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- NF-POGO Alumni Network for Oceans -

NF-POGO Alumni E-Newsletter – Volume 14, May 2018

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NF-POGO Alumni E-Newsletter – Volume 14, May 2018

This issue:

Cover page painting "A Safari from Space to Ocean", courtesy of Mr. K. M. David, Artist, CMFRI, Kochi 682018, Kerala, India

From the Editorial Board

This 14th Issue of NANO News is presented with focus on the SAFARI 2 symposium. This brings to light NANO's participation and contributions to international conferences and symposia. It is therefore with great pride that the Editorial Board brings you this edition, as NANO's tentacles grow longer and tougher, reaching out to remote areas.

This special issue of NANO News takes us in a safari of the oceans with a unique perspective. Over the years, scientists all over the world have attempted in many ways to understand the engine that keeps the Earth flourishing and to take necessary steps towards its maintenance so life on it would be comfortable and sustainable. Observation of nature has progressed from simple eye view to microscopic view and to "a bird's-eye view" from satellites, and now this era of satellite technology has offered "A Safari from Space to Ocean". It was a great opportunity for scientists from all over the world to meet at the heart of the Indian Ocean in Kochi, India, to share knowledge on the application of "Remote Sensing for Ecosystem Analysis and Fisheries" during the SAFARI 2 symposium. Dr. Nandini Menon, Dr. Grinson George, Dr. Meenakumari and others present to you aspects of the SAFARI symposium.

Although this edition of NANO News is dedicated to the SAFARI symposium, it would not be complete without contributions from other aspects such as NANO Research Projects, NANO Ponders and Research Communications. We therefore present to you a synopsis of NANO Global Research Project; Influence of climate change and anthropogenic impacts on global jellyfish populations in NANO Ponders; and a research communication on sea ice phenology in the Caspian Sea.

Our sincere gratitude goes to the contributors of this special issue. Great thanks to Dr. Trevor Platt and Dr. Shubha Sathyendranath not only for supporting NANO, but also for their support to SAFARI. Kudos to our honourable Patrons who keep supporting this great initiative. Our special thanks to them.

The ocean is vast and its inhabitants diverse, so also are its properties. Let's keep exploring.

Bennet Atsu Kwame Foli (a.k.a. Bentsufo)

Editor-in-chief

SAFARI AND NANO LINKAGES

Sophie Seeyave
Executive Director, Partnership for Observation of the Global Oceans

SAFARI (Societal Applications in Fisheries and Aquaculture using Remotely-Sensed Imagery), the global initiative to co-ordinate activities on global fisheries and aquaculture research and management using satellite remote sensing imagery, was established in 2007, and in due course entered into scientific interactions with ChloroGIN, IOCCG, POGO and GEO. Initially a task within the GEO Work Plan, it was one of the key ocean elements within GEO that were brought together under the umbrella of the GEO "Oceans and Society: the Blue Planet" initiative in 2012. A ChloroGIN/SAFARI workshop was held as a side event at the 2nd Blue Planet Symposium, which was attended by many NANO alumni. These ongoing strong links prompted NANO to be a partner in the organisation of the SAFARI 2 symposium. NANO announced financial support to the alumni, who were keen to participate in the symposium. This was received with great enthusiasm and four participants were funded by NANO to attend SAFARI 2. Mr. Rabie Ali Maroouf (Egypt), Mr. Bennet Atsu Kwame Foli (Ghana) and Dr. Phan Minh Thu (Vietnam) attended the symposium with NANO sponsorship. Unfortunately the fourth participant Dr. Tin Hoang Cong (Vietnam) had to cancel his trip to India at the last moment due to personal reasons.

The SAFARI 2 symposium on "Remote Sensing for Ecosystem Analysis and Fisheries" witnessed the advances in satellite remote sensing being presented with emphasis to ocean-colour sensors with increased spectral resolution, especially hyper-spectral resolution. Identification of phytoplankton functional types as well as improved quantification of chlorophyll and total suspended sediments, differentiation of dissolved organic compounds, monitoring of potentially toxic algal blooms in eutrophic coastal and inland waters, and the estimation of processes such as primary production in inland and coastal waters using the advanced techniques portrayed the state of the art knowledge on remote sensing for not only fisheries, but also the ocean ecosystem as a whole.

The active participation of members of the NANO family in SAFARI 2 is indeed a matter of pride and happiness to the organisers of NANO and of SAFARI. The responsibility of co-ordinating the SAFARI 2 symposium was shouldered by two NANO members Dr. Grinson George of ICAR-CMFRI, Kochi and Dr. Nandini Menon of NERCI, Kochi. Their untiring efforts along with the SAFARI organisers resulted in the conduct of a successful event. The unity and the strong bondage among the NANO alumni was evident throughout the symposium, and here we remember with gratitude the strong support of the patrons Dr. Shubha Sathyendranath and Prof. Trevor Platt in cementing the bond between the NANO alumni, be it from any part of the world. This enthusiasm should not be allowed to wane out, and, to keep up the cooperation and research interaction alive, the recommendations proposed during SAFARI 2 should be administered without delay. For this purpose, a network of SAFARI participants with commitment to ocean science should be formulated. Being the hub of activities of SAFARI events, the ideal location of the Secretariat would be Kochi and I feel that the ardour of SAFARI organisers to form a secretariat should be supported by all NANO members by taking up some key responsibilities of the secretariat.

SAFARI - THE SOJOURN FROM 2007 TO 2018

Meenakumari B[1] and Trevor Platt[2]
[1]Chairperson, National Biodiversity Authority, India
[2]Professor, Plymouth Marine Laboratory, United Kingdom
Alumna profile https://nf-pogo-alumni.org/profile/mbharat/

The history of SAFARI dates back to the early days of the intergovernmental GEO (Group on Earth Observations), a voluntary partnership of governments and international organizations, which had been striving hard to bring in international collaboration to build a Global Earth Observation System of Systems (GEOSS). Earlier, GEO had tried to develop some activity in the fisheries field, but was not satisfied with the progress that had been made. In July 2007, GEO officials sought the help of Prof. Trevor Platt to animate fisheries activities under GEO: Prof. Platt was a leader in international remote sensing, and was founding Chairman of the International Ocean-Colour Co-ordinating Group (IOCCG). At that time he received funding, for his personal research, from the Canadian Space Agency, and was developing the concept of the State of the Ecosystem in the north-west Atlantic Ocean, a weekly time series of chlorophyll biomass for the Eastern Canadian seaboard, derived from ocean-colour remote sensing. From these data could be calculated the interannual anomalies for phytoplankton phenology. The results were applied to make a successful operational test of the Cushing-Hjort hypothesis; that variations between years in the phase of the seasonal phytoplankton cycle could explain a significant portion of the variance in the recruitment of larval fish. The target fish in the case was the demersal haddock (*Melanogrammus aeglefinus*). Related work on the Northern Shrimp (*Pandalus borealis*) soon followed.

Prof. Platt drew up a prospectus of activities that would constitute a GEO fisheries program, to be called SAFARI (Societal Applications in Fisheries and Aquaculture using Remotely-sensed Imagery), and contacted the Canadian Space Agency for help, including funding, in making it a reality. This was quickly achieved, and SAFARI was initiated as a lead project of GEO in November 2007, with funding from the Canadian Space Agency. The funding was renewed for a further three years in 2010.

As part of promoting the application of Earth Observation data to fisheries research, SAFARI organised an International Symposium on Remote Sensing and Fisheries during 15-17 February 2010 in Kochi, India, which highlighted the regional and global applications of remote sensing to fisheries and aquaculture. Out of the 265 registered participants 78 were international, representing 34 countries. 163 abstracts were submitted and were presented as oral or poster presentations during the 3-day symposium. A pre-symposium training was conducted to teach the basics of remote sensing and its application in fisheries to 50 trainees including 23 foreign participants. As Director of the Central Institute of Fisheries Technology (CIFT), Kochi, India, Dr. Meenakumari, co-ordinated and hosted this mega event.

The SAFARI 1 symposium ran in parallel with other international developments such as those related to Chlorophyll Globally Integrated Network (ChloroGIN), which was later joined to SAFARI under the second round of Canadian funding. It was the untiring efforts, passion, dedication and perseverance of Prof. Trevor Platt and Dr. Shubha Sathyendranath that brought together and equipped some of the young talents to take up the challenges in remote sensing applications to fisheries. Thus, a ChloroGIN Workshop was held in Kochi during 18 - 19 February 2010, for which the Canadian Space Agency supported both the ChloroGIN and SAFARI initiatives and provided funding for a joint international Secretariat. Indian National Centre for Ocean Information Services (INCOIS), Joint Research Centre (JRC) and Plymouth Marine Laboratory (PML) were also active in the capacity building initiatives of ChloroGIN. Accordingly, in the European project DevCoCast, the marine component was led by ChloroGIN members; in another EU Project - Europe–Africa Marine EO Network - fellowships, training courses and academic programmes were offered to ChloroGIN members; and satellite data products produced by DevCoCast, PML, University of Cape Town and INCOIS were made available to ChloroGIN members from nine countries. The participating agencies worked together, sharing data, equipment and expertise with the aim of optimizing resources within the network. Bloom indicators - timing and magnitude of bloom, eutrophication index, water transparency, indices such as Red Tide Index (RTI); mesoscale features of Frontal zone - Potential Fishing Zones (PFZ), Primary Production estimates based on regional chlorophyll and Sea Surface Temperature (SST) anomalies were some of the initiatives under this programme.

The efforts that began with SAFARI 1 symposium during my tenure as Director, CIFT, Kochi, were continued by the researchers all over India trained by Prof. Platt and Dr. Sathyendranath. It is this untiring teamwork that led to the advancement of satellite remote sensing applications in oceanographic studies in India, which has culminated in the second SAFARI symposium on Remote Sensing for Ecosystem Analysis and Fisheries during January 15-17, 2018 in Kochi, India.

The pre-training that preceded the second symposium introduced the participants to Sentinel data available through the Copernicus programme.

One of the challenges in fisheries research is the difficulty in identifying the fish shoals or species remotely and making estimates of their abundances in a given region. For the effective exploitation of marine fish resources, fishermen must catch the most fish possible, at the same time, minimizing costs and optimizing the scheduling of their operations. Variations in environmental conditions affect the recruitment, distribution, abundance and availability of fishery resources. Information on SST is widely used to locate tuna, salmon and other pelagic fish shoals. Measurements made by space-borne sensors such as distribution of surface isotherms, location of frontal boundaries, regions of upwelling, currents, vertical and horizontal circulation features, surface optical or bio-optical properties grouped under the general term Ocean Colour (diffuse attenuation coefficient, total suspended matter, yellow substance, chlorophyll pigments and macrophytes) could also be employed to estimate the fish availability and production.

In short, the possibilities offered by Earth Observation data and ocean colour radiometry in the area of fisheries and aquaculture management are immense. Improvements in the quality of remote sensing data, such as availability of high spatial resolution data (<300m) are evident in the research findings presented in SAFARI 2, which proves beyond doubt that the legacy of SAFARI to benefit society through application to fisheries and aquaculture is being carried forward by the younger generations, at the same time giving due importance to maintaining the integrity of the structure and function of ocean ecosystems.

SAFARI - SCIENTIFIC AND SOCIAL PERSPECTIVES

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The international consensus to follow an ecosystem-based approach to fisheries management raises the imperative to design and implement a suite of ecological indicators with a view to detecting change in the ocean ecosystem, should it occur in response to perturbations, for example by climate change or by over-fishing. At a time when the blue economy is plagued by fluctuations in fish catch, mass mortality of cultured species and natural disasters, the relevance of satellite remote sensing, particularly, ocean colour applications is very high. Remote sensing aids in aquaculture and fishery management by efficient monitoring of water quality in coastal habitats; detecting the initiation, spread and senescence of harmful algal blooms; fish stock assessment, particularly, the impact of seasonal and inter-annual variability in phytoplankton community on the recruitment and growth of stock; fish harvesting by identification of suitable fishing grounds and thereby reducing fishing effort and increasing yield per unit effort; and ecosystem-based fisheries management by providing information on the dynamics of phytoplankton, which are at the base of all pelagic food chains.

SAFARI (Societal Applications in Fisheries and Aquaculture using Remotely-Sensed Imagery) is an initiative that provides a forum for coordination, at the international level, of activities in global fisheries research and management. The forum is open to all interested parties, including policy makers, research scientists, bureaucrats and those involved in the fishing industries. SAFARI also aims to help build capacity, and facilitate the application of rapidly-evolving satellite technology to address fisheries management questions on a global scale. The first SAFARI international symposium entitled “Remote Sensing and Fisheries” was held at Kochi, India (February 2010) and was organized by Central Institute of Fisheries Technology (CIFT), an institute belonging to the Indian Council of Agricultural Research (ICAR). The symposium focused on a special forum for regional and global applications of remote sensing to fisheries and aquaculture. After a span of 8 years, exploiting the provision in the DST-Jawaharlal Nehru Science Fellowship (JNSF) to Prof. Trevor Platt at the Central Marine Fisheries Research Institute (ICAR-CMFRI), Kochi, India, the second SAFARI international symposium was conceived with broad objectives such as:

- To review the recent advancements in the remote sensing technologies in fisheries and ecosystem analysis;
- To identify constraints and research needs of the remote sensing imagery in fisheries; and
- To identify and appraise new remote sensing technologies in fisheries and ecosystem analysis.

