Environment Pollution (Prevention & Control) Authority for the National Capital Region

Supplementary to report no 77a
Update on air pollution in NCR, Monday November 13, 2017

In the report submitted to the Hon'ble Supreme Court it was stated that weather conditions were expected to improve by the weekend and that by Sunday, 12th, NCR's air quality would be in the very poor category – from severe+ or emergency conditions.

This was the prediction of IMD, as communicated to the CPCB Task Force. By Friday (10th) and Saturday morning (11th) morning air quality had improved and there was some wind that allowed for dispersion of pollutants. But then by Saturday afternoon, this situation was reversed. Pollution continued to rise and concentration levels have remained in the severe+ over Sunday.

IMD says that this has happened because the mixing heights (also called boundary conditions) – the levels at which the ground level winds mix with the higher winds and allow dispersion has been extremely low. According to their data, mixing height went down to less than 45 meters during different periods over the weekend, as against 1600-2000 meters.

Therefore, what this implies is that pollutants in NCR – from local sources and those from the previous smog episode when winds came from west Asia, Punjab and Haryana – remain trapped in the air. They have no space to escape or disperse.

The latest report of IMD, received by EPCA, on Sunday evening forecasts the following (see attachment):

1. The wind flow from North Western side of Delhi (through Punjab & Haryana) is likely to continue till 12th Nov. 2017 only.
2. The wind will start flowing towards North West direction from Delhi (i.e. towards Punjab and Haryana) from 13th Nov., 2017 under the influence of western disturbance approaching Delhi. Very light rain/ Drizzle is likely to occur on 15.11.2017.
3. Under the above scenario, atmospheric circulation over Delhi will become favorable for substantial reduction of air pollutant's concentration starting from 13th Nov. 2017.
4. Maximum Mixing Height is likely to increase on 13.11.2017 in comparison to 12.11.2017 during day time which may increase the dispersion of air pollutants in Delhi but evening and night time mixing height will remain below 100 meter. (From tomorrow onwards, IMD will provide ventilation coefficient forecast for next five days)
5. Air Quality is in Severe Category today and likely to remain in severe category tomorrow also.
6. Airmass inflow in Delhi along with mixing height is attached.

Currently, the **severe+** measures of GRAP, namely ban on construction across NCR and ban on all trucks (other than those carrying essential commodities) are in force. These will remain imposed until air quality levels see improvement for at least 48 hours. The severe conditions will similarly remain imposed till there are visible improvements in air quality and the CPCB task Force advises EPCA that the situation has changed.

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

Indian Institute of Tropical Meteorology (IITM), Pune &
India Meteorology Department (IMD), New Delhi
MINISTRY OF EARTH SCINCES, GOVT. OF INDIA

DELHI WINTER AIR QUALITY FORECAST

(Valid as on 11th Nov.' 2017, 0100PM)

Prepared By:
Dr. Gufran Beig (Project Director, SAFAR)
and Neha Parkhi,
IITM, Pune, ESSO, MoES

1. As predicted by SAFAR forecast there is rapid decline in the levels of PM2.5 from 640µg/m^{3}on 8th Nov 2017 to 248µg/m3 on 11th Nov.' 2017 which will further improve. This forecast is validated within an accuracy of 2-5% with realistic observations.

2. The observed offset between known anthropogenic and weather induced natural sources and realistic observation is around 15-20%. **This may be attributed as GAIN due to unaccounted (in model) control measures like GRAP.**

3. These levels will fall further up to 200-210µg/m^3 till 13th Nov 2017 and remain in same range until 15th Nov 2017, which is close to background concentration range (climatology) for November month of Delhi.

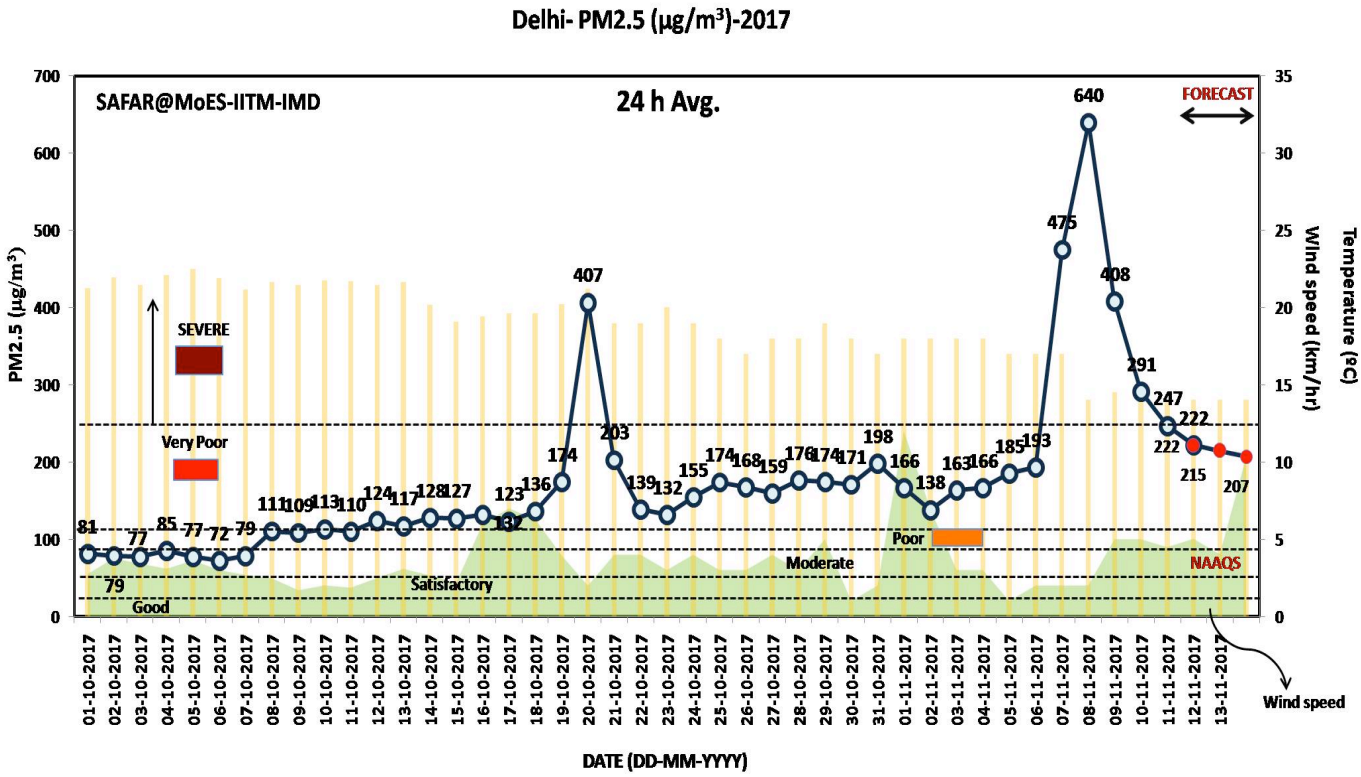
4. **Week Ahead-Forecast**: Westerly disturbance is the major phenomenon looming large for Delhi, withdrawal of which is expected on 16th-17th Nov 2017. This is likely to be accompanied by addition moisture in Delhi's air and fall in the temperature which may result in the increase in pollution levels. However, quantification of pollution level is possible only on 14th Nov as current SAFAR forecast model has capability to predict levels 3-4 days in advance.

