

## ***Interactive comment on*** “Differences between downscaling with spectral and grid nudging using WRF” **by P. Liu et al.**

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*We thank the reviewer for his thorough, thoughtful and constructive comments. Italicized responses to each of the comments are listed below.*

### **Comments:**

1. An additional comparison with “free” simulations would be interesting.

*Results from the simulations without nudging will be added.*

2. What are the synoptic (large scale) situations when the simulations differ strongly on the smaller scales?

*The frontal systems are, in part, associated with the stronger difference at the smaller*

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scales. For example, as shown in page 1210 Fig.3, during 8<sup>th</sup> and 9<sup>th</sup> of Jul 2009, simulation shows large differences at the smaller scales by spectral nudging. We used accumulated convective rain during those two days as the proxy of frontal systems and investigated the spatial distribution of the relative difference of horizontal kinetic energy at 850hpa between the driving field and WRF simulation at the small scale (as shown in Fig.1 here). We found out that the regions where simulations differ strongly at the small scale are usually the regions where convective rains occur (as shown in Fig. 2 here).

3. The concept that a difference between an RCM simulation and observations would necessarily represent an “error” is wrong; RCM simulations are ill-posed problems, and due to the internal chaotic dynamic, the model may develop different trajectories – a tendency which is strongly reduced when nudging is applied. This phenomenon is long known, and discussed in some detail in Weisse, R., H. Heyen and H. von Storch, 2000: Sensitivity of a regional atmospheric model to a sea state dependent roughness and the need of ensemble calculations. Mon. Wea. Rev. 128: 3631-3642 (see further references in that paper)

*We thank the reviewer for pointing this out. In page 1197 line 25, we mentioned that “similarity between NCEP/NCAR and NARR at small scale cannot be used directly as the criteria. Instead, the difference of similarity between large and small scale would be used as the reference when assessing whether the change in similarity between input and downscaled fields is reasonable.”*

4. Unfortunately, the authors have overseen the rich literature on related issues since our von Storch et al. (2000) paper, in particular: Feser, F., B. Rockel, H. von Storch, J. Winterfeldt, and M. Zahn, 2011: Regional climate models add value. Bull. Amer. Meteor. Soc. 92: 1181–1192 with many relevant references, and Feser, F., 2006: Enhanced detectability of added value in limited area model results separated into different spatial scales. Mon. Wea. Rev. 134(8), 2180-2190, in which a similar strategy was employed as in the present manuscript, namely regional analyses as a reference

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for determining the added value over the driving NCEP re-analyses.

*Our intent was not to present a thorough review in the introduction, but rather to cite a few important references. We agree that more could be added, and have included the suggested references and discussion.*

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Interactive comment on Atmos. Chem. Phys. Discuss., 12, 1191, 2012.

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12, C682–C686, 2012

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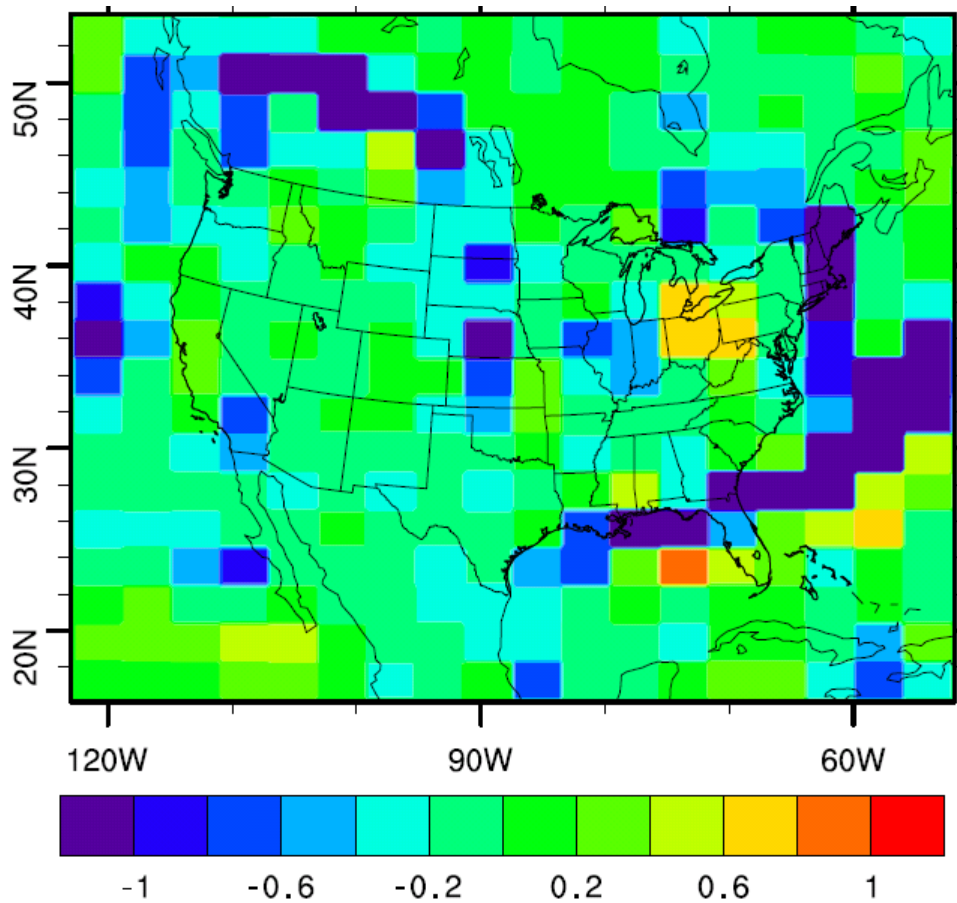


