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Modeled and observed properties related to the direct aerosol radiative effect of biomass burning aerosol over the southeastern Atlantic

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Table S1. Coordinates of the four transects of gridboxes used in this comparison. Gridboxes are numbered 1-8 (Diagonal, Meridional) or 1-11 (Zonal) from west to east and/or north to south.

Transect Name	Year(s)	Latitude	Longitude
Diagonal†	2016	7-11S 9-13S 11-15S 13-17S 15-19S 17-21S 19-23S 21-25S	2W-2E 0-4E 2-6E 4-8E 6-10E 8-12E 10-14E 12-16E
Meridional1	2016	7-9S 9-11S 11-13S 13-15S 15-17S 17-19S 19-21S 21-23S	9-11.75E
Zonal	2016, 2017	6-10S	15-13W 13-11W 11-9W 9-7W 7-5W 5-3W 3-1W 1W-1E 1-3E 3-5E 5-7E
Meridional2	2017, 2018	0.5N-1.5S 1.5-3.5S 3.5-5.5S 5.5-7.5S 7.5-9.5S 9.5-11.5S 11.5-13.5S 13.5-15.5S	4-6E

†For the Diagonal transect, coordinates given are for the latitudes of the north and south corners and the longitudes of the east and west corners of the gridbox.

Table S.2: The difference between the average of CF_{warm} at 10:30 and 13:30 and CF_{warm} for all times when SZA<75° (i.e. the expected ratio of MODIS daily avg CF_{warm} vs SEVIRI daily avg CF_{warm}) during the three field campaign periods

a) Zonal Transect			
Gridbox (W->E)	**2016**	**2017**	**2018**
1	-0.025	-0.009	-0.010
2	-0.030	0.002	-0.010
3	-0.034	0.007	-0.006
4	-0.024	-0.021	-0.008
5	-0.013	-0.027	-0.008
6	-0.023	-0.016	-0.003
7	-0.024	-0.018	0.004
8	-0.023	-0.018	0.001
9	-0.030	-0.013	-0.015
10	-0.038	-0.020	-0.014
11	-0.042	-0.032	-0.001
mean	*-0.053*	*-0.081*	*0.000*
std dev	*-0.063*	*-0.081*	*0.009*

b) Diagonal Transect	
Gridbox (NW->SE)	**2016**
1	-0.007
2	-0.004
3	-0.007
4	-0.030
5	-0.024
6	0.002
7	-0.007
8	-0.010
mean	*-0.011*
std dev	*0.011*

c) Meridional1 Transect	
Gridbox (N->S)	**2016**
1	-0.094
2	-0.143
3	-0.135
4	-0.090
5	-0.030
6	0.053
7	0.051
8	0.094
mean	*-0.037*
std dev	*0.092*

d) Meridional2 Transect		
Gridbox (N->S)	**2017**	**2018**
1	-0.080	0.105
2	-0.068	0.102
3	-0.040	0.040
4	-0.058	-0.053
5	-0.008	-0.079
6	0.012	-0.096
7	-0.012	-0.081
8	-0.034	-0.115
mean	*-0.036*	*-0.022*
std dev	*0.032*	*0.090*

Table S.3: As in Table S.2, but showing the difference in median COT_{warm} at 10:30 and 13:30 versus the median for the full daytime, based on an empirical fit to COT_{warm} versus CF_{warm} from the MODIS-ACAERO retrievals.

a) Zonal Transect			
Gridbox (W->E)	**2016**	**2017**	**2018**
1	-0.37	-0.16	-0.27
2	-0.41	-0.06	-0.66
3	-0.50	0.00	-0.85
4	-0.38	-0.30	-0.73
5	-0.23	-0.42	-0.85
6	-0.39	-0.27	-0.58
7	-0.41	-0.29	-0.46
8	-0.41	-0.30	-0.37
9	-0.51	-0.24	-0.54
10	-0.63	-0.36	-0.34
11	-0.66	-0.51	-0.34
mean	*-0.78*	*-1.05*	*-0.06*
std dev	*-0.88*	*-0.97*	*-0.38*

b) Diagonal Transect	
Gridbox (NW->SE)	**2016**
1	-0.14
2	-0.08
3	-0.14
4	-0.50
5	-0.37
6	0.01
7	-0.12
8	-0.11
mean	*-0.18*
std dev	*0.17*

c) Meridional1 Transect	
Gridbox (N->S)	**2016**
1	-1.03
2	-1.12
3	-0.79
4	-0.58
5	-0.43
6	-0.38
7	-0.01
8	0.22
mean	*-0.52*
std dev	*0.47*

d) Meridional2 Transect		
Gridbox (N->S)	**2017**	**2018**
1	-0.96	-0.02
2	-0.82	-0.06
3	-0.49	-0.21
4	-0.67	-0.39
5	-0.20	-0.45
6	0.19	-0.29
7	-0.23	-0.51
8	-0.61	-0.32
mean	*-0.48*	*-0.28*
std dev	*0.38*	*0.18*

