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Climate of the Past Discussions

Interactive comment on "An assessment of climate state reconstructions obtained using particle filtering methods" *by* S. Dubinkina and H. Goosse

Anonymous Referee #3

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Overall, I think this is an interesting and useful paper. The authors consider three variants of data assimilation methods, and test their performance for a regional reconstruction over the last 150 years. The investigation is perhaps a little limited, and they don't really assess climate state reconstructions, only reconstruction methods. Nevertheless, I consider that it should be published, after some mostly minor corrections.

I have one more substantial suggestion, which is that the performance should be evaluated against a no-assimilation solution. The reason for this is that the high correlations found between estimate and truth are (as the authors themselves note) largely due to the strong externally-forced trend, which the model follows independently of the assim-

ilation. One possible approach might be to calculate the correlation of residuals from the mean no-assim result. Alternatively, a conventional calculation of skill relative to the no-assim baseline.

The rest, below, is mostly terminology and wording.

Title: You are really assessing methods, not reconstructions. "An assessment of particle filtering methods for climate state reconstructions"?

p44 l15 "*such* as atmospheric..."?

l15-18 seems internally inconsistent - it is hard to see that opposite pattern (I presume this means negative correlation and skill) can be satisfactory for any application.

p45 l8 "biased" is a poor choice of word. "limited"? It may be worth mentioning the assumption of gaussian likelihood, which although you also adopt in this paper, is not necessary for particle filtering.

l24 This wording is imprecise - the variance of weights increases over time, irrespective of ensemble size. Also, so long as the degeneracy only takes place over several assimilation cycles, resampling is a reasonable solution. The approaches of van Leeuwen and others increase the efficiency.

p48 l23 "no information". But you generated the ensemble somehow. Probably you intend to sample randomly from the attractor (requiring sufficient spin up from perturbed initial conditions), which could be clearly stated here.

p49 Perhaps a couple of sentences to explain where the likelihood comes from, ie the probability of a particular set of observations, conditional on the underlying state. I think it's worth clarifying that the likelihood is not really an assumption of the algorithm or often even the data assimilation researcher, instead being determined by the observation uncertainties.

p50 l12 I think nudging is common enough in atmospheric modelling, especially these

days when using regional models for dynamical downscaling. But not, perhaps, for initialising predictions (which you mentioned previously). Suggest rewording here.

p50 l13 I like the terminology "implicit particle filter" for the generic approach (several papers use this phrase), though in the particular case, "nudging particle filter" might be more precise.

p51 l12,14 Notation seems unclear to me. Haven't you already defined the transition densities as having non-zero mean?

p53 l13 (0.5C)^2 would be less ambiguous.

p55 l20 As mentioned earlier, I strongly recommend that all calculations are performed relative to the no-assim run (i.e. mean of no-assim ensemble). This would enable a more direct assessment of the performance of the methods without conflating this with the forced response.

p57 The description here seems a bit garbled. You ignore data north of 60S in order that this does not introduce too many degrees of freedom and lead to degeneracy, right?

Interactive comment on Clim. Past Discuss., 9, 43, 2013.