

Earth Institute News

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Soot Adds to Melting of Earth's 'Third Pole' *Himalayan Glaciers Absorbing More Sun*



Researchers trekked high into the Himalayas to collect ice cores. (Institute of Tibetan Plateau Research, Chinese Academy of Sciences)

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Black soot deposited on Tibetan glaciers has contributed significantly to the retreat of the world's largest non-polar ice masses, according to new research by American and Chinese scientists.

Soot absorbs incoming solar radiation, and can speed glacial melting when deposited on snow in sufficient quantities.

Temperatures on the gigantic Tibetan Plateau — sometimes called Earth's "third pole" — have warmed by 0.3 degrees C (0.5°F) per decade over the past 30 years, about twice the rate of observed global temperature increases. But the research and ongoing modeling suggest that soot's

influence on Tibetan glaciers could rival that of greenhouse gases, which are thought to be driving the warming trend.

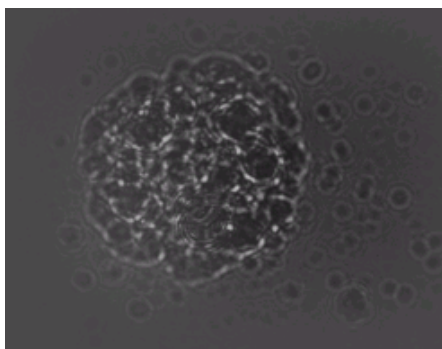
"Tibet's glaciers are retreating at an alarming rate," said [James Hansen](#), coauthor of the study and director of the [NASA Goddard Institute for Space Studies](#), an affiliate of the Earth Institute. "Black soot is probably responsible for as much as half of the glacial melt, and greenhouse gases are responsible for the rest." Junji Cao, a researcher from the Chinese Academy of Sciences in Beijing and a coauthor, said that during the last 20 years, black soot concentration in the glaciers has increased two- to three-fold relative to 1975.

The study, "[Black Soot and the Survival of Tibetan Glaciers](#)," appears in the [early edition of the Proceedings of the National Academy of Sciences](#).

According to coauthor Tandong Yao, director of the Chinese Academy's Institute of Tibetan Plateau Research, 50 percent of the glaciers in the Tibetan region were retreating from 1950 to 1980; that rose to 95 percent in the early 21st century. Some are retreating so quickly that they could disappear by mid-century if current trends continue, the researchers suggest.

Since meltwater from Tibetan glaciers replenishes many of Asia's major rivers, including the Indus, Ganges, Yellow and Brahmaputra, such losses could have profound impacts on the 1 billion people who rely on rivers for fresh water. While rain and snow would still help replenish the rivers in the absence of glaciers, the change could hamper efforts to manage seasonal water resources by altering when fresh water supplies are available in areas already prone to water shortages.

To do the study, researchers led by Baiqing Xu of the Chinese Academy trekked into the high Himalayas to drill five ice cores dating back to 1950 from various locations across the



Black soot is generated by industry, traffic, outdoor fires, and household burning of coal and biomass fuels. (Chere Petty, UMBC)

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Tibetan Plateau. During analysis, they looked for black carbon (a key component of soot) as well as organic carbon. The cores support the hypothesis that the amounts of black soot in the Himalayan glaciers correlate with black carbon emissions in Europe and South Asia.



Himalayan glaciers help replenish many of Asia's most important rivers. (NASA Johnson Space Center) [view larger image](#)

At Zuoqiupu glacier — a bellwether site on the southern edge of the plateau and downwind from the Indian subcontinent — black soot deposition increased by 30 percent between 1990 and 2003. The rise in soot levels at Zuoqiupu came after an earlier dip that followed the enactment of clean air regulations in Europe in the 1970s.

Most soot in the region comes from diesel engines, coal-fired power plants and outdoor cooking stoves. Many industrial

processes produce both black carbon and organic carbon, but often in different proportions. Diesel fuel produces mainly black carbon, for example, while wood produces mainly organic carbon. Since black carbon is darker and absorbs more radiation, it is thought to have a stronger warming effect than organic carbon.

To refine the emerging understanding of soot's impact on glaciers, scientists are striving to gather more measurements. "We can't expect this study to clarify the effect of black soot on the melting of Tibetan snow and glaciers entirely," said Cao. "Additional work that looks at [reflectivity], melting rate, and other types of reconnaissance is also needed."

Scientists are using satellite instruments such as the Moderate Resolution Imaging Spectroradiometer (MODIS), aboard the NASA satellites Terra and Aqua to enhance understanding of the region's ability to reflect solar radiation. And a new NASA climate satellite called Glory, which will launch late in 2010, will carry a new type of sensor that should be able to distinguish between different types of particles in the air more accurately than previous instruments.

"Reduced black soot emissions, in addition to reduced greenhouse gases, may be required to avoid demise of Himalayan glaciers and retain the benefits of glaciers for seasonal fresh water supplies," said Hansen.

[Read James Hansen's explanation of the study](#)

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