



Urban Air Quality Monitoring Activities in Metro Manila



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<http://www.observatory.ph/>



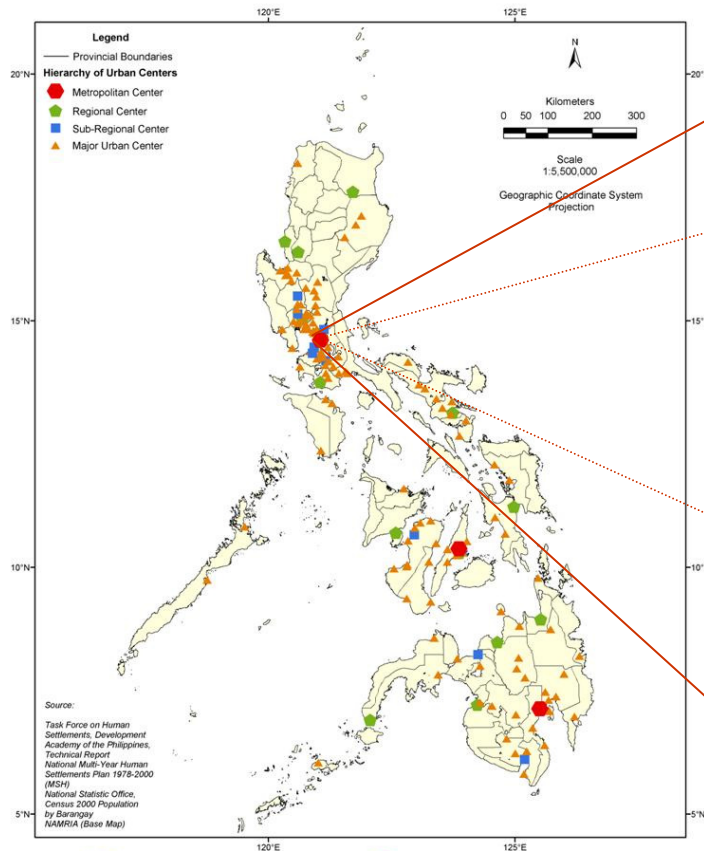
Outline

- Overview of Metro Manila
- Particulate Matter (PM) Monitoring Activities by the Manila Observatory
- PM Monitoring Activities by Other Institutions
- Other Related Activities
- Summary

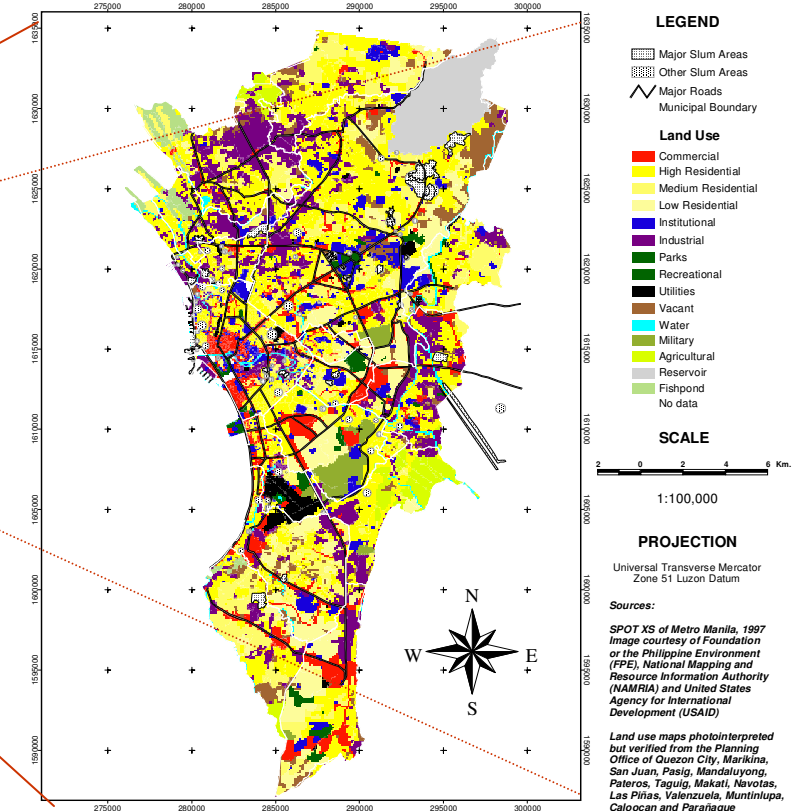


Overview of Metro Manila

Hierarchy of Urban Centers (2000)



Metro Manila Land Use (1997)



MANILA OBSERVATORY



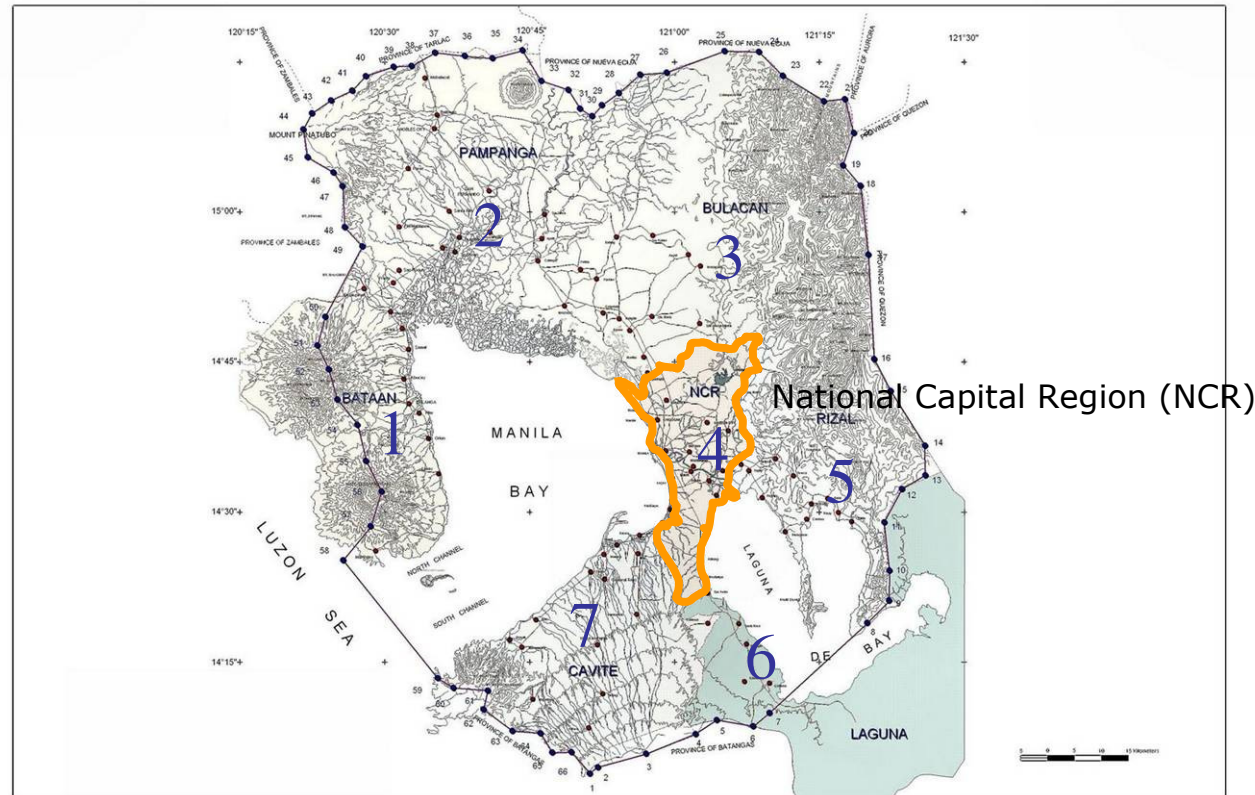
DEPARTMENT OF ENVIRONMENT AND
NATURAL RESOURCES

