

GENERAL OCEANOGRAPHIC STATUS OF ANDAMAN SEA

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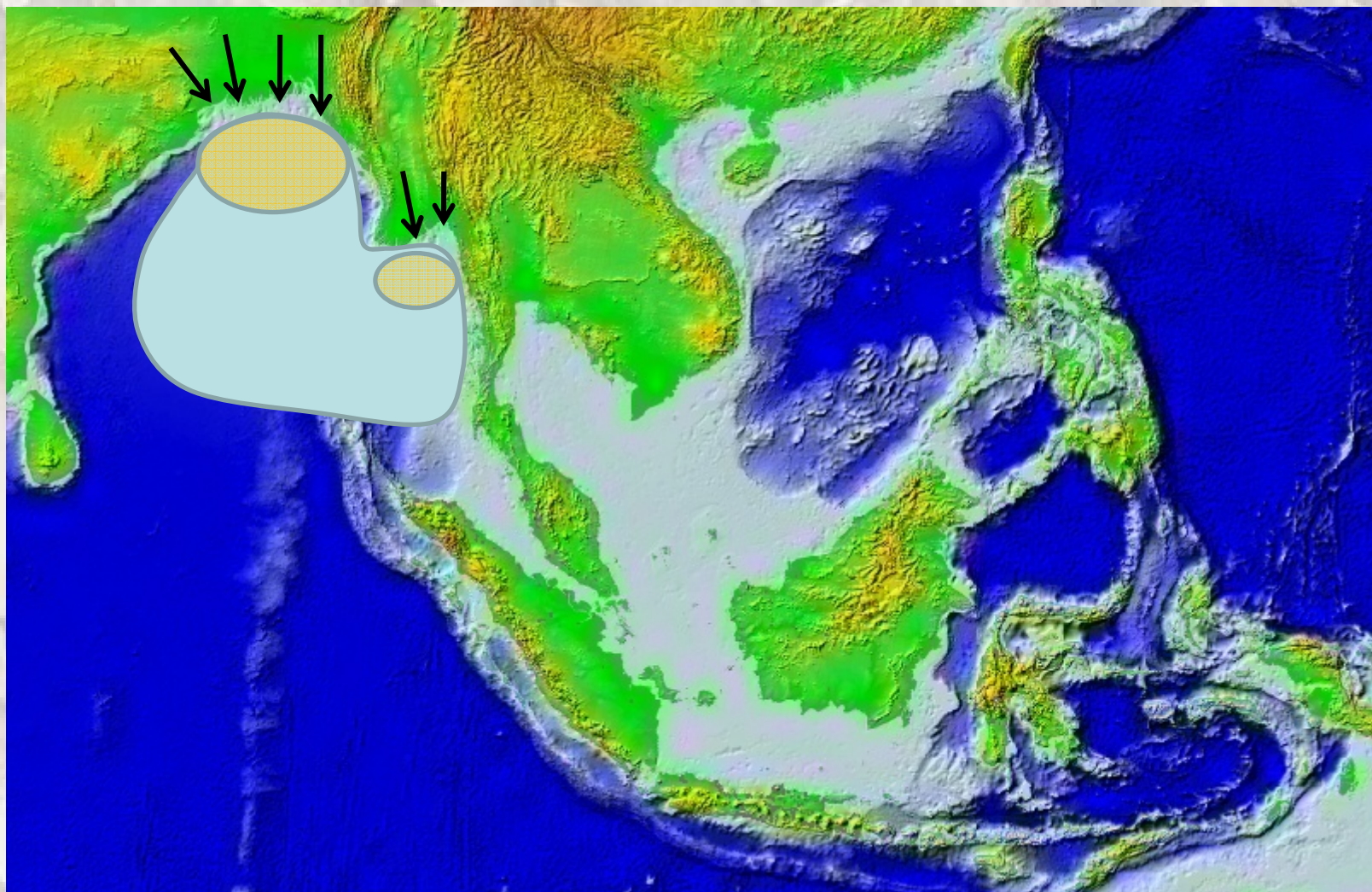
SEAFDEC, 9-10 January 2010



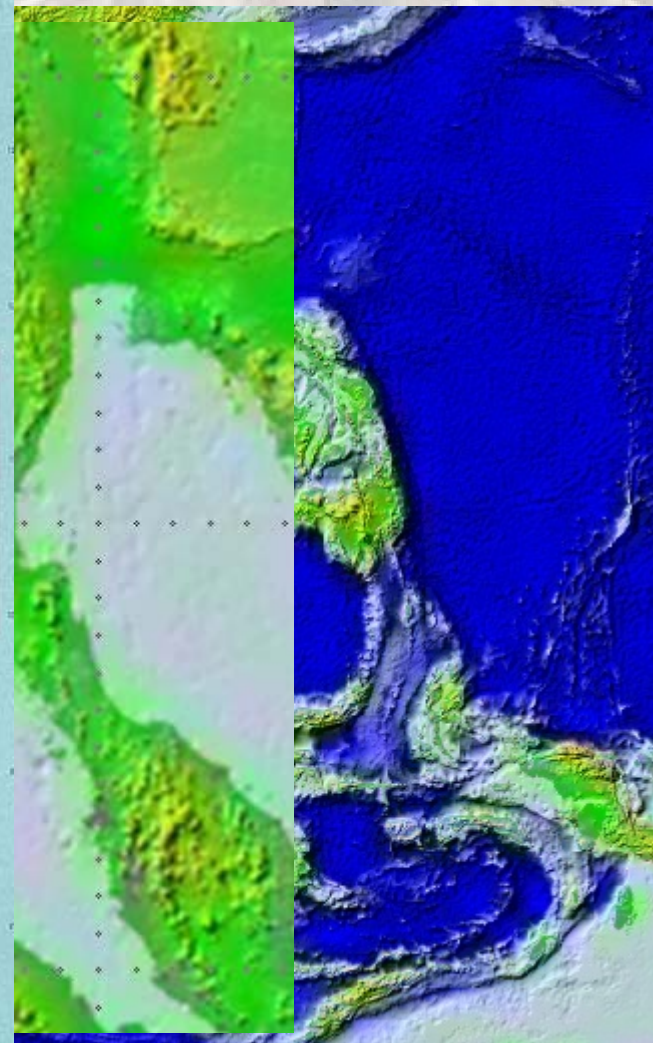
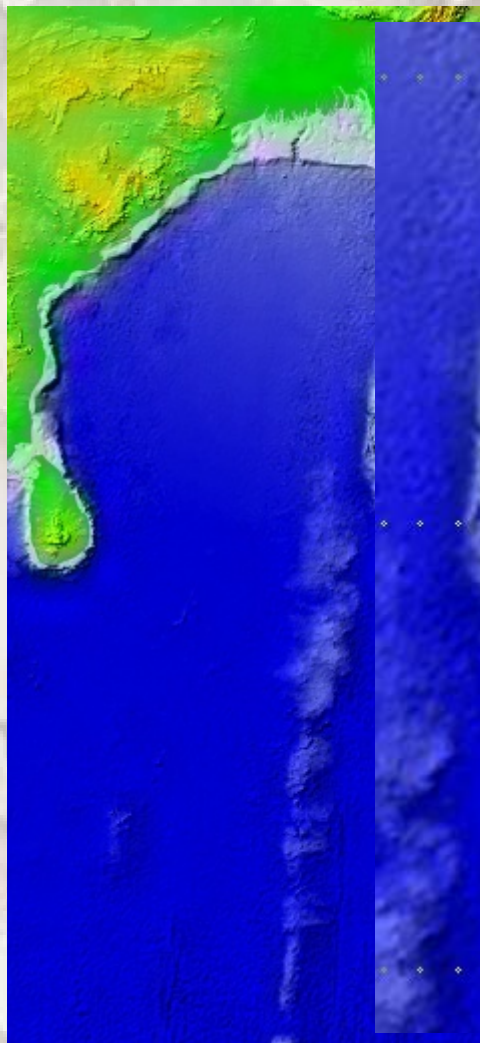
Content

1. **Water Circulation**
2. **Monsoon: summer and winter monsoon**
3. **Internal wave and its impact to coastal ecosystem**
4. **Indian Ocean Dipole (IOD) and its impacts on marine ecosystem**
5. **Ocean observing system**

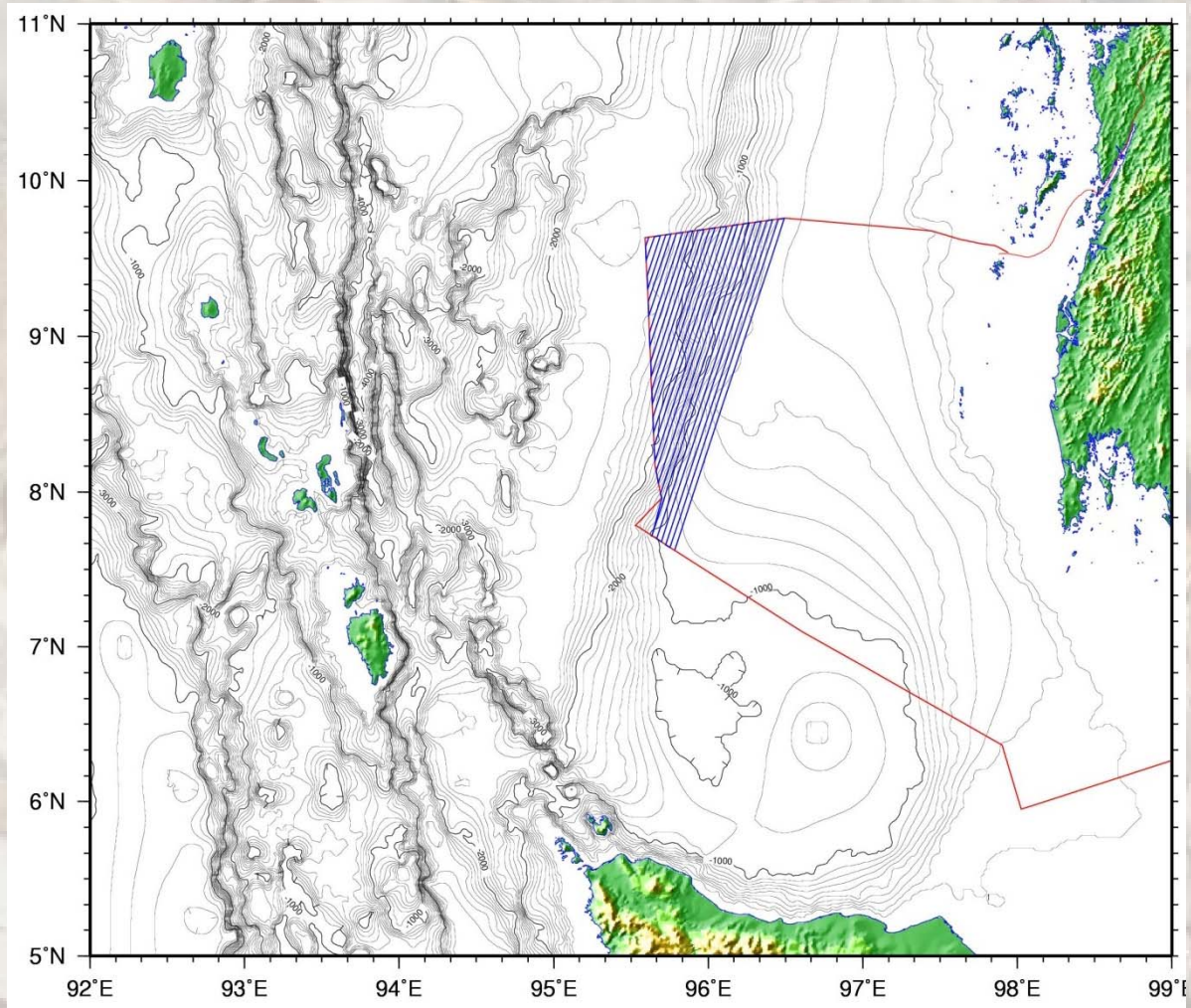
Bay of Bengal and Andaman Sea



Bay of Bengal and Andaman Sea



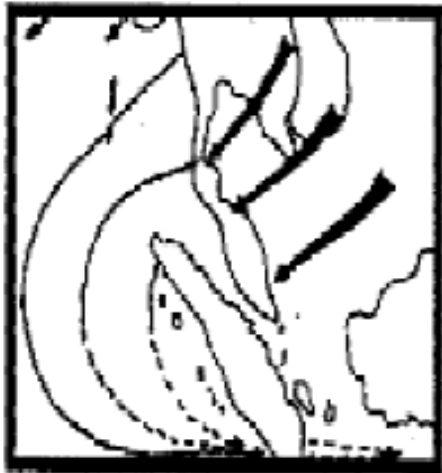
Andaman Sea



Oceanographic Feature in Andaman Sea



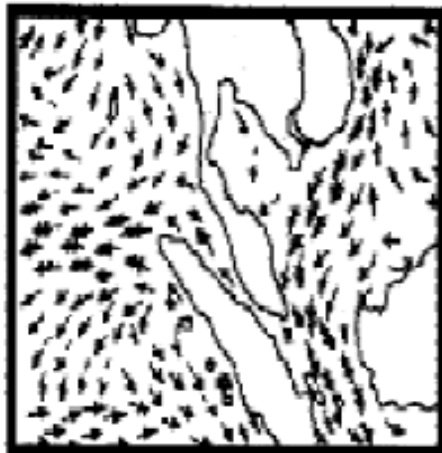
Water Circulation/Currents in
Andaman Sea



A1: Northeast Monsoon



A2: Southwest Monsoon



B1: Northeast Monsoon



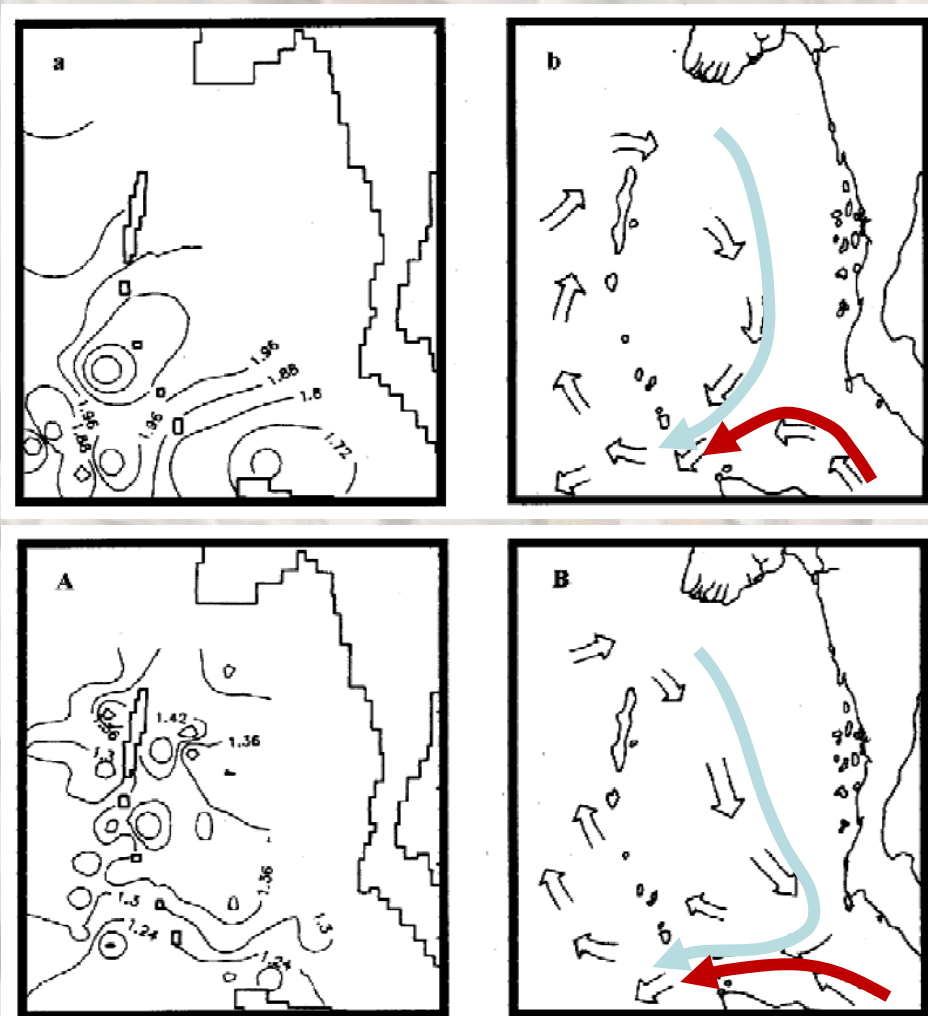
B2: Southwest Monsoon

Role of Monsoon on water circulation in Indian Ocean and Andaman Sea (Wind Driven Currents)

(adapted from Soegiarto 1985)

Oceanographic phenomena in Andaman

Monsoon: Northeast and Southwest Monsoon: water circulation

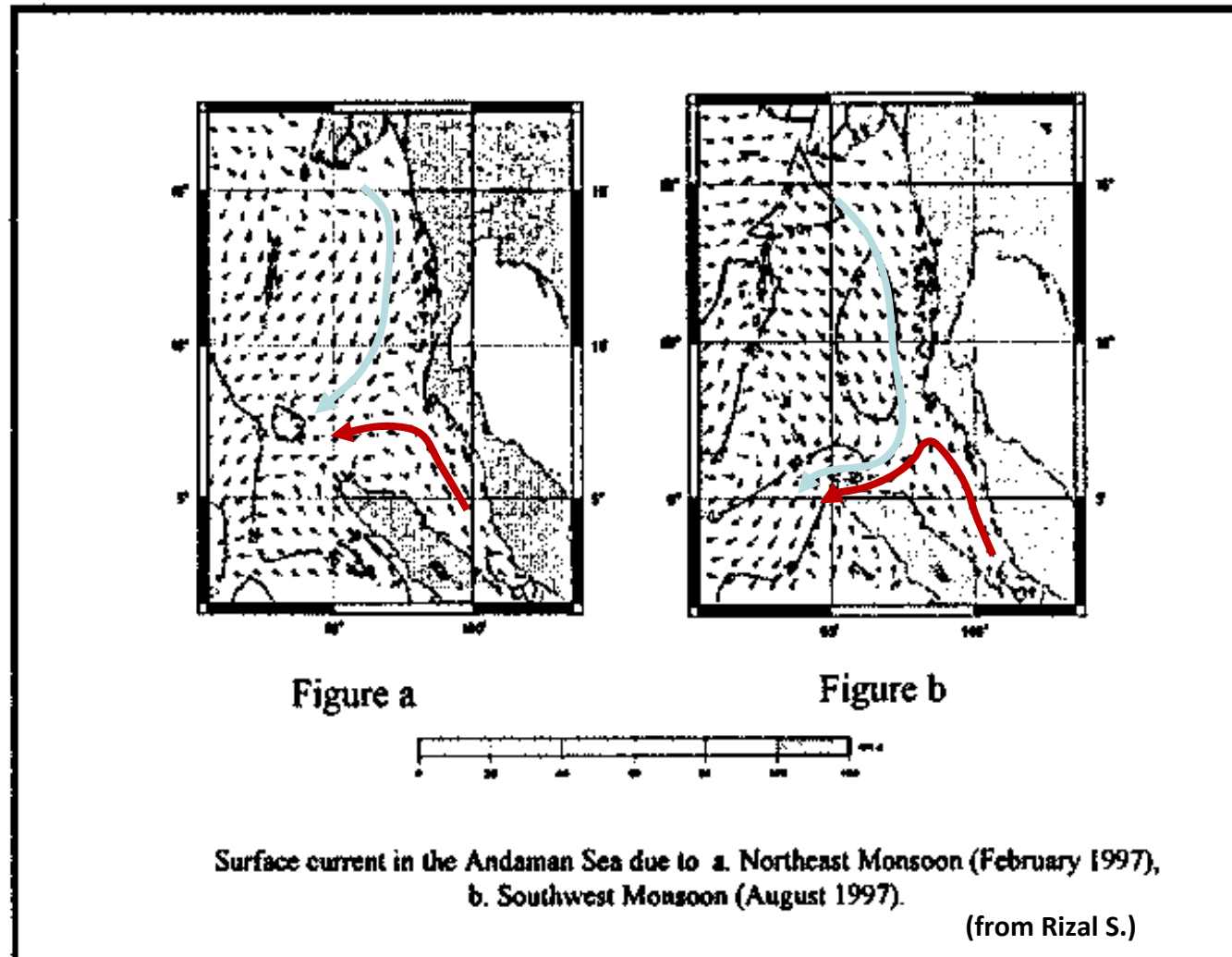


Showing water circulations during **Northeast Monsoon** which is base on dynamic topography (0/1000m); (a) the contour line of dynamic topography; and (b) the water circulation which is adapted from (a).

Showing water circulations during **Southwest Monsoon** which is base on dynamic topography (0/1000m); (a) the contour line of dynamic topography; and (b) the water circulation which is adapted from (a)

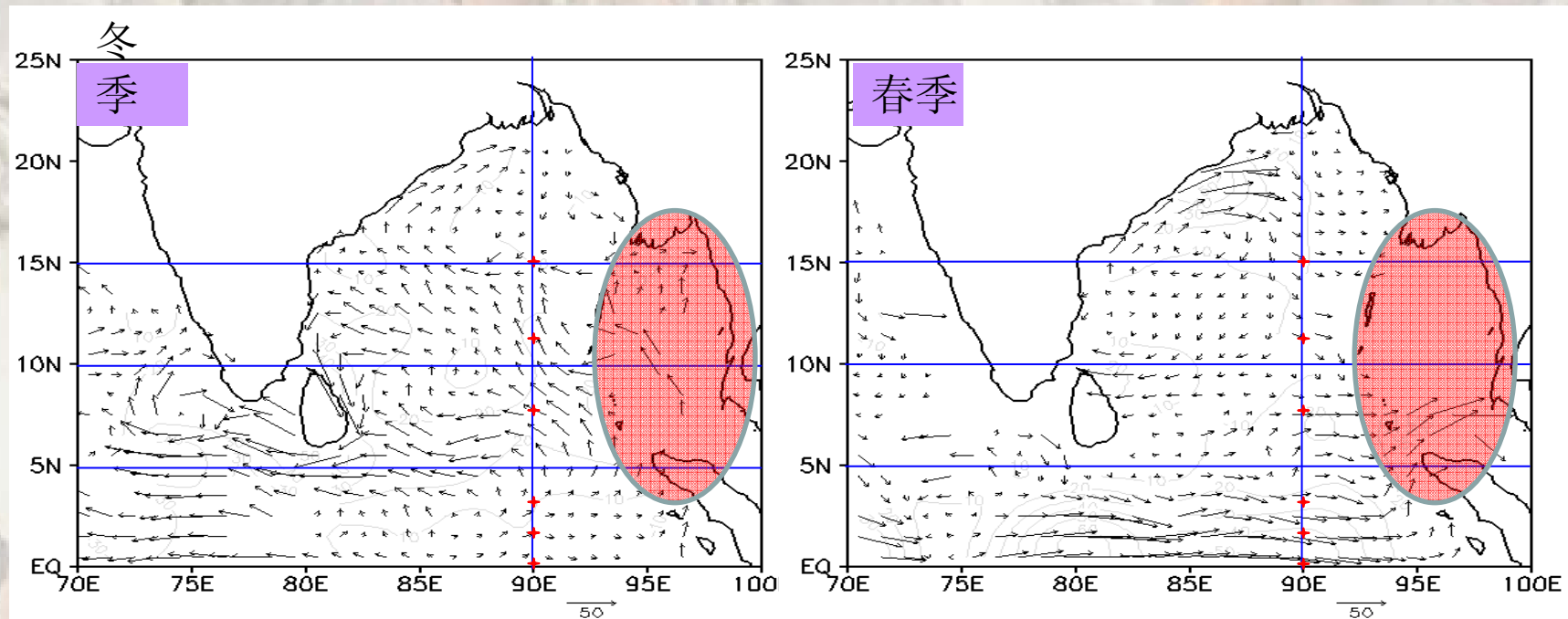
Oceanographic phenomena in Andaman

Monsoon: Northeast and Southwest Monsoon: water circulation



Oceanographic phenomena in Andaman

Monsoon: Northeast and Southwest Monsoon: water circulation



From presentation of Weidong Yu on the second expert meeting August 2009

Oceanographic phenomena in Andaman

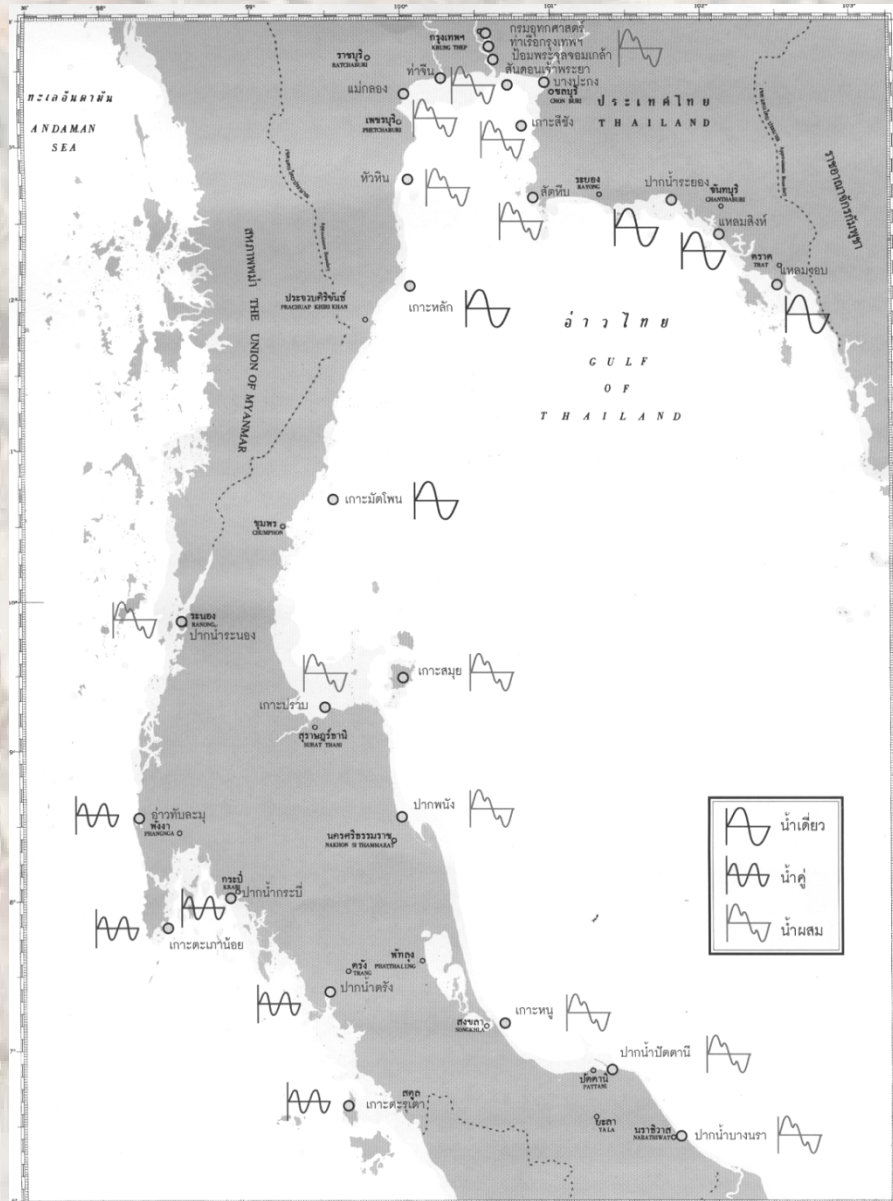
Coastal Water Circulation:

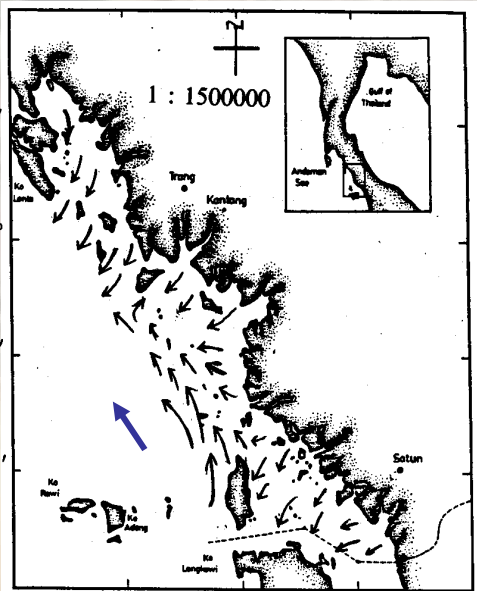
Strong Tidal Current is in Near-shore



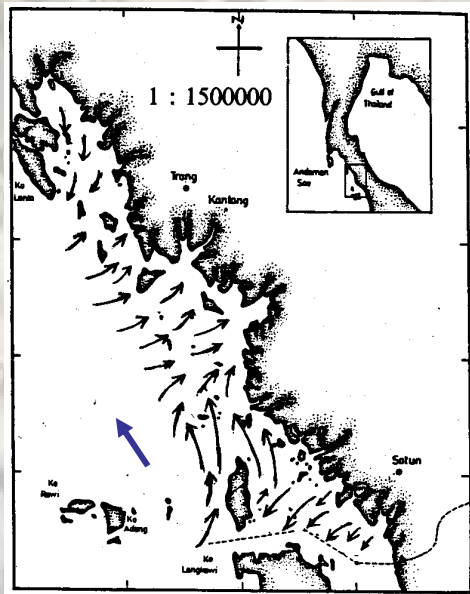
Oceanographic phenomena in Andaman

Tide in Andaman Sea is predominant by semidiurnal, which tidal range is approximately 2 meters.

