**Online Appendix for "The Health Impacts of Coal-Fired Power Plants in India and the Co-benefits of Greenhouse Gas Reductions"**

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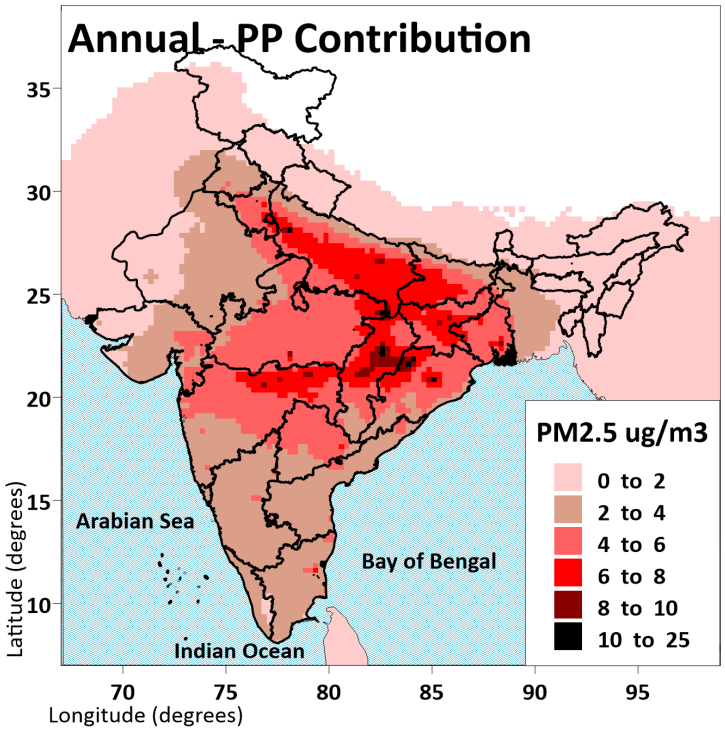


Figure A1a. Impact of 2018 Plants

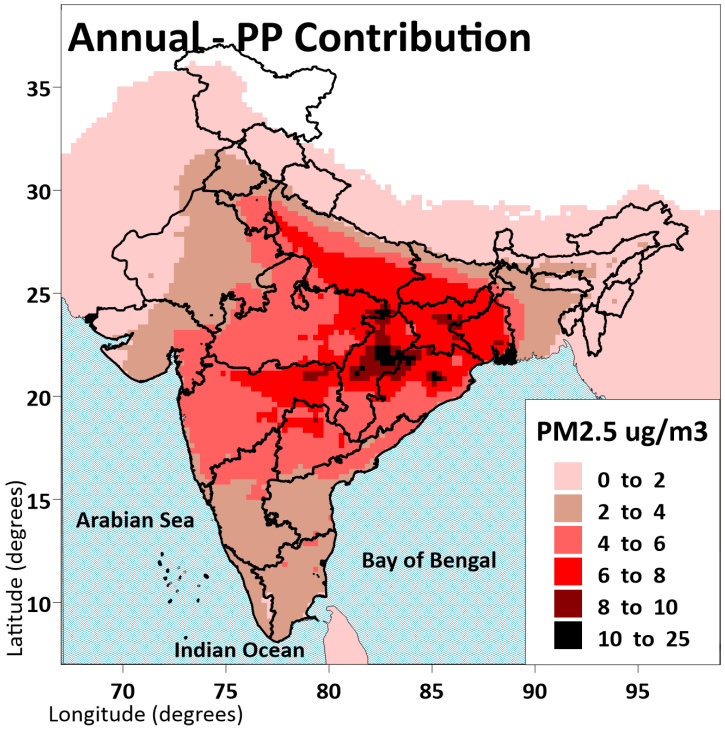


Figure A1b. Impact of 2018 Plants and New Plants

**Figure A1.** Impact of Coal-Fired Power Plants on Ambient $PM_{2.5}$

**Calculation of Deaths Attributable to Ambient $PM_{2.5}$**

To compute the deaths attributable to ambient $PM_{2.5}$, we calculate deaths for each $0.1^\circ$ x $0.1^\circ$ grid square, by cause of death, and then sum across all causes of death. We first describe the calculations (applied to each cause of death) allowing for exposure to household air pollution.

