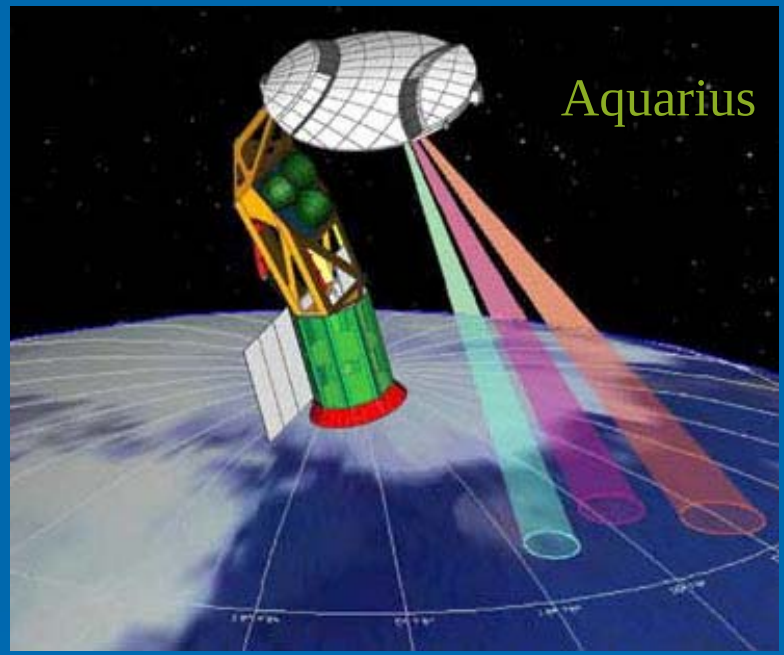
New Salinity Product in the Tropical Indian Ocean Estimated from OLR



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Introduction

- Measurements of SST from space using passive (infrared) and active (microwave) radiometers have been available since the 1970s, but as of now there are no direct measurements of salinity from satellite.

- Two satellite missions – the US ‘Aquarius’ and the European Space Agency Soil Moisture and Ocean Salinity (SMOS) are planned for launch in 2008.

- The present over all requirements for the SSS satellite sensor are 0.2 psu accuracy over 1°x1° grid for a monthly product and 0.4 psu accuracy for a swath product, and the repeatability of the data is between 7 and 10 days [http://aquarius.gsfc.nasa.gov/].

Introduction

- The OLR, a measure of the intensity of convection, is measured at cloud top temperatures, and in the absence of clouds, it is measured at Sea Surface Temperature (SST).

- Intense convection is assumed to have the lowest cloud top temperature and hence the lowest OLR. Therefore, the zones of lowest OLR are related to regions of intense convection over the tropical Oceans. Conversely, the zones of the highest OLR (say, >220 W/m^2) are related to regions of little convection or cloud-free skies.

- A new technique developed for retrieval of sea surface salinity from space-borne satellite measurements of OLR through the Effective Oceanic Layer (EOL). The EOL is defined as the geopotential thickness (m^2/s^2) of the stratified layer and is computed from:

$$EOL = \int_0^{30} \alpha . dp$$

Objectives

- To develop algorithms for the estimation of sea surface salinity (SSS) from space-OLR over the tropical oceans.

- To validate the estimated SSS using *in situ* surface salinity observations along WOCE and Joint Global Ocean Flux Studies (JGOFS) sections, along ships of opportunity tracks where salinity is collected, and available time-series data sets and cruises data;

- To refine the estimated SSS for advection and mixing through HYCOM (Hybrid Coordinate Ocean Model) simulations;

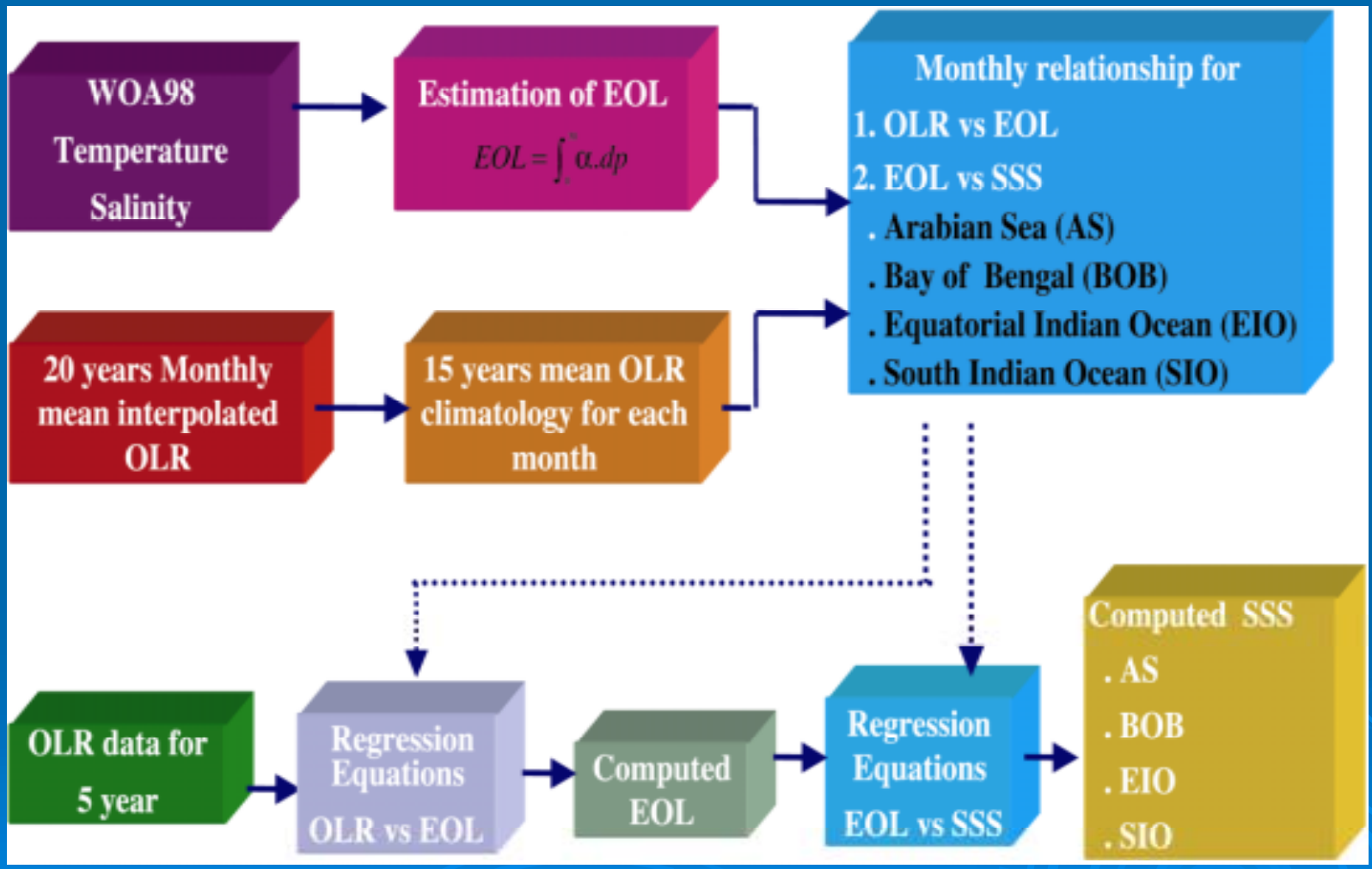
- To utilize the estimated SSS data to study the seasonal and interannual variability of SSS and the associated upper ocean processes

