



Climate Change and Black Carbon

What it means for Tribes and what you can do

What is black carbon?

Black carbon is produced as a result of the incomplete combustion of fossil fuels including coal or diesel (e.g., diesel generators and diesel-powered vehicles), biomass (e.g., forests and fire wood, yard trimmings, solid waste burning), and biofuels. Black carbon is emitted directly from combustion sources into the atmosphere as tiny particles of solid carbon, which fall under the fine particulate matter (PM-2.5) class of air pollutants regulated by the US Environmental Protection Agency (EPA).

In the United States, most black carbon emissions come from transportation, especially diesel-powered vehicles. Other sources include diesel-powered generators and open biomass burning, including wildfires. Globally, most black carbon emissions come from open burning and residential heating and cooking, although industrial facilities and diesel-reliant transportation sectors are also important contributors.

Importantly, particulate matter size categories (i.e., PM-10 or PM-2.5) are directly linked to the pollutant's potential for causing health problems. Black carbon falls into the smallest size fraction regulated by the US Environmental Protection Agency (PM-2.5), which is among the particles that can penetrate deep into the lungs where it may enter the bloodstream. Exposure to these particles is associated with respiratory and cardiovascular diseases, as well as premature death and is particularly hazardous for people with heart or lung diseases, as well as children and elderly adults.

Environmental Effects

Once emitted, black carbon disperses into the surrounding air and can lead to reduced visibility, or haze. PM-2.5, including black carbon, is linked to adverse impacts on ecosystems (e.g., reduced plant and animal growth and reproduction) and to agricultural crop damage in some parts of the world. Additionally, black carbon may be transported very long distances by wind into areas of high elevation or into the northern latitudes where it then deposits onto snow and ice. Accumulation of black carbon on snowpack and glaciers can accelerate melting, causing water runoff earlier in the spring and reducing the amount of snowmelt that normally would occur later in the spring and summer. These effects may further compromise water availability during the drier summer months when it is most needed by humans and ecosystems.



Why is black carbon important?

Black carbon negatively affects human health, the environment, and earth's climate. Unlike carbon dioxide (CO₂) and other greenhouse gas (GHG) pollutants, which can remain suspended in the atmosphere for extensive periods of time (some more than 100 years), black carbon has an atmospheric lifetime of roughly one week; at which point it is pulled out of the atmosphere by precipitation or falls onto the earth's surface as dry particles. For this reason, black carbon's impacts are primarily felt locally and regionally. Regions with high black carbon emissions are particularly vulnerable to its detrimental effects.

Public Health Effects

Black carbon falls into a category of particulate matter with a diameter of less than 2.5 micrometers (PM-2.5).

Climate Effects

In what is referred to as the



earth's energy balance, some of the incoming solar radiation (sunlight) remains within the earth's atmosphere, but much of it is reflected back out into space. This delicate balance between absorbed and reflected solar radiation maintains the earth at an optimal temperature. While suspended in the

atmosphere, black carbon raises atmospheric temperatures by directly absorbing solar radiation. Once deposited on snow and ice, black carbon reduces the reflectivity, or *albedo*, of that surface by absorbing more sunlight and therefore changes the earth's energy balance. This process accelerates the rate of snow and ice melt and creates a positive (or self-perpetuating)

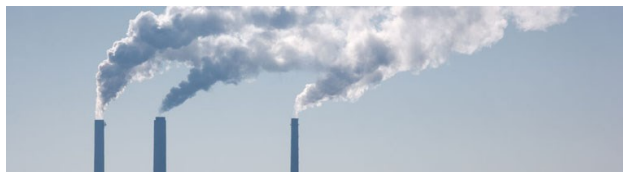


Image depicts normal albedo (left) and reduced albedo due to black carbon deposition (right); Photo courtesy of NASA Goddard Institute for Space Studies.

feedback loop in which the reduced albedo continues to amplify warming and undesirable snow and ice melt (see diagram above). Additionally, black carbon is also known to interact with clouds and can affect precipitation patterns. Scientists are continuing to study black carbon, particularly its interactions with clouds, to better understand its overall warming effects.

Taking Action to Reduce Black Carbon Emissions

Targeted strategies to mitigate black carbon emissions will have significant and immediate benefits to public health by reducing your community's exposure to PM-2.5 and black carbon. Black carbon reductions are also expected to reduce the rate of warming and slow the rate of ice, snow, and glacier melt, particularly in sensitive areas like the Arctic. One option for those



seeking to initiate or become involved in mitigation efforts is to conduct an emissions inventory (EI) to identify local sources of PM-2.5 and black carbon. The results of an EI can then inform an evaluation of air quality impacts and development of a mitigation plan. Such efforts should be performed in conjunction with reductions in long-lived greenhouse gases such as CO₂, in order to mitigate long-term impacts of climate change. To learn more about what you can do, see our fact sheet "Climate Change and Black Carbon: What it means for Alaska and what you can do."

To learn more about tribal climate change initiatives and the development of adaptation plans, please visit the Tribes & Climate Change website at

<http://www4.nau.edu/tribalclimatechange/index.asp>.



All photos and graphics provided courtesy of the US Environmental Protection Agency.

Resources

- 1) EPA. Black Carbon: <http://epa.gov/blackcarbon/>
- 2) EPA. Report to Congress on Black Carbon, March 2012: http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch14s14-4-4.html
- 3) UNEP. Integrated Assessment of Black Carbon and Tropospheric Ozone: http://www.unep.org/dewa/portals/67/pdf/BlackCarbon_report.pdf

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