CRUISE REPORT

R/V Aranda

Cruise 2/2016

Combine1 Leg 2/2016

25. January - 5. February 2016

This report is based on preliminary data and is subject to changes.

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Cruise 2/2015, Combine1 Leg 2

25th January – 5th February 2016

Chief scientist: Juha Flinkman

INTRODUCTION

The aim of the Cruise was to monitor hydrography and nutrient situation in the Baltic Sea according to the HELCOM/MONAS Combine programme (Combine1). In addition, since a major inflow of saline water into the Baltic Sea occurred during Dec 2014 – Jan 2015, the cruise station network was extended to Arkona and Bornholm basins to capture the situation. C1 Leg 2 covered Western GoF, Archipelago Sea (AS), Bothnian Sea (BS), Bothnian Bay (BB), Åland Sea (ÅS) and Northeastern, Central and Southern Baltic Proper (BP) during 25th Jan to 5th Feb 2016. Altogether 72 stations were visited during C1 Leg2. At every station CTD, O_2 profile, pH and nutrients were measured. In addition to the CTD profile, salinity and temperature were measured separately from 1m to bottom sample. Additional samples for QA measurements werte taken at several stations.

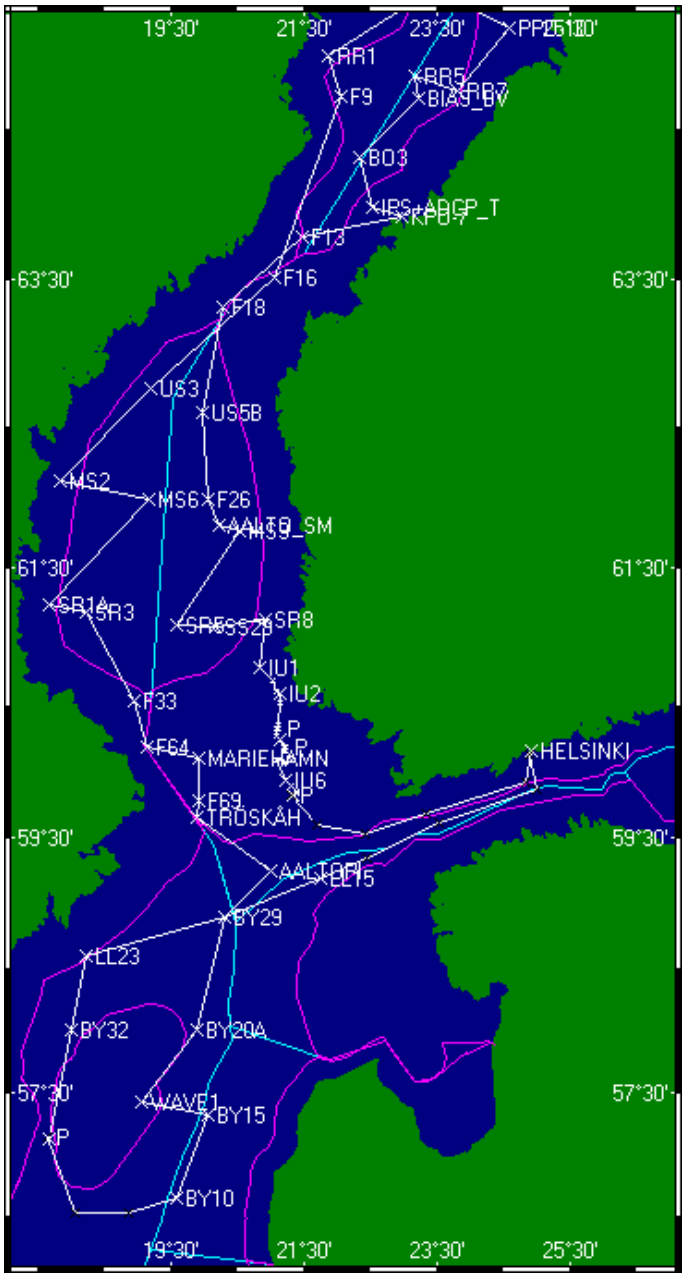


Figure 1. Cruise route of R/V Aranda during the cruise Combine1. Route marked in white, territorial water boundaries in purple, EEZ in blue.

SUMMARY

Winter 2015-2016 proved to be warmer than the previous one. After the major inflow event Dec 2014 – Jan-Feb 2015, subsequent smaller inflow were detected during this winter, which was characterized by stormy weather periods, significant rainfall and high temperatures all through the winter. This caused increase in riverine flow to the sea, which resulted in increased nutrient loading. Sea ice cover was practically missing outside costal areas of eastern GoF and GoB. Conditions in Baltic Proper were rather similar to previous winter despite additional smaller saline water inflow. Bornholm and Arakona basins contained saline water of even 24PSU in near bottom layers, and were well oxygenated. However, already at Gotland Deep the deep water was anoxic again. In the ÅS and Bay of Bothnia system, which are separated from the BP by the Salpausselkä sill, the deep water situation remains unchanged, with good oxygen conditions prevailing in deep water.

