The transport history of African biomass burning aerosols arriving in the remote Southeast Atlantic marine boundary layer and their impacts on cloud properties

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Supplementary

Table S1. CLARIFY aircraft flights used in this study.

Flight	Date	Take-off time	Duration (hours)	Pollution layer (MBL/FT)	In-cloud data (min)	MBL structure
C029	17/08/2017	08:56	3:23	MBL	5:38	e
C031	18/08/2017	11:59	3:43	MBL	4:00	d
C032	19/08/2017	10:01	3:43	MBL	33:24	f
C033	22/08/2017	08:54	3:45	FT	7:44	e
C036	24/08/2017	09:03	3:02	FT	23:40	e
C037	24/08/2017	13:46	3:07	FT	1:58	e
C038	25/08/2017	09:00	3:49	MBL&FT	14: 24	e
C039	25/08/2017	14:17	3:06	FT	7: 43	d
C042	28/08/2017	08:55	3:28	MBL&FT	14: 18	e
C044	29/08/2017	08:54	3:50	MBL&FT	36: 34	e
C045	29/08/2017	14:10	3:06	MBL&FT	33:12	e
C046	30/08/2017	08:45	4:06	MBL&FT	11:46	d
C047	01/09/2017	08:56	2:50	MBL&FT	2:21	d
C048	01/09/2017	13:26	3:57	MBL&FT	26:02	e
C049	02/09/2017	08:56	3:43	MBL&FT	11:11	d
C050	04/09/2017	13:28	3:46	MBL&FT	29:47	e
C051	05/09/2017	08:58	3:14	MBL&FT	38:41	d

Note: 1) "d" represents a decoupled stratocumulus MBL. 2) "e" represents a stratocumulus-over-cumulus MBL. 3) "f" represents a cumulus-capped MBL.

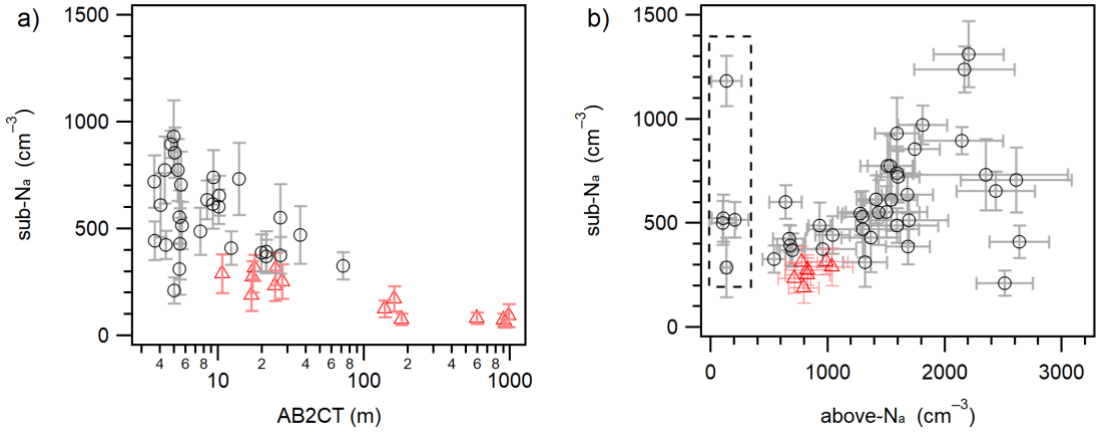

Figure S1: Relationships a) between sub-N_a and the distance between the bottom of the FT BB layer and cloud top (Aerosol Base to Cloud Top, AB2CT); b) between sub-N_a and above-N_a. The markers and error bars represent the average values and standard deviation for each profile. Black represents the BB-impacted MBL, and red represents the clean MBL.

