Nonlin. Processes Geophys. Discuss., 1, C612–C615, 2014
www.nonlin-processes-geophys-discuss.net/1/C612/2014/

Nonlinear Processes in Geophysics
Discussions
Open Access

NPGD
1, C612–C615, 2014

Interactive Comment

Interactive comment on "Precision variational approximations in statistical data assimilation" *by* J. Ye et al.

Anonymous Referee #1

Received and published: 18 November 2014

Overview: This article describes a pseudo-annealing procedure for solving the cost function normally obtained in algorithms described as 4DVar. The paper is interesting and presented in a mostly clear manner. I have a few points to make of a clarifying nature that I believe will help the reader to follow the material better in a few places.

1) In the abstract it is stated that the authors have described an "... annealing method ... giving a consistent global minimum." I am concerned about this sentence being interpreted as implying that the authors find a global minimum. I do see that on page 1612 that the author's qualify this statement by saying that they have no proof that it is a global minimum and then claim that the word "consistent" obviously clears up any possible confusion. I do not think it does. I do understand that their minimum is "consistent" with the condition on page 1608. Nevertheless, I was confused throughout

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

my read of the paper as to whether the authors were really finding a global minimum or not. Because no proof has been provided that the author's procedure finds the global minimum and (as in the next comment) there are questions as to whether or not it does I do not think it's fair to make this claim in the abstract. At the very least the author's need to state in the abstract that they have yet to prove that the procedure converges to the global minimum.

2) The issue of the global minimum in comment (1) is related to the notion that in simulated annealing there is another step that was not described in section 3. This part of the simulated annealing procedure is critical to the topics of this paper as it is the very part of the procedure that allows simulated annealing to find the global minimum. This step in simulated annealing is the part where one accepts or rejects a transition to a new energy level based on an acceptance probability function. This randomness in the procedure allows simulated annealing to jump out of local minimum and eventually find the global minimum. Because this part of simulated annealing was not described in section 3 I must assume that the authors are not making use of it. The author's did say on page 1609 that they were not doing standard simulated annealing. I understand that and my interpretation is that this is the part of the procedure that separates what they did from standard simulated annealing. However, this part that was removed is the part that finds the global minimum. So, I do not believe that there is any theoretical foundation for the author's to claim that their procedure will find a global minimum or even by analogy to simulated annealing will find a global minimum. It is possible that I did not understand the author's description of their annealing steps and therefore maybe they are doing the acceptance probabilities step. If this is true then I suggest a major rewriting of this section to more clearly describe the author's procedure. And, if not, then I do not think it's fair to state that the author's procedure finds the global minimum.

3) One part of the procedure that I did not understand was the details of how the noise amplitude (Rf) in the stochastic discrete time map on page 1605 was varied. I

NPGD

1, C612–C615, 2014

Interactive Comment

think that a better description of exactly what is happening in a step-by-step way for the Lorenz96 examples would help. For example, equation (7) does not have explicit stochastic forcing and yet the model on page 1605 does. I think some discussion of this should be made on page 1610 to describe what is meant by this. In this case what does Rf mean? At the end of the author's procedure have they found a particular Rf that produces a stochastic model that best approximates (7)?

4) It would also be interesting to know what happens when the author's do not estimate the forcing f in equation 7 but it is nevertheless wrong in the model. I understand that the author's attempt to discuss this issue through the use of the Lorenz63 model but I found the description of this part of this section to be extremely difficult to understand. Far more discussion, and probably figures, is required here to understand what is going on with this model setup. Moreover, after such a complicated description of this experimental setup only one sentence of interpretation is provided on 1612: "This example provides a graphic illustration of the . . ." Please provide far more guidance for the reader.

5) The paragraph on the top of page 1611 that begins with "It is important to note . . ." sounds very important but this single sentence on the topic does not properly convey what's important. Please discuss more why starting with large values of Rf is so obviously incorrect. This appears to provide all the motivation for the author's pseudo-annealing technique and probably should appear earlier in the manuscript.

6) I think section 4 would be much more powerful and descriptive if the results were compared to something. It's impossible to gauge whether something is "good" or "bad" at finding solutions if it's not compared to whatever the standard method is. I think that the results of this section would be clearer and more persuasive if the author's added the solution for the same problem for a standard 4DVar system and the ensemble Kalman filter with localization and inflation. These two systems are trivial to implement in Lorenz96. In this way the reader could then understand how easy or difficult this configuration of Lorenz96 is and how much better this new technique is.

NPGD
1, C612–C615, 2014

Interactive
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

7) Lastly, I was wondering if the author's title should be "Precise variational approximations . . ." rather than "Precision variational approximations . . ."?

Interactive comment on Nonlin. Processes Geophys. Discuss., 1, 1603, 2014.

NPGD

1, C612–C615, 2014