A Non-Profit Environmental and Climate Research Centre
Recognised by the Department of Scientific and Industrial Research (DSIR), Govt. of India.

Nansen Environmental Research Centre (India)
First Floor, KUFOS, Amenity Centre, Madavana Junction Panangad, Kochi - 682 506, Kerala, INDIA http://www.nerci.in
Phone: +91-484-2703351/94473-25564
e-mail: nansencentre.india@gmail.com

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Key Research Areas

- Carbon sequestration in coastal areas
- Marine Ecosystem, focusing on harmful algae blooms and aquaculture.
- Coastal circulation, upwelling and backwaters
- Coastal management, including Environmental Impact Assessment
- Regional sea level variations - present and future
- Monsoon variability and teleconnections with the Arctic

Nansen Environmental and Remote Sensing Centre (NERC)
First Floor, KUPOS, Amity Centre, Madavaya Junction Panangad, Kochi - 682 506, Kerala, INDIA
Phone: +91-484-2703351/94473-25564
e-mail: nersc@iac.ac.cn
The Nansen Environmental Research Centre India (NERCI) was established in 1999 as a non-profit research centre, within the group of international Nansen research centres. The Centre is registered with DSIR (Department of Scientific and Industrial Research) of Ministry of Science and Technology Govt. of India as an Industrial Research Organization (SIRO) (www.nerci.in).

The Centre conducts basic and applied research in ocean and atmospheric sciences as well as in coastal zone management with a core staff strength of 16 researchers and students. The research foci are on interdisciplinary research including:

- Regional sea-level variations – present and future
- Coastal circulation, upwelling and backwaters studies
- Marine Ecosystem, focusing on harmful algae blooms and aquaculture
- Climate and carbon cycle Monsoon variability and teleconnections with the Arctic
- Coastal management, including Environmental Impact Assessment

The Centre cooperates scientifically with the international Nansen Centers, Indian MoU partners and international associate partners like Plymouth Marine Laboratory (PML), UK; Italian Climate Research Centre (CMCC), Italy; AL TERRA, The Netherlands; IFREMER, France and the Nansen Scientific Society, Norway.

NERCI promotes Ph.D.-scholars and master students from India and abroad to conduct research and internship under the guidance of its distinguished scientists and partners. Currently, four full-time and two part-time doctoral students are doing their research at NERCI with affiliation at Kerala University of Fisheries and Ocean Studies (KUFOS) and Cochin University of Science and Technology (CUSAT), respectively. They are funded by DST, CSIR, Nansen Scientific Society, and KUFOS. In addition, 14 students are supervised by the staff at the Centre.

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**Our Vision**

To serve the society through advancing knowledge on Monsoon, Ocean Variability and Coastal Marine Ecosystem for sustainable development by promoting interdisciplinary research and education cooperation programmes in the spirit of Nobel laureate Fridtjof Nansen.

**Our Mission**

The Centre conducts basic and applied research in ocean, atmospheric sciences, and coastal zone management using observations, remote sensing, and GIS applications and numerical simulations for achieving sustainable development goals.
In 2019, NERCI has improved its number of scientific publications, capacity building, and knowledge exchange compared to last year’s. The number of externally funded projects has increased. The Centre has at present a staff of four full time core scientists and two administrative staff.

**Scientific publications**

The scientific production of NERCI in 2019 include ten peer reviewed publications. Two papers are published with co-authorship from NERSC scientists, two with other NERCI Associate partners, and four in cooperation with other Indian research institutions. In addition, six peer review papers with scientists from partner institutions as co-authors are under review for publication. NERCI scientists participated and presented papers in seven international and national scientific conferences.

**Supervision and education**

Research fellow Shinu Sheela Wilson, funded by the Nansen Scientific Society, has submitted her thesis on “An Investigation on the Variation in Monsoon Circulation Associated with the Changes in Low Level Jet-stream” to Cochin University of Science and Technology.

In addition four M.Tech students, nine M.Sc students registered at Indian universities have completed their master thesis supervised by NERCI scientists during 2019. One PhD student from the national institute, CSIR-Fourth Paradigm Institute in Bangalore has completed her course curriculum at NERCI and four full time and one part time PhD students are continuing their research at NERCI in collaboration with KUFOS.

