出國報告（出國類別：專案會議）

中美環保技術合作協定—
港口空氣品質清淨夥伴計畫
香港會議

服務機關：行政院環境保護署

姓名職稱：陳惠琦視察

派赴國家：中國香港

出國期間：100.7.12-13

報告日期：100.10.12

摘要

香港環保署於民國 100 年 7 月 12~13 日主辦「港區排放清單及管制工作技術交流會(Technical Exchange Meeting on Port-Related Emission Control Programs)」，邀請美國環保署、上海環保相關單位及本署出席，以分享各地的港區排放清冊建置及管制策略兩大項工作成果及工作經驗交流。為瞭解鄰近地區港口清冊建置現況及目前管制進程，而出席本次會議。本次會議共舉行 2 天，第 1 天在香港環保署進行，由各參與單位就本次議題內容進行專題報告，第 2 天則到香港海事處聽取香港維多莉雅港的各項管制現況，並實際於港內參觀。

臺灣的港區排放清冊因是比照美國推估方式及範圍，因此跟亞洲各國相比是涵蓋較為詳盡的港區污染源及污染物。臺灣與美國跟香港港區空氣污染物管制策略比較，大致各國的管制方向是相同，僅在要求程度有所不同，像是遠洋船舶皆是從航速、油品含硫量、岸電等管制項目著手，但要求程度則略有不同，美國為海域 200 浬內要求採用含硫量 1.5 %以下之油品，我方則是建議在 20 浬範圍，民國 100 年起採用含硫量 1.5%以下之油品。

目次

本文內容

一、目的

香港環保署於民國 100 年 7 月 12~13 日主辦「港區排放清單及管制工作技術交流會 Technical Exchange Meeting on Port-Related Emission Control Programs」，邀請美國環保署、上海環保相關單位及本署出席，以分享各地的港區排放清冊建置及管制策略兩大項工作成果及工作經驗交流。為瞭解鄰近地區港口清冊建置現況及目前管制進程，經簽奉核准由職與本案顧問公司承辦人員參與本次會議。

二、過程

本次會議共舉行 2 天，第 1 天在香港環保署進行，由各參與單位就本次議題內容進行專題報告，第 2 天則到香港海事處聽取香港維多莉雅港的各項管制現況，並實際於港內參觀。詳細議程參見表 1，會議進行相關照片如圖 1，各個演講題目及主要內容說明如下：

1. 演講項目：美國港區排放清單(Emissions Inventories at U.S. Ports)

   主要內容：介紹港口環境污染物對人類造成的健康影響、美國相關法規及規範、聖佩德羅灣潔淨空氣行動計畫執行經驗(包含洛杉磯港、長堤港)、聖佩德羅灣零排放貨櫃運輸系統、西北地區潔淨空氣策略、普捷灣海域空氣污染物排放清冊推估結果、紐約紐澤西港空氣污染物排放清冊推估結果。

2. 演講項目：臺灣港區空氣污染物管制策略及執行經驗(Implementation of Marine Control and Enforcement Experiences)

   主要內容：介紹經由台美環保技術合作協定，所衍生以港區空氣品質為主要議題的相關計畫內容說明，包含針對港區各項污染源所研擬之減量管制項目及因應策略、減量優先順序以及港區改善執行成果。

3. 演講項目：上海港港口船舶污染物排放現狀調查及對策研究(Investigation and Countermeasure of Emissions Status in Shanghai Port)

   主要內容：介紹上海港進出船舶的污染物排放總量及空間分布、上海港區的污染物排放量及空間分布、上海港口船舶的大氣污染物排放控制對策等三大主軸，並區分為四個子課題，上海港港口船舶污染物現狀調查、上海市典型碼頭 VOCs 排放現狀調查研究、上海市港口船舶排放污染物對環境空氣質量的影響及其控制對策建議措施研究及上海市港口船舶排放污染物控制對策經濟評估研究等，研究順序為先調查上海市港口船舶污染物排放現況，再依據調查成果，提出對策

建議措施及控制對策經濟評估。

4. 演講項目：香港船舶污染物排放清單研究(Hong Kong Study on Marine Vessels Emission Inventory)

主要內容：介紹香港船舶污染物排放清單研究目的、範圍以及基礎資料蒐集使用工具及表單等，呈現以 2007 年（基礎年）排放清單成果，並展現主要污染物的排放空間分佈圖，同時也介紹由 2007 年排放清單推估 1990-2006 歷史排放清單及 2008-2020 年排放清單趨勢預測方法。

5. 演講項目：臺灣港區空氣污染物排放清冊建置(Establishment of Port Air Pollutant Emissions Inventory)

主要內容：介紹臺灣 2009 年(基準年) 港區空氣污染物排放清冊推估及 2010-2021 年港區未來年空氣污染物排放量的推估成果，解析臺灣四個港口的空氣污染物排放特性及趨勢。

6. 演講項目：港勤和遠洋船舶使用低硫燃料和其它減排措施的經驗與法規和鼓勵計劃(Harbor Craft & OGVs U.S. Experiences & Regulation of Marine Fuel & Other Emission Reduction Strategies & Incentives)

主要內容：介紹美國環保署制定之遠洋船舶相關法規、美國對於硫排放管制區(ECA)的管制行為、硫排放管制區未來空氣品質改進模擬成果、加州海域法規及規則、遠洋船舶操作經驗調查結果。

7. 演講項目：香港港區排放管制計劃(Hong Kong Port-Related Emission Control Programs)

主要內容：介紹香港對於港區的多元管制計畫，像是遠洋船舶包含燃料規格管制、煙霧管制、航速管制等項目，未來管制計畫則是將針對數項策略詳以評估，像是停泊港口需切換燃油、船舶排放控制區、船舶使用減排設備、岸電等，考慮於未來實施管制。

表 1 「港區排放清單及管制工作技術交流會」議程表

Program for the Technical Meeting on 12 July 2011

2011 年 7 月 12 日技術交流會時間表

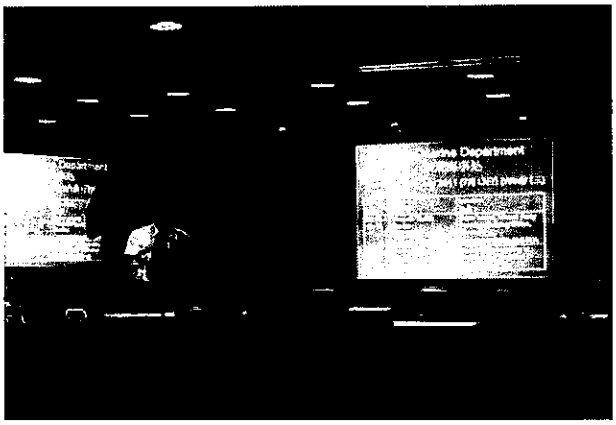
Time 時間	Program 項目	Speaker 講者
9:00 - 9:10	Registration 登記	
9:10 - 9:15	Opening Speech by EDP 香港環境保護署致開幕詞	Mr. WC Mok 莫偉全
9:15 - 9:20	Opening Speech by USEPA, Program Manager 美國環保局致開幕詞	Mr. Justin Harris 韓杰亭
Group photo 團體拍照		
9:20 - 10:50	Emissions Inventories at U.S. Ports 美國港區排放清單	Ms. Penelope McDaniel 馬貝洛
10:50 - 11:20	Implementation of Marine Control and Enforcement Experiences 港區空氣污染物管制策略及執行經驗	Ms. HC Chen 陳惠琦
11:20 - 11:35	Tea Break 小休	
11:35 - 12:05	Investigation and Countermeasure of Emissions Status in Shanghai Port 上海港港口船舶污染物排放現狀調查及對策研究	Mrs. Liu Juan 劉娟
12:05 –12:30	Q & A Session 問答時段	
12:30 - 14:00	Networking Lunch 午膳	
14:00 - 14:30	Hong Kong Study on Marine Vessels Emission Inventory 香港船舶污染物排放清單研究	Mr. KW Ng 吳家穎
14:30 - 15:00	Establishment of Port Air Pollutant Emissions Inventory 港區空氣污染物排放清冊建置	Mr. CH Liang 梁佳修
15:00 - 15:15	Tea Break 小休	
15:15 - 16:45	Harbor Craft & OGVs U.S. Experiences & Regulation of Marine Fuel & Other Emission Reduction Strategies & Incentives 港勤和遠洋船舶使用低硫燃料和其它減排措施的經驗與法規和鼓勵計劃	Ms. Penelope McDaniel 馬貝洛

16:45 - 17:00	Hong Kong Port-Related Emission Control Programs 香港港區排放管制計劃	Mr. YT Lee 李裕韜
17:00 - 17:30	Q & A Session 答問時段	
17:30 - 17:35	Closing Speech by EPD 香港環境保護署致閉幕詞	Mr. SW Pang 彭錫榮

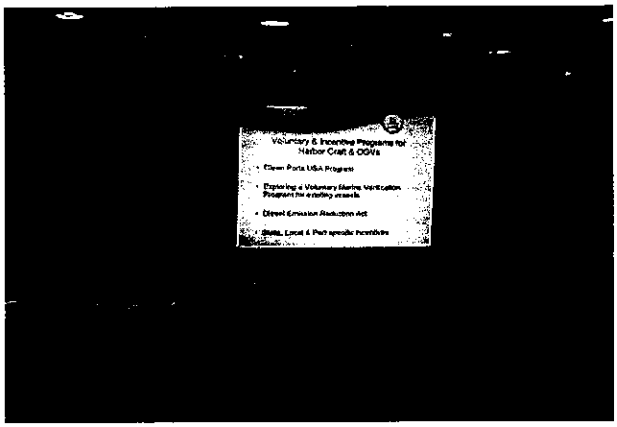
Program for Visit to Marine Department on 13 July 2011

2011 年 7 月 13 日參觀海事處時間表

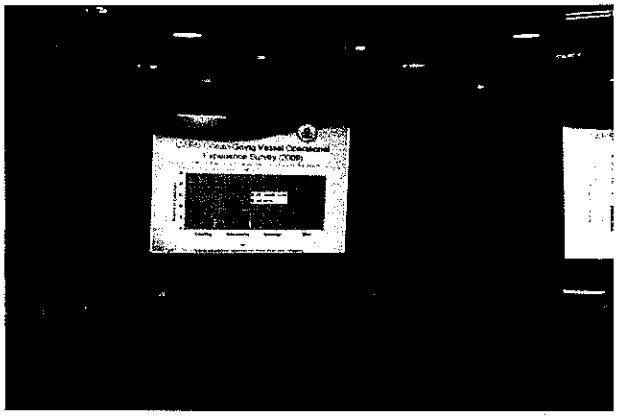
Time 時間	Program 項目	Location 地點
9:15 - 10:15	Vessel Traffic Centre 船隻航行監察中心	Outer Island, Macau Ferry Terminal Building Office, Centre 中環港澳客運碼頭的外碼頭
9:15 - 10:15	Harbor Tour 遊覽海港設施	Boarding/Unboarding at Macau Ferry Terminal 港澳客運碼頭上船



香港環境保護署致詞



美方代表簡報(1)



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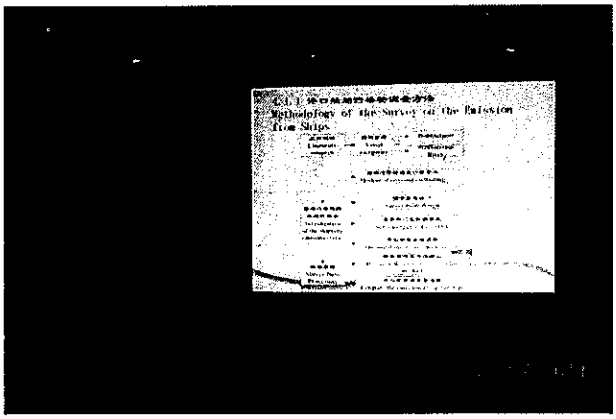

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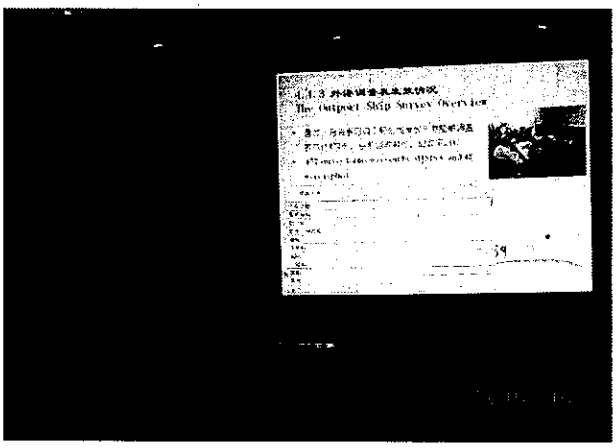

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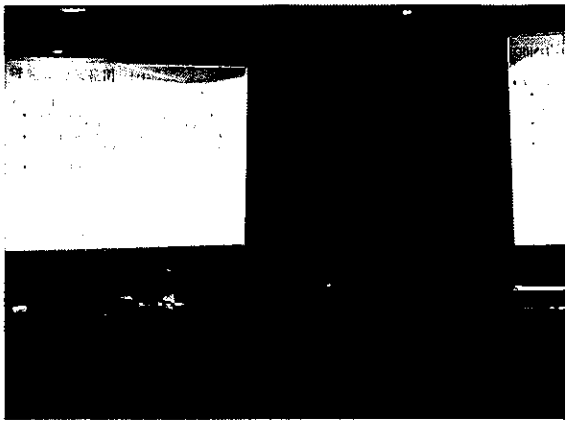
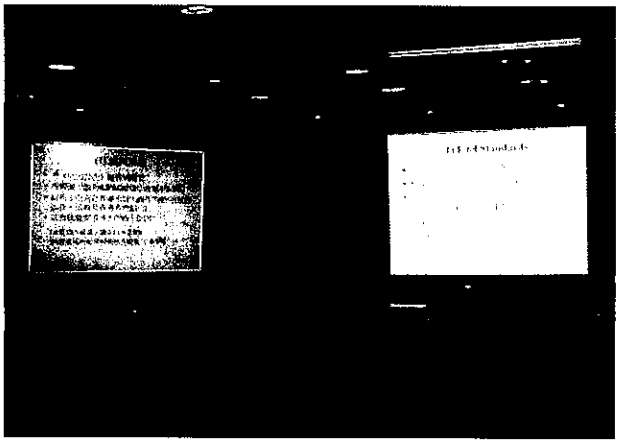


香港代表簡報(1)

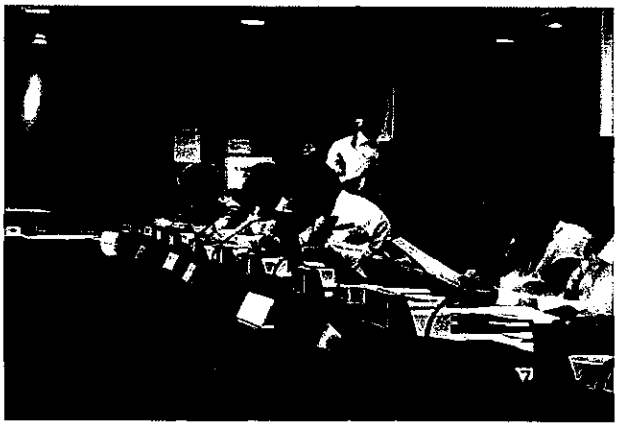
圖 1　港區排放清單及管制工作技術交流會



香港代表簡報(2)

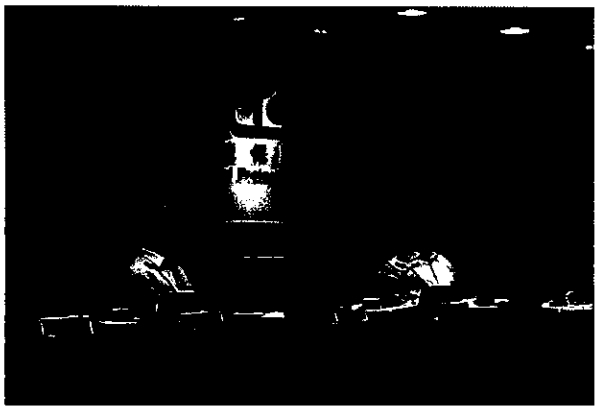
與會情形(1)

與會情形(2)



與會情形(3)

與會情形(4)



與會情形(5)

圖 1　港區排放清單及管制工作技術交流會(續)

三、心得與建議

依各國港區分享經驗，整理臺灣與各國相關經驗比較表如表 1~3，表 1~2 為美國港區空氣污染物排放清冊比較，臺灣的港區排放清冊因是比照美國推估方式及範圍，因此跟亞洲各國相比是涵蓋較為詳盡的港區污染源及污染物，在船舶活動資料與香港相比，香港是採行香港海事處船舶航行衛星監測資料，此資料對於船舶的活動資訊紀錄詳細，但資料數據龐大，因此香港僅引用兩星期的船舶航行衛星監測資料，補足其他資料的不足處，而我國則是引用交通部的船舶自動辨識系統，使用一整年的船舶活動數據，可清楚得知遠洋船舶的航行路線、時間等資訊，是與香港的推估來源有所不同之處。

表 3 為臺灣與美國跟香港港區空氣污染物管制策略比較，大致各國的管制方向是相同，僅在要求程度有所不同，像是遠洋船舶皆是從航速、油品含硫量、岸電等管制項目著手，但要求程度則略有不同，美國為海域 200 浬內要求採用含硫量 1.5 %以下之油品，我方則是建議在 20 浬範圍，民國 100 年起採用含硫量 1.5% 以下之油品。

表 1 美國港區空氣污染物排放清冊比較表

項目	洛杉磯	長堤港	普捷灣	紐約港	紐澤西港
推估基準年(最新版)	2009	2008	2011	2006	
推估項目	1.遠洋船舶 2.港勤船舶 3.貨物裝卸設備 4.火車機車 5.重型車輛		1.遠洋船舶 2.港勤船舶 3.貨物裝卸設備 4.火車機車 5.重型車輛 6.車隊	1.遠洋船舶 2.貨物裝卸設備 3.火車機車 4.重型車輛	
推估範圍	1.船舶-港口範圍 2.重型車輛-由港口到第一個休息點或是 SOCAB 邊界		西雅圖港、塔蔻碼港等六個港口	Howland Hook 海運碼頭、布魯克林港口管理局碼頭	紐瓦克港、伊莉莎白港口管理局碼頭、Bayonne/Jersey City 海運碼頭
污染物	1.SO_X 2.NO_X 3.PM_{10}、$PM_{2.5}$ 4.DPM 5.HC 6.CO 7.CH_4 8.N_2O 9.CO_2		1.SO_X 2.NO_X 3.PM 4.DPM 5.CO 6.CH_4 7.N_2O 8.VOC 9.CO_2	1.SO_X 2.NO_X 3.PM_{10}、$PM_{2.5}$ 4.CO 5.CH_4 6.N_2O 7.VOC	

表 2 亞洲港區空氣污染物排放清冊比較表

項目	香港	上海	臺灣
推估基準年 (最新版)	2007	2010	2009
推估項目	1.遠洋船舶	1.遠洋船舶 2.內河船舶	1.遠洋船舶 2.港勤船舶 3.貨物裝卸設備 4.火車機車 5.重型車輛 6.逸散性污染源
推估範圍	香港水域	上海行政邊界 參考港區邊界 (含洋山深水港)	港區行政範圍、港區 20 浬範圍
污染物	1.SO_2 2.NO_X 3.PM_{10}、$PM_{2.5}$ 4.VOC 5.CO	1.SO_2 2.NO_X 3.PM 4.VOC 5.CO 6.GHG	1.SO_2 2.NO_X 3.PM_{10}、$PM_{2.5}$ 4.DPM 5.VOC 6.CO 7.CH_4 8.N_2O 9.GHG
船舶基本資料	勞氏資料庫、問卷調查	問卷調查	勞氏資料庫、問卷調查
船舶活動資料	香港海事處船舶航行衛星監測資料	-	港務局船舶進出港資料、船舶自動辨識資料(AIS)

表 3 各國港區空氣污染物管制策略比較表

項目	美國	香港	臺灣
遠洋船舶	1. 船舶符合第三類引擎規定 2.硫排放管制區(海域200nm)使用低硫燃油(S<1.0%) 3.停泊使用岸電或是輔助控制技術	1. 燃油規格 2. 煙霧管制 3. 航速管制 4. 停泊切換燃油(S<0.5%)	1. 20 浬減速至 12 節以下 2. 20 浬使用低硫燃油 3.登船抽檢 4.推行減量控制技術 5.停泊採用岸電設施
港勤船舶	1.採用超低硫柴油(15ppm)	-	1.切換低硫燃油 2.採用岸電設施
貨物裝卸設備	1.採用超低硫柴油(15ppm)	1.改用電能 2.採用清潔燃料(50ppm) 3.管制運作	1.切換低硫燃油(10ppm) 2.改裝電力化引擎
重型車輛	1.採用超低硫柴油(15ppm)	1.採用超低硫柴油(50ppm)	1.推動反怠速活動 2.加入自主管理行列

