

Trans-boundary and Long range Transport of Air pollution

An Important Air Quality Issue in South Asia



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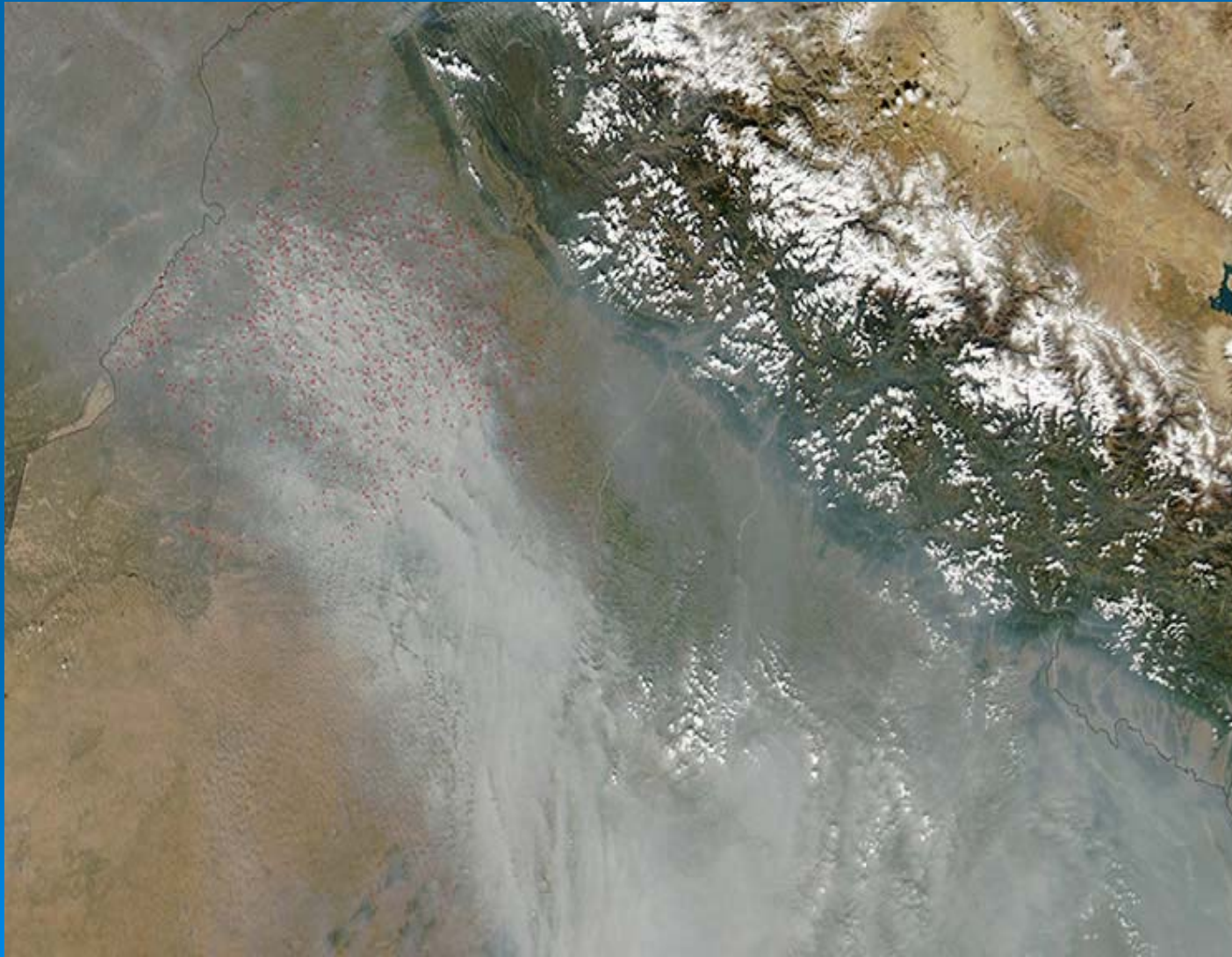
Major Issues related to Air Quality in south Asia

1. Biomass burning emissions
 2. Atmospheric Dust
 3. Trans-boundary and Long Range Transport
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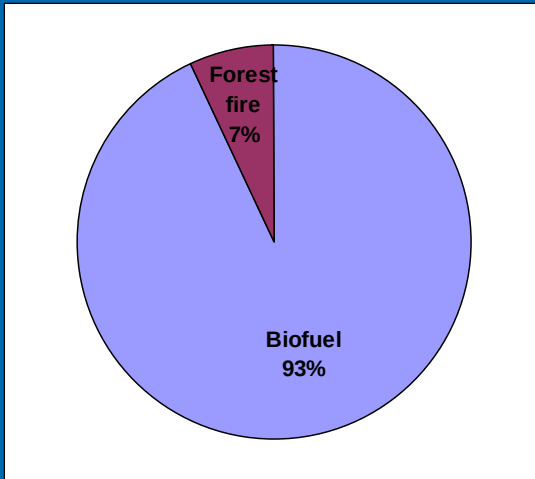
Crop burning



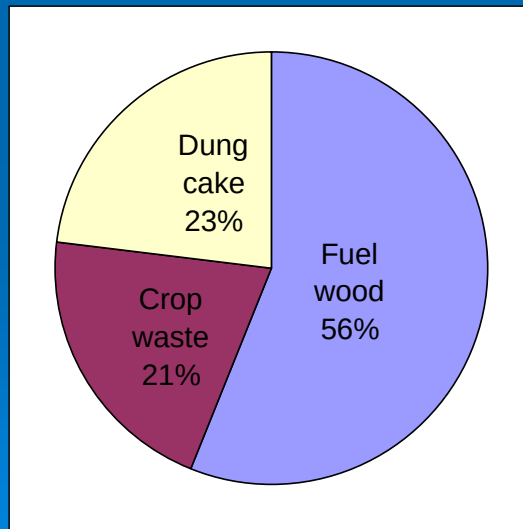
Biomass burning spots



% Share of different biomass in India



- Biofuels account 93% of total biomass consumption
- Forest fires only 7%.
- This is contrary to global patterns where forest fires dominate over biofuels



