Emission inventories and air quality in India

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The Energy and Resources Institute, New Delhi

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Contents

- Air pollution scenario in Indian Cities
- Some emission inventory studies in India

Causal Factors

- Increase in Urban Population (1991-2001)
  - Urban agglomerates : 23 to 35 cities
  - Urban Population : 218 to 285 million
  - % Share : 25.7 to 27.8%
- Increase in Vehicles
  - Total vehicles(2002) : 59 million
  - Personal vehicles : 83%
- Industrial Activity
  - Large and medium industries
  - Small-scale sector is poorly equipped to handle the pollution & many of them are located in densely populated areas.
- Power generation
  - Poor quality coal
- Domestic sources

Ambient Air Quality Monitoring

- NAMP- National Air Monitoring Program (CPCB) comprises of 295 stations covering 98 cities/towns. 4 criteria air pollutants viz. SO_2, NO_X, SPM and RSPM are regularly monitored.
- Ambient AQ status (27 cities) & trend analysis of selected cities for the period 1998-2002
  - Urban agglomerates
  - Other smaller cities
  - Industrial cities
- Indicator analysis: Ambient AQ status of all cities (77) for which data is available during 1998-2002
  - Exceedence Indicator

Categorization

- Urban agglomerates- Top 10 urban agglomerates based on 2001 census data that are the most urbanized and highly populated cities of the country:

  Mumbai, Kolkata, Delhi, Chennai, Bangalore, Hyderabad, Pune, Kanpur, Ahmedabad & Surat.

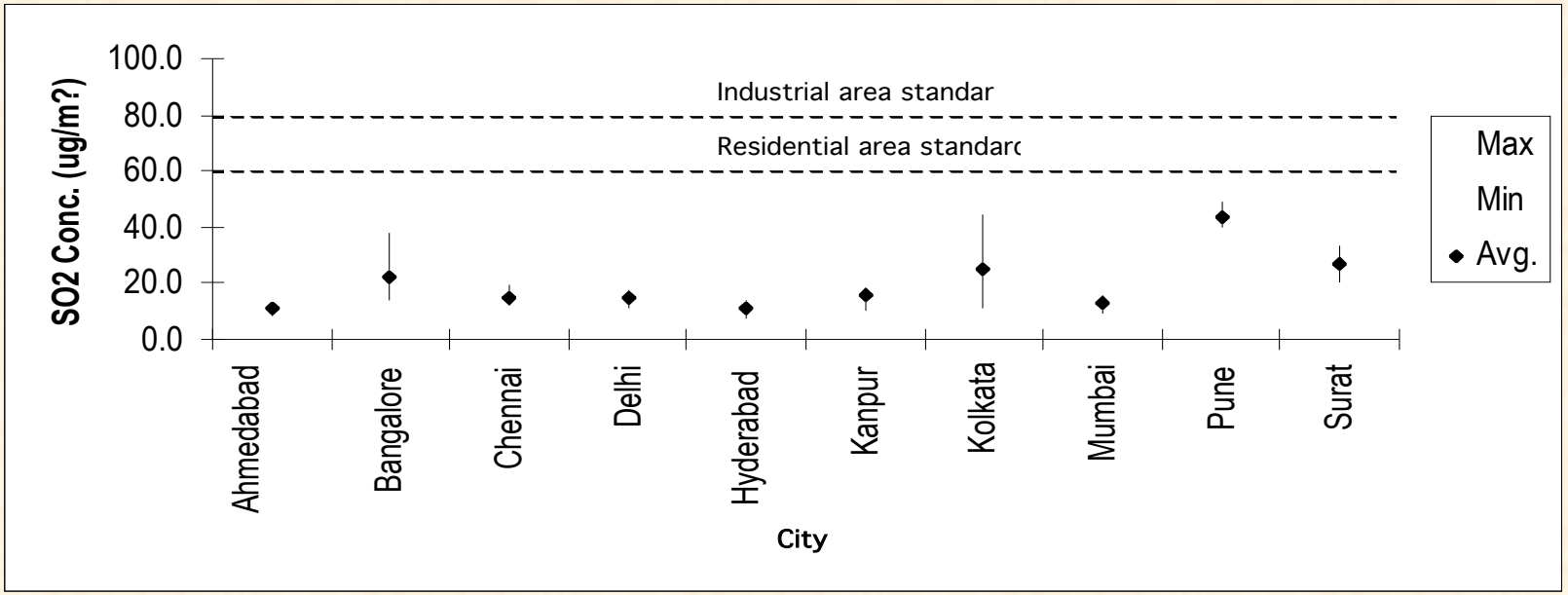
- Other smaller cities- Other important cities, which are less populated & urbanised than the above category.

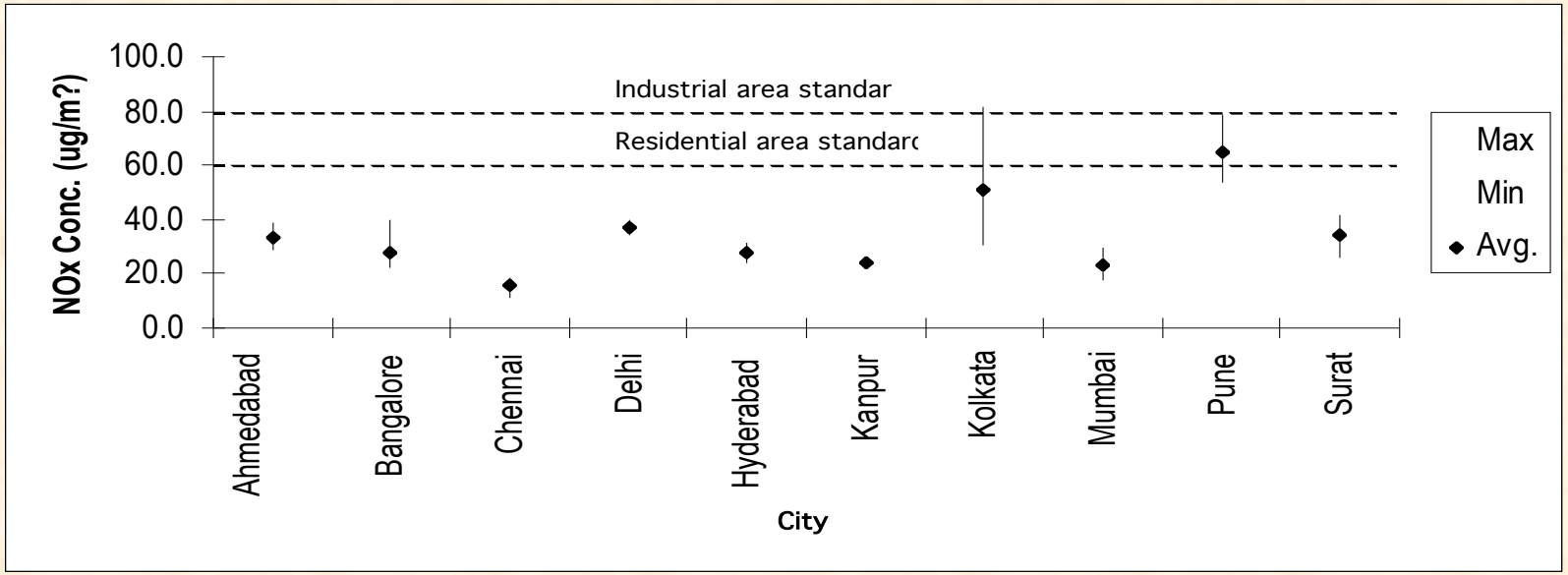
  Chandigarh, Dehradun, Faridabad, Howrah, Baroda, Mysore, Cochin, Bhopal, Jaipur, Shimla & Agra.

- Industrial cities- Cities exhibiting high degree of industrialization.

  Talcher, Dhanbad, Jharia, Kota, Anpara & Gajroula.

