

# ***Interactive comment on “Chaotic dynamics and the role of covariance inflation for reduced rank Kalman filters with model error” by Colin Grudzien et al.***

## **Anonymous Referee #1**

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Dear Editor,

I have read the manuscript Chaotic dynamics and the role of covariance inflation for reduced rank Kalman filters with model error by Colin Grudzien, Alberto Carrassi, and Marc Bocquet.

This paper deals with the role of covariance inflation for reduced rank, in particular for AUS variants, of Kalman filters, when the time evolution is affected by model error.

The authors analyze in a very formal and rigorous way the effect of the presence of model error in both filtered and unfiltered space. In particular they emphasize the role of the dynamical upwelling of model errors from the unfiltered to the filtered space and

the importance of this effect in leading to filter divergence.

The difference between covariant and Backward Lyapunov vectors is already known but the authors treat this subtle point in a very precise way and this is surely a merit for the paper.

The authors are also right when they state that this form of divergence is not due to nonlinearity of error dynamics and consequently is different from the case described in Palatella and Trevisan 2015.

the authors of a recent paper

Palatella, Luigi, and Fabio Grasso. "The EKF-AUS-NL algorithm implemented without the linear tangent model and in presence of parametric model error." *SoftwareX* 7 (2018): 28-33.

show a possible way to manage model error in the framework of EKF-AUS filters in a very low dimensional model. In particular they suggest that a new direction in the phase-space should be filtered for each degree of freedom of model error. Their approach is obviously unfeasible in high dimensional model, so I think that the approach followed by the authors of the manuscript under examination is important and worth of publication on NPG.

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Interactive comment on Nonlin. Processes Geophys. Discuss., <https://doi.org/10.5194/npg-2018-4>, 2018.

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