



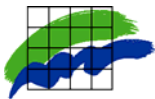
r/v Gunnar Thorson

Monitoring Cruise Report

Cruise no.: GT 251

Time: 14 - 17 September 2009

**Area: The Sound, the Arkona Sea,
the Belt Sea and the Kattegat**



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Data sheet

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Monitoring Cruise Report - Cruise No. GT 251, 14-17 September 2009

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Participants: Dorete W. Jensen
Gitte Jacobsen
Peter Kofoed
Andreas Petersen

Vessel: R/V Gunnar Thorson

Sampling region: The Sound, the Arkona Sea, the Belt Sea and the Kattegat

Primary aim: Monitoring of oxygen deficiency

This report is based on preliminary data, which might later be corrected. Citation permitted only when quoting is evident.

Introduction

The cruise is part of the Danish national monitoring programme (NOVA-NA), the HELCOM monitoring programme (COMBINE) for the Baltic Sea area, and the OSPARCOM monitoring programme (JAMP) for the Greater North Sea (the Kattegat). The primary aim of the cruise is to provide measurements of hydrography, nutrient concentrations and oxygen concentrations. *Figure 1* shows the locations of the monitoring sampling stations.



Figure 1 Map showing the stations sampled by the monitoring cruise, region sea names and the location of the transects plotted in the following figures.

Meteorology

The monthly averages in *Figure 2* show that summer 2009 air temperatures were slightly above the long-term average. The average for September 2009 was 1.4 degrees warmer. Precipitation in July was 30% above the long-term average, whilst August values were very close to the average. September 2009 was exceptionally dry with 38% less precipitation than average.

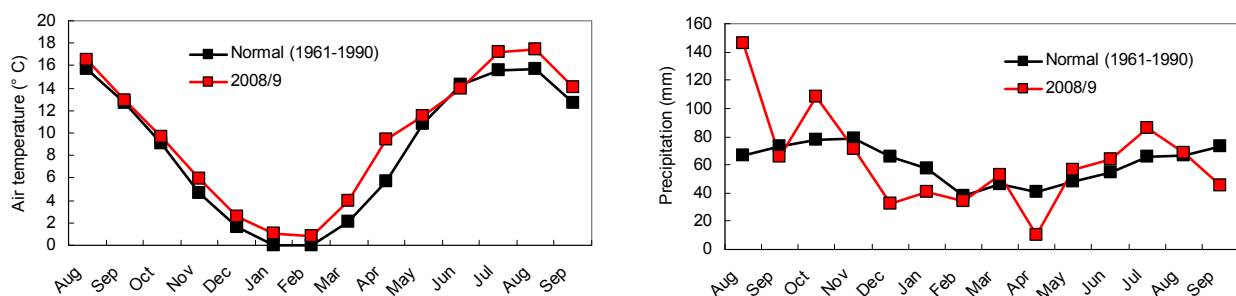


Figure 2 Monthly average air temperature and monthly total precipitation data for August 2008 to September 2009 compared with long-term averages (1961-1990). Data retrieved from the Danish Meteorological Institute (www.dmi.dk).

The weather for the weeks preceding the cruise is shown in *Figure 3*. The week of the cruise was relatively wind-still, although week 35 and 36 had average wind speeds above the long-term average. As seen with the monthly averages, the air temperatures were above average this summer.

