

System of Air Quality and Weather Forecasting and Research (SAFAR-India)



HOW SCIENCE OF FORECASTING SHAPES ACTION



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Ministry of Earth Sciences, Govt. of India

-Towards Facts leading to Self Mitigation.....

What is SAFAR ?

A COMPLETE SOLUTION MINUS MITIGATION

SAFAR Consists of FIVE major components

(1) MONITORING NETWORK:

To validate the forecast, establish Weather and air quality observational network strategically and operate 24x7. City Area and Population decides number. Optimize 10 stations for 3-5 million city.

(2) WEATHER FORECASTING SKILL:

Meteorology drives air quality. Develop skill for advance weather forecast. Validate with observations.

(3) EMISSION INVENTORIES: Key Input to Air Quality Forecasting model

(4) AIR QUALITY FORECASTING SKILL –ULTIMATE OBJECTIVE:

Develop capability for advance forecast (1-3-5 days?). Validate & Confidence

(5) OUTREACH:

Translate Data into Information and deliver products. Convey message to common public with advisories and Alerts. Sensitize regulators.

CHALLENGE

...of 4 Different Cities



1. Practical
2. Technical
3. Scientific

- DIFFERENT METEOROLOGY
- DIFFERENT TOPOGRAPHY
- DIFFERENT LEADING EMISSION SOURCES
- DIFFERENT SOCIO-ECONOMIC STATUS
- VARIOUS MICRO-ENVIRONMENTS

DELHI



AHMEDABAD

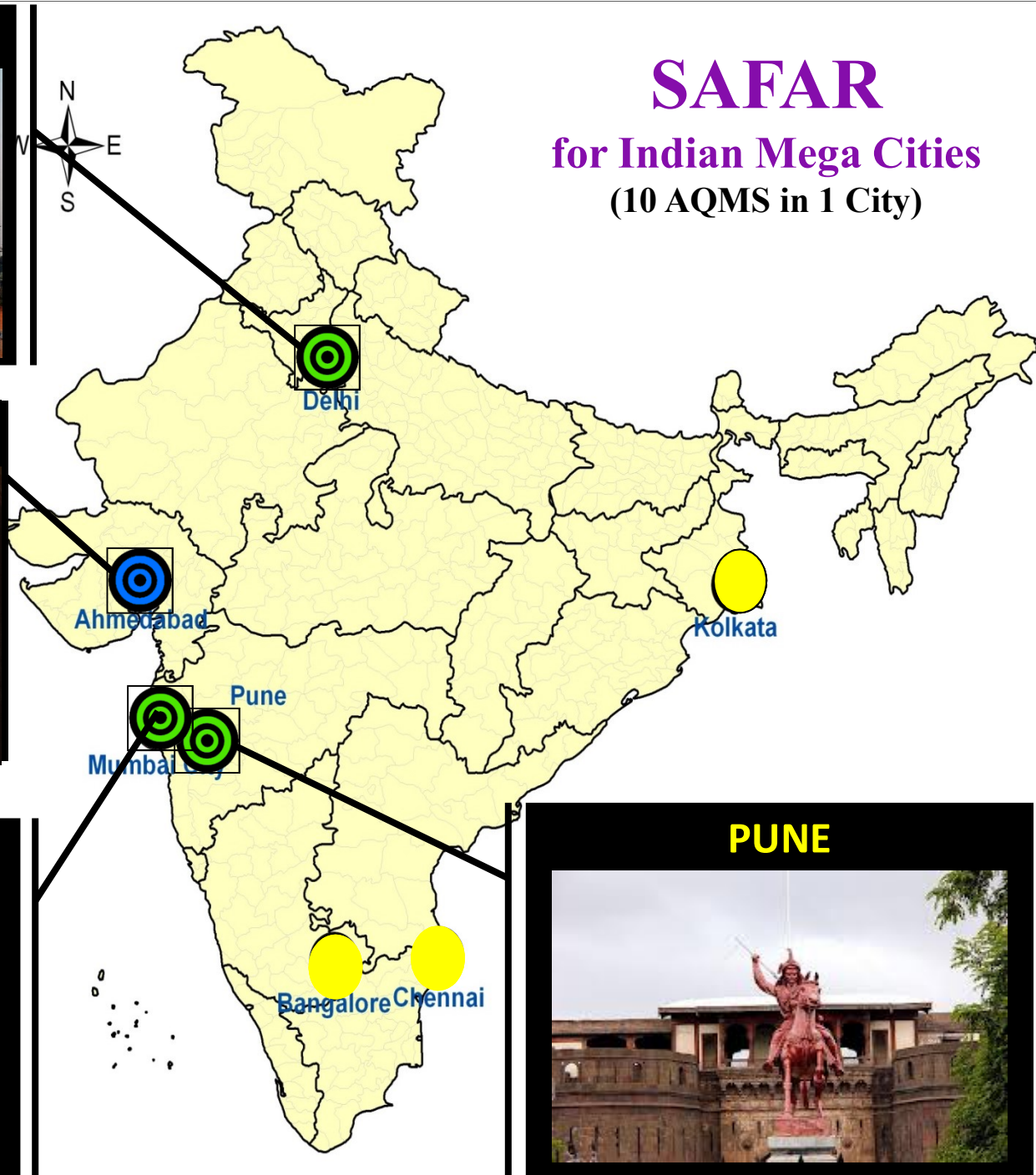


MUMBAI



SAFAR

for Indian Mega Cities
(10 AQMS in 1 City)



PUNE

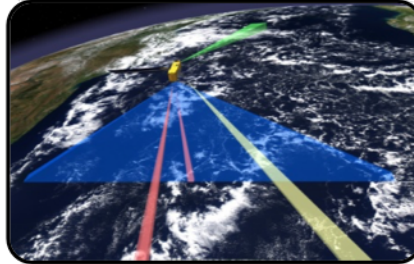


SAFAR-FORECASTING MODEL FRAMEWORK

Real Time AQMS and AWS Network Data



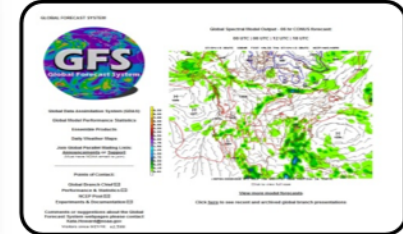
Real Time Satellite Data -Assimilation



Forecasted -MACC-Chemical IC & BC

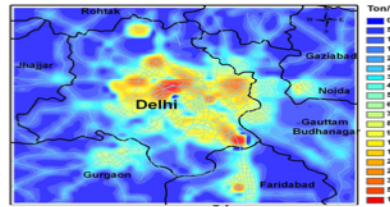


Forecasted -NCMRWF-GFS-Met IC&BC

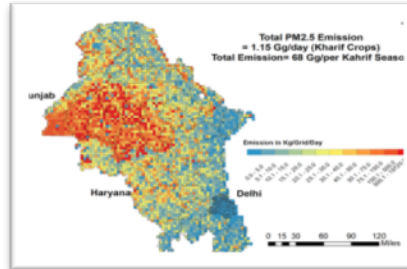


High Resolution Emission Scenario -Regional-2018

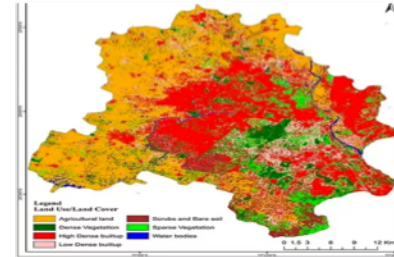
Total PM2.5 Emission for Delhi-NCT Region 2015
(At 1.67km Resolution)



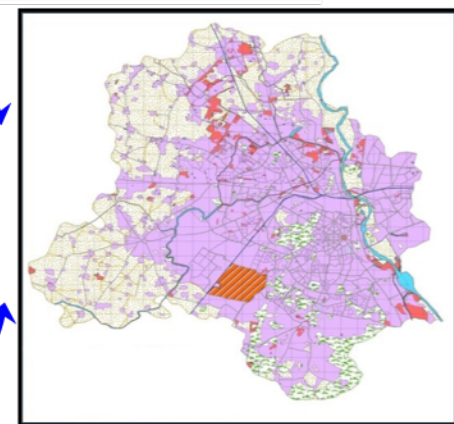
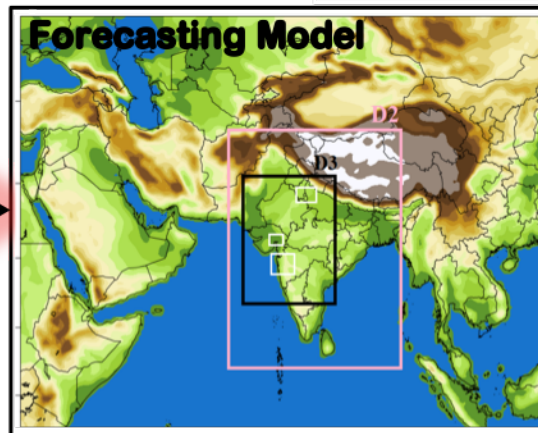
Stubble Bio-Mass Burning Emission Products-SAFAR..



