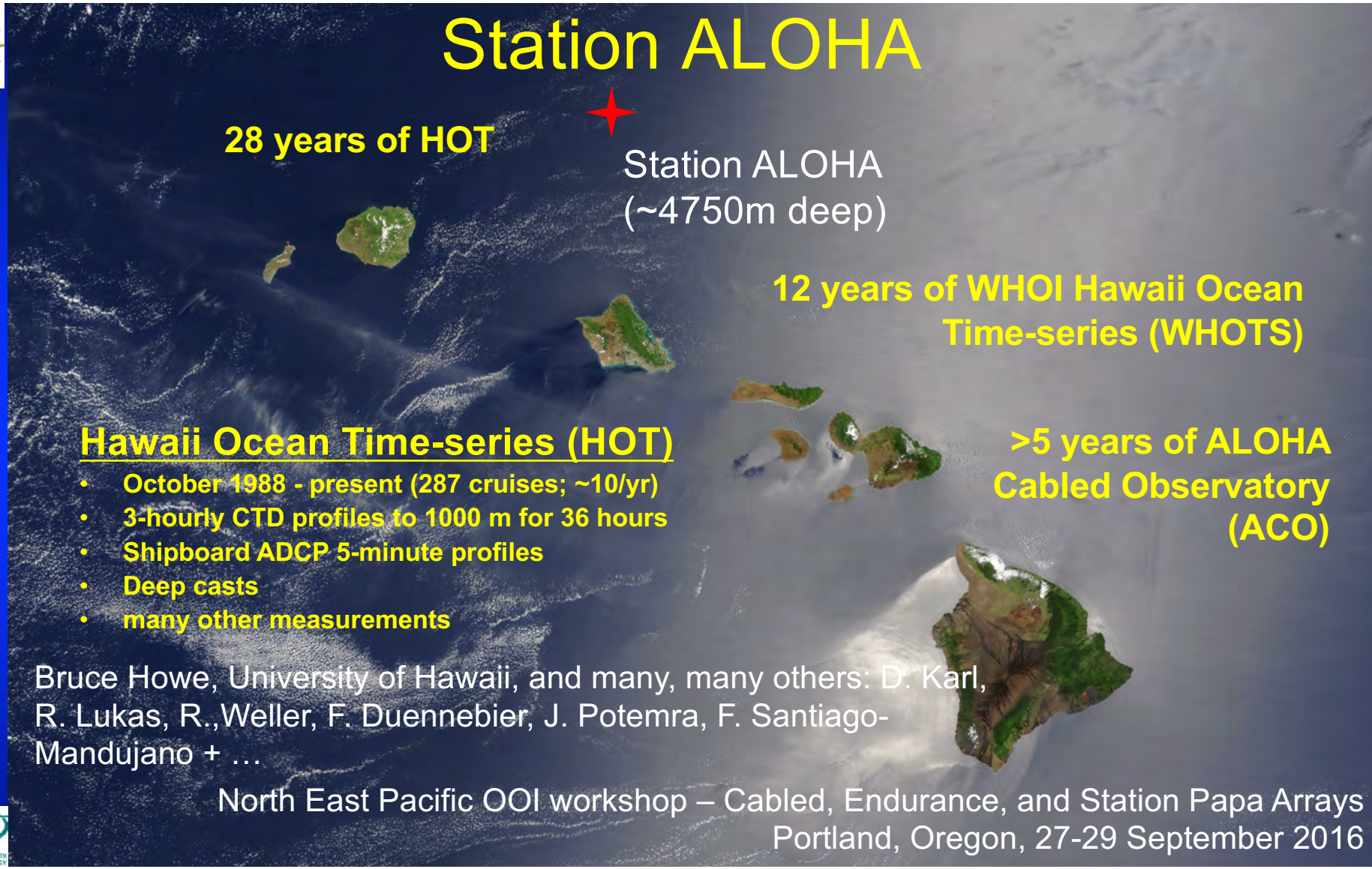
Station ALOHA



Bruce Howe, University of Hawaii, and many, many others: D. Karl, R. Lukas, R.,Weller, F. Duennebier, J. Potemra, F. Santiago-Mandujano + …

University of Hawaii Ocean Studies at Station ALOHA

http://aloha.manoa.hawaii.edu

SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY

Hawaii Ocean Time-series (HOT)

The Hawaii Ocean Time-series (HOT) aims to document, describe, and understand the physics and biogeochemistry of the ocean at Station ALOHA. Through research on ~monthly HOT cruises and analyses on land and sea, these objectives have been pursued for 23 years. Of particular importance is the documentation of variation over time in both physical and biogeochemical characteristics of the ocean - such as temperature and primary production - and its role in the earth's climate. Consistent and long-term data are crucial in finding and understanding any trends or abnormal events.

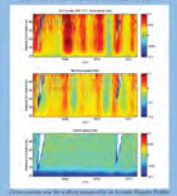
157 scientific publications have been produced directly by HOT and online data availability continuously provides scientists around the world much needed information for numerical model simulations and comparisons.

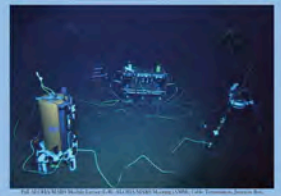
Some HOT Facts (as of 10/1/2011)

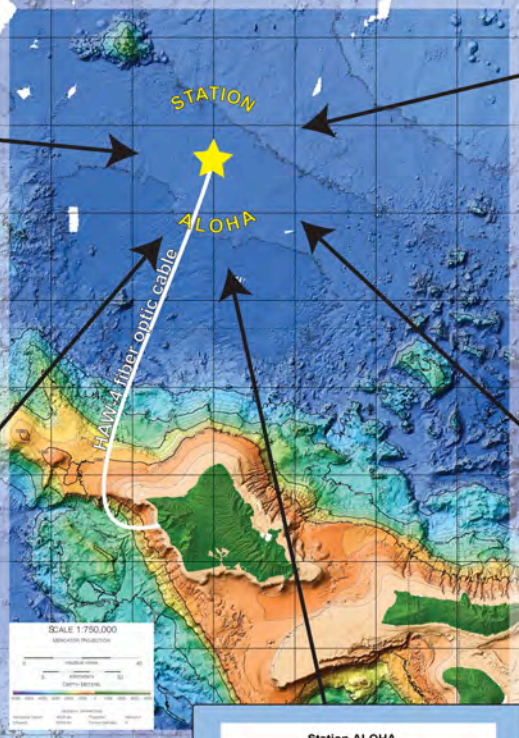
- 235 HOT cruises (and counting) completed.
- 219 graduate, undergraduate, and high school students and 38 high school and elementary school teachers have participated on HOT cruises.
- 635 different individuals participated on HOT cruises.
- 16 different ships used throughout the HOT project.
- 4,210 Conductivity-Temperature-Depth-Oxygen (CTD) with rosette water sampler casts done throughout all HOT cruises.
- 5,587,870 meters = total length of all CTD casts during HOT cruises.
- 877,908 liters of seawater collected during HOT cruises. (This is roughly 2.4x the amount of water held in the University of Hawai Manoa swimming pool!)
- 58,720 salinity water samples processed.
- 16,522 inorganic nutrient water samples processed.
- 24,826 oxygen water samples processed.