PROGRAM FOR THE TECHNICAL MEETING ON 12 JULY 2011
2011年7月12日技术交流会的时间表

Time 时间	**Program** 项目	**Speaker** 讲者
9:00 – 9:10	Registration 登记	
9:10 – 9:15	Opening Speech by EPD 香港环境保护署致开幕辞	Mr. WC Mok 莫伟全
9:15 – 9: 20	Opening Speech by USEPA, Program Manager 美国环保局致开幕辞	Mr. Justin Harris 韩杰亭
	Group photo 团体拍照	
9:20 – 10:50	Emissions Inventories at U.S. Ports 美国港区排放清单	Ms. Penelope McDaniel 马贝洛
10:50 – 11:20	Implementation of Marine Control and Enforcement Experiences 港区空气污染物管制策略及执行经验	Ms. HC Chen 陈惠琪
11:20 – 11:35	Tea Break 小休	
11:35 – 12:05	Investigation and Countermeasures of the Emissions Status in Shanghai Port 上海港港口船舶污染物排放现状调查及对策研究	Mrs. Liu Juan 刘娟
12:05 – 12:30	Q & A Session 答问时段	
12:30 – 14:00	Networking Lunch (hosted by Hong Kong EPD) 午膳	
14:00 – 14:30	Hong Kong Study on Marine Vessels Emission Inventory 香港船舶污染物排放清单研究	Mr. KW Ng 吴家颖
14:30 – 15:00	Establishment of Port Air Pollutant Emissions Inventory 港区空气污染物排放清册建置	Mr. CH Liang 梁佳修
15:00 – 15:15	Tea Break 小休	
15:15 – 16:45	Harbor Craft & OGVs U.S. Experiences & Regulation of Marine Fuel & Other Emission Reduction Strategies & Incentives 港勤和远洋船舶使用低硫燃料和其它减排措施的经验与法规和鼓励计划	Ms. Penelope McDaniel 马贝洛
16:45 – 17:00	Hong Kong port-related emission control programs 香港港区排放管制计划	Mr. YT Lee 李裕韬
17:00 – 17:30	Q & A Session 答问时段	
17:30 – 17:35	Closing Speech by EPD 香港环境保护署致闭幕辞	Mr. SW Pang 彭锡荣

PROGRAM FOR VISIT TO MARINE DEPARTMENT ON 13 JULY 2011
2011年7月13日参观海事处的时间表

Time 时间	**Program** 项目	**Location** 地点
09:15 – 10:15	Vessels Traffic Centre 船只航行监察中心	Outer Island, Macau Ferry Terminal Building Office, Central 中环港澳客运码头的外码头
10:15 – 12:15	Harbor Tour 游览海港设施	Boarding/Unboarding at Macau Ferry Terminal 港澳客运码头上落

Technical Exchange Meeting on Port-related Emission Control Programs (12 & 13 July 2011)
港区排放清单及管制工作技术交流会 (二零一一年七月十二及十三日)

List of Participants 参加者名单

	Name	姓名	Title	职位	Branch of Company/ 公司部门
A.	**Hong Kong Environmental Protection Department (HKEPD) 香港环境保护署**				
1	Mr. Mok Wai-chuen	莫伟全	Assistant Director	助理署长	Air Policy Division 空气政策科
2	Mr. Pang Sik-wing	彭锡荣	Principal Environmental Protection Officer	首席环保主任	Air Policy Group, Air Policy Division 空气政策科, 空气政策组
3	Mr. Lau Man-pang, Brian	刘万鹏	Senior Environmental Protection Officer	高级环保主任	Air Science Group, Air Policy Division 空气政策科, 空气科学组
4	Mr. Lee Yu-tao, Tony	李裕韬	Senior Environmental Protection Officer	高级环保主任	Air Policy Group, Air Policy Division 空气政策科, 空气政策组
5	Mr. Cheung Kam-hing, Billy	张金兴	Environmental Protection Officer	环保主任	Air Science Group, Air Policy Division 空气政策科, 空气科学组
6	Mr. Lai Kin-tong, Michael	黎健棠	Environmental Protection Officer	环保主任	Air Policy Group, Air Policy Division 空气政策科, 空气政策组
7	Ms. Lui Pik-ying, Phoebe	吕碧英	Assistant Environmental Protection Officer	助理环保主任	Air Policy Group, Air Policy Division 空气政策科, 空气政策组
B.	**Hong Kong Marine Department (HKMD) 香港海事处**				
8	Mr. Leung Wing-fai	梁荣辉	Senior Surveyor	高级验船主任	Local Vessels Safety Branch, Shipping Division 船舶事务科, 本地船舶安全部
9	Mr. Wong Sai-fat	王世发	Senior Surveyor	高级验船主任	Technical Policy Branch, Multi-lateral Policy Division 航运政策科, 技术政策部
C.	**US Environmental Protection Agency (USEPA) 美国环保局**				
10	Mr. Justin Harris	韩杰亭	Program Manager, Greater China (Taiwan/ Hong Kong)	企划经理	Office of International Affairs 国际事务部
11	Mr. Luis Troche	陆毅	Greater China Program Manager (for air, water, enforcement, and law)	企划经理	Office of International Affairs 国际事务部
12	Ms. Penelope McDaniel	马贝洛	Environmental Scientist and Lead of the West Coast Collaborative	环保科学家/ 西岸合作企划领导	Region 9 Air Division - Clean Energy and Climate Change Office 第9区(加州)空气科, 洁净能源和气候转变组
D.	**Environmental Protection Administration Taiwan (EPAT) 台湾环境保护署**				
13	Ms. Chen Huei-Chi	陈惠琪	Specialist	视察	Department of Air Quality Protection and Noise Control 空气品质保护及噪音管制处
E.	**Simenvi Company Ltd. (Simenvi) 景丰科技股份有限公司**				
14	Mr. Liang Chia-Hsiu	梁佳修	Project Manager	专案经理	NA
15	Ms. Huang Li-Ting	黄莉婷	Engineer	工程师	NA
F.	**Shanghai Environmental Monitoring Center (SEMC) 上海市环境监测中心**				
16	Mrs. Liu Juan	刘娟	Deputy Director	副主任	NA
17	Mr. Zhang Jian	张健	Deputy Director	副主任	Vehicle Pollution Monitoring Division 机动车污染监测室
18	Mrs. Xu Jie	徐捷	Senior Engineer	高级工程师	Atmospheric Pollution Monitoring Division 大气污染监测室
19	Mr. Shen Yin	沈寅	Engineer	工程师	Vehicle Pollution Monitoring Division 机动车污染监测室
20	Mr. Tan Hua	谭华	Engineer	工程师	Vehicle Pollution Monitoring Division 机动车污染监测室
G.	**Shanghai Port Administration Center (SPAC) 上海港港政管理中心**				
21	Mr. Cheng Jianmin	程健敏	Chief Engineer	总工程师	NA
22	Ms. Fang Yuanyuan	芳媛媛	Engineer	工程师	NA
H.	**Shanghai Academy of Environmental Sciences (SAES) 上海市环境科学研究院**				
23	Ms. Lin Li	林立	Engineer	工程师	NA
24	Ms. Lu Jun	鲁君	Engineer	工程师	NA
25	Mr. He Xiaochu	何校初	Engineer	工程师	NA
I.	**Shanghai Municipal Maritime Bureau (SMMB) 上海市地方海事局**				
26	Mr. Wang Zhengyu	王征瑜	Engineer	工程师	NA
J.	**Department of Environmental Science and Engineering, Fudan University 复旦大学环境科学与工程系**				
27	Ms. Zhang Yan	张艳	Associate Professor	讲师	NA
K.	**Hong Kong University of Science & Technology (HKUST) 香港科技大学**				
28	Mr. Ng Ka-wing, Simon	吴家颖	Visiting Scholar	访问学者	NA
29	Mr. Lin Chu-bin, Ben	林楚彬	Research Assistant	研究助理	NA

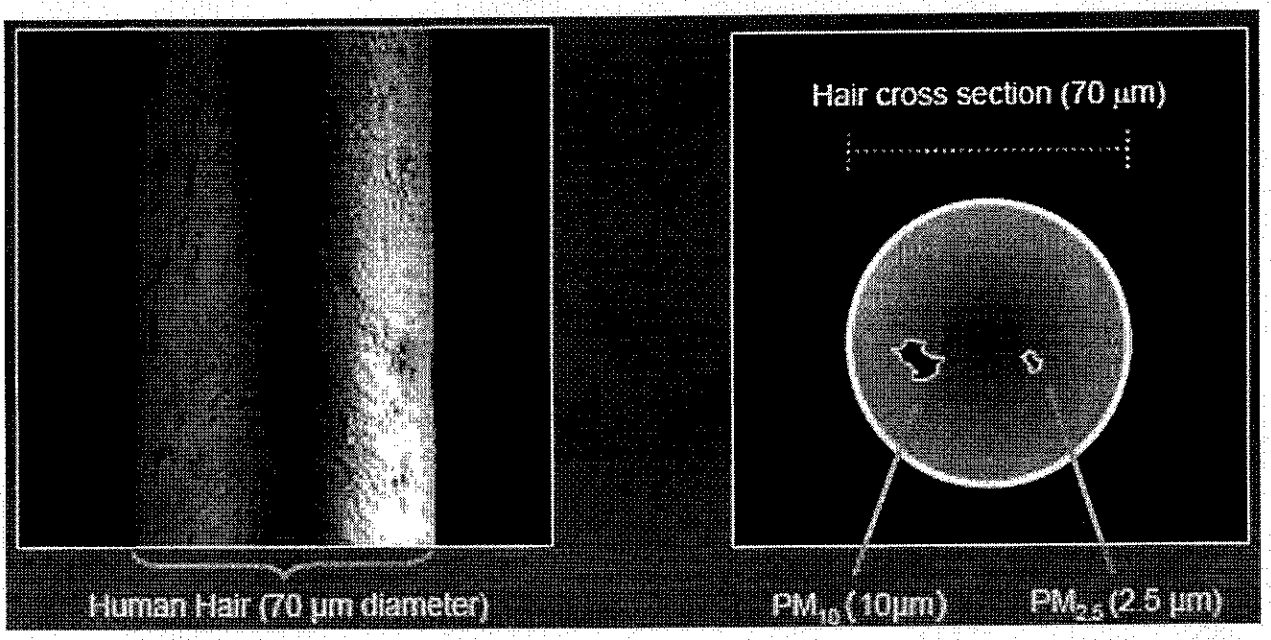
Emissions Inventories at U.S. Ports

Penelope McDaniel
U.S. Environmental Protection Agency
July 12, 2011
Hong Kong

Presentation Outline

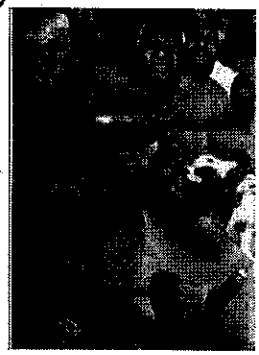
- Introduction
- Impetus: protect human health & the environment
- US EPA air quality regulations overview
  - CAA, mobile sources
- US Port Emission Inventories & Progress

Protecting Human Health & the Environment



Protecting Human Health & the Environment

- Exposure to diesel PM may result in both cancer and non-cancer health effects, including premature death
  - US EPA has classified $PM_{2.5}$ as a likely human carcinogen
  - Non-cancer health effects may include eye and lung irritation, allergic reactions in the lungs, asthma exacerbation, blood toxicity, immune system dysfunction, and developmental disorders.
- NOx adverse health effects in humans: respiratory irritation, immune system suppression, and asthma exacerbation.



Protecting Human Health & the Environment

- Children, elderly and immune compromised individuals are disproportionately affected by diesel emissions
- Children are especially sensitive because their respiratory systems are still developing, and they have a faster breathing rate
- Degrades air quality, impairs visibility and contributes to climate change

Summary of Health Effects

POLLUTANT	HEALTH EFFECTS	EXAMPLES OF SOURCES
Particulate Matter (PM2.5 and PM10: less than or equal to 2.5 or 10 microns, respectively)	• Hospitalizations for worsened heart diseases • Emergency room visits for asthma • Premature death	• Cars and trucks (especially diesels) • Fireplaces, woodstoves • Windblown dust from roadways, agriculture and construction
Ozone (O_3)	• Cough, chest tightness • Difficulty taking a deep breath • Worsened asthma symptoms • Lung inflammation	• Precursor sources*: motor vehicles, industrial emissions, and consumer products
Carbon Monoxide (CO)	• Chest pain in heart patients** • Headaches, nausea** • Reduced mental alertness** • Death at very high levels**	• Any source that burns fuel such as cars, trucks, construction and farming equipment, and residential heaters and stoves
Nitrogen Dioxide (NO_2)	• Increased response to allergens	• See carbon monoxide sources
Toxic Air Contaminants	• Cancer • Chronic eye, lung or skin irritation • Neurological and reproductive disorders	• Cars and trucks (especially diesels) • Industrial sources, such as chrome platers • Neighborhood businesses, such as dry cleaners and service stations • Building materials and products

US Mechanisms to Reduce Air Pollution

- Laws and Regulations
  - Federal (Congress, US EPA); State and Local; International Treaties
- Voluntary
  - Industry
  - Environmental and public health concerns, social responsibility, economic incentives, competition
- Combined regulatory and voluntary
  - Collaboration between regulators and industry

Laws & Regulations – Federal Clean Air Act

The Clean Air Act does not specifically regulate marine ports. However:

- Ambient air quality standards:
  (1) drive Federal, State, and Local regulations, and
  (2) create incentives for both government and industry to reduce emissions
- Mobile source standards apply to some elements of port activities and help reduce emissions

Laws & Regulations – Federal Clean Air Act

Clean Air Act

1) US EPA establishes National Ambient Air Quality Standards (NAAQS)
   - "ambient air quality" includes pollution from all sources

2) US EPA approves State/local programs that meet Clean Air Act requirements – joint enforcement

3) "Stationary sources" regulated differently from "mobile sources"

Laws & Regulations – Federal Clean Air Act

National Ambient Air Quality Standards (NAAQS):
Levels of "acceptable" ambient pollutant concentrations

1) carbon monoxide (CO)
2) sulfur dioxide (SO2)
3) nitrogen dioxide (NO2)
4) ozone (O3)
5) particulate matter (PM10 and PM2.5), and
6) lead (Pb)

- Based on ambient air monitoring data, US EPA designates all areas in the U.S. as "attainment" or "nonattainment"
- Continuous monitoring: designation may change

US EPA's Mobile Source Regulatory Roadmap

Tier 2 Light-Duty
final rule 1999
fully phased in 2009
Diesels held to same stringent standards as gasoline vehicles

Heavy-Duty Highway
sales 900,000 / yr
40B gallons / yr
final rule 2000
fully phased in 2010

Nonroad Diesel
sales over 550,000 / yr
12B gallons / yr
final rule 2004
fully phased in 2015

Ocean Going Vessels
CAA Rule Dec 2009
IMO MARPOL Annex VI
ECA Controls
- Fuel Based 2015
- SCR Catalyst Based 2016

Note: sales and diesel fuel usage vary year-to-year; these figures are for comparison purposes only

Locomotive/Marine
sales 40,000 marine engines, 1,000 locomotives / yr
6B gallons / yr
final rule 2008
fully phased in 2017

Federal & California Non-Road Diesel Fuel Standards

LSD & ULSD Implementation Schedule

Non-road Diesel Fuel Standards

Who	Covered Fuel	2006	2007	2008	2009	2010	2011	2012	2013	2014
Large Refiners & Importers	NON-ROAD	500+ ppm	500 ppm	500 ppm	500 ppm	15 ppm	15 ppm	15 ppm	15 ppm	15 ppm
Large Refiners & Importers	LOCOMOTIVE & MARINE	500+ ppm	500 ppm	500 ppm	500 ppm	500 ppm	500 ppm	15 ppm	15 ppm	15 ppm
Small Refiners & Other Exceptions	NON-ROAD, LOCOMOTIVE & MARINE	500+ ppm	500+ ppm	500+ ppm	500+ ppm	500 ppm	500 ppm	500 ppm	500 ppm	15 ppm

Except in California, compliance dates for Non-Road, Locomotive and Marine fuels in the years indicated are: June 1 for refiners and importers, August 1 downstream from refineries through fuel terminals, October 1 for retail outlets, and December 1 for in-use.

In California, all diesel fuel transitioned to ULSD in 2006. Locomotive and Marine diesel fuels were required to transition to 15 ppm ULSD effective January 1, 2007.

US Port Emissions Inventories

- Used to establish air quality "baseline" for port operations
- May also play roles in measuring emission reduction program success
- Frequency of updates varies, depending on data needs, funding and staffing

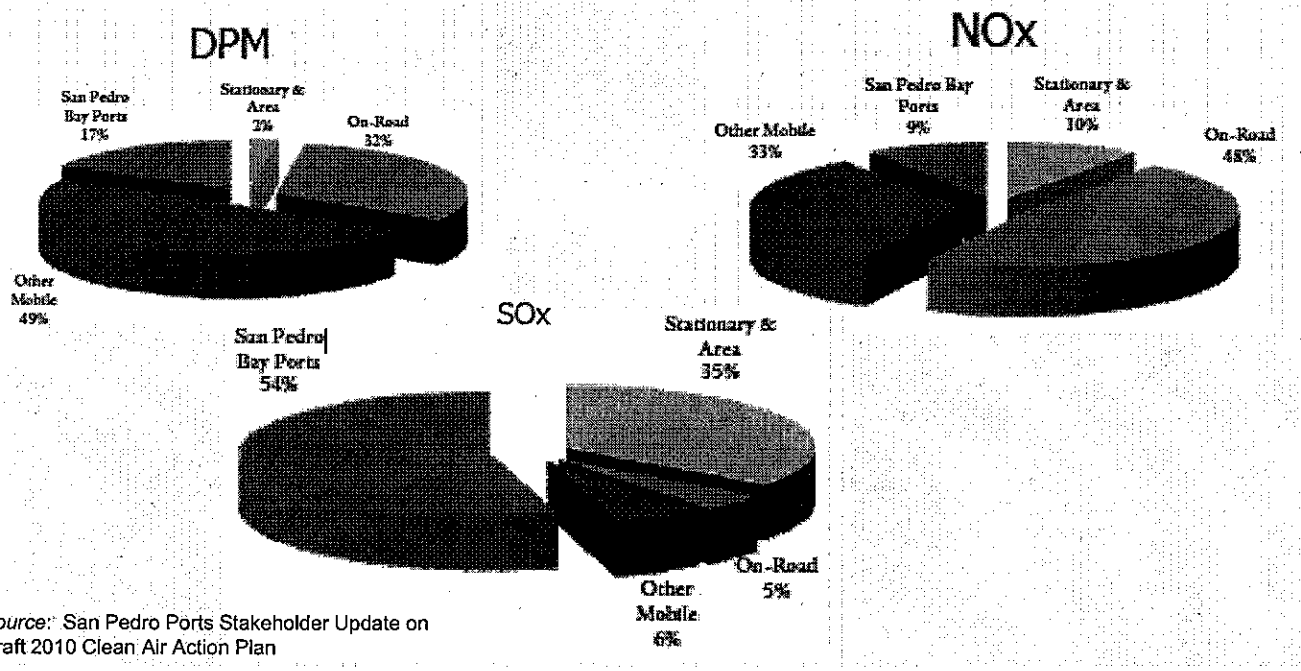
San Pedro Bay Ports Clean Air Action Plan Objectives

1. **San Pedro Bay Specific Objectives**
   - Reduce public health risk from toxic air contaminants associated with port-related mobile sources to acceptable levels.
   - Reduce criteria pollutant emissions to the levels that will assure that port related sources decrease their "fair share" of regional emissions.
   - Prevent port-related violations of the state and federal air quality standards.
2. **Project Specific Objectives**
   - Projects must meet a residential cancer risk threshold.
   - Projects that exceed thresholds for criteria pollutants must implement the maximum available controls and feasible mitigations for any emissions increases.
3. **Source Specific Objectives**
   - A series of performance goals for each of the five sectors.

