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Blue Economy Knowledge System (BEKS)
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Project	Sargasso Sea Commission: Governance of high-seas ecosystems and the use of Big Data/AI
Search themes	Big data and AI in ocean governance references - **GLOBAL**
Search period	9/11/2021 – 24/11/2021
Date of report	24/11/2021
Produced by	OSJ + AH
Recipients	NLAI team

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1 General Ocean Governance

1.1 Maritime Unmanned Systems Innovation Advisory Board discuss NATO innovation in maritime domain | Mirage News (November 2021)

The NATO Maritime Unmanned Systems (MUS) Innovation Advisory Board met on the 9-10 November 2021 for the first time at NATO Headquarters. It provides advice to NATO HQ on the development and use of Maritime Unmanned Systems and all new technologies in the maritime domain.

Since its creation in 2019, the MUS Innovation Advisory Board has been providing strategic advice to deliver capabilities and use new technologies to "change the game" in the maritime domain. The Digital Ocean Concept was presented in Spring 2021 at the Conference of National Armaments Directors (CNAD) and has been adopted by key Allied Navies. The Concept is designed to improve Allies' capacity to 'see our oceans' through the creation of a global scale network of sensors, from sea bed to space, to better predict, identify, classify and combat threats. It envisages maritime domain awareness, subsea sensors, unmanned surface vessels, drones and satellites, and exploits AI, big data and autonomous systems, alongside conventional assets.

This week, the NATO MUS Innovation Advisory Board engaged with experts and staff at NATO Headquarters to discuss innovation methodologies to accelerate capability development, in particular testing and developing new technologies in the maritime domain.

The Assistant Secretary for Defence Investment, General Camille Grand, and the Deputy Assistant Secretary General, Robert Weaver, discussed and endorsed recent achievements by the Board.

Mr. Grand said:

"A digital ocean is a fine example of an opportunity to exploit new and emerging technologies to maintain our operational advantage. We are committed to delivering the right capabilities our Alliance needs to carry out its core tasks and maintain our technological edge over potential adversaries and challengers. The MUS IAB are a very talented board who are committed to helping us achieve our goals, it is exciting and a privilege to have convened this Board here this week – I believe much good lies ahead!"

In line with NATO 2030, further development of the Alliance's vision of a digital ocean will help mitigate the risks of climate change, protect undersea critical infrastructure and safeguard essential supply chains and strategic waterways in a more affordable, sustainable and safe way.

1.2 The symposium on Global Maritime Cooperation and Ocean Governance 2021: Law, Blue Economy and Maritime Safety Cooperation

SANYA, China, Nov. 11, 2021 /PRNewswire/ -- The symposium on Global Maritime Cooperation and Ocean Governance 2021, held by National Institute for South China Studies, China, also focuses on themes containing "Frontier Research on International Law of the Sea", "Ocean Governance Practices in the Arctic", "International Cooperation on Maritime Security and Safety under the Influence of Covid-19", and "Blue Economy and Sustainable Ocean Development". Speakers shared their views on a variety of frontier research on International Law of the Sea (UNCLOS), including the role of UNCLOS in BBNJ negotiations and the relevance of UNCLOS on Anthropocene. The discussion was later extended over territorial entry in search and rescue operations, regional efforts on battling plastics pollution and international legal status of Coast Guards under the guidance of UNCLOS and other international law instruments, better facilitating the implementation and coordination around the existing UNCLOS regime.

Arctic states collaborative efforts and mechanisms, at different levels as well as the involvement and presence of Arctic stakeholder, commonly known as China, Japan, and Republic of Korea in Arctic affairs were also discussed. To conclude, major players in the Arctic will continue collaborating together to enhance the economic potential of the region and resolve conflicts before they emerge, as opportunities in the Arctic continue to strengthen.

International cooperation on maritime security and safety under the influence of Covid-19 has already attracted wide attention and this topic was also discussed extensively. Critical challenges faced by the world's 1.9 million seafarers including crew change crisis, no access to medical care and vaccination, required further global cooperation among international organizations and different countries. Besides, in the South China Sea, although the pandemic has significantly affected interactions among countries, the cooperation on maritime security and maritime safety particularly within the region remains robust.

Developing blue economy is another topic rising an extensive attention. In this session, inspiring suggestions based on solid field researches and advanced experience from Great Bay Area (GBA), islands state and regional countries were introduced. Hainan, as the only Free Trade Port of China and located just beside the South China Sea, has made up its mind to contribute to the regional prosperity and to better connect the world by propelling a sustainable ocean development.

1.3 COP26 Deal Sees Progress on Ocean Protection (November 2021)

Marine conservationists have welcomed an “important and hard-fought-for win” as the ocean was incorporated into the UN climate change regime at the close of the COP26 summit in Glasgow over the weekend.

But there was also a warning that any progress would be undone by the lack of near-term, verifiable action towards limiting global warming to 1.5C

“Pressure on the ocean will continue to increase,” said the OneOcean Flotilla, a collective of marine organizations that stressed the urgent need for ocean action, including “a robust High Seas Treaty, protection of at least 30% of the global ocean by 2030, a reduction in other current ocean stressors including overfishing, and in future threats such as deep-sea mining.”

The Glasgow Climate Pact, adopted late on Saturday evening, now recognizes the ocean under the UNFCCC (United Nations Framework Convention on Climate Change), with an invitation for all workstreams and constituted bodies to consider how to integrate and strengthen ocean-based action.

In its preamble, the pact highlights “the importance of ensuring the integrity of all ecosystems, including in forests, the ocean and the cryosphere, and the protection of biodiversity … when taking action to address climate change.”

Most significantly, the pact calls for an annual dialogue to strengthen ocean-based action, that will take place every May/June from 2022, before reporting back to the COP towards the end of the year.

Torsten Thiele, head of the Global Ocean Trust, who moderated the finance panel at the first UNFCCC Ocean–Climate Dialogue earlier this year, told China Dialogue Ocean: “COP26 succeeded in fully integrating ocean-based action into all workstreams. Now we need to ensure that … we have a solid commitment to stopping ocean degradation, supported by appropriate financial contribution.”

Campaigners, notably John Kerry, the US special climate envoy, had seen this annual dialogue as key to ensuring that the ocean would play a role in UN mitigation, adaptation and finance goals.

“When the world talks about the climate crisis, the ocean crisis must be front and center in that conversation. One way to ensure that happens will be to establish an ongoing forum for ocean issues here in Glasgow in the COP26 decision text,” Kerry said.

In a statement on the COP26 outcome, WWF Oceans said the annual Ocean–Climate Dialogue would be an important tool to increase ambition: “Priority actions should strengthen the mitigation, adaptation and resilience potential of the ocean, as well as dependent communities and economies, through nature-based solutions and measures that are biodiversity-positive and can deliver net-zero outcomes.”

Ocean–climate nexus

While ocean health, biodiversity and climate change have traditionally been siloed under UN processes, there has been increased recognition that they are inseparable issues. The ocean plays an essential role in climate

regulation: covering 70 percent of the planet, it absorbs CO2 and heat, and the life within it produces half the oxygen we breathe. But it is under existential threat due to anthropogenic climate change, pollution and overfishing. The latest science, particularly from the 2019 IPCC Special Report on the Ocean and Cryosphere and the 2021 Second World Ocean Assessment, indicates that tipping points are being reached and risk is increasing, namely from acidification, warming and sea-level rise.

It's not only the damage, but the ecosystem services provided by the ocean that are being increasingly valued economically and recognized politically. Protecting and restoring ocean ecosystems - from mangroves, salt marshes, coral reefs, seagrass beds to kelp forests - provides crucial services such as carbon sequestration, reducing vulnerability to storms and flooding, and supporting sustainable livelihoods for indigenous peoples and local communities.

While many high-level experts agreed that the relationship between the ocean and climate change – the "ocean–climate-nexus" – had now become mainstream, others said valuable time had been lost by excluding the ocean from the UNFCCC process for so long.

"I fervently hope that even the naysayers now realize that there cannot be a healthy planet without a healthy ocean, and that climate change and ocean change are basically one and the same thing," said Peter Thomson, the UN's special ocean envoy.

"It has taken 25 years – and we are still fighting," Waldemar Coutts, director for environment and oceans at Chile's Ministry of Foreign Affairs, commented. "That's very sad because the aim is to reach objectives of the Paris agreement, and if we don't use the nature-based solutions at hand – including the oceans – we will never reach it."

Representatives of small island states also noted progress at COP26, but stressed a need for further action. "We'd like to see [the COP] get consistently bluer," said Palau's UN ambassador, Ilana Seid. "Seeing traction in getting oceans incorporated into climate dialogue [is progress] but we need to see more. The voices of small island developing states haven't been amplified loudly enough and we must continue to push our agenda at future COPs."