- Metro Manila has a total land area 636 sq. kms, 0.2% of the Philippines total land area.
- It has a population of 9,932,560 (2000 Census), 12,98% of the Philippine population; and its population density is 15,617 persons/sq. kms. <http://www.census.gov.ph/data/pressrelease/2002/pr02178tx.html>



Overview of Metro Manila

Metro Manila Airshed



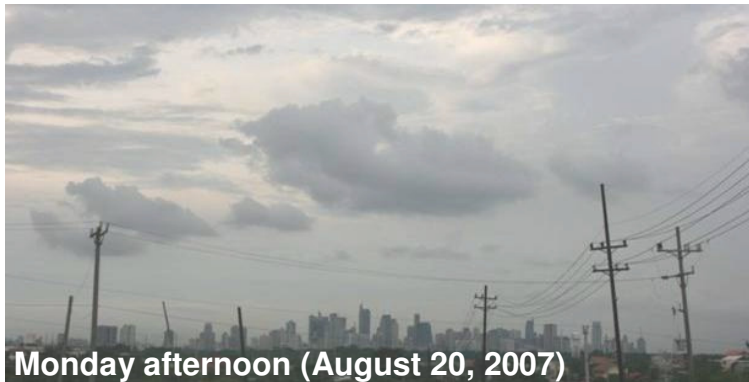
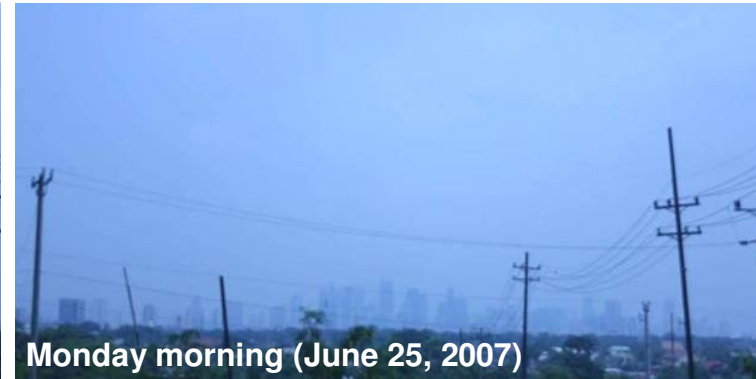
<http://www.emb.gov.ph/mmairshed/>

- The Metro Manila Airshed was defined based on the Philippine Clean Air Act. Seven provinces share the Metro Manila Airshed.



Overview of Metro Manila

Makati, Metro Manila



- The view of Makati (a major business center In Metro Manila) is oftentimes obscured by pollutants.



PM Monitoring Activities

Monitoring by the Manila Observatory

- Particulate Matter (PM) samples are collected on Filter Membranes using Air Samplers.
- Samples are weighed on a Microbalance.
- Samples are analyzed for Ionic and Elemental Content.

