A New Profiling Float for Coastal and Upper Water Column Applications

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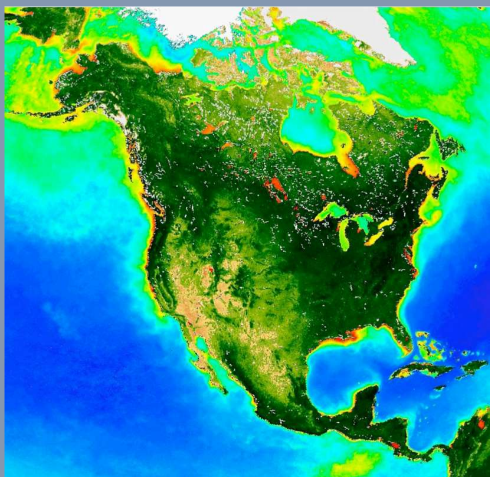
Monterey Bay Aquarium Research Institute, Moss Landing, CA, United States

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

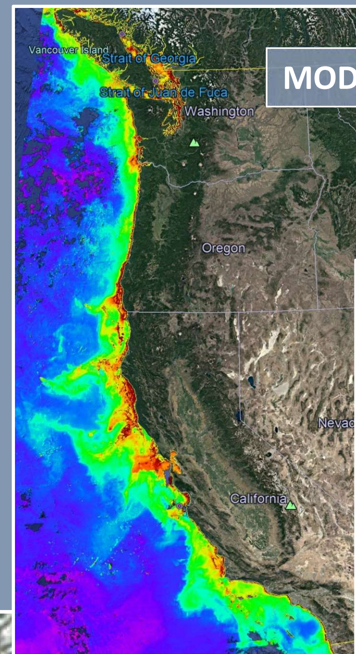
NSF'S 10 BIG IDEAS

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, O_2, 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

Risks and Relevant Examples

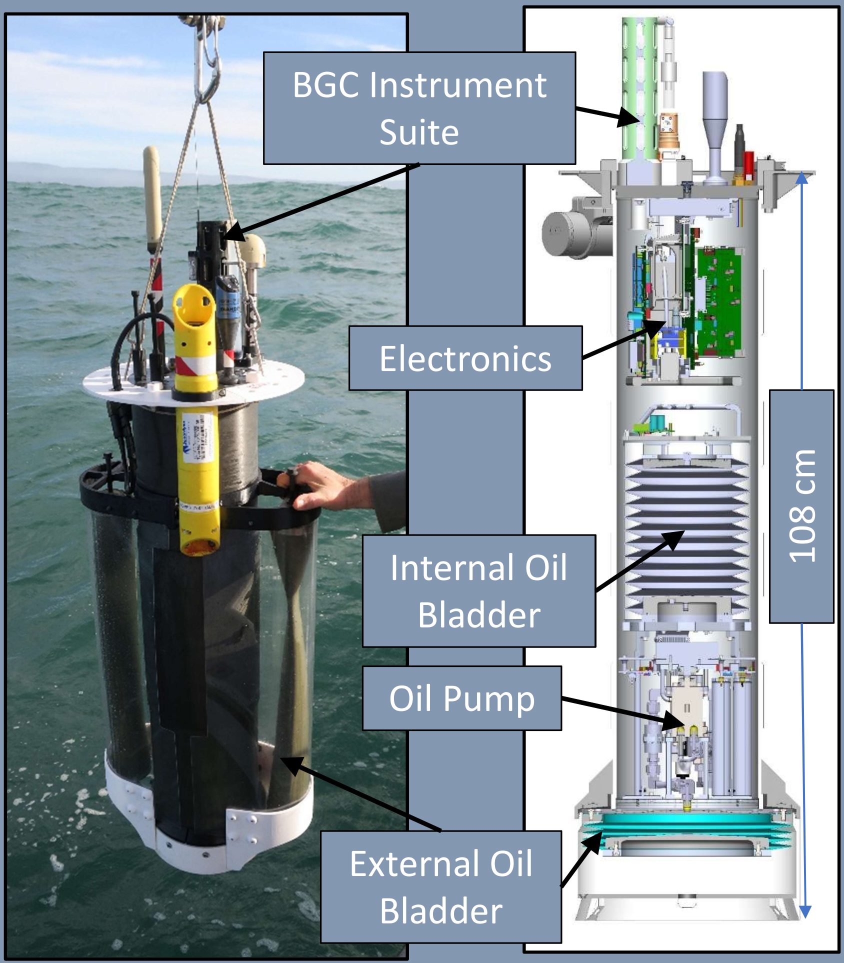
- Risks:
  - Working in shallow, coastal water
    - Can't drift on or off-shore
    - Need accurate velocity and depth control
  - Biofouling
- Relevant Examples:
  - Profiling Floats have proven to be very effective in deep water and open ocean applications, e.g. Argo and SOCCOM
  - Coastal Floats: Univ of SF BSOP, NKE Arvor-C, MRV Alamo, etc.

