The Indian Ocean Bubble 2

INTERNATIONAL INDIAN OCEAN EXPEDITION

Issue No. 15
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IN THIS ISSUE

Conferences/Meetings/Plans/Programmes

IIOSC-2020 Conference rescheduled to 14-18 March, 2022

Local Organising Committee
International Indian Ocean Science Conference (IIOSC-2022)
iiosc2020@incois.gov.in or iiosc2020@nio.org

We are making arrangements to organize the IIOSC-2022 in hybrid mode (In-person in Goa and Virtual Mode). Participants are encouraged to attend the conference In-person. However, if the travel situation does not improve due to COVID, or for those participants who would like to attend the event virtually there will be an online option.

The Registration Fee Structure has been revised to cater to both In-person and Virtual participants. The Registration Fees details are available at https://iiosc2020.incois.gov.in/IIOSC2020/RegistrationFees.jsp

If participants who registered for In-person attendance happen to attend virtually, the difference in registration amount will be refunded after the conference.

Participants who have already registered themselves for the IIOSC-2020 and made the necessary payments, you may please confirm your plan for participation in IIOSC-2022 and share the Registration Fee Receipt. To reserve the hotel for your accommodation please visit https://iiosc2020.incois.gov.in/IIOSC2020/Accommodation.jsp

All latest updates will be made available on https://iiosc2020.incois.gov.in/

For further assistance, please feel free to contact us at iiosc2020@incois.gov.in or iiosc2020@nio.org

We hope to meet you in Goa in March 2022.

IMPORTANT DATES

Abstract Acceptance : 22 December, 2021 NEW

Registration opens on : 15 December, 2021

Early Bird Registration : 15 January, 2022

Last Date for Registration : 15 February, 2022

Conference Website: https://iiosc2020.incois.gov.in/

OCEANS 2022 Conference & Exposition during February 21-24, 2020, IIT Madras Research Park, Chennai, India.

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Institution of Electrical and Electronic Engineers Oceanic Engineering Society (IEEE OES) and Marine Technology Society (MTS) are organizing the world's largest Ocean conference, Oceans 2022 Chennai for the first time in India. The event is jointly organized by the pioneers of India in the field of Ocean Technology, the Indian Institute of Technology (IIT) Madras, and the National Institute of Ocean Technology (NIOT), Chennai, and is scheduled during February 21-24, 2022, both in-person and virtual. The main theme of the conference, INSPIRE-INNOVATE-SUSTAIN, is expected to attract about 1000 delegates with 500 papers being planned for presentation with a good number of plenary sessions with talks from leading personalities around the globe contributing to the field of Ocean Engineering and technology.

With Technical paper presentations, Tutorials, social and networking opportunities, professional field trips, etc. IEEE OCEANS 2022 will provide the delegates an insight on evolving technology and knowledge in the areas of::

- UN Decade of Ocean Science for Sustainable development
- Underwater Acoustics and Acoustical Oceanography
- Sonar signal/image processing and communication
- Ocean Observing Platforms; systems and instrumentation
- Remote Sensing
- Ocean Data Visualization, Modelling, and Information Management
- Marine Environment, Oceanography and Meteorology
- Optics, Imaging, Vision and EM Systems
- Marine Law, Policy, Management, and Education
- Offshore Structures and Technology
- Ocean Vehicles and Floating Structures
- Petroleum Engineering

Some of the top plenary speakers are Dr. Margaret Leinen, Director, Scripps Institute of Oceanography, Dr. Satheesh Reddy, Secretary Department of Defence R&D and Chairman DRDO, Dr. Peter Haugan, Former Chair Intergovernmental Oceanographic Commission, UNESCO; Programme Director at Institute of Marine Research, Professor at the Geophysical Institute, University of Bergen, Norway; Dr. Shailesh Nayak, Former Secretary, Ministry of Earth Sciences to name a few. A panel discussion on the current topics of interest like Global warming with leading speakers also is planned. A student poster session featuring outstanding projects from around the globe is another event. Student Hackathon competition and other student activities will also be at the conference. A plethora of exhibitors showcasing their latest innovations will be another event.

All are welcome to register and attend the conference. Now that Covid restrictions are eased out, please attend in person. All safety precautions will be in place. For complete details visit https://chennai22.oceansconference.org/.

Ocean Voice - Opinions/ Discussion

Observed Ocean Acidification in the Mozambique Channel

Claire Lo Monaco, Nicolas Metzl and Aline Tribollet

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The authors look at the the long-term changes of Co_2 fugacity (fCO_2) and pH in the surface waters of the Mozambique Channel and their implications for ocean acidification and its impact on the coral reefs.

In 1963, during the Lusiad expedition, Charles D. Keeling made the first observations of sea surface pCO_2 in the Indian Ocean including in the Mozambique Channel (Keeling and Waterman, 1968). Such pCO_2 observations were first revisited 40 years after, in January 2004, and more recently in April 2019 in the frame of the OISO and CLIM-EPARSES projects (Figure-1), both cruises being onboard the RV Marion-Dufresne. These observations have enabled the understanding of the long-term change of CO_2 fugacity (fCO_2) and pH in the surface waters of the Mozambique Channel (Lo Monaco et al, 2021). From 1963 to 2019, human activities have emitted a total of 440 PgC from fossil fuels and land-use change (Friedlingstein et al. 2020) leading to an increase in atmospheric CO_2 concentrations from 315 ppm in 1963 to 411 ppm in 2019. A part of these emissions, about 25%, are captured by the ocean, increasing its CO_2 content and decreasing the pH, the so-called "ocean acidification" that would expose at risk the marine ecosystems including coral reefs such as those found in the Mozambique Channel and in the western Indian Ocean,(Eparses islands- Europa, Juan de Nova, and Glorieuses, Mayotte).

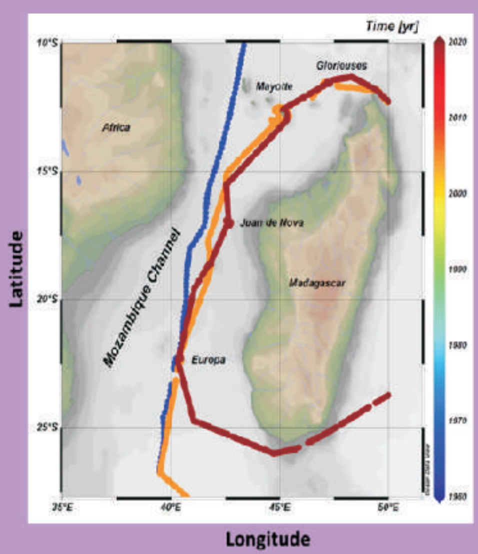

Figure-1: Map of cruises conducted in the Mozambique Channel in May 1963 (LUSIAD, in blue), January 2004 (OISO-11, in orange) and April 2019 (CLIM-EPARSES, in brown). Figure-1 produced with ODV (http:odv.awi.de).

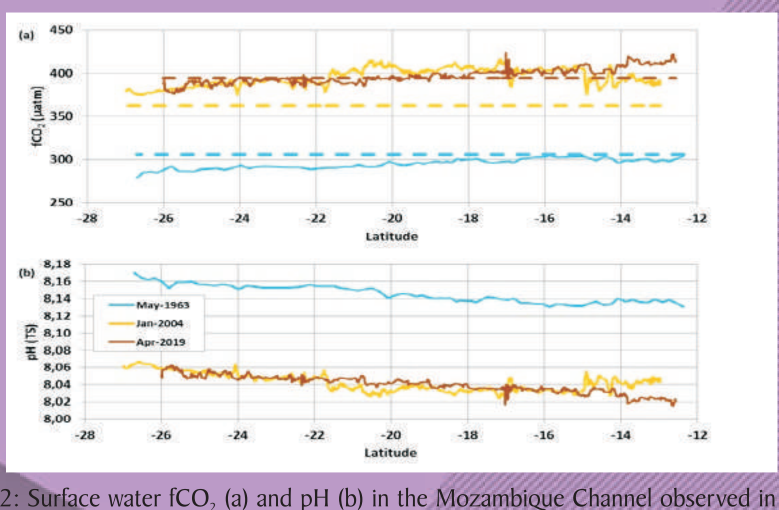

Figure-2: Surface water fCO_2 (a) and pH (b) in the Mozambique Channel observed in May 1963 (blue), January 2004 (orange) and April 2019 (brown). In (a) atmospheric fCO_2 also shown for each year (same color, dashed line). In (b) a pH value of 8.18 is an estimate for pre-industrial (year 1800). Results based on Lo Monaco et al (2021).

