

Air Pollution Management and Modeling - Indian Perspective



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- Air Quality Concerns
- Current Status of AQM
- Air Quality trends
- Air Chemistry Modeling
- Way Forward -Forecasting

Air Quality Concerns

■ METROS CITIES/URBAN AREAS

- 53 non-attainment cities
- Dominant Sources: Vehicular Emissions, Small/Medium Scale Industries, Gensets, Biomass burning, etc.
- Pollutants: Ozone, NO_x, SPM /PM2.5, 1.0 & CO

■ CRITICALLY POLLUTED AREAS

- 24 critically polluted areas
- Dominant Sources: Industries-Power Plants, Refineries, Chemical Plants, etc.)
- Pollutants: Ozone, NO_x, SPM/PM2.5, SO₂ VOCs, PAHs, etc.

■ RURAL AREAS

- Indoor air pollution: Use of Biomass, Coal, kerosene, etc.
- Outdoor air pollution: Unpaved roads, Biomass burning, Gen-sets etc.
- Pollutants: Ozone, SPM/PM2.5, 1.0, CO, etc.

Major Policy Implications: Discussion Points

- Transport sector focus: Why and why not?
- Fuel quality CNG vs Diesel: Ban on diesel
- Retrofitting old vehicles : buses, auto others
- Pricing of different fuels
- Taxes on vehicle ownership
- Ban on low cost cars
- Shifting of bus terminus outside city limit
- Public transport vis a vis personal transport

Current Status of AQM

- Institutional Mechanism
- Assessment of Air Quality
 - Monitoring
 - Emission Inventory
 - Source Apportionment
 - Air Pollution Exposure & Health Impacts
- Control Strategies
- City Specific AQM Action Plans

MAJOR INTERVENTIONS AND POLICY CHANGES

- Fuel Quality
- Fuel Change

- Emission standards (COP –EURO/Bharat)
- Industrial policy
- Industrial Fuel Quality

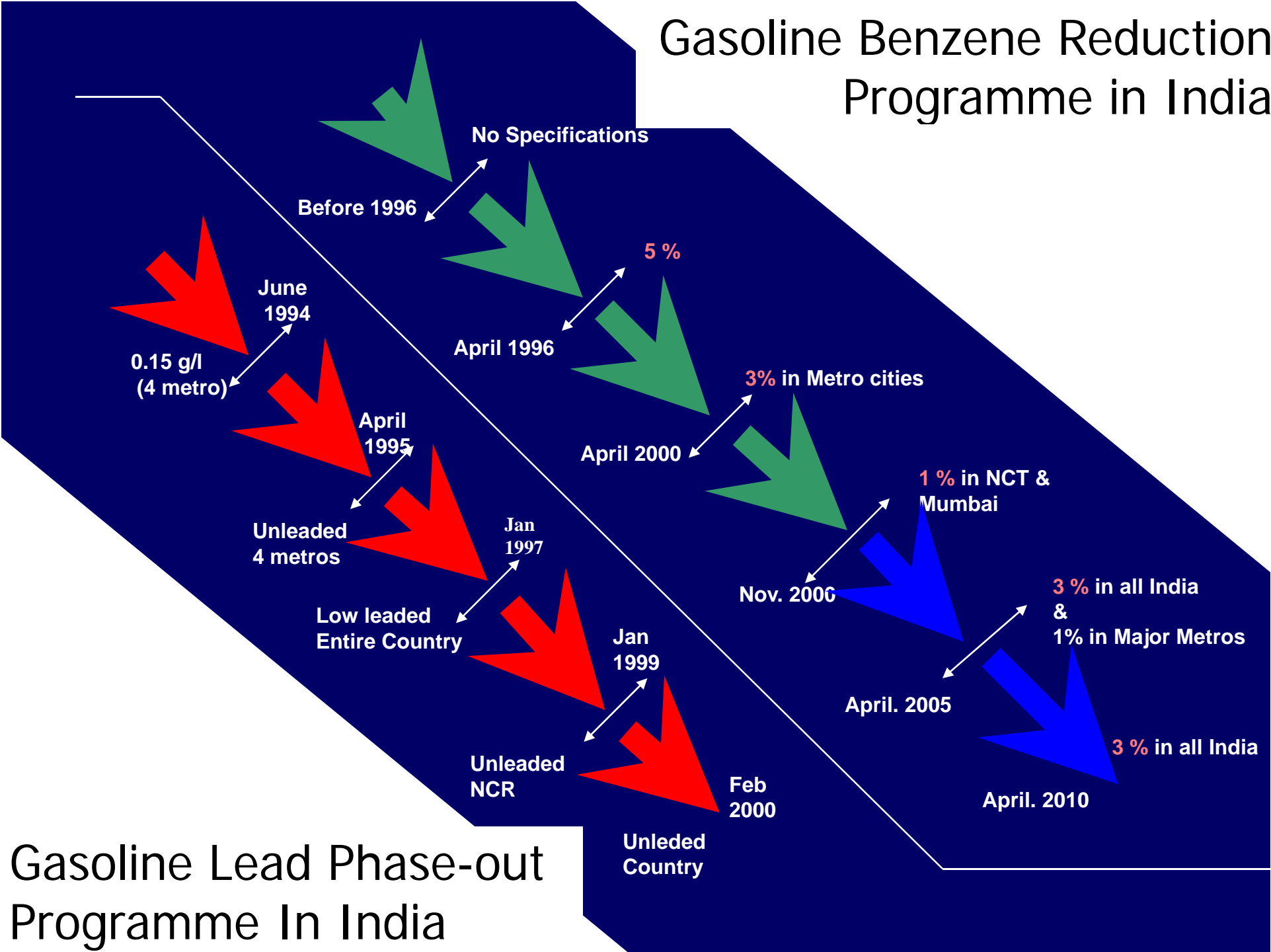
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Domestic Fuel Quality (LPG/PNG)

