南海航行状况研究报告

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《南海航行状况研究报告》编辑委员会

摘 要

南海（即南中国海）是“21 世纪海上丝绸之路”的重要水域，是目前世界上船舶活动最频繁的水域之一，也是世界各国高度关注的热点水域。境外部分媒体和个别国家就南海航行状况不时发声，对中国南海活动以及外交、经济等领域产生不良影响。

中国航海学会和上海海事大学的专家学者通过梳理南海水域岛礁分布、海峡水道、航行规则、天气系统以及推荐航路，分析和归纳了南海水域航海安全保障能力现状，基于对卫星 AIS 大数据采集、统计与分析，获取了南海水域船舶交通流量等基础数据，并比对南海航路分布及习惯航行方法等资料，首次就南海水域船舶航行安全实际状况进行了全面、客观的分析与论证，填补了国际上对南海水域船舶交通安全统计与分析的空白，也为相关部门提供了重要的参考依据。

研究报告结果表明：南海水域商船推荐航路被过往船舶自由选用，水域中船舶的流量、船长、船宽和吃水总体上较大，船舶平均航速稳定；过往船舶的目的港遍布世界 60 多个主要航运国家或地区，总运力匹配世界各个国家或地区前 50 船队的 91%以上；南海水域的灯塔等重要公益性服务设施有效地提升了南海通航保障与服务能力。

综上所述，南海水域船舶航行实际状况和基础数据研究表明，南海水域的航路分布是科学的，航路选择是自由的，船舶航行是顺畅、安全的。

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第 1 章 南海水域总述

1.1 水域范围

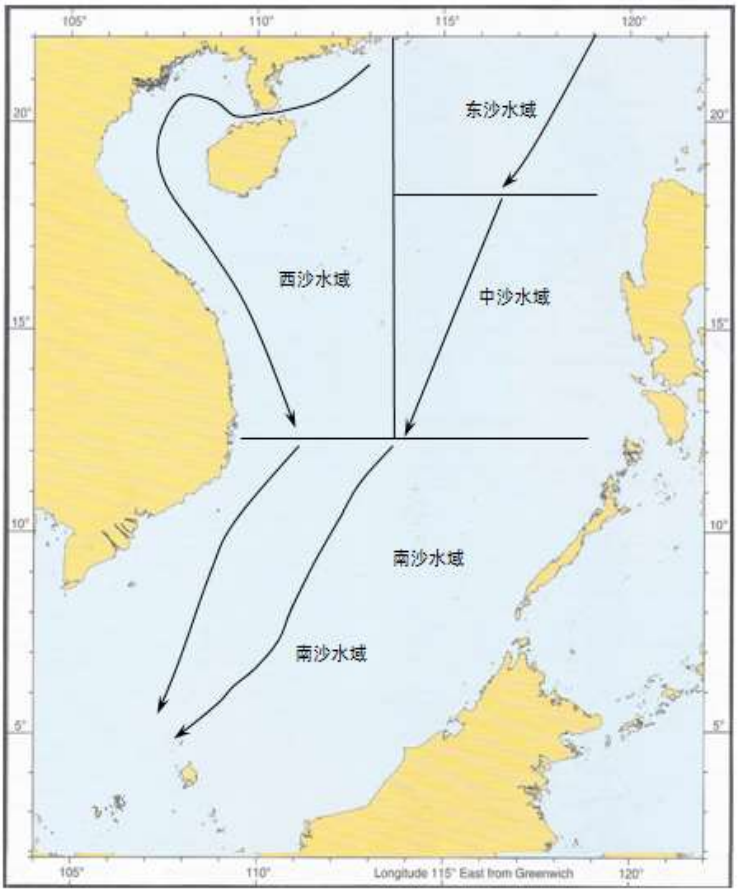
南海，国际诸多领域称谓或标识为南中国海（South China Sea）；在中国诸多图书文字记录中标识为南海（航海专业图书中英文对照标识用 South China Sea，以下简称南海）。

图 1-1 南海水域地理范围（源于海军航保部 2016 年航海图书目录）

如图 1-1 所示，南海水域宽广，主航路呈东北至西南走向。南海北部起于中国广东省沿岸的南澳岛（约 24°N），沿此岛向东南延至巴士海峡；东部为菲律宾群岛西侧和马来西亚（加里曼丹岛）西北部近海水域；西面邻接北部湾和越南的东部近海；南至 4°N～3°N（近曾母暗沙以南）水域。南海水域四周毗邻中国、越南、菲律宾、马来西

亚、文莱以及印度尼西亚等国家。南海水域船舶航行活动频繁，是目前世界上最重要的航行水域之一，也是世界各国高度关注的热点水域。根据航区通航主体航路和水域特征，可将南海分为 4 个航区（图 1-2）。

图 1-2 南海水域航区划分示意图



如图 1-2 所示，南海水域 4 个航区分别是东沙及周边海域（24°N～19°N 之间，113°30′E 以东水域，主体水域 20°20′N～21°20′N）；西沙及周边海域（22°N～13°N 之间，113°30′E 以西水域，主体水域 15°42′N～17°08′N，111°10′E～112°54′E 内）；中沙及周边海域（19°N～13°N 之间，113°30′E 以东水域，主体水域 15°24′N～16°15′N，113°40′E～114°57′E 内）；南沙及周边海域（13°N～2°N 之间，不包括泰国湾水域，主体水域 3°37′N～11°55′N，109°33′E～117°50′E 内）。

1.2 岛礁分布

1）东沙及周边岛礁分布

东沙群岛位于 20°33′N～21°10′N，115°54′E～116°57′E 之间的水域，居中国广东省、海南岛、台湾岛及菲律宾吕宋岛的中间位置，是中国南海诸岛中位置最北的一组群岛。

东沙岛（20°42′N，116°43′E）位于东沙礁盘的西端，东西长 2.8 千米，南北宽约 0.7 千米，面积约 1.8 平方千米，平均海拔高度 6 米。

2）西沙及周边岛礁分布

西沙及周边水域起自珠江口西面的海陵岛，向西延至湛江、琼州海峡、经北部湾西至越南近海水域，南到中建岛水域。西沙群岛位于 15°42′N～17°08′N，111°10′E～112°54′E，在海南岛的东南方、南海中部。西沙群岛属南海四大群岛之一，由宣德群岛、永乐群岛、华光礁、东岛、中建岛等构成，共有 22 个岛屿、7 个沙洲，另有 10 多个暗礁暗滩，岛屿总面积为 10 平方千米。西沙群岛以永兴岛为中心，距三亚市榆林港和文昌市清澜港都是 180 海里。

3）中沙及周边岛礁分布

中沙群岛位于东沙、西沙、南沙等三群岛之间，分布于南北长 600 千米、东西最宽约 440 千米的广大海域。中沙群岛包括中沙大环礁、黄岩岛和其他零星暗沙三部分，共有 1 个岛、2 个岩、2 个暗礁、26 个暗沙和 2 个暗滩（已命名 33 个）。黄岩岛（民主礁）中心位于 15°07′N，117°51′.0E 附近，为露出海面的环礁，形似等腰三角形，西边与南边各长 15 千米，面积约 150 平方千米。

4）南沙及周边岛礁分布

南沙及周边水域在 13°N～02°N 之间、主体水域（南沙群岛）位于 3°37′N～11°55′N，109°33′E～117°50′E。其中，南沙群岛南北宽约 550 海里，东西长约 650 海里。

南沙群岛依其岛礁分布情况可分为东、西、南等三个岛礁群。东礁群只有几个零星礁滩，南礁群全是暗礁、暗沙，唯有西礁群岛礁密布。南沙群岛有岛屿、沙洲、暗礁、暗滩和暗沙共 550 多个，其中大型岛屿 13 个，太平岛最大。

1.3 海峡水道

南海及周边水域有许多世界闻名的海峡、水道与邻海和大洋相通。西部的琼州海峡为中国的内海，是沟通广东沿海水域和北部湾的通道；北部东北有中国的台湾海峡联通南海与东海，东向有巴士海峡、巴林塘海峡和巴布延海峡通往太平洋；东部水域有民都洛海峡、巴拉巴克海峡通向苏禄海；南部向南远端可延伸到新加坡海峡、马六甲海峡通安达曼海，巽他海峡通印度洋。

1.4 航行规则

1）联合国海洋法公约

《联合国海洋法公约》特指联合国召开的 1982 年第三次会议所决议的海洋法公约（LOS）。《联合国海洋法公约》的主体内容在中文版一般是指 1982 年的决议条文。此公约对内水、领海、毗邻区、大陆架、专属经济区（亦称“排他性经济海域”，英文缩写：EEZ）、公海等重要概念作了界定。对当前全球海上天然资源管理、污染处理等具有重要的指导作用。

2）国际海上人命安全公约（SOLAS 公约）

《国际海上人命安全公约》（简称 “SOLAS”公约）是各缔约国政府愿增进海上人命安全而共同制订的统一性原则和有关规则。

3）STCW 马尼拉修正案

《海员培训、发证和值班标准国际公约》（简称“STCW”公约）。STCW 公约主要用于控制船员职业技术素质和值班行为，公约的实施

对促进各缔约国海员素质的提高，在全球范围内保障海上人命、财产的安全和保护海洋环境，有效地控制人为因素对海难事故的影响，起到了积极的作用。

4）国际海上避碰规则公约

《国际海上避碰规则公约》（简称“COLREGS”或“避碰规则”）是为防止船舶碰撞，确保船舶航行安全，规定船舶在海上航行时必须共同遵守的海上交通规则的国际公约。

5）国际防止船舶造成防污染公约

《国际防止船舶造成防污染公约》（简称“MARPOL”公约或“防污公约”）旨在将向海洋倾倒污染物、排放油类以及向大气中排放有害气体等污染降至最低的水平。

1.5 天气系统

南海水域主要受到季风（东北季风盛行期主要在 12 月到次年 1 月，西南季风盛行期主要在 5 月至 8 月，其他时间为季风过渡月份）以及热带气旋、风暴潮等天气系统的影响。

热带气旋活动季节在每年的 6 月下旬到 10 月中旬，大部分热带气旋移动到中国的南部海岸，其他部分朝西到越南北部。

根据统计，热带气旋活动规律一般是：11 月至翌年 4 月多在南海南部海区活动，以西行为主；5 月多东北行，主要影响粤西海区或移出南海；6 月至 8 月主要北至西北行，在华南沿海登陆；9 月后多西行，10 月下旬路径更偏西。

第 2 章 南海水域航路与航海保障

根据航海领域商船通用的英版《世界大洋航路》现行版资料可知，除渔业活动外，南海水域内推荐航路主要适用于通往中国沿海、日本、韩国以及东南亚各国港口之间的商船，航路以西南/东北向为主，总体上分东线、中线和西线，其中中线是主要航路（图 2-1）。

图 2-1 南海水域主要航路概况（注* ：源于英版《世界大洋航路》最新版 2014）

注*：基于原始资料的需要，图 2-1 中所有南海水域地点英文名称仅代表原版资料的标注。

2.1 南海航路

2.1.1 西南/东北向航路

1）东面航路（简称东线）

在东北季风期间（12 月到次年的 1 月为盛行期），某些低速船可优先考虑选择巴拉望（ Palawan）航线，该线又称东面航路（简称东线）。巴拉望（ Palawan）航线为双向航路：船舶沿着南海东部海岸向西南方向航行，可到达菲律宾沿海港口或继续南下到达新加坡；船舶也可由新加坡向东北向沿马来西亚近海向巴拉巴克海峡（Balabac Strait）航行，进而到达菲律宾西部沿海港口或继续北上到达中国沿海或日韩。因此，东面航路可通往巴拉巴克海峡（Balabac Strait）、民都洛海峡（Mindoro Strait）以及 Verde 岛（Verde Island）航道。

2）中间航路（南海的主航路，简称中线）

在所有季节驶离或驶往中国沿海、日韩（包括通过台湾海峡或巴士海峡）各港口的船舶均可选择中间航路，该航路也是商船常用的主要国际航线。由北向南可从台湾海峡南部的台湾浅滩（23°00′N，118°30′E）一侧起航，经过东沙岛（20°40′N，116°45′E）一侧（东侧或西侧）航行，直接到达中沙滩（15º50′N，114º30′E）和西沙群岛（16º40′N，112º00′E）南面的浪花礁（16º02′N，112º30′E）之间；然后驶向 A 点（10º00′N，110º05′E），再驶往沙勒特浅滩（7º08′N，107º35′E）的东南 25 海里处，选择 Aur 岛（2º27′N，104º31′E）和阿南巴斯群岛（3º00′N，106º00′E）之间航行到新加坡。

在东北季风较强盛期间（12 月到次年的 1 月），由北向南从台湾海峡南部的澎湖航道（23°30′N，119°53′E）起航，经过东沙岛（20°40′N，116°45′E）正东，直接航行到达中沙滩（15º50′N，114º30′E）东面，然后通过 A 点（10º00′N，110º05′E）与南沙群岛的西卫滩（7°53′N，

110°00′E）之间水域，再驶往沙勒特浅滩（7º08′N，107º35′E）东南25 海里以外水域，最后选择阿南巴斯群岛（3º00′N，106º00′E）和 Aur 岛（2º27′N，104º31′E）之间航道前往新加坡。

以上航线均是双向航路，即也可由新加坡驶往台湾海峡或香港，继续北上过台湾海峡或继续向东北航经吕宋海峡至台湾东部。

3）西面航路（简称西线）

在12月到次年的1月的东北季风和5月到8月的西南季风期间，南海水域航行可选西面航路。此外，由北部湾水域周边港口或越南沿海港口至新加坡往返航行也可选用此线。

从香港及周边或台湾海峡南部沿海出发，航路可直达西沙群岛（16º40′N，112º00′E）西面 30 海里处，继而航行到维雷拉角（12°54′N，109°28′E）以东 15~20 海里处，再到盖特威克（10°00′N，109°00′E）东侧，然后驶往沙勒特浅滩（7º08′N，107º35′E）东南 25 海里处，选择 Aur 岛（2º27′N，104º31′E）和阿南巴斯群岛（3º 00′ N，106º 00′ E）之间航路，最后前往新加坡。

从新加坡海峡进入南海驶往中国及日韩各港口船舶，在此期间也可沿此线北上。

2.1.2 东南/西北向航路

民都洛海峡航路（航线为东南/西北走向），是由香港及其周边港口驶往南太平洋及欧洲的航路，也是南海通往苏禄海以及大洋洲的重要航道。在东北季风弱时或季风转换期间，民都洛海峡为常用航道。每年 5-9 月由香港驶往南太平洋及欧洲的船舶，10 月由欧洲到达中国、日本的船舶常经过此海峡航行。

此外，该航区内还有一条东西向通往巴士海峡或巴林塘海峡航路，此航线也是中国南方港口通往太平洋的重要航路（图 2-1）。

2.2 航海保障

航海图书资料显示，南海北部水域的船舶通航保障设施分布趋于完善，特别是在其北部沿岸已经构建了完善的水上交通运输管理系统，中部和南部海域需进一步加强。

2.2.1 船舶交通管理与服务

1）船舶交通服务（VTS）系统

南海航区建立 VTS 系统的港口有香港港、深圳港、广州港和琼州海峡，详细情况可参阅相关港口的《VTS 用户指南》和《英版无线电信号表》。目前南海中部及南部水域还未建立船舶交通服务系统。

2）中国船舶报告系统

中国船舶报告系统适用南海水域中 9°N 以北、130°E 以西的海域，但不包括其他国家领海和内水。航行在中国船舶报告区域内，且航行时间超过 6 小时的 300 总吨及以上的中国籍船舶必须加入中国船舶报告系统，外国籍船舶和 300 总吨以下的中国籍船舶可自愿加入中国船舶报告系统。目前，南海 9°N 以南、130°E 以东的海域没有实施船舶报告系统的要求。

3）助导航设施

目前，中国在南沙群岛（图 2-2）有关岛礁上建设了华阳灯塔、赤瓜灯塔、渚碧灯塔、永暑灯塔和美济灯塔等五座大型多功能灯塔。

这五座灯塔，是中国在南海海域建设的重要公益性服务设施，五座灯塔的建成和投入使用也是中国履行相关国际责任和义务的体现，承担着南沙群岛水域海上搜寻救助、航行安全、渔业生产、海洋防灾减灾等航海保障功能。

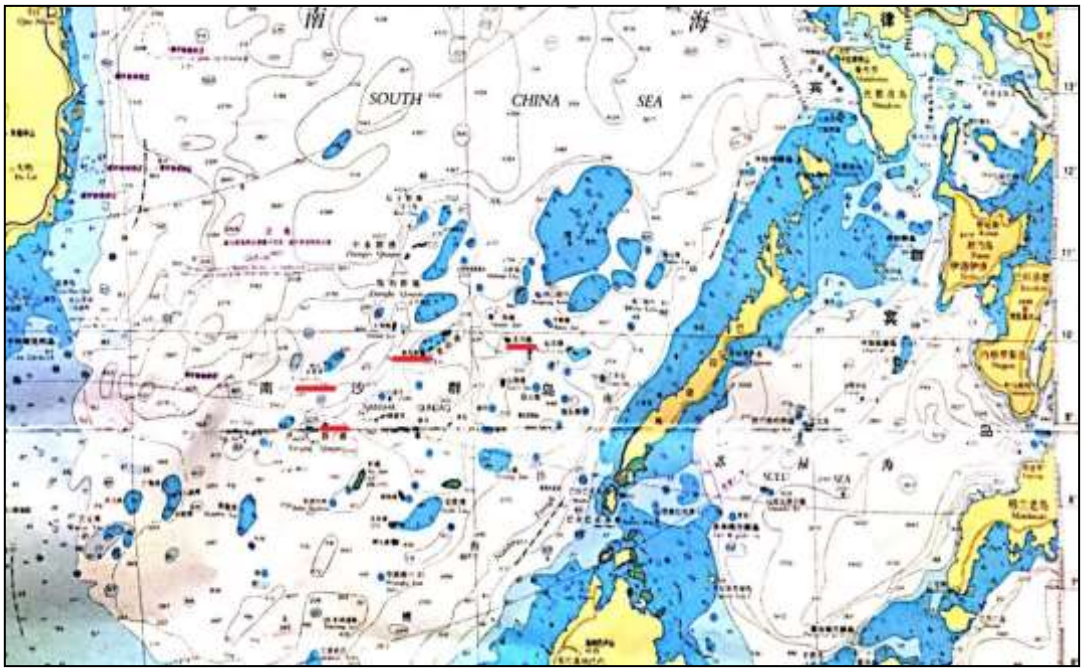


图2-2　南沙群岛水域岛礁分布

4）无线电航行警告

发布南海水域无线电航行警告电传（NAVTEX）信息的主要台站分布情况，可参阅表 2-1。

表 2-1　南海至新加坡水域 NAVTEX 站台信息

序号	国家（地区）	站台名称	位置	站台编码
1	中国（香港）	Hong Kong	22°11′ N,114°15′E	L
2	中国（广州）	Guangzhou	23°09′ N,113°30′E	N
3	中国（三亚）	Sanya	18°14′ N,109°30′E	M
4	越南（岘港）	Da Nang	16°03′.53N,108°12′.53E	K
5	越南（胡志明市）	Ho Chi Minh City	10°23′.53N,107°08′.95E	X
6	马来西亚（山打根）	Sandakan	5°54′ N,118°00′E	S
7	马来西亚（米里）	Miri	4°26′ N,114°01′E	T
8	新加坡（樟宜）	Singapore（Changi）	1°21′ N,103°59′E	C

2.2.2 航区应急救助服务

根据国际海事组织（IMO）发布的《国际海上搜寻救助公约》，中国香港向国际海事组织（IMO）通报了南海搜救责任区水域范围：中国香港在南海水域的海上搜救责任区为10°N以北、120°E以西除其

他国家领海之外的南海海域。

2006年中华人民共和国国务院发布《国家海上搜救应急预案》，该预案的适用范围涵盖“中国管辖水域和承担的海上搜救责任区内海上突发事件的应急反应行动”。

中国在搜救责任区内的应急救助服务主要由中国南部沿海各搜救中心具体负责，并在西沙水域的永兴岛上安排值班点，总体上应急救助能力较强。而南海周边的国家虽然也建立了自己的搜救指挥协调中心，但应急救助的能力与水平较低，覆盖范围基本上仅限于沿岸水域。因此，中国可以选择或利用有条件的岛屿建设固定的搜救站，并兼顾防污染的功能，以完善南海海域的安全保障体系。

目前，中国正积极推进中国—东盟国家在南海水域海上搜救的务实合作，以增进中国—东盟海上搜救机构相互了解，有效推进在海上搜救领域的协调、配合，提升各国联合搜救的能力和水平。

第 3 章 南海水域 AIS 船舶流量分析

3.1 南海水域 AIS 船舶交通流量观测与分析

南海水域各航区既具有相对独立的特点，又彼此相互关联。每个航区岛礁分布、水深浅点、风流要素、港口资源、锚地条件以及习惯航法等差别很大，需要船舶驾驶人员熟悉航区特点，掌握航行注意事项。因此，基于卫星 AIS 大数据采集、统计与分析是获取南海水域船舶交通流量的重要手段，也是对南海水域航路自由选择的科学认证。

