



**PR=CLIMAH**  
THIS IS PUBLIC HEALTH



Early Warning of Synoptic Air Quality  
Events to Improve Health and Well  
Being in the Greater Caribbean  
Region

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Graduate School of Public Health  
University of Puerto Rico-Medical Sciences Campus



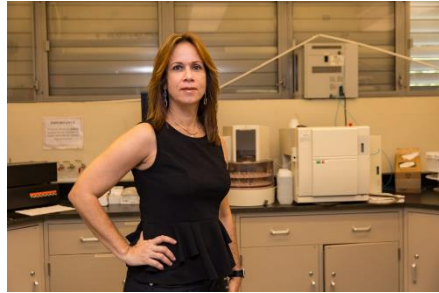
## Early Warning of Synoptic Air Quality Events to Improve Health and Well Being in the Greater Caribbean Region

- Nov 2017, we proposed to characterize the distribution pattern and variability of *Saharan Dust* using Earth observations data from satellites and ground stations, and quantify the impact on respiratory diseases in Puerto Rico.
- This research is co-designing a **Public Health Early Warning (Monitoring) System** that integrates data from Earth observing satellites, in situ, and modeled weather information, and public health data.
- Started 2019

# Core Team members: Epidemiology, Environmental Health, Remote Sensing, Chemistry, Atmospheric Science, Climatology



Olga L. Mayol-Bracero, Ph.D.



PI: Pablo A. Méndez-Lázaro, Ph.D.



Daniel Otis, PhD



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Cynthia M. Pérez-Cardona, Ph.D.



Digna Rueda-Roa, Ph.D.



Aluisio Pimenta, PhD, PE

# Early Warning of Synoptic Air Quality Events to Improve Health and Well Being in the Greater Caribbean Region

## Project Partners-End users-Stakeholders and Practitioners

Organization Type	Organizations
State Agency-Decision Makers	6
Federal Agency-Decision Makers	3
Academia Research	4
Private Health Clinics	4



**UNIVERSITY OF SOUTH FLORIDA**  
College of MARINE SCIENCE



Puerto Rico  
Science, Technology  
& Research Trust



UNIVERSIDAD  
ANA G. MÉNDEZ  
**UAGM**  
Recinto de Carolina



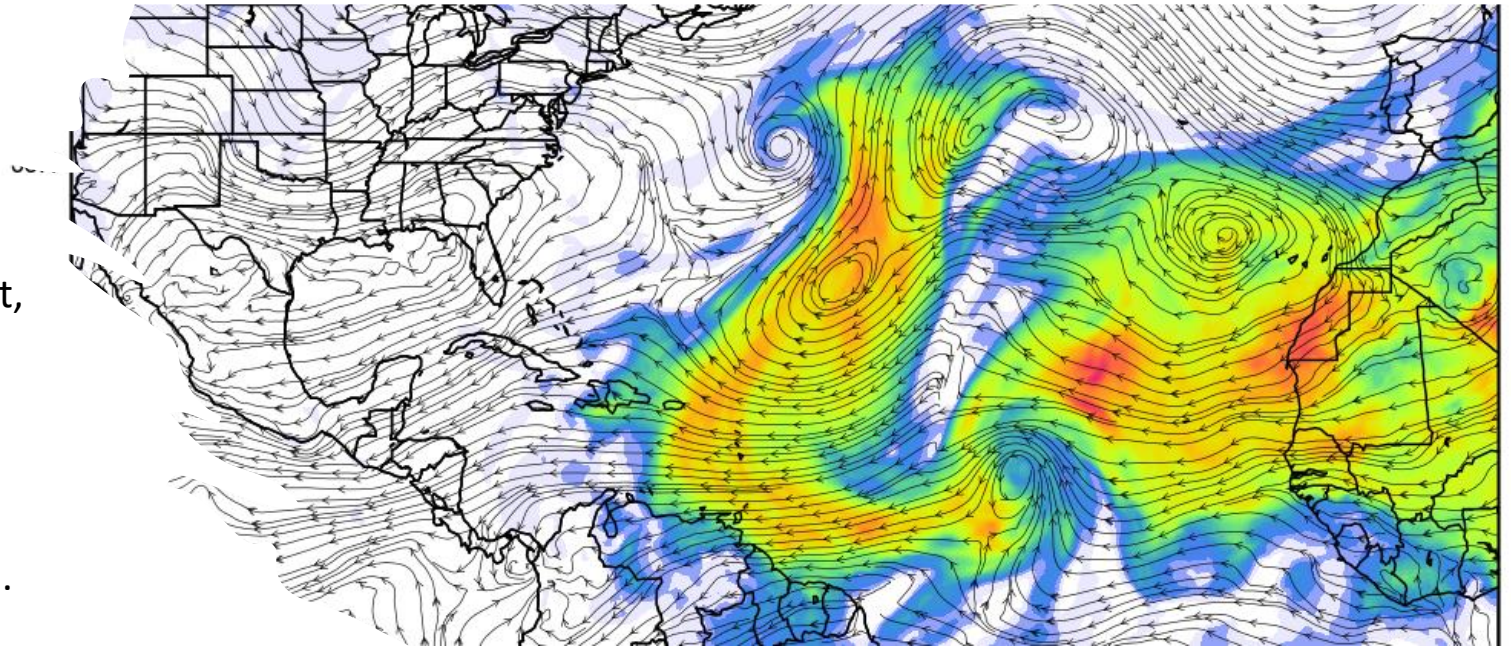
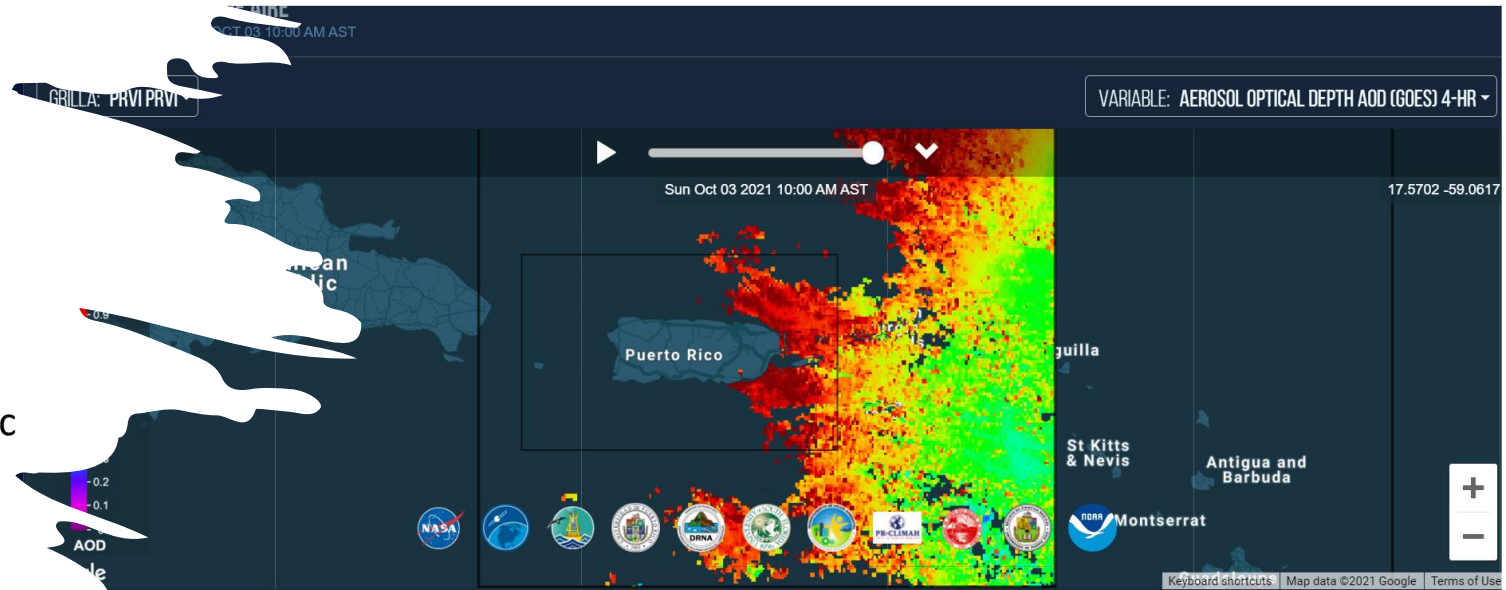
REGISTRO  
CENTRAL  
DE **CANCER**  
DE PUERTO RICO