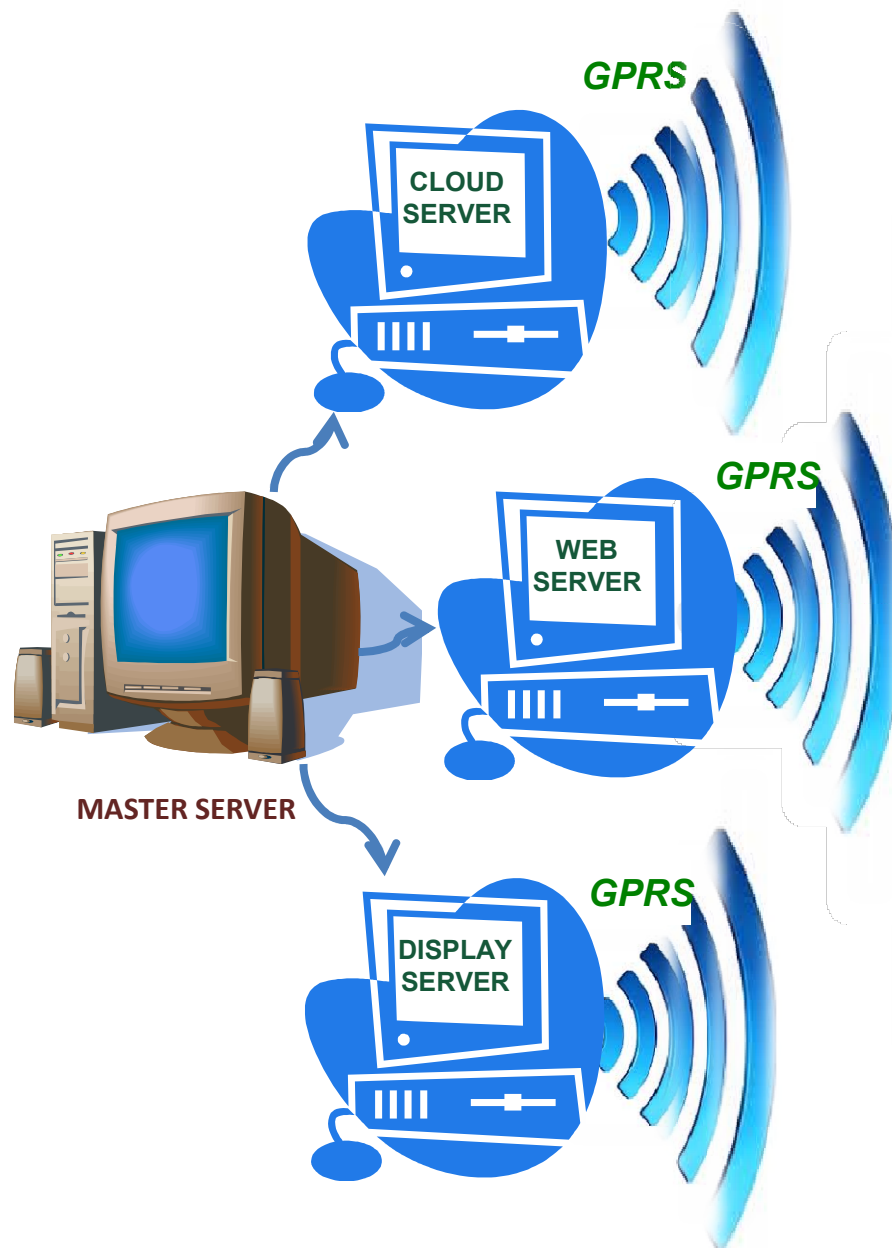
Land use and Land cover Products: IRS-Bhuvan:



72h -Air Quality Warning Products



DISSIMINATION TOOLS



LED DISPLAY BOARDS



HOW POLLUTION IS GENERATED?

EMISSION INVENTORY DELHI-2018

(400m x 400m)

**Accounting Local Anthropogenic
Sources of Emissions of Major
Pollutants**

EMISSIONS SOURCES -26 TYPES

- **TRANSPORT**
- **BIO-FUEL (SLUM)**
- **BRICK INDUSTRY**
- **STREET VENDOR**
- **HOTEL (DHABA)**
- **CONSTRUCTION SITE**
- **SPEED BREAKER**
- **MAJOR HOSPITAL**
- **TOURIST PLACES**
- **SHOPPING MALLS**
- **TRAFFIC JUNCTIONS**
- **RAILWAY STATION**
- **AIRPORT (AVIATION)**
- **INDUSTRY**
- **LOCAL TRANSPORT (OLA/UBER/TAXI)**
- **HOUSEHOLD SURVEY**
- **WASTE BURNING/PROCESSING**
- **BIOMEDICAL WASTE**
- **POWER PLANT**
- **CREMATORIUM DATA**
- **LARGE HOTEL**
- **LARGE SCHOOL/COLLEGE**
- **WIND-BLOWN DUST**
- **DIESEL GENERATOR**
- **MOBILE TOWERS**

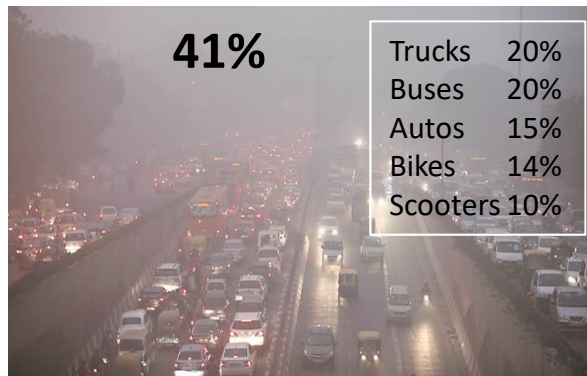


8 Tons of Biomass (Tudi) + 5 tons of Rubber is being used as fuel to generate **1 lakh Bricks semi-ZIGZAG** technology as compared to 10 tons coal for producing same number of bricks.

AMBIENT AIR POLLUTION

Motor vehicles, industries, road dust, building and construction, partly from household air pollution

PM2.5 as a marker (Delhi)



DELHI EMISSIONS 2010 2018

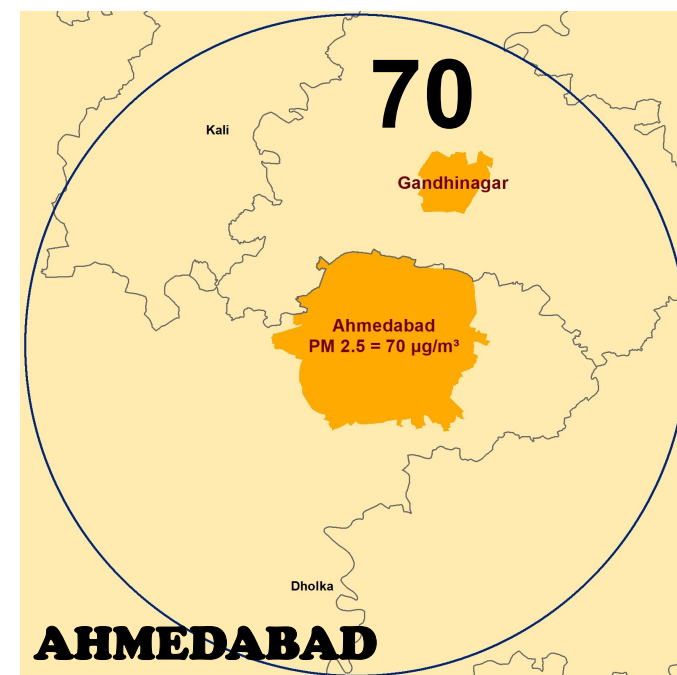
SOURCE SECTORS	PM2.5 (2018) Relative Share (%)	PM2.5 (2010) Relative Share (%)	GROWTH /DECLINE 2018 wrt 2010 (%)
Transport	41%	32%	+40% (Increase)
Industry	22.3%	17.3%	+48% (Increase)
Power	3.1%	3.0%	+16% (Increase)
Residential	5.7%	18.5%	-64% (Declined)
Re-suspended Dust	18.1%	27.8%	-26% (Declined)
Rest Others	11.7%	1.3%	NEW Sources
TOTAL (All Sectors) GROWTH in 2018 wrt 2010 (8 years) = +15% Ref.: Beig et al. (2018), SAFAR-Technical Report, MoES.			