USF BSOP

NKE Arvor-C

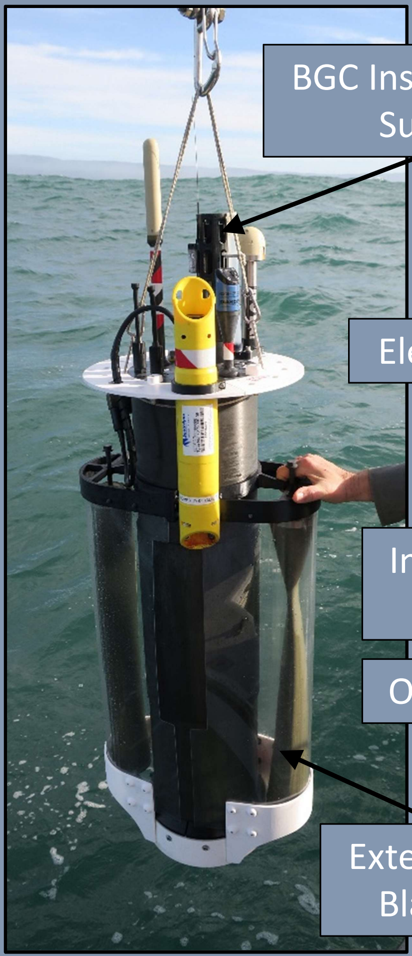
Current CPF Version 2.1 and 2.2

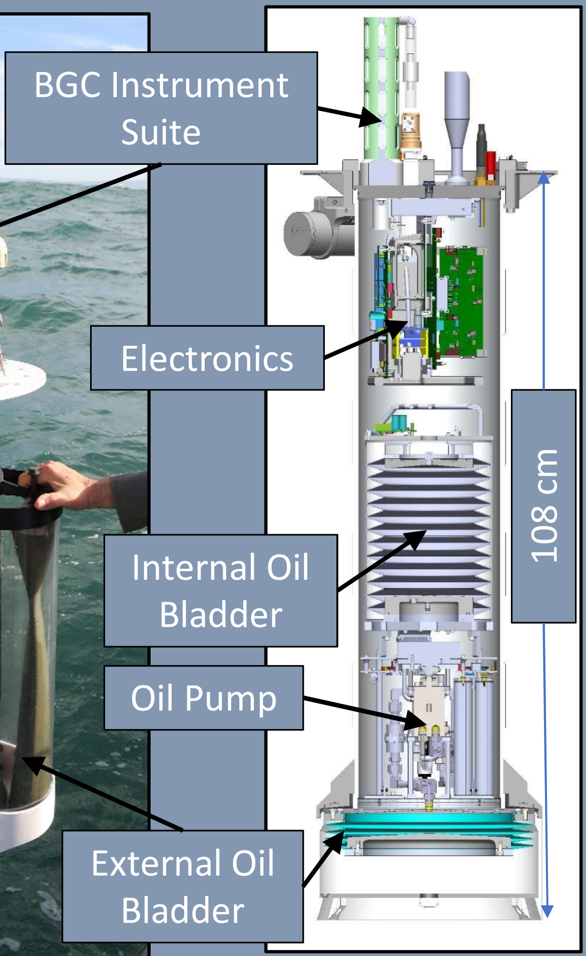
- **Depth range = 0 to 500 meters**



Current CPF Version 2.1 and 2.2

- Depth range = 0 to 500 meters
- **Buoyancy engine ∆V/V = 3.5 liters / 40 liters = 9%**
  - **Working density gradient = 1000 kg/m³ / 1025 kg/m³ = 2.5%**
  - **Vertical velocity = zero to ~50 cm/sec**
  - **Ability to anchor/deanchor**
  - **Reserve buoyancy to offset biofouling**





