

RBR

Welcome, the RBR Webinar will begin shortly...



Welcome to the RBR technical webinar:

Inductive Conductivity Cell: A primer on high-Accuracy CTD Technology

A few quick notes:

- This webinar will be recorded and posted on the RBR website
- Slides will be available on the website after the presentation
- You can use the chat section to ask questions at any time

Next week's webinar



Profiling CTDs: RBR instruments in Wirewalker, gliders/AUVs, and Argo floats

Greg Johnson

November 11, 2020

Learn about RBR's CTD integrations into different profiling platforms, and how this has helped increase mission duration and reduce price per profile.

RBR



RBR Webinar Series

Inductive Conductivity Cell: A Primer on High-Accuracy CTD Technology

Greg Johnson, PhD
President, RBR

CTD technology

Inductive Conductivity Cell

Thermistor

Pressure Sensor



RBR

A man with a mustache, wearing a grey cap and a yellow and black life vest, is sitting in a yellow kayak on a body of water. He is holding a white tag with a string attached, which has the text 'BR concerta' printed on it. A wooden paddle is resting in the kayak in front of him. The background is a blurred view of water and trees. The entire image has a semi-transparent red overlay.

Operating principles

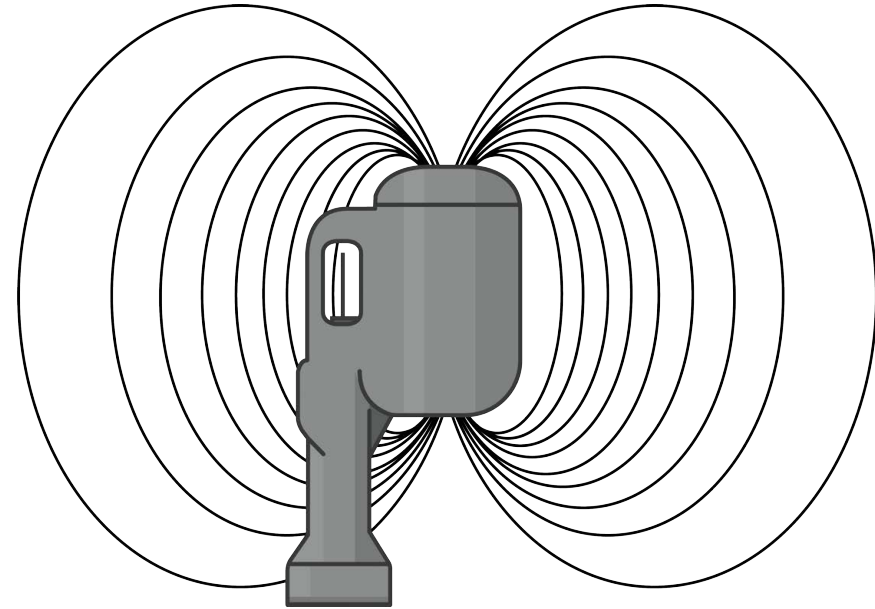
Measurement principle of an inductive conductivity cell

The measurement of conductivity is based on Faraday's law of induction.

- Variable magnetic flux drives a current in a circuit.

RBR uses a "double transformer" design

- Two independent toroidal coils
- Basic idea for this introduced 100 years ago:
 - *Piccard and Frivold (1920). *Démonstration de courants d'induction produits sans électrodes dans un électrolyte.*
 - **M. J. Relis (1947), *Electrodeless method for measuring low-frequency conductivity of electrolytes.*

