PacIOOS
PACIFIC ISLANDS OCEAN OBSERVING SYSTEM

Kewalo Basin, O'ahu

FRIENDS OF KEWALOS

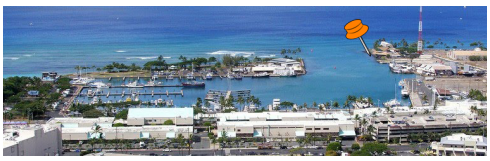
WATER QUALITY SENSOR PARTNERSHIP PROGRAM

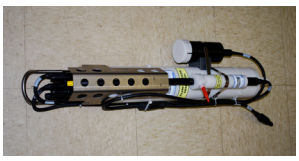
The Pacific Islands Ocean Observing System (PacIOOS) Water Quality Sensor Partnership Program (WQSPP) supports natural resource managers, scientists, and community organizations to collect water quality data in order to inform research, conservation, planning, and resource management projects throughout the Pacific Islands region. The WQSPP provides participating partners with sensors, data management, and technical capacity-building to allow for robust data collection.

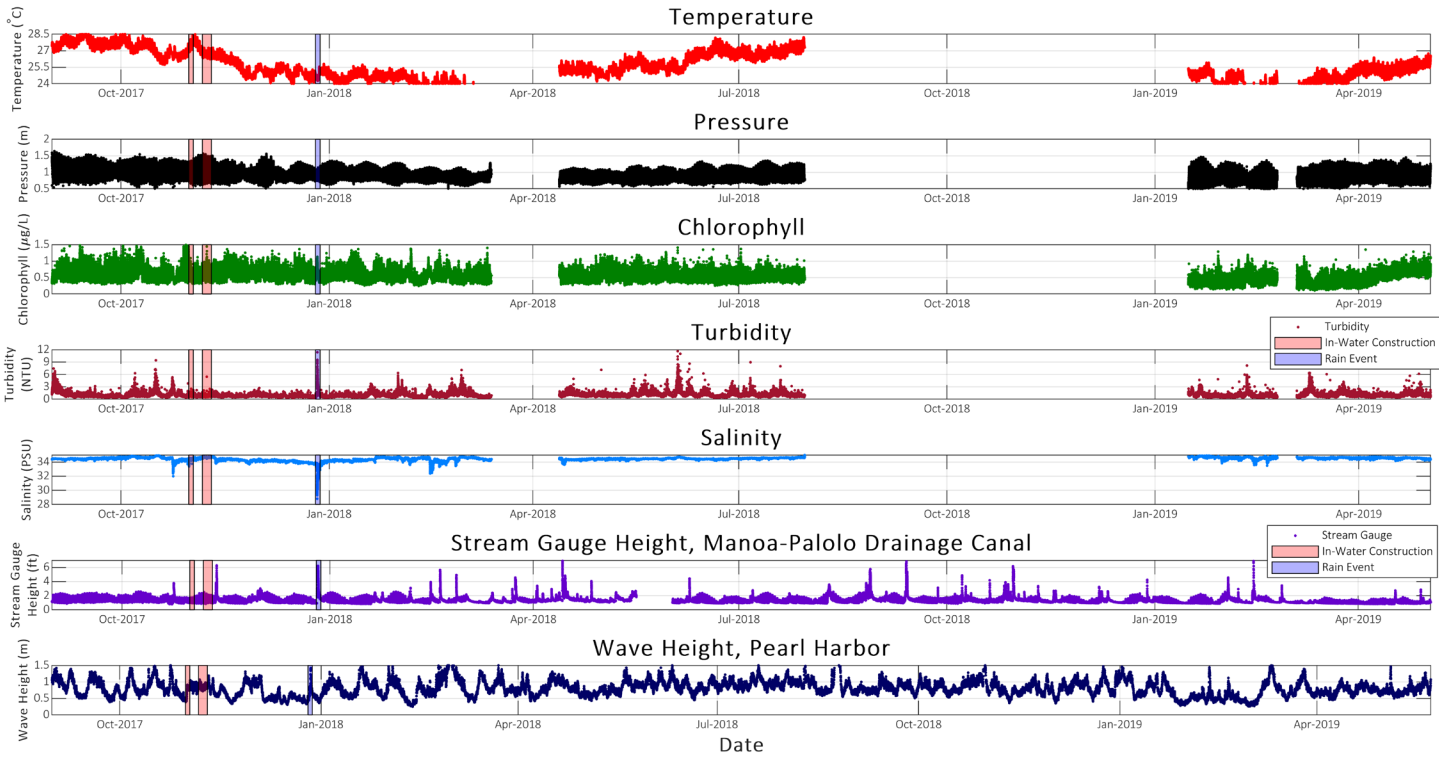
Friends of Kewalos is a non-profit organization comprised of recreational users committed to protecting and preserving the Kewalo Basin Park area. Together, Friends of Kewalos worked with the WQSPP to deploy and manage a sensor located on the south shore of O'ahu in Māmala Bay, at Kewalo Basin.

