

A New Profiling Float for Coastal and Upper Water Column Applications

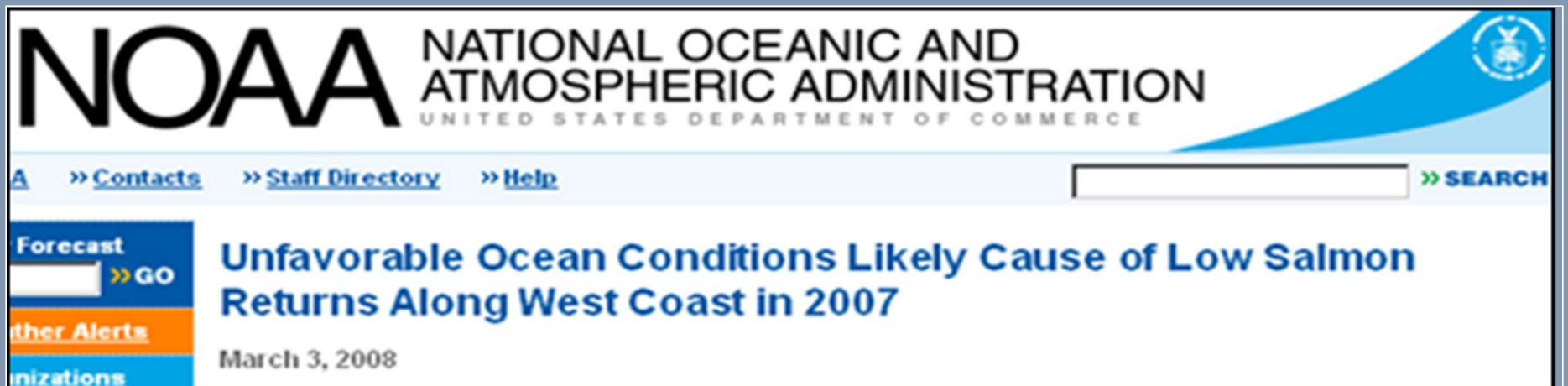
Gene Massion, Kenneth S Johnson, Eric J Martin,
Ed Mellinger, Paul McGill and Paul Coenen

Monterey Bay Aquarium Research Institute,
Moss Landing, CA, United States

Ocean Sciences Meeting, 20 February 2020



The Initial Motivation



"the widespread pattern of low returns along the West Coast for two species of salmon indicates an environmental anomaly [low nutrient production] occurred in the California Current in 2005."

More Motivation

“Further development of event-scale observing capacity (e.g., novel autonomous platforms) in all continental margin systems to better quantify impacts of episodic events on coastal carbon budgets”

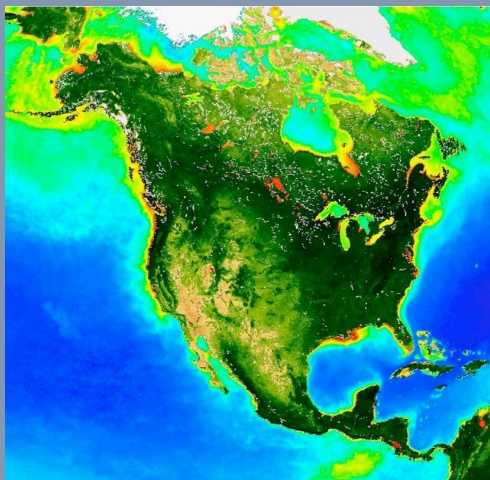
A Science Plan for Carbon Cycle Research in North American Coastal Waters 2016, Ocean Carbon and Bio. Program and NA Carbon Program



NSF'S 10 BIG IDEAS

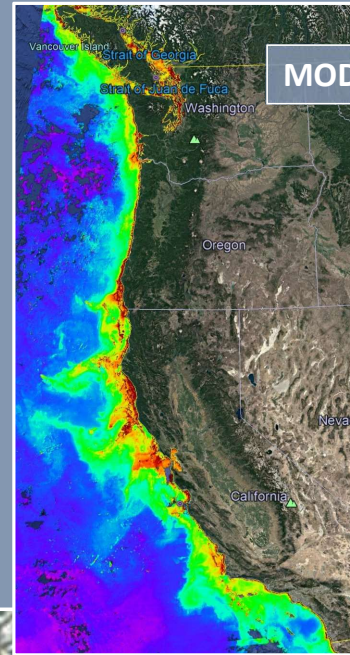
Navigating the New Arctic

“Current Arctic observations are sparse and inadequate for enabling discovery or simulation ... to assess their impacts on the broader Earth system”



Science Requirements

- A cost-effective, coastal ecosystem size observing system
- Sensor suite: CTD, O₂, pH, Nitrate, FL/BB and Optical Radiation
- Spatial Scale: coastal ecosystem, e.g., the west coast of North America
- Time Scale: up to 4 profiles/day (or more)
- 100s of profiles spread over several years
- Science targets: Fisheries, HABs, Oxygen Dead Zones, ...