- To further utilize the estimated daily SSS to study the air-sea coupling during tropical cyclones and possibly help improving prediction of tropical cyclone tracks.

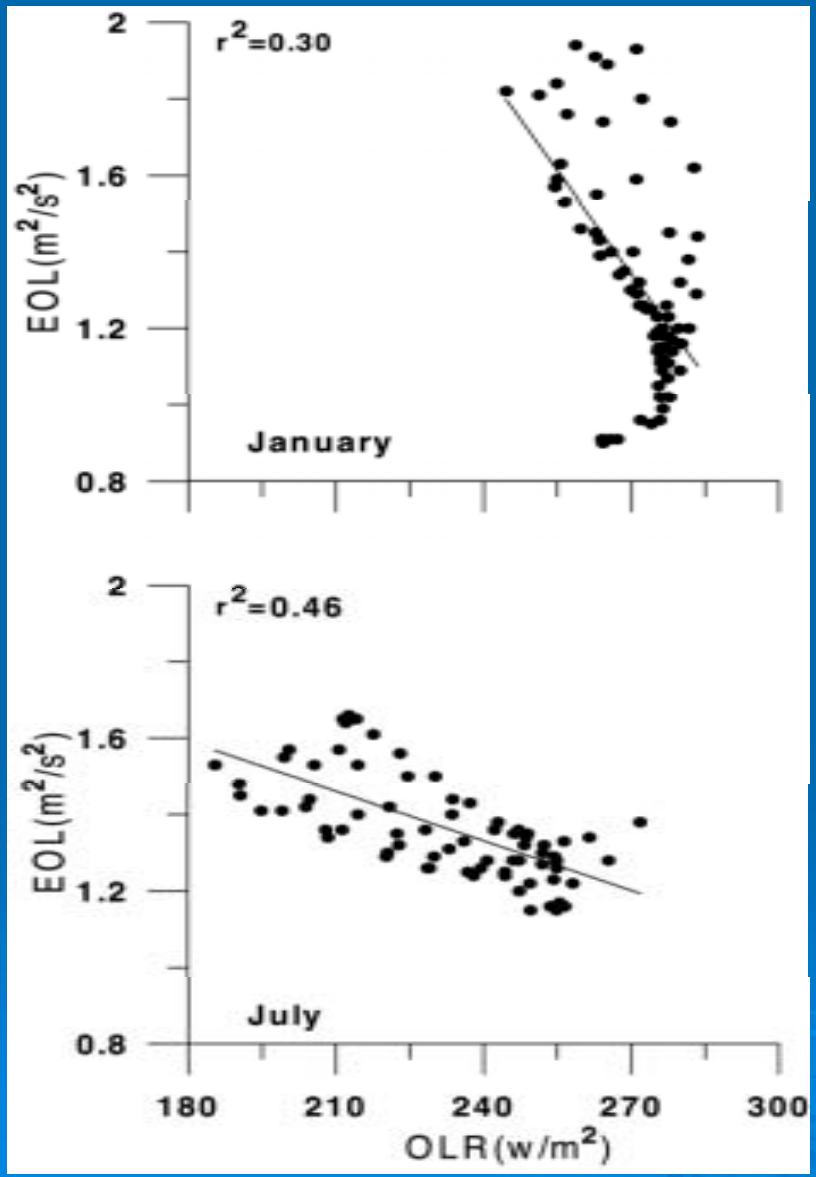
Data and Models

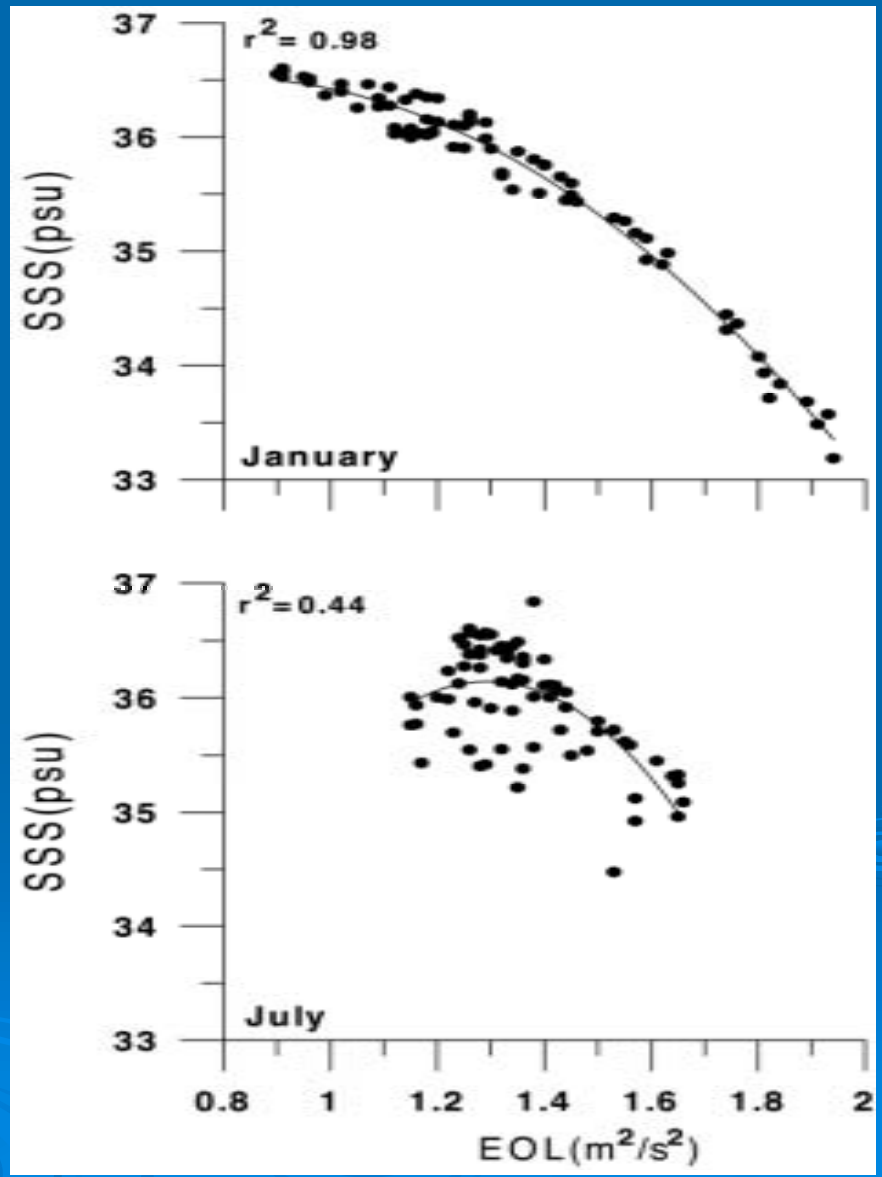
- Daily OLR at 2.5°x2.5° grids from 1975 to 2003.
- Monthly E-P from 1980-2003
- Monthly CMAP precipitation from 1979-2003
- World Ocean Atlas 2001 Temperature and Salinity data
- HYCOM model- surface currents are used to estimate advection and Mixing Processes
- SSS physical model - to identify the lag between the OLR and SSS, between P-E and SSS, and between P and SSS, and its effect on the estimated SSS in the tropical Oceans