- Typical ratios across different regions are-
 - 56 % fuelwood,
 - 23% crop waste
 - 21% Dung-cake

Biofuel consumption: 577 MT/y

Reddy and Raman, 2002

Biomass burning in

Domestic **cooking/ heating**

One village consumption of biofuel:

612 ton/y

(Singh et al., 2014)

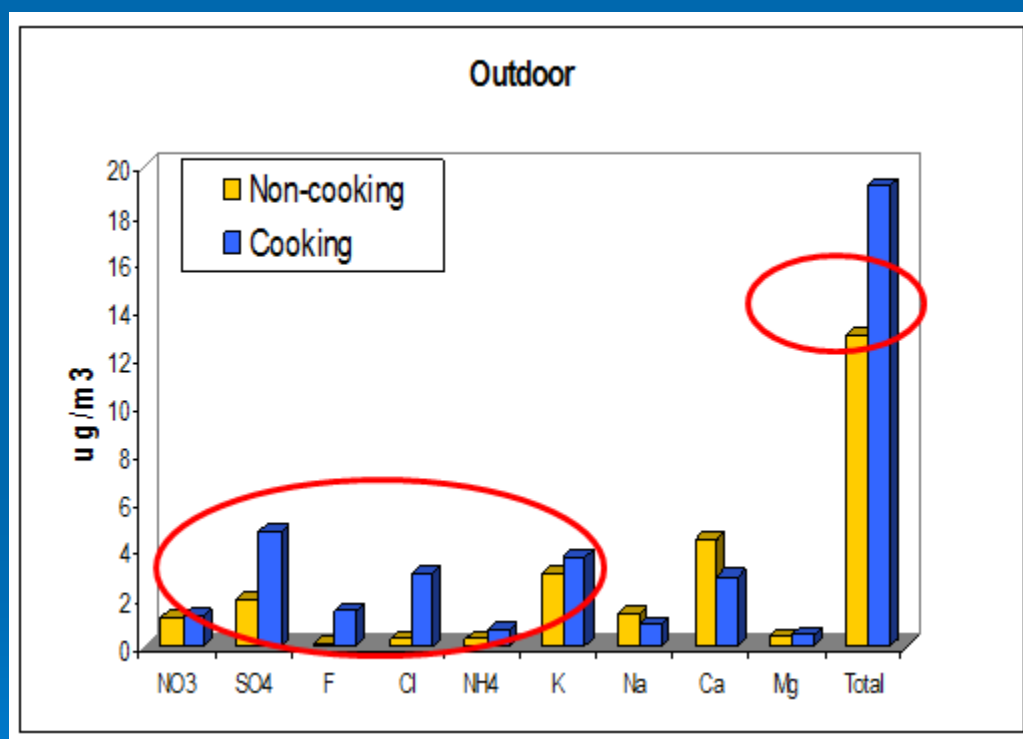


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Inorganic aerosols: Surya village-Khairatpur

Outdoor Aerosols

Cooking vs non-cooking period



Traditional Cooking contributes significant amount of SO₄, K, Cl, F, NH₄, NO₃.

