CRUISE REPORT

R/V Aranda

Cruise 1/2016

Combine1/2016 Leg 1

18th – 21th January, 2016

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

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Cruise 1/2016, Combine1

18th – 21th January, 2016

Chief scientist: Harri T. Kankaanpää

INTRODUCTION

The aim of the Cruise was to monitor hydrography and nutrient situation in the Gulf of Finland as part of the HELCOM/MONAS Combine programme (Combine1), and the national MSFD programme for hydrography and harmful substances.

The effects of the major inflow of saline water into the Baltic Sea (December 2014 – January/February 2015), were examined with a dense station network in the western Gulf of Finland. Altogether 15 stations were visited (Figure 1, Table 1). 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 were taken at station LL7. Training on use of novel protocols for hydrographic monitoring using electrochemistry-based *in situ* sensors commenced.

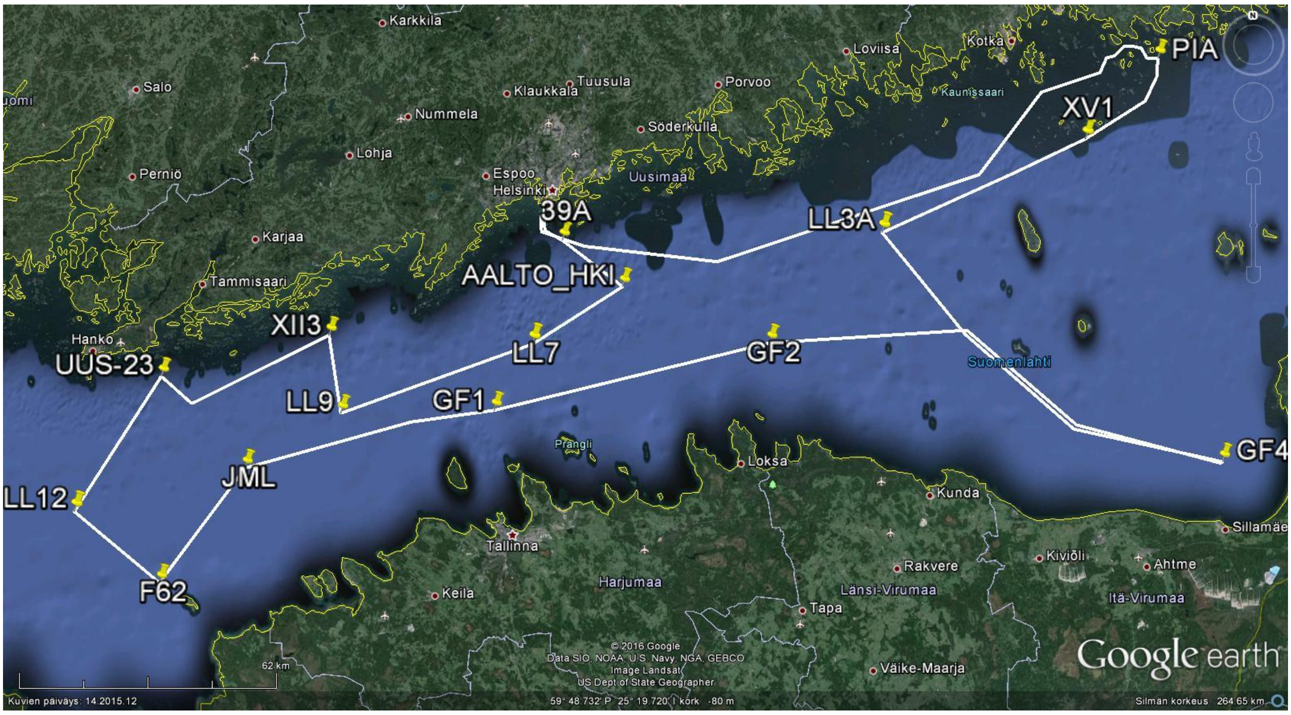


Figure 1. Research stations and the approximate route of R/V Aranda during the cruise of Combine1 Leg within the Gulf of Finland and its western entrance during January 18 – 21, 2016.

SUMMARY OF CHEMICAL AND PHYSICAL STATUS

Data on temperature, salinity and oxygen, were measured with a Sea-Bird SBE 911plus CTD, with in total 15 CTD casts during the entire cruise (Table 1). Temperature, salinity and oxygen concentrations revealed changes especially in the western Gulf of Finland area.

The major saline water inflow event that had occurred in December 2014 and January – February 2015 seemed to have a limited improving effect northeast of the Gotland Basin. In contrast, the stagnant deep water that has a low chemical quality had proceeded along the Gulf of Finland.

The Baltic-Sea-wide maps indicating hydrographic conditions during the entire Combine 1 campaign in January – February are depicted in Combine 1 Leg 2 cruise report.

The western Gulf of Finland and its western entrance

The water quality in the open sea area was poor. The inflow effect together with the local emissions from the soft organic-rich brackish-water muds deposits, the water quality had worsened from the previous year in the western pelagic Gulf of Finland (Table 2, Figures 2–4).

The salinity and temperature in deep water were larger than during the last years, and were also slightly higher than the respective average values during the last decades. The effect of inflow of the saline water through the Danish Straits can be seen as an increase of salinity immediately west of the Gulf of Finland and within the western Gulf of Finland.

There was very little or no oxygen in the deep water layer. Oxygen in near bottom water was absent at LL12, F62, JML and GF1. Hypoxic conditions occurred at LL7. Toxic H_2S was encountered within the southern W–E depression area at LL12, F62, JML and GF1, i.e. up to the longitude of Tallinn. The combined effects of H_2S and absence of O_2 deteriorate the ecological conditions in the area drastically. Only at one station (LL9, 65 m) that is situated at a local ridge, the near-bottom layer was well oxygenized, as has been during the last 50 years.

Phosphates that are readily usable for phytoplankton were abundant as has been common during the past years. There was no reduction in the concentration of phosphates; rather, an increase had taken place in the area compared to 2015. The data on phosphates indicated increase at LL12, F62 and JML also in the surface water. At station JML the concentration of phosphates in deep water was the highest recorded since 1998 and historically high in surface water layer. The same applied to station F62. The concentration of phosphates in the local depression in the middle between Helsinki and Tallinn, station, LL7, had increased in deep water. However, some decrease in the surface water concentration of phosphates had occurred at LL7.

Near the Finnish coastline the water quality was good overall.

The central Gulf of Finland near Helsinki metropolitan area

In the sea area south of Helsinki the conditions were rather good and near the long-time average. There was a good level of dissolved oxygen. No effects of the saline water inflow were detected at that longitude level. Rather, the salinity of near bottom water was somewhat decreased (Table 2). There was a decrease in the concentration of phosphates at station 39a.

The eastern Gulf of Finland

The Gulf of Finland east of Helsinki was in a relatively good status (Table 2, Figure 5). The shallow eastern Gulf of Finland stands out as a special enclave of hydrographically better water quality. There are practically no anoxic seafloor regions that would expel adversely affecting phosphates or hydrogen sulphide. In general, the water quality in this region has been satisfactory or good for years. Cut offs in nutrient loading are one apparent reason to this development.

Salinity at near bottom level was close to the historical average or slightly lower.

There was plenty of oxygen and the concentration of phosphates at the near-bottom layer was near the long-time average of last decades. At GF4 an apparent decrease in near-bottom and surface concentration of phosphates had occurred.

OBSERVATION STATIONS AND MEASUREMENTS

Total number of stations during the cruise was 15. Activities are listed in Table 1.

Station	**CTD**	**Hydrography**	**pH/H_2S sond**	**nutrients**	**total oil**	**Phosphorus**	**CDOM sampling**	**turbidity**
		O_2, pH, H_2S		PO_4^{3-}, NO_3^-		**research**		**deep water**
				SiO_4^{3-}, tot P		**water samples**		
39A	X	X	testing / training	X				X
AALTO_HKI	X							
LL7	X	X	testing / training	X	X	X	X	X
LL9	X	X		X		X	X	X
XII3	X	X		X				
UUS-23	X	X		X				
LL12	X	X	X	X	X	X	X	
F62	X	X	X	X		X		
JML	X	X	X	X		X		
GF1	X	X		X				
GF2	X	X	X	X		X		X
GF4	X	X		X	X			X
LL3A	X	X		X	X	X	X	X
XV1	X	X		X		X	X	X
PIA	X	X						X

Table 1. List of stations and monitoring activities.

Station	Bottom $[O_2]$ (depth)	Bottom T (depth)	Deepest CTD bottle $[O_2]$ (depth)	Deepest CTD bottle T (depth)	Deepest CTD bottle SAL (depth)	Bottom $[PO_4^{3-}]$ (depth)	Surface $[PO_4^{3-}]$ (winter data)
39a	↑ (41 m)	— (41m)	↑ (30 m)	↓ (30 m)	↓ (30 m)	↓ (41 m)	↘ or —
LL7	↓ (102 m)	— (102 m)	— (90 m)	↑ (90 m)	↑ (90 m)	↗ (102 m)	↘ or —
LL9	— (64 m)	↑ (64 m)	↑ (60 m)	↑ (60 m)	↗ (60 m)	— (64 m)	—
LL12	↓ (81 m)	↑ (81 m)	↓ (70 m)	↑ (70 m)	↑ (70 m)	↗ (81 m)	↗
F62	NA	↑ (96 m)	— (90 m)	↑ (90 m)	↑ (90 m)	↑ (96 m)	↗
JML	↓ (70 m)	↑ (70 m)	NA	↑ (70 m)	↑ (70 m)	↗ (79 m)	↑*
GF1	↓ (82 m)	↑ (82 m)	↓ (70 m)	↑ (70 m)	Fluct (↑)	↑ (81 m)	—
GF2	— (84 m)	↑ (84 m)	↑ (70 m)	↑ (70 m)	Fluct (↗) (70 m)	↘ (84 m)	—
GF4**	— (33 m)	— (33 m)	— (20m)	↑ (20 m)	↘ (20 m)	↘ (33 m)	↘
LL3a	↗ (68 m)	↑ (68 m)	↗ (60 m)	↑ (60 m)	— (60 m)	↘ (68 m)	—
XV1	↑ (67 m)	↗ (67 m)	↑ (50 m)	↗ (50 m)	— (50 m)	↘ (67 m)	—

Table 2. Direction of change compared to previous year level. ↑: increase; ↗ slight increase; —: no significant change; ↘: slight decrease; ↓: decrease; Fluct: fluctuating values over the past few years; NA: not available; green: oxic bottom with > 2 ml O_2 l^{-1}; yellow: hypoxic bottom with 0 – 2 ml O_2 l^{-1}; gray: anoxic bottom with presence of highly toxic H_2S and O_2 < 1 ml l^{-1}); *) previous data from 2014; **) previous data from 2011.

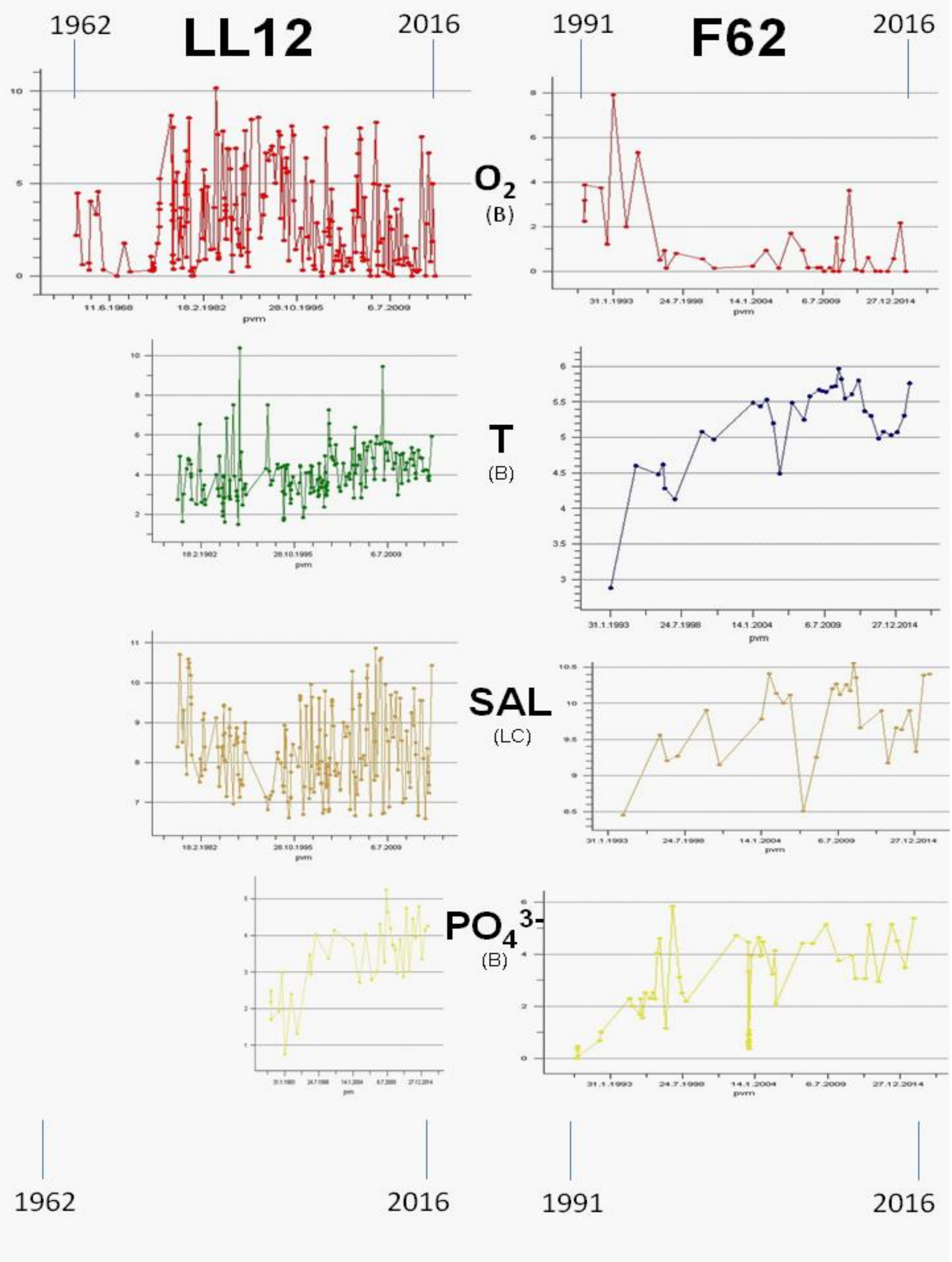


Figure 2. Temporal evolution of concentration of dissolved oxygen at one-metre above the seafloor (ml O_2 l^{-1}), temperature at one-metre above the seafloor (B), salinity (deepest CTD bottle; LC) and phosphate concentration (μM) at one-metre above the seafloor (B) at stations LL12 and F62 in 1962–2016 and 1991–2016 respectively.

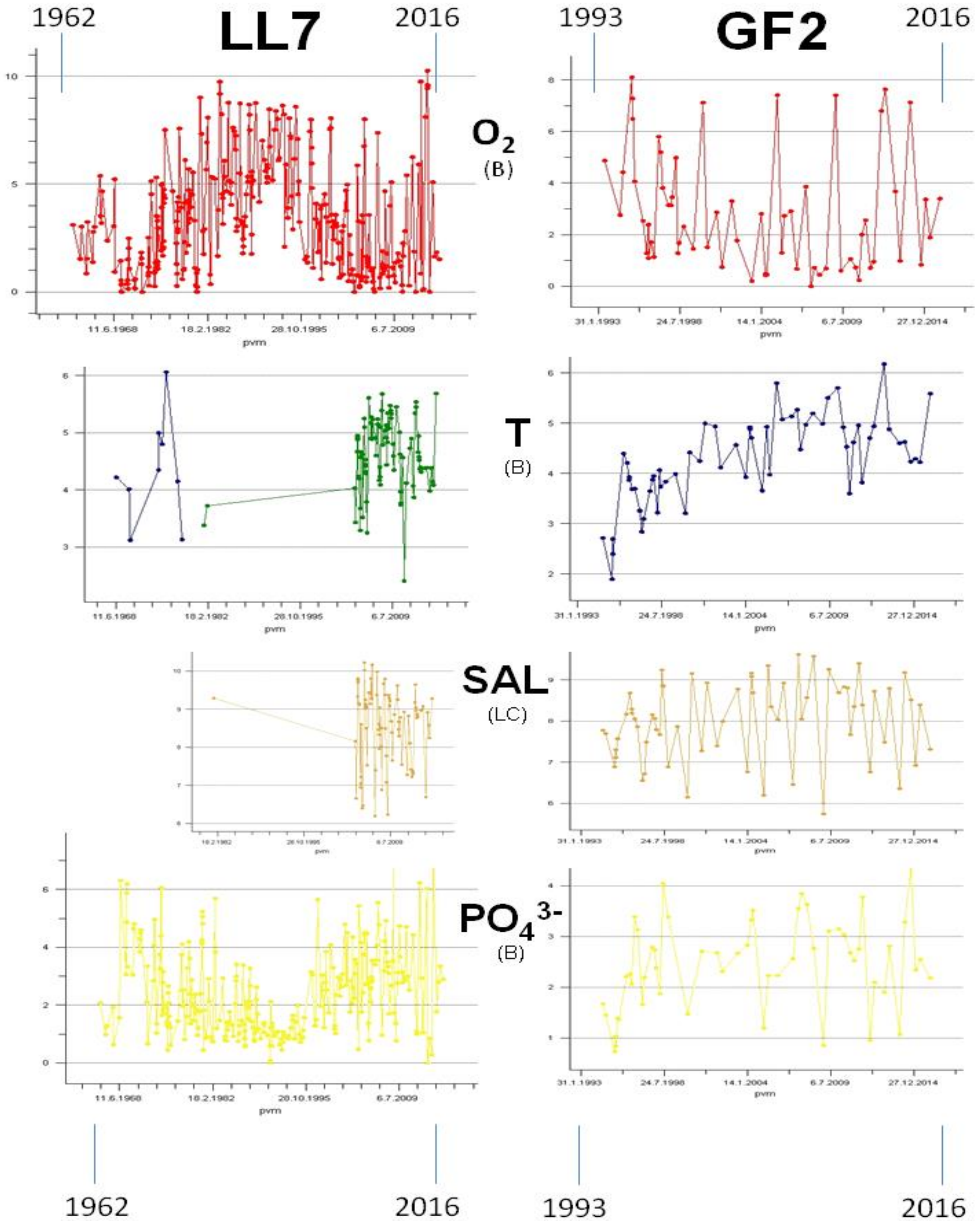


Figure 3. Temporal evolution of concentration of dissolved oxygen at one-metre above the seafloor (ml O_2 l^{-1}), temperature at one-metre above the seafloor (B), salinity (deepest CTD bottle; LC) and phosphate concentration (μM) at one-metre above the seafloor (B) at stations LL7 and GF2 in 1962–2016 and 1993–2016 respectively.