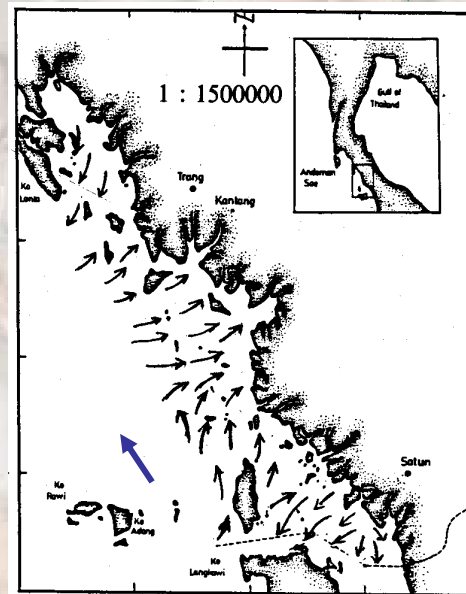




Surface



5 m dept

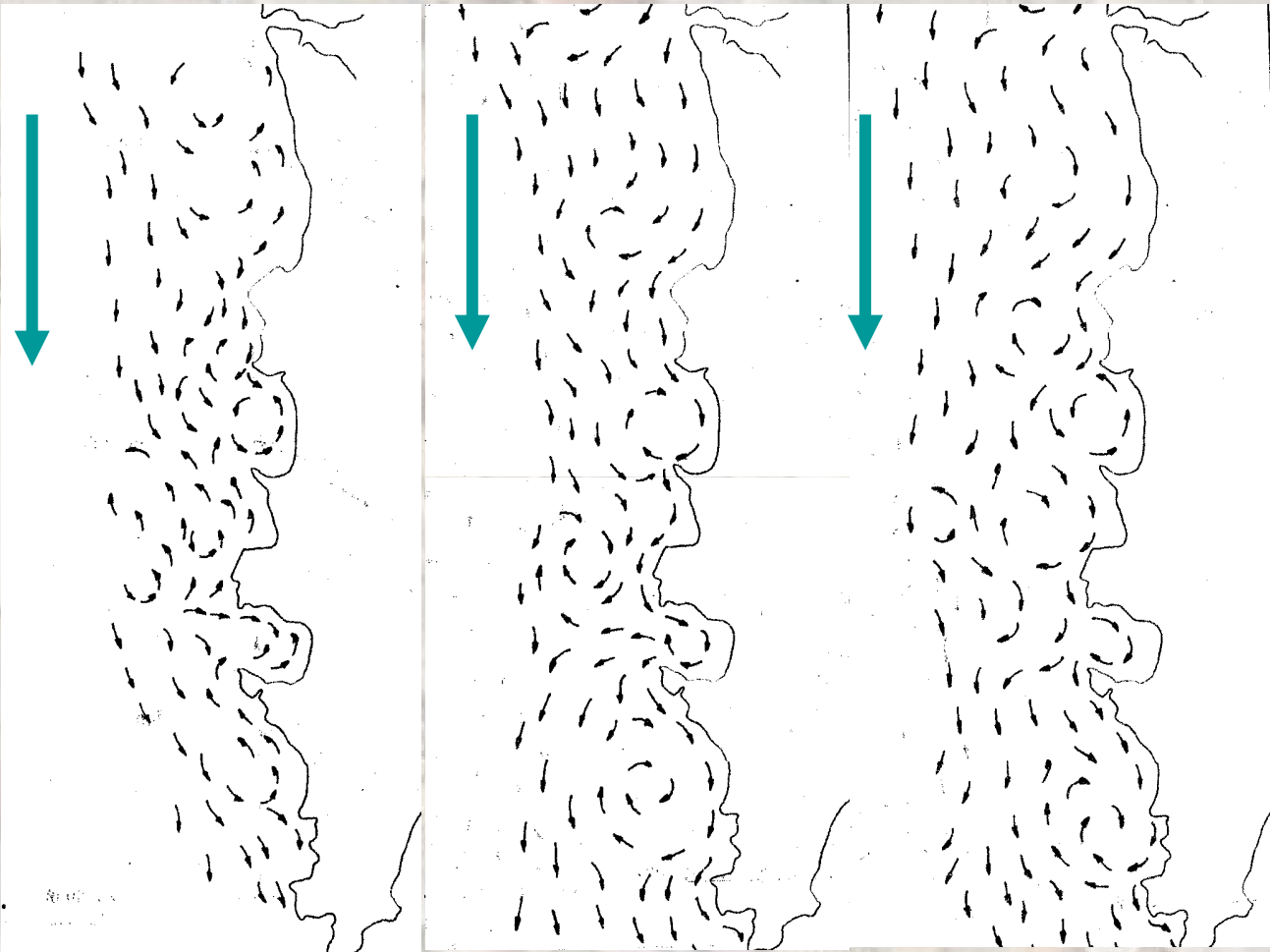


Bottom



Oceanographic phenomena in Andaman

Coastal Water Circulation:

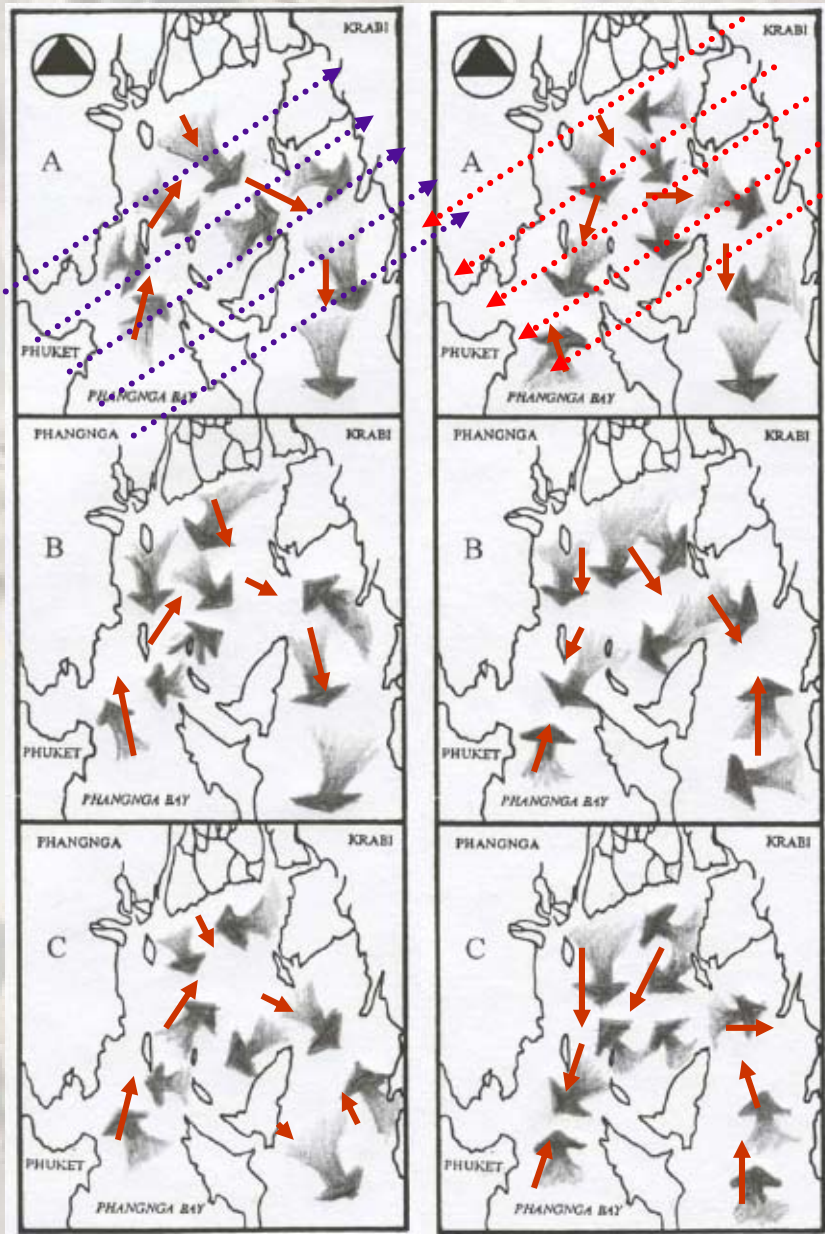


Surface

Mid

Bottom





SW-Monsoon

NE-Monsoon

Coastal Water Circulation:

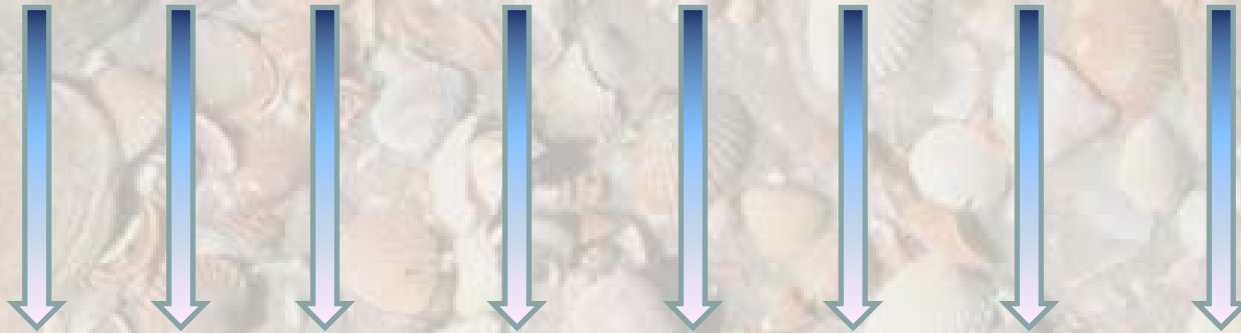
Water circulation in Phangnga Bay



Nearshore: tidal current

Offshore: wind-driven current

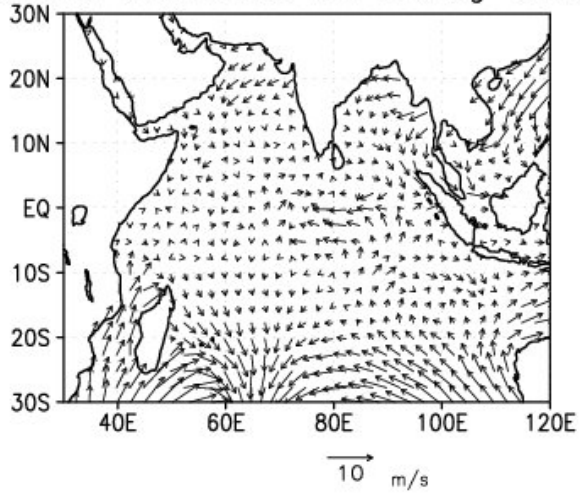
Oceanographic Feature in Andaman Sea



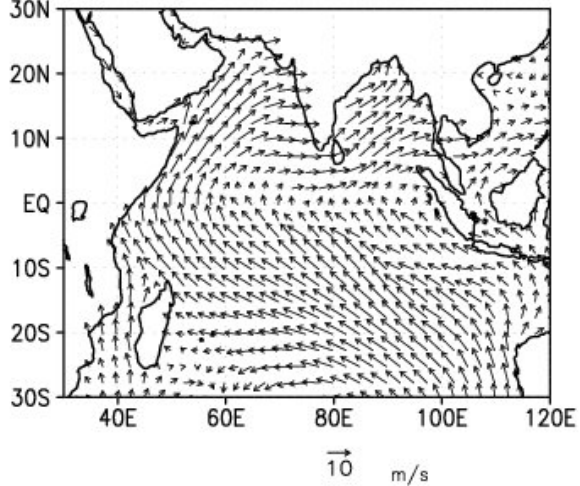
MONSOON

Summer (SW)/Winter (NE) Monsoon

Qscat wind anomalies for 24Aug–31Aug2009

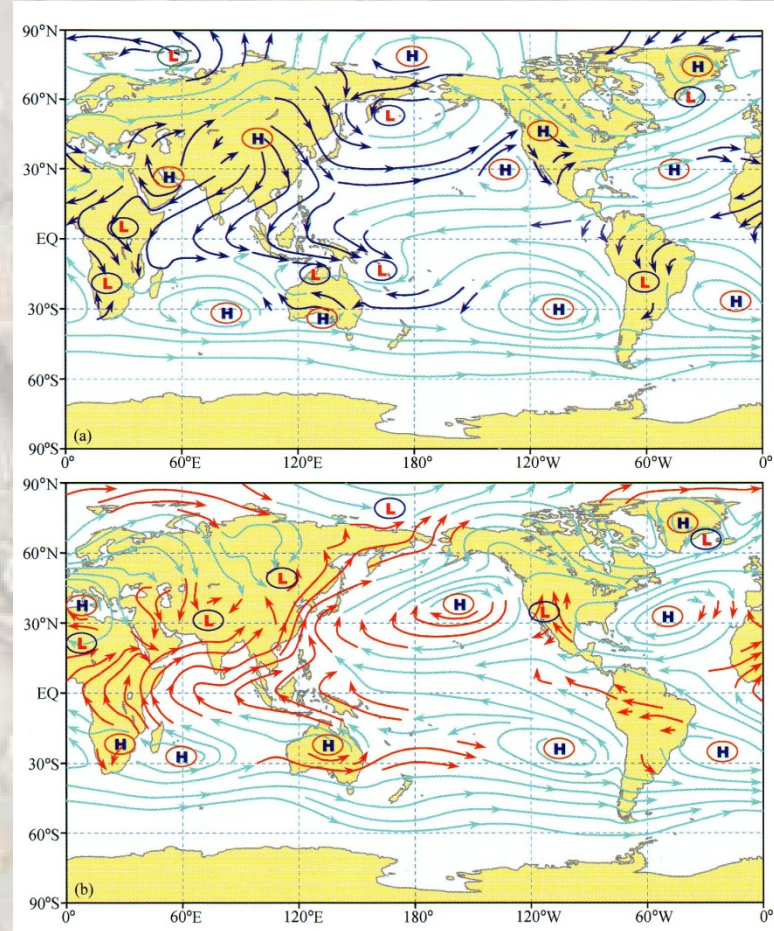


Qscat wind for 24Aug–31Aug2009

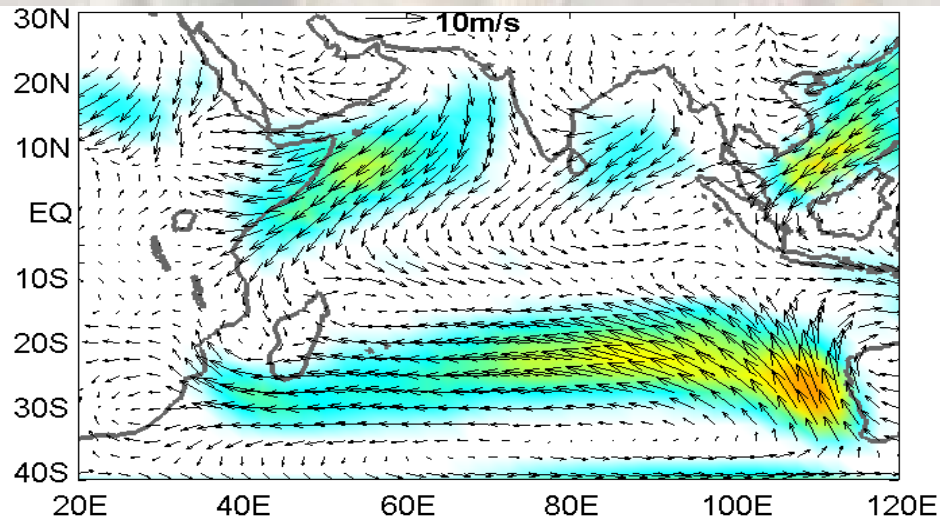


Observe by Quick Scat Remote Sensing

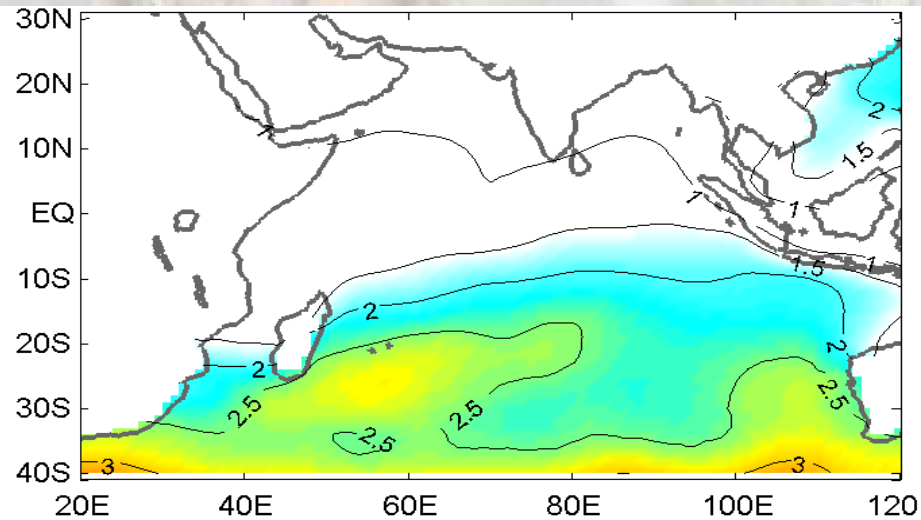
Winter/Northeast Monsoon



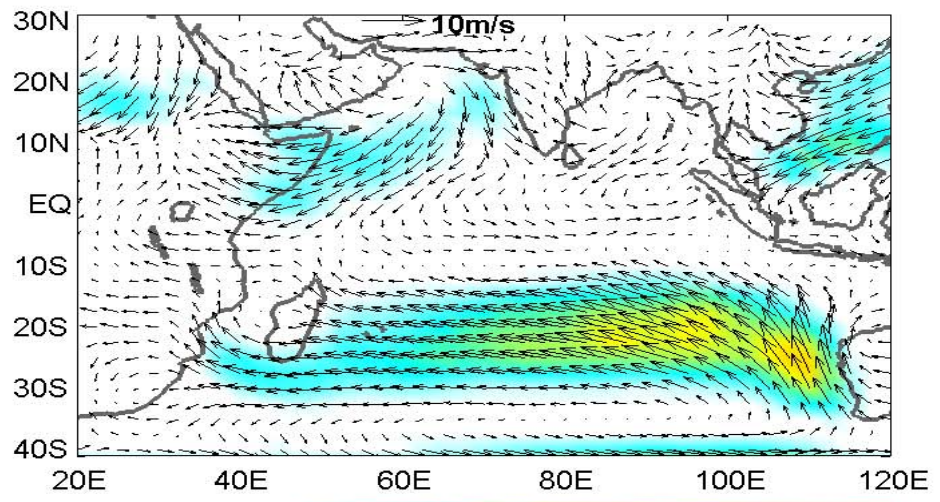
Summer/Southwest Monsoon



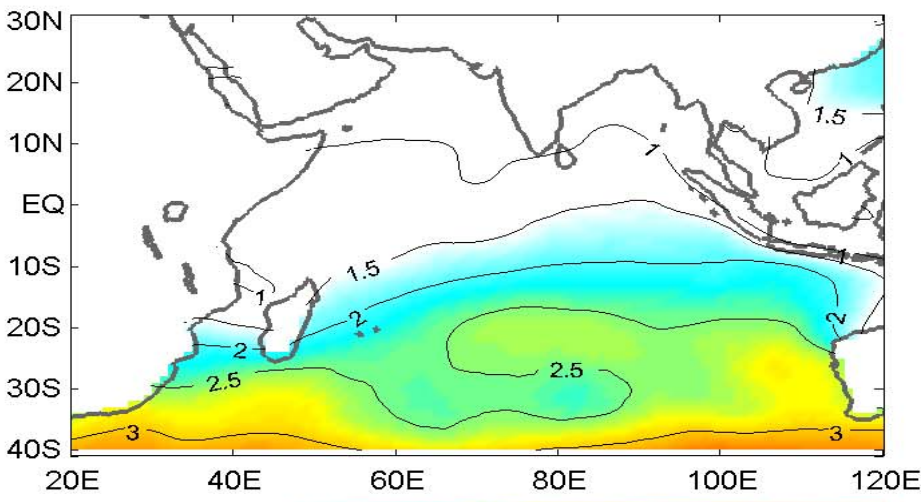
Mar.
 0 5 10 15
 Surface wind



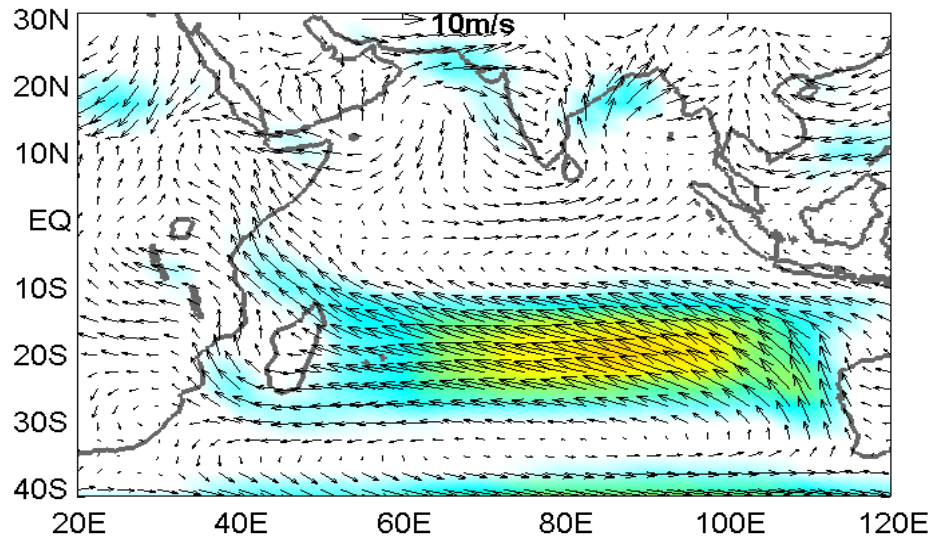
1 2 3 4
 Significant Wave height



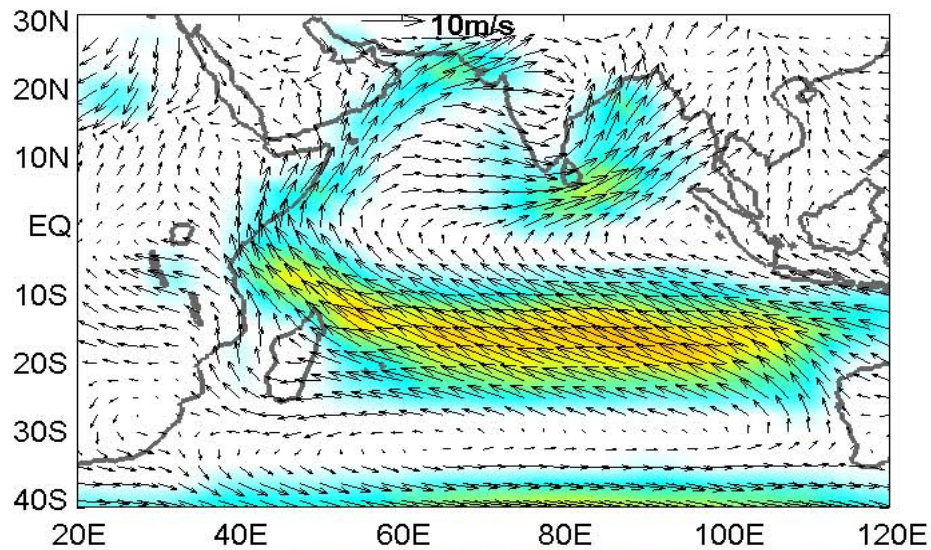
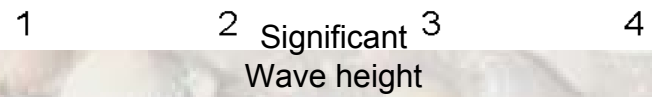
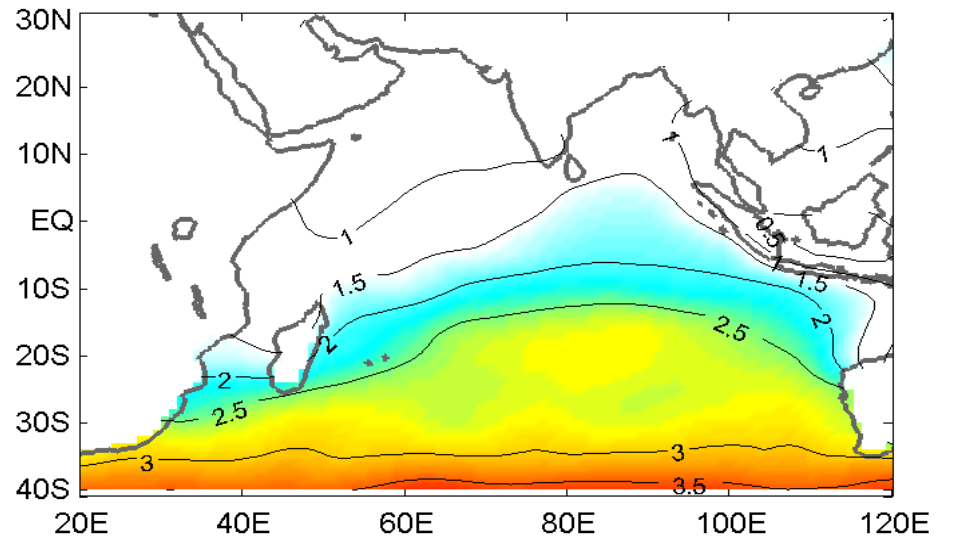
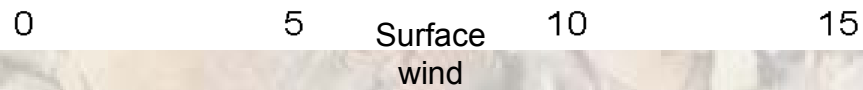
Apr.
 0 5 10 15
 Surface wind