Status- Urban Agglomerates





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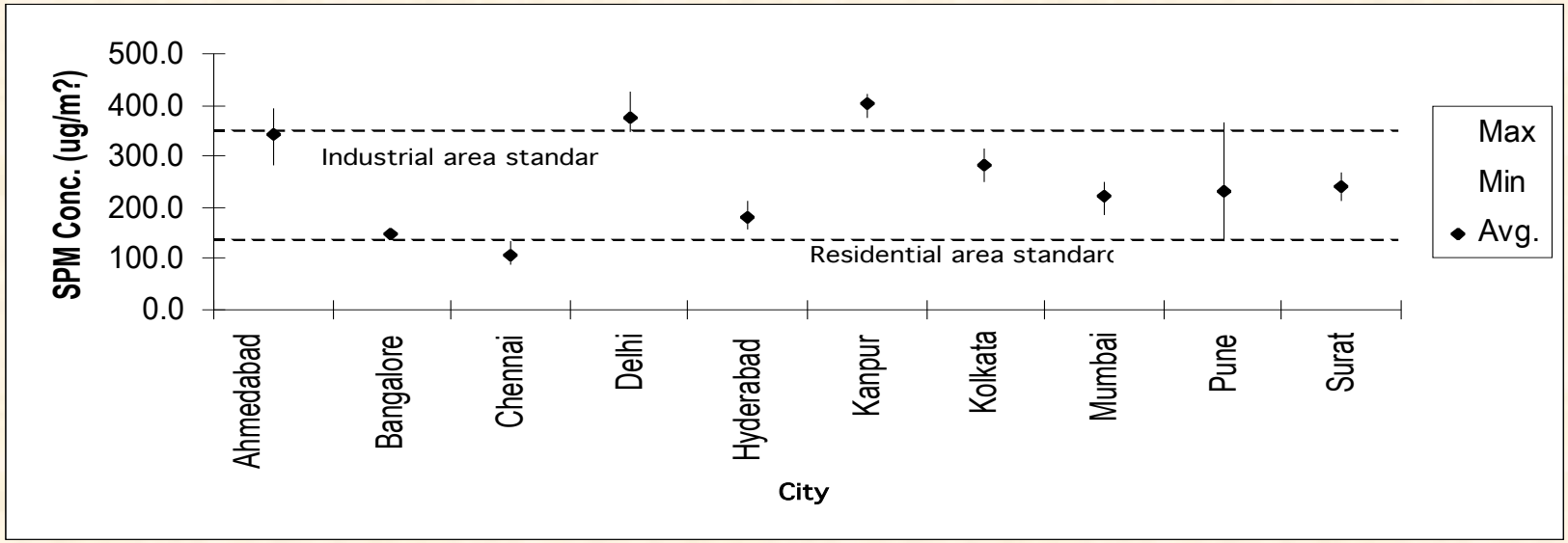
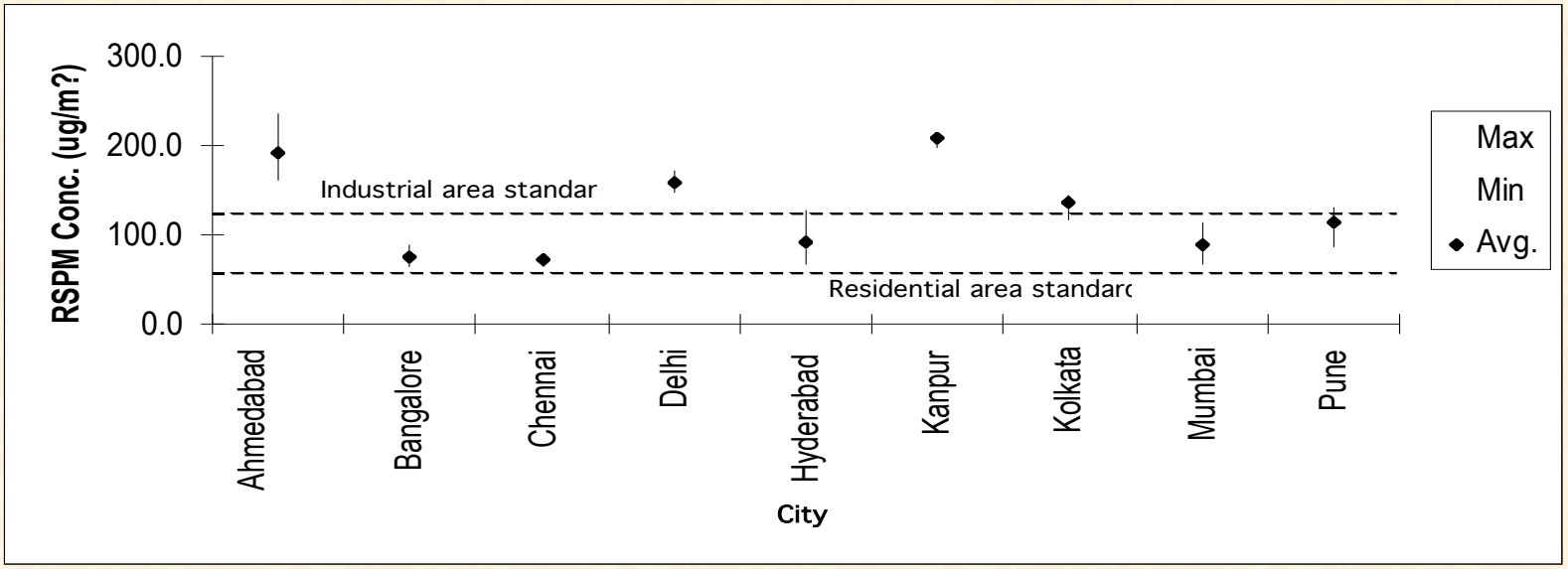
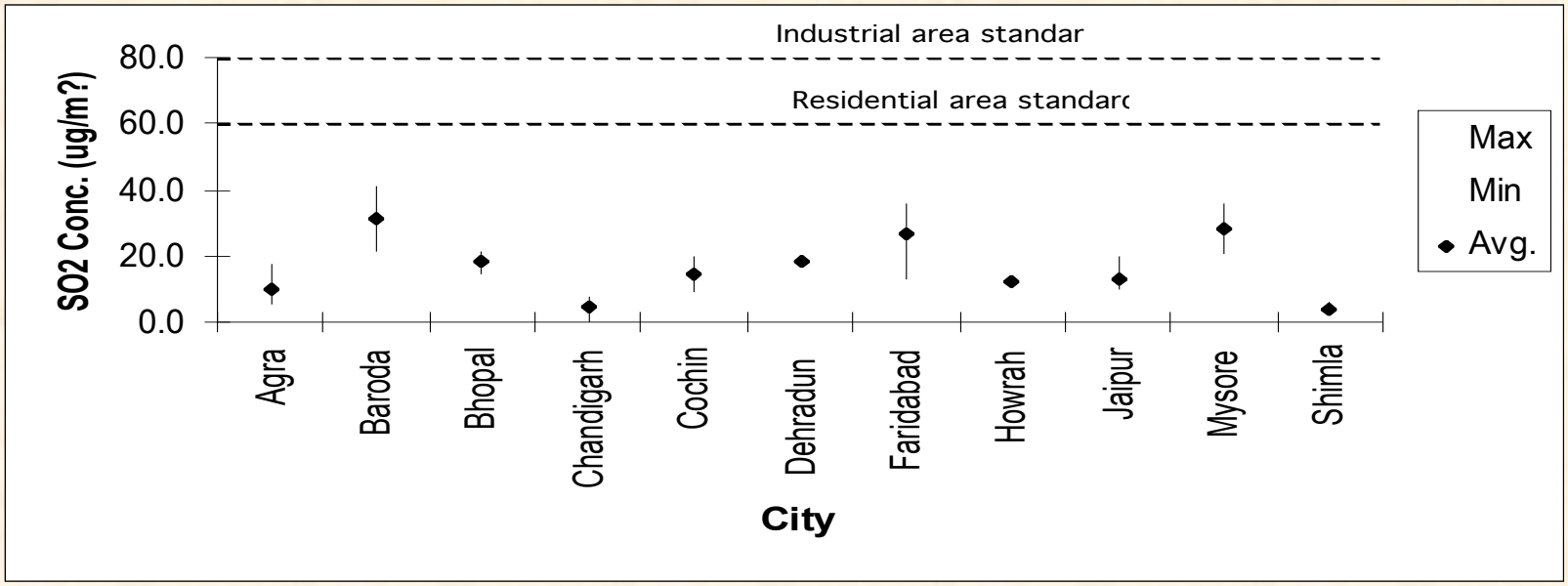
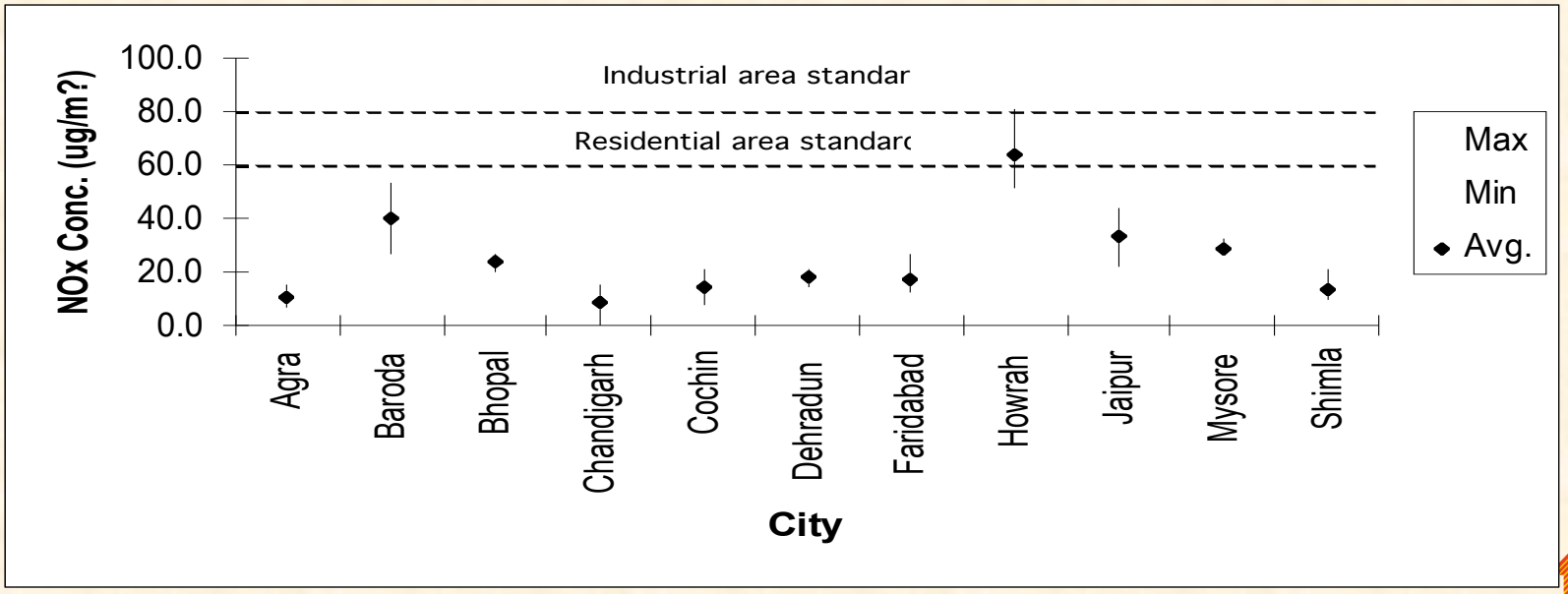