San Pedro Bay Ports Clean Air Action Plan Emission Reduction Initiatives

- Heavy-duty truck control measures
- OGV control measures
- Cargo handling equipment control measures
- Rail locomotive control measures
- Construction activities BMPs
- Technology Advancement Program
- Zero Emission Container Movement
- Operational efficiency improvement initiatives
- Continual improvement in EI

2008 San Pedro Bay Ports – Contribution to SoCAB Emissions



Source: San Pedro Ports Stakeholder Update on Draft 2010 Clean Air Action Plan

Port of Los Angeles

- Activity based emissions inventory
- 2001 inventory published July 2005
- 2003 inventory published 2007, first of annual updates
- 2006 inventory published 2008, first to include greenhouse gas emissions estimates
- 2008 inventory released December 2009

Port of Los Angeles: Inventory Source Categories

- Ocean-going vessels
- Harbor craft
- Cargo handling equipment
- Railroad locomotives
- Heavy-duty vehicles

Port of Los Angeles: Pollutant Emissions Estimated

- Particulate matter (PM) (10-micron, 2.5-micron)
- Diesel particulate matter (DPM)
- Oxides of nitrogen (NOx)
- Oxides of sulfur (SOx)
- Hydrocarbons (HC)
- Carbon monoxide (CO)

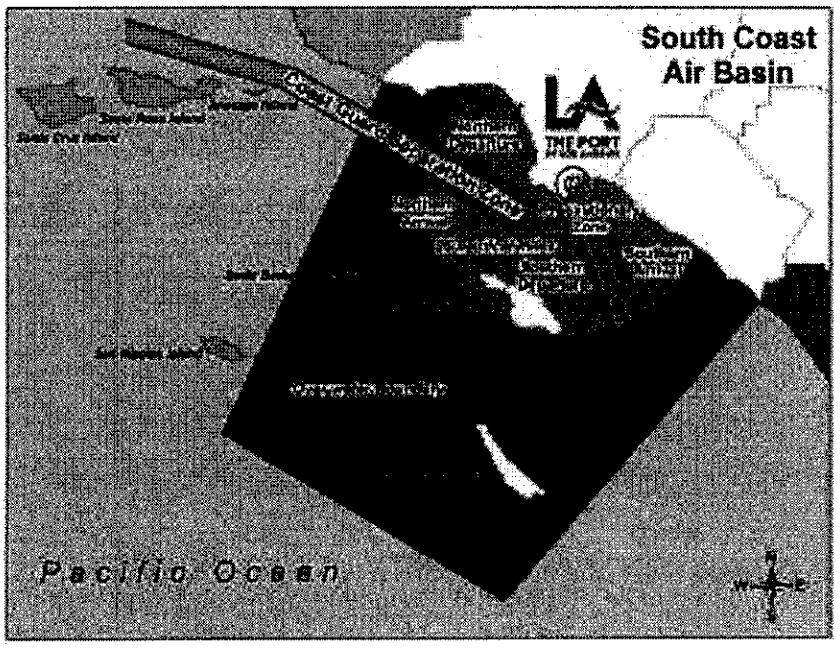
Port of Los Angeles: Greenhouse Gas Emissions Estimated

- Carbon dioxide (CO2)
- Methane (CH4)
- Nitrous oxide (N2O)

Port of Los Angeles: Geographical Extent

- emissions from all source categories within the harbor district;
- emissions from rail locomotives and on-road trucks transporting cargo to or from the Port up to the cargo's first point of rest within the South Coast Air Basin (SoCAB) or up to the basin boundary, whichever comes first; and
- emissions from commercial marine vessels within the harbor and up to the study area boundary.

Figure ES.2: OGV Inventory Geographical Extent



Port of Los Angeles: Emission Inventory Results

Table ES.4: Port-wide Emissions Comparison, tons per year and % Change

EI Year	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	HC
2009	511	436	467	11,244	2,432	2,777	599
2008	805	690	736	15,577	3,822	3,826	811
2007	777	673	682	17,052	3,553	4,036	875
2006	1,140	975	1,040	19,262	6,026	4,658	981
2005	1,062	908	974	16,812	5,552	4,093	870
Previous Year (2009-2008)	-37%	-37%	-37%	-28%	-36%	-27%	-26%
CAAP Progress (2009-2005)	-52%	-52%	-52%	-33%	-56%	-32%	-31%

Port of Long Beach

- Activity based emissions inventory
- 2002 baseline inventory published 2005
- Inventories published for 2005, 2006, 2007, 2008
- 2006 inventory published June 2008, first to include greenhouse gas emissions estimates
- 2009 inventory released June 2010

Port of Long Beach: Inventory Source Categories

- Ocean-going vessels
- Harbor craft
- Cargo handling equipment
- Railroad locomotives
- Heavy-duty vehicles

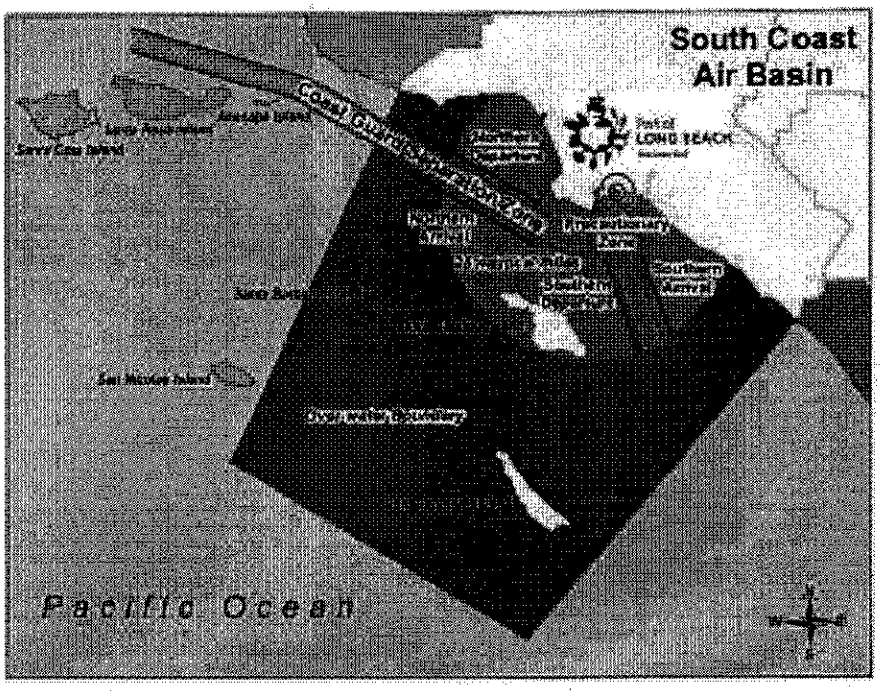
Port of Long Beach: Pollutant Emissions Estimated

- Particulate matter (PM) (10-micron, 2.5-micron)
- Diesel particulate matter (DPM)
- Oxides of nitrogen (NOx)
- Oxides of sulfur (SOx)
- Hydrocarbons (HC)
- Carbon monoxide (CO)
- Carbon dioxide (CO2)
- Methane (CH4)
- Nitrous oxide (N2O)

Port of Long Beach: Geographical Extent

- emissions from all source categories within the harbor district;
- emissions from rail locomotives and on-road trucks transporting cargo to or from the Port up to the cargo's first point of rest within the South Coast Air Basin (SoCAB) or up to the basin boundary, whichever comes first; and
- emissions from commercial marine vessels within the harbor and up to the study area boundary.

Figure ES.2: OGV Inventory Geographical Extent



Port of Long Beach: Emission Inventory Results

Table ES.6: Port-wide Emissions Comparison, tpy and % Change

EI Year	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	HC
2005	1,085	915	977	15,588	6,740	3,215	779
2009	543	453	471	10,129	3,661	1,819	483
Change (tpy)	-542	-462	-507	-5,459	-3,079	-1,396	-295
Change (%)	-50%	-51%	-52%	-35%	-46%	-43%	-38%

Proposed San Pedro Bay Ports Emission Reduction Standards

- By 2014, reduce emissions by:
  - 72% DPM
  - 22% NOx
  - 93% SOx
- By 2023, reduce emissions by:
  - 77% DPM
  - 59% NOx
  - 93% SOx

San Pedro Bay Ports Zero Emission Container Movement Systems (ZECMS)

- Short-term goal
  - determine if ZECMS are feasible for the ports and if so, demonstrate innovative technologies that can be utilized for more efficient and greener movement of cargo
- Long-term goal
  - to be able to handle anticipated cargo throughput growth with pollution-free technologies and strategies

Northwest Ports Clean Air Strategy

- Port of Seattle, Port of Tacoma, Port of Metro Vancouver

Objectives:

- Reduce maritime and port-related air quality impacts on human health, the environment, and the economy
- Reduce contribution to climate change through co-benefits associated with reducing air quality impacts
- Help the airshed continue to meet air quality emissions regulations and goals

Puget Sound
Maritime Emissions Inventory

- Identifies and quantifies pollutants emitted from maritime-related diesel equipment operating within the greater Puget Sound region.
- Baseline inventory covers 2005 emissions
- Update now underway for 2011 emissions

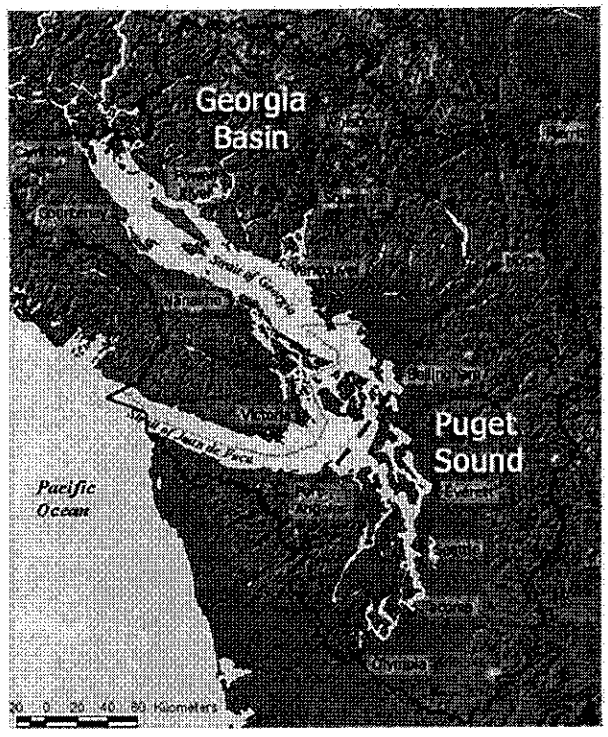
Puget Sound
Maritime Emissions Inventory

- Ocean-going vessels
- Harbor vessels
- Cargo handling equipment
- Rail
- Heavy-duty vehicles
- Fleet vehicles (passenger cars & trucks)

Puget Sound Maritime Emissions Inventory: Emissions Estimated

- Carbon monoxide (CO)
- Oxides of nitrogen (NOx)
- Oxides of sulfur (SO2)
- Volatile organic compounds (VOC)
- Particulate matter (PM)
- Carbon dioxide (CO2)
- Methane (CH4), and
- Nitrous oxide (N2O)
- Diesel particulate matter (DPM)

Figure O.1: Georgia Basin/Puget Sound Airshed

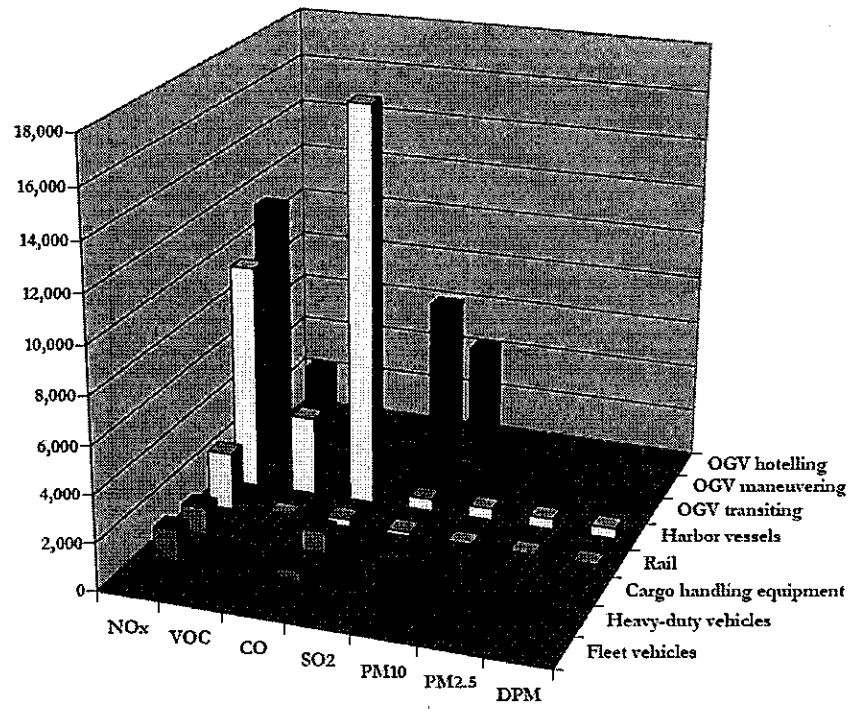


Puget Sound Maritime Emissions Inventory: Results

Table ES.3: Puget Sound 2005 Maritime Air Emissions Inventory Summary, tpy

Source Category	NOx	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	DPM	Greenhouse Gases, CO_2 eq
Ocean-going vessels:								
Hotelling	2,259	74	191	4,229	262	209	131	274,421
Maneuvering	313	24	33	191	22	17	21	12,481
Transiting	11,390	399	932	7,953	709	566	663	496,844
Harbor vessels	9,555	3,363	16,854	529	495	456	445	689,649
Rail, off-terminal	1,285	57	166	96	35	32	32	59,854
Rail, on-terminal	1,180	67	154	93	35	32	35	48,135
Cargo handling equipment	1,155	103	918	80	74	72	74	111,592
Heavy-duty vehicles, off-terminal	1,120	58	307	35	45	39	39	156,242
Heavy-duty vehicles, on-terminal	203	18	148	4	4	4	4	17,845
Fleet vehicles	10	5	50	0	0	0	0	3,365
Total	28,469	4,167	19,752	13,211	1,682	1,427	1,444	1,870,429

Figure ES.2: Puget Sound 2005 Maritime Air Emissions Inventory Summary, tpy



Puget Sound Maritime Clean Air Strategy Result Examples

- OGVs switch to low sulfur fuel while hotelling
- All CHE used at the ports now use ULSD fuels or equivalent
- All Port of Seattle dray trucks, Port Metro Vancouver trucks, 94% of dray truck at Port of Tacoma now comply with 1994 PM emission standards

Port Authority of New York and New Jersey

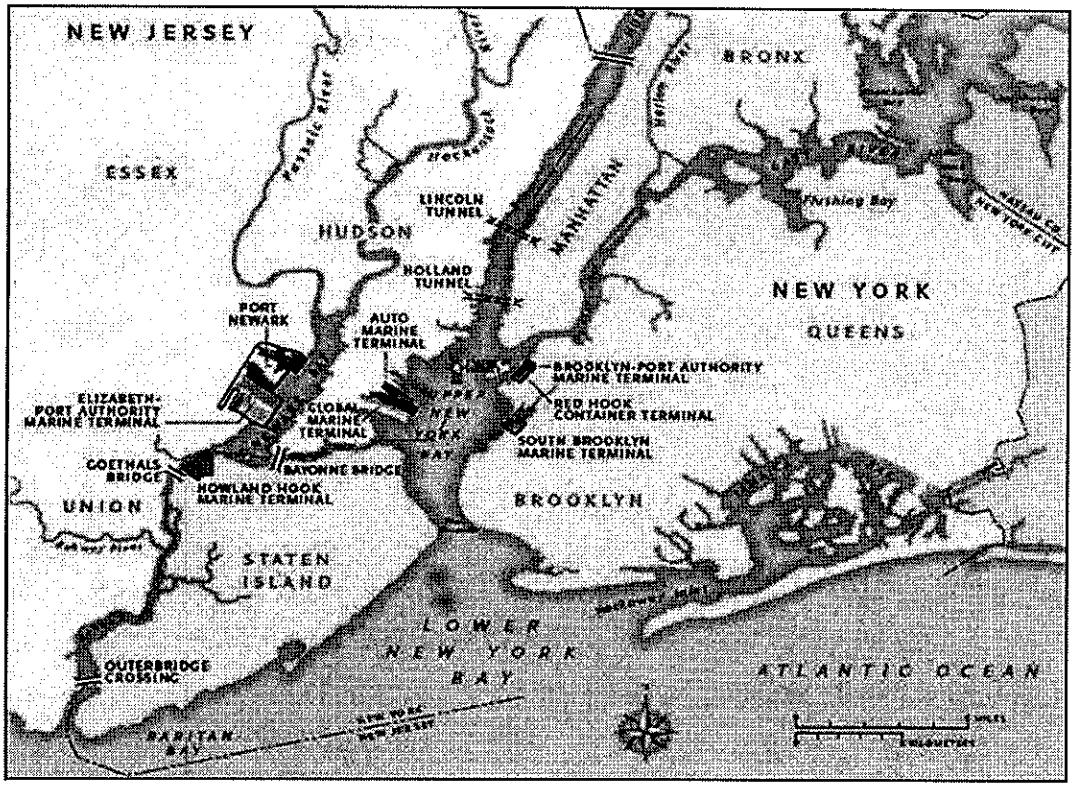
New Jersey:

- Port Newark
- Elizabeth Port Authority Marine Terminal
- Auto Marine Terminal (Bayonne/Jersey City).

New York:

- Howland Hook Marine Terminal (Staten Island)
- Brooklyn Port Authority Marine Terminal

Figure 1: Port Authority of New York and New Jersey Seaport Facilities Map



Clean Air Strategy for the Port of New York & New Jersey

- Reduce maritime-related air quality impacts on human health and the environment from criteria air pollutants, especially those that come from diesel particulate emissions
- Reduce maritime-related contribution to greenhouse gas emissions associated with climate change
- Contribute to the effort to bring the airshed into air quality attainment

Port Authority of New York and New Jersey

- 2006 baseline inventory published November 2008
- Previous partial inventories:
  - ocean-going vessels/harbor craft (2000)
  - on-dock railroad locomotives (2002)
  - heavy-duty diesel vehicles (on-road trucks, 2005)
  - cargo handling equipment (2002 and 2004).

