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Comment

## ***Interactive comment on “Quantifying the sub-grid variability of trace gases and aerosols based on WRF-Chem simulations” by Y. Qian et al.***

### **Anonymous Referee #2**

Received and published: 24 June 2010

This paper contains a detailed analysis of the sub grid scale variability that could be expected in a global climate model based on results from a regional model. The scientific work is thorough and relevant to current issues in atmospheric modeling. I therefore recommend it for publication subject to the following comments below.

#### General Comments:

Both the abstract and the discussion would benefit from expanding the discussion of the significance and applications of the work. For example this work could be related to the common experience that performance metrics are worse with higher resolution simulations. The work on cloud variability and land use variability (Avissar and Pielke) is mentioned in passing, but seem like they could benefit from more in-depth treatment in the discussion section. One application of SGV is the chemical processing that takes

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place in urban plumes but cannot be represented in global models, see for example the work of M. Mayer, J. Calbo and RG. Prinn.

There is a bit of ambiguity about the scale of features being explored. For example, Page 10780 Line 9 uses “small-scale”, but this should be defined more clearly. Maybe a table of scales of different features would help. Page 10779, Line 17: “SGV is present . . . even when very small grid spacings are employed” it seems this is either redundant, or can be meaningful in terms of a discussion of feature scale.

Would it be possible to include some experimental results of SGV or of PDF to complement the simulation results?

In general, I found sections 3 and 4 to be longer than they needed to be with the message swamped in details. If anything, Section 5 and 6 could maybe be adjusted to bring out the implications of the results more clearly.

Specific Comments:

Doesn't WRF use “eta” not “sigma” levels?

Page 10779, Line 23: full stop after “western US”

Page 10779, Line 26: “effectively extrapolate” was not clear to me what this means exactly.

Page 10796, Line 11: I thought that SD was the root of the square of the differences – the exponent is missing.

Page 10800, Line 10,11: Specie\*s\*? MOSAIC not MOSIAC

Page 10804, Line 22-23: “The SGV for C3 is larger than for C15” – wouldn't you expect this by definition? Given the model set-up, would it not be more accurate to talk about the SGV at 75km based on the C3 simulation. It seems that this is a further example of the need to discuss the scale of simulated features more thoroughly.

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Page 10806, Line 26-27: This is to be expected given that emissions take place during the day, and so presumably background / air mixed on a larger scale dominates at night?

Page 10807, Line 28 – 1: Again, it seems that this is fairly obvious (surface impact of terrain), but what is the implication of this?

Page 10812, Line 1-4: see note for pg 10804 above. You are approximating the SGV at 75km using simulations at 3km and 15km. The text is not entirely clear about this. It seems that the finer the simulations used to estimate the SGV, the larger the results would be?

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Interactive comment on Atmos. Chem. Phys. Discuss., 10, 10777, 2010.

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