CAHN Program
Some Thoughts
&
Current Status of University of Miami Activities

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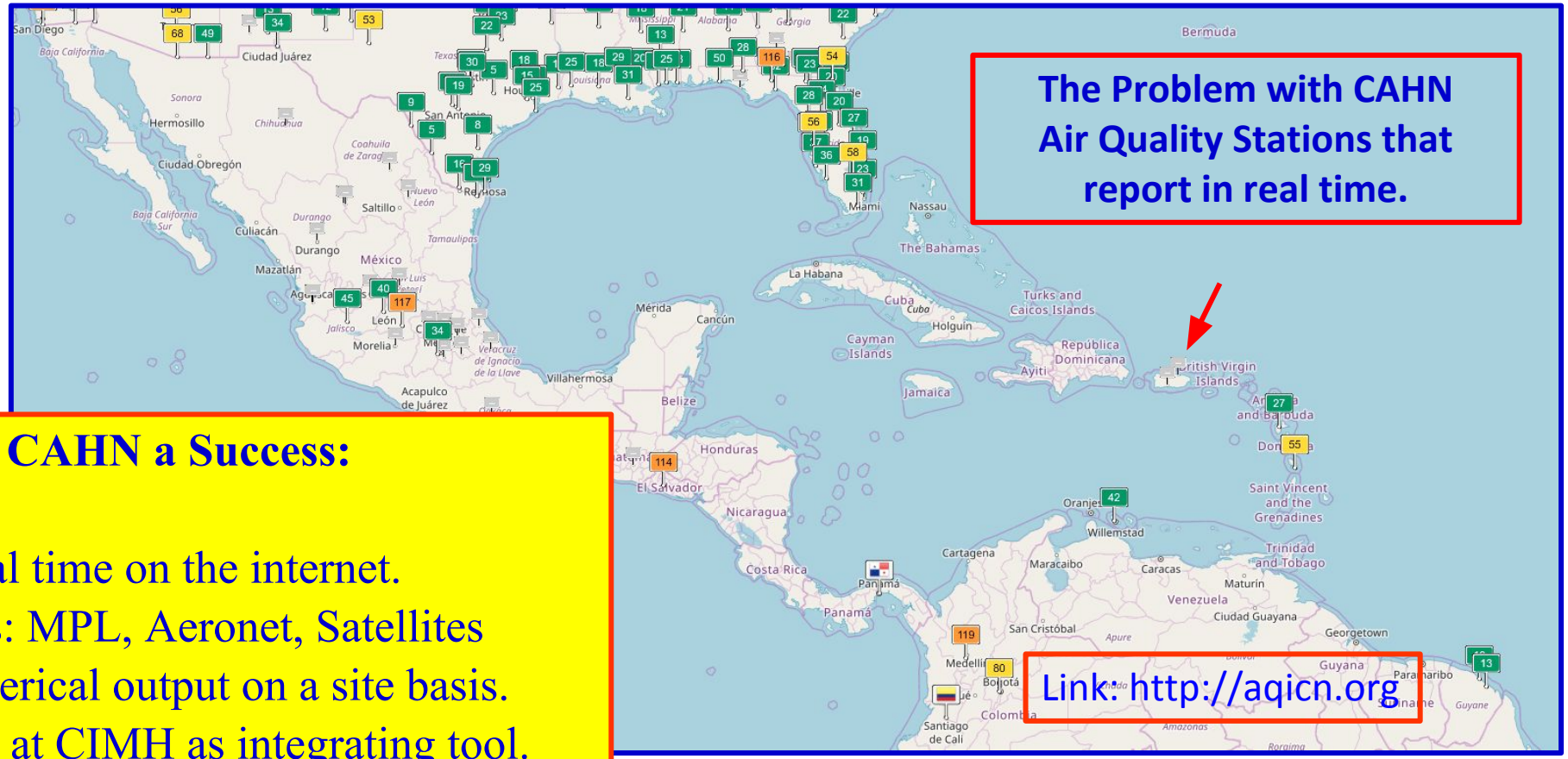
New Leadership at U. Miami

Cassandra (Cassie) J. Gaston

- Assistant Professor, Dept. Atmospheric Sciences, U.M.
- PhD, Kim Prather, University of California, San Diego
- Post Doc: Joel Thornton, U. Washington

- Gas and particle phase measurements: time-of-flight chemical ionization mass spectrometry (HR-TOF-CIMS)
- Single particle studies with laser ablation aerosol particle time-of-flight (LAAPTOF) mass spectrometer
- Role of organic composition and particle phase on the removal rates of reactive nitrogen oxides
- Reactive uptake of biogenic volatile organic compounds key to the formation of secondary organic aerosol
- Chemical “aging” of aerosol particles and impact on nucleation properties
- Long-range transport of mineral dust and biomass burning products

The Caribbean Aerosol and Health ad hoc Network:
We need to "add" to the "ad hoc" and link activities



Needed to Make CAHN a Success:

More data!

Make data available in near real time on the internet.

Integration with other products: MPL, Aeronet, Satellites

Dust Models: need model numerical output on a site basis.

Use the SDS-WAS dust model at CIMH as integrating tool.

Measurement-based validation of models

Connectivity to health infrastructure

Funding!

CAHN: The Need for Quantitative Model Products & Integration

- CIMH as an WMO SDS Node could serve as the nucleus of CAHN activities.
- Need specific forecasts for specific locations with a numerical output of expected concentrations for specific CAHN sites..
- Using these outputs, upon request at automatic email or text alert could be sent out by email to air-quality individuals who sign up for the service.
- They could then forward or publish these alerts to their specific communities.
- The forecast files for each site should be saved so that the data could be downloaded on request.
- With data made available in this mode, it will be possible for people to do ground-truthing of the product which will lead to improvement in the model.
- The domain is far too small compared to the designated domain of the SDS Americas Node.
    - Greater Caribbean Basin: equator on the South (to include Cayenne); the west coast of Mexico and Central America;
    - The southern coast of the US to about 32N to capture PM sites and AERONET sites.
- Model testing and validation is essential to developing trust in the model.
- The CIMH: the educational focus on air quality in the Caribbean. The site could be developed with that as a side objective.

Status of Barbados Operations

No Barbados funding for three years.