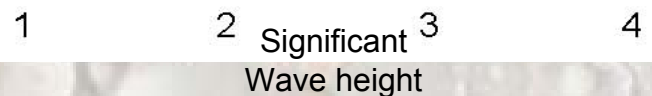
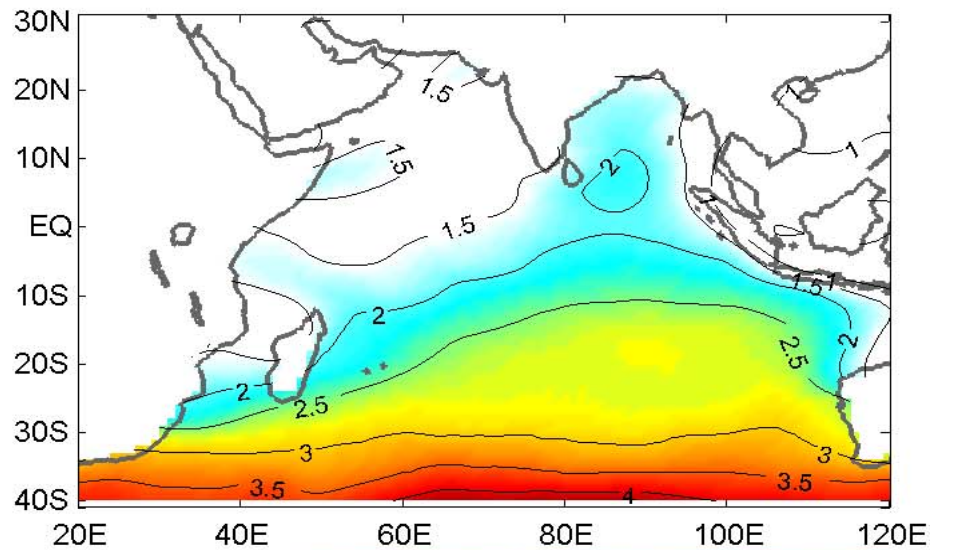
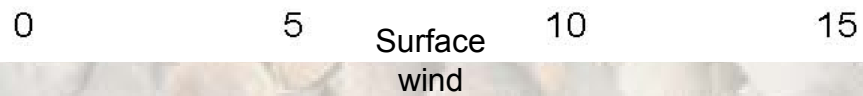
1 2 3 4
 Significant Wave height

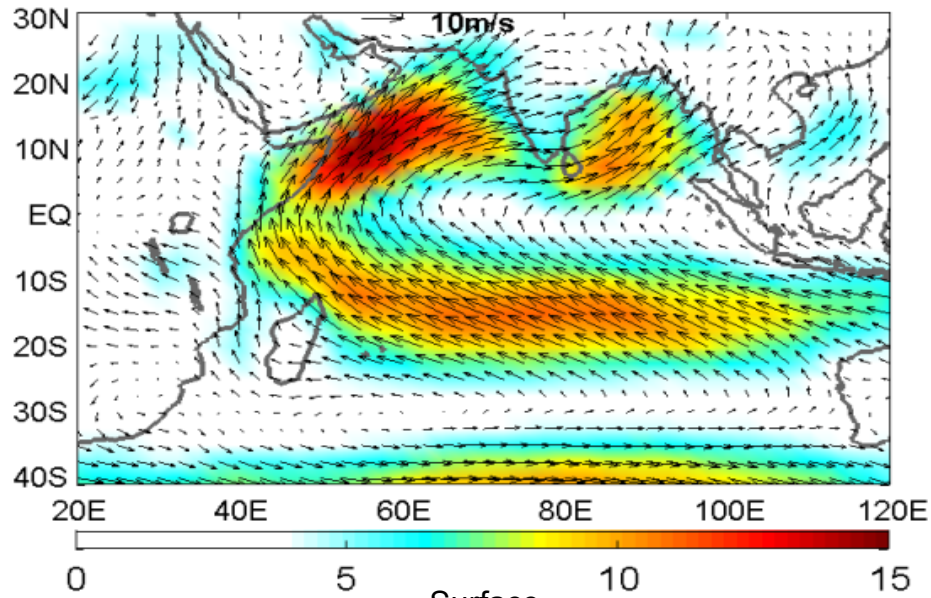


May

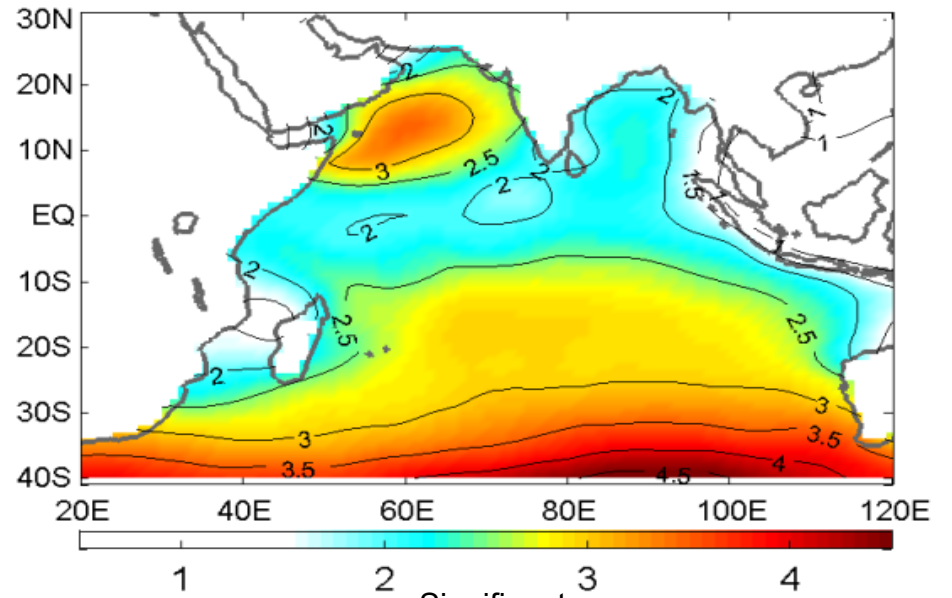


Jun.

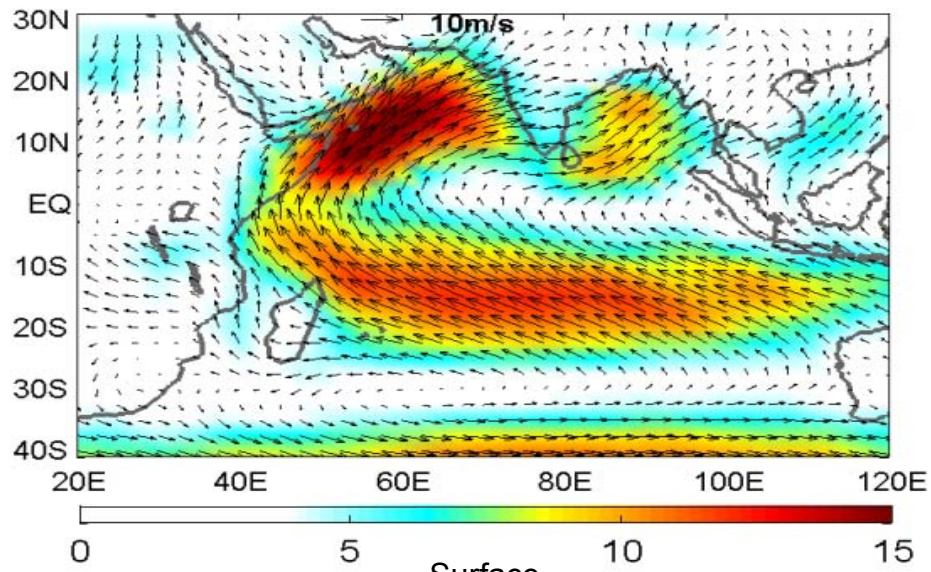




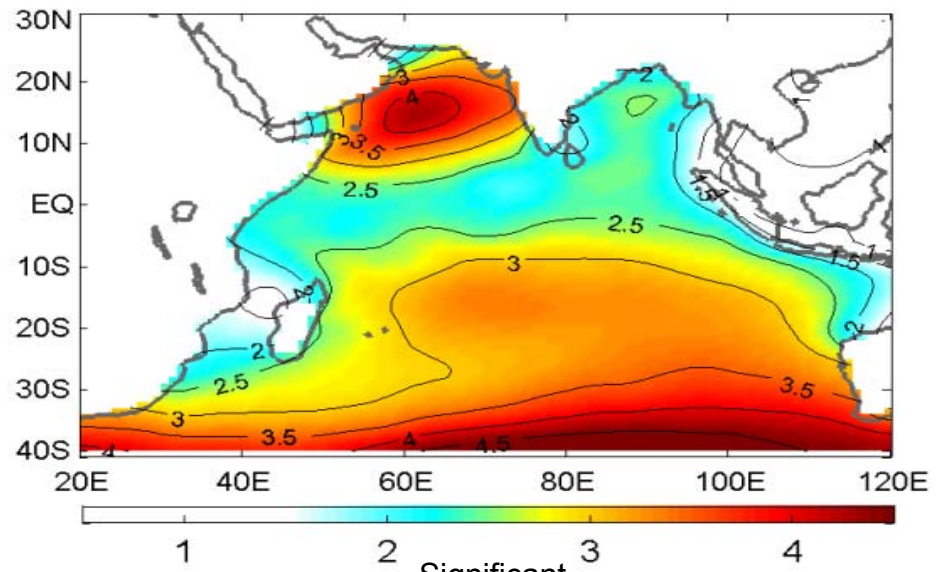
Surface
wind



Significant
Wave height

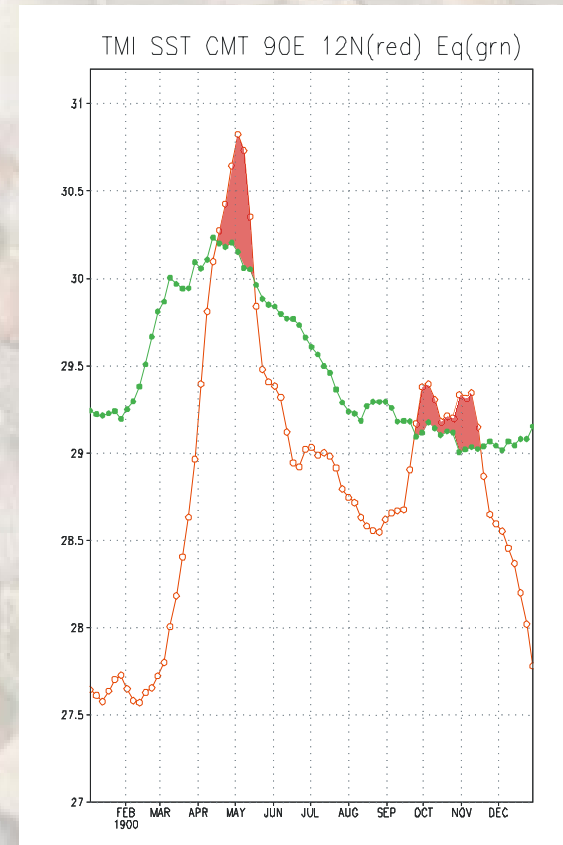
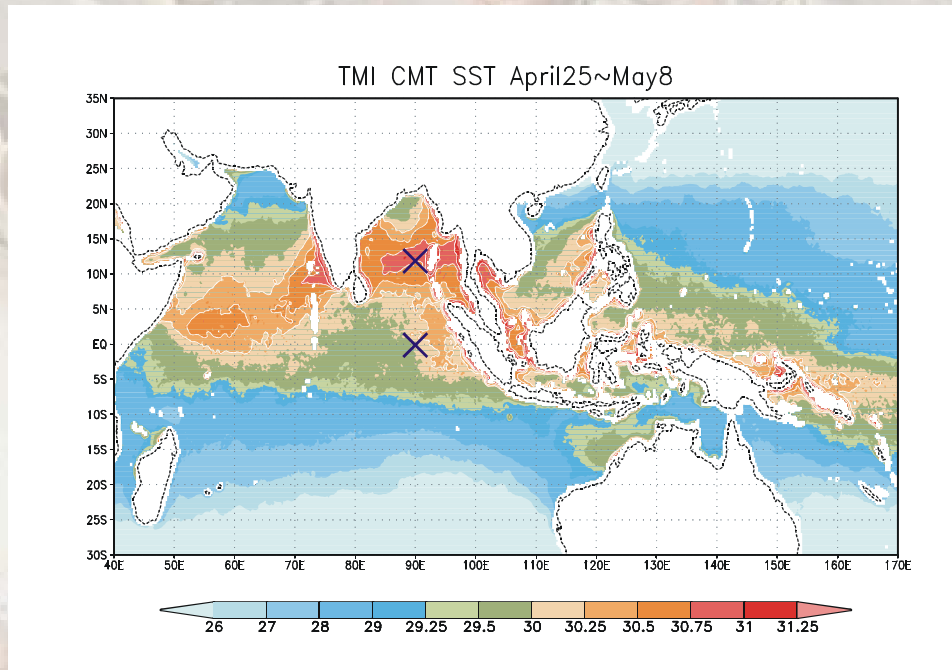


Surface
wind

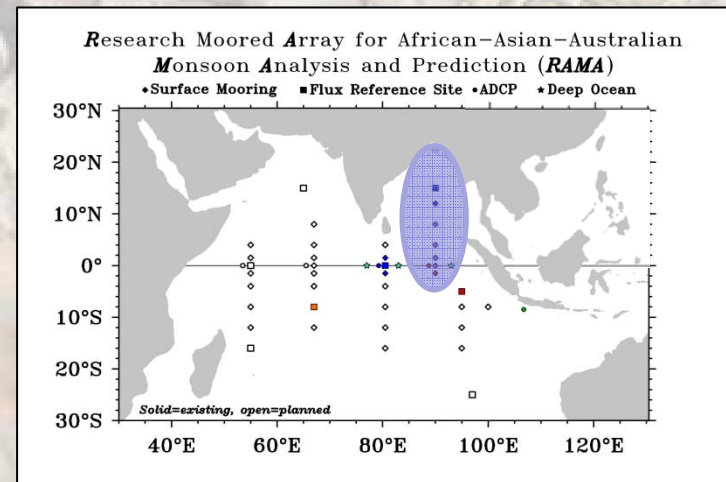
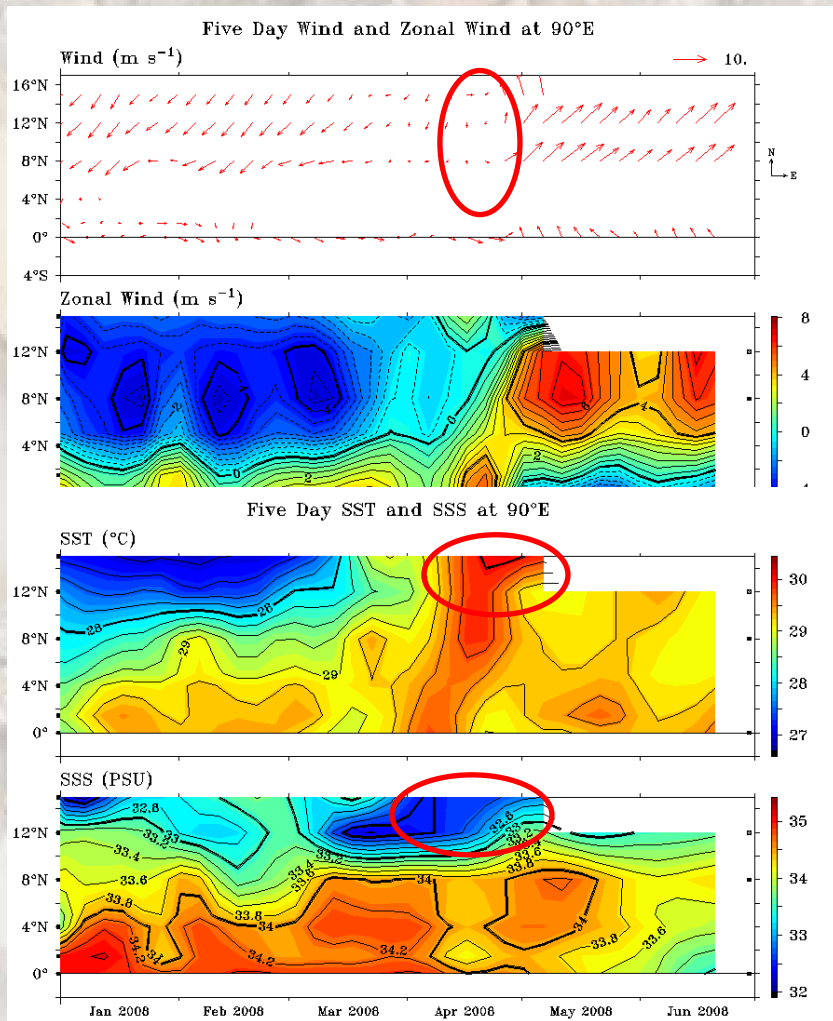


Significant
Wave height

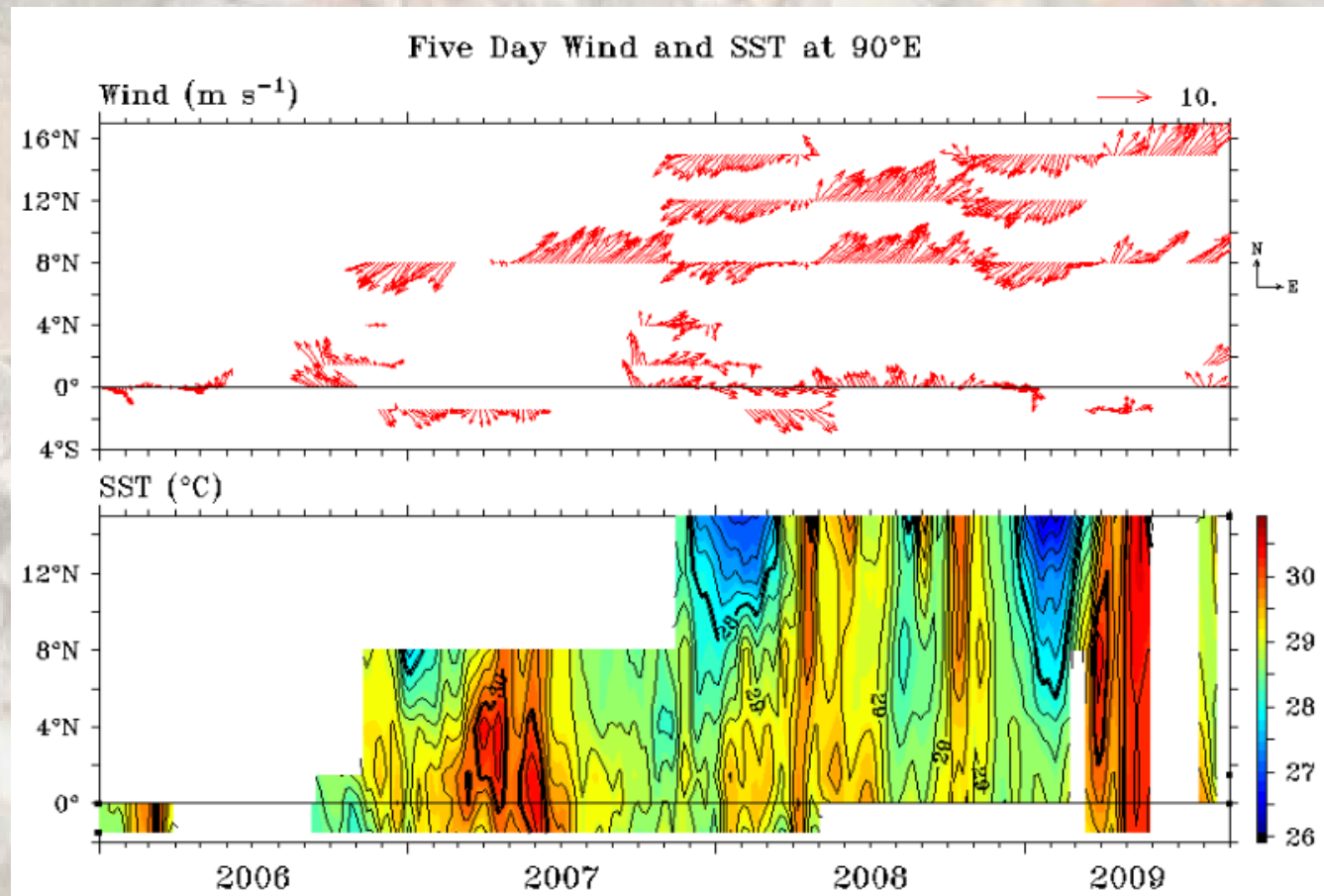
ROLE OF OCEANOGRAPHY ON MONSOON ONSET IN BAY OF BENGAL AND ANDAMAN SEA



ROLE OF OCEANOGRAPHY ON MONSOON ONSET IN BAY OF BENGAL AND ANDAMAN SEA



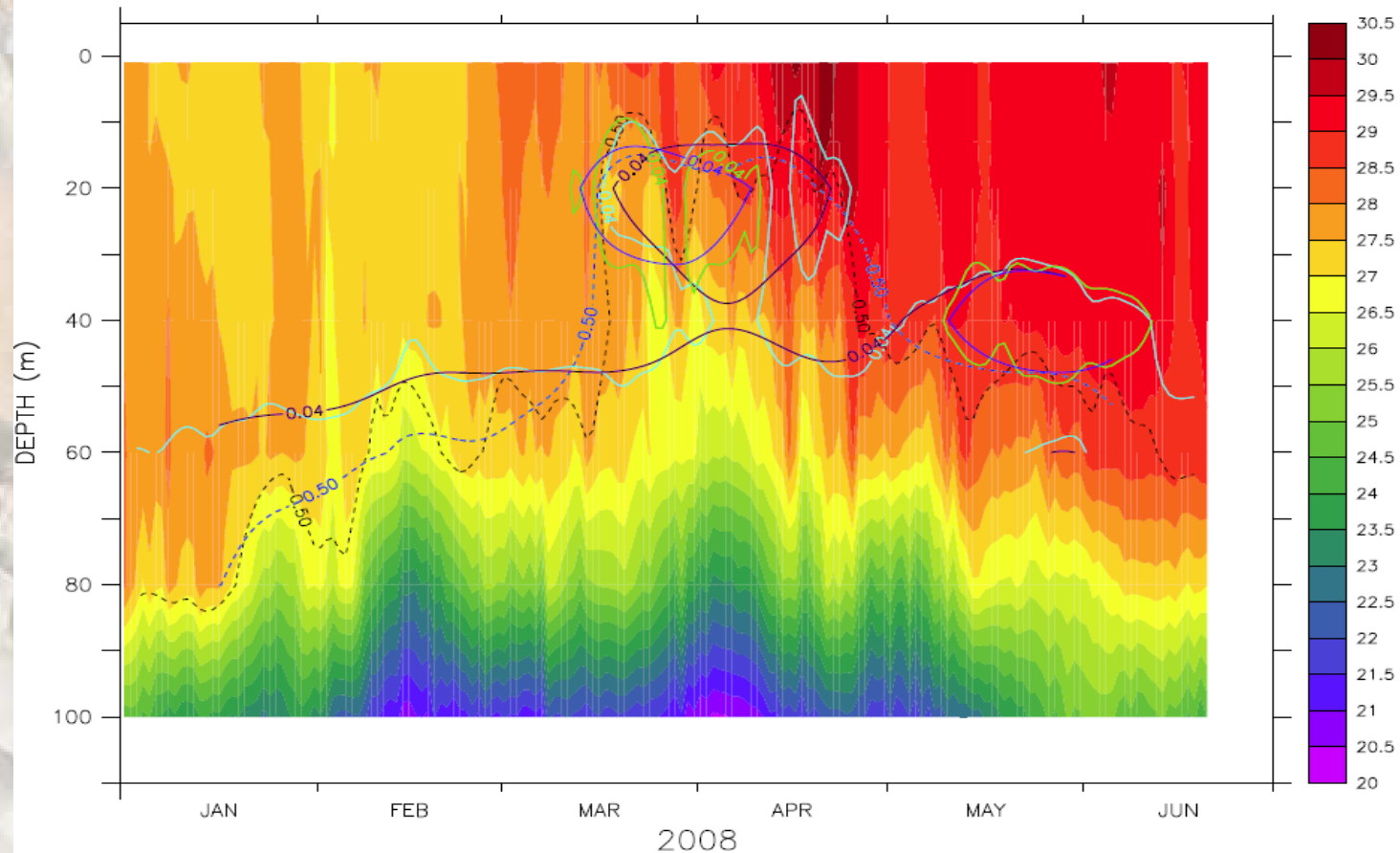
ROLE OF OCEANOGRAPHY ON MONSOON ONSET IN BAY OF BENGAL AND ANDAMAN SEA



ROLE OF OCEANOGRAPHY ON MONSOON ONSET IN BAY OF

LONGITUDE : 90E
LATITUDE : 12N

DATA SET: t12n90e_dy

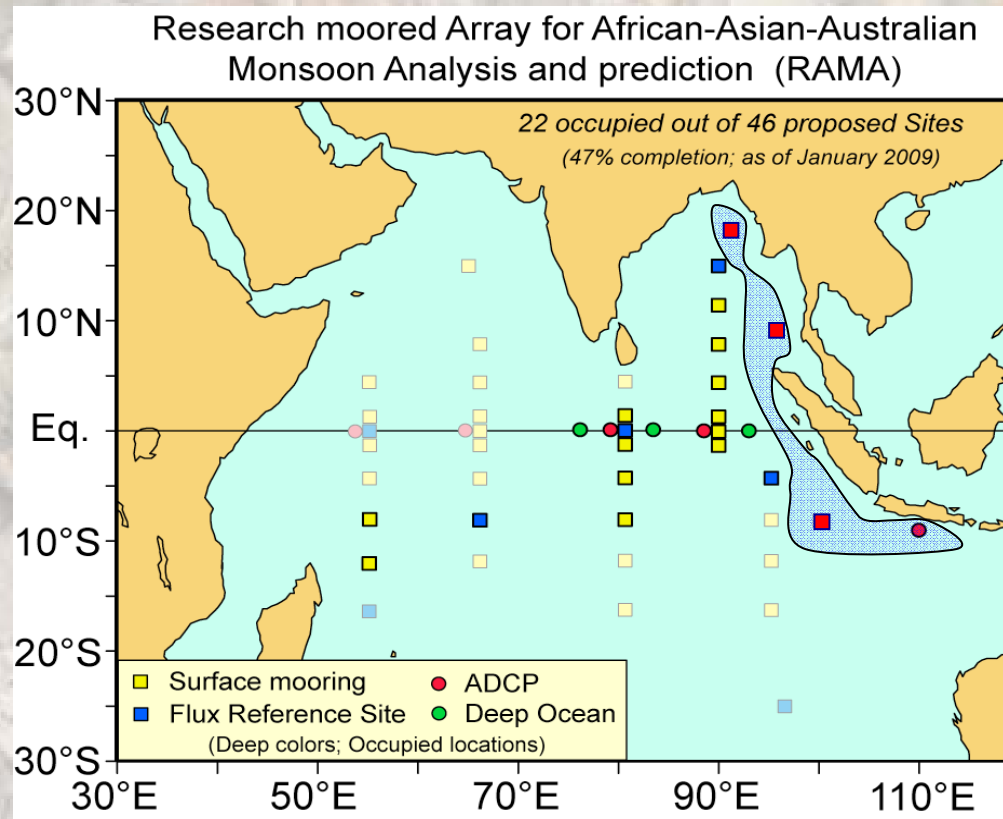


The base of mixed layer is represented by the dashed lines: black/blue (5/31 day running mean).