3.1.1 南海水域 AIS 船舶交通流量观测

南海水域季风气候特征明显，季风与船舶航路流量关联性极强，航区船舶活动呈现年复一年的规律性。因此，通过低轨道卫星 AIS 的数据库，选择 2016 年 3 月、6 月和 10 月等三个不同季节采集 AIS 商船信息数据，并对采集后的数据进行统计和分析，南海水域的船舶 AIS 交通流量总体情况如图 3-1～3-6 所示。

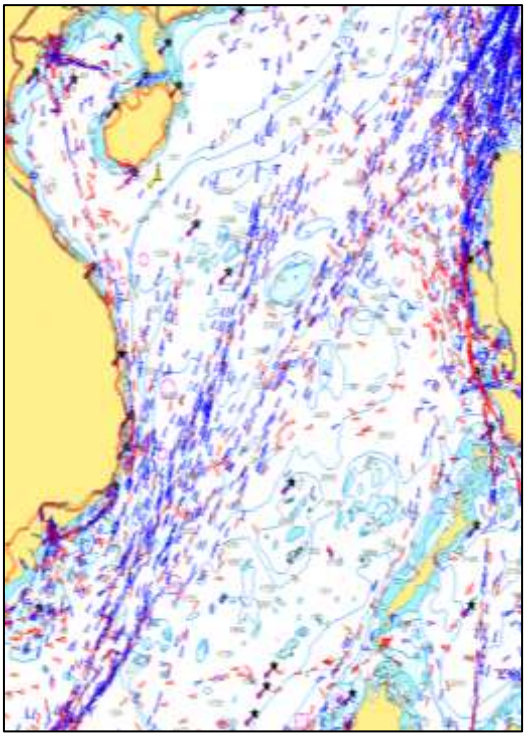


图 3-1　2016 年 3 月船舶船位信息

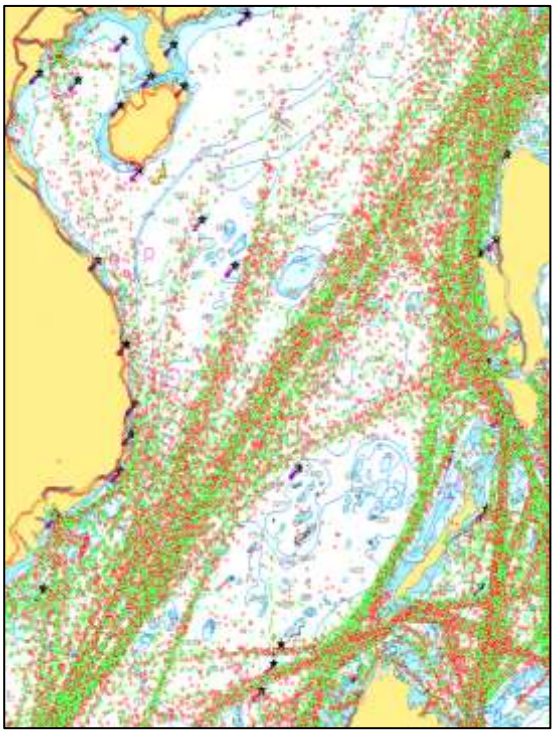


图 3-2　2016 年 3 月船舶轨迹（航路）

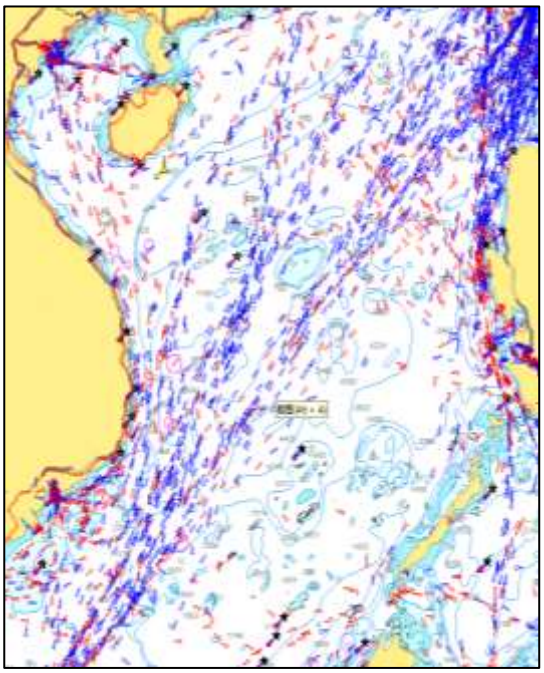


图 3-3　2016 年 6 月船舶船位信息

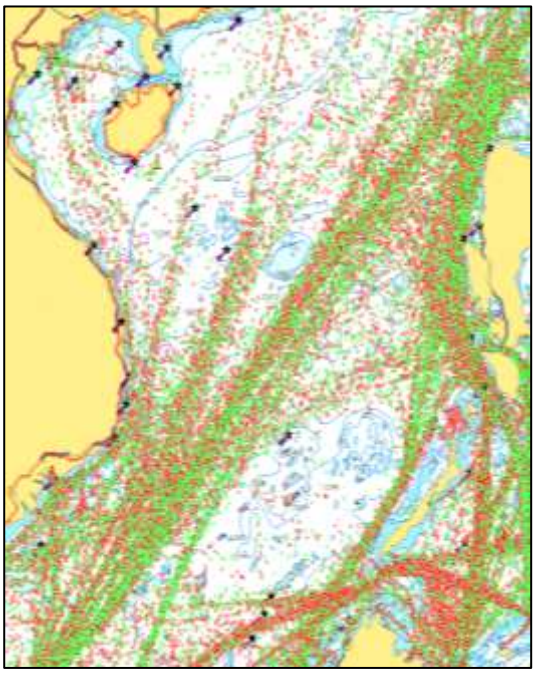


图 3-4　2016 年 6 月船舶轨迹（航路）

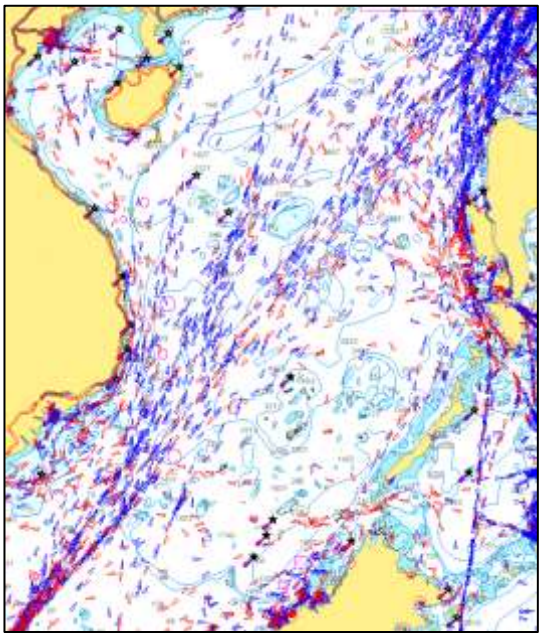


图 3-5　2016 年 10 月船舶船位信息

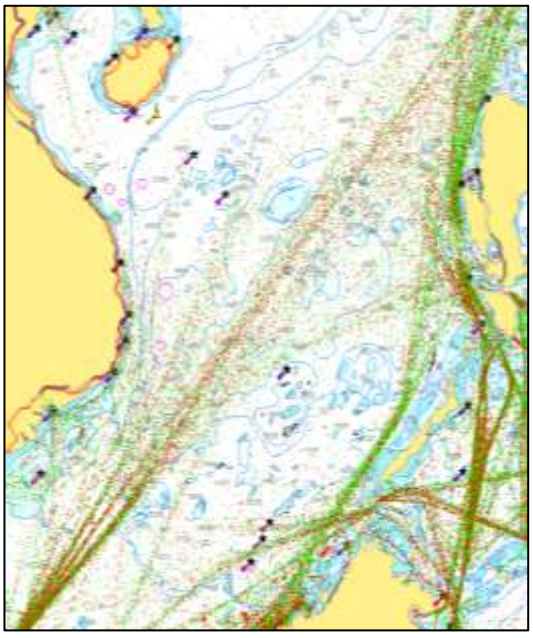


图 3-6　2016 年 10 月船舶轨迹（航路）

3.1.2 南海水域 AIS 船舶交通流量分析

根据船舶航行轨迹观测数据可知，船舶主要由北部湾、台湾海峡、巴士海峡、民都洛海峡、巴拉巴克海峡以及马六甲海峡进出南海水域。为便于对 AIS 数据进行统计和分析，根据南海水域的船舶主要流量分布情况，分别设置 6 条 AIS 数据研究区域观测门线进行详细分析。观

测门线的具体信息见表 3-1，位置如图 3-7 所示。

表 3-1 流量观测门线设置

观测门线编号	观测门线经纬度
1#	11° 27′ 22.44″ N，114° 12′ 47.7″ E 14° 15′ 00.00″ N，110° 01′ 49.25″ E
2#	10° 52′ 39.79"N，118° 41′ 45.28"E 12° 08′ 26.95"N，117° 24′ 05.50"E 13° 24′ 40.39"N，116° 43′ 12.98"E 15° 21′ 48.43"N，113° 54′ 48.60"E 16° 02′ 11.69"N，112° 07′ 43.01"E 16° 26′ 40.64"N，109° 50′ 22.54"E 15° 55′ 52.11"N，108° 22′ 54.15"E
3#	18° 39′ 58.93"N，120° 50′ 55.24"E 19° 49′ 51.61"N，118° 46′ 39.59"E 19° 54′ 30.05"N，110° 55′ 46.57"E
4#	18° 39′ 58.93"N，120° 50′ 55.24"E 21° 49′ 44.97"N，120° 51′ 44.29"E
5#	13° 04′ 53.37"N，120° 38′ 57.66"E 12° 23′ 45.27"N，119° 50′ 45.50"E
6#	5° 08′ 56.27"N，105° 39′ 56.78"E 3° 35′ 23.60"N，107° 56′ 11.84"E 2° 58′ 08.73"N，108° 44′ 42.16"E

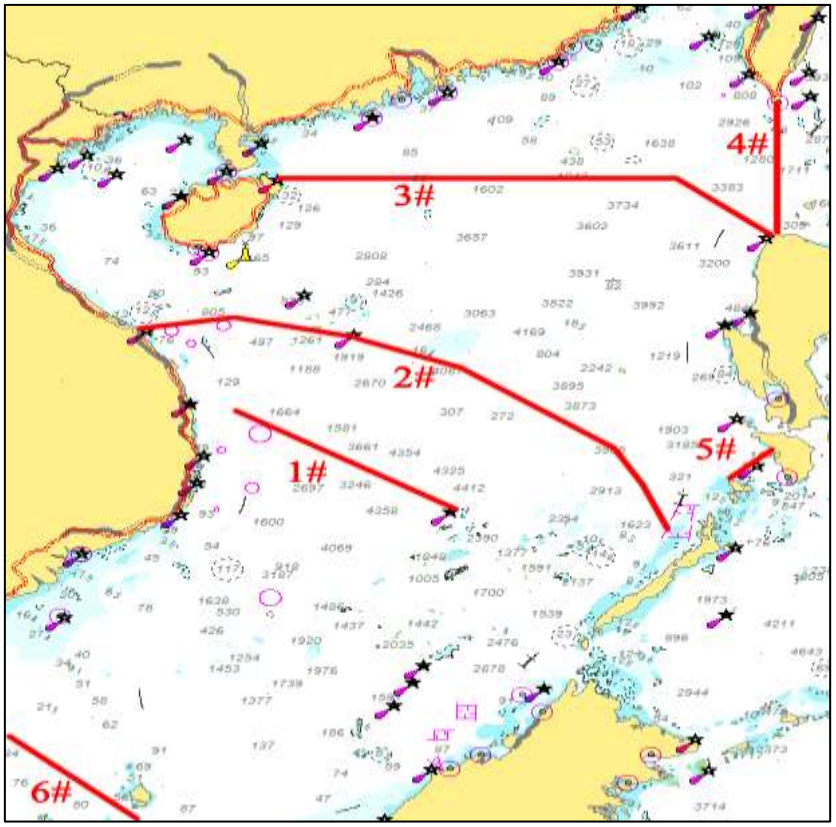


图 3-7 流量观测门线的分布

通过对不同观测门线位置进行 AIS 船舶流量的统计分析，再根据各流量观测门线截面的 AIS 船舶流量以及船舶航行方向来判断南海水域船舶交通流的规律。为统一和方便分析，以向北航行船舶和向东航行船舶为进口方向，具体分析情况如下：

1）2016 年 3 月的 AIS 交通流数据分析

根据卫星 AIS 数据统计结果，2016 年 3 月南海水域的船舶总数为 8110 艘次。

为获取船舶密度，将南海水域划分为 215 个网格，网格单元尺寸为 80000 米×80000 米（图 3-8）。经统计单位网格内通过的船舶数量，统计总数为 5668 艘次，单位网格最大为 875 艘次。

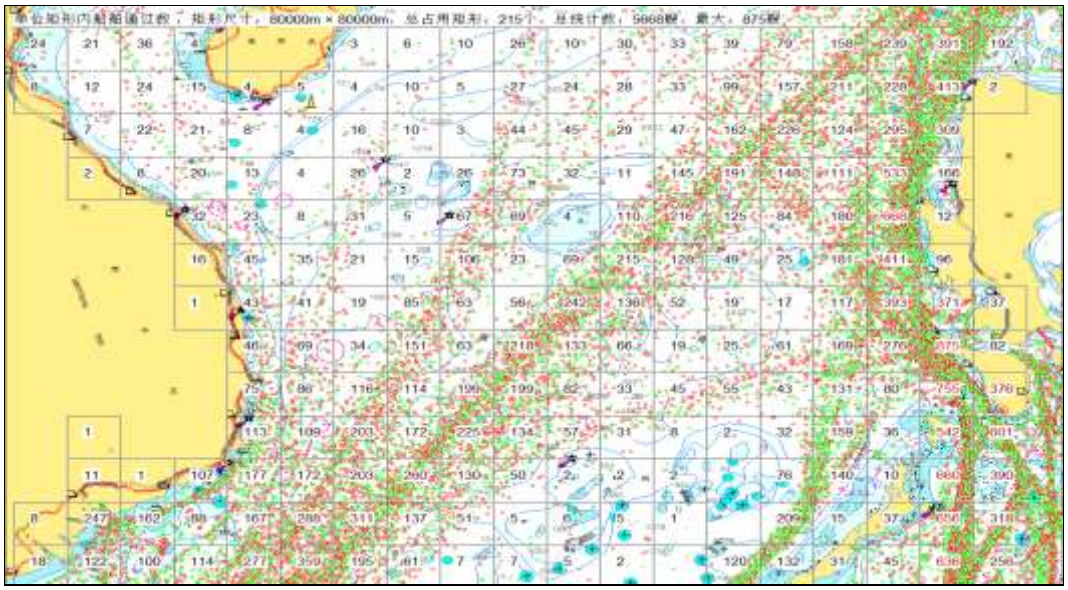


图 3-8　单位网格内船舶数量轨迹

2）2016 年 6 月的 AIS 交通流数据分析

根据卫星 AIS 数据统计结果，2016 年 6 月南海水域的船舶总数为 8166 艘次。

为获取船舶密度，将南海水域划分为 214 个网格，网格单元尺寸为 80000 米×80000 米（图 3-9）。经统计单位网格内通过的船舶数量，统计总数为 5971 艘次，单位网格最大为 1013 艘次。

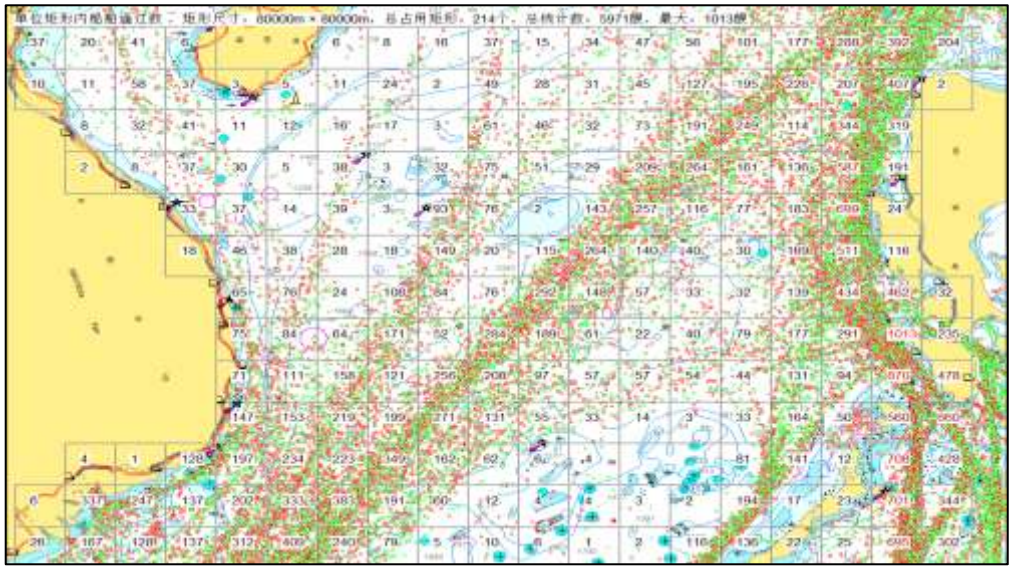


图 3-9 单位网格内船舶数量轨迹

3）2016 年 10 月的 AIS 交通流数据分析

根据卫星 AIS 数据统计结果，2016 年 10 月南海水域的船舶总数为 7891 艘次。

为获取船舶密度，将南海水域划分为 213 个网格，网格单元尺寸为 80000 米×80000 米（图 3-10）。经统计单位网格内通过的船舶数量，统计总数为 4119 艘次，单位网格最大为 774 艘次。

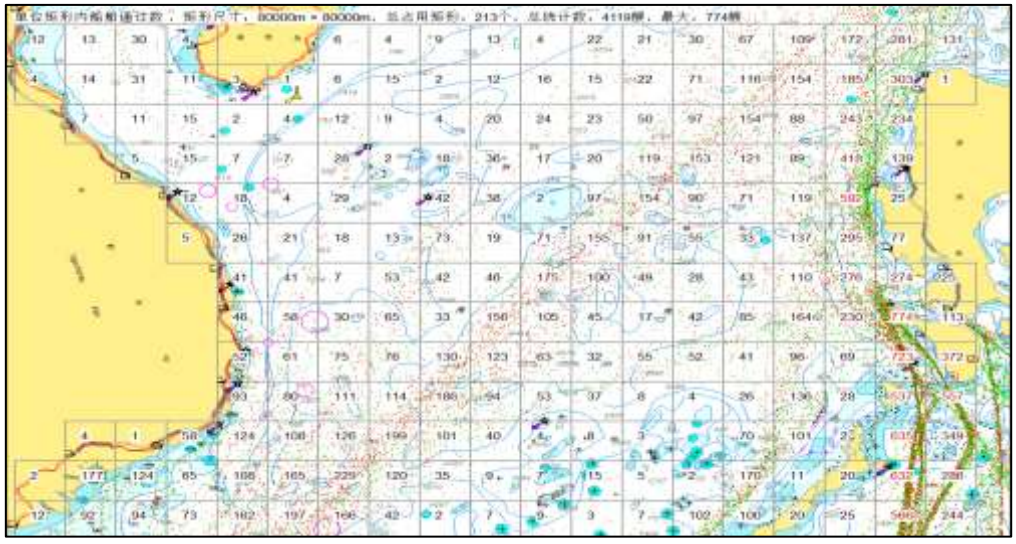


图 3-10 单位网格内船舶数量轨迹

3.2 主要船舶类型的交通流量

根据卫星 AIS 数据进行不同观测门线截面的船舶类型分类，以

分析相应的船舶交通流量特征。

1）南海水域 2016 年 3 月 AIS 交通流数据

2016 年 3 月的 1#～6#观测门线的统计信息如表 3-2 所示。

表 3-2　2016 年 3 月的 1#～6#观测门线的统计信息

观测门线	通过船舶数量/艘次	平均船长/米	平均船宽/米	平均吃水/米	平均过线航速/节
1#	2106.00	228.67	36.51	10.86	14.04
2#	2430.00	195.44	31.46	8.84	13.71
3#	2441.00	234.45	38.17	11.40	13.02
4#	1152.00	238.35	38.74	11.56	13.14
5#	1203.00	228.87	36.34	10.74	12.27
6#	3343.00	224.09	35.28	10.58	13.52

2）南海水域 2016 年 6 月 AIS 交通流数据

2016 年 6 月的 1#～6#观测门线的统计信息如表 3-3 所示。

表 3-3　2016 年 6 月的 1#～6#观测门线的统计信息

观测门线	通过船舶数量/艘次	平均船长/米	平均船宽/米	平均吃水/米	平均过线航速/节
1#	2419.00	226.96	35.97	11.13	13.99
2#	2808.00	182.35	29.12	8.18	13.72
3#	2655.00	231.58	37.75	11.40	13.27
4#	1268.00	237.78	38.89	11.69	13.32
5#	1306.00	233.53	37.05	10.83	12.30
6#	3707.00	228.55	35.77	10.83	13.83

3）南海水域 2016 年 10 月 AIS 交通流数据

2016 年 10 月的 1#～6#观测门线的统计信息如表 3-4 所示。

表 3-4　2016 年 10 月的 1#～6#观测门线的统计信息

观测门线	通过船舶数量/艘次	平均船长/米	平均船宽/米	平均吃水/米	平均过线航速/节
1#	1568.00	227.91	36.15	10.78	13.73
2#	1865.00	175.43	27.91	9.03	10.83
3#	1847.00	214.51	33.91	10.43	13.28
4#	875.00	241.70	39.54	11.65	13.03
5#	1156.00	233.59	37.12	10.53	12.35
6#	2484.00	173.42	28.31	8.73	12.18

