Forecasting General Circulation features

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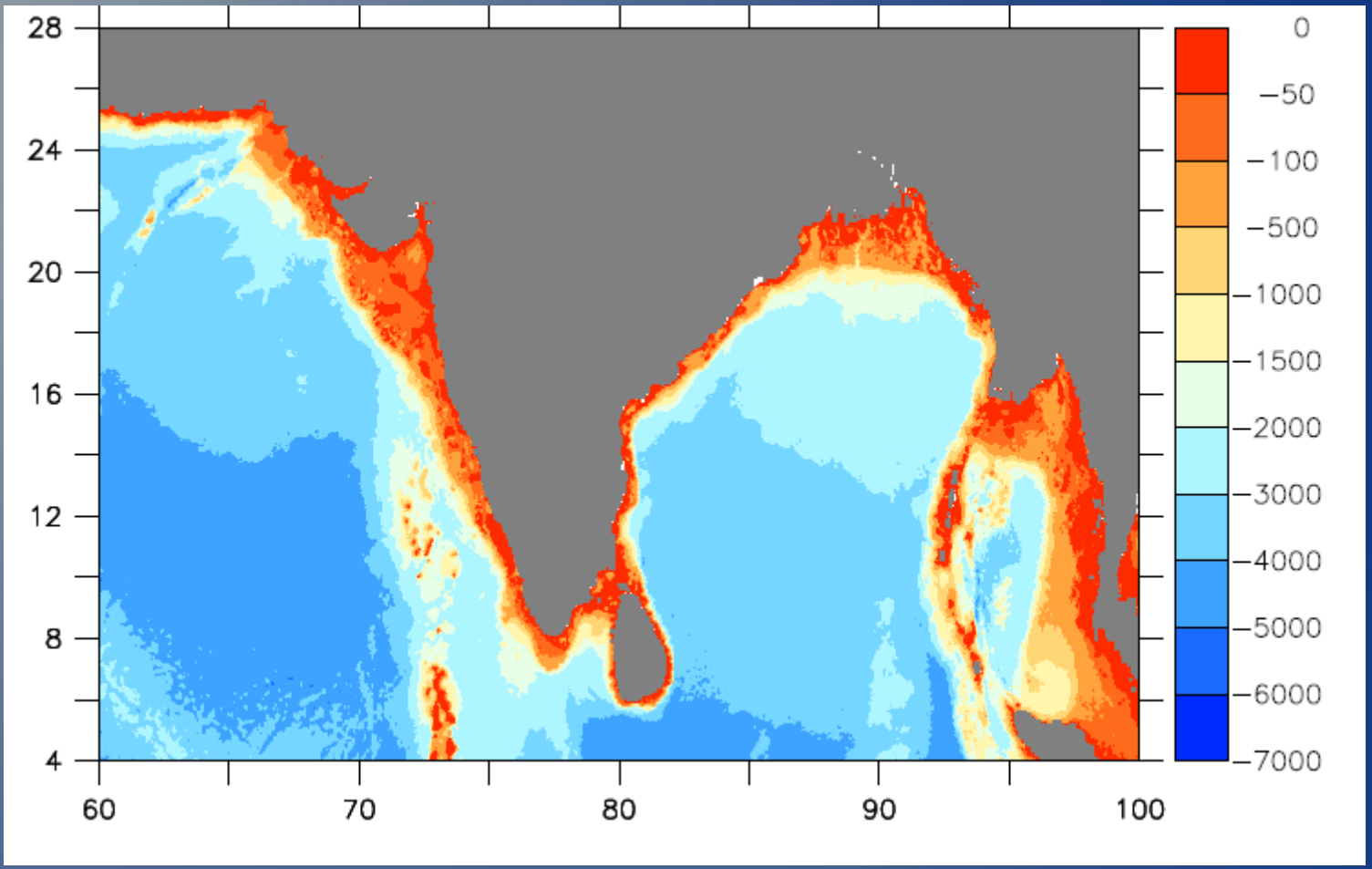
Ministry of Earth Sciences, Govt. Of India

2nd April 2014, INCOIS



India has a very long coastline of more than 7500km with Arabian Sea to the west and Bay of Bengal to the east.

There are two major island chains administered by India (Andaman and Nicobar islands in the Bay of Bengal and the Lakshadweep islands in the Arabian Sea)

Indian EEZ is approximately 2.5 million square kilometers in size.

About a quarter of Indian population (approximately 300 million) live along the coastline of India and depend oceans in one way or the other for their livelihood.

Even though oceans are found to be the most important drivers of Indian monsoon, which is the life-line India, Oceanography in India remained more or less descriptive until early 80's.

Lack of observation systems and trained manpower were the main bottle necks for the development of this branch of science.

The scenario changed after mid 80's when the National Institute of Oceanography, Goa started more field expeditions and initiated numerical modeling of the Indian Ocean.

In the last decade of 20th century, more institutes started ocean modeling activities, mainly to improve the understanding of the behaviour of the Indian Ocean.

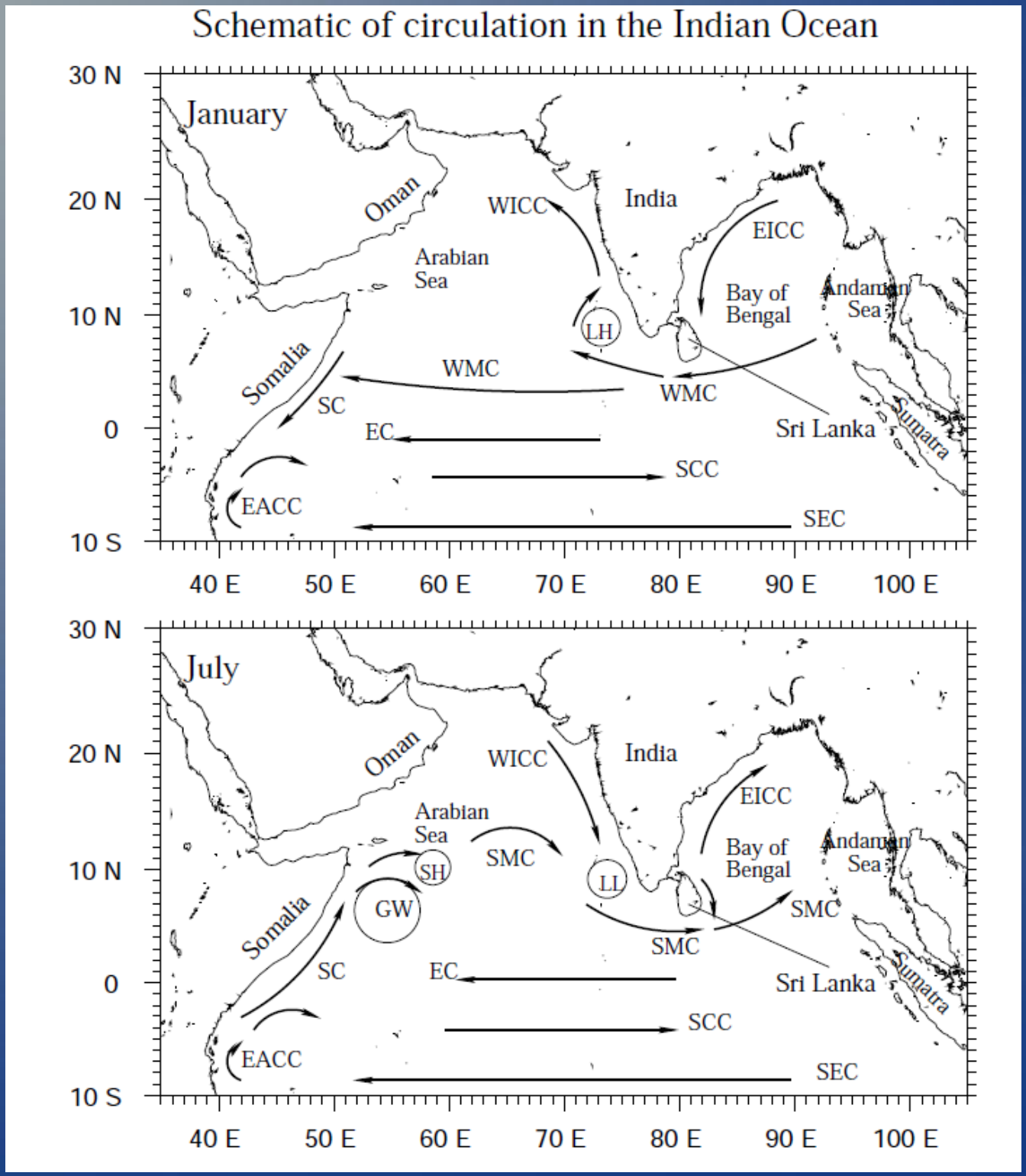
The Indian Climate Research Program (ICRP) initiated several observational campaigns in the Bay of Bengal and Arabain Sea, since late 90's with a specific aim to understand the role of Oceans in the variability of Indian Monsoon.

National Institute of Ocean Technology, Chennai initiated Indian Data Buoy Programme (IDBP) during late 90's though which it setup several moored buoys in the northern Indian Ocean.

The availability of significant amount of oceanographic data lead to the setting up of an exclusive institute, the **Indian National Centre for Ocean Information Services (INCOIS)** in Hyderabad, primarily to archive and distribute oceanographic data and provide value added services to the society.