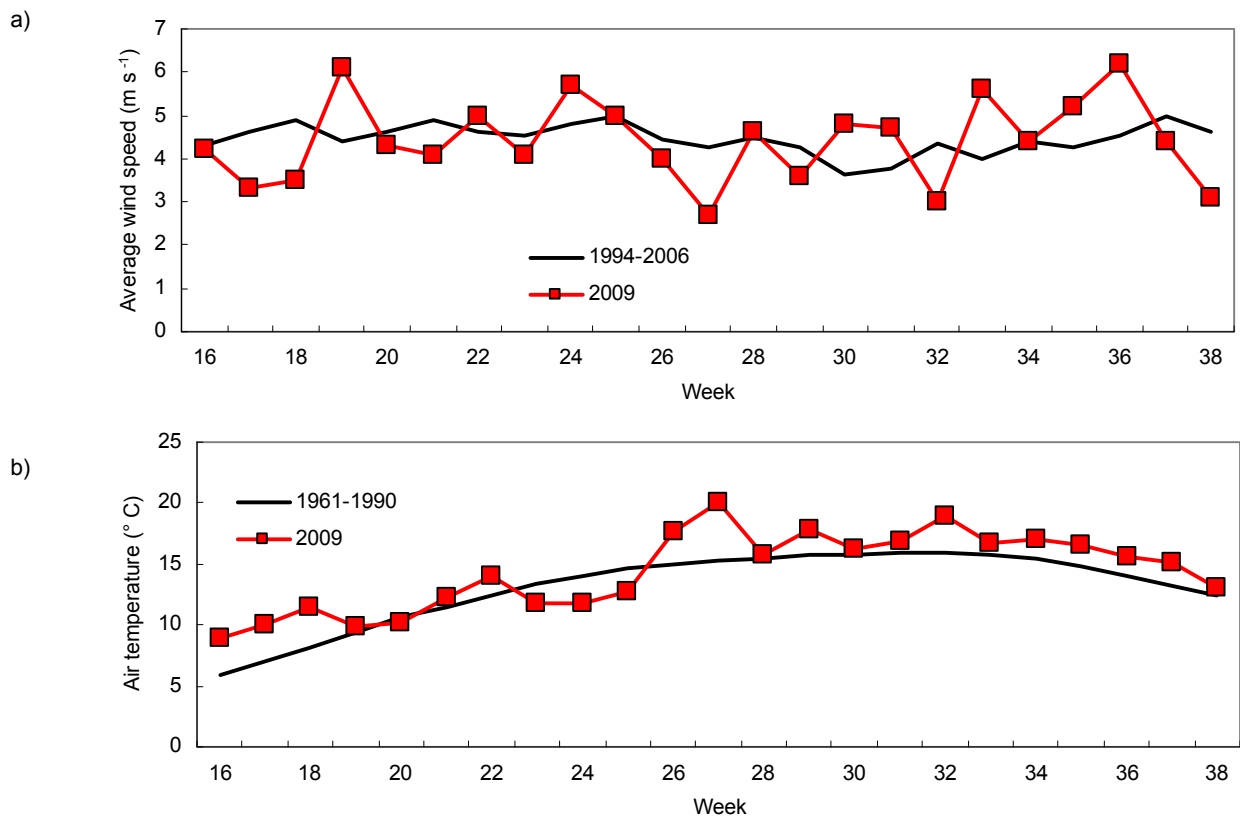


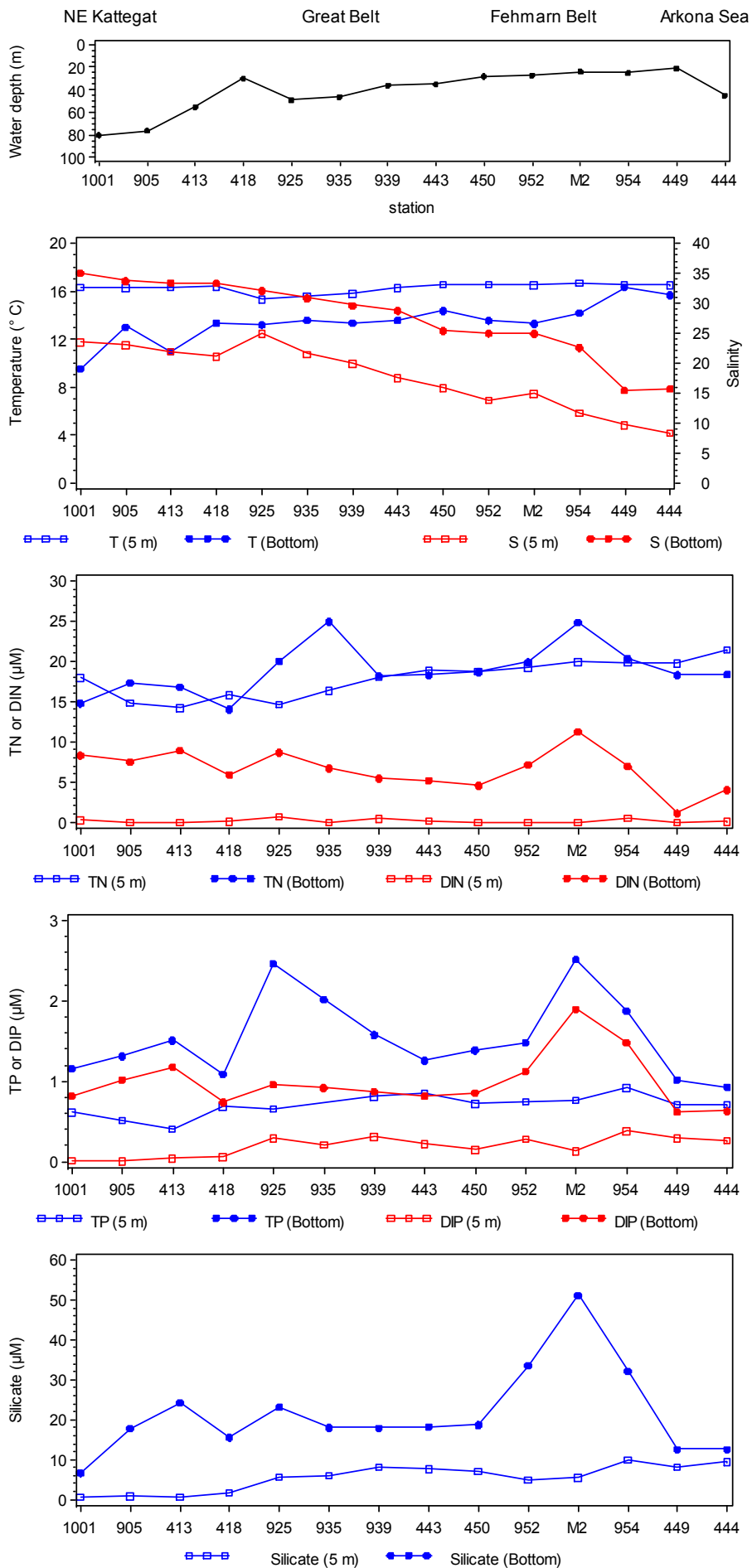
Figure 3 a) Weekly average wind speed from mid-March to the week of the cruise compared with average values from 1994-2006. b) Weekly air temperature from the same period compared to average values from 19961-1990. This cruise was in week 38.