Status- Smaller Cities





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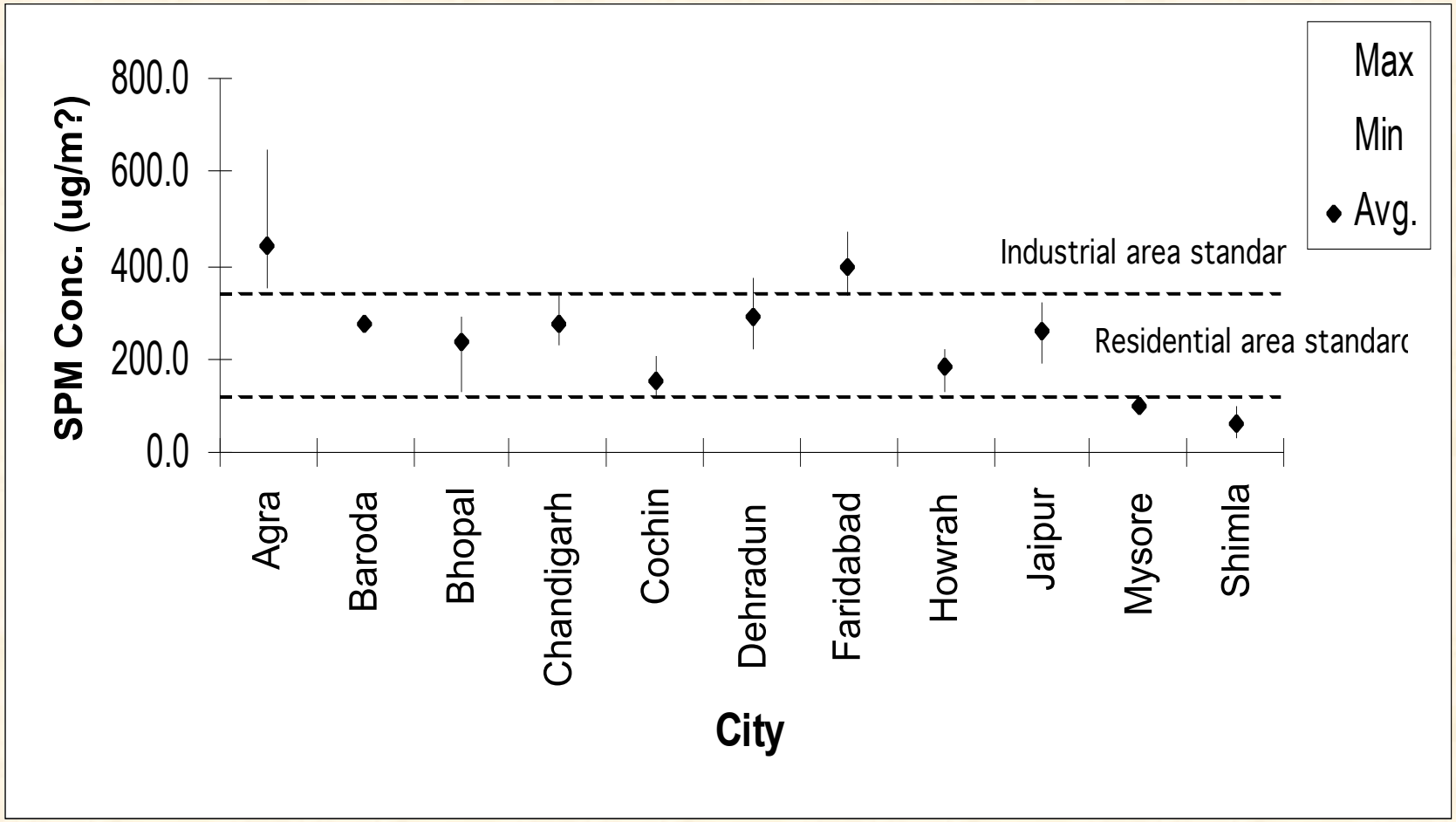