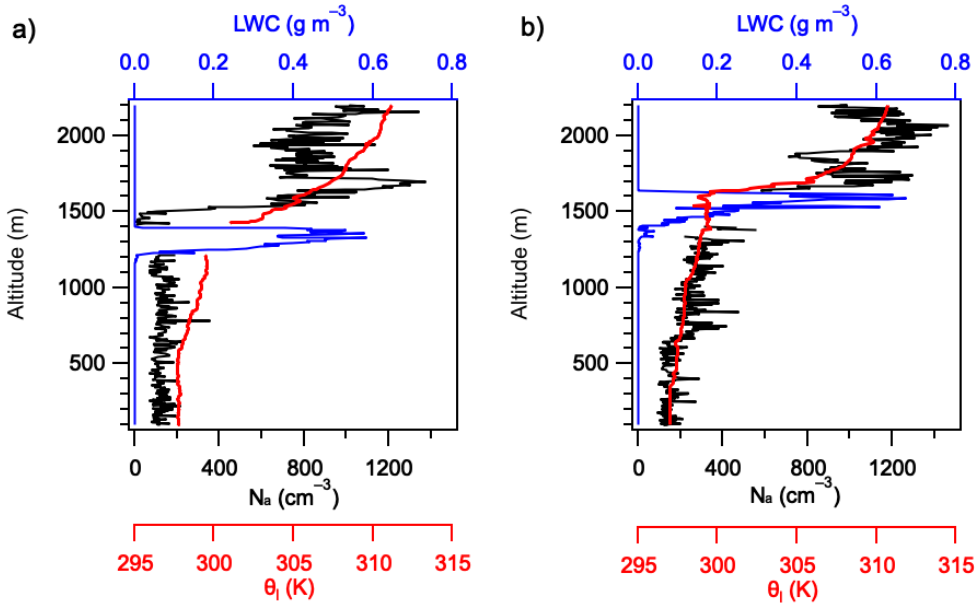

Figure S2: Vertical structures of N_a, LWC, and θ_l in example (a) separate and (b) contact profiles within the clean MBL.

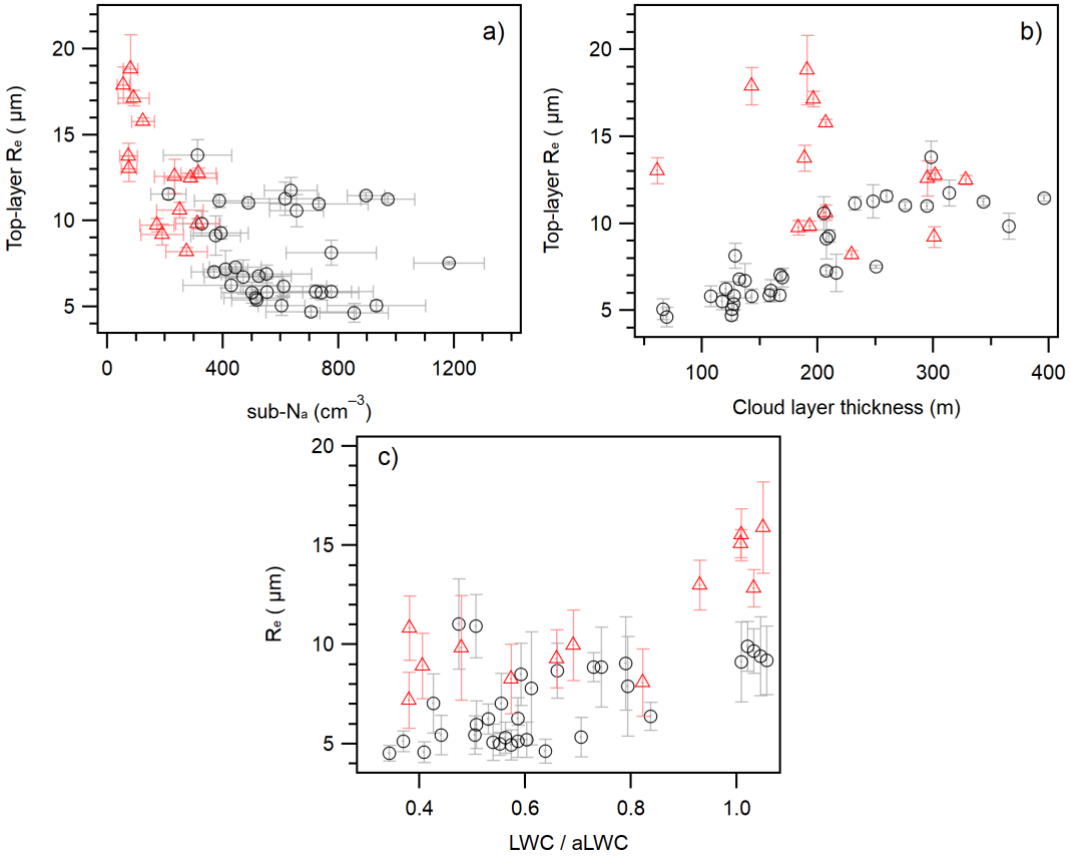

Figure S3: a) Relationship between cloud-top-layer R_e and sub-N_a for all analyzed profiles. b) Relationship between cloud-top-layer R_e and cloud layer depth for all analyzed profiles. c) Relationship between cloud-layer mean R_e and the average ratio of LWC/aLWC for all analyzed profiles. The markers and error bars represent the average values and standard deviation for each profile. Black represents the BB-impacted MBL, and red represents the clean MBL.

