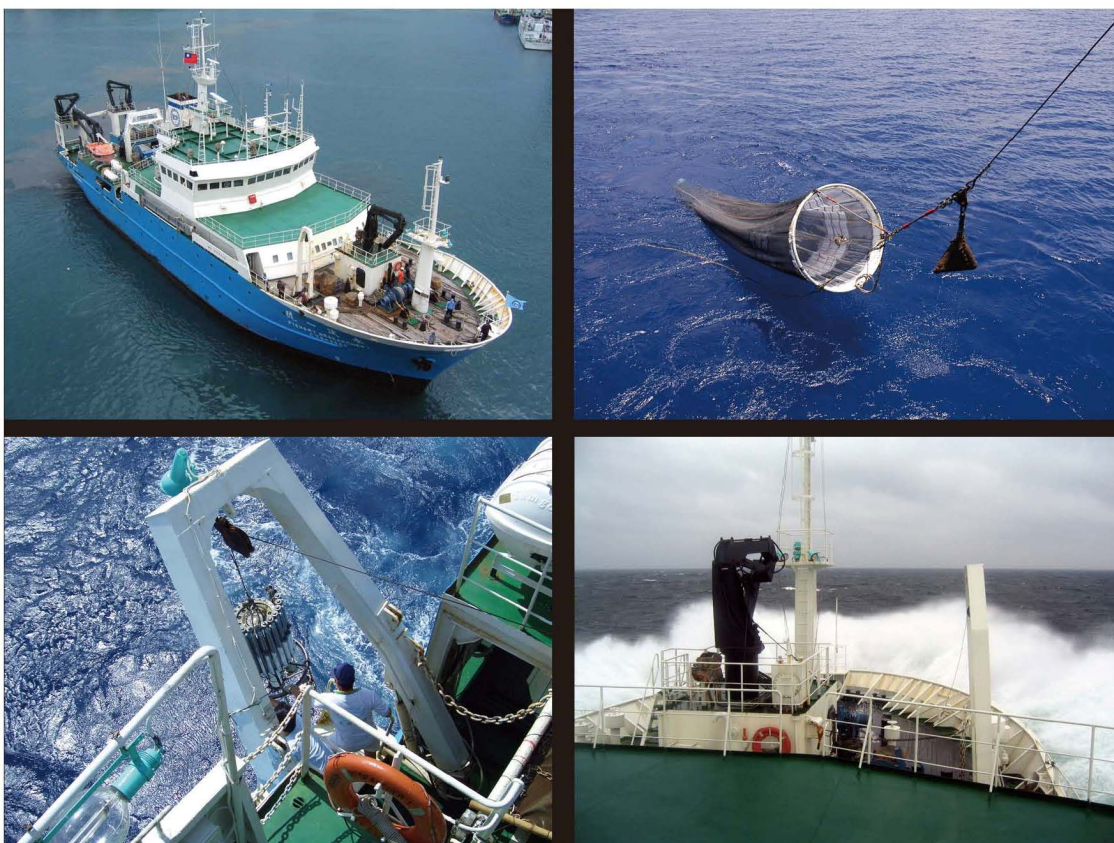




Cruise Report of TaiCOFI Surveys in 2013

2013年臺灣周邊海域漁場環境監測航次報告



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序

臺灣以海洋興國，周邊二百哩經濟海域內 43 萬平方公里的藍色國土，孕育著無限寬廣的機會，向海洋發展更見證了臺灣人民不畏艱苦的勤奮特性，而得天獨厚的海洋環境賜給我們豐富的漁業資源，各式新鮮美味的魚蝦蟹貝更是國人最優質的蛋白質來源。然而，臺灣沿近海漁業資源之利用已趨飽和，如何在人口增加的同時兼顧糧食需求的增加，謀求資源開發與生態保育間之平衡，將是我們未來最大的課題與挑戰。

漁業是一個古老的行業，但管理漁業資源卻需要最先進的科學。氣候變遷造成海水溫度升高，除了造成魚類棲地的改變，亦直接影響了魚群洄游的路徑與時間，改變了暖水性與冷水性魚種的分布界線，造成漁場的改變甚至消失，對漁業資源造成深遠的影響，而水溫、鹽度、基礎生產力等水團特性則是影響漁場、漁期變動的關鍵因子。為此，許多國家已致力於長期海洋環境及生物資源觀測資料庫之建置，以求有效監測海洋物理與化學環境，方能及時發現問題並提供解決對策，期能降低氣候變遷之衝擊。

長期海洋環境觀測是一個持續進行的過程，也是一連串的挑戰。本所自 2003 年起執行「臺灣周邊海域漁場環境監測計畫」，運用「水試一號」與「水試二號」試驗船及其配備的各項科儀設備，克服一切險阻按季於周邊海域各測站蒐集海域溫鹽、營養鹽、葉綠素甲、基礎生產力及浮游動物等漁場環境資訊，迄今連續 13 年未曾間斷。本專刊記載彙錄同仁們辛苦工作的結晶，衷心希冀藉由本專刊之發行，將調查成果作為學術應用、漁業管理與接軌國際之橋梁，為我國漁業資源永續利用奠定良好之基礎。

所長

陳君如

謹誌

中華民國一零四年十二月

Preface

Taiwan is an island and the ocean is our priceless property. The EEZ of Taiwan covers 430 thousand square kilometers of ocean and unlimited opportunities. Consequently, the government promotes "Ocean rejuvenating" policy ideas and it fits well with the diligent nature of people in Taiwan. Our ocean is favorably endowed with all kind of fishery resources, which provide our compatriots the best high quality animal protein. However, the coastal resources are declining in recent years. Therefore, the balance between fishery development and conservation will be the biggest challenge in the future.

Fishery is an old business, but to manage it properly requires state of the art science. Climate change lead to rising water temperature, with the consequences of changing habitats, alteration of distribution boundary, and the oscillation of fishing grounds of aquatic resources. The effect of climate change is profound for fishery resources and water temperature, salinity and primary production of the water masses are the key factors that affect the variation of fishing grounds and fishing season. As a result, in order to monitor our ocean and to detect anomalies effectively and to find a way to mitigate the impact of climate change, many countries have devoted to establishing their long-term database for marine environment and aquatic living resources.

Long-term observation of the ocean is a continuous process with a series of challenges. Fisheries Research Institute implemented the Taiwan Cooperative Oceanic Fisheries Investigations (TaiCOFI) program to investigate in the hydrography and fisheries resources in the surrounding waters of Taiwan since 2003 and now a consecutive 13 years database of marine environment was established. With the publication of "Cruise report of TaiCOFI surveys in 2013", we hope this project to be helpful for fishery researchers and policy makers and to promote international academic exchange. Finally, we hope this project will contribute more to the society and lead fisheries in Taiwan toward sustainability.

Director

June-ru Chen

Fisheries Research Institute

前言

近年來由於全球氣候變遷及海洋環境污染問題日益嚴重，許多國家已致力於海洋環境及生物資源之基礎探測與資料庫之建置。然以往我國有關海洋方面之研究計畫多侷限於局部海域之短期研究，觀測線或觀測點常隨計畫主題改變而改變，缺乏長期而有系統性的調查資料，再者，多數計畫係以海洋物理化學為研究重點，漁業研究學者欲將這些資料應用在水產資源研究上，著實不易。

有鑑於此，水產試驗所於 2003 年起著手實施「臺灣周邊海域漁場環境監測」計畫，於周邊海域設置 62 個測站按季蒐集水溫、鹽度、營養鹽、葉綠素、浮游動物等漁場環境資訊，嘗試透過此全面性之調查來瞭解臺灣周邊海域長期水文、海況及漁業生物時空分佈資訊，進而掌握影響臺灣周邊海域漁業資源變動的機制。多年來，承蒙各方提供寶貴之經驗與建議，不斷改進海洋探測科儀操作及採樣相關流程，在本所同仁與國內相關學術單位的共同努力下，無論在各項科儀操作效率、漁場環境調查技術或漁業生物研究上均已小有成果。

本專刊彙集本所於 2013 年執行「臺灣周邊海域漁場環境監測」計畫（農委會科技計畫編號：102 農科-11.2.2-水-A1(1)）之調查成果，計畫執行之海上採樣作業流程、各調查項目實驗室檢測流程、各航次出海採樣及樣本分析人員均有詳述於後，此外，利用 Surfer 軟體以圖示方式刊出臺灣周邊海域之水溫、鹽度、營養鹽、葉綠素、浮游動物及基礎生產力等漁場環境因子之調查成果以供各界參考。本計畫內容涉及廣泛專業領域，雖戮力以赴亦難免有疏漏不周之處，希冀各界先進不吝賜教斧正。

Introduction

With the changing of climate and the growing of marine environmental pollutions in recent years, many countries have devoted to establishing their database for marine environment and aquatic living resources. However, in the past, marine research programs in Taiwan were mostly confined to a short time scale and of a limited region. Besides, transects or stations of surveys were usually changing with the changing of projects, resulted in a scarcity of long term and systematic observations of waters around Taiwan. Furthermore, most programs were aimed at marine chemistry and physics studies. It is hard for fishery scientists to incorporate that information into fishery stock assessment.

As a result, Fisheries Research Institute implemented 「Taiwan Cooperative Oceanic Fisheries Investigations, TaiCOFI」 program in 2003 to conduct quarterly cruises to collect water temperature, salinity, nutrients, chlorophyll-*a* and zooplankton measurements at 62 stations in the surrounding waters of Taiwan. Through this thorough investigation, we try to understand the coupling of physical, chemical and biological dynamics in the surrounding waters of Taiwan to figure out the factors associated with the fluctuation of fishery resources. For the past years, we really appreciated for the valuable advices from academic communities to improve our field sampling techniques and operation procedures of marine observation instrument. With the hardworking of our staff members and associated academic organizations, now we have preliminary achievements in the operating efficiency of marine observation instruments, fishing ground investigation techniques and fisheries biology research.

The data presented in this report were collected by TaiCOFI cruises in 2013. Data from the cruises were collected and processed by personnel of FRI and Professor Cheng Shiue-Yuan of National Taiwan Ocean University participated in the analysis of primary productivity. Standard procedures of field program and sample analysis are described in detail and the distribution of water temperature, salinity, nutrients, chlorophyll-*a*, zooplankton and primary production are illustrated in figures for each cruise. Finally, we will extend our special thanks for your advices to improve this cruise report.

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海上採樣作業流程

在臺灣周邊海域選定 62 個測站，利用水試一號與水試二號試驗船及其裝備，按季節別於 2013 年 1 月、5 月及 10 月，進行下列之工作項目：

1.CTD 溫鹽調查：

採用 Seabird SBE-911PLUS 溫鹽深儀 (CTD)，每測站均投放至 1000 m (水深不足之測站則以實際水深少 10 m 為原則)，取得溫深鹽之連續資料。

2.分層採水：

利用 General Oceanics 之自動採水瓶，採取 5、25、50、75、100、150 m 等水層之海水各 2000 ml。

3.葉綠素甲測定：

取各層海水 1000 ml，利用 Millipore 濾紙過濾後，以 -20°C 急速冷凍保存，再攜回實驗室檢測。

4.營養鹽類測定：

分別收集各層海水 100 ml，以液態氮(-196°C)急速冷凍保存後，再攜回實驗室檢測。

5.浮游動物採集：

以 ORI 網下放至 200 m 深(水深不足之測站則以實際水深少 5 m 為原則)，以 1 m/s 速度上揚，取得之樣本以 5%福馬林海水溶液保存，再攜回實驗室測定生物量及分類。

Field Observations

The survey was carried out in the waters surrounding Taiwan by *Fishery Researcher I* and *Fishery Researcher II* during quarterly cruise in January, May and October in 2013. The following procedures were conducted at each station.

1. Temperature and salinity:

CTD, Seabird SBE-911PLUS, was lowered from the surface to 1000 m (or 10 m above the bottom for shallow areas).

2. Water sampling for chlorophyll-*a* and nutrients:

The Rosette (GO-1015), mounted on the frame of CTD, were sequentially closed and collected 2 liter water sample at specific target depths (5, 25, 50, 75, 100, 150 m) as the CTD was raised.

3. Chlorophyll-*a* concentration measurement:

One liter of sea water samples were immediately filtered through Whatman GF/F filter papers and then put in -20°C refrigerator for chlorophyll-*a* concentration measurement in the laboratory.

4. Nutrients concentration measurement:

100 ml of sea water samples for each depth were collected and then put in liquid nitrogen (-196°C) for nutrients concentration measurement in the laboratory.

5. Sampling gear and methods for zooplankton:

The ORI net, with a 1.6 m diameter mouth opening, 6 m in length and 0.333 mm meshes, was towed obliquely to 200 m (for shallow areas, 10 m above the bottom) at each station. The net opening is fastened with a short 3-lead bridle connected to several meters of line which attached to the towing cable by a clamp. A General Oceanic flowmeter is suspended across the center of the net mouth to measure the amount of water filtered during each tow. The net was towed at a ship speed of 1.0 knots for about 10 minutes. After the net was on board, samples were pouring into the PVC bottle and preserved immediately in 5 % formalin buffered with sodium borate.

樣本實驗檢測流程

壹、營養鹽、葉綠素及基礎生產力之測定流程

取各水層水樣急速凍結保存後，分析各水層之硝酸 (nitrate)、磷酸 (phosphate)、矽酸 (silicate) 等營養鹽，另外將濾畢各層海水之濾紙以丙酮溶解萃取出葉綠素分析其葉綠素甲濃度；利用光暗瓶溶解氧法，分析臺灣周邊海域之基礎生產力 (primary productivity)。

1. 硝酸測定：

硝酸以 Wood-Armstrong-Ricgard 法測定，將過濾之試水通過銅-鎘還原管，使硝酸還原成亞硝酸，然後加入 Sulfanilamide 及 NED 溶液，於分光光度計上以 542 nm 測定吸光值並計算其濃度，另取同樣試水不經銅-鎘還原管，直接測定水中之亞硝酸濃度，將經過銅-鎘還原管之數值扣除水中亞硝酸之濃度後，依銅-鎘還原管之還原率計算水中硝酸之濃度。

2. 磷酸測定：

磷酸以 Molybdenum blue-Ascorbic acid 法測定，將過濾後之試水加入以 Ammonium molybdate、Sulfuric acid、Ascorbic acid 及 Potassium antimonyl-tartrate 所配製的還原溶液，待其成色後在分光光度計以波長 885 nm 測定吸光值並計算待測物之濃度。

3. 矽酸測定：

矽酸以 Molybdosilicate 法測定，將過濾之試水先後添加 50 % HCl、10 % Ammonium molybdate 及 10 % Oxalic acid 後，加入以 1-amino-2-naphthol-4-sulfonic acid、 Na_2SO_3 及 NaHSO_3 所配製的還原試劑，混合完成後於分光光度計上以波長 815 nm 測定其吸光值，由各波長之吸光值並計算待測物之濃度。

4. 葉綠素甲測定：

葉綠素甲以 Trichromatic 法測定，將各水層過濾後的濾紙，分別加入丙酮研磨後，放入恆溫培養箱 (4 °C) 24 小時之後，將樣品置於冷凍離心機 4 °C、轉速 3000 rpm 離心 15 秒後，分別取出上清液，使用分光光度計測其各波長之吸光值後由公式 (Jeffrey and Humphrey, 1975) 計算葉綠素甲濃度。

5. 基礎生產力測定：

將試水分別裝入錫箔紙包覆之暗色溶氧及透明瓶中，分別進行光度恆溫培養，經 24 小時後，測定溶氧瓶中水樣始末之溶氧差，換算成碳生產力即得。

貳、浮游動物鑑種及計數流程

返航後先將樣品靜置，以便後續分量。

分樣：

取一瓶樣品，將其上部的澄清液先用小塊 100 目網布過濾直至網布上有浮游動物出現為止，然後先將樣品瓶中的動浮液倒入小燒杯中，再利用洗滌瓶將樣品瓶中及網布上的浮游動物完全沖洗至小燒杯內，再將採樣回來的樣品瓶上標籤撕下，貼在一個 150 ml 的標本瓶上。接著，將小燒杯中的動浮液倒入分樣器中，將分樣器左右擺動約十次，然後站在分樣器前方目測左右數量是否一致，若一致再將其倒出，倒出後會分為兩部分，將其中一部分裝入剛才貼有標籤的 150 ml 的標本瓶（該瓶分量為 1/2），將剩下的那一部分再倒入分樣器內進行分樣，重複上述步驟。直到目測該分量的樣品中約有 1000 隻左右浮游動物為止。

鑑種及計數：

將該測站的最小分量樣本瓶中的動浮液倒入培養皿，將裝有動浮液的培養皿擺上顯微鏡的載物台計數及鑑種，計數時以 Z 字的方法依序計數，一個方格內的動浮算完再算下一個方格，鑑一隻就按一下該種的計數器，緩慢移動培養皿，該培養皿算完後，將其倒入 250 ml 的燒杯中，再算第二盤直到將該最小分量樣本瓶中的動浮液全數算完，此時確認計數器的值全部加起來是否有超過 2000 隻，若超過 2000 隻，該測站即計算完畢；若尚未超過 2000 隻，則將另一瓶還未計算的最小分量樣本瓶的動浮液全數算完，若仍然小於 2000 隻，就再將上一分量的樣本瓶的動浮液全數算完，直到計數器全部加起來有超過 2000 隻，該測站樣本才算計數完畢。

生物沉澱量、排水容積、濕重：

1. 生物沉澱量：取 100 ml 沉澱管，將管中的水位都標定到 100，靜置一個晚上後，目視生物沉澱量刻度，在記錄沉澱管上的數值時需要往下數一格，以減少誤差。
2. 濕重：將一測站之樣本倒入沉澱管中，並注意沉澱管中樣本之容積之刻度，在將沉澱管中之樣品倒入吸引器中，將其樣本浮游動物與樣本液分開，吸至浮游動物沒有多餘之樣本液後，將其浮游動物放入秤中量其重量，即為其濕重。
3. 排水容積：濕重測量完畢時，剩下的澄清液倒入沉澱管中觀察其刻度。

Laboratory procedures

Seawater samples were collected at discrete depths (from 5 to 150 m) for inorganic nutrients (NO_3^- 、 PO_4^{3-} 、 SiO_2^{2-})、chlorophyll-*a* (chl-*a*) and primary productivity (PP) and then were analyzed with standard methods depending on variable chemical properties in the laboratory.

1. Nitrate

Nitrate (NO_3^-) was measured by reducing nitrate to nitrite (NO_2^-) and then determining the nitrite by employing the pink azo dye method. Sulfanilamide and NED solutions were added to seawater samples and then measured by using a spectrophotometer analyzer at 542 nm for final determination of concentrations.

2. Phosphate

Phosphate (PO_4^{3-}) was determined by the molybdenum blue method. Ammonium molybdate、Sulfuric acid、Ascorbic acid and Potassium antimonyl-tartrate mixed solutions at room temperature were added to seawater samples and then measured by using a spectrophotometer analyzer at 885 nm for final determination of concentrations.

3. Silicate

Silicate (SiO_2^{2-}) was measured by the Molybdenum blue method. Seawater samples were immediately acidified with 50 % Hydrochloric acid、10 % Ammonium molybdate and 10 % Oxalic acid and then 1-amino-2-naphthol-4-sulfonic acid、 Na_2SO_3 and NaHSO_3 mixed solutions was added to the samples. For final determination of concentrations, samples were measured by using a spectrophotometer analyzer at 815 nm.