The increase in oceanic fCO_2 in the Mozambique Channel is well reflected from the data in 1963, 2004 and 2019 (Figure-1): sea surface fCO_2 was much higher in 2004/2019 by about +100 μatm, an increase close to that observed in the atmosphere (+90 ppm). A small part of the fCO_2 increase between 1963 and 2019 is directly linked to the long-term ocean warming in this region (+0.11 °C.decade^{-1}). We estimated a mean decrease of -0.09 pH unit between 1963 and 2019 (Figure-1), typical of the preindustrial versus modern change in the global ocean. The use of other observations collected from the southern part of the Mozambique Channel allowed us in estimating a pH trend of -0.013 per decade for 1963-1995 and -0.023 per decade for 1995-2019.

The estimated strengthening of acidification in the Mozambique Channel is thus in agreement with the anthropogenic Co_2 forcing. Moreover, based on historical atmospheric CO_2 data we estimated that the pH in the Mozambique Channel was about 8.18 in the year 1800, i.e. 0.13 higher than in 2019. Together with reconstruction of pH from coral cores that were collected in the Eparses Islands in 2019 (ongoing work as part of CLIM-EPARSES project; Figure-3), these results will contribute to a better understanding of the impacts of ocean acidification on coral reefs, especially on coral calcification and bioerosion, the two main key processes involved in reef carbonate budget (Schönberg et al. 2017). This is one of the main goals of the program CLIM-EPARSES coordinated by Aline Tribollet (IRD Researcher at LOCEAN-IPSL). Such data should provide useful information to regional environmental authorities and reef managers involved in protecting coral reef ecosystems.

Figure-3: Coring of the large colony of Porites in Europa during the CLIM-EPARSES cruise in April 2019 (© A. Tribollet/LOCEAN-IPSL)

References:
Friedlingstein, P., et al. Global Carbon Budget 2020, Earth Syst. Sci. Data, 12, 3269–3340, https://doi.org/10.5194/essd-12-3269-2020, 2020.
Keeling, C. D., and Waterman, L. S., 1968. Carbon dioxide in surface ocean waters: 3. Measurements on Lusiad Expedition 1962–1963, J. Geophys. Res., 73(14), 4529–4541, doi:10.1029/JB073i014p04529.

Random Speculations on the role of Arabian Dust on Cyclone Tracks over the Arabian Sea

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[Prof. Murtugudde specialises in Earth System Modelling and Predictions and specifically focuses on Climate Impacts and the Ocean's role in Climate Variability.]

It is well known that the Arabian low, the dust loading in the northwestern corner of the Arabian Sea favours a stronger monsoon. The southwesterly winds are straightened by these chain of events (see Jin et al. 2021; https://doi.org/10.1016/j.earscirev.2021.103562).

The Indian Ocean is warming rapidly and monotonically and the warming is maximum in the western Arabian Sea. Does this begin to explain the changes in the cyclone numbers, rapid intensification and their tracks? No process studies have been done to demonstrate these, let alone attribute these, changes to anthropogenic forcing. But it is fun to speculate on how the trends over the Middle East in temperature, precipitation and dust may be affecting the cyclone tracks. If the southwesterly jet and the monsoon can be affected by the Arabian low, then it probably stands to reason that the pre-monsoon Arabian low can modify the steering winds and the cyclone tracks.

Figure-1(below) shows that the warming over the Middle East is highest across the tropical – subtropical latitudes. Since the month of May is important for the pre-monsoon cyclones, we can look at surface temperature anomalies for May 2020 and 2021 which show consistently warm anomalies in May as well (Figure-2). Climatological aerosols from MISR and MODIS are shown in the left panel of Figure-3. Precipitation from GPM and GPCP winds with 850 hPa and 200 hPa winds respectively, are shown in the right panel. The key question of course is – how do the cyclones modify the environment and the steering winds during the pre-monsoon cyclone season?

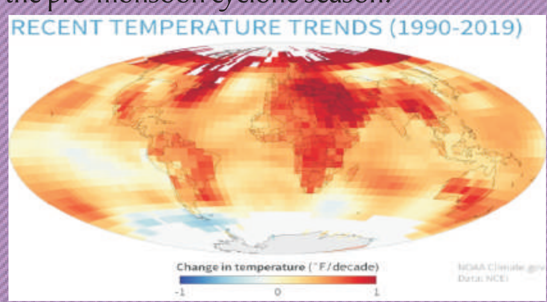

Figure-1: Surface temperature trends over 1990-2019 showing the highest rate of warming over the Middle East.

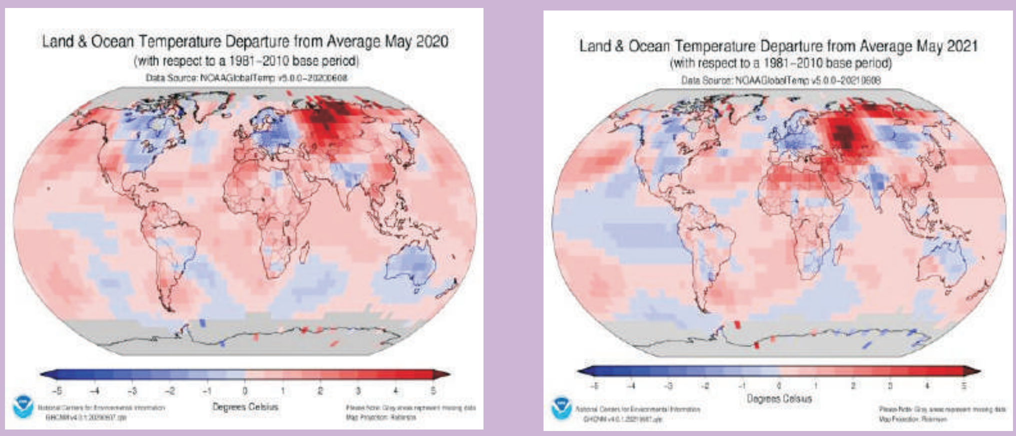

Figure -2: Surface temperature anomalies for May 2020 and May 2021 are consistent with the long term trends shown in Figure 1. The relative cooling over the Indian region also must be noted even though both years were heavenly affected by the COVID lockdowns and the related reductions in emissions and pollution.

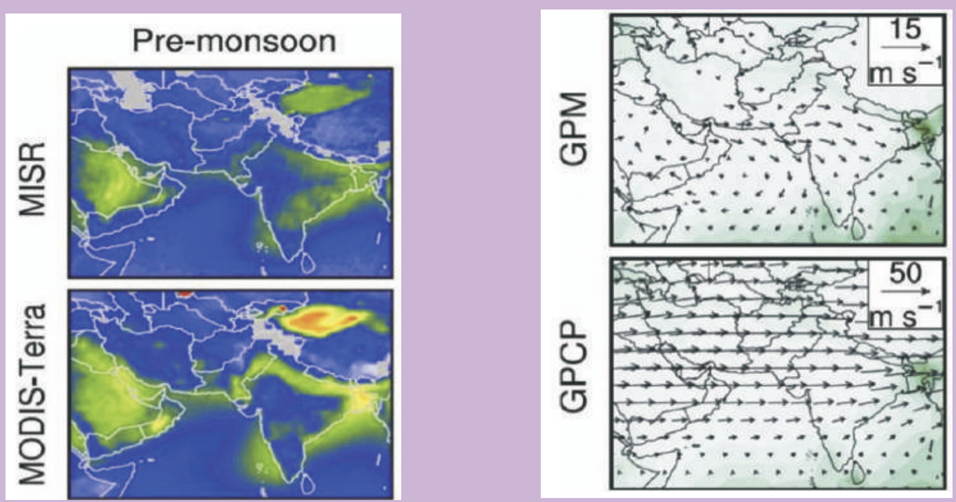

Figure-3: Premonsoon Aerosol Optical Depths from MISR and MODIS-Terra and the precipitation and 850 hPa winds from GPM and GPCP show the premonsoon dust loading and atmospheric circulation (from Jin et al. 2021).