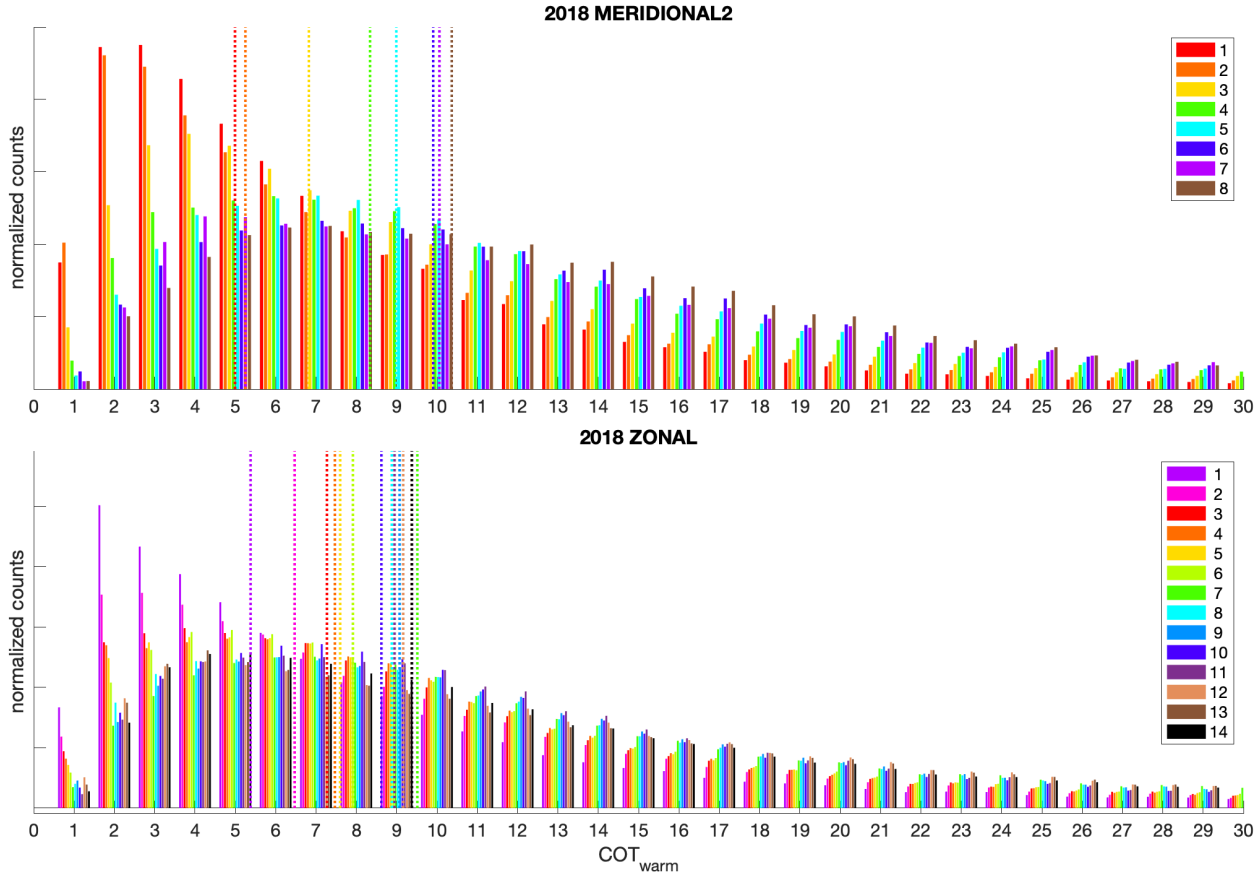

Figure S.1 A histogram of COT_{warm} from the MODIS-ACAERO retrievals for the 2018 Meridional2 and Zonal transects, colored by transect gridbox number (Figure 1). COT_{warm} for the transects in 2016 and 2018 have similarly shaped distributions.

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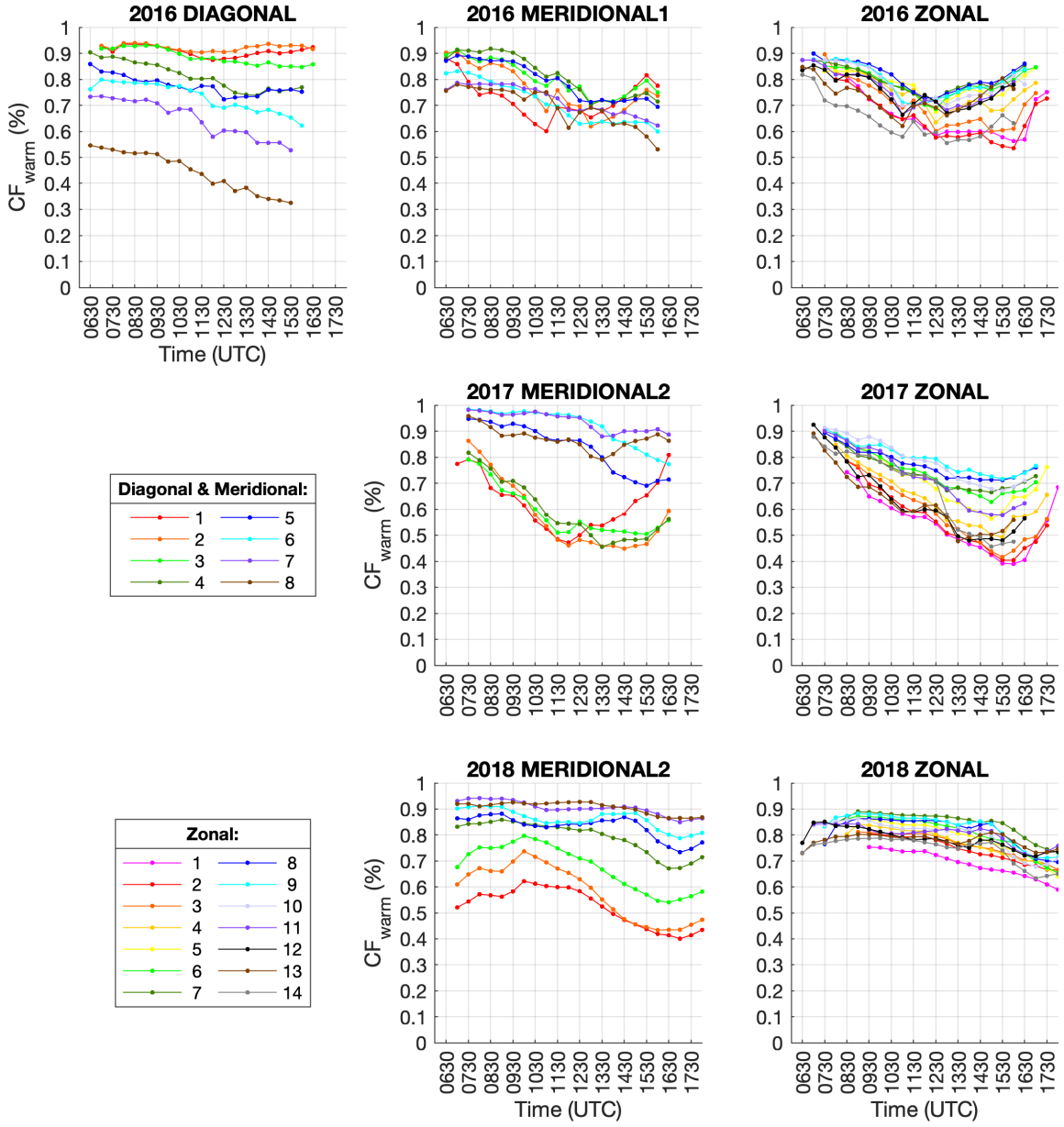

Figure S.2 CF_{warm} from the SEVIRI-LaRC retrievals, for all times when SZA<75°, showing the diurnal cycle in CF across the comparison gridboxes during the dates of the ORACLES field campaigns in 2016, 2017 and 2018.

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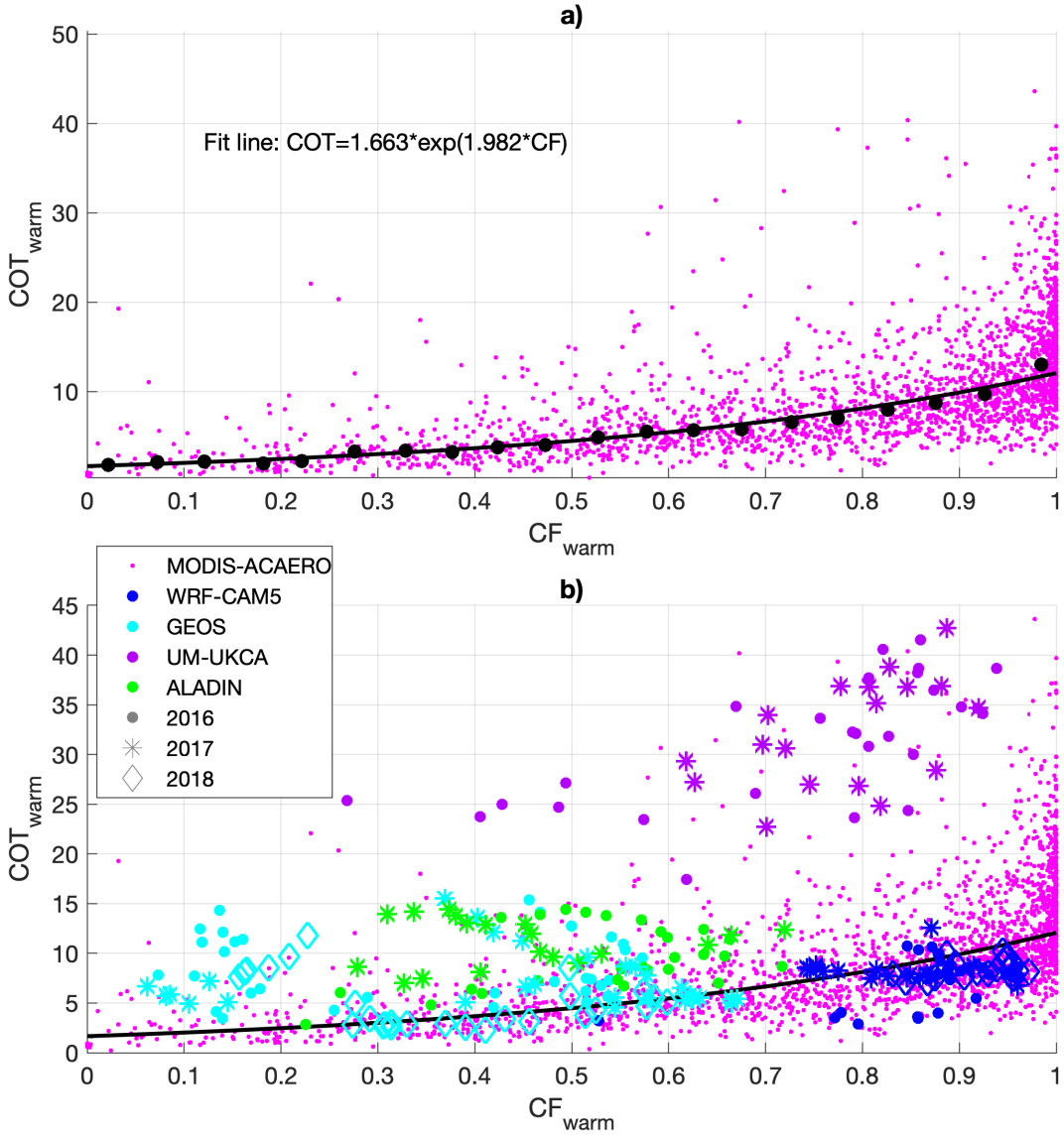