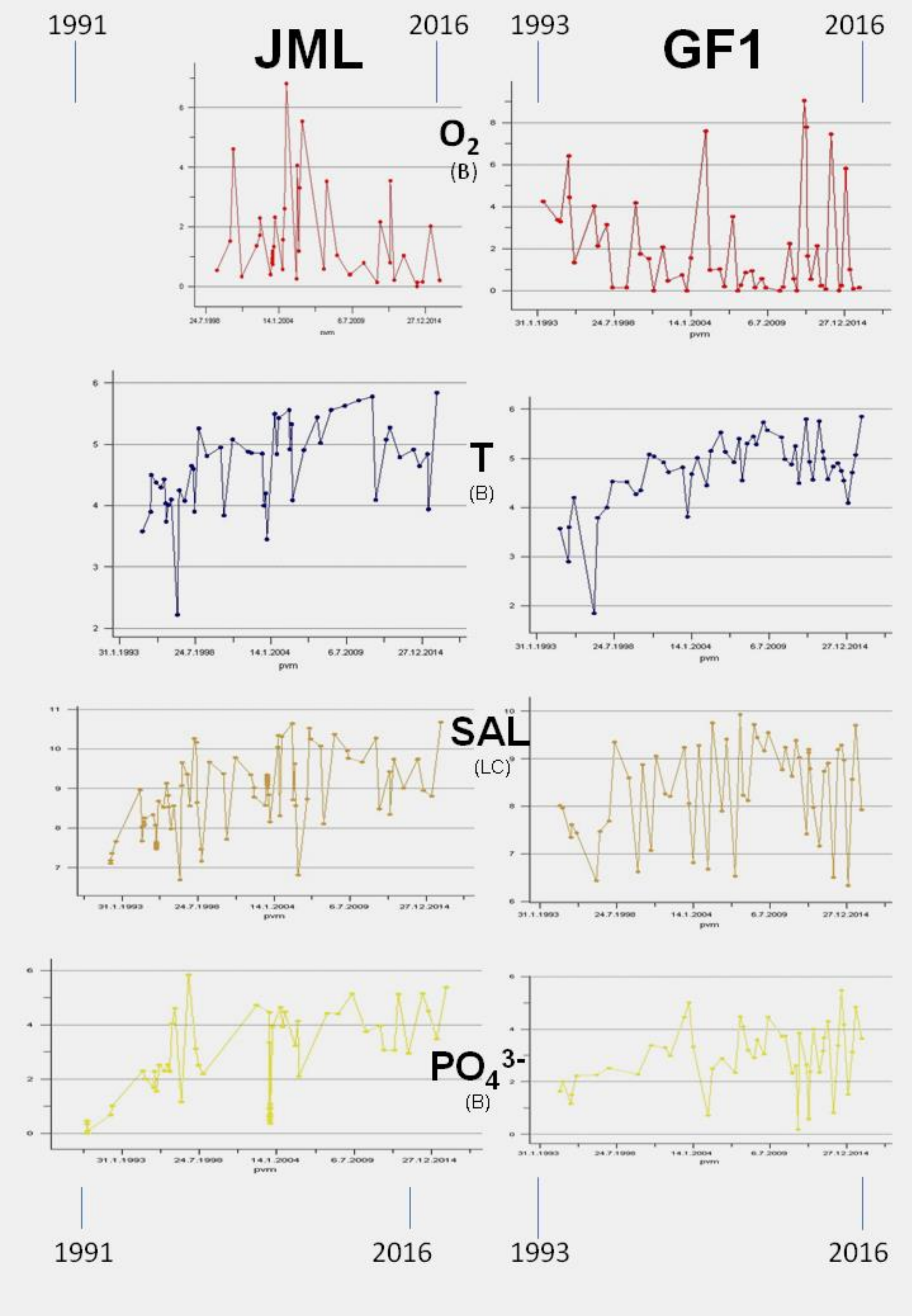


Figure 4. Temporal evolution of concentration of dissolved oxygen at one-metre above the seafloor (ml O_2 l^{-1}), temperature at one-metre above the seafloor (B), salinity (deepest CTD bottle; LC) and phosphate concentration (µM) at one-metre above the seafloor (B) at stations JML and GF1 in 1991–2016 and 1993–2016 respectively.

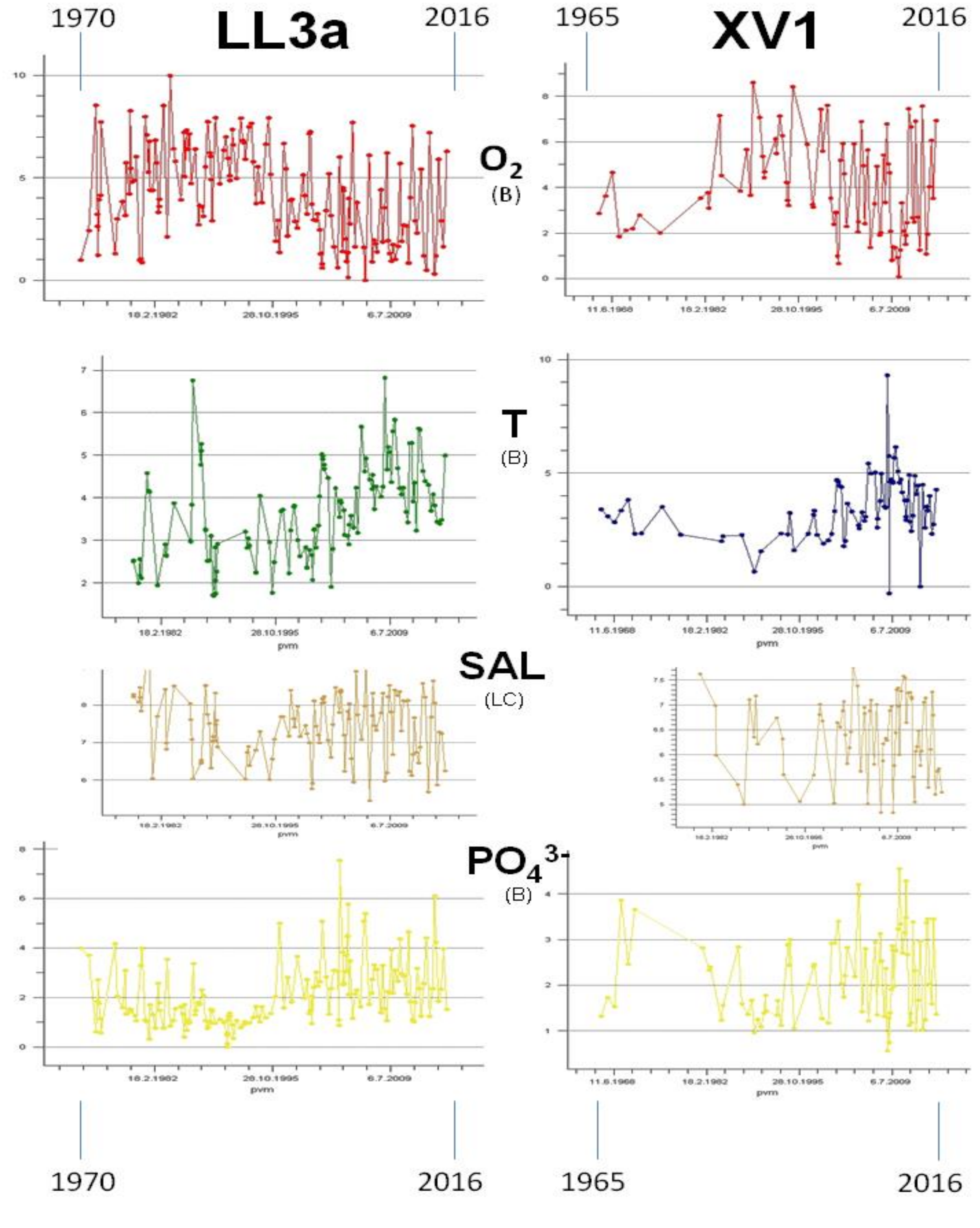


Figure 5. Temporal evolution of concentration of dissolved oxygen at one-metre above the seafloor (ml O_2 l^{-1}), temperature at one-metre above the seafloor (B), salinity (deepest CTD bottle; LC) and phosphate concentration (μM) at one-metre above the seafloor (B) at stations LL3a and XV1 in 1970–2016 and 1965–2016 respectively.

Operational use of the *in situ* pH/H_2S/T/P/O_2 probe

The sond was mainly used to train use in operational monitoring. Data on *in situ* pressure, pH, T and [O_2] were gathered (Table 1). Data on H_2S was unusable due to malfunction in the H_2S sensor.

Collection of subbottom echo sounding data

Single-beam (pinger) research echo sounder data was collected using the Meridata MDCS digital echo sounder unit (Table 3) controlling the ATLAS 12 kHz transducer. The collection covered approximately 60% of the route (Figure 6). Examples of subbottom profiles are provided in Figure 7. Part (10-20%) of the collected data was of low quality due to the ship's movement through ice.

Luotauspäiväkirja		**Aranda**							
R/V Aranda echo-sounder 12 kHz									
MD DSS									
WGS-84 UTM zone 34N center 21									
			WGS-84	WGS-84	WGS-84	WGS-84			
date	**time (UTC)**	**file**	**lat** beginn.	**lon** beginn.	**lat** end	**lon** end	**from …to…**	**note**	
18.1.2016	_11.24	61181124	60,09515	24,55373	60,09107	24,55387	Helsinki - H20-bunkraus	burst lenght 0.25 ms, effective length 200 ms, delay 5 ms	
18.1.2016	_13.51	61181351	60,09107	24,55387	60,041	24,5881	H2O-bunkraus --> 39A	äänennopeus 1450 (default) m/s	
18.1.2016	_15.53	61181553	60.04.006	24,5881	59.57.959	25,747	39 A --> AALTO_HKI	ensimmäinen faili hakemistoon meridata/data	
18.1.2016	_21.50	61181949	59,513	24,518	59,50791	24,5027	ennen LL7 --> LL7	loput hakemistoon c/meridata/data/Combine 1 Leg 1 - 2016	
19.1.2016	_07.11	61190708	59,5201	23,5881	59,4661	23,1577	XII3 --> UUS23	*Efflength = 150 ms *	
19.1.2016	_10.22	61191020	59,4661	23,1577	59,29013	22,5381	UUS23 --> LL12	Effl = 200 ms	
19.1.2016	_14.53	61191452	59,29013	22,5381	59.20.010	023.15.812	ll12->f62		
20.1.2016	_06.10	61200606	59.48.725	25,3558	59.50.438	025.52.171	to GF2		
20.1.2016	_09.34	61200931	59.50.438	025.52.171	59,3258	27,45911	GF 2 --> GF4	kaasuja lopussa	
20.1.2016	_16.01	61201601	59,3258	27,45911	60,2635	27,2545	GF 4 --> LL3a --> KYVY 8A	jäät LL3a:n jälkeen häiritsee	
21.1.2016	_06.01	61210601	60,2635	27,2545			to KYVY 8a		
21.1.2016	_0752	61210747	60,2502	27,3498	60,09101	24,5538	at Pia --> Hki		

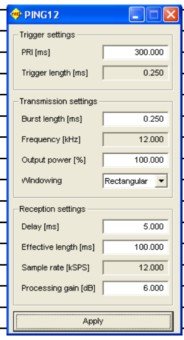


Table 3. Logbook of subbottom research echo sounding profiles during the cruise.

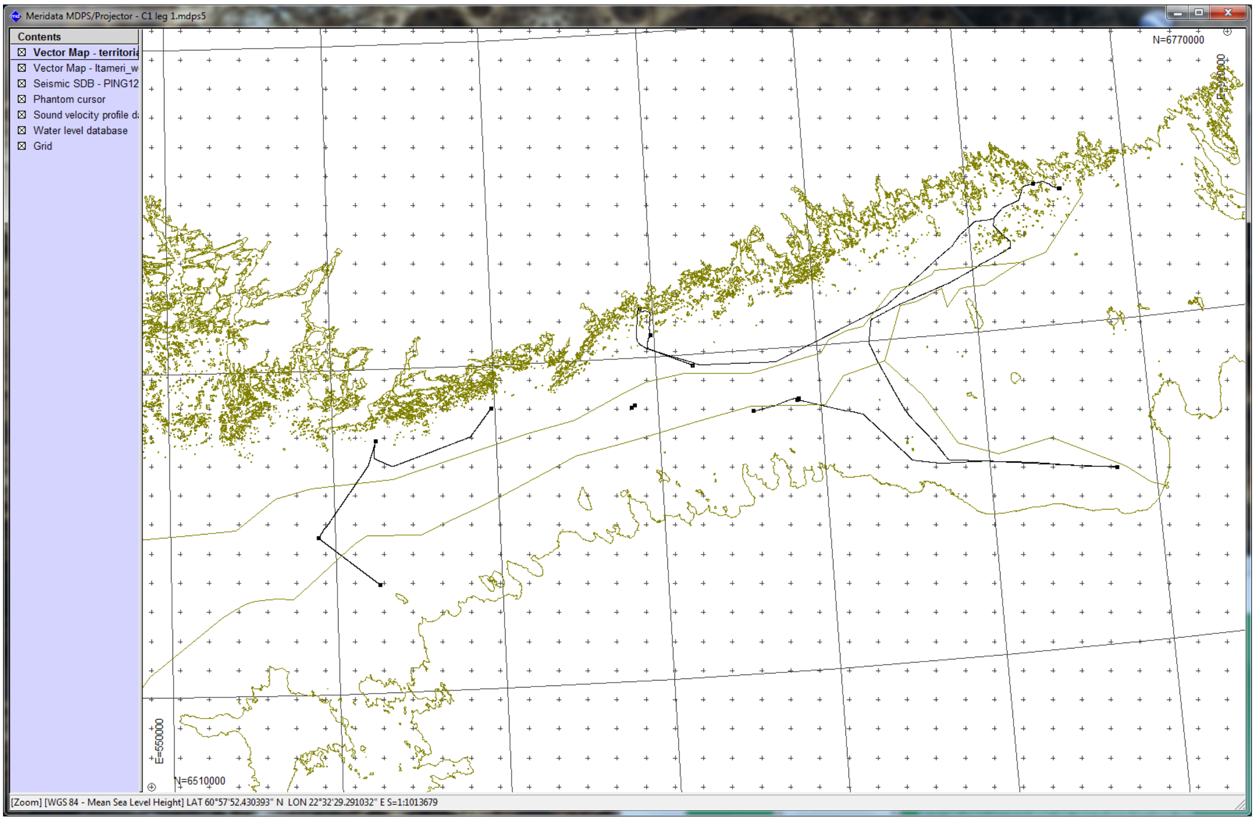


Figure 6. Map of subbottom profiling survey lines (black) during the cruise. The boundaries of the territorial waters are indicated.

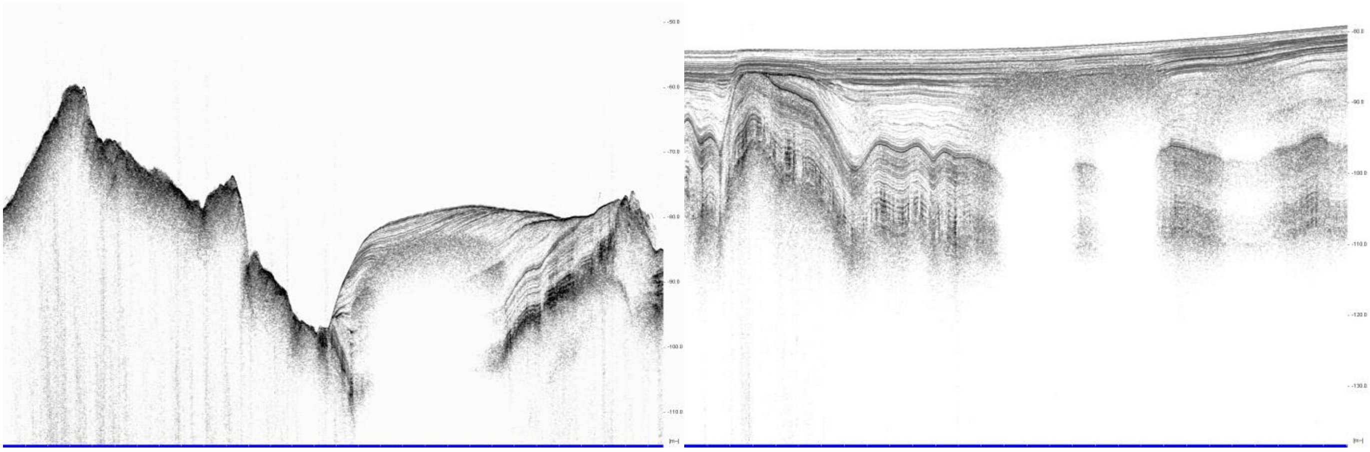


Figure 7. Examples of the 12 kHz single-beam digital subbottom profiles from the Gulf of Finland depicting large variability in substrate type (left; scale 50–110 m) and varying thickness of Holocene deposits (right) with occasional presence of internal gas causing acoustic reverberation (right; scale 80–130 m).

