Seasonal hypoxic zone adjacent the Changjiang Estuary

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1. Introduction

- **What's hypoxia?**

  hypoxia: DO<2mg/l;

  bottom with weak water exchange;

  an index to eutrophication;

- **What's its biological effects?**

  Organisms will die; more H_2S;

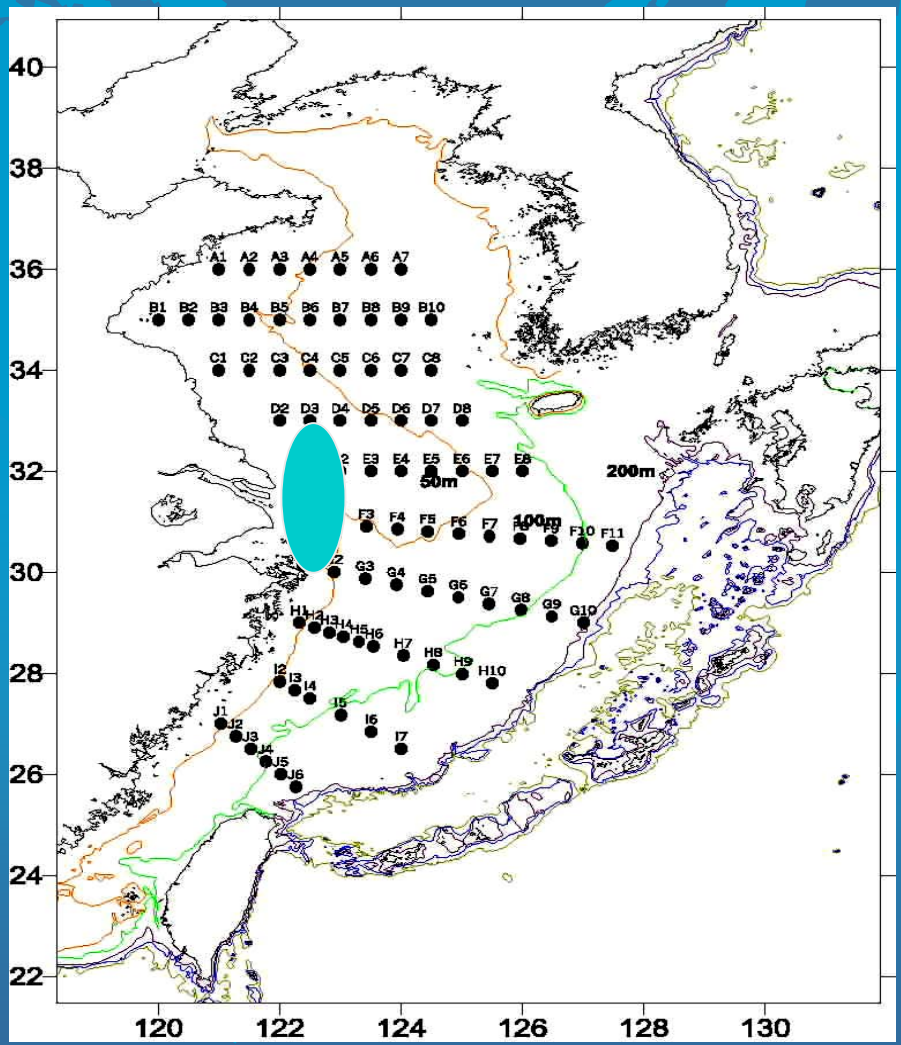
  Benthic community will change;

  Pelagic community will change.

Dead Zone in the Mississippi River Plume

Area: $2*10^4 km^2$

Hypoxic zone adjacent the Changjiang Estuary, EAST CHINA SEA



There is a large south-northward band of hypoxic zone (DO<2mg /l) adjacent the Changjiang estuary during warm season like other estuaries of large runoffs in the world. more sensitive, disappear as the north wind onset

Trends of hypoxia in the ECS

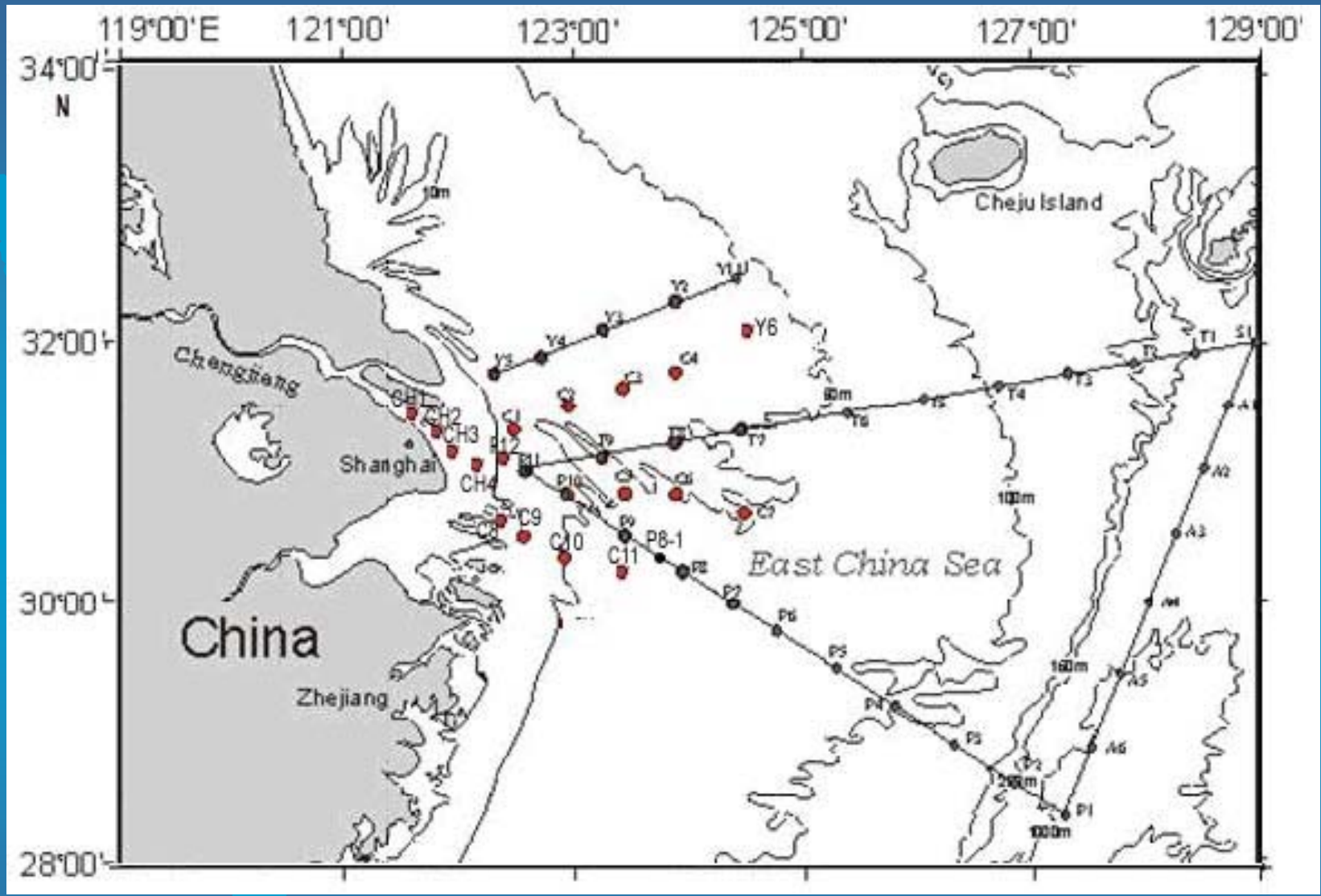
Time of survey	center of lowest DO zone	DO minimum value mg/l	Investigator
1959.8	123°00′E, 31°30′N	2.57	Hongkan Gu et.al. (1980)
1981.8	123°00′E, 30°50′N	**2.00**	Limeburner et.al. (1983)
1982.8	122°30′E, 31°15′N	2.85	Jiyu Chen et.al. (1988)
1988.8	123°00′E, 30°50′N	**1.96**	Tian et.al. (1993)
1999.8	122°59′E, 30°51′N	**1.00**	Daoji Li et.al. (2002)
2003.9	122°56′E, 30°49′N	**0.8**	This study

What induces and maintains the hypoxia adjacent the Changjiang Estuary?

- **Nutrients input from Changjiang and other areas increasing dramatically;**
- **POC increasing;**
- **Frequently HAB;**
- **Over fishing;**

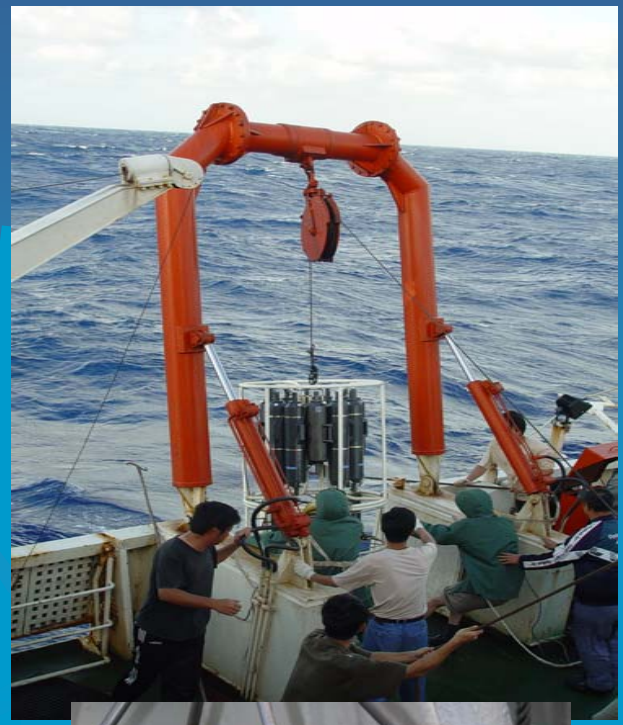
role of physical processes?

