

Reserve Name: JOB NERR Meteorological Metadata
Months and year the documentation covers: 01/01/2022 to 12/31/2022
Latest Update: 08/27/2024

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons

Jobos Bay National Estuarine Research Reserve

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2) Entry verification

Data are uploaded from the [choose logger(s) in use] CR1000/CR1000X data logger to a personal computer with a Windows 7 or newer operating system. Files are exported from LoggerNet in a comma-delimited format and uploaded to the CDMO where they undergo automated primary QAQC and become part of the CDMO's online provisional database. During primary QAQC, data are flagged if they are missing or out of sensor range. The edited file is then returned to the reserve where it is opened in Microsoft Excel and processed using the CDMO's NERRQAQC Excel macro. The macro inserts station codes, creates metadata worksheets for flagged data and summary statistics, and graphs the data for review. It allows the user to apply QAQC flags and codes to the data, append files, and export the resulting data file to the CDMO for tertiary QAQC and assimilation into the CDMO's authoritative online database. For more information on QAQC flags and QAQC codes, see Sections 11 and 12.

Data management is performed by Angel Dieppa and Enid Malavé.

3) Research objectives

The principal objective is to record long-term meteorological data to track changes in meteorological conditions that can be associated to changes in estuarine habitats and conditions and regionally as well. A secondary objective is to promote the access and use of reliable baseline information by federal and local agencies, universities, researchers, educators and local communities to enhance the process by which they make decisions regarding their daily activities. This data is also invaluable in the identification and development of future monitoring and research activities.

This meteorological weather station is located at 0.40 Km off the Jobos Bay coast and record data and information of the conditions affecting the estuary. The station is part of a System Wide Monitoring Program (SWMP) designed to evaluate the relative contributions of climate on coastal forcing and watershed inputs to hydrodynamics, nutrient dynamics, and other ecological processes within the estuary. Data is used as a

reference of atmospheric conditions for ongoing research projects at the Reserve as a support from NERR and for other short and long-term environmental monitoring projects within the Reserve.

4) Research methods

Campbell Scientific data telemetry equipment was installed at the JOBJBMET station on 07/20/06 and transmits data to the NOAA GOES satellite, NESDIS ID #3B018394. The transmissions are scheduled hourly at 0:00:10 after the hour and contain four (4) data sets reflecting fifteen-minute data sampling intervals. Upon receipt by the CDMO, the data undergoes the same automated primary QAQC process detailed in Section 2 above. The “real-time” telemetry data become part of the provisional dataset until undergoing secondary and tertiary QAQC and assimilation in the CDMO’s authoritative online database. Provisional and authoritative data are available at <http://cdmo.baruch.sc.edu>.

All data recorded in Atlantic Standard Time (AST) year-round.

The 15-minute Data are collected in the following formats for the **CR1000**:

Averages from 5-second data:

Air Temperature (°C), Relative Humidity (%), Barometric Pressure (mb), Wind Speed (m/s), Wind Direction (degrees), Battery Voltage (volts),

Maximum and Minimum Air Temperature (°C) and their times from 5-second data (these data are available from the Reserve).

Maximum Wind Speed (m/s) and time from 5-second data

Wind Direction Standard Deviation (degrees)

Totals:

Precipitation (mm), PAR (millimoles/m²), and Cumulative Precipitation (mm) (Cumulative precipitation is no longer available via export from the CDMO. Please contact the Reserve or the CDMO for more information or to obtain these data).

Calibration plan follows SWMP SOP’s. Wind Sensor, Temp, RH, Solar Radiation, Barometer are calibrated in a 1 or 2-year basis and Rain Bucket in a yearly basis.

Calibration information:

Recommended calibration frequency for the MET station sensors:

- Temperature/Humidity- yearly recalibration
- Rain Gauge- yearly recalibration
- Wind Speed/Direction- yearly or every 2 years (depending on the sensor)
- Barometric Pressure- every 2 years’ recalibration
- PAR- every 2 years’ recalibration
- CR1000-every 5 years

5) Site location and character

The Jobos Bay National Estuarine Research Reserve (JBNERR) is located on the southern coastal plain of the island of Puerto Rico, a reserve within the West Indies geographical area. JBNERR is composed of two major areas: (1) Mar Negro, located on the western margin of the Bay, and (2) Cayos Caribe (a chain of 17 tear-shaped islets located to the southeast) and Cayos Barca (a chain of 7 tear-shaped islets located to the southwest boundaries) both with a back-reef system. The Mar Negro area comprises the bulk of the Reserve and consists of mangrove forests and a complex system of lagoons and channels interspersed with salt and mud flats. Coral reefs and sea grass beds, with small beach deposits and upland areas fringe Cayos Caribe and Cayos Barca mangrove islands.