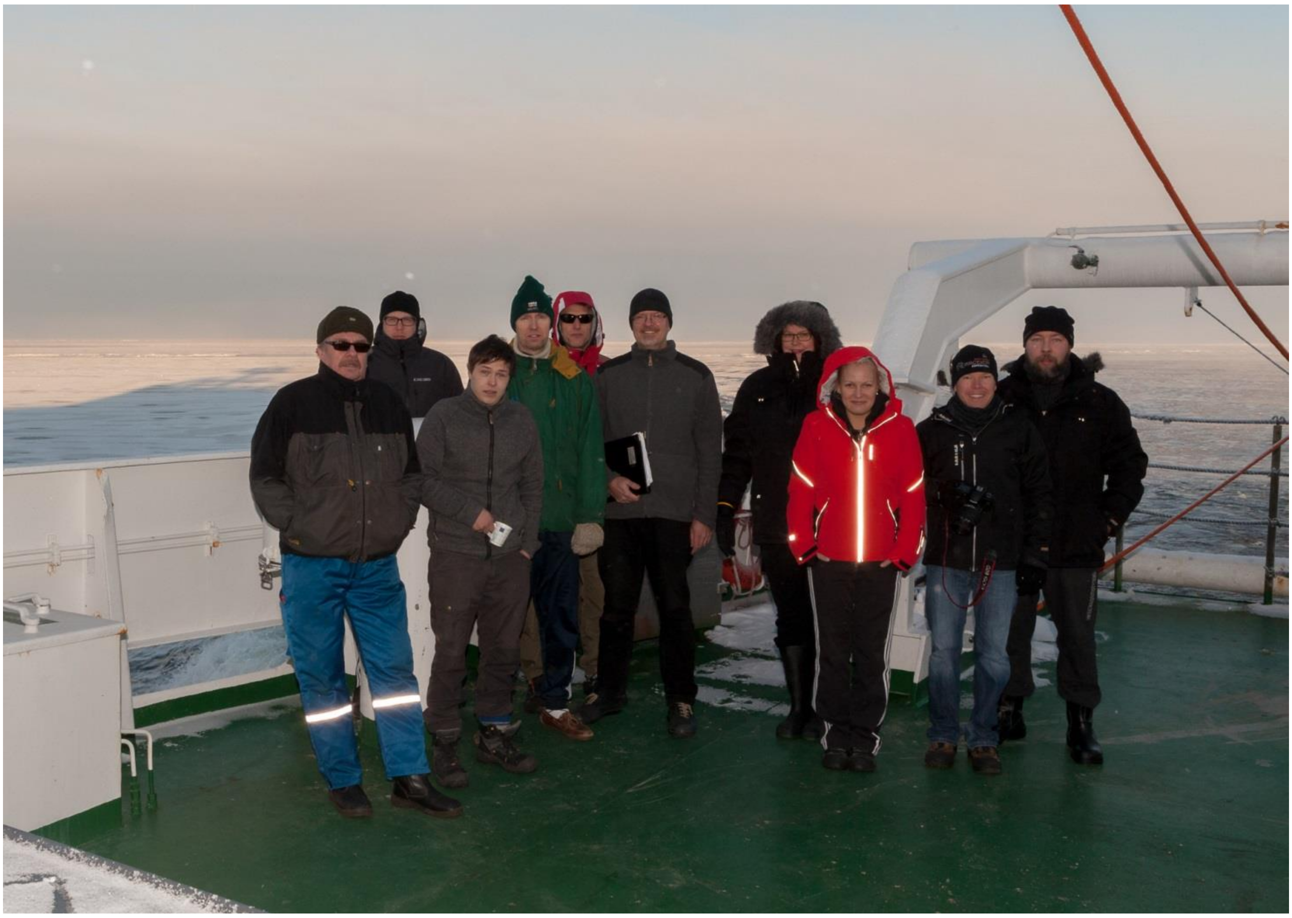
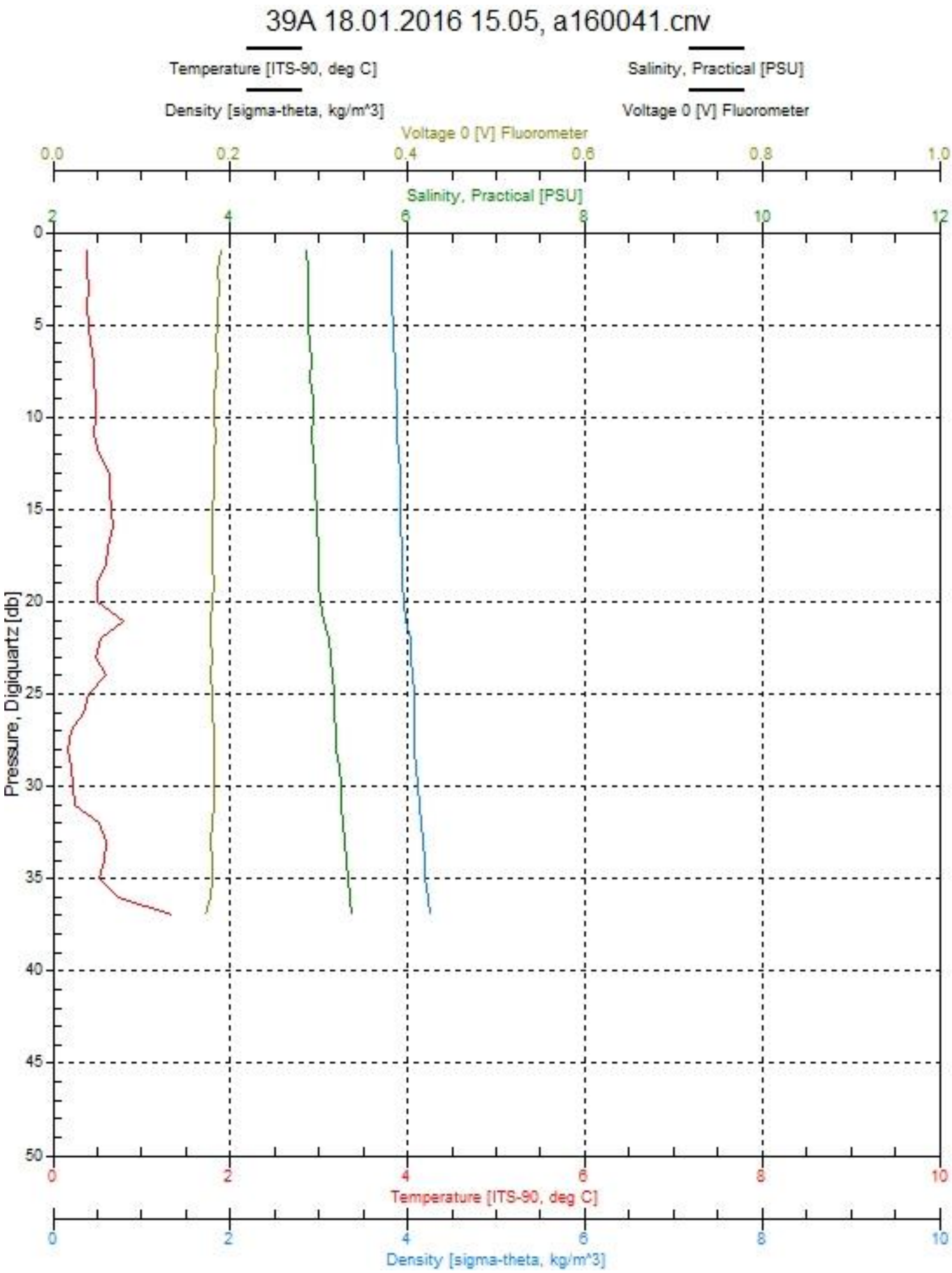
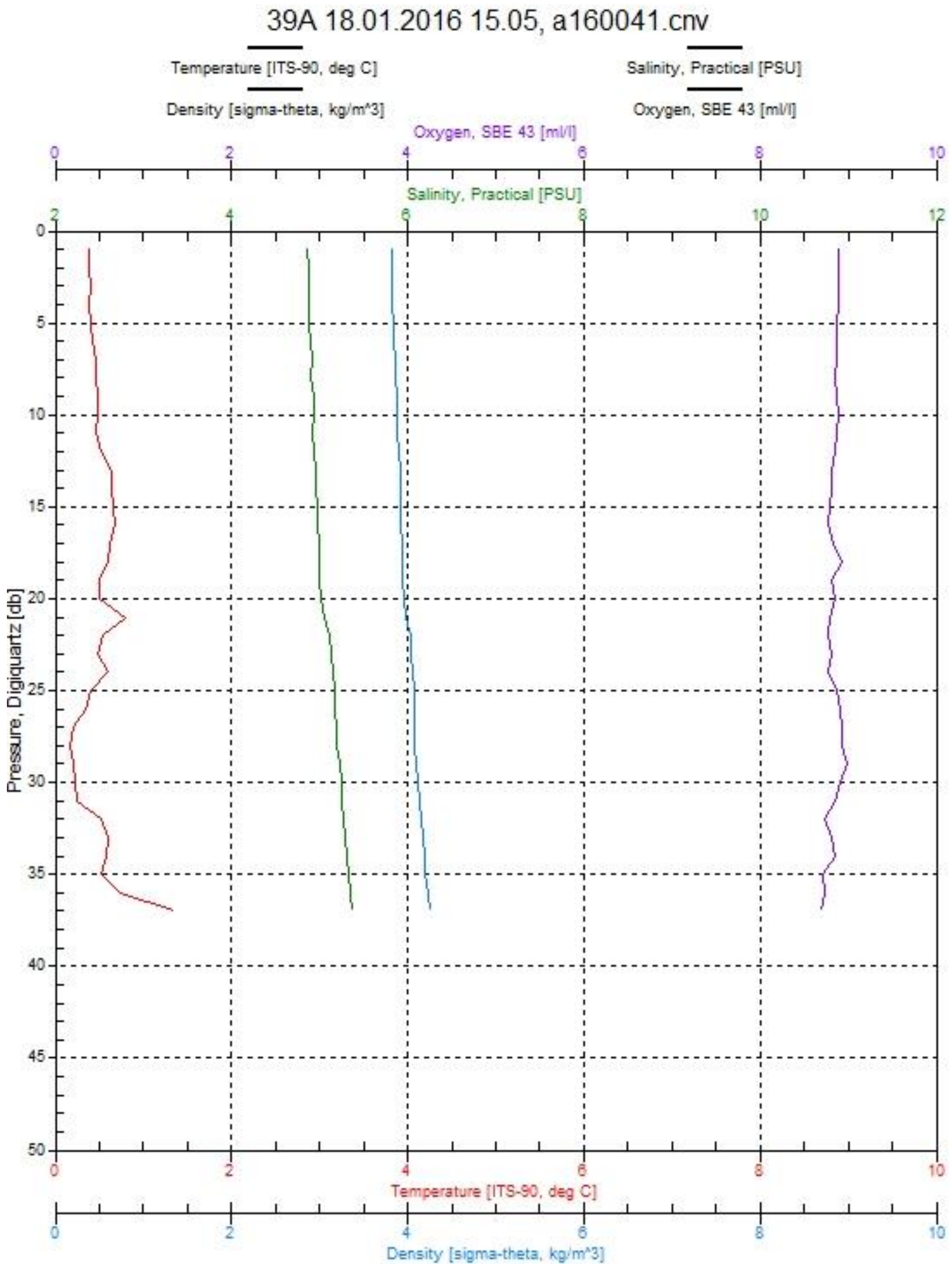
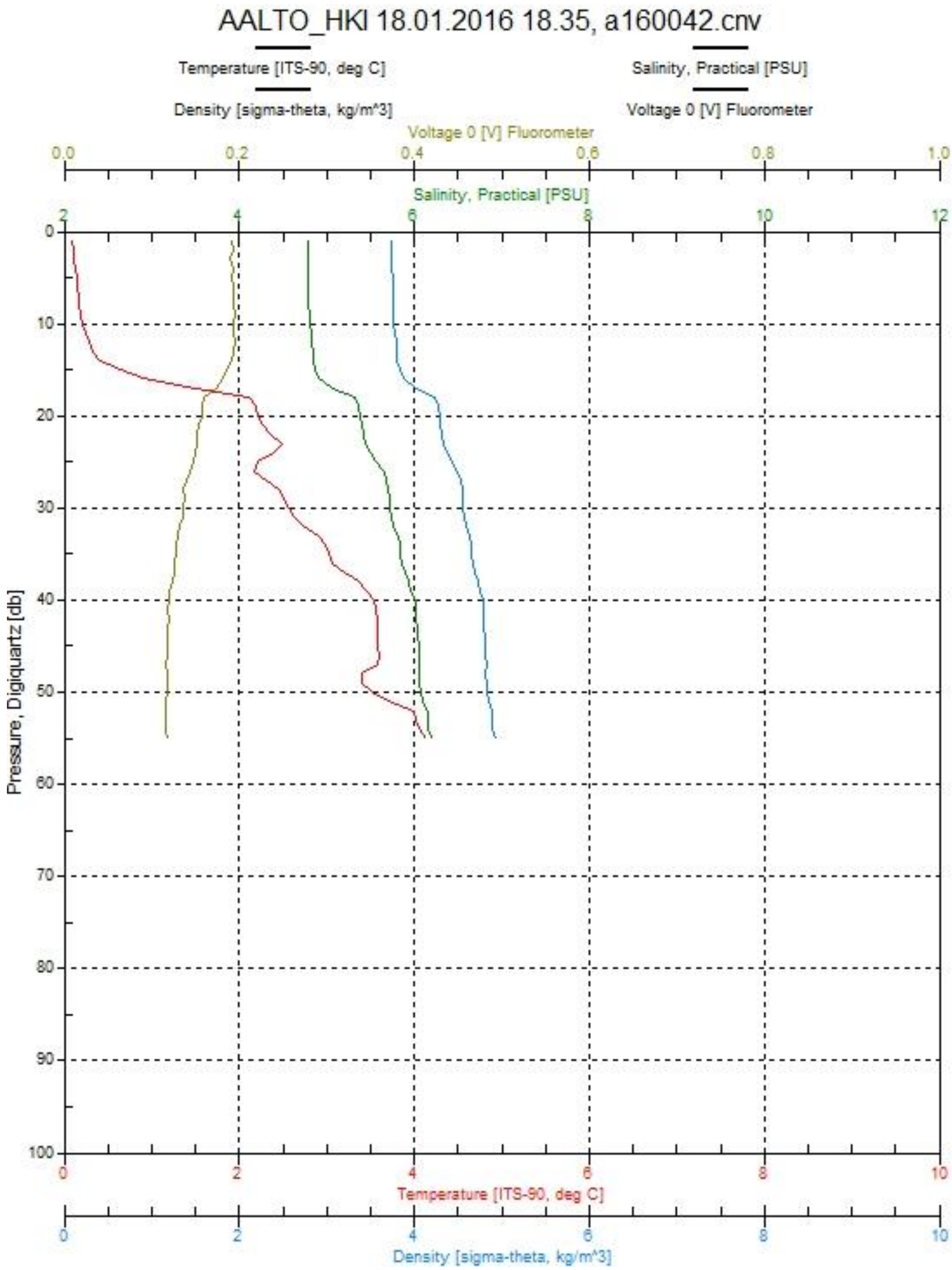


Figure 8. Group photo of the scientific crew during the Combine 1 Leg 1, 2016 cruise. From left to right: Pekka Kosloff, Jarkko Jyrälä, Eetu Savilahti, Tero Purokoski, Panu Hänninen, Harri Kankaanpää, Tanja Kinnunen, Pia Varmanen, Jere Riikonen and Ilkka Lastumäki. Photo courtesy of Mr. Ilkka Lastumäki (SYKE MRC).

Figures 9–38. CTD profiles obtained during the cruise.




39A 18.01.2016 15.05, a160041.cnv
Temperature [ITS-90, deg C]
Density [sigma-theta, kg/m^3]
Salinity, Practical [PSU]
Oxygen, SBE 43 [ml/l]
Pressure, Digiquartz [db]


AALTO_HKI 18.01.2016 18.35, a160042.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Voltage 0 [V] Fluorometer
Voltage 0 [V] Fluorometer
0.0
0.2
0.4
0.6
0.8
1.0
Salinity, Practical [PSU]
2
4
6
8
10
12
Pressure, Digiquartz [db]
0
10
20
30
40
50
60
70
80
90
100
Temperature [ITS-90, deg C]
0
2
4
6
8
10
Density [sigma-theta, kg/m^3]
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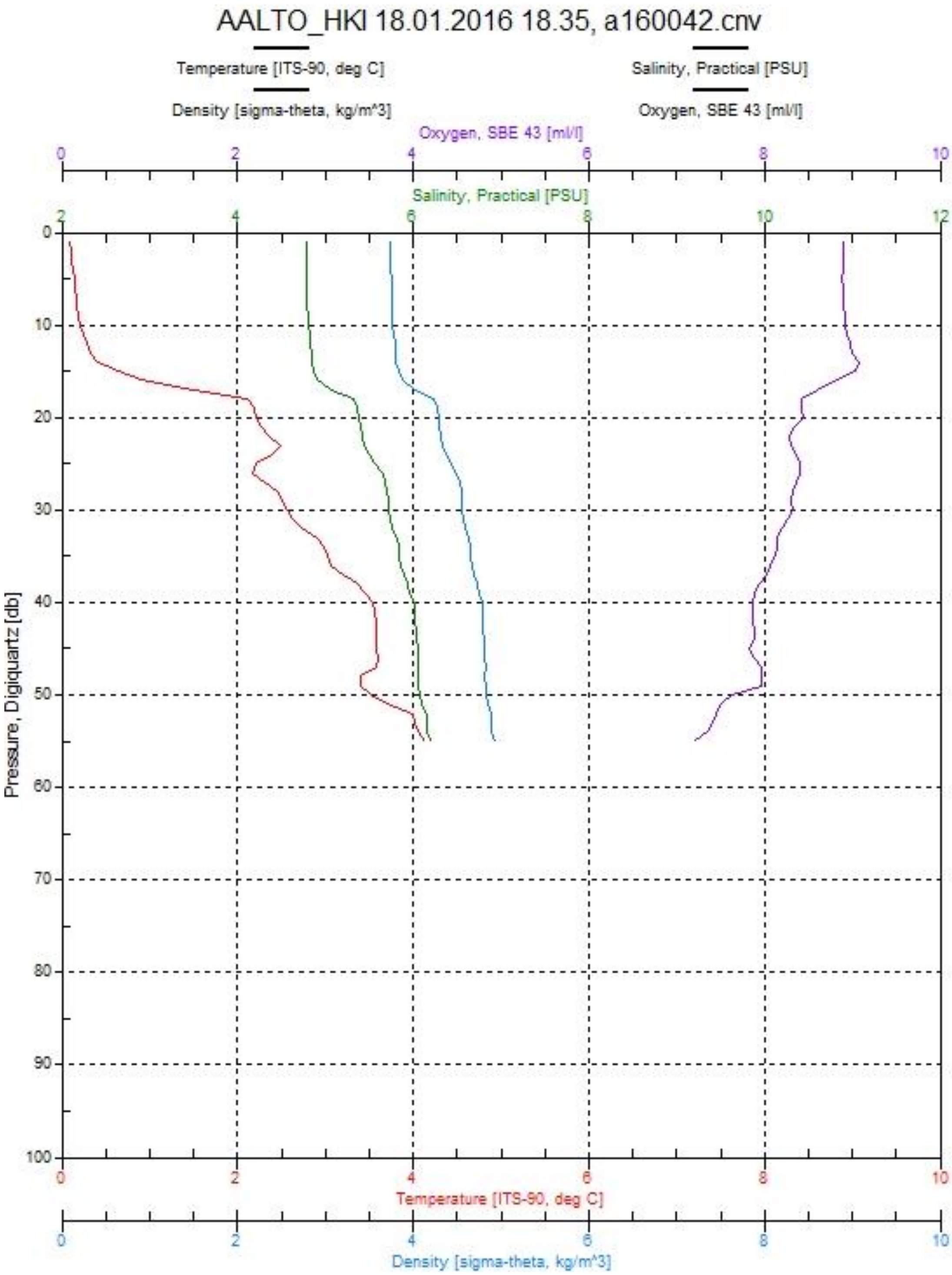
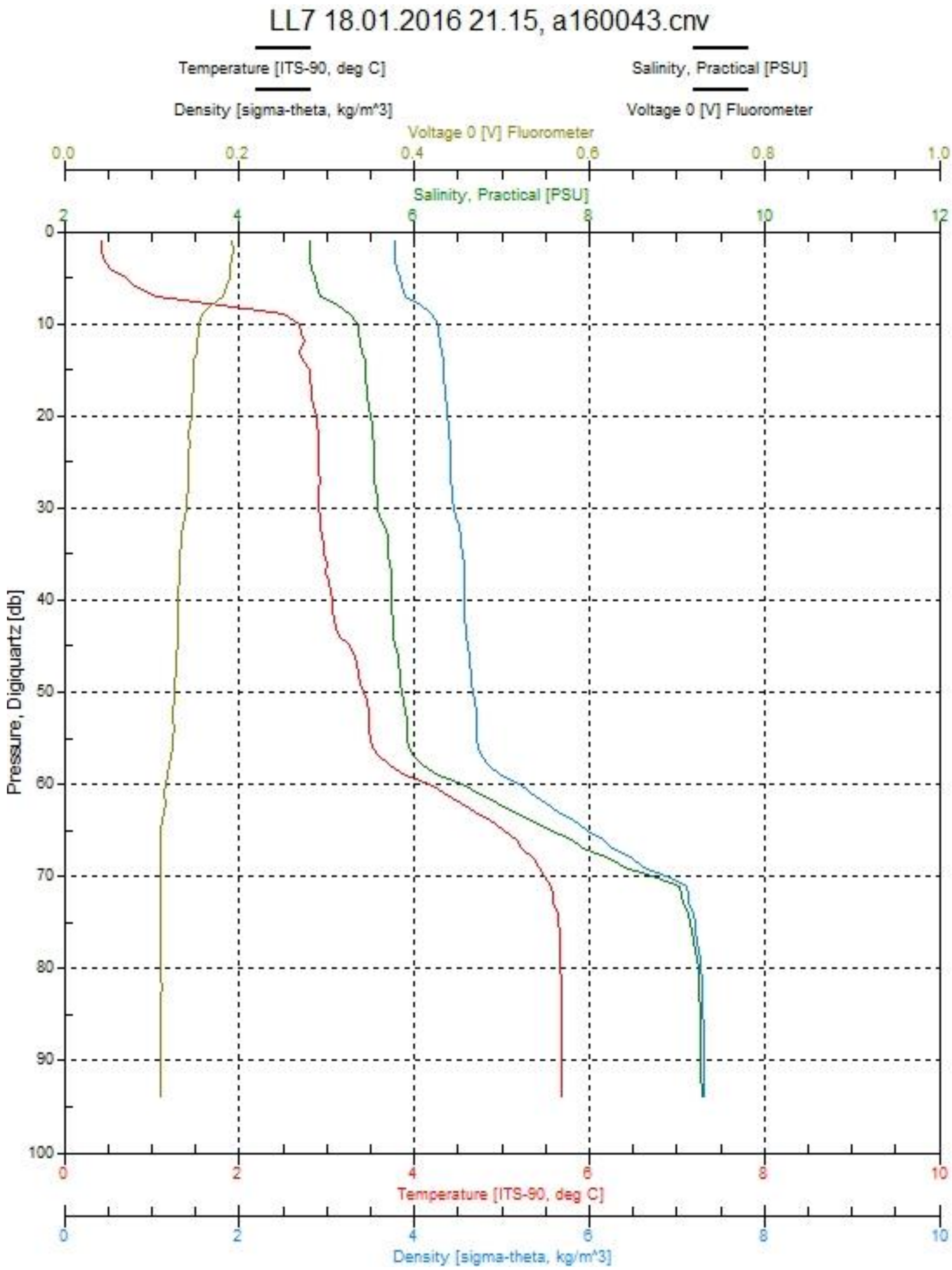
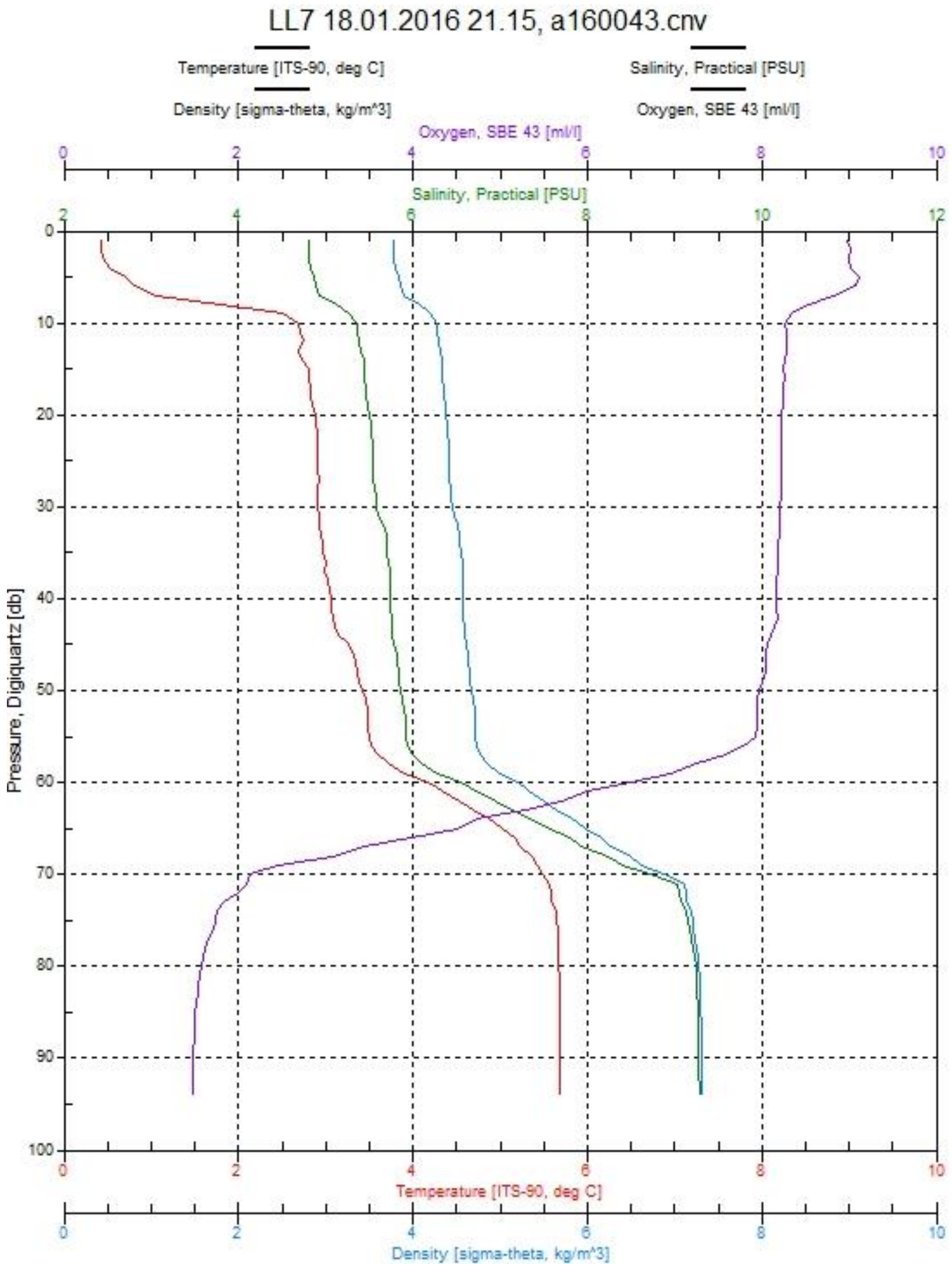
2
4
6
8
10


