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Distribution and Fate of Black Carbon Nanoparticles from Regional Urban Pollution and Wildfire at a Large Subalpine Lake in the Western United States

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Emitted to the atmosphere through fire and fossil fuel combustion, refractory black carbon nanoparticles (rBC) impact human health, climate, atmospheric chemistry, and the carbon cycle. Eventually these particles enter aquatic environments, where their distribution, fate and association with other pollutants are still poorly characterized. This study presents results from an evaluation of rBC in the waters of oligotrophic Lake Tahoe and its watershed in the western United States. The study period included a large wildfire within the Tahoe basin, seasonal snowmelt, and a number of storm events that resulted in pulsed urban runoff into the lake with rBC concentrations up to four orders of magnitude higher than mid-lake concentrations. The results show that elevated rBC concentrations from wildfire and urban runoff were rapidly attenuated in the lake, suggesting unexpected aggregation or degradation of the particles that prevent rBC concentrations from building up in the water of this lake, renowned for its clarity. The rBC concentrations were also measured in sediment cores from Lake Tahoe to evaluate the sediment archive as a potential combustion record. The evidence suggests that rBC is efficiently transferred to these sediments, which preserve a local-to-regional scale history of rBC emissions, as revealed by comparison with other pollutant records in the sediment. Rapid removal of rBC soon after entry into the lake has implications for transport of rBC in the global aquatic environment and flux of rBC from continents to the global ocean.