Shipping Dialogue 2:
Working towards a ship emission control area in Hong Kong and the Pearl River Delta

Ship emissions in the Pearl River Delta Region

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June 25, 2015 Hong Kong

Outline

- Background
- Method and data source
- Characteristics of shipping activities
- Ship emissions in the PRD
- Ship emissions in Hong Kong

BACKGROUND

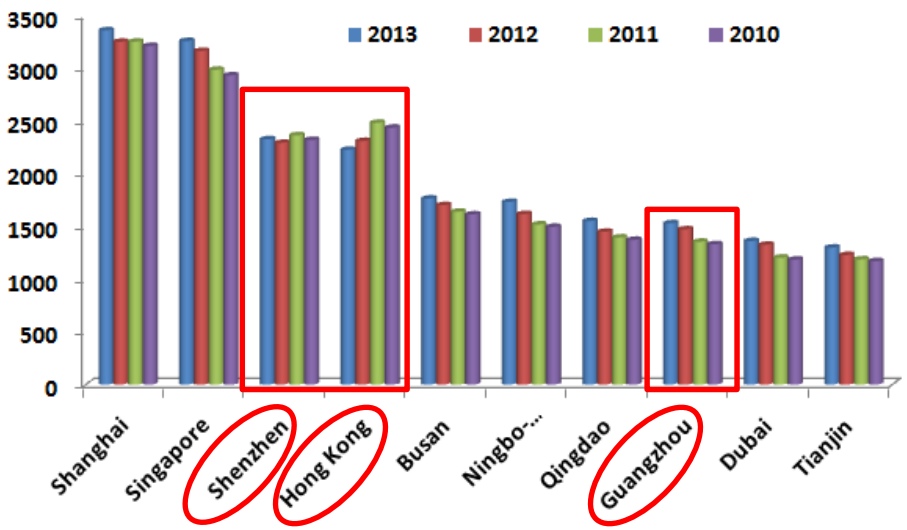
Ports and waterway intensive

- **Hierarchical development pattern:** Guangzhou and Shenzhen as main ports, Huizhou and Humen etc as important regional ports
- **High intensive waterway:** "Three vertical, three horizontal, and three line"

惠州港主要港区布局图

Expanding ports: dual challenges

Container handling volume of the global top ten ports (10000 TEUs)



- Container throughput of **Shenzhen, Hong Kong and Guangzhou** accounted for about **30%** in the world's top ten container ports；
- **Marine emissions has become an important source of air pollution.**

INVENTORY COMPILATION METHOD AND DATA SOURCE

Inventory compilation method

$$E = VAN \times P \times LF \times A \times EF$$

Vessel Calls:
Port information, **acquired from MD by investigation**

Power of vessel equipment:
Analysis by **the ship information database**

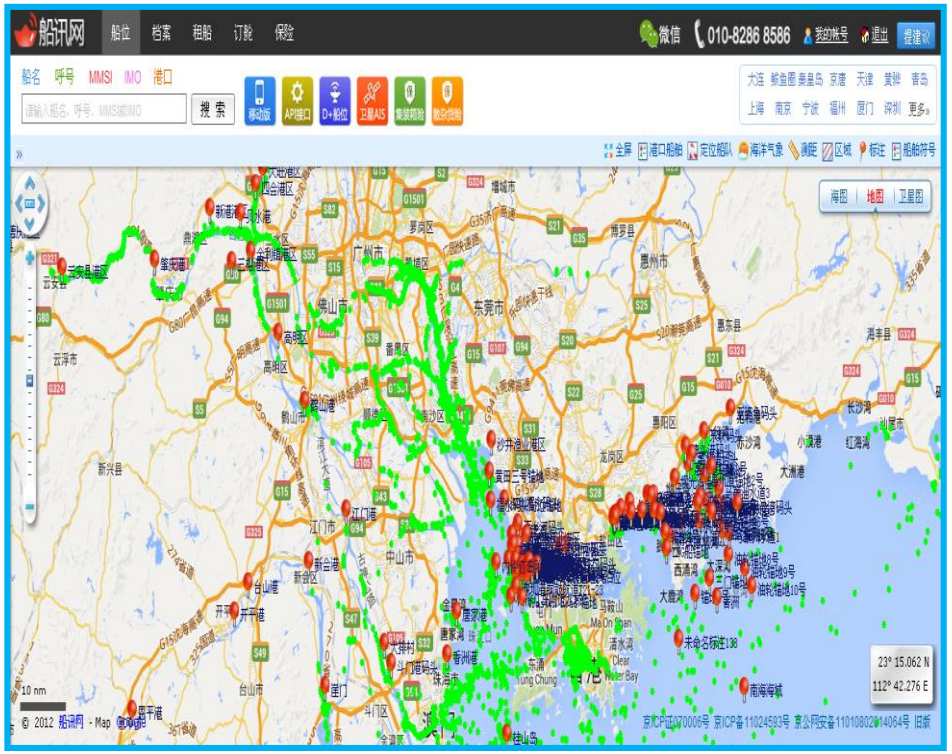
Fractional load of equipment in a specific mode :
Analysis by **the ship trajectory database**

Operation time-in-mode:
Analysis by **the ship trajectory database**

Emission factor :
Refer to the USEPA research reports and other publications

Automatic identification system(AIS)application

Printscreen 1



Printscreen 2

※ With AIS data , vessel registration information data (static information) and vessel trajectory data (dynamic information) can be collected.

AIS application : vessel information database

船舶名称	CSCL NEPTUNE 当前船位	船舶类型	Container Ship (Fully Cellular) (2012/05)
建造年份	2012/05	IMO编号	9467316
总吨	150,853	载重吨	155,263
MMSI	477598400	呼号	VRKJ3
船舶状态	In Service/Commission (2012/05/22)	船籍	Hong Kong, China (2012/05)
主机燃油消耗量	0	燃油消耗总量	0
最大船速	25.5	经济船速	24.1
船舶造价($)	170,000,000		

主机

Design: MAN-B&W , Engine Builder: Doosan Engine Co Ltd - South Korea , 1 x 12K98ME-C , 2 , IN-LINE,VERTICAL 12 Cy , 980 x 2400 , Mcr: 72240(98218) p 104 rpm

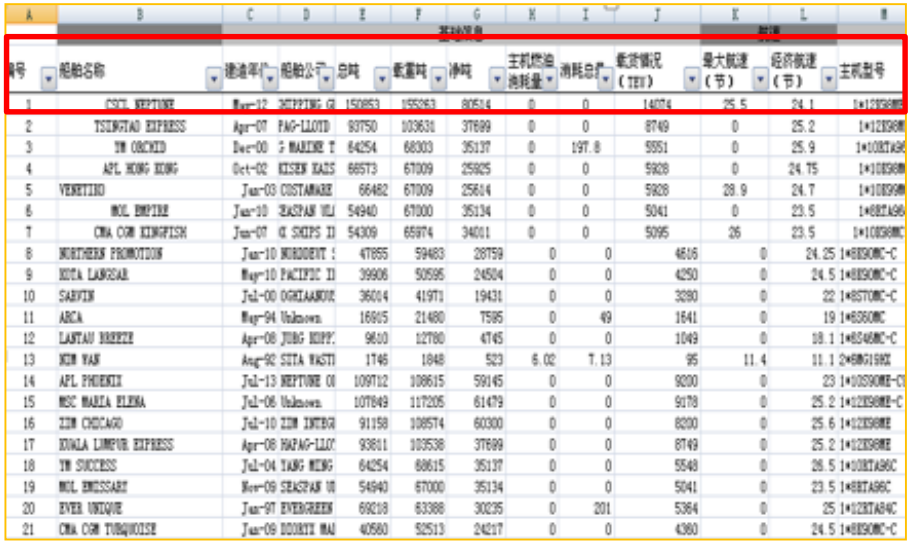
辅机

Design: Man-B&W , Engine Builder: Unknown , 3 x Unknown , Mcr: 2550 kw

燃油

FuelType1 Distillate Fuel , Capacity: 344 ; FuelType2 Residual Fuel , Capacity: 12258

