Defining the controls on microplastic settling in river systems to predict areas of ecological risk to microplastic pollution

Freija Mendrik[1,1], Daniel R. Parsons[1,1], Christopher R. Hackney[1,1], Catherine Waller[1,1], Robert Michael Dorrell[1,1], Vivien Cumming[2,2], and Grigorios Vasilopoulos[1,1]

[1]University of Hull
[2]Science Stories Limited

January 20, 2023

Abstract

The majority of marine plastic pollution originates from land-based sources with the dominant transport agent being riverine. Despite the widespread recognition that rivers dominate the global flux of plastics to the ocean, there is a key knowledge gap regarding the nature of the flux, the behaviour of microplastics (<5mm) in transport and its pathways from rivers into the ocean. To predict transport, fate and biological interactions of microplastics in aquatic environments at a global scale, the factors that control these processes must be identified and understood. Currently, there remains a large knowledge gap around prediction of microplastic transport in rivers, especially in regards to how biofilm formation influence particle settling velocities. This prevents progress in understanding microplastic fate and hotspot formation, as well as curtailing the evolution of effective mitigation and policy measures. A settling experiment was therefore undertaken to understand how different factors, including salinity, suspended sediment concentration and biofilm formation influence microplastic particle settling velocity. The results presented herein explore the role of biofilms on the generation of microplastic flocs and the impact on buoyancy and settling velocities. Five different polymers were tested and compared including fragments and fibres. Settling velocities were then combined with observed flow velocity data from the Mekong River, one of the top global contributors to marine plastic pollution, allowing predictions of areas of microplastic fallout and hotspots. The results highlight potential areas of highest ecological risk related to the dispersal and distribution of microplastics across the river-delta-coast system including the Tonle Sap Lake. Future work involves supporting predicted hotspots with aligned fieldwork from the Mekong River that details the particulate flux and transport of microplastic, throughout the vertical velocity profile.

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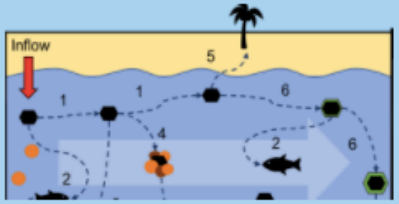
Energy and Environment Institute, University of Hull, UK Twitter @FreijaMendrik

Background

Plastic fragments floating on the surface of aquatic systems only represent **1-2%** of plastic pollution entering these environments annually, with the fate of the remaining plastics largely unknown[1].



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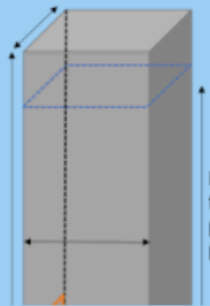
Approach



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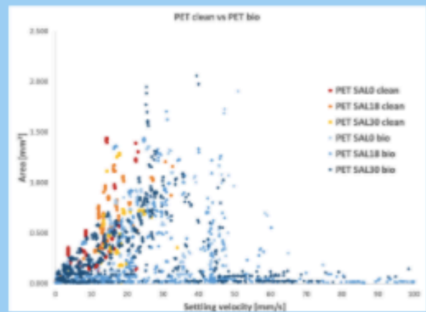
Biofilms and salinity



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MP type and salinity

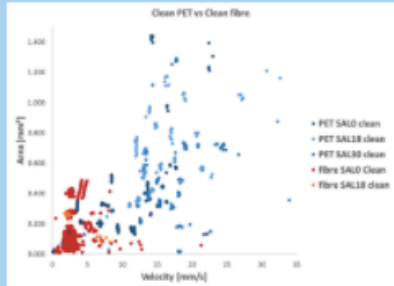

Fig. 5: The relationship between particle area

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Objectives

1. Establish if there is a difference between the settling velocity of different MP types (ie. fragments vs fibres).

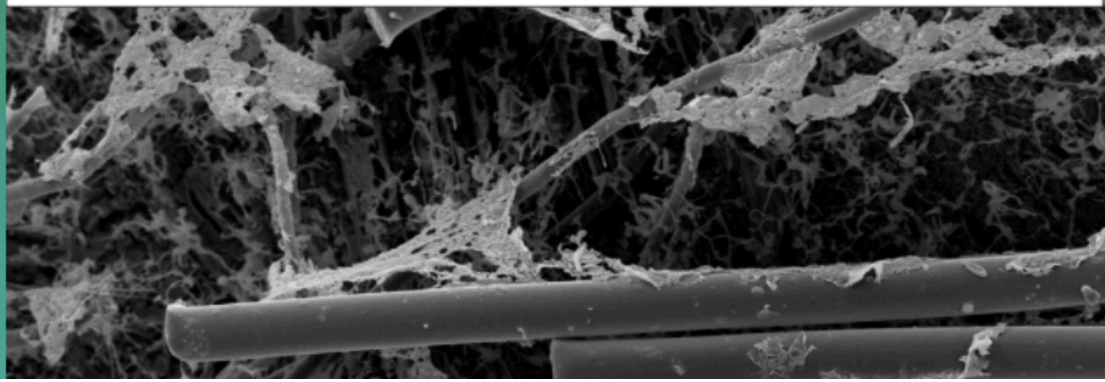
2. Understand the impact of salinity on settling velocity of "clean" and biofilmed MPs.

3. Determine how biofilm formation affects settling velocity of different MP types.

4. Combine settling velocities of MPs with flow data from the Mekong River, one of the top riverine contributers to marine plastic waste globally, to predict where MP will settle and therefore areas of ecological risk.

Fibre Biofilm SEM

100 µm



Next steps

- Conduct settling experiments with different sediment types to observe how sediment flocculation affects settling velocity of MP particles
- Re-analyse the preliminary results collected to ensure any non-MP particles are not being included
- Compare settling velocity of clean, biofilmed and flocculaed MPs to **flow data** collected from the Mekong River to determine where MPs may **fallout and form hotspots along the river-delta-**

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