AALTO_HKI 18.01.2016 18.35, a160042.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Oxygen, SBE 43 [ml/l]
Oxygen, SBE 43 [ml/l]
0
2
4
6
8
10
Salinity, Practical [PSU]
2
4
6
8
10
12
Pressure, Digiquartz [db]
0
10
20
30
40
50
60
70
80
90
100
Temperature [ITS-90, deg C]
Density [sigma-theta, kg/m^3]

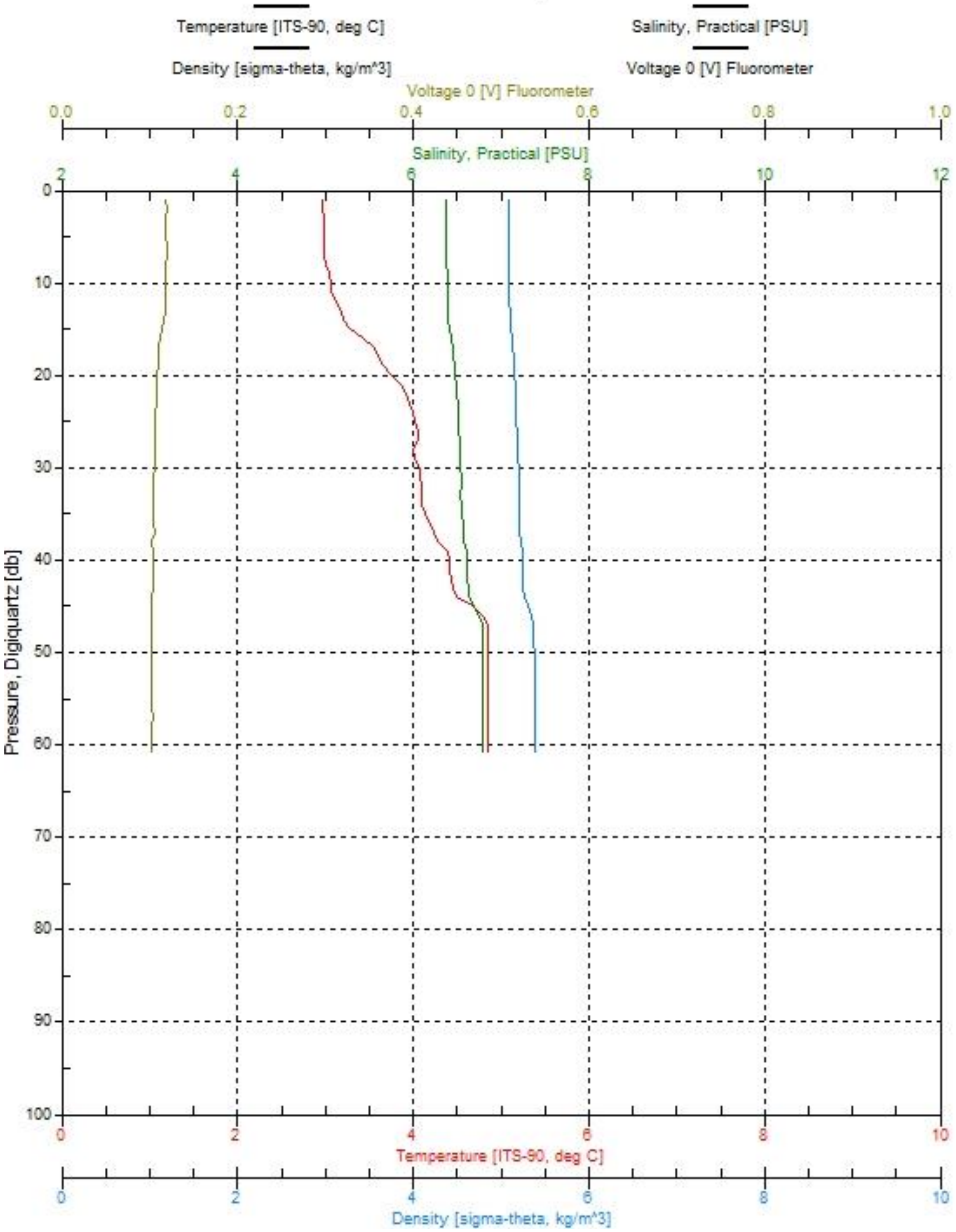


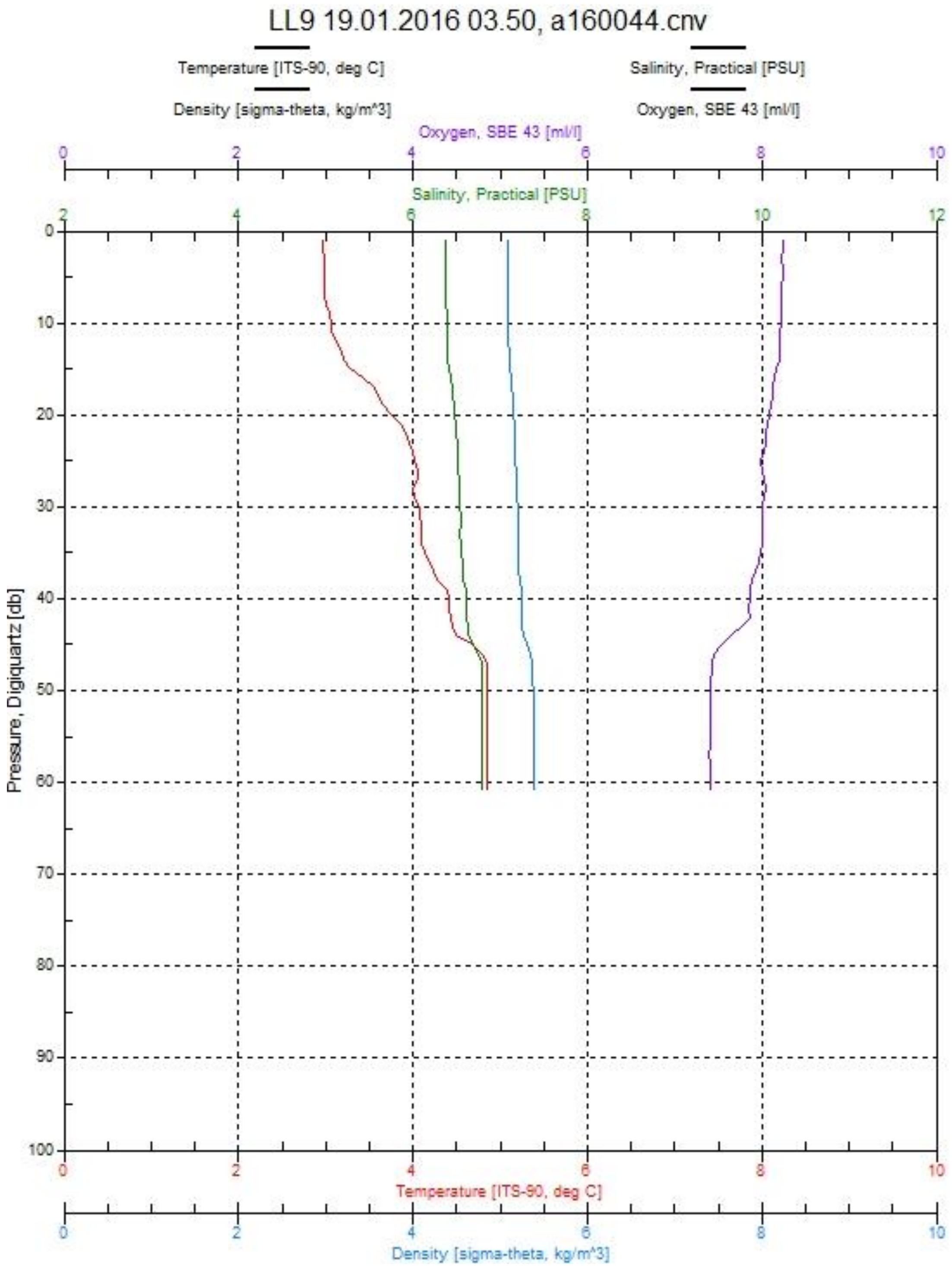
LL7 18.01.2016 21.15, a160043.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Voltage 0 [V] Fluorometer
Voltage 0 [V] Fluorometer
0.0
0.2
0.4
0.6
0.8
1.0
Salinity, Practical [PSU]
2
4
6
8
10
12
Pressure, Digiquartz [db]
0
10
20
30
40
50
60
70
80
90
100
0
2
4
6
8
10
Temperature [ITS-90, deg C]
0
2
4
6
8
10
Density [sigma-theta, kg/m^3]



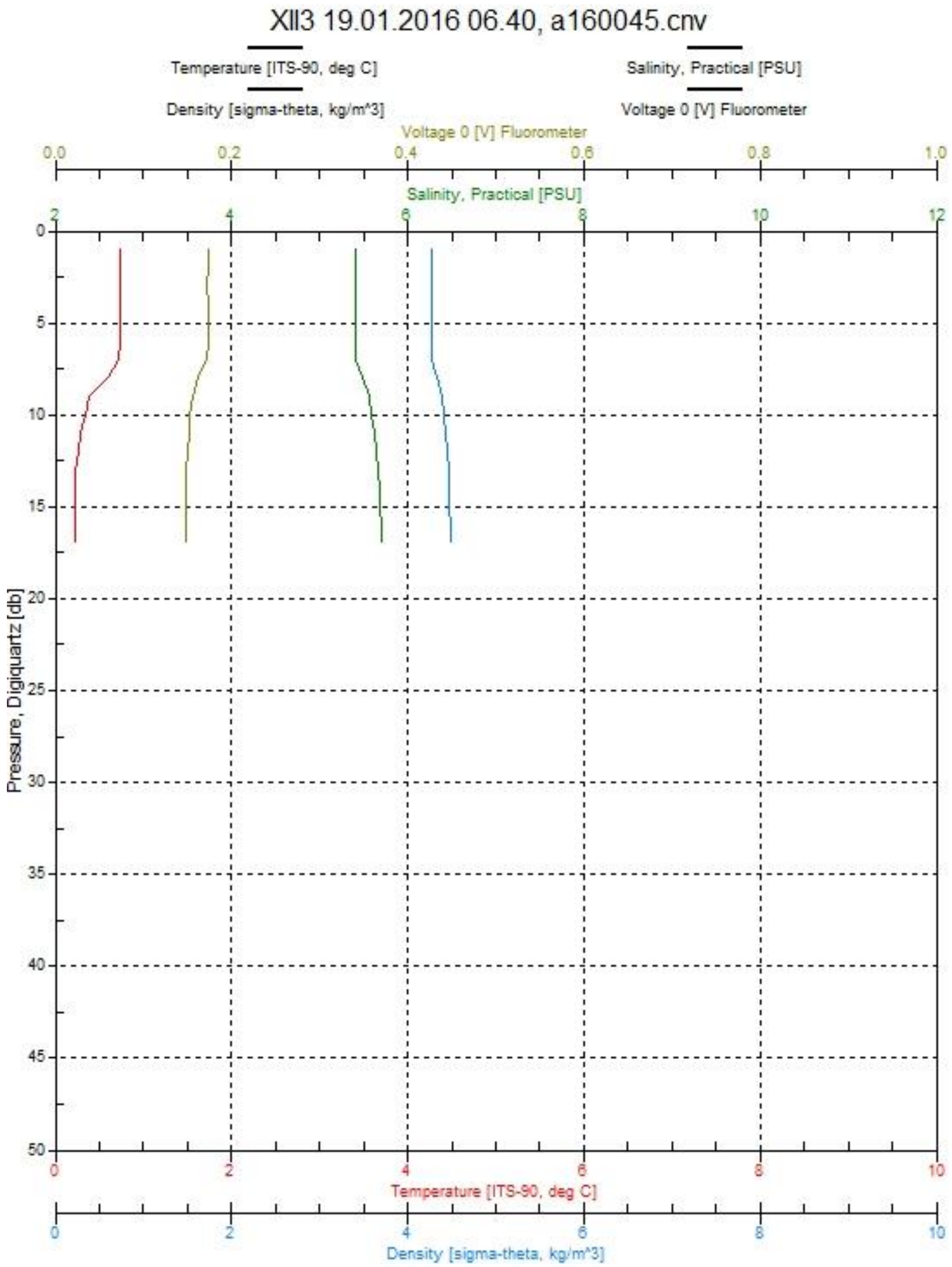
LL7 18.01.2016 21.15, a160043.cnv
Temperature [ITS-90, deg C]
Density [sigma-theta, kg/m^3]
Salinity, Practical [PSU]
Oxygen, SBE 43 [ml/l]
Oxygen, SBE 43 [ml/l]
0 2 4 6 8 10
Salinity, Practical [PSU]
2 4 6 8 10 12
Pressure, Digiquartz [db]
0 10 20 30 40 50 60 70 80 90 100
0 2 4 6 8 10
Temperature [ITS-90, deg C]
0 2 4 6 8 10
Density [sigma-theta, kg/m^3]

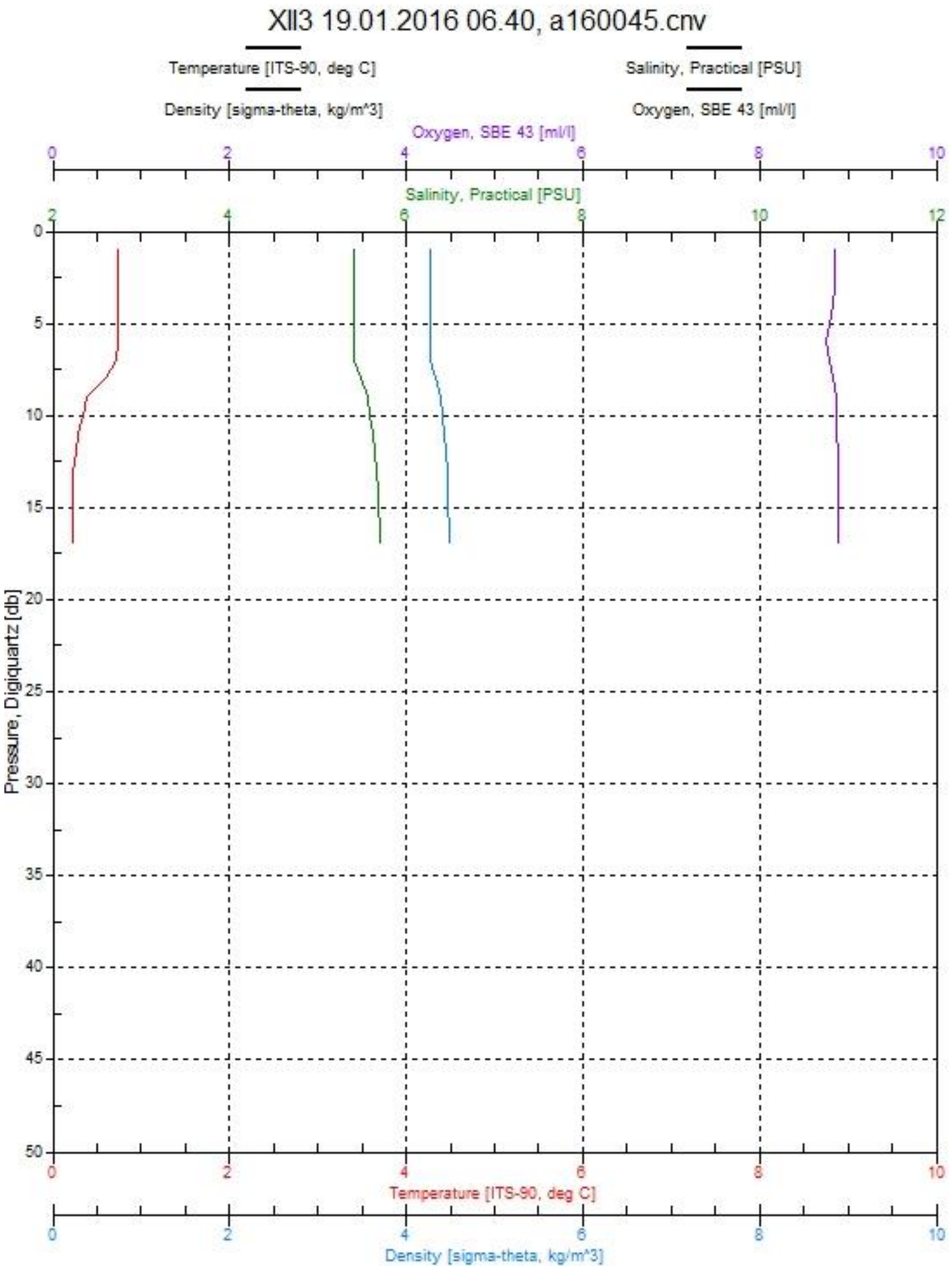
LL9 19.01.2016 03.50, a160044.cnv

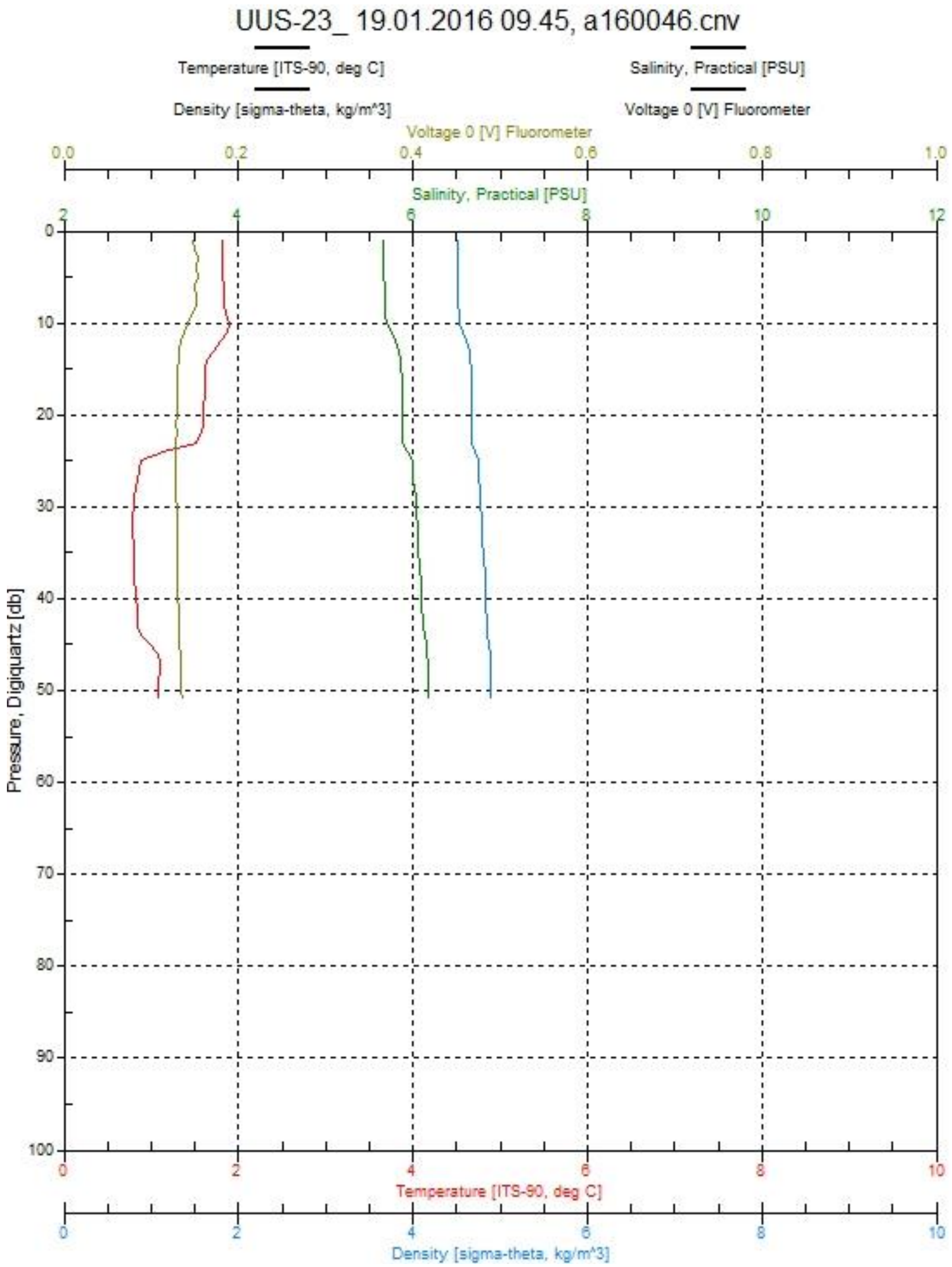




LL9 19.01.2016 03.50, a160044.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Oxygen, SBE 43 [ml/l]
Oxygen, SBE 43 [ml/l]
0
2
4
6
8
10
Salinity, Practical [PSU]
2
4
6
8
10
12
Pressure, Digiquartz [db]
0
10
20
30
40
50
60
70
80
90
100
0
2
4
6
8
10
Temperature [ITS-90, deg C]
0
2
4
6
8
10
Density [sigma-theta, kg/m^3]