3. Observation during late summer, 2003



Stations of cruise Sep.4-25, 2003

Chinese GLOBEC project ’973’



DONGFANGHONG 2 R/V

Seabird911^{+}CTD: Temperature and Salinity profiles

YSI: DO profiles

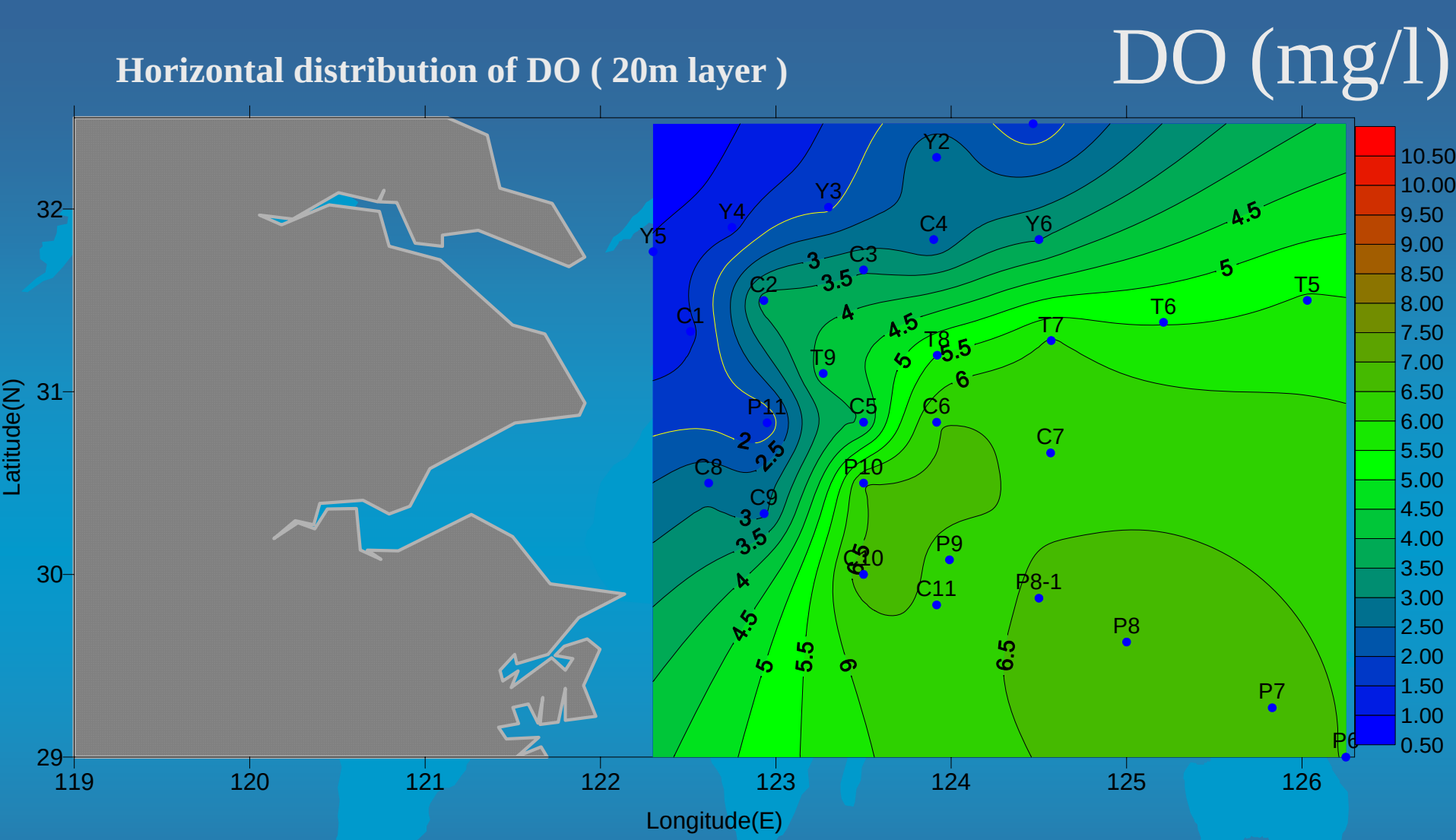
RDI OS75kHz ADCP: Current profiles

Hypoxic Zone

- **Dramatic low dissolved oxygen concentration (DO) less than 0.8mg/l was found during the cruise Sep. 2003. The hypoxic zone was about $2*10^4 km^2$ along the 20-50m isobaths.**

4. Analysis and Discussion

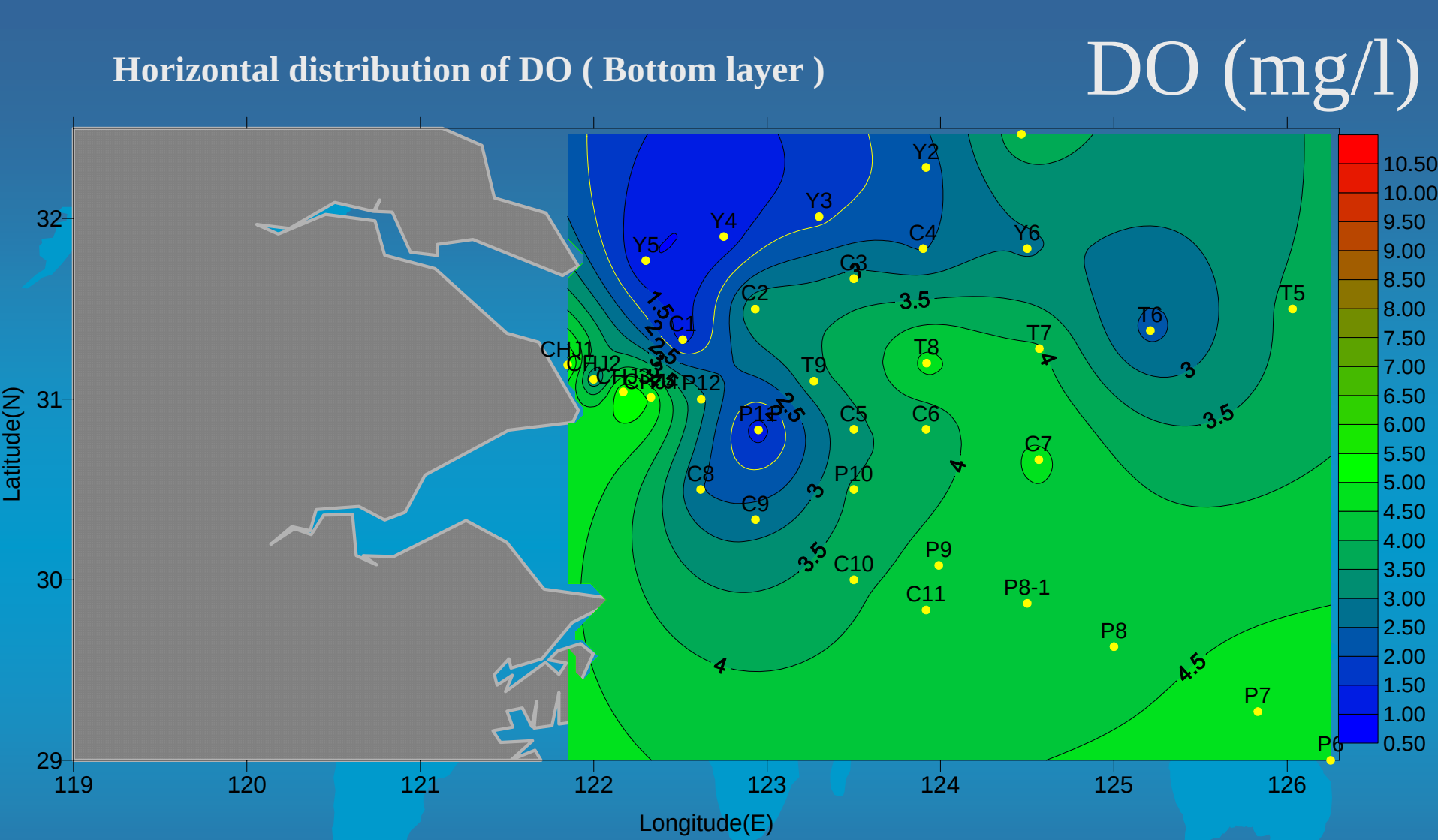
- DO distribution
- DO vs. water mass
- DO vs. density stratification
- DO vs. phytoplankton biomass
- DO vs. POC



Dissolved Oxygen(mg/L) of 20m layer in Sept. 2003

DO of 20m layer

Yellow line refers to 2mg/l



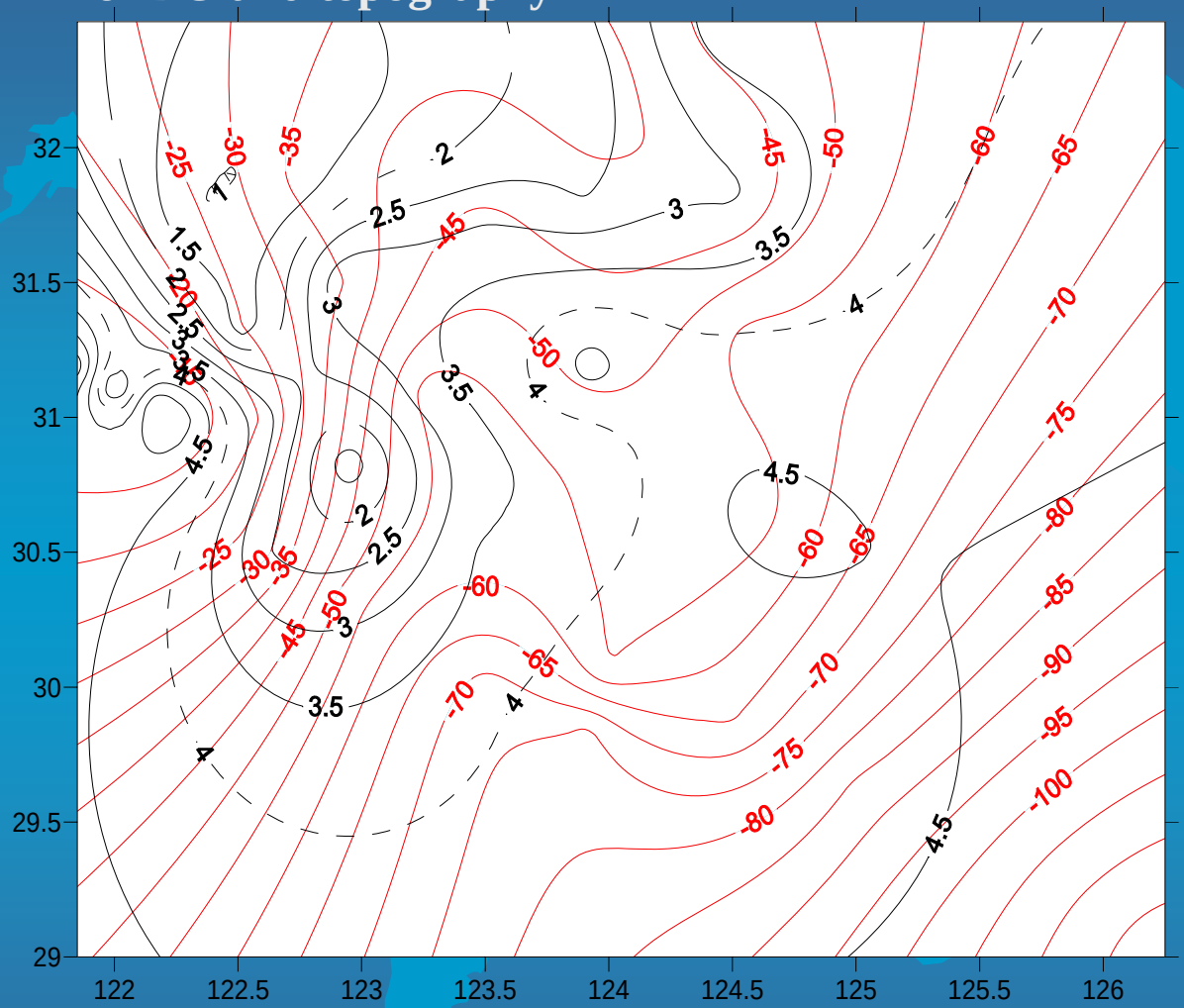
Dissolved Oxygen(mg/L) of bottom layer in Sept. 2003

