

Quality Issue #003: CODA optodes

Issue number: 3			
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Version	Date	Comments	Authors
1	2023-07-11	Creation of document	Chiara Monforte and Callum Rollo

1 Introduction

The RBR CODA oxygen sensors have shown a temporal drift and fail to detect low oxygen concentration. Some of the bottom waters where the gliders operate are known to be de-oxygenated. Water samples taken from periodic research vessel CTD casts show 0-5 $\mu\text{mol L}^{-1}$, as do other oxygen sensors used on gliders in the same area at the same time. However, the CODA sensors show a minimum value of 15-20 $\mu\text{mol L}^{-1}$ in waters that should be de-oxygenated. The gliders move vertically at 10 cm s^{-1} and the de-oxygenated layer is ~ 10 m thick. So the sensors should have time to adapt. None of the CODA sensors are able to detect the 0 $\mu\text{mol L}^{-1}$ oxygen concentration in the waters surveyed by the gliders.

Sensor serials 206116 and 206795 were sent for fault finding to the manufacturer and came back with foil replacement and re-calibration. On the deployments after maintenance, the sensors showed the drift again and could not detect the 0 $\mu\text{mol L}^{-1}$ oxygen (SEA067_M32; SEA066_M33; SEA067_M11).

Investigation is ongoing and no CODA sensors are deployed in the areas with low oxygen. Currently, the presence of hydrogen sulfide is suspected to affect the sensors.

The table below (Table 1) shows an updated list of all the mission deployed with a RBR CODA sensor, color-coded by severity. The flag column corresponds to data quality: suspect (3), fail (4), and good (1).

Table 1: Info summary for all the missions deployed with a RBR CODA sensor. The different basins mentioned in the 'Location' column, follow the division made by HELCOM which is shown in A.1

Glider	Mission	Location	Mission Start date	Sensor Serial	Issue description	Flag
SEA066	10	Bornholm Basin	2021-10-24	205592	B	4
	12	Bornholm Basin	2021-11-16	206795	B	4
	14	Bornholm Basin	2021-12-17	206795	B	4
	16	Skagerrak	2022-01-15	205592	C	4
	41	Northern Baltic Proper, Eastern Gotland Basin	2022-07-27	205592	B	4
	42	Northern Baltic Proper, Eastern Gotland Basin	2022-08-25	205592	B	4
	43	Eastern Gotland Basin, Northern Baltic Proper	2022-10-12	205592	B	4
	45	Northern Baltic Proper	2022-11-27	205592	B	4
SEA067	26	Northern Baltic Proper, Eastern Gotland Basin	2022-04-11	206115	D	4

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Table 1: Info summary for all the missions deployed with a RBR CODA sensor. The different basins mentioned in the 'Location' column, follow the division made by HELCOM which is shown in A.1 (Continued)

	27	Northern Baltic Proper, Eastern Gotland Basin	2022-05-06	206115	D	4
	29	Eastern Gotland Basin, Northern Baltic Proper	2022-06-01	206115	E	4
	30	Eastern Gotland Basin, Northern Baltic Proper	2022-06-21	206115	E	4
	32	Northern Baltic Proper, Eastern Gotland Basin	2022-09-22	206795	B	4
	37	Northern Baltic Proper, Eastern Gotland Basin	2022-11-13	210568	B	4
	39	Northern Baltic Proper, Eastern Gotland Basin	2022-12-16	210568	B	4
SEA068	27	Eastern Gotland Basin	2022-07-27	206795	D	4
SEA069	9	Eastern Gotland Basin	2022-07-27	206116	D	4
	11	Bornholm Basin	2022-09-23	206116	B	4
	13	Skagerrak	2022-10-24	206116	C	4
SEA076	8	Bornholm Basin	2022-10-05	210568	B	4
	9	Bornholm Basin	2022-10-20	210568	B	4
SEA077	11	Bornholm Basin	2022-09-06	210577	B	4
	12	Bornholm Basin	2022-10-03	210577	B	4
	13	Bornholm Basin	2022-10-12	210577	B	4
	15	Bornholm Basin	2022-11-13	210577	B	4
	17	Bornholm Basin	2022-12-08	210577	B	4
	18	Bornholm Basin	2023-01-10	210577	B	4

