2nd International Indian Ocean Expedition 2015-2025

Newsletter

(A basin-wide research program co-sponsored by IOC-UNESCO, SCOR and IOGOOS)

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To advance our understanding of interactions between geologic, oceanic and atmospheric processes that give rise to the complex physical dynamics of the Indian Ocean region, and to determine how those dynamics affect climate, extreme events, marine biogeochemical cycles, ecosystems and human populations.

Rapid Intensification of Super Cyclone Amphan fueled by Marine Heatwaves

With the continuous rise in greenhouse gases in the atmosphere, globally oceans are warming unabatedly from the surface to deeper depths. This anthropogenic warming of the oceans poses a threat for marine ecosystems and socio-economic prospects of many communities, and also facilitates the emerging risk of climate extremes. Two of such climate extremes are marine heatwaves and intense tropical cyclones that arise in the ocean-atmosphere coupled system. Our study is the first in the Indian Ocean that investigates a so-called compound extreme event, i.e. the interaction between a marine heatwave and tropical cyclone Amphan in the Bay of Bengal in May-2020. The Bay of Bengal exhibits high sea surface temperatures (~28°C) and strong surface ocean stratification. Consequently, this region of the Northern Indian Ocean is particularly prone to tropical cyclones and is home to ~5 to 7% of the total number of tropical cyclones that occur globally each year. The frequency of cyclone occurrence in the Bay of Bengal is about five times greater than in the Arabian Sea (Jangir et al., 2020, 2021).

