National Coral Reef Monitoring Program
Climate Monitoring Brief: St. Croix, USVI

Atlantic Oceanographic & Meteorological Laboratory (AOML) Coral Program, NOAA/AOML
University of Miami/Cooperative Institute of Marine and Atmospheric Science

N. Besemer, A. Palacio, A. Webb, G. Kolodziej, M. Chakraborty, I. Enochs – December 2022

Orbicella annularis at Castle Rock, St. Croix, USVI

Mission

The AOML Coral Program tracks the status and trends of coral reef ecosystems of the U.S. Atlantic and Caribbean as part of the National Coral Reef Monitoring Program (NCRMP). This summary brief provides an overview of the most recent climate monitoring efforts at St. Croix, US Virgin Islands.

Expedition summary

- The AOML Coral Program conducted NCRMP climate monitoring operations at St. Croix, USVI from September 4th to September 9th, 2022.
- A total of 16 different sites were visited by four AOML Coral Program members and local partners, comprising a total of 45 dives.

Data collection summary

Subsurface temperature

Subsurface temperature recorders (STRs) were recovered and redeployed at all 4 transects, each one located along the four cardinal compass directions of the island and composed of 3-4 depths (Fig. 1). In total, more than 4 million temperature observations were collected (Table 1).

Table 1. *Number of temperature observations collected by transect and depth. Sites marked with NA were either not deployed or not successfully recovered.*

Transect	1m	5m	15m	25m	Total
North	NA	313,850	313,887	257,270	885,007
East	314,505	314,508	315,351	315,345	1,259,709
South	231,351	315,094	315,095	315,091	1,176,631
West	NA	314,240	314,245	314,243	942,728

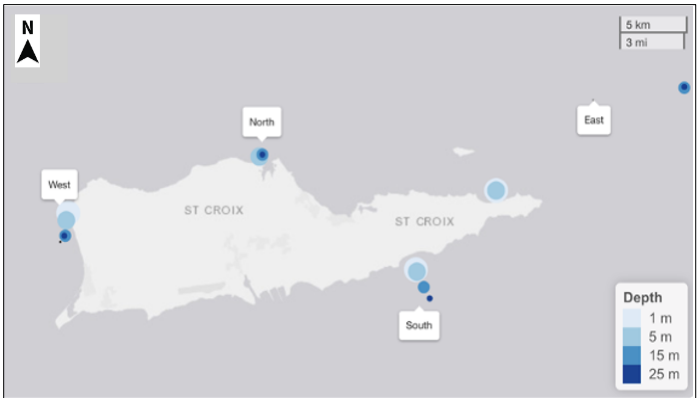

Figure 1: *Study sites and depths at St. Croix, USVI. Symbols were enlarged for visualization purposes only.*

NCRMP Climate Fixed Sentinel Site Monitoring

At Salt River (North -15m site), short term instruments (72h) were deployed to monitor daily fluctuations in:

- **Current**: 294 observations
- **pH**: 294 observations
- **Light**: 290 observations
- **Carbonate chemistry**: 15 samples

Habitat persistence

Changes in bioerosion and accretion were monitored at all 15m sites.

- **Carbonate budget surveys:** Benthic cover, sponge, urchin and parrotfish surveys at six fixed sites
- **Bioerosion**: 39 Bioerosion Monitoring Units (BMUs) collected, 40 redeployed
- **Calcification**: 18 Calcification Accretions Units (CAUs) collected, 20 redeployed
- **Benthic cover**: Six landscape mosaics

Subsurface Temperature

The temperatures that marine organisms experience are a function of depth and local oceanographic conditions. To monitor this, four cross-shelf transects were established at each cardinal compass direction surrounding the island. Three years of temperature measurements were retrieved and processed from 14 sites (depths). Each transect consists of STRs at 3-4 depths (1, 5, 15, 25m; Fig. 2). Temperature was measured using SeaBird Electronics Subsurface Temperature Recorders (STR)s that collected data at 5-minute intervals.