Hydrography

A transect that summarises the horizontal gradients in the hydrographic and nutrient measurements is presented in *Figure 4* and the locations of the transect is marked on *Figure 1*.

Surface water temperatures (0-5 m) were relatively uniform and varied between 15.3 and 16.8 degrees for all stations. Bottom water temperatures varied between 9.5 and 16.9 degrees and were lowest at the deep stations in the northern Kattegat (e.g. 1001, 80 m) and greatest at the shallow stations. Surface and bottom water salinities followed their normal trend with increasing values from east to west and lower salinities in surface waters. All stations were stratified.

Figure 4 Transects of surface and bottom water temperature, salinity and nutrient concentrations. Position of the transect is indicated in *Figure 1*.



Nutrients

Surface waters were on the whole devoid of inorganic N. All N was bound as organic N. TN concentrations in surface waters varied between 12.5 and 22.1 μM N with the lowest concentrations in the Northern Kattegat and highest concentrations in the Arkona Sea. With the exception of the shallow stations (e.g. N3, 441, 1728 409), inorganic nitrogen concentrations in bottom waters were much higher. Concentrations ranged between 10.4 and 24.9 μM N and represented between 11 and 56% of TN. Maximum TN and DIN concentrations were measured in the bottom waters of the Northern and Southern Belt Sea.

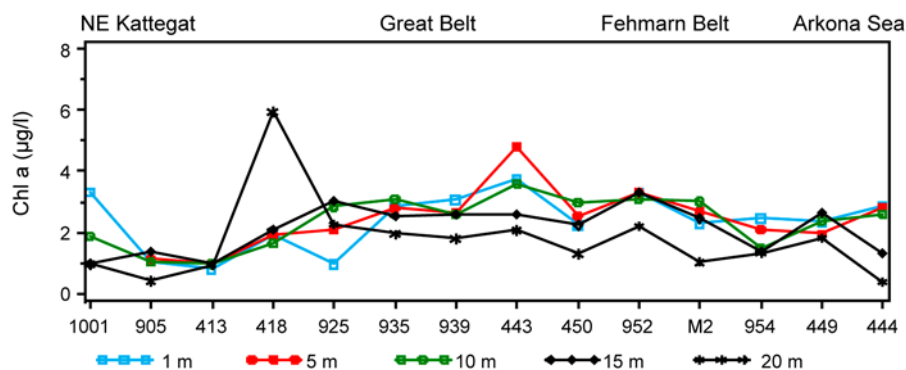
Inorganic phosphorus was nearly absent from the surface waters of the Northern Kattegat but otherwise varied between 0.06 and 0.39 μM in the rest of the region. TP concentrations in surface waters were relatively constant between 0.41-1.55 μM . Bottom waters, as expected, had much higher concentrations and the majority of P was present as inorganic P (average 63%). As seen for N, maximum bottom water concentrations were measured in the Northern and Southern Belt Sea.

Surface silicate concentrations followed the expected trend for this time of year in the region, decreasing from East to West and generally remaining below 10 μM . Bottom water silicate concentrations varied considerably. Lowest concentrations were measured at the shallow stations (less than 15 m) and in the Northern Kattegat. Concentrations were generally below 30 μM , except in the Southern Belt Sea and Sound where values up to 51 μM were measured. Concentrations in the bottom 25 m of the Sound were approximately 15 μM greater than expected for this time of year (See Appendix, St. 431).

Chlorophyll a

Chlorophyll concentrations ranged between 0.4 and 9.6 $\mu\text{g/l}$ in the surface 20 m. Highest concentrations were measured at St. 921 in the Southern Kattegat at 10 m. The values along the transect are shown in *Figure 5*. Values were generally higher than seen during the cruise in August, but at a similar level to that observed last year in September.

