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Supplement of

Measurement report: Hydrogen peroxide in the upper tropical troposphere over the Atlantic Ocean and western Africa during the CAFE-Africa aircraft campaign

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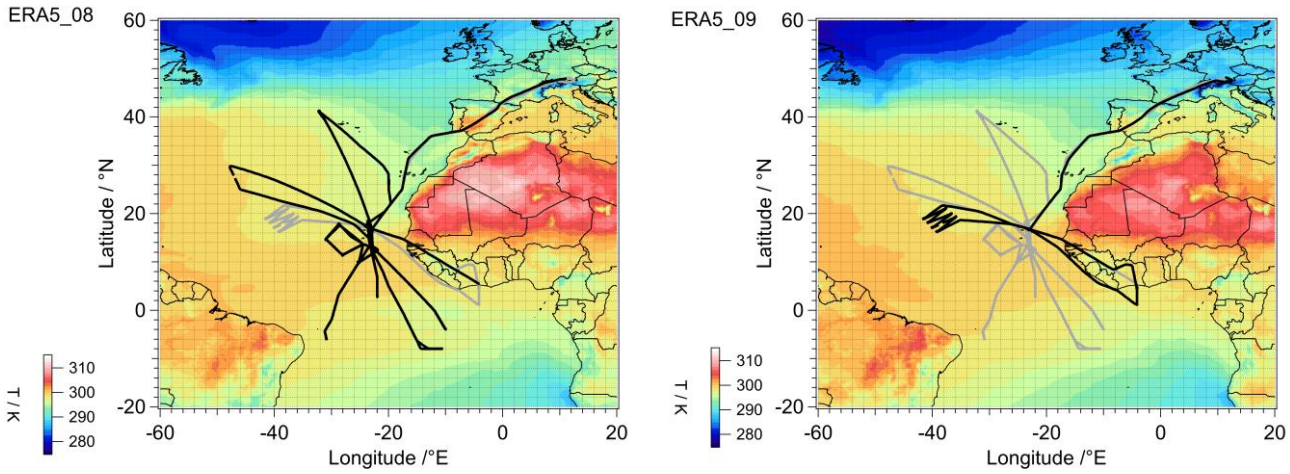

Figure S1. Average 2 m dewpoint temperature during the campaign CAFE-Africa in August (left) and September (right) 2018 based on ERA5 data output (contains modified Copernicus Climate Change Service information; Hersbach et al. 2019; Accessed on < 22-07-2022 >)[1]. The performed flights are indicated in black.

[1] **Hersbach, H., Bell, B., Berrisford, P., Biavati, G., Horányi, A., Muñoz Sabater, J., Nicolas, J., Peubey, C., Radu, R., Rozum, I., Schepers, D., Simmons, A., Soci, C., Dee, D., Thépaut, J-N. (2019): ERA5 monthly averaged data on single levels from 1959 to present. Copernicus Climate Change Service (C3S) Climate Data Store (CDS). (Accessed on < 22-07-2022 >), 10.24381/cds.f17050d7**