4. Chlorophyll-*a*

Chlorophyll-*a* (chl-*a*) was measured by the Trichromatic method. Pigments were extracted in cold acetone (90%) for 24 hours. The samples were centrifuged at 3000 rpm under 4°C for 5 minutes and then transfer the samples extracts from the centrifuge tube to the cuvette by careful pipeting. The final determination of chlorophyll-*a* samples were measured by using a spectrophotometer.

5. Primary productivity

Primary productivity (PP) were measured by the Dissolved Oxygen method. Seawater samples were cultured in the light and dark tanks for 24 h and then measured by using a DO meter analyzer on board.

6. Zooplankton

Each plankton sample was repeatedly divided with a Folsom splitter until its subsample contained 2000 specimens of zooplankton. Zooplanktons were then sorted and classified into 30 categories. The number of each category was recorded and the abundance of each category was expressed as the number of individuals per cubic meter (inds/m^3).

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浮游動物分類	林芝仔、潘佳怡

略語表

Abbreviations

Date	作業日期
SMT	作業開始時間
Lati.	緯度(°N)
Long.	經度(°E)
Depth	深度(m)
SST	表層水溫(°C)
Air T.	氣溫(°C)
Air P.	氣壓(mb)
Wind D.	風向
Wind F.	風速(節)
O.N.D.	作業水深(m)
Fl. Ct.	濾水器讀數
V.W.S.	濾水體積(m ³)
N.A.	Not Available

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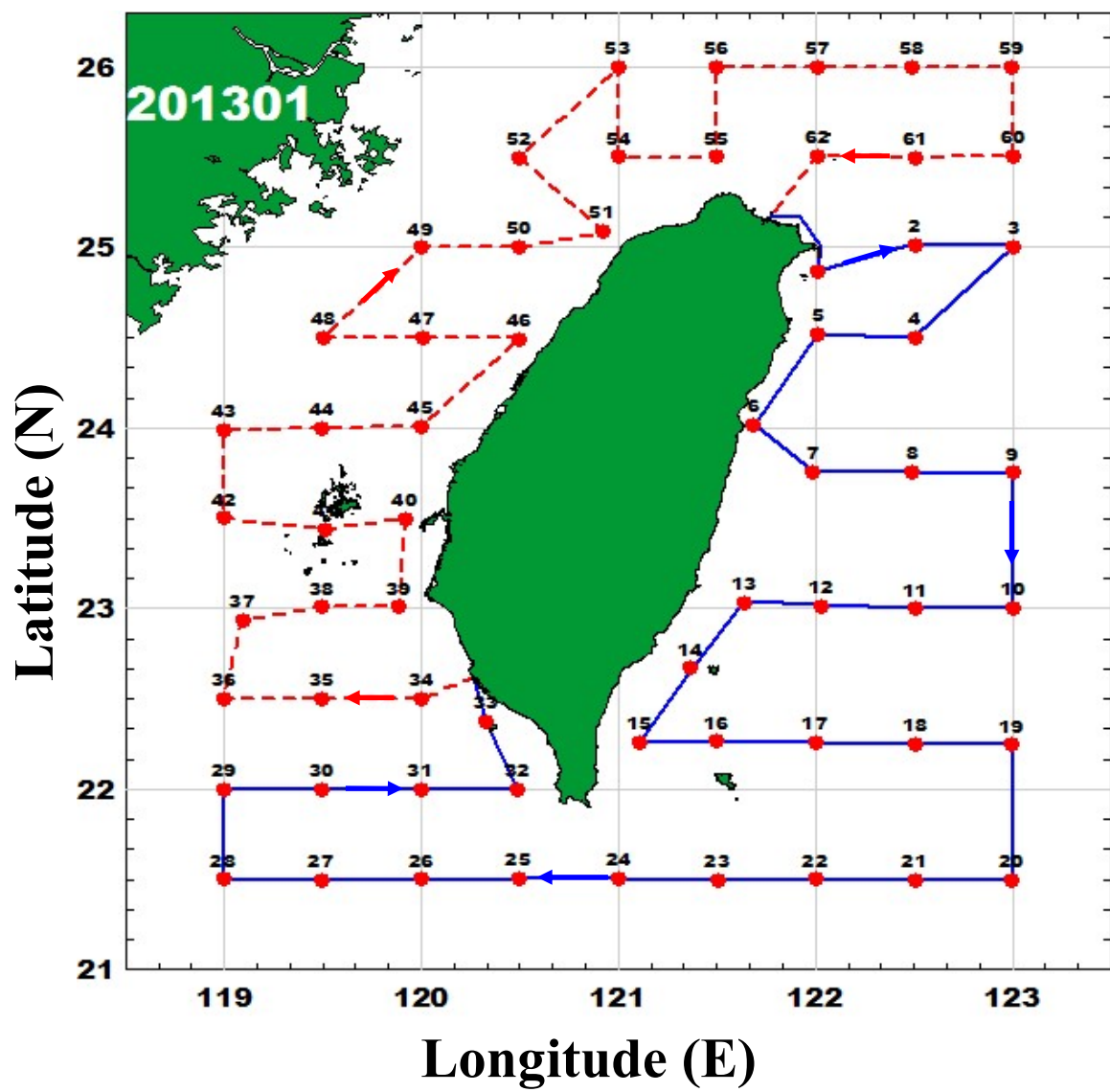


圖 01. 2013-01 航次航跡圖

Fig. 01. Stations and cruise tracks for TaiCOFI survey in Jan. 2013.

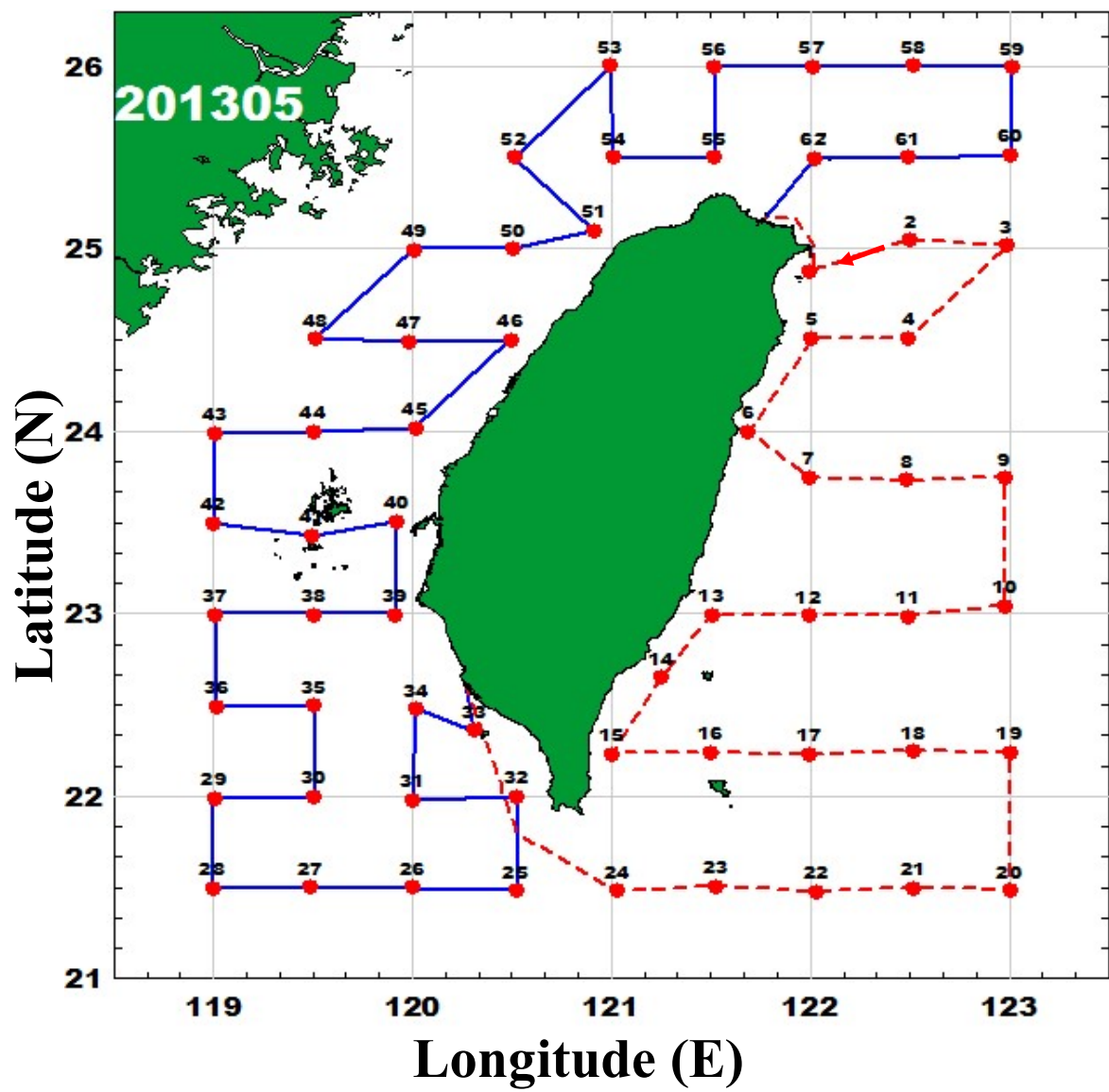


圖 02. 2013-05 航次航跡圖

Fig. 02. Stations and cruise tracks for TaiCOFI survey in May 2013.

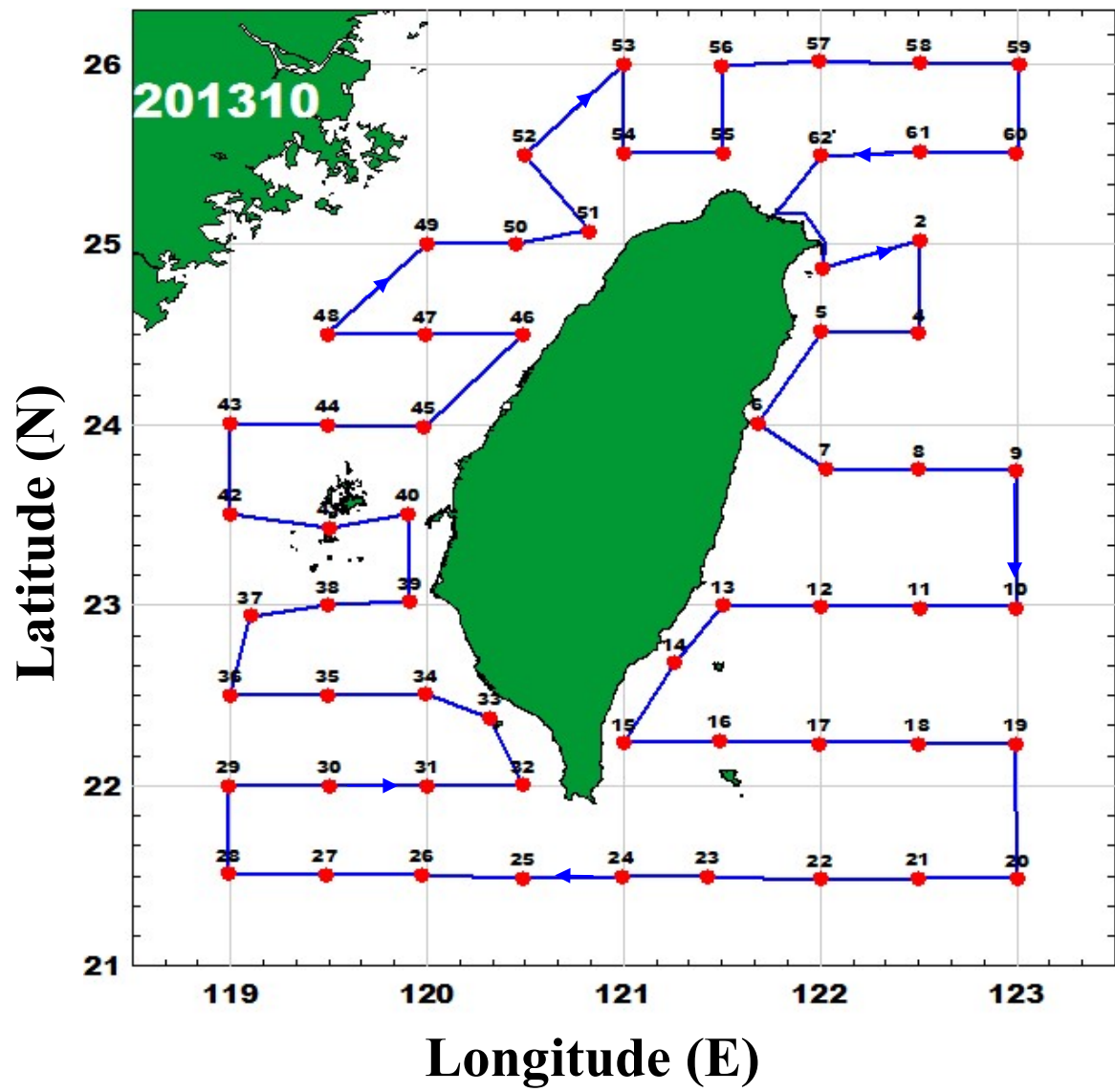


圖 03. 2013-10 航次航跡圖

Fig. 03. Stations and cruise tracks for TaiCOFI survey in Oct. 2013.

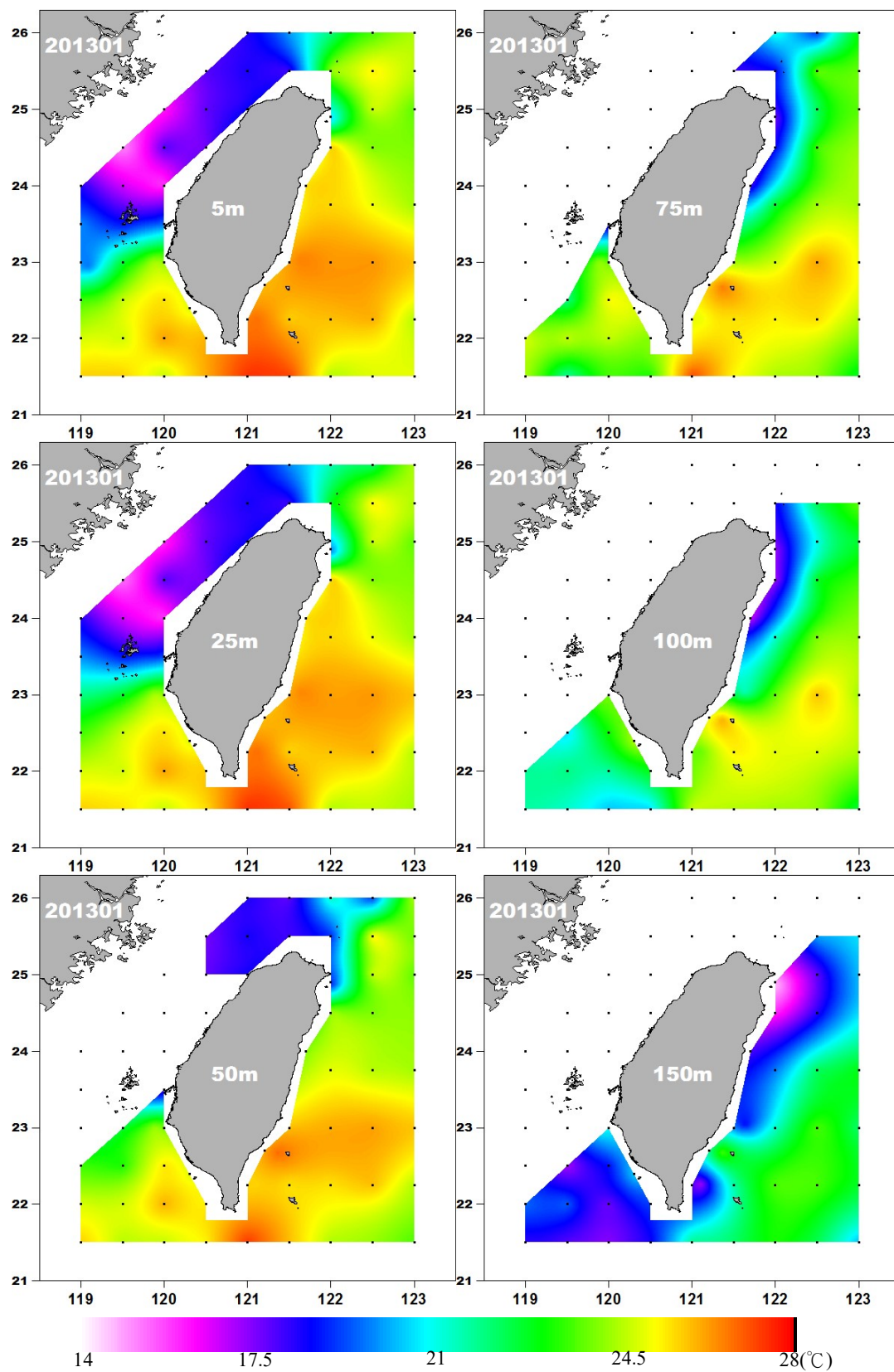


圖 04. 2013-01 航次水溫分布

Fig. 04. Temperature distribution in Jan. 2013.

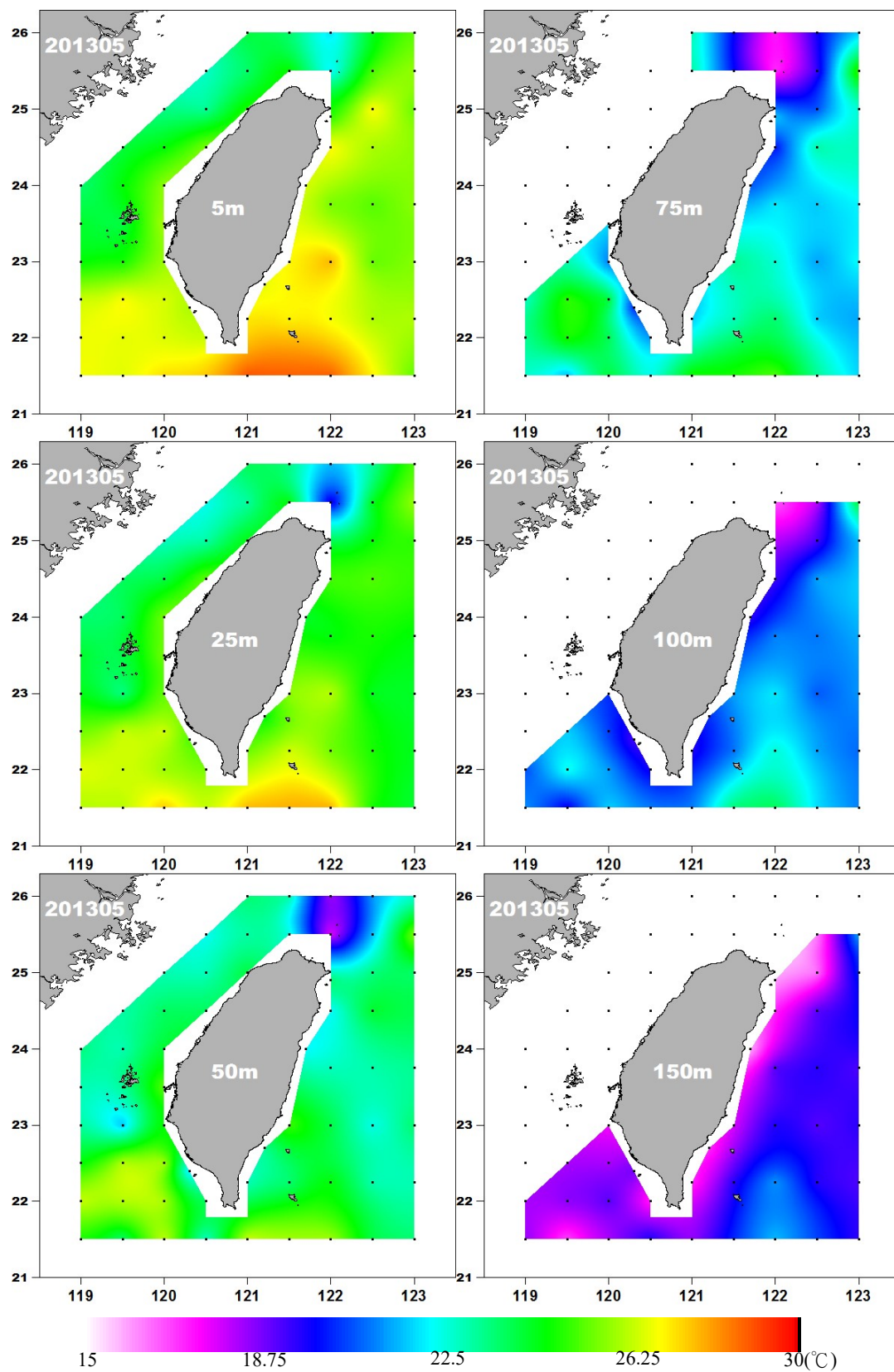


圖 05. 2013-05 航次水溫分布
Fig.05. Temperature distribution in May 2013.