Port Authority of New York and New Jersey: Emissions Estimated

- Oxides of nitrogen (NOx)
- Carbon monoxide (CO)
- Particulate matter less than 10 microns in diameter (PM10)
- Particulate matter less than 2.5 microns in diameter (PM2.5)
- Volatile organic compounds (VOCs)
- Sulfur dioxide (SO2)

- Carbon dioxide (CO2)
- Nitrous oxide (N2O)
- Methane (CH4)

Port Authority of New York and New Jersey: Geographical Extent

17 counties across the states of New Jersey and New York coincident with the New York/Northern New Jersey/Long Island Non-Attainment Area (NYNJLINA)

Contributions of port emissions to total NYNJLINA (2006 baseline)

Table 1: Total Criteria Emission Summary by Source Category, %

NYNJLINA Source Category	NO_x	PM_{10}	$PM_{2.5}$	VOC	CO	SO_2
PANYNJ Maritime Emissions	2%	< 1%	1%	< 1%	< 1%	2%
Stationary and Area Emissions	31%	93%	75%	2%	56%	84%
Other Mobile Emissions	23%	4%	16%	34%	17%	11%
On-Road Mobile Emission	44%	3%	8%	64%	27%	3%
Total NYNJLINA Emissions, tons per year	445,285	178,451	42,441	522,245	2,840,374	170,044

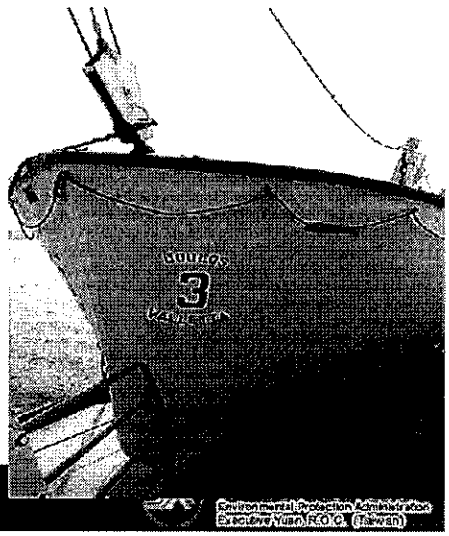
Port Authority of New York and New Jersey: Inventory Results

Table ES.1: Criteria Pollutant Emission Summary by Source Category, tpy - 2006

Source Category	NO_x	PM_{10}	$PM_{2.5}$	VOC	CO	SO_2
Cargo Handling Equipment	1,402	93	86	124	465	219
Heavy-Duty Diesel Vehicles	1,935	59	54	87	564	26
Railroad Locomotives	286	10	9	20	44	32
Ocean-Going Vessels	3,691	348	279	165	319	3,270
Harbor Craft	486	26	24	18	41	50
Total PANYNJ Emissions	**7,800**	**537**	**452**	**413**	**1,434**	**3,597**
NYNJLINA Emissions	**445,285**	**178,451**	**42,441**	**522,245**	**2,840,374**	**170,044**
PANYNJ Percentage	**1.8%**	**0.3%**	**1.1%**	**0.1%**	**0.05%**	**2.1%**

港區空氣污染物管制策略及執行經驗

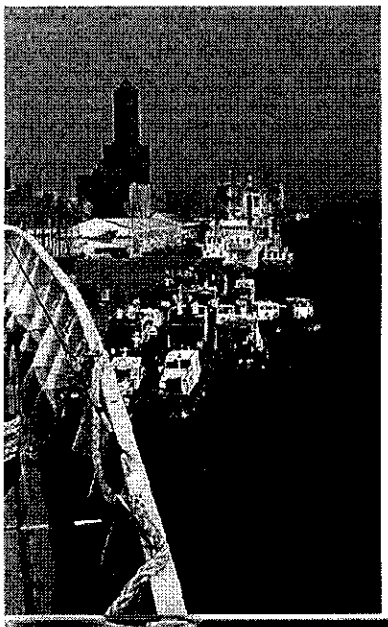
報告人：陳惠琪視察
行政院環境保護署
空氣品質保護及噪音管制處



2011 年7月12日

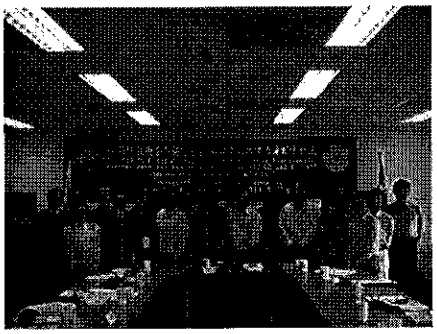
簡報內容

1. 簡 介
2. 計畫內容說明
3. 主要成果
4. 未來計畫
5. 結語



壹、簡介

- 「減少美國西北岸與台灣靠港海洋船舶空氣污染與溫室氣體排放」為台美環保技術合作協定第8號執行辦法(2008-2010年)之第6項工作。
- 2008.11.18～20日在高雄港、台北港及基隆港舉辦第1次港口清淨空氣品質夥伴會議
  - 第一次以改善港空氣品質為合作議題：雙方就我國與美國西北地區國際商港為達成空氣品質目標共同合作，為尋求未來合作的領域。
  - 簽署大會夥伴宣言



壹、簡介

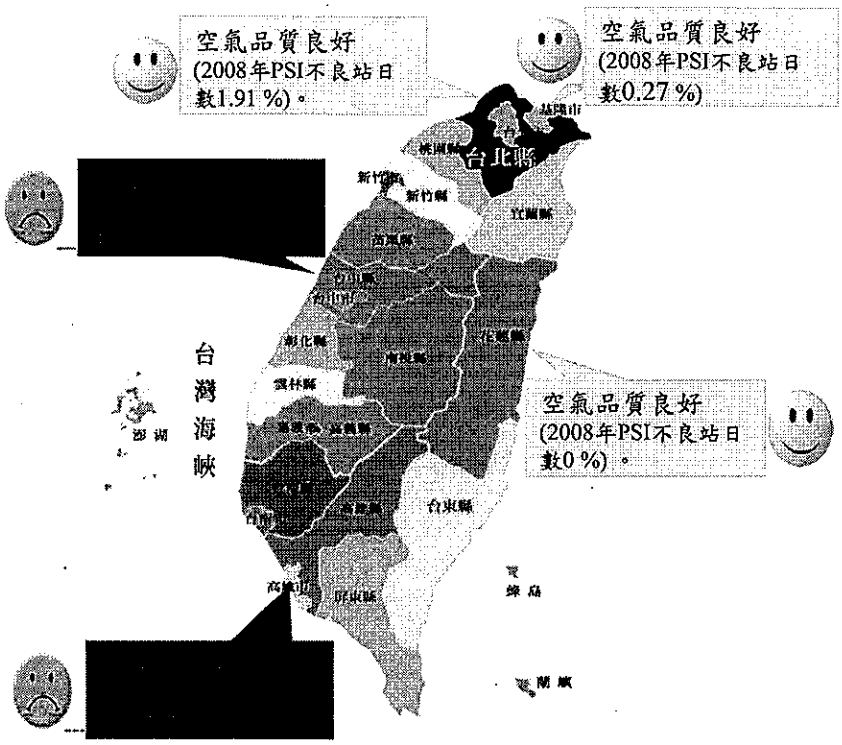
- 本次會議討論未來可逐步合作項目包括：
  - 發展港口或貨物處置柴油設備空氣污染物之排放清冊
  - 發展遵守防止船舶污染國際公約（MARPOL）附錄六修正案規定的國內法令
  - 港區空氣污染排放管制工作
- 2009.03.03 台中港舉辦第2次中美港口空氣品質清淨夥伴圓桌會議，本署提出「港區空氣污染物排放清冊建置及管制策略研擬」專案計畫構想。
- 2009.07.03開始執行「港區空氣污染物排放清冊建置及管制策略研擬」專案計畫
- 2009.11.09邀請美國環保署及專家參與研討會
  - 介紹美國環保署在發展港口空氣污染物排放量減量管制對策的經驗及遭遇之困難，相關管制方法包括了法規管制及自主性管制方案。
  - 與臺灣環保署、專家及各港務局相關人員展開座談，協助建立港區排放量推估方法之建立及管制對策之研擬。

貳、計畫內容說明

以綠色港口為最終目標

- 參考國家總量管制策略
- 參考港區所在縣市的空氣品質管理計畫
- 現階段港區及船商配合意願
- 實際控制技術可達性

港區潔淨空氣行動計畫



資料來源：空氣品質監測報告2008年年報，行政院環境保護署

貳、計畫內容說明

減量優先順序

近程目標

- ●遠洋船舶
- -切換低硫燃油
- -減速計畫
- ●港勤船舶
- -採用低硫燃油

中程目標

- ●遠洋船舶
- -切換低硫燃油
- -減速計畫
- ●港勤船舶&貨物裝卸設備
- -切換低硫燃油
- ●逸散性污染源
- -興建密閉式裝卸、倉儲系統

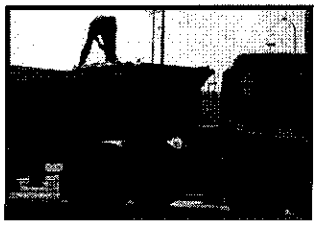
長程目標

- ●遠洋船舶
- -切換低硫燃油
- -減速計畫
- -簽署國際公約
- -使用岸電系統
- ●港勤船舶&貨物裝卸設備
- -切換低硫燃油
- ●卡車
- -管制排煙驗證及自主管理
- ●逸散性污染源
- -興建密閉式裝卸、倉儲系統

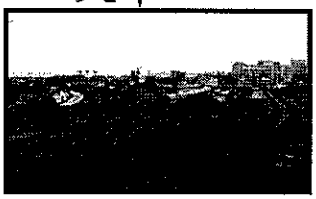
貳、計畫內容說明

污染源	減量管制項目	所使用的因應策略
遠洋船舶	船舶減速	自願性減量協議/誘因機制/國際合作機制
	切換燃油	行政管制/自願性減量協議/國際合作機制
	登船抽檢	行政管制
	推行船舶減量技術	輔導減量技術
	停泊港口採用岸電系統	自願性減量協議/誘因機制
港勤船舶		
	採用低硫燃料	租約協商
	加強油品抽檢	行政管制

貳、計畫內容說明

污染源	減量管制項目	所使用的因應策略
貨物裝卸設備		
	加強油品抽驗	行政管制
	改裝電力化引擎/潔淨引擎	誘因機制
卡車	加強油品及排煙抽檢	行政管制
	宣導反怠速活動	行政管制
	辨識系統管制排煙及自主管理	行政管制
	提高柴油車自主管理比例	誘因機制
	柴油車排煙認證及自主管理納入港區通行政核發要素之一	行政管制

貳、計畫內容說明

污染源	減量管制項目	所使用的因應策略	
火車			
	加強排煙抽檢	行政管制	
逸散性污染源	加嚴查緝堆置及碼頭作業揚塵	行政管制	固定污染源逸散性粒狀污染物空氣污染防制設施管理辦法
	港區道路定期清洗及排水	行政管制	
	車輛覆蓋防塵網並加嚴查緝	行政管制	
	物料裝卸區設置移動式防塵網及加強灑水	行政管制	
	查緝堆置場防塵網覆蓋及灑水情形	誘因機制/租約協商	
	鼓勵投資及興建密閉式倉儲及裝卸設備	行政管制	
	堆置場租約納入環保規範	行政管制	

參、主要成果

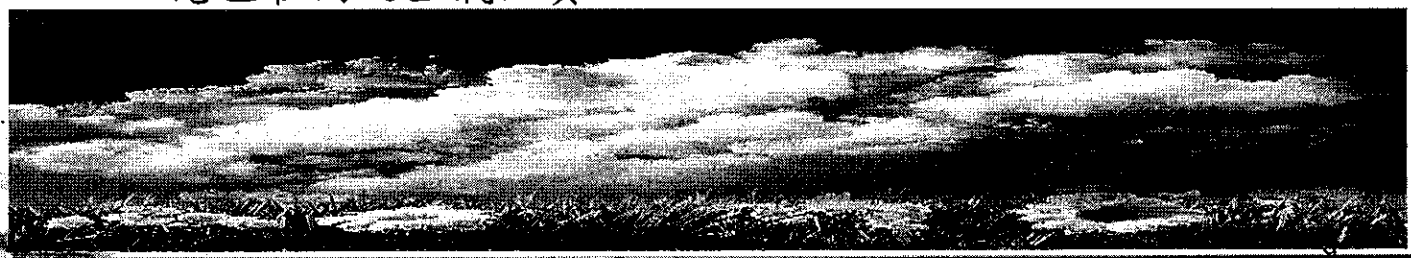
■相關法規及管制規範

■船舶、裝卸設備及車輛管制

國內法令
- 空氣污染防制法
- 商港法
- 船舶法

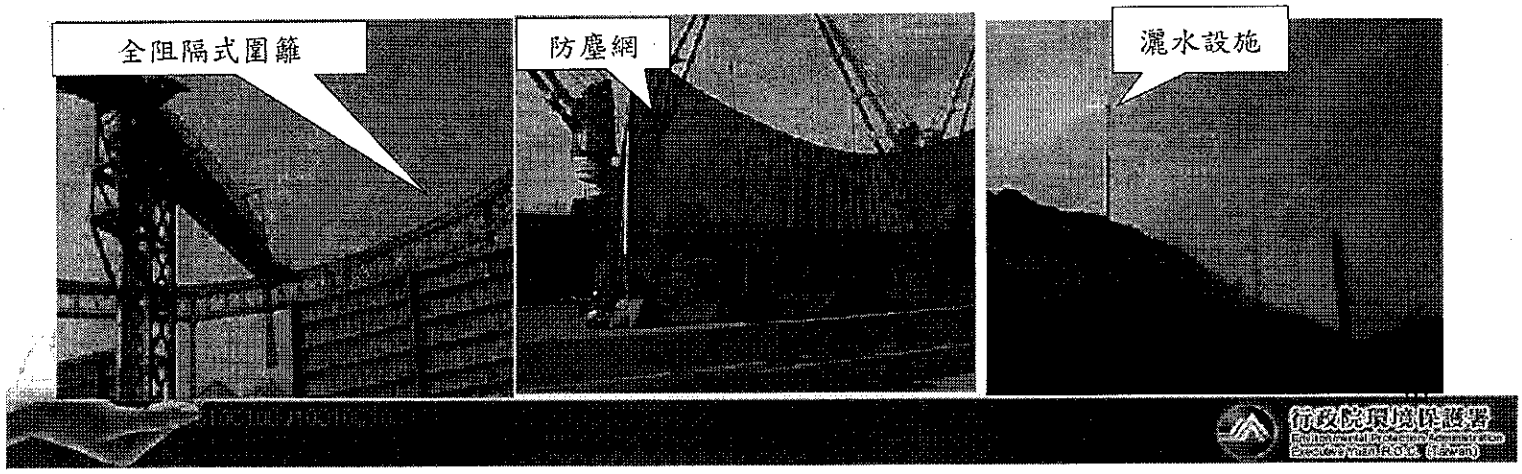
國際公約 －MARPOL 73/78 Annex VI

■逸散性粒狀物管制：2009.1.8頒佈執行「固定污染源逸散性粒狀污染物空氣污染防制設施管理辦法」，規範各項製程及作業應採行之空氣污染防制設施，以改善包含港區在內之空氣品質。



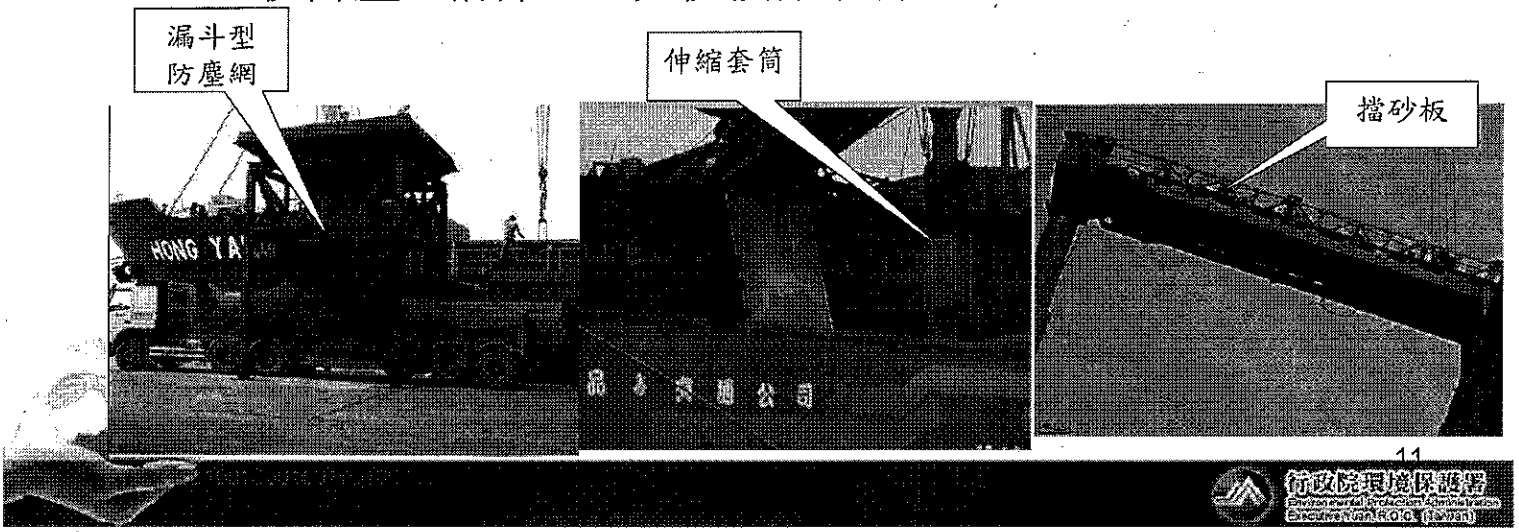
參、主要成果

- 物料堆置
  - 堆置場區設置阻隔牆或防塵網，阻隔自然風，降低風力吹蝕產生之揚塵污染
  - 堆置場設置自動灑水設施，增加堆置物料之含水率，降低風力吹蝕產生之揚塵污染



參、主要成果

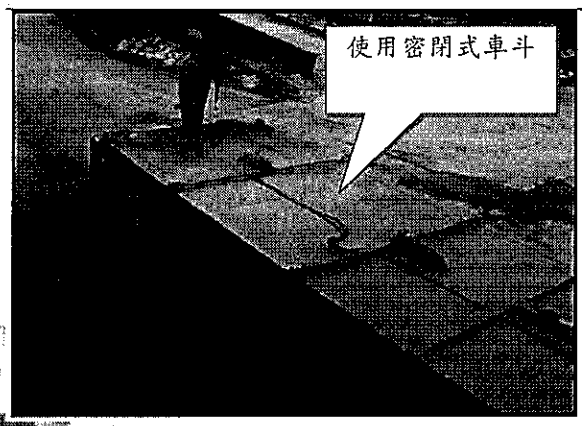
- 物料裝卸
  - 裝置漏斗型裝卸平台、伸縮套筒等設施，降低砂石掉落高度，減緩粒狀污染物揚起
  - 裝卸區以防塵網布包覆，將裝卸作業引起之揚塵阻隔於作業區內，利用重力自然沈降安定，作業完畢後，需將地面沈降塵土清掃，避免後續作業引起二次污染

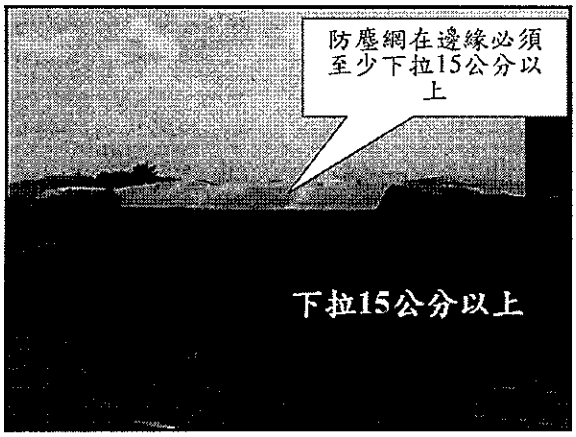


參、主要成果

■物料運輸

- ■為預防逸散性粒狀物在運輸過程中洩漏，卡車需緊密覆蓋，或使用密閉式車斗；覆蓋網／布必須確實紮綁，邊緣並需下拉至少15公分。





肆、未來計畫

- 依據「固定污染源逸散性粒狀污染物空氣污染防制設施管理辦法」，環保署已發包一評鑑計畫以評估各港的排放情況及改善情形。
- 依據交通部最新修訂之「船舶法」，已明訂各船必須裝置適當之空氣污染防制設備以符合MARPOL公約附則6之要求，並備妥相關文件；港務局可於必要時登船檢查。

伍、結語

- 感謝美國環保署長期對台美環保技術合作案的支持，以及提供豐富的港區排放推估及管制相關經驗供我國參考。
- 藉由執行「港區空氣污染物排放清冊建置及管制策略研擬」計畫，可建立港區完整的空氣污染物排放清冊，並研擬具體可行管制策略。
- 未來將持續與各港務管理機關與業者合作研擬相關管制措施，除採取法規管制外，並參考各國作法推動合作關係，與當地居民發展自願方案，以達到降低港區附近民眾陳情次數及維護港區空氣品質之目的。

