出國報告（出國類別：開會）

參加「International Symposium--Asian Dust/Aerosol and its Impact on Global Climate Chang」出國報告

服務機關：行政院環境保護署
姓名職稱：張順欽簡任技正
派赴國家：中國
出國期間：**99** 年 **8** 月 **7** 日至 **8** 月 **14** 日
報告日期：**99** 年 **10** 月 **22** 日

摘要

爲增進對亞洲沙塵研究之瞭解，以提升預報技術，參加上海復旦大學舉辦之「International Symposium--Asian Dust/Aerosol and its Impact on Global Climate Chang」(「亞洲沙塵氣膠及其對全球氣候變遷之影響」)國際研討會。會中邀請美國、日本、香港及中國本地專家，研討亞洲沙塵及氣膠的轉變、光學特性與對區域氣候之影響、霾害及長程傳輸與對海洋初級生產力之影響等。由於我國在每年 11 月至隔年 5 月之間常受到亞洲沙塵影響，最近二年沙塵影響更爲顯著。爰此，以「The impact of Asian dust on Taiwan air quality」爲題於本次會議中進行口頭發表，說明我國歷年來受沙塵之影響情形。鑒於有關中國大陸有關沙塵觀測或研究資訊蒐集不易，使得沙塵預報困難度相當高，出席本次研討會，有助於瞭解大陸在沙塵監測及研究狀況，促進資訊交流。例如 2010 年 3 月 21 日我國受中國大陸沙塵影響，PM_{10} 濃度高達 1724 $\mu g/m^3$，上海市也觀測到超過儀器偵測極限 1000 $\mu g/m^3$，南京市 PM_{10} 則觀測到超過 2000 $\mu g/m^3$。而其他影響我國空氣品質之沙塵個案，包括 2002 年 3 月 22 日、2002 年 4 月 8 日、2007 年 4 月 2 日，也同時造成上海市空氣品質變差，PM_{10} 濃度上升。分析過去沙塵影響路徑，通常沙塵會先抵達南京市或上海市地區，惟因大陸 PM_{10} 小時資料不能透過網路取得，有待透過兩岸合作方式，提供沙塵傳輸路徑的 PM_{10} 小時資料，作爲我國沙塵預報參考。此外，沙塵傳輸過程與空氣污染物之反應，部分沙塵會含有原生性硫酸鹽，可以說明過去本署監測發現，部分沙塵個案期間僅 $PM_{2.5}$ 的硫酸鹽濃度增加，並未發現其他空氣污染物的現象。研究發現沙塵的 Ca/Al 比值會因不同沙塵來源而有差異，來自新疆塔克拉瑪干沙漠的沙塵 Ca/Al 比值約爲 1.5；而來自戈壁沙漠的沙塵則約爲 0.5，可以作爲日後沙塵影響來源鑑別參考。

目錄

壹、目的

1.1 會議名稱

「International Symposium--Asian Dust/Aerosol and its Impact on Global Climate Chang」

1.2 出國人員

環保署環境監測及資訊處 張順欽簡任技正

1.3 出國日期

99 年 8 月 7 日至 14 日

1.4 預期效益

1. 發表我國空氣品質受中國大陸沙塵之影響論文，說明我國受污染物長程傳輸之影響，彰顯我國環境監測成果。
2. 同時尋求沙塵監測資訊取得與交流，有助於我國沙塵預報技術之提升。
3. 汲取國際環境監測新知及最新應用，供作本署環境監測業務推動參考。

1.5 發表論文摘要

來自中國大陸沙塵暴揚起的沙塵，在適當的天氣條件下，會伴隨東北季風影響台灣的空氣品質。會中以 2006 年 3 月 19 日、2009 年 4 月 25 日及 2010 年 3 月 21 日等三個嚴重影響全台空氣品質的大陸沙塵案例，介紹沙塵影響台灣空氣品質的特徵。2006 年 3 月 19 日台灣北部受沙塵影響 PM_{10} 超過 350 μg m^{-3}，使得 76 個測站中，50 個測站 PM_{10} 濃度日平均大於空氣品質標準 125 μg m^{-3}。同時，氣態污染物包括 SO_2、CO、及 O_3 濃度也隨之上升。$PM_{2.5}$ 硫酸鹽、硝酸鹽及黑碳濃度也都增加，顯示人為空氣污染物隨著沙塵影響台灣。沙塵期間粒徑分布顯示，小於 200 nm 粒徑數目顯著減少，說明 $PM_{2.5}$ 濃度上升主要來自較大粒徑微粒增加。2009 年 4 月 25 日受沙塵影響，台灣北部少部分測站 PM_{10} 濃度超過 1000 μg m^{-3}，使得 69 個測站超過空氣品質標準。根據逆軌跡回推高濃度沙塵自源區傳輸到台灣，約僅 48 小時，較過往沙塵通過上海 48 小時抵台速度快了許多。2010

年 3 月 21 日沙塵則創下台灣半數以上空氣品質監測站 PM_{10} 濃度超過 1000 μg m^{-3}，各地空氣污染指標(PSI)達 500 的歷史最高值。不過這二個案例影響期間，$PM_{2.5}$ 硫酸鹽濃度增加較爲顯著。沙塵影響期間，高濃度 PM_{10} 由北台灣向南傳輸，PM_{10} 以粗粒徑爲主，$PM_{2.5}$ 佔 PM_{10} 的比例會由本地污染累積時約 0.6 遽降至沙塵影響時約 0.2。因此，每年秋季開始至隔年春季，隨著東北季風長程傳輸的空氣污染物，不單是沙塵，來自中國大陸沿海的工業或都會區空氣污染物，都必須加以重視。由於沙塵源區資訊缺乏，華北、華中甚至東南沿海空氣品質資料獲得不易，難以瞭解沙塵暴的動態或工業污染物的排放資訊，使得沙塵預警工作倍極艱辛，預測的不確定性相當高。建議未來雙方在沙塵預警及空氣品質監測上，加強技術、人員及監測資料的交流。

1.6 2010 年 3 月 21 日沙塵個案

2010 年 3 月 21 日受到大陸沙塵嚴重影響台灣空氣品質，自 3 月 21 日清晨 3 時開始台灣北部開始出現高濃度 PM_{10}，上午 9 時 PM_{10} 濃度開始超過 1000 μg m^{-3}，最高濃度出現在 3 月 21 日 12 時士林測站 1724 μg m^{-3}。高濃度 PM_{10} 逐漸向南傳輸，中部崙背測站在 21 日 20 時出現最高濃度 1082 μg m^{-3}，小港則在 3 月 22 日 3 時出現最高濃度 915 μg m^{-3}。3 月 21 日 20 時東沙開始受到沙塵影響，濃度從 28 μg m^{-3} 增加爲 71 μg m^{-3}，在 3 月 22 日 2 時出現最高濃度 557 μg m^{-3}，同時 $PM_{2.5}$ 小時濃度也高達 146 μg m^{-3}，見證了大陸沙塵影響的範圍，如圖 1。以這波沙塵傳輸範圍，各地空氣品質監測結果顯示，韓國出現 PM_{10} 最高濃度約爲 3000 μg m^{-3}，上海、南京約爲 2000 μg m^{-3}，都高於台北及東沙出現的最高濃度，說明大陸沙塵對鄰近地區的影響程度。

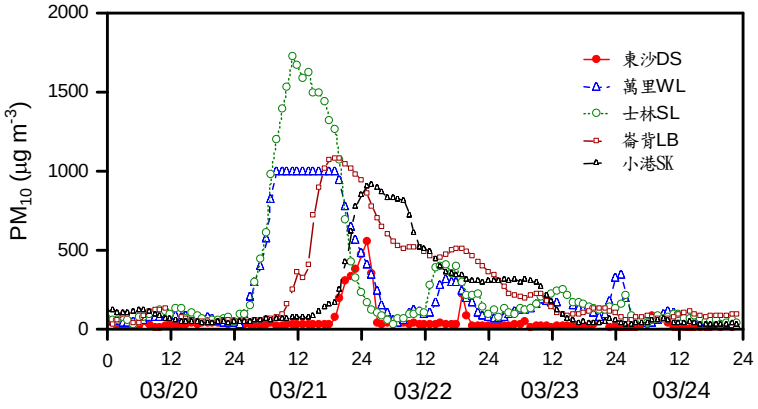


圖 1、2010 年 3 月 21 日沙塵影響東沙與台灣本島測站 PM_{10} 濃度變化

2010 年 3 月 21 日沙塵影響程度相當大，影響持續時間也長。3 月 21 日在全部 76 個監測站 PM_{10} 最高濃度共有 37 個測站超過 1000 μg m^{-3}，3 月 22 日仍有 10 個測站 PM_{10} 最高濃度超過 1000 μg m^{-3}。台灣北部共有 12 個測站及金門、馬祖二個測站，超過 1000 μg m^{-3} 的時間長達 10 個小時以上，其中馬祖測站超過 1000 μg m^{-3} 的時間更長達 18 個小時。這次沙塵造成的影響是台灣設置空氣品質監測站以來最嚴重的一次。

從台北超級測站監測結果可以發現，3 月 21 日 3 時開始受到沙塵影響，PM_{10} 與 $PM_{2.5}$ 濃度快速上升，PM_{10} 濃度最高達 1116 μg m^{-3}，而 $PM_{2.5}$ 濃度則高達 232 μg m^{-3}。在此之前屬於本地污染累積，$PM_{2.5}/PM_{10}$ 的比值大約在 0.6 之上，受沙塵影響 $PM_{2.5}/PM_{10}$ 的比值則快速降低至 0.2 左右，直到 3 月 22 日沙塵影響逐漸減弱，$PM_{2.5}/PM_{10}$ 的比值逐漸上升。3 月 22 日下午再次受到沙塵影響，可由 $PM_{2.5}/PM_{10}$ 的比值再次下降提供佐證。沙塵影響期間，台北超級測站 $PM_{2.5}$、$PM_{2.5-10}$ 及 $PM_{2.5}/PM_{10}$ 的比值時序變化詳如圖 2。

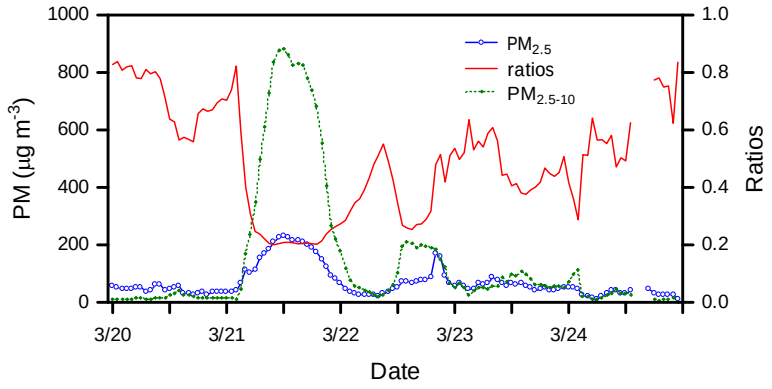


圖 2、2010 年 3 月 21 日沙塵影響期間 $PM_{2.5}$、$PM_{2.5-10}$ 及 $PM_{2.5}/PM_{10}$ 時序變化

沙塵影響期間，台北超級測站監測結果顯示，$PM_{2.5}$ 硫酸鹽隨著 $PM_{2.5}$ 在 3 月 21 日 3 時快速上升，濃度由 2 時的 7 μg m^{-3} 上升至 4 時的 31 μg m^{-3}，直到 12 時過後才降回 8 μg m^{-3}。顯示沙塵影響初期，$PM_{2.5}$ 硫酸鹽濃度高於本地污染。$PM_{2.5}$ 濃度持續上升至 12 時，但硫酸鹽濃度未隨之增加。3 月 22 日中午過後，$PM_{2.5}$ 濃度再次上升，此時硫酸鹽濃度變化與 $PM_{2.5}$ 一致。硝酸鹽濃度雖然在沙塵初期也有上升現象，最高濃度出現在 4 時的 6 μg m^{-3}，濃度低於本地污染階段。顯示這次沙塵初期也挾帶了一些人為污染物，這與 2006 年 3 月 19 日的沙塵個案類似，詳如圖 3。