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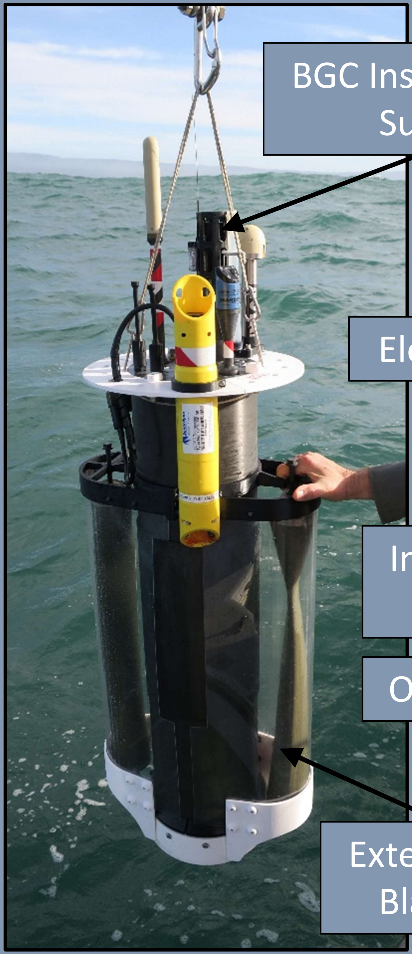