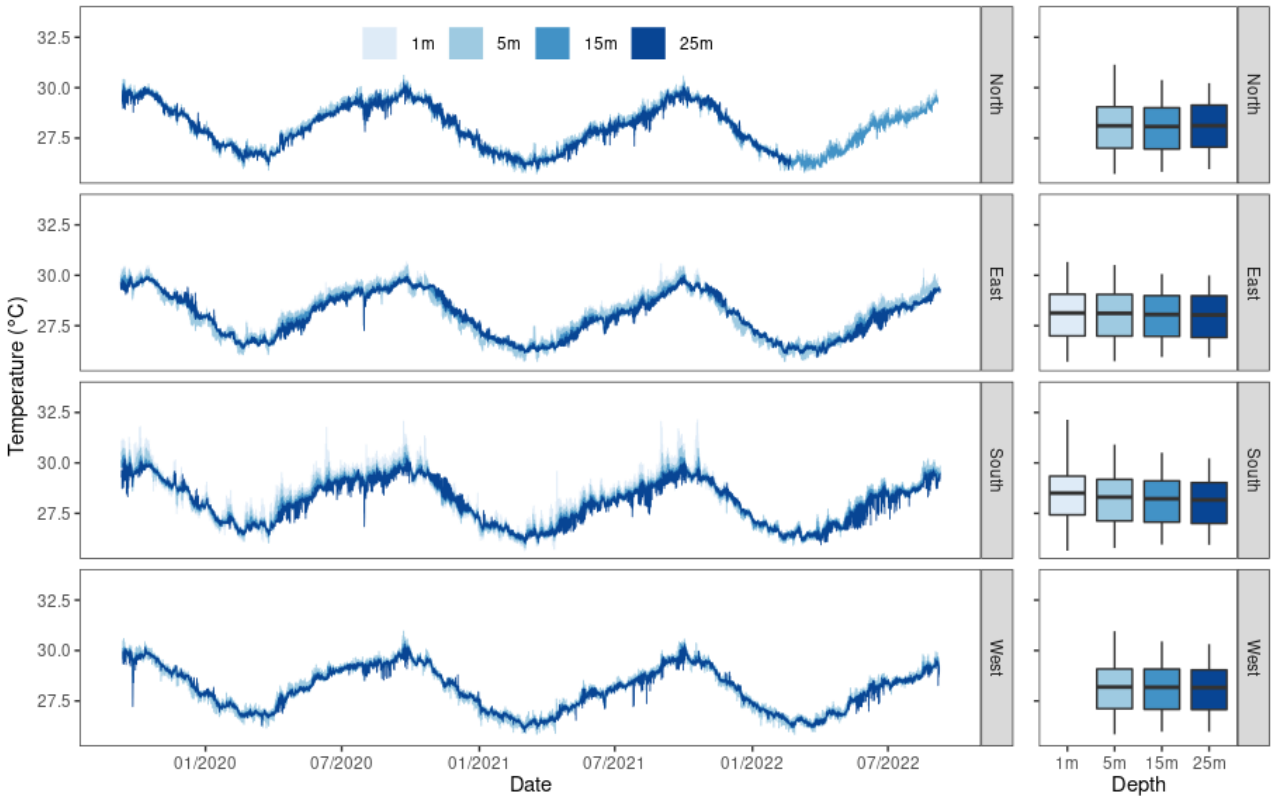

Figure 2: *Temperature conditions at four transects around the island of St. Croix (East, West, North and South) Colors represent depth. Data were collected from September 2019 to September 2022.*

Mean temperatures were similar among the transects and depths with the lowest temperatures generally occurring in March (mean: 26.56 °C, min: 25.64°C, max: 28.27°C) and the highest temperatures in September (mean: 29.68°C, min: 27.22°C, max: 32.11°C). The south 1m station presented the highest temperature variability and the maximum temperature values recorded in October 2021 (32.16°C) and September 2020 (32.11°C) (Fig. 2). The 25m STR from the north transect prematurely stopped recording in February 2022 and the 1m STR from the south transect similarly stopped recording in November 2011.

Diurnal Suite Deployment

Seawater carbonate chemistry can fluctuate diurnally, due to biological forcing and processes such as, photosynthesis and respiration, as well as calcification and dissolution. To characterize this, discrete water samples were collected at three-hour intervals (n=15) using Subsurface Automatic Samplers (SAS, https://www.coral.noaa.gov/accrete/sas/, Fig. 3). These samples will be analyzed for Total Alkalinity (TA), Dissolved Inorganic Carbon (DIC), and Spectrophotometric pH (SpecpH), which will be used to calculate pCO_2 and aragonite saturation state ($\Omega_{Aragonite}$).

A suite of instruments was deployed for a 72-hour period at the North 15m site, Salt River Bay (Fig. 4). A SeaFET was used to log pH, an EcoPAR measured Photosynthetically Active Radiation (PAR), and a Lowell Tiltmeter measured current speed and direction. Each collected measurements at 15-minute intervals.