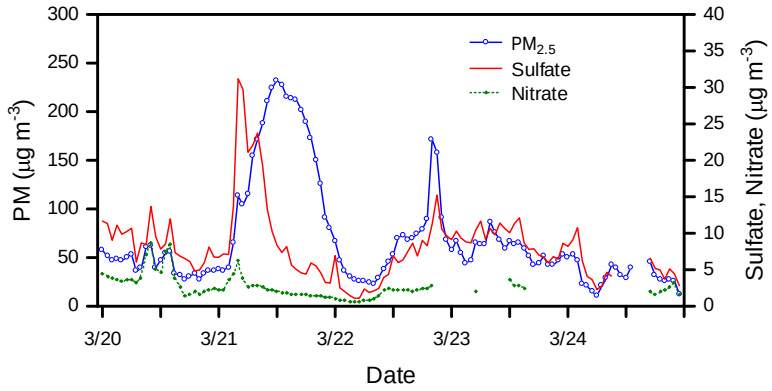


圖 3、2010 年 3 月 21 日沙塵影響期間 $PM_{2.5}$、Sulfate 及 Nitrate 時序變化

由台北超級測站監測結果顯示，沙塵期間 $PM_{2.5}$ EC 濃度並未上升，OC 濃度在 3 月 21 日清晨硫酸鹽或硝酸鹽出現最高值時，並未隨之增加。反而在 3 月 22 日中午過後，隨著 $PM_{2.5}$ 濃度上升而上升。EC 最高濃度出現在 3 月 22 日 21 時，此時 OC 也出現最濃度 22 μg m^{-3}，同時硫酸鹽也出現 15 μg m^{-3} 的高值，如圖 4。比較 $PM_{2.5}/PM_{10}$ 的比值，3 月 22 日下午約爲 0.25，硫酸鹽、硝酸鹽或 EC、OC 等濃度低，顯示仍受沙塵影響。3 月 22 日 21 時 $PM_{2.5}/PM_{10}$ 的比值上升至 0.5，顯示隨著沙塵影響減緩，本地污染物逐漸累積，$PM_{2.5}$ 硫酸鹽、硝酸鹽或 EC、OC 等濃度隨之上升。

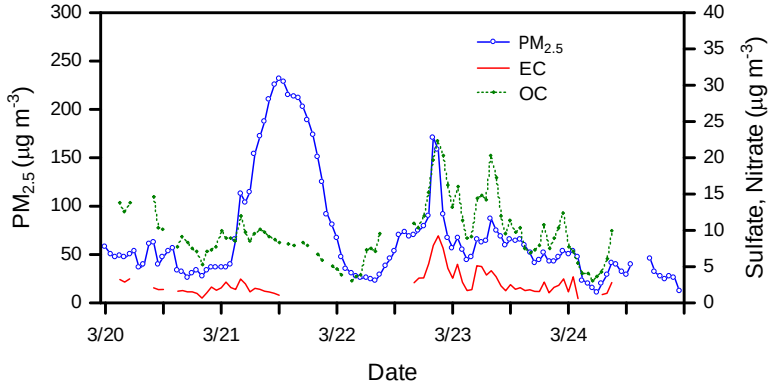


圖 4、2010 年 3 月 21 日沙塵影響期間台北超級測站 $PM_{2.5}$、EC 及 OC 時序變化

貳、會議過程

「International Symposium--Asian Dust/Aerosol and its Impact on Global Climate Chang」分爲「Composition, emission and transformation of Asisan dust/aerosols and their impact on air quality and primary production」及「Session 2:Optical properties and transport of Asian dust/aerosols and impact on regional/global climate」兩個部分，會議議程如附件一，與會人員大合照如圖 5。

圖 5、與會人員合照

2.1 會議論文投稿

本次參加「International Symposium--Asian Dust/Aerosol and its Impact on Global Climate Chang」以「The impact of Asian dust on Taiwan air quality」摘要先行投稿，論文經接受爲口頭發表。論文發表照片如圖 6。

2.2 論文簡報內容

論文簡報內容如附件二。

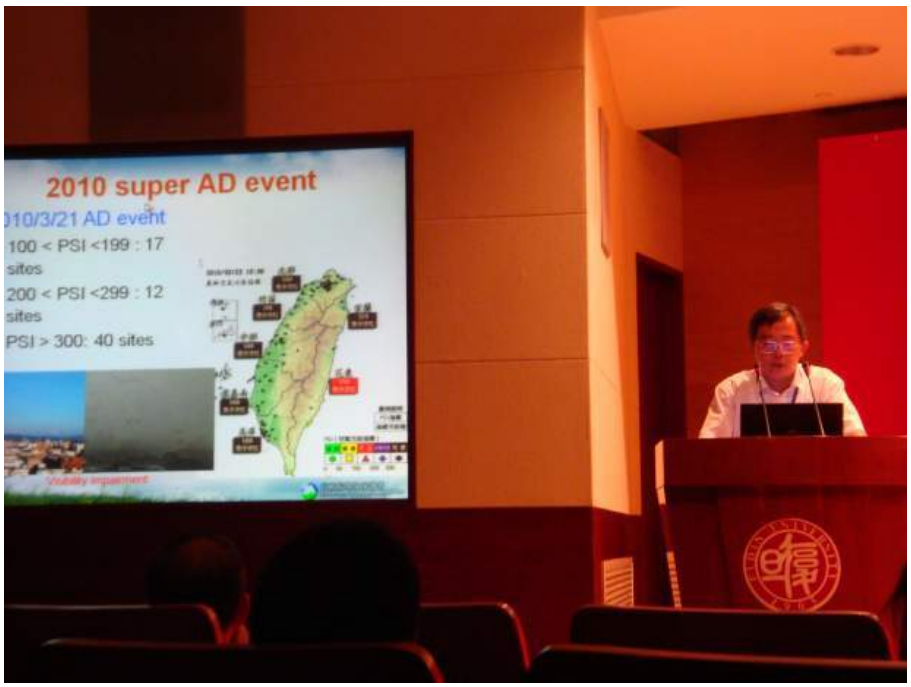


圖 6、論文發表照片

2.3 會後參訪

會後拜會上海市環保局及監測中心等，商討未來資料交流之可行性，如圖 7 及圖 8。

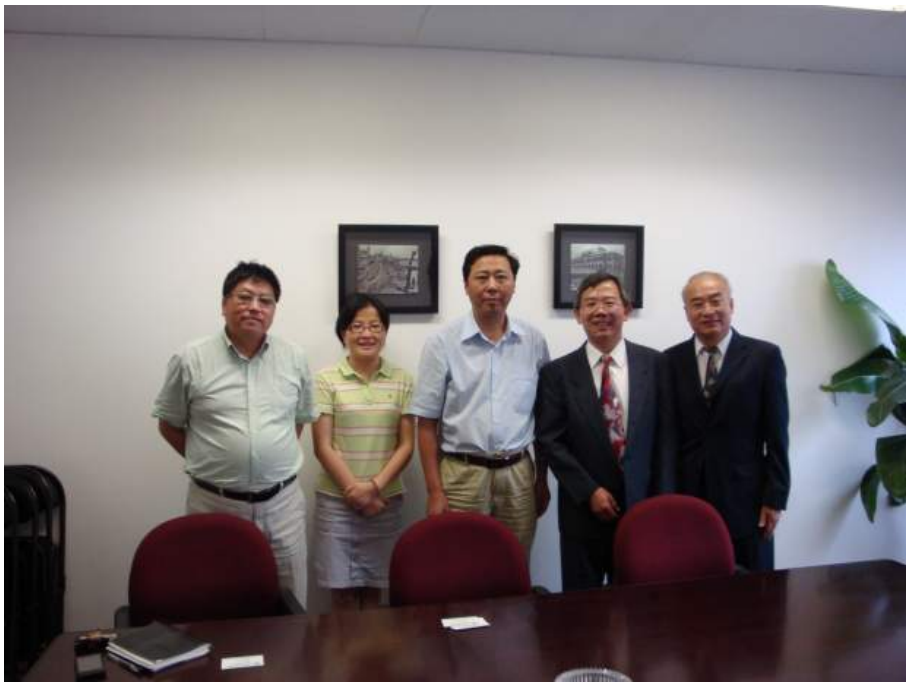


圖 7、拜會上海市環保局(孫建副局長表達兩岸監測技術合作交流之意願)

圖 8、參訪上海市環境監測中心(張明旭總工程師說明監測中心組織架構及運作)

參、重要心得與建議

3.1 上海地區 PM_{10} 觀測資料，可作爲我國沙塵預報重要參考

2010 年 3 月 21 日我國受中國大陸沙塵影響，PM_{10} 濃度高達 1724 $\mu g/m^3$，上海市也觀測到超過儀器偵測極限 1000 $\mu g/m^3$，南京市 PM_{10} 則觀測到超過 2000 $\mu g/m^3$。而其他影響我國空氣品質之沙塵個案，包括 2002 年 3 月 22 日、2002 年 4 月 8 日、2007 年 4 月 2 日，也同時造成上海市空氣品質變差，PM_{10} 濃度上升。

分析過去沙塵影響路徑，通常沙塵會先抵達南京市或上海市地區，惟因大陸 PM_{10} 小時資料不能透過網路取得，有待透過兩岸合作方式，提供沙塵傳輸路徑的 PM_{10} 小時資料，作爲我國沙塵預報參考。

3.2 沙塵傳輸過程與空氣污染物之反應，值得參考

沙塵傳輸過程因爲與空氣污染物反應，可能導致 pH 降低 2 左右，類似沙塵與空氣污染物結合傳輸的個案，對於健康的影響值得注意。部分沙塵會含有原生性硫酸鹽，可以說明過去本署監測發現，部分沙塵個案期間僅 $PM_{2.5}$ 的硫酸鹽濃度增加，並未發現其他空氣污染物的現象。

3.3 沙塵 Ca/Al 比值會因不同來源而有差異，值得參考

研究發現沙塵的 Ca/Al 比值會因不同沙塵來源而有差異，來自新疆塔克拉瑪干沙漠的沙塵 Ca/Al 比值約爲 1.5；而來自戈壁沙漠的沙塵則約爲 0.5，可以作爲日後沙塵影響來源鑑別參考。

3.4 沙塵傳輸的追蹤及對氣候之影響

應用衛星觀測技術追蹤沙塵長程傳輸，如氣膠光學厚度(Aerosol Optical Depth, AOD)，可以參考利用。沙塵微粒可以散射日光、吸收日光，進而影響全球氣候變化等。

3.5 沙塵傳輸對於海洋生物之影響

沙塵跨洲際的傳輸，可以提供海洋生物的營養源，也是熱帶雨林土壤營養的重要來源；不過對於含塵的大氣卻對於人體健康有所威脅。沙塵傳輸提供了海洋生物重要的營養來源，其中含鐵的生物可利用成分，與海洋表面海洋生物生長有關，進而影響全球碳循環與氣候變化。

3.6 兩岸監測合作，有助於追蹤沙塵動態

鑒於有關中國大陸有關沙塵觀測或研究資訊蒐集不易，使得我國沙塵影響的預報困難度相當高，經奉核可於會後安排拜會環保局、監測中心等，商討未來資料交流之可行性，臚列重要心得如下：

1.管理制度面

環境保護局下設環境監測中心及環境科學院，屬於科學技術單位，從事環境品質監測和污染源監測業務(含水、大氣環境品質、土壤、固體廢棄物及環境噪音等)；監測中心的業務受中國環境監測總站指導，行政業務則受上海市環境保護局指導。監測站包括國家補助的國定站及地方自行設置站。

上海市的環境監測經過二十年的建設和發展，以上海市環境監測中心爲龍頭(約 175 人，另聘用 50 人)，與全市二十個區（縣）級環境監測站，涵蓋了上海市全部行政地域範圍。市區（縣）兩級監測機構的監測對象包括地面水、廢水、大氣、廢氣、汽車尾氣、噪音、土壤和生物等。目前已設有 49 個監測站，監測項目包括 PM_{10}、SO_2、NO_X、CO、O_3、$PM_{2.5}$ 及 VOCs，此外針對灰霾監測設有能見度及微粒成分等項目。南京市監測中心站約有 120 人，設有 15 個監測站，監測項目包括 PM_{10}、SO_2、NO_X、CO 及 O_3 等。

環境監測中心及環境科學院執行各項監測或研究，可以支領薪資以外的獎金。目前環境影響評估、監測等均由類似監測中心或科學研究院等政府單位執

行，尚未開放民間公司(代檢測業)辦理。上海市環境監測中心則另成立公司執行多數監測站的維護工作，少數工作委外辦理。

2.空氣品質監測資料發布方式

上海市爲直轄市，監測資料除提供上海市環保局發佈外，按日報給環境監測總站；南京市則先報給江蘇省環境廳，再彙報給環境監測總站。

監測數據採按日發布，故透過網路僅能取得前一天監測結果，逐時資料不對外公開。故僅靠網路資料查詢，對於本署沙塵預報幫助有限，需透過合作交流才可能取得即時監測數值。

3.空氣品質監測品保品管

近年來大陸積極大量購置空氣品質監測設施，不過品保及品管的要求則有進步空間。例如，空氣品質自動監測儀器略去每日零點及全幅漂移檢查，僅每週執行一次校正，亦缺獨立查核的設計。

4.空氣品質預報系統

上海市已建立空氣品質預報系統，預報方式包括了統計預報及數值模擬預報，同時結合污染排放源資料來進行預報。由於常出現灰霾現象，上海市也正發展灰霾天氣預報。預報工作除了監測中心人員，也與上海市氣象局合作進行模擬工作。

