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Data Loggers for Environmental Research

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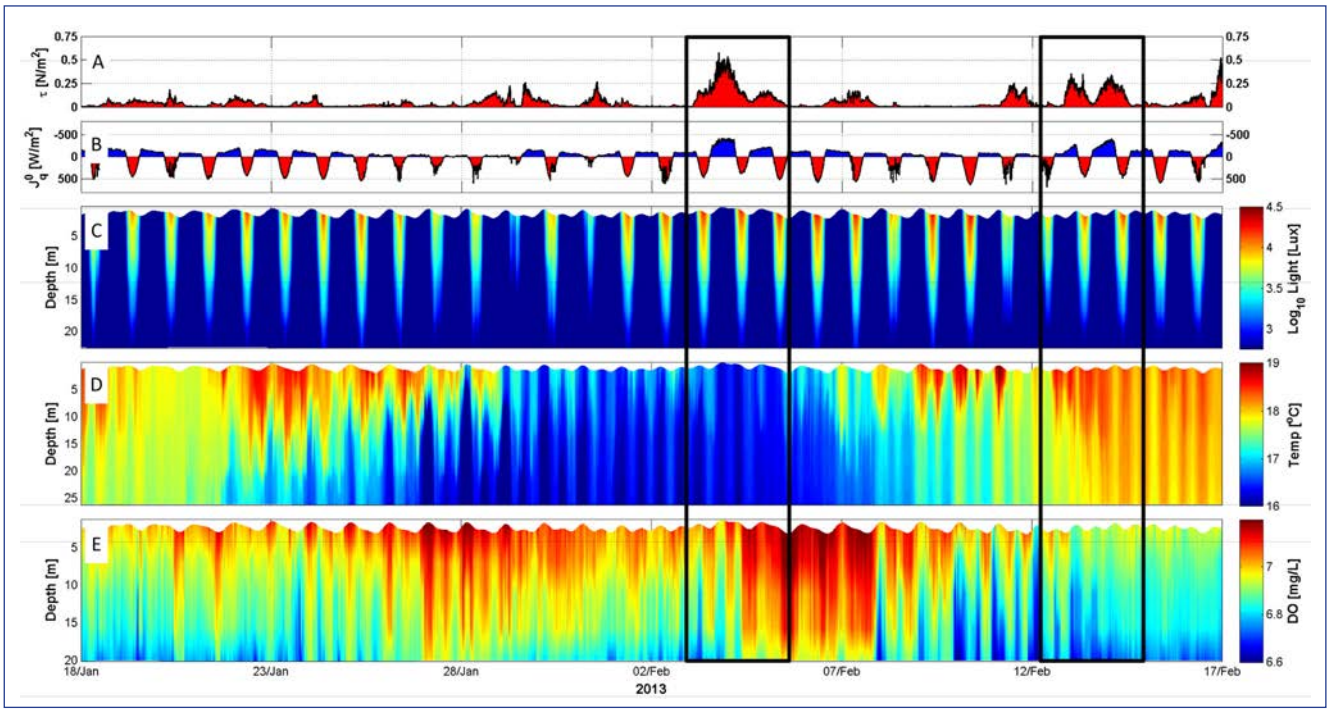
Shamals are strong, dry winds blowing from the North-Northwest that have a significant impact on surface heat (shortwave, longwave, sensible and latent) and momentum fluxes. Dr. Ayal Anis and Dr. Fahad Al Senafi broadly describe Shamal in a previous paper based on a 40-year study and explain the importance of research in understanding the impact of global climate change: "Effects of global climate change on the relative increase of surface temperatures, droughts, flooding, and intensity of weather events such as monsoons and hurricanes have been increasing steadily. The rise in number of environmental catastrophes due to severe weather events in the last 50 years has further motivated scientists to better understand the impacts of global climate change on weather systems and phenomena. In the Arabian/Persian Gulf, a unique weather phenomenon occurs throughout the year and has substantial impact on the society, economy, transportation, and the natural environment; it is known as a Shamal event."