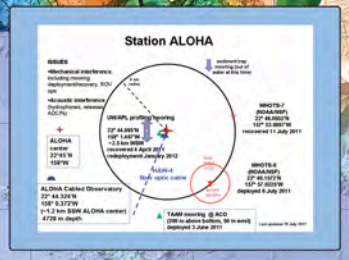
Aloha Cabled Observatory (ACO)

5 km (~3 miles) beneath the surface of the ocean at Station ALOHA, the ALOHA Cabled Observatory brings an infrequently observed and little understood habitat into light. It provides real-time ocean observations via a submarine fiber optic cable that comes ashore at Makaha on Oahu. In addition to ocean sounds, continuous observations of temperature, salinity, and ocean currents are obtained and shared with the oceanographic community and the general public. See our website for real-time and recorded data.



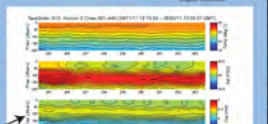


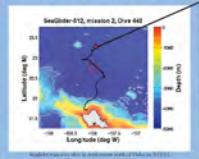




SOEST Ocean Gliders (SOG)

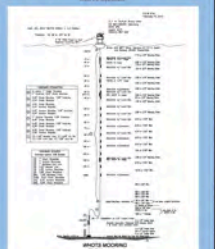
A glider is an efficient tool for ocean observations capable of autonomously recording data while diving and traveling hundreds to thousands of kilometers on either predetermined routes or as commanded by shore-based pilots. Starting in 2008, gliders deployed by the University of Hawai School of Ocean and Earth Science and Technology began visiting Station ALOHA. Between one and three times a year, one of the three gliders that frequent Station ALOHA is sent out, staying on average three months. The gliders measure and record similar data to that which is acquired on Hawai Ocean Time-series (HOT) cruises - temperature, salinity, optical data and more - except at a shallower depth and over 3 consecutive months rather than 4 consecutive days. The sea gliders have the capability to reach to about 1000 m but generally only dive to between 300 m and 500 m, concentrating on the upper 200 m of the ocean. Unfortunately, they cannot collect water samples needed for sensor calibration and for study of most biogeochemical variables.





Woods Hole Oceanographic Institution Hawaii Ocean Time-series (WHOTS)

WHOTS is a coordinated part of HOT, funded by NOAA and NSF, and consists of a full ocean depth mooring with surface buoy at Station ALOHA that has been providing state-of-the-art measurements of meteorology along with the associated upper ocean response since August 2004. The objective of this project is to provide long-term data on fluxes between the air and sea including heat, fresh water, momentum, and chemical fluxes at a representative location in the North Pacific Subtropical Gyre.



BATHYMETRY MAP FROM HAWAII MAPPING RESEARCH GROUP
HTTP://WWW.SOEST.HAWAII.EDU/HMRG/

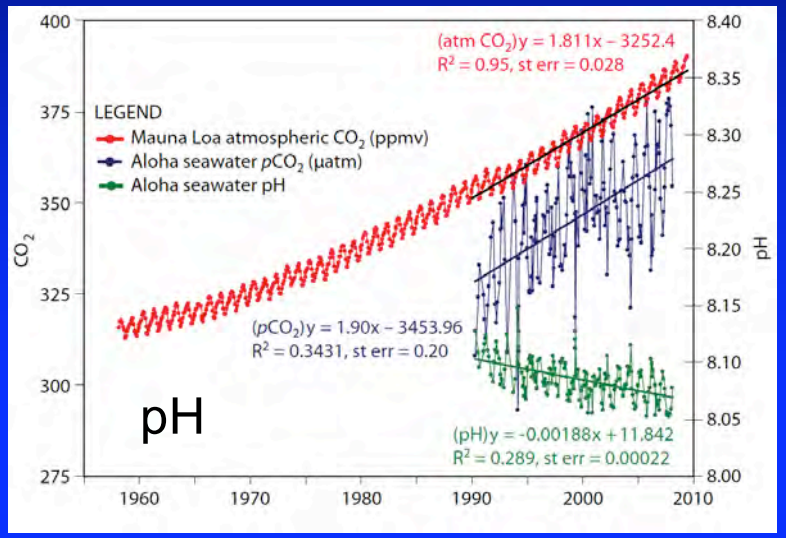
Station ALOHA

- Sustained, consistent, collaborative, interdisciplinary science
  - Long, accurate, high-resolution climatology, carbon and atmospheric forcing variables
  - Air-sea fluxes, coupling, modeling
  - Essential information on climate change, eddy fluxes, and ecosystem dynamics
- Impacts as part of a global observational network
  - Assessing ocean changes (incl. C) and enabling climate prediction
  - Atmosphere and ocean modeling – Ocean Reference Stations
- Institutions and agencies needed to sustain infrastructure
  - Sustained multi-institutional collaboration (WHOI, UH/SOEST, PMEL)
  - Collaborative funding, NOAA, NSF and SOEST
  - OceanSITES data management (setting metadata standards)

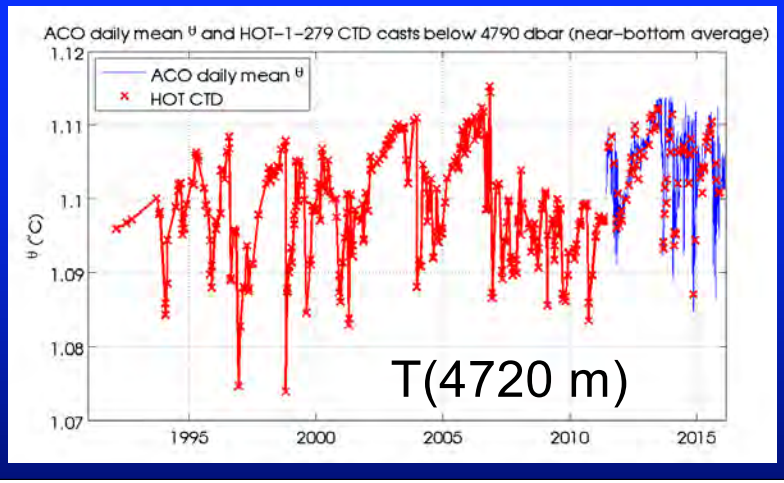
Confidence in changes **Connections among processes**