A description of the specific sampling station follows:

The weather station is situated in front of the JBNERR Visitor's Center, located in the community of Aguirre in Salinas, Puerto Rico. Its coordinates are latitude 17° 57' 23.34" N and longitude 66° 13' 22.56" W. The tower base is about 9m above sea level, approximately 110m north from Jobos Bay's southern shoreline. The station is installed in a 10-meter tower in front of the Main Building, the wind and PAR sensors are above the building height. At 11 meters to the northwest side of the tower there is a tree with a height of 15 meters presenting a minor obstruction to the sensors. In the southern region of Puerto Rico where JBNERR is located the winds persists from southeast and northeast, therefore the tree does not represent a significant obstruction for the winds. The high of the sensors are: wind sensor (9.75 m high), Temperature/ Humidity sensor (2.7m high), Barometric Pressure sensor (2.7 m high and inside the CR1000 enclosure), and PAR Sensor (9.60 m high) are all located on a 10m aluminum tower following the descriptions outlined in the CDMO Manual V 5.1. The Tipping Bucket Rain gauge is located to the SW side of the tower 1 meter over the ground. The sensors are wired to a CR1000 following the protocol in the CDMO Manual.

The weather station is at the following distance from SWMP stations used for water quality monitoring:

- 2.2 Km. from Station 09
- 4.2 Km. from Station 10
- 1.8 Km. from Station 19
- 3.1 Km. from Station 20

SWMP Station Timeline

Station Code	Station Name	SWMP Status	Location	Active Dates	Reason Decommissioned	Notes
jobjbmnet	Jobos Bay Weather	P	17° 57' 23.34 N, 66° 13' 22.56 W	01/01/2001-12/31/2022	NA	NA

6) Data collection period

The weather station was installed in 1999. On 7/20/06 new telemetry equipment was installed. From January 1st to December 31, 2022 data was collected and saved in a computer where the meteorology station is connected via wire and transmitted via NOAA-GOES near real time telemetry.

During year 2022 data is acquired following SWMP SOP's. This is in 15 minutes' interval year-round.

Raw file start and end dates and times:

File Start Date and Time	File End Date and Time
12/06/2021 09:30	01/11/2022 09:15
01/11/2022 09:30	01/18/2022 08:15
01/18/2022 08:30	02/01/2022 09:45
02/01/2022 10:00	02/22/2022 07:30
02/22/2022 07:45	03/08/2022 12:30
03/08/2022 12:45	03/23/2022 08:15
03/23/2022 08:30	04/05/2022 10:15
04/05/2022 10:30	04/18/2022 14:00
04/18/2022 14:00	05/02/2022 09:15
05/02/2022 09:30	05/16/2022 08:00
05/16/2022 08:15	05/31/2022 09:30

05/31/2022 09:45	06/13/2022 11:15
06/13/2022 11:30	06/27/2022 08:30
06/27/2022 08:45	07/18/2022 08:15
07/18/2022 08:30	08/08/2022 11:45
08/08/2022 12:00	08/22/2022 12:45
08/22/2022 13:00	09/06/2022 07:45
09/06/2022 08:00	09/21/2022 09:30
09/21/2022 09:45	10/04/2022 09:30
10/04/2022 09:45	10/18/2022 08:00
10/18/2022 08:15	11/01/2022 07:45
11/01/2022 08:00	11/14/2022 08:15
11/14/2022 08:30	11/28/2022 10:30
11/28/2022 10:45	12/13/2022 12:45
12/13/2022 13:00	01/09/2023 08:15

7) Distribution

NOAA retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The NERRS retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the NERR site where the data were collected should be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

Requested citation format:

NOAA National Estuarine Research Reserve System (NERRS). 2016. System-wide Monitoring Program. Data accessed from the NOAA NERRS Centralized Data Management Office website: <http://www.nerrsdata.org/>; accessed 12 October 2022.

NERR meteorological data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal Investigators and Contact Persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page www.nerrsdata.org. Data are available in comma delimited format.

8) Associated researchers and projects

The Jobos Bay NERR maintains four water quality monitoring stations as part of the System Wide Monitoring Program (SWMP) to monitor variability in the estuarine environment. Meteorological station collects continuous information that support water quality data intended to address short-term variability and long-term changes in estuarine water parameters within the bay (i.e., localized impacts of seasonal storms and hurricane events, variability due to tidal circulation, seasonal and inter-annual differences in rainfall, magnitude and influence of major events such hurricanes, spatial extent of oceanic and tidal forcing).

Our water quality monitoring program is a key component of SWMP. Variables measured include Temperature, Dissolved Oxygen, Turbidity, pH, Salinity, Chl-a fluorescence, and Depth in 4 permanent stations equipped with YSI data sondes. At the same stations, nitrogen, phosphorus, and chlorophyll are measured in a monthly basis.