New initiatives

The Glasgow Climate Pact followed two weeks of talks that saw more than 30,000 people arrive in Glasgow, including civil society, the media, world leaders and government representatives. There had been high hopes that the ocean would feature strongly on the agenda, with a dedicated themed day, and numerous side events and exhibits showcasing ocean-based climate solutions, fisheries, shipping emissions, offshore renewable energy and finance.

The first week began with 20 countries signing the third instalment of the 'Because the Ocean' Declaration, which called on states to integrate ocean, climate and biodiversity linkages in their plans to implement the Paris Agreement. More than 100 signatories to the Ocean for Climate Declaration – from civil society organizations, the private sector and academia – then called for governments to include ocean conservation initiatives within their formal commitments to reduce emissions.

In ocean funding, $145 million was announced for the Global Funds for Coral Reefs, while $20 million was committed towards supporting nature-based solutions and vulnerable communities at the Ocean Risk and Resilience Action Alliance roundtable. Elsewhere, the Great Blue Wall initiative was launched by states in the Western Indian Ocean, aiming to conserve and restore marine and coastal biodiversity, while Fiji announced its plan to issue a sovereign blue bond in 2022. Belize also pledged to develop a pioneering "project finance for permanence" scheme for marine protected areas (MPAs), conservation and coastal ecosystems.

But many ocean campaigners contrasted these initiatives against the high-profile funding pledges made on forests. "The forest people got the money and the ocean people didn't," said the Global Ocean Trust's Thiele. "We need a serious commitment to ocean climate finance. An extra $10 billion given to the oceans could have closed the gap on [the climate finance target of] $100 billion and helped the most at-risk – the small island coastal states, the people who made the Paris agreement happen.

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"[Action on oceans at COP] is not streamlined or focused in the right way, and we see from forests that this is needed. As we go into 2022 there are several big opportunities to close the finance gap – and we are asking countries to please step up and make that commitment."

After many postponements and delays due to Covid-19, there was a feeling at the talks that there is finally a solid and promising timetable of events in the next 12 months to build momentum for ocean protection. Of the months and events ahead, the UN's Peter Thomson said: "The two important conferences in my mind between now and COP27 are the biodiversity COP – where hopefully we will adopt a target of 30×30 protection of land and sea. And, secondly, the UN Environment Assembly, where I fully expect that member states will mandate the commencement of negotiations for an internationally binding treaty on plastic pollution."

Calls for "30×30" - to protect 30 percent of the world's land and ocean area by 2030 - were repeatedly made at COP26, and 77 countries are now backing the inclusion of this target in the final UN biodiversity treaty.

MPAs are considered one of the best ways to enhance coastal ecosystems, which capture and store atmospheric carbon dioxide. UN goals had aimed for 10 percent of ocean areas to be fully protected by 2020 – but only made it to 7.8 percent. "Now we say '30×30'. We need to get real here and be universal in our efforts," said Thomson. "Africa, Latin America, Russia, China need to be in there too. And we need the Southern Ocean MPAs. We would have 10×20 now if we could get them in place."

Thomson was referring to the latest round of CCAMLR talks on Antarctic protection, which recently failed - for the fifth year in a row - to increase protected areas in the Southern Ocean.

A significant announcement also made in the first week of COP26 was the plan for a new "mega-MPA" in the Eastern Tropical Pacific involving Colombia, Costa Rica, Ecuador and Panama. Enric Sala, National Geographic's explorer in residence, will next year lead an expedition to the "Ocean Highway" area using a manned submersible and remote cameras to survey current marine protected areas and identify potential new ones.

"This will be the first science ever conducted in these waters to assess abundance of marine life," Sala said. "It will also provide a benchmark against which future change will be measured."

Negotiations to protect marine Biodiversity in areas Beyond National Jurisdiction (BBNJ) – known as the High Seas Treaty – also look set to finally resume next year after delays due to the pandemic. Emmanuel Macron's One Ocean Summit, due to be held in Brest next February, reportedly aims to secure a high-level political commitment to large-scale marine protection, and give negotiators guidance for the final round of UN talks on the treaty scheduled for March in New York.

Countries are negotiating on four key topics, with the aim of ensuring that all nations can share equally and sustainably in the benefits and resources – biological and mineral – of the high seas, which cover 45 percent of the planet's surface and are home to 90 percent of marine life.

2 Coasts and Environments

2.1 Strengthening Coastal Adaptation through Innovative Technology | Mirage News (October 2021)

UN Climate Change News, 20 October 2021 – This year has seen unprecedented and life-threatening extreme climatic events across the globe, including flooding, forest fires and extreme heat. It is increasingly evident that innovative strategies under the Paris Agreement will be needed to reduce greenhouse gas emissions while adapting to the impacts of climate change.

In addition to technology, the critical role of healthy, biodiverse ecosystems in such mitigation and adaptation strategies is increasingly important. Combining conventional or technology-based engineering with a nature-based solution is seen as the way forward to build the climate resilience of oceans and coastal ecosystems.

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Against this backdrop, innovative approaches on adaptation technologies was the focus of an event on 13 October 2021, organized by the Technology Executive Committee (TEC), in collaboration with the IUCN FEBA and the Nairobi Work Programme (NWP) expert group on oceans.

Building on the outcomes of the first event on a similar topic held in September, the spotlight this time was on scaling up and implementing integrated approaches, particularly in relation to supporting countries in formulating and implementing their National Adaptation Plans (NAPs) and national climate action plans, (NDCs).

This event also highlighted the essential role of the ocean as a source of food security for humanity, a resource for industries and transport, and a new frontier for energy, biomedical research, and ocean and climate science.

Underlining the importance of innovative technologies, The SBSTA Chair Tosi Mpanu Mpanu said in his opening remarks: “The continually evolving challenge of both mitigating and adapting to climate change creates a moving target-that means that business-as-usual application of technologies will not be sufficient to achieve the commitments of the Paris Agreement”.

Xianfu Lu, Senior Strategy and Outreach Specialist, Climate Investment Fund (CIF), shared perspectives from the Pilot program for Climate Resilience (PPCR), a flagship initiative under the Climate Investment Funds (CIF). The PPCR has a USD1.2 billion portfolio of adaptation projects including investments in technological infrastructure and nature-based solutions in coastal areas in several countries.

“CIF finance has been used to pilot flood-resilient crop varieties in coastal areas and to establish an ecosystem of agribusinesses for enhancing the resilience of smallholder farmers,” Ms. Lu said. She also noted the importance of monitoring progress given the complexity of nature-based solution benefits, adding: “We need clear assessment benchmarks to help us track and monitor progress, which in turn, would help us make stronger business case for investing in nature including ocean and marine ecosystems.”

Sharon Dale Gonzalez, Director for Climate Change and Fisheries and Aquaculture Biodiversity, Vice ministry of Fisheries, spoke about building capacity for implementing selective fishing techniques and stressed the importance of formulating adaptation policies that focus on strengthening ancestral knowledge with modern technological systems.

In his closing remarks, TEC Chair Stephen Minas spoke about these being “times for making history” as regards the ocean-climate nexus: “Very soon we have the UN Climate Change Conference COP 26 in Glasgow. Next year we have the final session of the intergovernmental conference on high seas biodiversity, alongside many other negotiations and initiatives concerning ocean resilience and adaptation. This collaboration between TEC, Nairobi work programme, IUCN and FEBA has been a significant step forward in addressing the challenges ahead.”

The TEC will organize a third event on ocean and coastal adaptation at COP 26 in November 2021 in collaboration with the same partners, focusing on scaling integrated technological and ecosystem-based approaches to climate change adaptation at various levels of policy, financing and implementation.

3 Ships and shipping

3.1 Artificial intelligence to the rescue: Assisting the shipping container crisis (November 2021)

The shipping industry is continuing to struggle with the ongoing shipping container shortage with many companies trying to adjust and adapt to the issue. However, could artificial intelligence guide shipping back to smooth sailing?

With Christmas right around the corner media outlets from across the globe have been highlighting the ongoing shipping container crisis which has shown little, if any, signs of stabilising. With millions of people

around the world concerned for the festive season when it comes to gifts and certain food items, the industry has been working hard to adjust shipping methods and get products shipped where possible.

Alongside methods the industry has been taking such as repurposing containers, re-using older models and more, maritime navigation company ORCA AI believe that the implementation of artificial intelligence is the right way forward to tackle the crisis.

