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Interactive comment on "DATeS: A Highly-Extensible Data Assimilation Testing Suite" *by* Ahmed Attia and Adrian Sandu

Anonymous Referee #3

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General comments

I fully agree with the comments of the other two referees. In particular, I would like to echo Referee #1 specific comment on the need to improve scientific/technical aspect of the paper, so that it reads more like a scientific paper rather than a user manual. I also find Referee #2 comments on covariance localization and limitations due to using state-size square matrices very important to address.

Specific comments

1. What is the largest state size that DATeS can handle, given that a full-state quadratic matrix is used (Nstate x Nstate), as stated on page 8, line 15 and in Figure 13? On page 14, line 7, you mentioned that the state size was Nstate=16641 in your QG model

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experiment. Did you really evaluate matrices of the size 16641 x 16641 in that experiment? Please elaborate on how high-dimensional model state problems are addressed and what the limitations of the current algorithm are regarding this aspect. Furthermore, an option to use non-quadratic state matrices of size Nstate x Nens needs to be discussed as a possible extension in the future, explaining how this can be done.

2. Are applications of DATeS intended for complex atmospheric models, such as WRF or NOAA future operational global model (FV3, https://www.gfdl.noaa.gov/fv3/)? What about coupled atmosphere-ocean models, requiring coupled forecast error covariance and covariance localization? Please elaborate on these issues.

3. How extensible the DATeS is with respect to the following aspects: (1) Weak constraint ensemble, variational and hybrid ensemble-variational data assimilation (also pointed out by Referee #1) and (2) Data assimilation problems with correlated observation errors (e.g., addressing cross-channel correlations of satellite radiances).

4. A special attention needs to be taken to forecast error covariance localization for ensemble-based approaches (also pointed out by Referee #2). Two covariance localization methods are typically used: (1) localization in model space and (2) localization in observation space. Please explain, in more detail, the covariance localization approach used in the current version of DATeS and how you plan to extend it in future applications with more complex models.

5. Page 3, Eq. (3): The conditions should also include an assumption that the observation and background errors are independent (un-correlated).

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