LiquID™

**Application Note**

# Oceanographic Research

## With The **LiquID™** Station

### Oceanographic Research

The field of oceanography relies on knowing the precise physical, chemical, and biological state of seawater at different times, locations, and depths in the oceans of the world. The primary data collection means fall into two basic classes: ***remote sensing*** (as by satellites and aircraft) and ***direct sensing*** (as by ships, submersibles and buoy installations). Since the data stream from remote sensing primarily reflects surface and near-surface conditions, collecting data as a function of *depth* (a practice known as "profiling") requires direct means.

Profiling can be done by instrument packages towed behind ships at sea, carried aboard autonomous, self-propelled submersibles called "gliders", or mounted on robots that climb and descend the anchor lines of offshore buoys. The spectrum of direct sensing data that can be collected by these methods will be limited by the extent to which the instruments themselves can be successfully miniaturized and rendered seawater-proof and pressure- and shock-resistant.

***(Permission to use this image has not been secured)***

These are difficult engineering tasks which make submersible oceanographic instrumentation packages expensive. Note also that the costs of instrument failure during a research mission at sea are very large.

### About LiquID™

**The LiquID Station from ZAPS Technologies** (pictured below) is an innovative, optical instrument for continuous water quality monitoring. The automated online instrument analyzes a continuous flow-through stream from a pressurized water sample line using multi-spectral light and software algorithms, and uses no reagents nor produces any waste other than the original sample (which is returned or wasted as appropriate). With this method, the **LiquID** is capable of monitoring a wide range of water quality parameters in a number of different industry applications, including those relevant to municipal water and wastewater treatment, water reuse systems and industrial process control.



ZAPS TECHNOLOGIES

A data-collection technique which avoids the pitfalls related to deep immersion of the instruments themselves is one in which the sea water samples are continuously suctioned up to the surface through a submerged hose from different depths as the ship cruises, and then immediately analyzed by instruments installed onboard the ship. In this case, the only part of the apparatus that is submerged is the "sled" that carries the pump and hose. Although the shipboard instruments still must be robust enough to withstand the rigors of sailing on the open sea, they do not require miniaturization or waterproofing- and should they ever stop functioning properly, they can be promptly and conveniently attended to by scientists on board the vessel.

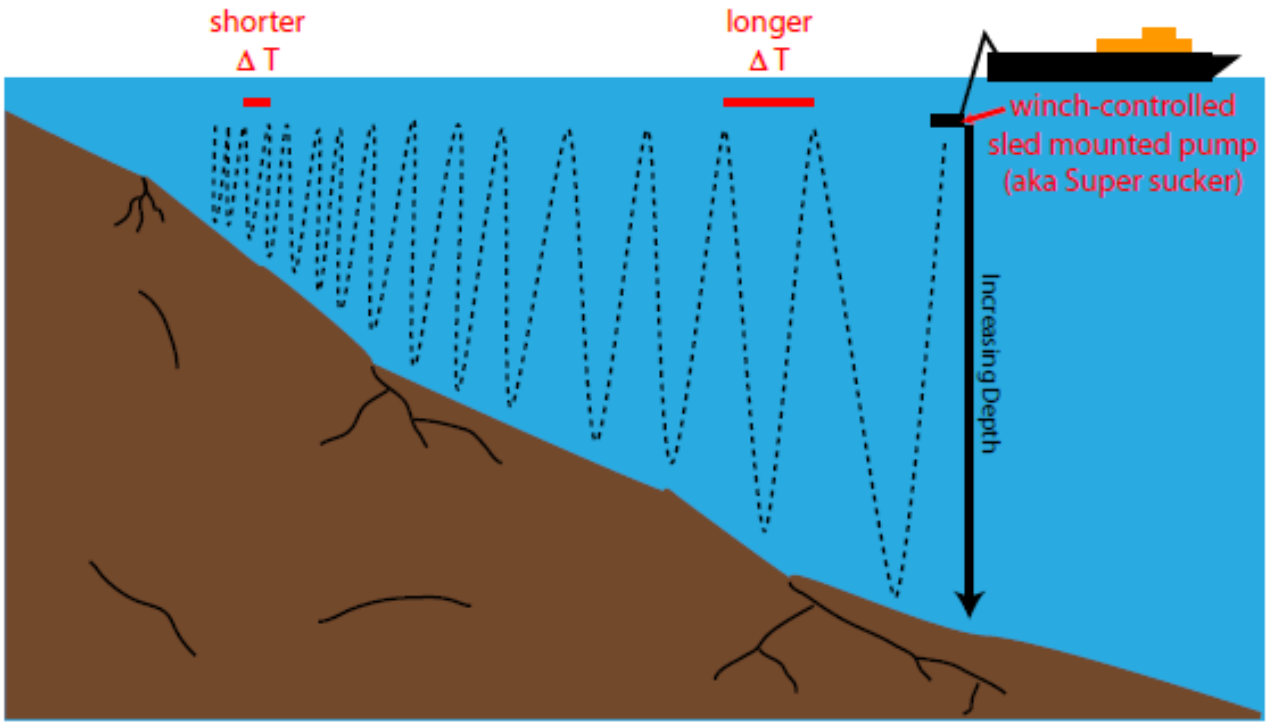
This paper describes how a **LiquID** station, installed on an oceanographic research vessel and fed seawater samples pumped up from different depths while the ship was in motion, was used to construct a continuous and highly-detailed record of the contents of the water as a function of depth and position off the Oregon coastline.