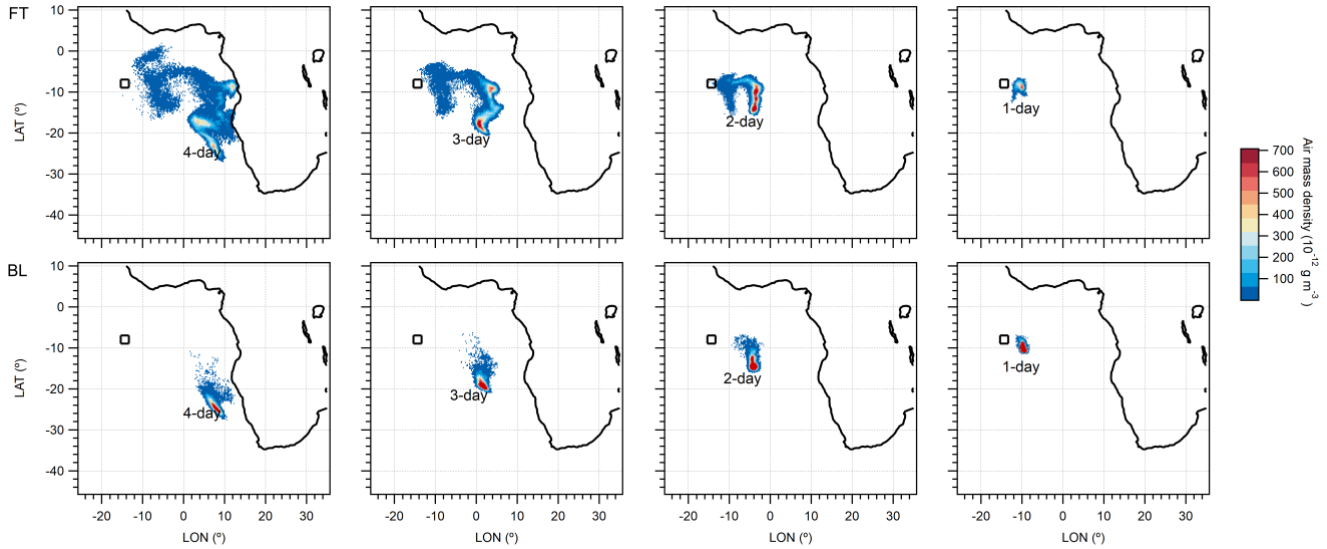

Figure S4: The instantaneous horizontal air parcel fields at each mid-day during 4 days prior to the NAME start time (air mass arrival at Ascension Island) for Case 1 (released on 18 August 2017 at 12:00 UTC). Top panels represent air parcel dispersion results attributed to the FT; bottom panels represent air parcel dispersion results attributed to the BL. From the left to right, the panels indicate the movement of air parcels before arrival at the release location around the Ascension Island area (black box). All plots are shown in the same color scale.