The measured nutrient concentrations of Gulf of Bothnia fit into the variation interval of the last ten years with only a few exceptions. Phosphate concentrations remained low in the Gulf of Bothnia. Nitrate concentrations are moderate in the Bothnian Sea and slightly higher in the Bothnian Bay, due to a lack of phosphate. There is a slight increase in surplus PO4 in southern Bothnian Sea. In the Baltic Proper, there is asignificant increase in PO4 top 15m layer, both in concentration and as surplus PO4 especially on Swedish coast between Gotland and Öland islands and mainland. Also in the Gulf of Finland there is a significant increase PO4 in all layers and surplus, in comparison to 2014.

OBSERVATION STATIONS

Total number of stations during the cruise was 42. The number of indexed observation stations at different sea areas was: 10 at the Baltic Proper, 3 at the Åland Sea, 15 at the Bothnian Sea and Quark, 9 at the Bothnian Bay, and 5 at the Archipelago Sea.

HYDROGRAPHIC CONDITIONS

Hydrographic data: temperature, salinity and oxygen, was measured with a Sea-Bird SBE 911plus CTD, totaling 42 CTD casts during the entire cruise. Temperature, salinity and oxygen content in different sea areas are presented below as averages of all stations in the area, and number of visited stations is also given.

Åland Sea, and the entire Golf of Bothnia system do not suffer from deep water oxygen depletion, as the sub halocline BP water can't enter the system. Oxygen content even at 290 m depth is over 5ml/l.

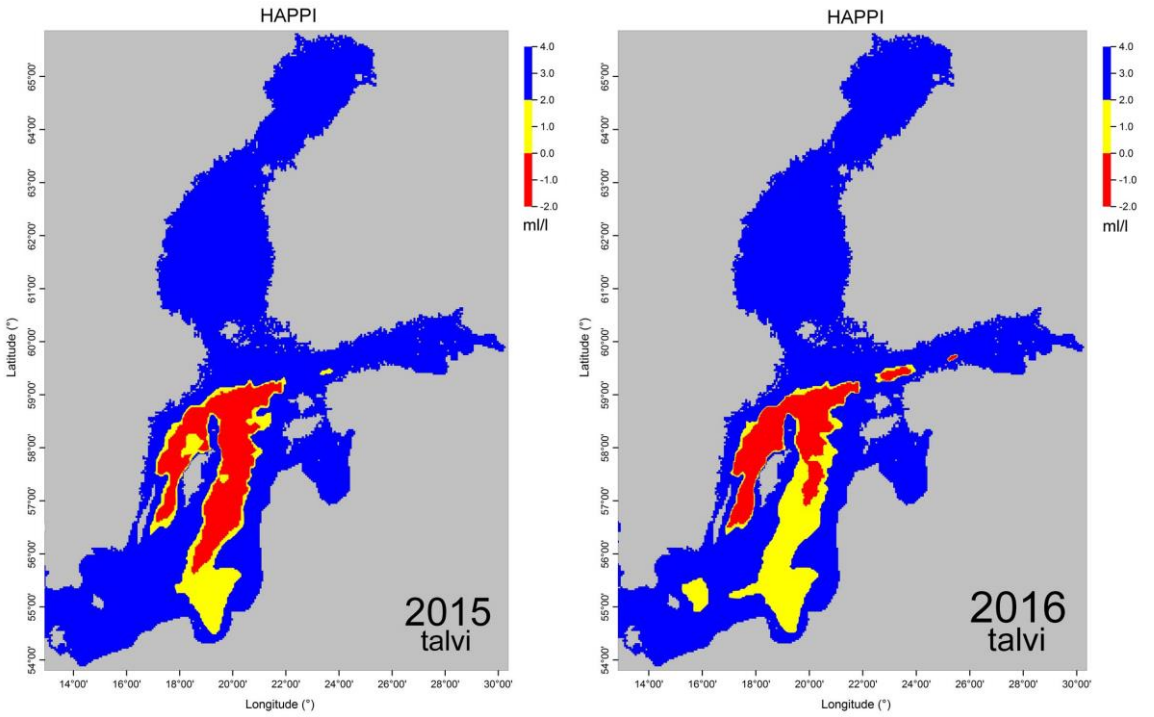
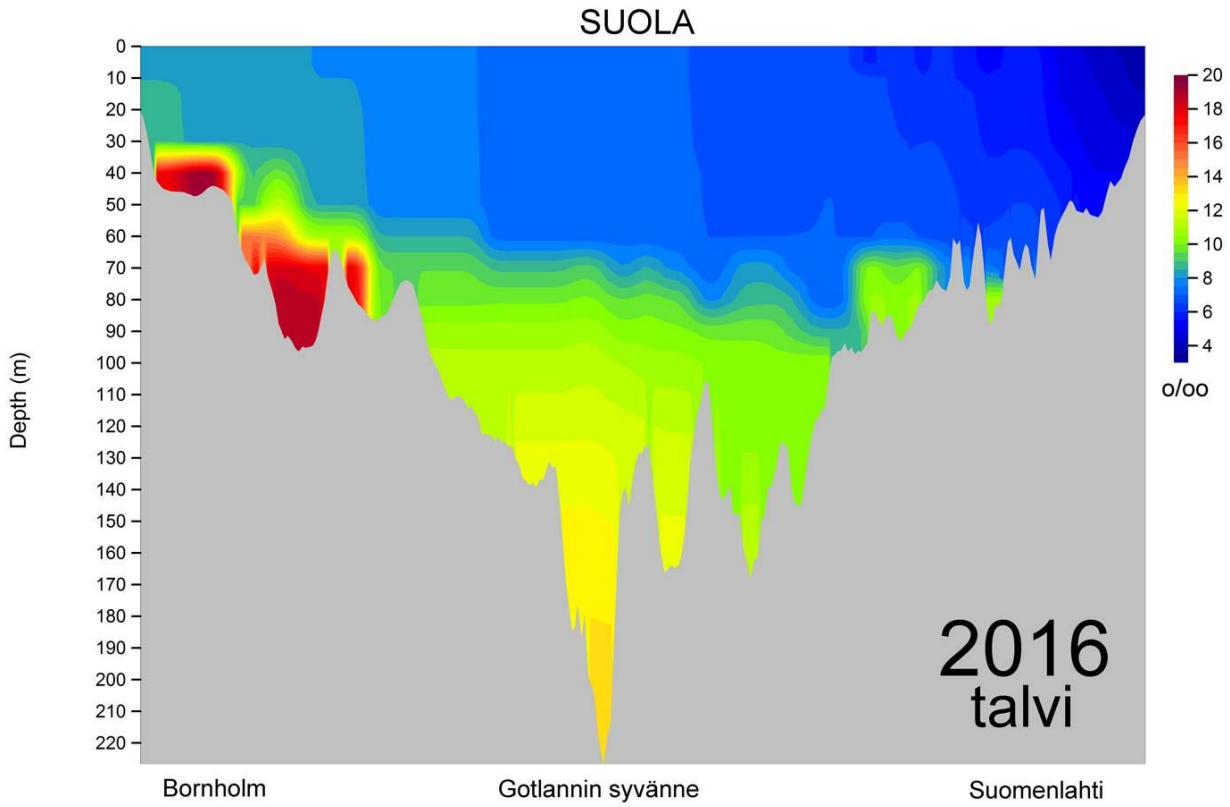


