Review of acm-2015-1015

Overall Comments:

This review concerns the manuscript acm-2015-1015, which I reviewed two times previously. I am still not in agreement with the authors on several aspects of the work. However, I do not think that agreement is necessary for publication. Given the back-and-forth with the authors along with the latest revision of the manuscript, I can at least determine what was done and that it appears to be consistent. Although my own personal opinion is that there are currently better ways for doing the type of downscaling that is the focus of this work, it will be up to future workers to decide what will ultimately be adopted and prevalent. My recommendation is to accept the work pending the authors' resolution of a few lingering issues (below).

Previous Review Major Comments:

1. Sub-grid turbulence model: I think we are starting to get through some of the confusion regarding this point, which in my opinion was driven by the combination of terminology used and a scattered description of what was done.

I will attempt to describe the model as briefly as possible. If my understanding is still incorrect, the authors should consider how they can edit the text such that the description is clear for future readers.

Let's consider only the equation for V:

$$V_{k+1} = V_k - \nabla_x \overline{p} \delta t - C_1 \frac{\varepsilon_k}{K_k} \left[V_k - \langle V \rangle \right] \delta t + \sqrt{C_0 \varepsilon_k} \Delta B_{k+1}. \tag{1}$$

Variable	How specified	Reference
V_{k+1}	Eq. 1 above	Line 374.5
V_k	particle velocity at previous iteration or initial condition	k subscripts not defined?
$\nabla_x \overline{p}$	Meso-NH coarse grid (forcing)	Lines 388-393
ε_k	Meso-NH coarse grid (forcing)	Lines 388-393
K_k	particle velocity along with average operator $\langle \cdot \rangle$	Lines 441-443
$\langle V \rangle$	particle velocity along with average operator $\langle \cdot \rangle$	Lines 366-368,441-443

Some final remarks regarding this point:

- Although I now think I understand what was done, and agree that it seems to be consistent, it still seems strange to me to dump the resolved velocity at the grid scale. The resolved velocity already resolves most of the TKE that the model is trying to replicate. Based on Fig. 1 of the reply, I have a hard time believing that the so-called 'velocity increment' approach was implemented correctly (V looks ok, something is clearly wrong with U and W because if filtered it would not follow the trend of the Meso-NH velocity). Regardless, the authors are free to use any approach they like, and it will be up to the community to decide which methodologies are ultimately adopted.
- The description of the methodology in the paper is, in the opinion of this reviewer, difficult to follow and cumbersome. Just to figure out how to implement Eq. 1 (above) requires sorting through several hundred of lines of text. I would think that a much clearer and condensed description is possible.

2.-5. Others: We are either in agreement or at an impasse regarding the other major comments, and no further discussion is likely to be fruitful.

Minor Comments from Previous Review:

16. Sect. 6.1.3 (velocity spectra) : I have quite a few concerns with this section : – For the SLM used here, we know that 1. An ensemble of particles at any location should have TKE K, and 2. The variance of particle velocity increments at any location should be $\langle du^2 \rangle = C_0 \varepsilon dt$, which is consistent with Kolmogorov theory. Given this, should we expect the particle velocity spectra to follow $k^{-5/3}$ scaling?

The SLM has been designed to follow the $k^{-5/3}$ scaling [6]. Here the idea is to assess the behaviour of particles driven by the SLM when it is forced by Meso-NH ?that is to say when the pressure gradient and the dissipation rate are given by Meso-NH.

I have searched the references to the work of Pope, and have found no mention of a requirement that the model should follow $k^{-5/3}$ scaling, rather that it should follow the second similarity hypothesis of Kolmogorov which implies $\langle du^2 \rangle = C_0 \varepsilon dt$. My understanding is that $k^{-5/3}$ is a consequence of both the first and second similarity hypotheses together. However, through our previous discussion we agreed that the model satisfies only the second similarity hypothesis. Can the authors please provide a more specific reference to the work of Pope to help me understand why we should expect the model to follow $k^{-5/3}$ scaling? If not, it seems that Sect. 6.1.3 requires some revision.