

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

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Core Team members



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New Collaborators and Partners:

Dr. Erick Suárez has a PhD in Medical Statistics from the London School of Hygiene and Tropical Medicine (LSHTM). He has been professor of Biostatistics for the last 31 years at the School of Public Health of the Medical Sciences Campus-University of Puerto Rico. Last year, he was appointed an elected member of the **International Statistical Institute (ISI)**.

Dr. Claudia de Napoli: European Centre for Medium-Range Weather Forecasts, Reading, UK (Copernicus). University of Reading (UK), School of Agriculture, Policy and Development.

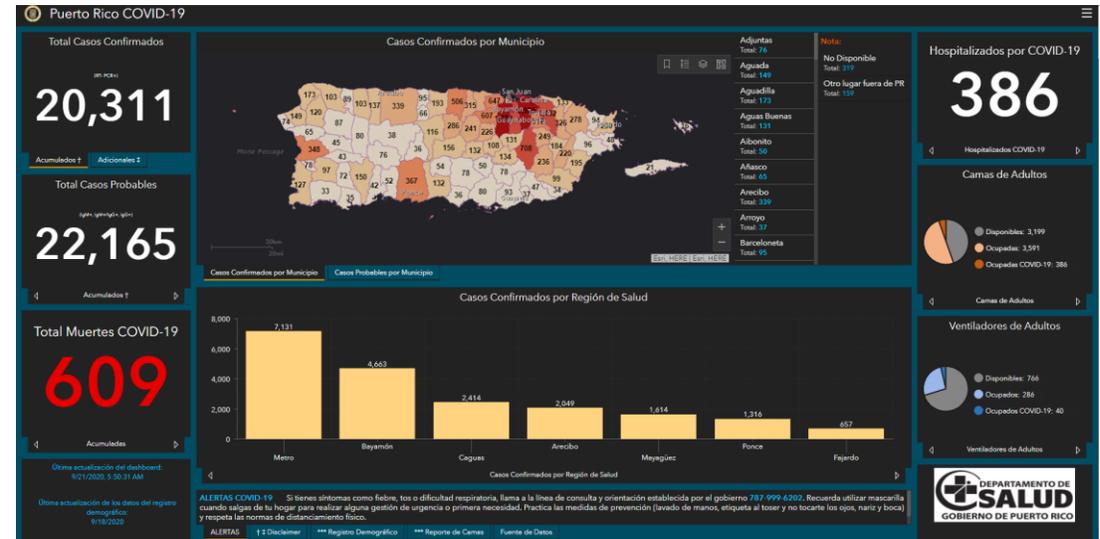
Dr. Sergio Caporali. Professor School of Public Health of the Medical Sciences Campus-University of Puerto Rico. Industrial Hygiene

Dr. Enid García. Director of the Endowed Health Services Research Center School of Medicine, University of Puerto Rico Medical Sciences Campus),

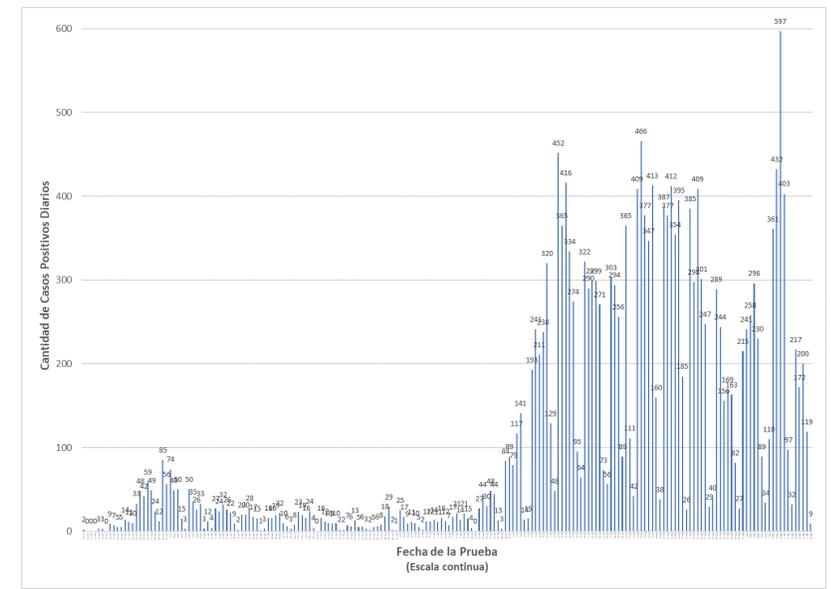
Risks of COVID-19 and Environmental Factors