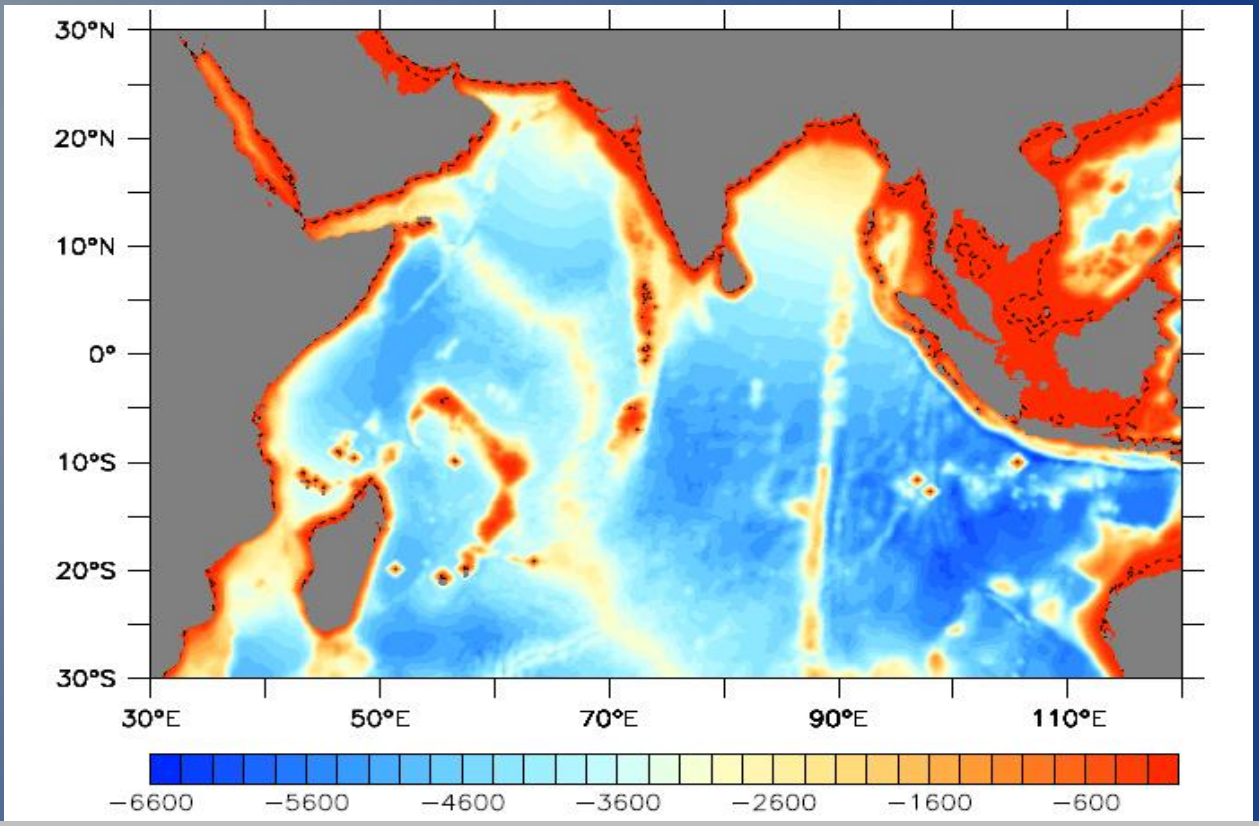
Currently, INCOIS leads and co-ordinates the oceanographic research in India and it has the responsibility to provide oceanographic services to the public and government

One of the important services INCOIS provides today is the Operational Ocean Forecast using a state-of-the art general circulation model.



(Shankar et al 2002)

Regional Ocean Modeling System setup



Domain : **30 ºE-120 ºE; 30 ºS-30 ºN**

Resolution : **1/12 º x 1/12 º (Horizontal)**
40 levels in the vertical

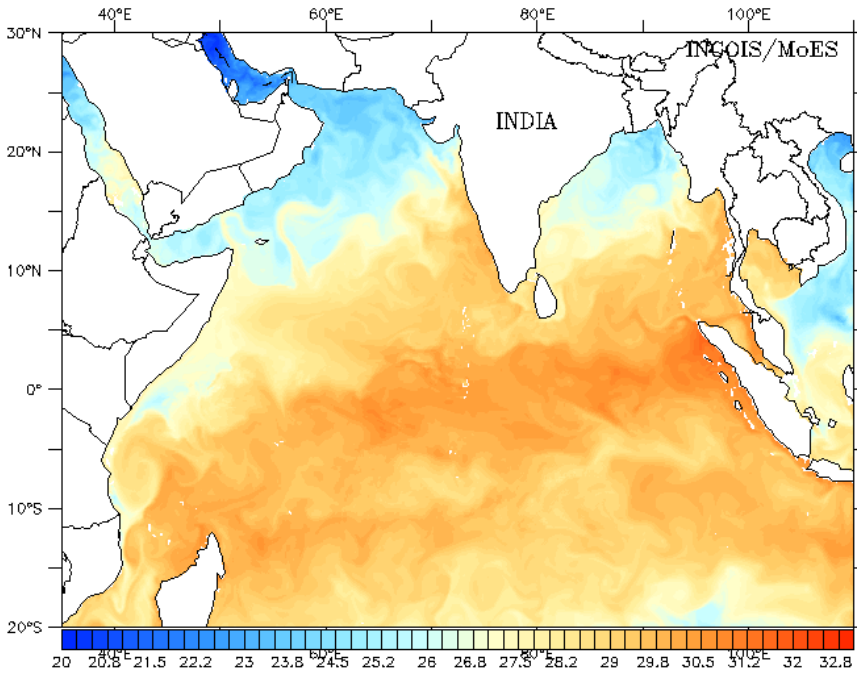
Atmospheric Forcing : **0.5 º x 0.5 º NCMRWF**

Initial Conditions : **from INCOIS-GODAS**

Boundary conditions : **South/East open; from GODAS**

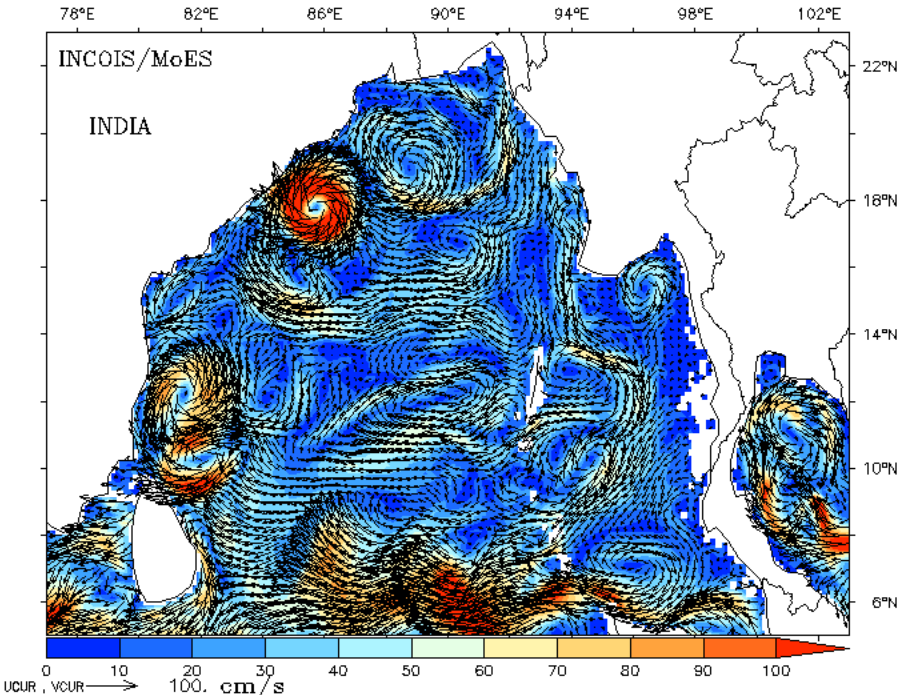
INDIAN OCEAN SEA SURFACE TEMPERATURE (Deg. C)

Forecast for : 1130IST of 21-02-2013 Issued on : 21-02-201



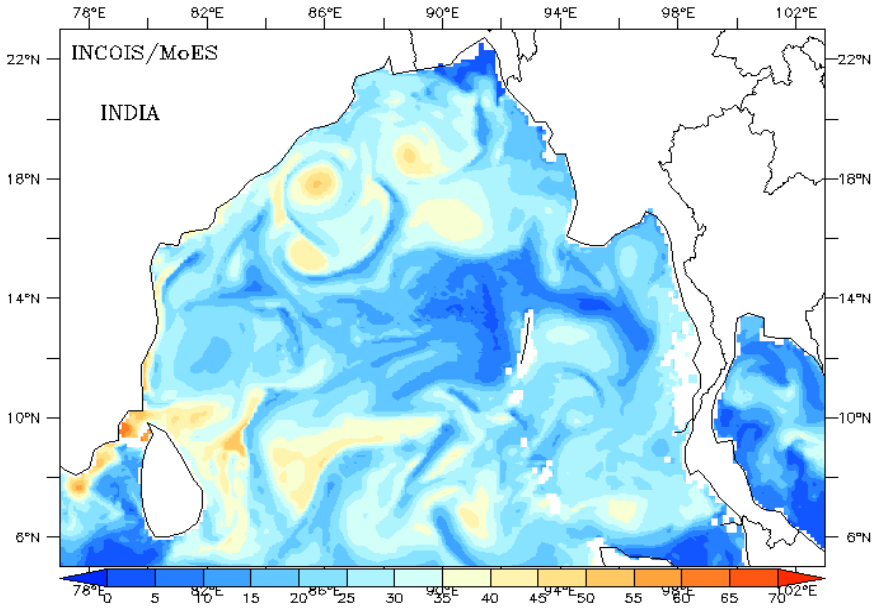
SEA SURFACE CURRENT (cm/s) IN THE BAY OF BENGAL

Forecast for : 1130IST of 21-02-2013 Issued on : 21-02-2013



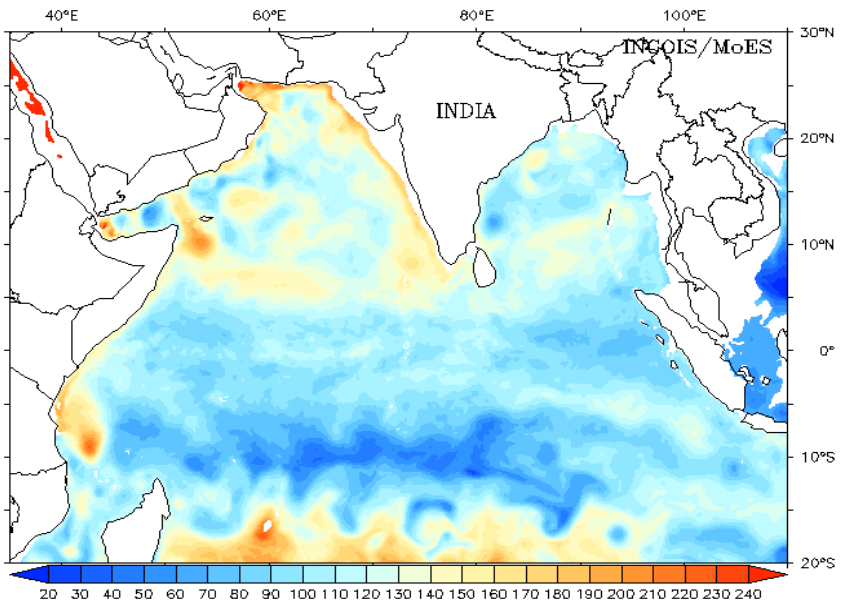
MIXED LAYER DEPTH (m) IN THE BAY OF BENGAL

Forecast for : 0530IST of 21-02-2013 Issued on : 21-02-2013



DEPTH OF 20 DEG ISOTHERM IN THE INDIAN OCEAN (m)

Forecast for : 1130IST of 21-02-2013 Issued on : 21-02-2013



http://www.incois.gov.in/Incois/indofos_main.jsp

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(An Autonomous Body under the Ministry of Earth Sciences, Government of India)

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NEW! **Maldives Forecast**

- Wave
- Wind (NCMRWF)
- Sea Surface Temperature
- Mixed Layer Depth
- Surface Currents

Indian Ocean Forecast System (INDOFOS)

The need

Having more than a quarter of the population residing along the coastlines of India, information on the state of the ocean surrounding the subcontinent is vital for the well being of the countrymen as well as for the socio-economic development of the country. Our marine activities ranges from conventional fishing to high-tech oil and natural gas exploration; transportation of goods to search and rescue operations in the high seas. Prior information of the state of the ocean would highly benefit these activities and ensure the safety of all those who venture into the sea. Further, the oceans around us play critical role in regulating the regional climate. In short, forecasting oceanographic parameters (both in surface and subsurface) at different time scales is extremely important for a wide spectrum of users ranging from weathermen to fishermen and from the navy to the off-shore industries. Keeping this in mind, Indian National Centre for Ocean Information Services (INCOIS) is bringing out a new integrated Indian Ocean Forecasting System (INDOFOS), which is capable of predicting the surface and subsurface features of the Indian Ocean well in advance.