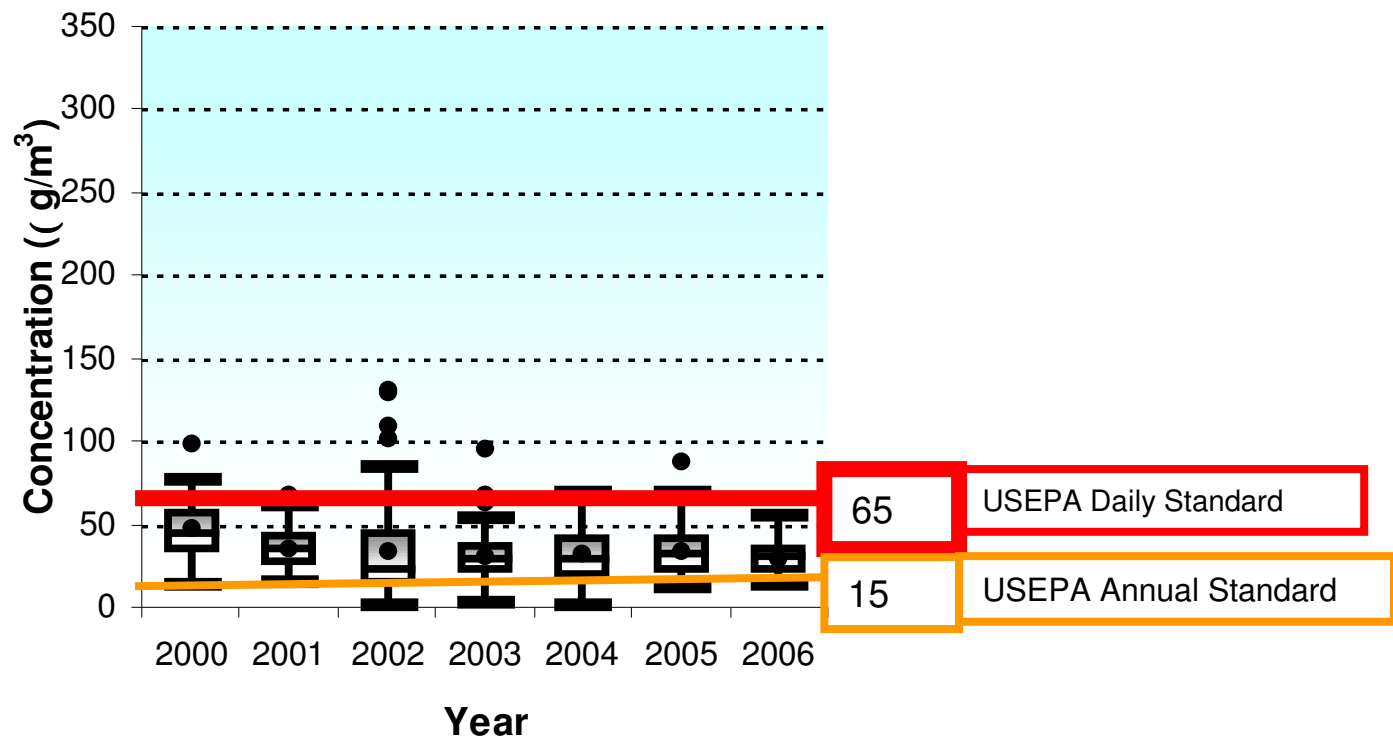




PM Monitoring Activities

Results

Manila Observatory, QC (Mixed Site) PM2.5 Concentrations

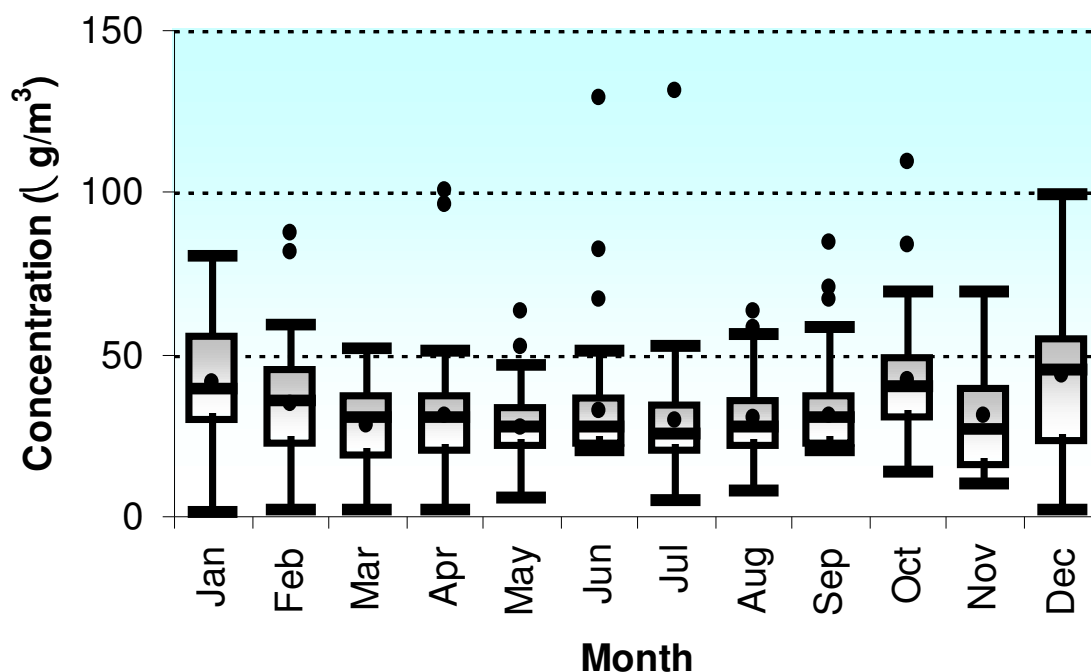


- Average measured PM2.5 values at the Manila Observatory were greatest in 2000 and decreased thereafter. The USEPA Annual Standard was exceeded in all years.



PM Monitoring Activities

Manila Observatory, QC (Mixed Site)
PM2.5 Monthly Boxplots (2000-2006)

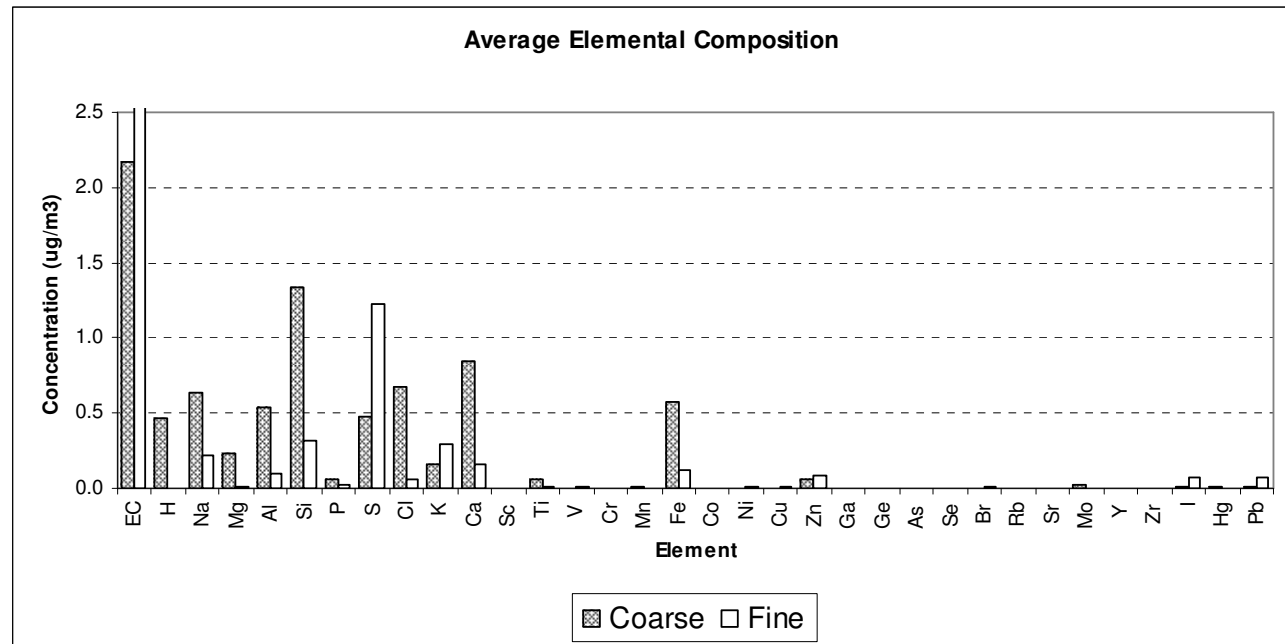


- Measured PM2.5 values were more widely distributed during the dry season. Average PM2.5 values were least during the wet season.



PM Monitoring Activities

Composition of Particulates in Manila Observatory (2004)



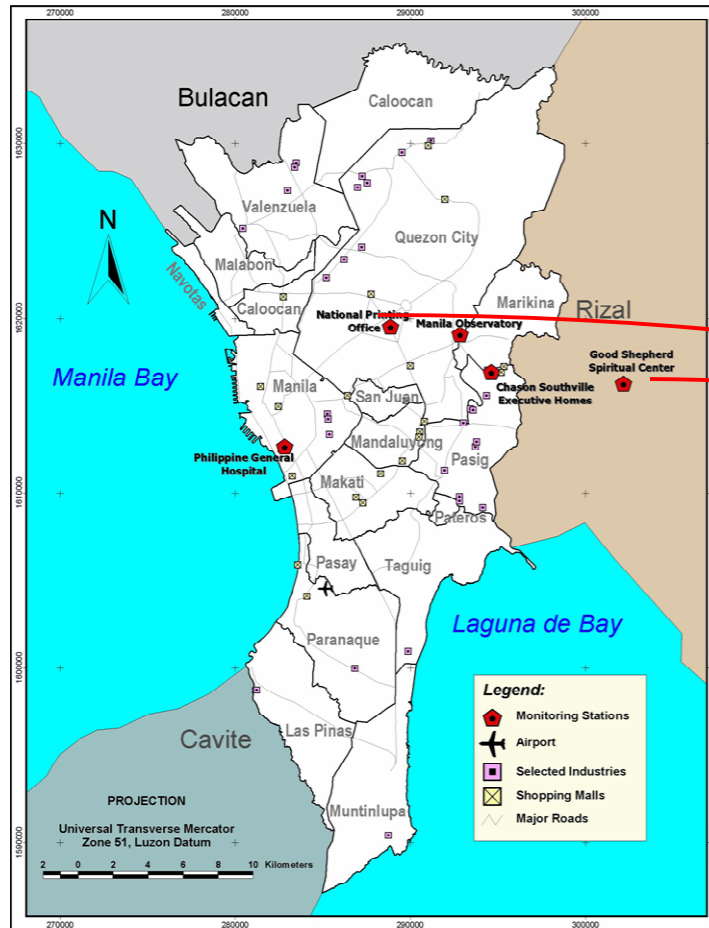
- Elements associated with mechanical processes such as soil re-suspension (Al, Si, Fe, Mn) and sea spray (Na, Cl) tend to have higher concentrations in the coarse fraction than in the fine while those associated with secondary pollutant formation (S) and combustion (Elemental C, K, Zn, Pb) tend to exhibit the opposite trend.



