

國際海洋資訊

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海洋委員會「《聯合國海洋法公約》 40週年與海洋政策國際研討會」紀要

Ocean Affairs Council "International Conference on the
40th Anniversary of the United Nations Convention on the
Law of the Sea and Ocean Policy": Memorandum of Conference

印度海洋資訊

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海洋委員會
Ocean Affairs Council

發行



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海洋治理展新頁 共創永續、安全、 繁榮的海洋

主任委員：管碧玲

《聯合國海洋法公約》通過40週年，本期【專題報導】專文分享本會2022年11月2日至3日舉辦之「聯合國海洋法公約40週年與海洋政策國際研討會」，邀請各國學者參與、討論如何維護以規則為基礎的國際秩序。

我國和印太國家共享民主、自由、人權和法治的普世價值，並樂於和理念相近國家攜手共創永續、安全、繁榮的海洋。為此，本期焦點關注印太區域關鍵位置的印度。印度地球科學部（Ministry of Earth Sciences, MoES）成立於2006年，研究範圍上至大氣下到海洋，更將極圈研究納入研究目標。MoES主要海洋倡議一為「藍色經濟政策」，印度政府規劃7大領域工作小組，2021年推出《印度藍色經濟政策草案》，以提高藍色經濟對印度GDP的貢獻；二為「海洋空間規劃」（Marine Spatial Planning, MSP），管理並協調不同用途的海洋空間以維持海洋環境，並與挪威等國共同合作，打造可複製的MSP框架。

在聯合國「海洋科學促進永續發展十年」（簡稱海洋科學十年）的目標下，印度成立「國家十年協調委員會」（National Decade Coordination Committee, NDCC），本期【資訊新知】介紹印度國立海洋資訊服務中心（Earth System Science Organization- Indian National Centre for Ocean Information Services, ESSO-INCOIS），如何透過海洋資料管理、訂定計畫並加強海洋建設，以實現該國十年目標。而【法規制度】也一併介紹西印度洋的海洋治理機制現況，該區域沿海國家在海洋環境、漁業資源及海域劃界等議題持續協調並規劃發展，未來國際組織及其他國家之協助，與相關治理量能之建立將是首要工作。

本期【國際議題】則介紹2022年海洋狀況先期報告（State of the Ocean Report 2022: Pilot edition），聚焦瞭解和打擊海洋污染、保護和復育生態系及生物多樣性等挑戰，面對海洋健康的惡化，全球仍需持續努力，更瞭解海洋、永續使用海洋！本會也將以最快速度推動《海洋保育法》等「海洋三法」完成審議及立法，深化《國家海洋政策綱領》與《海洋基本法》，保衛藍色國土以達成國人的期待。



圖說／位於孟加拉灣的印度聯邦屬地「安達曼-尼科巴群島」（Andaman and Nicobar Islands），具豐富珊瑚礁生態，旅遊業發達
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海洋委員會「《聯合國海洋法公約》40週年與海洋政策國際研討會」紀要

撰文／宋家和（國立政治大學亞太研究所博士生）

關鍵字／聯合國海洋法公約、海洋政策

2022年11月2至3日海洋委員會舉辦「聯合國海洋法公約40週年與海洋政策國際研討會」國際線上會議，回顧海洋法40年來的發展歷程與趨勢，就1982年《聯合國海洋法公約》（United Nations Convention on the Law of the Sea, UNCLOS）相關面向，包括海洋法之制度發展、海洋環境保護與海洋法、海洋資源養護與海洋法、海上安全與執法、海洋爭端與解決等5大議題進行學術研討。海洋委員會周美伍前代理主委於開幕致詞表示，《聯合國海洋法公約》自1994年生效以來，將原有的習慣國際法成文化，並被承認為「世界海洋憲章」。本次研討會邀請來自新加坡、韓國、美國、義大利、日本、英國、波蘭、菲律賓及我國的學者參與，針對相關主題進行發表、分享及交流，共同討論並維護以規則為基礎的國際秩序，以維護印太地區的自由與繁榮。

本會首先由中央研究院宋燕輝研究員以「《聯合國海洋法公約》及海洋主張：以臺灣海峽為例」進行專題演講。其特別指出，近期第4次臺海危機（2022年8月）後，我國遇到挑戰，包括國際承認層面，如臺灣長期在參加聯合國和UNCLOS相關的政府間組織會議時，不斷地遭遇到困難。此因

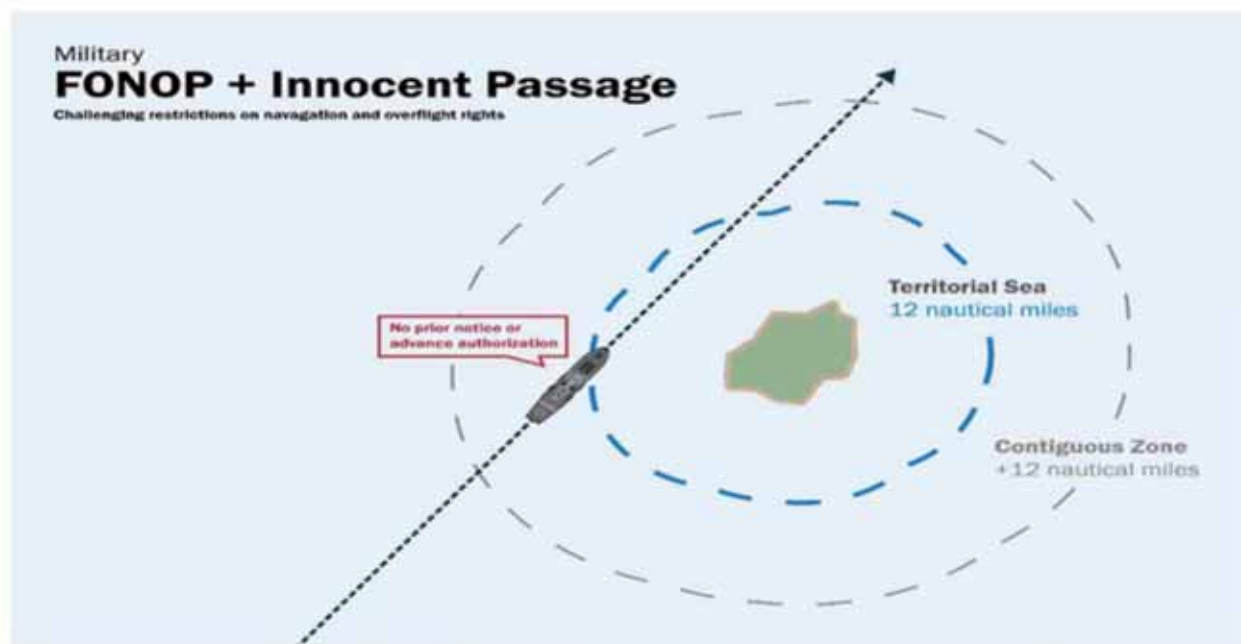


圖1／美國國防部自由航行計畫與無害通過
資料來源／哈佛大學肯尼迪學院貝爾弗科學與國際事務中心

素所引發的相關水域國際海洋法問題，值得持續探討。但此次危機相對亦引起美日等國家對臺海安全之進一步重視，可能擴大採取如同美國國防部自由航行計畫與無害通過（Freedom of Navigation Operation, FONOP）等行動。為因應局勢升溫，我們更迫切需要促進臺灣海峽兩岸及相關國家，尤其是美中之間的對話，以維護臺海和平。

首日會議重點：《聯合國海洋法公約》之發展、海洋保育及資源養護

本會首日第1場次「聯合國海洋法公約之發展」邀請新加坡國立大學Robert Beckman名譽教授發表主題：「在1982年海洋法公約下有關專屬經濟區內的適當顧及義務」，重點檢視了UNCLOS關於在沿海國專屬經濟區（Exclusive Economic Zone, EEZ）開展海軍行動的規定、談判歷史，及沿海國和其他國家在EEZ內的主權權利、管轄權和義務，包括分析從事「與航行和飛行自由有關的其他合法海洋用途」之權利。「適當顧及義務」強調須和主權國家進行協商，期待在南海問題上，由美國帶頭來做事先協商的角色，以減輕亞洲沿海國的憂慮。

而韓國仁荷大學法學院李錫武（Seokwoo LEE）教授所發表之主題為：「國家根據UNCLOS及相關公約和協定的義務，以及在國內立法政策的體現」，說明東南亞各國根據公約和協定，承擔、體現並反映在國內立法政策中關於保護海洋環境的義務相關法律及政策。以目前海洋保護區相關立法及措施來看，東南亞地區成果有限。最後國立中山大學胡念祖特聘教授發表的主題為：「跨界種群的漁業管理差距問題」指出，某些跨界種群（如太平洋黑鮪和日本鰻魚），皆面臨過度捕撈，其生物學或遷徙模式需要特別進行保護和管理。日本、臺灣及菲律賓在臺灣東部海域的專屬經濟區重疊，期待3國能發展更好的國際合作，建立跨國共同管理之非政府組織以促進生物養護。

第2場次「海洋環境保護與聯合國海洋法公約會議紀要」，由美國氣候評分組織代表普蘭·錢德拉·潘迪（Pooran Chandra Pandey）發表關於：「亞洲在多邊對話的世界裡：海洋政策、氣候條約及聯合國氣候變遷綱要公約第27屆締約方大會（Conference of the Parties, COP27）」，指出推動海洋議程的《巴黎協定》與UNCLOS重疊，2022年11月在埃及舉行的COP27也討論海洋資源、氣候和人類福祉，重要性日漸升高。鑑於亞洲的戰略重要性，UNCLOS從安全層面關注海洋資源、海上活動、航行自由，受保護的海底採礦和劃界具有更大的意義。對於多邊主義、航行自由、對話和法治能夠以亞洲共同繁榮為目標，臺灣亦扮演重要角色，共同維護國際和平與穩定。

接著國立臺灣海洋大學蔡沛倫助理教授所發表之：「UNCLOS下之海洋環境保育及養護：國際海洋法法庭（International Tribunal for the Law of the Sea, ITLOS）臨時措施和諮詢程序的貢獻」，內容提到ITLOS自成立以來提交的29個案件中，涉及保護和保全海洋環境問題的案件往往在臨時措施或諮詢程序中得到考慮。UNCLOS關於保護海洋環境的規定很少且大多抽象，判例可以在闡明各國對環境的義務上發揮關鍵作用，特別是ITLOS的臨時措施令闡明在緊急情況下需要做什麼，如何發揮更積極作用的潛力。接著由義大利熱那亞大學Lorenzo Schiano di PEPE教授發表「法庭的『侵權

訴訟」(Infringement procedure)以及歐盟海洋環境立法的執行」，主要談及根據《歐盟運作條約》第258、259和260條的「侵權訴訟」及其在執行適用於保護海洋環境的歐盟立法框架中的作用，並且提及在解決與海洋有關的爭端方面，國際／歐盟法律體系之間的對比。本場次最後由日本東京外國語大學石橋可奈美教授發表：「以UNCLOS來看日本核廢水排放至海洋」，闡述就UNCLOS而言，若有採取環境評估等一切措施，以防止海洋污染避免影響國家或國家管轄範圍的區域，則排放污水是被認可的，並不違反日本在UNCLOS上的義務(預防原則)。ITLOS也下令日本有進行磋商的義務。國際原子能總署(International Atomic Energy Agency, IAEA)對此表示可接受，並可為日本提供監測等相關支持。惟其總結時認為日本應持續尋求對環境污染風險更小之方法。

進入到第3場次「海洋資源養護與聯合國海洋法公約」，首先由英國諾丁漢特倫特大學法學院David ONG教授闡述「UNCLOS&BBNJ協定之海洋生物資源保育：持續的法律問題」，關於法源方面，UNCLOS的法律地位高於「聯合國國家管轄範圍外區域海洋生物多樣性養護及永續利用協定」(The United Nations Convention on the Law of Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction, BBNJ)，惟尚有問題待釐清，包括管轄範圍，因UNCLOS和BBNJ協議均涉及「定著物種」和「海洋遺傳資源」(Marine Genetic Resources, MGR)之間的關係。再者，在擬議的BBNJ協議下，保護任何資源的國際條約義務可與保護海洋生物多樣性的總體目標並列。第二則由國立中山大學海事所高世明副教授發表主題：「UNCLOS海洋漁業資源保護與管理方面以及臺灣遠洋漁業對策」，討論到UNCLOS及隨後通過的國際漁業法律文書中有關漁業資源養護和管理的規定具約束力，指出區域漁業管理組織(Regional Fisheries Management Organizations, RFMO)已被認定為遠洋漁業國家與沿海國之間的主要合作機制及實施海洋漁業資源養護和管理的執行機構。雖然仍有努力空間，但臺灣通過多項國內法律法規，顯示其打擊非法、未報告及不受規範漁業(Illegal, Unreported and Unregulated fishing, IUU)捕魚和強迫勞動問題的決心並履行相關國際義務。再來由東吳大學何婉君助理教授發表：「轉型中的藍色經濟：漁業貿易與永續發展目標一致？」，重點討論WTO第12屆部長級會議通過的《漁業補貼協定》向海洋永續邁出重要一步之貢獻，旨在禁止或減少漁業補貼。新協議不僅實現永續發展目標SDGs 14的任務，亦是第1個以環境義務為核心的多邊貿易協議。漁業資源永續利用對於發展藍色經濟至關重要。將環境永續規範納入貿易協定對於WTO和國際漁業制度而言，顯示出國際漁業治理結構轉型的新趨勢。

以上，11月2日之首日國際研討會主要藉由掌握國際海洋環境保育、海洋資源養護與海洋法之發展重點及脈動，瞭解日本、東南亞、歐盟等國之UNCLOS及相關海洋法之實踐情形及國際趨勢，並回顧我國對於海洋法的實踐現況。

次日會議重點：安全與執法

次日11月3日第4場次「安全與執法」首先邀請韓國海事研究所Young Kil PARK主任發表主題：「以法律觀點來看東海的緊張局勢：無法持續的穩定？」，其表示根據UNCLOS相關規範，在東海有兩種「臨時安排」，即漁業協議以及油氣開發協議。中國並未對重疊EEZ海域進行自我約束，其執法管轄權的立場體現在《中國海警法》和《中國海上交通安全法》。面對管轄權的擴張，可以將案件提交國際法院，或採取替代做法，如基於衡平原則進行之EEZ劃界、或締結聲明準則（或管理準則）來處理。接續由波蘭居里夫人大學政治學院Agata W. ZIĘTEK教授討論：「在區域安全系統下的南海」，其指出過去20年間南海成為競爭場域，圍繞懸而未決的主權問題。當前急迫問題包括油氣探勘權利、領土爭端、武力展示以及中美關係（包括臺灣）。南海安全問題可分為政治經濟上的安全威脅、瞭解意圖及選擇因應的安全困境、以及軍事上權力的平衡以防止其他國家擴張。未來亟待通過建立以法律為基礎的區域秩序，以管理衝突的可能風險。

本場次最後由中央警察大學陳偉華副教授發表主題：「在中美策略競爭下，臺灣的海洋權利及執法之困境」，回顧並展望中美在印太地區的對峙和競爭，臺灣的海洋權利面臨之壓力。一是美國推動南海仲裁案合法化的壓力，二為2022年8月中國在臺灣周邊海域舉行的軍事演習。美國國務院於2022年發布第150號《海洋界限》，指出中國非法主張對南海擁有主權和專屬管轄權。

本會之最後階段第5場次「海洋爭端與聯合國海洋法公約」由菲律賓大學Jay BATONGBACAL法學教授發表主題：「UNCLOS附錄七仲裁之爭端解決：其他可能性？」。報告中闡述UNCLOS附錄七仲裁的細節，各國可能可以有些選擇，透過談判、調解、特別仲裁、臨時措施等各種機制來和平解決爭端。爭端解決是問題解決的過程，各方皆應秉持善意、信任、透明公開等原則逐步去處理，而非期待一次解決。之後由國防大學戰略研究所郁瑞麟副教授兼所長發表：「軍艦通過臺灣海峽之法律及政治議題」，討論透過國際海洋法檢視沿岸國和美國相關法律論點，認為臺灣海峽既非國際水域，亦非國際海峽，而是軍艦／軍機應享有航行和飛越自由的EEZ海峽。中間有完整的專屬經濟海域航道，依據公約可排除臺海的過境通行權，故在航道可施以類似公海的自由航行權，但外國軍艦亦可選擇臺灣另一側（太平洋海域）通過，取決於政治判斷。最終由國立臺灣大學蔡季廷副教授發表：「主權的虛偽建構及南海爭端：南海仲裁案的特別指涉」提及主權概念本質在國際法上是可爭論的。中國實質運用人民主權模式和國際法相對規範性法律概念，將其在南海的領土主權、海洋管轄權和歷史權利主張合法化。

結語

此次國際會議研討以UNCLOS發展40年的經驗及相關國際法角度來觀察海洋政策發展，並以東海、南海及臺海之所涉及的國際法爭端問題進行深入探討。同時亦深入探討UNCLOS仲裁等爭端解決方式，以及南海仲裁案相關之衍生思考，有助我國掌握國際脈動，作為後續政策規劃之參據。

對於牽涉UNCLOS相關海洋議題以及各國政策的爭議，不僅充分反應出當前國際海洋發展趨勢的重要性，以及對於爭端的可能解決途徑，值得繼續關注；同時也凸顯出在東亞的海域以及海洋政策發展上，對於有爭議的海域，存在著政策解決的思考方向。此次線上研討會，參與者眾多，發表論文的專家均提供各層面的最新海洋發展現況，有利於我政府和學界關注這些相關議題，作為施政以及研擬政策的基礎資訊。



圖2／國際視訊會議合照
圖片提供／海洋委員會

2022年海洋狀態先期報告： 聚焦海洋科學十年挑戰

撰文／陳璋玲（國立成功大學海洋科技與事務研究所教授）

關鍵字／海洋狀態、海洋科學十年挑戰、永續發展

海洋科學知識有助翻轉海洋健康惡化、保護海洋生物、解決氣候變遷有關海洋面向的問題，以及永續使用海洋，改進人類生活。因此，聯合國2017年宣布海洋科學促進永續發展十年（Decade of Ocean Science for Sustainable Development 2021-2030），致力提升海洋科學能量，以於2030年完成「我們需要的科學達成我們要的海洋」（the science we need for the ocean we want）的願景。聯合國教育、科學及文化組織（United Nations Educational, Scientific, and Cultural Organization, UNESCO）政府間海洋學委員會（Intergovernmental Oceanographic Commission, IOC）發表2022年海洋狀況先期報告（State of the Ocean Report 2022: Pilot edition），聚焦於海洋科學的挑戰，稱之為「海洋科學十年挑戰」（Ocean Decade Challenges）。報告主要以定性方式描述這些挑戰，指出海洋科學能量在海洋污染、海洋觀測、海洋生態系保護，以及沿岸社區韌性等方面的不足。這顯示量化描述的迫切性，始能建立海洋狀態的基準及量測狀態改變的能力。

前言

聯合國大會於2017年第72次會期宣布「海洋科學促進永續發展十年」（以下簡稱「海洋科學十年」），預計於2030年完成「我們需要的科學達成我們要的海洋」的願景。我們要的海洋由7個面向組成：潔淨的海洋、健康和具回復力的海洋、具生產力的海洋、可預測的海洋、安全的海洋、可公開和平等地接近的海洋，以及令人啟發和參與的海洋。為達成「我們需要的科學達成我們要的海洋」的願景，「海洋科學十年」特別指出我們面臨的10項海洋科學挑戰。

IOC公布2022年海洋狀態先期報告（以下簡稱先期報告）[1]。該報告主要說明「海洋科學十年挑戰」的內容，報告中只描述9項挑戰，未列出「第三挑戰」，因為此挑戰和海洋永續提供全球人口食物有關，不屬於IOC的職掌。因應這些挑戰，先期報告指出海洋知識在許多面向缺乏可信賴的基礎資料，對挑戰的描述偏屬質性，未來極需量化描述。

海洋科學十年挑戰

● 挑戰一：瞭解和打擊海洋污染

海洋中來自陸地的污染持續地增加和擴大，包括農業、養殖漁業、家庭和工業廢水等。近幾十年來，海洋環境中氮、磷和塑膠污染無所不在，對於海洋生物的影響，以及連帶對人類健康的影響是可

見的，因此瞭解這些污染物對人體健康和海洋生態系可能造成的影響，並發展移除或減少污染物的方法是非常重要的。

氮和磷能促進水生植物大量生長，因此常造成水體缺氧。全球海岸地區超過500個地點為低氧區（氧濃度低於 $62\ \mu\text{mol kg}^{-1}$ ），大部分集中於美國東岸、波羅的海及日本海岸等處（圖1）。然而，儘管海洋污染是全球重要的議題，就地理空間分布而言，海洋觀測仍是非常侷限，僅多集中於海洋表面及沿岸地區。目前海洋污染程度已可以二維方式呈現，但三維方式仍是遙不可及。為解決海洋污染，一套更優良、有系統的觀測和綜整方法是迫切需要的。

