Supplement of

Regime-based Assessments of Aerosol-Cloud Interactions from CALIPSO-MODIS Observations and E3SMv2 Simulations over Eastern North Atlantic

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Table S1. Regime occurrences over ENA at 1 p.m. local time from ERA5 inputs

Count (Fraction %)*	Regime 1 Pre-Trough	Regime 2 Post-Trough	Regime 3 Ridge	Regime 4 Trough
Winter (DJF)	269 (33.2%)	166 (20.4%)	313 (38.6%)	63 (7.8%)
Spring (MAM)	193 (23.3%)	169 (20.4%)	424 (51.2%)	42 (5.1%)
Summer (JJA)	26 (3.1%)	22 (2.7%)	780 (94.2%)	0 (0%)
Fall (SON)	111 (13.6%)	122 (14.9%)	581 (70.9%)	5 (0.6%)
Total	599 (18.2%)	479 (14.6%)	2098 (63.8%)	110 (3.4%)

*Percentages in bracket denote the fractional occurrence of specific regime among total sample in each season category (and total sample).

Table S2. Regime-based precipitation status from Satellite and E3SMv2

Mean ± Std	Regime 1	Regime 2	Regime 3	Regime 4
Satellite (CloudSat)				
Drizzle* Fraction (%)	21.09 ± 22.89	21.79 ± 22.38	21.19 ± 23.35	18.73 ± 20.15
Light Rain** Fraction (%)	13.50 ± 19.93	11.86 ± 16.55	10.77 ± 17.55	13.75 ± 18.52
Rain*** Fraction (%)	12.39 ± 22.96	11.85 ± 21.72	7.80 ± 18.54	14.34 ± 23.71
(Drizzle + Light Rain + Rain) Fraction (%)	46.98 ± 36.11	45.49 ± 35.01	39.76 ± 36.37	46.81 ± 36.02
E3SMv2				
In-cloud Rain† Fraction (%)	50.25 ± 29.86	42.63 ± 29.37	34.27 ± 32.58	43.81 ± 26.52
In-cloud Rain LWP (g m2)	84.46 ± 205.62	43.23 ± 121.03	17.99 ± 95.99	118.84 ± 215.23

*CloudSat drizzle fraction as the number of points with $-15 \leq$ maximum dBZ ≤ -7 and CTH < 3 km divided by total number of CTH < 3 km, within each ~25km domain.

**CloudSat light rain fraction as the number of points with $-7 \leq$ maximum dBZ ≤ 0 and CTH < 3 km divided by total number of CTH < 3 km, within each ~25km domain.

***CloudSat rain fraction as the number of points maximum dBZ > 0 and CTH < 3 km divided by total number of CTH < 3 km, within each ~25km domain.

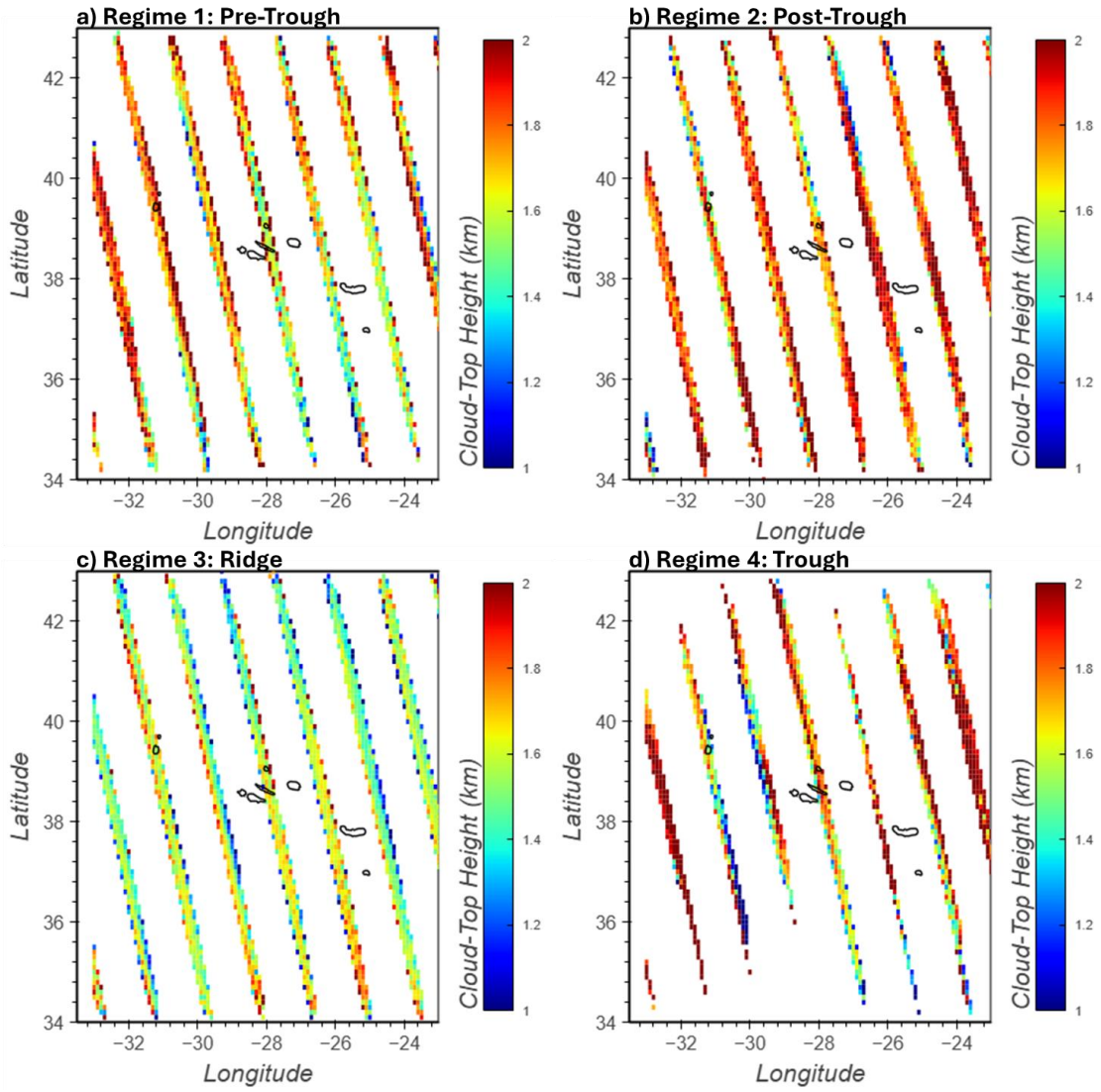†E3SM fractional rain area within each grid (~110 km).