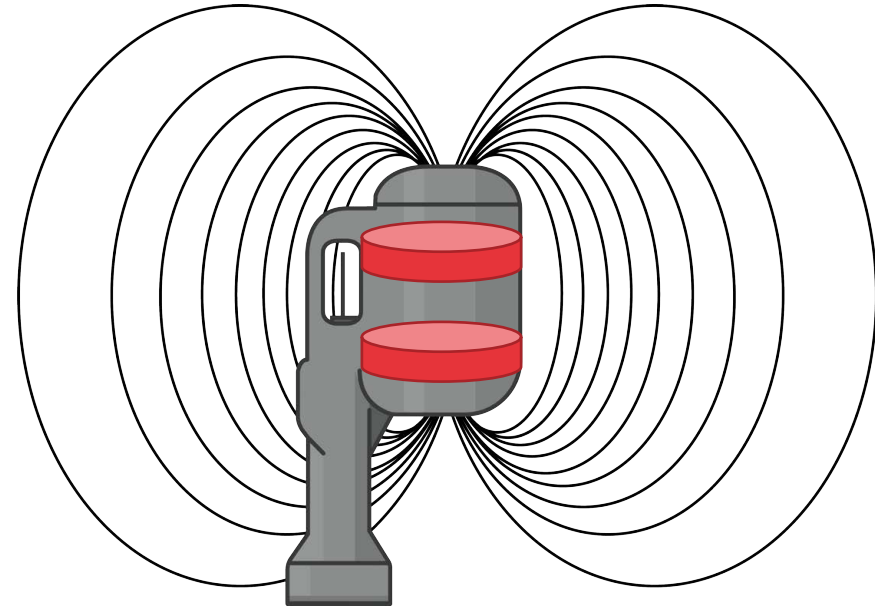


*<https://www.e-periodica.ch/digbib/view?pid=ads-001:1920:2::811#271>

**<https://dspace.mit.edu/bitstream/handle/1721.1/43268/28203965-MIT.pdf?sequence=2&isAllowed=y>

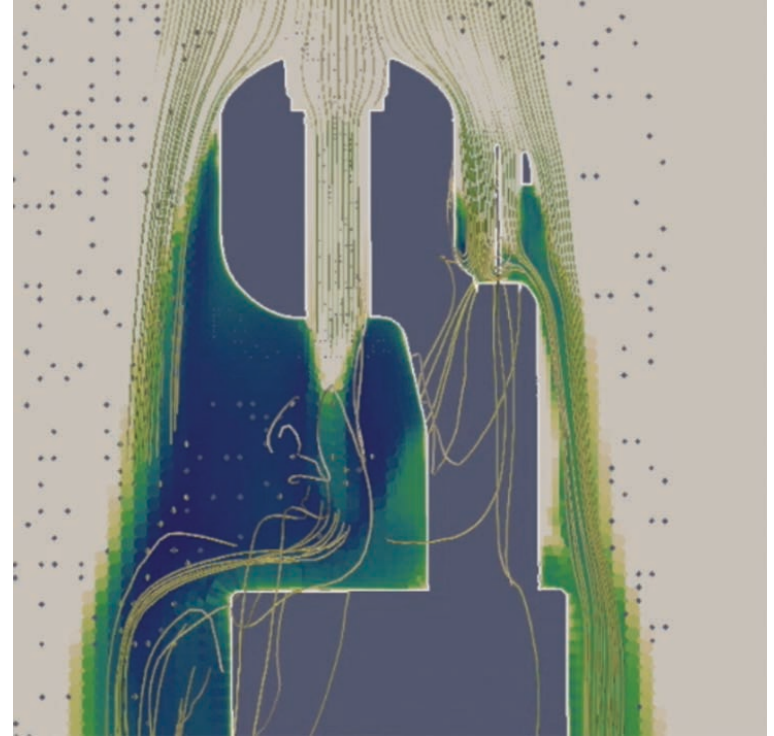
Measurement principle of an inductive conductivity cell

- Drive coil and receive coil
 - Apply an AC current to the drive coil
 - Causes a changing magnetic flux in the generating ferrite
 - Electrical current induced in sea water
 - Changing current in sea water induces magnetic flux in receiving ferrite
 - Changing magnetic flux in ferrite causes AC current in receiving coil
 - Current in receiving coil is **proportional to the seawater conductivity**