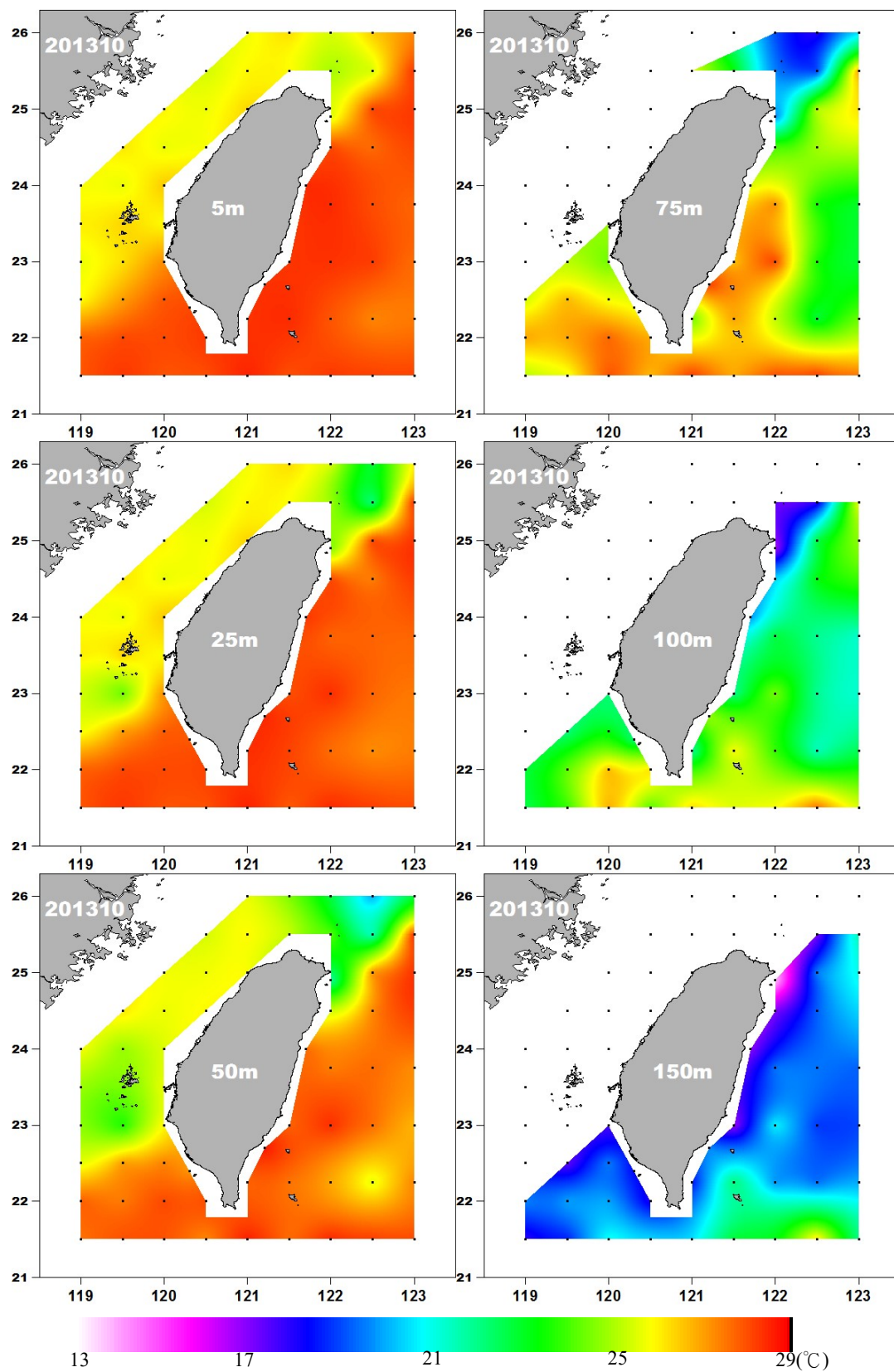


圖 06. 2013-10 航次水溫分布
Fig. 06. Temperature distribution in Oct. 2013.

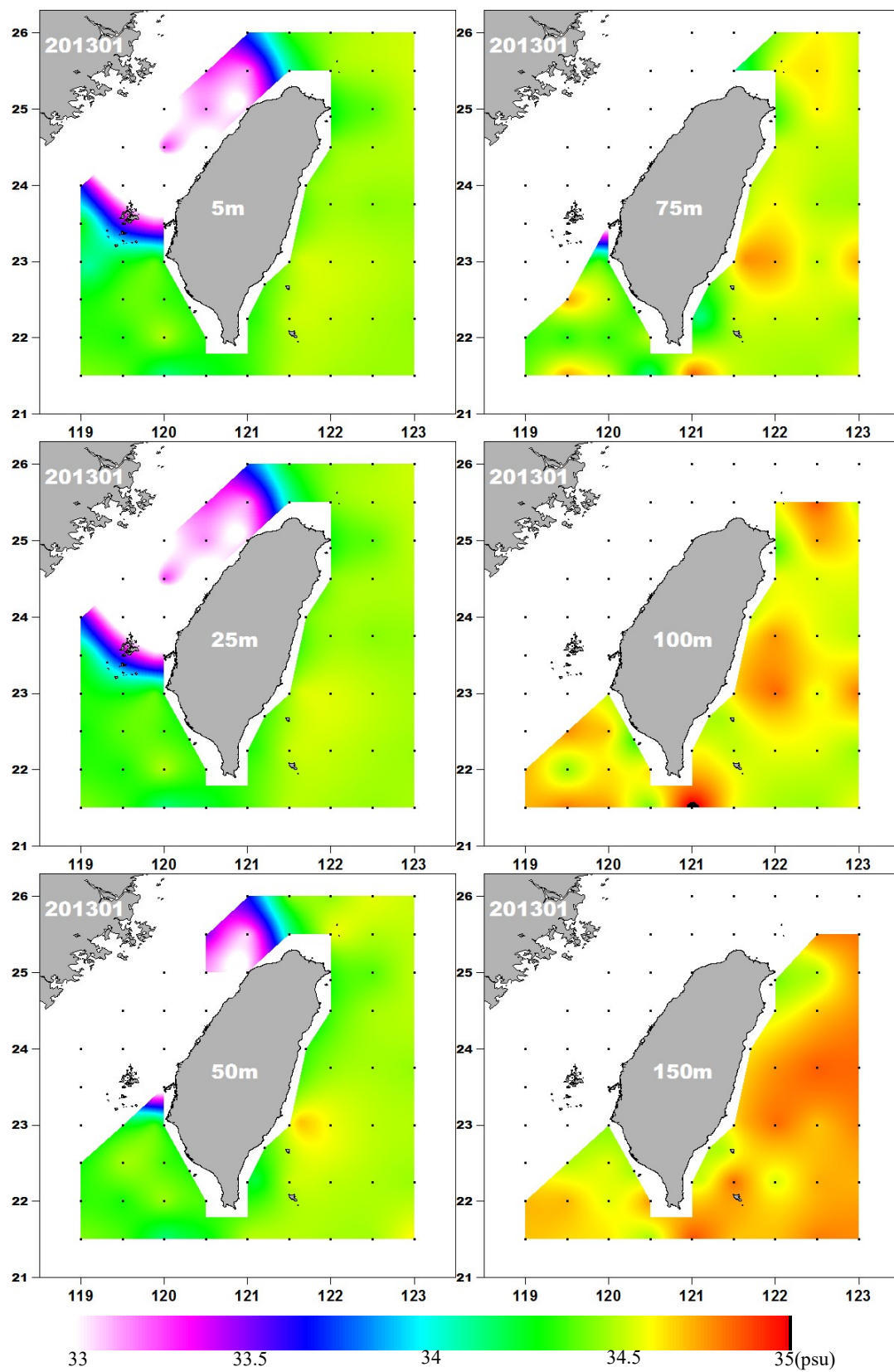


圖 07. 2013-01 航次鹽度分布
Fig. 07. Salinity distribution in Jan. 2013.

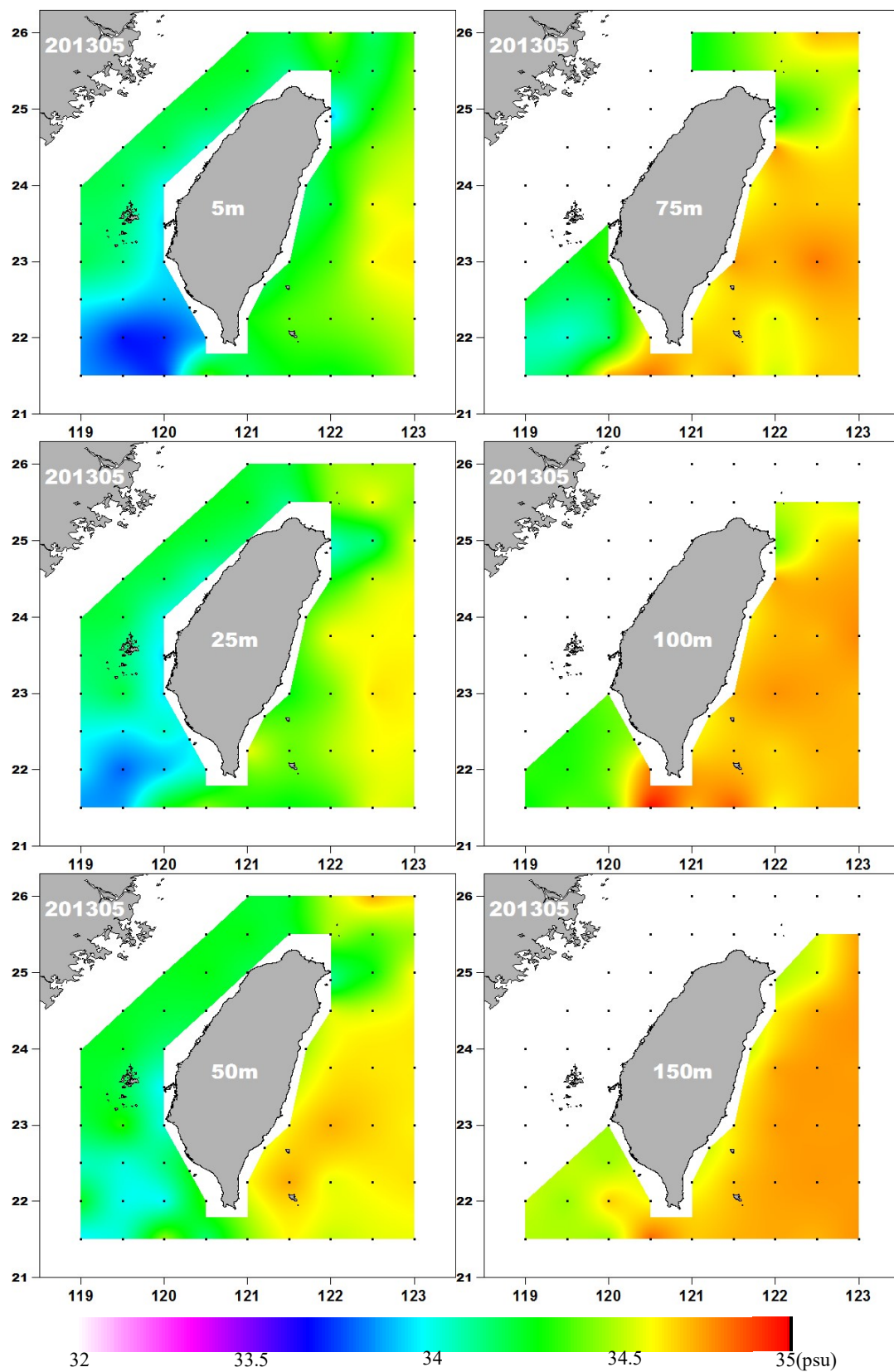


圖 08. 2013-05 航次鹽度分布
Fig. 08. Salinity distribution in May 2013.

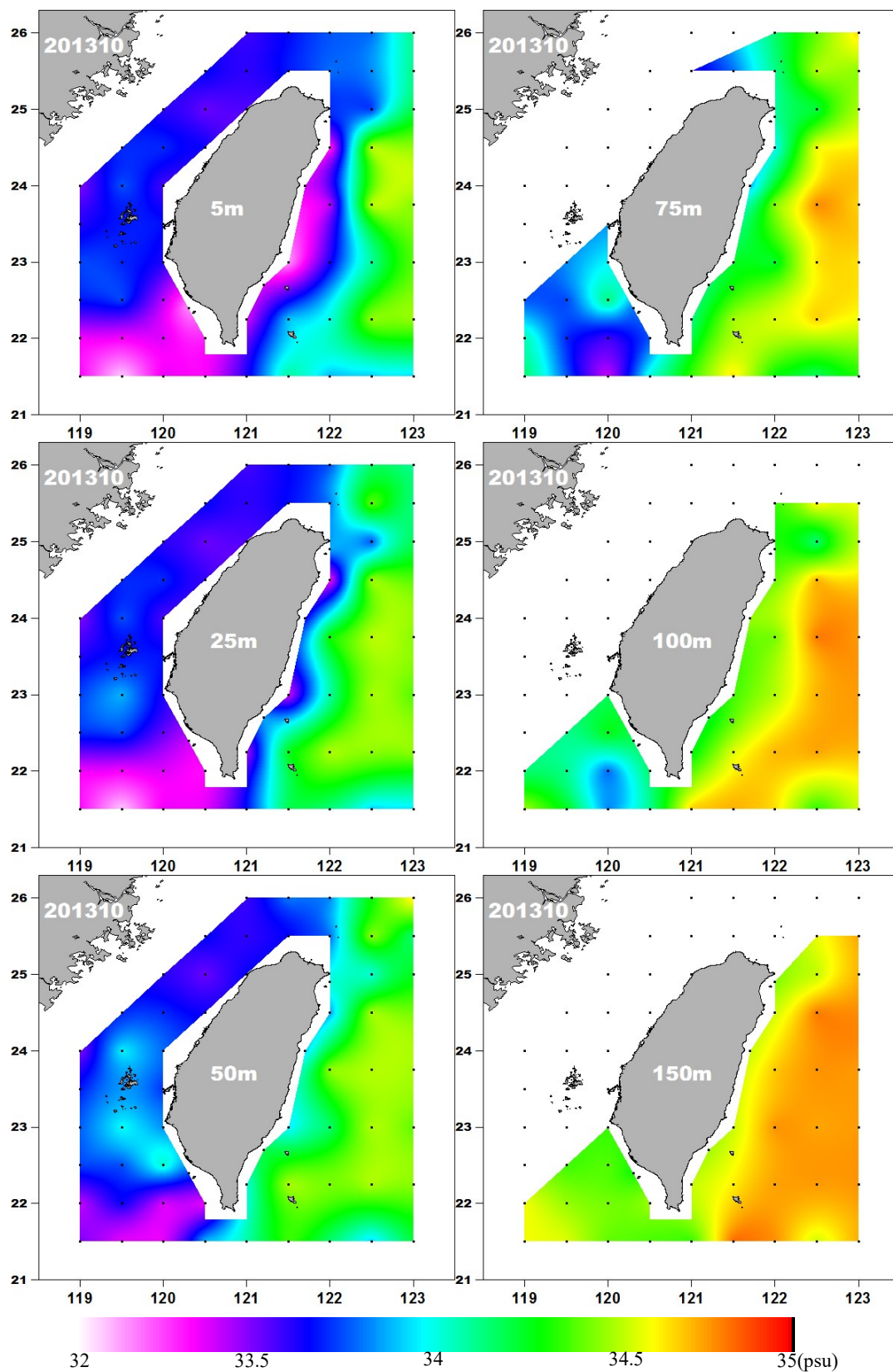


圖 09. 2013-10 航次鹽度分布
Fig. 09. Salinity distribution in Oct. 2013.

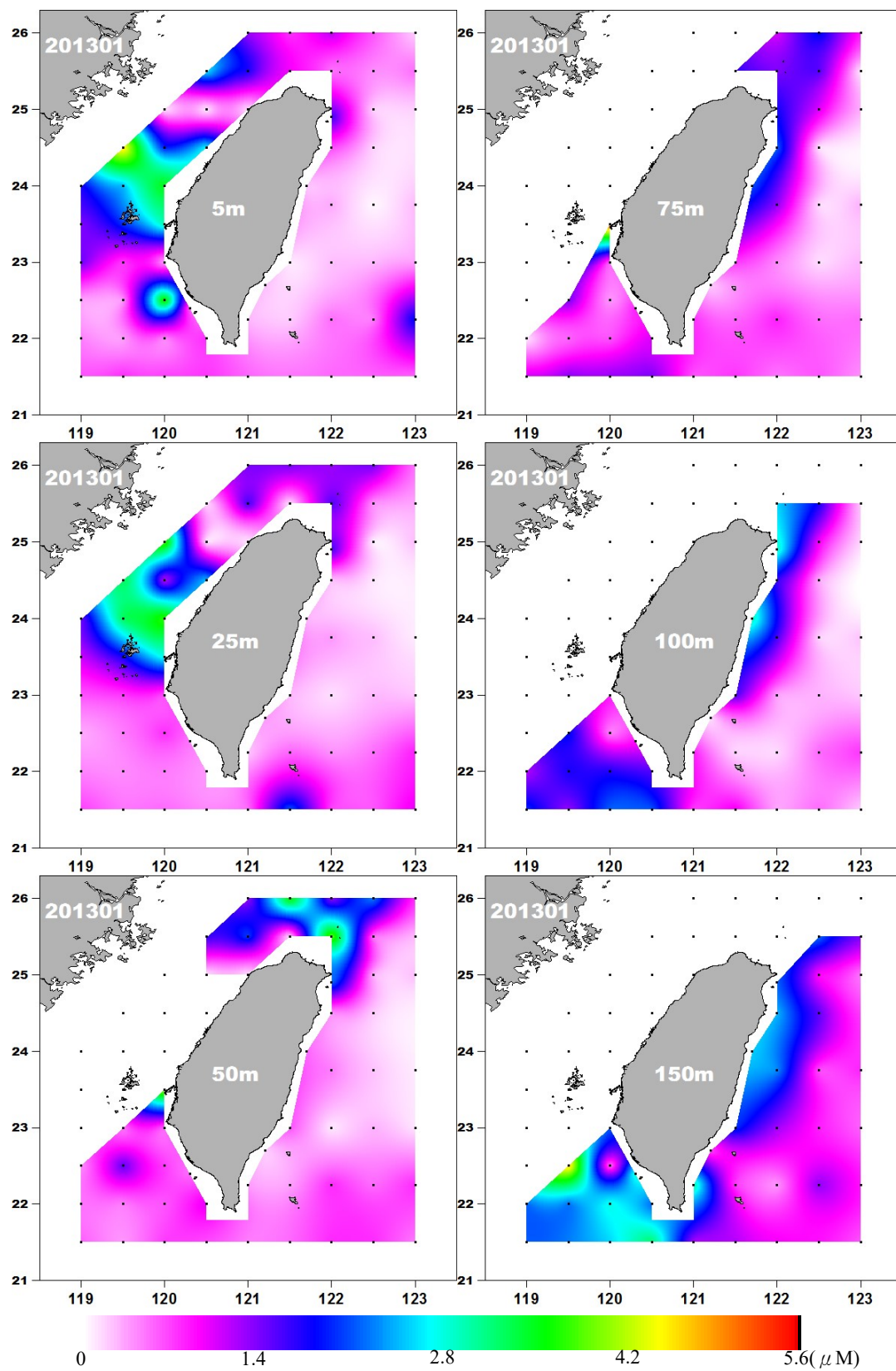


圖 10. 2013-01 航次硝酸鹽(NO_3^-)濃度分布
 Fig. 10. Nitrate (NO_3^-) distribution in Jan. 2013.

