Supplemental Material

Supplementary Material

1. Methods :

K-means clustering of the ULLCs mean diurnal cycles in SAFNWC :
The K-means clustering was applied on land-only pixels. A first sample of 2000 pixels amongst *x* pixels available (*x* = 114169) was randomly drawn, and their mean diurnal cycles were computed and normalized by setting the mean to 0. Then the K-means clustering was applied varying *n,* the number of clusters, from 3 to 6, and changing the initial seeds 200 times. The spatial distribution of the *n* clusters was obtained by computing for each pixel the correlation between its mean diurnal cycle and each cluster centroïd. A partitioning into 4 clusters was retained which shows a good match with the main geographical features of WCA. To assess the robustness of the procedure, a second sample of 2000 pixels was randomly drawn, the K-means and the correlations computed again. More than 95% of the *x* pixels available were attributed to the same cluster for the two samples.

2. Data :

EECRA MSLH product :
Low clouds base height is obtained from the EECRA Mean Seasonal Low Cloud Base Height (MSLH) product. Base height observations are taken concurrently with the rest of the cloud observation, so the timing is identical. Base heights are visually estimated within 9 bins by trained surface observers (the 9 bins boundaries are available at https://www.rsmas.miami.edu/users/pzuidema/CloudsCodes.pdf; note that boundaries are coarsening with increasing altitude).

Figure S1: Number of observations available at each EECRA station for the MMCA/MMCF products (JJAS) during daytime (left), nighttime (middle) and day+night (right).

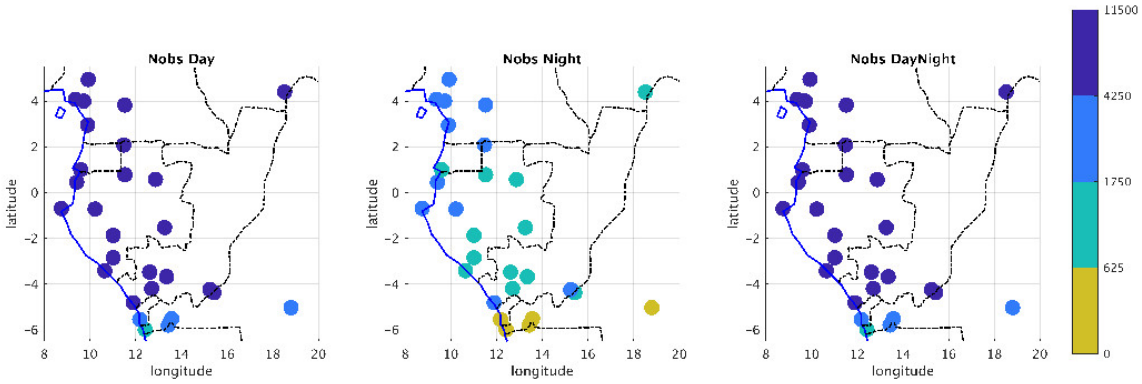

Figure S2: Number of observations available at each EECRA station for each 3-hourly period for the MSAT/MSFT products (JJA).

