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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Microphysical controls on the stratocumulus topped boundary-layer structure during VOCALS-REx" *by* I. A. Boutle and S. J. Abel

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General comment:

- We have added a sentence to the conclusions to state that parametrizations developed for one specific aspect can often have detrimental effects elsewhere, and pointed the reader to Abel and Boutle (2012) who show how the development of a parametrization utilising data from many different weather regimes can produce something that works on a global scale. We have also pointed out that more work is needed to develop an autoconversion parametrization that works accurately on a global scale.

Specific comments:

- We now state explicitly in the abstract that the changes are a modified autoconversion parametrization and a new rain drop size distribution.
- We have removed this sentence.
- We have now stated explicitly that Abel and Boutle (2012) introduce a new rain drop size distribution.
- We have introduced the abbreviation GA3.0 here, as suggested.
- We have not investigated whether the re-initialisation makes any difference to the simulation, although we agree with the reviewer that it probably doesn't. The option to re-initialise the global model existed, so we used it. This was also the simplest process of ensuring that the sea-surface temperatures were updated, and we now state explicitly in the text that these are also updated by this process. We have compared the T+24 forecast fields from 00 UTC on the 12th with the 00 UTC analysis on the 13th, and the differences in this region are very small.
- We feel that this example is clear enough to the reader, and have not made any changes to the text.
- Yes, (Wilson *et al.*, 2008), although we have now removed this sentence in response to reviewer 2.
- We have modified the abstract and conclusions to state that the increased horizontal and vertical resolution only makes small improvements to the bulk properties of the simulation. We feel that the improvements discussed in this section are more a result of the enhanced vertical resolution than any change to horizontal resolution, but have not investigated this in any detail so do not discuss it further in the paper.

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- We believe that it is the WRF boundary-layer scheme that is the main reason for its poor performance, although clearly further work would be needed to assess this. The Andrejczuk *et al.* (2011) paper cited uses quite sophisticated microphysics parametrizations (Morrison *et al.*, 2009; Thompson *et al.*, 2004), which probably perform better than the microphysics scheme of our control simulation and similar to our modified microphysics simulation. However, the Lock *et al.* (2000) boundary-layer scheme used in the MetUM is particularly good at simulating marine stratocumulus, partly because it is designed around its cloud top entrainment parametrization and the ability of cloud top cooling to directly generate turbulence within the scheme. We have recently tested the 3rd order TKE closure scheme of Nakanishi and Niino (2006) in the MetUM (a much improved version of the Mellor-Yamada Level 2.5 scheme available in WRF), but even this scheme does not perform as well as the Lock *et al.* (2000) scheme in several forecast trials.

- We have re-worded this sentence to state that the autoconversion parametrization is modified and we introduce a new rain drop size distribution.

- We have attempted to make all the shading on this plot a bit lighter - unfortunately it looked much darker in the final manuscript than it did in the original plot we sent. We will check that it appears brighter in the final typeset manuscript.

- The figure was tiled vertically in the submitted version. We have amended the caption to refer to a/b rather than top/bottom to avoid confusion.

References

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