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Cover Story: Riding the tide

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“We identified a significant gap in the market for operational datasets. There’s a clear demand for comprehensive ocean data, but it is often expensive.” - Mohd Fadzil (Photo by Ocean Hydro)

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When wreckage from the missing Malaysia Airlines flight MH370 was discovered on Reunion Island in 2015 — thousands of kilometres from the suspected crash site — scientists traced its likely path across the Indian Ocean using sophisticated ocean forecast models. These tools simulate how debris

drifts over time by factoring in ocean currents, wind, wave activity and other environmental conditions.

“By analysing how ocean conditions may have carried the debris across vast distances, investigators can generate probability maps to narrow down potential crash sites,” says Professor Dr Mohd Fadzil Mohd Akhir, founder of Ocean Hydro Sdn Bhd and one of the researchers who tracked the path of the MH370 debris.

But beyond disaster investigation, Mohd Fadzil saw broader potential for these models, especially in supporting small businesses in sectors such as logistics, fisheries, maritime services and ecotourism. From route planning for small shipping firms to safer fishing operations and marine farming, ocean forecasting can offer actionable insights for everyday decision-making.

“Ocean forecasting is not a new system; it has been here for years but it caters to a very exclusive market. Currently, only a few specialised companies offer these forecasts, and their services are quite expensive, making them accessible primarily to large industries. For instance, companies in the oil and gas sector likely employ their consultants for these forecasts due to the high cost,” he says.

The Malaysian Meteorological Department (MET Malaysia) already uses ocean forecast data to support marine-related activities and disaster risk management. However, Mohd Fadzil says such data is usually accessed on a limited basis, often only for reporting purposes rather than operational use.

“We identified a significant gap in the market for operational datasets. There’s a clear demand for comprehensive ocean data, but it is often expensive.”

To bridge this gap, Ocean Hydro — a start-up established by Universiti Malaysia Terengganu’s (UMT) Institute of Oceanography and Environment (INOS) and led by Mohd Fadzil, its director and lecturer — is working to democratise ocean forecasting.

Its Marine Forecast System (MFAST) is an affordable tool that allows users, including small enterprises, to anticipate ocean conditions and weather patterns with greater accuracy. This could reduce risks, optimise marine routes and even support climate adaptation strategies for coastal businesses.

“[To set up a company to commercialise a product based on research] you need to register at least for copyright and then you need to commercialise. We [researchers at INOS] sat down and thought [about] what kinds of products we wanted to commercialise. That’s when we decided we should look into the ocean forecast system,” says Mohd Fadzil.

MFAST was developed through a collaboration between UMT and China’s First Institute of Oceanography (FIO). It complements the Ocean Forecasting Demonstration System for Southeast Asian Waters, a pilot initiative under the Southeast Asian Global Ocean Observing System (Seagoos), which operates within the Intergovernmental Oceanographic Commission (IOC) Sub-Commission for the Western Pacific (Westpac).

Seagoos is a regional programme established in 2002 to enhance ocean observing capabilities, data sharing and forecasting across Southeast Asia. It operates under the IOC of Unesco via Westpac, which advocates for scientific cooperation among countries to ultimately enhance governance, foster sustainable development and protect the marine environment.

Westpac currently comprises 22 member states, including Malaysia, Indonesia, Singapore, Australia and Thailand.

“FIO China helped us to build a forecast system. One of the intentions is to make sure that each [member] country can produce their own ocean forecast. We started sometime in 2009 and 2010. Along the way, we produced some forecasts, and then we improvised along the way,” shares Mohd Fadzil.

After developing the initial ocean forecast system, Mohd Fadzil and his team turned their attention to securing intellectual property (IP) rights before moving towards commercialisation. By 2016, they had successfully created a basic, web-based ocean forecasting platform.

“If you are familiar with the Windy app, our website was something similar, but limited to ocean forecasting. It featured surface temperature, salinity and ocean wave forecasts but [we did not have] many users. We couldn’t track who was using the site because most people still relied on MET Malaysia for ocean data,” he explains.

Windy is a popular weather visualisation tool used by pilots, sailors and outdoor enthusiasts for its real-time wind, temperature and weather forecast maps.

