**New Programmes for Indian Ocean Observations under IIOE-II**

Dr. S.S.C. Shenoi  
Indian National Centre for Ocean Information Services (INCOIS)  
Hyderabad - 500 090

---

**IIOE - Background**

In the International Geophysical Year of 1957-1958, International Council of Scientific Unions (now the International Council for Science) established SCOR.

Following the 1st meeting of SCOR at Woods Hole in 1957, SCOR identified ‘Indian Ocean as the greatest unknown in the global ocean’ and envisioned the exploration of Indian Ocean as its first task.

Many scientists in USA got interested in the idea and started communicating through an informal news letter called ‘The Indian Ocean Bubble’.

SCOR appointed Robert G. Snider as Coordinator for the IIOE in 1959, and he continued in this post until the end of 1962, when the management of the expedition was transferred to IOC.  

[http://www.scor-int.org/IIOE_History.htm](http://www.scor-int.org/IIOE_History.htm)
The scientists involved in planning IIOE also felt need for the establishment of laboratories in this area in addition to sampling the Indian Ocean.

Prof. R.B. Montgomery was the first to express his desire that “…..this program can be so designed as to aid directly the development of one or more oceanographic centers in the countries bordering the Indian Ocean…..” (The Indian Ocean Bubble, issue 2, 27 Feb 1959).

The planners of IIOE also recognized the importance of standardization and intercalibration. An Indian Ocean Standard Net was adopted for plankton hauls and the Indian Ocean Biological Centre was established at Cochin to process the samples.

Established 15 SCOR/UNESCO Reference Stations in the IO

[http://www.scor-int.org/IIOE_History.htm](http://www.scor-int.org/IIOE_History.htm)

IIOE (1959-1965) officially ended in 1965 – peaked during 1962-64

Total 323 ship months (approx.)

1) Australia – 37
2) France – 20
3) Germany – ?
4) India – 24
5) Indonesia – 3
6) Japan – 20
7) Pakistan – 8
8) Portugal – 3
9) South Africa – 13
10) Thailand – 2
11) USSR – 20
12) UK – 35
13) USA - 119

UNESCO published 8 volumes of collected reprints of IIOE

IIOE ended in India with a Post Graduate level training programme (25 trainees ) held in Mumbai (sponsored by UNESCO and CSIR) and birth of NIO on 1 January 1966.
IIOE - Background

IIOE achieved for itself the distinction of being one of the best examples of cooperation between many nations from East and West

IIOE marked a watershed in the pursuit of knowledge of the Indian Ocean.

Chronology – IIOE-2


- IOGOOS-9 + IOP-9 + SIBER-3 + IRF-3 at Cape Town, South Africa in 2012 decided to champion IIOE-2 on behalf of Indian Ocean countries

- India appointed a National Organising Committee in March 2013 to coordinate the activities under IIOE-2

- A meeting of interested scientists was initiated by IOC Perth Programme Office and was hosted by INCOIS at Hyderabad, India in May 2013 under the banner of IIOE-2 Reference Group (Co-Chairs - N D'Adamo (IOGOOS/IOC), R Hood (SIBER/IMBER)).

- A report was submitted to IOC General Assembly held in Paris during June/July 2013

- IOC & SCOR commit to ‘championing’ IIOE-2 at respective Governmental & Scientific levels and decided consider the formalisation of IOC’s involvement in IIOE-2 (planned during 2015-2020) at the IOC Executive Council in 2014
Chronology – IIOE-2

• IOP-10 + SIBER-4 + IRF-4, discussed IIOE-2 again at Li Jiang, China in July 2013
• IOGOOS-10 held in Mauritius addressed IIOE-2 again in detail
• Introduced IIOE-2 to the Indian Ocean Rim Association meeting, in Perth, Australia in November 2013
• The second meeting of the Reference Group in Quingdao, China in November 2013
• Third meeting of Reference Group in Mauritius in February/March 2014 (planned)