The SAFARI 2 symposium on “Remote Sensing for Ecosystem Analysis and Fisheries” was held from January 15-17, 2018 by ICAR-CMFRI and supported by Nansen Environmental Research Centre India (NERCI). The 2-day pre-symposium training, as well as the deliberations made during the symposium, highlighted the improved capabilities of ocean colour sensors and their increased spatial and spectral resolutions; their application for identification of phytoplankton functional types; improved quantification of chlorophyll and total suspended sediments; differentiation of dissolved organic compounds; monitoring of potentially toxic algal blooms in eutrophic coastal and inland waters; and thereby applying efficient fisheries management strategies. The “societal applications” in the expansion of the acronym SAFARI was given justice by way of a special stakeholder session on disaster management involving fisherfolk and other stakeholders of the fishery community, in association with Indian National Centre for Ocean Information Services (INCOIS), the operational organisation for dissemination of remote sensing services in India, in which Smt. J. Mercykutty Amma, Fisheries Minister of Kerala served as the moderator. The keen interest of the government of Kerala State in propagating the advancements in remote sensing technology for the benefit of coastal communities was received with enthusiasm by the fisherfolk and the scientific community alike.

The general feeling that emerged from the symposium was that the integration of remote sensing with marine fisheries still needs to go a long way before it can be used to its full potential. On one hand, validation and modification of global or regional algorithms need to be carried out with sea-truthing, and on the other hand, fisheries scientists need to plunge more deeply into remote-sensing science. This calls for inter-institutional collaboration at both national as well as international levels, mainly through open databases and researcher exchanges. Suggestions to diversify the applications of remote sensing to newer arenas were put forth during the plenary session of the symposium. They were as follows:

1) Delineation of optimal sites for marine protected areas or aquaculture farms;

2) Improving our understanding on schooling, migration, spawning grounds, larval abundance, recruitment and food of fishes;

3) Precise mapping of vulnerable locations, durability of preventive and remedial measures, through remote sensing;

4) Increased and more precise information on ecology of fresh water, brackish water and sea areas for aquaculture to be collected through remote sensing (It is the prerequisite and need of the day for enhancing production. Rearing high value and hardy fish in all suitable areas would result in enhancing fish farmers’ income);

5) Estimation of the exact length of the Indian coastline; how it is put to use and how it can be protected (Remote sensing would be an indispensable tool for this);

6) Nurture of Coastal Regulation Zone (CRZ) (It is vital for fishing, fisheries activities and fishermen’s habitation. Displacement of fishermen for various other developmental activities is detrimental to fishermen and the fishing industry. The proposed industrial corridors may spell death-knell to fisheries development. Information generated through remote sensing can alleviate the distress of fishermen to a great extent);

7) Survey, mapping and monitoring of aquatic ecosystems such as lakes, rivers, wetlands and mangroves to assess the damage due to encroachment and pollution;

8) More refinements of models utilising remotely-sensed variables to increase accuracy in forecasting the fishery; and

9) New and low cost technologies of vessel tracking and communication to be implemented in order to address disaster management.

The recommendations generated during the deliberations, if implemented, will serve the user communities to exploit satellite remote-sensing data for applications related to aquatic ecosystems and fisheries. The momentum generated at the Symposium will surely act as a booster to improve the research in this field during the inter-session period leading up to the next SAFARI symposium.

To hold true to the acronym ‘SAFARI”, the research findings should be disseminated for the benefit of the society. It is fervently hoped that we, the organisers along with participants of the symposium establish a scientific society with a secretariat for carrying out the action items identified at the symposium. Only through the concerted efforts of a secretariat, can this concept be taken forward to benefit society and its science.

NANO AT SAFARI 2

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NANO REPRESENTATION AND SCIENTIFIC CONTRIBUTIONS TO SAFARI 2 SYMPOSIUM

Organisation and conduct of SAFARI 2 symposium could be viewed in large part as a potential NANO activity, as NANO members were involved in each and every stage of organisation of the symposium. The idea of SAFARI 2 was conceived by Prof. Trevor Platt and Dr. Shubha Sathyendranath, the founding members of NANO. We, the organisers are both active NANO members. The pre-symposium training held to introduce the participants to marine applications of satellite data, was also conducted by the NANO friend Dr. Marie Fanny Racault and NANO member Dr. Shovonlal Roy along with Dr. Hayley Evers King of Plymouth Marine Laboratory, an institution member of POGO. The participants in the SAFARI 2 symposium also included NANO members who have been active in the NANO Indian sub-continent regional projects 'Study of HABs and other aspects of sardine habitats around the Indian sub-continent (SHABASHI)' and 'Harmful algal blooms in coastal ecosystems: implications for future aquaculture (HABAQUA)'. So it is fitting that their scientific contributions are portrayed through the NANO newsletter.

Marie-Fanny Racault, Plymouth Marine Laboratory, UK

NANO friend https://nf-pogo-alumni.org/nano-friends/dr-marie-fanny-racault/

Dr. Racault, in her first invited talk 'Ecological indicators in support of comprehensive assessment of aquatic biodiversity' in the session 'Biodiversity', described the Marine Strategy Framework Directive (MSFD) that follows an ecosystem-based approach and takes a holistic view of the management and protection of marine ecosystems. She explained in detail the evaluation of the state of the aquatic ecosystem through the use of ecological indicators viz. chlorophyll, phytoplankton phenology and their relevance to fisheries biodiversity. She clearly brought out the role of networks of ocean observing systems and the Ocean Colour Climate Change Initiative (OC-CCI) in remote-sensing data processing and their relevance in evaluating the health of aquatic ecosystems.

In her second presentation 'Using remote-sensing imagery to assess impacts of El Niño variability on oceanic primary producers' in the session 'Aquatic Environment and Ecology', she presented the utility of remote-sensing imagery for assessing impacts of El Niño variability on oceanic primary producers. With the help of satellite imageries, she explained the impact of El Niño variability on the physical and biological oceanographic features in different regions of the world; its impact assessment and implications. According to her analyses, regionally-different patterns are observed in the response of biological and physical processes to two extreme types of El Niño: Eastern Pacific El Niño (e.g. 1997-1998 event) and Central Pacific El Niño (e.g. 2009-2010 event) which profoundly affect the marine ecosystem structure and functioning through variations in trophic interactions (Fig. 1). Dr. Racault concluded that the key climate impact information obtained from the study could be used for societal benefit: to get better information on possible risks and opportunities associated with El Niño events, and support more effectively mitigation and adaptation plans for local fisheries-dependent societies.

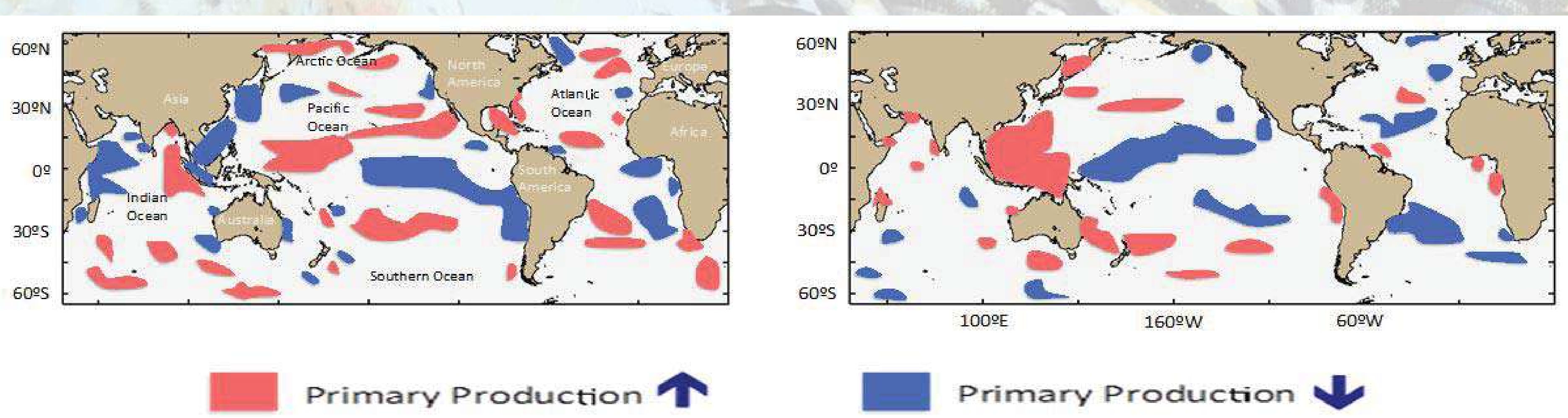


Fig.1: Regionally differentiated El Niño impacts - atlas of biological impacts adapted from Racault et al. (2017). Front. Mar. Sci. doi:10.3389/fmars.2017.00133

Bennet Atsu Kwame Foli, University of Ghana, Ghana

NANO Alumnus profile https://nf-pogo-alumni.org/profile/bfoli/

Mr. Foli presented a poster on “Fishery management initiatives by dissemination of early warning alerts on ocean condition in West Africa”. In the poster, he highlighted the causes of depletion of fishery resources in West Africa. The poster portrayed the work undertaken as part of the project on Monitoring for Environment and Security in Africa (MESA) by the University of Ghana and sponsored by the EU under the tenth European Development Funds (EDF). As per the project, forecasts of ocean condition parameters are generated and disseminated to local fishermen via an SMS early warning system. The benefits of the information on potential fishing zones (PFZs) using Earth Observation data in the better management of the fishery resources was clearly demonstrated.

Fig. 2: Mr Foli receiving an award for best poster in the SAFARI 2 Symposium.

Satya Prakash, Indian National Centre for Ocean Information Services, India

NANO Alumnus profile https://nf-pogo-alumni.org/profile/sprakas/

Dr. Satya Prakash in his talk on ‘ What triggers *Noctiluca scintillans* bloom in the northern Arabian Sea?’ in the ‘Biodiversity’ session explained the mechanism that helps *Noctiluca* to proliferate in the Arabian Sea. On studying the biogeochemical conditions associated with the *Noctiluca* bloom in 2015 and long term oxygen data from Argo-Oxygen floats, he stated that there was no indication of any mixed layer or photic zone oxygen depletion or any evidence of surface water hypoxia in the recent past (Fig. 3). However, he found that Si in the surface waters gets depleted at a faster rate making the western Arabian Sea climatologically silicate stressed, which facilitates easy community transition of diatom bloom to a *Noctiluca scintillans* bloom. He attributed a weaker convective mixing in winter to restrict the supply of silicate to the surface layer and thus facilitate a *Noctiluca* bloom.

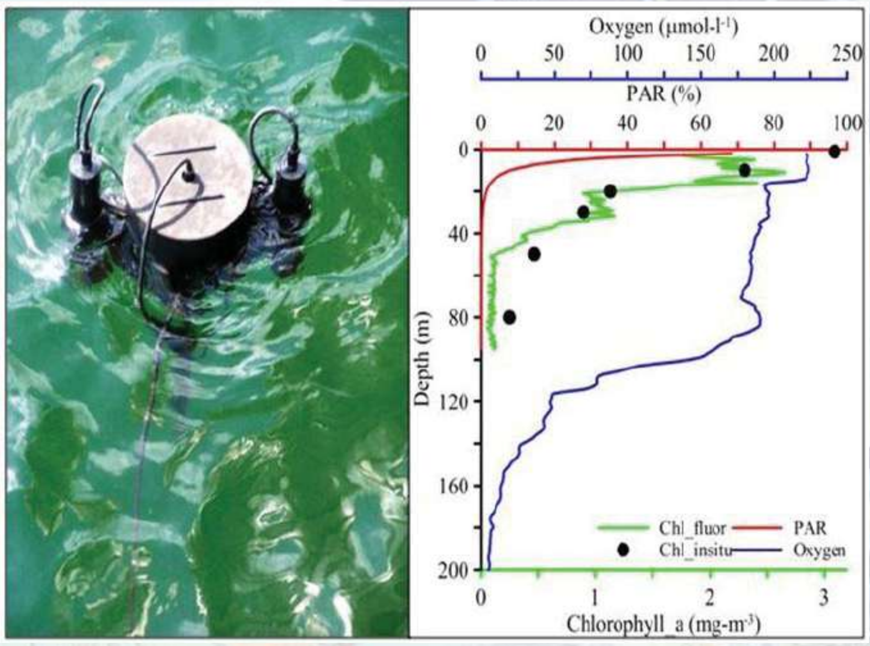


Fig. 3: Chlorophyll, dissolved oxygen and Photosynthetically Active Radiation (PAR) during *Noctiluca* bloom in western Arabian Sea obtained from Argo floats.

Habeeb Rehman H, Farook College, India

NANO Alumnus profile https://nf-pogo-alumni.org/profile/hrehman/

Dr. Rehman presented a poster on “Studies on the benthic polychaetes of Kadalundy estuary, southwest coast of India”, in the ‘Biodiversity’ session. He found a marked seasonal variation in the abundance of benthic polychaetes in the study area. Kadalundy estuary is one of the major stopover points for many migratory and shorebirds. He stated that as polychaetes are the indicators of a healthy aquatic environment, their periodic monitoring and assessment could serve as effective tool in environmental impact analysis and management of any vulnerable ecosystem.