Computational Methodology

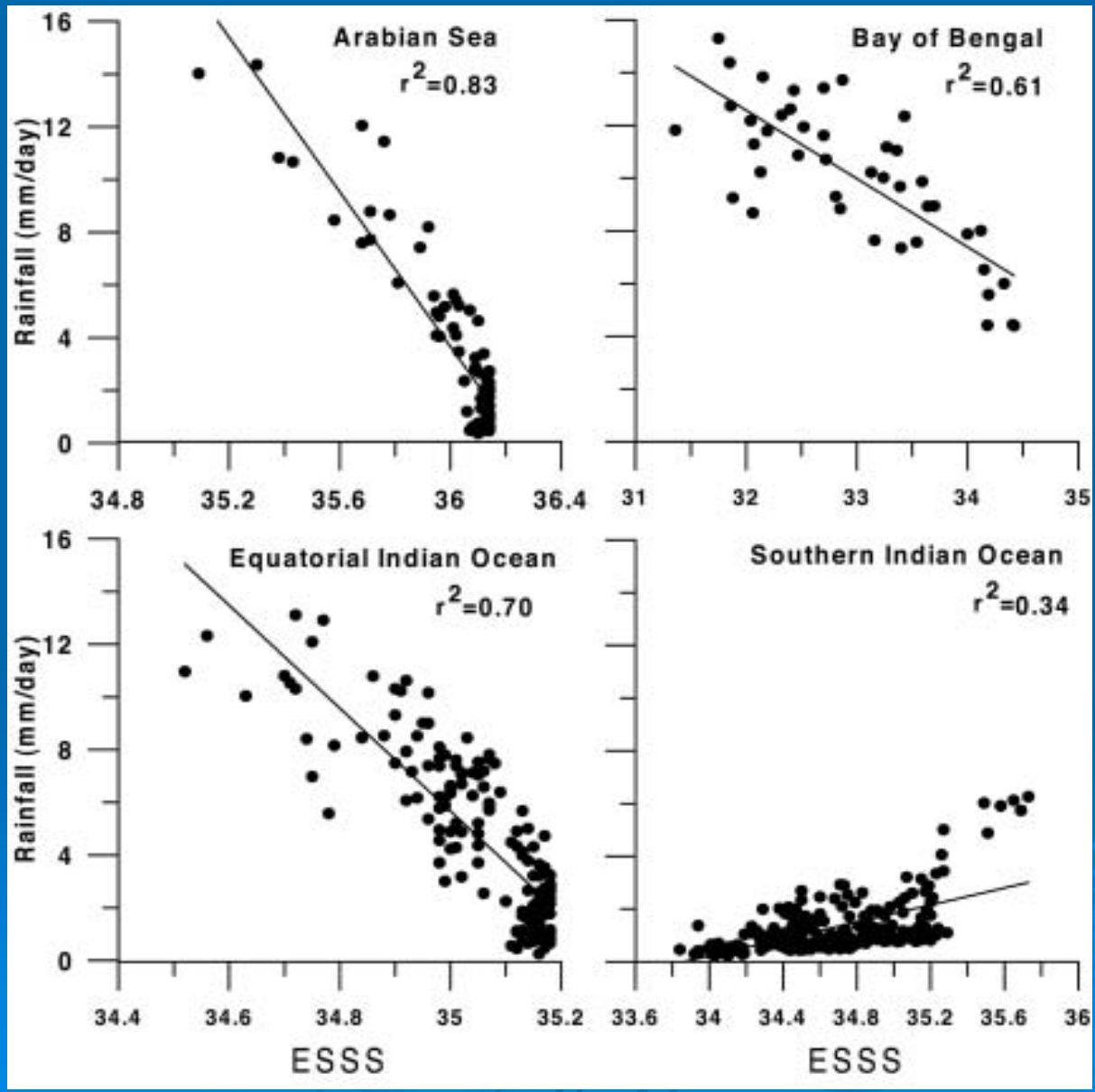


Scatter plots in Arabian Sea

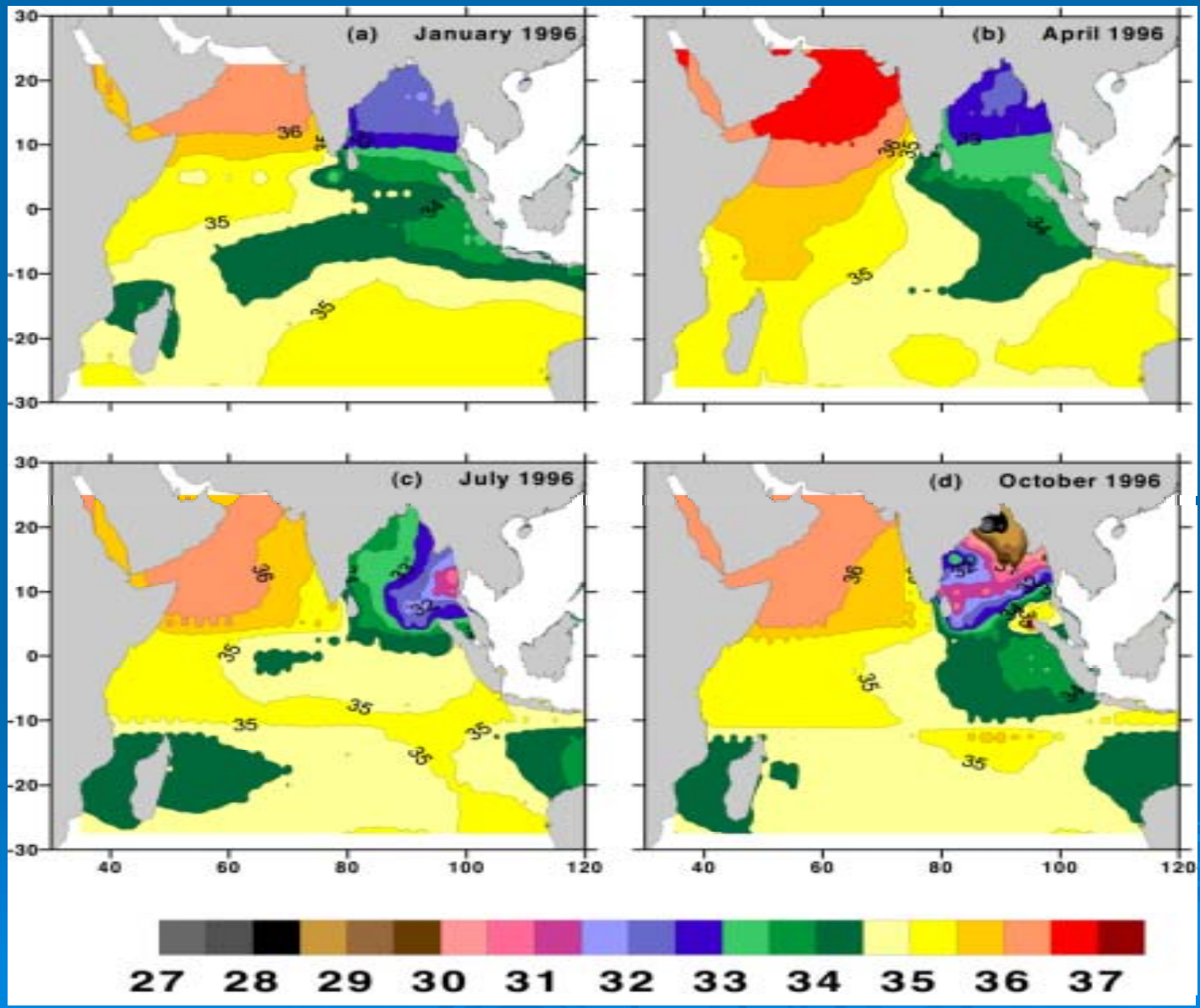