Interactions:

- SARS-CoV-2 is responsible for the present COVID-19 pandemic increasing the risk of mortality due to severe respiratory illness and cardiac injury.
- This novel virus is particularly concerning in lower and middle-income countries also exposed to powerful natural hazards and high risk for emergence of other pathogens potentially leading to disproportionately higher mortality.
- March 2, 2020 first reported COVID-19 cases in the Caribbean Region
- March 13, 2020 first reported COVID-19 cases in Puerto Rico
- March 15, 2020 the Government of Puerto Rico established a lockdown order and strict social distancing measures



<https://experience.arcgis.com/experience/852c30ea3baa48278175c13c211728e0/>

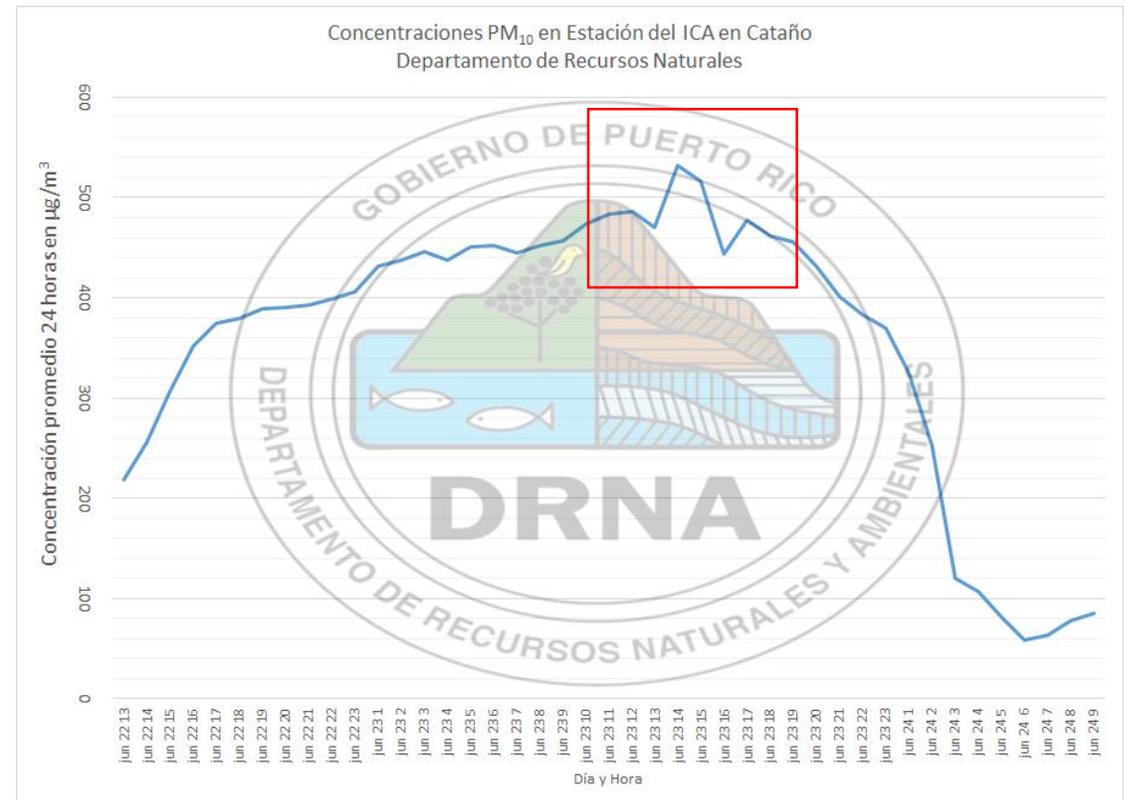
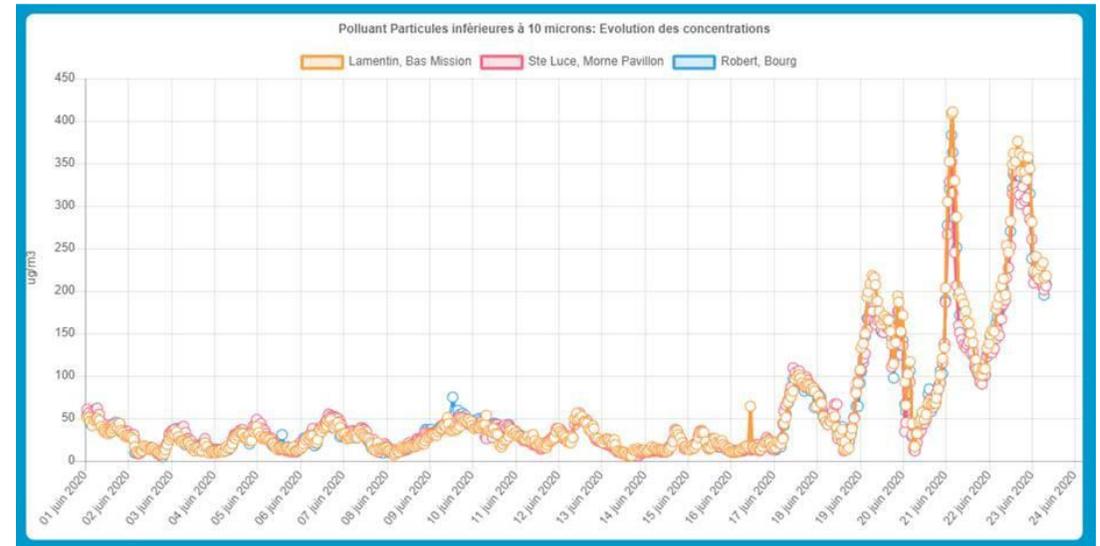