Strong tests of models

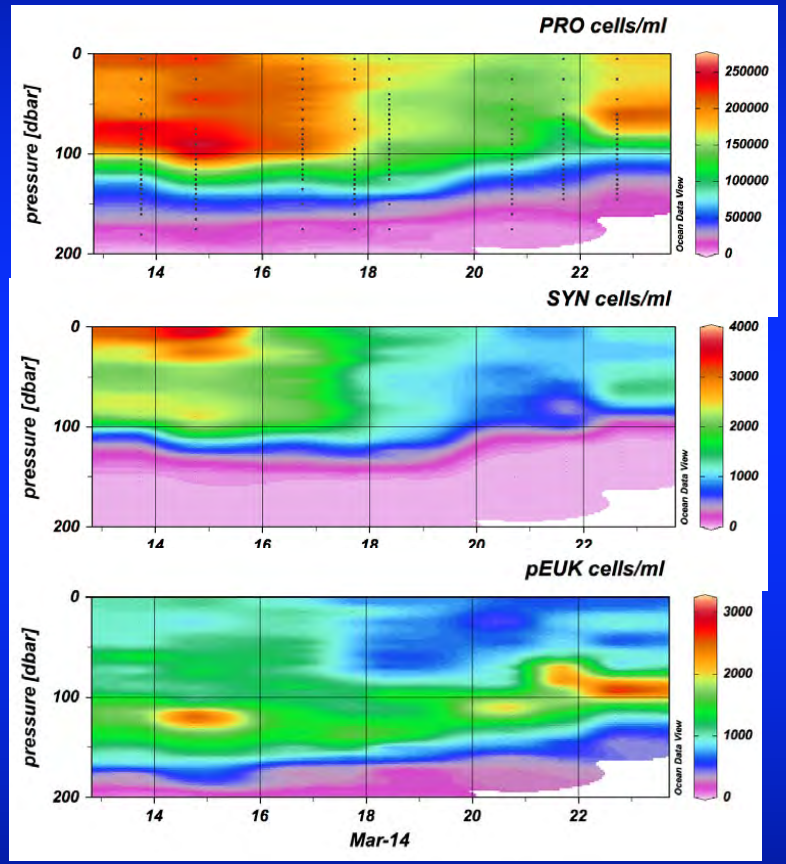
Examples from ALOHA



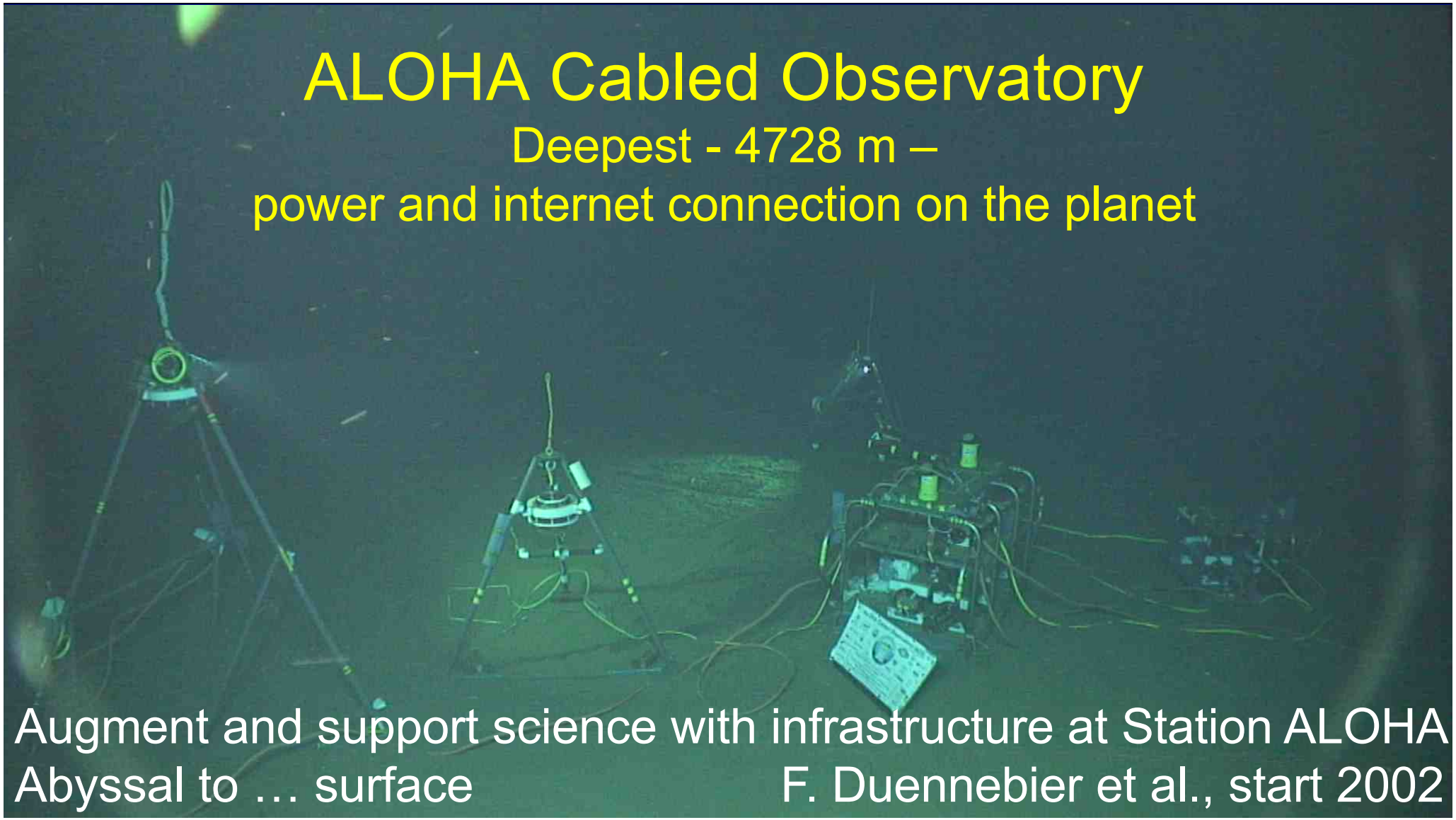
HOT
WHOTS
ACO
C-MORE
SCOPE
…

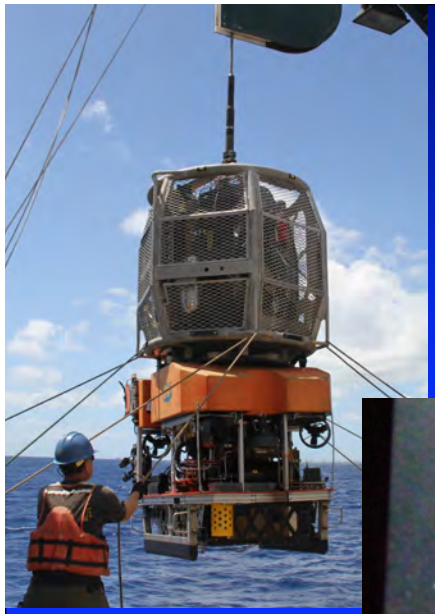


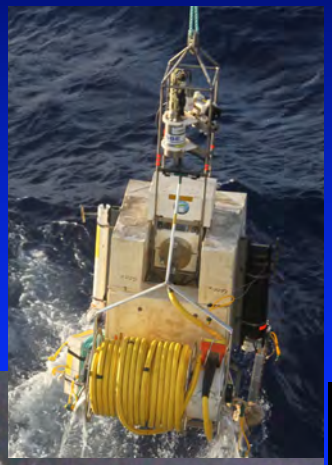
Microbial Community structure



HOE-BOE 1 Cruise, C-MORE

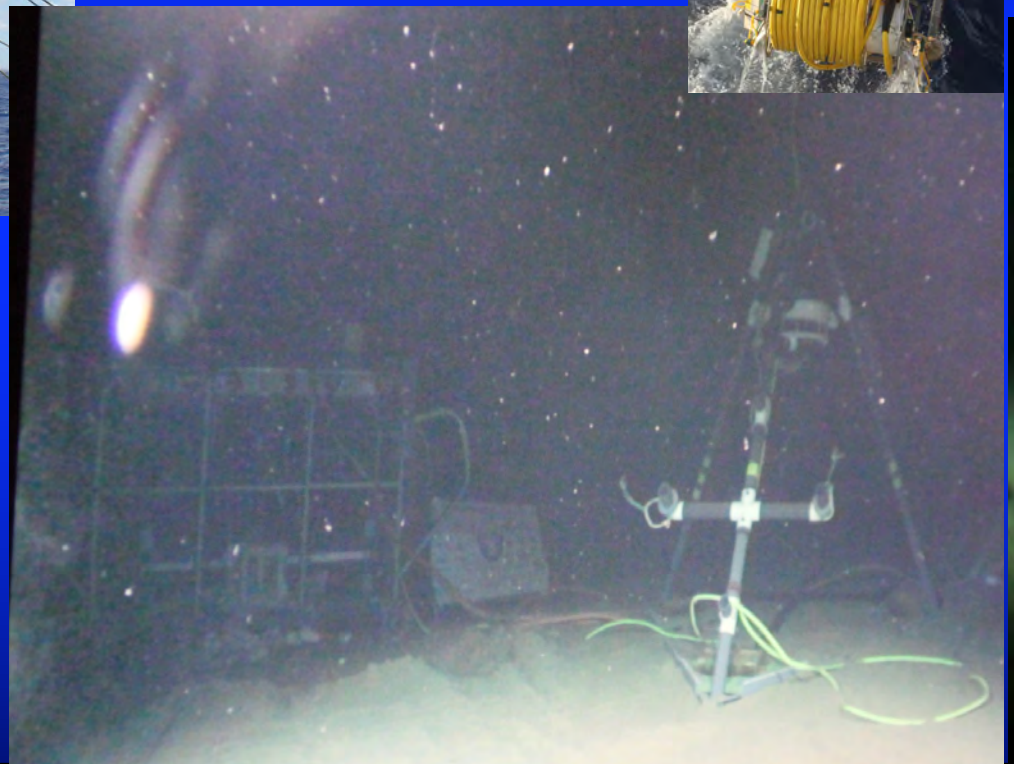

ALOHA Cabled Observatory
Deepest - 4728 m –
power and internet connection on the planet
Augment and support science with infrastructure at Station ALOHA
Abyssal to … surface
F. Duennebier et al., start 2002





