CRUISE REPORT

R/V Aranda

Cruise 2/2015

Combine1/2015

19th – 25th January, and 26th January – 7th February 2015

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

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Cruise 2/2015, Combine1

19th – 25th January, and 26th January – 7th February 2015

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), continue the enhanced monitoring of Gulf of Finland according to GoF Year 2014 trilateral enhanced monitoring programme. 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. The cruise was completed in two legs, the first covering Gulf of Finland (GoF)during 19th to 25th Jan, and the seconf leg covering Western GoF, Archipelago Sea (AS), Bothnian Sea (BS), Bothnian Bay (BB), Åland Sea (ÅS) and Northeastern, Central and Southern Baltic Proper (BP) during 26th Jan to 7th Feb 2015. The cruise area is shown in two separate panels in Fig.1. Altogether 72 stations were visited during both legs, with an extended station network in Russian waters and Southern Baltic Sea. 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.

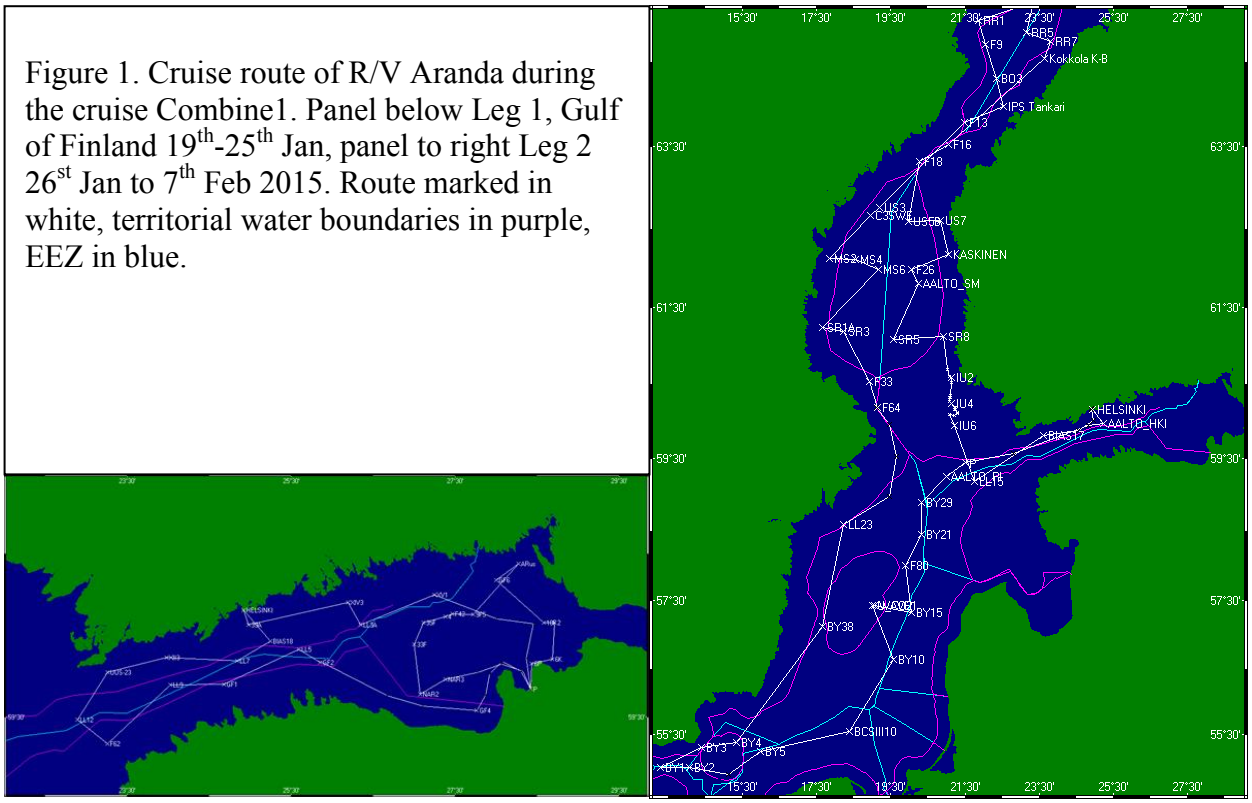


Figure 1. Cruise route of R/V Aranda during the cruise Combine1. Panel below Leg 1, Gulf of Finland 19th-25th Jan, panel to right Leg 2 26st Jan to 7th Feb 2015. Route marked in white, territorial water boundaries in purple, EEZ in blue.