Figure S.3 COT_{warm} versus CF_{warm} for a) pixel-level MODIS-ACAERO retrievals, with an empirical fit using averages (blue dots) in CF_{warm} bins of 0.05, and b) for both MODIS-ACAERO pixel-level retrievals gridbox averages from the four models included in this comparison.

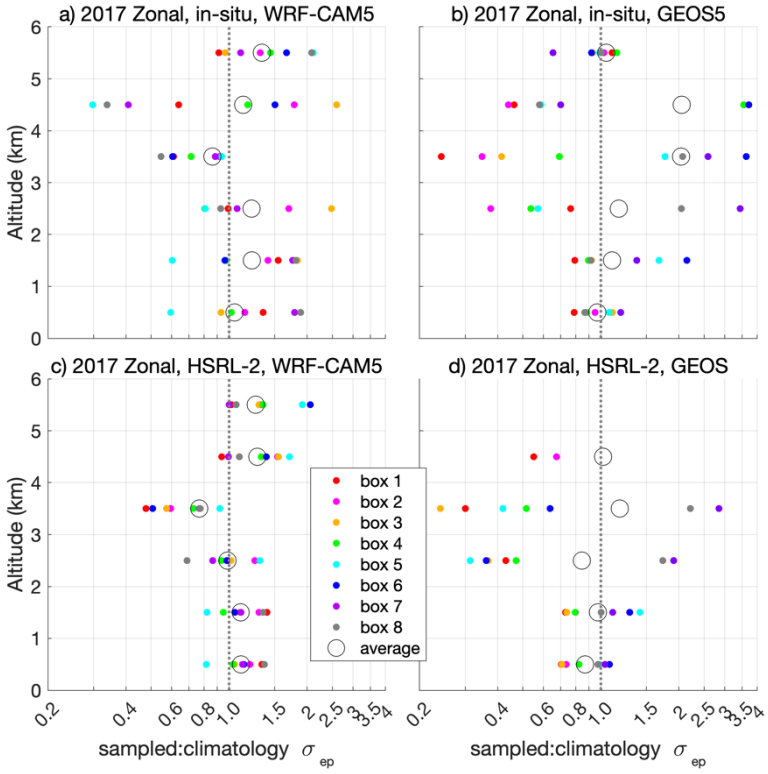
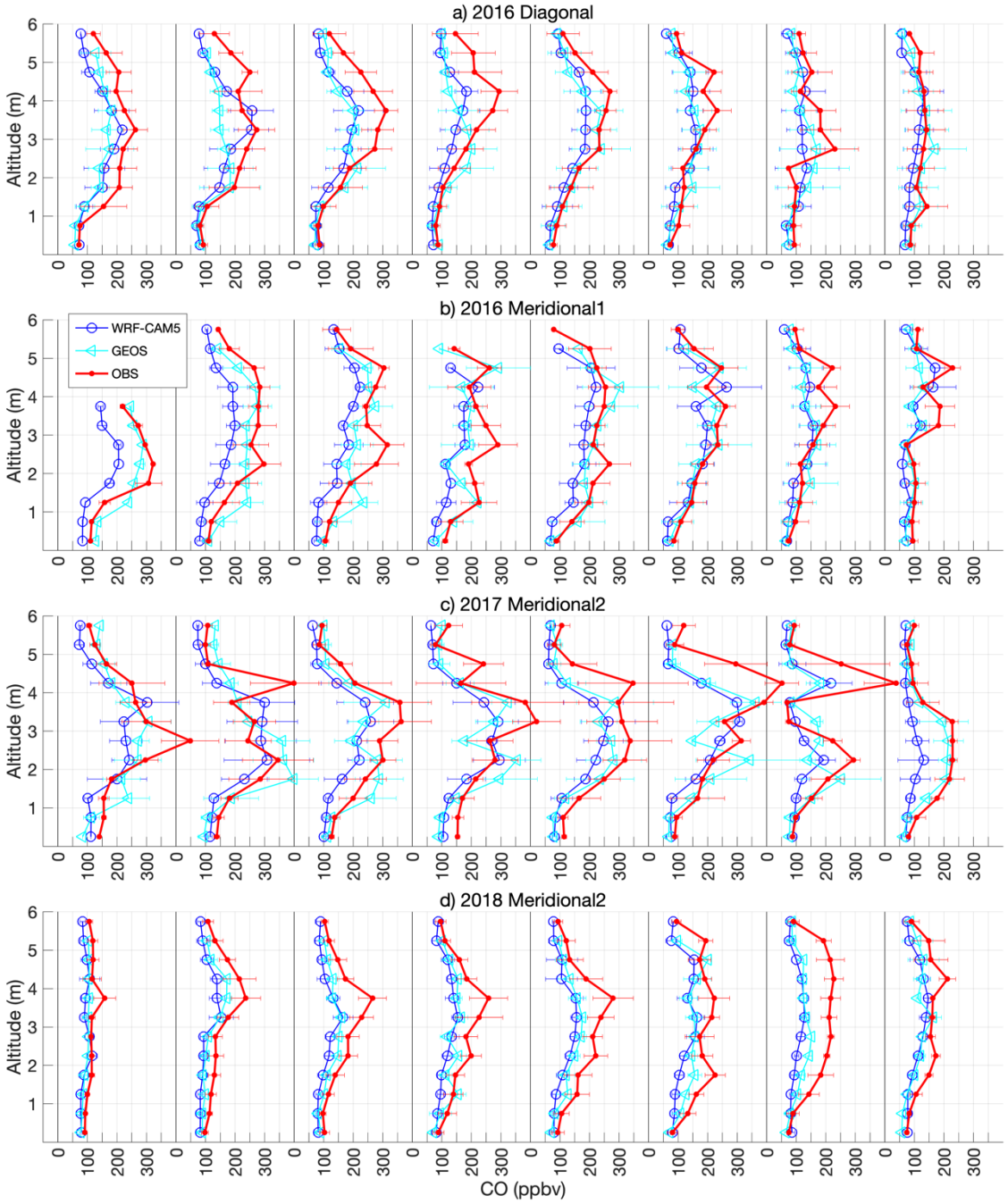


Figure S.4 As in Figure 3: Plots showing the representativeness of the in -situ (a and b) and HSRL-2 (c and d) sampled values of σ_{ep} for the 2017 Zonal transect from WRF-CAM5 (a and c) and GEOS (b and d) simulations.