ACO

Sept 2015 service
UH ROV *Lu'ukai*



Plan –
Add BSP2
Add LIGHT4
Recover:
CAM2,
BSP1,
LIGHT1

ACO

Installed
6/2011

Serviced
11/2014
9/2015

Camera-2
2 lights
hydrophone

Light-1

CT
ADCP
ADV
Light

Hydrophone
Pressure

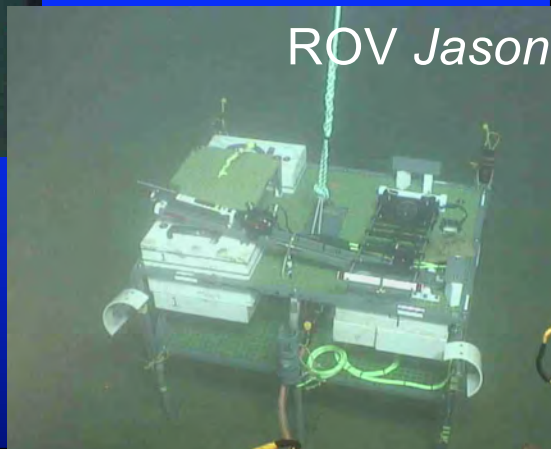
Camera-1
2 lights
hydrophone

4728 m

BSP2:
CTDO2, Pressure
FLNTU

BSP1:
CTDO2, ADCP
Modem, Pressure,
FLNTU

ROV *Jason*



Core measurements

- T, S, O2, v, chl a, turbidity, video, acoustics
- p, IES (depth integrating)
- Acoustic modem – acomms and nav (and IES)