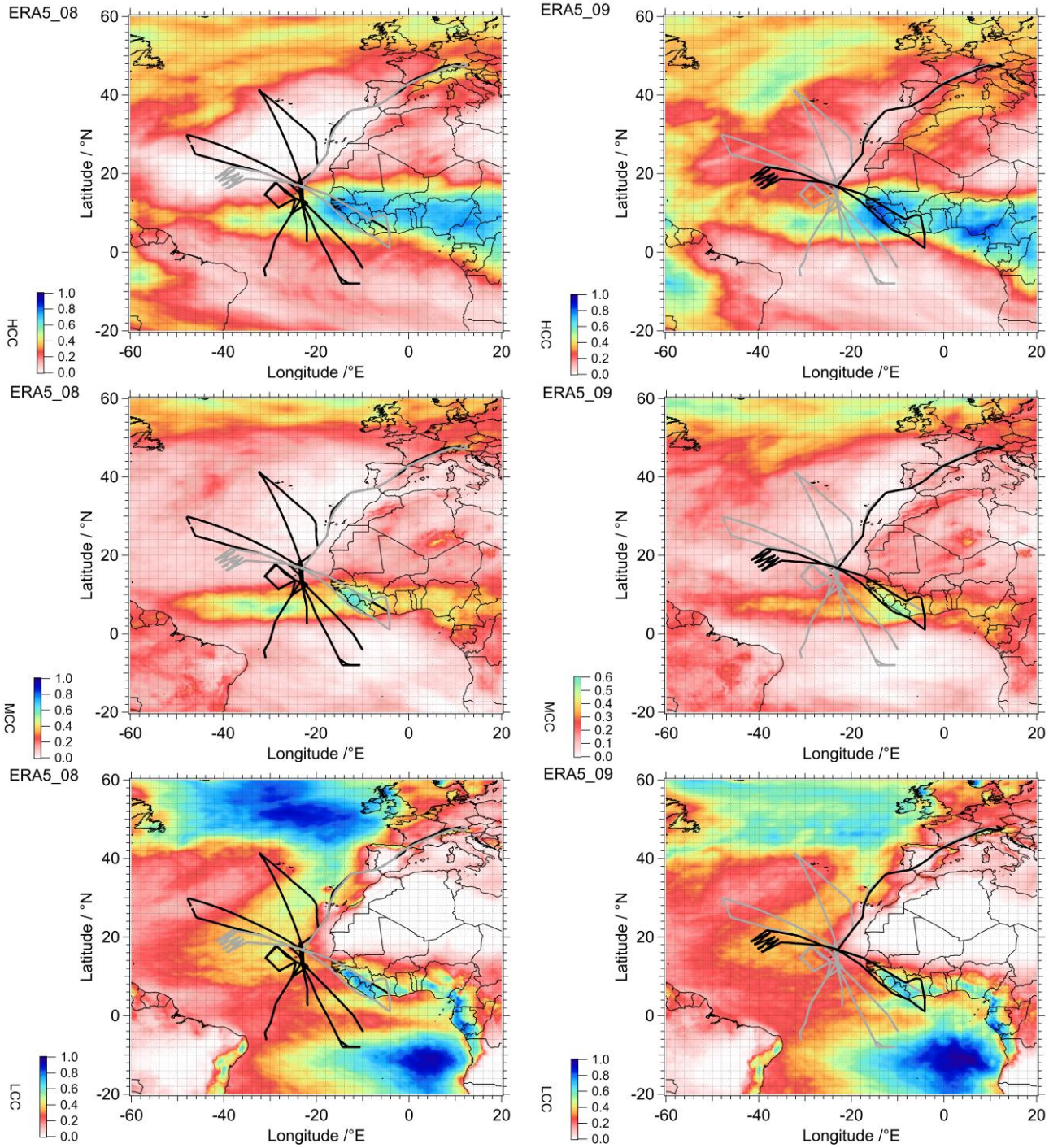

Figure S2. Average high, medium and low (top to bottom panels) cloud coverage during the campaign CAFE-Africa in August (left panel) and September (right panel) 2018 based on ERA5 data output (modified Copernicus Climate

Change Service information; Hersbach et al. 2019; Accessed on < 22-07-2022 >)[2]. The performed flights are indicated in black. Please note the approximate altitudinal range of low, medium and high cloud cover at 0–2, 2–6, >6 km, respectively.