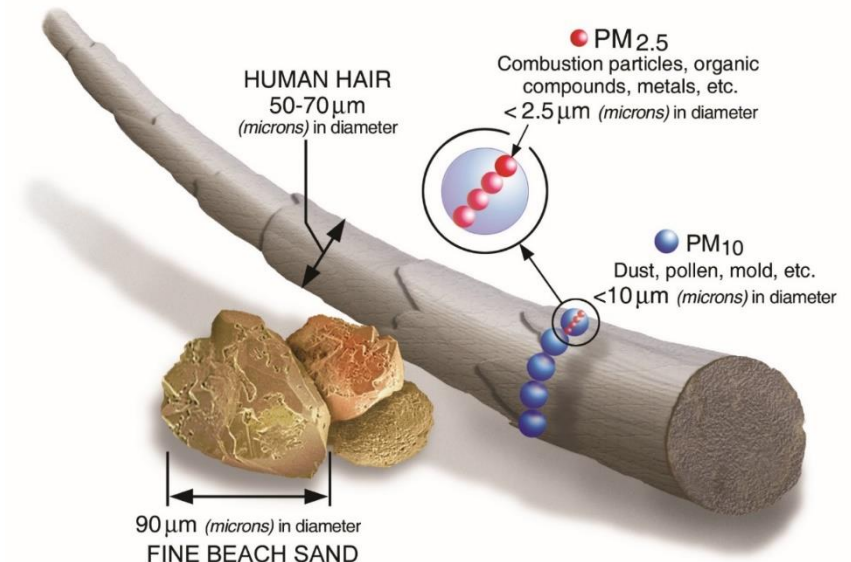
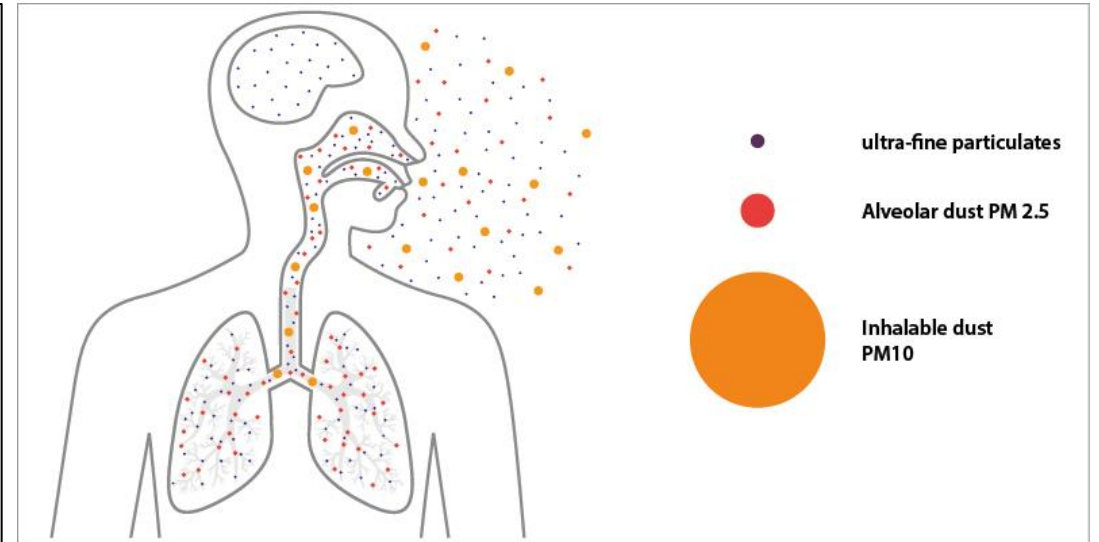
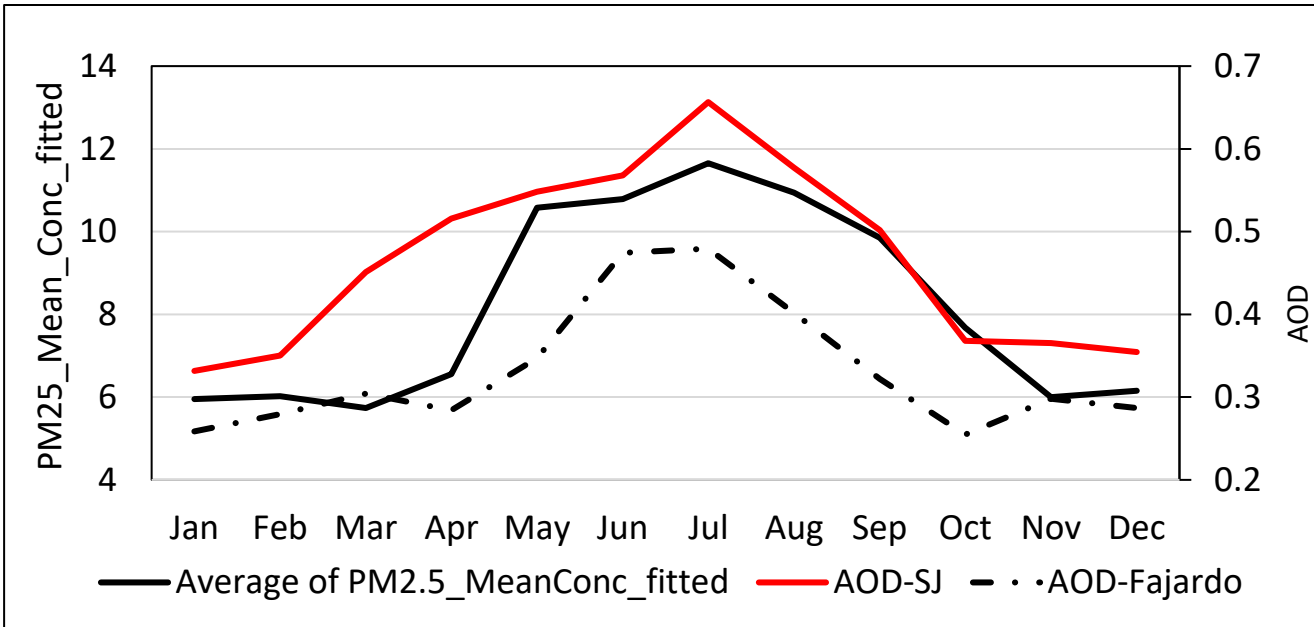
Hospitales  
**HIMA-San Pablo**

# What is Saharan Dust and its seasons in the Caribbean?

- The mineral dust particles that reach us in the Americas from Africa could contain minerals, organic matter, marine salts, viruses and bacteria.
  - Quartz and phyllosilicates are omnipresent
  - Calcite
  - Hematite
  - Sulfates
  - Others
- Dust Clouds are aerosols, small solid and liquid particles suspended in the atmosphere.
  - Examples of aerosols include windblown dust, sea salts, volcanic ash, smoke from fires, and factory pollution.
- These particles are important because they can affect the climate, ecosystems and people's health.



# Aerosol Optical Depth and PM2.5 seasonal patterns



Dust is positively associated with cardiovascular and respiratory conditions in the Caribbean (Lillianne et al. 2019).

Dust outbreaks have also been associated with increased to excessive risk of emergency room visits and hospitalizations related to asthma in children in Trinidad & Tobago (Gyan et al., 2005), Guadeloupe (Cadelis et al., 2015), and Grenada (Akpinar-Elci et al., 2015).

An optical thickness of less than 0.1 indicates a crystal clear sky with maximum visibility, while a value of 1 indicates the presence of aerosols so dense that people would have difficulty seeing the Sun, even at noon.