Ambient $PM_{2.5}$ ($PM_A$) affects both households who use solid fuels for cooking and those who do not. Let $p_H$ represent the fraction of the population in a grid square who are exposed to solid fuels from cooking and $PM_H$ represent their additional $PM_{2.5}$ exposure over and above $PM_A$. $1-p_H$ of the population is exposed only to $PM_A$. The total deaths due to $PM_{2.5}$ in the grid square (computed for each cause of death) is given by

(1) PM Deaths = $PAF(PM_A+PM_H)$*Baseline $deaths_{AP+HP}$ + $PAF(PM_A)$ * Baseline $deaths_{AP}$

where Baseline $deaths_{AP+HP}$ represents the total deaths among persons exposed to both ambient (AP) and household (HP) air pollution and Baseline $deaths_{AP}$ represents total deaths among persons exposed only to ambient pollution. (See below for calculation of Baseline $deaths_{AP}$ and Baseline $deaths_{AP+HP}$.) Let RR(z) represent the relative risk of death at PM = z. The Population Attributable Fraction (PAF) is the proportion of deaths attributable to PM and is given by

(2) PAF(z) = [RR(z) – 1]/RR(z)

The PAF is evaluated at z = $PM_A+PM_H$ for persons exposed to both AP and HP and evaluated at z = $PM_A$ for persons exposed to only to AP. Baseline deaths for each sub-group in the population can be calculated from total deaths (M), $p_H$ and the relative risk function, as described below.

The total deaths attributable to AP are calculated as

(3) AP Deaths = $[PM_A/(PM_A+PM_H)]$ $[PAF(PM_A+PM_H)$ * Baseline $deaths_{AAP+HAP}]$+ $PAF(PM_A)$ * Baseline $deaths_{AAP}$

which assumes that AP deaths among persons exposed to both sources of PM are proportional to the share of $PM_A$ in total PM exposure.

When we calculate deaths ignoring household air pollution, the term in the first line of (3) disappears, and Baseline $deaths_{AAP}$ are equal to total deaths (for each cause) in the grid square (M).

**Formulas for Baseline Deaths**

Let M represent total deaths (for some cause of death) in a grid square. Then

(4) $M = \lambda_T * RR(PM_A+PM_H) * Pop * p_H + \lambda_T * RR(PM_A) * Pop * (1-p_H)$

where $\lambda_T$ denotes the death rate at the background level of PM, RR(z) is the relative risk of death at exposure level z, Pop is the population of the grid square, and $p_H$ is the fraction of population in the grid square exposed to both HP and AP. Baseline deaths for each subgroup are given by

(5) Baseline $\text{deaths}_{AP+HP} = \lambda_T * RR(PM_A+PM_H) * Pop * p_H$

(6) Baseline $\text{deaths}_{AP} = \lambda_T * RR(PM_A) * Pop * (1-p_H)$

Equation (4) can be solved for $\lambda_T$

(7) $\lambda_T = [M/pop] * 1/[RR(PM_A+PM_H) * p_H + RR(PM_A) * (1-p_H)]$

and the result substituted into (5) and (6) to solve for Baseline $\text{deaths}_{AP+HP}$ and Baseline $\text{deaths}_{AP}$.

**Calculating Deaths Avoided by Not Building Power Plants**

If planned power plants are not built and all other sources of PM remain the same, the improvement in PM constitutes a marginal reduction in PM. The deaths avoidable by reducing $PM_A$ from $PM_A^0$ to $PM_A^1$ are measured by the reduction in risk of death from moving from $PM_A^0$ to $PM_A^1$ multiplied by baseline deaths

(8) $\Delta M = (\text{Baseline deaths}_{AP+HP})[RR(PM_A^1+PM_H)/RR(PM_A^0+PM_H) - 1] +$

$(\text{Baseline deaths}_{AP})\ [RR(PM_A^1)/RR(PM_A^0) -1]$

We calculate $\Delta M$ by setting $PM_A^0$ equal to the projected $PM_A$ level once all sources, including planned power plants, are operating, and $PM_A^1$ equal to the projected $PM_A$ level without planned plants.

Data on total deaths (M) for each cause of death for the year 2017 and $PM_H$ and $p_H$ for each state are given in the Data Appendix.