Diverse and high pollution of microplastics in seasonal snow across Northeastern China

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Snow scavenging is recognized as one of the major sinks for atmospheric microplastics (MPs). However, little is known about the properties of MPs in large-scale surface snow. Using Nile Red staining and micro-Fourier transform infrared spectroscopy, we identified the shapes, sizes, and polymer components of MPs in seasonal snow across northeastern (NE) China, a major industrial area. The average concentration of MPs was $(4.52 \pm 3.05) \times 10^4$ MPs L^{-1}, and the highest contamination $(6.65 \pm 3.89) \times 10^4$ MPs L^{-1} was observed in Changbai Mountains, which was the highest concentration observed in surface snow to the extent of literature. The majority of snow MPs were smaller than 50 μm and composed primarily of fragments. Ethylene vinyl acetate and polyethylene were the dominant contributors to their chemical components. Investigation with positive matrix factorization revealed that the MPs were primarily generated by debris from packaging materials, followed by industrial and construction activities. In addition, the winter atmospheric circulation over the northwestern Siberian and Mongolian plateaus likely dominated the wide-range dispersion and deposition of the MPs across NE China. These results provide a first comprehensive perspective of MPs from sources to removal associated with snow in a large geographic region.