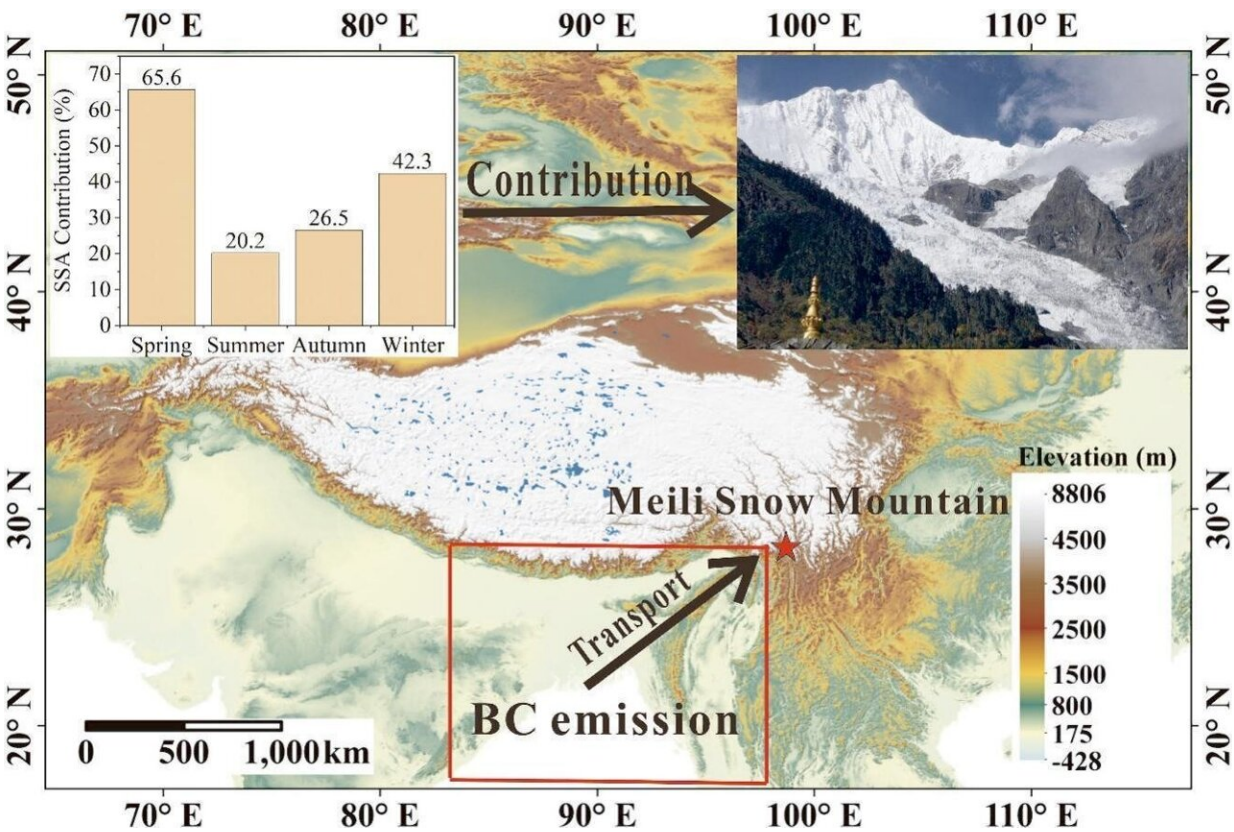
Researchers reveal sources of black carbon in southeastern Qinghai-Tibet plateau

April 19 2024, by Zhang Nannan



Credit: *Science of The Total Environment* (2024). DOI: 10.1016/j.scitotenv.2024.172262

Black carbon (BC) is the result of incomplete combustion of fossil fuels and biomass, with strong light absorption. It is second only to carbon dioxide as a climate-forcing factor for atmospheric warming. Deposition of BC on snow and ice surfaces reduces albedo, accelerates glacier and snow cover melting, and alters hydrological processes and water resources in the region.

The Qinghai-Tibet Plateau (QTP) is China's most developed cryosphere region, where glaciers are shrinking rapidly due to light-absorbing impurities such as BC. Both modeling and geochemical evidence indicate that BC emitted from this region can be transported across the Himalayas and reach the interior of the QTP, contributing over 60% of its BC.

This mainly affects the southern and central regions of the QTP. However, there is a lack of sufficient online monitoring of BC in the glacier area of the QTP, which requires stronger integration with model simulations.

Prof. Kang Shichang's research team from the Northwest Institute of Eco-Environment and Resources of the Chinese Academy of Sciences conducted extensive monitoring of BC in Mingyong Glacier under Meili Snow Mountain and analyzed its source and climate impact using the regional climatic chemical coupling model WRF-Chem.

The study was published in *Science of the Total Environment*.

The researchers found that the annual mean concentration of BC in the Mingyong Glacier was significantly higher than that in the interior of the QTP, with noticeable seasonal variation, reaching its peak value in April.

The bimodal shift pattern of BC shows the largest change amplitude in spring, indicating a significant influence of climatic conditions on the source, transport, and boundary layer thickness of BC.

At a wavelength of 370 nm, the absorption coefficient reaches its maximum value, with most absorption coefficient values below 20 Mm^{-1}. Brown carbon contributes significantly to the absorption coefficient, with an average annual contribution of 25.2%±12.8%.

South Asia and Southeast Asia are the main sources of BC in the study area, contributing 51.1% on average annually. The highest contribution occurs in spring (65.6%) and summer (20.2%), highlighting the importance of considering contributions from other regions.

The BC emitted from South and Southeast Asia contributes to a positive radiative forcing (RF) in the atmosphere of the study area. The near-surface RF exhibits significant seasonal variations, with higher values in winter and summer.

The study enhances our understanding of BC in the typical glacial region of the QTP, including its content, change, source, and influence. It also serves as a valuable reference for further discussions on the climate impact of BC and other light-absorbing pollutants, as well as for international cooperation on reducing BC emissions.

More information: Pengfei Chen et al, South and Southeast Asia controls black carbon characteristics of Meili Snow Mountains in southeast Tibetan Plateau, *Science of The Total Environment* (2024). DOI: 10.1016/j.scitotenv.2024.172262

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