Rajdeep Roy, National Remote Sensing Centre, India

NANO Alumnus profile https://nf-pogo-alumni.org/profile/rroy/

Dr. Roy spoke on "Revisiting the deep chlorophyll: context of phytoplankton adaptation in low light biophysical environment" in the session 'Aquatic Environment and Ecology'. He presented the variability in deep chlorophyll maxima (DCM) in conjunction with temperature, salinity and photic depth characteristics from central Bay of Bengal (BoB) during 2015 and 2016, coinciding with spring inter-monsoon. His observations showed that in 2015, a prominent low salinity cap (31-33 psu) was observed beyond 85°E and 17°N reaching a depth of 60 m. In contrast, surface water was marked by uniform salinity (<32.0 psu) to 88°E decreasing thereafter, suggesting intrusion of low saline surface water from the northeast. Chlorophyll fluorescence within the top ~50 m was negligible during both the investigations (85°E- 95°E) indicating extreme oligotrophic conditions. The location of DCM shoaled between 50 to 100 m in 2015, on the contrary, a stable DCM was observed in 2016 at a depth of ~75 m co-varying with light levels upto ~9 µmol m^{-2} s^{-1} (<1%). His results suggested the existence of strong phytoplankton populations adapted to very low/negligible light regimes. He discussed the findings based on our present understanding of these communities, discovered recently from similarly known biophysical environment in the northern Arabian Sea. Dr. Roy also spoke about the mesoscale pigment signatures from northern Indian Ocean in response to temperature fronts (Fig. 4) and found that fine changes occur in the community structure on a spatial scale of 5 km in response to temperature fonts. He presented the *Prochlorococcus* ecotypes distribution in the Northern Indian Ocean, DCM variability in BoB, implication in carbon cycling and food web structure of fronts/filaments and non-frontal areas on a spatial scale.

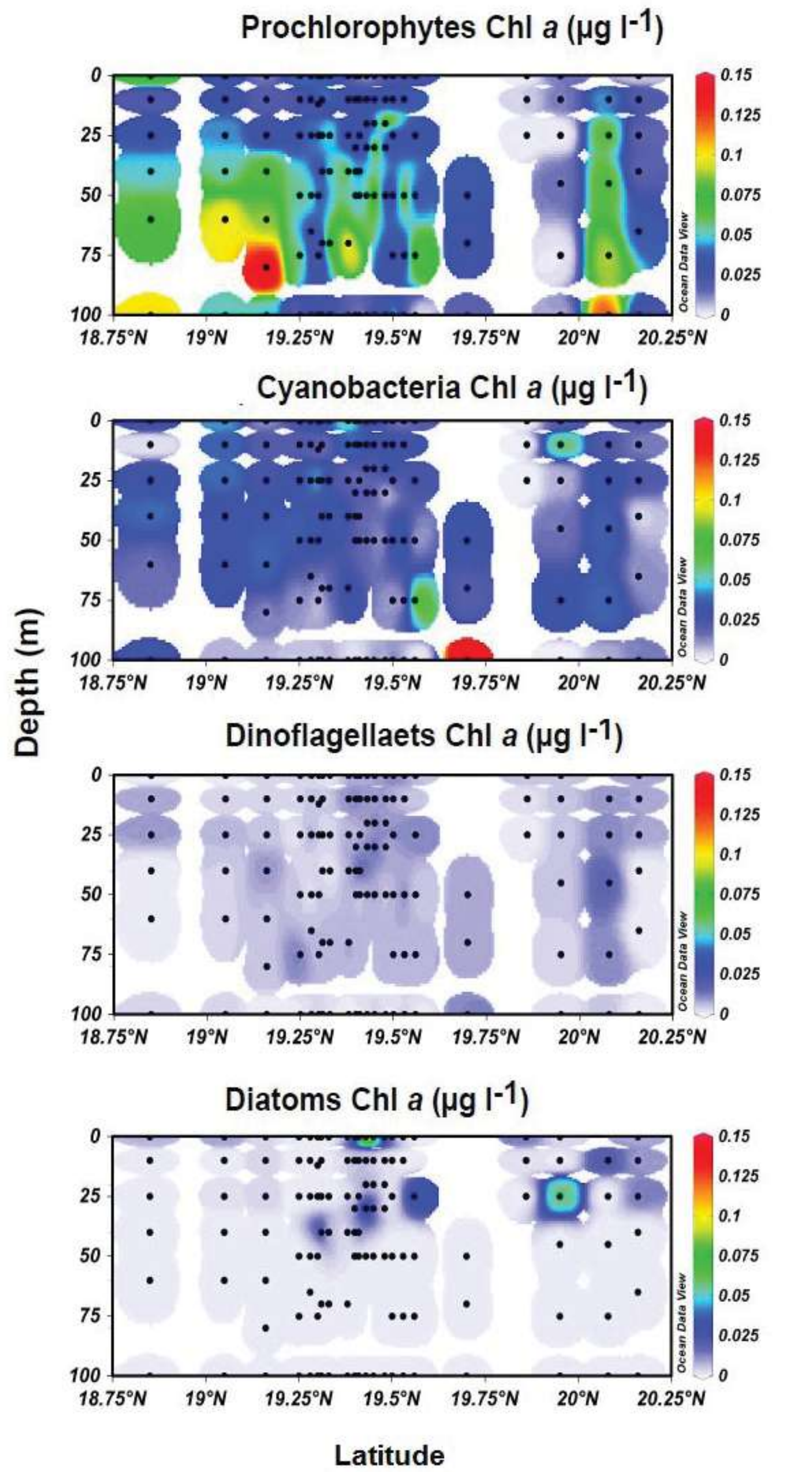


Fig. 4: Mesoscale pigment signatures from northern Indian Ocean in response to temperature fronts.

Rabie Ali Ismail Maarouf, University of Alexandria, Egypt

NANO alumnus profile https://nf-pogo-alumni.org/profile/Rabie/

Mr. Maarouf presented a paper on "Integrating water quality levels and remote sensing facilities to estimate aquaculture distribution in Egypt" in the 'Aquaculture' session. His work was a review on the integration of water quality and remote sensing applications for some of the main components of aquaculture, including location, facility, market, pollution, and its ecosystem impact. The relation between water quality and the Egyptian inland fisheries and aquaculture distribution and growth using remote sensing tools was discussed.

Shaju S S, Centre for Marine Living Resources and Ecology, India

NANO alumnus profile https://nf-pogo-alumni.org/profile/sshaju/

Dr. Shaju presented a poster titled "Variability of in-situ and satellite derived reflectance of *Trichodesmium* during bloom and non-bloom regions in Southeastern Arabian sea". In the poster, he briefed on the anomalous behaviour of remote sensing reflectance from the bloom and non-bloom areas. He also mentioned that remote sensing reflectance retrieved from satellite showed bias during *Trichodesmium* bloom conditions.

Phan Minh Thu, Vietnam Academy of Science and Technology, Vietnam.

NANO Alumnus profile https://nf-pogo-alumni.org/profile/pminhth/

Dr. Phan in his poster, “Variation of Chl-a concentration in Vietnamese sea by MODIS data and its relationship with fishery” in the session ‘Harvest Fishery’ explained how the variation in chlorophyll-a concentrations lead to change in the fishery in the Vietnam Sea. Based on processed MODIS images combined with in-situ data to extract Chl-a concentration during the period of 2003-2015, the variation of Chl-a and its relationship with fishery in Vietnamese sea was presented. According to him, the results could help in predicting fishing grounds by the phytoplankton biomass in marine regions.

Shovonlal Roy, University of Reading, UK

NANO alumnus profile https://nf-pogo-alumni.org/profile/sroy/

Dr. Roy, in addition to being a resource person for the pre-symposium training, presented a poster on “Stocks of oceanic phytoplankton carbon from remote sensing: New estimates and opportunities” in the session ‘Aquatic Environment and Ecology’. He highlighted the estimation of phytoplankton carbon based on a novel ocean colour based algorithm that combines cellular allometric properties and light-absorption properties of phytoplankton. The similarities and differences among various estimates of phytoplankton carbon from ocean-colour methods and data assimilation as well as the challenges in obtaining the carbon stocks in various phytoplankton types, and minimizing the estimation uncertainties, were discussed.

Nimit Kumar, Indian National Centre for Ocean Information Services, India

NANO alumnus profile https://nf-pogo-alumni.org/profile/jnimit/

Dr. Kumar delivered a lecture on ‘Harnessing high temporal resolution data from geostationary orbit for marine fishery predictions’ in Harvest Fisheries session. He presented the primary results on satellite applications to find fishes through successful Potential Fishing Zones (PFZ) identification (Fig. 5). The use of geostationary satellite (GS) and its limitations over polar-orbiting satellites (POS) for the PFZ applications by Indian Space Research Organisation (ISRO) and INCOIS were highlighted in the presentation. The success achieved after the launch of INSAT-3DR mission in September 2016 and its predecessor INSAT-3D mission helped in effective retrieval of SST data at 4 km spatial resolution for the Indian Ocean region. He emphasised that GS data not only helps in filling gaps in the POS data, but also provides opportunities for value-added services such as PFZ nowcast; paving the way for better utilisation of SST and ocean colour data from GS platforms.

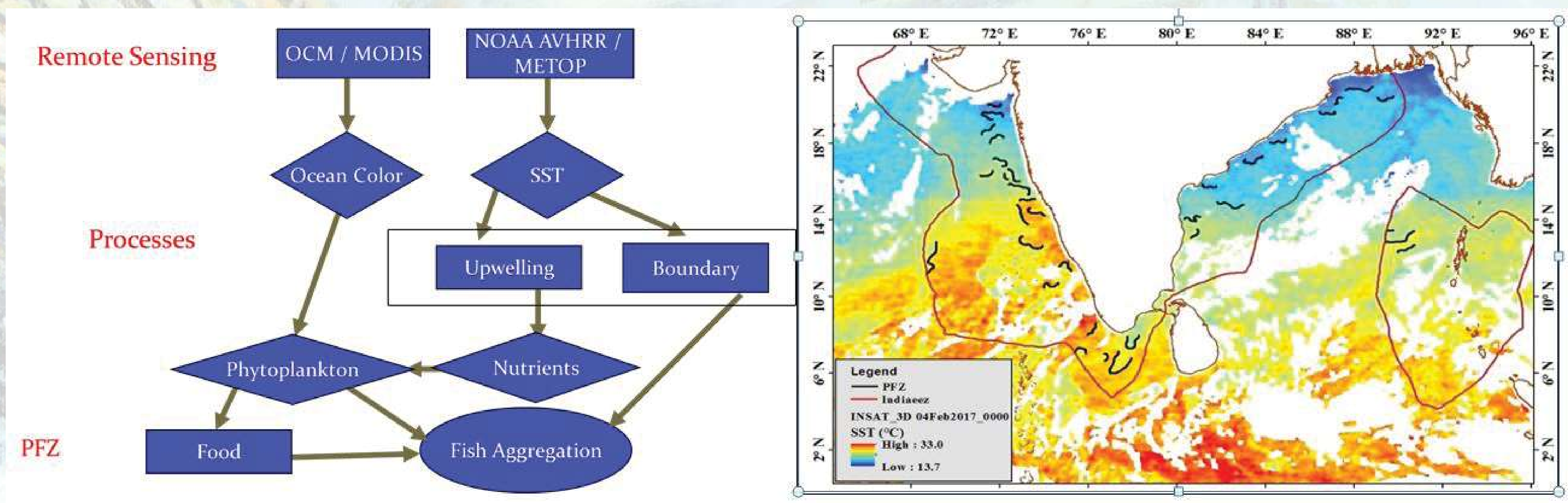


Fig. 5: The remote sensing approach for fish finding and harnessing geostationary satellite data for PFZ.

The Capacity Building session dealt with the network building, capacity building and outreach activities of PORSEC, NANO and SAFARI. We were supported by Dr. Nimit Kumar in holding this session.

Dr. Nimit Kumar (INCOIS) presented an overview of the remote sensing tutorials being held across the globe by the Pan Ocean Remote Sensing Conference Association (PORSEC Ass.) since 2004. He presented the conference and pre-conference tutorial (PCT) framework, and associated logistics, as evolved through time, and pointed out how the students and early-career researchers are benefitting from a complete package that introduces them to the field of satellite remote sensing and analysis techniques.

In addition to the members listed above, NANO members Dr. Mini Raman, Space Application Centre, India; Dr. Sanjiba Kumar Baliarsingh, INCOIS, India; Dr. Muhamed Ashraf, Central Institute of Fisheries Technology, India and Gunjan Motwani, Space Application Centre, India also attended the symposium and presented their contributions through their students. Our ongoing research activities were also presented as oral and poster presentations by our students.

The financial support extended by NANO in sponsoring three of its members was the first step in motivating the NANO members to attend the symposium. Realising the importance of the symposium theme and the need to portray the internationally relevant scientific work being done by them, NANO members responded enthusiastically to our invitation and took active interest in submitting abstracts and participating in the symposium. It was a matter of pride that Mr. Bennet Foli, a NANO alumnus won the best poster award (Fig. 2) whereas Ms. Meghal Shah, student of NANO alumnus Dr. Mini Raman won the best oral presentation award. The active participation of NANO alumni for SAFARI 2 was recognition of their exemplary work as well as testimony of the unity of the NANO family.