与劳式数据库同步，融合了多家权威海事机构的数据，数据内容包括详细的船舶和设备技术参数等权威档案资料200多项



序号	船舶名称	建造年份	船舶公司	总吨	载重吨	净吨	主机燃油消耗量	消耗总量	载货情况 (TEU)	最大航速 (节)	经济航速 (节)	主机型号
1	CSCL NEPTUNE	May-12	SHIPPING CO	150853	155263	80514	0	0	14074	25.5	24.1	1*12K98ME
2	TSINGTAO EXPRESS	Apr-07	PAC-LLOYD	93750	103631	37699	0	0	8749	0	25.2	1*12K98M
3	TM ORCHID	Dec-00	S MARINE T	64254	68303	35137	0	197.8	5551	0	25.9	1*10RTA96
4	APL HONG KONG	Oct-02	KISEN KAIS	66573	67009	25925	0	0	5928	0	24.75	1*10K98M
5	VERITINO	Jan-03	COSTAMARE	66482	67009	25614	0	0	5928	28.9	24.7	1*10K98M
6	MOL EMPIRE	Jan-10	SEASPAN ULS	54940	67000	35134	0	0	5041	0	23.5	1*8RTA96
7	CMA CGM KINGFISH	Jun-07	CI SHIPS II	54309	65974	34011	0	0	5095	26	23.5	1*10K98MC
8	NORTHERN PROMOTION	Jan-10	NORDDEUT	47855	59483	28759	0	0	4616	0	24.25	1*8K90MC-C
9	KOTA LABUAN	May-10	PACIFIC II	39906	50595	24504	0	0	4250	0	24.5	1*8K90MC-C
10	SARVIN	Jul-00	OGHAAMOUR	36004	41971	19431	0	0	3280	0	22	1*8S70MC-C
11	ARCA	May-94	Unknown	16915	21480	7595	0	49	1641	0	19	1*6S60MC
12	LANTAU BREEZE	Apr-08	JUBG HDPP	9610	12780	4745	0	0	1049	0	18.1	1*6S46MC-C
13	KOTA VAN	Aug-02	SITA WASTI	1746	1848	523	6.02	7.13	95	11.4	11.1	2*6M16AK
14	APL PHOENIX	Jul-13	NEPTUNE OI	109712	108615	59145	0	0	9200	0	23	1*10S90ME-C
15	MSC MARIA ELENA	Jul-06	Unknown	107849	117205	61479	0	0	9178	0	25.2	1*12K98ME-C
16	ZIM CHICAGO	Jul-10	ZIM INTERG	91158	108574	60300	0	0	8200	0	25.6	1*12K98ME
17	KUALA LUMPUR EXPRESS	Apr-08	HAPAG-LLO	93811	103538	37699	0	0	8749	0	25.2	1*12K98ME
18	TM SUCCESS	Jul-04	YANG MING	64254	68615	35137	0	0	5548	0	26.5	1*10RTA96C
19	MOL ENDEAVOUR	Nov-09	SEASPAN UL	54940	67000	35134	0	0	5041	0	23.5	1*8RTA96C
20	EVER UNIQUE	Jan-97	EVERGREEN	69218	63388	30235	0	201	5364	0	25	1*12RTA84C
21	CMA CGM TURQUOISE	Jun-09	DOERIX MAI	40580	52513	24217	0	0	4360	0	24.5	1*8K90MC-C

AIS data collection

Database establishment

Calculation support

Data mining and analysis

引擎类型		燃料类型	含硫率	SO_2	NO_X	PM_{10}	$PM_{2.5}$ [1)]	HC [2)]	CO
主引擎	低速柴油机	残渣油	2.70%	10.29	18.10	1.42	1.31	0.60	1.40
主引擎	低速柴油机	船用柴油	1.00%	3.62	17.00	0.45	0.42	0.60	1.40
主引擎	低速柴油机	船用汽油	0.50%	1.81	17.00	0.31	0.28	0.60	1.40
主引擎	中速柴油机	残渣油	2.70%	11.24	14.00	1.43	1.32	0.50	1.10
主引擎	中速柴油机	船用柴油	1.00%	3.97	13.20	0.47	0.43	0.50	1.10
主引擎	中速柴油机	船用汽油	0.50%	1.98	13.20	0.31	0.29	0.50	1.10
主引擎[3)]	柴油机	船用汽油	0.50%	2.08	13.20	0.31	0.29	0.47	1.10
辅助引擎	柴油机	残渣油	2.70%	11.98	14.70	1.44	1.32	0.40	1.10
辅助引擎	柴油机	船用柴油	1.00%	4.24	13.90	0.49	0.45	0.40	1.10
辅助引擎	柴油机	船用汽油	0.50%	2.12	13.90	0.32	0.29	0.40	1.10
辅助引擎[3)]	柴油机	船用汽油	0.50%	2.12	10.00	0.31	0.29	0.26	1.50

远洋/沿海/内河	船型	DWT分级	主机平均功率	辅机平均功率
/	/	/	KW	kw
远洋	化学品运载船	DWT<5000	1415	299
远洋	化学品运载船	DWT5000-9999	3001	633
远洋	化学品运载船	DWT 10000-19999	4455	940
远洋	化学品运载船	DWT 20000-39999	7613	1606
远洋	化学品运载船	DWT >=40000	9770	2061
远洋	普通货船	DWT <2000	699	134
远洋	普通货船	DWT 2000-4999	1590	304
远洋	普通货船	DWT 5000-9999	2663	509
远洋	普通货船	DWT 10000-29999	5462	1043
远洋	普通货船	DWT >=30000	11939	2280
远洋	散装干货船	DWT <10000	1858	412
远洋	散装干货船	DWT 10000-29999	5111	1135
远洋	散装干货船	DWT 30000-59999	8585	1906
远洋	散装干货船	DWT 60000-99999	10659	2366
远洋	散装干货船	DWT >=100000	13804	3065
远洋	集装箱船	DWT <10000	2931	645
远洋	集装箱船	DWT 10000-19999	8145	1792
远洋	集装箱船	DWT 20000-29999	11423	2513
远洋	集装箱船	DWT 30000-39999	21660	4765
远洋	集装箱船	DWT 40000-49999	27184	5980
远洋	集装箱船	DWT 50000-74999	44010	9682
远洋	集装箱船	DWT 75000-99999	60000	13200
远洋	集装箱船	DWT >=100000	64898	14278

AIS application : vessel trajectory database

A 时间	B 经度	C 纬度	D 航速（节）
2013/7/1 1:57	120-11.239E	37-40.671N	0.3
2013/7/1 4:57	120-11.180E	37-40.665N	0.4
2013/7/1 5:36	120-11.170E	37-40.650N	0.4
2013/7/1 8:51	120-11.210E	37-40.670N	0.4
2013/7/1 11:57	120-11.190E	37-40.670N	0.2
2013/7/1 15:06	120-11.130E	37-40.650N	0.1
2013/7/1 18:09	120-11.160E	37-40.660N	0.5
2013/7/1 21:12	120-11.190E	37-40.670N	0.3
2013/7/2 0:15	120-11.191E	37-40.674N	0.6
2013/7/2 1:18	120-10.939E	37-41.034N	1.9
2013/7/2 1:33	120-10.641E	37-41.387N	1.6
2013/7/2 1:48	120-10.380E	37-41.690N	1.2

AIS data collection

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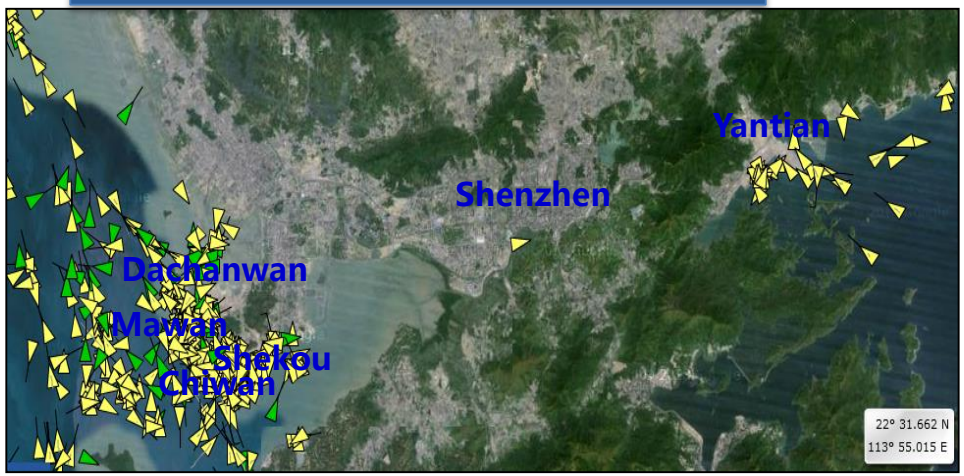
Data mining and analysis