XII3 19.01.2016 06.40, a160045.cnv
Temperature [ITS-90, deg C]
Density [sigma-theta, kg/m^3]
Salinity, Practical [PSU]
Voltage 0 [V] Fluorometer
Pressure, Digiquartz [db]


XII3 19.01.2016 06.40, a160045.cnv
Temperature [ITS-90, deg C]
Density [sigma-theta, kg/m^3]
Salinity, Practical [PSU]
Oxygen, SBE 43 [ml/l]
Oxygen, SBE 43 [ml/l]
Salinity, Practical [PSU]
Pressure, Digiquartz [db]
Temperature [ITS-90, deg C]
Density [sigma-theta, kg/m^3]



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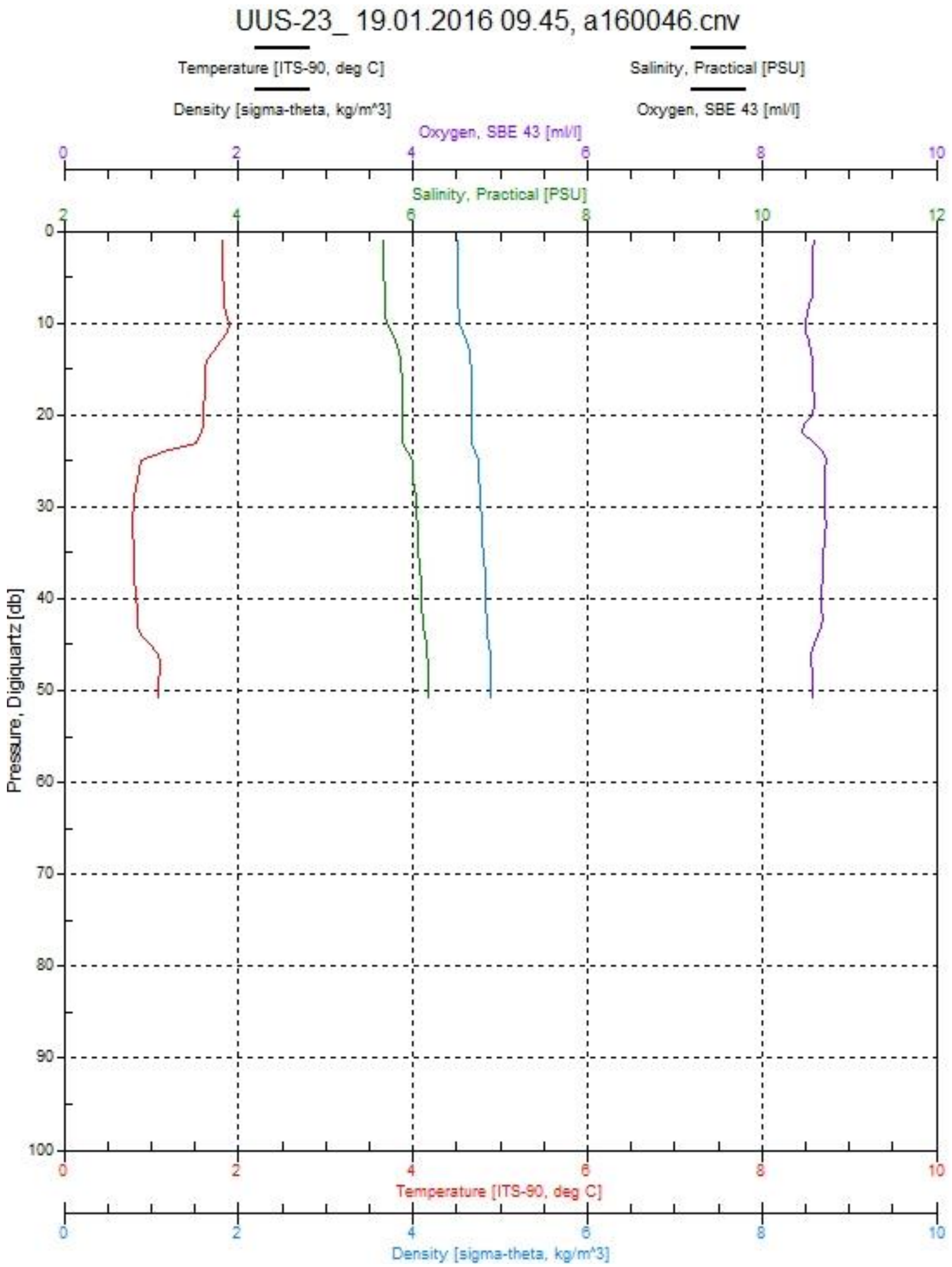
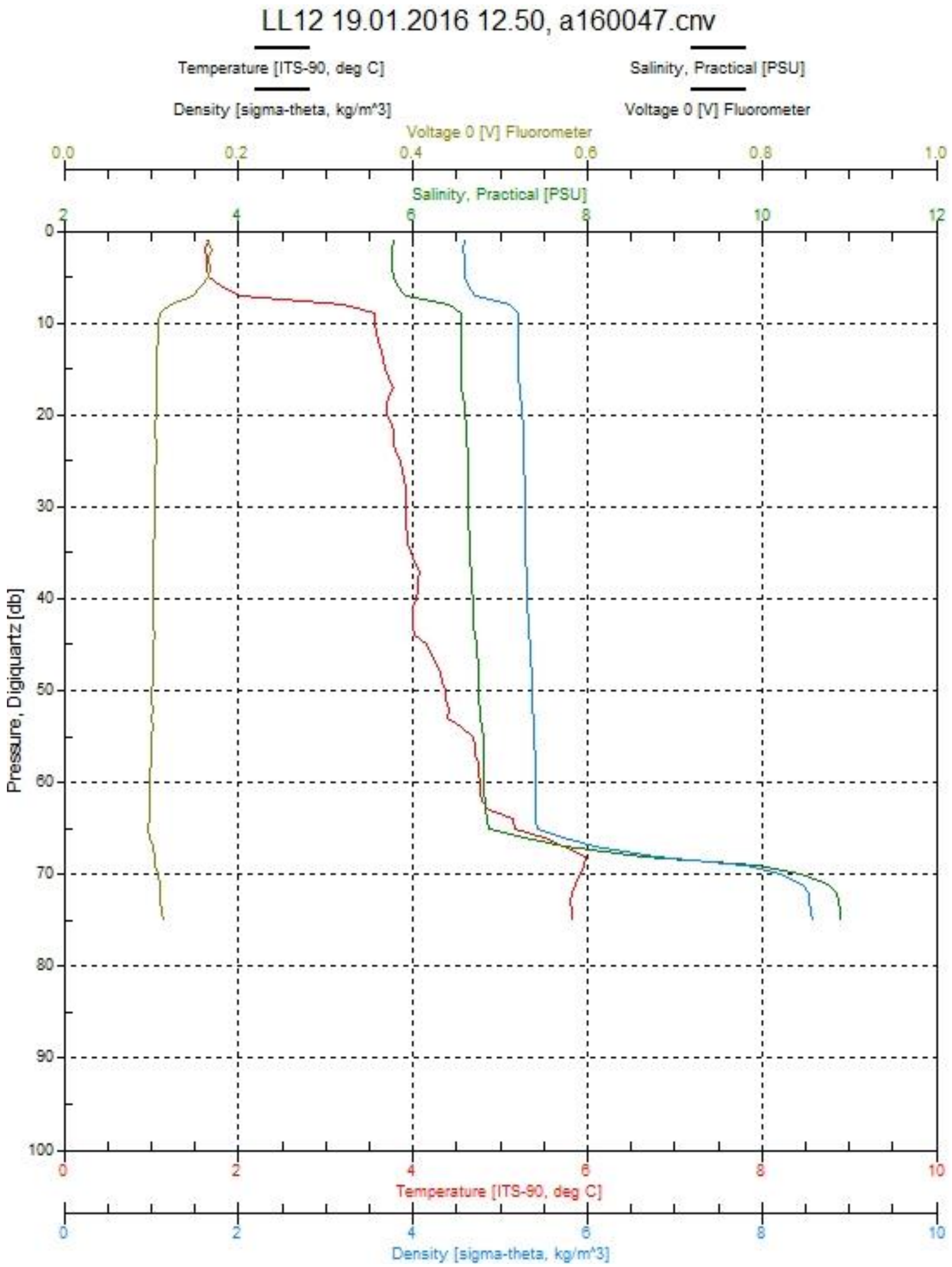
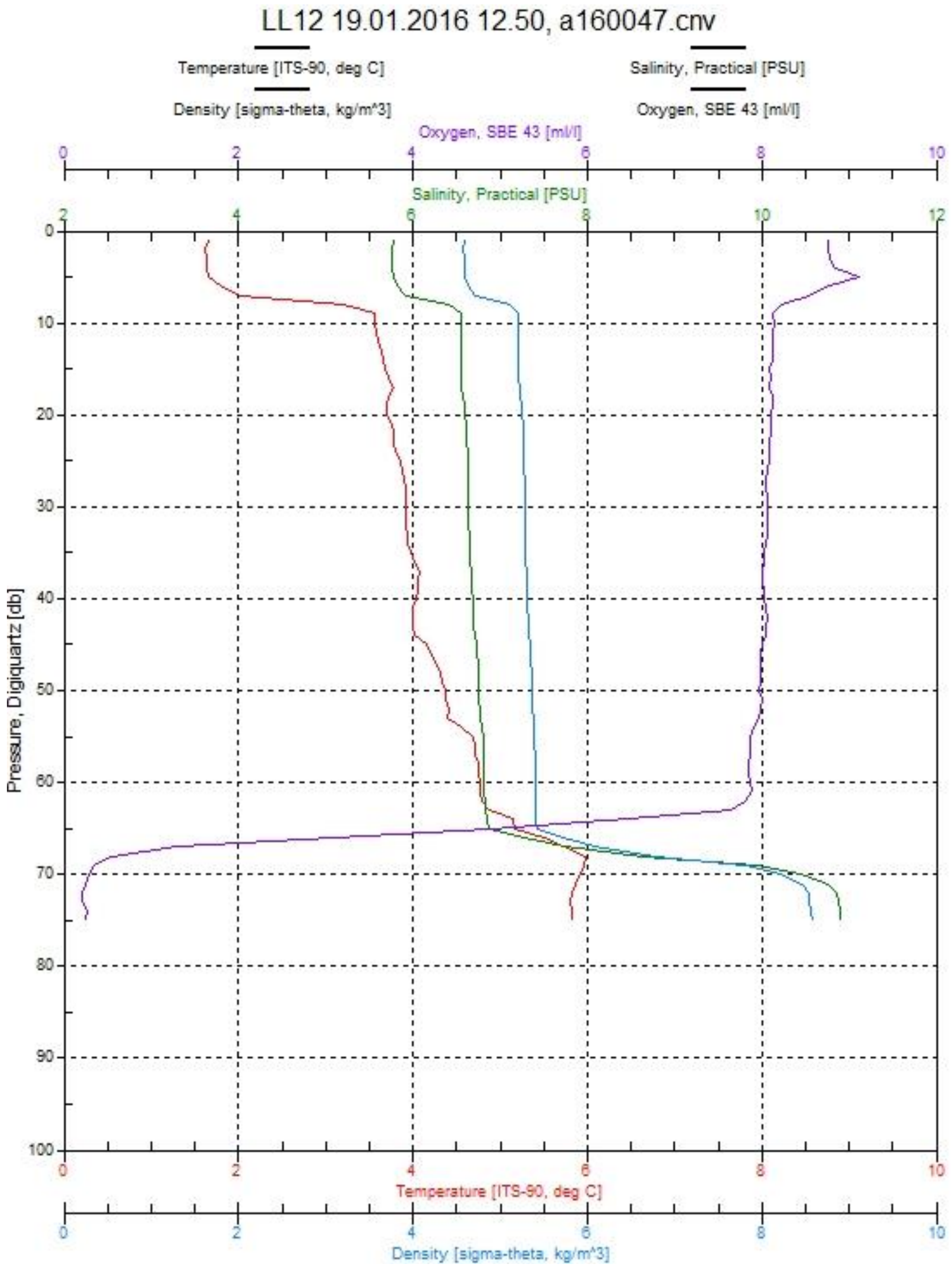
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Voltage 0 [V] Fluorometer
Voltage 0 [V] Fluorometer
0.0
0.2
0.4
0.6
0.8
1.0
Salinity, Practical [PSU]
2
4
6
8
10
12
Pressure, Digiquartz [db]
0
10
20
30
40
50
60
70
80
90
100
Temperature [ITS-90, deg C]
0
2
4
6
8
10
Density [sigma-theta, kg/m^3]
0
2
4
6
8
10



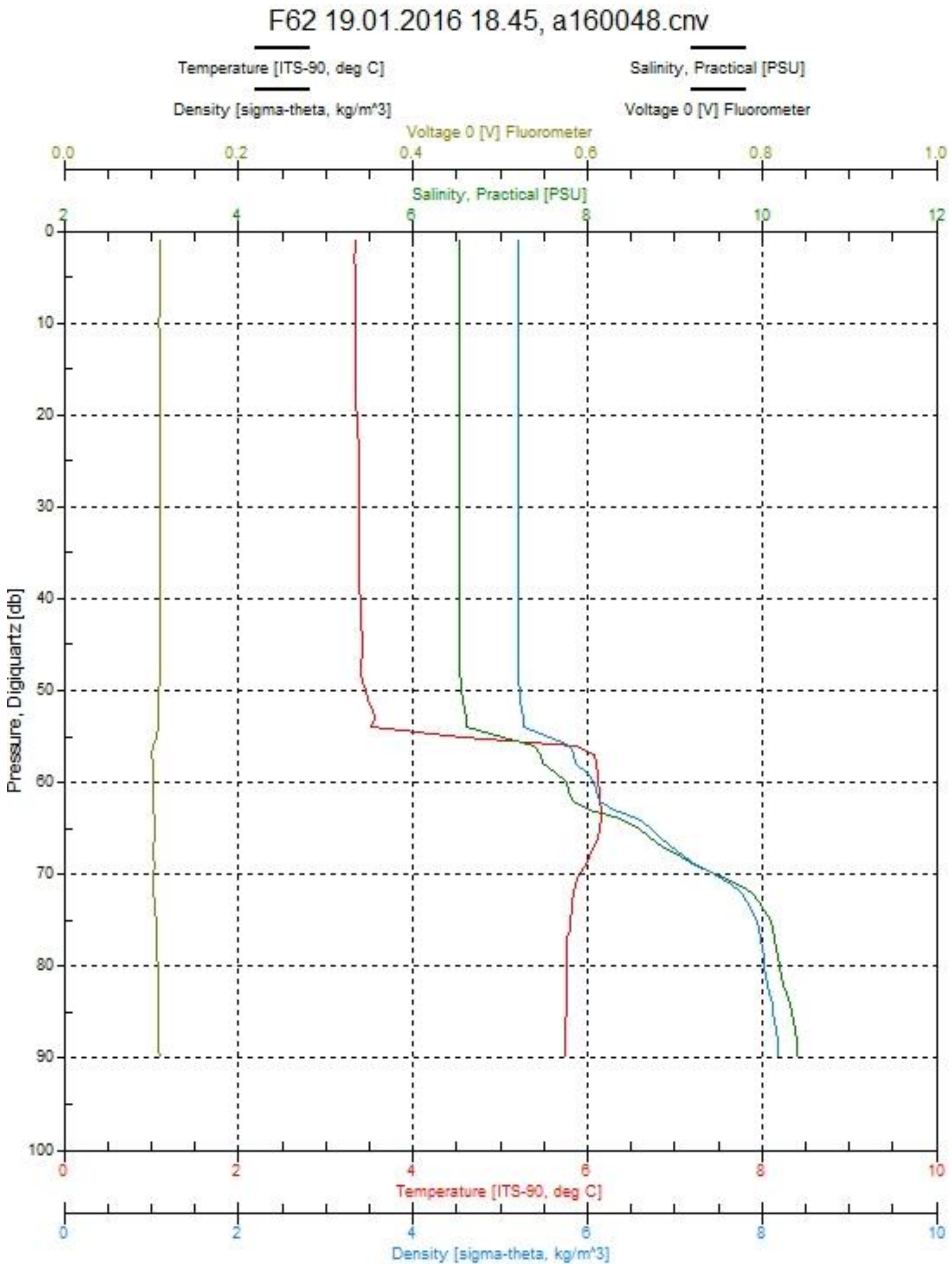
UUS-23_ 19.01.2016 09.45, a160046.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Oxygen, SBE 43 [ml/l]
Oxygen, SBE 43 [ml/l]
0 2 4 6 8 10
Salinity, Practical [PSU]
2 4 6 8 10 12
0 10 20 30 40 50 60 70 80 90 100
Pressure, Digiquartz [db]
0 2 4 6 8 10
Temperature [ITS-90, deg C]
0 2 4 6 8 10
Density [sigma-theta, kg/m^3]



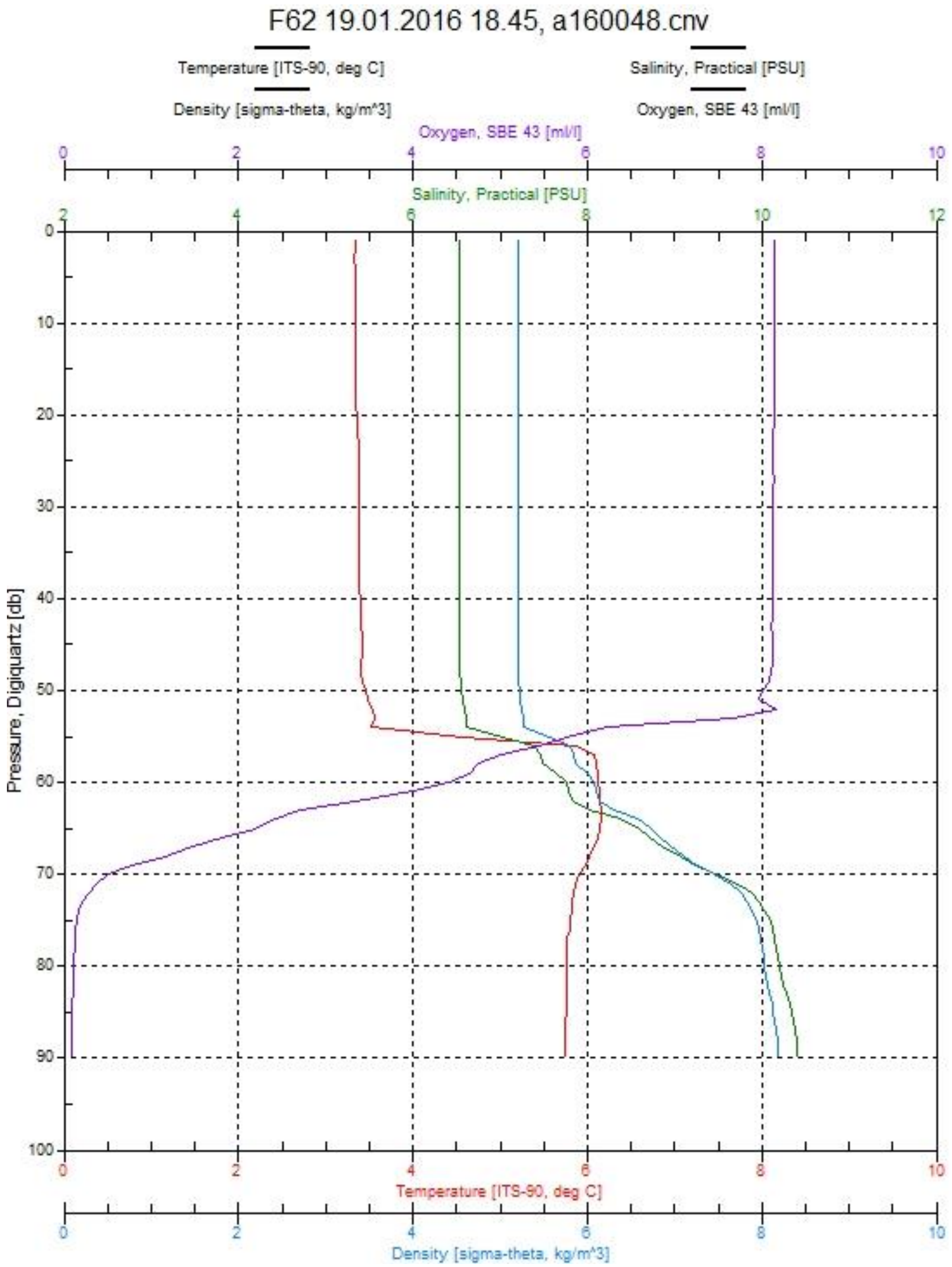
LL12 19.01.2016 12.50, a160047.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Voltage 0 [V] Fluorometer
Voltage 0 [V] Fluorometer
0.0
0.2
0.4
0.6
0.8
1.0
Salinity, Practical [PSU]
2
4
6
8
10
12
Pressure, Digiquartz [db]
0
10
20
30
40
50
60
70
80
90
100
Temperature [ITS-90, deg C]
0
2
4
6
8
10
Density [sigma-theta, kg/m^3]
0
2
4
6
8
10



