



EGUsphere, referee comment RC2
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Comment on egusphere-2022-719

Anonymous Referee #2

Referee comment on "Estimation of CH₄ emission based on an advanced 4D-LETKF assimilation system" by Jagat S. H. Bisht et al., EGU sphere,
<https://doi.org/10.5194/egusphere-2022-719-RC2>, 2022

General Comments

Bisht et al present a data assimilation system for local ensemble transform Kalman filter, and evaluate that through OSSEs, particularly testing three covariance inflation methods (fixed multiplicative, relaxation to prior spread, and adaptive multiplicative) and two observing networks (surface dense network and GOSAT satellite network). This manuscript describes several interesting findings. I have three concerns.

- This OSSE does not account model transport error, which would result in over-optimized solutions.
- The number of ensemble members is not sufficiently greater than the dimension of the state vectors, which might bias the inversion performance interpretation.
- Several sections require clarifications, as in the following "Specific Comments".

Specific Comments

L43: "CI in the stratosphere". Suggest including CI in the troposphere.

L22: Typo, "the ensemble forecast of CH₄ concentrations"

L79: "Advanced". Could you please specify what is the advanced aspect of this study, comparing to the previous studies using the same model? Is it the setup of the multi-window optimizing framework, or these inflation methods, or others?

L188: "by 30%". Unclear if this is uniform bias. According to the later text, the perturbation is not uniform. Could you please specify the way to combine this "30%" with the following regional/grid level perturbation?

L196: "Experiment1". The word is misleading. Confused the readers if these experiments are corresponding to the experiments in section 4.1 and 4.2 (in fact, they are not).

L196: "regional basis over land" and "every grid over ocean". Please explain why emissions over land and over ocean are perturbed differently.

L207: "Only surface layer CH4 concentrations are used". Both over land and ocean? Please explain if the "dense observation network" include all surface grids or a collection of surface networks. If it is the first case, the word "dense observation network" is confusing.

L208: "added a constant measurement uncertainty of 5ppb". Please explain the way to add this 5 ppb (uniformly increase/decrease 5 ppb?). Also, typo, space between "5" and "ppb".

L236: "3.4 Experiment2". In experiment 1, "dense observation formulation", the author added measurement uncertainty of 5 ppb. Please explain why experiment 2 has no observation error, given the fact that satellite observations have larger uncertainties than measurements of surface sites.

L406: "Machine learning tools could be used to". Machine learning comes from nowhere. Please explain why it would help.