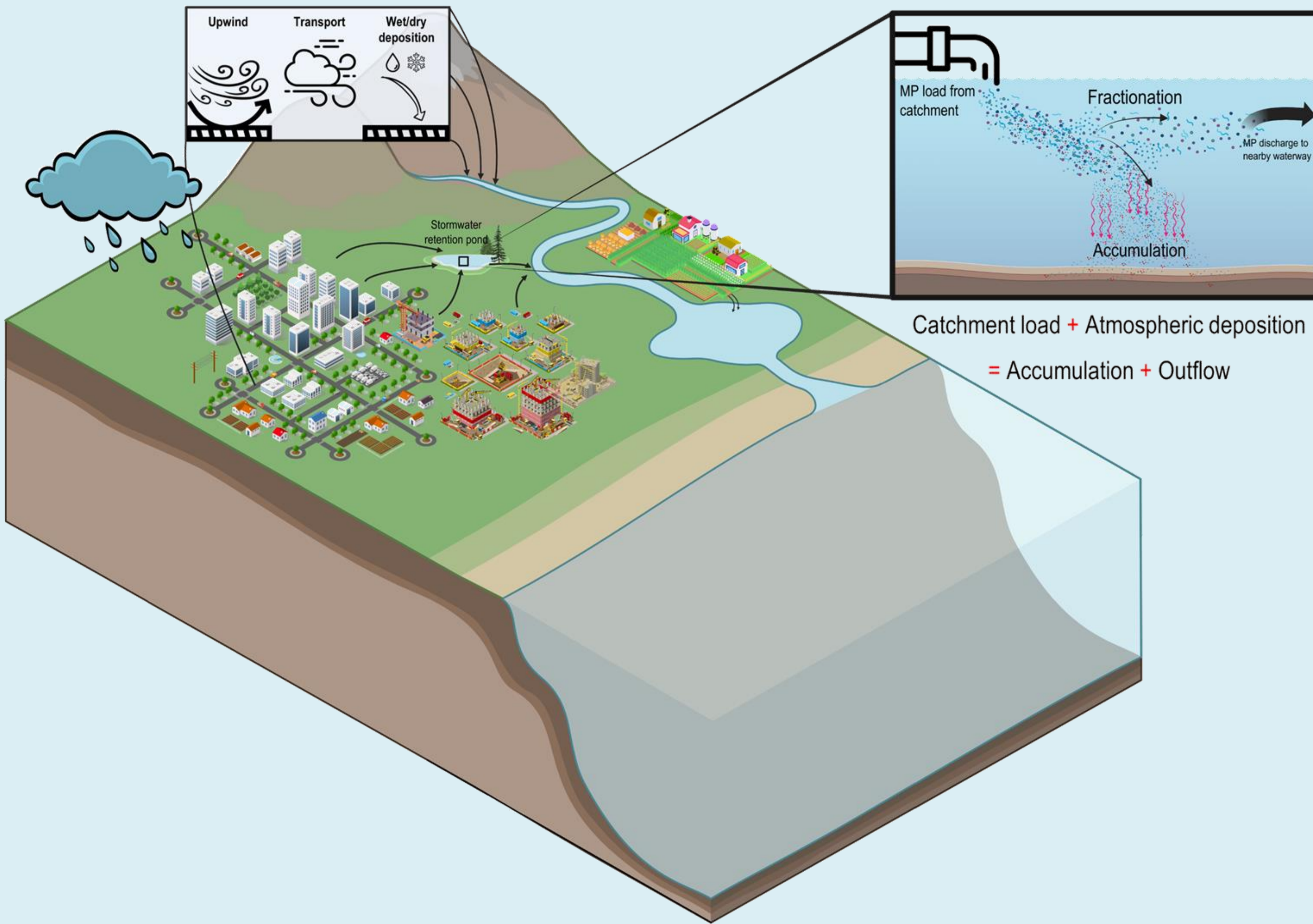# Investigating drivers of microplastic pollution in urban settings