**Research projects**

NERCI is currently implementing eight research projects. These include, five on-going international research projects with funding from Research Council of Norway (RCN), Partnership for Observation of Global Ocean (POGO)-Nippon foundation, The European Commission Horizon 2020, and co-funding from Government of India through Ministry of Earth Sciences, Department of Science and Technology and Department of Biotechnology. One international project funded by Australian Consulate has been completed in 2019. Three national projects funded by Department of Science and Technology, have been completed. In addition, another three national projects funded by Department of Science and Technology and Ministry of Earth Sciences are continuing through 2019.

**Capacity building and training**

NERCI also co-organised two capacity building training and research summer schools, as part of the Norwegian RCN ARCONOR: Arctic cooperation between Norway, Russia, India, China and US in satellite Earth observation and Education and DST – the Citizen science program projects respectively, in partnership with the Nansen Centres in Norway and Russia, and with its local MoU Partners in 2019. During 2019, six international delegates representing EU-India delegation office, Indo-French Centre for Advancement of Science, Uni-
University of Plymouth and Norwegian Embassy in New Delhi have visited NERCI.

**Memoranda of understanding**

The MoU with Anna University, Nansen Center, and Nansen Scientific Society was renewed for another 3 years. The MoU with Kerala University of Fisheries and Ocean Studies (KUFOS) is in the process of renewal.

**Research Facilities**

Full-fledged GIS and Remote sensing laboratory ArcGIS software, MATLAB version R2012a - including advanced tools for data processing and spatial analysis of geospatial environmental data are available at the centre.

High end HP server (HP PROLIANT DL580 G7 server with four processors with 128GB RAM and 1.86GHz) for data storage and computing facilities. This is used for the application of Ocean colour retrieval algorithms to estimate chlorophyll-a, TSM and DOC from satellite data, to run the coupled GOTM-ERSEM and the marine primary production (PP) models. The Weather Research and Forecasting Model (WRF) is also installed on the server to simulate and study the Indian monsoon and ocean variability.

PRIMER V6 Software (operated on a Windows platform) used for statistical analysis of multivariate data, e.g., species assemblages, physio-chemical variables, genetic, microbial, biomarker, diet, modelling etc. Application extends to studies like environmental effects of oil spills, disturbance or climatic effects on coral reef composition or fish communities, more fundamental biodiversity and community ecology patterns, mesocosm studies with multi-species outcomes, etc.

UV-Visible spectrophotometer (with integrating sphere) – Shimadzu UV-2700 model supplied with UV-probe software working on 32-bit Windows - for bio-optical marine and coastal studies.

Radiometer (Ocean Profiler II) – Satlantic model with additional sensors for measuring backscattering and reflectance in water bodies. Sat-view software - for bio-optical studies.

Ancillary field and laboratory equipment like Stereo microscope (Magnus), Trinocular research microscope (Olympus CX21i), Weighing balance (Shimadzu UX420H), Water sampler, Van veen Grab (grasping area of 250 sq.cm), pH meter (Ecotester pH1), Refractometer (Erma model – handheld 0-100% salinity range), Thermometer, Phytoplankton and Zooplankton nets and Multiple sieves are available at the centre.

**Board of Directors**

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- Dr. Annette Samuelsen, Scientist, NERSC, Norway.
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- Prof. P. V. Joseph, Director (Rtd)
  India Meteorological Department, Kochi, India.
- Dr. N. Nandini Menon, Deputy Director, NERCI.
Synergistic applications of Earth observation data-microwave SAR, IR and Visual data for the validation of Ocean State forecast for north Kerala

To utilise the directional wave rider buoy data from WAMAN (WAve Monitoring Along Nears-shore) buoy along the Kerala coast, particularly off Kozhikode for collection of site-specific real-time wave data for the validation of the daily Ocean State Forecast (OSF) for INCOIS for the period 2018-2020.

