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

IITM-PUNE AND IMD-DELHI,
MINISTRY OF EARTH SCINCES (MOES)

SCIENTIFIC ASSESSMENT OF DELHI WINTER AIR QUALITY CRISIS (6TH-16TH NOVEMBER' 2017)

CHRONOLOGICAL EVENTS LEADING TO DELHI AIR QUALITY CRISIS

(1) The climatological mean of Delhi Air Quality's PM2.5 remains as 140-190 μg/m^3 for the winter month of November which was maintained until 6th November 2017.

(2) **Extreme-1:** There was large Multi-day dust storm that emerged at Iraq, Kuwait, and Saudi Arabia in the last week of October 2017 and continued upto Nov 3-4. 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 (1.5-3 km, 700-850 hpa) where winds became very strong (15-20kmph) and direction became towards India (westerly, North-Westerly) and dust affected larger region of NCR including Delhi.

(3) **Extreme-2:** The stubble burning at Punjab, UP and Haryana counts were very high on 6th Nov and upper air winds became North Westerly (towards Delhi) with high speed and started pumping pollution in Delhi.

(4) **Air Quality plunged into SEVERE (Emergency) Zone** from 7th Nov (5AM) and touched a peak on 8th Nov (PM2.5 = 640 μg/m^3) and slowly recovered to VERY POOR level on Saturday (11th Nov). There was no pumping and influence of Stubble burning and Gulf storm dust after 10th Nov night onwards owing to slowing down of upper air winds and change in wind direction. So Delhi was out of External Influence.

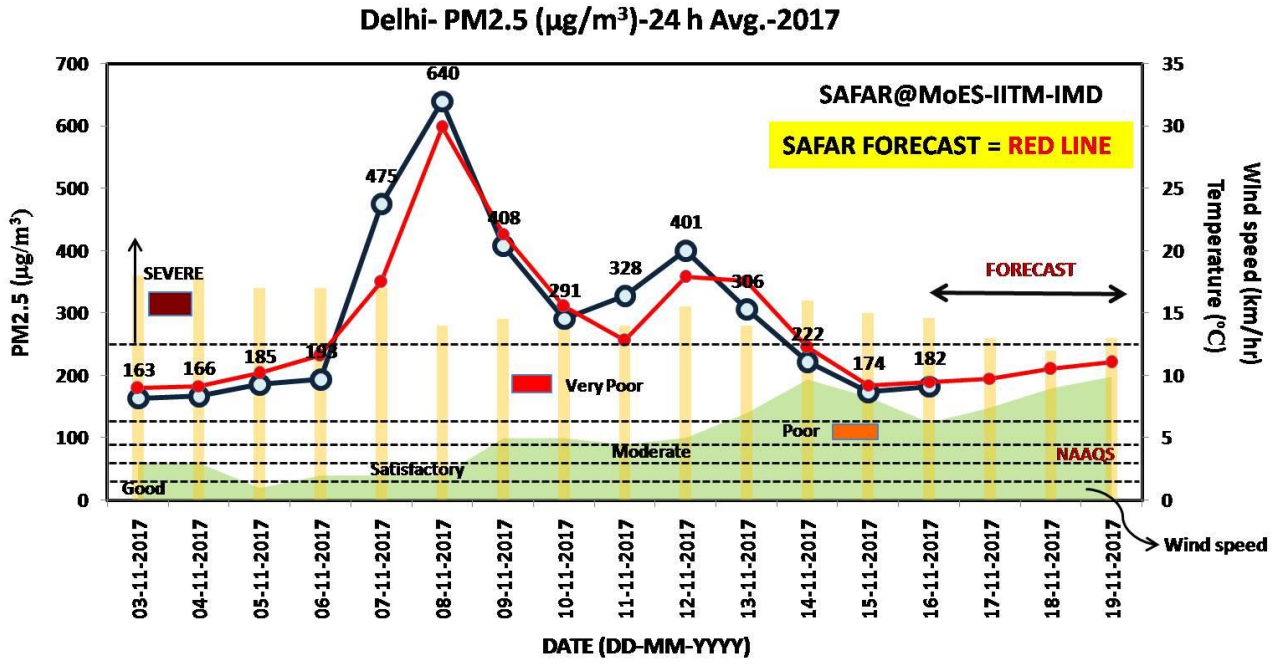
(5) **Gains due to Controls:** The offline model run reveals that the observed offset between known anthropogenic and weather induced natural sources and realistic observation is ***around 15%***. This may be attributed as gain due to unaccounted (in model) control measures like GRAP.

(6) **Extreme-3:** However, localized weather took over by 11th evening. Once pollutants are inside Delhi, calm winds, cool temperature, inversion layer trapped pollution within Delhi territory. It takes few days before Delhi can flush out these trapped pollutions. Before it could happen, inversion layer fell down from 1600m to just 45m in 8 hours on 11th and Delhi entered in SEVERE zone which delayed full recovery by 2 days.

(7) **Relative share of Internal v/s External sources:** As per SAFAR forecasting model run, the pollution contribution of Gulf Dust Storm on peak day (8th Nov 2017) was around ***40% and from Stubble Burning was ~25%***. Rest was Delhi Background of local sources. If external sources could not have played a role, Delhi Air quality during this period could have been ~200 μg/m^3 instead of 640 μg/m^3.

(8) **Successful SAFAR forecast**: (a) Predicted a rapid decline in the levels of PM2.5 from 640µg/m^{3}on 8th Nov 2017 to 248µg/m3 on 11th Nov.' 2017. Validated within 2-5% accuracy; (b) A steady decline in trend predicted wef 13th Nov 2017 until 15th and then to stabilize at 200µg/m^3 before withdrawal of Westerly disturbances deteriorates it from 18th Nov 2017.

(9) **Large Scale Weather:** The very calm surface wind conditions which do not allow to disperse pollution was due to anti-cyclonic circulation connected with late withdrawal of monsoon, persisting at about 700 hpa (lower troposphere) over northwest India with its centre near Delhi.



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