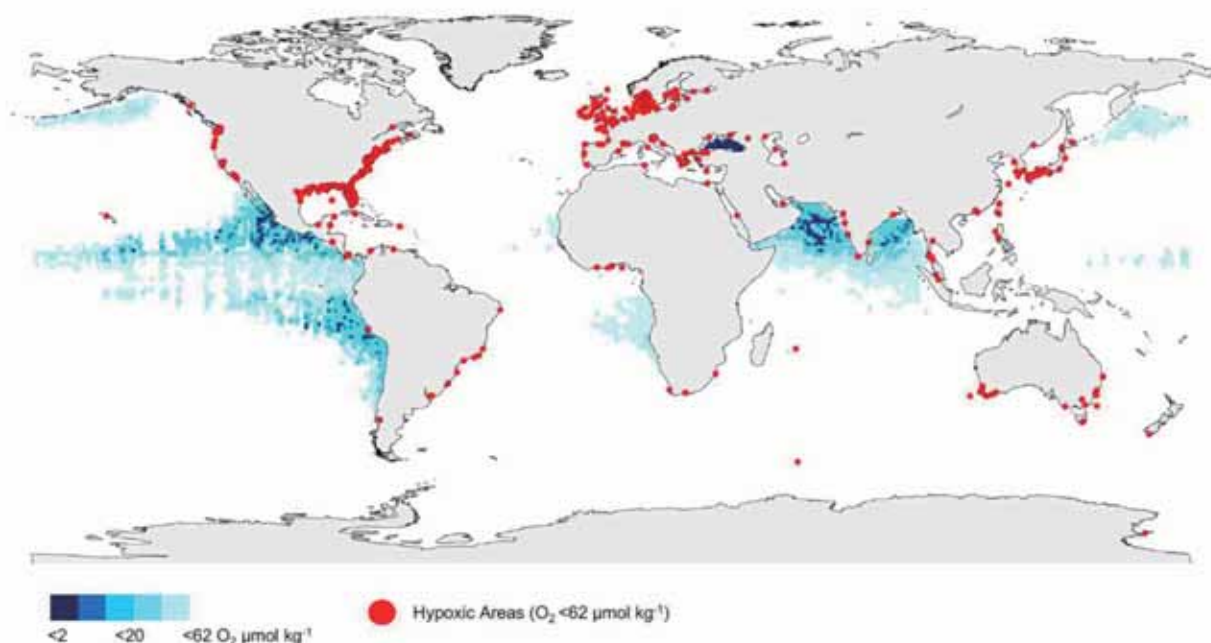


圖1／全球海岸低氧地區分布圖（以紅點表示，氧氣濃度低於 $62\ \mu\text{mol kg}^{-1}$ ）

資料來源／[1]

● 挑戰二：保護和復育生態系及生物多樣性

各式各樣的壓力因子，不管是個別，或是多重交互作用，正在形塑海洋生物多樣性的演變。這些因子包括海洋酸化、缺氧、暖化、更穩定的海水分層、洋流循環改變、漁撈、棲地破壞、外來種入侵，以及水下噪音等。因此，監測、保護、管理和復育海洋生態系及生物多樣性是高度優先的工作（圖2），為有效推動此工作，系統性地觀測和研究必須加強且予以充分資源。

目前透過環境DNA技術的使用、模式建構，以及資料整合分析，已能看出海洋生物演化的整體概況。在所有洋區中，已確認約240,000種海洋生物，每年亦發現約2,000種新物種。此外，低氧或死亡區、海水酸化、生物網變化，以及物種遷移至較冷區域等都是科學研究確認的事實。

● 挑戰三：永續提供全球人口所需食物

挑戰三涉及產生知識、支持創新，以及提供解決方法，使海洋在環境、社會和氣候變化狀態下，能永續提供全球人口所需食物[2]。由於此挑戰和永續提供全球人口食物有關，不屬於IOCC的職掌，故本報告未說明此挑戰。



圖2／監測、保護、管理和復育海洋生態系及生物多樣性是高度優先的工作
圖片提供／陳璋玲

● 挑戰四：發展永續和公平的海洋經濟

支持永續海洋經濟的系統性研究仍處於初期階段，相關的投資報酬管道、主要受益者、法規，以及市場機制等仍大都未知。海洋經濟和科學的互依關係更需進一步瞭解，尤其在海洋科學的投資報酬和實務應用方面。值得注意的是，海洋空間規劃（Marine Spatial Planning, MSP）有助加速推動永續海洋經濟。截至2022年4月，全球102個國家投入MSP，包括已通過、規劃中階段，或僅在初步規劃階段進度不一，共約300件。為推動MSP，實踐永續海洋經濟，在國家層級或公海區域中，應加強永續海洋空間規劃和管理能力的建置。

● 挑戰五：尋求以海洋為基礎的氣候變遷解方

增進瞭解海洋和大氣的關係，有助尋找以海洋為基礎的氣候變遷解方。海岸地帶的藍碳生態系（主要包括紅樹林、鹽沼和海草床生態系等3種）被認為是氣候變遷解方的重要場域（圖3）。研究調查發現全球藍碳生態系的面積約有4千萬公頃，分布在各大洲的海岸。這些碳儲存熱點每公頃固碳的速度比陸地生態系固碳的速度高約10多倍。目前國際整合型計畫已能就上述3種藍碳生態系的區位、面積、狀態，以及碳儲存潛力進行較準確的量化研究。

保護和管理藍碳生態系，其固碳效果相當於可減少目前碳排放量的2%，但由於沿岸都市及工業開發、水污染、破壞性漁法，以及農業和養殖對沿岸土地使用的壓力，全球20~50%的藍碳生態系已經消失或受到破壞。值得注意的是，紅樹林面積每年消失0.11~0.13%，鹽沼和海草床面積消失的速度更驚人，分別是每年1~2%、2~7%。



圖3／藍碳生態系（如紅樹林）被認為是氣候變遷解方的重要區域
圖片提供／陳璋玲

● 挑戰六：提升社區韌性因應海洋災害

海平面是氣候變遷最好的指標之一。依據歷年潮位資料，重建最近的海平面水位，顯示全球平均海平面呈增加的趨勢。1901~1990年，全球平均海平面增加12 +/- 5公分，平均速度每年1.3mm。1993~2002年期間，海平面從每年增加2.1mm，到2013~2021年期間的4.7mm。此顯示海平面上升，加上沿岸地區開發和人民移居至海岸地區的因子，使得沿岸地區韌性愈益受到威脅。

海嘯是海岸災害之一。為提升沿岸社區準備以因應海嘯，IOC設置全球海嘯警告和減災系統（Global Tsunami Warning and Mitigation System），在三大洋海盆布署12個海嘯服務提供者（Tsunami Service Providers），形成一個網路系統，提供海嘯預警資訊。然而，沿岸社區須認知海洋災害並妥為準備，始能有效率地反應海嘯警告，此系統才能發揮效果。為此，IOC研擬海嘯準備計畫（TsunamiReady Programme），設定了一個遠大的目標——2030年前將有海嘯風險的社區全部指認出來。對於被指認社區，進一步提升複合型災害早期預警服務，包括所有的地球物理、生態、生物、天氣、氣候和人為相關的海洋和海岸災害，以及強化社區準備和韌性。

● 挑戰七：擴大全球海洋觀測系統

全球海洋觀測系統（Global Ocean Observing System, GOOS）目前有8,208個海洋觀測平臺，係由84個國家設置，提供使用者即時、跨洋區的海洋觀測資料和資訊（圖4）。海洋觀測資料之項目，目前以海洋物理變數建置最為完全，包括溫度、鹽度、密度、潮汐、波浪、洋流等，而海洋生化觀測資料則有待擴大建置。這些觀測系統提供重要的資訊，提供氣象、氣候和海洋預報人員、航運、漁業，以及沿海社區使用。然而，此系統涵蓋區域範圍仍有不足，尤其是亟需海洋觀測資料的地區，如高度生物多樣性和人類使用強度高的地區。

● 挑戰八：開發海洋數位呈現系統

掌握海床地形和深度對於瞭解洋流循環、氣候變遷和氣象預測之間的關係、潮汐和波浪運動、漂砂運輸、海嘯波行進，以及海底地質變動等海洋過程是非常基本的。此外，海底測繪對於國家的安全和財富亦非常重要，因為它可用以推估自然資源，如海底礦產和漁場。然而，目前大部分的海底深度係以衛星測量儀資料推算估計出來，資料精準度差，且解析度為公里尺度，只能呈現海底大致形狀，因此使用先進的聲納技術測繪和測量海底深度是必要的工作。2030海底計畫（GEBCO Seabed 2030）即致力此工作，預計2030年之前完成全球海底測繪。使用的技術包括單音束聲納（single beam）、多波束回聲測深系統（multibeam echo sounder）、衛星水深測量（satellite-derived bathymetry）及光達系統（light detection and ranging）等。於2015~2021年之6年期間，海底測繪的面積覆蓋比例從6.7%增加至20.6%。未來希望透過各不同利益關係人的合作，發展一套全面性的海洋數位呈現系統，以數位資料呈現全球海洋的地形地貌，提供公開和免費使用。

● 挑戰九：提升全民海洋技能、知識和科技

為促進永續發展，亟需增加海洋科學能量，以解決各不同類型的科學挑戰。全球海洋教育學會（Ocean Teacher Global Academy, OTGA）致力於建置海洋科學能量。其設立網路學習平臺，於

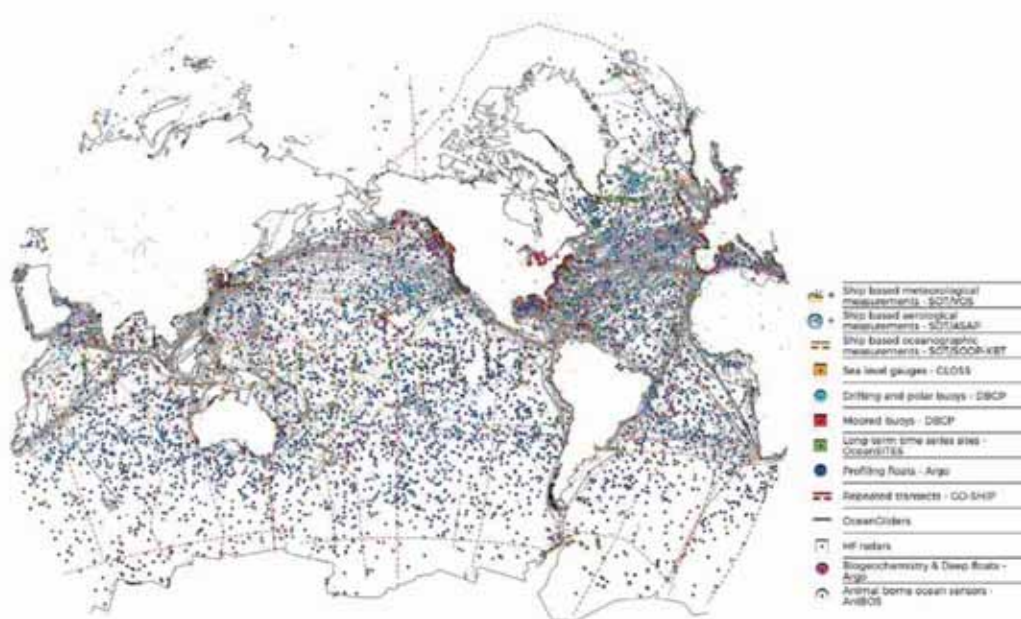


圖4／由8,208個海洋觀測平臺構成的海洋觀測系統
資料來源／[1]

2020～2021年開發40多個線上訓練課程，來自全球各大洲超過1,000人參加學習；2022年，進一步設立17個區域和特別學習中心（OTGA Regional and Specialized Training Centres），提供適合特定區域的課程和訓練。希望透過傳遞建置的海洋科學能量，確保所有利益關係人能公平地取得所有海洋科學面向的資料、資訊、知識和科技。

● 挑戰十：加強人和海洋的連結

所有海洋的問題都直接源自於我們對於海洋的影響，以及海洋對我們的影響的瞭解太少。因此，提升全球海洋知識對於海洋和海岸永續非常重要。最近幾年，瞭解海洋和社會之間複雜關係的重要性愈益受到重視。隨著各式學習資源的可及性增加，如手冊、學校活動、訓練課程、學習網路等，這方面已有很大的進展。

結論

海洋科學有助我們瞭解海洋狀態。雖然我們原則上知道海洋現正發生什麼事，也知道對於這些事我們應該做什麼，但對於海洋狀態的量化描述仍非常不完整，因此對於我們人類面臨的海洋問題，既有的海洋知識仍不足以產生有效的解決方法。

2020年海洋狀態先期報告係IOC秘書處小組和許多頂尖專家辛苦努力的結果。報告的焦點放在「海洋科學十年挑戰」的描述，但報告明確指出這種描述偏屬質性，未來亟需定量描述海洋狀態，後續版本將加入更多量化的資訊，以全面瞭解海洋議題。

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借鏡印度藍色經濟願景——給世界一個更好的臺灣

編譯／鍾政祺（國立臺灣海洋大學航運管理學系特聘教授）

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關鍵字／永續發展、藍色經濟願景、印度藍色經濟

藍色經濟促使人類與海洋共生，取得經濟與生態平衡。根據世界自然基金會（World Wide Fund for Nature, WWF）預估，全球海洋及沿岸創造的藍色經濟產值每年達2.5兆美元[1]。許多國家開始提倡藍色經濟，並制定及執行相關政策。本文介紹印度藍色經濟政策與願景，用以借鏡並反思我國在藍色經濟之課題，期望給世界一個更好的臺灣，以圖共同成長與守護地球。

藍色經濟之定義

在藍色經濟（Blue Economy）理念構建之前，綠色經濟（Green Economy）被廣泛探討與運用。根據聯合國環境規劃署（United Nations Environment Programme, UNEP）指出，綠色經濟強調低碳、資源使用效率及社會福祉[2]，而藍色經濟可視為綠色經濟之延伸；然綠色經濟的主軸是循環，而藍色經濟則著重於再生。

在2010年由Gunter Pauli發表《藍色經濟》著作，強調經濟模式應仿造生態系統，以現有的資源，利用其豐富性，創造就業機會，使更多人受益；同時在不產生廢棄物情況下，提升經濟且優化社會。根據世界銀行（World Bank）指出，藍色經濟被定義為永續運用海洋資源，以圖促進經濟增長，改善生活及就業，並保護海洋生態系統之健康[3]。而藍色經濟所概括範圍，包含再生能源、觀光休閒、氣候變遷、廢棄物管理、海洋運輸與漁業等。2018年世界銀行發起「PROBLUE」信託基金，其為牽式多方捐助者信託基金（MDTF），目的是協助各國通往藍色經濟之道路；有關PROBLUE關注4大方向，如圖1所示。



由圖1可知，PROBLUE關注的4大方向，分別為：「漁業與水產養殖之永續管理」、「解決與防止海洋污染對海洋健康造成威脅」、「支持海洋相關重要產業永續發展」、「幫助政府整合海洋及沿岸之資源」。此等方向主要針對海洋環境管理與發展，最終目的係為了保護人類的生存空間，進而提升生活品質。

圖1／PROBLUE關注4大方向
資料來源／The World Bank [4]

印度藍色經濟之目標

印度擁有獨特的海上地位，有12個主要港口和187個非主要港口，對於海洋貿易與貨物運送負擔重任，每年處理約14億噸貨物[5]。印度擁有超過200萬平方公里的專屬經濟區，蘊藏豐富的生物和非生物資源，包含大量原油和天然氣資源。印度沿海經濟維繫著超過400萬漁民及其他沿海社區生活[5]。憑藉巨大的海洋利益，印度藍色經濟與國家經濟增長有著至關重要關係，因此關心海洋經濟成為印度發展的重要課題。

在2019年印度聯邦預算中，財政部（Ministry of Finance）制定印度願景，並期望至2030年成為一個10兆美元之經濟體[6]。透過此多元的10大面向願景制定政策，印度將成為現代化、技術驅動、高速增長、公平和透明之社會。

印度政府強調需制定與整合不同部門的海洋政策，並由總理經濟顧問委員會（Economic Advisory Council to the Prime Minister, EAC-PM）發起跨部會與利益關係人之協商，以制定藍色經濟政策框架草案。目標為促進此新領域之永續性及包容性，帶動經濟增長以提高國家GDP，同時使印度發展目標與國家安全目標和國際間協議保持一致性。

EAC-PM考量現有政策和法規、行業的全球情景、短期和中期策略與評估將面臨挑戰，制定7個與印度發展藍色經濟關鍵優先領域的工作小組，分別為「藍色經濟和海洋治理的國家會計框架」、「沿海海洋空間規劃與旅遊業」、「海洋漁業、水產養殖和魚類加工」、「製造業、新興產業、貿易、科技、服務和技能發展」、「物流、基礎設施和航運（含轉運）」、「沿海、深海採礦和海上能源」及「安全、戰略層面和國際參與」等[5]；有關7大領域工作小組之重點目標，如表1所示。

表1／7大領域工作小組之重點目標

工作小組	重點目標
1. 藍色經濟和海洋治理的國家會計框架	對特定部門進行定期研究，以評估藍色經濟中不同子部門的相對構成，目的是評估與藍色經濟相關部門中不同組成部分之權重。
2. 沿海海洋空間規劃與旅遊業	審議沿海海洋空間規劃，以及沿海和海洋經濟旅遊業的潛力與方法，提出採納並調整政府間海洋學委員會教科文組織（UNESCO-IOC）2009指南的沿海海洋空間規劃方法、制定新的國家地圖和數據政策建議。
3. 海洋漁業、水產養殖和魚類加工	審查與漁業開發、管理、加工、行銷和金融有關的所有方面，並提出增加永續海洋捕撈漁業、提高海水養殖產量及海洋健康監測、評估和管理等詳細建議。
4. 製造業、新興產業、貿易、科技、服務和技能發展	研究廣泛相互關聯的經濟發展問題，仔細確定製造、貿易、技術服務和技能的「藍色」方面，且應與國民經濟結合。加強資金注入、組成專家小組應對藍色貿易遭遇的各項問題，設立研發中心，推動人工智慧（AI）和其他新技術在深海採礦、海洋物流和航運等海洋領域之應用。
5. 物流、基礎設施和航運（含轉運）	研究航運和港口基礎設施，及物流部門與海事領域有關問題，並針對船舶建造和海事集群發展，設立海事發展基金進行研究與建議。
6. 沿海、深海採礦和海上能源	審議海洋中的礦產和金屬資源提取價值之可能性、海上風能、波浪、潮汐和地熱資源產生再生能源之可能性，並審查未來科學研究和發展領域。
7. 安全、戰略層面和國際參與	研究藍色經濟在全球與海洋鄰域背景的策略、安全和地緣政治層面，並介紹包含注重海事領域意識、國際間合作及藍色外交等建議，從長遠來看捍衛印度之利益。

資料來源／整理自[5]

由表1可知，7大領域工作小組分工詳細，除各自重點研究與審查項目外，針對各領域發展提出策略與建議。印度希望藉藍色經濟潛力，優化GDP和就業增長、確保沿海地區漁民的福利、安全和生計，達成創新以確保零浪費、低碳技術，並為大部分人口帶來經濟紅利，亦促進海洋安全和平衡的國際參與。

印度藍色經濟之願景

藍色經濟是基於無浪費、無排放之概念，並擴展綠色經濟之理念，期望能為海洋領域如沿海製造業、航運業、遠洋或近洋相關能源技術之增值[6]，與國家經濟成長有著密不可分之關係。印度憑藉著海上強盛之利益，有效性及永續性地善用海洋所賦予之資源，整合及提升與海洋有關之能力，並同時保護永續環境發展目標。有關印度2030年10大發展願景，如圖2所示。

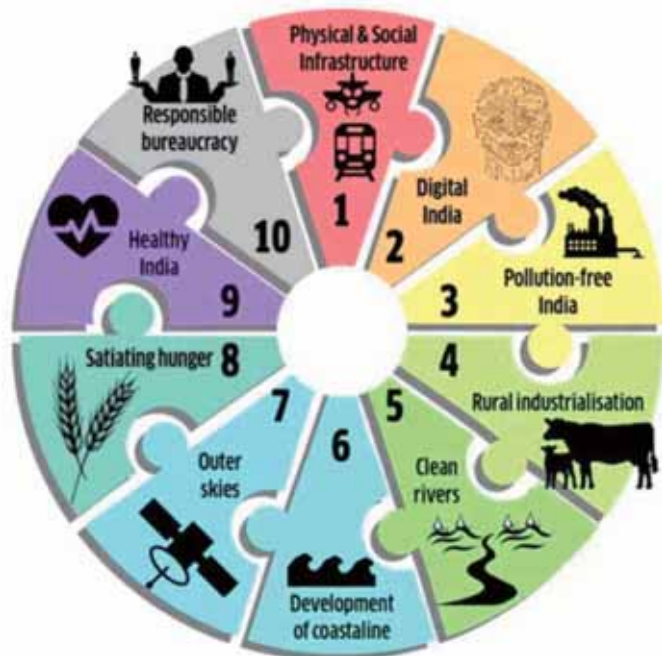


圖2／印度2030年10大發展願景
資料來源／[7]



圖3／印度藍色經濟5大整體願景
資料來源／[6]

由圖2可知，印度發展願景包含推動海岸線及海洋水域發展，透過深入規劃與執行藍色經濟政策，可促進沿海地區經濟增長，改善人民生計和就業問題，以及維持海洋生態系統之健康。

近年全球氣候變遷，日益惡化地區造成環境生態系統遭受強勁威脅，導致島嶼國家產生生存疑慮，印度洋生態保護系統為首要關注議題[6]。為倡導追求永續利用的地球資源，總理莫迪提出印度藍色經濟5大整體願景，如圖3所示。

期望將來能實現在印度洋區域範圍內的安全性與成長，莫迪總理聲稱，印度已做好充足準備與所有地區夥伴進行合作，蓬勃發展整個印度洋地區。為了達成目標，印度採取下列3項合作措施：

一、**安全措施**：印度與斯里蘭卡和馬爾地夫三邊的安全防護機制，與鄰近地區的雙邊海軍演習，為斯里蘭卡與馬爾地夫等國提供實質設備或培訓人才能力和調查海事案件。

二、發展與周遭區域間的夥伴關係：從東非沿海地區一直到西太平洋，以塞席爾共和國（Republic of Seychelles）、新加坡（Singapore）和薩摩亞（Samoa）為主軸，構建重要的新興經濟與穩固藍色經濟之發展。

三、教育與文化的相互合作：海洋教育研究之宗旨，在於制定通盤的策略以保護海洋生態資源，藉由沿海之瞭解，提高對於海洋環境與經濟之認識度，再經由人員培訓以向外推廣海洋教育計畫。