“When we spoke to MET Malaysia, we found their data focused on ocean temperature and current conditions. It wasn’t tailored for forecasting specifically. They visualised ocean currents, temperature and waves, but we wanted to go beyond that.”

From route planning for small shipping firms to safer fishing operations and marine farming, ocean forecasting can offer actionable insights for everyday decision-making (Photo by Ocean Hydro)

Making real-world impact

Mohd Fadzil’s academic interests lie in coastal physical oceanography, with a particular focus on field observations and numerical modelling.

His research centres on the southern South China Sea, examining ocean currents, wind patterns, waves and water masses. One of the most significant outcomes of this work has been the recent discovery of an upwelling system along the east coast of Peninsular Malaysia.

Upwelling is a process in which deep, cooler and nutrient-rich water rises to the surface, typically driven by wind and ocean current dynamics. This phenomenon can significantly boost marine productivity by supporting fisheries and enhancing biodiversity. Mohd Fadzil's findings suggest that this upwelling system, previously undocumented in the region, could have important implications for local fisheries management, climate studies and coastal planning.

"I studied civil engineering and somehow found myself interested in becoming a lecturer, although I had no teaching experience at the time. The first university I approached was UMT, and as it happened, they were looking for an oceanographer. Oceanography is a branch of marine science where you deal mainly with the physics of the ocean — temperature, currents and so on," he says.

Driven by a strong interest in environmental issues rather than structural design, Mohd Fadzil's devoted part of his final year in civil engineering to environmental engineering. His academic focus consistently gravitated towards environmental subjects, resulting in several year-end projects centred on coastal engineering.

Unlike ocean ecology, which deals with marine life and nutrients, physical oceanography is grounded in technical disciplines such as mathematics and physics, which worked well for Mohd Fadzil because of his foundation in engineering.

Building on this interest, he applied for a PhD programme in Physical Oceanography and went on to earn his doctorate from the University of Western Australia in Perth. This paved the way for his academic career as a lecturer at UMT.

However, as a government employee at a public university, Mohd Fadzil says he is unable to earn a profit from the start-up.

This is because public servants are generally prohibited from engaging in business activities, in order to maintain impartiality and avoid conflicts of interest. These restrictions are governed by civil service regulations designed to prevent misuse of public office and uphold ethical standards.

That said, in the higher education sector, Mohd Fadzil points out that innovation and research today increasingly require a path to commercialisation.

Commercialisation within universities bridges the gap between academic research and tangible real-world impact. It is the process through which discoveries and IP developed within universities are transformed into marketable products, services or technologies.

This mostly involves identifying commercially viable research, protecting IP rights and transferring these assets to industry through mechanisms such as licensing agreements or the establishment of university spin-off companies.

“Ocean Hydro was created as such. The Higher Education Ministry encourages our researchers to commercialise most of their innovative products. By encouraging and supporting start-up companies, universities can instil entrepreneurship culture and contribute to economic growth. The idea of a start-up within the university is practical,” he says.

MFAST was developed through a collaboration between UMT and China’s First Institute of Oceanography (FIO). It complements the Ocean Forecasting Demonstration System for Southeast Asian Waters, a pilot initiative under the Southeast Asian Global Ocean Observing System (Seagoos). (Photo by Ocean Hydro)

Tapping into climate technology

When Mohd Fadzil and his team founded Ocean Hydro in 2022, similar products already existed in the market, particularly in ocean forecasting and climate technologies. However, they set out to differentiate themselves by developing predictive solutions with user-friendly dashboards.

Climate tech solutions developed by both public and private players are a crucial link in the fight against climate change. They harness advanced technologies to remove carbon from the atmosphere, reduce future emissions, and strengthen resilience to environmental impacts.

“Before we started the company, we wanted to make these dashboards and our website easily accessible for our clients and government agencies that deal with coastal areas. [At that point] we only had data visuals and displays, which only looked nice without giving any proper information,” says Mohd Fadzil.

“The real question was, how can I get people to look into this visualisation and use that information efficiently? Then we came up with the idea that clients should be able to use data for decision-making. That was the whole idea and then we came up with a proper set-up and user interface to read predictive ocean data.”