115 **Figure S.5** As in Figure 4, but for profiles of carbon monoxide (CO) mixing ratio.

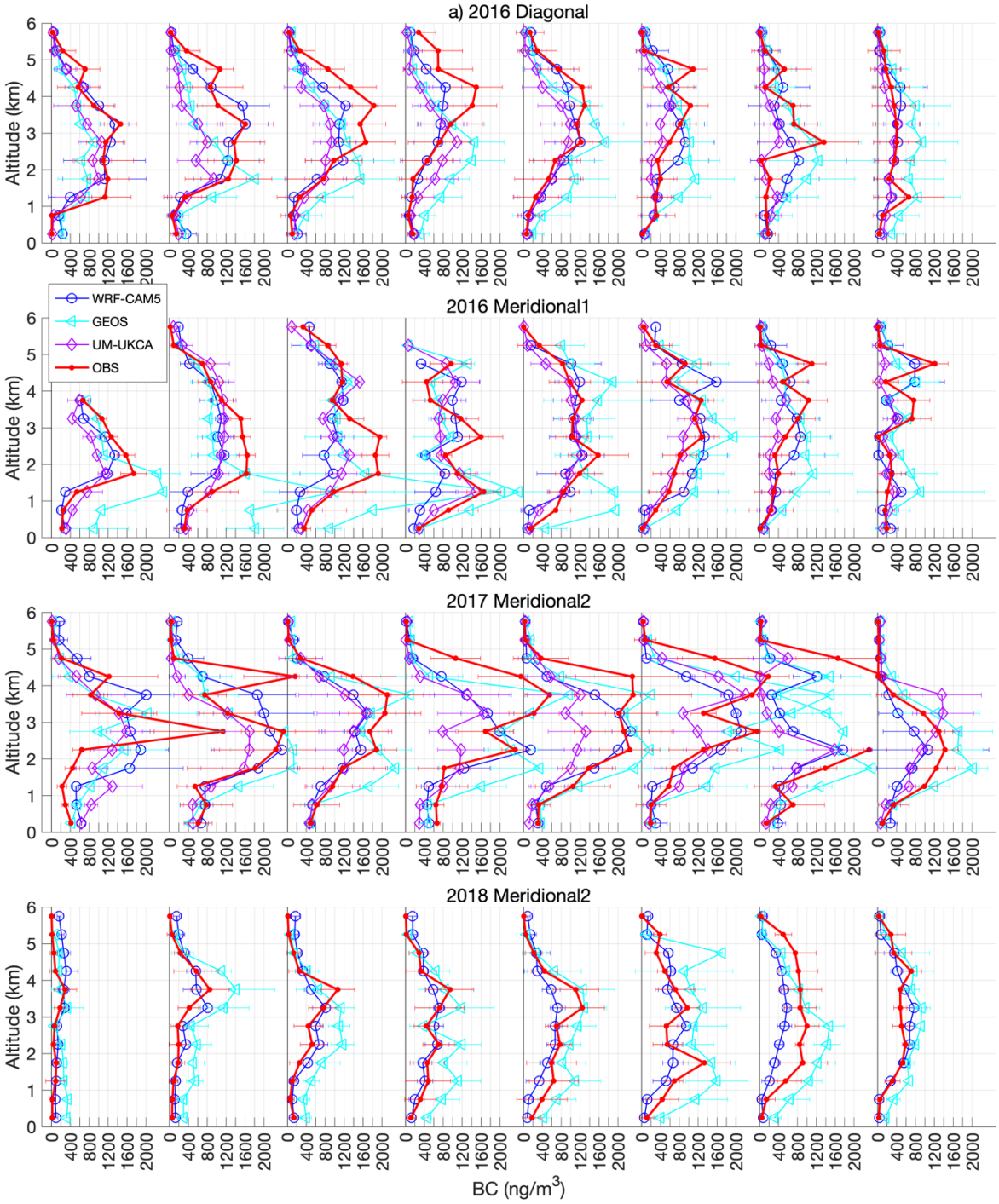


Figure S.6 As in Figure 4, but for black carbon (BC) mass concentration.

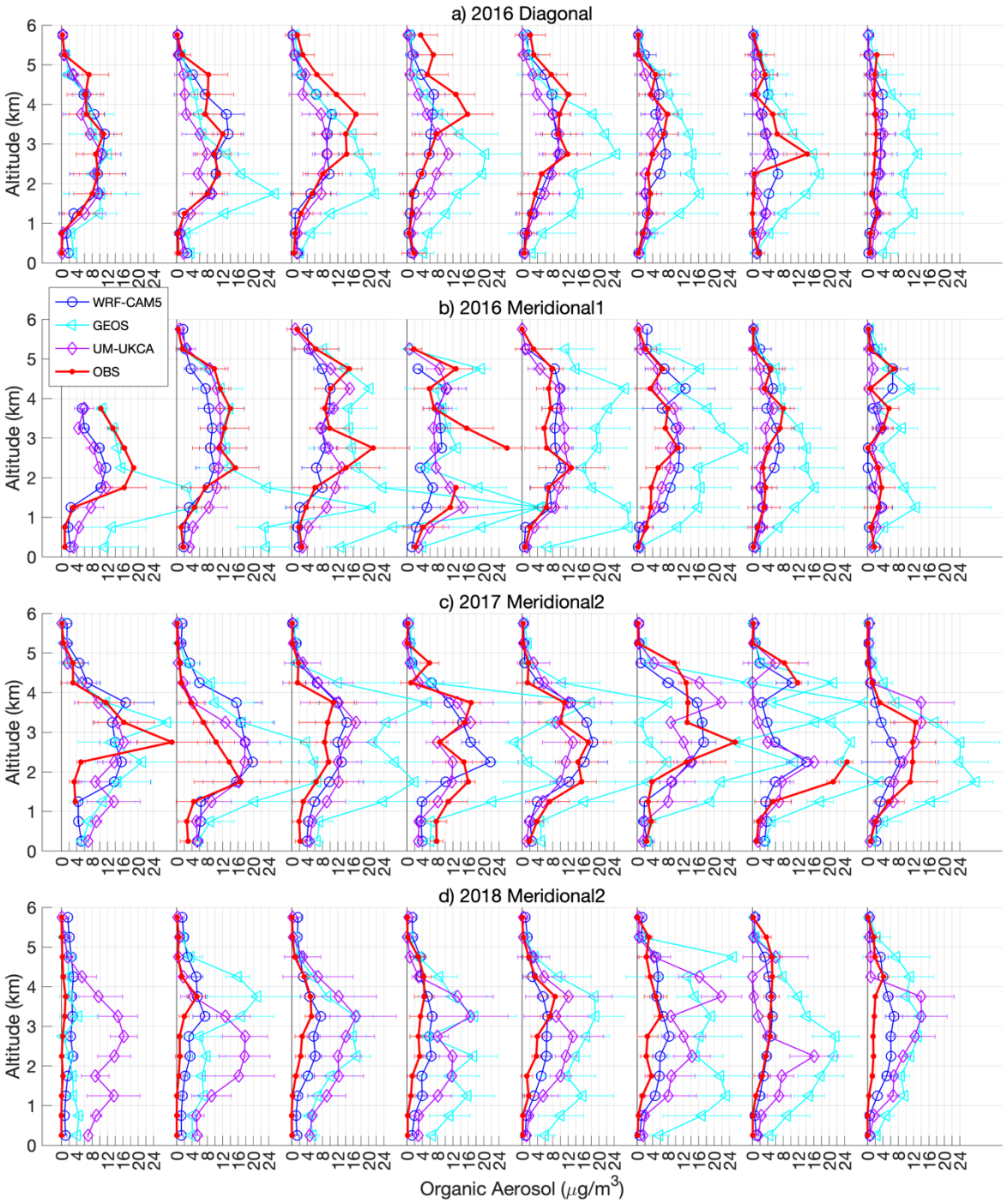


Figure S.7 As in Figure 4, but for organic aerosol (OA) mass concentration.