We speak to Dor Raviv, co-founder & CTO, Orca AI, to find out more about the artificial intelligence solutions which can assist the container crisis as well as the key benefits that this technology brings.

Frankie Youd (FY): When looking at the ongoing shipping container crisis do you think that AI is a solution to this problem?

Dor Raviv (DR): The container crisis has been caused by a combination of lack of staff and lack of equipment – AI can help support both of these areas.

Part of the importance of introducing technology throughout the industry is to increase automation – not only on ships for improved visuals and traffic updates, but also for port operators to increase efficiency. Automating part of the logistics chain reduces reliance on people where there are shortages, making the entire process more efficient through processing multiple data points at any given time, empowering the chain with new, unique insights.

It also significantly opens up communication between fleets and ports, with sensors and real time data being fed into a central point that is accessible to those on land and on sea, ensuring no ship is isolated. While it's not an overnight solution, it will help lessen the strain on what is being labelled 'Containergedon' and can be the catalyst for driving forward future innovation throughout the shipping world.

How would you suggest that AI is implemented into the industry to assist with the issue?

First, the industry needs to become familiar with the concept of data and its importance for decision making. Then, sensors and cameras installed on board a vessel can generate data for the individual responsible on the ship, creating visibility on decision making, presenting, and prioritizing information.

These sensors can be used to provide live updates to the ports, allowing them to advise ships to slow their approach and delay their arrival, which will help reduce idling ships waiting to get into port. Over time, this data can also be analysed to predict future incidents and provide the essential insight to prevent them.

Trials are already underway for automated cranes and vessels. The pilot of the automated driverless container trucks by Cosco Shipping Ports Limited can massively help reduce the time spent unloading ships, which can also be applied to cranes.

At Orca AI, we are working closely with shipping companies and oil majors to create a new safety system for autonomous cargo ships. This will create a new lookout support system for vessels by providing improved visibility in difficult conditions, prevent human error, and enable crews to make truly informed decisions. In the future, as more stakeholders adopt these data driven solutions, a data ecosystem will enable informed decisions throughout the entire supply chain.

Why do you think that maybe AI has not been included sooner to help with this issue?

Shipping is a very traditional industry, lagging behind the likes of the automotive and aviation industries when it comes to technological innovation. The recent pandemic has helped accelerate the maritime industry's acceptance of technology, such as AI, but we are still years behind other industries looking to achieve the same thing, with the technology still seen as a mystery to many.

However, the potential is vast and exciting. There are dozens of proofs of concepts being trialled across the globe that, in time, will bring us up the standard of planes where nearly all commercial airlines now have a partially automated cockpit, where in-between take-off and landing, the pilots are not actively having to fly the plane.

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At Orca AI, we are working towards projects that are able to achieve feats for the shipping industry, such as NYK and providing new data for the maritime insurers, and are excited at the future given the impact we've had in a relatively short time period.

What are the main benefits of using AI to help with this issue?

Captains, co-Captains and navigational officers on board have extremely difficult and complex jobs. To avoid dangerous objects and collisions while sailing, navigators currently use binoculars and multiple sensors such as radar, to visually recognise and prioritise dangerous objects. This job is made even harder with inexperienced crew members. Looking at the statistics – nearly 4,000 maritime accidents occur annually, and the majority are caused by human error.

With AI, this process for identifying obstructions and prioritising risks is made far easier under most conditions. The more traffic and complex the scenario, the more the AI excels as opposed to humans, mainly due to the fact it can process multiple data points at blinding speeds.

Thermal imaging cameras and AI-enabled visual support systems provide instant feedback, helping them analyse situations and provide them with all the data they need to give them a full understanding of what they need to do at any given moment in time.

Could you explain how the company is currently alleviating some issues through JIT?

In order to provide the whole suite of safety solutions, our technology uses AI both for the vessel, and also to process multiple data points on the fleet level. For example, AI can generate actionable insights due to its ability to identify trends, anomalies and benchmarks between vessels and fleets. It automatically clusters dangerous areas, pointing to distances, speeds, locations, and weather in order to create a comprehensive representation of the risk level.

This information can then be relayed to the rest of a fleet or even to ports, creating a more streamlined form of communication. Live updates and timings from the port to the ships will help reduce the backlog at entry as vessels will be able to reduce their speed to delay arrival, subsequently reducing their carbon footprint and fuel costs, while also relieving pressures on berth capacity.

Additionally, the data gained can be used by insurance providers to create a more accurate pricing structure that accurately reflects the ship's risk rates.

What do you think the future will hold for this shipping container crisis?

The pandemic has unfortunately put our industry under undue pressure, with the rising demand for products and shortage of skilled crew, and this problem is not going to go away overnight.

There are certainly a number of short-term solutions out there, such as opening 24/7 ports and adjusting delivery schedules so that empty containers are removed before new ones are brought in, but ultimately the solution can only come with further investment into new technologies, especially data driven solutions.

4 Maritime Security

4.1 New AI system identifies terrorist threats in Singapore waters in real time, Singapore News & Top Stories - The Straits Times (November 2021)

SINGAPORE - The Republic's shores will soon be safer with a new artificial intelligence data processing system that can identify threatening ships along Singapore's shores in real time.

The "sense-making system", which will be used by the Singapore Maritime Crisis Centre (SMCC), automatically takes in updated information from local and foreign governmental and commercial sources and uses anything from the crew's criminal records to the route the ship is sailing to determine threat levels.

This information and the vessel profile is then instantly shared with other maritime security agencies, allowing them to calibrate coordinated responses.

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Such responses include boarding a ship by force, diverting and managing maritime traffic, extinguishing fires on board a vessel or, as in a case of a chemical tanker in 2019, banning the crew of a suspicious ship from disembarking.

The agencies using the sense-making system together are the Republic of Singapore Navy, the Maritime and Port Authority of Singapore, the Immigration and Checkpoints Authority, Singapore Customs, the police and the Singapore Civil Defence Force.

In the SMCC control centre in Changi Naval Base on Friday (Nov 12), Colonel Desmond Low, director of the national maritime sense-making group, said the system, which replaces a previous one that could handle data only in batches, should be rolled out in the middle of next year.

Behind him, a map of Singapore beamed onto a screen was surrounded by blinking green dots, each representing one of more than 2,000 big vessels parked in Singapore waters daily.

He said: "With thousands of ships in Singapore waters and hundreds arriving each day, we cannot board or search every single one. We need to sense-make and focus on those of a higher risk. For SMCC, the objective is to detect threats early and as far away as possible."

"The new system will arrive at conclusions 10 times faster than its predecessor. This reduces time needed from hours to minutes."

The sense-making system has been in development since 2016 and is now in the final stages of integration and testing. The SMCC is also ensuring that the system is secure from hacking threats.

Col Low said that, ultimately, defence coverage should be more comprehensive while allowing the six agencies to share information with one another faster.

"One of the biggest differences is the number of sources that the system is taking in. It is much faster because the data is coming in through a direct system automatically. It also provides real-time analytics and continually refines vessel profiles.

"Because it is much faster, it frees up the officers to conduct higher-level investigations."

All six agencies have personnel seconded to the SMCC, and have just completed the inter-agency Exercise Highcrest 2021, during which they practised neutralising a hijacked vessel that was on course to crash into Jurong Island.

The crisis centre was created after the 2008 Mumbai terror attacks, when 10 members of Lashkar-e-Taiba carried out 12 coordinated shooting and bombing attacks lasting four days, killing 175 people.

Agencies here decided that Singapore needed a centralised organisation to make sure intelligence data is shared effectively and responses are coordinated - key gaps in India's 2008 response. It marks its 10th anniversary this year.

Senior Minister and Coordinating Minister for National Security Teo Chee Hean, who observed Exercise Highcrest on Friday, said: "We have to be ready for all kinds of different threats mainly because we sit on one of the key sea lanes in the world.

"I'm glad to see that each of the agencies in the past 10 years has increased its capability and coordination between the agencies has also increased."

He said the successful conclusion of the exercise proves the pandemic has not had an impact on operational readiness.

Asked if it has become more difficult to detect threats to national security as terrorist tactics evolve, Mr Teo said that it has always been difficult.

"The new sense-making system brings in more databases, and does more data analytics to try to detect possible threat patterns earlier, so that we can be sensitised to them and we can deal with them earlier."