3.7 綜合建議

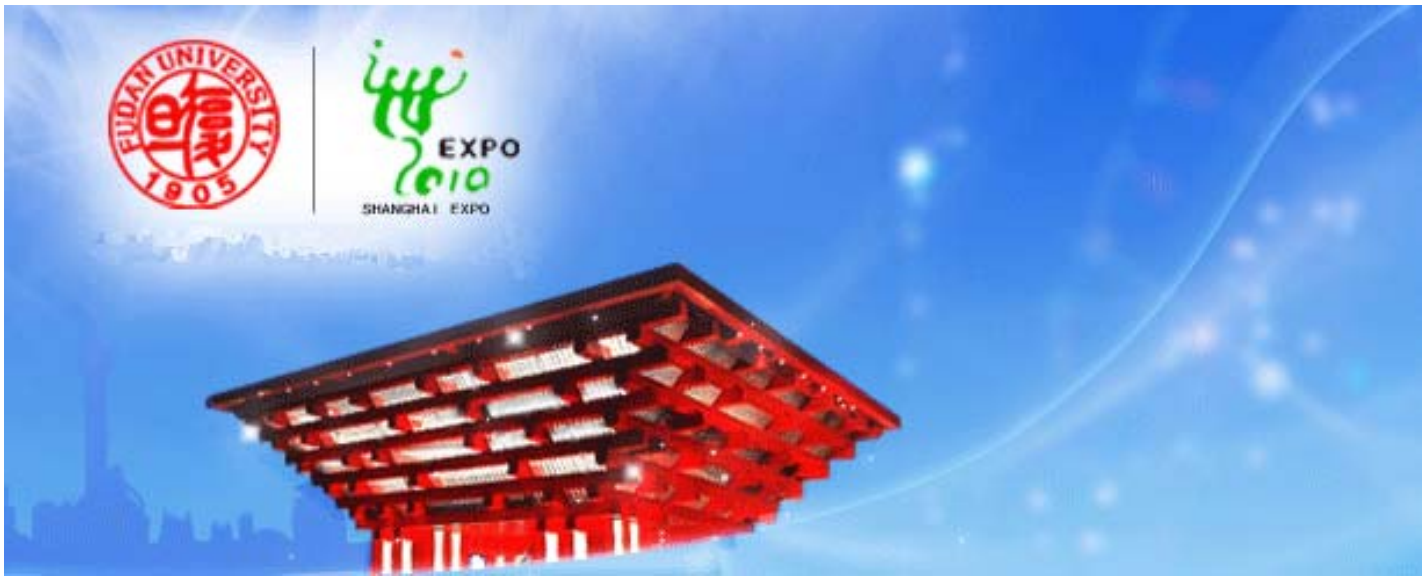
由於國內空氣品質逐漸改善，受中國大陸沙塵之影響日益顯著，本次會議蒐集到的資訊顯示，由於沙塵傳輸抵達台灣之前，多會經過上海市或南京市，因此，建議設法取得沙塵通過路徑的 PM_{10} 逐時監測資料，同時研析上海或南京等地，沙塵造成 PM_{10} 濃度上升與我國受沙塵影響之關聯性，作爲我國沙塵預測參考，以提升沙塵預測準確度。

附件一、「**International Symposium--Asian Dust/Aerosol and its Impact on Global Climate Chang**」議程

International Symposium on Asian Dust/Aerosol and its Impact on the Global Climate Change

August 8-11, 2010

Shanghai, China



Agenda

August 8, 2010, Registration
Venue: Qingyun Hotel at Fudan University

August 9, 2010
8:30 AM – 8:45 AM Opening Remarks
8:45 AM – 8:55 AM Symposium Photo Taken

8:55 AM – 6:00 PM Plenary Oral Presentations
Venue: Yifu Science and Technology Building

6:00 PM - Symposium Banquet
Venue: Professor Cafeteria at Fudan University

August 10, 2010
8:30 AM – 3:15 PM Session Oral Presentations
Session 1:Composition, emission and transformation of Asisan dust/aerosols and their impact on air quality and primary production
Session 2:Optical properties and transport of Asian dust/aerosols and impact on regional/global climate

3:30 PM – 5:30 PM Plenary Oral Presentations
5:30 PM – 6:30 PM Plenary Discussion & Summing-up
Venue: Yifu Science and Technology Building

August 9-10
12:00 noon – 9:30 PM Poster Presentations
Venue: Yifu Science and Technology Building

August 11, 2010
7:45 AM - Visit World Expo.

Time	Item	Name & Affiliations	Title
9-Aug-2010			
8:30	*Opening Remarks*	*Speakers :* ***Prof. Robert Duce, Chairman of Symposium*** ***Prof. Zhisheng An, Co-Chairman of Symposium*** ***Prof. Peter Liss, Ex-Chairman of SOLAS*** ***Prof. Li Jin, Vice President of Fudan University*** ***Prof. Joo Hwa Tay, Head of Dept. of ESE, Fudan University***	
8:45	*Symposium Photo Taken*		

9-Aug-2010		Plenary Oral Presentations	
	Chairman	**Prof. Robert A. Duce & Prof. Guoshun Zhuang**	
8:55		Robert A. Duce TEXAS A&M University, TX, USA	A Historical Case of Scientific Serendipity over the Pacific
9:20		Mitsuo Uematsu Atmosphere and Ocean Research Institute, The University of Tokyo, Japan	Impacts of Atmospheric Deposition of Nutrients over the Western North Pacific Ocean
9:45		Renyi Zhang TEXAS A&M University, TX, USA	Contributions of Organic Vapors to Nucleation and Growth of Nanoparticles in the Atmosphere
10:10		Joshua S. Fu University of Tennessee, Knoxville, TN, USA	Climate based dust and aerosol effects for the environment and health
10:35	*Coffee break*		
	Chairman	**Prof. Peter Liss & Prof. Mitsuo Uematsu**	
10:45		Hajime Akimoto Asia Center for Air Pollution Research, Japan	Impacts of black carbon and ozone on global warming and co-benefit approach initiative in Asia
11:10		Guoshun Zhuang Fudan University, Shanghai, China	Mixing and transformation of Asian dust with pollution aerosol during its long-range transport
11:35		Zhanqing Li University of Maryland, MD, USA	Can and how much aerosols account for the climate changes in China ?
12:00	*lunch*		
	Chairman	**Prof. Joshua Fu & Prof. Hong Liao**	
13:30		Song-Miao Fan NOAA Geophysical Fluid Dynamics Laboratory, Princeton, NJ, USA	Using Atmospheric and Oceanic Observations to Improve Global Modeling of Mineral Dust Aerosol and Aeolian Input of Soluble Iron to the Ocean
13:50		Kebin He Qinghua University, Beijing, China	Dust Storms Come to Central and Southwestern China, too: Implications from A Major Dust Event in Chongqing
14:10		Brent Holben NASA/Goddard Space Flight Center, Greenbelt, MD, USA	AERONET's contributions to Aerosol Science in Asia

14:30		Adina Paytan University of California Santa Cruz, CA, USA	Impacts of Atmospheric Deposition on Marine Phytoplankton
14:50		Jianmin Chen Fudan University, Shanghai China	Chemical characterization of aerosols over the Atlantic Ocean and the Pacific Ocean during two cruises in 2007 and 2008
15:10		Tong Zhu Peking University, Beijing, China	Accelerated atmospheric conversion of calcite to nitrate by nitrogen dioxide in the presence of H_2O: a Raman microscopic study
15:30	*Coffee break*		
	Chairman	**Dr. Brent Holben & Prof. Kebin He**	
15:40		Si-Chee Tsay Laboratory for Atmospheres, NASA/Goddard Space Flight Center Greenbelt, MD, USA	Airborne Dust, "the good guy or the bad guy": *how much do we know*?
16:00		Qilong Min Atmospheric Sciences Research Center, SUNY at Albany, USA	Evidence of mineral dust altering cloud microphysics and precipitation
16:20		Alfred Wiedensohler Leibniz Institute for Tropospheric Research, Leipzig, Germany	Hygroscopic Growth of Aerosol Particles in the North China Plain
16:40		Christina N. Hsu Laboratory for Atmospheres, NASA/Goddard Space Flight Center Greenbelt, MD, USA	Satellite Monitoring of Asian Dust Storms from SeaWiFS and MODIS: Source, Pathway, and Interannual Variability
17:00		Shih-Chieh Hsu Research Center for Environmental Changes, Academia Sinica, Taiwan	Systematic in the Aeolian Dust Iron Dissolution during Atmospheric Transport
17:20		Tetsuya Takemi Kyoto University, Uji, Kyoto, Japan	High-Resolution Modeling Study for the Vertical Transport of Dust Aerosols due to Microscale Boundary-Layer Processes
17:40		Zifa Wang Institute of Atmospheric Physics, CAS, China	Recent Progress in Regional Air Quality Modeling Research over China: IAP Contributions
18:00	*Symposium Banquet*		

10-Aug-2010	**Session Oral Presentations**

	Session 1	**Composition, emission and transformation of Asisan dust/aerosols and their impact on air quality and primary production**	
	Chairman	**Dr. Songmiao Fan & Prof. Tong Zhu**	
8:30		Gan Zhang Guangzhou Institute of Geochemistry, Guangzhou, China	Impact of anthropogenic emissions and open biomass burning on regional carbonaceous aerosols in south China
8:45		Fangqun Yu Atmospheric Sciences Research Center, SUNY at Albany, USA	Formation and transformation of secondary and primary aerosols over Asia
9:00		Maofa Ge, Shengrui Dong Institute of Chemistry, CAS, Beijing, China	Heterogeneous Chemistry of diethylamine on dust particles
9:15		Fujung Tsai Department of Marine Environmental Informatics, Keelung, Taiwan	Characterizing the southeastward transport of Asian dust
9:30		X. Jin Joint Institute for Regional Earth System Sciences and Engineering, University of California, Los Angeles, USA	Asian Dust and Primary Production in the North Pacific Ocean
9:45		Qi Zhang Department of Environmental Toxicology, University of California, Davis, CA, USA	Sources and Processes of Atmospheric Organic Aerosols: A Global Integrated View via Aerosol Mass Spectrometry
10:00		Yasuhito Igarashi Meteorological Research Institute, 1-1 Nagamine, Tsukuba, Japan	Evidence for Desertification in Asian Dust Source Regions: Implication from Relationship between Anthropogenic Radionuclides in Mongolian Surface Soil and Precipitation Rates
10:15	*Coffee break*		
	Chairman	**Dr. Fangqun Yu, Dr. Gan Zhang**	
10:30		Di Liu Guangzhou Institute of Geochemistry, Guangzhou, China	Development of a preparation system for the radiocarbon analysis of organic carbon in carbonaceous aerosols in China
10:45		Chengming Pang Institute of Atmospheric Physics, CAS, China	Chlorine depletion and mixing state of sea salt fine particles in ABL of Yellow Sea in spring

11:00	Xiaoyang Yang Chinese Research Academy of Environmental Sciences, China	Particle-associated polycyclic aromatic hydrocarbons in a source area of the Asian Dust
11:15	Hong Li Chinese Research Academy of Environmental Sciences, China	Characterization of Plant Wax n-Alkanes in Aerosols in Beijing during Spring Dust Storm Period
11:30	Kai Zhang Chinese Research Academy of Environmental Sciences, China	Research on variation characteristics of water-soluble salts in PM10 during sand dust process in Beijing
11:45	Gehui Wang Institute of Earth Environment, Chinese Academy of Sciences, Xian, China	Water-Soluble Organic Compounds in the Urban, Mountain and Marine Atmospheres over East Asia: Composition and Size Distribution
12:00	*lunch*	
Chairman	**Dr. Qilong Min & Prof. Huiwang Gao**	
13:30	Guangjian Wu Institute of Tibetan Plateau Research, China	The difference in major element composition of Asian dust on regional scale: evidence from ice core microparticles on the Tibetan Plateau
13:45	Jianhua Qi Ocean University of China, Qingdao, China	The concentration and size distribution of atmospheric particulate inorganic and bioaerosols in dust weather
14:00	Junbo Cui ETH (Swiss Federal Institute of Technology) Zurich, Switzerland	Dust evolution during the transport from desert areas of China and Mongolia to South-eastern China in 2008
14:15	Senlin Lu School of Environmental Sciences & Chemical Engineering,, Shanghai University, China	Why do the dust storm particles have relative lower bioreactivity compared with no-dust-storm particles? -a case study of Beijing mineral particles
14:30	Lei Jiang Chinese Research Academy of Environmental Sciences, China	Ab initio investigation of O_3 addition to double bonds of keto-limonene
14:45	Weijun Li Environment Research Institute, Shangdong University, China	Characterization of individual aerosol particles from the brown hazes in northern China

