

Interactive comment on “The fine-scale structure of the trade wind cumuli over Barbados – an introduction to the CARRIBA project” by H. Siebert et al.

Anonymous Referee #2

Received and published: 4 January 2013

This manuscript provides an overview of results from two field campaigns operating from Barbados that were designed to explore the aerosol, cloud, radiation, and turbulence associated with fair-weather cumuli during two separate one-month periods. The observations are based on unique observing platforms deployed on a helicopter. Although the manuscript gives a useful compilation of the type of observations that were made, it provides neither a compelling justification for the project nor an adequate highlight of the unique observing capability offered by the helicopter-borne instrument packages for sampling in and around clouds. This is a good first report and summary of the accomplishments, but this compilation in its current form is not sufficient to justify publication. A more detailed description of the issues related to this overall assessment

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is provided below. No minor comments are provided in this review, since major efforts will be needed to develop a manuscript that can be accepted for publication.

Major Issues:

Using the acronym CARRIBA in the title is not very useful. By itself it will have little or no meaning to the majority of potential readers. In studies that are part of major projects or programs that are well known, an acronym can be used in the title, but in general the use of acronyms in the title is not optimum. The introduction provides a good historical perspective of research on fair-weather cumulus clouds, but the coverage is broader and more general than needed. Similar summaries can be found in the literature. The authors go back to the earliest studies, but spend less time discussing the contemporary issues that motivate this project. Thus, for example, it would be good to know what this study provides that was not already explored during RICO or other recent projects focusing on small cumuli. The unique aspect of CARRIBA is that it makes use of instrumented package operated from a helicopter to provide detailed high-spatial and temporal measurements that cannot be obtained from traditional instrumented aircraft. The helicopter-borne platforms are ACTOS (Airborne Cloud Turbulence Observation System) and SMART-HELIOS (Spectral Modular Airborne Radiation measurement system). These platforms have impressive observing capabilities. But most of the observations shown in the manuscript could be obtained with an instrumented aircraft and offer little new insight into a range of scientific issues involving small cumulus clouds. Further, the actual amount and kind of cloud sampling is limited relative to that from an aircraft. Since each flight has a duration of about 2 hours, the total amount of time available for sampling is about 50 hours for the two months of time at the observing site. A single aircraft during a two-month period could easily make 200 hours of observations and due to the speed of the aircraft its sampling path would be substantially longer than that from the helicopter. It is not clear from the description of the flights how much of this sampling time was actually devoted to making the unique observing capabilities of this platform. In addition to the summary of the duration of the

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flights, it would be useful to know how many hours of cloud sampling were obtained on these flights and how many clouds were sampled. Further, although the in-cloud sampling was limited to near cloud top, the helicopter sampling would allow for the tracking of the temporal evolution of structure near the top of clouds. This particular point needs to be more prominently discussed. At the same time, these measurements can provide valid measurements that cannot be obtained from a faster moving aircraft. It would be good in an overview to highlight those observations that make full use of the helicopter sampling capabilities and strategies and discuss the scientific issues that can be addressed with these observations. The use of the surface-based observations with the helicopter measurements is also a positive aspect of this project, but again this strategy is not unique to this project.

Although the project and the treatment in this manuscript revolve around four elements—clouds, aerosols, radiation and turbulence—these elements appear to be un-equal in their potential for contributing to our scientific understanding. As noted, the elements that make full use of the helicopter-borne package capabilities have the best chance of making unique contributions. The “cloud” and “aerosol” observations discussed could be made with an instrumented aircraft. The in-cloud measurements shown in Fig. 11 are not unique; although they do illustrate the utility of measurement systems used. But the advantage of the helicopter measurements for making these observations is not obvious, particularly since the cloud sampling is limited to areas near the top of the cloud. Further, the utility of the helicopter “radiation” measurement from SMART- HELIOS was not fully established. Although in principle the in situ verification of the retrievals of effective radius and LWC from radiance measurements has merit, it is unclear what new insight has been gained from these measurements. Making good radiance measurements around small cumuli is very challenging because of small-scale in-homogeneities in the cloud edge structure and the cloud microphysical characteristics. Thus at some scales the radiation field is very multi-dimensional. This issue is not fully discussed. Further, since SMART cannot measure the incident radiances, the utility of these measurements is very limited. The “turbulence” discus-

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sion includes a description of the structure of the transition layer. The measurements shown, however, could also be obtained with a slow flying research aircraft and the characterization of the turbulence is not quantitative. The observations shown in Fig. 15 do highlight the unique observing capabilities available to the researchers. The LWC with turbulence dissipation rates at high spatial resolution shown in this figure are very promising. More of this type of analysis needs to be highlighted.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 28609, 2012.

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