Figure-4 below shows the precipitation anomalies during May 2020 and 2021, while Figure-5 depicts the aerosol optical depths for May 2020 and April 2021. Large patches of below normal rainfall can be seen over the Middle East in Figure 4. The trends in 550 nm in MODIS AOD are shown in Figure 6. The Arabian Heat low region is clearly seen with an increasing trend (https://acp.copernicus.org/articles/16/5063/2016/acp-16-5063-2016.pdf).

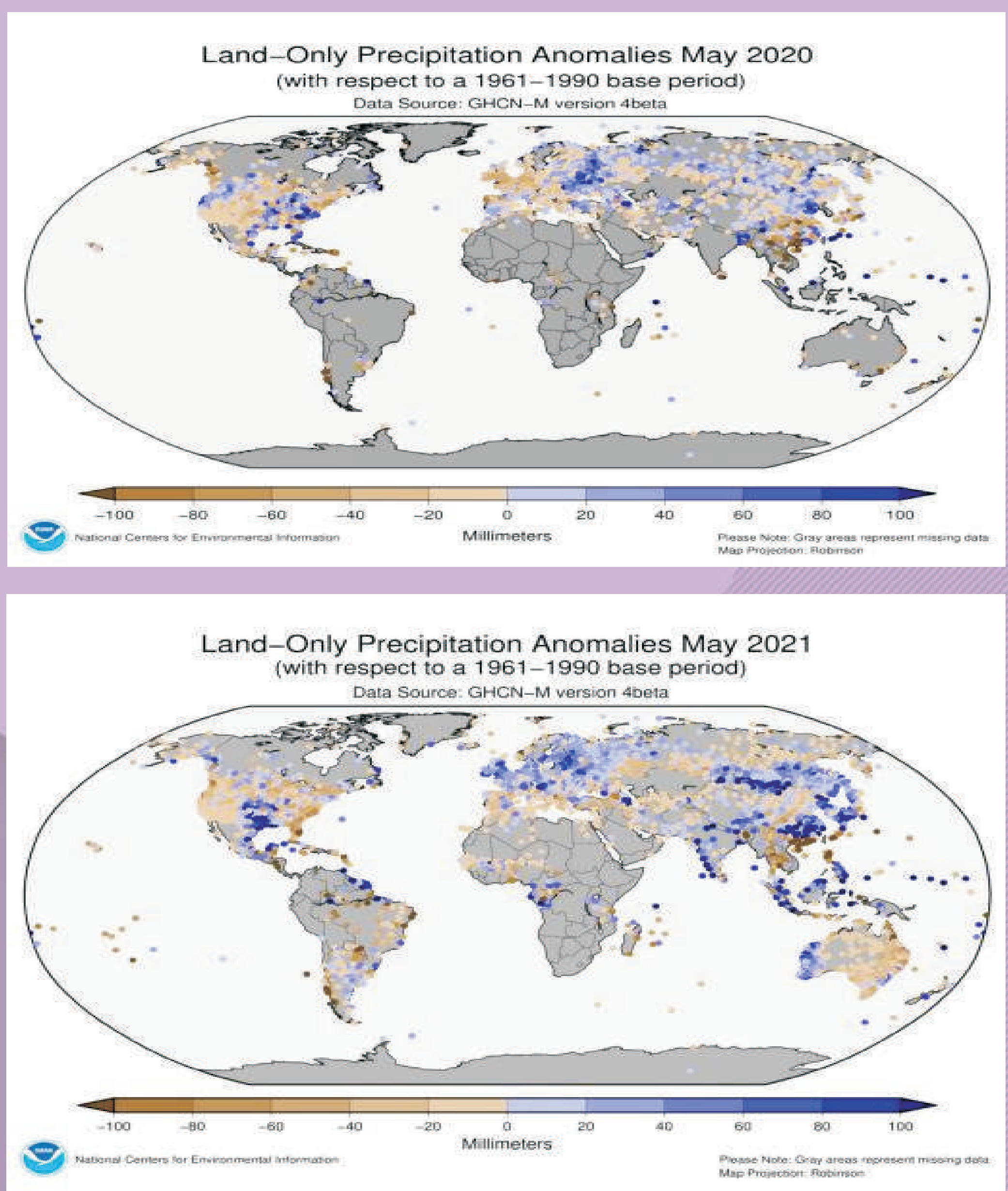

Figure-4: Precipitation anomalies during May 2020 and May 2021. Large patches of below normal rainfall can be seen over the Middle East.

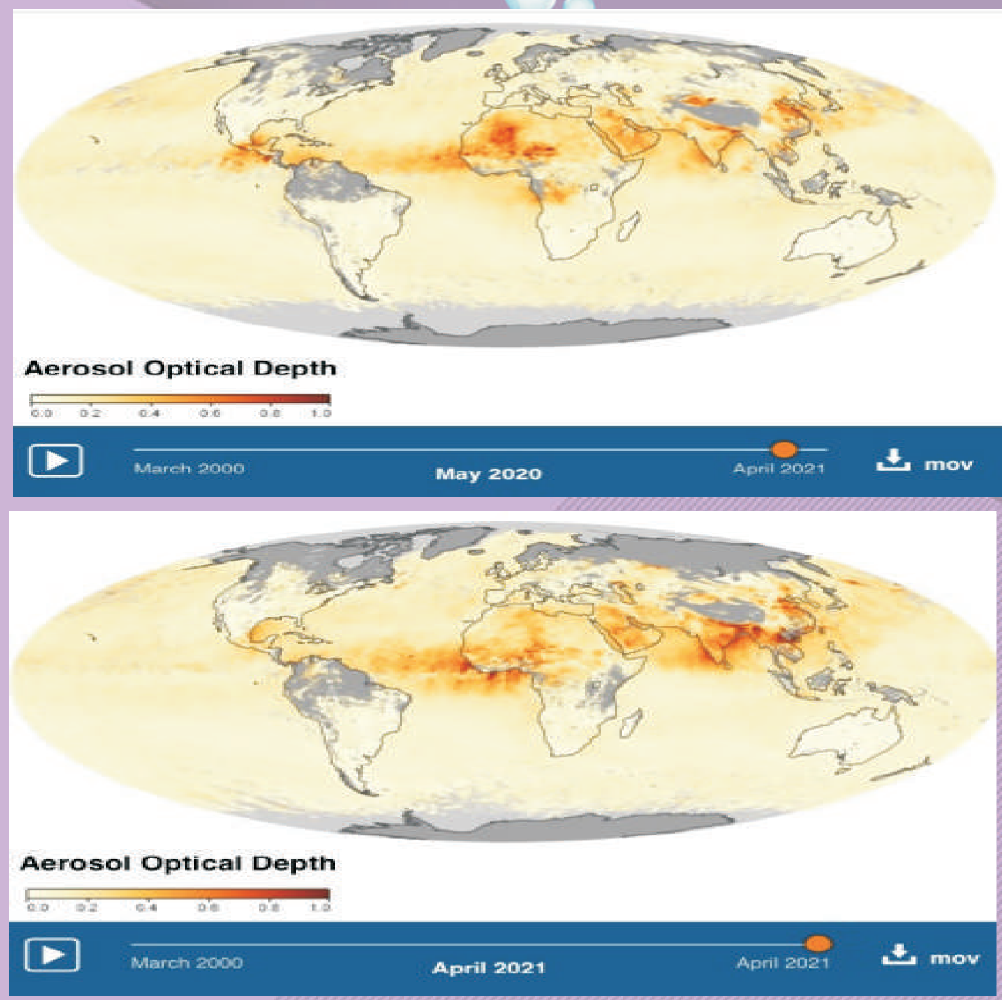

Figure-5: Map of Aerosol Optical Depths for May 2020 and April 2021 (from https://earthobservatory.nasa.gov/global-maps/MODAL2_M_AER_OD). May 2021 AODs were not available at the time of this writing.