Vessel Type	Statistics	Fairway Cruise/h	Slow Cruise/h	Maneuvering/h	Hotelling/h
Cargo Ship	52	0	0.43	5.52	18.49
Container Vessel	93	0.16	0.51	0.73	22.08
Dry Bulk Carrier	93	0.01	0.38	0.99	29.89
Chemical Carrier	110	0	0.64	4.27	32.41
Pleasure Vessel	50	0.77	0.03	0.18	0.99

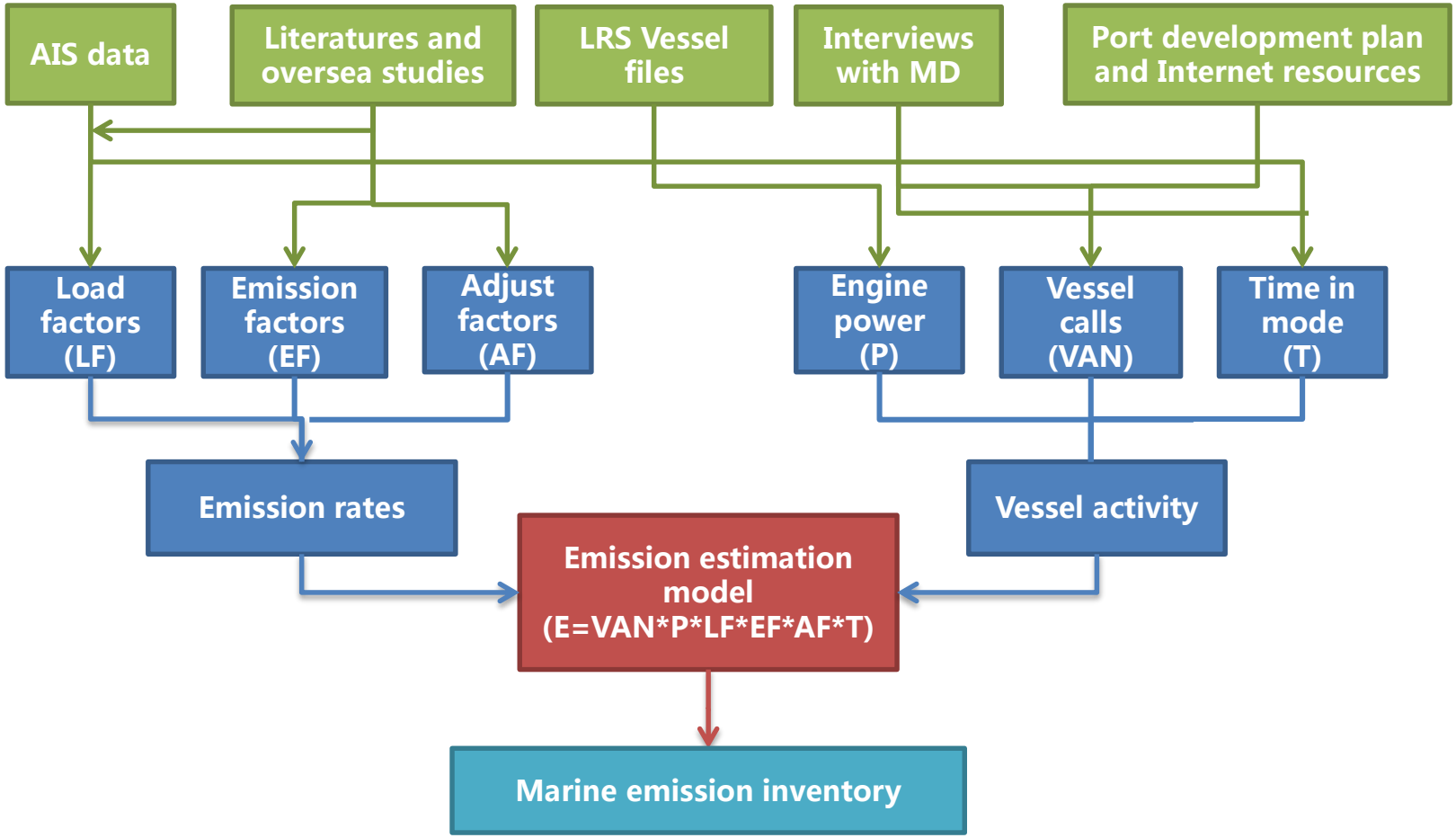
Database introduce

- **Vessel registration information database:** The number of vessels included is over **11,375**, containing **483** ocean-going vessels (**coded by IMO**), **4,612** coastal ships (**coded by MMSI but no IMO**), **6,280** river vessels (**acquired from MD through survey**), including ship owners, registered port, ship type, main power, auxiliary power, boiler, DWT, GT, NT, trade area, main routes, main type of trade goods and so on.
- **Vessel trajectory database:** The number of vessels included is more than **700**, with two years of historical vessel trajectory with time intervals of 0.5 to 8 minutes.

CHARACTERISTICS OF SHIPPING ACTIVITIES

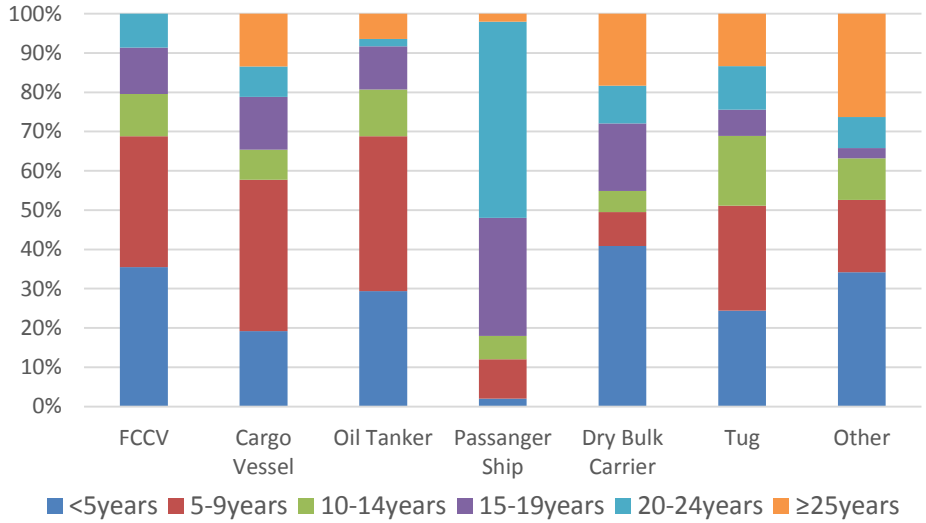
Emission Inventory compilation

- Based year:2013
- Pollutants covered: SO_2,NO_X,CO,PM_{10},$PM_{2.5}$ and VOCs
- Vessel types covered: Chemical product tanker, conventional cargo ship, bulk carrier, container ship, gas tanker, oil tanker, passenger ship, fishing vessel and tug

