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Interactive comment

Interactive comment on "Characterizing the diurnal cycle of South Atlantic stratocumulus cloud properties from satellite retrievals" *by* Chellappan Seethala et al.

Anonymous Referee #1

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REVIEW Seethala et al. (2018 ACP):

The manuscript documents marine low-cloud properties over the southeast Atlantic Ocean by combining TMI liquid water path and cloud retrievals from MODIS and SEVIRI. The specific focus of the paper is on daytime effective radius (reff), optical thickness (COT), and liquid water path from SEVIRI. The article is relevant as SEVIRI is the only satellite sensors with the necessary temporal resolution to resolve the diurnal cycle in cloud properties. Moreover, the manuscript is one of the few studies that attempt to analyze the diurnal cycle in reff and tau over this cloud regime. While I believe the paper should be accepted for publication, I would like to encourage the au-

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Discussion paper

thors to refine part of their analysis, provide support to several claims made throughout the manuscript, and clarify the main objective of their study. Since I have coauthored a couple of papers on the same topic, I am offering suggestions based on my past experience with geostationary retrievals (do not feel obligated to cite my papers).

Main objective: It is unclear if the goal of the study is to understand the seasonal/diurnal cloud evolution of the Namibia-Angola stratiform cloud regime (as suggested by the title) or to evaluate SEVIRI cloud retrievals with other datasets (most of the analysis revolves around the differences between SEVIRI and other datasets, and potential bias in SEVIRI retrievals). If the focus is to characterize the diurnal cycle, then please provide more detailed information about the amplitude of the daytime cycle and explain spatial/temporal changes in the context of the atmospheric circulation and thermodynamical structure. For instance, in Painemal et al. (2012, JGR), we attempted to understand the dynamical factors behind the cloud diurnal cycle in the SE Pacific, and showed hourly composites (maps) of cloud retrievals. In Painemal et al. (2013, J. Atmos Sc.), we further endeavored to understand variations in liquid water path and cloud fraction, in the context of the boundary layer depth evolution and subsidence variability. Similarly, we utilized a super-parameterized climate model and NASA-Langley SEVIRI retrievals for describing the diurnal evolution of cloud fraction and height over the Namibia-Angola stratocumulus cloud deck (Painemal et al., 2015 J. Climate). If the focus is mostly evaluating the ability of SEVIRI to reproduce the diurnal cycle, please modify the title and the introduction accordingly. More suggestions for evaluating SEVIRI are provided below.

Inhomogeneity and cloud mask: I was surprised that cloud fraction (mask) differences between SEVIRI CLAAS and MODIS collection 6 were not analyzed. I would speculate that the spatial pattern of the SEVIRI-MODIS difference near the equator in Figure S5d is most likely due to cloud fraction differences between both sensors/algorithms. Also, the use of some sort of inhomogeneity index would provide support to the hypothesis that pixel resolution is in part responsible for the COT difference between SEVIRI and

MODIS. Although the plane parallel bias is likely playing a role, it is puzzling that both SEVIRI COT and reff are generally smaller than their MODIS counterparts (1.6um), as one would expect that reff (COT) is overestimated (underestimated) as the pixel resolution becomes coarser (e.g. table 1a and 1b in Painemal et al., 2012 JGR). This points to other issues associated with differences in the retrieving algorithms, since SEVIRI visible channels were calibrated against MODIS. The question could be answered if the CLAAS algorithm were applied to MODIS (I do not know if this is even possible). At the very least, the authors should speculate about the causes for the inconsistencies between MODIS and SEVIRI that cannot be explained by the plane parallel bias or absorbing aerosols. Lastly, if the COT threshold was applied to SEVIRI (and MODIS), then a comparable threshold should be applied to TMI. If not, the comparison between TMI and SEVIRI.

Inconsistent results: The curve "SEV" in Fig. 2a is SEVIRI collocated with MODIS, correct? Does it mean that not always MODIS and SEVIRI are collocated? All the retrievals should be spatially and temporally collocated. I also noticed that in Fig S9, SEVIRI reff for overcast and all-sky samples is almost the same (Fig. S9a and b). In contrast, the all-sky and overcast averages are quite different for MODIS, why?

What is the purpose of showing the three MODIS reff's as the apples-to-apples comparison is between MODIS-SEVIRI at 1.6 um? I understand that this is useful for understanding the reff bias due to absorbing aerosols (which is not a novel result), but it is extremely confusing to understand figures 6-7 with so many symbols and retrievals, and the overall objective of including MODIS 2.1 and 3.7 reff is unclear. Similarly, just report one MODIS COT as the three MODIS COT are essentially the same. The authors mention that differences in MODIS reff at 1.6, 2.1, and 3.7 um might be providing information about the cloud vertical structure and precipitation; however, numerous papers (e.g. Zhang and Platnick, 2011, Painemal et al. 2013 ACP: "The impact of horizontal heterogeneities, cloud fraction, and liquid water path on warm cloud effective radii from CERES-like Aqua MODIS retrievals) have shown that the difference between the 3.7 um and 2.1 um reff (or 1.6 um) mostly reflect the effect of spatial inhomogeneity and clear-sky contamination in the retrievals (for stratiform clouds).

Figs S2 and S5 deserve to be included in the manuscript.

Remove “Discussion” from the title of Section 4. Page 12, line 349, I disagree, Figure S1 does not show any difference for COT.

Page 5, first paragraph: This is non-raining pixels according to the RSS algorithm. Depending on the threshold used to define a rainy pixel, drizzle or light precipitation is still possible.

Page 15, line 435: I cannot find the figure that shows the overestimation of SEVIRI (relative to MODIS) for broken scenes.

Page 16, first paragraph. This explanation is unlikely, since you removed samples with high liquid water path (precipitating samples according to the RSS algorithms). Moreover, the spectral difference in reff is mostly indicative of the effect of spatial inhomogeneity and 3D radiative effects in the retrievals rather than information about the vertical structure or precipitation.

Page 17, line 487, what do you mean by “smaller…”. Page 19 lines 547-549: I suspect this is mostly due to cloud thinning. If cloud fraction (mask) played a role, then cloud effective radius would be biased high due to clear-sky contamination and 3D radiative effects. Page 20 line 558: Use austral winter instead.

Page 4, line 102, replace “evaluated” with “analyzed”. Page 4, line 110, Add “In contrast,” before Painemal et al. (2012). Painemal et al. (2012) also utilized in-situ cloud probe to assess the bias in satellite cloud properties. Page 5 line 143: Define VIS/NIR. Page 6, line 157, If the physical retrievals are derived for COT>4, it seems logical to use the same threshold for comparing SEVIRI with MODIS.

Maps: It is very difficult to extract quantitative information from the maps due to the use of a continuous color palette (too many tones). Instead, it would be better to define only 10 or 12 discrete colors.

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