Fig. 1.

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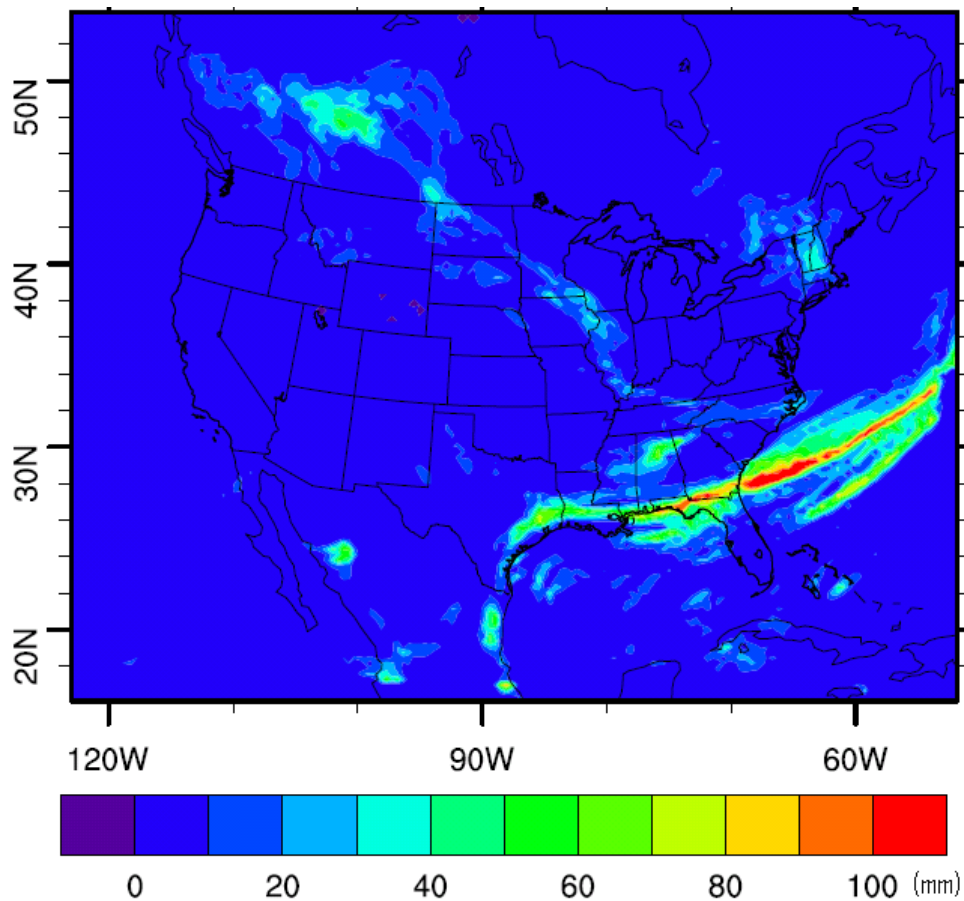


Fig. 2.