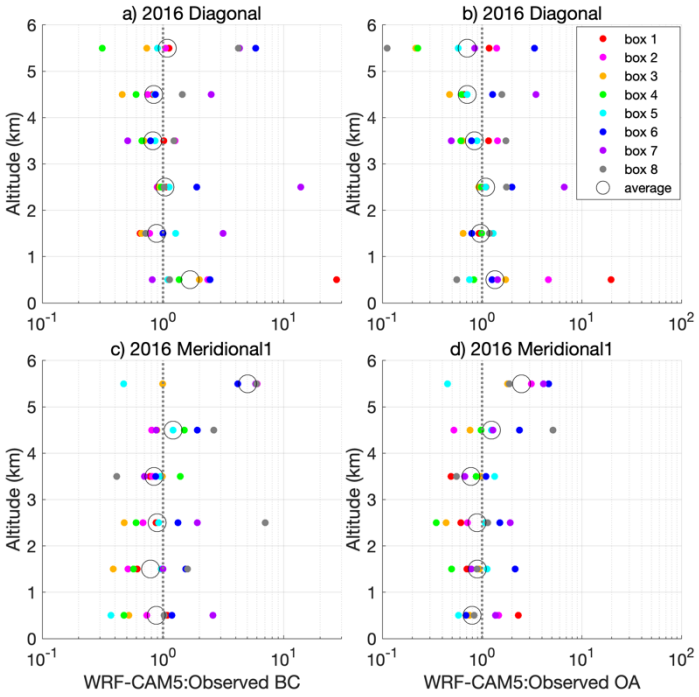


Figure S.8 Ratio of WRF-CAM5 modeled to observed BC (a, c) and OA (b, d) for the 2016 Diagonal (a, b) and 2016 Meridional1 (c, d) comparison transects. Averages for individual gridboxes are shown as well as the average across all gridboxes.

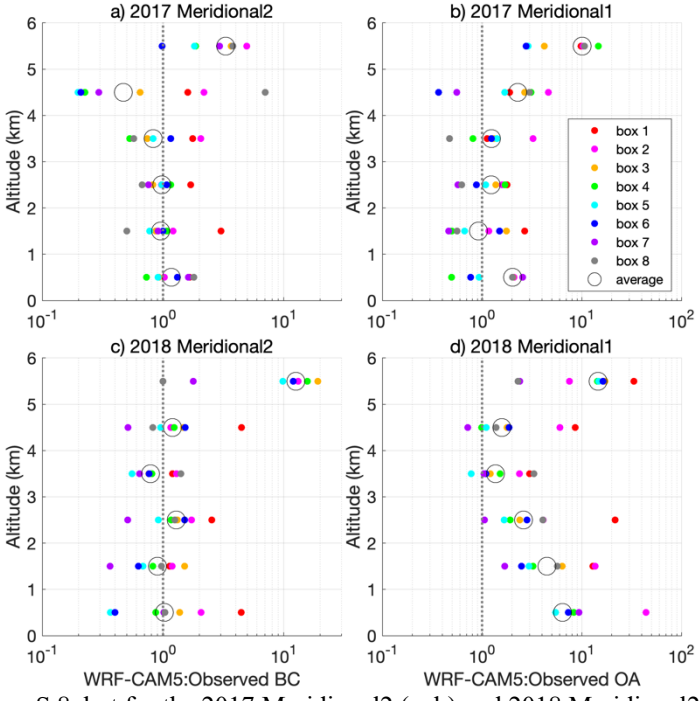


Figure S.9 As in Figure S.8, but for the 2017 Meridional2 (a, b) and 2018 Meridional2 (c, d) comparison transects.

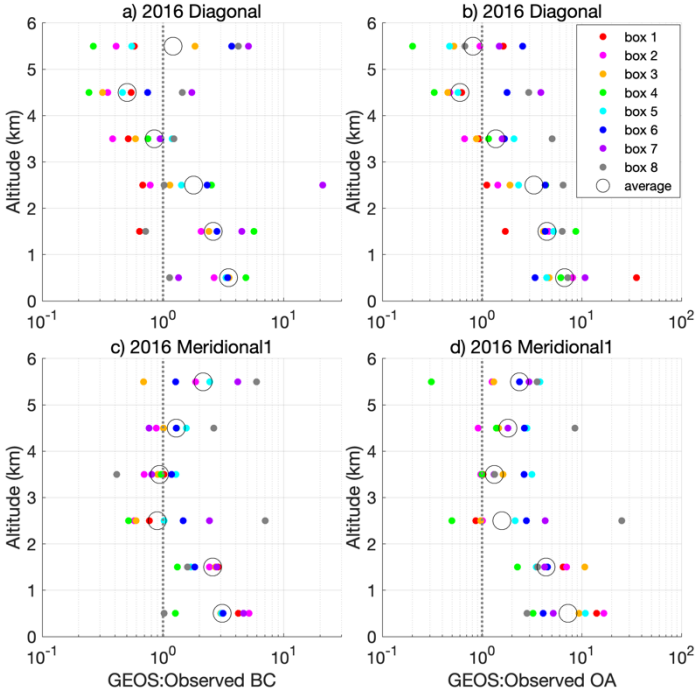
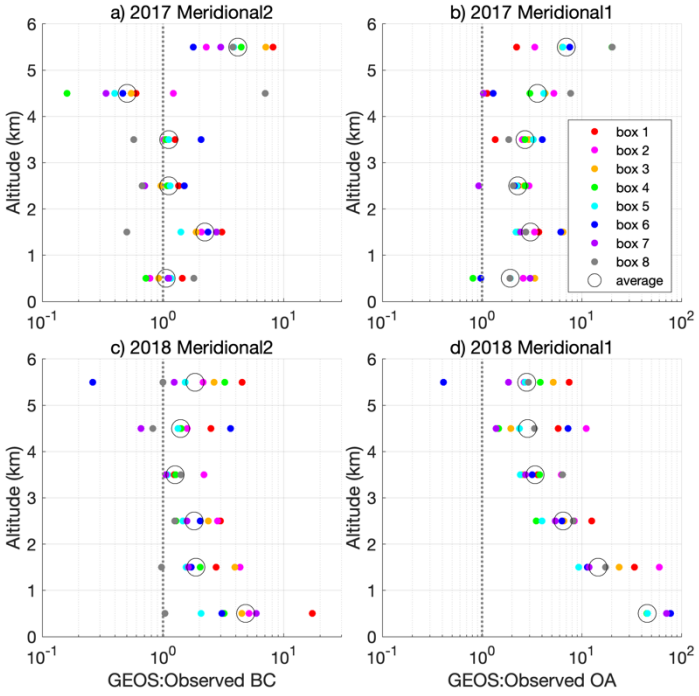


Figure S.10 Ratio of GEOS modeled to observed BC (a, c) and OA (b, d) for the 2016 Diagonal (a, b) and 2016 Meridional1 (c, d) comparison transects. Averages for individual gridboxes are shown as well as the average across all gridboxes.