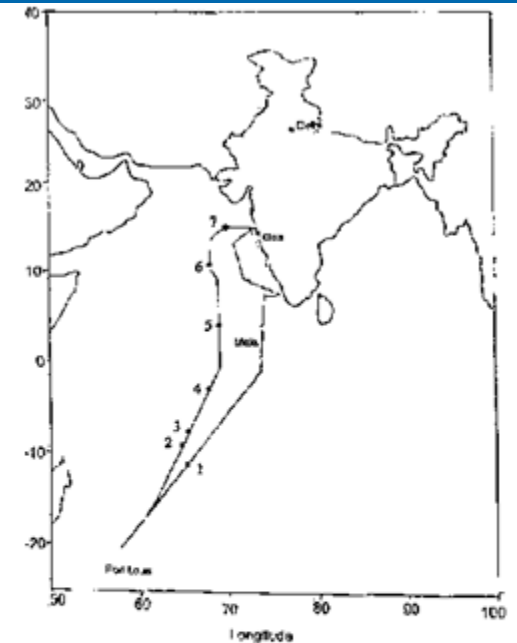
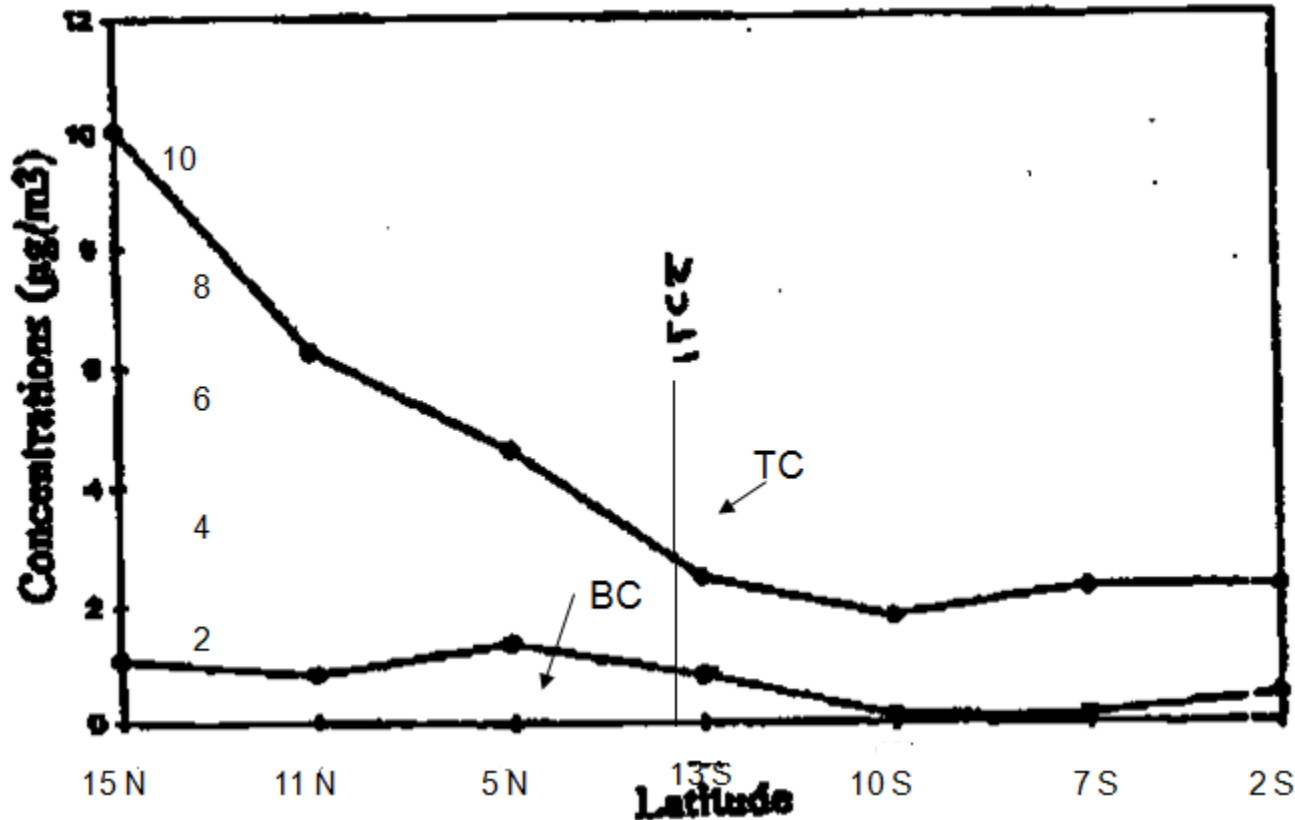
During cooking period, total aerosol ions were ~44% higher.

Estimates showed that cooking with Improved Cooking Stoves consumed 41% less biofuel as compared to Traditional Cooking Stoves.

ICS operation helps in reducing indoor air pollution as compared to TCS.

Singh et al., 2014

BC/TC variation in Indian region during INDOEX



Organic carbons (OC) (TC-BC) conc. are very high as compared to BC

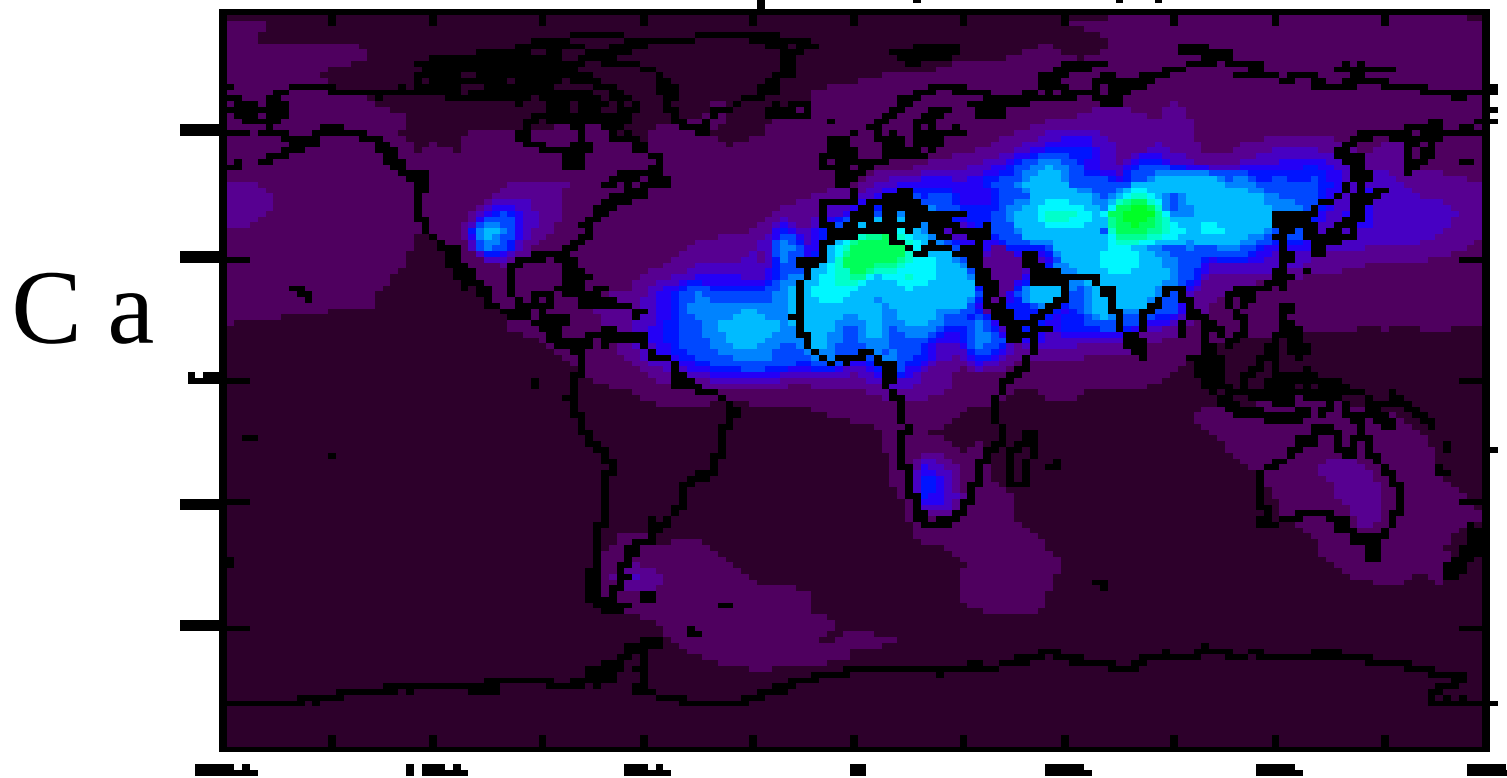
Source: Sarkar et al (2001), Current Science, 80, 176-179.