This sensor is equipped to measure biological and physical water quality parameters, including temperature, conductivity (salinity), pressure (depth), fluorescence (chlorophyll), and light attenuation (turbidity). Measurements are taken at approximately 1 meter in depth and at a frequency of 4 minutes. Parameters are collected by a Sea Bird Electronics Conductivity Temperature and Depth Sensor (CTD).

Data from this sensor package are used to characterize temporal variability in the water-column properties at the mouth of Kewalo Basin. Deployment extended from September 2017 to May 2019, including a period of in-water construction to the Kewalo Basin Harbor in November 2017. Gaps in data are due to malfunctions with the sensor and a required servicing at Sea Bird Electronics.







Daily fluctuations in **temperature** (Celsius) are due to solar heating. Seasonal fluctuations in temperature are evident within the dataset. Temperature ranges from 22.24 °C to 29.27 °C with an average of 25.49 °C. **Pressure** (meters) measures the water height above the sensor. Changes in pressure are due to Hawai'i's mixed semidiurnal tide cycles (two highs and two lows per day). Pressure ranges from 0.33 m to 1.64 m, with an average of 0.92 m. **Chlorophyll** (micro grams/liter) is a pigment found in phytoplankton, and is measured to monitor their presence. Fluctuations may be correlated with seasonal change and increased nutrient flux from surface water runoff. Chlorophyll ranges from 0.56 µg/L to 2.96 µg/L, with an average of 1.02 µg/L.

Turbidity (nephelometric turbidity units) shows the change in suspended particles in the water-column from surface water runoff and shifts in daily tides. Turbidity ranges from 0.53 NTU to 24.73 NTU, with an average of 1.26 NTU. **Salinity** (practical salinity units) fluctuates largely with freshwater input from land-based sources (e.g., stream and rain runoff). Salinity ranges from 28.81 PSU to 34.99 PSU, with an average of 34.46 PSU. **Stream gauge** (United States Geological Survey) and **wave height** (PacIOOS) data are displayed to show correlations between the fluctuations seen in the above parameters. Rain events impacting stream gauge height show a relationship between the above parameters. Wave height does not show any notable relationship.

