

Interactive comment on “Regional modelling of tracer transport by tropical convection – Part 2: Sensitivity to model resolutions” by J. Arteta et al.

J. Arteta et al.

joaquim.arteta@cnrs-orleans.fr

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General comments: You pointed out the lack of quantitative results in the paper. This is in agreement with the other referee’s review. This general remark has been taken into account in the revised version, in particular by providing more quantitative results for TRMM comparison (see details below) and a more focused discussion.

Measures of the model performances: More quantitative measures of the model performances are now added in the manuscript (see section 4.1). As in Part 1, we now use common measures for the precipitation forecast accuracy: the equitable threat score, the probability of detection and the false alarm ratio. We have also plotted the daily evolution of these measures (see Figure 6 in the revised version) and of the accumulated rainfall rates (see Figure 3 in the revised version). This allows us to analyse

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the model behaviour as a function of time. We also added a distribution plot of the monthly mean TRMM rainrates versus model (see Figure 5 in the revised version) to characterize the model behaviour for the different model resolutions. The analysis of all these plots shows that increasing the model vertical and horizontal resolutions provides significantly better results for surface precipitation, both in terms of accumulated value and of spatial distribution. It also gives a better prediction of the occurrence of convective events.

Origin of biases: The temperature biases and standard deviations are related to an underestimation in the troposphere, except in the TTL. In this layer the model overestimate the cold point temperature which is very low with a sharp gradient in this geographical area. For the temperature bias at the cold point the 300m the vertical resolution used in REF and HR simulations is not sufficient to reproduce the very sharp gradient observed. The wind speed biases are mainly related to an underestimation by the model of the wind speed and its large gradients in the TTL. The positive water vapour bias indicates an underestimation by the model of the water vapour conversion into precipitation. The vertical profiles of temperature, wind and water vapour are partly driven in the simulation by the convective activity. It induces a warming by condensation and the conversion of water vapour into precipitation in the troposphere below the TTL, strong outflows and a cooling above convection. All the model biases indicate an underestimation of the convection intensity and frequency in the model. HR run gives the lowest biases and standard deviations and therefore better meteorological fields. Using a fine horizontal resolution provides more active convection (as shown by the results from the TRMM analysis) corresponding to stronger updraft/outflows and to more precipitation. This leads to a larger impact in HR fields improving the model statistics compared to radiosounding data. The interpretation of the comparison of CVR against REF has to be done keeping in mind that the CVR statistics are calculated on a smaller number of levels. This means that the mean profile calculated using the radiosounding data for CVR is smoother in the upper troposphere and lower stratosphere. Nevertheless REF simulation generally gives better statistical results than CVR. This indicates

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an improvement when using a fine vertical resolution in the TTL. This is linked to convection which is more active in REF as shown in section 4.1 (revised version). This piece of information has been added in the discussion of the results in the revised version (see section 4.2).

English and paper length: We did our best to correct the English which is not our native language. We have worked on the text in order to make it as clear as possible. In particular we have shortened the long sentences in the paper. The paper was shortened by removing the subsection on the 25th November flights that did not add new significant results compared to the 23rd November flight. As explained above the discussion of the results has been improved in the revised version. Figure captions for Figure 4 and 6 have been corrected.

Table 3: To calculate these statistics, radiosounding data were averaged over the model vertical levels. The biases for individual Manus soundings have been computed and then averaged.

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Interactive comment on Atmos. Chem. Phys. Discuss., 9, 5929, 2009.

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