Dust Report: 23 June 2020: Godzilla Dust Event Overview

CAVEAT: The Dust Report is an informal ad hoc commentary that focuses on interesting African dust events. These reports should not be regarded as definitive statements on these events or their possible impacts.

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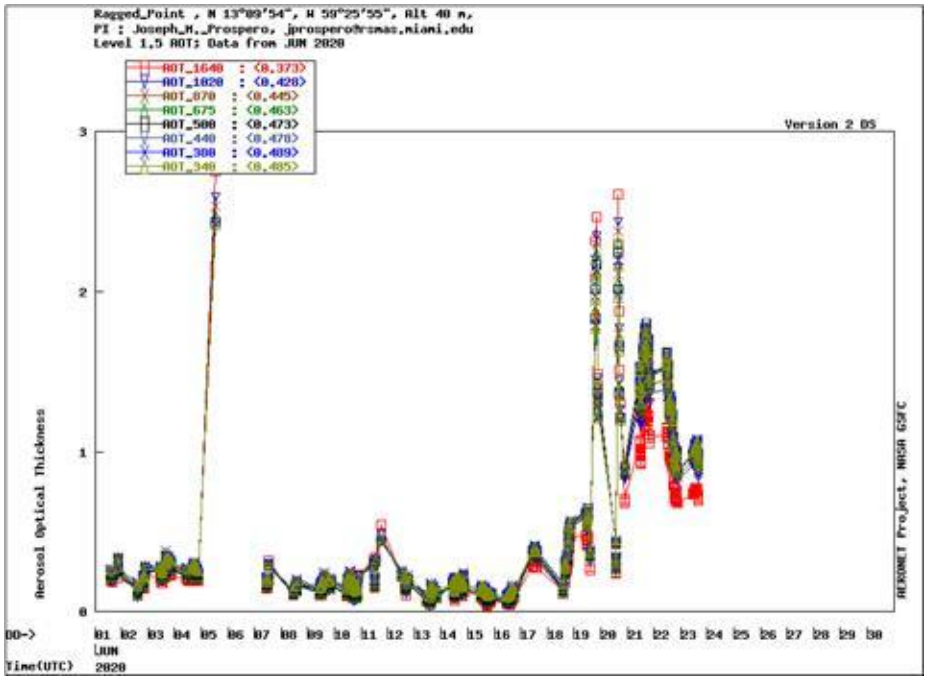
There is much interest in the media about the spectacular African dust event that impacts a huge area of the tropical Atlantic and, now, the Caribbean and Gulf of Mexico. Much of the coverage has been descriptive. Here I present some quantitative measures that help to put the event in a longer-term perspective.

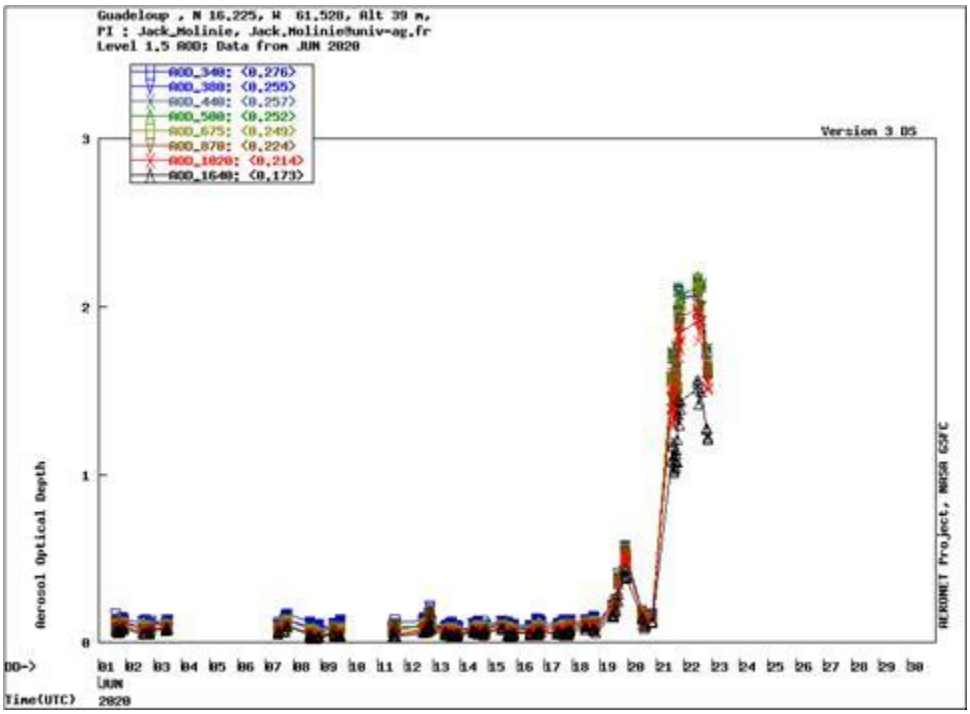
We have made measurements of mineral dust concentrations on Barbados since the late 1960s. Measurements continue to this day. The site is, at present, under the direction of Cassie Gaston, a faculty member in our school. Our basic measurement of dust concentration is based on the analysis of daily high-volume filter samples. It will take some time to return filters from Barbados to Miami and to carry out the analysis.