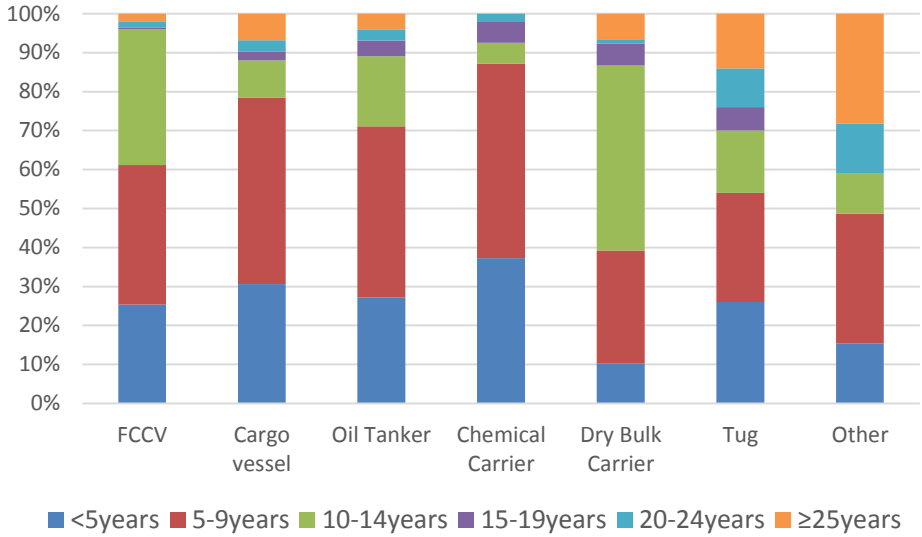


Characteristics analysis : distribution of age

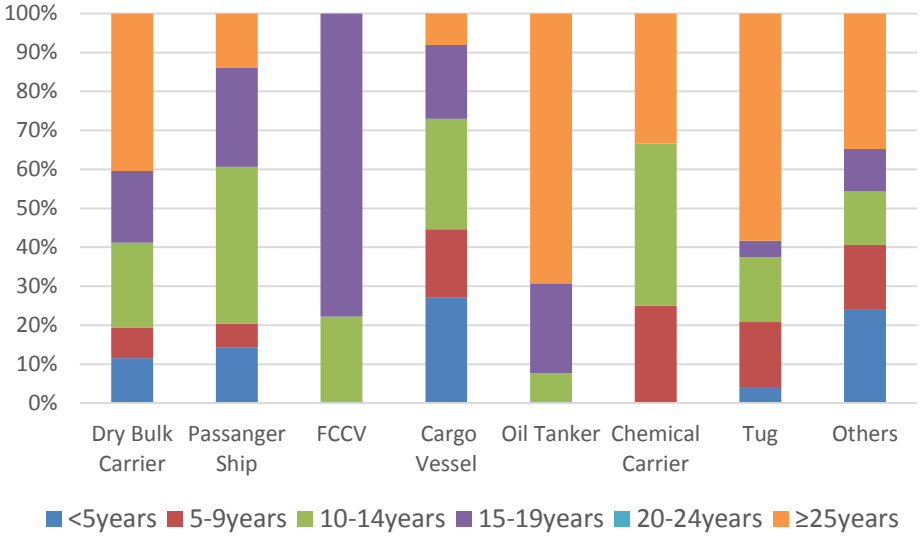
Ocean-going vessels



Coastal vessels



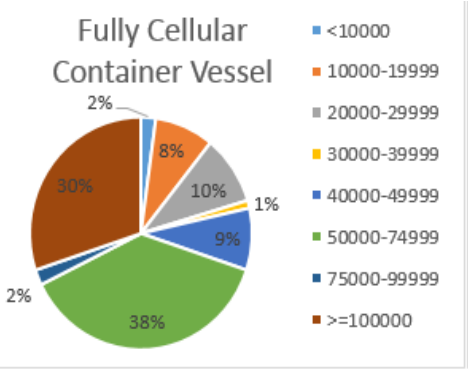
River vessels

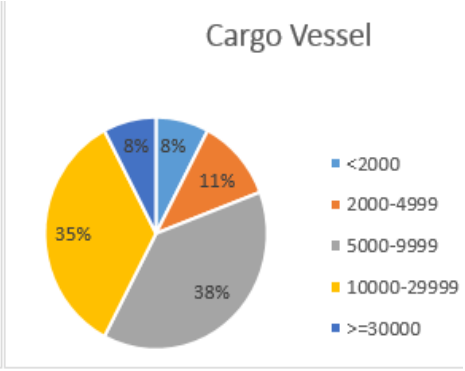


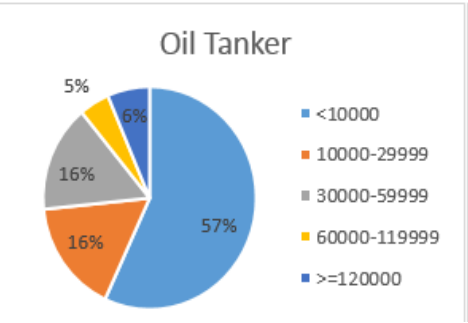
- **Oceangoing vessels**(except passenger vessels) accounted for more than 50% within 15 years;
- **Coastal vessels** accounted for more than 50% within 10 years, accounted for about 90% within 15 years;
- The age of about 70% **river vessels** are older than 10 years;
- In general, for vessels average age ,River ＞ Ocean-going ＞Coastal

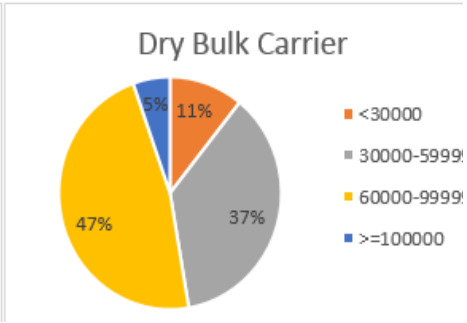
Characteristics analysis : distribution of vessel type and DWT

