Health Effects of Particulates and Black Carbon

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What is Black Carbon?

- Black carbon (BC) is the most strongly light-absorbing component of particulate matter (PM).
  - BC is a solid form of mostly pure carbon that absorbs solar radiation (light) at all wavelengths.
- Other types of particles, including sulfates, nitrates and organic carbon (OC), generally reflect light.

- BC is formed by incomplete combustion of fossil fuels, biofuels, and biomass.
- BC is emitted directly into the atmosphere in the form of fine particles (i.e., “direct PM$_{2.5}$”).
- BC is a major component of “soot”, a complex light-absorbing mixture that also contains organic carbon.
Significant Impacts of PM$_{2.5}$ on Public Health

- Studies indicate that fine particles pose a serious public health problem. Due to their small size, fine particles (PM$_{2.5}$) can penetrate deep into the lungs. Even the largest fine particle is about 30 times smaller than the diameter of the average human hair.

- Exposures to fine particles (PM$_{2.5}$), including black carbon, can cause premature death and harmful effects on the cardiovascular system (the heart, blood, and blood vessels).

- Fine particle exposure also is linked to a variety of other public health problems, including respiratory diseases.

- The people most at risk include people with heart or lung disease (including asthma), older adults, children, and people of lower socio-economic status.

- Exposure to PM$_{2.5}$ linked to 130,000-320,000 premature deaths in the U.S. in 2005 (5.4% of all deaths)$^1$

- Decreases in long-term PM$_{2.5}$ exposures in the U.S. have been associated with an estimated increase in average life expectancy$^2$

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$^1$ Source: Fann et al., 2012, Estimating the National Public Health Burden Associated with Exposure to Ambient PM$_{2.5}$ and Ozone, Risk Analysis 32(1) 81-95.


Cardiovascular Effects of BC

Conceptual Diagram of the Epidemiologic Evidence for the Association of BC with the Continuum of Cardiovascular Effects, including sub-clinical effects (bottom level of the pyramid) and clinical effects, increasing in severity moving up the pyramid.
Health Benefits of Reducing BC

- Health effects associated with BC are consistent with those associated with PM$_{2.5}$.
  - Includes respiratory and cardiovascular effects and premature death.
  - Also includes indoor smoke exposures (e.g., cookstoves in developing countries).

- Emissions and ambient concentrations of BC and other direct PM$_{2.5}$ are often highest in urban areas, where large numbers of people live.

- The 2010 Global Burden of Disease (GBD) analysis found that outdoor air pollution in the form of PM$_{2.5}$ is a much more significant public health risk than previously known - **contributing annually to over 3 million premature deaths worldwide and over 74 million years of healthy life lost.** It now ranks among the top global health risk burdens.

- The GBD places outdoor air pollution among the top 10 risks worldwide.
BC reductions can provide large public health benefits.

- Globally, can potentially avoid hundreds of thousands of premature deaths each year.
- In the United States, reducing directly emitted PM$_{2.5}$ can provide health benefits ranging from $230,000-$880,000 per ton (2010$).
- The cost of the controls necessary to achieve these reductions is generally far lower.
  - The costs of PM controls for new diesel engines are estimated to be less than $13,000 per ton PM$_{2.5}$ in the U.S.
More information

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