RBR

Proximity effects on conductivity measurements for the 2000dbar CT cell

Introduction

The proximity effect occurs when objects close to the conductivity sensor affect its calibration and accuracy. Conductivity, as measured by the inductive cell, is a weighted average of conductivity readings over the volume occupied by the current loops, with conductivity being most sensitive within the centre cylinder and becoming less sensitive with radial distance. Objects directly outside of the central cylinder may as well affect the conductivity measurements and, therefore, their accuracy.

Laboratory experiments at RBR show that an object must be within 15cm of the conductivity cell before any measurement accuracy is affected. Conductive objects (such as metal deployment frames) closer than 15cm may bias the conductivity reading higher. Nonconductive objects (such as insulated mooring lines) may bias the conductivity reading lower. The amount of bias is related to the proximity, the relative volume of the material, and the relative difference in conductivity compared to the ambient water.

The changes induced by proximity effects manifest as a scale factor (a multiplier), rather than an offset (an addition or a subtraction). As a point of reference, a standard 6mm insulated steel mooring line located 7.5cm from the inductive conductivity cell changes the conductivity calibration by -0.002mS/cm at 35PSU. This small amount is still within the initial accuracy specification of ±0.003mS/cm.

RBR routinely calibrates our products for permanent (static) objects in the near field of the sensor, negating their effect on the inductive cell. This includes instruments built with sensor guards, instruments that have numerous sensors mounted near the conductivity cell, instruments mounted in stainless steel cages, and conductivity cells mounted on Argo floats with a nearby antenna. When static objects are included in the conductivity calibration, the achieved calibration is always within the specified accuracy of ±0.003mS/cm.

It is not always possible to calibrate a CTD with all the objects placed in the vicinity of the conductivity cell during deployment. This document describes experiments performed at RBR to characterize the proximity effect of a non-conductive object at different distances from the conductivity cell.

The numbers provided below can give an idea of the impact of proximity effects on the measurement accuracy and may serve as a guideline for objects of similar size made of non-conductive materials.

> The measurements reported in this document shall not be used to correct measurements performed by a CTD.

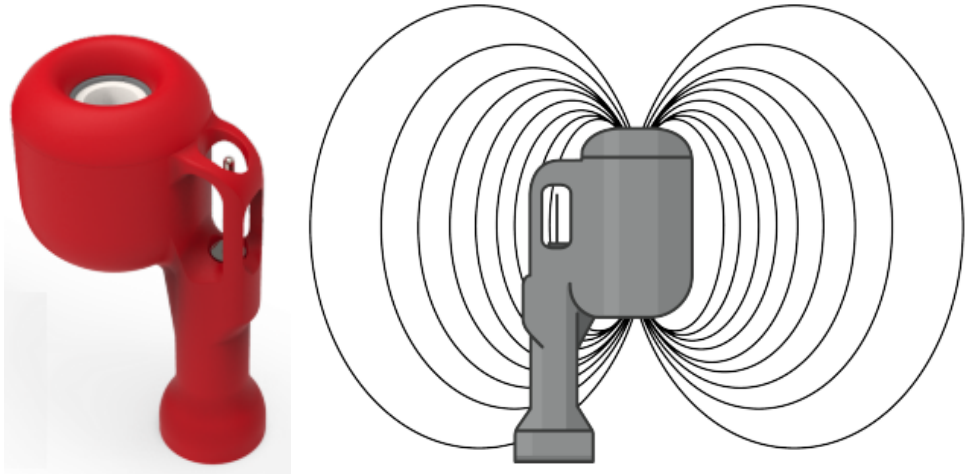

Figure 1. On the left, a 2000dbar CT cell. On the right, an illustration of the current field lines of the conductivity cell.

Experimental evaluation

Experimental setup

A plastic rod is placed vertically at different distances from the conductivity cell. Salinity is measured with and without the rod nearby. An RBR*concerto*^{3} C.T.D with a 2000dbar CT cell is used for the experiment.

Two long plastic rods with different diameters (OD=1.27cm and OD=2.54cm) are used for the experiment. The distances between the outer edge of the CT cell and the rod evaluated during the experiment include (cm): 1, 2, 2.54, 3, 4, 5.

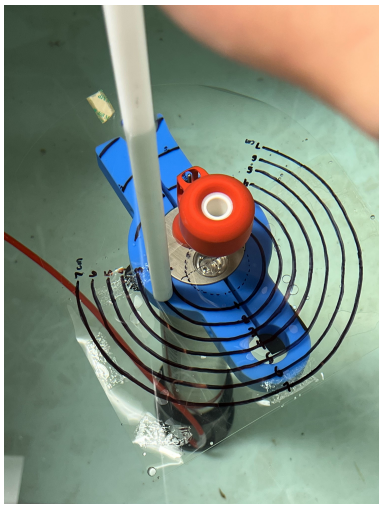

Figure 2. Experiment setup. The rod in this photo has an OD of 1.27cm and is placed 1cm away from the conductivity cell.

Results

Below are the experiment results. As shown in Figure 3, the salinity reading decreases with a plastic rod placed near the conductivity cell.