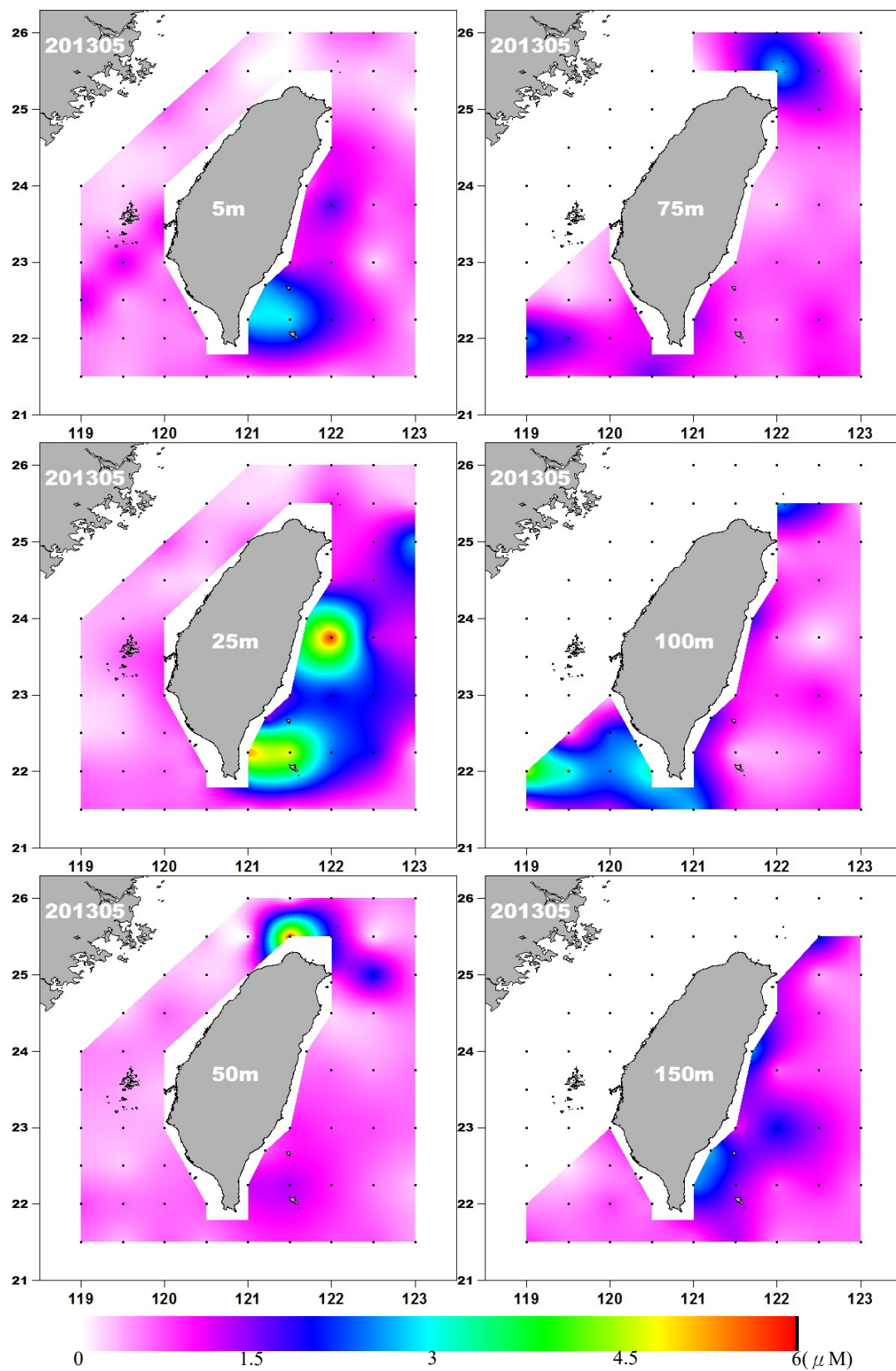


圖 11. 2013-05 航次硝酸鹽(NO_3^-)濃度分布
 Fig. 11. Nitrate (NO_3^-) distribution in May 2013.

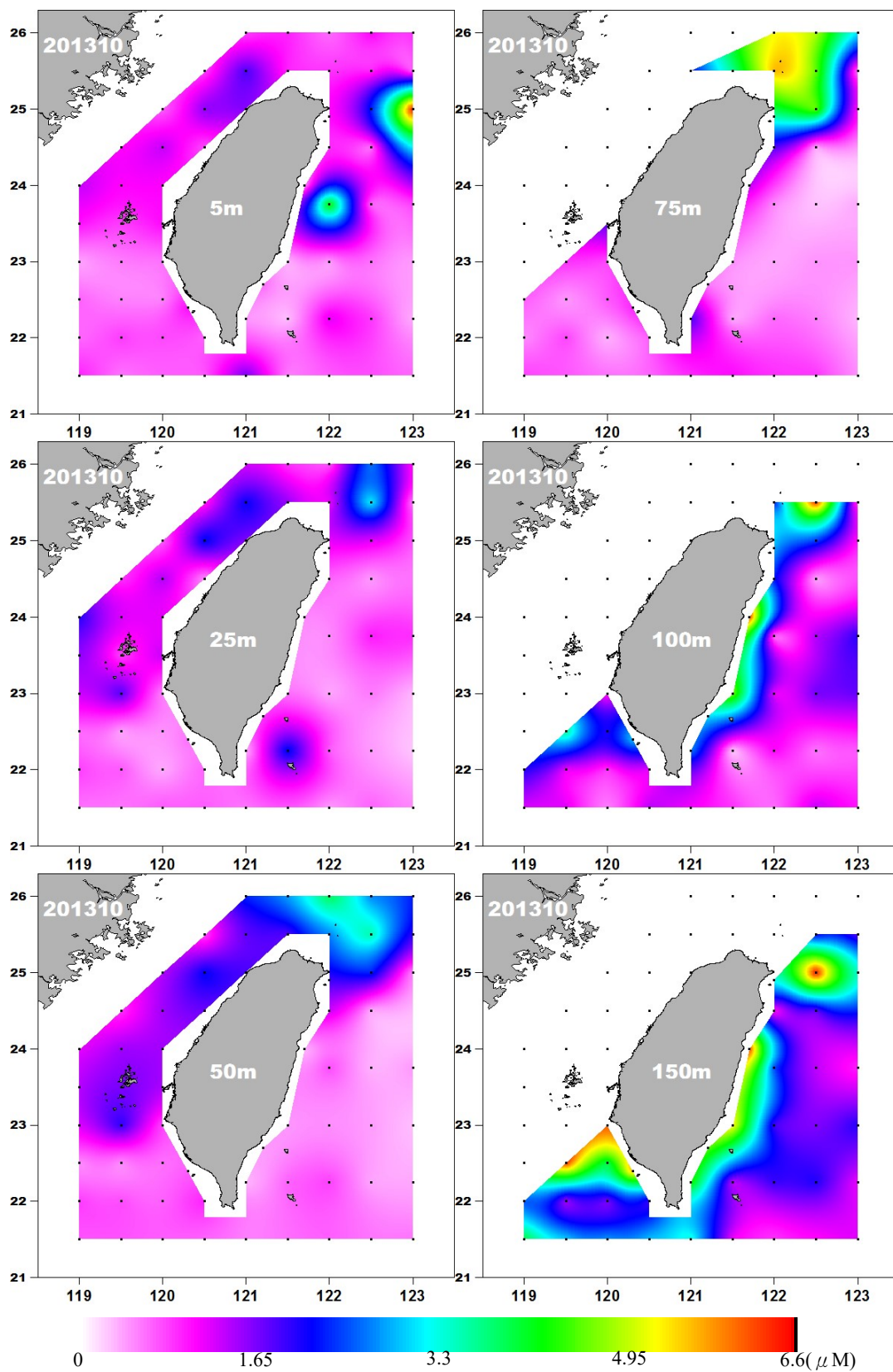


圖 12. 2013-10 航次硝酸鹽(NO_3^-)濃度分布
 Fig. 12. Nitrate (NO_3^-) distribution in Oct. 2013.

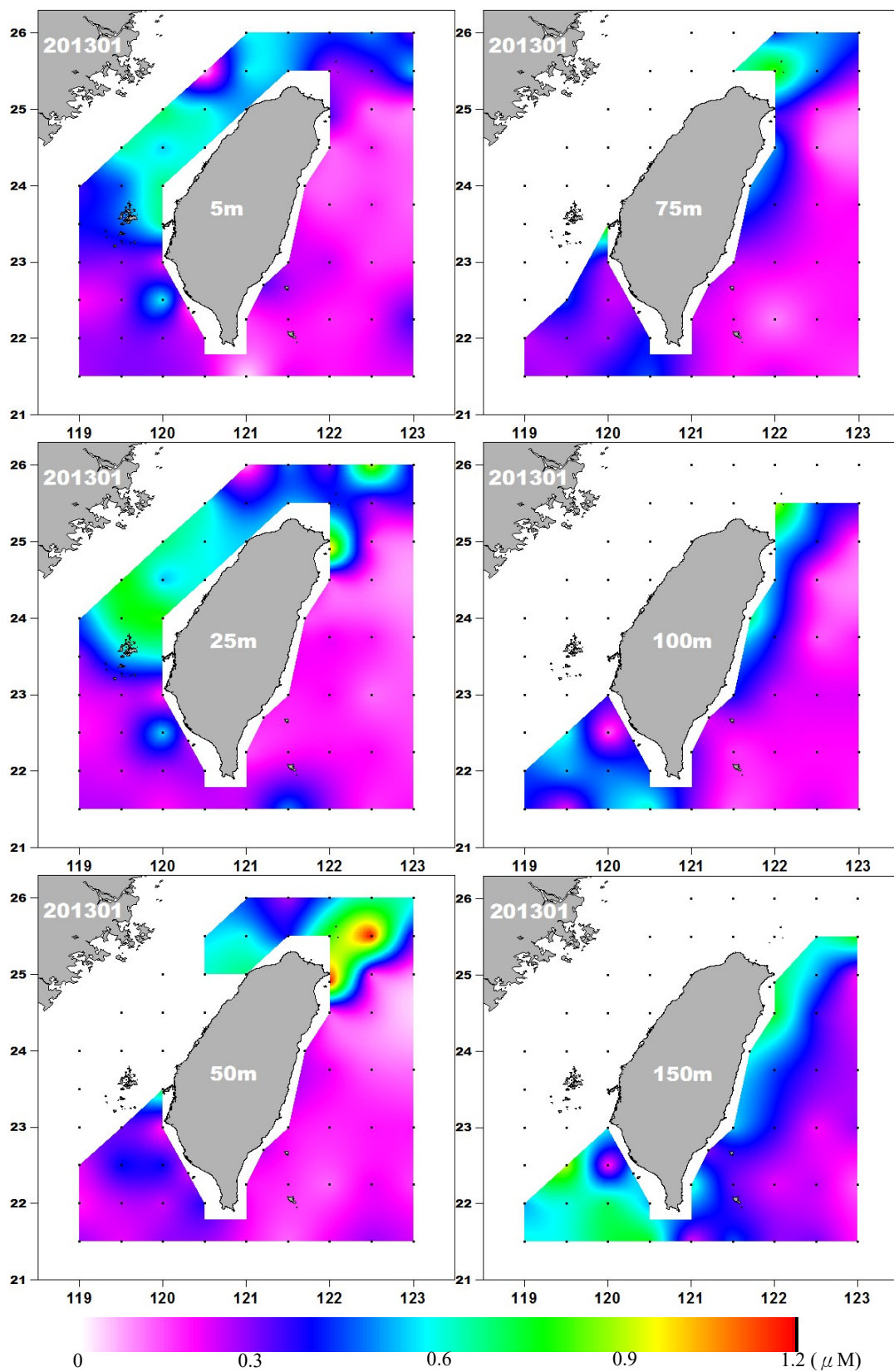


圖 13. 2013-01 航次磷酸鹽(PO_4^{3-})濃度分布
 Fig. 13. Phosphate (PO_4^{3-}) distribution in Jan. 2013.

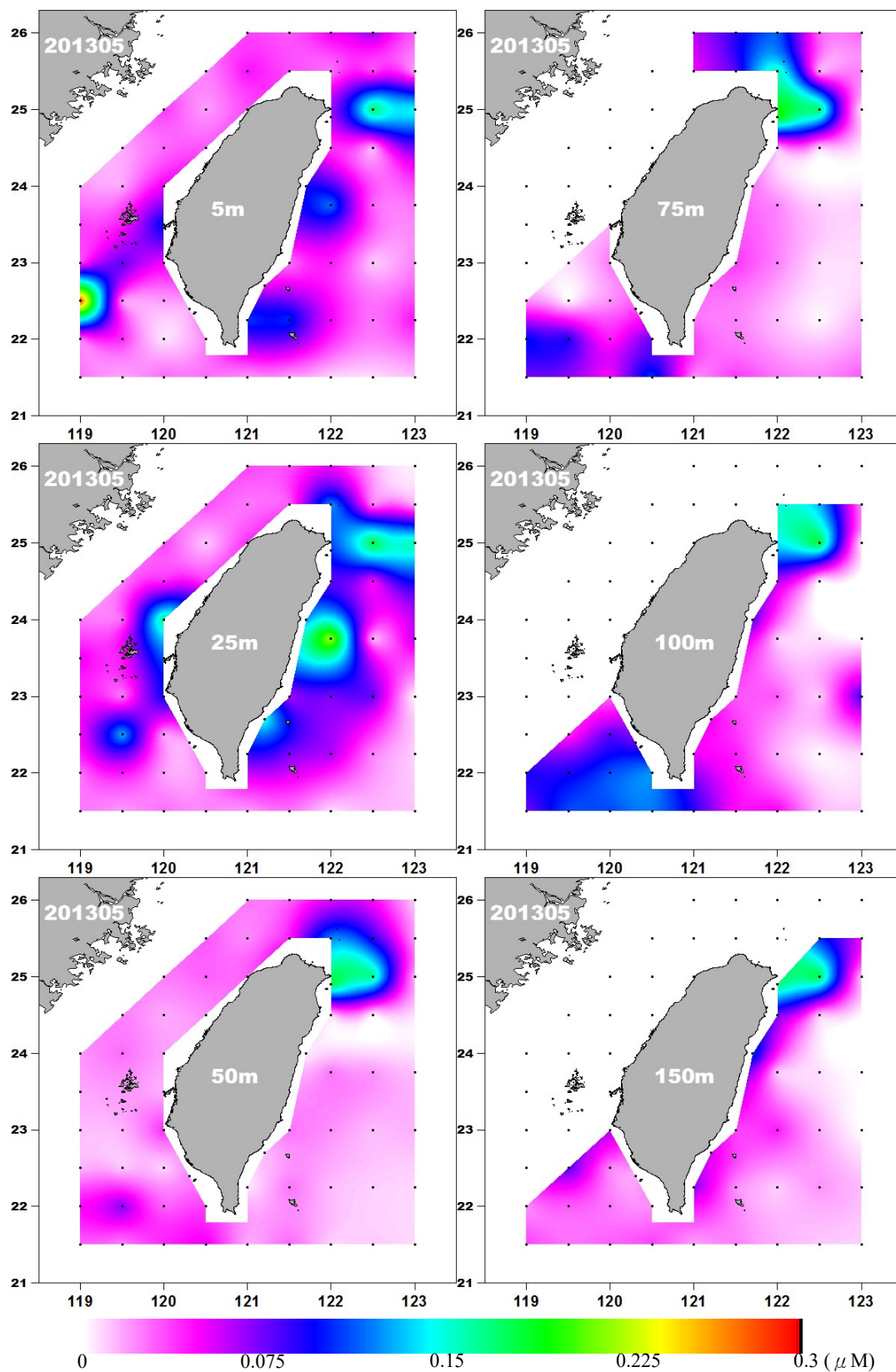


圖 14. 2013-05 航次磷酸鹽(PO_4^{3-})濃度分布
 Fig. 14. Phosphate (PO_4^{3-}) distribution in May 2013.

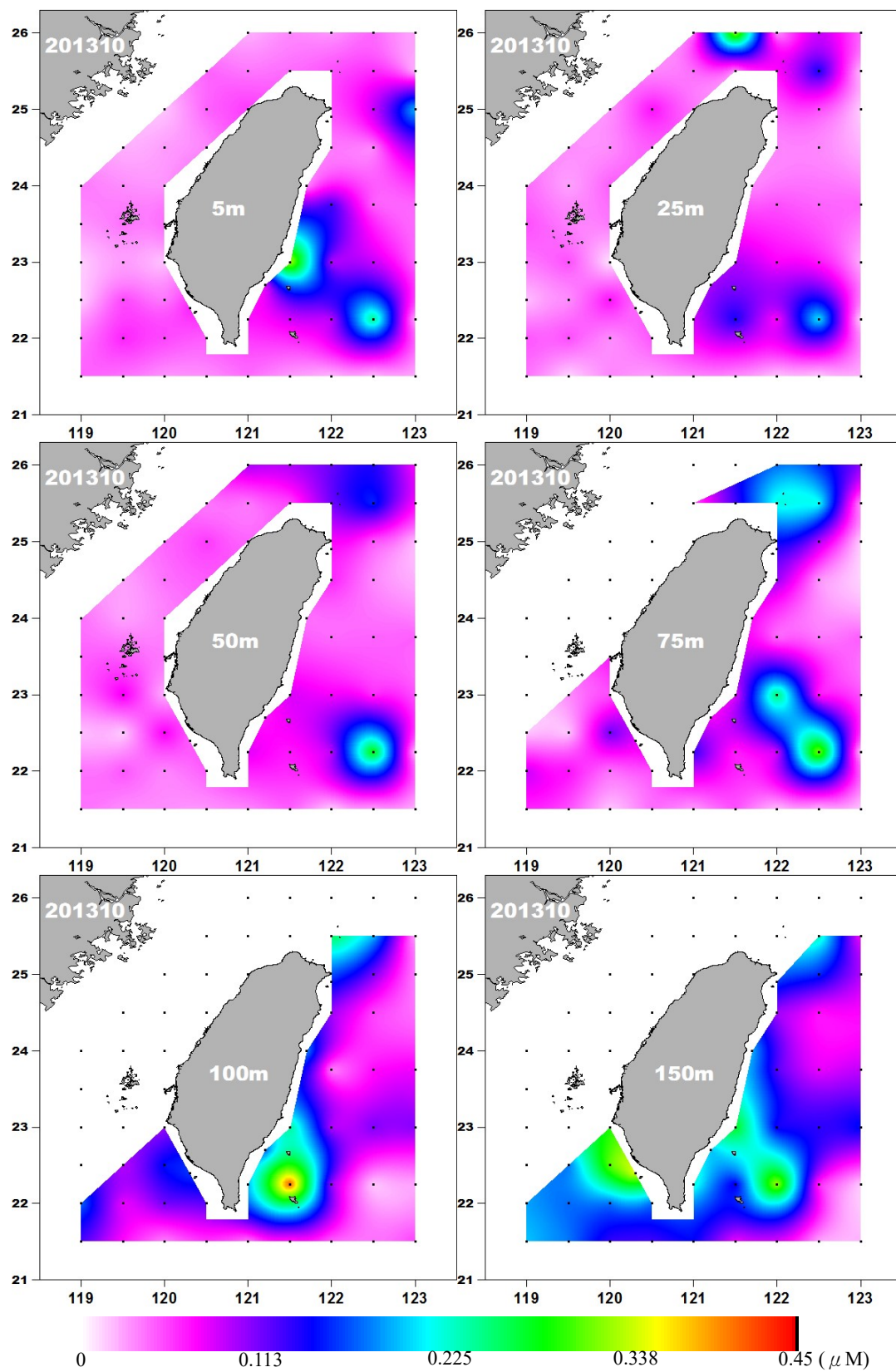


圖 15. 2013-10 航次磷酸鹽(PO_4^{3-})濃度分布
 Fig. 15. Phosphate (PO_4^{3-}) distribution in Oct. 2013.

