**Atmospheric
Measurement
Techniques
Discussions**

Interactive comment on "Reduction of radiation biases by incorporating the missing cloud variability via downscaling techniques: a study using the 3-D MoCaRT model" *by* S. Gimeno García et al.

Anonymous Referee #2

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In my view this is a well-written paper that has two main goals: To introduce readers to a new radiative transfer model, and to illustrate the performance of a stochastic model that can enhance the resolution of cloud fields. The study follows appropriate methodology with suitable care, and is very clearly written. The new radiative transfer model MoCaRT is highly capable and versatile; and includes some useful new tweaks in simulation methodology, for example the layer-dependent maximum cross section approach. I believe readers will be interested to learn about the model. The subsequent case study does not use all model capabilities described in the paper, but that

is OK. It is a fine case study, albeit with a little weak punch line. Overall, I recommend publishing the paper after some minor modifications. Please find my specific comments below.

Page 1545, line 9: Due to improved cloud detection capabilities, satellite estimates of global cloud cover have gone up since the 1995 study cited in the paper. Because there is no single best estimate of cloud cover (partly because there is no clear-cut definition of what exactly should be considered a cloud, and what should be a population of particles floating in clear air), I strongly recommend deleting the 62% value and only say something along the lines of "about two thirds" or "over 60%". Referencing more recent studies on cloud cover could also help, but is not crucial.

Page 1550, lines 6-9: It is not clear to me how the third method differs from the second one. A bit more detail would be welcome to clarify this.

Page 1551 lines 1-2: Because the Barker et al. (2003) paper describes several methods, a few key words identifying the method implemented in MoCaRT would help.

Most figures: Many figure labels are rather small, and I strongly suggest increasing them.

Page 1559, line 25 to page 1560, line 5: These sentences repeat the information in the figure caption and are not necessary.

Figure 6: While reflectivities themselves are of interest, it would also be useful for readers to estimate how the differences in reflectivities would affect satellite measurements of cloud properties. Even a simple conversion from R to tau using a 1D look-up table would give readers a better idea about the practical significance of differences. This would also connect the paper more closely to the main focus of the journal, atmospheric measurements.

Figure 8: It took me a little while to figure out the meaning of the thin line, and so I suggest describing it in the figure caption. I would also point out in the text a remarkable

feature of the figure, that 3D and small-scale variability always reduce reflectivity. (This means that cloud sides intercepting extra incoming sunlight is not the dominant effect even for low sun.) Also, it would be interesting to see how scene albedo behaves, and to discuss why the differences peak well after noon. Finally, the last two sentences of the figure caption are unnecessary (the first of the two repeats information from the text).

Page 1562, line 28 to page 1563, line 4: These sentences don't seem to be well connected to the earlier parts of the paragraph, and so they could be reworded or moved elsewhere.

Small language issues: - The correct spellings are "skies", not "skys"; "sake", not "seek", "latter", not "later". - Delete "from" in "Two main reasons prevent from this" - Add an "n" to "they deliver a exact solution" - Delete "it" from "simulation that it is going to be carried out" - Change because" to "that" in "The reason for these discrepancies is because" - Change "to" to "at" in "was left unchanged to 40 m" - Delete "ed" from "we did not considered" - Change "reflectivities" to "reflectivity" in "reflectivities differences" -