At present, INCOIS is providing forecasts of

1. Wave height and direction
2. Sea surface currents
3. Sea surface Temperature

- Mixed Layer Depth
- Surface Currents
- D20
- Tide Predictions
- Forecast for Islands

- Comparison of wave forecast with observations
- Data Downloads
- Reports

rivate Browsing)

Help

?selectbox1=indianocean&selectbox2=sst&select

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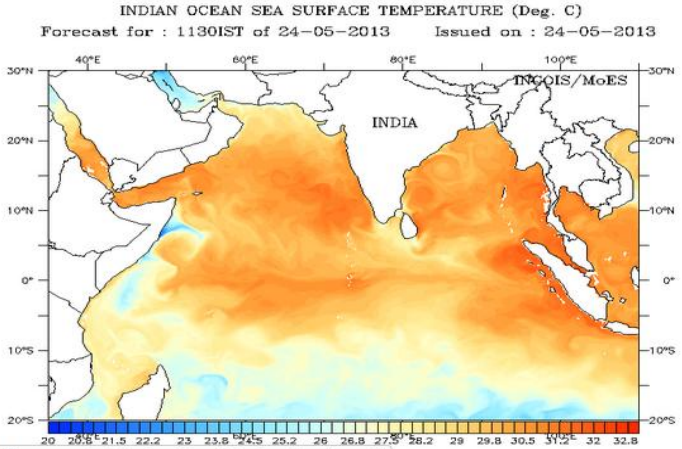
Indian Ocean Forecast System (INDOFOS)

Sea Surface Temperature (SST)

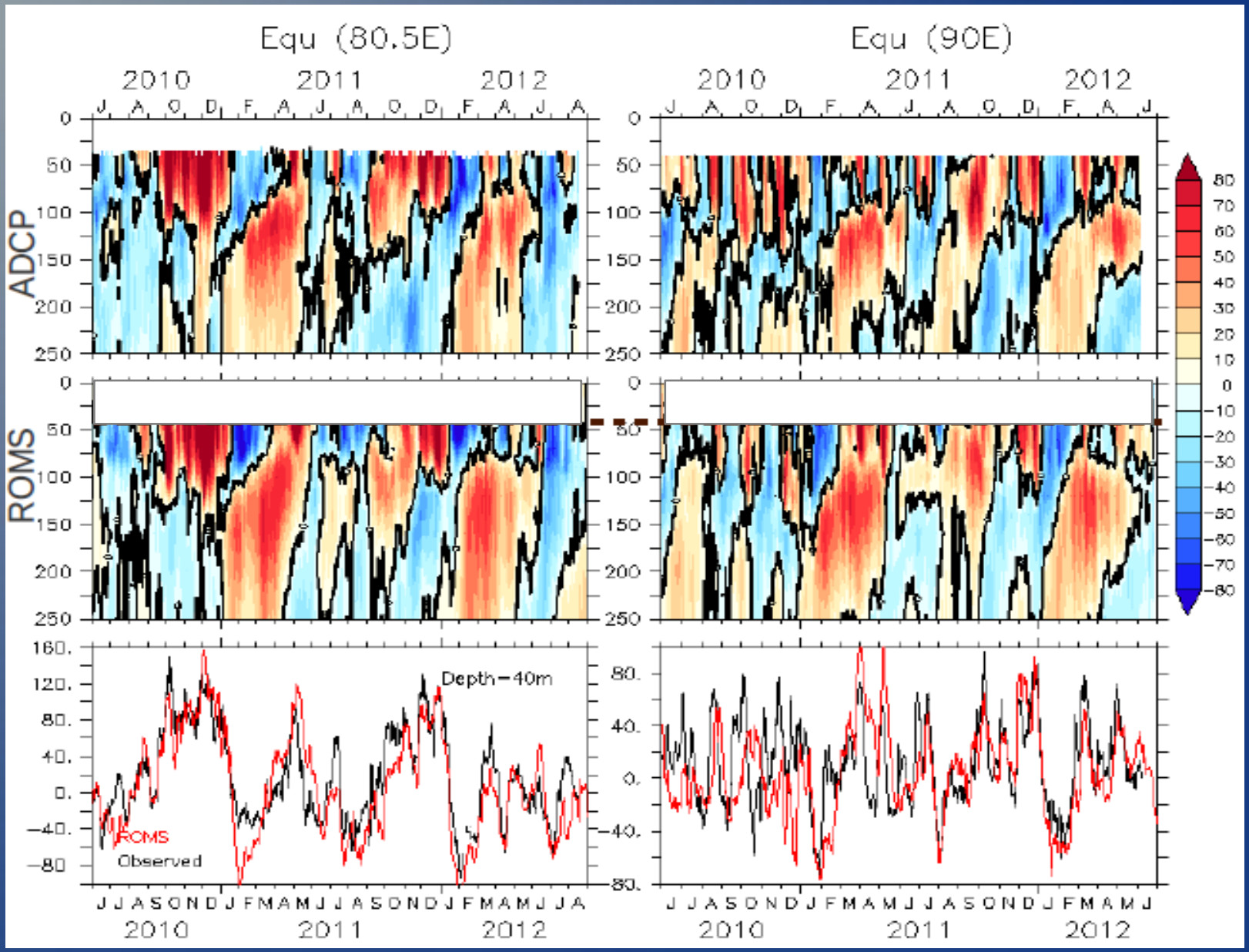
Select Region | Select Date & Time | Submit

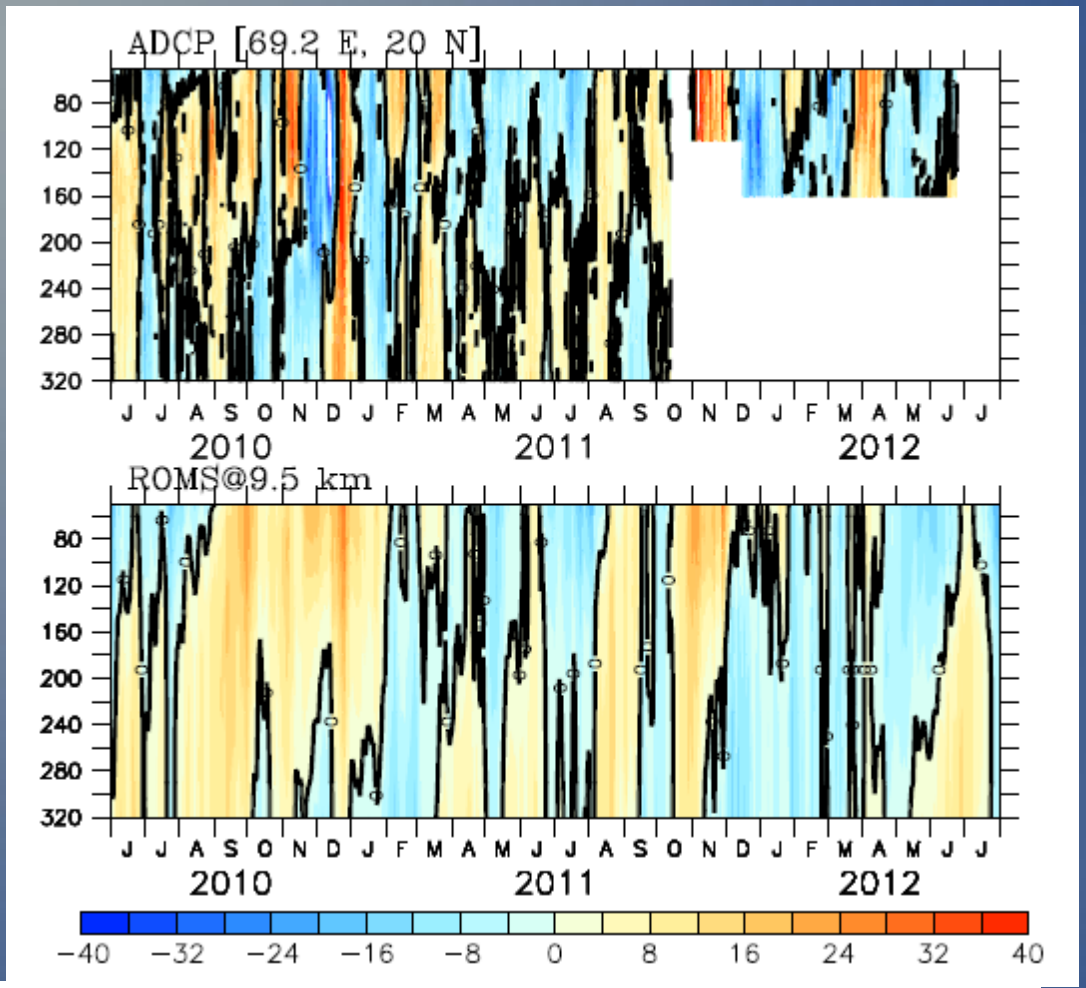
Click here for Animation

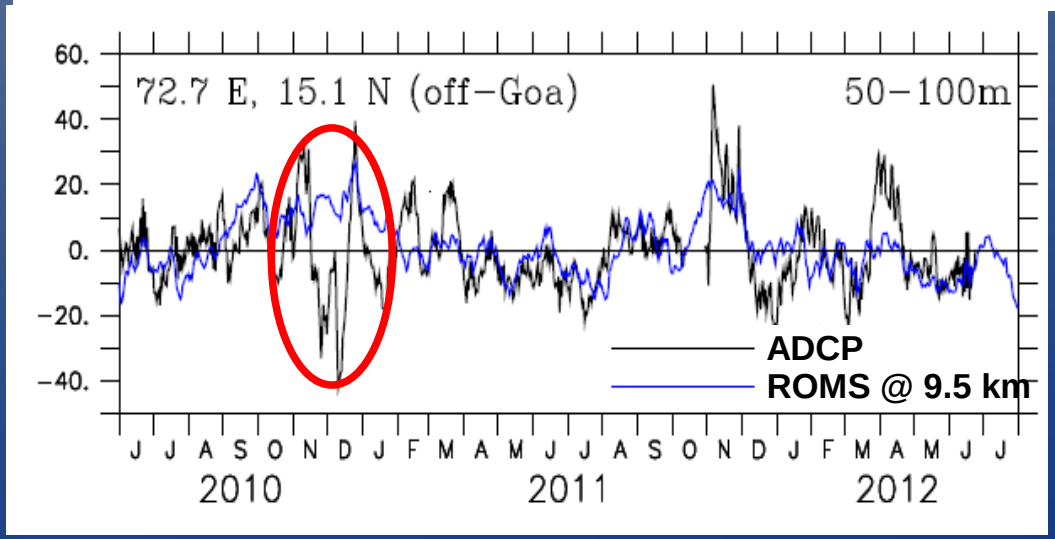


www.incois.gov.in/OSF_FILES/forecast/regional/indianocean/sst/animation/IO-sst-animation.gif