135 **Figure S.11** As in Figure S.10, but for the 2017 Meridional2 (a, b) and 2018 Meridional2 (c, d) comparison transects.

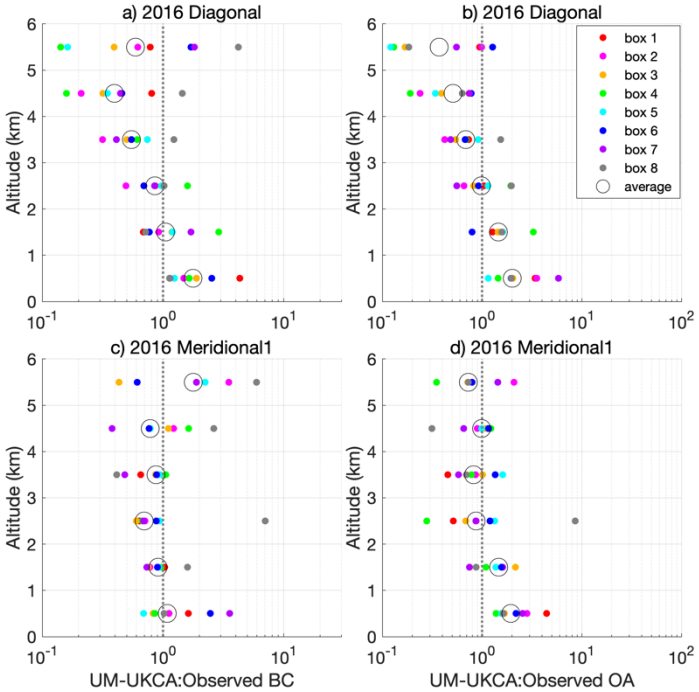


Figure S.12 Ratio of UM-UKCA modeled to observed BC (a, c) and OA (b, d) for the 2016 Diagonal (a, b) and 2016 Meridional1 (c, d) comparison transects. Averages for individual gridboxes are shown as well as the average across all gridboxes.

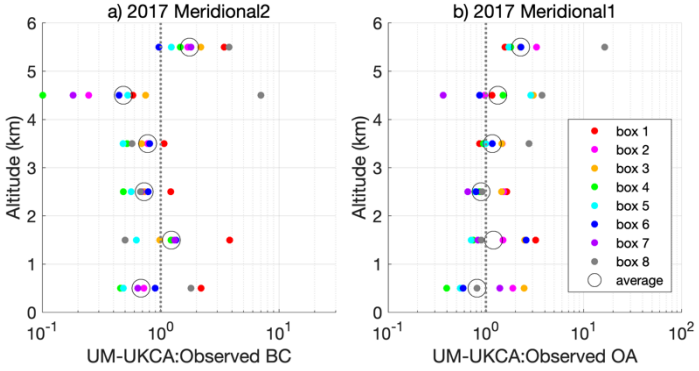


Figure S.13 As in Figure S.10, but for the 2017 Meridional2 comparison transect.

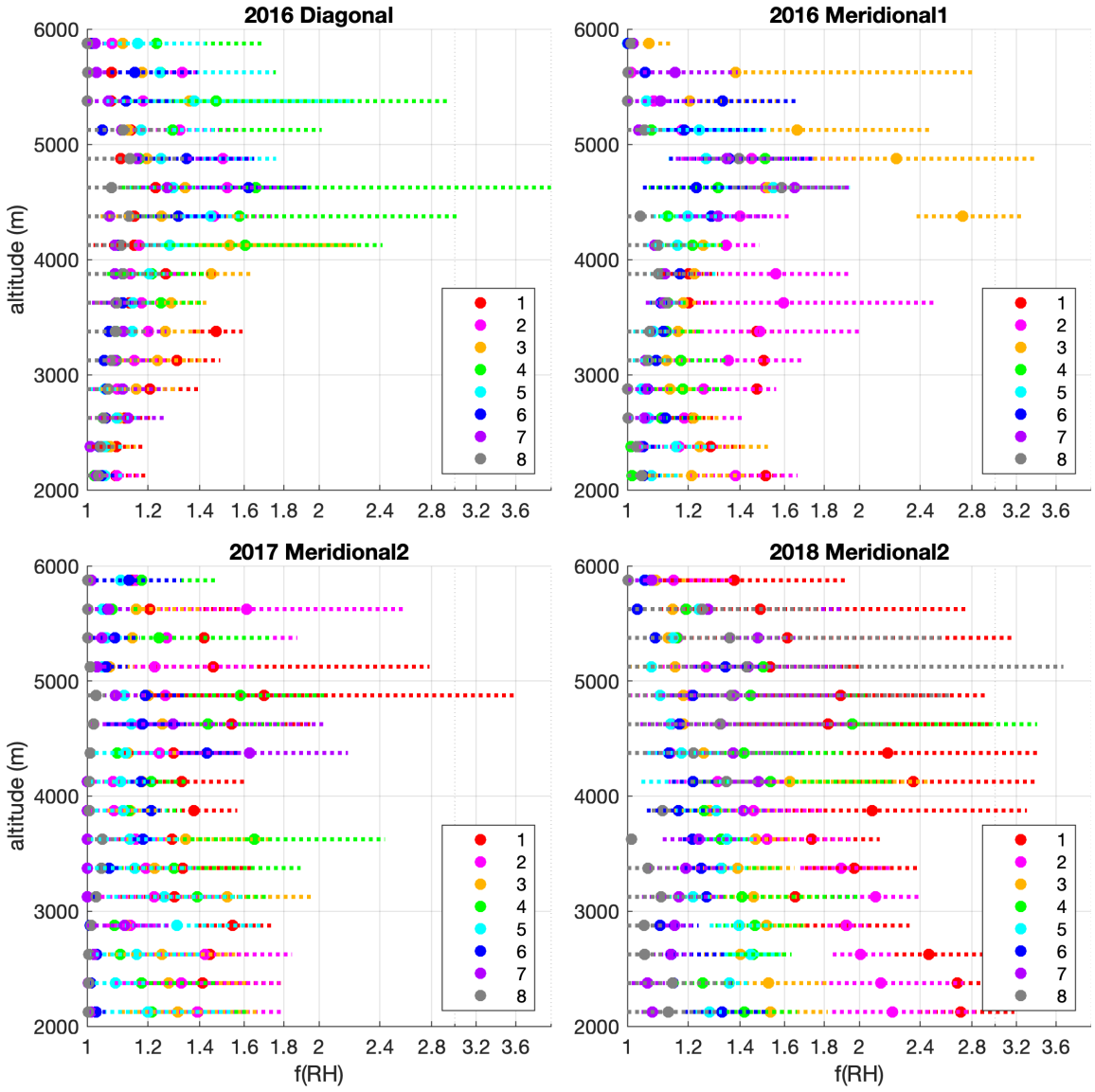


Figure S.14 Light scattering (σ_{sp}) humidification factor, f(RH), estimated for adjusting from the measured in-situ at low RH to ambient RH. This estimate uses the gamma fit to low and high (approx. 80%) RH light scattering measured in-situ in the P-3 aircraft, averaged for all data 2-5km altitude where σ_{sp}>25 Mm^{-1}. The campaign-wide averages from 2016 (γ=0.62) and 2018 (γ=0.62; used for both 2017 and 2018) are used with observed ambient RH (Figure 6) to calculate the f(RH) values shown here. Solid dots are f(RH) for the gridbox-mean ambient RH and the dashed horizontal bars for +/-1 sigma in ambient RH, with f(RH) truncated at 1.0 in the lower limit. Colors indicate the gridbox number, as shown in Figure 1.