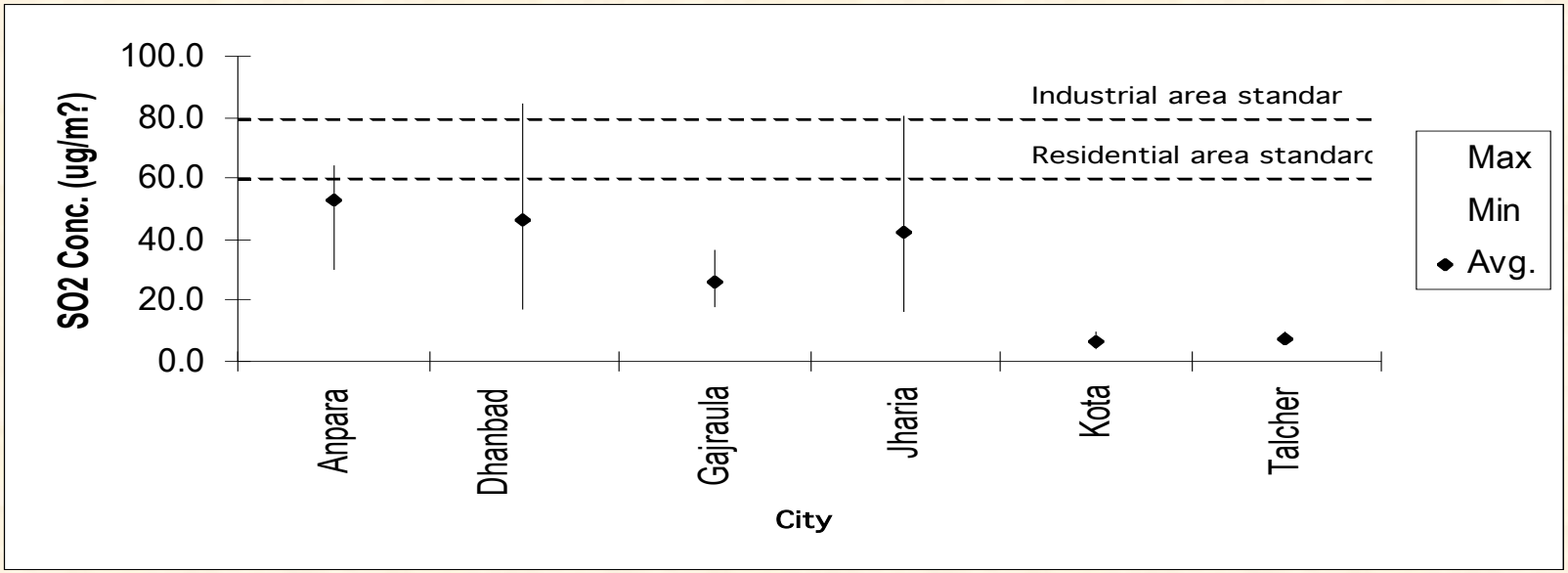
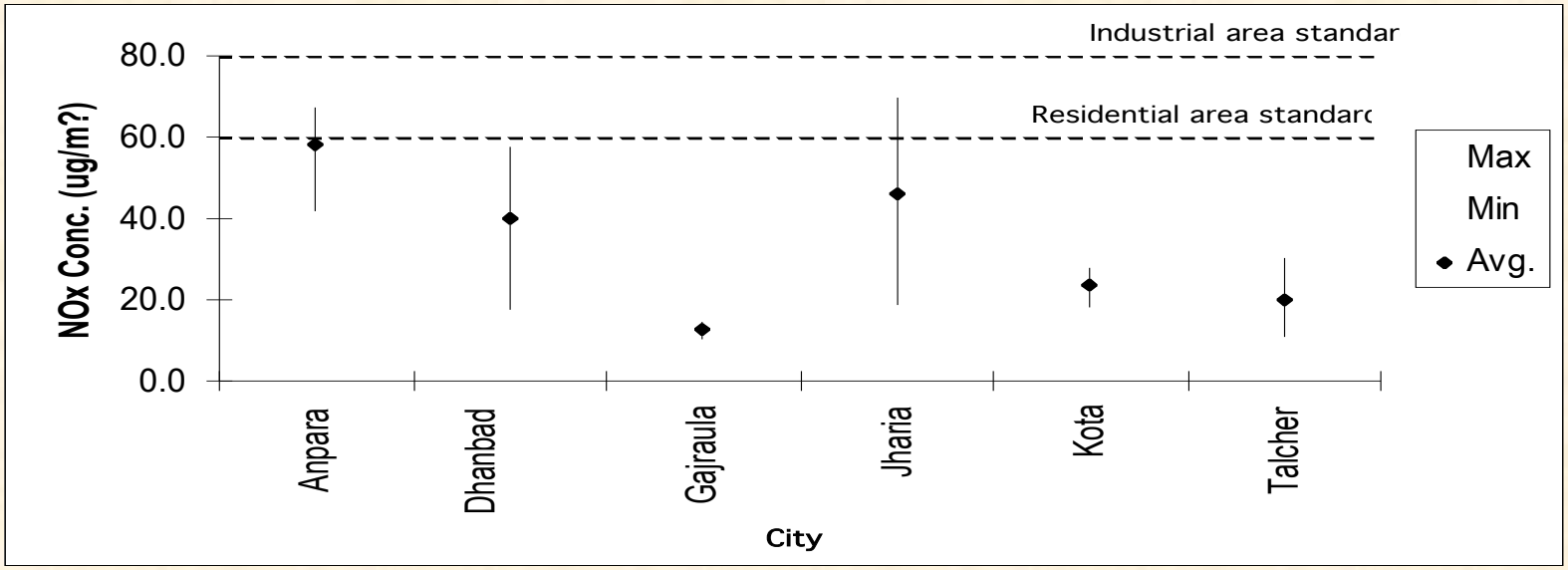
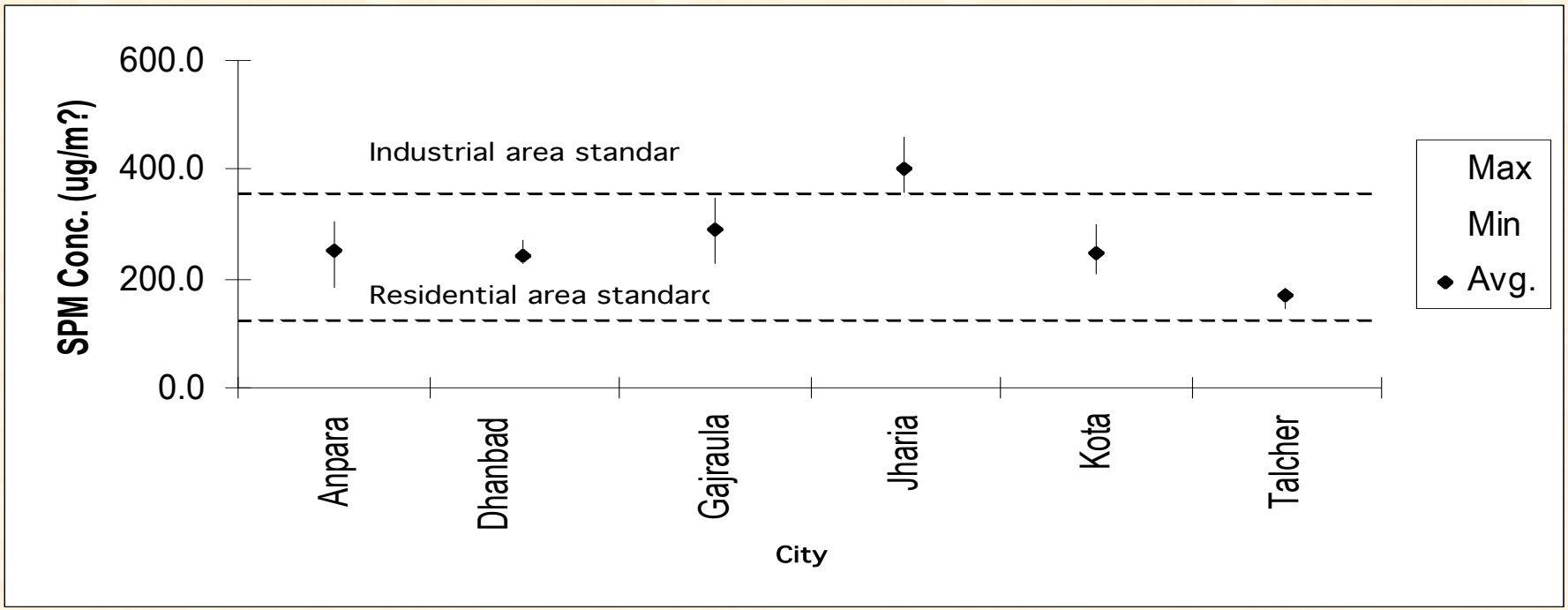