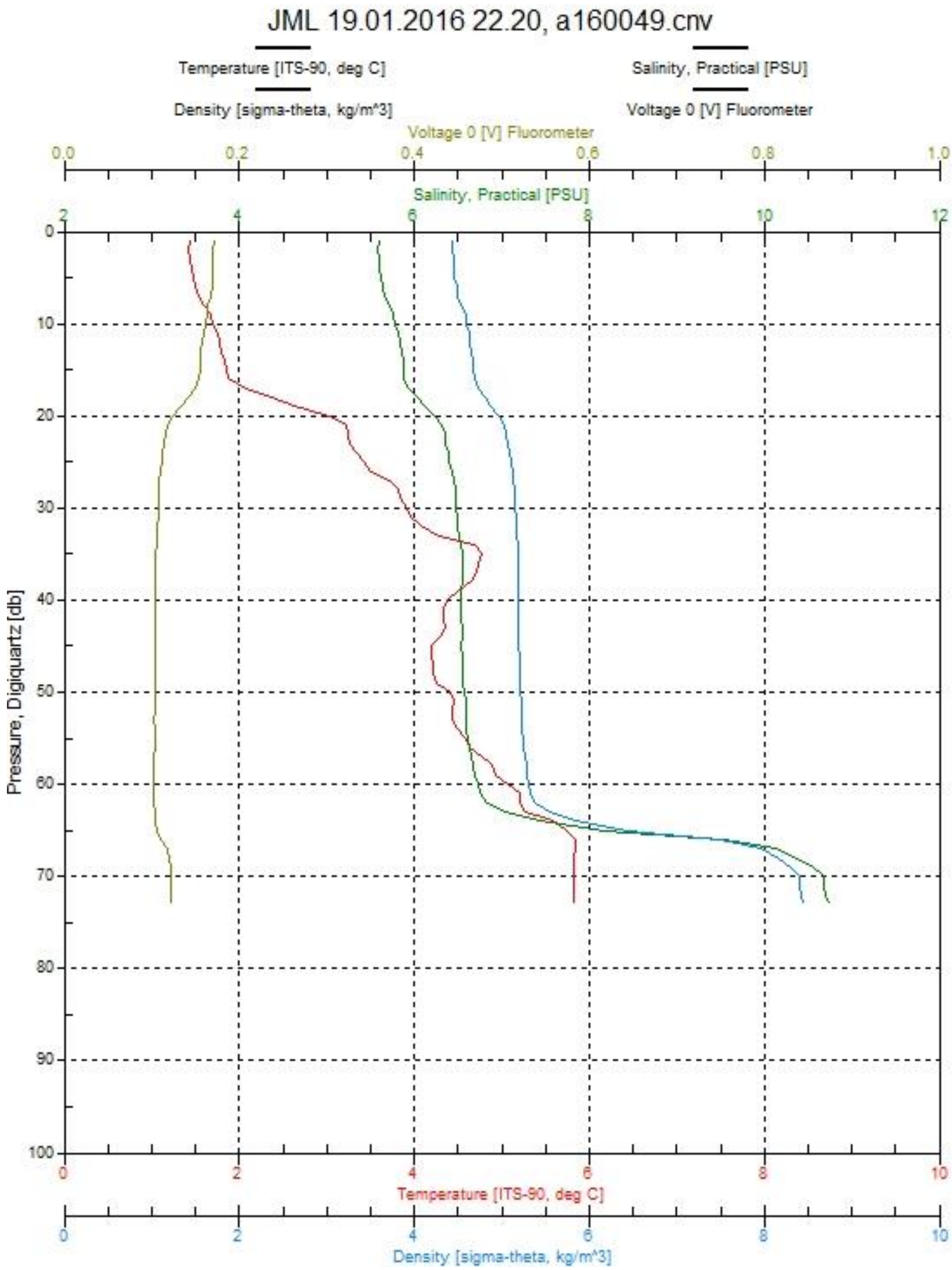
LL12 19.01.2016 12.50, a160047.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Oxygen, SBE 43 [ml/l]
Pressure, Digiquartz [db]

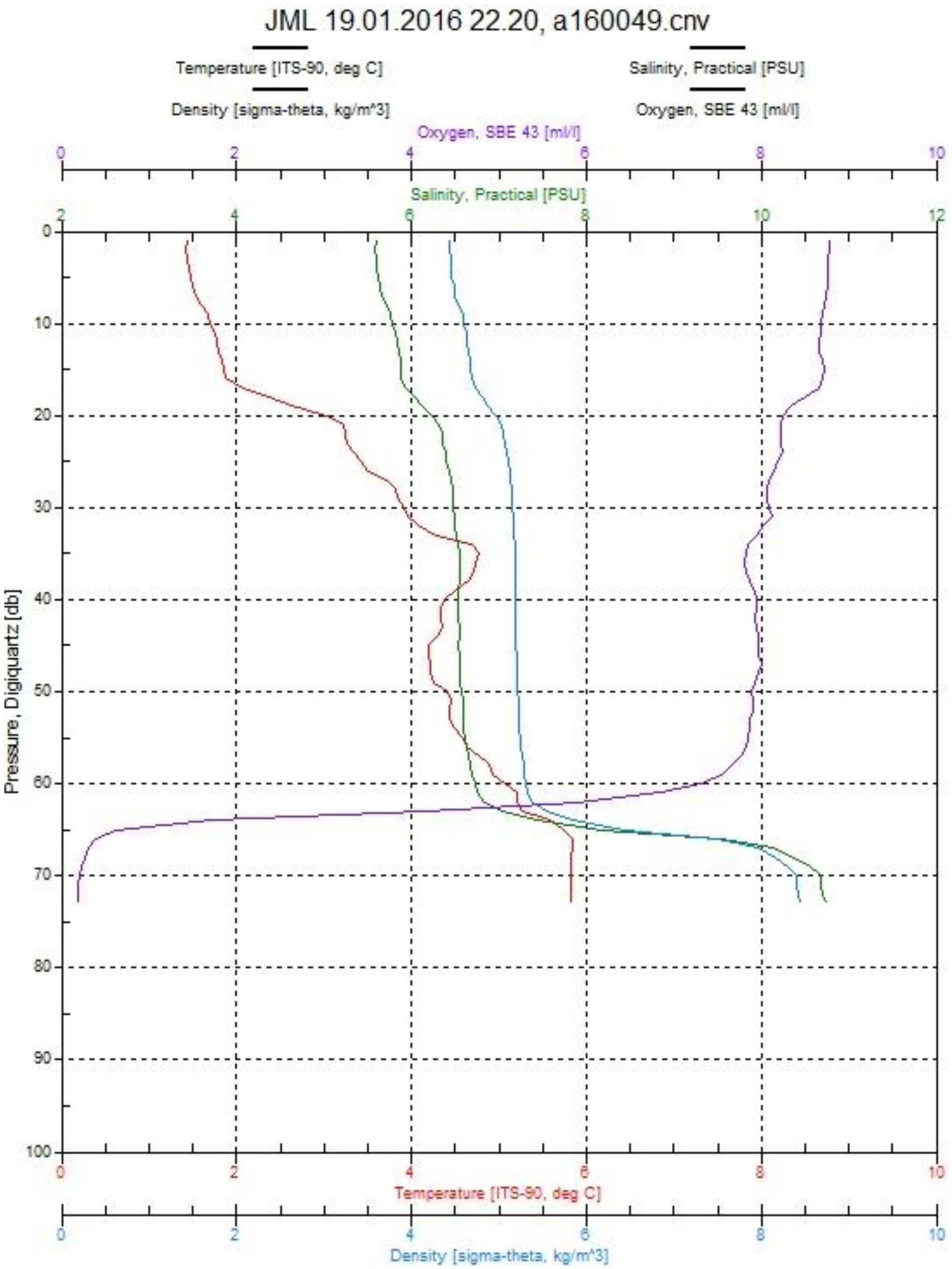


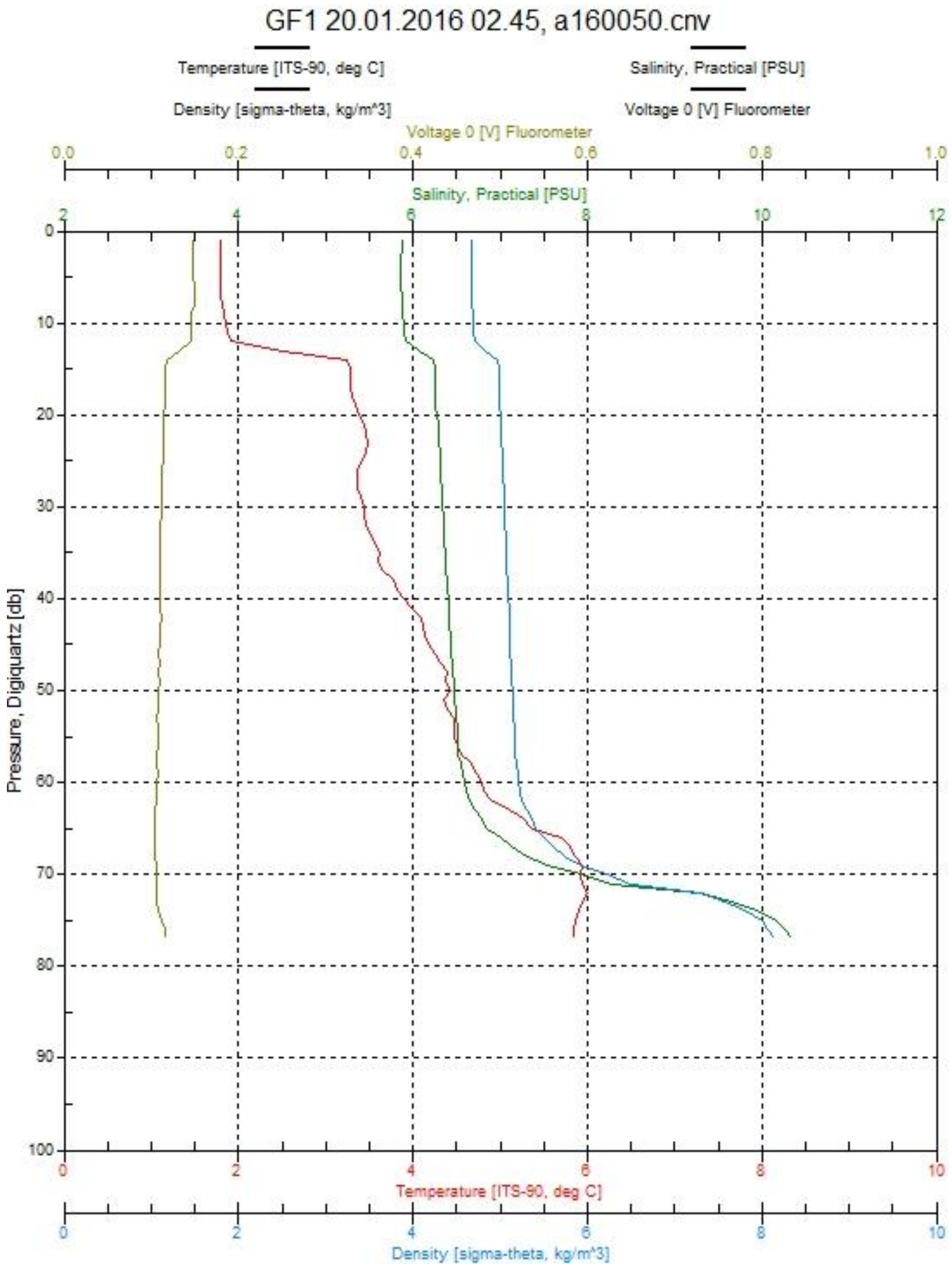
F62 19.01.2016 18.45, a160048.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Voltage 0 [V] Fluorometer
Voltage 0 [V] Fluorometer
0.0
0.2
0.4
0.6
0.8
1.0
Salinity, Practical [PSU]
2
4
6
8
10
12
Pressure, Digiquartz [db]
0
10
20
30
40
50
60
70
80
90
100
Temperature [ITS-90, deg C]
0
2
4
6
8
10
Density [sigma-theta, kg/m^3]



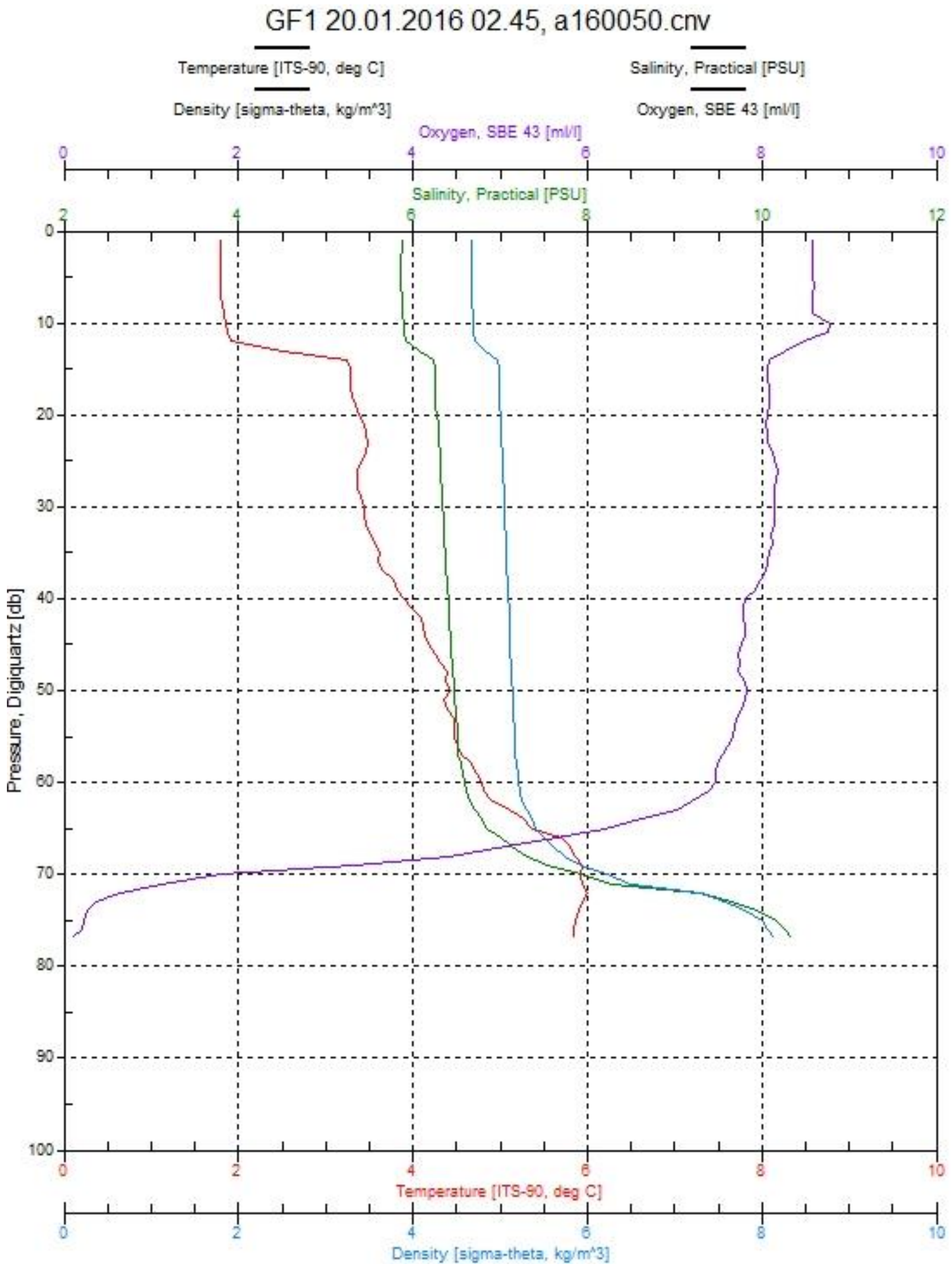
F62 19.01.2016 18.45, a160048.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Oxygen, SBE 43 [ml/l]
Oxygen, SBE 43 [ml/l]
0 2 4 6 8 10
Salinity, Practical [PSU]
2 4 6 8 10 12
Pressure, Digiquartz [db]
0 10 20 30 40 50 60 70 80 90 100
0 2 4 6 8 10
Temperature [ITS-90, deg C]
0 2 4 6 8 10
Density [sigma-theta, kg/m^3]


JML 19.01.2016 22.20, a160049.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Voltage 0 [V] Fluorometer
Voltage 0 [V] Fluorometer
Salinity, Practical [PSU]
Pressure, Digiquartz [db]
Temperature [ITS-90, deg C]
Density [sigma-theta, kg/m^3]

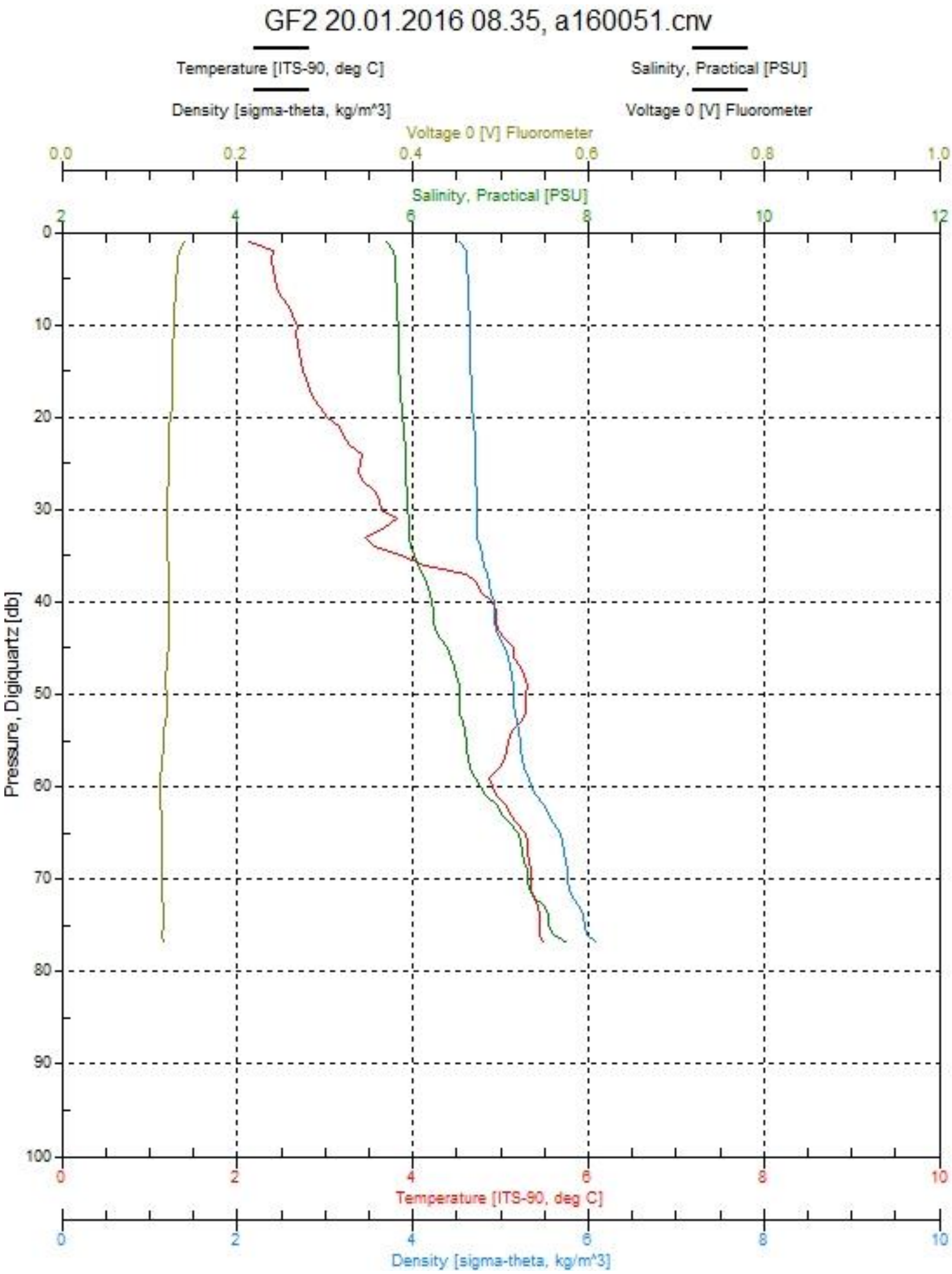

JML 19.01.2016 22.20, a160049.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Oxygen, SBE 43 [ml/l]
Oxygen, SBE 43 [ml/l]
Salinity, Practical [PSU]
Pressure, Digiquartz [db]
Temperature [ITS-90, deg C]
Density [sigma-theta, kg/m^3]