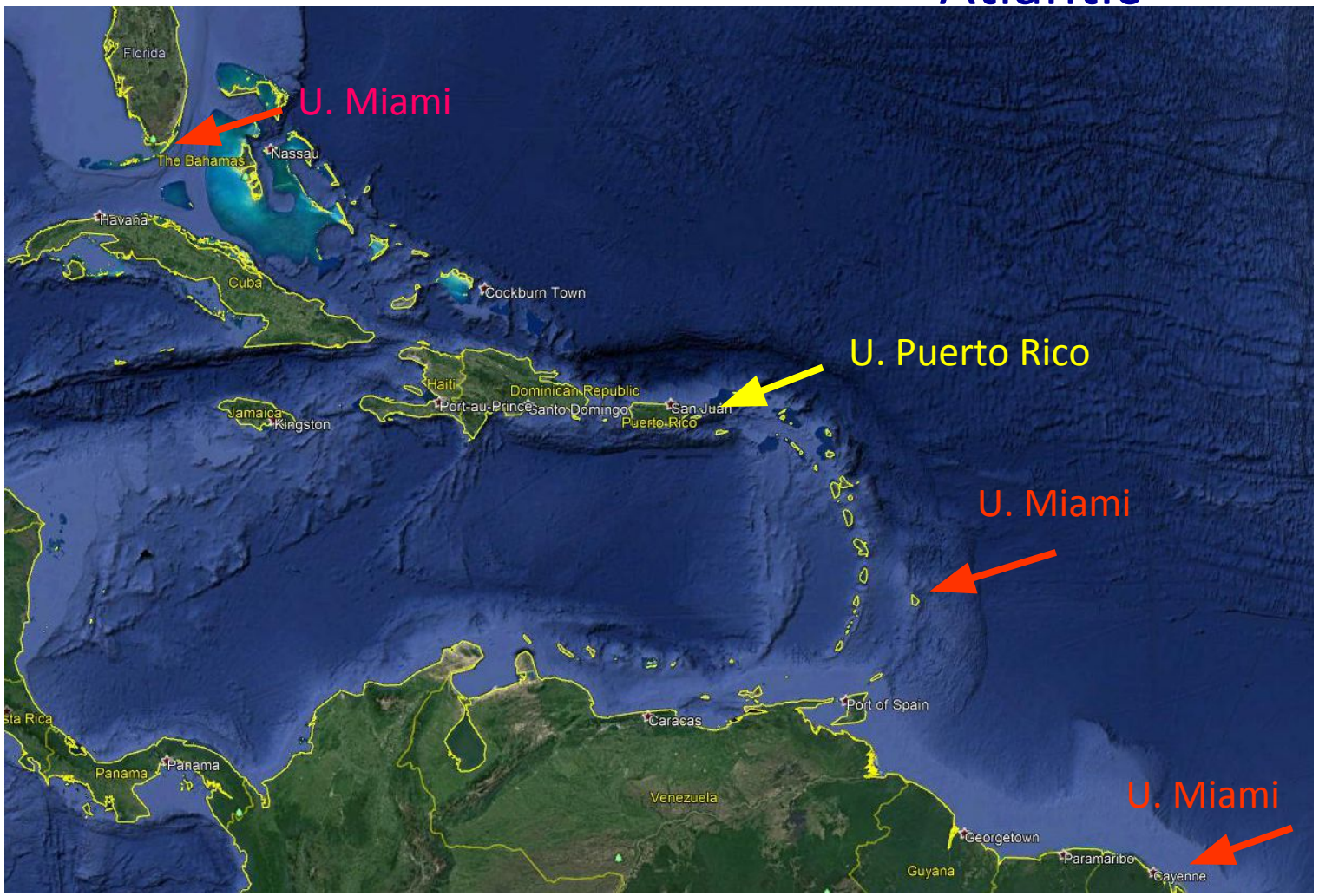
- Major problem with UM administration – concerns about operations.
- Working toward closer cooperation with CIMH.
- Operating with minor amounts of support from Rosenstiel School – for three years
- Minimal program: filter sampling with selective analysis (coop w. Olga Mayol)
- AERONET
- NO MPL!

Partnering with Chris & Mira Pohlker group, Max Planck Institute for Chemistry, Mainz
GRIMM Wide Range Aerosol Spectrometer (WRAS): 70 size channels from 5.5 nm to 32 µm

- TSI SMPS,
- TSI OPS,
- TSI CPC,
- CCN counter (Particle Technology)
- WIBS (The Wideband Integrated Bioaerosol Sensor (WIBS-4A)

Summer 2017: Ice nucleus measurements, Ben Murray,
Leeds.

U. Miami Aerosol Program Strategy & CAHN: Characterize Aerosol Chemical & Physical Properties over the Tropical Atlantic



Basic Research Sites in CAHN
The "Backbone" of the Network.

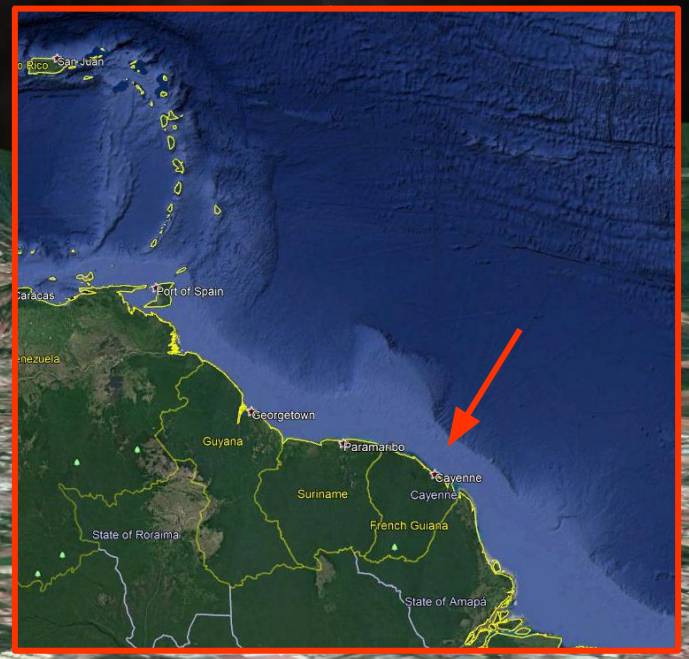
Three UM Sites:

- Miami, Florida
- Barbados, West Indies
- Cayenne, French Guiana

Two UPR Sites (Olga Mayol)

- Fajardo
- El Yunkue

New Focus on Spring Transport from Africa
UM Expansion to Cayenne, French Guiana



Montabo

Cité Castors

Rebard

University of Miami & Observatoire Régional de l'Air de Guyane (ORA)
Aerosol Sampling Site, Cayenne, French Guiana
Elevation 67 meters
Viewed from NE, direction of prevailing winds.

Image Landsat / Copernicus
© 2018 Google
Image © 2018 DigitalGlobe
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google Earth

In Cooperation with Jack Molinie (Université des Antilles et de la Guyane) and Observatoire Régional de l'Air de Guyane (ORA)

African dust transport to South America: First paper in 1981

Prospero, J. M., R. A. Glaccum, and R. T. Nees (1981), Atmospheric transport of soil dust from Africa to South America, *Nature, 289(5798), 570-572.*

Atmospheric transport of soil dust from Africa to South America

J. M. Prospero, R. A. Glaccum & R. T. Nees

Rosenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami, Florida 33149

The arid and desert regions of North Africa are a prolific source of atmospheric dust. This dust is, for example, responsible for the 'red snows' reported in the Alps and Pyrenees[1] and for dust falls further north in Europe[2–6], but these phenomena are infrequent and sporadic. By contrast, the transport of mineral dust into the tropical North Atlantic is common and often produces a widespread dense haze[7]. Investigations in the past 15 yr[8–11] have shown that, in the summer months[12,13], the distribution of dust is related to macro and micro-meteorological circumstances, that the dust often reaches altitudes of 5–7 km and that it may be spread over several hundreds of kilometres in latitude and extend to the Caribbean Sea and the south-east United States. We report here the results from an aerosol sampling station at Cayenne, French Guiana, which indicate that large quantities of soil dust are being carried out of North Africa and across the Atlantic during the winter months as well but at this time of year the transport is primarily to South America.

Since that time no quantitative measurements. Many speculative and modeling papers.

Swap, R., M. Garstang, S. Greco, R. Talbot, and P. Kallberg (1992), Saharan dust in the Amazon Basin, *Tellus B, 44(2), 133-149, doi:doi:10.1034/j.1600-0889.1992.t01-1-00005.x.*

Koren, I., Y. J. Kaufman, R. Washington, M. C. Todd, Y. Rudich, J. V. Martins, and D. Rosenfeld (2006), The Bodele depression: a single spot in the Sahara that provides most of the mineral dust to the Amazon forest, *Environmental Research Letters, 1(1), doi:014005*
Artn 014005.