Other related report: Satheesh and Ramanathan (2000), Nature, 405, 60-63.

Atmospheric Dust

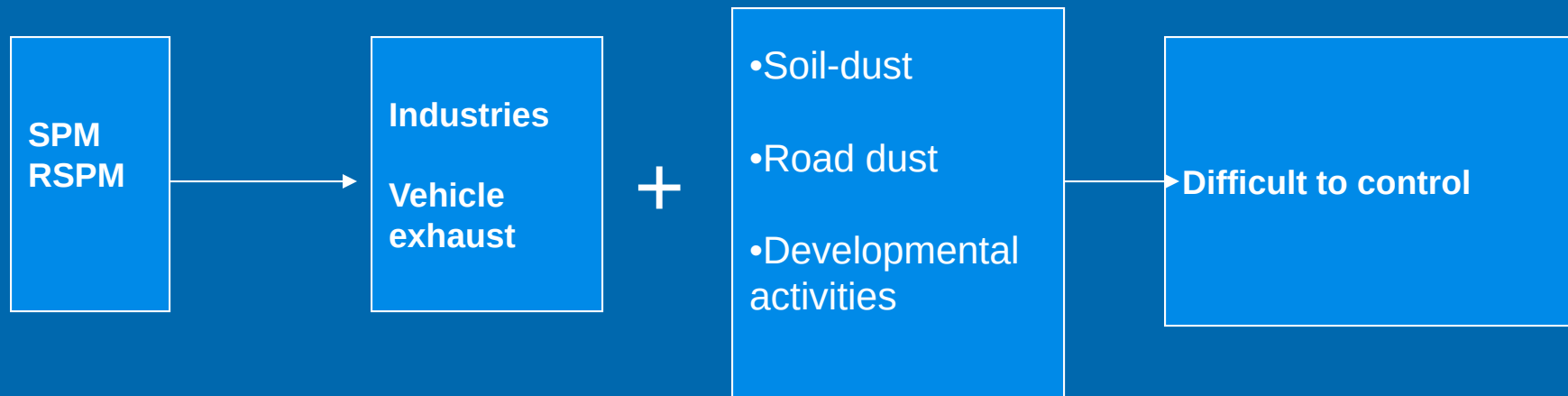


Global Ca deposition



Tegen and Fung

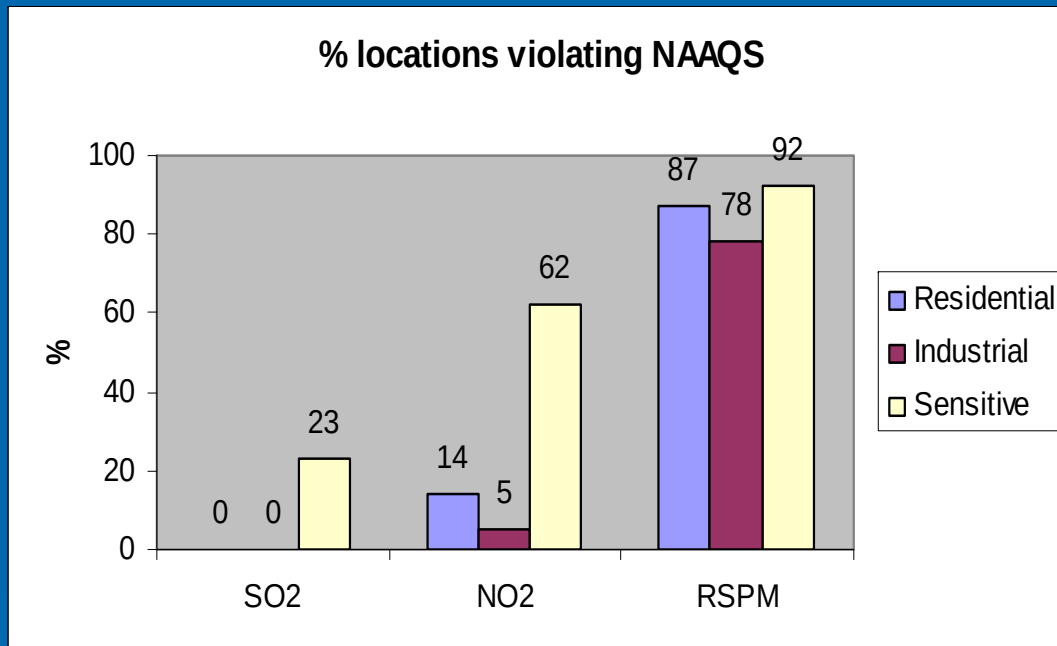
Atmospheric Dust is main cause of High Particulate Matter



High concentrations of atmospheric dust control acid rain in India and influence radiative forcing in Indian region