15:00		Xingang Dai Institute of Atmospheric Physics, CAS, China	Temperature Changes with Urbanization over the Last 50 Years in Interior Plain of Northeast China
15:15	*Coffee break*		
	Session 2	**Optical properties and transport of Asian dust/aerosols and impact on regional/global climate**	
	Chairman	**Prof. Zhanqing Li & Dr. Christina N. Hsu**	
8:30		Hsin-Chih Lai Cahang Jung Christian University, Taiwan	A Meteorological Overview of the High Ozone Polluted Days in Taiwan
8:45		X. Wang CNR – SPIN, Complesso Universitario Monte Sant'angelo, Italy	Special Aerosol Outbreak Event Observation in Napoli in the Framework of EARLINET Lidar Network
9:00		Qingyan Fu Fudan University, Shanghai China	The source and long-range transport of the highest-recorded pollution dust occurred over Yangzi River Delta, China
9:15		Kuan-Man Xu NASA Langley Research Center, VA, USA	Climate Modeling with an Improved Multiscale Modeling Framework
9:30		Yongxiang Hu NASA Langley Research Center, VA, USA	Using CALIPSO observations for studying aerosol and ice nucleation
9:45		Jun Wang University of Nebraska, Lincoln, USA	Improved algorithm for MODIS satellite retrievals of aerosol optical thickness over land in dusty atmosphere: Implications for air quality monitoring in China
10:00		Xiaoyan Jiang The University of Texas at Austin, USA	A sensitivity study of direct radiative effect of mineral dust aerosols in the Asian region with a coupled regional land-atmosphere-chemistry model
10:15		Can Li University of Maryland, College Park, USA	Anthropogenic pollution near dust source regions matters: Some results from *in situ* and satellite observations over northern China
10:30	*Coffee Break*		
	Chairman	**Dr. Si-Chee Tsay & Dr. Xin Yang**	

10:45	Kai Wang North Carolina State University, USA	Development of an Online Dust Module in CMAQ and its Application to Simulate the Trans-Pacific Transport of Asian Dust
11:00	Kan Huang Fudan University, Shanghai China	Relation between optical and chemical properties of dust/aerosol over Beijing and Yangzi River Delta, China
11:15	Meigen Zhang Institute of Atmospheric Physics, CAS, China	Episode simulation of Asian dust storms with an air quality modeling system
11:30	Xiaole Pan Institute of Atmospheric Physics, CAS, China	Diagnostic analysis of contribution of biomass burning on regional Carbon Oxide and Light Absorbing Carbon aerosol mass concentrations over rural tropospheric environment, East China
11:45	Yisheng Xu Chinese Research Academy of Environmental Sciences, China	Organic acid in neutral and positively charged atmospheric nucleation clusters: A theoretical study and atmospheric implications
12:00	*Lunch*	
	Chairman	**Prof. Alfred Wiedensohler & Prof. Jianmin Chen**
13:30	Xinhua Wang Chinese Research Academy of Environmental Sciences, China	Vertical profiles and size distribution of ultrafine particles measured by Aircraft over Bohai Bay
13:45	Chunsheng Zhao Peking University, China	HACHI (Haze in China) Project: hygroscopicity at high relative humidity and its relationship to aerosol optics and cloud physics
14:00	Yonghang Chen Tnstitute of Envirenment, Donghua University	Lidar remote sensing of aerosol properties of haze at Yangtze River Delta
14:15	Yan Yin Nanjing University of Information Science & Technology	Modeling the effects of mineral dust on cloud and precipitation
14:30	Zhiyuan Cong Institute of Tibetan Plateau Research, China	Aerosol optical properties at Nam Co, a remote site in central Tibetan Plateau

14:45		Zengzhou Hao The Second Institute of Oceanography, SOA, China	The Optical and Thermal Properties of Asian Dust Aerosol over Ocean
15:00		Xin Wang Lanzhou University, China	Surface Measurements of aerosol properties over Northwest China during ARM China-2008 deployment
15:15	*Coffee Break*		
		Plenary Oral Presentations	
	Chairman	**Prof. Peter Liss, Prof. Renyi Zhang, Prof. Mian Chin**	
15:30		Peter Liss University of East Anglia, Norwich, NR4 7TJ, UK	The spectre of marine geo-engineering
15:55		Mian Chin Laboratory for Atmospheres, NASA/Goddard Space Flight Center Greenbelt, MD, USA	Impact of Asian dust on climate and air quality
16:15		Shuenn-Chin Chang Environmental Protection Adminstration, Taiwan, Che-Ming Chang National Central University, Taiwan	The impact of Asian dust on Taiwan air quality
16:35		Hong Liao Institute of Atmospheric Physics, CAS, China	Role of dust-induced sea surface temperature responses in simulations of the climatic effect of dust
16:55		Oliver Wild Lancaster Environment Centre, Lancaster University, UK	Modeling the Intercontinental Transport of Ozone and Aerosols
17;15		Xin Yang Fudan University, Shanghai China	Secondary Aerosol Formation in Urban Atmosphere
17:35		Neng-Huei (George) Lin Department of Atmospheric Sciences, National Central University, Chung-Li, Taiwan	Overview of Dongsha Experiment and its observation on Asian dust
17:35-18:30		**Plenary discussion & Summing-up**	
	Chairman	**Prof. Robert Duce & Prof. Petr Liss**	

August 9-10	Posters 110cm×90cm	
	Chairman	**Prof. Zifa Wang, Prof. Zhigang Guo, Prof. Ying Chen**
	Junfeng Liu NOAA Geophysical Fluid Dynamics Laboratory, Princeton, NJ, USA	Factors controlling long-range transport of black carbon to the Arctic
	Junfeng Liu NOAA Geophysical Fluid Dynamics Laboratory, Princeton, NJ, USA	Inter-Continental Transport of PM2.5 and its impact on global health
	Gi Young Jeong Andong National University, Korea	Mineralogy of loess and Asian dust
	Yu Fu Institute of Atmospheric Physics, CAS, China	Biogenic emissions of volatile organic compounds in China estimated using satellite measurements of vegetation and the MEGAN module
	Wenyuan Chang Institute of Atmospheric Physics, CAS, China	Impacts of anthropogenic aerosols on extreme high temperatures in eastern China : A model simulation
	Jingjing Shang Institute of Atmospheric Physics, CAS, China	Impacts of ozone and aerosols on ultraviolet radiation at Xianghe in year 2008
	Lihui Han Beijing University of Technology, Beijing, China	Characterization and long-range transport of aerosol over Northern and Eastern China
	Liulin Yang Sun Yat-sen University, Guangzhou, China	Analysis of pollution characteristics and associated synoptic process of a severe dust event in Guangzhou
	Chuan Jin Ocean University of China, Qingdao, China	Diversity of microbe in bioaerosol in the Qingdao coastal region
	Zheng Liu Ocean University of China, Qingdao, China	Seasonal and Size Distribution of Atmospheric Particulate Inorganic Ions in Qingdao
	Qian Chen Nanjing University of Information Science & Technology	Simulation of a hailstorm with improved aerosol activation scheme
	Xiaomei Lu Beijing University of Aeronautics & Astronautics, China	Asian dust observed by CALIPSO lidar over Beijing in China
	Congrui Deng, Fudan University, Shanghai China	Characterization of Aerosols at the Summit of Mountain Tai in Central-eastern China

Yanfen Lin Fudan University, Shanghai China	The major contributor to the heavy haze over China
Kan Huang Fudan University, Shanghai China	The mixing of Asian dust with pollution aerosol and the transformation of aerosol components during the dust storm over China in spring, 2007
Chang Xu Fudan University, Shanghai China	The ultra-fine particle and the haze chemistry in Shanghai
Bing Hou Fudan University, Shanghai China	The characteristics, sources of carbonaceous aerosol over Shanghai and its implication on the formation of haze
Yilun Jiang Fudan University, Shanghai China	Characteristics, sources and formation of aerosol oxalate in Shanghai and its implication to haze pollution
Kan Huang Fudan University, Shanghai China	Biomass Burning & haze formation
Rong Zhang Fudan University, Shanghai China	Heavy pollution of As and Pb in aerosols over China
Qiongzhen Wang Fudan University, Shanghai China	Mixing of dust with pollution on the transport path of Asian dust--- revealed from the aerosol over Yulin, the north edge of Loess Plateau
Rui Guo Fudan University, Shanghai China	Characteristics of aerosols over Mongolia Gobi
Tian Wu Fudan University, Shanghai China	Characteristics of marine aerosols over East China Sea
Qiongzhen Fudan University, Shanghai China	The heavy dust pollution over Shanghai and Yangzi River Delta in 2010
Xing Wei Fudan University, Shanghai China	Did the special control measures improve the air quality in Beijing during 2008 Olympic Games?
Hao Yin Fudan University, Shanghai China	Atmospheric dry deposition of N species over Tai Lake, China

Fig. 1 Directions from Airport/Railway Station to Fudan University

Fig. 2　Map of Symposium Venues near Fudan University

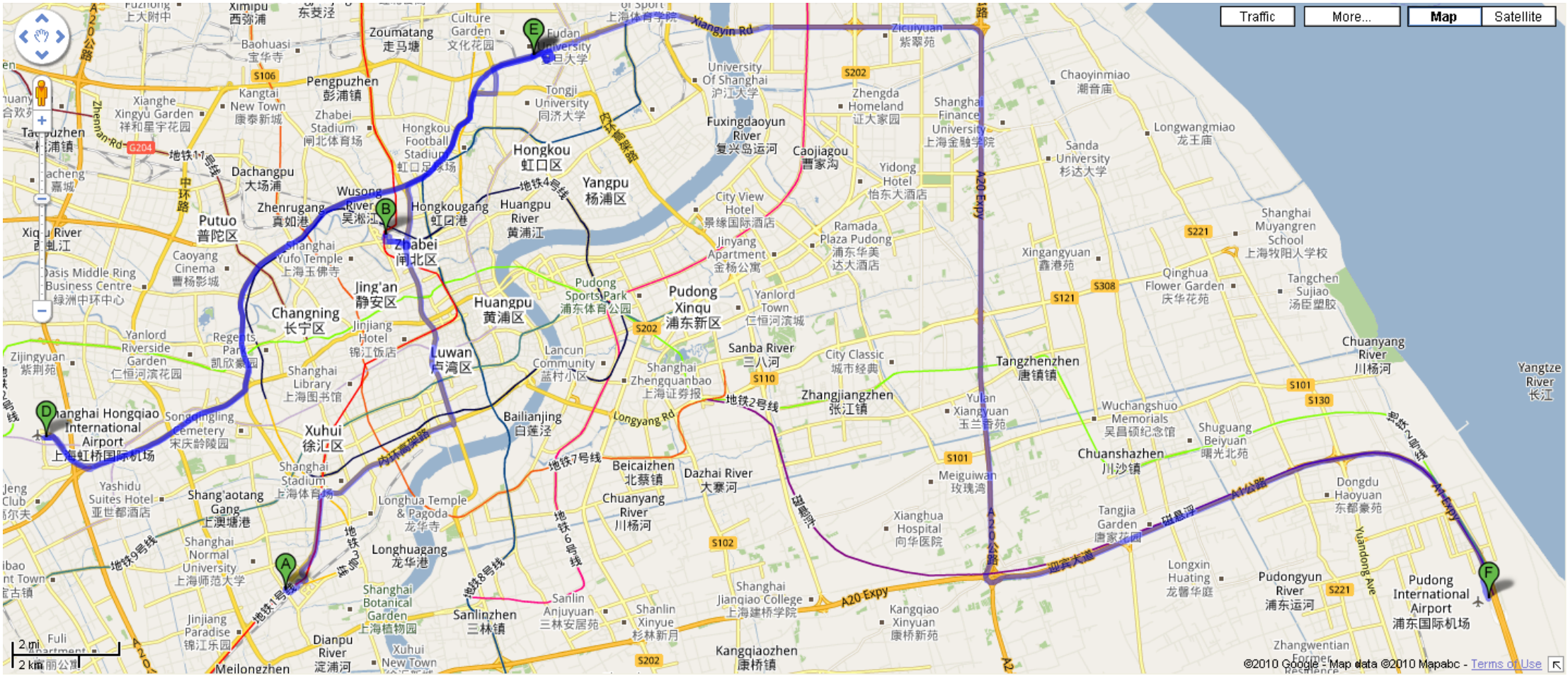


Fig. 1 Directions from Airport/Railway Station to Fudan University

E. Fudan University (复旦大学)　A. Shanghai South Railway Station (上海火车站南站)　B. Shanghai Railway Station (上海火车站)

D. Shanghai Hongqiao International Airport (上海虹桥国际机场)　F. Pudong International Airport (浦东国际机场)

Direction：

1. **F——>E：Subway #2 → at East Nanjing Rd. (南京东路站)Station Transfer to Subway #10 → at Wujiaochang (五角场站)Station →Get off，Walk or Take taxi to Hotel.**
2. **D——>E：Subway #2 → at Zhongshan Park Station Transfer to Subway #3 at Chifeng Stationget off, and take taxi to Hotel.**
3. **A——>E：Subway #3 at Chifeng Station（赤峰站）get off, and take taxi to Hotel.**
4. **B——>E：Subway #3 at Chifeng Station （赤峰站）get off, and take taxi to Hotel.**

Fig. 2 Map of Symposium Venues near Fudan University

附件二、「**The impact of Asian dust on Taiwan air quality**」簡報

行政院環境保護署
Environmental Protection Administration
Executive Yuan, R.O.C. (Taiwan)

The impact of Asian dust on Taiwan air quality

Shuenn-Chin Chang[1,2], Che-Ming Chang[3]
[1]Environmental Protection Administration, Taiwan
[2]Environmental Protection Society, Taiwan
[3]Center for Environmental Studies, National Central University, Taiwan

2010/8/10

Outline

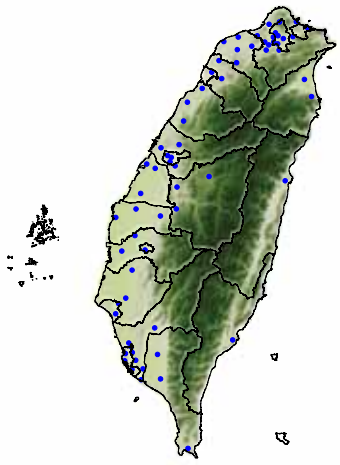
- Background
- Air Quality Monitoring System in Taiwan
- Characteristics of the impact of AD
- Three unusual Asian dust events
  - 2006/3/19 (dust mixed with pollutants)
  - 2009/4/25 (quick dust with high PM_{10})
  - 2010/3/22 (super dust with highest PM_{10})
- Summary

Background

- During winter - spring seasons, the Asian dust (AD) can be transported in a southeastward direction by a strong and cold high-pressure system affecting the air quality in Taiwan.
- The presence of AD may be associated with increased risk of respiratory and cardiovascular hospital admissions.
- It is important to reveal the pollutant constituents during AD events as basis for further investigation on their effects on human health.