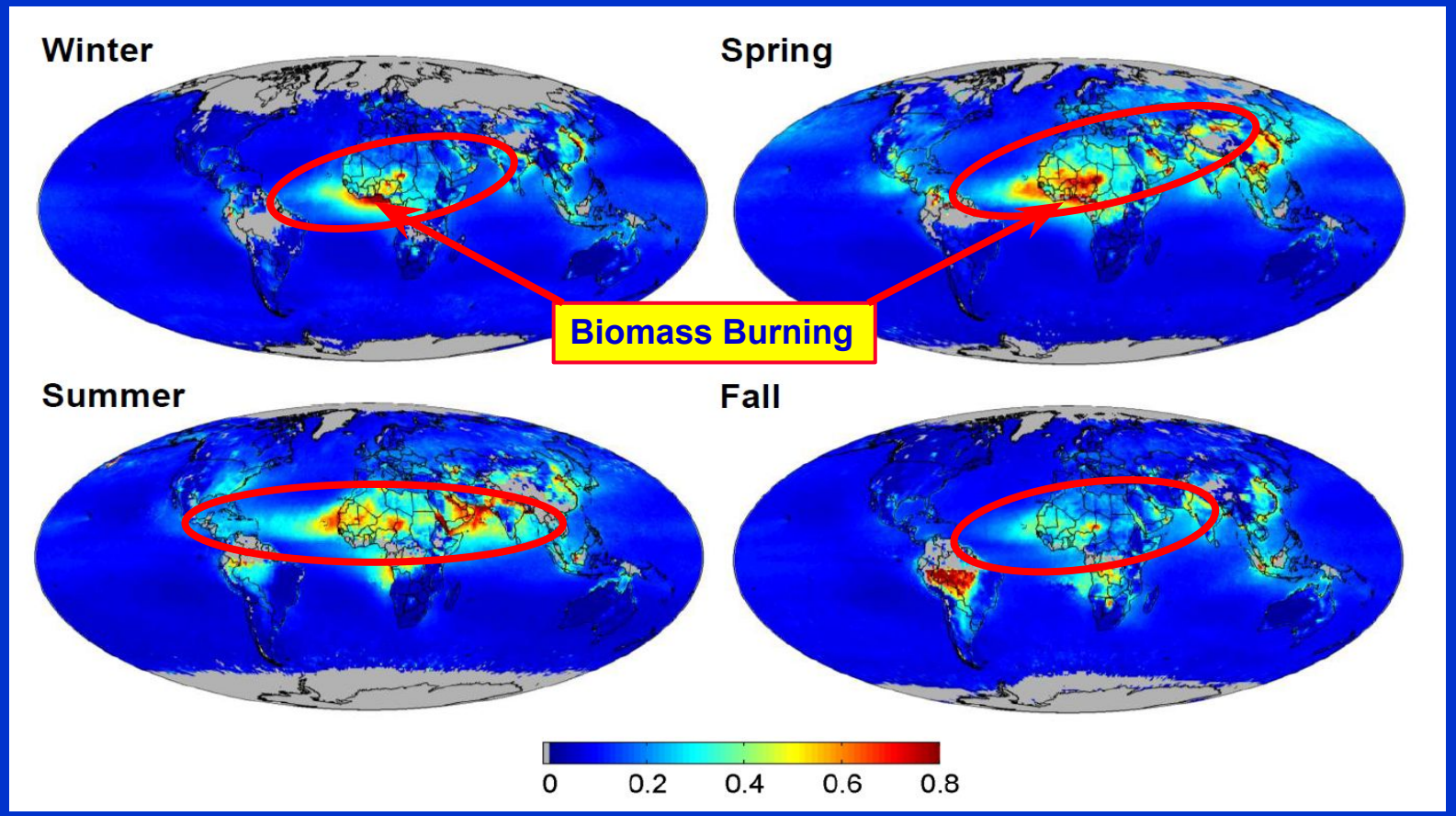
Bristow, et al. (2010), Fertilizing the Amazon and equatorial Atlantic with West African dust, *Geophysical Research Letters, 37(14), doi:10.1029/2010GL043486.*

Ben-Ami, Y., I. Koren, Y. Rudich, P. Artaxo, S. T. Martin, and M. O. Andreae (2010), Transport of North African dust from the Bodélé depression to the Amazon Basin: A case study, *Atmospheric Chemistry and Physics, 10(16), 7533-7544, doi:10.5194/acp-10-7533-2010.*

Yu, H., et al. (2015), The fertilizing role of African dust in the Amazon rainforest: A first multiyear assessment based on data from Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations, Geophysical Research Letters, 42(6), 1984-1991, doi:10.1002/2015GL063040.

Quantifying Dust Transport to South America

Major Point: There has been essentially no effort to quatify the transport to South Americ.