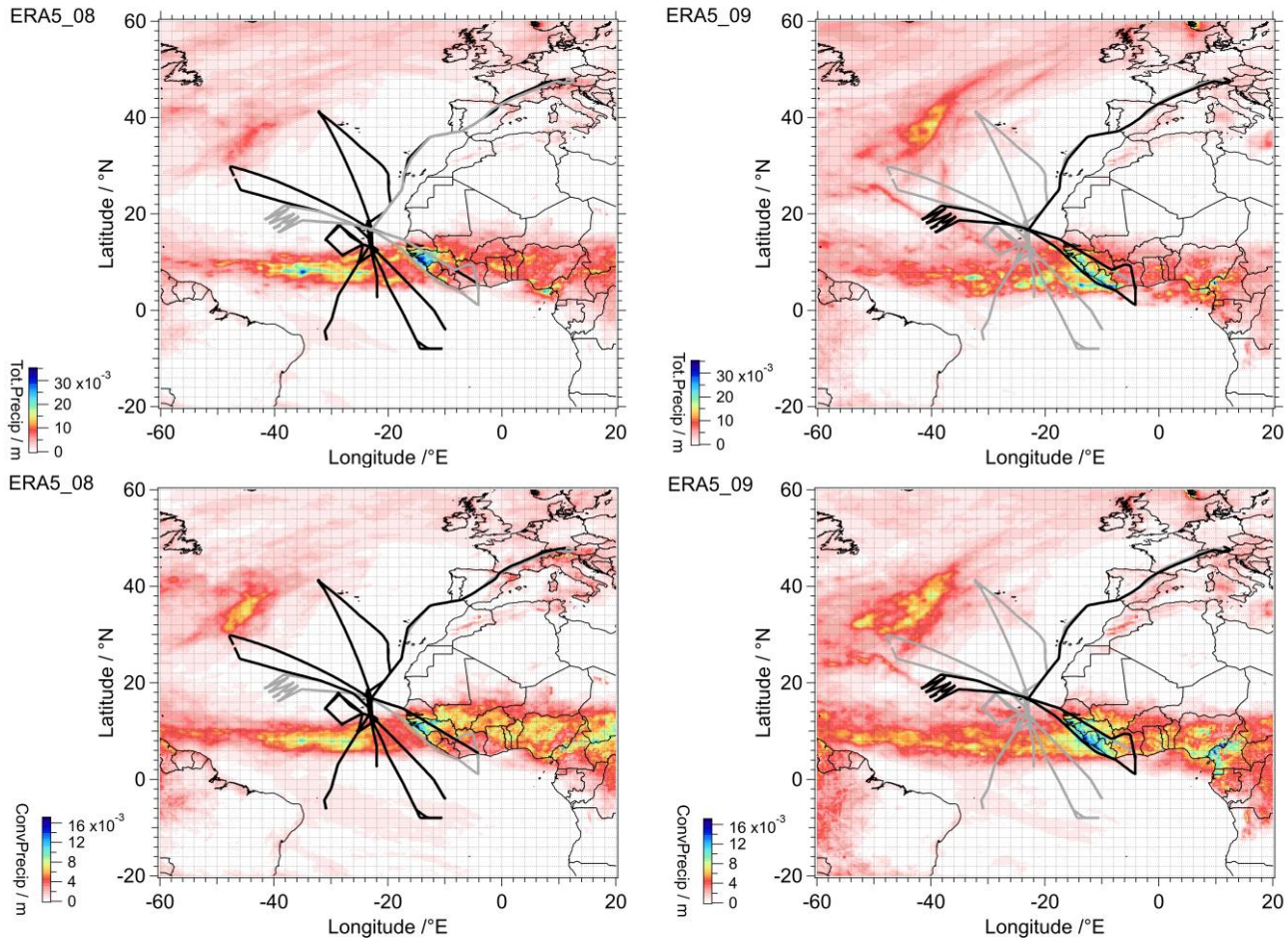

Figure S3. Average total and convective precipitation (top to bottom panels) during CAFE-Africa in August (left panel) and September (right panel) 2018 based on ERA5 datasets (contains modified Copernicus Climate Change Service information; Hersbach et al. 2019; Accessed on < 22-07-2022 >)[3]. The performed flights are indicated in black.

[2] **Hersbach, H., Bell, B., Berrisford, P., Biavati, G., Horányi, A., Muñoz Sabater, J., Nicolas, J., Peubey, C., Radu, R., Rozum, I., Schepers, D., Simmons, A., Soci, C., Dee, D., Thépaut, J-N. (2019): ERA5 monthly averaged data on single levels from 1959 to present. Copernicus Climate Change Service (C3S) Climate Data Store (CDS). (Accessed on < 22-07-2022 >), 10.24381/cds.f17050d7**

[3] **Hersbach, H., Bell, B., Berrisford, P., Biavati, G., Horányi, A., Muñoz Sabater, J., Nicolas, J., Peubey, C., Radu, R., Rozum, I., Schepers, D., Simmons, A., Soci, C., Dee, D., Thépaut, J-N. (2019): ERA5 monthly averaged data on single levels from 1959 to present. Copernicus Climate Change Service (C3S) Climate Data Store (CDS). (Accessed on < 22-07-2022 >), 10.24381/cds.f17050d7**

