



# Use of Profiler Moorings in the Ocean Observatories Initiative



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## Abstract

This Mini Review is intended to describe the history, design, and summarize the performance of one class of mooring used by the Ocean Observatories Initiative.

**Keywords:** Ocean Observatories Initiative; Observatory; Mooring; Buoy

**Abbreviations:** OOI: Ocean Observatories Initiative; NSF: National Science Foundation; WHOI: Woods Hole Oceanographic Institution; WFP: Wire Following Profilers; MMP: McLane Moored Profiler; ADCP: Acoustic Doppler Current Profiler; GPS: Global Positioning System

## Introduction

The Ocean Observatories Initiative (OOI) [1], supported by the National Science Foundation, is directed to operate and maintain arrays of moored and mobile assets in four locations around the globe. These locations include two coastal arrays off the east and west coasts of the United States and two global arrays in the Irminger Sea, and North Pacific. These arrays are currently functional, supplying oceanographic data to the scientific community in near real time. There are several types of moorings continuously deployed in these locations. The Coastal Profiler Moorings [2] are instrumented and designed to resolve compelling scientific “Essential Ocean Variables” through sustained measurements of ocean processes and properties. The OOI represents the result of more than two decades of scientific planning, leading to a deployed operating infrastructure based on science requirements derived from science themes. The OOI has an expected operation of 25 years or more, and data are freely available to users via the Internet. Wire Following Profilers have been in continuous operation at the Pioneer Array [3] since April of 2014 (Figure 1).

## Discussion

The OOI Wire Following Profiler Mooring is a combination of prior art and a commercially available product. The “Whale Detection Mooring” [4] designed and operated by Woods Hole Oceanographic Institution (WHOI) was adapted as a near real-time platform for a McLane Moored Profiler [5] (MMP). Profiler Moorings consist of a surface buoy containing batteries, single-board computer, and telemetry modules (GPS, Iridium ISU,

Iridium SBD, Wi-Fi, Free Wave Radio, Radar Target Enhancer, and a XEOS KILO beacon). The mooring riser includes a 50-foot stretch hose that serves as a compliant member to de-couple surface motion from the remainder of the mooring. The stretch hose includes electrical conductors to transmit data from the instruments. A 64” syntactic foam sphere provides tension for the inductive 5/16 jacketed wire rope that the Wire Following Profiler (WFP) climbs up and down. The wire rope, along with the seawater ground, provides the inductive pathway to transmit data from both the WFP and Teledyne RDI Acoustic Doppler Current Profiler (ADCP). There are two acoustic releases above the anchor which allow the riser portion to be detached from the anchor for recovery. The second acoustic release allows a line pack, attached to the anchor, to float to the surface so that the 6000 lbs. anchor can be recovered separately using a heavy lift winch.

## WFP Sensor Package

McLane Moored Profilers include:

- i. CTD – Sea Bird 52MP pumped CTD with attached
- ii. Sea Bird 43F Dissolved Oxygen sensor
- iii. Fluorometer - WetLabs ECOBBFL2
- iv. Acoustic Current Meter – Nortek Aquadopp2DVS
- v. PAR (Photosynthetic Available Radiation) sensor – Biospherical Instruments QSP-2200

