Rodríguez Vega– Aerosols in the Caribbean region: Types, Synoptic Patterns, and Transport

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Climatology Study of Aerosols in the Caribbean region:

Station	Lat, Lon (N,E)	Elevation (m)	Size of the island (km²)	Distance to the sea (km)	Distance to North America (km)	Start date of available measurements	Non-missing days in the analyzed period	Cloud free days (% of non-missing days)
Ragged Point (Barbados)	13.17, -59.43	40.0	432 km²	0.052	2715	28/8/2007	1556	67
Guadeloupe (Overseas territory of France)	16.22, -61.53	39.0	848 km²	0.385	2275	18/2/1997	1197	66
La Parguera (Puerto Rico)	17.97, -67.05	12.4	8900 km²	0.095	1790	30/6/2000	1804	85
Camagüey (Cuba)	21.42, -77.85	122.0	109884 km²	85	578	7/10/2008	1497	78

links with synoptic patterns, and the transport from different sources. Daily mean values of aerosol optical properties for the period 2008-2016 in four representative Caribbean AERONET stations, using the aerosol optical depth (AOD) and Ångström exponent (AE) to classify the dominant aerosol type.

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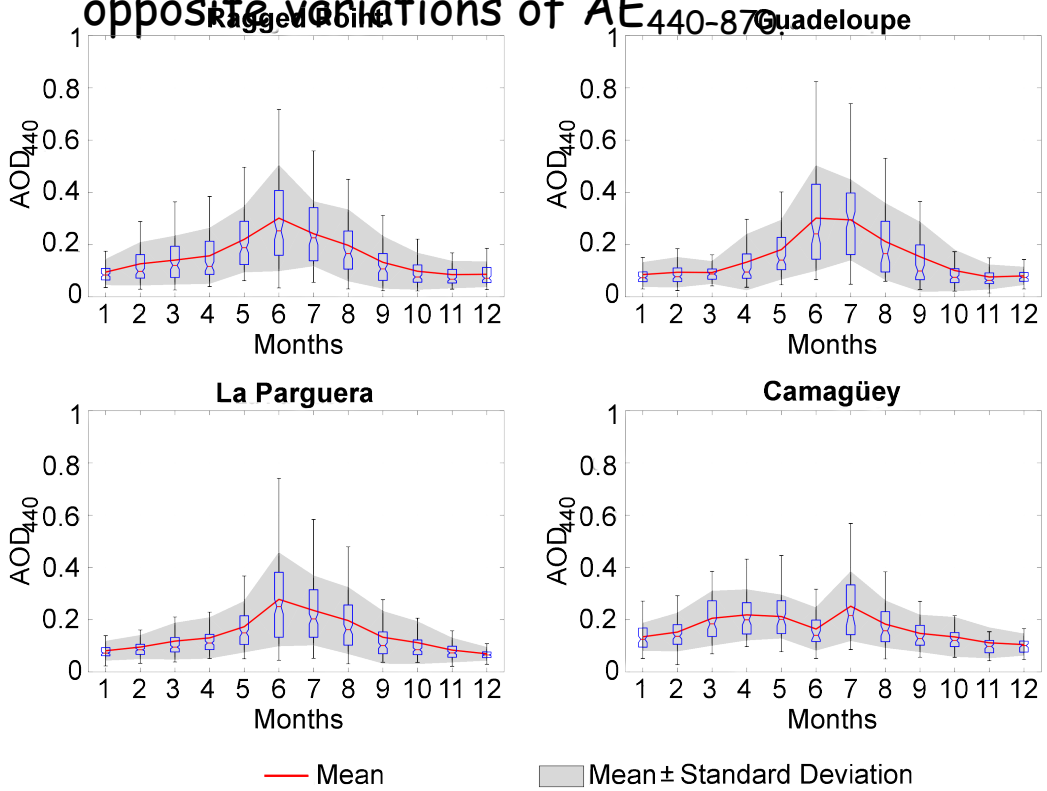
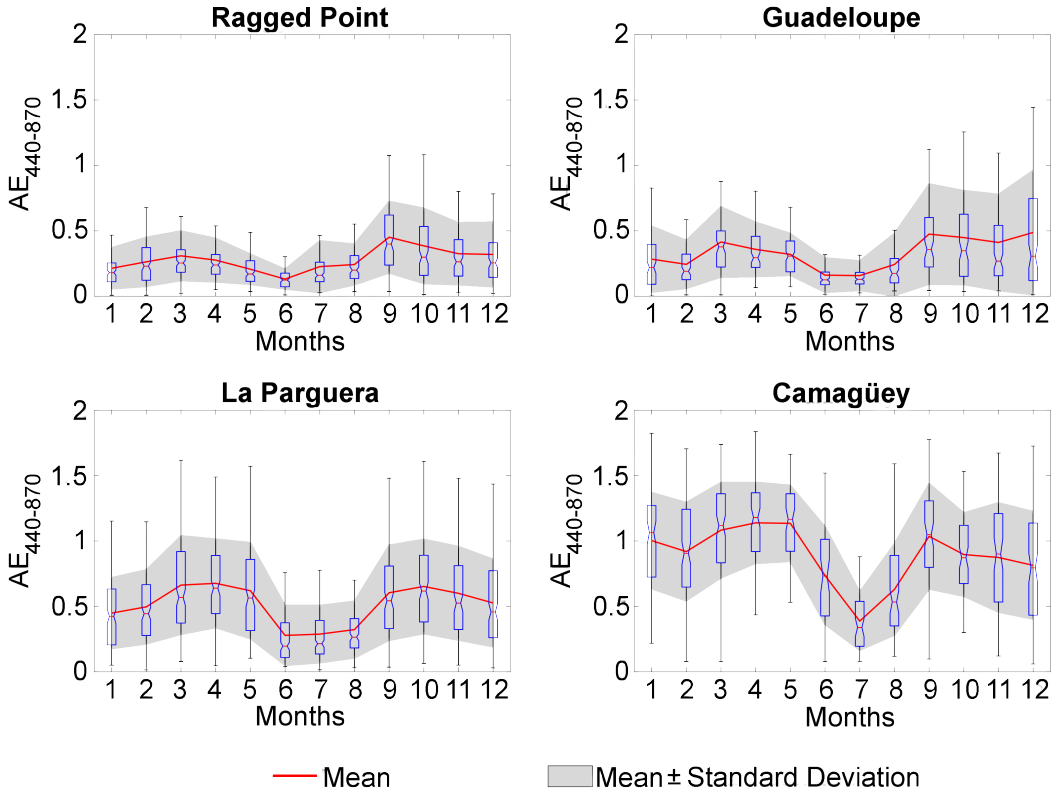
AOD_{440} and $AE_{440-870}$ distributions:

Annual cycle of AOD_{440} with increase in rainy season (April–October) and decreases in the dry season (November–March), with opposite variations of $AE_{440-870}$.





Seasonality in the aerosol source regions and climatological features of the atmospheric circulation are the major drivers of these seasonal changes in aerosol loading and speciation.

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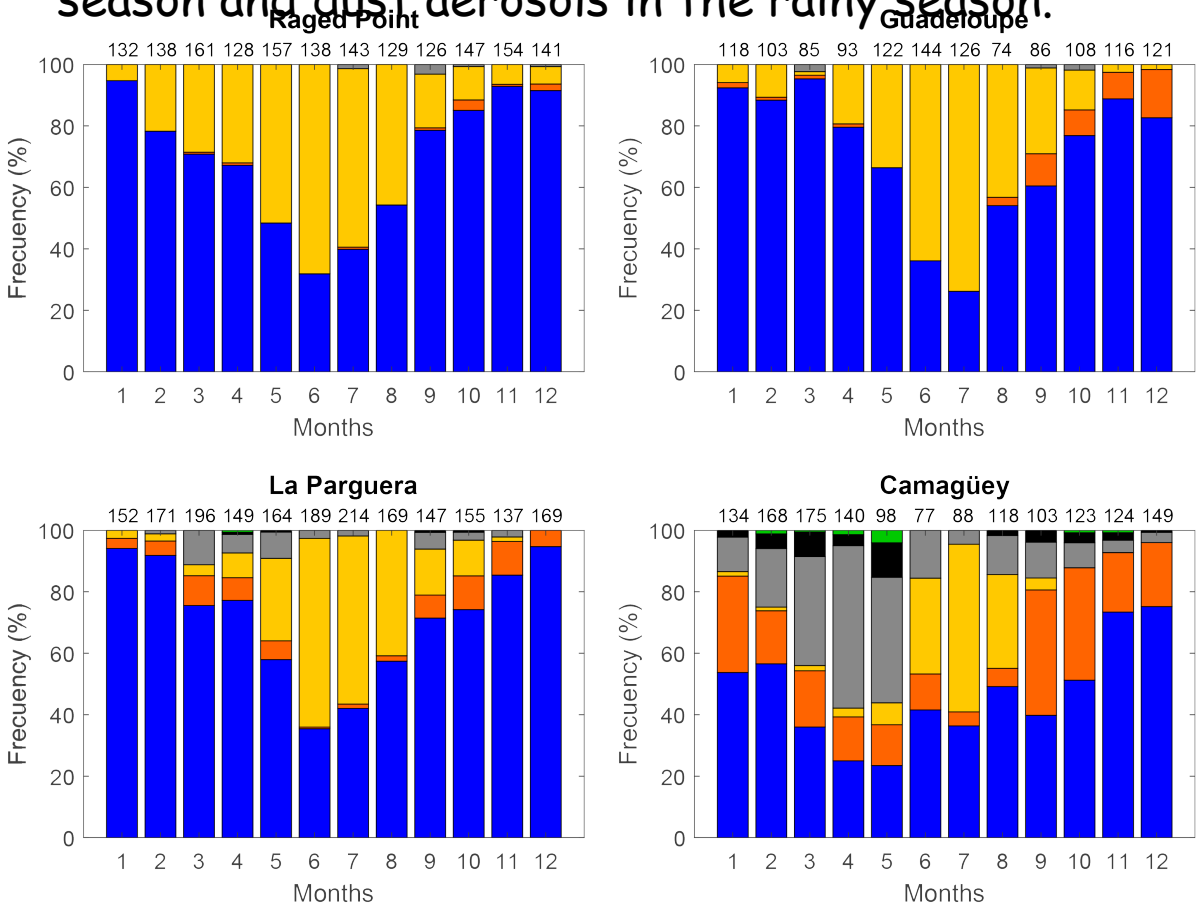
Spatiotemporal distribution of aerosol types:

Predominance of marine aerosols in the dry season and dust aerosols in the rainy season.



Aerosol Type	Stations			
	Ragged Point	Guadeloupe	La Parguera	Camagüey
Marine	1085 (70%)	820 (69%)	1271 (70%)	715 (48%)
Continental	12 (1%)	53 (4%)	99 (6%)	304 (20%)
Pure Dust	453 (29%)	319 (27%)	375 (21%)	130 (9%)
Mixture Dust	6 (~1%)	5 (~1%)	54 (3%)	280 (19%)
Polluted	0 (0%)	0 (0%)	4 (~1%)	57 (4%)
Biomass Burning	0 (0%)	0 (0%)	1 (~0%)	11 (~1%)

Spatial gradient in the distribution of coarse aerosols. More frequent in the easternmost islands, and decrease westward.

Large extent in agreement with their distances to the open sea. Geographical location (proximity to North America) and spatial extension of their islands.

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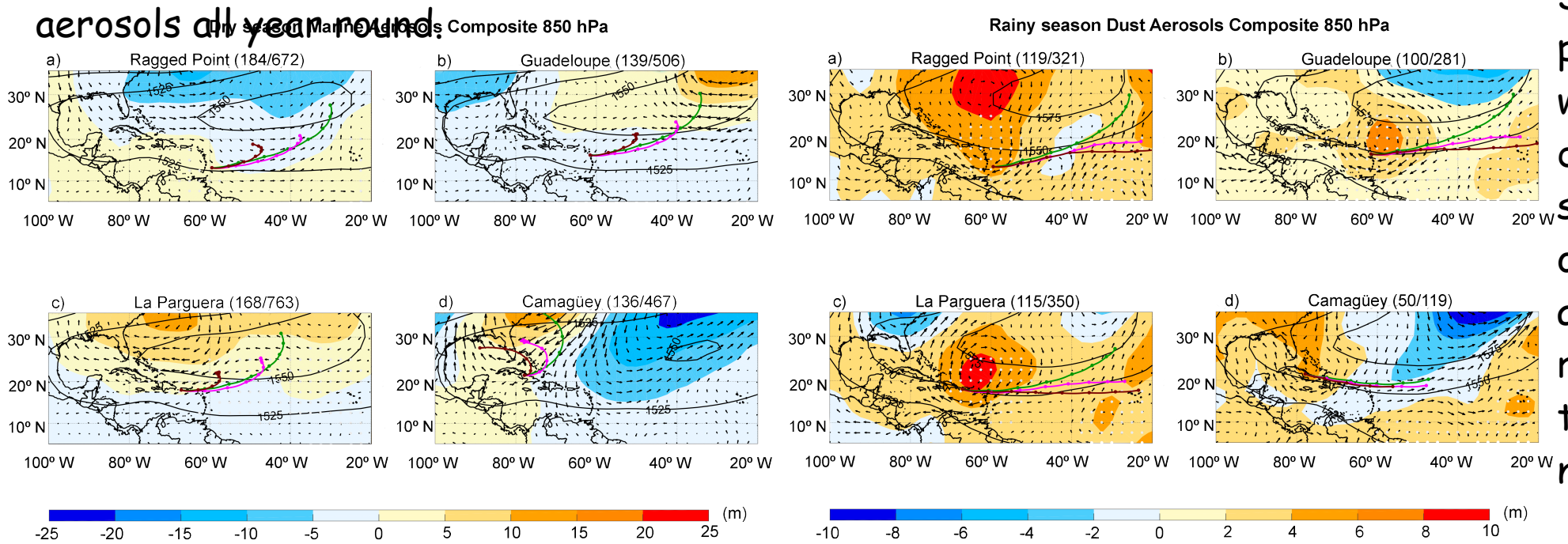
Synoptic Patterns and Transport:

Azores high and the continental anticyclone over North America are the main drivers of the large-scale wind conditions favorable for the transport of aerosols to the Caribbean. The easterlies arise as the dominant wind component associated with the main Caribbean aerosols all year round.