According to market research firm Fortune Business Insight, the global climate tech market was valued at US$25.32 billion in 2024. It is projected to grow from US$31.45 billion (RM133.48 billion) in 2025 to US$149.27 billion by 2032, reflecting a compound annual growth rate (CAGR) of 24.9%.

According to UMT’s website, MFAST is a high-resolution ocean forecasting tool developed using a wave-tide-circulation coupled model by the Laboratory of Marine Sciences and Numerical Modelling. MFAST provides up to five days of forecast data on ocean currents, temperature, surface waves and wind across a region stretching from 3°S to 15°N and 96°E to 123°E, updated at three-hour intervals.

Beyond oil and gas companies, Mohd Fadzil says port operators are also key stakeholders in ocean forecasting systems.

“Ocean forecast systems are vital for ports, ensuring safer navigation and operations by predicting sea conditions. I was quite surprised that some port operators in Malaysia do not have their own forecasting system. This is where we [came in and] started to communicate with more than 10 ports. Some of them only buy ocean data for simple analysis and reporting,” he adds.

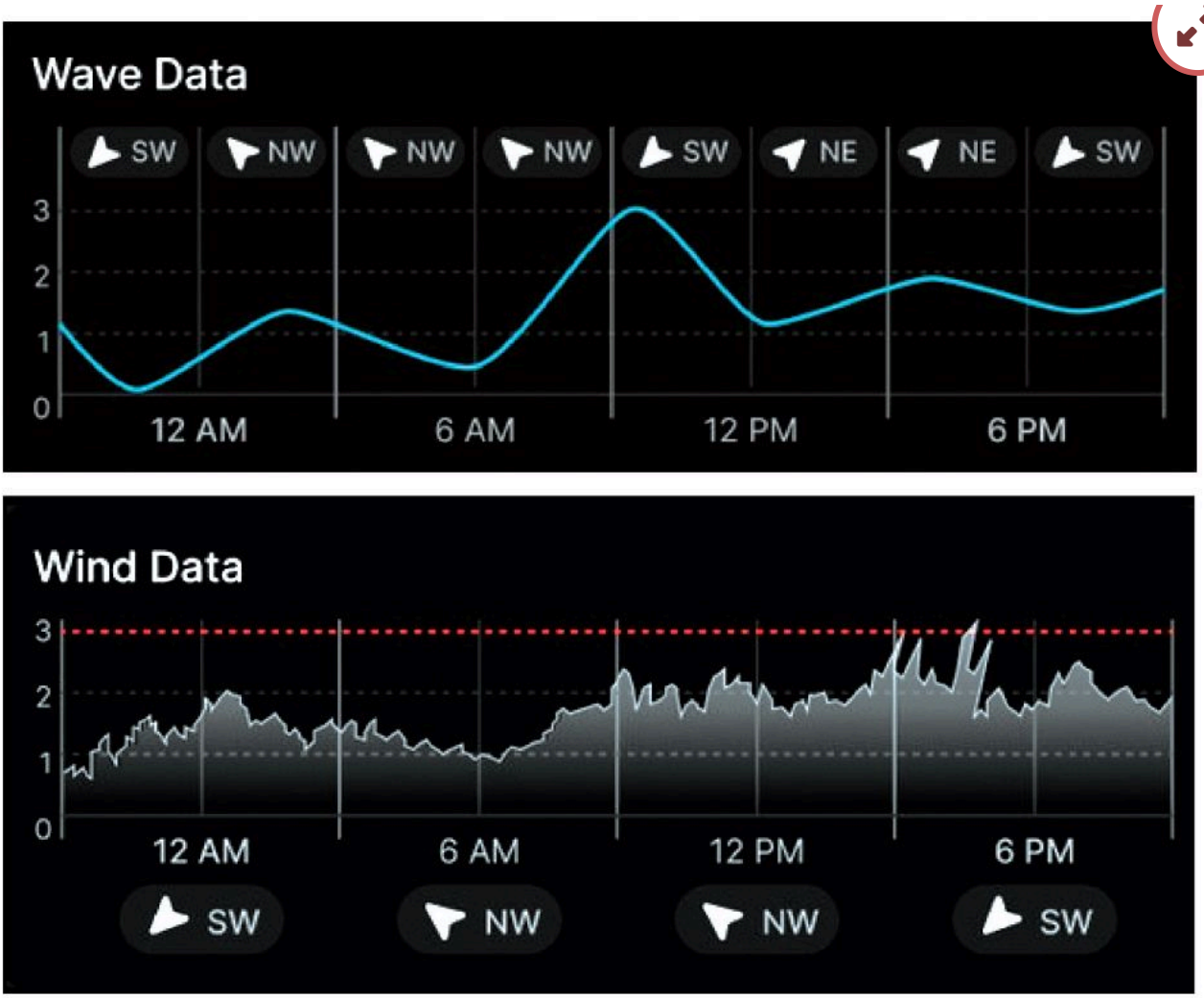
While ocean forecasts are not 100% accurate, they allow for optimised scheduling, reduce delays and more efficient resource allocation, which in the long term help minimise risks and operational costs. These systems also play a crucial role in environmental protection, particularly in supporting oil spill response efforts at ports.