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5 IUUF

5.1 Tightening Port Controls: African Nations to Use New Technology in, Fighting Illegal Fishing With Big Data - FrontPageAfrica (November 2021)

Dakar, Senegal – Four African nations and a regional fisheries organization are harnessing new technology to strengthen port controls and combat illegal fishing. The international nonprofits, Global Fishing Watch and Trygg Mat Tracking are partnering with Senegal, Ghana, Côte d'Ivoire, Kenya and the Fisheries Committee for the West Central Gulf of Guinea in a pilot project to provide authorities with satellite tracking data, analysis and training needed to assess a fishing vessel's recent operations and compliance risk. The collaboration will better position port authorities and fisheries officials to monitor the movements of fishing and carrier vessels, identify activity that may indicate an elevated risk of illegal behavior, and target inspections and enforcement where they are needed most.

"Implementing strong port controls is the best and most effective opportunity to ensure that illegal catch has no market, and illegal fishing operators are cut off from their profits," said Duncan Copeland, Executive Director of Trygg Mat Tracking. "To do so requires the ability to make rapid risk assessments to inform the key decisions on whether to let a vessel into port, and where to target inspections. We are very pleased to be adding this new port control focus to our cooperation with Cote d'Ivoire, Ghana, Kenya, Senegal and the Fisheries Committee for the West Central Gulf of Guinea, towards building the tools, data, routines and capacity needed to effectively implement the Port State Measures Agreement in East and West Africa."

Representatives from the four partner countries, West Africa's Fisheries Committee for the West Central Gulf of Guinea, regional experts, Global Fishing Watch and Trygg Mat Tracking will convene the project's first steering committee meeting Nov. 9-10, 2021, hosted by the Senegal Fisheries Protection and Surveillance Directorate, in Senegal's coastal city of Saly. Attendees will discuss challenges and opportunities surrounding the implementation of the Agreement on Port State Measures—an initiative of the Food and Agricultural Organization of the United Nations designed to deter and prevent illegal, unreported and unregulated (IUU) fishing—and ways to use emerging technology to strengthen port controls. Illegal fishing in East and West Africa is a well-documented challenge, involving vessels from all over the world. Ports are often the last checkpoint where fish can be clearly linked to the vessel that caught it, and they offer one of the best and most cost-effective opportunities to identify and deter illegal fishing.

"We are pleased to offer support to Senegal, Ghana, Côte d'Ivoire, Kenya and the Fisheries Committee for the West Central Gulf of Guinea as they step forward to address Africa's serious problem of illegal, unreported and unregulated fishing," said Tony Long, Chief Executive Officer of Global Fishing Watch. "African nations are aware of the grave threat illegal activity off their shores presents to their livelihoods and food security. Support for the landmark Agreement on Port State Measures has been promising and significant among the continent's coastal States since the agreement came into force in 2016, and with easy-to-access technology and training to use it, African States can better defend their fisheries for generations to come."

6 Marine Biodiversity

6.1 MOL to participate in Ocean180 project - Port Technology International (November 2021)

Tokyo-based shipping line Mitsui O.S.K. Lines, Ltd (MOL) has announced its intent to participate in the Ocean180 project, an industry-academia government collaborative project to conserve marine biodiversity.

Ocean180 aims to protect marine biodiversity which will visualise ocean ecosystems based on big data related to marine life, statistical modelling, and artificial intelligence.

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The project, led by the Professor Yasuhiro Kubota of the Biology Program, Marine and Natural Science Department in the Faculty of Science at the University of the Ryukyus, also works alongside research institutes such as universities, citizens, government agencies, companies, and financial institutions.

As part of this, MOL will provide ship operation data, which it has recently been collecting as part of its FOCUS project, cooperating in the development of technology to visualise the impact of shipping on ecosystems, integrating marine life data and ocean shipping data. This is expected to help promote the practice application of the project.

MOL's contribution to this project directly links in with its MOL Group Environmental Vision 2.1, which aims to achieve net-zero greenhouse gas (GHG) emissions by 2050. By working to preserve marine environments and protect biodiversity, the company has said it contributes to the sustainable development of our society and the preservation of nature.

"From the blue oceans, we sustain people's lives and ensure a prosperous future," the company said in its vision.

MOL has also recently contributed to its environmental vision through signing a Memorandum of Understanding (MoU) with MAN Energy Solutions (MAN) and Mitsui E&S Machinery, ltd (MES-M) aiming to order ammonia fuelled main engines to power its vessels.

7 Marine conservation

7.1 Study reveals first-time data on protection of China's marine habitats (November 2021)

A new study by an international team of scientists led by Ellen Pikitch, Ph.D., of Stony Brook University's School of Marine and Atmospheric Sciences (SoMAS), provides the first comprehensive and publicly available database of area-based marine conservation in China's waters. Published in Science Advances, the study provides insight into the country's progress toward meeting global commitments to protect marine waters. Because of China's global economic and political influence and its status as the world's top producer and consumer of seafood, the findings could serve to inform broader international dialog around management of marine biodiversity.

The United Nations through its Convention on Biodiversity (CBD) set a goal for countries to protect 10 percent of marine and coastal waters within their jurisdiction by way of marine protected areas (MPAs) and other effective area-based conservation measures (OECMs) by 2020. Recently, an international collaboration of scientists, including Pikitch, published a framework for protecting 30 percent of the ocean by 2030. See this press release for more details.

According to this paper, China has a six-decade history of protecting marine resources within its own borders, but up to this point few details have been available. The researchers developed a comprehensive dataset that includes 326 marine and coastal sites around China, and have made this publicly available.

They found that, overall, nearly 13 percent of China's seas are protected by a network of MPAs and potential OECMs that address 142 conservation objectives including a variety of species and ecosystems. Twenty-two percent of shallow habitats (less than 10 meters) were considered fully or highly protected and 20 percent of waters 10 to 50 meters deep were conserved, at least to some measure. However, less than 5 percent of China's deep waters (greater than 50 meters deep), are protected. These deep waters are considered important to protect because they likely contain unique marine life and important fishery resources. Habitats such as underwater canyons and seamounts beyond the continental shelf had no area-based protection.

"Our study may surprise experts and non-experts that despite its large consumption of marine life and other uses of the seas, China has made some substantial progress toward protecting its ocean waters. Yet there is much more work to be done. With the help of international experts in ocean conservation, China can take additional steps to ensure that the full suite of marine life and health of the oceans bordering the country is

safeguarded," says Pikitch, corresponding author, Endowed Professor of Ocean Conservation Science and Director, Institute for Ocean Conservation Science at SoMAS.

Pikitch notes that China's progress is impressive because of both the substantial area of ocean that is protected and legal strength of that protection, as many of their designated MPAs are fully protected. She also adds that providing a large dataset on the ocean habitats China has safeguarded is valuable to international efforts to secure more MPAs globally, and that the methods the team of researchers used to evaluate China's MPA network is applicable to other nations and regions.

"The information presented in this paper sheds new light on China's history of implementing MPAs, a crucial component to furthering efforts to reach global conservation targets," says Charlotte Hudson, Project Director for the Lenfest Ocean Program, which funded the study. "We hope that other scientists, resource managers, and marine and coastal stakeholders can use this assessment to inform future protected area planning."

The authors say that the study's findings and corresponding dataset may help to provide China with future directions for ocean conservation.

China is also the host country for the CBD's 15th conference of parties which will conclude in Spring 2022. Targets for biodiversity conservation of the oceans for the next decade are currently being negotiated by hundreds of countries attending the meeting, and over one hundred (not including China) have already endorsed expanding targets to protect 30% of the ocean.

In light of current and potential future goals, the authors suggest China may strengthen its nationwide marine conservation network by expanding protection in habitats and ecosystems that have been underrepresented to date (e.g., in deeper tropical waters), strengthening the level of protection in areas with less restrictive MPAs, and continuing to fortify protection in especially important ecosystems like mangrove forests and seagrass beds. The country may also benefit from developing long-term monitoring programs to understand management impact of MPAs beyond just numerical goals.

8 Technology: Sat-Based Solutions, Remote Sensing and Earth Observation

8.1 NOC GNSS-R Global Ocean Wind Speed and Sea-Ice Products Using Data from the TechDemoSat-1 Mission | IEEE Conference Publication | IEEE Xplore (February 2021)

Introduction

Here we present the advancements included in the latest version of the processor and a performance assessment of the updated ocean wind speed and sea-ice products (C-BRE v1.0) that are available from www.merrbys.co.uk. Validation relies on model output data from ECMWF ERA-5 re-analysis. Details are provided of the new quality control flags including a) on-board data processing anomalies, b) presence of sea-ice, and c) RFI detection. Further, details of the updated calibration are illustrated, now incorporating additional steps to address spatio-temporal variability of direct GNSS power between different transmitters, in time, and across different regions of the globe. Finally, a preliminary analysis of a novel spaceborne Galileo reflectometry dataset collected by TDS-1 is presented, comprising an investigation of the geophysical sensitivity of Galileo reflections collected from space to surface parameters.

