Review comments on "Life cycle of a flower cloud system during the EUREC^{4}A field campaign" by Cui *et. al.*

Summary and contributions

The authors present a case study of the life cycle of an individual flower cloud system (FCS). The mesoscale FCS occurred in the tropical North Atlantic winter trades east of Barbados on 2 February 2020 during the EUREC^{4}A field campaign. The authors present new insights and outline favourable meteorological conditions suitable during the life cycle FCS. For example, the FCS was surrounded by an airmass having high relative humidity and showed increased aerosol optical depth. The FCS was identified by a radiance threshold of 102 mW m^{-2} sr^{-1} (cm^{-1})$^{-1}$ in measurements of the GOES-16 ABI 11.2 μm channel and was manually tracked every 10 minutes. Based mainly on the total cloud area enclosed by the radiance threshold, the FCS life cycle was divided in (i) a developing, (ii) a mature, and (iii) a decaying stage. FCS characterization is based on cloud physical properties retrieved from GOES-16 ABI measurements, on cloud particle diameter measurements observed from the French SAFIRE ATR aircraft, and HALO aircraft dropsonde measurements. The environmental meteorological conditions have been studied with a variety of data, e.g. ERA5 reanalysis data, dropsonde measurements, retrievals from GOES-16 ABI as well as MODIS measurements. Studies about characterization and evolution of organized shallow convection and cloud organizations in the trades exist, to my knowledge however, the life cycle of an individual FCS was never considered. The results are sufficient to support the most interpretations/conclusions and they certainly will help evaluating numerical simulations. In my view, the presented work is worth publishing, as it provides meaningful contributions, most notably about the relationships between FCS life cycle stage and the meteorological (environmental) conditions. Even so, I believe some major improvements are needed before publication. Please find my detailed comments below.

General Comments:

1) The general impression is that the manuscript is written in a rush way and few ideas are mixed. English spelling is poor, but develops for the better as the manuscript progresses. A careful reading is necessary to smooth the whole document both the structure to there are many redundant sentences, the spelling, and miss-referencing of figures. May the authors ask a help from an native speaker at the department(s) for an assistance if necessary.

2) Data, methods, and results are mixed. Please structure the publication carefully. Temporal and spatial resolution is missing for any kind of data used and should be given in the data section. The description of the total precipitable water retrieval is missing in the data section. ERA5 is a powerful dataset that provides a great variety of meteorological variables, but which of them used for the study and their description is missing.

3) In my view, there are to many figures. The authors carefully should reduce the amount of figures. Move figures to appendix/supplementary material. Zoom on the FCS. Please show the 102 mW m^{-2} sr^{-1} $(cm^{-1})^{-1}$ isoline in any of the satellite images (radiance, CTH, COD) to clearly identify the FCS. Be consistent (UTC) vs. [UTC] or (μ) vs. [microns]. Please use round brackets.

Specific Comments

1) line 93: The authors state they follow the tracking methodology of Fiolleau and Roca (2013). It is a automatic tracking algorithm and identification is based on image segmentation using five brightness temperature intervals. This is a contradiction to manual tracking based on one radiance threshold value. Please clarify.

2) lines 269-276: I wonder how the propagation speed was calculated. Which method was used to identify the arcs, etc pp. Please describe it in the methodology section.

3) line 351: The authors state that the increase in SST, which is only $\sim$0.3 K, plays an important role in increasing the boundary layer height, which allows for higher cloud top. Vial et al. (2019) considered LES as well as in-situ and satellite observations to conclude that SST and associated variations in sea-surface fluxes unlikely to play an important role in driving the diurnal cycle of marine trade-wind cumulus cloud cover in the Carribean. This is contradictory to your statement. Please clarify.

4) line 354: The authors make use of the sea-surface temperature and argue there is cold advection at the surface. This is misleading because the velocity of the sea surface, as is known, is different to the wind speed at 10 m above sea-surface. Would it not be better to use the 2 m temperature from ERA5?

Technical Comments

1) Please be consistent in wording. E.g. SAFIRE-CORE = French ATR aircraft = microphysiscs airborne platform (PMA) observations. And others ...

2) line 89: Can you please clarify what MCSs is.

3) line 119: Please give more information. To my knowledge CPSD is not a GOES-16 ABI retrieval.

4) Section 3 Synoptic pattern, line 146: ...a frontal system... Is the frontal system always associated with FCSs or is the pre-cold frontal area favourable for FCSs?

5) lines 154ff: This is methodology.

6) line 157: After a series of ... Can the authors describe why the chosen threshold is suitable for the identification of the FCS.

7) lines 165ff: This is methodology or maybe introduction.

8) line172: The life cycle is divided in three stages based mainly on the area of the FCS. The subsequent lines describe CTH is another constraint. Please indicate the constraints.