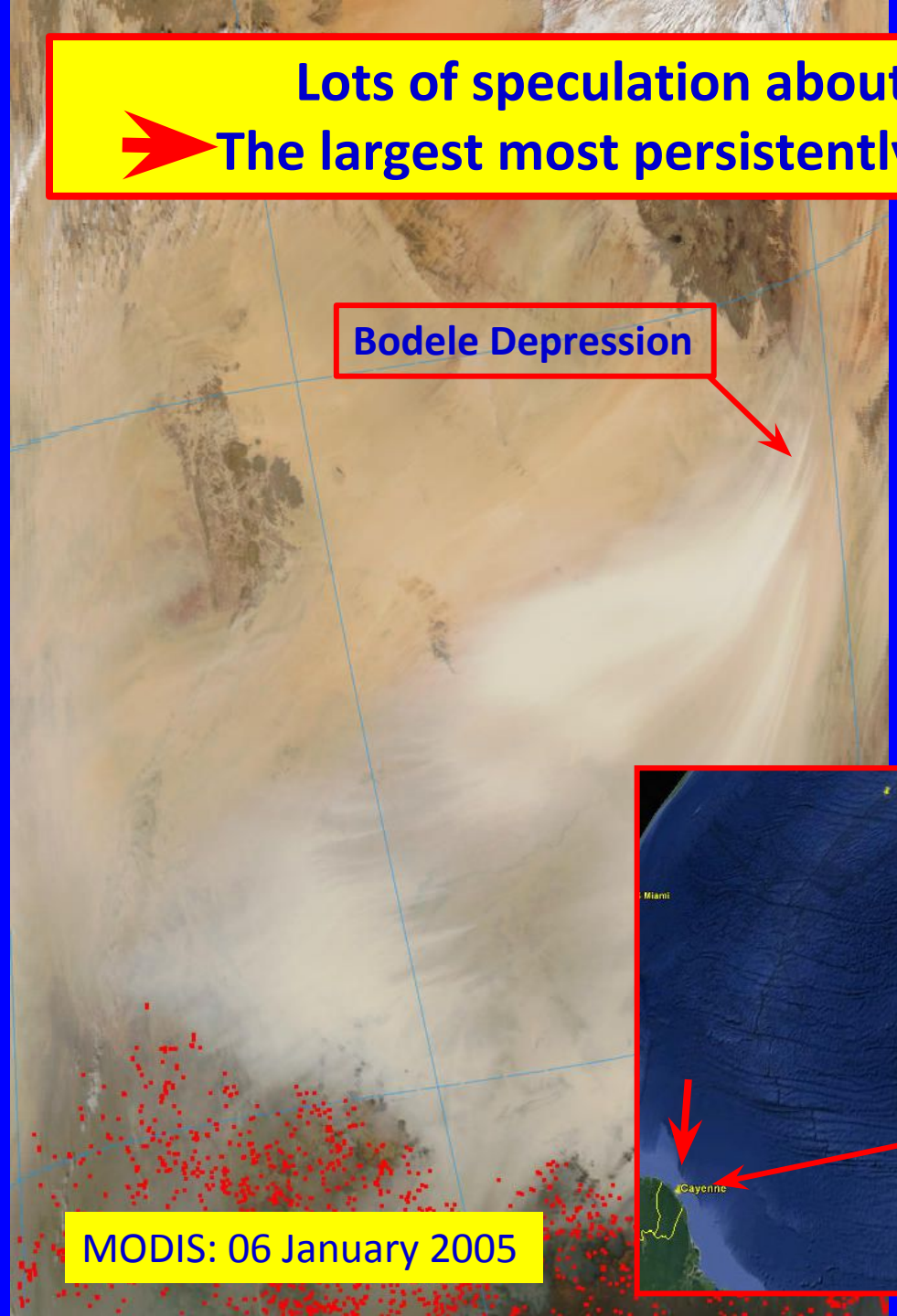


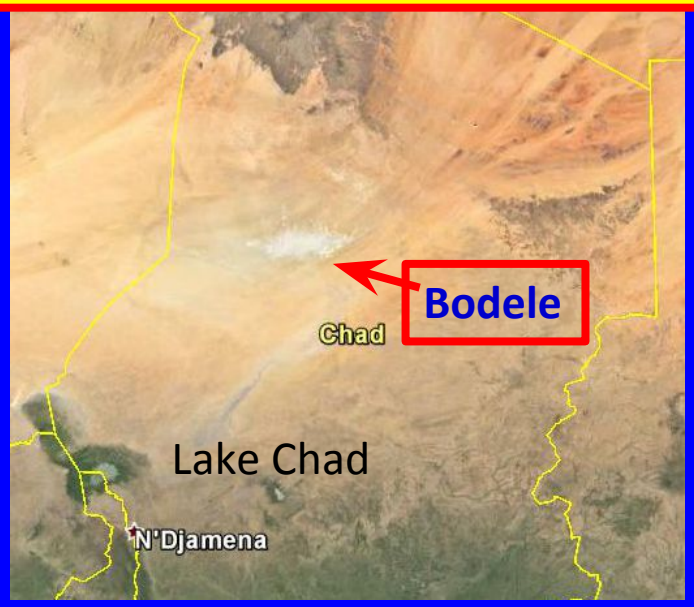
SeaWiFS seasonally averaged AOD at 550nm from 1997–2010. Hsu et al., 2012 ACP

Although this transport is not technically a part of the CAHN domain it is essential to understanding African sources

Lots of speculation about the Bodele Depression

The largest most persistently active dust source in the world.



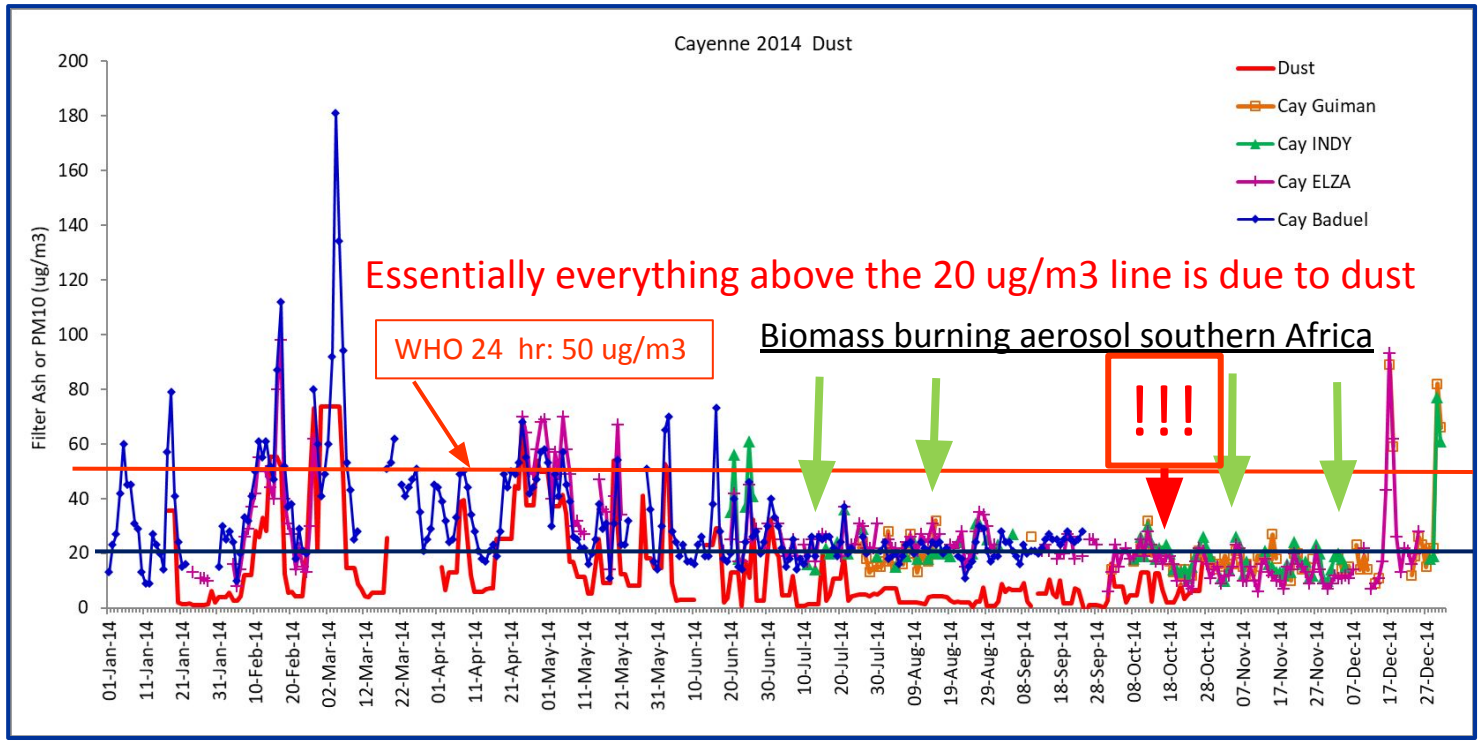


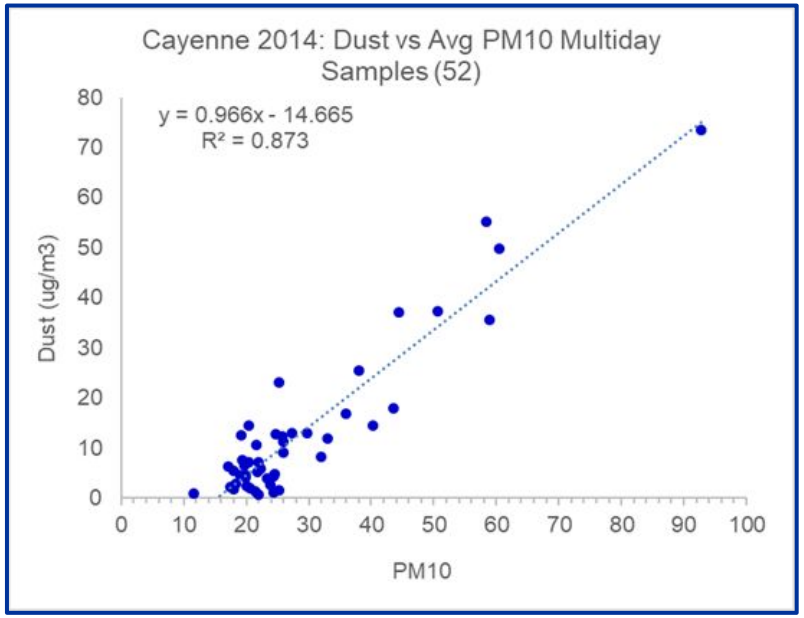
High Vol Filter Sampling Program at Cayenne: 2014 to Present