Zonal currents simulated by the Model at the Equator are compared with the observations





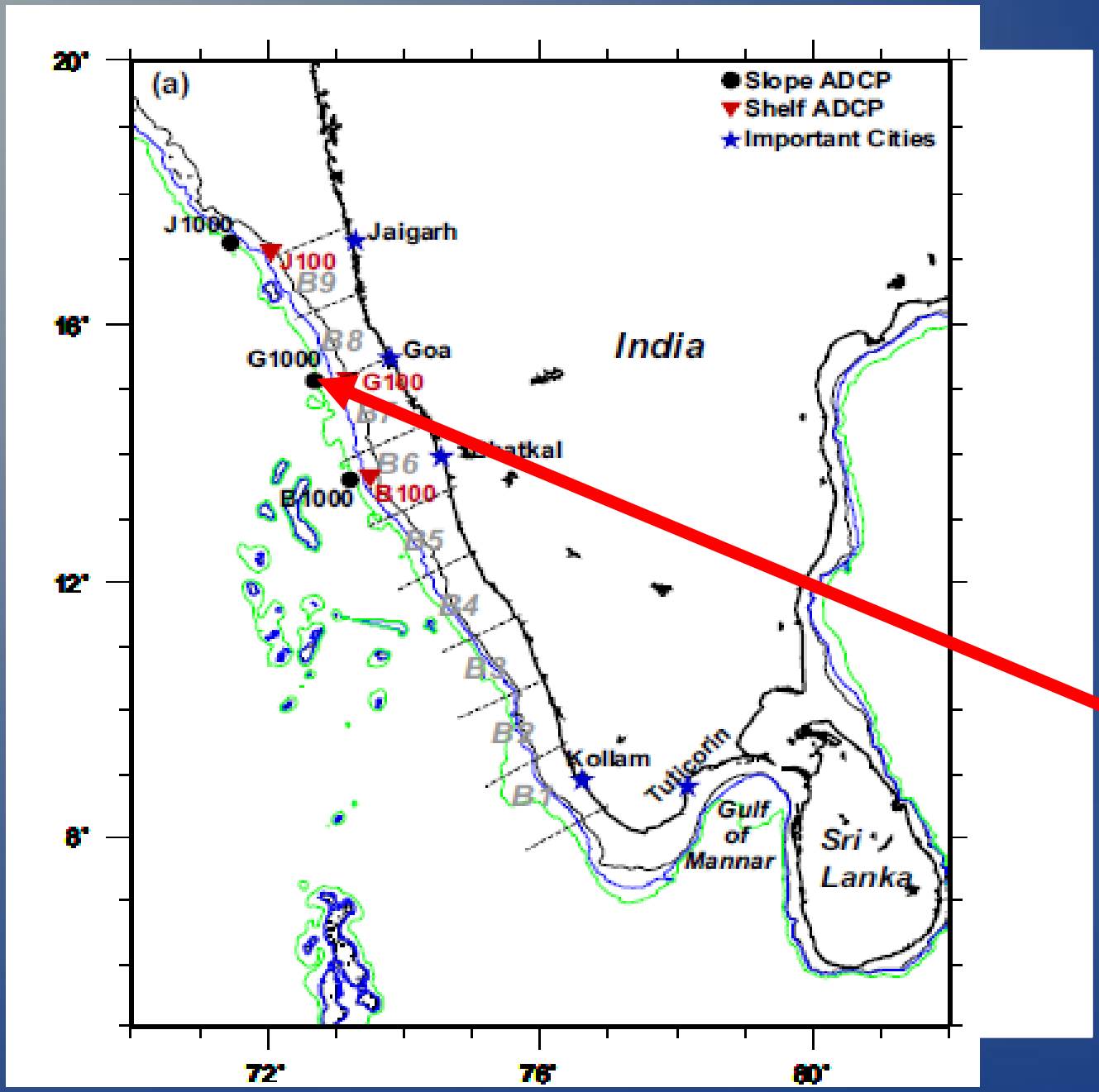


Compared to the open Ocean, simulations near the coasts are not very accurate.

There could be several reasons for the poor quality of simulations in the coastal waters.

One important limitation could be the horizontal resolution of the model.

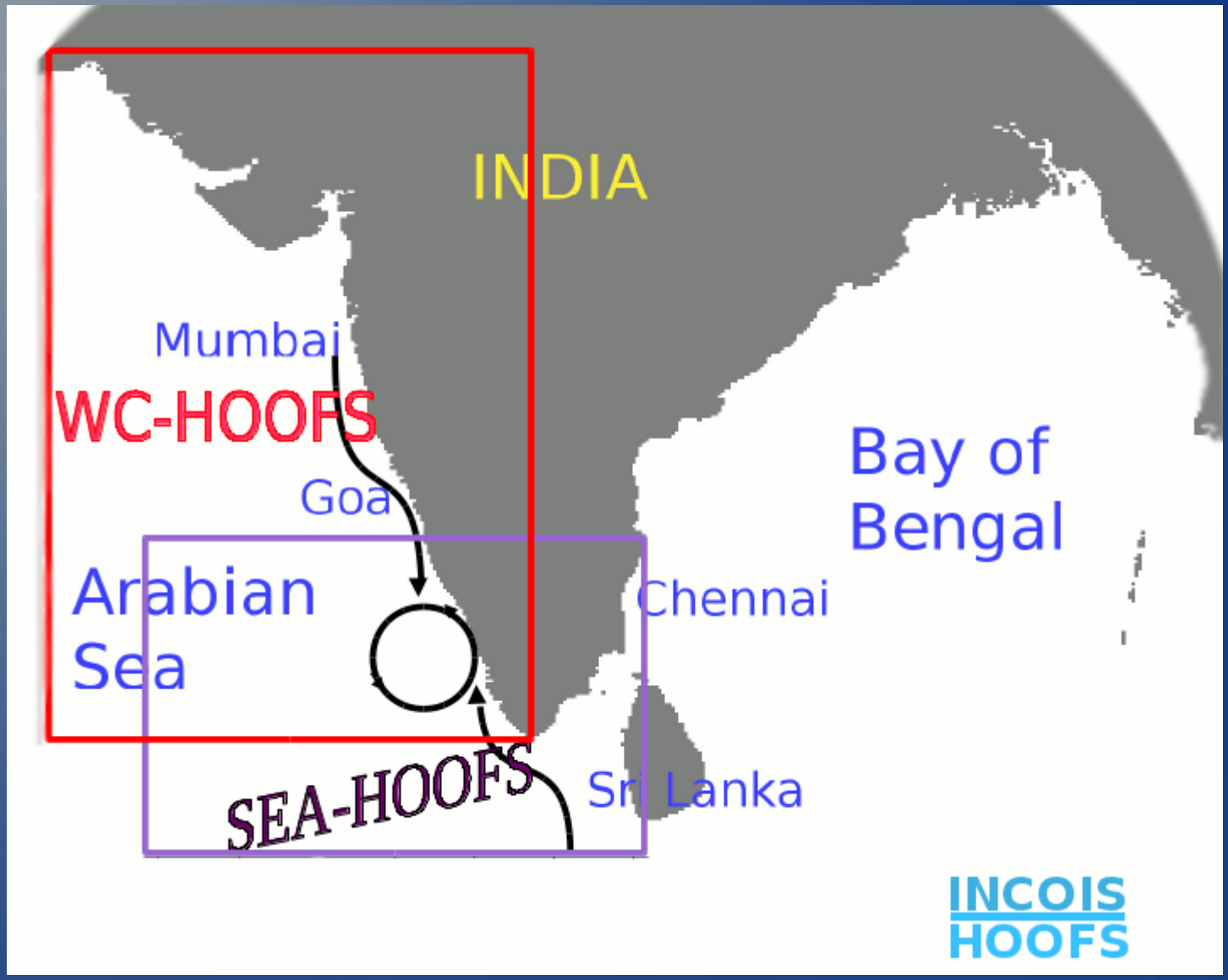
It is well known that the coastal circulation around the Indian subcontinent is highly influenced by remote effects.

