Hawaiʻi Natural Energy Institute Research Highlights

Grid Integration & Energy Efficiency

Seawater Air Conditioning Environmental Monitoring

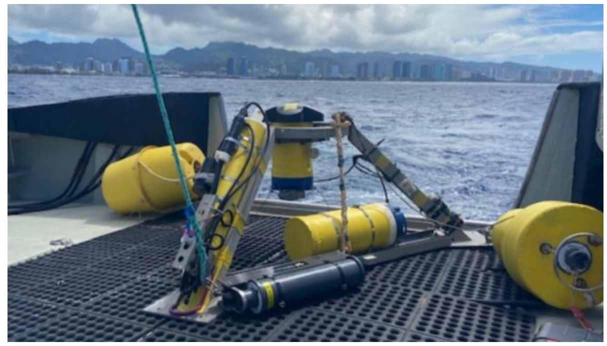
OBJECTIVE AND SIGNIFICANCE: The objective of this research was to develop a thorough understanding of the baseline oceanographic conditions at the proposed site of the Honolulu Seawater Air Conditioning (SWAC) system. These data can be used to assess the potential environmental impacts of a seawater air conditioning system on Māmala Bay or other potential developments. The study provides insight into the nearshore oceanography of Oʻahu and how it differs from more oceanic locations nearby.

BACKGROUND: Seawater air conditioning is a type of renewable energy that utilizes deep, cold seawater as a nearly carbon-neutral source of air conditioning coolant. The proposed Honolulu SWAC system was designed to draw deep, cold seawater from 500 m and release effluent via diffuser at 100-140 m. Artificial upwelling of high-nutrient deep seawater could cause changes in local oceanography and food web dynamics.

While the proposed Seawater Air Conditioning plant for Honolulu will not be constructed as previously planned, the results of this monitoring effort are a valuable resource for the environmental assessment of any future industrial developments in the Māmala Bay area as well as for advances in the understanding of near-island oceanography in an oligotrophic ocean basin.

PROJECT STATUS/RESULTS: Sampling for the SWAC monitoring project was carried out from 2012-2020 and included shipboard CTD profiling and bottom mooring deployments. This long term sampling effort resulted in high quality time series oceanographic data for parameters including currents, temperature, chlorophyll-a, dissolved inorganic carbon, nutrients, dissolved oxygen, methane, nitrous oxide, and phytoplankton. These parameters were measured at the proposed intake (500 m) and effluent (100-140 m) locations.

Key results from the project include a better understanding of currents and of the depth and variability of the mixed layer within the bay and outside it. Bathymetric forcing from a canyon, along with island-scale internal tides, increased the variability in temperature, nutrient, and oxygen variability in the near bottom environment of Māmala Bay. We observed a daily across-slope migration of the mesopelagic boundary community. This community is an important part of the near-island food web, providing food for spinner dolphins and other predators, and we found that they would interact with effluent waters of a SWAC plant in their nighttime shallower habitat.



Data collection ended in December 2020 and final sample analyses were completed in 2021. In 2022, as our final task, we characterized the onshore-offshore trends in phytoplankton, which will help to better understand the shifts in phytoplankton communities driven by the island mass effect – the increase in productivity near islands in oligotrophic systems.

This project has produced the following works:

- 2022, C.M. Comfort et al., **The island mass effect drives shifts in *Prochlorococcus*:*Synechococcus* ratios from nearshore Oʻahu, Hawaiʻi to oceanic waters**, Presented at the ProSynFest Conference, Córdoba, Spain, March 16-19.
- 2017, C.M Comfort, et al., **Observations of the Hawaiian Mesopelagic Boundary Community in Daytime and Nighttime Habitats Using Estimated Backscatter**, AIMS Geosciences, Vol. 3, Issue 3, pp. 304-326.
- 2015, C.M. Comfort, et al., **Environmental Properties of Coastal Waters in Māmala Bay, Oʻahu, Hawaiʻi, at the Future Site of a Seawater Air Conditioning Outfall**, Oceanography, Vol. 28, Issue 2, pp. 230-239.

Funding Source: Office of Naval Research; Energy Systems Development Special Fund

Contact: Margaret McManus, mamc@hawaii.edu; Christina Comfort, ccomfort@hawaii.edu

Last Updated: October 2023