Control Strategies Adopted

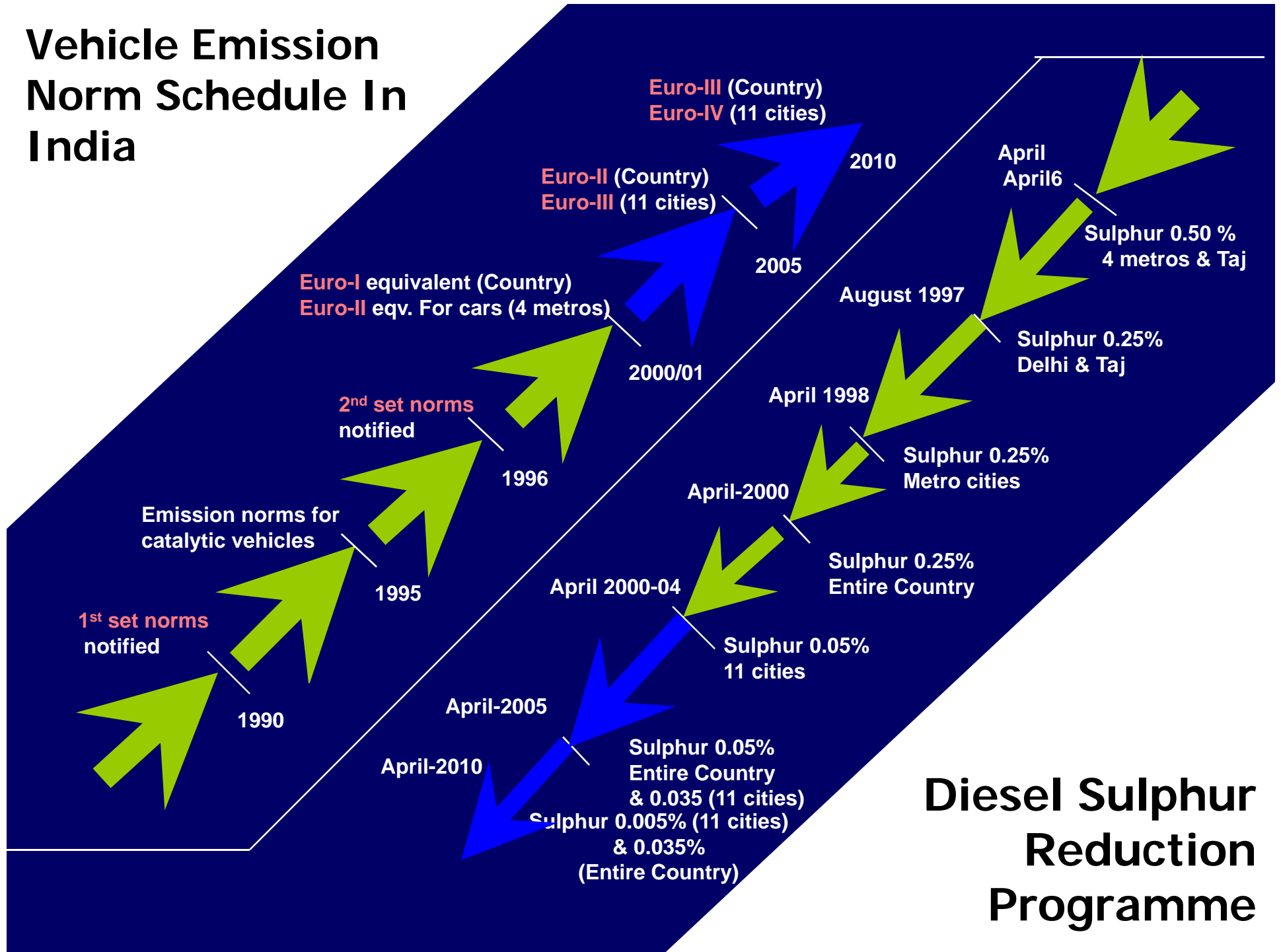
- **Air Quality Standards notified (1982 & 1994) and Air Pollution Control areas declared**
- **Emission Standards notified for Industries (, Vehicles (in-use & new), Gensets, etc.**
- **Fuel quality improvements. (Coal, gasoline & diesel).**
- **Relocation of polluting industries, phasing out older polluting vehicles, introduction of mass rapid transportation, etc.**
- **Road map for control of emissions from new and in-use vehicles developed up to year 2010**
- **Use of Alternate fuel (CNG,LPG,Ethanol petrol, Bio-diesel, Hydrogen,etc.)**