地球資源是有限的，必須經過有效地規劃，才能最大利用海洋資源，進而達到持續發展目標，同時納入現今所重視的生態保護及沿海地區居民的商業化利益[6]，以確保能實現將藍色經濟擴大延伸之機會。



圖4／印度與臺灣
圖片提供／鍾政棋

反思臺灣藍色經濟之課題

2020年6月我國海洋委員會（Ocean Affairs Council, OAC）提出「國家海洋政策白皮書」[8]，在海洋產業發展與創新章節談及藍色經濟，於此將其內容與最新資訊加以整理，並提出建議如下。

- 一、人才培育課題：從普及全民的海洋教育做起，深化對海洋之認同感，使國人皆具備海洋素養。政府、企業、學校應落實海洋教育政策白皮書所制定的2022～2026年海洋教育執行計畫，促進產學合作，孕育優秀的海洋產業人才，以充裕海洋產業實力。
- 二、海洋產業課題：在兼顧永續性之前提下，臺灣除了原本的傳統海洋產業，更應多加利用豐富的海洋資源，發展新興海洋產業，例如海洋生物科技、離岸風力發電、洋流發電、波浪能、海底電纜、深層海水及海洋環境保護產業。

三、海洋觀光課題：臺灣四面環海，擁有奇特的地形景觀，優美的海岸風光，以及多樣的海洋資源，應把握此等有利條件，結合臺灣海洋文化，發展海洋觀光休閒及遊憩，強化觀光休閒產業規模，進而與國際海洋休閒連結。

四、產業合作關係：臺灣必須建立完善的海洋新興產業之產業鏈和價值鏈，在中央與地方政府共同配合下，加強產業間的互助關係，促進民間組織積極參與，進而與全球連結，以圖提高國際競爭力。

五、法規制度課題：2019年11月通過《海洋基本法》，當時海洋委員會推動《海洋保育法》，《海域管理法》、《海洋產業發展條例》等海洋三法。然而目前三法仍處於草案階段，期望未來可更積極推動相關法規。

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印度地球科學部（MoES）及其主要海洋倡議行動

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關鍵字／印度、地球科學部、海洋倡議行動

全球36個生物多樣性熱點地區（Biodiversity Hotspots）中，印度就多達4個[1]，占世界九分之一。過去印度推動多個海洋倡議，為經濟增長、創新與就業帶來巨大的潛在動力。目前印度政府也意識到過度捕撈、氣候變化、海洋污染與生物多樣性的減少，帶來的環境壓力正逐漸削弱海洋價值，為了改善海洋生態的健康並永續發展，印度政府採取了許多措施與策略，並希望嚴格執行，努力讓人民更加關注海洋議題。是故，印度政府在氣候、海洋、沿海地區、水文、地震及自然災害的議題上，必須鑽研及提供更多的研究成果，以永續經營的方式，探索與利用海洋生物及非生物資源，並探索地球的「三極地區」（北極、南極及喜馬拉雅山），爰於2006年7月將原本的「海洋開發部」（Department of Ocean Development, DOD）組織改造為現今的「地球科學部」（Ministry of Earth Sciences, MoES）。

印度地球科學部之沿革

「地球科學部」的前身是DOD，DOD成立於1981年7月，直屬印度總理的內閣辦公廳，並於1982年3月成為獨立的部門，過去DOD的功能為組織、協調與促進印度各式的DOD，直到2006年2月依據總統命令印度政府將DOD改名為地球科學部，於2006年7月正式掛牌成立，並將位於德里（Delhi）的印度氣象局（India Meteorological Department, IMD）、位於浦那（Pune）的印度熱帶氣象研究所（Indian Institute of Tropical Meteorology, IITM）及位於諾伊達（Noida）的國家天氣預報中心（National Centre for Medium Range Weather Forecasting, NCMRWF）納入MoES的管理部門。組織架構上，MoES下轄地球系統科學組織（Earth System Science Organization），該組織由2個直屬機構（Subordinate offices）、3個附屬機構（Attached offices），及5個自治實體（Autonomous bodies）所組成[2]（圖1）。

印度地球科學部之功能

成立MoES的目標是希望其精進地球科學領域的知識與技術，並為國家帶來社會經濟利益，其主要功能如下[3]：

- 一、加強與維持於大氣、海洋、冰凍圈及固體地球的長期觀測，以記錄地球系統的變化。
- 二、通過動力模型與同化技術，發展大氣及海洋現象的預報能力，以建立天氣及災害預報系統。
- 三、瞭解地球系統的組成部分，與人類社會在不同空間及時間尺度上的交互作用。



圖1/印度地球科學部組織架構（橘底為直屬機構、綠底為附屬機構、藍底為自治實體）
資料來源/印度地球科學部官方網站，作者整理繪製

<https://moes.gov.in/index.php/about-us/organization-setup>

四、探索地球極地與公海區域，以發現新現象及新資源。

五、將地球科學的知識與見解轉化為社會、環境及經濟的利益服務。

六、開發海洋技術，以利於海洋資源探勘與社會應用。

MoES為了能為國家經濟與社會做出貢獻，並成為在地球科學知識上提供高品質服務的世界領先者，與向亞洲及非洲等發展中國家提供地球科學服務的領導者，同時考慮聯合國永續發展目標（Sustainable Development Goals, SDGs）的各項指標，亦提出規劃到2030年的願景文件，希望能持續深耕氣候與水文服務、海洋地質學、海洋調查與探索、大氣與海洋技術、極地科學與冰凍圈、地球科學與地震學、災害風險管理的預警系統，及人力資源開發與國際合作等各項議題[4]，除此之外，MoES亦展開許多計畫，加深於地球科學領域的研究，包含下列計畫：

一、大氣、氣候科學與服務（Atmospheric, Climate Science and Services, ACROSS）[5]：

進行季風對流、雲與氣候變化（MC4）、高性能計算系統（HPCS）、季風任務（MM-II）、大氣觀測網、天氣與氣候服務、預報系統升級及極化都卜勒天氣雷達（DWR）調試等相關研究。

二、極地科學與冰凍圈研究（Polar Science and Cryosphere Research, PACER）[6]：

極地地區積聚大量水資源，顯著影響全球的氣候，亦受到持續氣候變化的嚴重影響，所以研究極地地區是解開過去、瞭解現在與預測未來的關鍵。MoES下屬的國家極地與海洋研究中心（National Centre for Polar and Ocean Research, NCPOR）規劃南極計畫、印度北極計畫、印度南大洋計畫與冰凍圈及氣候計畫等4個子計畫，加強對極地科學的研究。

三、地震學及地球科學（Seismology and Geosciences, SAGE）[7]：

進行有關監測與微型區劃、地球動力學與地表進程、印度洋深海觀測與岩石圈演化動力學、地震帶的科學深鑽、地震活動與地震前兆，及建立地質年代學設施等研究。

印度地球科學部之主要海洋倡議行動

MoES為使印度的發展能以永續經營的方式繼續探索與利用海洋生物及非生物資源，所以採取許多策略，並提出許多海洋倡議行動，減少海洋環境目前面臨的壓力與困境，並提升海洋能為人類社會帶來的利益與價值，主要的海洋倡議行動包含如下：

一、藍色經濟政策（Blue Economy Policy）

印度擁有7,517公里的海岸線，港口計有199個，其中主要港口共計12個（圖2），2021年的貨物吞吐量達到5.4176億噸，此外，印度的專屬經濟區面積超過200萬平方公里，擁有豐富的生物與非生物資源（包含：原油與天然氣），沿海經濟支撐著超過400萬漁民與社區[8]。所以印度的藍色經濟被視為國民經濟的一部分，包含：整個海洋資源系統與管轄範圍內的海洋、陸上沿海的經濟基礎設施，有助於生產與經濟增長，具有重要的潛力地位。

是故，MoES在2021年推出《印度藍色經濟政策草案》（National Policy for India's Blue Economy），由工業界、非政府組織、學術界與公民在內的各利害關係人提出建議及意見。該草案概述印度政府可以採用的國內可用海洋資源的願景，並旨在提高藍色經濟對印度GDP的貢獻，以改善沿海社區生活、保護海洋生物多樣性、維護海洋區域與資源的國家安全[9]，並設立4個目標框架，包含：穩健機制框架、國家沿海海洋永續發展的框架、與藍色經濟相關之國內製造業、新興產業、貿易、旅遊、技術、服務、技能發展的框架及海洋治理框架等[10]。

二、海洋空間規劃（Marine Spatial Planning, MSP）

海洋空間規劃是全球海洋管理重要的議題，是永續發展綜合海洋管理的一個工具，可為海洋創建一個框架，最大限度地減少部門之間的衝突，藉由計畫、數據分析、瞭解生態系統特徵及管理應用的階段，並通過協調不同用途的海洋空間，保持良好的海洋環境狀況（圖3）。在該議題上，MoES的國家海岸研究中心（National Centre for Coastal Research, NCCR）先前已為3個區域訂定海岸帶管理計畫（Coastal Zone Management, CZM），分別為清奈（Chennai）、果阿（Goa）與奇灣（Gulf of Kutch），雖然這些計畫僅涉及沿海地區，但事實證明這些計畫成果都非常成功[11]。



圖2/印度12個主要港口

資料來源/International Shipping Magazine

<https://www.seanews.com.tr/india-s-12-major-ports-see-box-throughput-rise-to-730-000-teu-in-july/152412/>

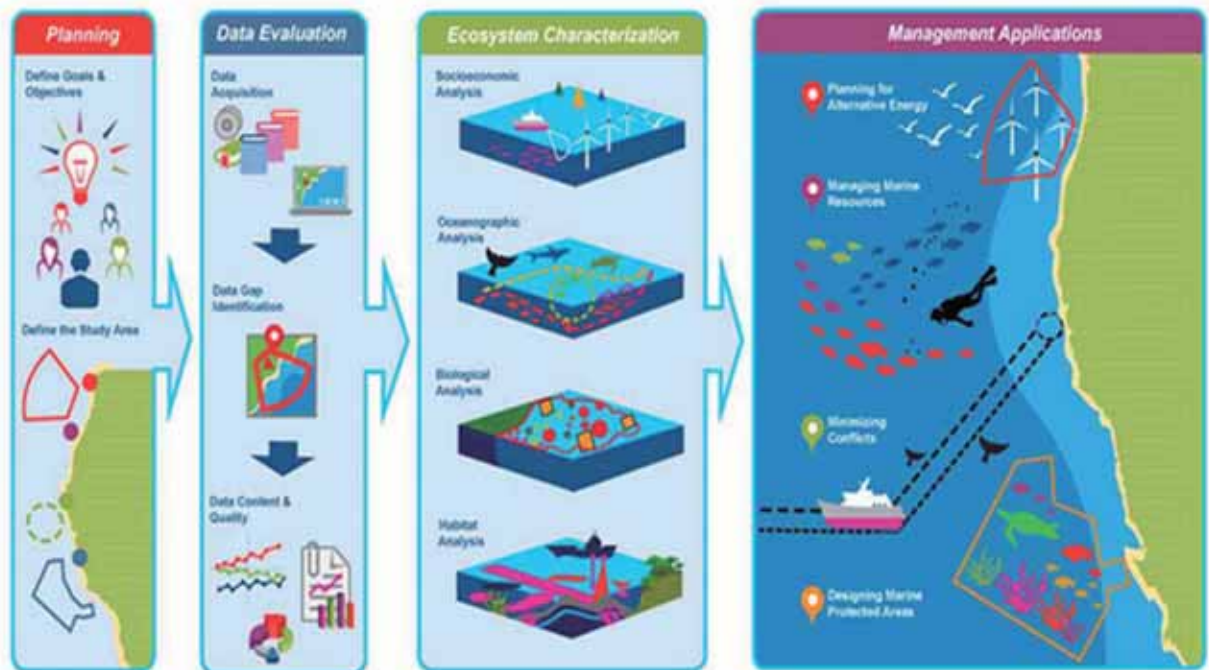


圖3／海洋空間規劃過程

資料來源／Pacific Islands Protected Area Portal

<https://pipap.sprep.org/content/01-what-marine-spatial-planning>

在2019年1月，印度與挪威簽署《印度-挪威海洋對話》（India-Norway Ocean Dialogue）。雙方在備忘錄中強調「採用綜合與基於生態系統的方法管理再生及不可再生自然資源」，將其確定為未來合作的共同領域，而印度的拉克沙群島（Lakshadweep）與朋迪治里市（Puducherry）已被確定為該計畫的試驗地點，選擇上述地點是因為它們的設置可以為多個行業（例如：工業、漁業與旅遊業）的蓬勃發展提供獨特的機會。目前，印度政府用於上述的研究與規劃的初始投資，每年約為8千萬至1億印度盧比，未來，這兩個關鍵區域的海洋空間規劃框架，即可複製到印度其他沿海地區[12]。

三、國家十年協調委員會（National Decade Coordination Committee, NDCC）

自聯合國大會宣布2021～2030年之10年為《聯合國海洋科學促進永續發展十年》（United Nations Decade of Ocean Science for Sustainable Development；簡稱「海洋科學十年」），旨在刺激海洋知識的產生，並提高公眾對海洋科學及永續利用的認識[13]。

MoES也籌組「國家十年協調委員會」，由MoES秘書長擔任主席，並涉及多個國家機構，其任務是在國家層面協調現有計畫並制定新方案，以實現海洋十年的目標。2021年2月3日印度的「海洋十年會議」在國立海洋資訊服務中心（Earth System Science Organization- Indian National Centre for Ocean Information Services, ESSO-INCOIS）正式啟動舉行。NDCC建議與其他國家研究中心與利益相關方協商，訂定國家海洋十年實施計畫，以凸顯印度對海洋科學十年的貢獻，並建議發起重要的全國外展活動，及提高中小學生與社會公眾對海洋重要性的認識。此外，印度也持續加強印度洋沿岸國家在海洋方面的建設措施[14]。

結語

我國海洋委員會2018年4月成立後，隸屬海洋委員會的國家海洋研究院亦於2019年4月24日成立，主要任務為辦理海洋政策規劃、海洋資源調查及海洋科學研究等業務[15]，定位為國家海洋智庫，性質與印度MoES相似，皆是進行海洋科學相關研究。惟印度MoES成立已久（包含前身之海洋開發部），在各項地球科學領域的研究上已有一定的基礎，尤其在氣候科學、極地科學與自然災害預防上更是有許多成就。除此之外，印度也與美國、阿拉伯聯合大公國、英國、模里西斯、挪威及德國等國家簽訂許多備忘錄，加強海洋科學議題等相關研究。而我國的國家海洋研究目前雖尚在發展階段，然而已在整合海洋科研資訊、完善海洋基礎調查、提升海洋研究發展、文化傳承人才培育，及引領海洋產業升級等方面有不少研究成果。

印度MoES亦為永續經營海洋發展，提出許多海洋倡議行動，其中藍色經濟政策是許多國家已採取的策略來永續利用海洋，包含：澳洲、巴西、英國、美國及俄羅斯等國均訂定其國家海洋政策。基於生態系統的海洋空間規劃也是印度MoES提倡的重點，我國也在制度面與法律面持續努力中。而印度成立的「國家十年協調委員會」也是值得我國參考的倡議行動之一，在明確的未來藍圖下進行政策規劃，才能有進程的提升與實現目標的可能。

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印度國立海洋資訊服務中心 (ESSO-INCOIS) 簡介

撰文／李孟學（國家海洋研究院海洋科學及資訊研究中心副研究員）

關鍵字／印度、海洋資訊服務、ESSO-INCOIS

本報導介紹國家級海洋資訊中心——印度國立海洋資訊服務中心（Earth System Science Organization- Indian National Centre for Ocean Information Services, ESSO-INCOIS）之海洋資訊服務，希望借鏡其他國家之海洋資訊服務規劃提升我國海洋資訊應用。

成立於1999年的ESSO-INCOIS隸屬於地球科學部（Ministry of Earth Sciences, MoES），是地球系統科學組織（ESSO）的一個單位。ESSO-INCOIS的任務為透過海洋監測儘可能提供社會、企業、政府機構和學界高品質的海洋資訊及諮詢服務，並藉由系統式和重點式的研究持續精進，期待成為海洋領域的知識及資訊技術之領頭羊。

ESSO-INCOIS設立宗旨與任務

ESSO-INCOIS設立宗旨與任務包括：

- 建立、維護和管理海洋資訊服務系統，用以進行相關數據之蒐集、分析、解釋和保存。
- 承擔、幫助、促進、指導和協調海洋資訊領域（包含衛星海洋學）的研究和相關服務。
- 使用衛星技術、船舶、浮標或任何其他平臺進行調查和監測，產製有關漁業、礦產、石油、生物、水文、地形測繪、地質、氣象、海岸管理和相關資源的資訊。
- 提供使用者所產製資料及相關資料之加值應用服務。
- 與其他國家和國際之海洋遙測、海洋、大氣和海岸管理機構合作。
- 建立海嘯和暴潮預警系統。
- 支持研究中心進行海洋過程、海氣交互作用、海岸資訊、資料整合、資料分析和資料收集相關的調查。
- 舉辦培訓課程、研討會和座談會，以推進與海洋科學和技術相關研究。
- 通過技術上可能的方法向大眾發布和傳播資訊、研究成果、資料產品、地圖和數位訊息，以促進研究並滿足社會對提高生活水準的需求。
- 提供海洋資訊諮詢服務。
- 利用衛星遙測獲取最先進的海洋資料。

組織架構

ESSO-INCOIS的組織架構主要包含3個組8個科（圖1），分別為：

- 作業化海洋服務與應用研究組（OSAR）：包含作業化海洋服務科（OOS）、應用研究及作業化研究科（ARO）共2科。
- 海洋觀測資料、模式及資料同化組（OMDA）：包含海洋模式及資料同化科（MDA）、海洋觀測網路科（OON）共2科。
- 資訊及通訊技術和資料管理組（ICTD）：包含海洋資料管理科（ODM）、資訊暨通訊技術科（ICT）共2科。

另外有計畫管理及發展科（PPC）及行政支援服務科（ESS）等。

在人力資源方面，2021年3月底ESSO-INCOIS之全職工作人員，正式人力計有主任1人、科學家40人、科學助理19人及行政人員10人共計70人，而計畫型人力計有計畫科學家28人、計畫助理28人、博士級研究人員18人及行政人員20人共計94人。

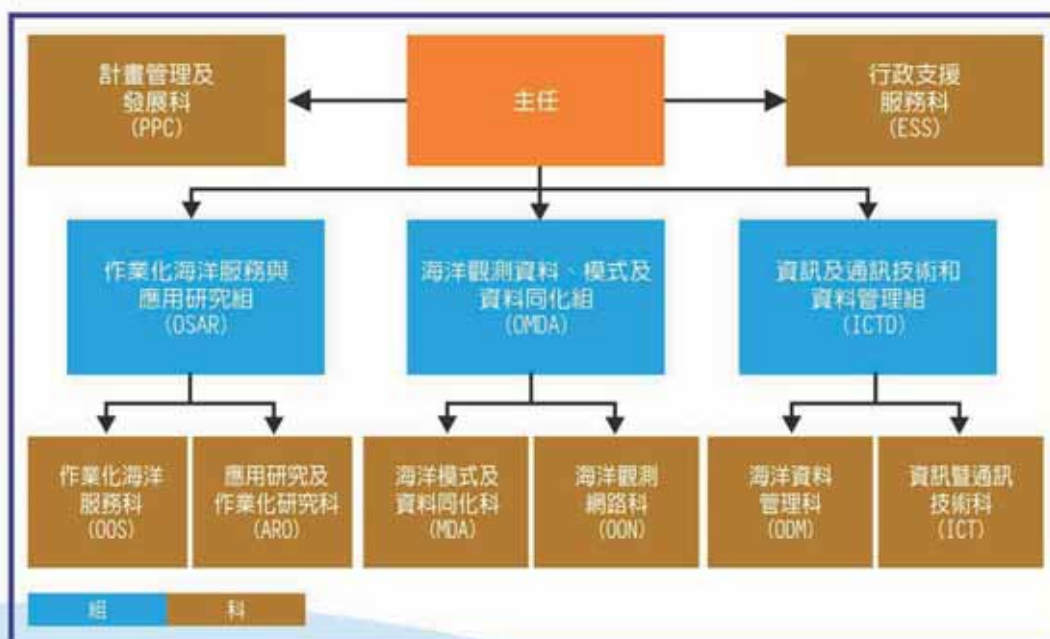


圖1/ESSO-INCOIS組織架構圖

圖片來源/[1]

海嘯預警系統（Tsunami Early Warning Services, TEWS）

2004年12月26日在印尼蘇門答臘島西邊160公里處（3°19' N, 95°51.24' E）發生蘇門答臘—安達曼地震，震源深度30公里[2]，地震規模約9.1到9.3，並引發了南亞大海嘯。由於當時印度洋和大西洋都尚未像太平洋有設置區域性的海嘯預警系統，此次海嘯受災嚴重的地區有印尼亞齊省、泰國普吉島渡假區、斯里蘭卡和印度坦米爾邦，造成約30萬人罹難。在太平洋地區，已經架設多套的海嘯感測器並與監控中心即時連線，所以海嘯發生時可以即時警告民眾，於海嘯抵達之前進行避難。雖然泰國是太平洋TEWS的成員之一，但是泰國之海嘯感測器都設在泰國的東部海域，並未架設於印度洋。美國

地質調查所 (United States Geological Survey, USGS) 認為海嘯監測和預警系統之建立將可以減少人命損失，尤其是斯里蘭卡和印度，在初次地震後尚有3個小時或者更多的時間可疏散沿海地區民衆，但因為系統性疏失，依舊造成嚴重傷亡。再者，在太平洋海嘯潛勢較高的國家之人民一般具備較充足的海嘯意識，當見到海岸突然大退潮即代表巨浪將至。除此之外，印度和斯里蘭卡對於地震分析過慢導致警告發出過遲。有鑑於此，印度政府將TEWS納入海洋資訊服務。