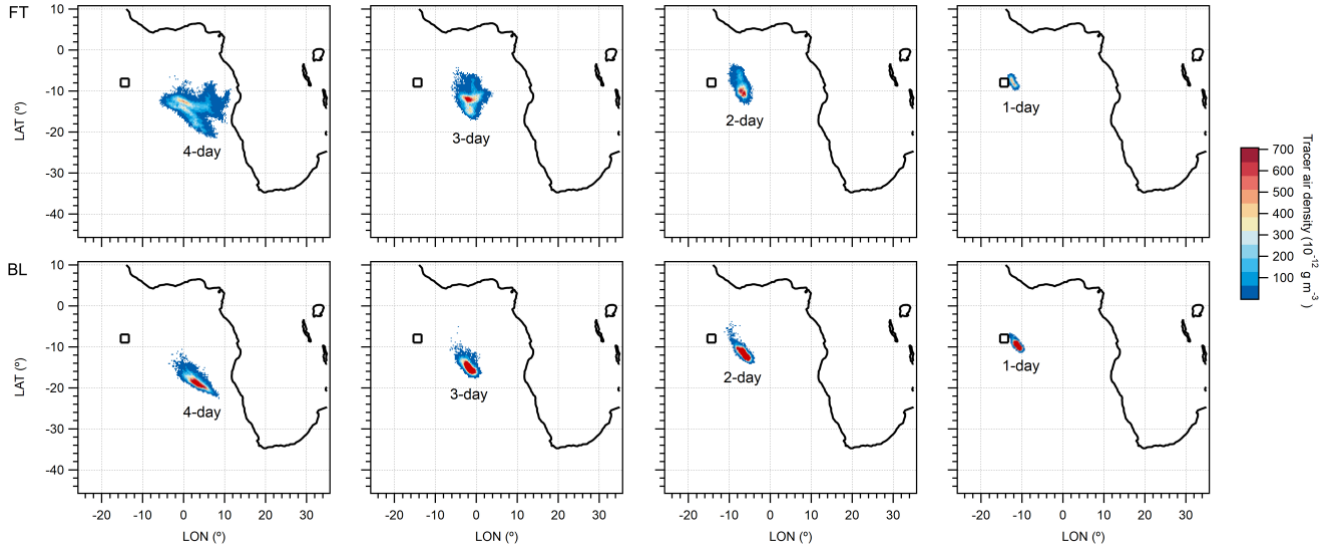

Figure S5: The instantaneous horizontal air parcel fields at each mid-day during 4 days prior to the NAME start time (arrival time at Ascension Island) for Case 3 (released on 26 August 2017 at 12:00 UTC). Top panels represent air parcel dispersion results attributed to the FT; bottom panels represent air parcel dispersion results attributed to the BL. From the left to right, the panels indicate the movement of air parcels before arrival at the release location around the Ascension Island area (black box). All plots are shown in the same color scale.

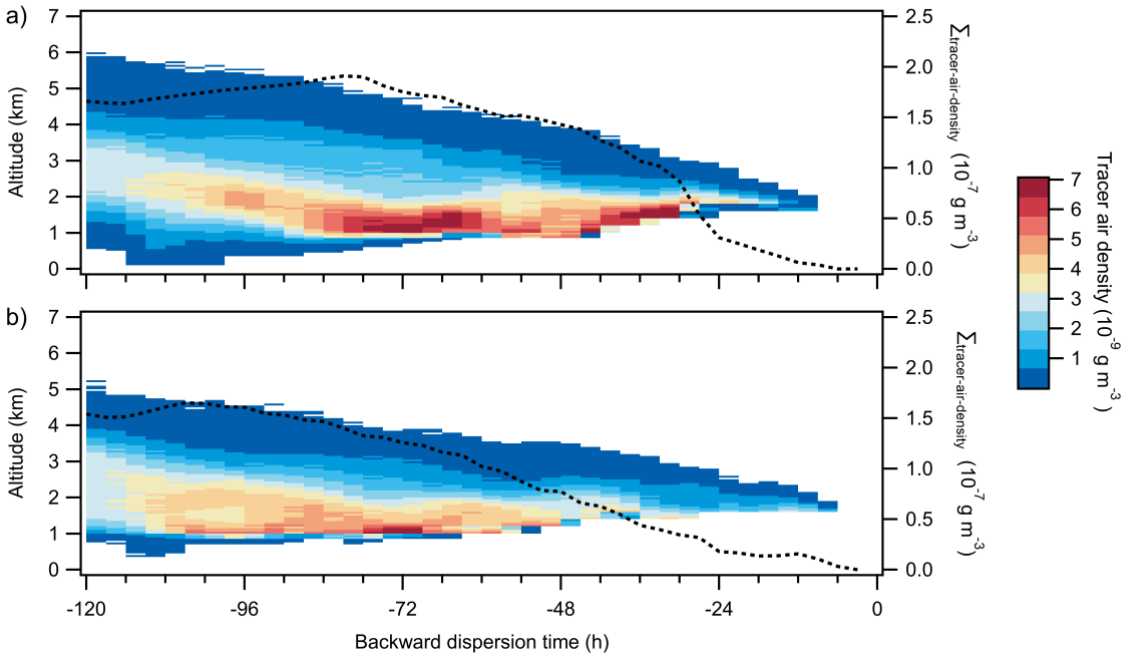

Figure S6: a-b) The 3-hourly time series of the vertical distribution of air parcels dispersed into the FT region identified in the horizontal area of 20°S – 0°N, 15°W – 12°E (see red box in Fig. 6), in terms of backward dispersion time from 3 to 120 h. The right axis (dashed black lines) is the corresponding cumulative exchange amounts of air parcels dispersed between the FT and MBL along backward simulations. a) is for Case 1 and b) is for Case 3.