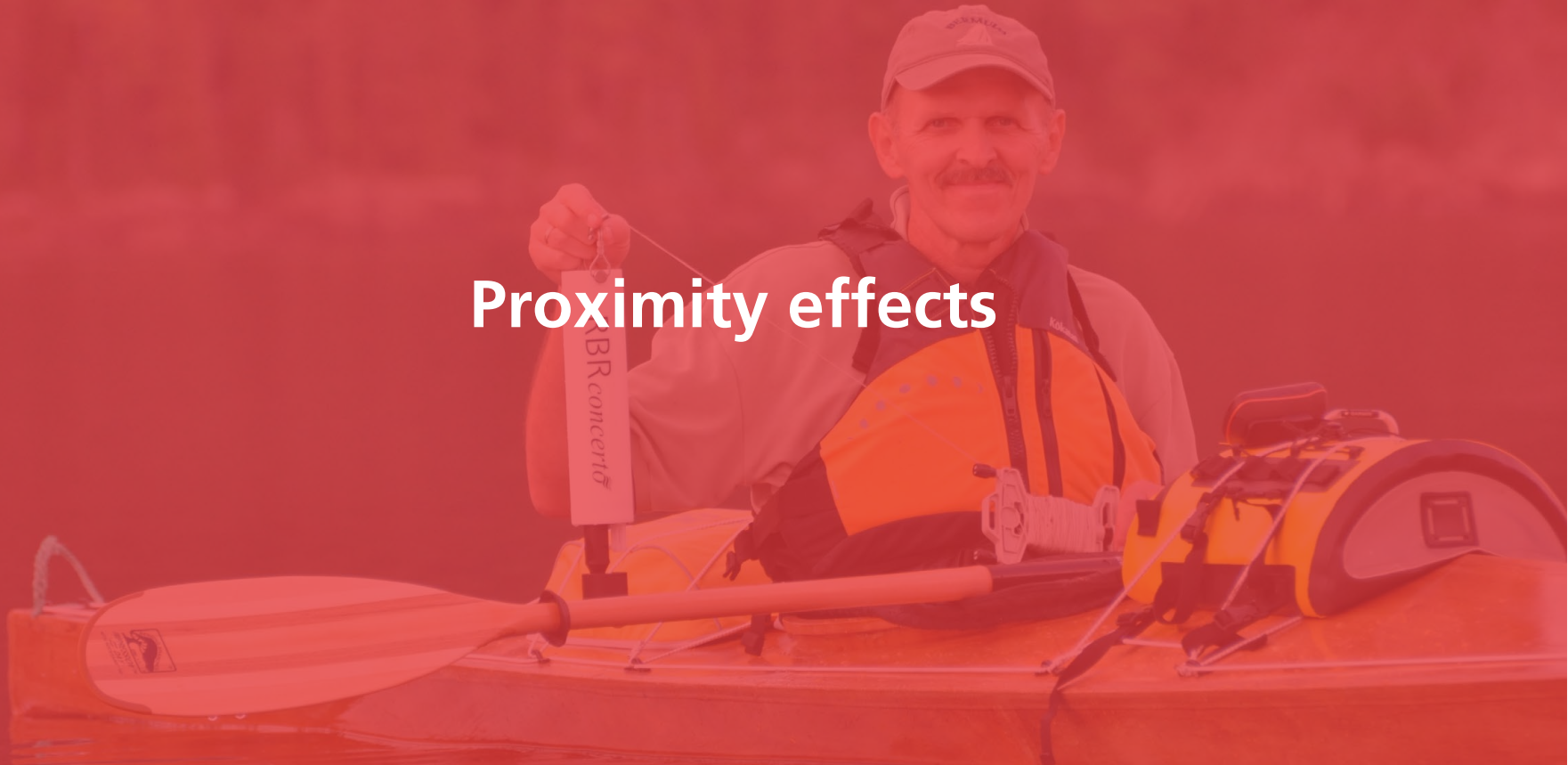


Benefits of inductive conductivity cells

- Conductivity cell can be built with a low aspect ratio
- Cell flushes naturally
 - No pump required
- Low power consumption
 - Acoustically quiet
- Robust
- No metal electrodes
 - Not affected by surface oils
- Can measure accurate conductivity when cell is 10cm from air-sea interface



Proximity effects



Proximity effects

Any material within close proximity of the conductivity cell changes the measured conductivity.