印度政府在ESSO-INCOIS建立了印度海嘯預警中心 (Indian Tsunami Early Warning Centre, ITEWC)，並於2007年10月開始運作。印度海嘯預警系統包括即時陸上震測站和海域觀測網 (海嘯浮標和潮位站) 和全天候服務之海嘯預警中心，檢測引發海嘯的地震和監測海嘯，透過12個海底壓力感測器 (Bottom Pressure Recorder, BPR) 進行地震檢測和震源參數估計以監測海嘯的發生，並即時地傳送給預警中心，亦即時向脆弱地區提供建議 (圖2)。



圖2／印度洋海嘯預警系統 (TEWS) 作業方式
圖片來源／[1]

一般海嘯模擬可以分為3個部分：一、海嘯生成；二、傳播及三、湧升 (溢淹)。海嘯生成模式常用模式[3][4]來計算靜態海底變形，這些模型所需的基本參數包括斷層區域 (長度和寬度)、走向角度、傾角、滑動、斷裂深度、錯位和地震矩震級，用以產生初始波形。海嘯波傳播速度與水深息息相關，海嘯波在深海和開闊的海洋中，以每小時500~1,000公里的速度行進。海嘯傳播至近岸受淺化效應影響，波高變高，透過高解析度地形高程資訊，可建立溢淹潛勢圖用以快速評估可能發生災害之範圍。ESSO-INCOIS利用TUNAMI N2 (Tohoku University's Numerical Analysis Model for Investigation of Near field tsunamis) 海嘯模式，針對5次歷史地震模擬，預測溢淹範圍並繪製成溢淹潛勢圖，提供給相關部門參考。

印度洋海嘯速算系統中包括50,000個海嘯情境資料庫，範圍涵蓋北緯30至40度，東經30至130度，網格間距約0.0450度 (5.01公里)。根據敏感性分析和歷史的地震綜整印度洋兩個海嘯源區，在俯衝帶上設置975個「模擬點」，每一個模擬點包含6種不同深度的組合 (10、20、40、60、80和100公里) 和7個矩量級 (Mw) (6.5、7.0、7.5、8.0、8.5、9.0和9.5) 及預先定義的單位源，總共提供大約50,000個情境，每個情境之海嘯於沿海不同位置的到達時間和波高都預先計算並存儲在數據庫中。當海嘯發生時可快速選取最接近情境，以識別風險區域，並利用2007年9月12日的海嘯進行了驗證如圖3。

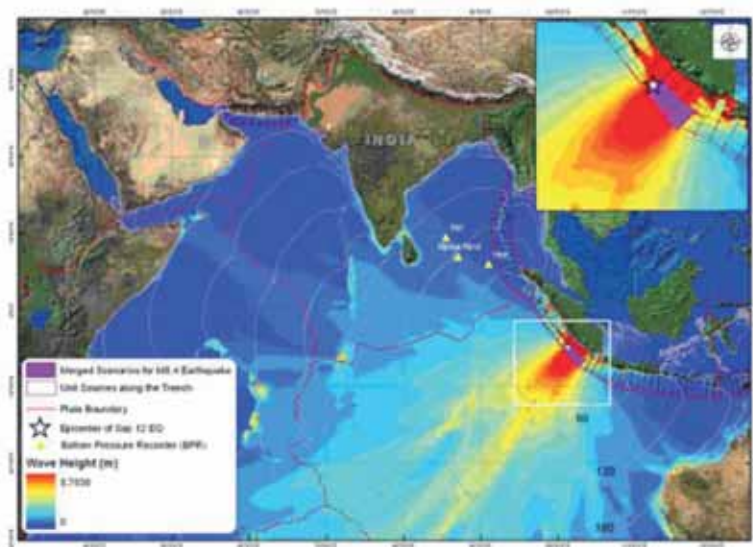


圖3／2007年9月12日8.4地震海嘯傳播圖
圖片來源／[1]

暴潮預報模式

相似於臺灣的颱風災害，北印度洋海岸飽受熱帶氣旋引發氣象暴潮及溢淹的危害，暴潮為近海水位高程因為風剪應力和氣壓作用下急速抬升的現象（圖4），例如亞洲地區的颱風或美洲的颶風等熱帶氣旋帶來強勁風場，其烈風（Gale）以及中心低氣壓將海水向近岸推送、擠壓，加上海域斜坡地形效應及天文潮（潮汐）的加總，每每觸發破紀錄之高水位和波高事件。此高水位的危害造成低窪地區的溢淹、河川流域的洪泛、海水倒灌鹽分入侵陸地造成土壤鹽化危害農牧耕作，或是海水滲透地下水層造成飲用水資源匱乏。另一方面，熱帶氣旋帶來的密集強降雨可能強達500mm/day，其預測的不確定性也進一步增加氣象暴潮的危害風險，在印度孟加拉灣尤其嚴重。鑑於過去因為氣象暴潮所累積的生命財產損失，ESSO-INCOIS建立印度暴潮預警系統。該系統使用先進環流（ADVanced CIRCulation, ADCIRC）模式計算潮汐和風驅生成的海洋環流，估計在近岸海域地形效應的水位抬升，所考慮之暴潮影響因子包括了熱帶氣旋的最大暴風半徑、陣風強度、氣旋中心移動速度、移動軌跡、氣旋中心氣壓、登陸位置、近岸陸域高程和海岸特徵。預警系統將印度海岸地區劃分風險：暴潮高度小於1.5公尺為輕度危險區域、暴潮高度1.5公尺至3公尺為中度危險區域、暴潮高度3公尺至5公尺為高度危險區域、暴潮高度5公尺為極度危險區域，預報流程如圖5。

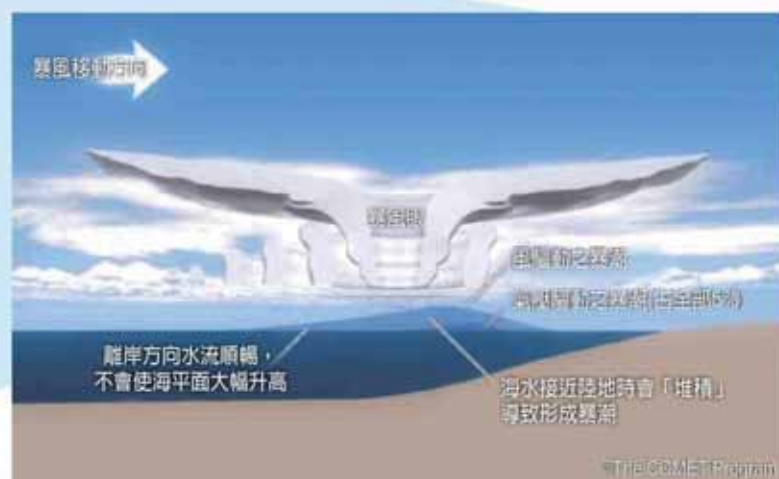
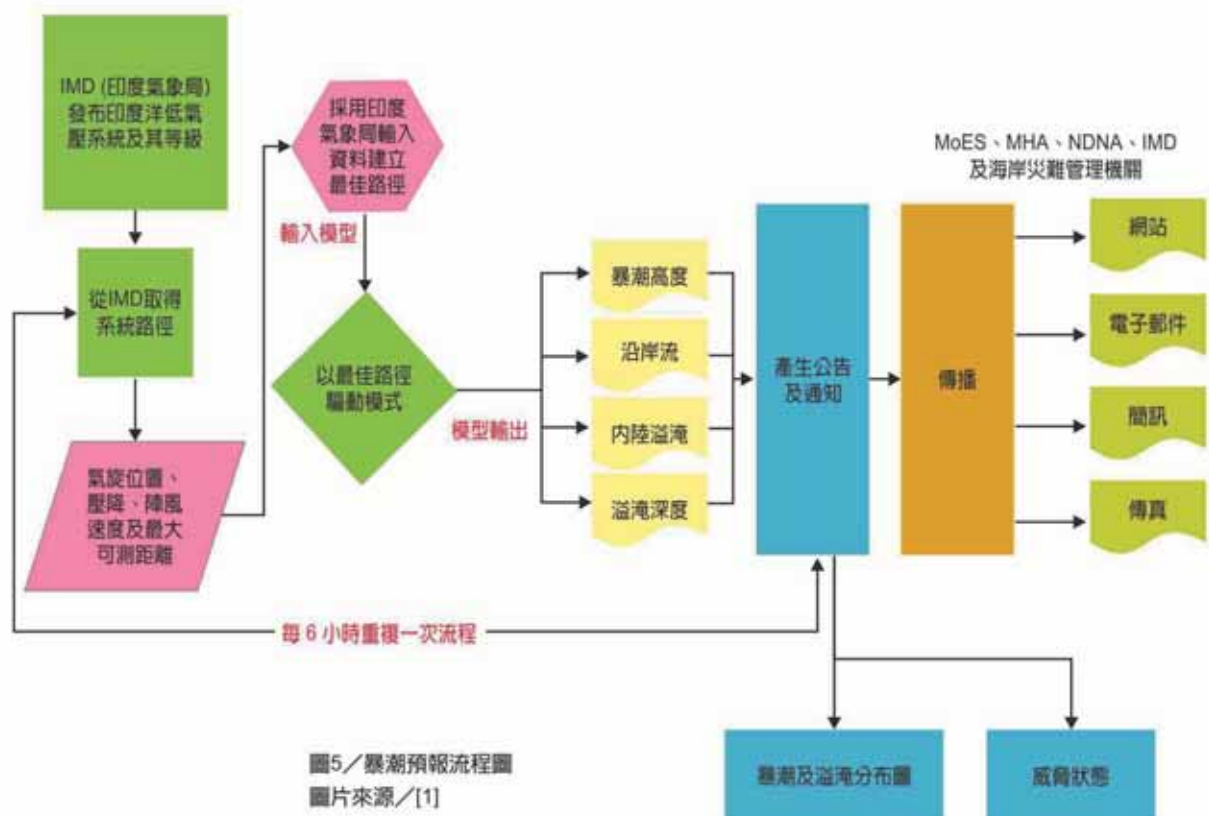


圖4／暴潮示意圖
圖片來源／[1]



結論

本文介紹印度國立海洋資訊服務中心組織與業務，可知印度政府對於海洋資料管理、加值與分享之重視。我國海洋委員會專責統合海洋事務與海洋政策之規劃及推動落實，根據《海洋基本法》第12條，應進行長期性、應用性、基礎性之調查研究，建立國家海洋資訊系統及共享平臺。有鑑於此，海洋委員會責成國家海洋研究院建置全國海洋資料庫並建立「國家海洋資料庫及共享平臺」(National Ocean Database And Sharing System, NODASS)，以充分發揮科研資源整合效益。期待藉由資料整合、資料治理、視覺化展視及資料共享等方式，可提供海洋發展規劃、環境生態維護、海域安全救難、防災及救災、建立環境保育機制等面向應用，讓民衆可知海、近海，讓海洋寫入大家的DNA。

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西印度洋區域海洋治理之現況

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關鍵字／西印度洋區域、海洋治理、奈洛比公約、國際水域、藍色經濟

本文主旨在介紹目前西印度洋（Western Indian Ocean, WIO）區域之海洋治理現況[1]。該區域之主要沿海國家包括：葛摩（Comoros）、法國（留尼旺、馬約特等海外屬地）、肯亞、馬達加斯加、模里西斯、莫三比克、塞席爾、索馬利亞、坦尚尼亞及南非等國。以下即從該區域之區域層級海洋治理機制之現況，以及該區域目前所重視之海洋治理議題等兩部分予以呈現。

區域層級海洋治理機制之現況

西印度洋在區域層級之海洋治理機制主要是提供該地區沿海國與鄰近國家在管理共享漁業資源、預防跨界海洋污染、生態系保育及協助海上交通等議題進行合作。此外，打擊海盜行為、深海採礦及海洋酸化等議題亦可從區域層級之機制著手處理獲得益處[1]。

一、海洋與海岸環境：《奈洛比公約》

目前在西印度洋區域已存在數個區域層級之海洋治理機制（除《東非區域海洋與海岸環境保護、管理與發展公約》〔Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region, 又稱奈洛比公約 Nairobi Convention〕外，還有《阿必尚公約》〔Convention for the Cooperation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region〕、《巴塞隆納公約》〔Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean〕及《吉達公約》〔Regional Convention for the Conservation of the Red Sea and of the Gulf of Aden Environment〕等關於非洲地區之區域海洋公約）。其中《奈洛比公約》是唯一一個區域體制被授權處理陸源與船舶污染、整合性海岸地區管理、棲地保育與保護區及跨界污染應變等環境治理議題，並已通過對抗污染[2]、污染緊急應變[3]及棲地保護[4]等3個議定書（Protocols）。此外，目前《奈洛比公約》亦已開始討論如何透過區域海洋治理提升該區域內之藍色經濟，以及該公約在國際水域（Area Beyond National Jurisdiction, ABNJ）之角色[5]。

二、海洋漁業資源：區域漁業管理組織

在漁業資源養護與管理方面，西印度洋區域主要有以下3個區域漁業管理組織（Regional Fisheries Management Organizations, RFMOs）：

- 印度洋鮪類委員會（Indian Ocean Tuna Commission, IOTC）：負責整個印度洋鮪類等高度洄游魚群之養護與管理。

- 南印度洋漁業協定 (Southern Indian Ocean Fisheries Agreement, SIOFA)：負責沿海國專屬經濟海域 (Exclusive Economic Zones, EEZs) 以外之魚群管理，但不含由IOTC管轄之魚種。
- 西南印度洋漁業委員會 (South West Indian Ocean Fisheries Commission, SWIOFC)：不具管理權限，主要是進行漁業資源評估並協調沿海國之漁業政策。

此外，南極海洋生物資源保育委員會 (Commission for the Conservation of Antarctic Marine Living Resources, CCAMLR)、南方黑鮪保育委員會 (Commission for the Conservation of Southern Bluefin Tuna, CCSBT) 及國際捕鯨委員會 (International Whaling Commission, IWC) 等組織，亦會因其所管轄之魚種洄游至該區域而有所關聯[1]。

近期西印度洋區域重要之海洋治理議題

近期西印度洋區域所關切之海洋治理議題如下：

一、海域邊界及國家管轄權外區域議題

目前西印度洋區域之沿海國已完成許多的雙邊海域劃界，包括模里西斯及塞席爾間與肯亞及坦尚尼亞間等，然仍有部分雙邊海域劃界之協商仍在進行中，譬如葛摩及莫三比克間與葛摩及坦尚尼亞間。

除葛摩外，西印度洋區域之各沿海國均已依照1982年《聯合國海洋法公約》(United Nations Convention on the Law of the Sea, UNCLOS) 之規定，向聯合國「大陸礁層界限委員會」(Commission on the Limits of the Continental Shelf, CLCS) 提交其主張超過200浬大陸礁層(又稱為「外大陸礁層」)之申請案。此外，2012年模里西斯與塞席爾簽署了雙邊協定，雙方同意在鄰接兩國EEZs外之公海海域建立一個「共同管理區」(Joint Management Area, JMA)，兩國在該區域內將聯合行使UNCLOS所賦予沿海國之主權權利，並針對兩國所主張外大陸礁層進行探勘及開發其上之自然資源。此外，南非與莫三比克亦已對兩國之外大陸礁層提案通過合作協定，共同處理此一議題。

而在ABNJ議題上，因西印度洋區域(特別在馬達加斯加及法屬留尼旺以南與索馬利亞間及馬爾地夫間)有著極為廣大之ABNJ，包括許多洋脊與海底山脈。其中，馬斯克林深海高原(Mascarene Plateau)包含了全球最大的海藻床，此一獨特生態系之大部分正好位於模里西斯及塞席爾之EEZs及前述之共同管理區中，故兩國依據UNCLOS第77條享有對該區域及生態系之主權權利[1]。

二、海事安全

海事安全及相關法規之確實執行是享有環境健康的海洋及藍色經濟之基石。所有西印度洋區域之沿海國(除索馬利亞外)均已批准1988年《制止危及海上航行安全非法行為公約》(Convention for the Suppression of Unlawful Acts Against the Safety of Maritime Navigation, SUA)，但許多國家仍未批准該公約於2005年之修約。在海事安全議題中，海盜議題是最受關注者，特別是索馬利亞海盜已造成全球經濟每年180億美元之損失。

為此，該區域於2009年時成立了「索馬利亞海岸海盜聯絡小組」（The Contact Group on Piracy off the Coast of Somalia, CGPCS），目標在協調對海盜行動之應變及鞏固與發展區域海事安全。此外，2017年時該區域亦通過了「吉布地行為準則」（Djibouti Code of Conduct）。該準則是一具法律約束力之區域協定，聯合西印度洋區域之沿海國、中東國家及聯合國相關組織用以打擊與對抗西印度洋區域之海盜行為[1]。

三、藍色經濟

2015年起，《奈洛比公約》之締約方（亦即所有西印度洋區域之沿海國）開始討論該區域應如何發展藍色經濟。在該區域中，藍色經濟之相關活動包括航運、離岸再生能源（特別是離岸風電）及非生物資源之開發、深海採礦、海岸旅遊等。其中，航運部分之發展重點包括強調國際海事組織（International Maritime Organization, IMO）《防止船舶污染國際公約》（International Convention for the Prevention of Pollution from Ships, MARPOL）相關文件之履行，以及綠色港埠發展。

而在離岸再生能源部分，雖然西印度洋區域目前離岸風電之發展仍在嬰兒期，但具有相當大的開發潛力，後續重點應置於如何增加投資誘因、公私部門間如何強化合作、電網及技術移轉之開放取得等，並透過海域空間規劃及環境影響評估等作法支持相關之投資，並避免對生態與環境產生負面衝擊。至於離岸非生物資源部分，雖然非洲地區有大量的油、氣、礦物等蘊藏，但所需開發成本亦十分可觀。未來除繼續鼓勵各方投資外，重點亦將置於該區域國家在開發上述非生物資源時不應對環境造成負面衝擊，而透過區域管理機制將可有效達成此一目標。

在深海採礦部分，目前國際海床管理局（International Seabed Authority, ISA）已在印度洋之ABNJ通過了5個深海採礦計畫。然而，受限於成本、先導型之計畫本質及先進技術之需求，目前上述5個計畫都發給了各國政府機關而非私人公司。由於西印度洋區域之國家缺少足夠的海域採礦政策、經驗與資源去滿足ISA之需求，因此目前只能先採取與其他國家合作以取得相關技術與利益，但亦需共同承擔對海洋環境造成負面影響之責任。

在海岸旅遊部分，除了郵輪及遊艇外，海洋休閒與海岸旅遊大多屬於國家管轄事務，但可透過區域及全球之經驗與管理獲得更大益處。西印度洋區域國家都支持永續旅遊，亦透過相同之工具達成此一目標，包括整合性海岸地區管理、海域空間規劃、海洋保護區之劃設及對旅遊業者進行規範與管理等。各國均已開始推動其國內海岸旅遊業，但如何在遊客能開放進入海岸地區及保護脆弱海岸地區生態與物種（如海龜、鯊魚、珊瑚礁等）間，各國間的政策與規範仍有很大之差異[1]。

四、環境與自然資源

目前西印度洋區域針對海岸地區、永續海岸城市、河流與濕地、生物多樣性、污染、ABNJ之永續性、氣候變遷與海洋酸化及漁業等議題都十分關注。其中，海岸都市地區人口快速增加已對海洋永續及海域遺址之保護產生挑戰，並對空氣與水源之品質及珊瑚礁、紅樹林及濕地等重要棲地造成負面衝

擊。此外，為保護生物多樣性，目前所有西印度洋區域國家均已劃設海洋保護區，但規模從最小之私人或社區建立的保護區到如塞席爾所劃設大洋級保護區不等，功能也從禁止捕撈到可以在該區域進行休閒活動而有很大之差異。

在ABNJ之永續性方面，前已述及目前RFMOs為ABNJ中漁業資源主要管理機制。雖然目前「聯合國國家管轄範圍外區域海洋生物多樣性養護及永續利用協定」（The United Nations Convention on the Law of Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction, BBNJ）正在聯合國進行討論中，但因船籍國多不願在公海上讓出其專屬排他之管轄權，在無有效執法機制情況下，目前BBNJ或許短期內將無法通過。因此，在西印度洋區域採行區域措施，針對該區域之特定議題進行協商與討論，或許可以避免前述全球協商所產生之問題[1]。

結語

由前述內容可知，西印度洋區域目前已有許多涉及海洋治理之區域機制存在，特別是處理海洋環境議題之《奈洛比公約》及管理海洋漁業資源之RFMOs。另一方面，目前該區域重視之海洋治理議題包括海域劃界與海域主張衝突、海事安全、藍色經濟、以及環境與自然資源等。

雖然已有相關海洋治理區域機制之存在，惟在該區域之沿海國多為開發中國家，不論在技術、資金、人力等方面都較已開發國家不足，故不論在藍色經濟之發展及法規執行與執法上仍需其他國家與國際組織之協助，未來海洋治理相關能量之建立將是該區域首要工作。

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New Pages of Marine Governance Join Forces to Build Sustainable, Safe and Prosperous Oceans

Minister of the Ocean Affairs Council: Bi-Ling Kuan

Translated by Linguitronics

The United Nations Convention on the Law of the Sea (UNCLOS) has been adopted for 40 years now. For this edition of *International Ocean Information*, the "Special Report" shares details of the conference on the 40th Anniversary of the United Nations Convention on the Law of the Sea and Ocean Policy, hosted by the Ocean Affairs Council (OAC) from November 2-3rd, 2022. The event invited scholars from various countries to discuss methods for maintaining fundamental international order based on regulations.