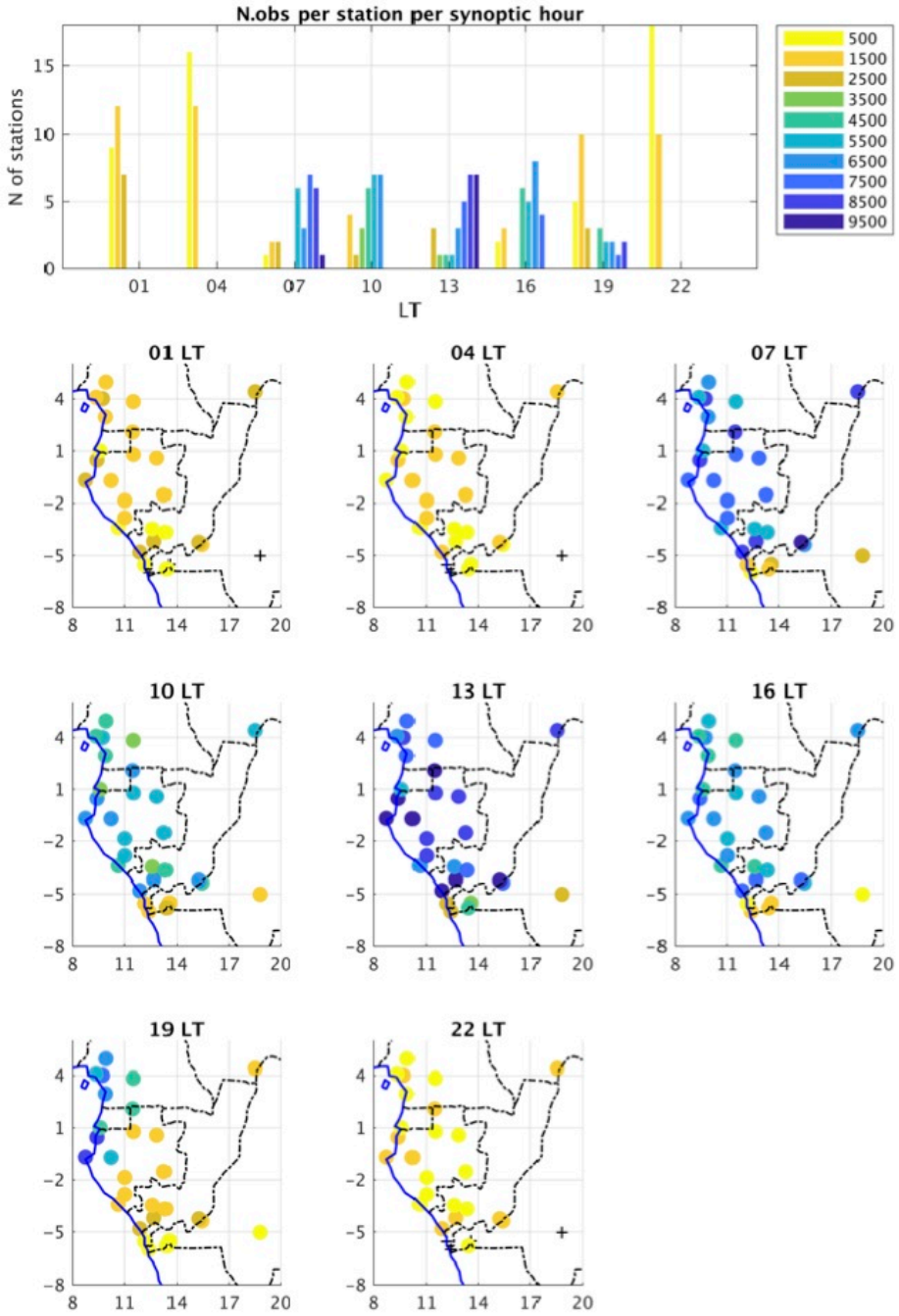

Figure S3 : ULLCs frequency (%) in JJAS at nighttime (left panels) and daytime (right panels) in (a-b) SAFNWC (02LT, 14LT) , (c-d) CALIOP (01.30 LT, 13.30LT), and (e-f) ERA-STF (01LT, 13LT).