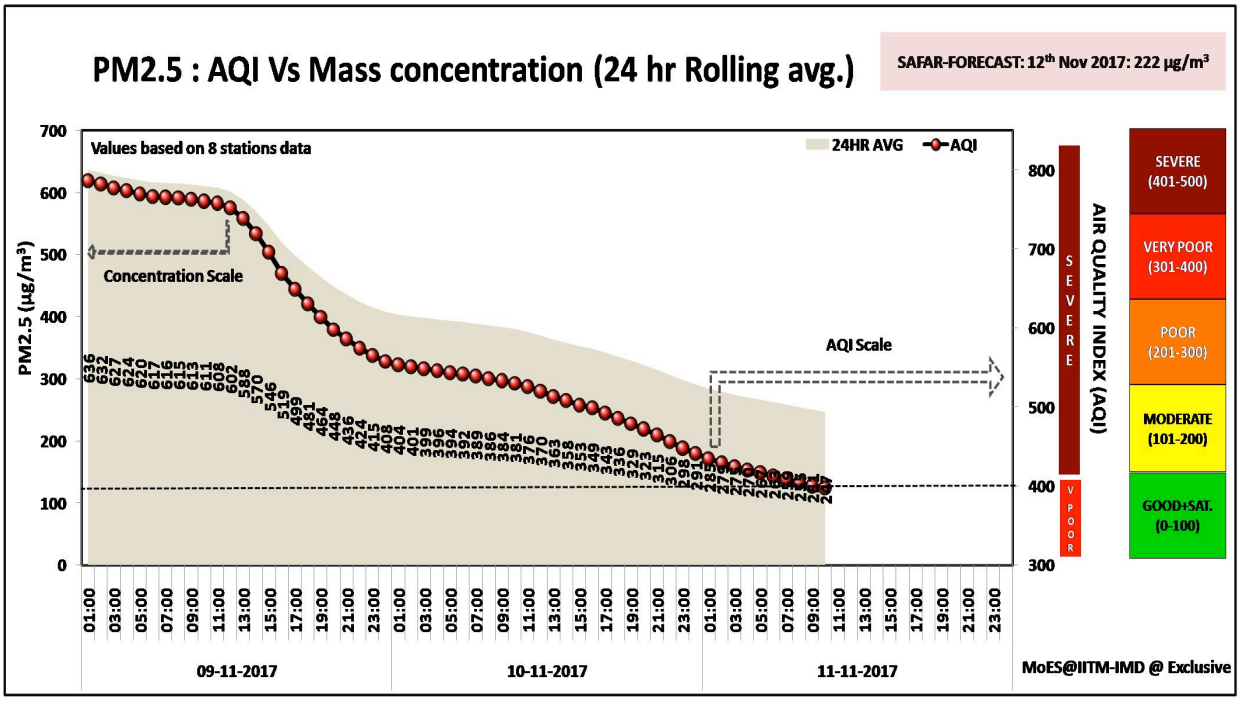
5. However, the WD induced increased in pollution level will certainly be much smaller in magnitude than what is witnessed this week due to Gulf Dust Storm and Stubble burning.

(Background Material: Reason for Extreme Pollution:

(1) The large Multi-day dust storm that emerged at Iraq, Kuwait, and Saudi Arabia in the last week of October 2017 continued upto Nov 3-4 as per Aqua satellite imagery. This dust storm was carried by relatively cool winds. As air temperatures drop, winds and dust was likely to slowly diminish but by that time, it got into upper part of atmosphere (700-850 hpa) where winds became very strong (15-20kmph) and direction became towards India being West-Northerly and dust affected larger region of NCR including Delhi.

(2) There is an anti-cyclonic circulation persisting at about 700 hpa (lower troposphere) over northwest India with its centre near Delhi resulting in calm surface wind condition. As per weather forecast, this condition is likely to persist till10th Nov and hence wind speed may increase from afternoon of 10th Nov which may start dispersing pollutants from Delhi.)


Delhi- PM2.5 (µg/m³)-2017
SAFAR@MoES-IITM-IMD
24 h Avg.
FORECAST
PM2.5 (µg/m³)
Wind speed (km/hr)
Temperature (°C)
SEVERE
Very Poor
Poor
Moderate
Satisfactory
Good
NAAQS
Wind speed
DATE (DD-MM-YYYY)


PM2.5 : AQI Vs Mass concentration (24 hr Rolling avg.)
SAFAR-FORECAST: 12th Nov 2017: 222 µg/m³
Values based on 8 stations data
24HR AVG
AQI
PM2.5 (µg/m³)
Concentration Scale
AQI Scale
AIR QUALITY INDEX (AQI)
SEVERE
V POOR
SEVERE (401-500)
VERY POOR (301-400)
POOR (201-300)
MODERATE (101-200)
GOOD+SAT. (0-100)
09-11-2017
10-11-2017
11-11-2017
MoES@IITM-IMD @ Exclusive

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

Indian Institute of Tropical Meteorology (IITM), Pune &
India Meteorology Department (IMD), New Delhi
MINISTRY OF EARTH SCINCES, GOVT. OF INDIA

DELHI WINTER AIR QUALITY FORECAST

(Valid as on 14th Nov.' 2017, 0100PM)

Prepared By:
Dr. Gufran Beig (Project Director, SAFAR)
and Neha Parkhi,
IITM, Pune, ESSO, MoES

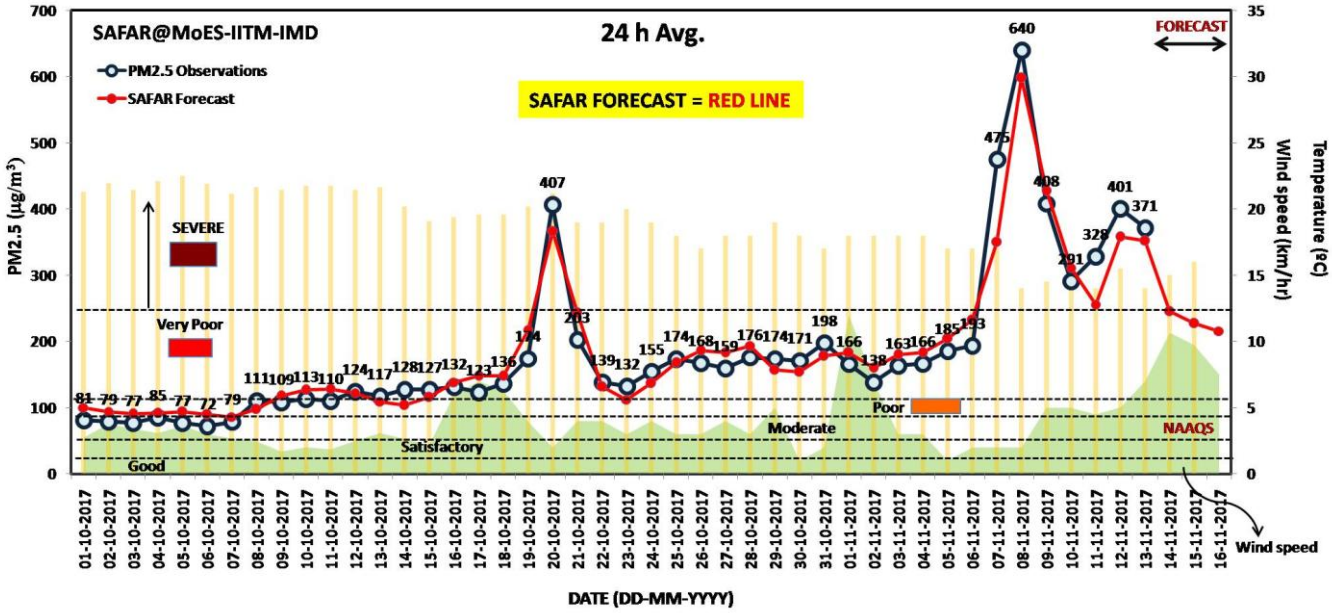
1. As predicted by SAFAR forecast there was rapid decline in the levels of $PM_{2.5}$ from 640µg/m^3 on 8th Nov 2017 to 248µg/m^3 on the morning of 11th Nov.' 2017. Wind speed picked up to 7kmph and flushing was even faster than expected. Before it could flush sufficient amount to a threshold level of no return to bad side, localized development and fall in maximum temperature, brought boundary layer as low as 45meters for the first time in the season, which was at around 1600 meters, a few hours back. This has brought wind speed from 7kmph to 2kmph in a matter of few hours which obviously, SAFAR forecast model cannot capture. Although external influx has nearly stopped, current situation is like same amount of pollution in a very narrow and small bottle results in increase concentration. This sudden development at local scale has restricted the desperation of pollutants and resulted in the increase in the pollution levels after 5pm on 11th Nov 2017.
2. After initializing the model with 12GMT boundary and initial conditions, forecast estimate is as follows:
   a. Ventilation coefficient to remain almost near zero until evening of Sunday.
   b. Calm surface winds blowing from NNW may result in the build-up of pollution levels until monday morning.
   c. Respite is expected by monday afternoon. Pollution levels will decrease steadily from 13th onwards with increase in the surface wind speed blowing NE,SE,E and may attain the background Delhi levels of ~245µg/m^3 by 14th evening when light shower is also expected.