Taiwan Air Quality Monitoring Network (TAQMN)

- 1980s
  - first set up by DEP
    - 19 stations in major cities
- 1993
  - TAQMN established by the TEPA
    - 66 stations, 2 Mobile Vans
    - 1 QA Lab
- 2004
  - expanded to 76 stations and renewed instrument
  - 8 Photochemical Assessment Monitoring Stations (PAMS)
  - 5 Aerosol Supersites

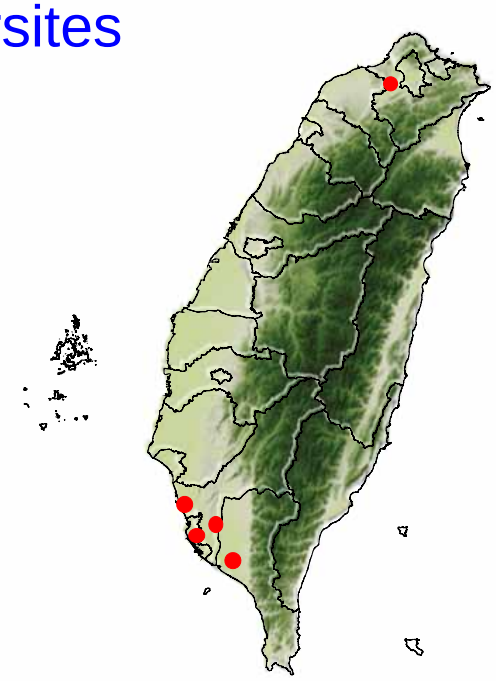


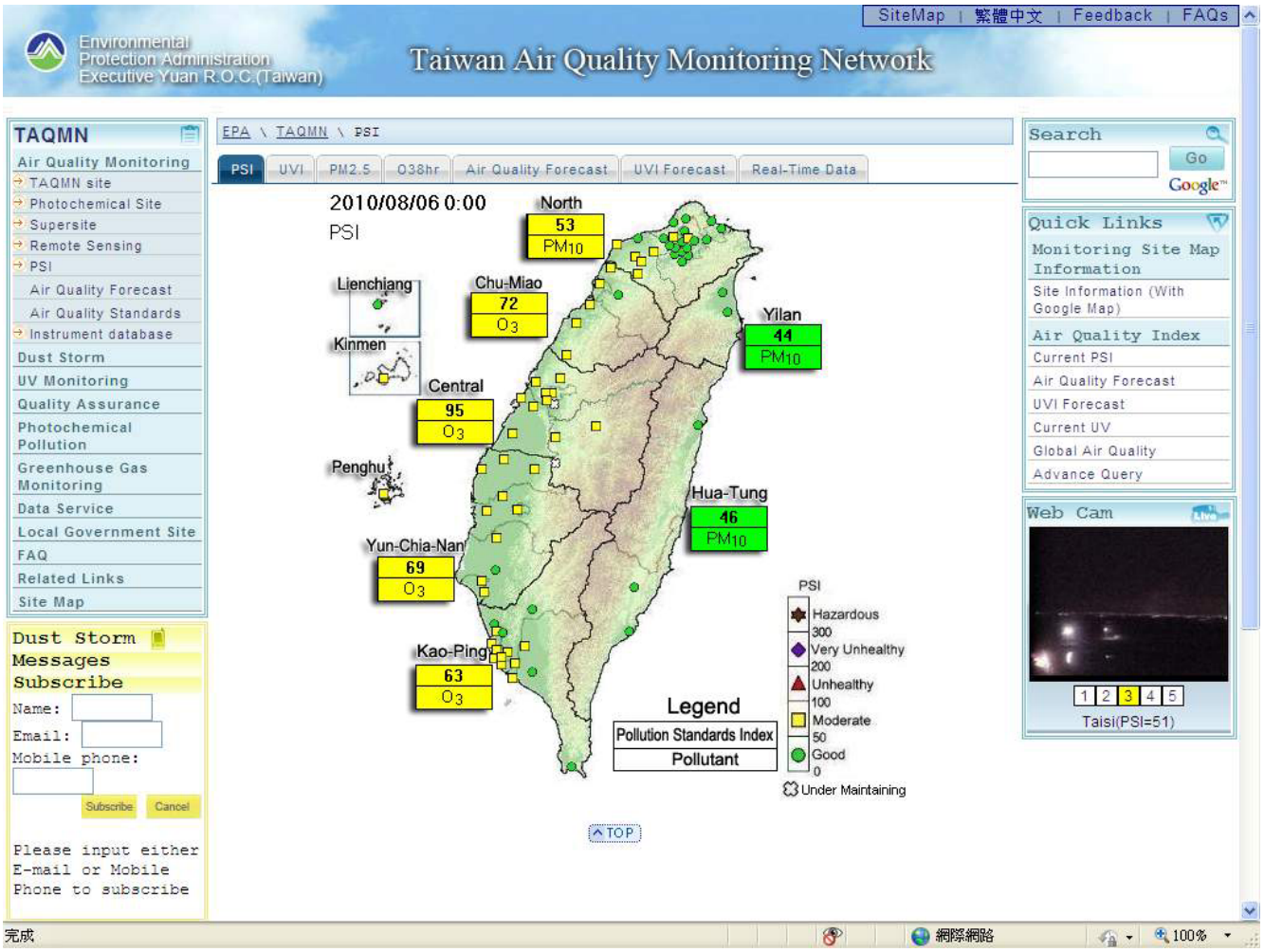
Ambient Monitoring station

- Criteria pollutants
  - PM_{10}, CO, SO_2, NO_X, O_3
- Meteorological parameters
  - Wind speed, Wind direction, Temperature, Humidity, Rainfall
- Others
  - Acid rain
  - THC, CH_4, NMHC
  - $PM_{2.5}$
  - UVB, UVA
  - BTEX
  - CO_2

Aerosol Supersite

- Measurements of supersites
  - PM_{10}, $PM_{2.5}$ mass
  - $PM_{2.5}$ speciation
    - Sulfate, nitrate
    - OC, EC
  - Size distribution
  - Scattering coefficient

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Environmental Protection Administration Executive Yuan R.O.C.(Taiwan)
Taiwan Air Quality Monitoring Network
TAQMN
Air Quality Monitoring
TAQMN site
Photochemical Site
Supersite
Remote Sensing
PSI
Air Quality Forecast
Air Quality Standards
Instrument database
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UV Monitoring
Quality Assurance
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Central
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O3
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Hua-Tung
46
PM10
Yun-Chia-Nan
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O3
Kao-Ping
63
O3
PSI
Hazardous
300
Very Unhealthy
200
Unhealthy
100
Moderate
50
Good
0
Under Maintaining
Legend
Pollution Standards Index
Pollutant
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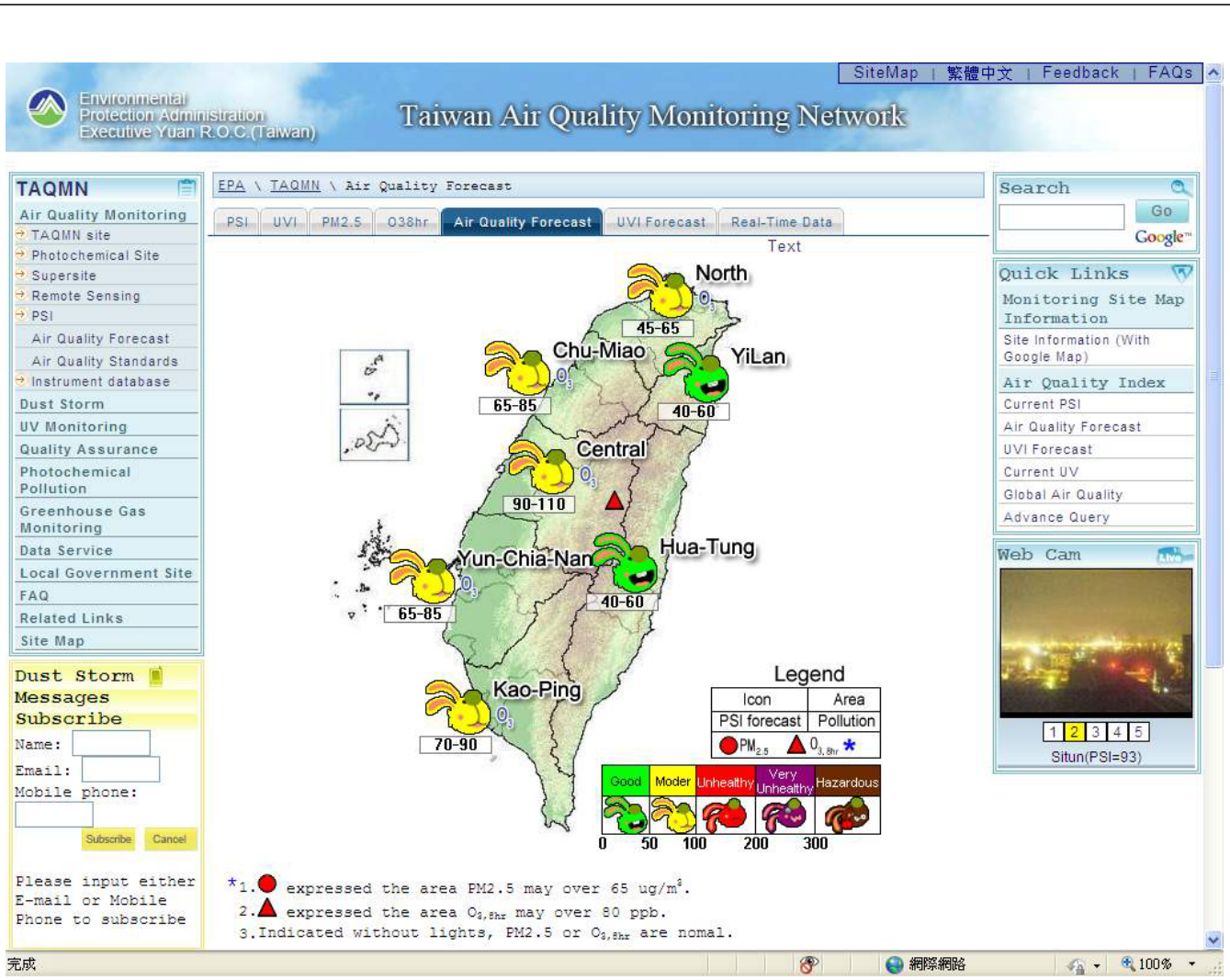
Site Information (With Google Map)
Air Quality Index
Current PSI
Air Quality Forecast
UVI Forecast
Current UV
Global Air Quality
Advance Query
Web Cam
1 2 3 4 5
Taisi(PSI=51)
完成
網際網路
100%