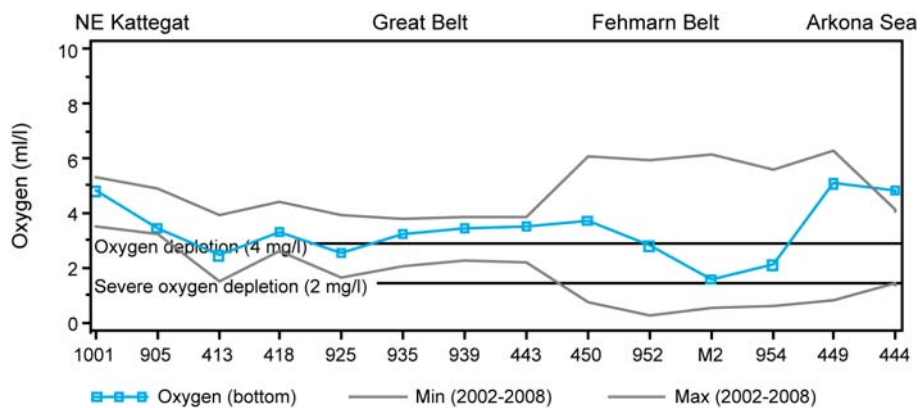
Figure 5 Chlorophyll a concentrations in surface waters along the transect shown in *Figure 1*.



Oxygen

As can be seen from *Figure 6*, bottom water oxygen concentrations were within the range of values measured in September during the last six years. Oxygen depletion (values < 4 mg/l or 2.86 ml/l) was detected at stations in the Fehmarn Belt (St. 952), Mecklenburg Bight (St. M2, St. 954), the Southern Kattegat (St. 413, St. 921) and the Sound (St. 431).

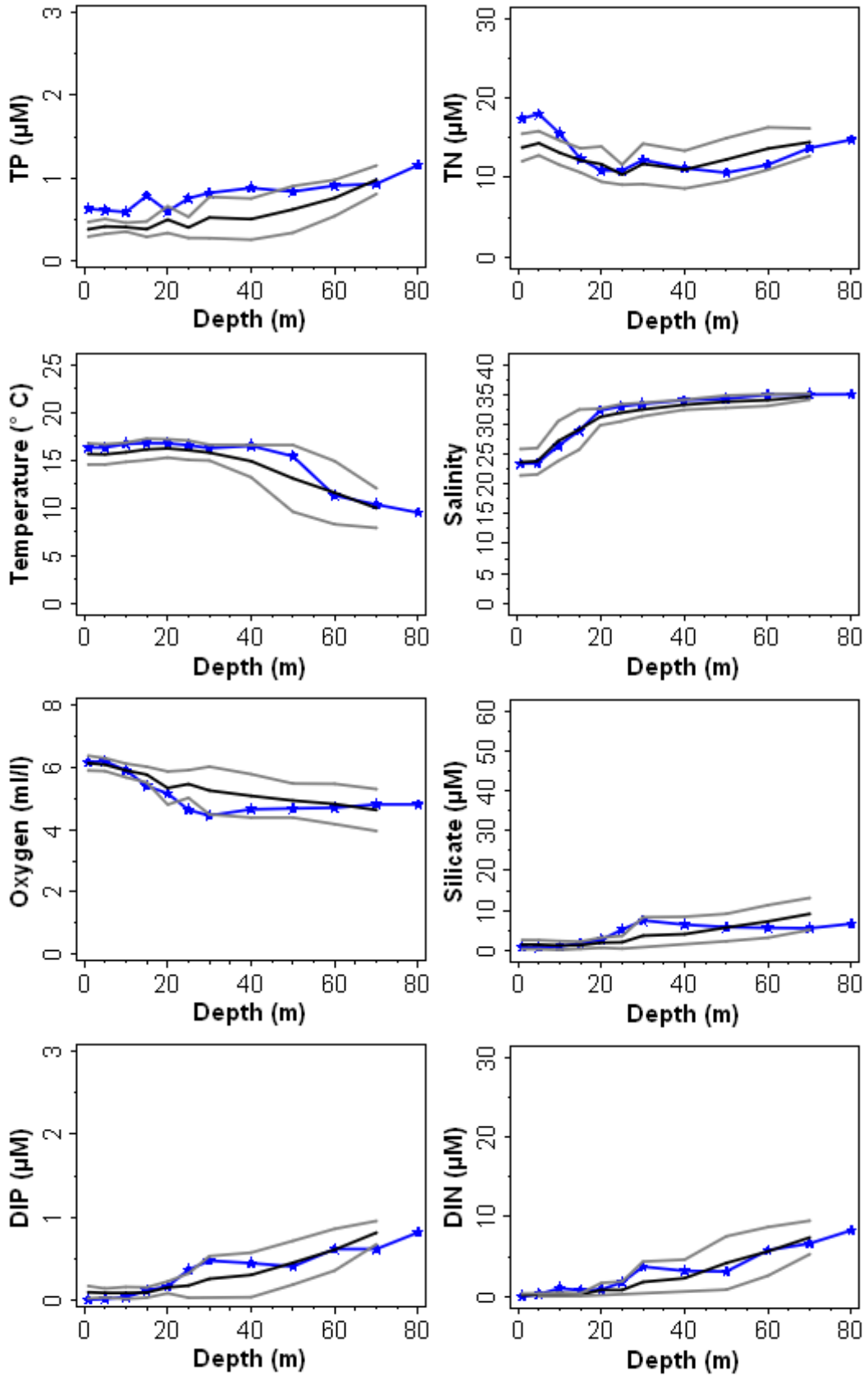
Figure 6 Bottom water oxygen concentrations along the transect shown in *Figure 1*. Also shown are the concentrations which define oxygen depletion and severe oxygen depletion.