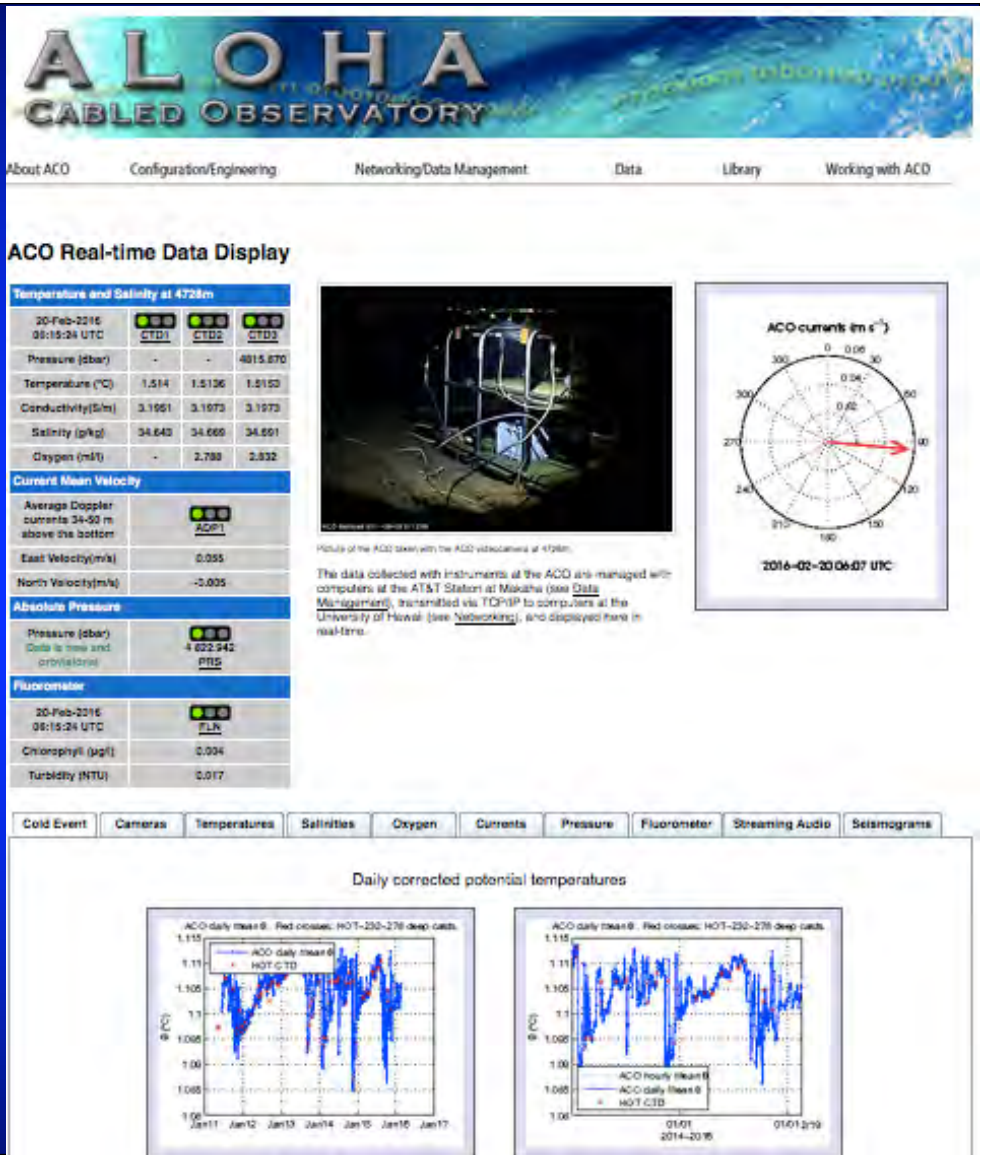
Data and results

ALOHA Cabled Observatory web site

aco-ssds.soest.hawaii.edu

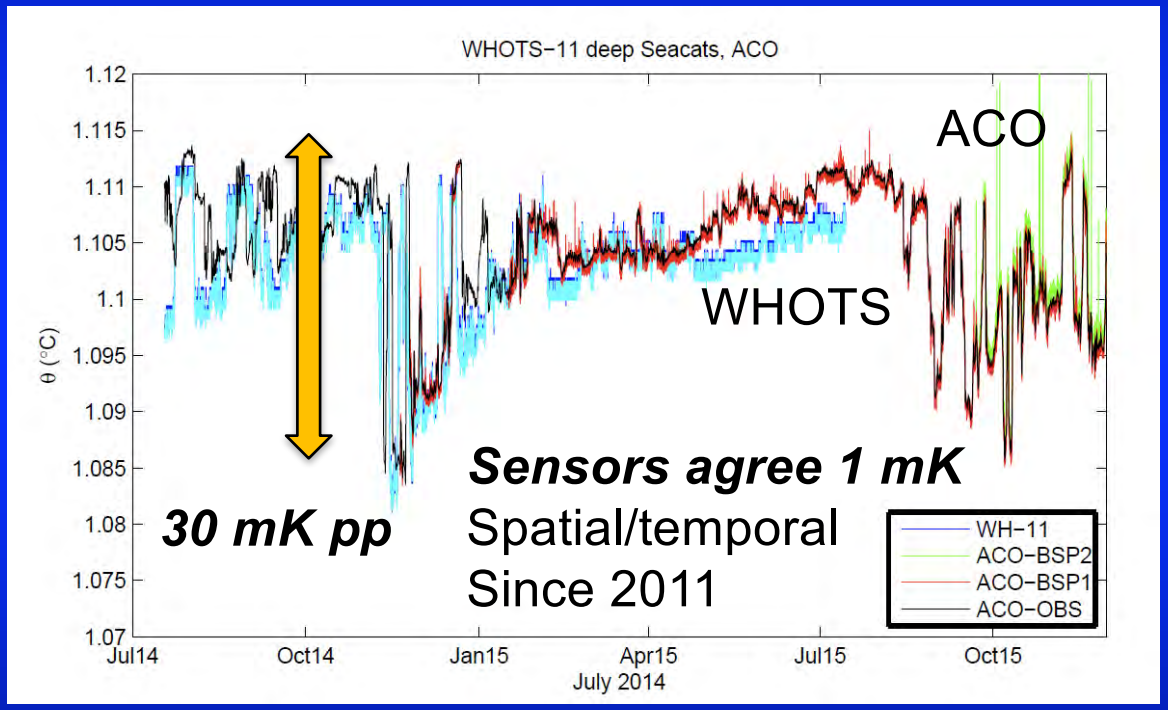
ACO Web Page

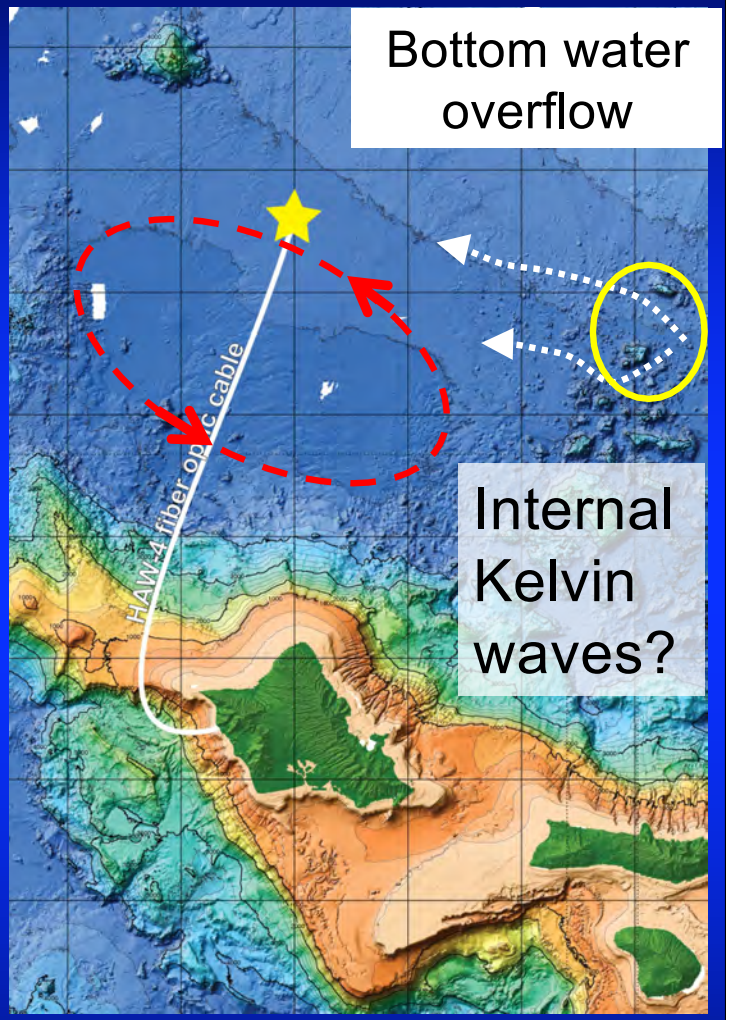
- Data
  - MBARI SIAM and SSDS 😀
  - Plots for last hour, … month
  - FTP for data
- Documentation
- Working with ACO
- aco-ssds.soest.hawaii.edu