The organisers

Nandini Menon N, Nansen Environmental Research Centre India, India

"NANO activities in a nutshell" was presented to the audience. The initiation of NANO (NF-POGO Alumni Network for Oceans), its growth into a global network and the various capacity building activities undertaken to widen the network were all introduced to the non-NANO members. The large representation of NANO members for the symposium was testimony to the strength and bonding in the NANO family.

Grinson George, Central Marine Fisheries Research Institute, India

"SAFARI- A retrospection and future plans", communicated the objectives of SAFARI and the two international symposia held under this initiative. The talk ended with an expression of the desire that participants of the symposium would establish a scientific society with a secretariat for carrying out the action items identified at the symposium.

Invited collaboration by POGO alumni

These alumni of POGO Capacity Building Programme presented the following studies at the SAFARI 2

Jean-Baptiste Kassi, Université Félix Houphouët-Boigny, Ivory Coast
POGO-SCOR Fellow 2016

Dr. Kassi delivered an oral presentation on the topic "Remotely sensing the biophysical drivers of *Sardinella aurita* in Ivorian waters" in the 'Fisheries Management' session. He focused on the assessment of risks and vulnerabilities of the marine environment of Gulf of Guinea for the responsible management of fishery resources. Using *S. aurita* (sardine) catch data from the Ministry of Fisheries in Abidjan (Ivory Coast), high-resolution remote-sensing ocean-colour data from ESA OC-CCI and wind and Sea Surface Temperature (SST) data from ECMWF, Dr. Kassi showed that even though the physical variables were statistically better predictors of the variations in *S. aurita* catch in the following year, biological variables are key to explaining alterations in trophic interactions, and understanding the fluctuations in commercially-important fisheries such as *S. aurita* (Fig. 1).

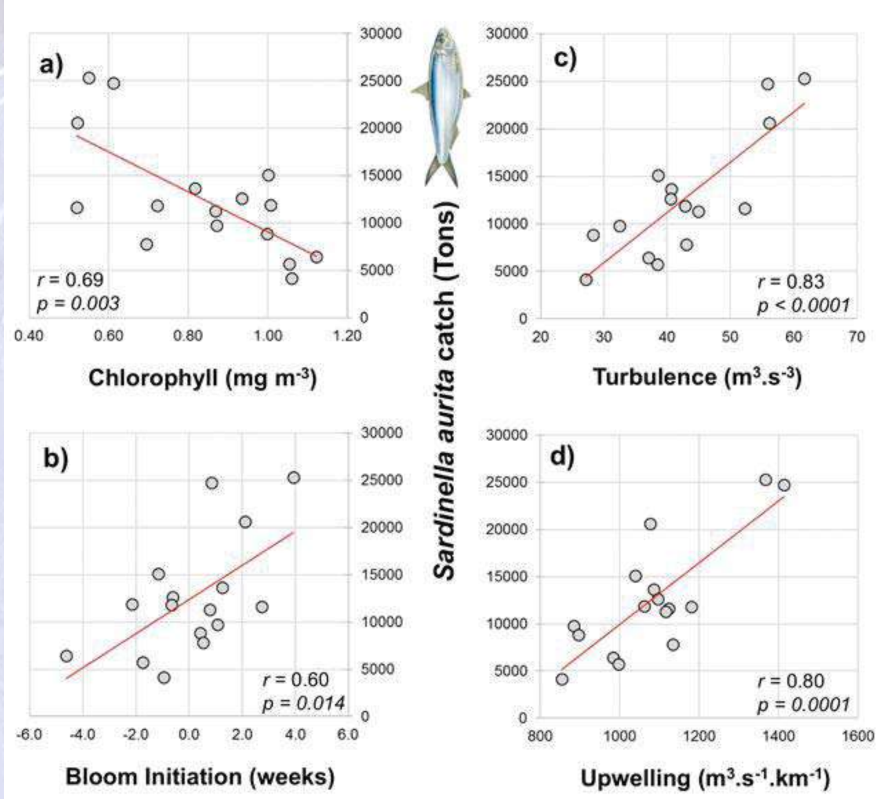


Fig. 1: Relationships between *Sardinella aurita* and biophysical variables.

Aneesh Lotliker, Indian National Centre for Ocean Information Services, India
POGO-SCOR Fellow 2011

Dr. Lotliker, in his invited talk on "Ocean Information & Forecast services of INCOIS – Overview" in the session 'Aquatic Environment and Ecology', educated the participants on data processing chain and quantitative validation carried out at INCOIS to prepare satellite datasets. The satellite remote sensing based services offered by INCOIS (Fig. 2) such as Potential Fishing Zone Atlas (PFZ), Ocean state forecast (OSF), Coral Bleach Alert System (CBAS), Disaster Related Services (TEWS, SS, HWA, SAR), Coastal Geospatial Services (CVI, MHVM, 3D GIS), Data related Services (IB &WBS, Ocean Portal), Capacity Building (ITCO Ocean) and Multi-lingual Mobile application were introduced to the symposium participants. The source and dissemination of the data products was also deliberated.

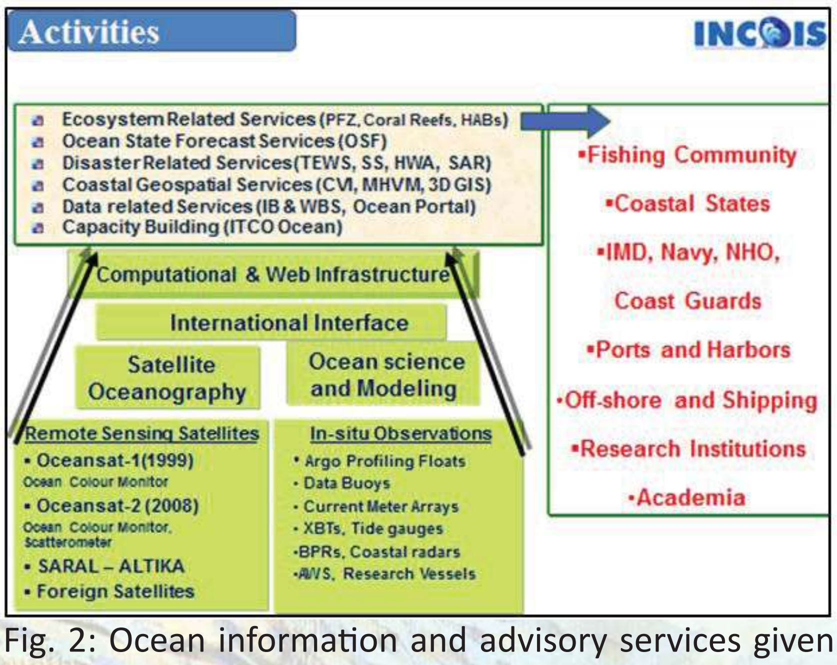


Fig. 2: Ocean information and advisory services given by INCOIS.

Dr. Lotliker's second presentation on "Optimal spectral bands for chl-a algorithm towards better prediction of fisheries along Indian coast using satellite remote sensing" in the session 'Harvest Fisheries' dealt with the development of new chl-a algorithm for the optically complex coastal waters of India for accurate prediction of fishery resources of Indian coast. He showed the classification of Indian coastal waters into four types based on the spectral variability of in-situ hyper-spectral remote sensing reflectance (R_{rs}) data-sets (Fig. 3). The new algorithm developed gave better Chlorophyll estimation with high correlation coefficient (r^2=0.92), slope (0.9), low intercept (0.02) and Root Mean-Square Error (0.12), as compared with standard algorithms and he stated the value of using these algorithms to retrieve chlorophyll datasets in optically complex Indian coastal waters.

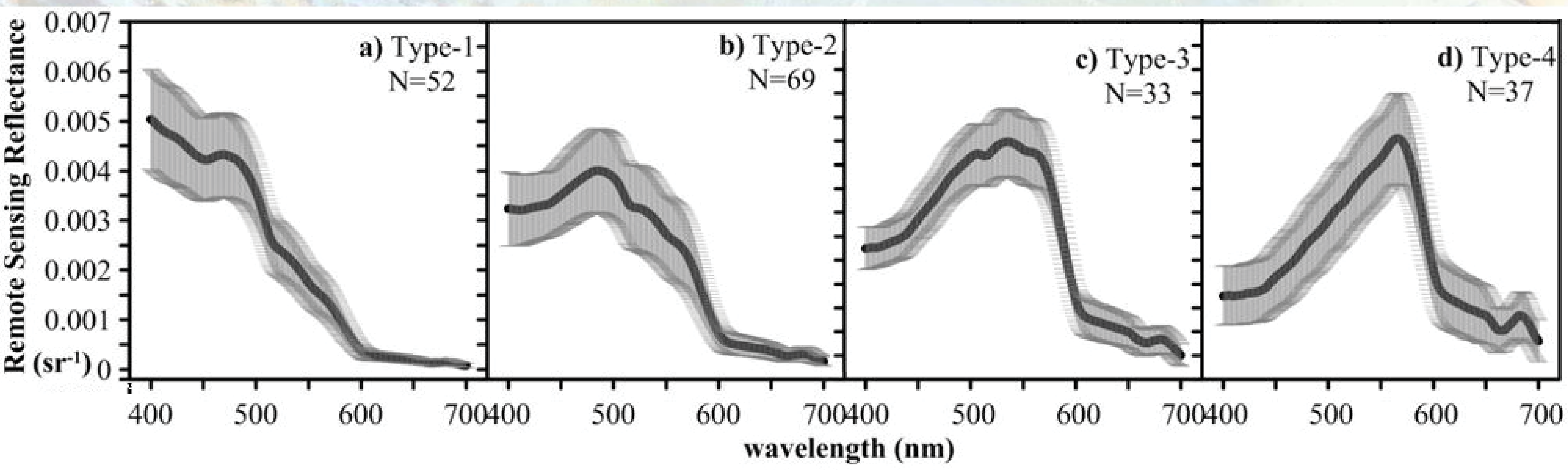


Fig. 3: Spectral remote sensing reflectance depicting four water types along Indian coast.

NANO/POGO Global Research and Development Project

Target-focused citizen science for coastal ocean temperature profiles collection

Kirill Kivva[1], Alexander Rakhman[2], Natalia Andreychenko[3] and Alexander Korolkov[4]

[1]Researcher at Russian Federal Research Institute of Fisheries and Oceanography, Russia
Alumnus profile: https://nf-pogo-alumni.org/profile/kkivva/
[2]Engineer at LLC "IPC ENERGIA", Russia
[3]Software Developer at LLC FunBox, Russia
[4]Senior Software Engineer at LLC Teplosberezheniye, Russia

For several years POGO has been supporting their alumni via local research projects such as NANO Africa and NANO SEA regional research projects (see information on regional research projects in previous issues of NANO News). Considering the success of this idea, POGO decided to announce Global Research Projects in 2016. At that time, we came out with an idea of project on coastal temperature data collection by volunteering parties with simple yet reliable sensors. The idea is based on the necessity for collecting more data in the coastal oceans. Indeed, physical constituents in the deep ocean are regularly obtained not only by many national and international surveys, but also by Argo profilers. On the other hand, most of the coastal ocean regions are largely under-sampled.

In our imagination, any person with access to the coastal ocean who is interested in basic oceanography may be volunteering for such a project. For instance, it may be a local fisherman, sailing boat owner or a school student. So the idea itself is citizen science based. However, oceanographic citizen science (OCS) projects are not numerous and particularly popular as virtually any oceanographic research requires special equipment. Those technical means are often relatively expensive and not easy enough for use by representatives of general public who have no scientific or engineering background. However, citizen science is a powerful and useful concept as it allows not only for substantial data collection, but also for simultaneous public education. Examples of successful OCS projects are Secchi disc study (http://www.secchidisk.org/) and Smartfin initiative (https://smartfin.org/). Both of them rely on relatively simple equipment (especially in case of Secchi disc) and smartphone applications.

To overcome the technical limitation of our project, we proposed to build a new system for coastal ocean temperature profiles collection. The system consists of three basic parts: a probe, smartphone application, and web portal (Fig. 1). The probe should be cheap yet reliable, and should be operated via smartphone as it would make the work with the probe quite easy for most of the users. Unfortunately, commercial equipment with such specifications does not yet exist. The smartphone application provides geolocation function, controls the probe, and transmits data from the probe to the web server. It may also be used to get basic visualization of recently measured data. The web portal collects the data and stores it. It also allows for public data access and basic data analysis such as filtering and spatio-temporal averaging, it may also provide other simple visualization function.

Fig. 1: Suggested system for temperature profiles collection.

We started the development of the probe in late 2017. To be honest, it is not very difficult to create a digital temperature sensor with memory function as necessary parts are available on the market. Some simple implementations may be done even by students with Arduino® kits. But many difficulties arise when one tries to connect the probe to the smartphone and to operate the probe via it. For now, we focus on Android® based smartphones as they are now more popular globally, and more frequent especially in the developing countries. We chose connection via Bluetooth® protocol, but it may be useful to change to Wi-Fi protocol later as it may be more easily implemented on iOS-based smartphones (i.e. iPhones). This is just an example of particular technical difficulties which showed up when trying to implement our idea. The scheme of the first version of developed probe is shown in Fig. 2. Overall, substantial development efforts are required to make this idea come true. But one can imagine possible outcomes when the system is implemented. Even random but massive data on vertical temperature distribution and dynamics in some regions of the Global Ocean would change our understanding of their functioning.

