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Interactive Comment

Interactive comment on "Switching cloud cover and dynamical regimes from open to closed Benard cells in response to the suppression of precipitation by aerosols" *by* D. Rosenfeld et al.

D. Rosenfeld et al.

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Our response to 'Further comments' from Referee #2

As in most cases in science - in this paper we add our contribution on the basis of information and insight gathered by many scientists presented in many papers to try and further develop our knowledge. It is true and we give references to papers that show connection between POCs and aerosols (we will add the suggested references by the reviewer). The quotes brought in the second comment of Referee #2 recognize that there might be a relation between the aerosols and the creation and maintenance of the POCs, but no specific mechanism is provided beyond what we have already ref-



erenced. Furthermore, Petters et al. (2006), which is the main reference that Referee #2 asserts as preempting our paper, states: "Although we are confident that scarcity of cloud condensation nuclei maintain the pockets, the mechanism itself is not clear."

In our paper we exactly address this question and suggest a comprehensive mechanism by which the amount (and type) of aerosols may control the POCs state and we show how small variations in aerosols loading may transform POCs between the two stable states (open or close). The formulation and publication of this hypothesis is necessary for the design of the measurements and simulations that can validate or disprove it. This is the main value to the scientific community in allowing our paper to be published, and this is in general the way science makes progress: hypotheses lead to measurements and calculations that validate or disprove them.

The validation of our proposed mechanism may lead to a different approach in the estimation of aerosol forcing - i.e. so far most of the studies showed linear or logarithmic dependence between aerosols and cloud properties. Here we suggest mechanism that reacts more like a step function between almost 100% cloud fraction (close cells) to less than 40% in case of open cells.

About the data and data analysis: when studying cloud aerosol interaction two major difficulties are raised: 1) our limited ability to remotely sense cloud and aerosol properties correctly and 2) cause and effect questions, namely, say that the indicated correlation between clouds and aerosols is correct, does it reflect the effect of aerosols on clouds, the effect of clouds on aerosols, or meteorology that effects both?

In this paper we show the variability of the cloud effective radius. 3D and other deviations from plain parallel may create apparent larger indicated effective radius. But in our case when one deals with one case study one can examine the variations in the cloud effective radius far from the cloud border where these problems are minimal. When doing so it is still clear that the transition from small to large cloud drop effective radius occurs between the closed and open cells. This is strongly supported by the ACPD

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paper of Petters et al. (2006). Also it is clear that ship tracks are maintained in the cloud free areas where runaway rainout and cleansing of the CCN probably occurred. Ship Tracks are clear areas where the aerosol loading is higher than the surroundings. In the figure, it is clear that the effective radius there is smaller than the 15 micron drizzle threshold even when in areas fully covered by clouds. In this example we use the effective radius as a measure to the amount of aerosols - showing the likelihood that the open areas are cleaner than the closed.

Unlike pollution aerosols, when dealing with dust or smoke there are no significant cloud processes that may enhance the amount of aerosols. Also when dealing with one case study of Marin stratocumulus the analysis is for a given meteorology, therefore the question of cause and effects is simpler and the implication that we do see aerosol effects is stronger.

Analyses using exactly the same data and methodology used to create our Figure 1 were already published in the Proceedings of National Academy of Sciences (Kaufman et al., 2005) and in Geophysical Research Letters (Koren et al., 2005). We find it unreasonable to apply to these analyses a double standard there and in ACP, when the reviewer does not point out to any new information beyond was already taken into account in these publications. The value of this analysis (shown as Figure 1) is in providing a link between the case study that we presented and the way by which the proposed mechanism is manifested climatologically.

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