The maximum of vertical density gradient is shown by the pink and purple solid line (5/31 day running mean).

The maximum of vertical salinity gradient is shown by the green and blue solid line (5/31 day running mean).

ROLE OF OCEANOGRAPHY ON MONSOON ONSET IN BAY OF BENGAL AND ANDAMAN SEA



Oceanographic Feature in Andaman Sea



INTERNAL WAVE

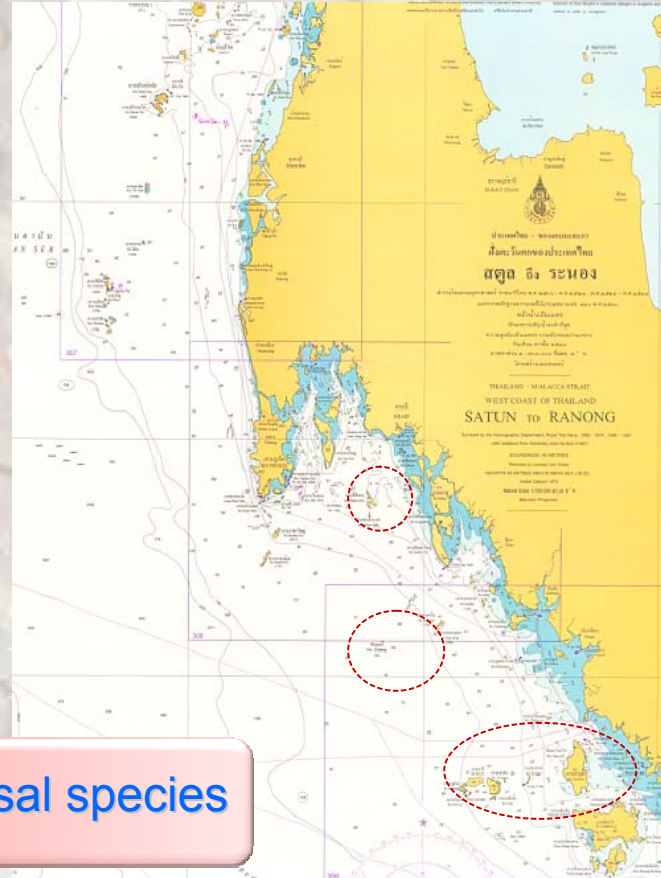


Internal wave in Andaman

Where did dead fishes find in Andaman Sea:
(during January to April 2007)

1. Phi Phi Island
2. Hin Moug-Hin Dang Island (Krabi Province)
3. Offshore of Satun Province

Note: there was also report of dead fishes found in Penang, Malaysia.

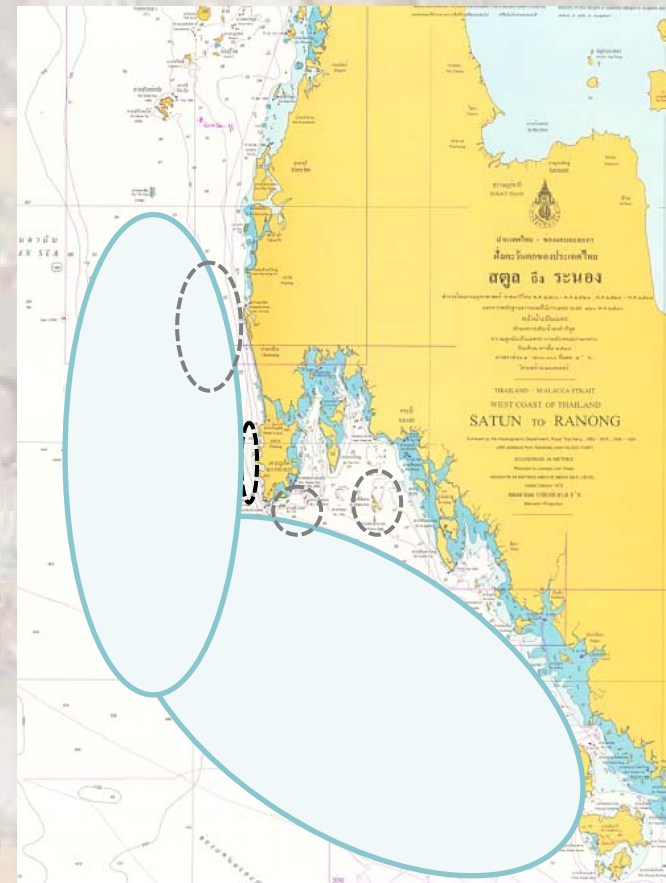


Most of dead fish and organism were demersal species

Internal wave in Andaman

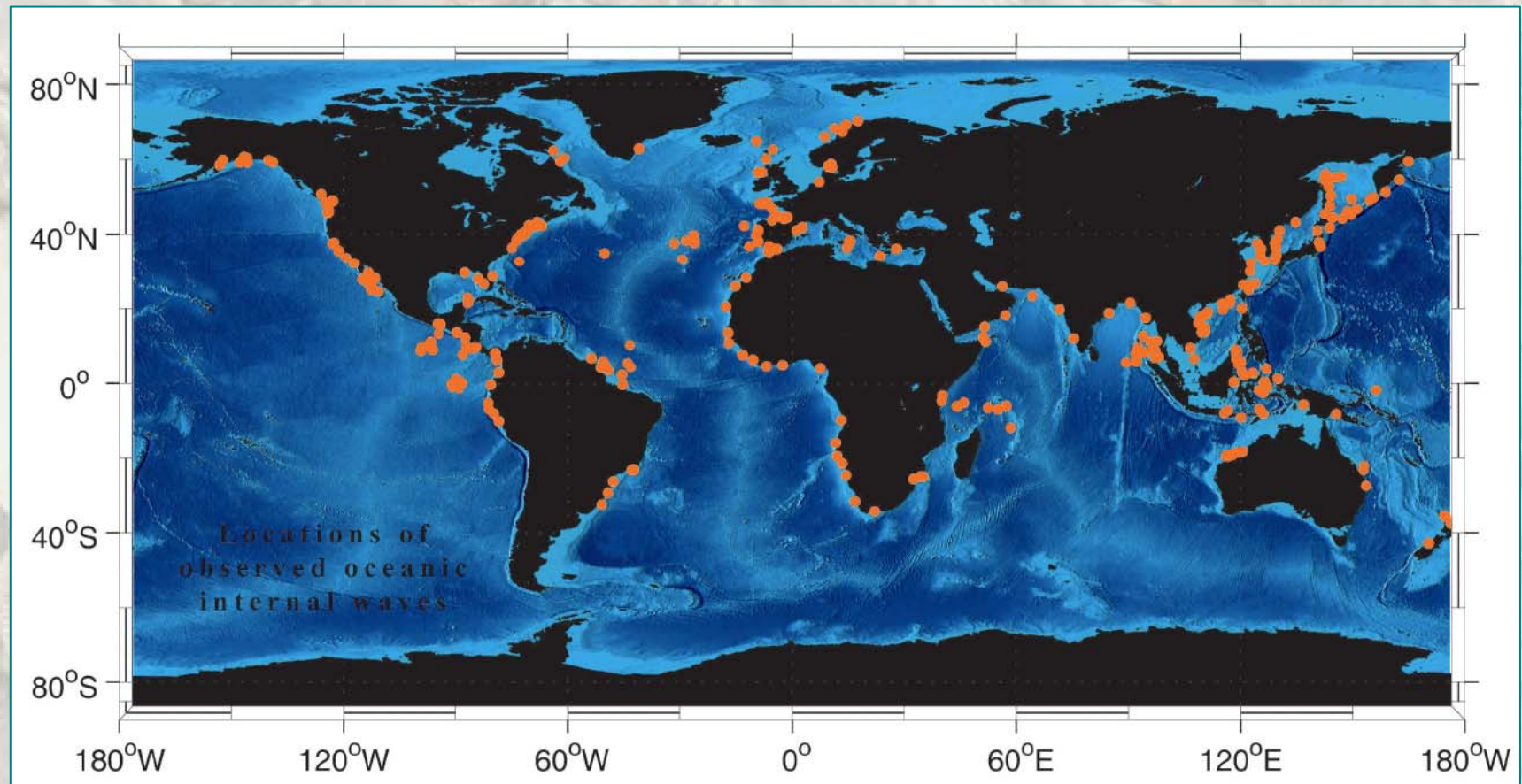
Coincide evidence during the period of dead fish:

1. Algae and Plankton bloom :
 - Patong Bay, Kata Beach, Naiyang Beach, Lone Island, Phi Phi Island, between main land and Simiulan Island etc.
 - Algae bloom is cause from increase of nutrient (as in some area is happen almost every year).
 - Plankton bloom is unusual: *Ceratium spp*, *Tricodesmiun spp*, and *Chaetoceros spp* etc.
2. Cool water mass was reported in many area.
3. Turbid water mass was reported in some area



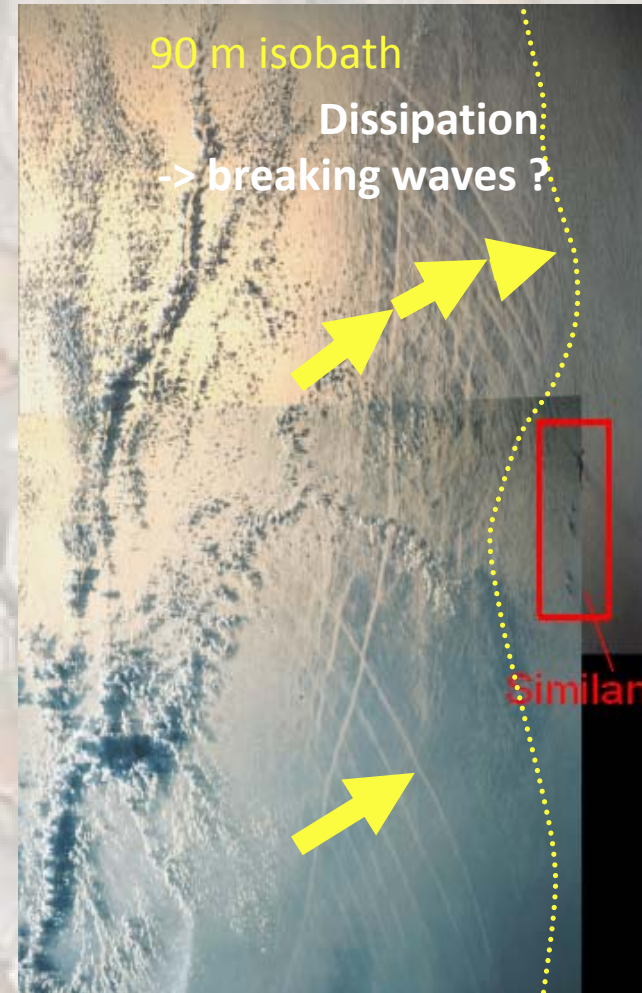
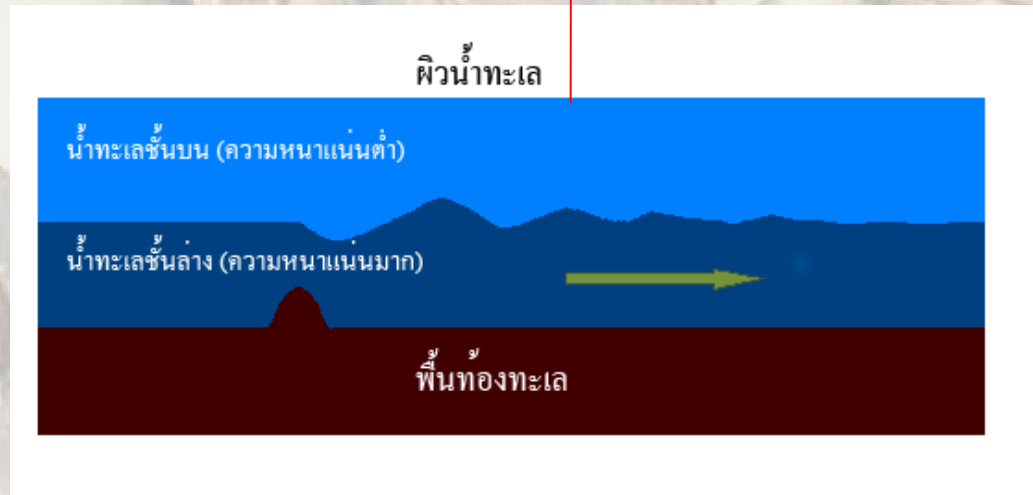
Internal wave in Andaman

Location of observed oceanic internal waves

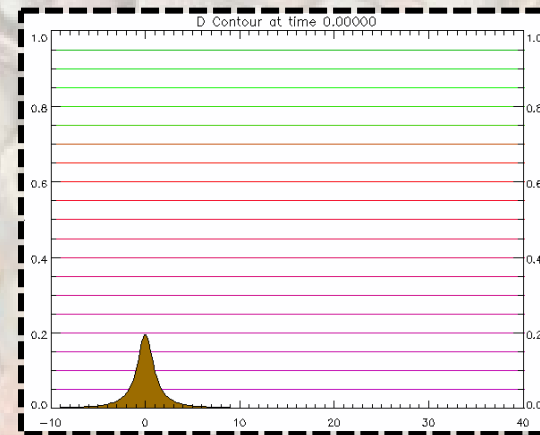
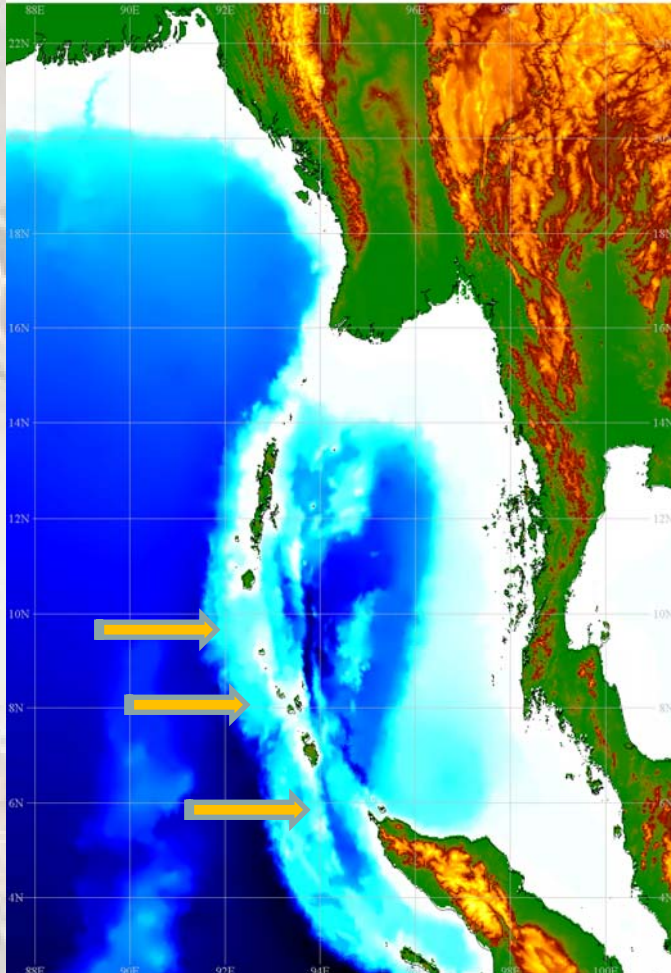


Internal wave in Andaman

Internal Wave



Internal wave in Andaman



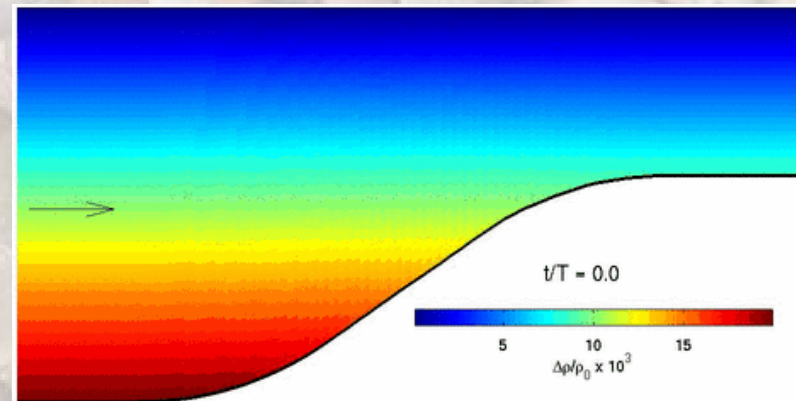
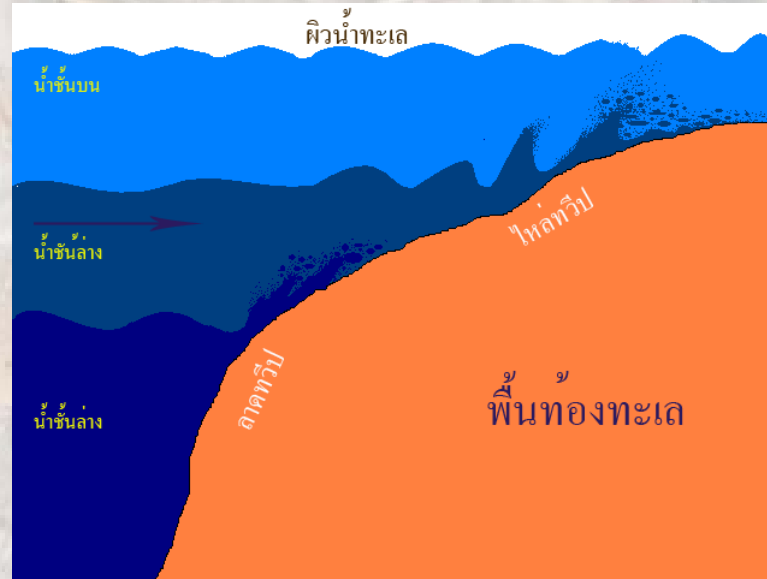
Internal wave in Andaman

Variability of pycnocline depth depend on season

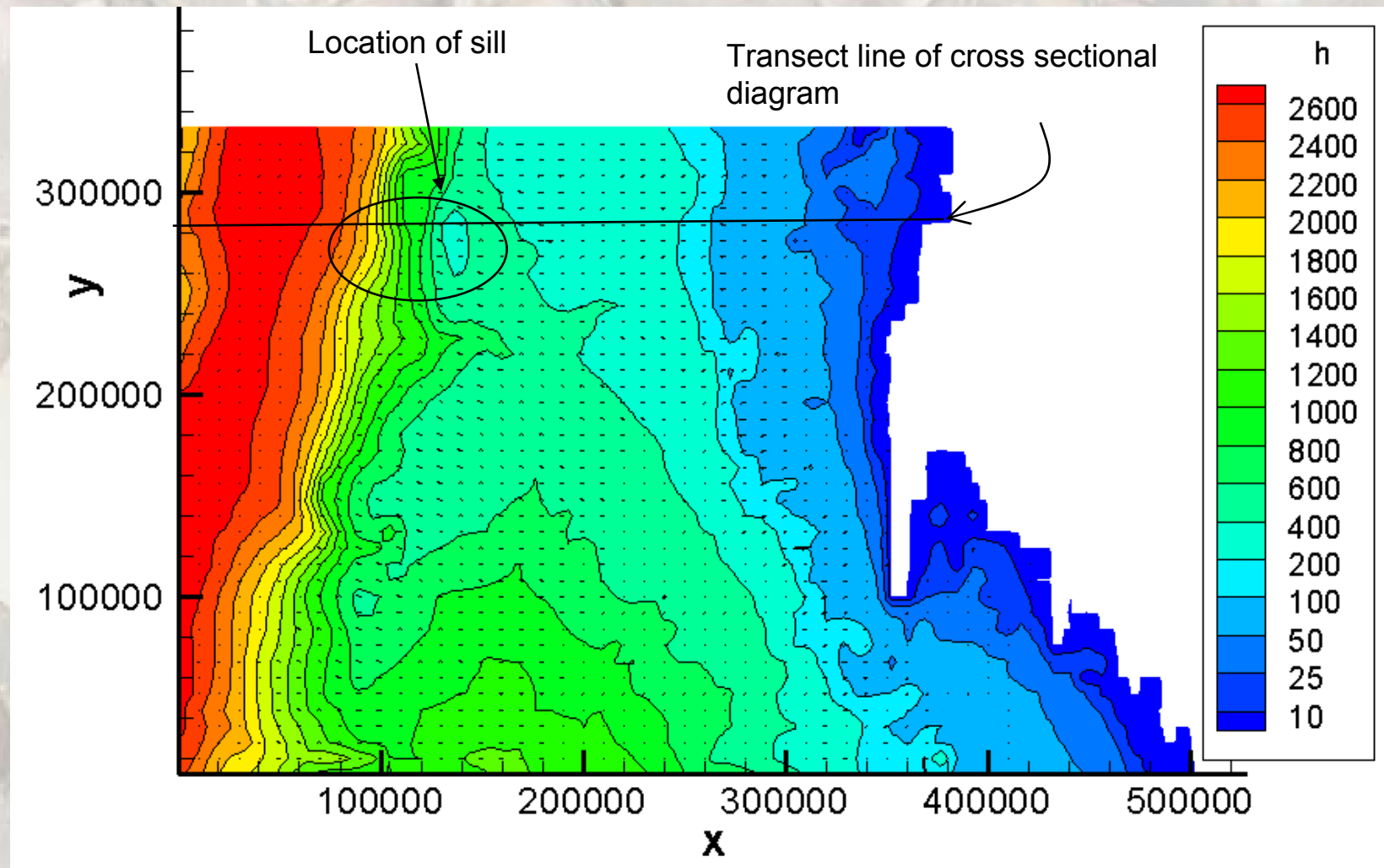


Pycnocline

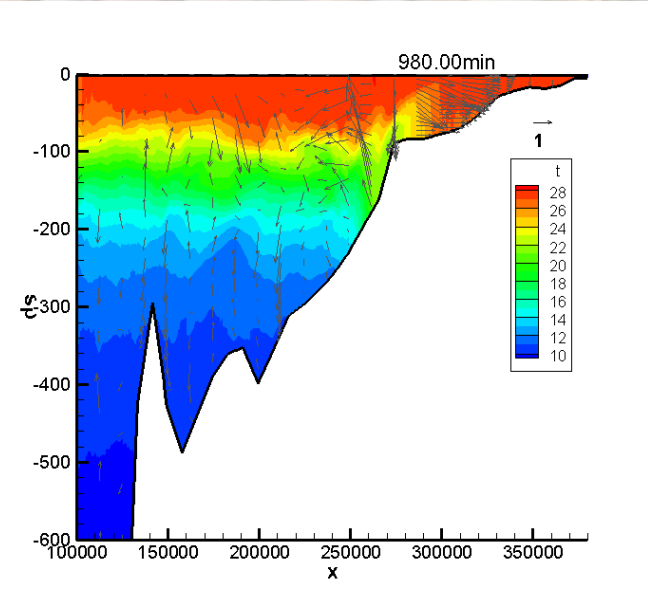
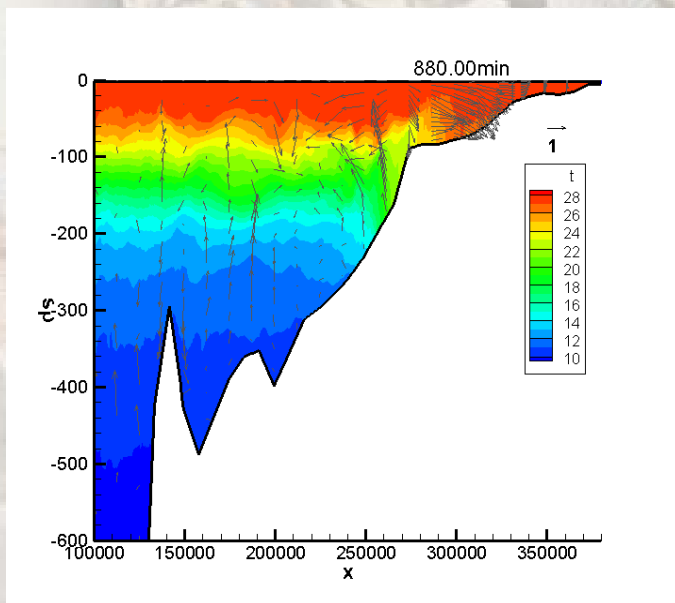
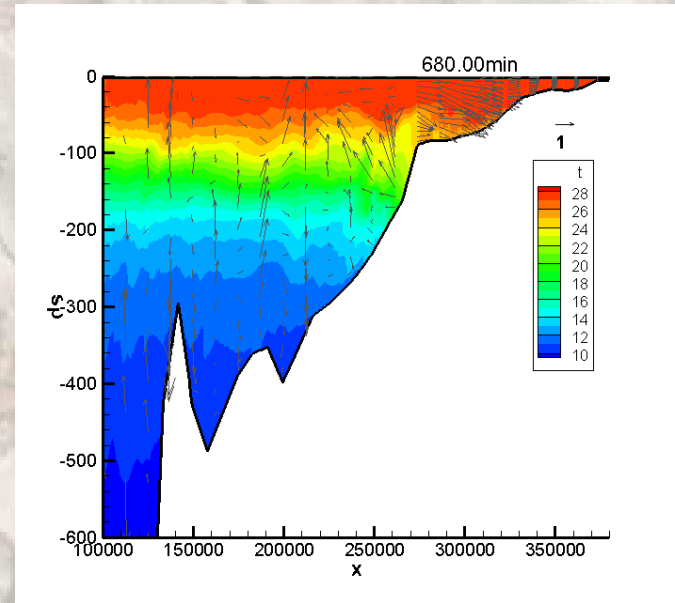
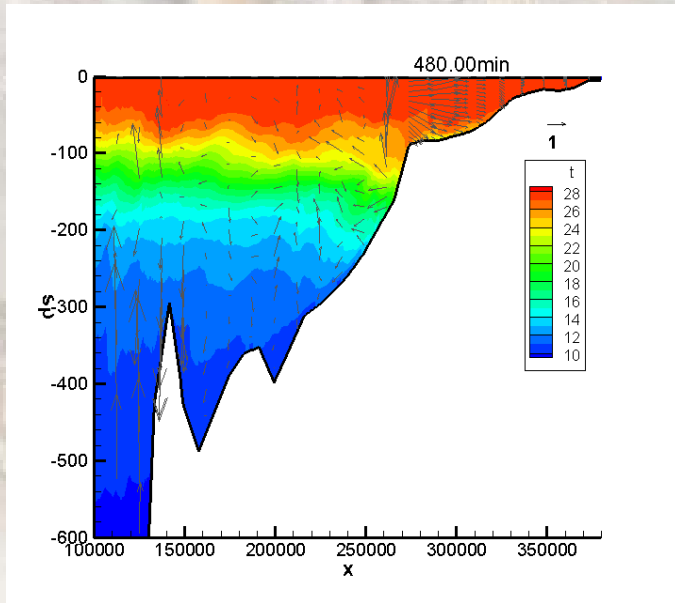
Pycnocline