STATUS OF AIR QUALITY IN INDIA

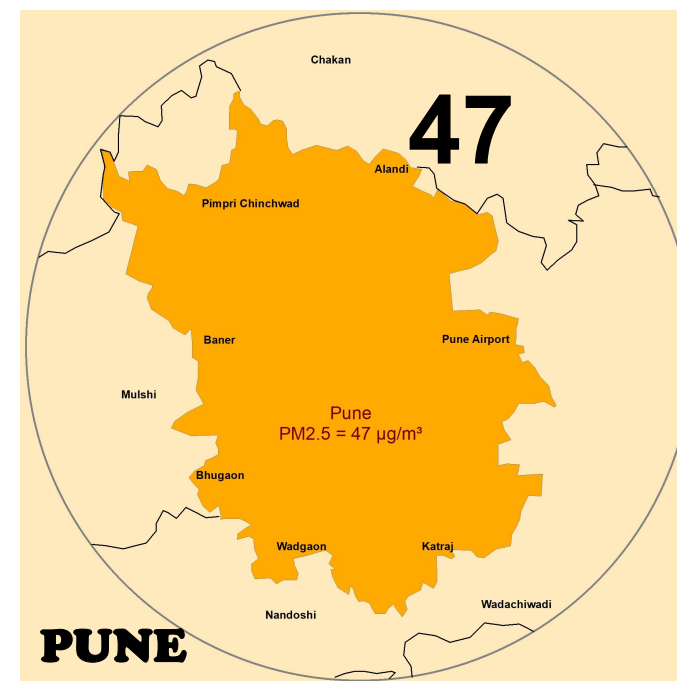




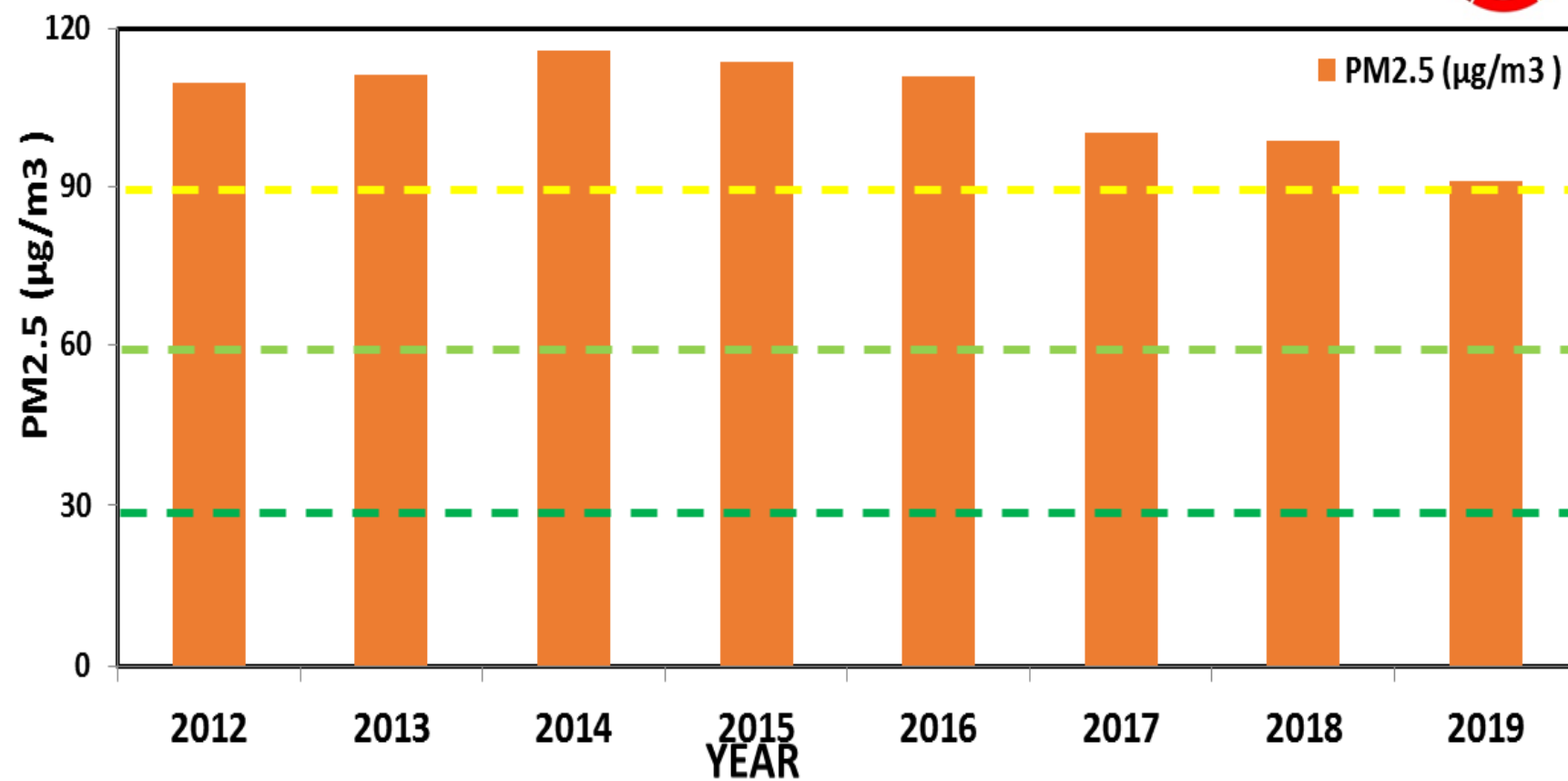
APPROX.
AREA OF
MITIGATION
FOR VISIBLE
IMPACT



