2nd International Workshop on Modeling the Ocean (IWMO-2010)

Simulation of the Circulation in the Malaysian Peninsula East Continental Shelf

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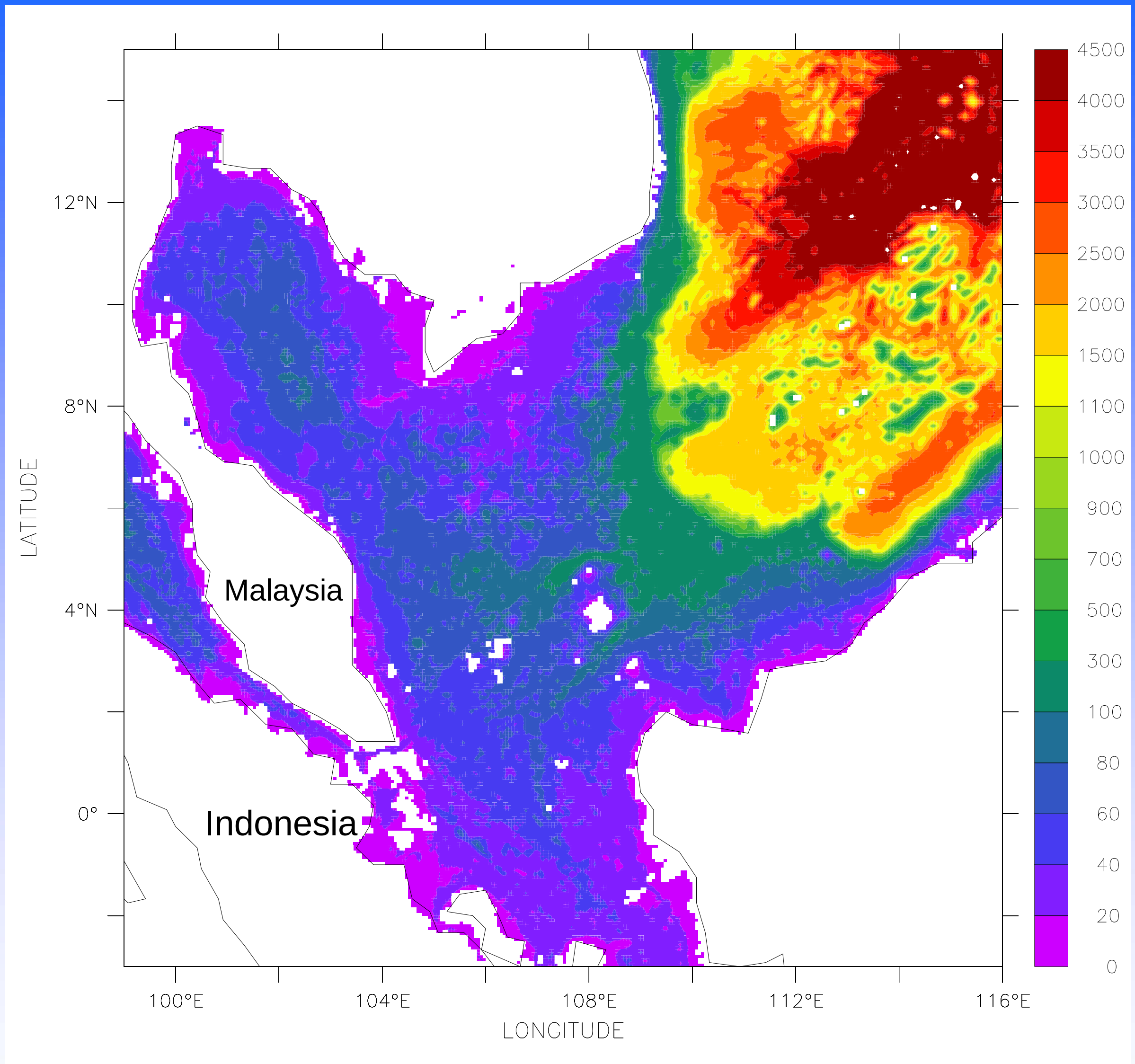
Contents

Introduction

- Malaysian Peninsula East Continental Shelf (MPECS) is in the Southern part of the South China Sea (SCS). Water depth ranges from 0-100m. The forcing factors include wind, heat flux and tide et al.
- Previous works mainly focus on the whole SCS. The study detail circulation structure in the MPECS is needed.
- A Wave-tide-circulation coupled model based on POM with fine horizontal resolution (6Km*6Km) is established to study the seasonal variation of the circulation in the MPECS region.



Model topography

- The model domain is 3° S-15° N, 99° E-116° E,
- Horizontal resolution 1/18° ×1/18° (6Km)
- 51 vertical sigma layers

The model is driven by monthly climatological (COADS) wind stresses and heat fluxes

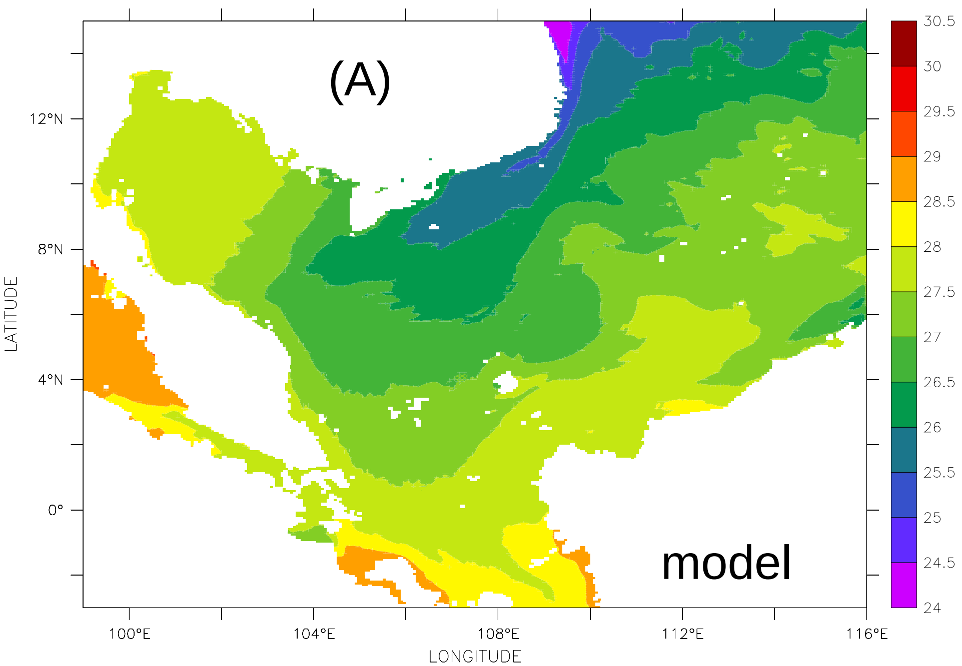
The initial temperature and salinity field are set to the Levitus annually averaged temperature and salinity

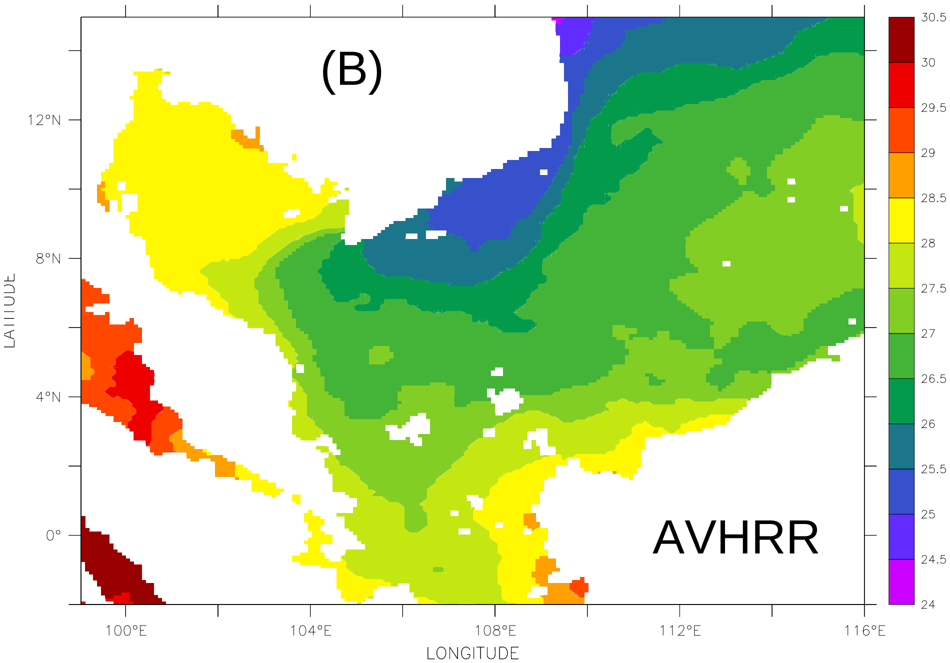
Variables (temperature, salinity, sea level and velocity) along the open lateral boundary are obtained by interpolation of the Indian pacific model $1/6^{\circ} \times 1/6^{\circ}$ model result

The harmonic constants of the tide along the lateral open B.C. is the TPX0.6 from the Oregon State University. 4 component tide M_2 ,S_2,K_1,O_1 are considered

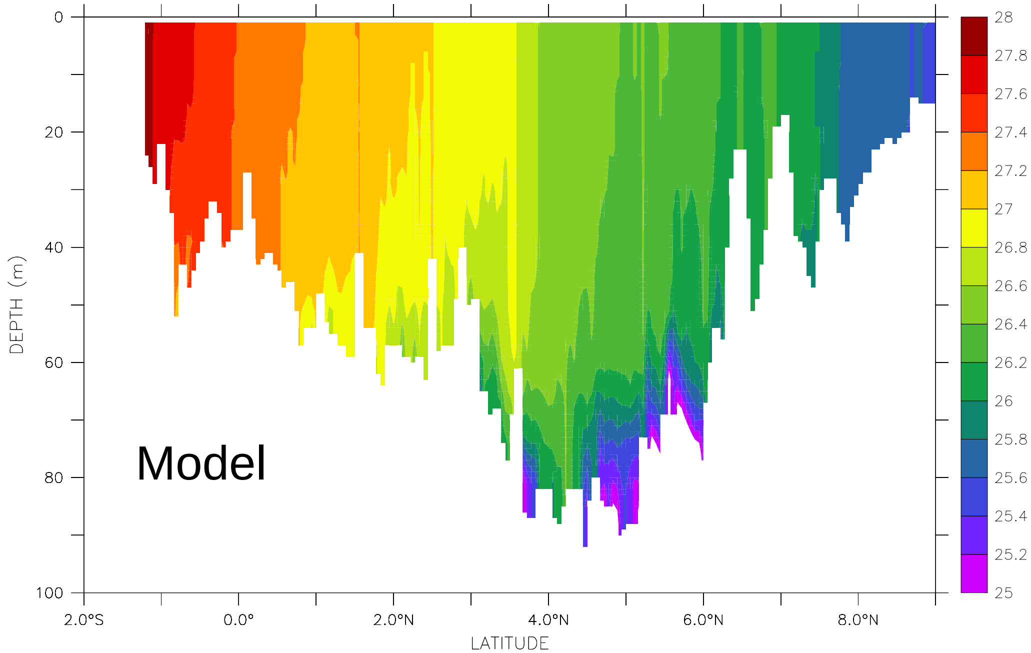
The model is integrated for 20 years and the obtained temperature, salinity and Eulerian residual current fields of last year are used to study the circulation patterns.

Model Validation

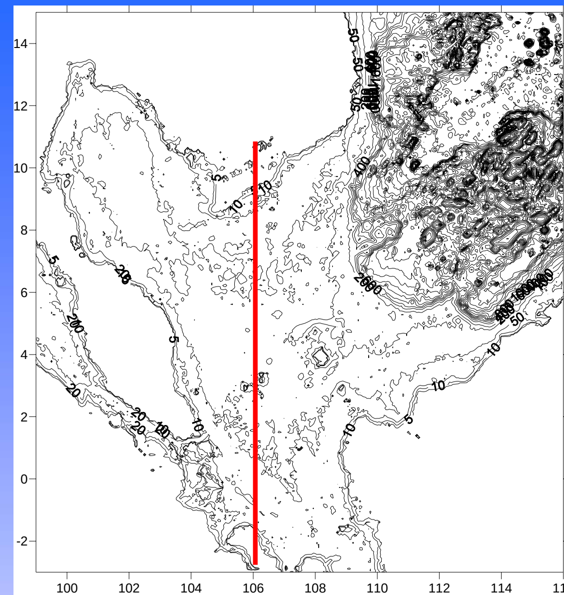




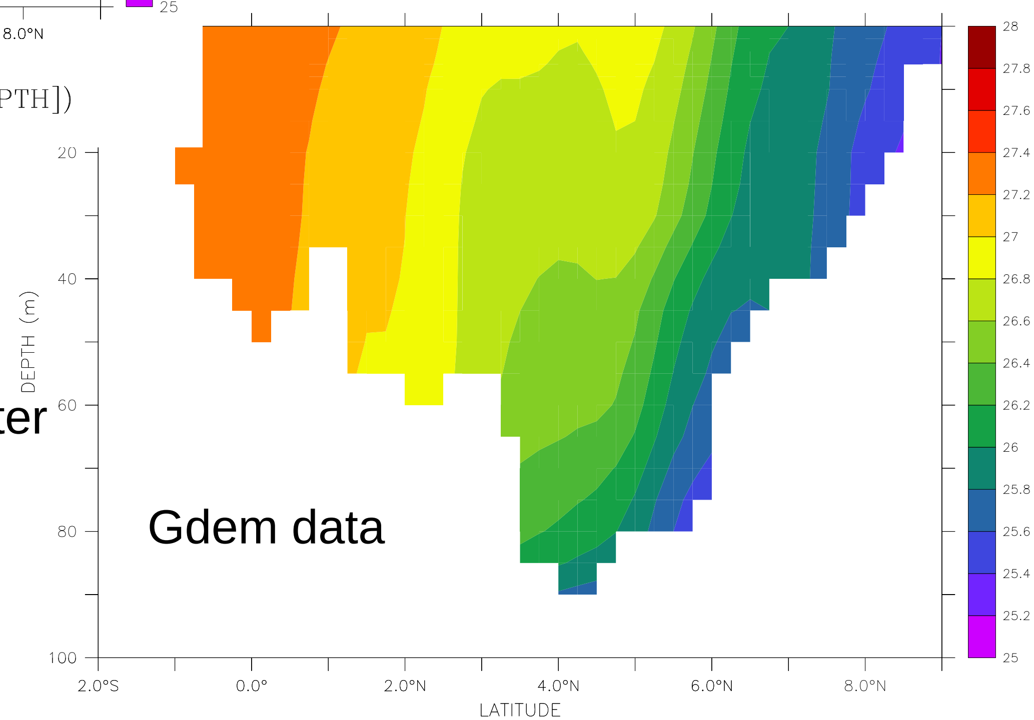
Winter SST (Feb)
(A) Model (B) AVHRR climatology SST