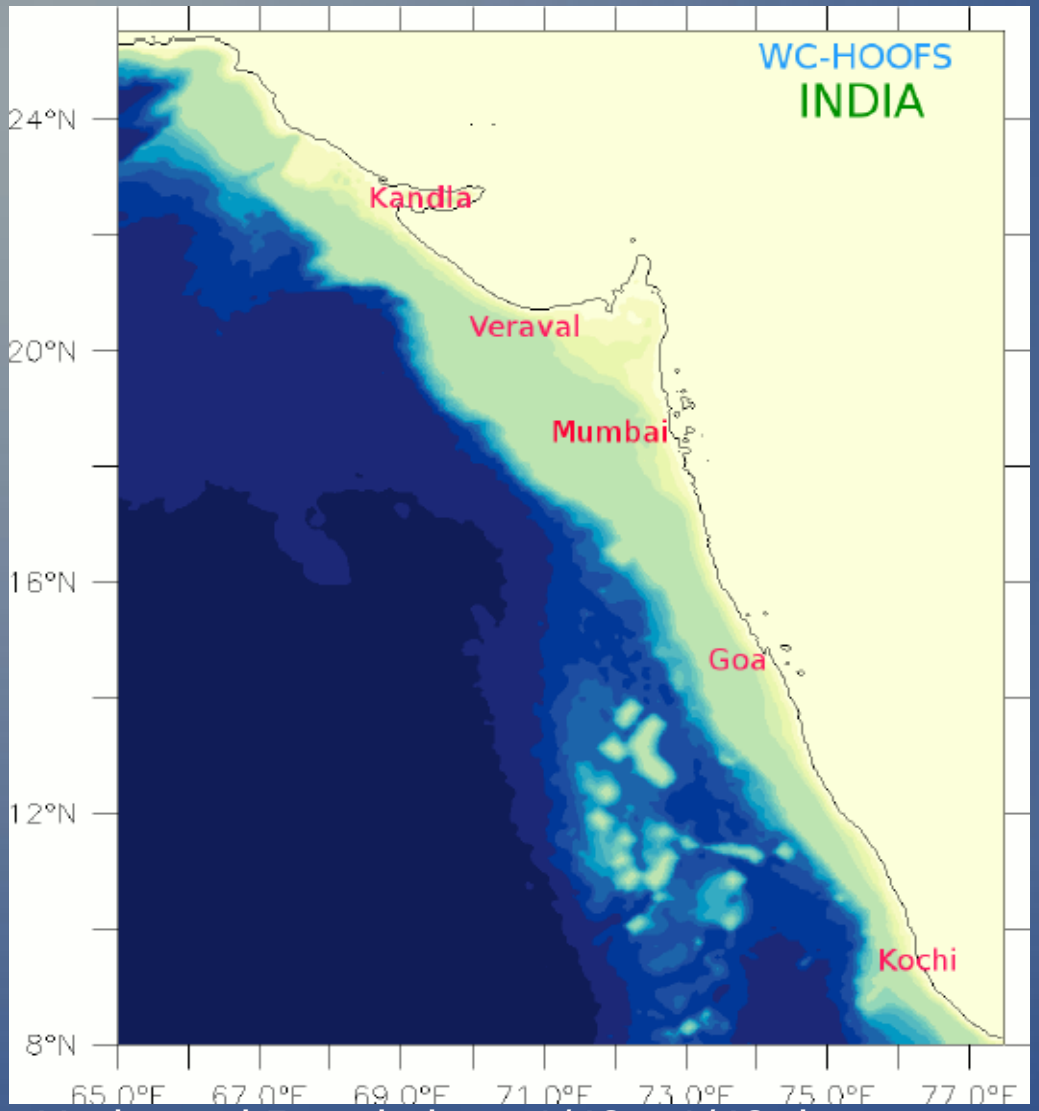


Location of the off-Goa Deep water ADCP

From Amol et al, JGR 2012.

High resolution Operational Ocean re-analysis and Forecast System (HOOFS)





Horizontal Resolution : 1/48 x 1/48 degree

Vertical resolution : 40 sigma levels

Boundary forcing : Basin-scale ROMS setup

Atmospheric forcing : NCMRWF (2010-present)

Highlights of the setup

Minimum water depth is upto 10m

Wet-dry option is incorporated

Effects of tides are included

Boundary forcing on a dialy basis

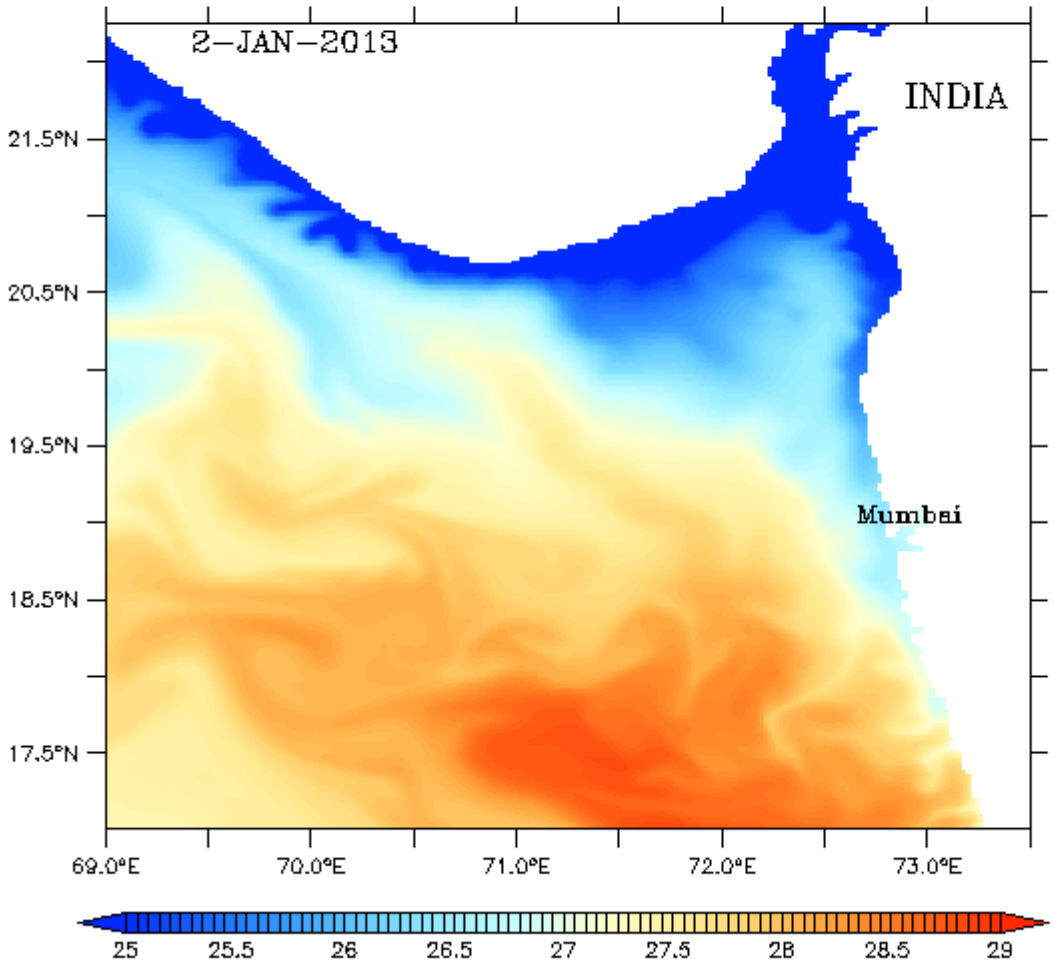
High resolution atmospheric forcing

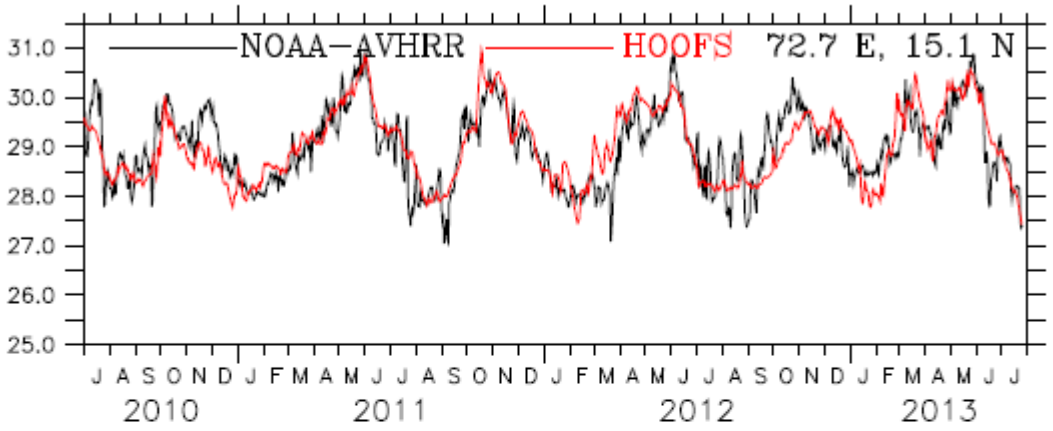
Bio-geo-chemistry module
Data assimilation

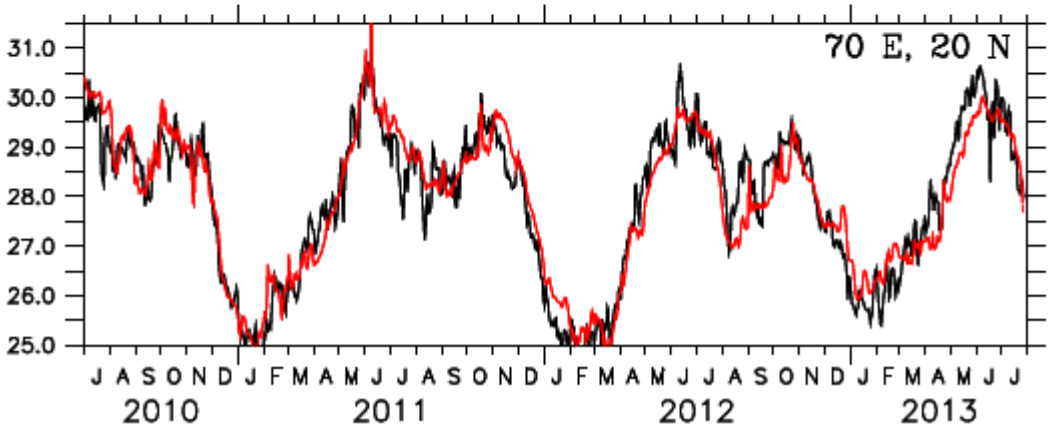
Wave-current interaction

River discharge

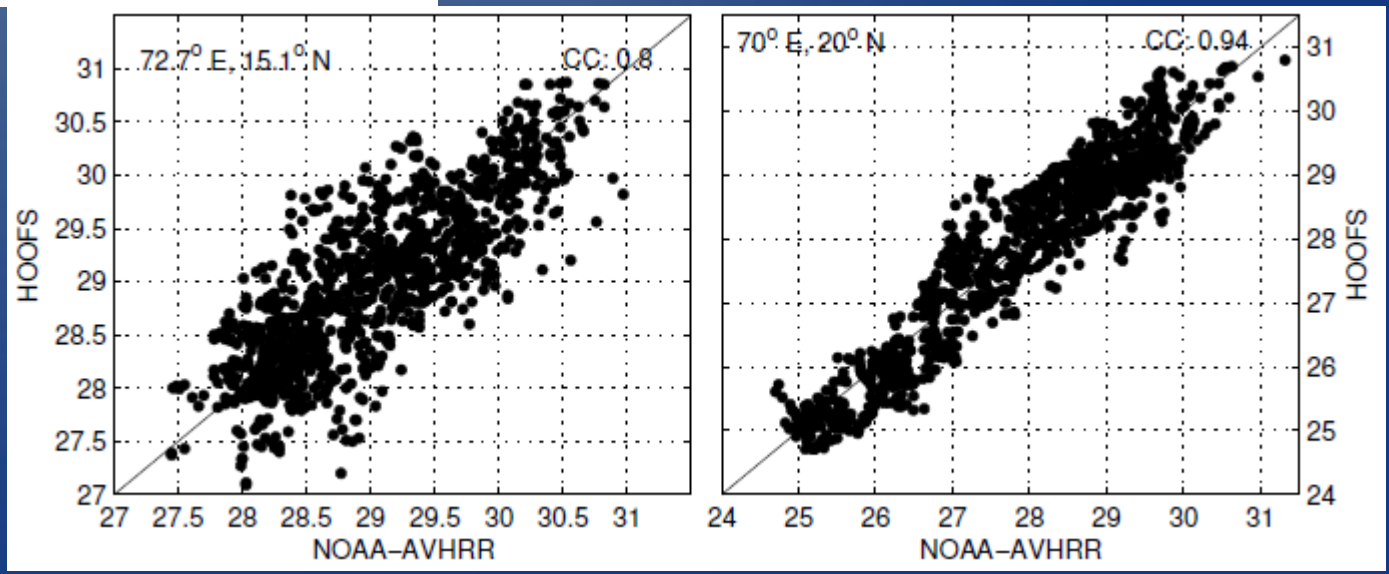
Sea Surface Temperature Simulated by WC-HOOFS