Project summary

- **The goal** of the proposed work is to better understand interactions between **COVID-19, Saharan dust,** and environmental factors (air temperature, sea surface temperature, wind, precipitation) in Puerto Rico as a proxy for the Caribbean Region, using state of the art Earth Observation Data and public health records.
- **We hypothesize that:**
 - African Dust events contribute to an excess number of COVID-19 deaths in Puerto Rico.
 - African Dust events, interacting with COVID-19 cases, will affect morbidity and mortality in Puerto Rico.

Research Questions

- **RQ1.** Can African dust intrusion be considered a co-factor of COVID-19's impact on risk of morbidity and mortality in Puerto Rico?
- **RQ2.** What are the main factors including, social determinants of health, that contribute to air quality and COVID-19 vulnerability?
- **RQ3.** How can climate, air quality, and COVID-19 information be translated into action to increase resiliency of our communities?



Risks of COVID-19 and Environmental Factors Interactions:

- Microorganisms in airborne particulate matters (PM) or dust can be linked to infectious diseases
- **Transmission via the inhalation of small, exhaled respiratory air droplets seems to be especially effective** (Guangbo et al., 2020; Service, 2020). (March-2020)
- A question is whether the health impacts of an interaction between the seasonal African dust outbreaks that occur every year in the Caribbean between May and August will have significant impacts on health and mortality due to the 2020 COVID-19 pandemic