Topics discussed – some generic themes, like …

- Data management - curation, portals, accessibility – GOOS data principles (free, timely, open access).
- Bathymetry - Identified as needing work to improve bathymetric characterisation of the IO.
- Ocean Carbon - A key area identified as providing a motivating theme for basin scale, multi-disciplinary and
- Planetary Waves - Kelvin and Rossby waves – their role in boundary currents – and related basin-shelf cascade of scales / inter-connectivity
- Biodiversity - Need for better inventory; understanding of ecosystem function/services; characterising the impacts of current and future human exploitation
- Paleoclimatology - Seychelles-Chagos Thermocline Ridge, IOD, MJO and ENSO/IOD feedback, inter-annual variability, primary productivity
- Basin wide currents - Greater Agulhas/Somalia Current system /ITF – impact on Global climate system

Reference Group Report
**Topics discussed – some generic themes, like …**

- Meso-scale eddy dynamics - cross-basin; IO Gyre / eddy interaction dynamics.
- Modelling/ocean forecasting - basin scale (role of IO wide data); own-scaling, nesting
- Nitrogen fixation - SIBER Science Plan and Implementation Strategy gives many ecologically and biogeochemically based recommendations relevant to IIOE-2
- Capacity Building / education: Raised as a major motivation for an IIOE-2
- Finalising IndOOS/ARAMA - NW IO – piracy as the key constraint – intergovernmental support (Naval), robotics
- Characterising vertical diffusion coefficients - for modelling (ez) upper mixed layer deepening
- Upwelling - role in coastal ecology, coupled climate impacts, East Indian Ocean Upwelling Research
- Initiative of IOP/SIBER – coastal upwelling within and associated with boundary current dynamics.

**Science questions emerged from the discussions …………**

**How do planetary waves impact the productivity, biogeochemistry and ecology of the Indian Ocean?**

The Indian Ocean is full of planetary waves that are excited by the seasonal changes in the monsoon winds. These waves influence boundary currents, upwelling/downwelling, primary production and ecological responses throughout the basin.

**How will the biogeochemistry and ecology of the Indian Ocean change in response to warming?**

The Indian Ocean is warming rapidly. This warming will have direct impacts on physical, biogeochemical and ecological processes and also indirect impacts through modification of the monsoonal forcing.

**What are the biogeochemical and ecological impacts of intra-seasonal, inter-annual and longer timescale physical forcings and how might these change in the future?**

The Indian Ocean is subject to unique sources of intra-seasonal, inter-annual and longer time scale physical variability (e.g., associated with MJO, Wyrtki Jets and the IOI).

**How does the ITF influence the productivity, biogeochemistry and ecology of the Indian Ocean?**

The Indonesian Throughflow and associated exchange along the eastern side of the basin is unique in the world ocean.

**What is the role of the Indian Ocean in the global nitrogen cycle and how might this role change in response to global warming and what might be the higher trophic level impacts?**

The Indian Ocean plays an important role in the global nitrogen cycle due, among other things, to denitrification associated with the Arabian Sea OMZ and anoxic shelf environments. Yet these denitrification rates are not fully constrained and there are very few measurements of nitrogen fixation.

**What are the large-scale biogeochemical and ecological impacts of mesoscale eddies in the Indian Ocean?**

There is intense mesoscale variability in many areas of the Indian Ocean, in particular associated with the boundary current systems where filaments and eddies are formed and shed. In some areas these eddies are very long-lived, especially in the southern hemisphere and they can propagate over very long distances.
EIOURI - East Indian Ocean Upwelling Research Initiative

Indian Ocean Upwelling Research Initiative

or have an IO wide effort?
An International Symposium on the 50th Anniversary of IIOE
India/SCOR/IOC
Goa - Nov/Dec 2015

Thank You
IOC-2 Ref Gp Mtg 2 - Gingko

Decided

1) Upwelling issue and IOC-2 portfolio in general for West IO to be explored at one more focussed IOC-2 Ref Gp workshop

2) West Africa and SW IO Island States

Host - Mauritius 7 (offered)
When - Jan/Feb 2014?
(In time for 4th IOC Ex Council June 2014)
Sponsorship support needed
IOC + SCOR liaison
SCOR Science community warmly invited to engage

Courtesy Nick D'Aadmo