Gasoline Benzene Reduction Programme in India



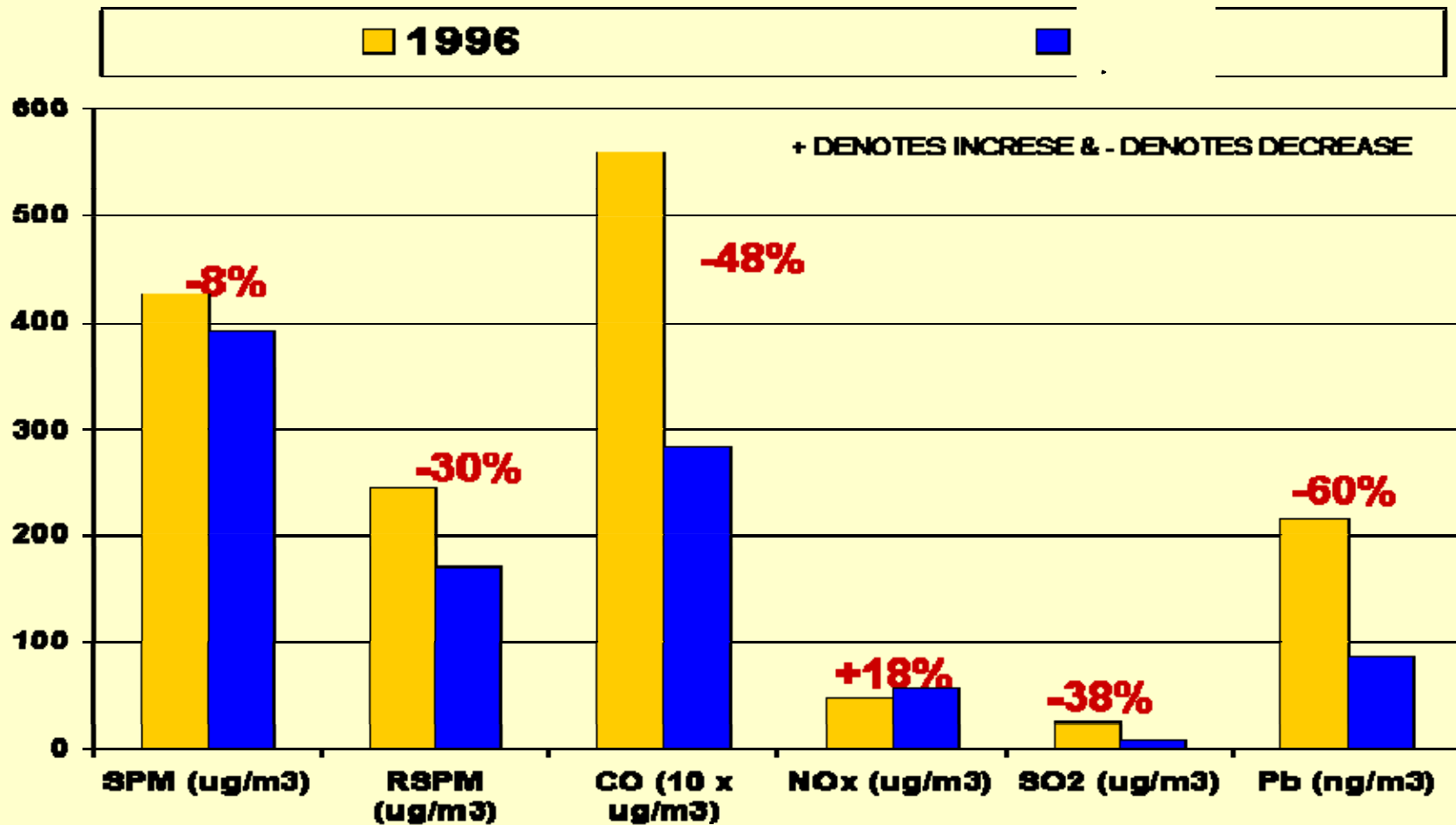
Gasoline Lead Phase-out Programme In India