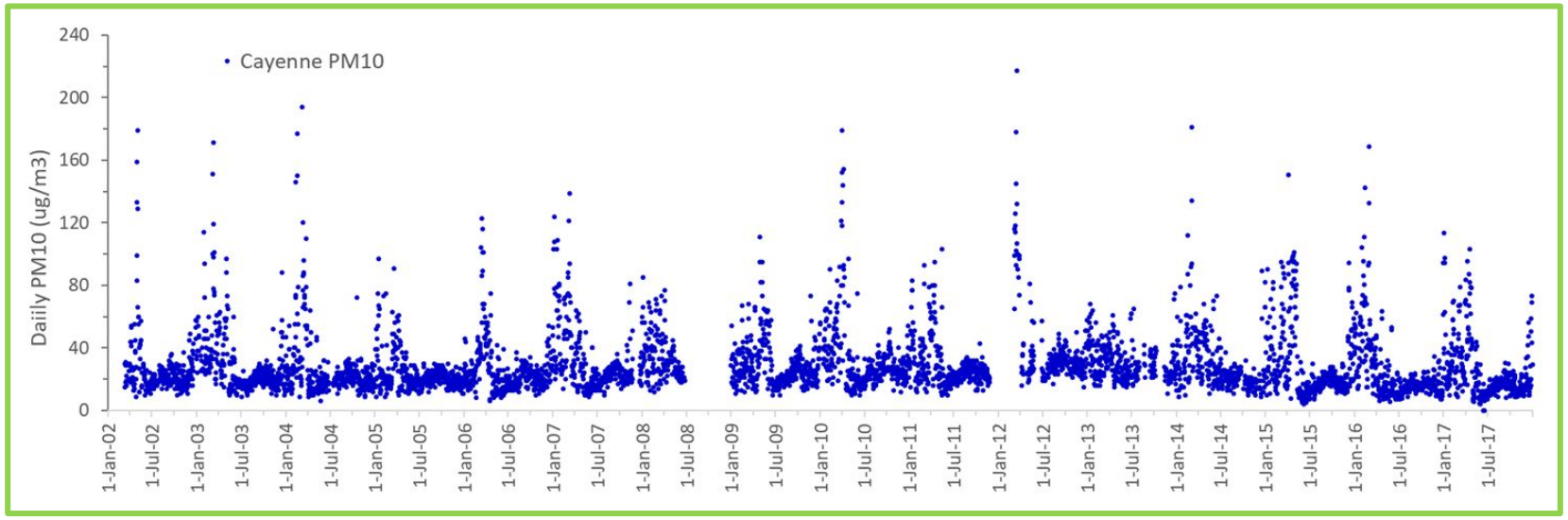
- Sampling initiated in 2014 and continues today
- Sampling carried out by personnel of the organization responsible for air quality measurements: Observatoire Regional de l'Air de Guyane. Facilitated by Jack Molinie.
- Sampler located on a 67m hill on North coast. Secure radar site.
- Filters sent to University of Miami for chemical analysis and measurements of concentrations of African dust and soluble species
- Further analysis of individual particles using University of Miami's microscopy center

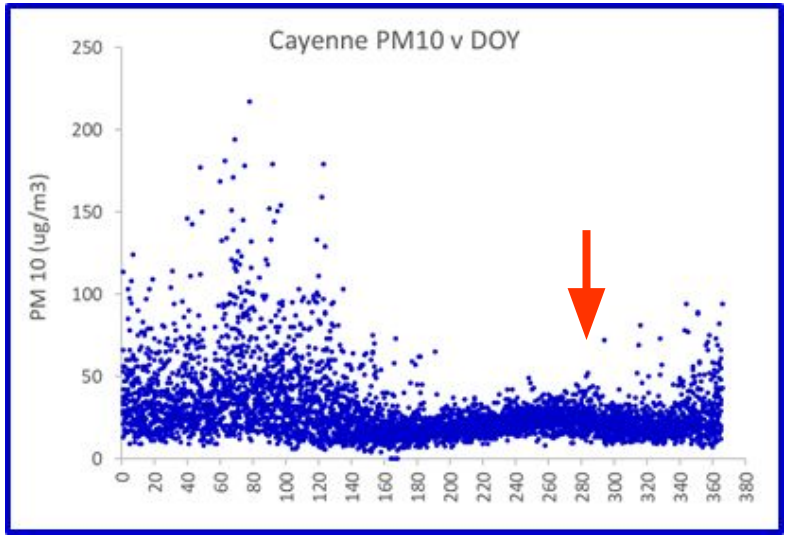
Photo of high volume air sampler in Cayenne. The same as used in previous UM global sampling activities.

