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## **Comprehensive Four-Year Study Finds Black Carbon Second Biggest Climate Pollutant Behind Carbon Dioxide**

*Double previous climate change estimates*

*Even stronger in Arctic, darkening snow and ice  
and accelerating warming; may also change Asian Monsoons*

*Diesel engines best mitigation targets,  
followed by residential cook stoves, brick kilns, other sources*

Washington, DC 15 January 2013 – Black carbon is the second most powerful climate pollutant behind only carbon dioxide, according to a landmark four-year assessment lead by T.C. Bond, S. J. Doherty, D. W. Fahey, and P. Forster, and a multinational team of 27 other experts, including prominent scientists from China and India. The results, *Bounding the role of black carbon in the climate system*, are scheduled to be published online Tuesday in the *Journal of Geophysical Research: Atmospheres*.

The direct effects of black carbon are nearly double the 2007 IPCC's Fourth Assessment, according to the assessment, confirming select earlier studies once considered outliers such as [Ramanathan and Carmichael \(2008\)](#). "This study confirms and goes beyond other research that suggested black carbon has a strong warming effect on climate, just ahead of methane," said co-lead author David Fahey from the U.S. National Oceanic and Atmospheric Administration.

"The potential to slow warming by cutting black carbon is even more important than previously understood," added Durwood Zaelke, President of the Institute for Governance & Sustainable Development, who served as a reviewer of the assessment.

Reducing diesel black carbon emissions along with other key sources including brick kilns and residential solid fuel burning will quickly reduce warming, according to the assessment.

The assessment also calculates that BC causes significantly higher warming over the Arctic and other vulnerable regions, and can affect rainfall patterns in areas where emissions are high, such as the Asian Monsoon system, confirming earlier studies by [Ramanathan et al. \(2005\)](#) and [Meehl et al. \(2007\)](#). In addition, the assessment establishes that black carbon is a significant cause of the rapid warming in the Northern Hemisphere at mid- to high-latitudes, including the northern United States, Canada, northern Europe, and northern Asia.

"This new research provides further compelling evidence to act on short-lived climate pollutants, including black carbon," said Achim Steiner, UN Under-Secretary-General and UN Environment Programme Executive Director. "I would urge more countries, companies and organizations to join the [Climate and Clean Air Coalition](#), which is leveraging several key pathways and new partnerships to manage down these climate, health and crop-damaging emissions." The Coalition is already pursuing projects to reduce black carbon emissions from heavy-duty diesel vehicles and engines, brick production, and municipal waste disposal, and is considering several new initiatives, including for residential cook stoves.

Since its founding February last year, the Coalition has grown from six to 25 State partners from both developed and developing countries, including Nigeria, Ghana, Bangladesh, Mexico, Norway, Japan, and the U.S. In May the G8 countries agreed to join, and commissioned the World Bank to prepare a report on ways to integrate reduction of near-term climate pollutants into their activities. Pending completion of the report, the [World Bank](#) has already pledged significant increases in funding to reduce black carbon and the other short-lived climate pollutants. Other members include the UN Environment Programme, which houses the Coalition's Secretariat, the UN Development Programme, and the European Commission, as well as several NGOs, bringing the total membership to 49.

"The Coalition is the first global effort to address black carbon and the other short-lived climate pollutants and is an essential platform for action," said Romina Picolotti, former secretary of environment for Argentina. "States interested in doing more to reduce their black carbon emissions should not miss the opportunity to join."

"Black carbon is not only more important for climate than we thought, it also kills over a million people every year who contract deadly respiratory diseases by breathing air polluted by black carbon," said Zaelke. "That number could be up to 3.6 million deaths by 2050. This is bad for development, which depends on a healthy population."

Over the past decade "the speed of Arctic climate change and glacial melt has increased the demand for mitigation options which can slow near-term warming," according to the assessment, and reducing black carbon along with other short-lived climate pollutants, "especially methane and tropospheric ozone (O<sub>3</sub>), could quickly decrease positive climate forcing and hence climate warming."

Black Carbon is one of the short-lived climate pollutants targeted by the Climate and Clean Air Coalition, along with methane, and HFCs. Fast action on black carbon and methane has the potential to cut the rate of climate change in half for the next several decades, reduce air pollution-related deaths by as much as 2.4 million a year, and annual crop losses by 30 to more than 100 million tonnes, according to a previous assessment of black carbon and tropospheric ozone by [UNEP and the World Meteorological Organization](#).

The new assessment is being released at the same time as the US's [draft third climate assessment report](#) by 240 scientists, which concludes that climate change is already a major threat, "largely because society and its infrastructure were designed for the climate of the past, not for the rapidly changing climate of the present or the future," with longer periods of extreme heat in summer, longer wildfire seasons in the Western US, increasing coastal erosion, and more frequent flooding.