EMISSION
WEATHER
GEOGRAPHY

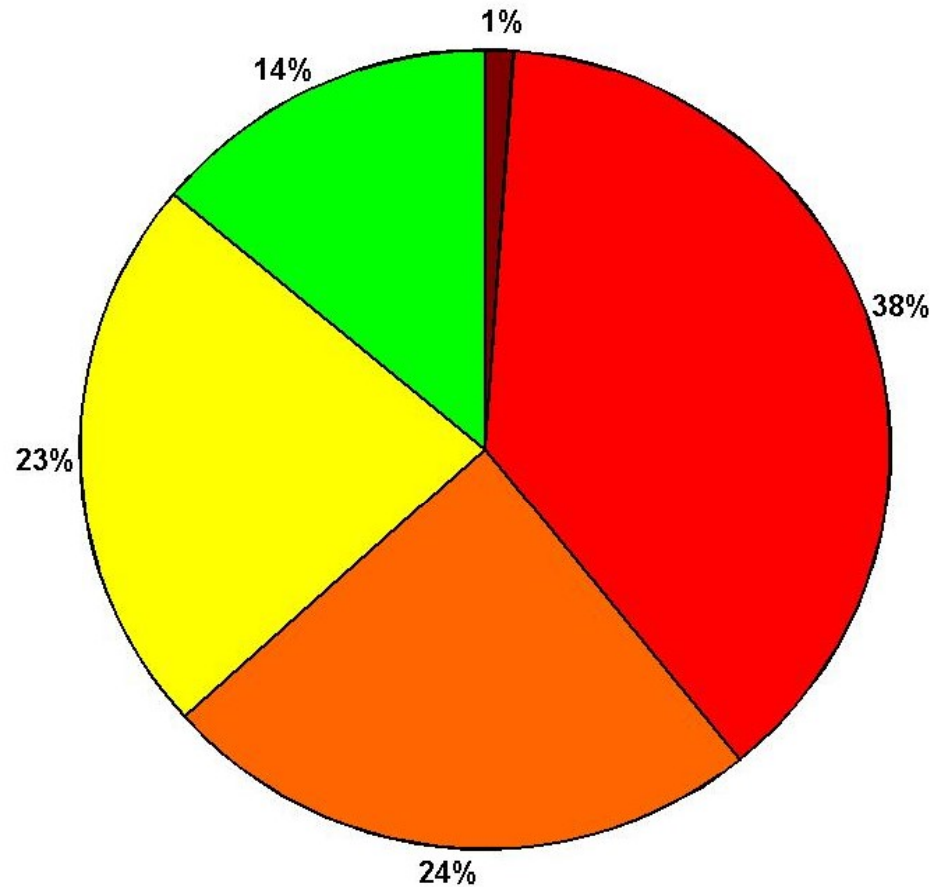


ANNUAL PM_{2.5} TRENDS (2012-2018)- DELHI

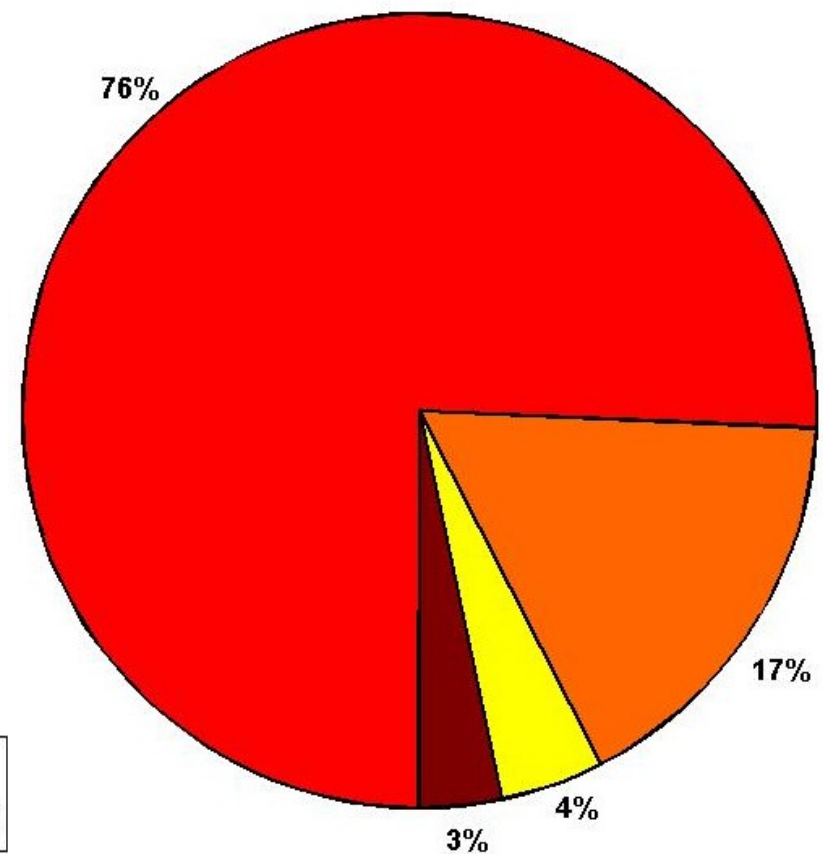


DELHI: PM2.5 (%) in different AQI ranges

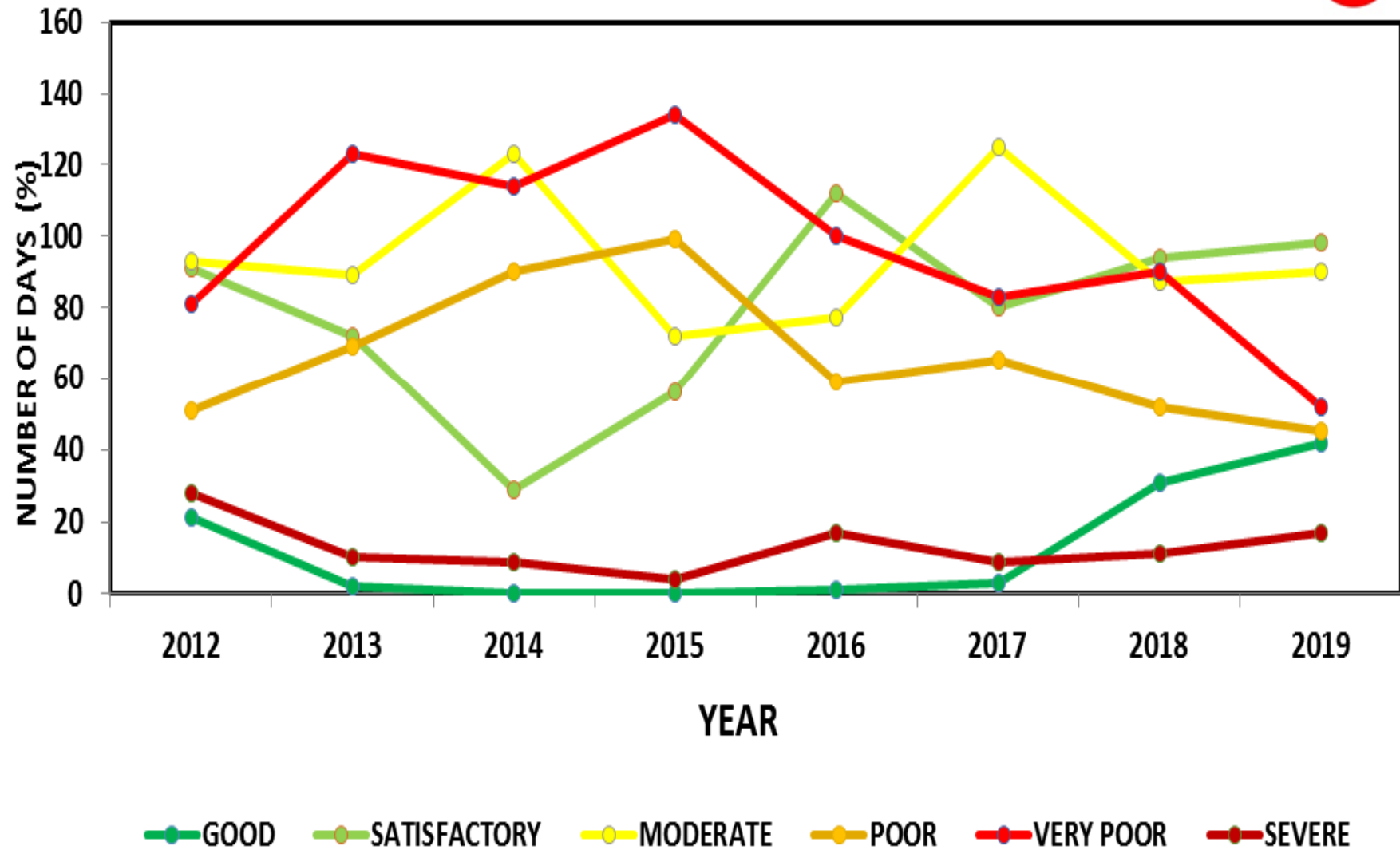
YEAR



WINTER



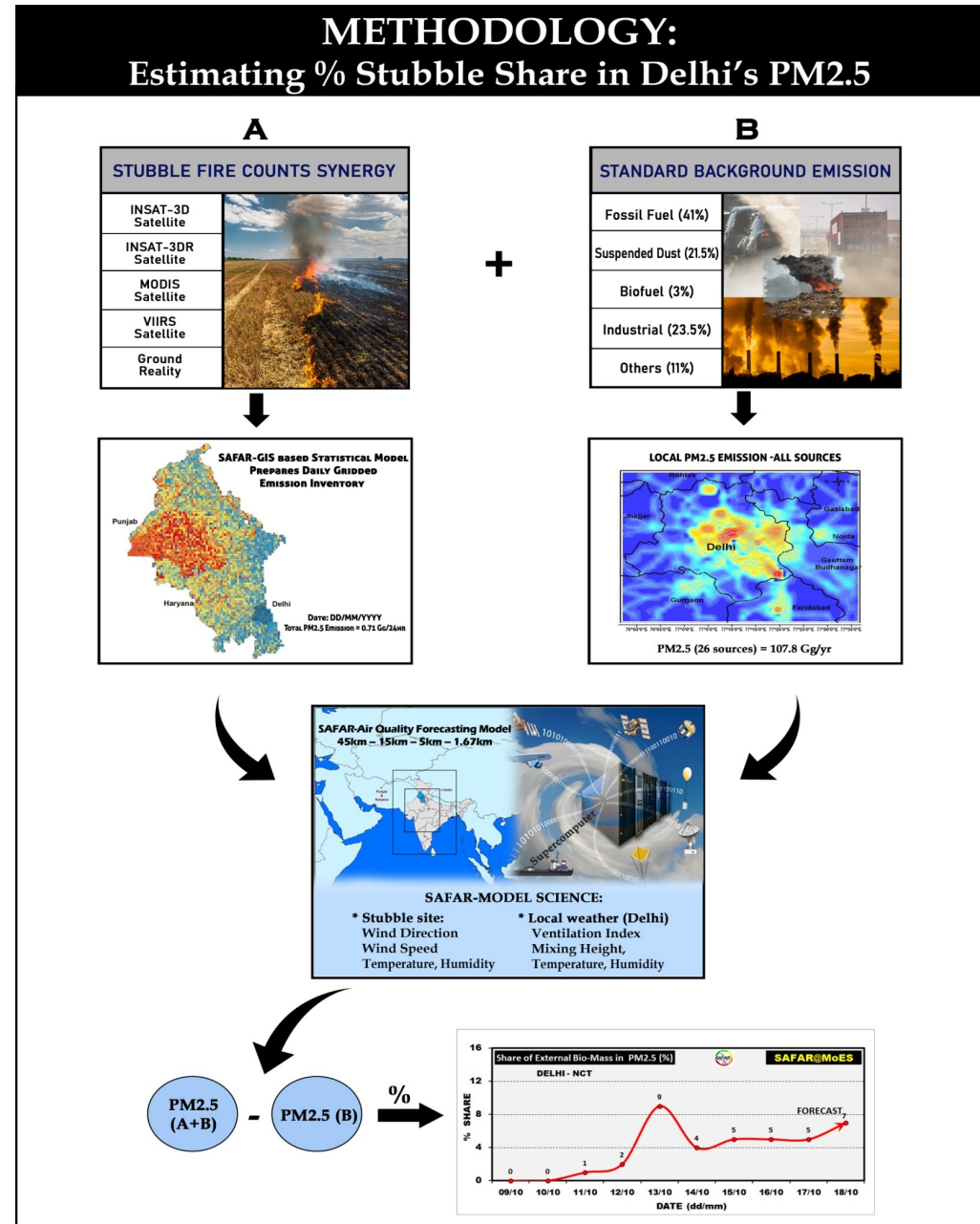
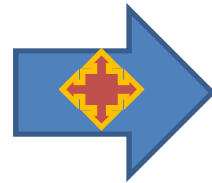
AQI-ANNUAL TRENDS (2012-19)



METHODOLOGY

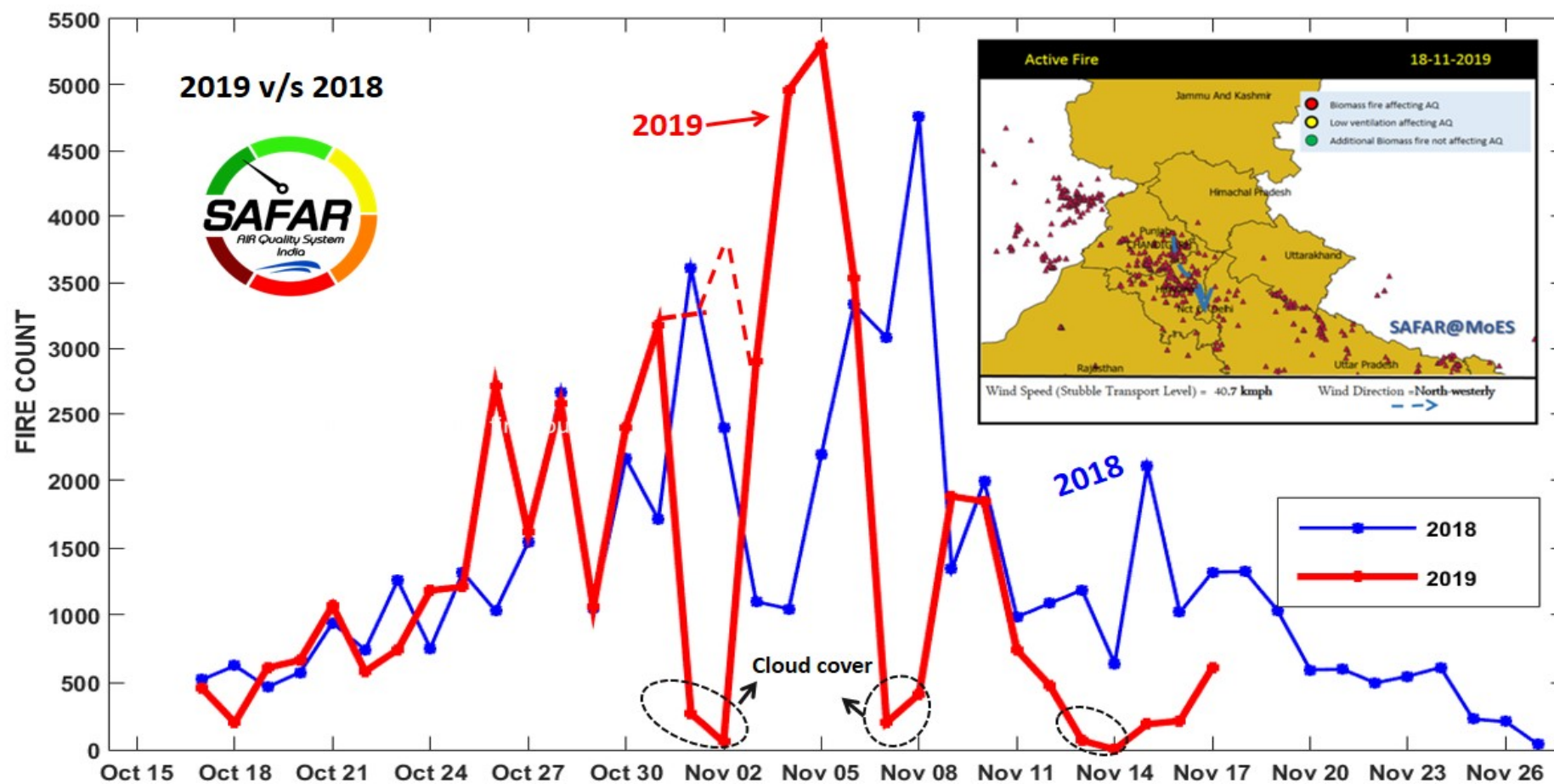
Estimating Share of Stubble Biomass
in Air Quality (PM_{2.5}) of Delhi