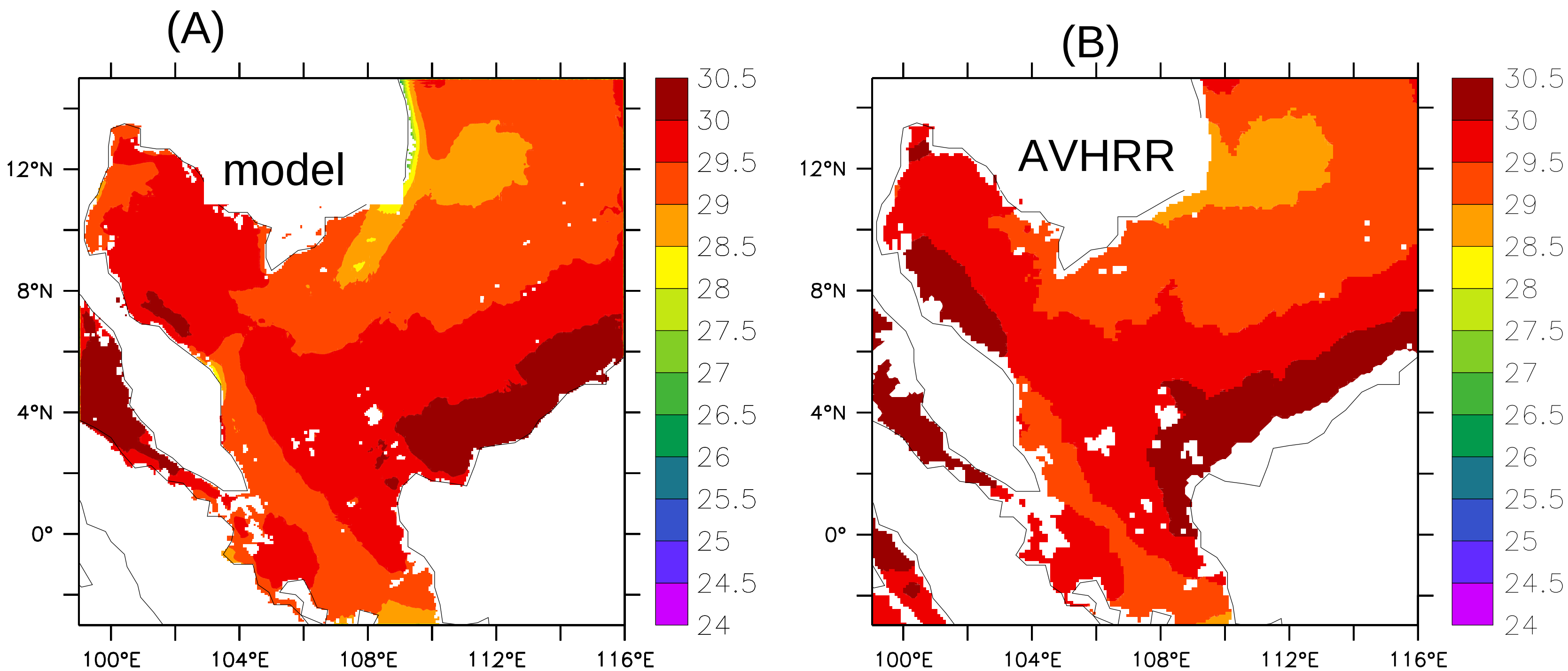
ZAXREPLACE(TEMP[D=080385],H3[D=h3],Z[GZ=ZDEPTH])



Temperature along106E section in winter



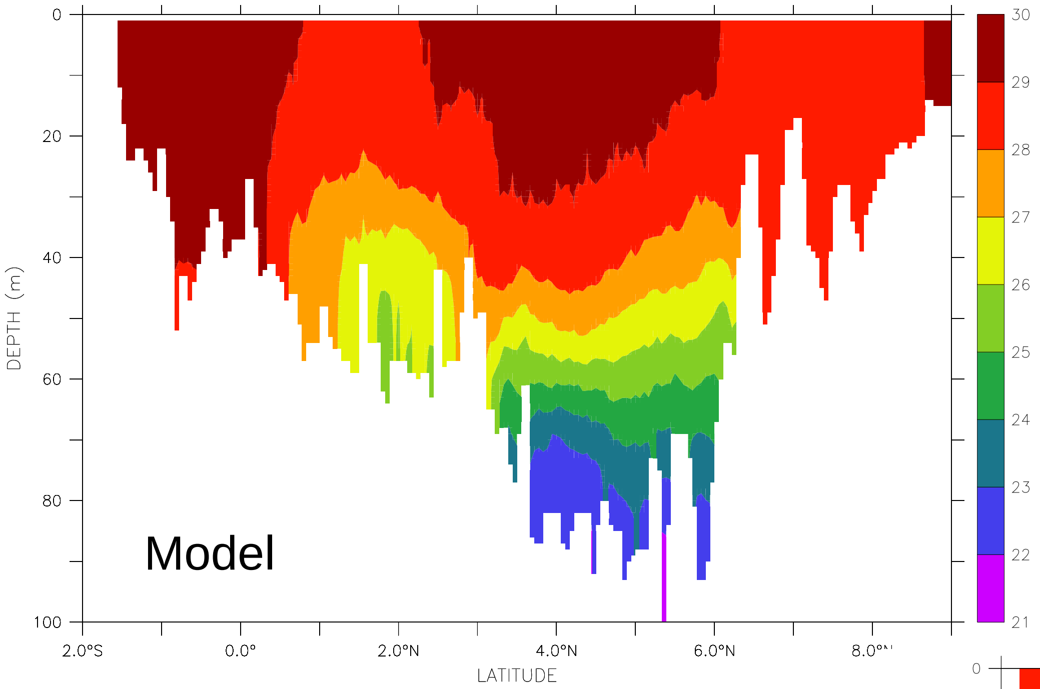
Model Validation

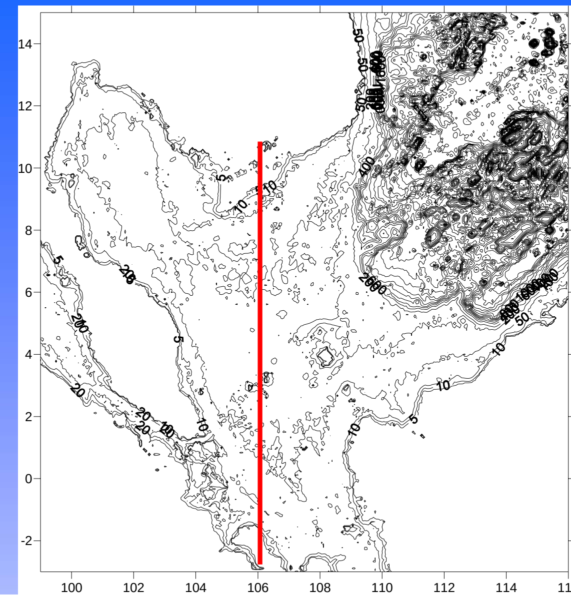


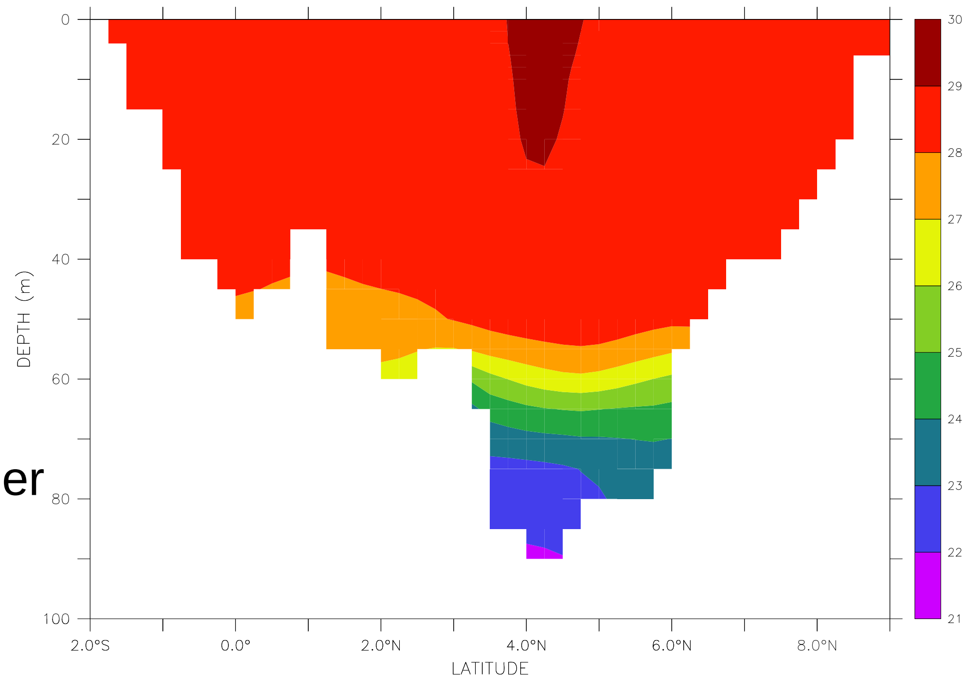
Summer SST (Aug)
(A) Model (B) AVHRR climatology SST

2.The MASNUM wave-tide-circulation coupled numerical model

- The circulation part is based on POM parallelized using MPI method
- The wave part is MASNUM-WAM model
- Add the wave-induced mixing coefficient *Bv* to the vertical mixing coefficient provide by the M-Y scheme in POM
- Tide is considered by adding tidal current on the open boundary