II. Physical Structure Descriptors

9) Sensor specifications

Sensors working from 05/06/2021 to as of 12/31/2022

Parameter: Temperature

Units: Celsius

Sensor type: 1000 Ω Platinum Resistance Thermometer (PRT)

Model #: EE181 Temperature and Relative Humidity Probe

Operating Temperature: -40°C to +60°C

Range: -40°C to +60°C

Accuracy: ± 0.2 °C @ +23°C

Serial Number: 201516001280B1

Date of Calibration: 4/16/2020

Dates of Sensor Use: 05/06/2021 – current as of 12/31/2022

Parameter: Relative Humidity

Units: Percent

Sensor type: HC101

Model #: EE181 Temperature and Relative Humidity Probe

Range: 0-100% non-condensing

Accuracy: -15 to 40 °C: $\leq 90\%$ RH $\pm (1.3 + 0.003 \cdot \text{RH reading}) \% \text{ RH}$

-15 to 40 °C: $> 90\%$ RH $\pm 2.3\% \text{ RH}$

-25 to 60 °C: $\pm (1.4 + 0.01 \cdot \text{RH reading}) \% \text{ RH}$

-40 to 60 °C: $\pm (1.5 + 0.015 \cdot \text{RH reading}) \% \text{ RH}$

Temperature dependence of RH measurement: typically 0.03% RH/°C

Note: This sensor caps relative humidity values at 100%, measured values $> 100\%$ are altered to 100%

Serial Number: 201516001280B1

Date of Calibration: 4/16/2020

Dates of Sensor Use: 05/06/2021 – current as of 12/31/2022

Parameter: Barometric Pressure

Units: millibars (mb)

Sensor type: Vaisala Barocap © silicon capacitive pressure sensor

Model #: PTB110 (180CA)

Operating Range: Pressure: 500 to 1100 mb; Temperature: -40°C to +60°C;

Humidity: non-condensing

Accuracy: ± 0.3 mb at +20°C, ± 0.6 mb at 0°C to 40°C, ± 1 mb at -20°C to +45°C, ± 1.5 mb at -40°C to +60°C

Stability: ± 0.1 mb per year

Serial Number: S1720920

Date of Calibration: 4/27/2020

Dates of Sensor Use: 05/06/2021 – current as of 12/31/2022

Parameter: Wind speed

Units: meter per second (m/s)

Sensor type: 18 cm diameter 4-blade helicoids propeller molded of polypropylene.

Model #: R.M. Young 05108-L Wind Monitor

Range: 0-100 m/s (0-224 mph)

Accuracy: ± 0.3 m/s (± 0.6 mph) or 1% of reading
Resolution: (0.1666 m/s)/(scan rate in seconds) or (0.3726 mph)/(scan rate in seconds)
Serial Number:
Date of Calibration: 07/23/2020
Dates of Sensor Use: 05/06/2021 – current as of 12/31/2022

Parameter: Wind direction
Units: degrees
Sensor type: balanced vane, 38 cm turning radius.
Wind sensor Mod 05108-L
Serial Number: WM179096
Date of Calibration: 7/23/2020
Dates of Sensor Use: 05/06/2021 – current as of 12/31/2022
**Sensor oriented to True North.

Parameter: Photosynthetically Active Radiation (PAR)
Units: mmoles m^{-2} (total flux)
Sensor type: Quantum Sensor; high stability silicon photodiode (blue enhanced) in anodized aluminum case with acrylic diffuser
Model #SQ110 Apogee Quantum Sensor
Light spectrum waveband: 410 to 655 nm
Temperature dependence: 0.06 ± 0.06 % per $^{\circ}\text{C}$
Stability: $< \pm 2\%$ change over 1 yr
Operating Temperature: -40°C to 70°C ; Humidity: 0 to 100%
Cosine Response: 45° zenith angle: $\pm 2\%$; 75° zenith angle: $\pm 5\%$
Sensitivity: $0.2 \mu\text{mol.m}^{-2}\text{s}^{-1}$
Serial Number: SQ-110-SS-L10_31176
Multiplier: 0.025 (this does not change)
Date of Calibration: 05/06/2021
Dates of Sensor Use: 05/06/2021 – current as of 12/31/2022

Parameter: Precipitation (non-heated rain gauge)
Units: millimeters (mm)
Sensor type: Tipping Bucket Rain Gauge
Model #: TR-525USW
Rainfall per tip: 0.01 inch
Operating range: Temperature: 0° to 50°C ; Humidity: 0 to 100%
Accuracy: $\pm 1.0\%$ up to 1 in./hr; $+0, -3\%$ from 1 to 2 in./hr; $+0, -5\%$ from 2 to 3 in./hr
Rain Gauge SN 43619-410
Most recent calibration: 12/21/2022, previous calibration 04/21/2021

The CR1000 has 2 MB of Flash EEPROM that is used to store the Operating System. Another 128 K Flash is used to store configuration settings. A minimum of 2 MB SRAM is (4 MB optional upgrade) available for program storage (16K), operating system use, and data storage. Additional storage is available by using a compact flash card in the optional CFM100 Compact Flash Module.