SiteMap | 繁體中文 | Feedback | FAQs
Environmental Protection Administration Executive Yuan R.O.C.(Taiwan)
Taiwan Air Quality Monitoring Network
TAQMN
Air Quality Monitoring
TAQMN site
Photochemical Site
Supersite
Remote Sensing
PSI
Air Quality Forecast
Air Quality Standards
Instrument database
Dust Storm
UV Monitoring
Quality Assurance
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UVI
PM2.5
O38hr
Air Quality Forecast
UVI Forecast
Real-Time Data
Text
North
45-65
Chu-Miao
65-85
YiLan
40-60
Central
90-110
Yun-Chia-Nan
65-85
Hua-Tung
40-60
Kao-Ping
70-90
Legend
Icon
Area
PSI forecast
Pollution
PM2.5
O3, 8hr
Good
Moder
Unhealthy
Very Unhealthy
Hazardous
0
50
100
200
300
*1. expressed the area PM2.5 may over 65 ug/m3.
2. expressed the area O3,8hr may over 80 ppb.
3.Indicated without lights, PM2.5 or O3,8hr are nomal.
Search
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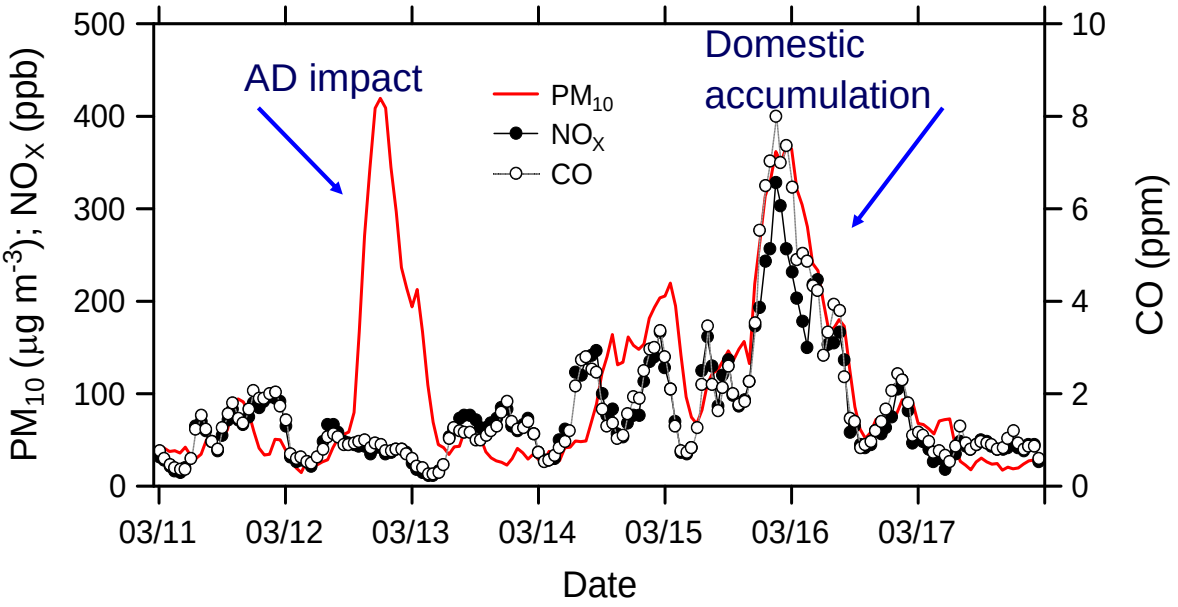
Air Quality Index
Current PSI
Air Quality Forecast
UVI Forecast
Current UV
Global Air Quality
Advance Query
Web Cam
1 2 3 4 5
Situn(PSI=93)
完成
網際網路
100%

Characteristics of the impact of AD



- AD event (dust rain) on March 12, 1995.

Reports of AD event on March 12, 1995

台灣日報 84.3.14 五版 監資處 環保署處

基隆宜蘭地區前晚下了一場泥雨

環保及氣象單位無法解釋原因 推測酸雨程度惡化

民眾疑協和電廠排放黑煙肇致基隆環保局檢視研判認應無關

台灣時報 84.3.14 監資處

鍋黑背廠電和協 落直直雨黑

首禍出揪促人芳瑞 白清其還位單保環

台灣時報 84.3.14 八版 監資處 北版 省環保處 監資處

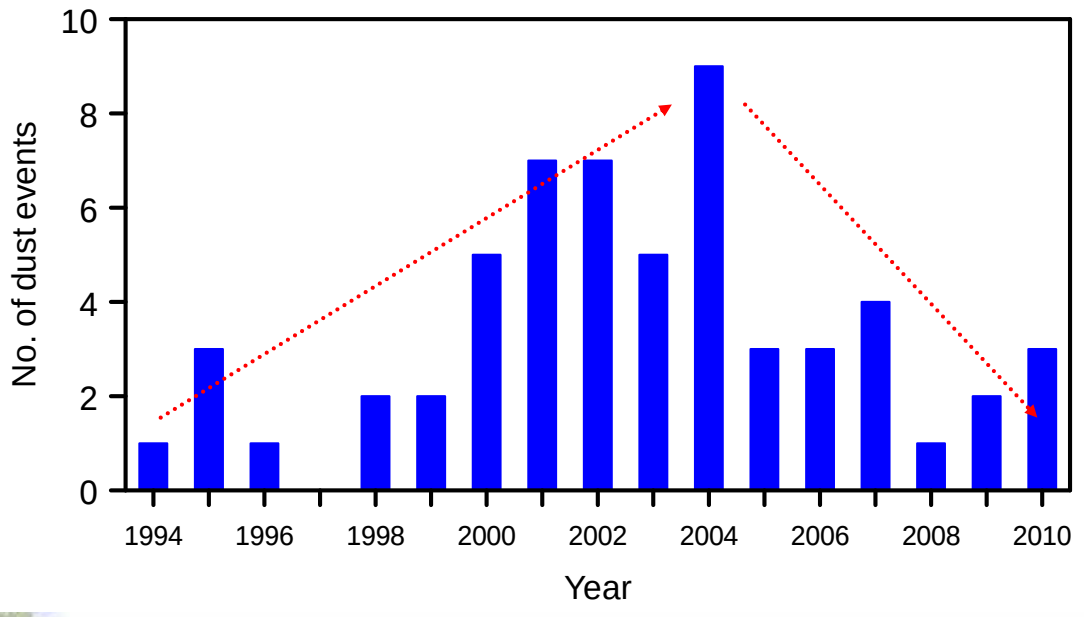
宜蘭下紅泥雨 居民驚訝

有人疑係廢土入侵造成 氣象局人員也不了解

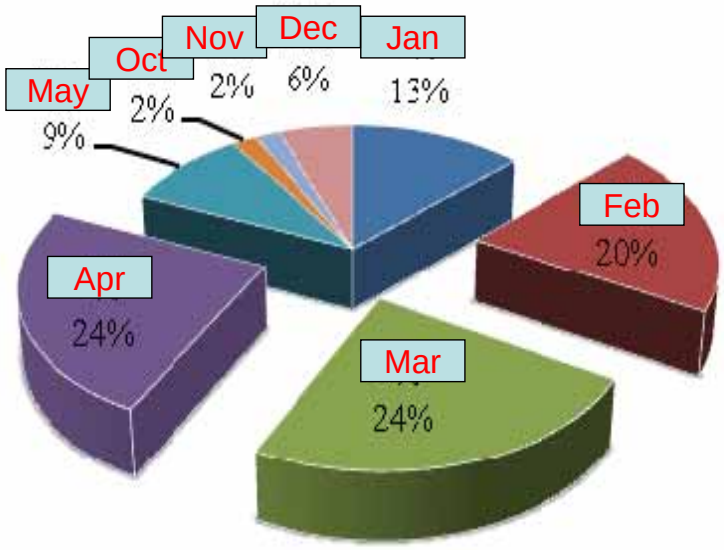
東北角下黑雨 一片灰濛濛

居民疑係附近火電廠造成

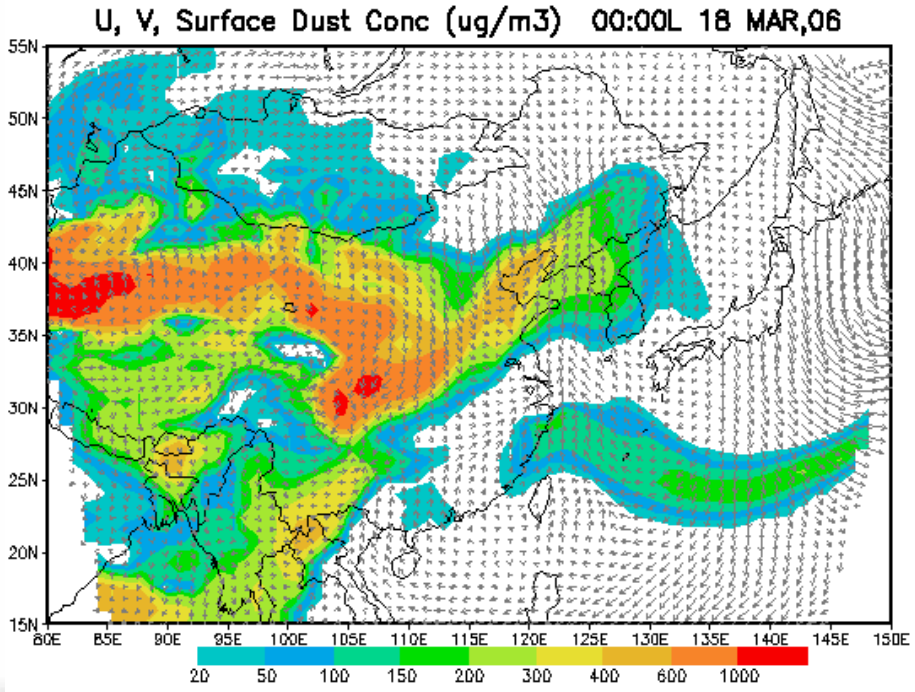
Number of AD events from 1994 to 2010



Monthly distribution of AD event



AD with pollutants in 2006



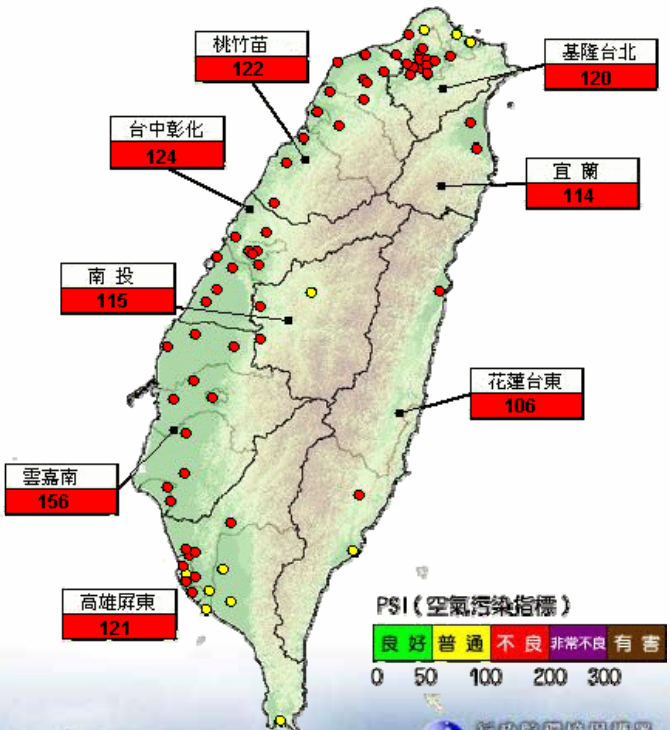
Air quality is impaired


近兩年最嚴重 沙塵暴 午後遠颺


塵暴發威 台東機場關閉

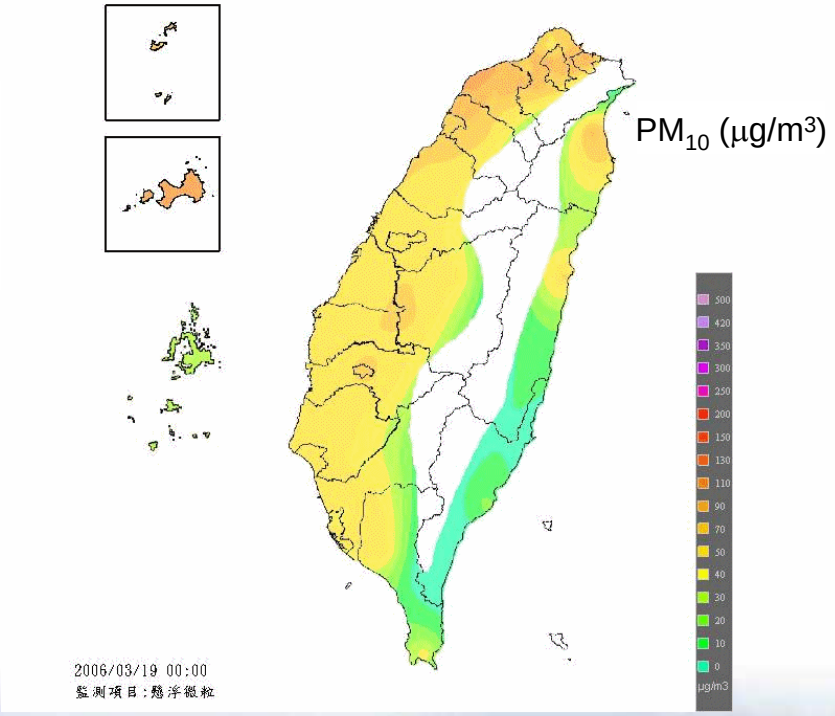
過敏激增 騎士：眼睛蒙呼吸


沙塵暴來了 台北天空灰濛濛



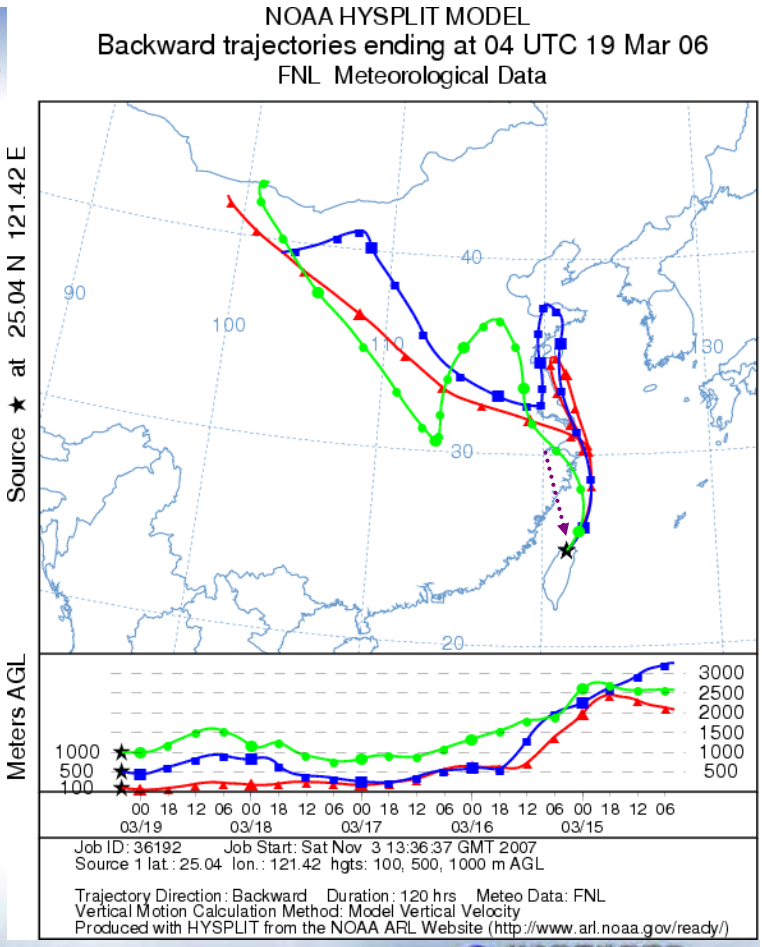
Dust moves from North to South

- Highest PM_{10} ~ 400 μg/m³.