Vehicle Emission Norm Schedule In India



Diesel Sulphur Reduction Programme

IMPACT OF INTERVENTIONS ON AIR QUALITY OF DELHI (1996 Vs. 2007)



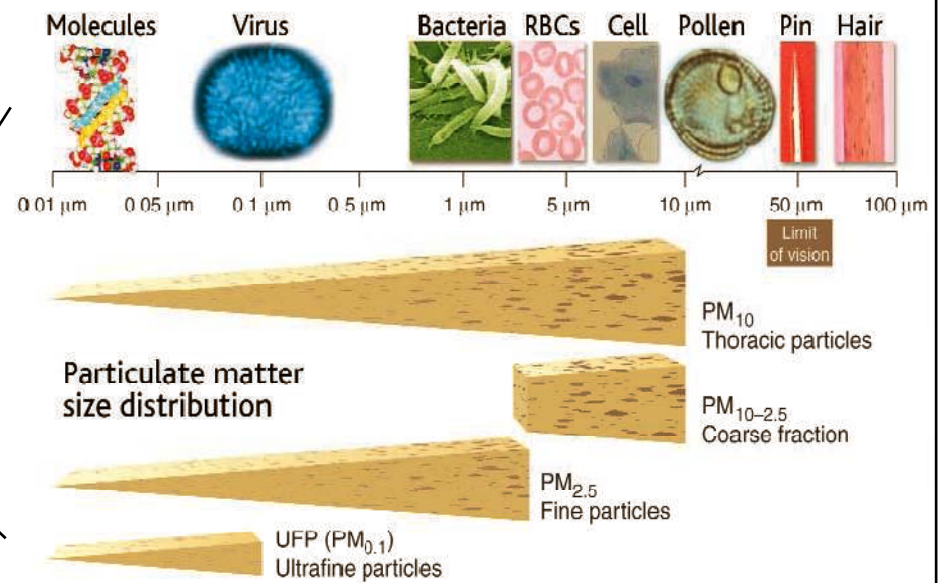
Air Quality Trends

- O₃ Very few measurements. Neglected by CPCB. Increasing trend by 0.5-1% /year in India. Exceeding standard around 50 days /year at Pashan (IITM)
- NO₂ Exceeding standard in many metros and showing increasing trend in some metros
- PM_{2.5} Exceeding standard in most cities except Delhi
- SPM Exceeding standard in most metros but with no definite trends
- CO Decreasing trend in Delhi but no trends in Pune

Why forecast air quality?

Pollutants of concern

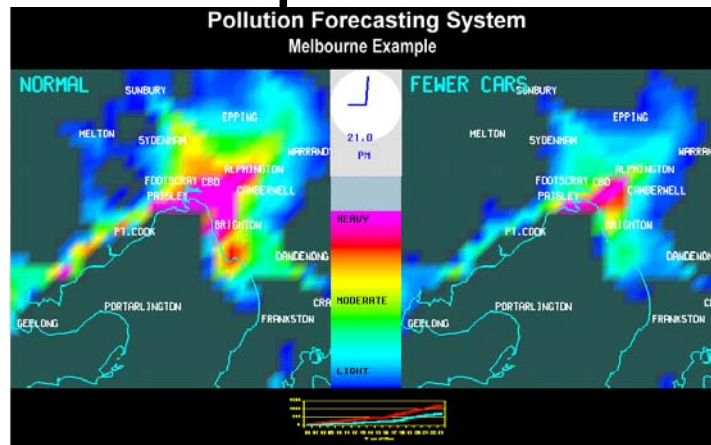
<u>Pollutant</u>	<u>Abbreviation</u>
Carbon Monoxide	CO
Sulfur Dioxide	SO ₂
Ozone	O ₃
Nitrogen Dioxide	NO ₂
Hydrocarbon Compounds	HC
Particulate Matter	PM



Why forecast air quality?

How are forecasts used:

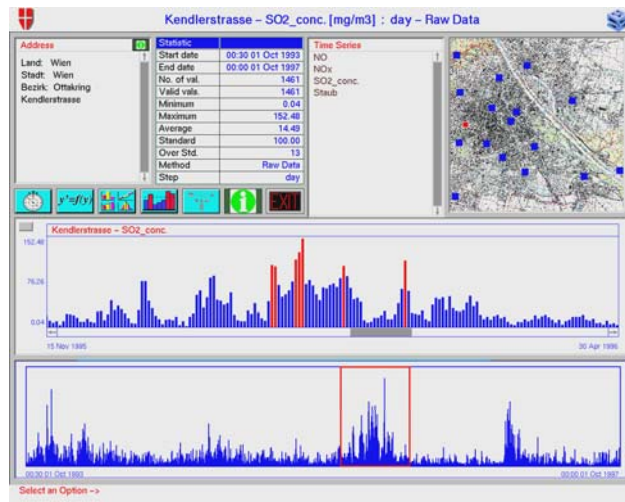
- Protect public health
- Operate emissions reduction programs
- Conduct special monitoring



What is needed?