SUMMARY

Winter 2014-2015 proved to be exceptional for the entire Baltic Sea. A major inflow event occurred at a typical time, Dec 2014 – Jan-Feb 2015. Eventually estimated as 3rd largest by volume in recorded history, this inflow will certainly have a significant impact on the entire Baltic in years to come. This winter was warm and stormy like the previous one, 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. In GoF, mostly due to stormy winter, well mixed water, and good conditions during previous years, the deep water oxygen levels were mostly good. Conditions in Baltic Proper were altered significally due to saline water inflow. Bornholm and Arakona basins contained saline water of even 24PSU in near bottom layers, and were well oxygenated. During the cruise in Jan Feb 2015, the saline water was met at BY7 in Stolpe Channel. 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 72. The number of indexed observation stations at different sea areas was: 26 at the Gulf of Finland, 22 at the Northern Baltic Proper, 2 at the Åland Sea, 12 at the Bothnian Sea and Quark, 9 at the Bothnian Bay, and 3 at the Archipelago Sea.

HYDROGRAPHIC CONDITIONS

Hydrographic data: temperature, salinity and oxygen, was measured with a Sea-Bird SBE 911plus CTD, totaling 72 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. Due to stormy conditions of the winters 2013-2014 and 2014-2015, Gulf of Finland remains well mixed by wind action, and deep water oxygen situation is better than in 2014. In the Southern Baltic the saline water influx can clearly be seen. Arkona and Bornholm basins contain saline water of over 24PSU in near bottom layer, and are well oxygenated in comparison to 2014.

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.