Cayenne PM10: Dominated by African Dust & Biomass Burning Products

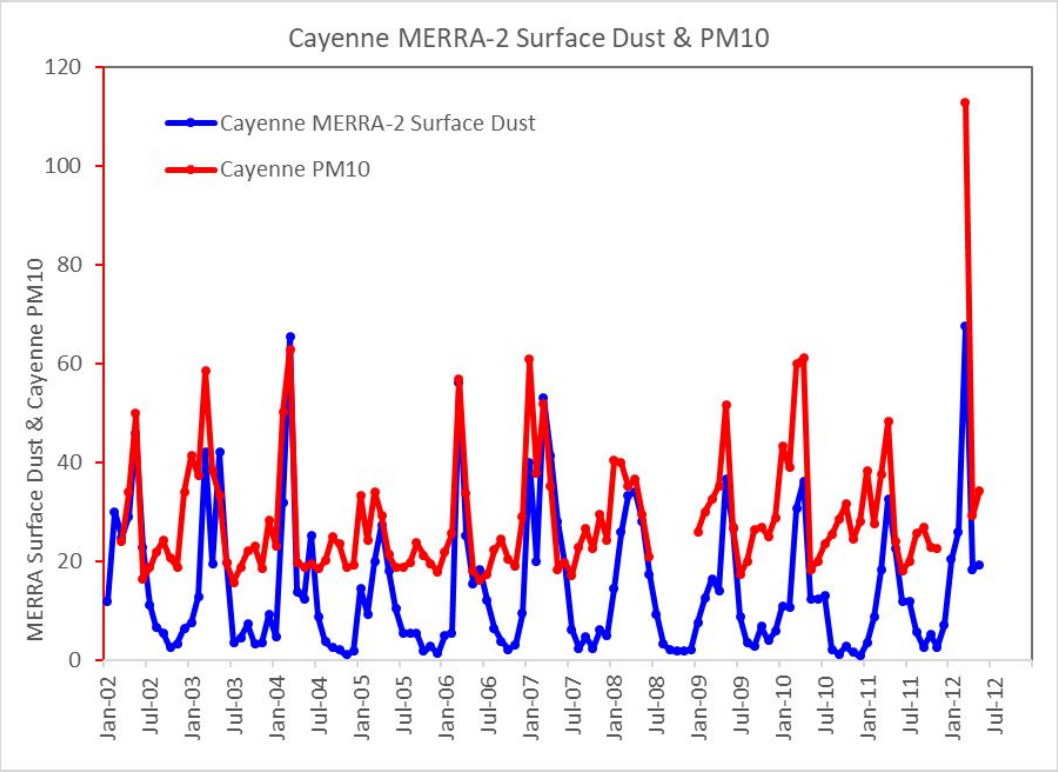


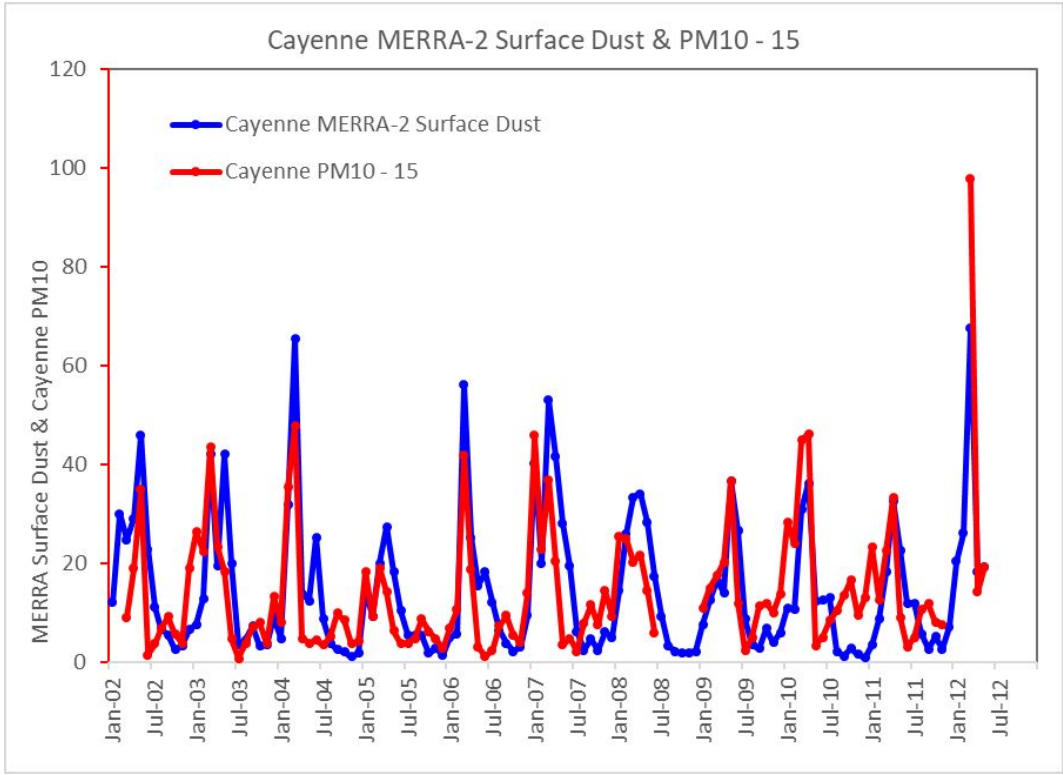






MERRA-2 and Cayenne Dust: It does a pretty good job.



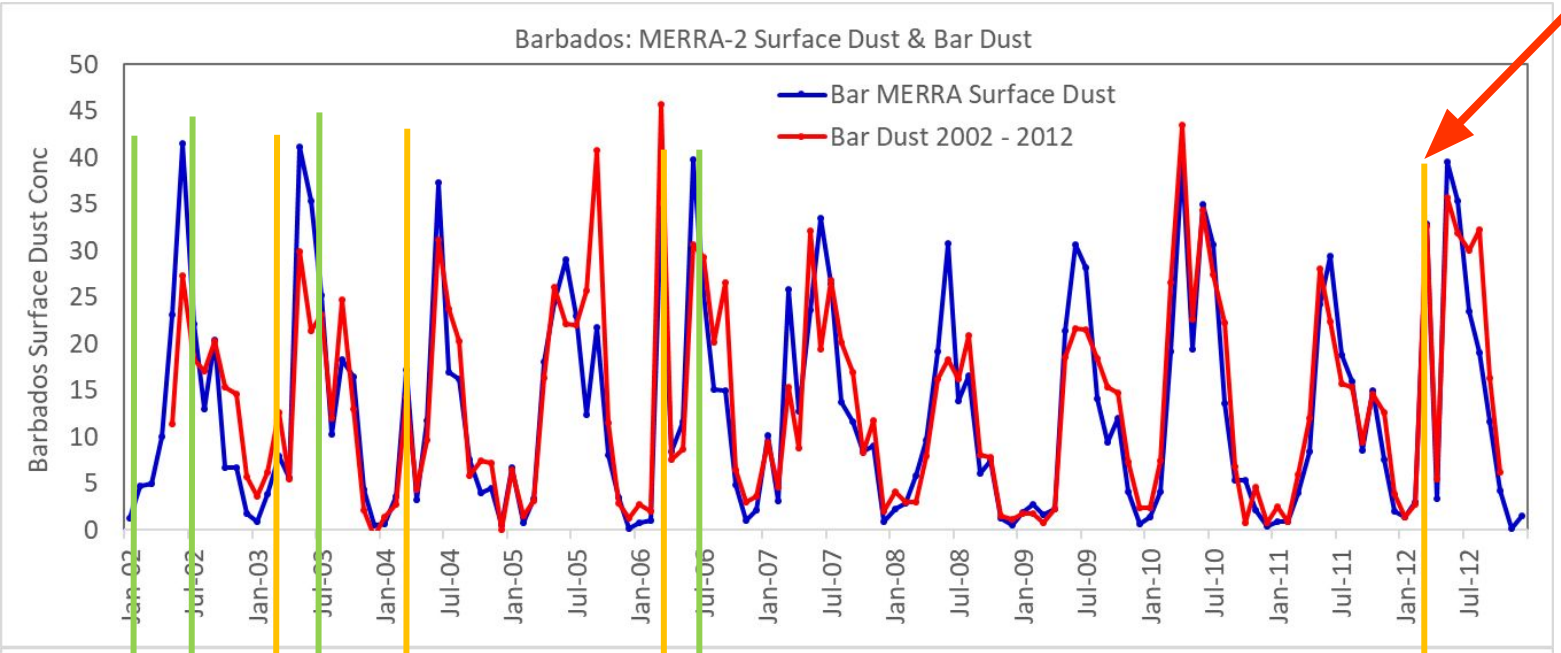


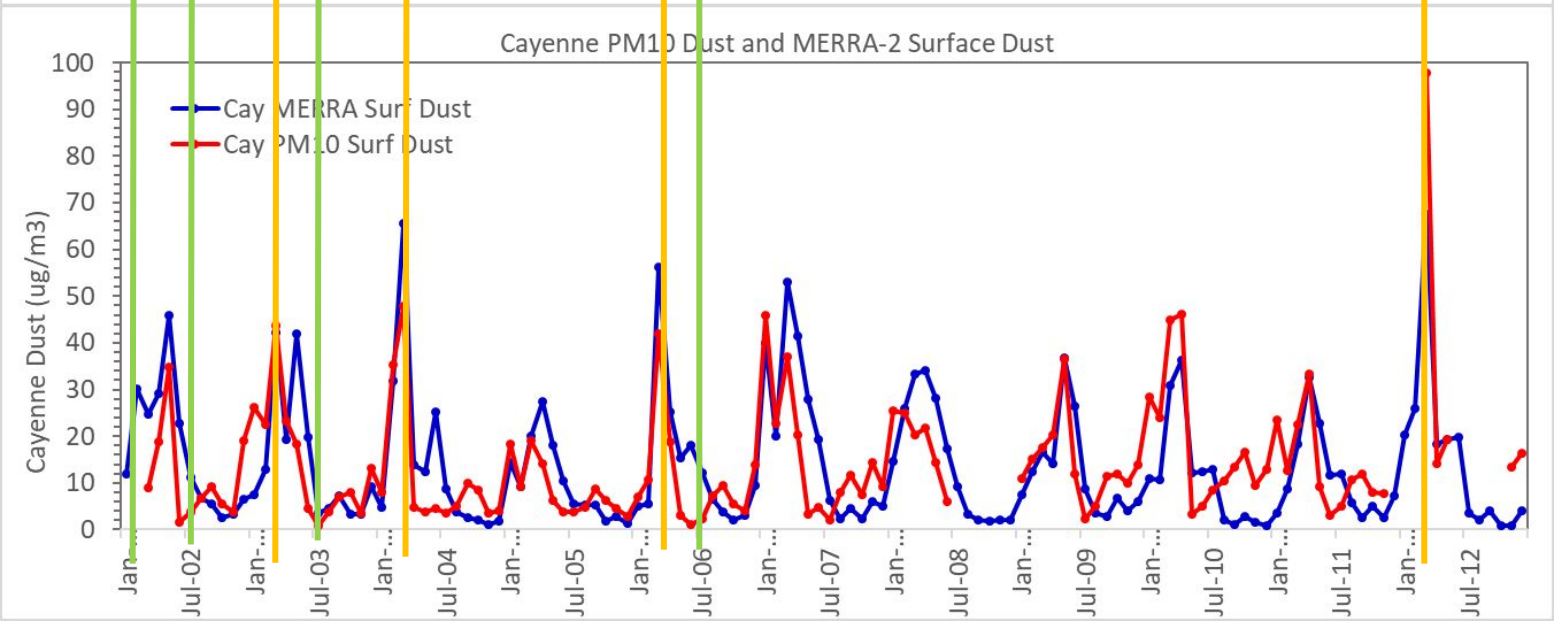
LEFT: Compares the raw monthly means of Cayenne PM10. with MERRA-2 monthly mean surface dust.