PM Monitoring Activities

Monitoring Sites (2000-2004)

- **GS, Antipolo (Background)**
- **MO, Quezon City (Mixed)**
- **NPO, Quezon City (Traffic)**
- **PGH, Manila (Commercial)**
- **PS, Pasig (Industrial)**



Manila Observatory
Spatio Temporal Distribution of
Fine Particulate Matter



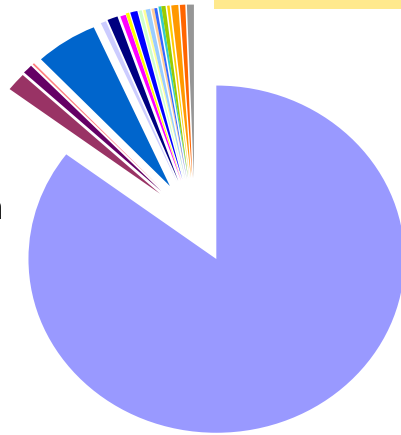
Source:
NAMRIA for Provincial, City and Municipal Boundaries



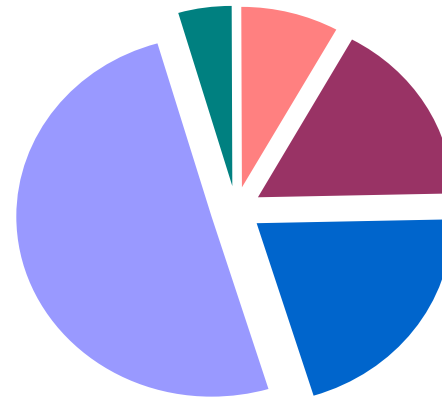
PM Monitoring Activities

Receptor-Based Modeling

**Elemental
Composition**



**Source Identity &
Apportionment**



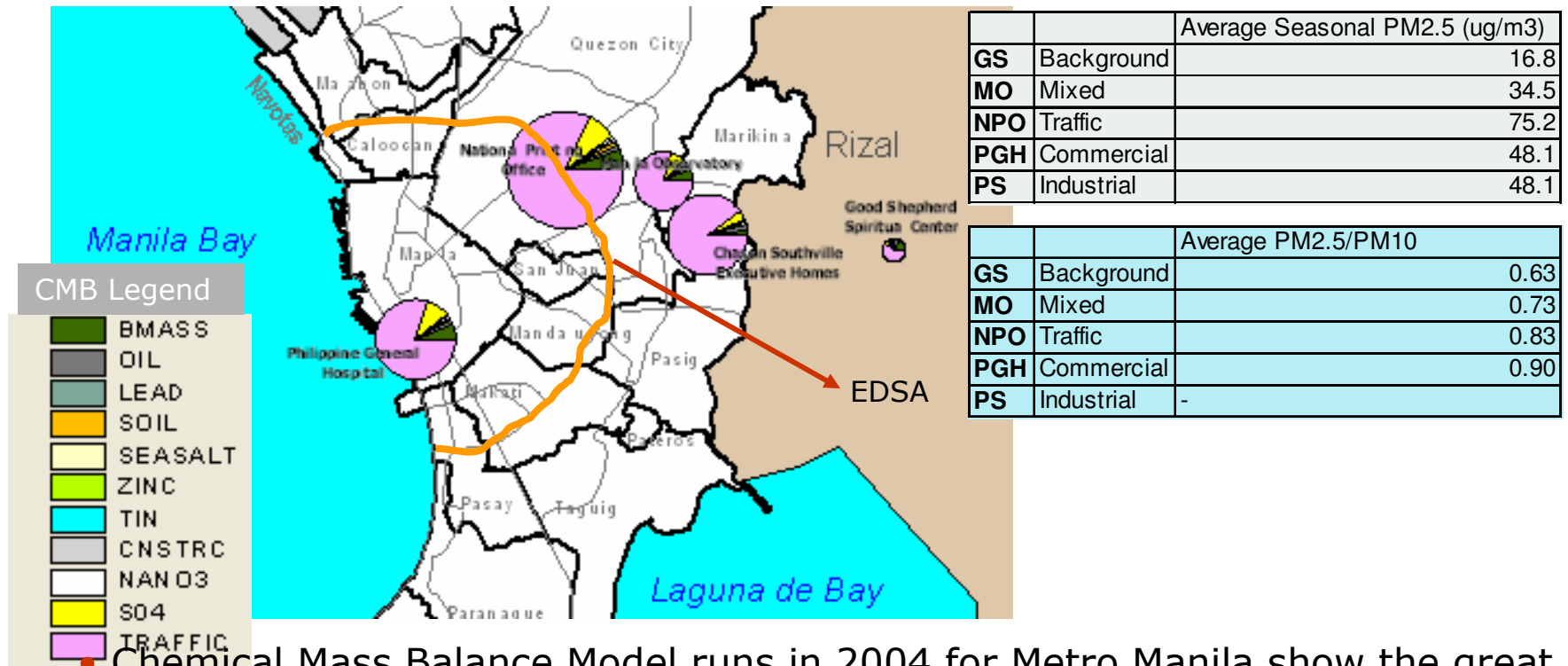
**Chemical Mass Balance 8
(CMB8)
And
Positive Matrix
Factorization (PMF)**

- Ionic and elemental content are inputted into a model which is run in order to determine source contributions to measured PM at a receptor site.



PM Monitoring Activities

Receptor Modeling Results (PM_{2.5})



- Chemical Mass Balance Model runs in 2004 for Metro Manila show the great contribution of traffic to the sites in and around Metro Manila.
- Positive Matrix Factorization points to a significant contributing factor to both the mixed site (MO) and background site (GS) PM_{2.5} dominated by Black Carbon.

