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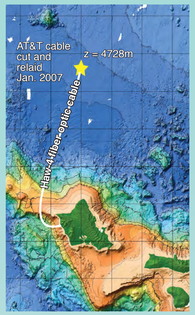
ALOHA Cabled Observatory: On-going results and new instruments

Bruce M. Howe and Roger Lukas

School of Ocean Earth Science and Technology, University of Hawaii at Manoa, Honolulu, Hawaii, USA

Abstract

Since June 2011, the ALOHA Cabled Observatory (ACO) has been collecting abyssal oceanographic data. The ACO is at Station ALOHA 100 km north of Oahu, the field site of the Hawaii Ocean Time-series (HOT) program that has collected biological, physical, and chemical oceanographic data since 1988. At 4728 m water depth, it is the world's deepest operating cabled observatory. On-going results include cold overflow events, deep sea biology, acoustic signatures of earthquakes, ships, marine mammals, wind, and rain. Two new instrument packages will be deployed: a basic sensor package (CTDO2, fluorometer, acoustic modem, ADCP), and a video/light/hydrophone combination.



Status

Working:

Thermister and conductivity on top of OBS, one ADP, hydrophones on Jbox, camera

Not working:

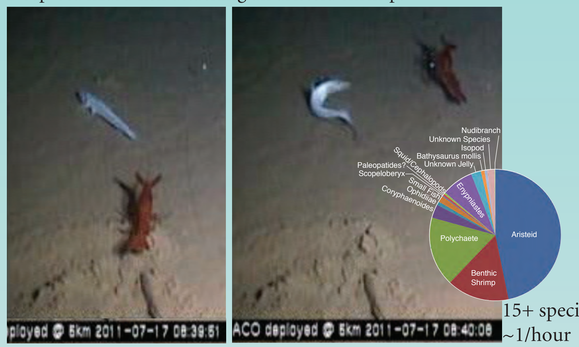
After about 6 weeks, lights failed (circuitry), hydrophone on camera
Paros digiquartz pressure sensor
Connections to AMM (with two CTDO2s and fluorometer) and TAAM mooring (thermistor array and acoustic modem);
thermistor data recorded internally and were recovered with the mooring.

Operations and Maintenance: Grant from NSF with 1 service cruise per year, 2012-2015, first cruise 2014; see right panel.

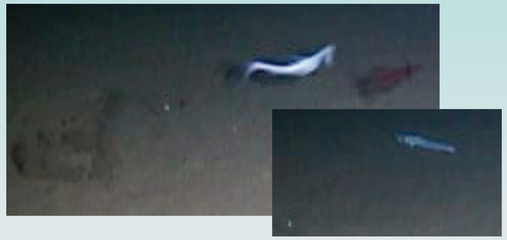
Sampling of results

While the camera operated only six weeks, more deep-sea life activity was observed than expected with an organism swimming or drifting by roughly twice an hour. Fifteen species were identified as well as a number of unidentified ones. The most exciting 20 seconds or so was when a deep-sea lizard fish attacked an aristeid shrimp (J. Drazen and A. Fleury, UH).

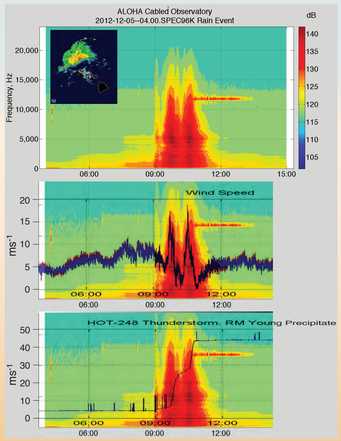
Deep-sea lizard fish attacking an aristeid shrimp.