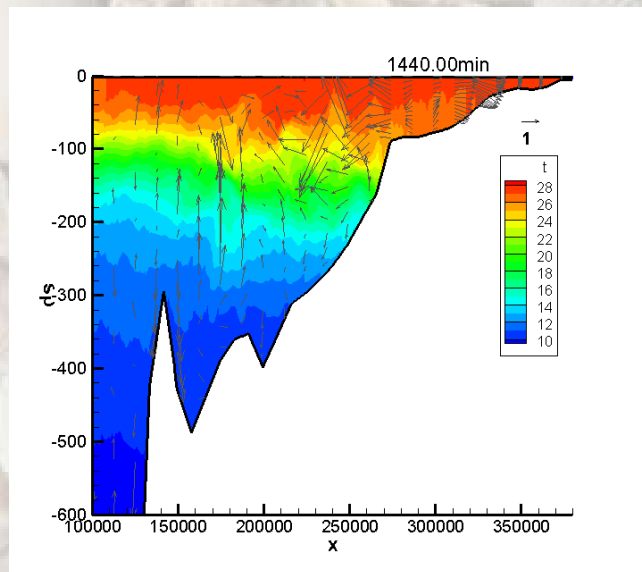
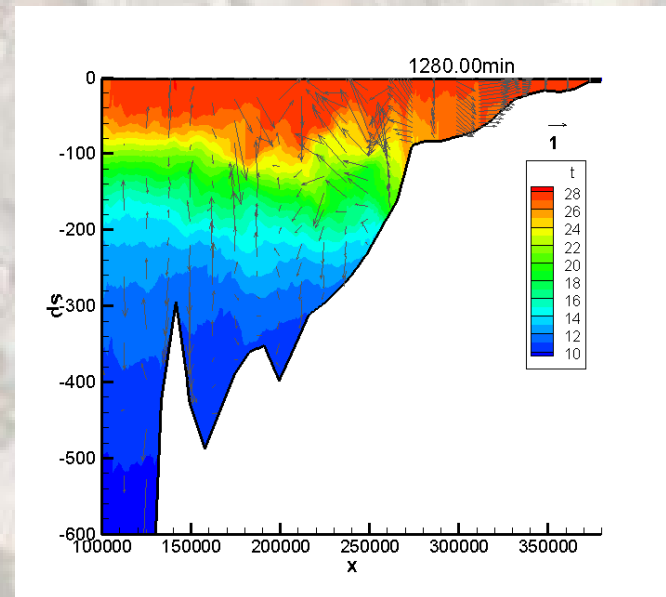
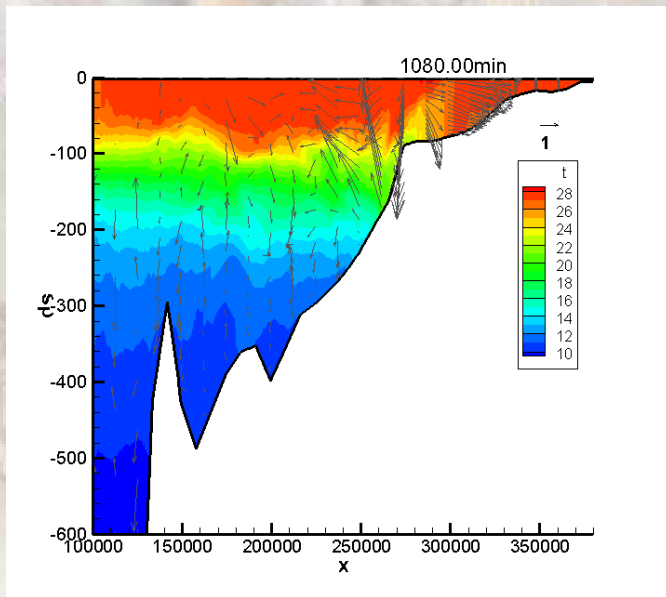
Internal wave in Andaman



Internal wave in Andaman



Internal wave in Andaman

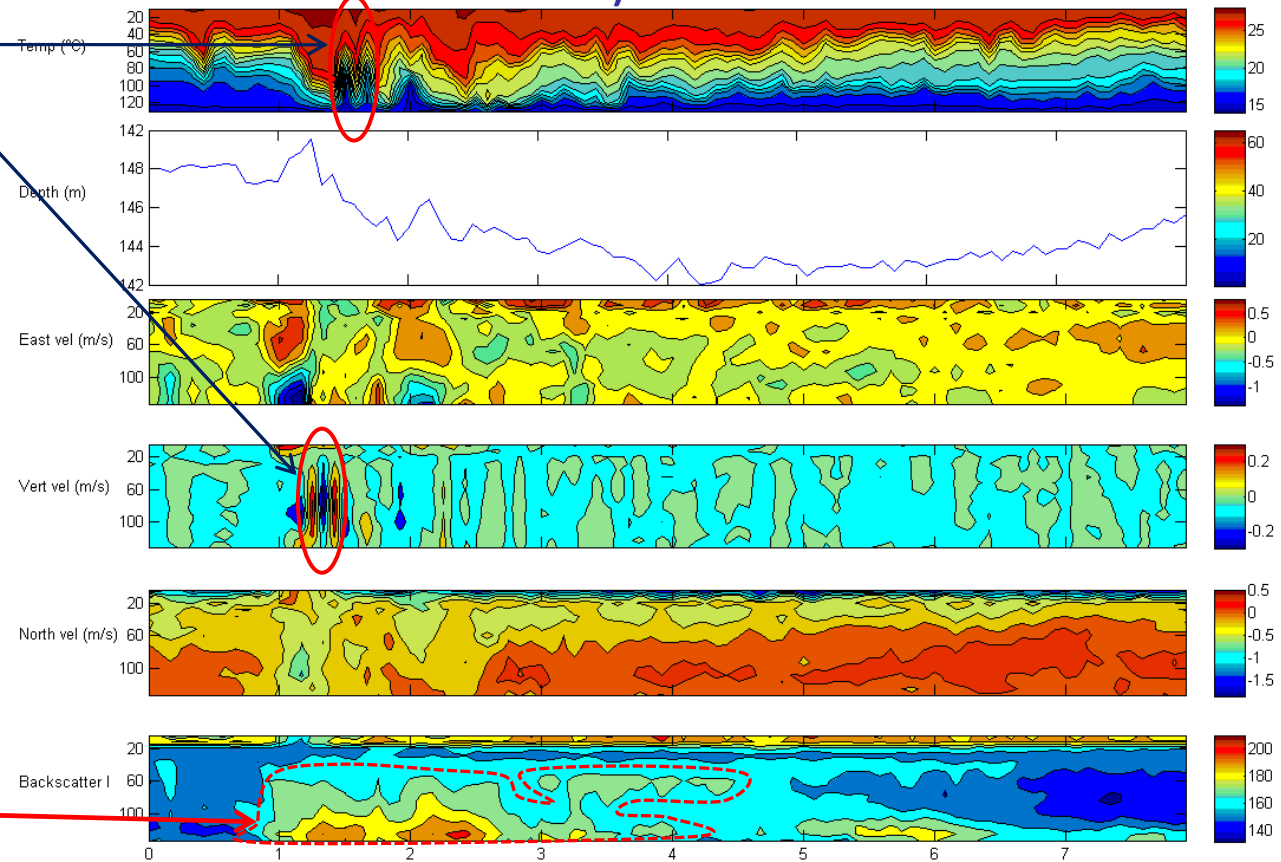


Internal wave in Andaman

Strong Internal Wave in Coastal Waters

Temperature, Depth, Current, Particles (8 h)

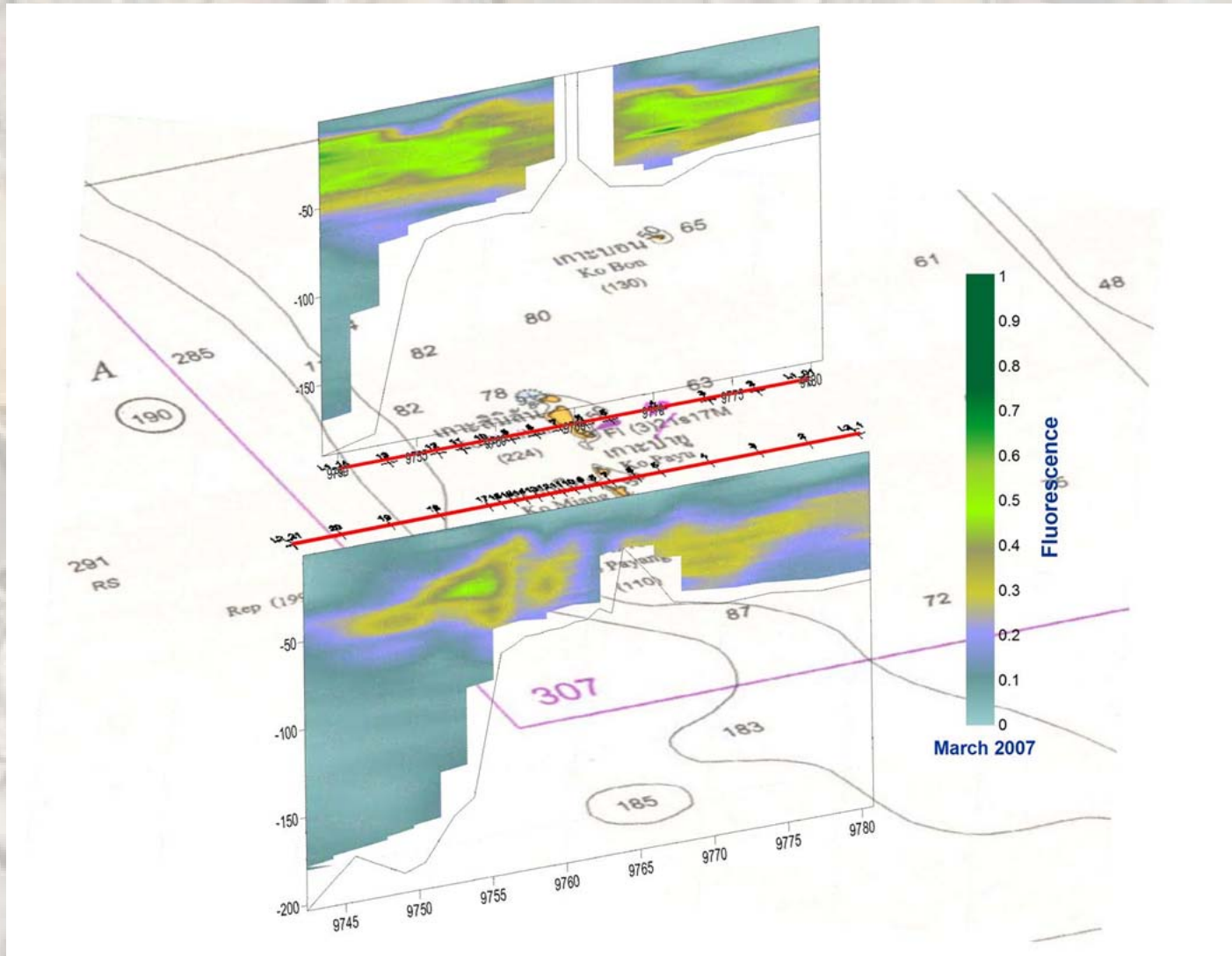
Movement of internal wave



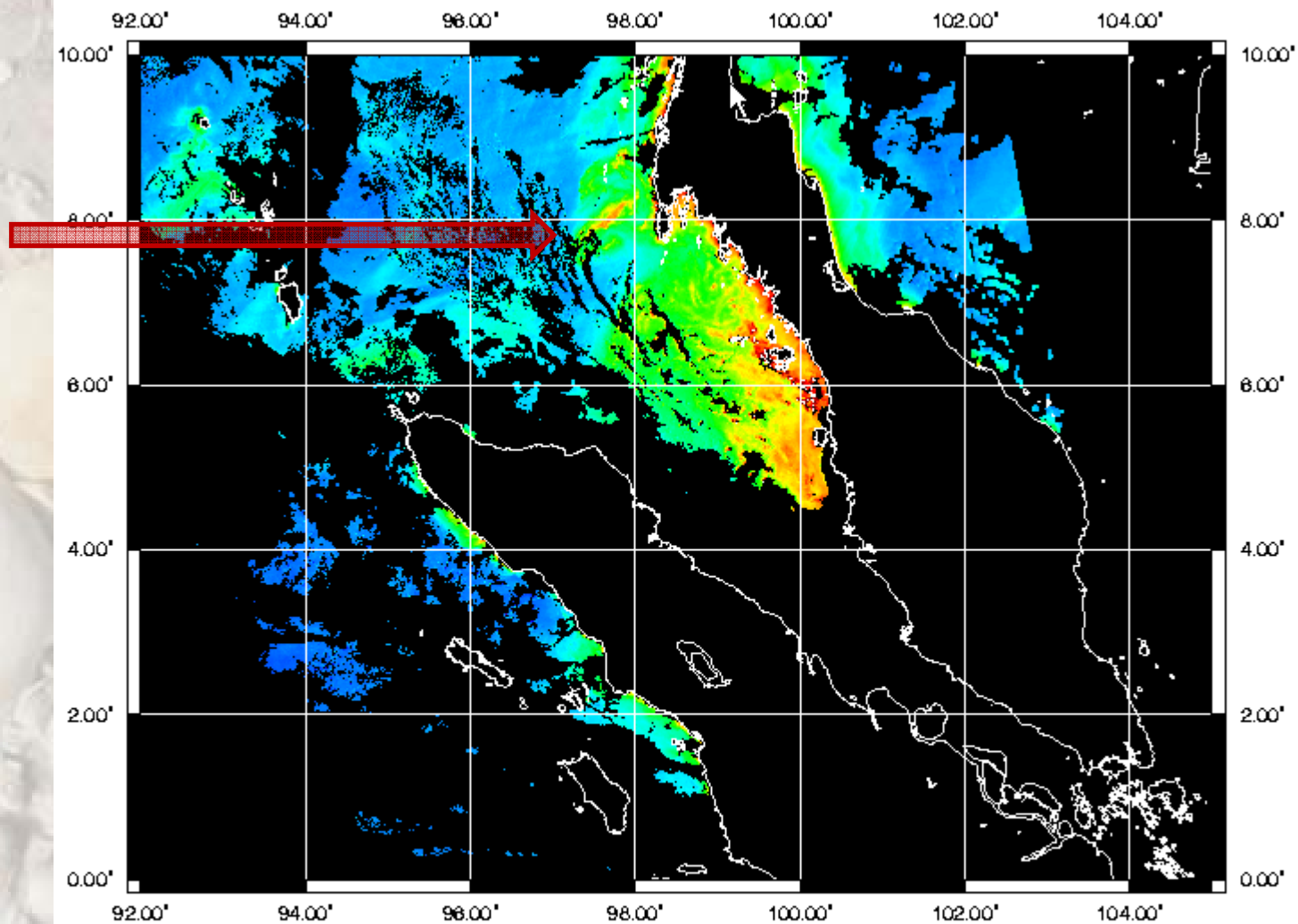
Resuspended of sediment from the sea floor

Results from subsurface buoy of ACDP and temperature logger along the depth showed strong signal of internal wave, which wave high is more than 60 m (on the west coast of Similan Island, at 150 m)

Internal wave in Andaman

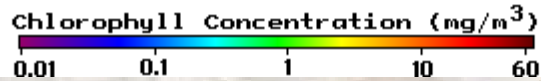


Internal wave in Andaman



Chlorophyll, 7 March 07, MODIS Aqua Image

A2007066072000.L2_LAC.Eastern_Indian_Ocean.chlor_a



Internal wave in Andaman

Internal Wave has been reported in Andaman Sea almost all year round

But the cool water mass is found in near shore only in early month of the year

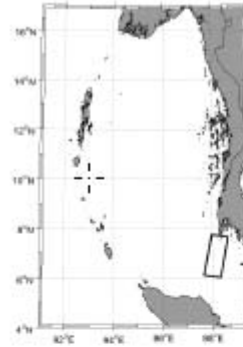
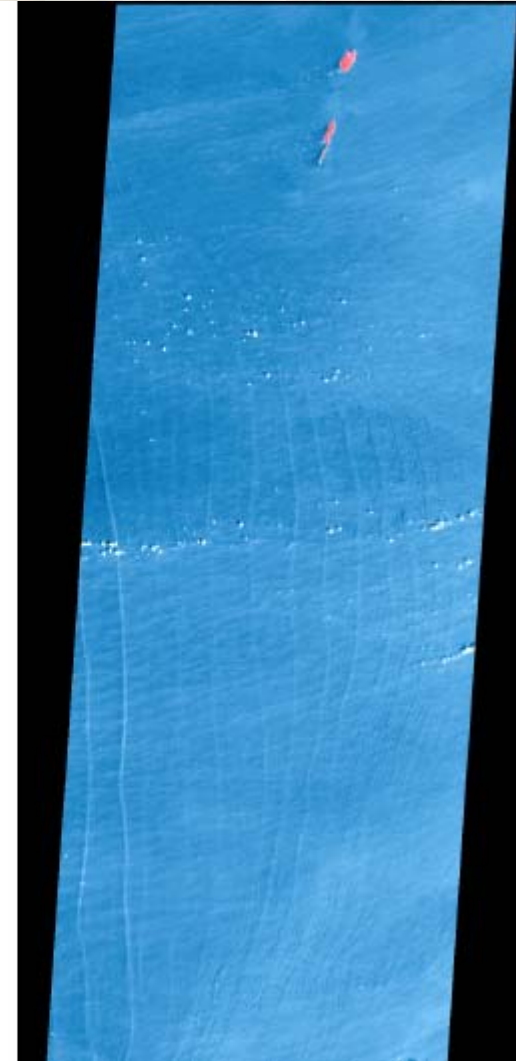
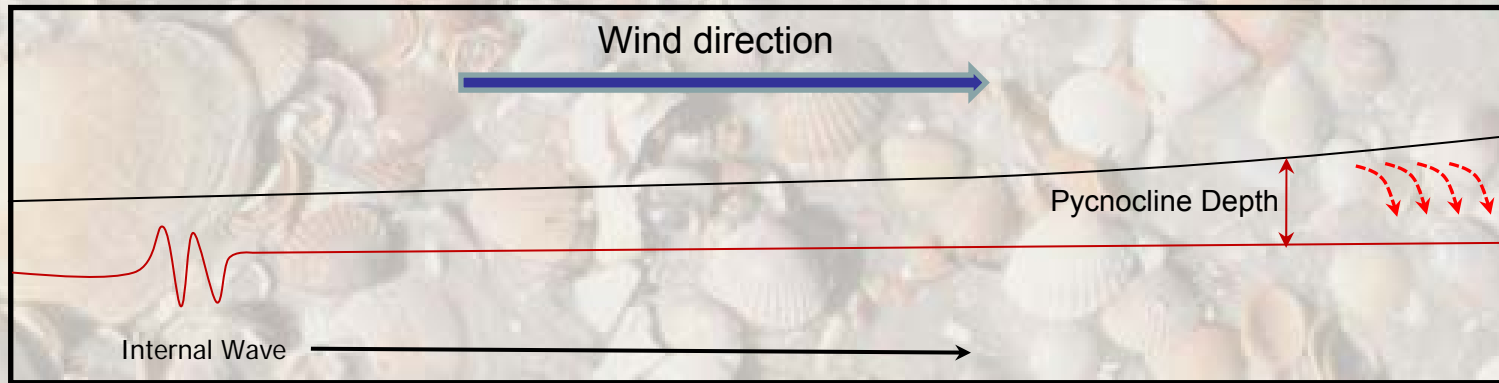


Figure 10. ASTER false-color VNIR image over the area between the Andaman Sea and the Strait of Malacca acquired on 31 January 2002 at 0406 UTC. The image shows the shoaling of large solitons at the shelf break near the 200-meter isobath. Imaged area is 60 km x 180 km.

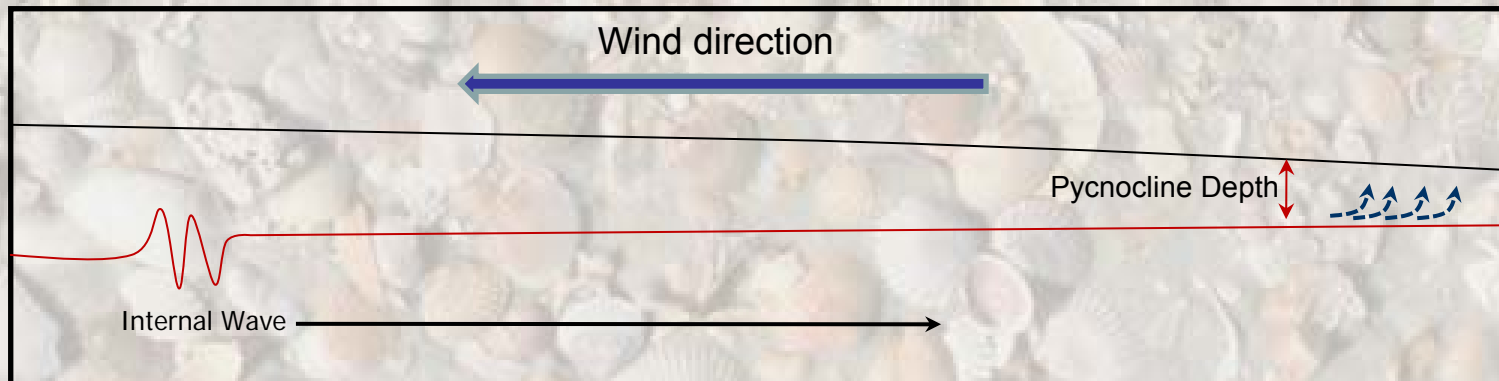


Internal wave in Andaman

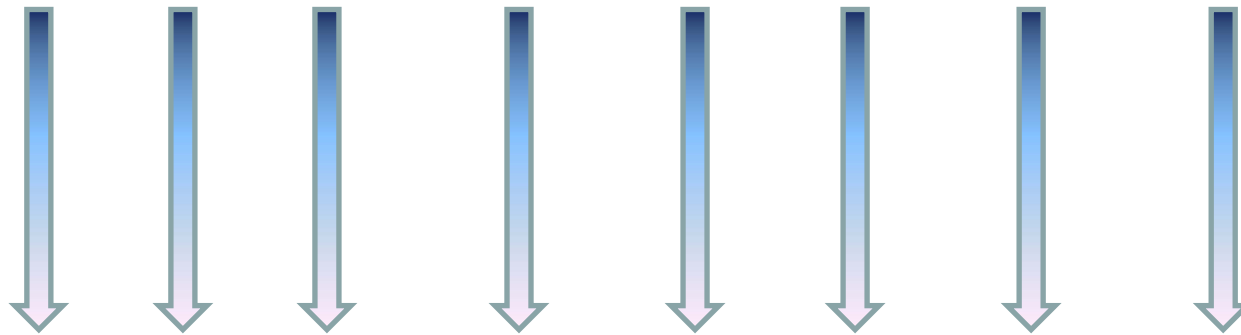
Southwest Monsoon



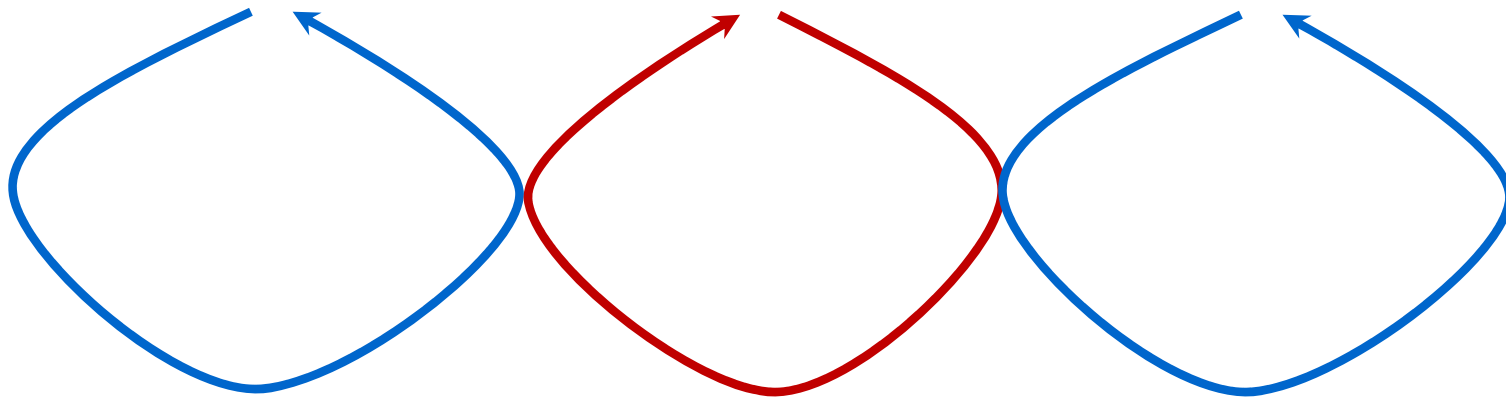
Northeast Monsoon



Oceanographic Feature in Andaman Sea

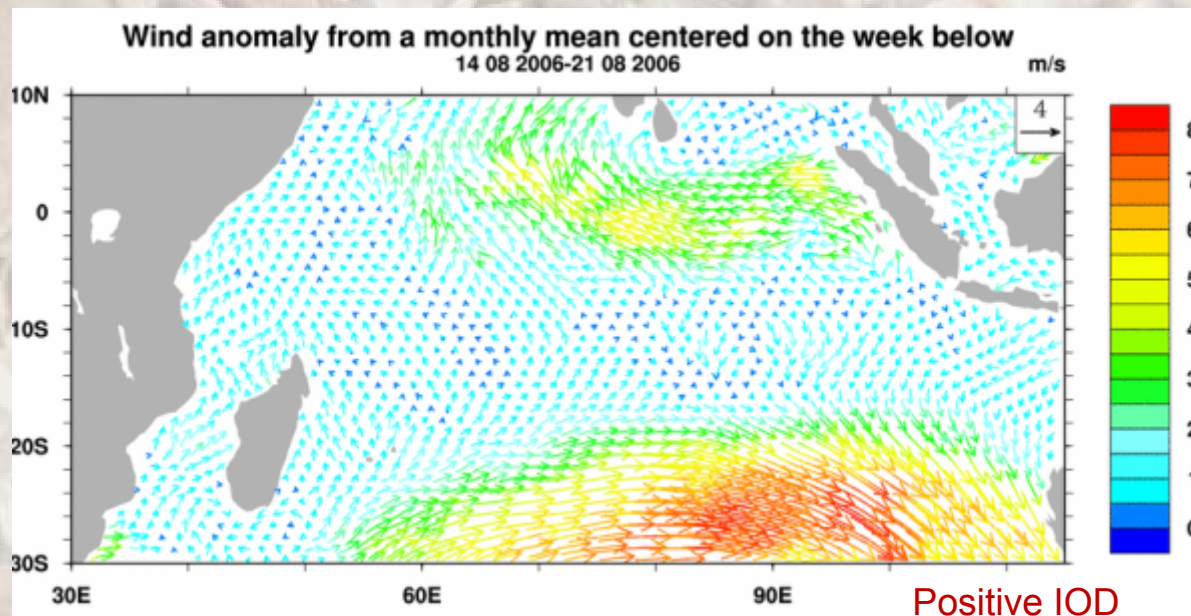


Indian Ocean Dipole (IOD)