The same synoptic perturbation could instigate episodes of marine aerosol type at different Caribbean stations as it travels over the Atlantic.

Similarly, the synoptic patterns associated with dust episodes during the dry season stress the importance of the trade winds and support the major role of easterly waves traveling from northern Africa.



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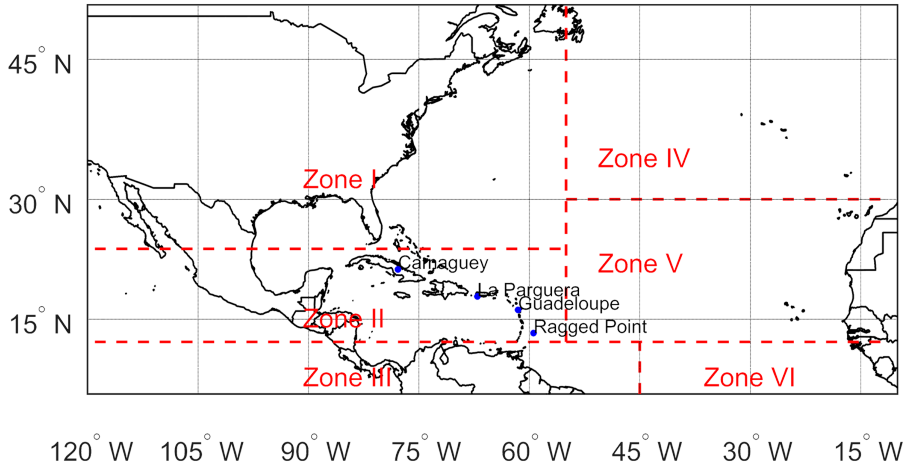

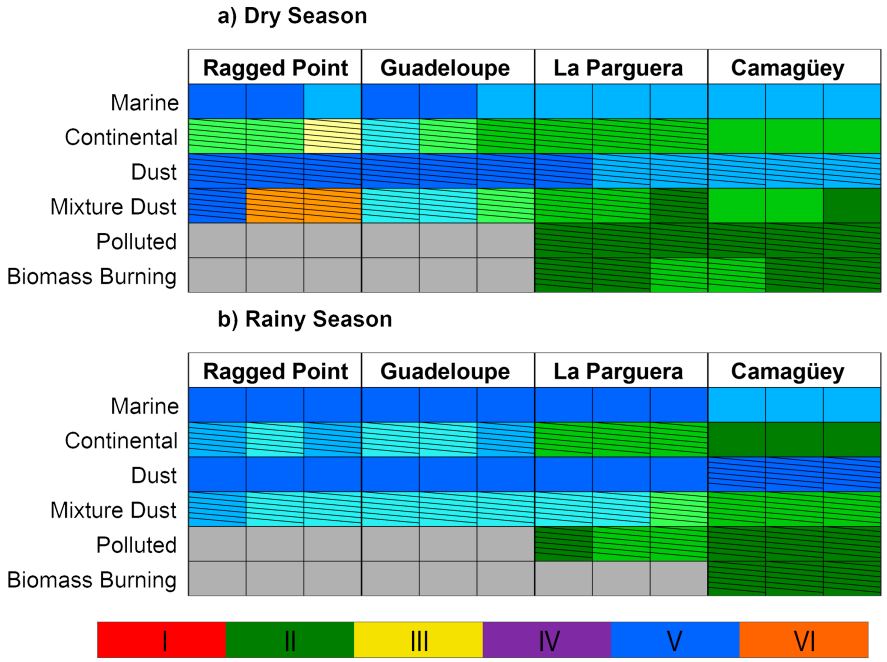

Synoptic Patterns and Transport :

- The eastern Atlantic (zone V) is the major source of marine and dust aerosols.
- Nearby regions (the Caribbean and North America) also act as the main sources of the few episodes of biomass burning, polluted and mixture dust aerosols detected in the westernmost stations, as well as of some extreme continental episodes linked to either natural (volcanic emissions) or anthropogenic (industrial activities) sources.

- Rodríguez Vega, A., Antuña-Marrero, J. C., Barriopedro, D., García, R., Cachorro, V., de Frutos, A., and Sánchez, J. C., R., 2022: Climatology of Aerosols over the Caribbean Islands: Aerosol Types, Synoptic Patterns, and Transport. Jour. Appl. Meteor. Clim., 61, 369-391. http://doi.org/10.1175/JAMC-D-21-0015.1.

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