9) line 179: ITC $\longrightarrow$ UTC

10) line 179: ...at high levels $\longrightarrow$ do you mean at cirrus level? Please clarify.

11) line 188: I wonder what happens between 0500 UTC and 0900 UTC?

12) line 189: The authors state that the local maxima in CTH were related to convective activity. Isn't the develeopment of the FCS also related to convective activity? Please be specific.

13) line 190-191: ...can be seen in Figures 5h - 5i... I cannot see it. Do you mean Figures 6h-i?

14) line 193: expansion of growing cumulus $\longrightarrow$ Do you mean vertical growth?

15) line 195: What do you mean with 'linked by a linear cloud'? Do you mean 2 FCS form a cloud street, a cloud line or maybe shallow mesoscale overturning circulations (SMOCs; George, 2023).

16) line 196: The authors describe that a cloud region separated from the main cloud. Is the process of splitting and merging an important feature in the development of a FCS? Please clarify.

17) line 197: Please describe the term 'area of the detrainment/entrainment cloud region' in more detail

18) line 202/203: What do you mean with '... developed to higher levels and were not dominated by those with top heights lower than 1600 m...'?

19) line 204: ...some clouds... Do you mean convectively active parts of the FCS?

20) line 208: at 1220 UTC there is only one Figure $\longrightarrow$ 8.c5

21) line 213: brown color $\longrightarrow$ dark red

22) line 222: there is no Figure 9.b1 - b5

23) line 225/226: Please give a reference to guide the reader

24) lines 230-253: Figure references, e.g 8.d6 = 1240 UTC; Which type of distribution is shown in Figure 9 (absolute, relative, probability density)? What does #L/micron mean in Figure 9? What is the meaning of the dashed vertical lines in Figure 9? It could be worth to combine Figures 10 and 11. Please give at least a legend in Figure 10. What does mean volume diameter mean? Is it MVD = $2r_e$? Lines 239-242 refer to a height, but there is no height visible at all in Figure 10. Line 250/251 '...perhaps suggest...' $\longrightarrow$ shows

25) line 258: The authors state in section 4.1 the mature stage lasted until 1900 UTC.

26) line 259: The gust fronts ... Is it the area highligted by the pink arrow? Please clarify.

27) line 262/263: '...one region of precipitation seen in the satellite observation...' This is speculative because satellite imagery shows r_e at cloud top. Furthermore, there is no Figure 7d9.

28) line 267: (Figure 13f) $\longrightarrow$ the pink arrow? Please clarify.

29) line 278: see comment line 258.

30) line 279/280: ...did not change much... I realize a wobbling patch.

31) line 281: ...a few local maxima of about 50 ... And some patches > 50.

32) line 285: ...the maximum values were about 45 μm ... decreasing to 45 μm...

33) line 293: Is there an explanation why r_e is particularly high at the boundary of the FCS?

34) lines 296-302: Move to methodology section. Figure 17 can be combined with Figure 11.

35) lines 309-310: Please clarify which channel and quantity (radiance, brightness temp.) is shown. Focus in Fig. 19 on the FCS, e.g. decrease lon/lat.

36) lines 311/312: several times UTC is missing

37) line 345ff: there is no -(lon) °W. Check also the subsequent sections.

38) line 372: Differences are usually given in K.

39) line 386: Γd $\longrightarrow$ Γ_d

40) line 403: The authors refer to cloud top height and pressure, but only the height is given. Please clarify.

41) line 410: ...during the developing and decaying stages... $\longrightarrow$ throughout the life cycle?

42) lines 412ff: move to data section.

43) line 430: MODIS is already defined.

44) line 480: EUREC4A $\longrightarrow$ EUREC^{4}A

45) line 481: (2021).. $\longrightarrow$ (2021)

46) line 485: ...propagation. analysis...

47) References: Please check alphabetical order.

48) page 22, Figure 1: Please indicate the time step of the surface weather analysis. To my knowledge the MODIS stripes are separated by about 100 minutes.

49) page 24, Figure 3: Shows the x-axis UTC or the time from evolution until decaying? Caption: describe the vertical lines.

50) page 25, Figure 4: Use the same tick marks on the x-axis as in Figure 3. Show the 3 stages in the life time of the FCS, e.g. vertical dotted lines. Show colorbar label (unit).

51) pages 26ff: Please revise the captions. Check (missing) colorbars $\longrightarrow$ labels/units. Figure 12 $\longrightarrow$ which time (UTC, local time); velocity unit missing; LWC unit missing. Figure 20a $\longrightarrow$ check unit.

52) Figures: be consistent with latitude and longitude. -59° = 59°W; latitude 10° = 10°N