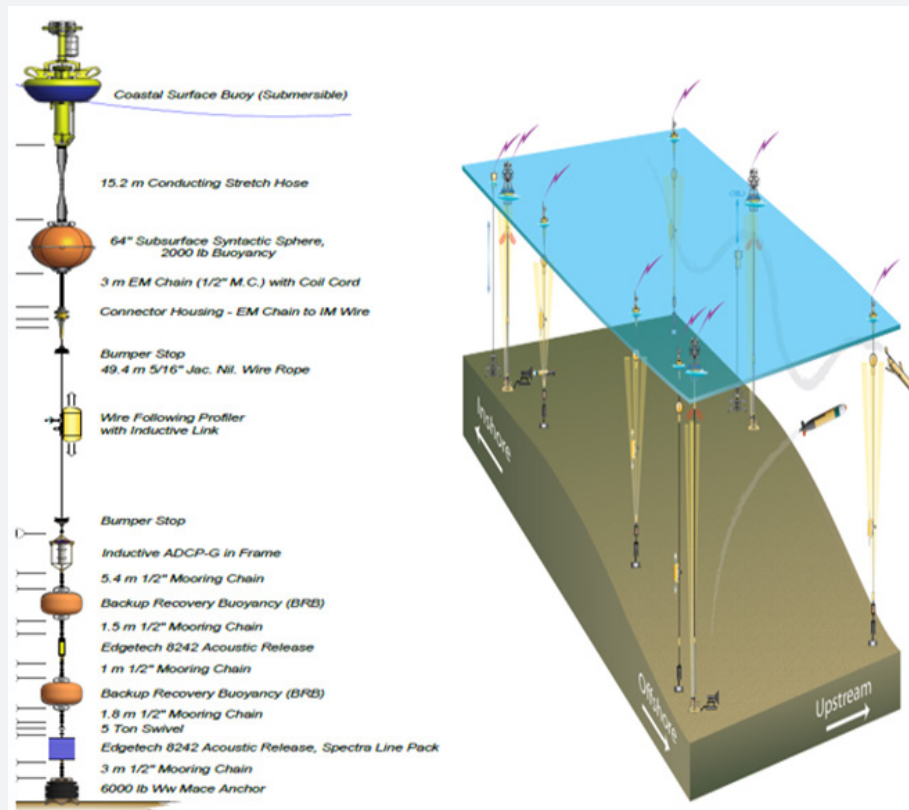


Figure 1: Mooring Schematic and Pioneer Array Isometric Diagram.

Profilers Moorings are serviced approximately every 6 months. Deployed moorings are recovered, and newly refurbished moorings are redeployed in nominally the same location. During the refurbishment period all batteries are replaced, instruments returned to vendors for recalibration. Telemetry and riser components, including the stretch hose, are inspected and serviced. Inductive wire rope and chain sections are replaced. Anchors, buoyancy spheres and buoy flotation foam are cleaned and painted. Buoys and instruments are reintegrated and burned-in for several weeks prior to redeployment.

**MMP Missions**

Profilers that operate in depths shallower than 200 meters are programmed to make full profiles every 90 minutes. The collected profile data is inductively transferred to the surface buoy every other dive. When the surface buoy is woken up by the profiler it initiates an Iridium data call to the OOI servers. Profilers (CP02PMUO and PC04OSPM) operating in water deeper than 200 meters perform a half profile to/from 200 meters between each full profile. These Profilers are programmed to profile every 180 minutes. Similarly, they telemeter data every other dive.

**Conclusion**

Table 1: Profiler Mooring Operational Statistics

Mooring Reference Designator	Dates	Number of Deployments Completed	Number of Profiles Completed	Vertical Distance Profiled (Meters)
CP02PMCI	4/2014 - 4/2019	11	22,625	1,629,000
CP02PMCO	4/2014 - 4/2019	11	23,025	2,164,350
CP02PMUI	11/2013 - 4/2019	12	21,972	900,852
CP02PMUO	4/2014 - 4/2019	12	11,611	3,448,467
CP04OSPM	4/2014 - 4/2019	10	11,949	3,447,287
CP01CNPM	11/2017 - 4/2019	2	4,215	261,330
CP03ISPM	11/2017 - 4/2019	2	5,085	167,805
Total		60	100,482	12,019,091

The continuous operation of these systems since 2014 has generated a statistically significant amount of engineering

data for performance analysis. This has allowed the operators to provide direct feedback to the vendor. The WFP has been

improved over time with this information and has led to an improved product for OOI and all users of this technology. Table one below is summary of operational statistics. Each platform deployed for the Ocean Observatories Initiative has a specific Reference Designator that indicates the type of system and its location. Column 1 are the seven deployed at the Pioneer Array. Column two are the deployment dates used to generate the data in columns three, four and five. The WFP has proven to be a robust, and effective platform. Since 2014, there have been 60 separate deployments, with over 100,000 profiles completed for a total of over 12 million meters of vertical travel (Table 1).

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