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Supplement of

Mid-level clouds are frequent above the southeast Atlantic stratocumulus clouds

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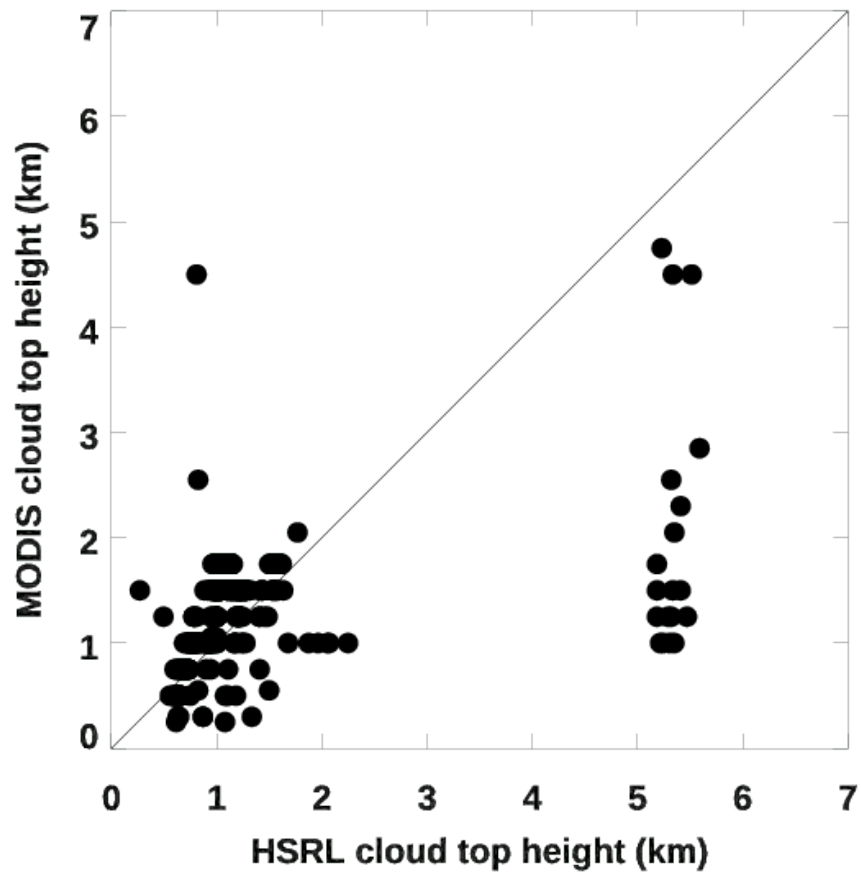


Figure S- 1: Similar to Fig. 2b. Scatterplot showing MODIS cloud top height as a function of HSRL cloud top height during ORACLES 2016 collocated within +/- 15 minutes.