Ocean-going vessels

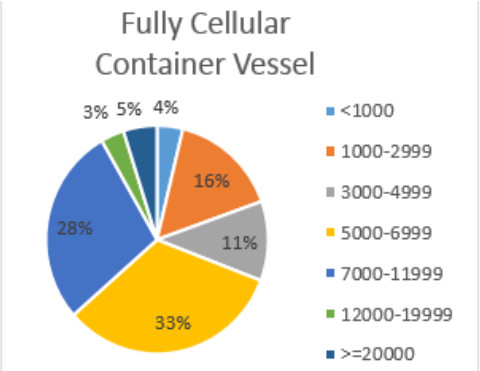


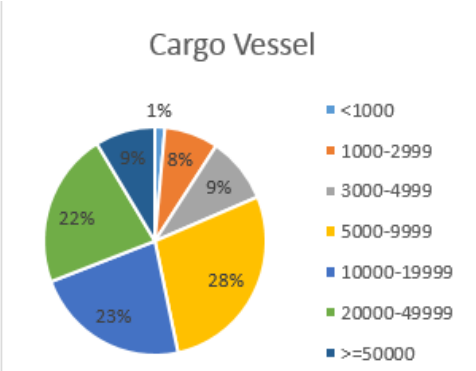


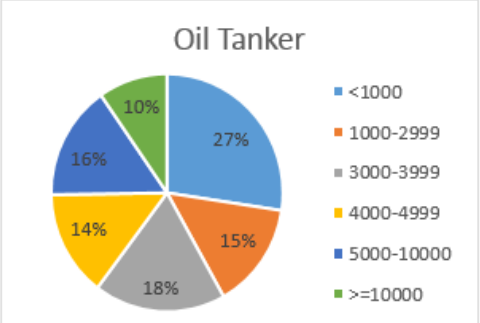


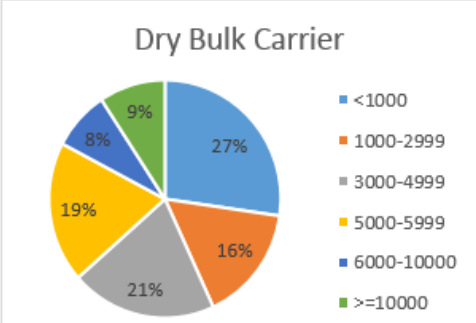


Coastal vessels

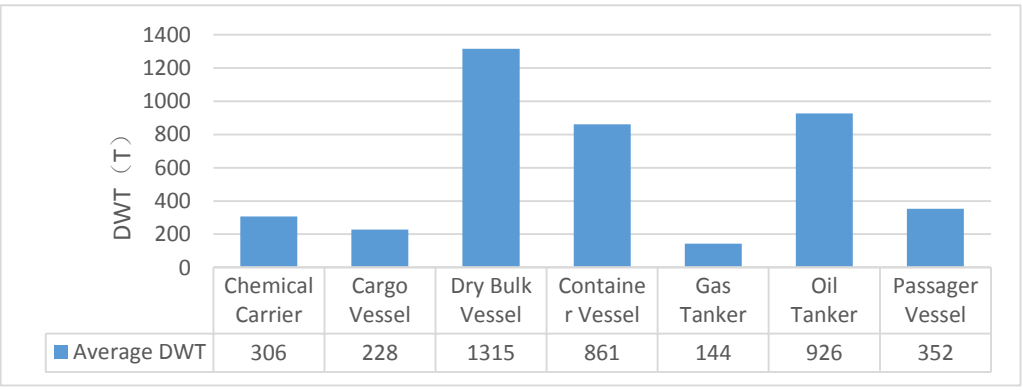








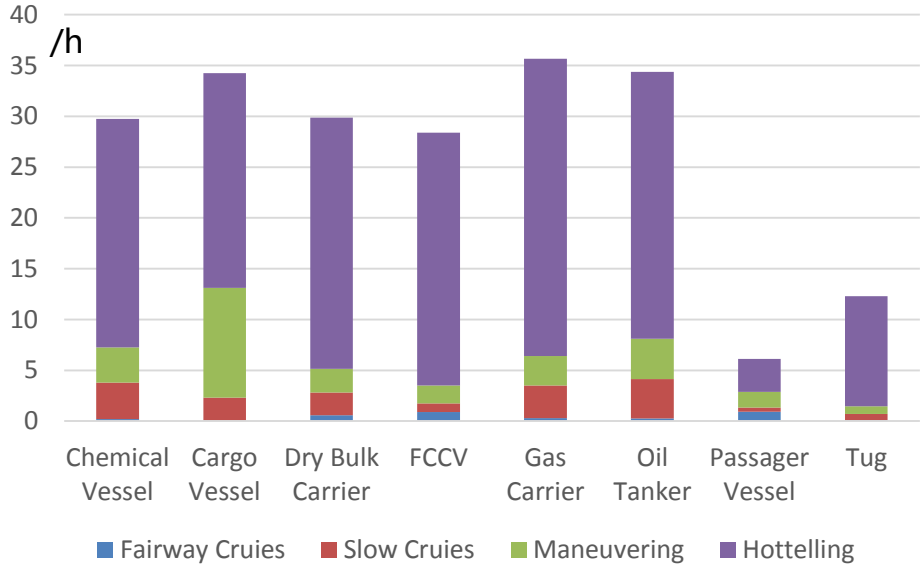
River vessels



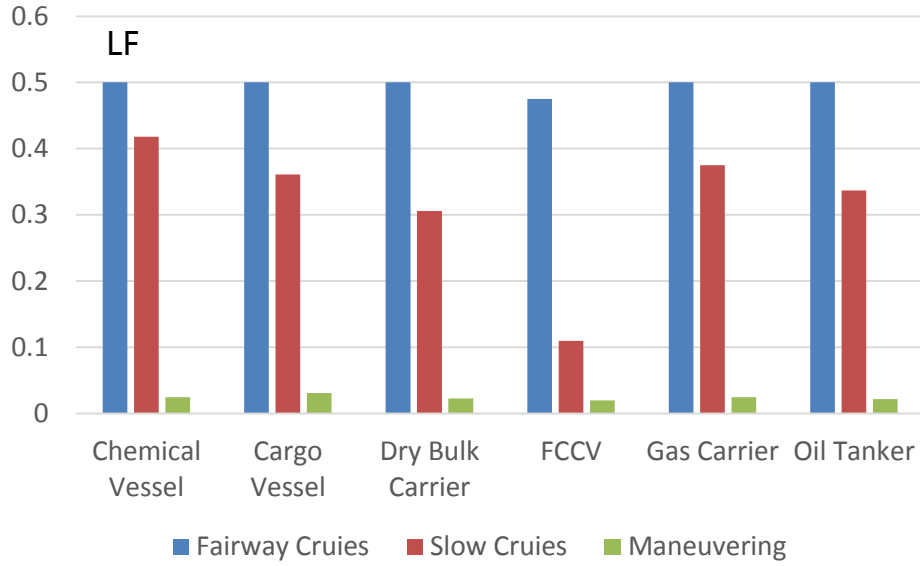
- ocean, coastal and river are quiet different in vessel types and DWT;

Characteristics analysis: operation time and LF

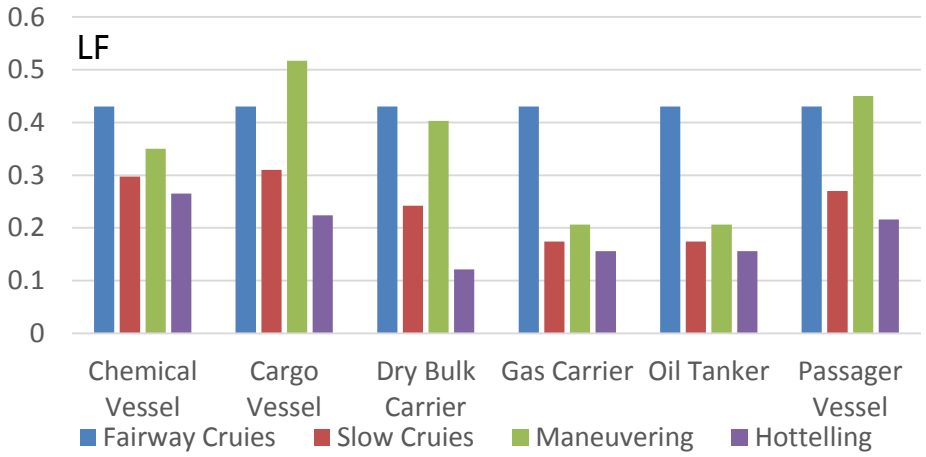
Averaged Operation time-in-mode



Averaged Main Engine Load Factors



Averaged Auxiliary Engine Load Factors



- Operation time-in-mode is quiet different for vessel types;
- Engine LF is quiet different for vessel types.

SHIP EMISSIONS IN PRD

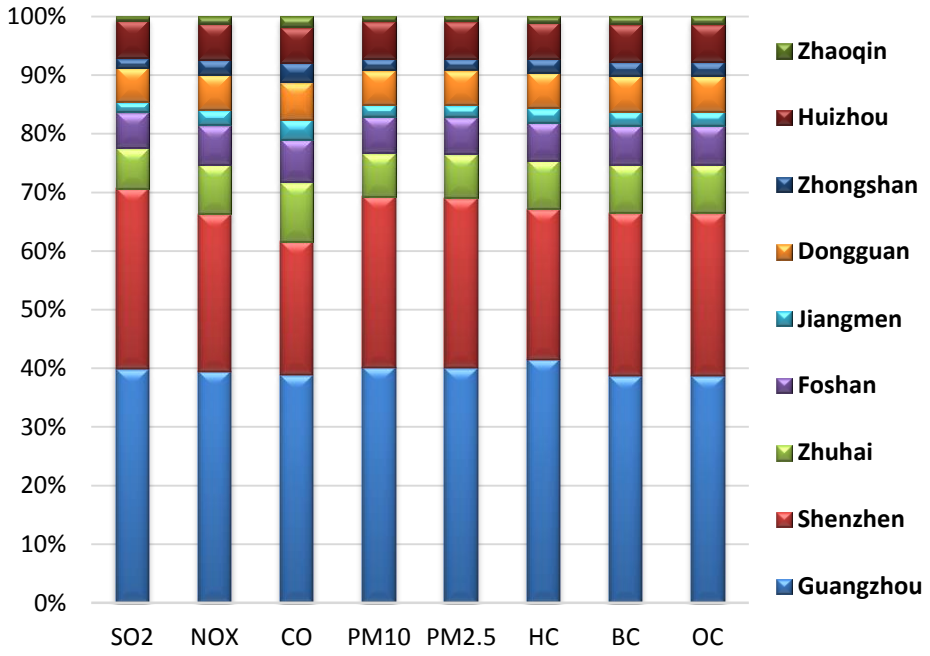
Marine emissions inventory in 2013, PRD

2013	**SO_2/t**	**NOx/t**	**CO/t**	**PM_{10}/t**	**$PM_{2.5}$/t**	**VOCs/t**
Total	**41187**	**80541**	**7903**	**5808**	**5379**	**2874**

