

Update on SIBER-India projects

funded by Ministry of Earth Sciences, Government of India

S.W.A. Naqvi CSIR-National Institute of Oceanography, Goa





India National SIBER Program Initiation



- SIBER India initiated and led by Wajih Naqvi
- > At a workshop in Goa April 13-14, 2009
- Sponsored by India's Ministry of Earth Sciences (MoES).
- Strong national participation
- This program is now funded and well underway
- Open Ocean cluster 6 projects
- Estuaries & Coasts cluster 8 projects

15 projects funded under SIBER-India - grouped into two clusters:(i) Open ocean and (ii) Estuaries and Coasts

Open-ocean cluster

S No.	Project Leader (Institute/University)	Project title
1	Dr. S.W.A. Naqvi, National Institute of Oceanography, Goa.	Long-term monitoring of oceanographic, biogeochemical and ecological processes in the North Indian Ocean through establishment of open-ocean time series stations in the Arabian Sea and Bay of Bengal.
2	Dr. N. Ramaiah, National Institute of Oceanography, Goa.	Elucidation of long-term changes in microbial communities in intensely denitrifying and oligotrophic environs through metagenomic analyses.
3	Dr. Sujitha Thomas, Central Marine Fisheries Research Institute, Mangalore.	Flow of matter through trophic levels and biogeochemical cycles in marine and estuarine ecosystems.
4	Dr. R. Rengarajan, Physical Research Laboratory, Ahmedabad.	Particulate organic carbon export flux from upper Arabian Sea and Bay of Bengal using ^{234Th} as a tracer.
5	Prof. R. Ramesh, Physical Research Laboratory, Ahmedabad.	The role of anaerobic ammonium oxidation (anammox) in nitrogen-loss from the Arabian Sea.
6	Dr. M.K. Sharada, C-MMACS, Bangalore.	Modelling of marine biogeochemical cycles in the Indian Ocean.

Estuaries and Coasts cluster

S No.	Project Leader (Institute/University)	Project title
1	Dr. SWA Naqvi, National Institute of Oceanography Dona Paula-Goa	Dynamics of selected biogenic elements in Indian estuaries – A case study of the Mandovi – Zuari estuarine system.
2	Prof. C Annapurna, Department of Zoology, Andhra University, Visakhapatnam.	Assessing macro and meiobenthic diversity off Goa Coast with special emphasis on OMZ
3	Dr. Vishnu Murty Matta, Department of Marine Sciences, Goa University	Atmospheric deposition and its influence on nutrients in coastal waters of Goa- West coast of India
4	Dr. B.R. Manjunatha, Department of Marine Geology, Mangalore University	Assessing the Anthropogenic Impact on South-West Coast of India
5	Dr. A.A. Mohamed Hatha, School of Marine Sciences, Cochin University of Science and Technology, Cochin	Role of Heterotrophic Bacteria and Cyanobacteria in the Nitrogen Cycle in the Cochin estuary and coastal waters with Special Reference to Nitrification, Denitrification and Nitrogen Fixing capabilities
6	Dr. V.N. Sanjeevan, Centre for Marine Living Resources and Ecology, Kochi	Time-Series studies on the Biogeochemical aspects in the estuarine and coastal waters of Kochi, southwest coast of India
7	Dr. T. Balasubramanian, Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai, Tamilnadu	Hydro – Biological studies of Vellar – Coleroon estuarine system
8	Dr. S. K. Mukhopadhyay, Department of Marine Science, University of Calcutta	Biogeochemical dynamics of the Hooghly-Matla estuarine systems along the northeast coast of the Bay of Bengal, India.

15 projects funded under SIBER-India - grouped into two clusters:i) Open ocean (6 projects) andii) Estuaries and Coasts (9 projects)



Establishment of long-term, multi-disciplinary, time-series at fixed sites in the open ocean (Arabian Sea and Bay of Bengal)

- Investigate variations in the physico-chemical environment and ecology
- Investigate biogeochemical and ecological processes arising from special attributes of the North Indian Ocean region (monsoonal upwelling, river runoff, oxygen minimum zones, anthropogenic impact)
- Time series studies at the open ocean sites (ASTS and BoBTS) have been carried out since 2010

Sediment trap moorings are deployed at ASTS and BoBTS.