2. Air quality monitoring program

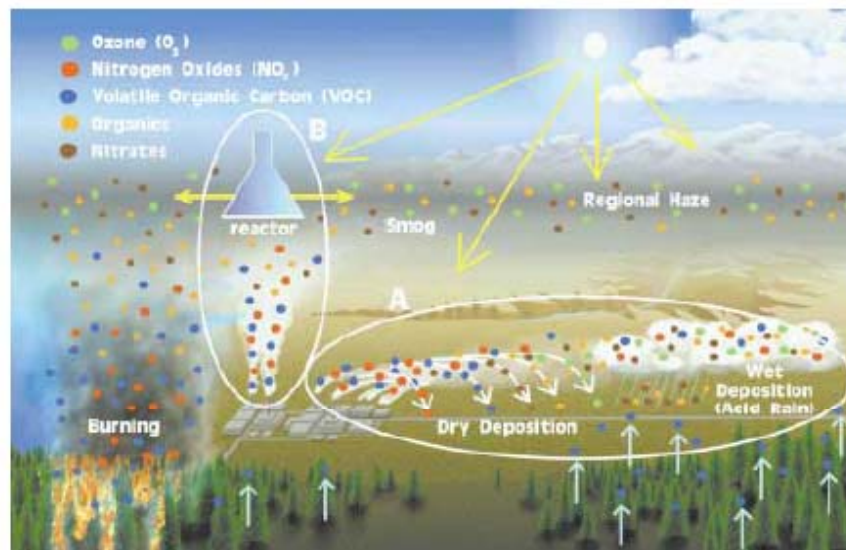
- Monitor network
- Historical data
- Real-time monitoring system



What is needed?

3. Understanding the interactions

- Determine how meteorological processes influence air pollution in an area



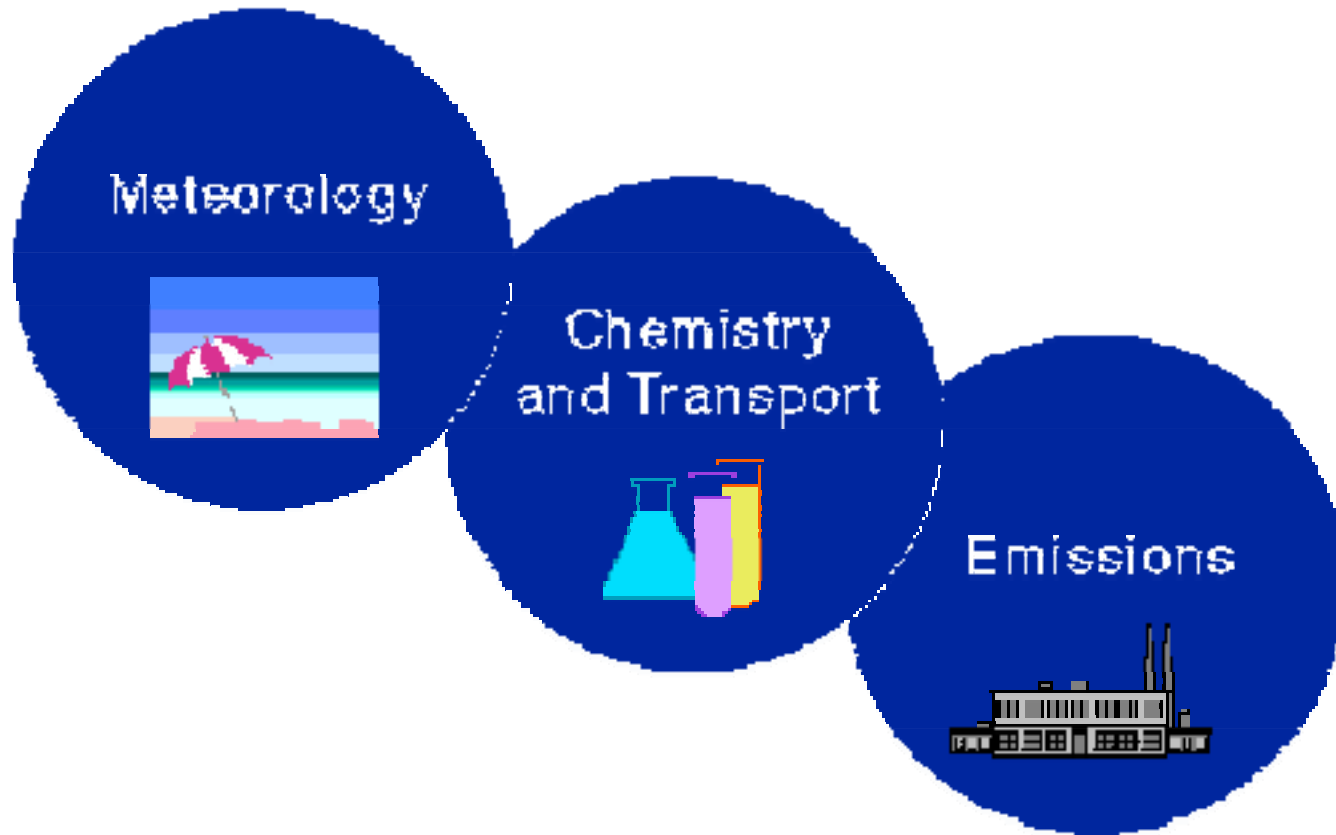
- Forecast the processes that affect air quality, then predict the air quality