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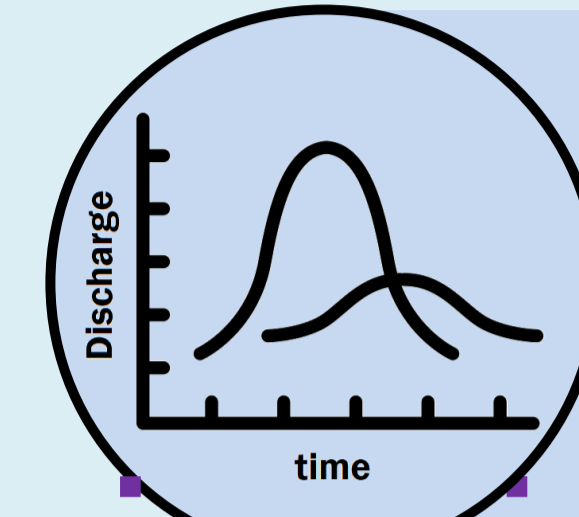
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UNIVERSITY OF WATERLOO · ecohydrology research group · Environment Canada · NSERC CRSNG · GWF · the water INSTITUTE University of Waterloo

Background

Microplastic (MP) pollution is an emerging problem in aquatic and terrestrial environments. However, catchment-level and climatic parameters affecting MP loads to receiving water bodies have not been explored across sites. This study synthesizes data from over 110 studies to identify relative impact of these parameters, with a focus on urban stormwater ponds.

Catchment load + Atmospheric deposition

= Accumulation + Outflow

Objectives

The main objectives of this study are to:

1. Investigate the relationships between urban catchment characteristics and MP concentrations and loads in urban streams and stormwater.
2. Examine how climatic factors contribute to controlling MP concentrations and loads.
3. Assess solutions to the challenges caused by the lack of data to be able to predict MP loads to our stormwater pond study sites..