Anis, a physical oceanographer and professor in the department of marine sciences at Texas A&M University, Galveston, and in the department of oceanography at Texas A&M University, College Station, continues to conduct studies to examine Shamal events and their effect on the hydrodynamics and water properties in the northern Arabian Gulf.

Anis's recent research set out to examine the response of the water column to Shamal events. Various meteorological data were collected over two periods—mid-January to mid-April 2013 and mid-October to mid-January 2014—and



Surface meteorological and hydrographical observations in the northern Arabian Gulf, January to February 2013. Two Shamal events occurred during this period. (A) Surface wind stress, (B) net surface heat flux, (C) light intensity, (D) temperature and (E) dissolved oxygen. (Image Credit: Dr. Ayal Anis)

Instrumented oceanographic mooring for the Shamal study, including PME Cyclops-7 fluorometers and PME miniDOT dissolved oxygen sensors.

included time series of water currents, temperature, salinity, dissolved oxygen (DO), fluorescence and light intensity.

Loggers for Shamal Study

On January 18, 2013, an instrumented oceanographic mooring was deployed about 2 naut. mi. northeast of Qarooh Island, off the coast of Kuwait (28° 50.938 N, 048° 47.534 E). Three PME Cyclops-7 chlorophyll fluorometers sampling every 5 min. and five PME miniDOT dissolved oxygen sensors sampling every 1 min. were part of the sensor suite on this mooring.

The Cyclops-7 logger was designed in partnership with Turner Designs, and each logger can connect to one Turner Designs Cyclops-7 sensor at a time. PME offers a fixed sensor version, as well as an interchangeable sensor version. The logger records measurements internally at a variety of sample rates and can collect roughly 28,000 samples before the batteries need to be replaced. Data are stored internally and downloaded to a computer via a standard USB cable. Included software allows the user to calibrate the sensor, change the sample rate and graphically view data after deployment.

The miniDOT logger is a completely submersible instrument that logs dissolved oxygen and temperature measurements at 100 m maximum depth. The oxygen sensor is an optode that measures dissolved oxygen concentration in water through a fluorescence method. Data are recorded to an internal SD card. Operation of the miniDOT logger, such as setting the time and sample interval, can be accomplished via USB cable.

Anis's analysis of the miniDOT data led to the observation that, as a result of the Shamal events, the dissolved oxygen concentration in the water column increases significantly, with elevated levels reaching down to the sea bottom at a depth of about 20 m. These elevated levels were observed to last more than two days after the event began.

Low levels of oxygen, if sustained for an extended period, may eventually result in hypoxic conditions in the water column. Elevated levels of oxygen resulting from strong mixing events, as has been observed to occur as a result of Shamal events, may disturb such buildup of hypoxic conditions.

Analysis of available data suggests an increase in the number of Shamal events during the past 14 years. However, it is premature to conclude if this may significantly decrease development of hypoxic conditions since, at the same time, global warming is promoting stratification of the water column, which is likely to decrease mixing.

As for the Cyclops-7 units in this study, they yielded only a relatively short data set (approximately 10 days). Unfortunately, the data set from the Cyclops-7 logger was not long enough to produce any conclusions. The idea was that the Cyclops-7 loggers would collect chlorophyll data for a long enough period that may have detected elevated chlorophyll levels resulting from Shamal events. The elevated levels of chlorophyll could have resulted from an increase in nutrient fluxes from bottom sediments into the euphotic zone.

Further Work

Anis said he intends to continue using PME instruments in his future coastal oceanographic and lake studies. He reports that both the miniDOT and the Cyclops-7 loggers are reliable, simple to operate and well-designed from a human engineering point of view, including ease of maintenance, programming, deployment and downloading of data. The data are stored into relatively small files several times a day, preventing loss of data that could happen when all data are stored in a single large file. The small files can be easily concatenated using software provided by PME. **ST**

Kristin Elliott has been involved with Precision Measurement Engineering since she was born. She enjoys new business development, discussing strategy and managing the daily processes of the company. She also enjoys spending time with her family outdoors on their annual camping trips.