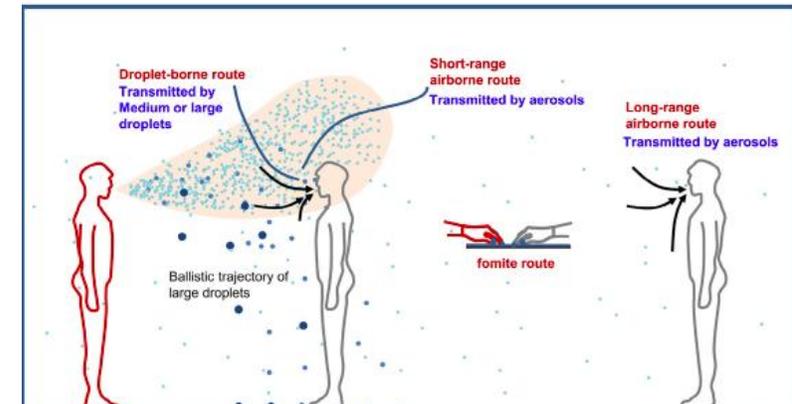
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REVIEW

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Weathering the pandemic: How the Caribbean Basin can use viral and environmental patterns to predict, prepare, and respond to COVID-19

David E. de Ángel Solá¹ | Leyao Wang² | Marietta Vázquez¹ |
Pablo A. Méndez-Lázaro³



Risks of COVID-19 and Environmental Factors Interactions:

- **Public Health Approach:** Two interesting trends would be whether the number of people getting tested spikes and/or the number of positive cases spike.
- We will use short-term measures of health data at the community level in prospective and retrospective studies of medical services.

Satellite Sensors			
Sensor/Platform	Data Availability	Potential Use	Institution
MODIS/Terra & Aqua	2000 – present 2002 – present	Characterize the magnitude and variability of aerosol and dust optical depth (AOD and DOD).	NASA
CALIOP/CALIPSO	2006 – present	5-km atmospheric profiles to characterize vertical structure of dust and aerosol.	NASA
VIIRS-SNPP	2012 – present	Aerosol / dust optical depth (AOD / DOD)	NASA
Goddard Earth Observing System Model (GEOS-FP)	Up to 14-day forecasts	Modelled forecasts of atmospheric dust and aerosol loading	NASA
SENTINEL 5-P (TROPOMI)	2017 – present	Aerosol / dust optical depth (AOD / DOD), aerosol index (AI), Aerosol Layer Height (ALH)	ESA
Copernicus Atmosphere Monitoring Service (CAMS)	2017 – present	Data and forecasts of aerosol / dust optical depth (AOD / DOD)	ESA

to evaluate the occurrence and magnitude of events, and the amplitude and period of relevant cycles including evaluating any shift in phase between parameters.

We will also explore the use of NOAA GOES-R and VIIRS data and ESA/Copernicus aerosol measurements.

Risks of COVID-19 and Environmental Factors Interactions:

- **Medical Records and Quantitative Analysis:** After statistical analysis (**GAM**) integrating data from Earth observing satellites, environmental data, public health data and the afore-mentioned diagnoses, a better characterization of any associations found will be sought by examining health records.
- Specific variables will include:
 - severity of illness
 - specific type of illness, where applicable,
 - number of medications specific to the conditions
 - type of medications and degree of symptom control
 - Adherence to treatment will also be examined
- **Memorandums of Understanding** with The Puerto Rico Association of Primary Health Care Providers (ASPPR, Spanish acronym).
- ASPPR is a non-profit organization funded by the US Department of Health and Human Services (HHS) to support the Primary Health Care Centers of Puerto Rico that are financed with funds from Section 330 of the Federal Public Health Law.
- These are composed by 22 organizations located in areas of high need of health services and are distributed in 85 primary care clinics across 67 municipalities of Puerto Rico.