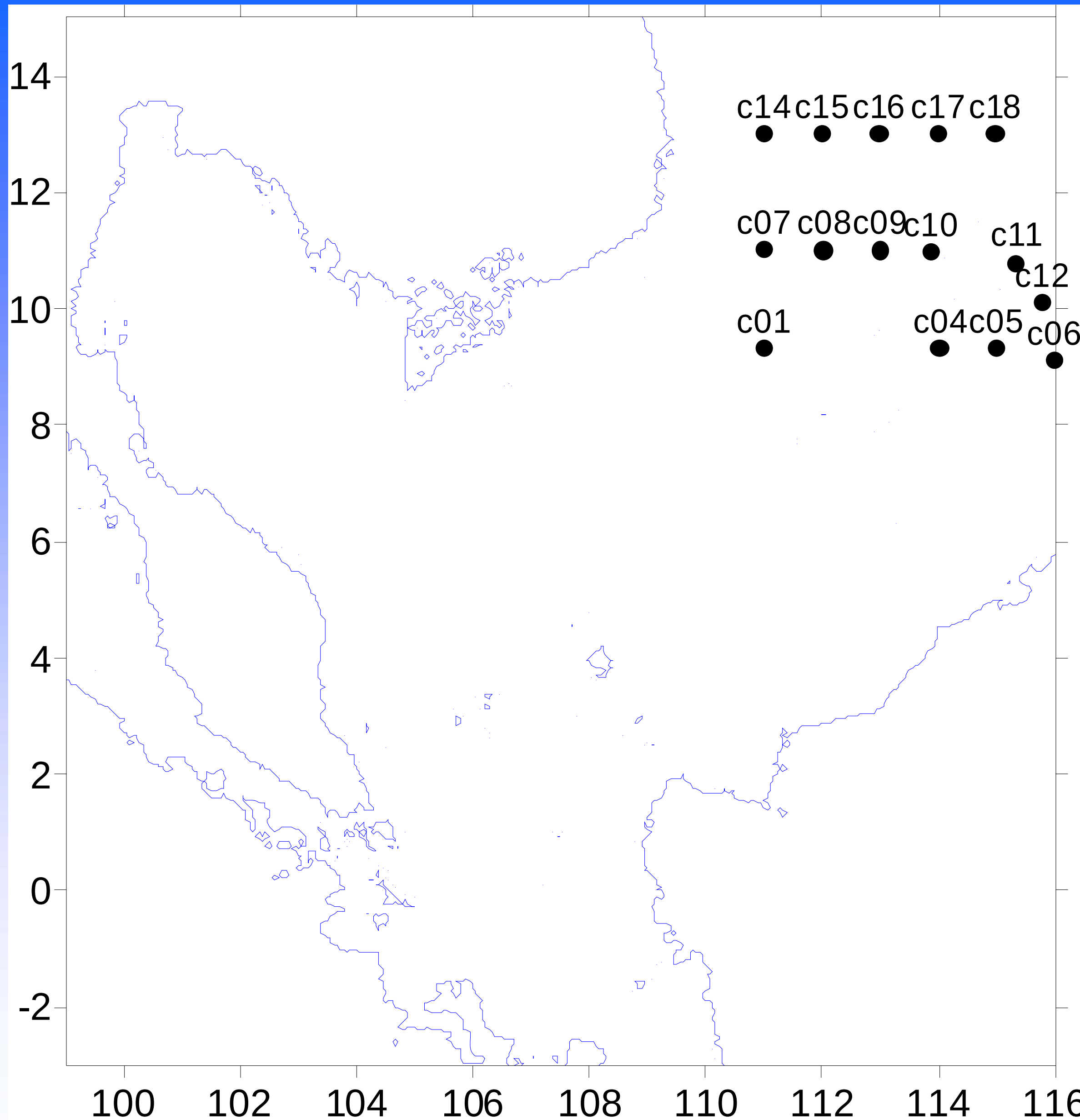


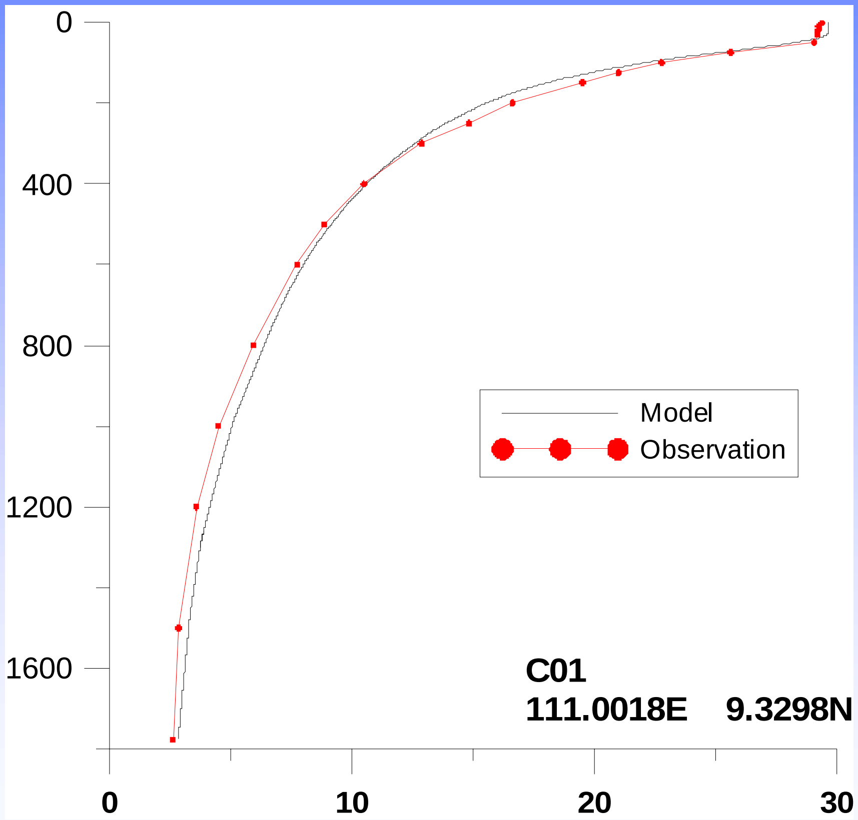
Temperature along106E section in Summer

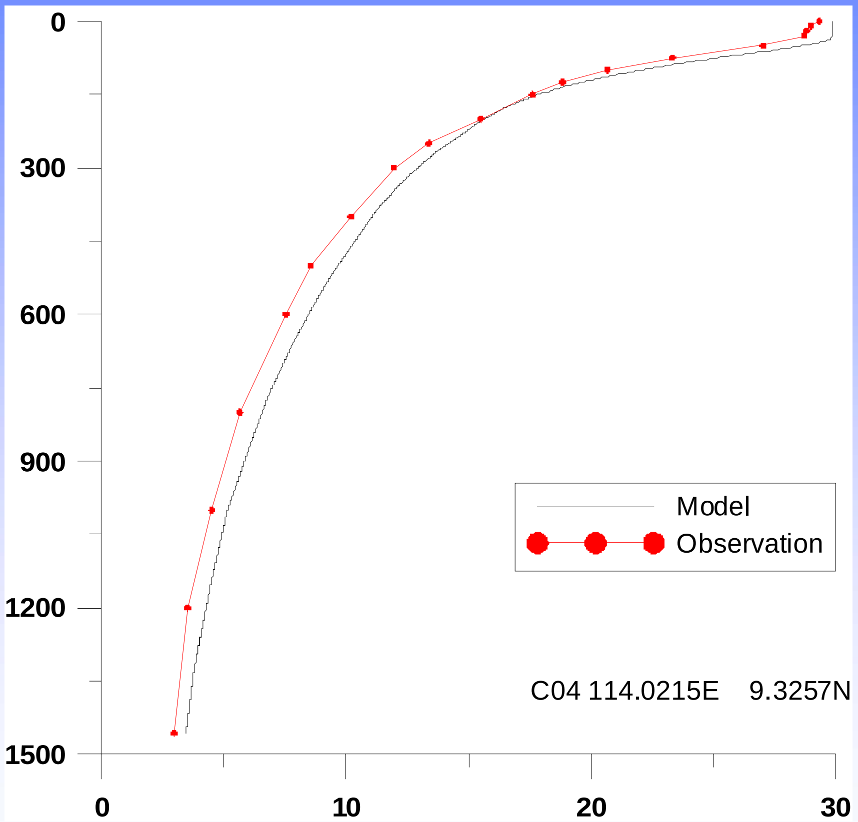
Model Validation

Compared with the Rose Cruise 2009 temperature Observation

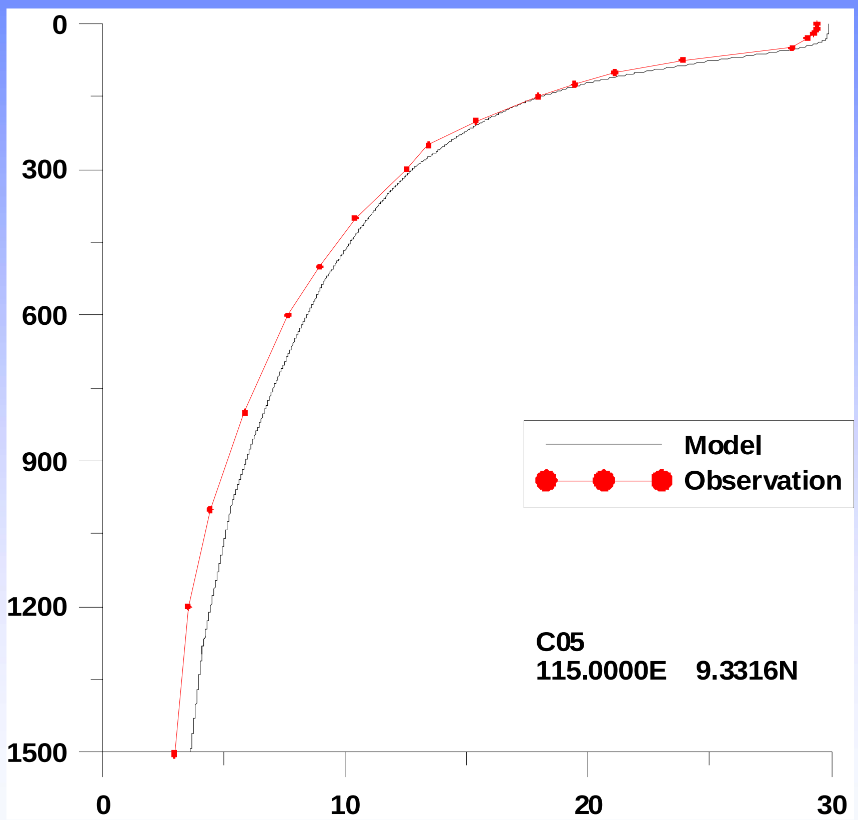
Jun 22~27 2009

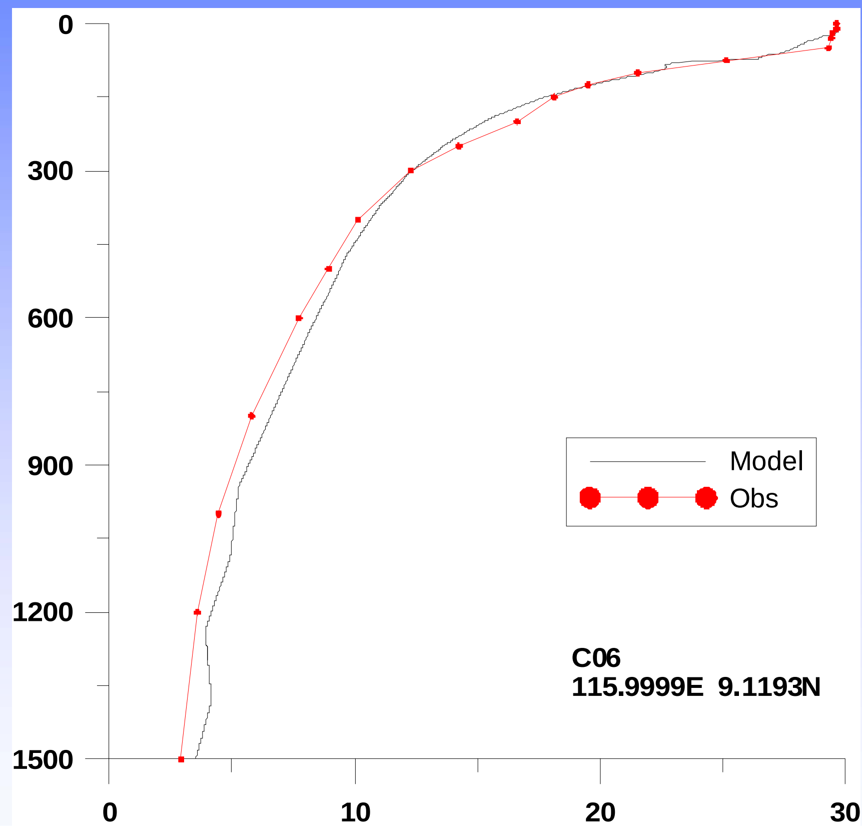




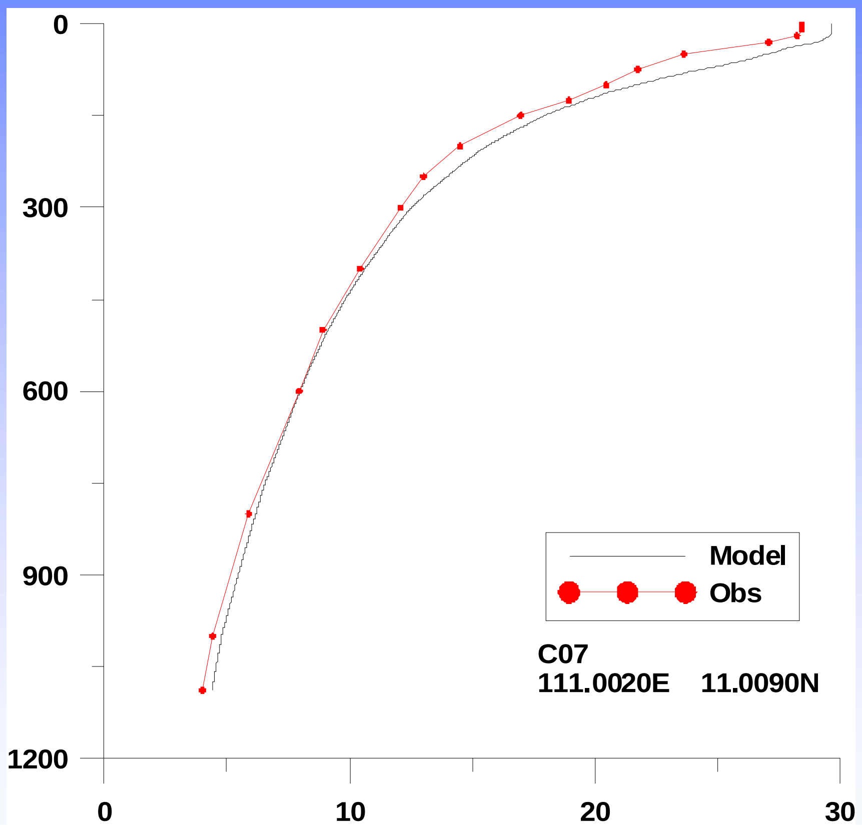


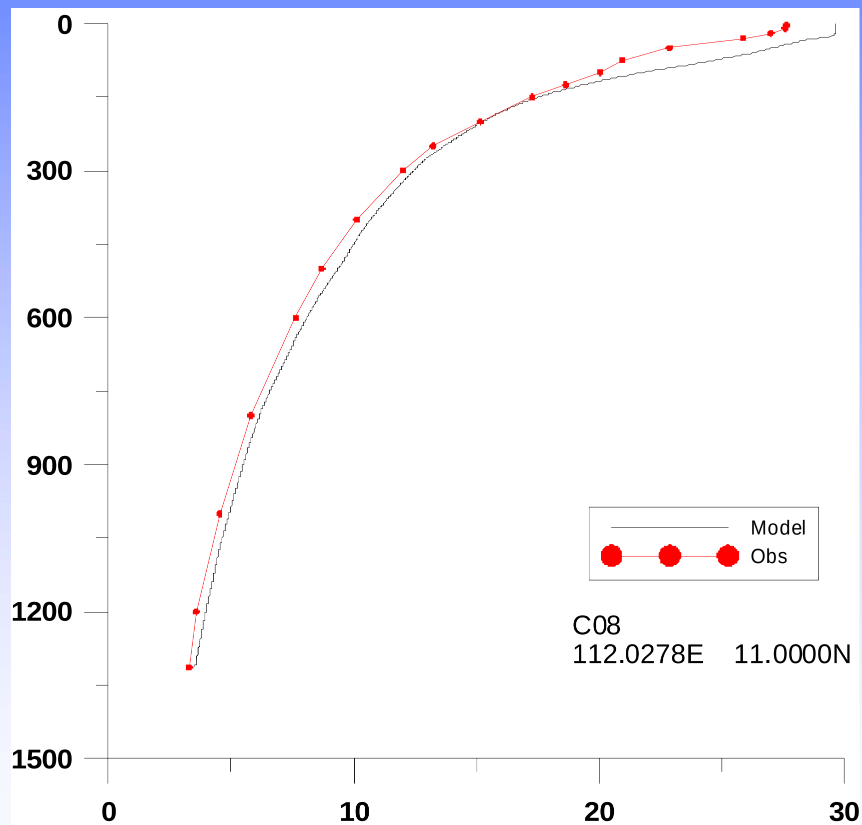
Temperature profile comparison at station c01 and C04



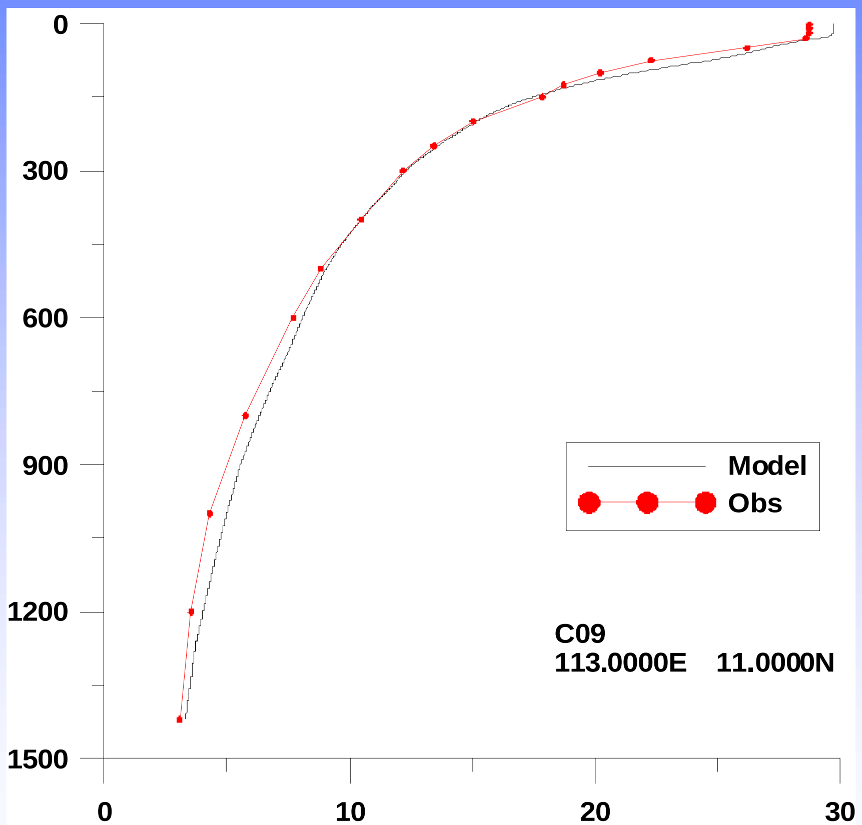


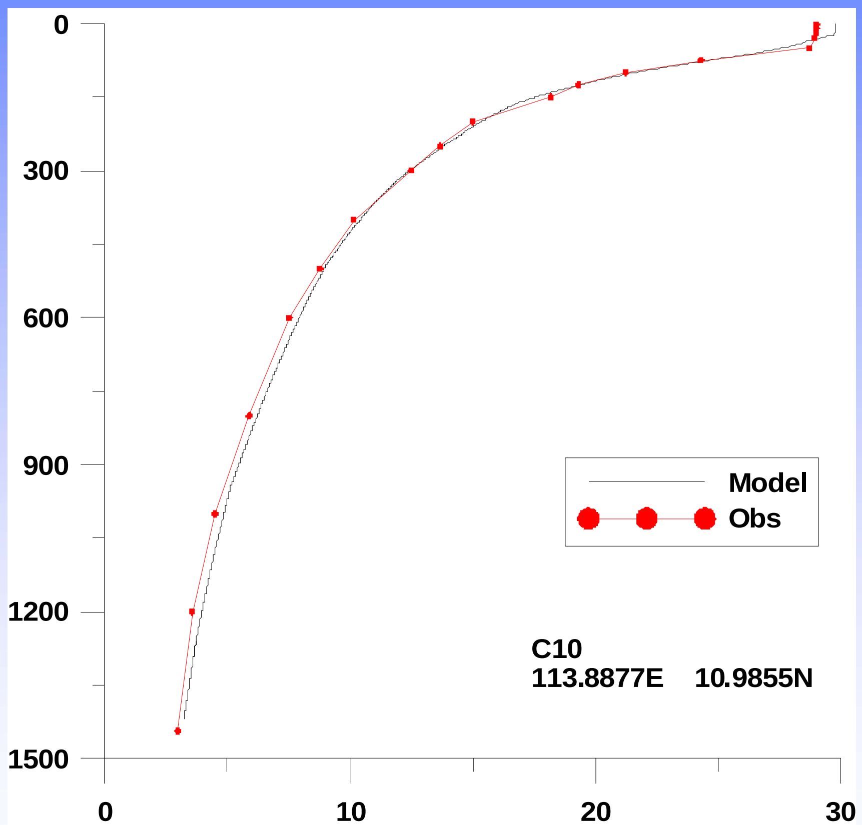
Temperature profile comparison at station c05 and C06