Fig. 2. Oxygen at near-botom layer in winter 2015 (left panel) and winter 2016 (right panel)



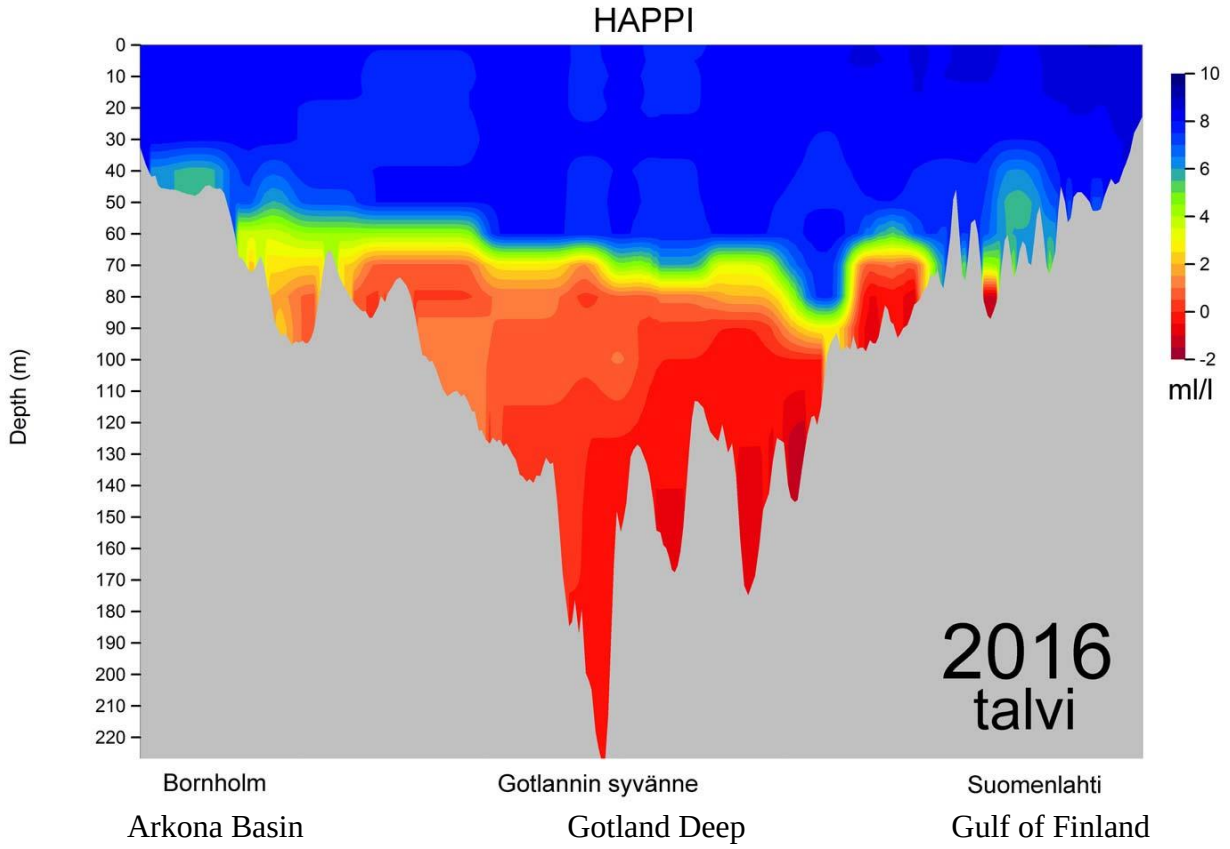
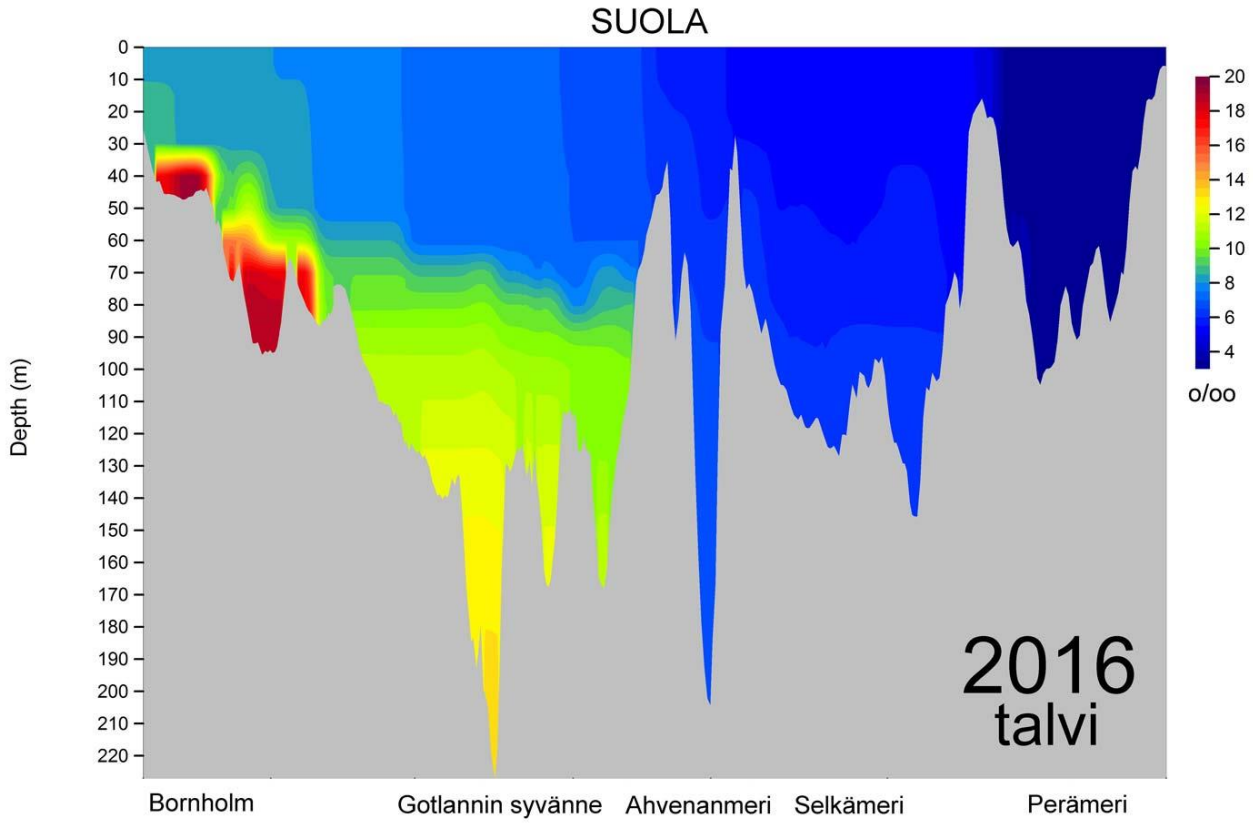


Figure 3. Salinity (upper panel) and dissolved oxygen (HAPPI, lower panel) from Arkona Basin via Gotland Deep in the Baltic Proper to Gulf of Finland in January - February 2016.