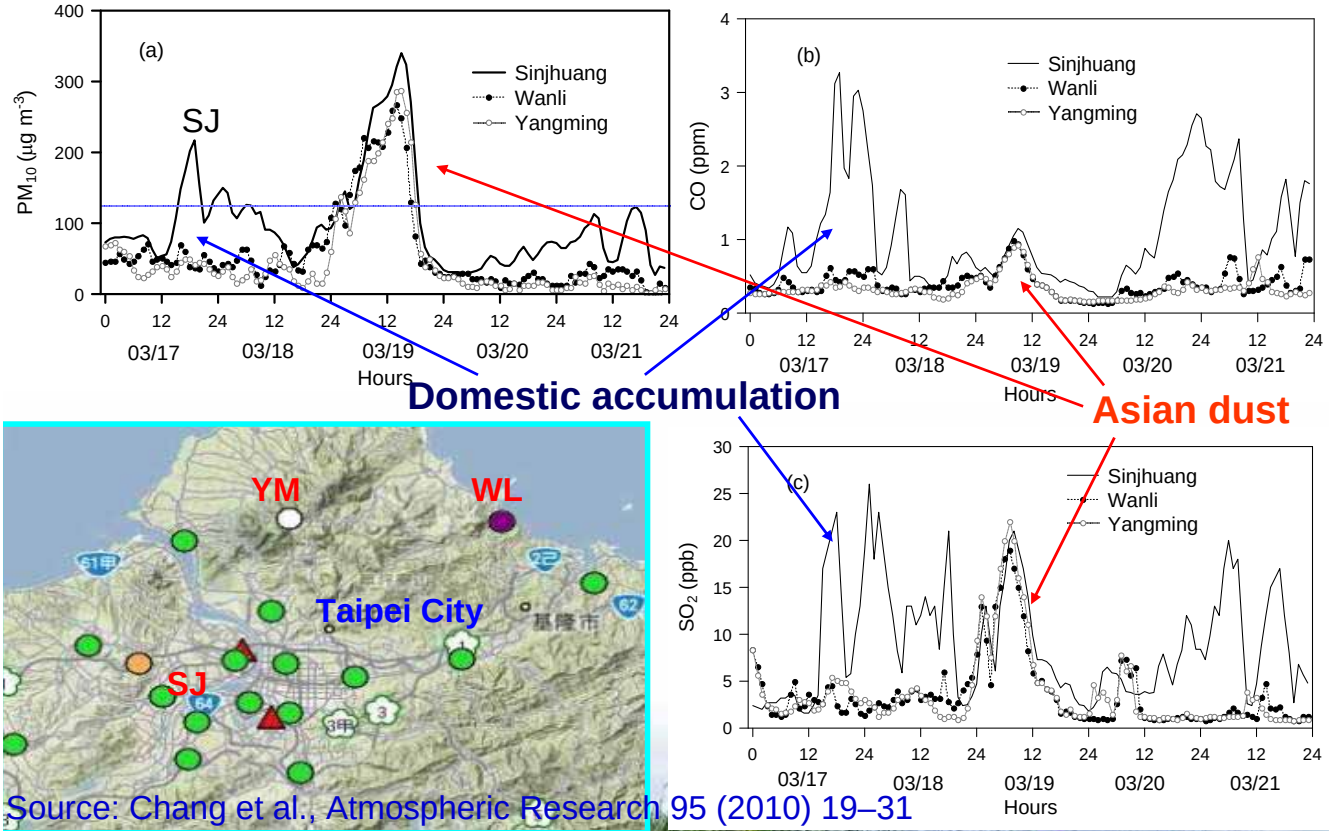


Backward trajectories

- From source area to Taipei: 4 days
- From Shanghai to Taipei: 2 days

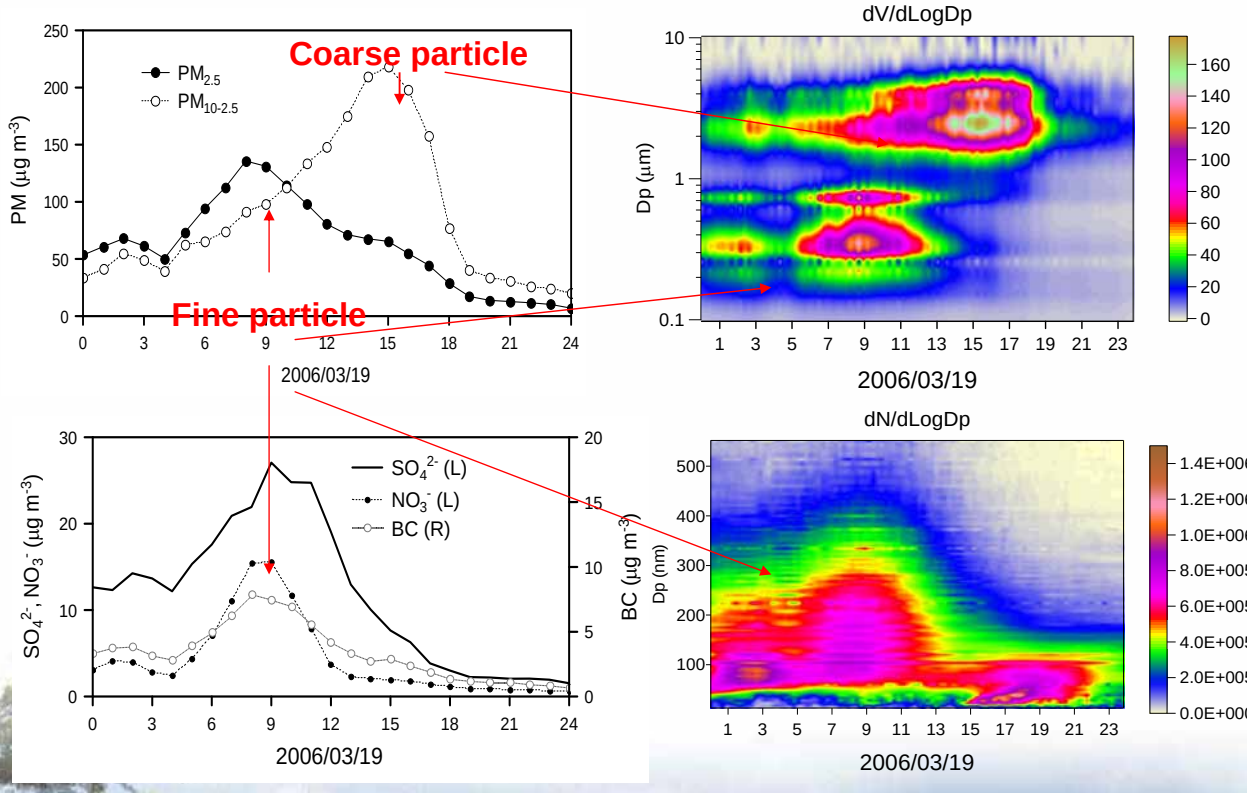


PM_{10}, CO, SO_2 during AD event



Source: Chang et al., Atmospheric Research 95 (2010) 19–31

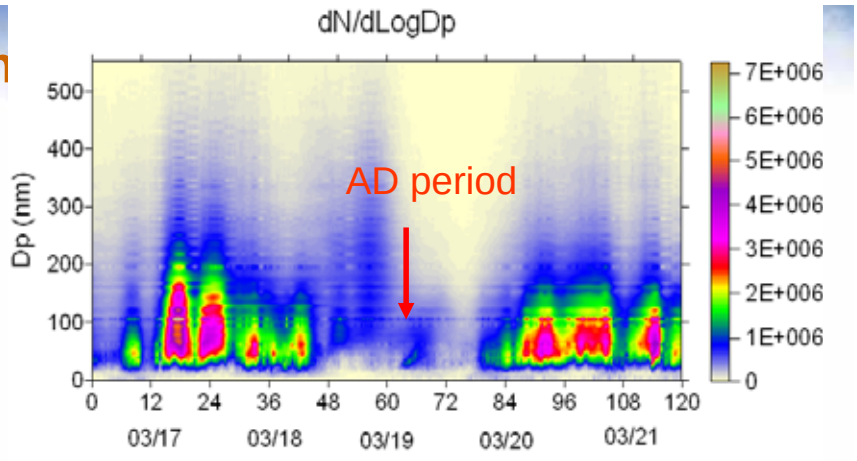
Size distribution and $PM_{2.5}$ speciation



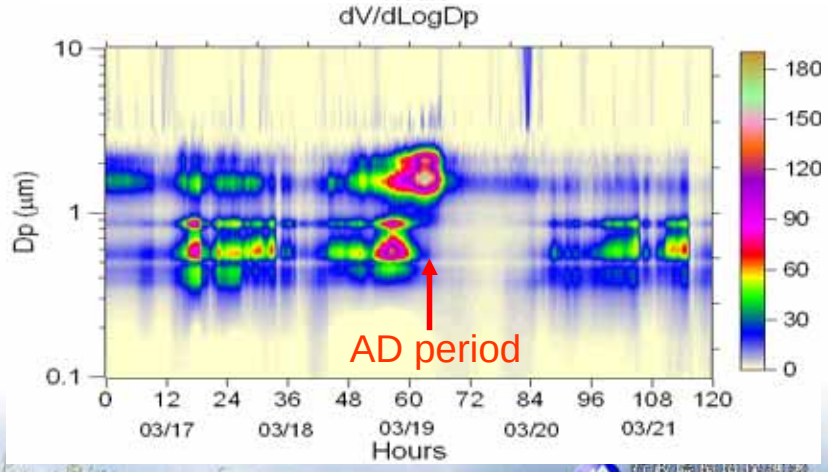
Source: Chang et al., Atmospheric Research 95 (2010) 19–31

Size distribution

- number size spectra



- volume size spectra



Source: Chang et al., Atmospheric Research 95 (2010) 19–31

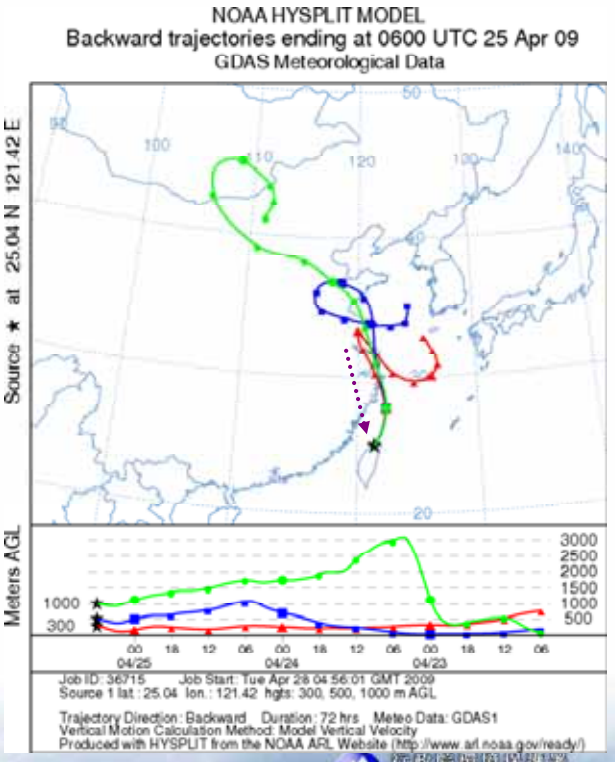
2009 AD event (Apr 25)

- The hourly PM_{10} concentrations higher than 1000 $\mu g\ m^{-3}$, about 20 times higher than usual level, were observed at several sites over northern Taiwan.

