7th 海洋環境監測及預報技術研討會

The 7th Workshop on the Monitoring and Forecasting Technologies of Marine Hazards and Environments

10 / 24 -10 / 25

2017 澎湖

澎湖縣馬公市澎湖科技大學國際會議廳

International Conference Hall, National Penghu University of Science and Technology, Penghu county, Taiwan

會議議程手冊及論文摘要彙編

Proceeding of The 7th Workshop on the Monitoring and Forecasting Technologies of Marine Hazards and Environments

目錄

一、會議資訊

1.1 基本資訊

會議時間：2017 年 10 月 24~25 日

會議地點：澎湖縣馬公市澎湖科技大學海科大樓國際會議廳

籌備委員：

-中山大學洪慶章特聘教授
-中央大學錢樺副教授
-廈門大學江毓武教授
-廈門大學黃邦欽副院長

主辦單位：

中央大學水文與海洋科學研究所

中山大學海洋科學系

澎湖科技大學海洋遊憩系

廈門大學福建省海陸界面生態環境重點實驗室

協辦單位：

行政院科技部

行政院教育部

行政院大陸委員會

科技部自然司地球科學研究推動中心

國研院台灣海洋科技研究中心

贊助單位：

澎湖國家風景區管理處

澎湖縣政府旅遊處

探海有限公司

慧技科學有限公司

1.2 研討會行程及時間表

時間		行程
10/23(Mon.)	15:00~16:00	參訪澎湖國家風景區管理處遊客中心
	16:00~18:00	百世多麗花園酒店大廳研討會報到、繳交海報
	18:00~20:00	Ice breaker 地點：百世多麗 2 館 1F 百匯廳
10/24(Tue.)	06:30~07:30	早餐，地點：百世多麗 1 館 1F 西餐廳
	08:00~15:30	研討會議程
	15:30~17:30	海岸現場踏勘
	17:30~20:00	福朋喜來登酒店晚宴 地點：喜來登珍珠廳
10/25(Wed.)	06:30~07:30	早餐，地點：百世多麗 1 館 1F 西餐廳
	08:00~18:00	研討會議程
	18:00~20:00	百世多麗花園酒店晚餐 地點：百世多麗 1 館 B1 貴菊廳
10/26(Thur.)	07:00~08:00	早餐，地點：百世多麗 1 館 1F 西餐廳 *請於 08:00 前完成退房
	08:00~12:00	海岸現場踏勘　*攜帶行李上車
	12:00~13:15	星月灣田媽媽餐廳午餐
	13:45	研討會結束馬公機場搭機

*地點請參考第 4~6 頁“重要地點”。

1.3 注意事項

1. **口頭報告及海報：**

   I. Keynote 報告時間為 30 分鐘(含提問與討論時間)，口頭報告為 15 分鐘(含提問與討論時間)，報告用 PPT 請於報到或休息時間上傳至會務組電腦。

   II. 海報尺寸 A0(寬 841mm，高 1189mm)，自行列印後帶至研討會報到處交於工作人員。海報交流時間為研討會茶歇時間，海報作者請於海報現場交流。海報作者如欲收回海報，請於 10 月 25 日 18:00 研討會結束後自行收回。

2. **交通：**

   交通車於以下時刻提供接送。

交通車時刻表

出發時間		起點➔目的地
10/23 Mon.	14:50	馬公機場➔澎湖遊客中心
	參訪結束 16:00	澎湖遊客中心➔百世多麗花園酒店
10/24 Tue.	07:30	百世多麗花園酒店➔澎湖科技大學
	議程結束 15:30	澎湖科技大學➔海岸踏勘
	17:30	海岸踏勘➔福朋喜來登酒店
10/25 Wed.	07:30	百世多麗花園酒店➔澎湖科技大學
	議程結束 18:00	澎湖科技大學➔百世多麗花園酒店
10/26 Thur.	08:00	百世多麗花園酒店➔海岸踏勘
	12:00	海岸踏勘➔星月灣餐廳
	13:15	星月灣餐廳➔馬公機場(13:45 抵達)

3. **住宿與餐費：**

   根據本研討會歷年慣例，不收註冊費，並提供會議期間用餐及考察活動費用，臺灣學者交通住宿自理。

4. **百世多麗花園酒店 Wifi：**

   大廳帳號： Pescadores_AP　　密碼：不需密碼

   客房帳號： Pescadores_(房號四碼)　　密碼：069219399

5. **澎科大國際會議廳 Wifi：**

   選擇網路： TANetRoaming

   帳號： wmfm01、wmfm02、wmfm03……、wmfm30

   密碼： 12345678

6. 重要地點：

A. 澎湖科技大學：澎湖縣馬公市六合路 300 號

B. 百世多麗花園酒店：澎湖縣馬公市新店路 420 號 (google map 有誤)

C. 福朋喜來登酒店：澎湖縣馬公市新店路 197 號 (google map 有誤)

D. 星月灣田媽媽餐廳：澎湖縣西嶼鄉大池村 132 號

二、研討會議程

10 月 24 日（星期二）上午

時間	活動		備註
08:00~08:20	開幕式 Opening Session	致詞： 1. 澎湖科技大學 校長翁進坪教授 2. 廈門大學 江毓武教授 3. 成功大學 高家俊教授	地點：澎湖科技大學海科大樓 國際會議廳 主持人：中山大學洪慶章、中央大學錢樺
08:20~08:30	大合照 Group Photo		
Session 1.1 – B.海洋雷達及遙測技術發展及應用 主持人：錢樺、賴堅戊			
08:30~09:00	S1. 專題演講 Keynote Speech	Pierre Jacques Flament	Observing the sub-mesoscale in the coastal transition zone: development and current state of in-situ and remote sensing technologies
09:00~09:15	S1.1	吳雄斌	On the Doppler offsets of the 1st Order HF Radar Sea Echoes
09:15~09:30	S1.2	錢樺	Analysis of wave parameters and directionality from simulated HF Radar Sea Echo during Typhoon Dujuan
09:30~09:45	S1.3	岳顯昌	Wave spreading factor derived from observations of HF surface wave radars in a network
09:45~10:00	S1.4	李炎	海面非微幅波的高頻地波雷達觀測
10:00~10:30	茶歇 Tea Break (A)		
10:30~10:45	S1.5	Suseentharan Veluchamy	An overview of Indian Coastal HF Radar Network
10:45~11:00	S1.6	賴堅戊	南灣作業化高頻雷達測流網所看見的冷水垂向混合現象
11:00~11:15	S1.7	陳振雄	Sea Surface Observations in the Taiwan Strait Using the Chung-Li VHF Array Radar

11:15~11:30	S1.8	陳章友	X 波段雷達圖像浪流反演的波束形成技術
11:30~11:45	S1.9	吳立中	航海雷達監測近岸地形水深技術之研擬
11:45~12:00	S1.10	胡建宇	Internal Solitary Wave Reflection in the South China Sea
12:00~13:00	午餐		

10 月 24 日（星期二）下午

Session 2 – D.海洋環境生物地球化學 主持人：周文臣			
13:00~13:30	S2. 專題 演講 Keynote Speech	陳鎮東	Carbon and nutrients in Submarine Groundwater Discharge around Taiwan
13:30~13:45	S2.1	李明安	Modelling of Essential Fish Habitat for Mugil cephalus Based on IPCC Climate Scenarios in the Taiwan Strait 透過 IPCC 情境模擬資料探討臺灣海峽重要物種棲地模型：以烏魚為例
13:45~14:00	S2.2	洪慶章	Enhanced particulate organic carbon export triggered by internal waves in the oligotrophic northern South China Sea
14:00~14:15	S2.3	蔣國平	The dynamic of a dominant dinoflagellate Noctiluca scintillans off the subtropical coastal waters of Matsu archipelago: in a high-gradient environment
14:15~14:30	S2.4	柯風溪	Bioaccumulation and trophic transfer of persistent organic chemicals in marine plankton 持久性有機污染物在海洋浮游生物之累積及食階傳遞
14:30~14:45	S2.5	方天熹	The contamination status of trace metals in sediment of the East China Sea
14:45~15:00	S2.6	周文臣	The storage effect on pH analysis for seawater samples
15:00~15:15	S2.7	馬劍	Automated spectrophotometric determination of carbonate ion concentration in seawater using a portable syringe pump based analyzer
15:15~15:30	S2.8	陳紀新	An Automatic flow-through monitoring system for planktonic ecological process study and its application
晚餐，地點：福朋喜來登酒店珍珠廳			

10 月 25 日（星期三）上午

Session 3 – A.海洋數值模式及預報技術發展應用 主持人：江毓武			
08:00~08:30	S3. 專題演講 Keynote Speech	王東曉	Intensified interannual variation of the southern South China Sea circulation during winter monsoon
08:30~08:45	S3.1	廖建明	台灣海峽高解析模式應用於海難搜救評估
08:45~09:00	S3.2	江毓武	Physical-biological model and its scientific research in the Taiwan Strait
09:00~09:15	S3.3	劉洋	基於全球潮汐潮流數值預報系統的南海及麻六甲海域潮汐潮流研究
09:15~09:30	S3.4	滕春慈	簡介氣象局波浪預報作業系統的改進
09:30~09:45	S3.5	傅賜福	風暴潮-近岸浪耦合漫堤數值預報系統在福建沿岸業務化應用
09:45~10:00	S3.6	王衛強	Lagrangian decomposition of the Indian-Ocean shallow meridional overturning circulation
10:00~10:15	S3.7	陳冠宇	數值格林函數在暴潮預報的應用
10:15~10:30	S3.8	任詩鶴	夏季臺灣海峽及周邊海域上升流鋒面的數值研究
10:30~11:00	茶歇 Tea Break (c)		
Session 1.2 – B.海洋雷達及遙測技術發展及應用 主持人：趙丰			
11:00~11:15	S1.11	高學民	Chinese Ocean Satellite Missions in the Near Future
11:15~11:30	S1.12	趙丰	Ocean circulation variations revealed by time-variable gravity from the GRACE satellite
11:30~11:45	S1.13	Richard L. Miller	Multi-resolution Retrieval of Water Quality Parameters in Coastal Waters using MODIS and Landsat OLI Data
11:45~12:00	S1.14	鄒斌	A Fast Distribution System for Ocean Satellite Data
12:00~13:00	午餐		

10 月 25 日（星期三）下午

Session 4 – E.海岸帶災害與管理 主持人：江文山			
13:00~13:30	S4. 專題演講 Keynote Speech	Prof. Bärbel Koppe	Flood and Coastal Protection at the German North Sea Coast
13:30~13:45	S4.1	Mullai Vendhan Kuppusamy	Beach Restoration with Submerged Reefs and Beach Nourishment in Puducherry, India
13:45~14:00	S4.2	Muh Aris Marfai	Band Ratio Modification for Monitoring the Suspended Sediment Distribution Pattern in the Coastal Area
14:00~14:15	S4.3	吳念祖	海堤安全評估作業程序探討
14:15~14:30	S4.4	江文山	區域性海岸越波風險分析
14:30~14:45	S4.5	Dyah Rahmawati Hizbaron	Urban Coastal Disaster Risk Management in Indonesian Context
14:45~15:00	S4.6	林宗儀	氣候變遷下台南七股洲潟海岸防護策略之討論
15:00~15:15	S4.7	曾筱君	Social-environmental analysis of methane and coastal management in the South China Sea and bordering countries
15:15~15:45	茶歇 Tea Break (B)		
Session 5 – C.海上觀測技術發展及應用 主持人：許建平、張文舟			
15:45~16:00	S5.1	許建平	西北太平洋颱風海域實時海洋監測及其應用前景
16:00~16:15	S5.2	楊穎堅	海氣象即時傳輸浮標之發展與測試
16:15~16:30	S5.3	Jaya Kumar Seelam	Investigations of surfzone processes along a beach stretch on central west coast of India
16:30~16:45	S5.4	Balaji Ramakrishnan	Capturing nearshore dynamics-A five institution joint exercise along Indian coastline
16:45~17:00	S5.5	鄭皓元	Development and Application of Miniature Wave Buoy

17:00~17:15	S5.6	王玉懷	金門海域漂流垃圾調查
17:15~17:30	S5.7	陳先文	台灣海峽西北部表面流場之探究 (Investigation of the Surface Flow Field in the Northwestern Taiwan Strait)
17:30~17:45	S5.8	張文舟	利用 Bio-Argo 觀測南海深海區葉綠素變化及分析
17:45~18:00	討論與會議閉幕		
晚餐，地點：百世多麗 1 館 B1 貴菊廳			

三、海報報告摘要列表

A. 海洋數值模式及預報技術發展應用		
編號	作者	題目
A1	藍元志	風浪模式透水底床與透水潛式結構效應之應用研究 (Application research on wind wave model incorporating the effect of submerged porous structures)
A2	林孟郁	近岸質量傳輸之質點模擬方法
A3	潘任飛	Satellite-derived Ocean Thermal Structure for the North Atlantic Hurricane Season
A4	張人懿	A Study on the Flow over Traveling a Grop of Wavy Foils by Using the Many Body Force Decomposition
A5	林波	應對人類工程副生災害的海洋預報技術
B. 海洋雷達及遙測技術發展及應用		
B1	呂黎光	Coastline mapping and isle area estimation by region growing approach for Penghu archipelago
B2	丁文祥	2017 年 2-3 月東海漁區魚群異常出現之原因初探
B3	吳研綸	Using remote-sensing environmental and fishery data to map potential yellowfin tuna habitats in the Indian Ocean
B4	呂宜潔	環臺岸基海洋雷達表層海流觀測網發展現況與應用
B5	王建亞	高頻海洋雷達電離層干擾濾除演算法
B6	張彩雲	廈門灣及其周邊海域海岸帶動態變化遙測系統關鍵技術研究與應用
B7	葉文豪	A Numerical Retrieval Algorithm for Delay-Doppler Map (DDM) Made by Oceanic Reflected GNSS signal
C. 海上觀測技術發展及應用		
C1	陳文定	閃電監測系統在海洋環境監測與預警之應用
C2	謝燕雙	臺灣海峽颱風過程海洋環境變化分析
C3	吳杰忠	Response of Land-Sea Interface in Xiamen Bay to Extreme Weather Events Observed with the Ecological Dynamic Buoy Array, a Multifunctional Sensors System
D. 海洋環境生物地球化學		
D1	施詠嚴	Terrestrial nutrient supply in the seas of Taiwan after typhoons
D2	林子翔	印度洋黃鰭鮪各年級群釣獲率與海洋環境變動關係之研究

D3	陳思穎	海洋資料庫之化學海洋資料簡介
D4	黃怡婷	Diel abundance, growth and loss rates of Synechococcus spp. and picoeukaryotes in coastal waters during summer
D5	羅國政	淡水河口域刺網漁業資源結構之研究
D6	黃婷萱	Interannual carbon and nutrients fluxes in southeastern Taiwan Strait
D7	謝學函	北南海顆粒側向傳輸
D8	黃侯鈞	台灣海峽中部浮游動物群集組成與水文因子之時空分佈與關連研究
D9	林煜軒	高雄港浮游動物群聚多樣性及存活率研究
D10	蕭世輝	颱風侵襲對雲林麥寮海域水質與浮游生物之影響-以 103 年至 105 年為例
D11	賀傳欣	颱風對雲林麥寮海域沉積物與底棲生物之影響探討
D12	林倉玉	Primary production and squid catches affected by typhoon events in the southern East China Sea
D13	黃邦欽	基於漂浮式沉積物捕獲器和模擬沉降柱的邊緣海生物泵及其調控研究
E. 海岸帶災害與管理		
E1	范揚洺	建置海象災防服務平臺
E2	賀傳欣	颱風對濁水溪河口周邊海域懸浮質輸運之影響
E3	麻德強	海岸線管理的國際經驗
E4	黃子鑒	科學決策在溢油事故治理中的應用

四、口頭報告摘要

10/24 Tue. Morning - Session 1.1

S1. Keynote

Observing the sub-mesoscale in the coastal transition zone: development and current state of in-situ and remote sensing technologies

Pierre Flament

University of Hawaii at Manoa

Abstract

The coastal transition zone, straddling the ocean from the near-shore to the large scale circulation offshore, displays a rich spectrum of mesoscale and sub-mesoscale eddies, excited by hydrodynamic instability of density fronts and of shear layers detached from obstacles, as well as directly forced by Ekman pumping in the lee of mountainous islands and isthmus. Topographic coupling between the basin-scale barotropic tide and short wavelength radiating baroclinic tides brings an additional level of complexity to the structure of the flows. Observing these flow features is a challenge, due to their horizontal scales smaller than the Rossby radius of deformation, and their rapid evolution shorter than the inertial period, precluding the use of classical ship-based hydrographic surveys. A variety of in-situ and remote sensing techniques have been used to advance the dynamical understanding of these processes. Early measurements of strain and vorticity were provided by clusters of drifting buoys, revealing a strong asymmetry between anticyclonic vorticity, capped at -f by the centrifugal instability limit, and cyclonic vorticity, observed to exceed 10*f at some fronts. While satellite-tracked drifting buoys ideally sample the Lagrangian component of the flow, three radar-based techniques complementing each other have the capability to image small-scale processes. The interferometric swath radar altimeter (the SWOT mission) provides direct snapshots of sea surface height, down to a resolution of 10 km, but is of limited use where the height gradient is small, in particular at low latitudes and in anticyclonic cyclostrophic flows. Interferometric along-track synthetic aperture radars provide snapshot of surface velocity, but require either very large antennas, or tandem missions, to obtain a useful velocity resolution. The global coverage of both satellite-based techniques is offset by coarse revisit periods of 10-30 days, making them elusive to sample the temporal evolution of instabilities. Shore-based High Frequency Doppler radars (HFDR) remain the tool of choice to map the sub-mesoscale. Considerable technological evolution of the hardware of HFDRs has taken place over the past three decades. Earlier pulsed radars, range-resolving in the time domain and broadcasting high power radio signals, have given way to low-power frequency-modulated continuous wave radars, range-resolving in the frequency domain, safely deployable in non-restricted areas. Long linear beam-forming antennas, originally used to obtain

azimuthal resolution, have given way to compact goniometric antennas and to small-footprint clusters of receive antennas. Advances in electronic components such as direct digital synthesizers, demodulators, analog-to-digital converters, monolithic integrated circuit amplifiers, as well as their mass production driven by the telecommunication industry, have reduced the cost of the radar instruments, to a level similar to other oceanographic instrumentation. The reduced power demand of modern electronic circuits now allow off-grid operation of HFDRs on solar, wind and fuel cells, expanding deployment opportunities in remote areas. Most future improvements are anticipated to result from new signal processing algorithms, making possible advanced modes of operations such as multi-static arrays, pseudo-random code modulation, and simultaneous multi-frequency phased-locked signals. The future Luzon Strait Observing system, which will be based on multiple HFDRs deployed on the northern shore of Luzon (Philippines), on the southern shore of Taiwan, and on the Batanes islands in the middle of the strait, will capitalize on these advances, to provide a detailed coverage of one of the most complex areas of the ocean, combining a looping boundary current, with wind-stress curl driven eddies, island wakes, and internal tides and solitons.

Keywords: ocean eddies, coastal currents, internal tide, high frequency radar, Luzon strait

S1.1

On the Doppler offsets of the 1st Order HF Radar Sea Echoes

Wu Xiongbin[1,2], Huang Qihua[1,2], Yue Xianchang[1,2], Zhang Lan[1,2]

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Abstract

The 1st order sea backscattered spectra point bear Doppler offset from $\pm f_B$ (Bragg frequency which = $0.102\sqrt{f_0}$, where f_0 is the radar carrier frequency in MHz) due to radial currents on the ocean surface. We found that the Doppler offset from $+f_B$ due to the approaching ocean wave is different in value from the Doppler offset from $-f_B$ due to the receding ocean wave spectra point and. More interestingly, we found the real Bragg frequency of the sea surface (f_{Br}) f_{Br} NOT equal to f_B in almost all the cases observed by our HF radar. This biased result is assumed to be caused by the local mean slope of ocean surface, which is supposed to be result of tidal waves, or may be caused by local strong wind. This result has been found to have observation-directivity dependence and to respond quickly to wind process. More observations and intensive studies are needed to research into the characteristics and cause of this phenomenon. This study may contribute to new theories and algorithms of wind parameter inversion based on 1st order sea echoes, and may also provide a means to reduce measurement deviation of HF radar ocean currents.