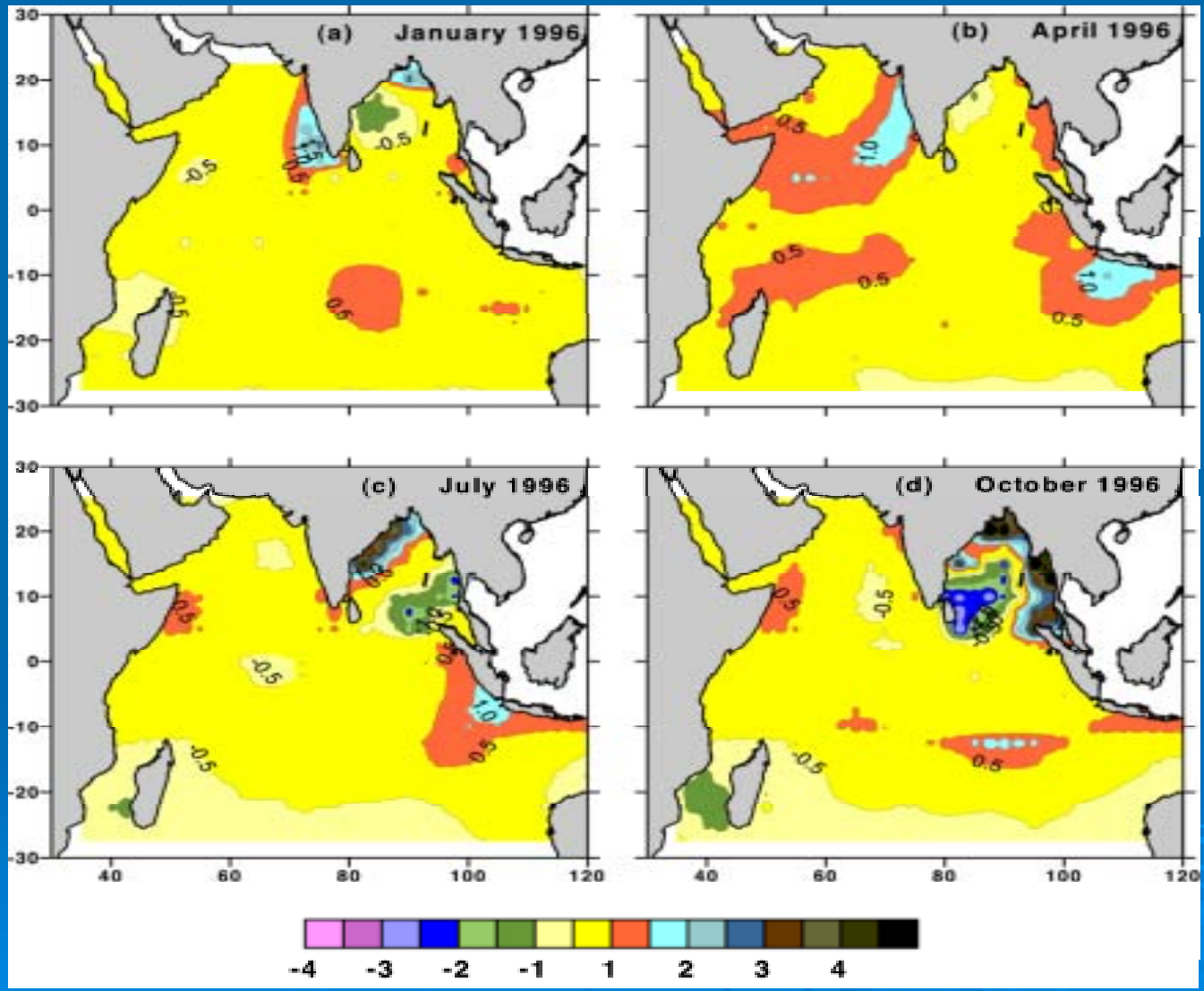
Scatter plots- Estimated Sea Surface Salinity Vs Rainfall



