

# ***Interactive comment on “Precision Annealing Monte Carlo Methods for Statistical Data Assimilation: Metropolis-Hastings Procedures” by Adrian S. et al.***

**Adrian S. et al.**

asw012@ucsd.edu

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Thank you for your suggestions about our paper.

**Bold text** are the referee’s specific comments, and non-bold text are our responses.

**the first major change that has to occur if for the notation to conform to that of Ide (1997) so it is possible for the reader to compare to other DA systems, rather than translating what we think you are doing.**

Our notation has been used widely, and to our knowledge, conforms to general use. X are state variables and Y measurements.

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**You refer to at one point a diagonal precision matrix, but how is that related to the error covariance matrices of current DA systems?**

Precision matrices are well known to be inverse covariance matrices for Gaussian distributions.

**What is beta? you perform a whole set of analyses on this parameter but it is never defined, nor is it named correctly. Having just looked over the manuscript i find that beta is defined in the caption of figure 2, this need to be in the text when it is first introduce so the reader is prepared for this to understand the discussion and the figure itself.**

If this were so, it would be quite unacceptable. Fortunately  $\beta$  is defined, we thought clearly, on p. 10 near equation (13).

**Equation 4: You make no reference to the two previous papers that introduced this formulation of 4DVAR, van Leeuwen and Evensen (1996) and Fletcher (2010).**

We think this goes back to work of Bennett around 2001. In any case, this is not a paper about 4Dvar, It is a paper about how to use Monte Carlo methods in performing expected value integrals such as Eq. (5). As such, the references to 4Dvar are limited, and references to Monte Carlo methods more extensive, e.g. Neal's paper from 2011. This is relevant to the subject of our paper.

**the figure caption for Figure 3 is too long.**

Actually we find it quite useful, and about the right length.

**The grammar is quite bad in places with tenses and pluralities incorrect too many times.**

We have read the paper over in detail several times. We do not find what the referee says here to be correct. It could be our flaw, of course, and we ask that some specific examples be identified so we may look at them.

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## How does this approach compare relative to CPU time to current variational and ensemble based system?

Thank you for the comment/suggestion. We have included an estimate of the computation times for the results shown, and further details will be shared as per Referee Penny's comments.

## How operationally viable is this approach? You need to address the feature or wall clock time for this approach

This not an operational paper. This is a theoretical method that we introduce that has not been considered before: MCMC with precision annealing (see the references). Again, this is not 4DVar which only seeks the minimum of  $A(X) = -\log[P(X)]$ . MCMC also samples in the neighborhood of those minima. 4DVar requires the derivatives of  $A(X)$ , MCMC does not. That was the motivation for exploring it.

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