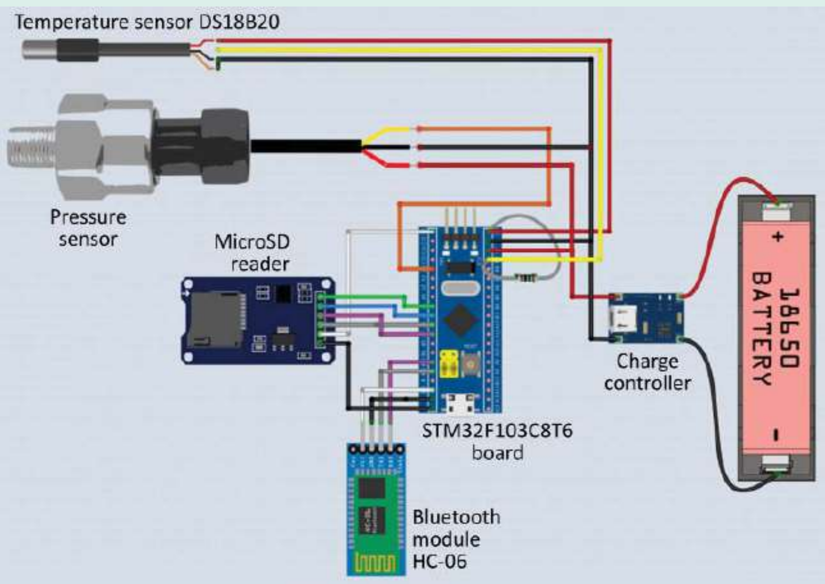


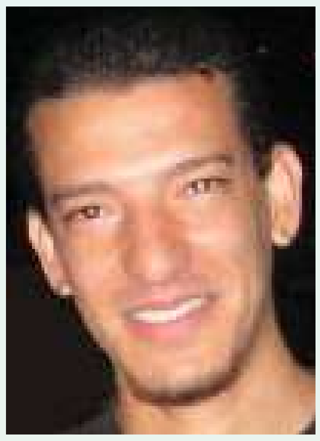
Fig. 2: Scheme of new probe based on cheap and simple parts.

We are grateful to POGO and NANO for supporting this project and look optimistically forward to completing it in the near future.

Monitoring for productivity, deoxygenation and acidification at selected coastal sites in Africa, Latin America and India

Houssem Smeti

Junior Oceanographer, United Nations Development Programme, Tunisia
Alumnus profile: https://nf-pogo-alumni.org/profile/hsmati/



NANO and the Global project

NANO (or NF-POGO Alumni Network for Oceans) is a global network of past and present NF-POGO scholars held together by a common interest in, and commitment to, ocean science, and by the common will to communicate the results of their work to the general public, so that they can be applied for the benefit of society at large.

The vision for the Network is "Integrated Observations of a Changing Ocean". The Nippon Foundation and the Partnership for Observation of the Global Oceans believe that the understanding of the ocean and coastal environment relies on an integrated observing system around the world maintained by qualified decision-makers, researchers and service providers.

In line with this vision of NF-POGO, the NANO global project started in April 2017 to initiate a global study of productivity, oxygenation and acidification in coastal areas. The first step was to launch a survey to help shape the global project objectives and deliverables based on direct feedbacks from NANO Alumni and friends. A total of 13 responses were received from 36 marine scientists and graduate students, representing 14 countries and 18 institutions.

Lisbon workshop

The project kickoff workshop was held in Lisbon, 18-20 April. NANO members from eleven countries attended the workshop (Argentina, Brazil, Colombia, Ghana, India, Mauritius, Mexico, Peru, South Africa, Trinidad and Tobago, Tunisia). The 2017-2018 project participants from Ecuador and Sudan where invited to the workshop but could not attend, but their presentations were given on their behalf.

The three-day workshop consisted of a series of presentations followed by discussions and had three components:

1) presentations from the participants on past and present oceanographic observation projects, including overviews and the main features of the study sites that will be the focus of the NANO global project.

2) a short introduction to oceanographic data management: "Quick recipe for Geodata management in oceanography", presented by Dr. Sebastian Krieger (physical oceanographer, Center of Excellence at BIOS, 2009). This short, but consistent, introduction was very well received by the workshop attendees and covered data collection and sampling strategies; data management and quality control; open source tools from data analysis and visualization. Also, a short introduction to "Operational oceanography and data availability" was given by Dr. Lilian Krug (NANO, Center of Excellence at BIOS, 2010).

3) Discussion and brainstorming about the 2018-2019 global project proposal and budget, to be submitted to NF-POGO by mid-May 2018.

Future aspiration

• The 2018-2019 proposal will focus on:

1) supporting the monitoring of basic oceanographic parameters (e.i. temperature, salinity, dissolved oxygen, pH) at existing time-series stations (e.g. ANTARES network) and at new sampling sites (e.g. Albion in Mauritius, Boughrara lagoon and Kuriat island in Tunisia).

2) encouraging comparative studies between study sites involved in NANO global project.

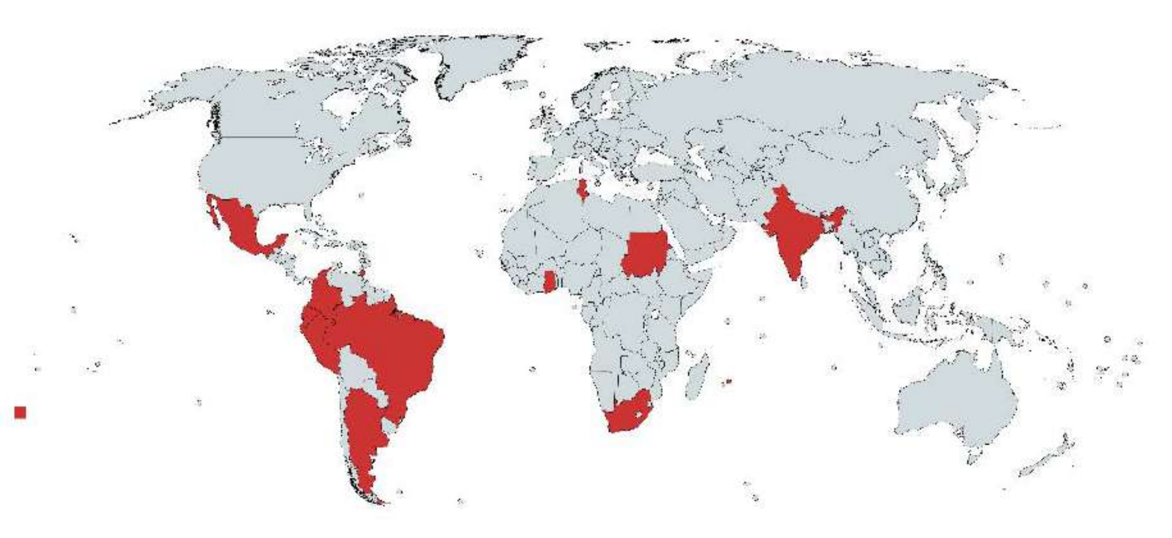
3) Capacity-building through the organization of webinars. Proposed subjects include: satellite data extraction for temperature and chlorophyll-a; oxygen and pH sensors calibration and configuration; Sentinel-3 high resolution data extraction for temperature and chlorophyll-a , pH measurements for acidification studies; statistics for comparative studies and time-series analysis; in situ measurement of chlorophyll-a.

• The global project participants are very keen to collaborate with the OpenMods project (Open Access Marine Observation Devices), led by the OGS (Italy) and AWI (Germany) and supported by POGO. More details about the OpenMODs project at: http://ocean-partners.org/OpenMODs.

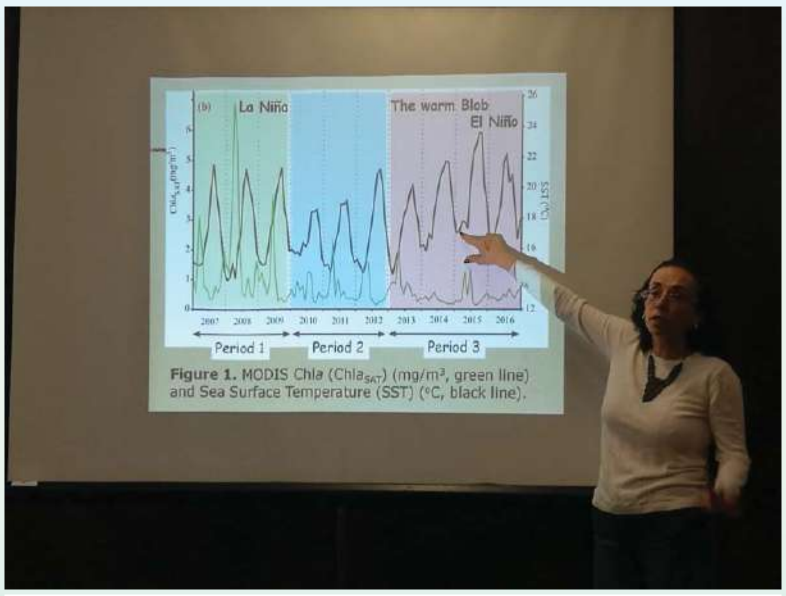
• Extend the geographic coverage of the study sites, especially in Africa and South East Asia, where several NANO members are located.

The global project is mentored by two senior scientists: Dr. Grant Pitcher (University of Cape Town, South Africa) and Dr. Milton Kampel (National Institute for Space research, Brazil).

Project web page: https://nf-pogo-alumni.org/projects/global/



Countries represented in the 1st workshop of the NANO global observation project.

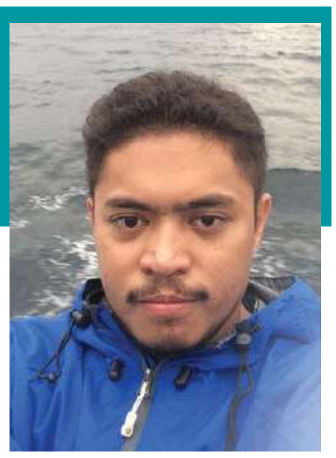


Workshop participant Adriana Gonzalez presenting results from a time-series analysis of MODIS Chlorophyll-a and SST at the Ensenada ANTARES station in Mexico. Photo credit: Houssem Smeti.

When NANO ponders...

Two points of view in regarding the enhancement of global jellyfish population

Gerry G. Salamena[1] and Michael Kingsford[2]



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Abstract

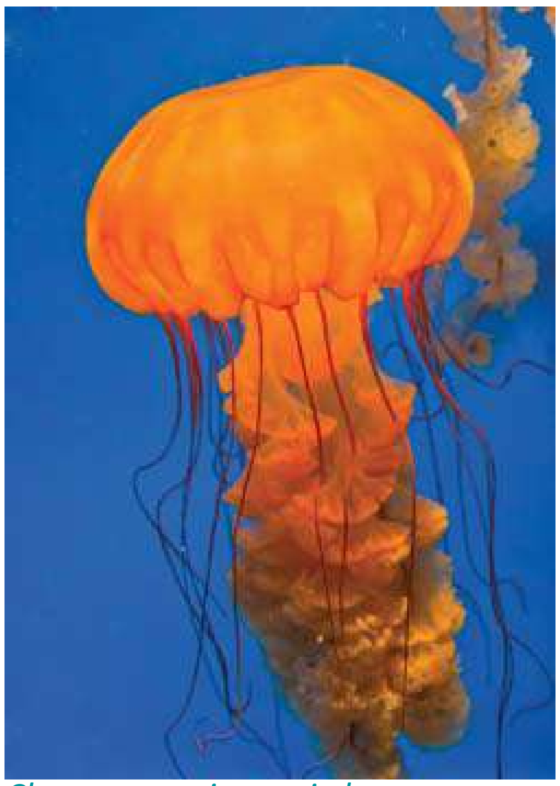
Climate change and anthropogenic impacts can play an essential role in driving changes in the marine environment and thus these changes influence jellyfish population worldwide. As a result, the enhancement of jellyfish population globally can be regarded as a result of these impacts. However, both climate change and anthropogenic activities have their own ways in affecting the upward trend of jellyfish population. The change in the magnitude of ENSO and NAO under global warming can be regarded as proxies to project this upward trend of the jellyfish population in climate change's point of view. On the other hand, annual rate of coastal development and overfishing of jellyfish predators can be considered as the other proxies to present an outlook of the possibility of jellyfish population enhancement due to anthropogenic impact.