DO of Bottom layer

Yellow line refers to 2mg/l

DO

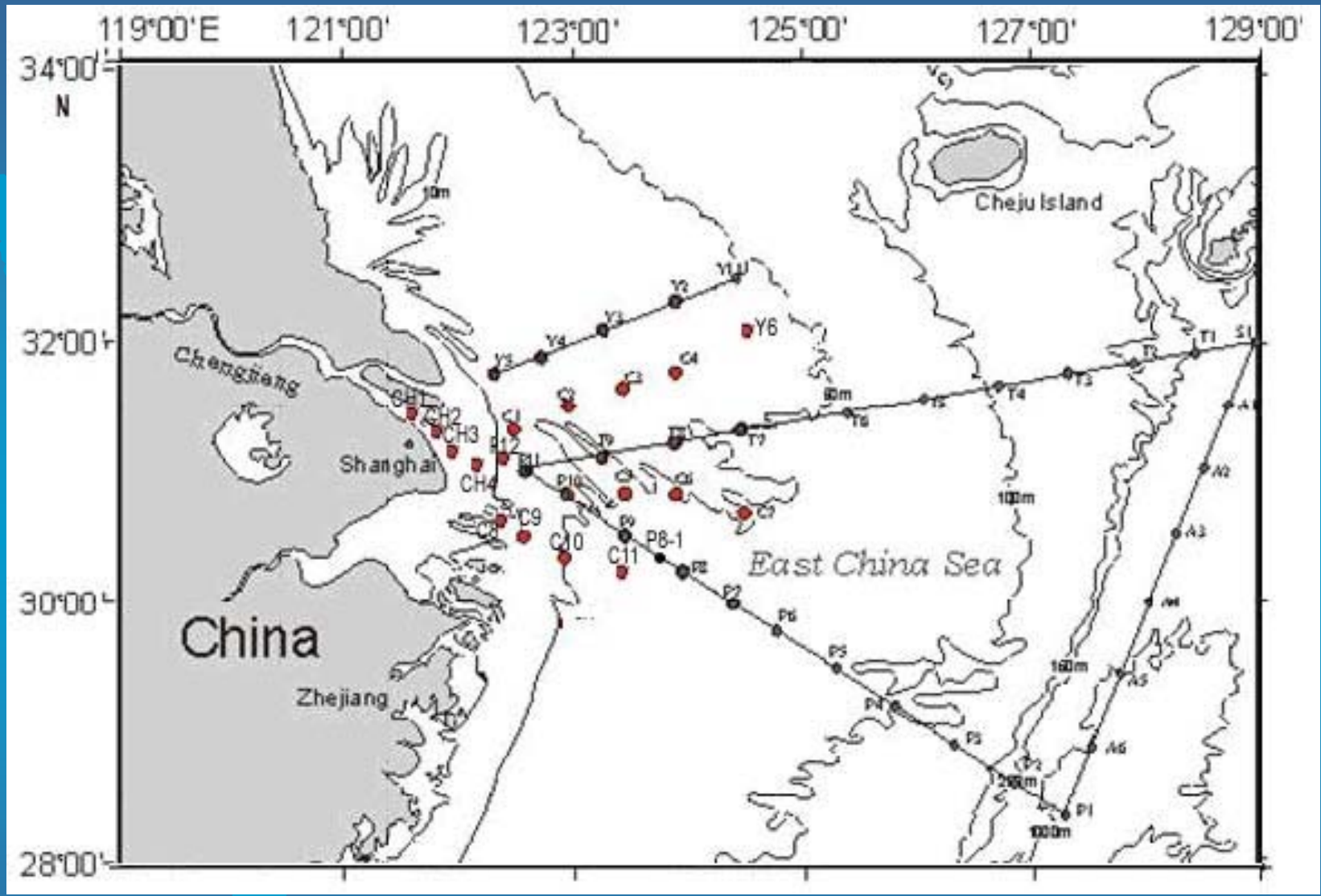
Relationship between horizontal distribution of DO and topography



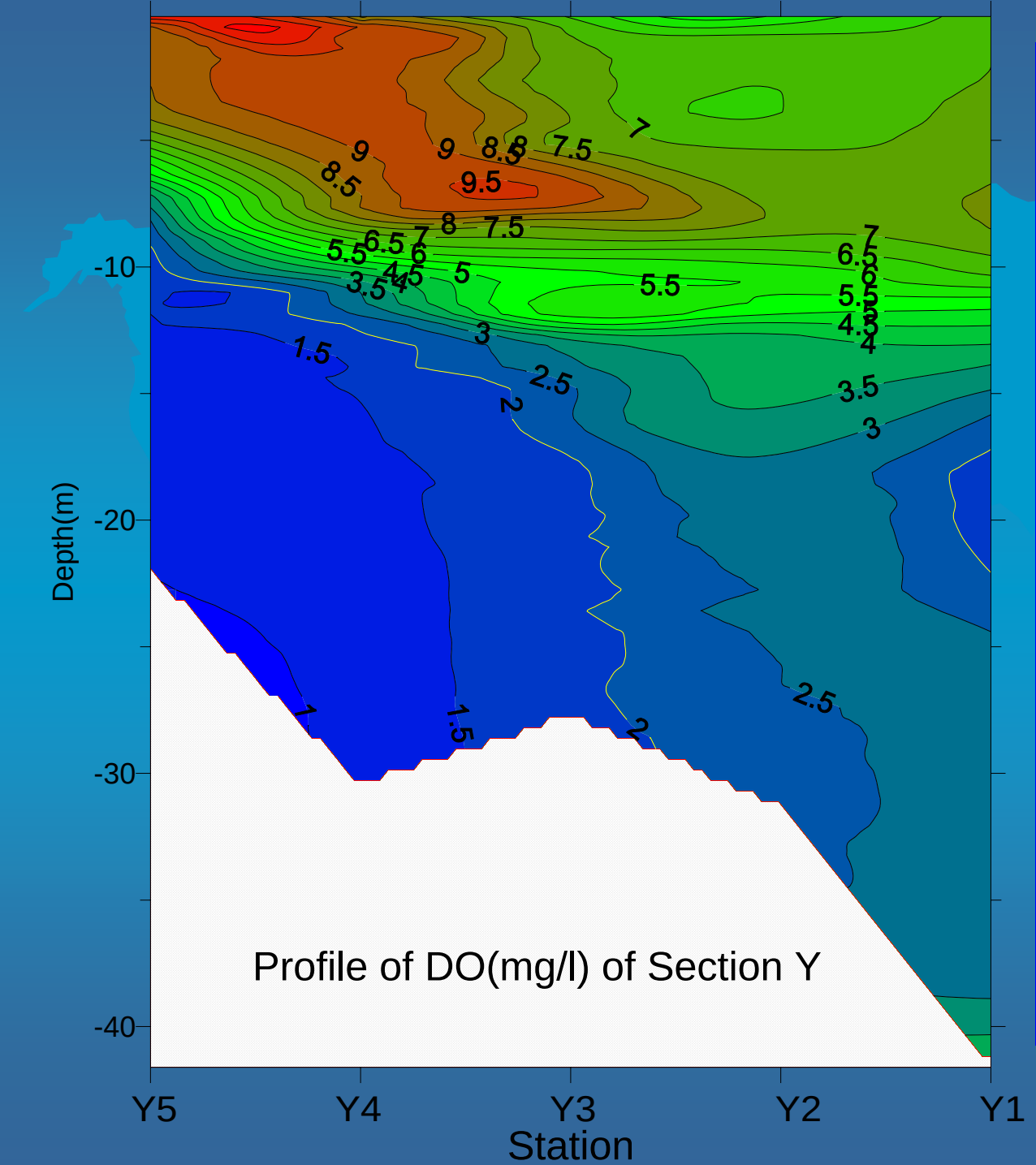
Trend of hypoxic zone has a good relationship to the 50m isobaths.

Red line represents isobaths

Black line represents isoline of DO



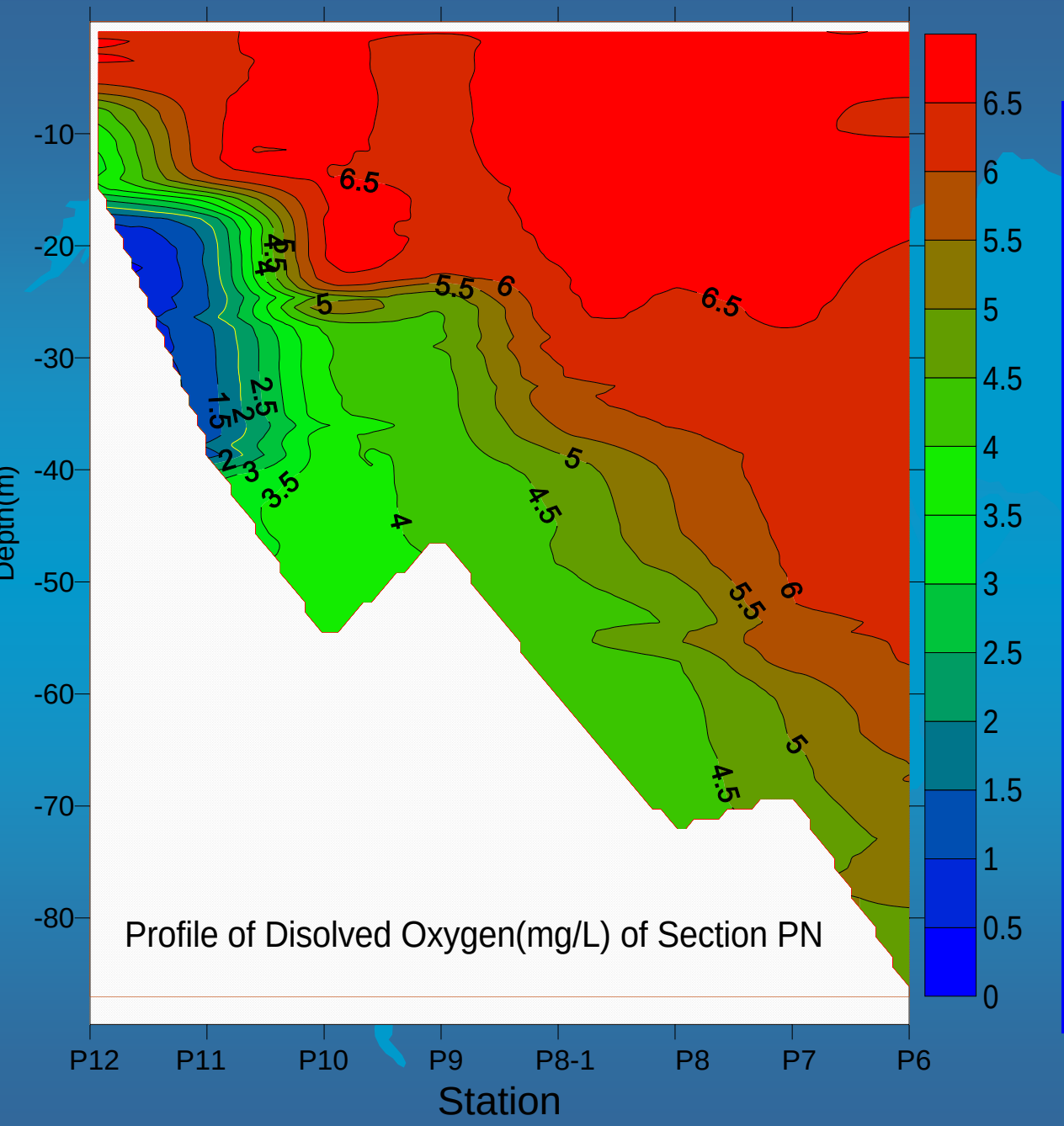
Vertical distribution of DO was mainly analyzed on section Y and section PN



DO on northern section Y:

Hypoxic zone exists under 10m depth and the area is larger.

