

Interactive comment on “Cloud Characteristics, Thermodynamic Controls and Radiative Impacts During the Observations and Modeling of the Green Ocean Amazon (GoAmazon2014/5) Experiment” by Scott E. Giangrande et al.

Anonymous Referee #3

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Review of “Cloud Characteristics, Thermodynamic Controls and Radiative Impacts During the Observations and Modeling of the Green Ocean Amazon (GoAmazon2014/5) Experiment” by Scott E. Giangrande et al.

Overview

This manuscript describe a unique long term set of observations, as well as aircraft IOPs, in the Amazon. These measurements are necessary to help better constrain global climate models and parameterizations of clouds and precipitation for regions,

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like the Amazon, that have been challenging to simulate. Due to the long term nature of the observations they are able to look at cloud and precipitation over the diurnal and seasonal time scales. Their observations of clouds, are limited from these long term sites due to the nature of their 1D observations. From an aircraft based background or a satellite perspective, these estimates of cloud fraction aren't ideal. The works isn't groundbreaking, but it is a good overview paper of the observations from the project that aren't addressed in the other GoAmazon papers.

Main Comments

1. How often are multi-layer clouds observed? The authors discuss the fact that if they removed the multi-level cases they wouldn't have enough data for analysis. This is a concern when thinking about sorting data by convective and stratiform. Are these categories meaningful if it's only based on the lower most data? What if there are both convective (low level) clouds and higher level stratiform clouds that are obscured? Does this have an impact on the rain rate? Are the rain rates difference from convective clouds only vs. multi-level clouds?
2. Estimates of uncertainty are missing and should be addressed. Also, on several figures an idea of the sample size would help put the data into context. It is difficult to evaluate the data when it is unclear how much data is actually included in the figures.
3. I'm confused why they bring in the other locations (Darwin, Nauru and Manus)? These data are not discussed anywhere else in the paper except in section 4 and to add a paragraph in section 5. It seems out of place, it could be part of another paper.
4. Have the authors considered using MODIS CF to get an idea how well their CF estimates match satellite observations? They can also use CALIOP to see how their estimates of multi-level cloud classifications compare to the ground measurements. Finally, they can use TRMM or GPCP data to get regional estimates of precipitation. These would put their work into a larger scale context.

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Minor Comments There are often generalizations and wording issues that make their points less clear. These issues can be fixed by modifying their text. See specific comments below:

Page 2 Line 30 – “cloud study complement to the...” → “cloud study to complement the...”

Page 3 Line 3 – “cloud types and contrasts” what do you mean by “contrasts”, do you mean differences in atmospheric conditions and thermodynamics, seasonal or diurnal changes. This is vague.

Page 3 Line 4-5 – Wording: “This analysis includes additional relationships to campaign aircraft in-cloud observations when available.” → “This analysis includes additional relationships between in-cloud aircraft campaign observations when available.”

Page 3 Line 10-11 – What does “possibly maritime-like atmospheric conditions” mean, this is a vague comment and needs clarification.

Page 3 Line 12 – Clarify what you mean by a region of “underlying moisture.” How would you define this, humidity, PW?

Page 3 Line 16 – “work has found a robust relation...” → “work has found a robust relationship...”

Page 3 Line 19 – Clarify “cloud lifecycle complexity” what complexities are you suggesting are additional versus not-additional, the wording here is unclear.

Page 3 Line 34 – What are the “environmental forcing data sets?”

Page 4 Line 8 – The pencil-beam/soda-straw description is not necessary.

Page 4 Line 9-10 – Please elaborate on how CF is described, so 50% cloud cover is recorded when there are cloud present for 30 minutes out of an hour? This seems strange compared to thinking of CF as a fraction of an area if I am interpreting the description correctly.

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Page 4 Lines 17-18 – Does this choice, of using the maximum virtual potential temperature, result in a bias towards higher CAPE? Did you try a max, min and mean virtual potential temperatures to see how this changed the results?

Page 4 Lines 32 – wording is strange for “on their suitability” I suggest rewording this sentence.

Page 4 Line 32 – Page 5 Line 1 – What is shown in panel a) of Figure 2. The text here suggests cloud fraction, but the label says “hydrometeor frequency.” Clarify.