Despite the growing need for climate tech, funding remains a major challenge, particularly for innovations developed within public universities, says Mohd Fadzil.

INOS at UMT was recognised by the Ministry of Higher Education as a Higher Institution Centre of Excellence under the research and innovation thrust. Under this initiative, the institute received more than RM10 million to support various innovation and research projects.

“We do not get the whole funding [of RM10 million]; we are part of the projects under that funding. Our project [at Ocean Hydro] was [initially] to study the oceanography and ocean health of Malaysia. We did our scientific work and one of the by-products of that work turned out to be forecast solutions,” he explains.

“We are also waiting to raise funds through Cradle (Fund). That one is to also help us with our system development and we have been in talks with the Ministry of Science, Technology and Innovation again for tech development. We want to make this available for the public as well so we need to make it as seamless as possible.”



Climate tech solutions developed by both public and private players are a crucial link in the fight against climate change (Photo by Ocean Hydro)

Incorporating AI into forecasting models

While still in its early stages, university-backed Ocean Hydro has already secured collaborations with various government agencies as well as national oil and gas giant Petroliam Nasional Bhd (Petronas) for its ocean forecasting services.

Ocean Hydro is also actively exploring the integration of artificial intelligence (AI) into its dashboards to enhance performance and user experience.

“We are currently developing an AI-forecast system for their [Petronas’ existing] platform to look at the ocean temperatures because there are some big concerns about the rapid changes of temperature that may cause accidents or fatalities for the personnel offshore. We are now improvising the existing forecast by implementing an AI approach,” says Mohd Fadzil.

Ocean Hydro has also worked with the Public Service Department, where it developed a basic tool to assist what Mohd Fadzil refers to as the “Baywatch response” team or coastal guards.

“We built a system for them, especially for Pantai Cenang in Langkawi, one of the busiest beaches in Malaysia. It was reported that there were a lot of accidents happening there among recreational users and tourists. The system was to monitor tides and raise alarms when there is strong waves or storm surge. It was a forecast system as well,” he adds.

Looking ahead, Mohd Fadzil says the system requires a complete overhaul for mobile deployment and better integration of AI components. He explains that AI will be used to enhance the accuracy of localised forecast data.

“For specific locations, from point A to B, where more information and accurate data are needed, AI will help provide and embed that accuracy in a very localised manner. Secondly, AI will extend the forecast capabilities beyond the current five-day window.”

By training on and learning from historical data, AI could eventually enable the system to predict conditions weeks or even months in advance. This is the direction Ocean Hydro is currently heading — focusing on hyperlocal precision and medium- to long-term forecasting.

“This is a practice already prevalent in countries like the US and Japan, and in the European continent, where AI is used in operational forecast products to provide better input, particularly during certain extreme events,” says Mohd Fadzil.

“We hope that we can grow not only in Malaysia but regionally as well and expand to other sectors like agriculture, not specifically with ocean data, but just forecast solutions in general.”