

**Review of “Influence of high-resolution surface databases on the modeling of local atmospheric circulation systems”**, Manuscript submitted by L. M. S. Paiva, G. C. R. Bodstein, and L. C. G. Pimentel to Geoscientific Model Development.

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### **General Comments:**

The authors develop subroutines to incorporate improved, high-resolution, land surface databases into the ARPS model. Their goal is to investigate effects of increased resolution of surface input fields on LES simulation results for the Metropolitan Area of Rio de Janeiro (MARJ). Six one-way nested LES simulations are performed with varying vertical and lateral resolutions and parameterizations. The authors recommend improved representation of land surface characteristics and input fields as these can dramatically influence the exchange of moisture, momentum and energy between the surface and the atmosphere.

The scientific significance and motivation behind developing the new tools is clearly described within the existing state of LES modelling. The authors do a good job in presenting the setup and performed simulations. The presented results and discussion however are not enough to support the derived conclusions and convince the reader of significant improvements in the higher resolution simulations versus the control run when compared to observations. **I recommend the paper be resubmitted once the authors address this major issue as well as the minor points listed below.**

### **Specific Comments:**

- Page 5, Line 9: “... although sensitive the soil temperature and moisture initialization”: Do you mean that their simulation results were sensitive to soil temperature and moisture initializations? This sentence is not very clear.
- Page 10, Line 25: “air basins I and II–III” are not previously defined or shown in Figure 1.
- Page 15, Line 9: “The ESA land-use database seems better than the USGS” should be rephrased to indicate how the ESA database is better (e.g. “The ESA land-use database is more detailed than the USGS”).
- Figure 1:
  - labels are difficult to read on this figure. A higher quality figure is needed to follow the description of observation stations. One suggestion here is to move the middle figure (showing locations of the nested domains) above the main two domains to provide space needed to make these larger and more legible.
  - The title of Figure 1 mentions G4-6 before they are described in the main text (Page 9 line6). Perhaps dividing the figure into parts a and b and referring to each respective part in its correct location in the main text would make things more clear.
  - It would be good to label which of the domains is G5 and which is G6 and mention clearly whether the middle domain represents G4 or not (if not, then the authors should consider adding a figure which shows G4 relative to G5 and G6).
- Figures 8-14: The quality and legibility of the figures need to be improved.

- Figures 8-14 can be reduced to a much smaller selection to demonstrate the main points the authors want to convey in comparing simulated high-resolution and control runs to observations. It is not necessary to show the timelines of all stations particularly since Table 5 provides a nice accompanying summary.

### **Technical Corrections:**

- Page 3, Line 23: "ARPS allow significant refinement of..." should be "ARPS allows ..."
- Page 4, Line 16: "Chow (2004) expresses the same concern in his simulations" should be in "... her simulations". You could also switch to passive form (e.g. "The same concerns are expressed in Chow 2004").
- Past tense should be used instead of present perfect in describing previous studies in the literature review, for instance:
  - Page 5, Line 2: "Chen et al. (2004) have used ARPS ..." should be "Chen et al. (2004) used ARPS ..."
  - Page 5, Line 5: "Sensitivity tests have been performed by Chow et al. (2006)" should be "Sensitivity tests were performed by Chow et al. (2006)"
  - Page 5, Lines 12-13: "Chow et al. (2006) have tried many different ways ..." should be "Chow et al. (2006) tried many different ways ..."
  - Page 5, Line 15: "Hanna and Yang (2001), who have used four..." should be "Hanna and Yang (2001), who used four..."
  - Page 6, Lines 1-2: "... have shown good agreement between numerical and observed data" should be "...showed good agreement between numerical and observed data"
- Page 9, Lines 6-7: "as seen at Fig. 1 and Table 1" should be "as seen in Fig. 1 and Table 1"
- Page 10, Lines 13-14: "which has 27km of horizontal resolution" should be "which has a horizontal resolution of 27km"
- Page 10, Lines 19-20: "In order to determine the horizontal resolutions for grids G1 to G4 of the one-way nested-grid setup ...", this is the first mention of grids G2-G4. A short line introducing these should be added prior to this sentence.
- Page 11, Line 21: "Depending of the run configuration" should be "Depending on the run configuration"
- Page 13, Line 6: "In additional to the atmospheric model component" should be "In addition to the atmospheric model component"
- Page 13, Line 9: "This scheme is in function of ..." should be "This scheme is a function of ..."
- Page 14, Line 6: "and they can been downloaded" should be "and they can be downloaded".
- Table 2:
  - The variables  $n_{zg}$ ,  $\Delta z_{min}$ ,  $\Delta z_{med}$ ,  $\Delta t$ , and  $\Delta \tau$  are not defined at the first mention of this table in the text.

- To avoid having equal signs within the equation for calculating the physical domain size in the description of the table, this can be rephrased as: “the physical domain size can be calculated as:  $L_x \times L_y \times H_z$ , where:  $L_x = (n_x - 3) \Delta x$ ,  $L_y = (n_y - 3) \Delta y$ , and  $H_z = (n_z - 3) \Delta z_{med}$ ”

- Figures 3 - 7 and Figure 17: The description inside the figure domain would be clearer if moved on top/outside of the dark shaded areas of the figures (for example, “(a) G5 30s – USGS” and “(b) G5 30s – USGS (adjusted)” in Figure 3).

#### **Suggestions for the Authors’ Consideration:**

- Page 3, Lines 25-26: “We chose the LES-ARPS model as our main tool because it is based on a 1.5-order TKE scheme and the Moeng and Wyngaard (1989) turbulence model ...”

It might be helpful for people from different fields to know why you chose these schemes.

- Page 4, Lines 17-19: “Usually, high-resolution numerical grids are often employed for simulations in small areas, since the number of grid points grows excessively as the resolution increases, which implies in a high computation cost.”

Suggested rephrase: “Usually, high-resolution numerical grids are often employed for simulations in small areas due to high computation cost.”