Journal of the American College of Cardiology Volume 72, Issue 17, October 2018

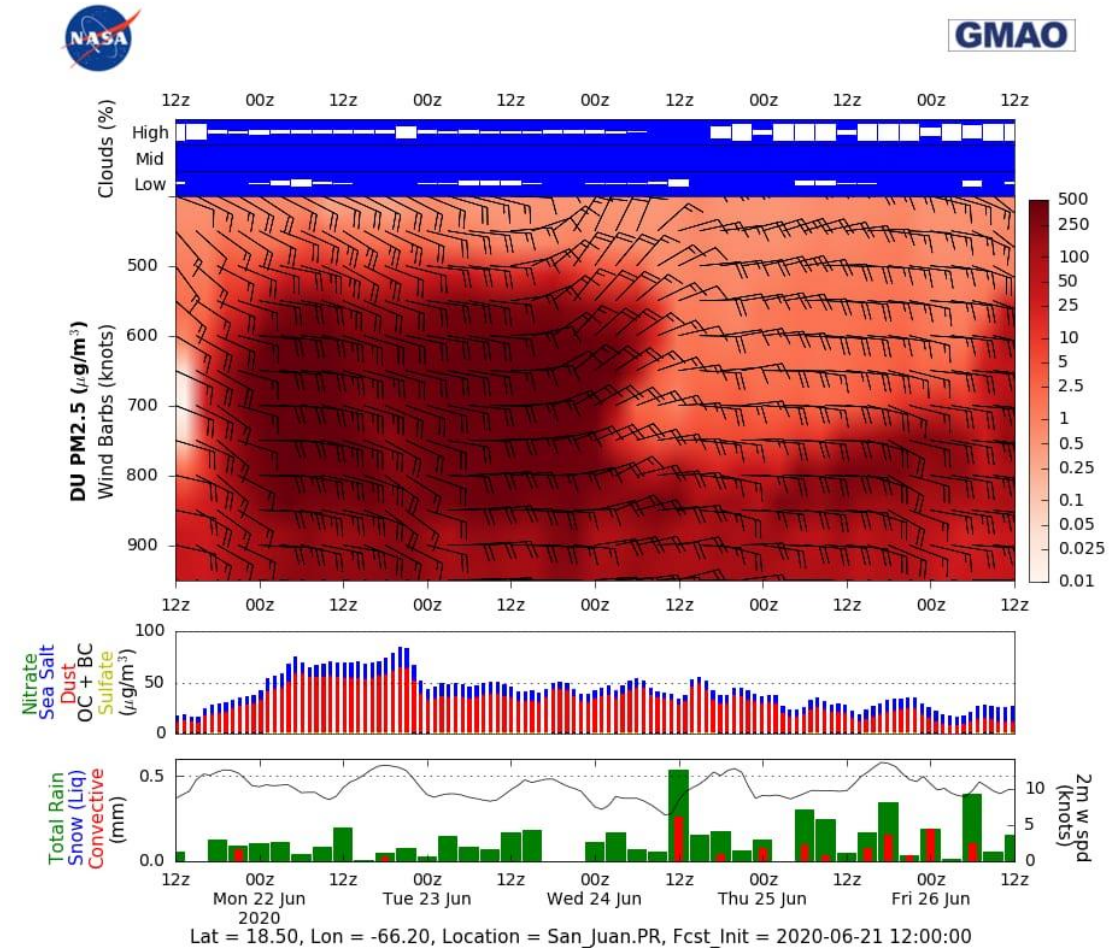
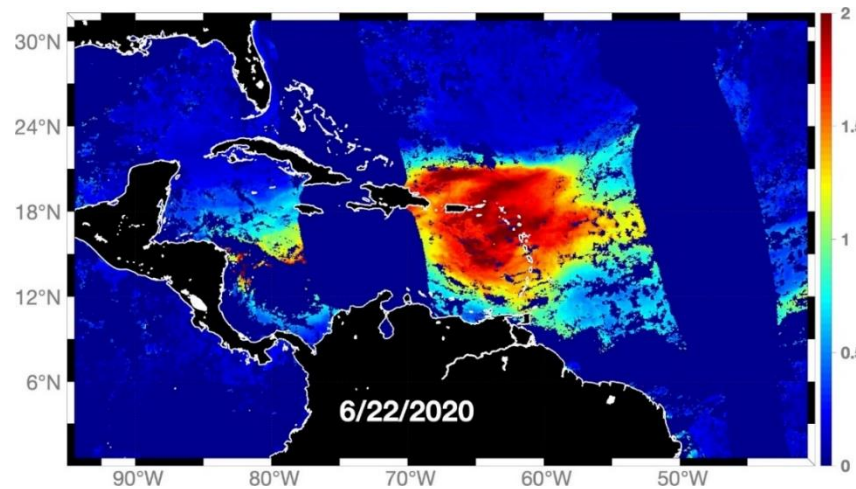
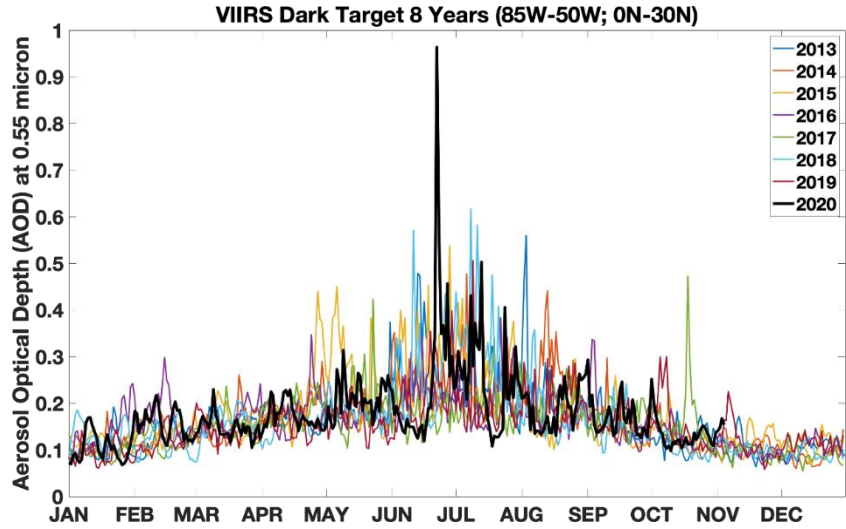
DOI: 10.1016/j.jacc.2018.07.099

# ESO Data

Data Source/Sensor	Variable	Temporal Resolution	Period
Visible Infrared Imaging Radiometer Suite (VIIRS)	AOD (n=1539)	Daily	2012-2020
	SAE (n=1512)		
	MC (n=1368)		
Multi-scale Ultra-high Resolution Sea Surface Temperature	SST (n=1536)	Daily	2012-2020
MODIS-Aqua: Land Surface Temperature	LSTd (n=921)	Daily	2012-2020
	LSTn (n=895)		
	UTCI (n=1539)		
ERA5-HEAT (Human thermal comfort)	HI (n=1539)	Daily	2012-2020
	T2M (n=1539)		



# Godzilla Dust Event: Summer 2020





## SALUD PÚBLICA Y POLVO DEL SAHARA

**¿Qué es el "Polvo del Sahara"?**  
 Partículas de polvo mineral provenientes del desierto del Sahara y del desierto del Sahel, al norte del continente africano.

**¿Qué puede contener el "Polvo del Sahara"?**

- Las nubes de polvo se miden como aerosoles en la atmósfera y podrían contener, pero no se limitan a: minerales, materia orgánica, sales marinas, virus y bacterias.
- El "Polvo del Sahara" es un fertilizante natural y provee beneficios a ecosistemas marinos y terrestres. De igual manera podría ser perjudicial para la salud pública.
- Es transportado por los vientos Alisios sobre el Océano Atlántico y recorre sobre 5,000 km para alcanzar las costas de Puerto Rico y el Caribe.

**Impactos del "Polvo del Sahara" a la Salud Pública**

- Puede exacerbar las condiciones de salud en poblaciones inmunocomprometidas, vulnerables o sensitivas.
- Los médicos y científicos han observado un aumento en el número de exacerbaciones de las condiciones respiratorias entre sus pacientes durante los eventos de "Polvo del Sahara".