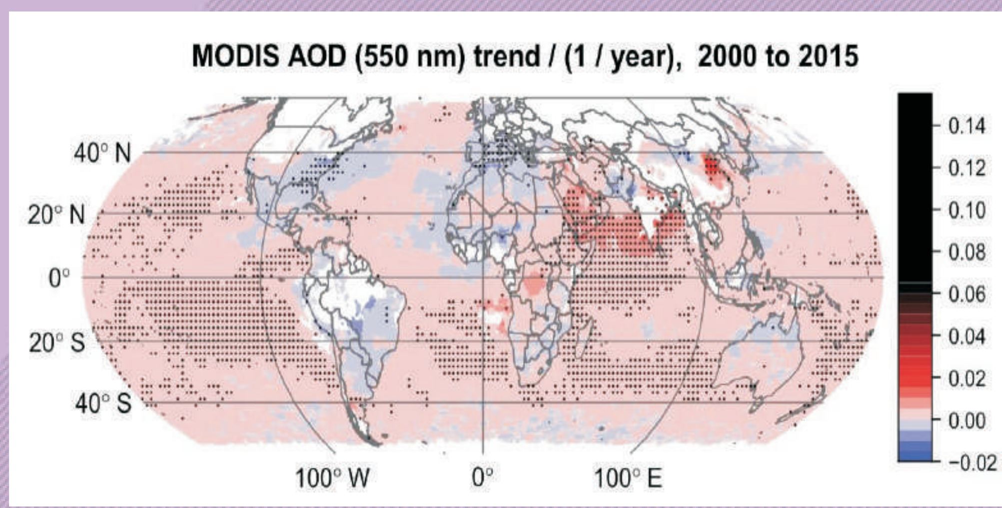

Figure-6. Target/Deep Blue 550 nm AOD from MODIS Terra, collection 6. Regions with significant trends (p value < 0.01) are dotted. The Middle East is clearly a hotspot.

I am going to go out on a limb and posit that the warming and dust loading trends over the Arabian low region are beginning to affect the cyclone tracks during the pre-monsoon months.

I hope the Young Turks in India will explore the dynamic impacts of the Middle East warming and the AOD trends on the cyclogenesis, rapid intensification, and most importantly, the tracks. The sea level rise, extreme rainfall events and any increase in pre-monsoon cyclones coming up the coast can be a deadly combination for a crowded metropolis like Mumbai.

All the focus has been on the Indian Ocean warming and the relative warming of the Arabian Sea vs. the Bay of Bengal. But the unique atmospheric circulation over the two seas must play a role as well in terms of the cyclone responses. This is also likely manifest in the pre- vs. post-monsoon cyclone trends over the Arabian Sea https://www.nature.com/articles/s41558-017-0008-6?WT.feed_name=subjects_attribution both in the number of cyclones and their tracks.

How Quickly does the Southern Ocean Warming affect the Tropical Indian Ocean?

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(The authors discuss the potential link between the Southern Ocean warming and the South Indian Ocean heat balance balance on both multi-decadal and decadal timescales)

The Indian Ocean plays an important role in modulating global climate through enhanced heat uptake. However, the vertical distribution of the ocean heat content (OHC) in the Southern Indian Ocean (SIO) is highly inhomogeneous. There is a widespread surface warming, a significant subtropical deep-reaching warming which penetrates down to 2000m at around 40°S-50°S, a secondary prominent subsurface warming which extends down to over 400 m at 30°S-20°S, and a prominent subsurface cooling which occurs mostly to the north of 40°S (Figure-1). The subsurface cooling in the tropical Indian Ocean thermocline has been attributed to local anomalous Ekman suction (e.g., Han et al., 2006) or the weakening of the Pacific trade winds (e.g., Alory et al., 2007). The cooling is not limited only to the tropical Indian Ocean thermocline, but is rather extensively distributed in the subsurface layers between 26.5 and 27.2 σ_θ (potential density minus 1000 kg m^{-3}), to the north of about 40°S. It should also be noted that the subsurface water above 26.5 σ_θ has warmed to the south of ~20°S but has cooled to the north of that latitude.

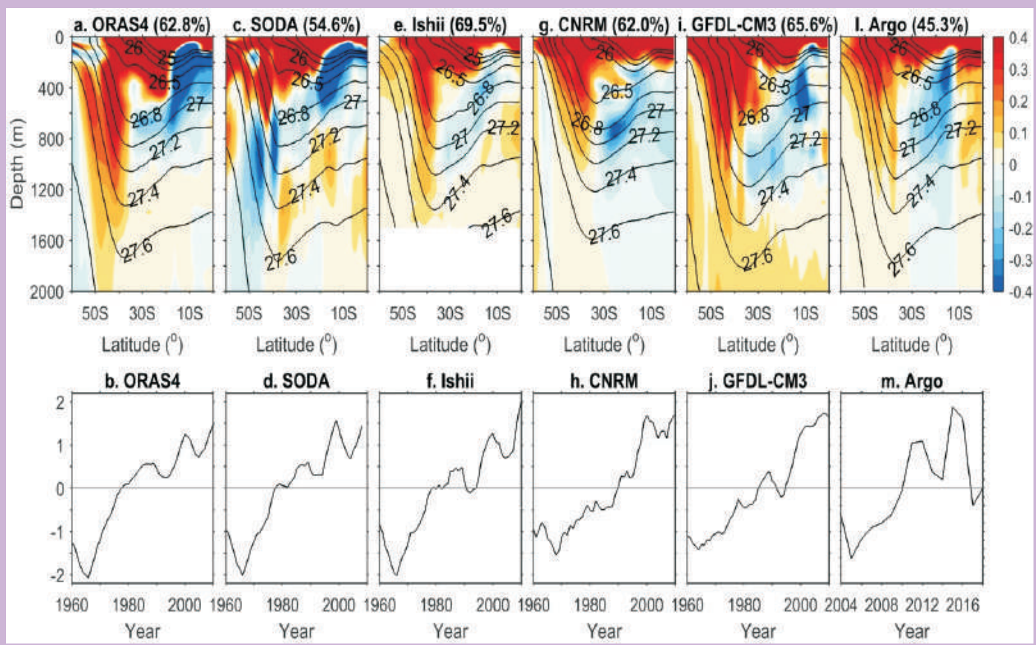

Figure-1: First mode of the EOF analyses of vertical distribution of zonal mean heat content per unit volume over the South Indian and Southern Oceans (60°S–0°, 21°E–115°E) using (a–b) ORAS4, (c–d) SODA, (e–f) Ishii, (g–h) CNRM, (i–j) GFDL-CM3, and (l–m) Argo data. In the upper panels, the values are multiplied by 1×10^{-6} J m^{-3}; black contours are climatological potential densities minus 1000 kg m^{-3}; the percentages in brackets are variance contributions. Note that the time series of Argo result start from the year 2004.

A notable northward propagations of zonal-mean potential temperature anomalies is also seen between 26.0 and 26.9σ_θ isopycnals, with a traveling time of about 10 years (Figure-2). It thus appears that the subsurface heat budget in the SIO is closely related to the Southern Ocean (SO) at a relatively fast decadal timescale. The critical issue is to understand how the signals are generated and transmitted.