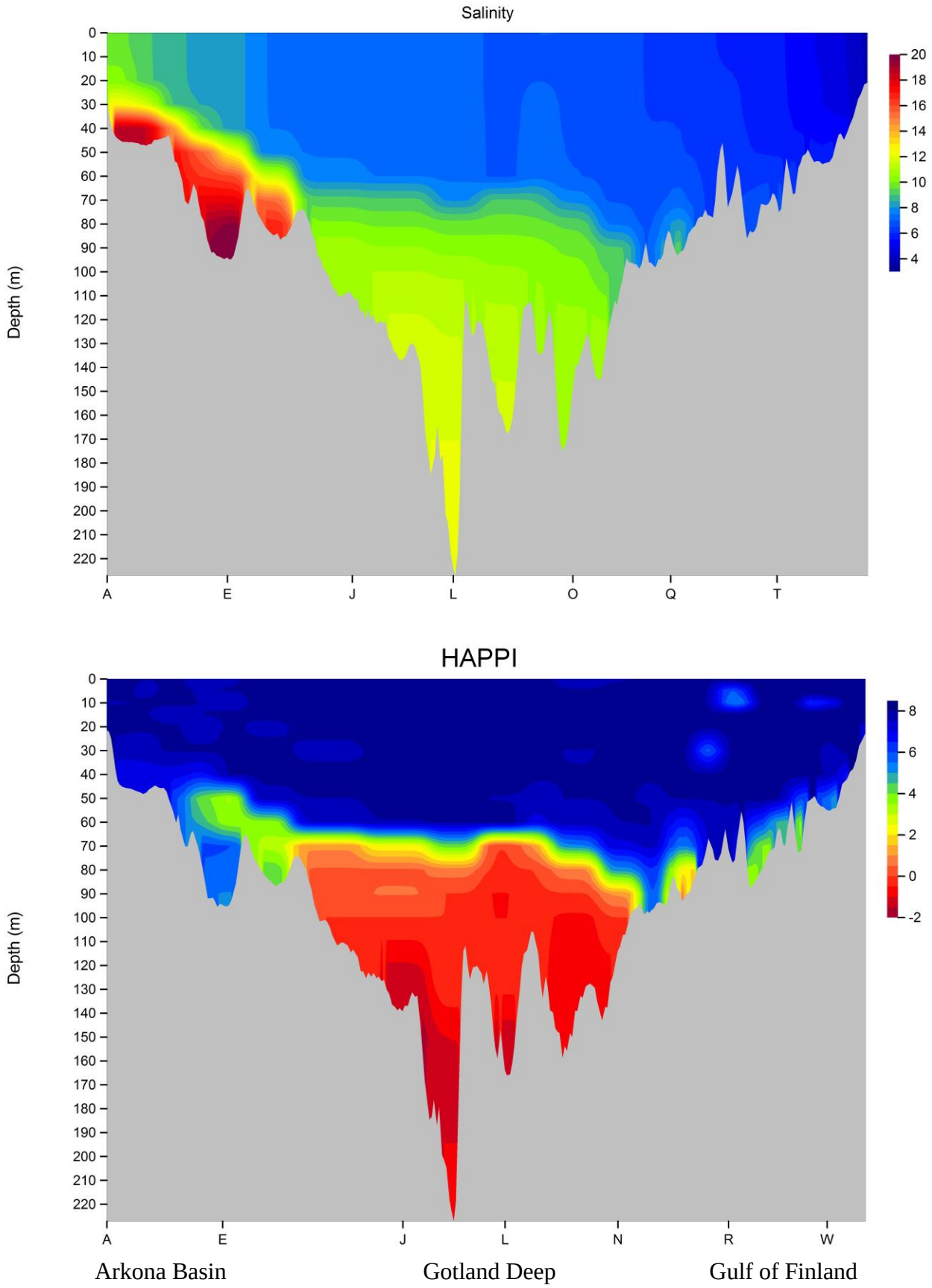


Figure 2. Salinity (upper panel) and dissolved oxygen (HAPPI, lower panel) from Arkona Basin via Gotland Deep in the Baltic Proper to Gulf of Finland in January 2015.