SAFAR-FORECASTING MODEL FRAMEWORK



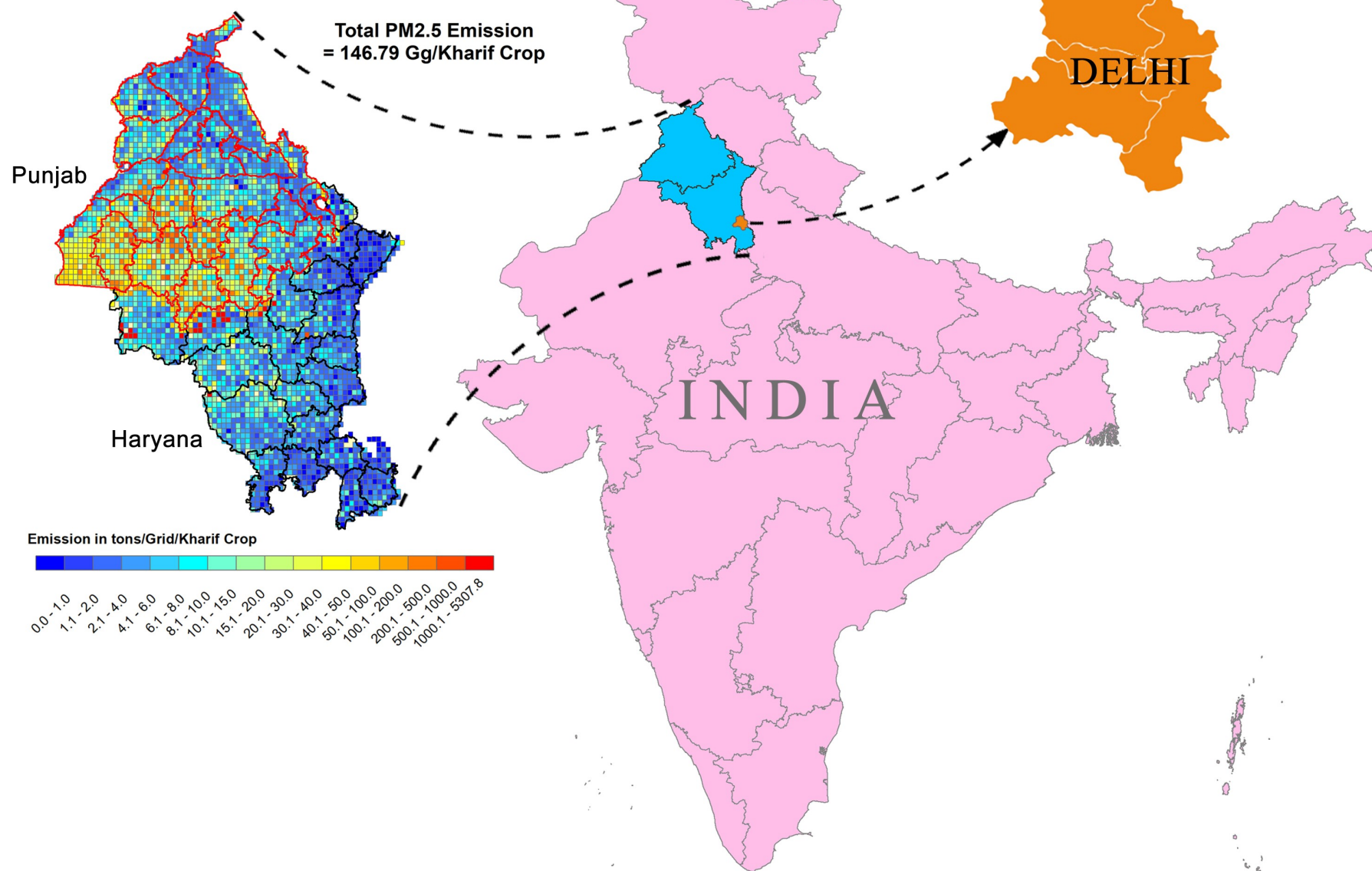
(Reference: Beig et al., Science of Total Env., 2019)

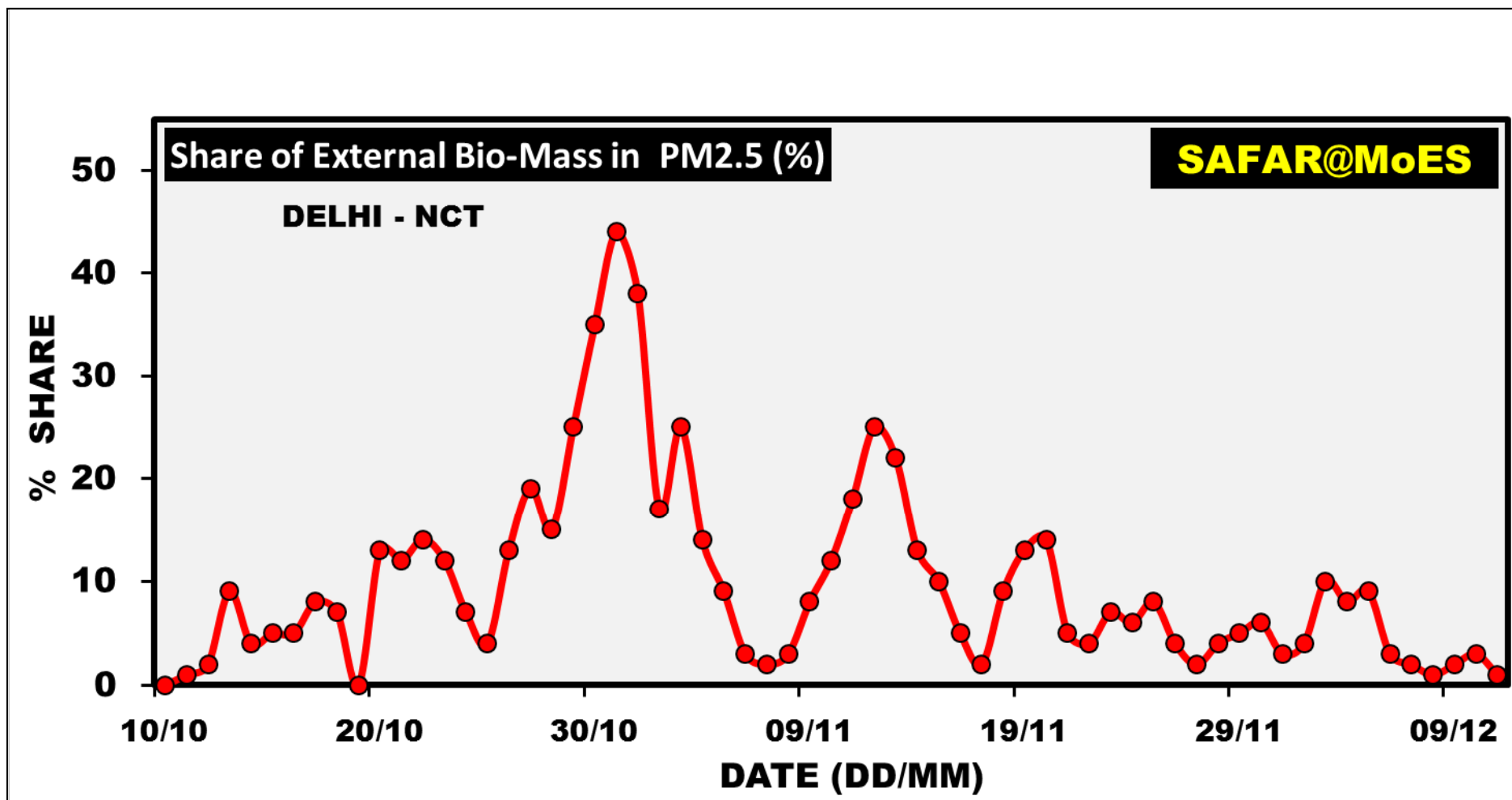
MULTI-SATELLITE FIRE COUNT PRODUCT LED TO DEVELOPMENT OF SAFAR-EMISSIONS INVENTORY TO ESTIMATE %
BIOMASS SHARE

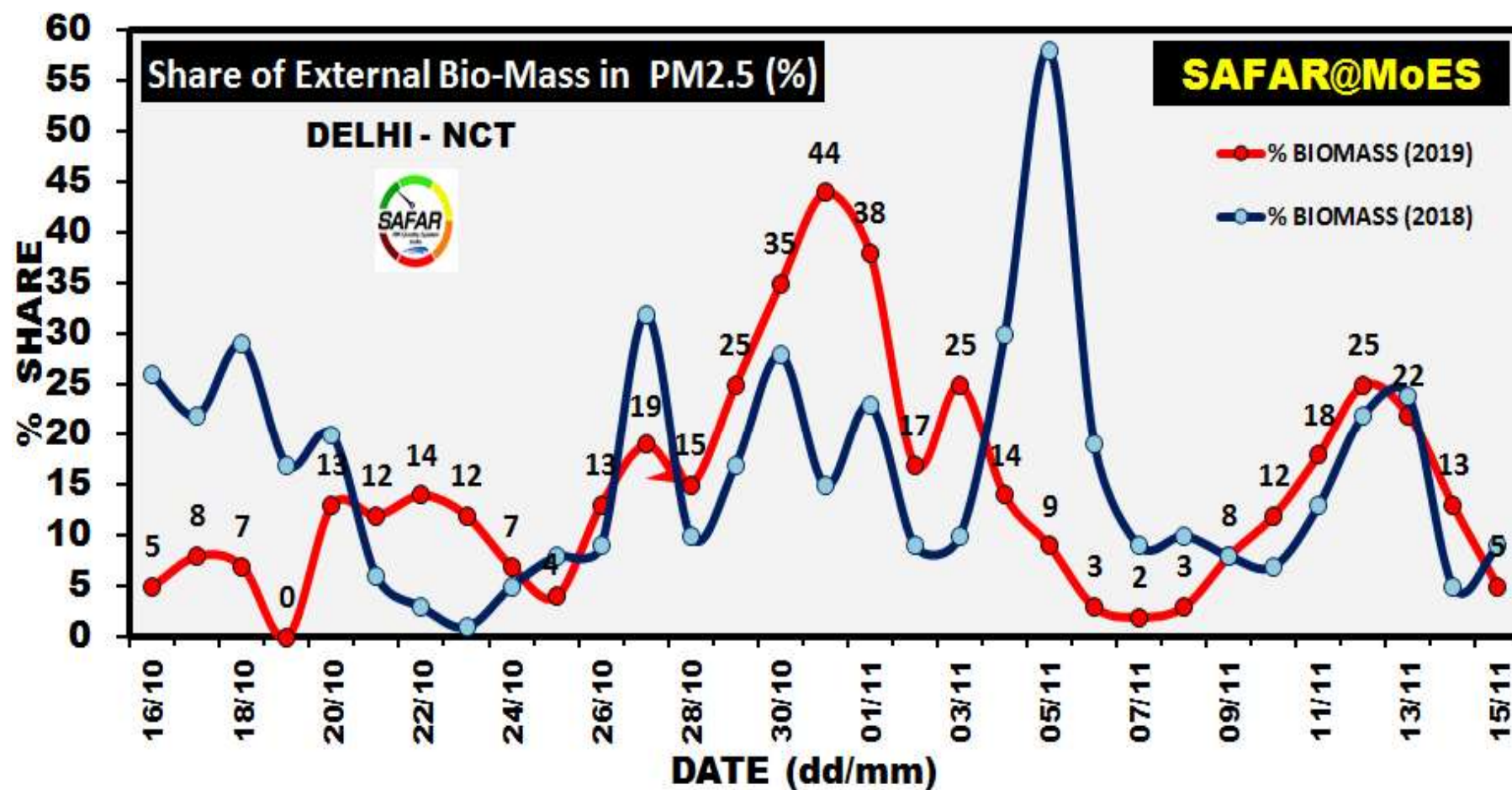


Ref for 2018 Emissions: Beig et al., Science of Total Environment (IF-5.6), In course of publication, 2019.