Temperature variability

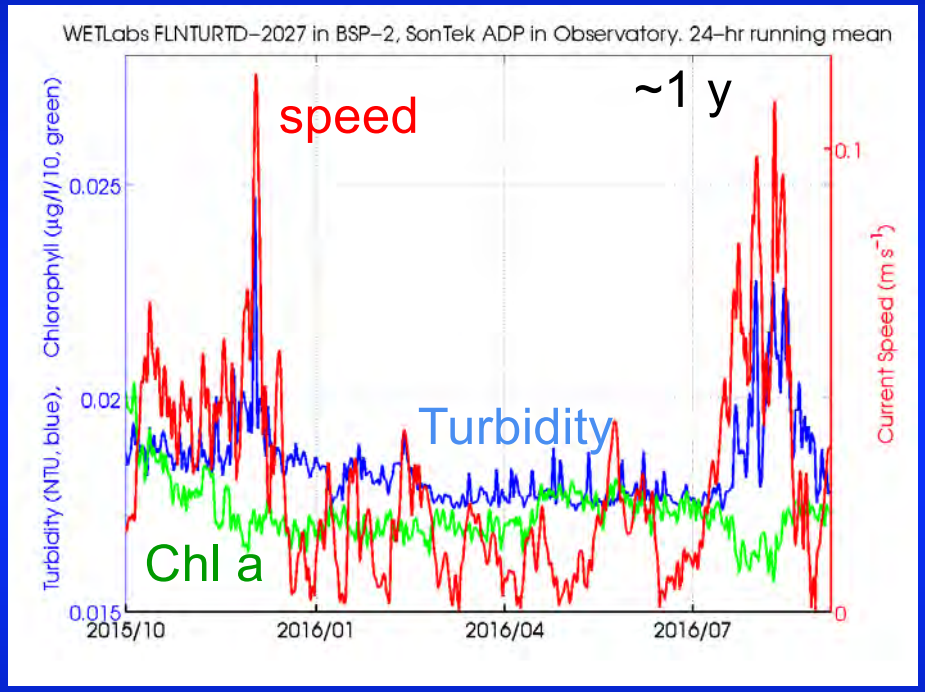
4700 m





Need sustained sampling

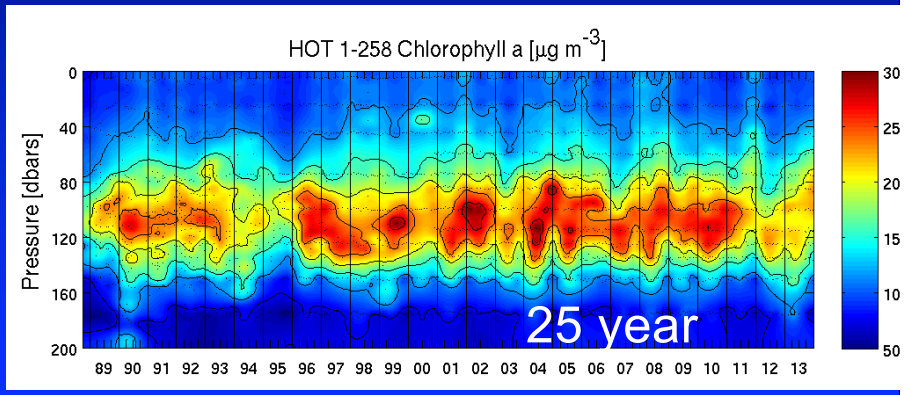
Turbidity and Fluorescence – chl a



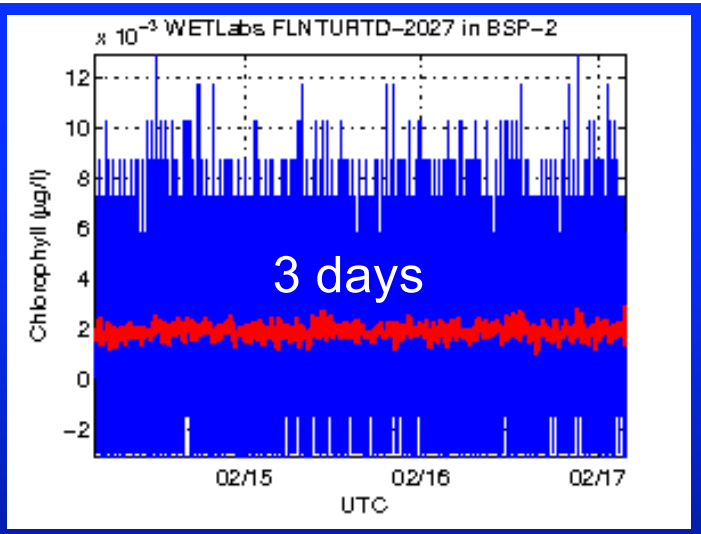
0 m

200 m

HOT – near surface



No events yet



Objective: Detect particle export events from (very) episodic surface blooms (Karl and Letelier)

Abyssal biology

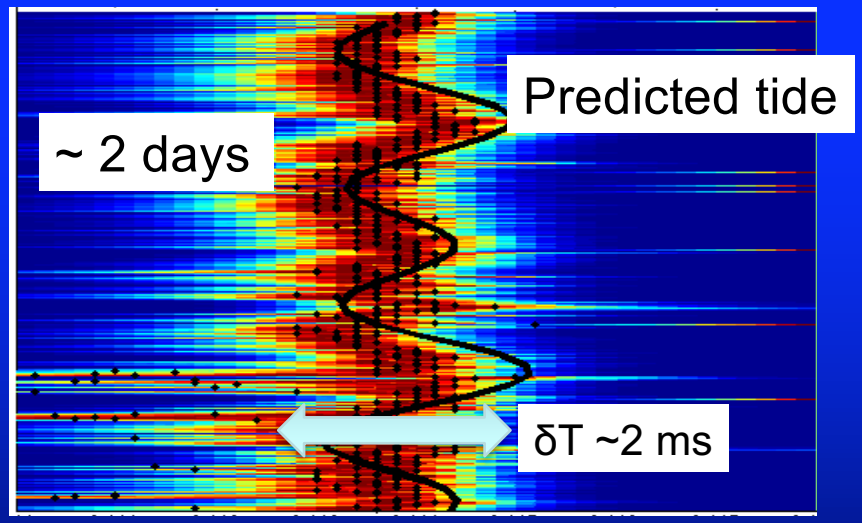
- June 2011 while lights working
- Lizard fish attacking Shrimp
- About 1 second
- Need for sustained continuous sampling
- Continuous high power and high bandwidth communications