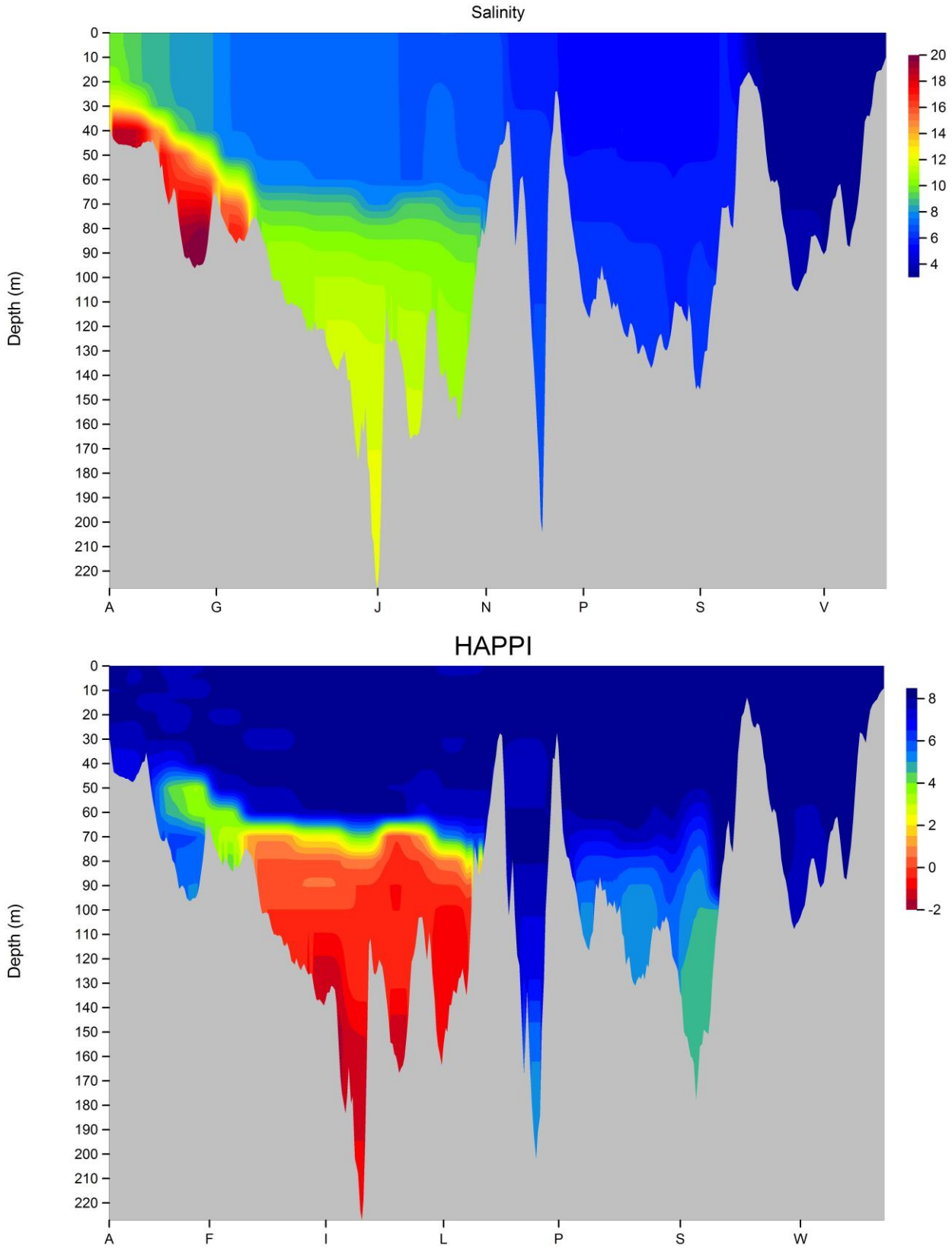
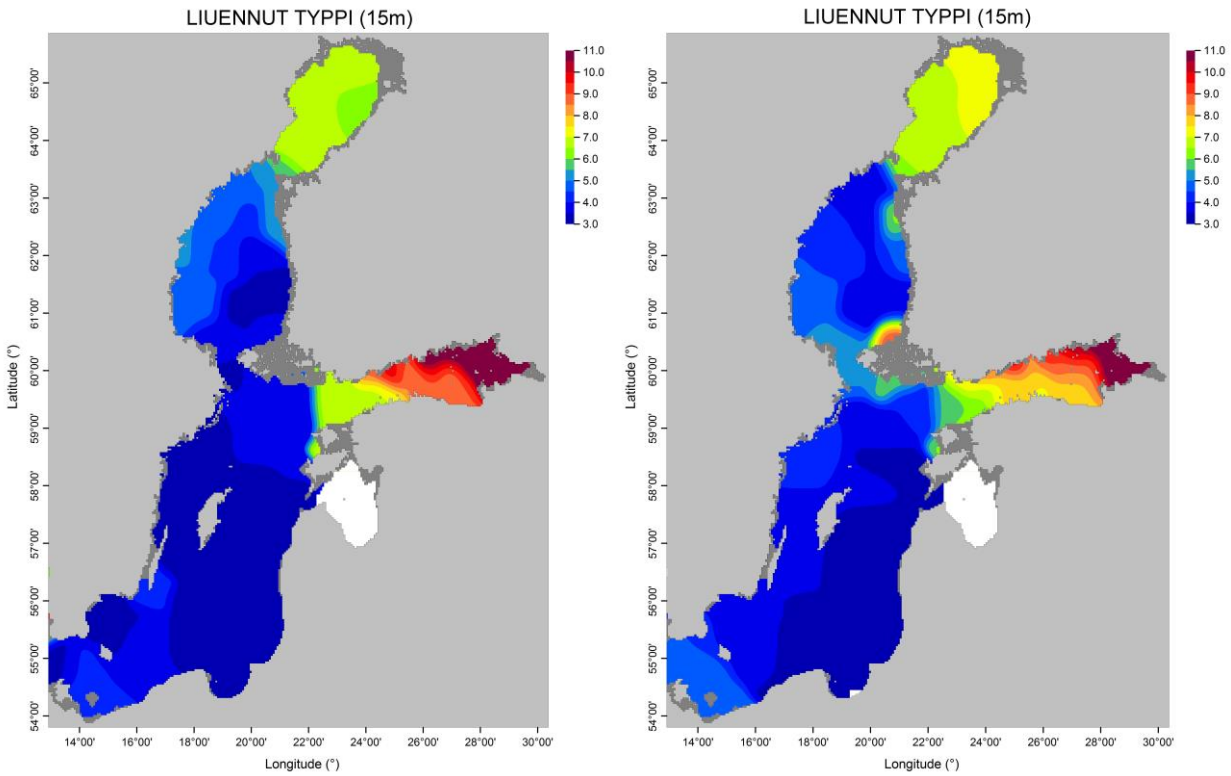


Figure 3. Salinity (upper panel) and dissolved oxygen (HAPPI, lower panel) from Arkona Basin via Gotland deep in the Baltic Proper to Bothnian Bay in January - February 2015.