**Síntomas asociados a la presencia del "Polvo del Sahara"**

- Irritación de la nariz
- Sinusitis
- Alergias
- Exacerbación del asma
- Irritación de la garganta
- Irritación de los ojos e irritación de la piel
- Bronquitis aguda
- Riesgo de infecciones respiratorias

**Prevención Para Eventos De "Polvo Del Sahara"**

- Tener disponible sus medicinas
- Mantenerse hidratado
- Usar ropa ligera
- Evitar actividades al aire libre
- Usar mascarilla y gafas

www.proyectoasmapr.com    programa.asma@salud.pr.gov

## WEBINARS Edición Polvo del Sahara y Salud Pública

13 al 17 de julio de 2020 3:00 p.m. a 4:00 p.m. **CienciaVirtual**

<b>lunes 13</b> <b>Sistemas de alertas temprana de polvo del Sahara para proteger la salud pública</b> Dr. Pablo Méndez Lázaro, Catedrático Asociado, UPR- RCM, Investigador Principal: NASA CALIMA-PH	<b>miércoles 15</b> <b>Taller: Cocinando en el EcoExploratorio</b> Chef Cobi, Chef de Restaurantes y Alimentos, Chef de Actividades de la Cocina
<b>martes 14</b> <b>El polvo del Sahara visto desde el espacio</b> Dra. Digna Rueda-Roa, Biólogo Marino USF College of Marine Science, NASA CALIMA-PH	<b>3:00 p.m.</b> <b>Pronóstico del Tiempo: Aerosoles y Polvo del Sahara en Puerto Rico</b> Ernesto Rodríguez MS y Ernesto Morales MS del Servicio Nacional de Meteorología de San Juan, NOAA
<b>jueves 16</b> <b>Impacto del Polvo del Sahara en la salud: Esfuerzos de investigación en Puerto Rico</b> Dra. Ana P. Ortiz, PhD, MPH, Profesora UPR- RCM, Centro Comprensivo de Cáncer, NASA CALIMA-PH	<b>3:00 p.m.</b> <b>Polvo del Sahara en Puerto Rico: ¿Qué es y cómo se mide?</b> Dra. Olga Rodríguez, Científica, ACAR, UPR- Río Piedras, Co-Investigadora Principal: NASA CALIMA-PH
<b>viernes 17</b> <b>NASA GEOS Aerosol forecasting system and its application to Saharan dust transport</b> Dr. Peter Colarco, Profesor, University of Miami	

Registro: [www.ecoexploratorio.org/cienciavirtual](http://www.ecoexploratorio.org/cienciavirtual)    Capacidad: ZOOM 500 personas    **Es gratis**    Ilimitada

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NATIONAL WEATHER SERVICE SAN JUAN, PUERTO RICO

*Air Quality Awareness Week*

Moderators: Ian Colón-Pagán (left) and Fernanda Ramos (right)

Register:

### WEBINAR: Saharan Dust & Air Quality

Thursday, May 6th, 2021 | 11:00 AM - 12:00 PM AST

- Ernesto Morales:** What is the NWS WFO San Juan?
- Ernesto Rodríguez:** WFO San Juan & Air Quality Events
- Dra. Olga L. Mayol-Bracero:** African Dust Measurements in the Caribbean
- Dra. Odalys Martinez:** African Dust in PR & USVI
- Dr. Pablo Méndez-Lázaro:** Aerosol Monitoring Support Tool

Co-design strategies and solutions by engaging scientist and public health officials in all project phases. >400,000 people impacted

AEROSOLS/SAHARAN DUST  
LAST UPDATE: APR 13 12:00 PM AST

Share Tweet

GAUGE SAN JUAN, PR ⓘ



GAUGE PONCE, PR ⓘ



GAUGE MAYAGUEZ, PR ⓘ



GAUGE FAJARDO, PR ⓘ



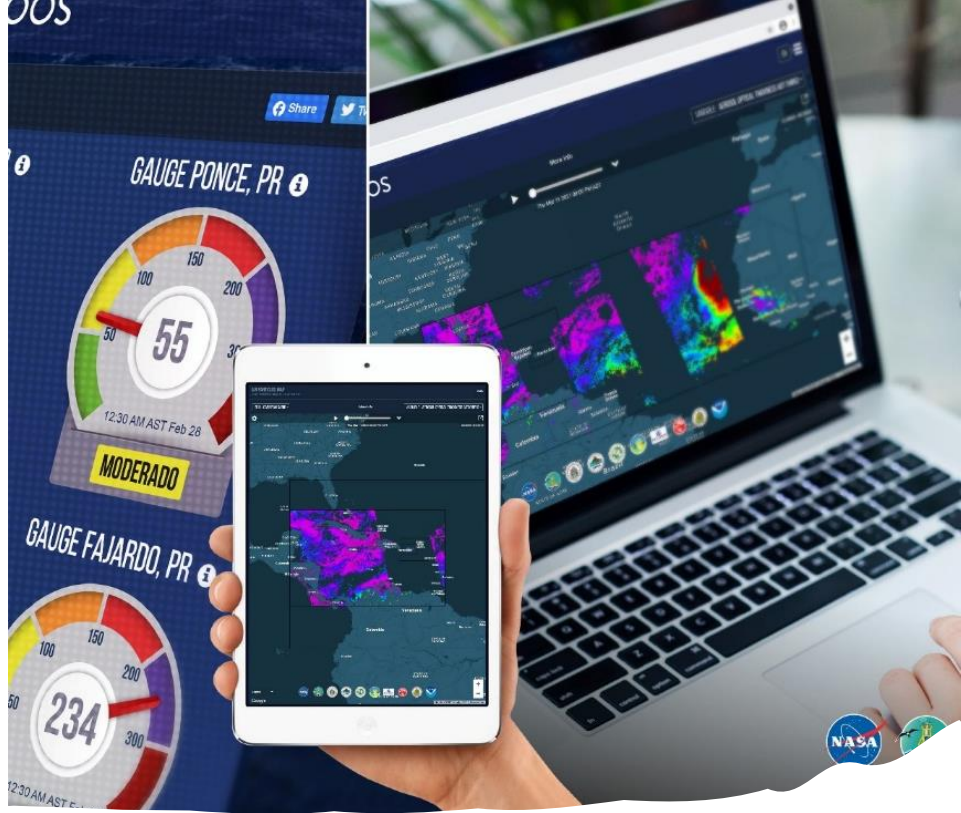
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AirNow

Current Forecast Loops



Higüey

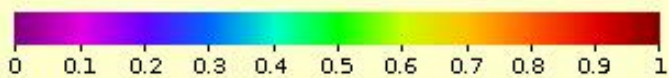
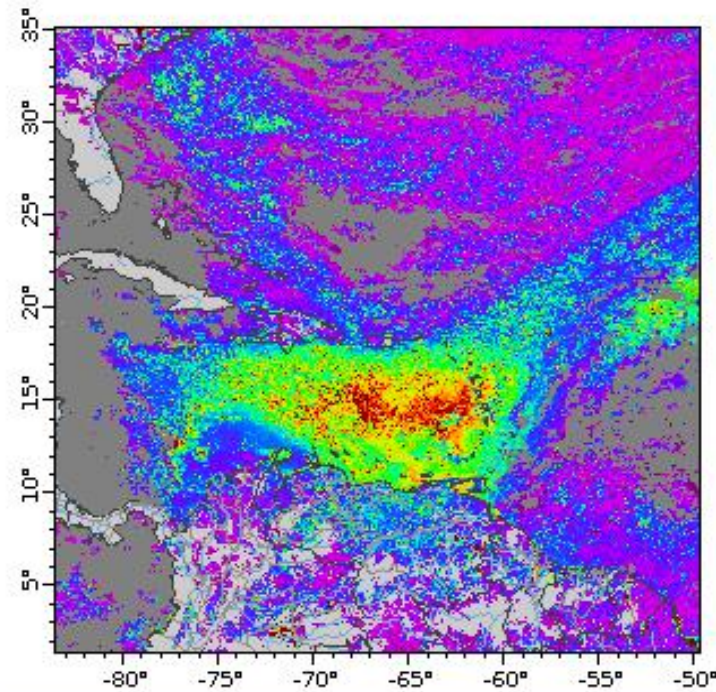
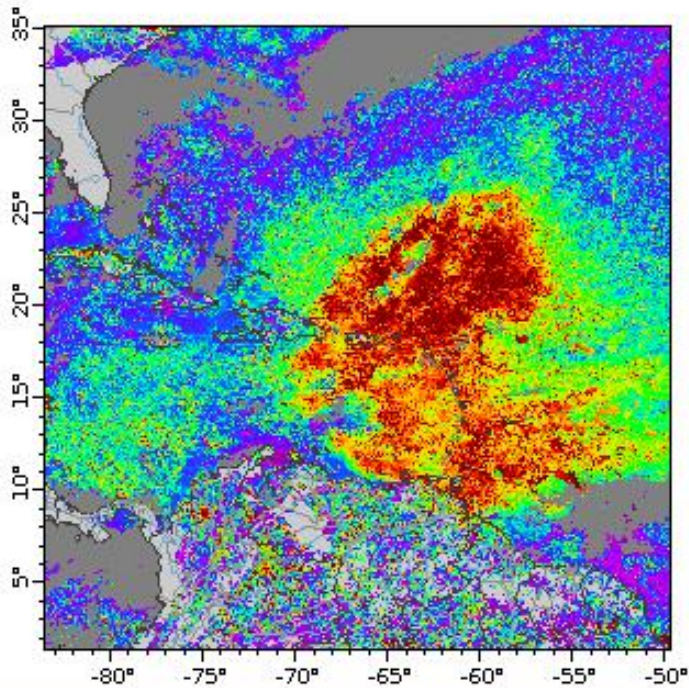