簡報完畢
敬請指教

上海港港口船舶污染物排放现状调查及对策研究

Investigation and Countermeasures of the Emissions Status in Shanghai Port

SEMC Fudan University SAES SPAC
SHMSA SHMMSA

July 12, 2011

上海市环境监测中心
Shanghai Environmental Monitoring Center

主要内容
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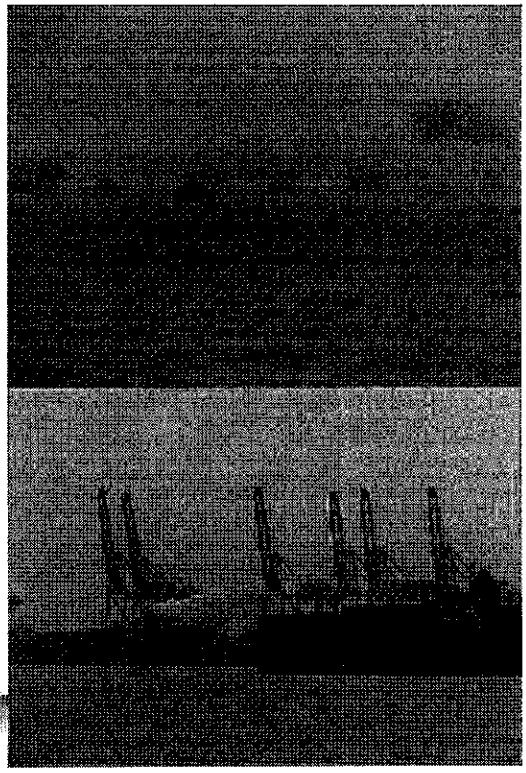
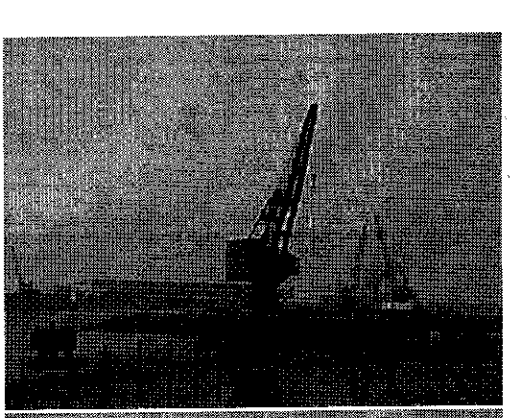
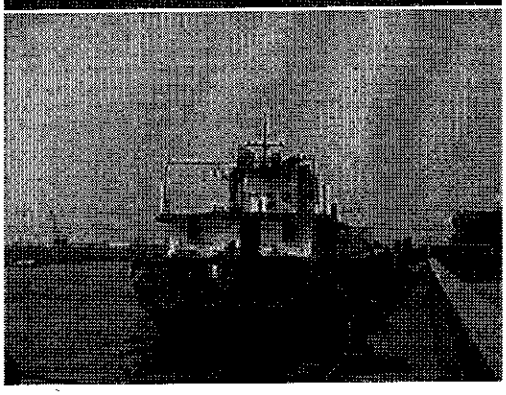


http://www.semc.gov.cn





1. 研究背景
Background

1.1 上海港航运概况
Goods Movement of Shanghai Port

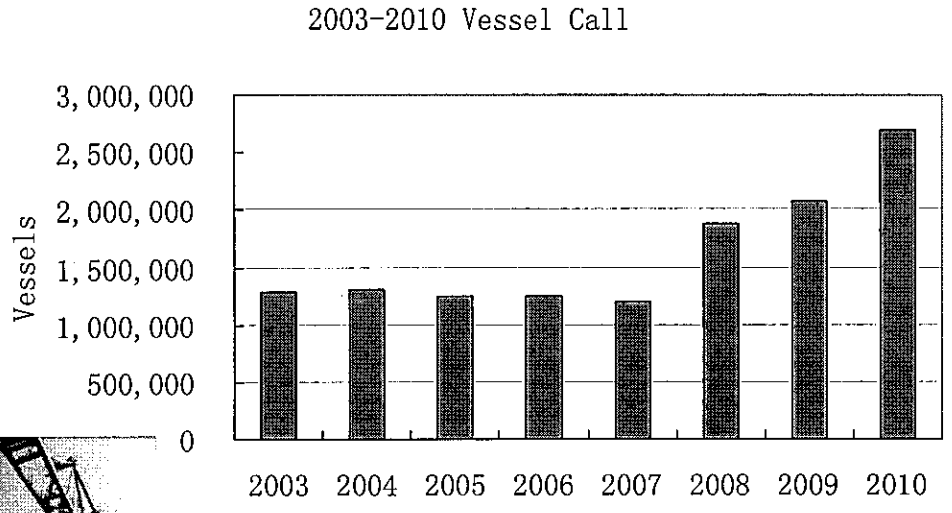
- 上海港2010年完成集装箱吞吐量2906.9万个标准箱，同比增长16%，首次超越新加坡，跃居世界第一。全国31个省市都有货物经过上海港装卸或换装转口。
- **In 2010, the container cargo's throughput of Shanghai port ranked 1st in the world, the total throughput at the Port of Shanghai was 2.9 millions TEUs , 16% more than 2009. Goods from all 31 provinces of China（Include Taiwan） were handled or reloaded in Shanghai Port.**

上海市环境监测中心
Shanghai Environmental Monitoring Center
http://www.semc.gov.cn

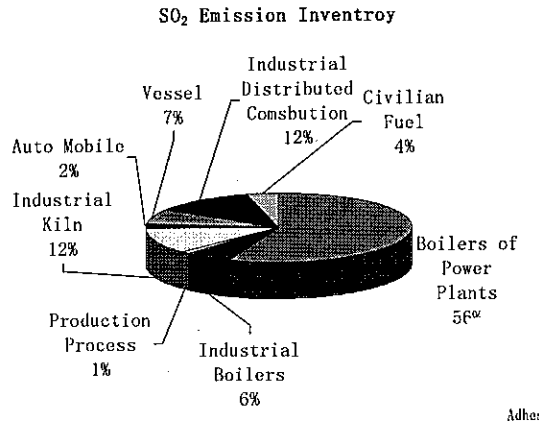
1.2 2010年上海港航运情况
The Shipping Movements of 2010

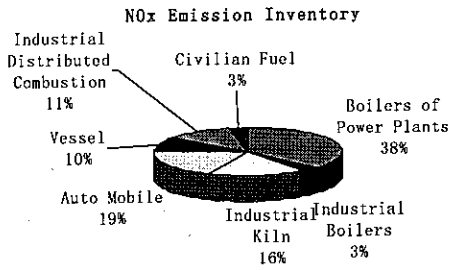
- 2010年，进出上海港船舶艘次为270万艘次，其中主要进出外港船舶艘次为170万艘次，进出内河船舶艘次为100万艘次，分别占上海港进出船舶数量的62.8%和37.2%。
- **In 2010, there were 2.7 millions vessels called at the Port of Shanghai, 1.7 millions vessels were outport vessels, the proportion was 62.8%, and 1 million vessels were internal river vessels, the proportion is 37.2%.**

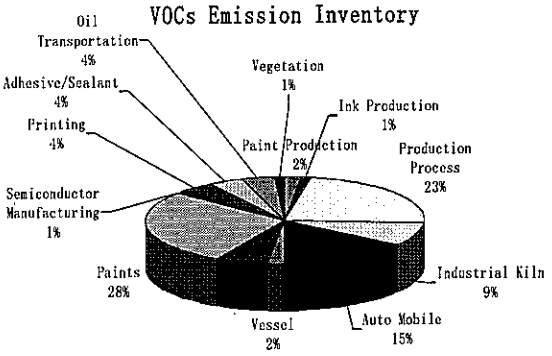
1.3 2003-2010年上海港船舶流量增长趋势
Vessel Call Increase During 2003 to 2010



1.4 2006年上海排放分担率
Emission Inventory of 2006







1.5 国内相关法律法规
Relevant Laws and Regulations

- 《中华人民共和国大气污染防治法》
- 《中华人民共和国海洋环境保护法》
- 《防治船舶污染海洋环境管理条例》
- 《中华人民共和国船舶及其有关作业活动污染海洋环境防治管理规定》
- 《中华人民共和国海上海事行政处罚规定》
- 地方上有《上海市实施〈中华人民共和国大气污染防治法〉办法》。

➢ 从现有法律、法规规定来看，有关船舶废气排放控制的规定散布在不同的法律、法规之中，而且较为原则性，缺乏专门的、系统的管理规定，无法满足船舶废气排放控制管理需求。

➢ **Lack of systemic management**

➢ **Lack of emission standards**

➢ **Can not meet the requirement of emission control**

1.6 课题研究目标
Target of the Study

- 上海港进出船舶的污染物排放总量及空间分布

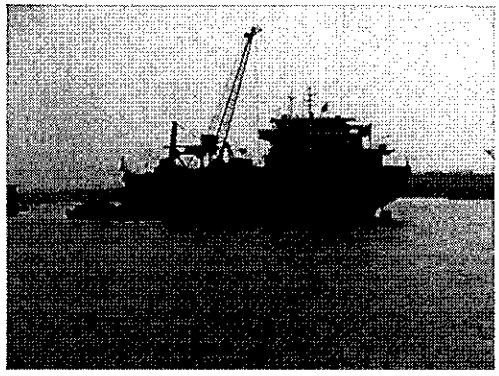
  Estimate the ship emission and its spatial distribution in Shanghai Port

- 上海港区的污染物排放量及空间分布

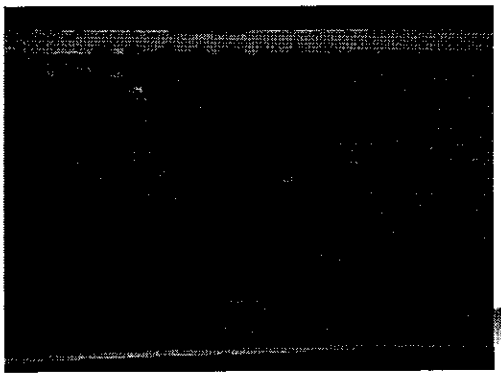
  Estimate the emission from port activities and its spatial distribution in Shanghai Port

- 上海港口船舶的大气污染物排放控制对策

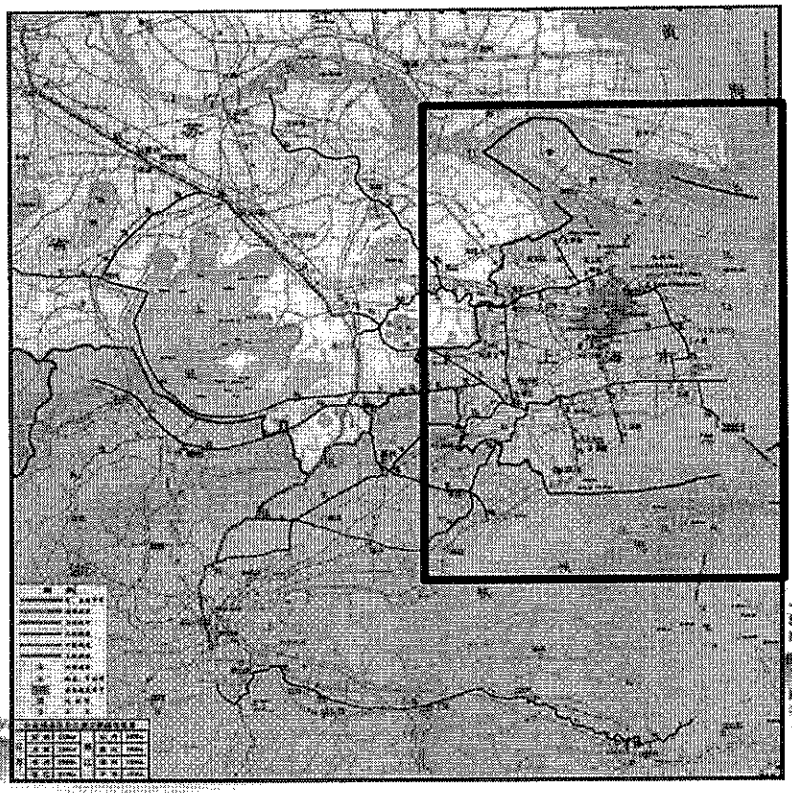
  Propose the control countermeasure of the emission from ship and port activities



2. 上海港口航道概况
Overview of Shanghai Port



2.1 上海港地理位置
The Location of Shanghai Port



2.2 上海港行政区划
Administrative Division of Shanghai Port

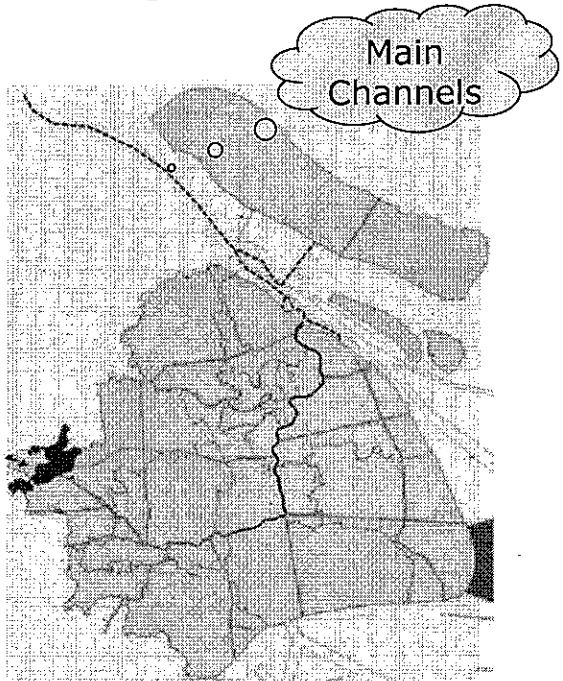
·上海港港区分为外港和内河两个区域；

·外港指沿东海、长江、以及黄浦江中下游海事管理段，由上海海事局管理；

·内河主要指各个行政区（海事处）所管辖的各级河道，由上海地方海事局管理。

·There are 2 administrative division in Shanghai port, outport and internal river. The outport is defined as the area within the jurisdiction of Shanghai MSA, include the East China Sea in Shanghai Municipality, the Yangtze River in Shanghai Municipality and the middle and lower reaches of Huangpu River.

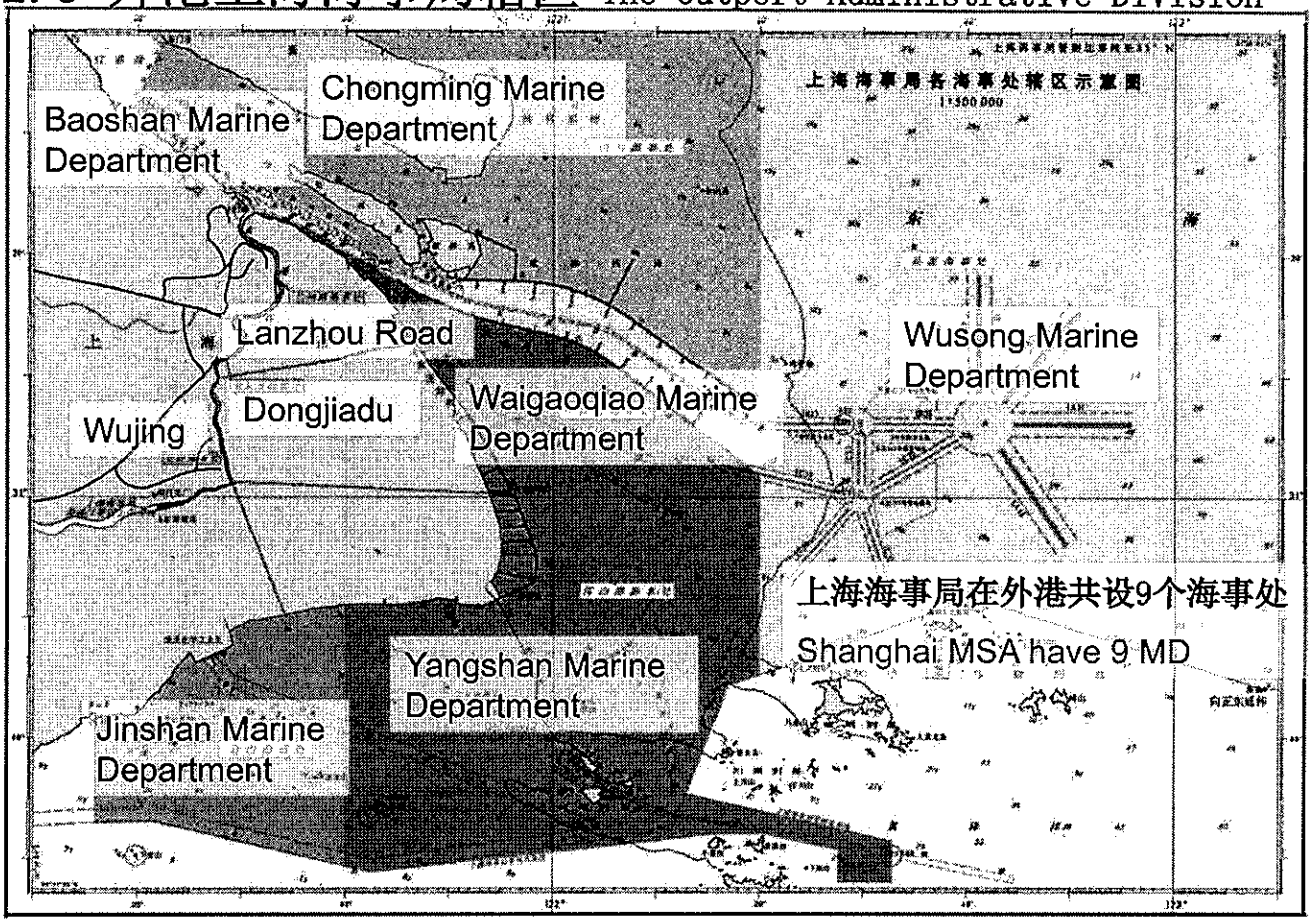
The internal river is defined as the watercourse within the jurisdiction of Shanghai Municipal MSA.



图中：红线代表外港船舶航线；绿线代表内河船舶航线

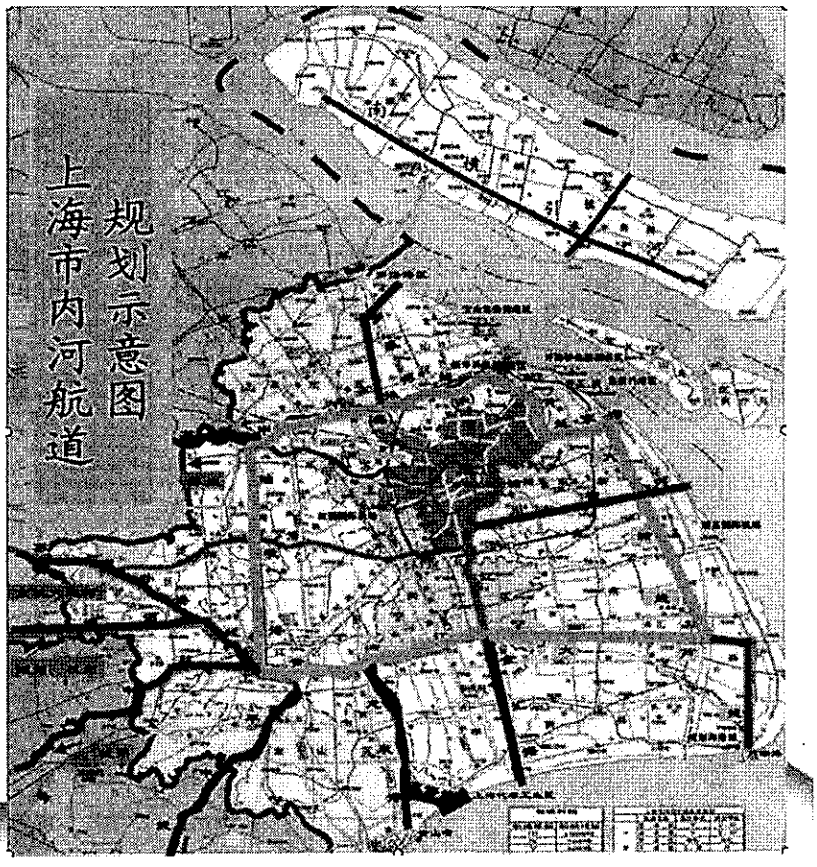
Red lines means the channel; the blue lines means the channel

