

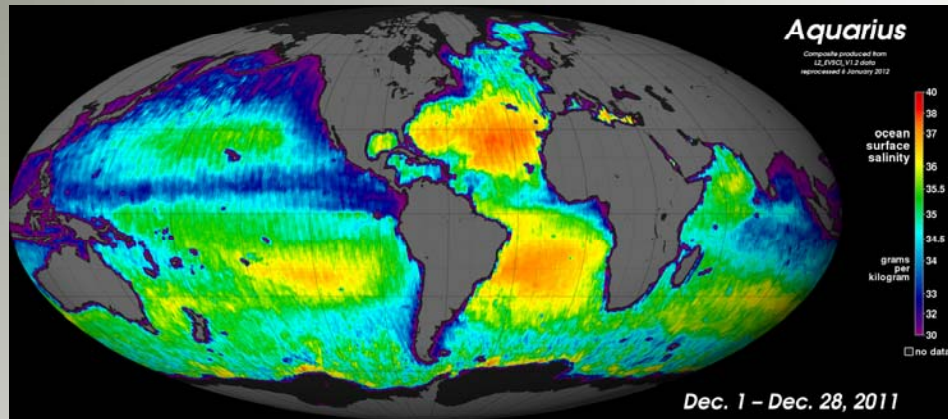


Near-Surface Variability of Temperature and Salinity: Observations from Profiling Floats

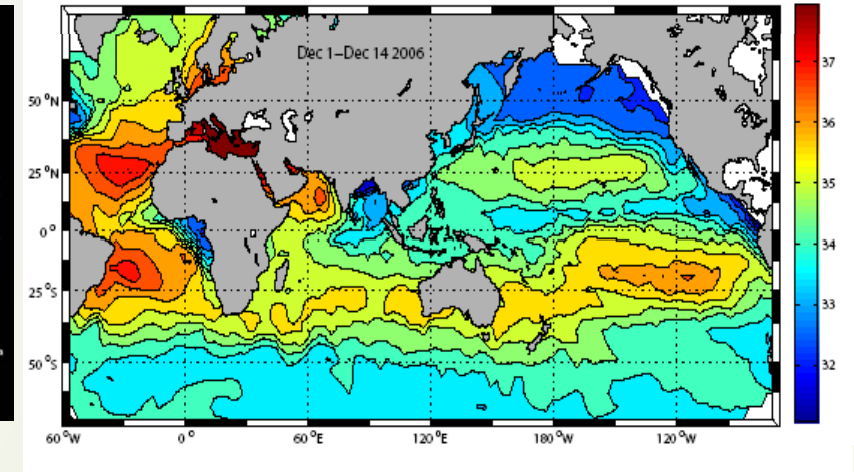
Jessica E. Anderson and Stephen C. Riser

School of Oceanography
University of Washington

Ocean Salinity



Surface salinity, monthly composite from Aquarius

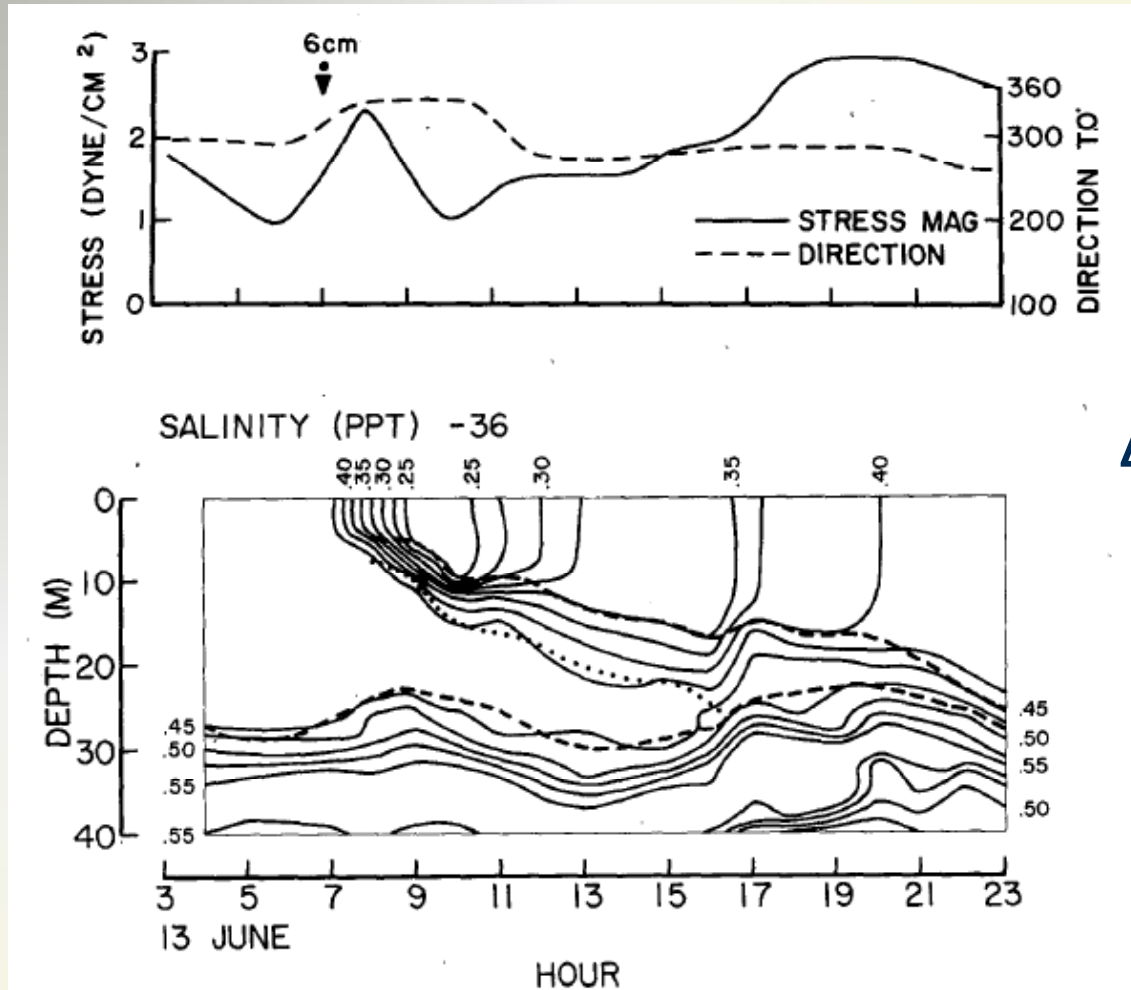


Salinity at 5 meters, estimated from the Argo dataset.
(Dr. Li Ren)

- Generally, we have a poor understanding of the links between the water cycle and ocean circulation as well as their relation to climate.
- Aquarius/SAC-D will improve spatial resolution, however it senses only the uppermost ~1 cm.
- We need accurate, near-surface salinity data that can be used to connect Aquarius data at the sea surface to Argo at 5m and below.

Ocean Near-Surface Salinity

Smaller Scale Variability

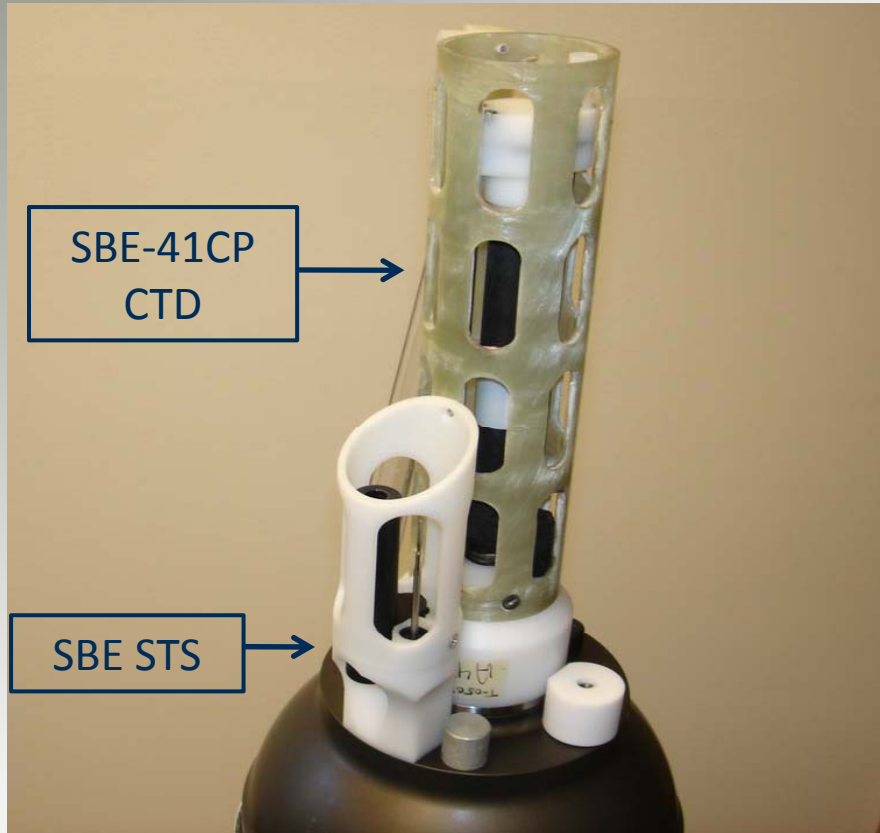


$\Delta S: 0.15 \text{ PSU}$

Shipboard CTD off the West Florida continental shelf.

Price, JPO, 1979

STS Float Design



SeaBird

Surface Temperature & Salinity sensor
(STS)

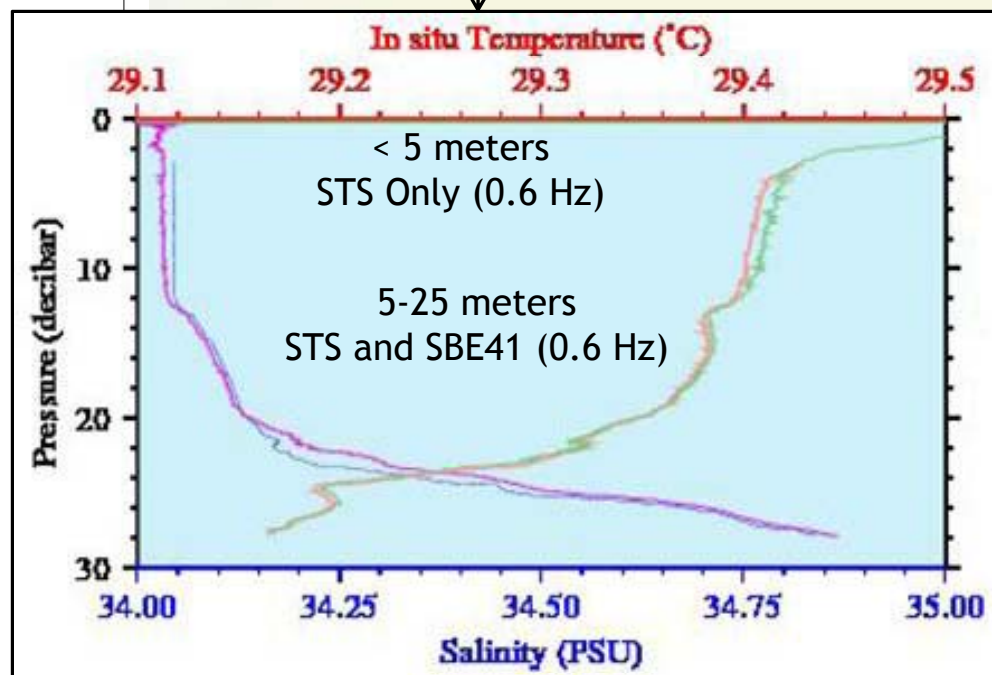
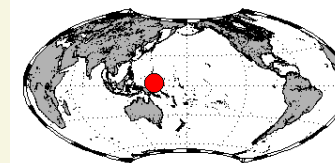
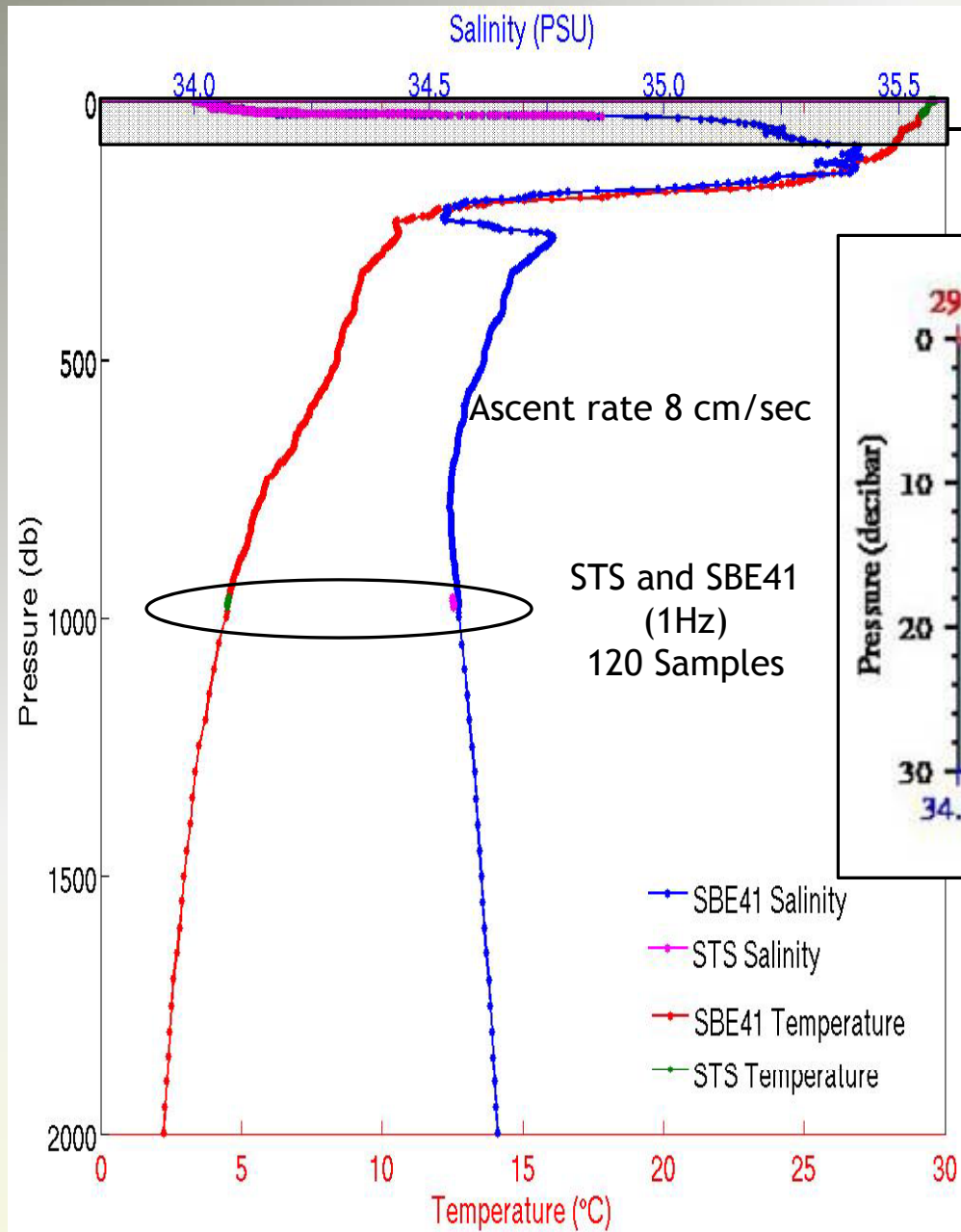
T~0.005°C; S~0.05 PSU; Z~5cm