“X-perimental Decision Support Tool “

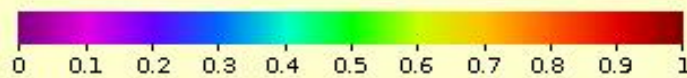
# GOES-16: daily datasets: Experimental NRT AOD daily composite created from ABI L2 data from GOES-16. Fields generated by Atlantic OceanWatch node at NOAA/AOML

July 07, 2021

June 29, 2021



**ABI L2+ Aerosol Optical Depth at 550 nm (1)**  
 Experimental NRT AOD daily composite created from ABI L2 data from GOES-16. Fields generated by Atlantic OceanWatch node at NOAA/AOML (2021-07-07T00:00:00Z)  
 Data courtesy of USD/C/NOAA/OAR/AOML/PHOD



**ABI L2+ Aerosol Optical Depth at 550 nm (1)**  
 Experimental NRT AOD daily composite created from ABI L2 data from GOES-16. Fields generated by Atlantic OceanWatch node at NOAA/AOML (2021-06-29T00:00:00Z)  
 Data courtesy of USD/C/NOAA/OAR/AOML/PHOD



**CARICOOS**  
 AEROSOLS/SAHARAN DUST  
 GAUGE SAN JUAN, PR: 41 (LEVE)  
 GAUGE PONCE, PR: 55 (MODERADO)  
 GAUGE MAYAGUEZ, PR: 50  
 GAUGE FAJARDO, PR: 234

**CARICOOS**  
 AEROSOLS/SAHARAN DUST  
 GAUGE SAN JUAN, PR: 41 (LEVE)  
 GAUGE PONCE, PR: 55 (MODERADO)  
 GAUGE MAYAGUEZ, PR: 43 (BUENO)  
 GAUGE FAJARDO, PR: 234 (MUY PELIGROSO)

ENVIAR SUGERENCIAS

Ir a página de Departamento de...

# AEROSOLES/POLVO DEL SAHARA

OCT 03 10:00 AM AST

## SAN JUAN, PR

0.23 0.33 0.64

0 1

Oct 03 10:00 AM

**MUY ALTO**

Share Tweet

50 100 150 200 300

**Unhealthy**

Current Air Quality 6 AM AST Oct 9

163 NowCast AQI | PM2.5

Forecast AQI Today Tomorrow More

Not Available Not Available

ZIP Code, City, or State

San Juan, PR  
Catano Reporting Area

Monitors Near Me Recent Trends

EPA and PARTNERS

Data Provided by...

Rico 14m

What is Saharan Dust?  
¿Qué es polvo del Sahara?  
#prwx #usviwx

### SAHARA PUBLIC HEALTH AND SAHARA DUST

¿Qué es el "Polvo del Sahara"?

¿Qué puede contener el "Polvo del Sahara"?

¿Qué efectos del "Polvo del Sahara" a la Salud Pública?

Síntomas asociados a la presencia del "Polvo del Sahara"

Precauciones Para Eventos De "Polvo Del Sahara"

What is the Saharan Dust?

What could contain the Saharan Dust?

Impacts of Saharan Dust to Public Health:

Symptoms associated to Saharan Dust presence

Prevention for Saharan Dust event:

2 8 Shares

Ada Monzon 5m

...a Aerosoles de CARICOOS.org que aunque no distingue partículas, sí establece su concentración general. Vea cómo...

### AIR QUALITY INDEX

San Juan, PR: 0.97 VERY HIGH

Ponce, PR: N/A

Mayaguez, PR: N/A

Fajardo, PR: 0.88 VERY HIGH

Legend: GOOD (0-0.23), MODERATE (0.23-0.33), HIGH (0.33-0.64), VERY HIGH (>0.64)

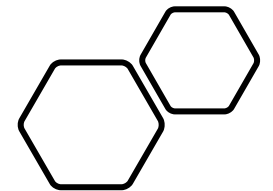
AEROSOLESCARICOOS.ORG

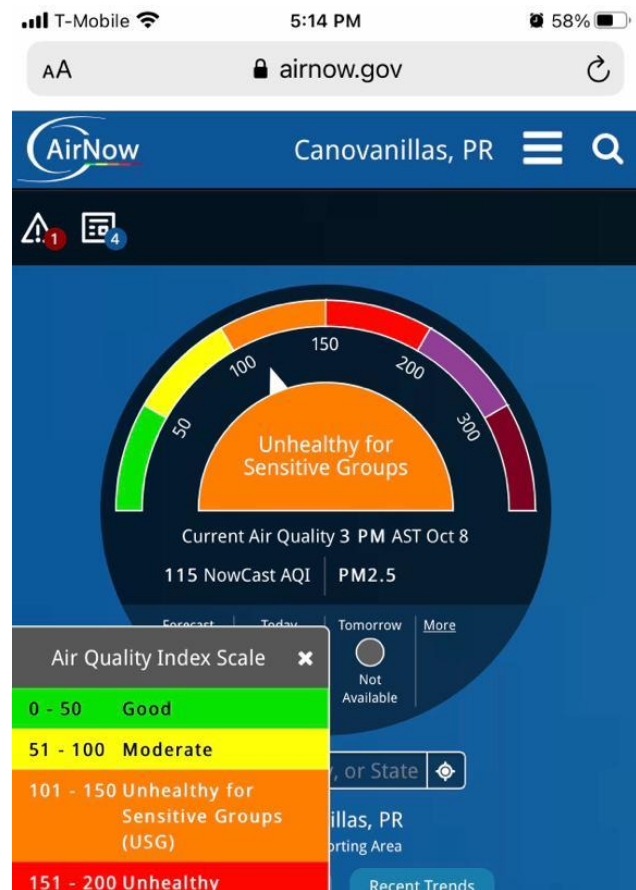
### CARICOOS Latest Conditions and Forecast

8 5 Comments

Like Comment Share

October 3<sup>rd</sup>, 2021





PROGRAMA DE MANEJO Y CONTROL DEL ASMA  
DEPARTAMENTO DE SALUD

## POLVO DEL SAHARA Y ASMA

El Polvo del Sahara es uno de los factores ambientales asociado a complicaciones respiratorias. Estas nubes pueden contener virus, bacterias, materia orgánica, esporas de hongos, entre otros, que a su vez, se consideran provocadores del asma.

El asma es una enfermedad crónica que se caracteriza por la inflamación y estrechamiento de las vías respiratorias, produciendo un exceso de mucosidad que dificulta el paso del aire.

**En Puerto Rico, aproximadamente:**

- 1 de cada 6 niños tiene asma actual
- 1 de cada 10 adultos tiene asma actual

Ante eventos asociados al polvo del Sahara, es importante que todas las personas tomen precauciones, especialmente aquellas que padecen de enfermedades respiratorias.

- Use sus medicamentos de mantenimiento, y tenga disponible los medicamentos de rescate.
- Limite sus actividades al aire libre. Si necesita salir, haga uso de mascarilla y gafas.
- Manténgase hidratado.