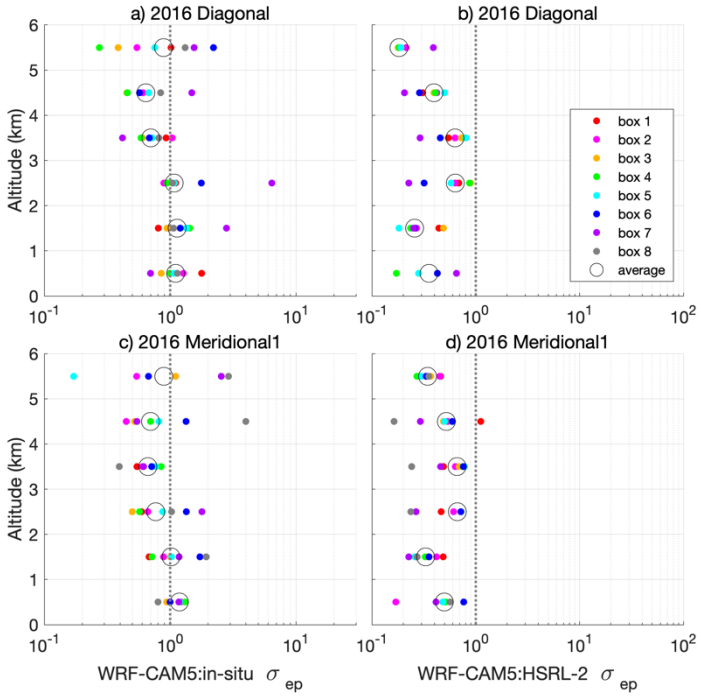


Figure S.15 Ratio of modeled ambient-RH, mid-visible σ_{ep} to in-situ dry (a, c) and HSRL-2 ambient-RH (b, d) mid-visible σ_{ep} for the WRF-CAM5 model along the 2016 Diagonal (a, b) and Meridional1 (c, d) transects. Averages for individual gridboxes are shown as well as the average across all gridboxes.

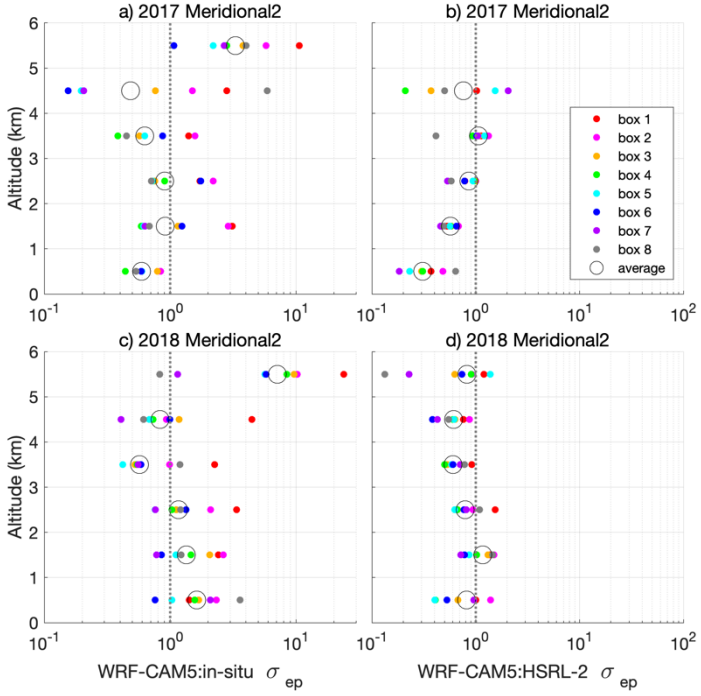


Figure S.16 As in Figure S.16, but for the 2017 (a, b) and 2018 (c, d) Meridional2 transect comparisons.

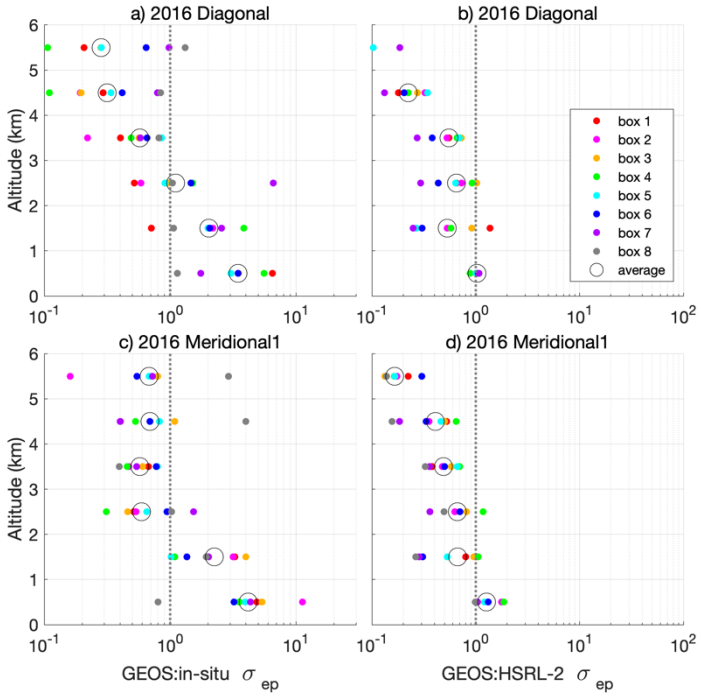


Figure S.17 As in Figure S.15 but for comparison to the GEOS modelled values of σ_{ep}.