"Fast cuts to black carbon and other short-lived climate pollutants are critical for both mitigation and adaptation," said Zaelke, "because they can quickly reduce the rate of warming by half and reduce impacts significantly over the next several decades." "Success also builds the momentum and confidence we need to address carbon dioxide from energy production, which is essential for a safe climate," he added.

The new assessment and the Coalition are clear that cuts in black carbon and the other short-lived climate pollutants alone cannot protect the Planet and its people from dangerous levels of climate change over the 21<sup>st</sup> century unless aggressive reductions are also made in carbon dioxide, the primary greenhouse gas.

- The assessment will be available Tuesday 15 January at 13:00 GMT [here](#).
- *A Primer on Short-Lived Climate Pollutants* (2012) by IGSD is [here](#).
- Wallack, J. S., & Ramanathan, V., *The Other Climate Changers: Why Black Carbon and Ozone Also Matter*, FOREIGN AFFAIRS (2009), is [here](#); and Clare, D., Pistone K., & Ramanathan V., *Getting Rid of Black Carbon*, GEORGETOWN JOURNAL OF INTERNATIONAL AFFAIRS (2010) is [here](#).

**The following are major findings of the scientific assessment, generally presented as quotes:**

**BC Second Only to CO<sub>2</sub>**

- Black carbon is the “second most important human emission ...; only carbon dioxide is estimated to have a greater forcing...” (Abstract)
- The total climate forcing of black carbon is 1.1 W m<sup>-2</sup>, with the high end of the range at 2.1 W m<sup>-2</sup>, which would put black carbon far above carbon dioxide, which is 1.7 W m<sup>-2</sup>.
- The “direct radiative forcing of +0.88 W m<sup>-2</sup> ... is similar to the +0.9 W m<sup>-2</sup> given by [Ramanathan and Carmichael \[2008\]](#).” (Section 9.6.28.2)
- “[T]otal climate forcing of black carbon is greater than the direct forcing given in the fourth Intergovernmental Panel on Climate Change (IPCC) report.” (Section 0.2.3.2)
- [This is also higher than the direct forcing estimates from the 2011 [UNEP&WMO Integrated Assessment of Black Carbon and Tropospheric Ozone](#), which calculated direct forcing from BC between 0.3 and 0.6 W m<sup>-2</sup>.]

**Stronger Regional Warming in Arctic and Over Ice and Snow**

- Black carbon has an even more powerful effect in some regions, including the Arctic, where deposition on snow and ice causes positive climate forcing. This is true even for aerosol sources that have high co-emitted cooling aerosols; even these “can produce positive climate forcing in the Arctic because of their effects on snow and ice.” (Section 0.2.6.1)
- “The best estimate of climate forcing from black carbon deposition on snow and sea ice in the industrial era is +0.13 W m<sup>-2</sup>”, although at the high end, it could be as much as +0.33 W m<sup>-2</sup>. (Section 0.2.6.2)
- “*Black carbon forcing concentrates climate warming in the mid-high latitude Northern Hemisphere.*” [This includes the northern US, Canada, Northern Europe, and Asia.] “It is also likely to be one of the causes of Arctic warming in the early 20th century.” (Section 0.2.12.2)
- In particularly vulnerable regions, direct radiative forcing from BC can be more than ten times greater than the global average, “on the order of +10 W m<sup>-2</sup>, for example, over regions of East and South Asia.” (Section 5.1.2)

**BC May Shift Monsoons**

- “Regional circulation and precipitation changes may occur in response to black-carbon climate forcings. These changes include a northward shift in the Inter-Tropical Convergence Zone and changes in Asian monsoon systems where concentrations of absorbing aerosols are large.” (Section 0.2.7.2)

**BC Emissions Have Been Underestimated in Many Vulnerable Regions**

- “*Black-carbon emission rates from both energy-related combustion and biomass burning currently appear underestimated.* Underestimates occur largely in Asia and Africa.” (Section 0.2.9.3)

**Diesel and Residential Best Mitigation Targets**

- Some black carbon sources co-emit cooling aerosol pollutants, and the best climate mitigation opportunities are generally those with the highest black carbon ratio.
- “*Mitigation of diesel-engine sources appears to offer the most confidence in reducing near-term climate forcing.* Mitigating emissions from residential solid fuels also may yield a reduction in net positive forcing. The net effect of other sources, such as small industrial coal boilers and ships, depends on the sulfur content, and net climate benefits are possible by mitigating some individual source types.” (Section 0.2.11.2)
- “In prioritizing potential black-carbon mitigation actions, non-science factors, such as technical feasibility, costs, policy design, and implementation feasibility play important roles.” (Abstract)

**BC Harms Public Health**

- “Regardless of net climate forcing or other climatic effects, all BC mitigation options bring health benefits through reduced particulate matter exposure.” (Section 12.1.2)