Figure S1. Regime-based composite map of cloud-top height derived from satellite (MODIS) for a) Regime 1, b) Regime 2, c) Regime 3 and d) Regime 4. The raw 25km grids along the granule are further aggregated into 100km grid-cells in producing this plot to ensure the composite sample sizes and a better visualization.
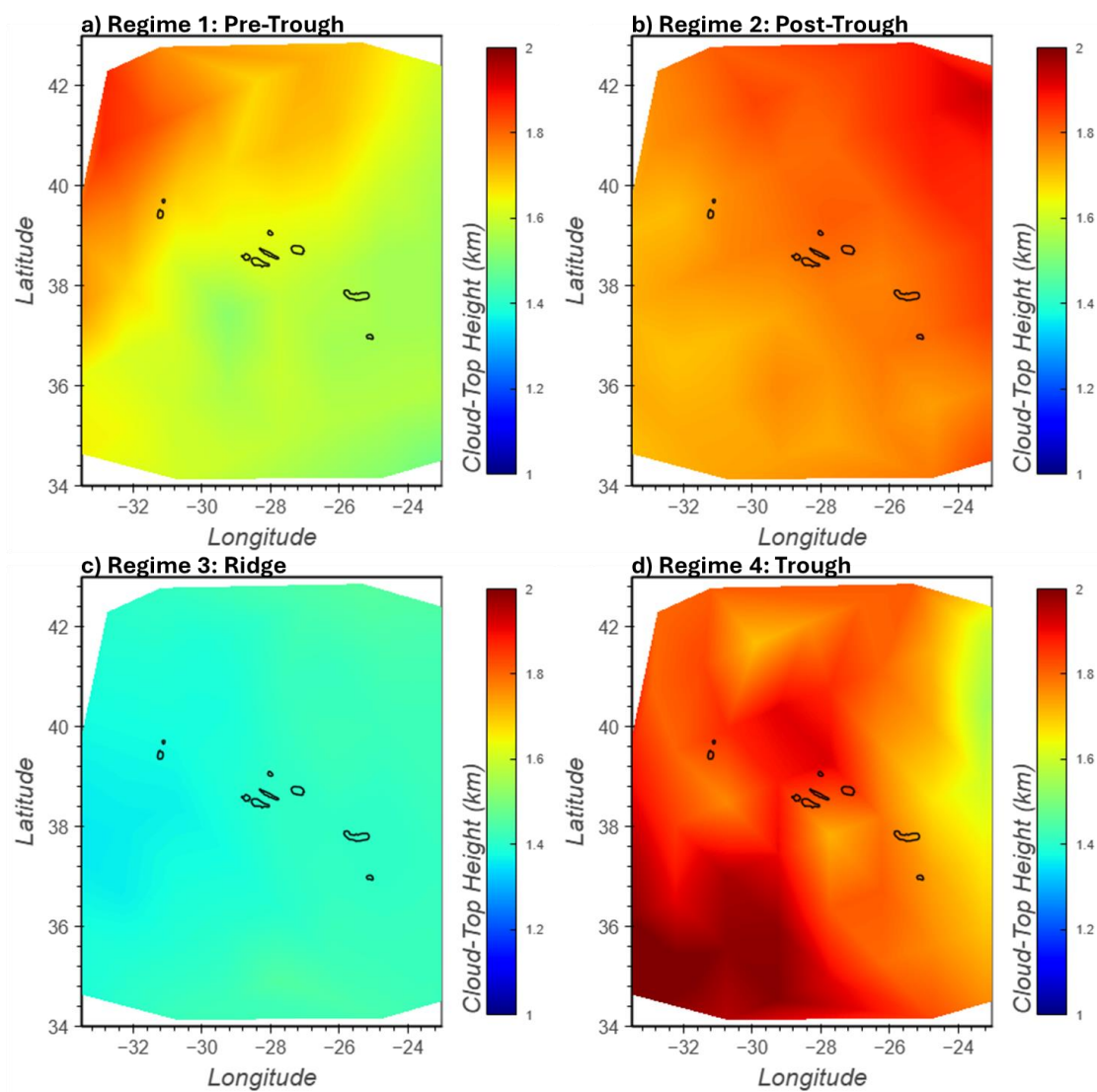
Figure S2. Regime-based composite map of cloud-top height derived from E3SMv2 for a) Regime 1, b) Regime 2, c) Regime 3 and d) Regime 4. The raw irregular model grid cell data is triangularly-smoothed and rasterized for better visualization.