The Fishing Vessel Ocean Observing Network (FVON):
Collaborative Observations to Fill Key Data Gaps

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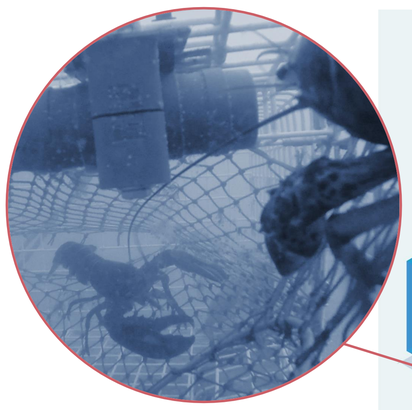
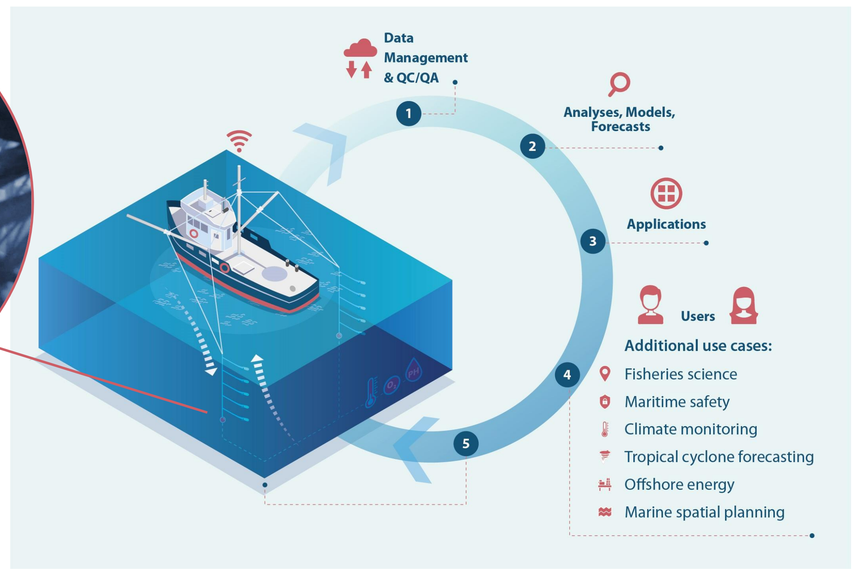
Abstract

While there have been great leaps forward in monitoring of our oceans there are still critical data gaps. The uncertainty from these data gaps hinders ocean predictions and forecasts leading to suboptimal management and policy decisions. Fisheries represent a vast opportunity to create a paradigm shift in ocean observing: the spatio-temporal extent of ocean data gaps overlaps significantly with fishers' activities. Fishing vessels can serve as platforms that can host and deploy an assortment of oceanographic instrumentations; and, the fact that many fishing gear types already profile through the water column presents a unique subsurface data collection opportunity that are dearly needed for improving ocean predictions. This opportunity can complement existing ocean observing networks by enabling the cost-effective collection of subsurface ocean data to dramatically increase coverage in data-sparse regions. While there are clear opportunities that arise from partnering with fishing vessels, there are also challenges ranging from geographic and cultural differences in fleets, fishing methods and practices, data processing and management for heterogeneous data, as well as long term engagement of the fishers. To advance fishing vessel-based ocean observations on a global scale, the Fishing Vessel Ocean Observing Network (FVON) formed to maximize data value, establish best practices, and facilitate observation uptake. The aim is to become a GOOS Network with the network mission of being the coastal, shelf, and boundary complement to Argo. FVON's objectives are to foster collaborative fishing vessel-based observations, democratize ocean observation, improve ocean forecasts, promote sustainable fishing, and power a data-driven blue economy.



ZebraTech TD in a lobster trap

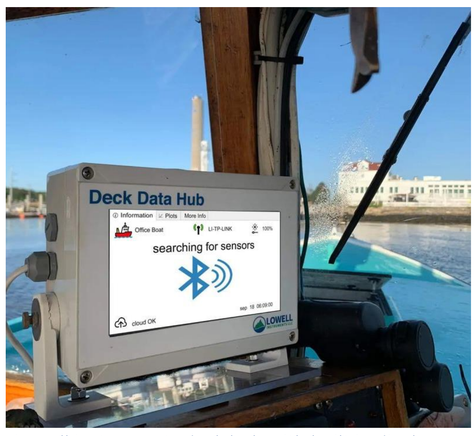


Technology

LEFT: Deck units recording GPS catch data packets sent via Bluetooth or WiFi from sensors as soon as they surface after a fishing event. Data packets, with accompanying GPS, are then relayed to a cloud DB using cellular or satellite communication

RIGHT: A growing assortment of instruments are well-suited for integration with fishing operations. Instruments have a variety of requirements: durability, calibration robustness, long-battery life, automatic wireless data offload, and fast measurement response time.