Introduction

Jellyfish blooms are a condition in which jellyfish has a high abundance in marine environment (Purcell, 2005). These jellyfish blooms occur annually in sub-tropical and polar regions and are representative of seasonal variability of the organisms (Brinckmann-Voss, 1996; Fraser, 1970; Ishii & Katsukoshi, 2010). Recently, according to long-term time series data of the jellyfish blooms (1940-2011) recorded in many waters around the world, the global population of jellyfish seems to show an upward trend (Condon et al., 2013). Some argue that this may be a result of the increase of jellyfish population in recent years on global scale (Mills, 2001; Pauly et al., 2009; Purcell et al., 2007; Xian et al., 2005) while on a local scale, there is also an indication of this increase (Mills, 2001). This enhancement is believed to be representative of essential changes that have been taking place in the marine ecosystems (Parsons & Lalli, 2002). The question that should be addressed is "what types of changes occurring in the marine ecosystems drive the enhancement of jellyfish population?". There are two possible aspects thought to be likely the answer to represent changes of marine ecosystems: climate change and anthropogenic impacts (Purcell et al., 2007). On the one hand, since climate modes (e.g. El Niño Southern Oscillation, ENSO and North Atlantic Oscillation, NAO) have statistical relationship with jellyfish blooms (Lynam et al., 2005; Raskoff, 2001), the increase of magnitude of these climate modes (IPCC, 2007) might be believed to be significant to drive the intensity of jellyfish blooms due to ocean warming on the pelagic environments (Purcell, 2012). On the other hand, human activities such as intensive coastal developments cause coastal pollution, eutrophication processes and artificial structures by which the jellyfish blooms can occur (Condon et al., 2013; Purcell et al., 2007). Moreover, overfishing also plays a significant role in these blooms (Lynam et al., 2006; Xian et al., 2005). Although both climate change and anthropogenic impacts seem to contribute to the increase of jellyfish population, it is important to examine in what ways the increase of population of jellyfish can be attributed to these drivers. This essay will discuss how climate change and anthropogenic activities can play essential roles in causing the increase in jellyfish populations.

Roles of climate change in influencing enhancement of jellyfish population

In terms of climate-jellyfish abundance relationship, climate variability plays a significant role to drive jellyfish blooms (Lynam et al., 2005). This discussion is only concerned on North Atlantic Ocean as most of the long-term time series data of jellyfish abundance is located in this region (Condon et al., 2013). North Atlantic Oscillation (NAO) index (NAOI) shows a significant correlation with jellyfish abundance (Lynam et al., 2005). This climate signal influences the blooms via its role on oceanographic features such as ocean currents over North Atlantic Ocean e.g. Gulf Stream current, Continental Shelf Jet, Labrador Sea Intermediate Water and North Atlantic Deep Water which directly affect the prey of jellyfish in this particular region (e.g. copepods) (Planque & Taylor, 1998; Reid et al., 1998). For example, the position of Gulf Stream driven by the NAO has high correlation with most of copepods abundance over North Sea (Planque & Taylor, 1998) while NAO index exhibits inversely high correlation with abundance of *Calanus finmarchicus* and *Calanus helgolandicus*, the predominant copepods in northern and southern parts of the North Atlantic (Fromentin & Planque, 1996). Besides NAO, ENSO interannual event also influences the abundance of the prey of jelly fish via the strength of Gulf Stream current via atmospheric forcing (Taylor et al., 1998). Furthermore, ENSO teleconnection strengthens low NAO condition (Giannini et al., 2001; Li & Lau, 2011) by which *C. finmarchicus* can bloom (Fromentin & Planque, 1996; Planque & Taylor, 1998). This implies that climate signals such as NAO and ENSO can play a significant role to drive jellyfish blooms in North Atlantic Ocean. In addition, with regard to the changes in the amplitude of NAO and ENSO in the future due to global warming (Gillett et al., 2003; Guilyardi, 2006; Van Oldenborgh et al., 2005; Zelle et al., 2005; Zhang et al., 2008), we can expect that the magnitude of jellyfish blooms would increase in the future.



Chrysaora quinquecirrha.
Photo credit: Antoine Taveneaux

Anthropogenic activities and the increase of jellyfish population

On small scales such as coastal environments, there are anthropogenic impacts related to jellyfish abundance. Firstly, the existence of artificial structures driven by coastal industries and shipments can provide refuge for jellyfish polyps, the early stage of jellyfish life phase; this refuge function enables jellyfish to bloom (Condon et al., 2013; Duarte et al., 2012). Secondly, coastal pollution leads to eutrophication (Purcell, 2012; Purcell & Arai, 2001; Purcell et al., 2007). Eutrophication provides hydroxic condition which is low dissolved oxygen in water column (Purcell et al., 2001) and this condition is favorable for some species such as *Chrysaora quinuecirrha* and *Mnemiopsis leidyi* (Purcell et al., 2001). Finally, overfishing also may contribute to trigger the blooms because this activity can eliminate the jellyfish's predator (Purcell & Arai, 2001). For instance, *Chrysaora* and *Cyanea* blooms are triggered by overfishing of their predators (Lynam et al., 2006; Xian et al., 2005). The following are the details of the influence of these three major anthropogenic factors on the increase of jellyfish population

In terms of the increase of the jellyfish population worldwide due to human artificial structures, it is important to consider in what way jellyfish population is claimed to be increased. This is because years of observations did not show the existence of jellyfish polyps on the artificial structures (Duarte et al., 2012). In fact, the high abundance of the jellyfish polyps appears when establishment of new structures in coastal areas exists (Duarte et al., 2012). This implies that the higher abundance of jellyfish polyps is dependent on the rate of new structure deployment in the ocean. Global annual growth rate of artificial structures of aquaculture farms, maritime shipping, and offshore wind energy are 7.5%, 3.7% and 28.3%, respectively (Duarte et al., 2012). Thus, these rates could indicate possibility of upward trend for abundance of jellyfish polyps worldwide on coastal areas.

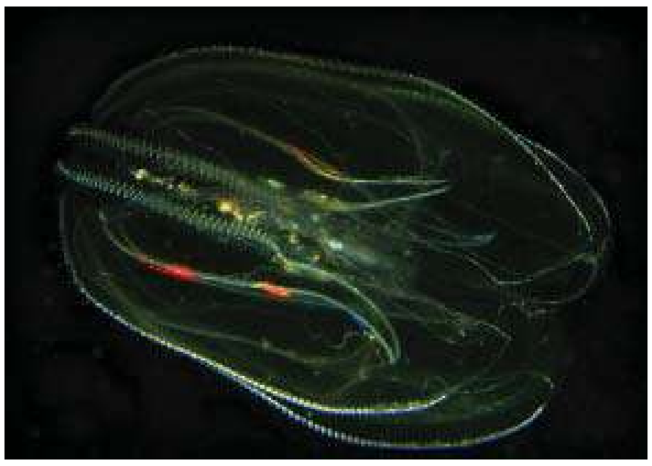
For a contribution of coastal pollution due to eutrophication causing jellyfish blooms, offshore aquaculture farms contribute to hypoxia conditions favorable to some jellyfishes (e.g. *Chrysaora quinuecirrha* and *Mnemiopsis leidyi*) (Diaz et al., 2012; Purcell et al., 2001). This environmental condition is contributed by pollution from fish feeding (Diaz et al., 2012; Ojiegbe, 2008). The rate of global aquaculture development on the coastal areas is 7.5% per year (Duarte et al., 2012) and thus this rate can be used to predict increases in populations of *Chrysaora quinuecirrha* and *Mnemiopsis leidyi*.

In terms of the upward trend of jellyfish population due to overfishing, Japanese authors have reported this upward trend since the 1960s and 1980s in Tokyo Bay and Seto Inland Sea, respectively (Omori et al., 1995; Uye et al., 2003). Furthermore, Lynam et al. (2006) also reported that overfishing taking place intensively since the 1970s in the northern Benguela upwelling region, off Angola, has resulted in the increase of jellyfish abundance. Overfishing can play a significant role in increasing the jellyfish population because the activity may remove both jellyfish predators and jellyfish competitors (Purcell & Arai, 2001). For instance, jellyfish predators are some commercial fish such as *Onorhynchus keta*, *Peprilus triacanthus* and *Squalus acanthias* (Arai, 1988; 2005; Purcell & Arai, 2001). If the demand for these commercial fish species increases, jellyfish growth could be enhanced by reduced predation. In fact, the demand for these jellyfish grazers for food has increased. For instance, the demand of *O. keta* as food shows upward trends (Morita et al., 2006).

This demand enhancement implies that in temporal scale overfishing on this jellyfish predator can increase jellyfish abundance.

Conclusion

In summary, both climate change and anthropogenic impacts have their own roles to describe the increased population of jellyfish in recent years. Magnitude enhancement of NAO and ENSO due to global warming could drive the increase of jellyfish population via physical and biological oceanographic influence including ocean currents and availability of food for jellyfish. On the other hand, anthropogenic impacts could provide their influence to increase jellyfish population through rate of coastal development and rate of fishing.



Mnemiopsis leidyi. Photo credit: Vidar@aqua

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NANO Profile - Q&A

Marie-Fanny Racault

Earth Observation Scientist, Plymouth Marine Laboratory, United Kingdom

Dr. Marie-Fanny Racault is an experienced Earth observation scientist. Her field of expertise includes the influence of global and regional climate phenomena on the variability of primary producers and assessing future responses of the marine ecosystem under climate change. She is keenly involved in capacity building, working with fellows from developing countries, and creating educational and research tools. Dr. Racault was present at the meeting that led to the creation of NANO in 2010, and has been a friend of the network since then. Dr. Racault was also an invited speaker at the SAFARI 2 Symposium.

NN You were an invited speaker at the 2nd Symposium on Societal Applications in Fisheries and Aquaculture using Remote Sensing Imagery (SAFARI 2). How well developed is this field, at both global and regional scales?

MR First, I would like to recommend reading two very good reviews on the topic of "Biological oceanography and fisheries management" published in 1996 and 2007 by Platt and Sathyendranath[1] and Platt et al.[2], respectively.

I will now share some reflexions about Ocean-Colour Remote-Sensing Applications based on my experience in this field, which started around 2006. At that time, one decade of continuous ocean-colour observations had just been gathered by the satellite sensor SeaWiFS (launched in 1997); another two sensors MODIS and MERIS had been in-orbit since 2002. The ocean-colour observations that had been collected were extremely valuable and exciting to work with: we were able to analyse, anywhere in the oceans, the year-to-year variations of primary producers at ~1km and ~1day resolution. This high spatio-temporal resolution combined with the multi-year availability of the observations permitted us to resolve very important and long-standing hypotheses in the field of fisheries and oceanography. In particular, in 2003, Platt et al. verified and tested operationally the 100-year old match/mismatch hypothesis of Cushing and Hjort relating the success of fish larval recruitment to the timing of availability of primary producers. A few years later, in 2008, a suite of ecological metrics to evaluate the health of the ecosystem was described (see Platt and Sathyendranath, 2008). The metrics provided an operational context to using remote-sensing information as a decision support tool in fisheries management; and inspired the work of many researchers, including myself. For instance, during my PhD, I developed ocean-colour applications of phytoplankton phenology (i.e., one type of ecological metric) for the global oceans.

In the following decade, from around 2010, emphasis has been given to the generation of multi-decadal continuous datasets of Essential Climate Variables (ECVs). In the field of remote-sensing, research efforts supported by the European Space Agency Climate Change Initiative (CCI) programme have permitted us to merge observations from multiple satellite sensors and construct error-characterised, bias-corrected, climate-quality controlled datasets of 13 ECVs, including ocean-colour (http://www.esa-oceancolour-cci.org). With these new datasets, researchers are improving our understanding of bio-physical interactions, climate feedback mechanisms, and evaluating climate impact on the marine ecosystem at local, regional and global scales. This new information is starting to be widely used to inform decision-makers of possible risks and benefits to fisheries, biodiversity, and how these may affect ecosystem services and dependent communities.

The remote sensing developments realised and consolidated over the past decades have been well reflected in the sessions laid-out at the SAFARI2 Symposium, with presentations on remote-sensing applications in Biodiversity, Aquatic Environment and Ecology, Harvest Fisheries, Fisheries Management, Socio-economics and Communication Technologies in Disaster Management, and Aquaculture. The presentations provided strong evidence on how research findings based on remote-sensing observations are helping us to improve and protect the lives of fishermen and reduce their fuel consumption, by providing them for instance with maps of SST and ocean-colour fronts, and high-resolution weather conditions. We also saw examples of applications in the detection and generation of maps of Harmful Algal Blooms, providing essential information for aquaculture, tourism, and human health. The next key steps will be to provide operational contexts for these applications and improve interpretation of remote-sensing information so that it can be used routinely by decision makers and further help us to protect the marine environment and its resources.

NN From your experience, what advice would you give to a young scientist starting in this field?

MR My suggestions would be to start by: 1) reading some of the comprehensive reports and reviews, which are publicly available from the International Ocean Colour Coordinating Group (IOCCG) website: http://ioccg.org/what-we-do/ioccg-publications/ioccg-reports/; 2) attending an introductory course and tutorial on ocean-colour – I would recommend looking at online courses, such as the Monitoring the Oceans from Space https://www.futurelearn.com/courses/oceans-from-space and the Ocean-Colour Data in Climate Studies https://classroom.oceanteacher.org/enrol/index.php?id=286 (all material and tutorials can be looked at from your own workstation, with free-of-charge access), and attending a short course or summer school – these are offered for instance via EUMETSAT/ Copernicus Platform http://training.eumetsat.int, IODE/IOC Ocean Teacher Global Academy https://classroom.oceanteacher.org, and IOCCG http://ioccg.org/2018/01/february-2018/. These courses will usually provide you with the fundamentals of ocean-colour, as well as help you to get started with hands-on practical applications. You will also be able to make new and long-lasting connections with the course lecturers and other fellows who are also starting in the field. These courses should help you to access the best available knowledge and data products to develop your own research projects.

NN You have recently become involved in a project to survey and forecast cholera outbreaks in India. Can you tell us more about this project and the links between remote sensing and human health?