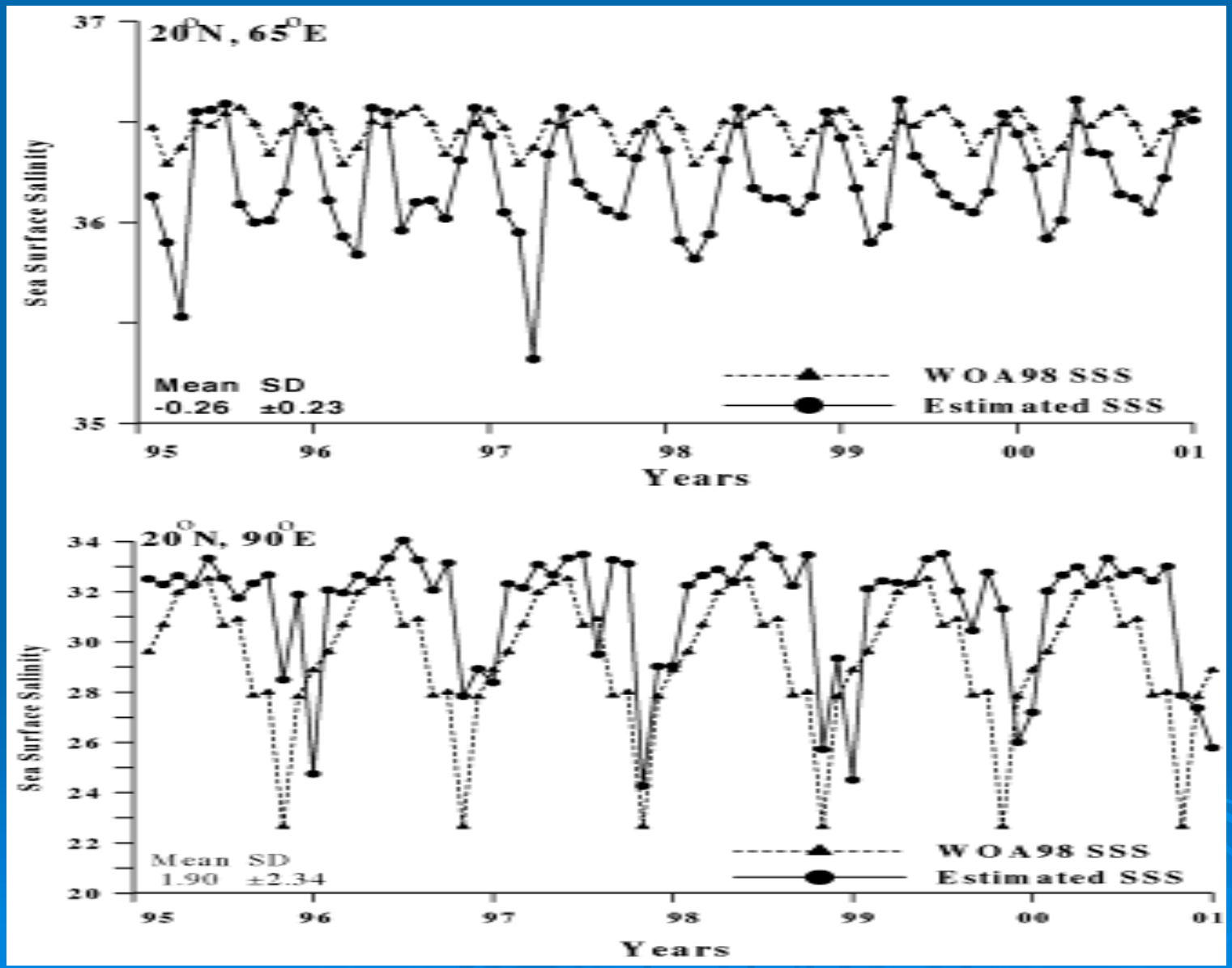
Estimated Sea Surface Salinity from OLR



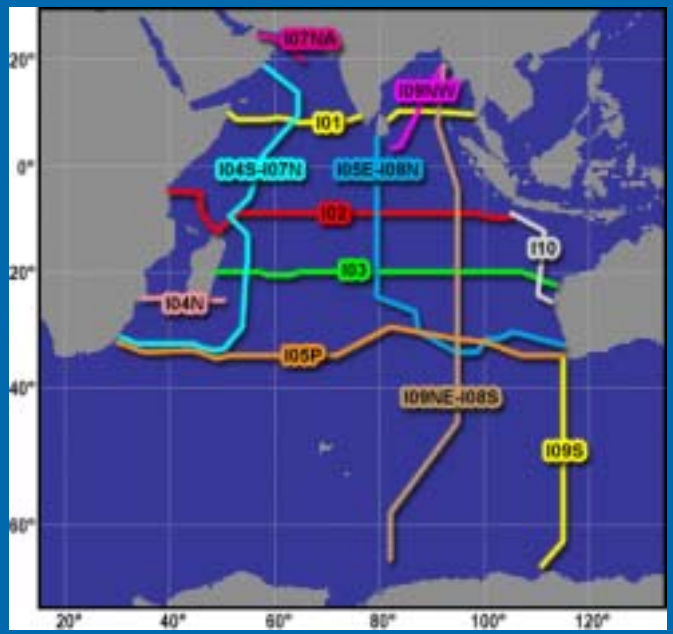
Difference between estimated Salinity and Levitus Climatology