MP load via atmospheric deposition

- 83% Tire abrasion
- 11% Sea spray
- 5% Soil emissions
- 0.01 / 0.40% / 1%
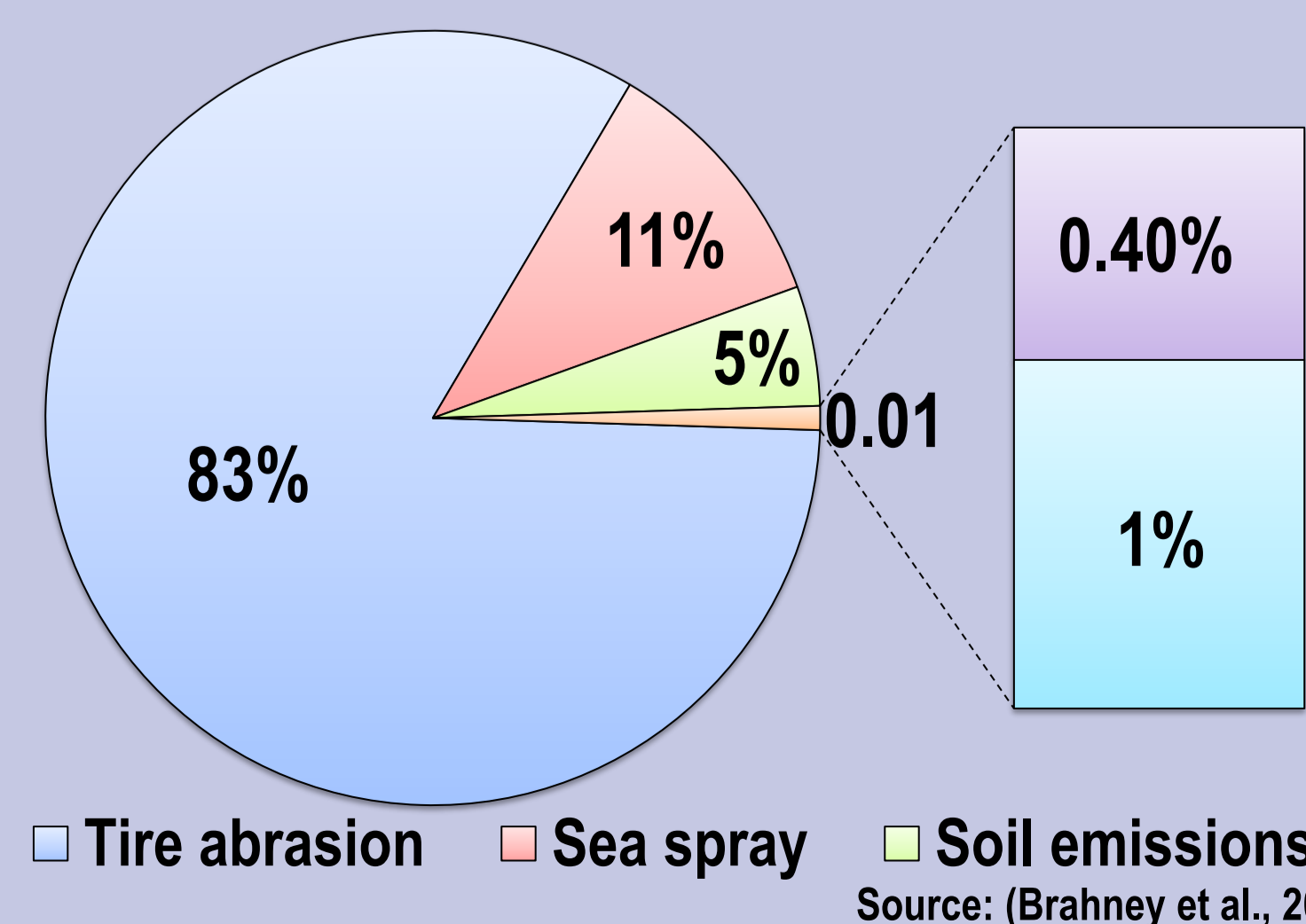
- Tire abrasion is the major source of atmospheric microplastic.
  - One of the major sources of microplastic pollution in urban areas.
- Fibers are dominant particle morphology in atmospheric deposition.

Source: (Brahney et al., 2021)