Industrial Cites

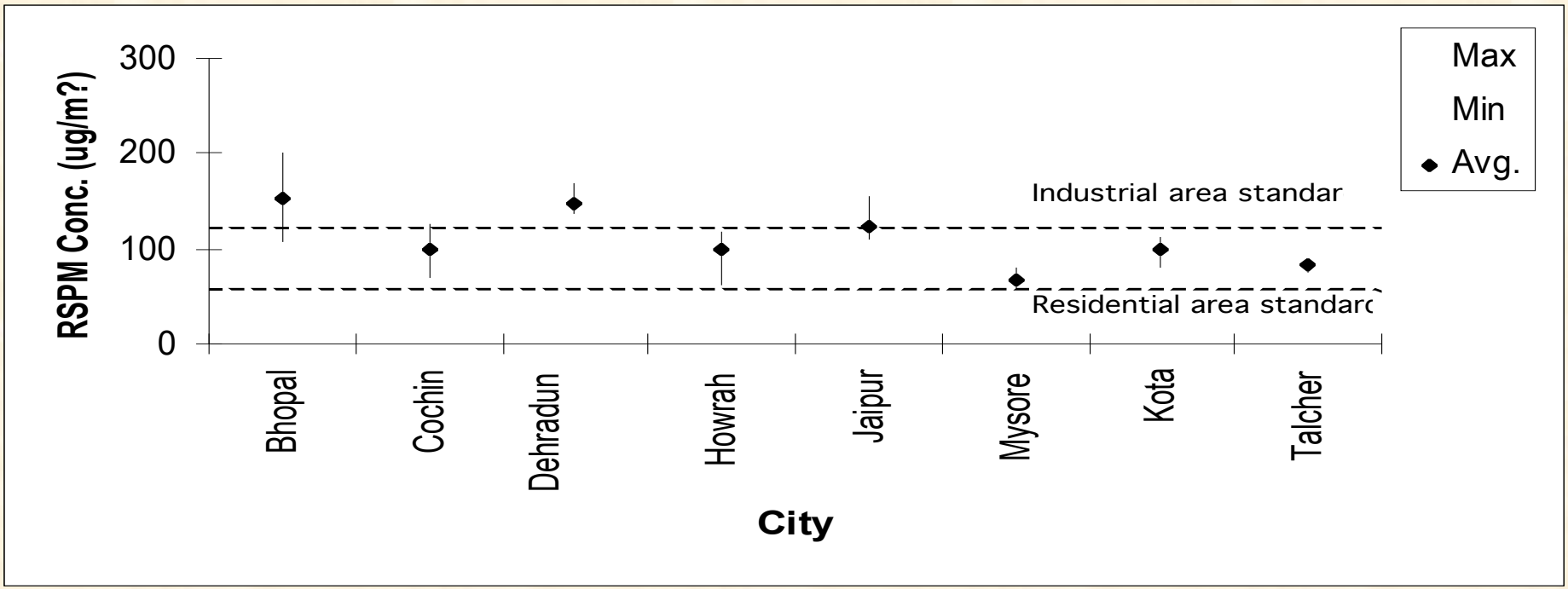




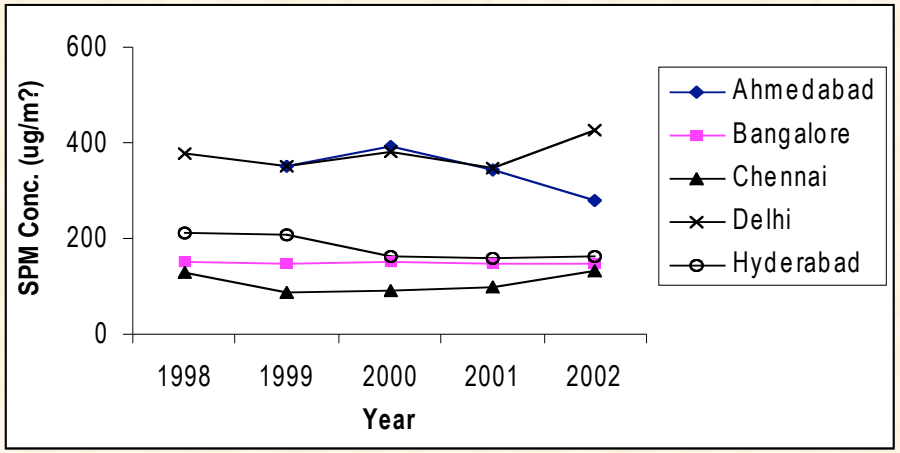
Industrial Cities

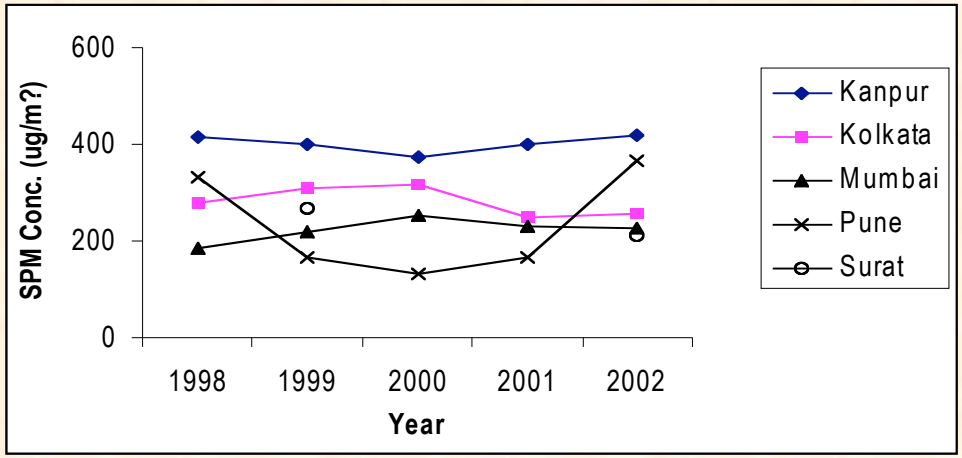


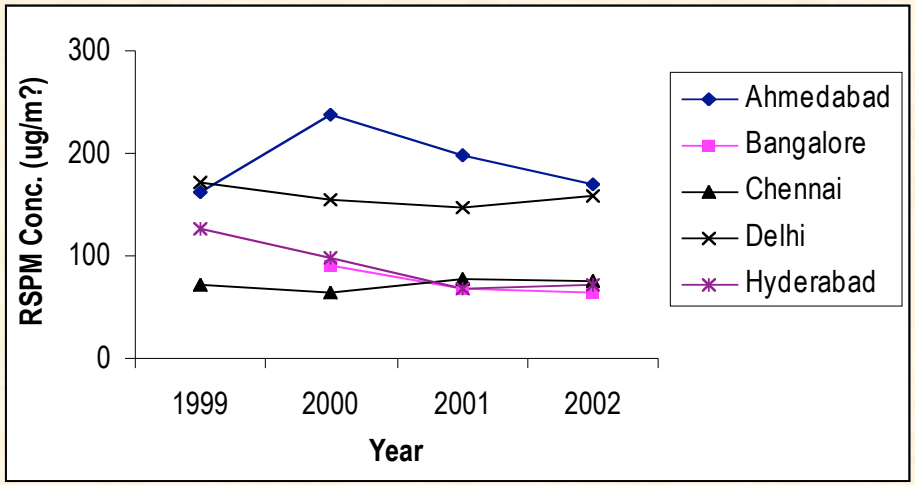
Industrial and smaller cities

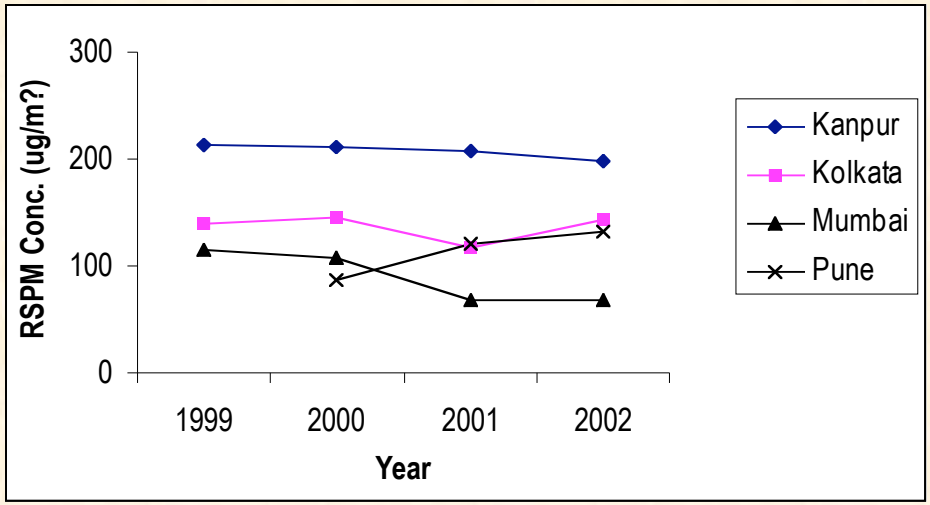