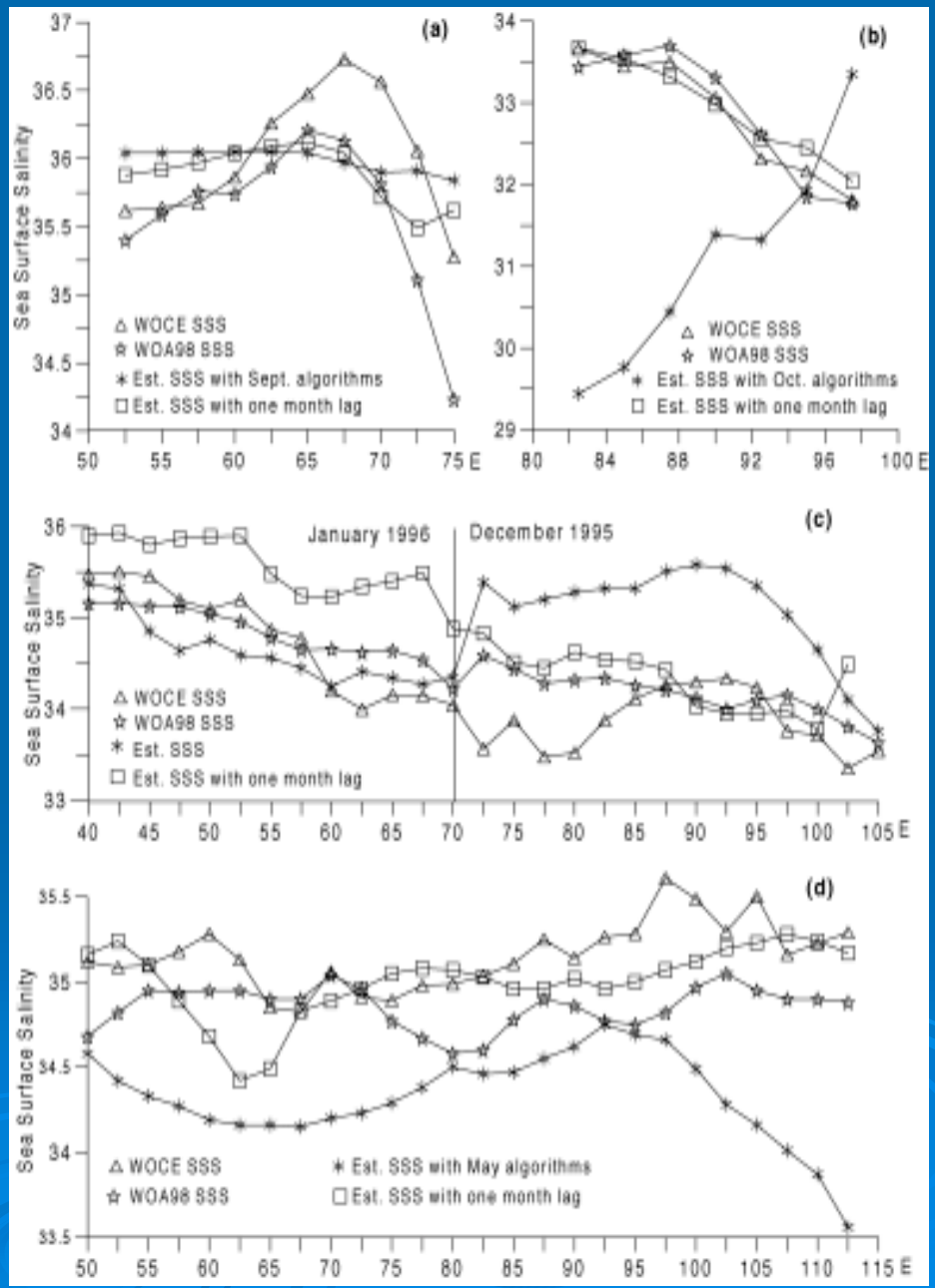


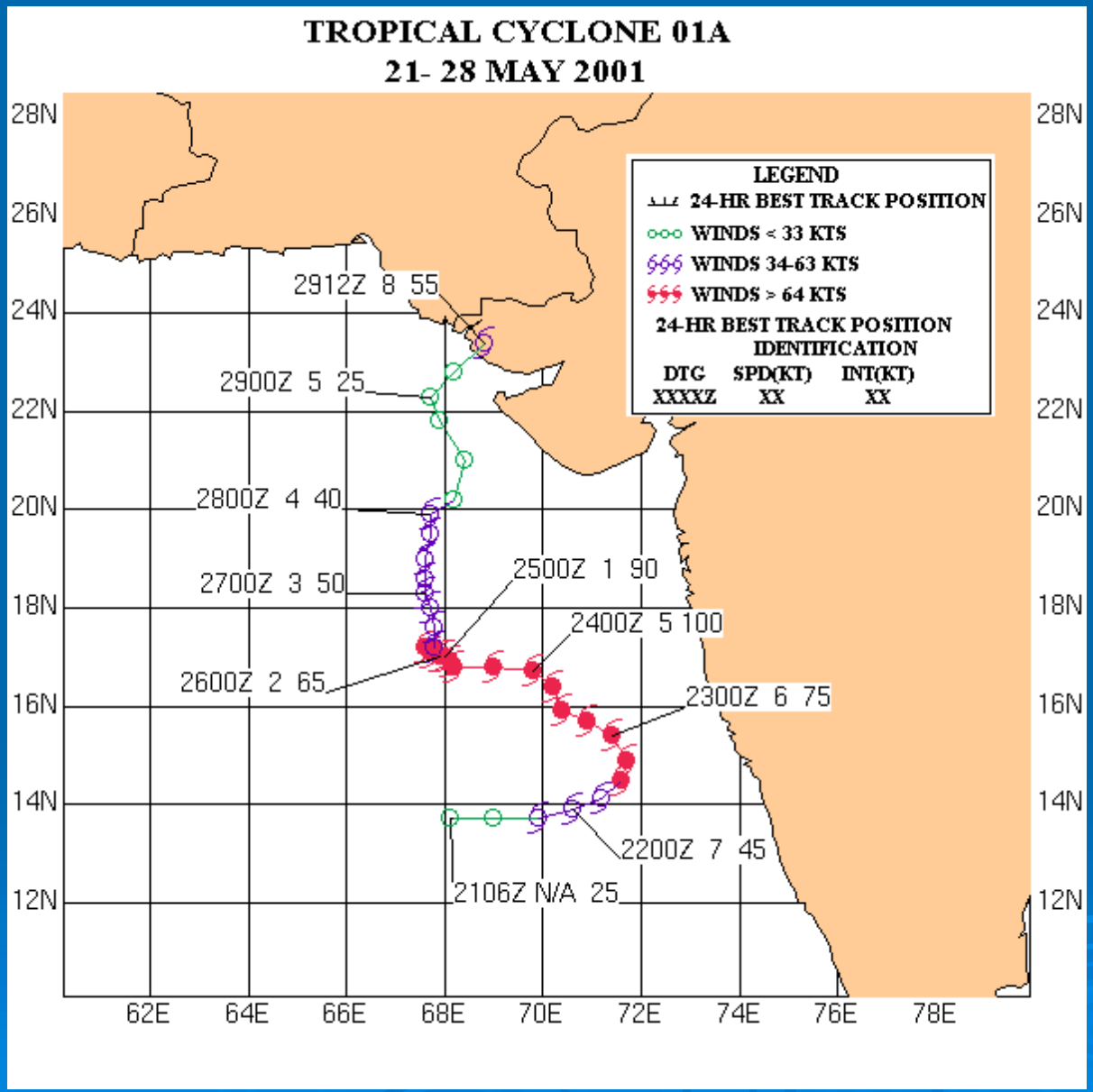
Comparison of interannual estimated salinity with Levitus climatology