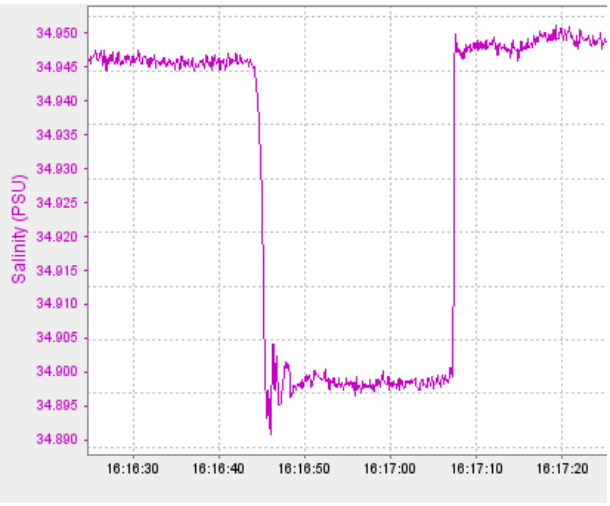

Figure 3. A typical salinity decrease when the plastic rod is placed near the conductivity cell. The data shown above is acquired with a plastic rod (d=2.54cm) placed 1cm away from the conductivity cell.

Table 1 shows the result of all the measured data points, and it is visualized in Figure 4.

Distance between the rod and the CT cell (cm)	**Offset in salinity, mPSU**	
	Plastic rod1 (OD=1.27cm)	**Plastic rod2 (OD=2.54cm)**
1	-10.3	-47.7
2	-5	-14.7
2.54	-4.3	-11.1
3	-3.6	-8.6
4	-3	-5.2
5	-2	-3.8

Table 1. The salinity measurement decreases as a function of the plastic rod OD and the distance between the rod and the conductivity cell.

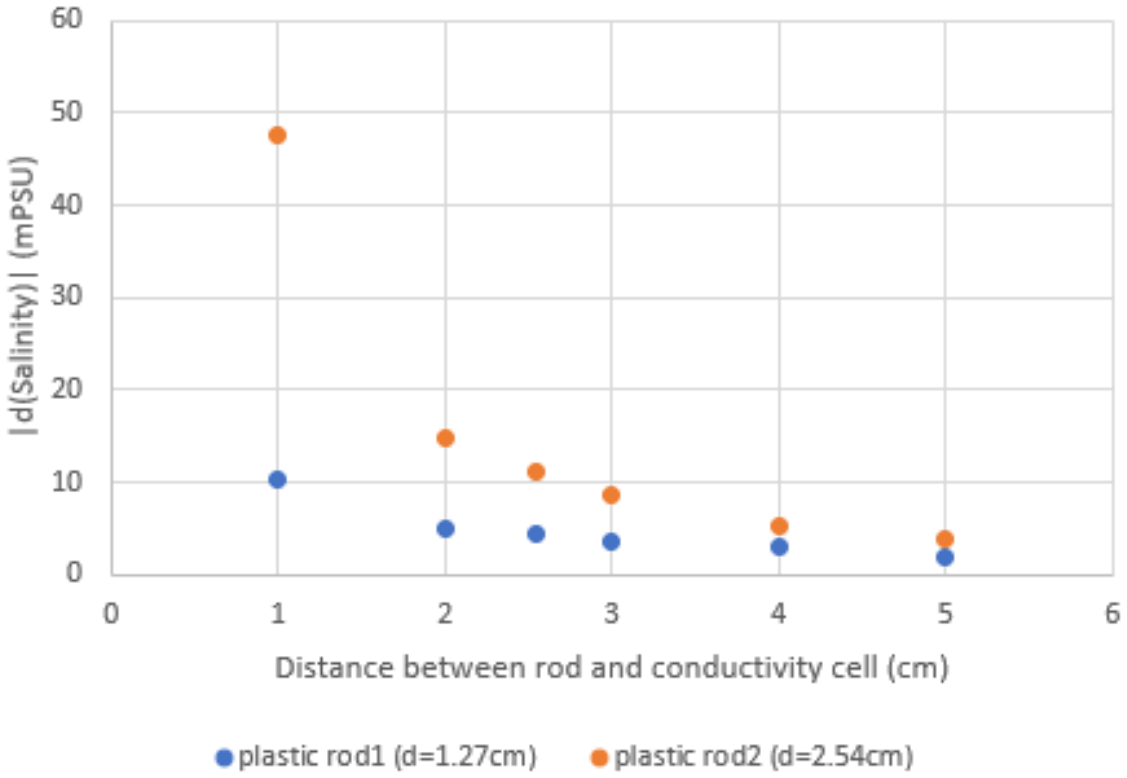

Figure 4. A scattered plot to visualize the results presented in Table 1. The x-axis is the distance between the plastic rod and conductivity cell in cm, the y-axis is the absolute value of salinity difference in mPSU.

Continued RBR support

RBR is committed to providing the best product and service to your company in order to help you achieve your goals. If there are any questions or concerns with the changes listed in this document, do not hesitate to contact us for help and information.

Revision Log

Rev	Revised by	Date	Description of Change
A	Xiaowei Yang	Jun 28, 2022	Initial Release