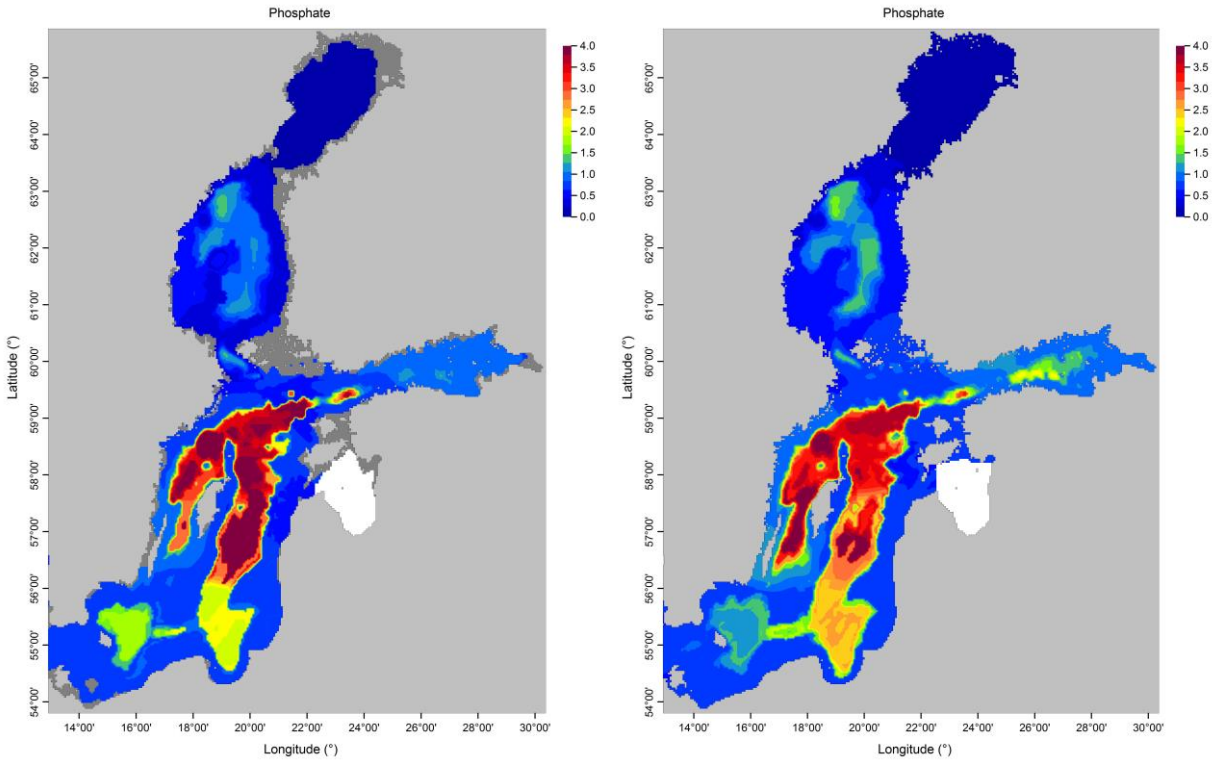
NUTRIENT CONDITIONS

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 (fig 5.), 15m. layer (fig 6.), and surplus PO4 (after spring bloom, calculated using Redfield ratio, fig 7.) 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, indicating possibilities of heavy blue green blooms in summer 2015, provided the suitable conditions develop. In Gulf of Finland however, the top 15m PO4 concentration is somewhat lower than in winter 2014, although surplus PO4 is higher than in 2014, probably due to higher PO4 concentrations in the deep layers.