DO (mg/l)

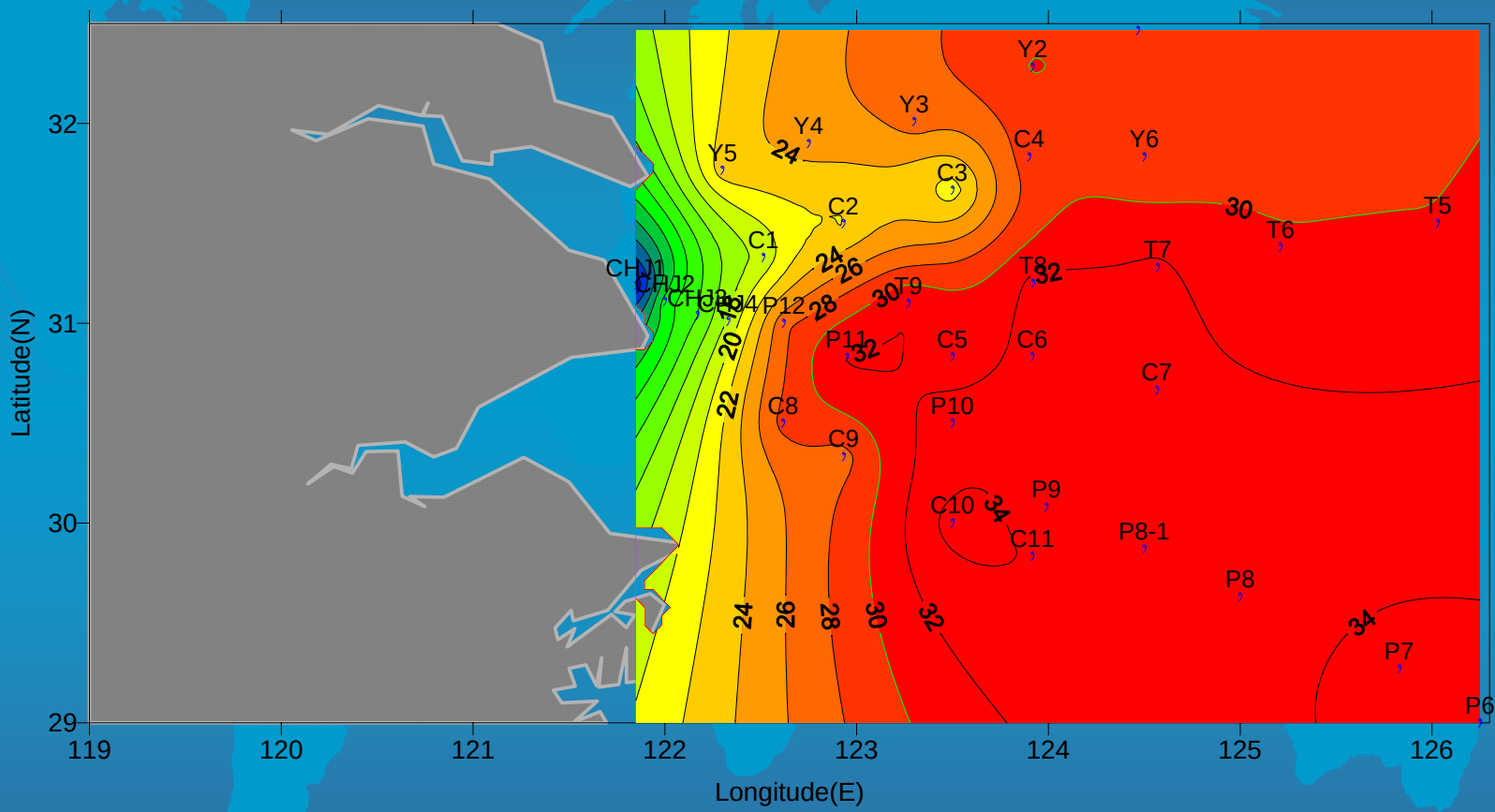


DO on southern section PN:

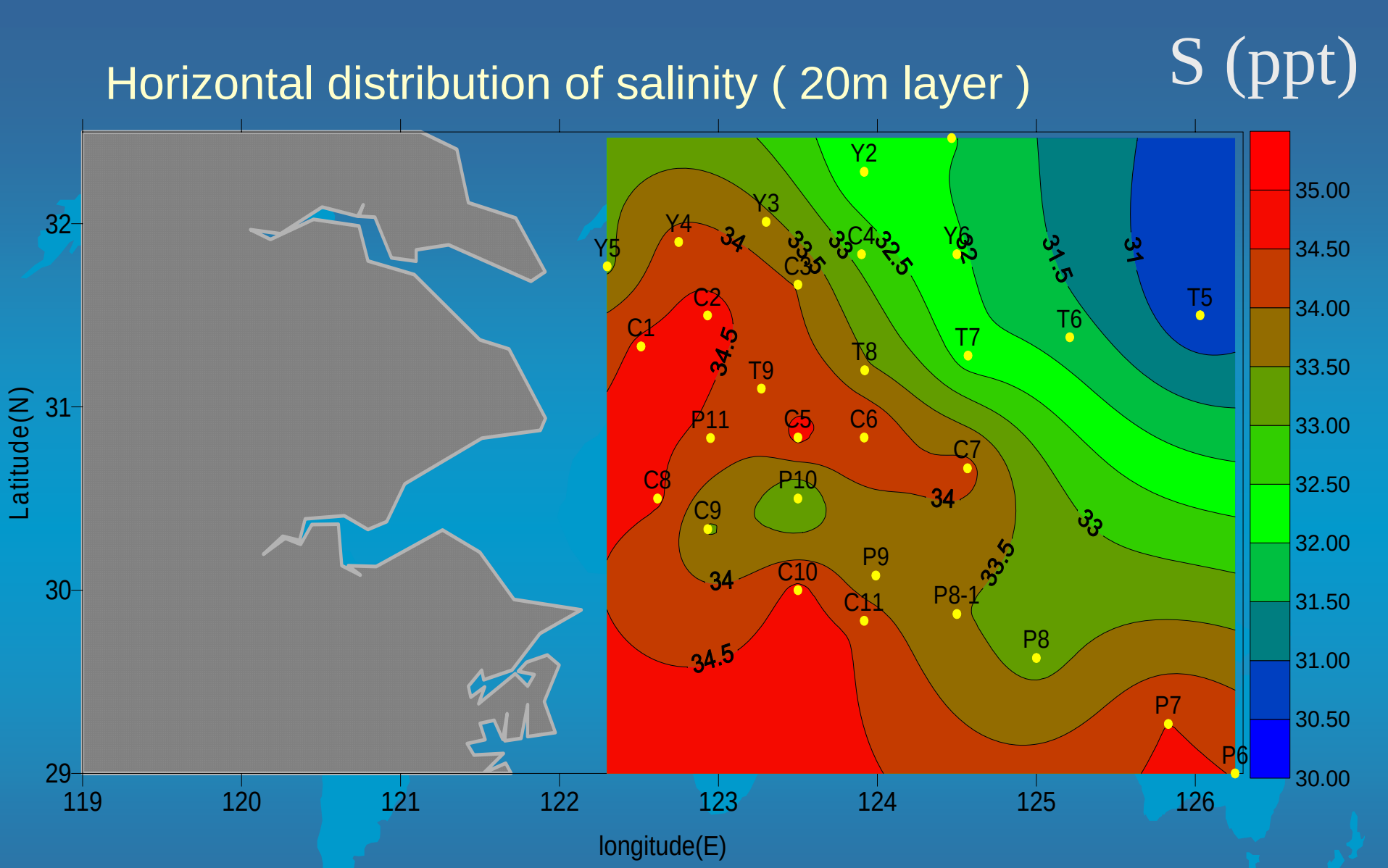
Hypoxic zone is at the depth of 18-40m and much smaller.

DO (mg/l)

Horizontal distribution of salinity (Surface layer)

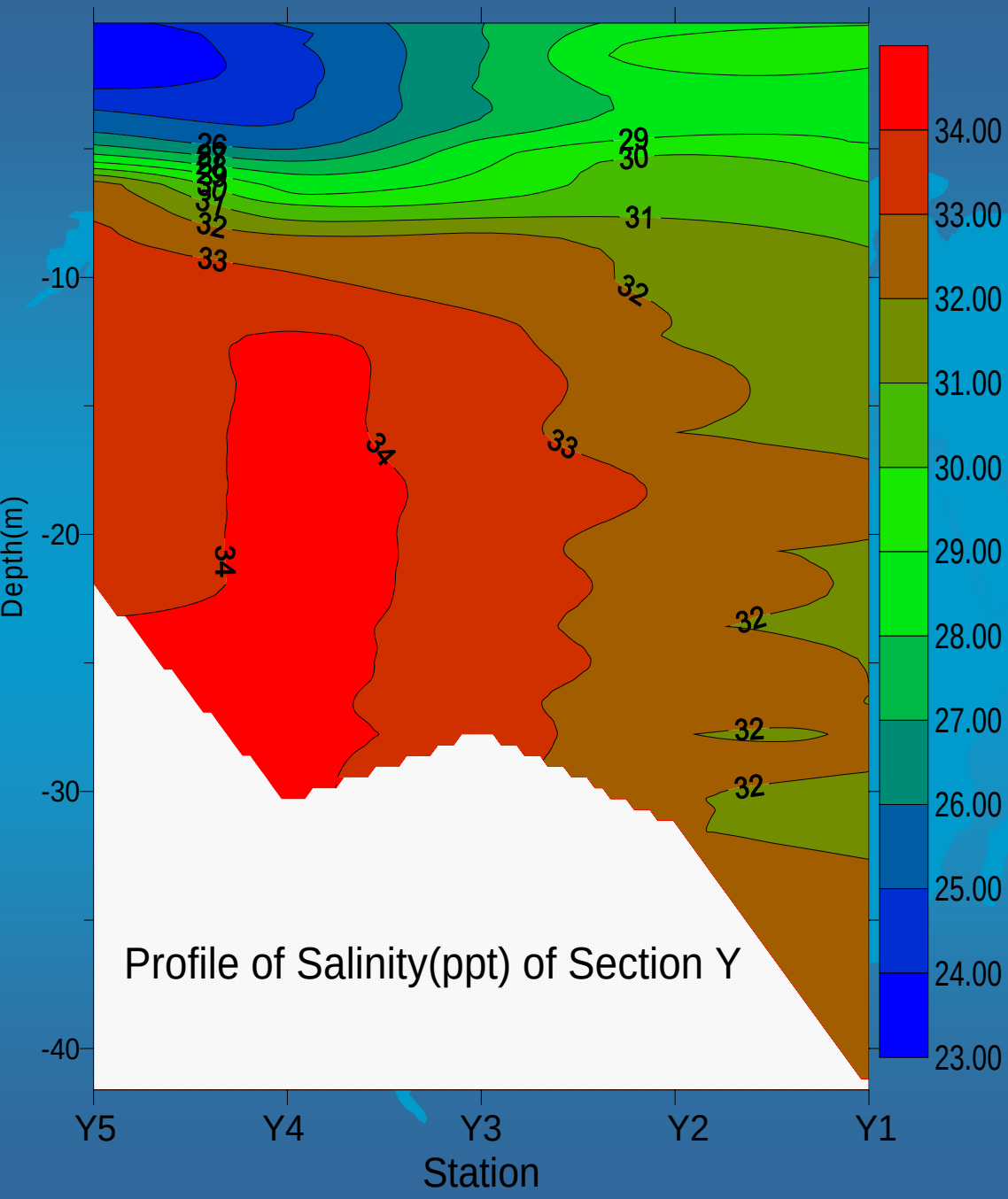


Surface salinity shows that Changjiang diluted water (CDW) plume points to ENE.