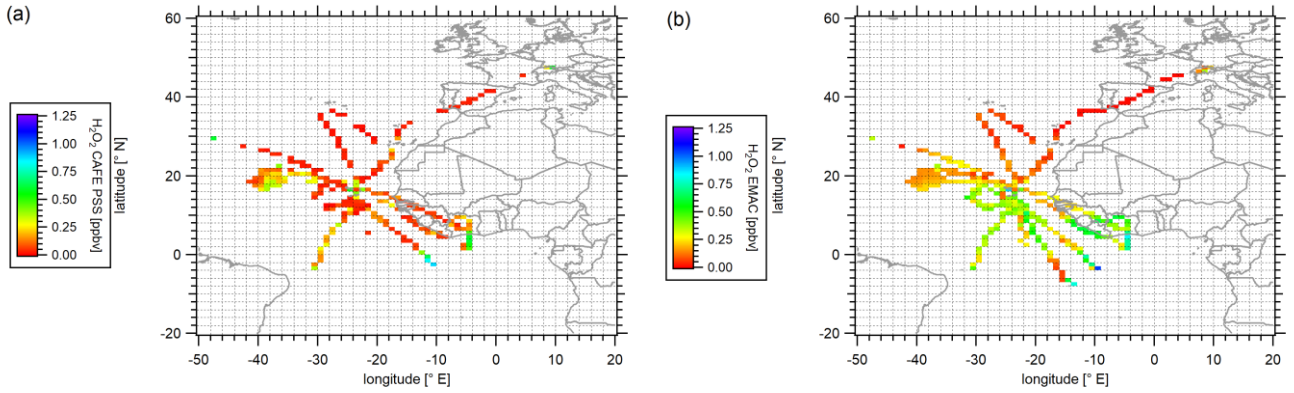

Figure S4. Spatial distribution of hydrogen peroxide modelled based on photostationary steady state conditions (a) and simulated by the model EMAC (b) in the upper troposphere (≥8 km) during CAFE-Africa campaign. Data were binned into 1°x1° bins over the full extension of the flight tracks.

Table S1. General mean (± 1 sigma) and median overview of measured, simulated and modelled based on steady state conditions hydrogen peroxide mixing ratios subdivided into northern (approx. 20 °N- 40 °N; top) hemisphere, ITCZ (approx. 5 °N < 20 °N; middle) and southern hemisphere (approx. 10 °S < 5 °N; bottom).

Northern Hemisphere

	CAFE-Africa	EMAC	CAFE PSS
Mean ± 1sigma	0.14 ±0.11	0.11 ±0.08	0.08 ±0.11
Median	0.12	0.11	0.04

Intertropical Convergence Zone

	CAFE-Africa	EMAC	CAFE PSS
Mean ± 1sigma	0.20 ±0.13	0.35 ±0.17	0.14 ±0.15
Median	0.17	0.33	0.08

Southern Hemisphere

	CAFE-Africa	EMAC	CAFE PSS
Mean ± 1sigma	0.15 ±0.12	0.38 ±0.24	0.31 ±0.25
Median	0.12	0.31	0.25