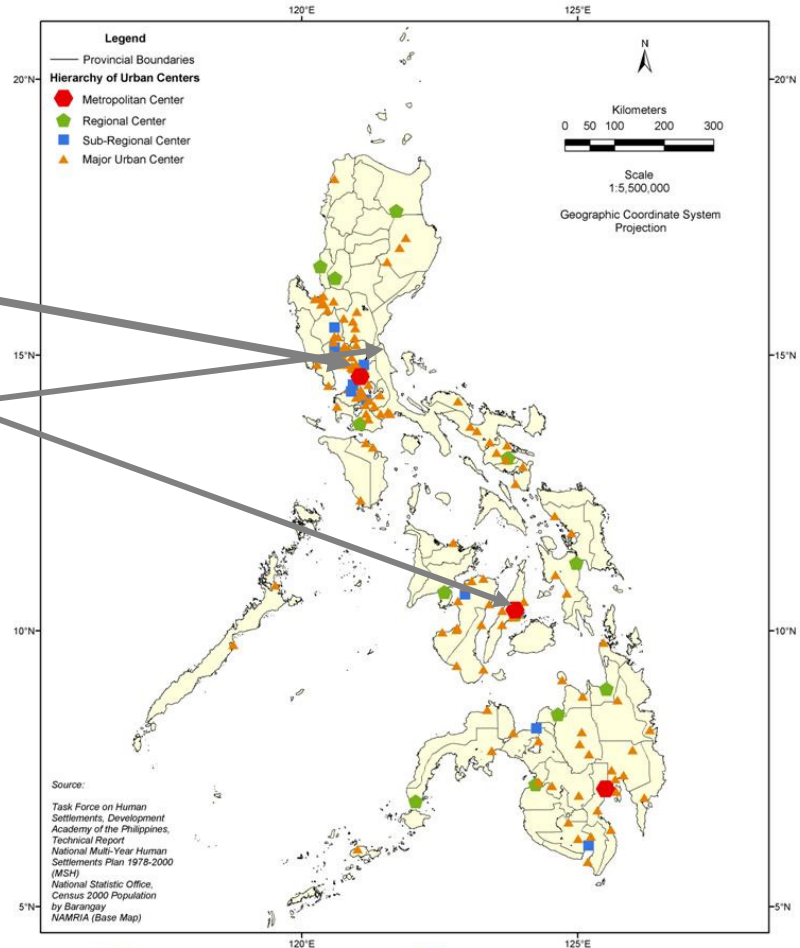


PM Monitoring Activities

Monitoring Sites (2004 - present)

- MO, Quezon City (Mixed)
- CB, Cebu City (Mixed)
- GB, Gabaldon, Nueva Ecija (Background)

Hierarchy of Urban Centers (2000)



MANILA OBSERVATORY

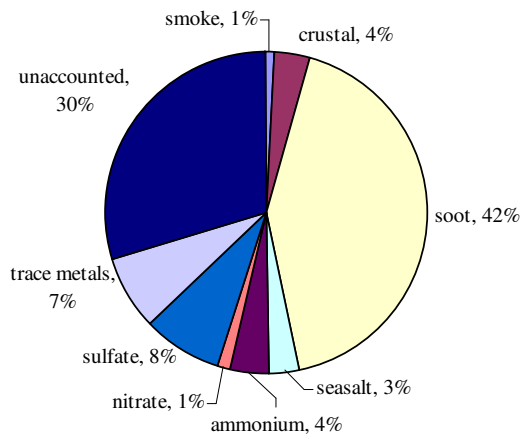


DEPARTMENT OF ENVIRONMENT AND
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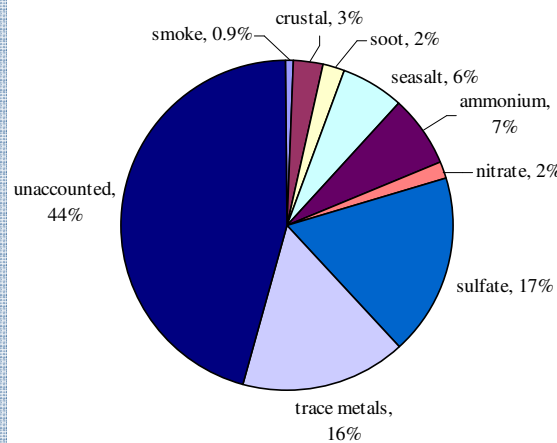
PM Monitoring Activities

MO (Mixed Site)



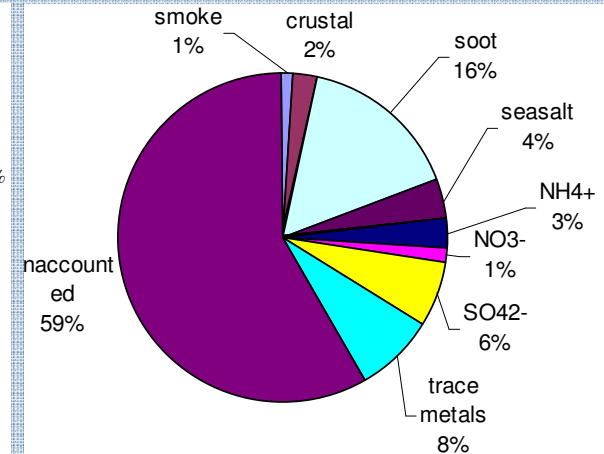
Reconstructed Mass of Dry Season PM2.5

GB (Background Site)



Reconstructed Mass of PM2.5

CB (Mixed Site)



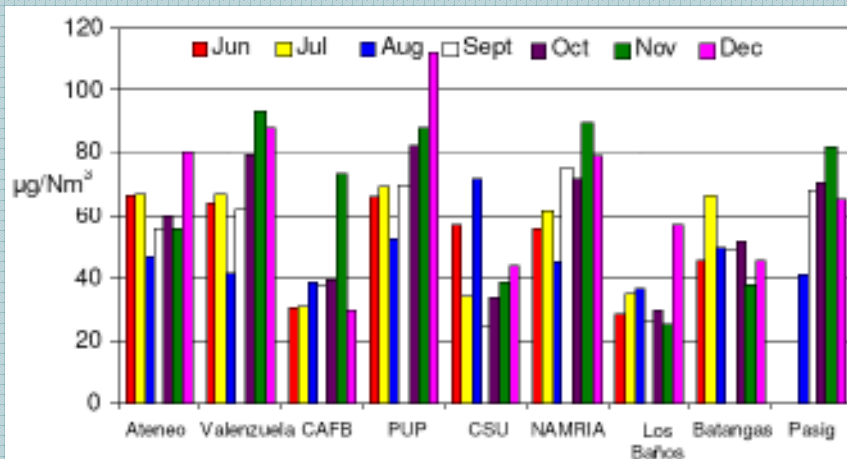
Reconstructed Mass of PM2.5

- Contribution to PM2.5 in MO is mostly from combustion; source contributions remain fairly constant across seasons.
- Sulfate and trace metals are the major contributors to PM in Gabaldon.