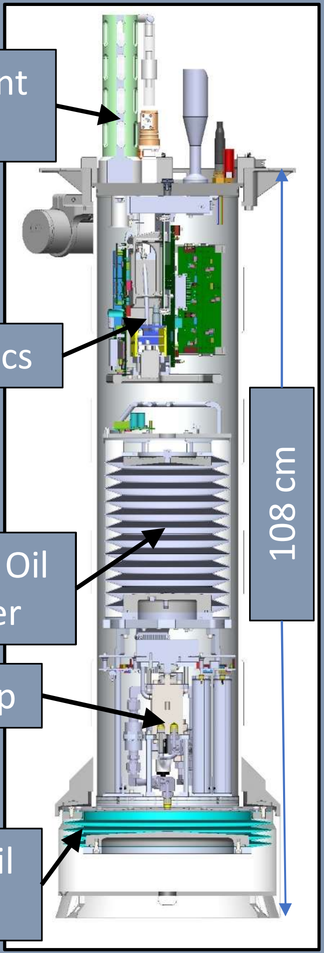

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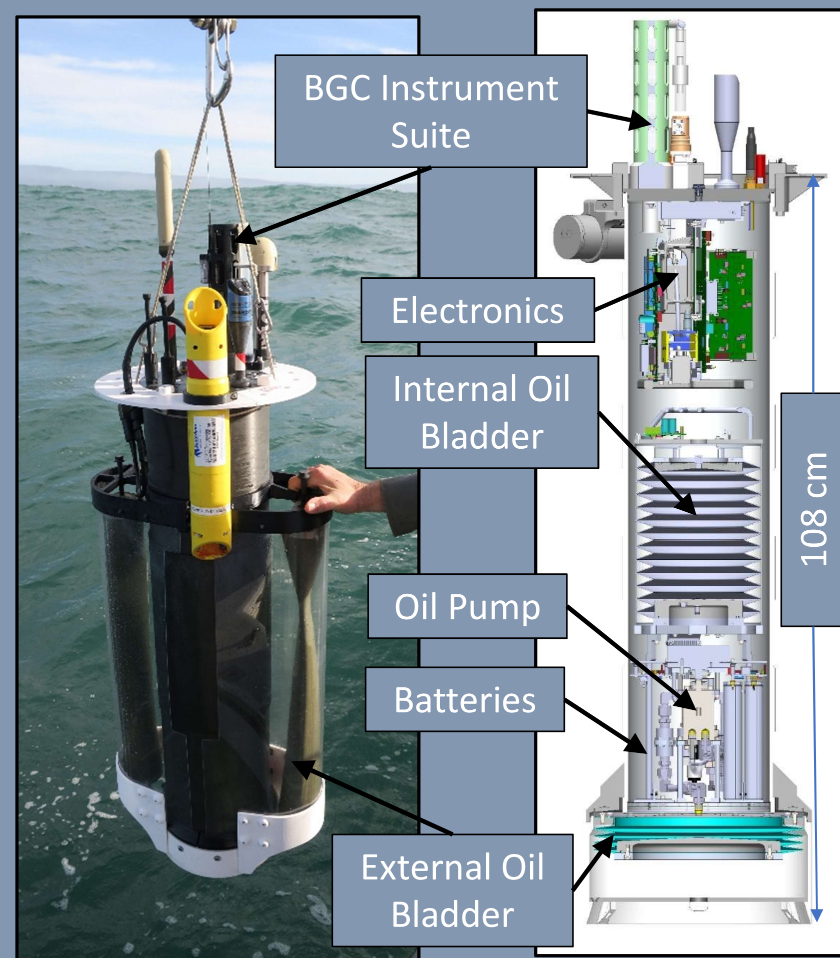
