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FOREWORD

A very happy new year to all readers!

It is with great pleasure that I present to you the latest issue of our Ocean Quest Newsletter.

Since the 3rd issue of October 2016, other interesting things happened at the Institute. A selection of events hosted by MOI includes a presentation on GIS model integration for Environmental Applications held in October 2016 and a working session, in December 2016, with the Director of Marine Biodiversity, Exploitation, and Conservation (MARBEC) and the Director of IFREMER, to discuss potential areas of collaboration between MOI and MARBEC. In November 2016, the MOI also co-hosted a half day working session with the Australian High Commission and representatives from the Commonwealth scientific and Industrial Research Organisation (CSIRO), where local stakeholders had the opportunity to present their ongoing research, the limitations in their respective research areas and how best collaborations could be established. On an expedition to the southern Antarctic waters in December 2016 on board the MV Agulhas, the group Director from the National Centre for Antarctic and Ocean research (NCAOR) called on the MOI to explain the objectives of the Indian scientific expedition to the southern Antarctic waters as well as to discuss possible areas of collaboration between both research institutions. More recently in January 2017, there was a talk on the setup of coastal laboratories and numerical modeling of coastal processes by the Regional Coordinator for NANO-Nearshore Hydrodynamics group of the NF-POGO Consortium.

Visits from interns and students through the AIESEC and the SIDs Youth Hub (SYAH - Seychelles) programmes respectively allowed MOI to showcase its scientific research and activities to the enthusiastic young visitors.

In December 2016, the MOI received one trainee and six interns, under the Service to Mauritius programme, of the Ministry of Finance and Economic Development of the Government of Mauritius. The interns placed in different departments of the Institute, are actively involved in MOI’s ongoing research and are developing other innovative research projects as well.

In this particular issue, the highlight is on the core projects being undertaken at the MOI, from bio-prospecting of our waters, the assessment of marine biodiversity and marine biosecurity, to the hydrodynamics and submarine groundwater discharge in our near-shore waters. It also includes the studies of local seismicity around Mauritius and the Central Ridge region as well as the crustal structure beneath Mauritius.

The MOI expects to initiate a number of projects from new collaborations developed through newly signed Memorandum of Understandings and those awaiting signature or in preparation.

The development of new projects with international collaborators is always an exciting moment and I hope to be able to tell you more in the next issue!

In the meantime, I wish you happy reading!

Dr. Ruby MOOTHIEN PILLAY
Director

PREFACE

At the beginning of a New Year, it is always most satisfying to look back on the previous year and to be able to proudly say that 2016 was a very productive year in terms of achievements for the MOI was able to deliver on all fronts.

I recall that under the MOI Act, the main role of the MOI is to undertake and coordinate oceanographic research, and advise Government on the formulation and implementation of policies and programmes related to oceanography.

Over and above, generating Ocean Knowledge that provides much needed data so that policies and strategies of the government can be defined, MOI has also undertaken many research projects and surveys to support specific projects in aquaculture to attract investments and to create employment.

MOI has endeavoured to seek collaboration with world class research Institutions/Universities of many countries such as Australia, India, USA, South Africa amongst others in its quest to build capacity, and become a National, Regional and a World Class Research Institute of Oceanography.

Main Outputs of MOI had been with regard to mapping and characterisation of the Mauritian Waters including specific aquaculture sites, producing data for the preparation of the national Tsunami map, assessing the marine living resources in our national EEZ, monitoring of port waters against bio fouling as well as against alien species.

MOI has also hosted many VIPs and representatives from famous worldwide Institutions, including a visit from the White House Science Envoy for the Ocean, Dr. Jane Lubchenco for a working session with MOI Staff, senior scientists from Stanford University, USA; as well as scientists from South Africa, Australia and France.

MOI had also ran 8 national and international workshops and had participated in some 5 expeditions. This is an important activity as it presents MOI scientists with unique, international opportunities to participate in expeditions in the region with a view to collect geophysical data of ocean seabed, and other areas of the regional sea as well as in our own waters which could thereafter be useful for decision making for economic exploitation.

MOI has already signed 4 MoUs with international institutions of excellence and 4 other MoUs are pending for signature in 2017.