Iridium telemetry

7 minutes surface time
2-way communication
> 30 possible commands

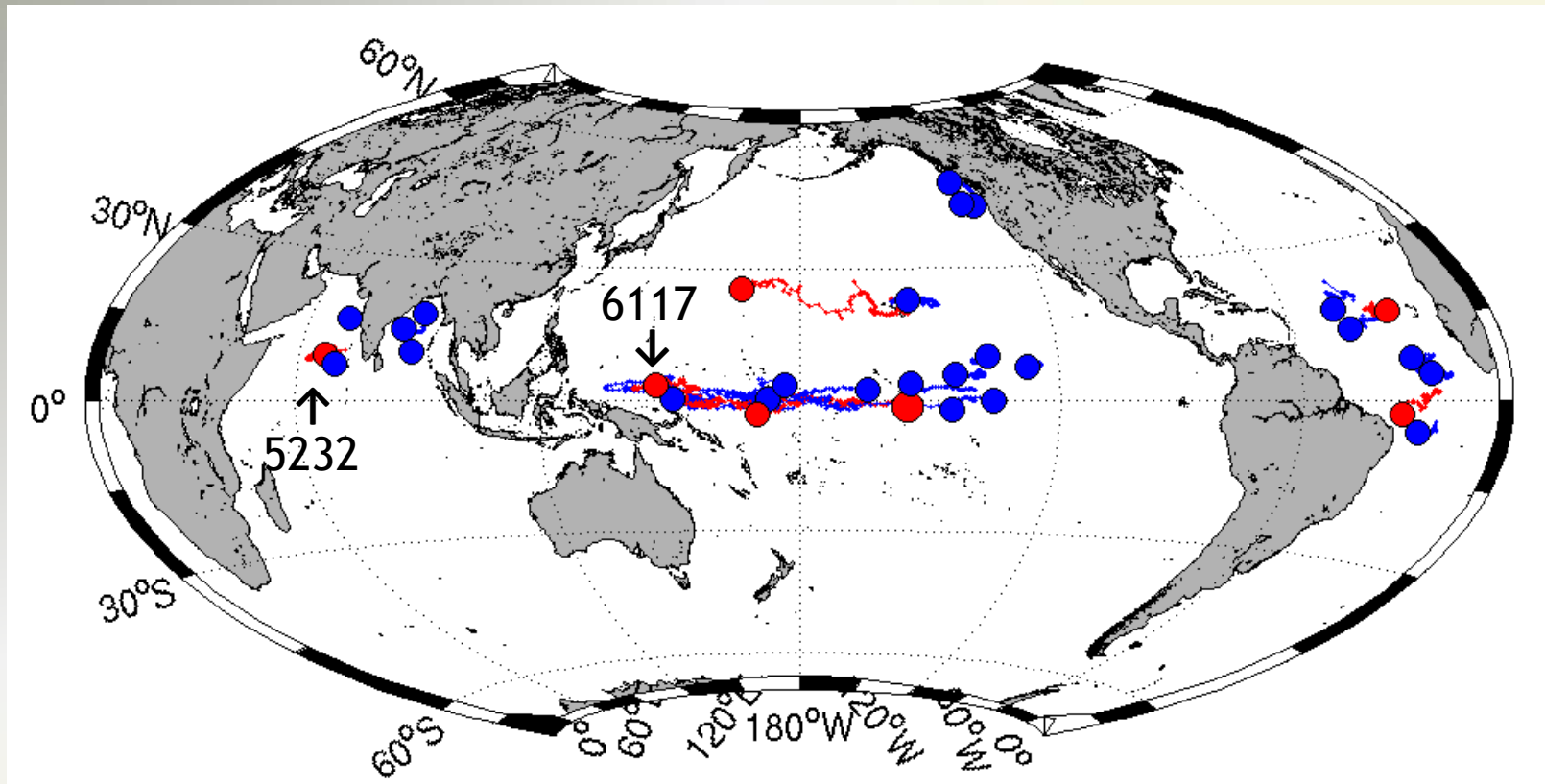
STS Float Operation - Example Profile



Float 6117
Profile 228
8/15/2009

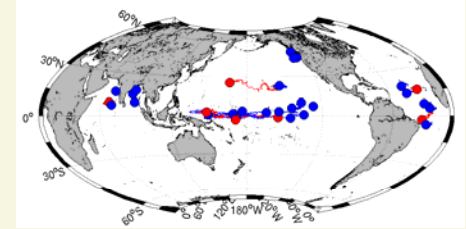
Deployment Locations

- Fast cycle
- No fast cycle

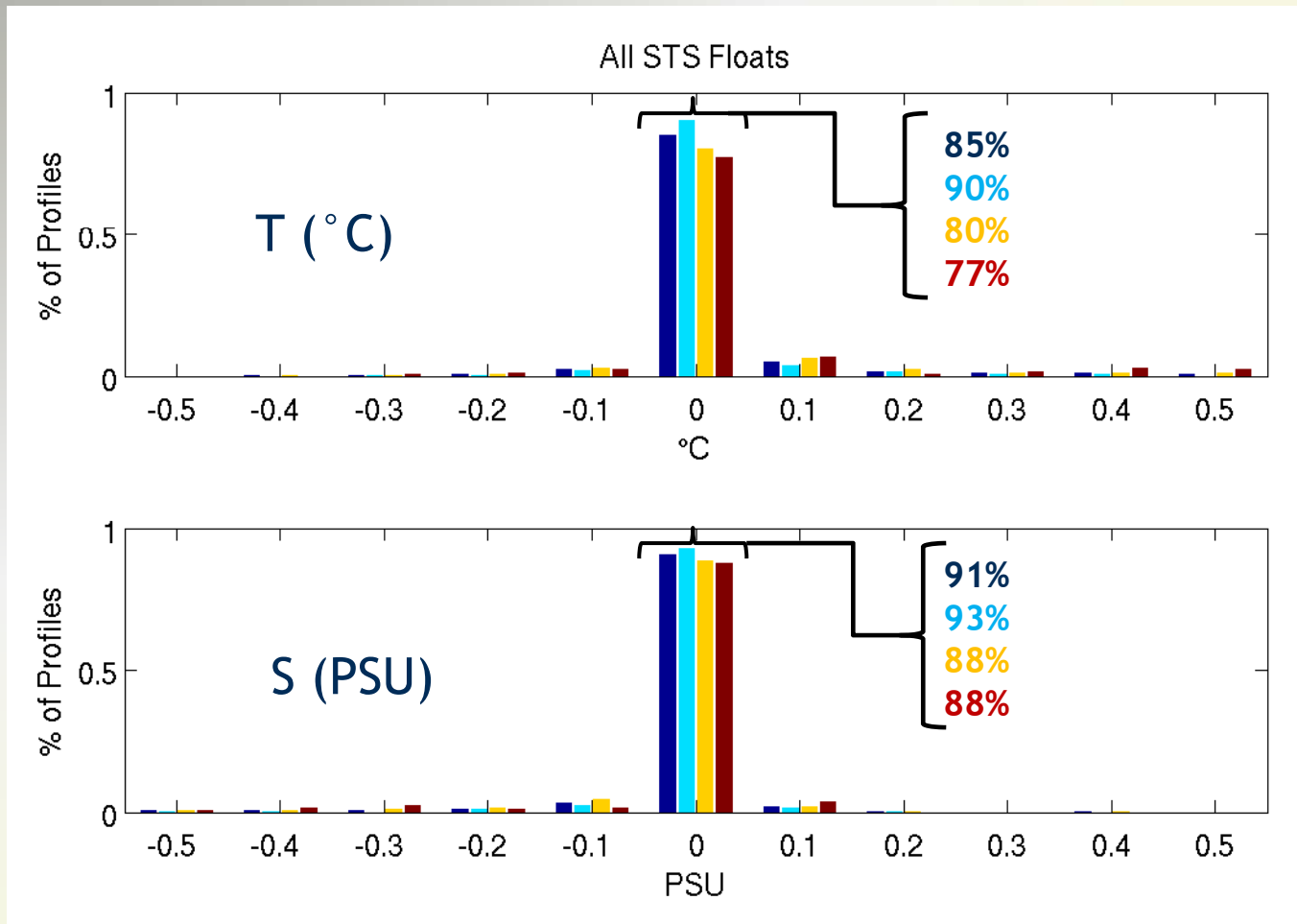


To date, 31 STS floats have been deployed.

Regional Variations

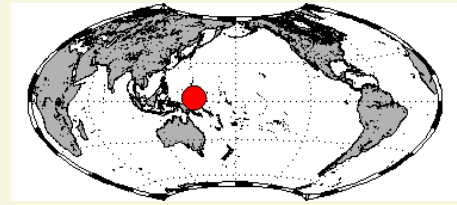


STS(surface) - STS(4m)

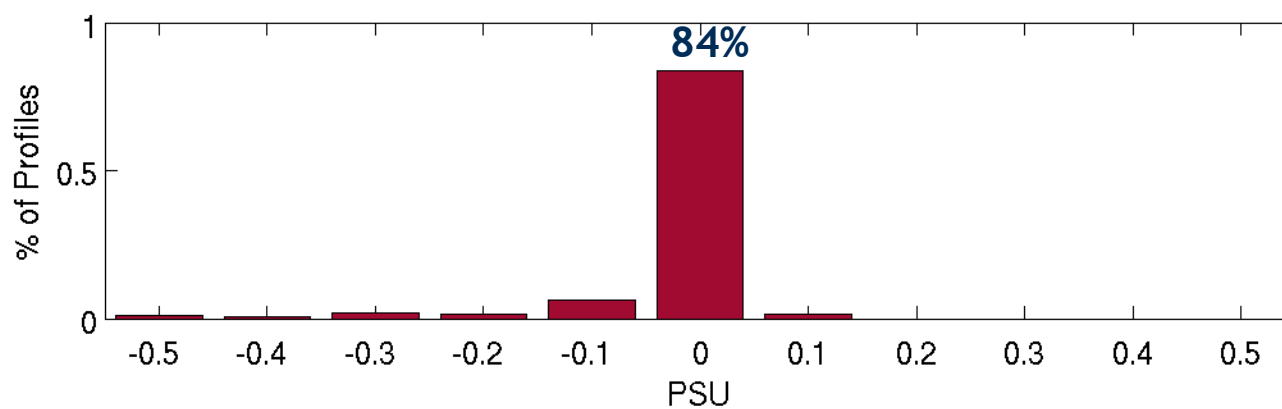
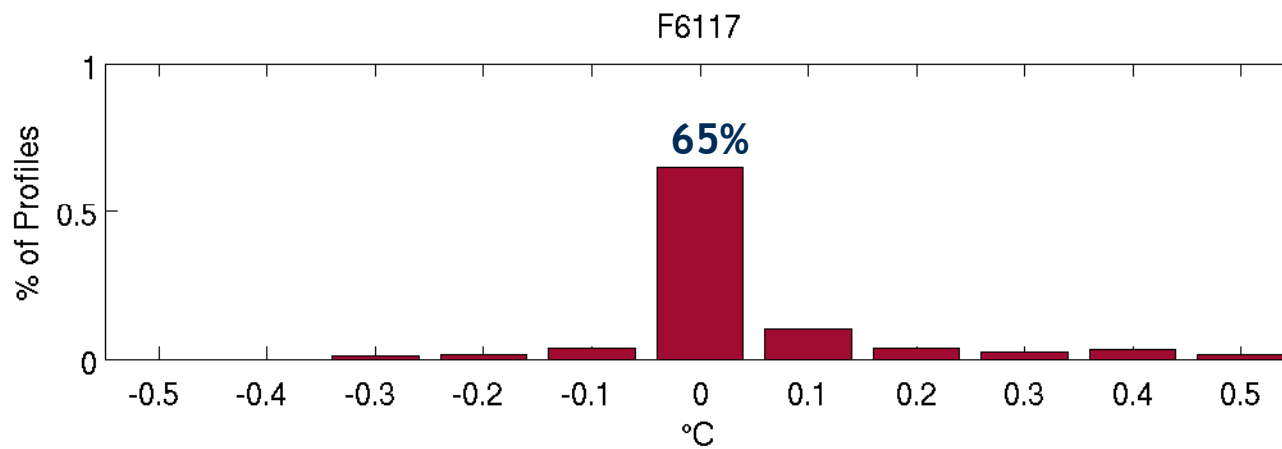
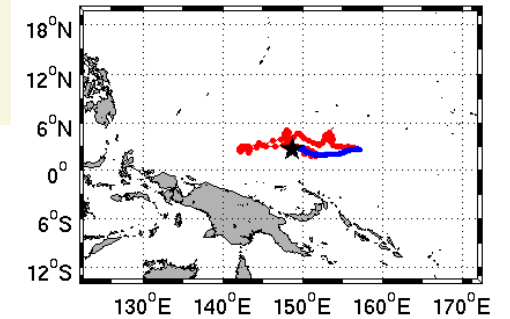


All Floats (31)
Atlantic
Pacific
Indian

Float 6117 - Tropical Western Pacific



STS(surface) - STS(4m)

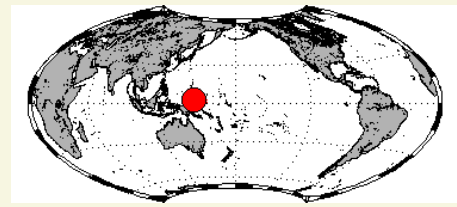


311 profiles

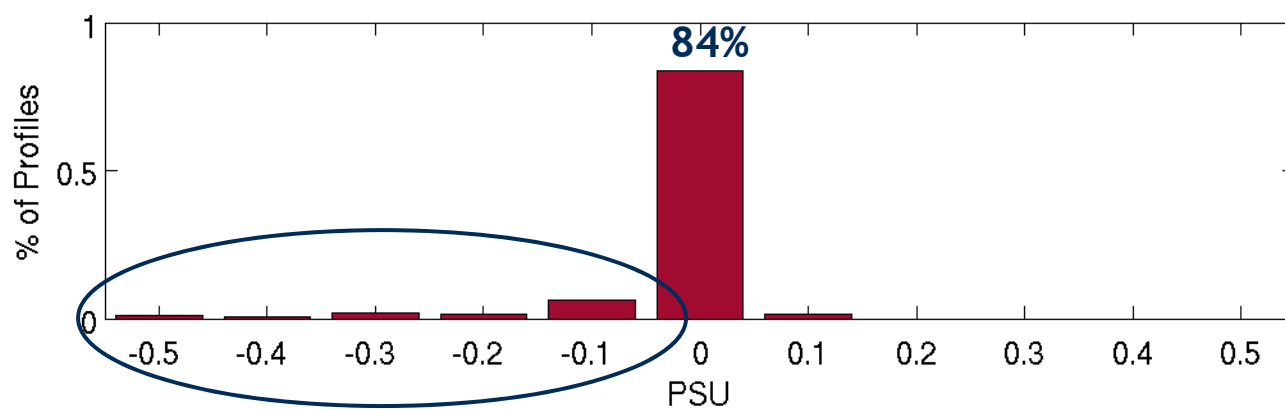
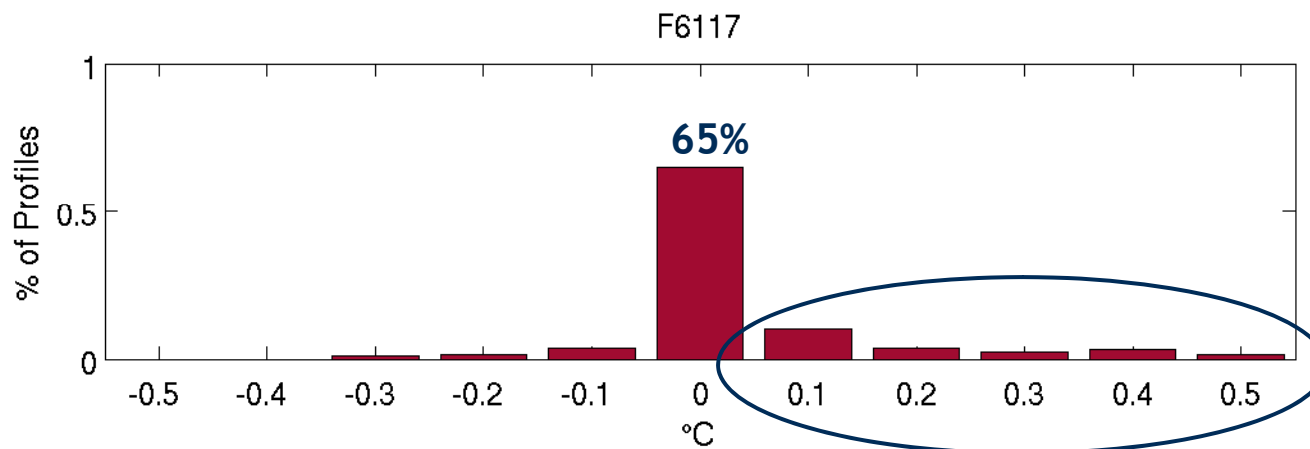
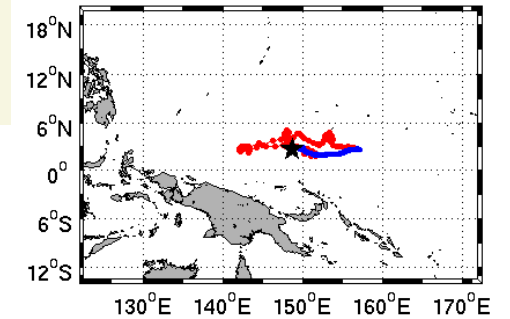
Mean $\Delta T = 0.09$ °C