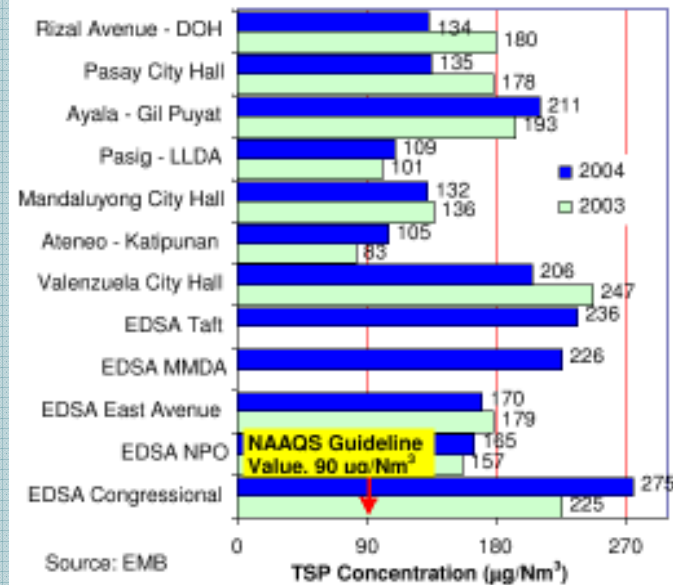
PM Monitoring Activities by Other Institutions

DENR - EMB



Monthly averaged PM10 Concentrations in the Metro Manila Airshed Air Quality Monitoring Stations, June - December 2004. National Air Quality Status Report (2003-2004)

Annual Geometric Mean of Roadside TSP Levels in Metro Manila, 2003 - 2004 (mg/Nm³)

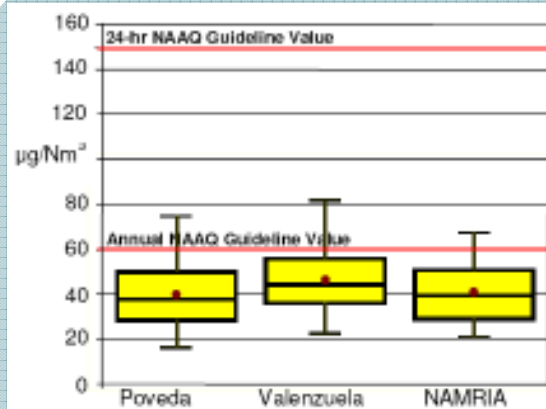


- PM10 levels in 2004 in the designated Metro Manila Air Shed sites increased in December.
- Monitoring by the DENR-EMB(NCR) along roadsides in Metro Manila reveal highest roadside TSP levels along major intersections.



PM Monitoring Activities by Other Institutions

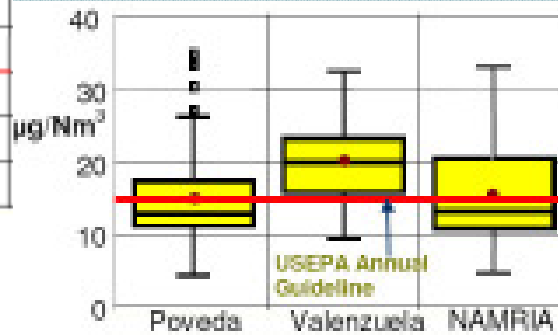
PNRI



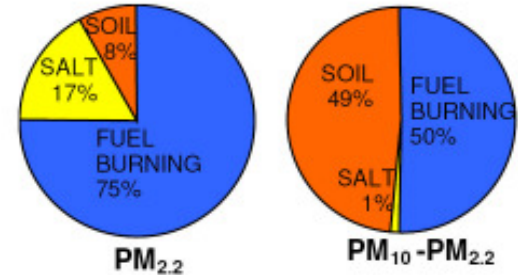
Source: PNRI

PM10 Levels in Metro Manila, 2004

Fine Particulate Levels in Metro Manila, 2004



Source: PNRI



SOURCE: PNRI

Pollutant Sources for PM10

National Air Quality Status Report (2003-2004)

- Measured PM10 levels and averages in sites monitored by the PNRI were less than the guideline values set in the Clean Air Act. Fine particulate averages exceeded the USEPA Annual Guideline Values in the same sites.
- Source apportionment using 2002 elemental data for PM2.2 conducted by PNRI showed that the primary source of PM2.2 (about 75%) was fuel combustion.