Our study found that during the strong El-Nino years (2015 - 2016), wavelet spectrum shows a good peak over a period in between 16 to 32 seconds. The significant wave height is comparatively not large during the monsoon months with its high energy density for significant wave heights in between 1.5 to 2.0m. Similarly also during the weak La-Nina years (2016- 2017), wavelet spectrum shows a peak over a period in between 16 to 32 seconds but it not as prominent as during El-Nino years, the significant wave height is comparatively less during the monsoon months with high energy density for significant wave heights in between 1.0m to 1.75m. Whereas during the monsoon months of normal years (2013-2014), the wavelet spectrum shows a good peak over a period between 16 to 32 seconds and the significant wave height is comparatively high during the monsoon months with high energy density for significant wave heights in between 2.0m to 2.5m. It is also noticed that this peculiar characteristics of the wind waves in North Kerala coast is evident only for the monsoon months whereas that for the non-monsoon months particularly during the fair weather season there observed any significant changes in the wave characteristics irrespective of the occurrence of extreme weather events like El Nino and La Nina during the period 2013-2017.
**Arctic cooperation between Norway, Russia, India, China and US in satellite Earth observation and Education (ARCONOR);**

**Research and higher education related to sea-ice, environment, climate change, and operational conditions in the Arctic Ocean focusing on the Northern Sea Route**

In order to sustain long term international partnership and cooperation between Norway, Russia, India, China, and US through advancing research, higher education and recruitment within satellite Earth Observations for monitoring and forecasting of the Arctic and support to Arctic shipping, a collaborative research programme was funded by the Research Council of Norway for the period 2017-2019.

The project is led by the Nansen Environmental and Remote Sensing Center and includes partnership with Nansen Scientific Society, Nansen International Environmental and Remote Sensing Centre, Russia, Nansen-Zhu International Research Centre, China, University of Connecticut, USA and Nansen Environmental Research Centre India. Through this project, exchange visits and hosting of summer research schools and scientific workshops are organized.

The main ARCONOR educational activities were related to the planning, announcement and implementation of two international interdisciplinary Ph.D. and Post-Doc research schools in 2018 and 2019:

- The Arctic Ocean: atmosphere, ice and ocean interactions – implications for future climate and human activities hosted at National Centre for Polar and Ocean Research (ESO-NCPOR) in Goa, India November 2018 with 30 students and 22 lecturers.
- Observing and Modelling the Arctic Environment-Climate processes, prediction and projection, at Nansen International Environmental and Remote Sensing Center (NIER-SC), St. Petersburg, Russia, September 2019 with 32 students and 22 lectures.

A proper interdisciplinary curriculum related to shipping in the Arctic, with focus on the Northern Sea Route is implemented by developing future research network beyond ARCONOR participation.
Rehabilitation of Vibrio Infested waters of Vembanad Lake: pollution and solution (REVIVAL)

“Multi-institutional project funded under the India-UK Water Quality Initiative of the UK’s Natural Environment Research Council (NERC) and the Engineering and Physical Sciences Research Council (EPSRC) in partnership with India’s DST. Tenure of the project is from 2018 - 2021. The project is led by Dr. Anas Abdulaziz, CSIR-National Institute of Oceanography (NIO), Kochi as the lead Indian PI and Dr. Shubha Sathyendranath, Plymouth Marine Laboratory (PML), UK as Lead UK PI.

Vembanad Lake, the largest water body in the state of Kerala, a Ramsar site, and a cultural icon is the study area of the project REVIVAL. Around 2 million people are directly dependent on the lake and a larger number indirectly dependent on it for livelihood. It is a place where many competing interests clash: as well as being a generator of massive revenues from tourism, it is also an area where traditional rice cultivation and fishing practices are still carried on. The lake has become one of the most polluted water bodies in India. Apart from the polluting industries, the lake represents a public health hazard as it acts as a reservoir of Vibrio bacteria, which causes cholera both chronically and as outbreaks reaching epidemic proportions in the vicinity of the lake. The REVIVAL project is an attempt combining in situ and remote sensing approaches to elucidate the responsible environmental conditions and propose remedial action for microbial contamination in the lake, thus enhancing welfare through improving public health. Our work plan (Fig.1) recognised the special challenges posed by the study area: a large lake extending about 100 km, very fragmented and extremely narrow and shallow in places, with immense diversity in environmental conditions, strong seasonality in forcing leading to highly variable eco-systems. The plan of sampling therefore designed was to observe the system at a variety of scales, ranging from point observations, transects, grids and finally, remote sensing to scale up the observations to the level of the entire lake.