Mean $\Delta S = -0.05$ PSU

Float 6117 - Tropical Western Pacific

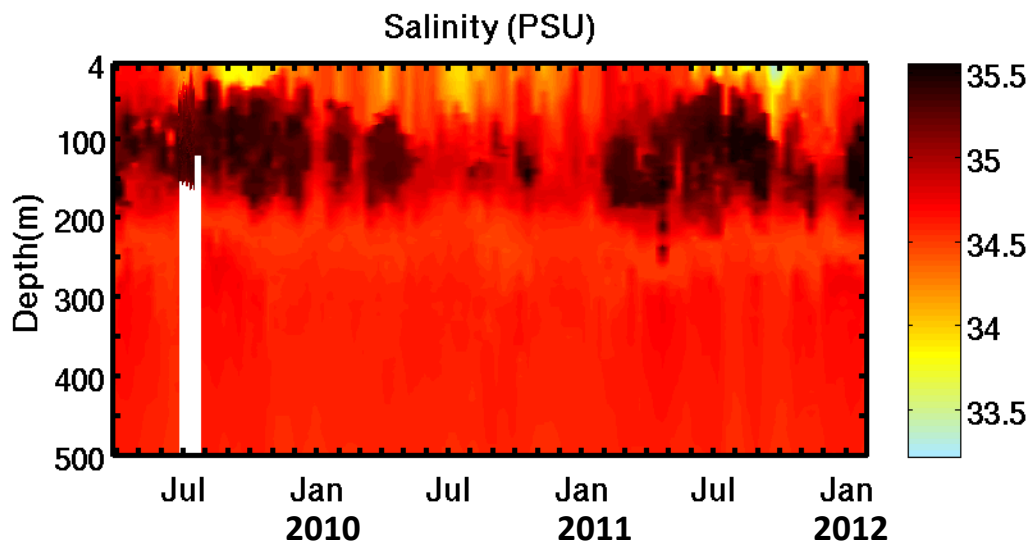
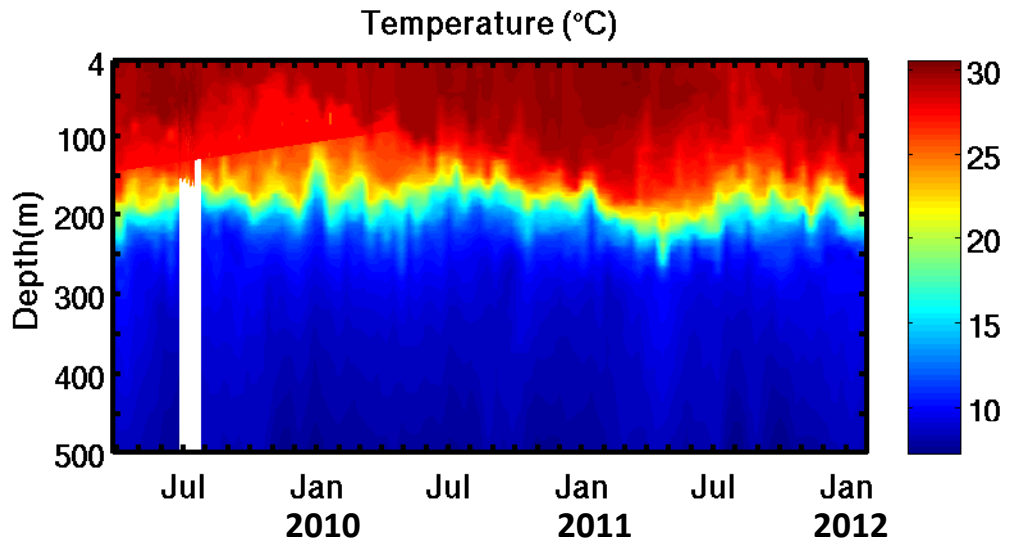
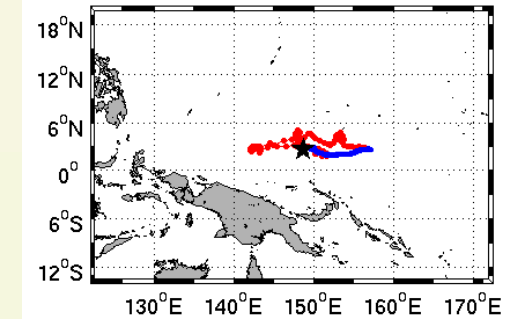
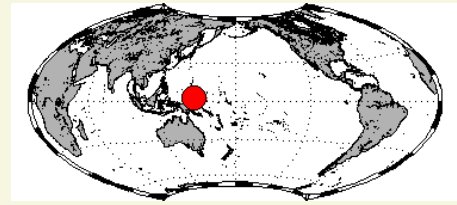


STS(surface) - STS(4m)



311 profiles
Mean $\Delta T = 0.09$ °C
Mean $\Delta S = -0.05$ PSU

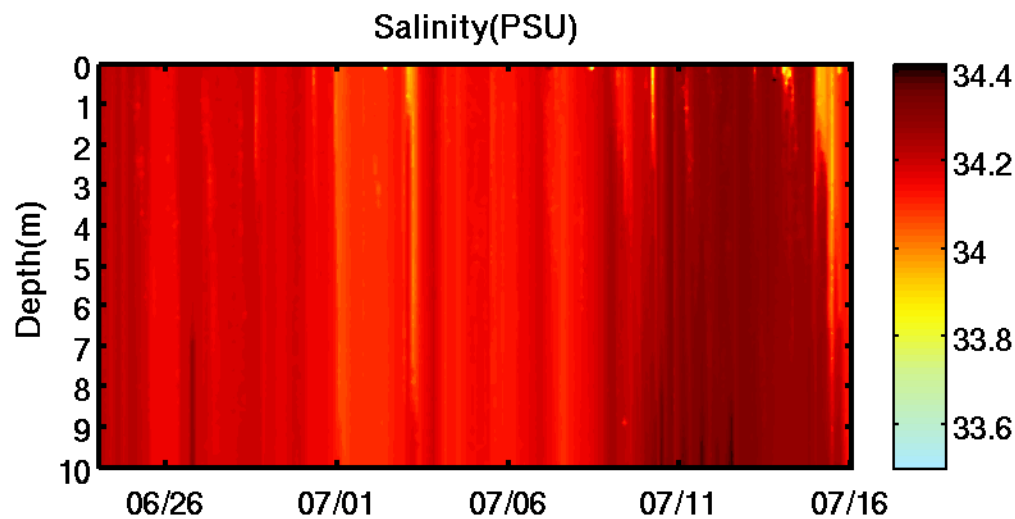
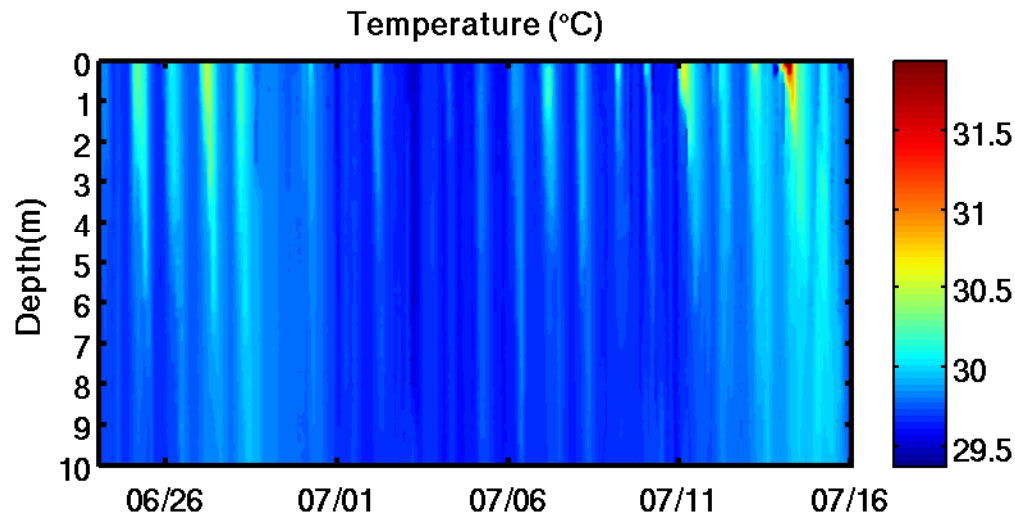
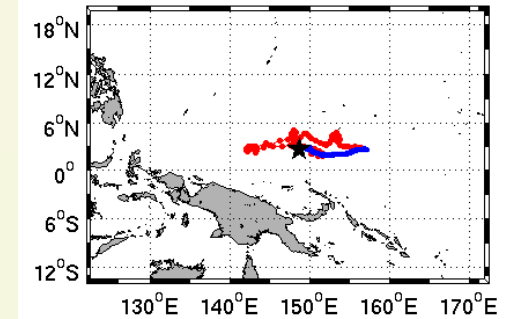
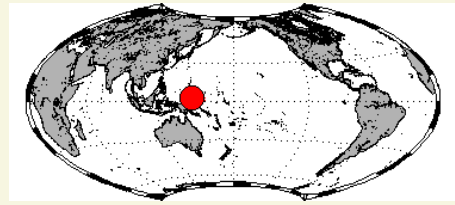
Float 6117 - Tropical Western Pacific



Upper 500 meters
Profile every 10 days

3/24/2009 - 1/28/2012

Float 6117 - Tropical Western Pacific

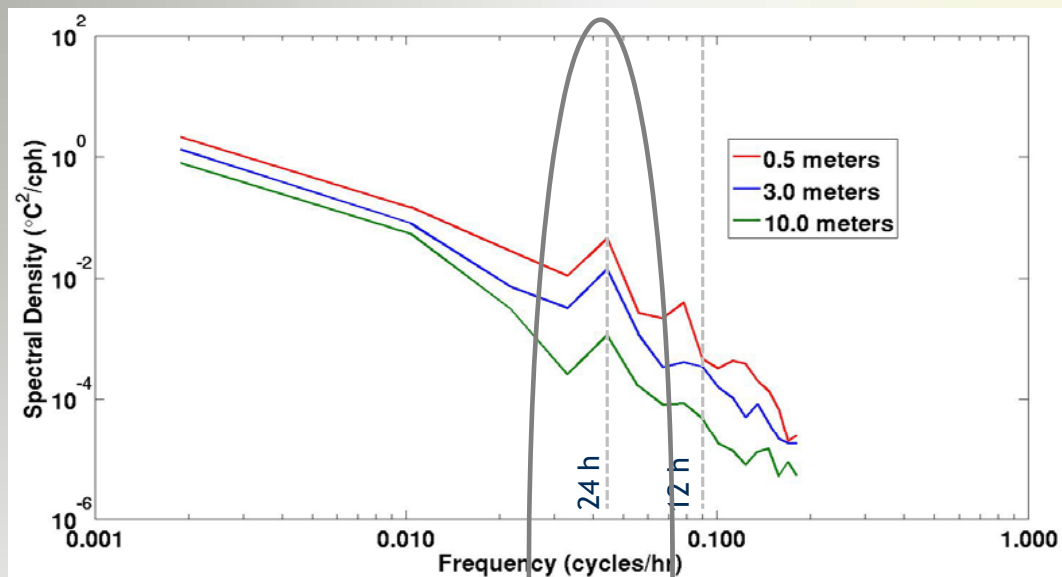


Upper 10 meters
Profile every 2 hours
3 week time period

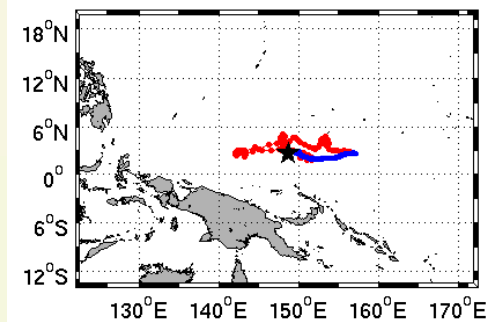
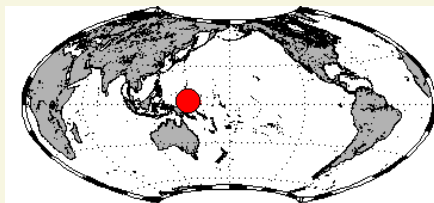
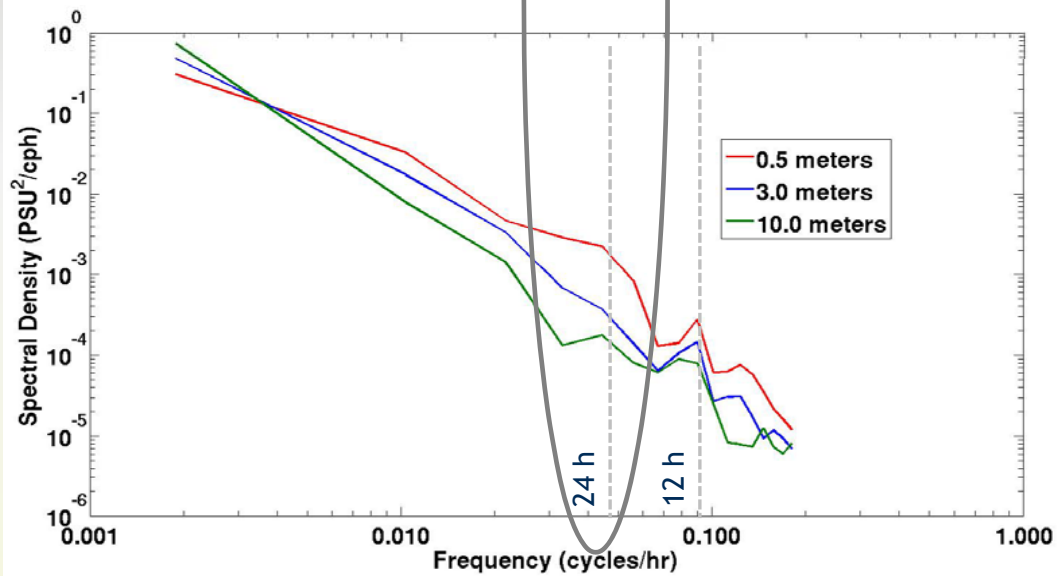
6/24/2009 - 7/15/2009