Visibility impairment

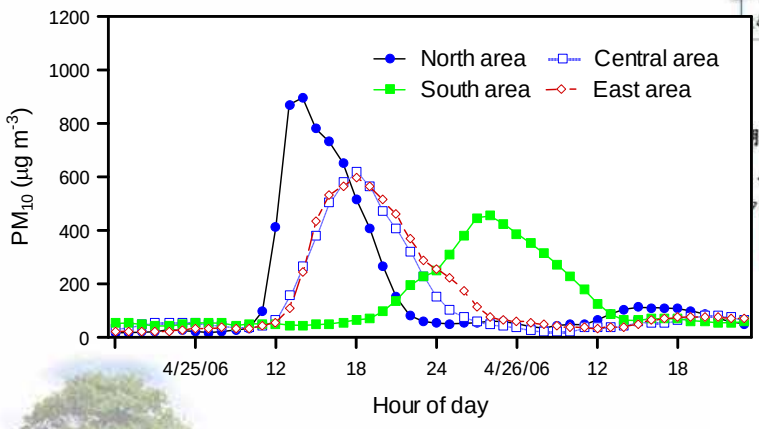
2009 AD event

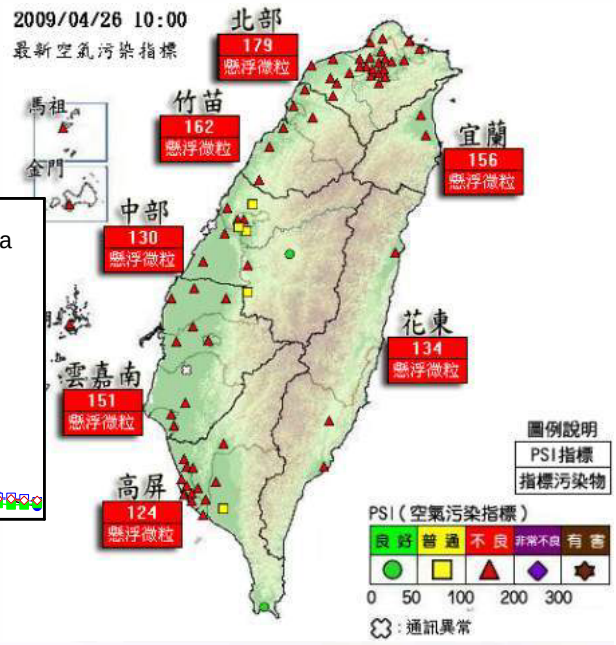
- Taipei PM_{10} concentration was over 1000 μg m^{-3}.
- From source to Taipei: 2 days
- From Shanghai to Taipei: 1 day



2009 AD event

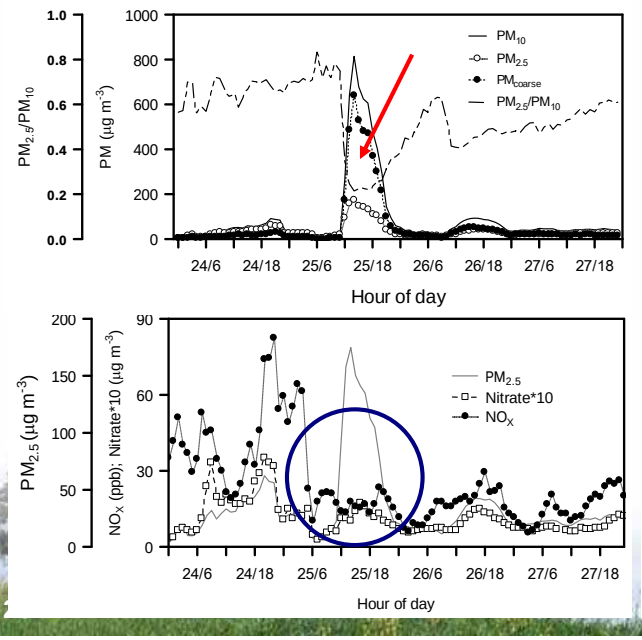
- High PM_{10} move from the North to the South.

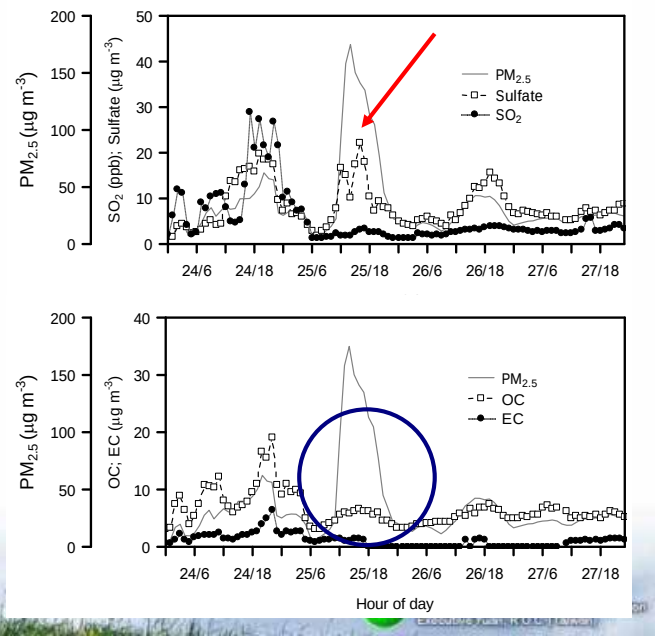




2009 AD event

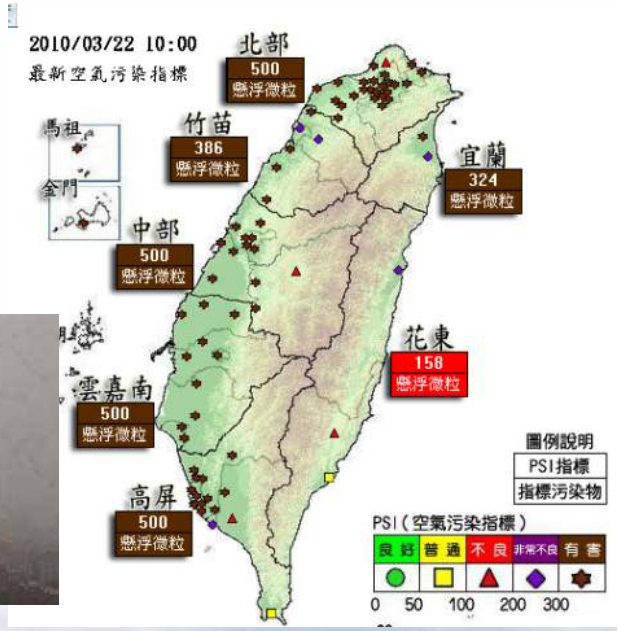
- $PM_{2.5}/PM_{10}$ deceases
- Only $PM_{2.5}$ sulfate increased





2010 super AD event

- 2010/3/21 AD event
  - 100 < PSI <199 : 17 sites
  - 200 < PSI <299 : 12 sites
  - PSI > 300: 40 sites

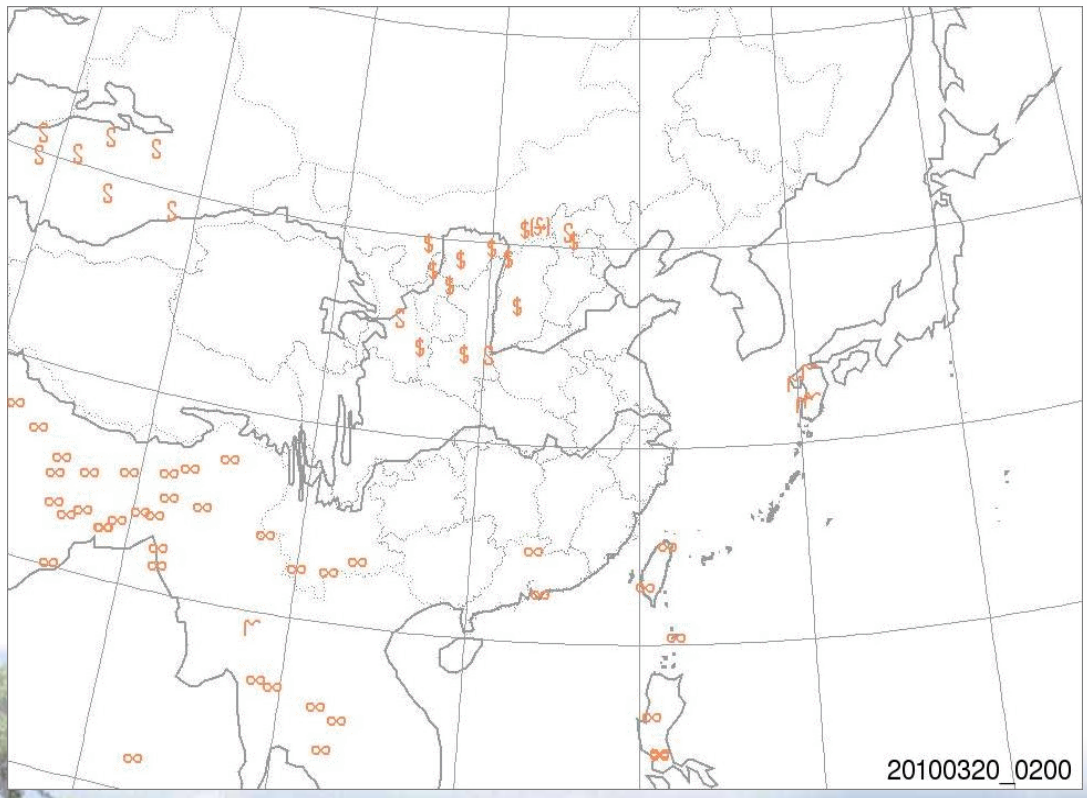


Visibility impairment

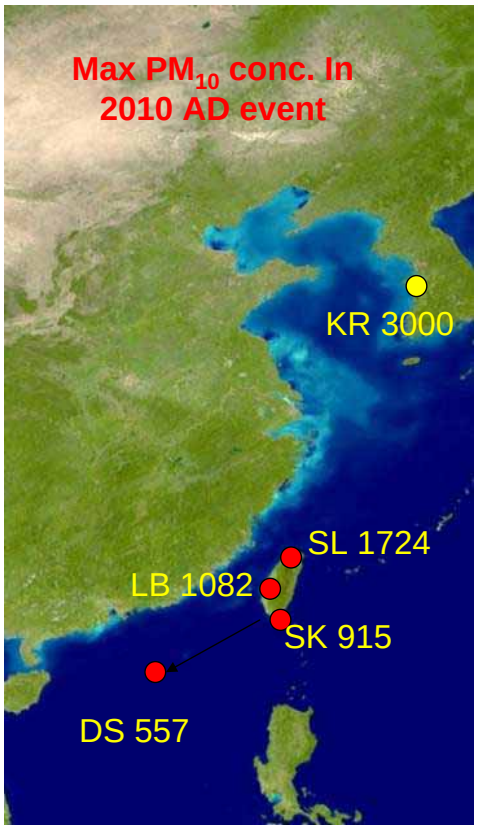
Reports of 2010 AD event

Reports of 2010 AD event

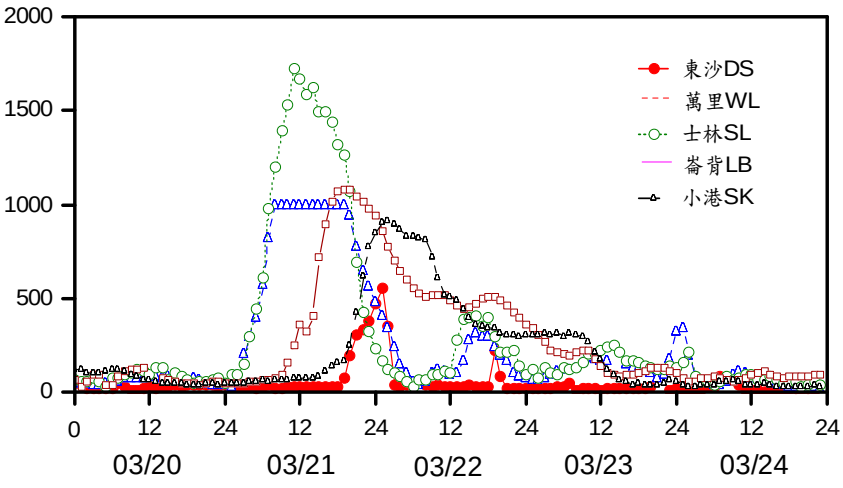
Surface observation of dust



2010 AD event



- Max PM_{10} is 1724 μg m^{-3} in Taipei
- Dust spreads over Dongsha island (PM_{10}= 557 μg m^{-3})



Summary

- The trans-boundary transport of AD and other air pollutants is becoming more crucial to reach national goals of air quality standard.
- How to improve the accuracy of AD forecast is a challenge task.

Thank you for your attention!!