In the interim, we have other data that enable us to scale the event. Our site at Ragged Point is a part of the NASA AERONET robotic network.
https://aeronet.gsfc.nasa.gov/cgi-bin/type_one_station_opera_v2_new?site=Ragged_Point&nachal=2&level=1&place_code=10
The station was in operation from 1996 to 2000 and then from 2007 to the present. The aerosol optical depth (AOD) measurements at this site can provide some insight on the scale of this event compared to those in the past, keeping in mind that the AOD is a column measure while the filters are a surface measure. This is the record for the month of June.



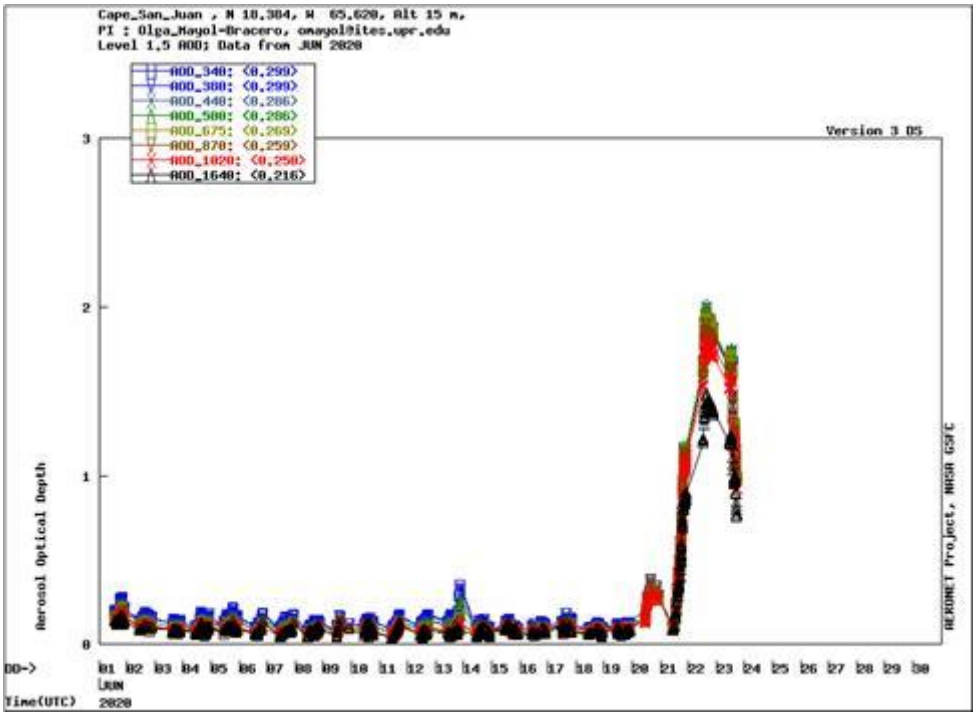
These data have undergone Level 1.5 screening as part of the AERONET process. I would be skeptical of single measurements (such as on 05 June). But the sharp spikes on 19 and 20 June are multiple points. In any event, the values on 21 June fall mostly in the range of 1.6 – 1.8 (measured at 500nm). These values exceed by substantial margins all previous measurements made at this site. On 22 June values peak at 1.6 and fall to 1.0 at the end of the day. On both days (and throughout the event thus far), the Angstrom exponent is essentially zero, a value that confirms that the AOD is driven by mineral dust (if anyone had any doubts).

The measurements on Barbados are confirmed by the data from the AERONET site on Guadeloupe, located 400km (at 320 degrees). The record begins in 1997 although it is spotty in the early years.



The AOD values on 21-22 June range from 1.5 to 2.2. They far exceed all previous measurements in this record.

