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Pole-to-pole observations of black carbon aerosol in the remote Pacific and Arctic

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Efforts are now underway to expand global measurements of black carbon (BC) aerosol from aircraft to better assess the impact of fossil fuel combustion and biomass-burning sources of BC on global air quality and climate. Understanding the processes controlling BC aerosol abundance in the atmosphere is necessary to constrain transport and microphysics in global aerosol models, evaluate climate impacts, and develop mitigation strategies. Yet measurements of BC above the surface have been very limited until recently and measurement-model comparisons of BC often show large discrepancies. Recent measurements from the HIAPER Pole-to-Pole Observations (HIPPO) study add new insight into the global distribution of BC and greenhouse gas species at finer spatial resolution than obtainable from satellite measurements with the goal of assessing emissions, transport timescales, and removal processes. Three HIPPO campaigns have been completed over three seasons and include over 400 vertical profiles from 0.3 to 14 km altitude between 85N and 67S latitude in the remote Pacific and Arctic regions. In the Arctic, highlights include observations of persistent stratified pollution from boreal autumn through spring. In the northern Pacific midlatitudes and subtropics, very polluted conditions were encountered over a deep portion of the troposphere with BC mass loadings varying between 100 and 1000 ng/kg in large-scale plumes from anthropogenic and biomass burning sources in Asia in boreal spring. Some of the first airborne observations of BC mass loadings in the southern hemisphere show large interhemispheric gradients in boreal spring. The northern hemisphere BC mass loadings account for over 90% of the pole-to-pole burden in the remote Pacific in boreal spring.