2017 is the year when MOI will be much more proactive in terms of its oceanographic research programs thus leading in terms of data generation as 1) it is better structured in its new Research Complex at Albion with the most modern facilities, 2) enhanced technical capabilities and 3) it is fully equipped to undertake and coordinate oceanographic research, and advise Government on the formulation and implementation of policies and programmes related to oceanography, as per its mandate under the MOI Act... I recognise the immense and important contribution made by the Research Advisory Council, the Finance Committee and the Staff Committee of the MOI.

Last but not least, I salute and thank every single Staff of MOI for their contributions to meeting the objectives set and to making MOI an Oceanographic Institution of Excellence at the service of the Republic of Mauritius.

Raj Hemansing PRAYAG, PDSM, FIEM
Chairman
Talk on “GIS Model Integration for Environmental Applications”

Ms. Nussaibah Raja-Schoob gave a talk on “GIS Model Integration for Environmental Applications” at the MOI on Friday 21st October 2016. The talk emphasised the pressure increase on environmental scientist/modellers to both, undertake good science in an efficient and timely manner under increasing resource constraints, and ensure that the science being performed is immediately relevant to a particular environmental management context.

To support this modelling, tools and technologies from the field of mathematics and computer science are being transferred to applied environmental science fields, and a range of new modelling and software development approaches are being pursued. This presentation provided some ideas about such statistical and computational integrations into GIS, using Ms Raja-Schoob’s own research as example. Topics that were covered included modelling and forecasting of environmental phenomena, and risk analysis of environmental hazards.

Ms. Raja-Schoob has a master’s degree in Physical Geography from the Ankara University, with a background in dealing with environmental data and geospatial analysis.

Working Session by Scientists from Ocean Sector in Mauritius and CSIRO

On the occasion of the visit of Dr. Mat Vanderklift and Dr. Andy Steven from the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia, the Australian High Commission in collaboration with the MOI, organised a half day working session on Tuesday 22nd November 2016 from 09 30 to 12 30 hours in the MOI Conference Room.

The aim of the working session was to foster scientific collaboration among key agencies operating within the Ocean Sector in the Indian Ocean. The working session included presentations from CSIRO representatives as well as local scientists on main projects being undertaken by their respective organisations, namely the University of Mauritius, the Albion Fisheries Research Centre and the MOI. The discussions included comments from Non-Governmental Organisations (NGOs) involved in the marine sector on research project priorities and possible areas of collaboration between the CSIRO and other agencies.

Presentation on “The setup of coastal observatories and the numerical modelling of coastal processes”

A presentation by Dr. Houssem SMETI, on “The setup of coastal observatories and the numerical modelling of coastal processes” was held on Thursday 12th January 2017 in the MOI Conference Room with all MOI Scientific Staff.

Dr. Houssem Smeti holds a Doctorate degree in Oceanography from the Mediterranean Institute of Oceanography at Aix-Marseille University (France), a Post graduate diploma in Observational Oceanography from the Bermuda Institute of Ocean Sciences (Bermuda), a master’s degree in Hydrodynamics and Coastal Environments Modelling from the Tunis National School of Engineers (Tunisia) and a bachelor’s degree in Marine Biotechnology from the University of Monastir (Tunisia).

He is also the regional coordinator of the NANO-Nearshore Hydrodynamics Group, a subgroup of the Nippon Foundation/Partnership for Observation of the Global Oceans (NF-POGO) Alumni Network for Ocean (NANO). Since the creation of NANO-NHG in December 2012, Dr. Smeti has been coordinating the observational and numerical modelling activities of the group members in Angola, Brazil, Ivory Coast, Mauritius and Tunisia, in collaboration with scientists from South Africa. The NANO-NHG research project (2013-2017) focuses primarily on the enhancement of the observational capabilities of the participant institutions and capacity building in the fields of observational oceanography and numerical modelling.
EVENTS

Visit of AIESEC Interns
(International Association of Students in Economic and Commercial Sciences)

On the 5th January 2017, the MOI received the visit of 10 international students under the AIESEC programme on sustainable environment of the Sustainable Development Goal (SDG) 13.

AIESEC is the world’s largest youth-led network creating positive impact through personal development and shared global experiences. AIESEC enables young people to build strong foundation of core values as they develop into responsible and entrepreneurial young leaders.