OUR EFFORTS

Air Pollution Modeling Efforts in India

- CPCB efforts are mainly directed towards hot spot area monitoring and control strategy management
- Majority of the scientific institutions in India are involved in dispersion modeling
- A few institutions are really involved in Whole chemistry-transport modeling.
- Efforts of IITM, Pune in large and medium scale air pollution air pollution modeling (CTM).
- Marching towards achieving capability to predict short term pollution level on a wider but local scale.

Coupling of different aspects for Air Pollution Modeling



ATMOSPHERIC CHEMISTRY-TRANSPORT MODELING

(1) Global: Troposphere & LS (0-40 km)

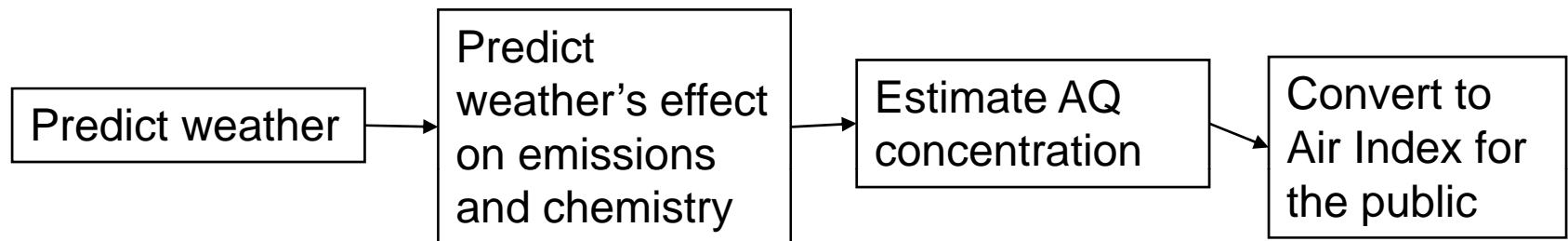
MOZART (1.8° x 1.8°, 1 km)

(2) Development of Emission Inventory for India

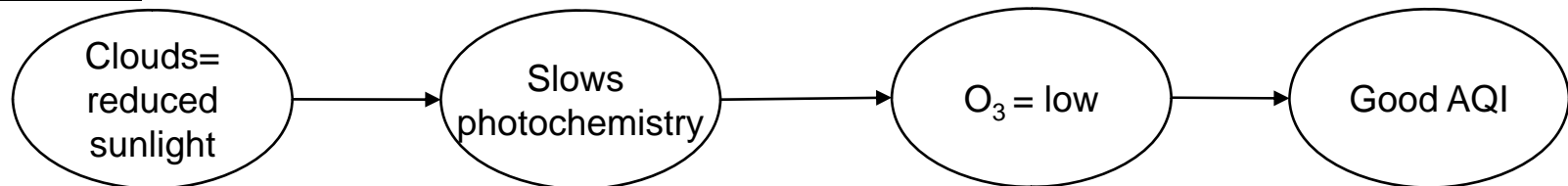
(3) Regional: Air Pollution Model –Near Surface /LT

REMO-Chem (Indian /South Asian domain) (1/2°x1/2°, 1 km)

