Delayed-Mode Calibration of Hydrographic Data Obtained from Animal-Borne Satellite Relay Data Loggers

FABIEN ROQUET,* JEAN-BENOIT CHARRASSIN, AND STEPHANE MARCHAND

LOCEAN/Museum National d'Histoire Naturelle, Paris, France

LARS BOEHME AND MIKE FEDAK

Sea Mammal Research Unit, Scottish Oceans Institute, Natural Environment Research Council, St. Andrews, United Kingdom

GILLES REVERDIN

LOCEAN/IPSL, Paris, France

CHRISTOPHE GUINET

CEBC-CNRS UPR 1934, F-79360, Villiers en Bois, France

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ABSTRACT

A delayed-mode calibration procedure is presented to improve the quality of hydrographic data from CTD–Satellite Relay Data Loggers (CTD–SRDL) deployed on elephant seals. This procedure is applied on a dataset obtained with 10 CTD–SRDLs deployed at Kerguelen Islands in 2007. A comparison of CTD–SRDLs with a ship-based CTD system is first presented. A pressure-effect correction, linear with pressure, is deduced for both temperature and salinity measurements. An external field effect on the conductivity sensor is also detected, inducing an additional salinity offset. The salinity offset cannot be estimated directly from the ship-based CTD comparisons, because the attachment of the CTD–SRDL on the seal head modifies the magnitude of the external field effect. Two methods are proposed for estimating a posteriori the salinity offset. The first method uses the stable salinity maximum characterizing the Lower Circumpolar Deep Water (LCDW), sampled by seals foraging south of the Southern Antarctic Circumpolar Current Front. Where this approach is not possible, a statistical method of cross-comparison of CTD–SRDLs surface salinity measurements is used over the sluggish Northern Kerguelen Plateau. Accuracies are respectively estimated as ±0.02°C for temperature and ±0.1 for derived salinity without corrections. The delayed-mode calibration significantly improves the CTD–SRDL data, improving accuracies to ±0.01°C and ±0.03, respectively. A better salinity accuracy of ±0.02 is achieved when the LCDW method can be used. For CTD–SRDLs where ship-based CTD comparisons are not available, the expected accuracy would be ±0.02°C for temperature and ±0.04 for the derived salinity.

1. Introduction

Our understanding of the at-sea behavior and physiology of free-ranging marine animals has been revolutionized in the last decades by the development and deployment of a variety of loggers (see the review of Bost et al. 2009). This new field of biologging was made possible thanks to recent progress in microelectronics, miniaturization, and satellite telemetry. While loggers

* Current affiliation: Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, Massachusetts.

Corresponding author address: Fabien Roquet, Dept. of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, MA 02139.
E-mail: roquet@mit.edu

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