3.3 南海中国沿岸船舶流量占比情况

根据 2016 年 3 月、6 月和 10 月等三个月的南海水域船舶卫星 AIS 数据信息，结合网格化船舶流量数据，统计出南海水域的中国沿岸船舶流量（包括海南岛及南海诸岛礁 12 海里范围内），主要是进出这些岛屿的船舶，如表 3-5 和图 3-11 所示。

表 3-5　南海中国沿岸船舶流量占比

AIS 数据时段	船舶总流量/艘次	中国沿岸船舶流量/艘次	中国沿岸船舶流量占总流量比率/%
2016 年 3 月	8110	170	2.10
2016 年 6 月	8166	241	2.95
2016 年 10 月	7891	257	3.25
平均值	8055.67	222.67	2.77

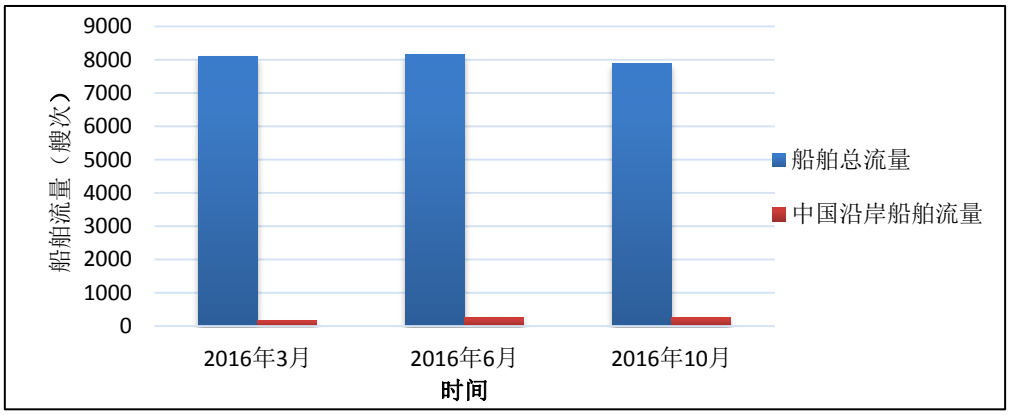


图 3-11　南海船舶总流量和南海中国沿岸船舶流量对比

由表 3-5 和图 3-11 可知，中国沿岸船舶流量占南中海船舶总流量平均值为 2.77%，即岛礁区的船舶流量很小，有 97.23%的船舶在开阔水域通过南海。

3.4 主要航路上的船籍国分布

1）南海水域船籍国分布情况

根据 3 次（2016 年 3 月、6 月和 10 月）不同时间段的南海水域船舶卫星 AIS 数据信息，可统计船籍国（船舶属于的国家或地区）的分布情况。具体分析数据如图 3-12，3-13 和图 3-14 所示。

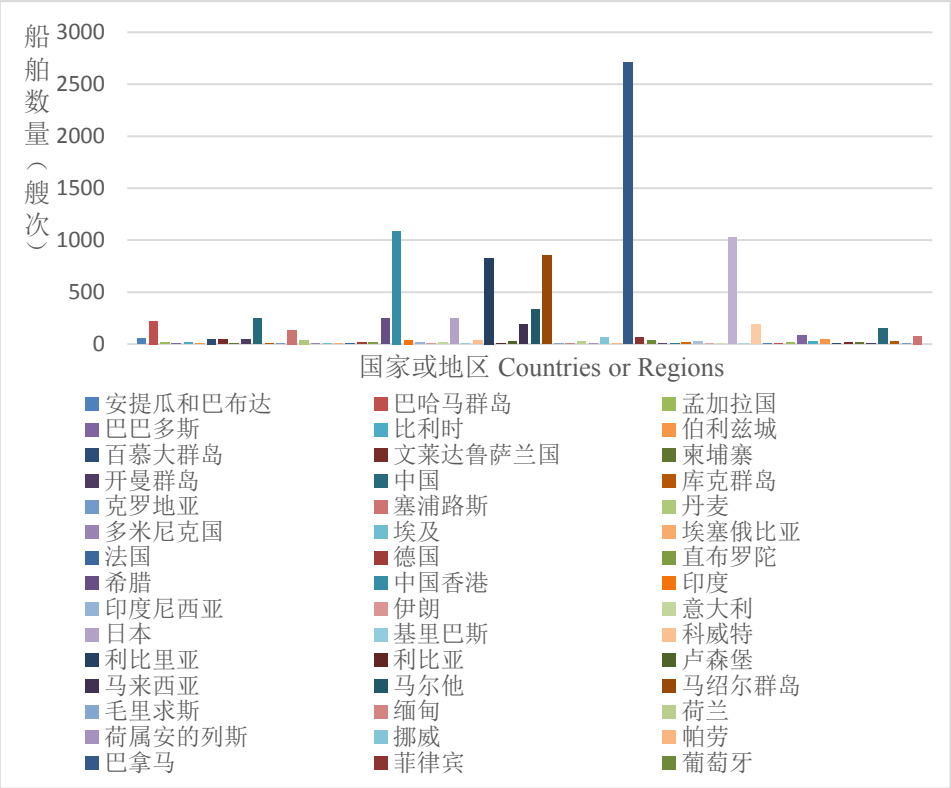


图 3-12　2016 年 3 月船籍国分布

根据图 3-12 中数据，2016 年 3 月在南海水域的船籍国共有 68 个国家或地区，其中最多的区域为巴拿马，其次为中国香港。

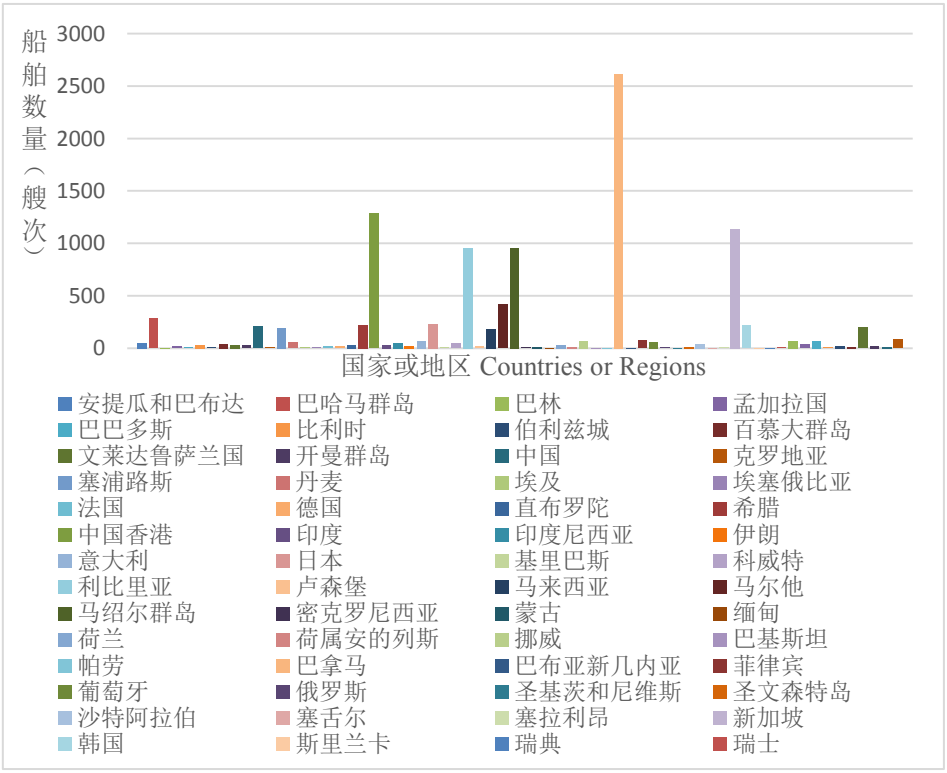


图 3-13　2016 年 6 月船籍国分布

根据图 3-13 中数据，2016 年 6 月在南海水域的船籍国共有 66 个国家或地区，其中最多的区域为巴拿马，其次为中国香港和新加坡。

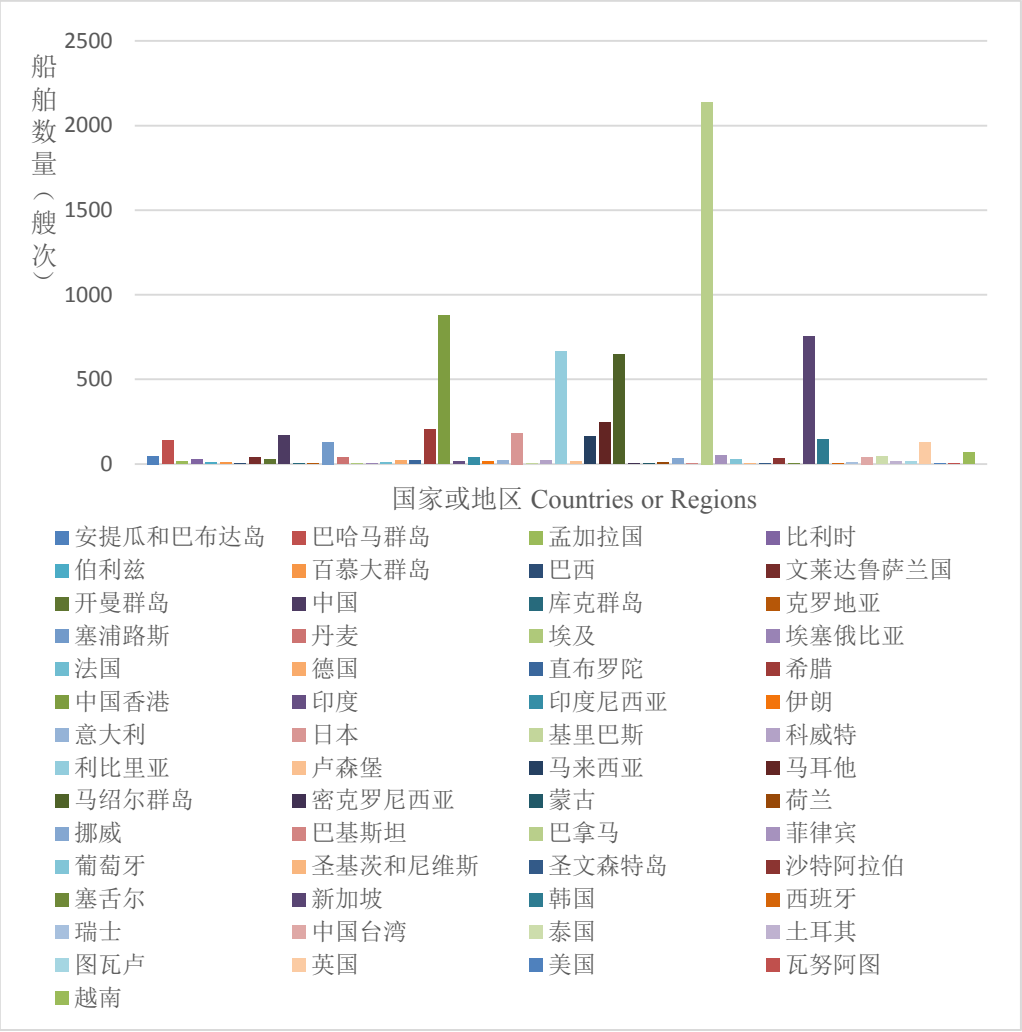


图 3-14　2016 年 10 月船籍国分布

根据图 3-14 中数据，2016 年 10 月在南海水域的船籍国共有 57 个国家或地区，其中最多的区域为巴拿马，其次为中国香港和新加坡。

2）世界各国或地区前 50 船队总运力统计排名数据

为分析 3 次（2016 年 3 月、6 月和 10 月）不同时间段的南海水域船舶卫星 AIS 数据信息和统计其船籍国的分布情况，采用了同时期（2016 年 3 月、6 月和 10 月）的 Clarkson SIN（克拉克森海运情报网）数据库中提供的世界各个国家或地区总运力（每个国家或地区前 50 名船队的总运力）统计排名数据，经比较分析获得南海水域船舶交通流走向趋势和航行行为及分布情况，具体分析数据如表 3-6～3-8。

表 3-6　2016 年 3 月世界各个“国家或地区前 Top50 船队总运力”排名（Clarkson SIN）

排名	国家或地区	船舶数量/艘次	总载重量/吨	排名	国家或地区	船舶数量/艘次	总载重量/吨	排名	国家或地区	船舶数量/艘次	总载重量/吨
1	希腊	2514	239462483	63	巴哈马	40	754604	125	斐济	40	12552
2	日本	3356	223599469	64	阿塞拜疆	310	715960	126	马德拉	5	10992
3	中国	3334	185575773	65	厄瓜多尔	119	688028	127	加蓬	26	10357
4	德国	2400	94091790	66	秘鲁	89	634771	128	佛得角	19	10252
5	韩国	1456	82097855	67	马耳他	76	604750	129	海地	8	10147
6	挪威	1926	67828747	68	也门	49	594500	130	根西	3	9865
7	美国	2814	54647512	69	古巴	75	567754	131	毛利塔尼亚	3	9135
8	新加坡	2233	54330203	70	马恩岛	26	544176	132	库克群岛	4	9125
9	中国台湾	1054	53029457	71	阿根廷	167	504068	133	苏里南	11	8211
10	意大利	1509	46725023	72	马绍尔群岛	62	486676	134	马达加斯加	25	7974
11	丹麦	1401	43441601	73	朝鲜	128	483905	135	赤道几内亚	12	6724
12	中国香港	781	38387320	74	哈萨克斯坦	81	421616	136	安的列斯群岛	1	6384
13	加拿大	928	36664891	75	伊拉克	96	405846	137	美属维尔京群岛	11	6030
14	英国	1084	32547276	76	埃塞俄比亚	13	366010	138	圣文森特和格林纳丁斯	6	4802
15	比利时	454	24893183	77	文莱	95	365895	139	多米尼克	26	4789
16	法国	810	22008295	78	喀麦隆	14	364592	140	尼加拉瓜	6	4764
17	印度	1043	18979693	79	英属维尔京群岛	39	330247	141	索马里	6	4506
18	伊朗	481	18821261	80	爱沙尼亚	138	318945	142	塞内加尔	14	4378
19	沙特阿拉伯	543	18579010	81	突尼斯	57	316539	143	几内亚	8	4316
20	俄罗斯	1120	18384404	82	巴拿马	186	306049	144	瓦努阿图	3	3697
21	土耳其	948	18175660	83	泽西岛	4	301663	145	密克罗尼西亚	5	3504
22	马来西亚	1131	17424021	84	直布罗陀	18	286285	146	柬埔寨	2	3373
23	巴西	654	16602058	85	立陶宛	96	278568	147	波多黎各	29	3338
24	荷兰	1723	16280047	86	斯里兰卡	75	237002	148	刚果	12	3332
25	百慕大群岛	73	11893142	87	约旦	45	214623	149	安圭拉	3	3150
26	科威特	233	11709048	88	塞舌尔	27	208145	150	圣赫勒拿岛	1	3130
27	瑞士	247	9858503	89	利比里亚	23	200869	151	新喀里多尼亚	10	3063
28	印度尼西亚	2463	9695674	90	缅甸	96	200643	152	冈比亚	8	3006
29	阿联酋	981	9177878	91	哥伦比亚	133	176456	153	所罗门	13	2942
30	瑞典	460	7545490	92	巴布亚新几内亚	136	153569	154	瓜德罗普	24	2798
31	阿曼	76	7495475	93	毛里求斯	18	149209	155	玻利维亚国	4	2663
32	澳大利亚	374	6571317	94	黑山	14	143736	156	关岛	8	2564
33	越南	641	6524511	95	圣基茨和尼维斯	18	136077	157	列支敦士登	4	2464
34	泰国	567	6337546	96	澳大利亚	6	132060	158	库拉索	14	2327
35	塞浦路斯	218	5977040	97	冰岛	47	129779	159	安提瓜和巴布达	5	2199
36	卡塔尔	164	4890694	98	巴林	125	116985	160	危地马拉	9	2121
37	以色列	163	4435421	99	阿尔巴尼亚	64	108041	161	汤加	6	2076
38	埃及	454	3628920	100	摩洛哥	84	100350	162	马提尼克	6	2072
39	安哥拉	91	3343358	101	坦桑尼亚	50	100137	163	巴巴多斯	1	2040
40	西班牙	519	3296893	102	马尔代夫群岛	50	92488	164	基里巴斯	3	1973
41	克罗地亚	236	3174975	103	土库曼斯坦	33	81679	165	圣路达	1	1821
42	波兰	257	3101613	104	法罗群岛	48	76368	166	萨摩亚群岛	7	1803
43	智利	309	2901963	105	肯尼亚	48	66266	167	贝宁	6	1716
44	摩纳哥	57	2888279	106	乌拉圭	56	57635	168	牙买加	12	1658
45	委内瑞拉	241	2721086	107	洪都拉斯	61	55248	169	特克斯和凯科斯群岛	3	1615
46	利比亚	102	2570382	108	格陵兰岛	15	55187	170	瓦利斯群岛	1	1562
47	芬兰	213	2304850	109	吉布提	14	55115	171	库克群岛	4	1521
48	乌克兰	472	2283194	110	新西兰	96	51040	172	科特迪瓦	5	1348
49	孟加拉共和国	231	2053722	111	圭亚那	56	48975	173	科摩罗群岛	1	1103
50	尼日利亚	385	1828346	112	巴拉圭	38	37861	174	福克兰群岛	2	1001
51	墨西哥	449	1765335	113	法属波利尼西亚	47	29729	175	马里亚纳岛	4	980
52	爱尔兰	185	1745282	114	苏丹	22	27610	176	多哥共和国	7	943
53	黎巴嫩	160	1739910	115	伯利兹	20	26119	177	开曼群岛	3	919
54	保加利亚	137	1665395	116	加纳	48	25666	178	阿鲁巴	2	700
55	南非	144	1579195	117	特立尼达	99	25221	179	美属萨摩亚群岛	4	593
56	巴里斯坦	62	1470335	118	加那利群岛	13	20825	180	老挝	1	578
57	阿尔及利亚	119	1346494	119	莫桑比克	25	20615	181	东帝汶	2	532
58	菲律宾	655	1285077	120	格鲁吉亚	48	18886	182	格林纳达	11	385
59	葡萄牙	137	1256768	121	斯洛文尼亚	9	18765	183	留尼汪岛	5	213
60	拉脱维亚	93	1051481	122	刚果	12	16625	184	图瓦卢	1	212
61	罗马尼亚	179	969624	123	塞拉利昂	20	15896	185	纳米比亚	2	183
62	叙利亚共和国	102	808435	124	厄立特里亚	9	13841	186	多米尼加	1	155