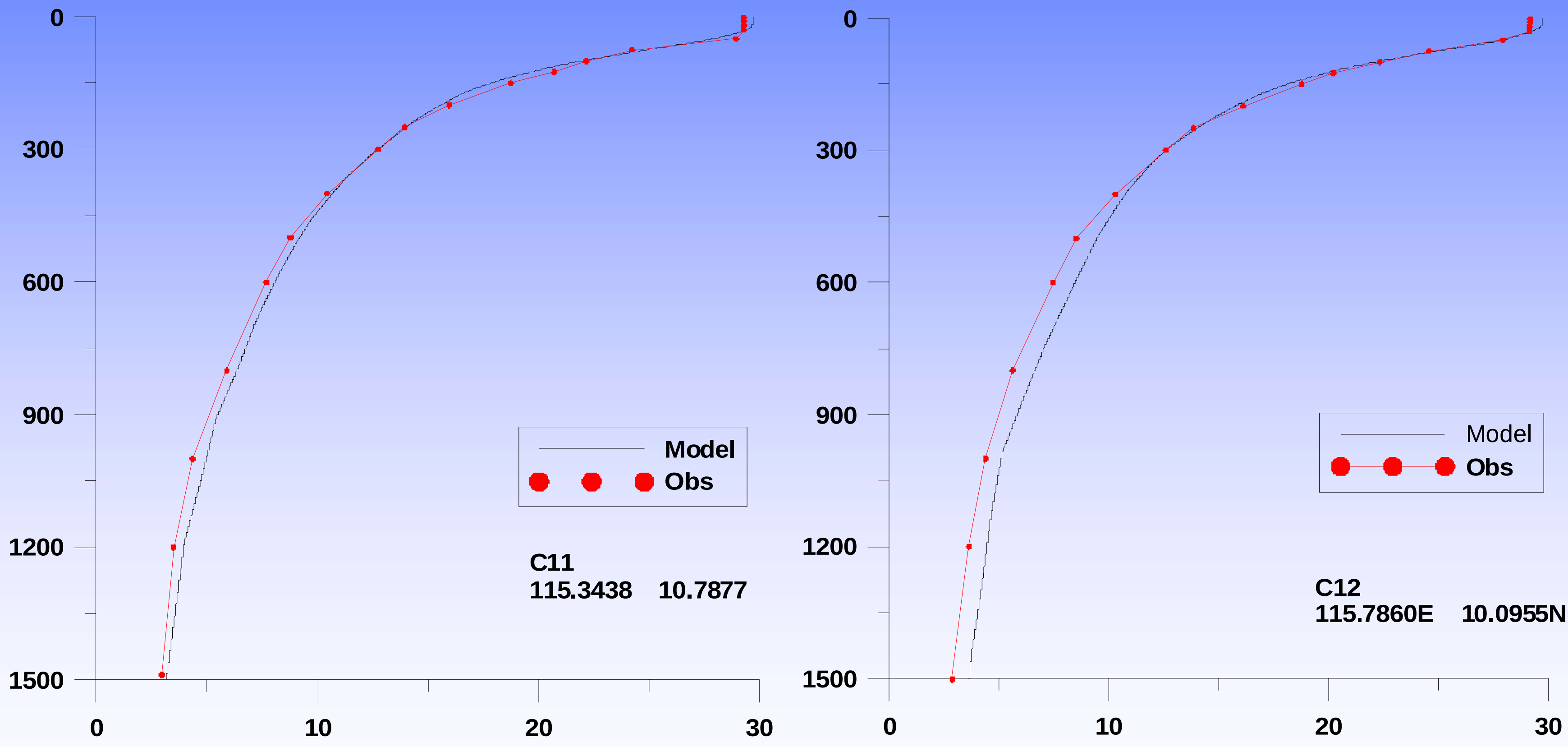


Temperature profile comparison at station c07 and C08

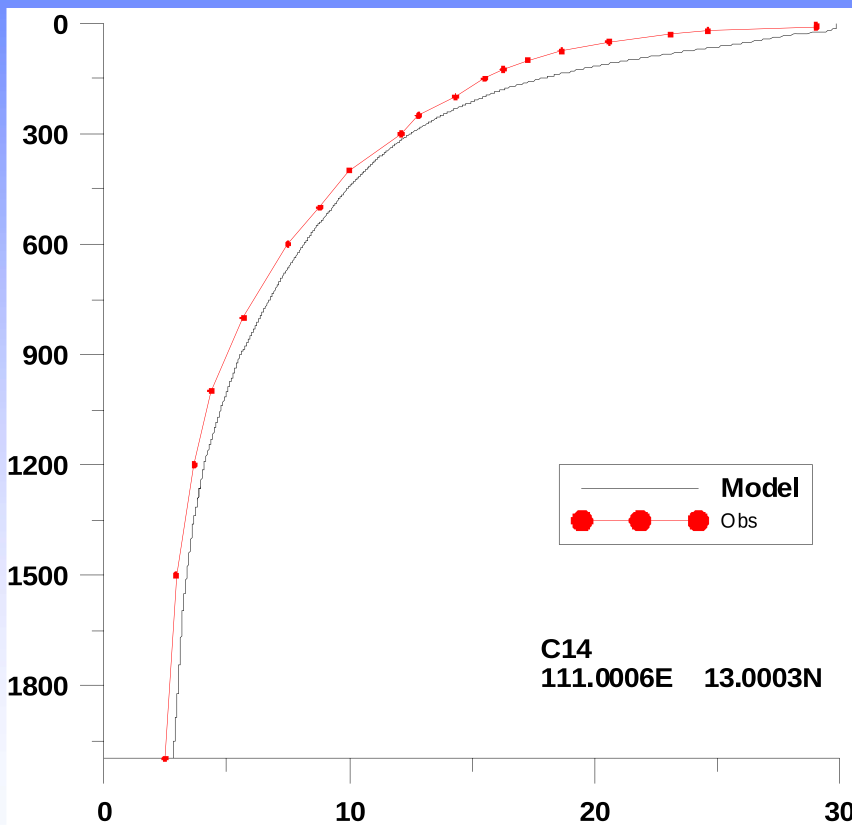


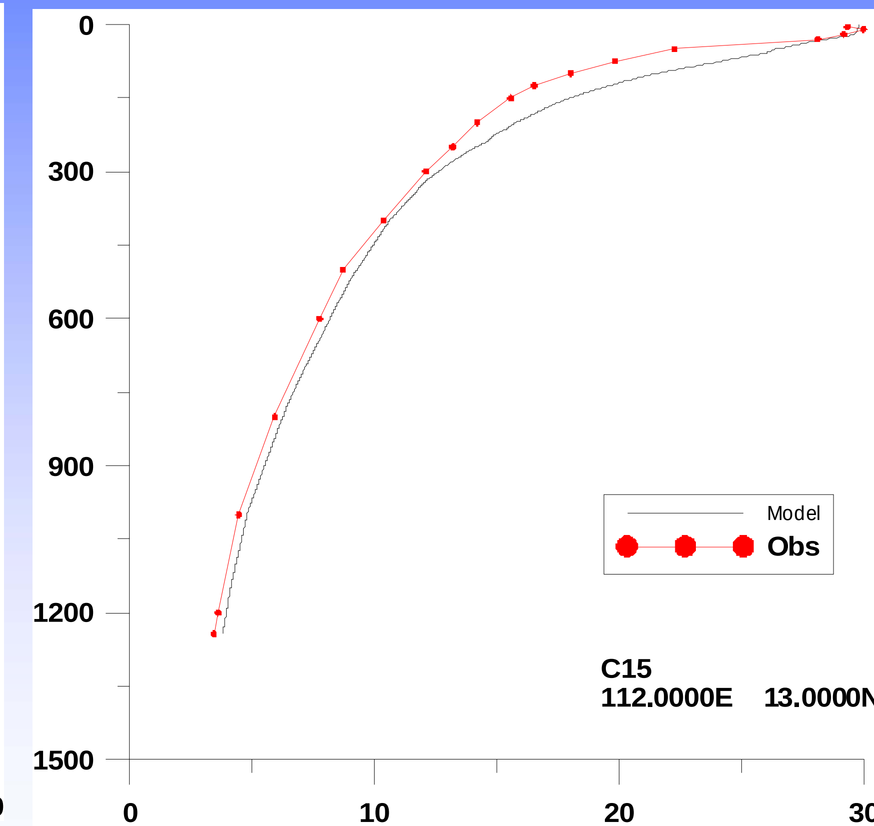


Temperature profile comparison at station c09 and C10

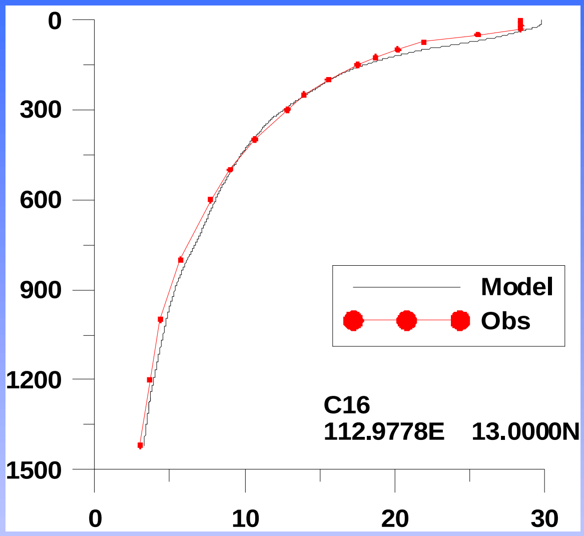


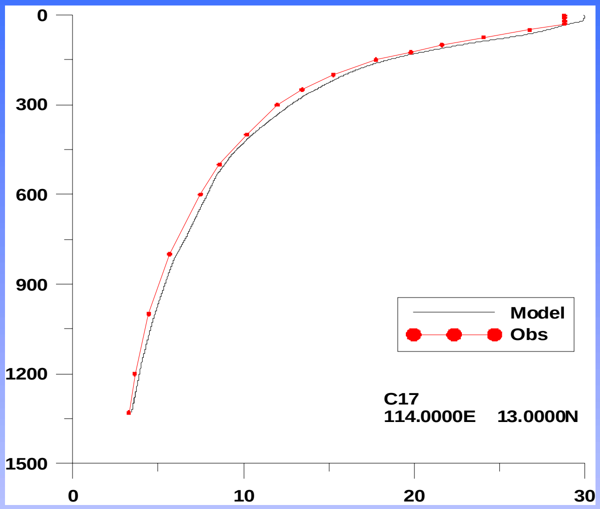
Temperature profile comparison at station c11 and C12