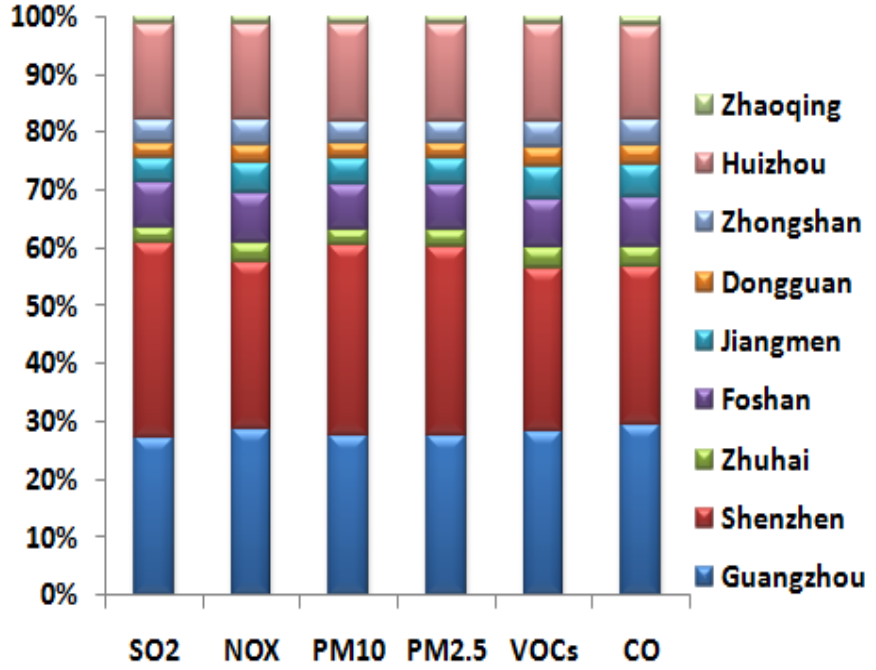
- Emission numbers to be verified and published soon.

Source contribution of marine emissions : 2013 VS 2010

2013



2010

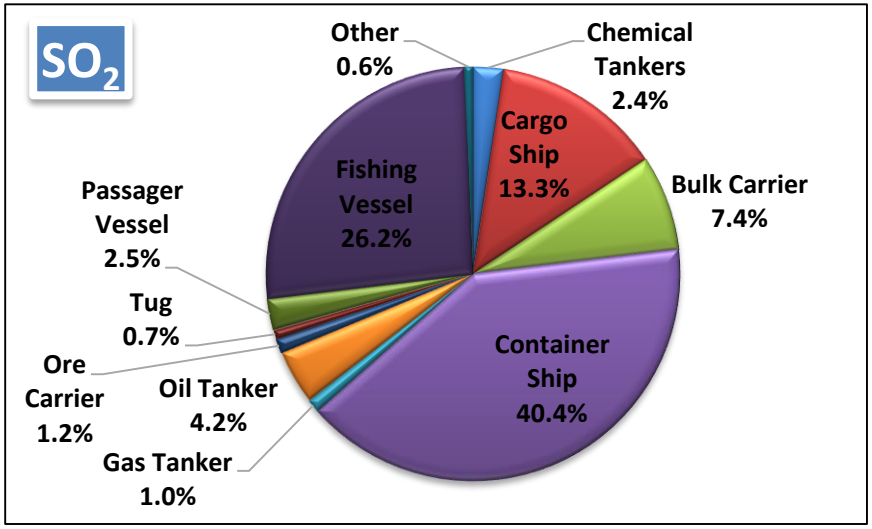


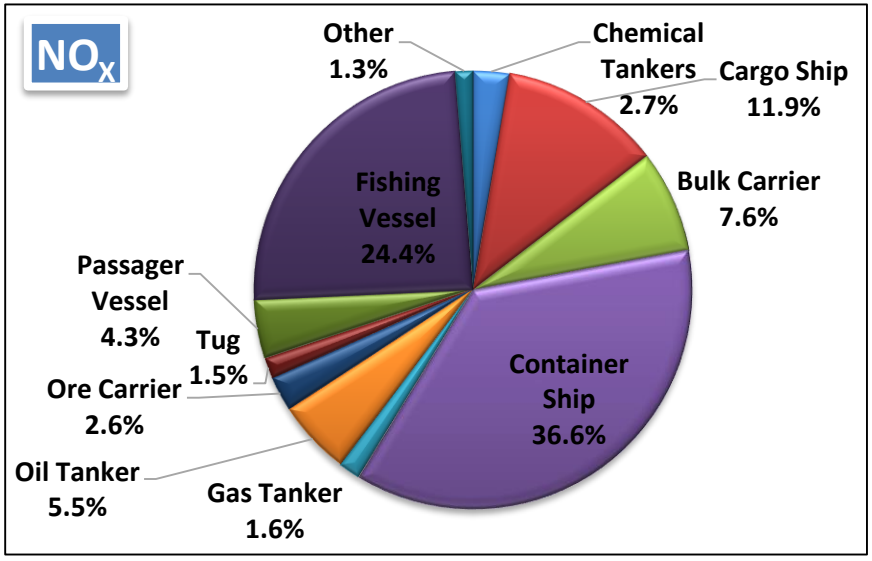
Pollution contribution in 2013 in line with throughput ranking by cities

2013年	Guangzhou	Shenzhen	Zhuhai	Foshan	Jiangmen	Dongguan	Zhongshan	Huizhou	Zhaoqin
Cargo throughput/10kt	45125.16	22806.67	7745.44	5253.01	6210.67	9227.73	5153.47	5256.85	2729.07
Passenger throughput/10kP	74.89	432.57	583.88	74.12	16.63	32.3	118.52	0	0
Ocean foreign trade/10kt	11080.67	17706.8	1724.31	2133.57	562.04	2020.77	639.14	2336.6	273.33

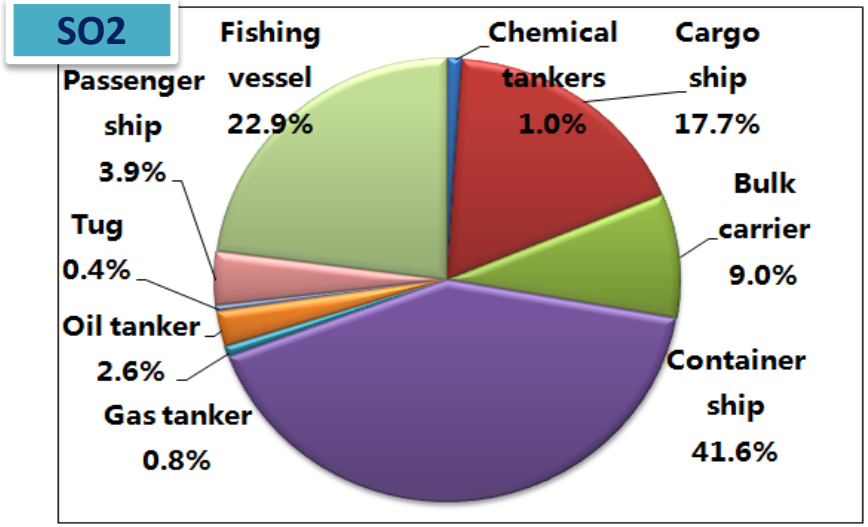
Source contribution of marine emissions : 2013 VS 2010