Taiwan shares universal values such as democracy, freedom, human rights, and rule of law with other Indo-Pacific countries. We are also happy to join like-minded nations and work together towards building sustainable, safe, and prosperous oceans. As such, this issue focuses on India's critical geographic location in the Indo-Pacific Region. India's Ministry of Earth Sciences (MoES) was founded in 2006 with a scope of research from the atmosphere to the oceans. It actively includes the polar circle into its research objectives. MoES primarily advocates ocean sustainability by implementing the National Policy on Blue Economy. Task forces are planned for 7 major sectors and the National Policy on Blue Economy was drafted in 2021 to increase the Blue Economy's contribution to India's GDP. Secondly, marine spatial planning (MSP) is utilized to manage and coordinate marine spaces for various uses and maintain maritime environments. A partnership was formed with Norway to build a replicable MSP framework.

India established a National Decade Coordination Committee (NDCC) under the UN's framework of the United Nations Decade of Ocean Science for Sustainable Development (Ocean Decade). This issue's "Latest News" describes how India's Earth System Science Organization- Indian National Centre for Ocean Information Services (ESSO-INCOIS) utilizes marine data management, plan formulation, and strengthening of marine infrastructure to achieve planned objectives for Ocean Decade. In addition, "Regulatory Systems" introduces matters such as the current governance mechanisms of the West Indian Ocean and the marine environments, fishery resources, and maritime boundaries of the region, which are under ongoing cooperation and planning. Assistance from the United Nations and other nations, as well as the establishment of governance resources will prove essential for progress in the future.

This issue's "International Issues" discusses the *State of the Ocean Report 2022: Pilot edition*, which focuses on challenges, such as "Understand and beat marine pollution" and "Protect and restore ecosystems and biodiversity". When dealing with deteriorating oceans, the world must continue to work hard to learn about and use the oceans sustainably! OAC will join such effort by striving to expedite the debate and enactment of the Marine Conservation Act and other two major ocean-related legislations, as well as ensure effective implementation of the National Oceans Policy Guidelines and the Ocean Basic Act. We will thus fulfill the expectations of all Taiwanese citizens by protecting our territorial waters.

Ocean Affairs Council "International Conference on the 40th Anniversary of the United Nations Convention on the Law of the Sea and Ocean Policy": Memorandum of Conference

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Keywords: UNCLOS, Marine Policy

On November 2-3, 2022, "the International Conference on 40th Anniversary of the United Nations Convention on the Law of the Sea (UNCLOS) and Ocean Policy" was held online under the guidance of Ocean Affairs Council (OAC) and in cooperation with the organizers. In order to review the development of UNCLOS, 1982, over the past 40 years, the conference discussed five major issues related; including institutional development of the law of the sea, protection of the marine environment and the law of the sea, conservation of marine resources and the law of the sea, maritime security and law enforcement, also maritime disputes and their resolution. In his opening speech, OAC former Deputy minister, Mei-Wu Chou addressed that UNCLOS, which came into force in 1994, has codified the original customary international law and has been recognized as the "World Charter for the Oceans". Scholars from Singapore, Republic of Korea, the United States, Italy, Japan, the United Kingdom, Poland, Republic of the Philippines, and Taiwan R.O.C. were invited to present, share and exchange views on relevant topics, discuss and uphold a rule-based international order to safeguard the freedom and prosperity of the Indo-Pacific region.

After the opening, Research Fellow Yann-Huei Song from Academia Sinica gave a lecture on "The United Nations Convention on the Law of the Sea and Maritime Claims: The Taiwan Strait as an Example". In particular, he pointed out that after the recent 4th Taiwan Strait Crisis (August, 2022), Taiwan has encountered challenges. For example, Taiwan has long encountered difficulties in participating in meetings of the United Nations and UNCLOS-related intergovernmental organizations. The international law of the sea issues arising from this factor are worthy of continued exploration. However, this crisis has also caused the United States and Japan to pay even more attention to Taiwan Strait's security, possibly increasing operations such as U.S. Department of Defense Freedom of Navigation Program and Innocent Passage (FONOP) related to this area. In response to the rising situation, there is an urgent need to promote dialogue between the two sides of the Taiwan Strait and relevant countries, especially the United States and China, in order to maintain peace in the Taiwan Strait.

First Day Highlights: Developments in the United Nations Convention on the Law of the Sea and Conservation in Marine and Resource

The first session of "Development of the 1982 UNCLOS" invited Emeritus Professor Robert Beckman of the National University of Singapore to present on the topic of "NAVAL OPERATIONS IN THE EEZ AND THE 'DUE REGARD' OBLIGATION IN 1982 UNCLOS", focusing on the provisions of UNCLOS regarding

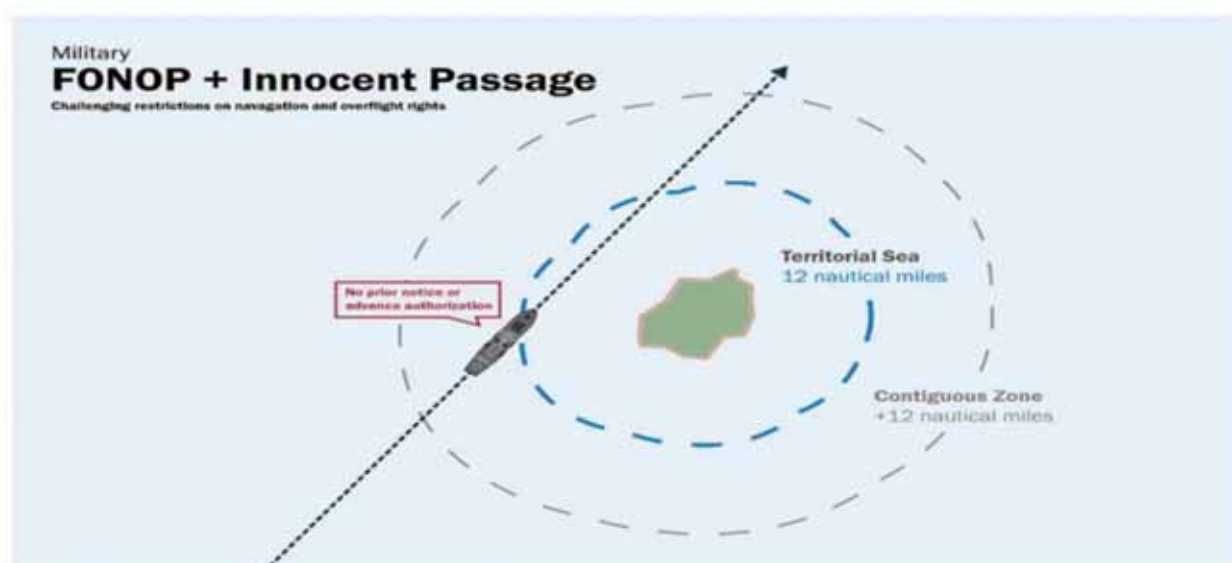


Figure 1/ U.S. Department of Defense Freedom of Navigation Program and Innocent Passage
Source/ Belfer Center for Science and International Affairs, Harvard Kennedy School

naval operations in the Exclusive Economic Zone (EEZ) of coastal states, the history of the negotiations, and the sovereign rights, jurisdiction and obligations of coastal states and other states in the EEZ including an analysis of the right to engage in other lawful uses of the sea in connection with freedom of navigation and flight. "Due regard for obligations" emphasizes the need for consultation with sovereign states and looks to the United States to take the lead on prior consultation in the South China Sea to alleviate the concerns of Asian coastal states.

Professor Seokwoo LEE of the College of Law, Inha University, Korea, presented on the topic of "OBLIGATIONS ASSUMED BY THE STATE UNDER THE UNCLOS AND RELEVANT CONVENTIONS AND AGREEMENTS, EMBODIED AND REFLECTED IN DOMESTIC LEGISLATION POLICIES", which illustrated that Southeast Asian countries have assumed, implemented, and reflected in their domestic legislative policies laws and policies related to the obligations of protecting the marine environment under the conventions and agreements. In terms of the current legislation and measures for marine protected areas, Southeast Asia has achieved limited results. Finally, Distinguished Professor Nien-Tsu Alfred Hu of National Sun Yat-sen University presented on the topic of "A Fisheries Management Gap for Transboundary Stocks in the Eastern Waters of Taiwan: Biological requirements vs. geopolitical realities", pointing out that certain transboundary stocks (such as Pacific bluefin tuna and Japanese eel) are facing over-exploitation and their biology or migration patterns need special protection and management. As the exclusive economic zones of Japan, Taiwan and the Philippines overlap in the eastern waters of Taiwan, it is expected that the three countries will develop better international cooperation and establish a cross-national management NGO to promote biological conservation.

The second session of the "Minutes of the Conference on Protection of the Marine Environment and the United Nations Convention on the Law of the Sea" was presented by Pooran Chandra Pandey, representative of the US Climate Rating Group, on "Asia in a World of Multilateral Dialogue: Ocean Policy, Climate Treaty and Conference of the Parties (COP) 27". The COP 27 in Egypt in November 2022 will also discuss ocean resources, climate and human well-being, which is gaining importance. Given the strategic importance of Asia, the UNCLOS focus on marine resources, maritime activities, freedom of navigation, protected seabed mining and demarcation has taken on greater significance in the context of security. For multilateralism, freedom of navigation, dialogue and the rule of law can be aimed at the common prosperity of Asia, Taiwan also plays an important role in maintaining international peace and stability.

Following the publication of Assistant Professor Pei-Lun Tsai of National Taiwan Ocean University, "Conservation and Protection of the Marine Environment under UNCLOS: The Contribution of the International Tribunal for the Law of the Sea (ITLOS) Provisional Measures and Advisory Proceedings," it is mentioned that of the 29 cases filed by ITLOS since its inception, cases involving the protection and preservation of the marine environment have often been considered in provisional measures or advisory proceedings. The UNCLOS provisions on the protection of the marine environment are few and mostly abstract, and jurisprudence can play a key role in clarifying the obligations of states towards the environment, especially as ITLOS interim measures have the potential to clarify what needs to be done and to play a more active role in emergency situations. Followed by a presentation from Professor Lorenzo Schiano di PEPE of the University of Genoa, Italy, on "The Infringement procedure before the courts and the enforcement of EU marine environment legislation", which focused on "Infringement proceedings" under Articles 258, 259 and 260 of the Treaty on the Functioning of the EU and their role in the enforcement of the EU legislative framework applicable to the protection of the marine environment. It also touched on the contrast between the international/EU legal systems in the resolution of marine-related disputes. The session concluded with a presentation by Professor Kanami Ishibashi of Tokyo University of Foreign Studies on "Discharge of Japanese Nuclear Wastewater into the Sea in the Context of UNCLOS", which explained that the discharge of sewage is recognized and does not violate Japan's obligations under UNCLOS (the precautionary principle) if all measures are taken, including environmental assessments, to prevent marine pollution from affecting the country or the area under its jurisdiction. ITLOS has also ordered that Japan has an obligation to conduct consultations. The International Atomic Energy Agency (IAEA) accepts this and can provide Japan with monitoring and other related support. However, she concluded that Japan should continue to seek means to reduce the risk of environmental pollution.

The third session of "Marine Resources Conservation and the United Nations Convention on the Law of the Sea" began with a presentation by Professor David ONG of Nottingham Trent University School of Law on "UNCLOS & BBNJ Agreement on Marine Living Resources Conservation: Continuing Legal Issues". Both UNCLOS and the BBNJ Agreement (The United Nations Convention on the Law of Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction, BBNJ) deal with the relationship between "definitive species" and "marine genetic resources (MGR)". Furthermore, under the proposed BBNJ Agreement, international treaty obligations to protect any resource can be juxtaposed with the overall goal of protecting marine biodiversity. The second topic was presented by Associate Professor Shih-Ming Kao from the Graduate Institute of Marine Affairs, National Sun Yat-sen University: "UNCLOS and Taiwan's response to the protection and management of marine fisheries resources", discussing the binding effect of the provisions on the conservation and management of fisheries resources in UNCLOS and subsequent international fisheries legal instruments. The Regional Fisheries Management Organizations (RFMOs) has been recognized as the main mechanism for cooperation between distant-water fishing countries and coastal countries and as the executive body for implementing the conservation and management of marine fisheries resources. Although there is still room for effort, Taiwan has passed a number of domestic laws and regulations to demonstrate its determination to combat Illegal, Unreported and Unregulated (IUU) fishing and forced labor and to fulfill its international obligations. Another presentation by Assistant Professor Wan-Chun Wendy Ho of Soochow University, "A Blue Economy in Transition: Is Fisheries Trade Aligned with Sustainable Development Goals?" This session focused on the contribution of the Fisheries Subsidy Agreement (FSA), adopted at the 12th WTO Ministerial Conference, to the sustainability of the oceans by banning or reducing fisheries subsidies. The new agreement not only fulfills the mandate of SDG 14, but is also the first multilateral trade agreement to focus on environmental obligations. The sustainable use of fisheries resources is crucial to the development of a blue economy. The inclusion of environmental sustainability norms in trade agreements represents a

new trend in the transformation of the international fisheries governance structure for the WTO and the international fisheries regime.

The first day of the international conference on November 2nd was devoted to understanding the key points and trends of the development of international marine environment conservation, marine resources protection and the law of the sea, understanding the practice of UNCLOS and related law of the sea in Japan, Southeast Asia and the European Union, and reviewing the current situation of our country's practice of the law of the sea.

Second day's meeting focus: safety and law enforcement

The fourth session of "Safety and Law Enforcement" on the following day, Nov. 3rd, began with a presentation by Young Kil PARK, director of the Korea Maritime Institute, on the topic "Tension in the East Sea from a Legal Perspective: Unsustainable Stability?" He stated that according to UNCLOS, there are two types of "temporary arrangements" in the East China Sea, namely, fisheries agreements and oil and gas development agreements. China is not self-restrained in the overlapping EEZ waters, and its assertive stance on enforcement jurisdiction is reflected in the China Marine Police Law and the China Maritime Traffic Safety Law. In the face of this expansion of jurisdiction, cases can be brought before the International Court of Justice, or alternative approaches such as delimitation of EEZ boundaries based on *Ex Aequo Et Bono* (Equitable Principle), or the conclusion of declaration guidelines (or management guidelines) can be pursued. Continuing the discussion on "The South China Sea in a Regional Security System" by Professor Agata W. ZIĘTEK of the Institute of Political Science at the Maria Curie - Skłodowska University of Poland, he pointed out that the South China Sea has become a contested area over the past 20 years, with unresolved sovereignty issues surrounding it. The pressing issues at hand include oil and gas exploration rights, territorial disputes, show of force, and Sino-U.S. relations (including Taiwan). Security issues in the South China Sea can be divided into political and economic security threats, understanding intentions and choosing to respond to security dilemmas, and the military balance of power to prevent the expansion of other states. There is an urgent need to manage the potential risks of conflict through the establishment of a law-based regional order.

This session concluded with a presentation by Associate Professor Wei-Hua Chen of Central Police University on "Taiwan's Maritime Rights and Law Enforcement Dilemmas under the Strategic Competition between the U.S. and China", reviewing and looking at the pressure on Taiwan's maritime rights in the face of the confrontation and competition between the U.S. and China in the Indo-Pacific region. The first is the pressure from the U.S. to legalize the South China Sea arbitration case, and the second is the Chinese military exercises to be held in the waters surrounding Taiwan in August 2022. In 2022, the U.S. Department of State released Maritime Limits NO. 150, which accused China of illegally asserting sovereignty and exclusive jurisdiction over the South China Sea.

The final session of the conference, "Maritime Disputes and the United Nations Convention on the Law of the Sea", was presented by Professor Jay Batongbacal of the University of the Philippines on the theme "Dispute Resolution in UNCLOS Appendix VII Arbitration: Other Possibilities?" The report elaborates on the details of UNCLOS Appendix VII arbitration and the options available to states to resolve disputes peacefully through various mechanisms such as negotiation, mediation, arbitration, and interim measures. Dispute resolution is a process of problem solving, and all parties should handle it step by step with the principles of goodwill, trust, transparency and openness, rather than expecting a one-time solution. Later, Ruei-Lin Yu (Associate Professor and Director of the Institute of Strategic Studies, National Defense University) presented "Legal and Political Issues of Warships Passing through the Taiwan Strait", discussing the legal arguments of the littoral states and the U.S. through international law of the sea, and concluded that the Taiwan Strait is neither international waters nor an international strait, but a strait of exclusive economic zone where warships and military aircraft should

enjoy freedom of navigation and overflight. There is a complete channel of exclusive economic zone in the middle of the Strait, and the right of transit passage in the Taiwan Strait can be excluded according to the Convention, so the right of freedom of navigation can be granted in the channel similar to the high seas. Finally, Associate Professor Chi-Ting Tsai of National Taiwan University published "The False Construct of Sovereignty and the South China Sea Controversy: Special Implications of the South China Sea Arbitration Case", mentioning that the nature of the concept of sovereignty is debatable in international law. China has essentially used the people's rights model and international law to legitimize its claims of territorial, maritime jurisdiction and historical rights in the South China Sea.

Conclusion

This international conference looked at the development of maritime policy from the perspective of UNCLOS's 40 years of experience and relevant international law and explored in depth the disputes involved in the East China Sea, South China Sea, and Taiwan Strait. In addition, also discussed the UNCLOS arbitration and other dispute resolution methods, as well as the derivative thinking related to the South China Sea arbitration case, which will help our country to grasp the international pulse and serve as a reference for subsequent policy planning.

The controversies involving UNCLOS-related maritime issues and national policies not only reflect the importance of the current international maritime development trend and the possible ways to resolve the disputes, but also highlight the direction of thinking about policy solutions for the disputed maritime areas in East Asia and the development of maritime policies. The online seminar was well attended, and the experts who presented papers provided the latest status of ocean development at all levels, which is beneficial to our government and academia in focusing on these related issues as a basis for governance and policy development.



Figure 2/ International Video Conference Group Photo
Image by Ocean Affairs Council

State of the Ocean Report 2022: Pilot Edition With a Focus on Ocean Decade Challenges

Chung-Ling Chen (Professor, Institute of Ocean Technology and Marine Affairs, National Cheng Kung University)

Keywords: State of the ocean, Ocean Decade Challenges, sustainable development

Ocean scientific knowledge contributes to reversing the decline in ocean health, conserving marine life, addressing ocean aspects of climate change, and using the ocean sustainably to improve people's lives. The United Nations proclaimed the UN Decade of Ocean Science for Sustainable Development 2021-2030 in 2017, which is dedicated to enhancing ocean scientific capacity and thus realizing the vision 'the science we need for the ocean we want' by 2030. The Intergovernmental Oceanographic Commission of UNESCO (IOC) issued the pilot edition of State of the Ocean Report 2020, focusing on the challenges in ocean science, called as Ocean Decade Challenges. The report mainly describes the challenges in a descriptive manner and identifies insufficient capacity of the ocean science on marine pollution, ocean observing, protection of marine ecosystems, resilience of coastal communities, etc. This indicates an urgent need of a quantitative description of the challenges in the future in order to establish benchmarks of the state of the ocean as well as the capacity to measure its change. (The content of this essay is mostly excerpted and compiled from [1].)

Introduction

The United Nations proclaimed the UN Decade of Ocean Science for Sustainable Development 2021-2030 (referred to as 'the Ocean Decade') in the 72nd Session of UN General Assembly in 2017. It aims to realize the vision of the Ocean Decade is 'the science we need for the ocean we want'. 'The ocean we want' consists of a clean ocean, a healthy and resilient ocean, a productive ocean, a predicted ocean, a safe ocean, an accessible ocean, an inspiring and engaging ocean. To make this vision come true, the Ocean Decade specifically identifies ten challenges in ocean science, called as Ocean Decade Challenges.

The IOC issued the pilot edition of State of the Ocean Report 2020 (referred to as 'pilot report'), specifying the Ocean Decade Challenges. However, the pilot report only covers nine of the ten Decade Challenges, not including Challenge 3, which examines how the ocean can sustainably feed the world's population. This aspect is not covered by IOC mandate and therefore not addressed in the pilot edition. In response to these challenges, the pilot report reveals a lack of reliable benchmarks in many aspects of ocean knowledge, and mainly describes these challenges in a descriptive manner. There is an urgent need of a quantitative description.

Ocean Decade Challenges

● Challenge 1: Understanding and beat marine pollution

There is a continued increase and expansion of land-based pollution in the ocean, including pollution from agriculture, aquaculture, and household and industrial wastewater. In recent decades, nitrogen, phosphorous and plastics pollution in the ocean have become ubiquitous and their impact on

marine, with consequences for human health, is discernible. Understanding these pollutants and their impacts on human health and marine ecosystems and developing ways to remove and reduce the pollutants are therefore essential.

Nitrogen and phosphorous can boost growth of aquatic plants and excess plant growth often leads to anaerobic conditions. Globally, there are more than 500 sites of low O_2 areas (i.e., $O_2 < 62 \mu\text{mol kg}^{-1}$), mostly locating along the east and gulf coasts of the USA, in the Baltic region, and off the coast of Japan (Figure 1). However, despite the global significance of marine pollution, observations remain limited in terms of geographic distribution, being mainly concentrated at the ocean surface and in coastal areas. While a 2-D representation of pollution is a possibility, a 3-D is still beyond reach. To address ocean pollution, a more resourced and systematic approach to observation and synthesis of ocean pollution is urgently needed.