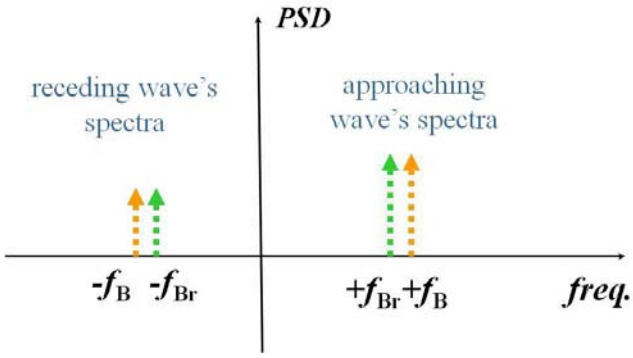
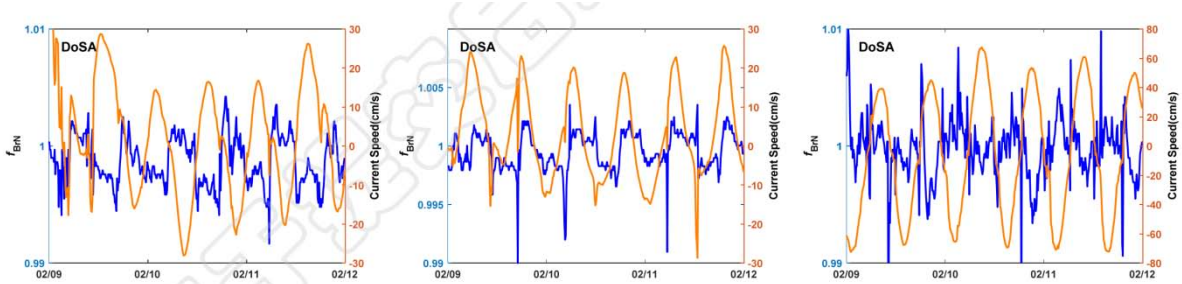


Fig. 1 Bragg wave's real resonant frequency f_{Br} is NOT equal to f_B =



(a) (b) (c)

Fig. 2 Typical f_{BrN} (which is defined as f_{Br}/f_B) variation compared with radial currents

(Data of Dongshan HFSWR site, 2013, a/b/c refers to different locations within the radar coverage)

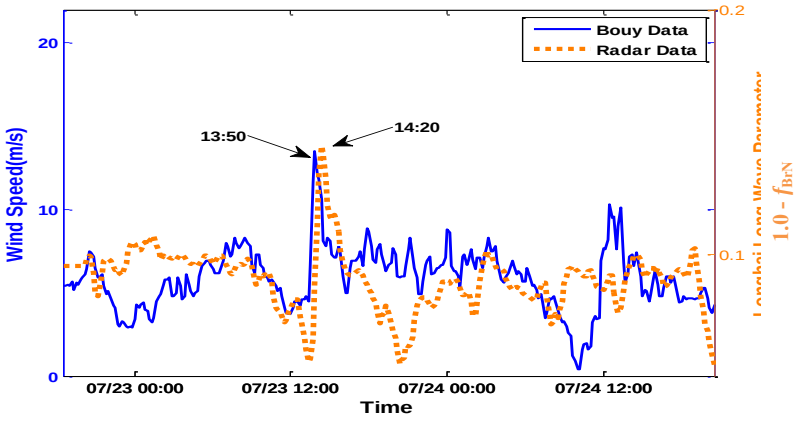


Fig. 3 Response of 1.0 - f_{BrN} to wind speed

(Data of Longhai HFSWR site, 2013, the buoy is about 80km away from the radar site)

Keywords: HF surface wave radar, 1st order sea echo, Doppler offset

S1.2

Analysis of Wave Parameters and Directionality from simulated HF Radar Sea echo during Typhoon Dujuan

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Abstract

The typhoon strength is dominated by the air-sea heat, moisture and momentum fluxes, which depend on the roughness characteristics of sea surface. The sea surface roughness scale under the high wind speed during the typhoon period are very important, but yet little is known at present. The wave field ,which is usually described using the wave directional spectrum, is the most important factor influencing the surface roughness. On the other hand, repeated impact from typhoon wave is the primary loading responsible for the fatigue failure of the offshore structures and marine vehicles. The directional spectrum is the essential information needed for their design, installation, operation and maintenance and should be clearly characterized and monitored for safety consideration. Still, technologies for directional spectrum monitoring under extreme typhoon conditions are rare. Innovations are needed for comparatively low-cost and robust capability, and the HF coastal radar could be the promising alternative.

A project of using HF-radar to monitor the upper ocean dynamics during typhoon is on-going in Taiwan, the island that most frequent attacked by severe typhoons worldwide. National Central University, Taiwan, the Taiwan Ocean Research Institute (TORI) and the University of Hawaii signed a cooperation agreement in 2017, in which University of Hawaii will provide three sets of self-developed antenna array High Frequency systems to Taiwan. A set of 16 antennas array that suitable for wave observation will be installed at the NCU Coastal Observatory at the northwestern coast of Taiwan for long-term monitoring of the Taiwan Strait. The system is scheduled to complete the installation in early 2018.

A test-bed for numerical experiment is setup to provided as a platform for the evaluation and assessment of the directional spectrum estimating algorithms and methods. This test-bed simulates the Doppler-Range spectrum using the given sea state using Barrick's theory. In this study, we perform two cases simulations, e.g. steady wind and typhoon Dujuan (2015)

to assess and compare the performance of 4 exsiting methods of the retrieval of significal wave height, period, wave directional and directional spreading.

For the Typhoon Dujuan (2015) case, the directional spectra in the maxium wind speed radius of the tphoon were simulated using a third generation spectral wave model that driven by ultra high resolution (1 km) wind field from ensemble analysis. High resolution un-structure grid along the trajectory of typhoon Dujuan was setup for the wave simulation so enable the capability of simulating the extremely heteogenious wave fields near the typhoon eye. The patterns of the directional spectrum in 4 quadrates of the typhoon were discussed. Two and three vitual HF radar sites with difference configurations and locations were designed amd numerically put around the typhoon eye. The results from the estimators demonstrated the advantages and the limits of using HF radar for typhoon wave monitoring.

Key word: High Frequency surface wave radar, Directional wave spectrum, Typhoon waves

S1.3

Wave spreading factor derived from observations of HF surface wave radars in a network

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Abstract

The spreading factor, s, is a key parameter describing the concentration of the directional distribution of sea wave energy. s obtained from the buoy's observation can be well approximated by functions in term of sea surface wind. We have developed a scheme employing the MUSIC-APES algorithm to extract s from simultaneous and co-sea-surface observations of two broad-beam HF surface wave radar (HFSWR) at different sites. By using this scheme, the surface and temporal distribution of s is estimated from a three-month data set observed by two OSMAR071 HFSWR in a network at the Taiwan Straits. The spreading factor can be obtained as far as the sea currents observed by the radar. The dependence of the derived s on fetches in each wind direction is then analyzed. This study attributes to the inversion of sea surface wind speed from HFSWR observations.

Keywords: HF surface wave radar, spreading factor, wind direction inversion, sea surface remote sensing

S1.4

海面非微幅波的高频地波雷达观测

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摘要

目前通行的高频地波雷达海流测量原理均建立在微幅波理论（也被称为 Ariy 波理论）基础上，利用深水条件下雷达波海面 Bragg 散射所对应微幅波速仅为与其波数相关常量的特征，基于雷达波海面 Bragg 散射 Doppler 正频移信号计算海表流场。2011 年，武汉大学吴雄斌研究组提出了利用雷达波海面 Bragg 散射 Doppler 正负频移信号联解微幅波波速和海表流场径向流速的算法。武汉大学李伦等（2012）对 2008 年 6 月台湾海峡南部观测序列进行的再处理，用其小于 10cm/s 的实测波速日均值偏移，验证了雷达波海面 Bragg 散射和微幅波两个假设的统计合理性，但其实测波速统计直方图也以高达 27cm/s 的 2 倍均方差，揭示了非微幅波影响的存在。厦门大学钟耀照等（2014）针对性设计了包括基于频移的一级质量控制、基于波速的二级质量控制的正负频移信号联解法高频地波雷达数据质量控制流程，实现 2011 年 7-8 月江苏北部潮间浅滩观测序列正负频移信号联解和自动数据质量检验，其获取的实测月平均波速平面分布图像能够正确地反映辐射状沙脊与潮流通道地貌形态，显示了雷达波海面 Bragg 散射和微幅波两个假设的统计合理性。但该文通过设于潮流通道的水文连续观测站数据，加上雷达波海面 Bragg 散射 Doppler 正负频移信号，检验了潮流通道波速各向同性假设，发现不符合该假设的异常点主要表现为海流前进方向波速正异常（而按各向同性假设导出的视在波速呈负异常），同样揭示了涨潮“潮头”溃坝波一类非微幅波的影响。统计涨潮阶段的平均波速平面分布图像，可发现溃坝波类波速异常所导致的视在波速负异常带沿水深较大的潮流通道分布，而沿极浅的潮流沙脊形成的视在波速正异常带，可能是波速高于微幅波且各向同性的浅水高阶 Stokes 波影响带。上述运用雷达波海面 Bragg 散射 Doppler 正负频移信号联解视在波速和流速识别非微幅波时空影响的经验，似可推广到其他非微幅波强影响海态的探测领域，借以研究具有溃坝波特征的海啸波，以及比高阶 Stokes 波还具更强波高-波速正相关关系的畸形波（疯狗浪）等探测可能，拓展台湾海峡两岸海洋高频地波雷达探测系统的服务能力。

關鍵字: 高频地波雷达、波速观测、浅水波、畸形波、海啸波

S1.5

An overview of Indian Coastal HF Radar Network

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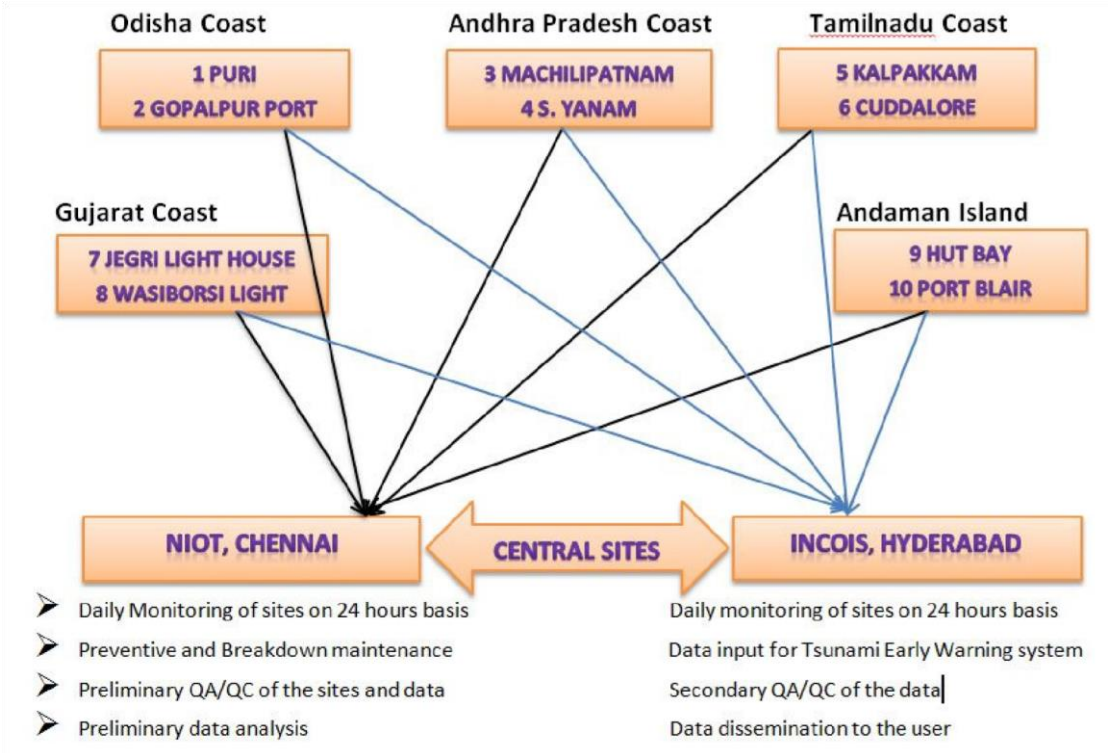
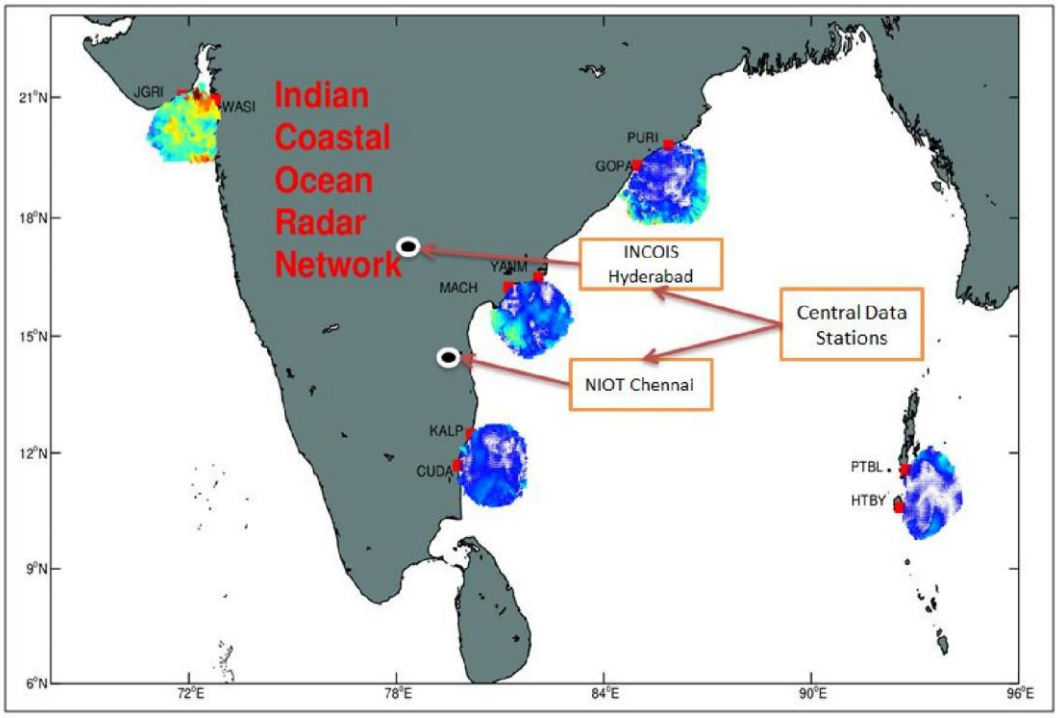
Abstract

The Costal HF Radar is a shore based remote sensing system. It uses beyond the horizon radar technology to measure ocean surface parameters such as speed and direction of currents, waves and wind direction. It is long range and high resolution monitoring system operates with radio frequencies between 5 and 50 MHz. A vertical polarised electromagnetic wave is coupled to the conductive ocean surface and will follow the curvature of the earth. The rough ocean surface interacts with the radio wave and due to the Bragg Effect back-scattered signals can be detected from ranges of more than 200 km.

Under the Tsunami Early Warning System (TEWS) project, NIOT is mandated with establishing and maintaining a network of coastal HF radar along Indian Coast. The network of ten remote stations and two Central Stations are operational. The installations of these systems were carried out in phased manner between March 2008 and May 2010.



The locations of these stations are Cuddalore and Kalpakkam in Tamilnadu Coast, Machilipatnam and S.Yanam in Andra Pradesh Coast, Gopalpur and Puri in Odisha Coast, Jegri and Wasi-borsi light house in Gujarat Coast, and Port Blair and Hut-Bay in Andaman & Nicobar Island. Along with these, NIOT Chennai and INCOIS Hyderabad are avail with Central Station facility. The real time data has been transferred to both the central station through V-SAT communication facility. Though the technology is sound there are some limitations within the system. The ranges of the data get hampered during calm sea condition and interference from ionosphere and other noises.



Currently, a small percentage of Indian coast was covered with HF Radar system. This surface current data set has been used for the validation of numerical model, seasonal variation, nearshore current changes and oil spill model in limited places. However, the present coverage is not sufficient for said objective and hence it is proposed to increase the spatial coverage of Indian coast with increased HF radar installation.

Keywords: HF Radar, HFR, coastal current, surface currents, mapping of surface currents

S1.6

南灣作業化高頻雷達觀測網所看到的冷水垂向混合現象

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摘要

南灣，向來以台灣島最南端的美麗熱帶海灘聞名，海灣周遭海域以裙狀礁珊瑚為主，又是高溫鹽的黑潮洋流北上的首衝位置，海洋生物多樣性高，是個不論在學術研究課題或是觀光資源上都極具價值的海域。根據珊瑚礁學會孟培傑博士(2010)的調查彙整指出，南灣海域由於土地開發、社會發展以及全球氣候變遷等因素，使得南灣珊瑚礁承受各種自然與人為的干擾。包括颱風、湧升冷水入侵、二氧化碳濃度變動、過度捕捉藻食性魚類、水質優養化、沉積物、白化事件、疾病大發生、人類遊憩活動等，已使得許多珊瑚礁生態面臨滅亡和衰敗的威脅。影響此海域海流變動的因素有很多，如黑潮及其支流、風驅流、湧升流或颱風引起冷水團上升，湧升作用能將底層高營養鹽之水團帶至表層，由潮流或風驅流等動力傳輸過程進到南灣灣內，成就南灣海域生物多樣性之環境生態。然而從水動力到生物化學相關的機制，仍待參考在其它海域之研究成果，進行跨領域、有系統的研究。

本研究嘗試運用國研院海洋中心 Taiwan Ocean Radar Observing System (TOROS) 觀測平台自 2014 年 7 月間於南灣周遭海域所建置的三套 13/24MHz 集成式高頻海洋雷達系統所觀測之高解析逐時表層海流觀測數據，以自動化渦旋偵測方法建立追蹤渦旋變動之資料庫；並利用海洋中心近年於南灣珊瑚產卵前後約一個月間之底碇 ADCP 流速儀與溫鹽串所觀測到之流速及垂直剖面之溫度變化數據，從逐時表層海流及其渦旋生成消散的過程與溫鹽串數據進行比對，嘗試探討南灣冷水入侵及其在垂向混合之過程與機制。

國研院海洋中心為科技部設置之法人研究機構，以建構前瞻科研平台、支援學術研究為主要任務，平台維運團隊期望透過提供高品質的高頻雷達遙測海流數據及開發衍生之渦旋資料庫，使得海洋物理及海洋生物領域之學者得以實現跨領域、有系統的研究工作成果，為南灣海域環境的永續利用提供具價值的科學的論述。

關鍵字: 高頻雷達、作業化觀測網、表層海流、渦旋偵測、冷水入侵

S1.7

Sea Surface Observations in the Taiwan Strait Using the Chung-Li VHF Array Radar

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Abstract

Multireceiver technique implemented in the Chung-Li VHF radar was employed for the first time to observe the sea surface waves in the Taiwan Strait. The radar was located at Xinwu county seashore (121º01′E and 24º01′N), at nothern Taiwan, and used a four-element Yagi antenna to transmit the radar waves at the carrier frequency of 52 MHz. A linear array consisting of four vertical dipole antennas with four independent and identical receivers was used for collecting radar returns. In addition to echo power and Doppler velocity, the direction of arrival of radar echoes determined by using the Capon method, an optimization beamforming approach, were also computed. Observational results show that the semidiurnal oscillations were dominant in the temporal variations of the VHF radar echo intensities, that matched well the time series of the local tide-gauge measurements and sea level simulations. By contrast, the semidiurnal tidal variations were absent in the echo intensities of the CODAR HF radar. The echo centers were found to gradually shift its location to the radar beam axis with decreasing distance in the range interval between 15 and 25 km. Moreover, the echo center locations also showed semidiurnal oscillations, especially in the range interval between 15 and 25 km. Plausible physical processes responsible for the change in the echo center locations with the range, and the correlation between echo intensities and echo center locations, are propposed and discussed.