MODIS Chlorophyll July 2019

Devastating toxic algae bloom plagues Florida's Gulf Coast

By TAMARA LUSH (AP), August 10, 2018

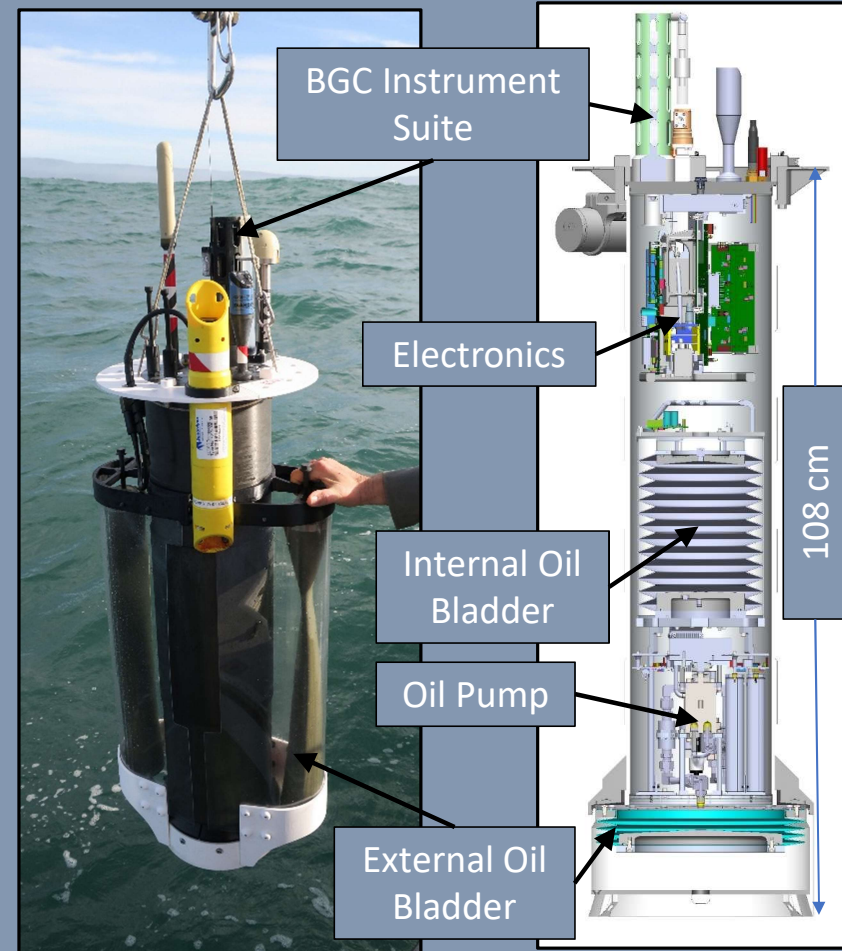


Declining oxygen in the global ocean and coastal waters

Denise Breitburg, et. al.,
Science 05 Jan 2018:
Vol. 359, Issue 6371

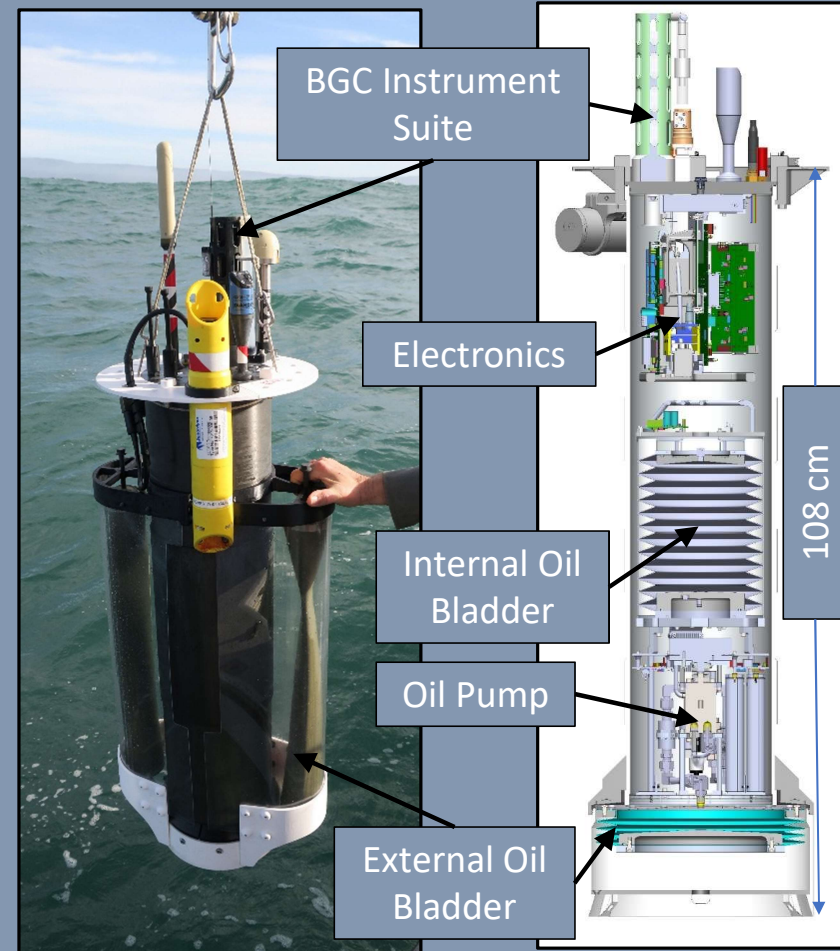
Current CPF Version 2.1 and 2.2

