Inventory of PM_{10} and $PM_{2.5}$ Emission from Paved and Unpaved Road in India (2018)

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Introduction:

- Air pollution, especially from particulate matter (PM), is widely identified as one of the main risk factors for premature deaths and hospital admissions worldwide. (WHO,2016), In India, the condition of road deteriorate easily due to climatic factor, construction quality and overuse.
- Out of different sources, resuspended vehicular road dust has a greater contribution. Moreover road dust in most of the Indian cities is released due to poor road condition and shoulders. (Sahu et. al; 2011,USEPA, 2011, AP-42) The vehicle-induced resuspension of road dust is somehow a very complex process which gets affected by several parameters such as the state of pavement, road surface humidity, silt content on the road, average weight and speed of the vehicle as well as climatic factors such as temperature and rainfall etc.(Amato et. al, 2012)

Objective:

The present work emphasizes to develop the first ever gridded (~10x10 km) emission inventory of PM_{10} and $PM_{2.5}$ from paved and unpaved road in urban and rural India for the year 2018. The study domain includes the entire Indian region, which is diversely rich in rural as well as urban zones.

Data & Methodology:

- The methodology incorporates country specific urban/rural factors like surface silt content, surface moisture content, mean vehicle speed, VKT(vehicle-kilometer-travel), plying condition, average weight of the vehicle and number of precipitation days in year.
- This work includes the data over 716 districts, district level distribution of total ~280 millions of vehicle over India, ~0.63 million village level population, road network analysis of almost ~13 lakhs kilometer as well as district level rainfall data.

Emission factors Used:

$$EF = \left[\frac{k\left(\frac{s}{12}\right)^{a}\left(\frac{S}{30}\right)^{d}}{\left(\frac{M}{0.5}\right)^{c}} - C\right]\left[\frac{(365-P)}{365}\right] \qquad EF = \left([k(sL)^{0.91} \times (W)^{1.02}] + C\right)\left(1-\frac{P}{4N}\right)$$

(Unpaved road) **(Paved road)**

s = surface material silt content (%)

M = surface material moisture content (%)

S = mean vehicle speed (mph)

sL = road surface silt loading (grams per square meter) (g/m^2)

W = average weight (tons) of the vehicles traveling the road

C = EF for 1980's vehicle fleet exhaust, brake wear and tire wear

P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation. k,a,and d are empirical constants.

Emission Estimation:

ETot = EF x VKT

Where EF = Road-specific Emission factors

VKT = Vehicle Kilometers Travelled.

Some of the critically modulating factors for the EF are silt loading (s/sL), mean vehicle speed (S) and average vehicle weight (W). Region specific estimation leads to variation in the above modulating factors. One of the factors to be explained here is the '**sL**' factor which varies substantially for rural to be 36 % and urban to be 30%.

Result and Discussion:

- ✓ First ever high resolution gridded emission inventory of PM_{10} and $PM_{2.5}$ from paved and unpaved road for Indian geographic is prepared where the estimated emission is found to be **4.3 Tg/yr** for PM_{10} and **0.4 Tg/yr** for $PM_{2.5}$ in 2018
- ✓ **Figure-1 (a)** depicts the relative contribution of the vehicle category to the total PM_{10} emission, where the 2-wheeler and Car are major contributor to the sector. **Figure 1(b) and 1(c)** depicts the gridded PM10 and $PM_{2.5}$ emission from Indian subcontinent. It is found that the more urban and industrial regions are dominated by more dust due to heavy vehicle plying on the road. The central, Eastern, Norther-Eastern, Norther tip are couple of low emission zone due to low vehicle and population density followed by large agricultural/forest cover.
- ✓ The developed new emission data is part of SaBe National Emission Inventory for India (SNEII v1.0) dataset for climate/chemistry modelling study.

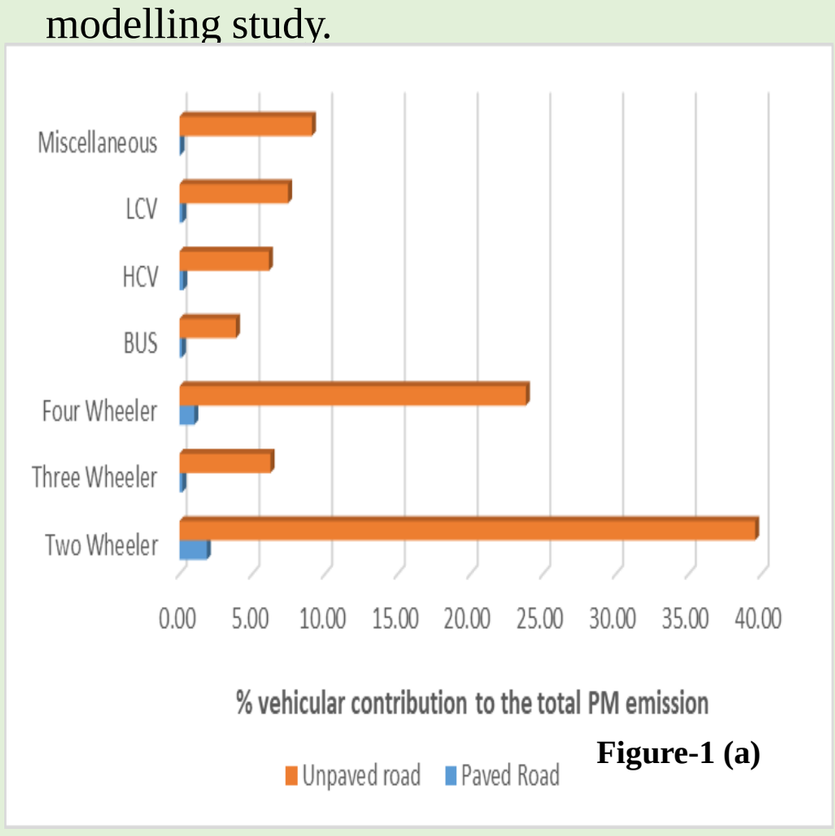

Figure-1 (a)