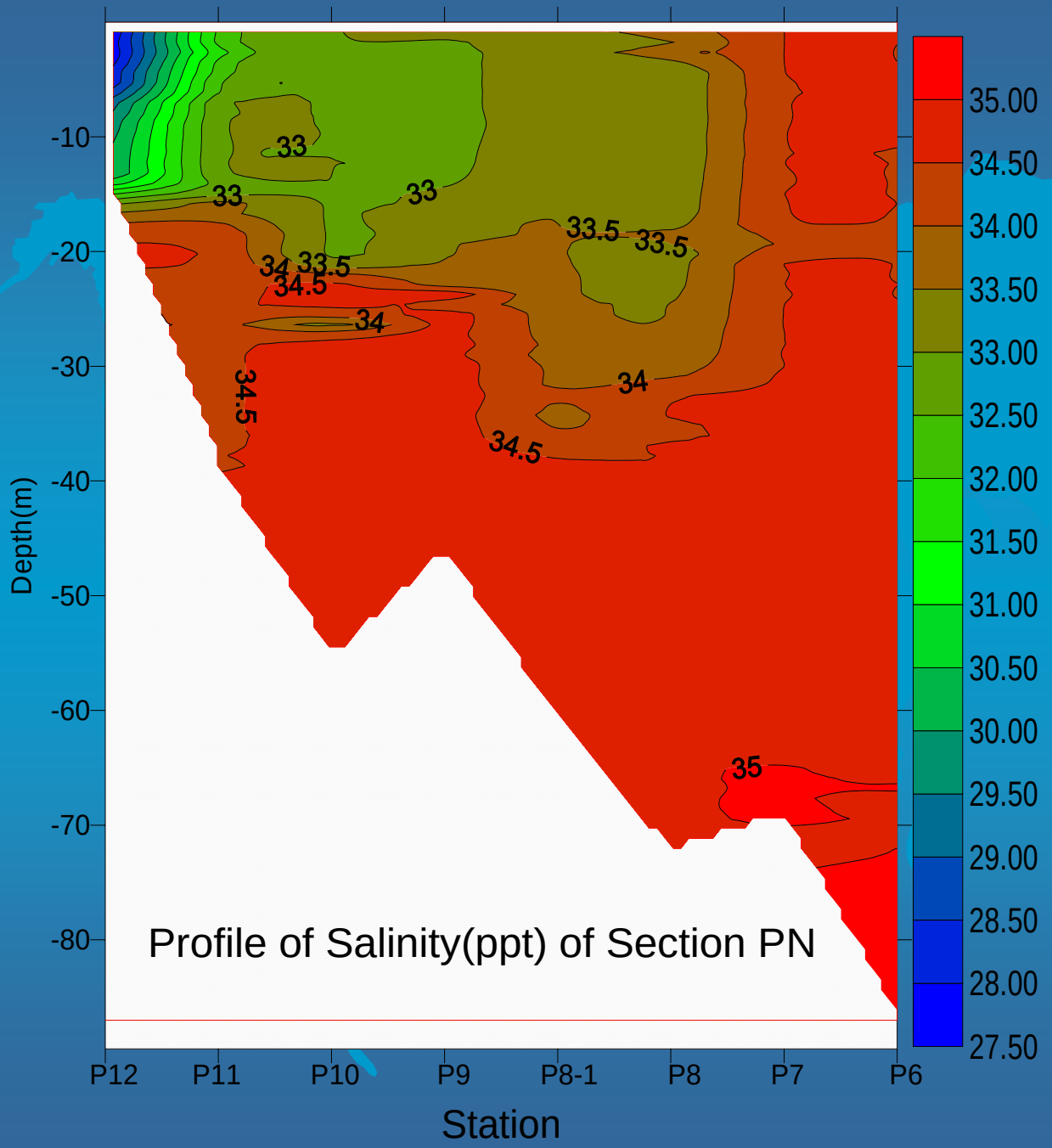
Salinity(ppt) of 20m layer in Sept. 2003

S(ppt) of 20m layer



Northern Section Y:

high salinity water at stations Y3 to Y5.

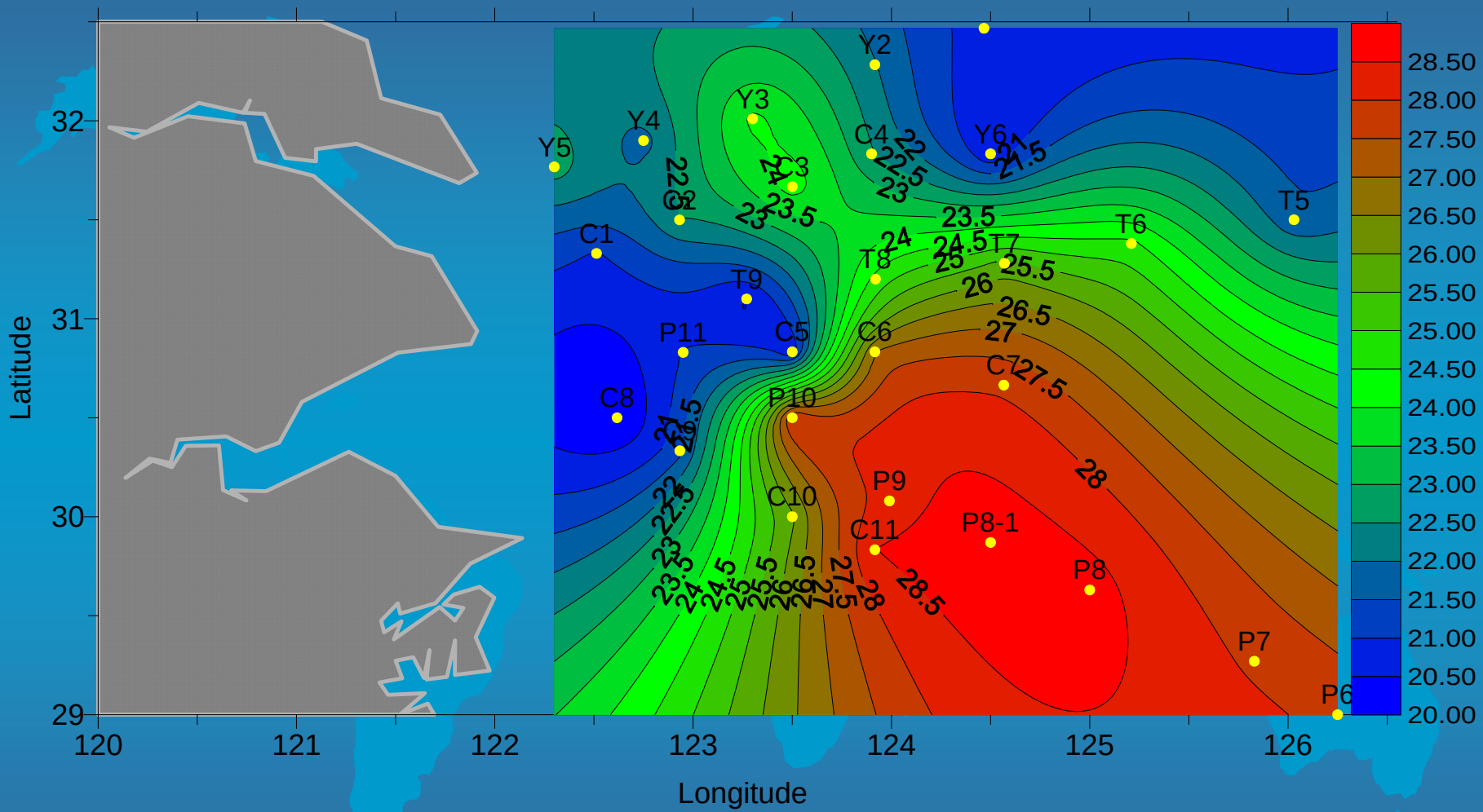


Southern Section PN:

Less influence in the south as CDW turns northeast when run out of mouth

Horizontal distribution of sea temperature (20m layer)

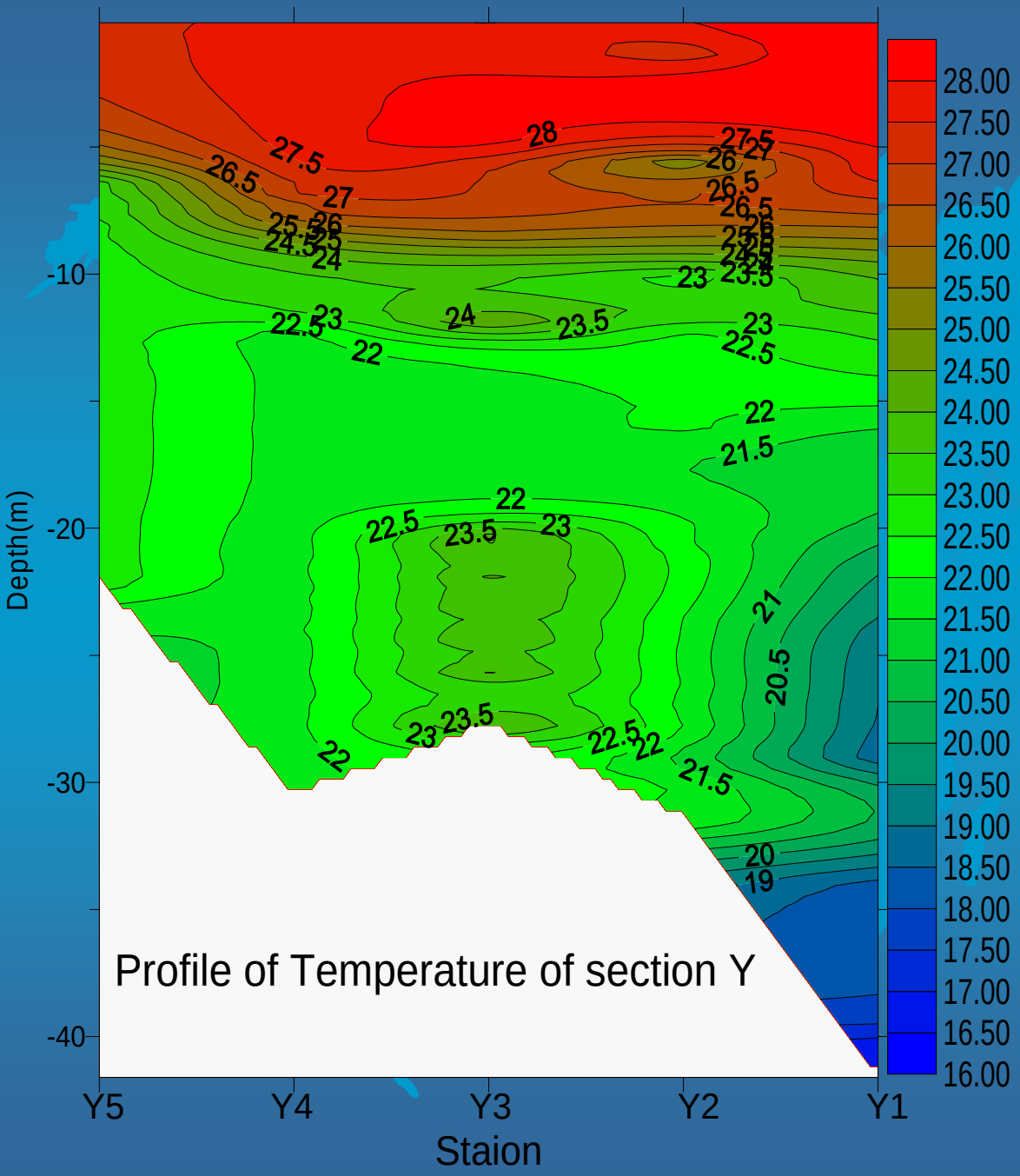
T ( )