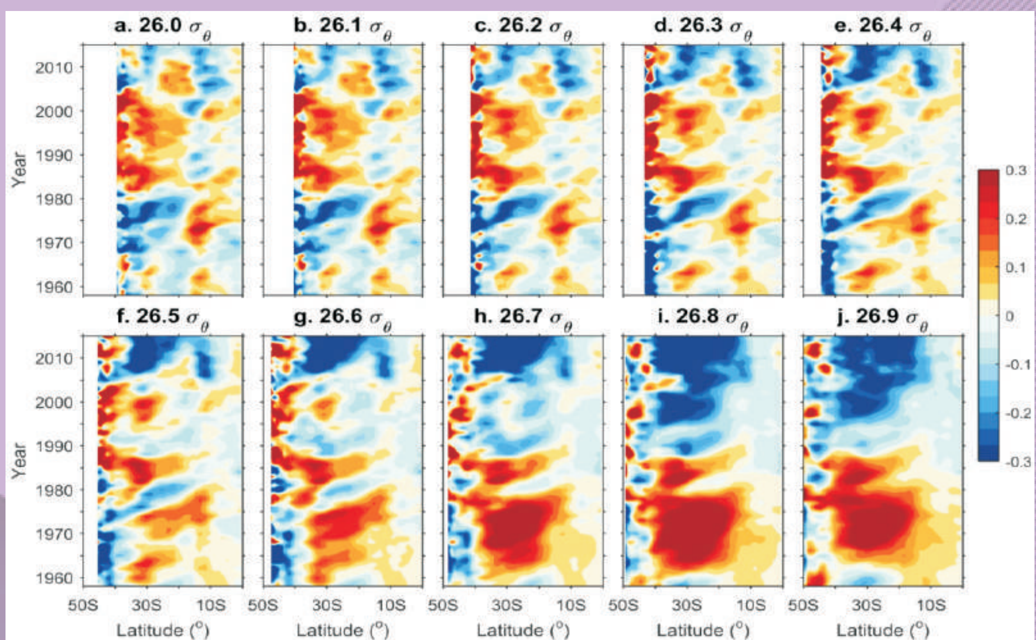

Figure-2: Zonal-mean potential temperature anomaly over the period 1958-2015 along isopycnal surfaces between 26.0 and 26.9σ_θ (potential density minus 1000 kg m^{-3}) based on ORAS4. Unit: °C

The net surface heat fluxes in the ventilation area of isopycnals between 26.0 and 26.9 σ_θ in the SO (area between the red the green lines in Figure-3a) show a close relationship with the principal component of the leading mode of the EOF of zonal-mean OHC (Figure-3b), implying a key role of the surface heat budget in the SO in modulating the heat balance in the SIO. From the year 1960 onwards, the net surface heat flux shows an apparent linear increasing trend, leading to an associated warmer sea surface and a deeper troposphere (blue line in Figure-3c). The increase in the extratropical tropopause height acts to suppress baroclinic instability and inhibits the breakdown of the Hadley Cell (HC) (Lu et al., 2007). Thus, as the tropopause height in the SO increases, the subsiding branch of the HC (red line in Figure-3c) extends poleward from around 30°S to 33.5°S. Consequently, the westerlies and then the wind stress curl, which is a major driver of ocean gyres (Munk, 1950), also shift poleward (Figure-3d) and result in a poleward displacement of the entire subtropical gyre. Based on the fact that the isothermals are essentially parallel to the isopycnals and that waters at the same depth get colder farther away from the isopycnal trough, the ocean on the equatorial side of the trough gets cooler while that on the polar side gets warmer as the subtropical gyre shifts poleward.

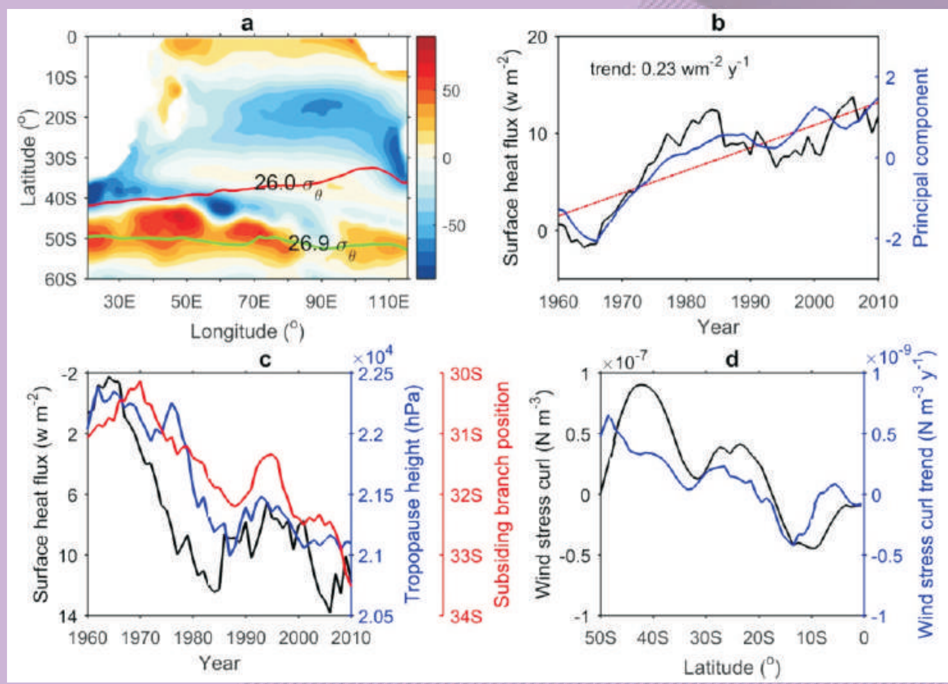

Figure-3(a) Time-mean net downward surface heat flux for the period 1960-2010 based on the ensemble mean of NCEP/NCAR, JRA-55, and ERA-20C (background colors, unit: w m^{-2}) and ventilation latitudes of 26.0 (red line) and 26.9 σ_θ (green line) isopycnals based on ORAS4. (b) Five-year running mean time series of area-mean net surface heat flux into the SO between the ventilation latitudes of 26.0 and 26.9 σ_θ (black solid line) isopycnals and the linear fitting curve (red dashed line). For comparison, the principal component of the leading mode of the EOF analysis of OHC in Figure-2b is superimposed (blue line). (c) Five-year running mean time series of area-mean net surface heat flux into the SO (black line), tropopause heigh over the SO (blue line), and latitudinal position of the subsiding branch of the HC (red line). (d) Time-mean (1960-2010, black line) and

Five-year running mean time series of area-mean net surface heat flux into the SO between the ventilation latitudes of 26.0 and 26.9 σ_θ (black solid line) isopycnals and the linear fitting curve (red dashed line). For comparison, the principal component of the leading mode of the EOF analysis of OHC in Figure-2b is superimposed (blue line). (c) Five-year running mean time series of area-mean net surface heat flux into the SO (black line), tropopause heigh over the SO (blue line), and latitudinal position of the subsiding branch of the HC (red line). (d) Time-mean (1960-2010, black line) and trend (blue line) of zonal-mean wind stress curl over the SIO and SO.

Most propagating signals shown in Figure-2 are the ones caused by the poleward displacement of the subtropical gyre. It takes about 10 years for the signals to propagate from 40°S to around 8°S, with the transmission speed of about 1.13 cm s^{-1}. It is consistent with that of the northward Meridional Overturning Circulation (MOC) in the eastern ocean basin (90°E-115°E) to the north of 40°S, which mostly ranges over 0.80-1.13 cm s^{-1}. Thus, it is via the MOC that the SO warming-induced signals manage to travel equatorward, implying a profound influence of the SO on the SIO at decadal timescales.