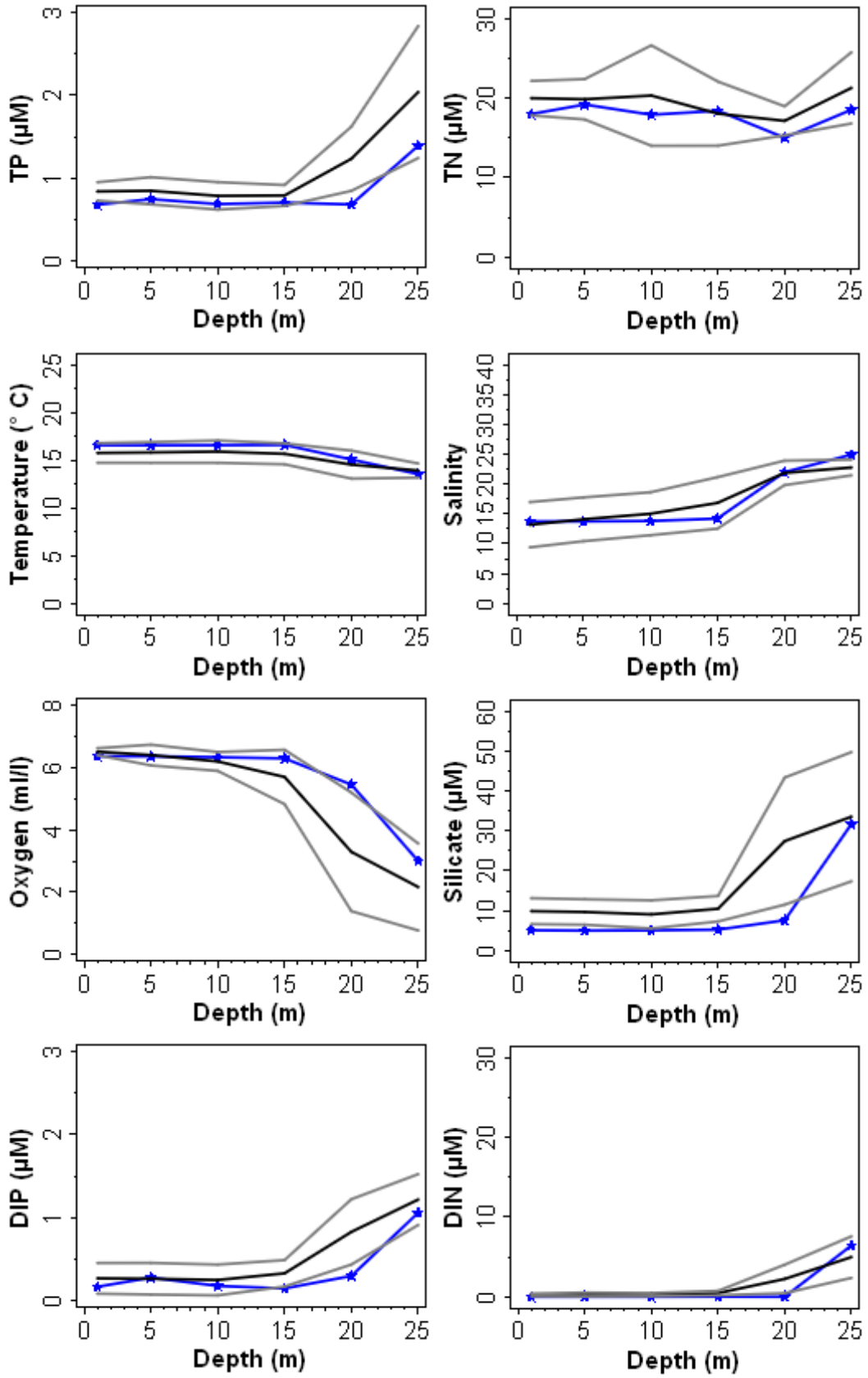
Appendix

The following graphs show profiles of the measured parameters at seven chosen stations (blue lines). The mean profiles are also plotted for the station from the same cruise during the period 2002-2008 (black). The grey lines are the upper and lower 95% confidence limits for the mean.