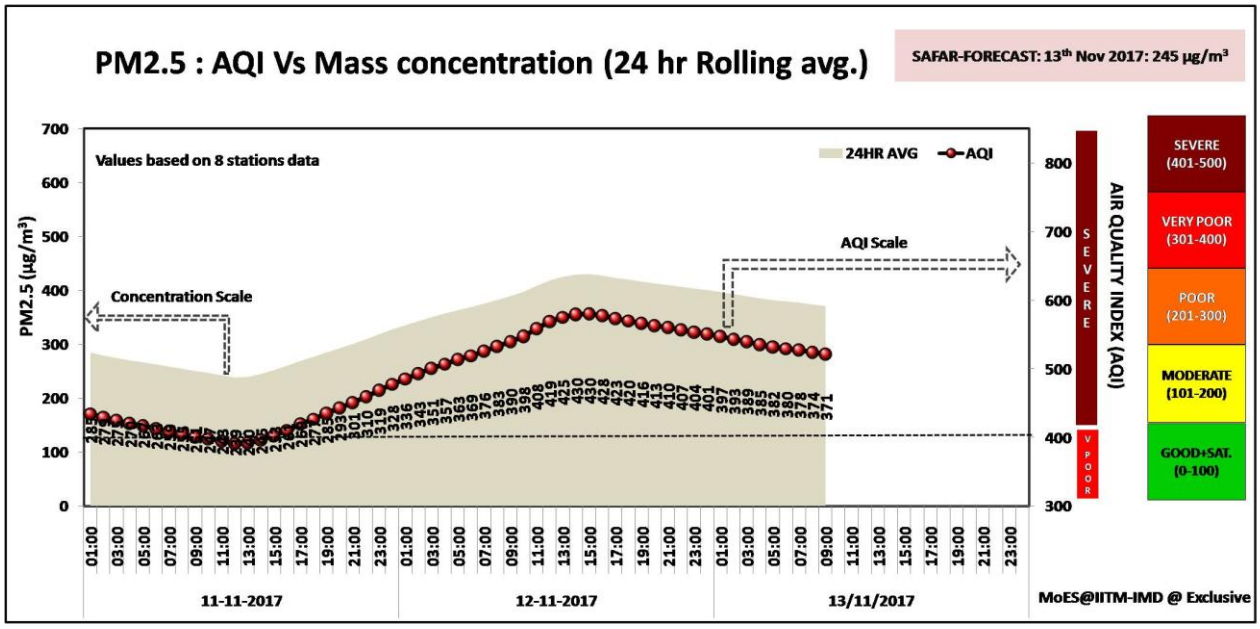
(Background Material: Reason for Extreme Pollution:

(1) The large Multi-day dust storm that emerged at Iraq, Kuwait, and Saudi Arabia in the last week of October 2017 continued upto Nov 3-4 as per Aqua satellite imagery. This dust storm was carried by relatively cool winds. As air temperatures drop, winds and dust was likely to slowly diminish but by that time, it got into upper part of atmosphere (700-850 hpa) where winds became very strong (15-20kmph) and direction became towards India being West-Northerly and dust affected larger region of NCR including Delhi.

(2) There is an anti-cyclonic circulation persisting at about 700 hpa (lower troposphere) over northwest India with its centre near Delhi resulting in calm surface wind condition. As per weather forecast, this condition is likely to persist till10th Nov and hence wind speed may increase from afternoon of 10th Nov which may start dispersing pollutants from Delhi.)

Delhi- PM2.5 (µg/m³)-2017





Air Quality Status for Delhi & NCR
Dated- November 12, 2017

- **Delhi NCR air quality found into following AQI category. The details are as below:**

City	Air Quality	AQI Value	Prominent Pollutant	Health Statement (corresponding AQI)
Delhi	Severe	460↑	$PM_{2.5,}$ CO	Affects healthy people and seriously impacts those with existing diseases
Faridabad	Severe	468↑	$PM_{2.5}$	
Ghaziabad	Severe	498↑	$PM_{2.5}$	
Gurugram	Severe	460↑	$PM_{2.5}$	
Noida	Severe	492↑	$PM_{2.5}$	

- **AQI for hotspot on Delhi:**

Location	Air quality	AQI Value	Prominent Pollutant
Shadipur	Severe	***497***	$PM_{2.5}$
IHBAS	Severe	439	$PM_{2.5}$
NSIT Dwarka	Severe	***481***	$PM_{2.5}$
R. K. Puram – DPCC	Severe	***496***	PM_{10}
Punjabi Bagh - DPCC	Severe	***495***	$PM_{2.5}$
Siri Fort	Severe	***496***	$PM_{2.5}$
DTU	Severe	***499***	$PM_{2.5}$
ITO	Severe	***494***	$PM_{2.5}$
Aya Nagar, New Delhi - IMD	Severe	***483***	$PM_{2.5}$
Burari Crossing, New Delhi - IMD	Severe	***473***	$PM_{2.5}$
Lodhi Road, Delhi - IMD	Severe	***499***	$PM_{2.5}$
North Campus, DU, New Delhi - IMD	Severe	***499***	$PM_{2.5}$
Pusa, New Delhi - IMD	Severe	***482***	PM_{10}
CRRI Mathura Road, Delhi – IMD	Severe	***494***	$PM_{2.5}$
IGI Airport Terminal-3, Delhi - IMD	Severe	***479***	$PM_{2.5}$

- **Air quality forecast for Delhi by IMD:**

November 13, 2017		**November 14, 2017- November 16, 2017**	
Concentration	AQI Category	Concentration	AQI Category
PM_{10} – 597 µg/m^3 $PM_{2.5}$ – 376 µg/m^3	Severe+	PM_{10} – 531 µg/m^3 $PM_{2.5}$ – 334 µg/m^3	Severe+

- **IMD alert issued for period November 12, 2017 to November 18, 2017 is as follows :**

  - ✓ The wind flow from North Western side of Delhi (through Punjab & Haryana) is likely to continue till 12th Nov. 2017 only.
  - ✓ The wind will start flowing towards North West direction from Delhi (i.e. towards Punjab and Haryana) from 13th Nov., 2017 under the influence of western disturbance approaching Delhi. Very light rain/ Drizzle are likely to occur on 15.11.2017.
  - ✓ Under the above scenario, atmospheric circulation over Delhi will become favorable for substantial reduction of air pollutant's concentration starting from 13th Nov. 2017.

- ✓ Maximum Mixing Height is likely to increase on 13.11.2017 in comparison to 12.11.2017 during day time which may increase the dispersion of air pollutants in Delhi but evening and night time mixing height will remain below 100 meter.
- ✓ Air Quality is in Severe Category today and likely to remain in severe category tomorrow also.