15+ species ~1/hour

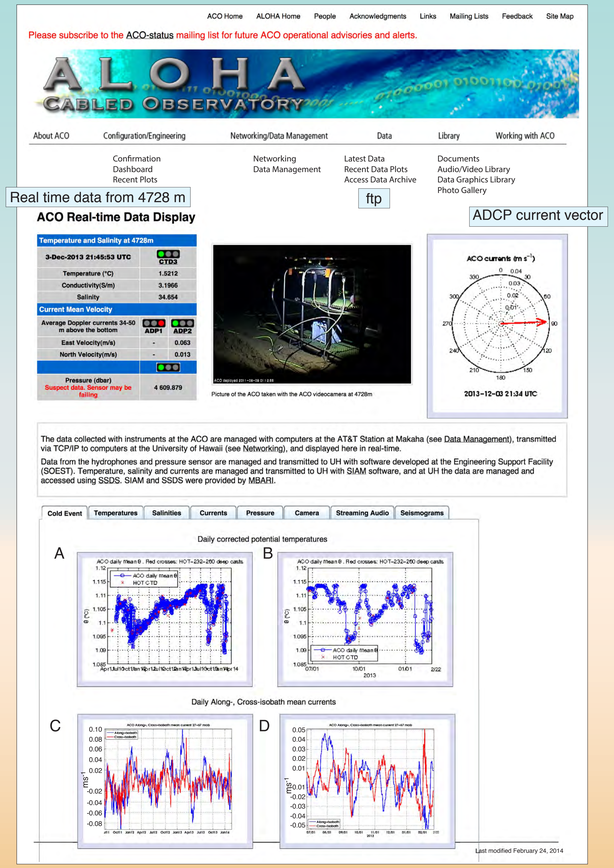


Acoustic data is being used to study marine mammals, soundscapes, anthropogenic sound (e.g., shipping), wind and rain, and surface gravity wave directional spectra. Shown is an example of a heavy rain even, with WHOTS surface mooring wind and precipitation data plotted on top of the acoustic spectrogram, and the corresponding Doppler radar image (the R/V *Kilo Moana* CTD 12 kHz pinger starts at ~10:30). The acoustic wind and rain data is being analyzed in the context of the fresh water cycle.



Daily mean filtered potential temperatures show ~ 20 mK cold overflow events, dynamic oscillations, and slow recovery in the Kauai Deep (A,B below). Our working hypothesis is that cold water from the Maui deep basin to the east flows westward over the Oahu Seamounts sill into the Kauai deep basin (with Station ALOHA on the slope). Oscillations are set up that are likely either a sloshing mode and/or bathymetrically trapped edge waves. The thermistor array data indicate bottom intensification with a scale height of about 100 m. The ADCP data shows some correlation to the temperature data (C,D). A more complete analysis is ongoing. Such events are likely occurring in many other abyssal locations, and that they cause intense mixing that is in addition to that caused by internal tides. The magnitudes and time-scales of the temperature variations have strong implications in regard to observing the deep ocean for climate studies and suggest interesting dynamics.

Web: aco-ssds.soest.hawaii.edu

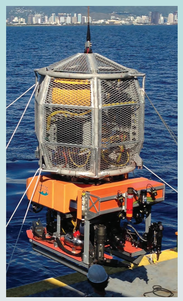


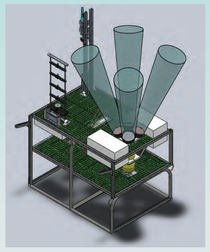
Regarding "observatory science" we make three points: 1) measurements can be affected by the observatory itself, in this case (not unexpectedly) by thermal plumes (a form of "Heisenberg uncertainty principle"); fortunately median filtering can effectively remove these; 2) the high temporal resolution observatory observations are in stark contrast to the clearly aliased intermittent ship-based measurements; and, 3) the excellent agreement between the various temperature sensors is a testament to the decades of instrument development and calibration effort.

Next

In 2014, a basic sensor package, camera tripod, and stand-alone light will be deployed using the new UH ROV *Lu'ukai* (Sea Diver).
On the basic sensor package are: CTDO2, pumped (Seabird SBE-52MP/43P), fluorometer and backscatter (Wetlabs FLNTU), acoustic modem (WHOI micro-modem), and ADCP (RDI direct reading broadband DR-BB-ADCP-150).

On the camera tripod are: Video surveillance camera with PTZ (Axis Q6035), hydrophone (ITC-1072B, 20 – 8,000 Hz), and LED lights (Cathx Ocean Aphos series 4, up to 7000 lumen each). A separate stand-alone light will also be deployed. When deployed, we expect to have two functioning cameras with overlapping illuminated areas.





Concluding remarks

The ACO is an example of a modest scale and cost cable observatory that re-uses a retired submarine telecommunication system. With the current limited core sensor suite, new scientific results are being obtained. Over time, we expect new experiments in deep sea ecosystems, carbon and biogeochemical cycling, and water column physics, using moorings and mobile platforms to extend the spatial sampling footprint. The community is encouraged to propose experiments to use this infrastructure to contribute to and to take advantage of all the science being conducted at the unique Station ALOHA.

Acknowledgments

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