MR The new project, REVIVAL - Rehabilitation of Vibrio-infested waters of Lake Vembanad, is a UK-India collaborative funded project, aiming at finding a solution for the disease outbreaks of cholera that affect 1.6 million people living along the shores of the Lake Vembanad in Kerala, India.

We are working with a wide-range of datasets, including in-situ field measurements, remote-sensing observations from miniature drones and from Earth-orbit spacecraft, microbial lab-cultures, mesocosm experiments, and also genetic information. We combine and analyse these datasets to advance understanding of the links between lake organisms and the cholera disease outbreaks, the environmental conditions that allow pathogens to survive and spread, how their abundance changes by season, and how they can infect the communities living on the lake's shores.

The project is led by NANO Patron Prof. Shubha Sathyendranath at the Plymouth Marine Laboratory (PML, UK) and carried out in collaborations with several NANO alumni based at the PML, the Nansen Environmental Research Centre (NERCI, India), the Central Marine Fisheries Research Institute (CMFRI, India); and with researchers from the University of Stirling (UK) and the National Institute of Oceanography Kochi (CSIR-NIO, India).

In the next decade, new remote-sensing applications for human health studies are likely to emerge and evolve rapidly. These new developments will be facilitated by coincident technological and analytical advancements in the fields of remote-sensing, e.g., ESA Sentinel observations available at ~300m resolution, drones using multispectral imaging camera sensors; genetics, e.g., rapid micro-arrays, whole-genome sequencing; modelling e.g., bioinformatic tools deciphering interactions at the molecular level, high-performance computing; and climate e.g., robust and high-resolution prediction systems. However, this panoply of information is not straightforward to analyse comprehensively and the formation of multidisciplinary teams will be essential if we are to develop novel Earth observation applications for human health that will provide data products such as disease outbreak risk-maps, which will help protect and save human lives.

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1 http://www.ices.dk/sites/pub/CM%20Doccuments/1996/O/1996_O3.pdf

2 https://academic.oup.com/icesjms/article/64/5/863/642505

NN Let's talk a bit about NANO. You were present at the inaugural meeting in Abingdon, 2010. Since then, the network has grown and started new challenges such as joint research and outreach initiatives carried out by our alumni. What are your thoughts on such initiatives?

MR I have been extremely impressed by the breadth of research projects developed by the NANO community. These projects address fundamental and contemporary issues related to regional water eutrophication, Harmful Algal Blooms, invasive species, fisheries, societal awareness, shoreline erosion, long-term time-series stations, as well as global changes in productivity, deoxygenation and ocean acidification. Such projects, together with the NANO outreach initiatives, have helped significantly in building necessary regional and global networks of experts, providing an excellent framework for the community, especially for young researchers to express and develop new ideas, and foster the implementation of sustained long-term ocean observations.

Dr. Marie Fanny, invited speaker and session chair at SAFARI2, receiving a memento from the symposium organisers.

NN How would you describe NANO progress in these years of the network? Do you have any suggestions to help steer its future?

MR I believe that NANO should be extremely pleased by the outstanding progress and accomplishments (e.g., research projects, publications, outreach activities, sustained time-series of ocean observations…), and the remarkable regionally-balanced growth of its alumni community over the years. The NANO News articles have really helped members to stay connected, find out about new developments and opportunities, and promote connection between young and more established researchers.

In terms of future development, I think that it would be really valuable if NANO increased its visibility with intergovernmental organisations and related initiatives such as the GEO Blue Planet. Furthermore, long-term rewards could be achieved from sustained support of NANO to its existing regional projects (see examples of projects in question 4 above) as well as support new project developments. The rewards would be apparent as the community would have sufficient time to build new capacity, to strengthen this new capacity, and permit delivery of sustained and high-quality ocean observations with associated scientific analyses and publications. Such progress may only be achieved by providing sustained support over the course of a few years.

Finally, I believe that additional benefits would be gained if NANO could also support on-going and new activities, such as research projects or working groups, which have not been created under the NANO umbrella, but which involve a group of alumni (an example is the new REVIVAL project, in which five NANO alumni are working together with other international partners, see further details in question 3). Towards these kinds of activities, NANO's contributions could be practical (e.g., sharing projects or working groups' information with the NANO community and the public via social media), financial (e.g., providing funds to help alumni attend regional or international events or workshops), and advisory (e.g., recommendations on best practice to communicate with international organisations or local communities affected by the research).

Sea ice phenology in the Caspian Sea

Forough Fendereski
Helmholtz Centre for Polar and Marine Research, Alfred Wegener Institute, Germany
Alumna profile: https://nf-pogo-alumni.org/profile/foroughfendereski/

The Caspian Sea (CS) is located in the Western Asia and the Eastern Europe. With a surface area of approximately 378,000 km^2, the CS is considered as the world's largest enclosed water body (UNEP, 2006). Due to its latitudinal extension, the CS crosses multiple climatic zones and encounters a strong north to south gradient in geological, physical, and chemical properties (Barale, 2008; Kosarev, 2005). These conditions create different habitats for the diverse groups of organisms living in this complex ecosystem (Kosarev and Kostianoy, 2005; UNEP, 2006). Conventionally, the CS has been divided into three major basins according to water depth and geographical location, namely the Northern, Middle, and Southern CS (Fairbridge, 1966; Ibrayev et al., 2010). The North Caspian Sea (NCS) is very shallow (with an average depth of less than 5m and maximum depth of 20m; UNEP, 2006) and is located on the extreme southern boundary of sea ice cover development in the Northern Hemisphere (Kouraev et al., 2004). Every year, its surface area freezes during winter, while most of the middle and south CS stays ice free year-round (Kosarev, 2005; Barale, 2008). Thickness of sea ice may reach to 75 cm in the western and central NCS and 120 cm in the eastern parts of this basin. The cumulative impacts of climate conditions, wind fields, water currents, and sea morphology lead to a significant temporal and spatial variability in the sea ice cover over the CS (Kouraev et al., 2004).

Here, I studied sea ice phenology (freeze-up, break-up, and duration) in the NCS for the period 2004 to 2012. I used sea ice data, provided by the Centre for Ice Hydro-meteorological Information at the Arctic and Antarctic Research Institute in St. Petersburg (AARI). Weekly binary maps of sea ice presence and absence in 0.1 x 0.1 degree resolution were created. Percentage of sea ice cover over the NCS in each year was computed as the total number of ice covered pixels in each year divided by the total number of pixels in the NCS. Time of ice formation (week) was considered as the time when sea ice appeared for the first time in a year in a pixel that was ice free in its previous two weeks. The time of ice break up (week) was calculated as the time when ice was observed for the last time in a year in a given pixel, while the pixel remained ice-free for at least two subsequent weeks. The duration of ice coverage in a pixel (weeks) was calculated as the difference between the time of ice formation and ice melt. Linear trend in the sea ice phenology (start, end, duration) for each pixel during the period of study (2004 to 2012) was analyzed using Mann-Kendall test ($P<0.05$). The magnitude of inter-annual variability (iv) in the phenological characteristics of the sea ice (i.e., timing of the ice formation and break-up, and the duration of the sea ice coverage) for each individual grid point in the NCS was computed based on the standardized temporal anomalies in the ice phenology metrics in each year. To this aim, the differences between all the grid points for each phenological feature in each year and their climatological averages (2004-2012) were computed and divided by the standard deviation (2004-2012; Soppa et al., 2016). Average climatologies of anomalies of the phenological features over the study period (2004-2012) were calculated and the magnitude of their interannual variability were computed as absolute temporal mean of anomalies from 2004 to 2012.

Results show that percentage of sea ice covered area in the CS took a fluctuating trend from 2004 to 2012, from as low percentages as 54.24 and 71.19% in 2004 and 2007 to as high as 89.79 to 89.97% in 2008 and 2006, respectively (Fig. 1). The observed oscillation in the sea ice coverage can be explained by changes in the severity of different winters during this period (Kouraev et al., 2004). A gradual west/southwards gradient is observed in the time of the sea ice formation in the NCS. The shallow eastern parts of the NCS freeze earlier than other parts of the NCS (from the second half of November to the first half of January; Fig. 2a). The sea ice later spreads out to the west (because of the Volga runoff impact; Kouraev et al., 2004) and the latest ice develops in the southern parts of the NCS (in late February and early March; Fig. 2a), where larger depths and increase in the water exchange with the Middle CS limit further development of sea ice cover in this area (Kouraev et al., 2004). CS ice decays earlier in the southern parts of the NCS (from as early as the first half of January), then in the western parts of this area near the Volga delta, and finally, last CS ice disappears in the eastern parts of the NCS (as late as March and April), where the thickest ice is observed (average of 40-50 cm; Kouraev et al., 2004; Fig. 2b). Expectedly, longest periods of ice coverage are in the eastern NCS

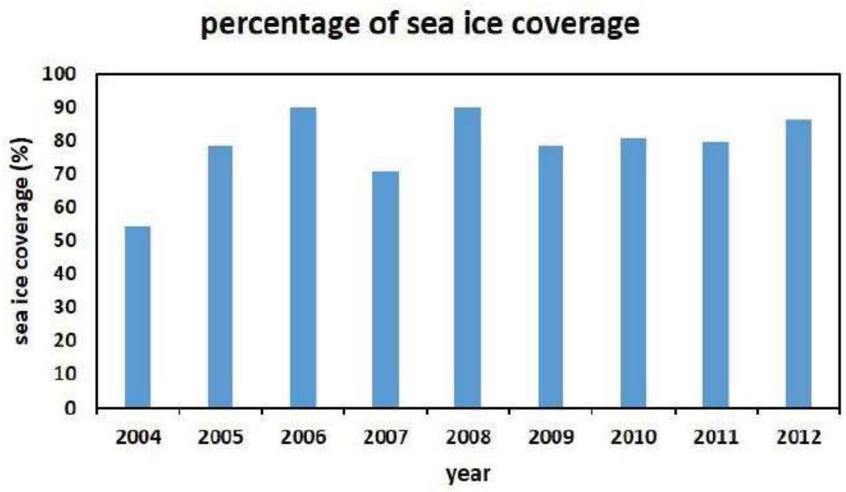

Fig. 1 Percentage of sea ice coverage in the north Caspian Sea from 2004 to 2012.

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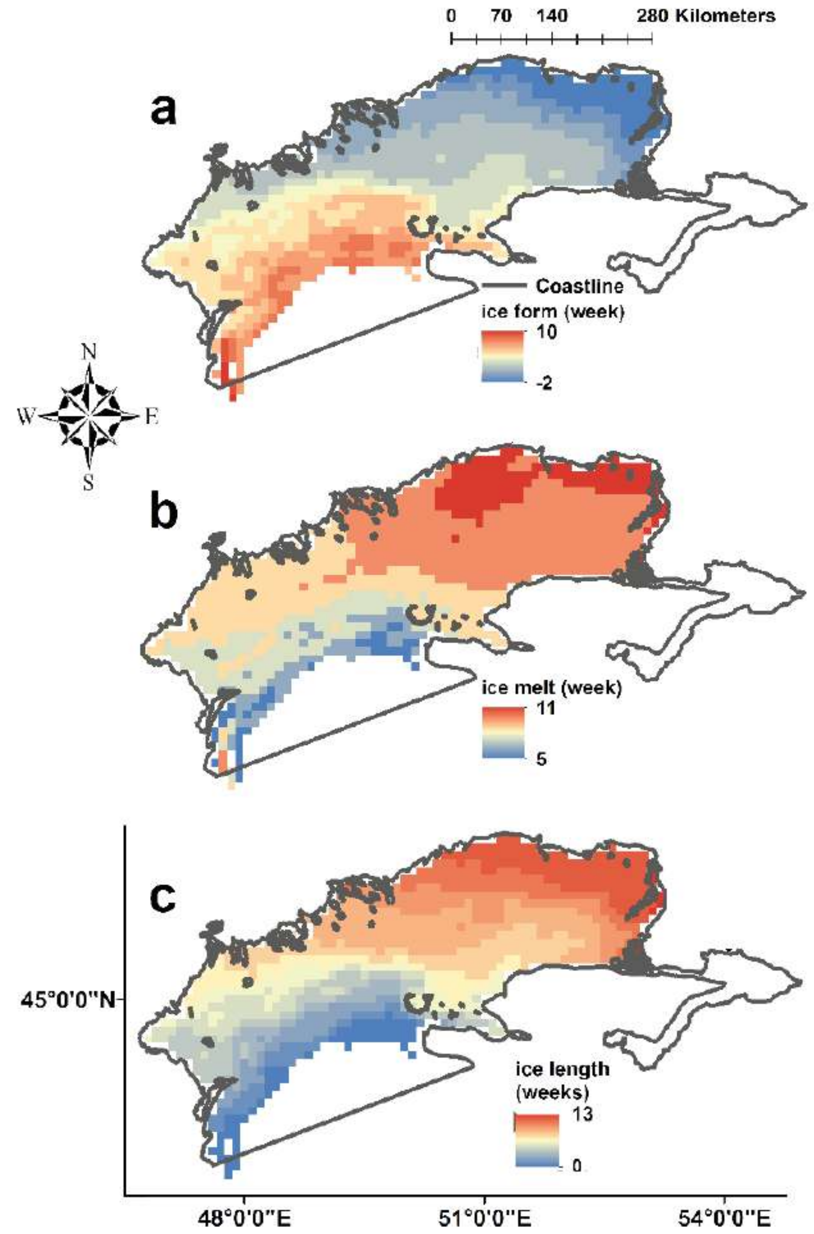

Fig. 2: Climatological mean of the timing of the (a) sea ice formation (week), (b) sea ice melt (week), and (c) duration of the sea ice coverage (weeks) in the Caspian Sea from 2004 to 2012.