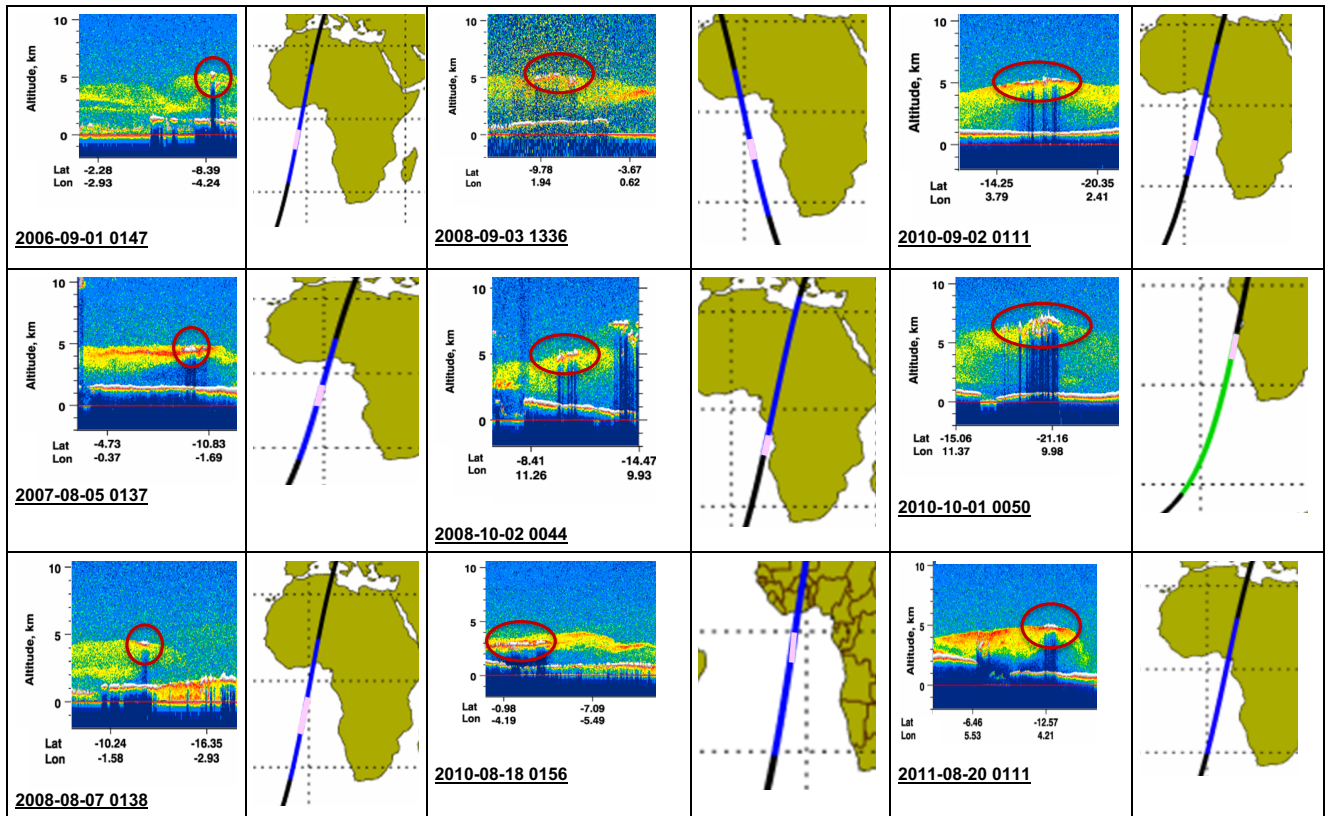


Figure S- 2: Similar to Fig. 1a, examples from CALIPSO showing CALIOP 532-nm total attenuated backscatter ($\text{km}^{-1} \text{sr}^{-1}$) with identifiable mid-level clouds, smoke, and/or low-level clouds. The mid-level clouds are highlighted with red circular shape, while the geographical location is shown in the adjacent map identified by pink shaded region on the blue- or green-colored CALIPSO overpass.

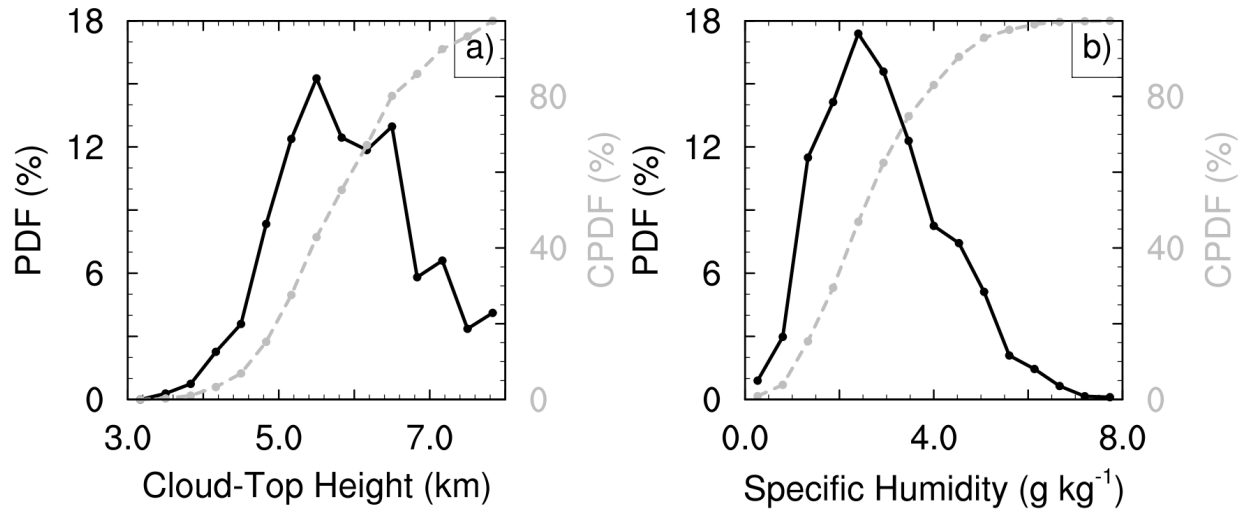


Figure S- 3: As in Fig. 4a-c, but for (a) cloud-top heights, (b) specific humidity and of mid-level clouds over southeast Atlantic obtained from the merged CloudSat-CALIPSO datasets.