Trends- Urban Agglomerates

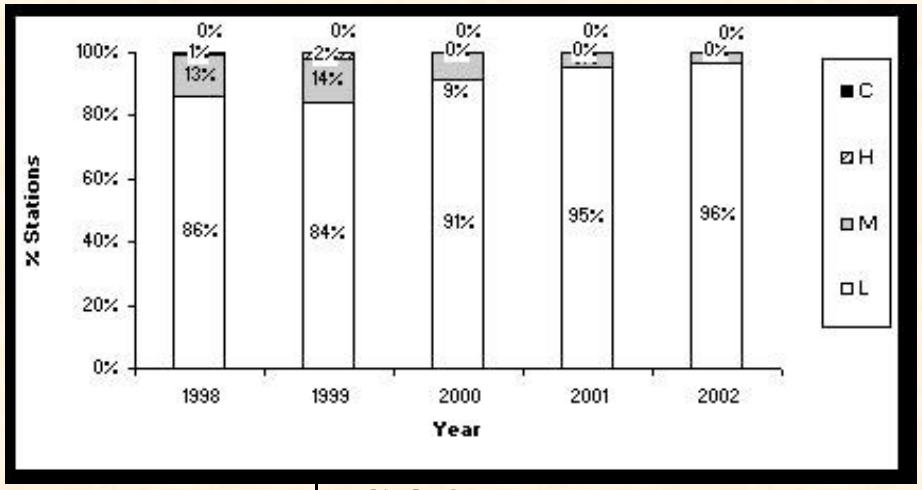




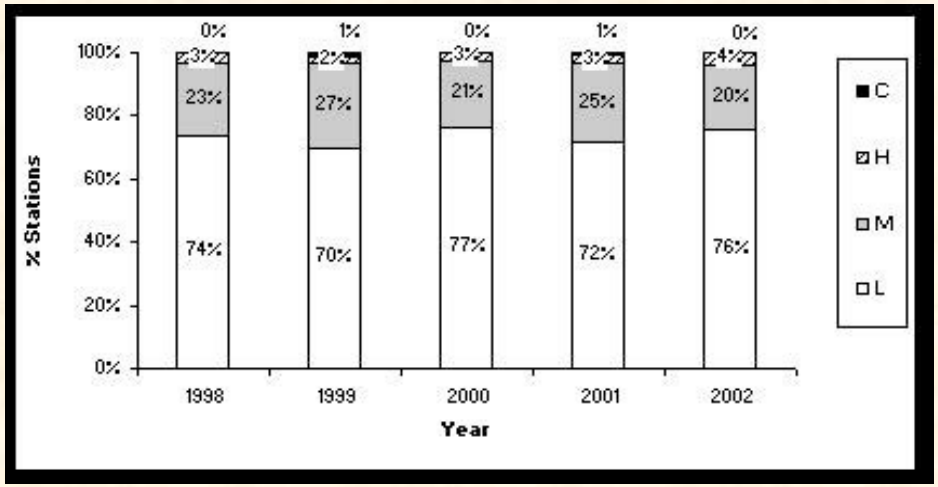




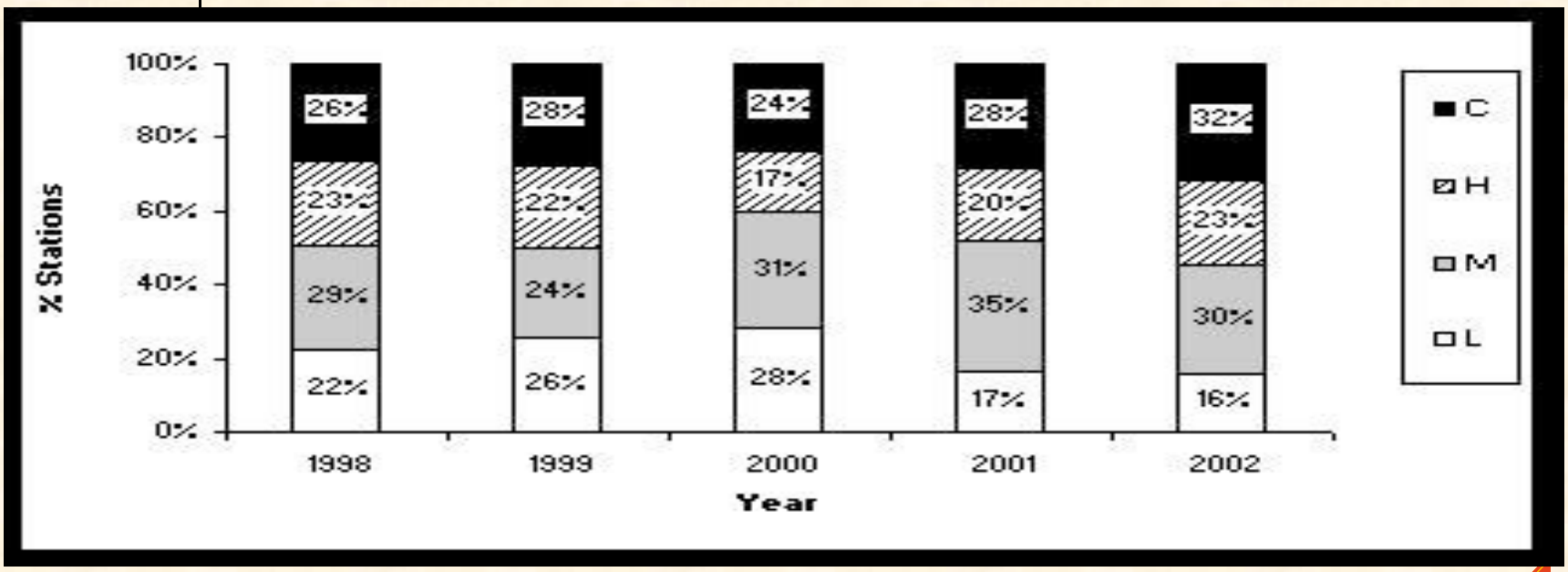
Exceedence Indicator



SO2

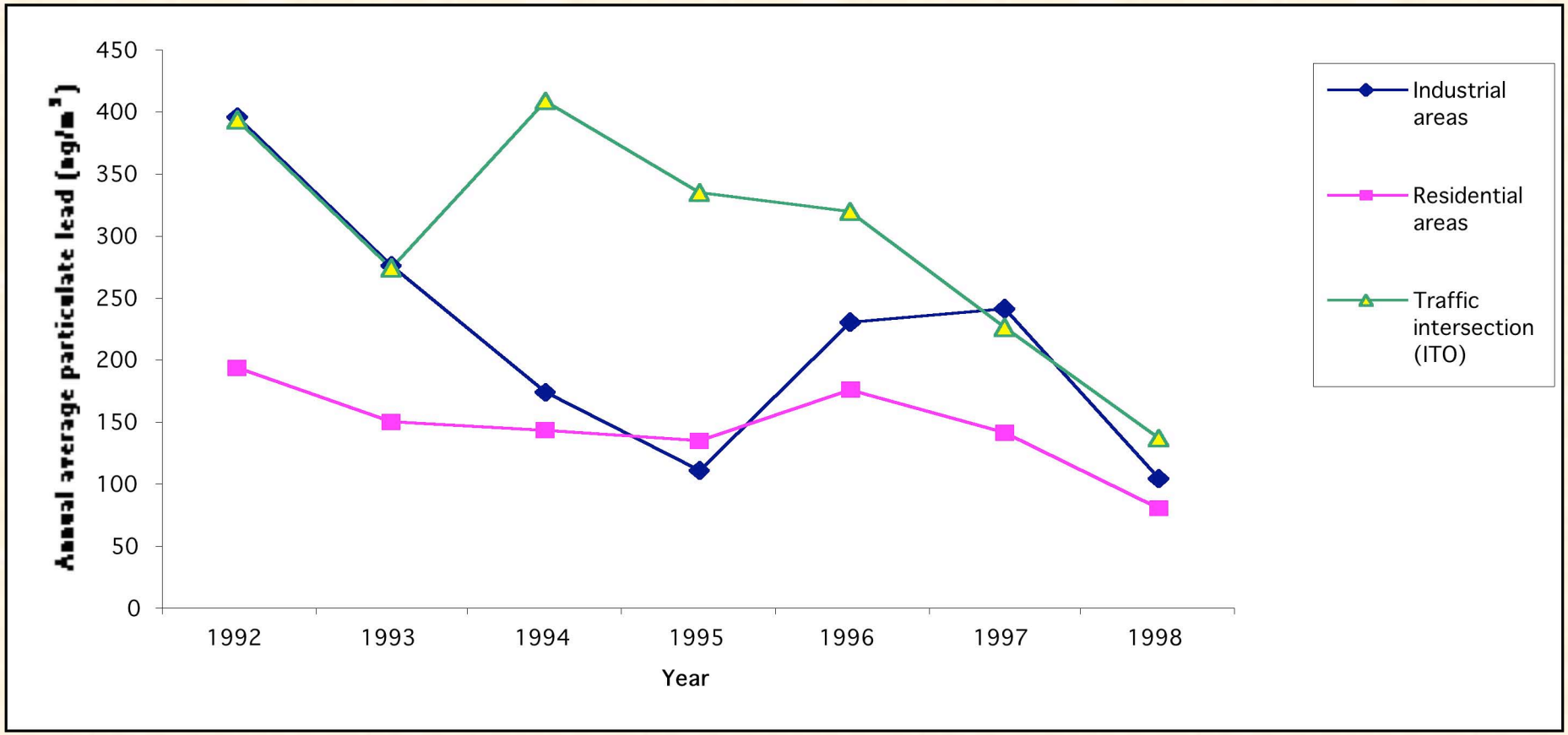


NOx



SPM

Trends of particulate lead in ambient air of Delhi (ng/m^3)