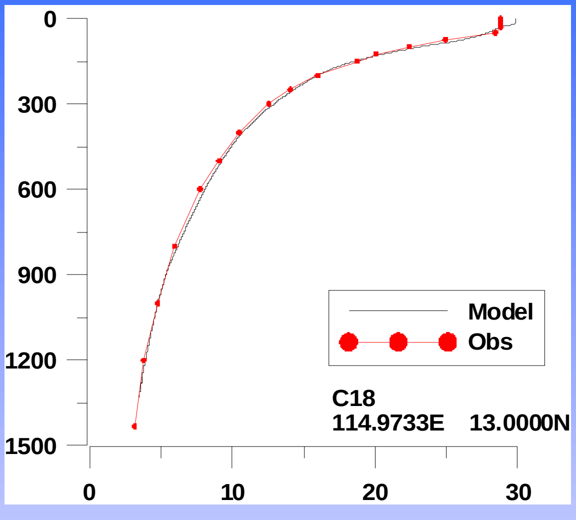




Temperature profile comparison at station c14 and C15





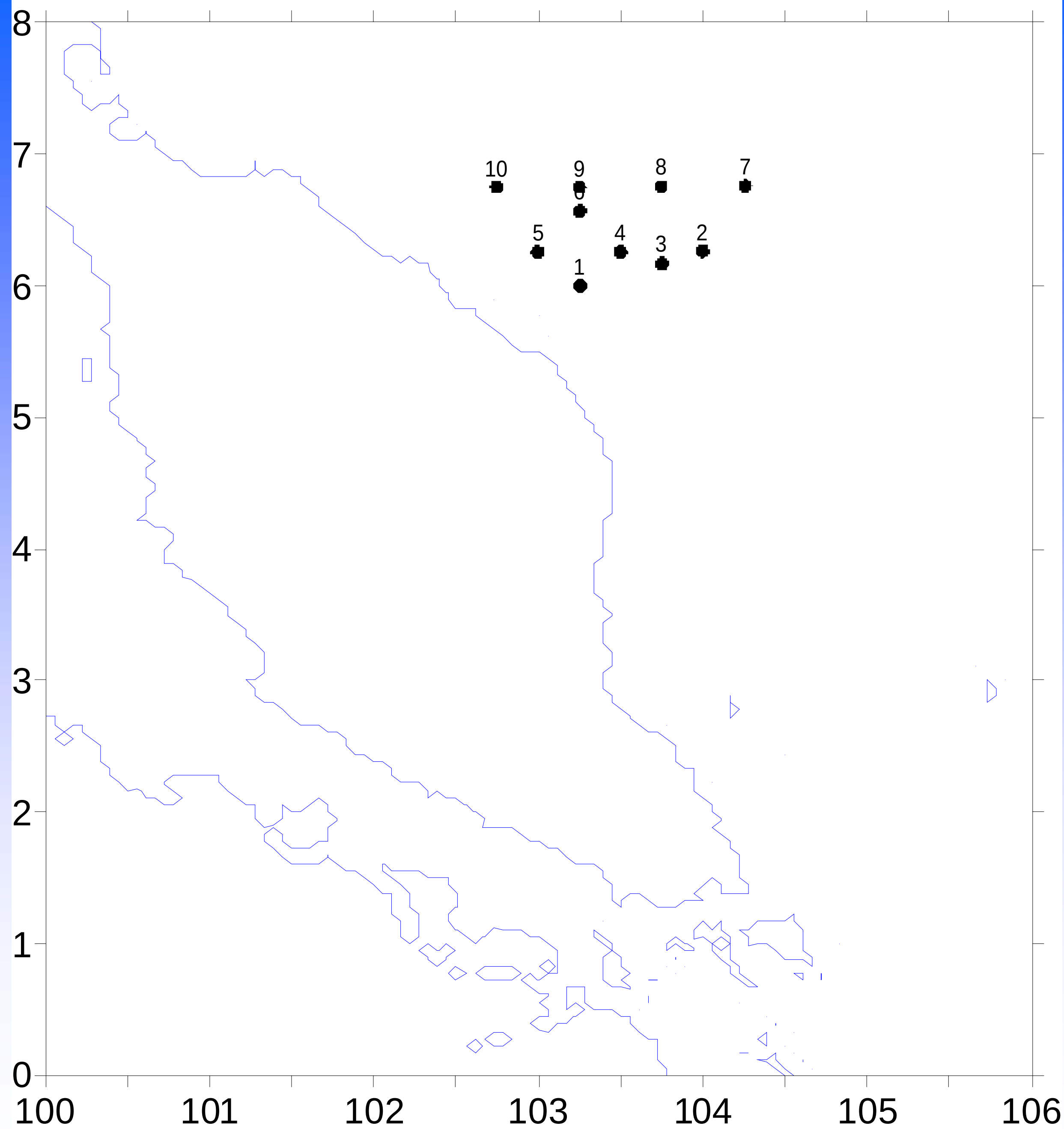


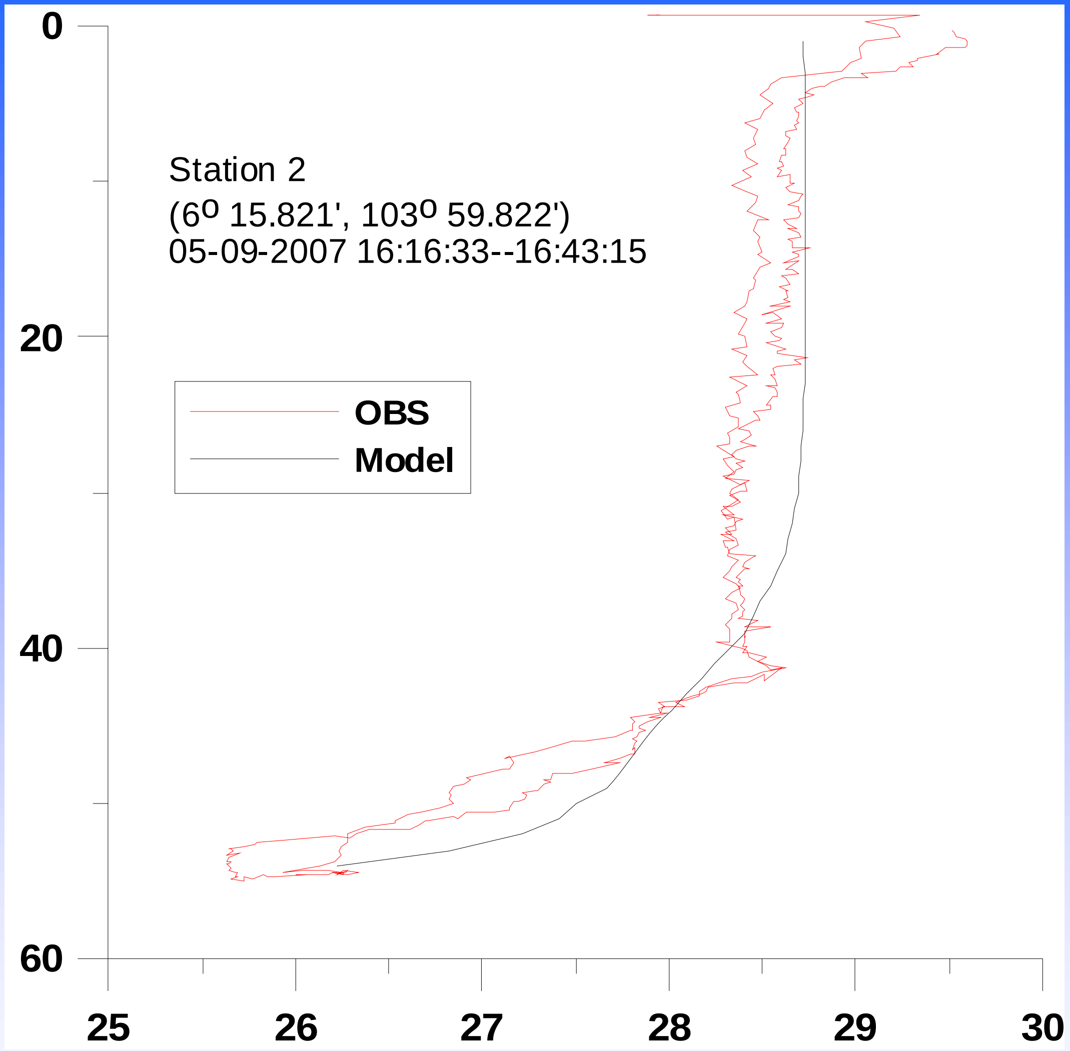
Temperature profile comparison at station c16 ,C17 and C18

Model Validation

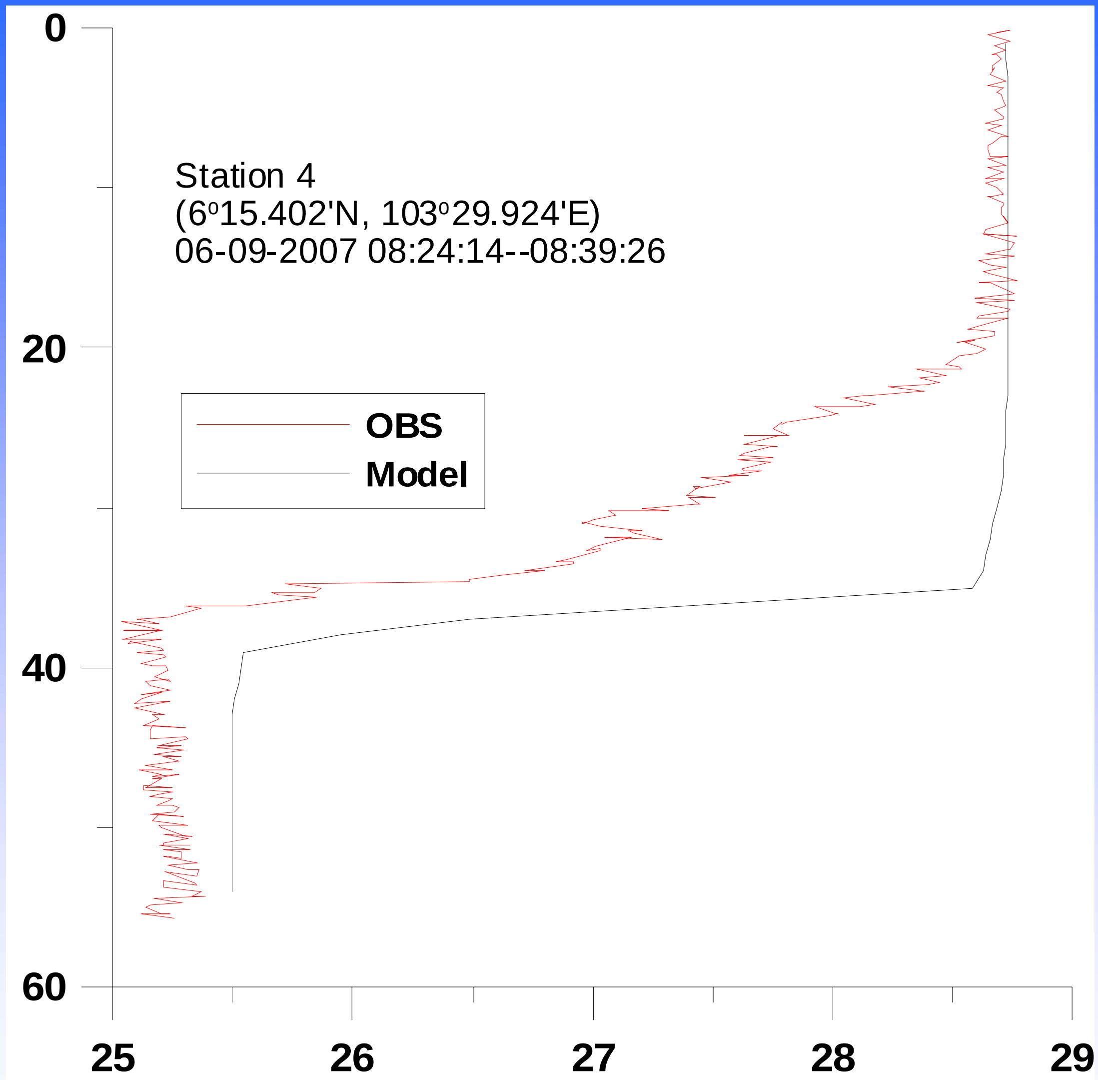
Compared with
the Malaysian
Cruise temperature
Observation during

3rd to 8th Sep. 2007

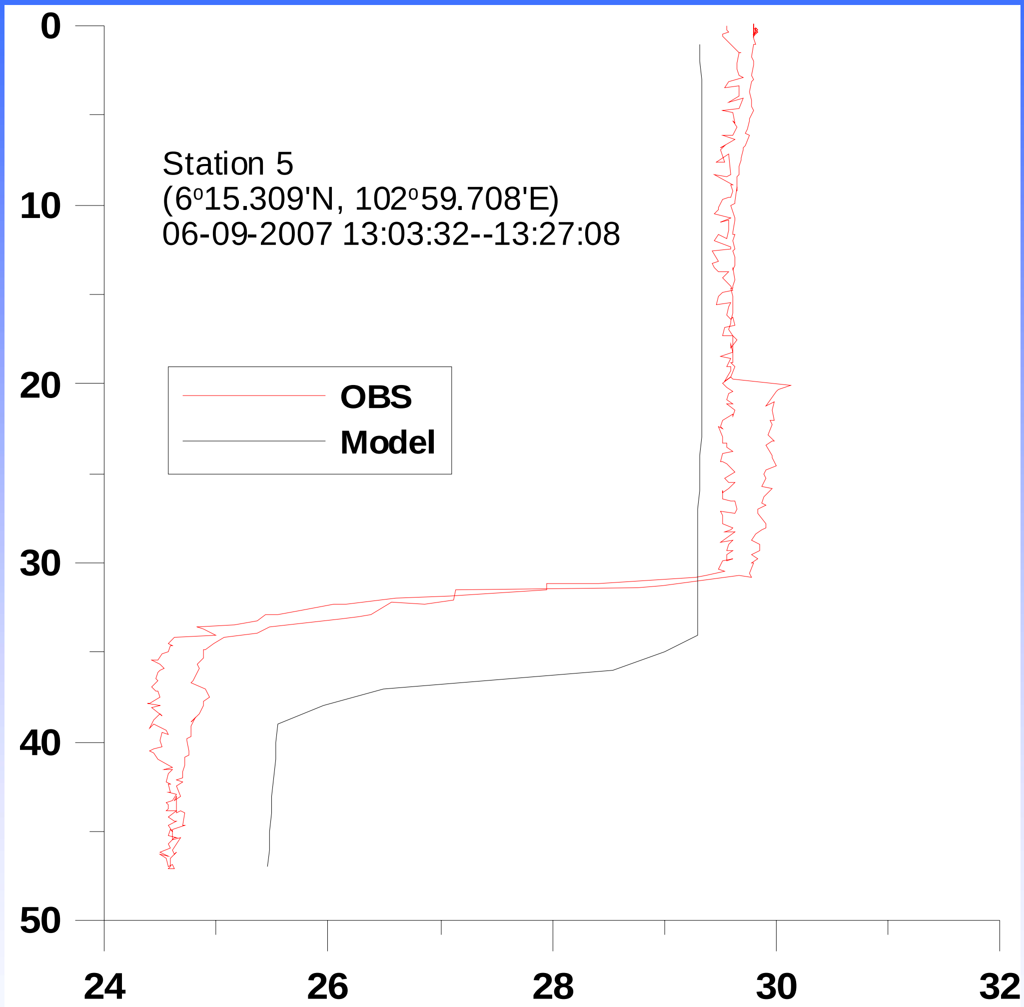




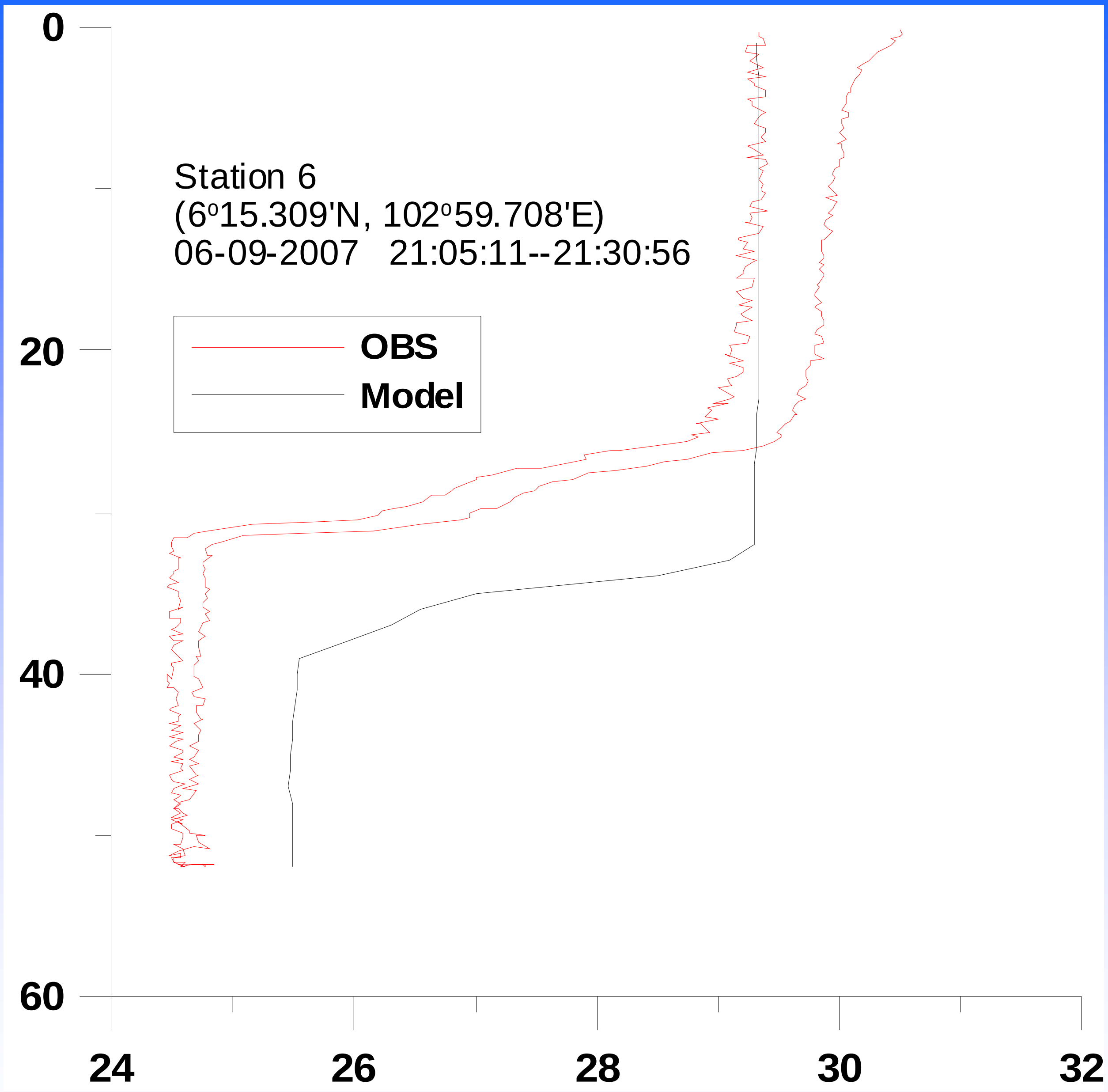
Temperature profile comparison at station 2