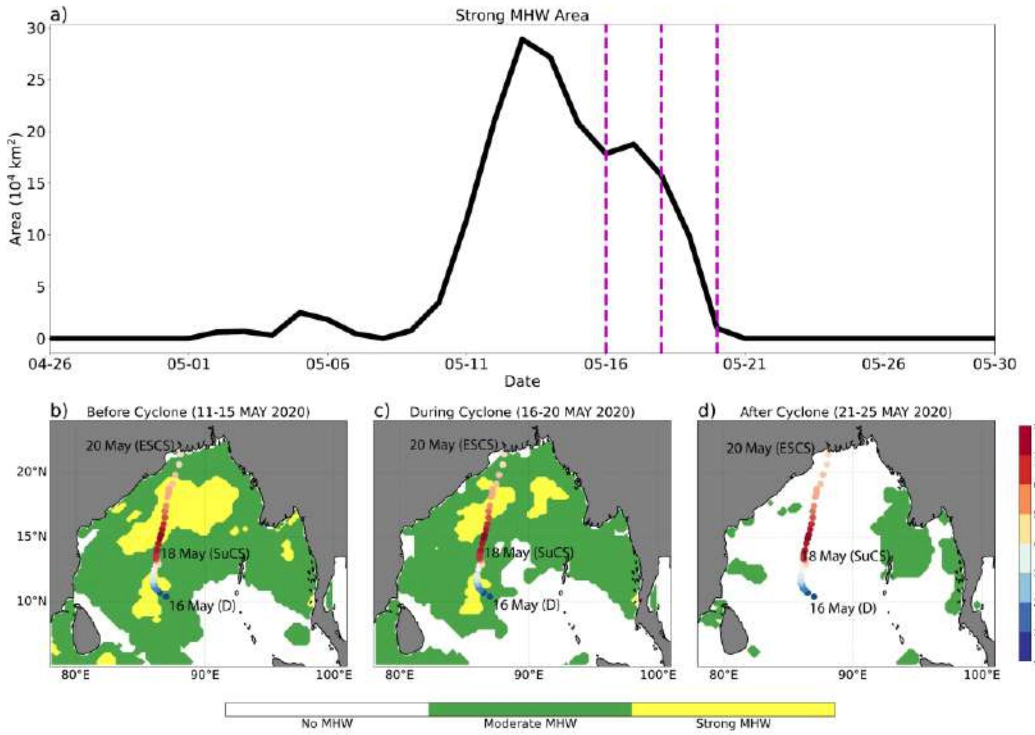

Figure-1: (a) Ocean surface area of the Bay of Bengal covered by strong marine heatwave conditions with vertical magenta lines representing cyclogenesis (left), cyclone intensification (middle) and landfall (right) for tropical cyclone Amphan. (b–d) categories of marine heatwave over the Bay of Bengal before the tropical cyclone Amphan (averaged over 11–15 May 2020), during the cyclone (averaged over 16–20 May 2020) and after the cyclone (averaged over 21–25 May 2020) overlaid by the track of the cyclone which is shaded by the mean daily intensity of the cyclone (m s – 1) with the date of cyclogenesis (CS, 16-May-2020), date of super cyclonic storm (SuCS, 18-May-2020) and landfall as extremely severe cyclonic storm (ESCS 20-May-2020). From Rathore et al. (2022).

Anomalously high sea surface temperature (SST) values sustained for a period of time in regional ocean basins are known as marine heatwaves (MHWs), which are observed across the global ocean. Strong marine heatwave conditions occurred in the Bay of Bengal in spring 2020 prior to the formation of cyclone Amphan. Previous studies have shown an unusual rapid intensification of the tropical cyclone Amphan from category 1 (cyclonic storm) to category 5 (super cyclone) in less than 24 hours. Interestingly, as compared to the total life span of Amphan over the ocean (5 days), this unprecedented rapid intensification in a short period of time was puzzling (Balasubramanian & Chalamalla, 2020; Vishwakarma et al., 2022).