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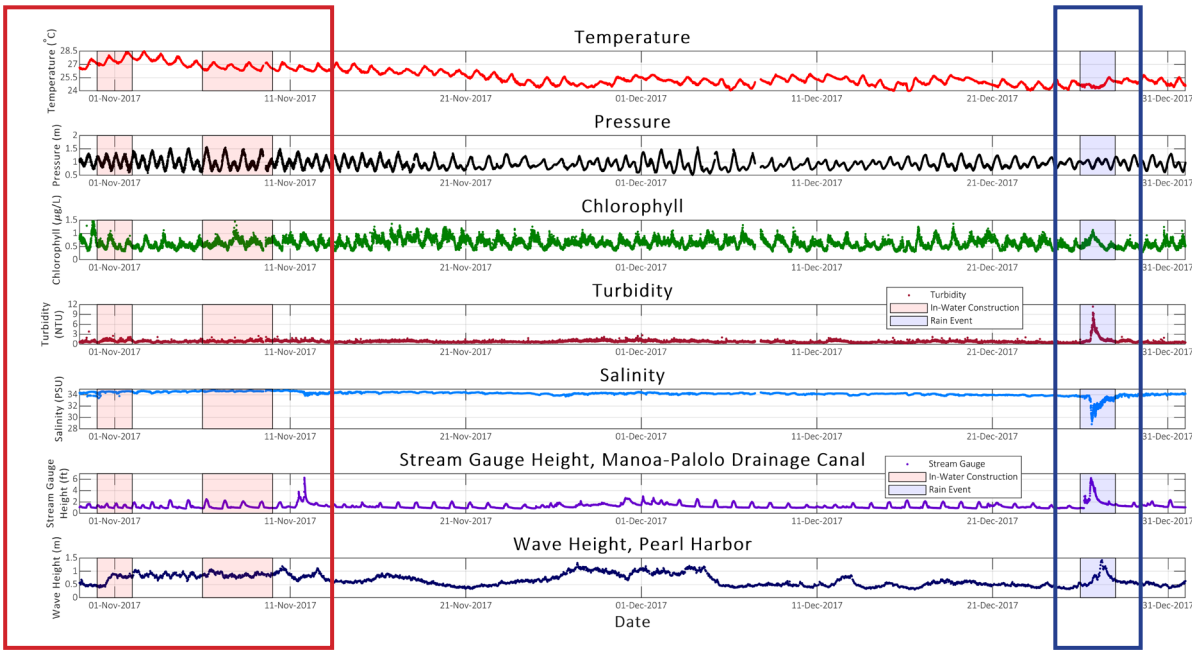
CASE STUDY



To get a better understanding of how each parameter is connected, we are taking a closer look at two separate events. The first case study focuses on "in-water work days" (highlighted in red) during the Kewalo Basin Harbor construction project from October 31 to November 2, and November 6-10, 2017. The second reviews a rain event (highlighted in blue) that occurred on December 26, 2017. By comparing each measured parameter, we are able to see how one additional change to the environment can actually affect many aspects of our nearshore waters.

IN-WATER CONSTRUCTION

Friends of Kewalos and other community members were worried that this construction may have adverse effects to both the surrounding marine environment and to those who enjoy it.

Findings from the nearshore sensor do not show any noticeable changes in the measured parameters over the course of each in-water construction period.

RAIN EVENT

The average **stream gauge** height from December 26 to 28 was 2.50 ft, with a maximum level of 6.21 ft on the 26th. While this period does not show the greatest stream gauge height recorded over the duration of deployment, it does show increased levels accompanied with a dropping tide.

A dropping tide and decrease in **pressure** means less salt influx from offshore waters, offering a higher chance for freshwater input to drop the average level of salinity.

Salinity across this case study ranged from 28.81 PSU to 34.17 PSU, with an average of 33.18 PSU—which is lower than the average across the entire deployment. The largest drop in salinity over the duration of this study is documented on mid-day December 26, 2017. This dip is correlated with increased rainfall and stream gauge height over the same time period.

Chlorophyll levels rise as runoff and likely nutrient levels increase and initiate algal growth. As these photosynthetic microorganisms multiply, so does the amount of chlorophyll pigment measured in the water. This case study shows a slight increase in chlorophyll over the course of this rain event.

Turbidity levels increase as more particulates become suspended in the water column and as different water masses are advected over the sensor. Rain events can increase the amount of sediment that streams bring to nearshore waters. The maximum turbidity level during this period was recorded at 11.64 NTU, one of the highest throughout the deployment.

Lastly, **temperature** was also affected by the influx of cooler, fresh water and the drop in salinity. The lowest temperature found during this rain event was 24.27 °C in the evening of December 26.

CONCLUSION

The parameters measured over the course of the partnership between Friends of Kewalos and the PacIOOS WQSPP are within normal and expected ranges and have been compared against the long-term PacIOOS nearshore sensors at the Hilton Hawaiian Village Atlantis Submarine Dock and the Hawai'i Yacht Club. To view all data online, please visit: http://www.pacioos.hawaii.edu/water/sensor-kewalo/

Friends of Kewalos would like to say mahalo to Howard Hughes and Sea Engineering for doing an excellent job on the Kewalo Basin renovation. As shown in PacIOOS' data collection, the sediment debris was well contained during the chipping and piling work and the negative impacts (if any) to the nearshore waters were very minimal.