4 September, 2016

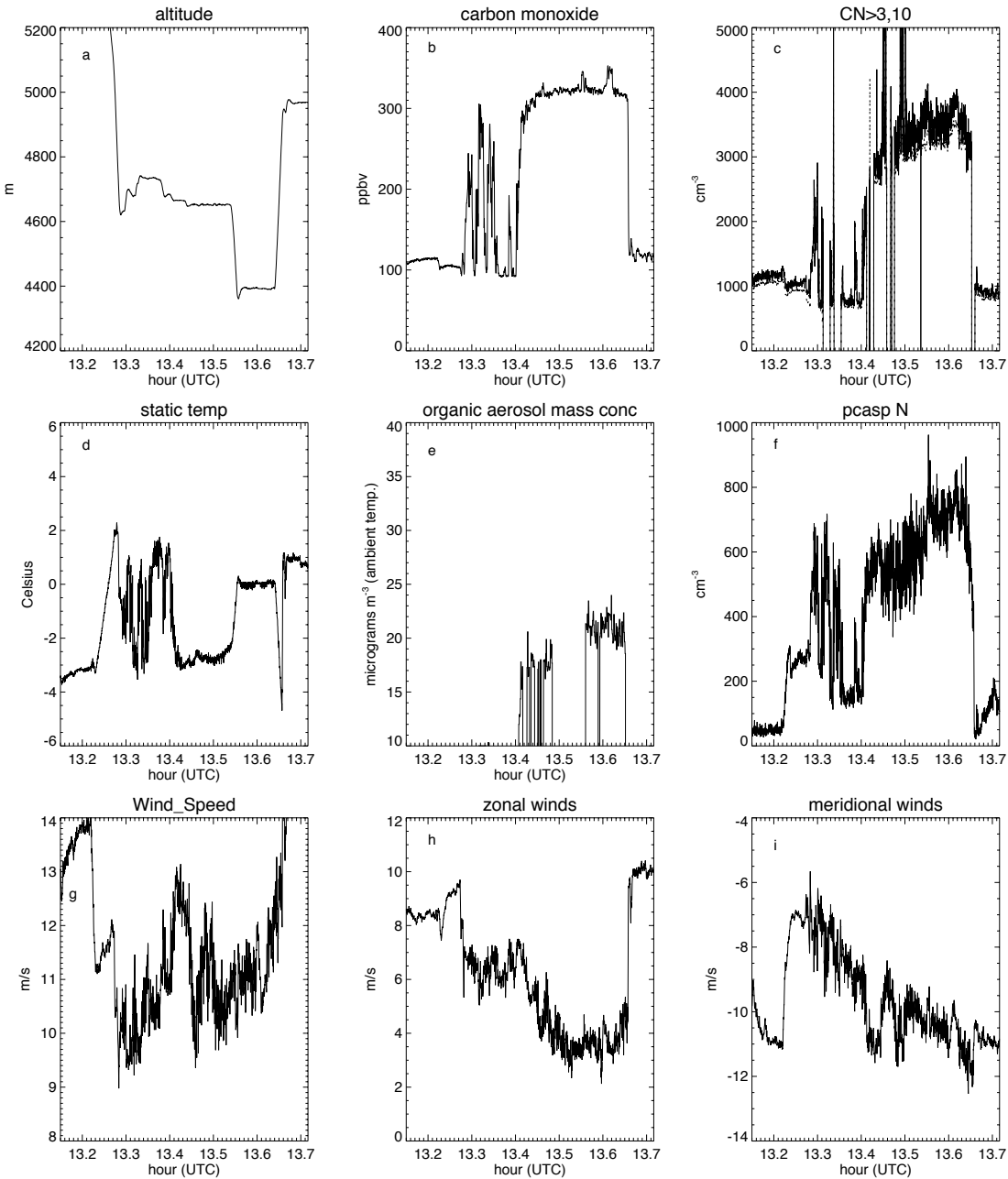


Figure S- 4: In-situ characterization of mid-level cloud sampled at approximately 13:30 (13.5) UTC on 4 September 2016, prior to a descent to subsequent sampling of 4.4 km of the embedding smoke plume. Descriptions of the individual instruments are available through Redemann et al., (2020). a) GPS-derived altitude, b) carbon monoxide, c) condensation nuclei concentrations of particle diameters exceeding 3 and 10 nm, d) temperature, e) organic aerosol mass concentrations from an aerosol mass spectrometer, f) Passive Cavity Aerosol Spectrometer Probe (PCASP; responsive to particle diameters between 0.1 to 3.0 micron) number concentration, g) wind speed, h) zonal winds, i) meridional winds

