Workshop: Baltic Sea Stratification

The Baltic Sea – A stratified sea and consequences thereof

In the beginning of this workshop you have been dealing with the main characteristics of the Baltic Sea, being a semi-enclosed sea. You have learned, that the Baltic Sea water is a mixture of North Sea water and freshwater. You have been studying the inflow of North Sea water into the Baltic Sea and the distribution of salt in different basins and different depth levels using a model. In this part you will tackle with consequences of stratified waters for the distribution of oxygen in the Baltic Sea.

1) Study the profiles of salinity and oxygen presented in worksheet 2.
2) Run the experiment 2 in groups of 2-3 students. Read the instructions first, conduct the experiment and answer all given questions afterwards.

Worksheet 2: How to study oceanographic parameters across the whole water column

One of the workhorses of modern oceanography are the so called **CTD** unites. **C** stands for **c**onductivity (salinity), **T** for **t**emperature and **D** for **d**epth. All these sensors are equipped to a rosette system. Usually also oxygen sensor are attached. The CTDs are operated from research vessels. Using a winch they can be lowered from the surface waters across the whole water column towards the seafloor and backwards. While going up and down the sensors automatically measure and the data can be real time monitored on a PC screen on the research vessel. Additionally the CTD rosette host a series of water bottles allowing collecting water samples at distinct depth levels. The derived water samples can be used to investigate particulate and dissolved chemical compounds and organisms, e.g. algae and bacteria.

Fig. 1: CTD device in operation.

Results derived from CTD sampling from both the Gotland Basin and the uppermost basin, the Bothnian Bay (check Fig. 1 from the other workshop for location) are displayed in the figure on the next page. Please compare the profiles for salinity, temperature and oxygen and answer the given questions.

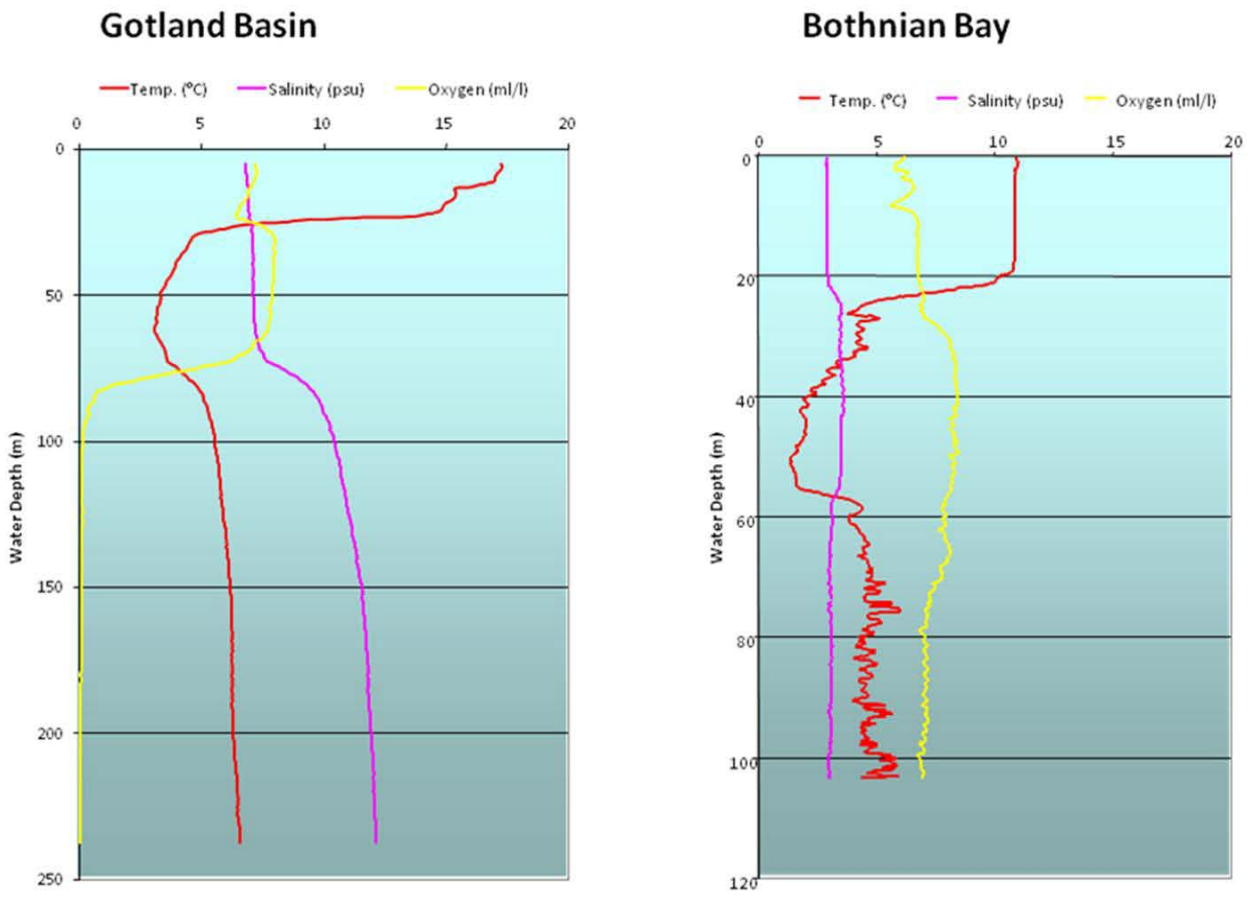

Fig. 2: Profiles of temperature, salinity and oxygen from Gotland Basin and Bothnian Bay across the whole water column.

Tasks:

1) Describe the profiles for salinity, temperature and oxygen at both stations.
2) Which parameters show the same trend at both stations and which do not?
3) If a parameter shows different trends, try to find reason(s) for it.

Notes:

Experiment 2: Can you arrange water in a pile? If yes, does the boundary layer have an impact on distribution of matter?

Instruments:

beaker glasses in different sizes, measuring cylinder, glass stirrer, electronic balance

Chemicals:

freshwater, salt (sodiumchlorid), blue ink, baking soda

Fig. 3: Pupil trying to arrange water of different salinities in a pile.

Preparations/Instructions:

1. prepare each one liter of water containing 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 PSU salt (calculate first the amount of salt you need, re-assure if it´s right with a supervisor)
2. put 200 ml freshwater into a 500 ml beaker glass
3. put 100 ml from 10 PSU water into a 200 ml beaker glass and add 10 ml of blue ink
4. pour the coloured saltwater gently into the beaker containing freshwater (see instruction point 2.), carefully watch the boundary layer between the upper and lower water column, take pictures when the experiment is finished (side view)
5. when the experiment is finished, clean the beaker glass repeat steps 2 to 4 but use the less concentrated salt solutions now (going down from 9 to 1)
6. stop the experiment when you don´t get stratified water
7. repeat the first experiment and add a little amount of baking soda, take a picture when the experiment is finished (side view)
8. repeat experiment described in point 7., but with salt concentration which are stratified, take a picture when the experiment is finished (side view)

Tasks:

1. Write down your observations what happened when you put salt water into freshwater. Give reasons why this happened.
2. At which threshold (difference in PSU between the upper and lower water column) the boundary layer did not show up?
3. Describe what happens when you put baking soda into the water (e.g. along with reaction equation).
4. Describe how the gas (which escaped after putting baking soda into the water) got distributed
   a) in stratified water and
5. b) in non-stratified water.
6. Which consequence does the boundary layer might have for distribution of oxygen in the Baltic Sea. Cross check your answer with the profiles given in Fig. 5.

Notes:

Part-financed by the European Union
(European Regional Development Fund)