Orographic impacts of Réunion Island and Madagascar on heavy rainfall during Tropical Cyclone Batsirai (2022)

By K. O. Lee et al.

Reply to the referee's comments

In the following, the comments made by the referees appear in black, while our replies are in red, and the proposed modified text in the typescript is in blue.

Referee #2 comments

Summary general comments

The manuscript by Lee et al. provides a model based evidence on the impact of orography on TC induced precipitation in Madagascar and Réunion Islands. The paper is well written and concise and I have only a few minor comments that should be resolved before the publication. The most pressing comment is that right now the paper does not draw any broader implications of the results towards our understanding of atmospheric processes, which is a necessary condition for papers published in the ACP journal.

We thank the reviewer for the careful evaluation of our manuscript and for the constructive comments. Below we provide our point-by-point response.

Minor corrections:

L10 the Meso-NH model -> a non-hydrostatic research (atmospheric?) model.

Revised.

♣ Page 1, line 10

"[…] Using a non-hydrostatic research atmospheric model at 2 km resolution […]"

L397-L400 and L411-L414: But there is also a robust converegence region on the windward side, which probably corresponds with a part of the flow over the mountain and a corresponding GW generation (visible in the flux patterns) , which later contributes to the leeward convergence as well. You acknowledge this mechanism later in Fig. 11 and from L420, but in this light the paragraphs read confusing.

To improve clarity, the relevant description in the manuscript has been revised accordingly.

♣ Page 18, lines 414–415

"[…] Meanwhile, the partially split low-level flow was uplifted over the southeastern mountain slope, generating complex wind patterns (Fig. 9e). […]"

Figure 12 - Dashed line meaning?

Relevant information is added in caption.

♣ Page 22, line 520 (caption of Figure 12)

"Figure 12. […] The spiral rainband along the coastline of Madagascar is delineated by the black dashed contour in panel (a)."

Figs. 12 and 13 - Can you adjust the color scale to show the full regional distribution of w? It is not a good practice to show a blank space just due to a deliberate choice of a color scale. Also overlaying regions of convergence and divergence may be helpfull.

Revised. The color scale has been improved as suggested; however, regions of convergence and divergence have not been added for better readability.

♣ Figure 12

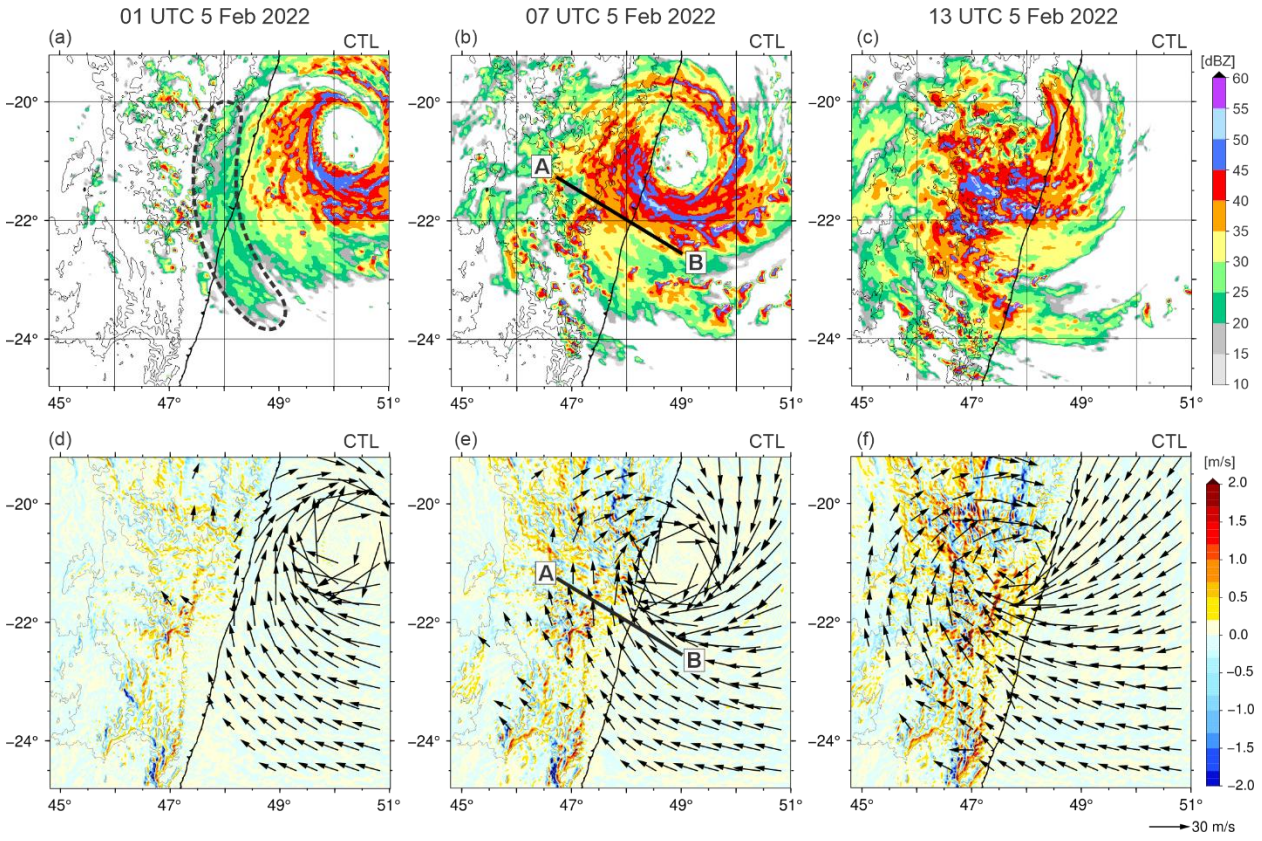

Figure 12. Horizontal distributions of CTL-simulated (a–c) reflectivity at 3 km above sea level and (d–f) vertical velocity at 20 m above sea level at 01, 07, and 13 UTC on 5 February 2022. The southeastern coastline of Madagascar is indicated by a thick solid line, and topographic contours at 500 m intervals are shown by thin solid lines in all panels. Horizontal wind vectors exceeding 10 m s^{-1} are shown. The location of the vertical cross section along A–B used in Fig. 14 is marked by a black solid line in panels (b) and (e). The spiral rainband along the coastline of Madagascar is delineated by black dashed contour in panel (a).