Float 6117 - Tropical Western Pacific Spectral Density

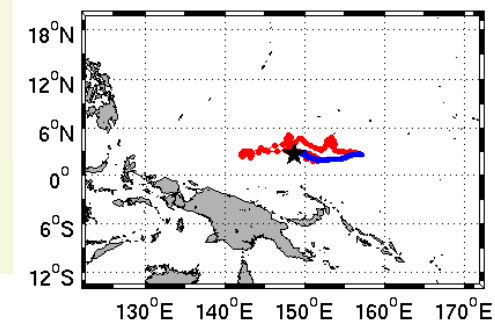
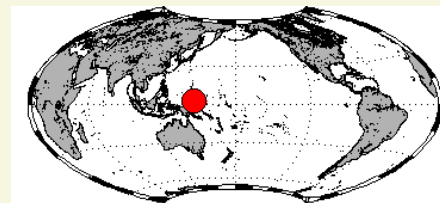
T (°C)



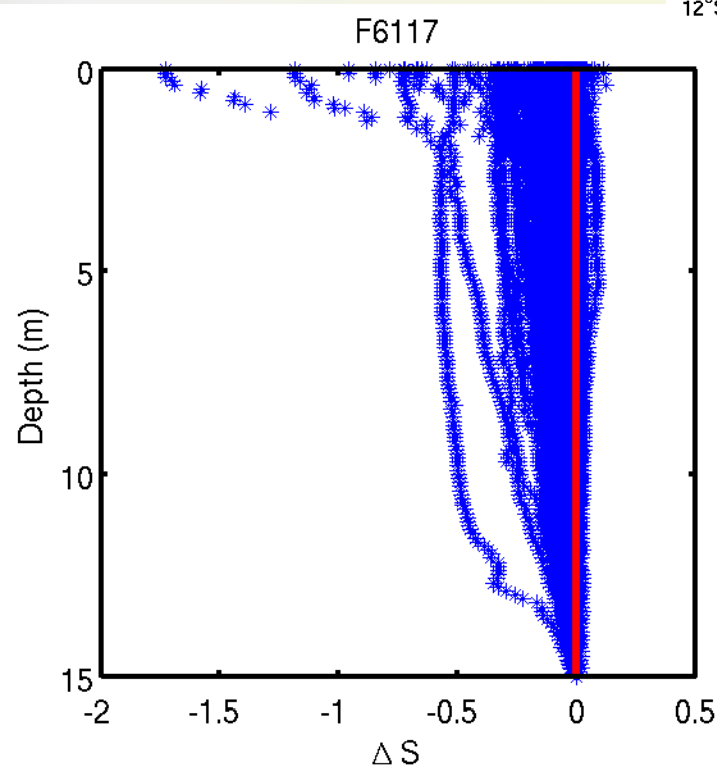
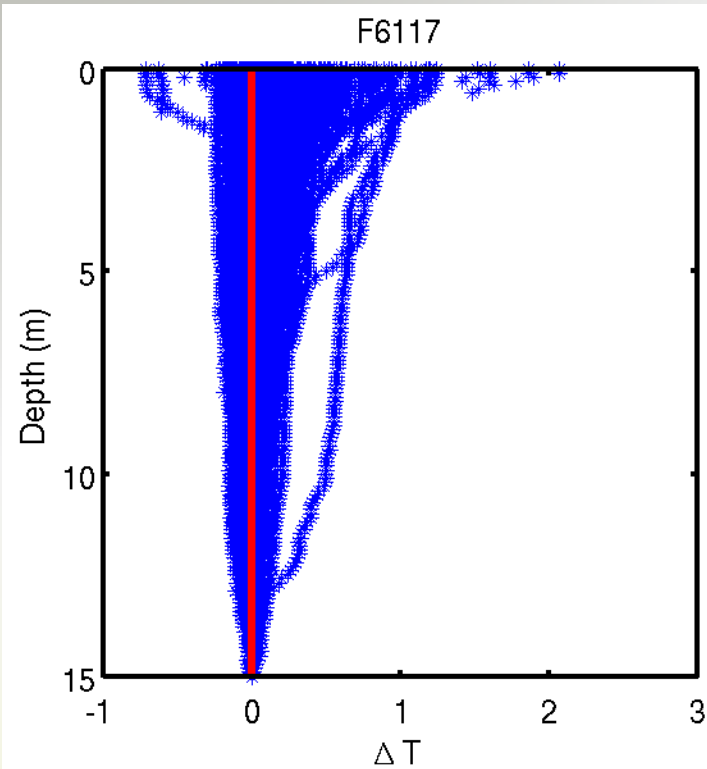
S (PSU)



Float 6117 - Tropical Western Pacific



STS - STS(15m)



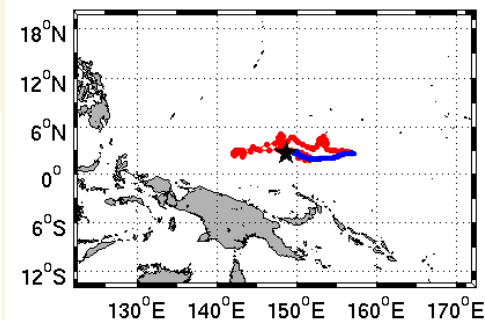
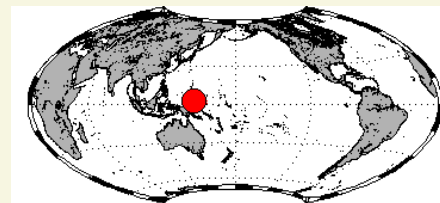
311 profiles

T ($^{\circ}$ C)

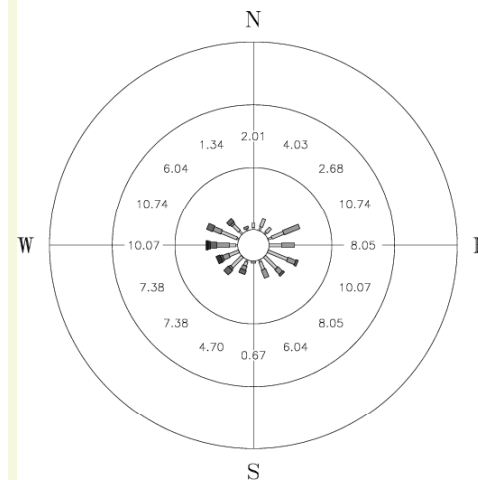
S (PSU)

Float 6117 - Tropical Western Pacific

Composite Mean Anomalies

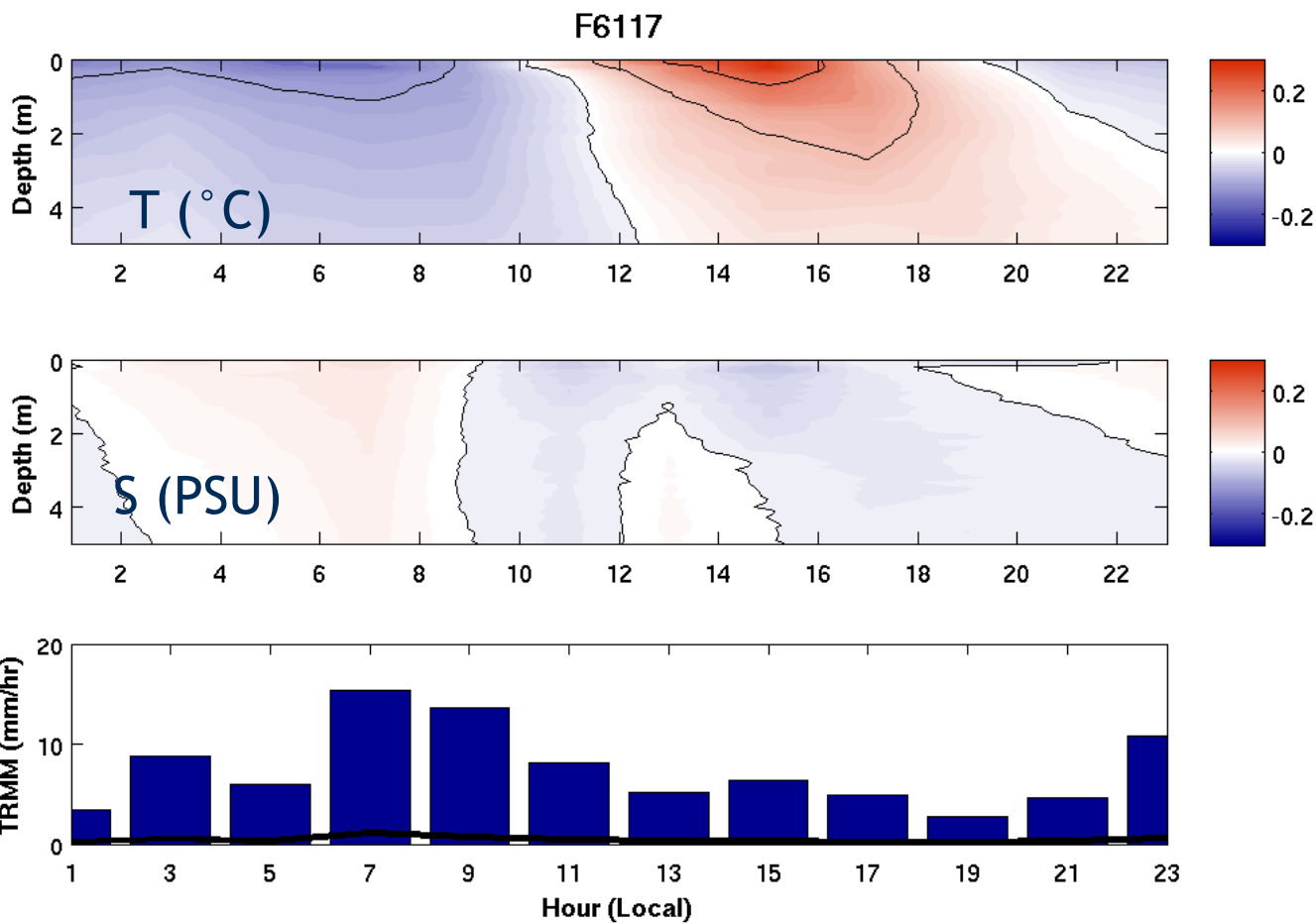


QuikSCAT Daily Observations (01–15 July 2000–2009)
LAT 1.75N LONG 150.75E

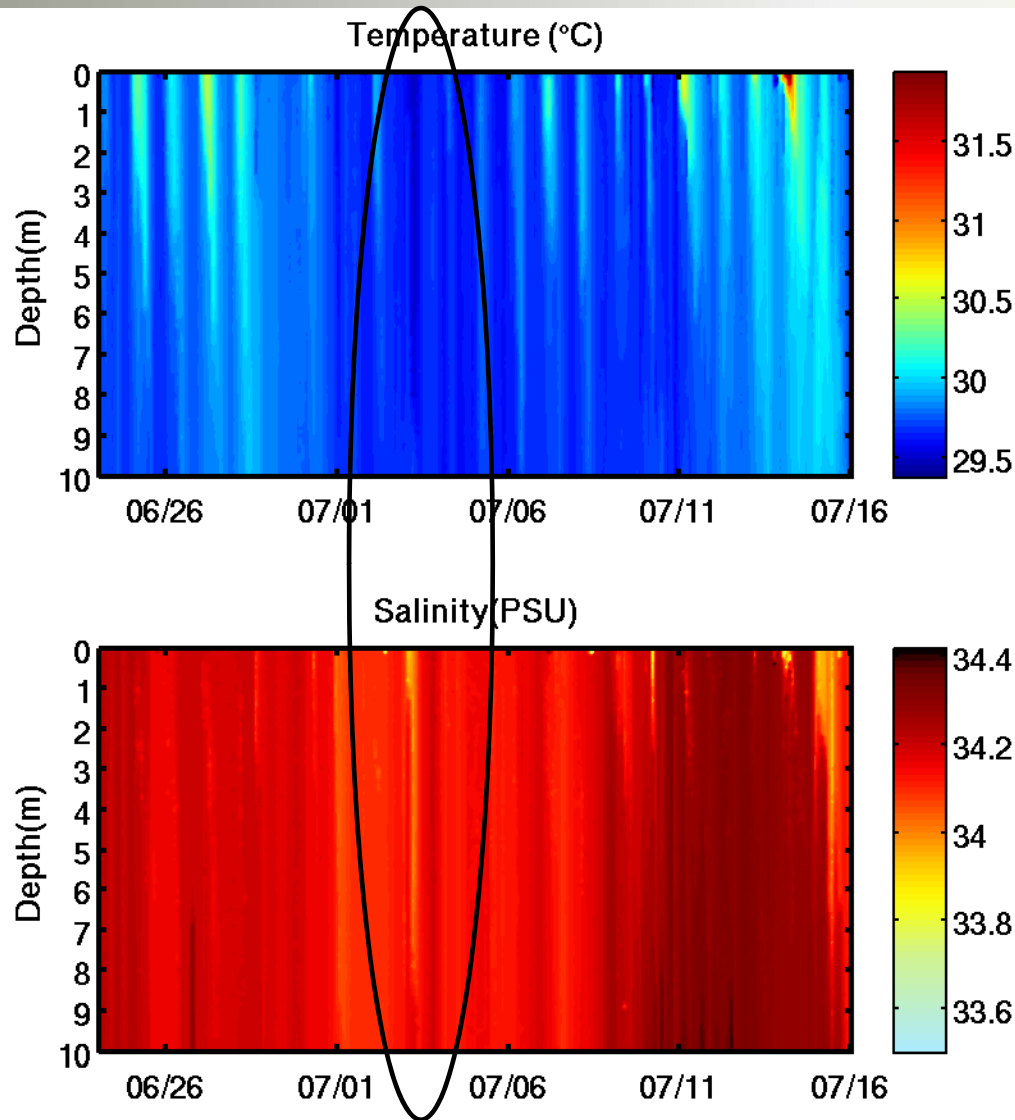
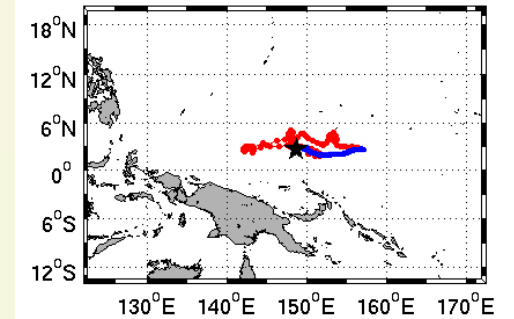
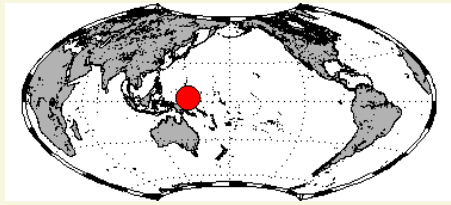