Keywords: VHF radar; beamforming; Capon method; direction of arrival; echo center; semidiurnal tides

S1.8

X 波段雷達圖像浪流反演的波束形成技術

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摘要

本文利用波束形成技术提出一套从 x 波段雷达海洋回波图像序列估计海洋浪和流参数的新算法。当雷达海洋回波图像像素值的时间变化视为经典阵列波束形成领域阵列天线所接收到的信号时，波束形成技术就可以从图像时间序列获取海浪方向谱。海流的提取基于正确的海流速度保证阵列波束形成中阵列的总接收能量为最大值。利用波速形成技术提取浪流参数可以避免经典算法中的图像插值及坐标变换；波束形成技术固有的滤波功能可以有效消除移动船只和阴影调制对经典算法的影响。仿真和实测海洋回波信号的处理都验证波束形成算法是可行的。算法的工程化实现需要后期更细致的研究。

關鍵字: X 波段海洋雷达、波束形成、海流速度、有向浪高谱

S1.9

航海雷達監測近岸地形水深技術之研擬

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[1] 成功大學近海水文中心

[2] 經濟部水利署

摘要

海堤前與河口之水域為海陸空三種截然不同環境系統交互作用之區域，也是溢淹預警與防治的關鍵。不論是堤前或是河口水域，其本身複雜的環境條件再加上人工結構物或是河川水流的影響，加重了禦潮防災工作的困難度。為能在這些防災重點區域落實相關保護工作，常須借助數值模式進行水理演算以及溢淹之預測。然而不論是河口地區的河川洪水演算或是海堤波浪溯升越波的推估，大多需要仰賴近岸水深地形資料作為模式演算輸入的邊界條件。透過水中聲學技術進行現場水深量測作業雖可取得極為精準的近岸水深地形資訊，但海上現場作業必須面對複雜多變的海洋環境，增添海上作業的風險以及人物力成本。非接觸式觀測科技具有廣景覽要的優點，且可透過岸邊設站的方式進行隔空探測，減緩直接出海作業的風險。本研究提出了一項以改裝航海雷達為硬體設備的海堤前與河口地形水深非接觸式觀測科技，能夠快速有效掌握近岸的地形水深特徵，可藉此更有效落實海堤後方與河口附近低窪地區的溢淹預警及防治工作。

本研究提出發展非接觸式地形水深遙測自主關鍵技術之架構，包括雷達訊號擷取、影像分析與水深解算之軟硬體技術皆為自行研發。利用航海雷達所測得之海面回波影像為依據，導入線性波分散關係理論與希爾伯特轉換演算技術，可從雷達影像的波紋特徵反演出觀測區域的水深資訊。透過此一技術，在岸邊即可取得方圓數公里內的近岸水深地形資訊，可有效降低水深地形觀測作業的風險，且所需時間不到半小時，證實發展此一非接觸式觀測技術可大幅提升水深量測之效率。

關鍵字: 航海雷達、近岸地形水深

S1.10

Internal Solitary Wave Reflection in the South China Sea

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Abstract

Internal solitary wave (ISW) reflection is rarely observed in satellite images, even in the South China Sea (SCS), where the strongest and most energetic ISWs in the world have been observed. Compared to the large number of satellite images showing shoaling ISW in the SCS, fewer than ten satellite images have been reported showing ISW reflection. In this study, we collect recent satellite images and implement a numerical model to analyze ISW reflection near Dongsha Atoll, in the SCS. Satellite observations show that the reflection appears to be associated with the large-amplitude ISWs generated by strong tidal currents in Luzon Strait. Numerical simulations show that ISWs break when reaching the sloping bottom. Part of ISW energy is reflected by mode-1 waves and their trailing mode-2 waves. The mode-1 waves have two types: long inertial-gravity waves and breaking ISW-induced short waves. They propagate quickly but induce weak vertical velocity and surface imprints. Mode-2 waves induce strong vertical velocity, showing visible signature in satellites. Horizontal distribution of the energy indicates that a maximum energy of about 2% of the incident energy is contained in a single reflected wave. This could explain why the reflected waves are rarely observed, because reflected waves must be sufficiently large to be detected in satellite images. Although individual wave's energy is small, in total up to 20% of the incident wave is reflected by the groups of mode-1 and mode-2 waves. This suggests that ISW reflection has a significant impact on energy distribution over the continental slopes.

Keywords: Internal solitary wave, reflection, near Dongsha Atoll, South China Sea

口頭報告摘要

10/24 Tue. Afternoon - Session 2

S2. Keynote

Carbon and nutrients in Submarine Groundwater Discharge around Taiwan

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Abstract

Submarine groundwater discharge (SGD) is the submarine seepage of all fluids from coastal sediments into the overlying coastal areas. It has been well documented that SGD may contribute many allochthonous nutrients to the coastlines. It is, however, less known how much carbon enters the ocean via SGD. Nutrients (NO_3, NO_2, NH_4, PO_4, SiO_2), alkalinity and dissolved inorganic carbon (DIC) in the SGD were measured at 20 sites around Taiwan. The total N/P/Si yields from the SDG are respectively $3.28\pm2.3\times10^4$, $2.6\pm1.8\times10^2$ and $1.89\pm1.33\times10^4$ mol/km^2/yr, compared with $9.5\pm6.7\times10^5$ mol/km^2/yr for alkalinity and $8.8\pm6.2\times10^5$ mol/km^2/yr for DIC. Primary production supported by these nutrient outflows is insufficient to compensate the DIC supplied by the SGD. As a result, the SGD helps making the coastal waters in Taiwan heterotrophic.

Keywords: submarine groundwater discharge, carbon, nutrients, Taiwan, yield, flux, hetero-trophy.

S2.1

Modelling of Essential Fish Habitat for Mugil cephalus Based on IPCC Climate Scenarios in the Taiwan Strait

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Abstract

Grey mullet (Mugil cephalus L.) is one of the most important commercial species of fish in the coastal fisheries of Taiwan. It was recorded that the spawning and nursery grounds are distributed in the coastal waters of the southeastern Taiwan Strait (TS). For previous studies, the feeding grounds are located in the coastal and estuarine waters of China which at 25-30°N and migrates to the coastal waters of the southeastern TS for spawning in the cold North China Coastal Current in winter. We investigate impacts of climate change in fishing conditions and environmental variability of mullet fishing grounds in the coastal waters of China. Oceanography data of four scenarios (RCP2.6, RCP4.5, RCP6.0 and RCP8.5) from the fifth assessment report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) will be used to develop fishery resources and habitat coupled ecological models. The species distribution model (SDM) for grey mullet was developed using the maximum entropy (MaxEnt) model and were identified the potential habitat in the coastal waters of China. For the results, the high CPUE for mullet fishery was located in the coastal waters of western Taiwan. The high suitable areas and following with low corresponding SD were concentrated in the coastal waters of China at 25-25.4°N and the coastal waters of Taiwan at 22.8-24.1°N. Through the MaxEnt habitat model, we provide the scientific assessment to set the effective management strategy and may provide the references for the further study on fingerling released for our government or fishery management organization

Keywords: climate change, IPCC AR5, species distribution model, Mugil cephalus

S2.2

Enhanced particulate organic carbon export triggered by internal waves in the oligotrophic northern South China Sea

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Abstract

Internal waves are important in maintaining physical structure of ocean, and in the cycling of biogenic elements. Large internal waves with amplitude exceed 150 m are frequently observed in the northern South China Sea (SCS) where biogeochemical processes are greatly influenced by external physical forcing. However, there is no published report on how internal waves affect particulate organic carbon (POC) export in the northern SCS, especially in the deep basin area. Therefore, we deployed drifting sediment traps in the propagation route of internal waves in the northern SCS for the first time. Rapid increasing temperature and elevation of mooring sensor depth at ~160 m suggested the influence of internal waves during trap deployment. The trap-measured POC flux influenced by internal waves was 110.9±10.7 mg C m^{-2} d^{-1} in the deep basin, which was two times higher than non-typhoon period. Such large POC export was probably contributed by downward transport of upper layer POC triggered by internal waves, verified by significantly increasing Chlorophyll *a* (Chl *a*) and increasing temperature below euphotic zone after internal waves. Shifting of subsurface POC maximum from within euphotic zone to depth was also directly observed in a shelf station. Such rapid transport of POC make the carbon stock below euphotic zone relatively fresh, and likely degraded rapidly with depth. Besides, subsurface Chl *a* maximum increased by ~0.12 μg L^{-1}, suggested in-situ production of Chl *a* after internal wave. The biological production was possibly supported by diffusion of subsurface nutrient induced by internal waves.

Keywords: Northern South China Sea, Internal waves, Particulate organic carbon

S2.3

The dynamic of a dominant dinoflagellate *Noctiluca scintillans* off the subtropical coastal waters of Matsu archipelago: in a high-gradient environment

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Abstract

The sea sparkle, formed by the dinoflagellate *Noctiluca scintillans* bloom, is a famous scenic spot in Matsu archipelago. Due to the mechanism of the bloom formation in Matsu archipelago is still unknown, the relationship between the abundance of *N. scintillans* and environmental factors was examined in the subtropical coastal waters from April to December 2016. Hydrographic (temperature, salinity, rain, dissolved oxygen), biological (chlorophyll a and diatom abundance) and chemical (NO_2+NO_3, PO_4 and SiO_4) factors were investigated. *N. scintillans* disappeared when sea water temperature was high (> 27 oC, after June 20th, non-flood season), indicating that temperature is a factor for the existence of *N. scintillans*. Diatoms were observed in food vacuoles of *N. scintillans*. PCA analysis showed highly inversely correlated between *N. scintillans* and diatom, another import regulating factor, implying that diatom suffered high grazing pressure from *N. scintillans*. The abundance of *N. scintillans* appeared during the flood season (from April to June), where relationship of salinity and SiO_4 was negatively correlated, indicating that Minjiang River brought a lot of SiO_4 into the area of Matsu archipelago, making the abundance of diatom higher in the flood season than non-flood season. *N. scintillans* may survive by the sexual reproduction under the unfavorable environment when their abundance was rare.

Keywords: blue tears, Minjiang River, *Noctiluca scintillans*, silicate limitation, temporal variation

S2.4

Bioaccumulation and trophic transfer of persistent organic pollutants in marine plankton

持久性有機污染物在海洋浮游生物之累積及食階傳遞

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Abstract

The sorption and partitioning of persistent organic pollutants (POPs) between the particulate and dissolved phases control their environmental fate and transport in the aquatic systems. As a primary producer and consumer in the marine ecosystem, phytoplankton and zooplankton represent the early stage in the bioaccumulation of many environmental chemicals in the marine food chain, especially the persistent organic chemicals. Highly variable physical, chemical and biological processes complicate the analysis of chemicals and the related distributions and transports in the marine and coastal waters. In this three-year study, a novel gas-purging system is designed to maintain constant dissolved concentrations of POPs with various hydrophobicities to accurately study their uptake behaviors of POPs to the exposed plankton including phytoplankton and zooplankton. The uptake and bioconcentration kinetics of these chemicals by different species plankton are found in this study. The correlations between the bioconcentration factor (BCF) of the POPs to the plankton and the chemical hydrophobicities (represented by K_{ow}) are also compared and discussed in this study. While the uptake of POPs to the phytoplankton reaches equilibrium, the zooplankton is applied into the reactor to measure the trophic transfer of POPs (bioaccumulation factor; BAF) between the plankton. All the parameters of sorption, uptake and transfer of these compounds from phytoplankton to zooplankton by grazing are utilized to model the organic chemical transport in the marine ecosystem.

Keywords: sorption, bioaccumulation, POPs, BCFs, food web

S2.5

The contamination status of trace metals in sediment of the East China Sea

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Abstract

The present study reviewed the published papers (1998-2017) investigated the trace metal (Al, Cd, Cu, Fe, Pb, Mn, Ni, Zn and Hg) concentrations in the East China Sea (ECS) to assess the contamination status of the ECS. The published data showed that the trace metal concentrations in surface sediments of the ECS were as follows: Al, < LD-10 %; Cd, 0.019-0.127 μg/g; Cu, 1.9-41.5 μg/g; Fe, 0.17-4.92 %; Pb, 6.2-44.8 μg/g; Mn, 152-1783 μg/g; Ni, 8.17-108 μg/g; Zn, 18-134 μg/g and Hg, <0.5-62.3 ng/g. The spatial distribution of trace metals generally exhibited higher concentration in the inner shelf, especially in the estuarine mouth of the Changjiang Estuary, and the concentrations decreased with seaward. However, the concentration variations between the middle and the outer shelves were not significant. With the exception of Ni, the published data of trace metal concentrations in sediment of the ECS were generally lower than the values of the A level of the China EPA and the adverse biological effect range-low (ERL) of the NOAA, USA. In contrast, there were 122 Ni data among 135 data exceeded the ERL value (20.9 μg/g) and 22 data exceeded the ERM value (51.6 μg/g). This result suggests that the ECS was contaminated by Ni element, and the contamination by the other elements was not significant.

Key words: East China Sea, sediments, trace metals, NOAA

S2.6

The storage effect on pH analysis for seawater samples

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Abstract

To evaluate the effect of sample storage on pH analysis, a comparison experiment between field and laboratory pH measurements was conducted on a total of 88 seawater samples collected on the East China Sea shelf during 16-29 July 2014. The results show that although pH directly measured onboard was statistically higher than the pH later measured onshore with an average residual of 0.0052±0.0057, after correcting for the perturbation caused by the addition of the HgCl2 solution, the observed difference was within the uncertainty in pH measurement. Therefore, our result suggests that, similar to total alkalinity and dissolved inorganic carbon determinations, seawater samples can be stored for pH analysis with a precision that is comparable to the uncertainty of onboard measurement for a period of at least 20 days.

Keywords: pH, CO_2, storage

S2.7

Automated spectrophotometric determination of carbonate ion concentration in seawater using a portable syringe pump based analyzer

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Abstract

Seawater carbonate ion concentration observations are critical for assessing the ecological effects of ocean acidification. However, currently available methods are labor intensive or too complex for field applications. Here, we report the design and performance of the first fully automated portable carbonate ion analyzer. Measurements are based on reaction of carbonate ions with Pb(II) and UV spectrophotometric detection. The core hardware is a syringe pump equipped with a multi-position valve that is controlled by software written in LabVIEW. Measurement precision is ±1.13 μmol/kg with a measurement frequency of 12 h^{-1}. The analyzer was applied to continuously monitor carbonate ion variations in a 2500 L coral reef tank for five days (test 1), and used for shipboard underway and vertical profile analysis during a 13-day cruise (test 2). The total numbers of samples in these two tests were 1659 and 3101. The overall analyzer offset relative to conventional measurements during the two tests were -2.4±15.7 μmol/kg (n=14) and 2.3±6.8 μmol/kg (n=75). The analyzer, which uses of a syringe pump for mixing seawater and reagent solution, is robust, functionally flexible, and quite suitable for autonomous environmental monitoring under harsh conditions.

Keywords: Seawater; carbonate ion; automated flow analysis; spectrophotometric detection; coral reef; underway analysis

S2.8

An Automatic flow-through monitoring system for planktonic ecological process study and its application

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Abstract

With the deepening of the study of marine ecological processes, the methods of research are changing accordingly. The methods of observation largely determine the extent of our understanding of the oceans. The frequency and duration of the observations largely determine the truth we can understand. Our goal is to construct a set of automatic, long time and high frequency measurement system for the ecological parameters of marine environment to enhance the research and understanding of the complex marine ecological processes.

Based on a LabVIEW platform, a continuous automatic flow-through monitoring system of ecological environment parameter data were designed and constructed, recording the ecological environment parameters included algae composition, chlorophyll, algae, phycocyanin, phycoerythrin, dissolved oxygen, pH, turbidity, conductivity, temperature and CDOM. The system can directly view real-time data and be operated remotely, with automatic sampling. The system can run continuously and automatically for a long time, eliminating the trouble of manual maintenance and sampling. Data collection frequency can be set according to actual requirement, with the highest 1Hz acquisition frequency. During half year's application in a riverine location close to Jiulong River Estuary, couples of algal bloom events, storms and flooding events were recorded detailedly to reveal the process and succession of phytoplankton community corresponding to weather events and seasonal changes. Some informative parameters like organic carbon(POC、DOC) were derived from directly obtained data to help further understanding the biogeochemical process in riverine ecological events.

Keywords: Automatic flow-through mointoring system; ecological process; labview; phytoplankton; algal bloom

口頭報告摘要

10/25 Wed. Morning - Session 3 、Session1.2

S3. Keynote

Intensified interannual variation of the southern South China Sea circulation during winter monsoon

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Abstract

Surface geostrophic current derived from altimetry remote sensing data, and current profiles observed from in-situ ADCP mooring in the northern South China Sea (NSCS) and southern South China Sea (SSCS) are utilized to study the kinetic and energetic interannual variability of the circulation in the South China Sea (SCS) during winter monsoon. Results reveal a more significant interannual variation of the circulation and water properties in the SSCS than in the NSCS. Composite ananlysis shows a greatly reduced WBC and a closed cyclonic eddy in the SSCS during the mature phase of El Nino event, but a strong WBC and an unclosed cyclonic circulation in normal or La Nina years. The SST is warmer while the subsurface water is colder and fresher in the mature phase of El Nino event in the SSCS. Numerical experiments and energy analysis suggest that the WBC advection enhances the response of the SSCS circulation to the atmospheric forcing by transferring the variation in the NSCS to the SSCS. While the larger/smaller Luzon Strait transport caused by the increase/decrease northeasterly winter monsoon counteracts with the energetic and temperature change induced by the variation of the atmospheric forcing in the NSCS, which makes the interannual variation in the NSCS less obvious than that in the SSCS during winter monsoon.

Keywords: Interannual variability, South China Sea, winter monsoon, western boundary current, ENSO

S3.1

台灣海峽高解析模式應用於海難搜救評估

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摘要

本研究利用海洋中心資料同化 POM (Princeton Ocean Model)海流模式，透過巢狀格網計算方式，藉以提高台灣海峽海流模擬的解析度，根據台灣海域模式提供洋流與潮流合成邊界條件驅動模式運作，同時考慮台灣西部主要河川之入流輸入，透過實測資料的比對驗證模式之合理性，並將模式與海洋中心岸基雷達觀測資料導入美國 ASA (Applied Science Associates)公司所研發之海上搜救軟體 SARMAP (Search & Rescue Model and Response System)，利用西南海域布放之漂流浮標進行軌跡比對，以瞭解不同海洋資料於模擬之特性，並討論 SARMAP 軟體中模擬質點數量和目標物風壓差之參數設定，其測試與驗證為了提升模擬海上搜救模擬精準度，建立台灣在地化高解析海洋環境數據及其搜救應用。

關鍵字: 海洋模式、漂流浮標、海難搜救

S3.2

Physical-biological model and its scientific research in the Taiwan Strait

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Abstract

The Taiwan Strait Nowcast/Forecast System (TFOR), which is based on the Regional Ocean Modeling System (ROMS), is the first operational ocean model to include physical and biological processes in the Taiwan Strait (TWS). In this study, we assessed the performance of TFOR, thereby illustrating the ability of TFOR to reproduce significant physical and biological processes. Besides, a two-way nesting approach is utilized in the model to simulate the hydrodynamic processes in estuaries along the western coast of the TWS. For example, the environmental impact of the warm water discharge from the nuclear power station is assessed, and the sea surface floating garbage from the Jiulong River to the TWS is predicted for maritime office. With the use of this model, some scientific problems have been studied. These issues include the upwelling dynamics, the cold disaster in 2008, the winter Bloom in the TWS and the Luzon Bloom, etc.