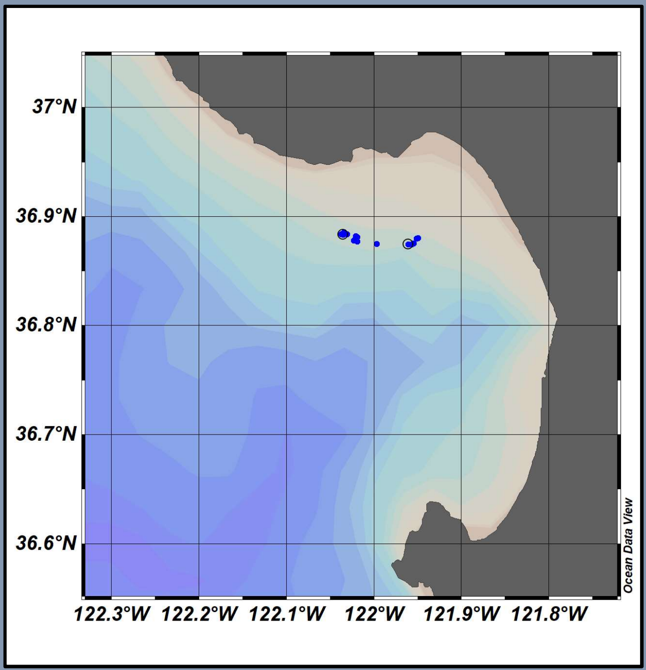
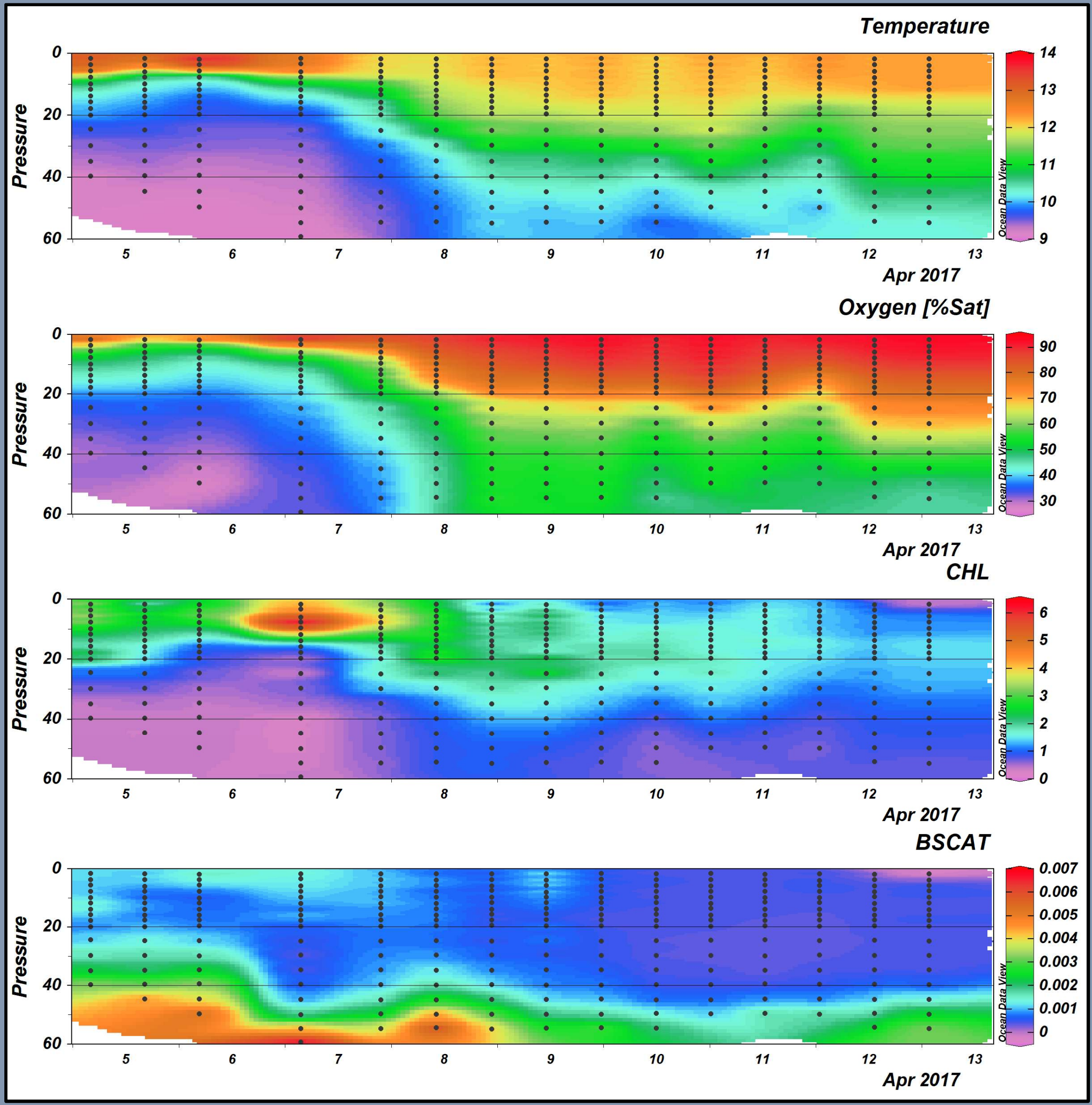
- **Iridium SBD and RUDICS communications**