Methodology

TDS-1 was launched in July 2014 into a Low Earth Orbit with a nominal altitude of 635km and an inclination of 98.4°. As a technology demonstration platform, the satellite carried eight experimental payloads. These payloads included a prototype GNSS-R receiver known as the Space GNSS Receiver Remote Sensing Instrument (SGR-ReSI) which was operational from September 2014 until the end of 2018.

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This paper details some of the advancements incorporated in the latest version (v1.0) of the NOC GNSS-R processor. This development activity builds on the baseline NOC C-BRE v0.5 algorithm which inverts wind speed using the DDM peak SNR, with considerations made for a number of parameters including bistatic geometry and antenna gain towards the specular point (Foti et al., 2015). The baseline version was limited to latitudes in a ±55° latitudinal range to reduce possible contamination from sea-ice.

The updated version incorporates instead an independent sea-ice detection and flagging submodule, solely based on the shape of the received GNSS-R waveform. Additionally, the latest version includes further calibration stages to address some of the issues associated with bistatic GNSS geometry in the polar areas. Courtesy of the combination of these improvements, the NOC processor now a) achieves global coverage, b) supports retrieval of ocean winds even in the polar seas, and c) delivers a novel GNSS-R sea-ice product. Further to these advancements, the processor now relies on a refined radiometric calibration scheme that can operate using ambient noise data derived either from the internal receiver blackbody or an external target, interchangeably. This dual-reference calibration scheme allows optimal and continuous radiometric calibration over the entire lifetime of the mission, and has led to a significant increase in the TDS-1 Level 2 catalogue volume.

In terms of data quality, further advancements included in the new products are represented by a) the introduction of data quality control flagging mechanisms for GPS-like RFI, and b) an additional stage for automatic flagging of corrupted delay-Doppler data.

Finally, the new version of the processor also features an upgraded power calibration strategy, offering the ability to mitigate some effects related to the variability of available direct GPS power in time and across different regions.

The TDS-1 mission was programmed to collect a number of non-GPS reflections in raw collection mode. These reflected signals have now been processed on the ground by SSTL and represent the first dataset containing both Galileo and BeiDou reflections collected from a spaceborne sensor.

The initial stages of the NOC processing strategy have been adapted taking into account the signal characteristics of the two navigation systems. This study also includes a preliminary analysis of non-GPS reflections alongside the first assessment of the geophysical sensitivity of Galileo reflected signals to ocean wind speed and sea-ice using ECMWF ERA-5 reanalysis model output data for verification.

Results

The GNSS-R sea-ice extent product developed at NOC has been found to agree to better than 96% with ERA-5 sea-ice data, in both hemispheres.

However, achievement of global coverage also requires overcoming additional issues associated with the polar areas, including reduced available direct power and thus typically weaker reflections. At the same time, in-flight calibration becomes more challenging because of the limited ocean data available. The updated calibration scheme appears to provide good mitigation of these effects with results showing that meridional variability of Sigma0 is now fairly well constrained across all latitudes at given surface conditions.

Results also show that new data quality control and RFI flagging sub-algorithms successfully mitigate biases that had previously been observed at Level 2. Exploiting information from the whole DDM, the RFI detection sub-module is found to perform better than kurtosis-based approaches. Both RFI and correlator anomaly detection schemes are shown to have very high detection rates, providing substantial reduction of propagation of contaminated Level-1 data into biased Level-2 products.

The combination of these advances has allowed extension of the algorithm validity to all latitudes, which in combination with the new updated radiometric calibration strategy and data quality control has led to a) achievement of global ocean wind speed retrieval capability, b) ~ 120% increase in the volume of L2 wind data inverted from the TDS-1 L1b record with respect to the baseline version (v0.5), c) rejection of corrupted DDM data, and d) filtering of most RFI contaminated data.

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To mitigate the effects linked to temporal variability of transmitted GPS power, periodic recalibration update mechanisms have also been developed. This has led to vastly improved retrieval stability throughout the mission and wind speed retrieval bias is now shown to be constrained within 0±0.5 m.s−1 for the entire mission (~4 years).

Additional operational changes in emitted GNSS power have also been observed to affect GPS Block IIF satellites over certain geographical regions. New correction steps have been introduced in the upgraded NOC GNSS-R processor to address these effects resulting in no bias (0.0 m.s−1) on average between the affected regions and the rest of the globe.

Galileo DDMs have been processed using the newly developed sea-ice detection module and are shown to provide similar detection capability to GPS, subject to tuning of the signal processing. Using these ground-processed Galileo data, sensitivity to ocean wind speed is also examined, and a similar relationship to that of GPS is found, demonstrating the opportunity for future missions to use Galileo in concert with GPS to substantially increase instrument sampling.

The NOC C-BRE v1.0 processor is found to provide strongly performing wind speed retrieval and sea-ice detection products using data from the TDS-1 mission. These updated products are available from www.merrbys.co.uk at no cost.

The Future, HydroGNSS

The work undertaken on TDS-1 has led to a better understanding and mitigation of dominant error terms in the use of GNSS-Reflectometry for scatterometric purposes, including uncertainty in incident transmit powers from the GNSS satellites, uncertainty of the receiver antenna pattern, and man-made interfering signals. This experience is valuable for oceans, but can be translated into other applications of GNSS-Reflectometry over land and ice.

HydroGNSS is a mission concept selected by ESA as a Scout candidate, and consists of a 40 kg satellite that addresses land hydrological parameters using the technique of GNSS-Reflectometry, a form of bistatic L-Band radar using satnav signals as the radar source. The four targeted essential climate variables (ECVs) are of established importance to our understanding of climate evolution and human interaction, and comprise soil moisture, inundation / wetlands, freeze / thaw (notably over permafrost), and above ground biomass.

NOC is a member of the HydroGNSS team and is helping address some of the error mitigation and calibration techniques developed over the ocean but applied in this case over the land. While HydroGNSS is primarily addressing land variables, it will also be operated over oceans to help determine correction terms for application over the land, and is expected to generate some secondary data products and research data over oceans and ice to provide continuity and advancement from the TDS-1 mission.

8.2 Opinion: Artificial Intelligence Could Save Earth | Blogs (November 2021)

With Earth being in the middle of climate crisis, there have been talks about the ways to save our planet over the past few years. Here a technology like Artificial Intelligence (AI) has the potential to achieve this. AI was valued at USD $62.3 billion in 2020, growing with a CAGR of 40.2 per cent it is expected to value USD $997.77 billion by 2028. This machine learning driven platform aids in identifying patterns using huge chunks of data. The respondents involved in AI projects state that in the next 3 to 5 years AI enabled medical devices are predicted to reduce average global emissions by 18.3 per cent. As per reports AI enabled use cases have the potential to reduce EEI (Economic Emissions Intensity) i.e., the total number of greenhouse gas emissions for every unit of GDP fr9m 11 to 45 per cent by 2030.

AI applications are used for battling climate change, for conservation of fresh water bodies, for energy management, waste management, natural resource conservation, wildlife protection and a lot more. Following are some of the ways AI helps save our planet.

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Fighting Climate Change

Climate change is the biggest threat for Earth. By 2100, rising sea levels are projected to wipe out $14t per year from the global economy, upending business and infrastructure while endangering the lives of humans, plants and animals.

AI is used to analyze satellite data for mapping ice surfaces, tracking how they change over time. Satellites and drones are used to explore the cryosphere, and algorithms trained to parse data to create a precise picture of each unique ice surface and determine its melting rate. Building monitoring tools and predicting melt into the future requires cutting edge technology and AI tools. Without it, there would be large uncertainty on future predictions of glacier and ice sheet melting and sea level rise.

Conservation Of Fresh Water Bodies

AI technology such as satellite remote sensing can help us to monitor, map and potentially predict when and where algae blooms will occur. Formation of harmful algae blooms are slowly decreasing the quality of fresh water bodies worldwide. These toxic overgrowths can have negative impacts on fisheries and tourism industries, and be harmful to people and animals.

Soil Conservation

Soil degradation is one of the rapidly growing issue causing a huge amount of stress to the farmers as it takes a longer period of time for generating just 3 centimetres of topsoil and the rapidly increasing soil degradation causes a huge havoc.

The use of AI technology could help the problem of rapidly increasing soil degradation as it helps to marsh the land by using complex algorithms with the help of robots and drones to monitor the soil health as well as detect erosion.

Forecasting Natural Disasters

Fire detectors built with AI technology help send warnings to the foresters by detecting smoke or by keeping an eye on infrared thermal data.