表 3-7　2016 年 6 月世界各个“国家或地区前 Top50 船队总运力”排名（Clarkson SIN）

排名	国家或地区	船舶数量/艘次	总载重量/吨	排名	国家或地区	船舶数量/艘次	总载重量/吨	排名	国家或地区	船舶数量/艘次	总载重量/吨
1	希腊	2514	239462483	63	巴哈马	40	754604	125	斐济	40	12552
2	日本	3356	223599469	64	阿塞拜疆	310	715960	126	马德拉	5	10992
3	中国	3334	185575773	65	厄瓜多尔	119	688028	127	加蓬	26	10357
4	德国	2400	94091790	66	秘鲁	89	634771	128	佛得角	19	10252
5	韩国	1456	82097855	67	马耳他	76	604750	129	海地	8	10147
6	挪威	1926	67828747	68	也门	49	594500	130	根西	3	9865
7	美国	2814	54647512	69	古巴	75	567754	131	毛利塔尼亚	3	9135
8	新加坡	2233	54330203	70	马恩岛	26	544176	132	库克群岛	4	9125
9	中国台湾	1054	53029457	71	阿根廷	167	504068	133	苏里南	11	8211
10	意大利	1509	46725023	72	马绍尔群岛	62	486676	134	马达加斯加	25	7974
11	丹麦	1401	43441601	73	朝鲜	128	483905	135	赤道几内亚	12	6724
12	中国香港	781	38387320	74	哈萨克斯坦	81	421616	136	安的列斯群岛	1	6384
13	加拿大	928	36664891	75	伊拉克	96	405846	137	美属维尔京群岛	11	6030
14	英国	1084	32547276	76	埃塞俄比亚	13	366010	138	圣文森特和格林纳丁斯	6	4802
15	比利时	454	24893183	77	文莱	95	365895	139	多明尼加共和国	26	4789
16	法国	810	22008295	78	喀麦隆	14	364592	140	尼加拉瓜	6	4764
17	印度	1043	18979693	79	英属维尔京群岛	39	330247	141	索马里	6	4506
18	伊朗	481	18821261	80	爱沙尼亚	138	318945	142	塞内加尔	14	4378
19	沙特阿拉伯	543	18579010	81	突尼斯	57	316539	143	几内亚	8	4316
20	俄罗斯	1120	18384404	82	巴拿马	186	306049	144	瓦努阿图	3	3697
21	土耳其	948	18175660	83	泽西岛	4	301663	145	密克罗尼西亚	5	3504
22	马来西亚	1131	17424021	84	直布罗陀	18	286285	146	柬埔寨	2	3373
23	巴西	654	16602058	85	立陶宛	96	278568	147	波多黎各	29	3338
24	荷兰	1723	16280047	86	斯里兰卡	75	237002	148	刚果	12	3332
25	百慕大群岛	73	11893142	87	约旦	45	214623	149	安圭拉	3	3150
26	科威特	233	11709048	88	塞舌尔	27	208145	150	圣赫勒拿岛	1	3130
27	瑞士	247	9858503	89	利比里亚	23	200869	151	新喀里多尼亚	10	3063
28	印度尼西亚	2463	9695674	90	缅甸	96	200643	152	冈比亚	8	3006
29	阿联酋	981	9177878	91	哥伦比亚	133	176456	153	所罗门	13	2942
30	瑞典	460	7545490	92	巴布亚新几内亚	136	153569	154	瓜德罗普	24	2798
31	阿曼	76	7495475	93	毛里求斯	18	149209	155	玻利维亚国	4	2663
32	澳大利亚	374	6571317	94	黑山	14	143736	156	关岛	8	2564
33	越南	641	6524511	95	圣基茨和尼维斯	18	136077	157	列支敦士登	4	2464
34	泰国	567	6337546	96	澳大利亚	6	132060	158	库拉索	14	2327
35	塞浦路斯	218	5977040	97	冰岛	47	129779	159	安提瓜和巴布达	5	2199
36	卡塔尔	164	4890694	98	巴林	125	116985	160	危地马拉	9	2121
37	以色列	163	4435421	99	阿尔巴尼亚	64	108041	161	汤加	6	2076
38	埃及	454	3628920	100	摩洛哥	84	100350	162	马提尼克	6	2072
39	安哥拉	91	3343358	101	坦桑尼亚	50	100137	163	巴巴多斯	1	2040
40	西班牙	519	3296893	102	马尔代夫群岛	50	92488	164	基里巴斯	3	1973
41	克罗地亚	236	3174975	103	土库曼斯坦	33	81679	165	圣路达	1	1821
42	波兰	257	3101613	104	法罗群岛	48	76368	166	萨摩亚群岛	7	1803
43	智利	309	2901963	105	肯尼亚	48	66266	167	贝宁	6	1716
44	摩纳哥	57	2888279	106	乌拉圭	56	57635	168	牙买加	12	1658
45	委内瑞拉	241	2721086	107	洪都拉斯	61	55248	169	特克斯和凯科斯群岛	3	1615
46	利比亚	102	2570382	108	格陵兰岛	15	55187	170	瓦利斯群岛	1	1562
47	芬兰	213	2304850	109	吉布提	14	55115	171	库克群岛	4	1521
48	乌克兰	472	2283194	110	新西兰	96	51040	172	科特迪瓦	5	1348
49	孟加拉共和国	231	2053722	111	圭亚那	56	48975	173	科摩罗群岛	1	1103
50	尼日利亚	385	1828346	112	巴拉圭	38	37861	174	福克兰群岛	2	1001
51	墨西哥	449	1765335	113	法属波利尼西亚	47	29729	175	马里亚纳岛	4	980
52	爱尔兰	185	1745282	114	苏丹	22	27610	176	多哥共和国	7	943
53	黎巴嫩	160	1739910	115	伯利兹	20	26119	177	开曼群岛	3	919
54	保加利亚	137	1665395	116	加纳	48	25666	178	阿鲁巴	2	700
55	南非	144	1579195	117	特立尼达	99	25221	179	美属萨摩亚群岛	4	593
56	巴里斯坦	62	1470335	118	加那利群岛	13	20825	180	老挝	1	578
57	阿尔及利亚	119	1346494	119	莫桑比克	25	20615	181	东帝汶	2	532
58	菲律宾	655	1285077	120	格鲁吉亚	48	18886	182	格林纳达	11	385
59	葡萄牙	137	1256768	121	斯洛文尼亚	9	18765	183	留尼汪岛	5	213
60	拉脱维亚	93	1051481	122	刚果	12	16625	184	图瓦卢	1	212
61	罗马尼亚	179	969624	123	塞拉利昂	20	15896	185	纳米比亚	2	183
62	叙利亚共和国	102	808435	124	厄立特里亚	9	13841	186	多米尼加	1	155

表 3-8　2016 年 10 月世界各个“国家或地区前 Top50 船队总运力”排名（Clarkson SIN）

排名	国家或地区	船舶数量/艘次	总载重量/吨	排名	国家或地区	船舶数量/艘次	总载重量/吨	排名	国家或地区	船舶数量/艘次	总载重量/吨
1	希腊	2514	239462483	63	巴哈马	40	754604	125	斐济	40	12552
2	日本	3356	223599469	64	阿塞拜疆	310	715960	126	马德拉	5	10992
3	中国	3334	185575773	65	厄瓜多尔	119	688028	127	加蓬	26	10357
4	德国	2400	94091790	66	秘鲁	89	634771	128	佛得角	19	10252
5	韩国	1456	82097855	67	马耳他	76	604750	129	海地	8	10147
6	挪威	1926	67828747	68	也门	49	594500	130	根西	3	9865
7	美国	2814	54647512	69	古巴	75	567754	131	毛利塔尼亚	3	9135
8	新加坡	2233	54330203	70	马恩岛	26	544176	132	库克群岛	4	9125
9	中国台湾	1054	53029457	71	阿根廷	167	504068	133	苏里南	11	8211
10	意大利	1509	46725023	72	马绍尔群岛	62	486676	134	马达加斯加	25	7974
11	丹麦	1401	43441601	73	朝鲜	128	483905	135	赤道几内亚	12	6724
12	中国香港	781	38387320	74	哈萨克斯坦	81	421616	136	安的列斯群岛	1	6384
13	加拿大	928	36664891	75	伊拉克	96	405846	137	美属维尔京群岛	11	6030
14	英国	1084	32547276	76	埃塞俄比亚	13	366010	138	圣文森特和格林纳丁斯	6	4802
15	比利时	454	24893183	77	文莱	95	365895	139	多明尼加共和国	26	4789
16	法国	810	22008295	78	喀麦隆	14	364592	140	尼加拉瓜	6	4764
17	印度	1043	18979693	79	属维尔京群	39	330247	141	索马里	6	4506
18	伊朗	481	18821261	80	爱沙尼亚	138	318945	142	塞内加尔	14	4378
19	沙特阿拉伯	543	18579010	81	突尼斯	57	316539	143	几内亚	8	4316
20	俄罗斯	1120	18384404	82	巴拿马	186	306049	144	瓦努阿图	3	3697
21	土耳其	948	18175660	83	泽西岛	4	301663	145	密克罗尼西亚	5	3504
22	马来西亚	1131	17424021	84	直布罗陀	18	286285	146	柬埔寨	2	3373
23	巴西	654	16602058	85	立陶宛	96	278568	147	波多黎各	29	3338
24	荷兰	1723	16280047	86	斯里兰卡	75	237002	148	刚果	12	3332
25	百慕大群岛	73	11893142	87	约旦	45	214623	149	安圭拉	3	3150
26	科威特	233	11709048	88	塞舌尔	27	208145	150	圣赫勒拿岛	1	3130
27	瑞士	247	9858503	89	利比里亚	23	200869	151	新喀里多尼亚	10	3063
28	印度尼西亚	2463	9695674	90	缅甸	96	200643	152	冈比亚	8	3006
29	阿联酋	981	9177878	91	哥伦比亚	133	176456	153	所罗门	13	2942
30	瑞典	460	7545490	92	布亚新几内	136	153569	154	瓜德罗普	24	2798
31	阿曼	76	7495475	93	毛里求斯	18	149209	155	玻利维亚国	4	2663
32	澳大利亚	374	6571317	94	黑山	14	143736	156	关岛	8	2564
33	越南	641	6524511	95	基茨和尼维	18	136077	157	列支敦士登	4	2464
34	泰国	567	6337546	96	澳大利亚	6	132060	158	库拉索	14	2327
35	塞浦路斯	218	5977040	97	冰岛	47	129779	159	安提瓜和巴布达	5	2199
36	卡塔尔	164	4890694	98	巴林	125	116985	160	危地马拉	9	2121
37	以色列	163	4435421	99	阿尔巴尼亚	64	108041	161	汤加	6	2076
38	埃及	454	3628920	100	摩洛哥	84	100350	162	马提尼克	6	2072
39	安哥拉	91	3343358	101	坦桑尼亚	50	100137	163	巴巴多斯	1	2040
40	西班牙	519	3296893	102	马尔代夫群岛	50	92488	164	基里巴斯	3	1973
41	克罗地亚	236	3174975	103	土库曼斯坦	33	81679	165	圣路达	1	1821
42	波兰	257	3101613	104	法罗群岛	48	76368	166	萨摩亚群岛	7	1803
43	智利	309	2901963	105	肯尼亚	48	66266	167	贝宁	6	1716
44	摩纳哥	57	2888279	106	乌拉圭	56	57635	168	牙买加	12	1658
45	委内瑞拉	241	2721086	107	洪都拉斯	61	55248	169	克斯和凯科斯群岛	3	1615
46	利比亚	102	2570382	108	格陵兰岛	15	55187	170	瓦利斯群岛	1	1562
47	芬兰	213	2304850	109	吉布提	14	55115	171	库克群岛	4	1521
48	乌克兰	472	2283194	110	新西兰	96	51040	172	科特迪瓦	5	1348
49	孟加拉共和国	231	2053722	111	圭亚那	56	48975	173	科摩罗群岛	1	1103
50	尼日利亚	385	1828346	112	巴拉圭	38	37861	174	福克兰群岛	2	1001
51	墨西哥	449	1765335	113	属波利尼西	47	29729	175	马里亚纳岛	4	980
52	爱尔兰	185	1745282	114	苏丹	22	27610	176	多哥共和国	7	943
53	黎巴嫩	160	1739910	115	伯利兹	20	26119	177	开曼群岛	3	919
54	保加利亚	137	1665395	116	加纳	48	25666	178	阿鲁巴	2	700
55	南非	144	1579195	117	特立尼达	99	25221	179	美属萨摩亚群岛	4	593
56	巴里斯坦	62	1470335	118	加那利群岛	13	20825	180	老挝	1	578
57	阿尔及利亚	119	1346494	119	莫桑比克	25	20615	181	东帝汶	2	532
58	菲律宾	655	1285077	120	格鲁吉亚	48	18886	182	格林纳达	11	385
59	葡萄牙	137	1256768	121	斯洛文尼亚	9	18765	183	留尼汪岛	5	213
60	拉脱维亚	93	1051481	122	刚果	12	16625	184	图瓦卢	1	212
61	罗马尼亚	179	969624	123	塞拉利昂	20	15896	185	纳米比亚	2	183
62	叙利亚共和国	102	808435	124	厄立特里亚	9	13841	186	多米尼加	1	155

表3-6～3-8统计了国际上186个国家或地区的总运力统计数据排名情况，涂色部分为2016年3月、6月和10月出现在南海水域中的船舶国家或地区。从标记分布可知，在船舶运力排名前100的国家或地区中，大部分都有船舶在南海水域航行，特别是运力总体实力排名前35的国家或地区，基本都出现在南海水域。由此可见，南海水域航行的船舶国籍遍布全球，分布广泛，船舶运力排名前35的国家或地区、船舶运力排名后35的国家或地区均有分布。目前该片水域航行自由、便利。

3）船舶卫星AIS数据和世界各个国家或地区总运力比对分析

（1）表3-6～3-8列明了国际上186个国家或地区的总运力统计数据排名情况。

（2）经过南海水域的船舶和世界各个国家或地区船队比例分析

为反映经过南海水域的船舶和世界各个国家或地区船队比例关系，将图3-12～3-14和表3-6～3-8进行对标分析，结果表明：南海可供世界各个国家或地区所有商船自由航行（表3-9～3-11）。

表3-9　南海水域的船舶和世界各个国家或地区船队比例（2016年3月）

水域	船舶数量	总载重量
经过南海	42856艘次	1488062776吨
全球	52661艘次	1611781147吨
比例	81.3809%	92.324121%

表3-10 南海水域的船舶和世界各个国家或地区船队比例（2016年6月）

水域	船舶数量	总载重量
经过南海	41845艘次	1474842883吨
全球	52661艘次	1611781147吨
比例	79.4610813%	91.503917%

表3-11 南海水域的船舶和世界各个国家或地区船队比例（2016年10月）

水域	船舶数量	总载重量
经过南海	40931艘次	1467987466吨
全球	52661艘次	1611781147吨
比例	77.7254515%	91.0785852%

第 4 章 南海水域航行安全状况

4.1 南海水域海上交通安全总况

南海水域海上交通安全主要包括灾害性天气、水上交通事故、来自外界的保安事件、航路与航行安全以及航海保障能力状况。

随着航海技术的快速发展和船舶大型化、高速化以及船员综合能力的提升，船舶预防灾害性天气（如热带气旋过境）的能力得到了充分保障，近十年该水域此类事故发生的概率极低。目前，船舶保安事件（海盗袭击和船舶武装抢劫）在南海周边水域时有发生，但主体不在南海核心水域。

此外，船舶通航保障设施在南海北部水域趋于完善，特别是在北部水域。中国沿岸已经构建了先进的水上交通服务系统（VTS 系统），南海中部和南部海域则需要进一步完善。

4.2 南海航路选择是自由的

海上航路的选择基于“安全、经济”的基本原则。因此，在南海水域内的商船航路主要是根据船舶吨位/功率和季风自由选择东线（Palawan 航线）、中线（Main Route）或西线等推荐航路，但航区航路分布均远离岛礁区（一般离岛礁远在 10 海里以上）。此外，南海水域中的一些岛礁建设也远离航路，尤其是南沙群岛水域。卫星 AIS 数据船舶交通流量基础数据充分佐证了推荐航路被过往船舶反复选用。显而易见，南海水域的航路选择是自由的，商船在岛礁附近水域航行也是自由的。

4.3 南海航行是安全的

安全源于保障。航海安全保障能力主要包括航区内的导航与避险、

天气信息预报与发布以及海难救助，其核心是设施配置、建设和规则执行管理。

目前 GPS、DGPS 以及北斗导航系统覆盖整个南海海域，商船可以全天候获得船位；中国政府还在南沙群岛华阳礁等上面建设了五座大型多功能灯塔（图 2-2），其灯光射程均在 20 海里以上，为选用中线航路过往南海的船舶提供导航与避险服务。

中国政府在西沙水域建成了晋卿岛等四座灯桩，在永兴岛等设置了四座船舶自动识别系统基站，实现了西沙重点水域信号的全覆盖；开播了海上安全信息广播业务（包括无线电航行警告信息），实现了对西沙、中沙水域信号的覆盖，为过往船舶提供天气预报信息。

根据 IMO 缔约国须提供海上搜寻救助服务的要求，中国建立了中国船舶报告系统（China Ship Reporting System，简称 CHISREP ）。船舶报告站负责接收船舶通过卫星或无线电台发送的船舶报告，并传送到中国船舶报告管理中心。交通部南海救助局在海口、三亚、西沙、广州、阳江、深圳、湛江、汕头、北海设有救助基地，值班船舶分别安排在相关海区值班待命，随时提供保障服务。因此，南海船舶航行是安全的。

第 5 章 结 论

基于南海水域船舶流量卫星 AIS 数据定量与定性研究，以及对南海水域航路和安全保障等综合分析表明：南海水域商船推荐航路被过往船舶反复自由选用，水域中船舶的流量、船长、船宽和吃水总体上较大，船舶平均航速稳定；过往船舶的目的港遍布世界 60 多个主要航运国家或地区，总运力匹配世界各个国家或地区前 50 船队的 91%以上；南海水域的灯塔和岛礁等重要公益性服务设施建设有效地提升了南海通航保障与服务能力。

南海水域的航路分布是科学的，航路选择是自由的，船舶航行是顺畅、安全的。具体综述如下：

第一，定量分析 AIS 数据表明，南海水域航行的商船不分国籍和地区，航速稳定、航行顺畅，过往全程未受任何影响。

第二，中国对南海水域的定期巡航和长期管理，保障了该海域的安全形势，南海可供世界各国或地区商业船队自由、安全航行。

第三，南海水域商船航路远离岛礁，商船航路选择是自由的和安全的。岛礁建设可有效提升南海通航保障与服务能力。

第四，中国在南海水域建设的灯塔、灯桩、船舶自动识别系统基站等重要公益性服务设施，为南海水域安全航行提供了技术保障，是中国履行相关国际责任与义务的体现。

第五，中国历来履行国际通航水域沿岸国、国际公约缔约国的义务与职责，对南海水域航行安全实施有效监管，使南海成为世界通航水域的安全典范。

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Research Report on Navigation Status in the South China Sea

China Institute of Navigation
Shanghai Maritime University

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Editorial Board

Abstract

The South China Sea as the significant waters along the 21st Century Maritime Silk Road is presently one of the busiest vessel traffic centers in the world. The South China Sea has become a hot spot area with the world-wide attention. There have been some negative voices from the media and the countries overseas, which interfere with China's activities in the South China Sea, diplomacy, economy and so on.

Experts and scholars from China Institute of Navigation and from Shanghai Maritime University comprehensively explored, for the first time, the actual vessel traffic conditions and situations in the South China Sea. Research findings filled the international niche of vessel traffic safety and security statistics and analyses of the very area and provided valuable references for departments concerned. The research described the marine aids to navigation and the services to the safety of navigation in the South China Sea and analyzed island and reef distribution, strait waters, shipping regulations and rules, weather systems and recommended sea routes. Moreover, in comparison with resources on the very sea route distribution and regular traffic methods, the benchmark data of the vessel traffic flow in the South China Sea were clarified based on the Satellite AIS data collection, statistics and analyses.

Findings of this research are as follow. In the South China Sea, the recommended routes are regularly and freely chosen by the large traffic flow of passing merchant ships with relatively big length, breath and draft at the stable speed; the passing vessels with their total capacities matching more than 91% of the world-wide national or regional top 50 fleets are destined for more than 60 major shipping countries and districts in the world; light houses and other public interest service facilities on islands and reefs are effectively safeguarding and serving the traffic in the South China Sea.

In conclusion, the research on the actual conditions and situations of navigation and on the benchmark data of the South China Sea show that the navigation in the South China Sea is unimpeded and safe with the scientifically-distributed and freely-chosen sea routes.

CONTENTS

Chapter 1 An Overview of the South China Sea Waters

1.1 Extent of the South China Sea Waters

The South China Sea, as named or identified in many international fields, is identified in various Chinese publications and written records as Nanhai. Hereinafter in this report referred to as the South China Sea.

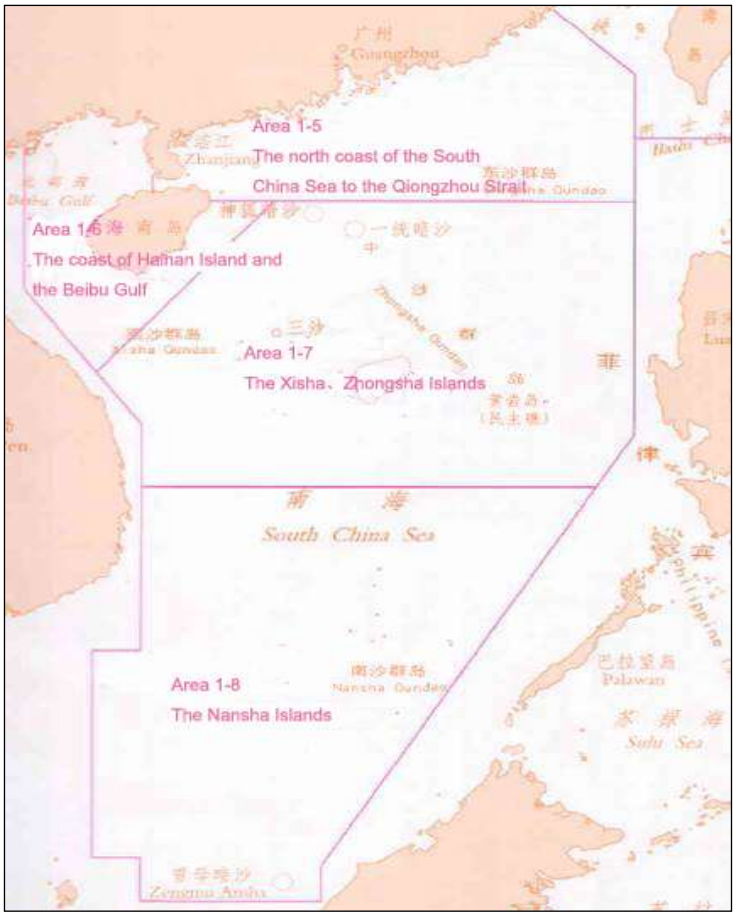

Figure 1-1 Extent of the South China Sea（From the 2016 *Catalogue of Nautical Publications* by the Navigation Guarantee Department of the Chinese Navy Headquarters）

As shown in Figure 1-1, the South China Sea has broad and vast waters with the main routes running from northeast to southwest. The Northern Coast of the South China Sea starts from Nan'ao island (about 24°N) located on the coast of Guangdong Province, China, and extends southeast to the Bashi Channel; to its east are the western part of the Philippine Islands and the northwest coastal waters of Malaysia (Kalimantan Island); to the west Beibu Bay and the east coast of Vietnam; to the south the waters with the latitudes of 4°N～3°N (near the south of the Zengmu Reef). The adjacent countries of the South China Sea include China, Vietnam, Philippines, Malaysia, Brunei, and Indonesia. With very heavy vessel traffic, this area is presently one of the most important navigable waters in the world, and also attracts high world attentions. The South China Sea can be divided into four navigation areas according

to the main routes and the features of navigable waters (Figure 1-2).