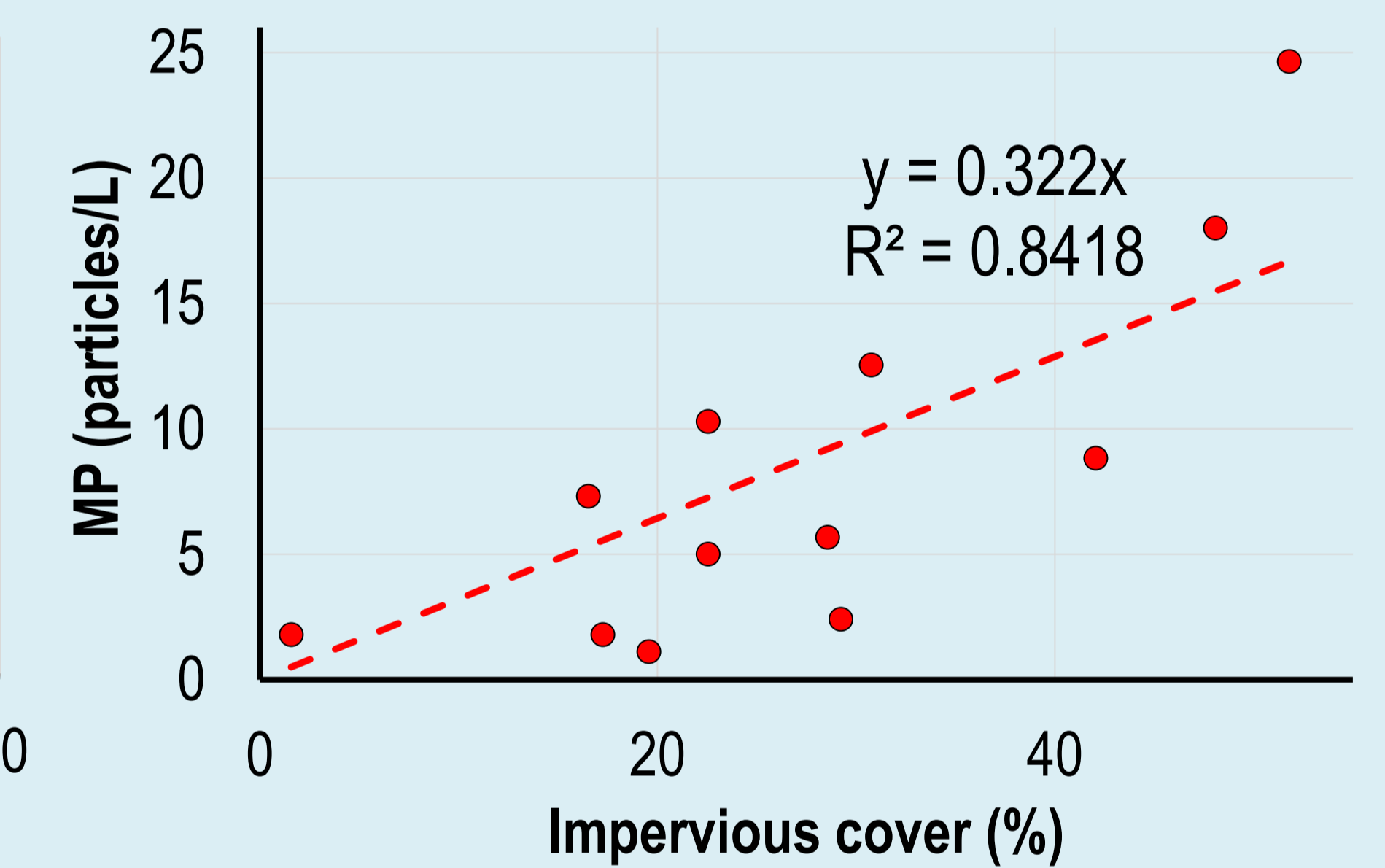