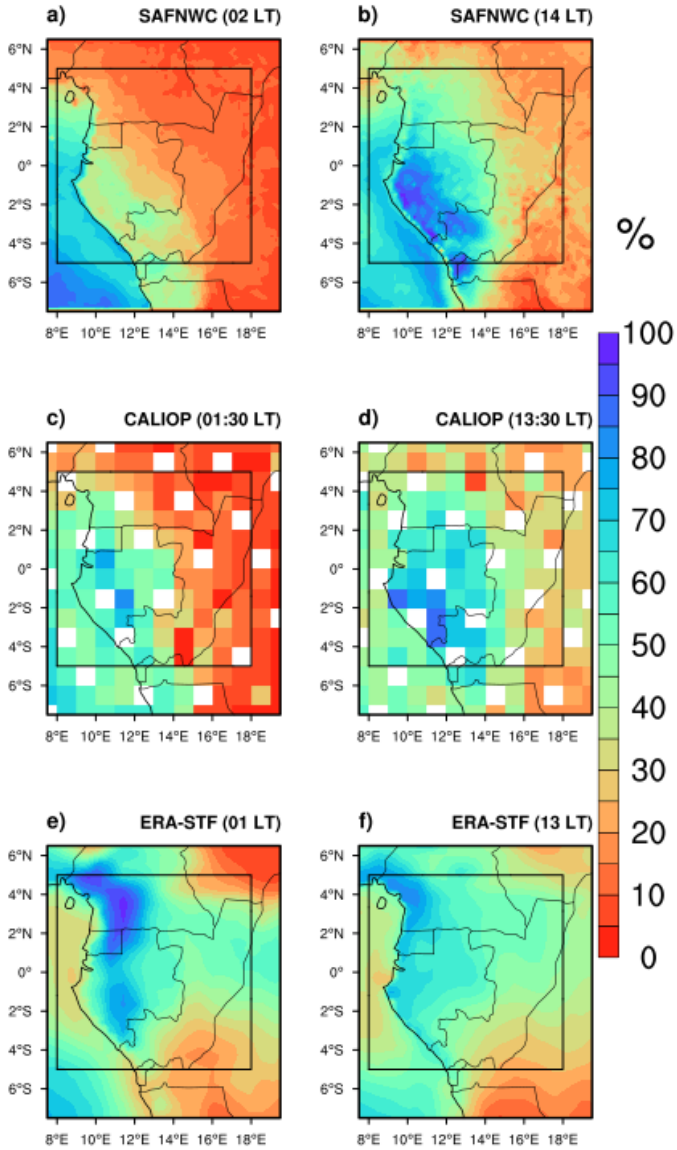

Figure S4: Difference (in %) in ULLCs amount between 2 consecutive 3-hourly periods for EECRA.

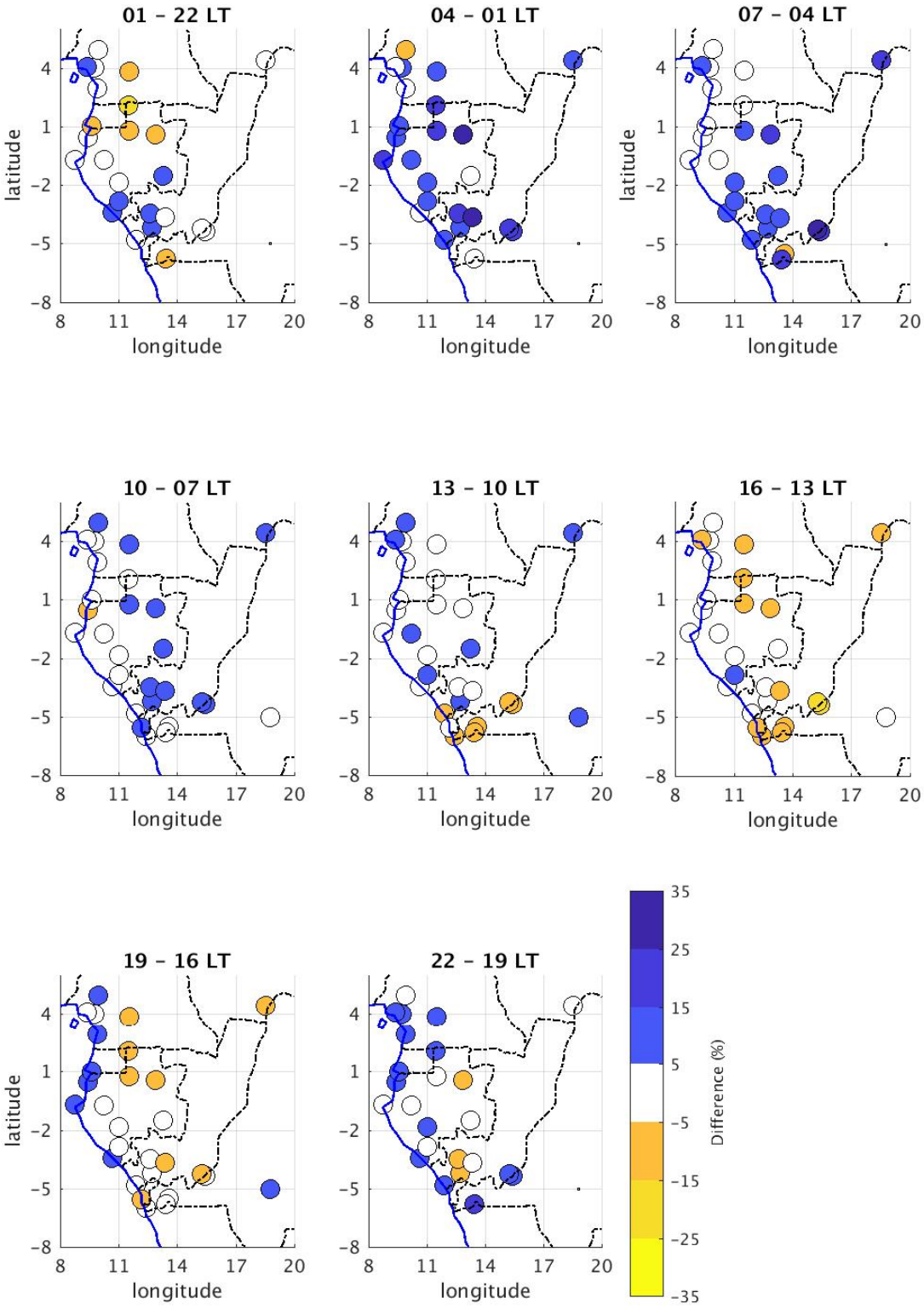
01 – 22 LT
04 – 01 LT
07 – 04 LT
10 – 07 LT
13 – 10 LT
16 – 13 LT
19 – 16 LT
22 – 19 LT
latitude
longitude
Difference (%)
35
25
15
5
−5
−15
−25
−35