NASA, PR-CLIMAH, DEPARTAMENTO DE SALUD

www.proyectoasmapr.com proyectoasmapr@gmail.com

### Area Forecast Discussion

Issued by NWS San Juan, PR

[Current Version](#) | [Previous Version](#) | [Text Only](#) | [Print](#) | [Product List](#) | [Glossary Off](#)

Versions: [1](#) [2](#) [3](#) [4](#) [5](#) [6](#) [7](#) [8](#) [9](#) [10](#) [11](#) [12](#) [13](#) [14](#) [15](#) [16](#) [17](#) [18](#) [19](#) [20](#) [21](#) [22](#) [23](#) [24](#) [25](#) [26](#) [27](#) [28](#) [29](#) [30](#)

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AFDSJU

[Area Forecast Discussion](#)  
National Weather Service San Juan PR  
412 PM AST Thu Oct 7 2021

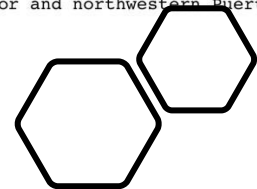
.SYNOPSIS...  
Saharan dust will result in hazy skies through at least e the weekend. However, afternoon activity may still develop the northwestern quadrant of Puerto Rico. **Unsettled** weath conditions are expected for the first half of the next wo **Seas** are gradually improving, but still remaining a littl

&&

.SHORT TERM...Tonight through Saturday...  
A surface high pressure over the central Atlantic will ma moderate east-southeast wind **flow** through the next severa. At the mid-levels, a **ridge** holds just west of Puerto Rico at the upper levels, a **trough** lingers north of the island: **infrared satellite imagery** shows small areas of clouds ad toward the region. The high resolution models have some o areas reaching portions of the U.S. Virgin Islands and ea southeast Puerto Rico, but with **rainfall** accumulation mai one inch.

On Friday, a drier **air mass** east of the **Leeward** Islands a evident in Total **Precipitable Water** from **GOES-16** will rea local islands, with values falling to 1.3 to 1.5 inches. ' mass also contain Saharan dust, that will linger at least early in the weekend, hence hazy skies are expected. Each Friday and Saturday, passing showers may move over portio eastern Puerto Rico and the U.S. Virgin Islands through t then in the afternoon showers with **isolated** thunderstorms develop over the interior and northwestern Puerto Rico.

October 07, 2021



# Media Coverage

<https://www.primerahora.com/noticias/puerto-rico/notas/insalubre-la-calidad-del-aire-ante-presencia-de-polvo-del-sahara/>

<https://www.noticel.com/el-tiempo/20211009/continua-insalubre-el-indice-de-calidad-del-aire/>

<https://www.elnuevodia.com/noticias/el-tiempo/notas/la-calidad-de-aire-amanece-insalubre-en-varias-partes-de-puerto-rico/>

<https://www.elnuevodia.com/noticias/locales/notas/densa-bruma-que-afecta-a-puerto-rico-desde-hace-una-semana-deteriora-la-calidad-del-aire/>



# Mememes and Salsa Songs

"abre la puerta para que  
entre un poco de aire"

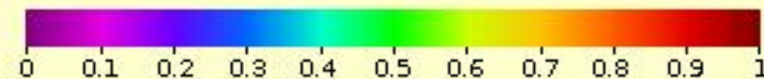
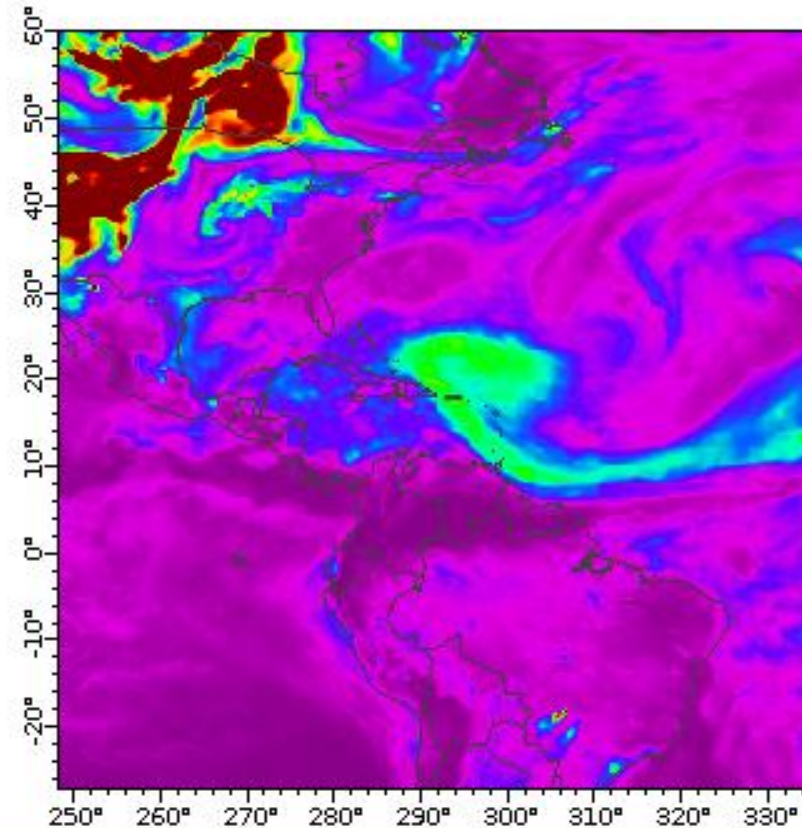
- ok



Screenshot of the Amazon Music website showing the page for "Los Polvos del Sahara" by Víctor Manuelle. The page includes the album cover, the title, the artist's name, and the release date (May 31, 2017). There are buttons for "Listen Now" and "Buy song \$1.29".

# Next Steps

- AOD forecast from GEFS-Aerosols
- Experimental NRT AOD 4 hour composite created from ABI L2 data from GOES-16. Atlantic OceanWatch node at NOAA/AOML. Tks. Dr. Joaquin Triñanes
- Data Centralization
- Social Media Campaign
- Design posts that can be used in various Social Media sites to promote the application.
- The same posts will be created in Spanish and English.
- Video showing how to use the application
- Educational video



**Aerosol Optical Thickness (Numeric)**  
3 hour AOD forecast from GEFS-Aerosols  
(2021-07-12T15:00:00Z)  
Data courtesy of NOAA/AOML/PHOD/Atlantic OceanWatch



Study of Imminent Interactions between SARS-CoV-2 (COVID-19), Air Quality due to Saharan Dust and Urban Aerosols, and Social-environmental Factors in Puerto Rico in summer 2020: Proxies of Health Risks in Small Island States in the Caribbean Region

- The goal of the proposed work is to expand the scope of current NASA-sponsored Saharan dust research (80NSSC19K0194) **to better understand possible interactions between COVID-19, Saharan dust, and environmental factors (air temperature, sea surface temperature, and precipitation) in Puerto Rico.** Results may help develop a proxy for the Caribbean Region using state of the art Earth Observation Data and public health records.

Study of Imminent Interactions between SARS-CoV-2 (COVID-19), Air Quality due to Saharan Dust and Urban Aerosols, and Social-environmental Factors in Puerto Rico in summer 2020: Proxies of Health Risks in Small Island States in the Caribbean Region

- Designed and implemented (Cross sectional study) qualitative instruments aiming to capture **physicians and patients' risks, barriers, and vulnerabilities.**
  - Physicians N=55
  - Patients COVID-19 confirmed cases N=104
  - IRB-Protocol Number B1540520
- **Emergency Room Visits and Hospitalizations-2020-2021**
  - COVID-19 Weekly 2020-2021
  - Weekly in specific diseases of the respiratory system.
  - RR adjusted by environmental data (weekly 2015-2020)
- **All Causes Excess Mortality Analysis Islandwide (weekly 2015-2020) Including COVID-19**
  - Weekly average deaths during 2015-2020: overall and by season
  - Weekly average deaths during 2015-2020: overall by year of death for each season
  - Weekly average during 2015-2020 in specific diseases of the respiratory system.
  - COVID-19 Mortality Analysis (weekly 2020)
  - RR adjusted by environmental data (weekly 2015-2020)
- **Medical Record Analysis**

# Alliances

- Reached out to several clinical sites in the Río Piedras Medical Center, the main supra-tertiary medical hub in Puerto Rico.
- Clinical sites were selected based on their focus working with COVID-19 patients and main sites were identified.
- The Alliance is a National Institutes of Health (NIH) sponsored clinical and translational research facility where service priorities are established in accordance to the National Institute of General Medicine (NIGMS) guidelines.