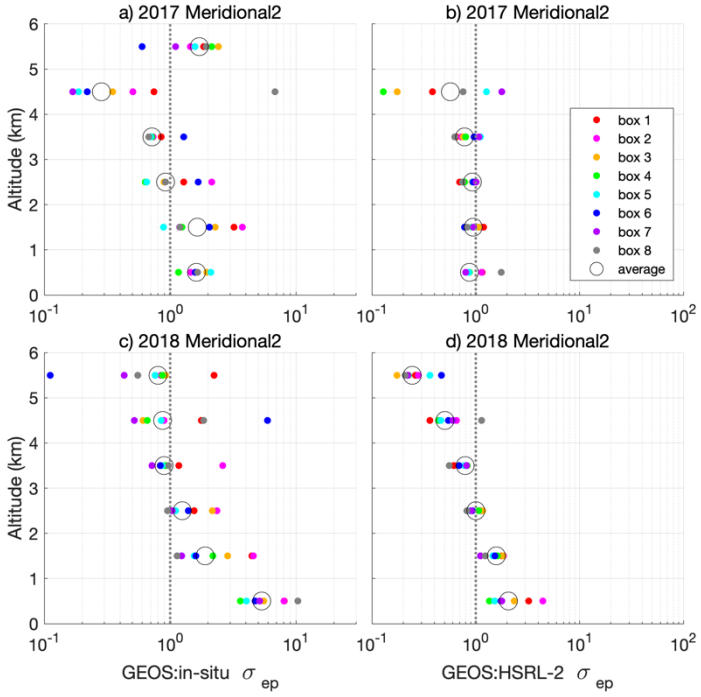
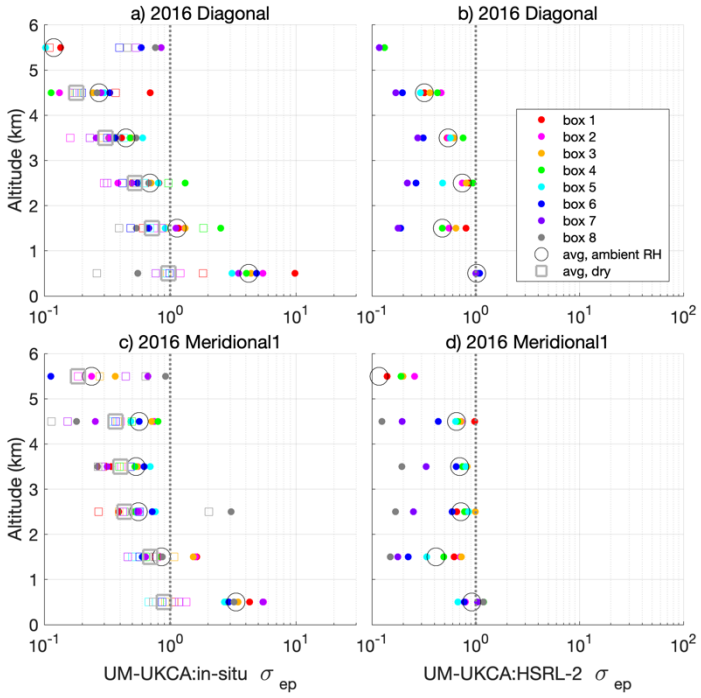


Figure S.18 As in Figure S.17 but for the 2017 (a, b) and 2018 (c, d) Meridional2 transect comparisons.



195 **Figure S.19** As in Figure S.15 but for comparison to the UM-UKCA modelled values of σ_{ep}. Here, comparisons are made to both dry and ambient-RH σ_{ep} from the model.

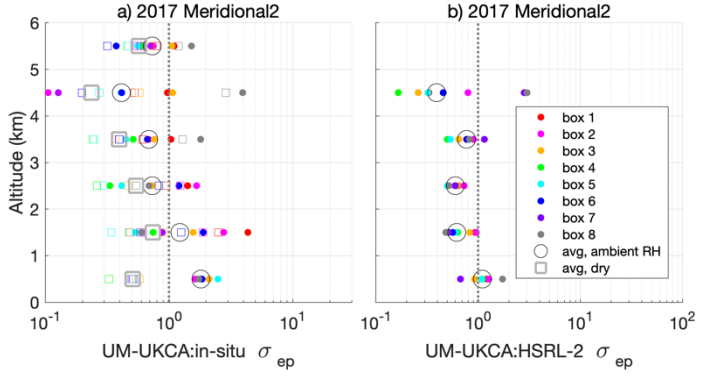


Figure S.20 As in Figure S.19 but for the 2017 Meridional2 transect comparisons.

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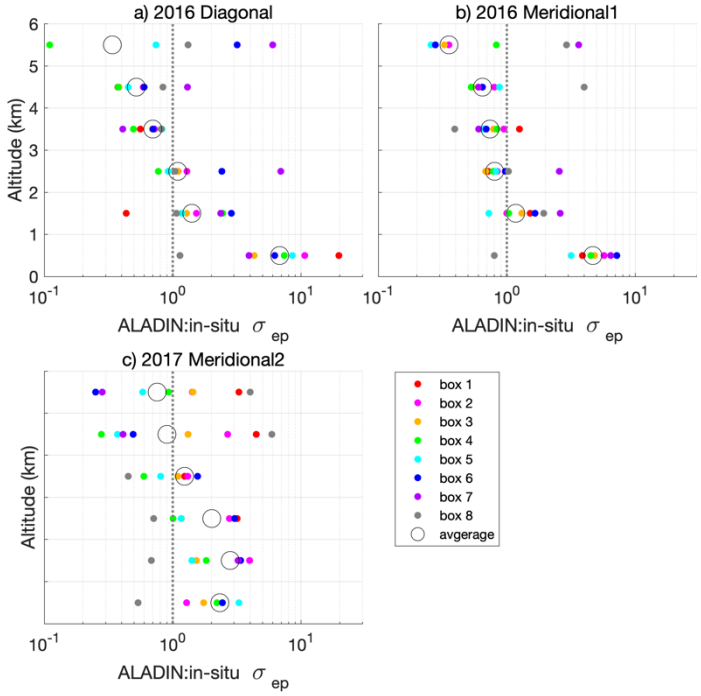

Figure S.21 As in Figure S.15 but for comparison to the ALADIN modelled values of σ_{ep} for the a) 2016 Diagonal1 b) 2016 Meridional1 and c) 2017 Meridional2 comparison transects.

205

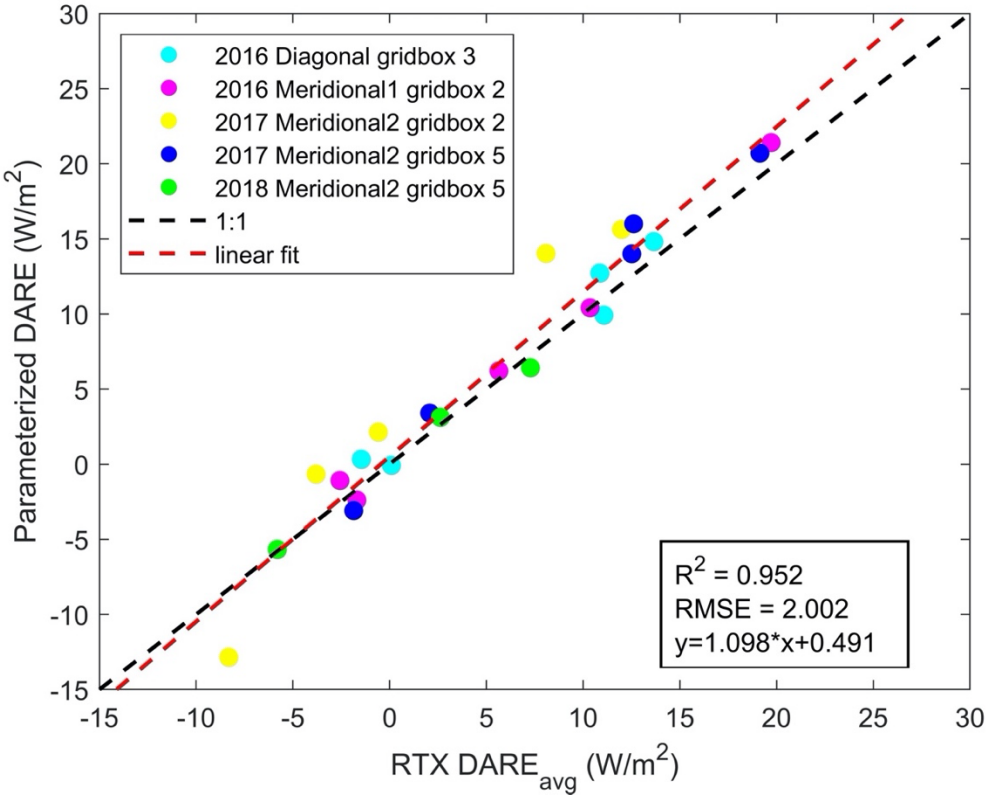

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Figure S.22 Comparison of parameterized DARE from Equation [3] versus DARE from full radiative transfer calculations, as described in the text.