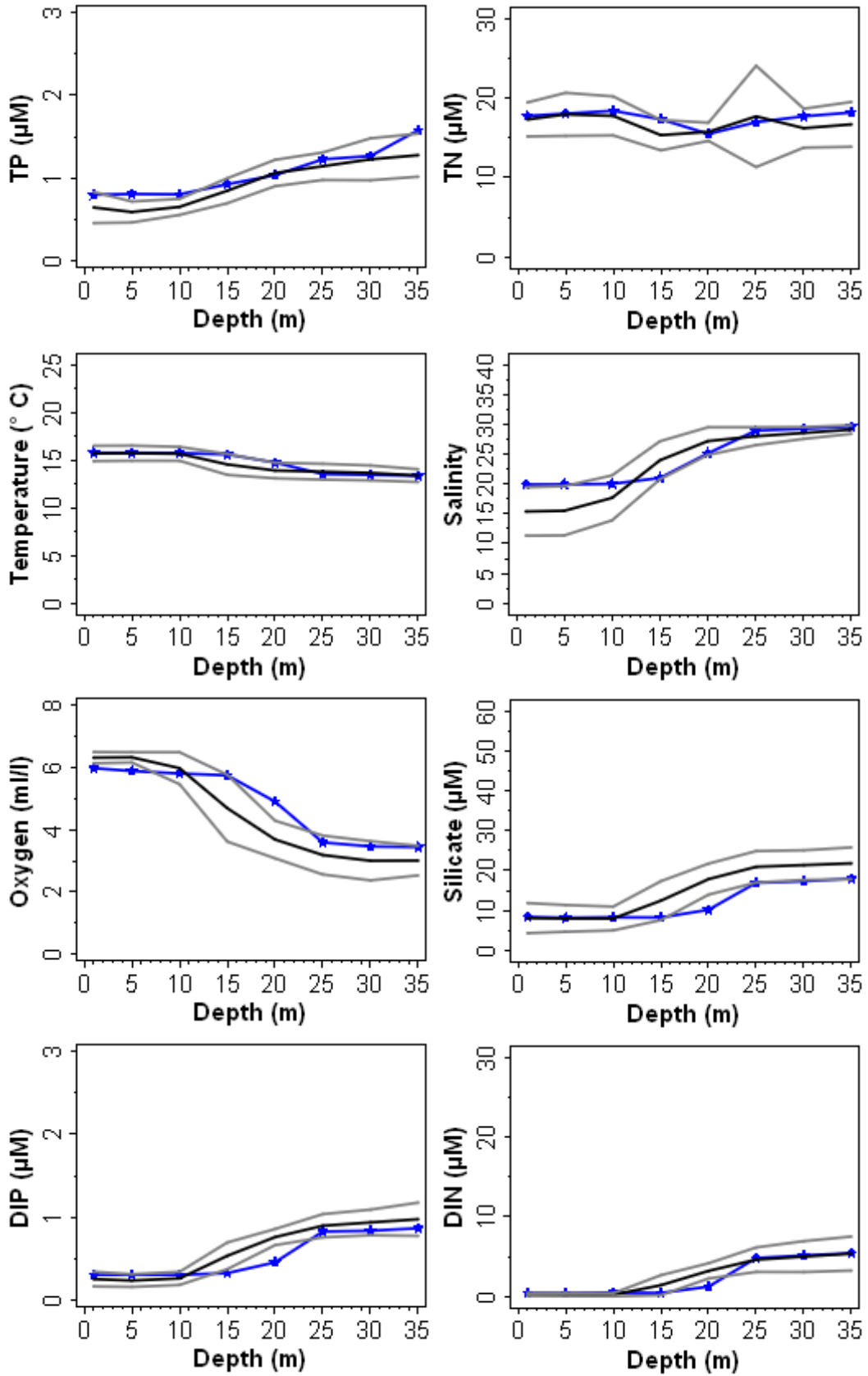
St. 1001, GT 251, September 2009



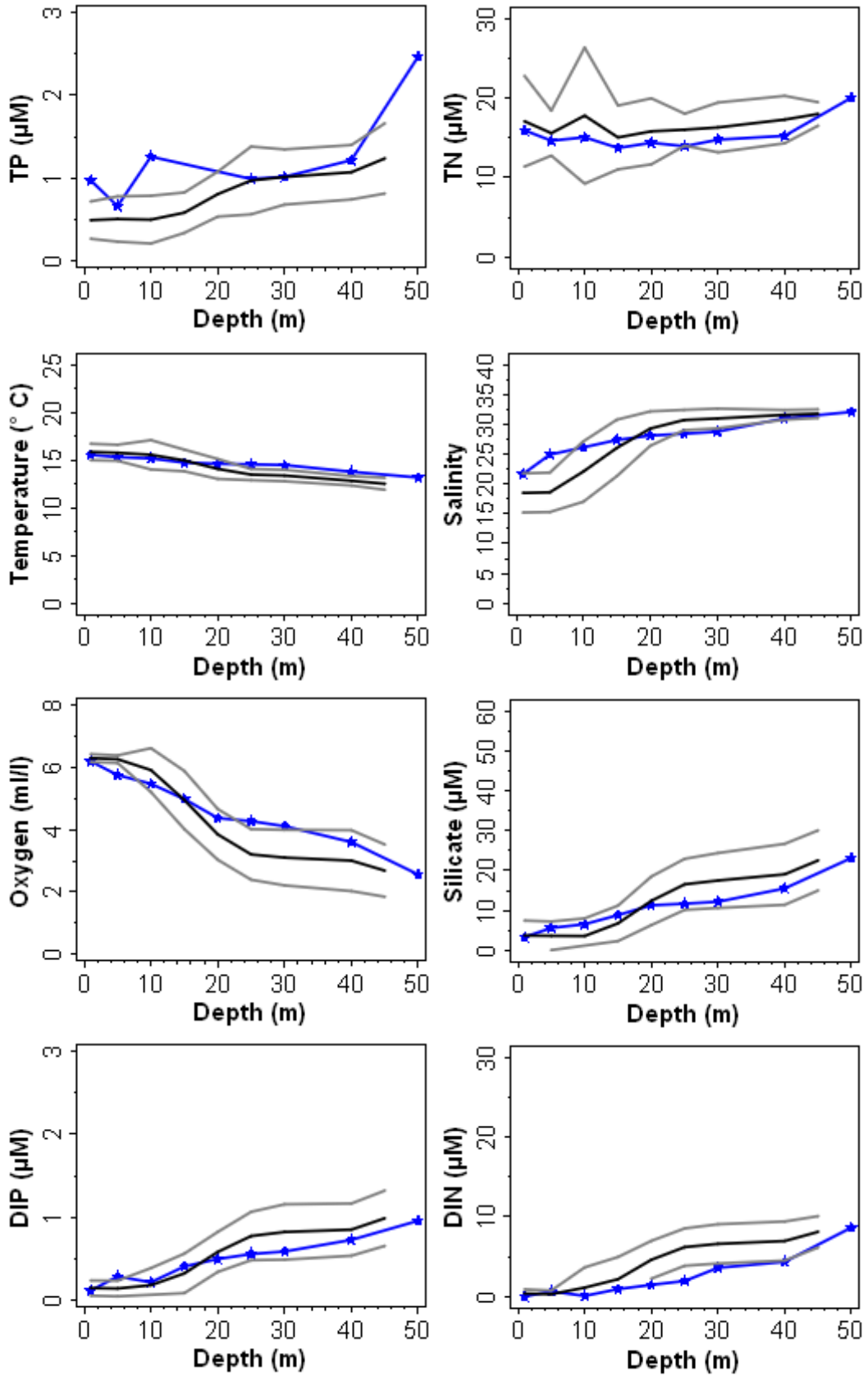
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