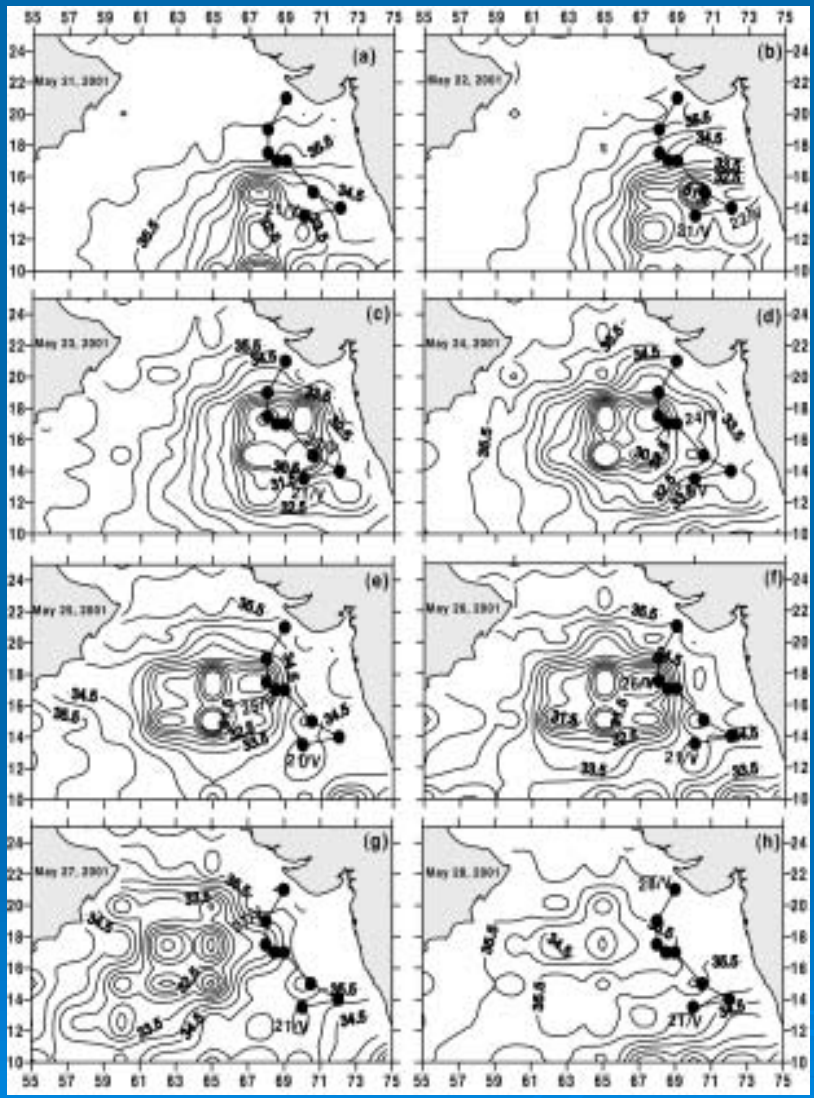
Comparison with WOCE sections





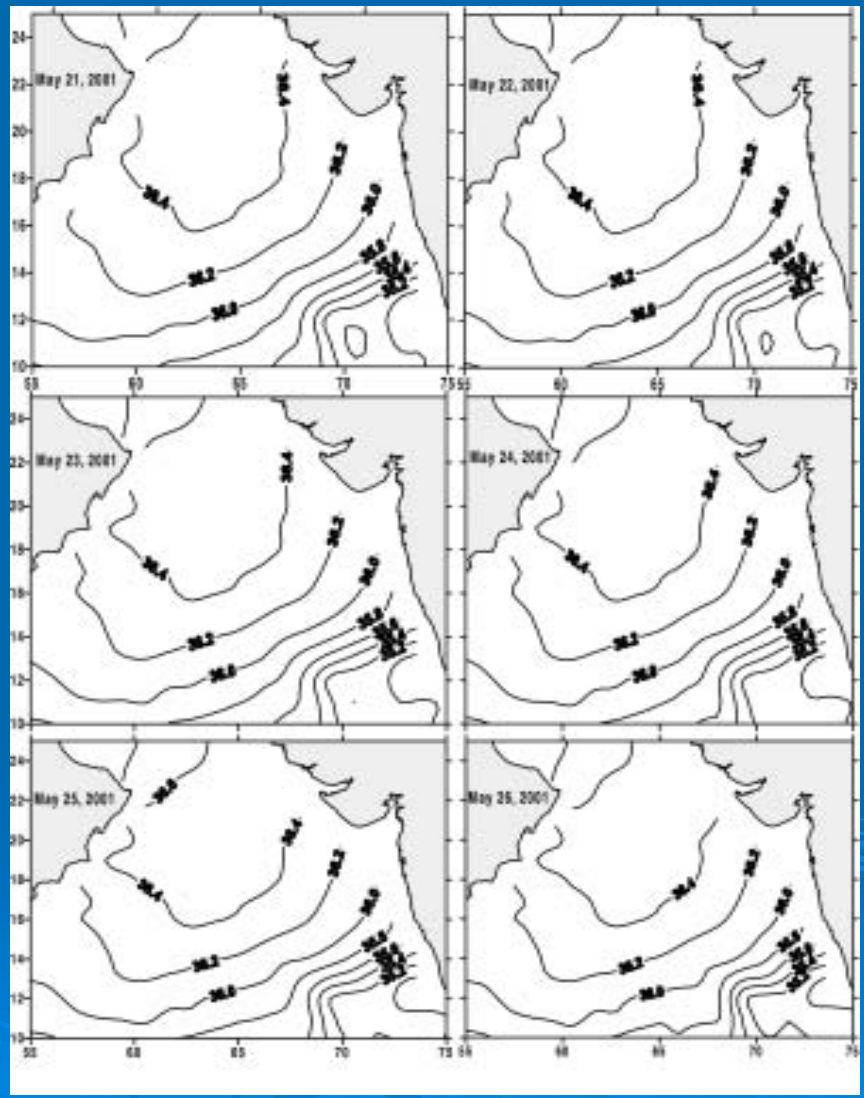

TROPICAL CYCLONE 01A
21- 28 MAY 2001
LEGEND
24-HR BEST TRACK POSITION
WINDS < 33 KTS
WINDS 34-63 KTS
WINDS > 64 KTS
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XX
2912Z 8 55
2900Z 5 25
2800Z 4 40
2700Z 3 50
2600Z 2 65
2500Z 1 90
2400Z 5 100
2300Z 6 75
2200Z 7 45
2106Z N/A 25
28N
26N
24N
22N
20N
18N
16N
14N
12N
62E
64E
66E
68E
70E
72E
74E
76E
78E

Salinity estimated from OLR



MODAS Salinity

(NRL Modular Ocean Data Analysis System)



Conclusions

- This study provides algorithms through statistical relationships for obtaining the surface salinity in the tropical Oceans using OLR.
- We expect the oceanographers' community will benefit from the sea surface salinity derived from satellite observations of OLR, for the obvious importance of salinity in many studies related to upper ocean processes.
- Whenever ocean models assimilate data and use to produce forecasts, it is important to investigate the impact of surface/subsurface salinity data on the forecast.
- In some oceanic areas like northern Indian Ocean, particularly Bay of Bengal, salinity contributes greatly, besides temperature, for a relationship with density, and investigators identified the consequences that arise ignoring salinity information, especially on the upper ocean thermodynamics.
- Salinity can have important consequences, especially on El Niño phenomena formation.
- The growing tendency for obtaining the sea surface of the global oceans would, if measured accurately, boost the coupled model studies, ENSO forecast models as well as ocean global circulation models (OGCM) or regional scale circulation models and predicting the tropical cyclones.