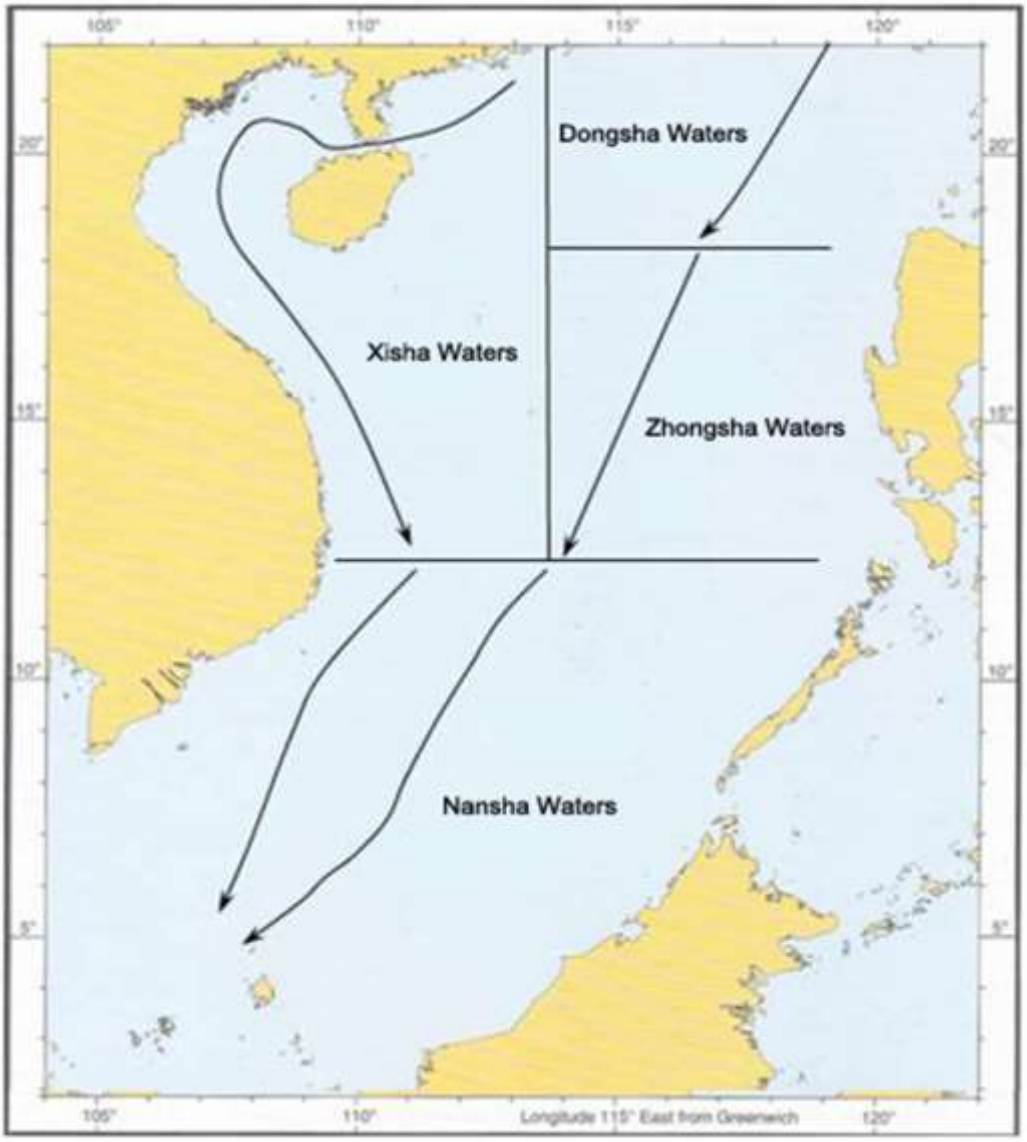

Fig. 1-2 Sketch map of navigation area divisions in the South China Sea

As shown in Figure 1-2, the four navigation areas are:

Dongsha and the surrounding waters (the latitudes 24°N～19°N,east of the longtitude113°30′E, with the main waters of 20°20′N～21°20′N);

Xisha and the surrounding waters (the latitudes 22°N～13°N, west of the longitude113°30′E， with the main waters of 15°42′N～17°08′N， 111°10′E～112°54′E);

Zhongsha and the surrounding waters (the latitudes 19°N～13°N, east of the longitude113°30′E， with the main waters of 15°24′N～16°15′N， 113°40′E～114°57′E);

Nansha and the surrounding waters (the latitudes 13°N～2°N excluding the Thailand Gulf, with the main waters of 3°37′N～11°55′N，109°33′E～117°50′E).

1.2 Island and Reef Distribution

1) Island and reef distribution in Dongsha and the surrounding waters

Dongsha Qundao (the Dongsha Islands) lie in the waters of 20°33′N～21°10′N，115°54′E～116°57′E, which is in the middle of Guangdong Province, Hainan Island, Taiwan Island and Luzon Island of Philippines, and are the northernmost islands among Nanhai Zhudao (the South China Sea Islands).

Dongsha Dao (the Dongsha Island) (20°42′N，116°43′E）is located in the west of the Dongsha Reef，2.8km from east to west, 0.7km from north to south, with the total area of about 1.8km^2，and the average altitude above mean sea level 6 meters.

2) Island and reef distribution in Xisha and the surrounding waters

Xisha and its surrounding waters start from Hailing Island to the west of Pearl River estuary, extending westward to Zhanjiang Port, Qiongzhou Straits, through the Beibu Bay to the coastal waters of Vietnam, southward to the waters of Zhongjian Dao (the Zhongjian Island). Xisha Qundao (the Xisha Islands) lie in waters of 15°42′N～17°08′N，111°10′E～112°54′E, to the southeast of Hainan Island, the middle of the South China Sea. Xisha Qundao (the Xisha Islands) are one of the four archipelagos in the South China Sea, which is composed of the Xuande Islands, the Yongle Islands, the Huaguang Reef, the Dong Island, and the Zhongjian Island and etc., totally 22 islands, 7 sandbanks, and 10 reefs and hidden shoals, with the total area of 10km^2. Xisha Qundao (the Xisha Islands), centered at the Yongxing Island, is 180 nautical miles away from both Yulin Harbor of Sanya City and Qianlan Harbor of Wenchang City, China.

3）Island and reef distribution in Zhongsha and the surrounding waters

Zhogsha Qundao (the Zhongsha Islands) lie in the vast waters between Dongsha Qundao (the Dongsha Islands), Xisha Qundao (the Xisha Islands) and Nansha Qundao (the Nansha Islands), 600km from south to north and 440km from east to west. Zhongsha Qundao (the Zhongsha Islands) are composed of the Zhongsha Grand Atolls, the Huangyan Island and other sporadic shoals, totally 1 island, 2 rocks, 2 reefs, 26 underwater sand beaches and 2 hidden shoals, 33 of which have been named. Huangyan Dao (the Huangyan Island), centered at 15°07′N，117°51′.0E, is an exposed atoll with the form of an isosceles triangle, 15km long both of the west and the east sides, the total area about 150km^2.

4) Island and reef distribution in Nansha and the surrounding waters

Nansha and the surrounding waters lie in the area of 13°N～02°N, with the main waters of 3°37′N～11°55′N，109°33′E～117°50′E, in which Nansha Qundao (the Nansha Islands) are about 550 nautical miles from north to south and 650 nautical miles from east to west.

Nansha Qundao (the Nansha Islands), according to the distribution of islets and reefs, can be divided into the eastern reefs, the western reefs and the southern reefs. There are a few scattered reefs in the east, submerged reefs and shoals in the south, and reefs and rocks full of the west. There are totally more than 550 islands, (hidden) shoals, hidden rocks, reefs and submarine banks in this water, of which Taiping Dao (the Taiping Island) is the biggest of 13 large islands.

1.3 Narrow Channels

The South China Sea and its surrounding waters have many world-famous straits and channels which are interlinked with adjacent seas and oceans. In the west, the Qiongzhou Strait is the inland sea of China, linking Guangdong coastal waters and Beibu Bay; in the north, Taiwan Strait northeast is the passage connecting Donghai (the East China Sea) and the South China Sea, east-wise, the Bashi Channel, the Balintang Channel, and the Babuyan Channel leading to the Pacific Ocean; in the east, there are the Mindoro Strait and the Balabac Strait leading to the Sulu Sea; and in the south, the waters are connected with the Andaman Sea by the Singapore Strait and the Malacca Strait, with the India Ocean by the Sunda Strait.

1.4 Navigation Rules

1) *United Nations Convention on the Law of the Sea* (UNCLOS)

The *United Nations Convention on the Law of the Sea* is the international agreement resulted from the third United Nations Conference on the Law of the Sea in 1982. UNCLOS defines such important terms as inland waters, territorial seas, , contiguous zones, continental shelves, exclusive economic zones (also called "exclusive economic waters", EEZ), international waters and so on, which provides guidelines with respect to the marine natural resource management, pollution treatment and so on.

2）*International Convention for the Safety of Life at Sea* (SOLAS）

The *International Convention for the Safety of Life at Sea* (SOLAS）is an international convention establishing in a common agreement among the Contracting Governments the uniform principles and the relevant rules for promoting safety of life at sea.

3) *2010 Manila Amendments to STCW Convention*

The *International Convention on Standards of Training, Certification and Watch-keeping for Seafarers* (STCW) sets qualification standards for masters, officers and watch personnel on seagoing merchant ships. The implementation of the Convention contributes actively to the competency improvement of the Parties' seafarers, to the effective control of the impact of human factors on marine accidents, and to the protection of safety of property, life at sea and of the marine environment.

4) *International Regulations for Preventing Collision at Sea, 1972, as amended*

The *International Regulations for Preventing Collision at Sea,1972, as amended* （COLREGs）set out navigation rules to be followed by ships and other vessels at sea to prevent collisions between two or more vessels, thus maintaining the safety of navigation at sea.

5) *International Convention for the Prevention of Pollution from Ships 1973/1978*

The *International Convention for the Prevention of Pollution from Ships,1973/1978* (MARPOL73/78) is an international convention aiming at minimizing the pollution from ships by dumping pollutants and discharging oil into the sea, and by emitting harmful gases into the air.

1.5 Weather Systems

The South China Sea are mainly affected by the monsoons (the northeast monsoon prevailing mainly from December to the following January, the southwest monsoon from May to August and the monsoon transition time for the rest) and from the tropical cyclones, storm surges and other weather systems. The tropical cyclone season ranges from late June to mid-October each year with the most tropical cyclones moving to the southern coasts of China, others westward to the north of Vietnam.

According to statistics, the general moving pattern of the tropical cyclones is:

From November to April of the following year, mostly moving in the southern part of the South China Sea, mainly westbound;

In May, mostly moving northeast, affecting the west coasts of Guangdong Province, China or moving out of the South China Sea;

From June to August, mainly moving northwards to northeastwards, and landing on the southern coasts of China;

After September, mostly moving westwards; and more westerly in late October.

Chapter2 Routes and Navigation Guarantee in the South China Sea

According to the current edition of *Ocean Passages for the World* (2014)[1], except for fishing activities, the recommended routes in the South China Sea mainly apply to the merchant ships sailing to/from ports in China, Japan, Korea, and Southeast Asian countries. These routes are mainly divided into the east routes, the middle routes and the west routes, running mainly with a direction of southwest-northeast, and the middle routes are identified as the main routes (Figure2-1).

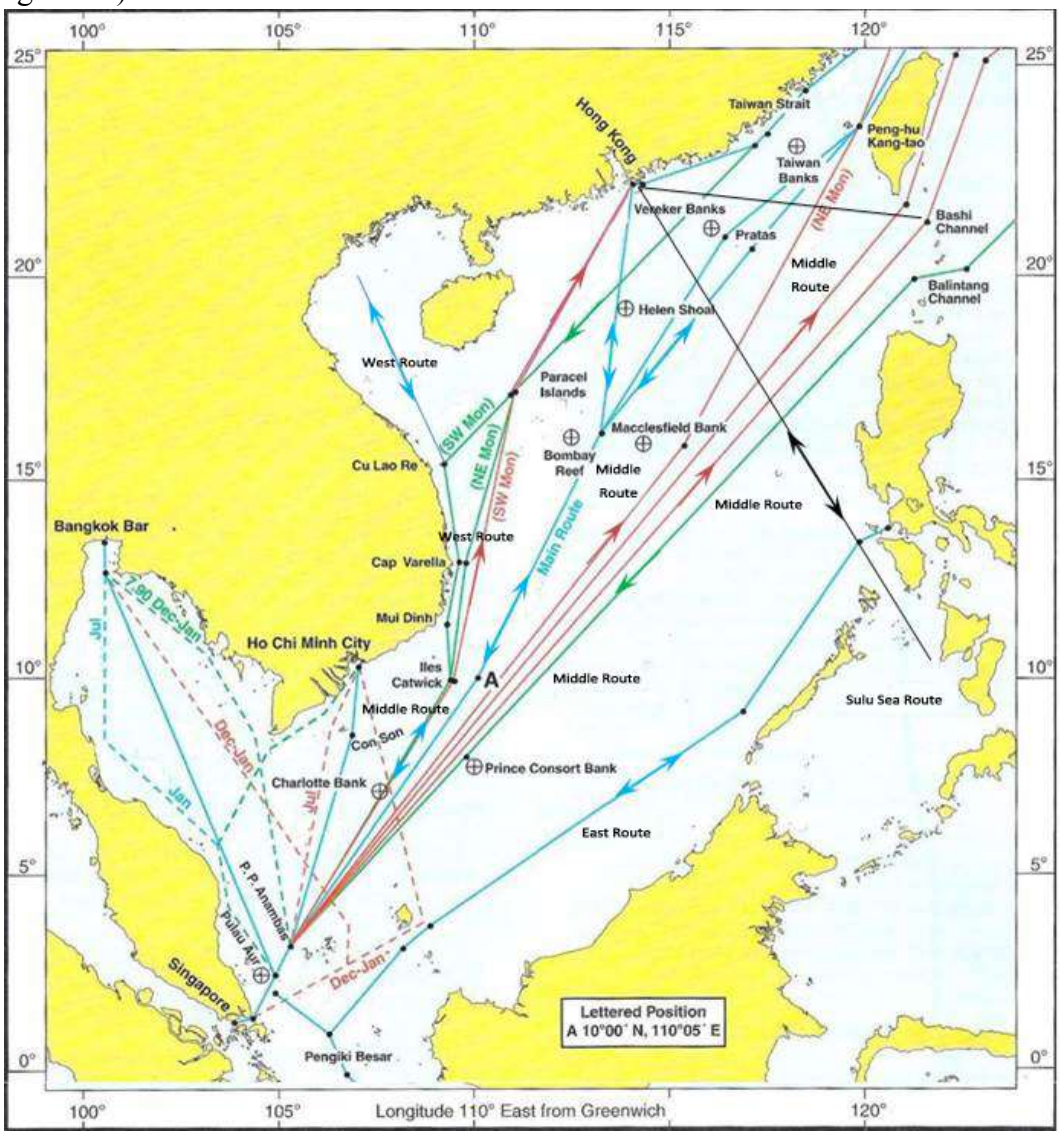

Figure2-1 Overview of the recommended routes in the South China Sea (*Ocean Passages for the World* 2014)

[1]*Ocean Passages for the World* is in common use by merchant ships in the shipping industry. Geographic names in the original charts and publications are retained as of the publishers'.

2.1 Routes in the South China Sea

2.1.1 Southwest-northeast routes

1) East routes

During the northeast monsoon period (prevailing from December to the following January), certain low speed vessels may give priority to the choices of the east routes which are also called Palawan routes. The east routes are two-way routes: vessels sailing southwestwards along the South China Sea east coasts can reach the Philippines coastal ports or continue down south to Singapore; vessels can also sail from Singapore northeastwards along Malaysia coastal waters to the Balabac Strait, and then reach the western coastal ports of the Philippines or continue northwards to the northern coasts of China, Japan or South Korea. Therefore, the east routes can lead to the Balabac Strait, the Mindoro Strait and the Verde Island Passage.

2) Middle routes（Main routes in the South China Sea）

Vessels sailing to/from China coasts, Japan and South Korea (including through the Taiwan Strait, the Bashi Channel) can select the middle routes in all seasons, which are the major international routes generally used by merchant ships. Vessels can sail north to south from either side of the Taiwan Banks (23°00′N，118°30′E) located in the southern part of the Taiwan Strait, pass through either side (the east or the west side) of Dongsha Dao (the Dongsha Island) (20°40′N，116°45′E) and directly proceed to the position between Zhongsha Tan (the Zhongsha Bank，15º50′N,114º30′E) and the Bombay Reef (16º02′N,112º30′E) in the southern part of Xisha Qundao (the Xisha Islands), the width of which route is 65 nautical miles. Then the route goes to the position A (10º00′N,110º05′E), forward to the position 25 nautical miles southeast from the Charlotte Bank (7º08′N,107º35′E), destined for Singapore through the passage between the Pulau Aur Island (2º27′N，104º31′E) and the Pulau-Pulau Anambas Islands (3º00′N,106º00′E).

During the northeast monsoon period(from December to the following January), vessels can also sail north to south from the Peng-hu Kang-ta Channel(23°30′N，119°53′) in the southern part of the Taiwan Strait, pass through the east of Dongsha Dao (the Dongsha Island) (20°40′N，116°45′E) and directly proceed to the east of Zhongsha Tan (the Zhongsha Bank) (15º50′N,114º30′E). Then the route goes to the waters between the position A (10º00′N,110º05′E) and the Prince Consort Bank (7°53′N,110°00′) in Nansha Qundao (the Nansha Islands), forward to the position 25 nautical miles southeast away from the Charlotte Bank (7º08′N,107º35′E), destined for Singapore through the passage between the Pulau Aur Island (2º27′N，104º31′E) and the Pulau-Pulau Anambas Islands (3º00′N,106º00′E).

The above are all two-way routes, i.e., vessels can reverse the routes sailing from Singapore to the Taiwan Strait or to Hong Kong, continuing northwards up through the Taiwan Strait to China coasts, Japan and South Korea or northeastwards through the Luzon Strait to the east of Taiwan.

3）West routes

During northeast monsoon period (from December to the following January) and southwest monsoon period (from May to August), vessels sailing in the South China Sea can take west routes. In addition, vessels sailing from the ports along the Beibu Bay or Vietnam coasts to Singapore can take west routes as well.

Vessels sailing from Hong Kong and the adjacent waters or from the south of the Taiwan Strait, directly to the position 30 nautical miles west of Xisha Qundao (the Xisha Islands) (16º40′N，112º00′E), can proceed to the position 15~20 nautical miles east of Cap Varella (12°54′N，109°28′E), to the east of Iles Catwick (10°00′N，109°00′E), and then to the position 25 nautical miles southeast away from the Charlotte Bank (7º08′N,107º35′E), destined for Singapore through the passage between the Pulau Aur Island (2º27′N，104º31′E) and the Pulau-Pulau Anambas Islands (3º00′N,106º00′E).

Vessels sailing from the Singapore Strait via the South China Sea to the ports in China, in Japan and in South Korea, can proceed north up along those routes during these periods.

2.1.2 Southeast-northwest routes

The Mindoro Strait Route (southeast-northwest) is a route from Hong Kong and its adjacent ports to the South Pacific Ocean and Europe, and also an important passage from the South China Sea to the Sulu Sea and Australia. When the northeast monsoon is in transition or weak, the Mindoro Strait Route is commonly selected. Vessels sailing from Hong Kong to the South Pacific Ocean and Europe in May to September and from Europe to China, Japan and South Korea in October usually pass through this strait.

In addition，there exists in this area an east-west route leading to the Bashi Channel or the Balintang Channel, which is also an important route from the southern ports in China to the Pacific Ocean (as is shown in Figure2-1).

2.2 Navigation Guarantee

The navigation charts and publications show navigation guarantee has been fully developed especially in the northern part of the South China Sea with the advanced waterborne traffic management systems along the northern coasts, while there is the need for further improvement in the middle and the southern waters.

2.2.1 Vessel traffic management and service

1) Vessel Traffic System (VTS)

Ports in the South China Sea with VTS include the Hong Kong Port, the Shenzhen Port, the Guangzhou Port, and the Qiongzhou Strait, which can be referenced from *VTS User Guidelines* and *Radio Signal Tables*. There is not yet VTS

in the middle or the southern part of the South China Sea.

2) China Ship Reporting System (CHISREP)

The China Ship Reporting System applies to the waters north of 9°N and west of 130°E, excluding the territorial sea and the internal waters of other countries. 300-tonnage and above China-registered ships sailing for more than 6 hours in the China Ship Reporting Area shall report to CHISREP; foreign registered ships and China-registered ships below 300 tonnages may volunteer to report. There is no requirement for the ship reporting system in the waters south of 9°N and east of 130°E.

3) Marine aids to navigation

At present, China has built five large-scale multifunction light houses on such islands and reefs in the South China Sea as the Huayang Reef, the Chigua Reef, the Zhubi Reef, the Yongshu Reef and the Meiji Reef.