- Depth range = 0 to 350 meters



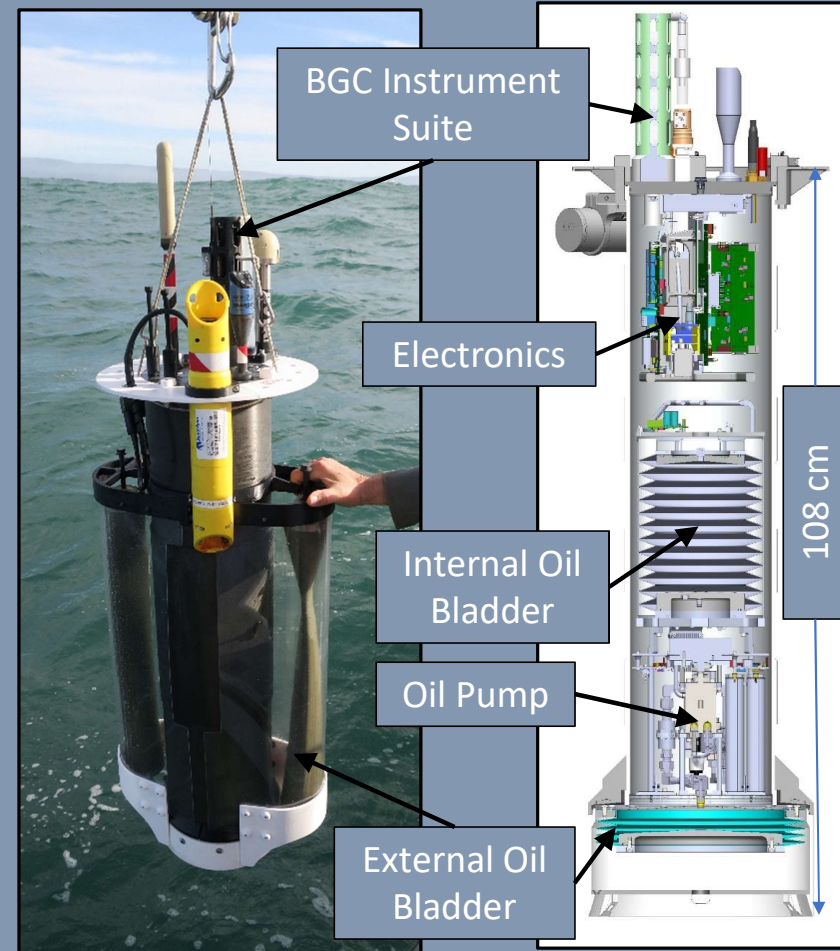
Current CPF Version 2.1 and 2.2

- Depth range = 0 to 350 meters
- **Buoyancy engine** $\Delta V/V = 3.5$ liters / 40 liters = 9%
 - Working density gradient = $1000 \text{ kg/m}^3 / 1025 \text{ kg/m}^3 = 2.5\%$
- Vertical velocity = zero to ~ 50 cm/sec
- Ability to anchor/deanchor
- Reserve buoyancy to offset biofouling