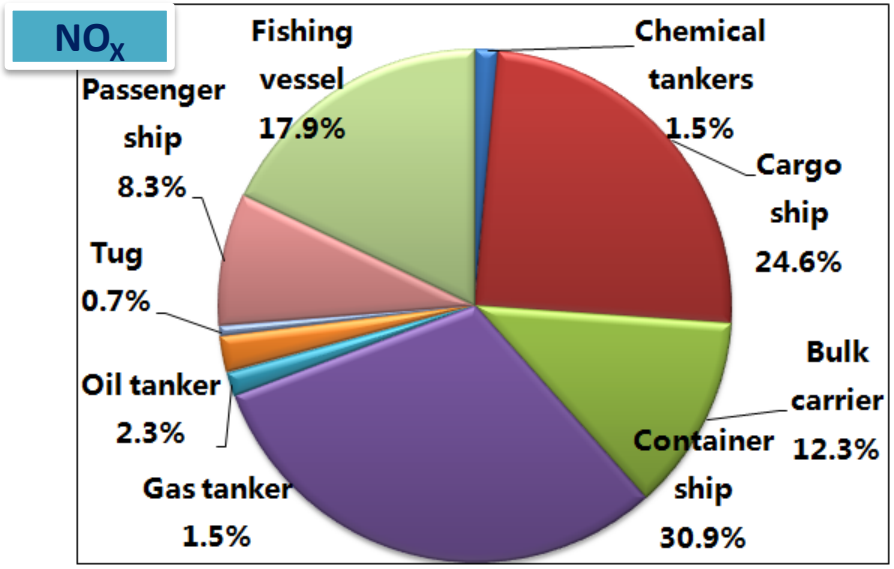
2013





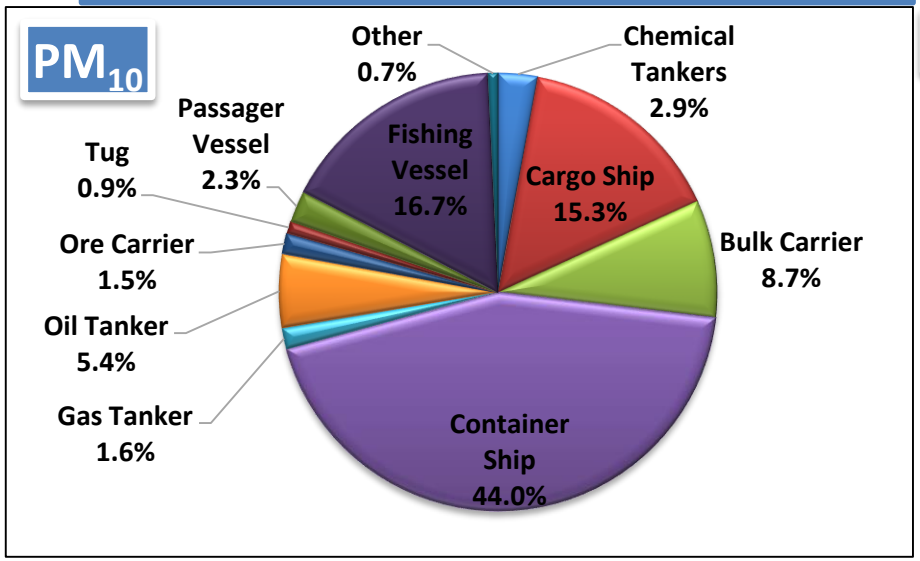
2010

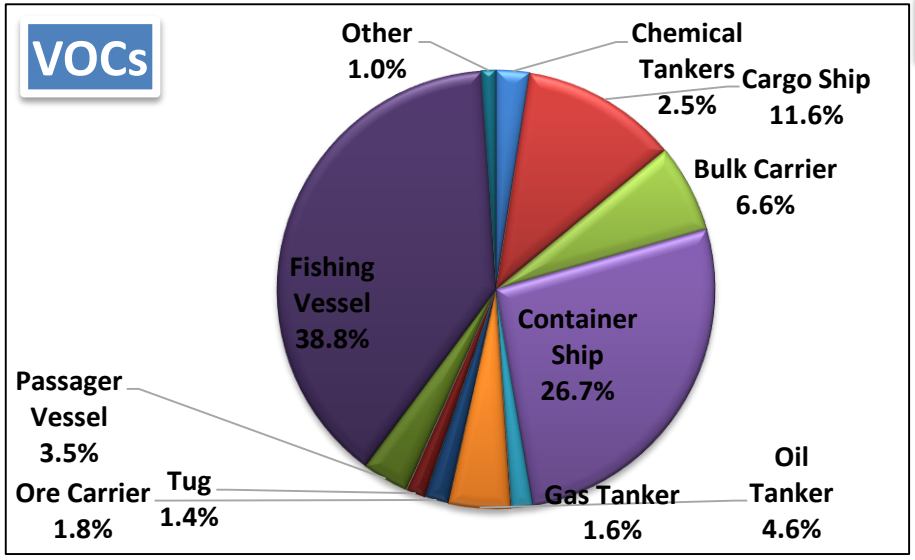




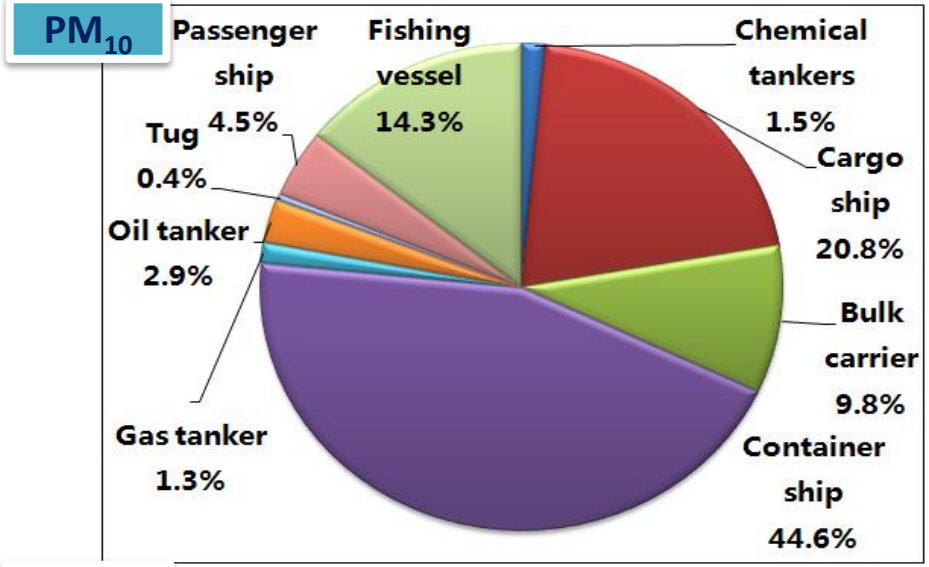
Source contribution of marine emissions : 2013 VS 2010