Data logger Campbell Sci.
CR1000-RMA
Serial Number: 5278
Date of Calibration: 05/29/2015
Date Installed: 06/19/2015.
Dates of Logger Use: 06/19/2015 – current as of 05/06/2021

CR1000 Firmware Version (s): 32.05, date of update unknown

CR1000 Program Version(s):

JOBIBMET_V5.5_041608 used from 04/16/2008 to 02/27/2015.
JOBIBMET_V5.5_022715 used from 02/27/2015 to 06/17/2015.
JOBIBMET_V5.5_022715 used from 06/17/2015 to 10/10/2018.
JOBIBMET_V5.5.1_101018.cri used from 10/11/2018 to 04/20/2021.
JOBIBMET_V5.5.4_050621 used from 05/06/2021 as of 12/31/2022.

GOES Transmitter:

Model Number: TX321-G

Serial Number: 2394

Date Installed: unknown:

10) Coded variable definitions

Sampling station:	Sampling site code:	Station code:
Jobos Meteorology	JB	JOBIBMET

11) QAQC flag definitions

QAQC flags provide documentation of the data and are applied to individual data points by insertion into the parameter's associated flag column (header preceded by an F_). During primary automated QAQC (performed by the CDMO), -5, -4, and -2 flags are applied automatically to indicate data that is above or below sensor range or missing. All remaining data are then flagged 0, as passing initial QAQC checks. During secondary and tertiary QAQC 1, -3, and 5 flags may be used to note data as suspect, rejected due to QAQC, or corrected.

- 5 Outside High Sensor Range
- 4 Outside Low Sensor Range
- 3 Data Rejected due to QAQC
- 2 Missing Data
- 1 Optional SWMP supported Parameter
- 0 Passed Initial QAQC Checks
- 1 Suspect Data
- 2 *Open - reserved for later flag*
- 3 *Open - reserved for later flag*
- 4 Historical Data: Pre-Auto QAQC
- 5 Corrected Data

12) QAQC code definitions

QAQC codes are used in conjunction with QAQC flags to provide further documentation of the data and are also applied by insertion into the associated flag column. There are three (3) different code categories, general, sensor, and comment. General errors document general problems with the CR1000, sensor errors are sensor specific, and comment codes are used to further document conditions or a problem with the data. Only one general or sensor error and one comment code can be applied to a particular data point, but some comment codes (marked with an * below) can be applied to the entire record in the F Record column.

General Errors

GIM	Instrument malfunction
GIT	Instrument recording error, recovered telemetry data

GMC	No instrument deployed due to maintenance/calibration
GMT	Instrument maintenance
GPD	Power down
GPF	Power failure / low battery
GPR	Program reload
GQR	Data rejected due to QA/QC checks
GSM	See metadata
Sensor Errors	
SDG	Suspect due to sensor diagnostics
SIC	Incorrect calibration constant, multiplier or offset
SIW	Incorrect wiring
SMT	Sensor maintenance
SNV	Negative value
SOC	Out of calibration
SQR	Data rejected due to QAQC checks
SSD	Sensor drift
SSN	Not a number / unknown value
SSM	Sensor malfunction
SSR	Sensor removed
Comments	
CAF	Acceptable calibration/accuracy error of sensor
CCU	Cause unknown
CDF	Data appear to fit conditions
CML	Snow melt from previous snowfall event
CRE*	Significant rain event
CSM*	See metadata
CVT*	Possible vandalism/tampering
CWE*	Significant weather event

13) Other remarks/notes

Data are missing due to equipment or associated specific sensors not being deployed, equipment failure, time of maintenance or calibration of equipment, or repair/replacement of a sampling station platform. Any NANs in the dataset stand for “not a number” and are the result of low power, disconnected wires, or out of range readings. If additional information on missing data is needed, contact the Research Coordinator at the reserve submitting the data.

Relative Humidity data greater than 100 are within range of the sensor accuracy of +/-3% and are flagged and coded as suspect, <1> (CAF). Values greater than 103 are rejected <-3>.

Data recorded for all parameters (with the exception of cumulative precipitation) at the midnight timestamp (00:00) are the 15-minute averages and totals for the 23:45-23:59 time period of the previous day. Cumulative precipitation data at the midnight timestamp (00:00) are the sum of raw (unrounded) precipitation data from 00:00 to 23:59 of the previous day. Summing each individual 15-minute total precipitation value from the same period will result in small differences from cumulative precipitation due to rounding. It is especially important to note how data at the midnight timestamp are recorded when using January 1st and December 31st data.
Note: Cumulative precipitation is no longer available via export from the CDMO. Please contact the Reserve or the CDMO for more information or to obtain these data.

Suspect Out of Calibration Data:

All data are considered suspect for the entire year, unless otherwise flagged as rejected or missing, due to the out of calibration CR1000, {CSM}, <1> [SOC]. The datalogger has been out of calibration since 2020.