ZebraTech solar deck unit in Ghana

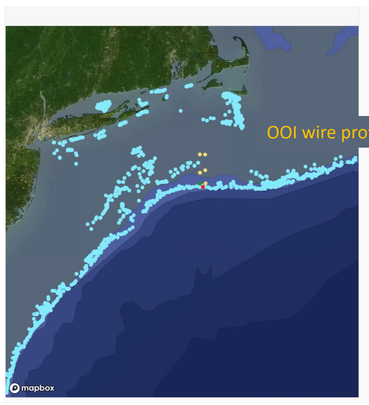


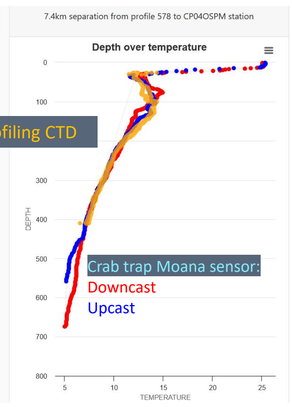
Lowell Instruments deck hub with built in display

JFE CTD in Japan

ZebraTech TD, salmon trolling off Alaska

NKE TD, scallop dredging off Maine



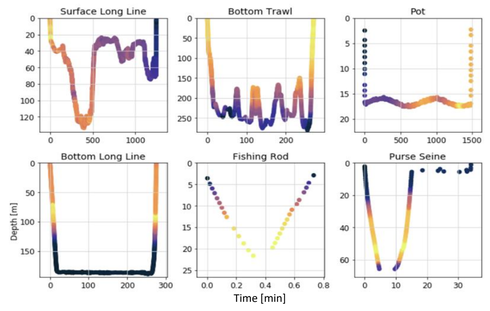


Data Quality and Management

Fishing offers a unique subsurface data collection opportunity which has been proven to collect high quality data. However, there are challenges integrating with, and standardizing the resulting data from the diversity of fishing practices around the world. Co-design is key in all of these processes, along with FAIR data standards and CARE principles.

LEFT: Temperature profile comparison between a crab trap deployed ZebraTech Moana sensor and a wire crawling Seabird CTD as part of the Ocean Observatories Coastal Pioneer Array. The fishing vessel provides data coverage up and down the shelf break, and accurately resolves the water column temperature to a similar degree as the OOI mooring, which is several orders of magnitude more costly.

RIGHT: A selection of depth over time series showing the diversity of data which can be produced by fishing. For sending to the WMO-GTS just the upcast is taken as a profile. Data are currently subjected to automated Quality Control routines based upon QARTOD and Argo standards.