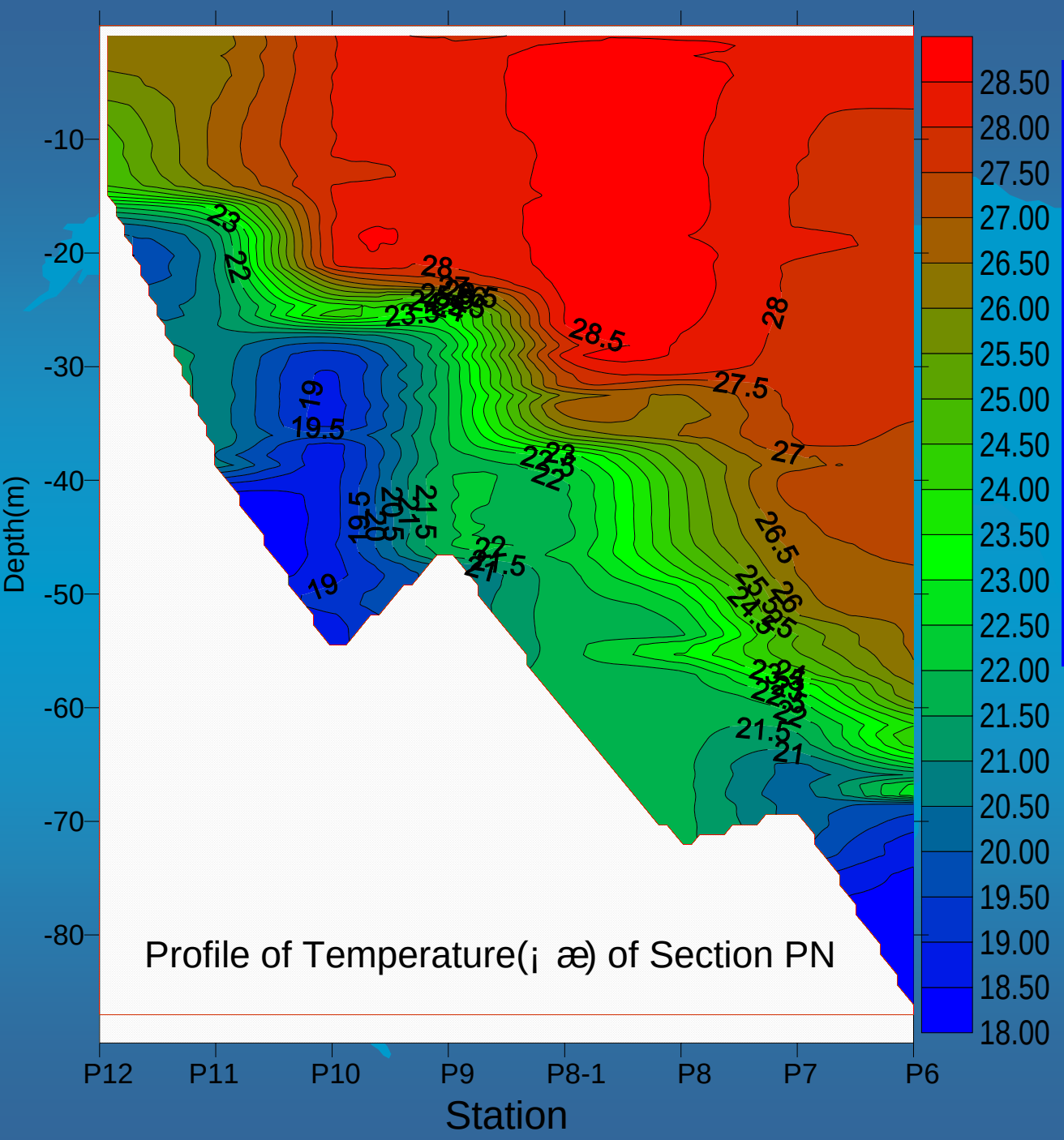
Temperature of 20m layer

T of 20m layer

T( )



Temperature on northern section Y : thermocline at the depth of 5-10m with 4m thickness; a warmer core at depth larger than 25m of station Y3 which was taken as the leading edge of TWC.



Temperature on southern section PN:

Step like thermal stratification;

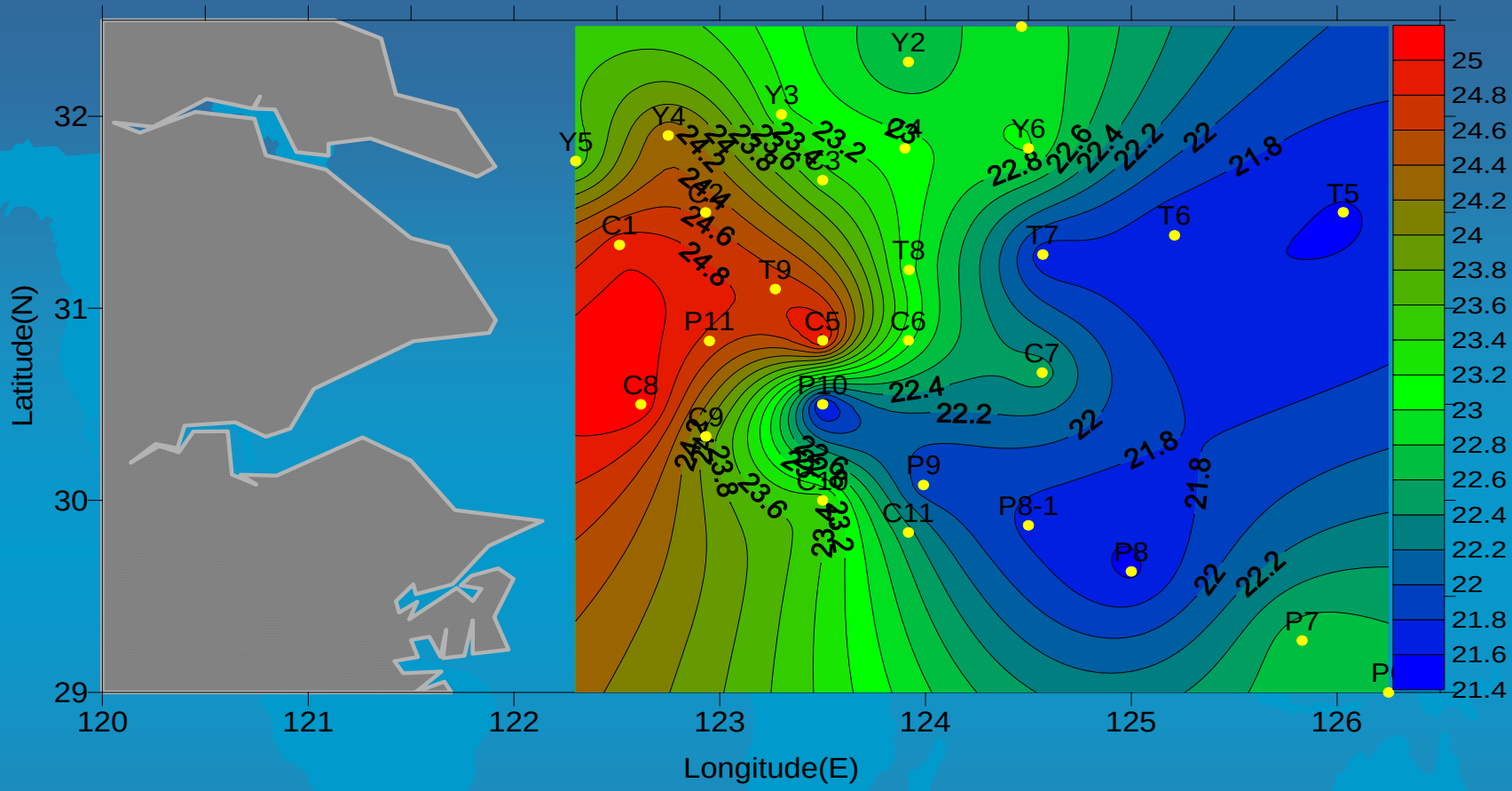
surface thermal front at P11-P10 station ;

Cold water at P11-P10 deeper than 30m

T ( )

Lower DO is not the character of a water mass!