In conclusion, the SO, which is a more directly connected neighbor of the SIO, is an important contributor to the SIO heat balance on both multi-decadal and decadal timescales. Considering the role the tropical Indian Ocean warming has been reported to be playing in the Pacific Ocean response to anthropogenic forcing and in the Atlantic MOC, this fast pipelines between the SO and the tropical Indian Ocean needs more immediate attention in terms of sustained observations and model experiments.

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4. Munk, W. H. (1950). On the wind-driven ocean circulation. Journal of meteorology, 7(2), 80–93.
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Ocean Vision

Illuminating Biodiversity of the Ningaloo Canyons: Science in the time of COVID-19 (Part-I)

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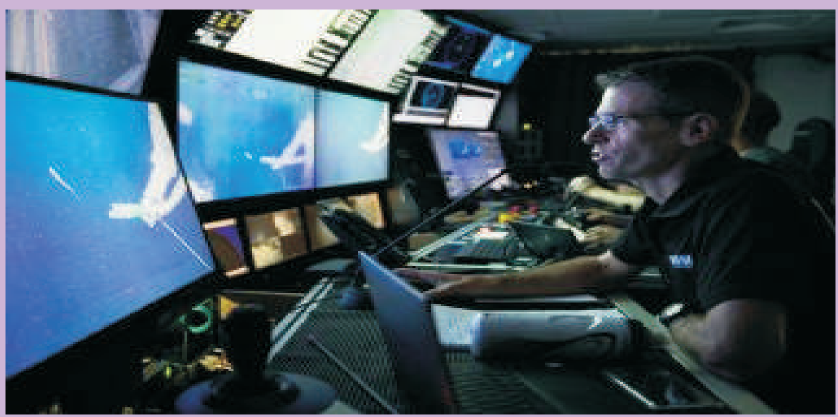
[Dr. Nerida Wilson is a marine molecular biologist who currently manages the Molecular Systematics Unit at the Western Australian Museum. Her research interests focus on understanding and describing the extent of biological diversity present on earth and resolving the evolutionary relationships among those taxa. Dr. Wilson was the Chief Scientist of the R/V Falkor voyage which studied the biodiversity of Ningaloo Canyons, as part of the IIOE-2 endorsed project #33 (https://IIOE-2.incois.gov.in/IIOE-2/EP33.jsp, "Exploring the marine biodiversity of the submarine Cape Range Canyon, northwestern Australia). This article and the next one are from the Schmidt Ocean Institute blogs of 01 and 15 April 2021 respectively. https://schmidtocean.org/cruise-log-post/science-in-the-time-of-covid-19/ and https://schmidtocean.org/cruise-log-post/it-takes-a-village-and-a-few-history-books/]

Organising a large scientific expedition takes some time – years, in fact. There are challenges for every time horizon, and no aspect is too big or too small. There is a crack team of scientists to assemble – often from many parts of the world, especially since taxonomic expertise in certain groups is hard to find. Freight, customs, administration, travel, logistics: all of these form a part of the immense planning.



Dr. Glenn Moore (Curator, Western Australian Museum) watches feed from the ROV's cameras.
Alex Ingle / SOI

Expeditions can be easily impacted by a single small box of filter paper forgotten, or a tiny package left behind. Once out on the ocean, you are isolated and every problem needs to be addressed with only what you have at hand.

Luckily, on R/V Falkor, this is less of a problem than usual. There is an amazing support team here, with creative ideas and tools to make those a reality. While they cannot conjure up things out of thin air, sometimes it seems close….. The ROV supervisor, Russ Coffield, has a 3D printer onboard that can produce solutions for problems you did not know you had!

The control room can quickly fill up as people rush to catch a glimpse of stunning sea life.
Alex Ingle / SOI

But some issues are bigger than your expedition. And so, we find ourselves in an isolated 'science bubble' out to sea. Although we are connected to the public every day, streaming and narrating our science in real time, we have no physical contact with the outside world. In the week since we left the port of Fremantle, the world has become a different place.

With increasing concerns about spreading the virus, we have modified our plans to have additional staff join us halfway through the expedition. Now, some staff will depart, but no new members will join us. We are a self-isolated group, with no physical contact with the outside world. We will sail on, and see…

A fun moment on deck practicing "Social Distancing" at sea so that when crew disembarks, they will not be unprepared.

It takes a village… and a few history books: Science in the time of COVID-19 (Part-II)

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Now that the departing science team is all home safely, our thoughts turn toward the next stages of our work. You might remember in the earlier blog we spoke of the timelines involved in carrying out such an expedition. First there is the long planning phase, and then the expedition itself, which is an intense, frenetic data collection phase. Finally, there is the verification and synthesis phase, which can take years. Let us take a look back over the work done to date, and what the future has in store…

The planning phase is probably the most minimalist in terms of number of people involved, but still with many behind-the-scenes folks hard at work. But once we hit the expedition time, things can get crazy. Schmidt Ocean Institute and the R/V Falkor team provide an incredible array of staff to help get the job done. From the ship's crew to the ROV team; from logistics to outreach; from the chefs to the stewards; from the engineers to the marine technicians – every person plays a unique role in supporting the science. Keeping the ship running smoothly, and people fed and organised, ensures that we can focus on our job: science.

But we are also not alone here. For each scientist or technician on board, there is usually a shoreside team of collaborators and friends that help us along the way. Sometimes these people are far away in other countries and connect via imagery and specimens, during or after the cruise. Sometimes they are closer shoreside and might be using WhatsApp to ask us questions during a live-streamed dive. This connectivity allows us to better sample, image, and collect for specific science questions. In our case, since many of the science team could no longer join us at the mid cruise port call, this allowed them to still remain intimately involved with the expedition.

Figure 1. Dr Glenn Moore (Curator, Western Australian Museum) enjoys a moment of excitement as a fish appears on the ROV's cameras. The video is also streamed live over social media, and with his finger on the microphone he is about to share his excitement with the audience at home.

And now, the painstaking process of identifying the collected animals begins (verification and synthesis phase). As taxonomists and systematists, we need to compare our newly found animals with all others found before us. That is a big job. We follow the International Code of Zoological Nomenclature (ICZN) to ensure that every animal has a unique and universally accepted scientific name. The ICZN was founded in 1895, and in searching out names and descriptions of species, we must examine scientific literature that goes back to 1735, to the initial publication of Carl Linnaeus's Systema Naturae, where the binomial system of naming began. Our task is to understand whether our specimen matches a description published in the scientific literature during the last 285 years. And it is not all on Google! If we do find a match, we apply that name to our specimen. If it does not, we should name that species as a new one. Sounds simple, right?

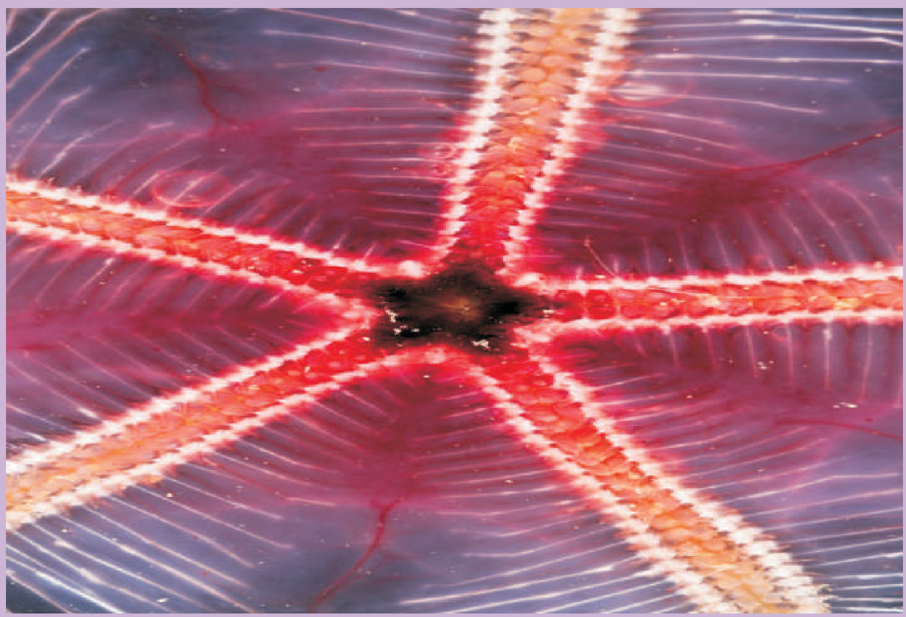

Figure-2: A hymenaster, a type of deep sea starfish (also known as slime stars) is photographed in the wet lab before being preserved. A small selection of the amazing specimens gathered after just the first week of the cruise.