- Recommended to keep objects ~15cm from cell
- High bias for conductive material (e.g., stainless steel guard)
- Low bias for non-conductive material (e.g., rope or insulated mooring line)
- Calibration can eliminate proximity effect
 - Instrument calibrated in the guard
 - Float heads calibrated with Iridium antenna and oxygen optode



Proximity errors from insulated steel mooring line

75mm clamp



150mm clamp



<i>Calibration spec</i>	<i>~0.003 PSU</i>
75mm clamp	Error = 0.0025 PSU
150mm clamp	Error < 0.0001 PSU

Accuracy, resolution, and stability

From the RBR data sheets:

Calibration Accuracy

- ± 0.003 mS/cm (0 – 85 mS/cm)

Precision

- 0.001 mS/cm

Stability

- 0.010 mS/cm/yr


RBR
MEASURE THE BLUE PLANET

rbr-global.com

RBRduo³ C.T / RBRconcerto³ C.T.D

MOORED AND PROFILING INSTRUMENTS

CT AND CTD DATA LOGGERS



The RBRduo³ C.T and the RBRconcerto³ C.T.D are unique data loggers dedicated to the determination of salinity. Salinity is calculated by measuring the conductivity and temperature of the water. Equipped with a depth channel, the RBRconcerto³ C.T.D can also derive density anomaly and speed of sound. The RBRduo³ C.T and the RBRconcerto³ C.T.D are available in configurations that support moored or profiling applications, and come equipped with twist activation.

FEATURES

- Wi-Fi ready
- Twist activation
- 240M readings
- Up to 32Hz sampling
- USB-C download
- Realtime communications