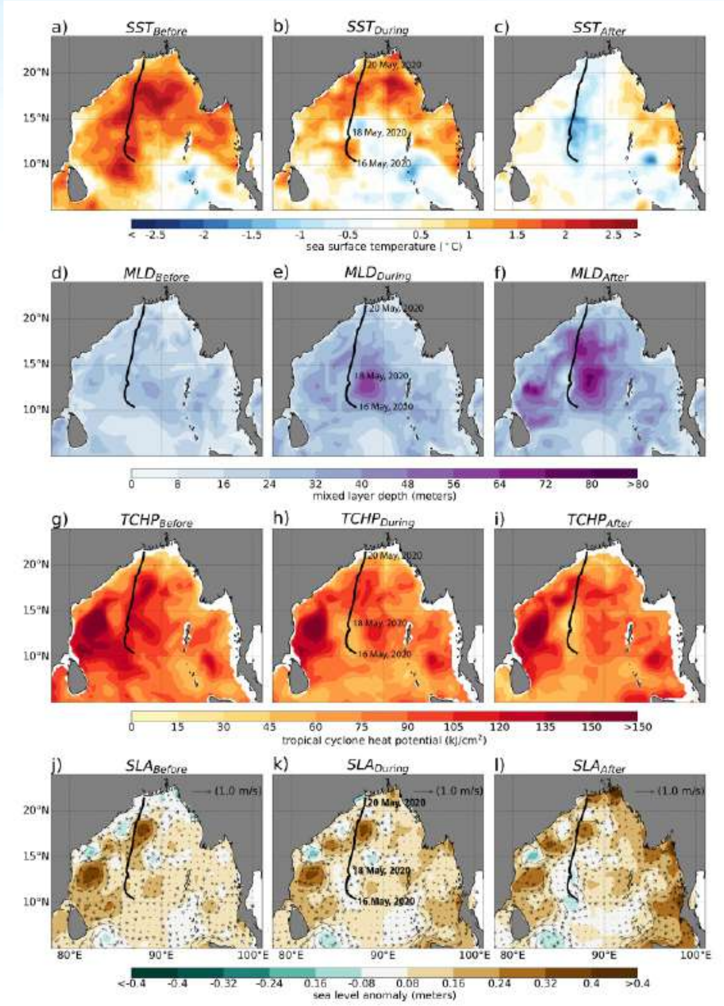

Figure-2: Basin-wide features before, during and after the cyclone Amphan

Our study infers that the rapid intensification of Amphan into a super cyclonic storm is primarily due to the presence of a strong marine heatwave underneath the track of the cyclone (Figure 1). We demonstrate that the generation of the marine heatwave was due to the coupled ocean-atmosphere processes which included shoaling of the mixed layer depth due to reduced wind speed, increased net surface shortwave radiation flux into the ocean, temperature generated upper ocean stratification, and increased subsurface warming (tropical cyclone heat potential). As the cyclone approached landfall, the intense wind-induced mixing deepened the mixed layer, cooled the sea surface temperature leading to the demise of the marine heatwave, along with reduced tropical cyclone heat potential (Figure-2).

Our study brings a new perspective to understanding the risk of compound extreme events emerging from climate change that have severe socio-economic consequences in the affected countries.

Citation: Rathore S, Goyal R, Jangir B, Ummenhofer CC, Feng M and Mishra M (2022) Interactions Between a Marine Heatwave and Tropical Cyclone Amphan in the Bay of Bengal in 2020. Front. Clim. 4:861477. doi: 10.3389/fclim.2022.861477

[Report Courtesy: Saurabh Rathore (E-mail: rohitsrb2020@gmail.com), Laboratoire d'Océanographie et du Climat Expérimentations et Approches Numériques (LOCEAN), Paris, France; Caroline C. Ummenhofer, and Ming Feng]

Evaluation of Pre-monsoon Dust Aerosol Dynamics over South Asia

Dust/Mineral dust is one of earth's atmospheric aerosols. It contributes ~30% to the optical thickness and about 70% to aerosol mass load, and scatters and absorbs solar and terrestrial radiation. It can, directly and indirectly, affect the radiation budget. Dust has a broad range of impacts on local and global climate, human health, ocean biogeochemistry, tropical cyclones, and local and remote air quality. Observational studies have shown a decrease in dust loading over the Indian landmass, possibly due to changing precipitation patterns and atmospheric circulation. To unravel changes in dust over the dust source regions of the North-Western Indian subcontinent, researchers from the Indian Institute of Technology Bhubaneswar used a state-of-the-art regional climate-chemistry model, RegCM4.5, with an updated land module, for the period 2001–2015. The outcome of this modelling study provides new insights into understanding the cause, effects, and impacts of the long-term changes in dust concentration. The study found that the area-averaged dust aerosol optical depth (AOD) over the arid and semi-arid desert regions of North-Western India has declined by 17% since the start of this millennium. The rainfall over these regions exhibits a positive trend of 0.1 mm day^{-1} $year^{-1}$ and a net increase of >50%. The wet deposition is dominant and ~five-fold larger in magnitude over dry deposition and exhibits total changes of ~79 and 48% in the trends in atmospheric dust. Response to dust changes, a significant difference in the surface (11%), top of the atmosphere radiative forcing (7%), and widespread atmospheric cooling are observed in the short-wave domain of the radiation spectrum over the Northern part of the Indian landmass. Past studies have linked Indian summer monsoon precipitation dynamics to pre-monsoon dust aerosols over India. Therefore, similar quantification and long-term change studies will help in understanding regional climate change and the water cycle.

