Accelerating Climate Benefits While Improving Air Quality

The Co-Benefits of Reducing Black Carbon

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Xi’an - 12 May 2010
Key Points

- Black carbon (BC) is a potent climate forcer with significant health impacts

- Many opportunities currently exist to get immediate climate & public health benefits by reducing BC

- Efforts to coordinate BC reductions to achieve air quality & climate co-benefits can save money and lives
  - AND complement efforts to reduce long-lived GHG’s such as CO₂
Health Impacts of Black Carbon

• Black carbon is a component of PM$_{2.5}$
  • In US cities: Typically 3-12% of total annual PM$_{2.5}$

• Many scientific studies have reported associations between exposure to ambient PM$_{2.5}$ and a range of health effects

• World-wide, over 3 million lives per year are cut short as a result of outdoor PM$_{2.5}$ air pollution (Anenberg, et al, 2010)
Black Carbon’s Role in Climate

Carbon dioxide, a GHG, is the most important global warming component.

Black carbon’s global warming impact is large.

Organic carbon (also formed by incomplete combustion) has a cooling effect.*

From: IPCC 2007
Impacts on Himalayan Glaciers

Water sources of 14 major rivers may be severely depleted by 2035

In the Himalayan region, solar heating from BLACK CARBON at high elevations may be just as important as carbon dioxide in the melting of snowpacks and glaciers (Ramanathan & Carmichael, 2008)

Global Sources of Black Carbon:

Total Black Carbon Emissions in 2000
Source: T Bond Database, V 7.1.1 Feb 2009
Plus Bond et al., 2004

Total: 7900 gigagrams

- Forest and Grassland: 38.4%
- Transport: 16.6%
- Industry: 19.0%
- Household: 24.7%
- Agriculture Burning: 4.1%
- Ag Burning: 0.3%
- Waste Burning: 0.3%
- Power: 0.7%
- Ships and Aircraft: 1.7%

Pie Chart from Kirk Smith, UC Berkeley
Considerations for Designing Control Programs for Black Carbon

- Location of reductions matters because black carbon is more local/regional in nature than long-lived GHGs.
- BC’s warming effect is offset somewhat by cooling from reflective pollutants emitted at the same source, especially organic carbon (OC):
  - Diesel engine exhaust is mostly BC.
  - Biomass burning is mostly OC.
- Significant uncertainties remain: additional research is needed on emission inventories and assessing net climate impacts of reductions from particular source categories.
Prioritizing BC Mitigation Options

• Key Questions:
  – What is the expected net climate impact of controls on a specific source type, considering location, composition, and magnitude of anticipated emissions reductions?
  – How feasible are these controls, considering type and number of sources, country of origin, and technological availability?
  – What is the anticipated cost of control, factoring in the offsetting benefits to public health, and who should pay?

• Considering all of these factors, relative to available control opportunities for other climate pollutants, enables policymakers to determine the relative emphasis that should be placed on controlling sources of BC for climate purposes.

• Important: Reductions in black carbon (and associated PM) also provide significant public health benefits.
U.S. Actions

- US EPA Report to Congress on Black Carbon
  - Expected: April 2011
  - Inventory major sources of black carbon
  - Assess the impacts of BC on global and regional climate
  - Assess potential metrics and approaches for quantifying the climatic effects of BC emissions (including its radiative forcing and warming effects) and comparing those effects to the effects of carbon dioxide and other greenhouse gases
  - Identify most cost-effective approaches to reduce BC emissions
  - Analyze the climatic effects and other environmental and public health benefits of those approaches.

- Several petitions for action under the Clean Air Act
- Existing Air Quality Management Program (e.g. NAAQS reviews)
## International Assessments

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<td>- Task Force on Hemispheric Transport of AP</td>
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<td>- Ad Hoc Expert Group on Black Carbon</td>
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