- **Wind Forecast for Delhi**:

Dates	Wind speed (at surface) in km/h*		Wind speed (at 900 m) in km/h*	Wind Direction**
	As per IMD(at 17:30 hrs)	As per windy.com(at 16:00 hrs)	As per windy.com(at 16:00 hrs)	
November 13, 2017	5	7	10	SE
November 14, 2017	10	9	17	SE
November 15, 2017	5	8	17	SE
November 16, 2017	5	7	11	NE
November 17, 2017	10	10	11	NNW

- Average mixing height is 415m. (Air lab cpcb)

- **Stubble Burning Status:**

State	**Active Burning Sites (on November 12, 2017)**	**Districts**
Haryana	**No Active Fire Location were found.**	
Punjab	AWAITED	

7 DAYS FORECAST

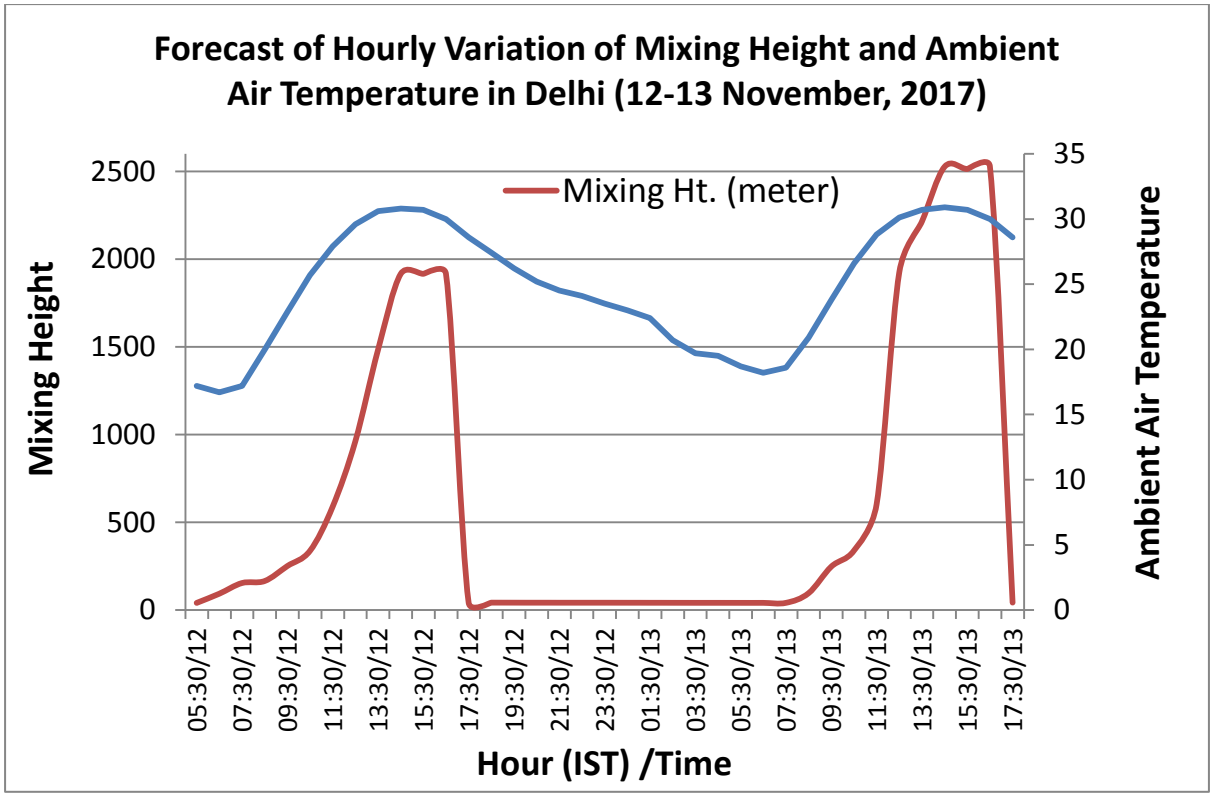
Regional Weather Forecast Center, New Delhi

DATED: - 12-Nov-17

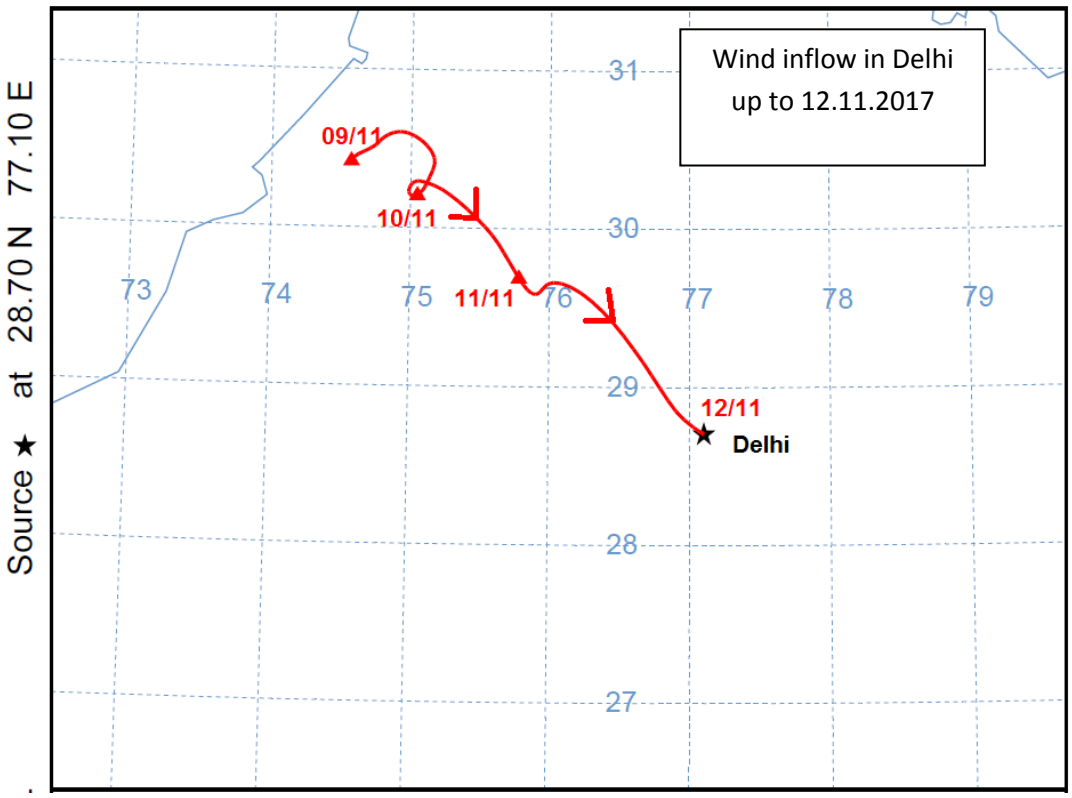
DATE	DAY	MIN °C	MAX °C	DIRECTION / WIND SPEED (KMPH) 05:30 HRS (IST)	11:30 HRS (IST)	17:30 HRS (IST)	FORECAST
12 / 11 / 2017	D1	13.6	27	CALM	CALM	Wind speed 05 km/hr coming from North West direction towards Delhi	MAINLY Cloud Free Sky. SHALLOW/MODERATE FOG IN THE MORNING.
13 / 11 / 2017	D2	14	28	CALM	Wind speed 05 km/hr coming from North West direction towards Delhi	Wind speed 05 km/hr coming from South East direction towards Delhi	MAINLY Cloud Free Sky. MIST/SHALLOW IN THE MORNING.
14 / 11 / 2017	D3	15	28	Wind speed 10 km/hr coming from South East direction towards Delhi	Wind speed 20 km/hr coming from South East direction towards Delhi	Wind speed 10 km/hr coming from South East direction towards Delhi	PARTLY CLOUDY SKY WITH POSSIBILITY OF THUNDERY DEVELOPMENT.
15 / 11 / 2017	D4	16	27	Wind speed 10 km/hr coming from East South East direction towards Delhi	Wind speed 20 km/hr coming from South East direction towards Delhi	Wind speed 05 km/hr coming from South East direction towards Delhi	PARTLY CLOUDY SKY WITH VERY LIGHT RAIN/DRIZZLE LIKELY TO OCCUR.
16 / 11 / 2017	D5	16	26	Wind speed 05 km/hr coming from East direction towards Delhi	Wind speed 05 km/hr coming from East direction towards Delhi	Wind speed 05 km/hr coming from North East direction towards Delhi	PARTLY CLOUDY SKY. MIST/SHALLOW IN THE MORNING.
17 / 11 / 2017	D6	14	26	Wind speed 05 km/hr coming from North East direction towards Delhi	Wind speed 05 km/hr coming from North direction towards Delhi	Wind speed 10 km/hr coming from North North West direction towards Delhi	Cloud Free Sky.. MIST/SHALLOW IN THE MORNING.
18 / 11 / 2017	D7	13	26	Wind speed 05 km/hr coming from North direction towards Delhi	Wind speed 10 km/hr coming from North North West direction towards Delhi	Wind speed 10 km/hr coming from North North West direction towards Delhi	Cloud Free Sky. MIST/SHALLOW IN THE MORNING.
NORMAL		13.6	28.5				