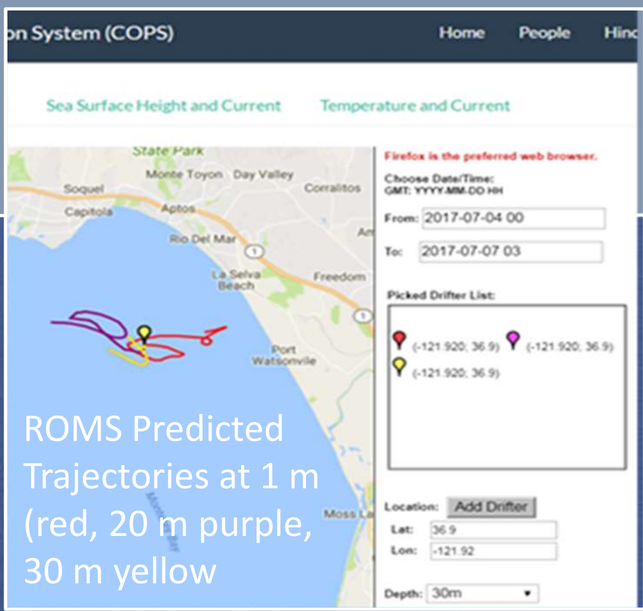
Science Data Products



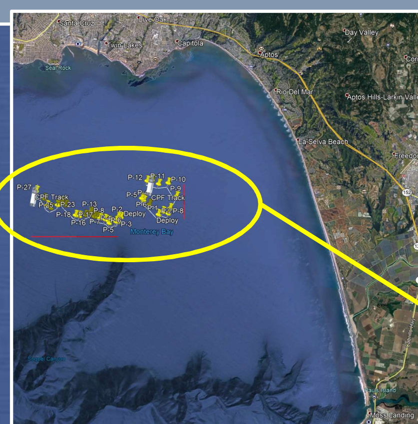


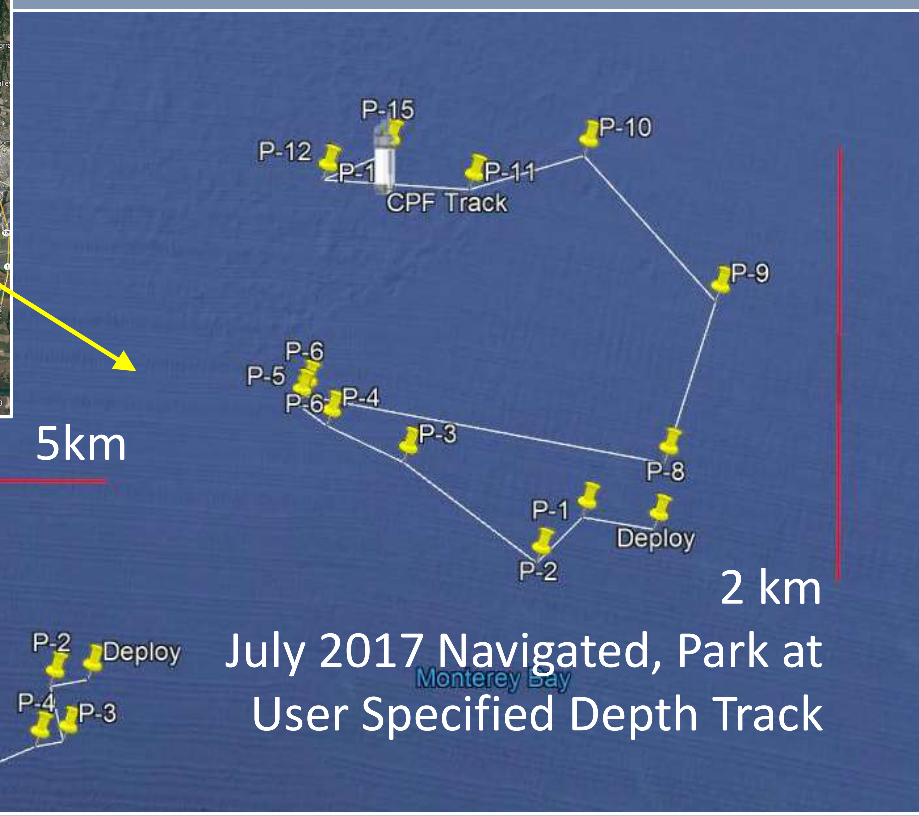
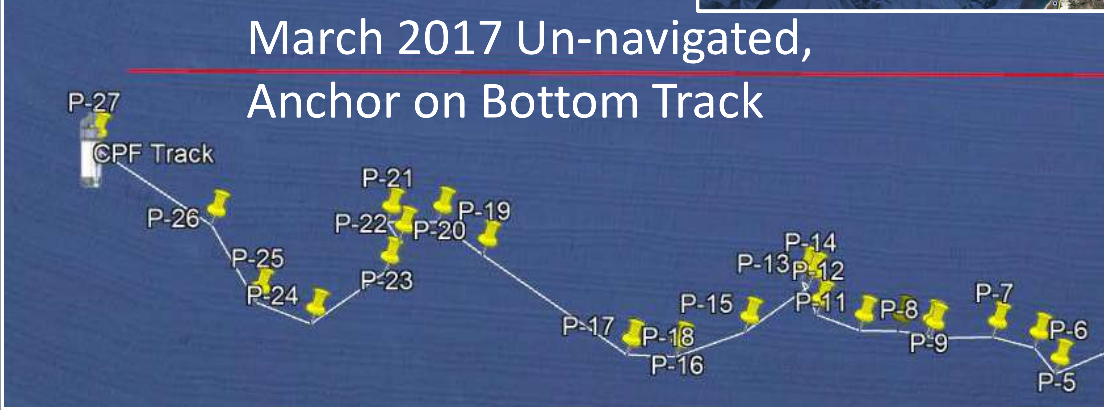
Float Navigation