We are using citizen science to fill gaps in data, and modelling to arrive at forecasts, and solutions. Implementation of solution involves user engagement. In situ sampling in 13 representative stations along the Vembanad Lake was done for a period of one year from April 2018. Events quickly began to overtake the planned work with August 2018 witnessing the highest rainfall and...
floods of the century. Along with the microbiological sampling and analysis, a notable and successful contribution to the flood relief was made by the prototype mini-Secchi disc manufactured under REVIVAL, which was deployed to give instant optical classification of well water to distinguish between visibly contaminated and uncontaminated sources of drinking water. In cases of extreme visible contamination, samples were taken for molecular analysis to check for presence of cholera and typhoid bacteria. Such help, and the provision of expert advice in emergency meetings at ministerial levels have contributed massively to the regional credibility of REVIVAL. Along with in situ sampling, a mathematical model incorporating the concentration of V. cholera in the reservoir (the lake), numbers of people and their status with respect to infection, flow of infection, the effect of environment on the growth rate of the bacteria (blue), and the effect of filtration of drinking water to minimise infection (brown) has been developed. Preliminary results show that the software runs correctly and that the model yields plausible results using parameters drawn from the literature.

The outcomes of the proposed work will contribute to the economic development of India through securing the future of tourism in the Backwaters, so important to the State of Kerala; through providing an information base to be used by policy makers and regulators reconciling the competing interests in the water body; through providing solutions to clean up, improve, monitor and maintain water quality in the lake; and restore its ecosystem. The outcomes may be used as model approaches for other Indian water bodies located outside Kerala. This will contribute to welfare through improvement of public health, maintenance of a secure income and provision of a cleaner environment.

![Fig.1 Outline of the REVIVAL work plan.](image-url)
Pathways of Dispersal for Cholera and Solution Tools (PODCAST)

To advance the knowledge on Vibrio infection pathways and the antibiotic resistance acquired by Vibrio cholerae, the project acronymed PODCAST was proposed under the “Towards a Sustainable Earth (TaSE 2018)” call with Dr. Marie-Fanny Racault, at PML, UK as the team leader. PODCAST involves partners from UK, India and Japan. Dr. Anas Abdulaziz, NIO, Kochi is the lead PI from India with Dr. Grinson George, CMFRI, Kochi and Dr. Nandini Menon N, NERCI as co-investigators. The 2-year project funded by Dept. of Biotechnology, India started in August 2019.

Cholera outbreaks are increasing across the world, especially in Asian and African countries. In 2016, the World Health Organisation (WHO) reported cholera cases in 38 countries with 57% of the cases from countries bordering the northern Indian Ocean. Cholera outbreaks are connected with enhanced pollution of water bodies and food sources, notably contamination of drinking water sources by the pathogen Vibrio cholerae. The dynamics of cholera outbreaks have been associated with rainfall and storm events, both of which serve to re-suspend bacteria associated with sediments and to redistribute them through flooding and water currents. In the northern Indian Ocean, year-to-year variations in oceanic and atmospheric conditions are influenced by large-scale climatic perturbations such as El Niño and Indian Ocean Dipole (i.e., accounting for 30 and 12% of the variability in sea surface temperature respectively). These variations in climate conditions have been shown to modulate biological productivity and affect the dynamics of cholera outbreaks in the regions. The effect of environmental or climatic disturbance would then operate through the effects on this reservoir. This knowledge is used to explore the dynamics of Vibrio reservoirs and the variations in their transmission routes due to climate variability and characterise the associated impact on human health.

Our study area includes the northern Indian Ocean, with its western (Arabian Sea) and eastern (Bay of Bengal) basins (fig.2). By way of in situ sampling, remote sensing observations, particle tracking and mathematical models in the coastal waters of Kochi, Chennai and Digha, we intend to: 1) identify environmental reservoirs of Vibrio cholerae as well as possible advective transport via ocean currents and long-distance transmission routes for cholera outbreaks;
2) characterise the influence of climate perturbations on cholera outbreaks and environmental transmission routes; 3) build an epidemiological model integrating environmental factors and human-to-human transmission routes; and 4) produce forecasts for cholera outbreaks in coastal regions of the Northern Indian Ocean. NERCI is involved in Engagement with NGOs and public health services and provide information on seasonal variations in the incidence of disease, availability of quality drinking water to coastal population of selected regions, and the use of by way of surveys with local population, NGOs and public health workers. A sanitation APP named ‘CLEANSE’ has been developed for the purpose.