Following a presentation on the activities undertaken by MOI, a guided tour of the research facility was also held by members of the scientific staff.

Visit of SIDS Youth Alms Hub-Seychelles (SYAH) International students - 'Prosperity & environment: promoting sustainable development opportunities for youth in the Blue Economy sector.'

The MOI received the visit of 15 SIDS Youth Alms Hub-Seychelles (SYAH) international students on Thursday 12th January 2017 as part of a Blue Economy exchange programme. They were welcomed by the MOI Director followed by a presentation on the main research activities of MOI by Mr. Motah.

SYAH is a youth-led NGO promoting and advancing sustainable development through youth-led projects. During their visit, a presentation on the research activities of the MOI was held, followed by a guided tour of the research facility.

Aged between 16 and 21 years, the young participants received 2 weeks of work attachment in various organisations falling under the blue economy sector within the region. The aim of the internship was to inspire young people to take up a career in the ocean-based economy tackling Sustainable Development Goals 14 (life below water) and 8 (Decent work and economic growth). The internship included a merit based application for any young person in the Seychelles to spend two weeks to learn about the various sectors that are included under the Blue Economy. The two-week internship included class-based sessions conducted by a researcher from University College London and the Scottish Association of Marine Science (SAMS), as well as ‘Finding innovative solutions and setting up an enterprise’ workshops.

This visit enabled them to learn about the different existing organisations and substantial topics in Mauritius and different initiatives and enterprises related to the ocean-based economy in Mauritius, and allowed the sharing of ideas and best practices.
Bioprospecting of Mauritius waters

In recent years, marine natural product bio-prospecting has yielded a considerable number of drug candidates. Mauritius has a rich and unique biodiversity of marine fauna and flora that offers a vast potential for discovering novel bioactive secondary metabolites. Marine sponges have been the dominant and most important source of bioactive marine natural product for the discovery of new pharmaceuticals especially anti-cancer agents, e.g. Yondelis®, Halaven® and Adcetris®. The MOI-led Bioprospecting project aims at searching for new bioactive compounds with therapeutic properties from marine sponges.

To date, more than 50 marine sponge specimens have been taxonomically identified and screened for diseases such as cancer, Alzheimer and diabetes. Some extracts displayed promising activities and can be further purified to isolate the bioactive components. The potential uncovered within our midst has provided incentive to further investigate species of sponges in Mauritius waters and to strengthen MOI’s research capacity in marine drug development.

With the recent signing of a MoU with the University of Cape Town, MOI intends to encourage research in marine natural product discovery within the Mauritian Exclusive Economic Zone (EEZ), thereby contributing to the development of the Ocean Economy in the field of pharmaceuticals.

Molecular Characterization/Assessment of living resources in the EEZ of Mauritius

Marine biodiversity is under constant stress from human activities and climate change, with a large number of species becoming extinct even before being documented. The marine ecosystem in Mauritius is no exception, as it faces continuous coastal habitat degradation and over-exploitation of its marine living resources. In this context, it is critical that the existing organisms present in the waters of Mauritius are properly identified and inventoried using contemporary tools such as DNA-based techniques.

Initiated in 2010, this project aims at establishing an inventory of commercially important marine species in the waters of Mauritius using a combination of both traditional taxonomic identification tools and DNA based identification techniques. The data generated are commonly updated on the MOI’s online Marine Diversity and Genetic Data Bank.

The project is in line with the Government programme 2015-2020 as well as with its Vision 2030, whereby protection and preservation of marine living resources is key to the establishment of a sustainable Ocean Economy.
FOCUS - RESEARCH PROJECTS

Marine Biosecurity Programme

As part of the Marine Biosecurity Programme, the Biotechnology Unit is currently undertaking two main projects namely: a) The Port biological baseline survey, Port Mathurin, Rodrigues, and b) Survey of invasive aquatic species related to biofouling, Port Louis harbour, Mauritius. The underlying reason for these surveys is to gather baseline information on marine biodiversity within the port area, with emphasis on non-indigenous marine species (NIS) which may have been introduced by shipping, either in ballast water or attached to hulls, as well as by other vectors.

