OBJECTIVE AND SIGNIFICANCE: The objective of this research is to develop a thorough understanding of the baseline oceanographic conditions at the proposed site of the Honolulu Seawater Air Conditioning (SWAC) system, and ultimately to use these data to assess the environmental impacts of the operation of the SWAC system. The district-scale system will be the largest of its kind in a tropical environment.

BACKGROUND: Seawater air conditioning is a type of renewable energy that utilizes deep, cold seawater in a heat-exchange system to cool a freshwater loop. The cold fresh water will then circulate to buildings and act as air conditioning coolant, thereby providing nearly carbon-neutral air conditioning. After the deep seawater is warmed in the heat exchange process, it will be released back to the ocean via diffuser.

In the proposed Honolulu SWAC system, deep seawater will be drawn from 500 m and released via diffuser at 100-140 m. Seawater at 500 m has significantly different characteristics than seawater at the diffuser depth, including nutrient concentrations that are higher by several orders of magnitude. The input of high-nutrient water could cause changes in food web dynamics.

PROJECT STATUS/RESULTS: Since 2012, we have characterized the oceanographic environment with deployments of long-term moorings, water column profiles, and water samples at both the intake (500 m) and proposed release (100-140 m) locations. Results have indicated that the plume of high-nutrient deep seawater may sink below the lit region of the ocean where phytoplankton grow (photic zone), reducing the potential environmental impacts. However, the depth of the plume release is at an area of rapid density change, and it is also possible that the plume may spread horizontally along the density surface and remain near the base of the photic layer. During strong wind events, deep mixing may bring the nutrient-rich water into the shallow photic zone, creating the possibility of a phytoplankton blooms (Comfort, 2015). Observations of the mesopelagic boundary community’s daily across-slope migration indicated that the mid-trophic level organisms of this ecosystem will interact directly with the plume waters during their daily migration (Comfort, 2017).

Currently, monitoring efforts are ongoing and the temporal and spatial dynamics of phytoplankton at the proposed SWAC site are being investigated. Cell count data reveal higher concentrations of *Synechococcus* and lower *Prochlorococcus* at the nearshore release site than offshore near the intake site, which could be related to island effects of light availability and nutrients in the upper water column. We are currently characterizing the seasonality of phytoplankton which will provide the necessary baseline to assess if the operation of SWAC alters concentrations beyond natural fluctuations. Nutrients and phytoplankton counts were tightly correlated, suggesting that an input of nutrients from deep water to the photic zone from the SWAC system would alter the plankton dynamics of the region.

This project has produced the following publications:


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