♣ Figure 13

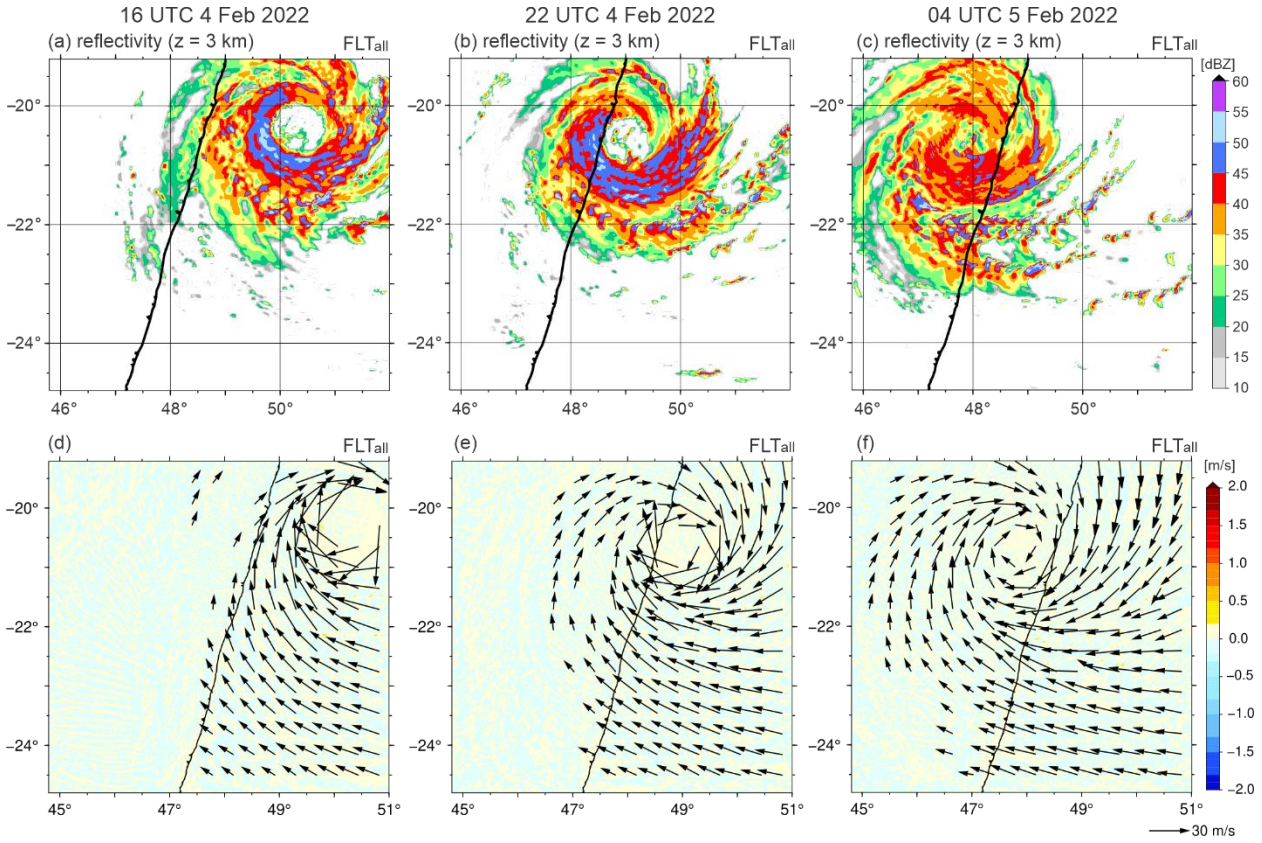

Figure 13. Same as Fig. 12, but showing results from the *FLT$_{all}$* simulation. Horizontal distributions of reflectivity at 3 km above sea level (a–c) and vertical velocity at 20 m above sea level (d–f) are shown at the corresponding times. Topographic contours, coastline, and horizontal wind vectors are displayed as in Fig. 12.

Fig. 14 - What is the meaning of the red arrow? (add this information to the caption)

The red arrow indicates the deepened warm and moist layer above the mountainous ridge (page 25, line 574). This information has been added to the figure caption.

♣ Page 25, line 565 (caption of Figure 14)

"Figure 14. […] A downward red arrow indicates the localized warm and moist layer at low altitude above the mountain ridge."

Concluding section - A paragraph containing broader implications of the results (outside of this particular region) is needed in the conclusions. For example, one can speculate based on your results that improper representation of the orography effects in the models can contribute to model biases in TC trajectories in general.

Right, good point.

♣ Page 27, lines 635–637

"In this study, we thoroughly examined the roles of Réunion Island and Madagascar in generating localized heavy precipitation during the passage of an intense TC using both observations and a high-resolution numerical model. This study demonstrates how sensitive the localized precipitation around complex terrain is to the underlying topography, underscoring the importance of employing appropriate terrain data in numerical models. Based on […]"

L660 Team list - please delete this section if you do not need it.

Removed. In the meantime, financial support section has been specified, while code and data availability section has been improved.