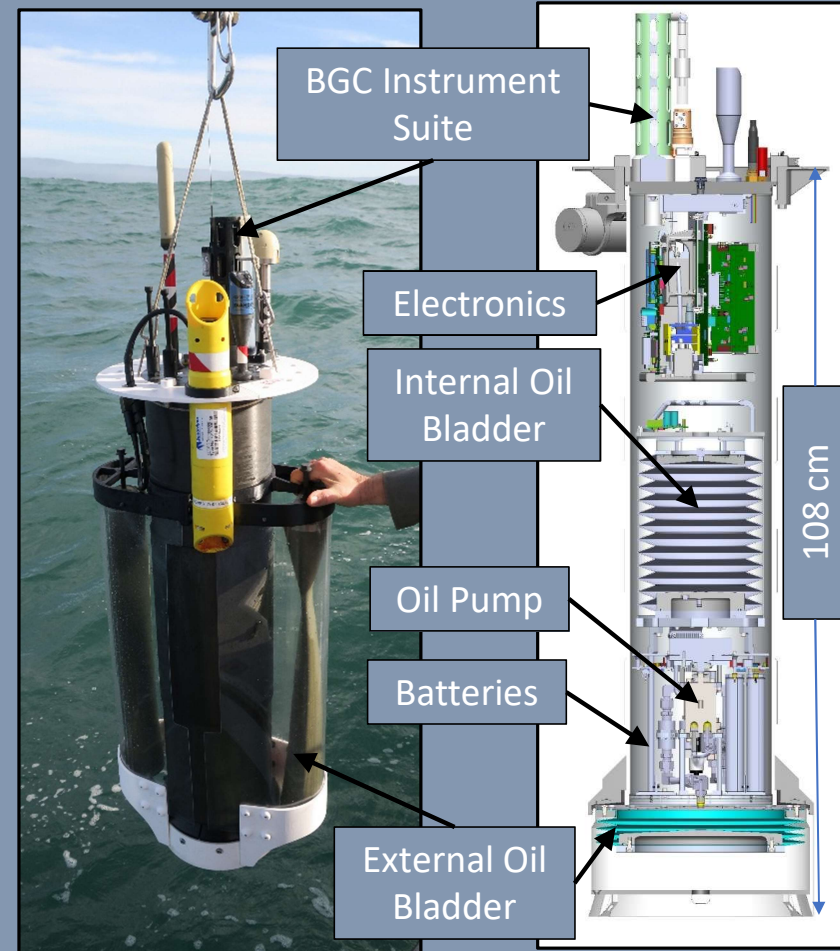
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- **Science Payload = 9 sensor ports: 6 BGC sensors plus 3 more**