2.3 外港上海海事局辖区 The Outport Administrative Division



2.4 内河上海地方海事局辖区 The Internal River Area

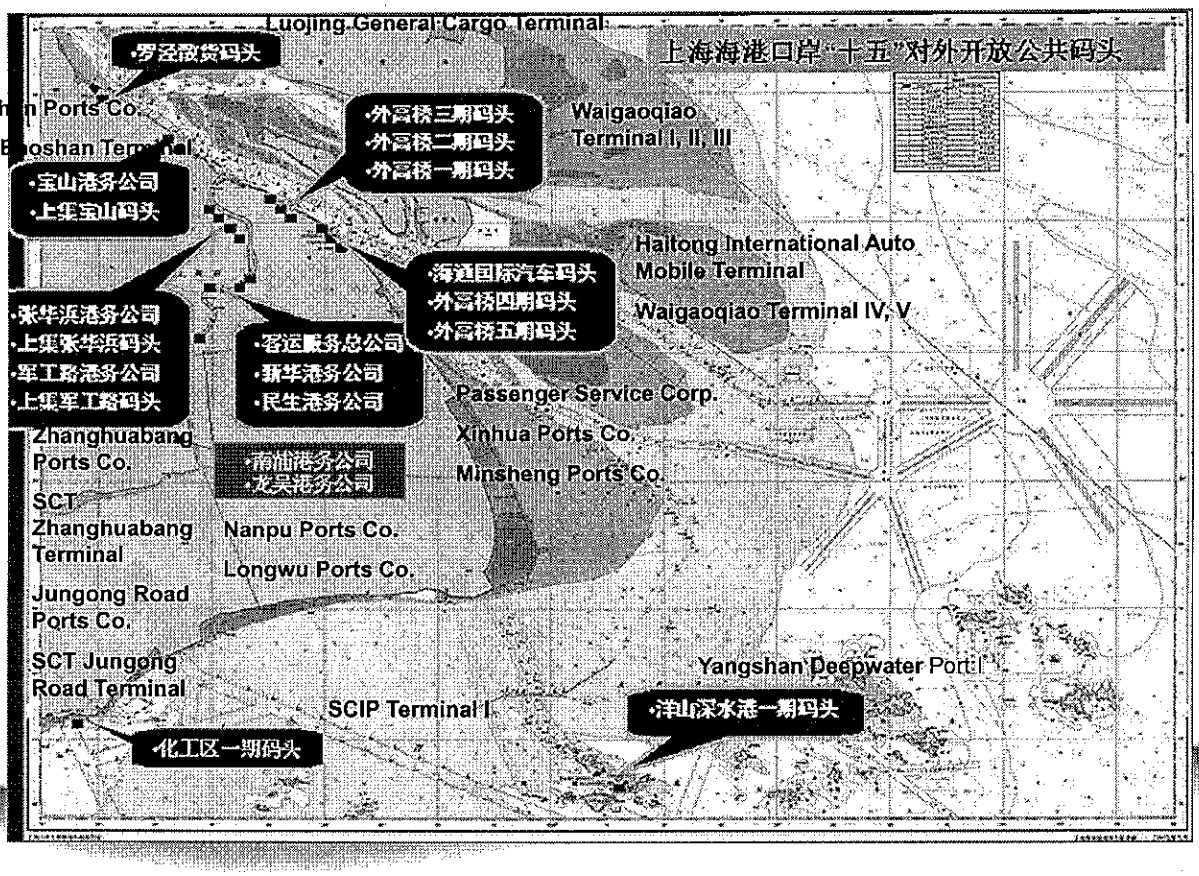
一环	十射
One Ring	Ten Channel
蕴藻浜	赵家沟
油墩港	大浦线
黄浦江	大芦线
苏申内港线	龙泉港
苏申外港线	金汇港
太浦河	大芦线
杭申线	川杨河
平申线	罗蕴河



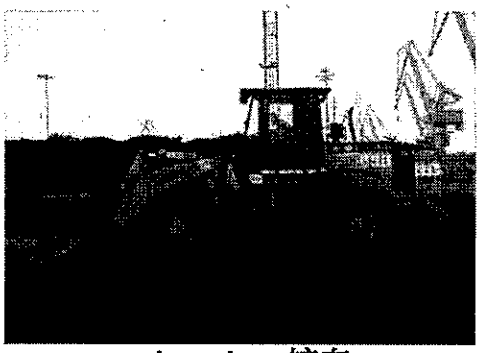
2.6 上海港港区概况
Shanghai Port Overview

- 至2009年底，上海港拥有各类海港码头泊位约1100个，各类内河码头泊位约1300个，其中海港集装箱专用泊位40个。
- Up to the end of 2009, there were 1100 outport berths and 1300 internal river berths in the Port of Shanghai, which have 40 container terminals.
- 至2009年底，海港码头单位共260家， 其中国际港务集团（公用码头）下属单位25家， 其它码头单位（专用码头）235家。
- Up to the end of 2009, there are 260 port unit in Shanghai port， and 25 of them are managed by SIPG.
- 码头非道路机械分类：散货、集装箱、件杂货、客运。
- Cargo handling equipmengt includes: bulk cargo, container cargo, general cargo, passenger transportation.

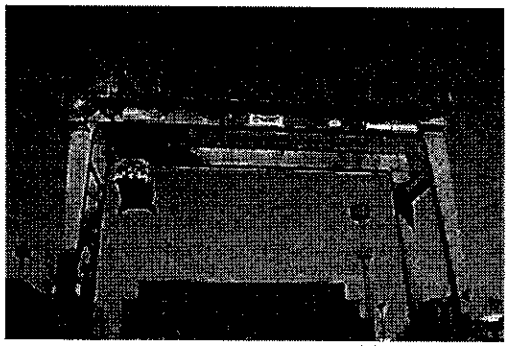
2.7 外港码头分布情况图 Outport Terminals



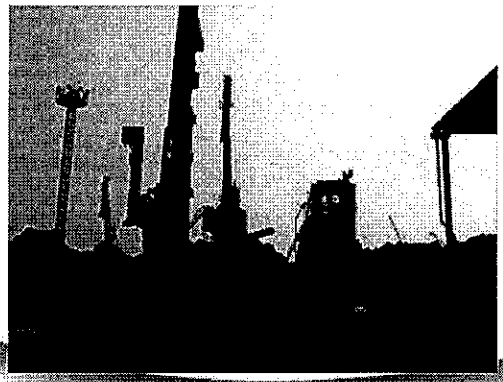
2.9 典型港作机械
Typical Cargo Handling Equipment



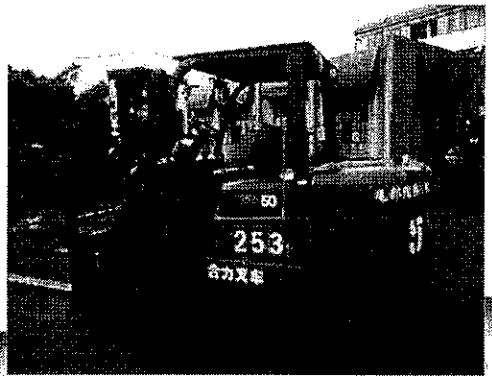
Loader 铲车



Container Crane 轮胎吊



Container Stacker 堆高机

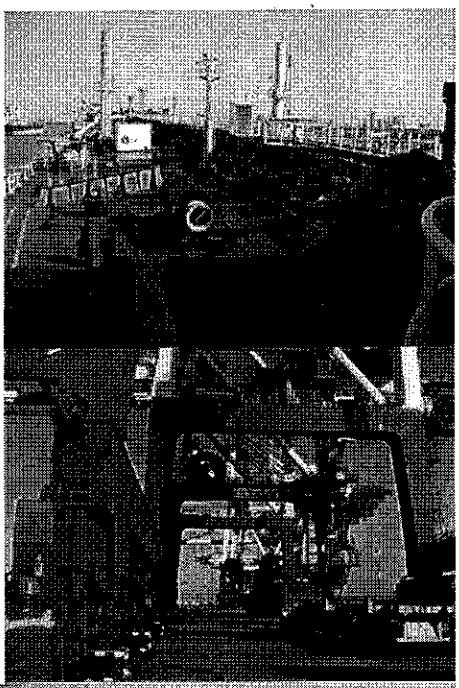


Forklift 叉车

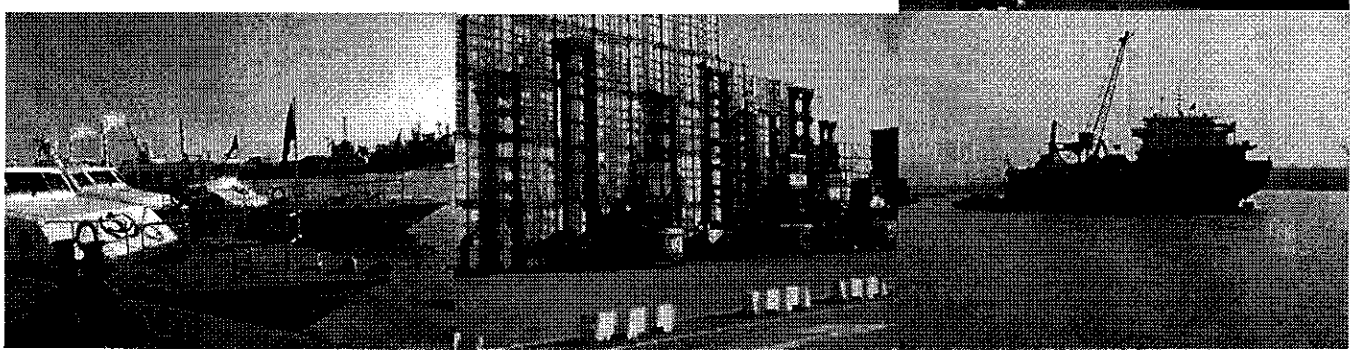
2.10 上海港船舶分类
Ship Categories

- 上海港船舶分为外港船舶和内河船舶
  - 外港船舶分为三类：上海港国际航行船舶、各海事处辖区码头内河船舶、上海港沿海海船。
- **The main vessel type of Shanghai port is internal river vessel and maritime shipping vessel. The maritime shipping vessel is divided into 3 categories: ocean-going vessel, internal river vessel and coast vessel.**

区域 Area	船舶类型 Vessel Type	船舶种类 Vessel Characteristic
外港 Outport	远洋船 Ocean-Going Vessel	集装箱船Container Vessel，干杂货船Dry Bulk Carrier，散货船Bulk Cargo Carrier、化学品船Chemical Carrier/Tanker、油轮Oil Tanker、多用途船Multiple-Function Vessel、客滚船Ro-Ro Cargo Vessel、拖轮Tug、冷藏船Reefers、液化气船LPG Carrier、其他Others
	各海事处辖区码头内河船舶 Internal River Vessel (within the jurisdiction of Shanghai MSA)	杂货船Dry Bulk Cargo Carrier、车客渡Ferry、驳船Barge、高速客船Speed Passenger、油船Oil Tanker、客船Passenger、集装箱船Container Vessel、拖船Tug、挂桨机船、散货船Bulk Cargo Carrier、其他Others
	上海港沿海海船 Coast Vessel	杂货船Dry Bulk Cargo Carrier、高速客船Speed Passenger、油轮Oil Tanker、散货船Bulk Cargo Carrier、集装箱船Container Vessel、拖轮Tug、多用途船Multiple-Function Vessel，工程船Engineering Vessel、客滚船Ro-Ro Cargo、其他Others
内河 Internal river	内河船舶 Internal River Vessel	杂货船Dry Bulk Cargo Carrier、驳船Barge、拖船Tug、液货船Liquid Carrier、其他Others



3. 课题研究内容
Contents of the Study



3.1 总体研究内容
General Content

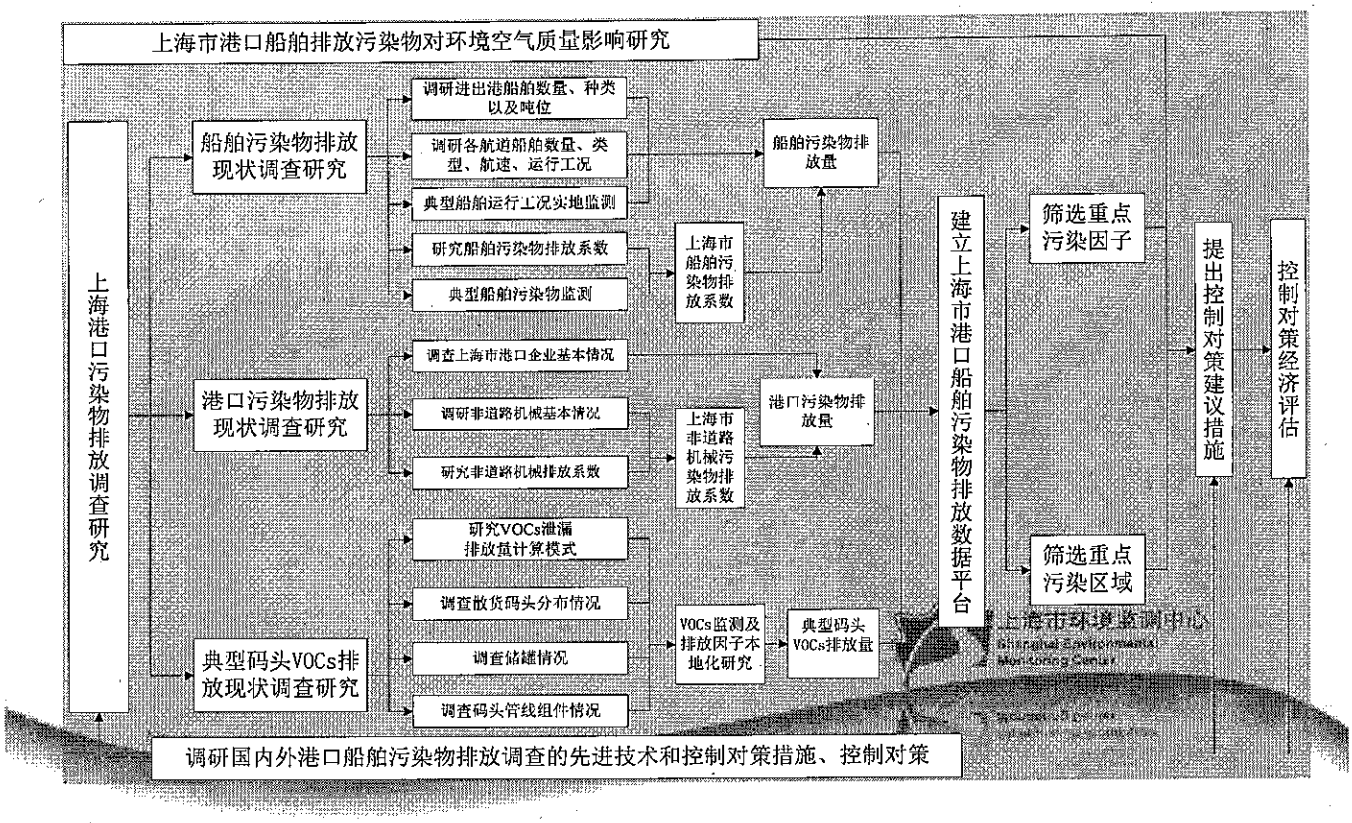
- 开展上海市港口船舶污染物排放现状调查
- 依据调查成果，提出对策建议措施
- 控制对策经济评估。
- **The content of the study is to survey the emission status from shipping and port activities。After then, the suggestions， and the economic evaluation of the emission controling countermeasures can be given.**

3.1 总体研究内容
General Content

- 数据基础年　Data base:2010
- 研究区域　Scope:
  - 上海行政边界参考港区边界（含洋山深水港）Shanghai Municipality+Shanghai MSA jurisdiction(include Yangshan Port)
- 港口船舶主要污染物　Pollutant:
  - NOx、SO_2、PM、VOC、 CO，兼顾CO_2等温室气体（GHG）。

上海市环境监测中心
Shanghai Environmental Monitoring Center
http://www.semc.gov.cn

3.2 课题技术路线
Summary of Methodology



3.3 本研究分为四个子课题
The Study is Divided into 4 Sub-projects

- **子课题1：上海港港口船舶污染物现状调查**

  Sub-project 1: The Investigation of the Emission Status in Shanghai Port

- **子课题2:上海市典型码头VOCs排放现状调查研究**

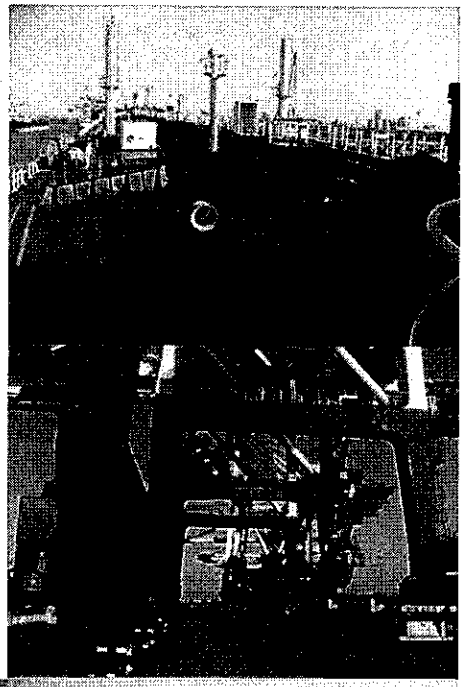
  Sub-project 2: VOCs Emissions from Typical Terminals In Shanghai

- **子课题3:上海市港口船舶排放污染物对环境空气质量的影响及其控制对策建议措施研究**

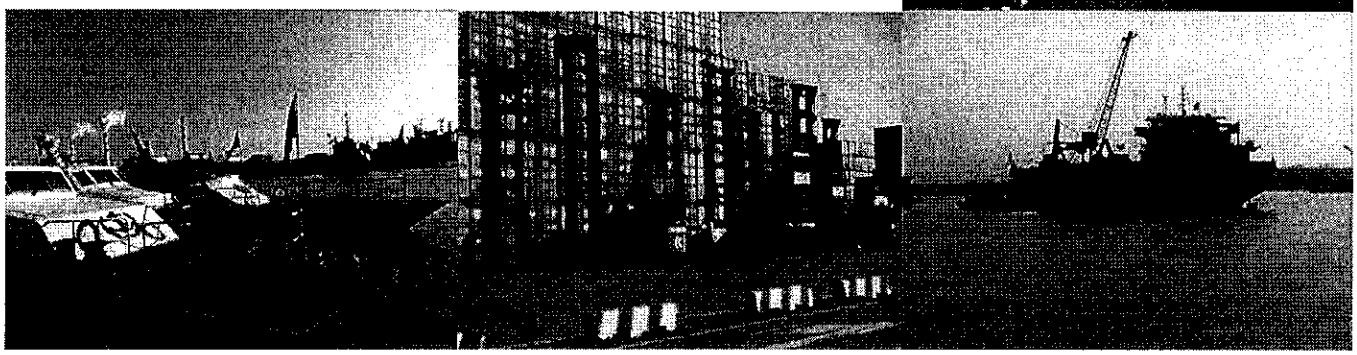
  Sub-project 3: The control, strategies, suggestions and practical analyses for the impact of the emissions from ships and port activities on the air quality in Shanghai Port

- **子课题4：上海市港口船舶排放污染物控制对策经济评估研究**

  Sub-project 4:The economic evaluation for the ship emission controlling countermeasures in Shanghai Port