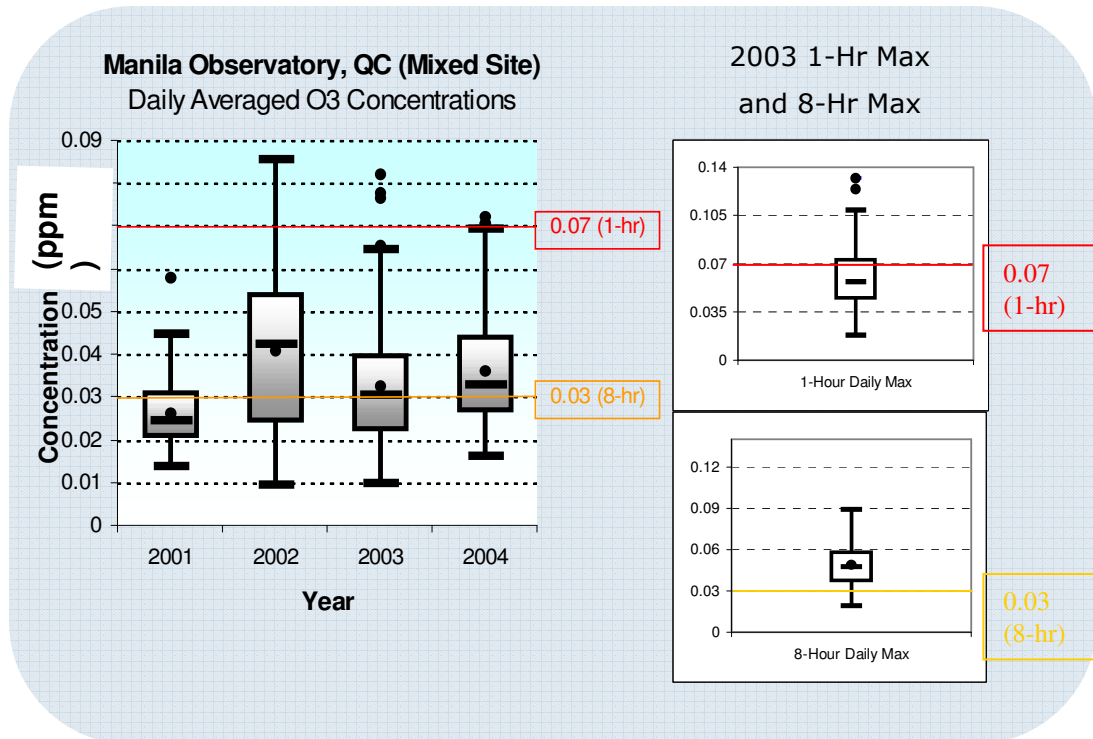


Other Related Activities

DOAS



Receiver (top and right) and Analyzer

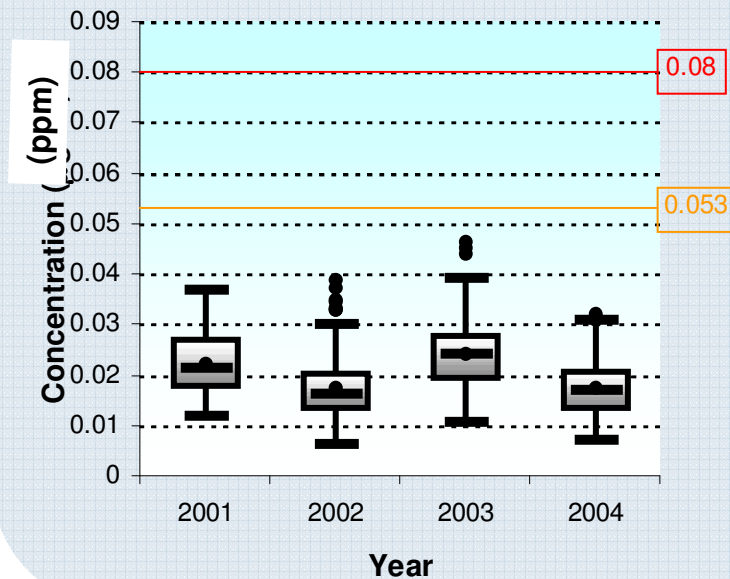


- Average ozone decreased in 2003.
- Most of the daily 8-hr maximum values of ozone were above the National Ambient Air Quality Guideline Value (NAAQGV). Not as much of the 1-hr maximum values were above the NAAQGV, though enough to exceed the limit set by the CAA.

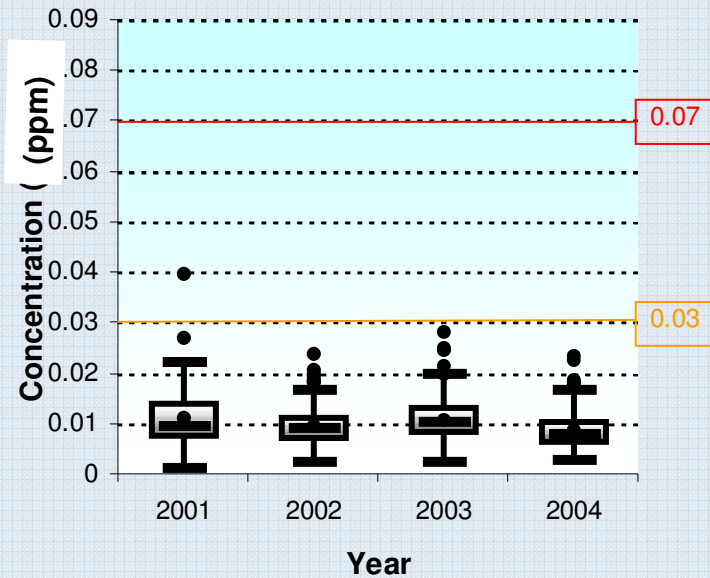


Other Related Activities

Manila Observatory, QC (Mixed Site)
Daily Averaged NO₂ Concentrations



Manila Observatory, QC (Mixed Site)
Daily Averaged SO₂ Concentrations



- Daily NO₂ and SO₂ averages were below the 24-hr NAAQGV from 2001 to 2004. Annual averages were also below the guideline values.
- The greatest changes in concentrations happened in 2002, when NO₂ concentrations decreased by 27% and SO₂ by 19%.

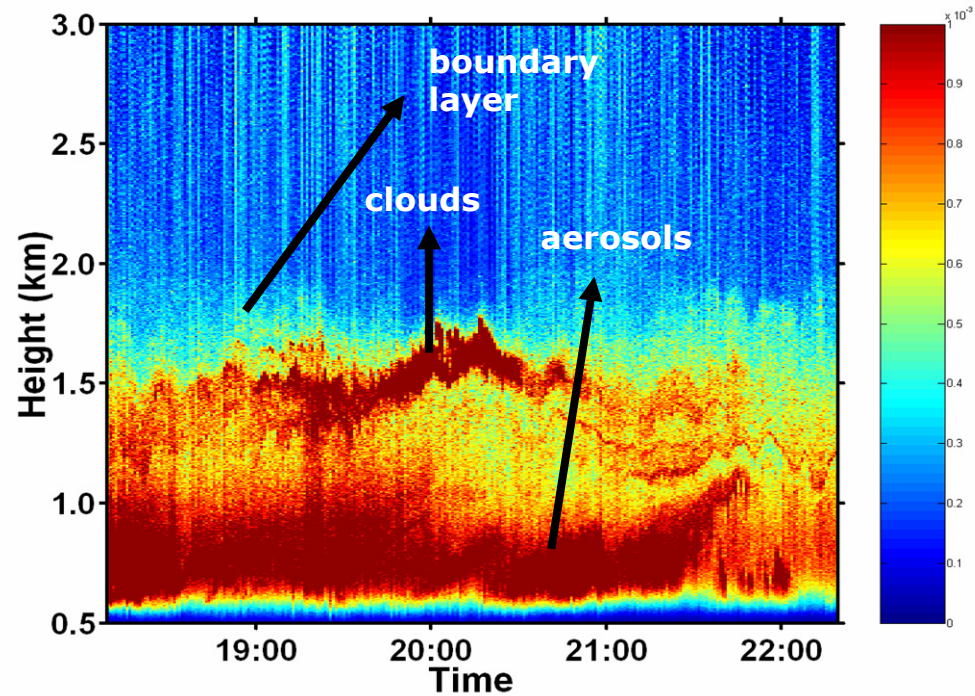


Other Related Activities

LIDAR



A sample of LIDAR data taken on October 15, 2005 from MO.



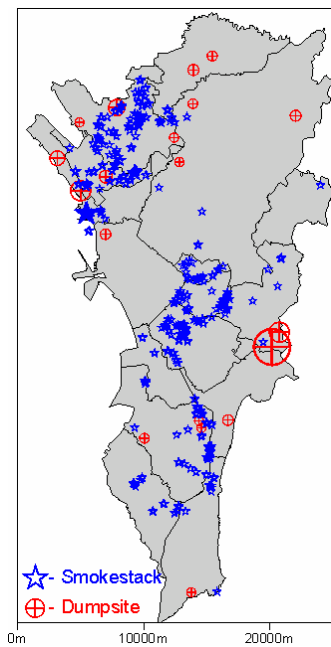
- The data shows heavy aerosol loading near the ground. The red color shows high backscattered signals from particulates. The boundary layer height, which is the border between the yellow and the blue signals, is around 1.75km.