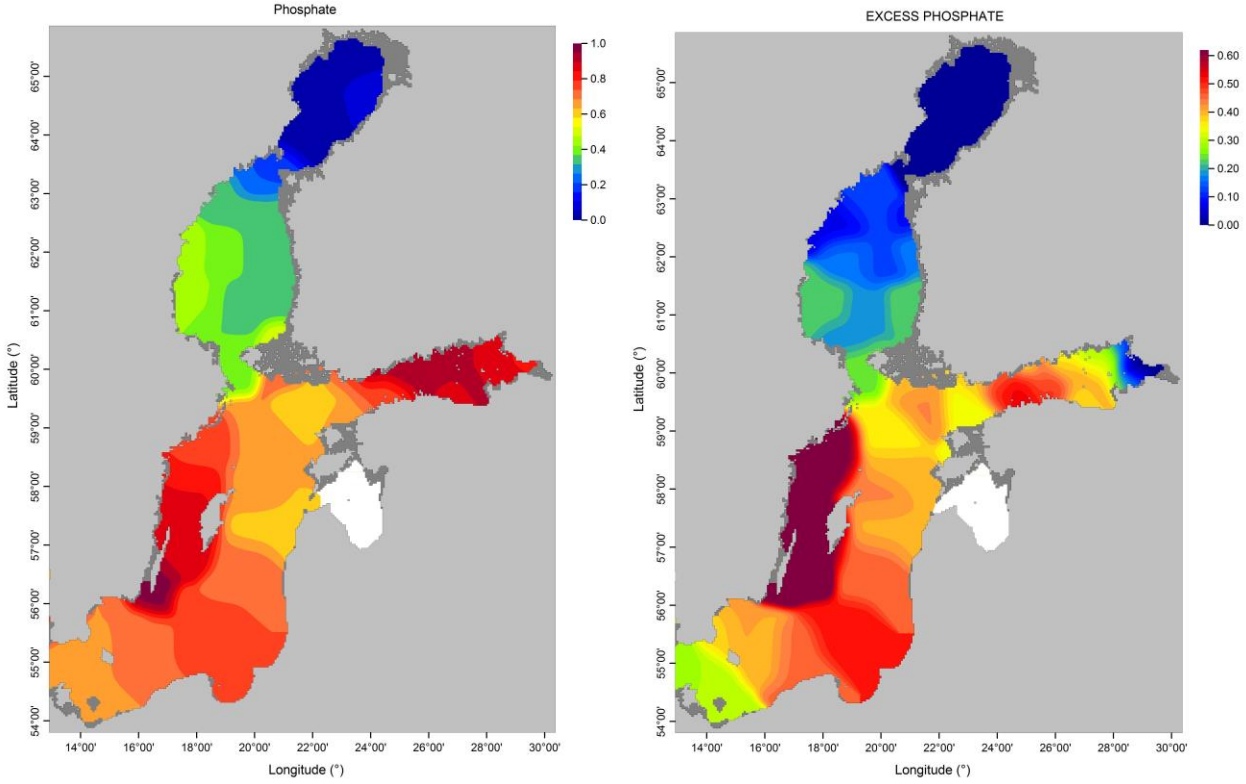
January 2014 January 2015

Figure 4. Dissolved inorganic nitrogen in winter 2014 (left panel) and winter 2015 (right panel).



January 2014 January 2015

Figure 5. Phosphate phosphorus (PO4) in near bottom layers in winter 2014 (left panel) and winter 2015 (right panel).



January 2014 January 2015

Figure 6. Phosphate phosphorus (PO4) in top 15m. layer in winter 2014 (left panel) and in winter 2015 (right panel).