## Case Study: Going To Sea With The LiquID

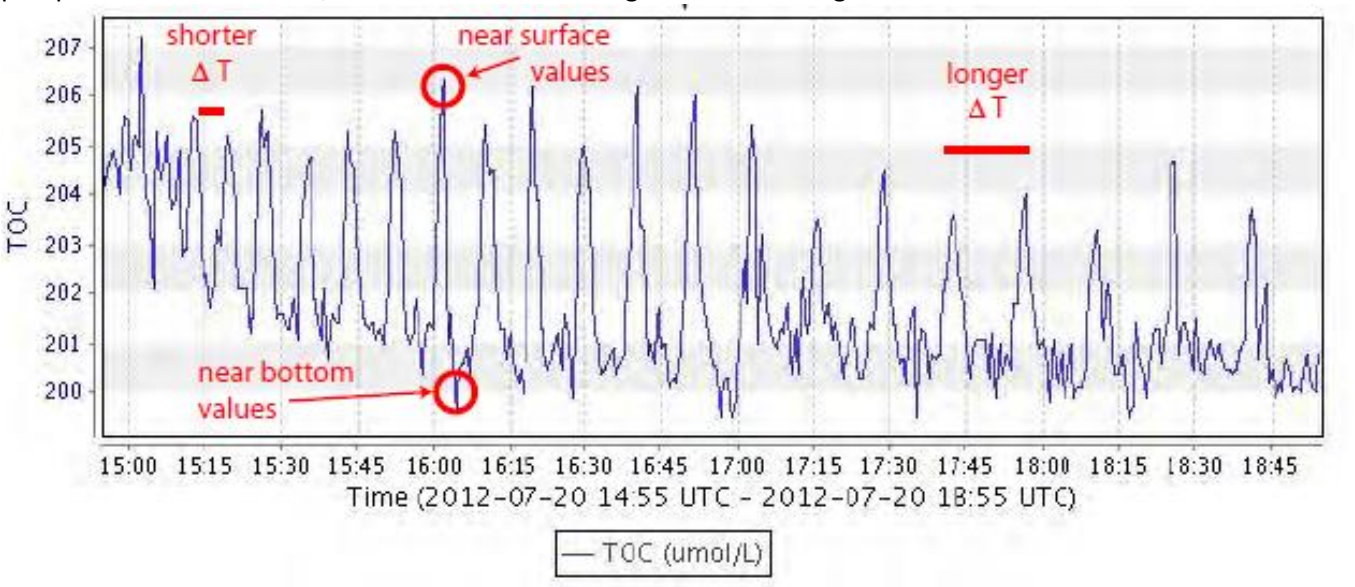
In July of 2012, a **LiquID** station was installed by **ZAPS Technologies, Inc.** of Corvallis, Oregon on the *R/V Oceanus*, an oceanographic research vessel owned by the National Science Foundation and operated by Oregon State University in Corvallis.