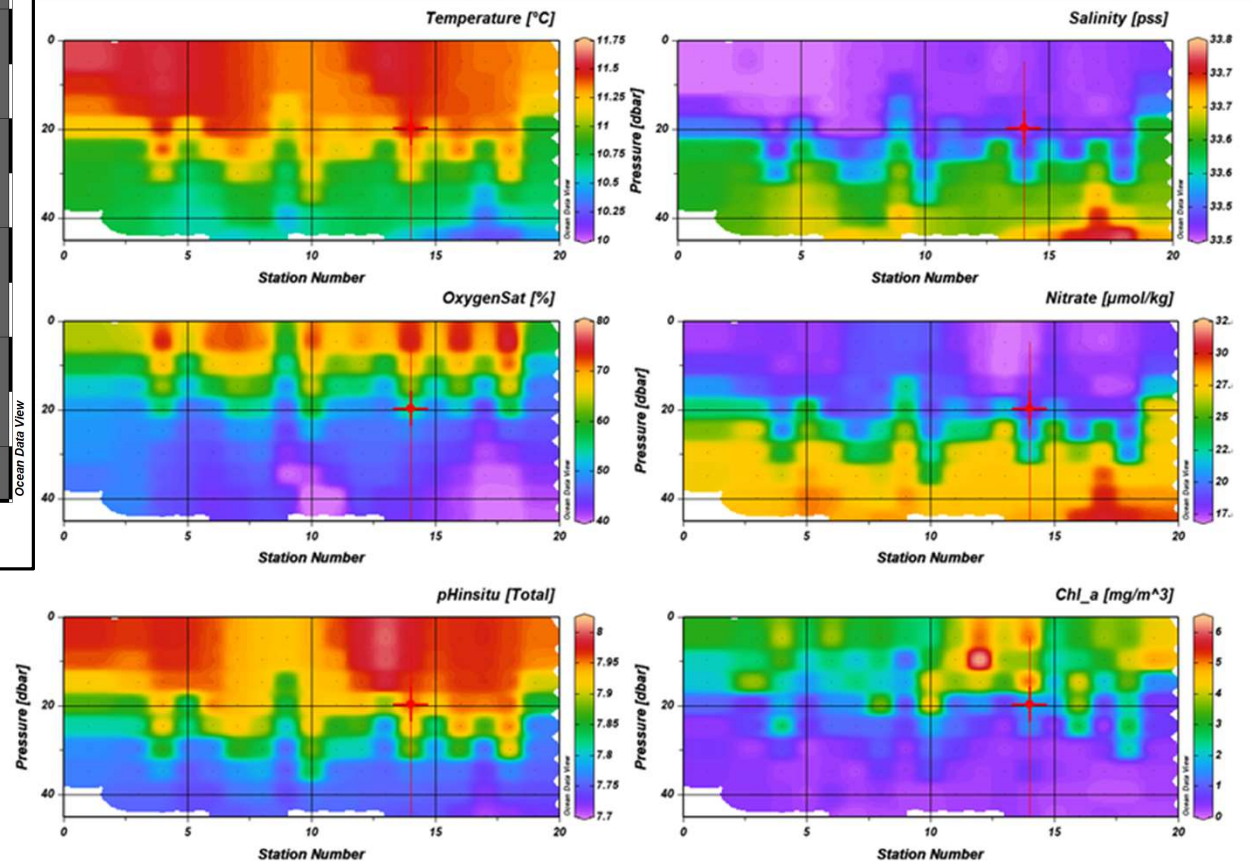
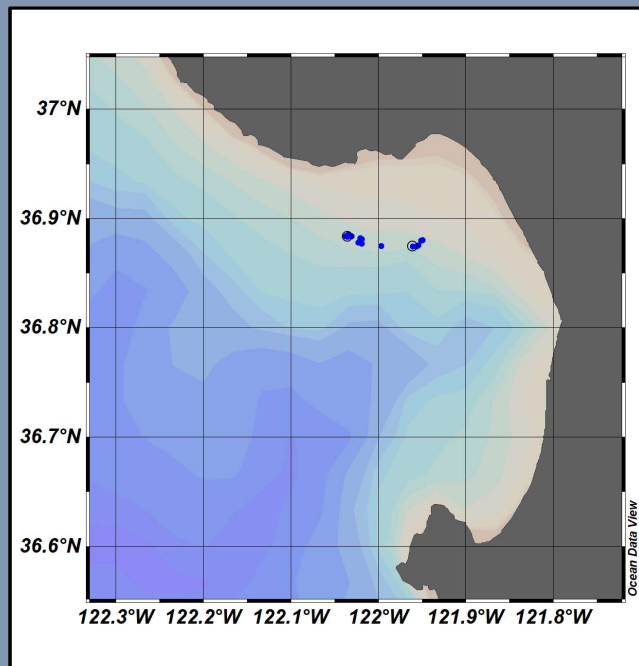


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- **Iridium SBD and RUDICS communications**



