**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

Anonymous Referee #1

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The authors use satellite data and meteorological reanalysis to investigate the subseasonal variability of cloud radiative properties in the southeast Pacific stratocumulus deck, and the factors which modulate it. The thorough analysis emphasizes the complex relationships among the factors which control the cloud albedo. Moreover, it brings new arguments for the idea developed in a few recent studies that meteorology and aerosol impacts on cloud properties are strongly convolved, and cannot be separated from observations alone (Brenguier and Wood, 2009, Stevens and Brenguier, 2009). The authors also investigate the patterns which explain the large scale meteorological variability and which modulate the cloud macrophysical, microphysical and radiative properties. The approach and the questions raised are novel and even though

the EOF analysis may sometimes not be straightforward for one who's not used with the method, the results and the main conclusions are clearly highlighted both within the analysis and the discussions/conclusions. With a few exceptions that I will detail below, the paper is very well-written and the main points are clearly brought out.

General comment

An important point was left out and would be valuable to be discussed in the paper. Namely, the authors do not discuss, or at least mention, the potential observational biases/caveats of the MODIS data set. I think it is important to warn the reader that in regions of shallow cumulus the cloud fraction (CF) liquid (used here) probably underestimates the real cloud fraction, and that the cloud top temperature retrievals suffer from surface contamination (ac. to Zuidema et al. this is true for all the cases with CF <0.9). I was also wondering how reliable are re and tau, especially for broken stratocumulus decks/shallow cumulus fields (like for e.g. west of 90W and below 30S, fig.1b)? The same question holds for the use of eqs. 2 and 3. How much one should trust the Nc and LWP retrievals for broken stratocumulus and shallow cumulus?

Specific comments

1. Second to fourth paragraphs page 25278/9: The link between the ideas developed in these 3 paragraphs is missing. The thread of thought would be easier to follow if the first phrase in the second paragraph would be followed by the references to previous studies (third paragraph of the introduction), and then by a phrase stating the main purpose of this paper, i.e. to study how patterns of subseasonal meteorological variability relate to the cloud variability and albedo (the phrase on lines 15-18). If then the discussion of the stratocumulus, which is out place here, would be left out (or displaced), the discussion about the albedo made in paragraph 4 would follow more naturally.

2. Lines 24-26 page 25279 The phrase "The results allow us…" is not clearly formulated.

3. Second paragraph on page 25281. What are the inputs of this radiative model?

4. Lines 3-5 page 25283. The idea behind the phrase "Dry subsiding..." is not clearly expressed. What do you mean by a latent cooling? Wouldn't be more appropriate to say a decrease in the latent heat flux?

5. Page 25283/4. Why not inverse the order of the 3rd and 4th paragraphs in section 2.2. This would avoid discussing fig 1, then fig 2, and then fig 1 again, which makes the discussion line hard to follow.

6. Line 3 page 25284. You could mention as well here (i.e. at the end of the phrase "Interpreting..."), "or to changes in the meteorological forcing".

7. Lines 6-7 page 25284. The degree of spatial correlation mentioned here is not very obvious.

8. Section 3. I was wondering if a more meaningful (less technical) expression could be found for "a fraction of variance methodology", both in line 17 and the title of section 3.1.

9. Line 14-19 page 25285. Isn't the contribution of the cloud albedo of the same order of magnitude? (Fig.1b)

10. line 7 page 25288 by "cloud variability" you mean "cloud fraction variability"?

11. Section 4.1. I think this section would be easier to understand if the authors stated from the beginning the purpose of the analysis described here, i.e. to study the modes of SLP variability. And then say that for this purpose they apply an EOF analysis. Couldn't the discussion in the first paragraph come only afterwards? It would also be helpful if the authors could mention in this first paragraph at the time series of which variables are they going to look at (for e.g in lines 11, 13).

12. lines 13-14 page 25289: What to you mean by "in keeping with a slower.....(Holton, 1992).

13. Lines 10-11 page 25290 The phrase "Despite this ..." should be rephrased to express more clearly that it is the Nd which does not contribute strongly to the albedo variance

14. Lines 25-28 page 25296. The phrase "This mechanism...." leaves the impression that the aerosol indirect effects necessarily imply a positive correlation between Nd and LWP; which, is not the case, as the authors even mention in the introduction.

15. Line 4 page 25297 I find that the ideas expressed from this point on (Hence, there are ...) are not related to the ones developed in the first part of this paragraph. Shouldn't a new paragraph be more appropriate?

16. Caption fig 3. what do you mean by "coefficients of variation for fc..."?

17. Caption fig 4, line 4 "all computed by dividing ..." is this true also for fig 3 and not mentioned?

18. Caption fig. 6 : What's the "red noise" here?

Technical corrections

1. Line 6 page 25281. "and by deriving alpha_cld with a simple ..."

2. Line 23 page 25283. Cloud "condensation" nuclei.

3.. Line 14 page 25285 A reference to the albedo could be added, for e.g. "their Lp, hence their albedo, are also greater"

4. Line 25 page 25287 a "that" should be removed

5. line 10 page 25289 captures "the" modulation

6. Line 18 page 25298 "macrophysical and microphysical" instead of "microphysical and microphysical"

7. Line 19 page 25300 in the use "of" the model

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