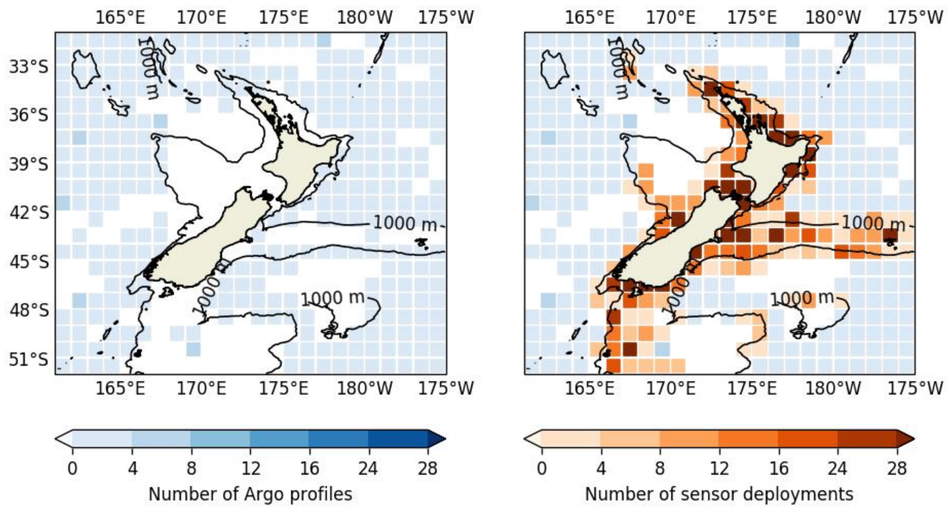


FVON Mission: The Coastal/Shelf Complement to Argo

Due to the success of the Argo program providing sustained observation in the open ocean, there are gaps in subsurface ocean observation coverage in shelf and coastal regions (left map). Complex bathymetry, coastlines and frontal mixing zones complicate autonomous ocean observation platform operation - but concentrate fish and therefore fishing. Beyond being productive biodiversity hotspots, the coastal seas are also the regions most directly relevant to coastal communities and the blue economy.

Comparing today's operational subsurface observation networks with the distribution of fishing activities suitable for sensor integration shows that fishing occurs precisely where observations today are lacking in shelf and coastal regions. This pattern is repeated, with few exceptions, around the world (Van Vranken et al., 2020). New Zealand has realized this opportunity with the first nation-wide fishing vessel observing network (right map). Approximately 250 New Zealand vessels are instrumented as part of the Moana project, resulting in an unprecedented wealth of coastal data.

These data can be used for a wide range of purposes. For example, data collected through the eMOLT program in the northeast U.S are used both to improve the forecast used by the US Coast Guard for search and rescue operations, and in the American lobster (*Homarus americanus*) stock assessment.



A win-win for Industry

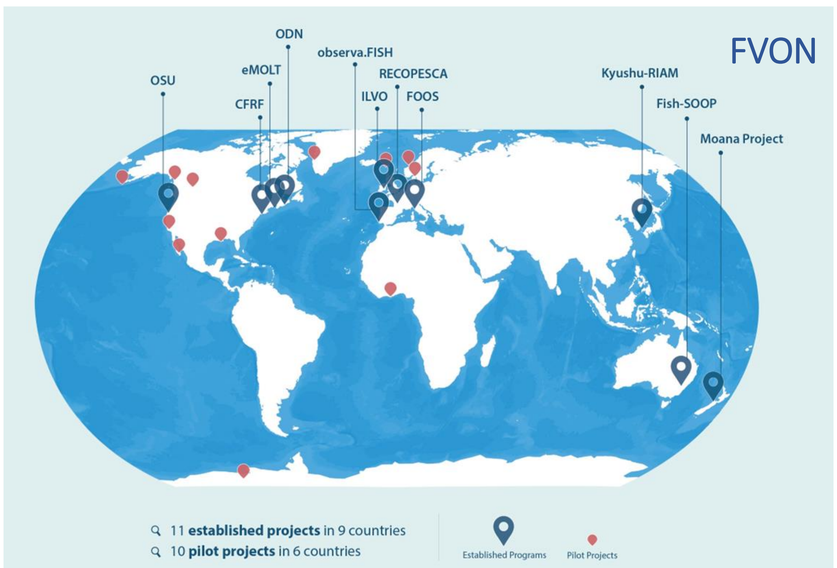
Fishing vessels and fleets use these data streams for an assortment of purposes including:

Bycatch avoidance by understanding temperature preferences of different species

Gear sink rate & performance analytics (seine nets and fixed gears)

Having a seat at the table and contributing to science on their own terms, which often leads to further additional collaborations

Extra source of income via stipends for small scale vessels. Larger fleets are increasingly funding the data collection on their own.



Fishing vessel collected ocean data is an inclusive way to complement existing observing networks by enabling the cost-effective collection of vast amounts of ocean information in data-sparse regions. The co-design and inherent inclusivity of this collaborative approach helps to democratize ocean observation.

FVON aims to maximize data value by establishing best practices and facilitating observation uptake. We aim to become a GOOS Network with the network mission of being the coastal, shelf, and boundary complement to Argo. FVON's objectives are to foster collaborative fishing vessel-based observations, democratize ocean observation, improve ocean predictions and forecasts, promote sustainable fishing, and power a data-driven blue economy. Please visit www.fvon.org for more information.

Van Vranken, C., Vastenhoud, B. M. J., Manning, J. P., Plet-Hansen, K. S., Jakoboski, J., Gorringe, P., & Martinelli, M. (2020). Fishing Gear as a Data Collection Platform: Opportunities to Fill Spatial and Temporal Gaps in Operational Sub-Surface Observation Networks. Frontiers in Marine Science https://doi.org/10.3389/fmars.2020.485512

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