a) Port Mathurin Port Biological baseline survey

The Ministry of Ocean Economy, Marine Resources, Fisheries, Shipping and Outer Islands (Shipping Division) is actively pursuing the development of a ballast water management regime for Mauritius and as part of a cohesive approach, the programme has now been extended to include survey Port Mathurin, Rodrigues. The current grant aims at conducting a port baseline survey of Port Mathurin, Rodrigues. The purpose of the survey is to gather baseline information on marine biodiversity within the port area, with emphasis on non-indigenous marine species. Overall, this project will increase our adherence to Article 6 of the International Convention for the Control and Management of Ship’s Ballast Water and Sediments (BWM Convention).

b) Survey of invasive aquatic species related to biofouling, Port Louis harbour, Mauritius

Marine biofouling occurs mainly through attached or sessile marine species. Shipping has been identified as the major vector for the spread of invasive aquatic species on a global and regional scale. The resulting transfer and introduction of invasive aquatic species through ship’s biofouling threatens the conservation and sustainable use of biological diversity. In context and pertinent to the 2011 Guidelines for the Control and Management of Ship’s Biofouling to Minimize the Transfer of Invasive Aquatic Species, this project aims at developing a standardized template for hull inspection as a decision support tool and its application to survey invasive aquatic species related to biofouling.

POGO/ NANO-AFRICA: Nearshore Hydrodynamics Project in Mauritius

The Partnership for Observation of the Global Oceans (POGO) is a consortium of the major oceanographic institutions around the world to promote global oceanography capacity building. In 2014, two MOI scientists participated in a 10 months’ in-service training course at the Nippon Foundation (NF)-POGO Centre of Excellence (CoE) in ‘Observational Oceanography’ at the Alfred Wegener Institute (AWI), Helmholtz Centre for Polar and Marine Research in Germany. After successfully completing the programme, they were awarded an ‘Ocean Observations Postgraduate Certificate’ and joined the NF-POGO Alumni Network for Oceans (NANO).

The NANO-Africa Group was created in December 2012 and focusses mainly on Nearshore Hydrodynamics-Erosion studies. The aim of this group is to strengthen the observation of coastal zone hydrodynamics and promote long-term collaboration between the members of NANO-Africa.

Under this collaborative programme, the MOI is carrying out nearshore hydrodynamics studies in the western coast of Mauritius

This study will provide accurate long-term wave, tide and wind data on an operational basis and help build capacity in ocean and coastal observation, to eventually come up with nearshore hydrodynamics modelling studies in the study area. Modelling results will help have a better understanding of wave and tide characteristics, sediment transport and dynamics in the western region of Mauritius. Therefore this project will eventually assist local institutions and policy makers to plan future development and provide best management practices and services.
Assessing the Submarine Groundwater Discharge (SGD) Flux to Meet Potable Water Demand and Improve Domestic Water Supply in Coastal Regions

Mauritius relies heavily on groundwater as a source of freshwater for domestic use. With an increase in coastal population and activities, coupled with recent droughts, there is an urgent need to find and exploit new sources of potable water. Since a considerable part of ground water is lost at sea through submarine groundwater discharge, the main goals of this project were to investigate the locations of SGD around the island and to quantify the flux of SGD in specific regions of high freshwater demand.

A multidisciplinary approach was adopted, including techniques to measure naturally occurring radioisotopes $^{222}$Radon and Radium. The first part of the project was the identification of SGD sites around Mauritius and has been completed. Field investigations have led to the identification of 28 major near shore SGD sites around Mauritius. This will contribute to the marine spatial planning of the near shore waters.

The second part of the project is a more detailed investigation of the site of Trou aux Biches (TaB) to determine the flux of SGD in this region. Six large springs are present in the lagoon as shown in Figure 1A. Fresh water seeps are also seen on the beach (Figure 1C). The goal of this study was to determine the flux and the chemical composition of SGD entering the lagoon. Radon was monitored 24-hours in the 6 springs of the lagoon. Simultaneously, water samples were analysed for nutrients, anions/cations, and stable $^{18}$O and $^2$H isotopes. These data complemented the investigation by providing a daily estimate for the input of these chemicals in the lagoon. Following the chemical analysis of water samples from the 6 individual springs, we expect to map the origin of the waters of each of the springs.