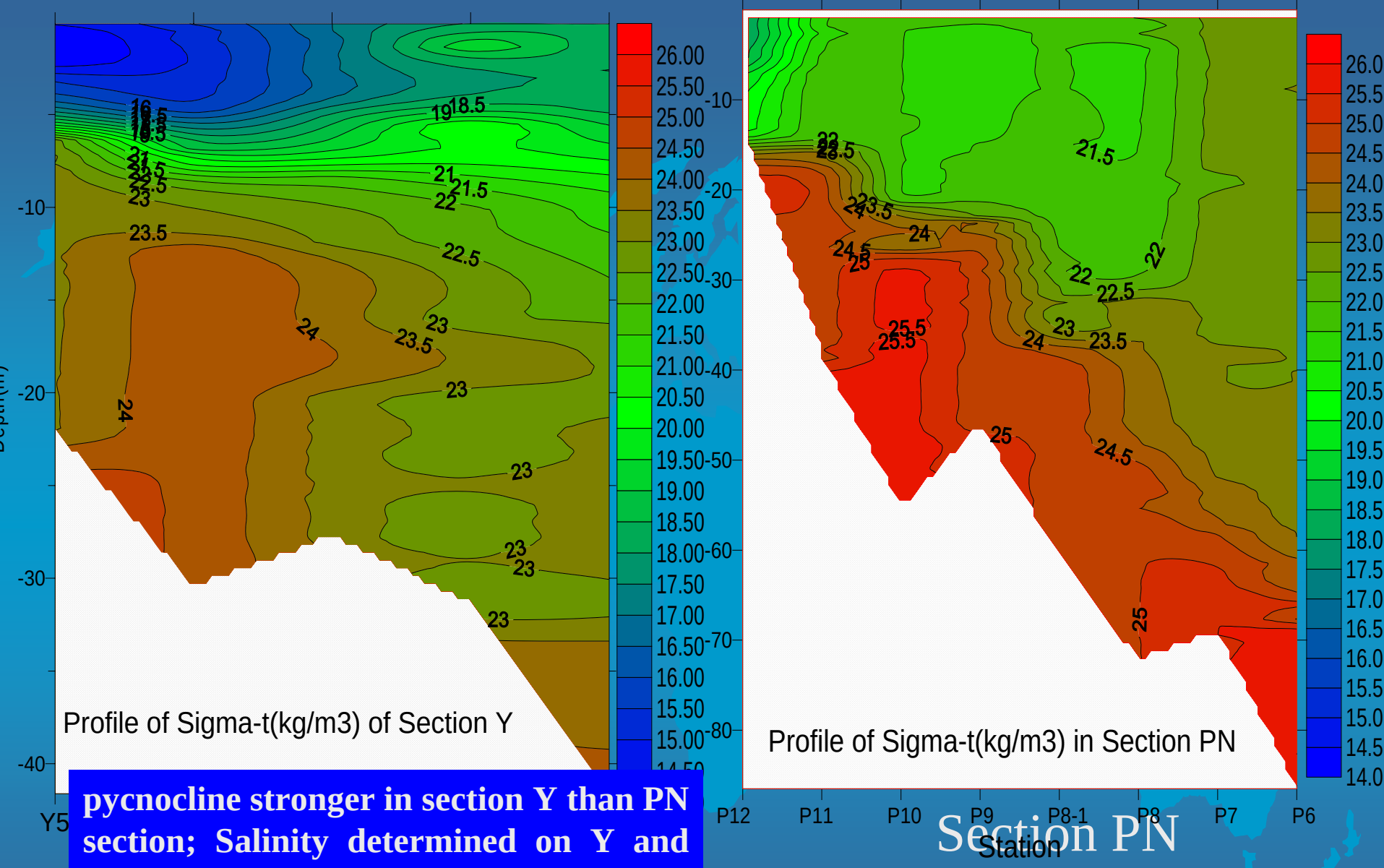
Density distribution



Density(kg/m3) of 20m layer

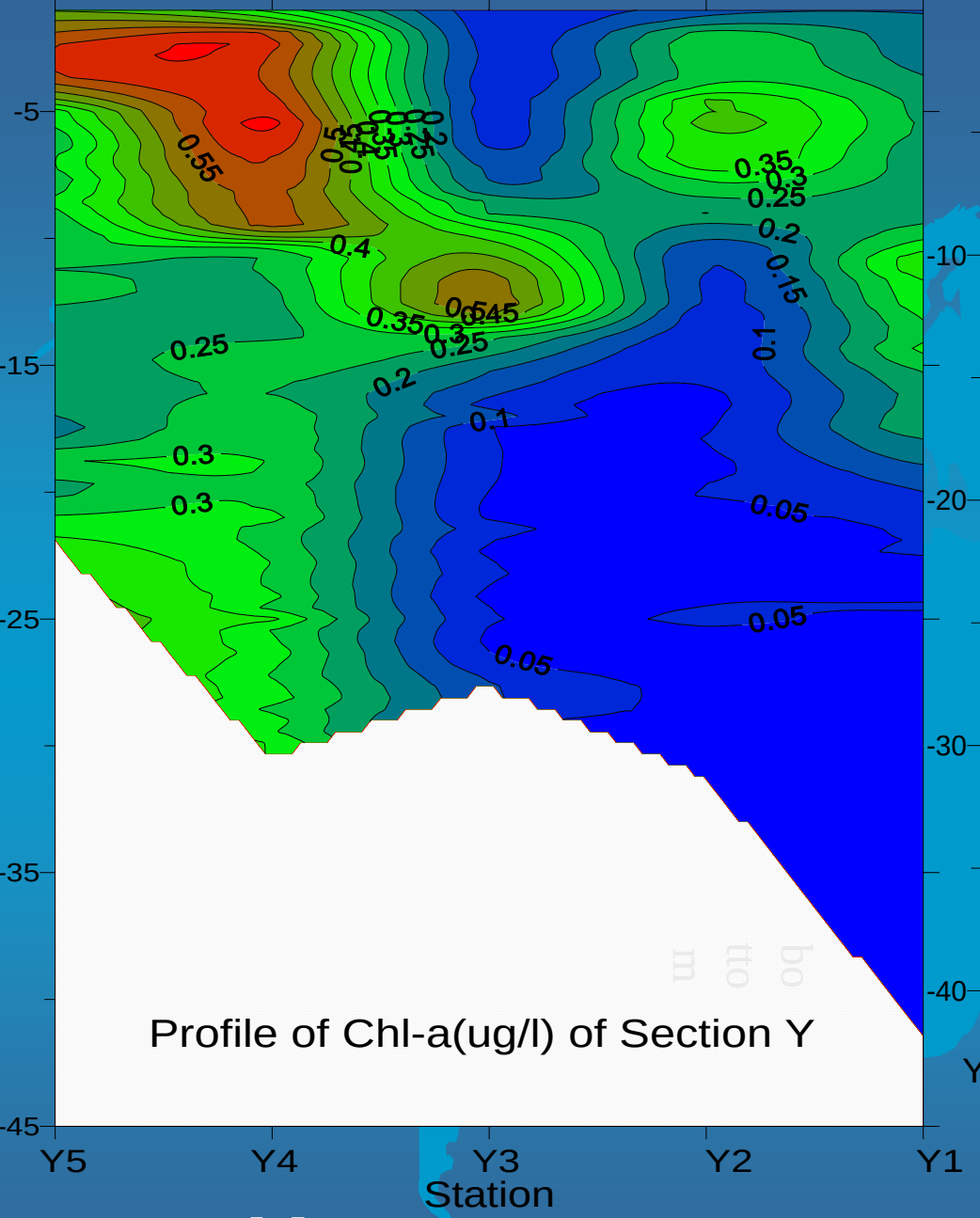
SIGMT at the depth of 20m layer

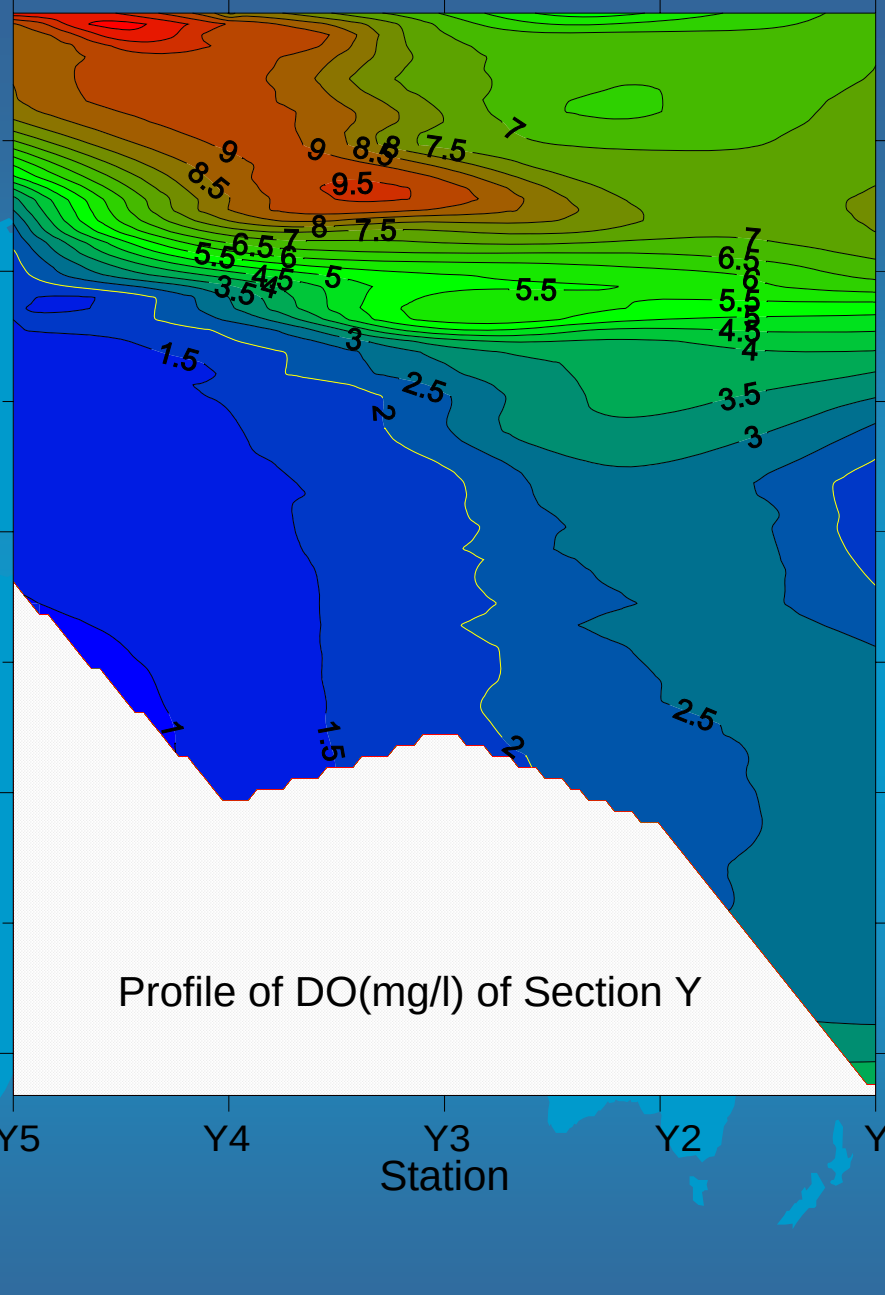
Dense water at inner side



pycnocline stronger in section Y than PN section; Salinity determined on Y and temperature determined on PN

Hypoxia consistent with stronger density stratification.



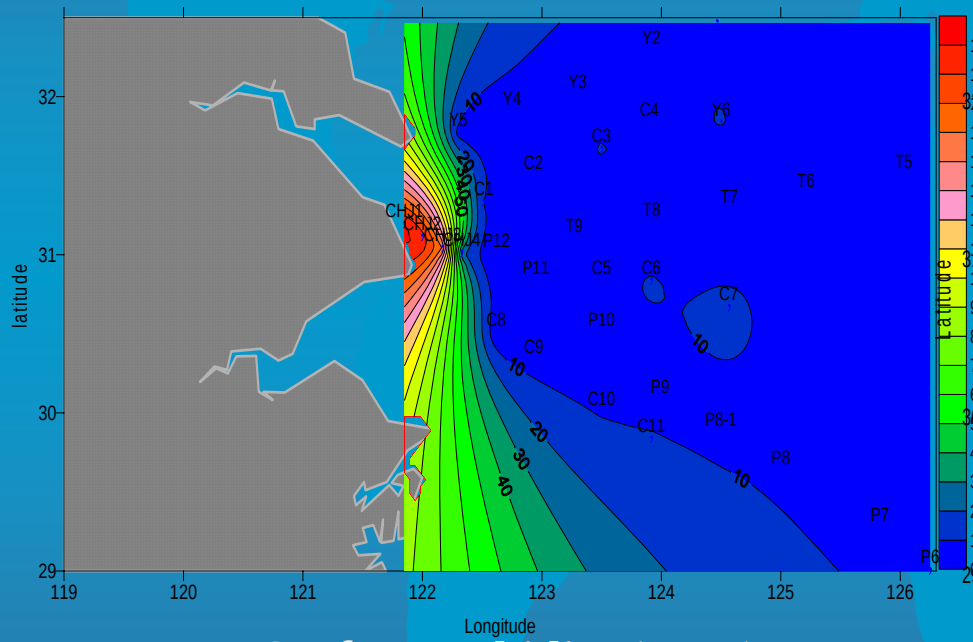


Chl-a concentration vs. Hypoxic zone

Bottom hypoxic zone was the same as high bottom Chl-a distribution.