Legend		Flag
A	Data is good	1
B	Deterioration of the foil has caused errors in the dissolved oxygen concentration. Values are observed to be substantially higher than the reference CTD cast at deployment. There is an apparent temporal increase in dissolved oxygen concentration throughout the mission.	4
C	Dissolved oxygen concentration values may be inaccurate. Deterioration of the foil has caused errors and temporal drift in other missions with this sensor during this timeframe. We have not observed issues in this particular mission, but we recommend caution when using this data.	4
D	Deterioration of the foil has caused errors in the dissolved oxygen concentration. Values are observed to be substantially higher than the reference CTD cast at deployment. There is an apparent temporal decrease in dissolved oxygen concentration throughout the mission.	4
E	Dissolved oxygen concentration values are inaccurate. Deterioration of the foil has caused errors and temporal drift in other missions with this sensor during this timeframe. We do not observe a temporal drift in this particular mission, but the sensor does observe the expected 0 $\mu\text{mol L}^{-1}$ oxygen concentration in anoxic waters.	4

2 Examples

We show below part of the data in order to better visualize the issue. The minimum oxygen values detected are around 18 $\mu\text{mol L}^{-1}$ as opposed to the expected 0. Moreover, a temporal drift is evident (Figure 1).

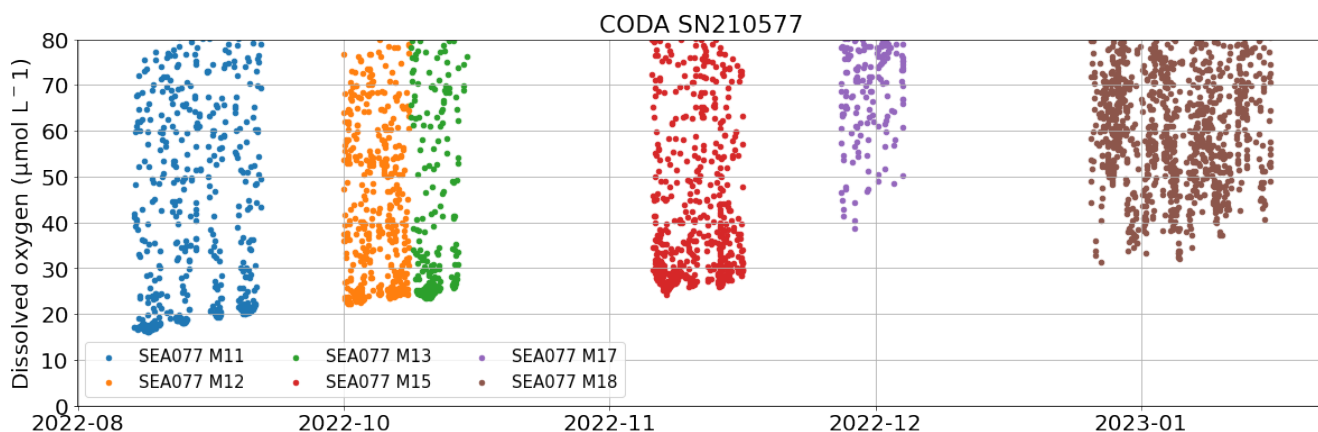


Figure 1: Oxygen concentration over time for each mission completed with CODA SN 210577. Y-axis range of 0-80 $\mu\text{mol L}^{-1}$ in order to highlight the temporal drift in the bottom waters and sensor's poor performance in anoxic water.

A Appendix



Figure A.1: Map of the Baltic Sea showing the 17 sub-basins (Map taken from <http://stateofthebalticsea.helcom.fi/in-brief/our-baltic-sea/>)