Air Quality: key issues

- Despite many measures taken, urban AQ still remains a serious cause for concern. The air quality trend analysis for various pollutants for different cities shows a mixed trend.

- SPM & RSPM (PM_{10}) concentrations are high in many cities. NOx levels slightly high in a few cities

- Reduction of lead and SO_2 levels – success stories

- Besides consolidating ongoing programmes, new initiatives are required for tackling air pollution.
  - Expansion of monitoring network : $PM_{2.5}$, ozone, air toxics
  - Synergy between local air pollution control and benefits in terms of climate change

Emission inventory studies

Summary of emission inventory studies at national level undertaken by different authors/agencies

India's national greenhouse gas inventories in Gg for the base year 1994

Total (net) emission	CO_2	CH_4	N_2O	CO_2 eq.
In Gg for the base year 1994	817023	18083	178	1228540

Source: MoEF, GoI, 2004,

Emissions inventory of India

A Garg and P R Shukla, Tata McGraw Hill, 2002

- District-wise emission inventory for India for five pollutants: CO_2, CH_4, N_20, NO_X, SO_2 for 1990 and 1995
- Sector and fuel based emissions

Emissions (Gg)	1990	1995
CO_2	592470	777960
CH_4	17054	18049
N2O	213	251
NO_X	2636	3462
SO_2	3542	4638
CO_2 Eq.	1016634	1234799

Emission Inventory studies

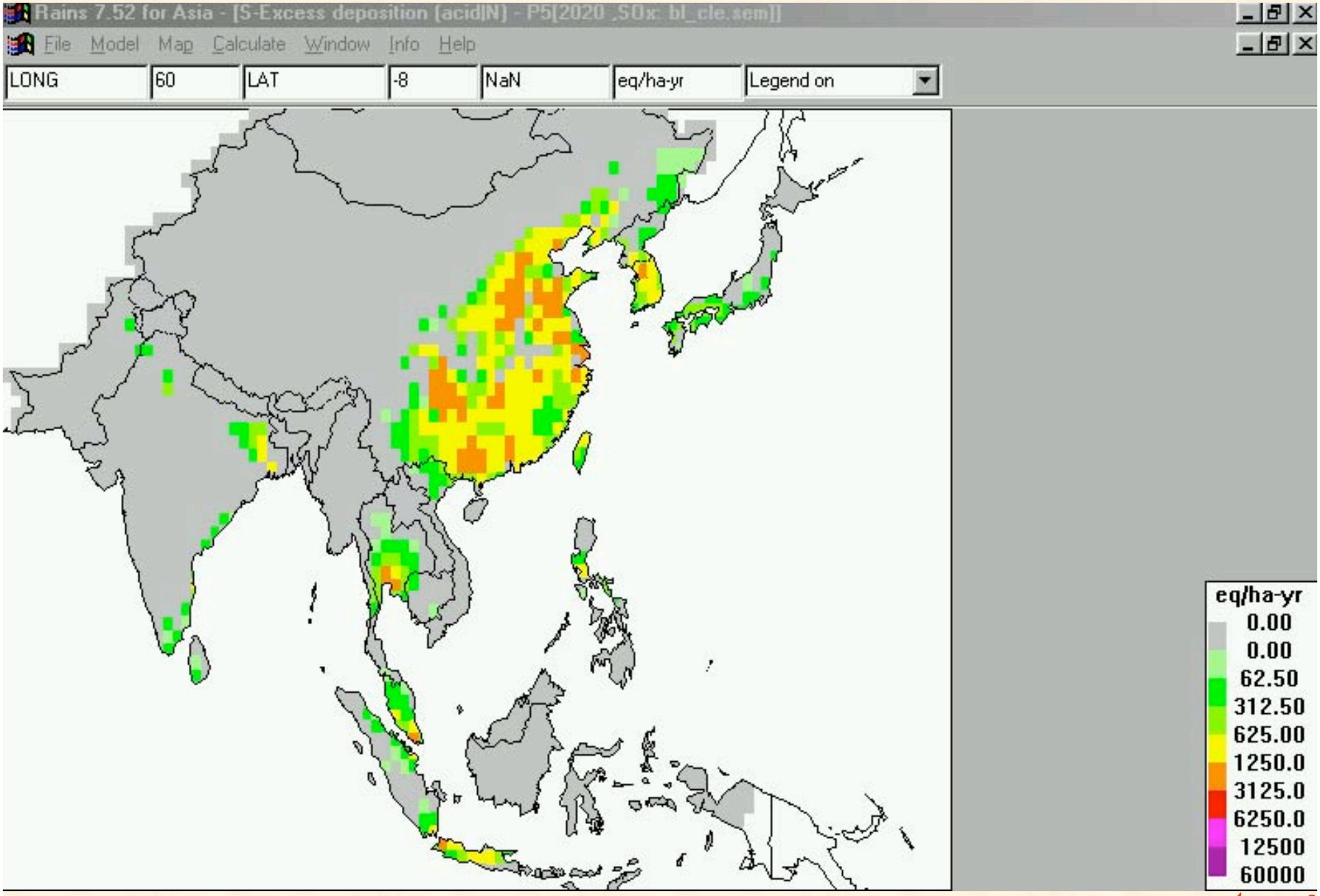
- RAINS ASIA model, Ver 7.52, 2001
  - 23 Asian countries (including sea lanes); 94 regions
  - Energy consumption by region for various Asian countries (17 fuel types and 6 sectors)
  - End use sectors: Industry/Domestic/Power plants/ Transport/ Fuel production& conversion/Non energy use
  - 20 regions in India (mostly corresponding to large states)
  - SO_2 emissions for different energy pathways
  - LPS and area sources considered: Environmental impacts in terms of S deposition on ecosystems

Source: RAINS Asia model

RAINS Asia model

Baseline scenario- current emission and fuel standards

	1990	**2000**	2010	2020
Energy consumption(PJ) India	15273	20246	27320	37673
SO2 emissions ('000 tonnes) **India**	3743	**5707 (14%)**	8158	12481
SO2 emissions ('000 tonnes) **China**	20814	**26747 (66%)**	29453	29514
All countries	32417	**40421**	48527	57075



RAINS 7.52: Excess S deposition in 2020, P5 (Source: RAINS Asia Model)

SO_2 emissions ('000 T)
Comparison of results from the two RAINS versions

2000	RAINS 7.01 (base)	RAINS 7.52 (base_cle)	% reduction
India	6,594	5,707	13
Total-Asia	53,161	40,421	24

SO_2 emissions in Asia 1985-1997

David Streets et. al., Atm. Env. 34(2000)

- Asian SO_2 emissions may peak in the region 40-45 Tg by 2020 as compared to previous predictions of 80-110 Tg in 2020; leading to lower than anticipated concentrations of sulphate aerosols
- 1997
  - India: 6277 Gg (or '000 Tonnes)
  - Asia: 39180 Gg

Estimation of SO_2 and BC for India

(TERI - UCSD project ongoing)