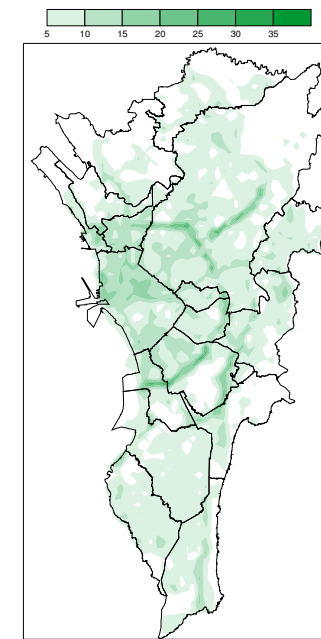
Other Related Activities

Dispersion Modeling

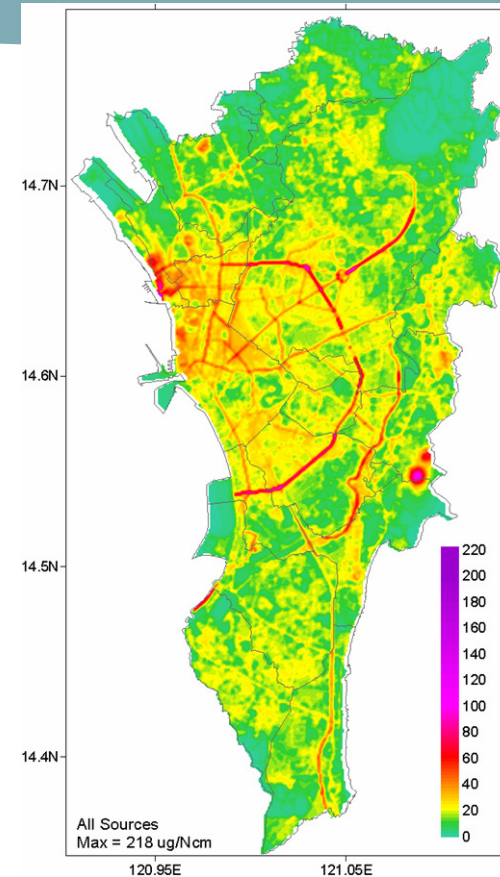
Industrial Source Complex v.3 (ISC3)



Stationary Sources



Traffic Emissions

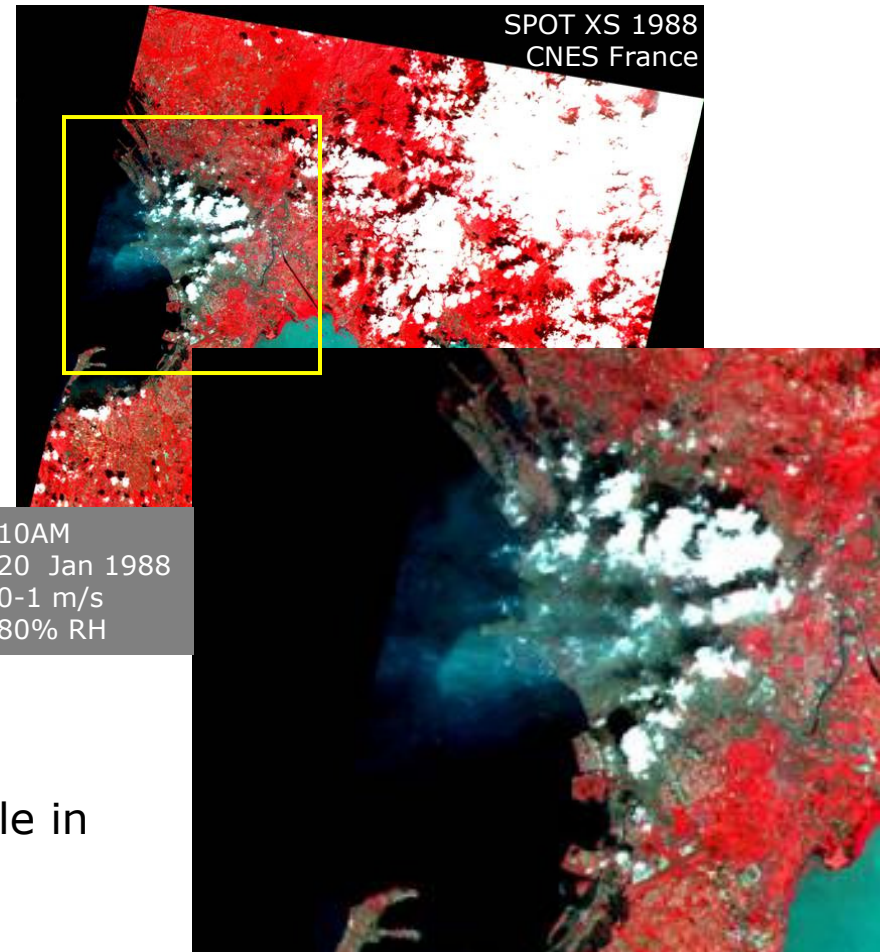
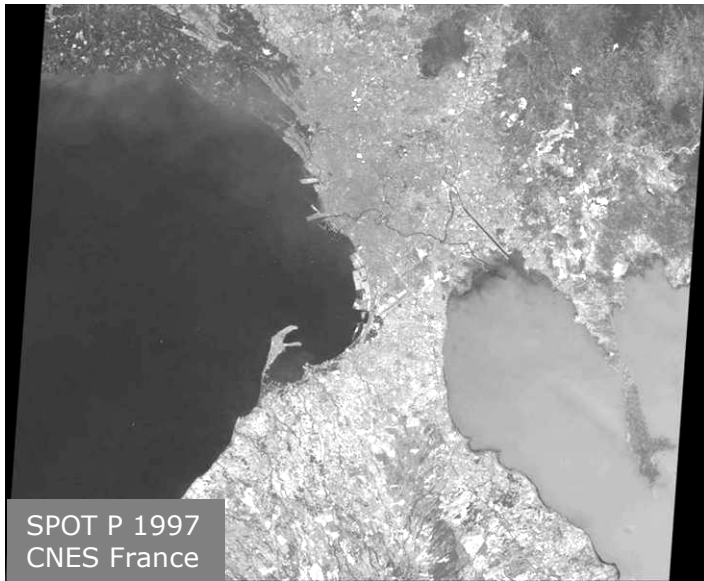


- Results of Dispersion Model runs in 2004 for Metro Manila reveal elevated levels of annual PM10 downtown and along major thoroughfares.



Other Related Activities

Satellite Imagery



- Air pollution at Manila Bay is visible in the satellite images above.



Summary

- Metro Manila is a large urban center in the Philippines.
- Urban Air Quality Monitoring Activities that were discussed involved particulate matter monitoring and modeling in Metro Manila.
- Results from these and related activities suggest a large contribution of traffic related emissions to ambient particulate matter in Metro Manila.



Acknowledgements

- Asian Institute of Technology (AIT)
- Swedish International Development Cooperation Agency (SIDA)
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- Ford Foundation
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Thank you very much.



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