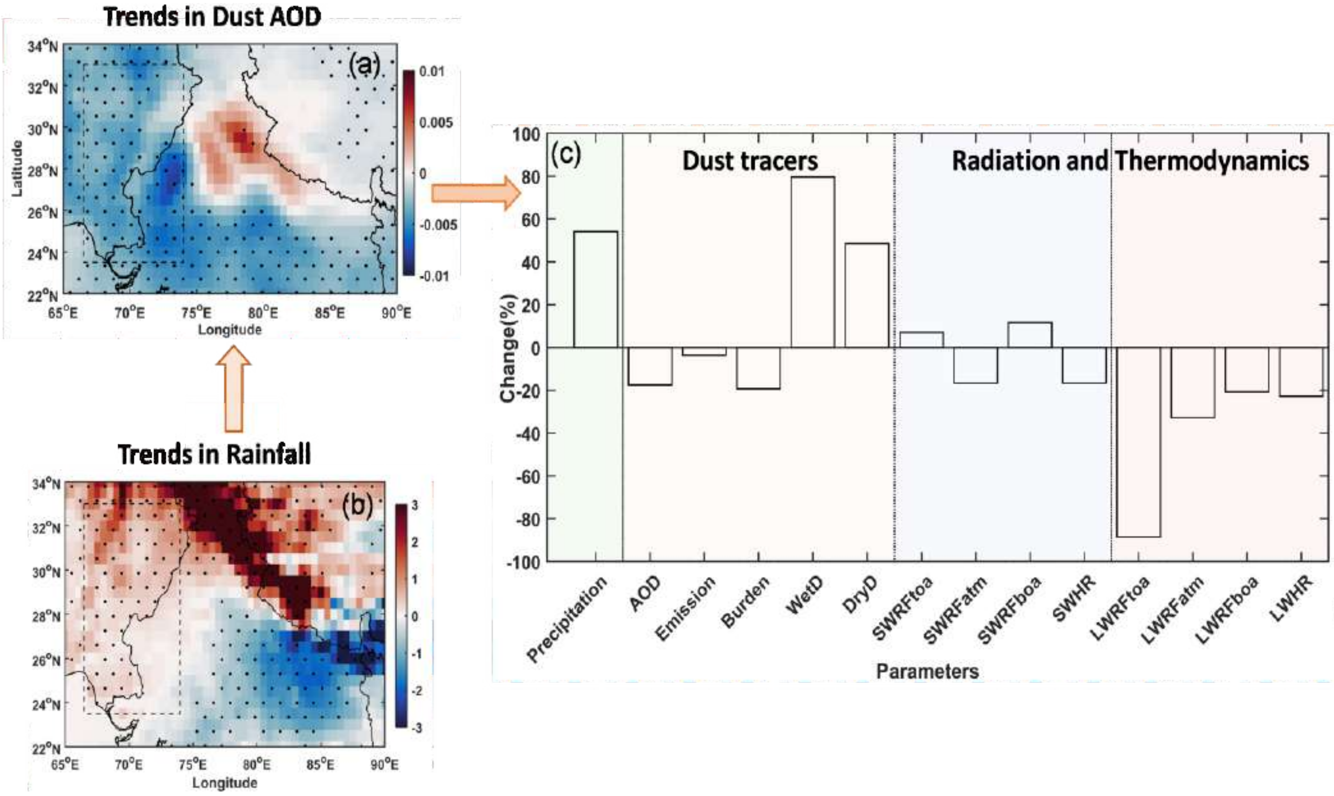

Figure shows (a) the long-term trend (2001-2015) in pre-monsoon aerosol optical depth, (b) rainfall, and (c) overall changes (percentage) in various parameters within the NW box (marked as a rectangular box) with respect to the base year (2001). SW, LW, and HR are acronyms for Shortwave, Longwave, and Heating rate, respectively (Image reprinted with permission from Springer, Coastal Research Library, Singh et al., 2022)

Citation: Asutosh, A., Pandey, S. K., Vinoj, V., Ramisetty, R., & Mittal, N. (2021). Assessment of Recent Changes in Dust over South Asia Using RegCM4 Regional Climate Model. Remote Sensing, 13(21), 4309.

https://doi.org/10.3390/rs13214309

[Report Courtesy: Acharya Asutosh (asutosh.acharya@gmail.com), School of Earth, Ocean, and Climate Sciences, Indian Institute of Technology Bhubaneswar, India]

Record of deep-sea shrimps of Pasiphaea sivado species group (Pasiphaeidae:Crustacea) in the western Indian Ocean collected by the R/V Anton Bruun

From 1959 to 1965 nine nations participated in a cooperative scientific investigation of the Indian Ocean. The staff of the Indian Ocean Biological Centre (IOBC) at Cochin sorted a large collection of Sergestids which was loaned to and studied at the Marine Reference Collection and Resource Centre, University of Karachi. The findings were first presented as PhD dissertation (Yousuf, 2006), then covered by Yousuf and Kazmi (2005, 2008, 2016) and Kazmi et al(2005) .