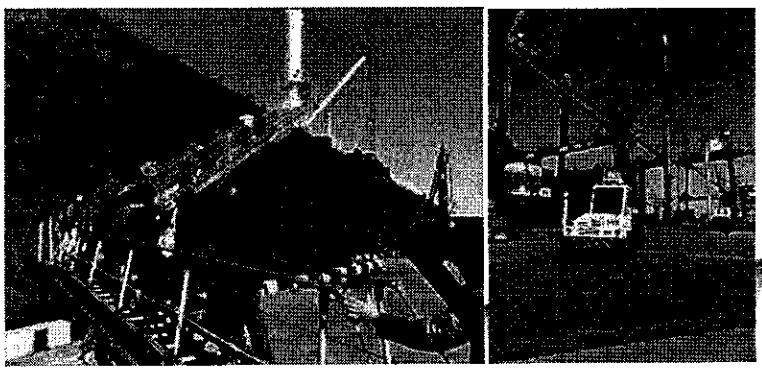


4. 初步结果
Preliminary Results



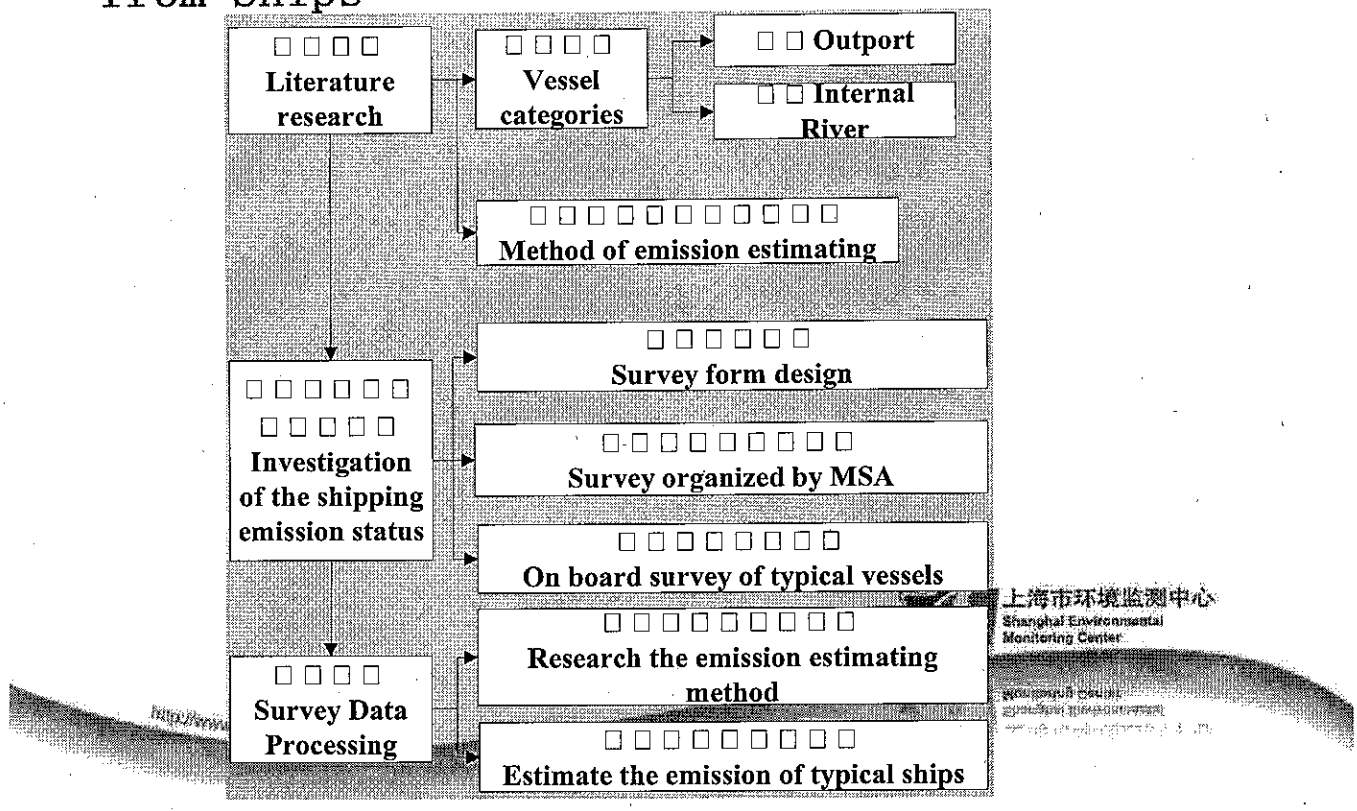
4.1 子课题1：上海港港口船舶污染物现状调查

Sub-project 1: The Investigation of the Emission Status in Shanghai Port

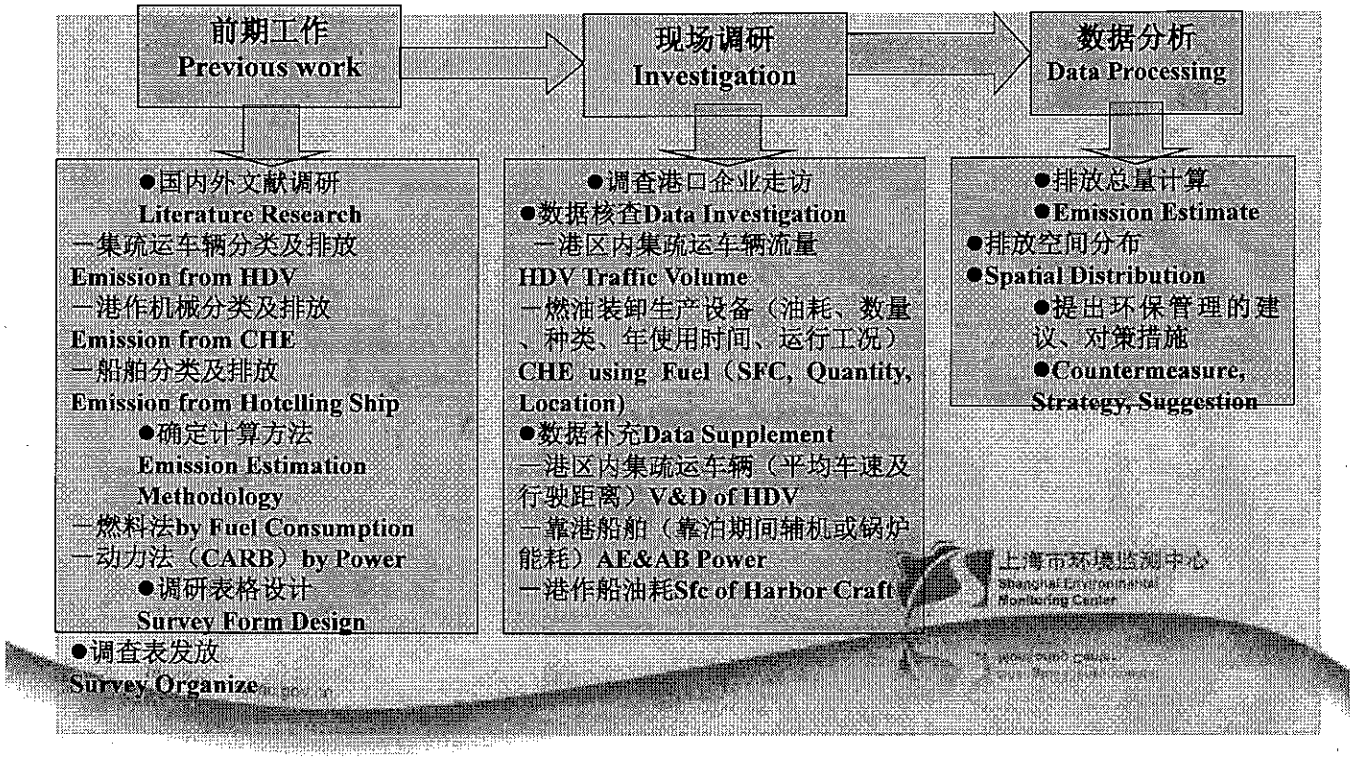


上海市环境监测中心
Shanghai Environmental Monitoring Center

4.1.1 港口船舶污染物调查方法
Methodology of the Survey on the Emission from Ships



4.1.2 港口污染物调查方法
Methodology of the Survey on the Emission from Port Activities



4.1.3 船舶污染物调查进度
The Progress of the Investigation on Ships' Emission

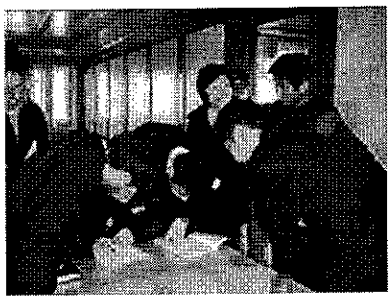
- 完成了调查表格的设计
  Survey form designed
- 由上海海事局发放了《上海港船舶大气污染物排放情况调查表》
  The outport ship survey organized by SHMSA
- 上海地方海事局发放了《内河船舶工况调查表》
  The internal river ship survey organized by SHMMSA
- 确定了2010年船舶流量
  Ship Traffic volume provided by SHMSA
- 确定了船舶排放计算方法
  Estimating method confirmed
- 计算典型外港船舶的排放量
  Estimate the Emission from typical ships

4.1.3 外港调查表发放情况
The Outport Ship Survey Overview

- 通过上海海事局向个船公司发放外港船舶调查表共计172份，目前回收42份，回收率24%。
- 172 survey forms was sent by SHMSA, and 42 were replied.

总吨分布	100~499	500~999	1000~2999	3000~9999	10000~49999	50000总吨及以上	合计
干杂货船	-	-	1	2	-	-	3
集装箱船	-	-	-	1	4	5	10
散货船	-	-	2	-	6	-	8
散装化学品船	1	-	1	3	-	-	5
油船	7	2	1	2	1	-	13
滚装船	-	-	-	-	-	-	0
拖轮	-	-	-	-	-	-	0
工程船	2	-	-	-	-	-	2
客船	-	-	-	-	-	-	0
其他	-	-	-	-	1	-	1
合计	10	2	5	8	12	5	42

4.1.3 内河船舶污染物排放调查情况
The Internal River Ship Survey Overview

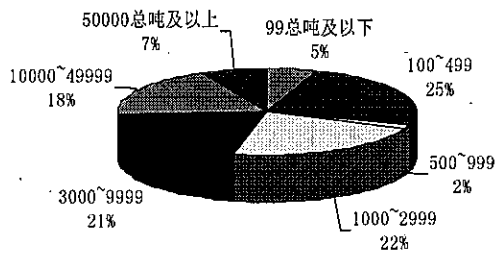


- 调查于5月1日至5月15日开展，共对238艘船舶进行了现场问卷调查。
- **The survey was organized by Shanghai Municipal MSA during May 1 to May 15, 238 internal river ships have been investigated.**

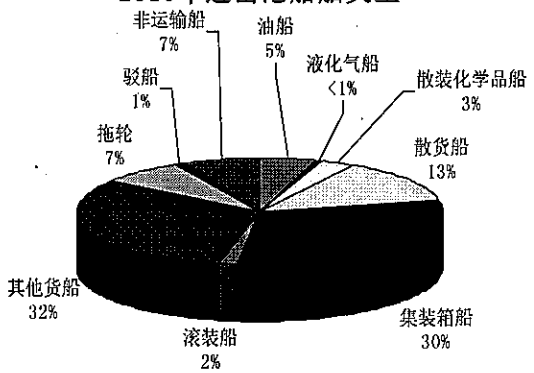
典型船舶种类	普通货船类			
总吨（吨位）	300以下	300（含）到500	500（含）到1000	1000及以上
典型船舶航次（航次）	183	45	5	5
平均载货量（吨/航次）	249.3	639.7	824.0	5304.0
典型发动机类型	6135	6160	6160	XCW6200ZC
平均主机功率（千瓦/艘）	127.1	220.6	308.0	903.8
市内平均行驶航程（千米/航次）	81.7	105.5	23.2	108.0
平均行驶时间（小时）	10.2	12.7	1.8	10.0
辅机使用率（%）	10%	10%	30%	80%
平均辅机使用时间（小时）	24.0	24.0	48.0	200.0
燃油类型	0#柴油	0#柴油	0#柴油	0#柴油
燃油消耗（升/千米）	2.6	3.1	3.6	5.0

4.1.4 2010年船舶吨位分布
Statistics in Main OutPortShip Characteristic and GT of 2010

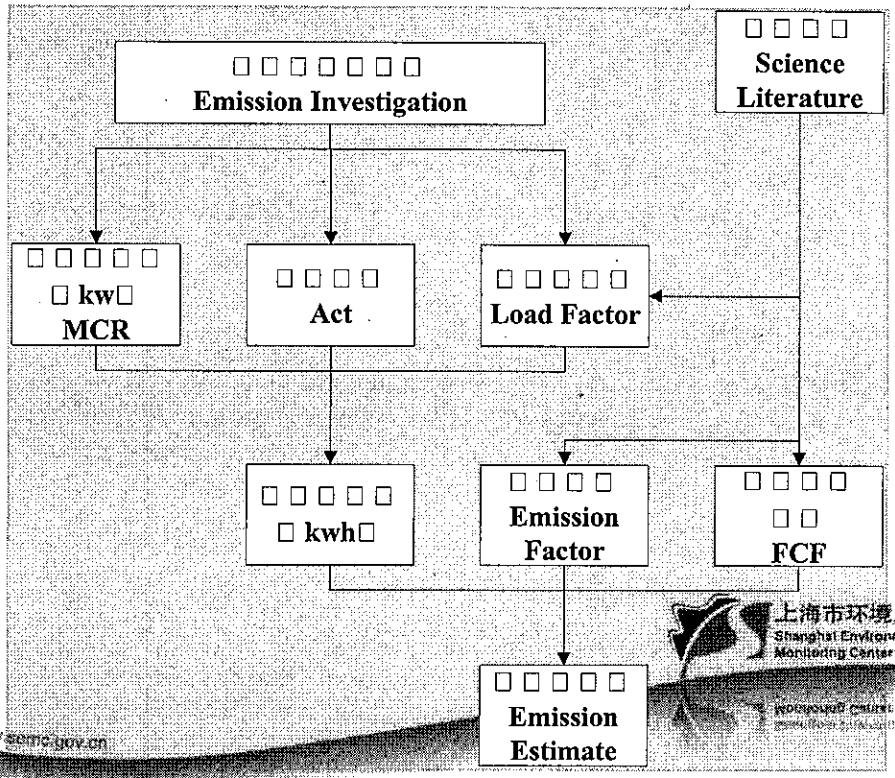
2010年上海港进出港船舶吨位分布



2010年进出港船舶类型



4.1.5 污染物计算方法
Emission Estimation Methodology



4.1.5 污染物计算方法
Emission Estimation Methodology

计算公式：$W = MCR \times LF \times Act$

W = 船舶所做的功（千瓦时；$kw \cdot h$）

MCR = 发动机额定功率

LF = 负载因子（平均负荷与最大负荷的比值）

Act = 工作时间

$$E = W \times EF \times FCF \times CF \times 10^{-6}$$

E = 排放量（吨/年；$t/year$）

EF = 排放因子（克/千瓦时；$g/kw \cdot h$）

FCF = 燃料修正因子

CF = 排放控制因子（使用了减排措施后的变化）

4.1.5 污染物计算方法
Emission Estimation Methodology

- 船舶的行驶工况分为4种：
  4 operation locatings

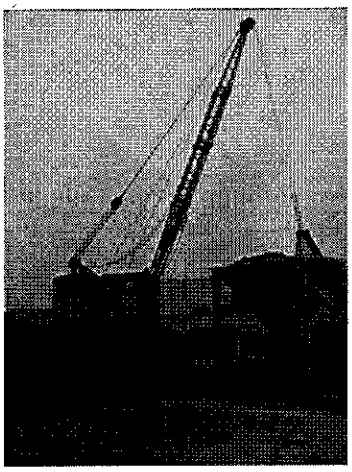
1. 巡航状态 Cruising:
   - 工作时间=行距÷航速平均
     Act=D/V
   - 主机负载在30%-85%
     LF of ME is 30%-85%
   - 辅机负载因船而异，差别较大
     LF of AE is differ from ship types
   - 使用废气锅炉
   - Using Exhaust Boiler
2. 离靠泊状 Maneuvering:
   - 工作时间=离靠泊距离÷航速
     Act=Maneuvering D/V
   - 主机负载在3%-30%
     LF of ME is 3%-30%
   - 辅机负载增加
     LF of AE is larger than Crusing
   - 主机功率较小时，锅炉开启
     Boiler is turned up when the ME's power is lower
3. 装卸货状态 Loading&Unloading:
   - 工作时间从调查而得
     Act=Survey Data
   - 除部分特定船种如散装化学品船和油船，主机关机
     ME is off except some type of ship such as Tanker
   - 辅机用于供电，负载较大
     AE is used as generator, and LF is larger than Crusing
   - 锅炉开启
     Boiler is on
4. 停靠状态 Berthing:
   - 工作时间从调查而得
     Act=Survey Data
   - 主机关机
     ME is off
   - 辅机用于供电，负载较大
     AE is used as generator, and LF is larger than Crusing
   - 锅炉开启
     Boiler is on

4.1.6 港口码头污染物排放调查进展
The Progress of the Port Emission Survey

- 确定调查范围 Survey scope confirmed:
  - 海港码头单位共260家，其中：国际港务集团（公用码头）下属单位25家，其它码头单位（专用码头）235家

    260 port company, 25 managed by Shanghai International Port Group, and 235 are managed by other company
  - 涉及军事、公务、修造船厂用途的30家单位，不在调研范围内。

    Excluding the terminals for military, official use and Shipyards



4.1.6 港口码头污染物排放调查进展
The Progress of the Port Emission Survey

- 确定计算方法 Estimating method confirmed

A. 燃料法 Estimate by Fuel Consumption

对总量进行计算

Estimate total emissions

对排放空间分布进行分析

Spatial distribution Analyse

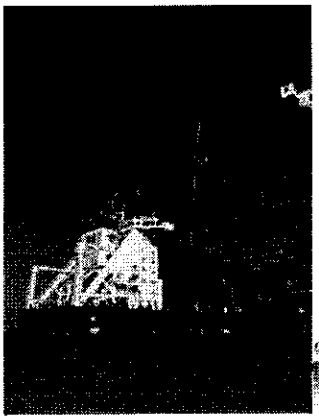
B. 动力法 Estimate by Engine Power

对调查海港码头企业进行典型计算

Estimate the emissions from typical terminal

4.1.6 港口码头污染物排放调查进展
The Progress of the Port Emission Survey

- 确定调查内容 Survey Content Confirmed
  - 港区集疏运车辆 Heavy Duty Vehicle
    - 车型 Type 车流量 Volume 港区内平均车速 Average Speed
  - 港区燃油装卸生产设备 Cargo Handling Equipment
    - 油耗 SFC、设备名称Type、制造厂Manufacturers、额定净功率 MCR
  - 靠港船舶 Berthing Vessel
    - 吨位 GT、船舶数量 Quantity、平均停泊时间 Average Berthing Time



上海市环境监测中心 Shanghai Environmental Monitoring Center

4.1.7港口码头污染物排放调查情况
Port Emission Survey Overview

- 调查范围 Survey Area:
  - 调查单位岸线位于黄浦江浦西、黄浦江浦东、长江口南岸、杭州湾北岸、崇明岛、长兴岛、横沙岛、黄浦江小港、小洋山岛。

    Terminals in Puxi, Pudong, south coast of Yangtze river, north coast of Hangzhou bay, Chongming Island, Changxing Island, Hengsha Island, Xiaoyangshan Island are investigated.
- 调查表发放情况 Survey Form Sent&Replied:
  - 目前已发放调查表194份，共回收100份，回收率达到51.5%。

    194 survey forms were sent, 100 were replied.

4.1.8 港口码头污染物排放计算方法
Estimate Methodology of Port Emission

燃料法计算公式：I= EF×C×106

--I为某种污染物排放量（吨/年）

--EF为该污染物的排放因子（克/升）

--C非道路移动机械总燃油耗量（升/年）

动力法计算公式:E = Power x Act x LF x EF x FCF x CF

--E = 排放量（吨/年）

--Power = 发动机功率（hp or kw）

--Act = 设备运行时间（小时/年）

--LF = 负荷因子

--EF = 排放因子(g/hp-hr 或 kw/hp-hr)

--FCF = 燃料修正因子

--CF = 排放控制因子

4.2 子课题：上海市典型码头VOCs排放现状调查研究

Sub-project 2: VOCs Emissions from Typical Terminals in Shanghai

上海市环境监测中心
Shanghai Environmental Monitoring Center

http://www.semc.gov.cn

4.2.1 工作进展 Progress

文献调研
Literature Review

- 排放源分类 Source Categories
  - *港口码头的VOCs排放源简介*
  - *储罐、管线、装卸等设施损失排放特性*
- 排放计算模型 Emission Estimate Models
  - *国内外排放估算模式汇总*
- 排放控制对策 Control Messures
  - *排放量介绍*
  - *控制对策介绍*

排放源调查
Emission Sources Review

- 研制调查表 Questionnaire
- 内河外港企业规模普查 Port-scale Survey
- 实地探勘座谈 Field exploration
- 典型企业设施特性详查 Detailed investigation of emission sources

排放量估算 Emission Estimate

- 排放量估算方法研究
- 典型企业排放量估算
- 典型企业排放控制现状

排放总量估算
Total Emission Estimate

排放因子本地化研究初探
Emission Factors Localization

排放控制对策
Countermeasures

控制对策的经济评估
Economic Evaluation

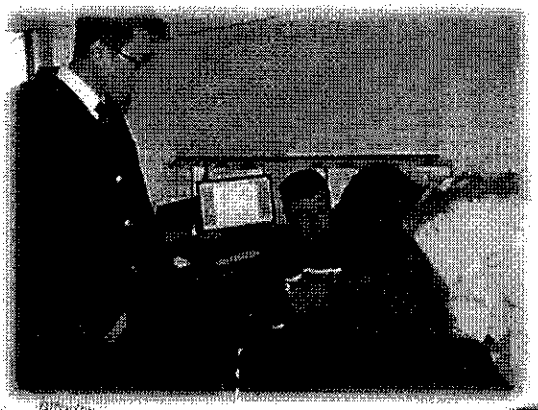
上海市环境监测中心
Shanghai Environmental Monitoring Center

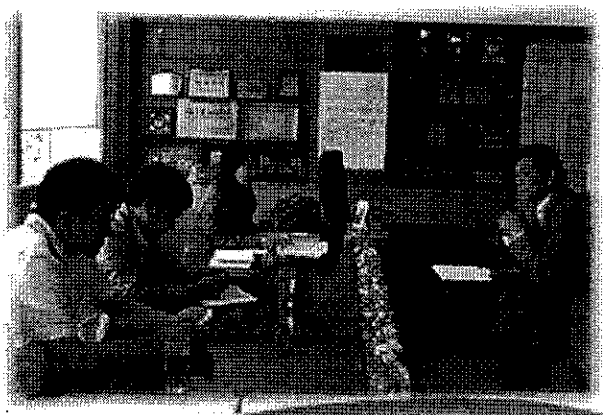
http://www.semc.gov.cn

4.2.2 上海内河码头企业排放源调查情况
Overview of Source Survey-internal River Port Company

•调查上海内河码头31家企业，回收16家企业，回收率为51.6%

31 internal river port companies have been investigated, 16 companies had the survey forms replied