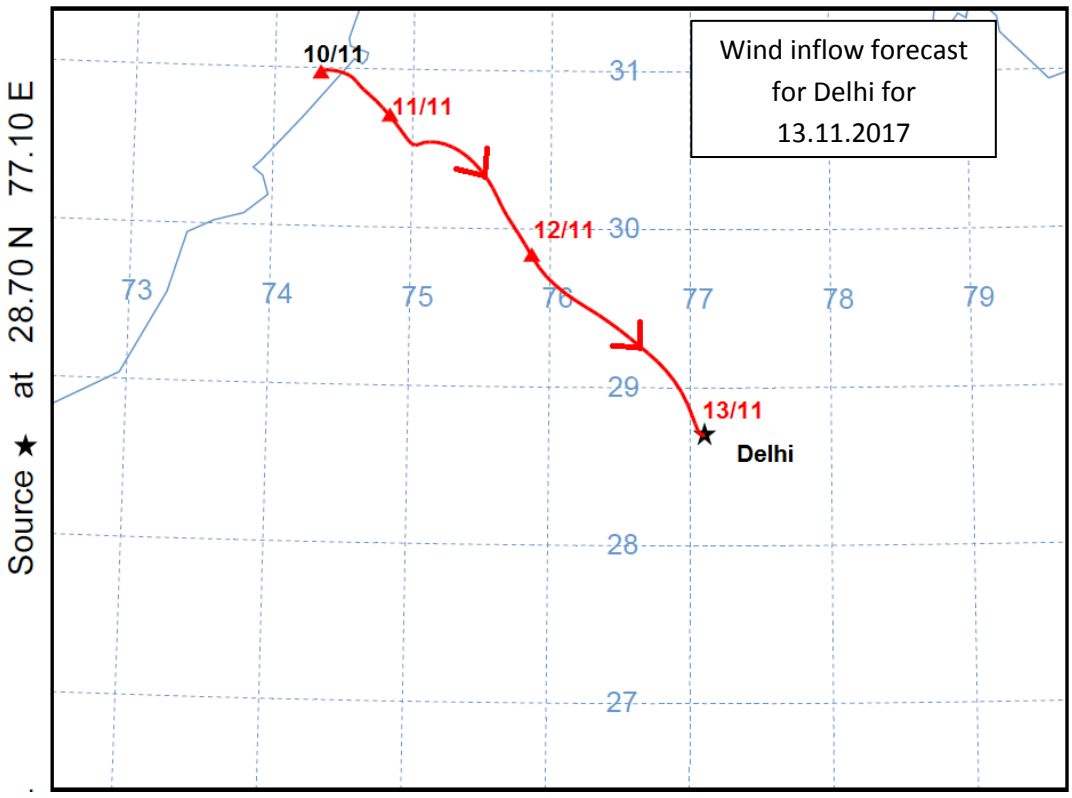
Wind Pattern and Mixing Height Forecast

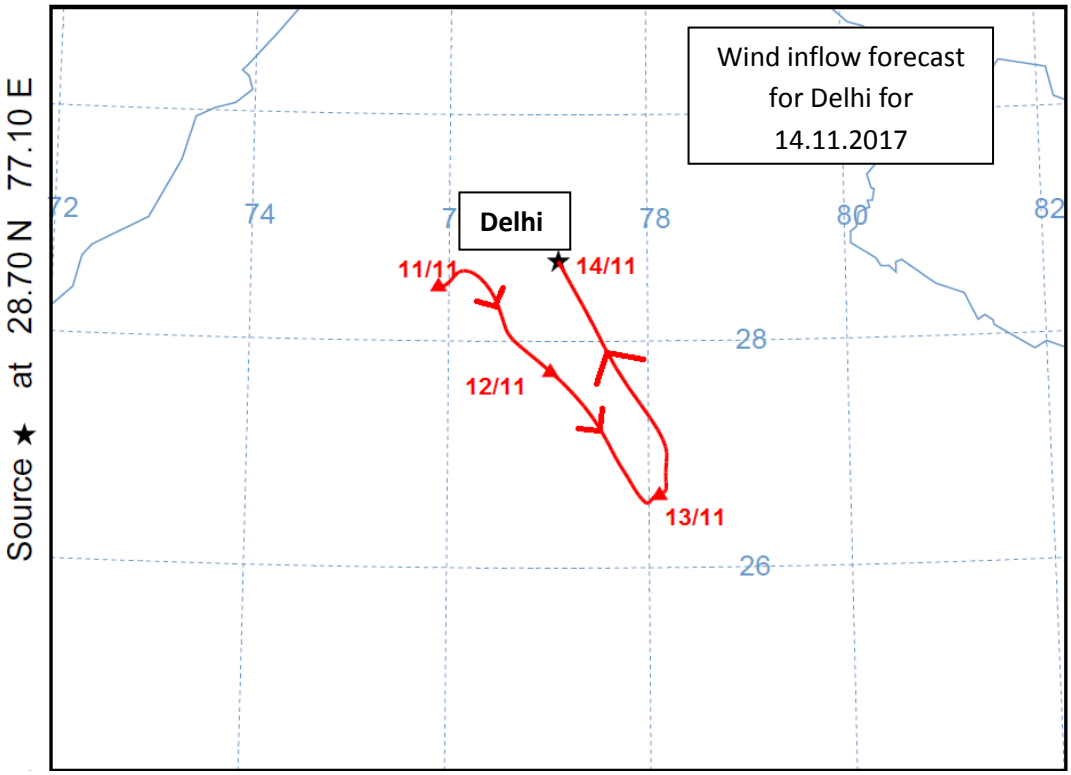
1. Mixing Height

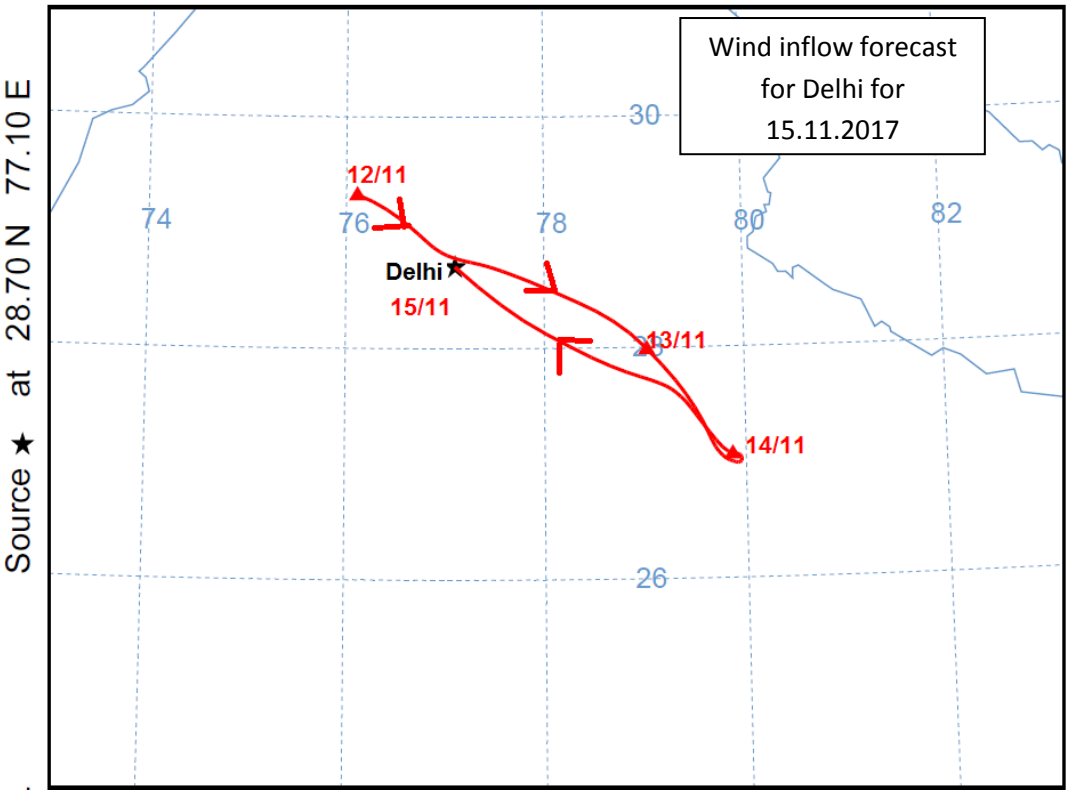


2. Wind Pattern Forecast



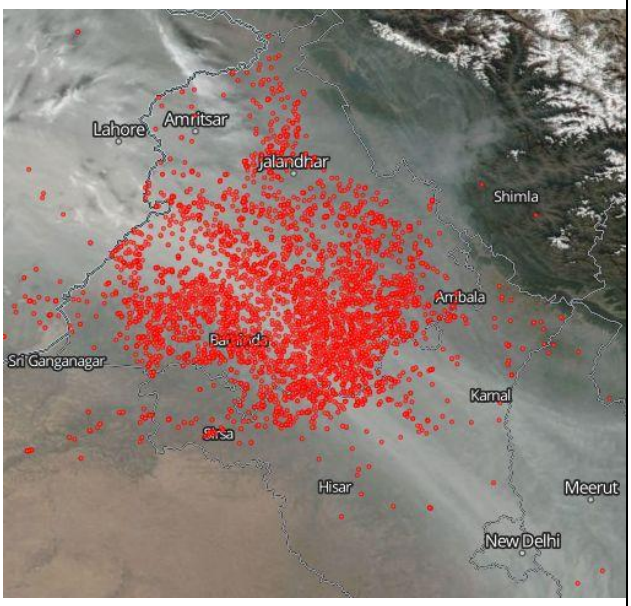



Wind inflow forecast
for Delhi for
14.11.2017
Delhi
11/11
14/11
12/11
13/11
72
74
78
80
82
28
26
Source ★ at 28.70 N 77.10 E

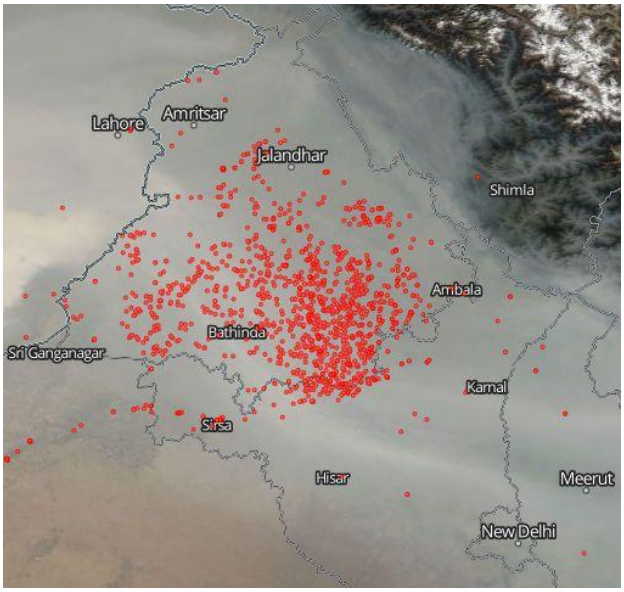

Wind inflow forecast
for Delhi for
15.11.2017
30
12/11
74
76
78
80
82
Delhi
15/11
13/11
14/11
26
Source ★ at 28.70 N 77.10 E

Satellite Images of Crop Residue Burning over Northern India (Punjab, Haryana and NCR)