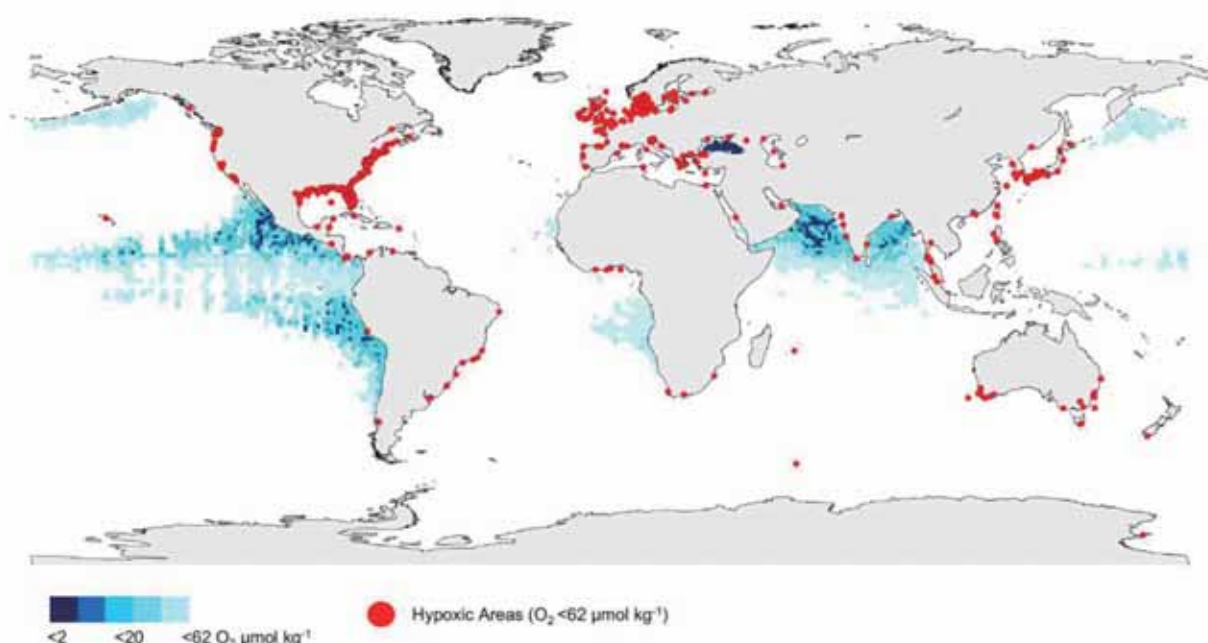


Figure 1/ Locations of low O_2 areas in coastal zone (red dots present the sites where O_2 is less than $62 \mu\text{mol kg}^{-1}$)
Source/ [1]

● Challenge 2: Protect and restore ecosystems and biodiversity

Various types of stressors, including acidification, deoxygenation, warming, more stable water stratification, circulation changes, fishing, habitat destruction, invasive alien species and underwater noise, acting individually or interactively, is shaping the current evolution of marine biodiversity. Given this, monitoring, protecting, managing and restoring marine ecosystems and biodiversity is clearly a very high priority, and to make it effective, systematic observations and research need to be strengthened and resourced.

Currently, an overall picture of evolving marine life is emerging through the use of new eDNA techniques, modelling and data syntheses. To date, approximately 240,000 marine species have been recognized in all oceans, with roughly 2,000 new species being found every year. In addition, hypoxia or dead zones, acidification of the ocean, changes in the food chain and migration of species to colder waters are scientifically established facts.

● Challenge 3: Sustainably feed the global population

This challenge involves in generating knowledge, supporting innovation, and developing solutions to optimize the role of the ocean in sustainably feeding the world's population under changing environmental, social and climate conditions [2]. Since it cares about sustainably feeding the world's population, which is not within the IOC mandates, the pilot edition did not examine this challenge.

● Challenge 4: Develop a sustainable and equitable ocean economy

Systematic research in support of a sustainable ocean economy is in its early stages. Not much is known regarding channels for return on investment, main beneficiaries, legislation, and market mechanisms. The symbiosis between the ocean economy and science requires a better understanding, particularly in the areas of return on investment in marine science and its practical applications. In addition, it is noted that marine spatial planning (MSP) is a key accelerator of the sustainable ocean economy. By April 2022, 102 countries have engaged in approximately 300 MSP initiatives which are in different stages of development, including plans approved, MSP at intermediary stage, and MSP at early stage. To promote MSP and thus realize sustainable ocean economy, it is a need to strengthen capacity development for sustainable ocean planning and management, both at the national level and for the high seas.

● Challenge 5: Unlock ocean-based solutions to climate change

Understanding the ocean-climate nexus contributes to seeking ocean-based solutions to climate change. The coastal blue carbon ecosystems (including mangroves, salt marshes and seagrasses) are considered as one significant area of climate change solutions (Figure 2). Forty million hectares of these ecosystems globally are found along the coastline of continents, housing mangroves, salt marshes and seagrasses. These hotspots for carbon storage have sequestration rates per hectare that are up to ten times larger than those of terrestrial ecosystems. Currently, internationally coordinated research has been able to achieve a more precise quantification of location, area, state and potential of carbon sequestration, for these three types of ecosystems.

Improved protection and management of coastal blue carbon ecosystems can reduce current total carbon emissions by up to 2%. However, due to urban and industrial coastal development, coastal pollution, destructive fishing practices, and pollution and pressures on the land use from agriculture and aquaculture, 20-50% of global blue carbon ecosystems have already been lost or degraded. It is worth noting that a reduction in the loss of mangroves is at 0.11-0.13% annually. More alarmingly, a dramatic loss of salt marshes and seagrasses is at 1-2% and 2-7% annually, respectively.



Figure 2/ The coastal blue carbon ecosystems (e.g., mangroves) are considered as one significant area of climate change solutions
Image by Chung-Ling Chen

● **Challenge 6: Increase community resilience to ocean hazards**

Sea level is one of the best indicators of climate change. Most recent sea level reconstruction based on the tide gauge data indicates a rising trend of sea levels. Specifically, the global mean sea level rose by 12 +/- 5 cm between 1901 and 1990, with a mean rate of rise of 1.3 mm/year over the period. The global mean level rise rate has increased from 2.1 mm/year over 1993-2002 to 4.7 mm/year over 2013-2021. This shows that rising sea levels, together with coastal development and people's migration to coastal zone, put coastal resilience under increasing threat.

Tsunami is one of coastal hazards. To enhance community preparedness in response to this hazard, the IOC developed the global tsunami warning and mitigation System, which comprises a network of 12 tsunami service providers in three oceans basins. This system provides tsunami forecast information. However, such a system will only work if coastal communities have awareness of and preparedness for coastal disasters and then can react efficiently to warnings. For this, the IOC has developed the TsunamiReady Programme, which carries an ambitious objective – 100% coastal communities at risk of tsunami to be recognized by 2030. For these communities recognized, it is a need to further enhance multi-hazard early warning services for all geophysical, ecological, biological, weather, climate and anthropogenic related ocean and coastal hazards as well as strengthen community preparedness and resilience.

● **Challenge 7: Expand the Global Ocean Observing System**

The current Global Ocean Observing System (GOOS) embraces 8,208 ocean observing platforms with 84 contributing to this system, providing users with real-time observing data and information across oceans (Figure 3). Among these observing data, the physical ocean variables are the most developed, including temperature, salinity, density, water color, tides, wave, current, and biogeochemical observations are yet to be expanded. The observing system provides essential data and products to weather, climate and ocean forecasters, maritime commerce, fisheries and coastal communities. However, the areas covered under this system are still insufficient, particularly the areas where observing data are urgently needed, such as the areas with high biodiversity and intense human pressures.

● **Challenge 8: Create a digital representation of the ocean**

Knowing the shape and depth of the seafloor is fundamental to understanding interactions between ocean circulation, climate change and weather forecasting; tides and wave action; sediment transport; tsunami wave propagation; and underwater geohazards. Furthermore, seabed mapping is also essential for the security, safety and economic wealth of nations as it underpins the estimation of natural resources, such as seabed minerals and fishing grounds. Yet, majority of the ocean depths are mostly inferred from satellite altimetry data with very coarse km-scale resolutions that return only a crude representation of the shape of the ocean seafloor. Using advanced echo-sounding techniques to map and measure the ocean depths is therefore a necessary task. The GEBCO Seabed 2030 project is engaged in this task with an ultimate goal of having 100% of the ocean floor mapped. The techniques used include single beam, multibeam echo sounder, satellite-derived bathymetry, light detection and ranging, etc. In the period of six years, from 2015 to 2021, the percentage of total area of the ocean represented by gridded data has increased from 6.7% to 20.6%. It is hoped that through multi-stakeholder collaboration, a comprehensive digital representation of the ocean be developed, which means using digital data to represent global oceans' topography, providing free and open access for all.

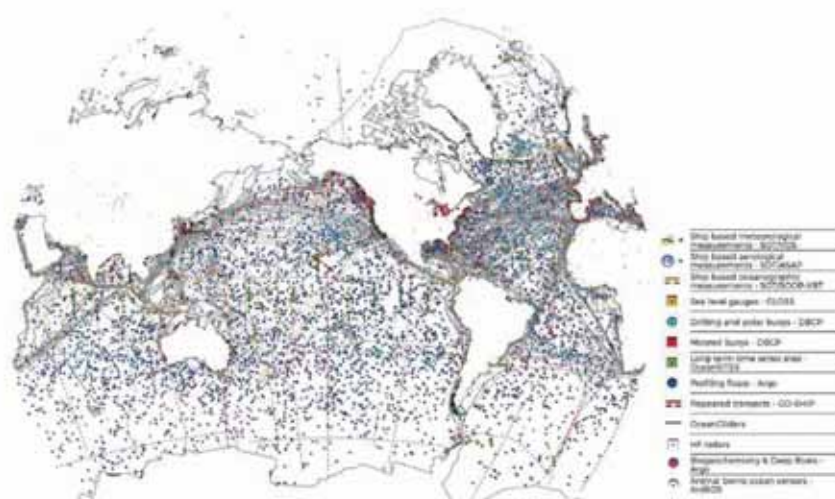


Figure 3/ Global Ocean Observing System consists of more than 8,208 ocean observing platforms

Source/ [1]

● Challenge 9: Skills, knowledge and technology for all

There is an urgent need to increase the capacity of ocean science to address various challenges and successfully contribute to sustainable development. To this end, the Ocean Teacher Global Academy (OTGA) is dedicated to capacity development of ocean science. It already set up a learning platform which organized over 40 online training courses in 2020-2021, with more than 1,000 participants from all continents. In 2022, 17 OTGA Regional and Specialized Training Centres were further established to offer courses and training programs tailored to specific regional needs. It is envisioned that by delivering comprehensive capacity development for the ocean, equitable access to data, information, knowledge and technology across all aspects of ocean science is ensured for all stakeholders.

● Challenge 10: Strengthen humanity's relationship with the ocean

All the issues relating to the ocean are the direct consequence of too little understanding of our influence on the ocean and its influence on us. It is therefore critical to enhance global ocean literacy to the future sustainability of the ocean, coasts and seas. Recent years have witnessed a growing emphasis on the need to understand the complex relationships between society and the ocean. Major advances have been made in this area, with the increased availability of various learning resources such as toolkits, school activities, training courses, networks, etc.

Conclusion

Marine science contributes to understanding of the state of the ocean. While we are aware in principle of what is happening in the ocean, and what should be done about it, the quantitative description of the ocean is drastically incomplete and, as a result, current knowledge is insufficient to effectively inform solutions to the ocean issues that humanity is now facing.

The pilot report is the result of strenuous efforts on the part of the IOC Secretariat and many leading experts. While it mainly focuses on Ocean Decade Challenges, it points out that the description tends to be descriptive and a quantitative description of the state of the ocean is an urgent needed in order to fully understand the ocean issues. As a result, more quantitative information will be included in subsequent editions.

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Through Blue Economy Vision in India: Giving the World a Better Taiwan

Compiled by Cheng-Chi Chung (Distinguished Professor, Dept. of Shipping and Transportation Management, National Taiwan Ocean University); Ching-Wen Shih, Pin-Ni Chen, and Chi Chung (Master Degree Student, Dept. of Shipping and Transportation Management, National Taiwan Ocean University)

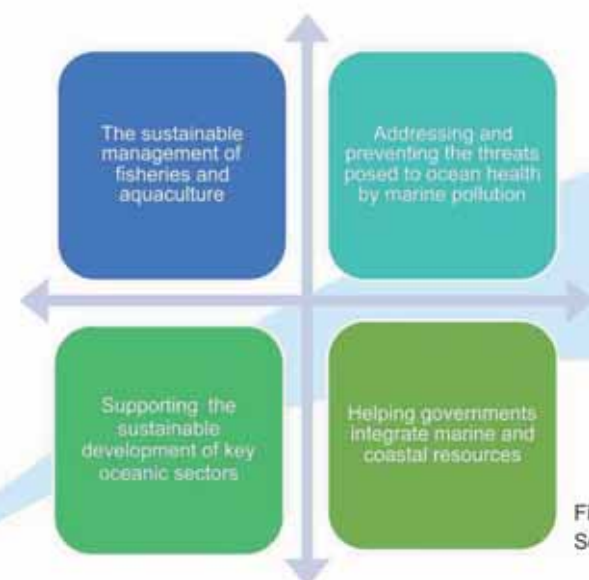
Keywords: Sustainable development, blue economy vision, India's blue economy

The blue economy promotes the symbiosis of human beings and the ocean, making a balance between economy and ecology. According to the estimate of the World Wildlife Fund for Nature (WWF), the blue economy created by worldwide ocean and coastal areas reaches USD 2.5 trillion per year [1]. Many countries have begun to advocate the blue economy, enacting and implementing relevant policies. This article dives into the blue economy vision in India to rethink blue economy issues in Taiwan and give the world a better Taiwan, in order to grow together and protect the earth.

The Definition of the Blue Economy

Before the concept of blue economy was built, green economy has been widely discussed and applied. According to the United Nations Environment Programme (UNEP), a green economy is defined as low carbon, resource efficient and socially inclusive [2], and the blue economy can be regarded as an extension of the green economy. Additionally, the main point of the green economy is circulation; while the blue economy emphasizes on regeneration.

In 2010, Gunter Pauli published the book "The Blue Economy", emphasizing that the economic model should imitate the ecosystem. By using existing resources and taking advantage of their richness to create employment opportunities to benefit more people. Meanwhile, this improves the economy and optimize the society without generating any waste. According to the World Bank, the blue economy is defined as the sustainable use of ocean resources for promoting economic growth, improving livelihoods and employment, and protecting the health of ocean ecosystem [3]. The range of the blue economy includes renewable energy, tourism leisure, climate change, waste management, marine transport, fisheries, and etc. In 2018, the World Bank launched the "PROBLUE" trust fund, which is an umbrella multi-donor trust fund (MDTF), with the purpose of assisting every country to lead the road of blue economy. The PROBLUE focuses on four key themes (Figure 1).



From Figure 1, the PROBLUE focuses on four key themes, namely "the sustainable management of fisheries and aquaculture, addressing and preventing the threats posed to ocean health by marine pollution, supporting the sustainable development of relevant oceanic sectors, and helping governments integrate marine and coastal resources." These directions are mainly aimed at the ocean environment management and development. Ultimately, the goal is to protect the human beings' living space and enhance the quality of life.

Figure 1/ The PROBLUE Focuses on Four Key Themes
Source/ [4]

The Goal of India's Blue Economy

India has a unique maritime position. The country has 12 major ports and 187 non-major ports, handling about 1.4 billion tons of cargo every year [5]. India's exclusive economic zone of over two million square kilometers is rich in living and non-living resources and holds significant recoverable resources of crude oil and natural gas. The coastal economy also sustains over four million fishermen and other coastal communities [5]. With these massive maritime interests, the blue economy in India has a vital relationship with the nation's economic growth. Thus, caring about ocean economy has become an important issue for India's development.

In the union budget of India 2019, the Ministry of Finance laid out the vision of 2030 while highlighting India's transformation. India is poised to become a \$10 trillion economy by 2030 [6]. With this comprehensive ten-dimensional vision, India will become a modern, technology driven, high growth, equitable and transparent society.

The Indian government's emphasis on the need to formulate and integrate marine policies in different sectors, the Economic Advisory Council to the Prime Minister (EAC-PM) initiated a cross-ministerial consultation with stakeholders to formulate a draft for blue economic policy framework. The objective of this policy framework is to enhance the country's GDP by promoting sustainable and inclusive economic growth in this new domain while aligning India's development agenda with national security goals and international commitments.

Considering the existing policies and regulations, the global scenario of the industry, short-term and medium-term strategies and assessments will face challenges; the EAC-PM formulated seven working

Table 1 / The key objectives of the working groups in the seven major areas

Working Group	Key Objectives
1. National Accounting Framework for Blue Economy and Ocean Governance	Sector-specific studies are carried out regularly to assess the relative composition of the different subsectors in the blue economy, with the aim of assessing the weight of the different components in sectors relevant to the blue economy.
2. Coastal Marine Spatial Planning and Tourism	Examine the potential and methodologies for coastal marine spatial planning and coastal and marine economic tourism, and propose approaches to coastal marine spatial planning, including adoption and adaptation of the Intergovernmental Oceanographic Commission (UNESCO-IOC) 2009 Guidelines, to development new national maps and data policy recommendations.
3. Marine Fisheries, Aquaculture and Fish Processing	Review all aspects related to fisheries development, management, processing, marketing and finance, and propose detailed recommendations including increasing sustainable marine capture fisheries, increasing mariculture production, and ocean health monitoring, assessment and management.
4. Manufacturing, Emerging Industries, Trade, Technology, Services and Skill Development	Study broadly on interrelated economic development issues, carefully identify the 'blue' aspects of manufacturing, trade, technical services and skills, and should be integrated with the national economy. Strengthen capital injection, form an expert group to deal with various problems encountered by blue trade, set up a research and development center, and promote the application of artificial intelligence (AI) and other new technologies in deep-sea mining, ocean logistics, and shipping.
5. Logistics, Infrastructure and Shipping (including transshipments)	To study the entire shipping and port infrastructure, as well as issues related to the logistics sector and the maritime field, and set up a maritime development fund to conduct research and proposals for shipbuilding and maritime cluster development.
6. Coastal and Deep-sea Mining and Offshore Energy	To consider the possibility of extracting value from mineral and metal resources in the ocean, and to generate renewable energy from offshore wind, wave, tidal and geothermal resources, and to examine areas for future scientific research and development.
7. Security, Strategic Dimensions and International Engagement	Study the strategic, security and geopolitical aspects of the blue economy in the context of the global and maritime neighborhood, and introduce recommendations including emphasizing awareness in the maritime domain, international cooperation and blue diplomacy to safeguard India's interests in the long run.

Source/ [5]

groups related to the key priority areas of India's development of the blue economy. The working groups are "National Accounting Framework for Blue Economy and Ocean Governance," "Coastal Marine Spatial Planning and Tourism," "Marine Fisheries, Aquaculture and Fish Processing," "Manufacturing, Emerging Industries, Trade, Technology, Services and Skill Development," "Logistics, Infrastructure and Shipping (including transshipments)," "Coastal and Deep-sea Mining and Offshore Energy," and "Security, Strategic Dimensions and International Engagement" respectively [5]. The key objectives of the working groups in the seven major areas are shown in Table 1.

As can be seen from Table 1, the working groups in the seven major areas have a detailed division of labor, and in addition to their respective key research and review projects, they put forward strategies and propositions for the development in each field. India hopes to use the potential of the blue economy to optimize GDP and employment growth, ensure the welfare, safety and livelihood of fishermen in coastal areas, achieve innovation to ensure zero waste, low-carbon technology, and bring economic dividends to a large part of the population, and also promote marine safety and balanced international engagement.

The Vision of India's Blue Economy

The blue economy is based on the concept of no waste and no emissions, and expands the concept of green economy. It is expected to add value to marine fields, including coastal manufacturing, shipping, and offshore or coastal related energy technologies [6], and has a significant relationship with the growth up of the national economy. Relying on the puissant vantage, India strives for efficient and sustainable utilization of ocean resources, both integrates and boost the related capabilities in maritime domain, and simultaneously protects the development of marine environmental objectives sustainably. The ten development visions for India in 2030 are shown in Figure 2.

As can be seen from Figure 2, India's development visions include the development of coastlines and marine waters. Through a comprehensive planning and the enforcement of blue economy policy, it can accelerate economic growth in coastal areas, not only ameliorate the living standard of people and employment issues, but also maintain the health of the marine ecosystem.

In recent years, owing to the extreme global climate change, it has caused serious threats to the environment and ecosystems in deteriorating areas, result in causing doubts about the survival of island countries; therefore, the ecological protection system of the Indian Ocean is the primary concern [6]. In order to advocate the pursuit of sustainable use of earth resources, Prime Minister Modi proposed five overall visions for India's blue economy, as shown in Figure 3.

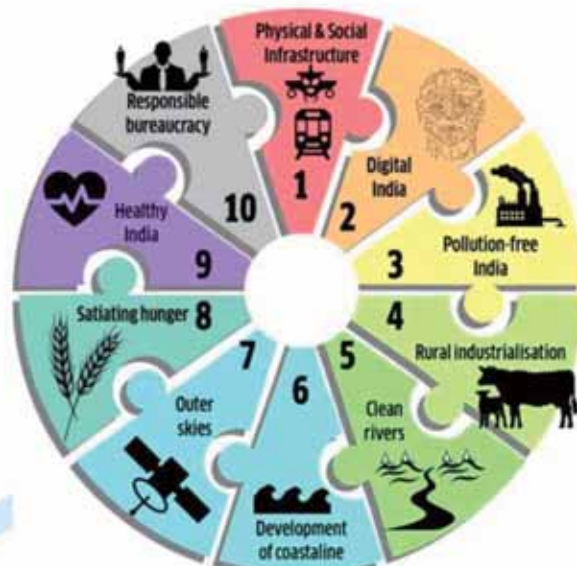


Figure 2/ India's Ten Development Visions for 2030
Source/ [7]



Figure 3/ The Five Visions for India's Blue Economy
Source/ [6]

India expects to achieve safety and growth within the Indian Ocean region in the future. Prime Minister Modi stated that India is well prepared to cooperate with all regional partners to prosper all Indian Ocean regions. In order to achieve the above objectives, India adopts the following three cooperative initiatives:

- I. **Security Measures:** According to the trilateral security mechanism with Sri Lanka and Maldives, and bilateral naval exercises with regional partners, India provides substantial equipment or training of human capacity and investigation of maritime incidents for Sri Lanka and Maldives.
- II. **Development Partnerships with Surrounding Regions:** From the East Coast of Africa to the Western Pacific Ocean, with the Republic of Seychelles, Singapore and Samoa as the main partnership, to build a significant emerging economy and stabilize the development of the blue economy.
- III. **Education and Cultural Cooperation:** The purpose of marine education research is to formulate wide comprehensive strategies to protect marine ecological resources, improve the knowledge of the marine environment and economy through the understanding of the coast, and promote the marine education program through personnel training.