Temperature profile comparison at station 4



Temperature profile comparison at station 5

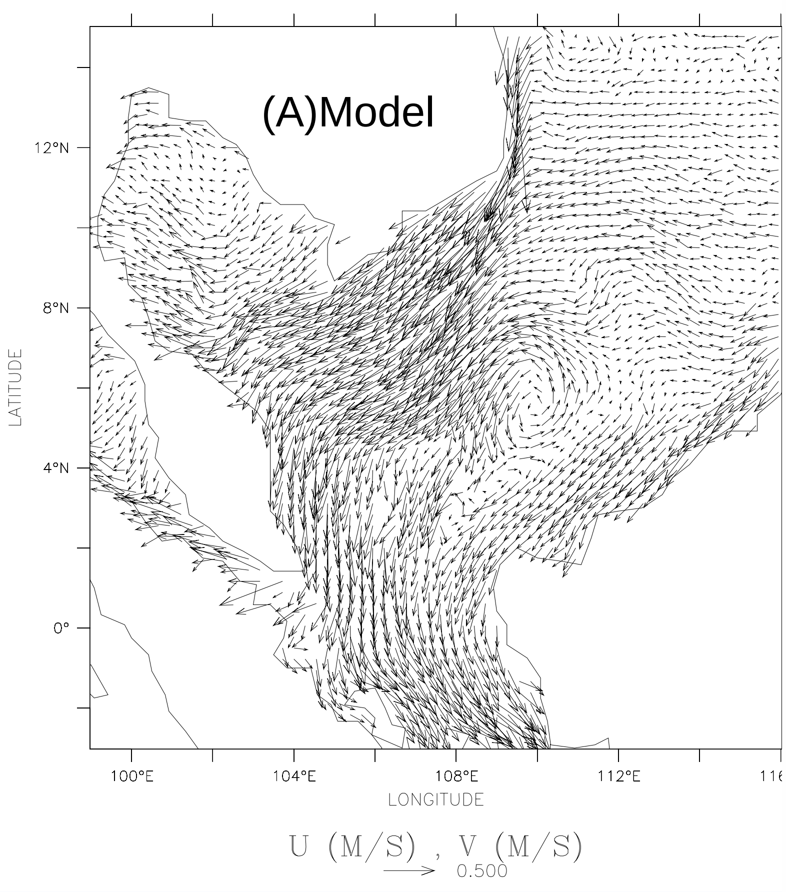


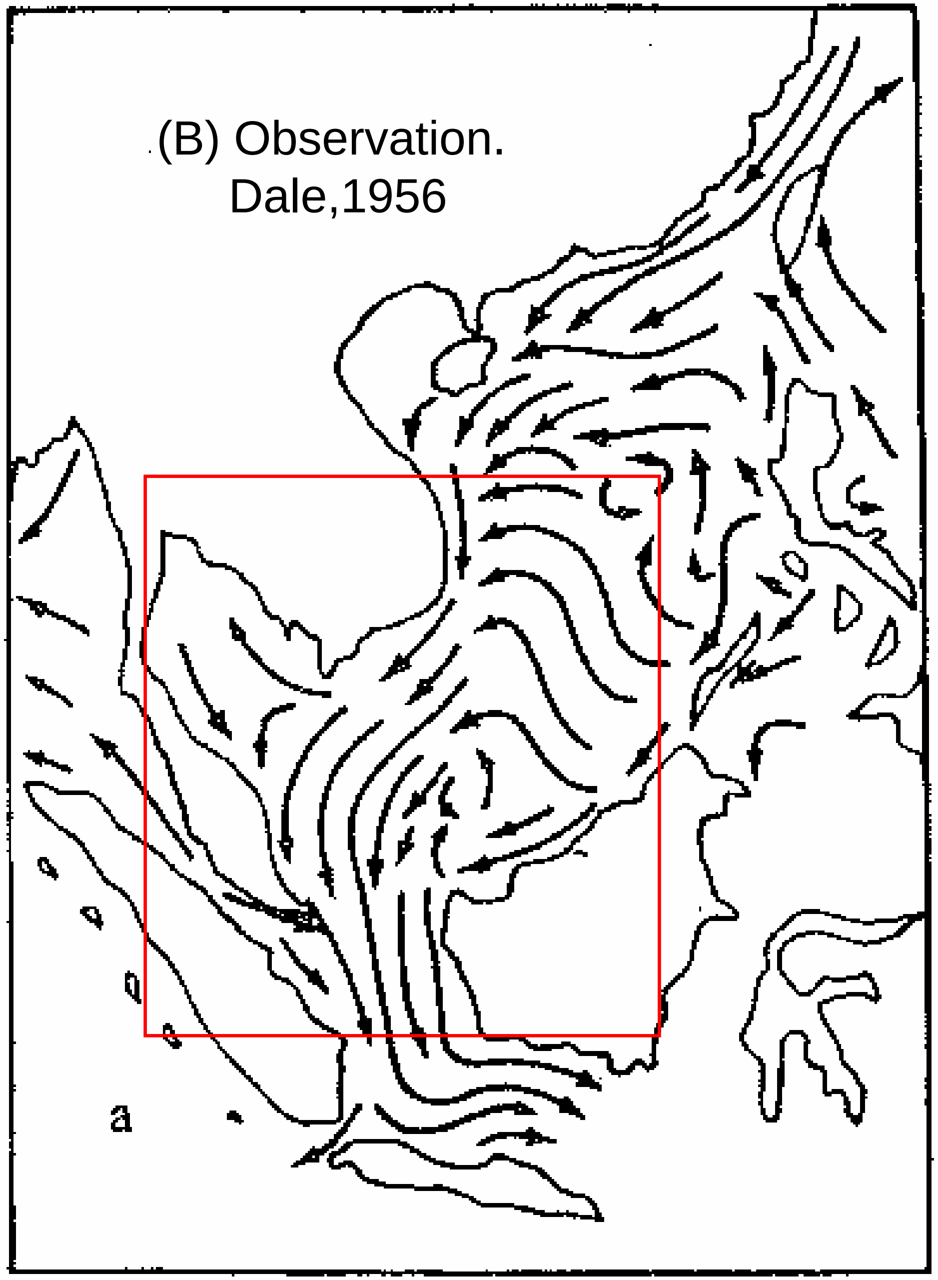
Temperature profile comparison at station 6

Circulation patterns

Surface flow in winter

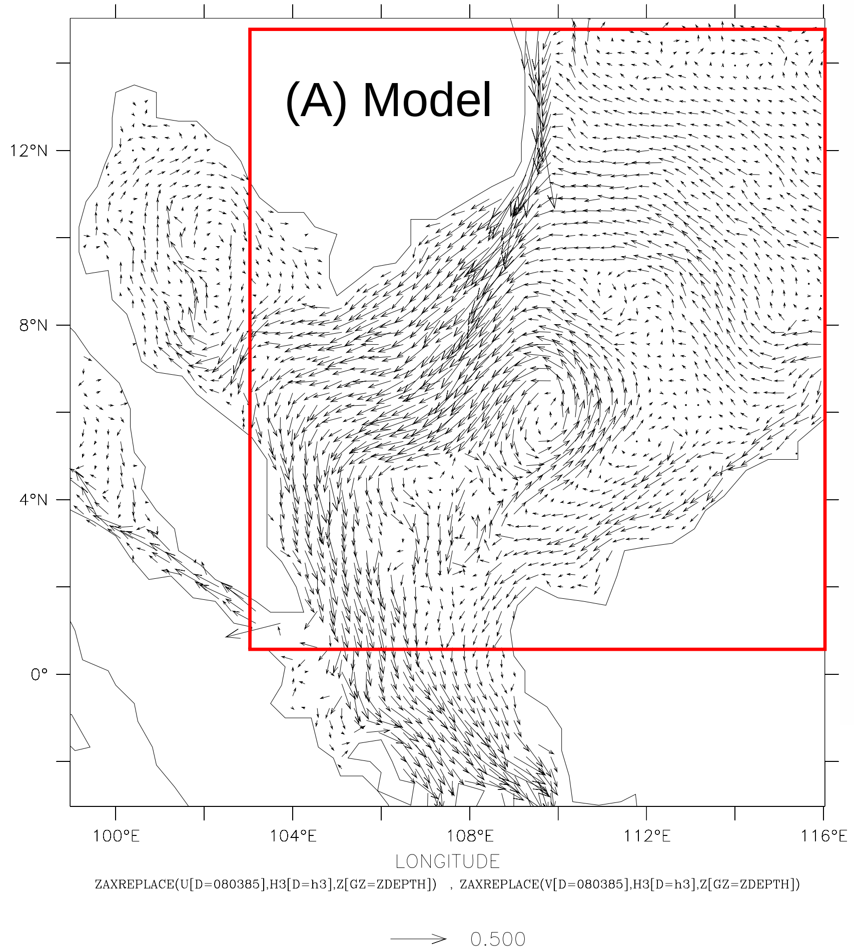
(A) Model (B) Schematic Map based On Observation by Dale,1966

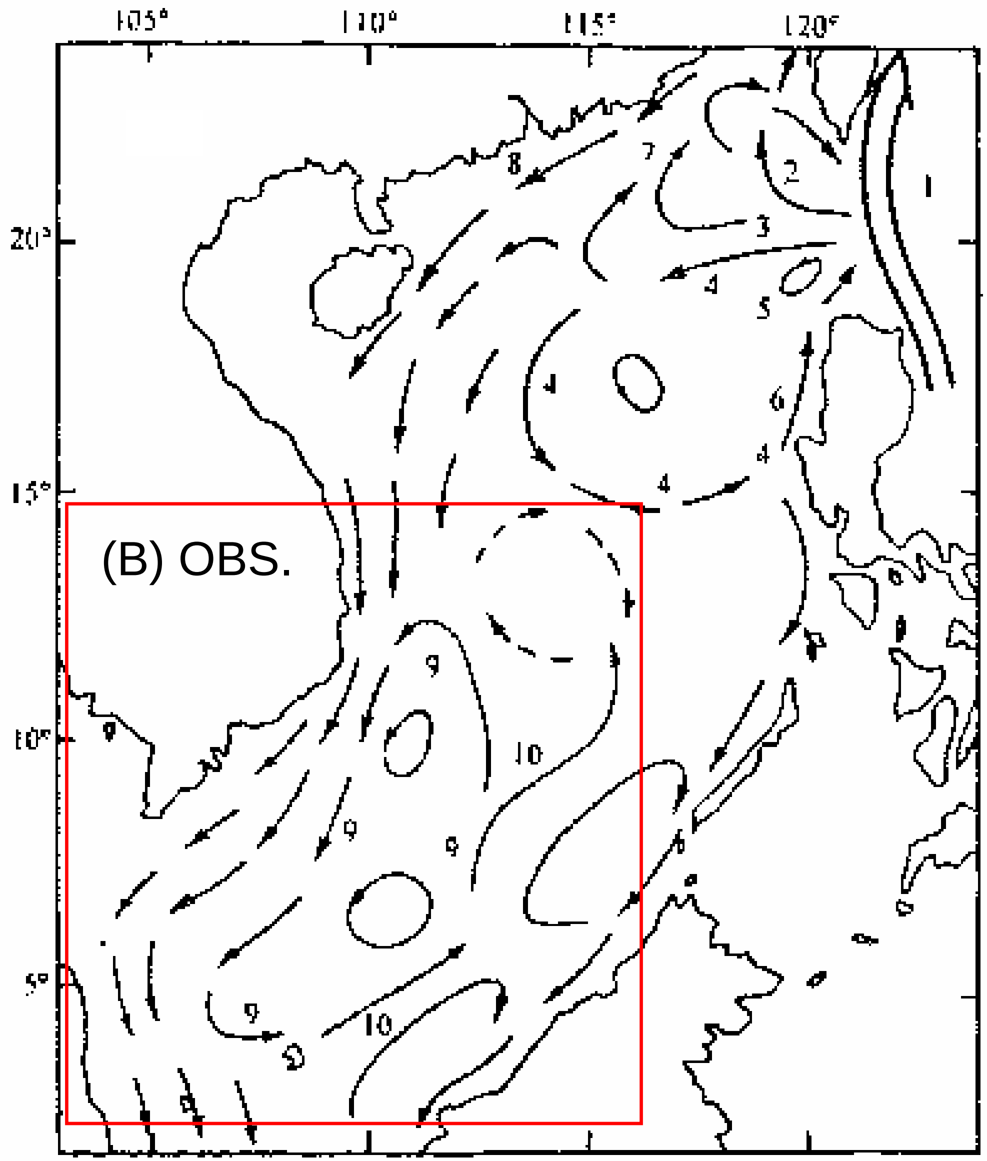




Flow at the upper layer in winter

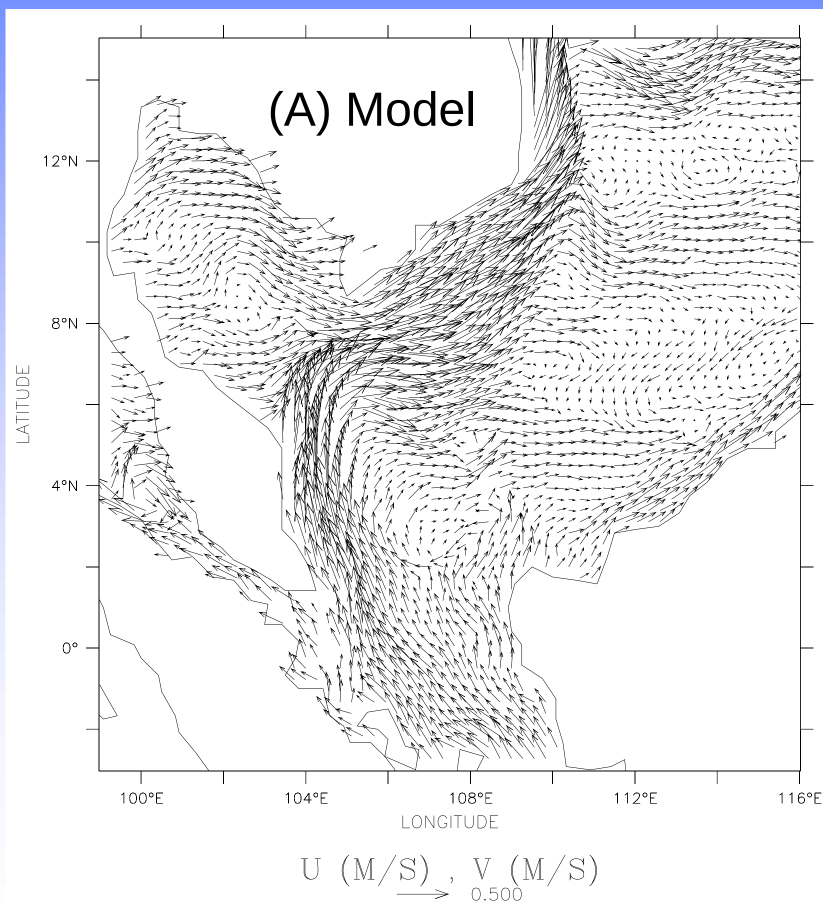
(A) Model (B) Schematic Map based On Observation by Fang et. al,1998