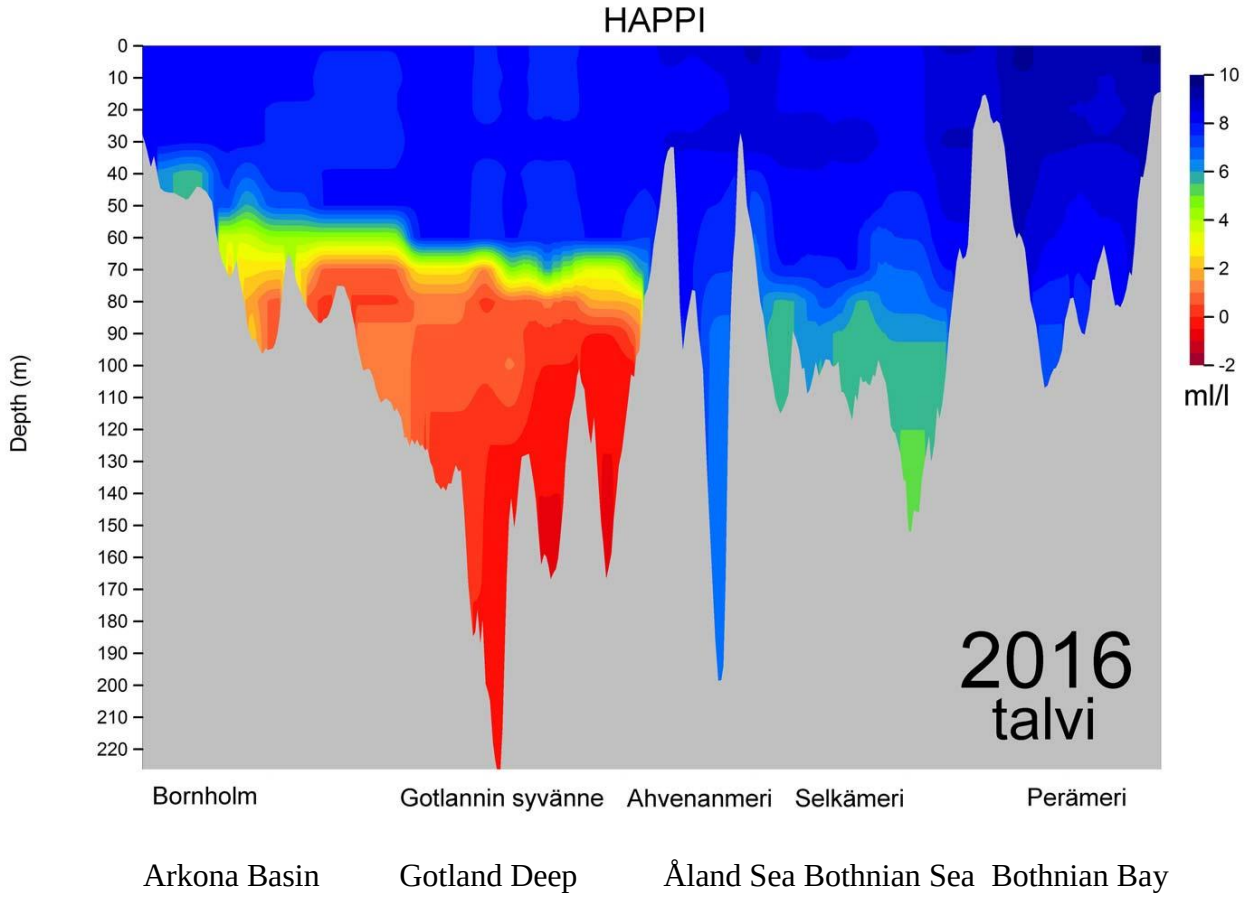
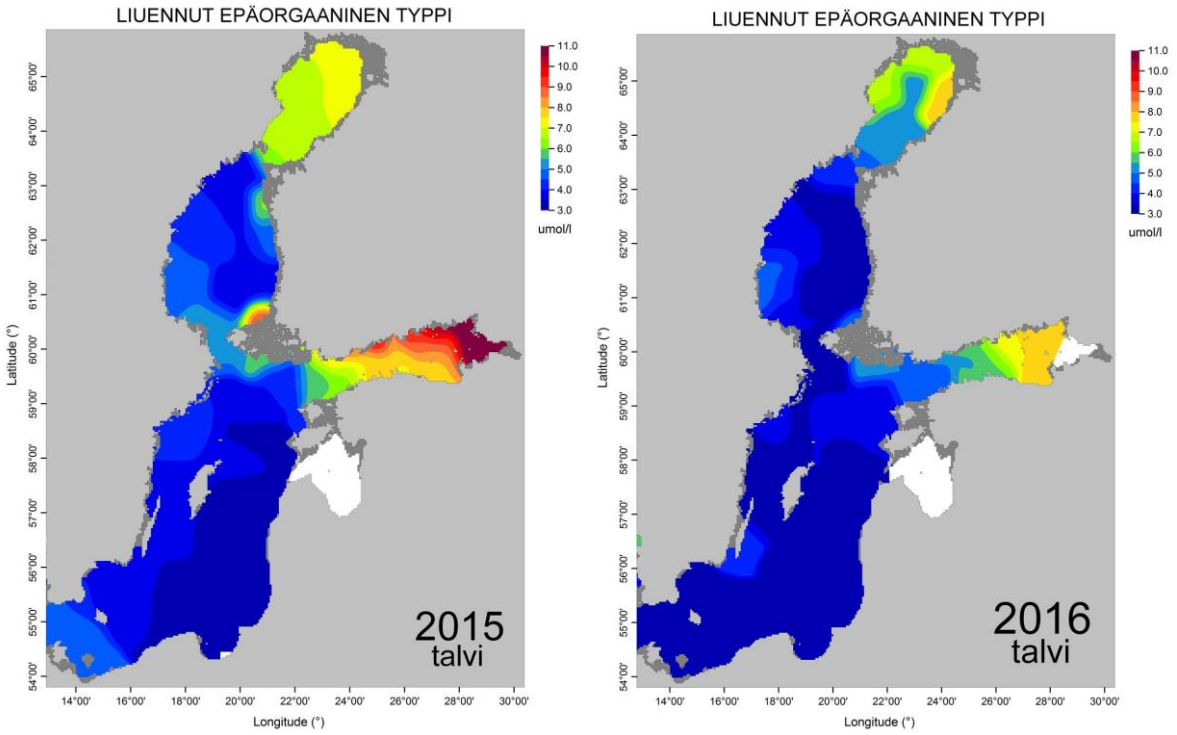