24 September, 2016

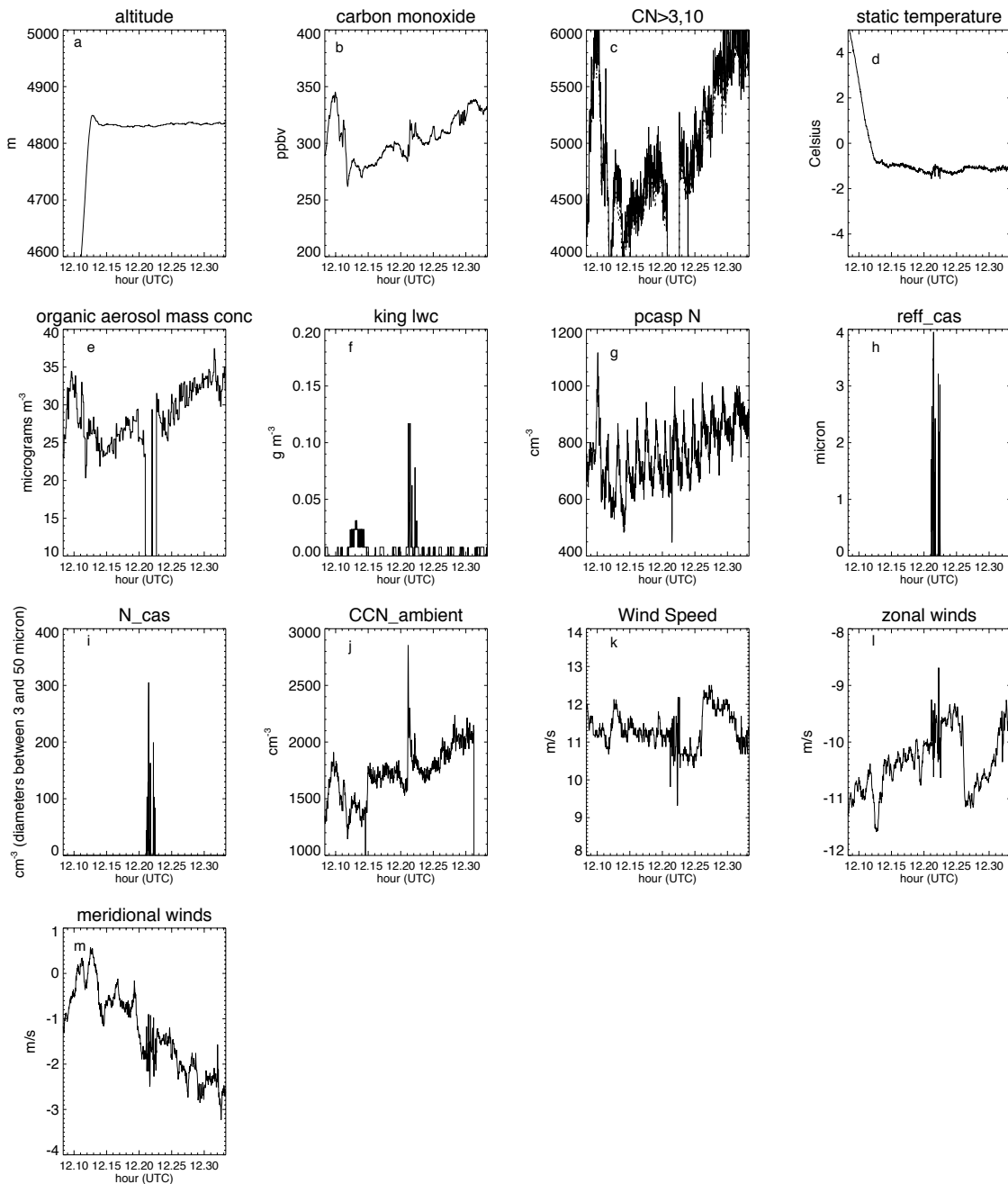


Figure S- 5: In-situ characterization of mid-level cloud sampled at approximately 12:12 (12.2) UTC on 24 September 2016. a) GPS-derived altitude, b) carbon monoxide, c) condensation nuclei concentrations of particle diameters exceeding 3 and 10 nm, d) temperature, e) organic aerosol mass concentrations from an aerosol mass spectrometer, g) Passive Cavity Aerosol Spectrometer Probe (PCASP; responsive to particle diameters between 0.1 to 3.0 micron) number concentration, h) effective radius from a Cloud Aerosol Spectrometer (CAS; particle diameters span 3 to 50 micron), i) CAS number concentrations corresponding to h, j) cloud condensation nuclei concentrations at ambient temperature, k) wind speed, l) zonal winds, and m) meridional winds.