With the help of analysing real time data and simulation of weather and climate events, AI helps in determining strategy, seek solutions to vulnerable problems, provide response through emergency information capabilities and more.

Air Pollution Detection

AI enabled technology helps the planet by measuring and identifying air quality and sources of pollution. The use of AI will help the air quality experts to identify and respond to accidental emissions quickly and more easily. Apart from this, predicting mortality rate, creating emission maps, and evaluating financial costs for emergency responses will become easier than ever.

Since automobile vehicles are a huge source of generating air pollution enabling AI based vehicles will help to reduce oil consumption and decline greenhouse gas by 2 per cent to 4 per cent annually. AI system-based vehicles are predicted to reduce travel time by 25 per cent and idling time by 40 per cent.

Smart Agriculture and Food Systems

The global AI in agriculture market was valued at around USD $1.1 billion in 2019 and is estimated to grow and value more than USD $3.8 billion by 2024. AI enables smart agriculture and create smart food systems as the use of AI augmented machines use robots for corrective actions like early detection of crop issues and diseases while it also helps in decision making process.

Field farming using AI itself has a market share of 60 per cent. The use of AI will help in the protection of our planet as it provides the experts with timed nutrition to livestock also suggests returns and inputs monitoring the demand and supply of goods.

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AI increases the capacity to hold climatic extremes while also increases the resource efficiency of the agricultural industry as AI reduces the damage to the ecosystem by cutting down the use of fertilizers, water and pesticides.

Reducing Food Waste

Food wastage has a huge toll on the food chain market and creates environmental issues as these food wastes produces greenhouse gas and carbon dioxide which are harmful for the environment.

AI has the potential to enable environment sustainability. AI techniques can change how the world works by optimizing efficiency, increasing productivity and help in reducing the carbon footprints. As with all complex global challenges, there is no silver bullet. AI technological revolution must work towards tackling the environmental issues and healthier green Earth.

8.3 Space technology and artificial intelligence to monitor whale mass stranding events (November 2021)

An international team of scientists led by British Antarctic Survey have published research today on using new technology to study mass stranding of whales from space and how the technology could be used to help protect populations.

The study, published in Frontiers in Marine Science, found that high-resolution satellite imagery could help build long-term cetacean (i.e., whales, dolphins and porpoises) stranding monitoring programs in remote regions and stranding networks globally. The team behind the study includes scientists from British Antarctic Survey, CEAZA (Center for Advanced Research in Arid Zones), Oceanswell and the University of Massey.

Whale strandings are becoming a critical ocean health issue and an increase in capacity to monitor and understand strandings is urgently required. The World Health Organisation recently announced their 'One Health' approach, which recognizes oceanic conditions that impact whales often affect the marine ecosystem, with potential ramifications for human health too. Leading marine mammal experts made whale stranding response one of three core goals of the World Marine Mammal Conference in 2019.

The researchers discuss making satellites a viable long-term monitoring tool, particularly for places where stranding response capacity is very limited and where surveys are infrequent. For remote regions, satellites could form an 'early response' tool, alerting managers to a problem and allowing for appropriate response, which could increase the likelihood of attaining useful diagnostic samples to understand exactly what is causing these events.

Penny Clarke, Lead Author of the study and Ph.D. Researcher at British Antarctic Survey, said: "This study reveals that we need to increase the monitoring of mass strandings across the globe to greater understand cetacean populations, the threats they face and to evaluate the impact of future change. This is particularly important in remote regions, absent of stranding monitoring networks, where satellites offer an opportunity to gather baseline data in these regions."

Example whale stranding sightings in satellite images. Credit: Maxar Technologies

Dr. Jennifer Jackson, Whale Biologist at British Antarctic Survey said: "As whale populations recover from whaling and suffer growing impacts from humans and from climate change, we need new tools to monitor these impacts, particularly in remote areas. Satellites hold a lot of promise for helping monitor those strandings over huge areas, as well as to look at local sea conditions, to help identify the causes faster, and make the right recommendations for ocean protection and management."

Dr. Asha de Vos, Founder and Executive Director of Oceanswell in Sri Lanka said: "Strandings happen across all our coastlines, but not all of us are equipped to monitor or document these events.

Satellites provide us with a unique opportunity to monitor even the most far flung places but the key thing is increasing access. If we want to truly understand and protect our planet, we need to ensure equitable access to tools that can help us solve our greatest challenges together."

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The team analyzed satellite imagery collected from the Golfo de Penas, Chile in 2019, an area of annually recurring mass stranding events and the location of the original largest known mass stranding of baleen whales in 2015. The results show the power of satellites to deduce the timings of events, which could be vital for long-term monitoring programs.

The international team hope to challenge the current disparity in stranding monitoring efforts through use of satellites. They also call for collaborative partnerships between satellite providers and stranding networks governments and NGOs, for equal access to satellite imagery, a recommendation endorsed by the International Whaling Commission Scientific Committee.

The research highlights the importance of collaborating across remote sensing specialisms to determine if satellites may help understand the environmental and human induced conditions before, during and after a mass stranding event. Other remotely sensed data could help to highlight changes in the ocean environment and to provide an early warning system to mitigate mass stranding events and develop more informed, knowledgeable and rapid response stranding networks.

Moving forward, the team plans to test the robustness of this technology by partnering with existing and efficient stranding networks in hotspot areas, such as New Zealand, to develop working protocols and automated detection procedures. Following this they will concentrate on remote priority locations such as: the Chilean Patagonia region; much of the West and Eastern coastlines of Africa; the Polar Regions; and coasts in politically turbulent regions such as the North West Indian Ocean.

8.4 Remote Sensing Analysis Tool Now Freely Available | Hydro International November 2021)

OceanWise has announced that, as of 1 November 2021, the RSOBIA toolbar is available free of charge. The software tool, which takes raster imagery and segments the data into geographic areas with similar statistical properties, has been particularly successful in supporting those working in research, development and education.

The tool's creator Tim Le Bas and OceanWise, who have thoroughly enjoyed collaborating over the last few years on the sale of the tool, have decided that, while it will still be available and maintained, the tool will longer be sold as a commercial product. Instead, Tim Le Bas will maintain and support the tool himself and offer free licences to those who request one.

Tim Le Bas commented: "I would like more people to have access to the tools, so removing all costs should allow new users to trial the tools and see how they can help their data processing and interpretation."

Remote Sensing Object-based Image Analysis

Remote Sensing Object-based Image Analysis or 'RSOBIA' is a software tool for Esri ArcMap, which interprets and digitizes the areas and boundaries seen in imagery (such as sidescan sonar and multibeam backscatter) and creates a polygonized map of the results (e.g. areas of similar seafloor type). It supports segmentation and classification – key techniques for image analysis – and gives quick, easy, repeatable results.

OceanWise will no longer be involved in the sale or support of the RSOBIA tool. As it will be a free tool, its distribution and maintenance will now be looked after solely by Tim Le Bas, the tool's creator. "We have loved being involved with the tool and hope to work with Tim in the future on other projects. OceanWise will of course support its existing customers with any transition required and resolve any outstanding queries," the company states.

9 Technology: Artificial Intelligence and Machine Learning

9.1 Will AI be the New Frontier at the Service of Climate Studies? (November 2021)

Global warming is considered to be responsible for aggravating extreme weather and climate events. The interaction between various forms of hazards activated by climate change will result in future cross-sectoral impacts influencing a range of natural and human systems.

The study can enhance the awareness of such interactions and dynamics to help decision-makers in regulating current and future climate change threats, also as a result of an enhanced potential to forecast anticipated risks and measure their impacts.

Over the past few years, the scientific community has started testing new methodological methods, technologies and tools, among which the application of machine learning can help utilize the potential of huge and varied amounts of environmental tracking data available at present (big data).

What are the outcomes of the exponential increase in the application of machine learning techniques for the evaluation of climate-induced risks?

In the study titled, "Exploring machine learning potential for climate change risk assessment," a team of researchers from the CMCC Foundation and Ca' Foscari University of Venice performed an in-depth review of over 1,200 articles on the subject, reported in the past two decades. This stresses the ability and limitations of machine learning in this field.

Furthermore, the study discloses that machine learning has two significant potentials that make it specifically interesting when employed in this field of study.

The first is that algorithms can learn from data: the more data, the better algorithms learn. As a result of its potential to examine and process big amounts of data, machine learning enables scientists to unravel complicated relationships underlying the working of socio-ecological systems.

This exploits the big data gathered from several sources, such as sensors for environmental analysis at high temporal frequency, social media, satellite data and images and drones.

The second is that they have the ability to integrate various kinds of data, thus allowing an evaluation of the risk extent while considering all its dimensions. These include not only the activating hazard (for instance, an increase in rainfall) but also the exposure and vulnerability of the socio-economic system at stake. These are critical factors in an evaluation of total impacts.