Suspect Data/Corrected Data:

The logger program uploaded on 05/06/2021 did not include updated coding for the newly installed wind sensor, model number 5108. Instead, the multiplier used after the upload in 2021 and until early 2024 was for the model number 5103 wind sensor. Wind speed and maximum wind speed were corrected during tertiary review by the CDMO. Corrected wind speed data are considered suspect not only due to corrections but also because of the out of calibration CR1000, <5> [SOC] (CSM)

5103 multiplier for m/s wind speed measurement: 0.098

5108 multiplier for m/s wind speed measurement: 0.1666

(Incorrect wind speed/0.098) * 0.1666 = corrected wind speed

Rejected Data:

9/19/2022 @ 12:15:00 to 12/31/22 @ 23:45 barometer sensor failure

Other Events:

BP Pulse for Hunga Tonga–Hunga Ha‘apai eruption (see below for more information about the eruption)

Dates and Time of BP Pulses at JOBJBMET, (CSM)

Pulse Date	Time	BP (mB)
01/15/2022	11:45	1018.703
01/16/2022	01:15	1016.641
01/16/2022	22:45	1016.576
01/17/2022	12:30	1017.344
01/18/2022	10:30	1018.597
01/19/2022	00:00	1017.475

Significant rain events:

Significant rain events at JOB NERR are rainfall >0.75 inches (19mm) that may influence water quality. For 2022 precipitation data are considered suspect due to an out of calibration CR1000 logger, {CSM}, <1> [SOC](CRE). Data are coded for both total (duration of rain event) and cumulative precipitation (coded until the midnight timestamp). Storms marked with * below are also considered significant weather events for all parameters, {CWE}.

Date	Precipitation (mm)	Event associated with
04/30/2022	27.7	
07/02/2022	71.1	Tropical storm over the tropical Atlantic 7/1 and 7/2.
08/27/2022	22.1	
09/04/2022	33.0	Tropical Storm EARL North of Puerto Rico.
09/05/2022	68.6	Tropical Storm EARL North of Puerto Rico.
09/18/2022	442	Hurricane FIONA*
09/19/2022	87.6	Hurricane FIONA*
10/26/2022	90.9	Tropical Storm Ian*
10/27/2022	79.0	Tropical Storm Ian*

10/30/2022	48.5	
11/04/2022	41.9	
11/05/2022	127	Tropical Storm Lisa*
11/14/2022	37.1	
11/15/2022	13.7	Continued rain event from 11/14/2022

Weather sensor inventory 2022:

Inventory for JOB - MET							
Logger-CR100006192015-IN SERVICE			Serial Number	Manufacture Year	Date in Service	SWMP	Last Update
5278	2004	06/19/2015	Yes	05/14/2016			
Type	Code	Model	Serial Number	Manufacture Year	Date in Service	SWMP	Last Update
precip	precip05072019	precip06042018	43619-410	2004	05/07/2019	Yes	05/13/2022
PAR	PAR05062021	SQ-110	SQ-110-SS-L10_31176	2020	05/06/2021	Yes	05/13/2022
wind	wind05062021	05108-5A	WM179096	2020	05/06/2021	Yes	05/13/2022
temp/RH	tempRH05062021	EE181-M1A1	201516001280B1	2020	05/06/2021	Yes	05/13/2022
BP	BP05062021	PTB110	S1720920	2020	05/06/2021	Yes	05/13/2022

Logger-CR100006192015-IN SERVICE			Serial Number	Manufacture Year	Date in Service
			5278	2004	06/19/2015
Type	Code	Model	Serial Number	Manufacture Year	Date in Service
precip	precip05072019	precip06042018	43619-410	2004	05/07/2019
PAR	PAR05062021	SQ-110	SQ-110-SS-L10_31176	2020	05/06/2021
wind	wind05062021	05108-5A	WM179096	2020	05/06/2021
temp/RH	tempRH05062021	EE181-M1A1	201516001280B1	2020	05/06/2021
BP	BP05062021	PTB110	S1720920	2020	05/06/2021

Hunga Tonga–Hunga Ha'apai Volcano Eruption 15 January 2022

On 20 December 2021, an [eruption](#) began on [Hunga Tonga–Hunga Ha'apai](#), a [submarine volcano](#) in the [Tongan](#) archipelago in the southern [Pacific Ocean](#). The eruption reached a very large and powerful climax nearly four weeks later, on 15 January 2022. Hunga Tonga–Hunga Ha'apai is 65 km (40 mi) north of [Tongatapu](#), the country's main island,^[3] and is part of the highly active [Tonga–Kermadec Islands volcanic arc](#), a [subduction zone](#) extending from [New Zealand](#) north-northeast to [Fiji](#).^{[4][5]}

The eruption caused [tsunamis](#) in [Tonga](#), [Fiji](#), [American Samoa](#), [Vanuatu](#), and along the Pacific rim, including damaging tsunamis in [New Zealand](#), [Japan](#), the [United States](#), the [Russian Far East](#), [Chile](#), and [Peru](#). At least four people were killed, some were injured, and some remain possibly missing in Tonga from tsunami waves up to 15 m (49 ft) high. Two people drowned in Peru when a 2 m (6 ft 7 in) wave struck the coast. Preliminary data indicate that the event was probably the [largest volcanic eruption in the 21st century](#), and the largest recorded since the [1991 eruption of Mount Pinatubo](#).^[6] [NASA](#) determined that the eruption was "hundreds of times more powerful" than [the atomic bomb dropped on Hiroshima](#).^[7]