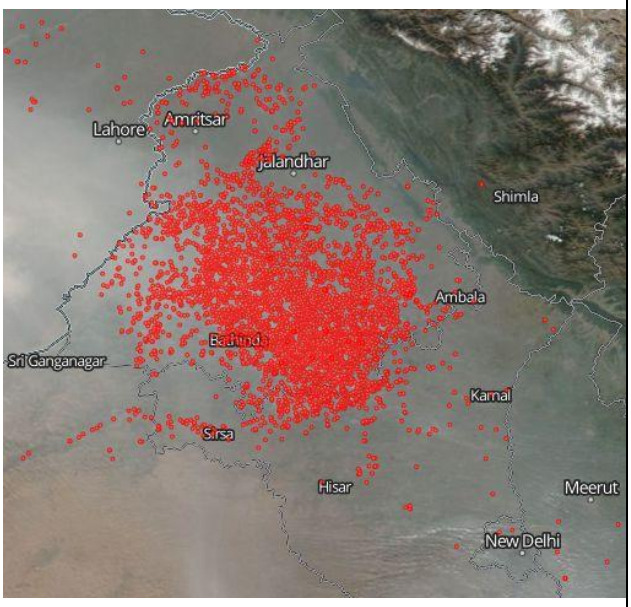
October 31st 2017



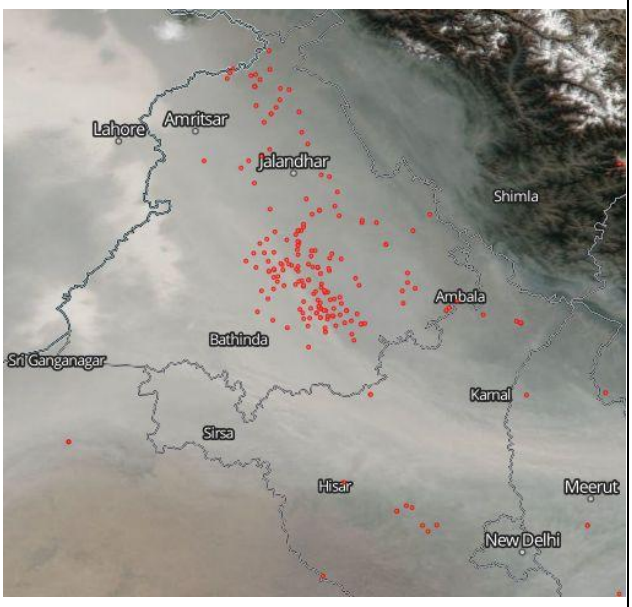
November 2nd 2017



November 4th 2017

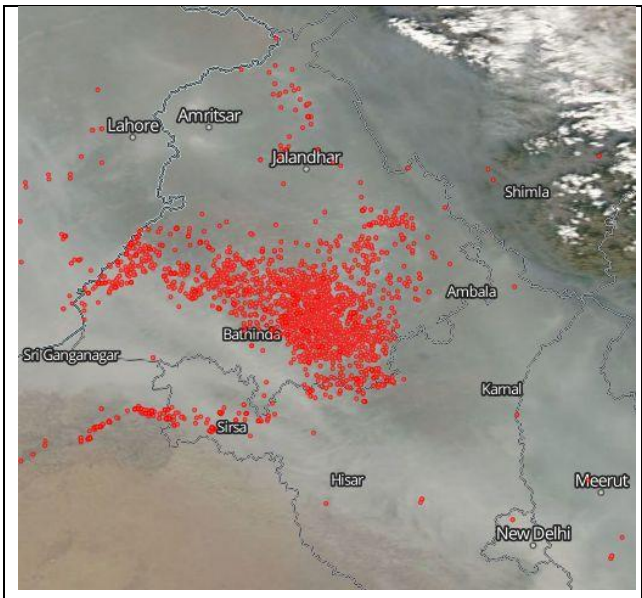


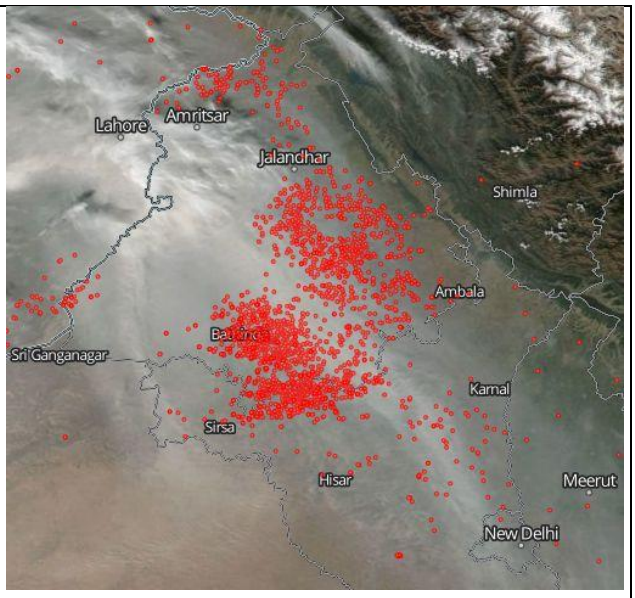
November 6th 2017



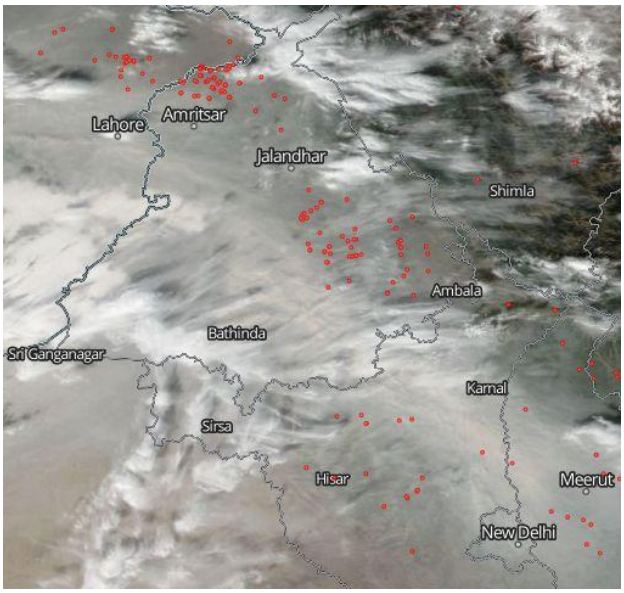
November 8th 2017