Figure-3: The vast amount of imagery and samples taken during the cruise will help to shed new light on the biodiversity of Cape Range and Cloates Canyons off Ningaloo.

So spare us a thought when you wonder why we have not yet published our new species yet! We head off in our separate ways to sequence DNA, count scales, interpret curves, illustrate chaetae, and consult with other experts. And read, read, read. Sometimes being a taxonomist is like being a cold-case historical detective; it takes time, thoroughness, and a sharp mind to pull the puzzle together. We rely heavily on the museum collections to make these comparisons. And sometimes the result is just to say – this specimen is Psychropotes longicauda. After checking the Atlas of Living Australia, which brings together all Australian state museum records, we can see if these identifications represent new records for the state or country, or provide new distributional records. Whatever eventuates, the accumulated knowledge is beautiful and pulls each individual thread together, into a story of the deep-sea canyons off Ningaloo.

Ocean Remote Sensing towards Climate Resilience

Impact of COVID-19 lockdown on the Indian coastal water quality

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Source: Lotliker AA, Baliarsingh SK, Shesu RV, Samanta A, Naik RC and Balakrishnan Nair TM (2021) Did the Coronavirus Disease 2019 Lockdown Phase Influence Coastal Water Quality Parameters off Major Indian Cities and River Basins? Frontiers in Marine Science, 8:648166. doi: 10.3389/fmars.2021.648166.

The end of the last decade experienced the outbreak of coronavirus disease 2019 (COVID-19) that spread across the globe within a short span of time and was declared as a pandemic by the World Health Organization. In order to contain the spread of COVID-19, the Government of India imposed lockdown in various phases (Figure-1). During strict lockdown period (SLP), barring emergency services, restrictions were imposed on physical gathering, industrial operations, and agriculture activities; the restrictions were subsequently reduced during relaxed lockdown period (RLP). A team of satellite oceanographers from INCOIS, Hyderabad studied the effect of anthropogenic material influx on coastal water ecology during the lockdown period on a synoptic scale using satellite remote sensing. The team analyzed the daily climatology (2003–2019) and anomaly (2020) of water quality parameters such as chlorophyll-a, diffused attenuation coefficient of solar insolation, and particulate organic carbon in the coastal waters off major Indian cities (Mumbai and Chennai) and river basins (Narmada, Mandovi-Zuari, Netravathi, Periyar, Kaveri, Krishna-Godavari, Mahanadi, and Hooghly) (Figure-1)

The study revealed significant reduction in the water quality parameters in the Indian coastal milieu. The reduction was more pronounced in the coastal waters of the western Bay of Bengal as opposed to the eastern Arabian Sea. During SLP, the coastal waters of the western Bay of Bengal showed a significant negative anomaly in the magnitude of water quality parameters, which was not the case for the Eastern Arabian Sea, probably due to the lesser dependence of the latter on the river-borne anthropogenic material. Among the different studied locations, the magnitude of water quality parameters significantly decreased off Chennai and Hooghly during SLP, which subsequently increased during RLP probably due to reduction in anthropogenic material influx during SLP and increase during RLP. During RLP, the coastal waters off Mahanadi showed a maximum decrease in the magnitude of water quality parameters followed by Mandovi-Zuari, irrespective of these regions' quantum of anthropogenic material input, possibly due to the higher response time of the ecosystem to reflect the reduction in anthropogenic perturbations. In general, the significant reduction in anthropogenic fluxes of nutrients during the first phase of lockdown, could have led to a decrease in primary biological productivity and production of organic matter, thus increasing the water clarity and improving the health of the coastal environment. The satellite-retrieved water quality parameters have thus provided valuable insight to efficiently describe the changes in the health of the Indian coastal environment in terms of phytoplankton biomass and water clarity.

Figure-1: Schematic showing the various stages of lockdown in India during COVID-19 pandemic

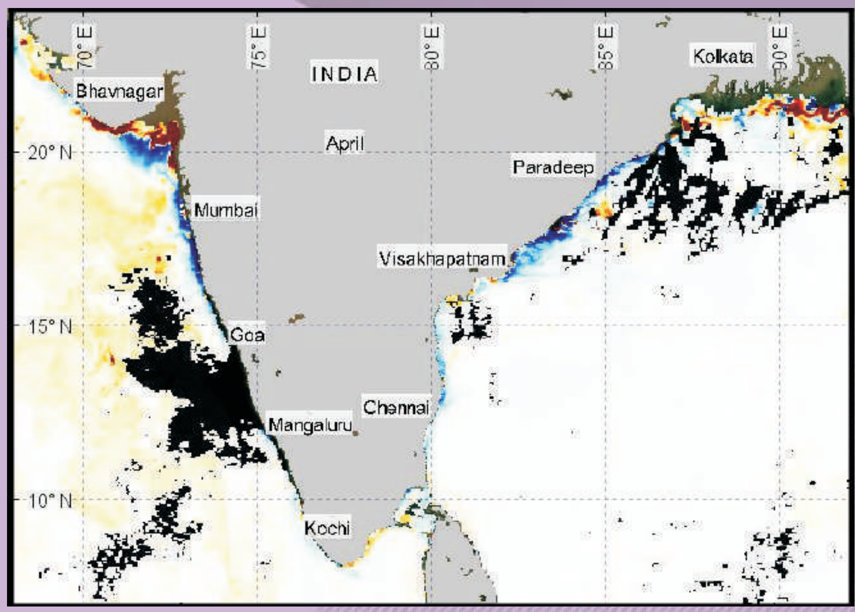

Figure-2: Map showing anomaly of chlorophyll-a during April 2021

Source: Lotliker et al. 2021

Marine Ecosystem Research and (Operational) Services (MERS)

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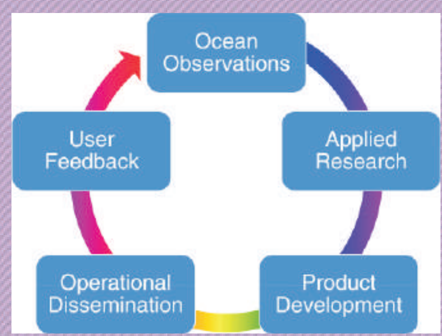
[Dr. Nimit Kumar is a marine ecologist serving as a scientist at INCOIS. He has played lead role in preparation of the MoES strategic document, satellite telemetry of tuna, NOAA-MoES collaboration, and primary productivity modeling, among others. He is executive board member of PORSEC (Pan Ocean Remote Sensing Conference) association and one of the founders of the IIOE-2 ECSN. He is also alumni of NF-POGO, IOC-WESTPAC's MOMSEI and IMBeR-IMECaN, to name a few.]



One of the important initiatives of the ongoing International Indian Ocean Expedition (IIOE-2) has been to establish a platform for Early Career Scientists (ECS), namely "an Early Career Scientists' Network" (IIOE-2 ECSN). At the beginning of the IIOE-2, the ECS outlined the potential scientific topics that need to be addressed in the Indian Ocean region (Singh et al., 2016).

