Plastics Pollution and the Planetary Boundaries Framework

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Abstract

Plastics have become an international governance priority because of their extensive and resource-intensive production, uncontrolled environmental releases, and failure to control the chemicals within the materials. This paper examines the evidence that plastics have exceeded the planetary safe operating space, discussing how pollution by plastics and their additives affects multiple Earth system processes along the impact pathway from resource extraction and production to release to environmental fate and impacts. Multiple lines of evidence are necessary to capture the complex reality of these novel entities. Attempts to quantify a planetary boundary in isolation would be detrimental to the global governance of plastics. We demonstrate causal links between plastics and other major environmental problems at global scale, exacerbating the consequences of breaching other planetary boundaries, especially climate change and biodiversity loss. We propose ways to translate these assessments into biophysically-defined control variables for the planetary boundaries framework, as a way to measure, monitor and mitigate global plastics pollution. Efforts should be oriented towards further developing and monitoring a set of control variables that describe the actual state of the system along the impact pathway. We call for experts and policymakers to take urgent action, recognizing plastics pollution not only as a waste management problem but as an integrative part of climate change, biodiversity, and natural resource use policy.

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