Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2019-95-RC2, 2019

Geoscientific Model Development Discussions

Interactive comment on "Volcanic ash forecast using ensemble-based data assimilation: the Ensemble Transform Kalman Filter coupled with FALL3D-7.2 model (ETKF-FALL3D, version 1.0)" *by* Soledad Osores et al.

Fei Lu (Referee)

feilu@math.jhu.edu

Received and published: 30 August 2019

The paper provides a nice application of data assimilation method to volcanic ash forecast, using the Ensemble Transform Kalman Filter with the FALL3D model. In particular, the paper investigates the possibility of estimating the parameters in the model, so as to reduce uncertainties related to eruption source parameters. The author reported that the joint estimation of concentration and source parameters lead to better analysis and forecast of the 3D ash concentrations.

Parameter estimation is an important part of model development. The paper investigated different scenarios: static parameters, time-dependent parameters, and sensitivity analysis. Such a systematic study of joint parameter state estimation will be helpful for further development of volcanic ash cloud modeling. Therefore, I recommend its publication at GMD. But a few important details seem missing:

- What is the model for the parameter flow in the ETKF? In page 4 line 30, the authors mentioned that "a persistence model is assumed for the model parameters (i..e $\theta_t^f = \theta_{t-1}^a$)". This would mean that the model for the parameter flow is $\theta_t = \theta_{t-1}$, and the ensemble of the parameters will only shrink, which does not agree with the plots in Figure 4, where the ensemble oscillates as if $\theta_t = c\theta_{t-1} + W_t$.
- How is the ensemble of the parameter generated at the initial time? How is the physical constraint (page 8 line 15) ensured in the spread of the ensemble at all times? The physically meaningful range (page 8 line 15) is 0-20 km and 0-15, but the spreads in tests are 500m and 0.5 (page 8 line 24). Is there any specific reason for such a relatively small spread?
- Is it possible to describe how does the FALL3D model depend on the parameters? Are there some parameters lead to instability or unphysical state values?

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2019-95, 2019.