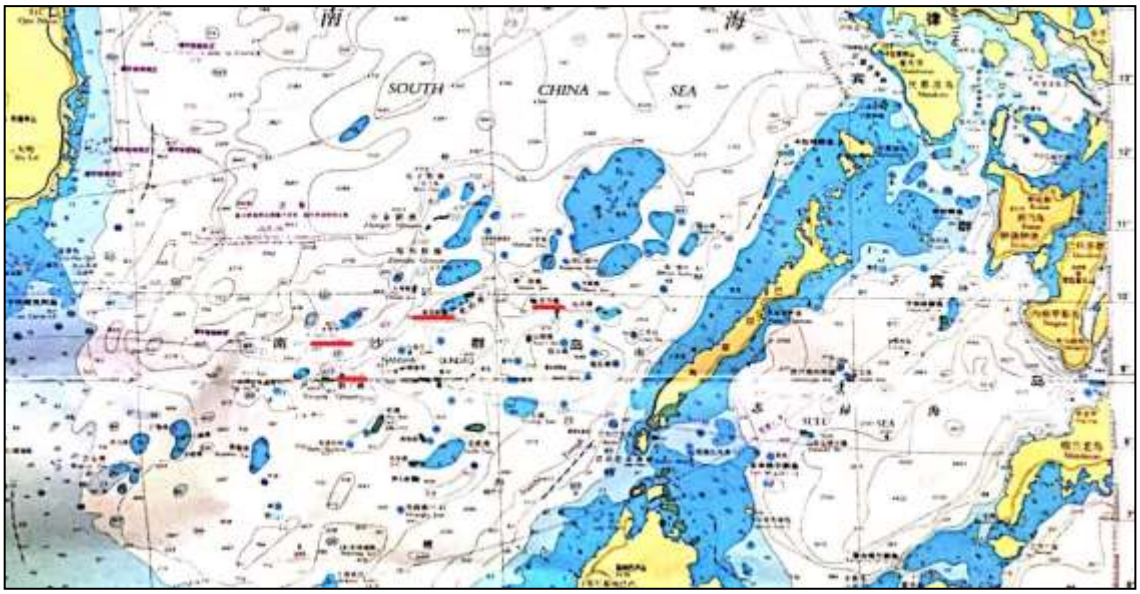

Fig.2-2 Island and reef distribution inNanshaQundao (the Nansha Islands) waters

These five lighthouses are important public interest service facilities built by China in the South China Sea providing such navigation guarantee as maritime search and rescue, services for the safety of navigation and fishery and the prevention of marine disasters, which represent the implementation of the international responsibilities and obligations on the part of China as an IMO member state.

4) Radio Navigational Warnings

Navigational Telex (NAVTEX) in the South China Sea can be referenced from Table 2-1 as follows:

Table 2-1 NAVTEX in the waters from the South China Sea to Singapore

No.	Country（Region）	Station Name	Location	Code
1	China（Hong Kong）	Hong Kong	22°11′ N,114°15′E	L
2	China（Guangzhou）	Guangzhou	23°09′ N,113°30′E	N
3	China（Sanya）	Sanya	18°14′N,109°30′E	M
4	Vietnam（Da Nang）	Da Nang	16°03′.53N,108°12′.53E	K
5	Vietnam (Ho Chi Minh City）	Ho Chi Minh City	10°23′.53N,107°08′.95E	X
6	Malaysia(Sandakan）	Sandakan	5°54′ N,118°00′E	S
7	Malaysia（Miri）	Miri	4°26′ N,114°01′E	T
8	Singapore (Changi)	Singapore（Changi）	1°21′ N,103°59′E	C

2.2.2 Emergency SAR service in the South China Sea

In accordance with the *IMO International Convention on Maritime Search and Rescue*, Hong Kong (China) reported to IMO with regard to the search and rescue area in the South China Sea as north of 10°N, west of 120 °E excluding other countries' territorial sea.

The State Council of the People's Republic of China promulgated the *National Emergency Plan for Maritime Search and Rescue*, which plan applies to "the emergency response to marine distresses on the part of China in Chinese maritime jurisdiction and SAR responsibility waters".

China has the full capabilities with the search and rescue centers along China's southern coasts and the watchkeeping stations on Yongxing Dao (the Yongxing Island) of the Xisha waters. Meanwhile, other coastal countries around the South China Sea have relatively limited capabilities with their search and rescue centers covering only coastal waters. China is therefore apt for setting up permanent search and rescue stations with the pollution-prevention function on proper islands to promote the safety guarantee in the South China Sea.

China is now actively promoting the practical cooperation of maritime search and rescue in the South China Sea among China-ASEAN countries, which aims at the mutual understanding and the improvement of joint research and rescue capabilities through effective coordination and collaboration.

Chapter 3 Analyses of AIS Vessel Traffic Flow in the South China Sea

3.1 Observation and Analyses of AIS Vessel Traffic Flow in the South China Sea

Navigation areas in the South China Sea are specifically characterized and mutually connected. The remarkable differences among navigation areas such as island and reef distribution, shallow water, wind and current elements, port resources, anchor conditions and customary way of navigation and etc. require the ship navigators to be familiar with the features of these navigation areas and to master precautions for navigation. Therefore, the satellite AIS data statistics is an important way to obtaining the vessel traffic flow and to the scientific clarification of navigation freedom in the South China Sea.

3.1.1 Observation and measurements of AIS vessel traffic flow in the South China Sea

Considering the eminent monsoon climate in the South China Sea, the navigation activities are strongly influenced by the monsoon and show a yearly cyclical feature. Statistical results of the merchant vessel traffic flow data in March, June and October 2016 from the low-orbit satellite AIS database are shown as figures from 3.1 to 3.6.

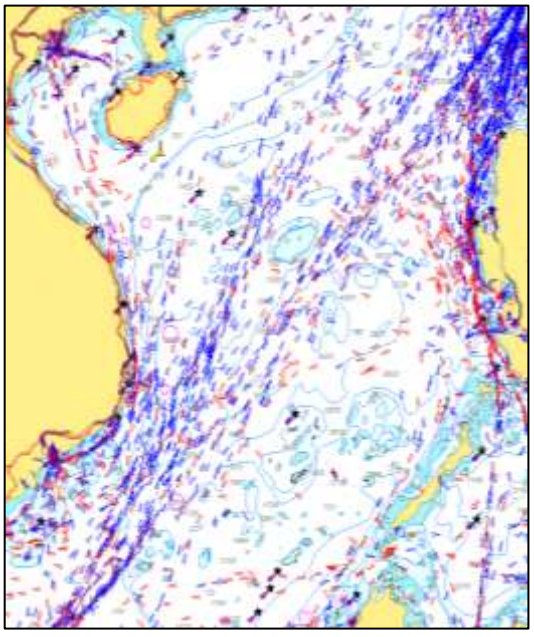

Fig 3-1 Ship position graph in March 2016

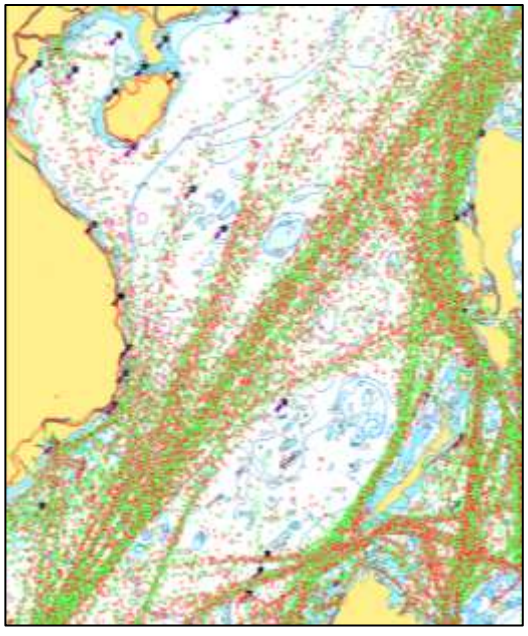

Fig 3-2 Ship trajectory graph in March 2016

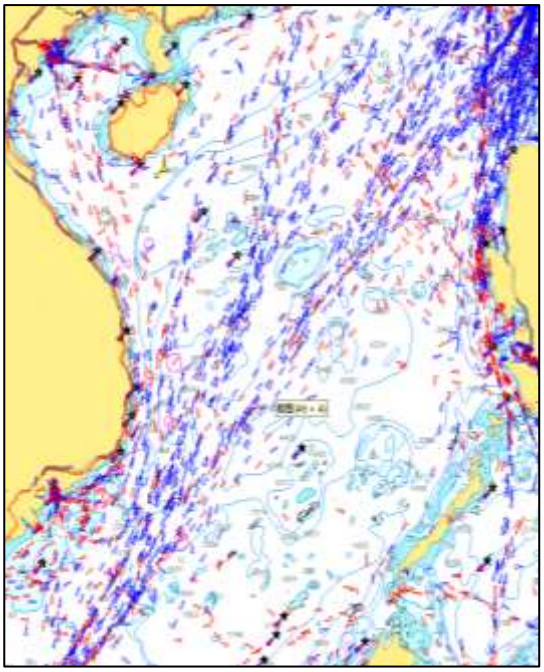

Fig 3-3 Ship position graph in June2016

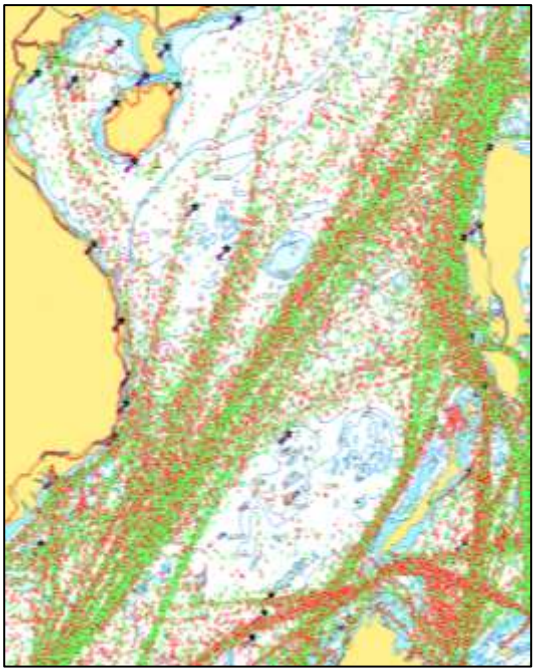

Fig 3-4 Ship trajectory graph in June 2016

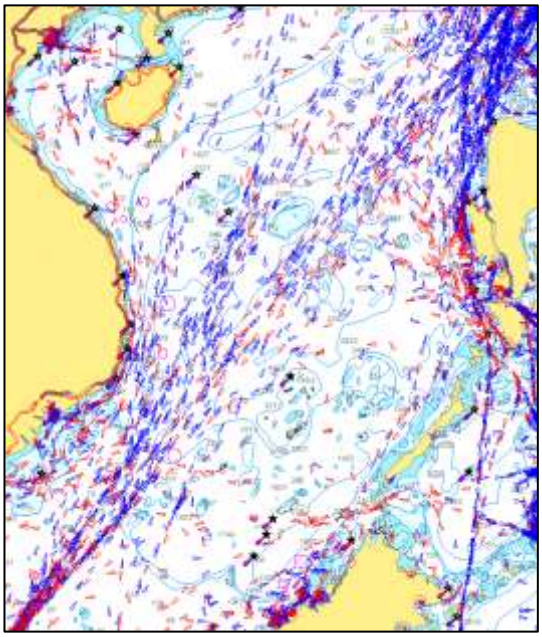

Fig 3-5 Ship position graph in October 2016

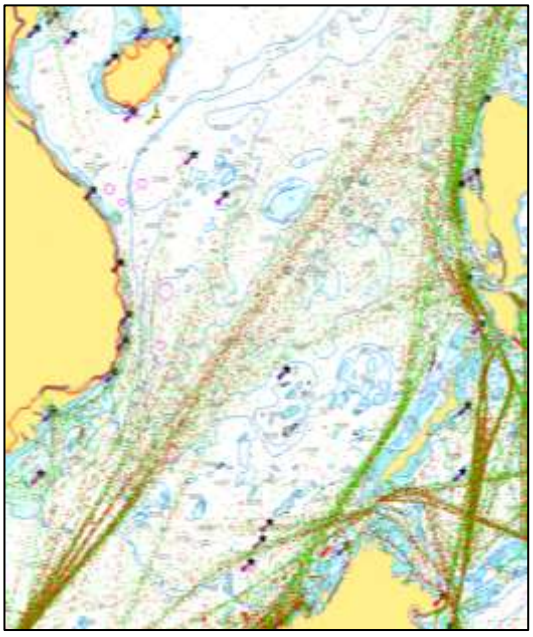

Fig 3-6 Ship trajectory graph in October 2016

3.1.2 Analyses of AIS vessel traffic flow in the South China Sea

The ship position and trajectory graphs show vessels sail into and out of the South China Sea mainly from the Beibu Bay, the Taiwan Strait, the Bashi Channel, the Mindoro Strait, the Balabac Strait and from the Malacca Strait. For the sake of the AIS statistics, six AIS data observation planes are set for the detailed analyses of the vessel traffic flow distribution in the South China Sea. See Table 3-1and Fig. 3-7 for observation plane details.

Table 3-1 Positions of the vessel traffic flow observation planes

Observation plane	Latitude and longitude
1#	11°27′22.44″N，114°12′47.7″E 14°15′00.00″N，110°01′49.25″E
2#	10°52′39.79"N，118°41′45.28"E 12°08′26.95"N，117°24′05.50"E 13°24′40.39"N，116°43′12.98"E 15°21′48.43"N，113°54′48.60"E 16°02′11.69"N，112°07′43.01"E 16°26′40.64"N，109°50′22.54"E 15°55′52.11"N，108°22′54.15"E
3#	18°39′58.93"N，120°50′55.24"E 19°49′51.61"N，118°46′39.59"E 19°54′30.05"N，110°55′46.57"E
4#	18°39′58.93"N，120°50′55.24"E 21°49′44.97"N，120°51′44.29"E
5#	13°04′53.37"N，120°38′57.66"E 12°23′45.27"N，119°50′45.50"E
6#	05°08′56.27"N，105°39′56.78"E 03°35′23.60"N，107°56′11.84"E 02°58′08.73"N，108°44′42.16"E

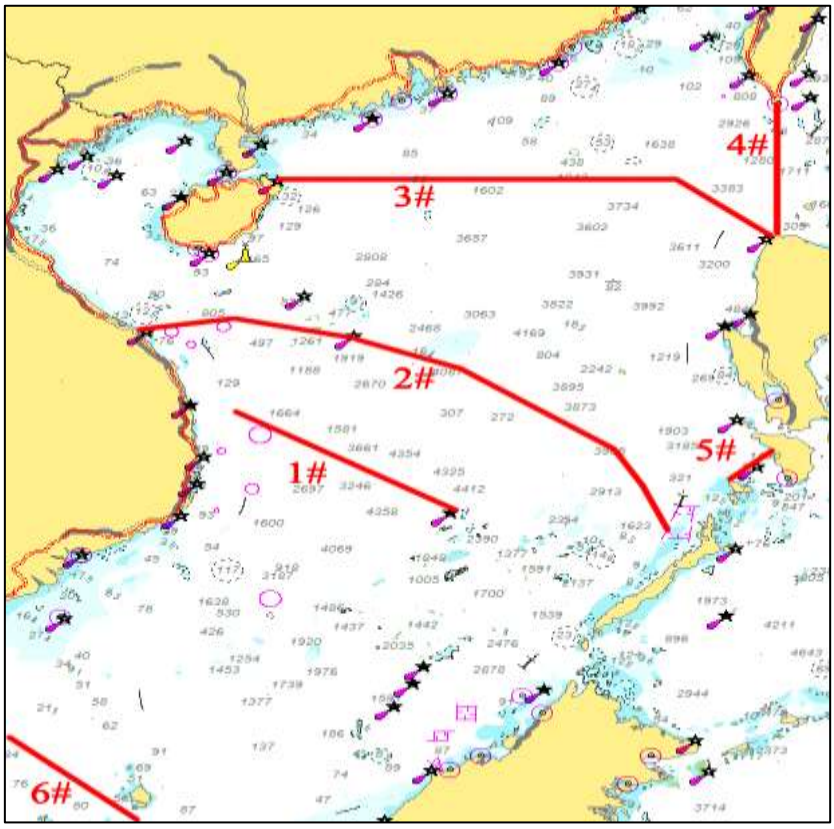

Fig. 3-7 Distribution of the vessel traffic flow observation planes

The nature of the vessel traffic flow in the South China Sea is determined by the

AIS vessel traffic flow statistics of various observation plane positions and cross-sections and of vessel sailing directions. For the sake of consistency, the northbound and eastbound vessels are taken as the entrance direction. Detailed analyses are as follow.

1) AIS vessel traffic flow statistics of March 2016

According to the satellite AIS statistics, the total number of vessels in the South China Sea in March 2016 is 8110.

The waters in the South China Sea are divided into 215 grids at the scale of 80000m×80000m to get the ship density (See Fig. 3-8). Statistics of the ship number passing the unit grid show the total number as 5668,with the unit maximum of 875.

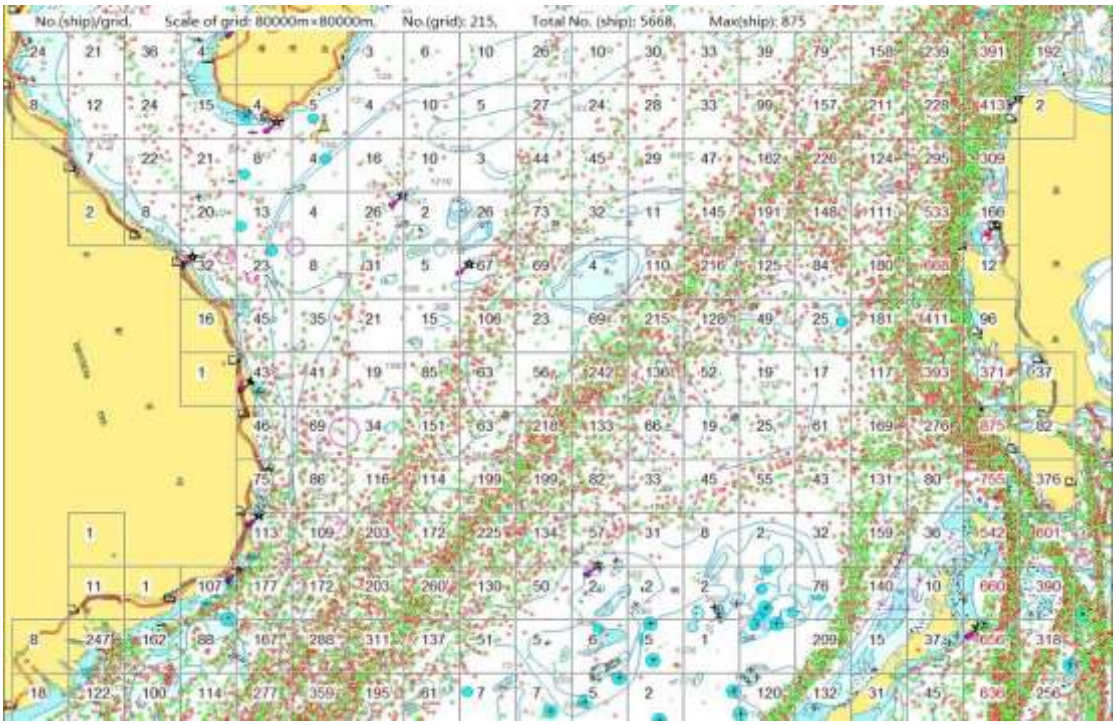

Fig. 3-8 In-grid ship number trajectories

2) AIS vessel traffic flow statistics of June 2016

According to the satellite AIS statistics, the total number of the ships in the South China Sea in June 2016 is 8166.

The waters in the South China Sea are divided into 214 grids at the scale of 80000m×80000m to get the ship density (See Fig. 3-9). Statistics of the ship number passing the unit grid show the total number as 5971, with the unit maximum of 1013.

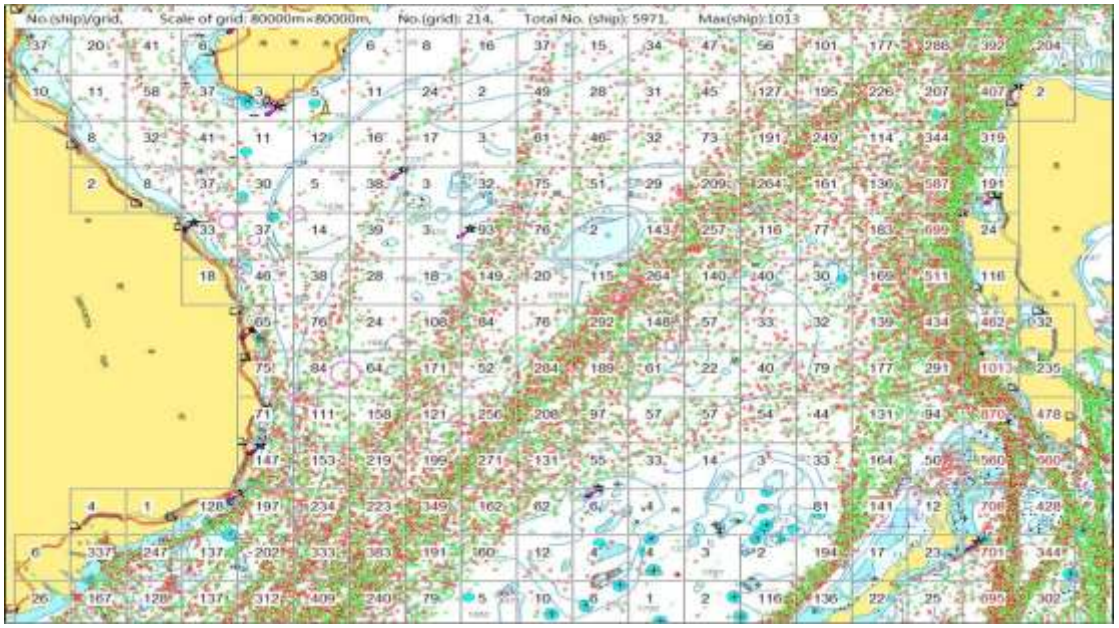

Fig. 3-9 In-grid ship number trajectories

3) AIS vessel traffic flow statistics of October 2016

According to the satellite AIS statistics, the total number of the ships in the South China Sea in October 2016 is 7891.