While returning the collection of sergestids to the Smithsonian Institution, Washington, a single unreported pasipheid specimen belonging to the genus Pasiphaea was noticed in one sample. Careful examination revealed that this species was close to the species Pasiphaea sivado(Risso, 1816), which has not been before reported from the given coordinates. Identification was not satisfactorily determined. The same is being reported here.

One specimen probably female, was not sexed by checking the presence/absence of appendix masculina on the endopod of the second pleopod, as is usual in caridean shrimps.But it looks a female as all five pleopod protopods are thinner and elongated (Simãoet al,2017)

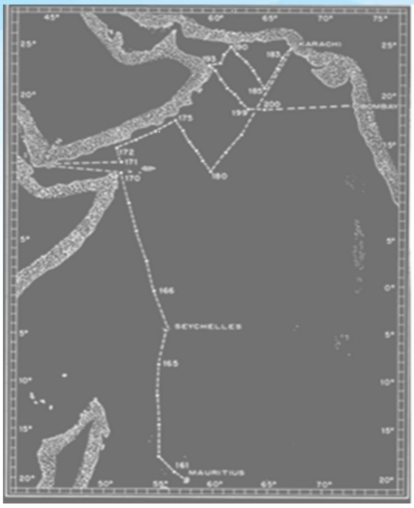

Figure-1: Cruise track of R/V Anton Bruun, Cruise4A station 185 20°39'N, 64°41'E, night 3173, dated 30, October ,1963

The specimen collected from the Indian Ocean is close to species P.sivado, sharing the following characters: rostrum triangular with pointed apex, arising behind frontal margin of carapace; sixth pleomere armed with poster dorsal median tooth; posterior margin of telson truncate, armed with four pairs of spines differing in having inner pairs though shorter than outer, but not gradually decreasing in size .We have based our identification on rostral shape .

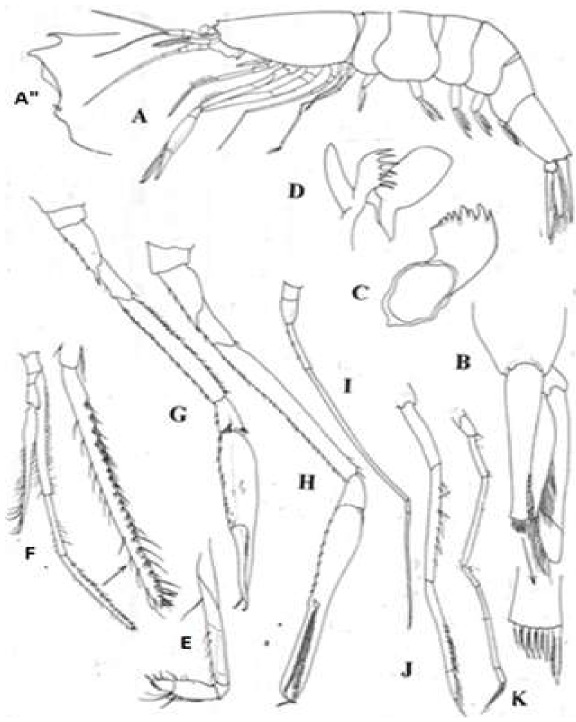

Figure-2: Pasiphaea sivado A.entire; A.rostrumandfront; B.telsonandrighturopod; C.maxillula; D.mandible; E.secondmaxilliped; F.thirdmaxilliped; G.firstleg; H.secondleg; I.thirdleg; J.fourthleg; K.fifthleg

[Report Courtesy: Quddusi B.Kazmi, M.Afzal Kazmi, Department of Zoology, University of Karachi, Pakistan, E-mail: qbkazmi@yahoo.com]

INDIAN OCEAN: Poetic View Point of a Budding Oceanographer

I am the Indian ocean,
I was called the eastern ocean,
And I am the warmest ocean.

