Geosci. Model Dev. Discuss., 8, C941–C943, 2015
www.geosci-model-dev-discuss.net/8/C941/2015/

Geoscientific Model Development Discussions

Interactive comment on "A semi-Lagrangian advection scheme for radioactive tracers in a regional spectral model" *by* E.-C. Chang and K. Yoshimura

Anonymous Referee #1

Received and published: 3 June 2015

General Comments:

This article investigated implementation of semi-Lagrangian advection scheme in a specific type of numerical atmospheric model for limited-area, namely the Regional Spectral Model. It is mathematically known that usage of spectral dynamics can show up negative values when some features have spatially discontinuous distribution: known as Gibbs phenomenon. Since tracers and hydrometeors are definitely impossible to have negative value in the nature, the phenomenon causes serious errors especially when there is a single point emission of tracers.

The authors implemented semi-Lagrangian scheme to avoid the Gibbs phenomenon

and evaluated behavior of simulated radioactive tracers with new advection scheme in their model, throughout a case of Japanese nuclear power plant explosion when it was hit by earthquake-induced tsunami. Effect of new advection scheme is very clear: noise-like signals formerly induced by Gibbs phenomenon are completely eliminated for tracers as well as hydrometeors.

The uniqueness of this study lies in their model framework and target of simulation; this advection scheme has rarely introduced in regional spectral model so far especially with considering emission of radioactive tracers. The objective of this study is very clear and it accomplished the authors' purpose appropriately. The paper is well-prepared and worth to be published. This reviewer raises few suggestions as below.

Specific Comments:

[1] Besides elimination of Gibbs phenomenon for nonnegative variables, can the model bring additional improvements, such as enhanced performance and/or predictability? It is questionable at this stage; this reviewer recommends providing more and clarifying explanations in the manuscript.

[2] Page 4222, in the first paragraph of the introduction, the authors may need to emphasize what the specific advantage of "regional" spectral model is.

[3] This reviewer recommends strengthening information given by the introduction section. Study of Staniforth and Côté (1991) provides classical and comprehensive review, which may be referable in this paper. Recently, some studies have endeavored semi-Lagrangian advection scheme in regional model frameworks (e.g., Aranami et al. 2014); referring and comparison with those studies may helpful to address uniqueness of this study.

[4] Page 4223, line 3 to 4, it would be helpful if the authors provides brief descriptions about what kinds of topics have investigated with usage of regional spectral models. Besides NCEP RSM, there are series of regional spectral models that have been used

(e.g., Lee and Hong 2014 and some references therein), which would be helpful to strengthen the importance of this study.

[5] Page 4231, line 21, “However, $\sim$ errors.” Regarding to aforementioned description, it is hard to find materials underpinning this. Even though the simulated precipitation is far from the observation, as noted by the authors at the last paragraph of the last section, this reviewer thinks it is worth to show corresponding observation with respect to figure 9 and provide statistical index such as spatial correlation and/or root-mean-square error. This would be helpful to objectively explain even when model results are similar between ORG and SL experiments.

Technical Corrections:

[1] Page 4224, line 1 to 2, GMP looks like different model to GRIMs while the GMP is a part of GRIMs. Please clarify the sentence.

References:

Aranami, K., T. Davies, and N. Wood, 2014: A mass restoration scheme for limited-area models with semi-Lagrangian advection. Q.J.R. Meteorol. Soc.. doi: 10.1002/qj.2482.

Lee, J.-W., and S.-Y. Hong, 2014: Potential for added value to downscaled climate extremes over Korea by increased resolution of a regional climate model. Theor. Appl. Climatol., 117, 667-677, doi: 10.1007/s00704-013-1034-6.

Staniforth A. and J. Côté, 1991: Semi-Lagrangian Integration Schemes for Atmospheric ModelsâĂŤA Review. Mon. Wea. Rev., 119, 2206–2223. doi:10.1175/1520-0493(1991)119<2206:SLISFA>2.0.CO;2

Interactive comment on Geosci. Model Dev. Discuss., 8, 4221, 2015.