RIGHT: Uses these same Cayenne PM10 data after subtracting a nominal background value, 15 ug/m3.

Figures: E:\Pap_Oct2017\Pap_new\Cayene Dust Events 2014\Sat products\Multi year\[Cay_mon means MERRA-2_dust ext_550nm_2002-2012 Giovani.xlsx]GRAPHS_Dust surface

Comparing MERRA Surface Dust with PM10-Dust at Cayenne and Total Dust at Barbados

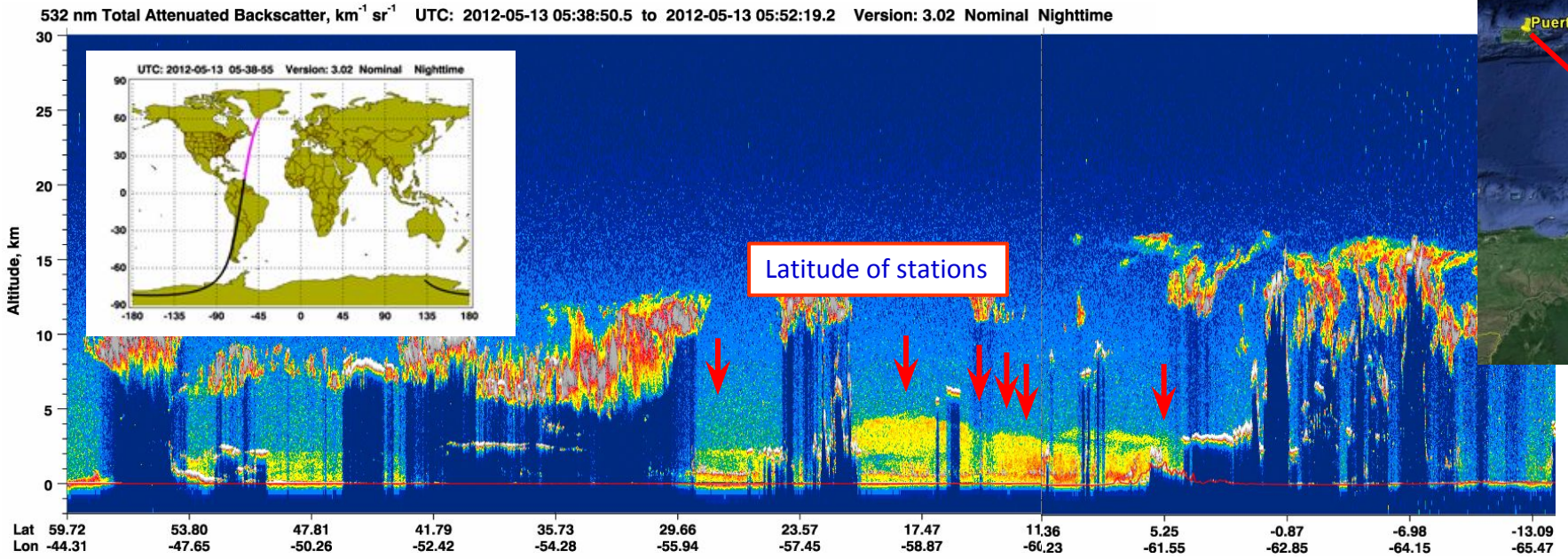


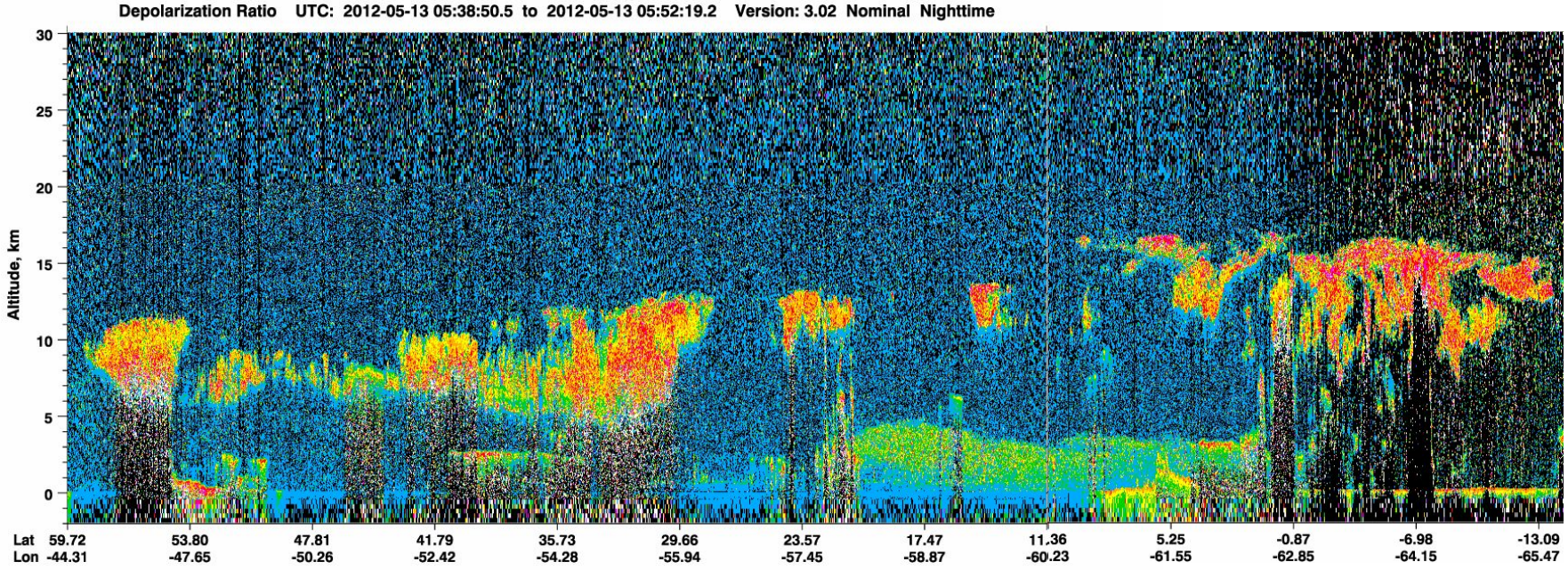


Note that Spring dust events at Barbados line up with Cayenne dust season events!

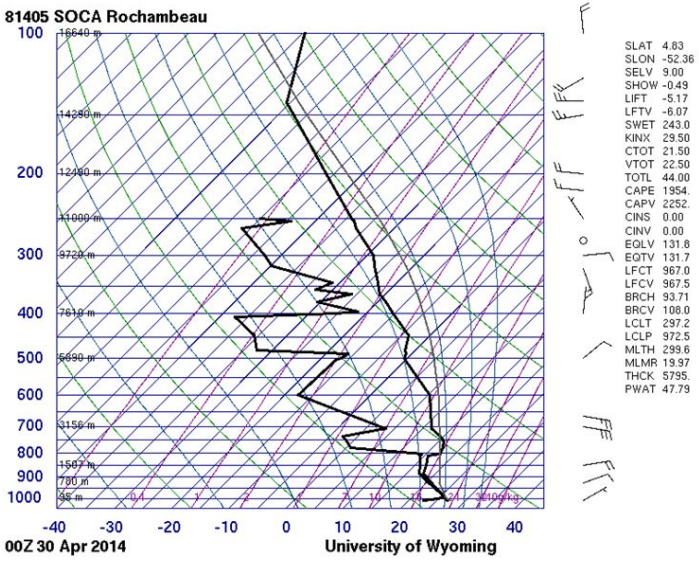
- MERRA-2 does a good job after 2002 when it assimilated MODIS.
- It does a bad job prior to 2002 when it used AVHRR.
- It is somewhat better at Barbados. Gets peak centered nicely.
- Does OK at Cayenne but does not define the peaks as well as it does at Barbados.
- MERRA yields very poor results at Miami
- MERRA yields very poor results at Bermuda

