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Interactive comment on "The "ABC-DA system" (v1.4): a variational data assimilation system for convective scale assimilation research with a study of the impact of a balance constraint" *by* Ross Noel Bannister

Anonymous Referee #1

This paper describes a DA system that has been built for the ABC model of Petrie et al. (2017). The entire system, ABC-DA, is described as flexible, configurable, and efficient enough to be run on a personal computer. One of the stated applications of the ABC-DA is to study convective-scale DA. This system could also clearly be used as a teaching aid for DA students. Section 4 gives a tutorial on variation data assimilaton and a practical "how to" for constructing a 3DVar system. Section 4 gives a tutorial on control variable transforms (CVTs) and is also a practical "how to" for developing CVTs. These two sections are well written tutorials which, by themselves, could serve as a

good teaching aids.

I would recommend the publication of this paper after the author addresses a few minor comments.

1. Figure 7 might be more easily interpreted if the correlation rather covariance were plotted. It is not easy evaluate the importance of the cross-covariances (columns 2 & 3).

2. A ensemble of forecast perturbations is used for training/developing the CVT. The author describes this raw ensemble in this way: " We regard the raw covariances as a guide to the 'true' covariances that should ideally be modeled by the CVT.". In principal, the ensemble could be made large enough to provide a very accurate covariance, from which the implied covariances (from CVT choices) could be directly evaluated. Is the model state size too large to create a full rank (or nearly full) for this type of comparison?

3. Following on comment #2. If the training ensemble is of low rank, then it is well known that the covariances must be localized. It is possible that the covariance used for the experiments (i.e. bottom row of Figure 7) should be localized before used for developing the CVT?

4. There is much current research on using ensembles to represent the B matrix in variational DA. Can you comment on any plans to incorporate the ability to directly use an ensemble to perform the background covariance multiply, or possibility a hybrid approach?