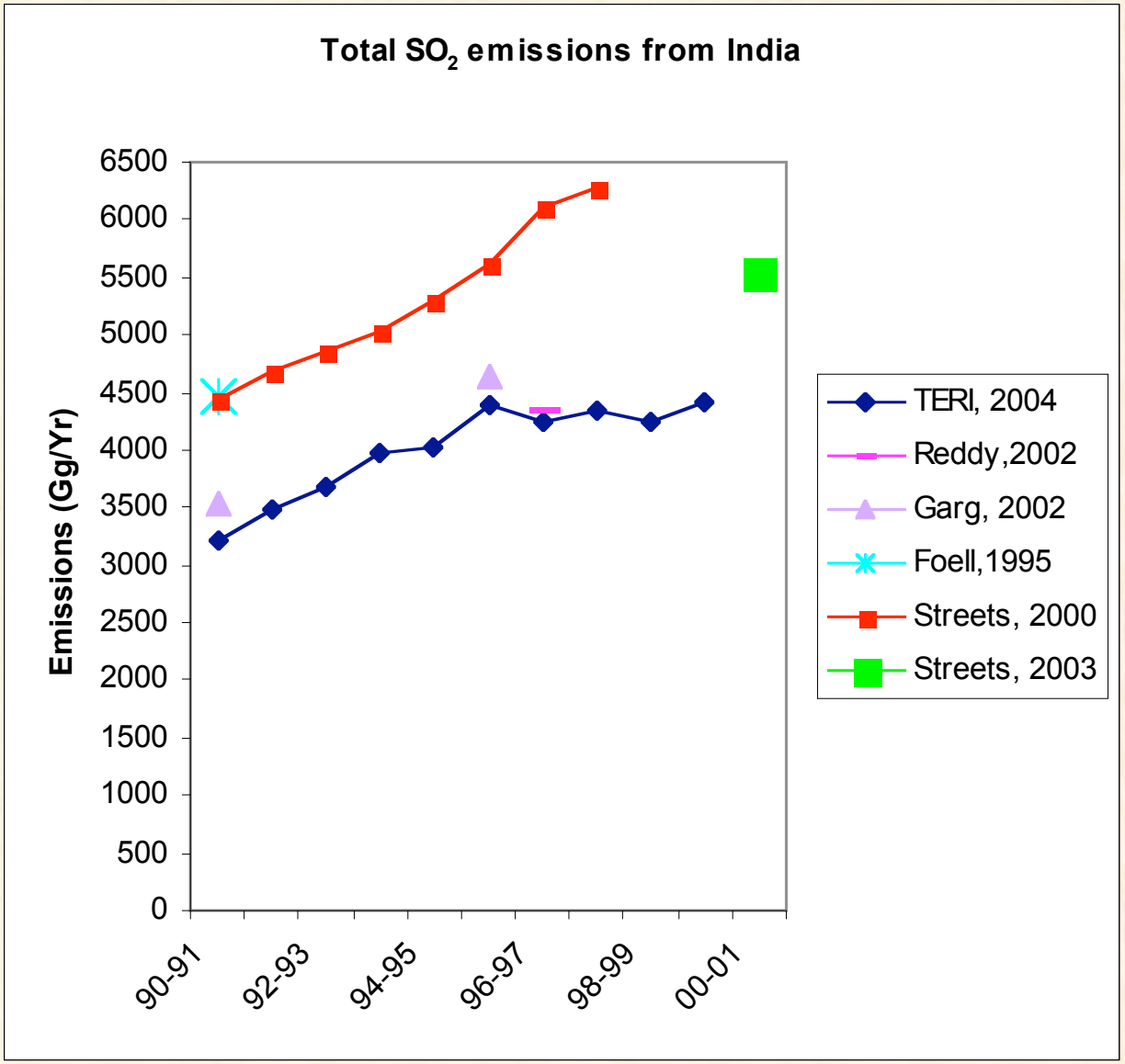
From both fossil fuel and biomass combustion during the period 1990-91-1999-00

Gg/yr	SO_2	Black carbon
1990-91	3220	390
1995-96	4398	487
1999-00	4425	531

Source: TERI, 2004 report submitted to UCSD

Total SO_2 emissions from India

from both fossil fuel and biomass combustion



Source: TERI-UCSD project

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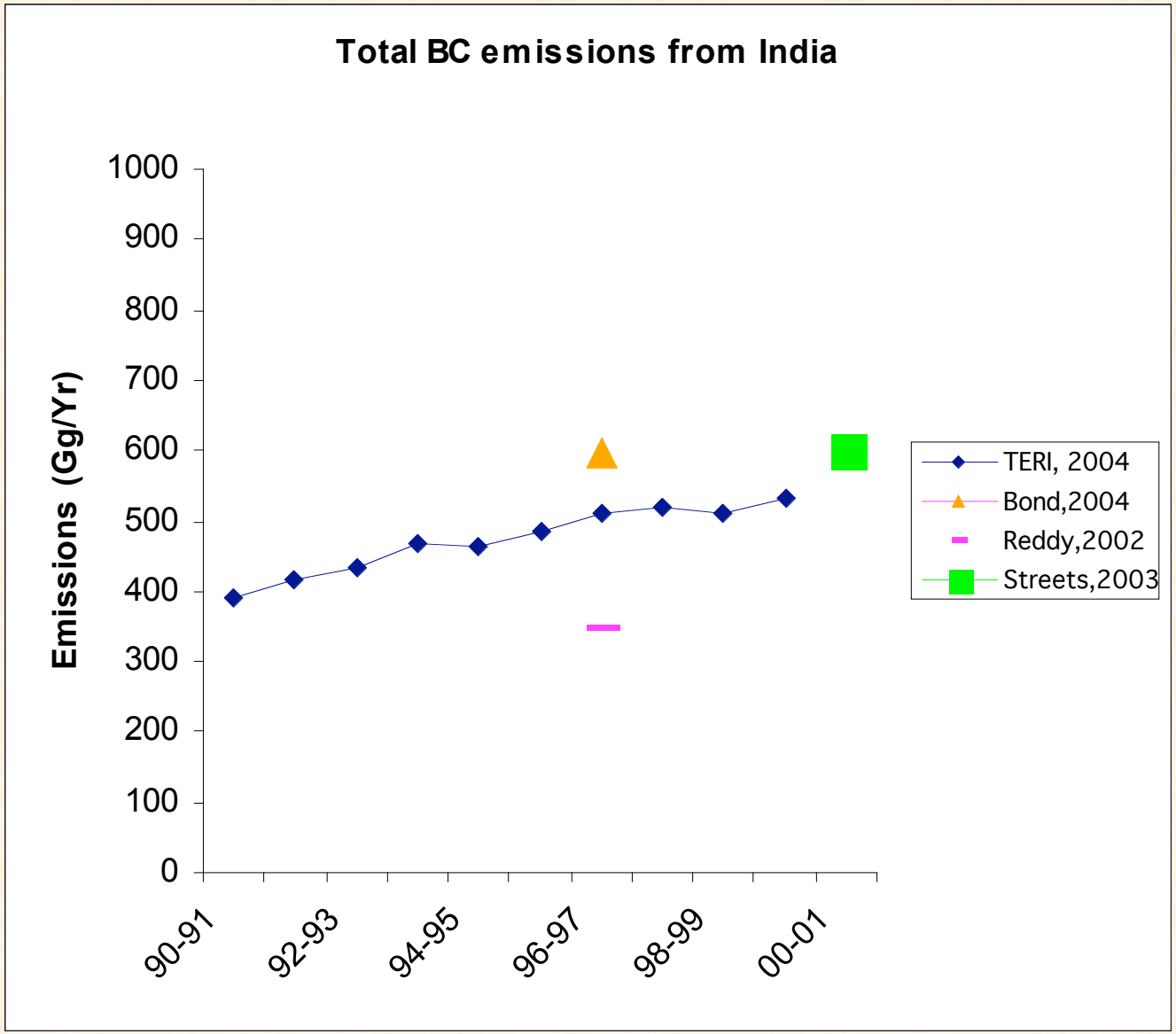

Source: TERI-UCSD project

Key issues

- Regular updating of energy scenario and the consequent changes in the emission inventory
- Appropriate selection and development of local emission factors
- Source apportionment studies: identification of sources of various pollutant species

Some issues for tackling both local and trans-boundary air pollution

- Climate air pollution linkages: reduction in local pollution has beneficial impact on climate
- Sustainable transport options- Import dependency about 70%, stress to be provided to mass transport options
- Thermal power plants: coal consumption in TPP's about 77% of the total consumption, importance of clean coal technologies such as IGCC that have higher efficiencies