S3.3

基於全球潮汐潮流數值預報系統的南海及麻六甲海域潮汐潮流研究

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摘要

基於國家海洋環境預報中心全球業務化海洋學預報系統中的全球潮汐潮流數值預報子系統、大洋和近海驗潮站實測水位及衛星高度計資料開展針對南海及马六甲海域的潮汐特徵分析。通過調和分析及潮汐潮流要素資料統計、形態比對等方式進行數值預報結果驗證。結果显示，該預報系統能夠較為準確類比南海及马六甲海域複合潮波特徵；數值結果通過刻畫南海北部珠江口附近不正規半日潮、南海其他海域的不正規全日潮和马六甲海峽內部的正規半日潮為主、馬來半島東側北部不規則全日潮及南部不規則半日潮的複雜潮汐類型，較好地揭示了該海區的潮汐分佈情況；同時潮流結果表明，其運動性質改變主要受水深變化及潮汐性質影響。

關鍵字: 潮汐、潮流、南海、马六甲海峽、數值預報

S3.4

簡介氣象局波浪預報作業系統的改進

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摘要

海洋及其相關產業佔全球經濟產值中重要的一塊，但是不論是海運、沿海旅遊、海洋漁業以及海洋工程等，都受到海洋波浪的影響，如何加強海洋波浪的即時監測與提高臺灣海域的波浪預報的準確度，進而保障海域活動的安全，一直是臺灣中央氣象局重要的業務發展之一。自 2001 年引進美國氣象局(NOAA/NWS)波浪模式 NWW3(NOAA WINDWACH III)後，臺灣中央氣象局一直以其為作業的波浪模式，進行波浪預報作業。為了得到臺灣鄰近海域更準確的波浪預報，除在作業系統建置之初，詳細比較模式內各種參數化的差異，也不時進行模式模擬，以期持續提升波浪預報準確能力。

透過套疊太平洋範圍波浪模式的波浪模擬推測，受到東亞島弧遮蔽的效果，中、東太平洋西傳波浪不易影響邊緣海內波浪的大小，易形成封閉環境，邊緣海內的波浪主要受邊緣海內海氣條件影響。又，愈能掌握沿岸地區詳細的地形變化，愈能掌握近岸海域的波浪變化，模式解析度的增加，可以提高近岸海域波浪預報準確度。持續引進最新的 NWW3 波浪模式以及持續增加沿岸地形解析度，是未來的工作重點之一。

2014 年臺灣中央氣象局，建置波浪系集預報系統，充分涵蓋海洋初始狀況及預報風場造成的預報不確定性，並提供台灣四周海域之波浪機率數值預報產品，在開放海域有區別事件發生及未發生的預報能力。因為波浪的弱非線性特性，系集各成員間的離散度不大，使用不同作業中心的風場預報，是有效增加系集成員間的離散程度的一種方法，不過系集成員間的離散度不足，仍是目前系集預報系統的一個重要研究課題。

關鍵字: NWW3、波浪預報、波浪系集預報

S3.5

风暴潮-近岸浪耦合漫堤数值预报系统在福建沿岸业务化应用

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摘要

风暴潮漫堤是海潮与海浪、强风等物理要素在沿岸作用于障碍物（堤坝）后海水剧烈上涌翻越障碍物的物理过程，其显著的特点就是物理过程非线性强，瞬间作用力大，破坏性强，随着沿海防汛要求的不断发展变化，提供更有科学、更具针对性的预警产品成为海洋预报部门的重要课题。

本文利用一个浪、潮实时双向耦合模型（ADCIRC+SWAN 耦合模型）、基于非结构三角形网格和高分辨率基础地理数据（海堤、岸线和水深等）构建福建沿海精细化风暴潮漫堤数值预报系统，该系统在近岸网格分辨率最高达 80-100m，可精确刻画福建各海湾复杂地形；系统的耦合模型采用同一套网格并行计算，其计算效率优越，计算 5d 的风暴潮、海浪过程仅需 15min；此外，在福建省崇武镇前江海堤布设了一套基于视频法观测海浪爬高和堤前海浪的仪器，通过对 2013 年所获取数据的计算分析，建立了堤上海浪爬高与堤前有效波高的拟合关系式用于漫堤通用判断条件。

该系统在经过多次历史重大过程后报检验证明可信后，2013 年台风期间起用于福建沿海海堤漫堤风险预警的发布。通过对“潭美”和“天兔”两次较大台风过程的预报发现：（1）预报系统对风暴潮、潮位和波高的预报与实测较吻合，预报准确率较高，但由于海浪谱模型 SWAN 对海浪绕射等物理过程刻画较不真实，在海岛背风面的海浪计算可能偏小；（2）预报系统考虑波浪爬高后计算的各沿海漫堤情况与灾害调查实况较吻合，对台风“潭美”和“天兔”漫堤预报准确率超过 80%（基于灾害调查），通过与灾后调查的海堤漫堤实况对比，结果较准确。说明该预报系统能较全面刻画沿海漫堤情况，可为沿海防汛提供较科学依据。

關鍵字: 浪潮耦合、爬坡观测、漫堤预报

S3.6

Lagrangian decomposition of the Indian Ocean shallow meridional overturning circulation

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Abstract

Based on the high-resolution OFES output, the shallow meridional overturning circulation (SMOC) in the Indian Ocean is decomposed by Lagrangian tracing method aiming to estimate the relative contributions from open boundaries. The tracers are released on the eastern boundary of the Indian Ocean at 114°E, which mainly concludes the ITF transport, and the southern boundary at 34°S trans-ocean section, which captures transport exchange between the Indian Ocean and the Southern Ocean. The experiments reveal that ~59% of the SMOC transport can be derived from the eastern boundary and the rest is from the southern boundary. Overturning circulation inferred from trajectories originating from the eastern boundary confine is confined mainly in upper 200m with northward transport crossing 6°S. In contrast, that from the southern boundary expands to deeper layers with strong northward transport crossing 6°S in subsurface 300-500m. Most of particles released in the southern boundary experience strong subduction in the subtropical region before reaching the Africa coast. The time-sacle is ~8 years for surface pariticles subducting more than 200m. However, only 16% particles from the eastern boundary subducts with shorter time-scale.

Keywords: Indian Ocean, shallow meridional overturning circulation, subdcution

S3.7

數值格林函數在暴潮預報的應用

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摘要

對海洋災害的預報與防災一般多使用情境(scenario)模擬的方式，但利用情境分析 (scenario analysis)對海洋災害進行預報會有許多限制；若是使用情境模擬的方式，許多海洋災害也因此讓人無法及時反應。相較之下，事先算好部分結果的快速預報海洋災害的限制較少，因此也應該是應對海洋災害的重要選項。

所謂格林函數是控制方程式的基本解，意即系統對集中荷載(外力)的反應。本文說明數值格林函數之互逆性，並選取海嘯災害與暴潮災害，闡釋應用事先算好的數值互逆格林函數可以對暴潮等海洋災害進行快速預報，其準確性與直接對淺水方程組進行的模擬並無太大差異，但其經濟性與穩定性皆優於直接模擬等方式，而其彈性又優於情境模擬等其他先行進行模擬的方法。在短期預報下，格林函數非常快就完成預報，所以可以進行許多不同颱風路徑、不同強度的暴潮模擬，並將這些結果綜合起來進行機率式預報。

一般進行暴潮的數值模式研究，都要面臨如何移轉給業務單位的問題。也就是說業務單位還要培養一批熟悉數值模式操作的人，或是委託原來發展的單位繼續操作，在災害發生時才能及時進行預報。培養一批熟悉數值模式操作的人說來簡單，但其實不容易做到；因為操作數值模式常常會有這樣那樣的問題，以致數值模式結果常常不如人意，甚至因為不穩定而爆掉。委託原來發展數值模式的單位繼續操作雖然可行，但不符合分工之需求。格林函數的好處是非常穩定；因為只需要做乘法和加法，所以不會有爆掉的情形，最適合移轉給業務單位使用。

關鍵字: 數值格林函數、暴潮、快速預報

S3.8

夏季台湾海峡及周边海域上升流锋面的数值研究

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摘要

台湾海峡夏季一个显著的特点就是在海峡内存在显著的上升流。本文首先提出一种结合梯度法和 Canny 边缘检测法的海洋锋检测方法，然后将该方法应用于高分辨率的遥感海表温度资料和数值模式结果，对台湾海峡及其附近海域存在的海表温度锋面进行诊断分析。夏季台湾海峡附近海域的锋面主要分布在粤东汕头外海以及台湾浅滩附近，通过对温度方程各项的热收支分析发现粤东锋面和台湾浅滩锋面都属于上升流引起的底层冷水上翻形成的锋面。此外还通过一次夏季台湾海峡的锋面演变过程分析得出结论：西南季风是引起粤东上升流的关键因素，但对台湾浅滩上升流锋面的贡献并不显著，台湾浅滩上升流的形成机理比较复杂，与地形和局地平流作用有很大的相关性。

關鍵字: 台湾海峡、上升流、海洋锋

S1.11

Chinese Ocean Satellite Missions in the Near Future

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Abstract

There will be 5-8 ocean satellites lauched within 2-5 years. These include 2 ocean oceancolor satellites, 2 ocean dynamic parameters monitoring, 1 China and France satellite and others. Also There will some new kind of ocean satellite like spectrum programable ocean color satellite and salt detecting satellite. The satellite missions are divided into three series: ocean color satellites (HY-1 series), ocean dynamic environment satellites (HY-2 series) and ocean surveillance satellites (HY-3 series). These satellite will provide the ocean department with enhanced ability to measure the sea surface salinity, ocean vector winds, wave spectrum, sea surface temperature, sea surface height, significant wave heights, ocean color and biological productivity.There are many applications for ocean environment monitor, ocean disaster monitor and forecast assimilation by ocean application in China. This paper will be give a whole understanding about China ocean satellite missions and their potential applications.)

Keywords: ocean satellite missions

S1.12

Ocean circulation variations revealed by time-variable gravity from the GRACE satellite

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Abstract

The gravity signal obtained by the twin-satellite mission of GRACE has become a powerful remote-sensing tool since 2002. It provides time-variable gravity data revealing mass transport on or in the Earth at spatial resolution of ~200 km at 10-day or monthly intervals. We study two cases of ocean circulation: the Antarctica Circumpolar Current (ACC) and the Argentine Gyre (AG), by means of the Empirical Orthogonal Functions (EOF) technique. For ACC, the leading EOF mode of the interannual ocean-bottom pressure field delineates a unison oscillation around Antarctica, time history closely in pace with the Southern Annular Mode Index with a high correlation of 0.77. This variation gives rise to a variation in the geostrophic flow field; we find heightened variations in the zonal velocity that resides primarily in the eastern-hemispheric portion of the ACC and coincided geographically with the southernmost boundary of the ACC's main stream. For the AG at mesoscale the leading EOF mode shows an overall, up-and-down undulation of the AG, temporally in pace with the Antarctic Oscillation Index, indicting a cause-and-effect relation of the generation of the AG. On the other hand, the complex EOF analysis of the high-frequency signal confirms a ~25-day oscillation within the AG that has been found previously, which exhibits a counterclockwise circulation of a dipolar pattern. These studies demonstrate the facility and efficiency of the GRACE time-variable gravity observations.

Key words: Ocean circulation, Antarctica Circumpolar Current, Argentine Gyre, GRACE satellite, time-variable gravity

S1.13

Multi-resolution Retrieval of Water Quality Parameters in Coastal Waters using MODIS and Landsat OLI Data

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Abstract

Coastal and near shore waters are critical environmental systems worldwide that are highly vulnerable to human-induced and natural change. Unfortunately, there are many challenges to monitoring these highly dynamic, complex systems. Data required to effectively manage these systems are often missing due to many factors including the expense of data acquisition and processing at the requisite temporal and spatial scale and resolutions.

We present the details and results of using 250 m MODIS (Moderate-resolution imaging spectroradiometer) and 30 m Landsat OLI (Operational Land Imager) data for monitoring total suspended matter (TSM) concentration in the Albemarle-Pamlico Estuarine System (APES), a large, shallow, complex estuary-lagoonal system in eastern North Carolina, USA. TSM containing both inorganic and organic particles suspended within the water column has been shown to be a major water quality parameter that governs many biological, chemical and geological processes in the APES. We demonstrate how the use of these data helps gain a better understanding of the dynamics of TSM within this system.

Examples of the application of MODIS and OLI data to Penhu and adjacent coastal waters will also be presented.

Keywords: MODIS, Operational Land Imager, suspended sediments, coastal processes

S1.14

A Fast Distribution System for Ocean Satellite Data

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Abstract

Abstract How to find the satellite data need effectively? How to get the data in time? How do I analyze and use these data? These are three main questions asked by many satellite data users. This paper introduces a fast satellite data distribution and application system to solve these questions. The system consists of four part, including multi-source satellite data organizing,satellite data processing ,data distributing through cable net or by satellite broadcasting, and data synthesize analysis platform. This system can collect and process multi-source marine satellite data automatically send the data to the user quickly and can be used as a seamless operational data provider for disaster prevention and environmental forecasting system.

Keywords: ocean satellite data, fast distribution system, satellite data broadcasting system

口頭報告摘要

10/25 Wed. Afternoon - Session 4 、Session5

S4. Keynote

Flood and Coastal Protection at the German North Sea Coast

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Abstract

The North Sea is part of the shelf sea that borders the Atlantic Ocean and is located between the shores of France, Belgium, the Netherlands, Germany, Denmark, Sweden, Norway and the United Kingdam. The approx. 1,170 km long German North Sea coast is characterised by young barrier islands, marsh islands as well as islands with morainic hills protecting the marshy mainland coasts. Spring tides are 1.8 to 3.5 m high at the coastline and even higher in the tidal rivers Elbe and Weser with a maximum of 4.2 m in the river Weser in Bremen. The landforms at the coastline vary from sandy beaches and steep cliffs to mudflats, the so-called Wadden Sea, which is the largest unbroken system of intertidal sand and mud flats in the world, reaching from Denmark to the Netherlands with its centre in Germany.

The German North Sea coast is an important settlement and economic region especially concerning the transport and logistic, energy and tourism sectors. Therefore, flood and coastal protection is important not only today but already since more than 1,000 years. The presentation will give an insight in the historical morphologic development of the German North Sea coast since the last glacial time approx. 20,000 years ago and in the first flood and coastal protection measures in the Middle Age. Furthermore, information on natural loads like tides, storm surges, waves and ice will be given and state of the art coastal and flood protection measures like dikes and seawalls, groins, beach nourishment, tidal polders, and storm surge barriers are described. Finally, new concepts of coastal and flood protection at the German North Sea coast will be presented, offering advantages in tackling with anticipated climate change challenges.

Keywords: Flood Protection, Coastal Protection, North Sea, Germany, Climate Change

S4.1

Beach Restoration with Submerged Reefs and Beach Nourishment in Puducherry, India

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Abstract

The coastal town of Puducherry in the south eastern India did not have a sandy beach in recent memory. The very famous promenade at Puducherry obscures the fact that the city once had a wide beach prior to the construction of port in 1986. The natural causes and reorientation of coast due to port breakwater led to severe erosion due to modification of sediment pattern. As a result, not only is the habitat progressively destroyed, but also the lives and properties of nearby residents are threatened. The seawalls and Groins are constructed by Puducherry government at various timelines to mitigate the problem protected the coastal infrastructure but erosion shifted further North.

To better manage the coast of Puducherry a shoreline management plan was developed by National Institute of Ocean Technology (NIOT), Ministry of Earth Sciences (Government of India). To evolve long term shore protection measures for beach restoration, a detailed study was taken up which includes long term shoreline change analysis, detailed processed based measurement and Numerical modeling. Based on the study a hybrid solution with two submerged reefs and beach nourishment are identified to restore the lost beach along Puducherry and one of the submerged reef and beach nourishment is being implemented at the site. Beach is already formed south of reef to an extent of 60m and with the steady progress of the project the city's coastline can soon travel back in time to its sandy past.

Keywords: Coastal erosion, Field measuremnts, Shoreline evolution, Numerical modelling, Sediment transport, Beach restoration, submerged reef, Beach nourishment.

S4.2

Band Ratio Modification for Monitoring the Suspended Sediment Distribution Pattern in the Coastal Area

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Abstract

Indonesia is a country with the potential of the complex dynamics of the coastal area. This is partly because Indonesia is made up of more than 17,000 islands. The occurrence of coastal dynamics requires monitoring prior to the dynamics of the coastal area had an adverse impact on humans who depend on the coastal area. Geographic information system is a technology that can be utilized in monitoring to the coastal dynamics. Monitoring of suspended sediment spreading pattern in the coastal area becomes important as a first step in reducing the adverse effects that can be caused by the coastal dynamic. The purpose of this research was to determine the spreading pattern of suspended sediment in the coastal area of Kendal Regency as one of the regencies with a high population growth, then comparing the distribution pattern formed on two transitional seasons between the east and west season and between the east and west season. The main method used is the band ratio of Landsat satellite imagery 8 OLI / TIRS on band 3 and 2 using ENVI software. The result is a potential distribution of suspended sediment dominant to the northeast on the east-west translational season. Different conditions are shown in the dominance of the spread of suspended sediment for the transitional season of east-west that shown heterogeneous direction, however, the transitional season of east-west seen their circulation sediment at certain points that can become benchmark potential locations for silting occurrence because of the presence of sediment concentrations.

Keywords: coastal sedimentation, band ratio method, Kendal, Indonesia

S4.3

海堤安全評估作業程序探討

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摘要

海堤歷經颱風及海浪侵蝕會出現變形、沉陷、淘空與材料劣化等現象，恐降低其安全性與防護性，影響沿岸居民生命財產安全，故有必要針對海堤進行檢查及安全評估，早期發現海堤堤體結構及週邊環境的損壞與異常，以掌握使用現況及損壞情形，採取必要之修復與對策，使其維持良好狀態與功能。

有鑒於此，參考國內、外海堤檢測評估技術及各河川局辦理海堤安全性評估分析研究成果，且透過整理海堤損壞型態、原因分析及破壞機制的探討，並輔以現場檢測經驗，設計較為詳細的海堤現場檢查表，包括海堤基本資料表、海堤定期現場檢查表及海堤現場不定期檢查表，並明確訂定各部位損壞程度判定標準，提供檢測員統一執行的標準，更藉由選定之 12 公里示範海堤實施目視檢測及非破壞性檢測，測試此一檢查表之適用性，並由現場檢測員之回饋資訊更新修訂檢查表，以建立一較詳細之檢查作業模式。

根據海堤現場檢測結果，研擬海堤單元或全段之狀況指標(CI)及優選指標(PI)評估方法，可進一步進行分級評估工作，以掌握海堤劣化狀況，作為維護工作優先次序之參考。為使海堤檢測評估資料可安全並簡便的保存及迅速查詢等作業需求，並建議採網頁操作平台方式建置海堤維護管理資訊系統及資料庫。

關鍵字: 海堤、目視檢測、非破壞性檢測、海堤現場檢測表、海堤安全評估

S4.4

區域性海岸越波風險分析

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摘要

海水所能夠上溯海岸的高度主要取決於向岸傳播的波浪、氣象潮與天文潮汐水位等因素的結合，傳統上假設波浪與氣象潮為完全正相關，再應用數值模擬或是經驗公式估算海水位溯升高，然實際上氣象潮與波浪通常並不完全相關，因此若以前述的方式進行越波風險機率估算，必然發生高估的結果。為更合理估算越波風險，本文以雲林離島工業區為研究區域考慮影響溯升之各因子間的關聯性，利用關聯結構函數建構多變數的機率分布模式，並結合 Monte Carlo 統計抽樣模擬，得到各種參數的條件組合，再分別根據經驗公式與數值模式進行區域性越波風險分析。聯合機率分布概念在 1990 年代以前普遍僅限於當變數的邊緣機率為相同型式條件下，如分布為常態時，其聯合機率分布滿足雙變數聯合機率分布，才能據以推算聯合發生機率。對於多變數且為不同機率分布型態情況，其理論聯合機率分布型式難以求解。直到 1990 年代以後，利用關聯結構(Copula)建立起邊緣機率分布與聯合機率分布之間的轉換關係後，利用多變數聯合機率分布推求發生概率的應用才逐漸地被推廣使用。換言之，利用關聯結構函数，可以將經過轉換後各變數的邊緣分布，鏈結到聯合機率分布，而且各變數的邊緣分布不限於相同分布，如此使得聯合機率分布的計算變得簡單且易於應用。本文選定 Archemedian 型的 Frank、Clayton 與 Gumbel 關聯結構函數來描述波高與氣象潮的相關性。根據雲林離島工業區海域過去近 20 年的實測波浪與潮位資料，考量發生越波的可能性並提升分析效率，設定波高與潮位達一定高度的門檻且資料間之時間間隔大於 6 小時，進行資料篩選，之後分別針對各變數套疊機率分布函數型態，得到最適的配套型式。其次，考量的關聯變數有波高、尖銳度與暴潮，分為兩組一為波高與尖銳度；另一為波高與暴潮，分別以一個二維的關聯結構函數描述其間的相關性。進而以 Gibbs 取樣方法配合 Monte Carlo 統計抽樣，得到各種參數組合條件，對於典型的海岸地形剖面以 Mase et al.(2013)發展的經驗公式估算溯升高與越波風險；對於雲林海域實際的地形則以 Lin et al.(2008)發展之 CMS-Wave 模式進行溯升高估算。本文統計模式模擬得到之資料與實測資料散佈圖如圖 1，顯示模擬資料可再現研究區域波浪尖銳度隨波高增加的特性。假設不同海底床坡度的情況估算溯升高如圖 2，可見海底床坡度對溯升高度的影響大於波高影響，更大於海平面上升的影響。圖 3 為雲林海域可能發生越波的區位與機率。