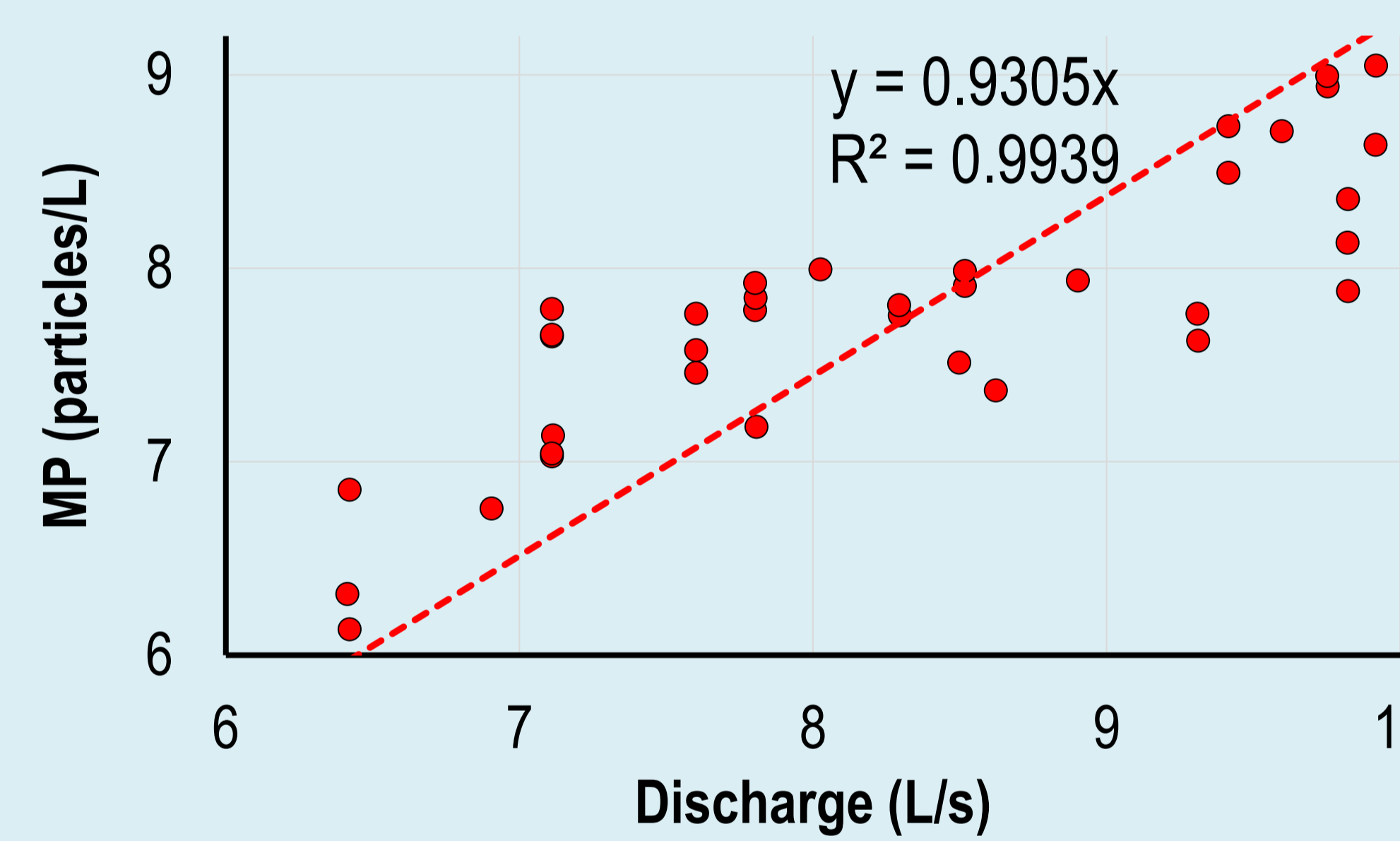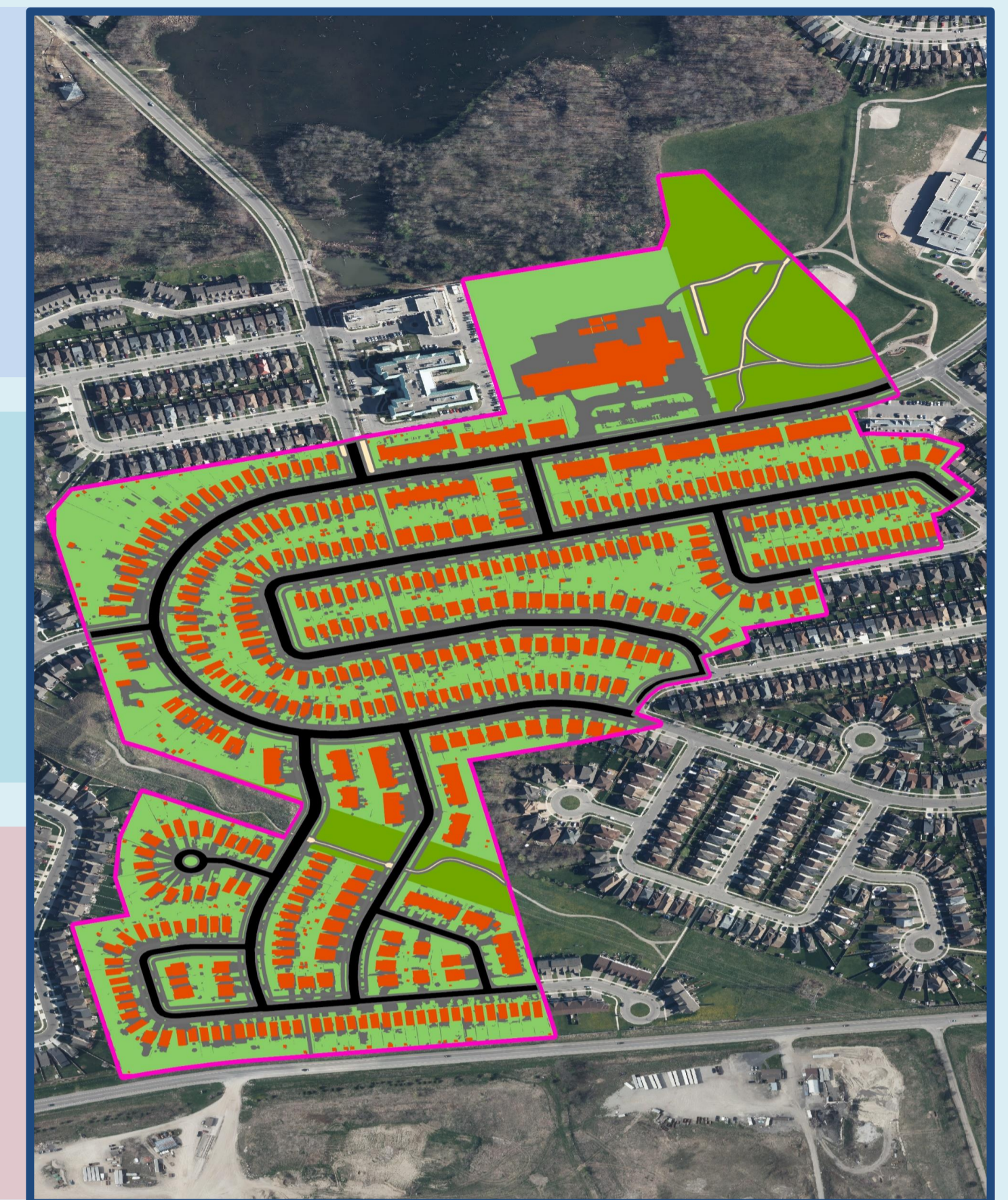## Contribution of urban areas to MP pollution