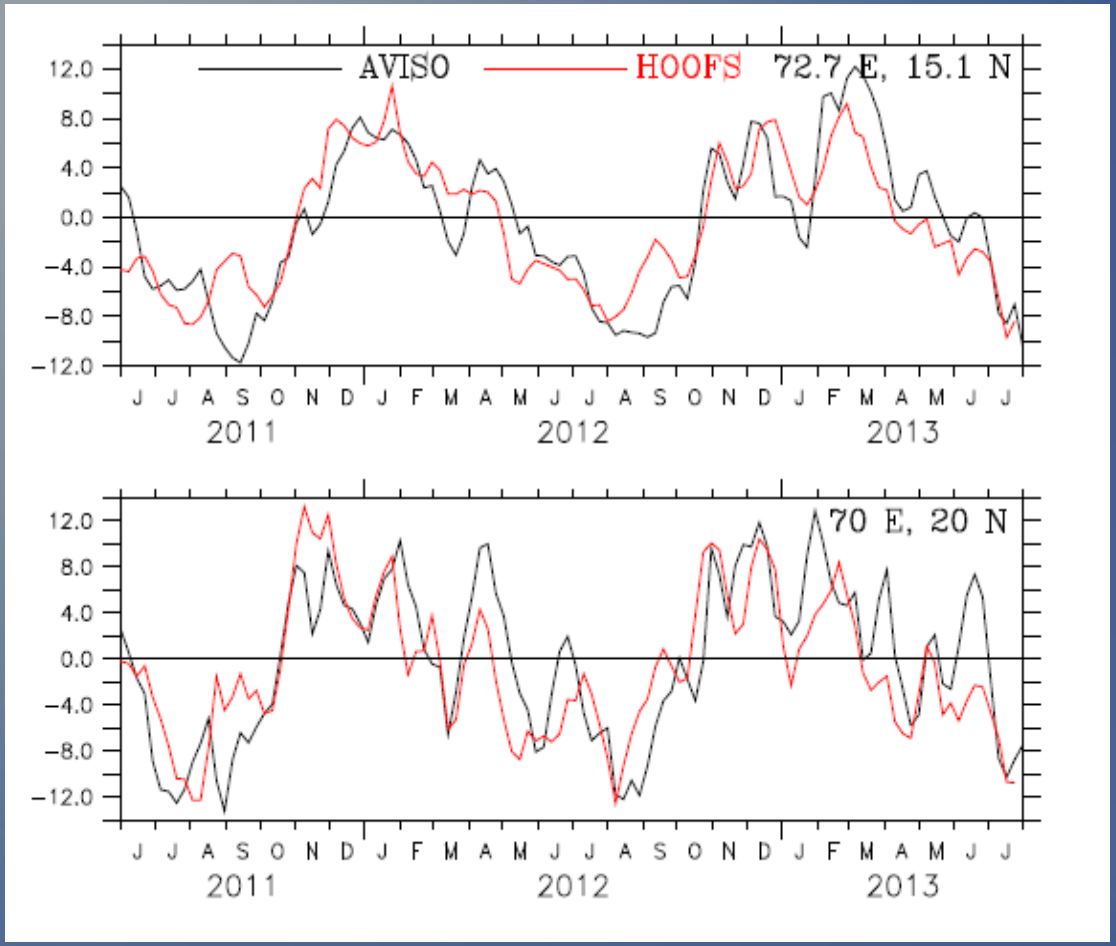




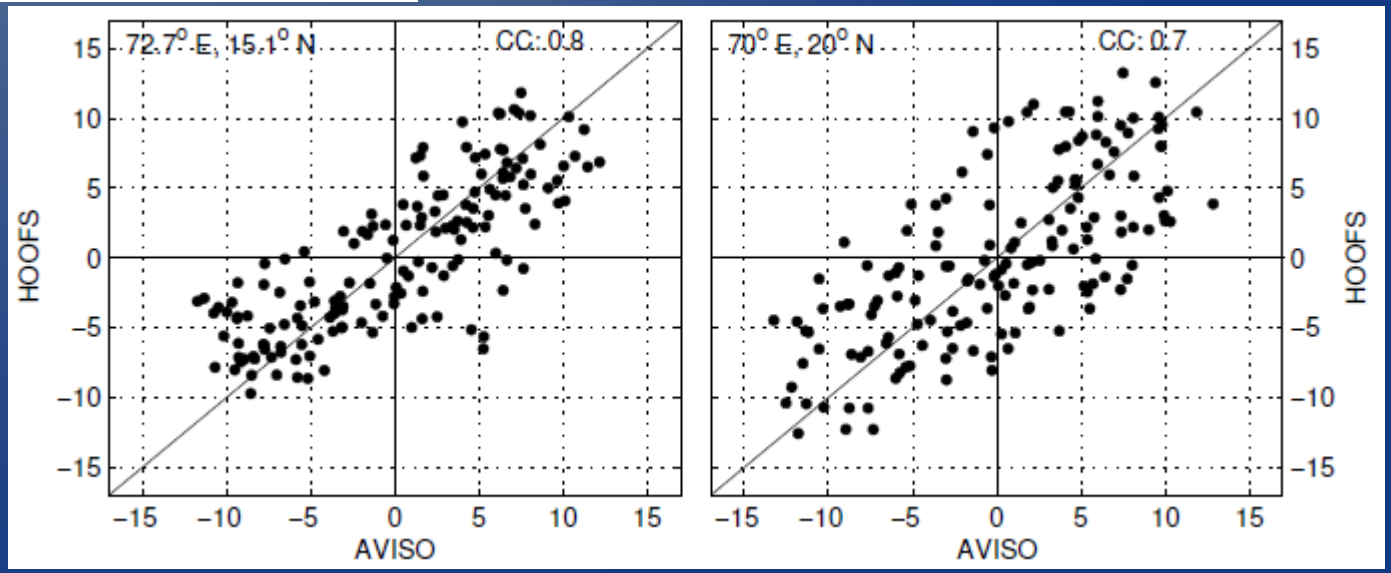


SST Simulated by WC-HOOFS is compared with NOAA-AVHRR observation



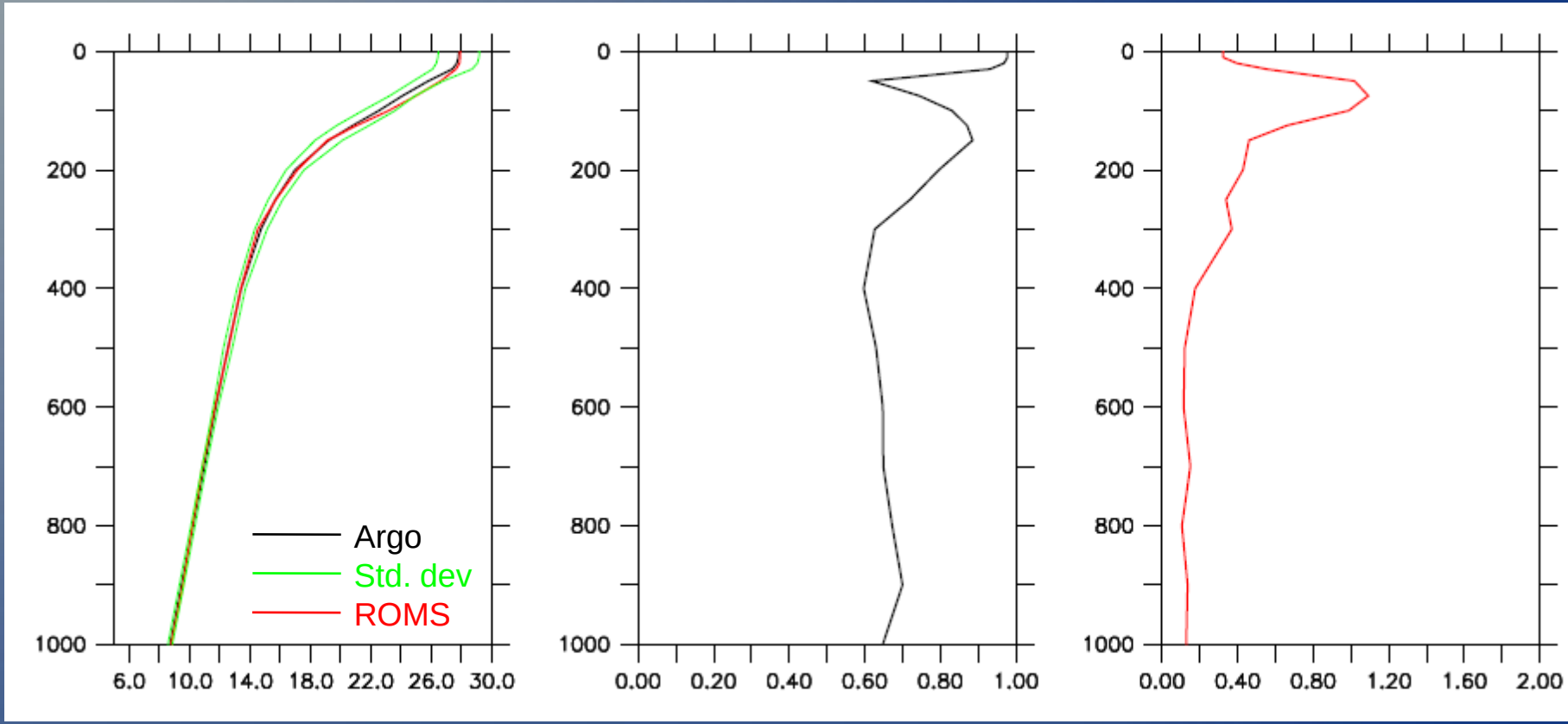


SLA simulated by WC-HOOFS is compared with AVISO Merged SLA



Statistical validation of temperature profiles simulated by WC-HOOFS in the N-E Arabian Sea (66-68º E, 17-20º N)