0 5 10 15 20 25
Wind Speed (Knots)

Rings at 20% intervals
Total no. of obs. = 149



Float 6117 - Tropical Western Pacific



Upper 10 meters
Profile every 2 hours
3 week time period

6/24/2009 - 7/15/2009

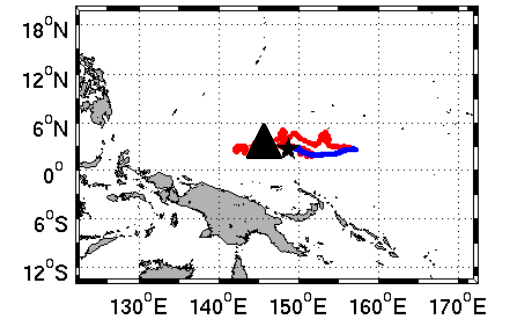
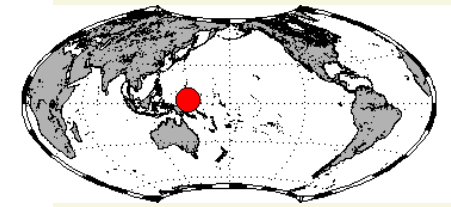
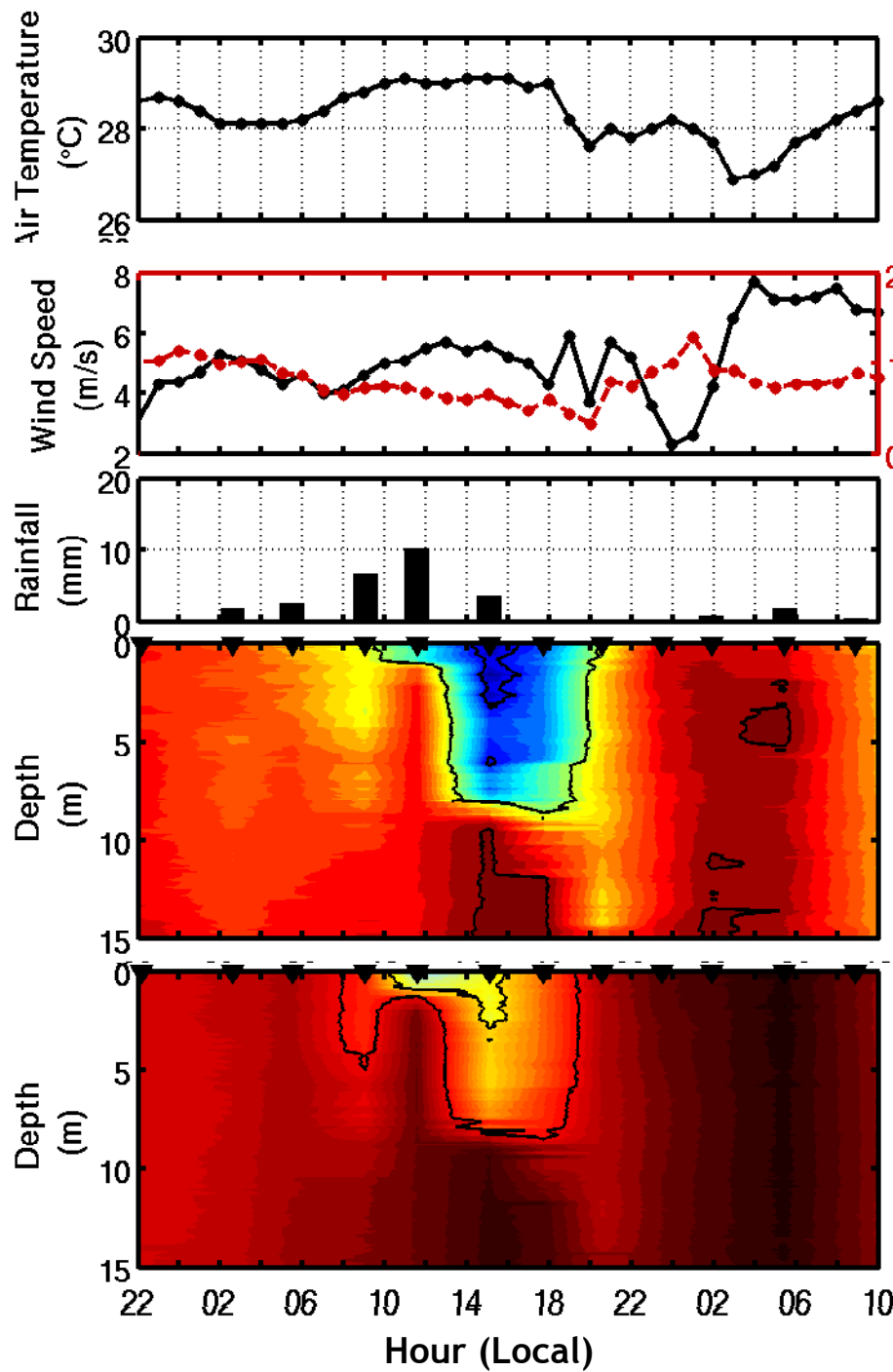
Float 6117

TAO mooring
2°N, 147°E

TRMM
(3 hourly)

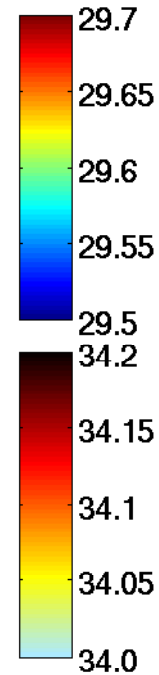
STS
Temperature

STS
Salinity

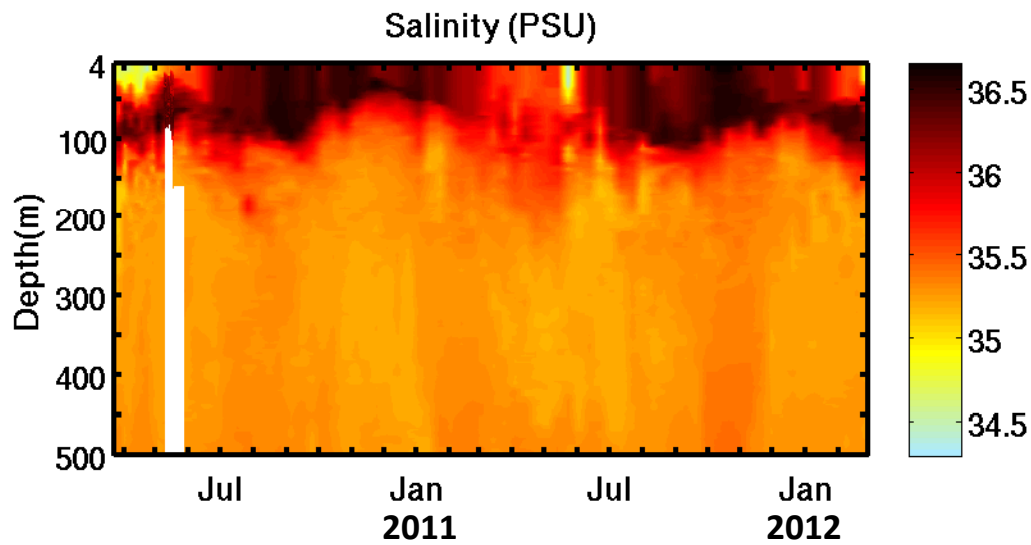
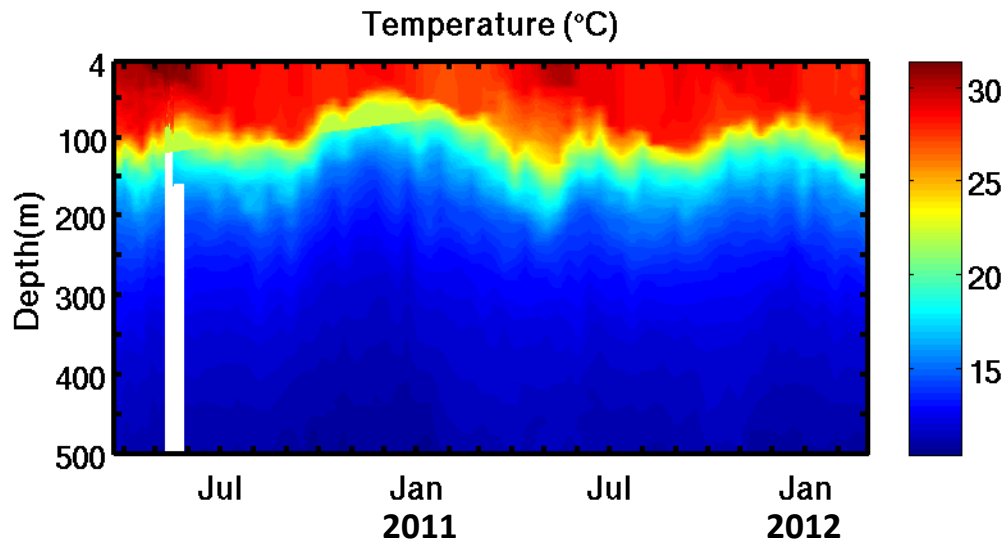
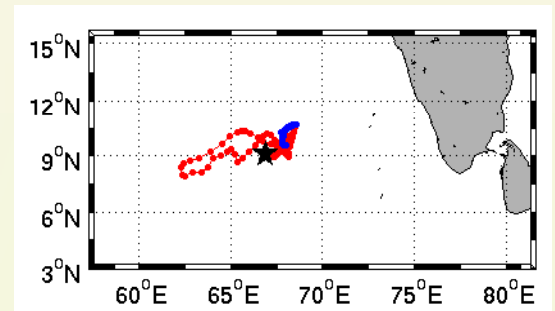
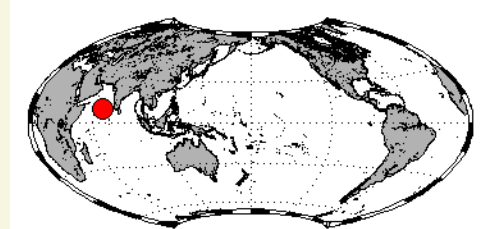


7/3/2009

Rainfall: 25mm
 ΔS : 0.15 PSU
 ΔT : 0.18 °C



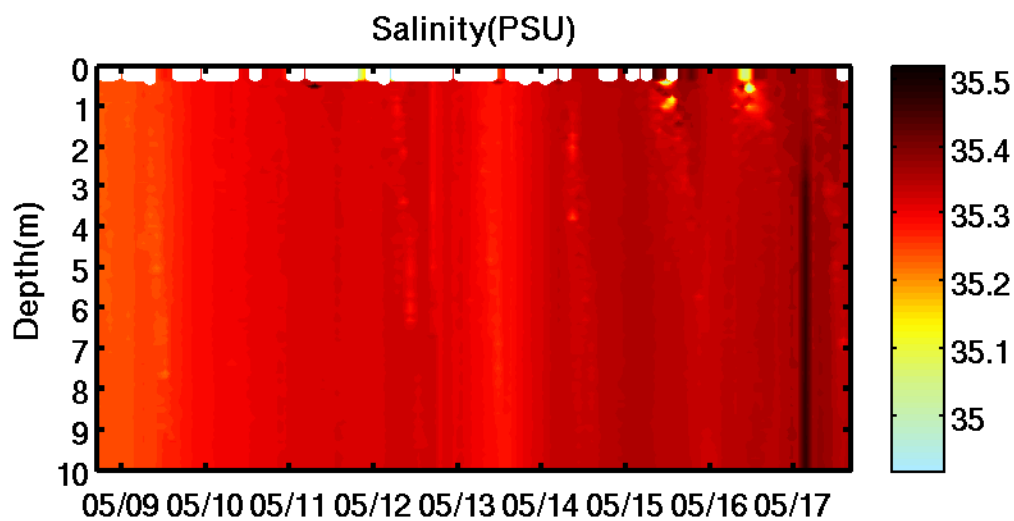
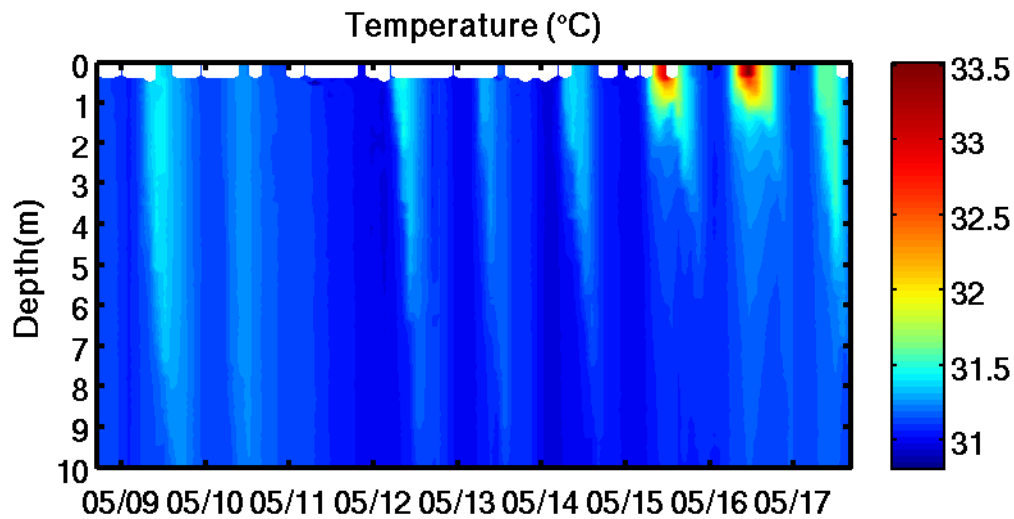
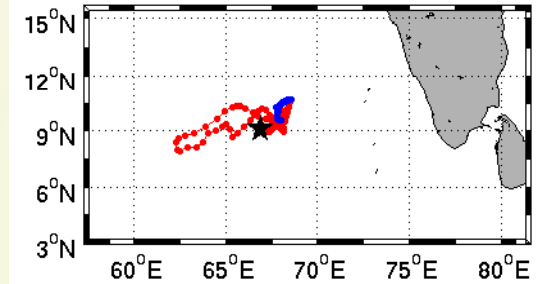
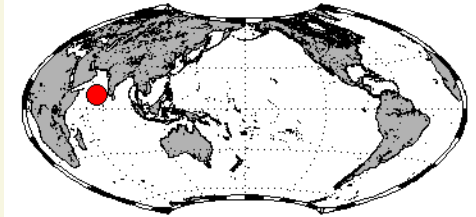
Float 5232 - Arabian



