

Black Carbon: The Dark Horse in the Climate System

A Research Focus of the NOAA ESRL Chemical Sciences Division



Motivation: An Option for Non-CO₂ Climate Mitigation and Air Quality Benefits

- Black carbon—the major component of “soot”—is a byproduct of burning fossil fuels, and also is released by the burning of biomass (e.g., wildfires, cookstoves).
- Black carbon has a short residence time in the atmosphere (and is a short-lived climate pollutant, SLCP). Measures to reduce black carbon could bring rapid relief for both climate and air quality.



Black Carbon Affects Climate. Black carbon particles absorb sunlight. This contributes to climate warming, accelerates melting when the particles fall on snow or ice, and suppresses the formation of clouds. Black carbon is the second largest climate forcer after CO₂ (see figure below).

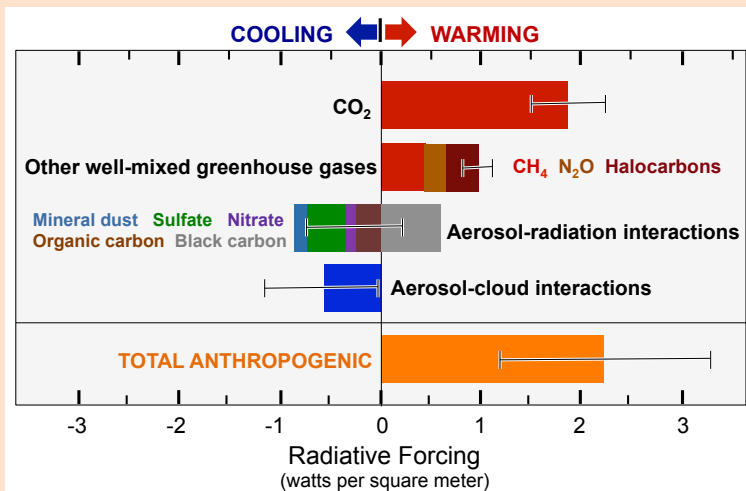
Black Carbon Affects Air Quality. Black carbon is a component of fine-particle pollution, called PM_{2.5}, which is associated with adverse health effects and impaired visibility.

What Information is Needed on Black Carbon?

- Identify and quantify emission sources
- Determine properties, transport, and transformations in the atmosphere
- Determine effects on climate—in the air; deposited on surfaces (snow, ice); effects on cloud formation and persistence

Why NOAA, and Why CSD?

- Expertise in state-of-the-art measurements
- History of studying air quality and climate *together*, needed for advancing black carbon science and understanding
- Expertise in laboratory, modeling and measurements needed for comprehensive picture



The warming effects of black carbon offsets much of the cooling effect of other atmospheric particles.

In 2012, CSD helped to lead the first scientific assessment of black carbon, which provided decision makers with key information needed for effective decisions.

Expected Payoffs

- Improved understanding of black carbon emissions and chemistry
- Quantitative assessments of the implications of black carbon for climate, air quality, and public health
- Reduced uncertainty in climate models, and increased confidence in model projections
- Information for decisions related to climate mitigation and air quality improvement