November 10th 2017

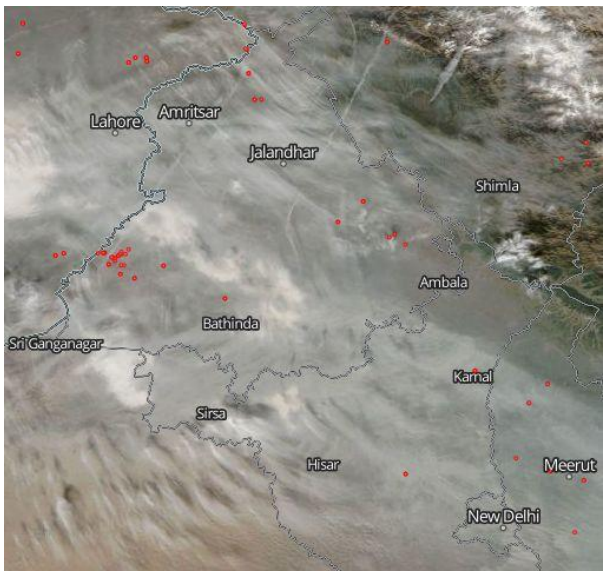




November 11th2017

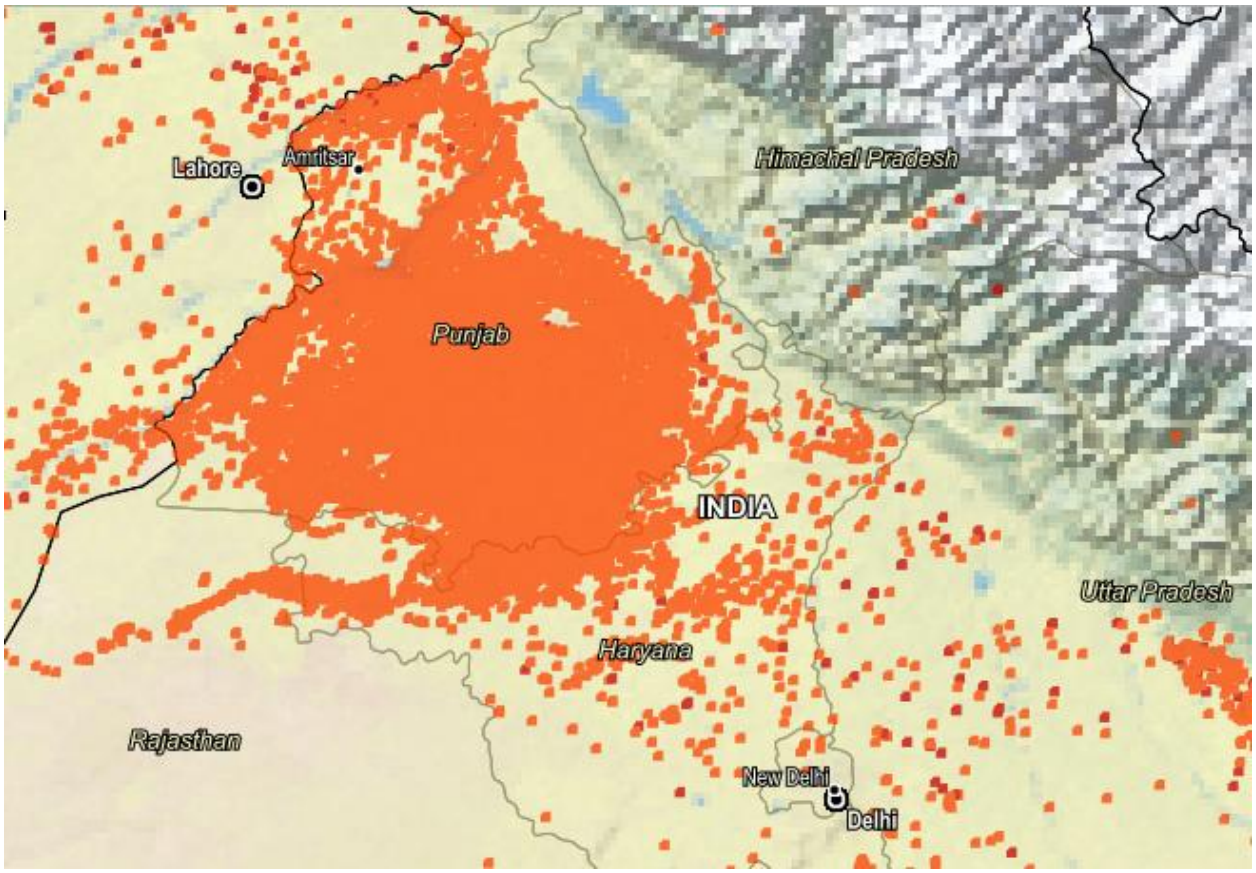


November 12th 2017



Source: NASA MODIS and VIIRS Satellite Imagery

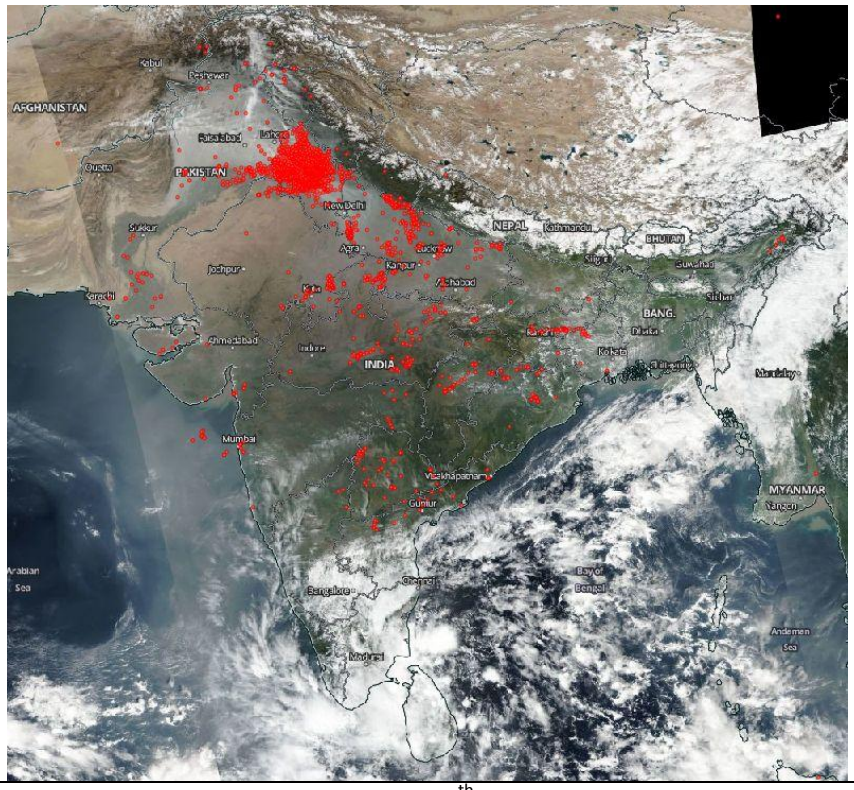
NASA FireMapper Cumulative Fires (31.10.17-12.11.17)