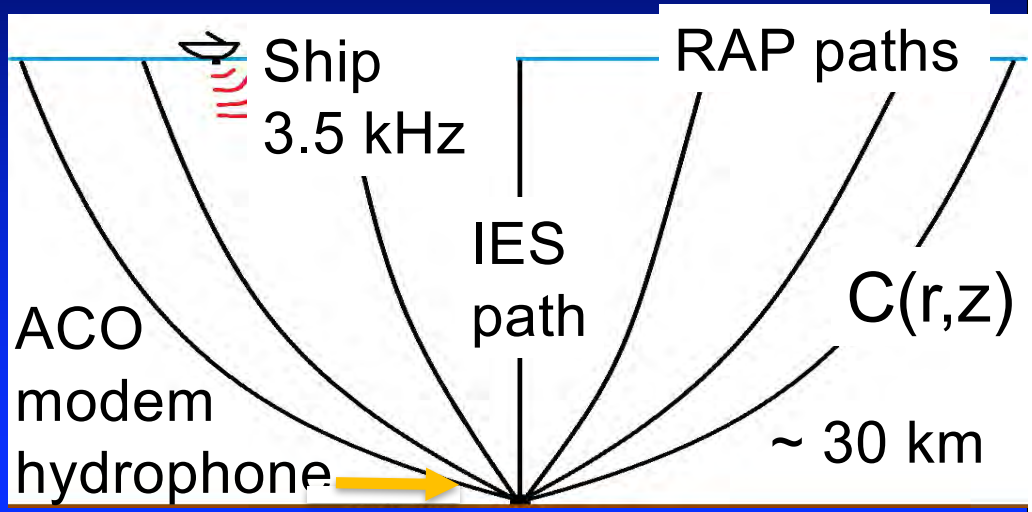
Howe, *Eos*, 2014

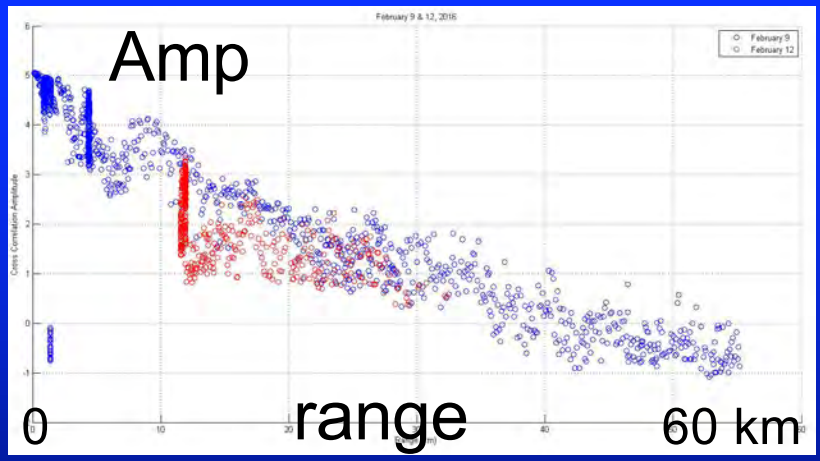
- J. Drazen and A. Fleury

Acoustics – toward depth averaged sound speed

ACO Modem
~ inverted echosounder







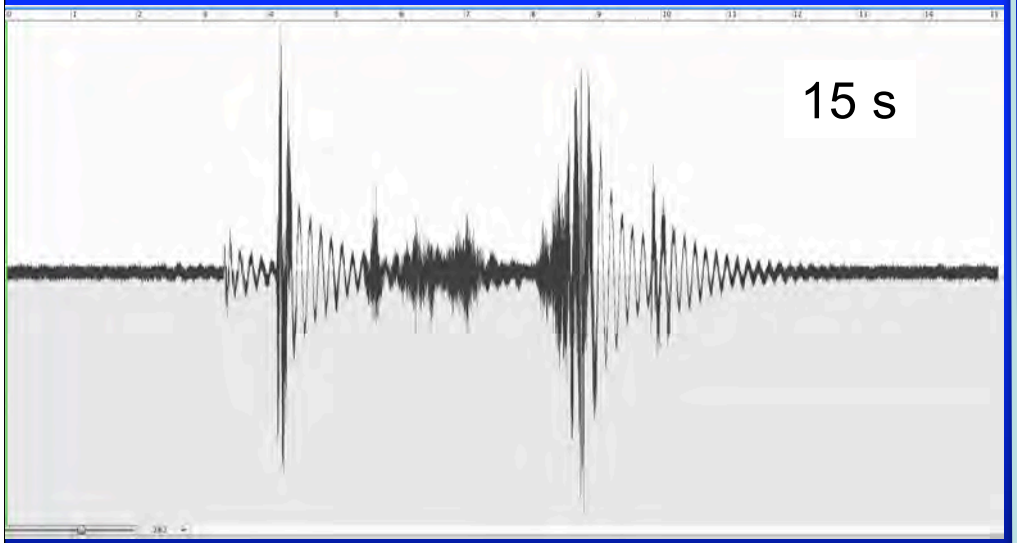
With Freitag and Singh

Varamo, ONR

Sounds (in addition to whales, ships, rain…)

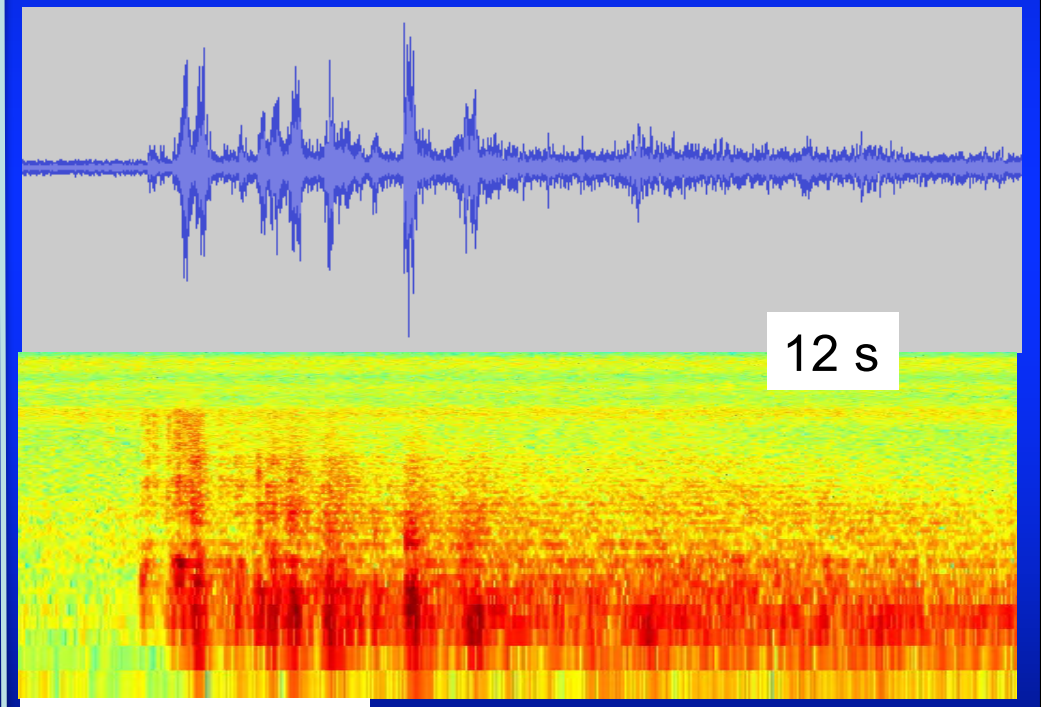
Animal scraping frame?

Higher frequencies –
Animal's body scraping frame?



~10 Hz – frame rocking resonance?

Thunder



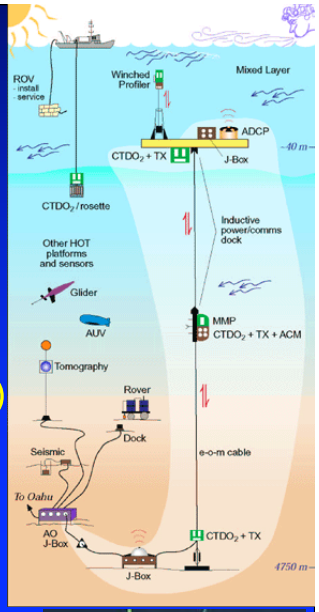
15 – 6000 Hz

Concluding remarks

ACO working from June 2011

Deepest power and internet on the planet, 4728 m

- Suite of bottom instruments – Most donated, thanks! ☺
  - Need dual sensors, acoustic modem/inverted echosounder, calibrated hydrophone, O2, …
  - However, challenges – cables, connectors, sensors, …, ROV, … deep test bed
- Science:
  - Bottom flow and mixing,
  - Deep biology,
  - Shallow-deep bio connections
  - Pressure (sea level, circulation, tides, tsunami, …),
  - Soundscapes, rain, wind, thunder, …
- Need direct access to upper ocean: profiler mooring
- *Need users – data and instruments – propose!*



ALOHA Cabled Observatory (ACO)

Station ALOHA 22° 45' N, 158° W, depth 4728 m
University of Hawaii
School of Ocean and Earth Science and Technology
http://ALOHA.manoa.hawaii.edu/ACO
Thank you for substantial support and/or in-kind donation

aco-ssds.soest.hawaii.edu

Station ALOHA web site

http://aco-ssds.soest.hawaii.edu/ALOHA/

ALOHA Cabled Observatory web site

aco-ssds.soest.hawaii.edu/dataDisplay.php

ACO

Installed
6/2011

Serviced
11/2014
9/2015

Camera-2
2 lights
hydrophone

Light-1

CT
ADCP
ADV
Light

Hydrophone
Pressure

Camera-1
2 lights
hydrophone

4728 m

BSP2:
CTDO2, Pressure
FLNTU

BSP1:
CTDO2, ADCP
Modem, Pressure,
FLNTU