October 7, 2021

**Pablo A. Mendez-Lazaro, PhD**  
Principal Investigator

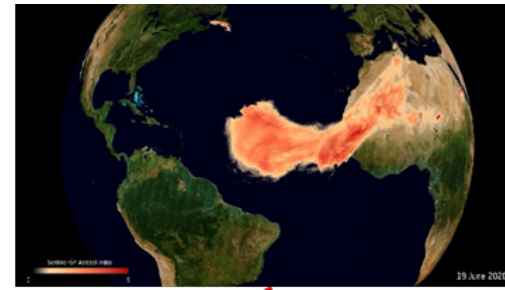
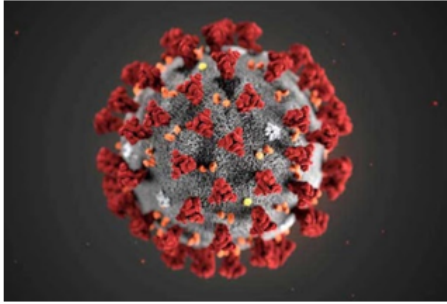
Dear doctor Mendez-Lazaro:

**Approval Notification**

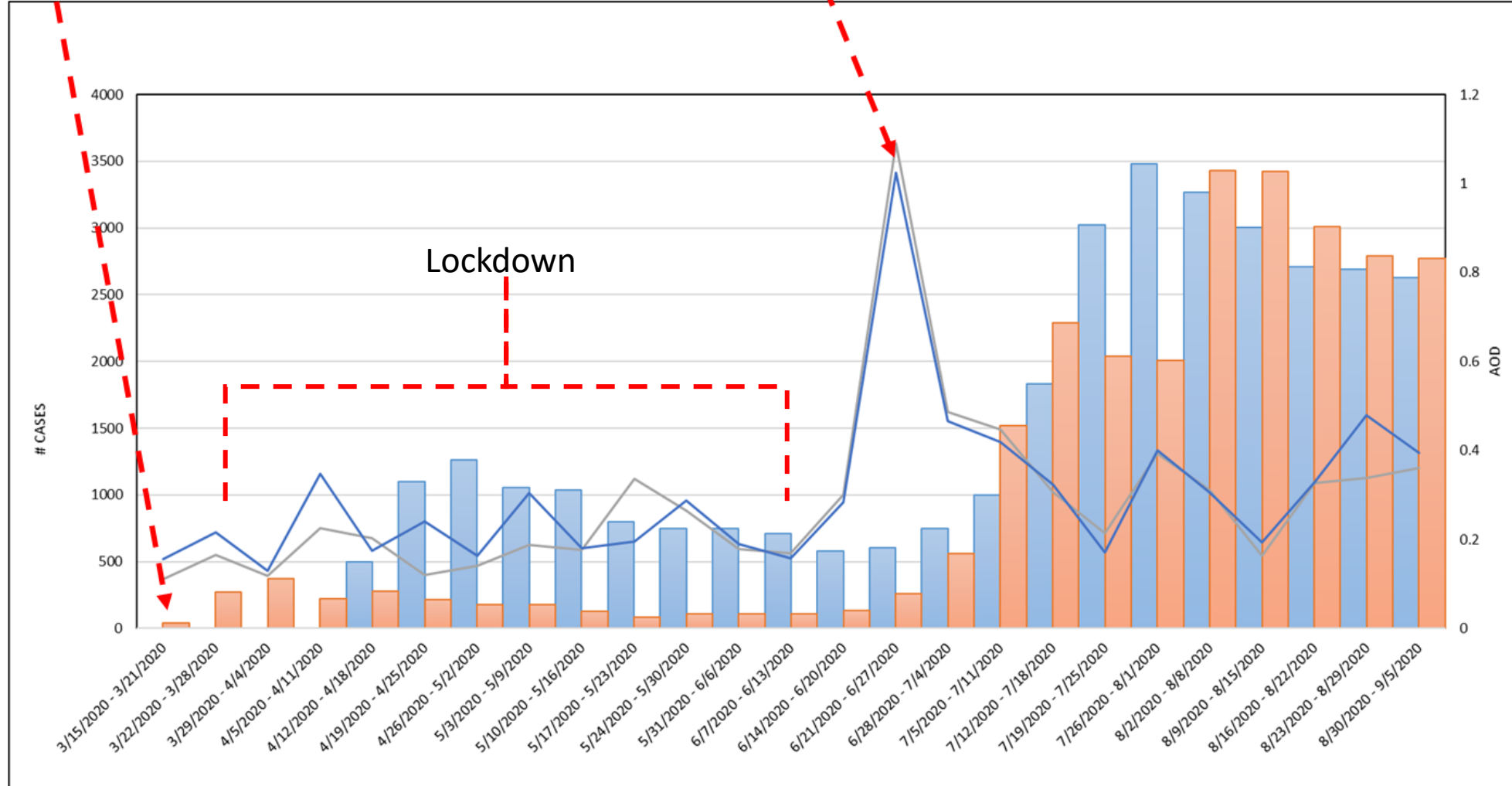
This is to inform you that your protocol, “*Study of Imminent Interactions between SARS-CoV-2 (COVID-19), Air Quality due to Saharan Dust and Urban Aerosols, and Social-Environmental Factors in Puerto Rico in summer 2020: Proxies of Health Risks in Small Island States in the Caribbean Region*”(Short title: *SIIF*) was approved to receive services and resources from the Biostatistics, Epidemiology, and Research Design Core (BERD) and from the Biomedical Informatics, Bioinformatics, and Cyberinfrastructure Enhancement Core (BiBEC) at the Hispanic Alliance for Clinical and Translational Research (Alliance).

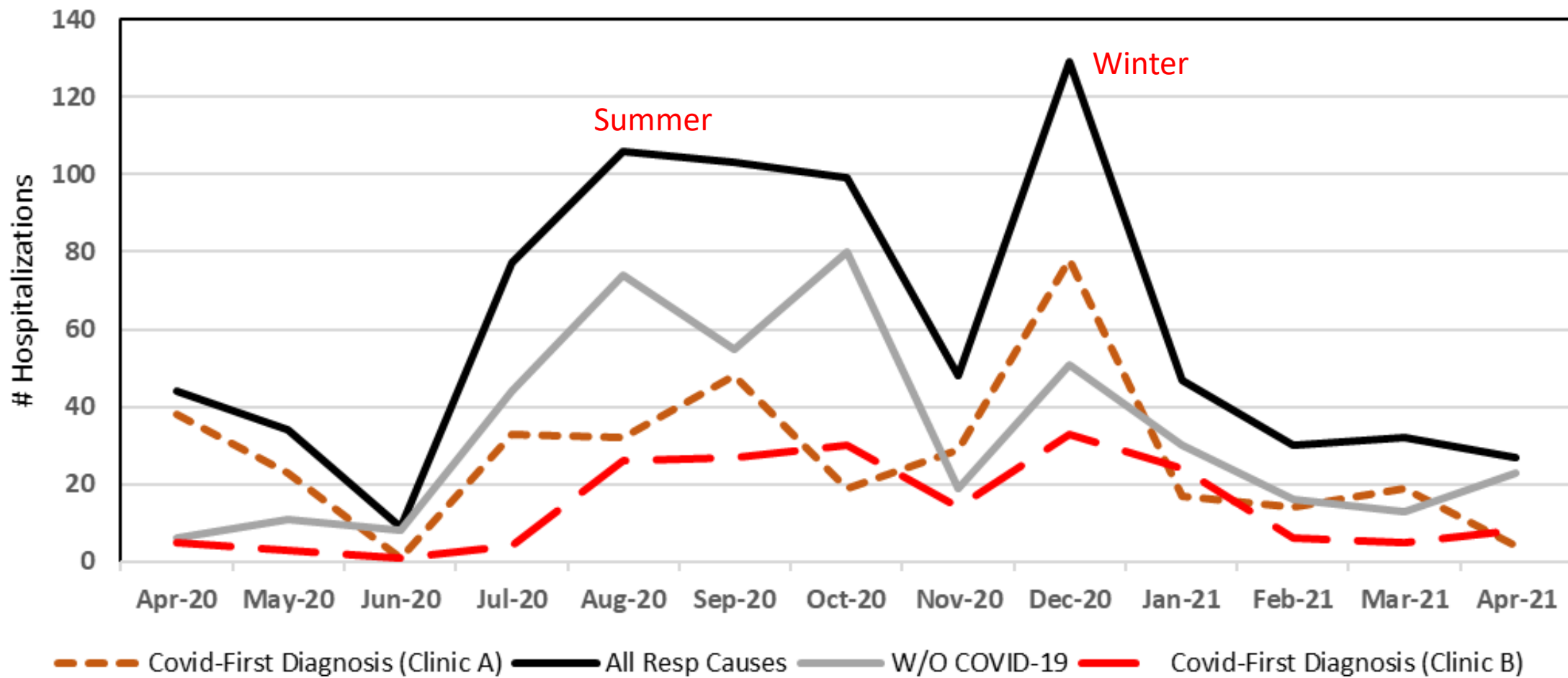
Organization Type	Sector
Medical Services Administration (ASEM)	Public
University District Hospital	Public
External Clinics (affiliated with the University of Puerto Rico)	Public
San Juan City Hospital	public
<i>Concilio de Loíza</i>	Private
<i>Centro NeoMed</i>	Private