The PODCAST project will generate maps of Vibrio hotspots and a forecast system for cholera outbreaks that will be developed in consultation with local populations and decision-makers, to meet the needs to reduce the risks of waterborne diseases for human health. The products generated will also be relevant for further actions towards sustainable human-environment interactions, for instance, by providing policy information on coastal areas where microbial and antibiotic pollution should be treated as priorities. In turn, these water-management actions will also help to regulate the threat of waterborne diseases.

The work will help to achieve the Sustainable Development Goals and targets on Health (Goal 3), Water Quality (Goal 6), Climate (Goal 13) and Life under the water (Goal 14) by addressing major gaps in knowledge and understanding in the ecology of microbial pathogens, epidemiology of waterborne diseases and the associated impacts and risks for human health.

![Fig. 2 Study area](image)
A global study of coastal productivity, deoxygenation and ocean acidification at selected sites

“Supported by Partnership for Observation of Global Oceans (POGO) and NF-POGO Alumni Network for Oceans (NANO) and co-ordinated by Houssem Smeti, POGO, UK and Adriana Gonzalez, Autonomous University of Baja California, Mexico; the global project started in 2018 and has been continuing gathering information from coastal locations in Mexico, Peru, Ecuador, Argentina, Brazil, Columbia, Tunisia, Mauritius, Ghana, South Africa and India. NERCI has been co-ordinating the Indian work on NANO global project since its inception.”

India emitted 2,299 million tonnes of carbon dioxide in 2018, 4.8% rise from the previous year, according to a report by the International Energy Agency (IEA). Analysis of the conditions in Kochi, southwest coast of India by the Cities Development Initiative for Asia (CDIA) showed that annual Carbon dioxide (CO2) emission in Kochi due to vehicular movement was 7.65 million tonnes in 2010 and this was supposed to increase with years. Oceans, which act as carbon sinks, are able to absorb one quarter of this anthropogenic CO2. A first order estimate of the carbon mass balance shows that net production of dissolved inorganic carbon is an order of magnitude higher than the net loss of dissolved and particulate organic carbon from the Cochin estuary. The study reveals that the Cochin estuary, a previously autotrophic (CO2 sink) system, has been transformed to a heterotrophic (CO2 source) system following rapid urbanization and industrialization. Excess CO2 in the aquatic system affects the health of phytoplankton which in turn could affect the marine fisheries adversely. The phytoplankton utilises iron in presence of carbonate ions and the increased acidity due to CO2 will decrease the availability of carbonate and iron. It is predicted that the carbonate availability by phytoplankton would be less than 50% by the end of century which could lead to collapse of fishery and other living resources. Recognising the urgent need to study these aspects on
a long-term basis as documented data are very meagre, the global project was initiated. From earlier studies of NERCI during 2009-16 in the surface waters, dissolved oxygen (DO) levels were found to decrease in the estuarine, barmouth and coastal regions of Kochi while chlorophyll-a concentration showed an increasing trend in the barmouth region (N=70). A recent study showed that the estuarine discharges and anthropogenic inputs into the coastal waters of Kochi have influenced the carbon uptake rate of phytoplankton resulting in increased primary production which has modulated the coastal biogeochemistry. Lack of data and well-organized database to study the link between bio-optics, biogeochemistry and carbon flux in the coastal regions is an impediment in ocean acidification studies in India.

Continuous time-series measurements at fixed locations are pre-requisites for forecasting and warning operations as well as for a variety of basic and applied research studies. With the NANO global project, we undertake regular sampling (fig.3) along a horizontal transect from Cochin bar mouth into the shelf waters of south eastern Arabian Sea till the water depth reaches 30 m. By way of the measurements of chlorophyll-a, DO, pH, temperature and various bio-optical parameters are made and a database on biogeochemistry, bio-optical and carbon flux characteristics off Kochi waters is being developed. Study on the dynamics of different bio optical characteristics with season and factors influencing oxygen and carbon flux is also being done.