Taken from:

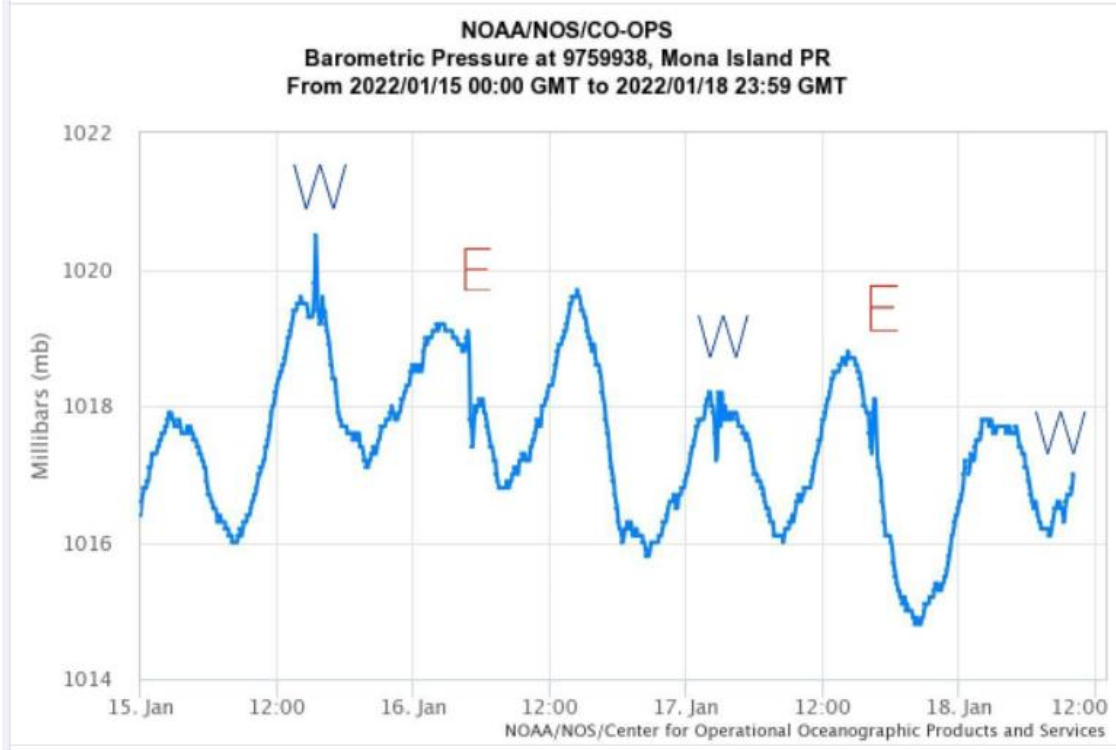
https://en.wikipedia.org/wiki/2022_Hunga_Tonga%E2%80%93Hunga_Ha%27apai_eruption_and_tsunami



Ocean Physics Education

January 18 · 🌐

Los pulsos atmosféricos de la erupción en Tonga luego de llegar a Puerto Rico volvieron a pasar sobre Puerto Rico un día con once horas y unos pocos minutos más tarde, luego de circunvalar el globo terrestre. Los pulsos positivos que llegaron del Oeste (W) avanzaron unos pocos minutos más comparados con los negativos del Este (E).