# 1<sup>st</sup> COVID-19 Confirmed Case In Puerto Rico



# Godzilla Dust Event



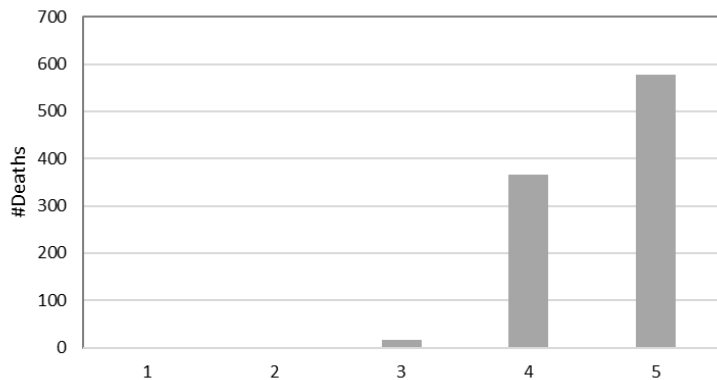


# Deaths per year of death and season

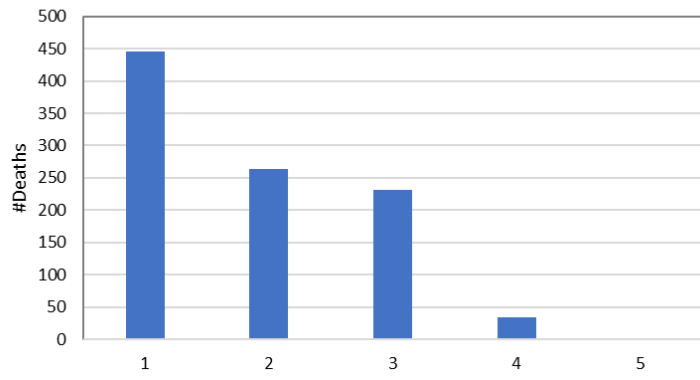
Deaths per year of death and season

dyr	winter	summer	autumn	spring	Total
2015	6,937	6,828	7,590	6,768	28,123
2016	8,113	7,691	7,478	6,375	29,657
2017	7,410	7,095	9,451	7,164	31,120
2018	8,240	7,356	7,206	6,425	29,227
2019	7,885	7,187	7,236	7,298	29,606
2020	6,463	8,573	8,166	8,077	31,279
Total	45,048	44,730	47,127	42,107	179,012

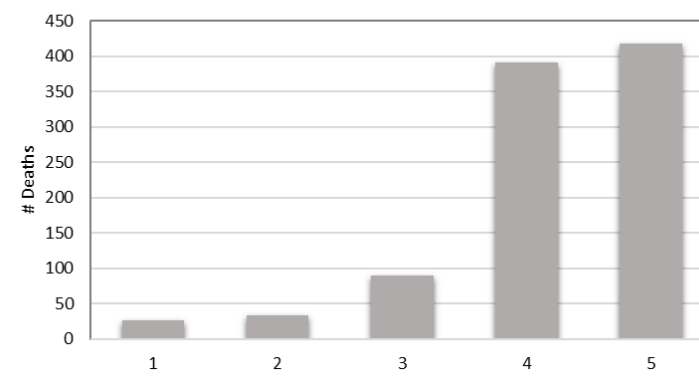
quantiles of heat index (Pneumonia summer)



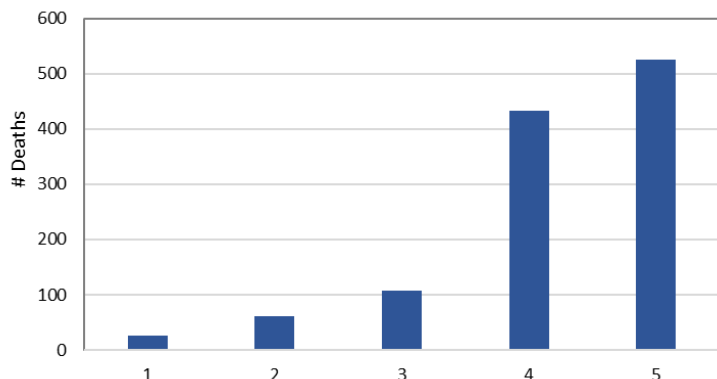
quantiles of aod550 (Pneumonia-winter)



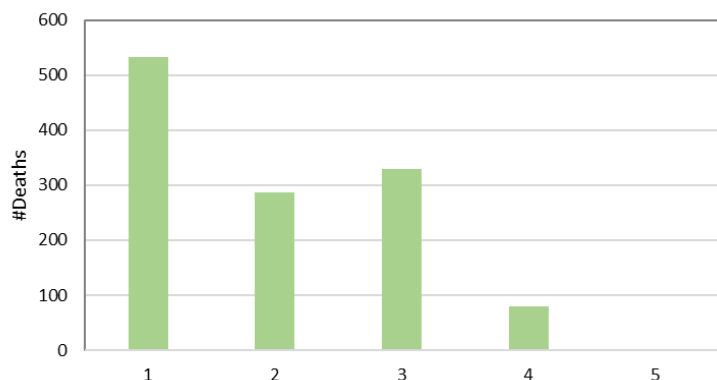
quantiles of aod550 (Pneumonia-Summer)



quantiles aod550 (COPD-Summer)



quantiles aod550 (COPD-winter)



**Poisson model to estimate the Relative Ratio (RR).** We used 5 years of deaths in 5 groups of environmental variables (using quintiles), the RR indicates average number of deaths in one group per 1 death in the reference group; in this case, the reference group was the first quintile.

**COPD:**

the estimated number had values of UTCI  $\geq 29.25$  was 15% (RR: 1.15; 95%CI: .936,1.42) higher than in environments of COPD weekly deaths when the environment with UTCI values  $< 25.73$ . Heat index  $\geq 86.93$  was 10% (RR: 1.10; 95%CI: .954,1.26) higher than in environments with heat index values  $< 78.92$ .

**Pneumonia:**

the estimated number of pneumonia weekly deaths when the environment had values of UTCI  $\geq 29.25$  was 11% (RR: 1.11; 95%CI: .875,1.42) higher than in environments with UTCI values  $< 25.75$ . HEAT INDEX  $\geq 86.93$  was 8% (RR: 1.08; 95%CI: .797,1.45)

# Next Steps

- Given the situation with public health data, we requested a No-cost extension for this Grant.
- Next steps for medical record analysis:
  - 1) Completion of the database
  - 2) Analysis of the comorbidities most associated with COVID-19 and related diagnoses.
  - 4) Final, in depth medical record review.



# Questions!

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Principal Investigator: NASA Grant Number 80NSSC19K0194

Principal Investigator: NASA Grant Number 80NSSC20K1588

**Supported by:** NASA Research Announcement (NRA) NNH20ZDA001N-RRNES, Research Opportunities in Space and Earth Science (ROSES-2020), Program Element A.28 Rapid Response and Novel Research in Earth Science (RRNES).