MP particles build up on urban impervious surfaces and are then washed off by precipitation and/or wind. Thus, the urban land cover fraction is an influential factor controlling MP loads from catchments.

Building predictive relationships between catchment characteristics, climatic factors and MP loads will enable us to predict MP loads to stormwater ponds as a function of catchment characteristics using a hydrology + contaminant model (EPA-SWMM).

Each hectare of urbanization = 0.1% increase in in-stream MP concentration.
MP concentrations and discharge have strong positive relationship.


$y = 0.9305x$
$R^2 = 0.9939$

MP (particles/L) vs Discharge (L/s)

$y = 0.322x$
$R^2 = 0.8418$

MP (particles/L) vs Impervious cover (%)

Total suspended solids as a proxy for MP pollution

- Total suspended solids (TSS) is a commonly measured and studied indicator of water quality.
- Due to their similar build-up/washoff characteristics, TSS and MP show a strong ($R^2 > 0.9$) linear correlation.
- In the absence of sufficient data, this linear relationship makes TSS a reliable alternative for estimating MP pollution.
- This correlation exists regardless of sample location within a water body. However, the slope of the relationship (the MP:TSS ratio) will vary as a function of catchment characteristics.

Baily et al. 2021

$y = 0.5924x$
$R^2 = 0.9634$

MP (particles/L) vs TSS (particles/L)
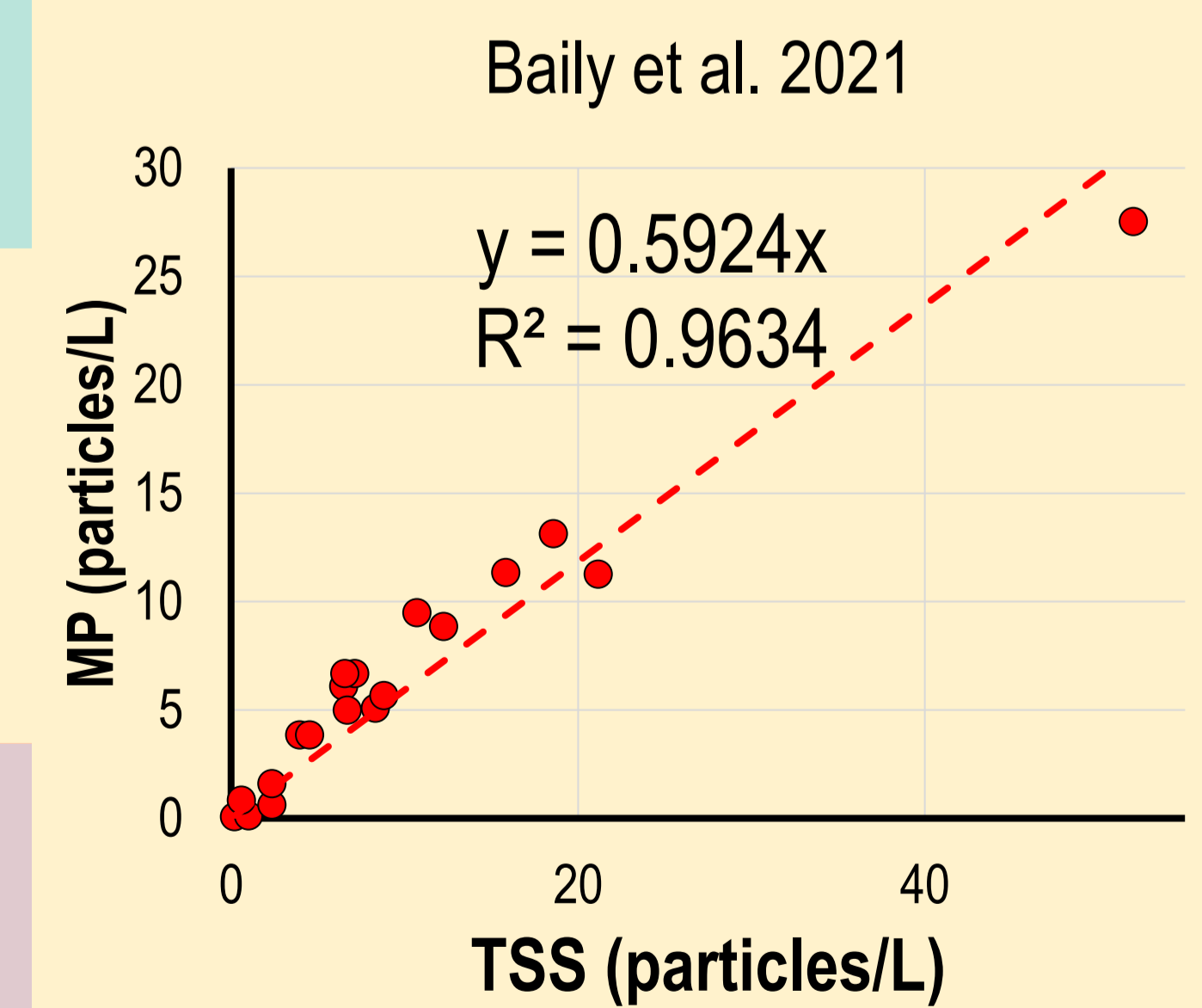
References

Brahney, J., Mahowald, N., Prank, M., Cornwell, G., Klimont, Z., Matsui, H. and Prather, K.A., 2021. Constraining the atmospheric limb of the plastic cycle. Proceedings of the National Academy of Sciences, 118(16), p.e2020719118.

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