Zennaro added, "Machine learning represents the future of risk assessment, but its great potential is not yet widely exploited. Our research shows that there are still few studies that use these models to develop long-term future risk scenarios (up to 2100). The vast majority of studies focus on the short term, probably influenced by the reduced availability of extended time series data capable of supporting adequate model training for long-term projections."

According to study co-author Elisa Furlan who is a scientist at the CMCC Foundation and Ca'Foscari University Venice, the next step is to design machine learning models that are highly efficient at studying and untangling the complicated spatiotemporal interrelationships among various environmental, climatic and socioeconomic variables, thereby enhancing understanding of the behaviour of complicated systems.

9.2 University of Exeter: Environmental Intelligence commitment at COP26 – India Education | Latest Education News | Global Educational News | Recent Educational News (November 2021)

The agreement sees the continuation of the Joint Centre, created in Exeter in December 2020, which brings together world-leading researchers from the University of Exeter and the Met Office to pioneer the

development of environmental intelligence research and deliver innovative, interdisciplinary education and training.

Environmental intelligence is a new field of knowledge that joins environmental data with artificial intelligence (AI) to create solutions to some of the most important challenges facing society today.

The Joint Centre aims to provide the meaningful insight needed to inform decision making around weather and climate to improve risk management and provide the expertise, skills and capability to fully use artificial intelligence to address the threats of climate change.

The Centre also collaborates with The Alan Turing Institute, the UK's national centre for data science and AI, and provides a hub for research and training to support a community in environmental intelligence and promotes the UK as a leader in the field.

Complex interactions between the environment, climate, ecosystems, societies, economies and human health will all be under the microscope for the Joint Centre.

The signing of the collaboration agreement at COP26 represents a 5-year commitment, which will enable continued growth, development and ongoing impact of the Joint Centre in the coming years.

The Joint Centre aligns with the overarching goals of COP, with the development of a Climate Impacts, Mitigation, Adaptation and Resilience (CLIMAR) Framework creating decision-ready information for policy-makers, industry and the public to achieve net zero carbon emissions and adapt to protect communities and natural habitats.

Professor Stephen Belcher, Chief Scientist at the Met Office said, "It's vitally important that we collaborate to address some of society's most pressing issues. By working with the University of Exeter on the Joint Centre, we're able to pool talent to use the latest technology and advancements to provide tangible information for policy-makers around the globe."

Professor Mark Goodwin, Deputy Vice-Chancellor, at the University of Exeter said, "This long-term commitment to the Joint Centre is incredibly welcome and timely. I am excited to see the potential of Environmental Intelligence being unlocked in the coming years, and further development of innovative solutions to help tackle the environmental challenges faced by humanity."

The Joint Centre is holding its annual conference on 16 and 17 December 2021, with the focus on 'Beyond COP26: The Road to Net Zero'. This virtual event will showcase the use of transformative technologies to support the UK's Net Zero ambitions and explore opportunities to support the next generation of environmental and data scientists. Find out more and register on EventBrite.

9.3 Industry-first artificial intelligence register launched - SAFETY4SEA November 2021)

Lloyd's Register launched an Artificial Intelligence (AI) Register, a standardised digital register of LR certified AI providers and solutions, a first of its kind for the maritime industry.

Lloyd's explained, the AI Register helps the maritime industry embrace technology advances in artificial intelligence.

LR's new AI Register, the first of its kind for the maritime industry, has been designed to help maritime stakeholders find safe and proven providers and solutions, so they can successfully benefit from these technology advances, by ultimately improving business outcomes and competitive advantage.

…Joseph Morelos, Technology Innovation Manager at LR, added.

It is known that AI technology, the engineered systems that have hardware and software elements that mimic human capacity for observing, understanding and decision-making, is continuing to grow in maritime with applications ranging from digital twins, virtual commissioning and autonomous navigation systems.

To support this uptake in technology, LR's AI Register has been developed to signpost proven and reliable AI technology to help maritime stakeholders benefit from the latest applications.

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The AI Register will assist maritime stakeholders in finding appropriate providers and solutions for business challenges, minimising the risk and cost of investing in AI technology. AI providers can also use the Register to assess existing technology and solutions from the market.

…LR notes.

Each AI solution entered into the LR AI Register will be categorised against their LR certification status, such as Digital Twin Ready, Digital Twin Approved, Digital Twin Commissioned and Digital Twin Live from LR's ShipRight Digital Compliance framework.

The AI Register will also provide details about what the specific solution offers, such as key business benefits, target applications, functions, and performance.

9.4 The Impact Of Climate Change And How AI Can Help (November 2021)

As California experiences an unprecedented wildfire season and the East Coast is battered by stronger hurricanes, it's no secret that the realities of climate change are becoming direr than ever. This year is already on track to be between the fifth and seventh hottest year on record.

The phrase "if we don't take immediate action, then it will be too late" has become all too familiar for people around the world. Fortunately, there are many opportunities and solutions available for us to invest in right now. It's just a matter of making those investments.

It has become obvious that technology is going to be a key player in the battle against climate change. However, there are many technologies left to be widely explored as potential solutions to this large-scale problem. For example, artificial intelligence has proven to be effective in many different fields, from helping people with disabilities to innovating within the farming industry. However, when it comes to combating the vigorous effects of climate change, artificial intelligence deserves more investment.

AI can be an integral part of managing our responses to worsening natural disasters, from before it even happens to afterward when we have to pick up the pieces.

In pre-disaster settings, artificial intelligence and visual insights could have the power to save lives. AI is able to improve our weather forecasting and can even warn people in time to evacuate before the disaster occurs. For example, NASA's new artificial intelligence can predict when and where a hurricane will intensify and warn those that are in its path.

Flooding is the most common and deadly natural disaster in the world. Some studies say that early warning systems can reduce deaths and economic damages by over a third. Fortunately, AI could predict when and where flooding will occur. In fact, Google's AI can predict floods with 75% precision.

In a post-disaster setting, AI can boost response and help manage resources. Having visual insights after a disaster like a wildfire or a hurricane could mean life or death. AI is capable of rapidly analyzing satellite photos and essentially detecting anything from flooding to damaged or collapsed houses from a fire.

After the 2018 Hokkaido earthquake, AI was used to experiment with landslide detection. They found that AI takes only five minutes to conduct image interpretation to detect damaged places with an accuracy of 93% compared with human visual interpretation. By having close to real-time insights, disaster response teams could make swift and effective decisions.

Another silent yet deadly consequence of climate change is air pollution. The World Health Organization predicts that nine out of 10 people breathe polluted air. A spike in air pollutants also leads to an increase in hospital admissions. Fortunately, through the use of AI, it is now possible to predict ozone pollution up to 14 days ahead of time. These models could give local governments ample warning to control pollution emission sources.

Artificial intelligence has the potential to be a huge player in managing and responding to the disastrous consequences of a changing climate. Whether it's retrieving victims from a flooded area or protecting

residents from harmful air pollutants, artificial intelligence provides a glimmer of hope in the gloom-filled climate predictions we read about every day.

Embracing and implementing artificial intelligence in our organizations is a huge step toward adjusting to our harsh reality. In order to do this in businesses, you must invest in the right talent and the right technology to mobilize your talent. By embracing these forces of innovation and following forward-thinkers, the future looks a lot brighter.

9.5 RightShip Eyes Zero Harm Maritime Sector with New Singapore Innovation (November 2021)

RightShip, the world's biggest third-party maritime risk assessment and due diligence organisation, strengthens its presence in Asia-Pacific (APAC) by announcing the opening of its Singapore office. This new space will be an innovation hub to deliver zero harm solutions, housing key leadership functions including the product and innovation team, headed up by Chris Saunders, Chief Product Officer. Situated in downtown CBD, the office has the capacity to host 28 employees, with a view to expand recruitment in the region further.

The new Singapore office builds on extended collaboration with and support from local Singaporean organisations, including the recent MOU signed with the Singapore Maritime Institute to cooperate on a Maritime Artificial Intelligence (AI) R&D Programme. It will also be home to two of the company's recent strategic additions at the C-suite level: Tarun Mehrotra, Chief Strategy Officer, and Gurpreet Singh, Chief Commercial Officer.

RightShip CEO, Steen Lund, comments: "For an organisation striving to create a zero harm maritime industry using digital technology, Singapore is a natural second home. The government here recognises the opportunity and responsibility it has for international leadership in this respect, as evidenced from the launch of its Global Centre for Maritime Decarbonisation earlier this year. With its established commitment to combating climate change and its shipping heritage, it's the perfect place to build a sector that is safer for the maritime industry, safer for the mariners themselves, and safer for the planet."