Science Data Products



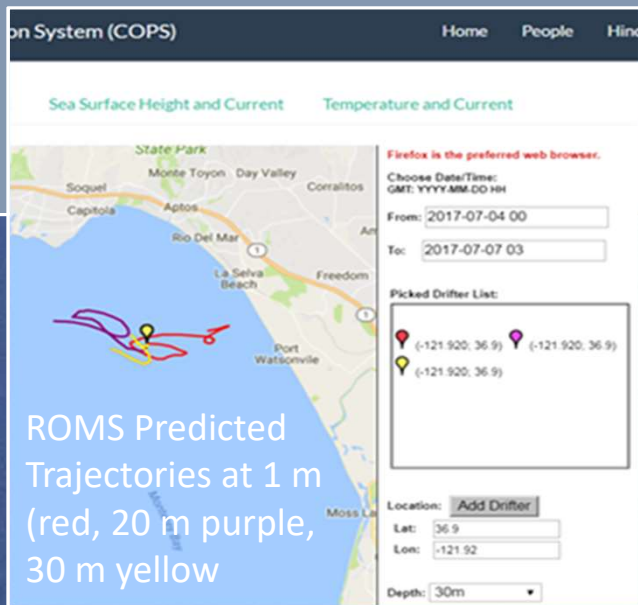
CPFViz

<https://www3.mbari.org/chemsensor/cpfviz.htm>

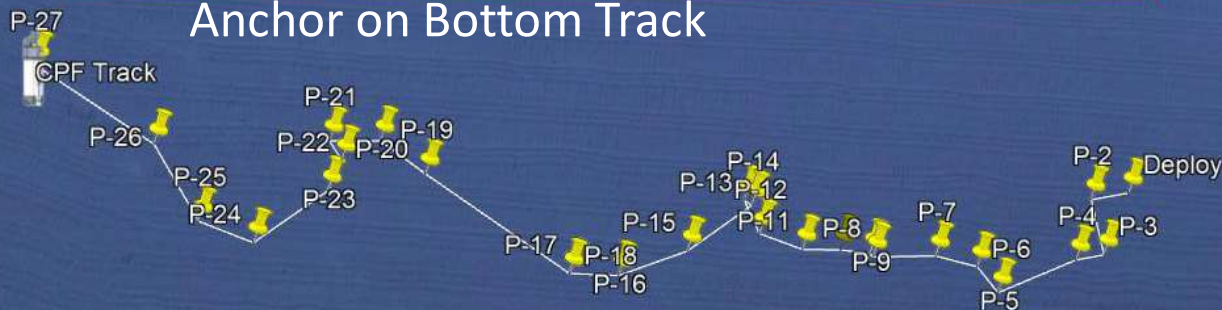
CPFViz - Data visualization for a Coastal Profiling Float				
Using Deep-Sea DuraFET pH sensors in Coastal Profiling Floats				
Quick Instructions				
Select Output Type and Send Request: Plot ↑ Text File ↓ SEND Raw Data or Adjusted Data: Raw ↑ Adjusted ↓ Data Quality Flag: All Data ↑ Good and Quest. ↓ Good Only ↓ What dates? All Dates available ↑ Week Ending on End Date ↓ Month Ending on End Date ↓ Specify Start/End Date ↓ Change dates: (MM/DD/YYYY) Start Date 09/17/2007 End Date	Select CPF Mission (ctrl click for more than one) CPF003_2021-9-16..... CPF003_2021-10-21..... CPF003_2021-11-2..... CPF003_2021-11-12..... CPF003_2021-11-16..... CPF003_2022-2-23..... CPF003_2022-3-14..... CPF003_2022-3-29..... CPF003_2022-4-25.....	Select One X Variable Depth[m] Pressure[dbar] Date Cycle Salinity[pss] Temperature[°C] Sigma_theta[kg/m^3] Oxygen[μmol/kg] OxygenSat[%] Nitrate[μmol/kg] Chl_a[μg/l] b_bp700[1/m] pHinsitu[Total] Lon [°E] Lat [°N]	Select Y Variables (ctrl click >1) Depth[m] Pressure[dbar] Date Cycle Salinity[pss] Temperature[°C] Sigma_theta[kg/m^3] Oxygen[μmol/kg] OxygenSat[%] Nitrate[μmol/kg] Chl_a[μg/l] b_bp700[1/m] pHinsitu[Total] Lon [°E] Lat [°N]	Autoscale X & Y axis : On Off Enter Ranges if Autoscale is Off (Min & max ranges default to 0 and 200 if Autoscale off and box is empty. Depth ranges are entered as negative values on Y axis and as positive values on X axis.) X Min: X Max: Y Min: Y Max: Y Stack: (In a single graph, multiple Y variables or multiple stations are stacked vertically if it is On) On Off Enter Min and Max Depth range for data used in Time Series Plot (X Var = Date) Min Depth: 0 Max Depth: 250

Float Navigation

- Experiment: Park the CPF at various depths and compare track to ROMS nowcast and previous missions that anchored on the bottom after every profile