Figure S5: Same as figure S4 but for SAFNWC and ULLCs frequency.

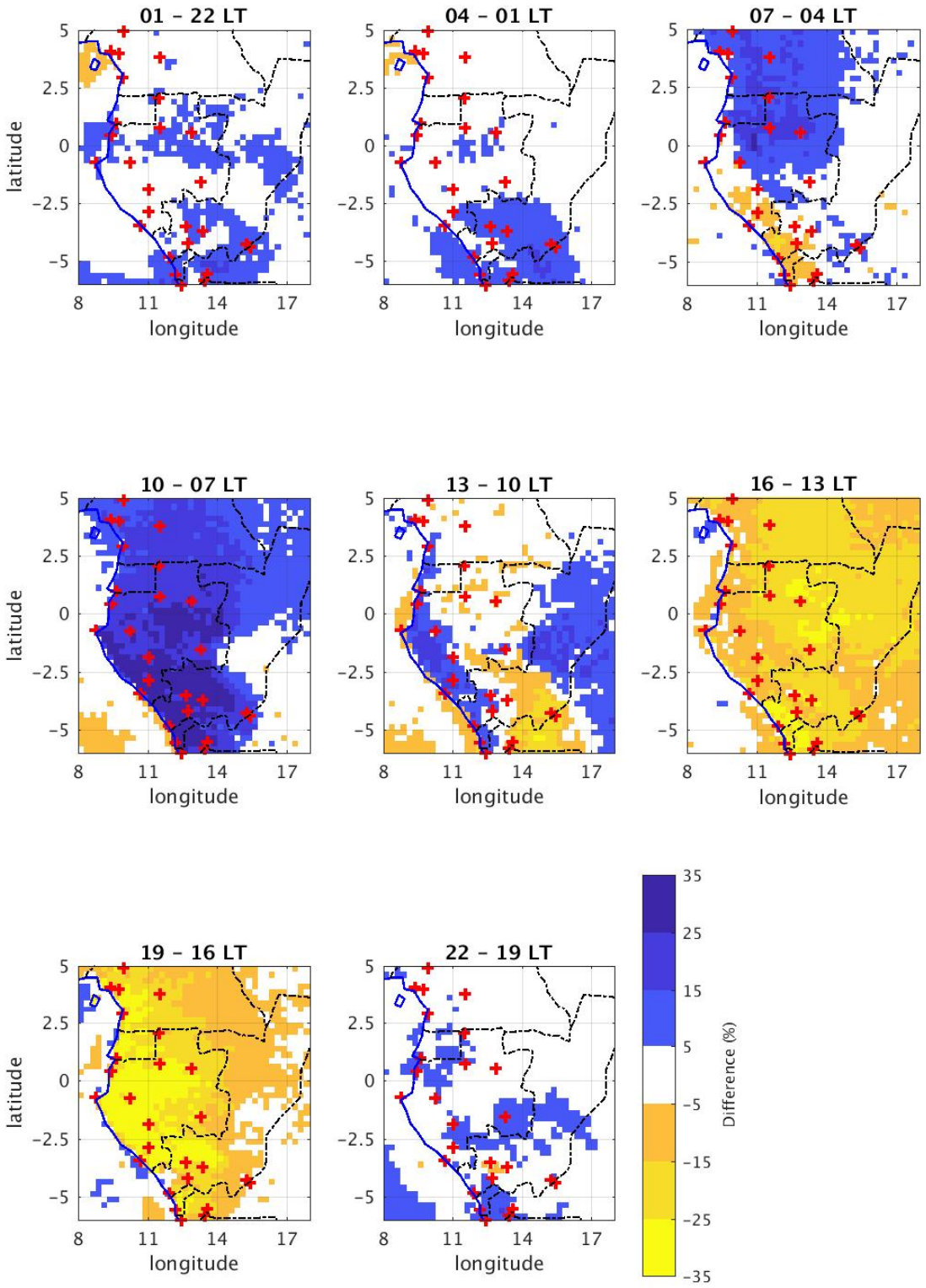

Figure S6 : JJAS longitude-altitude cross sections of (a) cloud fraction (%), (b) wind speed (m/s), and (c) static stability (K/hpa) at 2°S from ERA-STF. The static stability is computed as the variation of potential temperature (Thetae) with respect of pressure.

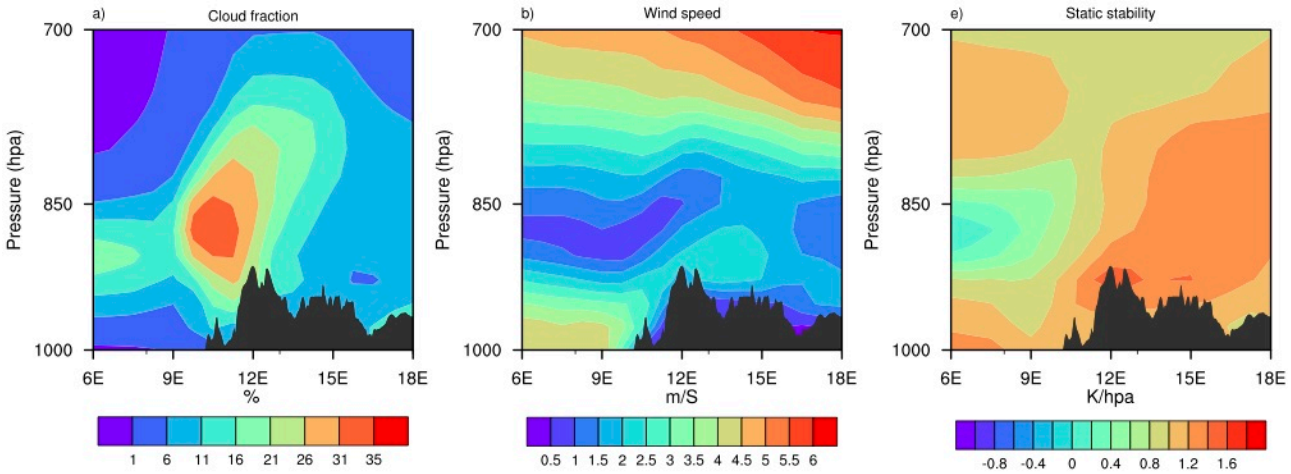

Figure S7 : Stratocumulus base height evolution across the diurnal cycle for the 28 EECRA stations (ordered according to their altitude). Data issued from EECRA MSLH product.