Gridded PM2.5 Emission from Kharif Crop Residue Burning in Punjab-Haryana (2018)

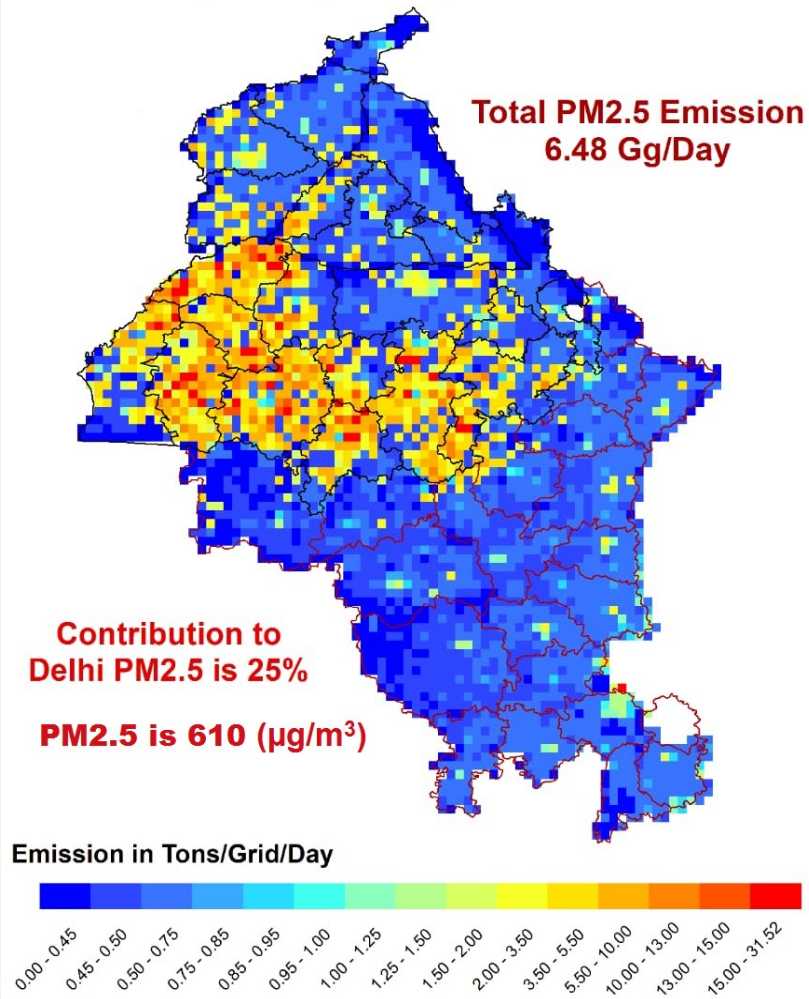






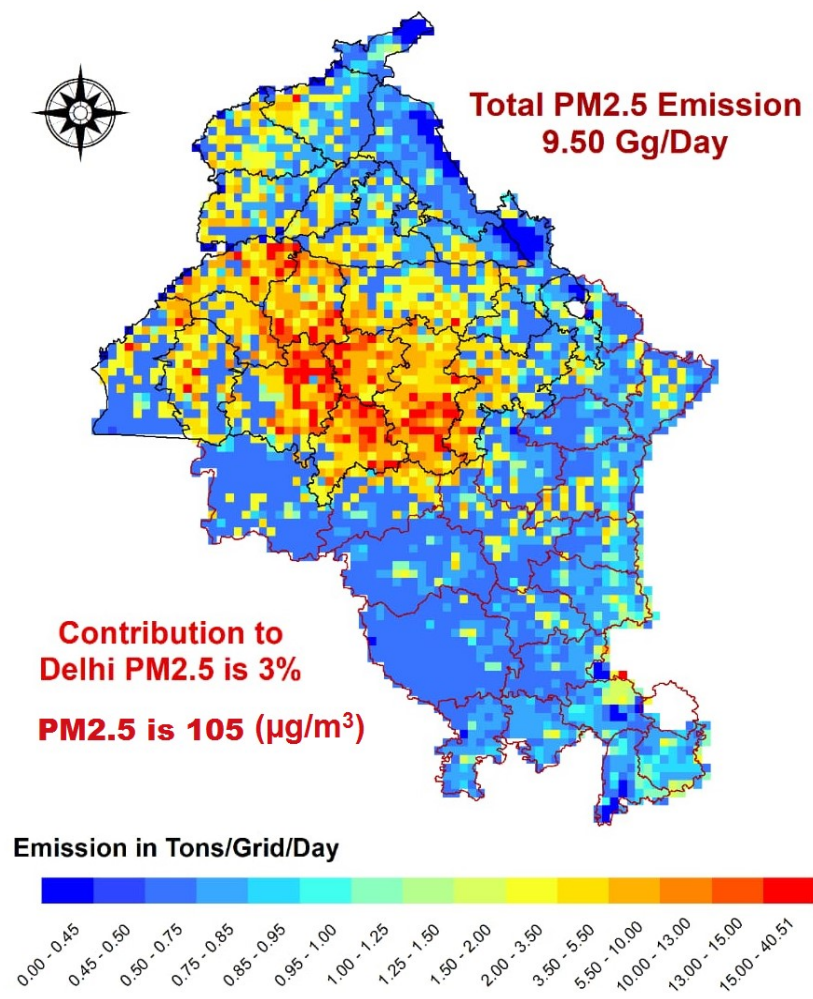
LOW Stubble Emission BUT Very HIGH % Share

Gridded PM2.5 Emission from Kharif Crop Residue Burning in Punjab-Haryana (03 Nov, 2019)



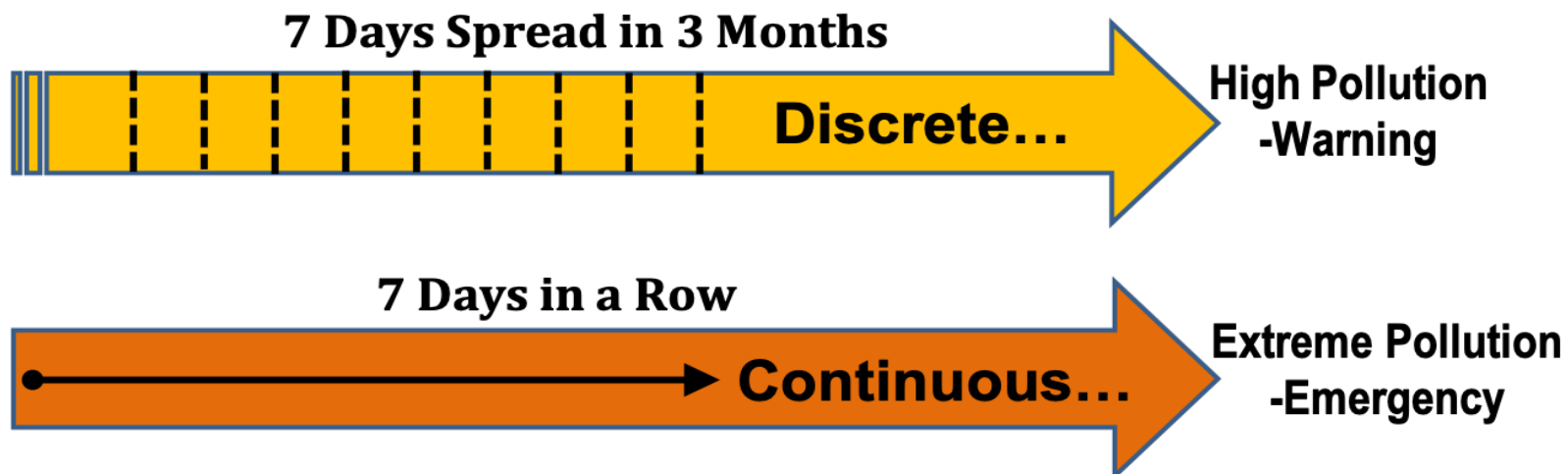
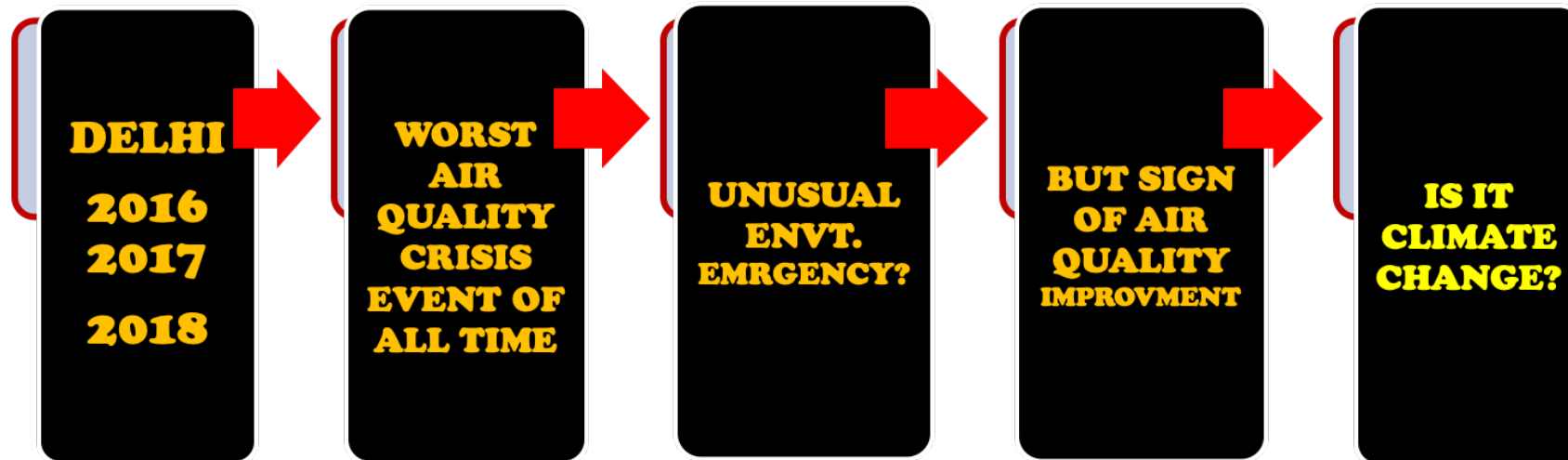
HIGH Stubble Emission BUT Very LESS % Share