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



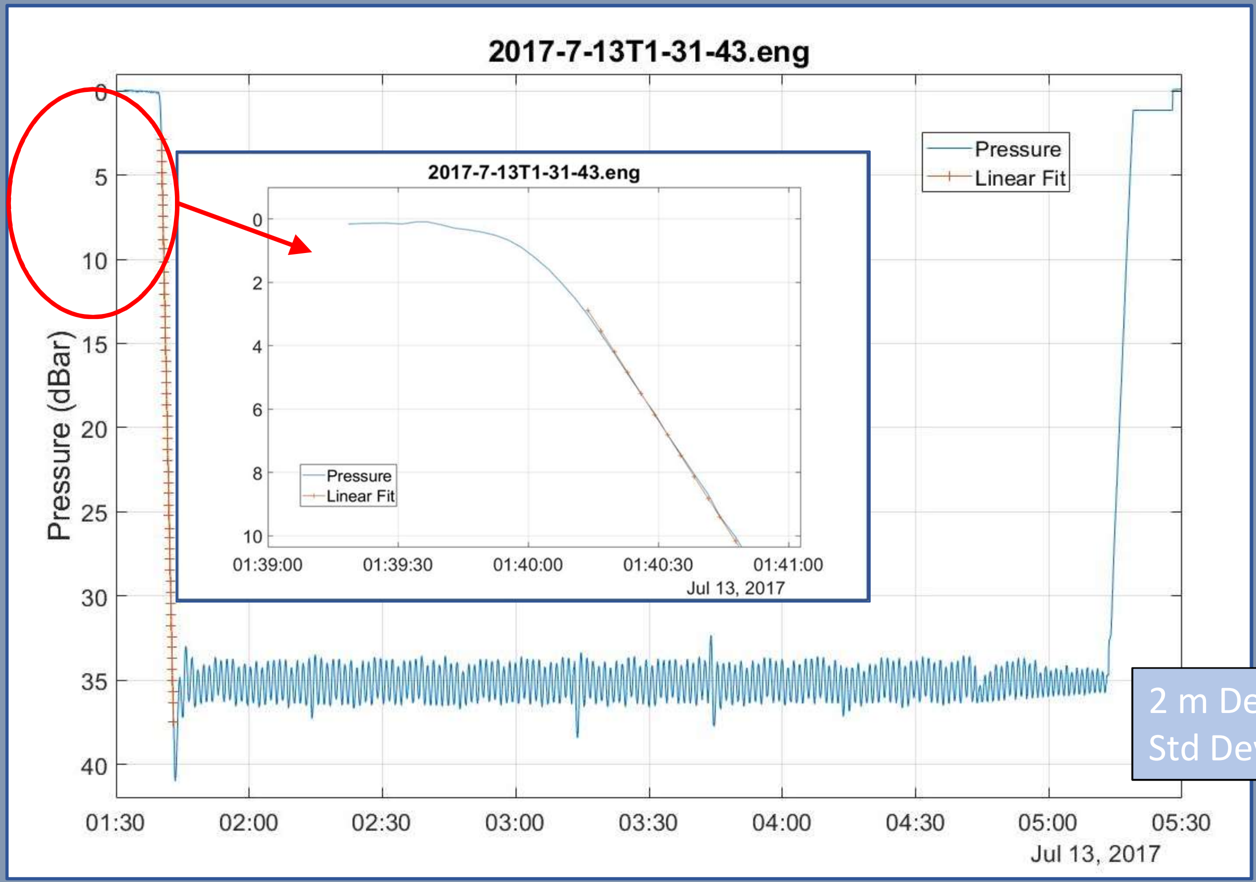
ROMS Predicted Trajectories at 1 m (red, 20 m purple, 30 m yellow



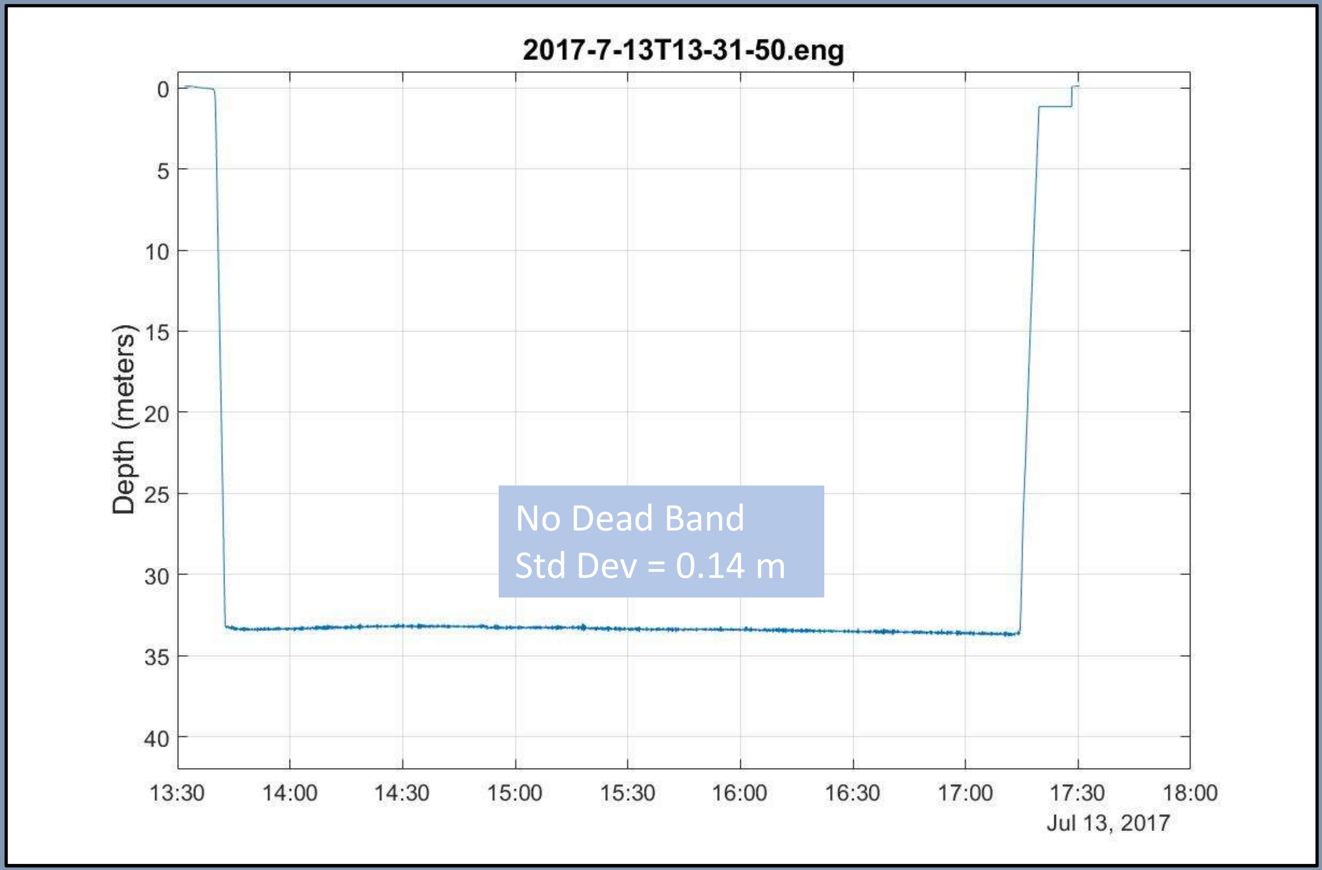
July 2017 Navigated, Park at User Specified Depth Track