Due to the limited resources of earth, it must be planned by an effective strategy to maximize the use of marine resources and achieve sustainable development goals. Meanwhile, ecological protection and the commercial interests of residents in coastal areas are involved nowadays [6] to ensure that the opportunities of extending blue economy would be realized.



Figure 4/ India and Taiwan
Image by Cheng-Chi Chung

Reflection on the Blue Economy Issues in Taiwan

In June of 2020, the Ocean Affairs Council (OAC) in Taiwan published the National Ocean Policy White Paper [8], which discussed the blue economy in the chapter on marine industry development and innovation. The contents and latest information are integrated with suggestions as follows.

- I. Talent Cultivation Issues:** Starting from the maritime education for the publics, expanding the sense of identity with the ocean, and making everyone in our country have maritime literacy. The government, businesses and schools should realize maritime education implementation plan formulated in the National Ocean Policy White Paper from 2022~2026, promote cooperation between industries and schools, and nurture excellent maritime industry talents to enrich the strength of the maritime industry.
- II. The Marine Industry Issues:** On the premise of sustainability, except from the traditional shipping industries in Taiwan, we should take more advantage of abundant marine resources and develop emerging marine industries, such as marine biotechnology, offshore wind power, ocean current power generation, wave energy, submarine cables, deep-sea water, and marine environmental protection industries.
- III. Ocean Tourism Issues:** Taiwan is surrounded by the sea with unique landscape, beautiful coastal scenery, and diverse marine resources. We should seize these advantageous conditions, combine Taiwan's maritime culture, develop maritime tourism, leisure and recreation, strengthen the tourism and leisure industry scale, and thus, connect with international maritime leisure.
- IV. Industrial Cooperation:** Taiwan must establish a thorough industrial chain and value chain for maritime emerging industries. With the cooperation between the central and regional governments, strengthen the mutual assistance relationship between industries, promote the active participation of non-governmental organizations, and then connect with the world to improve our international competitiveness.
- V. Legal Issues:** "Ocean Basic Act" was passed in November of 2019. At that time, the Ocean Affairs Council promoted the "Marine Conservation Law", "Ocean Area Management Law", and "Marine Industry Development Regulations" and etc. However, the three regulations are currently on the draft, hoping relevant regulations can be actively promoted in the future.

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India's Ministry of Earth Sciences (MoES) and Major Ocean Initiatives

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Keywords: India, Ministry of Earth Sciences, Ocean Initiatives

There are 36 Biodiversity Hotspots in the world, India has as many as 4 Biodiversity Hotspots [1], accounting for 1/9 of the world. India had signed lots of ocean initiatives in the past, those also benefit a huge potential driver for economic growth, innovation and employment. However, the Indian government also aware that environmental pressures from overfishing, climate change, marine pollution and loss of biodiversity are gradually weakening the value of the ocean. Therefore, in order to improve the health of marine ecology and sustainable development, the Indian government has implemented many strict strategies, and strive to make people pay more attention to marine issues. The Indian government focuses on more research on climate, ocean and coastal areas, hydrology, earthquakes and natural disasters. They hope to explore marine biological and non-living resources in a sustainable manner, and explore the three poles of the Earth (Arctic, Antarctic and Himalayas). For the purpose mentioned above, in July 2006, the Indian government had changed the original Department of Ocean Development (DOD) to the current Ministry of Earth Sciences (MoES).

History of India's Ministry of Earth Sciences

MoES was formerly the DOD, which was created in July 1981 as a part of the Cabinet Secretariat directly under the charge of the Prime Minister of India. It came into existence as a separate department in March 1982. The function of DOD was to be a nodal institution for organizing, coordinating and promoting ocean development activities in the country. The Indian government notified DOD as the Ministry of Ocean Development in February 2006. Until July 2006, the Ministry of Ocean Development was reorganized by the Indian government into the new Ministry of Earth Sciences (MoES). This brought the Indian Meteorological Department (IMD), Delhi, the Indian Institute of Tropical Meteorology (IITM), Pune, and National Centre for Medium Range Weather Forecasting (NCMRWF), Noida under the range of MoES administration. In terms of organizational setup, MoES governs the Earth System Science Organization, which consists of 2 subordinate offices, 3 attached offices, and 5 autonomous bodies [2] (Figure 1).

Functions of the Ministry of Earth Sciences

The vision of establishing MoES is to improve knowledge and technology in the field of Earth Sciences and bring socio-economic benefit of the society. The functions of MoES are [3]:

- I. To augment and sustain long-term observations of atmosphere, ocean, cryosphere and solid earth to record the vital signs of Earth System and changes.
- II. To develop forecasting capability of atmosphere and oceanic phenomena through dynamical models and assimilation techniques and to build prediction system for weather climate and hazards.
- III. To understand interaction between components of Earth Systems and human systems at various spatial and temporal scales.

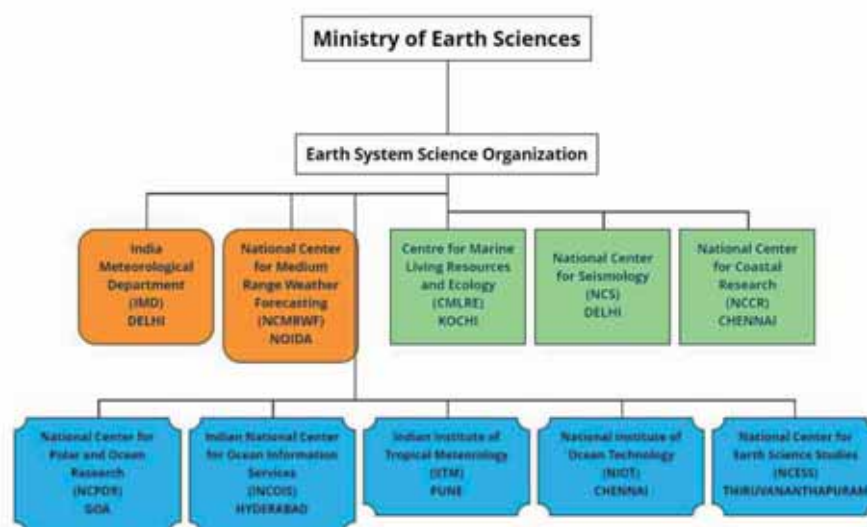


Figure 1/ The Organization Setup of Indian Ministry of Earth Sciences (MoES) (The orange background is the subordinate offices, the green background is the attached offices, and the blue background is the autonomous bodies)

Source/ The official website of MoES, compiled and drawn by the author
<https://moes.gov.in/index.php/about-us/organization-setup>

- IV. To explore polar and high seas regions of the Earth towards discovery of new phenomenon and resources.
- V. To translate knowledge and insights from Earth systems science into services for societal, environmental and economic benefit.
- VI. Development of ocean technology for exploration of oceanic resources and societal applications.

MoES aims to become a world leader in providing high-quality services in Earth Sciences knowledge while contributing to the economy and society. MoES also would like to be a leader in providing all possible services in Earth Sciences to developing countries in Asia and Africa. At the same time, considering the various indicators of the Sustainable Development Goals (SDGs), it also proposes a vision document until 2030. This document looks forward to continuing the research of weather, climate and hydrological services, ocean services and marine geology, ocean survey and exploration, atmospheric and ocean technology, polar sciences and cryosphere, geosciences and seismology, multi-hazard early warning systems for disaster risk management and basic research, infrastructure, human resources development and international collaboration [4].

In addition, MoES has launched many projects to deepen research in the field of Earth Sciences, including:

I. Atmospheric, Climate Science and Services, ACROSS [5]

Focusing on the research of Monsoon Convection, Clouds, and Climate Change (MC4), High Performance Computing System (HPCS), Monsoon Mission (MM-II), Atmospheric Observations Network, Weather & Climate Services, Upgradation of Forecast System, Commissioning of Polarimetric Doppler Weather Radars (DWRs).

II. Polar Science and Cryosphere Research, PACER [6]

The Polar Regions amass massive reserves of water (in the form of snow and ice), they significantly affect global climate and are in turn also acutely affected by the ongoing climate changes. Hence, studying the Polar Regions is key to unlocking the past, better understanding the present and predicting the future. National Centre for Polar and Ocean Research (NCPOR), which belongs to MoES, has four sub-schemes under it to strength the study of the Polar Regions, namely, the Antarctic Program, Indian Arctic Program, Indian Southern Ocean Program and Cryosphere and Climate Program.

III. Seismology and Geosciences, SAGE [7]

Focusing on the research of seismological monitoring and microzonation, geodynamics and surface processes, Indian deep ocean observations and dynamics of lithospheric evolution, scientific deep drilling in the seismic zone, seismicity and earthquake precursors and setting up a facility for geochronology.

The major Ocean Initiatives of Ministry of Earth Sciences

In the purpose of continuing to explore marine biological and non-living resources in the way of sustainable development, MoES adopts many strategies and ocean initiatives, which will reduce the pressure and difficulties of marine environment, and enhance the benefits that the ocean can bring to human society. The major Ocean Initiatives include:

I. Blue Economy Policy

India has a remarkable marine position with 7,517 kilometers of coastline and comprises 199 ports of which 12 are major ports (Figure 2) that handled 541.76 million tonnes in 2021. In addition, exclusive economic zone of India covers an area of more than 2 million km² and is rich in biological and non-living resources (oil and natural gas). The coastal economy sustains over 4 million fishermen and coastal towns [8]. Therefore, India's blue economy is regarded as a part of the national economy, including: the entire marine resource system and the ocean within the jurisdiction, land and coastal economic infrastructure, which is conducive to production and economic growth, and has an important potential position.

MoES established the "National Policy for India's Blue Economy" in 2021, with suggestions and opinions from various stakeholders including industry, NGOs, academia and citizen. The draft outlines a vision of domestically available marine resources that the Indian government can adopt. The goal of the policy document is to increase the blue economy's contribution to India's GDP, improve the lives of coastal residents, protect marine biodiversity, and ensure the national security of maritime areas and resources [9]. The four objectives of this blue economy policy are: framework for robust mechanism, sustainable framework for a national coastal marine, framework to domestic manufacturing, emerging industries, trade, tourism, technology, services and skill development connected with the BEP, framework for ocean governance [10].

II. Marine Spatial Planning, MSP

MSP is an important issue in global ocean management, and it is a tool for sustainable development of ocean management. It aims to create a framework for the ocean that minimizes conflicts between economic sectors and maintains the good environmental status of the ocean through the identification of ocean spaces that are appropriate for different uses and activities (Figure 3). MoES, through National Centre for Coastal Research (NCCR), had previously developed Coastal Zone Management (CZM) plans for three areas, namely Chennai, Goa and Gulf of Kutch, which pertained only to the coast and near coastal areas. Although these programs only involve coastal areas, they have all proved to be very successful [11].



Figure 2/ 12 major ports in India
Source/ International Shipping Magazine
<https://www.seanews.com.tr/india-s-12-major-ports-see-box-throughput-rise-to-730-000-teu-in-july/152412/>

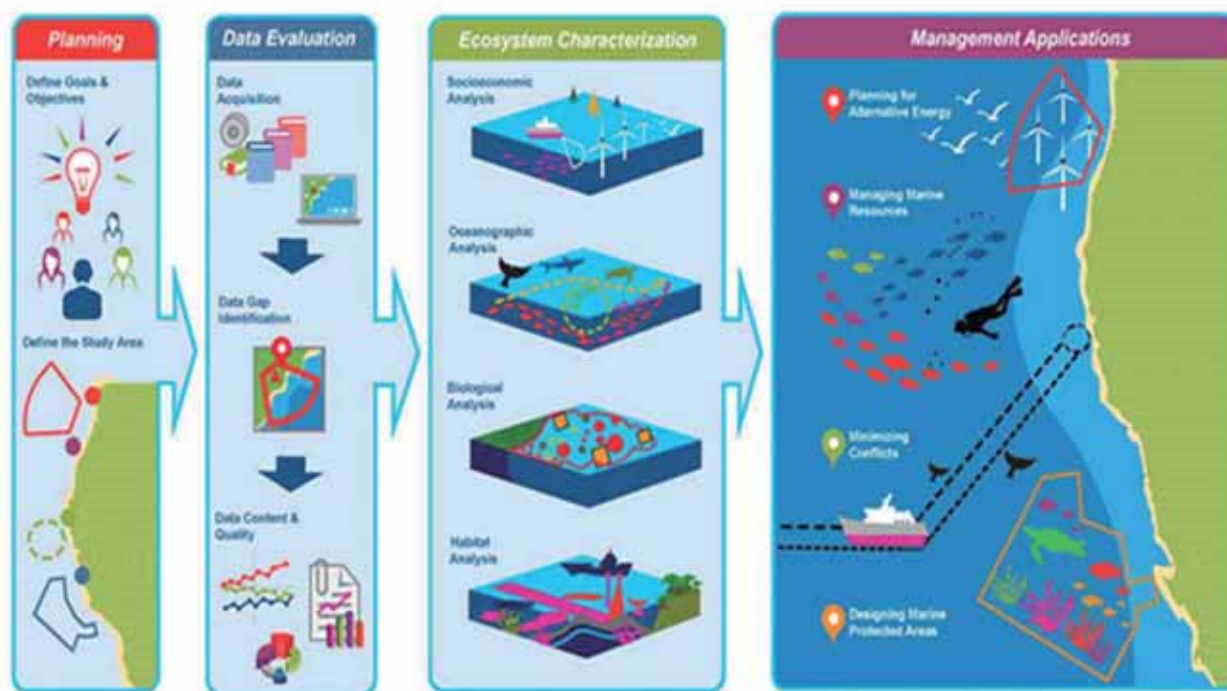


Figure 3/ The process of Marine Spatial Planning
Source/ Pacific Islands Protected Area Portal
<https://pipap.sprep.org/content/01-what-marine-spatial-planning>

In January 2019, India and Norway signed Memorandum of Understanding (MoU) of "India-Norway Ocean Dialogue". In the MoU, the two sides emphasized "the need to move towards integrated and ecosystem-based approaches in the management of renewable and non-renewable natural resources" and identified it as a common area for future collaboration. Lakshadweep and Puducherry in India have been identified as test sites for the project. These sites have been chosen for the pilot project in view of their setups with unique opportunities for multiple sectors (such as industries, fisheries, and tourism) to flourish. The Government of India's initial investments for undertaking the studies and planning are estimated to be around INR 8-10 crores per annum. In the future, MSP framework of these two key areas can be replicated to other coastal areas of India [12].

III. National Decade Coordination Committee, NDCC

Since the United Nations announced the 10 years from 2021 to 2030 as the "United Nations Decade of Ocean Science for Sustainable Development (Ocean Decade)", it aims to stimulate the generation of marine knowledge, and raise public awareness of marine science and sustainable development [13].

MoES constituted a National Decade Coordination Committee (NDCC), which involved various national institutions and stakeholders, under the chairmanship of Secretary. Its mandate is to coordinate existing programs and develop new programs at the national level to achieve the goals of the Ocean Decade. On February 3, 2021, India's "Ocean Decade Conference" was officially launched at the Indian National Centre for Ocean Information Services (INCOIS). Ocean Decade Conference recommends developing a National Ocean Decade Implementation Plan in consultation with other national research centers and stakeholders to highlight India's contribution to the awareness of primary school students and the public on the importance of the ocean. In addition, India has also continued to strengthen the maritime construction measures of the countries along the Indian Ocean [14].

Conclusion

After the establishment of the Ocean Affairs Council (OAC) of Taiwan in April 2018, the National Academy of Marine Research (NAMR) affiliated to the OAC was also established in April 24, 2019. The main tasks are to plan marine policy, study on marine resource and marine scientific research [15]. It is regarded as a national marine think tank, similar with MoES in India, both of which conduct marine science research. However, MoES has been established for a long time (including the predecessor DOD), and has a certain foundation on research in various fields of earth sciences, especially in climate science, polar science and natural disaster prevention. In addition, India has also signed many Memorandum of Understanding with the United States, the United Arab Emirates, the United Kingdom, Mauritius, Norway, Germany and other countries to strengthen research on marine science. Taiwan's NAMR is still in the development stage, but it has achieved many research results in integrating marine scientific research information, improving basic marine surveys, enhancing the development of marine research, cultivating cultural heritage talents, and leading the upgrading of the marine industry.

MoES has also proposed many ocean initiatives for the sustainable development of the ocean. Among them, the blue economy policy is a strategy adopted by many countries to sustainably use the ocean, including: Australia, Brazil, the United Kingdom, the United States, Russia and other countries. Ecosystem-based marine spatial planning is also the focus of the MoES, and Taiwan is also making continuous efforts in the institutional and legal aspects of marine spatial planning. The National Decade Coordination Committee established by India is also one of the initiatives which is worthy for Taiwan to refer. Only by carrying out policy planning under a clear future blueprint can the process be improved and the goal achieved.

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Earth System Science Organization - Indian National Centre for Ocean Information Services (ESSO-INCOIS)

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Translated by Linguitronics

Keywords: India, ocean information services, ESSO-INCOIS

This report introduces India's national-level ocean information center Earth System Science Organization - Indian National Centre for Ocean Information Services (ESSO-INCOIS) in the hopes that Taiwan can improve its application of ocean information by following the example of other nations' ocean information services.

Founded in 1999, ESSO-INCOIS falls under the authority of Ministry of Earth Science (MoES) and is a department within the Earth System Science Organization. The mission of ESSO-INCOIS is to monitor the oceans and provide society, industry, academia, and government institutions with high-quality ocean information and consulting services. Systemic and focused research is continually advanced in hopes of becoming the leader of knowledge and information technologies in the ocean sector.

Founding Principles and Missions of ESSO-INCOIS

The founding principles and missions of ESSO-INCOIS include:

- Establish, maintain, and manage ocean information service systems to collect, analyze, interpret, and preserve relevant data.
- Take on, support, promote, guide, and coordinate research and related services in the field of ocean information (including satellite oceanography).
- Utilize satellite technology, vessels, buoys, or other platforms to conduct surveys and monitoring to output data on the fishing industry, mining industry, and oil industry, as well as organisms, hydrology, topographical mapping, geology, weather, and coastal management.
- Provide users with output data and the value-added services of relevant data.
- Cooperate with ocean, atmosphere, and coastal management institutions of other nations for the remote monitoring of international waters.
- Establish early warning systems for tsunamis and storm surges.
- Support research centers in conducting relevant research for data integration, analysis, and collection on ocean processes, air-sea interactions, and coastal information.
- Organize training courses, symposiums, and seminars to promote research related to ocean science and technology.
- Utilize viable technologies to spread information, research results, ocean data products, maps, and digital data to the general public to promote research and satisfy society's demand for a rising standard of living.
- Provide consultation services for ocean information.
- Utilize satellites to obtain the most advanced ocean data remotely.

Organizational Structure

The organizational structure of ESSO-INCOIS primarily includes 3 groups and 8 divisions (Figure 1), namely:

- Operational Ocean Services & Applied Research (OSAR): Includes the 2 divisions of Operational Ocean Services (OOS) and Applied Research and Research to Operations (ARO).
- Ocean Observations, Modeling & Data Assimilation (OMDA): Includes the 2 divisions of Ocean Modeling & Data Assimilation (MDA) and Ocean Observations Network (OON).
- Information & Communication Technology and Data Management (ICTD): Includes the 2 divisions of Ocean Data Management (ODM) and Information & Communication Technology (ICT).

Additionally, there are the divisions of Program Planning & Coordination and Capacity Development (PPC) and Executive Support Services (ESS).

In terms of human resources, the number of full-time employees at ESSO-INCOIS as of March 2021 included one director, 40 scientists, 19 research assistants, and 10 administrative staff for a total of 70 employees. Project-based human resources included 28 project scientists, 28 project assistants, 18 postdoctoral research fellows, and 20 administrative staff for a total of 94 positions.