Seafloor mapping of the Mauritius EEZ (Acquisition, processing and interpretation of geophysical data)

Around the world, coastal states have embarked into exploring and exploiting the oceans, its seabed and subsoil. The Exclusive Economic Zone (EEZ) of Mauritius is around 2 million square kilometres and is largely unexploited.

The MOI is supporting the Government’s vision of the Ocean economy by carrying out research and participating in geophysical surveys of the seafloor of the Mauritius EEZ (Mascarene Basin, southern part of the Mascarene Plateau, Central Indian Ridge) to acquire the relevant data for the sustainable development of the ocean economy including for maritime spatial planning. The MOI is also assisting the Prime Minister’s Office in the survey of the Mauritius-Seychelles Joint Management Area.

The overall goal of these scientific studies and surveys is to characterise the seafloor and sub-seafloor and its structures to understand the tectonics, formation and evolution of the region and ultimately to identify areas of potential resources.
Mapping of coastal and oceanic environments including characterisation of earmarked Aquaculture sites

Since 2016, the MOI has been characterising coastal and offshore waters of mainland Mauritius, including the earmarked aquaculture sites. During the different field surveys, various water parameters are investigated, e.g. temperature, pH, conductivity/salinity, dissolved oxygen, bathymetry, current profiles, fluorescence and turbidity, in addition to nutrient parameters such as nitrate, nitrite, ammonium, phosphate and silicate.

With the support of the Hydrography Unit of the Ministry of Housing and Lands, one offshore site in Trou Aux Biches was surveyed for bathymetry. The bathymetric survey of the offshore site at Anse La Raie was conducted with the collaboration of the Indian Navy INS Darshak. So far, the MOI has completed ten earmarked aquaculture sites and another five sites are being currently surveyed.

In line with the Government’s vision, the MOI has been providing its services via its parent Ministry to various stakeholders for the sustainable development of the ocean economy. These services included full reports, maps and charts of the state selected areas of the coastal waters around island of Mauritius.

Database of Oceanographic data of the MOI

Oceanographic data collection, which is an ongoing process that enables us understand the ocean and the climate system, plays a vital role in the decision making process for the sustainable development and management of ocean resources. The Republic of Mauritius, being a Small Island Developing States (SIDS), relies heavily on the ocean resources that are already threatened by changes in climate and ocean conditions. Besides, the development of sustainable ocean-related business activities such as aquaculture, a growing economic sector in many developing countries, also requires a good understanding of the ocean thus the need for reliable oceanographic data.

Since its establishment in 2000 the MOI has been generating large amounts of oceanographic data through various projects. These data include physical, biological and chemical measurements derived from in situ and earth observations (remotely sensed satellite data). The volume of data available has prompted the MOI to come up with a project to create a database of all oceanographic data available for the coast and ocean of Mauritius. The project is in phases and phase one, whereby a preliminary metadata map has been setup, comprising information on all the data available around the island of Mauritius, has been completed.

The map is available on the MOI website (http://moi.govmu.org/moidatainvent.html). This metadata platform is likely to expand over the whole Indian Ocean, including the Exclusive Economic Zone (EEZ) of the Republic of Mauritius and the Joint Management Area (JMA) as it will incorporate data from ship cruises and satellite information (imagery and data).
**Tsunami Preparedness Map Project**

The MOI has been collaborating closely with the National Disaster Risk Reduction and Management Centre (NDRRMC) for the setting up of a Tsunami Inundation map for Mauritius and Rodrigues. In order to determine regions vulnerable to tsunamis, the MOI carried out numerical modelling and topographic studies in order to simulate their generation, propagation and influence on the coastal regions.

Several scenarios have been incorporated, including tsunamis originating from the Makran region in the north Indian Ocean as well as the region of Sumatra. In order to complete the study, further modelling is underway, namely for the Java region where there is a risk of a major tsunami-generating earthquake in the near future.

The scientific research undertaken by MOI in relation with the development of the Tsunami Inundation map and its importance, was presented, at a one-day workshop hosted by the Mauritius Meteorological Services and NDRRMC on the 3rd of November 2016, in the context of the World Tsunami Awareness Day.

