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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Subseasonal variability of low cloud radiative properties over the southeast Pacific Ocean" *by* R. C. George and R. Wood

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We would like to thank both reviewers for their constructive comments and error-spotting, which will clearly improve the quality of the paper with the corrections and improvements suggested.

The short comment in response to Reviewer #1 contains our author response to the specific issues brought up by that reviewer. Investigation since the open discussion period indicates that our response to the specific comment #12 is not accurate. Comparing 500 hPa height composite patterns to the SLP composite patterns shows a non-barotropic response, that is the 500 hPa anomalies are offset to the west of the

SLP anomalies. While Rossby waves may be a part of the story, we cannot make the simple argument that the dominant modes of SLP variability are influenced by different wavelength barotropic Rossby waves just because their behavior seems consistent with such an idea. We have modified the manuscript accordingly.

Also, in their general comment, Reviewer #1 makes the point that MODIS CF probably underestimates the real cloud fraction. We responded that this probably will not affect our general conclusions significantly, but here we provide a more thorough response:

There are several issues with regard to low cloud fraction estimation, including 1) the diurnal cycle, 2) masking by high clouds overlying warm clouds, and 3) overestimation of pixel-level cloudiness in the case of small clouds. (1) and (3) would lead to an overestimation of cloud fraction, while (2) would lead to an underestimation. None of them are likely to have a strong influence on our results.

1)–In the open discussion paper (Line 23-25, Page 25281) we explain that the cloud fraction likely overestimates the daytime mean cloud fraction– the retrieval occurs at 10:30 am when the cloud cover could still be high, and thus the significant decrease in cloud cover in the afternoon that often happens is not taken into account.

2)–Although it is true that in cases where high cirrus overlaps shallow cumulus that the warm cloud fraction underestimates the real cloud fraction, introducing a bias, we focus on the stratocumulus properties, and our computation of cloud albedo requires the cloud be liquid, given the assumptions we made. To include high clouds in the cloud fraction estimate would not fix the problem because the calculation of cloud albedo would be severely hindered, introducing a new bias to the albedo proxy.

Also, upon further investigation, we find that in the region of most stratocumulus around 10-30S there are few high clouds - they are much more prevalent to the south of the domain, and given the large amount of data used, we expect that any bias introduced doesn't impact our final conclusions. In this region of subsidence of warm dry air, the conditions just aren't suitable in the mean for the formation of many high clouds. The

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MODIS estimate of total cloud fraction is on average (2000-2008) less than 0.05 larger than the low cloud fraction north of 30S, though does increase to as large as 0.2 on average near 40S. Also, Wood and Hartmann (2006) showed that in this region the high cloud amount for ISCCP data for September/October 1984-1999 was less than 10-15%.

3)–The MODIS low cloud fraction we used — the level 3, 1 degree grid data, is computed with an algorithm identifying 'cloudy' and 'clear' pixels of the higher resolution dataset (level 2, 1-5 km data). Dey et. al. (2008) showed that for trade wind cumulus clouds in the western Atlantic (studied using Advanced Spaceborne Thermal Emission and Reflection Radiometer, ASTER, scenes) lowering the pixel resolution leads to greater cloud fractions because low resolution pixels that contain broken clouds tend to be diagnosed as entirely cloudy. Although the algorithm in Dey et. al. (2008) is not exactly that used for the MODIS data, one would expect to see a similar overestimation of cloud fraction at lower resolutions in MODIS data in regions with substantial sub-pixel variability. The documentation on the MODIS algorithm states the method is 'conservative' with respect to assigning 'clear' pixels, so one would expect an overestimate of cloud fraction to be more likely than an underestimate. Cumulus clouds would have a much stronger effect than the stratocumulus we study, so this effect is likely minimal.

In response to reviewer #2, the corrections noted have been made, thank you for the thorough summary of the purpose and main points of the paper.

With regard to the corrections to the Appendix – the final equation was derived correctly, but a shorter derivation was attempted for space purposes in the paper. The shorter version contained an error, which the reviewer noted, and thus the original derivation will be used instead. On the second minor comment, I believe you meant 'f_c', not 'r_e'? In this case the phrasing has been adjusted. The other corrections noted have been made.

References:

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Dey, S, Di Girolamo, L., Zhao, GY.: Scale effect on statistics of the macrophysical properties of trade wind cumuli over the tropical western Atlantic during RICO, JGR-Atmospheres, 113, 0148-0227, 2008.

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