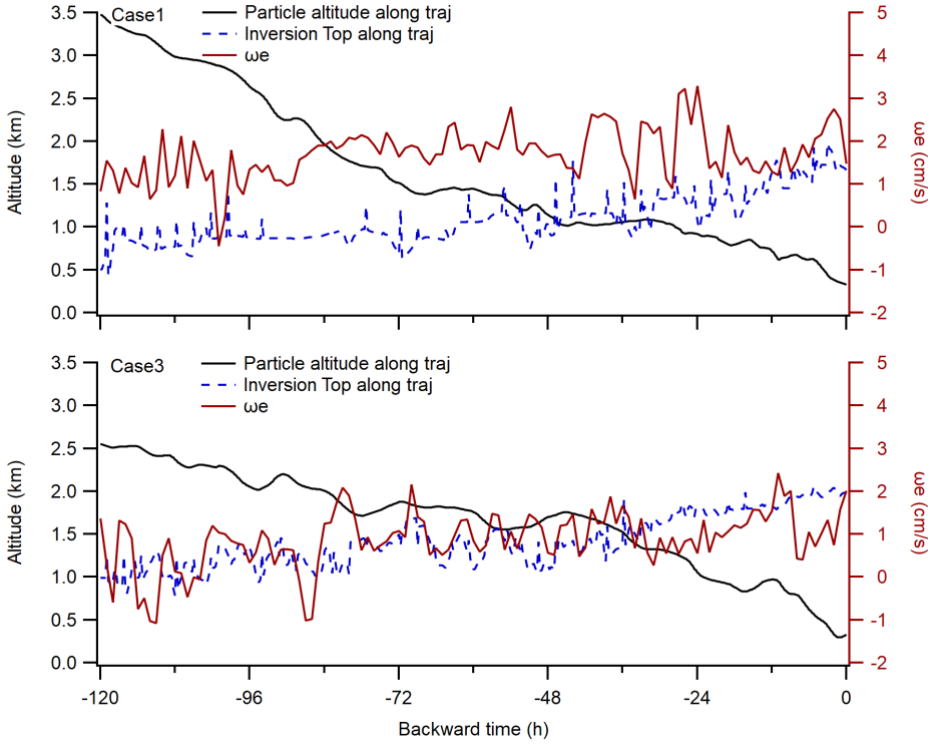

Figure S7: The entrainment rate (red solid lines) at the BL top along back trajectories from a) Case 1 and b) Case 3, as well as the air parcel altitude (black solid lines) and inversion top height (dashed blue lines) along the back trajectory.