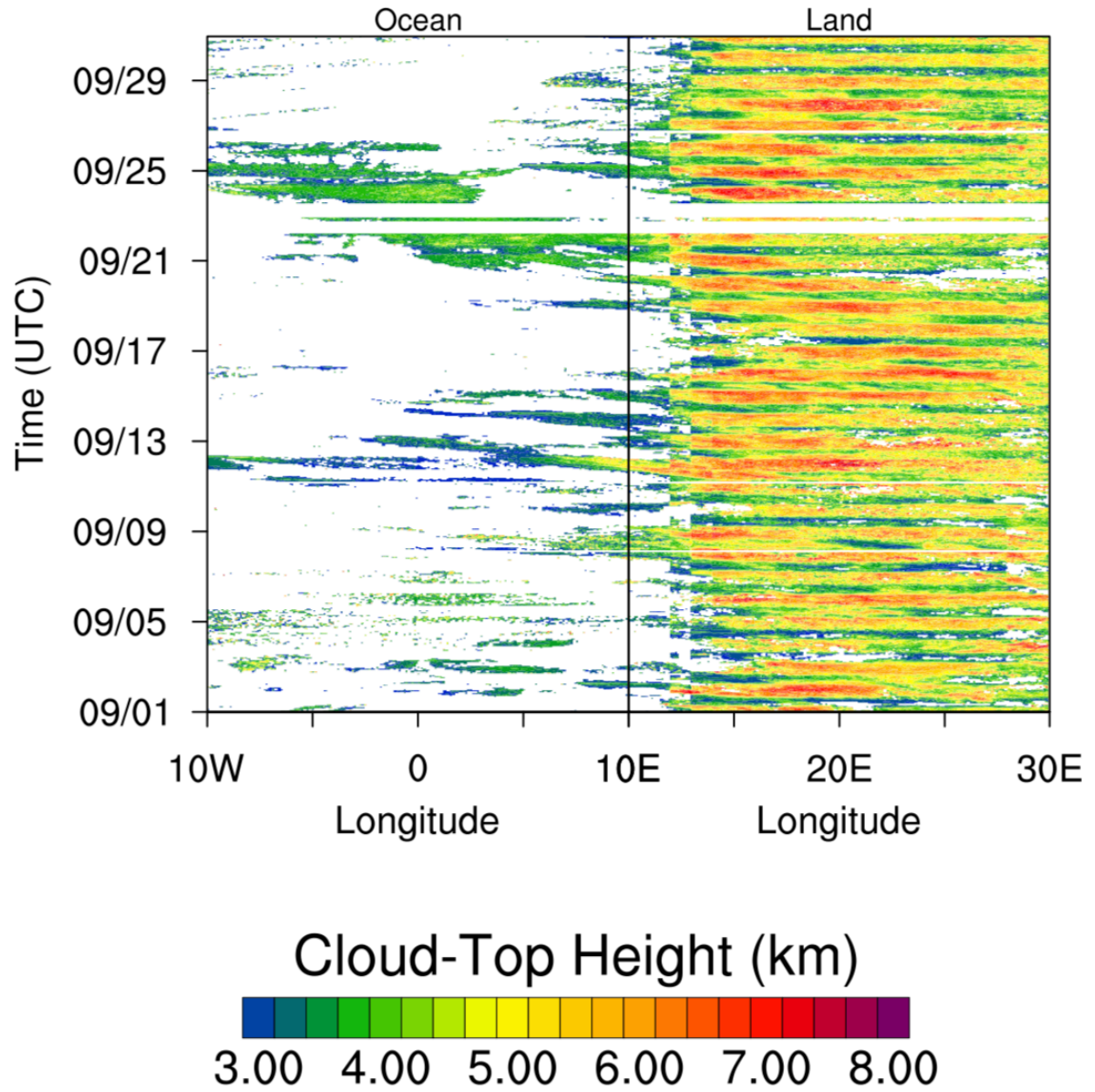


Figure S- 6: Showing the longitude-time cross-section of the mid-level cloud-top heights (km) at hourly resolution between 3–8 km and latitude range of 5°S-20°S for 01-30 September 2016.

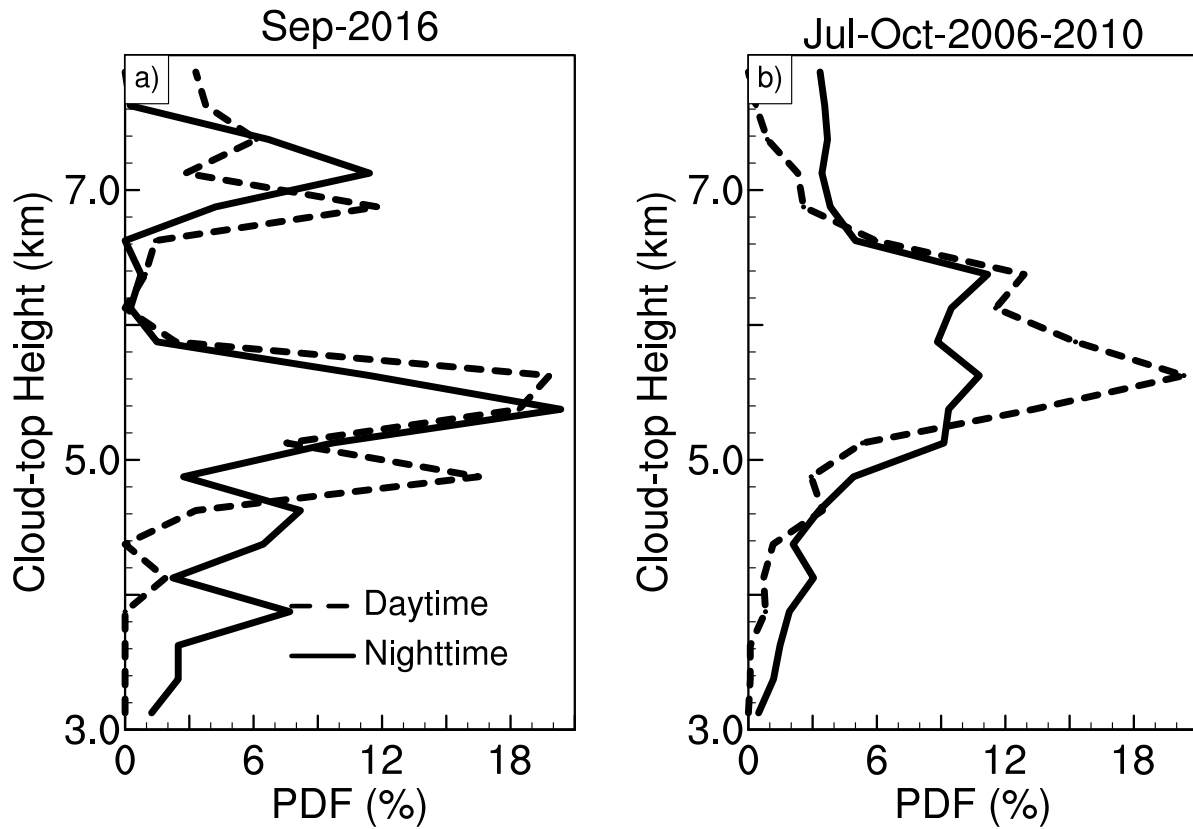


Figure S- 7: The probability distribution of mid-level cloud-top heights (km) obtained from CALIOP for night time (solid line; overpass typically between 00:30 and 01:30 UTC) and daytime (dashed lines; overpass typically between 12:30 and 13:30 UTC) for (a) September 2016 and for (b) July-October 2006-2010.