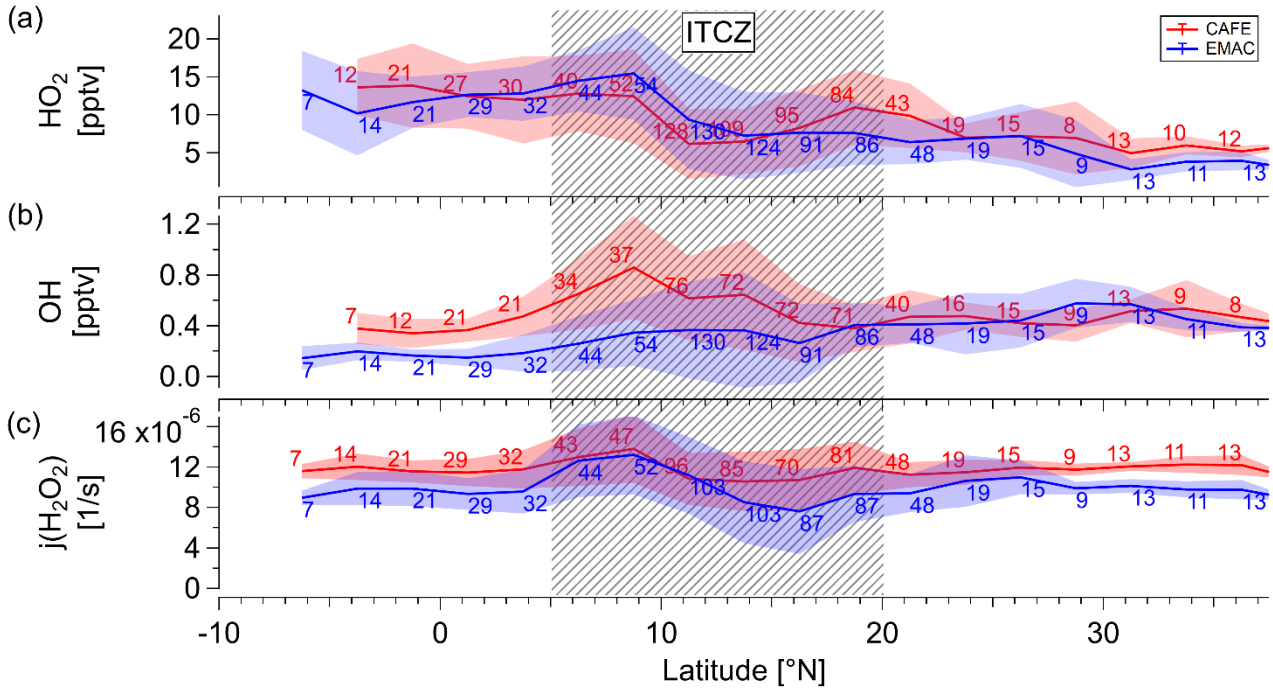

Figure S5. Latitudinal dependence of measured (red) hydroperoxyl radical levels (a), hydroxyl radical concentrations (b) and hydrogen peroxide photolysis rates (c; mean ± 1 sigma) compared to EMAC simulations (blue). The data sets with 6 min time resolution and mean values were binned for 2.5° of latitude at altitudes ≥ 8 km. The corresponding numbers indicate the total amount of data points per bin. The shaded pattern marks the ITCZ.

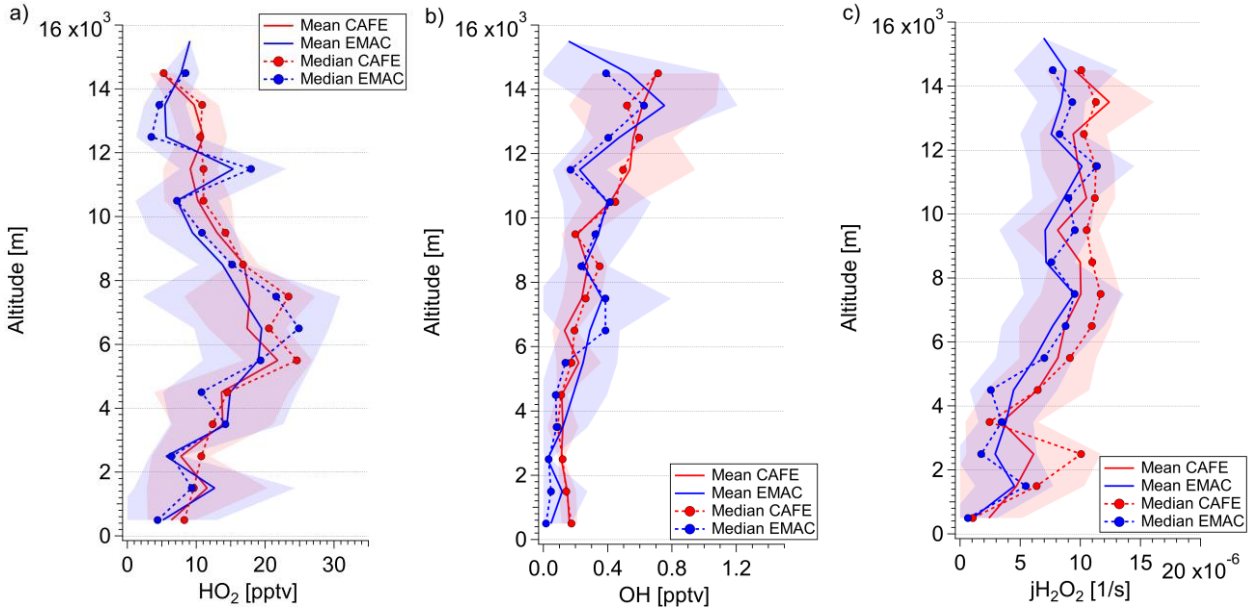

Figure S6. Vertical profiles of observed (red) and simulated (blue) hydroperoxyl radical (a), hydroxyl radical (b) and hydrogen peroxide photolysis rates (c). Vertical profile estimations were calculated within 1000 m means and medians over the entire probed atmospheric column based on data obtained within the region of the base of operation in Sal, Cape Verde (approx.16° 35' – 16° 51' N; 22° 52' - 23 °W).