I am the third largest ocean,
I yield 40% of the world's oil production,
And 80% of the world trade is only my ocean-borne.

Though I am not deep as Mariana trench,
But I am quite deep owing Sunda trench,
I have many marginal seas,
And I hold the world's largest submarine fans.

I carry many active spreading ridges,
It includes Broken ridge, Madagascar ridge, and of course, those mid Indian ocean ridges,
I carry many varieties of organisms,
It includes seaweeds, mangroves, turtles, oysters, and clams.

I have been healing the atmosphere,
And feeding the biosphere,
But I have been exploited and destroyed for years and years.

I am tired of exploitation, destruction, and pollution for a long time,
Can you derive a permanent solution this time?
You promise, and every time you forget,
I am still filled with plastic and toxic waste.

I was the primordial life soup,
Now I am a garbage patch and the plastic soup,
I am deteriorated, But I can regenerate,
Only if you support and act, I am under threat,
Promise me! you will protect.

This ocean day, no more fake promises,
But only actions, No more fake resolutions,
But only true solutions.

[Poem Courtesy: B. Goutami, Department of Marine Sciences, Berhampur University, Odisha, India, E-mail: goutamirao143@gmail.com]

DEEP-SEA RESEARCH PART II

THE SUBMISSION PORTAL FOR VOL. 6 OF THE DEEP-SEA RESEARCH II SPECIAL ISSUE SERIES ON THE IIOE-2 IS NOW OPEN

Submission of manuscripts that describe the results of studies related to the physical, chemical, biological, and/or ecological variability and dynamics of the Indian Ocean (including higher trophic levels) is encouraged.

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

If you are interested in submitting a manuscript, please contact Raleigh Hood (rhood@umces.edu).

Endorse your projects in IIOE-2

Don't miss the opportunity to network, collaborate, flesh out your research project and participate in IIOE-2 cruises!!

The endorsement of your scientific proposal or a scientific activity focusing on the Indian Ocean region is a recognition of the proposal's or activity's alignment with the mission and objectives of IIOE-2, of its potential for contributing to an increased multi-disciplinary understanding of the dynamics of the Indian Ocean, and of its contribution to the achievement of societal objectives within the Indian Ocean region. Over 48 international, multi-disciplinary scientific projects have already been endorsed to date by the IIOE-2. Yours could be the next one!

Visit https://iioe-2.incois.gov.in/IIOE-2/EndorsementForm.jsp for further details and for projects already endorsed by IIOE-2 https://iioe-2.incois.gov.in/IIOE-2/Endorsed_Projects.jsp.

CLIVAR June 2022 Bulletin is available online

The International CLIVAR Project Office distributes a monthly bulletin with announcements, funding opportunities, meeting notifications relevant to the ocean/climate science community.

The latest CLIVAR Bulletin June, 2022 is available at:

https://mailchi.mp/clivar.org/clivar-june-2022-bulletin

Call for Contributions

Informal articles/short notes of general interest to the IIOE-2 community are invited for the next (July-end) issue of the IIOE-2 Newsletter. Contributions referring IIOE-2 endorsed projects, cruises, conferences, workshops, "plain language summary" of published papers focused on the Indian Ocean etc. are welcome. Articles may be up to 500 words in length (Word files) accompanied by suitable figures, photos.(separate.jpg files).

Deadline: **25 July, 2022**

The Indian Ocean Bubble 2

Access the latest issue of Indian Ocean Bubble-2

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