Upper 500 meters
Profile every 10 days

03/21/2010 - 2/28/2012

Float 5232 - Arabian



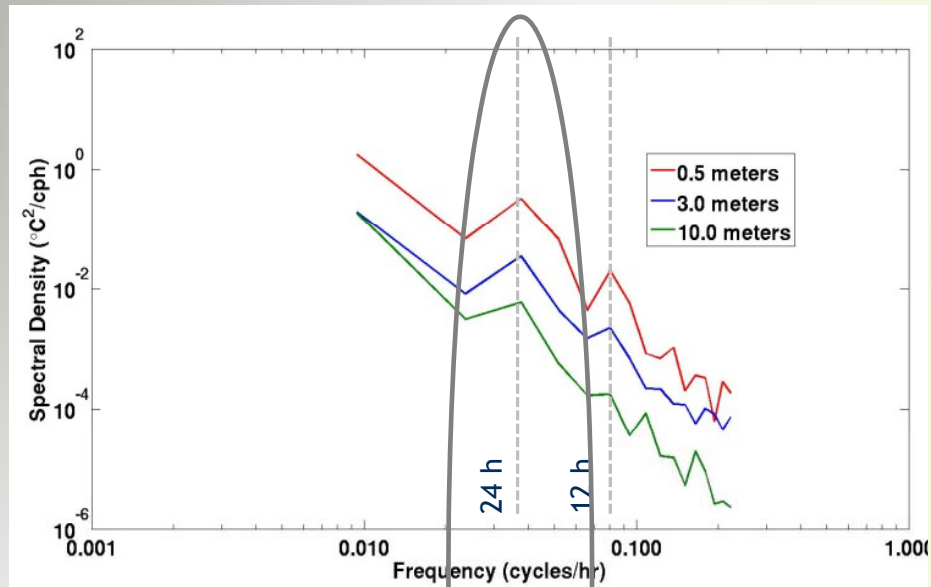
Upper 10 meters
Profile every 2 hours
1 week time period

5/8/2010 - 5/17/2010

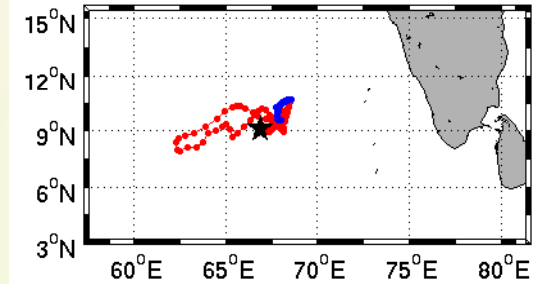
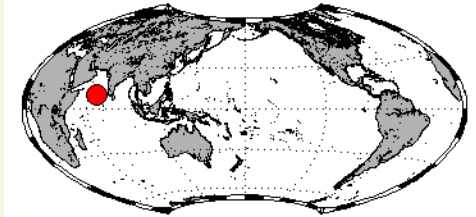
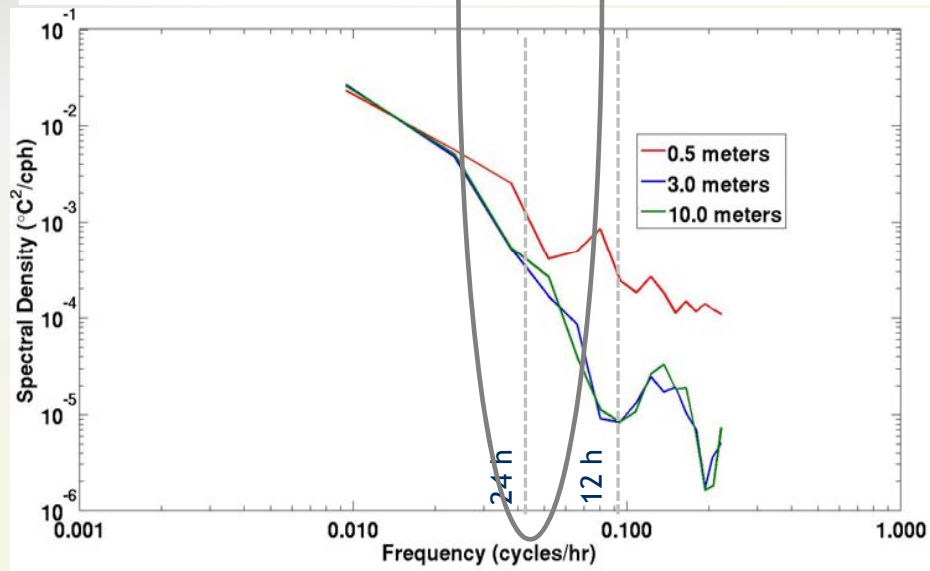
Float 5232 - Arabian

Spectral Density

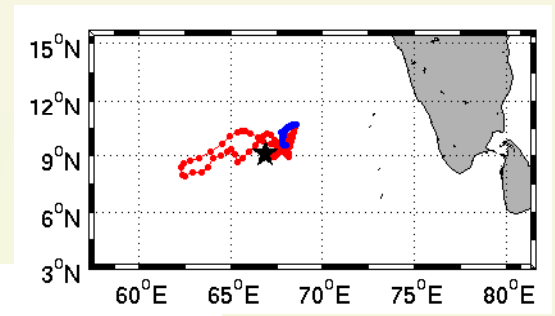
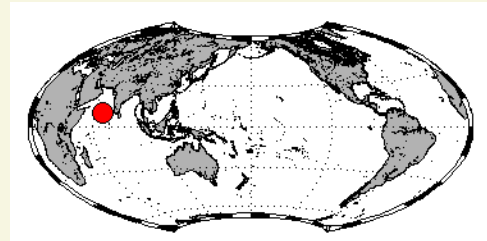
T (°C)



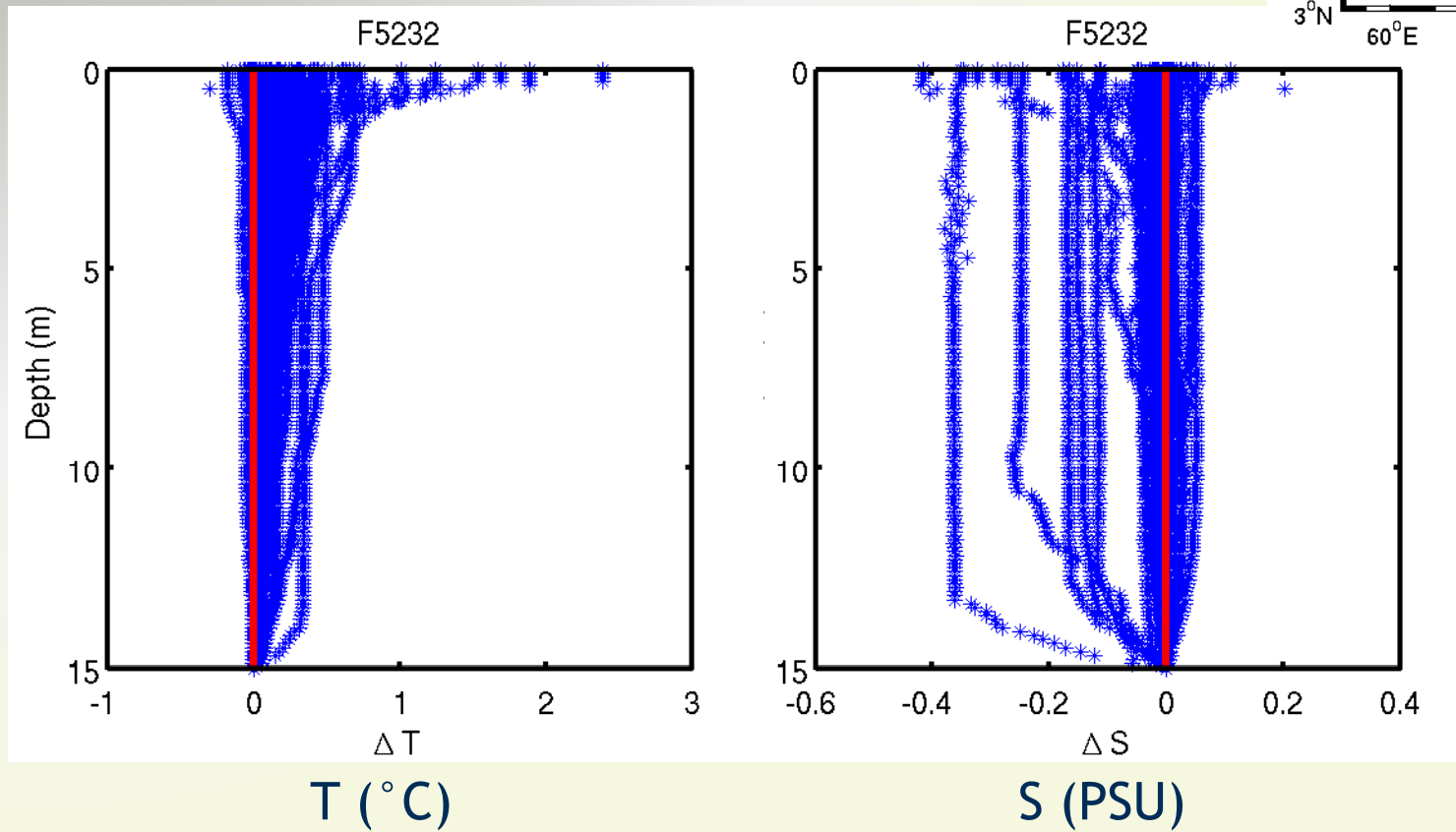
S (PSU)



Float 5232 - Arabian



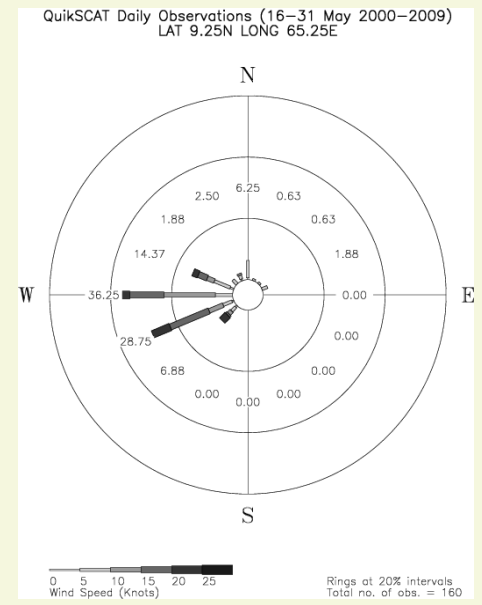
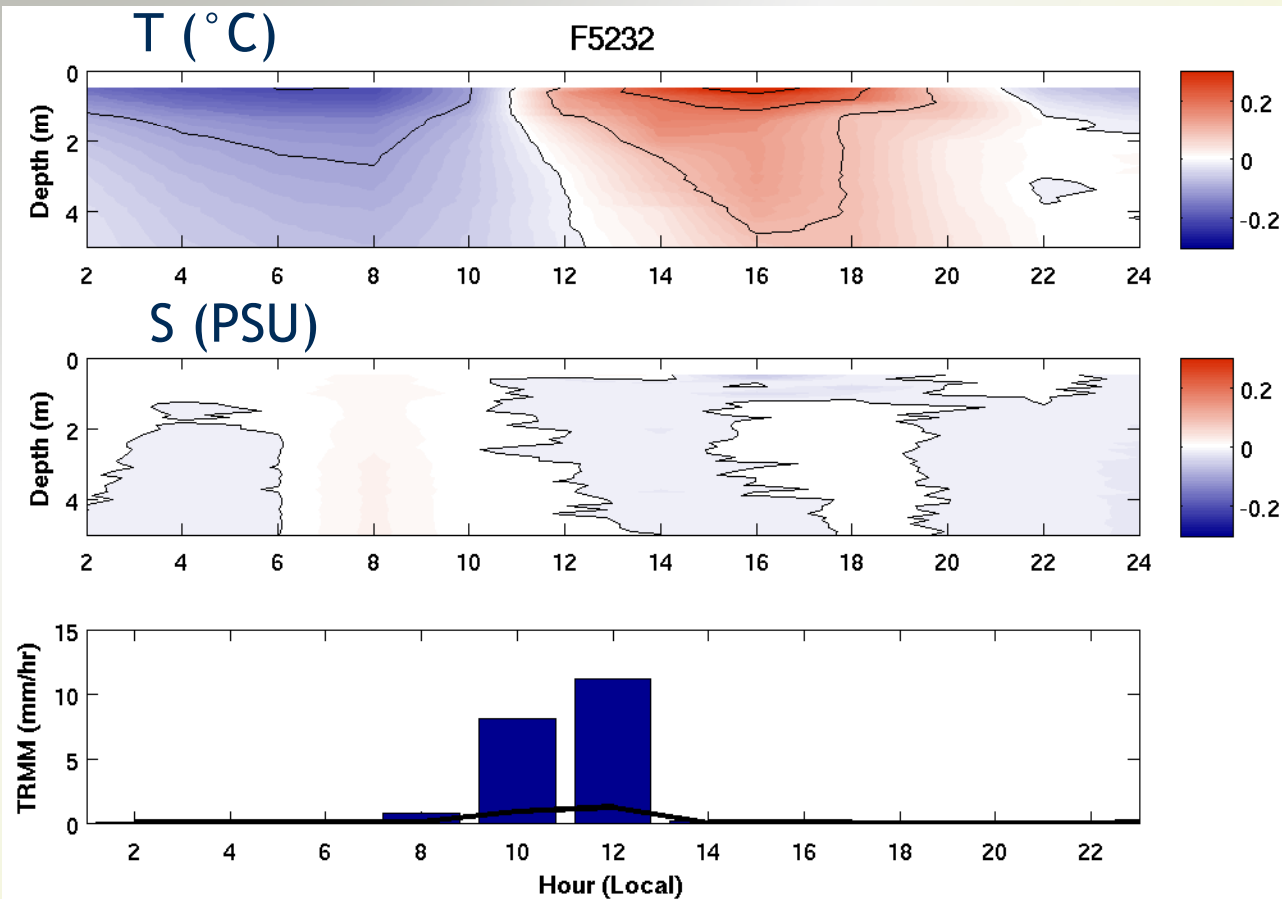
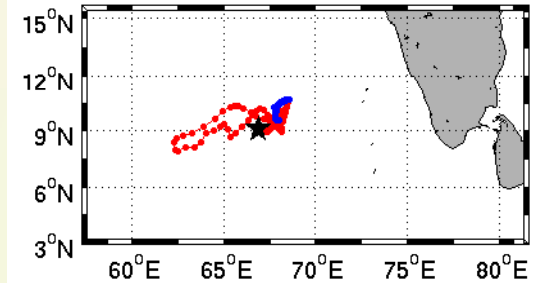
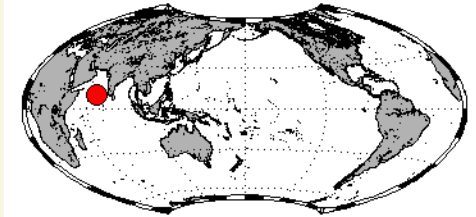
STS - STS(15m)