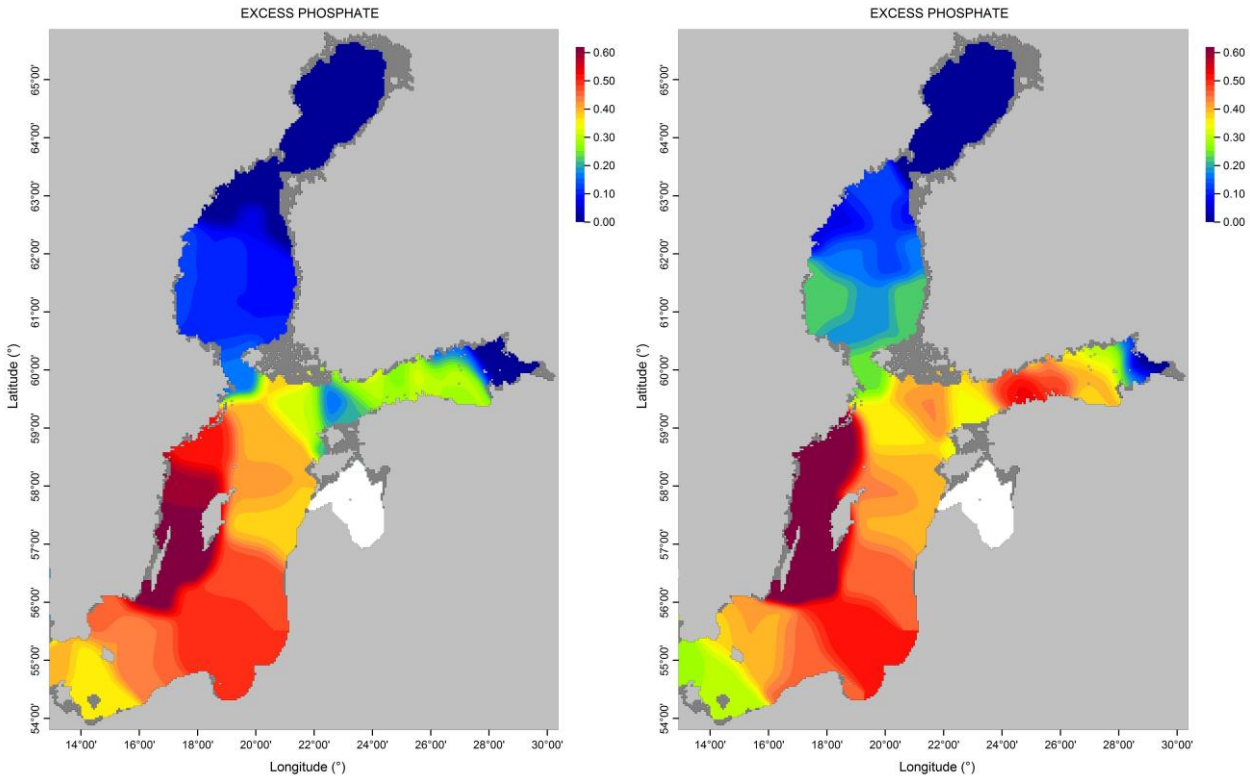


Figure 7. Surplus PO4 at top 15m. layer in winter 2014 (left panel) and in winter 2015 (right panel). Assumed situation after sprinfg bloom, calculated by using Redfield ratio.

SCIENTIFIC STAFF:

	Leg 1	Leg 2
Chief scientist:	Juha Flinkman	Juha Flinkman
Participants:	Flinkman Juha	Bruun Janne
	Hänninen Panu	Kinnunen Tanja
	Varmanen Pia	Hyvärinen Kirsi
	Hyvärinen Kirsi	Hyvärinen Susanna
	Hyvärinen Susanna	Lastumäki Ilkka
	Lastumäki Ilkka	Riikonen Jere
	Lehtiniemi Maiju	Tikka Kimmo
	Riikonen Jere	Kosloff Pekka
	Purokoski Tero	Roine Tuomo
	Roine Tuomo	Lehkonen Janne
	Savilahti Eetu	
	Andrejeva Irina	
	Kotelnikova Anna	

Master: Jaakko Raatikainen

Departure from HELSINKI on Monday 19.01.2015 at 14:30
Arrival to HELSINKI on Thursday 07.02.2015 at 13:00
Other harbours that were visited during the cruise: HELSINKI at 25. - 26.01.2015

LIST OF STATIONS (coordinates in WGS-84)

Leg 1

Index	Sation	Lat	Lon	Depth [m]	Date	Time [UTC]
01 0031	39A	N60.0401	E024.5881	43.00	20150119	1428
01 0032	XIV3	N60.1219	E026.1157	77.00	20150119	2018
01 0033	LL3A	N60.0403	E026.2080	69.00	20150119	2253
01 0034	XV1	N60.1500	E027.1482	68.00	20150120	0251
01 0035	6P	N59.4980	E028.2600	28.00	20150121	1848
01 0036	6K	N59.5149	E028.4146	26.00	20150121	2101
01 0037	2	N60.0503	E028.4266	38.00	20150122	0024
01 0038	ARUS	N60.2631	E028.1616	30.00	20150122	0610
01 0039	GF6	N60.2002	E027.5973	55.00	20150122	0824
01 0040	9F5	N60.0790	E027.4350	51.00	20150122	1100
01 0041	F42	N60.0804	E027.2794	66.00	20150122	1310
01 0042	35F	N60.0500	E027.0700	69.00	20150122	1543
01 0043	33F	N59.5700	E027.0000	69.00	20150122	1751
01 0044	NAR2	N59.3861	E027.0461	56.00	20150122	2128
01 0045	NAR3	N59.4413	E027.2288	67.00	20150123	0003
01 0046	GF2	N59.5031	E025.5141	85.00	20150123	2255
01 0047	LL5	N59.5501	E025.3582	70.00	20150124	0133
01 0048	LL7	N59.5080	E024.5024	106.00	20150124	0449
01 0049	GF1	N59.4230	E024.4093	87.00	20150124	0854
01 0050	LL9	N59.4201	E024.0181	69.00	20150124	1222
01 0051	F62	N59.2001	E023.1581	100.00	20150124	1628
01 0052	LL12	N59.2901	E022.5381	82.00	20150124	1929
01 0053	UUS-23	N59.4661	E023.1577	57.00	20150124	2326