As the world looks for more opportunities to slow the impacts of global warming, it has become clear that technology and innovation will be pivotal success drivers. For this reason, having a physical presence close to its customer base will enable RightShip to be on the front line of the conversation. Working with key industry figures on the ground to bring products to life, industry-led innovation will be the driver for more effective market-focused solutions.

Chris Saunders adds: "Singapore is the heart and soul of the APAC maritime industry. It is home to the shipping companies themselves, but also the lenders, insurers, ship owners and managers, and cargo holders and charterers that are essential to the sector. It boasts some of the world's most advanced port infrastructure with deep understanding of dry and wet bulk, and container shipping. If your goal is to build genuinely industry-led products, then you go where that stakeholder expertise and experience is deepest. Add to that the fact that our customers, prospects and shareholders are here – all stakeholders we want to collaboratively build our solutions with – and it's clear that Singapore is the right place for RightShip."

The new office is the latest in a number of moves RightShip has made to expand its presence in Asia: opening representative offices in as a sales representative in Shanghai, China in July 2021, followed by Hiroshima, Japan in November 2021.

9.6 Saving seaweed with machine learning | MIT News | Massachusetts Institute of Technology (October 2021)

PhD candidate Charlene Xia is developing a low-cost system to monitor the microbiome of seaweed farms and identify diseases before they spread.

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Last year, Charlene Xia ’17, SM ’20 found herself at a crossroads. She was finishing up her master’s degree in media arts and sciences from the MIT Media Lab and had just submitted applications to doctoral degree programs. All Xia could do was sit and wait. In the meantime, she narrowed down her career options, regardless of whether she was accepted to any program.

“I had two thoughts: I’m either going to get a PhD to work on a project that protects our planet, or I’m going to start a restaurant,” recalls Xia.

Xia poured over her extensive cookbook collection, researching international cuisines as she anxiously awaited word about her graduate school applications. She even looked into the cost of a food truck permit in the Boston area. Just as she started hatching plans to open a plant-based skewer restaurant, Xia received word that she had been accepted into the mechanical engineering graduate program at MIT.

Shortly after starting her doctoral studies, Xia’s advisor, Professor David Wallace, approached her with an interesting opportunity. MathWorks, a software company known for developing the MATLAB computing platform, had announced a new seed funding program in MIT’s Department of Mechanical Engineering. The program encouraged collaborative research projects focused on the health of the planet.

“I saw this as a super-fun opportunity to combine my passion for food, my technical expertise in ocean engineering, and my interest in sustainably helping our planet,” says Xia.

Wallace knew Xia would be up to the task of taking an interdisciplinary approach to solve an issue related to the health of the planet. “Charlene is a remarkable student with extraordinary talent and deep thoughtfulness. She is pretty much fearless, embracing challenges in almost any domain with the well-founded belief that, with effort, she will become a master,” says Wallace.

Alongside Wallace and Associate Professor Stefanie Mueller, Xia proposed a project to predict and prevent the spread of diseases in aquaculture. The team focused on seaweed farms in particular.

Already popular in East Asian cuisines, seaweed holds tremendous potential as a sustainable food source for the world’s ever-growing population. In addition to its nutritive value, seaweed combats various environmental threats. It helps fight climate change by absorbing excess carbon dioxide in the atmosphere, and can also absorb fertilizer run-off, keeping coasts cleaner.

As with so much of marine life, seaweed is threatened by the very thing it helps mitigate against: climate change. Climate stressors like warm temperatures or minimal sunlight encourage the growth of harmful bacteria such as ice-ice disease. Within days, entire seaweed farms are decimated by unchecked bacterial growth.

To solve this problem, Xia turned to the microbiota present in these seaweed farms as a predictive indicator of any threat to the seaweed or livestock. “Our project is to develop a low-cost device that can detect and prevent diseases before they affect seaweed or livestock by monitoring the microbiome of the environment,” says Xia.

The team pairs old technology with the latest in computing. Using a submersible digital holographic microscope, they take a 2D image. They then use a machine learning system known as a neural network to convert the 2D image into a representation of the microbiome present in the 3D environment.

“Using a machine learning network, you can take a 2D image and reconstruct it almost in real time to get an idea of what the microbiome looks like in a 3D space,” says Xia.

The software can be run in a small Raspberry Pi that could be attached to the holographic microscope. To figure out how to communicate these data back to the research team, Xia drew upon her master’s degree research.

In that work, under the guidance of Professor Allan Adams and Professor Joseph Paradiso in the Media Lab, Xia focused on developing small underwater communication devices that can relay data about the ocean back to researchers. Rather than the usual $4,000, these devices were designed to cost less than $100, helping lower the cost barrier for those interested in uncovering the many mysteries of our oceans. The

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communication devices can be used to relay data about the ocean environment from the machine learning algorithms.

By combining these low-cost communication devices along with microscopic images and machine learning, Xia hopes to design a low-cost, real-time monitoring system that can be scaled to cover entire seaweed farms.

“It’s almost like having the ‘internet of things’ underwater,” adds Xia. “I’m developing this whole underwater camera system alongside the wireless communication I developed that can give me the data while I’m sitting on dry land.”

Armed with these data about the microbiome, Xia and her team can detect whether or not a disease is about to strike and jeopardize seaweed or livestock before it is too late.

While Xia still daydreams about opening a restaurant, she hopes the seaweed project will prompt people to rethink how they consider food production in general.

“We should think about farming and food production in terms of the entire ecosystem,” she says. “My meta-goal for this project would be to get people to think about food production in a more holistic and natural way.”

10 Technology: Big data

10.1 NVIDIA position their digital twin of Earth as key in fighting climate change (November 2021)

Many announcements were made at the GPU Technology Conference (GTC), which celebrated the transformation of NVIDIA from a hardware company into a full-stack computing company. However, a focus of CEO Jensen Huang’s keynote speech was the environment.

NVIDIA are intending to use a range of its products to simulate the effects of climate change to predict and therefore mitigate environmental disasters. They plan to do this by creating a digital twin of Earth.

This twin will be a new supercomputer named E2 (Earth 2), which they will develop in their Omniverse. CEO Jensen Huang hoped that this digital twin, which models the climate of Earth, would be able to make accurate regional impact predictions up to 30 years into the future.

A data driven approach

NVIDIA’s approach is focused on fast, informative, predictive, data modeling using machine learning and their accelerated, high-performance computing, which they hope can then be transformed into predictions that can help mitigate climate change-related disasters.

NVIDIA also announced that they are forming a partnership with the Massachusetts Institute of Technology through a worldwide consortium of public and private sector entities, including Amazon Web Services’ Sustainable Data Initiative, to provide all climate scientists with a way to pool their data and resources.

Mitigating the inevitable

This focus on disaster prevention is an alarming sign that humanity is already having to look at how best to mitigate the effects of climate change rather than prevent it, as it becomes an inevitability that Earth will continue to rise in temperature. Hopes of reducing the emissions that cause climate change in time to avoid these consequences altogether have been dashed, as we are experiencing them already in the form of increased flooding, droughts, and wildfires.

NVIDIA is already working to mitigate these consequences. They have partnered with the Lockheed Martin AI Center to launch an initiative that uses advanced AI and machine learning to increase the accuracy and response time of wildfire predictions. This then enables operators to act quickly to limit the spread of fires.

NVIDIA AI capabilities

As established simulation specialists, with extensive AI capabilities, NVIDIA are good candidates for this task. However, Huang is right in describing this scale of simulation as 'daunting'. The multitude of data and the interactions between them are unfathomably large.

Huang announced that their new NVIDIA Modulus product, a training framework, will help to achieve this. They will use principled physics models and observed data to teach AI to predict climate in super real time. Modulus will continuously readjust, calibrate, and improve the predictions with observed data, which will enable it to generate predictions again and again. Huang hopes this will be up and running in the Omniverse in 'a couple of years'.

NVIDIA faces European competitors

NVIDIA is not the first to try to make a digital twin of the Earth. In March 2021, the European Centre for Medium-Range Weather Forecasts presented their project, Destination Earth (DestinE). This project has several advantages over NVIDIA, as it is partnered with the European Space Agency (ESA) and the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT).

These organizations have extensive experience with weather forecasts but also have access to Earth observation data, both of which are vital resources in the development of a digital twin of Earth. They do not, however, have the software and AI capabilities that NVIDIA claims are essential for the project. Perhaps it would be mutually beneficial—not only for these organizations but for humanity—if they were to join forces in the battle against climate change.