Engineering Results



2 m Dead Band
Std Dev = 0.90 m

More Engineering Results



One More Engineering Results

CPF V1.1 with sediment trap and acoustic modem

Next Steps

- Run science missions with all 6 sensors
  - 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**

Acknowledgements

- The CPF Village also includes: Jerry Allen, Larry Bird, Luke Coletti, Jared Figurski, Tom Marion, Jim Montgomery, Mike Parker, Josh Plant, Erich Rienecker, Jose Rosal, Aaron Schnittger, Ray Thompson and Mark Tynes
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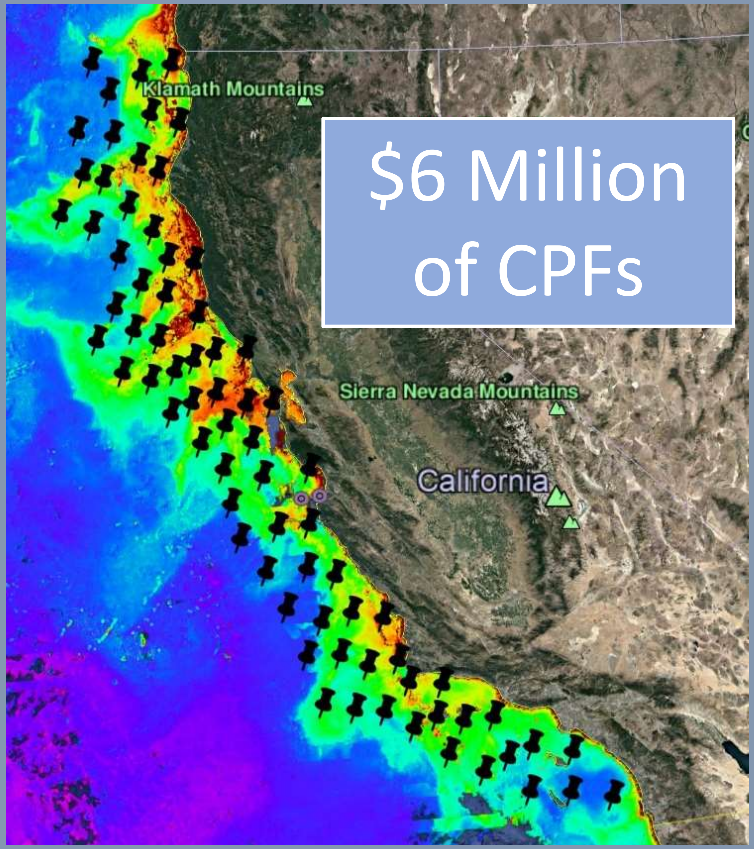

Thank you

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