The waters in the South China Sea are divided into 213 grids at the scale of 80000m×80000mto get the ship density (See Fig. 3-10). Statistics of the ship number passing the unit grid show the total number as 4119, with the unit maximum of 774.

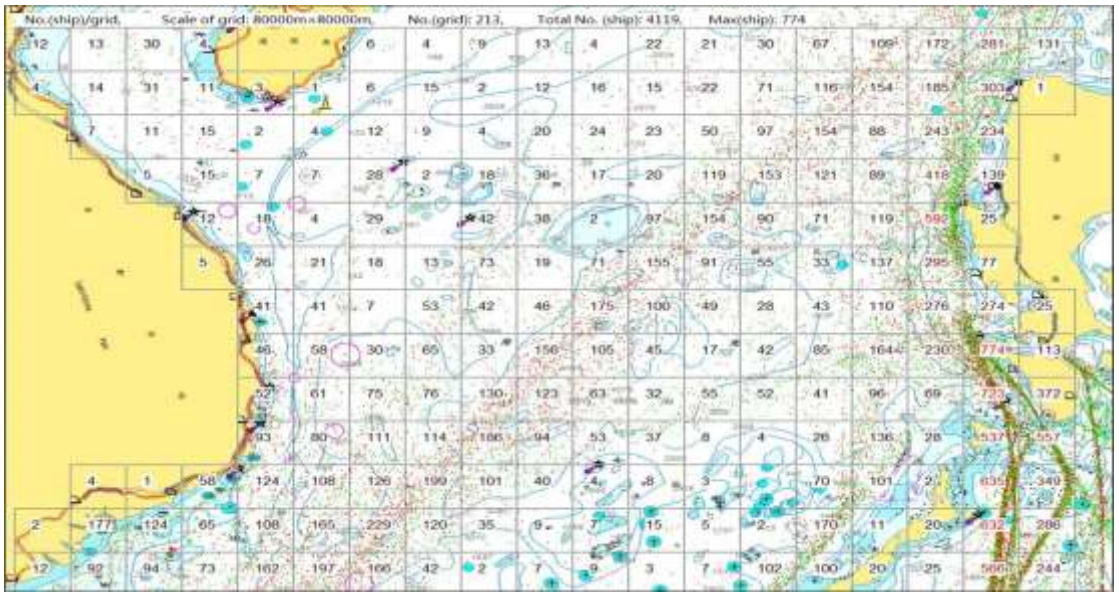

Fig. 3-10 In-grid ship number trajectories

3.2 Traffic flow of Main Ship Types

The satellite AIS statistics of the vessel traffic flow features are also made on the parameter of ship types across different observation planes.

1) Statistics of AIS vessel traffic flow in the South China Sea in March 2016

The AIS statistics on 1#～6# observation planes in March 2016 are shown as Table 3-2.

Table 3-2 Statistics of March 2016 on1#～6# observation planes

Observation plane	Number (ships)	Average ship length(meter)	Average ship width (meter)	Average draft	Average passing speed (knot)
1#	2106.00	228.67	36.51	10.86	14.04
2#	2430.00	195.44	31.46	8.84	13.71
3#	2441.00	234.45	38.17	11.40	13.02
4#	1152.00	238.35	38.74	11.56	13.14
5#	1203.00	228.87	36.34	10.74	12.27
6#	3343.00	224.09	35.28	10.58	13.52

2) Statistics of AIS vessel traffic flow in the South China Sea in June 2016

The AIS statistics on 1#～6# observation planes in June 2016 are shown as Table 3-3.

Table 3-3 Statistics of June 2016 on 1#～6# observation planes

Observation plane	Number (ships)	Average ship length(meter)	Average ship width (meter)	Average draft	Average passing speed (knot)
1#	2419.00	226.96	35.97	11.13	13.99
2#	2808.00	182.35	29.12	8.18	13.72
3#	2655.00	231.58	37.75	11.40	13.27
4#	1268.00	237.78	38.89	11.69	13.32
5#	1306.00	233.53	37.05	10.83	12.30
6#	3707.00	228.55	35.77	10.83	13.83

3) Statistics of AIS vessel traffic flow in the South China Sea in October 2016

The AIS statistics on 1#～6# observation planes in June 2016 are shown as Table 3-4.

Table 3-4 Statistics of October 2016 on 1#～6# observation planes

Observation plane	Number (ships)	Average ship length(meter)	Average ship width (meter)	Average draft	Average passing speed (knot)
1#	1568.00	227.91	36.15	10.78	13.73
2#	1865.00	175.43	27.91	9.03	10.83
3#	1847.00	214.51	33.91	10.43	13.28
4#	875.00	241.70	39.54	11.65	13.03
5#	1156.00	233.59	37.12	10.53	12.35
6#	2484.00	173.42	28.31	8.73	12.18

3.3 The Ratio of Vessel Traffic Flow in China Coastal Waters of the South China Sea

The vessel traffic flow in China coastal waters (within 12 nautical miles from the Hainan Island and the Nanhai Islands and Reefs), mainly of the vessels in and out these islands, is analyzed based on the statistics of AIS vessel traffic flow in the South China Sea in March, June and October 2016, combined with those of grid vessel traffic flow. Results are shown as Table 3-5 and Figure 3-11.

Table 3-5 Proportion of the vessel traffic flow in China coastal waters of the South China Sea

Time	Total No. in the South China Sea(ships)	No. in China coastal waters(ships)	Proportion
March 2016	8110	170	2.10%
June 2016	8166	241	2.95%
October 2016	7891	257	3.25%
Average			2.77%

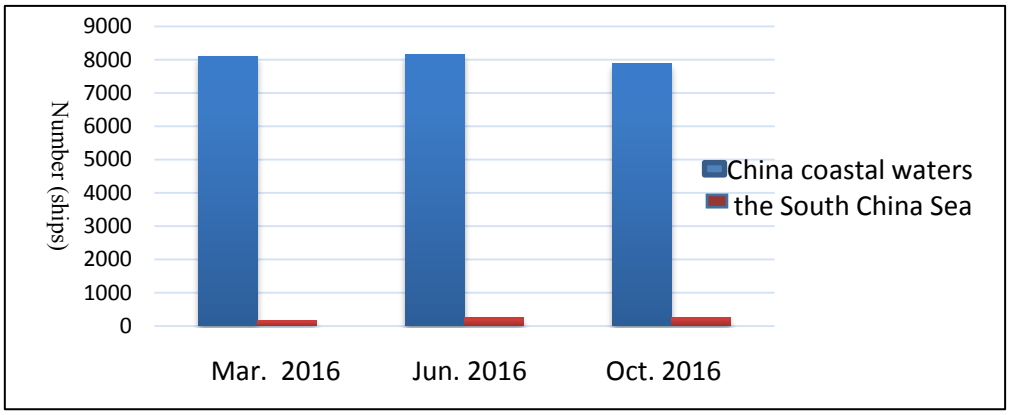

Fig. 3-11 Contrast between the vessel traffic flow in China coastal waters and that in the South China Sea

As seen from Table 3-5 and Figure 3-11, the average ratio of the vessel traffic flow in China coastal waters to that in the South China Sea is 2.77%, which means a small vessel traffic flow in the island and reef area. The 97.23% majority of the ships sail through the South China Sea in open areas.

3.4 Registry Distribution on Recommended Routes

1) Registry distribution in the South China Sea

Vessel registry (country/region of registration) distribution is calculated based on the satellite AIS statistics of March, June and October 2016, as is shown in Figure 3-12, 3-13 and 3-14.

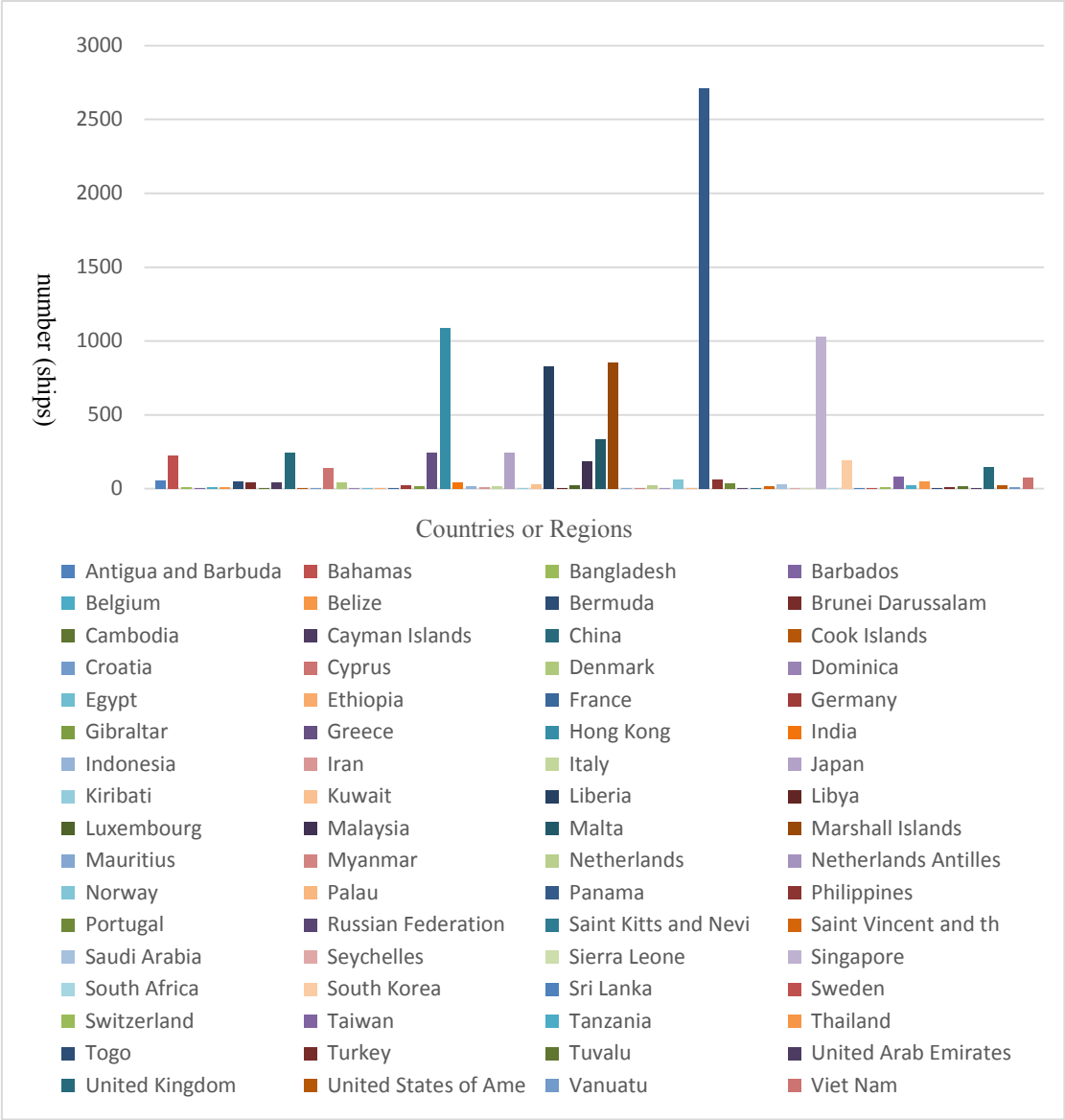

Fig 3-12 Registry distribution in March 2016

As seen from Figure 3-12, out of vessels registered in 68 countries or areas sailing in the South China Sea in March 2016, those of Panama rank the top and those of Hong Kong (China) the second.

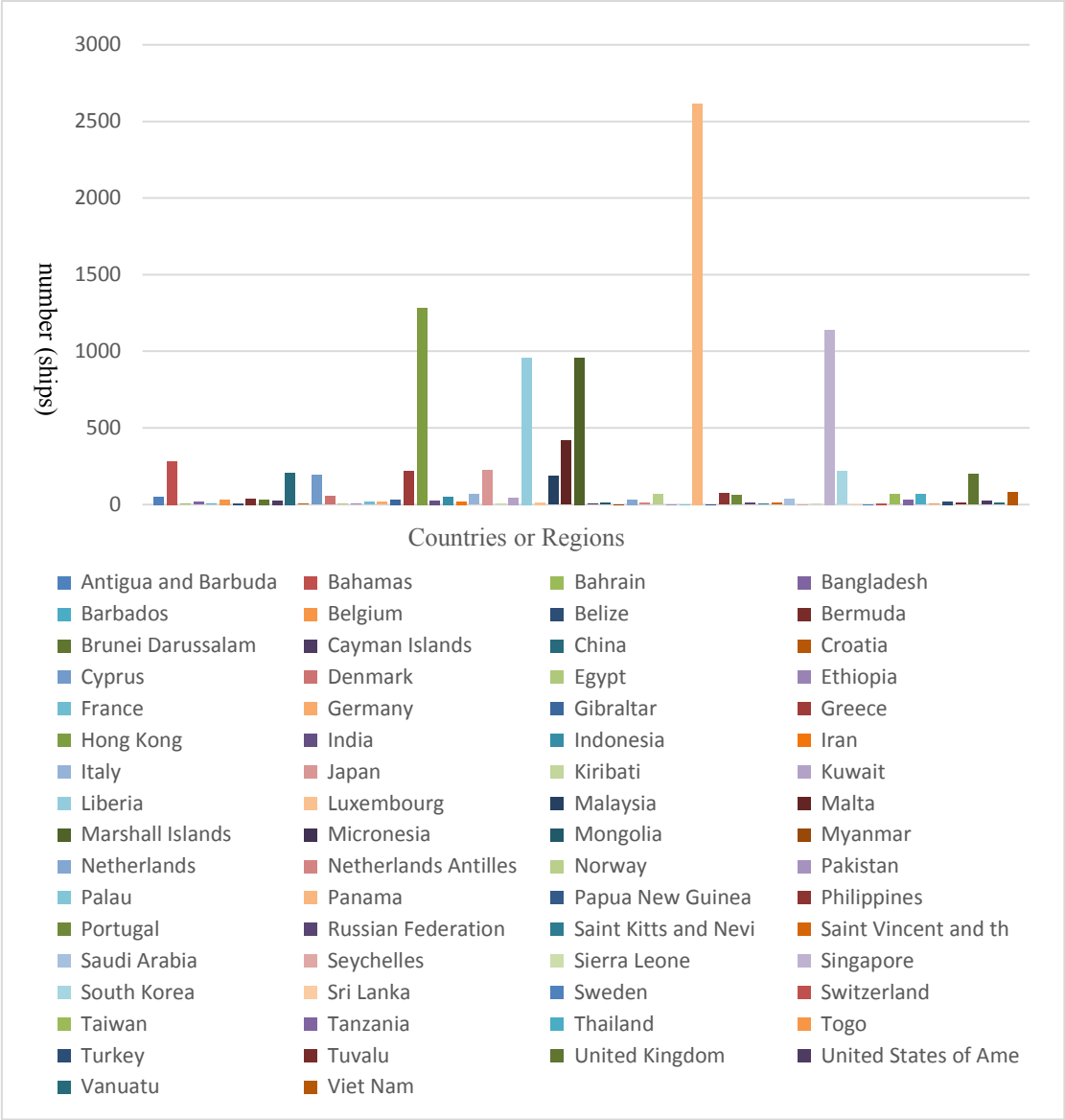

Fig 3-13 Registry distribution in June 2016

As seen from Figure 3-13, out of vessels registered in 66 countries or areas sailing in the South China Sea in June 2016, those of Panama rank the top and those of Hong Kong (China) and of Singapore the second.

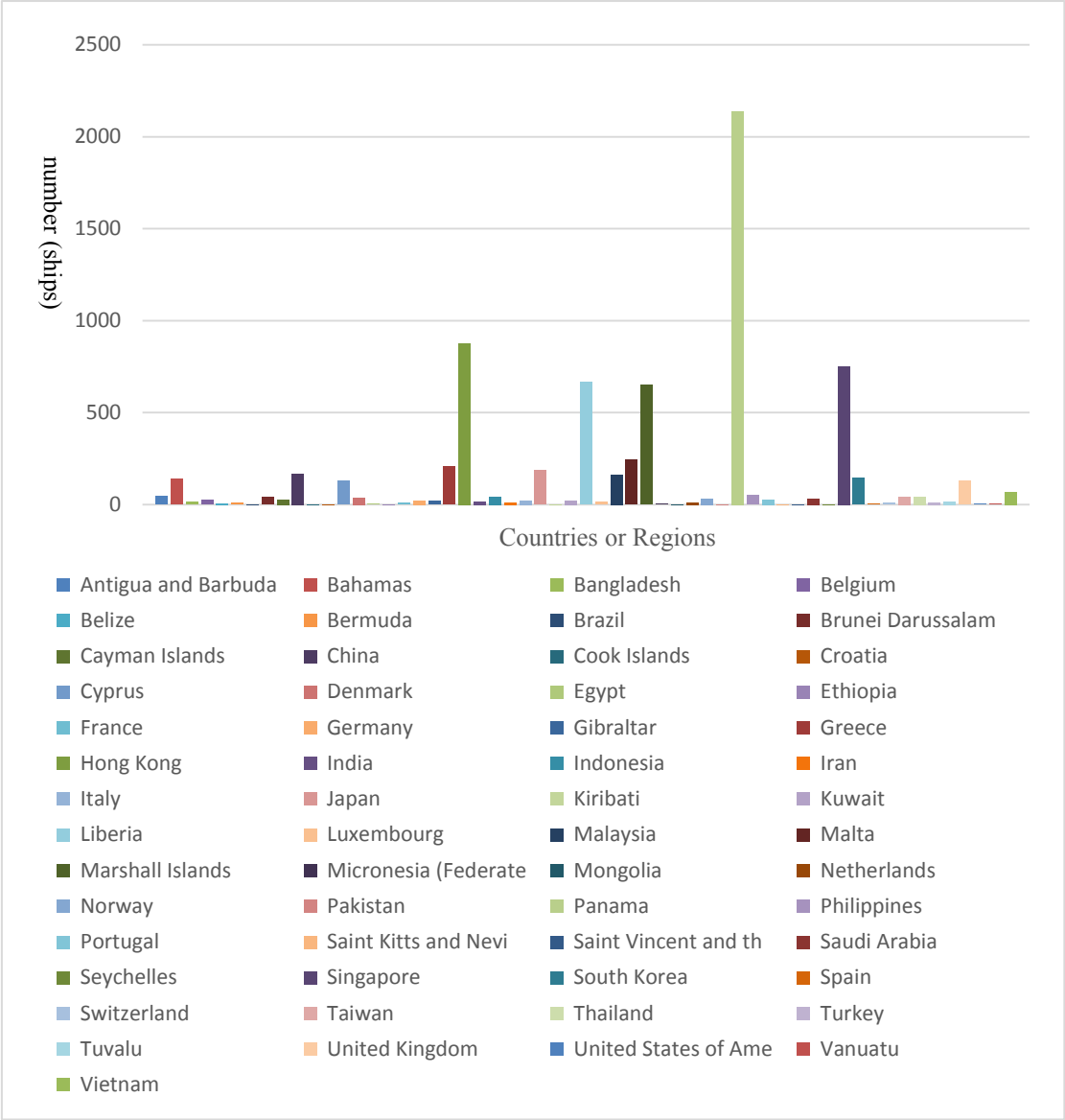

Fig 3-14 Registry distribution in October 2016

As seen from Figure 3-14, out of vessels registered in 57 countries or areas sailing in the South China Sea in October 2016, those of Panama rank the top and those of Hong Kong (China) and of Singapore the second.

2) Statistics of total capacity of top 50 national/regional fleets

The South China Sea vessel traffic flow trends, navigation activities and their distribution can be further clarified by the comparison between the AIS flow and registry statistics (of the time March, June and October 2016) and national/regional total fleet capacity statistics (top 50 fleets) provided by Clarkson SIN (Clarkson Shipping Intelligence Network). Results are shown in Table 3-6, 3-7 and 3-8.