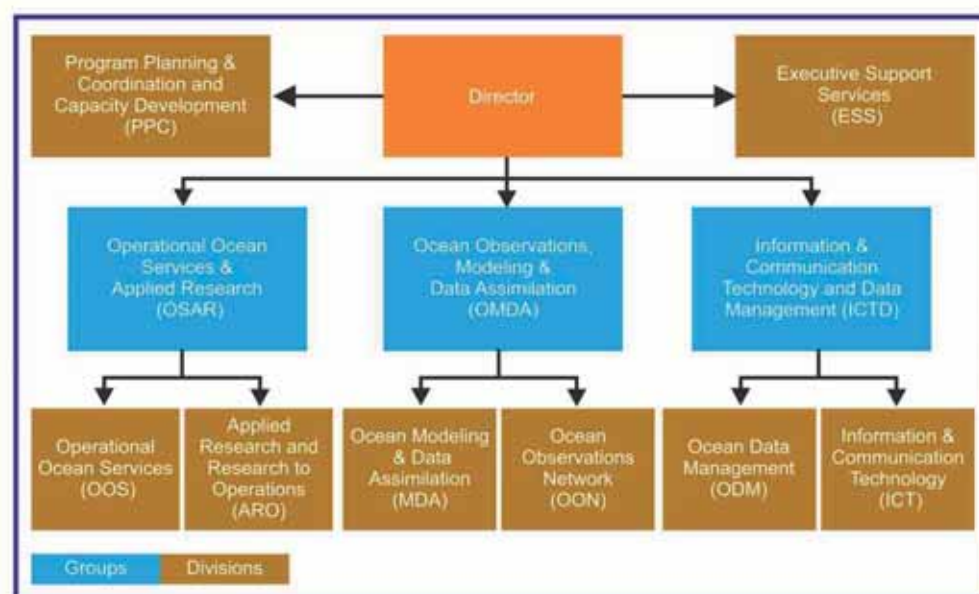


Figure 1/ Organizational Structure of ESSO-INCOIS
Source/ [1]

Tsunami Early Warning Services (TEWS)

On December 26, 2004, Sumatra-Andaman earthquake occurred 160 kilometers west ($3^{\circ}19'N$, $95^{\circ}51.24'E$) of Sumatra, Indonesia. The 9.1-9.3 magnitude quake occurred at a depth of 30 km [2] and caused a massive tsunami in South Asia. Regions severely damaged by the tsunami included Indonesia's Aceh province, Thailand's Phuket resort area, Sri Lanka, and India's Tamil Nadu, resulting in the death or injury of 300,000 people. This was partly because a regional tsunami early warning service similar to those installed in the Pacific Ocean did not exist in the Indian Ocean or Atlantic Ocean at the time. In the Pacific Ocean, multiple sets of tsunami sensors with real-time connection to monitoring centers have been installed so that in the event of a tsunami, civilians will receive real-time warnings for them to evacuate before the tsunami arrives. While Thailand is a member of the Pacific TEWS, the country's tsunami sensors are installed in their eastern waters as opposed to the Indian Ocean. The United States Geological Survey (USGS) believes that establishing

tsunami monitoring and early warning systems can effectively reduce the loss of life. This is especially true in Sri Lanka and India, where there were 3 or more hours after the initial earthquake to evacuate civilians in coastal regions; however, systemic negligence still led to severe deaths and injuries. Additionally, people more susceptible to potential tsunamis in countries around the Pacific Ocean are generally more aware of tsunamis, understanding that a sudden ebbing of the tide on the coast represents a massive incoming wave. Also, the excessively slow earthquake analysis in India and Sri Lanka led to warnings being issued too late. As such, the Indian government included TEWS into their ocean information services.

The Indian government established an Indian Tsunami Early Warning Centre (ITEWC) in ESSO-INCOIS that launched operations in October 2007. ITEWC is a Tsunami Early Warning Centre that operates 24-7 and includes a seismic monitoring station on land and ocean observation network (tsunami buoys and tide station) to offer continuous detection and monitoring of tsunamis caused by earthquakes. The use of 12 undersea bottom pressure sensors (BPR) enables earthquake testing and uses seismic parameters to estimate and track the occurrence of tsunamis, instantly sending this data to ITEWC and offering real-time recommendations to vulnerable regions (Figure 2).

Generally, tsunami simulations can be categorized into 3 parts: I. Tsunami generation; II. Propagation, and III. Retrograde motion (Overflow). Tsunami generation models often utilize models such as [3] and [4] to calculate changes in static seabeds. These models require basic parameters including the fault area (length and width), strike angle, dip, slip, fracture depth, dislocation, and seismic magnitude to generate an initial waveform. Tsunami propagation speed is closely related to water depth. Tsunami waves travel at speeds between 500-1,000 km/hour when deep underwater and in the open seas. When they approach coastal areas, tsunamis are affected by shoaling, which causes a height increase. High-resolution terrain elevation data can be applied to establish potential flood maps for quickly evaluating the possible affected area of disasters. ESSO-INCOIS applied the TUNAMI N2 (Tohoku University's Numerical Analysis Model for Investigation of Near field tsunamis) model in 5 simulations of recorded earthquakes, predicted flood areas, and drew a potential flood map for the reference of relevant agencies.

The rapid calculation system for tsunami propagation in the Indian Ocean includes a database of 50,000 tsunami scenarios, covering a range from 30 to 40°N and 30 to 130°E latitude with grid spacing of about 0.0450° (5.01 km). The Indian Ocean's two tsunami generation zones are covered using sensitivity analysis and historical earthquake data to set up 975 simulation points on the subduction zone. Each simulation point includes 6 different depth combinations (10, 20, 40, 60, 80, and 100 km) and 7 levels of magnitude (Mw) (6.5, 7.0, 7.5, 8.0, 9.0, and 9.5 Mw), as well as a pre-defined unit source. In total, approximately 50,000 scenarios, each with different coastal locations, arrival time, and wave height are predicted and stored in the database. In the event of a tsunami, the closest scenario can be selected to identify risk areas. The tsunami that occurred on September 12, 2007 was used to conduct verification as shown in Figure 3.

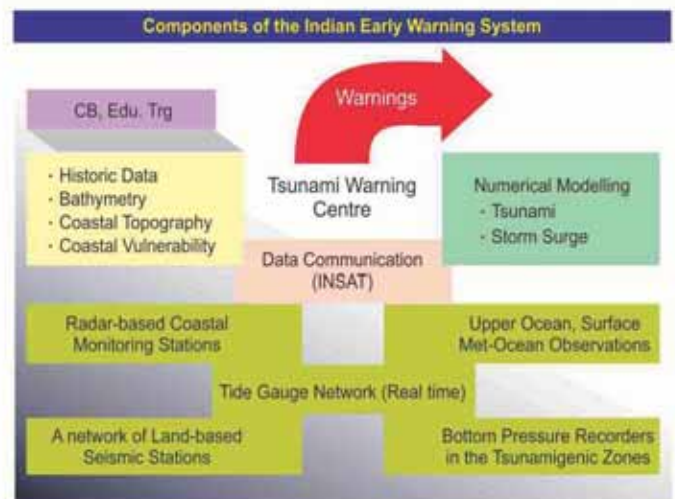


Figure 2/ Operation of TEWS in the Indian Ocean
Source/ [1]

Storm Surge Early Warning Model

Similar to typhoon damage in Taiwan, the coasts of Northern India suffer from hazards such as storm surges and flooding due to tropical winds. A storm surge is a phenomenon in which the sea level rises rapidly due to wind shear and air pressure (Figure 4), similar to powerful wind fields caused by tropical winds, such as typhoons in Asia and or hurricanes in the Americas. Their gale and low central pressure push and squeeze seawater towards coasts, which is added to the topographic effect of slopes in the ocean and astronomical tides (tides) to repeatedly trigger incidents where

new records in water level and wave height occur. Extreme water levels cause hazards by flooding low-lying regions, causing rivers to overflow, leading to soil salinization due to salt from seawater flooding inland, thereby endangering crops and livestock, or driving seawater to enter the water table, resulting in scarcity of drinking water. On the other hand, tropical winds also bring intense, concentrated rainfall of up to 500mm/day. The uncertainty in their prediction further exacerbates the risks of storm surges, especially in India's Bay of Bengal. ESSO-INCOIS established an Indian Storm Surge Early Warning System due to the cumulative loss of life and property from storm surges. The system applies the ADvanced CIRCulation (ADCIRC) model to calculate ocean currents generated by tides and winds, thereby estimating the rise in sea level caused by topographic effects in coastal regions. The factors considered for storm surges due to tropical winds include maximum storm radius, gale intensity, central movement speed, movement trajectory, center air pressure, landing location, coastal land elevation, and coastal features. The early warning system categorizes the risk of India's coastal regions as follows: Surge heights below 1.5 m are considered light risk zones, surge heights between 1.5 m to 3 m are considered moderate risk zones, surge heights between 3 m to 5 m are considered high risk zones, and surge heights above 5 m are very high risk zones. The early warning process is as shown in Figure 5.

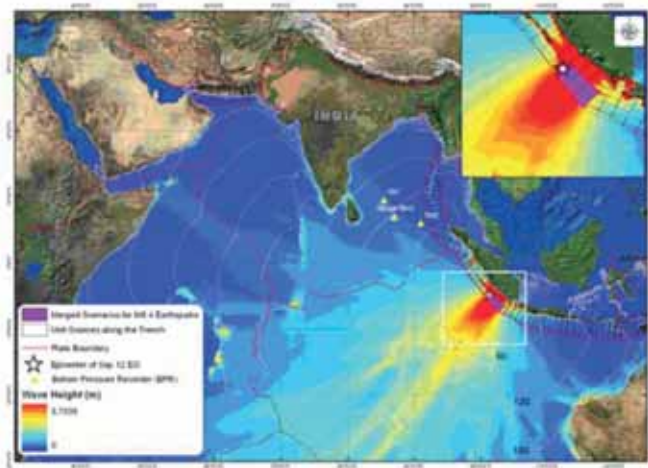
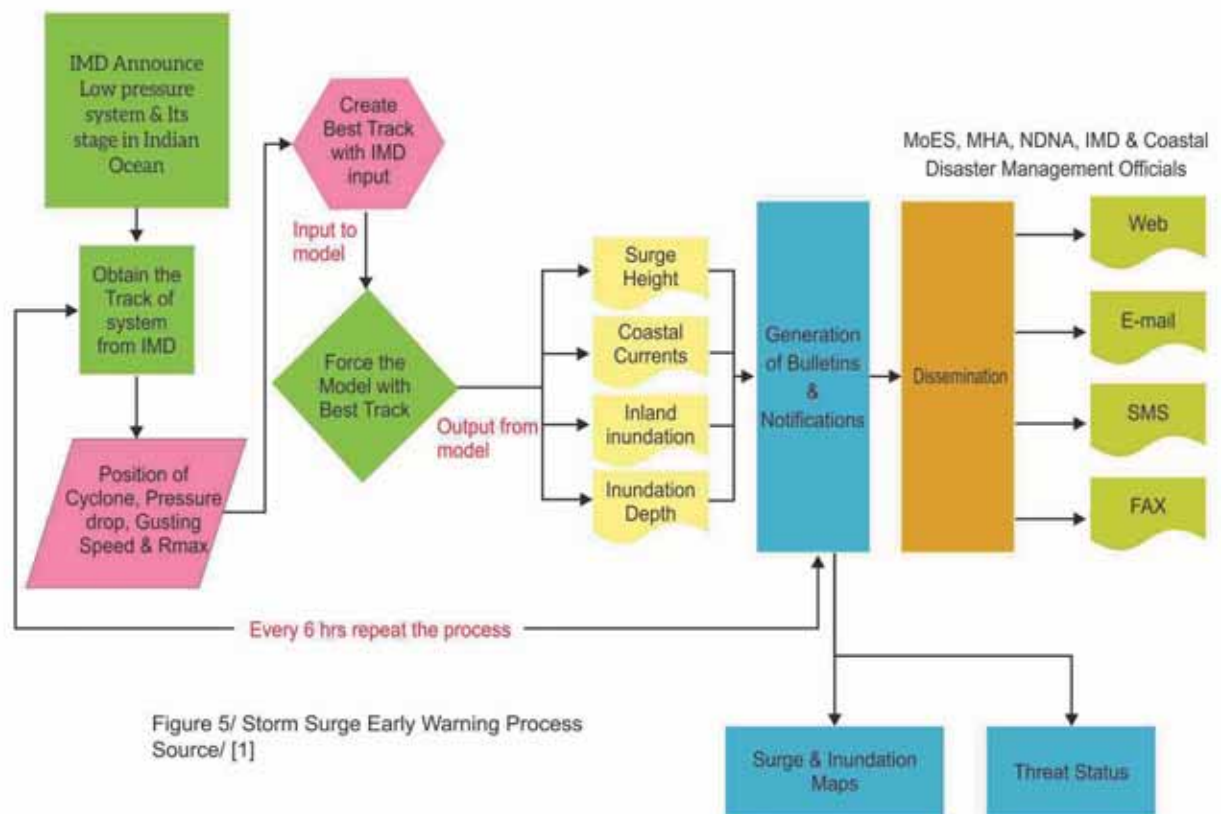


Figure 3/ Tsunami Propagation Map After the 8.4 Magnitude Earthquake of September 12, 2007
Source/ [1]



Figure 4/ Storm Surge Diagram
Source/ [1]



Conclusion

This article offers an introduction of the organization and operations of the ESSO-INCOIS. It is clear that India's government places great emphasis on the management, value-adding, and sharing of ocean data. Taiwan's Ocean Affairs Council (OAC) is responsible for consolidating ocean affairs, as well as the planning and implementation of ocean policies. Article 12 of the Ocean Basic Act requires OAC to conduct long-term, practical, and basic surveys and research, as well as establish and maintain a national marine information system and sharing platform. In the light of this, OAC has instructed the National Academy of Marine Research (NAMR) to establish and implement a National Ocean Database and Sharing System (NODASS) to maximize the synergistic effect of consolidating ocean scientific resources. Hopefully, the consolidation, data governance, visualization, and sharing of data can be applied to plan for marine development, protect ecological environments, and assist in marine rescue, disaster prevention, and emergency relief, as well as establish mechanisms of environmental conservation. This can help the public learn about our oceans and approach them more easily, writing the oceans into our DNA.

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The State of Ocean Governance in the Western Indian Ocean Region

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Keywords: Western Indian Ocean (WIO) Region, Ocean Governance, the Nairobi Convention, Areas Beyond National Jurisdiction (ABNJ), Blue Economy

This Article aims to introduce the state of ocean governance in the Western Indian Ocean (WIO) region. Coastal States in the WIO region mainly include Comoros, France (Reunion and Mayotte), Kenya, Madagascar, Mauritius, Mozambique, Seychelles, Somalia, Tanzania and the Republic of South Africa. Following, this Article presents regional mechanisms and thematic and important issues in relation to ocean governance in the WIO region.

The State of Regional Mechanism in Relation to Ocean Governance

Regional mechanisms in relation to ocean governance in the WIO region are to enable coastal countries to cooperate with neighboring countries with which they share the ocean, including shared fish stocks, prevent transboundary pollution, conserve ecosystems, and facilitate marine transport. In addition, issues such as piracy, deep seabed mining and ocean acidification also benefit from a regional approach [1].

I. Ocean and Coastal Environment: Nairobi Convention

Several regional mechanisms in relation to ocean governance have been established in the WIO region (In addition to the Nairobi Convention, other regional conventions include the Convention for the Cooperation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region [Abidjan Convention], the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean [Barcelona Convention], and the Regional Convention for the Conservation of the Red Sea and of the Gulf of Aden Environment [Jidda Convention] that are related to ocean governance in the WIO region), among which the Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region (Nairobi Convention) is the only regional institution mandated to address the environmental governance of land and sea sources of pollution, integrated coastal zone management, conservation of habitats, including through protected areas, and transboundary pollution emergency management. Currently, three protocols; on combating pollution [2], pollution emergencies [3], and habitat protection [4] have been adopted and in effect. In addition, currently the Nairobi Convention has begun to examine measures to advance the region's blue economy, and its role with respect to Areas Beyond National Jurisdiction (ABNJ) [5].

II. Marine Fisheries Resources: Regional Fisheries Management Organizations

In relation to the conservation and management of fisheries resources, there are three regional fisheries management organizations (RFMOs) that are responsible for this task in the WIO region:

- i. The Indian Ocean Tuna Commission (IOTC), which has a mandate to manage the tuna stocks (specified highly migratory species, HMS) of the entire Indian Ocean;
- ii. The Southern Indian Ocean Fisheries Agreement (SIOFA), which is tasked with managing fisheries outside the exclusive economic zones (EEZs) (excluding tunas and other HMS falling under the IOTC mandate); and

- iii. The South West Indian Ocean Fisheries Commission (SWIOFC), which does not have a management role but regularly assesses the status of fishery resources and provides a means of coordinating the fisheries policies and activities of the region's coastal countries.

In addition, the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), and the International Whaling Commission (IWC) are also relevant to the conservation and management of fisheries resources because the fish stocks they manage may migrate into the WIO region [1].

Thematic and Important Issues in Relation to Ocean Governance in the WIO region

Recent thematic and important issues related to ocean governance include:

I. Maritime Boundaries and Areas Beyond National Jurisdiction

Coastal States have already agreed on many bilateral maritime boundaries in the region, including between Mauritius and Seychelles as well as between Kenya and Tanzania. However, there are still some outstanding bilateral maritime boundaries negotiations, such as negotiations between Comoros and Mozambique as well as between Comoros and Tanzania.

Except for Comoros, all coastal States in the WIO region have submitted their information to the Commission on the Limits of the Continental Shelf (CLCS) established by the 1982 United Nations Convention on the Law of the Sea (UNCLOS) for an extended continental shelf that is beyond 200 nm measured from the territorial baselines. In 2012 Mauritius and Seychelles agreed to the establishment of a Joint Management Area (JMA) in which the two States exercise sovereign rights jointly for the purpose of exploring the continental shelf and exploiting its natural resources. In addition, an agreement also exists between Mozambique and South Africa with respect to the harmonization of extended continental shelf claims.

In relation to ABNJ, vast areas of the WIO lie in the ABNJ, including numerous ocean ridges and seamounts, particularly south of Madagascar and Réunion and between Somalia and Maldives. Among these areas, most of the Mascarene Plateau that hosts the world's largest seagrass area lies within the JMA and the EEZs of Mauritius and Seychelles, where both Mauritius and Seychelles exercise sovereign rights over the seabed and subsoil as per article 77 of UNCLOS [1].

II. Maritime Security

Maritime security and the rule of law are the foundation of environmentally-healthy oceans and the blue economy. All WIO States except Somalia have ratified the 1998 Convention for the Suppression of Unlawful Acts Against the Safety of Maritime Navigation (SUA) but not the more recent amended 2005 SUA. Piracy is the most concerned among those related to maritime security, particularly Somali piracy has resulted in an estimated loss of US\$18 billion per year to the world economy.

To this end, the Contact Group on Piracy off the Coast of Somalia (CGPCS) was established in 2009 to coordinate the response to piracy and consolidate and develop regional maritime security in the region. In addition, the Djibouti Code of Conduct was adopted in 2017, which is a binding multilateral agreement to combat piracy in the region through the collaboration between WIO coastal States, Middle Eastern States and relevant UN organizations [1].

III. Blue Economy

Since 2015, the Parties to Nairobi Convention (also the coastal States in the WIO region) have decided to discuss how to pursue a blue economy approach to development. Blue economy includes a diversity of

economic activities in the WIO region, including shipping, offshore renewable energy (particularly offshore wind power) and non-living resources, deep sea mining, coastal tourisms, etc. As to the development of shipping, the key elements include the emphasis of the implementation of the International Convention for the Prevention of Pollution from Ships (MARPOL) and related instruments from the International Maritime Organization (IMO), as well as the development of green ports.

As regards to offshore renewable energy, despite the fact that it is still in its infancy in the WIO region, there is considerable potential. Measures to promote offshore renewable energy include investment incentives, public private partnerships, opening access to the electric grid and technology transfer, and to underpin investment and avoid, or minimize negative through measures such as marine spatial planning (MSP) and environmental impact assessments (EIAs). In relation to offshore non-living resources, there are huge oil, gas, and mineral reserves in the African region, but the costs for exploitation may also be high. In addition to continue encouraging investments, emphasis should be placed to prevent negative impacts to the environment when States exploit these non-living resources in the WIO region. Through regional regulatory mechanism will effectively achieve this goal.

In relation to deep sea mining, currently five contracts have been approved by the International Seabed Authority (ISA) for deep sea mining in the Indian Ocean ABNJ. However, subject to the costs, pioneering nature and advanced technology involved, the existing ISA contracts are with State-sponsored agencies rather than private companies. Coastal States in the WIO region lack adequate marine-mining policies, experience and resources to deal with the ISA requirements, and therefore they may associate with other countries to participate in technologies and benefits. However, some of the liability for environmental damage would remain with any such sponsoring coastal States in the WIO region.

Regarding coastal tourisms, other than the operation of cruise ships and yachts, marine leisure and coastal tourism is largely a matter of national governance, but can benefit from regional and global experiences. All coastal States in the WIO region share similar sustainable tourism goals, and use many of the same tools to plan and foster sustainable tourism, including integrated coastal zone management (ICZM), marine spatial planning (MSP), creation of marine protected areas and reserves, and use of codes of conduct for tourism operators. Many States have growing domestic tourism, but the protection of any right of public access to the foreshore, as well as the protection of vulnerable habitats and species (e.g., sea turtles, sharks, coral reefs) varies considerably in the region [1].

IV. Environment and Nature Resources

Currently, issues related to environment and nature resources concerned in the WIO regions include coastal zones, sustainable coast cities, rivers and wetlands, biodiversity, pollutions, sustainability in ABNJ, climate change and ocean acidification, and fisheries. In particular, the impact of the growing coastal urban population presents a major challenge to sustainable oceans and conservation of maritime heritage sites, as well as negative impacts on all habitats and natural resources: reefs, mangroves, rivers and wetlands and the quality of air and water. In addition, all coastal States in the WIO region have established Marine Protected Areas (MPAs). However, these range from small private MPAs and community MPAs to large ocean-scape MPAs such as that in Seychelles. In addition, they provide different levels of protection functions from 'no take' areas to limited extractive or recreational use.

In relation to the sustainability in ABNJ, as mentioned above RFMOs have become the primary management mechanism for fisheries resources in ABNJ. Despite the fact that the negotiation of the Nations Convention on the Law of Sea on the conservation and sustainable use of marine biological

diversity of areas beyond national jurisdiction (BBNJ) Agreement is currently discussing in the United Nations, flag states are unwilling to cede their exclusive jurisdiction rights on the high seas. Without an effective enforcement mechanism, the proposed global BBNJ Agreement is likely to be adopted in the near future. This is where a regional approach can move from global provisions, which are difficult to negotiate, to specific provisions targeting clearly-defined regional challenges [1].

Conclusion

According to the above sections, there are already many regional mechanisms in relation to ocean government in the WIO regional, particularly the Nairobi Convention which specifically addresses marine environment issues as well as RFMOs that manage marine fisheries resources. In addition, ocean governance issues concerned in the region include maritime boundaries and conflicts among maritime claims, maritime security, blue economy, and environment and natural resources.

Despite the existence of these relevant regional mechanisms in relation to ocean governance, coastal States in the WIO region are mostly developing States. Comparing to developed States, they are insufficient in technology, finance, and human resources in this regard. Assistance from other States or international organizations for the development of blue economy and law enforcement is highly needed. Therefore, capacity building will be the first priority in relation to ocean governance in the WIO region.

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