Indian Ocean Dipole (IOD)

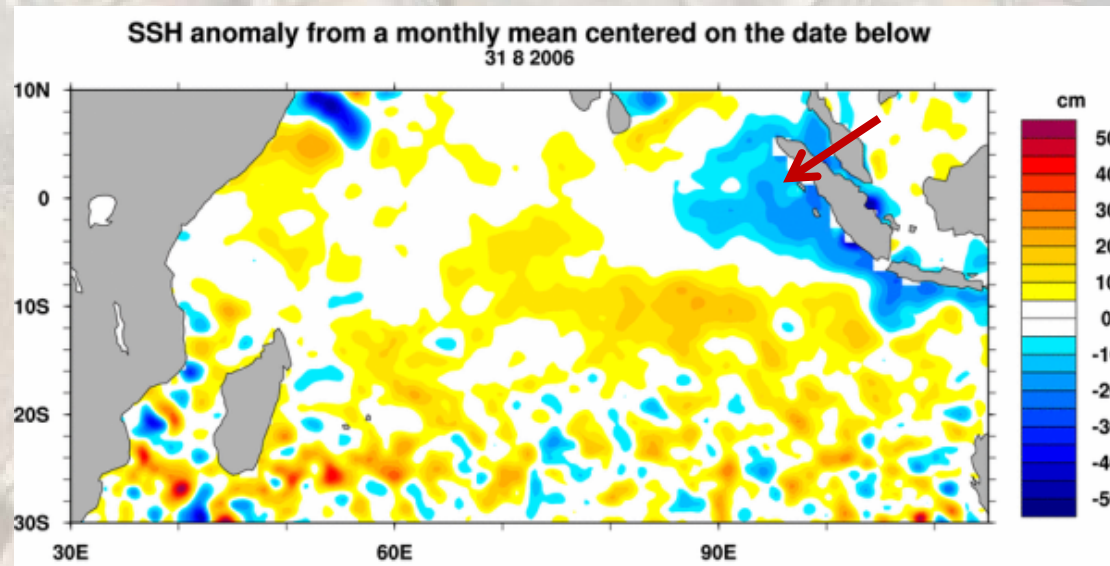
Indian Ocean Dipole (IOD): เป็นปรากฏการณ์ที่เกิดขึ้นในมหาสมุทรอินเดีย ที่บริเวณใกล้แนวเส้นศูนย์สูตร อันเนื่องจากการเปลี่ยนแปลงทิศทางและความเร็วของกระแสลม



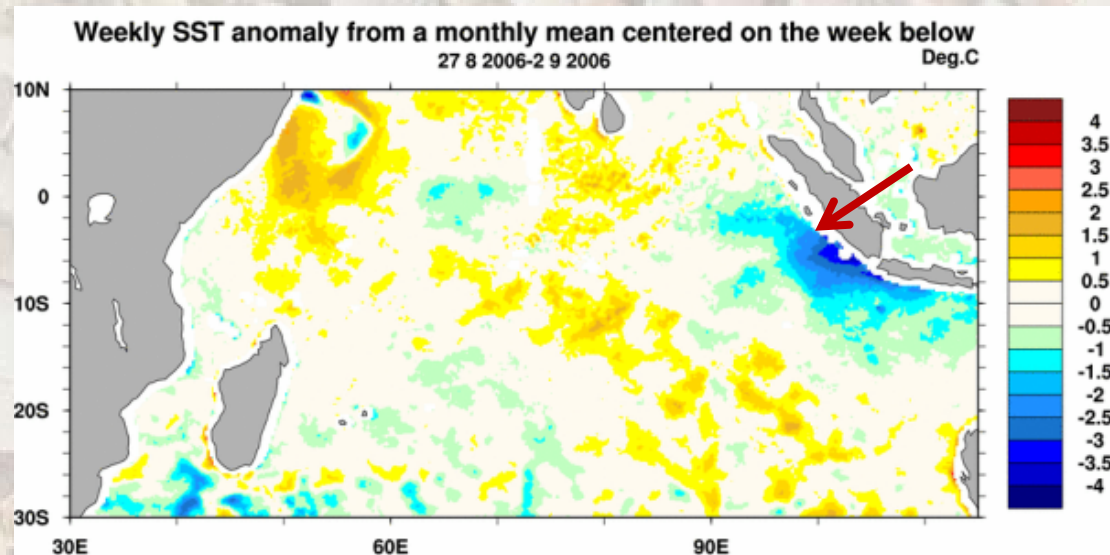
Positive IOD = La Nina

Negative IOD = El Nino

Indian Ocean Dipole (IOD)

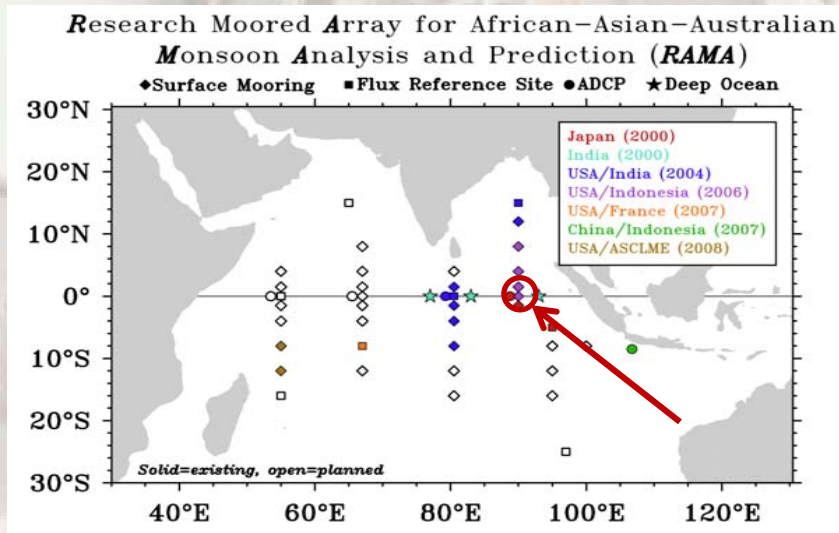
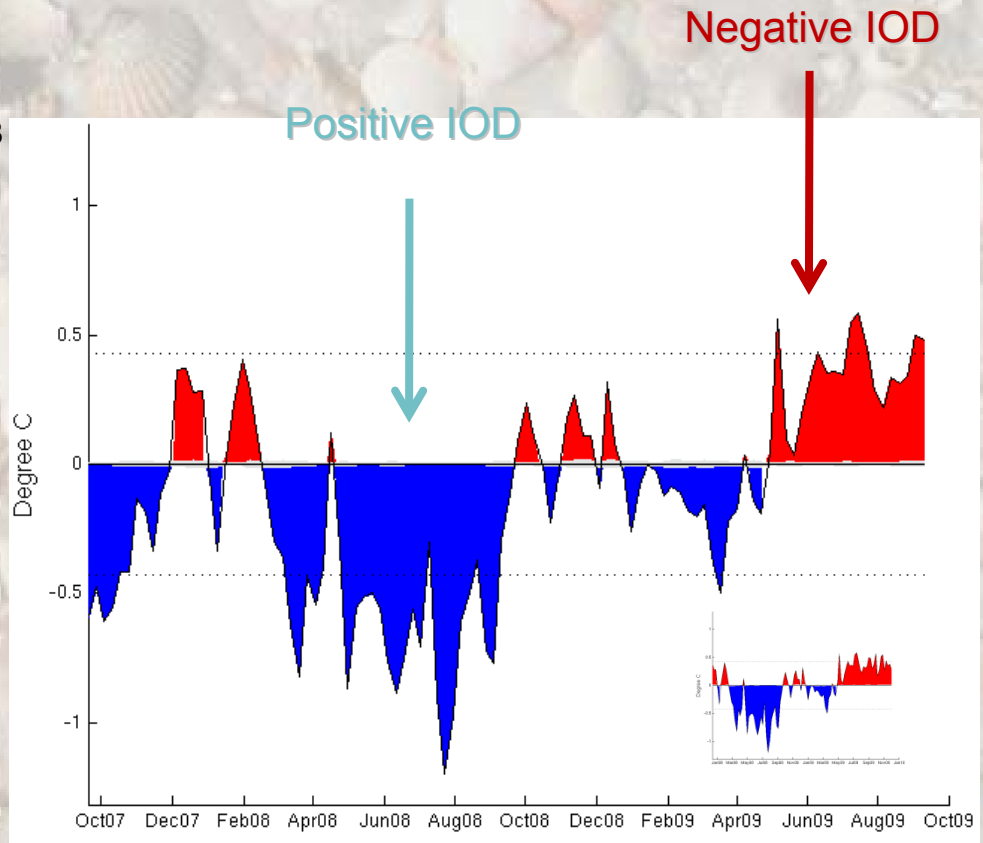
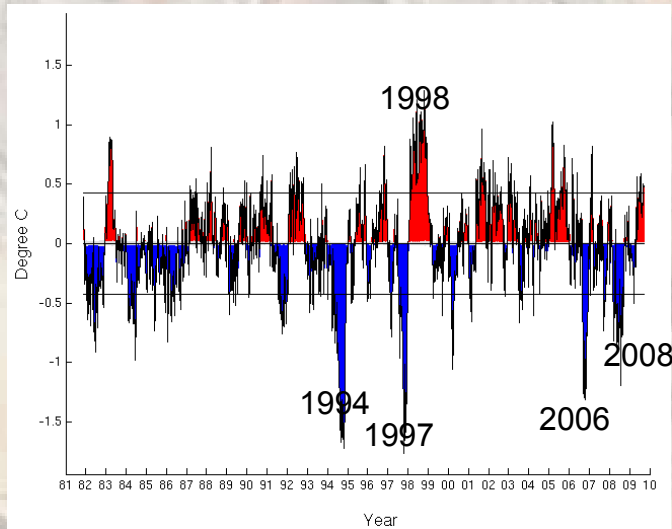


Sea Surface Height



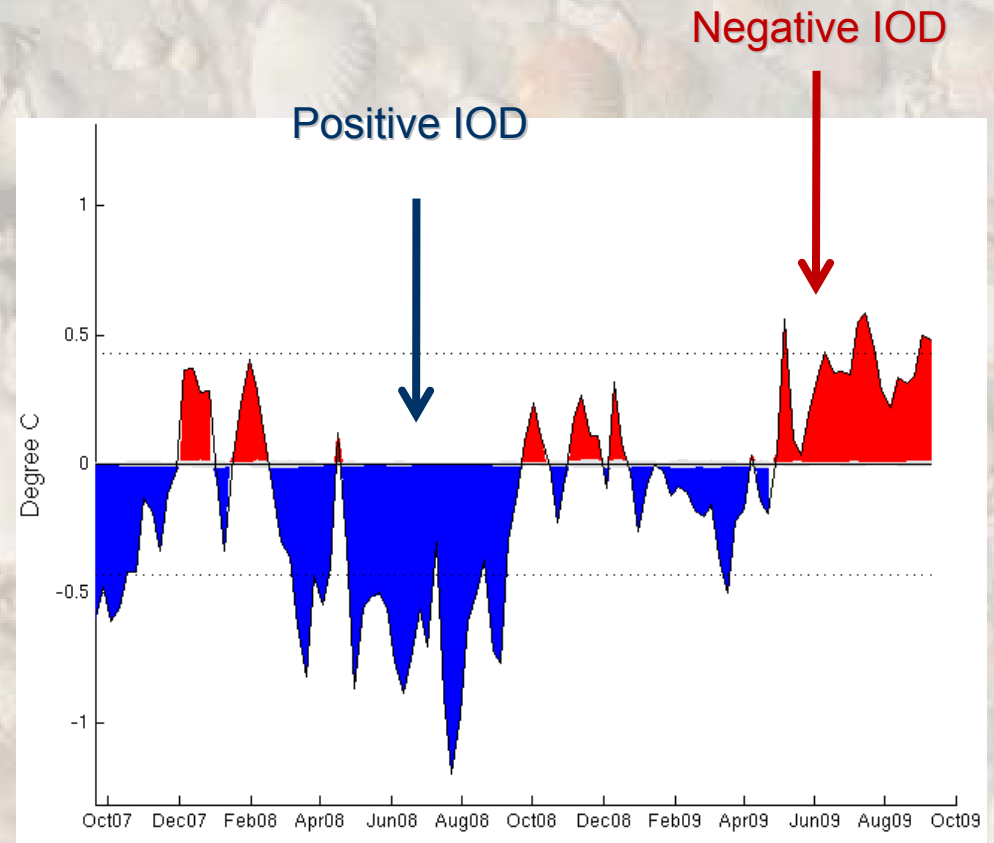
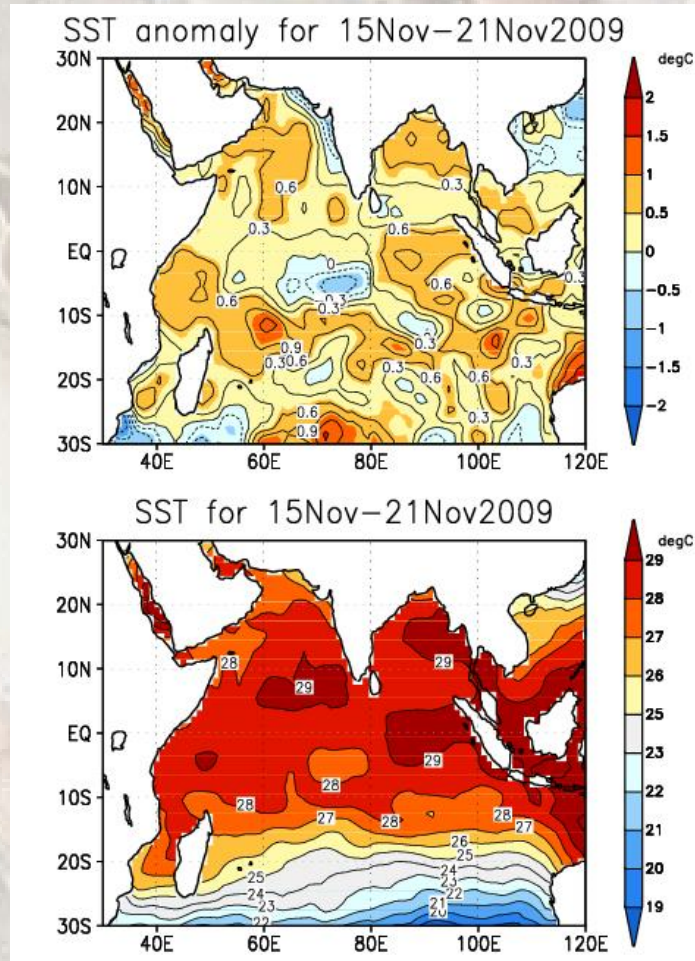
Sea Surface Temperature

Indian Ocean Dipole (IOD)

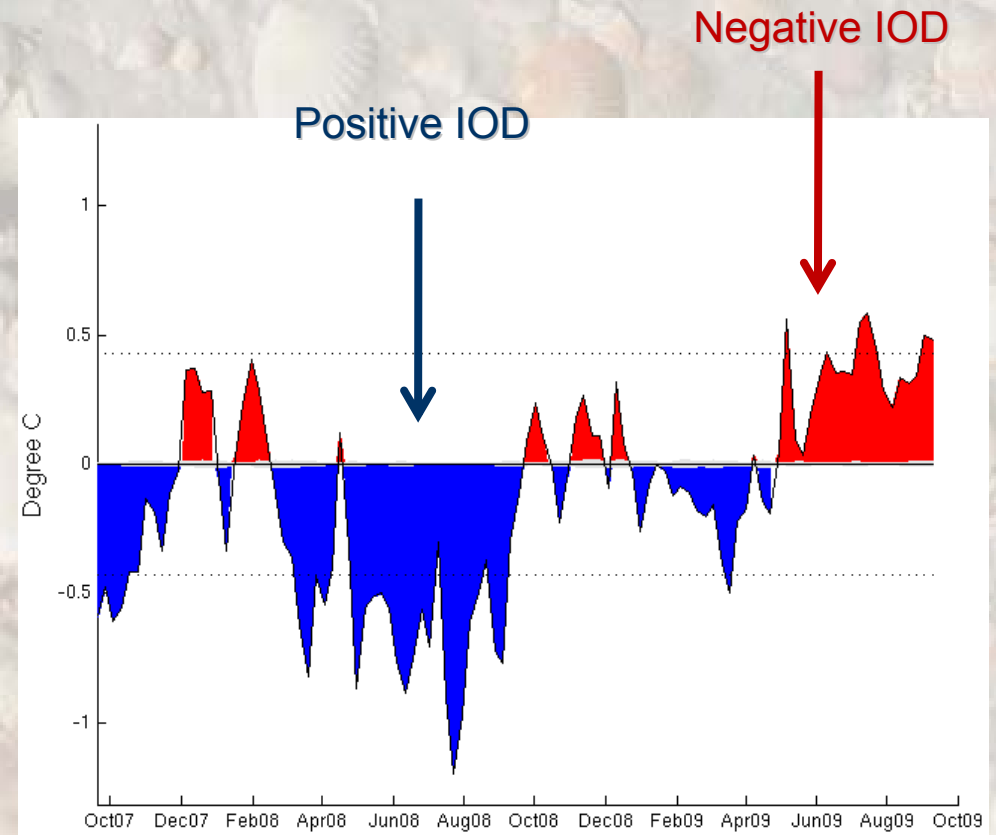
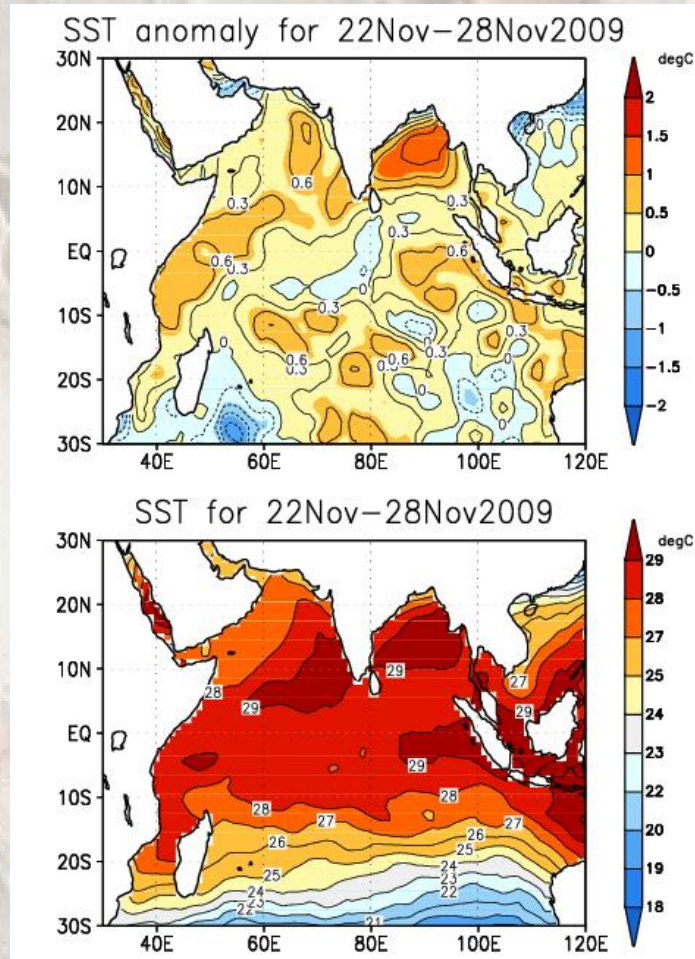


RAMA as of December 2008
(from McPhaden et al., 2009)

Indian Ocean Dipole (IOD)



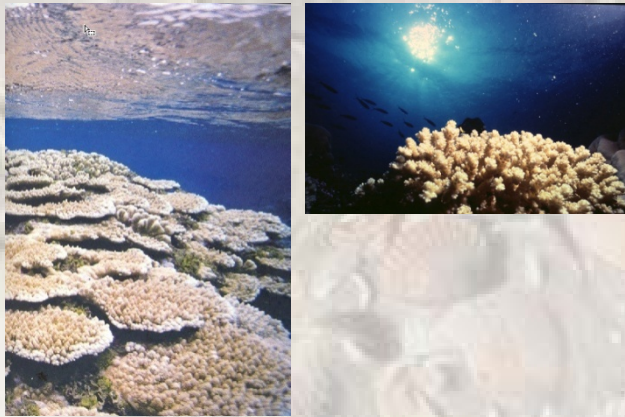
Indian Ocean Dipole (IOD)



Indian Ocean Dipole (IOD)

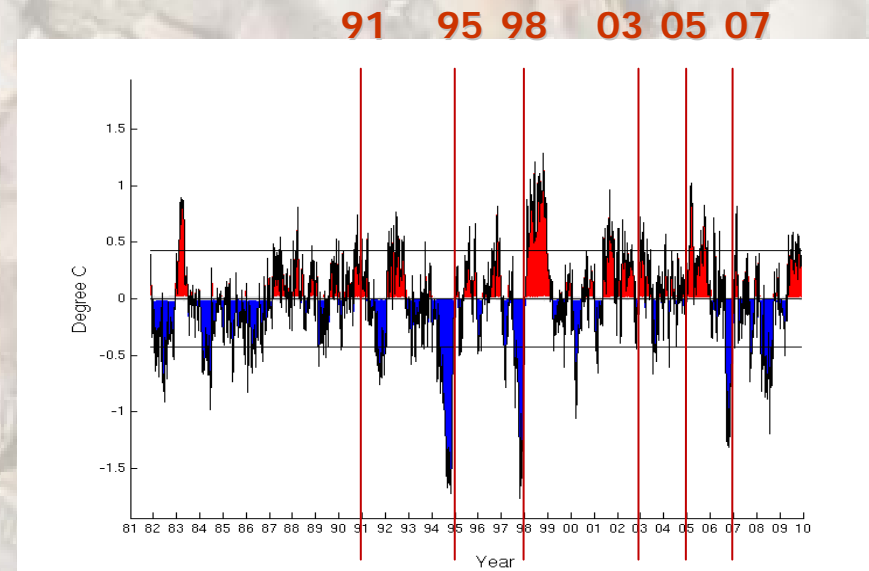
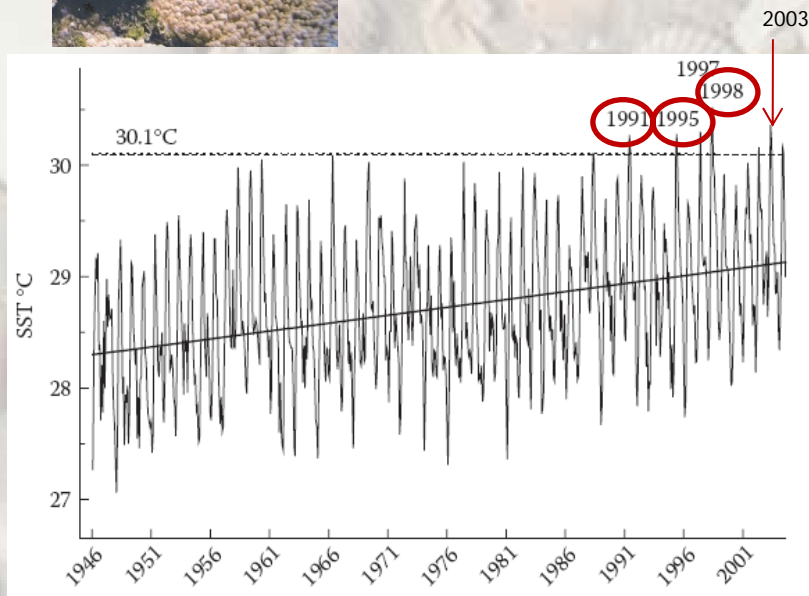
Marine Ecosystem: Coral Bleaching, Storm, Low salinity at nearshore, etc.