Figure 4. Salinity (upper panel) and dissolved oxygen (HAPPI, lower panel) from Arkona Basin via Gotland deep in the Baltic Proper to Bothnian Bay in January - February 2016.

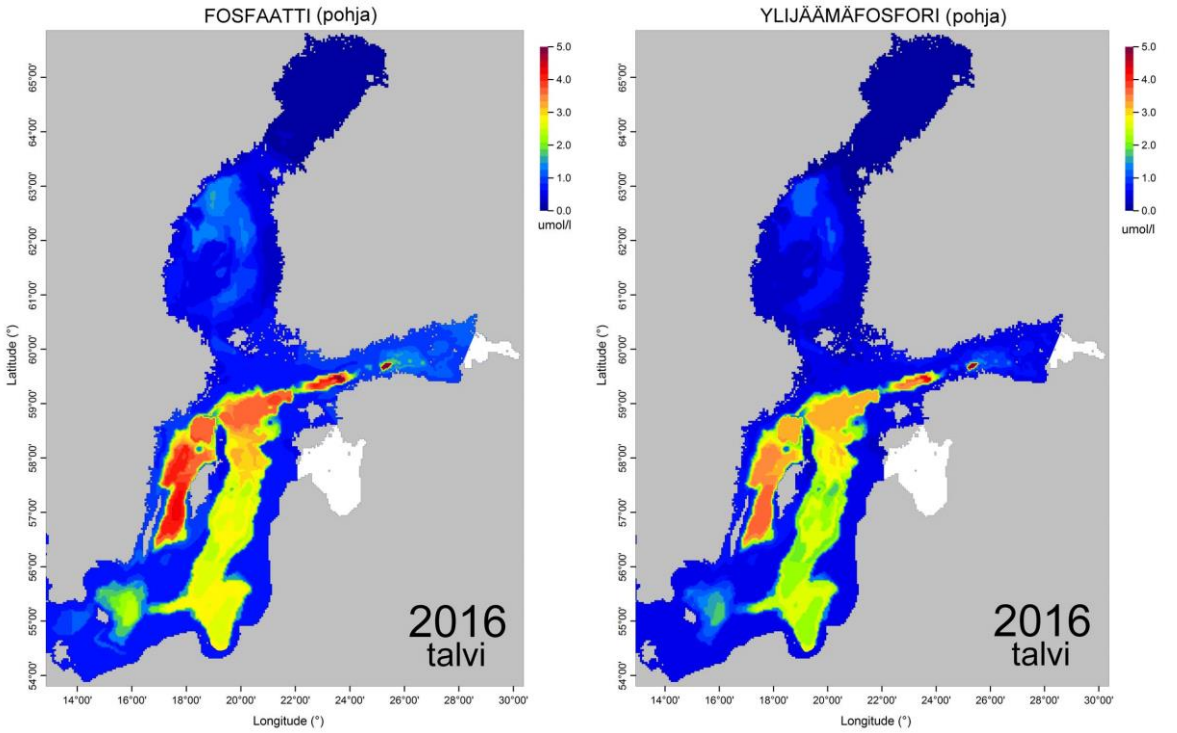
NUTRIENT CONDITIONS

Nutrient concentrations [µmol/l] were measured at all monitoring stations during the cruise. Nutrient levels are given maps below, expressed as dissolved inorganic nitroget (DIN) at 15 m depth (fig 4.), Phosphate phosphorus (PO4) in near bottom layer, and surplus PO4 (after spring bloom, calculated using Redfield ratio, fig 6.) over the entire cruise area. While there are no significant changes in DIN, there is a general increase of PO4 in deep layers in all areas including Bothnian Sea. In western Baltic Proper this increase is significant especially in top 15 m. layer and in surplus PO4.



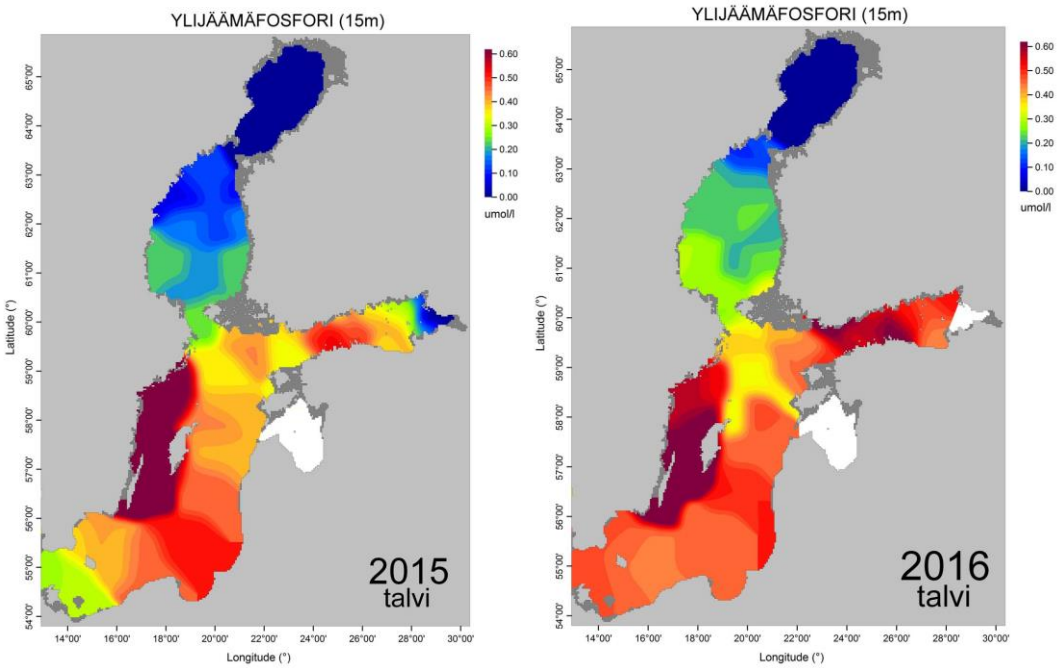
January 2015 January 2016

Figure 5. Dissolved inorganic nitrogen at 15m depth in winter 2015 (left panel) and winter 2016 (right panel).