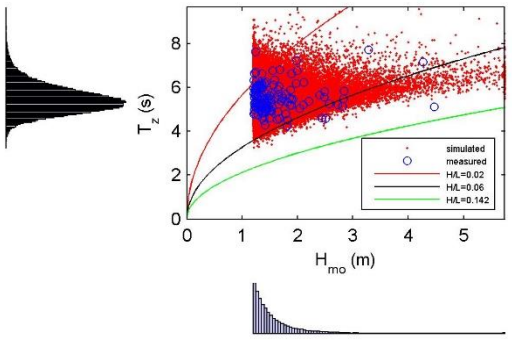

圖 1 本文統計模式模擬得到之資料與實測資料散佈圖

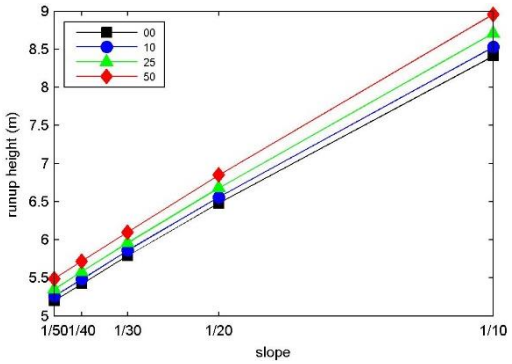

圖 2 溯升高隨海底床坡度、波高與海平面上升的變動

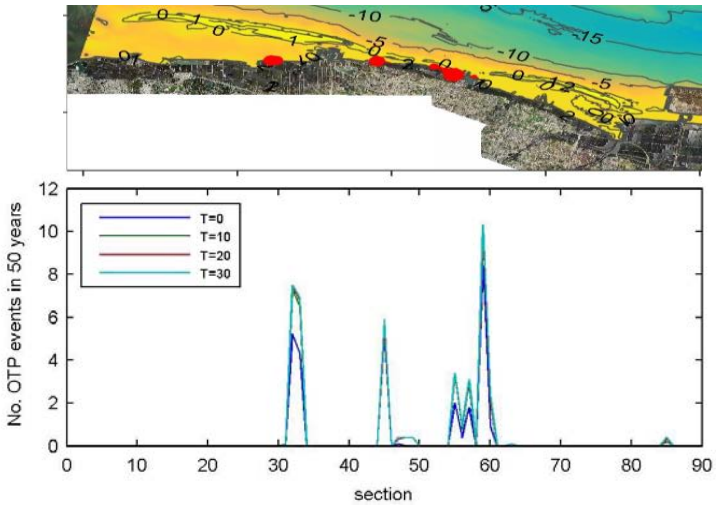

圖 3 為雲林海域可能發生越波的區位與機率

關鍵字: 越波, 關聯結構函數, 多變數機率分布

S4.5

Urban-Coastal Disaster Risk Management in Indonesian Context

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Abstract

Republic Indonesia extends along more than 81.000 kilometers of coastline. In fact, nearly 24 important cities, 5 metropolitans, 5 large scale cities, 32 middle scale cities and 5 small scale cities are located at coastal area (Hizbaron, 2016). Along with that, Republic Indonesia had amalgamated Act No. 24/2007 on Disaster Management and Act No. 26/2007 on Coastal and Small Islands Management. Such national mandates has been articulated into several guidelines and regulations, including National Action Plan on Climate Change for Urban Area and National Action Plan for Disaster Risk Reduction. Unfortunately, among important urbanized coastal areas especially in Java, Indonesia were generally presented with poor environmental condition and yet inclusive towards such policy in the related theme (Marfai and Hizbaron, 2011). The purpose of the research is describing spatial distribution of urban risk in Java, Indonesia, and analyzing possible mitigation strategies which in line with national mandates. The research employed land suitability analysis for micro level unit analysis, and expand the observation into spatial-descriptive matrixes. The result revealed that most of North Coast of Java exposed to specific various disaster risk compared to South Coast of Java. The specific likelihood of natural hazard influences selections towards mitigation strategies. Therefore, this research argued, that mitigation strategies towards urban coastal areas, should at least consider its micro-level land use activities, characteristics of local dwellers, and availability of local political supports.

Keywords: urban, coastal, risk, disaster, Indonesia

S4.6

氣候變遷下台南七股洲潟海岸防護策略之討論

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摘要

台南七股洲潟海岸由七股潟湖和其外側的青山港汕、網子寮汕和頂頭額汕等離岸沙洲所組成。七股潟湖是十八世紀台江內海殘存的部分水域，外側離岸沙洲則扮演海岸天然屏障的角色，阻擋風浪的侵擾，海水透過潮流從兩個主要潮口帶進營養鹽，也為潟湖內養蚵與定置網帶來極大的經濟產值。但近二十年來，七股海岸洲潟系統在自然環境變遷與人為設施干擾的夾擊下，海岸地形、水文與主要的海岸營力作用都產生明顯的變化。潟湖外側的網子寮汕沙洲因為頻繁的波浪越洗作用而明顯向陸側(向東)遷移，同時也因為優勢的沿岸流輸砂方向而使沙洲向南延展。南段沙洲是沙洲本身輸砂的主要堆積區，變動較小。但北段沙洲的高程因為越洗作用頻繁而逐漸降低，而地形面的降低又促進了越洗作用的發生，這種地形的正回饋增強效應，也使得北段沙洲有更頻繁的潮口變動，包含新潮口的形成、遷移及閉合，並且使沙洲快速內移。研究成果顯示，冬季的沿岸輸砂及季節性向南搬運的風砂活動，是促使夏季形成的潮口閉合之最主要作用營力。面對這些主要因為全球氣候變遷因素，造成海水面上升，進而引發的沙洲向陸遷移之自然系統反應，相關單位曾在外側沙洲建了一小段海堤，也曾經挖取潟湖沉積物將潮口封閉，或將潟湖內浚挖的土砂直接在外側沙洲上築成一道人工土堤，臨海側的堤腳並且佈放大量人工砂腸袋或尼龍砂袋以為保護。但這樣的防護對策雖在短期間內看似減緩了整個沙洲的向陸遷移速度，實際上每年都要持續投入大量經費進行維護，而這些人工設施也已經明顯改變潟湖的地形與內部的潮汐水文環境，進而使得北段沙洲的內側潟湖逐漸淤積變淺，範圍也漸縮小，預估未來可能縮小到現有面積的三分之二或一半。潟湖面積的縮小，有部份原因可能和內陸側興建海堤有關。如果不以海堤固定海岸線，而讓內陸側海岸線可以隨著海水面的上升而內移，則潟湖可以維持其面積。潟湖範圍不縮小，潮流的流動自然可以維持潮口的寬度與深度，潟湖內部的水質也不致因水流停滯而惡化，潟湖內部的漁業經濟產值也能夠維持。此外自然沙洲環境被土堤工程的覆土破壞後，缺乏自然植被的儲砂功能，海岸沙丘也因而失去其自然增大增強的機會，因此只要能夠恢復沙洲上的自然環境及其生態機能，並且在鄰近地區漁港建設所帶來對沿岸輸砂量衝擊逐漸減小的情況下，沙丘有機會發揮其防潮禦浪的功能，進而有效保護內陸側的海岸。

關鍵字: 氣候變遷、海水面上升、洲潟海岸、防護策略、沙丘復育

S4.7

Social-environmental analysis of methane and coastal management in the South China Sea and bordering countries

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Abstract

The study includes a preliminary assessment of the greenhouse effect of methane (CH_4) emissions in the South China Sea (SCS) on human welfare using the Driver-Pressure-State-Impact-Response (DPSIR) framework and the Systems Approach Framework (SAF).

CH_4 is one of the most important greenhouse gases (GHGs) and has high global warming potential. Atmospheric CH_4 concentration has significantly increased since the industrial era. It is very likely to be caused by human activities. Human activities have also increased the input of organic matter into rivers and coastal areas and thus increased CH_4 concentrations in water and possibly enhanced CH_4 emissions to the atmosphere.

This research discusses possible future impact on human welfare as a result of climate change. In dealing with the complex issues of GHG emissions and climate change mitigation, many interrelated factors must be considered. The SCS is surrounded by nations of the Asia-Pacific region that are currently experiencing rapid urbanization, industrialization and economic growth, and is one of the most contested maritime areas of the world. Climate change may aggravate regional tensions, promote natural disasters, create climate refugees and reduce food security by reducing the size of fish catches and crops. International environmental protection, as well as the mitigation of, and adaption to, climate change not only protect environmental sustainability, but also provide an international platform of cooperation for all countries around the SCS.

The study identified eight management responses across various spatial and temporal scales that can be useful in addressing the issue of GHG (CH_4) in the SCS.

Keywords: South China Sea, CH_4, greenhouse gases, Driver-Pressure-State-Impact-Response, Systems Approach Framework

S5.1

西北太平洋台风海域实时海洋监测及其应用前景

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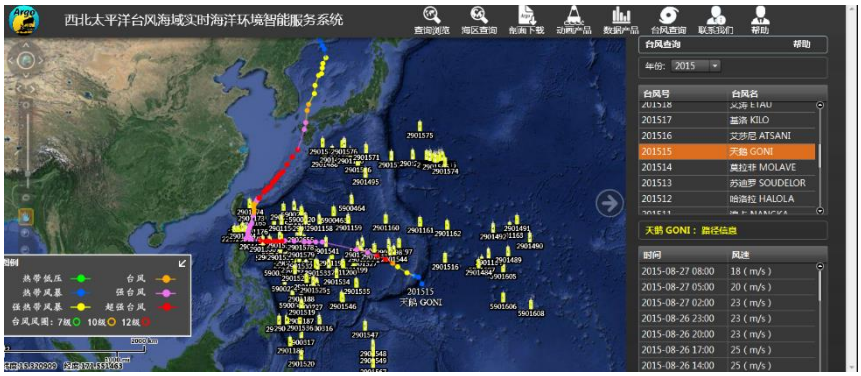
摘要

中国大陆和台湾地区毗邻北太平洋，该海域是全球热带气旋（台风）发生最为集中的区域，每年有占全球一半以上的热带气旋发生在这一海域，其中约 80%会发展成台风。热带气旋是影响中国大陆和台湾地区的主要灾害性天气之一，通常伴随有巨浪、暴雨、狂风和风暴潮，造成洪涝，冲毁水库，引发山体滑坡和泥石流，对经过地区的人民生命财产和生产活动造成巨大威胁，对海上作业、海洋渔业和海水养殖业等造成重大安全隐患和经济损失。随着沿海地带经济的迅速发展和全球气候变暖，台风灾害有愈演愈烈之势，已成为中国大陆、台湾地区，乃至东南亚国家海洋经济可持续发展的一个制约因素。故而深化对台风生成与发展机理的认识，提高对台风的实时监测和预报能力，减少台风和风暴潮等气象和海洋灾害对沿海社会经济和人民生命财产带来的重大损失，无疑是防灾减灾的重大需要。

过去几十年，随着卫星遥感、数值模拟和数据同化技术的发展，台风路径预报能力有了显著提高，但有关台风强度的预报水平发展仍相对缓慢，其原因在于台风强度变化不但与大气复杂的涡旋动力学、热力学过程紧密联系，而且与海气相互作用密切相关。因此，加强对台风条件下上层海洋的认识，无疑将有助于人们了解由台风引起的海洋夹卷、湍流混合及近惯性内波等不同尺度过程的变异机制。然而，长期以来制约台风研究和影响台风预报精度的根本原因，除了台风过程中气象资料的缺乏，还在于缺乏台风生成源地或路径附近海域长时间序列的实时海洋（次表层）观测资料，以及台风天气和恶劣海况下观测海洋环境要素的有效手段和方法，从而阻碍了人们对海洋与台风相互作用过程的深入了解和准确模拟，更无法获得台风预报所需要的、可靠的海洋初始场。因此，如果在台风路径附近能获取实时的、大面积范围内（300 km）的上层海洋观测资料，对研究上层海洋对台风的响应和调制机理，进而提高台风预报精度能起到重要作用。21 世纪初开始在全球海洋中构建的实时海洋观测网（核心 Argo），为人们带来了观测台风作用下的海洋是如何变化的新希望和新思路。自动剖面浮标（具有双向通讯、高速率传输功能的 IRIDIUM 和 BEIDOU 通讯系统）将会是今后较长一段时间内有能力监测台风海域实时海洋环境的重要手段。



西北太平洋台风路径附近海域 0－500 m、间隔 2-3 天的大量加密剖面资料，为研究上层海洋对台风的响应提供了丰富的数据来源，并已在台风过境海洋上层响应过程和上层海洋对热带气旋的响应和反馈等方面取得了一批可喜的调查研究成果。早期调查发现，由台风影响的混合层盐度变化在台风路径两侧分布对称，而当台风经过暖池区时，往往会导致海面盐度下降；海洋上混合层深度在台风作用下会增加，并向大气释放潜热。进一步研究表明，在台风经过的前、中、后三个阶段，海洋的响应是不同的，台风经过时主要是垂向的湍流混合，而台风过后则主要是近惯性流引起的埃克曼涌升和惯性抽吸；在热带风暴经过的 3 天内，海洋向大气提供能量以维持热带风暴，其年平均总值约为 9.1 W/m^2，其中 3.2 W/m^2 来自于热带风暴，剩余的 5.9 W/m^2 来自台风，且在台风经过后（平均 4-20 天），海洋获得能量，而热带风暴经过后，海洋则损失能量；云云。

自动剖面浮标观测资料的成功应用，大大加深了人们对台风活动的认识。自动剖面浮标有能力对台风海域海洋环境进行实时监测，从而可以大范围、长时间、高分辨率和实时地获取台风天气条件下的上层海洋环境资料。这些数据源对发展和完善海洋与台风相互作用的理论方法、耦合数值模式等相关基础研究具有重要意义。海峡两岸海洋和气象部门应充分利用大陆成功开发北斗剖面浮标的契机，在邻近的西太平洋（台风）海域构建起实时海洋监测系统。通过北斗（BEIDOU）卫星或铱(IRIDIUM)卫星及时调整浮标观测参数，以获取更多的加密观测资料，以及快速检索台风路径附近海域的自动剖面浮标观测资料并自动生成相关数据产品，以便帮助科学家了解大尺度实时海洋的变化，为大陆和台湾地区，甚至东南亚各国气象服务部门准实时提供台风海域的相关海洋环境数据和信息服务，提高天气和海洋预报的精度，有效防御这一地区日益严重的天气和海洋灾害（如飓风、台风、龙卷风、冰暴、洪水和干旱，以及风暴潮、赤潮等）给人类造成的威胁。

關鍵字: 自动剖面浮标、实时海洋监测、海洋环境、台风、预测预报

S5.2

海氣象即時傳輸浮標之發展與測試

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摘要

台灣東側之西北太平洋為颱風生成的熱區，此海域的颱風較其他海域多且強，每年造成沿岸地區大量生命與財產的損失。颱風生命週期中，大多時間滯留於海面上，因此海氣交互作用相當顯著。除了大氣環境會影響其生長外，海洋狀態亦非常重要；上層海洋熱結構與颱風強度的改變息息相關，若要有效改善颱風強度的預報，即時的海洋熱結構資料是不可或缺的。因此國立臺灣大學海洋研究所開發了一款可抵擋颱風惡劣海況的海氣象即時傳輸浮標，此浮標可收集溫、濕度、風向、風速、氣壓、短波輻射、淨輻射與降水量等氣象資料，以其波浪、流速、海洋上層 500 公尺的溫、鹽度等海象資料，並將收集到的資料用衛星傳回陸上工作站，進行資料作業化處理。除此之外，衛星回傳頻率、探針採樣頻率皆可透過衛星或無線電做調整。從 2015 年起，每年夏天於鵝鑾鼻東南方海域約 375 與 175 公里處進行測試，此二站點分別命名為 NTU1 與 NTU2 站。在測試期間內，計有蓮花、昌鴻、蘇迪勒、天鵝、尼伯特、莫蘭蒂、馬勒卡、梅姬、艾利、尼莎、天鴿共十個颱風經過附近海域，其中尼伯特與 NTU1 和 NTU2 站距離分別為 5.7 km 和 15 km，並在 NTU2 站量到最低氣壓 911 hPa 與最高風速 46 m/s，且海表溫在颱風過後下降約 3˚C，而馬勒卡颱風距離 NTU1 站僅數百公尺，並量到最低氣壓 936 hpa，更完整的系統介紹與測試結果將於研討會中展示。

關鍵字: 浮標、颱風

S5.3

Investigations of surfzone processes along a beach stretch on central west coast of India

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Abstract

Surfzone measurements and beach profile studies along the coastal stretch between Miramar and Keri beaches on the central west coast of India are being carried out by CSIR-National Institute of Oceanography, Goa. Beach profiles over a period of 23 years along Miramar beach are measured. Littoral Environmental observation measurements comprising of breaking wave parameters are measured at various locations and at different intervals and seasons, and these parameters are used to estimate the longshore sediment transport along the coastal stretch. Self-recording pressure transducers and recording currents were deployed in the surfzone to measure the surfzone wave parameters and currents respectively, which was carried out for the first time in this region. GPS based drifters, designed and developed in house are used to track the surfzone currents over half tidal cycle.

Analysis of surfzone wave parameters indicated the influence of tide on the wave heights. Surfzone currents measured in the field were compared with existing formulae in the literature and found that most of the equations cannot be used as it is for estimating the longshore currents for this region. From the beach profile analysis, the maximum vertical elevation changes and horizontal excursion of the berm are estimated. Numerical modelling of the nearshore and surfzone waves and currents are carried out using SWASH, MIKE21 and Delft3D numerical models with varying satisfaction levels. This presentation includes the experiences gained by the author and his team in the measurements and numerical modelling surfzone and nearshore coastal physical processes.

Keywords: sediment transport, near shore processes, surfzone dynamics, beach profile changes, numerical modelling

S5.4

Capturing nearshore dynamics-A five institution joint exercise along Indian coastline

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Abstract

Surf zone is the most dynamic coastal region with spatially and temporally varying wave, current and sediment transport characteristics. The hydrodynamics along this surf zone are constantly changing and obtaining measurements of currents and waves in the surf zone has always been challenging. Any field measurement attempt along surf zone require more planning to collect useful data. The present study focus on the nearshore current mapping using set of low-cost Global Navigation Satellite System (GNSS)-tracked surface drifters. An array of 10 drifters were deployed on the beach of Pondicherry coastline where the coastal erosion has been a persistent problem and an artificial reef system is being constructed to regain the beach for public. The longshore currents and drifter trajectories were recorded throughout a day during flooding and ebbing tide. The results reveal that wave induced currents are moving towards south to north direction irrespective of any tidal variation. It clearly shows that wave direction play a major role along this coastline and influence the movement of longshore currents and sediment particles. Simultaneous wave and current measurements were also taken on the same day using DWR and ADCP, the currents were compared with that obtained using drifters and found to be in agreement. This paper describes the temporal and spatially varying currents along Pondicherry coastline and the results from field measurement campaign.

Keywords: longshore currents, Surf zone hydrodynamics, low-cost GPS drifters

S5.5

Development and Application of Miniature Wave buoy

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Abstract

The miniature wave buoy is in a small size of sphere of 26cm diameter, which is equipped with 9-DOF motion sensor, GLONASS positioning system, high accuracy water temperature sensor, and wireless communication module. In order to have good sea surface following capability, the miniature wave buoy is a lightweight design with 2.7 kilogram.

To validate the wave buoy system, we design two experiments, one is a laboratory scale in a super wave tank and the other one is an open ocean scale experiment. In laboratory task, we do the comparison in two kinds of wave condition. One is the regular wave condition which is the combinations of significant wave heights in 40cm, 50cm, 60cm, 70cm, 80cm and peak wave periods in 3 sec, 4sec, 5sec, 7sec. The other one is irregular wave condition that is the combinations of significant wave heights in 30cm, 40cm, 50cm, and 60cm, where the peak wave period is set to 5 seconds. The miniature wave buoys are mounted in corresponding to the location of wave gauges.

The results of laboratory experiment show that the miniature wave buoy can represent the water surface motion induced by wave propagation. The wave buoy can detect the precision frequency peak and wave height of given waves. The measurement accuracy of significant wave height and peak wave period from miniature wave buoy is 5% and 1% in corresponding to measured wave parameters. In overall speaking, the miniature wave buoy has excellent performance to represent the wave conditions, where compare to the record of wave gauges.

In order to further understand the performance of miniature wave buoy, the open ocean experiment was achieved. The miniature wave buoy is deployed in fifteen meters of water depth in northeastern of Taiwan, where the location is nearby to an operational weather buoy. The operational weather buoy is a disk type buoy with diameter of 2.5 meter. The comparison of wave measurements between miniature wave buoy and operational weather buoy show that the miniature wave buoy not only represents the real open ocean conditions but also has good following capability to the ocean surface variances.