March 2017 Un-navigated,
Anchor on Bottom Track

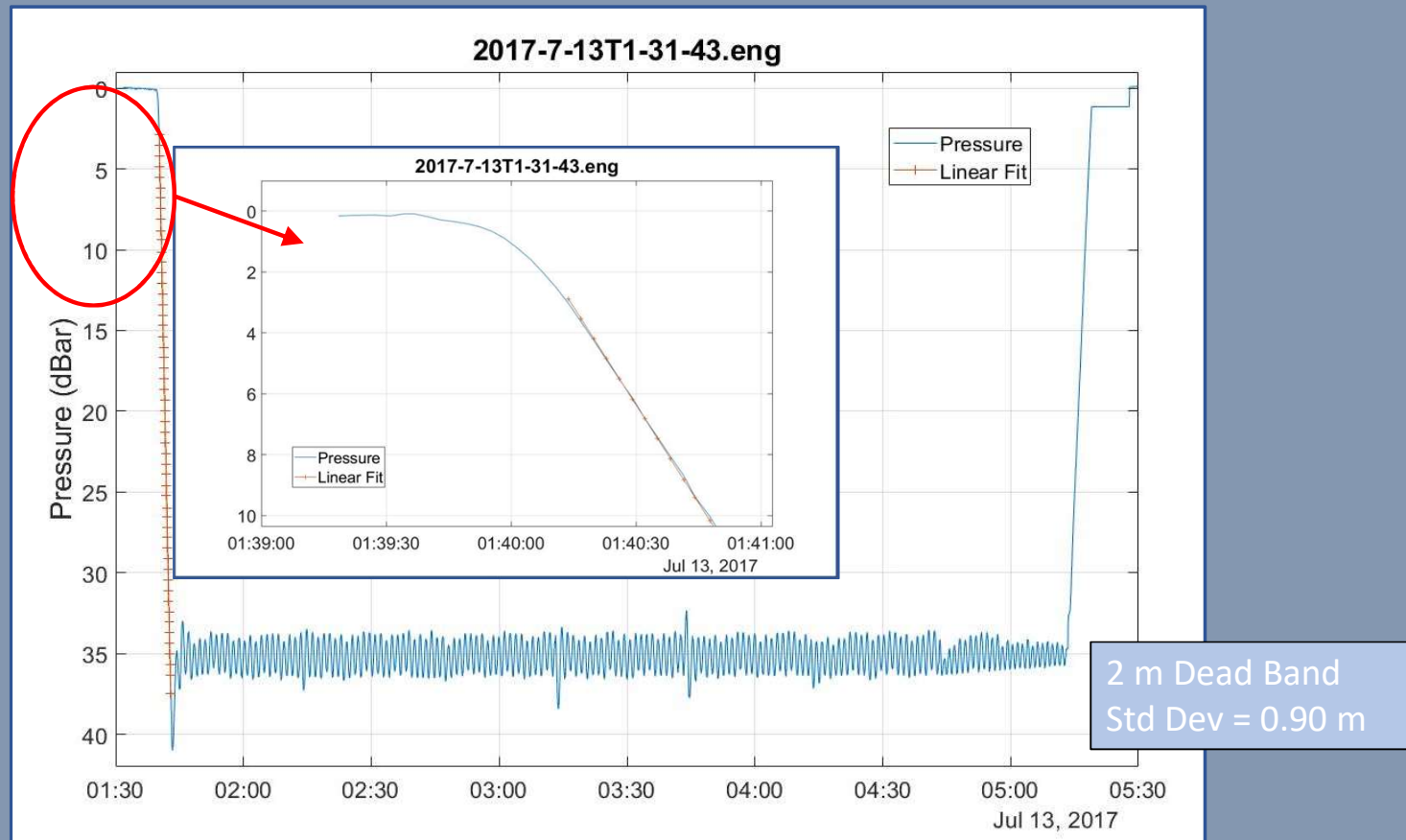


5km



July 2017 Navigated, Park at
User Specified Depth Track

Engineering Results



More Engineering Results



A Pickup Truck for the Sea?



Next Steps

- Run science missions with all 3 of our CPFs
 - The influence of lateral nutrient transfer from upwelling plumes versus canyon upwelling on the development of high chlorophyll levels in the Monterey Bay “upwelling shadow”

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- **Make the CPF tech. available to the community**