(8-18 weeks) and as we go further west and south, sea ice lasts shorter (Fig. 2c). Previous studies also demonstrated similar spatial patterns in the CS ice phenology (Kouraev et al., 2004). Likewise, Kouraev et al (2004) found correspondence between their observed timing of the sea ice in different regions of the NCS with the historical observations in the region. Spatial differences in the sea ice timing has been also reported in other parts of the World Ocean (for example, Ji et al. (2012) in the Arctic Ocean).

Significant trend is observed in the timing and duration of the sea ice in most parts of the NCS ($P<0.05$; Fig. 3). 94.67% of the NCS show significant trend in the time of their ice freeze-up from 2004 to 2012, the majority of which (67.09%) show trends towards earlier ice formation dates ($P<0.05$; Fig. 3a). While eastern NCS region shows negative trends in the time of ice start, western parts show positive trends ($P<0.05$; Fig. 3a). In contrast to the ice formation times, of 69.05% area in the NCS that shows significant trend in the time of ice decay, 88.21% show trends towards later ice break-up ($P<0.05$; Fig. 3b). In terms of the length of ice period, of 71.76% area of the NCS that shows significant trends in this metric, with 91.74% of these pixels show trends towards longer periods of ice cover ($P<0.05$; Fig. 3c). In terms of the interannual changes in the sea ice phenology in the NCS, generally, timing of the ice formation and the duration of ice coverage show higher degree of interannual variability from 2004 to 2012 than the timing of the ice disappearance (Fig. 4). Almost 91% of the NCS show higher than 0.7 weeks of interannual variability in the time of the beginning of their ice season and duration of their ice season (Fig. 4a and 4c, respectively), while only 42.52% of this basin show the same degree of interannual variability for the time of ice break-up (Fig.4b). Unlike the ice phenology metrics, no pronounced spatial gradient in the interannual changes of ice phenology characteristics are observed during the period of study (2004 to 2012; Fig. 4).

Previous works on the ice in the CS for a period from 1998 to 2002 showed changes in the dates of ice start and break-up and gradual reduction in the ice cover (Kouraev et al., 2004). They attributed their observed changes in the CS ice to the changes in the thermal regime towards mild winters in this region and left the open question of whether the observed changes are indicative of a long-term warming trend or just a series of warm winters. They suggested that one way to answer their question is to extend time series with new types of data. Covering the period from 2004 to 2012, results of the current study did not show similar patterns as observed between 1998 and 2002. That is, I observed interannual fluctuations in the sea ice extent rather than a decreasing trend in this feature, and in contrast to

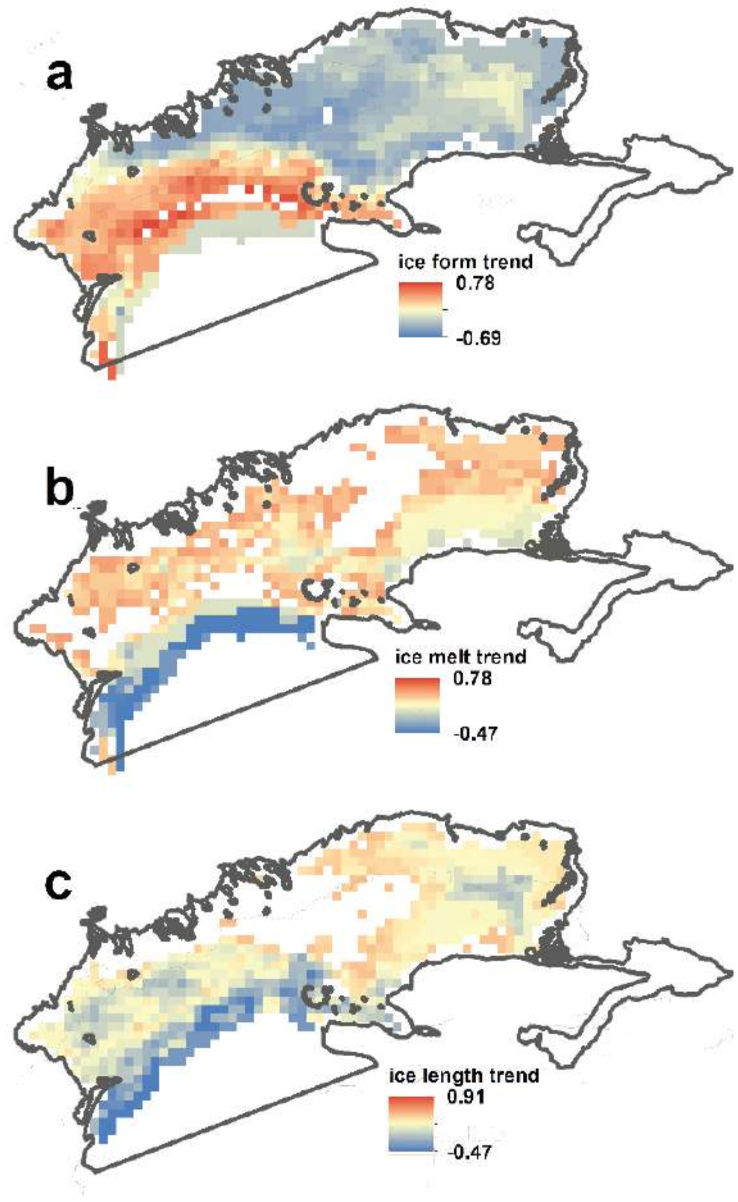

Fig. 3: Trend in the (a) sea ice formation, (b) sea ice melt, and (c) duration of the sea ice coverage in the Caspian Sea during 2004 to 2012 ($P<0.05$). White pixels indicates no significant trend in the sea ice phenology in the Caspian Sea during the period of study (2004 to 2012; $P>0.05$).

previous reports, my results showed trends towards earlier ice formation and longer ice periods in most parts of the NCS.

In summary, results of this study showed regional differences within the NCS in the sea ice phenological features during 2004 to 2012. Earlier sea ice formation, later ice melt, and longer ice periods were observed in the eastern NCS. Most of the NCS region showed significant trends towards earlier ice formation, later ice melt, and longer ice periods ($P<0.05$). Given the ecological importance of the NCS, in particular the eastern parts of this basin as a reproduction, nursery, and moulting habitat for unique and vulnerable species, such as the Caspian seal (Phoca caspica; Dmitrieva et al, 2015), which is listed on the IUCN Red List of Threatened Species, and considering the importance of the sea ice timing on phytoplankton bloom phenology (Ji et al., 2012), and thereby the whole food web (match-mismatch hypothesis; Cushing, 1990; Platt et al., 2003), the observed changes in the CS ice suggest the necessity of a comprehensive study on the impact of global warming on the sea ice and primary producers' phenology and their implications for higher trophic levels in this area.

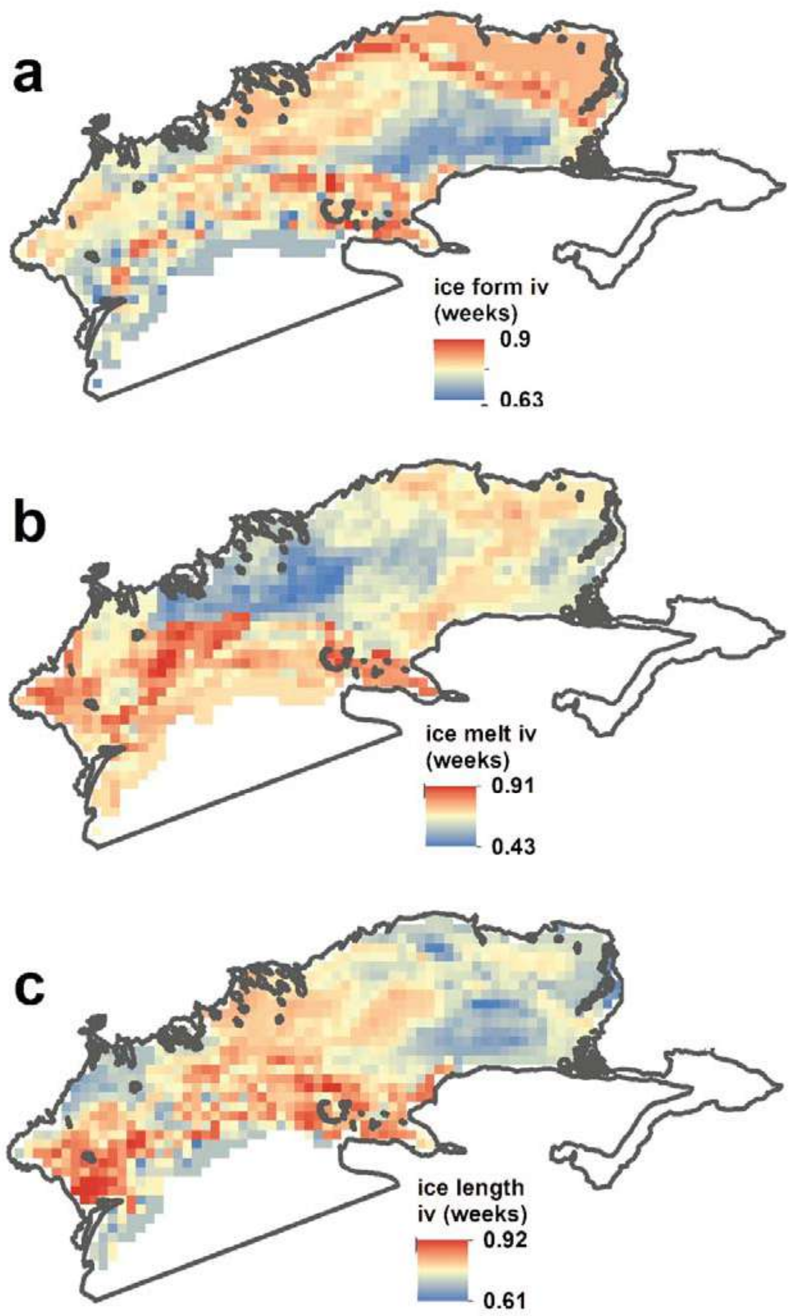

Fig. 4: Climatological mean of the standardized anomaly of the magnitude of interannual variability (iv) in the (a) sea ice formation (weeks), (b) sea ice melt (weeks), and (c) duration of the sea ice coverage (weeks) in the Caspian Sea during 2004 to 2012.

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Scientific events announcements

4th GEO Blue Planet Symposium
Toulouse, France
4 – 6 July 2018

The symposium will serve as a forum for discussion of ocean and coastal information for sustainable development, Blue Growth and societal awareness. The symposium will bring together producers, and current and potential users, of ocean and coastal information, who will share their experience with the audience.

Deadline
13 May 2018

Contact: via website
https://symposium.geoblueplanet.org/

Oceans and Climate Change
Valetta, Malta
12 - 14 June 2019

Bearing in mind the central role oceans play in our planet, it is very important to identify and quantify the impacts of climate change on oceans, and discuss and disseminate ways and mechanisms via which these can be addressed. It is based on the above needs that the Symposium "Oceans and Climate Change: towards a better understanding and handling of the impacts of climate change to oceans, biodiversity and livelihoods" is being organized. During the event, an update on the production of the "Special Report on the Ocean and Cryosphere in a Changing Climate" (SROCC), prepared by IPCC and to be finalized in September 2019, is expected to be presented.

Deadline
30 July 2018

Contact: jelena(@)barbir.com.es
https://www.haw-hamburg.de/en/ftz-nk/events/oceans2019.html

Gordon Research Seminar - Biogeochemistry of Marine Interfaces
Kowloon, Hong Kong
7 - 8 July 2018

The Gordon Research Seminar on Ocean Biogeochemistry is a unique forum for graduate students, post-docs, and other scientists with comparable levels of experience and education to present and exchange new data and cutting edge ideas. The 2018 GRS on Ocean Biogeochemistry will highlight research being conducted by early career scientists at and between marine interfaces. Oral presentations, poster sessions, and open floor discussions will focus on biogeochemical fluxes between the atmosphere and the ocean; between the surface ocean, the mesopelagic zone, and abyssal depths; between the deep ocean, the seafloor and the sub-seafloor; between coastal and open ocean environments; and along meridional gradients. Science policy work relating to these topics will also be considered.

Deadline
9 June 2018

Contact: Via website
https://www.grc.org/ocean-biogeochemistry-grs-conference/2018/

13th CoastGIS Symposium and Exhibition - "Spatial Planning and Climate Change"
Ísafjörðu, Iceland
27 - 29 September 2018

CoastGIS is a biennial series of symposia that brings together practitioners and researchers in the field of marine and coastal Geographic Information Systems, remote sensing and computer cartography. It is an established major international coastal and marine event attracting delegates from around the globe. The conference theme "Spatial Planning and Climate Change" refers to the challenges faced worldwide in light of climate change, particularly in the Arctic. Also emphasis will be on cooperation in spatial planning between countries.

Deadline
20 August 2018

Contact: coastgis2018@uw.is
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