Finally, the miniature wave buoy is used in certain projects, such as surface wave monitoring during the passes of internal wave, surf zone wave measurements, and operational long-term wave monitoring.

Keyword: Wave measurement, miniature wave buoy

S5.6

金門海域漂流垃圾調查

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摘要

本研究在金門地區周邊海域，執行海域水流調查、海域垃圾漂流路徑調查作業。海流觀測方法主要為將 ADCP 架設於半浮式拖曳架上，搭配儀器本身的底床追蹤(Bottom tracking)功能以及船上 GPS 功能進行移動式測流，儀器量測流場資料可透過電纜即時接收進電腦。除了硬體設備及現場操作技術外，同時應用海潮流分析的技術，將觀測資料經回歸分析得到潮流與平均流之空間分布。一般海上垃圾漂流，主要受表面海流及風的影響，本研究透過漂流浮標，來模擬海上垃圾的漂流情況。GPS 表層測流浮標設計，主要分為三個部分：定位系統、拖傘、主體結構。浮標力求輕量化的設計，整體高度小於三米，浮標在水下之長度小於一米。拖傘由市售燈籠形狀的風箏成品改裝而成。為強化拖傘結構，需在風箏原先空心的骨架中嵌入不鏽鋼條，增加拖傘在水平及垂直方向上的韌性與承受衝擊的能力。主體結構以可伸縮之鋁棒為浮標主杆，上方固定追蹤系統，即防水盒內置無線電系統。測量方式於九龍江出海口放置定位浮標，任其自由漂流，若超出擬作業範圍或是作業時間，即予以回收或重新佈放；接著自浮標下載數據進行資料篩選，刪除浮標漂流過程受瞬間風速或其他不明影響，所造成的異常數值。將其結果與漂流模擬模式作驗證，以強化模式準確性。在西南季風、東北季風期間各進行 1 次，每次共施放 20 組次浮標，在 2016 年 5 月(西南季風)及 2016 年 9 月 (東北季風)進行。

關鍵字: 金門海域、漂流垃圾、水流調查、漂流浮標

S5.7

台灣海峽西北部表面流場之探究

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摘要

本研究在 2013 年 5 月及 6 月於台灣海峽西北部靠近馬祖之水域施放兩顆表面浮標，配合風場資料，研究該海域之表面流場。觀察浮標漂流之軌跡，可以發現該處表層海流大致沿著等深線移動，且大陸沿岸流及黑潮支流約以 50 米等深線做為分界，以東的表面流場以黑潮支流為主，平均流速約為 0.05 m/s；以西則以大陸沿岸流為主，流速約為 0.17 m/s。該海域之潮流是以 M2 分潮為主要成分，經過濾潮後之殘餘流與風速做相關分析，得到殘餘流與風應力最佳相關性約在 30 至 80 小時之間 (相關係數約 0.6-0.8)，而風應力約比殘餘流提早 0 至 10 小時，對照過去之相關學術研究成果，潮流分析及殘餘流與風應力的相關性之結果相當一致。

關鍵字: 台灣海峽、大陸沿岸流、表層流場、漂流浮標、相關分析

S5.8

利用 Bio-Argo 观测南海深海区叶绿素变化及分析

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摘要

利用两个 Bi-Argo 漂流浮标观测研究了南海深水区叶绿素浓度变化。在 2014 年 9 月至 2015 年 8 月，南海中部 48 至 96 米有一持续存在的次表层叶绿素最大值（SCM）。在南海北部，SCM 在冬季消失，被表层高叶绿素的浮游植物爆发所取代。SCM 的值受到等温线的垂直迁移影响。强风和海表冷却是冬季高叶绿素的主要物理驱动因子。在南海北部，风比南海中部更强，海表温度更低，加上黑潮水的入侵，南海北部更有利于富营养盐深层水的向上传输。冬季，有大量硝酸盐通过平流从台湾海峡和浅大陆架海域向南海北部海盆输运。强风混合、海表冷却、黑潮水入侵、水平平流输运共同作用引起南海北部冬季出现浮游植物爆发。

关键字：Bio-Argo，叶绿素，南海

五、海報報告摘要

A1

風浪模式透水底床與透水潛式結構效應之應用研究

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摘要

本研究建立一可模擬波浪通過透水底床、潛礁與水生植被引致波浪減衰效應之風浪數值模式。控制方程式以 WWM (Wind Wave Model) 模式之波浪作用力平衡方程式為基礎，參考延伸型緩坡方程式(Extended Mild-Slope Equation, EMSE)所提出透水介質之緩坡方程式數值模式，定義透水層效應能量消散係數與源項，進一步推導出具有透水底床、潛礁與水生植被效應之波浪作用力平衡方程式。本研究另提出了一種估計透水介質中紊流摩擦阻力特性參數的方法，以縮短參數估算時間。模式建置後以透水底床與透水潛堤實驗配置進行模式驗證，藉由相關試驗案例分析驗證模式之正確性，對於本研究所提出之潛式透水介質效應波能消散源項中之參數權重值，建議為 2.5 可獲得較合理的模擬結果。最後選擇具代表性台灣近岸海域進行現場實際案例模擬與比較，探討以風浪模式考慮透水底床、透水潛礁效應對波浪的影響，並依據分析結果修正數值參數，改良模式使其能適用於實際海域問題。模擬結果顯示，臺灣西部海域沙質底床可達 8.7%-9.0%的波高減衰率；東沙島海域透水潛礁、植被的季風波浪波高減衰率約為 26.7%-75%。本研究成果將可提升風浪數值模式在近岸海域之模擬精度，擴展模式之應用價值。

關鍵字: 風浪模式、相位平均、潛式透水介質、緩坡方程式、波浪減衰

A2

近岸質量傳輸之質點模擬方法

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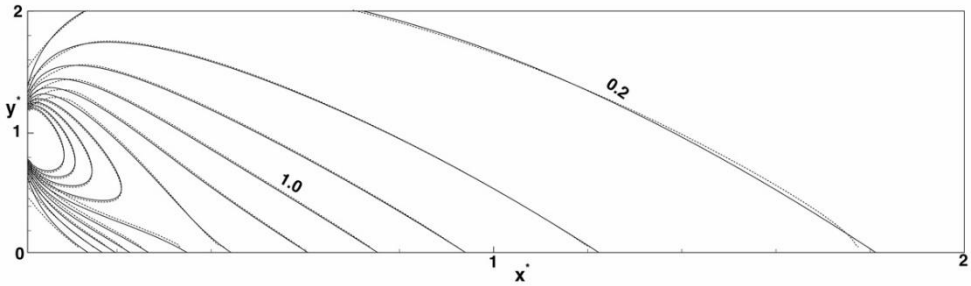
摘要

本研究使用確定性質點追蹤法 (deterministic particle-tracking method)，建立二維之數值模式，模擬近岸潮汐水流造成之污染物傳輸現象。模式假設近岸為一理想化之直線海岸，底床為一斜坡地形，延散係數 (dispersion coefficient) 為水深之函數，污染物則在深度方向充分混合。控制方程式為深度平均之二維傳輸－延散方程式，並使用 Lagraigian 質點法求解。連續的濃度分佈使用帶有濃度之質點近似之，質點隨潮流而移動，其濃度則因延散效應而改變。濃度的延散使用質點強度交換法 (particle strength exchange) 進行計算。圖一中虛線為使用此模式計算斜坡海岸在單向穩態水流作用下至穩態之濃度分佈，實線則為解析解的成果。由圖可知本模式可準確模擬此流場之質量傳輸現象。本研究將藉由改變點源的輸入函數，分析數種隨時間變化的輸入方式對於濃度分佈的效應，以探討能有效降低污染物濃度累積的排放策略。



圖一 斜坡海岸之單向穩態水流中持續注入污染物之濃度分佈。

關鍵字: 質量傳輸、質點法、數值模擬

A3

Satellite-derived Ocean Thermal Structure for the North Atlantic Hurricane Season

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Abstract

This study developed a new regression model, using satellite altimetry to estimate daily upper-ocean temperature structure with high spatial resolution, or Satellite-derived North Atlantic Profiles (SNAP). Using about 139,000 observed temperature profiles, a spatially-dependent regression model is developed for the North Atlantic Ocean during hurricane season. A new step introduced in this work is the inclusion of daily ocean mixed layer depth, which is estimated based on a one-dimensional Price-Weller-Pinkel ocean mixed layer model with time-dependent surface forcing.

The accuracy of SNAP is assessed by comparison to 19,076 independent Argo profiles from the hurricane seasons of 2011 and 2013. The root-mean-squared (rms) differences of the SNAP-estimated isotherm depths are found to be 10-25 m for upper thermocline isotherms (29°C to 19°C), 35-55 m for middle isotherms (18°C to 7°C), and 60-100 m for lower isotherms (6°C to 4°C). The primary error sources include uncertainty of sea surface height anomaly (SSHA), high frequency fluctuations of isotherm depths, salinity effects and the barotropic component of SSHA. These account for roughly 29%, 25%, 19% and 10% of the estimation error, respectively. The rms differences of hurricane-related ocean parameters, upper-ocean heat content and averaged temperature of the upper 100 m, are ~10 kJ cm-2 and ~0.8°C, respectively over the North Atlantic basin. These errors are typical also of the open ocean underlying the majority of hurricane tracks. Errors are somewhat larger over regions of greatest mesoscale variability, i.e., the Gulf Stream and the Loop Current within the Gulf of Mexico.

Keywords: Typhoon, Temperature profiles, Satellite altimetry, Mixed layer depth

A4

A Study on the Flow over Traveling a Grop of Wavy Foils by Using the Many Body Force Decomposition

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Abstract

The thrust due to the vortices generated by an undulating motion as well as the shape and frictional drag as wavy foils swim forward and encounter is very difficult to identify. In this study, we extends the force decomposition method which is provided by Howe in 1995 to develop the many body force decomposition method to analyze the force exerted on side by side and a group of wavy foils mimicking fish-like locomotion. The force interaction system between wavy foils and flow will be investigated by both theoretical analysis and numerical simulations. The numerical results are obtained by the SIMPLEC method of the commercial code Ansys FLUENT based on the control-volume method in this work. In order to increase accuracies and make wavy foils moving reasonably in present model, dynamic-mesh technique, and conformal hybrid grid are carried out. Finally, the characteristics of whole flow filed under the force interaction system as flow propagating through side by side and three wavy foils are computationally studied under different conditions. The result shows added-mass force is the most significant thrust source among all considered motions.

Keywords: Many body force decomposition method, Wavy foils, Numerical modeling, Cycle movement, Dynamic mesh, Reynolds number

A5

應對人類工程副生災害的海洋預報技術

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摘要

海峽屬雙海岸帶海域，是地球上人類活動最密集地帶，也是人類工程分佈最密集區域。人類工程又叫人造工程，它是指人類為自身生活、生產、發展需要而建設的大型工程，如超級城市化、大型工交礦產設施、港口碼頭、跨海大橋（隧道）、潮汐發電站、核電站、人工島礁群、海產養殖場、海洋作業平台及管網等。人類工程不可避免地會產生大量有害的氣體、液體、固體、射線、聲波及負作用力，從而形成人類工程副生災害。人類工程副生災害，是迄今為止尚鮮為人知和未被引起人們重視的海洋災害（圖 1 人類工程副生災害分類表／圖略）。

人類工程副生災害，也稱人類工程負作用力，它是指人類工程在建設過程或運行過程產生的、對人類危害或不利影響總體上要遠小於或輕于工程本身對人類貢獻總量的災害。但這是就人類工程整體而言，對於海洋觀測數據和海洋預報產品來說，此負作用力是很明顯的，如跨海大橋（隧道）、潮汐發電站、人工島礁群、海洋作業平台及管網等，對海流、海浪、潮汐、風力的力學影響；超級城市化、大型工交礦產設施、核電站、海產養殖場等，對海洋環境、海洋生物、海洋生態系統、海洋漁業的干擾破壞（圖 2 人類工程負作用力效應圖／圖略）。

據初步研究，人類工程負作用力對海洋觀測數據與海洋預報產品的質量影響，主要表現為三個方面：一是導致海洋觀測數據代表性失信，即在時間維度上數據發生斷崖式異化和在空間維度上產生失真性誤差；二是導致海洋預報的準確率偏移，即由於採用了失信數據而出現預報產品的質量問題；三是導致海洋預報數值模式響應落後，即數據的代表性失信和預報準確率偏移，使得原先相對理想化的海洋預報數值模式，無法與預報產品的（準確率）期望值相協調，數值模式能力偏弱于預報產品的質量期望（圖 3 人類工程負作用力路徑圖／圖略）。

應對策略：（1）研製兼顧人類工程負作用力的觀測數據質量控制方法；（2）研製兼顧異化環境觀測數據的預報模式；（3）研製可持續的環境異化數據智能處理平台。

關鍵字: 海峽、人類工程、副生災害、海洋預報、策略

B1

COASTLINE MAPPING AND ISLE AREA ESTIMATION by REGION GROWING APPROACH FOR PENGHU ARCHIPELAGO

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Abstract

To field survey of land resources, it is hard to survey and update the information of coastline and area of many an isle quickly and frequently. Many early researches were limited on coastline mapping and changing detection along a part of shore. This study using SPOT imagery by image process carries out the goal of coastline mapping and area estimation of each isle. The automatic detection and analysis of coastline and isle area through image process can be applied to retrieve and update the information of land resources quickly, effectively and economically. Remote sensing technology is regarded as an effectively auxiliary tool in field survey. Cases study in ten isles of Penghu archipelagoes by Region Growing Approach shows that the average errors of coastline mapping and isle area estimation derived from multi-spectral (abbreviated as XS) imagery are around 5% and the errors of ten isles almost fall within 10%. The same process and analysis were applied to SPOT 1 near infrared (NIR) and SPOT 5 short wave infrared (SWIR) imagery. These results indicate that the coastline mapping and isle area estimation using SWIR imagery are better than XS and NIR ones. Remote sensing of land resources can not only get the brand-new and updated information quickly but also control and manage land resources effectively. By the way, this research can highlight reefs and assure the safety of navigation. It can also apply relative information to survey and research the marine ecology, marine environment, and fishery etc.

Keywords ： Coastline mapping, Land resources, Region growing approach

B2

2017 年 2-3 月东海渔区鱼群异常出现之原因初探

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摘要

2017 年 2 月下旬和 3 月上旬，东海渔区的 1891 海区和 1592 海区发现有大量鱼群，非常罕见。本文基于卫星遥感数据来探究这一现象发生的主要原因。初步分析结果表明，东海渔区 2017 年 2、3 月份的风速明显强于往年，尤其是西风的明显增强。强劲的西风使得东海冷水舌向东推进，由冷水舌形成的锋面整体得到加强且向东偏移，从而在 2017 年冷水舌锋面区域形成明显的降温区。1891 海区和 1592 海区均位于冷水舌锋面位置，且附近分别有台湾暖流和对马暖流的分支经过。东进的冷水舌与东部高温海水以及附近的暖流相遇，产生强的混合，导致底部沉积的营养物质上浮，从而浮游植物增多，叶绿素浓度明显增加。上浮的营养物质和浮游植物为鱼类提供了丰富的饵料，吸引大量鱼类在这里聚集。此外，冷水舌东移产生的强大的温度梯度，会形成“水障”，导致鱼类的不适应，主动上浮，即产生 2017 年 2、3 月份在东海渔区有大量鱼群浮在水面的现象。

关键字：卫星遥感、东海渔场、冷水舌

B3

Using remote-sensing environmental and fishery data to map potential yellowfin tuna habitats in the Indian Ocean

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Abstract

The purpose of this study was to investigate relationships between environmental variation (SST, SSHA, MLD and Chl-a) and catch rates of 1 degree logbook data to identify the underlying processes influencing yellowfin tuna catch rates and their distribution in the Indian Ocean, and thereby predict distribution. These functional relationships can be used to evaluate the impacts of oceanic variability on the spatial pattern and vulnerability of yellowfin tuna. All variables in the GAM model for the yellowfin tuna catch rates of 1 degree logbook were significant ($p<0.01$) in the period from 2010~2012. The cumulative deviance explained by the GAM models was 35.9%, respectively. The result showed the fishing season is during October to March of the coming year. Yellowfin tuna CPUE had positive effect on SST about 25˚C~30˚C, SSH about 0.2m~0.4m, MLD about 0m~30m and Chl-a less than 0.25mg/m3.The distribution of yellowfin tuna predicated CPUE showed the major fishing grounds were in the central-western Indian ocean and had seasonal variations, and the logbook data had higher correlation between nominal and predicated CPUE. The yellowfin tuna predicated catch rates of 2013 based on the model of 2010~2012 also showed the high correlation of $r=0.52$ in in March. In conclusion, the main fishing ground of yellowfin tuna was in the central-western Indian Ocean and changed in the third season. Our results suggest that models of catch rates of the 1° spatial grid data that incorporate relevant environmental variables can be used to infer possible responses in the distribution of highly migratory species.

Keywords: Indian Ocean、Bigeye tuna、Yellowfin tuna、Generalized Additive Models、Spatial distribution

B4

環臺岸基海洋雷達表層海流觀測網發展現況與應用

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摘要

國研院海洋中心之 Taiwan Ocean Radar Observing System (TOROS) 團隊於 2009 至 2015 年 1 月逐步完成 17 座 CODAR SeaSonde 系統之測站建置，包含 12 座長距型測站及 5 座標準型測站，雷達系統因使用不同頻率而有觀測距離之差異，TOROS 團隊依據不同的量測目的架設測站，已初步達成 10 公里空間解析等級之環臺測流之目標。為消弭本島近岸觀測盲區，於 2017 年 9 月新增枋寮標準型測站，增加小琉球以東之屏東近岸海域海流資訊，枋寮站的架設為臺灣西南海域的海洋科學研究與海難搜救提供良好的數據支撐。

在海流資料品管中，TOROS 團隊導入 3 倍標準差之品管概念，依據各徑向系統觀測區域之海流特性，大幅改善了自雷達回波都卜勒譜中框定海流訊息之參數設定可靠度，此外亦加入時間與空間連續性、合理性的資料品管機制，期望能改善異常干擾所導致的海流觀測誤差。同時並發展出與氣象局/水利署所佈建之錨碇浮標測流資料之近即時自動化比對監測網頁，透過監測雷達與浮標系統測流之偏差變化來近即時地檢出系統異常事件。在另一方面，亦採用帶有 2 公尺拖曳傘之 GPS 報位漂流浮標推算表層海流速度並與雷達系統之徑向與合成海流資料比對，實現點與線的表層海流資料比對驗證工作。

海洋中心以建構海洋科技研發平台、支援學術研究與推動海洋科技前瞻研究為主要任務，近年更積極推展科研工作的在地價值，例如支援海岸巡防署導入優選化搜救系統(SAROPS)，以前瞻科技所觀測而得之海洋環境數據，提升我國海難搜救規劃、走私查緝等海洋事務管理之效益。此外，今年初更因綠島遭受油汙染事件影響，而在環保署油汙應變團隊的要求下，提供實測表層海流數據作為 OILMAP 溢油擴散模擬軟體之環境計算參數以及提供雷達回波資訊作為事發海域航行船隻偵測之用途。此一作業化觀測網將持續精進維運能量與技術，提供更高品質的海洋環境數據，提升我國海洋科研與海洋事務之水平。

關鍵字: 高頻雷達、作業化觀測網、表層海流、資料品管、浮標驗證、海難搜救、油污擴散、船艦偵測

B5

高頻海洋雷達電離層干擾濾除演算法

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摘要

海洋中心所設置的高頻雷達測流系統 (Taiwan Ocean Radar Observing System, TOROS)，由於使用頻段及天線系統特性，雷達回波訊號常受到赤道異常區電離層電漿不規則體現象，及不明無電線波頻率干擾，這些現象夜間比日間顯著又夏季比冬季明顯，除了導致測流系統在流場產出的不穩定性，也影響測流的精確度。本報告為建構一套濾除電離層及無線電波干擾訊號的方法。首先由瞭解 CODAR 系統之資料結構，從原始訊號的 I、Q 訊號，完成建立解析系統回波訊號能力。統計 2015 年 6-7 閱資料，顯示夜間比日間的背景雜訊最大可達約 15 dBm，同時在回波距離 100-150 km 間的背景雜訊，也高出約 5 dBm。另外發展出一套處理 CODAR 雷達海面回波互相關頻譜方法，從頻譜上區別海波、不規則體回波及無電線波干擾訊號，由互相關頻譜的同調性與相位差，是否具有結構性分布，做為區別電離層或雜訊干擾的主要特徵(Wang et al.2017)。基於這個特徵開發可以濾除電離層回波、外部電波或其他雜訊干擾的演算法。

B6

厦门湾及其周边海域海岸带动态变化遥测系统关键技术研究与应用

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摘要

本研究利用多源卫星遥感资料，结合车/船载全景采集平台、无人机以及视频监控等多种遥感技术初步构建了厦门湾及其周边海域的海岸带高分辨率遥感监测系统，开展了一系列海岸带遥感信息提取关键技术的研发，如水边线、DEM、土地利用/土地覆盖分类、湿地类型以及 SST/悬浮泥沙等信息的提取与反演；此外，基于 WebGIS 及 SQL 研发了厦门岸线、海滩以及滨海湿地动态变化监测系统软件平台，可初步实现卫星遥感岸线提取、海岸带海岛土地利用变化和红树林湿地等专题信息的展示与分析，并提供海岸带景观照片、视频以及无人机影像等可视化产品的查询与浏览。在此基础上，重点分析了厦门湾海岸线、红树林和潮滩等的动态变化特征，以及“莫兰蒂”台风事件对海岸带景观的影响，为厦门湾海岸带管理与评估提供重要的遥感技术支撑。

關鍵字: 卫星遥感、海岸带遥感信息提取、厦门湾、无人机、红树林、潮滩

B7

A Numerical Retrieval Algorithm for Delay-Doppler Map (DDM) Made by Oceanic Reflected GNSS signal

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Abstract

The research of Global Positioning System (GPS) signal begins at the end of 20 century and the beginning of 21 century. For example, the UK-DMS satellite has a payload of GPS reflective signal receiver and launched at September 27th, 2003. The reflective signal can be used to retrieve the sea surface roughness and then inverse the sea surface wind speed. In July 8th, 2014, the satellite of Technology Demonstration Satellite-1 (TDS-1) mission has been launched and also used to do the research of GPS reflective signal to inverse the sea surface wind speed. The mission of Cyclone Global Navigation Satellite System (CYGNSS) has launched 8 satellites in December 15th, 2016 to do the research of tropical cyclone by using the GPS reflective signal. As a part of F-7/C-2 mission, an additional satellite called FORMOSAT7-R developed by National Space Organization (NSPO) of Taiwan will carry GNSS reflectometer to measure the roughness and wind speed on ocean surface.