Fig.3 Insitu Sampling of water Quality
Atmospheric Carbon sequestration potential of trees in Kochi city under the changing Environmental Scenario

Kochi is undergoing drastic environmental changes in the last few decades with the introduction of metro rail and other developmental activities. The present study focuses on the decrease in carbon sequestration potential of vegetation due to clearance of vegetation. Use of Remote Sensing data & techniques, supported by field observations was followed for the study.

The two satellite scenes each of 26th February 2013 and 5th February 2017 are used to study the change in carbon sequestration capacity of the area. The study integrates field inventory data with the satellite images. Analysis involves four major steps, namely, (i) Image processing, (ii) derivation of vegetation indices using satellite imagery (iii) ground truthing through field stratification and collection of field inventory data and (iv) calculation of carbon stock. Major change in vegetation area is observed along metro corridor. The vegetation has decreased in many parts of the study area. The total study area is approximately 65799ha with half of the area having different types of vegetation with different carbon sequestration capacity. The vegetation area which is covering 31721.8ha in 2013 have decreased to 31525.4ha in 2017, i.e; 196.4ha. This change is manifested in the NDVI & carbon content of the study area (Fig.4 & 5). The total carbon content of 41284.85 tons in 2013 is reduced to 30271.96 tons in 2017, i.e. a reduction of 11013 tons. So while taking the carbon content of the area as a whole, it is decreased from 1.3 tons/ha in 2013 to 0.96 tons/ha in 2017. Though Kochi Metro Rail Limited (KMRL) is promoting afforestation programs at various places within city, it will take time to make up the decrease in carbon sequestration caused by cutting mature trees with high NDVI. Further, the survival of plants planted in the area is subject to uncertainty.
Figure 4 change NDVI

Figure 5 change in carbon content
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A tree survey was carried out along the proposed alignment by the KMRL metro line. The trees that could be affected by the implementation of the project were enumerated within 10 m (5m on either side from the center of the alignment). The tree volume and biomass were determined according to the standard methods of forest mensuration. The trees along the sides of the proposed alignment are mostly planted for shade purpose and a few are fruit bearing trees and coconut trees. There are very few trees which fall under the definition of The Kerala Preservation of Trees Act, 1986. It is observed that majority of the trees planted on the sides are cut. Most of the trees have girth greater than 70 cm. That means mature trees with high carbon content. About 477 trees exist on the proposed alignment. The estimated biomass loss of 477 trees was 97tons and ten times the number of trees was planned to be planted as done by KMRL. Hence about 4770 plants are required to be planted in the project area in an area of 2 ha. A green belt for the Muttom Dock Yard was also in the plan as a compensatory afforestation work.

The recommended plant species for afforestation include Alstoniascholaris, Polyalthialongifolia, Pongamiaglabra, Mimusopselengi, Sweitenia mahogany, Hydnocarpuslaurifolia, Hopeaparviflora, Strychnosnuxvomica, Cassia fistula and Casuarinaequisetifolia. As per the latest report from different sources, 6937 trees are claimed to be planted in different areas, along the metro and other public places and institutions, by KMRL to compensate for the loss. Though KMRL promoted afforestation programs at various places within city, it has to be noted that the trees being cut are larger and older having greater sequestration potential in comparison to newly planted trees. So it may take years to compensate for the loss. And one more fact is that survival of plants, planted in the area is subject to uncertainty. It has to be assessed from time to time.
Bamboo as a resource for community development and climate change mitigation involving community bamboo plantation to mitigate climate change and skill development training

This study was made possible by the funding given by Australian Consulate-General’s Direct Aid Program (DAP) which is a flexible small grants program funded from Australia’s aid budget. The purpose of this study is to make plans for community development through usage of bamboo as raw material for small scale units of low capital and high labour intensity and to analyse the role of bamboo plantations in carbon sequestration for sustainable development.

The study area selected is Wayanad as bamboo species are prevalent in the area. Bambusa bamboos and Dendrocalamus strictus are the two major species of bamboo in the area. The study will highlight the use of the indigenous sciences and technology for the upliftment of local community in the area combined with sustainable development plans. The bamboo plantation needs only minimal capital investments. The products and businesses centred on bamboo are always sure to rejuvenate the rural economy.