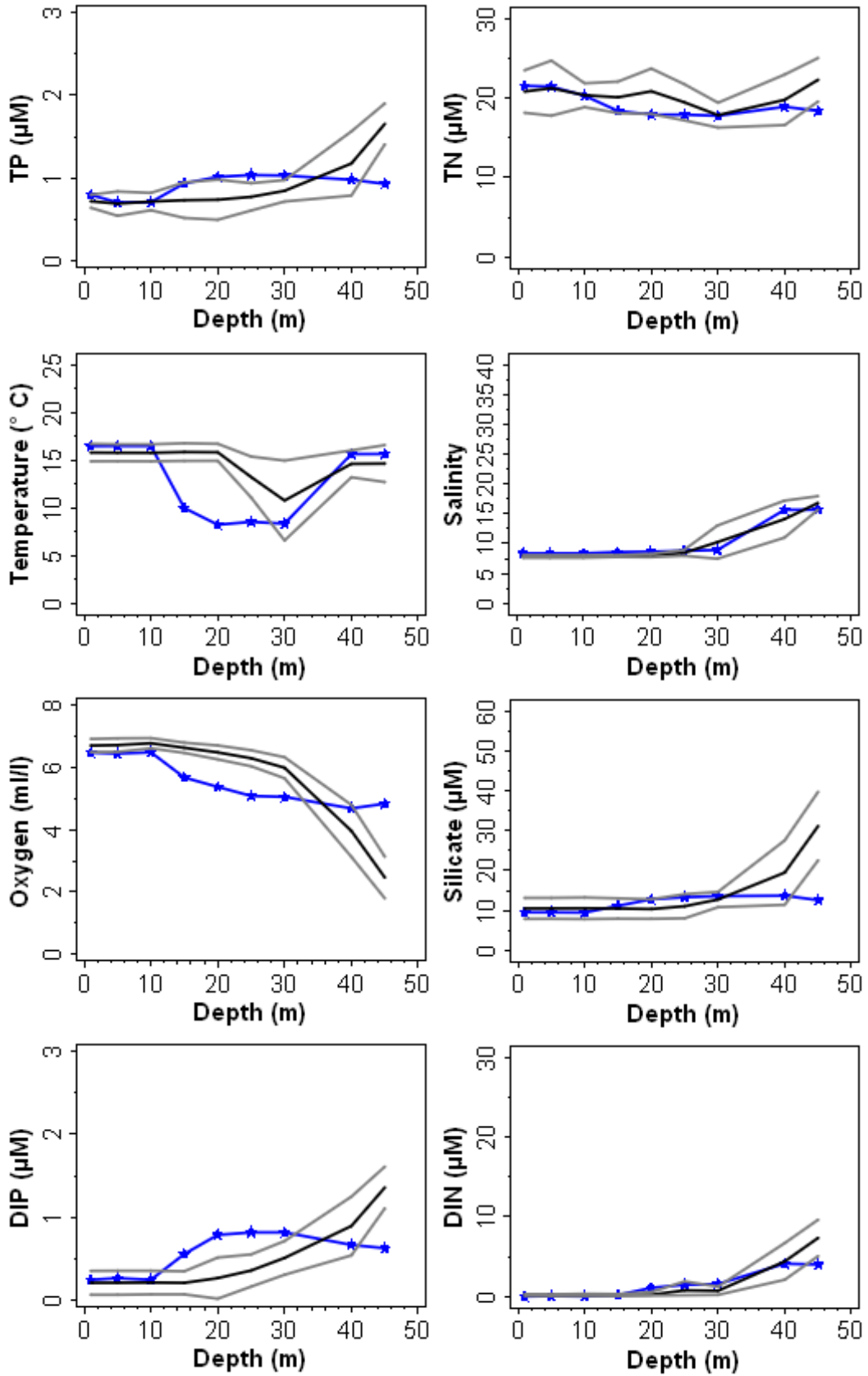
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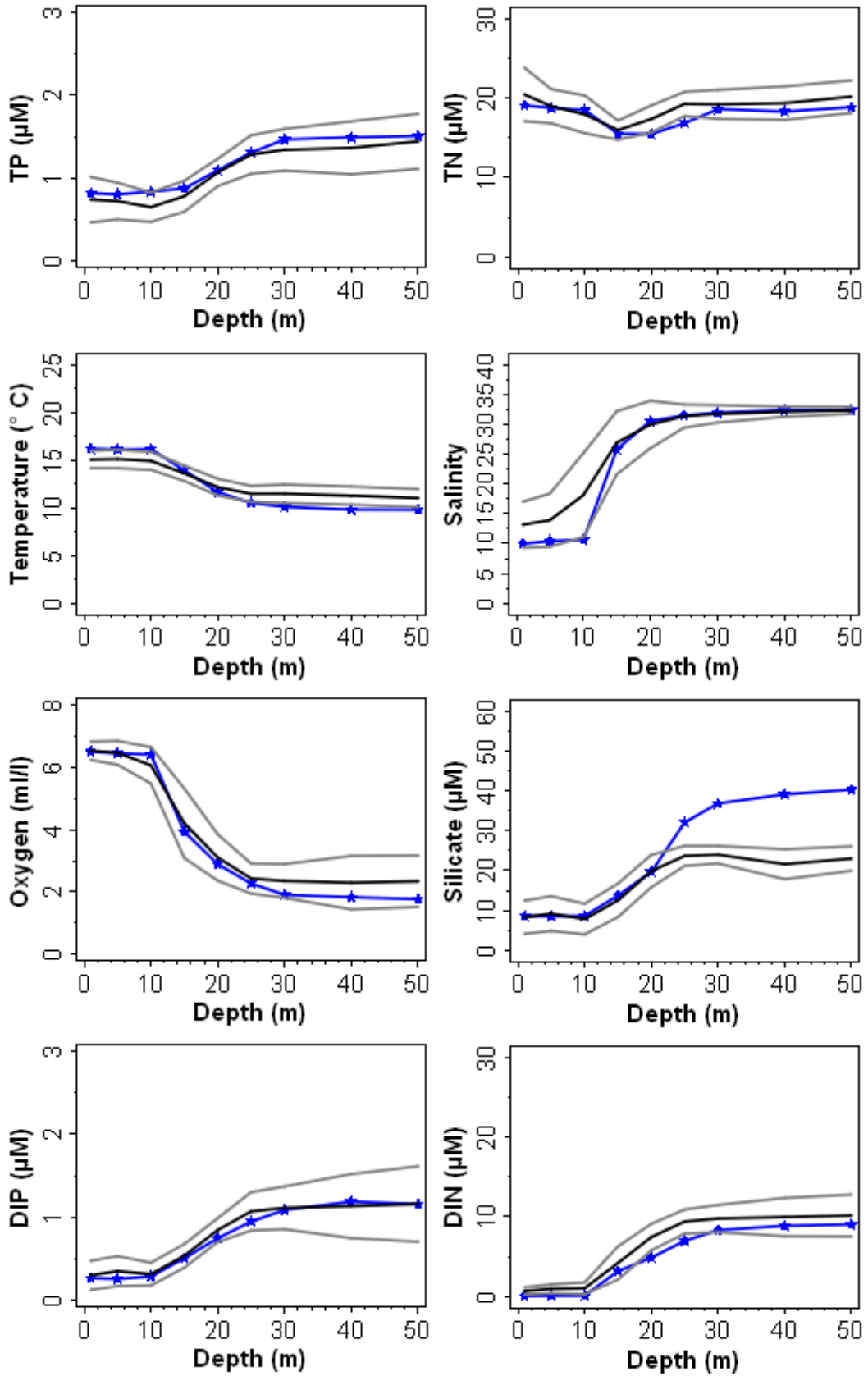
St. 925, GT 251, September 2009



St. 444, GT 251, September 2009



St. 431, GT 251, September 2009



St. 413, GT 251, September 2009