Air quality in India

% of locations violating NAAQS in 2008



SO2 is mostly well within NAAQS limits

NO2 moderately crossing the NAAQS

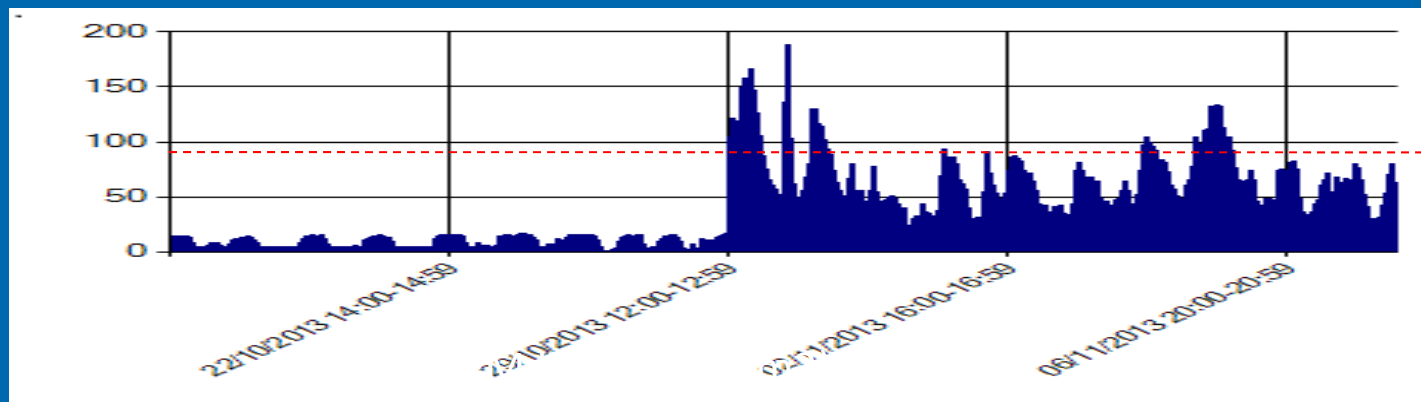
SPM and RSPM mostly higher than NAAQS

(Source: NAAQMS/33/2009-10 (CPCB))

Annual NAAQS during 2008

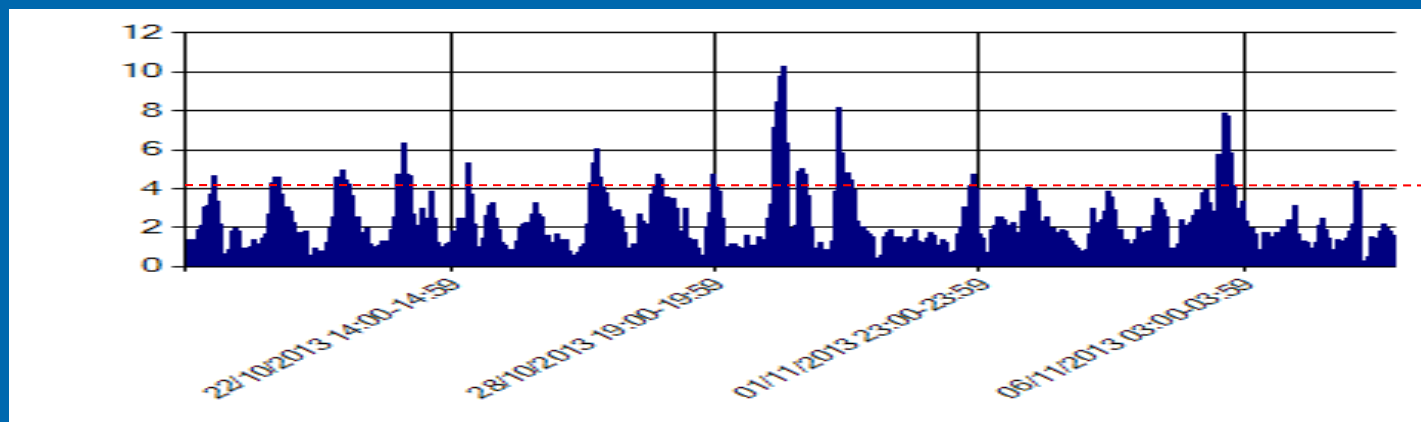
Pollutant	Industrial (ug/m3)	Residential (ug/m3)	Sensitive (ug/m3)
SO2	80	60	15
NO2	80	60	15
RSPM	120	60	50