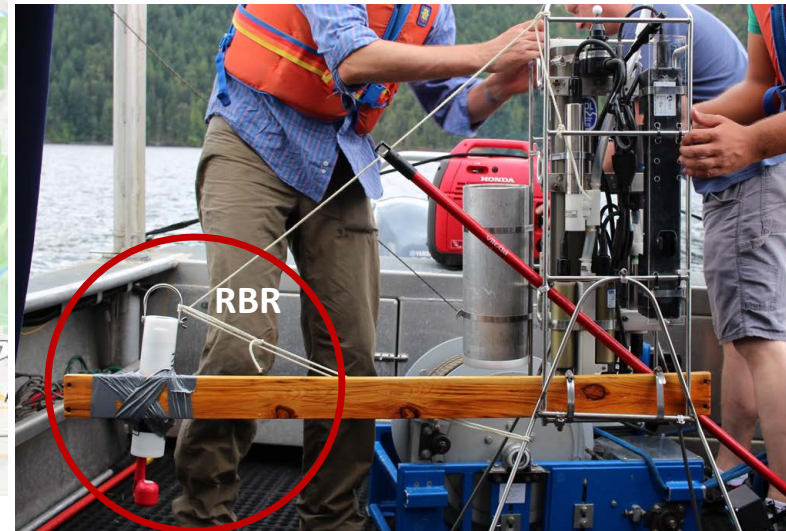
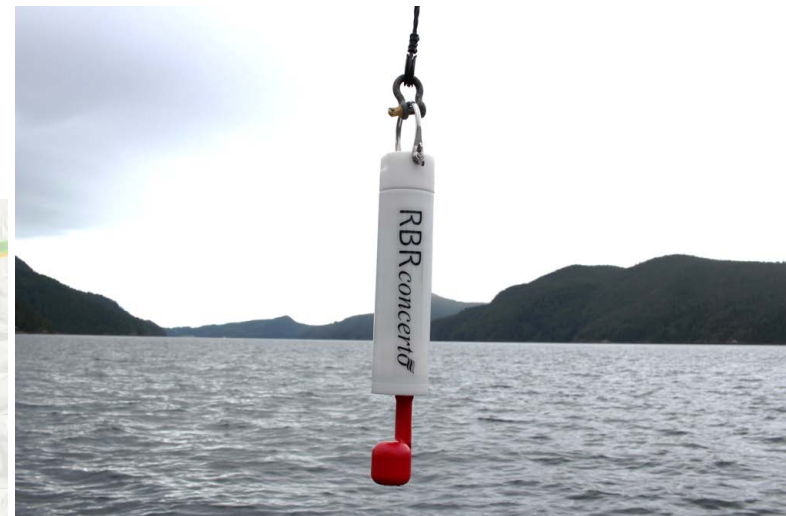
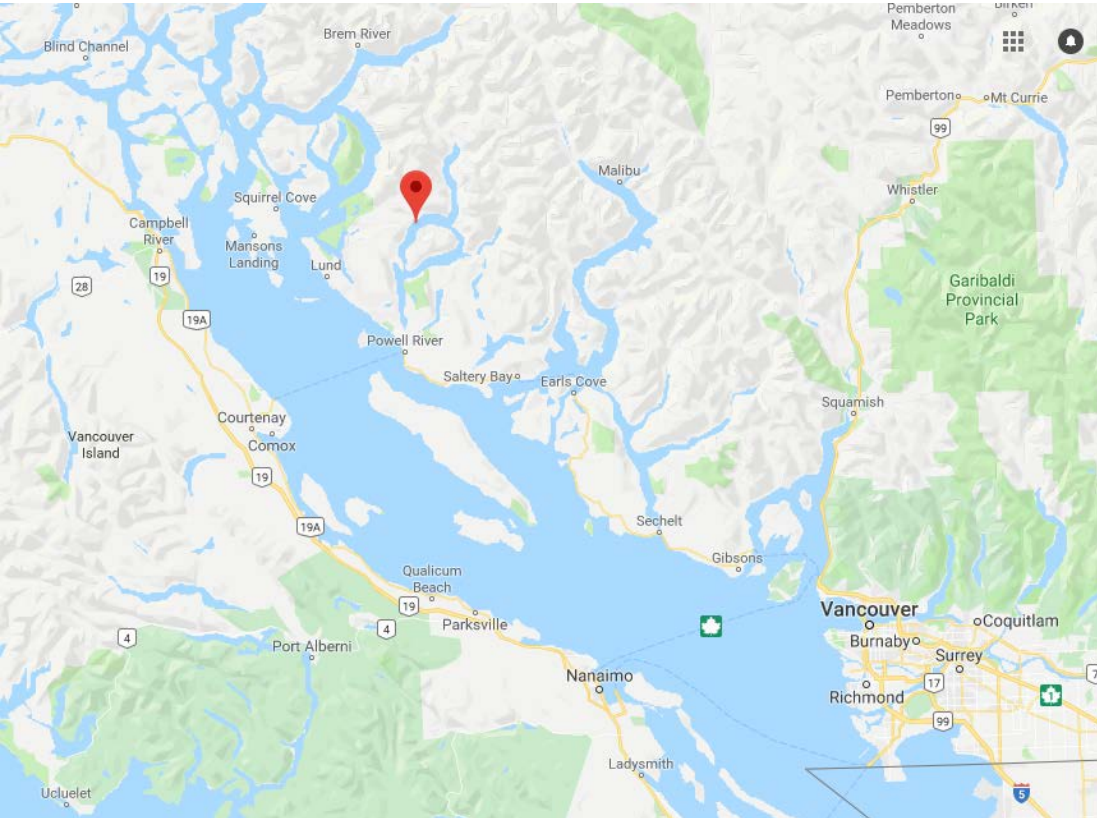
RBR CT and CTD data loggers are available in the following configurations:

- ▶ RBRduo³ C.T moored instrument; measures conductivity and temperature
- ▶ RBRconcerto³ C.T.D moored instrument; measures conductivity, temperature and depth
- ▶ RBRconcerto³ C.T.D | fast8 turbidity, 8Hz profiling instrument; fast sensor response
- ▶ RBRconcerto³ C.T.D | fast16 16Hz profiling instrument; fast sensor response
- ▶ RBRconcerto³ C.T.D | fast32 32Hz profiling instrument; fast sensor response

RBR CT and CTD loggers make it simple to configure the optimum sampling regime for your measurements. The large data storage capacity and fast download ability facilitate long deployments with higher sampling rates. The loggers are available in a standard body or extended body with additional power for extended deployments. Conductivity measurements are performed using a rugged inductive cell that can be frozen into ice. Dataset export to Matlab, Excel, OceanDataView®, or text files makes post processing with your own algorithms effortless.

RBR

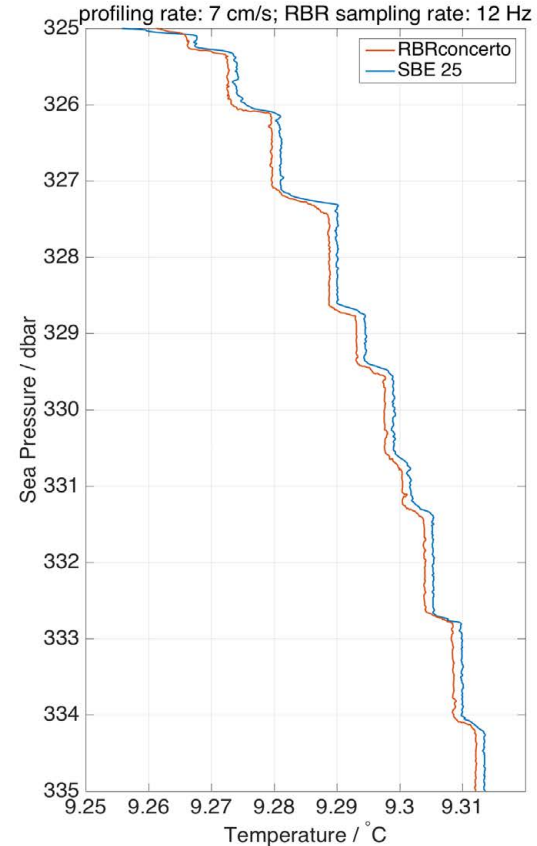
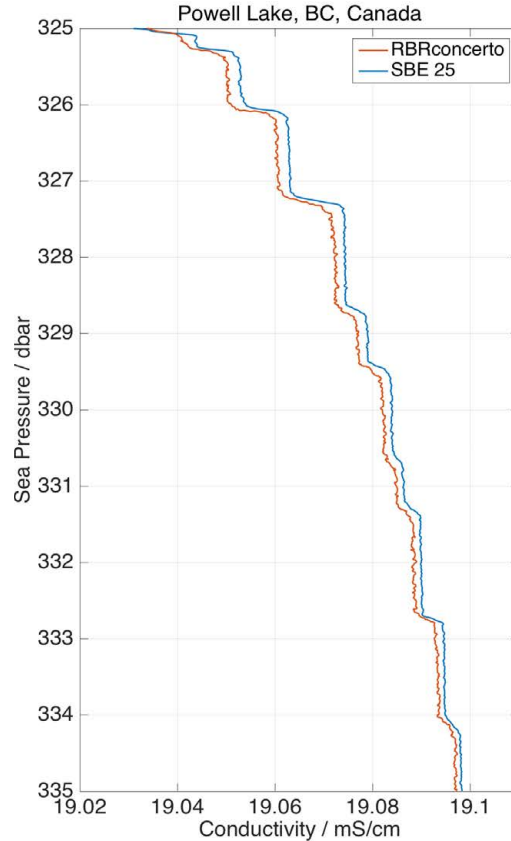
Resolution demo: Powell Lake, BC