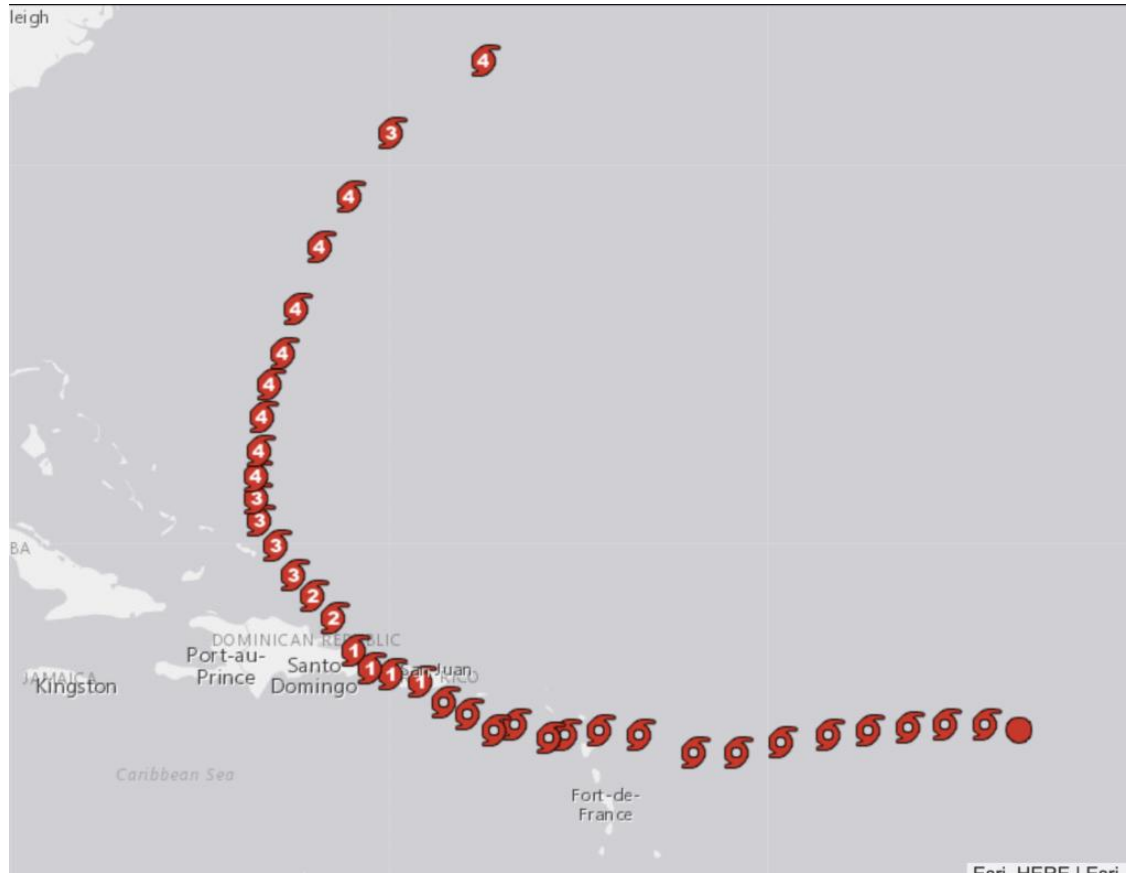
Taken from:

<https://www.facebook.com/OceanPhysicsEducation/photos/a.762560633842491/4589101801188336/>

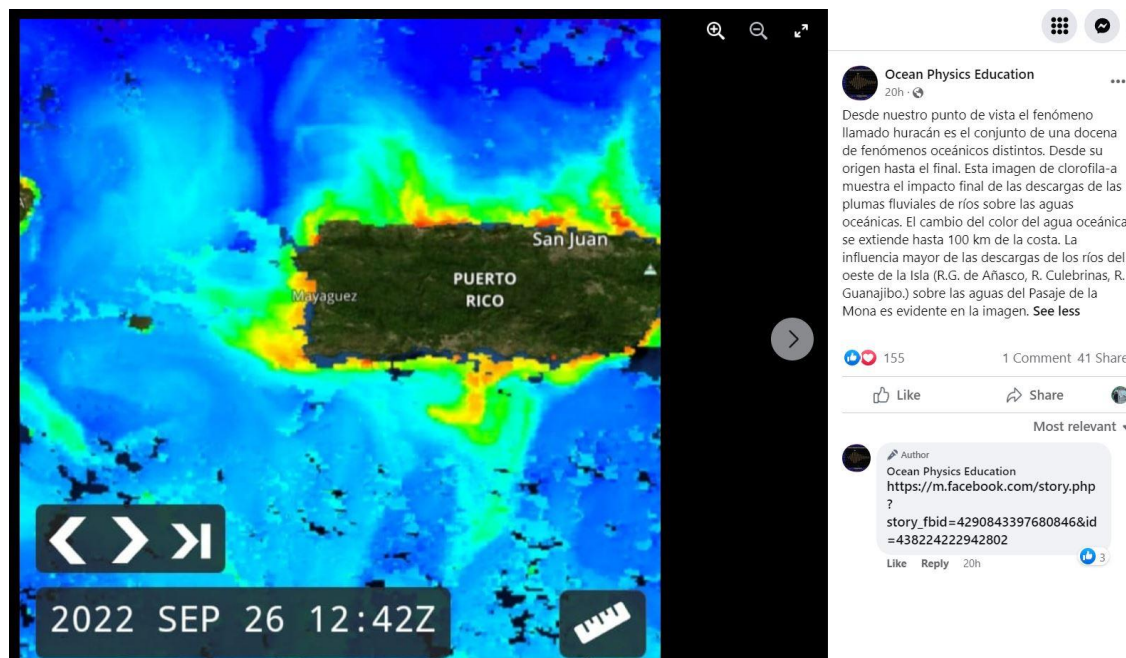
Hunga Tonga–Hunga Ha'apai Volcano Eruption 15 January 2022						
All times GMT	Positive Pulse From west (+)	Negative Pulse From East (-)	Positive Pulse From	Negative Pulse From	Positive Pulse From west (+)	Negative Pulse From
Started Eruption	1/15/22 4:10	1/15/22 4:10	1/15/22 4:10	1/15/22 4:10	1/15/22 4:10	1/15/22 4:10
Time of arrival	1/15/22 15:36	1/16/22 5:00	1/17/22 2:42	1/17/22 16:24	1/18/22 13:48	1/19/22 3:48
Elapsed Time	11:26	0:50	22:32	12:14	9:38	23:38
Time interval to go around the planet			1.4625	1.475	1.4625	1.475

Figure: Barometric Pulses Arrivals to Puerto Rico After Tonga Volcano Eruption Calculated by Dr. Edwin Alfonso-Sosa (Ocean Physics Education). All times in GMT.