Figure 3: *Submerged Automated Samplers (SAS) deployed to collect water samples every 3 hours.*

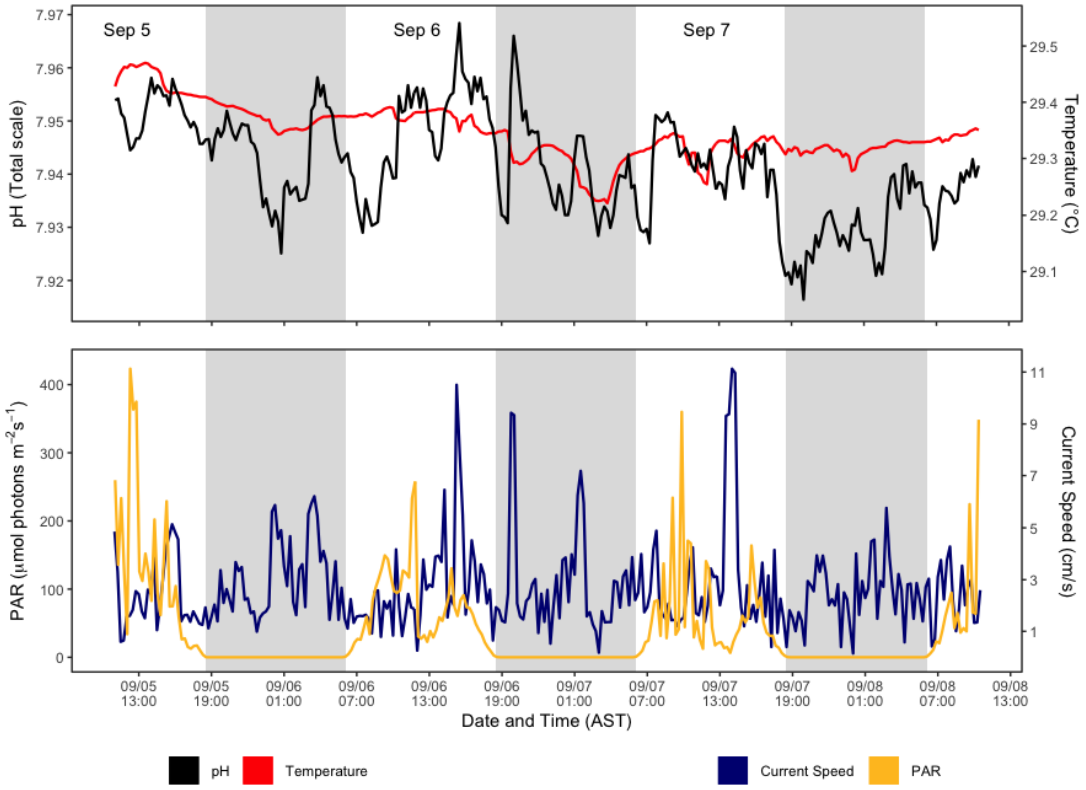

Figure 4: *Data from the Salt River Bay diurnal suite monitoring from Sept 5th to Sept 8th. Top panel: pH and temperature from SeaFET. Bottom panel: Photosynthetically Available Radiation (PAR) and current speed from EcoPAR and Tiltmeter. Grey blocks denote night time throughout sequence of the plot. Instruments measured parameters every 15 minutes.*

Habitat persistence

Carbonate budget assessments use transect-based surveys to quantify the abundance of carbonate producers, such as corals and crustose coralline algae, as well as carbonate bioeroders, such as grazing parrotfish and sea urchins. Abundances are multiplied by taxon-specific rates of carbonate alteration to determine if a reef is in a state of net accretion (habitat growth) or net loss (habitat loss). At Salt River Bay, six transects were established and surveyed in 2019 to obtain carbonate budgets. We revisited this site to find out the new status of carbonate budget after three years. The transect results showed that carbonate budgets have become negative in 2022, suggesting that this site has shifted to a net erosional state (Fig. 5). This trend is driven by a reduction in coral cover and calcification.