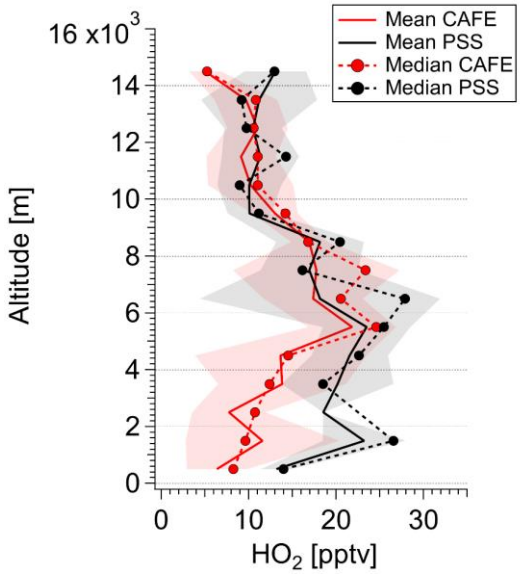

Figure S7. Vertical profile of observed (red) and PSS calculated (black) hydroperoxyl radical calculated within 1000 m means and medians over the entire probed atmospheric column based on data obtained at the base of operation. Please note that the HO_2 PSS calculations are based on assumptions made in Eq. 6 in the manuscript.

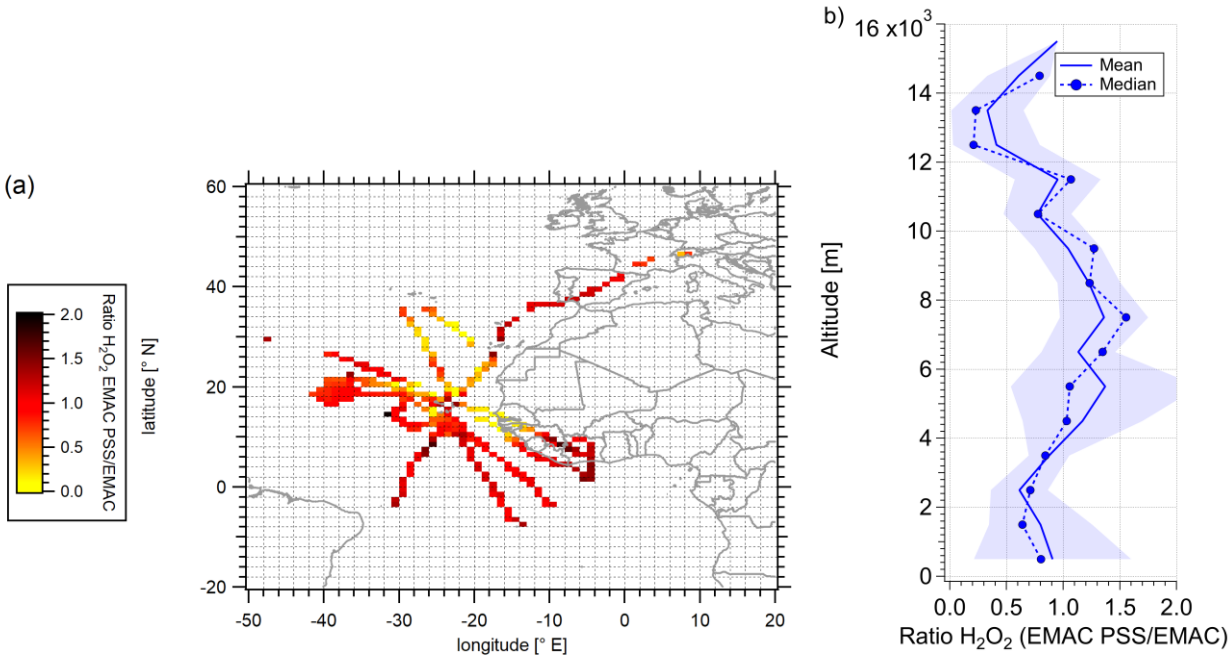

Figure S8. Spatial distribution of H2O2(PSS EMAC)/H2O2(EMAC) ratio (a) and the corresponding vertical profile (b) in the upper troposphere (≥8 km) during CAFE-Africa campaign. For the purposes of the spatial distribution analysis, data were binned into 1°x1° bins over the full extension of the flight tracks. The vertical distribution was estimated within 1000 m altitude bins over the entire probed column based on the simulated data within the region of the base of operation in Sal, Cape Verde (approx.16° 35' – 16° 51' N; 22° 52' - 23 °W).