Due to the rapid change of sea surface wave, the receiving frequency of signal should be large to grasp the change of sea surface wave. However, the limit of data volume and transfer speed cannot allow too high receive frequency. The data format of Delay-Doppler Map (DDM) is first used in UK-DMC mission to resolve the problem and also used in TDS-1 and CYGNSS missions. DDM is the magnitude of cross correlation of signal delay and frequency. Otherwise, Zavorotny and Voronovich, (2000) inversed the multivariate normal distribution equation to express the DDM by using optical theories. In Z-V model, it contains the relative position and velocity of GPS satellite and receiver, Directional Mean Square Slopes (DMSS(σ^2_{up}, σ^2_{down})), and Principal Wave Slope Direction (PWSD(ϕ)). DMSS and PWSD are three unknow parameters in Z-V model. The purpose of this report is to develop a numerical retrieve algorithm to retrieve DMSS and PWSD in Z-V model. In order to make the retrieve ability of data analysis center before the statistic algorithm be developed after satellite launch. Then inverse the sea surface wind speed and furthermore put the sea surface wind speed into the forecast model to increase the accuracy of weather forecasting.

C1

閃電監測系統在海洋環境監測與預警之應用

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摘要

在海洋上航行的船隻，不論大小、用途，天氣和其航行安全有絕對的關係；海面上危險的天氣系統帶來強陣風，使船隻暴露於高安全風險中，常見的危險天氣包括颱風、梅雨鋒面、春季鋒面等。面對颱風，不論是中央氣象局或各式傳播媒體,都可以至少提前於2-3天前預警，海面作業有充分的時間進行整備應變。但面對梅雨鋒面或春末夏初的鋒面系統，其移動速度快，且強對流位置飄忽不定，天氣預報難以事先掌握雷雨區，僅能靠傳統緊盯雷達迴波的監控守視；由於雷達迴波的主動式掃描原理，加上整合時間，迴波產出時平均已落後實際時間10-15 分鐘，對於海面上強對流系統的掌握已有落後，應變時間極為短暫。

在對流系統的發展過程中，閃電是必然發生的過程。當一個對流胞逐漸高聳、向上發展，雲內冰晶上升時互相摩擦逐漸累積電荷，這便是閃電的能量來源。在對流胞發展的過程，對流胞內會先發生雲內的放電，稱「雲中閃電」；當對流胞發展成熟，雲內冰晶開始下墜，降雨及強陣風等較劇烈的天氣現象便會緊接出現，同時開始出現對地閃電，也就是我們熟知的「雷擊」。雲中閃電的密集發生，便可作為劇烈天氣發生前的徵兆指標。

有別於雷達迴波的主動式掃描需耗費一定時間，閃電監測儀器接收閃電發出的電磁波，可即時定位閃電發生位置，沒有任何時間落差。對全方位閃電監測網而言，其偵測波段含括「雲中閃電」、「對地閃電」，對雲中閃電的良好偵測，可以提前觀察到劇烈對流胞的發展，提前預警接下來可能出現的強降雨、強陣風等危險的天氣現象。

在實際航行應用上，全方位閃電監測網可對船隻發布基本的閃電接近預警，告知閃電所在船隻的相對位置和接近程度。當海面上明顯的雷雨胞發展，閃電監測網觀察到大量的雲中閃電數「躍昇」，系統可根據雷雨胞的過去軌跡，自動判定該雷雨胞未來 30 分鐘可能影響的區域，提前針對該區域提出危險雷雨預警。

閃電系統作為新型的劇烈天氣監測技術，可輔助雷達迴波同時監看，降低劇烈天氣對船隻航行造成的風險。

關鍵字：雲中閃電、對地閃電、全方位閃電監測網、閃電數躍昇、雷雨預警

C2

台湾海峡台风过程海洋环境变化分析

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摘要

颱風是短期改變海洋環境的重要動力因素，會對近岸海洋環境產生巨大的影響，颱風對海洋環境及氣候的影響，也越來越多的受到國際上的關注。福建沿海颱風影響頻繁，本文選取 2013 年 1307 號 “蘇力”和 1312 號“潭美”兩個路徑相似的颱風，基於福建近岸浮標及 MODIS 遙感的海表溫度、葉綠素等環境生態資料，分析福建近岸主要環境生態要素對颱風過程的回應及其變化規律，並借助於浮標有效波高和測風資料及遙感風場資料嘗試初步闡明其回應機制。

關鍵字: 颱風；海洋環境；福建近岸

C3

Response of Land-Sea Interface in Xiamen Bay to Extreme Weather Events Observed with the Ecological Dynamic Buoy Array, a Multifunctional Sensors System

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Abstract

Recent climate observations suggest that global climate change may result in an increase of extreme weather events (such as tropical cyclones, intense precipitation i.e. heavy rains) in frequency and/or intensity in certain world regions. Subtropical coastal regions are often densely populated areas experiencing rapid development and widespread changes to the aquatic environment. The biogeochemical and ecological responses of coastal systems to extreme weather events are of increasing concern. Enhanced river nutrients input following rain storms has been linked to the ecological responses at land-sea interface. These land-sea interactions can be studied using multifunctional sensors systems. In our study, the Ecological Dynamic Buoy Array, a monitoring system with multiple sensors, was deployed in Xiamen Bay for near real time measurements of different parameters. The Ecological Dynamic Buoy Array is a deep water net cage which functions in long-term synchronous observation of dynamic ecological characteristics with the support of an aerograph, water-watch, LOBO (Land/Ocean Biogeochemical Observatory), ADCP, CTD chain system, YSI vertical profiler, flow cytometer, sea surface camera, and "communication box". The study showed that rain storms during multiple typhoons resulted in greater fluctuations of salinity, N concentration, and other water environmental conditions, which might have been connected with algal blooms (so-called red tide) in Xiamen Bay.

Keywords: Ecological Dynamic Buoy Array; Land-Sea Interface; Extreme Weather Events; Xiamen Bay

D1

Terrestrial nutrient supply in the seas of Taiwan after typhoons

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Abstract

It has been reported that typhoons have significant impacts on nutrient supply in the ocean, but it is difficult to quantitatively evaluate terrestrial nutrient input in the seas of Taiwan due to sampling dangersous during typhoon conditions or flood periods. Our preliminary analysis showed the annual riverine discharge after typhoons in Taiwan was appropriately 25 (7~69) times higher than that during non-typhoon seasons from 2004 to 2016. The contribution of terrestrial nutrient export after the passage of typhoons was conservatively estimated about 40 (23~69) % of the annual nutrient supply. The result suggests that typhoons can elevately increase terrestrial nutrient export to the seas of Taiwan.

Keywords: nutrients, small mountainous rivers, typhoons

D2

印度洋黃鰭鮪各年級群釣獲率與海洋環境變動關係之研究

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摘要

本研究收集 2003-2012 年台灣鮪延繩釣於印度洋黃鰭鮪漁獲與體長量測資料，配合衛星遙測海洋環境資料包含海水表面溫度(SST)、葉綠素濃度(CHL)、混和層深度(MLD)、海水表面高度(SSH)等 4 項海洋環境因子與氣候變異指數，以解析黃鰭鮪各年級群之分布與氣候變遷所造成環境變動因素對各年級群之漁況與資源量長期變動的影響，並推測索餌場及產卵場與年級群變動之關係。各年級群與環境因子及氣候之關係為，黃鰭鮪未成熟群於第一、二季變動主要集中西北印度洋，而三、四季集中西南印度洋，且 MLD 與 CHL 為主要影響未成熟群分布之因子。綜合分析推測印度洋黃鰭鮪會在索餌場以及產卵場之間有遷移行為。

關鍵字：黃鰭鮪、印度洋、海洋環境變動、氣候變動、經驗正交函數。

D3

海洋資料庫之化學海洋資料簡介

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摘要

科技部海洋學門資料庫之化學海洋資料庫資料來源主要有三：其一是電子探針數據，來自海洋研究船，海研一、二、三號三艘海洋研究船所裝載的各式光學探針及導電度探針，包含有溶氧探針(Dissolved Oxygen Sensor)、透光度探針(Transmissometer)及螢光度探針(Fluorometer)等。其二是化學技術員從科技部海洋學門計畫資料上傳系統中搜尋可用數據，加以整合整併而得:根據「科技部海洋學門海洋量測資料繳交與釋出規定」計畫持人必須將資料繳交於海洋學門資料庫，但是繳交的資料可能無法利用，或是可以使用但相關航次資訊遺漏等，因此化學技術員會先將可用的數據篩選出來，再針對遺漏、不足甚至是重複繳交的部分，進行整併及整合，最後再依據標準格式進行入庫。資料庫最後一個很重要的實測資料來源，是南海時間序列研究站(South East Asia Time-Serious, SEATS)以及中山大學海洋科學系中山講座陳鎮東教授將歷年採樣實驗數據轉移海洋學門資料庫管理之數據。

截至 2017 年 7 月，海洋學門資料庫隨船電子探針數據共計有 3,169 個航次，52,987 個測站，若以每公尺深度為 1 筆資料計算，則資料總數為共 14,822,077 筆數據。實驗手測數據共計有 109 個航次，949 個測站，共 40,293 筆數據包含各式營養鹽、葉綠素及有機碳及無機碳等數據。

關鍵字: 海洋資料庫、海洋化學、營養鹽、葉綠素

D4

Diel abundance, growth and loss rates of *Synechococcus* spp. and picoeukaryotes in coastal waters during summer

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Abstract

We used flow cytometry to follow the diel variations of *Synechococcus* spp. and picoeukaryotic abundance in subtropical western Pacific coastal waters June 2017. Diel changed in the nanoflagellate grazing and viral-mediated mortality of *Synechococcus* spp. and picoeukaryotes were simultaneously estimated using a modified dilution method in this study. Abundance of *Synechococcus* spp. and picoeukaryotes showed clear diel patterns, with the highest values recorded at night. In our study, however, the apparent growth rate of *Synechococcus* spp. and picoeukaryotes decreased significantly upon dilution of nanoflagellate or viruses during daytime incubation. Our data imply that picophytoplankton production is in part dependent on virus-mediated nutrient cycling by bacteria during daytime. Furthermore, the estimated averaged mortality of *Synechococcus* spp. at night due to nanoflagellate grazing and viral lysis was 0.02 h^{-1} and 0.04 h^{-1}, respectively. In addition, this study found that nanoflagellate grazing played a key role in controlling picoeukaryotic abundance at night.

Keywords: *Synechococcus* spp., picoeukaryotes, mortality, nanoflagellate grazing, viral lysis

D5

淡水河口域刺網漁業資源結構之研究

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摘要

本研究收集 2014 年至 2016 年淡水河口域刺網漁業作業船之月別漁獲資料(logbook)，透過計算相對重要性指數(Important Relative Index, IRI)、更替指數(AI)、遷移指數(MI)、多樣性閥值(Dv)，藉以了解淡水河口內之漁業資源結構與海洋環境關聯之特性。研究結果顯示，2014 年春、夏季主要優勢種(IRI>1000)分別為白口(3101)、沙魚(2302)；白口(1003)、黑口(1113)，同年秋、冬季主要優勢種(IRI>1000)為白力魚(2073)；白鯧(1378)、烏魚(10024)。至於 2015 年春、夏季主要優勢種(為馬加鰆(7376)；沙魚(4446)；秋、冬季主要優勢種(相對重要性指數 IRI>1000)為白鯧(3902)、白力魚(1270)；烏魚(3117)、馬加鰆(1877)。此外，2016 年春、夏季物種大多皆為重要種(100≦IRI<1000)，依序為鯊、銅鏡、沙魚、甘仔、馬加春；銅鏡、三牙、小白鯧、鯊漁、白口；秋、冬季主要優勢種為馬加鰆(4031)、烏魚(2761)；鯊魚(7178)、烏魚(1734)。透過多樣性指數分析，淡水河口水域豐富度指數主要落在 0.5-1.0，多樣性閥值為 0-2.0，顯示該海域物種多樣性並無明顯變動。另外更替指數與遷移指數各季大致相同，顯示淡水河口水域各季移出和移入的物種數較接近，物種多樣性動態尚屬平衡。但更替指數在 2016 年第一季變動最大，表示此季的群落穩定性相較其他季差，其原因推測應與前一季水溫明顯降溫致使物種數明顯減少有關。

關鍵字: 淡水河口、相對重要性指數、生物多樣性、刺網漁業

D6

Interannual carbon and nutrients fluxes in southeastern Taiwan Strait

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Abstract

Connecting the South China Sea (SCS) and East China Sea (ECS) directly, the Taiwan Strait transports the mixed SCS water and the West Philippines Sea (WPS) water to the ECS (primarily in summer). In winter, the Minzhe Coastal Water flows southward. Located in the deepest part of the Taiwan Strait, the Penghu Channel contributes 60% of the northward flow. The volume transport is strongly influenced by the local wind speed which relates to ENSO. On the other hand, the westward transport of the WPS water through the Luzon Strait increases during El Nino events, and that increases the ratio of the WPS water in the northern SCS. The characteristics of the WPS surface water is warm, salty, and contains less carbon and nutrients than the SCS seawater. Different mixing ratios of the WPS water and the SCS water also affect the salinity, carbon and nutrients of the seawater in the Taiwan Strait. Interestingly, the highest wind speed and salinity do not appear in phase, suggesting that the water transportation and seawater mixing ratios may be influenced by different mechanisms.

This study focuses on how transported water volume and chemical parameters affect annual carbon and nutrient fluxes. The monthly transportation of water volume was adopted from the Hybrid Coordinate Ocean Model (HYCOM) results, and the CTD data were provided by the Ocean Data Bank (http://www.odb.ntu.edu.tw/; 1991-2014). The chemical parameter data were collected during 19 cruises in the Penghu Channel during 2000-2011. Niño 3.4 index leads the salinity anomaly which reflects the seawater mixing raito, but lags the satellite wind speed anomaly.

Keywords: Taiwan Strait, the South China Sea, ENSO, carbon flux, nutrients flux

D7

北南海顆粒側向傳輸

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摘要

在中國沿海海域，南海為熟知的貧營養鹽區域，在此處觀測得之葉綠素濃度也較低，先前研究認為在低葉綠素濃度區域應該會有較低之顆粒性有機碳濃度及通量。藉由自 2012 年起在南海北部東經 120 度 20 分，北緯 22 度站點在不同深度採集水樣以及佈放沉積物捕獲器獲得之長期觀測資料顯示，北南海區域表層海水葉綠素濃度約在 0.03 g L^{-1} 至 0.3 g L^{-1} 間，而葉綠素極大值出現在水深 50 公尺至 100 公尺水域，實測濃度區間在 0.4 g L^{-1} 至 0.65 g L^{-1}。在此樣點觀測之表層顆粒性有機碳 (Particulate Organic Carbon, POC) 濃度區間為 0.17 g L^{-1} 至 0.51 g L^{-1}。然而在此處水深 700 至 900 公尺觀測得之 POC 濃度相對於 150 至 600 公尺之濃度有升高現象。藉由衛星及現場實測資料計算，此處藉由表層生物產生之 POC 輸出至光透層以下不會產生如此高值。且經由沉積物捕獲器蒐集之下沉顆粒中可看到許多為非生物產生之陸源顆粒。因此推測此處深層水域產生之高 POC 通量及高濃度懸浮物質可能經由底層顆粒的再懸浮作用使底層顆粒上升至此深度，或高 POC 區域之顆粒經由海流側向傳輸至其他區域，使此處測得之 POC 濃度較高。

關鍵字：北南海、顆粒性有機碳(POC)、葉綠素(chl-*a*)、碳通量。

D8

台灣海峽中部浮游動物群集組成與水文因子之時空分佈與關連研究

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摘要

本研究利用海研二號研究船於 2017 年 4 月及 7 月航次在台灣海峽中部(位於雲彰隆起，自彰化海岸線向台灣海峽延伸 60 餘公里之海域)所設置的 5 個測站進行水文及浮游動物群聚時空分布之調查研究。研究結果顯示，7 月平均溫度較 4 月高出約 4°C，鹽度方面則以 4 月較高，透光度亦以 7 月時較高，但兩季間溶氧量與葉綠素 *a* 濃度差異不明顯。4 月時溶氧量與葉綠素 *a* 濃度由近岸向遠岸漸減，但 7 月則是呈相反的趨勢。透光度通常以近岸較低，7 月溫度有由近致遠岸漸減的趨勢，但在 4 月測站間差異不大，測站間之鹽度變化並不明顯。生物因子方面，兩季共發現 28 個浮游動物類群，平均測站豐度為 24,430±7,263$inds./100m^3$，平均類群豐富度(d)為 2.26±0.12、均勻度(J')0.52±0.03、歧異度(H')2.32±0.14。兩季的浮游動物群聚組成有明顯的差異，主要優勢類群為橈足類(哲水蚤和劍水蚤)，平均占總豐度的七成，但是其他優勢物種組成則有明顯不同，4 月其他優勢類群為毛顎類、蝦類幼生及介形類，7 月則為枝角類、海桶類及翼足類。7 月表層與深層之間浮游動物群聚組成有明顯的不同，但 4 月則不明顯，推測可能是因為 4 月海況風浪較大，水層混和較深，而 7 月浪況平穩，水層有明顯的分層所致。總體來說，此區域浮游動物群集組成以及水文環境因子隨著季節有明顯的差異，在前十大優勢的類群分析中，大多與鹽度與葉綠素 *a* 有明顯關聯。

關鍵字: 台灣海峽、浮游動物、季節差異

D9

高雄港浮游動物群聚多樣性及存活率研究

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摘要

本研究在 106 年 2 月及 5 月於高雄港內 12 個測站進行水文和浮游動物的採樣調查，探討港區內水文環境對浮游動物群聚時空分佈及存活率之影響。研究結果顯示 2 月的海水重金屬，包括銅、鋅、錳平均濃度均高於 5 月，但 5 月的水溫、PH 值、溶氧量、及葉綠素 A 濃度顯著較 2 月高。浮游動物平均存活率 2 月略低於 5 月，而浮游動物平均豐度則以 2 月顯著較高於 5 月，歧異度亦以 2 月較高，但差異不顯著。浮游動物的 2 月前三優勢物種為哲水蚤、劍水蚤、及橈足類幼生，5 月前三優勢物種為哲水蚤、蝦類幼生、及翼足類。由群聚分析結果顯示，水文站群群聚有一定程度的季節差異，但 2 月的測站 12 明顯不同於其他測站，主要是因為該站有超高的錳濃度所致；浮游動物群聚則分 3 個類群，2 月位於港口出入口的 4 個測站自成一群，5 月份的另一個群聚位於水道出海口處及港口出入口處。高雄港區內的研究數據顯示，2 月的海水錳濃度與浮游動物存活率呈負相關，與豐度和歧異度則無顯著相關。