NO₂
ITO



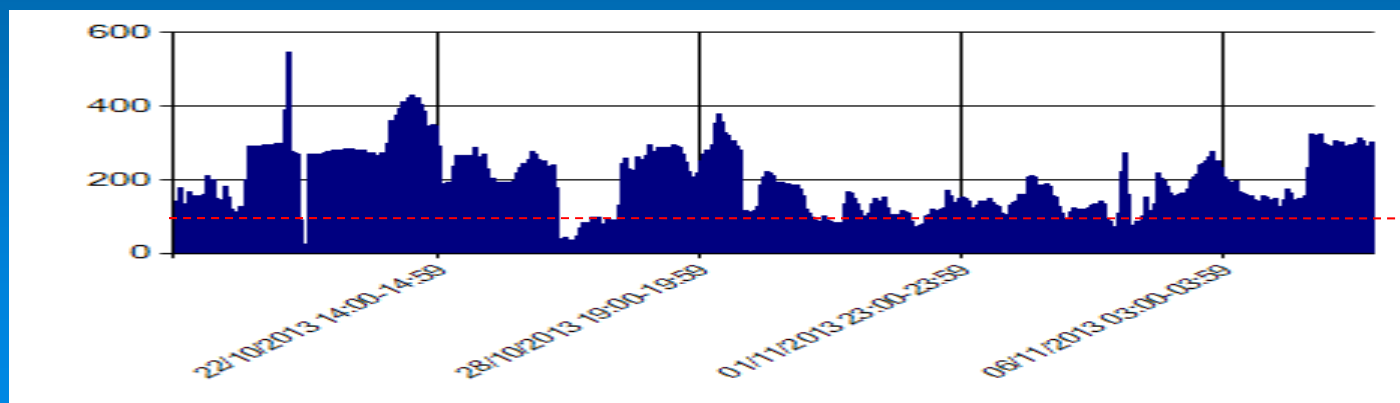
80 ug/m³

CO
ITO



4 mg/m³

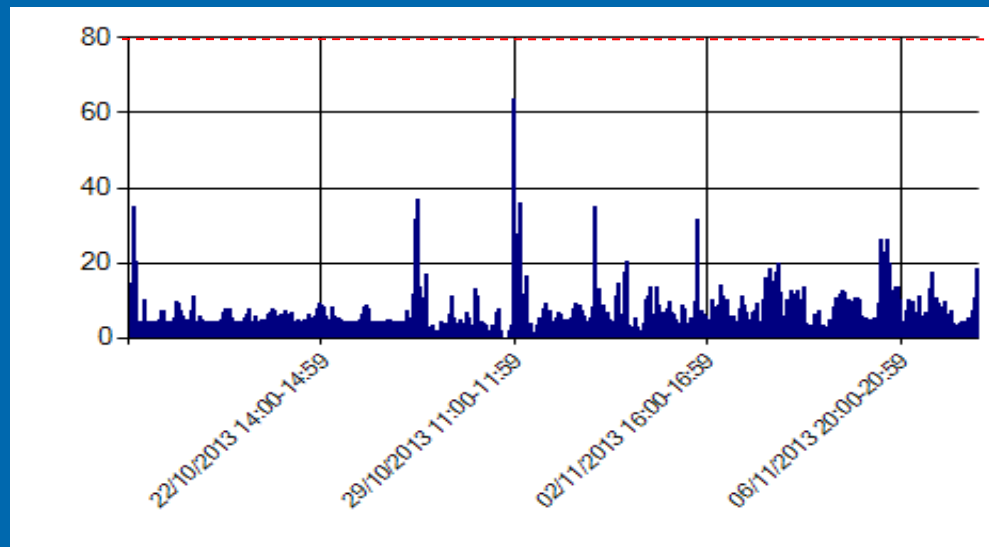
PM_{2.5}
ITO



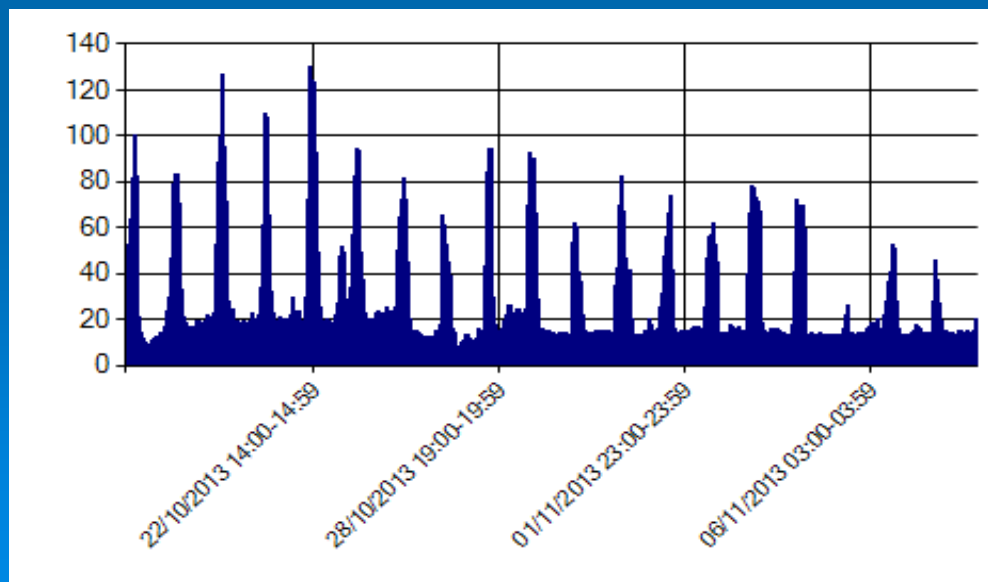
60 ug/m³

Status of air quality in Delhi: Normal vs Diwali 2013

SO₂
ITO



O₃
ITO



Source:CPC

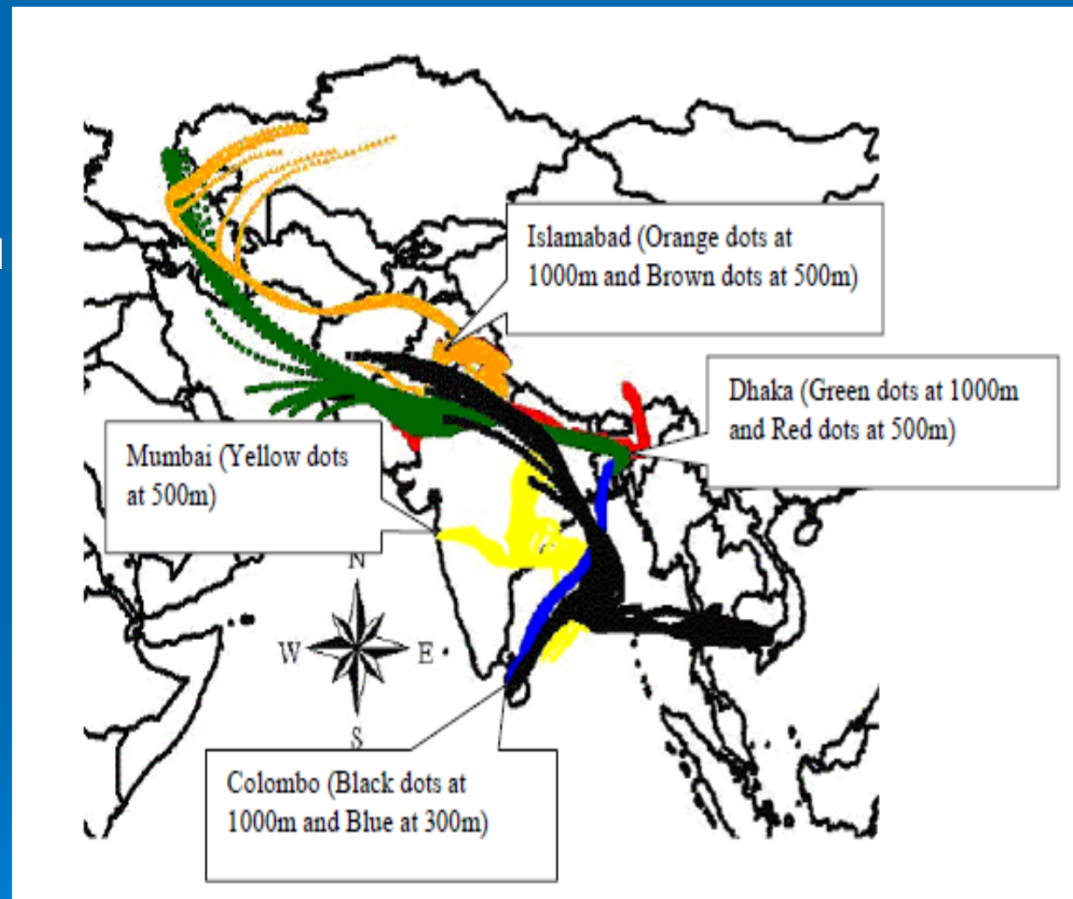
Trans-boundary and Long Range Transport of Pollutants



Aerosol Transport: India, Bangladesh Pakistan and Srilanka

BC rich smoke is contributed by agricultural waste burning sources located mainly in northern India