Mean Profiles | Correlation | RMSE

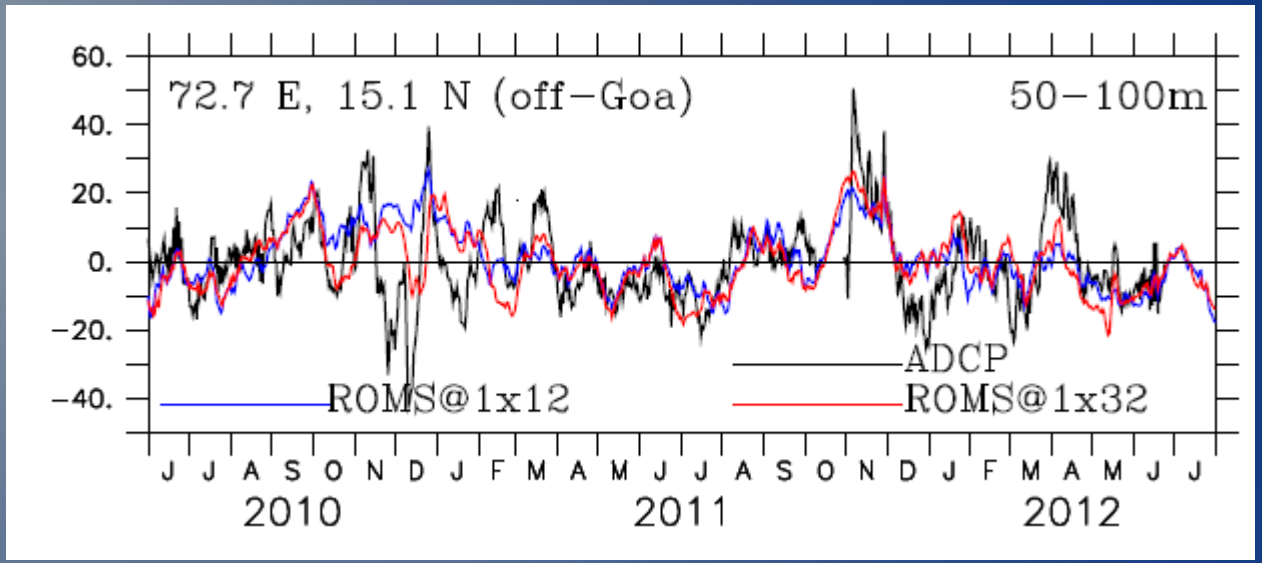


Mean of the observed and simulated temperature profiles are very close.

There is very high correlation between the observation and the simulation even in the deeper levels

Root Mean Square Error is very low. Maximum error of 1º C is observed near the thermocline region.

Time series of along-shore current off-Goa simulated by WC-HOOFS is compared with observation

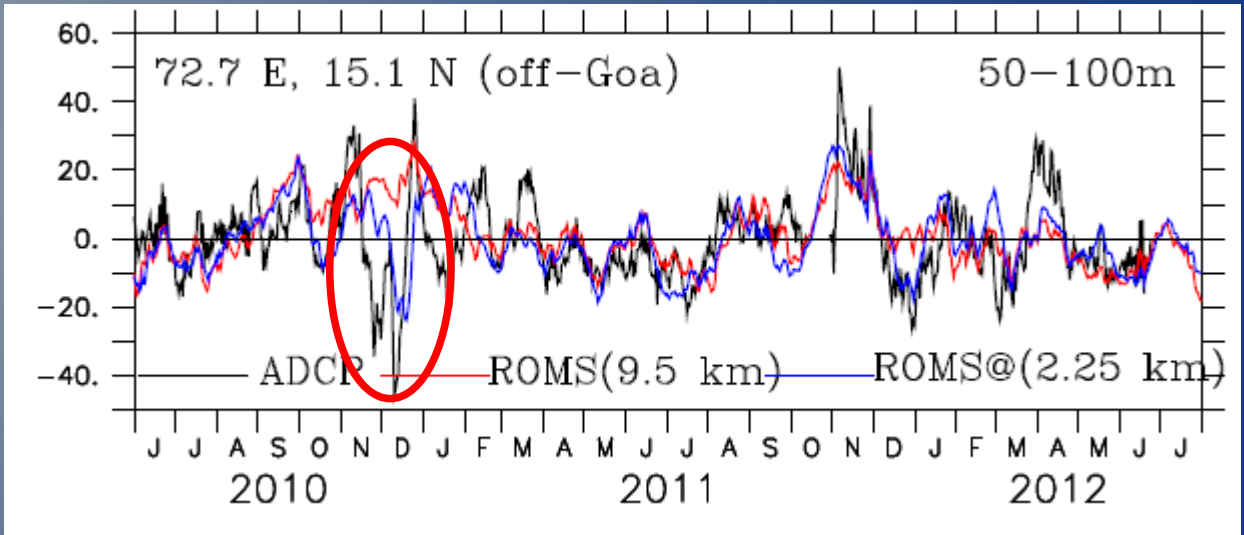


Several experiments were carried out to identify the ideal horizontal resolution of the model

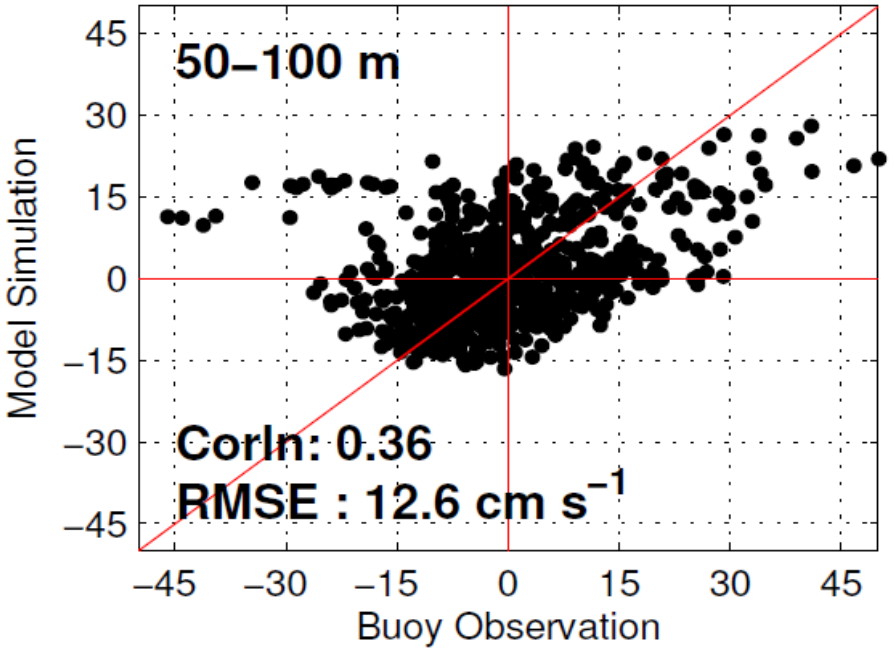
A model setup with 1/32 degree resolution showed significant improvement in capturing the variability of the along-shore current off-Goa, particularly for the event in November-December 2010.

However, the resolution is refined further to 1/48 to see the response.

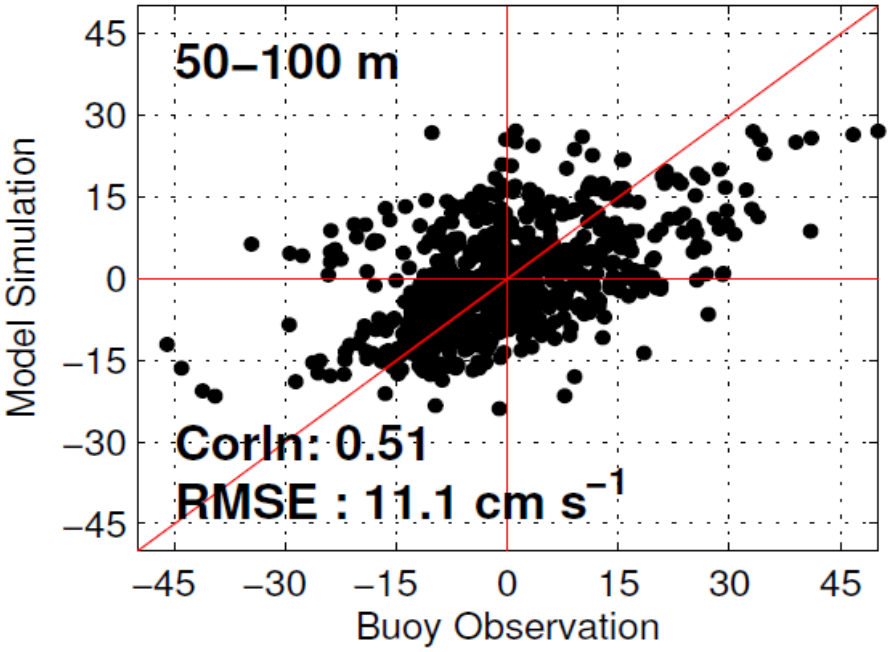
Time series of along-shore current off-Goa simulated by WC-HOOFS is compared with observation