January 2016

Figure 6. Phosphate phosphorus (PO4) in near bottom layer (left panel) and **surplus phosphorus** (PO4) in near bottom layer (right panel) in winter 2016.



January 2015 January 2016

Figure 7. Surplus PO4 at top 15m. layer in winter 2015 (left panel) and in winter 2016 (right panel). Assumed situation after sprinfg bloom, calculated by using Redfield ratio.

SCIENTIFIC STAFF:	**Time onboard**	**Organisation**
Flinkman Juha	**25. 1. – 5. 2. 2016**	**SYKE MK**
Bruun Janne	**25. 1. – 5. 2. 2016**	**SYKE MK**
Hänninen Panu	**25. 1. – 5. 2. 2016**	**SYKE MK**
Varmanen Pia	**25. 1. – 5. 2. 2016**	**SYKE MK**
Lastumäki Ilkka	**25. 1. – 5. 2. 2016**	**SYKE MK**
Riikonen Jere	**25. 1. – 5. 2. 2016**	**SYKE MK**
Lehtiniemi Maiju	**25. 1. – 5. 2. 2016**	**SYKE MK**
Budimir Stjepan	**25. 1 – 1. 2. 2016**	**SYKE MK**
Hietala Riikka	**25. 1. – 5. 2. 2016**	**IL**
Kosloff Pekka	**25. 1. – 5. 2. 2016**	**IL**
Roine Tuomo	**25. 1. – 5. 2. 2016**	**IL**
Gorokhova Elena	**1. – 5. 2. 2016**	**Stockholm Univ**