Conductivity resolution: Powell Lake, BC

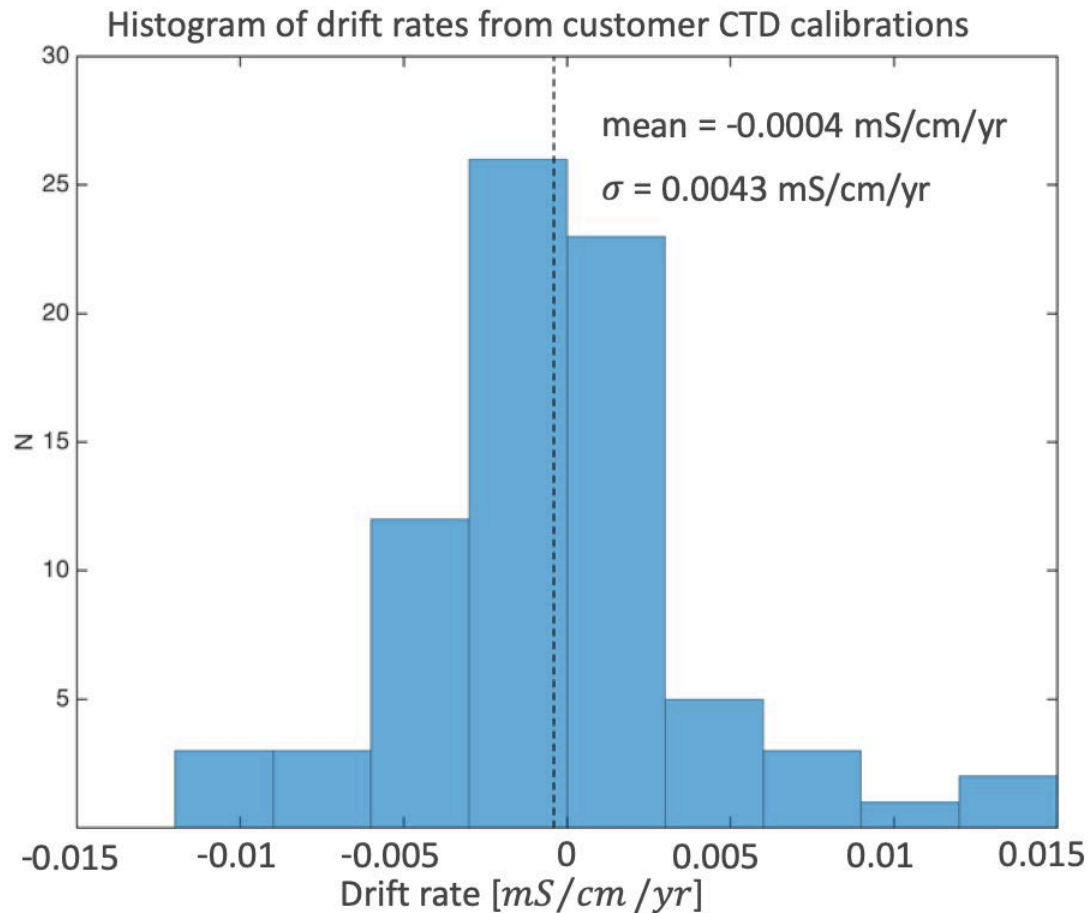
Able to resolve:

- 1 m thick uniform layers
- 10 cm thick interfaces
- ΔT (adjacent layers) $\sim 0.005^\circ\text{C}$
- ΔS (adjacent layers) ~ 0.002



