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Conceptualising the "Plastic Cycle" – the need to consider the role of landscape processes in the movements of plastics through terrestrial and freshwater environments

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It is now widely acknowledged that plastic pollution is almost ubiquitous across the Earth's active zone. Almost every study which has looked for plastic pollution in the environment has identified it. In the past few years micro- and macro-plastic has been found on the beaches of uninhabited islands in the Pacific Ocean, in the ice of polar ice caps and the deepest ocean trenches. A growth in our scientific understanding of marine plastic pollution has been matched by an increase in public awareness of the problem. Plastic pollution is increasingly recognised as one of the most serious environmental issues threatening the planet with policy makers seeking ways to address the problem. There is increasing awareness that plastic pollution is also widespread in terrestrial, atmospheric and freshwater environments, with much of the overall plastic pollution in the environment also originating from terrestrial sources. Our understanding of plastic behaviour in these environments is incomplete and there is a pressing need to consider how different parts of the environment are interlinked with respect to plastic pollution.

We present a conceptual model of the potential terrestrial and freshwater stores of plastic pollution and the vectors and transport pathways which deliver new plastics to these stores and transfer particles between them. A key implication of this conceptual model is that interdisciplinary studies are likely needed to quantify the stores and transport of plastic material within and between these environments. Using such an approach we can both better constrain estimates of (micro)plastic fluxes from rivers to the ocean and understand how the original sources of different types of plastic pollution are linked to its abundance in different locations. By understanding where plastic is being stored in the environment we can better predict levels of exposure and so to better understand long-term ecological and human health implications. Ultimately, geomorphological, hydrological and sedimentological knowledge and techniques need to be integrated into studies of plastic pollution to help effectively identify important sources of plastic pollution, understand the behaviour of plastic particles in the environment and to design effective mitigation policies.