Master: Jaakko Raatikainen

Departure from HELSINKI on Monday 25.01.2016 at 12:00
Arrival to HELSINKI on Friday 05.02.2016 at 05:00
Other harbours that were visited during the cruise: Mariehamn at 01. Feb 2015

LIST OF STATIONS (coordinates in WGS-84)

Index/station	lat	lon	depth	time
01 0056 IU7	**N59.4891**	**E021.2020**	**92.00**	**20160126 0556**
01 0057 IU6	**N59.5621**	**E021.1324**	**120.00**	**20160126 0734**
01 0058 IU4	**N60.1400**	**E021.0880**	**49.00**	**20160126 1350**
01 0059 IU4_LAATU	**N60.1400**	**E021.0880**	**49.00**	**20160126 1500**
01 0060 IU2	**N60.3503**	**E021.0784**	**50.00**	**20160126 1854**
01 0061 SR8	**N61.0760**	**E020.5581**	**47.00**	**20160127 0025**
01 0062 SS29	**N61.0389**	**E020.0963**	**107.00**	**20160127 0438**
01 0063 SR5	**N61.0499**	**E019.3480**	**125.00**	**20160127 0756**
01 0064 MS9	**N61.4601**	**E020.3184**	**101.00**	**20160127 1515**
01 0065 AALTO_SM	**N61.4769**	**E020.1399**	**113.00**	**20160127 1727**
01 0066 F26	**N61.5901**	**E020.0378**	**137.00**	**20160127 1944**
01 0067 US5B	**N62.3518**	**E019.5808**	**220.00**	**20160128 0130**
01 0068 F18	**N63.1886**	**E020.1636**	**103.00**	**20160128 0729**
01 0069 F13	**N63.4678**	**E021.2815**	**64.00**	**20160128 1230**
01 0070 IPS+ADCP_T	**N63.5863**	**E022.3126**	**34.00**	**20160128 1620**
01 0071 BO3	**N64.1812**	**E022.2058**	**110.00**	**20160128 2001**
01 0072 BIAS_BV	**N64.4105**	**E023.1441**	**82.00**	**20160129 0015**
01 0073 RR5	**N64.5002**	**E023.0976**	**66.00**	**20160129 0145**
01 0074 RR7	**N64.4403**	**E023.4878**	**39.00**	**20160129 0423**
01 0075 F2	**N65.2304**	**E023.2784**	**92.00**	**20160129 1054**
01 0076 RR1	**N64.5803**	**E021.5175**	**85.00**	**20160129 1915**
01 0077 F9	**N64.4202**	**E022.0377**	**121.00**	**20160129 2150**
01 0078 F16	**N63.3101**	**E021.0378**	**49.00**	**20160130 0530**
01 0079 US3	**N62.4555**	**E019.1188**	**178.00**	**20160130 1515**
01 0080 MS2	**N62.0700**	**E017.5078**	**72.00**	**20160130 2043**
01 0081 MS6	**N61.5902**	**E019.0981**	**72.00**	**20160131 0100**
01 0082 SR1A	**N61.1400**	**E017.3979**	**61.00**	**20160131 0811**
01 0083 SR3	**N61.1100**	**E018.1380**	**73.00**	**20160131 1045**
01 0084 F33	**N60.3199**	**E018.5626**	**135.00**	**20160131 1543**
01 0085 F64	**N60.1134**	**E019.0855**	**287.00**	**20160131 1912**
01 0086 F69	**N59.4700**	**E019.5580**	**191.00**	**20160201 1210**
01 0087 TROSKAH	**N59.3961**	**E019.5300**	**40.00**	**20160201 1607**
01 0088 LL23	**N58.3499**	**E018.1384**	**446.00**	**20160202 0445**
01 0089 BY32	**N57.5999**	**E017.5981**	**169.00**	**20160202 1330**
01 0090 BY38	**N57.0700**	**E017.4000**	**110.00**	**20160202 2035**
01 0091 WAVE1	**N57.2490**	**E019.0289**	**39.00**	**20160203 0830**
01 0092 BY15	**N57.1921**	**E020.0300**	**238.00**	**20160203 1430**
01 0093 BY20A	**N58.0000**	**E019.5401**	**193.00**	**20160203 1956**
01 0094 BY29	**N58.5300**	**E020.1900**	**164.00**	**20160204 0200**
01 0095 BY29_LAATU	**N58.5300**	**E020.1900**	**164.00**	**20160204 0327**
01 0096 AALTO_PI	**N59.1502**	**E020.5982**	**98.00**	**20160204 0734**
01 0097 LL15	**N59.1100**	**E021.4481**	**131.00**	**20160204 1330**