This is the data for the month of June from the AERONET site on Cape San Juan, Puerto Rico (900 km at 310 degrees). The record extends from 2005 to 2020



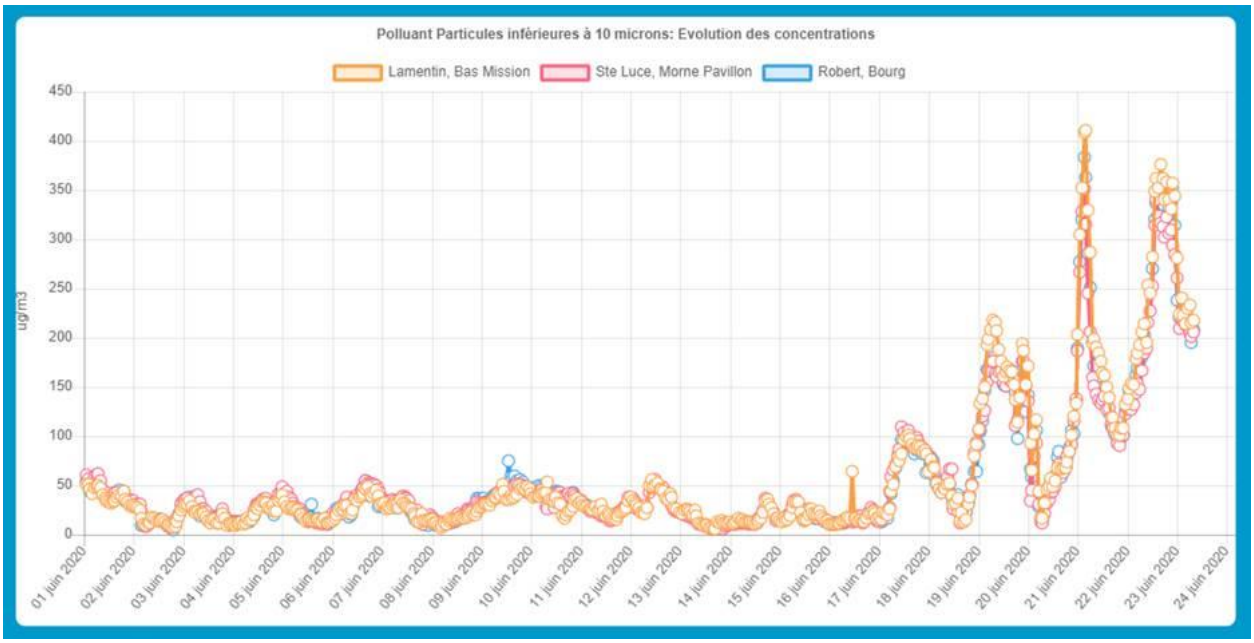
On 22 June, there is a long 9 hour run of measurements and they mostly fall between 1.8 and 1.8 (again, at 500nm). The Angstrom exponent on 22 June is in the range of 0.06 to 0.08, i.e., essentially zero.

Note that on 21 – 22 June, AOD values at Guadeloupe and Cape San Juan exceed those on Barbados. GOES East shows that the main plume axis lies to the north of Barbados.

As noted in my lead-in, the long term record at Barbados is based on filter dust measurements. To relate the current episode to the record, we can use PM10 data from Martinique. Our previous work has shown that the dust in African dust events at Barbados is essentially all in the PM10 range. Measurements made by our group here in Miami using the standard PM instrumentation (TEOMs) confirms this statement. About a third to a half of the dust mass is PM2.5. We have previously used PM10 measurements in Cayenne to quantify African dust transport to South America:

Prospero, J. M., Collard, F.-X., Molinié, J., & Jeannot, A. (2014). Characterizing the annual cycle of African dust transport to the Caribbean Basin and South America and its impact on the environment and air quality. Global Biogeochemical Cycles, 2013GB004802. doi:10.1002/2013GB004802

Here I present the PM10 record from Martinique, 215 km from Barbados, at 314 degrees.



Martinique is a department of France. As such, it operates and air quality monitoring program that is identical to those on continental France. These are three sites in non-urban areas. The Bourg site is on the extreme east coast of the island The plot shows one-hour averages. The three curves overlay one-another and, thus, confirm that the particles are not produced from local sources – except sea-salt with is the primary component of the background aerosol. (There are seven sites on the island. They all track as in the figure shown here.)

I have perused our long term filter data-base and I find that since the early 1970s the daily dust concentration exceeds 200 ug/m3 only on four days. Two of these days were during the intense African drought of the early-mid 1980s. Thus, on the basis of dust concentration, the concentrations of PM10 in this event is comparable to, or exceeds, the most extreme events in the past.

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