Page 5 Line 7-8 – Referring to Figure 3, it is not obvious in the CAPE panel that there is a difference between the wet and dry periods. They look the same based on Figure 3a.

Page 6 Lines 27-28 – How are the SCMWF analysis outputs constrained using the surface rainfall? The constraints are not identified in the text. Is it precip or no-precip? A certain amount of precip with a specific threshold? Clarify.

Page 7 Lines 31-32 – (also noted in the figure comments) – where is the red bars located? Are they the thin lines above panel c? If so, a new way to note this should be found, it is not clear or easy to use these bars for the purposes described in the text.

Page 8 Lines 5-6 – Why are there no stratus or stratocumulus categories? The only stratiform clouds are altocumulus and cirrocumulus? Are there just so few of these cloud categories that you are leaving them out?

Page 8 Lines 24-25 – You bring up that the 2014-2015 rainy season maybe be different than climatology. Perhaps it would be beneficial to show a monthly climatology for a long period of time to which you can compare the 2014-2015 rainy season? This way the readers can know how different this particular year is from the climatological average. After reading this comment I was left wondering if these results are just a special case or if they are in fact representative of this region in a general sense.

Page 8 Lines 25-27 – This would be a good place to include a more detailed description

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of how you calculate the precipitation as a function of convective and stratiform clouds. This is difficult and the method isn't clearly stated.

Page 9 Line 19 – What do you mean by “rare?” How often do these sea breeze intrusions occur? How many times did this happen over the study period? What impact do these intrusions have on the results?

Page 10 Line 8 – Please describe how you separate the rainfall rates in to convective and stratiform types. Is this based solely on the cloud classification (as shown in Figure 5 c)?

Page 11 Line 3 – “stratiform precipitation (identified as “Deep Convection” . . .” this is confusing. Do you mean stratiform as in cirrostratus? Usually when I see the term stratiform I think of stratus or stratocumulus. Clarify this section.

Page 12 Line 14 – The “green ocean” comment again, it's not really fully discussed in the beginning section (Page 3 Line 10) where it is first mentioned so it's strange to mention it again.

Page 12 Line 28 – “better” this is not a descriptive term. What makes it better? Be more specific.

Table Comments

Table 1-3 – The format of these tables is difficult to read in the current format. I'm assuming that they will be formatted differently when published.

Table 3 – Why are the authors including these other locations that are very far from the Amazon. When reading the text, there doesn't seem to be a solid justification for this other than to make a quick comparison.

Figure Comments

Figure 2 – Continue the IOP dashed lines all the way to the top of the figure through panels a, b, and c. Perhaps make solid lines to section off the wet and dry periods as

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well. This would be helpful for knowing where the cut offs are. I drew them on myself to make it easier for me to see when they started and ended. What is “hydrometeor frequency” shown in panel a). In the text it suggests CF (Page 4-5 Lines 32 -33 “The more pronounced shifts during the wet season include increased CF in the mid0to-upper troposphere (between 3-10 km, Fig 2a). So is it CF or something else that is being shown as frequency. Please clarify.

Figure 3 – Axes labels are small and hard to read. What is going on with the 19 am data for CIN. Why are they essentially a point?

Figure 4 – Hard to read the panel labels for (g), (h), and (i). Perhaps move them outside and next to the left side of the figures for all the panels.

Figure 5 – It is difficult to read the label of panel c), it is obscured by the cirrus clouds. The green and red line above panel c), is that the red bars referred to on Page 7 Lines 31-32. If so, these are near impossible to see clearly.

Figure 6 – The white contours (starting at 10%) are difficult to see, perhaps increase the line thickness.

Figure 7 – For a) How many days are included (are there equal number of days in all the time bins?) b) same as a), how much data is included? c) Define the fractional accumulation more clearly (convective/stratiform). Does the number of samples change for each time bin? Are some time bins 100 samples (80 wet 20 dry) while others are 10 samples (8 wet 2 dry). It would be nice to know how much data is going into these curves.

Figure 8 & Figure 9 – Perhaps these two can be merged so you can easily compare the difference between the wet and dry seasons. A difference panel, or just showing the difference between wet and dry would be a good way to show where the differences are most pronounced. As with Figure 6, the white contours (starting at 10%) are difficult to see, perhaps increase the line thickness.

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