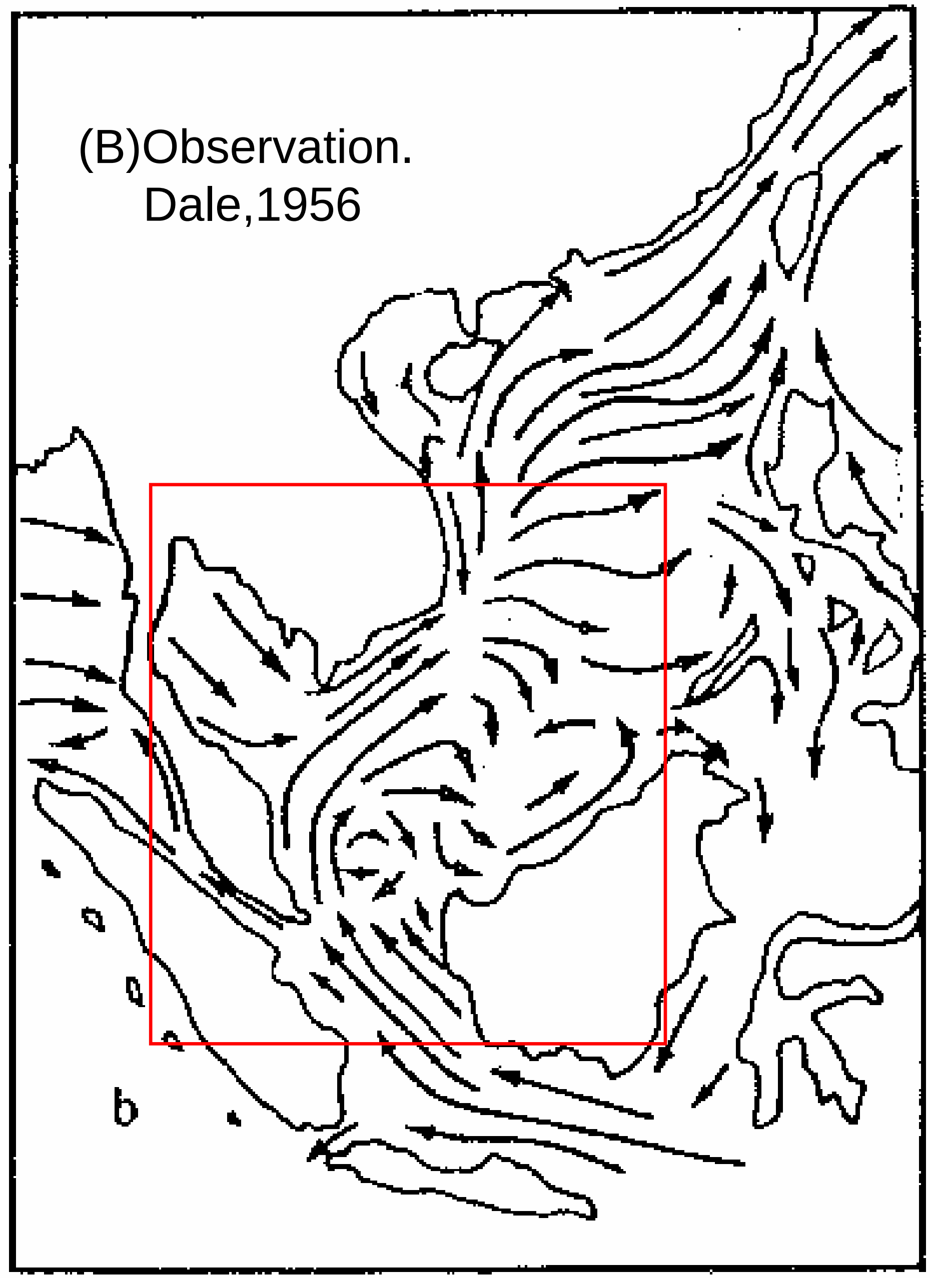




Surface flow in summer

(A) Model (B) Schematic Map based On Observation by Dale,1966

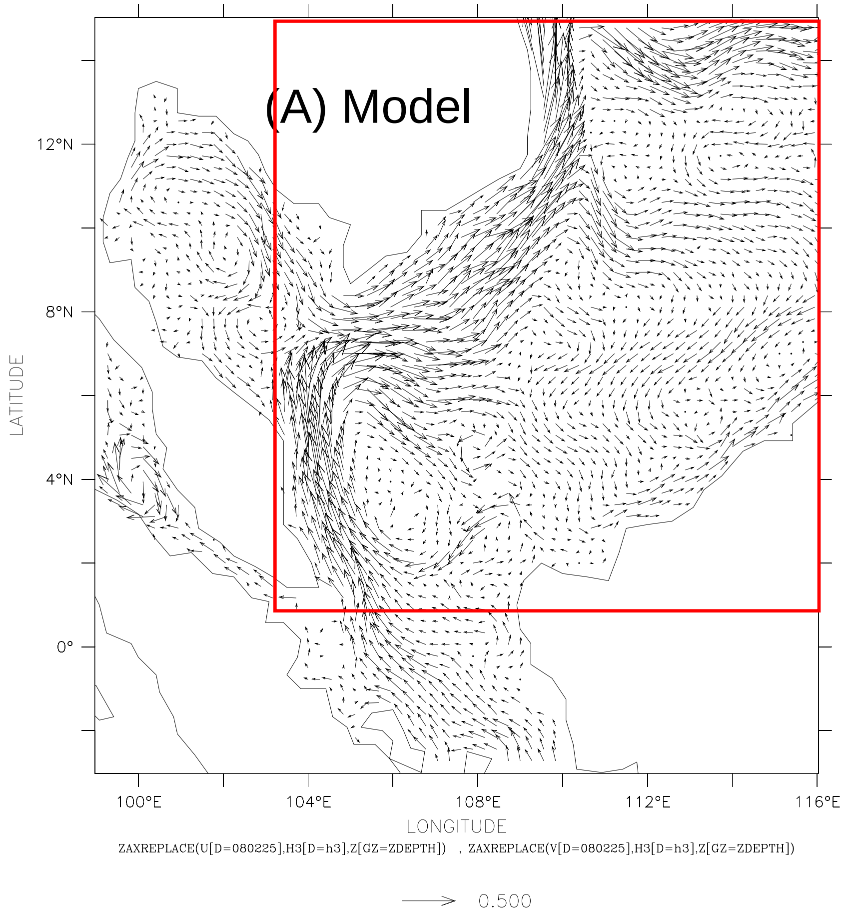


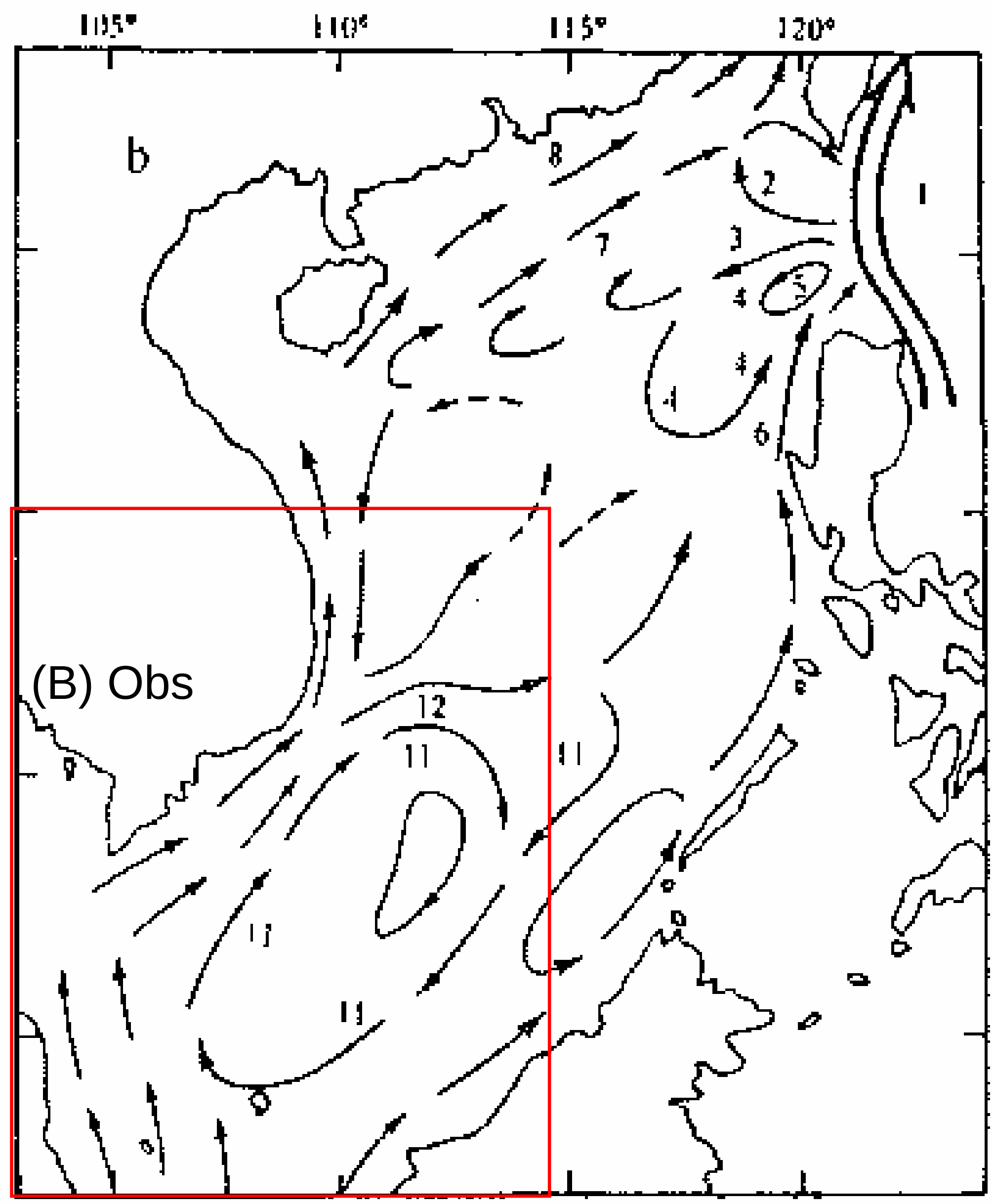


surface Flow in Summer

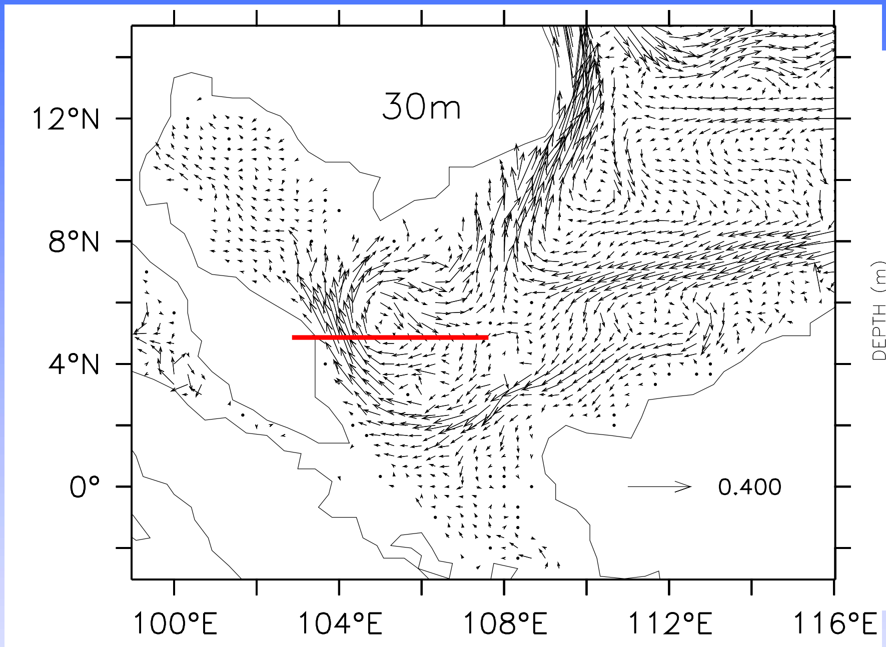
Flow at upper layer in summer

(A) Model (B) Schematic Map based On Observation by Fang et. al,1998

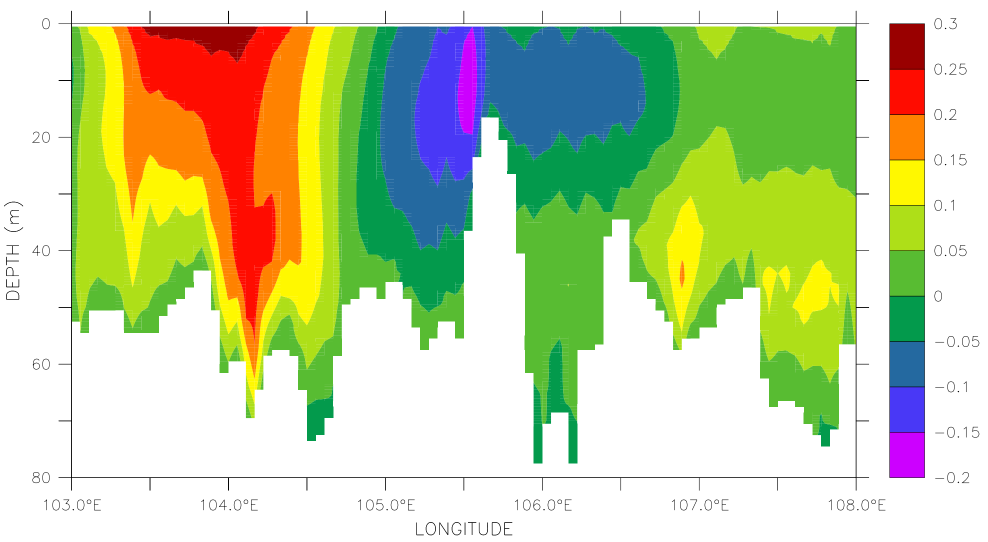




The cyclonic eddy in the MPECS in summer centered at (105E,5.5N)



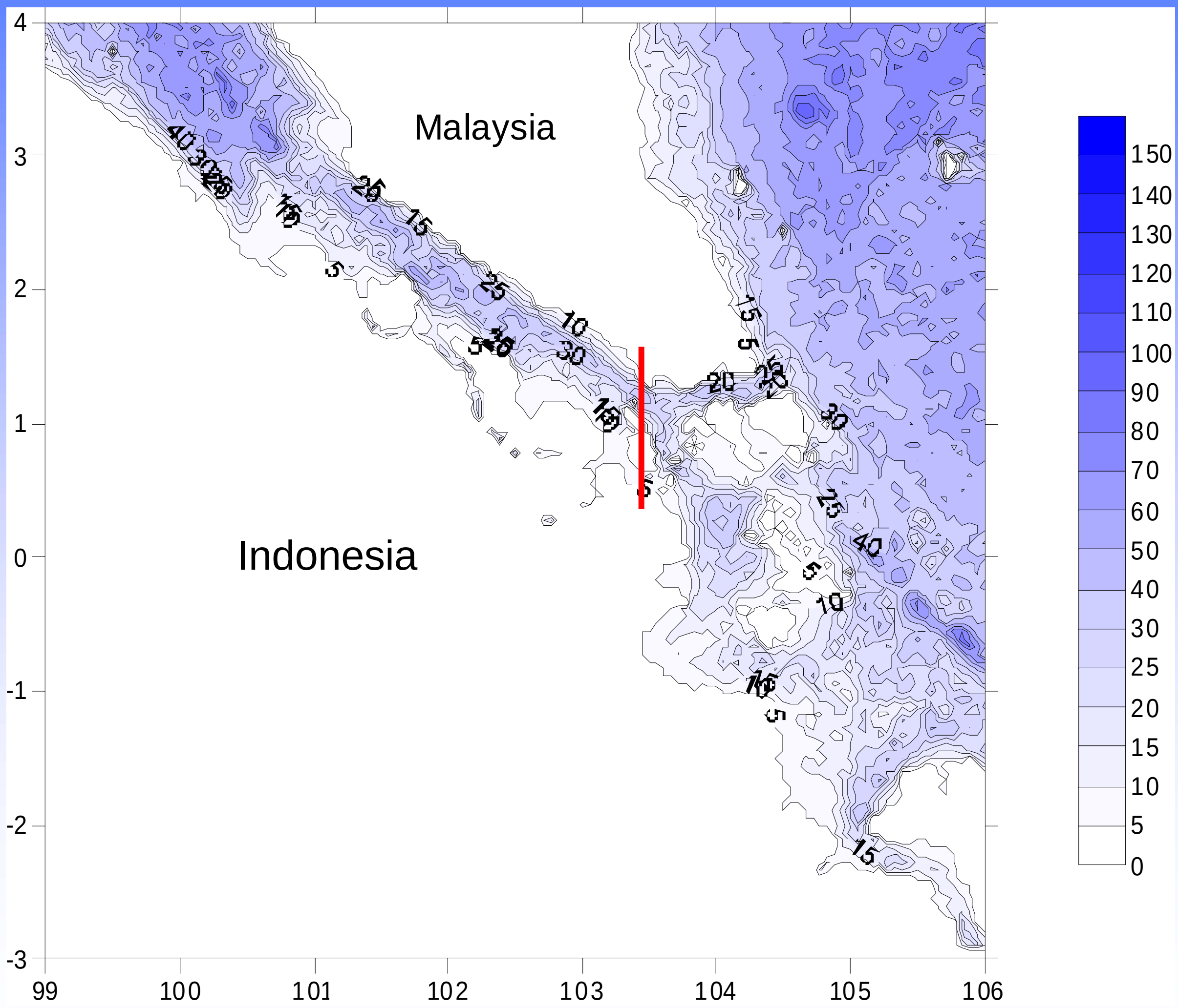
Flow field in the depth of 30m in summer