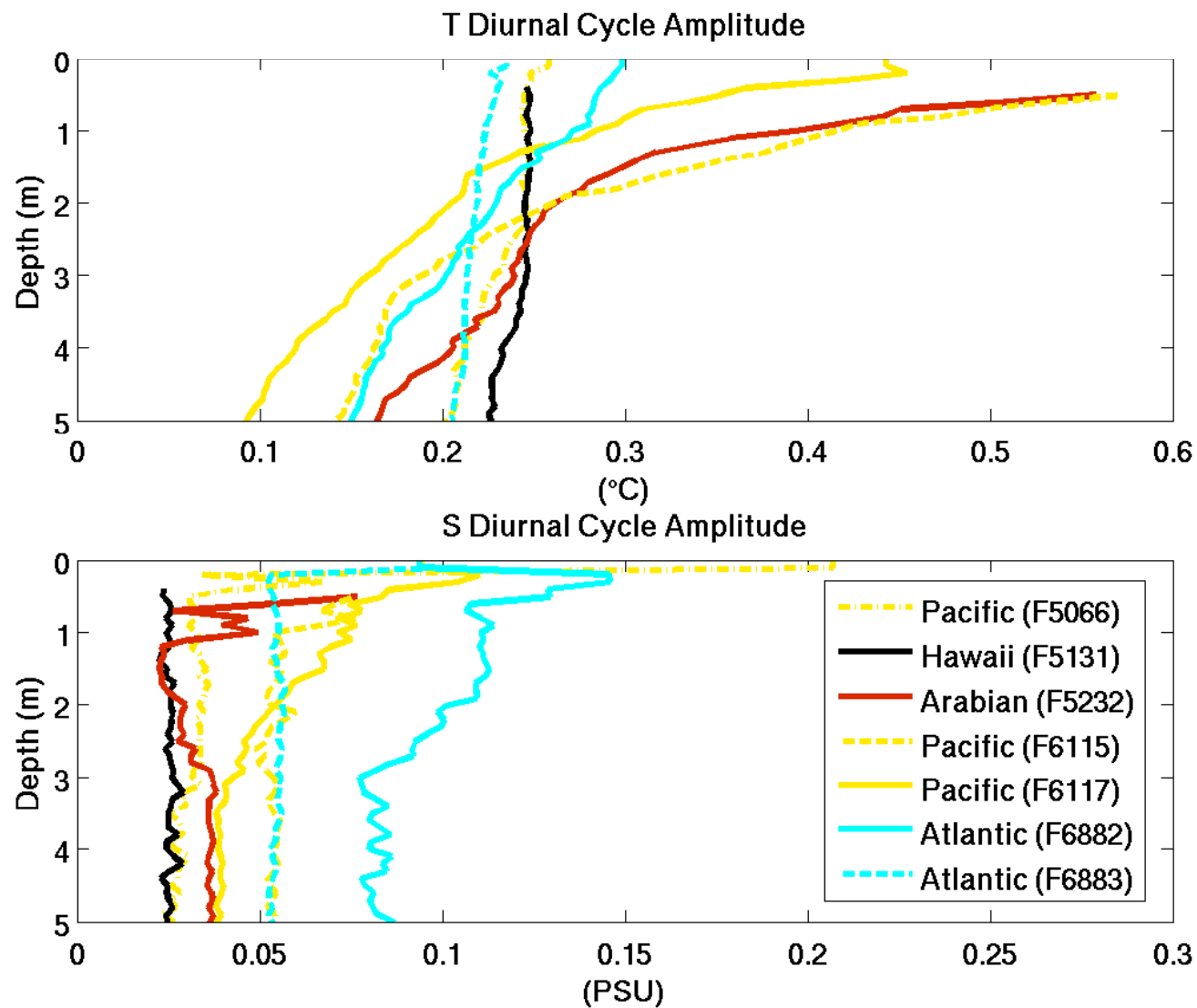
181 profiles

Float 5232 - Arabian

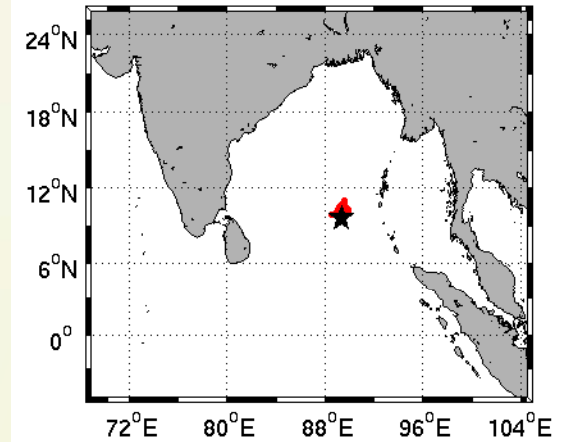
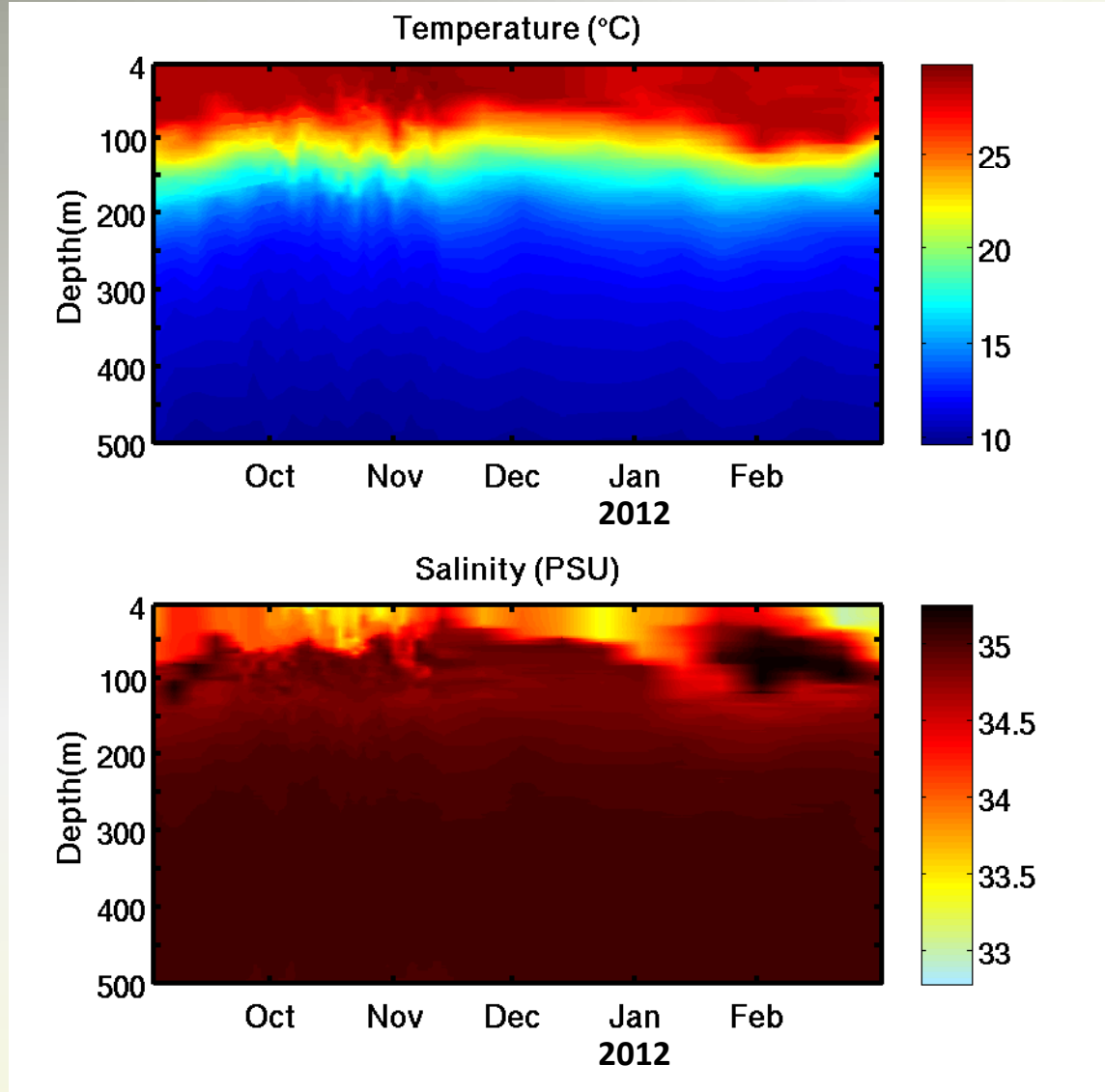
Composite Mean Anomalies



STS Completed Fast Cycle



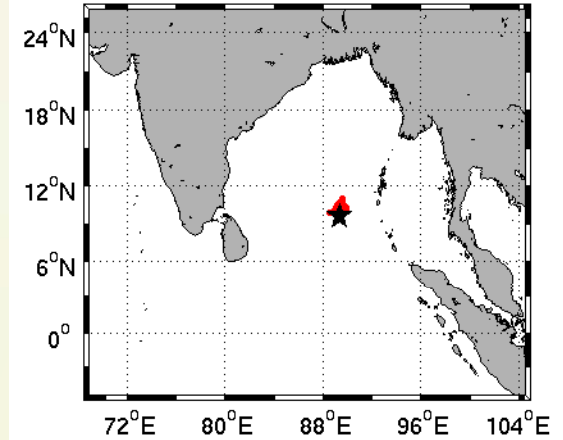
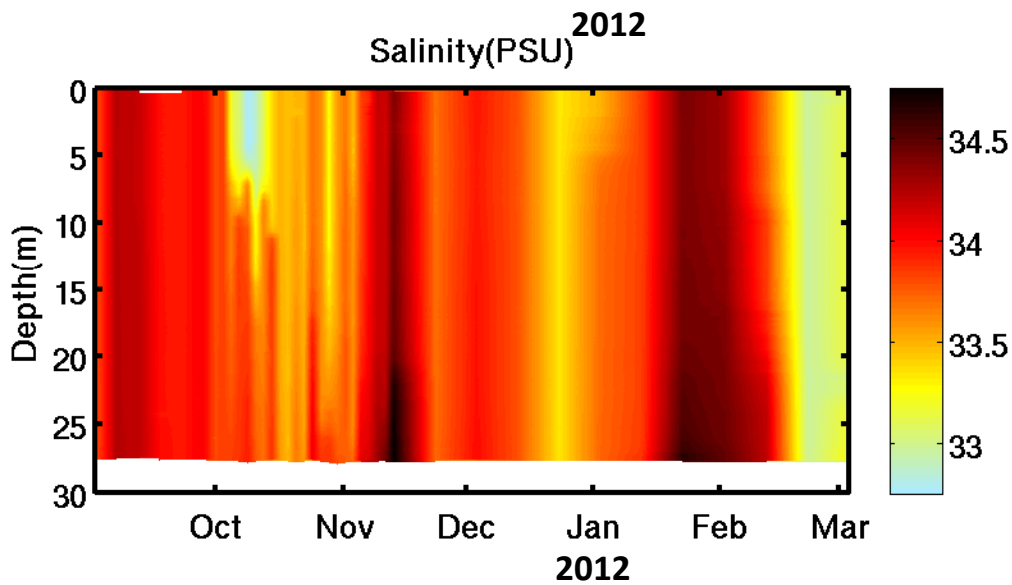
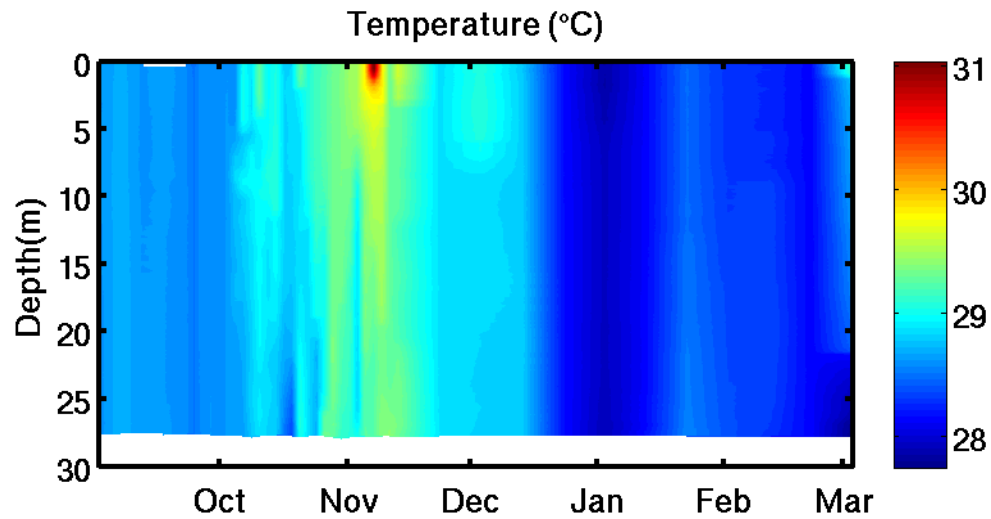
Float 6920 - Bay of Bengal



Upper 500 meters

8/31/2011 - 3/3/2012

Float 6920 - Bay of Bengal



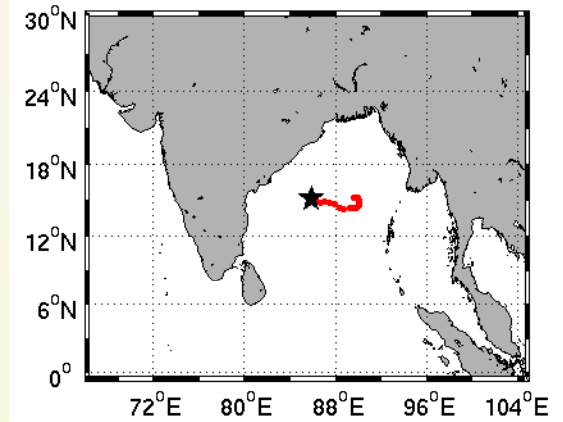
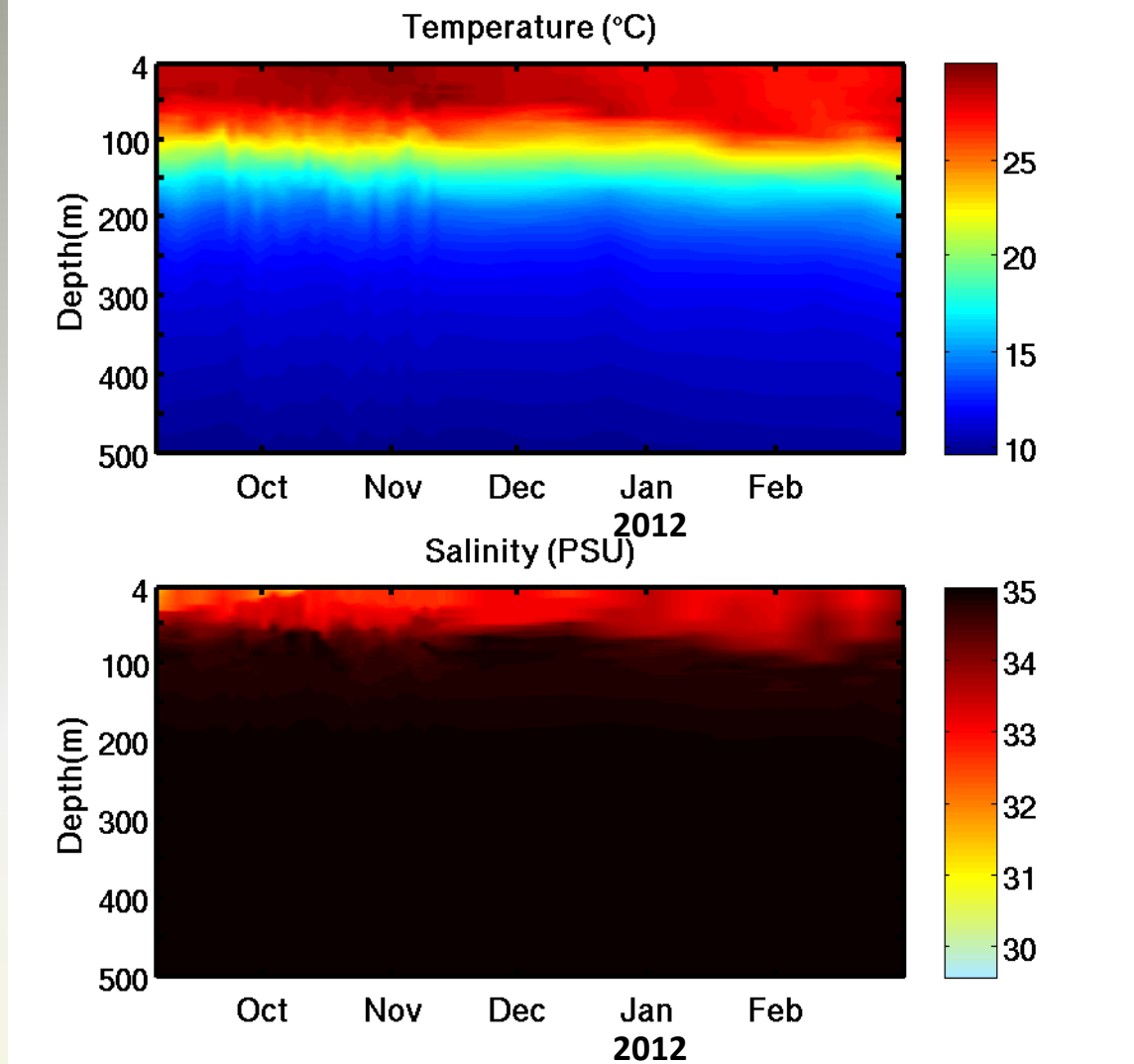
Upper 30 meters

8/31/2011 - 3/3/2012

Conclusions

- STS sensors added to Argo-type floats allow for a high resolution evaluation of the near-surface layer.
- In general there is little difference in temperature and salinity in the upper 5 meters (~85/90% of the time), however
 - differences larger than 0.1 PSU and 0.1 °C are sometimes observed, especially in the Tropical Pacific
 - a strong diurnal signal in temperature is observed and is controlled primarily by solar radiation
 - a weak diurnal signal in salinity is observed and appears to be controlled by local precipitation and mixing.
- This work shows the promise of using Aquarius and Argo together to improve our knowledge of the freshwater cycle in the ocean.

