Review of : Impacts of the mountain-plains solenoid and cold pool dynamics on the diurnal variation of precipitation over Northern China

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Recommendation: Accept with minor revisions

Overview

This paper describes a series of convection-resolving simulations over East-Asia aimed at determining how the mountain-plains (MPS) solenoid influences convection and how various effects of convection (latent heating, evaporative cooling) influence the MPS. Overall, the paper is interesting, well-written and informative. However, attribution of the strength and propagation characteristics of the MPS and convection to various causes is complicated because of their close coupling. Another aspect complicating the interpretation of results concerns differences in the design of the control simulation (CNTL) and the sensitivity studies (FAKE-DRY, and NOEVAP). The paper could be strengthened with either some additional results and/or more clarifying discussion of these limitations of the current experimental design and analysis (see general comments below).

General Comments:

1. CNTL is a 15-day continuously running simulation, while the sensitivity studies designed to test the effect of eliminating various moist processes are much shorter (24-h) simulations that use initial conditions from CNTL (which includes moist processes). The authors argue that this experiment design is necessary in order to preserve large-scale conditions found in CNTL for the sensitivity experiments. This is a legitimate concern and perhaps a valid reason for the current design. However, such a design may obscure the overall (e.g., climatological) effects of the withheld moist processes on the MPS circulations.

For instance, it is very well known that vertical circulations are stronger in deep, moist convection than in the surrounding dry air. I would argue that this effect largely explains the stronger vertical motions in the CNTL MPS than it's analog in FAKE-DRY - a point hinted at by reviewer Dr. C. C. Wang in his comments concerning what is the MPS and what is convection?

To assess the overall effect of latent heating processes, analysis of a 15-day continuously running FAKE-DRY simulation should also be included. The longer-term elimination of atmospheric temperature changes due to convection would favor a dry-adiabatic stratification in the interior of the domain. In that situation, one might imagine a very different result with a stronger MPS than that occurring in CNTL, since there would be less resistance to vertical displacements in an environment with much lower static stability. At the very least, the authors need to discuss this possibly in the revised version of the paper.

2. The “no evaporation” (NOVAP) experiment produces the interesting result of more precipitation and a stronger MPS than in CNTL. However, there is very limited discussion of why this might be true, which I found somewhat dissatisfying. In fact, other than to show that evaporation influences the movement of both the precipitation and the vertical motion pattern, it is not clear why this experiment was even presented in the paper. The authors argue that there would be stronger mountain-plains temperature gradients (on a constant pressure surface), and thus a stronger MPS, during the day when evaporation is not included, due to less local cooling from mountain convection. I agree with this conclusion. However, there are factors independent of the MPS that might be influencing the heavier precipitation in the NOVAP experiment. First, evaporatively cooled downdrafts have been shown in some situations to have negative effects on the strength of the convection and amount of precipitation (e.g., Schumacher 2009, Trier et al. 2011). This is not mentioned. The authors emphasize only the positive effects of cold pools on sustaining precipitation systems instead of the possible negative ones. Second, a more obvious effect of excluding evaporation is that for convection of a given strength, more precipitation reaches the ground when evaporation is withheld. These aspects should be quantified (or at least discussed) when NOVAP is presented.

Specific Comments:

1. **P. 27893, lines 9-25.** This comment concerns this literature review of propagating convection in the lee of major mountain ranges. Here, the authors have failed to mention recent work on observed (Laing et al. 2008) and simulated (Laing et al. 2012) propagating convection in the lee of mountains in tropical northern Africa. Given that such propagating convection is global in nature, the authors should consider referencing these studies, since most of the current references are limited to the midlatitudes.

2. **P. 27896, lines 26-29.** Why is only evaporation neglected in experiment NOVAP? If you are testing the effects of latent cooling, it seems you’d want to eliminate all such physical processes including melting.

3. **P. 27901, lines 9-12.** I would argue that vertical motions of order 1 m/s are still quite strong given that scales less than L ~ 200 km have apparently been removed.

4. **Figs. 8, 10, 11 and related discussion.** Please consider enlarging or re-organizing these figures in some other fashion. The circulation vectors were very hard to read on my copy, which made it more difficult to follow the related discussion.

5. **P. 27905, lines 4-7.** This statement of evaporation providing convective enhancement appears somewhat at odds with results from the NOVAP run shown in Figs. 4 and 6 (see general comment 2).

6. **P. 27098, lines 8-10.** Similar to the previous comment, it is not clear to me from the figures presented that the NOVAP MPS is weaker than the CNTL MPS.

References:

Laing, A. G., R. E. Carbone, V. Levizzani, and J. Tuttle, 2008: The propagation and diurnal cycles of deep convection in northern tropical Africa. *Quart. J. Roy. Meteor. Soc.*, **134**, 93-109.

Laing, A. G., S. B. Trier, and C. A. Davis, 2012: Numerical simulations of organized convection in tropical northern Africa. *Mon. Wea. Rev.*, **140**, 2874-2886.

Schumacher, R. S., 2009: Mechanisms for quasi-stationary behavior in simulated heavy-rain-producing convective systems. *J. Atmos. Sci.*, **66**, 1543-1568.

Trier, S. B., J. H. Marsham, C. A. Davis, and D. A. Ahijevych, 2011: Numerical simulations of the postsunrise reorganization of a nocturnal mesoscale convective system during 13 June IHOP_2002, *J. Atmos. Sci.*, **68**, 2988-3011.