Dust Front: Calipso 13 May 2012





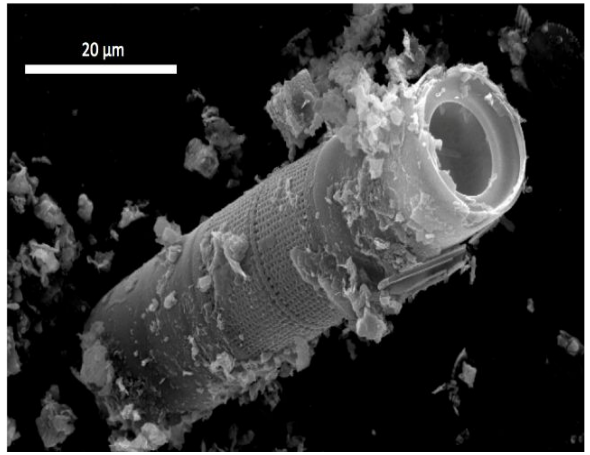
Soundings yield SAL-type profiles but often torn up.

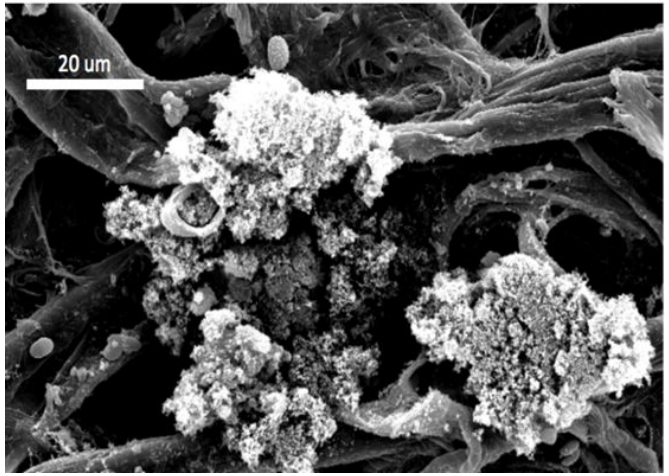


Evidence of PM Transport from the Bodélé Depression to Cayenne

SEM images, fossilized diatoms from the Bodélé Depression are transported to Cayenne

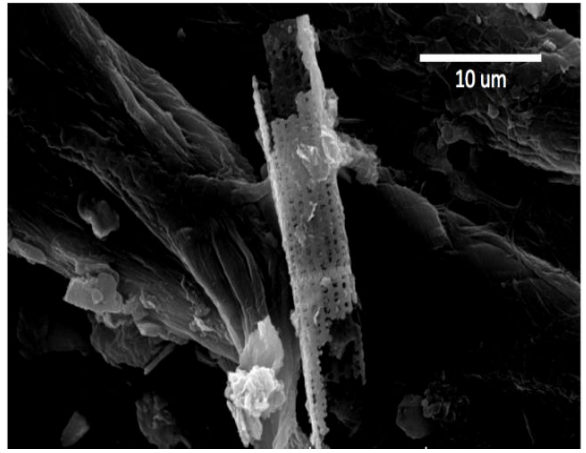
Soil sample Bodélé Depression





Soot particles from biomass burning

Filter sample Cayenne

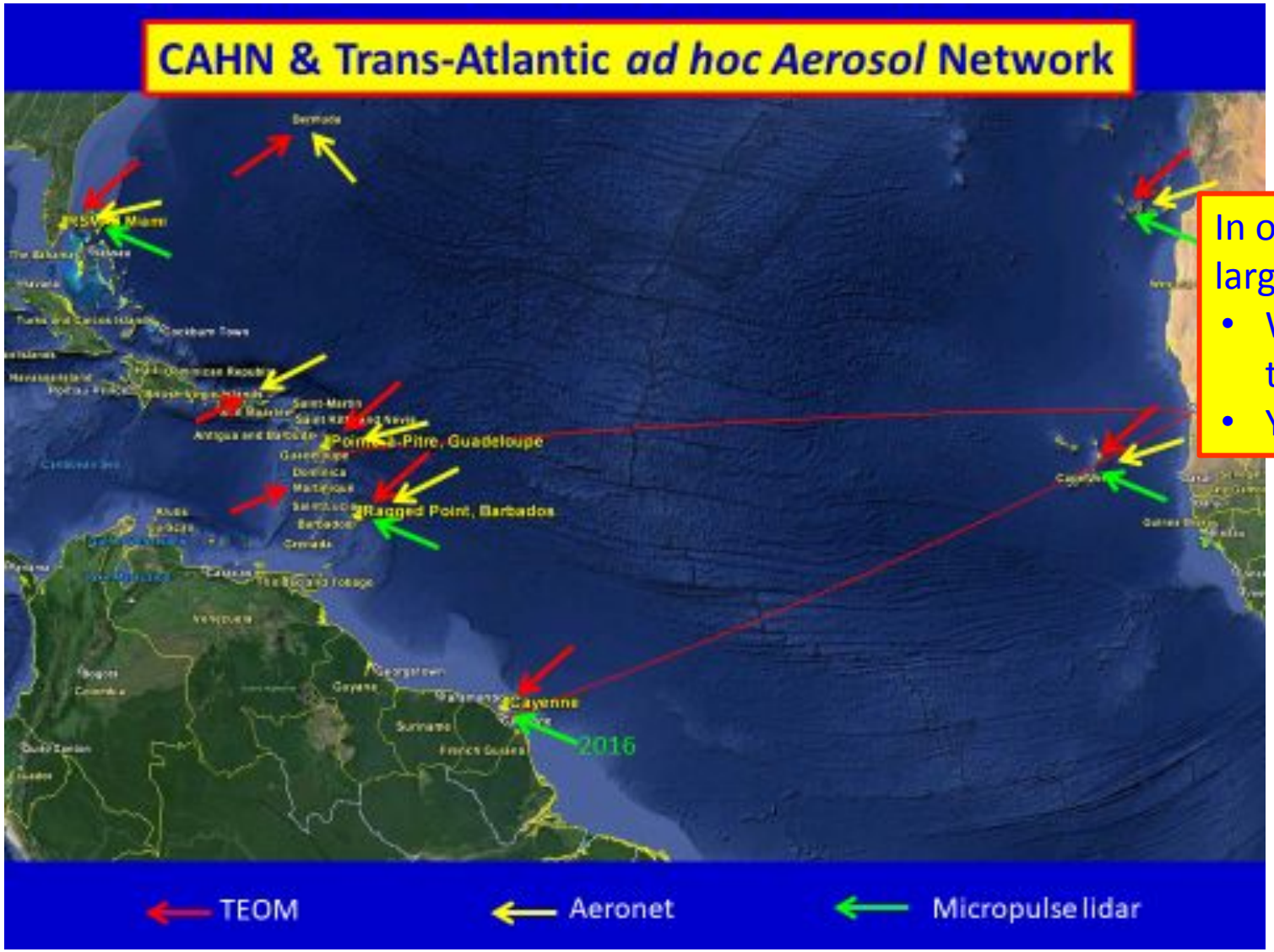


NOTE: We do NOT see Bodele dust at Barbados.
Based on isotopic signatures of dust compared to Bodele soil.
Currently doing isotopic work with Cayenne samples.

Barkley et al., 2018 In Prep

The Complete Picture: CAHN Linked to Africa and the Atlantic

Key to Understanding Dust, Climate and Health -
Follow Dust from the Source to the Receptors



In order to place measurements in the Caribbean into a larger scientific context:

- We must link measurements made in the Americas to those made in Africa and the North Atlantic.
- You must be alert to changes with changing climate.

THANK YOU FOR YOUR ATTENTION!