Gridded PM2.5 Emission from Kharif Crop Residue Burning in Punjab-Haryana (06 Nov, 2019)

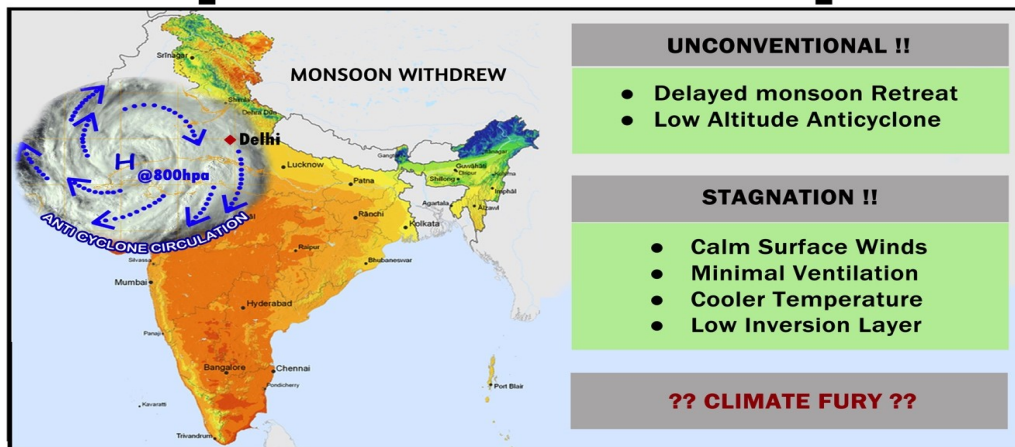
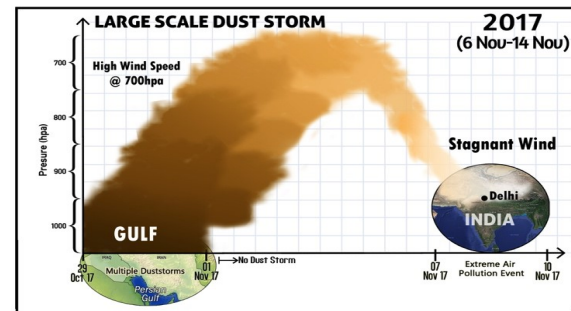
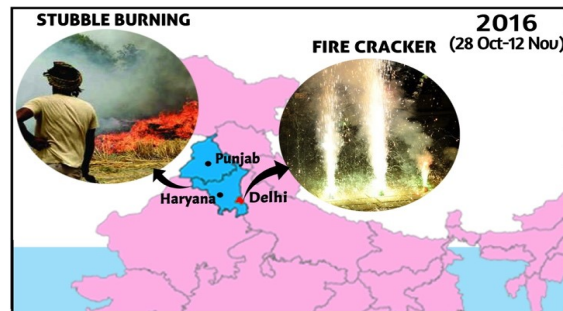


THE BIG SMOG!!

Understanding Delhi's New Pollution Trend



**DELHI-2019: EXTREME
POLLUTION EVENTS
ON RISE**



SAFAR OFFERING TOWARDS MITIGATION AND PLANNING

- 1) LONG-TERM MITIGATION:** Identify Permanent local Emission Hot Spots from updated SAFAR-Emission Inventory (400m² resolution)
- 2) MEDIUM-TERM MITIGATION:** Ranking emission sources on each identified hot spot for focused and effective mitigation options.
- 3) SHORT-TERM MITIGATION:** Estimating Weekly Dynamic Air Pollution Hot Spots in Delhi- A composite of spot emissions and predicted concentration of PM.

TOTAL 85 EMISSION HOT SPOTS OF DELHI AND DOMINANT RANKING

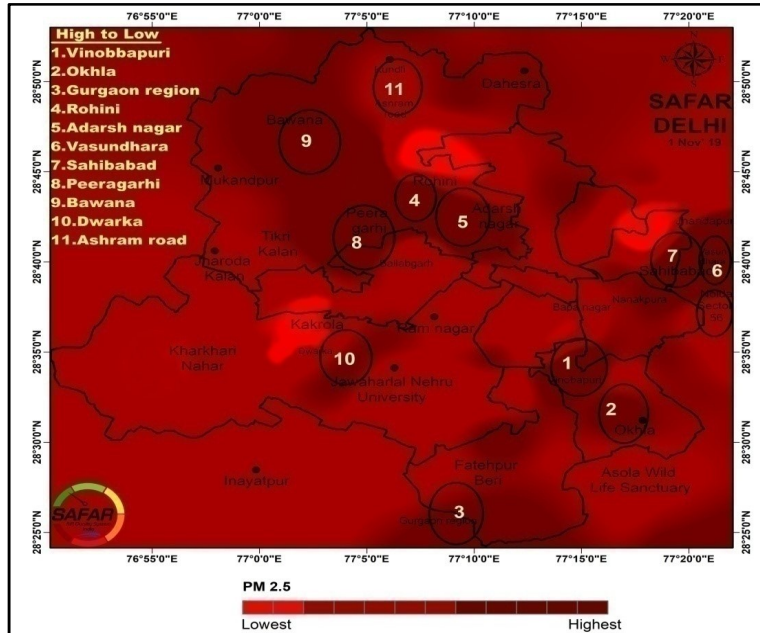
COLOR CODING: Each colour denotes a specific sector associated with pollution:-

	Heavy Traffic Congestion		Street Vendors/Hotels /Cooking Activities		Open Landfill Burning
	Small /Unorganised Industries		Diesel Generators (Market)		Brick kiln
	Windblown Road/Dusty Roads		Crematorium		Thermal power plant

TABLE-1: Major Emission Sources on 83 pollution Hot spots of Delhi & Fringe areas.

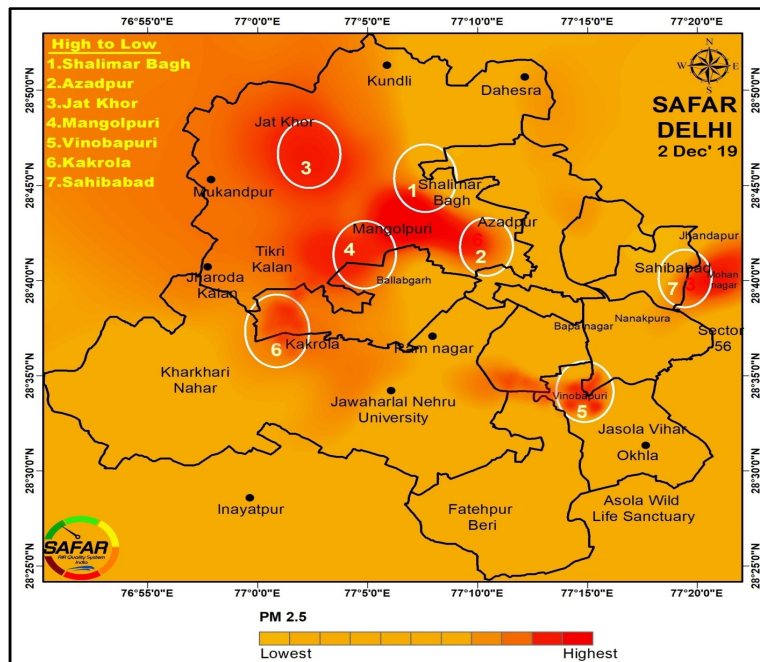
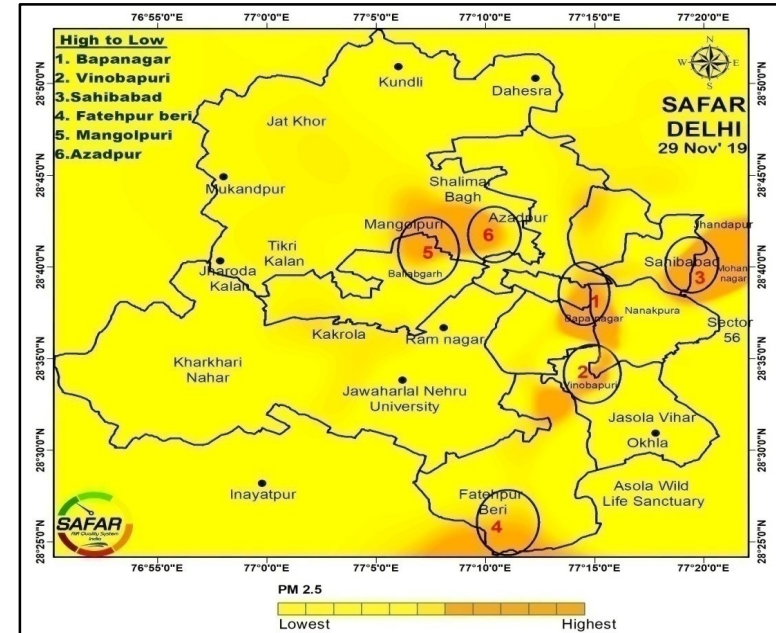
S. N.	AREA	1 st	2 nd	3 rd		S. N.	AREA	1 st	2 nd	3 rd
1	Anand Parbat					43	India_Gate			
2	AIIMS					44	Qutab Minar			
3	Wazirpur					45	MP Marg			
4	Mayapuri					46	Rani Jhansi Road			
5	Samaypur					47	Mahatma Hansraj Marg			
6	Karol Bagh					48	Gurjarsamrat Mihir Bhoj Marg			
7	Kashmere Gate					49	Peeragarhi			
8	Rohini					50	Vikas Marg			
9	Naraina					51	Guru Govind Singh Marg			
10	Jhilmil Industrial Area					52	Lajpat Nagar Flyover			
11	Sarojini Nagar					53	Mrudika Marg			
12	Paharganj					54	Noida Link road			
13	Bawana					55	Rampura Industrial Area			
14	Delhi Meerut Expressway					56	Najafgarh Road			
15	Swami Dayanand Marg					57	Delhi-Rohtak Road			
16	Delhi-Mathura Highway					58	MG Marg			
17	Connaught Place					59	Old Seelampur			
18	Badarpur					60	Baba Kharak Singh Marg			
19	Rajghat					61	Vinobapuri			
20	Mathura road					62	Hapur Road			