4.2.3 上海内河液散码头分布图
Location of Internal River Liquid Cargo&bulk Terminals

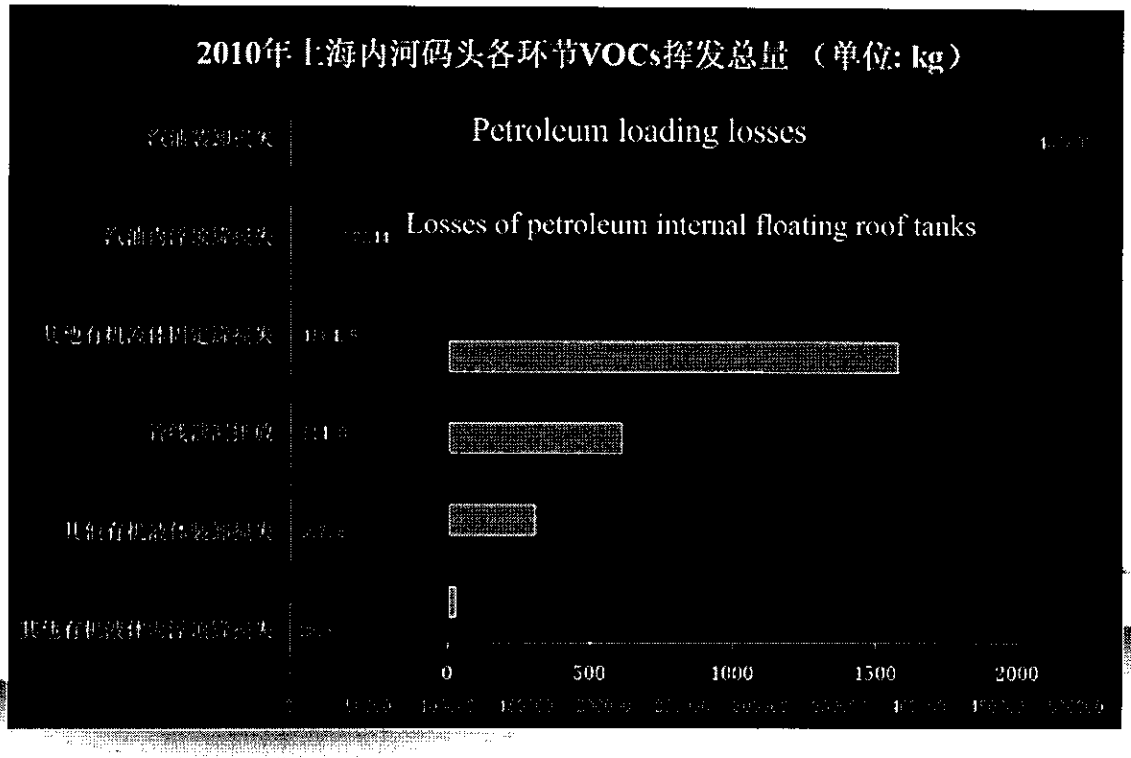
表格回收企业名单

- ✓ 上海巨盛化工有限公司
- ✓ 上海皇城石油有限公司
- ✓ 上海外高桥油品储运销售有限公司
- ✓ 上海金山石化物流有限公司
- ✓ 上海东土石油化工有限公司
- ✓ 上海建筑防水材料厂
- ✓ 上海兴玻物资有限公司
- ✓ 上海半图油库有限公司
- ✓ 上海吴淞煤气制气有限公司
- ✓ 上海东昊油品有限公司
- ✓ 上海宝山月浦加油站油库
- ✓ 上海锦盛化工有限公司
- ✓ 上海鑫联石油有限公司
- ✓ 上海浦东内航经贸发展有限公司
- ✓ 上海赛孚燃油发展有限公司
- ✓ 中石化上海石油分公司物流中心

上海市环境监测中心
Shanghai Environmental Monitoring Center

（注：内河码头企业主要经营产品为汽柴油）

4.2.5 上海内河码头VOCs排放总量估算
Estimation of VOCs Emissions from Internal River Terminals in Shanghai



4.2.6 初步研究结果
Preliminary Conclusions

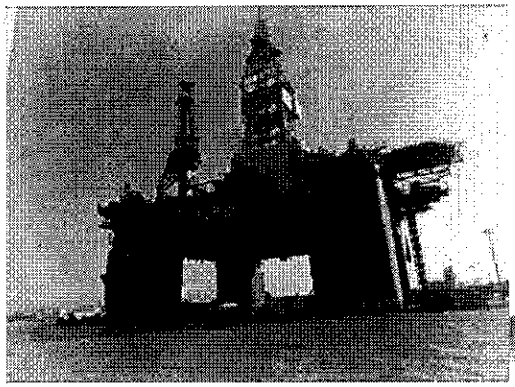
1. 上海内河码头相对较重的组分，如柴油diesel一般用固定顶罐External Floating Roof Tanks （拱顶罐）装载，而汽油Gasoline等轻质组分用内浮顶罐Internal Floating Roof Tanks装载；重油、石脑油等较汽柴油重的油品存储、管线组件泄漏以及装卸过程损失排放可忽略。

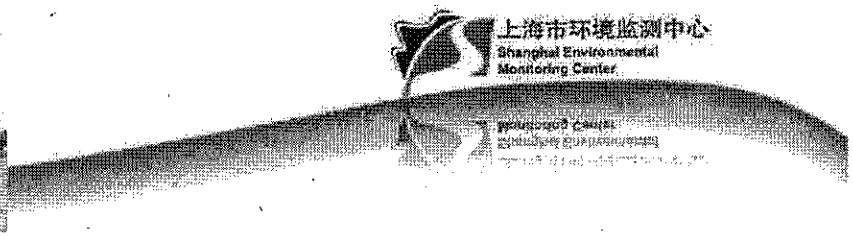
2. 装卸过程很少有蒸汽平衡/回收系统Steam Balance/Recover System，主要原因是油品运输的管道，可能难满足各类槽车、船舶的接口，今后上海在推行油品装卸过程的经济措施时，需要考虑到接口问题。具油气回收的槽车装卸过程较无油气回收的损失率下降20%左右。

3. 根据计算结果可知，轻质组分的储存及装卸过程损失挥发量相对较大，与一般化工企业不同的是，由于码头企业的设备管线组件线路简单、数量小，故泄漏排放量较小，可忽略。重质液体的储存与装卸占总量的百分比也可忽略不计。

4.3 子课题3：上海市港口船舶排放污染物对环境空气质量的影响及其控制对策建议措施研究

Sub-project 3: The Control, Strategies, Suggestions and Practical Analyses for the Impact of the Emissions from Ships and Ports' Activities on the Air Quality in Shanghai Port

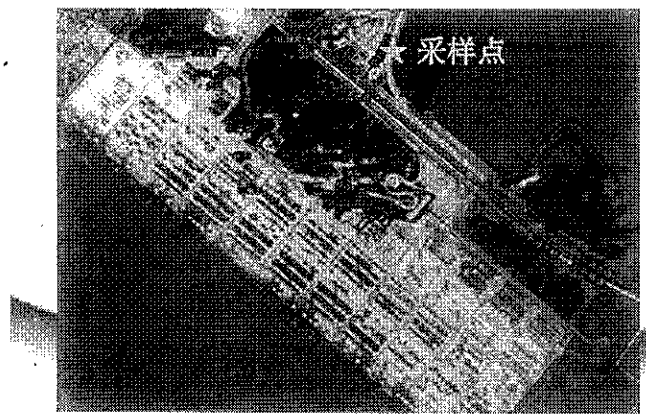




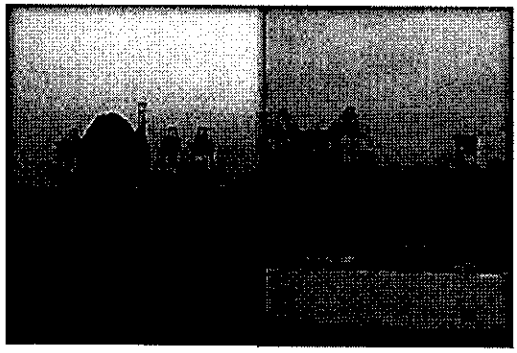
4.3.1 洋山港采样初步结果

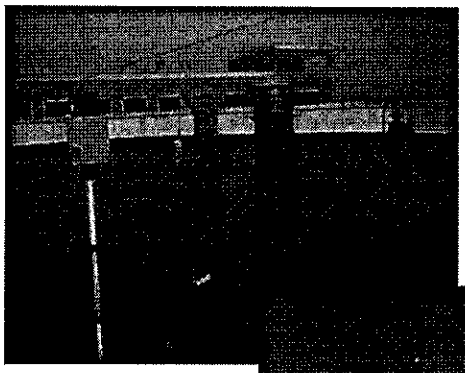
Preliminary Results of Air Quality Monitoring at Yangshan Port

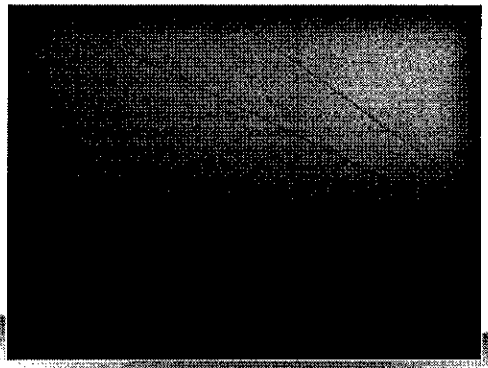
- 采样时间 Sample Time：
  - 冬季 Winter：2011年1 月13—19日；春季 Spring：5 月10—22日
- 采样仪器 Sample Equipment：
  - Andersen大流量采样器 Large Volume Sampler
  - 武汉天虹颗粒物采样器 PM Sampler：TSP和$PM_{2.5}$
  - DUSTTRAK 8533在线测量 Realtime Monitoring：PM_{10}\$PM_{2.5}$
- 采样地点 Site：洋山
- 采样数量 Quantity：共53个，冬季 Winter 14个，春季 Spring 39个

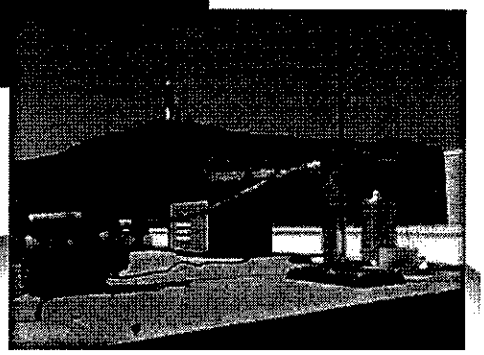


4.3.2 采样点周边环境
Monitoring Site

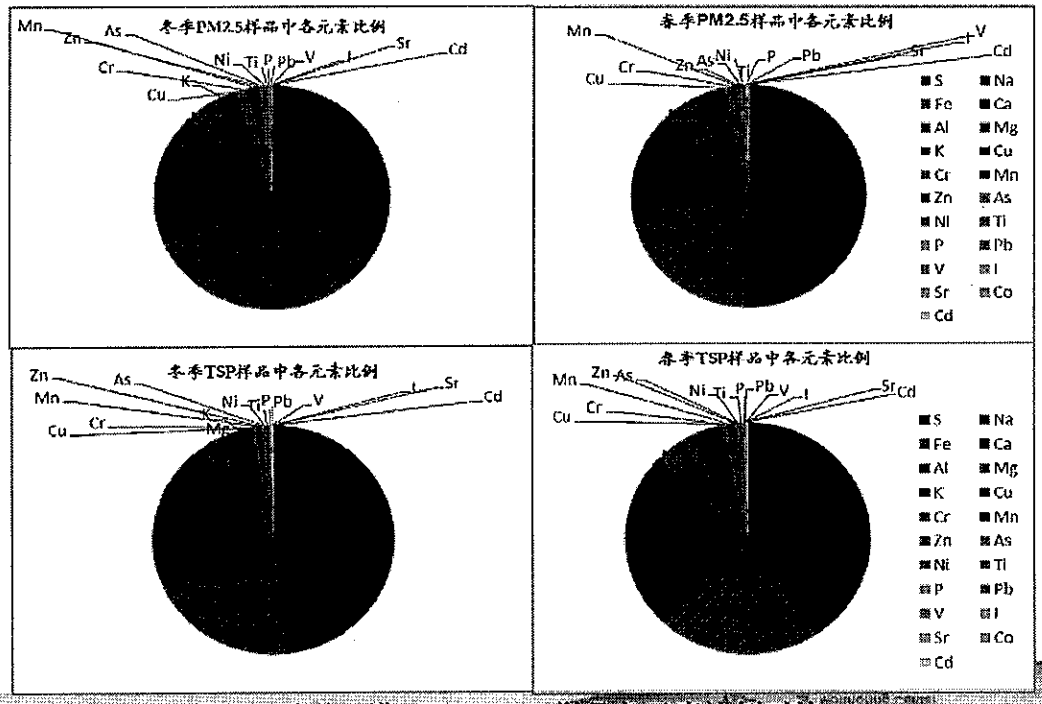








4.3.3 气溶胶元素总体特征分析（元素组成比例）
The Proportion of Each Elements in Aerosols



冬春两季洋山港$PM_{2.5}$、TSP样品各元素比例对比

The proportion of each elements in $PM_{2.5}$, TSP samples in winter and spring

4.3.4 气溶胶元素总体特征分析（元素组成比例）
The Proportion of Each Elements in Aerosols

- 气溶胶样品中主要元素为Na、Fe、Ca、S，其中：
  Na, Fe, Ca, S are in the major proportion
- Ca和Fe、Al来自地壳，Na、Mg主要来自海洋源，而S来自化石燃料燃烧或者船舶排放等人为源
  Sulfur is mainly caused by fuel combustion, ship emissions and other man-made sources
- 冬季样品中的Fe、Ca、Al含量（45.4%）明显高于春季样品（34.3%）
  The proportion of Fe, Ca, Al from the earth in winter samples is larger than in spring
- Na元素含量(22.4%)夏季明显高于冬季(11.9%)
  The proportion of Na from ocean in spring is larger than in winter

4.3.5 气溶胶元素总体特征分析（元素组成比例）
The Proportion of Each Elements in Aerosols

相同季节TSP与$PM_{2.5}$对比

The comparison between TSP and $PM_{2.5}$ samples of the same season

➢S元素在TSP中的比例明显小于$PM_{2.5}$样品，证明S元素主要富集在直径小于2.5μm细颗粒物中。

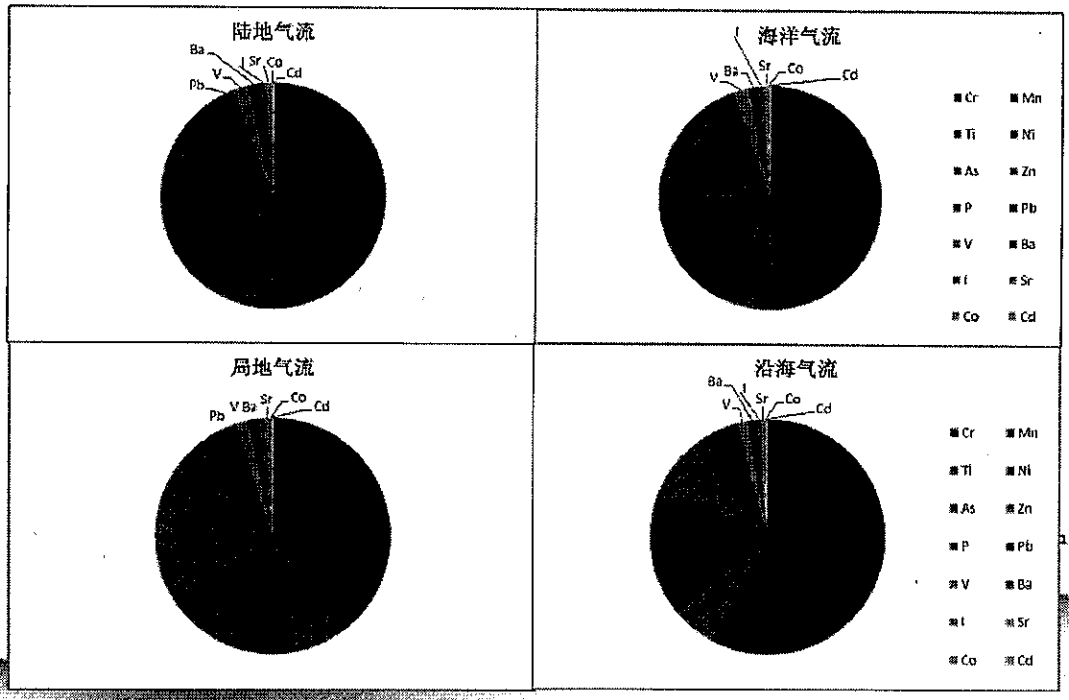
The proportion of sulfur in TSP is far smaller than in $PM_{2.5}$ samples, sulfur enriched in fine particles.

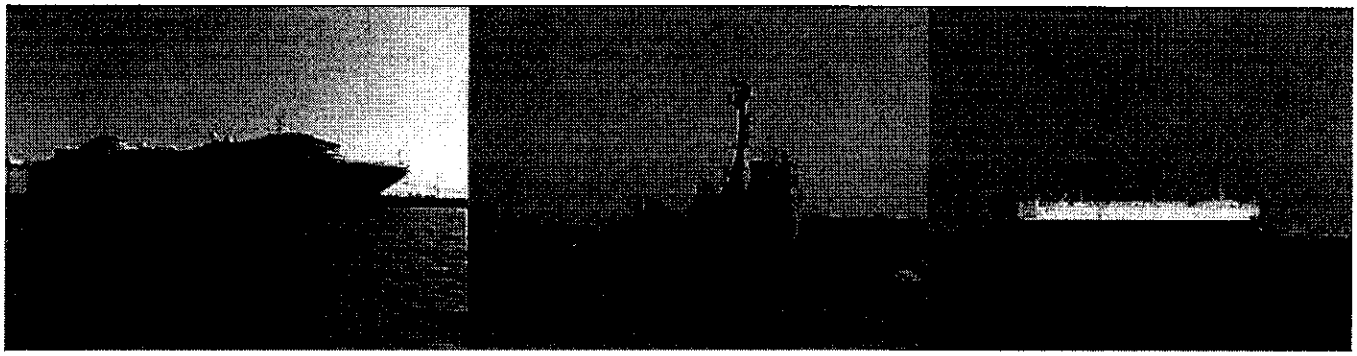
➢除了Na 、Fe、Ca、Al 、Mg这些主要元素外，其他微量元素在$PM_{2.5}$和TSP中所占的总比例分别为：（冬）5.3%、3.0%；（春）4.2%、3.0%，证明微量重金属元素在PM2.5中的含量高于TSP。

The proportion of trace heavy metal elements in $PM_{2.5}$ samples is higher than that in TSP.

4.3.5 不同气流中元素浓度对比

The Comparison of Different Elements' Proportions in Different Airs





5. 问题与建议

Questions and Suggestions

问题
Questions

1. 远洋船排放因子是否需要本地化

   The localization of the EF of OGV

2. 国内航行船只的排放因子的确定

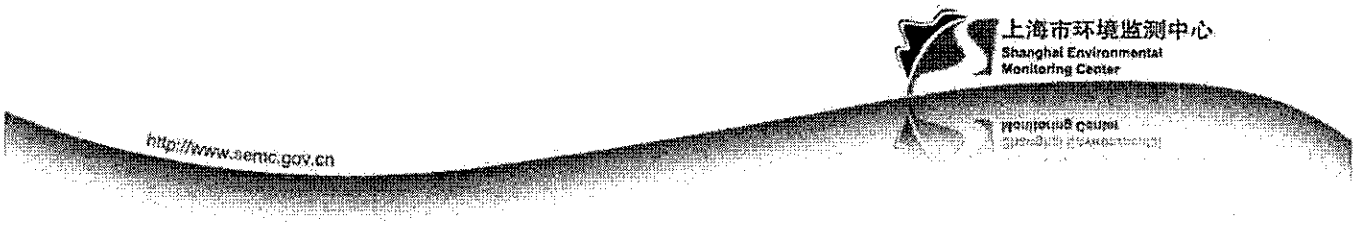
   How to confirm the domestic Ships' EF

3. 船舶排放污染监测的方法

   The methodology of testing the realtime emission of a ship

谢谢！

Thanks!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