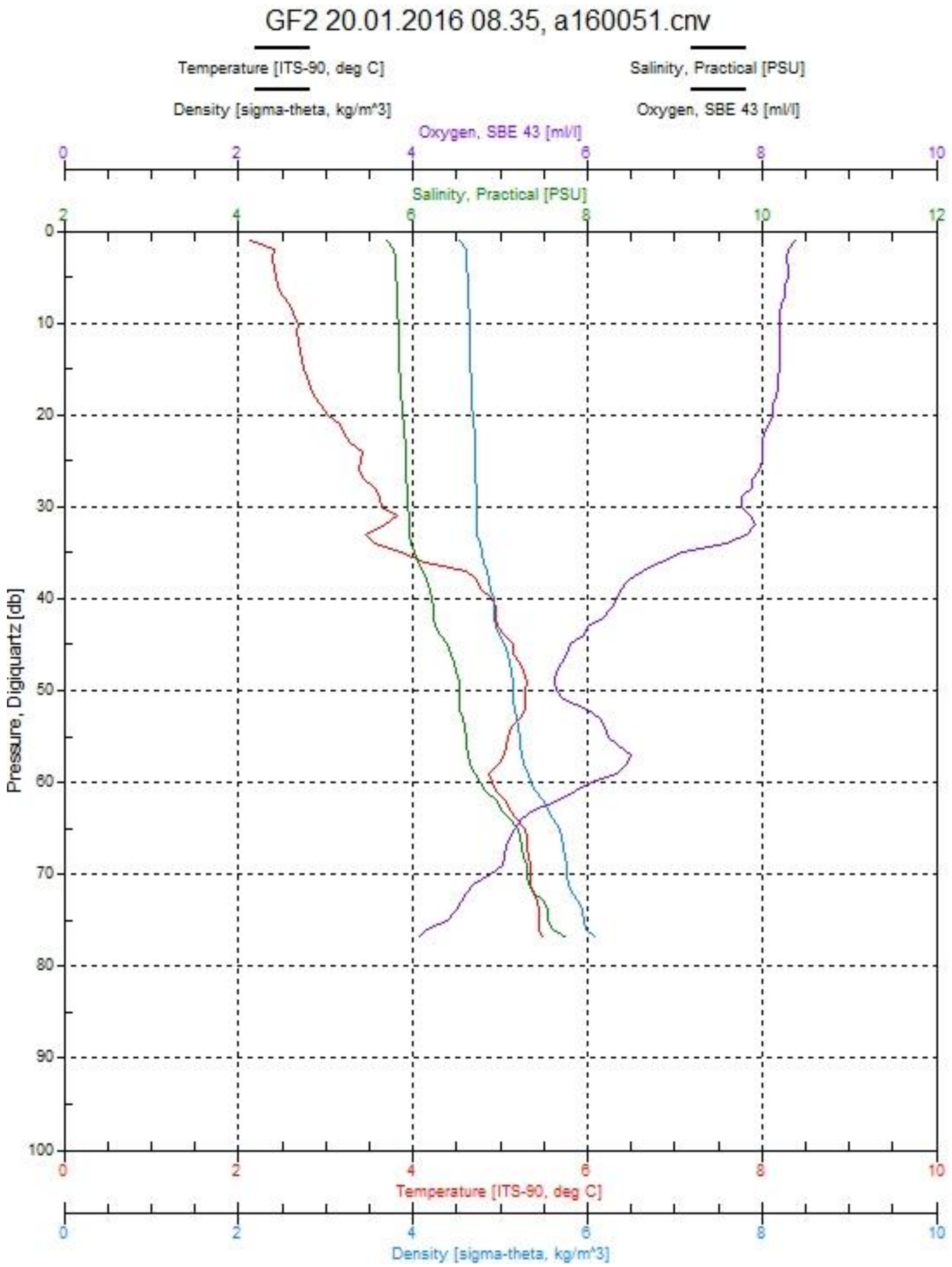
GF1 20.01.2016 02.45, a160050.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Voltage 0 [V] Fluorometer
Voltage 0 [V] Fluorometer
0.0
0.2
0.4
0.6
0.8
1.0
Salinity, Practical [PSU]
2
4
6
8
10
12
Pressure, Digiquartz [db]
0
10
20
30
40
50
60
70
80
90
100
0
2
4
6
8
10
Temperature [ITS-90, deg C]
0
2
4
6
8
10
Density [sigma-theta, kg/m^3]



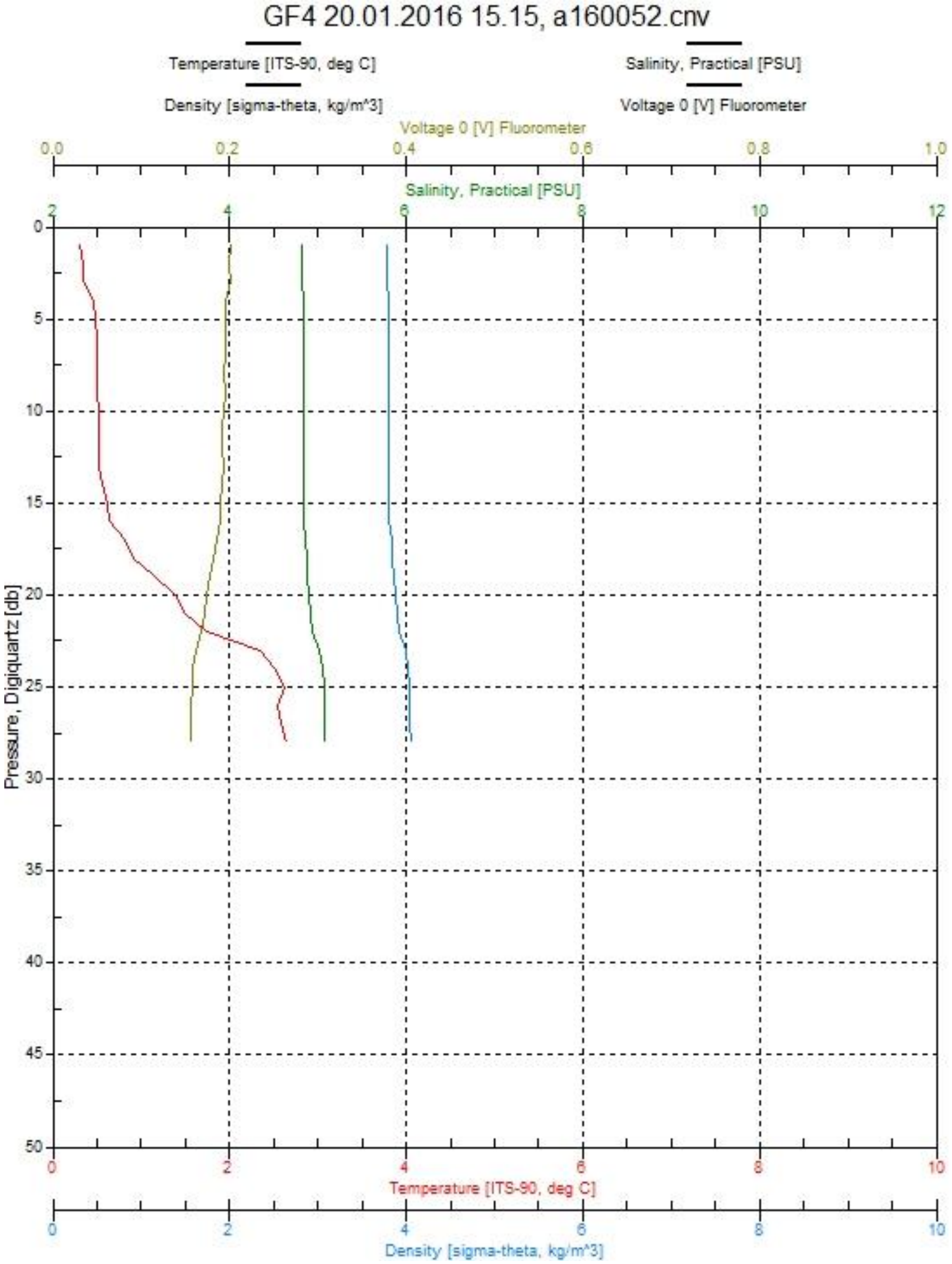
GF1 20.01.2016 02.45, a160050.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Oxygen, SBE 43 [ml/l]
Oxygen, SBE 43 [ml/l]
0
2
4
6
8
10
Salinity, Practical [PSU]
2
4
6
8
10
12
Pressure, Digiquartz [db]
0
10
20
30
40
50
60
70
80
90
100
Temperature [ITS-90, deg C]
Density [sigma-theta, kg/m^3]



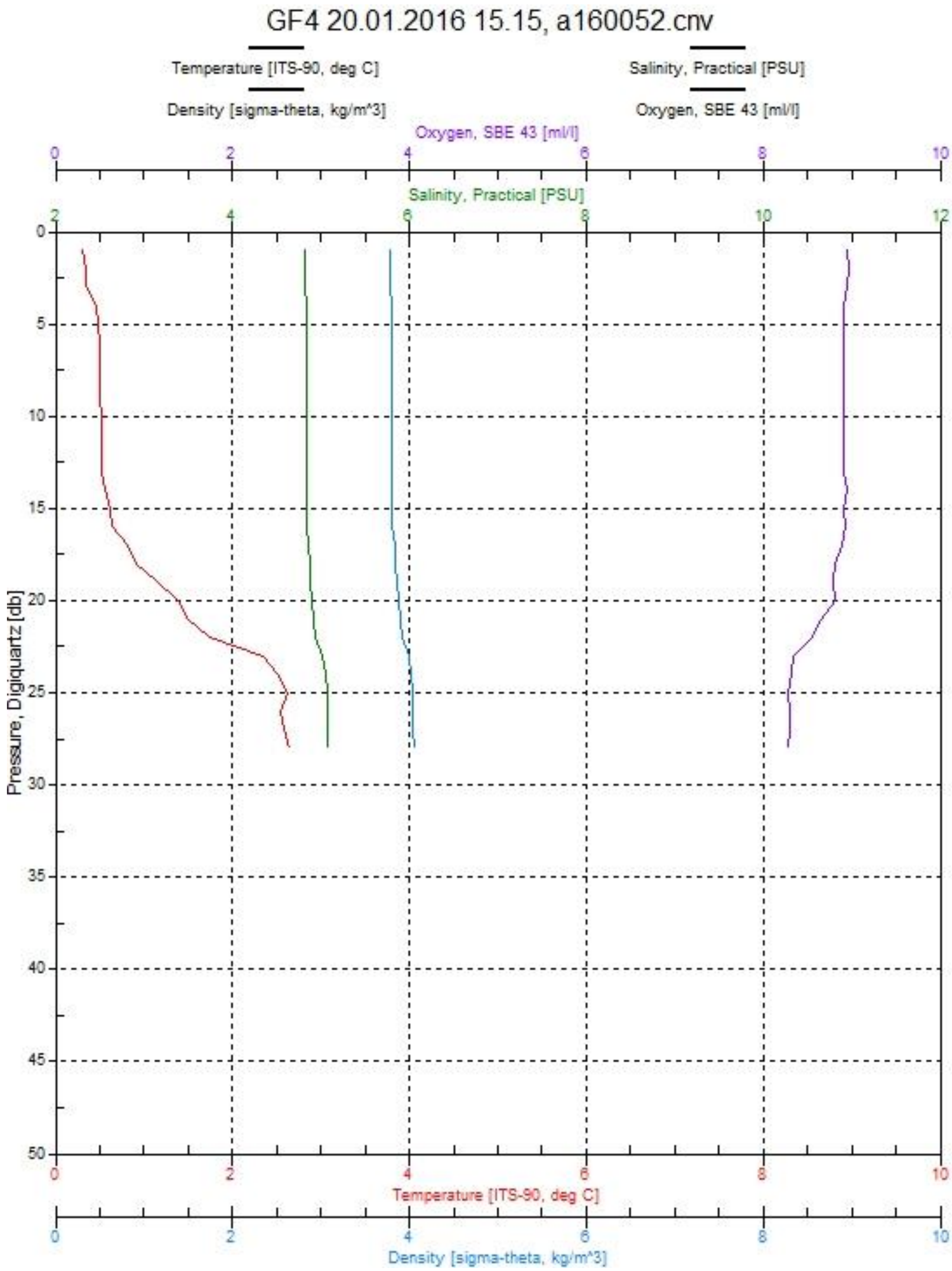
GF2 20.01.2016 08.35, a160051.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Voltage 0 [V] Fluorometer
Voltage 0 [V] Fluorometer
0.0
0.2
0.4
0.6
0.8
1.0
Salinity, Practical [PSU]
2
4
6
8
10
12
Pressure, Digiquartz [db]
0
10
20
30
40
50
60
70
80
90
100
Temperature [ITS-90, deg C]
0
2
4
6
8
10
Density [sigma-theta, kg/m^3]
0
2
4
6
8
10

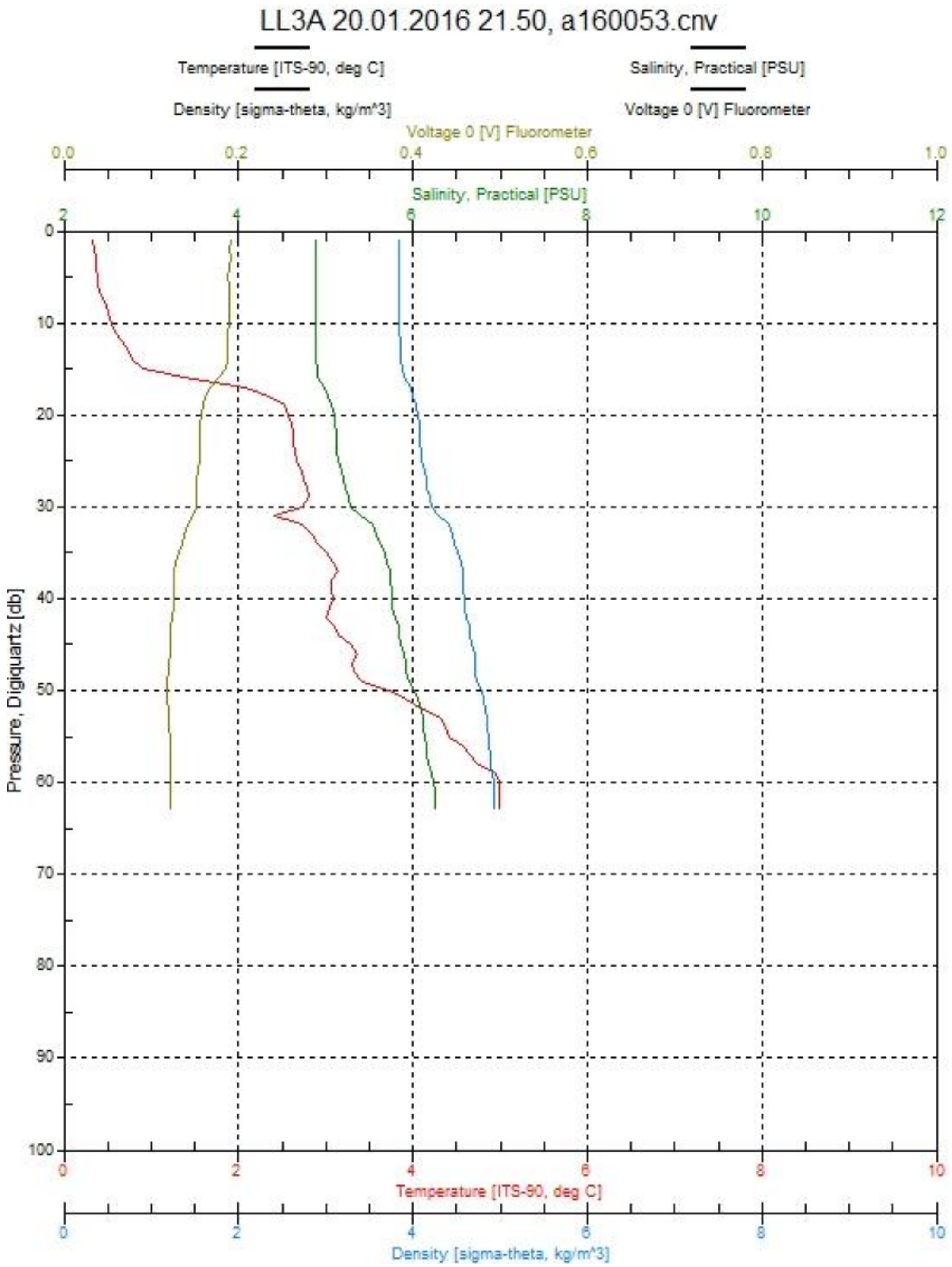


GF2 20.01.2016 08.35, a160051.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Oxygen, SBE 43 [ml/l]
Oxygen, SBE 43 [ml/l]
Salinity, Practical [PSU]
Pressure, Digiquartz [db]
Temperature [ITS-90, deg C]
Density [sigma-theta, kg/m^3]

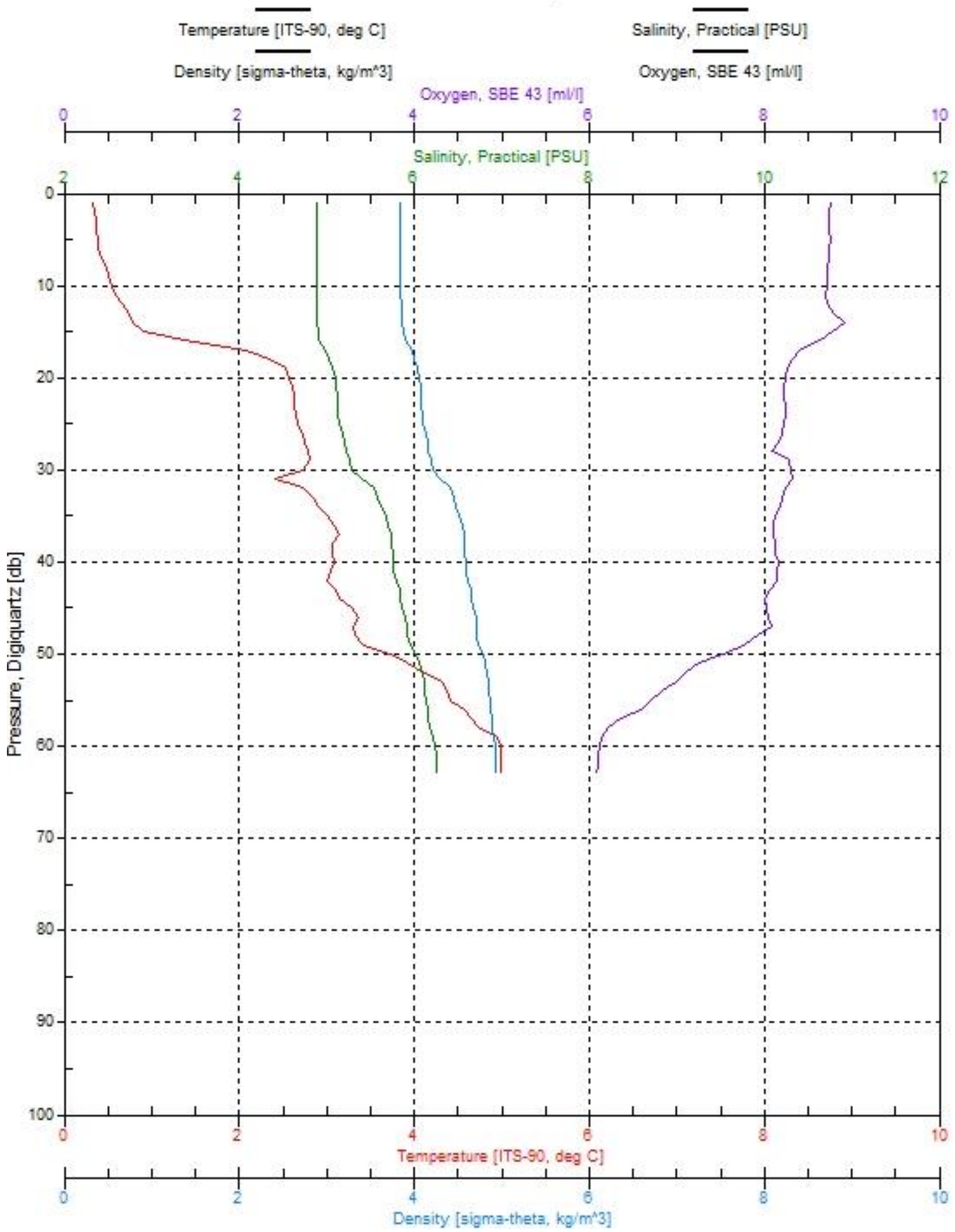


GF4 20.01.2016 15.15, a160052.cnv
Temperature [ITS-90, deg C]
Density [sigma-theta, kg/m^3]
Salinity, Practical [PSU]
Voltage 0 [V] Fluorometer
Voltage 0 [V] Fluorometer
0.0
0.2
0.4
0.6
0.8
1.0
Salinity, Practical [PSU]
2
4
6
8
10
12
Pressure, Digiquartz [db]
0
5
10
15
20
25
30
35
40
45
50
0
2
4
6
8
10
Temperature [ITS-90, deg C]
0
2
4
6
8
10
Density [sigma-theta, kg/m^3]