Long range transport of the desert dust from Oman through the Gulf and Iran is transported to Pakistan and other south Asian countries



Airmass trajectories showing the likely source areas for smoke in India, Bangladesh, Pakistan and Srilanka [Begum et al].

LRT of PM₁₀ aerosols

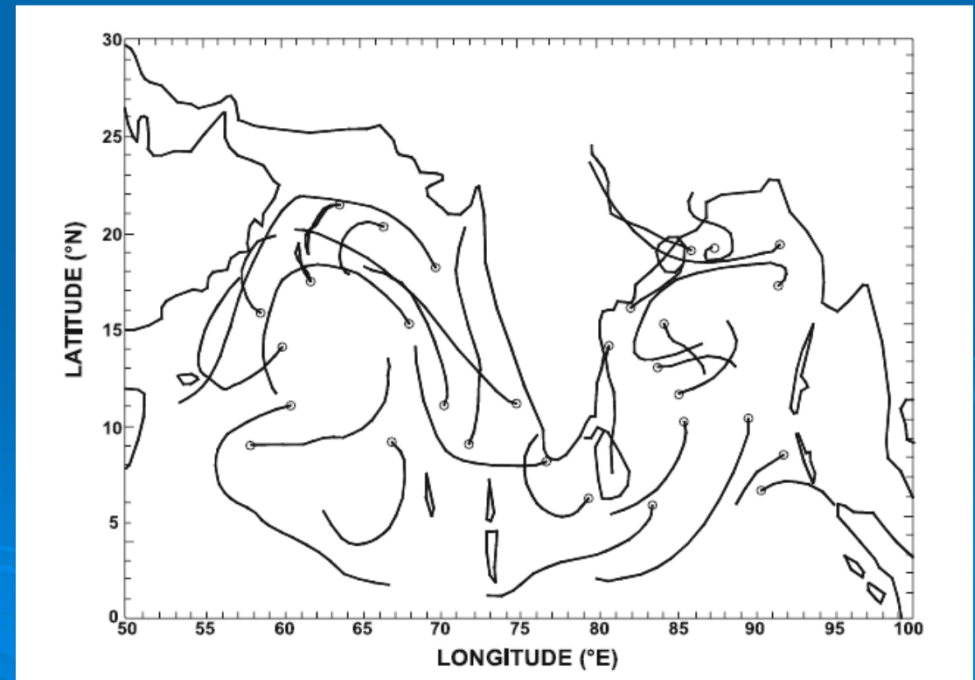
During Integrated Campaign on Aerosol and trace gas Radiative Forcing (ICARB).

Regions of Bay of Bengal and Arabian Sea were influenced by the airmasses coming from four sectors-

- (i) passing through Indian land,
- (ii) from Indian Ocean region,
- (iii) from northern Arabian Sea and Middle East and
- (iv) African continent.