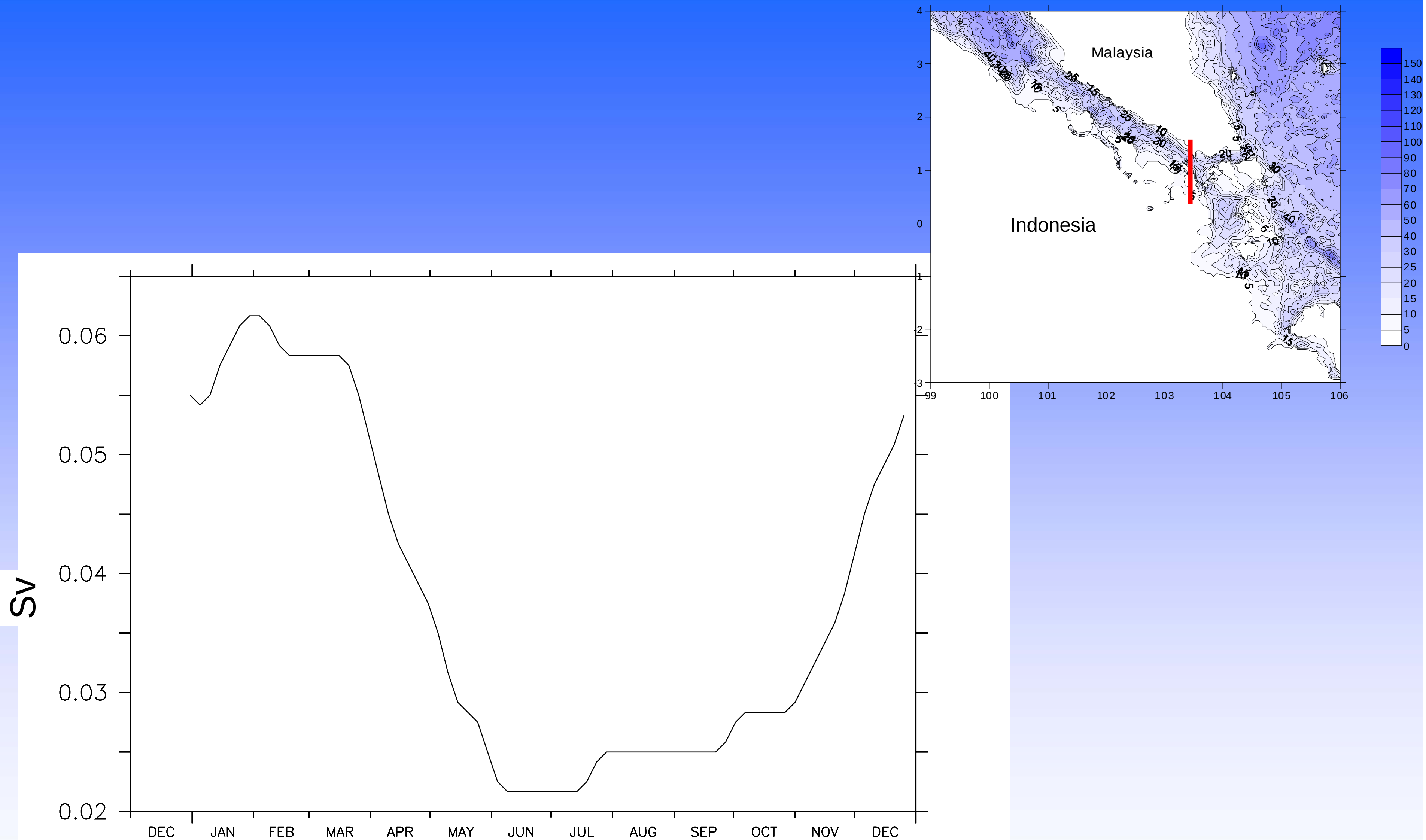
Distribution of velocity v across the cyclonic eddy during summer

Sensitive Study 1:

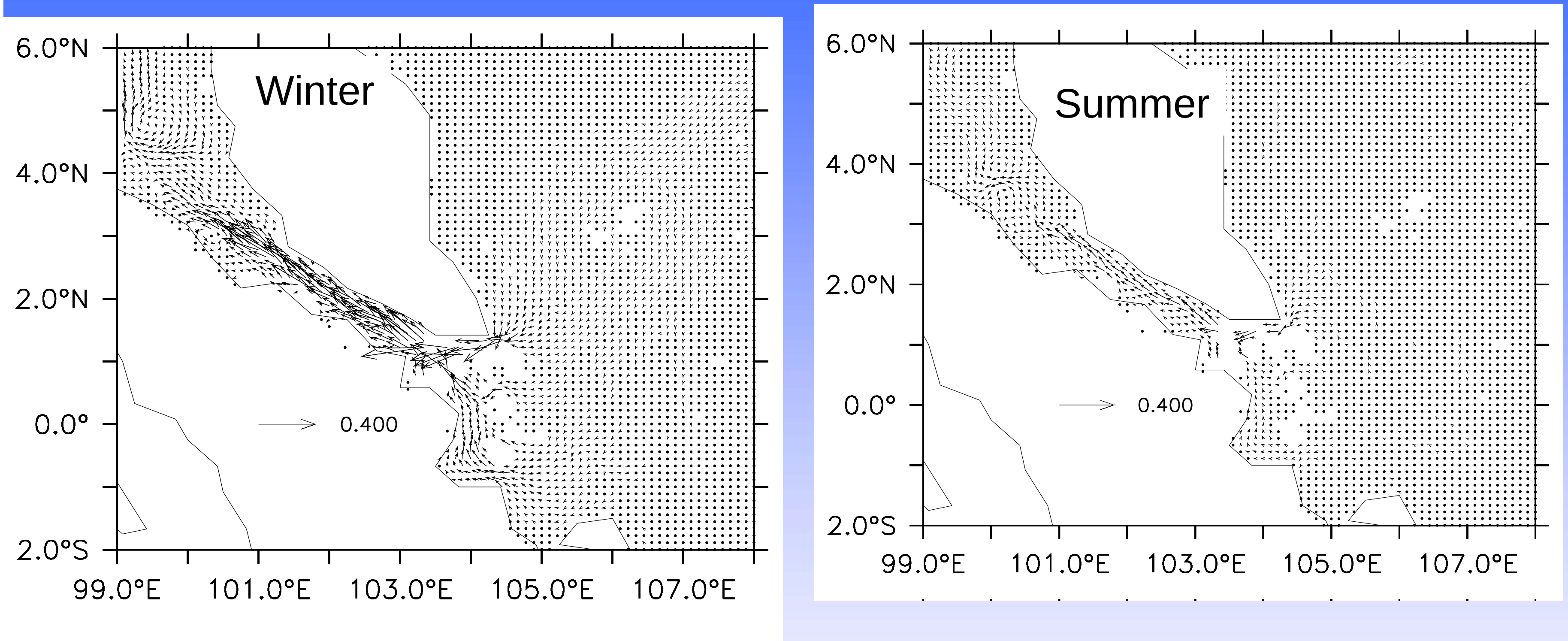
Closing the Malacca Strait



the Malacca Strait
Mini with 37Km
Water depth: 25-150m



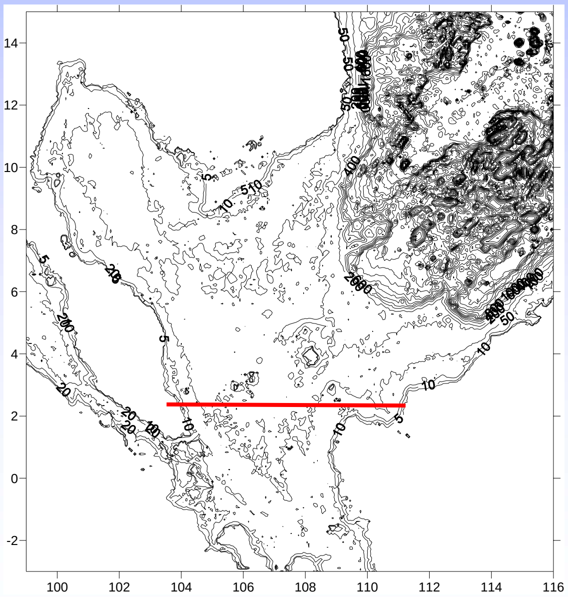
Flux through the Malacca Straits at the section 103.5

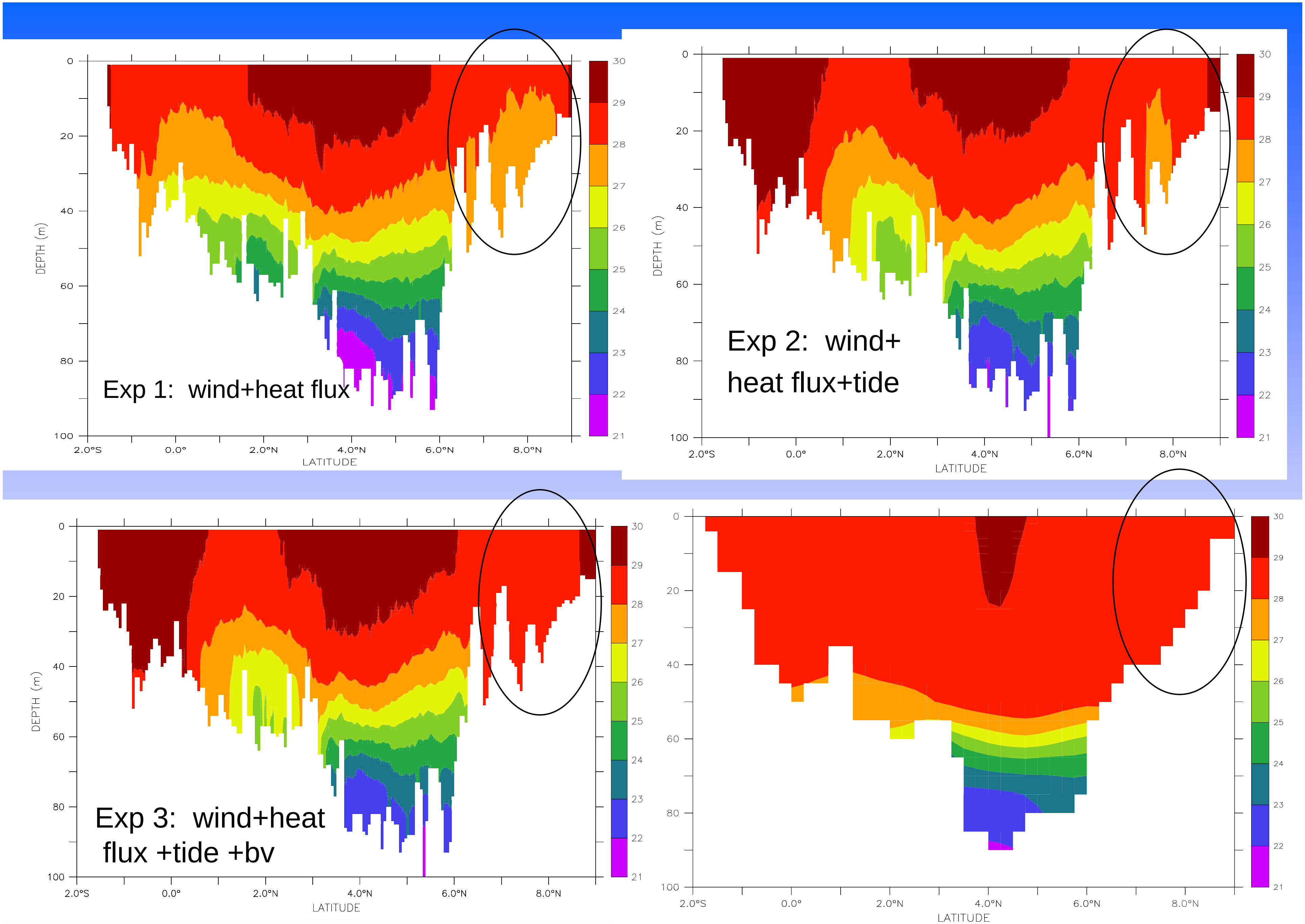


surface circulation difference (Ctrl – St. Malacca closed)
a) winter b) summer

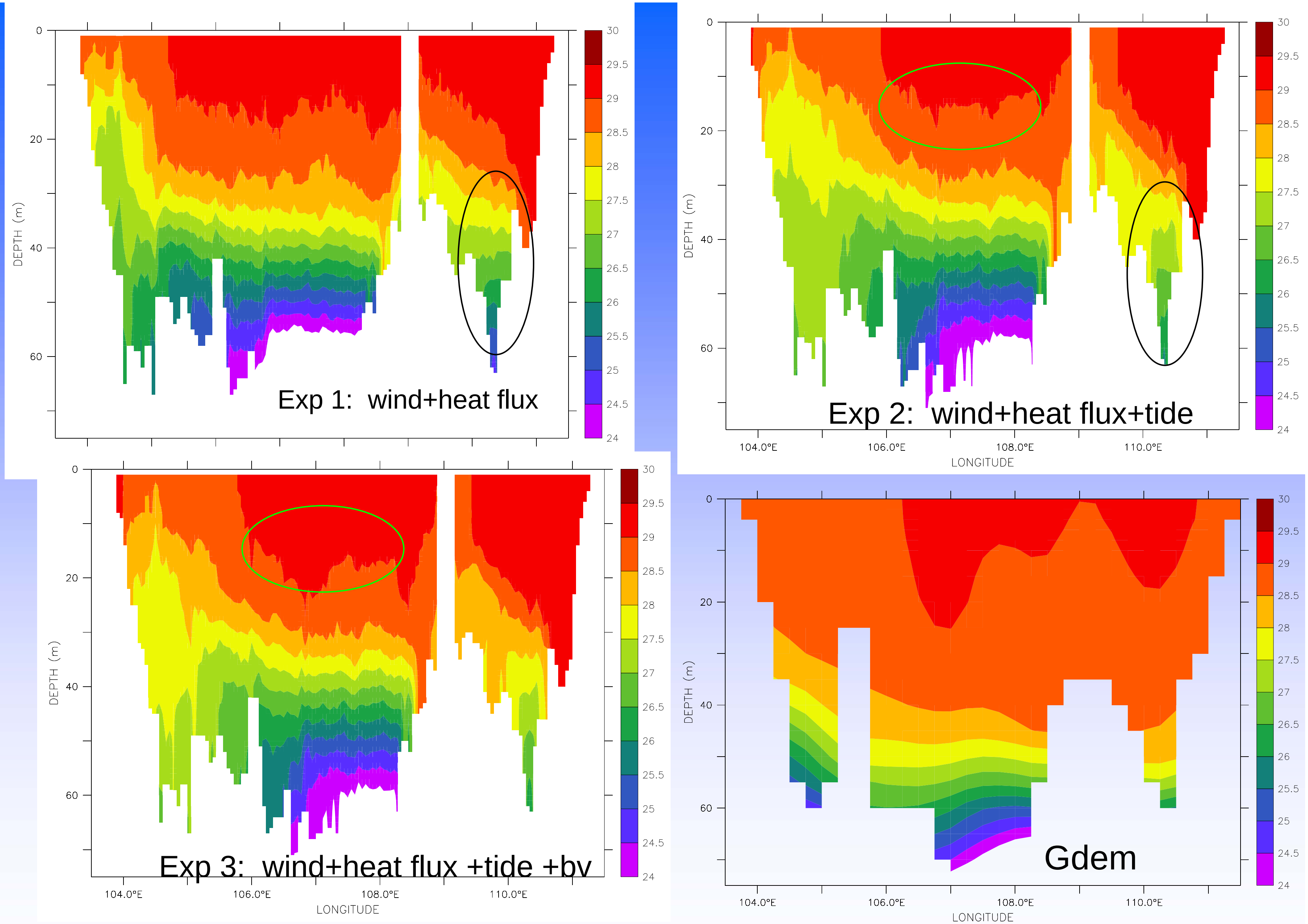
Sensitive Study 2:
Forcing factor of MLD in summer

- Exp 1: wind+heat flux
- Exp 2: wind+heat flux +tide
- Exp 3: wind+heat flux +tide +bv





Vertical temperature distribution along 106E section in summer



Vertical temperature distribution along 2.5N section in summer

Conclusions and future work

- A Wave-tide-circulation coupled model based on POM is established to study the seasonal variation of the circulation in the Malaysian Peninsula East Continental Shelf (MPECS) region.
- The upper layer flow field is controlled by the north-east monsoon in winter and south-west monsoon in summer .
- There is a cyclonic eddy in the MPECS in summer, centered at (105E,5.5N)
- The flux through the malacca straits rangs from 0.02-0.06Sv.
- Sensitive study shows that wave-induced mixing has significant effect on the formation of the upper mixed layer in summer. Tide induced mixing is important to the bottom mixed layer and the front.