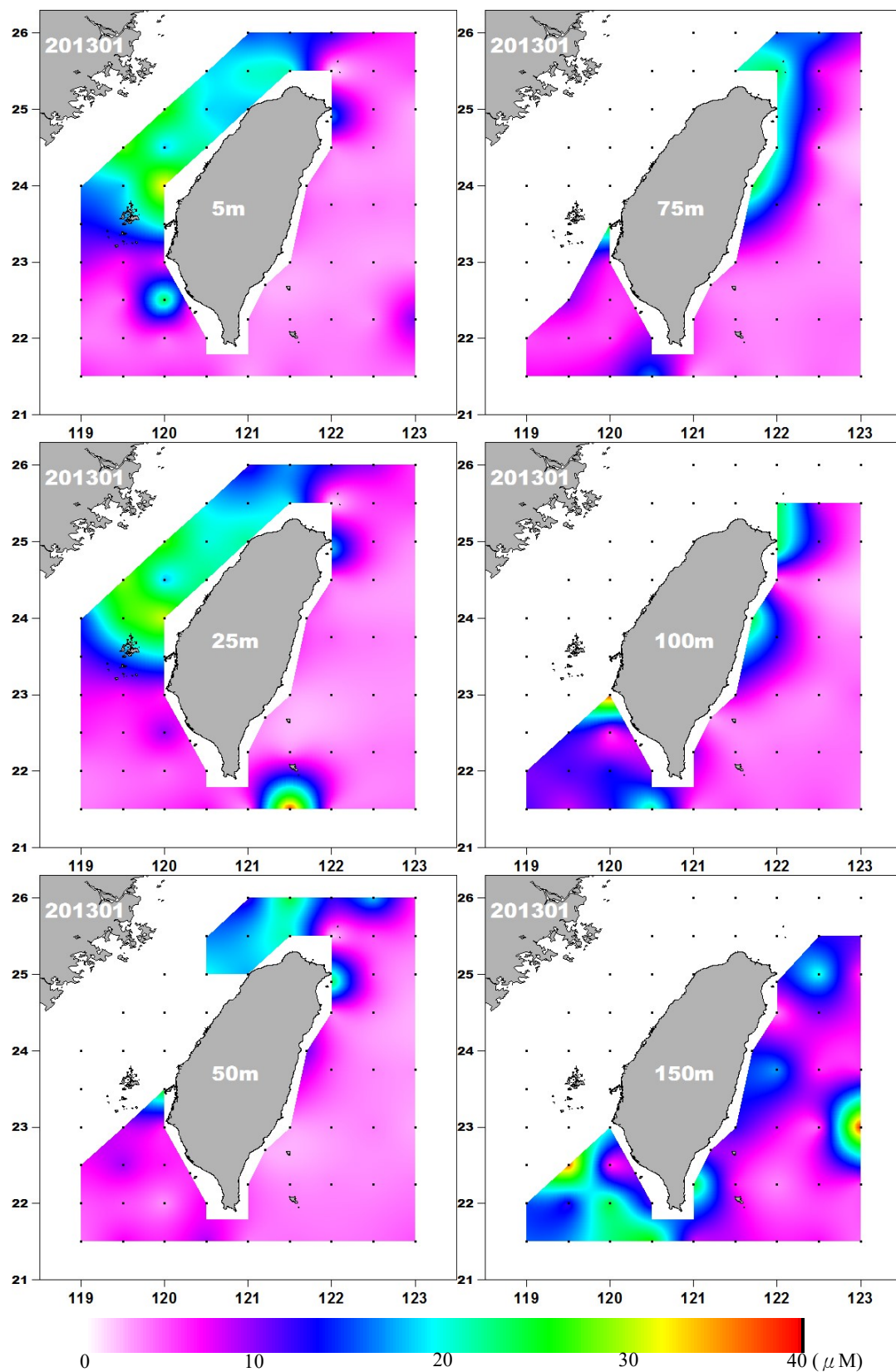


圖 16. 2013-01 航次矽酸鹽(SiO_2^{2-})濃度分布
 Fig. 16. Silicate (SiO_2^{2-}) distribution in Jan. 2013.

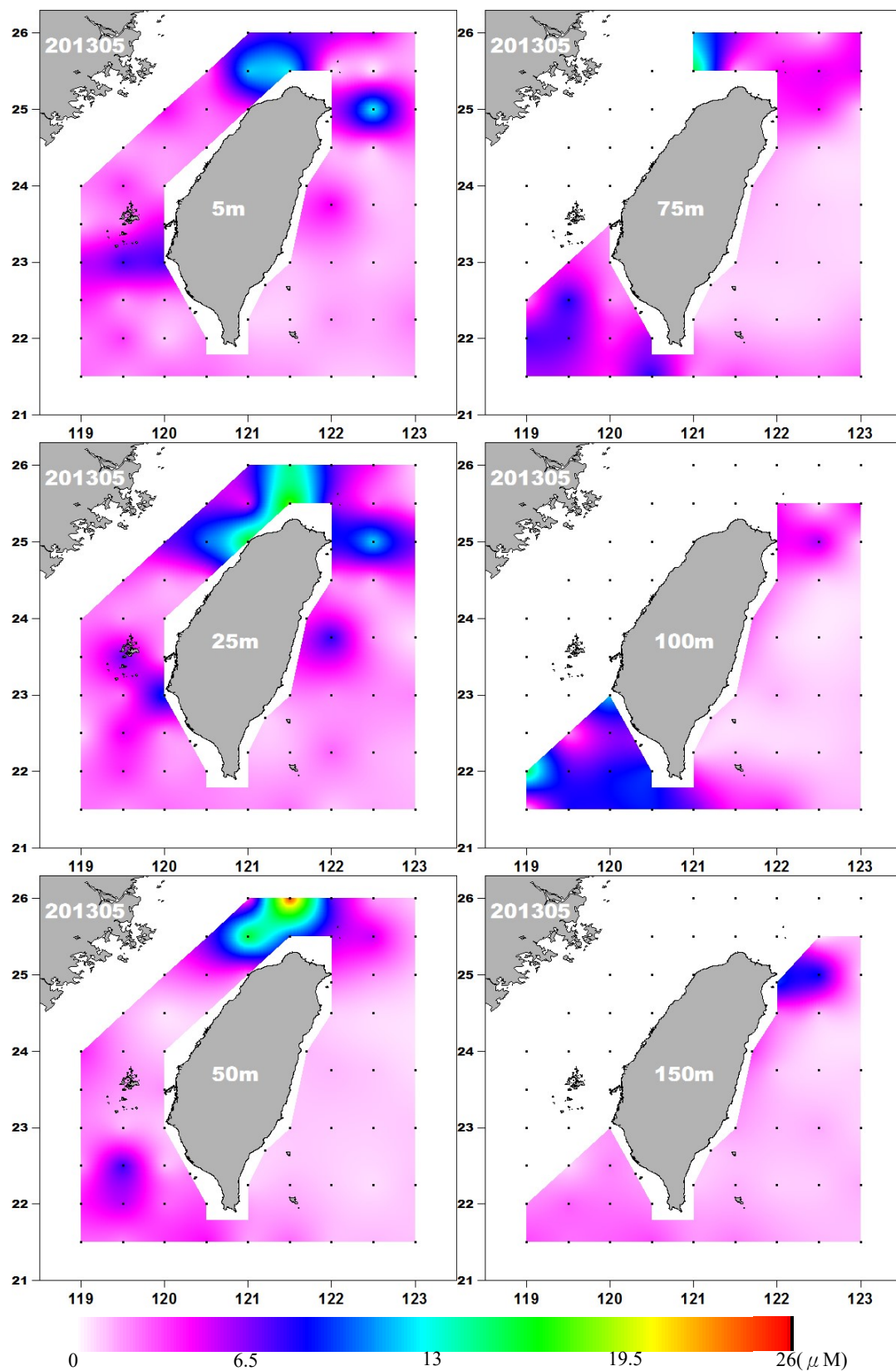


圖 17. 2013-05 航次矽酸鹽(SiO_2^{2-})濃度分布
 Fig. 17. Silicate (SiO_2^{2-}) distribution in May 2013.

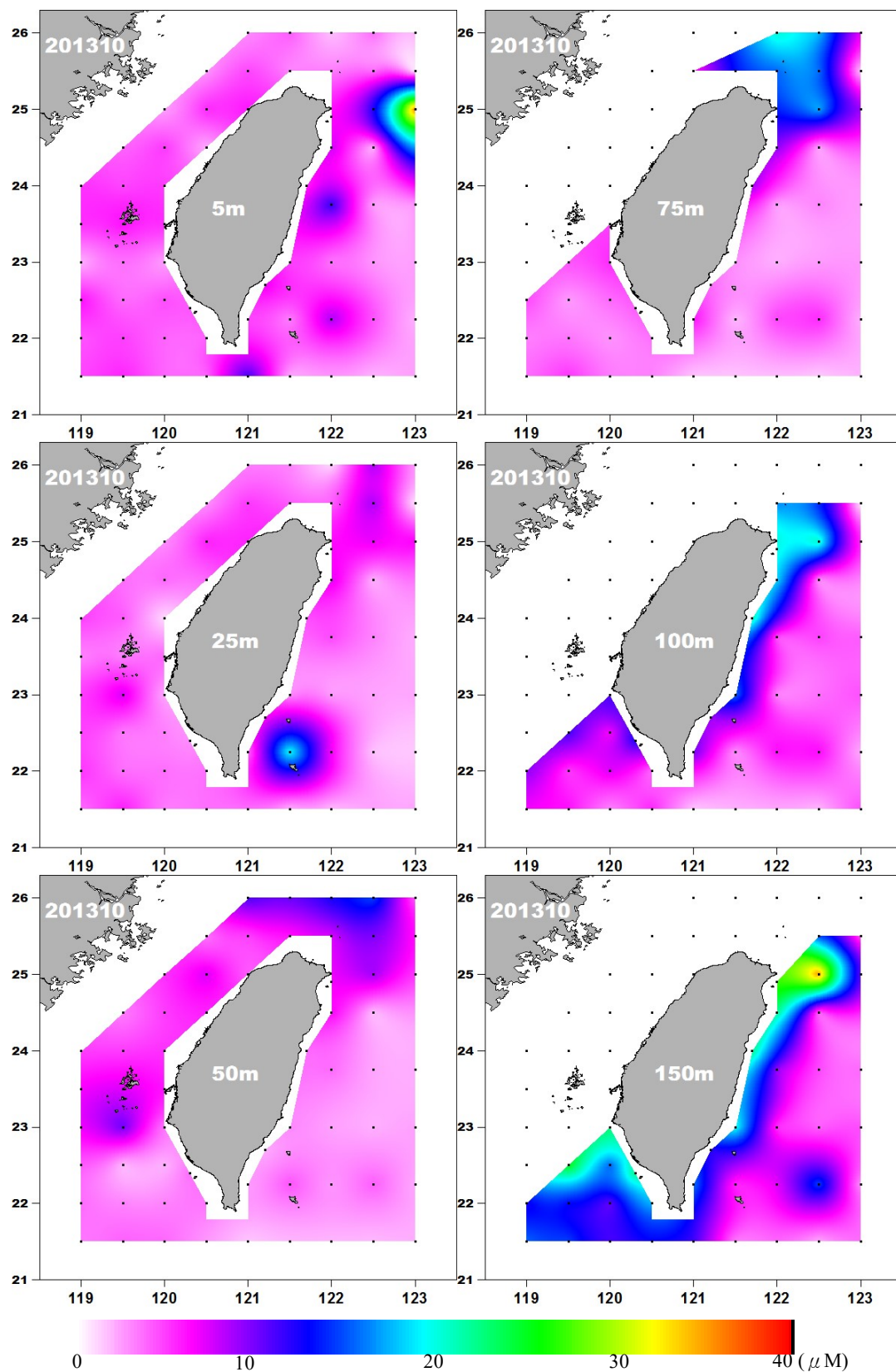


圖 18. 2013-10 航次矽酸鹽(SiO_2^{2-})濃度分布
 Fig. 18. Silicate (SiO_2^{2-}) distribution in Oct. 2013.

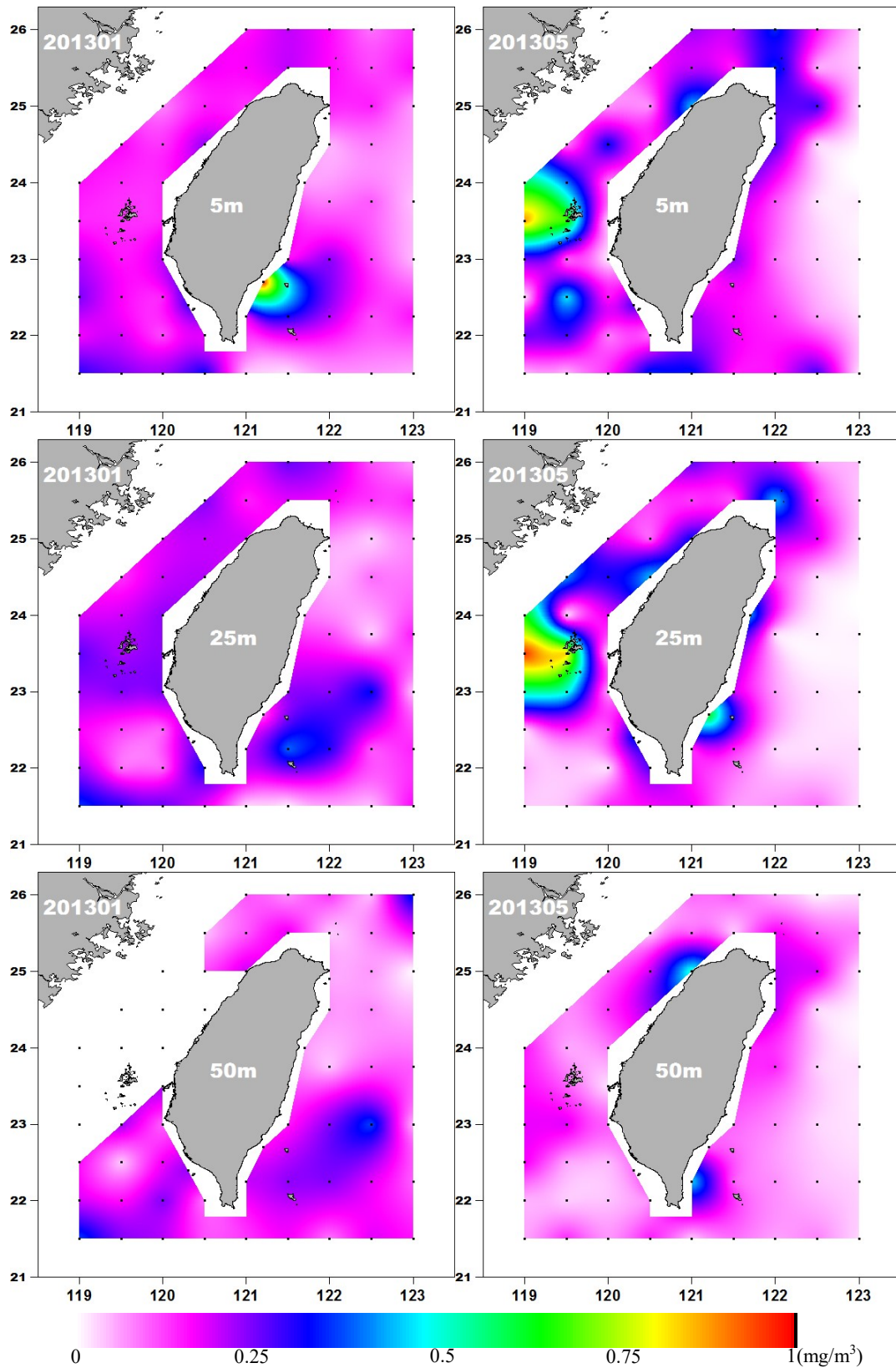


圖 19. 2013 年 1 月及 5 月葉綠素甲(chl-*a*)分布
 Fig. 19. Chlorophyll-*a* (chl-*a*) distribution in Jan. and May 2013.