Coral Bleach



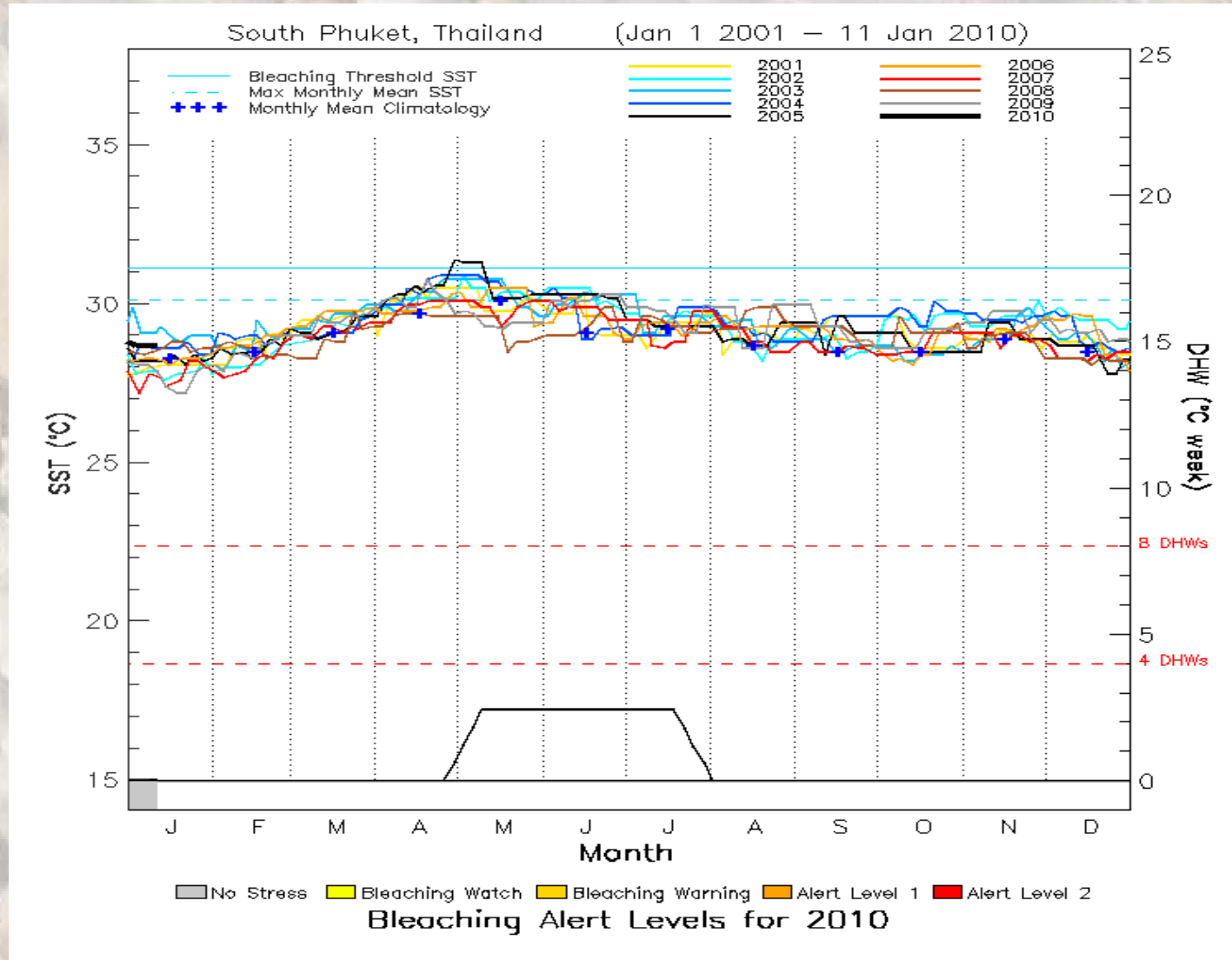
Coral Bleaching in Thailand:

- 1991 and 1995 = very severe (AS)
- 1998 = very site specific (AS&GoT)
- 2003, 2005, 2007 = site specific and very mild (AS&GoT)

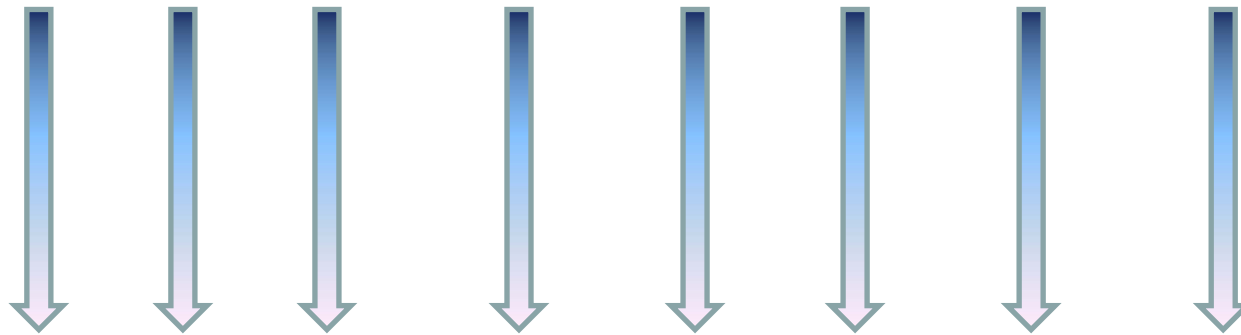


Indian Ocean Dipole (IOD)

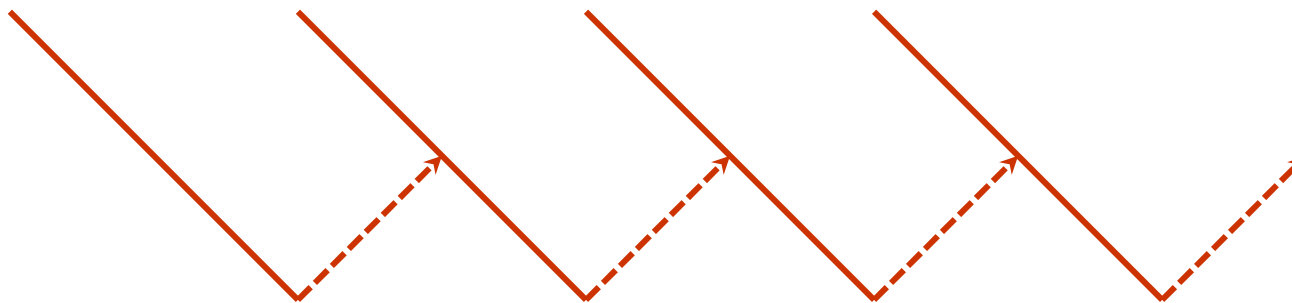
Marine Ecosystem: Coral Bleaching, Storm, Low salinity at nearshore, etc.



Oceanographic Feature in Andaman Sea



Climate Change



Climate Change

Changing of Monsoon season.....?

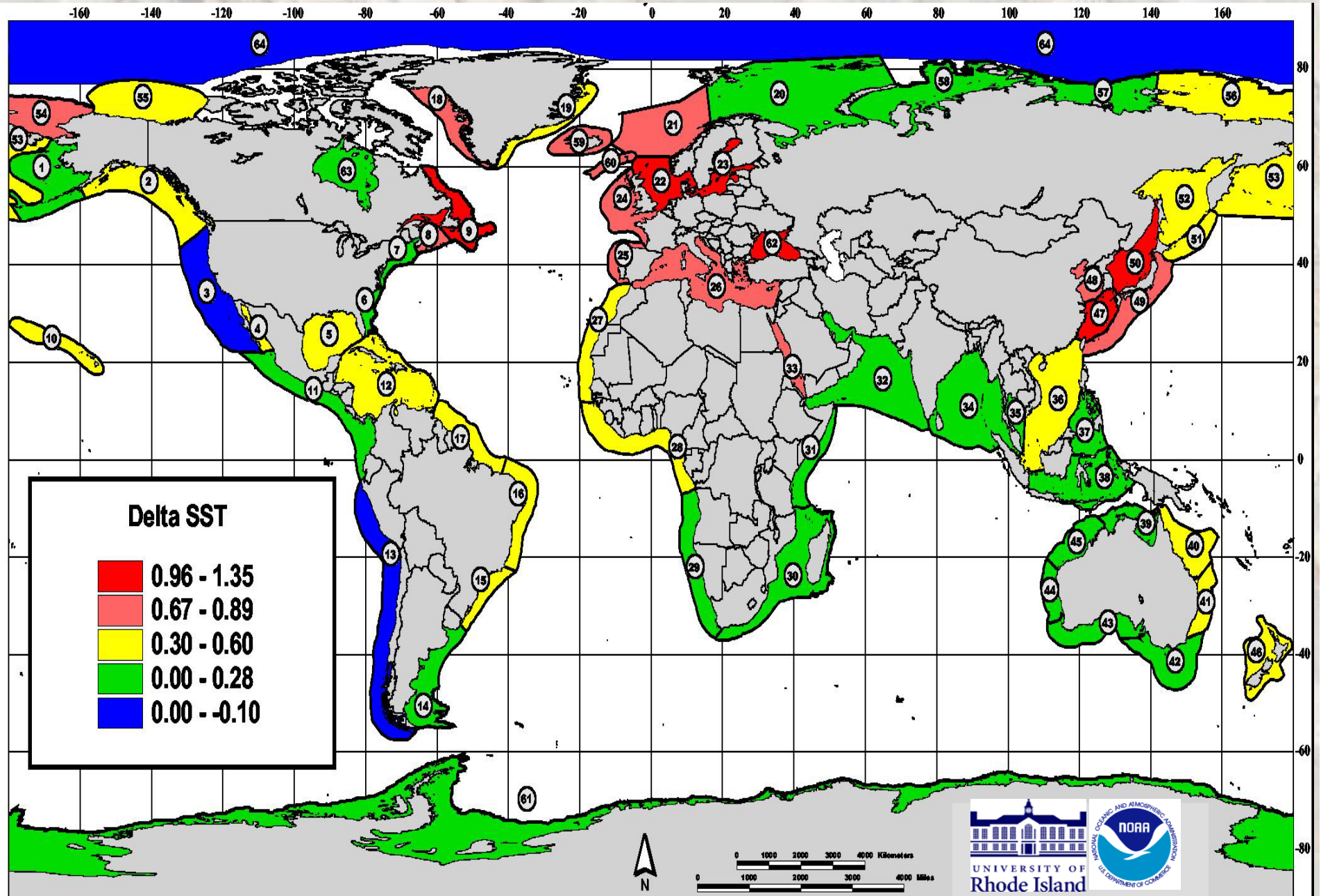
Changing of water circulation.....?

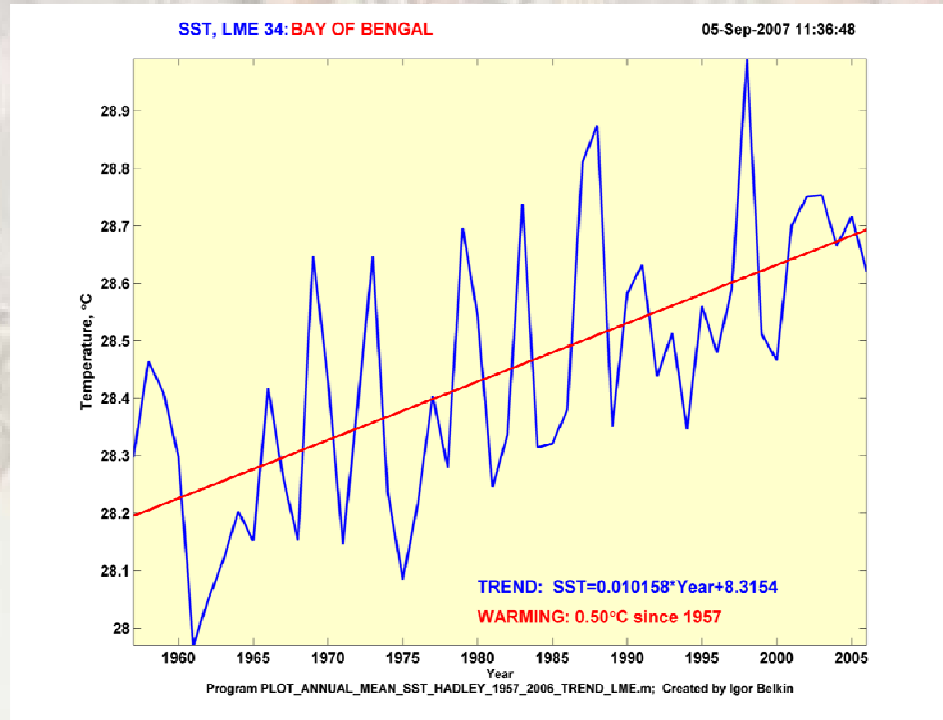
Changing of sea level.....?

Changing of acidification of seawater.....?

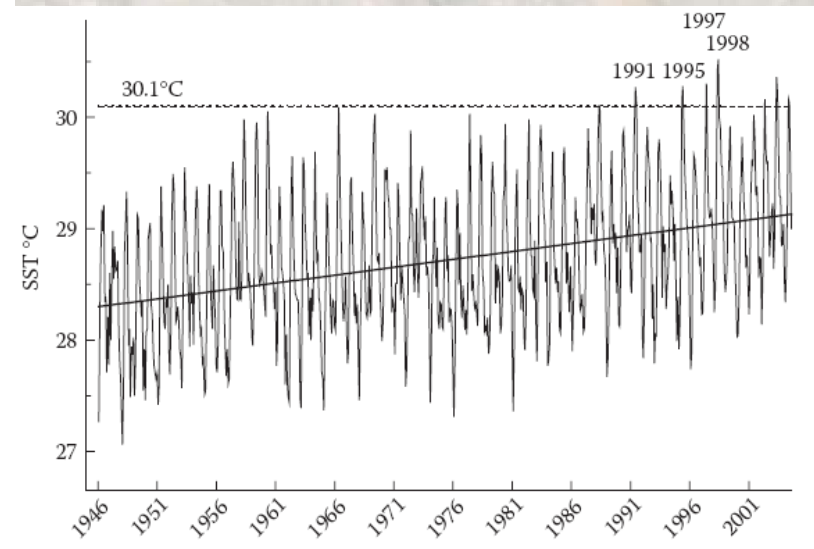
Changing of sea surface temperature?

SST Trends, 1982-2006, in Large Marine Ecosystems

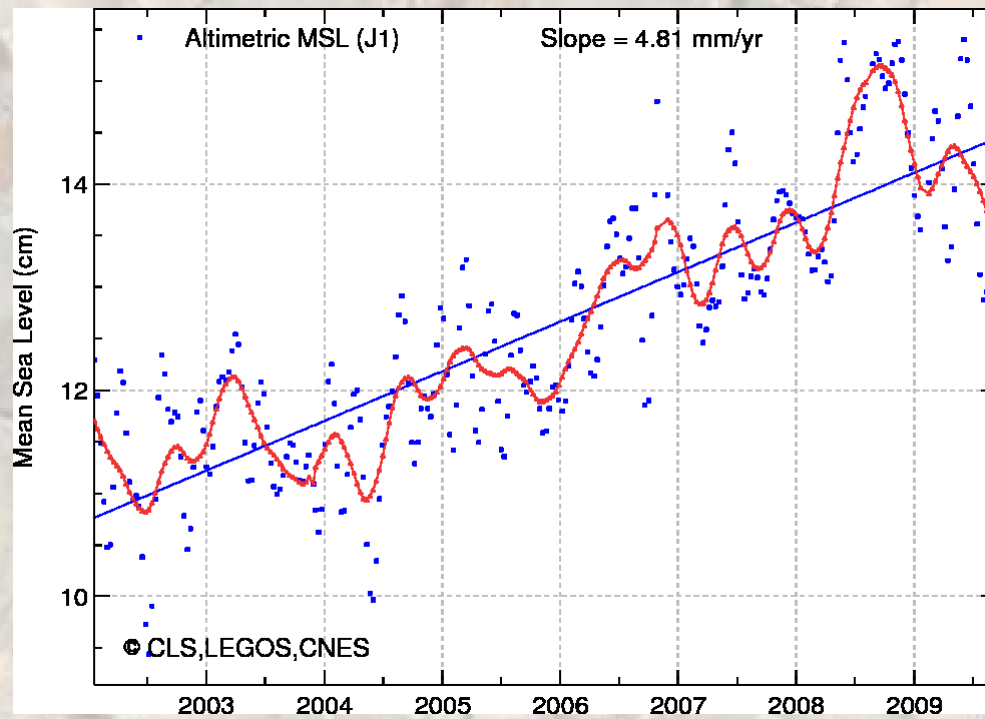




Increase of sea surface temperature about 0.5 °C within 50 yrs



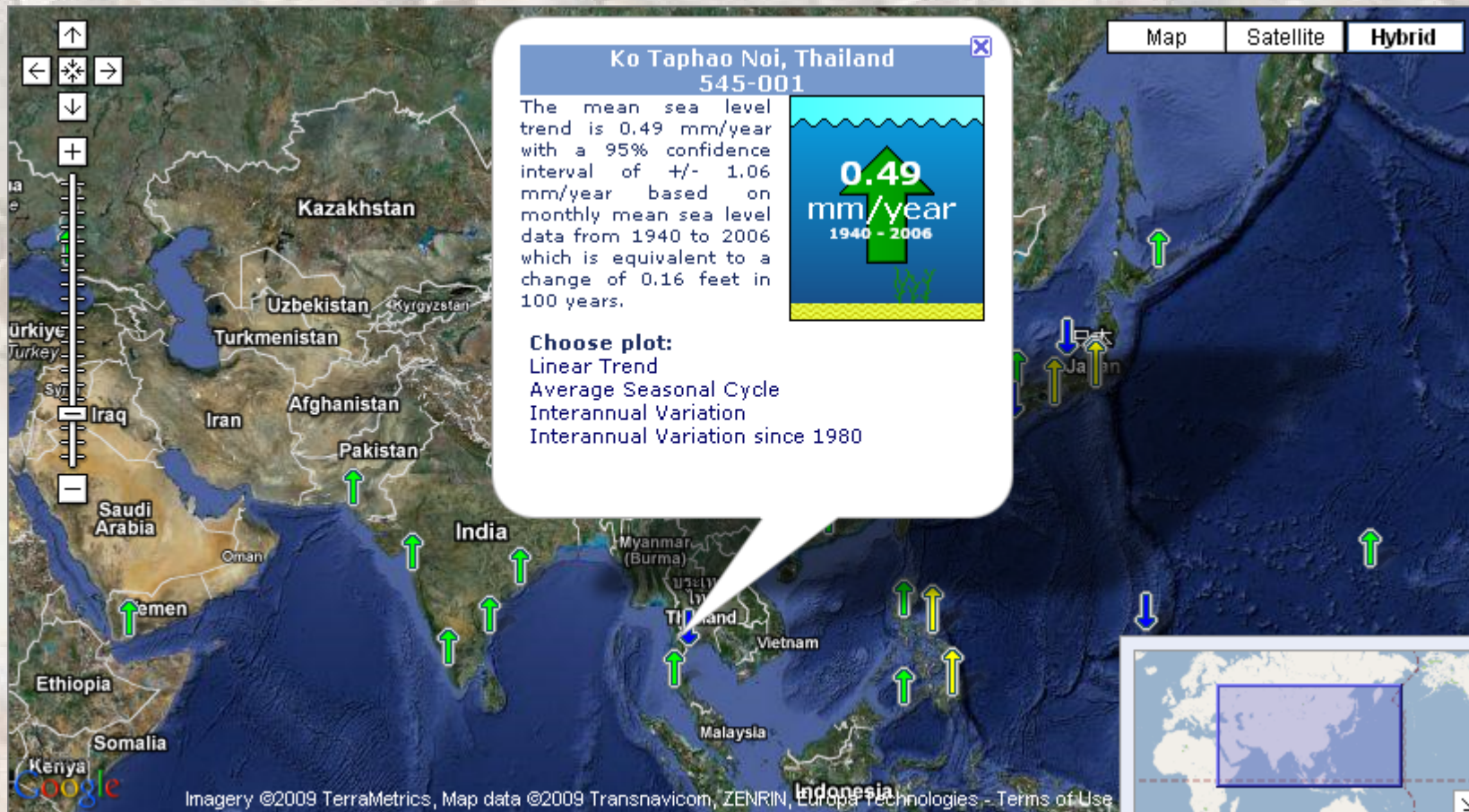
Recent analyses of historical sea temperature data and contemporary continuous sea-surface measurements in the Andaman Sea at Phuket show an interesting trend for the eastern Indian Ocean where there has been a significant increase in **sea-surface temperatures over the last 50 yr of at least 0.126 °C decade⁻¹** (Brown et al. 1996).



From AVISIO website
<http://www.avisio.oceanobs.com/>

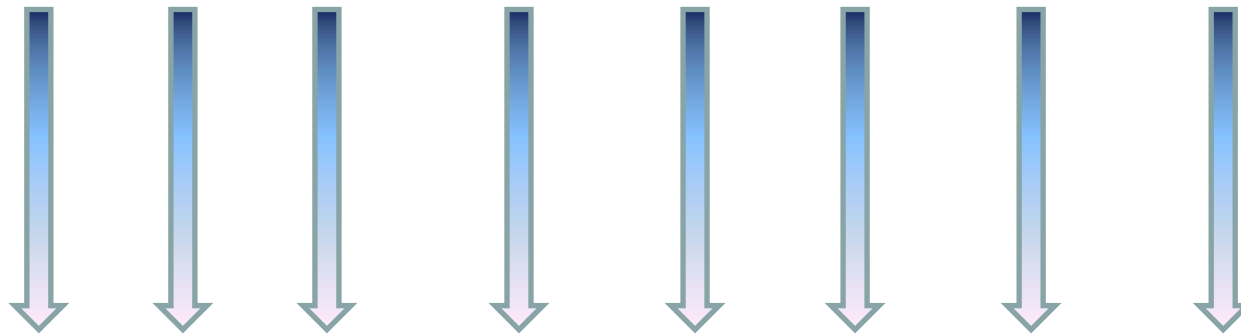
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<input type="button" value="Download the image"/>		<input type="button" value="Download the data"/>	

*: preferred settings
 **: seasonal, annual signals



From NOAA: Tide and Current website
<http://tidesandcurrents.noaa.gov/sltrends/sltrends.html>

