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Geoscientific Model Development Discussions

Interactive comment on "A low-order coupled chemistry meteorology model for testing online and offline data assimilation schemes" *by* J.-M. Haussaire and M. Bocquet

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General comment

This manuscript is dealing with the development of a low-order coupled chemistry-atmospheric model, extending a previous model version developed by Bocquet and Sakov (2013). In this new version, a photochemistry module is incorporated allowing for the production and destruction of chemical species (essentially Ozone and NOx formation). In the present manuscript It is used for analyzing the impact of data assimilation on the estimation of wind and chemical species fields, and different experimental setup are investigated to clarify the best data assimilation scheme to use and the best

strategies to adopt to assimilate chemical data. This manuscript is very well written and this new model is well documented. To my opinion this paper deserves publication since it provides a new very usefull tool for investigating the coupling between dynamics and chemistry.

I would like only drawing the attention of the authors to some points that would deserve some clarifications and/or comments.

Specific comments

First, it is not very clear to me what is the nature of the nonlinearities of the chemical module. Could you clarify that aspect (maybe when discussing Eq. 12)? If there are nonlinearities, what are their impact of the presence of these nonlinearities on the emergence of different solutions (for fixed parameters)? And would you please clarify (or comment) if this chemistry module could lead to complex dynamics (e.g. chaotic dynamics)?

Second as far as I remember the L95 model displays features like anti-correlations in space that looks to me quite unrealistic. Moreover I am not aware if this system can display more space-time intermittent behaviors, regimes that could be very interesting to explore when dealing with more realistic dynamics close the surface of the Earth (and at smaller scales). Personally I would have chosen an advection model with turbulent properties like the Burgers model or the Kuramoto-Sivashinsky model that are displaying very rich dynamics with potentially intermittent behaviors, and very interesting predictability properties (e.g. Vannitsem and Nicolis, Predictability experiments on a simplified thermal convection model: The role of spatial scales, J. Geophys. Res., 99,10377–10385, 1994). Could you comment on the limitations of the L95 system for such an investigation (This could be part of the discussion in your conclusions on the extension of the model)?

Finally I am wondering whether there is any impact of the daily variations of the rate "constant" k3 (non-autonomous dynamics) on the performances of the data assimila-

tion schemes. Does this temporal variation have no impact?

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