Madsen and Skotner (2005) or Ricci *et al.* (2011) or Jean-Baptiste *et al.* (2012).

NPGD
1, C99–C102, 2014

2.5 Page 413, lines 3 to 9

You mention the issue of the "propagation ensemble degradation" encountered with the EnKF. As shown in the paper of Burgers *et al.* (1998) this issue can be circumvent if the observations are treated like random variables during the analysis steps. But mathematically this is equivalent to what you did in equation page 412, ii-correction step (b) so your ensemble should not degrade.

To study the correct spread of your ensemble I recommend that you use a rank histogram (or "Talagrand diagram") for both EnKF and VEnKF. If the rank histogram is the same for both EnKF and VEnKF then your argument about the EnKF and the ensemble degradation doesn't hold anymore. See Talagrand *et al.* (1999) or Hamill and Colucci (1997).

On the other hand the ensemble degradation should be mitigated by the use of covariance inflation methods, did you test those methods in that case ? And if not, why ? You should read the paper of Li *et al.* (2008) about covariance inflation estimation.

2.6 Page 416, line 19

Here again it is not clear if you want to show that the VEnKF performs better than the EnKF or the EKF or both algorithms.

3 Technical corrections

Page 414, line 12

Isn't it $\sqrt{S-1}$ instead of $\sqrt{S}$?

NPGD

1, C99–C102, 2014

3.1 Page 415, line 3

Take care of the capital letters in EQ.(9).

3.2 Figures page 435-442-443-444-445

Don't put the legend over the results lines !

You put the results only for the VEnKF and the EKF but it would be interesting for the reader to compare those results whith those of the model only (without assimilation) and those of the EnKF all gathered on the same figure. Can you do this ?

Interactive comment on Nonlin. Processes Geophys. Discuss., 1, 403, 2014.