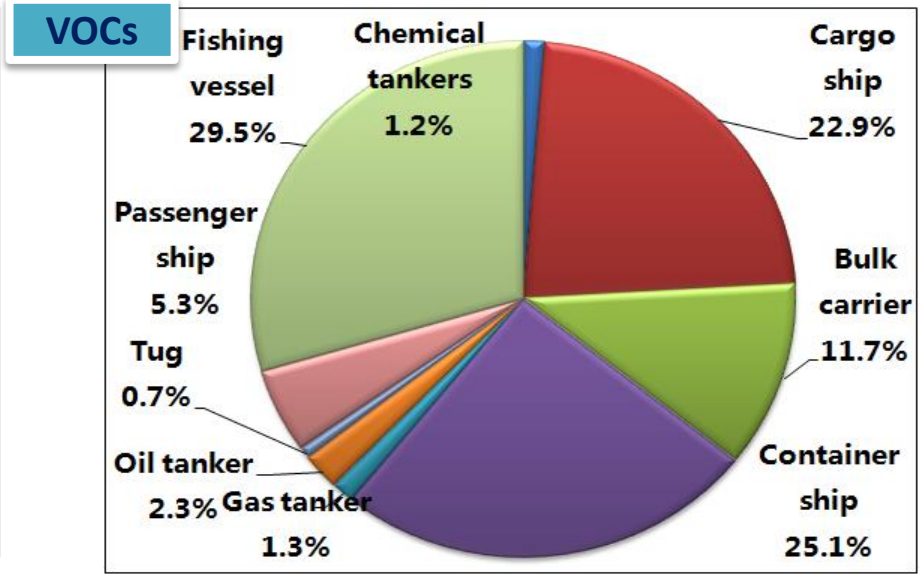
2013



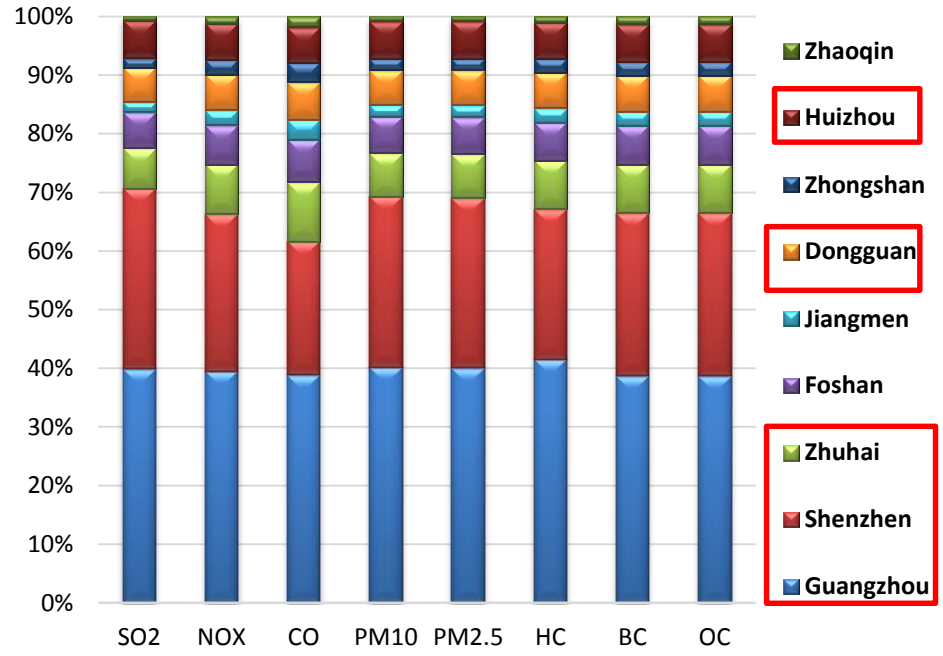


2010





Source contribution of marine emissions : analysis

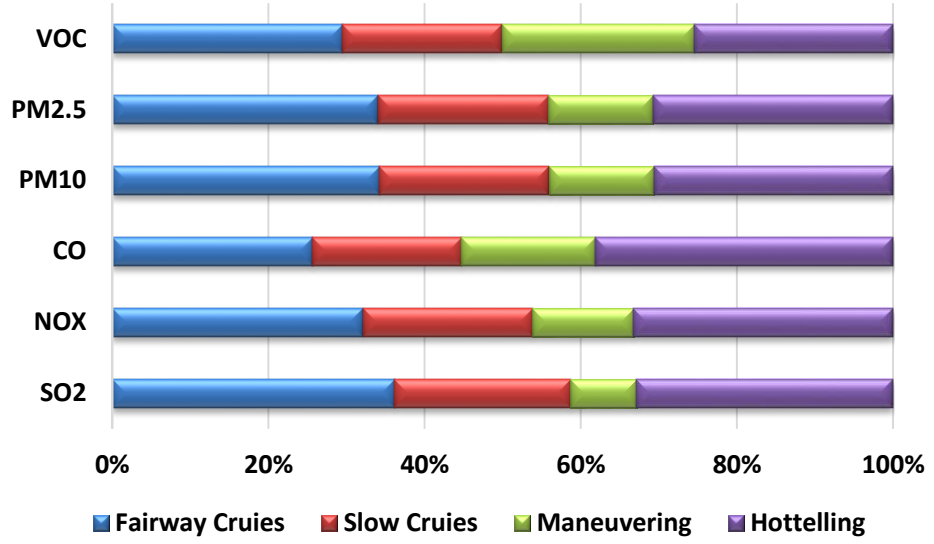


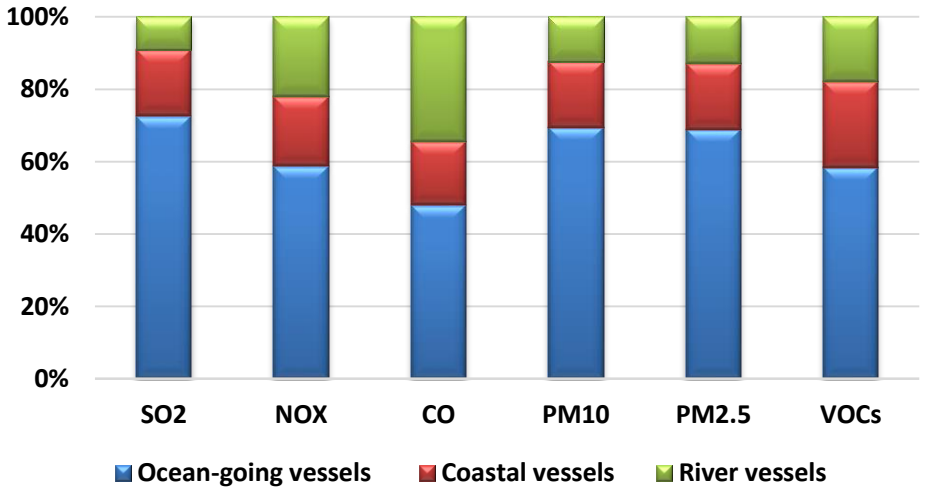
Top three

- Guangzhou
- Shenzhen
- Huizhou

>70%

Source contributions by cities



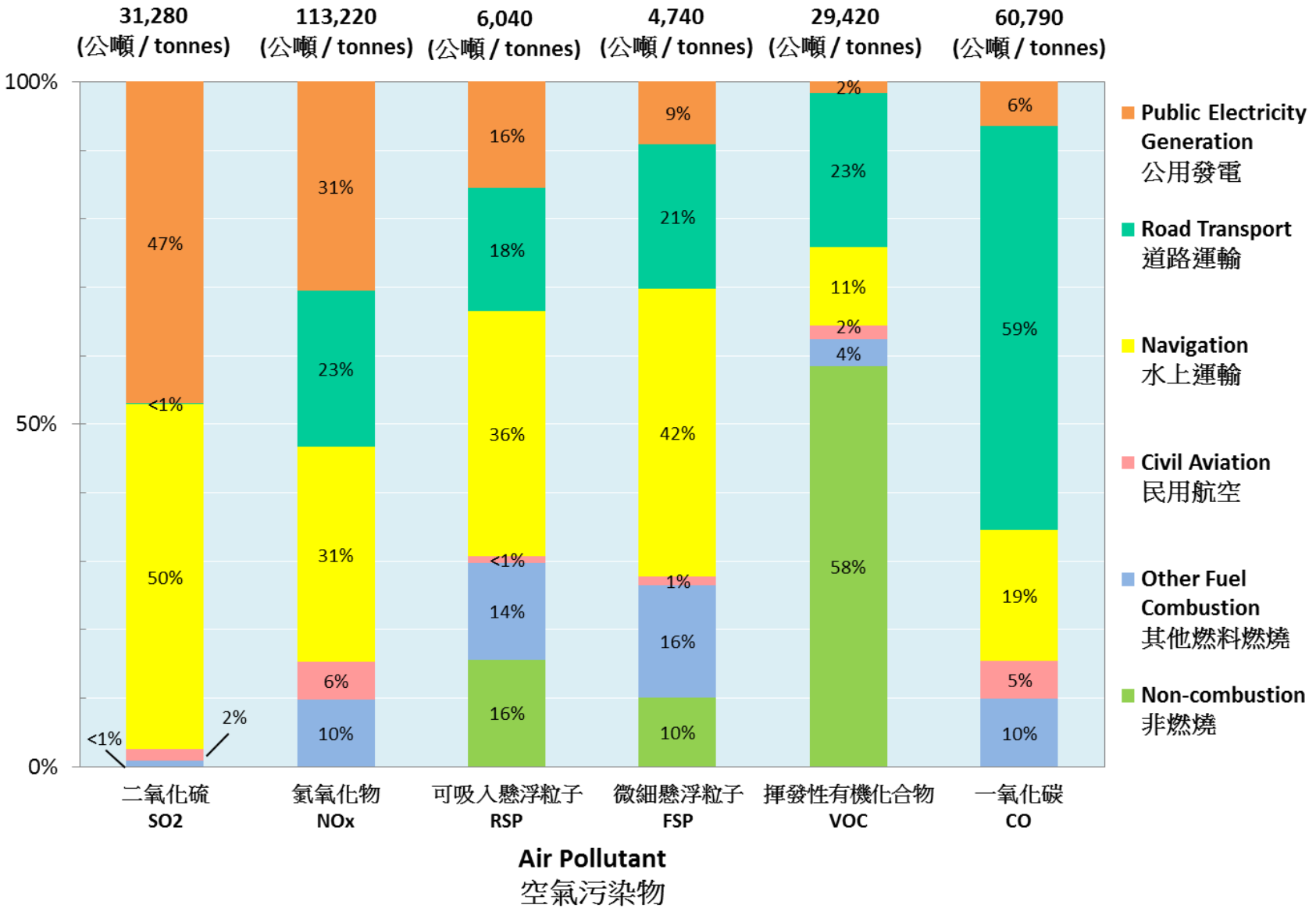


Source contributions by modes and driving area

5

SHIP EMISSIONS IN HONG KONG

HK air pollutant emission inventory 2013



THANKYOU FOR YOUR ATTENTION!