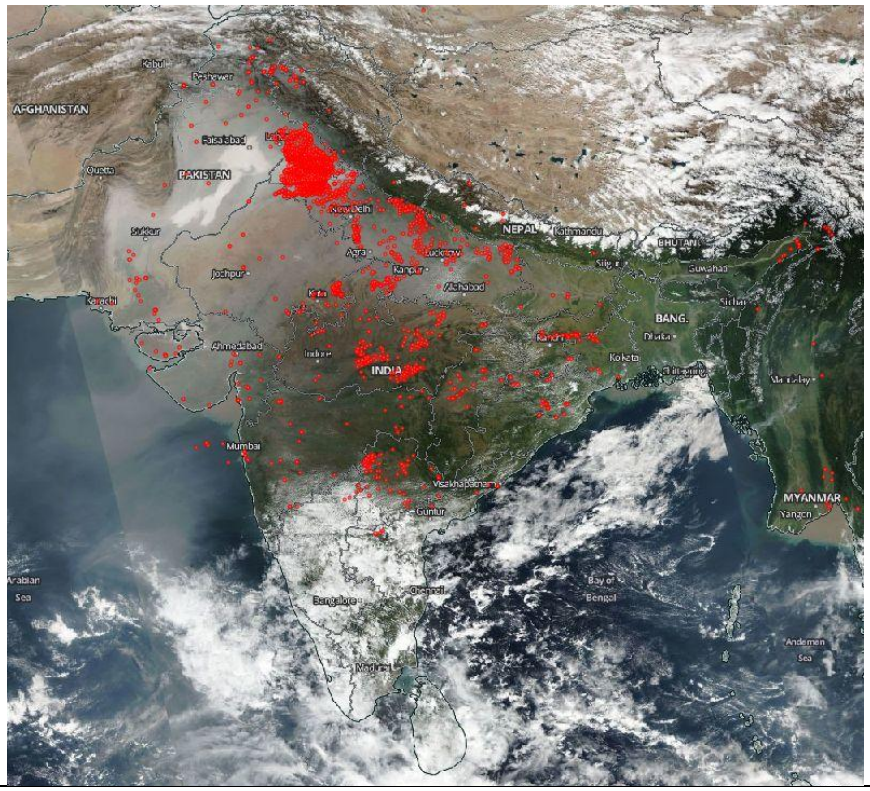
- The above images depict the cumulative number and location of fires over Punjab and Haryana between October 30 and November 12.
- Wind directions and indicative images show smoke dispersion in South-East direction, over Eastern UP and NCR.
- **Fires have reduced in intensity since October 11th.**

Satellite Images of Crop Residue Burning over South Asia

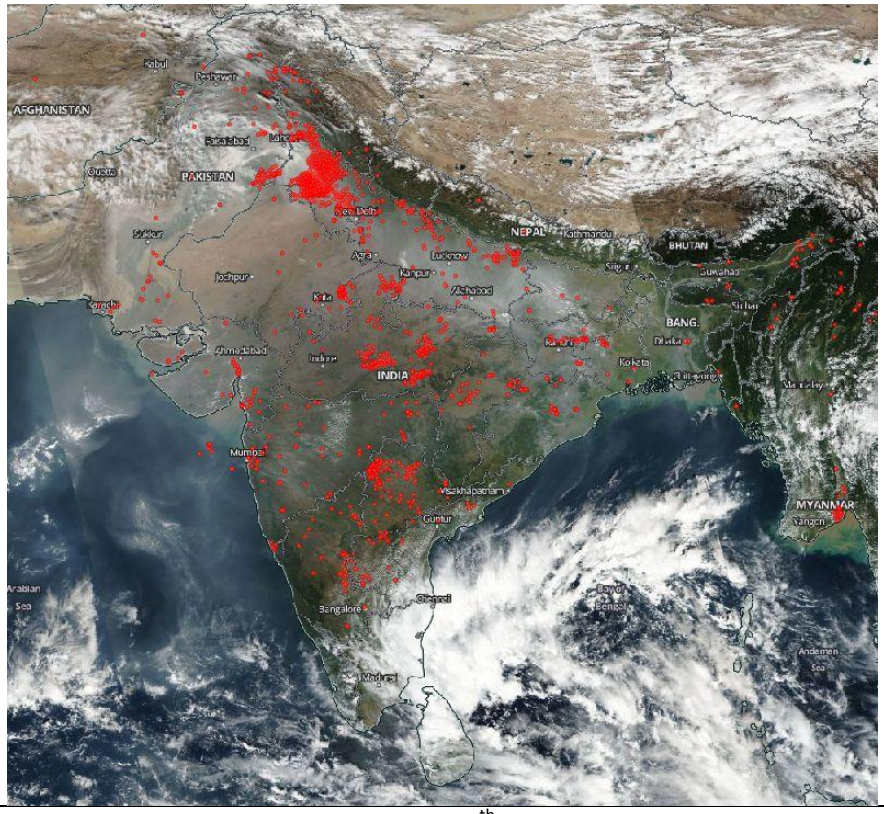
October 31st 2017



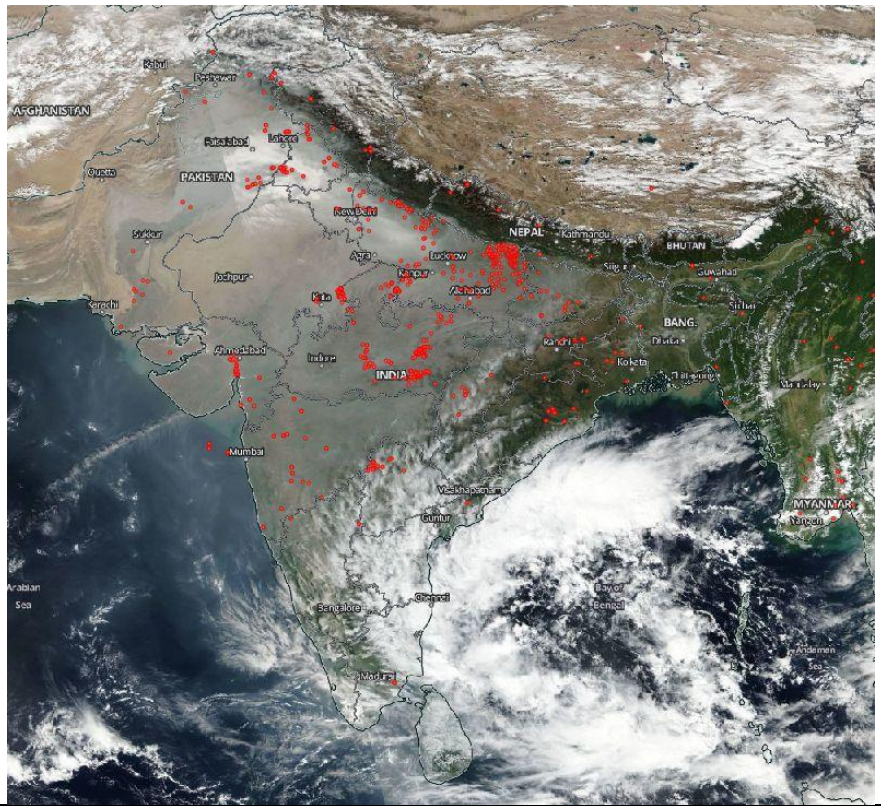
November 5th 2017



November 10th 2017



November 12th 2017



Source: NASA MODIS and VIIRS Satellite Imagery