Images associated to Hurricane Fiona (Landfall 09/18/2022)



Accessed from PBS News Hours (<https://www.pbs.org/newshour/science/live-map-track-the-path-of-hurricane-fiona>) on 10/31/2022



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Desde nuestro punto de vista el fenómeno llamado huracán es el conjunto de una docena de fenómenos oceánicos distintos. Desde su origen hasta el final. Esta imagen de clorofila-a muestra el impacto final de las descargas de las plumas fluviales de ríos sobre las aguas oceánicas. El cambio del color del agua oceánica se extiende hasta 100 km de la costa. La influencia mayor de las descargas de los ríos del oeste de la Isla (R.G. de Añasco, R. Culebrinas, R. Guanajibo.) sobre las aguas del Pasaje de la Mona es evidente en la imagen. [See less](#)

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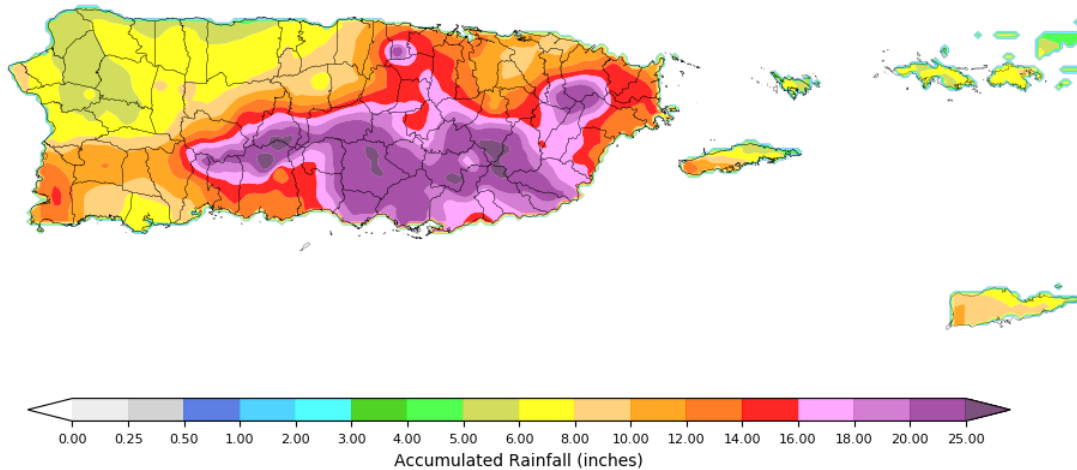
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Satellite image showing river discharges around Puerto Rico after Hurricane Fiona rain events.
Taken from Facebook page Ocean Physics Education by Dr. Edwin Alfonso-Sosa.

Preliminary Rainfall Totals for Puerto Rico and the U.S. Virgin Islands

Data Source: MPE (Radar Estimates & Rain Gages)

Valid from 09/16/2022 18Z to 09/20/2022 12Z

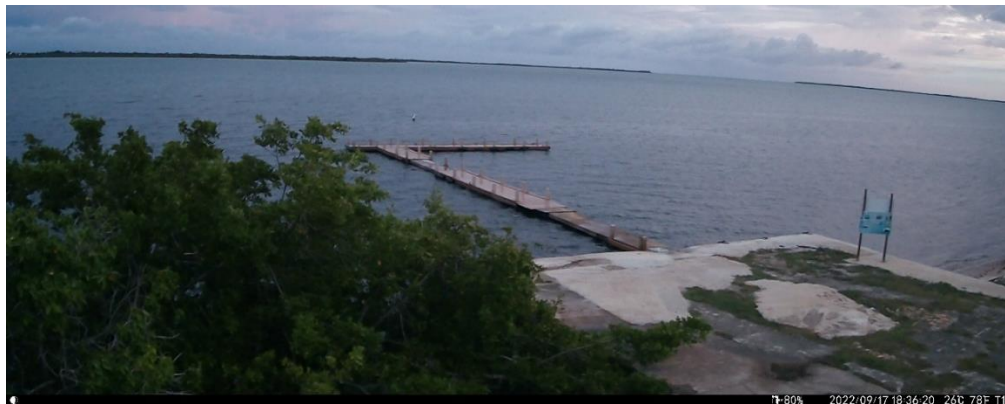


National Weather Service
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Accessed from National Weather Service (<https://www.weather.gov/sju/fiona2022>) on 10/31/2022

Hurricane Fiona:



22/09/17 @ 18:36:20



22/09/18 @ 15:21:20



22/09/19 @ 06:21:19

Pictures of JBNERR's pier before, during, and after Hurricane Fiona.