Twilight zone observation network: A distributed observation network for sustained, real-time interrogation of the ocean's twilight zone

Simon R. Thorrold  
*Woods Hole Oceanographic Institution*

Allan Adams  
*Massachusetts Institute of Technology*

Ann Bucklin  
*University of Connecticut*

Ken Buesseler  
*Woods Hole Oceanographic Institution*

Godi Fischer  
*University of Rhode Island, fischer@uri.edu*

See next page for additional authors
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Authors

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Vision and Potential Transformative Impact

Our Ocean-Shot vision is a series of scalable TZ observation networks emplaced in critical locations throughout the global ocean, beginning with a pilot observation network off the continental shelf of southern New England. Our team will deploy modular optical, acoustic, and geochemical sensor packages on apex predators, swarms of robots and “smart” floats, and tow bodies deployed from oceanographic vessels and other vessels of opportunity. Network sensors will log biophysical measurements at sub-Hz frequencies across 250,000 square kilometers over several years. In-water assets will connect to autonomous surface vehicles to facilitate data acquisition and assimilation in real time complemented by miniaturized multiplex frequency acoustic receivers that detect sound emitted by sources deployed on an array of moorings for tracking assets throughout the water column. Data from sensor packages deployed on apex predators will lead us to “hotspots” of activity and inform locations for intensive field operations using conventional shipboard technologies. The network will stimulate rich opportunities for advancement of scientific equipment, engineering, and data analysis that will drive new knowledge. The resulting data will transform efforts to inform policy and implement strategies for conservation and sustainable fisheries management in the high seas, as well as predicting the impacts of climate change.

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Realizable, With Connections to Existing U.S. Scientific Infrastructure, Technology Development, and Public–Private Partnerships

Woods Hole Oceanographic Institution (WHOI) is well positioned to lead the development of an international T2 observation network. The WHOI community of scientific and technical staff, ships’ crew and officers, and support staff facilitates several large projects funded by public and private sources with relevance to our Ocean-Shot. We have started Year 3 of a six-year, $32m OTZ Project funded by philanthropic sources. The Northeast U.S. Shelf (NES) Long-Term Ecological Research (LTER) project, funded by NSF, is also based at WHOI. The LTER integrates observations, experiments, and models to understand how planktonic food webs are changing in shelf ecosystems adjacent to the proposed OTZ Observation Network. Finally, WHOI is lead organization for the Ocean Observing Initiative’s Pioneer Array that is also located on the NES. We will leverage the knowledge gained, technologies under development, and engineering and technical capabilities from these efforts to ensure that our vision is realizable.

Scientific/Technological Sectors Engaged Outside of Traditional Ocean Sciences

Our T2 observation network aligns with the Defense Advanced Research Projects Agency’s (DARPA) Ocean of Things (DOT) initiative that aims to “enable persistent maritime situational awareness over large ocean areas by deploying thousands of low-cost, environmentally friendly, intelligent floats that drift as a distributed sensor network.” Their goal is to establish real-time communications with swarms of floating and swimming sensors. The sensors will use common technologies including GPS sensors, accelerometers, microphones, temperature sensors, and cameras. Several private companies are also invested in DOT. There are natural synergies between our Ocean-Shot and DOT that will be formalized during program development.

Develops Global Capacity and Encourages the Development of the Next Generation of Ocean Scientists, Engineers, and Technologists

We often speak of the “democratization” of data, enabling scientists from around the globe to access raw data to advance their own scientific interests. The OTZ observation network aims to set a new standard as one of the tenets of our current OTZ project is open sharing of data. This project will also advance the vision of the OTZ project to reduce “barriers to entry” for ocean science institutions in the developing world by developing low-cost pervasive sensors. We are hopeful that this democratization will also help to inspire prospective ocean scientists from these nations to seek further education opportunities.

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