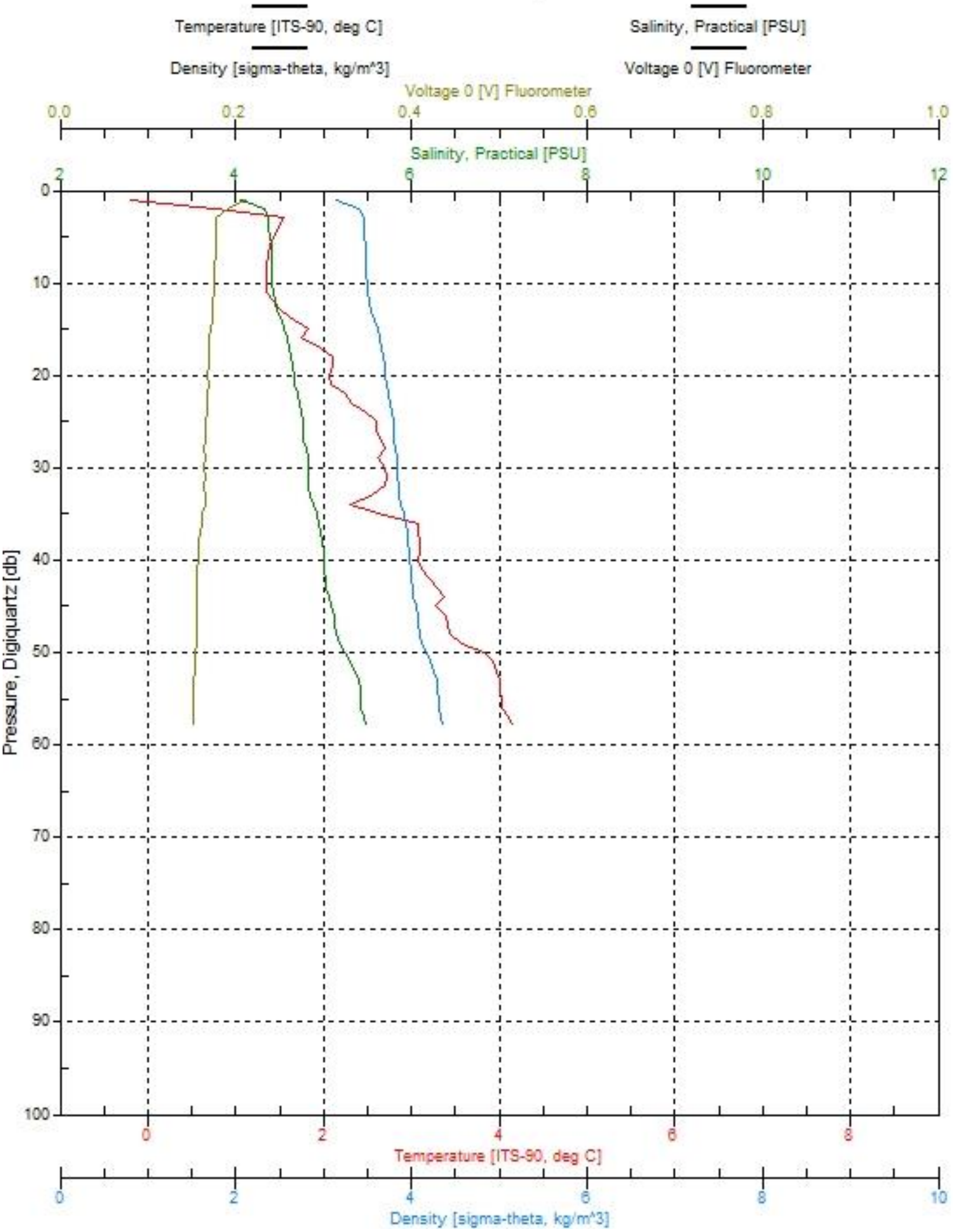

GF4 20.01.2016 15.15, a160052.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Oxygen, SBE 43 [ml/l]
Oxygen, SBE 43 [ml/l]
0
2
4
6
8
10
Salinity, Practical [PSU]
2
4
6
8
10
12
Pressure, Digiquartz [db]
0
5
10
15
20
25
30
35
40
45
50
Temperature [ITS-90, deg C]
Density [sigma-theta, kg/m^3]

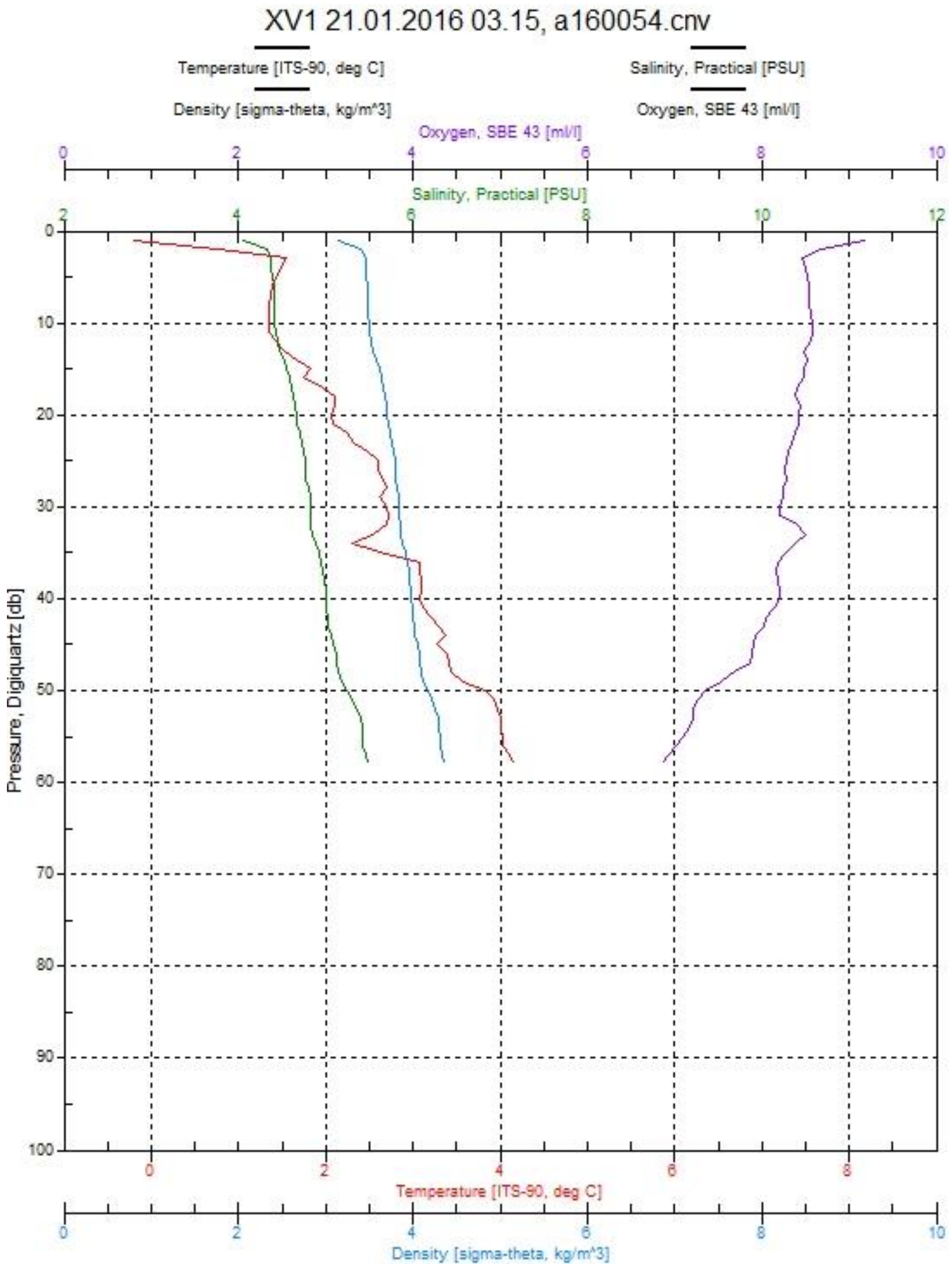

LL3A 20.01.2016 21.50, a160053.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Voltage 0 [V] Fluorometer
Voltage 0 [V] Fluorometer
0.0
0.2
0.4
0.6
0.8
1.0
Salinity, Practical [PSU]
2
4
6
8
10
12
Pressure, Digiquartz [db]
0
10
20
30
40
50
60
70
80
90
100
Temperature [ITS-90, deg C]
0
2
4
6
8
10
Density [sigma-theta, kg/m^3]
0
2
4
6
8
10

LL3A 20.01.2016 21.50, a160053.cnv

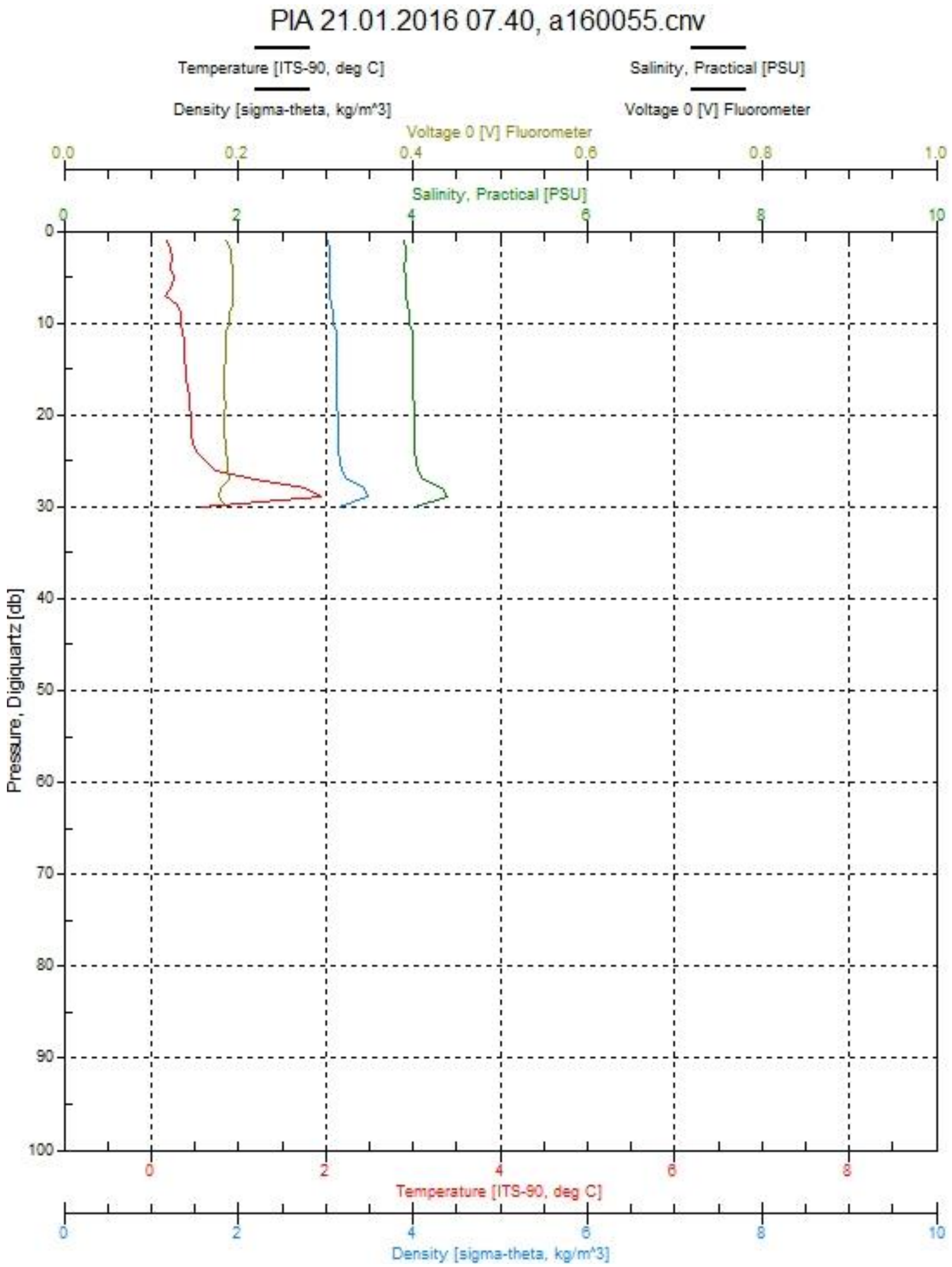


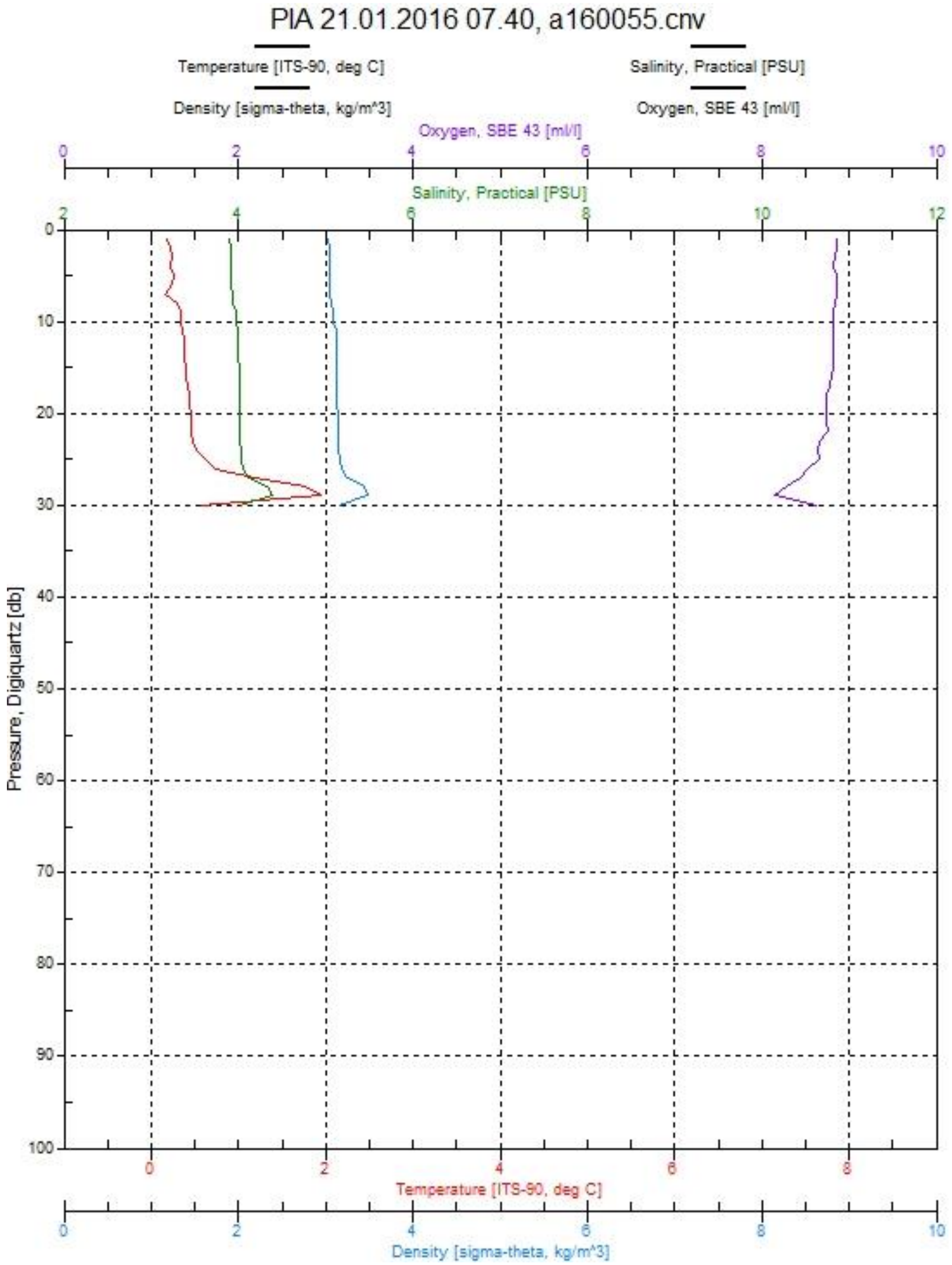
XV1 21.01.2016 03.15, a160054.cnv





XV1 21.01.2016 03.15, a160054.cnv
Temperature [ITS-90, deg C]
Density [sigma-theta, kg/m^3]
Salinity, Practical [PSU]
Oxygen, SBE 43 [ml/l]
Oxygen, SBE 43 [ml/l]
0 2 4 6 8 10
Salinity, Practical [PSU]
2 4 6 8 10 12
Pressure, Digiquartz [db]
0 10 20 30 40 50 60 70 80 90 100
0 2 4 6 8
Temperature [ITS-90, deg C]
0 2 4 6 8 10
Density [sigma-theta, kg/m^3]


PIA 21.01.2016 07.40, a160055.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Voltage 0 [V] Fluorometer
Voltage 0 [V] Fluorometer
0.0
0.2
0.4
0.6
0.8
1.0
Salinity, Practical [PSU]
0
2
4
6
8
10
Pressure, Digiquartz [db]
0
10
20
30
40
50
60
70
80
90
100
0
2
4
6
8
Temperature [ITS-90, deg C]
0
2
4
6
8
10
Density [sigma-theta, kg/m^3]


PIA 21.01.2016 07.40, a160055.cnv
Temperature [ITS-90, deg C]
Salinity, Practical [PSU]
Density [sigma-theta, kg/m^3]
Oxygen, SBE 43 [ml/l]
Oxygen, SBE 43 [ml/l]
0 2 4 6 8 10
Salinity, Practical [PSU]
2 4 6 8 10 12
Pressure, Digiquartz [db]
0 10 20 30 40 50 60 70 80 90 100
0 2 4 6 8
Temperature [ITS-90, deg C]
0 2 4 6 8 10
Density [sigma-theta, kg/m^3]

SCIENTIFIC STAFF

Chief scientist: Kankaanpää Harri T.

Participants:
Hänninen Panu
Kosloff Pekka
Varmanen Pia
Kinnunen Tanja
Lastumäki Ilkka
Riikonen Jere
Purokoski Tero
Savilahti Eetu
Jyrälä Jaakko

Master: Jaakko Helanto

Departure from Helsinki on Monday January 18, 2016 at 13:45 local time

Arrival to Helsinki on Thursday January 21, 2016 at 19:00 local time

No other harbours were visited during the cruise.

LIST OF STATIONS (coordinates are in WGS-84)

Index	Station	coordinates (Lat/Lon)	Depth [m]	Date	Time (UTC)
0041	39A	N60.0401 E024.5882	42.00	20160118	1501
0042	AALTO_HKI	N59.5793 E025.1410	62.00	20160118	1823
0043	LL7	N59.5079 E024.5027	103.00	20160118	2122
0044	LL9	N59.4201 E024.0181	65.00	20160119	0341
0045	XII3	N59.5201 E023.5881	23.00	20160119	0640
0046	UUS-23	N59.4661 E023.1577	57.00	20160119	0939
0047	LL12	N59.2901 E022.5381	82.00	20160119	1249
0048	F62	N59.2001 E023.1581	97.00	20160119	1631
0049	JML	N59.3491 E023.3761	80.00	20160119	2219
0050	GF1	N59.4230 E024.4093	83.00	20160120	0235
0051	GF2	N59.5031 E025.5141	85.00	20160120	0835
0052	GF4	N59.3258 E027.4591	34.00	20160120	1517
0053	LL3A	N60.0403 E026.2106	69.00	20160120	2233
0054	XV1	N60.1499 E027.1475	68.00	20160121	0312
0055	PIA	N60.2502 E027.3498	36.00	20160121	0738