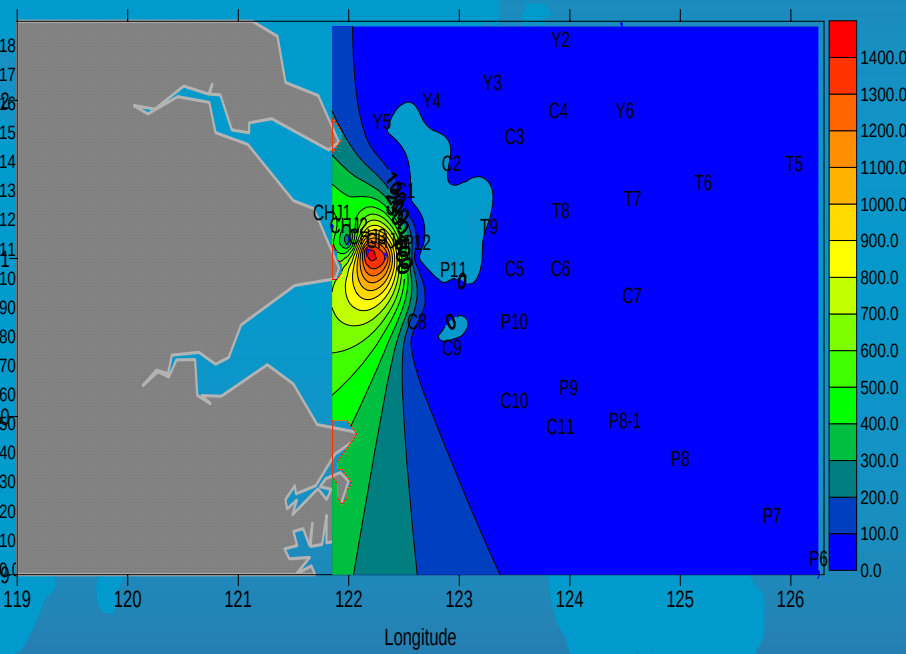
We speculated that bottom algae rather than the surface bloom should be the source of the particulate organisms that consume the dissolved oxygen when then decay.

Particulate materials from Changjiang River



Surface turbidity (NTU)

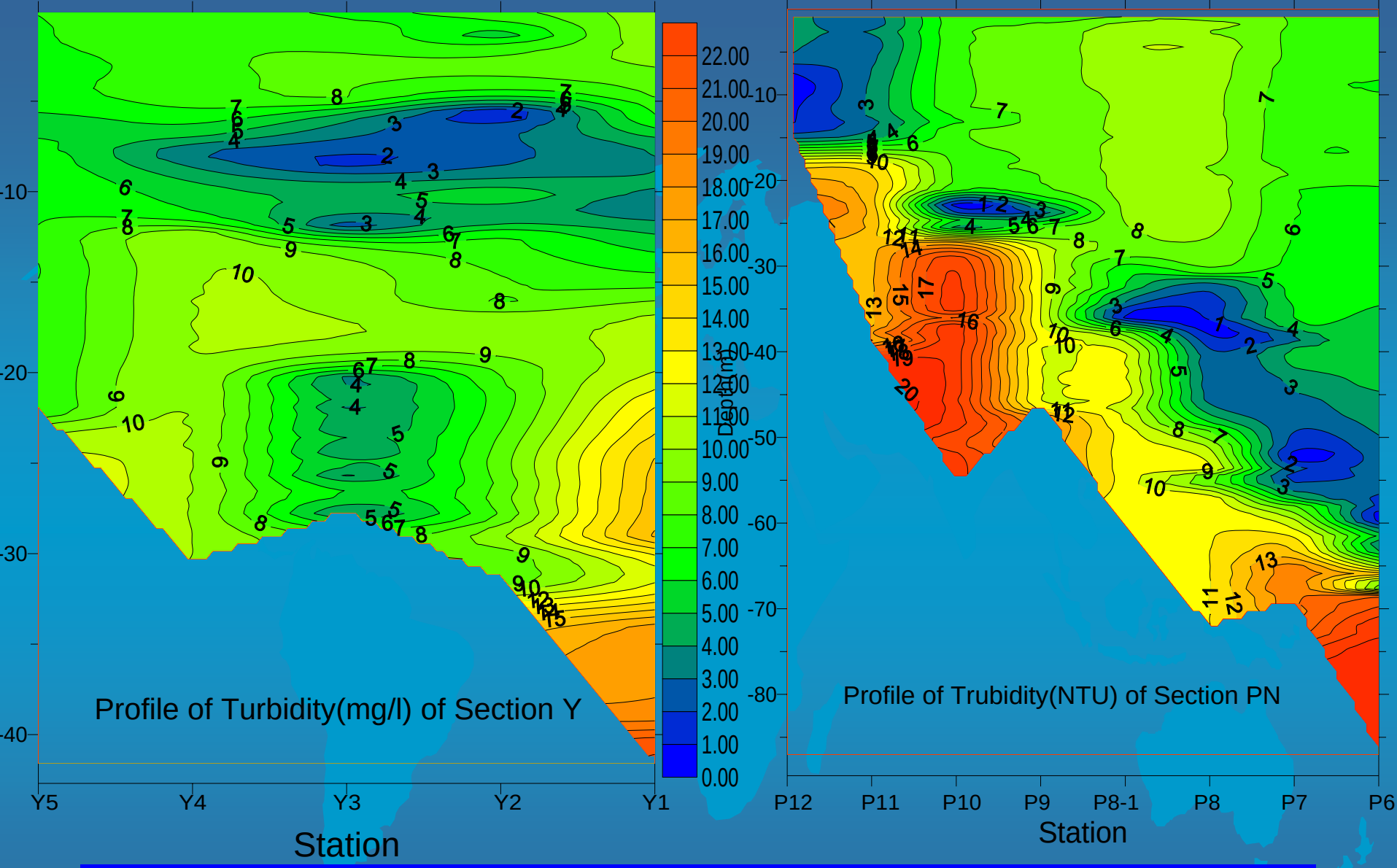
Max.~180



Bottom turbidity (NTU)

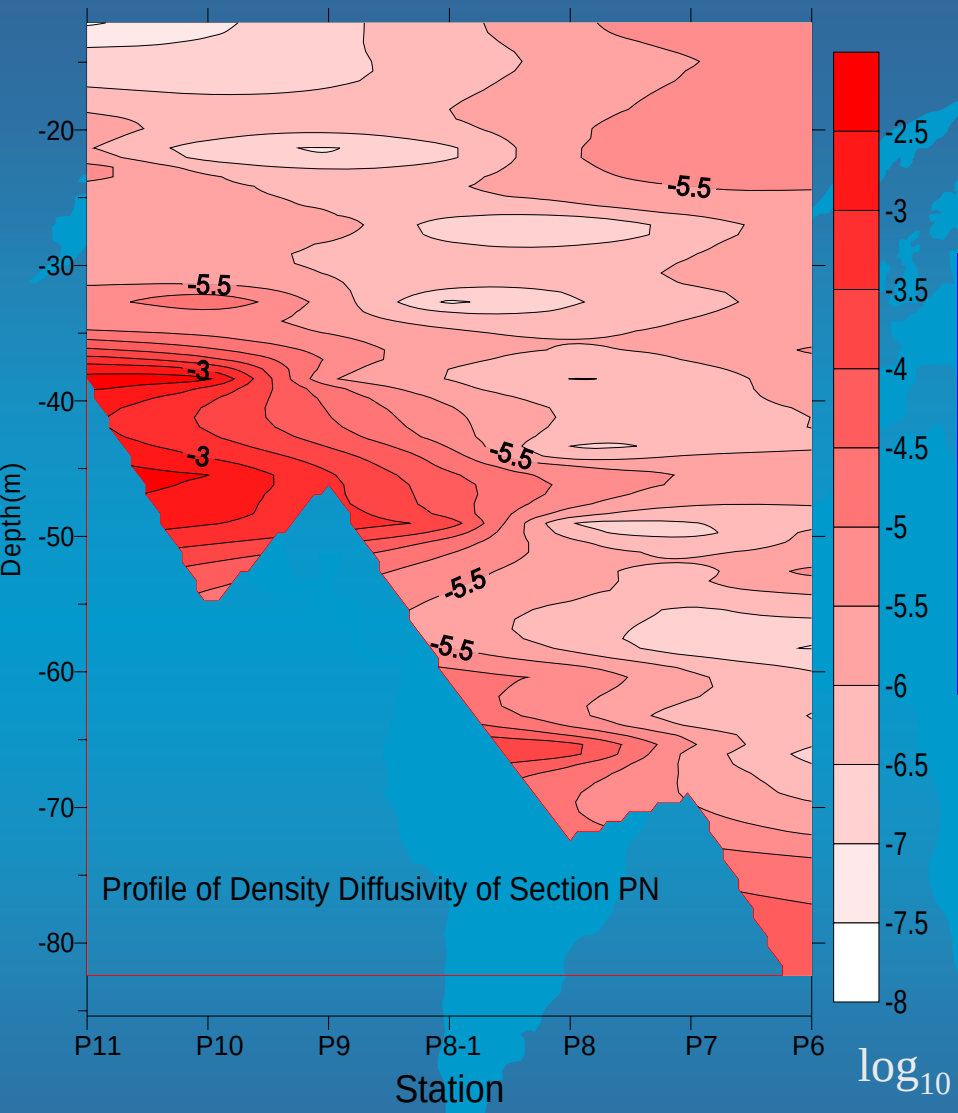
Max.~1400

Most SPM from Changjiang sediment inside turbidity front



DO vs. Particulate materials

Min. of Turb in pycnocline → POC doesn't deposit locally



Source of POC:

settled from upper layer, horizontal transport, vertical mixing, resuspension relate to sediment type

Mixing

Remarks:

- **DO vs. water mass**

  lower DO is not the character of a water mass

- **DO vs. density stratification**

  strong density stratification maintains the hypoxia zone in the open area;

  plume at upper layer and salty water at lower layer make the high density difference; hypoxia area determined by extension of plume and salty water;

- **DO vs. phytoplankton biomass**

  not directly?

- **DO vs. POC**

  not locally?

5 Perspective

- Worth to further research

representative for wide shelf with strong tide under monsoon and influenced by west boundary current; more complicate

- Not take as one box, more research will be given in quantificational way. Mixing?
- Community structure change? Organism adequate? Is it harm?
- What's the main reason? Could be the hypoxia volume decreased? How?


Thanks for your attention !