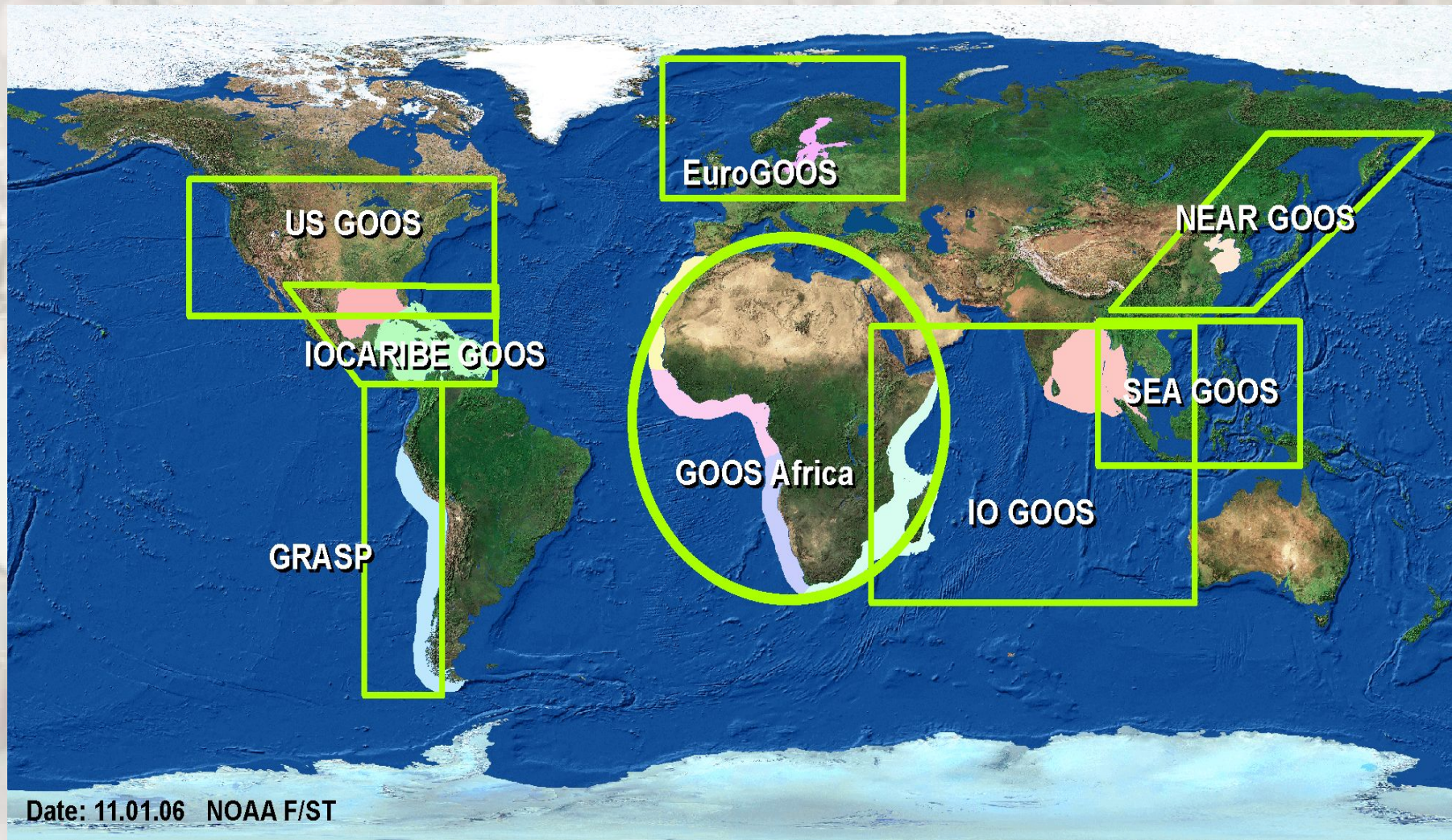
Oceanographic Feature in Andaman Sea



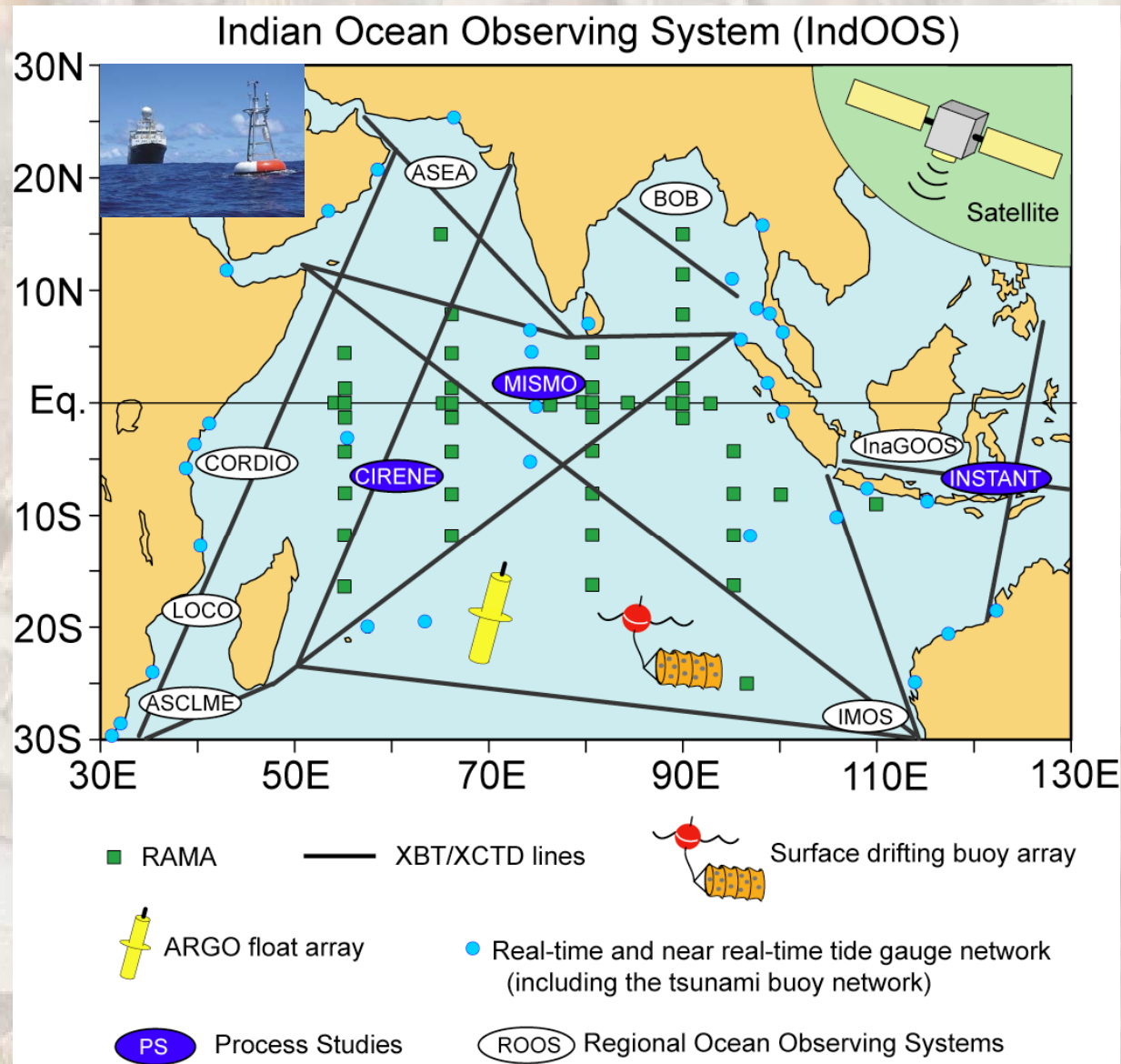
Ocean Observing System



Ocean Observing System

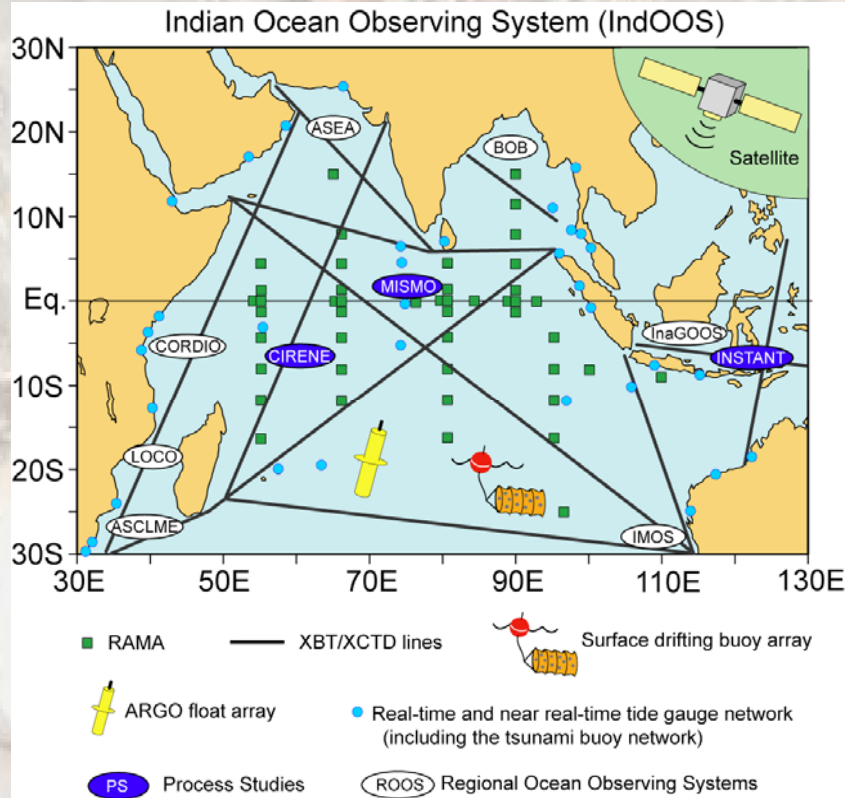


Ocean Observing System

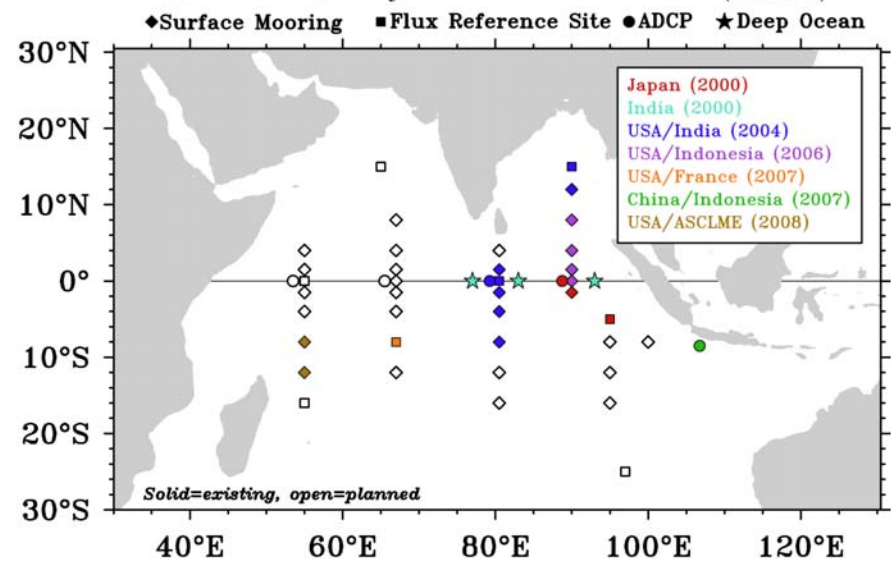


Schematic chart of IndOOS and the ROOS
(From Matsumoto, Yu and Meyers, 2009)

Ocean Observing System



Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA)

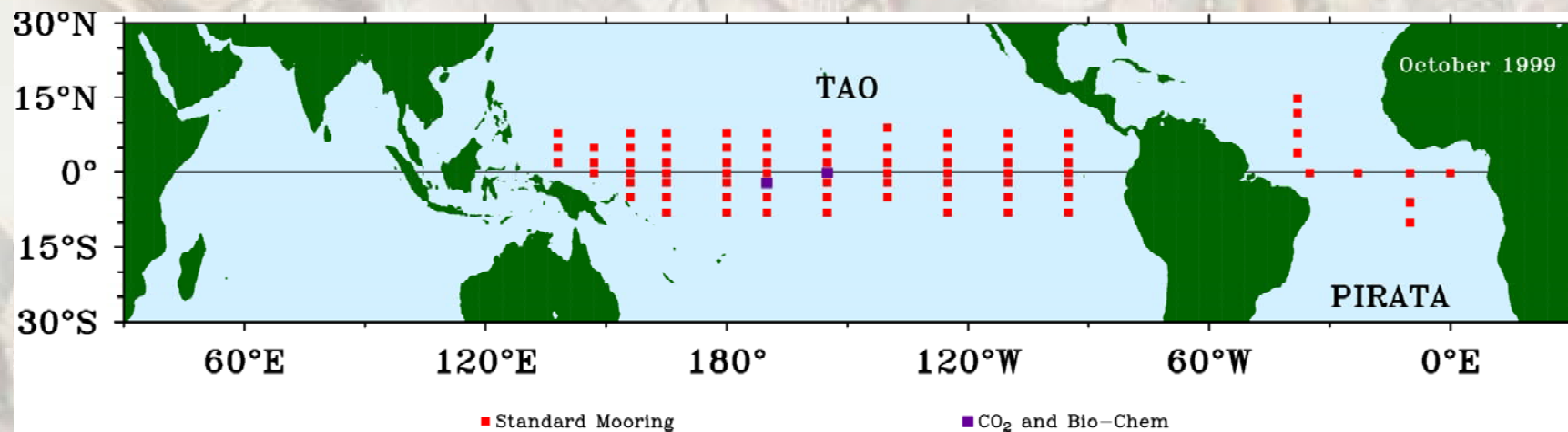
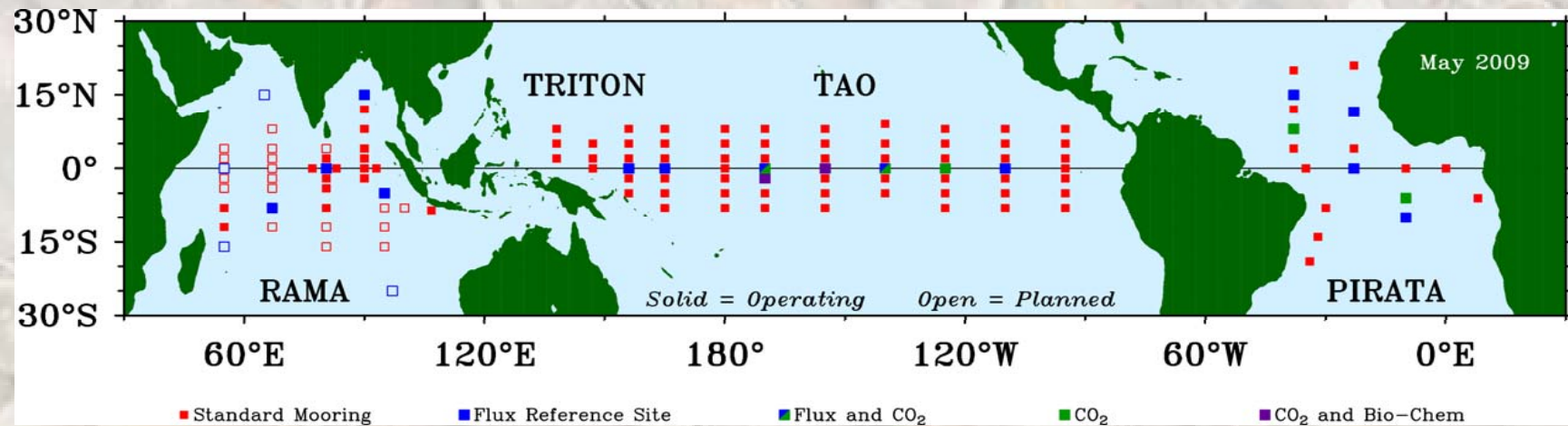


Schematic chart of IndOOS and the ROOS
(From Matsumoto, Yu and Meyers, 2009)

RAMA as of December 2008

(from McPhaden et al., 2009)

Ocean Observing System



The global tropical Moored Buoy Array in 2008 (top) and October 1999 (bottom), from *McPhaden et al., 2009*

Ocean Observing System

Tropical Atmosphere Ocean project
Home Project overview Data display and delivery El Niño & La Niña Site Map



Data display and delivery

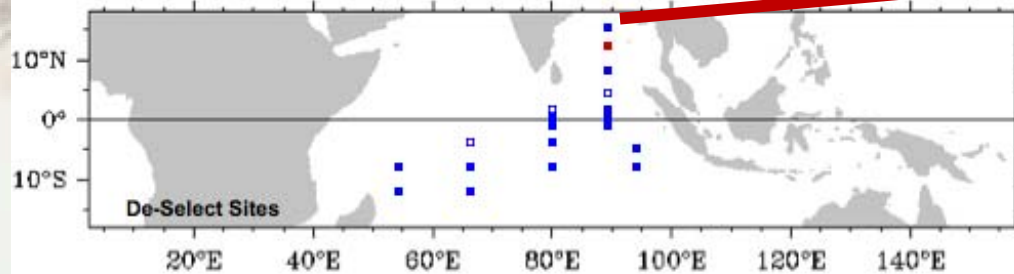
Find

To select mooring sites, click orange boxes to select lines of sites, or click single sites. Red indicates which sites are selected. Solid squares show where all selected variables are available. Half filled squares show where some are available. Empty squares show where none are available. **NOTE:** Please do not use the **Back Button** in your browser frame. You may click the orange **Clear** button to reset the page. **Mac OS X Users:** [Safari is recommended](#)

TAO/TRITON (Pacific)

PIRATA (Atlantic)

RAMA (Indian)



Time Series

Profiles

Time Section

Lat Lon Map

Depth Section

- One Variable One Site Separate Plots Overlay
- SW Rad LW Rad Rain Wspd Uwnd Vwnd Wdir Wnd Vec RH
- Air T SLP SST T(z) SSS S(z) SSD D(z) Heat
- Dyn Ht 20C Ucur Vcur Cur Vec Uadcp Vadcp Long Lat

2010 JAN 1 2010 FEB 5 Daily

files by site ASCII Compression

Definitions

Availability

Clear

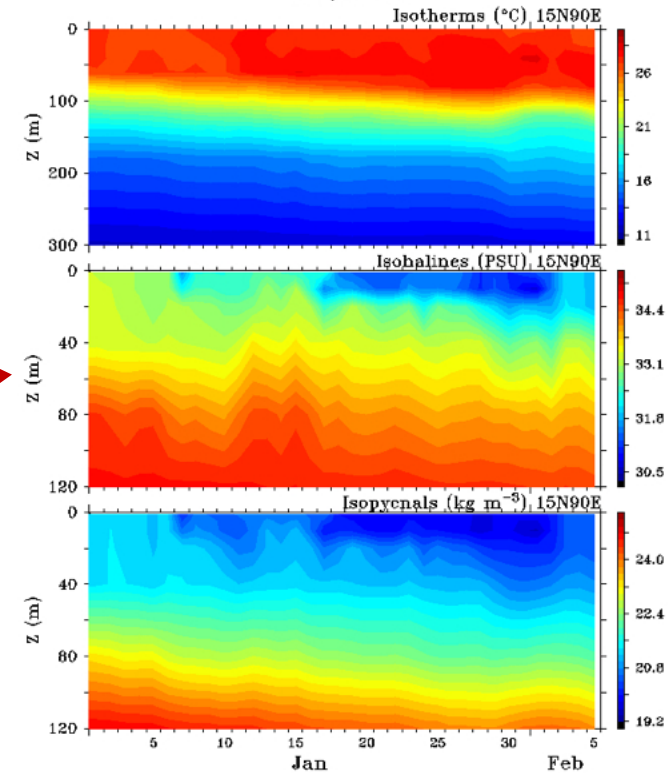
Deliver

Display

[Problems?](#) [Hints on Usage](#) [JAVA Version](#) [Comments or Suggestions?](#) [Acknowledgment for use of data](#)

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Daily Data



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2010

Feb. 5 2010

Ocean Observing System

Tropical Atmosphere Ocean project
[Home](#) [Project overview](#) [Data display and delivery](#) [El Niño & La Niña](#) [Site Map](#)

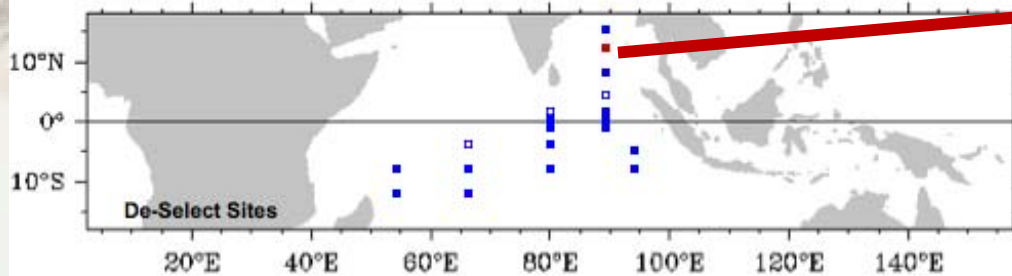


Data display and delivery

Find

To select mooring sites, click orange boxes to select lines of sites, or click single sites. Red indicates which sites are selected. Solid squares show where all selected variables are available. Half filled squares show where some are available. Empty squares show where none are available. **NOTE:** Please do not use the **Back Button** in your browser frame. You may click the orange **Clear** button to reset the page. **Mac OS X Users:** [Safari is recommended](#)

TAO/TRITON (Pacific) **PIRATA (Atlantic)** **RAMA (Indian)**



Time Series **Profiles** **Time Section** **Lat Lon Map** **Depth Section**

- One Variable
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2010 JAN 1 2010 FEB 5 Daily

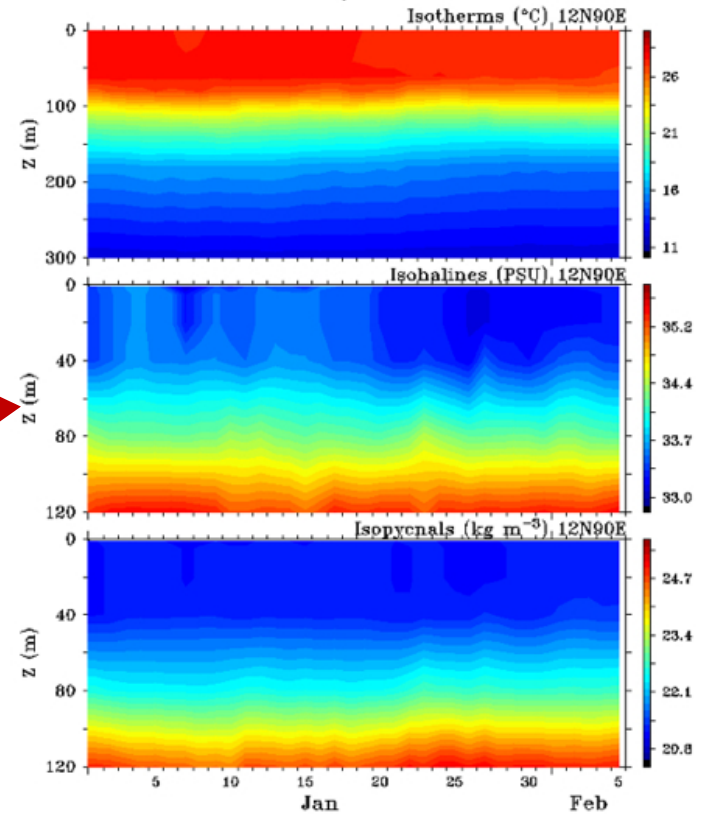
files by site ASCII Compression

Definitions **Availability** **Clear** **Deliver** **Display**

[Problems?](#) [Hints on Usage](#) [JAVA Version](#) [Comments or Suggestions?](#) [Acknowledgment for use of data](#)

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Daily Data



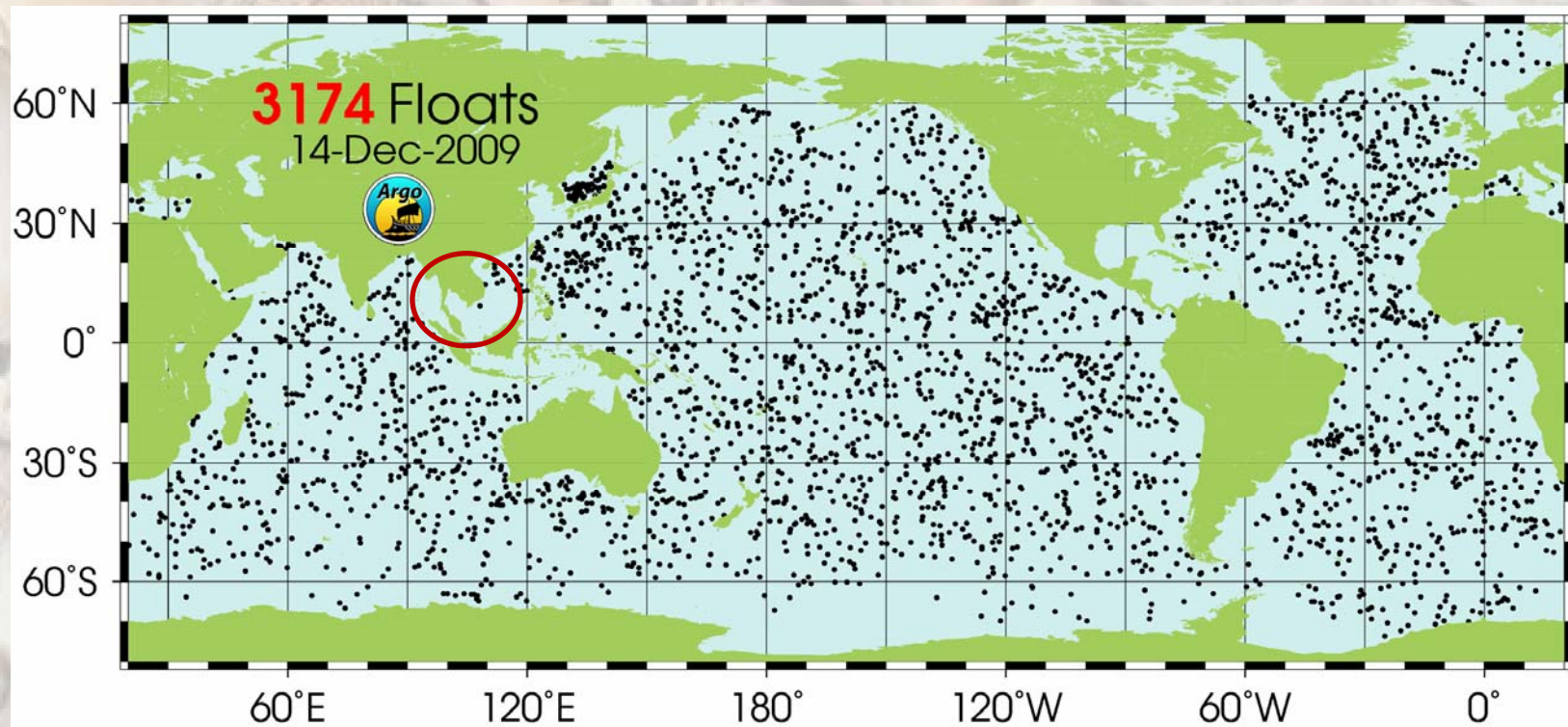
TAO Project Office/PMEL/NOAA

2010

Feb 6 2010

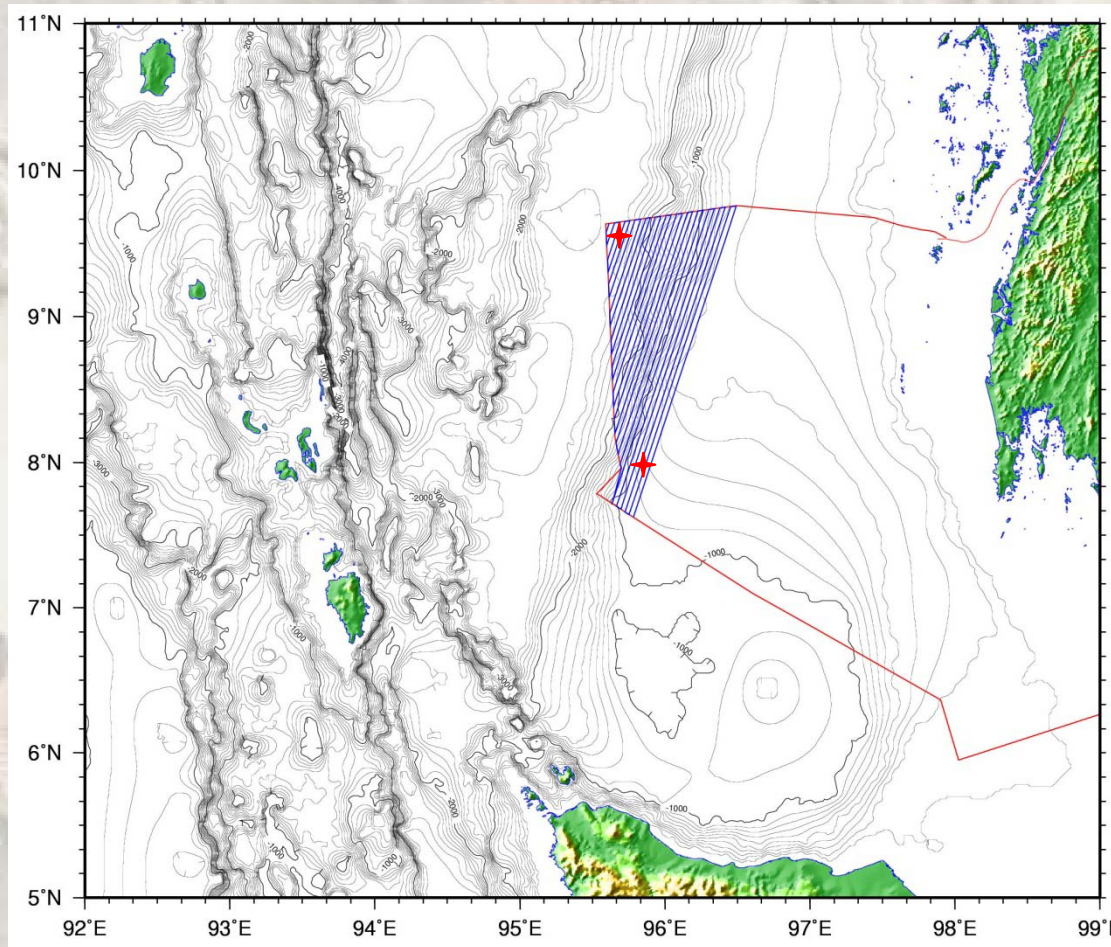
Ocean Observing System

Argo Buoy



Ocean Observing System

Research Cruise under Cooperation of PMBC and FIO:



**Monsoon onset Monitoring
and Its Impacts on Social
and Ecosystem (MOMSIE)**

Thank you for your attention