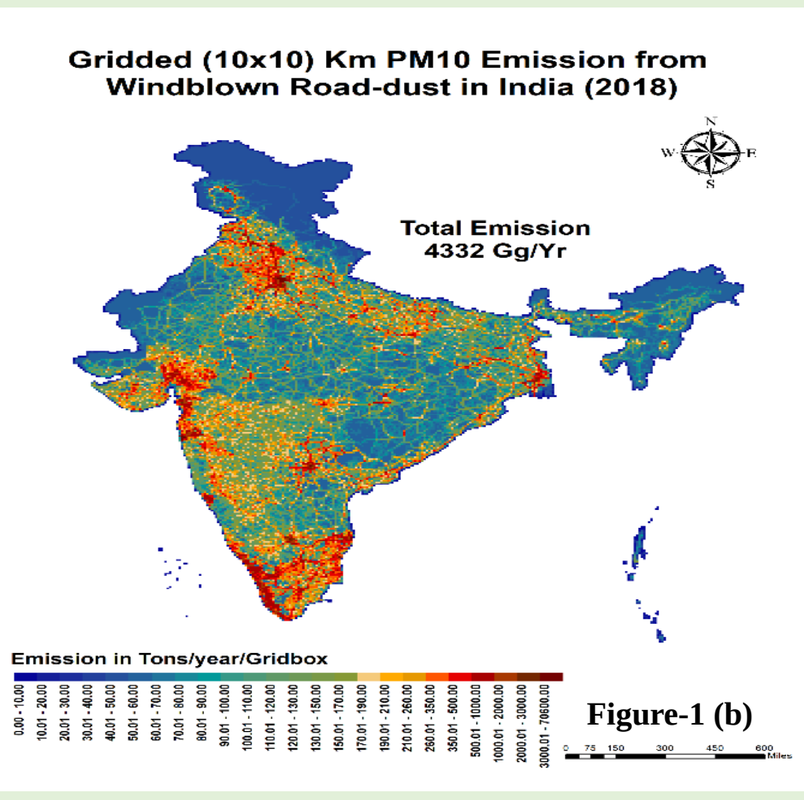

Figure-1 (b)

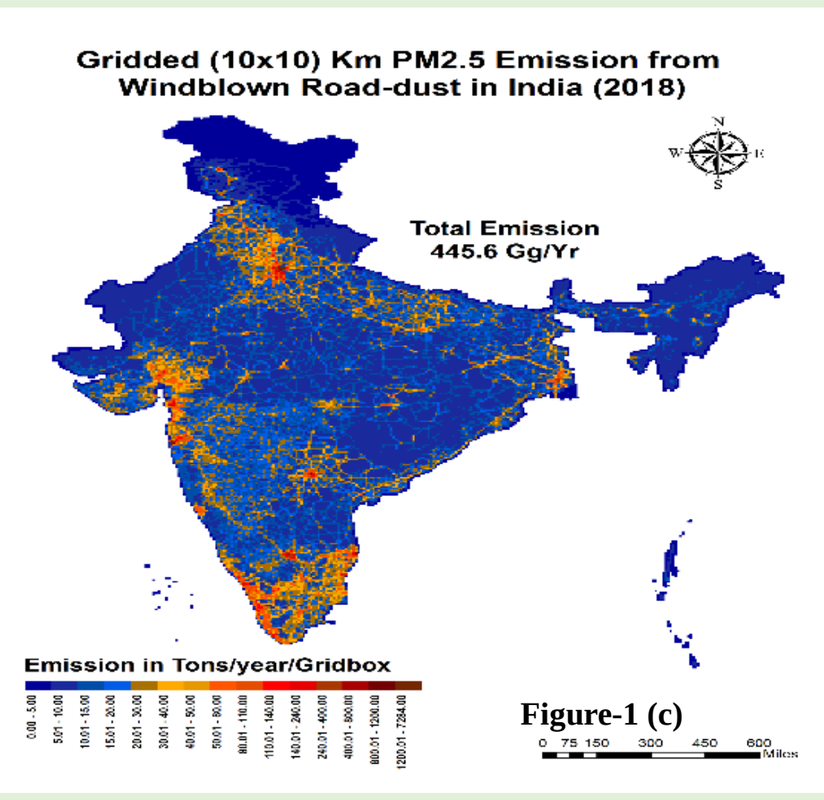

Figure-1 (c)

References:

- ✓ World Health Organization WHO Global Urban Ambient Air Pollution Database(update2016)http://www.who.int/phe/health_topics/outdoorair/databases/cities/en/. 2016. Accessed January 19, 2018.
- ✓ Sahu, S.K., Beig, G., Parkhi, N., 2011. Emissions inventory of anthropogenic PM2.5 and PM10 in Delhi during Commonwealth Games 2010 Atmospheric Environment 45 (2011) 6180e6190
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- ✓ Amato, Fulvio, AngelikiKaranasiou, Teresa Moreno, Alastuey, Andres, Orza, J.A.G., Lumbreras, J., Borge, R., Boldo, E., Linares, C., Querol, Xavier, 2012. Emissionfactors from road dust resuspension in a Mediterranean freeway. Atmos. Environ.