The objectives include Skill development training in bamboo processing for the local community and Community bamboo plantation to mitigate climate change. It is planned through the following activities: i) Preliminary workshop involving the local community, NGOs and local authority to make them aware of the importance and relevance of the project and the planned activities, ii) Uplift the downtrodden and the marginalised community economically by helping them to upgrade the local resource processing skills and also ensure that the local community is equipped with appropriate technologies, iii) Analyse the activities of NGOs, State Bamboo Mission and also the project under the Rashtriya Sam Vikas Yojana (RSVJ) programme of Government of India in order to uplift the downtrodden section of the local community including traditional artisans, tribes and women, iv) Plan workshops/training programs along with them which will provide platform to make people aware of importance of
bamboos in climate change mitigation, and also will help people get involved in community development program using bamboo as raw material, v) Encourage business based on bamboo, which can also help the rural community re-establish its control over natural resources and help market their products, vi) Plan more plantations based on preliminary survey of the area using remote sensing data, thus converting many degraded lands to useful ones, vii) Estimate the carbon sequestration capacity of different species of bamboo and analyse the contribution of bamboos in climate change mitigation and plan for more plantations which contribute to sustainable development. The work is divided into three parts (1) Assessing the status of bamboo cultivation in Wayanad (Fig.6) (2) Skill development training for the marginalised community (Fig.7) (3) Planning replantation (Fig.8) with the help of institutions and individuals interested.
Monitoring and Forecasting of Coastal Circulation using GPS/GSM Technology and Hydrodynamic Modelling

The project is to derive the circulation dynamics of South West Coast of India (SWCI) especially the eddy induced circulation at the near shore regions of Vembanad lake using satellite remote sensing, GPS (Global Positioning System) -GSM (Global System for Mobile Communication) based drifters and hydrodynamic modelling. This 3-year project with funding under Women Scientist Scheme (WOS-A) of the Dept. of Science and Technology (DST), India started in September 2018 with Ms. Jaini Sara Babu, NERCI as the Principal Investigator and Dr. K. Ajith Joseph, NERCI as the scientist-mentor.

The proposed modelling study complimented with GPS/GSM techniques, remote sensing applications and in situ measurements of hydrodynamic parameters would help to better understand the circulation dynamics of the SWCI. However, the remote sensing data so far used for studying the coastal circulation is mainly from satellite altimetry which has its own limitations and hence it is proposed to utilize it along with indigenously available surface drifters embedded with GPS to locate the drifter and GSM for transmitting the position coordinates of the drifter to the user mobile. This approach can be utilized for studying the coastal as well as inland currents in order to monitor the near shore coastal circulation that can answer many of the coastal phenomena that are influencing the coastal regions. Similarly, the hydrodynamic model outputs will also be validated with combined data of surface drifters and satellite remote sensing and is analysed to identify near shore regions which are highly dynamic. This data would help the fishermen community as well as local authorities in their annual planning of fishing operations in safe waters for the region. Using satellite remote sensing, impact of extreme climatic events, ENSO (El Niño /Southern Oscillation) and IOD (Indian Ocean Dipole) on the circulation near SWCI were studied for the period 1997-2016 are shown in Fig.9.

This study demonstrates that the coastal circulation as well as the Eddy Kinetic Energy (EKE) intensity near SWCI is highly influenced in dominant NIOD (2014) during monsoon period while during post-monsoon, higher coastal circulation is observed in dominant PIOD (2012) and EKE in 2005.
Fig. 9 Study on the influence of dominant events (El Niño, La Niña, PIOD, and NIOD) and combined events (El Niño - PIOD and La Niña - NIOD) on coastal circulation (a. premonsoon, b. monsoon and c. post monsoon) near SW coast of India.
Peer-reviewed Publications in 2019


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Phone: +91-484-2703351/94473-25564
e-mail: nansencentre.india@gmail.com

Nansen Environmental and Remote Sensing Center
Bergen, Norway
http://www.nersc.no

Nansen International Environmental and Remote Sensing Centre
St. Petersburg Russia
http://www.niersc.spb.ru/

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NERCI

NANSEN ENVIRONMENTAL RESEARCH CENTRE (INDIA)
First Floor, KUFOS, Amenity Centre, Madavana Junction Panangad,
Kochi - 682 506, Kerala, INDIA http://www.nerci.in
Phone: +91-484-2703351/94473-25564
e-mail: nansencentre.india@gmail.com