400 In BoB, High particle flux during **BoB trap 2011-2012** 350 southwest monsoon (August**a** 300 250 Sept. 2011) 200 150 Flux Higher flux in the middle and 100 50 deep traps than the shallow trap 0 162 179 195 212 229 247 263 263 281 298 315 349 35 52 69 85 03 19 365 29 331 Later flux maximum in the **Julian day** -Shallow — middle — Deep middle and deep traps

Rates of redox nitrogen transformations by ¹⁵N-labelled tracer experiments at the coastal sites



Production of labeled nitrogen in samples incubated with ¹⁵NO₂⁻ at G3 (off Goa) and at M1 (off Mangalore) during SSK-024 cruise (Sept-Oct 2011).

> Extremely high rates of denitrification (~8 μ mol/l/d) in sulphidic waters, the highest ever reported from any marine environment.

- > Active coupling between nitrogen and sulphur cycles possibly account for the huge N_2O accumulation in the region.
- Very low rates of anammox and DNRA indicate denitrification is the sole process responsible for the observed oxidized nitrogen loss.

Time series studies have been carried in the Mandovi and Zuari estuaries since 2010





Isotopic analysis of SPOM in Zuari Estuary

> Both δ^{13} C and δ^{15} N show distinct marine signatures at the estuarine mouth (~-21‰ and ~5.7‰, respectively)

Significant terrestrial source (~-29‰ and ~1‰) is observed upstream

> mean C:N ratio (6.64 \pm 0.9, n=42) indicates the dominance of planktonic source of organic matter



Seasonal variation in $\delta^{15}N$ and $\delta^{13}C$ (‰) in the Zuari Estuary during 2010-20111

Assessing the macro and meiobenthic diversity off Goa coast with special emphasis to the effects of seasonal anoxia on benthic population.



Time-series studies off Kochi, southwest coast of India (KoTS – Kochi Time series; CMLRE)

 O_2 saturation levels seems to have decreased compared to 1959 (Banse, 1968) despite 2012 is an El-Nino year. The analysis of Temp & Sal profiles suggests that an early onset and relatively intense upwelling coupled with less precipitation in 2012 (compared to 1959) as the main cause for this change.

Multi-fold increase in anthropogenic loadings in the last five decades may have influenced the O_2 levels.

Effects of global warming, changing precipitation patterns, upwelling intensities and anthropogenic loadings need to be looked in detail as O_2 changes alter the fishery potential.





Comparison of O_2 saturation levels between 2012 (a) and 1959 (b) (Banse, 1968).

(b)

Biological Studies of Vellar-Coleroon Estuarine systems and Parangipettai coastal waters (East coast of India)

The study undertaken in two estuarine ecosystems revealed strong seasonal variations in the levels of physico – chemical parameters



Comparing seasons, wet season showed elevated level of nutrients than dry season .

Phytoplankton, zooplankton and macro benthos were found to be more abundant in the Coleroon estuary compared to Parangipettai coastal waters.

Biogeochemical dynamics of the Hooghly –Matla estuarine system along the northeast coast of the Bay of Bengal, India.

Diurnal variation in Saptamukhi estuary

The concentration of NO_3^--N and NH_4^+-N varied from 4.03 to16.23 and from 0.73 to 9.17 μ M, respectively.

Average chlorophyll concentration was 4.5 mg m⁻³ and net primary production during pre-monsoon season was 30.36 mg C m⁻² h⁻¹.



Fig: Map of the Hoogly-Matla estuarine system showing the station locations.

The average dissolved methane concentration was found to be 46.92 ± 15.26 nmol L⁻¹ with an avg. sea-to-air flux of methane 265 ± 95 nmol m⁻² h⁻¹.

The estuary was found to be strongly heterotrophic having a P/R ratio of 0.27.