CHANGING COLOURS OF DELHI NCT (Winter-2019)



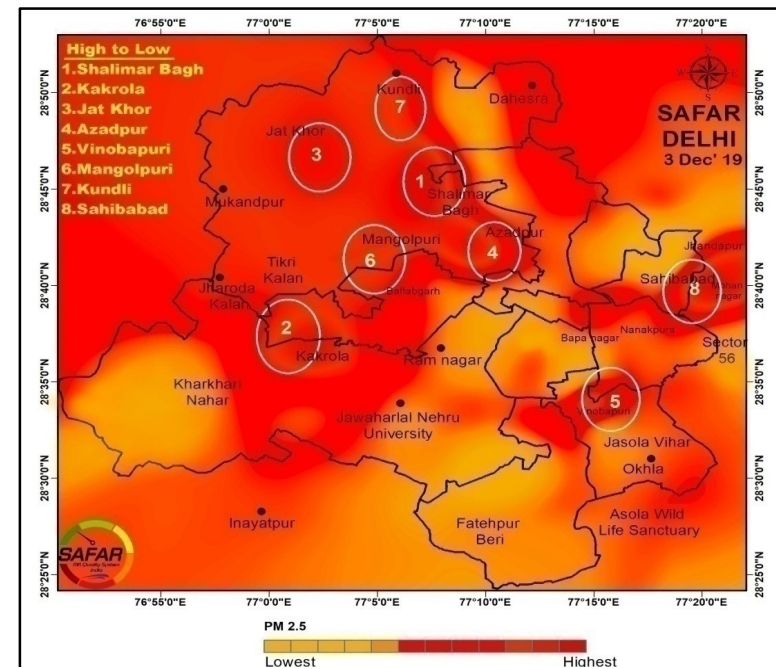
29/11

1/11



3/12

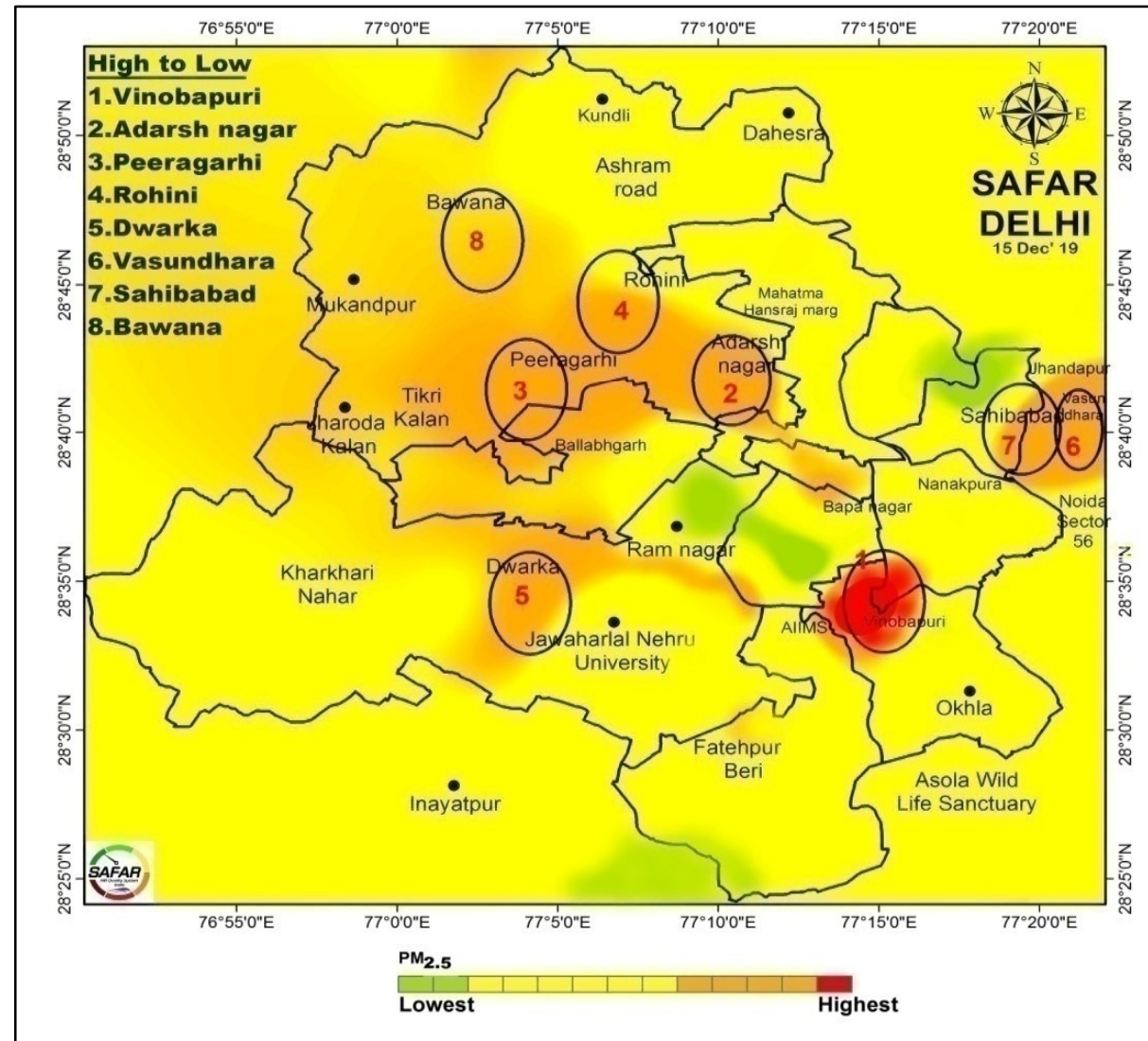
2/12

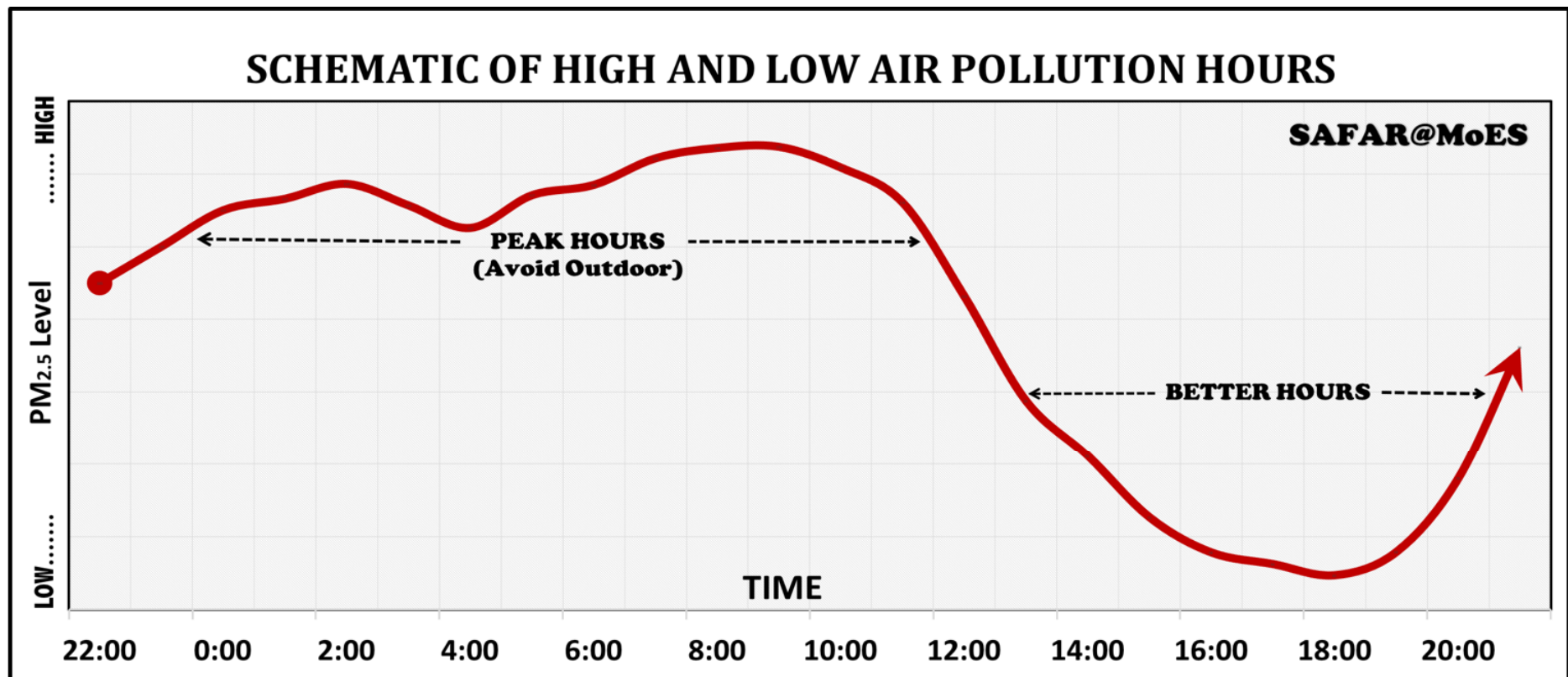


SIGNATURES OF TRUE LOCAL SOURCES

15th December 2019

4 AQI COLOURS IN A DAY AFTER
RAIN CLEANSING





When the sun sets, additional heating and mixing stops, dooming everything in the lower atmosphere to stay there through the night. On the Diwali day, this means ~8pm mixing will stop. If there is firework, smoke will suddenly get trapped forcing overnight levels of particles and smoke in the air to make significantly higher than they would be naturally, and are stuck that way until sunrise or breeze mixes it away. Highest polluted hours in the night of 7-8 Nov will be “11PM to 4AM” –SAFAR-Advisory

OUTREACH: SAFAR-School Flag Awareness Program on Air Quality



THANK YOU

SAFAR-School Flag Awareness Program on Air Quality

