

Interactive comment on “The Role of 1D and 3D Radiative Heating on the Organization of Shallow Cumulus Convection and the Formation of Cloud Streets” by Fabian Jakub and Bernhard Mayer

Anonymous Referee #2

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The manuscript explores the role of 3-D radiative transfer, particularly in terms of its creation of surface shadowing, on cloud organization into streets. It employs a large number of LES simulations for different solar configurations, surface heat capacities, and horizontal wind speeds to evaluate the contribution of 3-D radiation to cloud street formation. It is found that even in the absence of horizontal wind, 3-D radiation has a tendency to generate organization of streets orthogonal to the solar azimuth. In the presence of horizontal wind, 3D radiation can either enhance or suppress the tendency to organization into streets depending on the configuration.

I found the manuscript intriguing and highly interesting, but in need of quite a few

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clarifications, possible analyses to dig a little deeper, and technical corrections (grammatical). (I will address the former and leave the grammatical aspects to a technical editor.)

1) The paper is very short and could do with more material. To start with it should inform the reader about the theory of streets. Line 51/52 is insufficient. The authors tend to be in a hurry to tie the paper up and not deal with details like teasing out the extent to which horizontal photon transport contributes to the results (Line 190). I would have appreciated more analysis. A few choice simulations to focus on various issues would greatly add to the impact of the paper.

2) The influence of 3-D longwave cooling should be discussed.

3) I liked the intuitive sketch (Fig. 5) but would appreciate a similar sketch pertaining to the dynamics of streets that might help understand the amplification/offsetting of the radiation - particularly the length scales in question.

4) The congruence with the quote by Weckwerth (1997) and subsequent sentences (line 210 - 217) really needs some deeper thought and analysis.

5) Please comment on how static heterogeneities might play out over land, where the 3-D solar radiation influence is significant. Particularly when the wind advects a boundary layer that includes the net effect of upstream static (and dynamic) heterogeneity. The scale of the patches and the advective wind will be important. This links in to my request to tie the discussion more tightly to the dynamic theory of streets.

6) Finally, the paper contains some testable hypotheses that I urge the authors to pursue with data since it will add much value to this line of research. (I'm not saying this should be done in the current paper.)

Minor:

7) Line 267: I think you mean “simulations” rather than data.

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8) Line 272: Again please include more theoretical explanation of dynamically induced cloud streets.

9) When you use the phrase “surface heterogeneities” in the text, please be clear that this is a dynamical heterogeneity.

10) The LWP threshold > 0 for the cloud mask is much too rigid but I expect has little to no bearing on the results other than how it will bias the quoted cloud fractions. An optical depth threshold might be more useful/relevant anyhow.

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