ROMS@1x12 km



ROMS@1x48 km

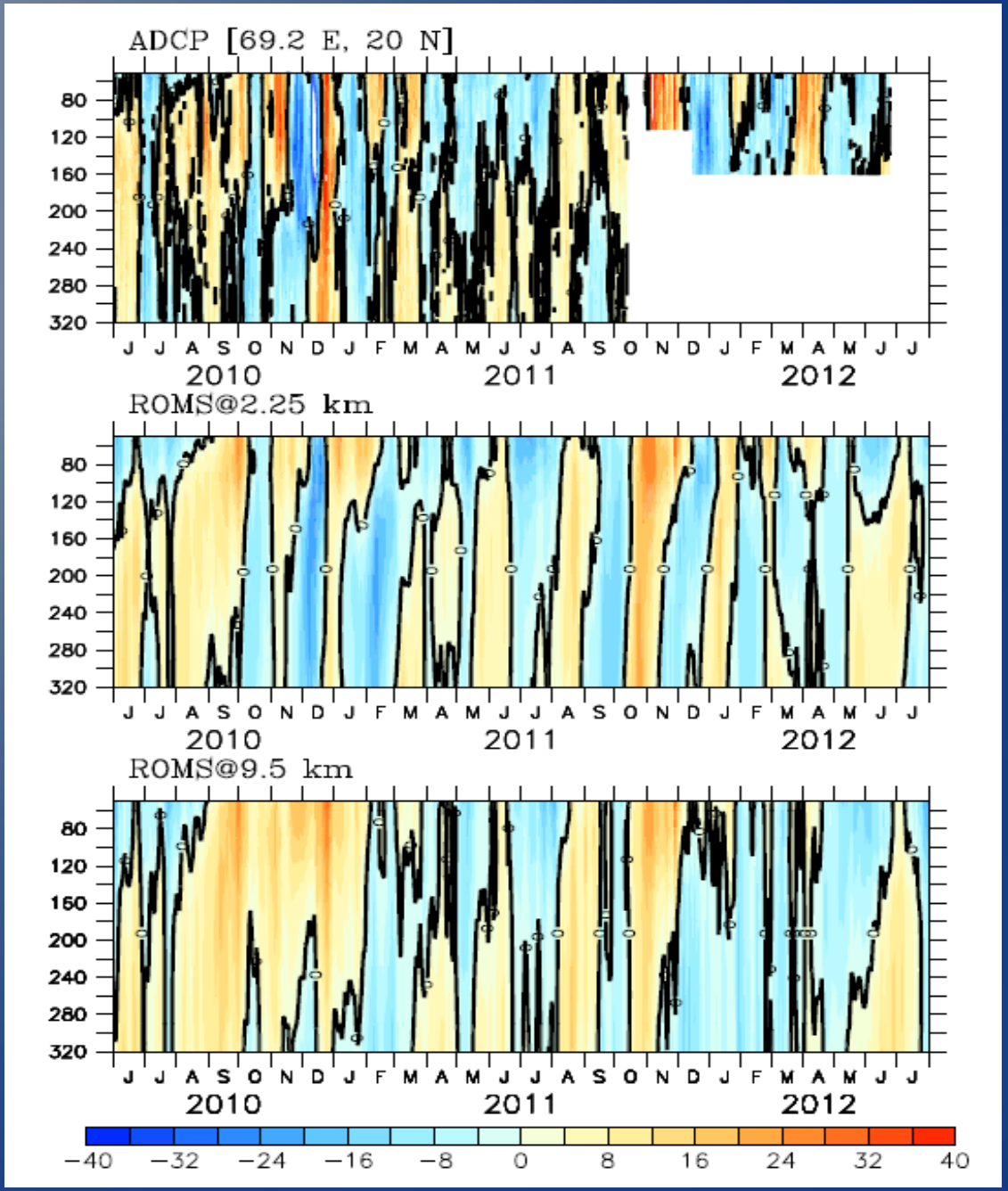


Vertical section of along-shore current off-Goa simulated by the WC-HOOFS is compared with observation

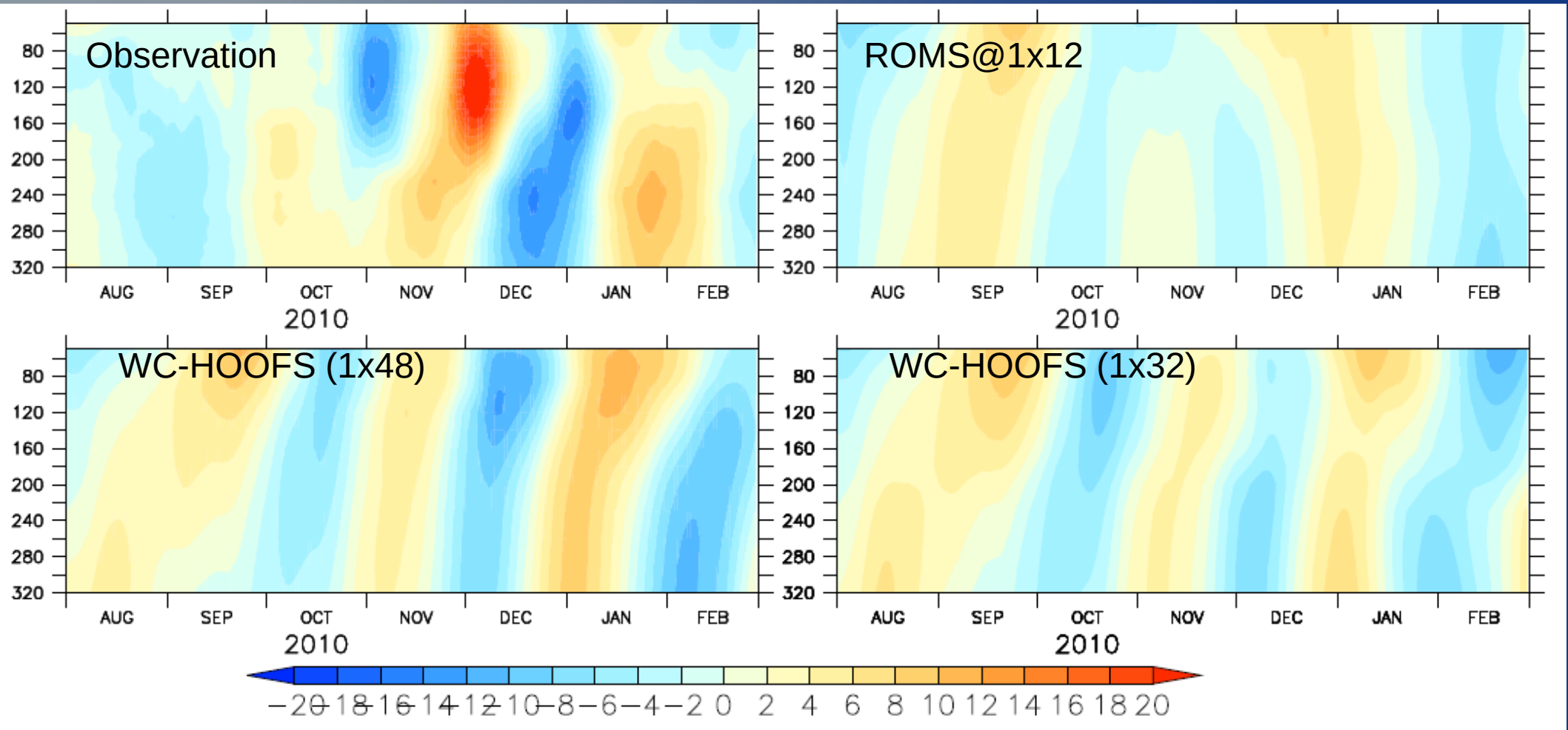
Observation

WC-HOOFS

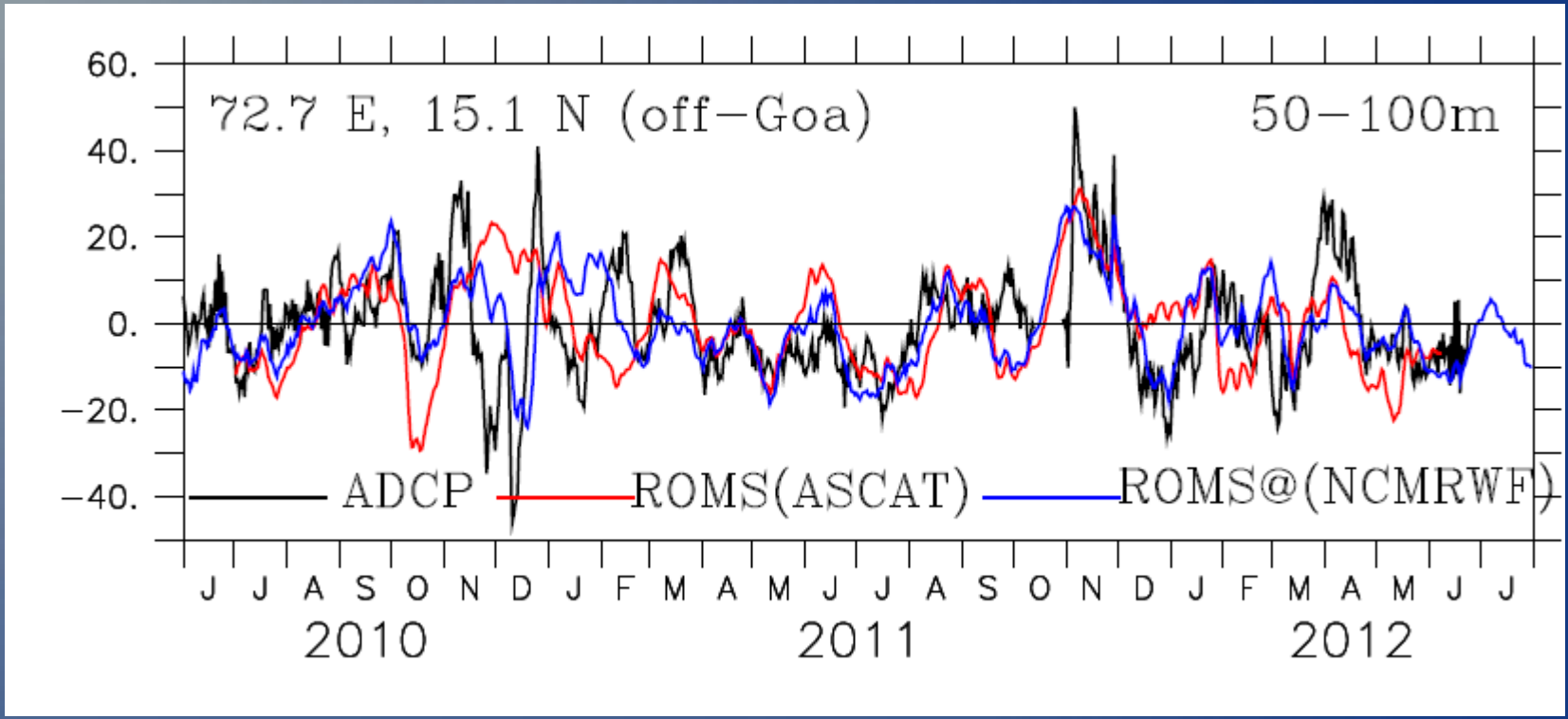
ROMS@1x12



30-90 Day Band-pass Filtered Along-shore Current off-Goa



Time series of along-shore currents off-Goa simulated by WC-HOOFS are compared with observation



WC-HOOFS when forced with NCMRWF atmospheric analysis reproduced the variability of coastal current off-Goa more realistically compared to the simulation forced with ASCAT winds.

Since the boundary conditions for both the simulations are identical, a possible reason for this difference in simulation could be the difference in the modulation of the circulaion associated with the coastal Kelvin wave within the model domain, when forced with NCMRWF atmospheric analysis and ASCAT.

THANK YOU

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