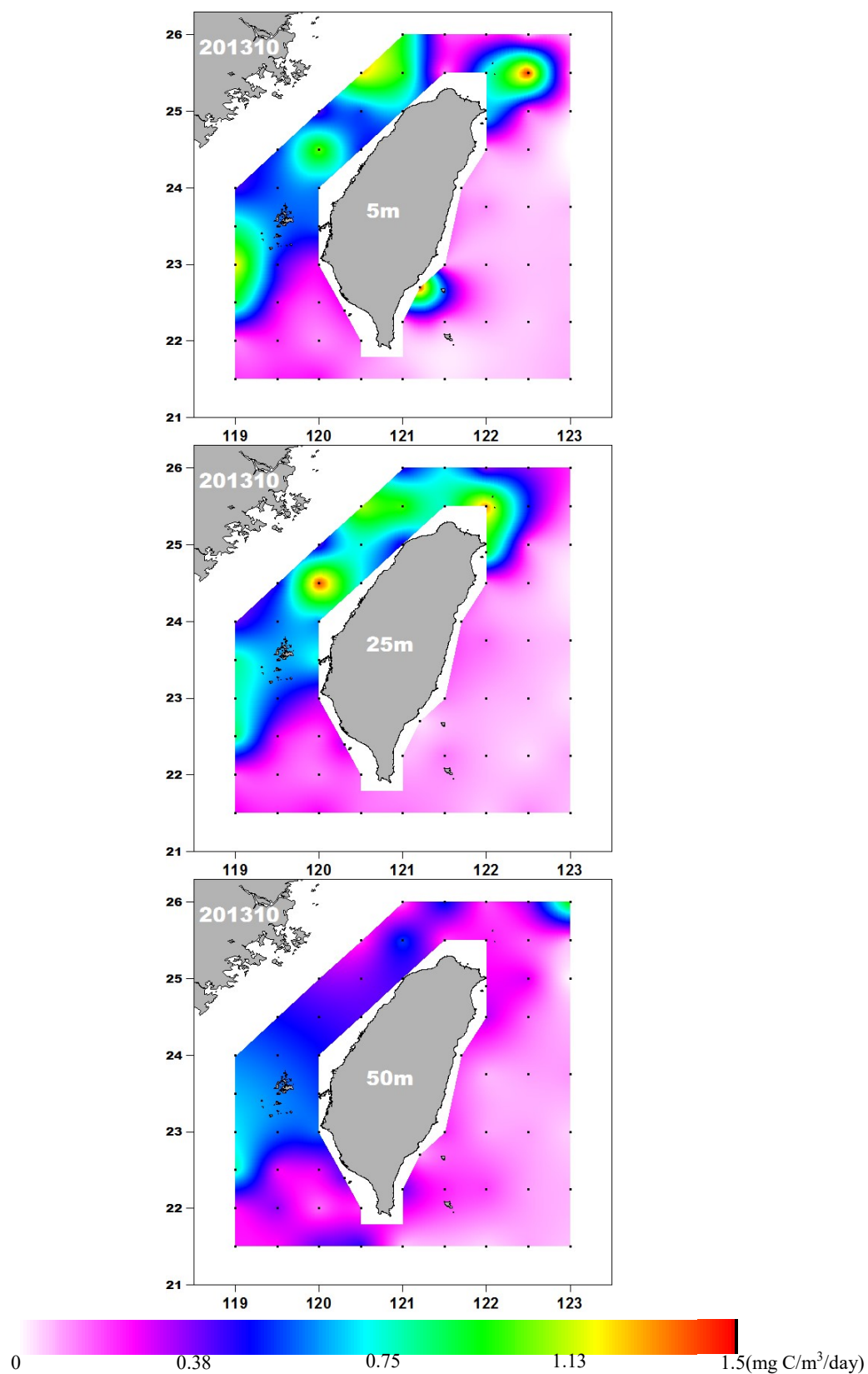


圖 20. 2013 年 10 月葉綠素甲(chl-a)分布
 Fig. 20. Chlorophyll-*a* (chl-*a*) distribution in Oct. 2013.

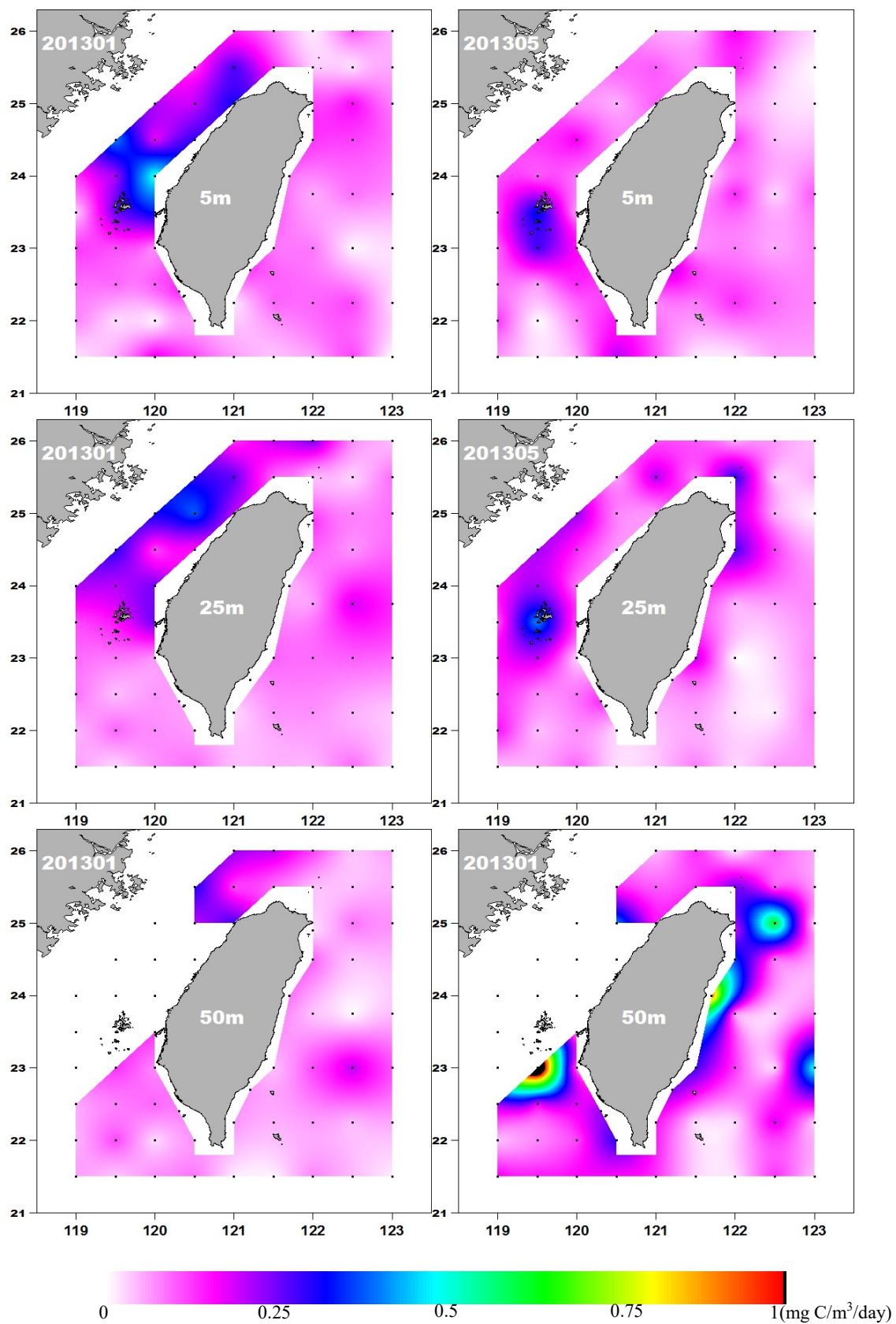


圖 21. 2013 年 1 月及 5 月基礎生產力分布

Fig. 21. Primary production distribution in Jan. and May 2013.

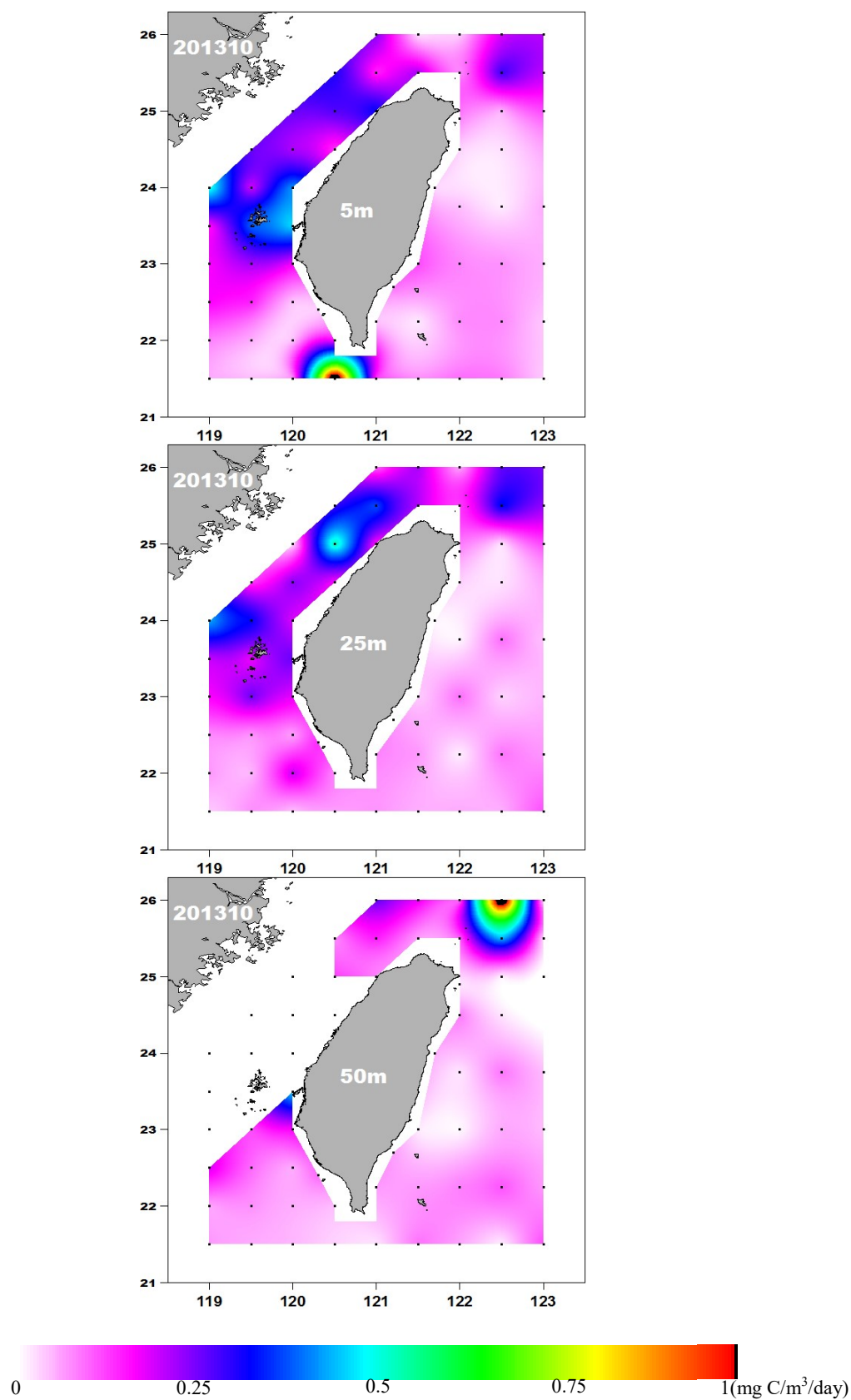


圖 22. 2013 年 10 月基礎生產力分布
 Fig. 22. Primary production distribution in Oct. 2013.

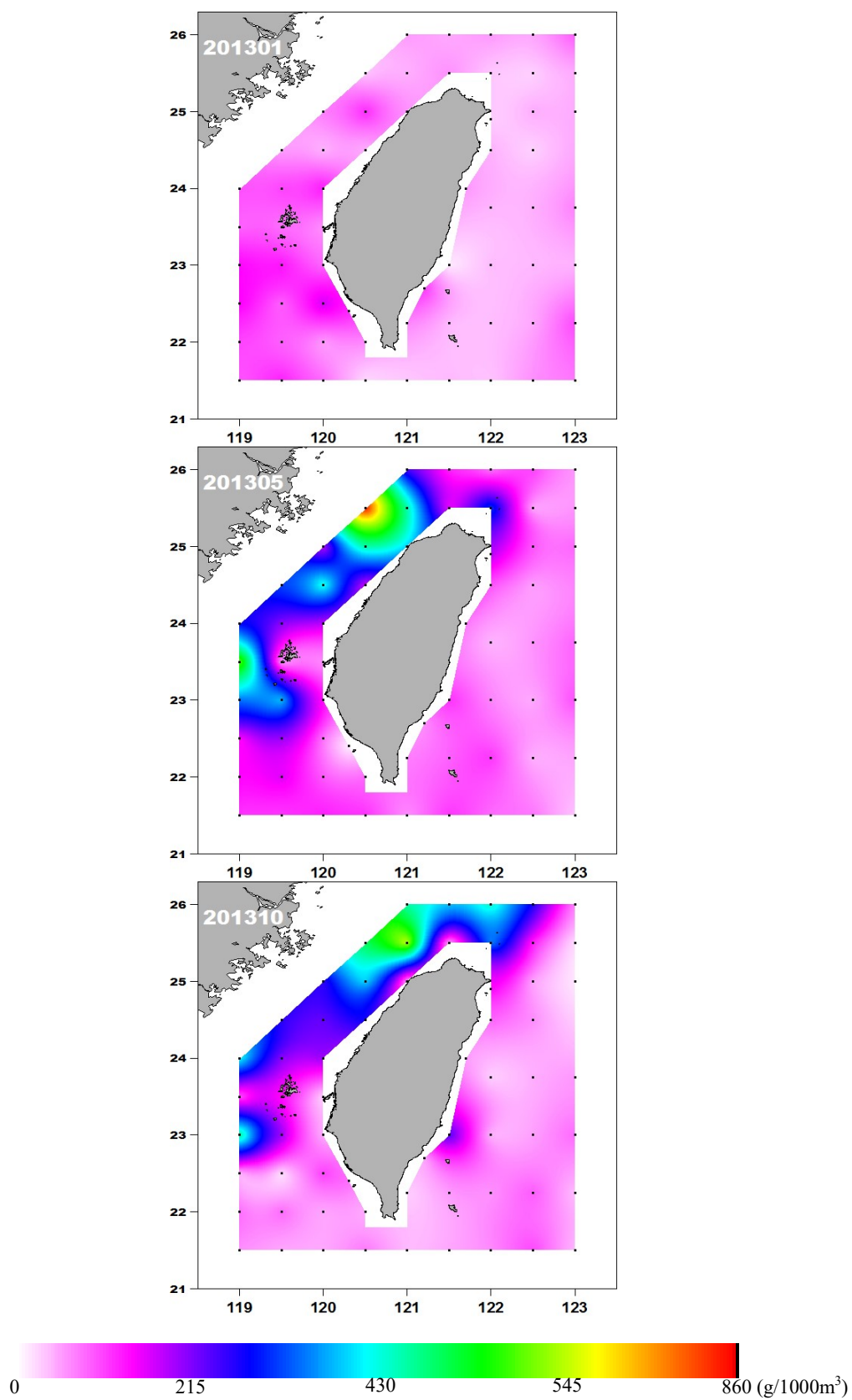


圖 23. 2013 年 1 月、5 月及 10 月浮游動物生物量分布
Fig. 23. Biomass of zooplankton sample in 2013.

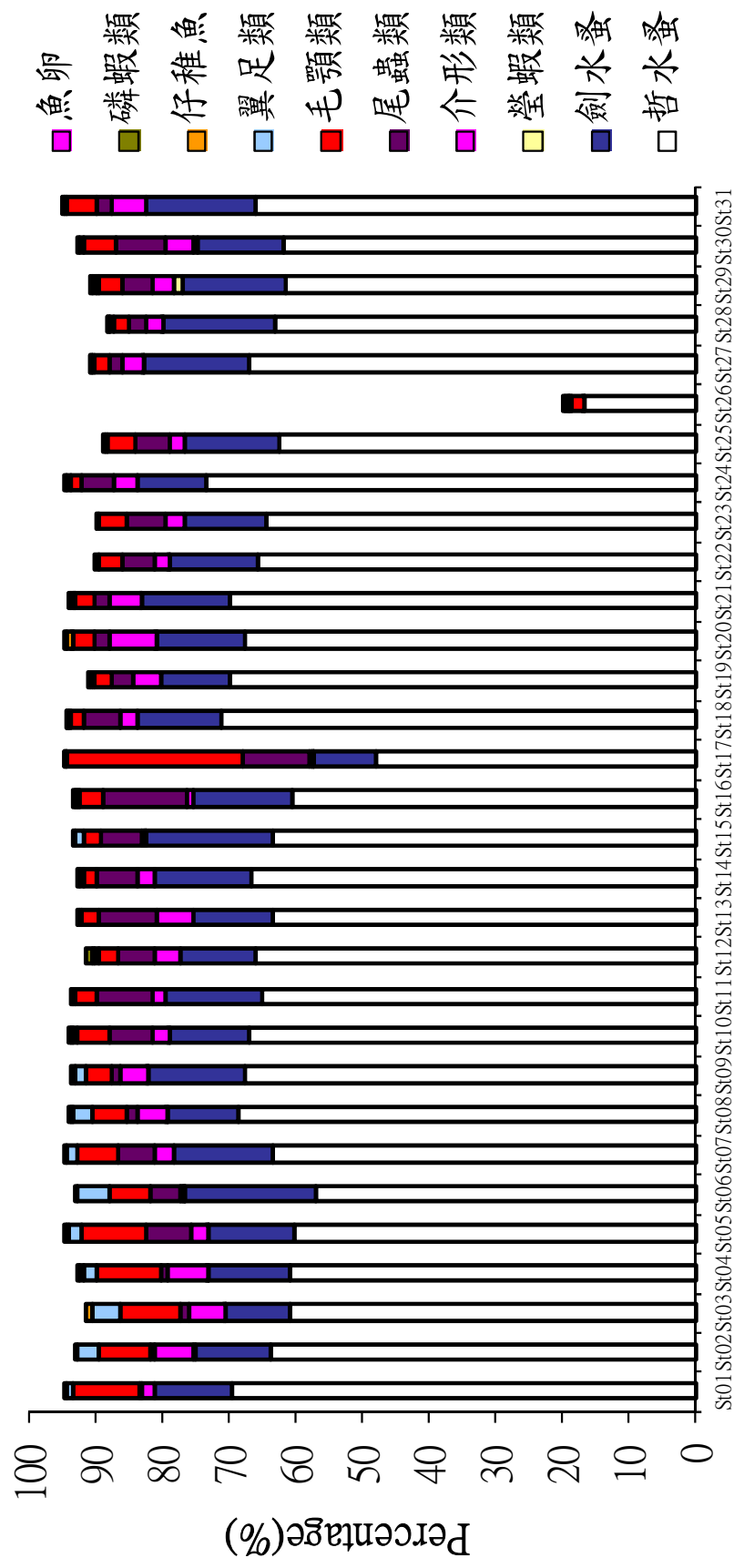


圖 24. 2013-01 航次浮游動物優勢大類出現百分率
Fig. 24. Percentage of the composition of zooplankton in Jan. 2013.

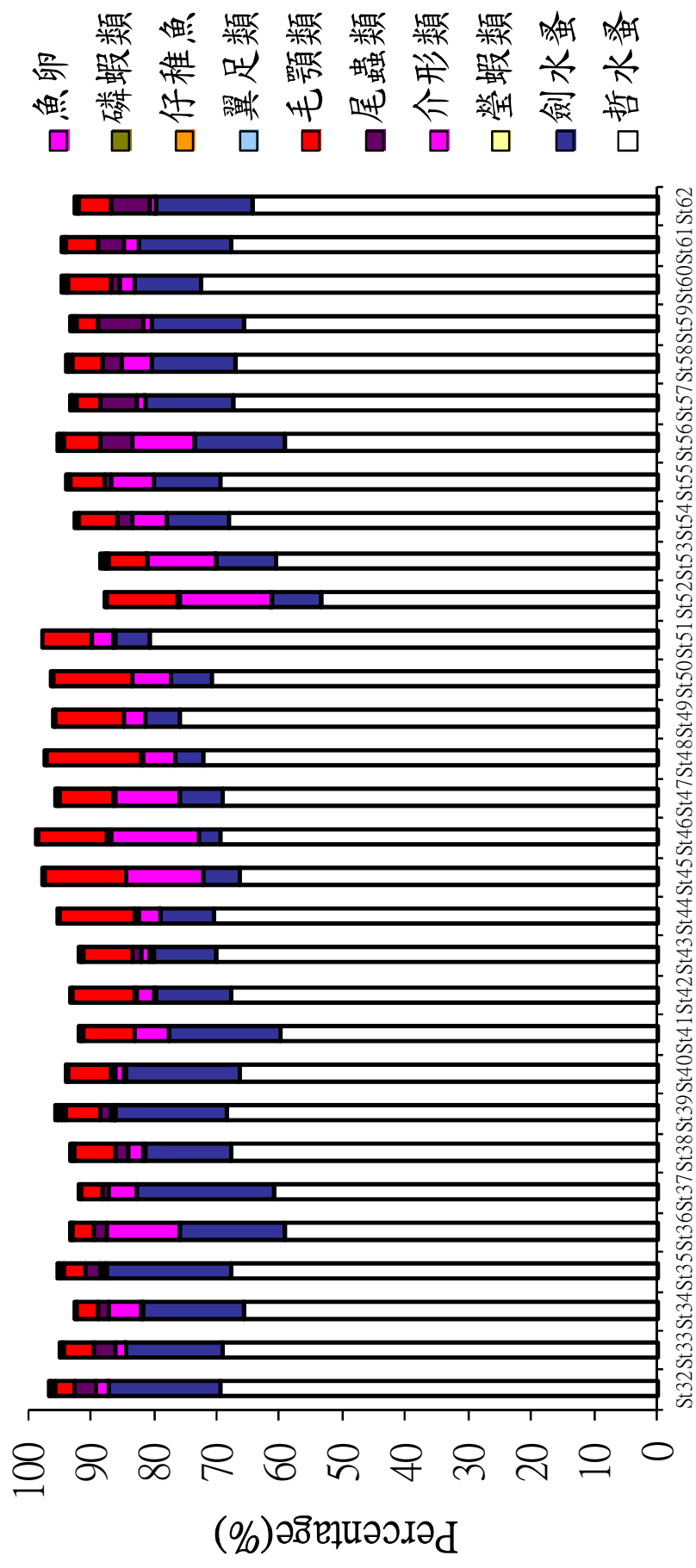


圖 25. 2013-01 航次浮游動物優勢大類出現百分率(續)
Fig. 25. Percentage of the composition of zooplankton in Jan. 2013.