Recently in order to provide a baseline for future studies to be carried out in the Indian Ocean under the framework of ECSN, an inter-journal (Biogeosciences, Atmospheric Chemistry and Physics, Ocean Science, and Solid Earth) special issue titled 'Understanding the Indian Ocean system: past, present and future (BG/ACP/OS/SE inter-journal SI)' has been brought out (Bange et al. 2021). As a part of this, a roadmap of potential operational services has been laid out in the form of a peer-reviewed paper (Nimit K., 2021). The demographics and the status of scientific advancement of marine studies in the Indian Ocean rim countries have been considered as the most crucial factors for various operational services pertaining to the marine ecosystem. These include some of the existing/developing and other conceptual services that can change how millions in this region perceive and interact with the ocean ecosystem. Moreover, it provides a direction on how the already existing multilateral collaborations and frameworks may be utilized in propagating the objectives of the UN Decade of Ocean Science for Sustainable Development (UNDOSSD, 2021-2030).

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The Naming of Tropical Cyclones in the northern Indian Ocean

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[Dr. Joshua D'Mello is a Science and Engineering Research Board (SERB)– National Post-Doctoral Fellow (NPDF) at the National Centre for Polar and Ocean Research (NCPOR), Goa. The writer acknowledges the support of SERB– a statutory body of the Department of Science and Technology, Government of India and NCPOR, Ministry of Earth Sciences, Government of India. In this article, D'Mello describes how the tropical cyclones in the northern Indian Ocean are named.]

We have just witnessed the devastation brought about by the cyclone Tauktae along the west coast of India. However, just as this cyclone dissipated, a new cyclonic system in the Bay of Bengal formed. It was named Yaas, as it reached sustained wind-speeds of around 34 knots (~ 62 km/hour).

One might wonder how these cyclones are named, and by whom.The naming of cyclones forming in the northern Indian Ocean is a fairly recent practice, only since 2004. A few of the big pre-2004 cyclonic-storms have eventually come to be referred to as the 1970 Bhola cyclone, 1999 Orissa cyclone, etc.

World-wide, there are six Regional Specialised Meteorological Centres (RSMCs) and five regional Tropical Cyclone Warning Centres (TCWCs) mandated for issuing advisories and naming of tropical cyclones. The RSMC, New Delhi is the designated authority to name the tropical cyclones developing over the north Indian Ocean.

At the 27th session of the World Meteorological Organisation (WMO)/ ESCAP Panel on Tropical Cyclones (PTC), held in Muscat, Oman, in 2000, it was agreed in principle to assign names to the tropical cyclones in the Bay of Bengal and the Arabian Sea. Since then, eight member-countries, viz. Bangladesh, India, Maldives, Myanmar, Oman, Pakistan, Sri Lanka and Thailand, have contributed eight names each, for a total of sixty-four. The first named-cyclone was Onil (name contributed by Bangladesh) that it made land-fall near Porbandar in October 2004. Cyclone Agni (name contributed by India) was next, hitting Somalia in December 2004. The 64th cyclone Amphan (named so by Thailand) made landfall in West Bengal in May 2020.

A list of names for tropical cyclones which might develop in the northern Indian Ocean in the coming years has already been drawn up by the original eight plus an additional five new member-countries of the region (Iran, Saudi Arabia, Qatar, United Arab Emirates and Yemen) This list together with the report has been accepted by WMO/ ESCAP PTC by consensus in April 2020.

The 13 countries have contributed 13 names each, for a total of 169. The first in this newly-accepted list "Nisarga" (name contributed by Bangladesh) made landfall near Alibaug, Maharashtra in June 2020. Tauktae was the fifth in this list and Yaas (name contributed by Oman), the sixth. The next two cyclones, which might form in the north Indian Ocean, will be named Gulab (Pakistan) and Shaheen (Qatar). The 169th and final name in this list is Samhah (Yemen).

https://mausam.imd.gov.in/backend/assets/press_release_pdf/Press_Release_Names_of_Tropical_Cyclones_28042020.pdf

Remembering Dr. Satya Prakash

"Don't cry because it ended, cherish because it happened", was the line at the crematorium, which sounded as a parting advice by the Late Dr. Satya Prakash (Satya to his friends). It inherently defined the life Satya lived and led, cherishing each and every moment. It would be hard to find a person who ever saw him not smiling. That joyfulness of his personality instantly connected him to anyone he met and that's the very reason he was the binding force for the various groups of friends and colleagues whose nature and interests were very diverse otherwise. What could be better example of this, than the Chai pe Charcha or CPC (i.e. Conversations over a Cup of tea) at the workplace (INCOIS) that he pioneered? Certainly he was an avid fan of the Hon'ble Indian Prime Minister who coined the term. The CPC at INCOIS (abandoned since the onset of COVID-19) were short interactions (about 20 mins) twice a day where almost anything under the sun was discussed and the platform played an instrumental role in pulling the otherwise lazy colleagues (desktop oceanographers!) to interact with others. It resulted in scientific collaborations as well, besides the social bonding. The success of this congregation can be realized from the fact that upto a quarter of INCOIS staff were fairly regular participants, whereas almost half would have been participants to the "brainy debates" at least once a month. At this point, another quote at the crematorium "Death is not the end of the life, but part of it", the pillar of the life-cycle concept of Hinduism (instead of linearity between birth and death as two end-points), reminds us that Satya has already been born in his next life. We wish him to bring equal joy and togetherness into this world.

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INTERNATIONAL INDIAN OCEAN EXPEDITION 2

The Indian Ocean Bubble 2

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Submission of manuscripts from students and early career scientists is also encouraged.

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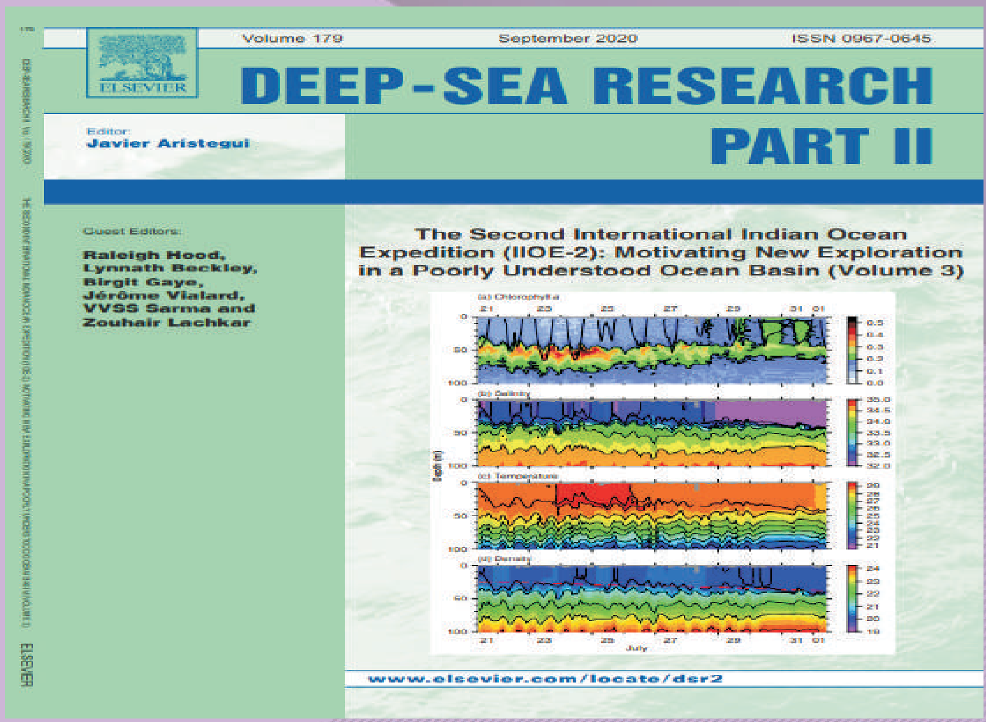

Call for Contributions

Informal articles are invited for the next issue. Contributions referring Indian Ocean studies, cruises, conferences, workshops, tributes to other oceanographers etc. are welcome. Articles may be up to 1500 words in length (MS-Word) accompanied by suitable figures, photos (separate .jpg files).

Deadline: 31st January, 2022

Send Your Contributions as usual to iioe-2@incois.gov.in

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