01 0054	XII3	N59.5201	E023.5881	26.00	20150125	0330

Leg 2

Index	Station	lat	lon	Depth (m)	Date	Time (UTC)
0055	AALTO-HKI	N59.5790	E025.1414	64.00	20150126	1431
0056	TEILI	N59.2602	E021.3001	157.00	20150127	0303
0057	BY29	N58.5300	E020.1900	169.00	20150127	1133
0058	BY21	N58.2600	E020.1981	120.00	20150127	1500
0059	F80	N58.0000	E019.5381	195.00	20150127	1940
0060	BY15	N57.1920	E020.0300	246.00	20150128	0230
0061	WAVE1	N57.2498	E019.0294	36.00	20150128	0640
0062	U_CO2	N57.2537	E018.5962	22.00	20150128	0941
0063	BY10	N56.3800	E019.3500	143.00	20150128	1450
0064	BCSIII10	N55.3300	E018.2399	88.00	20150129	0325
0065	BY7	N55.1300	E017.0400	93.00	20150129	1344
0066	BY5	N55.1500	E015.5900	91.00	20150129	1720
0067	BY3	N55.1800	E014.2400	51.00	20150130	0315
0068	BY1	N55.0095	E013.1800	46.00	20150130	0835
0069	BY2	N55.0000	E014.0500	46.00	20150130	1220
0070	BY4	N55.2300	E015.2000	92.00	20150130	1815
0071	BCSIII2	N56.4200	E017.0700	88.00	20150131	0510
0072	BY38	N57.0700	E017.4000	114.00	20150131	1024
0073	BY38LAATU	N57.0700	E017.4000	114.00	20150131	1100
0074	LL23	N58.3499	E018.1383	449.00	20150131	1930
0075	AALTOPI	N59.1503	E021.0120	94.00	20150201	0830
0076	F64	N60.1134	E019.0855	287.00	20150201	1815
0077	F33	N60.3199	E018.5626	139.00	20150202	0005
0078	SR3	N61.1100	E018.1379	73.00	20150202	0600
0079	MS6	N61.5902	E019.0981	72.00	20150202	1700
0080	F26	N61.5901	E020.0378	143.00	20150202	2236
0081	KASKINEN	N62.1001	E021.0278	42.00	20150203	0224
0082	US7	N62.3601	E020.4978	29.00	20150203	0551
0083	US5B	N62.3517	E019.5813	219.00	20150203	0900
0084	F18	N63.1886	E020.1636	104.00	20150203	1520
0085	F16	N63.3101	E021.0377	49.00	20150203	1910
0086	KOKKOLAKB	N64.3190	E023.3804	39.00	20150204	0430
0087	III1	N64.5102	E023.1277	93.00	20150204	0710
0088	F9	N64.4202	E022.0377	127.00	20150204	1200
0089	BO3	N64.1812	E022.2059	107.00	20150204	1500
0090	F13	N63.4701	E021.2877	63.00	20150204	1940
0091	US3	N62.4553	E019.1174	173.00	20150205	0350
0092	C3SWE	N62.3917	E018.5714	196.00	20150205	0620
0093	SR5	N61.0500	E019.3478	123.00	20150205	1620
0094	SR8	N61.0760	E020.5583	50.00	20150205	2140
0095	IU2	N60.3501	E021.0780	47.00	20150206	0300
0096	IU4	N60.1400	E021.0880	48.00	20150206	0630
0097	IU6	N59.5621	E021.1326	124.00	20150206	1112
0098	LL15	N59.1100	E021.4481	131.00	20150206	1745
0099	BIAS17	N59.4806	E023.3690	31.00	20150207	0625