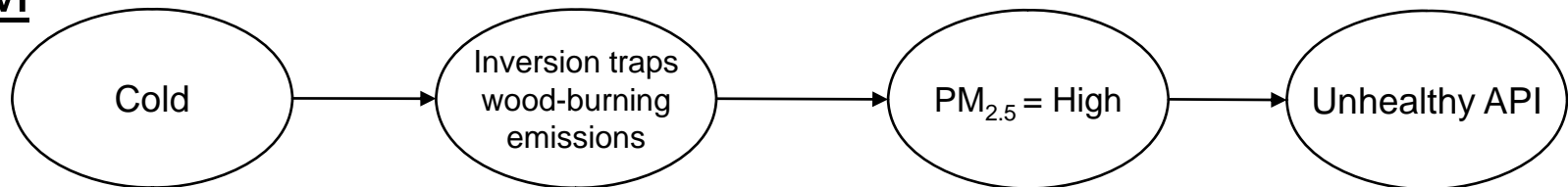
Weather v/s Pollutant



Ozone



PM



Emission Inventory Initiatives in India

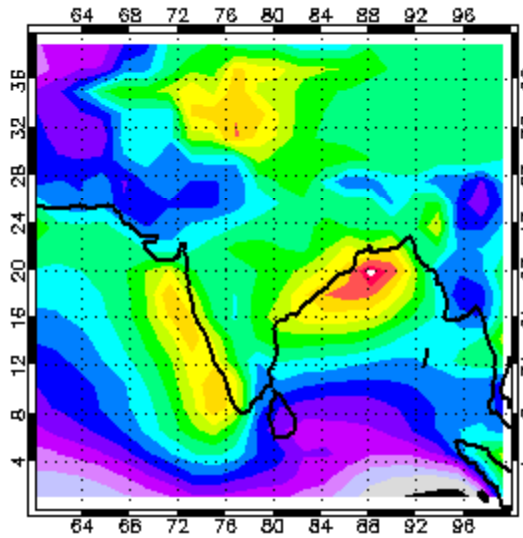
- **Global Change Program (CSIR, New Delhi and MoEF, New Delhi) led by NPL (1990-1993).**
- **ALGAS (Asian least cost GHG amendment strategy) (Asian Development Bank & MoEF): Several Indian Institution (1993-1996).**
- **NATCOM (Indian's National Communication, P-1), MoEF, New Delhi (parties to UNFCCC) (2004-2006).**
- **Latest Emission inventories using GIS methodology – IITM, Pune**

EMISSION STATUS

- **Gridded New Indian Emission Inventory of all important pollutants in $1/2 \times 1/2$ degree resolution ready (IITM+NPL)**
- **In India, maximum contribution is from coal sources for BC emissions. For CO, maximum contribution is from bio-fuel sources and for NO_x, maximum contribution is from fossil fuel sources in the present time.**

EDGAR-Emissions (A)

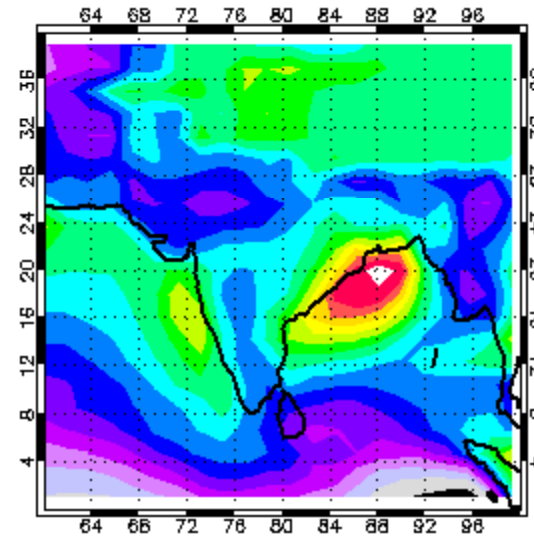
OX_VMR_avg [ppb], MPIM Jan 2001 0.0 km



Surface

New Indian-Emissions (B)

OX_VMR_avg [ppb], New India Jan 2001 0.0 km

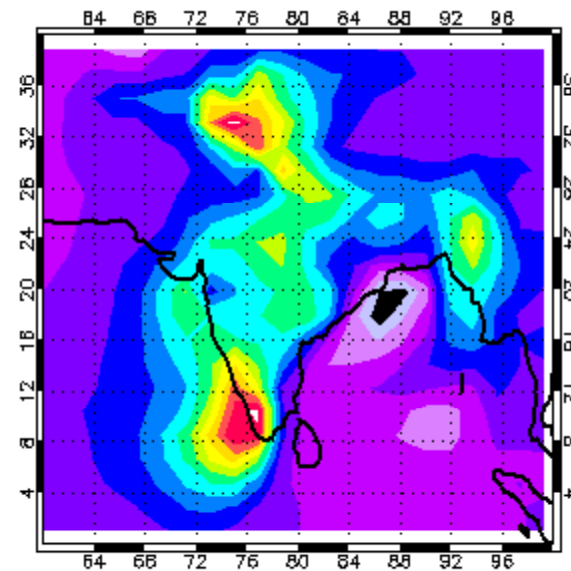


EDGAR-Overestimates
Absolute Difference
(A - B)



