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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Evaluating intense precipitation in high-resolution numerical model over a tropical island: impact of model horizontal resolution" *by* N. Yu

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General response: The revised manuscript has been modified based on your constructive comments and questions. Unfortunately, none of our authors is a native English speaker. We contacted a native English speaker, but she had no time to carefully work on the manuscript before the deadline. We will look for the professional language service to refine the English after accepting the manuscript. Our responses to the comments are given below in the question-answer format.

Chapter 2.2.

- For clarification: Was the analysis used as large-scale forcing throughout the episode or only for the initialization?

The analyses at 8 km resolution are used to initialize the simulation and as boundary conditions (large-scale forcing) every 6 hours. A sentence has been added in the paragraph to clarify this point.

- Were the finer scale simulations nested within the 4 km or the 2 km simulation?

The 1 km and 500 m domains are nested in the 2-km domain (See Table 1). Figure 1 shows the domains position. We carried out the 4-km and 2-km simulations in the large red square. The smaller red square shows the position of the 1-km or 500-m domain nested in the 2-km domain.

- How high is the model top located? Is it high enough to sufficiently resolve tropical deep convection?

The vertical level of simulations extends up to 26 km. It is enough to resolve the tropical deep convections in our region.

- Is the vertical resolution the same for all horizontal resolutions? Wouldn't at least the highest horizontal resolution simulations require also an increased vertical resolution?

Yes, the vertical resolution (70 levels from surface to 26km) is the same for all simulations. This is a reasonably sufficient resolution for the simulations at the highest horizontal resolution 500m, regarding previous studies published in the literature. The increase of the vertical resolution as function of the horizontal resolution should be a very interesting numerical experiment. However, the multiple vertical-resolutions configuration between father and son domains is not allowed in the current MesoNH numerical model.

- Is there any adaptation to the extreme high resolution

We have no special adaptation to the high resolution except for the turbulence scheme.

At 2 km (or 4 km) resolution, since the horizontal resolution is not enough to resolve large gradients, we selected the quasi-1D (Bougeault and Lacarrère 1989) scheme. While in the high resolution simulation (1 km and 500 m), the three-dimensional turbulent fluxes scheme is used. This is consistent with the previous studies with Meso-NH (Cuxart et al., 2000 ; Honnert et al., 2011).

Chapter 3.2

- Page 1009 line 14: Presumably you meant 4 and 2 km instead of 1 and 2 km, consider also reordering the sentence

Yes, this is a typo, thanks. This sentence is to explain the quantile diagram showed in Fig8b. It should be 4 and 2 km instead of 1 and 2 km.

- Page 1009: Consider rephrasing the sentence starting line 19

This sentence has been modified to: The 4-day cumulative simulated and measured precipitations for each rain gauge are calculated. The ratio of simulation to observation is shown in Figure 9 as a function of the altitude and affiliated zone of rain gauge.

Chapter 4

- Page 1010/1011 and Fig. 12: What is the effect of averaging the 2 stations especially on the wind? The statement of a “good agreement” for the wind seems not obvious and needs at least more explanation.

We selected the observations data from two meteorological stations to confirm the “cold pool” and “land breeze” seen in the 1km- and 500m-resolution runs. Due to the large variability of observed winds, the comparison between simulation and observation at just one meteorological station is not fully relevant. That is the reason why we averaged the data at two stations located in the cold pool area. The point is that there is neither cold pool, nor land breeze in the 2km-resolution numerical experiment. However, we agree that the statement of “good agreement” is not appropriate. We have corrected these sentences in abstract and Section 4.

Chapter 5

- Page 1012 line 18: Which improvements do you expect from the larger parent domain and why?

Due to the limitation of computer resource, our parent domain is relatively small. It cannot cover the whole trajectory of the depression (see Fig 1) around the Reunion Island. Thus, the position and intensity of this depression is mainly provided by the boundary conditions every 6 hours. We believe that a larger parent domain which covers the depression will be better.

Figures:

- Are Figure 5a and 6a with the 24h resolution really needed, when you provide the 12-hourly resolution in Figure 5b/6b. It might be more helpful to include a graphic with the absolute rainfall amounts in the observation and simulations. The absolute daily rainfall can be seen in Fig.4. In Figure 5 and Figure 6, we just want to show the degraded model performance when reducing the time resolution from 24h to 12h.

Language:

The text contains many errors (precipitations, rainfalls, are showed) or missing articles (the) and other language related problems. Not all are mentioned here specifically. This should be checked and improved thoroughly.

- Page 1000 line 23: consider using kilometer scale instead of kilometric Thank you, we have corrected it.

- Page 1000 line 26: consider putting citation after hydrological models The citation is now after hydrological models.

- Page 1008: Consider completing the sentence Starting line 10: “Growth of temporal. . .” The whole sentence was modified as follow: The reference scores reflecting the inherent variability of rainfall exhibit similar behaviors as the numerical sim-

ulations. High CVRMSD value and low correlation coefficient for the 6 h precipitation suggest the large spatial and temporal variability in such observed rainfall.

- Page 1008 line 25: Sentence needs to be corrected We corrected this sentence as: The previous evaluation was mainly based on the information of the space-averaged rain intensity.

- Page 1009 line 8: Consider reordering the sentence to: “20% of the record a daily. . .” Yes, we did it.

- Page 1010 line 8/9: replace “are showed” with “are shown” Thank you. We have corrected it.

- Page 1010 line 25: The “5” has to be removed. Ok.

- Page 1011 (and elsewhere): replace “precipitations” with “precipitation” Ok.

- Page 1011 lines 17/19: Consider rephrasing the sentence “Interistingly,. . ..” We changed this sentence to: It is remarkable that the simulation at 1 km resolution without evaporation process misses the cold pool phenomenon. The precipitation pattern in this run is shifted to the volcanic area and little rainfall is produced over the north-east coastal area (Fig. 13b and c).

- Page 1011 lines 20/22: Consider rephrasing the sentence starting with “these results suggest. . .” We simplified this sentence as: These results suggest that the microphysical process at 1 km scale is important to well simulate the cooling process caused by evaporation.

- Page 1011 lines 26/28: Consider rephrasing the sentence starting with “The deep convection. . .” and reduces its complexity by splitting it in two or more sentences. We corrected it as: The deep convection triggered by the cold pool through thermal lifting and convergence enforces the cloud formation near the coast. The short wave radiation during daytime is further reduced by the cloud.

- Page 1011 lines 27/29: There is also something wrong with this sentence. Now the sentence is: Figure 14 shows the simulated short-wave radiation arriving on surface at 12:00 UTC on 30 January for the 2 km, 1 km and 1 km without evaporation runs.

- Page 1012 lines 21/22: Consider rephrasing the sentence starting with “This maybe do to the. . ..” We changed this sentence to: We also found little improvement between the 1 km and 500m simulations based on the current raingauge network. Rainfall observation at higher resolution is necessary to evaluate these simulations.

Cuxart, J., Bougeault, Ph. and Redelsperger, J.L., 2000: A turbulence scheme allowing for mesoscale and large-eddy simulations. Q. J. R. Meteorol. Soc., 126, 1-30.

Honnert, R., V. Masson, and F. Couvreux, A diagnostic for evaluating the representation of turbulence in atmospheric models at the kilometric scale, J. Atmos. Sci., 68, 3112-3131, 2011

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