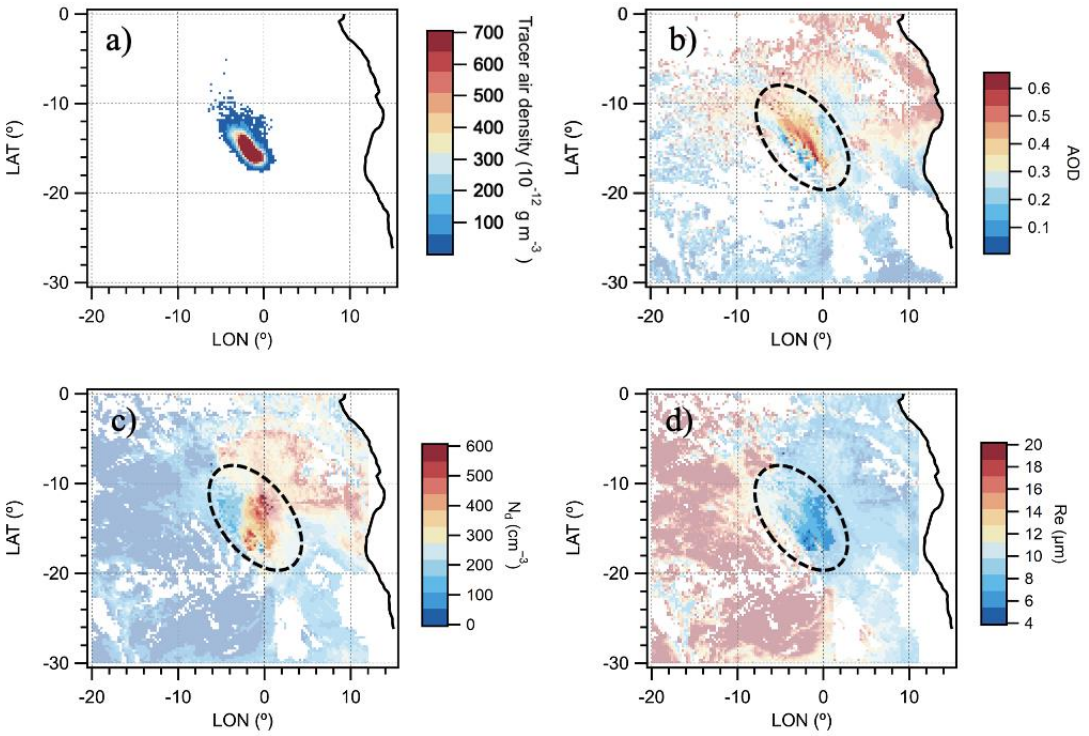

Figure S8: Examples of the co-location relationship between NAME instantaneous horizontal footprints and SEVIRI-retrieved aerosol and cloud fields. a) is an example BL instantaneous horizontal footprint from NAME simulations. b-d) are the example SEVIRI-retrieved AOD, N_d and R_e at the time of the example BL horizontal footprint. The parts of the scene (b-d) that are co-located with the contemporaneous horizontal footprints are highlighted. The air-density-weighted average SEVIRI-retrievals were calculated for these co-located areas at 3-hourly backward step.

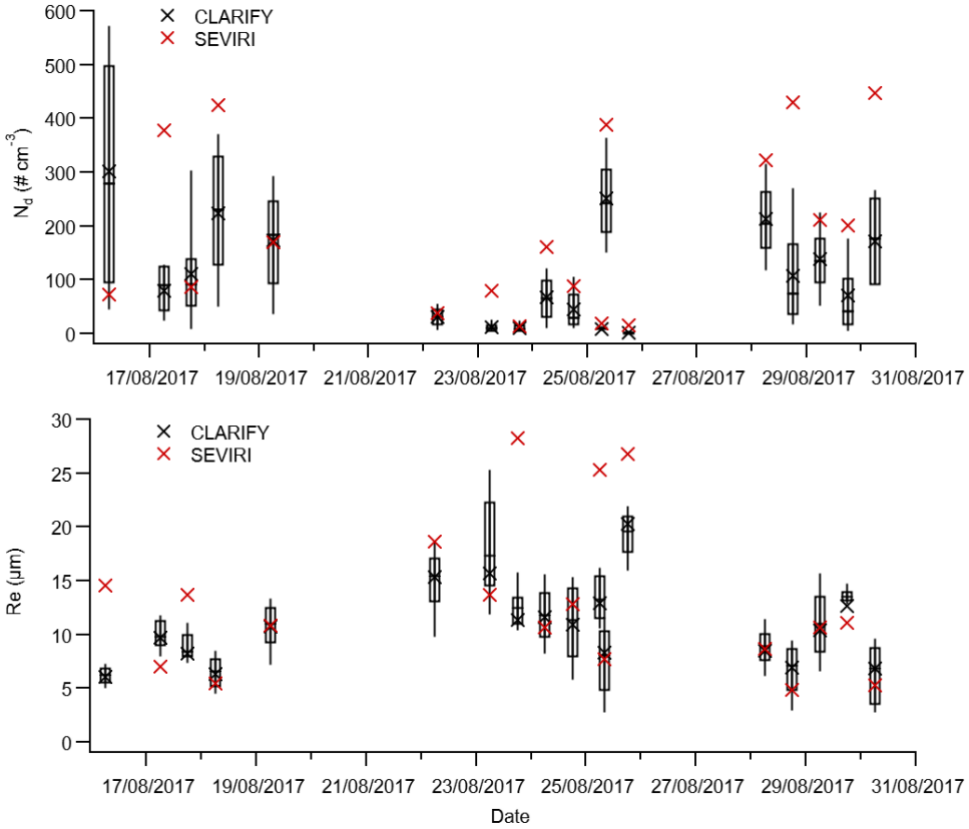

Figure S9: The comparison between averaged SEVIRI-retrieved N_d and R_e along CLARIFY flight tracks and the top-layer (highest 50 m layer) N_d and R_e calculated from CDP measurements during CLARIFY, the boxes and whiskers represent 10, 25, 50, 75 and 90 percentile, the markers represent average values.