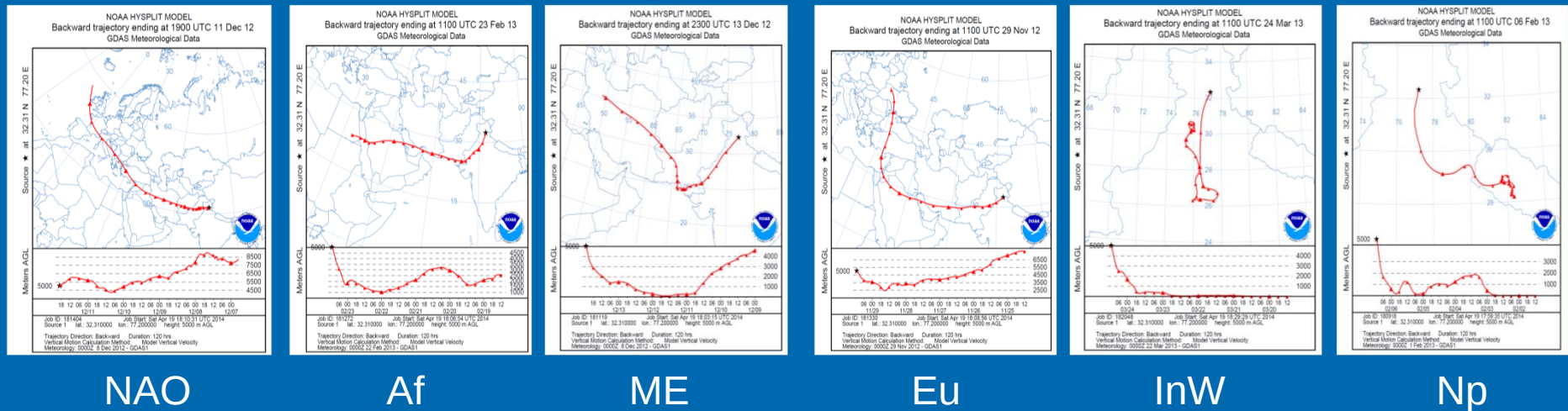
The highest nss SO₄²⁻ was observed during airmasses coming from the Indian land

while the lowest concentrations were observed when the airmasses were coming from oceanic region.



Reddy et al (2008)

Trans-boundary and LRT of acidifying pollutants At Koti (western Himalaya)



North Atlantic Ocean origin (NAO) - represented the highest number of events (40%).

African origin (Af) - 23 % of snowfall events.

Middle East origin (ME) - 10% of snowfall events.

European origin (Eu) – 6% of snowfall events.

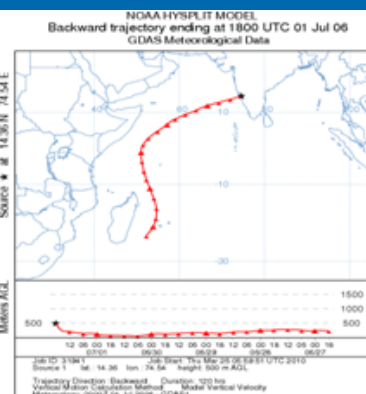
Western India origin (InW) - 13% of snowfall events.

Nepal origin (Np) - 8 % snowfall events.

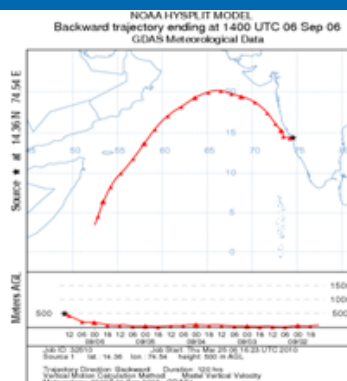
- Out of total, 83% samples showed pH of snow above 5.6 while 17 % samples only were found to be acidic
- Acidic snow samples were found at this site in airmasses originated from Middle East and Europe mainly.

(Kumar and Kulshrestha, 2014)

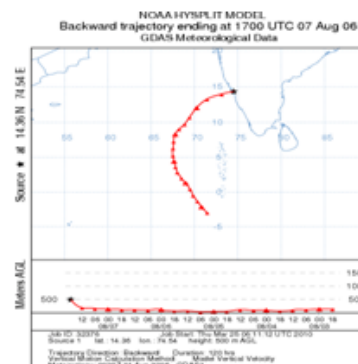
Five trajectories reaching at the site during monsoon season-



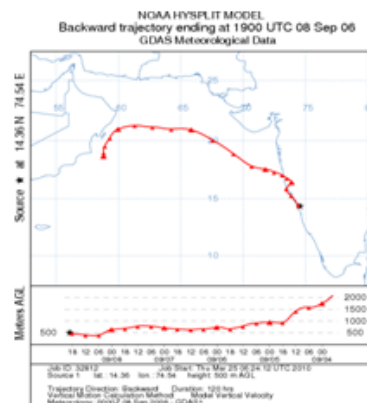
South-west Indian Ocean



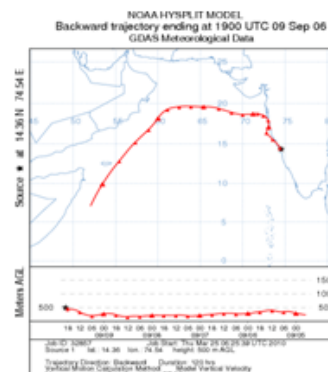
North-west Indian Ocean



Central Indian Ocean



Gulf



North-West Indian Ocean + South-West Indian Continent.

Satyanarayana et al (2010), J Atmospheric Chemistry

Summary

- Trans-boundary, LRT, biomass burning and atmospheric dust are the major issues related to air quality in South Asia. These topics need comprehensive investigation.
- Common task force involving scientists, administrators, policy makers from South Asian countries is needed to tackle LRT issues.
- Certain natural factors are beyond human control; however, measurements of heavy metal content in aerosol samples need to be done in order to assess any human health effects.
- Emissions from open biomass burning and household cooking can be reduced by deploying suitable technology for improved human health and climate.
- In rural areas, supply of efficient stoves will help in reducing emissions of gases and aerosols from traditional cooking.

FOR THE FUTURE



Save the Planet