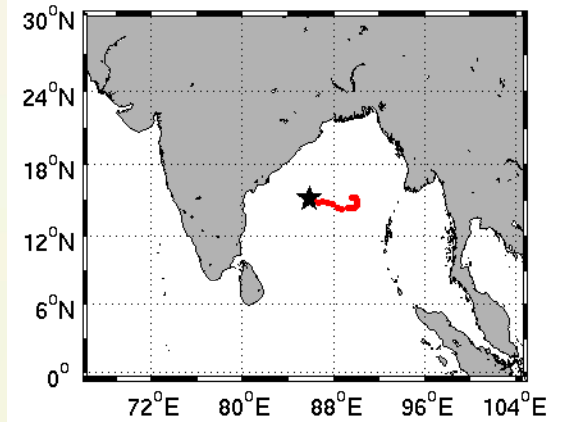
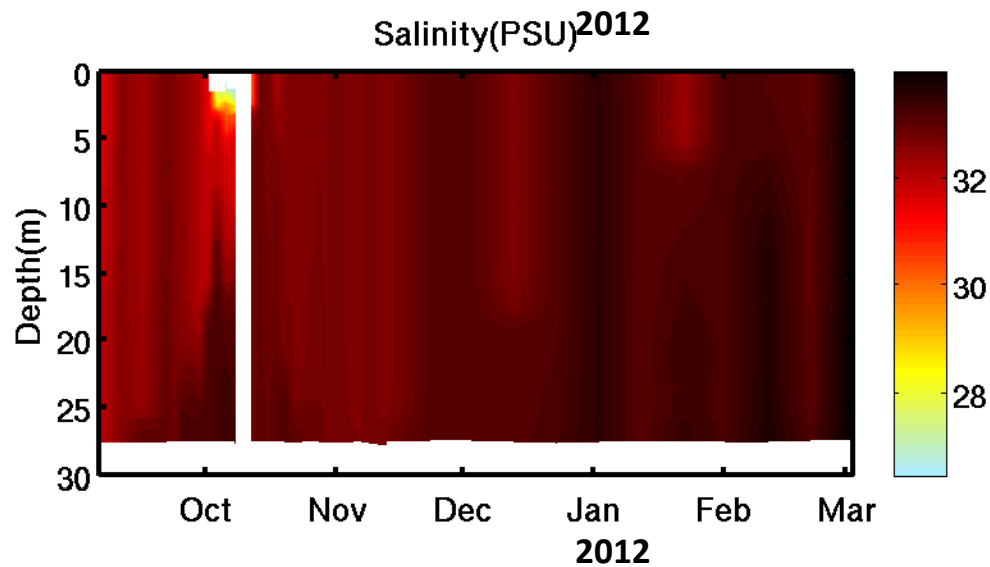
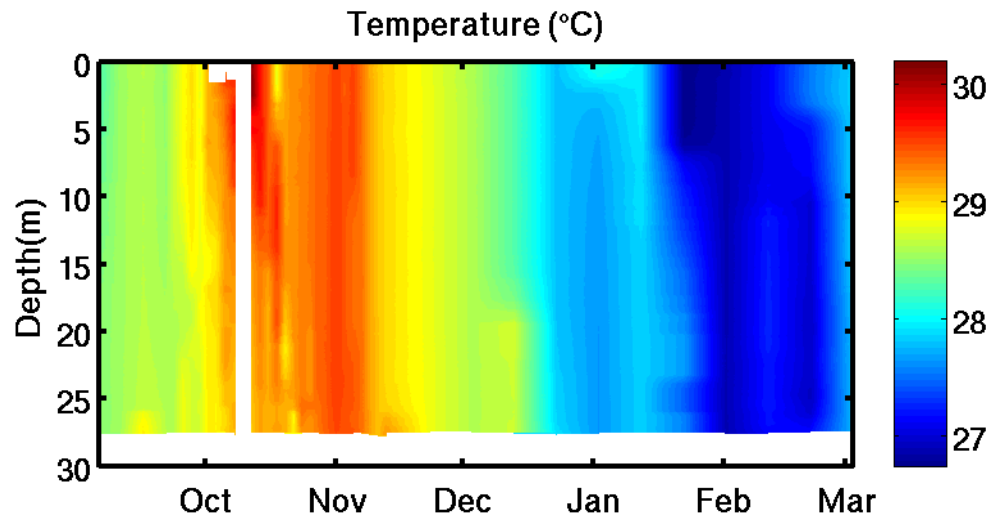
Float 6922 - Bay of Bengal



Upper 500 meters

9/4/2011 - 3/2/2012

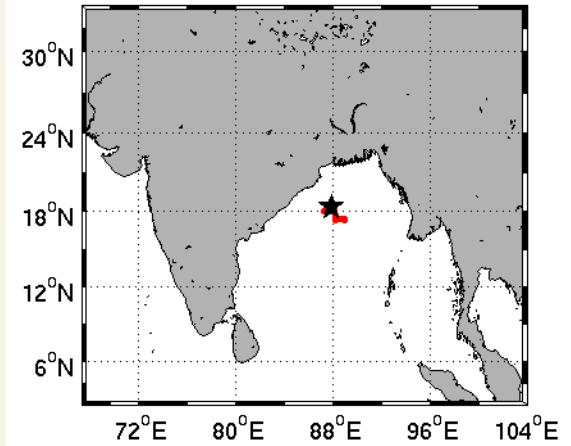
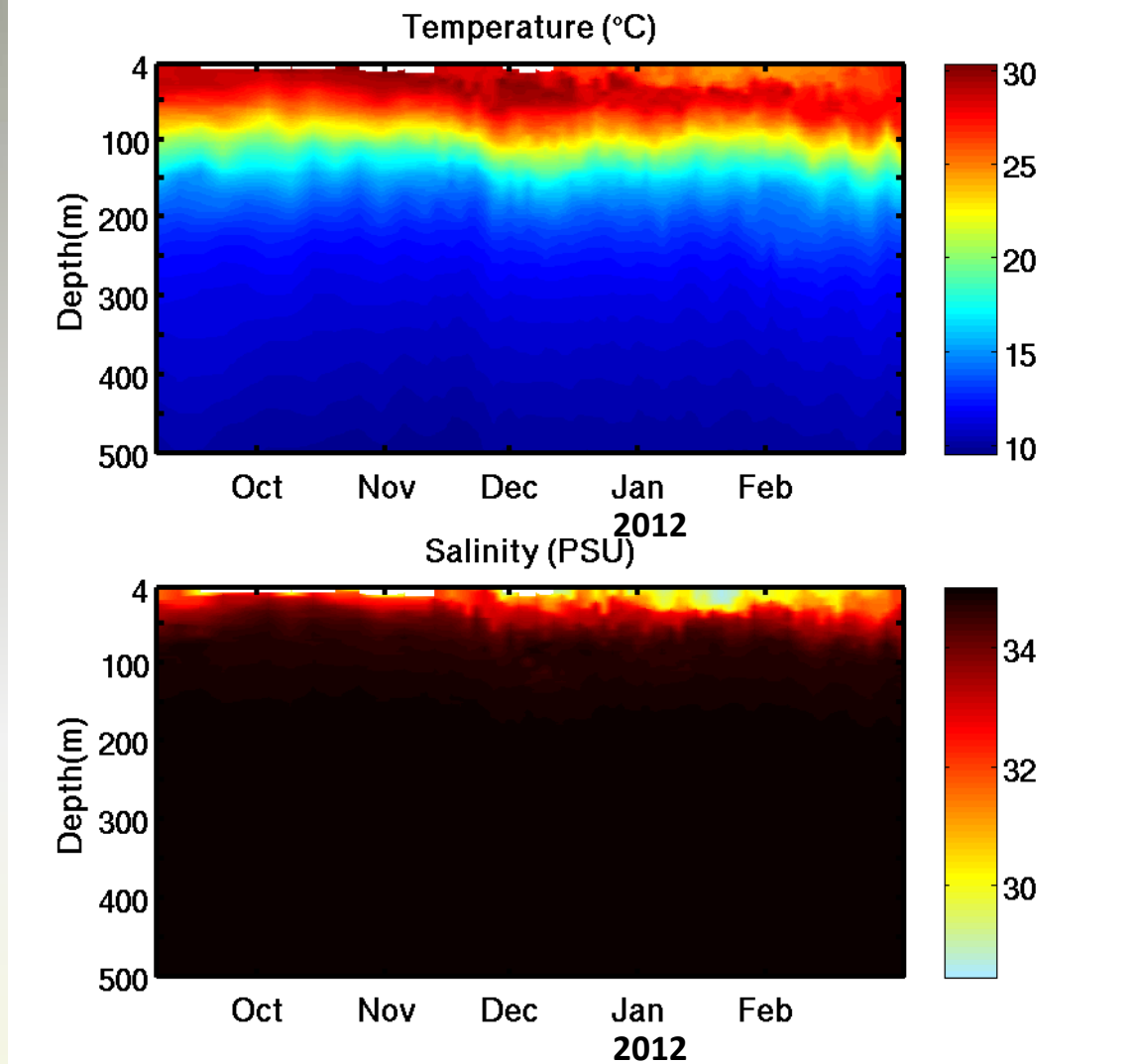
Float 6922 - Bay of Bengal



Upper 30 meters

9/4/2011 - 3/2/2012

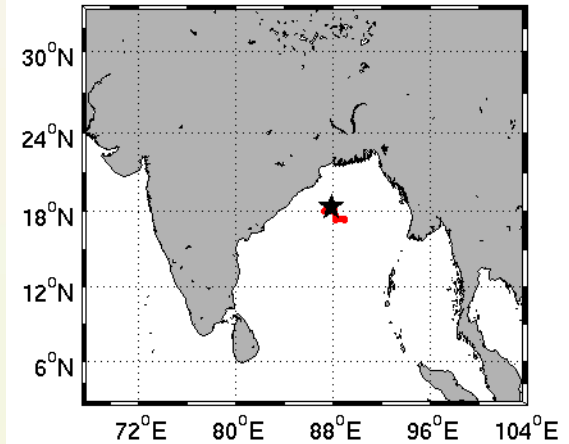
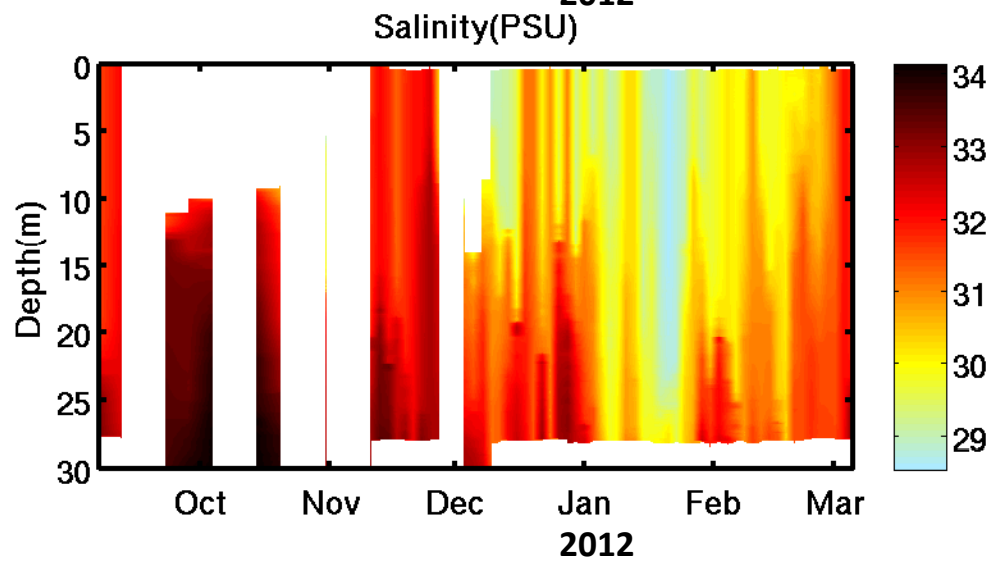
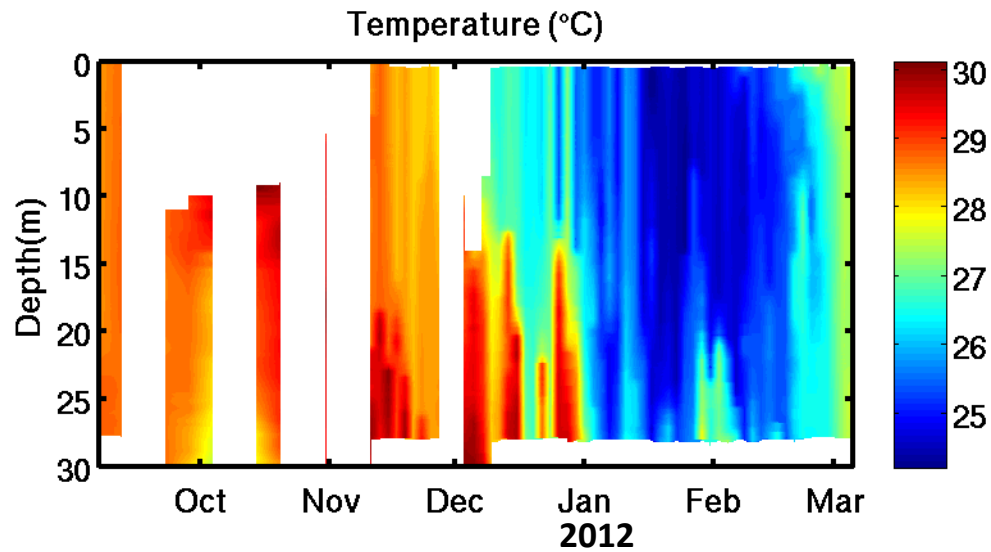
Float 6924 - Bay of Bengal



Upper 500 meters

9/6/2011 - 3/5/2012

Float 6924 - Bay of Bengal



Upper 30 meters

9/6/2011 - 3/5/2012