關鍵字: 高雄港、中性紅、重金屬、浮游動物存活率

D10

颱風侵襲對雲林麥寮海域水質與浮游生物之影響 -以 103 年至 105 年為例

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摘要

本研究根據麥寮周遭海域水質生態 103-105 年共 12 季調查結果進行分析，每年調查均在 1、4、7、10 月進行。結果顯示，採樣前未有颱風影響時，本海域浮游生物豐度呈現 4、7 月高於 1、10 月的季節性變化；採樣前有颱風影響時，浮游生物豐度明顯下降，但海域水質中之矽酸鹽、硝酸鹽與亞硝酸鹽三種營養鹽與溶解態重金屬元素 Cd 與 Co 的濃度則有上升的現象。

由調查期間該海域浮游生物豐度的資料來看，颱風侵襲後，浮游生物族群豐度需一年時間得以回復，然浮游生物豐度與水質之相關性統計結果顯示，浮游植物豐度與三種營養鹽的相關性不明顯，但與重金屬鋅有明顯相關；而浮游動物則僅與葉綠素 a 及重金屬六價鉻有明顯相關，但該海域最常見之優勢物種 *Temora turbinata* 豐度則與水溫有明顯相關。

關鍵字: 麥寮、海域生態、浮游生物、颱風

D11

颱風對雲林麥寮海域沉積物與底棲生物之影響探討

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摘要

雲林麥寮周遭海域沉積物分布長期受濁水溪注入陸緣懸浮顆粒的影響，濁水溪為臺灣第一大河，其形成之沖積扇總面積約 1,800 平方公里，為本省最大沖積扇，谷口扇頂以礫石及砂為主，扇末端則以細砂及泥為主。根據過去對濁水溪沖積扇地層重金屬的調查，沖積扇沉積物中含有高濃度的砷。

本研究係於 2015 至 2017 年 4 月間進行 10 季次沉積物及底棲性生物族群豐度調查，沉積物採樣位置包括麥寮海域濁水溪口潮間帶、新虎尾溪口以及離島工業區外水深 10 公尺與 20 公尺處共 14 個測站；調查項目沉積物重金屬砷與沉積物粒徑。調查則於 2016 至 2017 年 4 月間進行 6 季次調查，路線是以離島工業區六輕園區溫排水渠道口為界，以蝦拖網船進行南、北二側水深 10 公尺與 20 公尺四條測線拖網作業，每條測線作業時間 0.5 小時。

沉積物重金屬砷之季平均值介於 4.76~12.88 mg/kg，以 2016 年第 4 季測值最低，2017 年第 1 季最高。經比較研究期間颱風出現時間、各季採樣時間、沉積物重金屬砷測值與環保署濁水溪西螺大橋每月懸浮固體濃度測值後，發現麥寮沿海沉積物重金屬砷濃度，在颱風通過台灣中部區域隔日，並未出現隨濁水溪懸浮固體濃度升高的現象，6 日後則隨著濁水溪懸浮固體濃度的減少而逐漸升高，另外砷濃度會隨季節變化由冬季至夏季逐漸降低；整體空間分布則以濁水溪口潮間帶與新虎尾溪口二處沉積物的砷濃度相對較高。

麥寮海域沉積物顆粒組成主要為中等粗砂、粗砂、細砂及泥，基本上，濁水溪口至六輕園區溫排水渠道口以砂質為主，六輕園區溫排水渠道口至新虎尾溪口以泥質為主；水深 20 公尺處的沉積物顆粒粒徑大於水深 10 公尺處，並從冬季至夏季逐漸變小，夏秋季颱風後粒徑則再因濁水溪補注入海而增大。

底棲性生物 6 季次調查種類數介於 33~62 種，豐度介於 932~2,277 隻；空間分布上，則以六輕園區溫排水渠道口南側豐度高於北側，水深 20 公尺處之豐度高於水深 10 公尺處，並未發現颱風對底棲性生物豐度有明顯影響。

D12

Primary production and squid catches affected by typhoon events in the southern East China Sea

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Abstract

Typhoons can cause billions in property damage and great human toll on land and sea.However,Typhoons occurring in open ocean and their collective effects upon the marine environment and fishery remain undefined because of sampling difficulties. Here we investigated hydrographic data, plankton and squids catch data in the Southern East China Sea (SECS) prior to and following the passage of several typhoons from 2008-2010. The results shows that (1)The average integrated Chl-a concentrations (110 mg m–2) post-typhoon were significantly higher than that before the typhoons (35 mg m–3) ,and (2)Abundance of surface microphytoplankton are remarkable increased.(3) The pre- and post-typhoon daily squid catch per unit effort (kg d–1 boat–1) was 15 ± 31 and 240 ± 281 (p=0.005, n=13), 107 ± 201 and 106 ± 82 (p=0.1, n=12), and 160 ± 136 and 283 ± 274 (p=0.01, n=13) for typhoons Fengwong, Sinlaku and Jangmi, respectively. This suggests that typhoons may mitigate the effects of overfishing in marginal seas.

Keywords: Typhoon, Primary Production, Squid Catches, Southern East China Sea, Marginal Seas.

D13

基于漂浮式沉积物捕获器和模拟沉降柱的边缘海生物泵及其调控研究

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摘要

海洋生物泵是海洋生态系统储碳的重要途径，而颗粒沉降是生物泵有机碳输运的关键过程。相对于开阔大洋，全球边缘海虽然面积很小，但因初级生产力高，对有机碳的埋藏贡献大，因此，边缘海对全球碳循环和碳埋藏具有重要意义。然而，由于边缘海环境梯度和生物群落时空变化大，其颗粒有机碳输出通量和生物泵效率的调控机制目前尚不清楚。

本研究采用漂浮式沉积物捕获器、甲板模拟沉降等实验手段，在夏季南海北部不同生态系统（陆架、陆坡、海盆）开展颗粒有机碳（POC）输出通量、浮游植物和浮游动物群落结构（丰度、生物量、类群组成）、浮游植物和浮游动物粪球沉降速率研究，同时在东海春季藻华期间开展对比研究，探讨不同生态系统和藻华事件对 POC 输出通量及其与浮游生物群落结构的关系，初步结果如下：

1. 内陆架区 A8 站（水深 57 m）、中陆架区 C6 站 （水深 70 m）和陆坡区 C9 站（水深 1300 m）真光层底部 POC 输出通量分别为 73.8 mg C m^{-2} d^{-1} 、86.2 mg C m^{-2} d^{-1} 和 124.2 mg C m^{-2} d^{-1}。POC 输出通量呈陆架-陆坡测站增加趋势，陆架区上层浮游植物输出通量与浮游动物粪球相当，但在真光层底部，后者为主要贡献者。

2. 上述测站浮游动物粪球 POC 输出通量分别为 34.2 mg C m^{-2} d^{-1}、49.2 mg C m^{-2} d^{-1} 和 104.2 mg C m^{-2} d^{-1}，浮游动物粪球对 POC 输出通量贡献率约为 27~84%。陆架-陆坡测站浮游动物粪球 POC 输出通量逐渐增大，且贡献比例亦逐渐增大。浮游动物粪球主要来自桡足类的圆柱形粪球，占总粪球 POC 输出通量的比率约为 42-64%。

3. 从近岸-陆架到陆坡断面，水柱中浮游植物和浮游动物生物量、浮游动物粪球 POC 含量呈逐渐降低的趋势。甲板模拟沉降实验的计算结果表明，真光层底部浮游动物粪球 POC 输出通量对总 POC 输出通量的贡献比率逐渐升高（57-86%），而浮游植物 POC 输出通量贡献逐渐减少（43-14%）。GAM 模型分析结果显示，水柱中浮游动物粪球 POC 含量与优势浮游植物类群（如原绿球藻、硅藻、绿藻、定鞭藻等）生物量呈显著正相关，而浮游动物粪球沉降速率与浮游植物和硅藻生物量显著正相关。浮游植物群落结构的变化不仅改变浮游植物输出通量，还影响浮游动物粪球沉降速率和输出通量，进而调控生物泵效率。

关键词：边缘海、群落结构、浮游植物、浮游动物粪球、颗粒有机碳、输出通量

E1

建置海象災防服務平台

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摘要

臺灣位於颱風容易侵襲的亞熱帶區域之太平洋西岸，惡劣的海象災害如颱風波浪、暴潮溢淹、甚至是海嘯衝擊等，容易造成外洋的船隻觸礁、碰撞甚至傾覆，造成油污溢油，對於住在海岸的居民生命財產也造成威脅，因此海氣象資訊對於海上航行安全、海岸結構設計等影響極大，準確的海氣象資訊是減少意外災害的發生及生命財產的損失之重要一環。

為了有效因應災害應變以及維護民眾的生命安全，本研究積極發展海象災防應用技術，以提升海象觀測與預測的應用價值。海象災防應用技術發展包含「臺灣海象災防服務平台」、「西北太平洋海象資料庫」、「海象災防應用技術」。「臺灣海象災防服務平台」是一個提供資訊服務的網路平台，透過人性化的介面，將海象資料透過動畫、地圖與不同的警示顏色展示，以便利的網頁和使用者互動。為了使平台能順利提供資料，儲存巨量海象資料的「西北太平洋海象資料庫」亦不可或缺，「西北太平洋海象資料庫」整合西北太平洋與臺灣附近海域之海流、潮位、波浪、海水位與海溫等觀測與模式資料，對外提供海象測報展示或資料下載；除了即時的觀測資料，也包含災害期間的歷史資料，例如：即時近岸海流資料、颱風波浪資料、海平面上升數據等等。「海象災防應用技術」配合平台展示的災害資訊以及所蒐集之資料進行加值分析，整合各機關需求之災防預測技術，建立溢油漂流、海難漂流、颱風波浪、暴潮溢淹、海嘯溢淹、海平面上升、海運安全、潮間帶警示、熱含量分析等海象預警資訊，透過該平台掌握特定海域、季節之海洋環境觀測資訊，以及災害性海象之預測結果，協助我國相關權責機關進行災害防救任務時參考。此外，臺灣海象災防服務平台也可供應相關學術單位取得研究所需的海象觀測資料，獲取近岸地區的海象觀測資訊將有助於海洋科學、海洋工程領域的研究，亦可進一步運用數值模式準確預測或預警可能發生的海象災害。

關鍵字: 臺灣海象災防服務平台、海象災防應用技術、西北太平洋海象資料庫

E2

颱風對濁水溪河口周邊海域懸浮質輸運之影響

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摘要

濁水溪流域地層屬易受侵蝕的板岩、頁岩及沙岩，溪水夾帶大量懸浮沉積物輸出至河口，其懸浮沉積物輸送的時空分佈，始終是個未知數，學界估算之年輸砂量約為 3000~6000 萬方不等，為台灣地區懸浮沉積物輸送量最大的河川。雲林縣離島式基礎工業區的開發產生突堤效應，打破濁水溪河口周邊特別是河口南岸的輸沙平衡，造成南側海岸之侵蝕。為緩解突堤效應之影響，台塑企業每年拋放良質沙 60 萬方，以減緩沿岸的侵蝕情況。本研究皆選擇大潮時段以船拖 ADCP 圍繞海拋區進行完整潮週期之連續監測，記錄由表水層至底床的流速剖面及回聲強度剖面。回聲強度經水樣濃度校正後，轉換為懸浮質濃度，與流速剖面積分即得各測線的懸浮質通量。

2016 年 6 月 3 日（拋沙作業結束後的第二天）、2016 年 9 月 22 日（莫蘭蒂颱風過境後的第七天、馬勒卡颱風過境後的第四天）及 2017 年 5 月 1 日（空白對照，無拋沙作業無颱風豪雨）三種不同條件下調查結果顯示，海拋區東測線三次調查之淨懸浮質通量由高至低依序為颱風豪雨 2.48±0.79 g/m^{2}s 向東、拋沙作業 1.34±0.56 g/m^{2}s 向東和空白對照 0.32±0.66 g/m^{2}s 向東，颱風引起的懸浮質向東之輸運量約為拋沙作業的 2 倍、空白對照的 8 倍；南、北二測線三次調查之近岸淨懸浮質通量均向北，通量值為颱風豪雨（南側測線 2.94±1.97 g/m^{2}s，北側測線 3.29±1.46 g/m^{2}s）最高、拋沙作業（南側測線 1.60±1.66 g/m^{2}s，北側測線 2.67±1.71 g/m^{2}s）其次，空白對照（南側測線 1.50±1.20 g/m^{2}s，北側測線 1.53±1.23 g/m^{2}s）最低，顯示颱風豪雨事件會引起更多的懸浮質沿近岸向北輸運。離岸段之懸浮質輸運情況則頗為複雜：北側測線上離岸段在空白對照組情況下，具最大的南向淨懸浮質通量-0.34±0.31 g/m^{2}s（負號代表通量向南，下同），其次為拋沙作業情況-0.20±0.85 g/m^{2}s，而颱風豪雨情況下淨懸浮質通量轉而向北 2.96±0.35 g/m^{2}s；南側測線上離岸段之淨懸浮質通量則均向南，但通量值以颱風豪雨為最大-2.80±0.33 g/m^{2}s，其次為空白對照的-2.04±0.37 g/m^{2}s，拋沙作業的最小-1.47±0.68 g/m^{2}s。同步進行的水樣採集量測結果顯示，拋沙作業最大濃度 11.16 mg/L 低於颱風豪雨影響下最大濃度 55.82 mg/L 和空白對照的最大濃度 14.84 mg/L，僅颱風條件下的最大漂沙濃度高於影響牡蠣生長濃度 50 mg/L。

關鍵字：海岸侵蝕、拋沙養灘、颱風、懸浮質濃度

E3

海岸線管理的國際經驗

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摘要

海岸线不是一条线，而是陆地与海洋之间相互作用的一个区域。当前海岸线面临着人为威胁和自然威胁，人为威胁表现为海岸线资源利用冲突加剧，海水水质恶化以及栖息地破坏；自然威胁包括海平面上升、海岸侵蚀和风暴潮洪灾的威胁。本研究旨在分析总结美国、澳大利亚、日本等世界主要海洋强国海岸线管理经验，为我国海岸线管理提供借鉴。研究发现当前国际海岸线管理的主要经验如下：（1）强调法规和规划先行，如美国沿海各州根据《1972 年海岸带管理法》的规定通过实施国家海岸带管理项目来统筹解决沿海开发与自然环境和资源保护以及应对气候变化影响的问题；加拿大根据《加拿大海洋法》的规定所制定的《加拿大海洋战略》和《加拿大海洋行动计划》选择在优先区域实施综合管理规划来对海岸线开发利用活动实行基于生态系统的管理，确保海岸线生态系统健康；此外，加拿大沿海各省还制定了相应的气候变化适应性规划，用于解决因气候变化引起的海平面上升、海岸侵蚀和极端天气等影响。澳大利亚通过各州制定的海岸规划来解决各州的海岸线开发利用与保护问题；韩国通过实施沿岸整治十年计划来进行海岸侵蚀和防灾减灾的管理。（2）强调保护优先。如美国通过实施活力海岸线项目（Living Shorelines）（图 1）对海岸线进行修复；日本对不同行业实施以岸线保护为目的管理措施，包括海岸保护区制度、围填海管理、港口环境治理等。（3）强调公众参与。如美国《1972 年海岸带管理法》要求联邦政府通过公开和公众评估的方式对沿海各州的海岸带管理项目实施成效进行评估；如澳大利亚昆士兰州的海岸规划就要求沿海社区参与海岸带管理的决策过程，并与之分享海岸带资源及其管理信息。

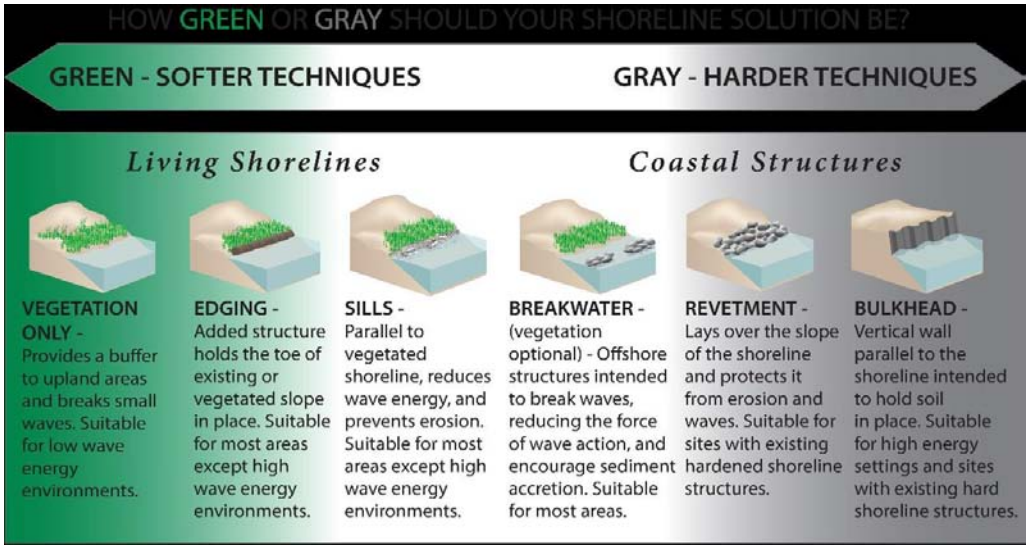

图 1 美国活力海岸线技术

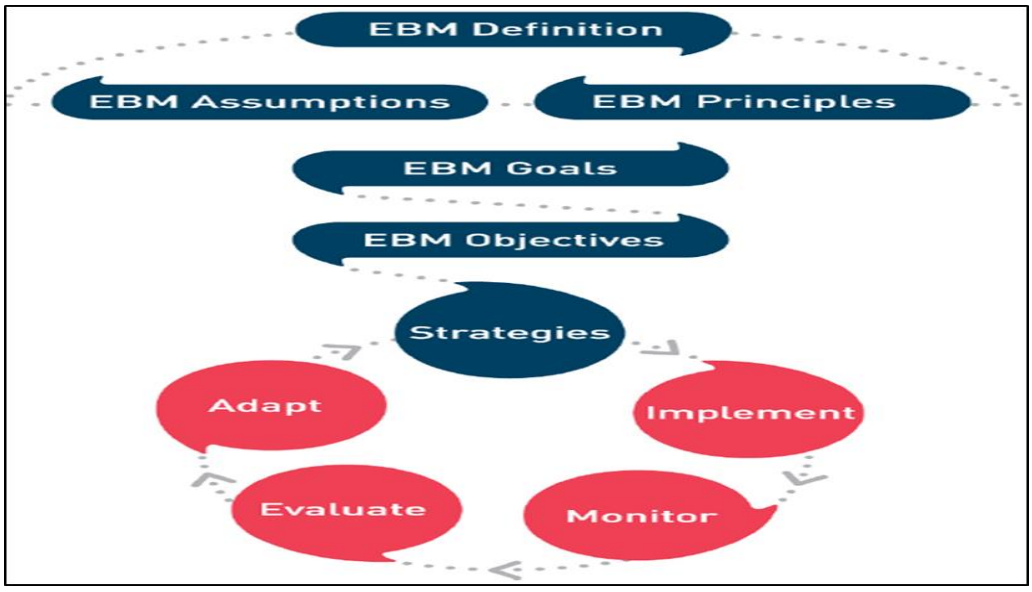

图 2 基于生态系统管理的太平洋北部海岸综合管理区规划框架

關鍵字: 海岸线，威胁，管理，国际经验

E4

科学决策在溢油事故治理中的应用

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摘要

溢油事故是当今人类社会面临的重大海洋环境污染风险，随着科学技术的不断进步，海洋石油开发由近海走向深水，从而导致风险进一步加大，应对该风险则需要与之对应的高科技手段。诚如在 2010 年墨西哥湾深水地平线事故治理过程中所呈现的一样，科技支撑下的科学决策主导了整个事故的治理，从应急到赔偿，再到修复，在多个角度，多个维度均发挥了不可替代的作用。本文将对科学决策在溢油事故治理中的角色进行分析，同时以深水地平线事故为例剖析科学决策的重要意义。

關鍵字: 科学决策、溢油事故、治理

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