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Six Years of Operational History of Cabled Ocean Observatories Installed off the Coast of Oman

L. Belabbassi (1), S. Ingle (1), Z. Wang (2), S. DiMarco (2), M. Stoessel (2), X. Zhang (2), K. DuVall (1), and J. Snider (1)

(1) Lighthouse R & D Enterprises, Inc., Houston, Texas, United States, (2) Texas A&M University, Department of Oceanography, College Station, Texas, United States

Lighthouse R&D Enterprises, Inc. installed the first cabled ocean observatory system for the Sultanate of Oman's Ministry of Agriculture and Fisheries Wealth in mid-2005 and a second cabled system in early 2010. The systems are designed to study a range of oceanic phenomena and provide a wealth of data to manage fisheries resources and recreational activities, monitor water quality, and groundtruth regional circulation models used to understand complex circulation patterns and current phenomena in the region. Autonomous moorings were also installed and used off the Omani coast from 2005 to the present to study a range of dynamical processes. Both cabled and moored data systems use state-of-the art oceanographic sensors to measure current speed and direction, salinity, temperature, dissolved oxygen, turbidity, pressure, and acoustic backscatter at hourly intervals. The long-term operational success of the observatories has resulted in a continuous, six year time series of quality controlled oceanic data.

The scientific analysis and synthesis of the cabled and moored observational data revealed three major scientific findings. (1) A strong seasonal cycle of hypoxia is seen in dissolved oxygen concentration. Hypoxic conditions on the northern shelf of Oman are believed to be associated with the seasonal migration of the oxygen minimum zone during the monsoonal season. (2) Long term changes in the distribution of myctophid layers and the substantial diel vertical migrations of these layers are observed throughout the record of acoustic backscatter intensity data. (3) The systems recorded the oceanic responses to tropical Cyclone Gonu. After the passage of Cyclone Gonu in June 2007, substantial variability is seen in the hydrographic properties at about 250 m. What is more, even very deep waters – such as those at nearly 3000 m depth – were affected by Cyclone Gonu. To our knowledge, this is the first direct observation of the effect of an extreme weather event on water near the seafloor in the Indian Ocean.

The Sea of Oman and Arabian Sea are not well studied and most knowledge thus far is based on surface observations. The breakthrough scientific findings reported here would not have been possible without regular, in-situ sampling over a long time interval and over the entire water column. Time-series data clearly provide a wealth of knowledge on multiple time scales. Our new daily, seasonal, and annual observations, as well as observations on a disruption to the system by a transient event, have substantially improved our understanding of the oceanography in this previously poorly understood region.