**Study of Local Seismicity around Rodrigues - CIR Region using array techniques**

Located at approximately 250 kms from the active Central Indian Ridge, the seismicity around Rodrigues Island is generally characterized by events recorded on this Ridge system. The largest magnitudes recorded are 6.3 and 6.7 in August 2010 and July 2012, respectively. In order to characterize the seismic activity around the island, a joint project between Goethe-Universitat, Frankfurt and the MOI, Mauritius was started in 2014. The aim was to deploy a dense array of seismic stations on the Rodrigues Island and use array techniques for the detection and location of earthquakes in the region with respect to intraplate seismicity. This deployment lasted 22 months (September, 2014 - June 2016, Figure below). Each station consisted of MARK L-4C-3D geophone and Omniscore DATA-CUBE with sampling rate of 100Hz. Currently, the project is in data analysis phase. The final report will be submitted by December 2017.

**The Crustal Structure Beneath Mauritius**

Seismic data collected under RHUM-RUM project from the land stations deployed in Mauritius were used to conduct receiver function studies to determine the crustal structure below Mauritius. Since seismic data are direct data, the obtained results are more reliable. By applying the H-k stacking technique to the obtained 382 P receiver functions, the derived crustal thicknesses of approximately 10–15 km were obtained. Furthermore, the forward modelling technique of the receiver functions showed that Mauritius has transitional Moho with a thickness of approximately 10km. The study was conducted in collaboration with Goethe-Universitat, Frankfurt. The findings were published in Geophysical Research Letters in September 2016.

“Third MESA-IOC-MOI Regional Technical Working Committee Meeting”

In the framework of the Monitoring for Environment and Security in Africa (MESA) project, the MOI as the Regional Implementation Centre (RIC) organised the 3rd MESA-IOC-MOI Regional Technical Working Committee Meeting on the 9th and 10th November 2016 at the MOI in Albion, Mauritius.

The objectives of this meeting were (i) to discuss the status of MESA station delivery and installation in the different countries, (ii) to examine the status of service development, implementation and usage at national level, and (iii) to share information about the status of the MESA station software.

During this third meeting, the MOI made a series of presentations covering the following topics: Service Development and Implementation, Service Deliverables, MESA Capacity Building Programme and upcoming activities. Representatives from Kenya, Madagascar and Tanzania explained how MESA data was used by their institutions and at national level. They also highlighted some challenges regarding training and data gaps.

In addition to MOI and MESA staff, some 7 participants from IOC Member States, Mozambique, Kenya and Tanzania participated in this annual technical meeting.

VISITS

1. Dr. L. Dagorn, Director of L’Instut de Recherche pour le Developpement (IRD) and currently the head of a research lab in France on Marine Biodiversity named MARBEC and Dr. Jean-Marc Fromentin, Director of IFREMER (Sète) visited the MOI on Tuesday 6th December 2016. The visit included a presentation followed by a discussion on the possible collaboration between MOI & IRD.

2. Visit of Dr. N. Anil Kumar, Group Director of the Indian Scientific expedition to the Southern Ocean/Antarctic Waters from the National Centre for Antarctic and Ocean Research (NCAOR), Goa, India, called on the MOI in December 2016 to explain the objectives of the Indian expedition to the Southern waters and to discuss avenues of collaboration.

MoU

1. MoU between the MOI and the Goethe University Frankfurt, Germany was signed on 12th December 2016 with the aim to collaborate mainly in the field of Geosciences specifically, Geophysics and Geology.

2. MoU between the MOI and the University of Cape Town was signed on 11th January 2017 with the aim to collaborate mainly in the field of marine natural products.

Interns

1. In December 2016 six interns, under the Service to Mauritius programme hosted by the Ministry of Finance and Economic Development of the Government of Mauritius, joined the MOI. Most of the interns, have recently graduated while others have postgraduate qualifications, were placed in the different departments depending on their educational fields. They are actively involved in the ongoing research activities and will be expected to participate in the implementation of any future projects developed by each department during their stay at the Institute.

2. Ms. Houriiyah Tegally, an undergraduate in Molecular Biology from the University form the University of Yale, USA joined the MOI on a two months’s internship as from as from the 3rd January 2017.

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