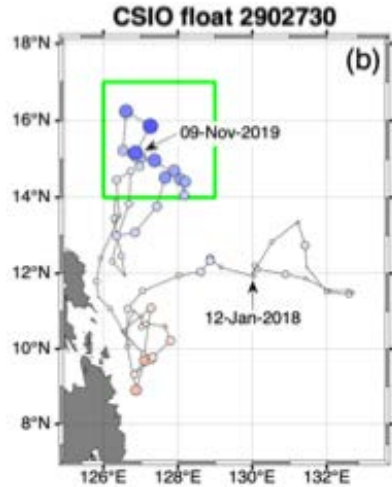
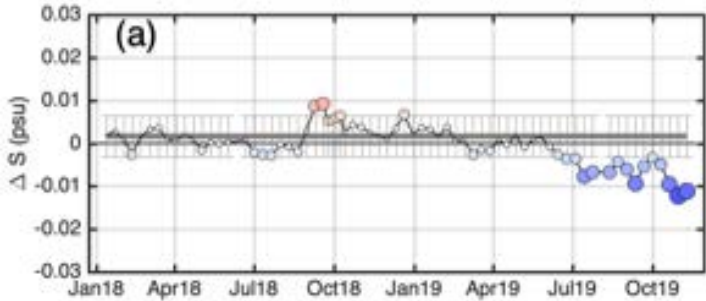
Conductivity: long-term sensor stability

Calibration lab results: stability

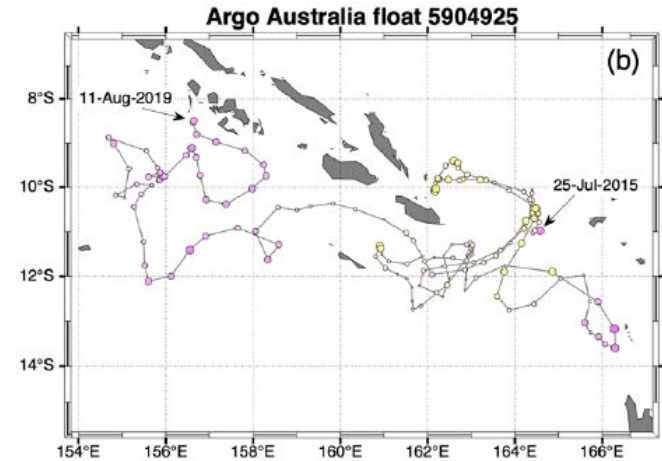
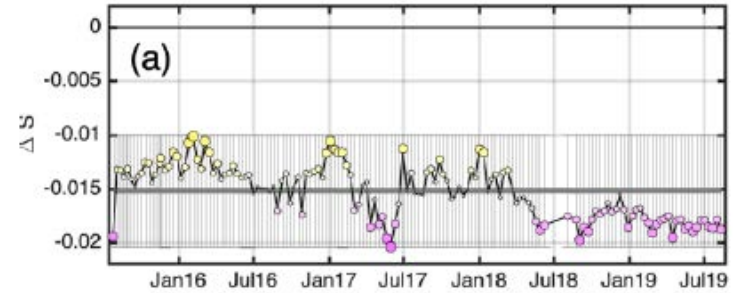


- Mean = -0.0004 mS/cm/yr
- $\sigma = 0.0043$ mS/cm/yr
- 70% of instruments have a drift rate of 0.003 mS/cm/yr or less

China Argo



Australia Argo



No drift relative to standard reference data when analyzed with Owens-Wong stability analysis (over 4+ years!)

Conductivity cell for different max pressure rating

Three versions, each rated for a different maximum pressure



750dbar



2000dbar



6000dbar

RBR



Thank you!

Contact Us

rbr-global.com

info@rbr-global.com

+1 613 599 8900

RBR