Ozone (ppb)

OX Diff [ppb], wrt New India Jan 2001 0.0 km

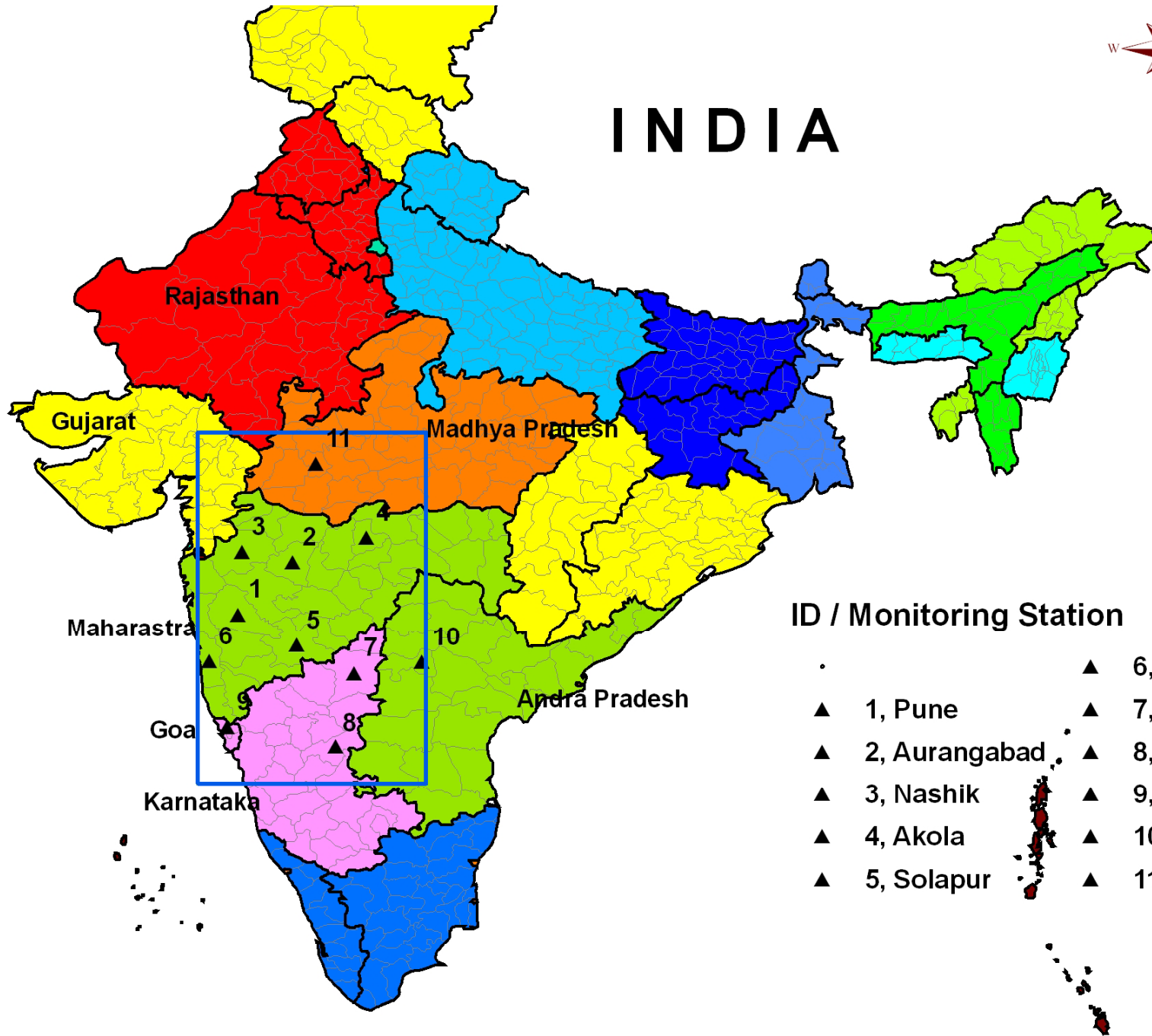


Road Map

- **Building capability to predict short term pollution level on a wider but local scale in 2 years time.**
- **Role of aerosols in modulating the Indian summer monsoon ?**



INDIA



ID / Monitoring Station

- | | |
|-----------------|-----------------|
| • | ▲ 6, Ratnagiri |
| ▲ 1, Pune | ▲ 7, Gulbarga |
| ▲ 2, Aurangabad | ▲ 8, Bellary |
| ▲ 3, Nashik | ▲ 9, Panaji |
| ▲ 4, Akola | ▲ 10, Hyderabad |
| ▲ 5, Solapur | ▲ 11, Indore |