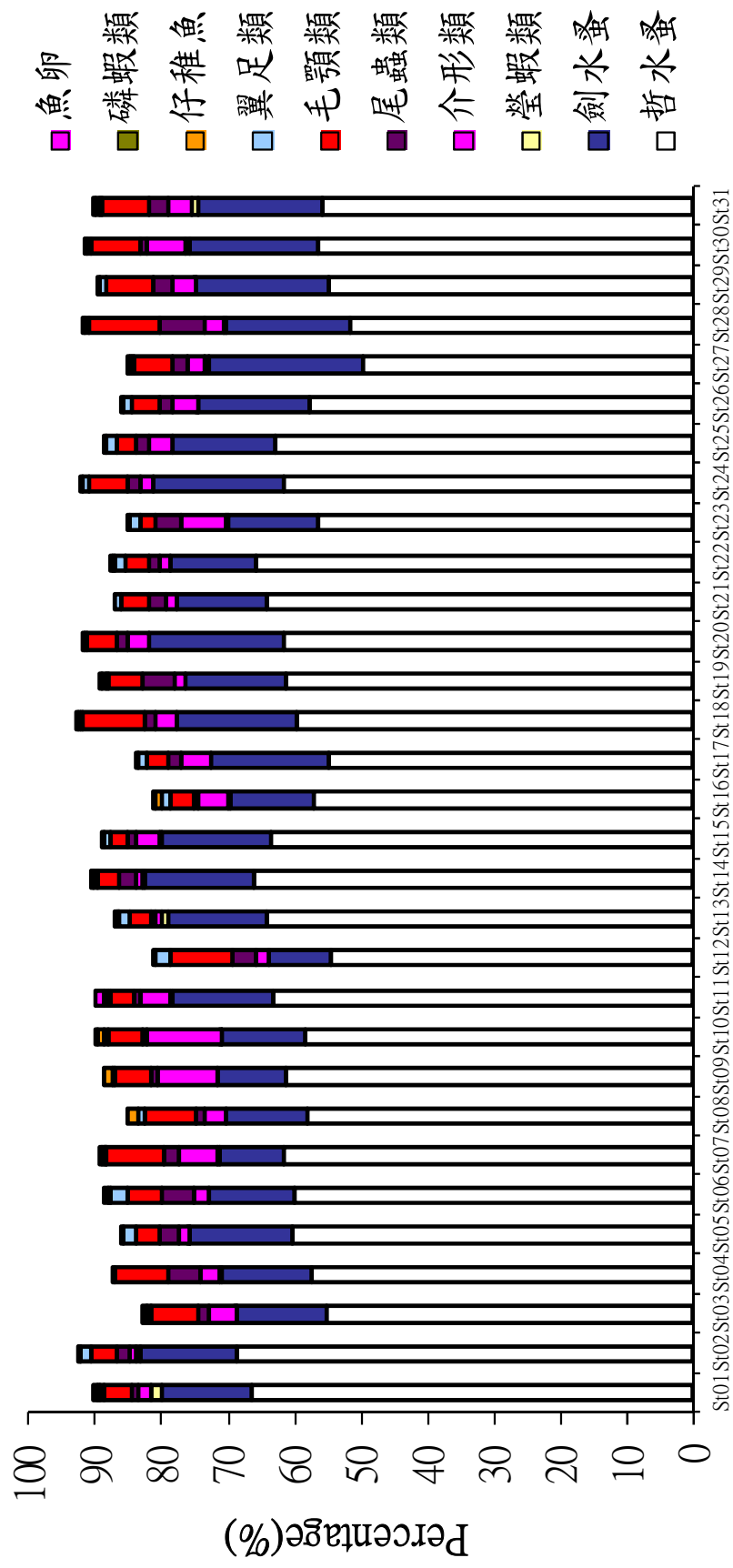


圖 26. 2013-05 航次浮游動物優勢大類出現百分率

Fig. 26. Percentage of the composition of zooplankton in May 2013.

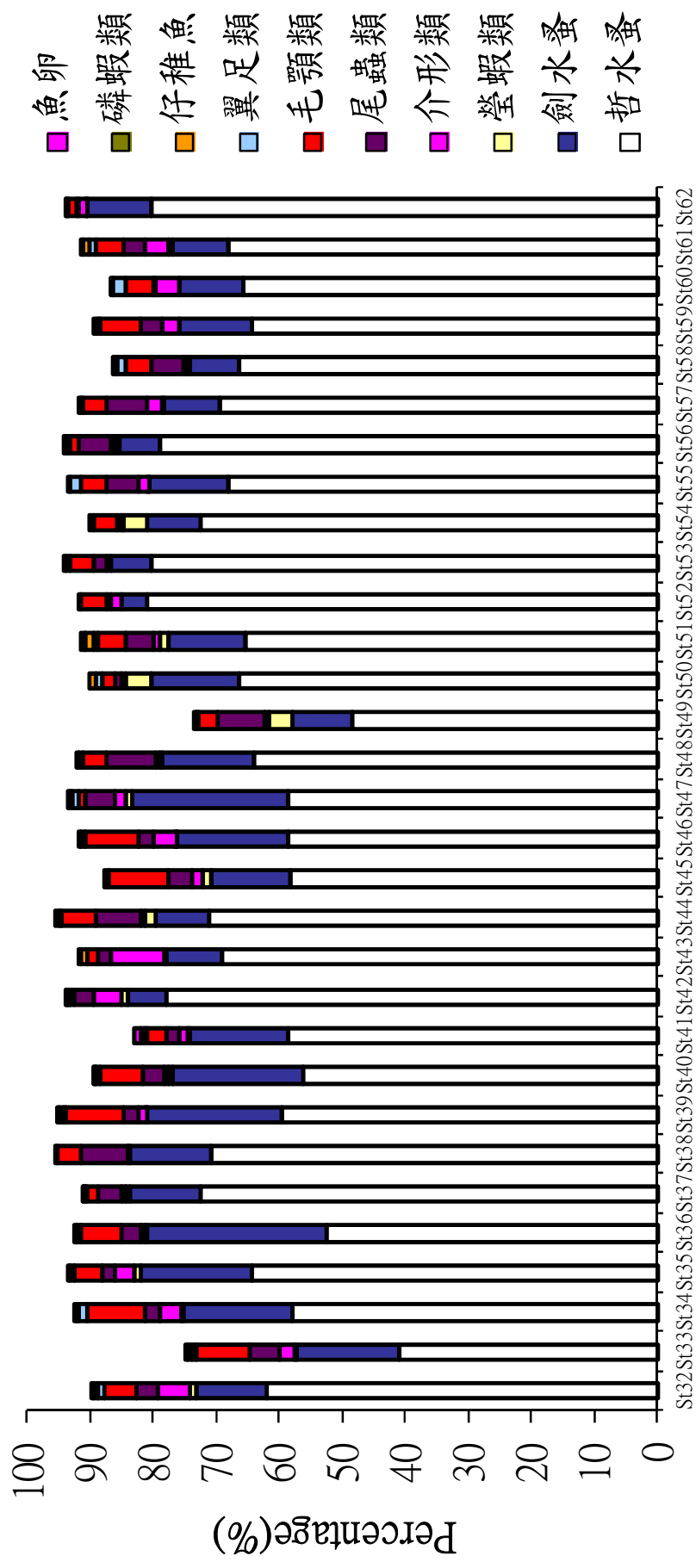


圖 27. 2013-05 航次浮游動物優勢大類出現百分率(續)
Fig. 27. Percentage of the composition of zooplankton in May 2013.

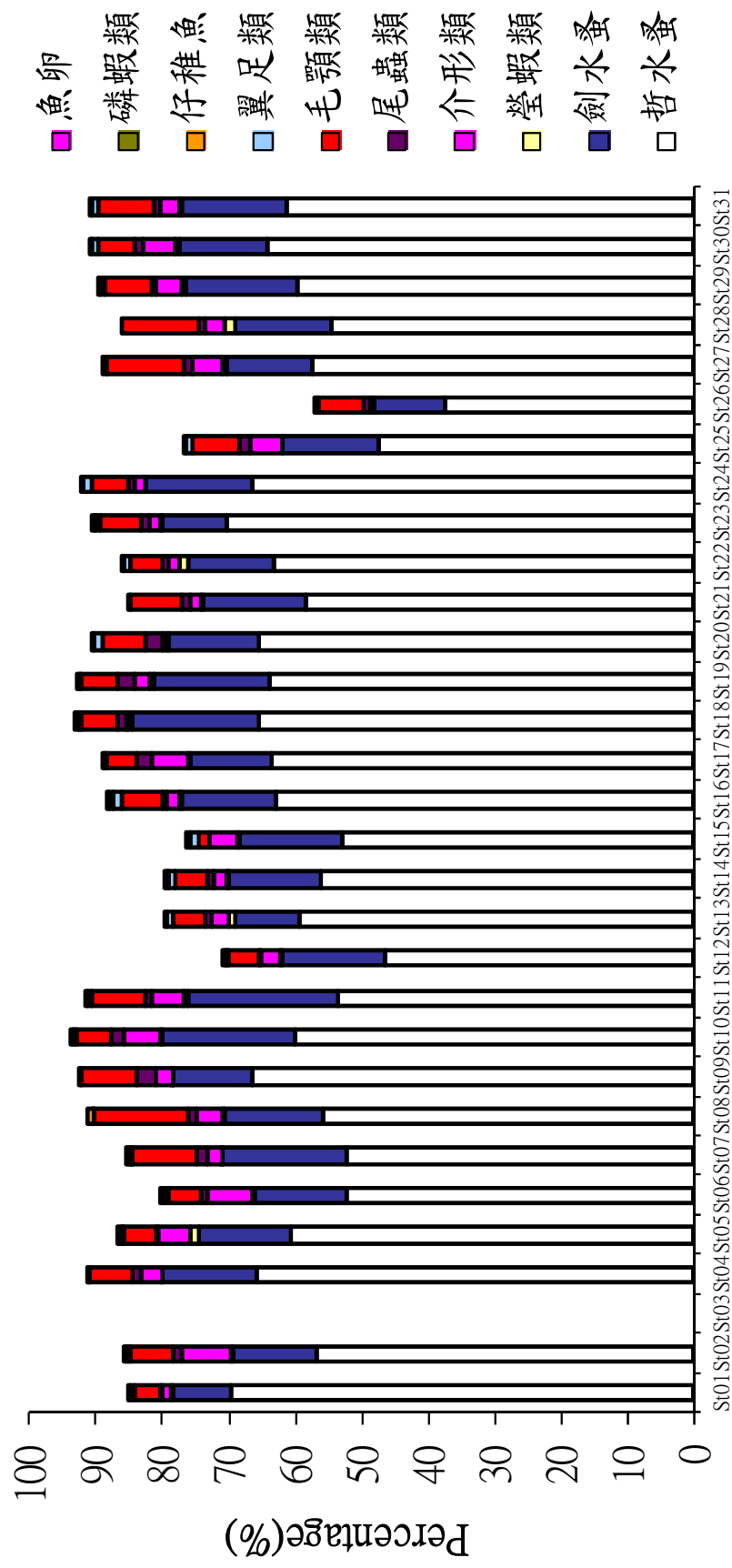


圖 28. 2013-10 航次浮游動物優勢大類出現百分率

Fig. 28. Percentage of the composition of zooplankton in Oct. 2013.

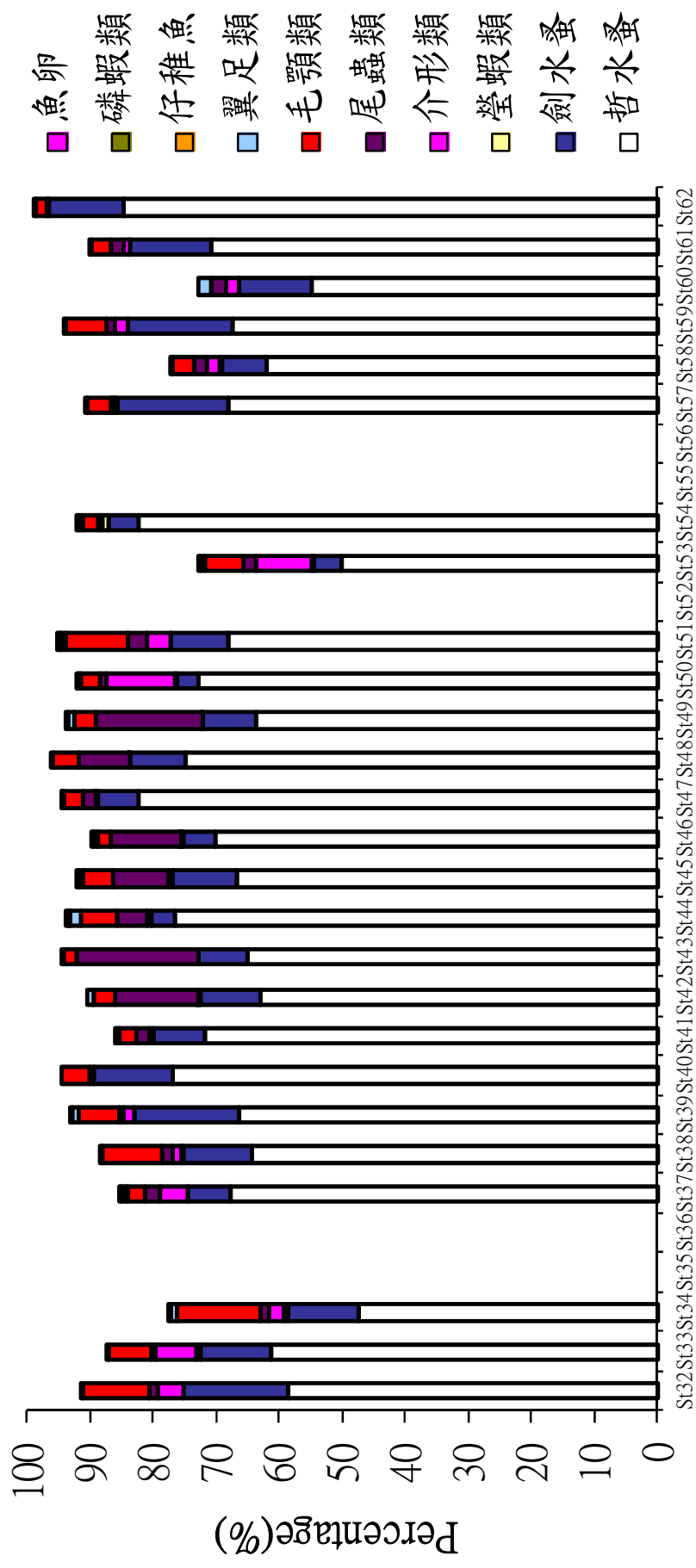


圖 29. 2013-10 航次浮游動物優勢大類出現百分率(續)
 Fig. 29. Percentage of the composition of zooplankton in Oct. 2013.