The purpose of the installation was to profile the contents of the ocean from its surface to near the ocean floor using a winch-operated suction hose called the "Supersucker," which conveyed sea water samples from a submerged sled up to the **LiquID** station onboard the *Oceanus* while the ship was underway.

Here is a schematic diagram of the setup. Note that as the depth of the water varied, so did the time required for a complete descent/ascent cycle, which is shown here as delta T.




This variation in delta T shows up in the data charts produced by the LiquID station as it analyzes the samples pumped to it from the sled, as shown in the following chart of total organic matter versus time:

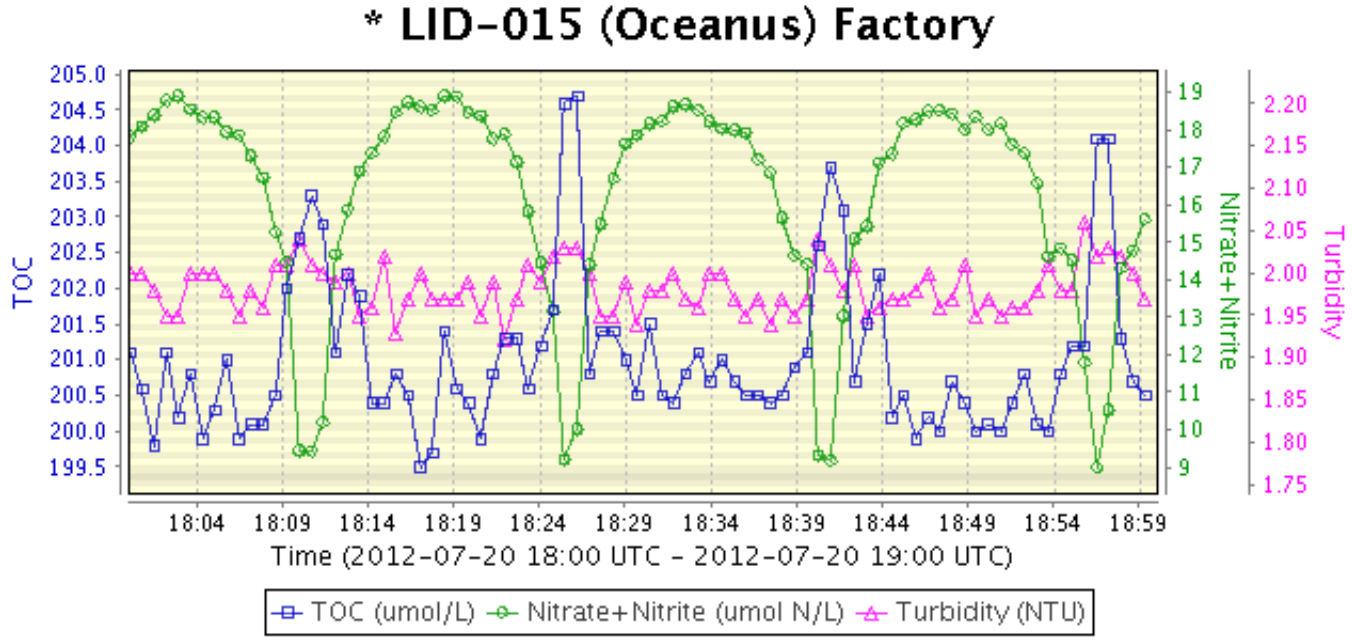



You can see here that the amount of total organic carbon in the seawater is greater near the surface than near the bottom.