Table 3-6 Total capacity of top 50 fleets in countries and regions (March 2016) (from Clarkson SIN)

Rank	Country	No. of Vessels	GT	Rank	Country	No. of Vessels	GT	Rank	Country	No. of Vessels	GT
1	Greece	2514	239462483	63	Bahamas	40	754604	125	Fiji	40	12552
2	Japan	3,356	223599469	64	Azerbaijan	310	715960	126	Madeira	5	10992
3	China P.R.	3334	185575773	65	Ecuador	119	688028	127	Gabon	26	10357
4	Germany	2400	94091790	66	Peru	89	634771	128	Cape Verde	19	10252
5	South Korea	1456	82097855	67	Malta	76	604750	129	Haiti	8	10147
6	Norway	1926	67828747	68	Yemen	49	594500	130	Guernsey	3	9865
7	United States	2814	54647512	69	Cuba	75	567754	131	Mauritania	3	9135
8	Singapore	2233	54330203	70	Isle Of Man	26	544176	132	Cook Islands	4	9125
9	Taiwan	1054	53029457	71	Argentina	167	504068	133	Suriname	11	8211
10	Italy	1509	46725023	72	Marshall Is.	62	486676	134	Madagascar	25	7974
11	Denmark	1401	43441601	73	North Korea	128	483905	135	Equatorial Guinea	12	6724
12	Hong Kong	781	38387320	74	Kazakhstan	81	421616	136	Neth. Antilles	1	6384
13	Canada	928	36664891	75	Iraq	96	405846	137	Vir.Is.Us	11	6030
14	United Kingdom	1084	32547276	76	Ethiopia	13	366010	138	St.Vincent& G.	6	4802
15	Belgium	454	24893183	77	Brunei	95	365895	139	Dominican Rep	26	4789
16	France	810	22008295	78	Cameroon	14	364592	140	Nicaragua	6	4764
17	India	1043	18979693	79	Vir Is British	39	330247	141	Somalia	6	4506
18	Iran	481	18821261	80	Estonia	138	318945	142	Senegal	14	4378
19	Saudi Arabia	543	18579010	81	Tunisia	57	316539	143	Guinea	8	4316
20	Russia	1120	18384404	82	Panama	186	306049	144	Vanuatu	3	3697
21	Turkey	948	18175660	83	Jersey	4	301663	145	Micronesia	5	3504
22	Malaysia	1131	17424021	84	Gibraltar	18	286285	146	Cambodia	2	3373
23	Brazil	654	16602058	85	Lithuania	96	278568	147	Puerto Rico	29	3338
24	Netherlands	1723	16280047	86	Sri Lanka	75	237002	148	Congo	12	3332
25	Bermuda	73	11893142	87	Jordan	45	214623	149	Anguilla	3	3150
26	Kuwait	233	11709048	88	Seychelles	27	208145	150	St. Helena	1	3130
27	Switzerland	247	9858503	89	Liberia	23	200869	151	New Caledonia	10	3063
28	Indonesia	2463	9695674	90	Myanmar	96	200643	152	Gambia	8	3006
29	U.A.E.	981	9177878	91	Colombia	133	176456	153	Solomon	13	2942
30	Sweden	460	7545490	92	Papua N. Guinea	136	153569	154	Guadeloupe	24	2798
31	Oman	76	7495475	93	Mauritius	18	149209	155	Bolivia	4	2663
32	Australia	374	6571317	94	Montenegro	14	143736	156	Guam	8	2564
33	Vietnam	641	6524511	95	St. Kitts&Nevis	18	136077	157	Liechtenstein	4	2464
34	Thailand	567	6337546	96	Austria	6	132060	158	Curacao	14	2327
35	Cyprus	218	5977040	97	Iceland	47	129779	159	Antigua &B.	5	2199
36	Qatar	164	4890694	98	Bahrain	125	116985	160	Guatemala	9	2121
37	Israel	163	4435421	99	Albania	64	108041	161	Tonga	6	2076
38	Egypt	454	3628920	100	Morocco	84	100350	162	Martinique	6	2072
39	Angola	91	3343358	101	Tanzania	50	100137	163	Barbados	1	2040
40	Spain	519	3296893	102	Maldive Is.	50	92488	164	Kiribati	3	1973
41	Croatia	236	3174975	103	Turkmenistan	33	81679	165	Saint Luda	1	1821
42	Poland	257	3101613	104	Faroe Islands	48	76368	166	Samoa	7	1803
43	Chile	309	2901963	105	Kenya	48	66266	167	Benin	6	1716
44	Monaco	57	2888279	106	Uruguay	56	57635	168	Jamaica	12	1658
45	Venezuela	241	2721086	107	Honduras	61	55248	169	Turks & Caicos Is	3	1615

Rank	Country	No. of Vessels	GT	Rank	Country	No. of Vessels	GT	Rank	Country	No. of Vessels	GT
46	Libya	102	2570382	108	Greenland	15	55187	170	Wallis & F Is	1	1562
47	Finland	213	2304850	109	Djibouti	14	55115	171	Cook Islands	4	1521
48	Ukraine	472	2283194	110	New Zealand	96	51040	172	Ivory Coast	5	1348
49	Bangladesh	231	2053722	111	Guyana	56	48975	173	Comoros Islands	1	1103
50	Nigeria	385	1828346	112	Paraguay	38	37861	174	Falkland Islands	2	1001
51	Mexico	449	1765335	113	French Poly.	47	29729	175	N. Mariana Island	4	980
52	Ireland	185	1745282	114	Sudan	22	27610	176	Togo	7	943
53	Lebanon	160	1739910	115	Belize	20	26119	177	Cayman Islands	3	919
54	Bulgaria	137	1665395	116	Ghana	48	25666	178	Aruba	2	700
55	South Africa	144	1579195	117	Trinidad	99	25221	179	Americ.an Samoa	4	593
56	Pakistan	62	1470335	118	Canary Islands	13	20825	180	Laos	1	578
57	Algeria	119	1346494	119	Mozambique	25	20615	181	Timor-Leste	2	532
58	Philippines	655	1285077	120	Georgia	48	18886	182	Grenada	11	385
59	Portugal	137	1256768	121	Slovenia	9	18765	183	Reunion	5	213
60	Latvia	93	1051481	122	Congo	12	16625	184	Tuvalu	1	212
61	Romania	179	969624	123	Sierra Leone	20	15896	185	Namibia	2	183
62	Syria	102	808435	124	Eritrea	9	13841	186	Dominica	1	155

Table 3-7 Total capacity of top 50 fleets in countries and regions (June 2016)
(from Clarkson SIN)

Rank	Country	No. of Vessels	GT	Rank	Country	No. of Vessels	GT	Rank	Country	No. of Vessels	GT
1	Greece	2514	239462483	63	Bahamas	40	754604	125	Fiji	40	12552
2	Japan	3,356	223599469	64	Azerbaijan	310	715960	126	Madeira	5	10992
3	China P.R.	3334	185575773	65	Ecuador	119	688028	127	Gabon	26	10357
4	Germany	2400	94091790	66	Peru	89	634771	128	Cape Verde	19	10252
5	South Korea	1456	82097855	67	Malta	76	604750	129	Haiti	8	10147
6	Norway	1926	67828747	68	Yemen	49	594500	130	Guernsey	3	9865
7	United States	2814	54647512	69	Cuba	75	567754	131	Mauritania	3	9135
8	Singapore	2233	54330203	70	Isle Of Man	26	544176	132	Cook Islands	4	9125
9	Taiwan	1054	53029457	71	Argentina	167	504068	133	Suriname	11	8211
10	Italy	1509	46725023	72	Marshall Is.	62	486676	134	Madagascar	25	7974
11	Denmark	1401	43441601	73	North Korea	128	483905	135	Equatorial Guinea	12	6724
12	Hong Kong	781	38387320	74	Kazakhstan	81	421616	136	Neth. Antilles	1	6384
13	Canada	928	36664891	75	Iraq	96	405846	137	Vir.Is.Us	11	6030
14	United Kingdom	1084	32547276	76	Ethiopia	13	366010	138	St.Vincent& G.	6	4802
15	Belgium	454	24893183	77	Brunei	95	365895	139	Dominican Rep	26	4789
16	France	810	22008295	78	Cameroon	14	364592	140	Nicaragua	6	4764
17	India	1043	18979693	79	Vir Is British	39	330247	141	Somalia	6	4506
18	Iran	481	18821261	80	Estonia	138	318945	142	Senegal	14	4378
19	Saudi Arabia	543	18579010	81	Tunisia	57	316539	143	Guinea	8	4316
20	Russia	1120	18384404	82	Panama	186	306049	144	Vanuatu	3	3697
21	Turkey	948	18175660	83	Jersey	4	301663	145	Micronesia	5	3504
22	Malaysia	1131	17424021	84	Gibraltar	18	286285	146	Cambodia	2	3373
23	Brazil	654	16602058	85	Lithuania	96	278568	147	Puerto Rico	29	3338

Rank	Country	No. of Vessels	GT	Rank	Country	No. of Vessels	GT	Rank	Country	No. of Vessels	GT
24	Netherlands	1723	16280047	86	Sri Lanka	75	237002	148	Congo	12	3332
25	Bermuda	73	11893142	87	Jordan	45	214623	149	Anguilla	3	3150
26	Kuwait	233	11709048	88	Seychelles	27	208145	150	St. Helena	1	3130
27	Switzerland	247	9858503	89	Liberia	23	200869	151	New Caledonia	10	3063
28	Indonesia	2463	9695674	90	Myanmar	96	200643	152	Gambia	8	3006
29	U.A.E.	981	9177878	91	Colombia	133	176456	153	Solomon	13	2942
30	Sweden	460	7545490	92	Papua N. Guinea	136	153569	154	Guadeloupe	24	2798
31	Oman	76	7495475	93	Mauritius	18	149209	155	Bolivia	4	2663
32	Australia	374	6571317	94	Montenegro	14	143736	156	Guam	8	2564
33	Vietnam	641	6524511	95	St. Kitts&Nevis	18	136077	157	Liechtenstein	4	2464
34	Thailand	567	6337546	96	Austria	6	132060	158	Curacao	14	2327
35	Cyprus	218	5977040	97	Iceland	47	129779	159	Antigua &B.	5	2199
36	Qatar	164	4890694	98	Bahrain	125	116985	160	Guatemala	9	2121
37	Israel	163	4435421	99	Albania	64	108041	161	Tonga	6	2076
38	Egypt	454	3628920	100	Morocco	84	100350	162	Martinique	6	2072
39	Angola	91	3343358	101	Tanzania	50	100137	163	Barbados	1	2040
40	Spain	519	3296893	102	Maldive Is.	50	92488	164	Kiribati	3	1973
41	Croatia	236	3174975	103	Turkmenistan	33	81679	165	Saint Luda	1	1821
42	Poland	257	3101613	104	Faroe Islands	48	76368	166	Samoa	7	1803
43	Chile	309	2901963	105	Kenya	48	66266	167	Benin	6	1716
44	Monaco	57	2888279	106	Uruguay	56	57635	168	Jamaica	12	1658
45	Venezuela	241	2721086	107	Honduras	61	55248	169	Turks & Caicos Is	3	1615
46	Libya	102	2570382	108	Greenland	15	55187	170	Wallis & F Is. ..	1	1562
47	Finland	213	2304850	109	Djibouti	14	55115	171	Cook Islands	4	1521
48	Ukraine	472	2283194	110	New Zealand	96	51040	172	Ivory Coast	5	1348
49	Bangladesh	231	2053722	111	Guyana	56	48975	173	Comoros Islands	1	1103
50	Nigeria	385	1828346	112	Paraguay	38	37861	174	Falkland Islands	2	1001
51	Mexico	449	1765335	113	French Poly.	47	29729	175	N. Mariana Island	4	980
52	Ireland	185	1745282	114	Sudan	22	27610	176	Togo	7	943
53	Lebanon	160	1739910	115	Belize	20	26119	177	Cayman Islands	3	919
54	Bulgaria	137	1665395	116	Ghana	48	25666	178	Aruba	2	700
55	South Africa	144	1579195	117	Trinidad	99	25221	179	Americ.an Samoa	4	593
56	Pakistan	62	1470335	118	Canary Islands	13	20825	180	Laos	1	578
57	Algeria	119	1346494	119	Mozambique	25	20615	181	Timor-Leste	2	532
58	Philippines	655	1285077	120	Georgia	48	18886	182	Grenada	11	385
59	Portugal	137	1256768	121	Slovenia	9	18765	183	Reunion	5	213
60	Latvia	93	1051481	122	Congo	12	16625	184	Tuvalu	1	212
61	Romania	179	969624	123	Sierra Leone	20	15896	185	Namibia	2	183
62	Syria	102	808435	124	Eritrea	9	13841	186	Dominica	1	155

Table 3-8 Total capacity of top 50 fleets in countries and regions (October 2016)
(from Clarkson SIN)

Rank	Country	No. of Vessels	GT	Rank	Country	No. of Vessels	GT	Rank	Country	No. of Vessels	GT
1	Greece	2514	239462483	63	Bahamas	40	754604	125	Fiji	40	12552
2	Japan	3,356	223599469	64	Azerbaijan	310	715960	126	Madeira	5	10992
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4	Germany	2400	94091790	66	Peru	89	634771	128	Cape Verde	19	10252
5	South Korea	1456	82097855	67	Malta	76	604750	129	Haiti	8	10147
6	Norway	1926	67828747	68	Yemen	49	594500	130	Guernsey	3	9865
7	United States	2814	54647512	69	Cuba	75	567754	131	Mauritania	3	9135
8	Singapore	2233	54330203	70	Isle Of Man	26	544176	132	Cook Islands	4	9125
9	Taiwan	1054	53029457	71	Argentina	167	504068	133	Suriname	11	8211
10	Italy	1509	46725023	72	Marshall Is.	62	486676	134	Madagascar	25	7974
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48	Ukraine	472	2283194	110	New Zealand	96	51040	172	Ivory Coast	5	1348
49	Bangladesh	231	2053722	111	Guyana	56	48975	173	Comoros Islands	1	1103
50	Nigeria	385	1828346	112	Paraguay 38 37861	38	37861	174	Falkland Islands	2	1001
51	Mexico	449	1765335	113	French Poly.	47	29729	175	N. Mariana Island	4	980
52	Ireland	185	1745282	114	Sudan	22	27610	176	Togo	7	943
53	Lebanon	160	1739910	115	Belize	20	26119	177	Cayman Islands	3	919
54	Bulgaria	137	1665395	116	Ghana	48	25666	178	Aruba	2	700
55	South Africa	144	1579195	117	Trinidad	99	25221	179	Americ.an Samoa	4	593
56	Pakistan	62	1470335	118	Canary Islands	13	20825	180	Laos	1	578
57	Algeria	119	1346494	119	Mozambique	25	20615	181	Timor-Leste	2	532
58	Philippines	655	1285077	120	Georgia	48	18886	182	Grenada	11	385
59	Portugal	137	1256768	121	Slovenia	9	18765	183	Reunion	5	213
60	Latvia	93	1051481	122	Congo	12	16625	184	Tuvalu	1	212
61	Romania	179	969624	123	Sierra Leone	20	15896	185	Namibia	2	183
62	Syria	102	808435	124	Eritrea	9	13841	186	Dominica	1	155

Table 3-6, 3-7 and 3-8 show the ranks of 186 countries or regions in the world in terms of their top 50 fleet total capacities with those having ships in the South China Sea during March, June and October 2016 highlighted. It can be concluded that among the top 100 countries or regions, especially the top 35, the vast majority have vessels in the South China Sea. Flag states with vessels in the South China Sea spread all over the world, including the fleet capacity top 35 and last 35 countries or regions. The freedom of navigation in the South China Sea waters is enjoyed by all states.

3) Comparison and contrast between the AIS statistics and the world total fleet capacities

(1) Table 3-6, 3-7 and 3-8 show the ranks of 186 countries or regions in the world in terms of their top 50 fleet total capacities.

(2) Ratios of ships in the South China Sea to the world total fleets

The benchmarking analyses of Figure 3-12, 3-13, 3-14 and Table 3-6, 3-7 and 3-8 get the ratios of ships in the South China Sea to the world total fleets, which prove the freedom of navigation in the South China Sea is enjoyed by merchant ships from all countries and regions in the world.

Table 3-9 Percentages of ships in the South China Sea to the world total fleets (March 2016)

Waters	**Number of vessels**	**GT**
The South China Sea	42856	1488062776
World	52661	1611781147
Percentage（%）	81.3809	92.324121

Table 3-10 Percentages of ships in the South China Sea to the world total fleets (June 2016)

Waters	Number of vessels	GT
The South China Sea	41845	1474842883
World	52661	1611781147
Percentage（%）	79.4610813	91.503917

Table 3-11 Percentages of ships in the South China Sea to the world total fleets (October 2016)

waters	Ship number	GT
The South China Sea	40931	1467987466
World	52661	1611781147
Percentage（%）	77.7254515	91.0785852

Chapter 4 Navigation Safety and Securities in the South China Sea

4.1 Navigation Safety and Securities Profile in the South China Sea

Navigation safety and securities in the South China Sea involve disastrous weather, marine accidents, external security incidents, route and navigation safety and navigation guarantee conditions.

Owing to the rapid developments of maritime technologies, of large-scale and high-speed vessels and of seafarers' improved integrative competence, vessel disastrous weather (such as tropical cyclone transit) prevention capabilities have been fully guaranteed. Probability of marine accidents caused by weather in the South China Sea is therefore extremely low. There occasionally happen security incidents (such as pirate attack and armed ship robbery) in the peripheral areas of the South China Sea, but not within the core areas.

Moreover, the navigation guarantee has been fully developed especially in the northern part of the South China Sea. China coast-line areas have been equipped with advanced Vessel Traffic Services (VTS). Further work is to be done in the central and the south areas of the South China Sea.

4.2 Freely-chosen Routes in the South China Sea

In light of the "safety and economy" fundamental principle of sea route choosing, merchant ships have the options of recommended routes such as the east routes (Palawan), the middle (Main) routes and the west routes in accordance with vessel tonnage/power and with monsoons. Sea routes are distributed away from islands and reefs (with the average distance of more than 10 nautical miles). Moreover, island and reef constructions in the South China Sea, especially those of Nansha Qundao (the Nansha Islands) are far away from sea routes. Satellite AIS data analyses of the vessel traffic flow in the South China Sea show recommended sea routes are regularly chosen by passing vessels. It can be concluded that sea routes in the South China Sea are freely chosen by merchant ships and there is no direct correlation between island/reef construction and safety of ship's navigation.

4.3 Safe and Secure Navigation in the South China Sea

Safety is out of aids and service involving navigation and risk prevention, weather prognostics and bulletins, marine salvage, the essence of which is facility allocation and construction, regulation implementation and management.

Presently, merchant ships can receive position all the time with GPS, DGPS and the Beidou Satellite Navigation System covering the complete areas of the South China Sea. Five large-scale multifunction light houses with the light range of more than 20 nautical miles constructed by the Chinese Government on the sites of the Huayang Reef, Nansha Qundao (the Nansha Islands) and so on provide navigation

and risk prevention services for passing vessels of the middle routes.

Signal coverage of Xisha Qundao (the Xisha Islands) major waters has been completed by the Chinese Government with four light beacons on such islands of the Jinqing Island (Drummond Island) and four automatic identification base stations on such islands of Yongxing Dao (the Yongxing Island). Signal coverage of Xisha Qundao (theXisha Islands) waters and of Zhongsha Qundao (the Zhongsha Islands) waters has been realized with the broadcast service of safety message at sea (including radio navigational warnings) and weather prognostics.

In accordance with the provision that IMO member states shall provide the service of maritime search and rescue, China Ship Reporting System (CHISREP) is in operation with stations receiving ship reports via satellites and radios and sending to China Ship Reporting Management Centre. Aids and services are accessible all the time with the rescue bases set up by Nanhai Rescue Bureau of the Ministry of Transport of PRC (NRB) in the cities of Haikou, Sanya, Xisha, Guangzhou, Yangjiang, Shenzhen, Zhanjiang and Beihai, watchkeeping ships being deployed on stand-by in sea areas concerned. In conclusion, Navigation in the South China Sea is safe and secure.

Chapter 5 Conclusions

Findings from the quantitative and qualitative analyses of Satellite AIS statistics of vessel traffic flow in the South China Sea and from the integrated analyses including those of routes, safety and security aids and services are as follow. In the South China Sea, the recommended routes are regularly and freely chosen by the large traffic flow of passing merchant ships with relatively big length, breath and draft at a stable speed; the passing ships with their total capacities matching more than 91% of the world-wide national or regional top 50 fleets are destined for more than 60 major shipping countries and districts in the world; light houses and other public interest service facilities constructed on islands and reefs are effectively safeguarding and serving the navigation in the South China Sea.

In conclusion, the traffic in the South China Sea is unhindered and safe with the scientifically-distributed and freely-chosen sea routes, specifically:

- The quantitative analyses of Satellite AIS statistics show merchant ships of different nations or regions navigate in the South China Sea safely and smoothly with a stable speed;
- Free and safe navigation in the South China Sea is accessible for merchant fleets of different nations or regions worldwide with China's regular cruising and continuous management safeguarding the very area.
- With the recommended routes for merchant ships far away from islands and reefs, the freedom of navigation is enjoyed by merchant ships. Island and reef constructions can effectively serve and safeguard the traffic in the South China Sea.
- Public interest service facilities in the South China Sea including light houses, light beacons, automatic identification system base stations and so on provide the technological support for the safe and secure navigation, which represents the implementation of the international responsibilities and obligations on the part of China as an IMO member state.
- China has continuously committed to the effective implementation of the responsibilities and obligations as a coastal state of international navigable waters and as an IMO member state. The effective supervision and management of vessel traffic in the South China Sea has represented this area as a navigation safety excellence in international navigable waters.

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