Work-plan

TASKS	Lead Institution and Co-Leaders	PROJECT																					
		September				October				November				December				January				Feb	
		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16	W17	W18	W19	W20	W21	W22
Qualitative Analysis	UPR-GSPH (Ana, Cynthia, Pablo)																						
IRB Process (Submission)	UPR-GSPH (Ana, Cynthia, Pablo)																						
Instruments (surveys, interviews, other)	UPR-GSPH (Ana, Cynthia, Pablo)																						
Medical Record Template	UPR-GSPH (David, Ana, Cynthia, Pablo)																						
*IRB APPROVAL																							
Recruitment (stakeholders, participants, practitioners, other)	UPR-GSPH (Ana, Cynthia, Pablo, David)																						
First Round of Interviews/Surveys/Questionnaires	UPR-GSPH																						
Continue Interviews/Surveys/Questionnaires	UPR-GSPH																						
Completion of Interviews/Surveys/Questionnaires	UPR-GSPH																						
Executive Orders Review	UPR-GSPH																						
Executive Orders Analysis	UPR-GSPH																						
Medical Record Request	UPR-GSPH (David, Ana, Cynthia, Pablo)																						
Identification of cases and their selection	UPR-GSPH (David, Ana, Cynthia, Pablo)																						
Medical Record Analysis	UPR-GSPH (David, Ana, Cynthia, Pablo)																						
Selection and records at medical facilities	UPR-GSPH (David, Ana, Cynthia, Pablo)																						
Medical record database	UPR-GSPH (David, Ana, Cynthia, Pablo)																						
Medical record analysis	UPR-GSPH (David, Ana, Cynthia, Pablo)																						
Data Inventory and Literature Review	UPR-GSPH (Pablo, Ana, Cynthia, Frank, Dan, Digna, Benjamin)																						
ID Methods	UPR-GSPH (Pablo, Ana, Cynthia)																						
ID Environmental Data (Earth Observation Data)	UPR-GSPH-USF (Dan, Frank, Digna, Pablo)																						
SST	UPR-GSPH-USF (Dan, Frank, Digna, Pablo)																						
VIIRS AERDT AOD - extracted over water (finished)	USF (Dan)																						
VIIRS AERDB AOD - extracted over land	USF (Dan)																						
AST	UPR-GSPH-USF (Dan, Frank, Digna, Pablo)																						
Relative Humidity	UPR-GSPH-USF (Dan, Frank, Digna, Pablo)																						
Rainfall	UPR-GSPH-USF (Dan, Frank, Digna, Pablo)																						
PM2.5	UPR-GSPH-USF (Dan, Frank, Digna, Pablo)																						
Black Carbon (MERRA-2 model)	USF (Dan)																						
NO2 (OMI, TROPOMI)	USF (Dan)																						
PM10	UPR-GSPH-USF (Dan, Frank, Digna, Pablo)																						
Other	UPR-GSPH-USF (Dan, Frank, Digna, Pablo)																						
Download Environmental Data (Earth Observation Data)	USF-UPR-GSPH (Dan, Frank, Digna, Pablo)																						
ID Databases sources	USF-UPR-GSPH (Dan, Frank, Digna, Pablo)																						
ID Social Data	UPR-GSPH																						
ID Public Health Data	UPR-GSPH (Cynthia, Pablo, Ana)																						
Mortality	UPR-GSPH (Cynthia, Pablo, Ana)																						
Confirmed Cases	UPR-GSPH (Cynthia, Pablo, Ana)																						
Aerobiology Data	UPR-Benjamin-Xaymara																						
Data Management & Statistical Analysis	UPR-GSPH (Erick and the rest of the team)																						
Data Integration	UPR-GSPH (Erick and the rest of the team)																						
Descriptive analysis of attribution	UPR-GSPH (Erick and the rest of the team)																						
Mathematical modeling by cause	UPR-GSPH (Erick and the rest of the team)																						
Instruments Transcription	UPR-GSPH (Pablo, Ana, Cynthia)																						
Qualitative Data Analysis and Integration	UPR-GSPH (Pablo, Ana, Cynthia)																						

Gracias!



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