表 01. 2013-01-04 航次基礎觀測資料
Chart 01. Basic observation data in Jan. 2013

Station	Date	SMT	Lati.	Long.	Depth	SST	Air T.	Air P.	Wind D.	Wind F.	O.N.D	Fl. Ct.	V.M.S.
St.01	20130104	2029	24.87	122.01	280	20.5	17.2	1016.65	034	9.4	200	1353	811.8
St.02	20130105	0005	25.02	122.51	1426	23.1	18.8	1014.70	061	10.4	200	1693	1015.8
St.03	20130105	0352	25.01	123.01	1606	23.1	19.7	1014.16	083	84.0	200	952	571.2
St.04	20130105	0855	24.50	122.50	600	24.1	20.9	1015.94	087	5.5	200	863	517.8
St.05	20130105	1225	24.52	122.01	2708	24.3	18.6	1013.64	346	13.4	200	761	456.6
St.06	20130105	1731	24.02	121.69	129	25.4	20.9	1014.35	034	14.6	200	1463	877.8
St.07	20130105	2040	23.76	121.99	3279	25.1	20.9	1015.23	029	10.7	200	1131	678.6
St.08	20130106	0056	23.76	122.49	2702	25.1	21.6	1013.98	050	9.8	200	1040	624.0
St.09	20130106	0439	23.75	123.00	3643	25.0	21.9	1013.81	076	8.9	200	954	572.4
St.10	20130106	1003	23.01	123.00	2716	25.9	22.5	1014.87	068	9.2	200	963	577.8
St.11	20130106	1337	23.00	122.51	5537	26.7	22.9	1012.20	076	8.1	200	863	517.8
St.12	20130106	1743	23.02	122.03	4808	26.1	21.5	1013.98	054	6.1	200	1019	611.4
St.13	20130106	2122	23.04	121.64	2756	26.3	22.1	1014.87	022	10.3	200	1098	658.8
St.14	20130107	0155	22.67	121.37	1346	27.1	23.6	1013.45	020	9.8	200	1064	638.4
St.15	20130107	0612	22.26	121.11	1180	28.2	23.3	1013.63	021	7.5	200	1300	780.0
St.16	20130107	0902	22.27	121.50	441	27.7	24.4	1014.70	026	9.7	200	1466	879.6
St.17	20130107	1223	22.26	122.00	4569	27.1	22.7	1012.20	007	6.8	200	1263	757.8
St.18	20130107	1546	22.25	122.51	4855	27.5	22.9	1011.49	059	1.0	200	910	546.0
St.19	20130107	1901	22.25	123.00	3564	27.3	24.1	1012.74	157	4.6	200	822	493.2
St.20	20130107	2352	21.50	123.00	4726	27.1	24.3	1012.38	144	6.0	200	1110	666.0
St.21	20130108	0241	21.50	122.50	4788	27.2	24.3	1011.31	134	3.1	200	1181	708.6
St.22	20130108	0550	21.50	122.00	3464	27.1	23.8	1012.20	031	4.7	200	994	596.4
St.23	20130108	0917	21.50	121.50	2096	28.1	24.8	1013.09	050	9.1	200	964	578.4
St.24	20130108	1220	21.51	121.00	1180	28.2	23.9	1010.60	021	13.2	200	1039	623.4
St.25	20130108	1526	21.51	120.49	1606	27.2	22.3	1010.60	357	10.0	200	1356	813.6
St.26	20130108	1830	21.50	120.00	2950	26.7	23.4	1012.03	028	6.8	200	949	569.4
St.27	20130108	2143	21.50	119.49	2965	27.1	22.5	1013.98	004	6.8	200	1009	605.4
St.28	20130109	0046	21.50	119.00	2766	26.9	21.3	1013.98	358	9.6	200	802	481.2
St.29	20130109	0445	22.00	119.00	1443	25.7	19.0	1013.98	006	13.8	200	1054	632.4
St.30	20130109	0818	22.00	119.50	2371	25.3	20.0	1015.59	008	12.0	200	971	582.6
St.31	20130109	1140	22.00	120.00	1070	25.8	20.2	1013.81	356	10.8	200	924	554.4
St.32	20130109	1525	22.00	120.49	400	26.6	20.6	1012.03	018	5.4	200	906	543.6
St.33	20130109	1802	22.38	120.33	510	26.0	18.5	1013.45	343	8.0	200	1113	667.8
St.34	20130111	1741	22.50	120.00	616	25.6	19.6	1015.94	345	8.3	200	861	516.6
St.35	20130111	2034	22.50	119.50	223	25.2	18.6	1016.30	013	11.6	200	983	589.8
St.36	20130111	2323	22.50	119.00	84	24.3	18.1	1016.83	022	12.0	80	336	201.6
St.37	20130112	0404	22.94	119.09	26	21.9	16.2	1016.48	022	13.7	20	128	76.8
St.38	20130112	0657	23.01	119.49	73	22.4	16.9	1015.59	010	15.2	70	415	249.0
St.39	20130112	0933	23.01	119.89	170	23.5	18.6	1015.41	025	16.7	160	861	516.6
St.40	20130112	1443	23.50	119.92	122	22.9	17.2	1012.74	010	15.2	110	711	426.6
St.41	20130112	1747	23.44	119.51	54	21.0	15.8	1012.20	020	13.0	45	236	141.6
St.42	20130112	2039	23.50	119.00	51	20.8	14.3	1013.45	013	13.8	45	256	153.6
St.43	20130113	0053	23.99	119.00	60	19.5	13.1	1013.81	017	13.6	50	275	165.0
St.44	20130113	0417	24.00	119.50	60	18.1	13.4	1011.14	015	14.6	55	328	196.8
St.45	20130113	0712	24.01	120.00	41	18.1	14.5	1011.49	032	12.6	35	205	123.0
St.46	20130113	1137	24.50	120.50	54	19.3	15.5	1011.67	014	9.2	50	257	154.2
St.47	20130113	1424	24.50	120.01	62	18.6	14.8	1010.96	013	11.1	55	339	203.4
St.48	20130113	1707	24.50	119.50	63	18.1	14.5	1011.85	039	9.7	45	249	149.4
St.49	20130113	2132	25.00	120.00	56	18.2	14.9	1013.81	037	13.2	50	278	166.8
St.50	20130114	0058	25.00	120.50	77	18.6	14.5	1015.05	032	14.7	75	444	266.4
St.51	20130114	0340	25.09	120.92	73	18.8	13.7	1016.83	035	14.0	65	395	237.0
St.52	20130114	0712	25.50	120.50	60	18.4	12.1	1019.32	026	11.7	50	332	199.2
St.53	20130114	1301	26.00	121.00	80	18.4	11.7	1019.15	029	11.0	75	409	245.4
St.54	20130114	1553	25.50	121.00	91	19.3	13.2	1019.86	049	9.8	85	349	209.4
St.55	20130114	1854	25.50	121.50	117	19.2	14.4	1020.39	046	10.3	105	637	382.2
St.56	20130114	2222	26.00	121.50	68	20.0	14.1	1021.82	044	9.2	60	354	212.4
St.57	20130115	0134	26.00	122.01	98	21.3	15.3	1021.46	050	9.1	95	460	276.0
St.58	20130115	0419	26.00	122.49	105	22.1	15.4	1021.99	066	11.0	97	490	294.0
St.59	20130115	0712	26.00	123.00	97	23.1	15.4	1022.35	053	10.5	90	390	234.0
St.60	20130115	1037	25.51	123.00	774	23.9	17.0	1020.39	087	6.4	200	1002	601.2
St.61	20130115	1331	25.50	122.51	458	25.3	18.2	1018.97	110	5.7	200	1245	747.0
St.62	20130115	1642	25.51	122.01	126	25.4	19.2	1017.90	102	6.1	110	654	392.4

表 02. 2013-05-08 航次基礎觀測資料
Chart 02. Basic observation data in May 2013

Station	Date	SMT	Lati.	Long.	Depth	SST	Air T.	Air P.	Wind D.	Wind F.	O.N.D	Fl. Ct.	V.M.S.
St.01	20130518	0229	24.88	122.00	250	24.7	24.9	1006.00	011	0.5	200	825	495.0
St.02	20130517	2257	25.05	122.50	1433	24.8	25.3	1008.00	257	4.6	200	738	442.8
St.03	20130517	1905	25.02	122.99	1688	25.1	25.5	1007.00	009	0.2	200	889	533.4
St.04	20130517	1535	24.51	122.49	626	25.3	25.8	1005.00	012	0.8	200	828	496.8
St.05	20130517	1254	24.51	122.01	855	25.2	26.8	1007.00	002	31.0	200	717	430.2
St.06	20130517	1000	24.00	121.69	410	25.5	26.6	1008.00	003	31.0	200	647	388.2
St.07	20130517	0730	23.75	121.99	3450	26.0	25.8	1008.00	015	0.7	200	1026	615.6
St.08	20130517	0413	23.73	122.48	3657	25.4	26.9	1006.00	009	1.4	200	864	518.4
St.09	20130517	0030	23.75	122.98	5400	25.4	26.4	1006.00	048	4.4	200	661	396.6
St.10	20130516	1931	23.05	122.98	5501	25.7	26.8	1008.00	276	3.0	200	934	560.4
St.11	20130516	1618	22.99	122.49	5591	25.8	26.8	1007.00	015	0.1	200	1068	640.8
St.12	20130516	1331	22.99	121.99	1300	25.9	26.7	1008.00	022	1.5	200	589	353.4
St.13	20130516	1026	23.00	121.50	1340	26.5	27.1	1009.00	048	8.6	200	683	409.8
St.14	20130516	0748	22.65	121.25	1087	27.3	24.5	1009.00	051	12.2	200	935	561.0
St.15	20130516	0434	22.24	121.00	1100	27.4	24.8	1007.00	014	0.2	200	937	562.2
St.16	20130516	0056	22.24	121.50	850	27.3	25.3	1007.00	016	0.3	200	754	452.4
St.17	20130515	2125	22.23	121.99	4580	27.4	24.8	1008.00	065	5.0	200	1043	625.8
St.18	20130515	1749	22.25	122.52	4800	25.7	26.4	1007.00	060	4.0	200	659	395.4
St.19	20130515	1441	22.24	123.00	2600	25.3	26.1	1007.00	012	1.3	200	876	525.6
St.20	20130515	0954	21.49	123.00	3882	26.2	26.3	1009.00	012	1.0	200	1154	692.4
St.21	20130515	0700	21.50	122.52	4791	26.1	26.4	1008.00	044	5.1	200	843	505.8
St.22	20130515	0352	21.48	122.03	1400	26.8	26.5	1007.00	056	3.9	200	819	491.4
St.23	20130515	0020	21.51	121.52	1300	27.7	26.7	1008.00	008	0.3	200	1027	616.2
St.24	20130514	2100	21.48	121.03	980	28.1	26.8	1009.00	011	1.0	200	949	569.4
St.25	20130512	1911	21.49	120.52	1291	26.9	26.0	1010.00	049	5.3	200	768	460.8
St.26	20130512	1610	21.50	120.00	2970	26.9	26.3	1010.00	044	5.8	200	598	358.8
St.27	20130512	1255	21.50	119.49	1340	26.9	26.8	1010.00	004	0.9	200	956	573.6
St.28	20130512	0933	21.50	119.00	949	27.1	26.9	1010.00	000	0.2	200	732	439.2
St.29	20130512	0623	21.99	119.00	1039	26.2	25.5	1010.00	030	4.9	200	677	406.2
St.30	20130512	0246	22.00	119.51	2400	26.8	25.7	1010.00	070	2.5	200	1007	604.2
St.31	20130513	0248	21.98	120.00	1143	26.9	25.9	1010.00	006	0.3	200	950	570.0
St.32	20130512	2310	22.00	120.53	686	26.9	25.8	1010.00	007	0.3	200	985	591.0
St.33	20130513	1520	22.36	120.31	580	27.9	27.0	1007.00	030	3.6	200	862	517.2
St.34	20130513	0640	22.48	120.02	560	26.9	26.3	1010.00	004	53.0	200	961	576.6
St.35	20130511	2250	22.50	119.50	241	25.0	24.1	1010.00	003	0.8	200	780	468.0
St.36	20130511	1942	22.49	119.02	95	25.7	25.0	1010.00	007	0.8	88	442	265.2
St.37	20130511	1710	23.00	119.01	24	26.0	25.1	1010.00	050	2.9	24	58	34.8
St.38	20130511	1433	23.00	119.50	77	25.5	24.8	1010.00	044	2.8	70	261	156.6
St.39	20130511	1207	23.00	119.91	135	26.0	25.9	1010.00	011	0.3	123	596	357.6
St.40	20130511	0850	23.51	119.92	106	24.8	25.3	1010.00	007	0.6	110	564	338.4
St.41	20130511	0643	23.43	119.50	52	24.4	25.1	1010.00	031	8.8	52	193	115.8
St.42	20130511	0418	23.50	119.00	54	22.7	23.5	1009.00	052	7.9	49	242	145.2
St.43	20130511	0146	23.99	119.01	67	22.2	23.4	1009.00	013	0.6	60	254	152.4
St.44	20130510	2311	24.00	119.50	70	23.4	23.8	1010.00	011	0.8	63	195	117.0
St.45	20130510	2037	24.02	120.01	44	23.4	23.8	1010.00	067	9.9	41	169	101.4
St.46	20130510	1628	24.50	120.49	52	23.8	23.5	1010.00	052	18.8	52	246	147.6
St.47	20130510	1403	24.49	119.99	66	23.5	23.3	1010.00	014	0.6	60	191	114.6
St.48	20130510	1125	24.51	119.51	68	21.4	23.0	1010.00	009	0.7	66	167	100.2
St.49	20130510	0730	25.00	120.01	54	20.7	24.2	1009.00	011	5.2	53	253	151.8
St.50	20130510	0445	25.00	120.51	77	22.4	24.9	1007.00	044	3.5	72	366	219.6
St.51	20130510	0219	25.10	120.91	83	23.2	25.5	1008.00	006	1.0	77	142	85.2
St.52	20130509	2313	25.50	120.51	72	23.2	25.1	1009.00	006	0.3	60	307	184.2
St.53	20130509	1935	26.00	120.99	80	21.9	24.0	1009.00	150	7.1	75	475	285.0
St.54	20130509	1702	25.50	121.01	92	22.8	24.0	1008.00	021	3.1	93	421	252.6
St.55	20130509	1355	25.50	121.52	125	23.1	24.7	1009.00	004	0.2	105	478	286.8
St.56	20130509	1111	26.00	121.52	78	22.4	24.1	1011.00	008	0.2	67	373	223.8
St.57	20130509	0823	26.00	122.01	103	22.3	23.9	1011.00	064	13.1	98	479	287.4
St.58	20130509	0529	26.01	122.52	109	23.4	23.8	1011.00	044	16.3	100	492	295.2
St.59	20130509	0236	26.00	123.01	102	23.5	23.6	1011.00	024	2.8	100	470	282.0
St.60	20130508	2325	25.52	123.00	787	24.8	24.1	1012.00	013	0.1	200	862	517.2
St.61	20130508	2000	25.50	122.49	404	24.0	24.3	1012.00	056	13.4	200	902	541.2
St.62	20130508	1629	25.50	122.02	126	23.0	24.2	1012.00	055	14.3	130	634	380.4

表 03.2013-10-27 航次基礎觀測資料
Chart 03. Basic observation data in Oct. 2013

Station	Date	SMT	Lati.	Long.	Depth	SST	Air T.	Air P.	Wind D.	Wind F.	O.N.D	Fl. Ct.	V.M.S.
St.01	20131010	1450	24.87	122.01	372	29.1	26.7	1010.42	044	4.7	200	945	567.0
St.02	20131010	0945	25.02	122.51	1417	29.9	27.2	1012.38	022	3.7	200	907	544.2
St.03	-	-	-	-	-	-	-	-	-	-	-	-	-
St.04	20131010	0239	24.51	122.50	598	29.1	26.3	1010.42	004	4.8	200	942	565.2
St.05	20131009	2237	24.52	122.01	632	29.3	25.7	1011.31	012	6.4	200	1011	606.6
St.06	20131009	1814	24.01	121.68	273	30.0	26.4	1010.25	028	8.3	200	772	463.2
St.07	20131009	1430	23.76	122.03	3294	30.1	27.0	1008.82	033	8.4	200	857	514.2
St.08	20131009	1030	23.75	122.50	3124	30.4	28.7	1010.25	061	0.0	200	980	588.0
St.09	20131009	0705	23.75	123.00	3622	29.8	27.3	1009.89	194	0.0	200	765	459.0
St.10	20131009	0048	22.99	123.00	4854	29.9	27.0	1008.11	180	0.0	200	1173	703.8
St.11	20131008	2030	22.99	122.51	5548	30.4	27.5	1008.47	153	3.8	200	1295	777.0
St.12	20131008	1632	22.99	122.00	4907	30.7	27.9	1005.97	194	4.2	200	850	510.0
St.13	20131008	1246	23.00	121.51	2044	30.7	28.4	1004.73	199	7.0	200	1191	714.6
St.14	20131008	0938	22.68	121.26	1072	30.7	27.8	1005.62	204	4.6	200	1218	730.8
St.15	20131008	0614	22.24	121.00	1178	29.8	26.8	1004.91	203	4.4	200	984	590.4
St.16	20131008	0245	22.25	121.49	682	29.8	27.5	1003.48	271	7.2	200	1074	644.4
St.17	20131007	2310	22.24	122.00	4582	29.4	27.6	1002.77	237	10.1	200	1091	654.6
St.18	20131007	1945	22.24	122.50	4854	30.0	27.8	1002.59	225	8.1	200	1032	619.2
St.19	20131007	1613	22.23	122.99	3652	30.0	27.9	1000.46	220	9.1	200	903	541.8
St.20	20131007	1026	21.49	123.00	4670	30.6	28.5	1001.35	237	9.2	200	1170	702.0
St.21	20131007	0714	21.49	122.50	4791	30.5	28.1	1000.99	246	10.5	200	1023	613.8
St.22	20131007	0400	21.48	122.00	3453	30.7	28.1	998.14	256	12.4	200	1408	844.8
St.23	20131007	0017	21.50	121.43	2611	30.3	28.8	999.74	271	10.6	200	704	422.4
St.24	20131006	2023	21.50	120.99	1229	29.9	27.4	998.50	328	13.1	200	1018	610.8
St.25	20131006	1631	21.49	120.49	1510	29.8	27.6	997.96	314	14.0	200	954	572.4
St.26	20131006	1256	21.51	119.98	2969	29.7	27.4	999.92	319	15.4	200	1464	878.4
St.27	20131006	0858	21.51	119.48	2962	29.6	27.0	1003.30	331	15.0	200	1113	667.8
St.28	20131006	0442	21.51	118.99	2746	30.4	27.1	1002.95	357	13.8	200	971	582.6
St.29	20131006	0057	22.00	118.99	1392	29.2	26.6	1002.77	019	15.6	200	939	563.4
St.30	20131005	2133	22.00	119.50	2409	29.6	26.8	1002.95	015	14.9	200	728	436.8
St.31	20131005	1749	22.00	120.00	1081	29.7	26.6	1002.59	350	10.3	200	673	403.8
St.32	20131005	1432	22.01	120.49	380	30.1	27.1	1002.41	324	7.1	200	997	598.2
St.33	20131005	1133	22.38	120.32	528	29.4	26.8	1004.55	317	8.7	200	912	547.2
St.34	20131005	0848	22.51	119.99	729	28.8	25.2	1006.69	001	8.0	200	797	478.2
St.35	20131005	0533	22.50	119.49	220	28.5	25.3	1004.37	012	12.4	200	897	538.2
St.36	20131005	0213	22.50	119.00	85	28.4	25.1	1005.44	017	12.9	77	421	252.6
St.37	20131004	2345	22.94	119.10	30	27.8	25.1	1006.51	001	12.3	23	156	93.6
St.38	20131004	2120	23.00	119.50	77	28.2	25.3	1007.58	022	14.8	70	392	235.2
St.39	20131004	1849	23.02	119.91	126	28.9	24.9	1006.33	010	15.9	120	850	510.0
St.40	20131004	1536	23.51	119.90	121	27.6	24.7	1005.97	023	15.9	115	672	403.2
St.41	20131004	1220	23.43	119.50	51	27.7	24.7	1007.93	031	15.6	44	226	135.6
St.42	20131004	0903	23.51	119.00	52	28.2	24.4	1010.07	024	15.1	49	340	204.0
St.43	20131004	0529	24.01	119.00	57	27.6	24.4	1009.00	031	14.2	52	299	179.4
St.44	20131004	0229	24.00	119.50	62	27.4	24.7	1008.82	030	14.5	56	252	151.2
St.45	20131003	2335	23.99	119.99	47	28.0	24.5	1007.40	023	16.2	39	313	187.8
St.46	20131003	1948	24.50	120.49	52	27.2	24.1	1008.64	045	15.6	45	221	132.6
St.47	20131003	1534	24.50	119.99	57	27.1	24.0	1009.36	026	16.1	55	270	162.0
St.48	20131003	1138	24.50	119.49	71	28.3	24.2	1010.42	030	16.4	63	292	175.2
St.49	20131003	0725	25.00	120.00	55	27.6	24.6	1010.96	037	16.3	49	222	133.2
St.50	20131003	0428	25.00	120.45	74	27.9	25.3	1010.25	040	14.5	70	411	246.6
St.51	20131003	0157	25.08	120.82	81	27.7	25.6	1011.49	047	13.6	59	416	249.6
St.52	20131002	2205	25.50	120.50	64	28.6	25.2	1012.56	049	11.0	60	278	166.8
St.53	20131002	1810	26.00	121.00	79	27.9	25.0	1011.85	045	10.0	72	361	216.6
St.54	20131002	1440	25.51	121.00	87	28.0	24.8	1010.60	033	10.5	83	426	255.6
St.55	20131002	1106	25.51	121.51	118	28.8	25.1	1011.67	028	9.8	110	493	295.8
St.56	20131002	0758	25.99	121.50	68	28.3	25.2	1011.49	017	9.8	63	406	243.6
St.57	20131002	0509	26.02	122.00	99	27.8	25.2	1009.71	005	9.8	95	485	291.0
St.58	20131002	0151	26.00	122.50	105	28.5	25.7	1010.25	028	9.0	100	390	234.0
St.59	20131001	2238	26.00	123.01	94	28.9	26.0	1010.96	037	8.5	89	352	211.2
St.60	20131001	1858	25.51	123.00	775	29.1	26.9	1009.53	018	9.2	200	824	494.4
St.61	20131001	1533	25.52	122.50	280	28.1	26.1	1009.53	020	9.7	200	1162	697.2
St.62	20131001	1200	25.49	122.00	116	28.3	25.5	1010.42	026	8.8	115	414	248.4

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