

On Returning Seismic Data from the Oceans in Near-Real Time: The Past, Present, and Future of the MERMAID Project

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MERMAID, short for *Mobile Earthquake Recorder in Marine Areas by Independent Divers*, is an autonomous, freely-drifting oceanic seismic sensor. The goal of the MERMAID project is the near-real time recording and transmission of seismic data from the oceans suitable for regional and global tomography. Since late 2012, some fifteen MERMAIDS have sent over 3,300 seismograms to shore from the Mediterranean Sea, the southern Indian Ocean, and the Pacific Ocean near the Galapagos. For these data I have written software that identifies the arrival times of *P*-waves, and other phases, and returns the estimated timing error associated with each. Arrival times are defined in a maximum-likelihood sense via the Akaike Information Criterion, and they are identified at multiple scales (frequencies) via wavelet transform. This software package is now being extended to match these arrival times with the seismic phases they most likely represent by modeling, via forward simulation, the seismograms themselves. This is in preparation for the coming year of exciting MERMAID deployments, beginning in August 2018, when 16 new Princeton-owned MERMAIDS will be deployed in a circle around Tahiti to image the plume thought to underlie the island. Looking ahead to 2019, our fleet will be joined by some 30 other MERMAIDS purchased by our international collaborators in an effort to seed the oceans in much the same way as the wildly successful Argo project. To oversee the MERMAID project, an international organization aptly named EarthScope *Oceans* (earthscopeoceans.org) has been created and currently is designing and building a data center for the soon-to-be voluminous data stream. In all, the data returned by these new MERMAIDS, and the software we have developed to process them, will culminate in a publicly available database of MERMAID seismograms, each one complete with metadata detailing multiscale arrival times and their estimated timing error, as well as the seismic phases corresponding to each arrival. This project marks a leap forward for the community as a continuous flow of seismic data is returned in near-real time from the oceans.

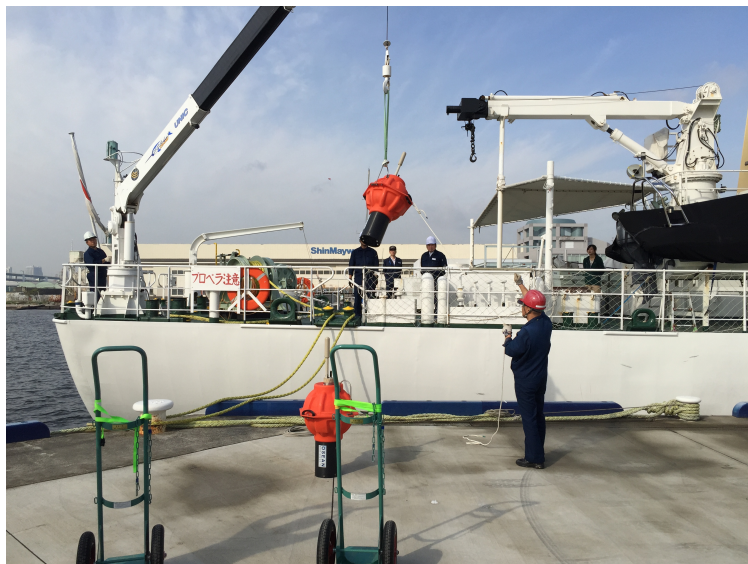


Figure 1: Two MERMAIDS are loaded onto the *Fukae Maru* on April 11, 2018 in preparation for a training cruise with our international collaborators in which MERMAID was deployed and recovered in the Pacific Ocean.