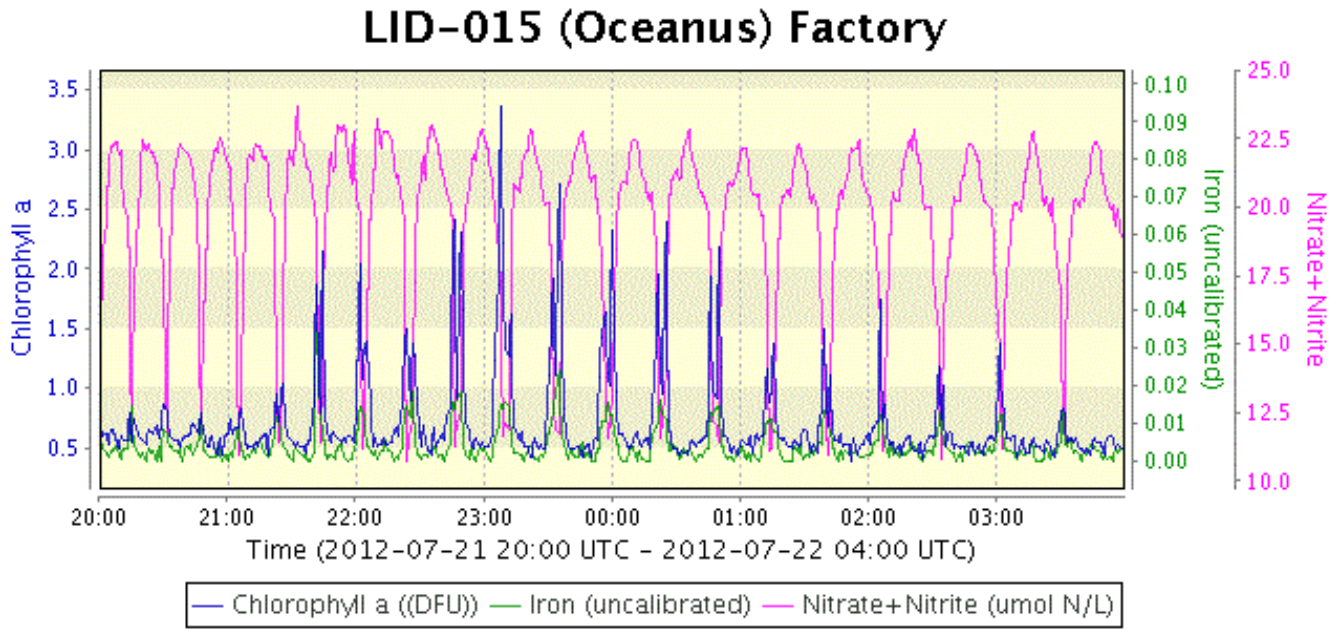
In these runs, the **LiquID** station was measuring a variety of seawater parameters including total organic carbon, nitrate + nitrite, dissolved iron and turbidity at approximately one-minute intervals as the winch lowered and raised the sled during the cruise. The winch motor was automatically controlled by a sonar pinger on the sled to accurately maintain its descent and ascent rates and also to reverse the sled descent at a safe distance from the sea floor, so the sled would not be accidentally driven into the mud as the distance to the bottom varied during the cruise. A depth sensor affixed to the suction intake on the towed sled allowed precise correlation of the measured water parameters to the depths at which the samples had been collected. Time signals generated by a clock on the sled allowed precise correlation of the samples with GPS location data provided by the ship's navigation system, and enabled the scientists on board to account for the transit time of the water samples in the Supersucker hose.

## Data Examples

Here are some examples of the data which the **LiquID** station collected during its cruise on the *Oceanus*. In the chart below, we see that as the sled approaches the sea floor, the amount of total organic carbon (blue line) falls and reaches its minimum values at maximum depth. In contrast, the nitrate + nitrite (green line) values are highest at maximum depth and lowest near the surface. The turbidity is just slightly higher near the surface than it is near the bottom.



In the chart below, the **LiquID** station was measuring chlorophyll a (blue line), dissolved iron (green line), and nitrate + nitrite (magenta line) in the seawater as the ship's path took it by chance through a diatom bloom near the surface. Because the diatoms contain chlorophyll, their sudden appearance caused the chlorophyll a detection channel in the **LiquID** station to respond each time the sled's path rose up into the cloud of floating diatoms. The extent of the diatom bloom and the distribution of diatoms in the water column show clearly in the **LiquID** station's data log.




## SUMMARY

These results demonstrate that the LiquID station's unique capabilities render it useful not only for continuous, real-time, on-line, multi-parameter monitoring of wastewater treatment plant, drinking water plant, and industrial facility influent and effluent streams, but also for collecting oceanographic data in shipboard installations.

Contact **ZAPS Technologies, Inc**. to learn more about how the **LiquID** station can add value to your product stream.

**Contact ZAPS For More Information**

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