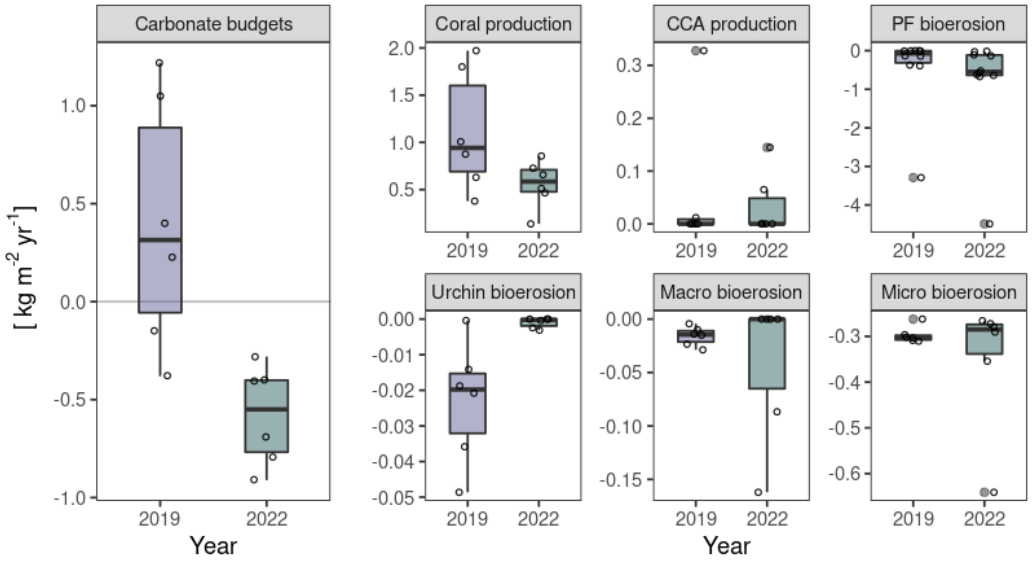

Figure 5: *Carbonate budgets Salt River Bay in 2019 and 2022 and the processes contributing to calcification and bioerosion. The horizontal line in the "Net carbonate production panel" denotes accretionary stasis, the point where the budget flips from habitat growth to loss. PF represents Parrotfish.*

Landscape mosaics are used to quantify the benthic community, and to monitor changes in coral cover over time. Thousands of underwater images are digitally stitched together to create a high-resolution archive of the reef at the time of collection (Fig. 6).

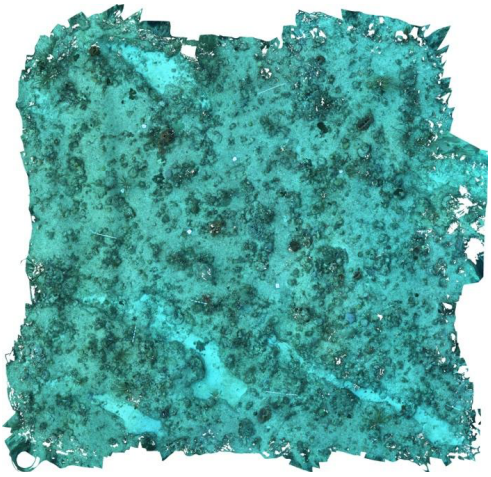

Figure 6: *Landscape Mosaic collected from Transect 6.*

Finally, **Calcification Accretion Units (CAUs)** and **Bioerosion Monitoring Units (BMUs)** were used to investigate the balance between calcification and erosion. CAUs and BMUs were collected and redeployed for the next sampling cycle (Fig. 7). CAUs are processed by the Pacific Climate group and the data will be available within a year. BMUs will be dried and cleaned using a hydrogen peroxide solution. These samples will be weighed and scanned using a CT scanner and then compared to their pre-scans to quantify bioerosion. Data will be available in a year. Please reference previous datasets for more information.

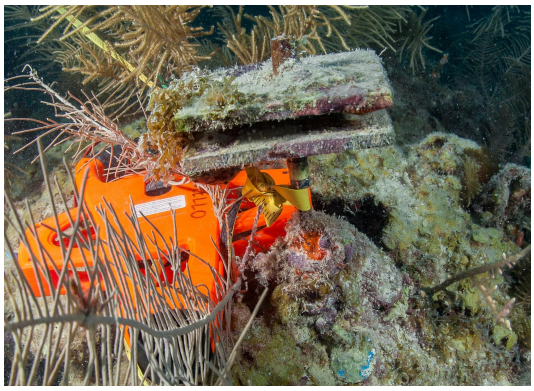

Figure 7: *CAU and BMU pair before retrieval after being deployed for three years. CAUs are two parallel PVC plates to quantify settled accretors. BMU is mounted coral skeleton installed at the base of the metal stake and has been encrusted.*

About the monitoring program

AOML's climate monitoring is a key part of the National Coral Reef Monitoring Program of NOAA's Coral Reef Conservation Program (CRCP), providing integrated, consistent, and comparable data across U.S. coral reef ecosystems. NCRMP efforts aim to:

- Document the status of reef species of ecological and economic importance
- Track and assess changes in reef communities in response to environmental stressors or human activities
- Deliver high–quality data, data products, and tools to the coral reef conservation community

Points of Contact

Atlantic Climate Operations Coordinator: nicole.besemer@noaa.gov
Principal Investigator: ian.enochs@noaa.gov
NCRMP Coordinator: erica.towle@noaa.gov

For more information

Coral Reef Conservation Program: http://coralreef.noaa.gov
NCRMP climate monitoring: https://www.coris.noaa.gov/monitoring/climate.html
NOAA Atlantic Oceanographic and Meteorological Laboratory: http://www.aoml.noaa.gov/
USVI Reef Status Report 2020
National Coral Reef Status Report 2020

Acknowledgments

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Our Team

St. Croix, USVI 2022 Field team

AOMLs NCRMP Atlantic and Caribbean Climate Team: I. Enochs, N. Besemer, G. Kolodziej, M. Chakraborty, A.Boyd, M. Jankulak, A. Palacio-Castro, A. Webb, B. Chomitz