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Final Conference of the EU INTERREG Baltic Sea Region FanpLESStic-SEA project

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What do we know about entry points, pathways and recipients of microplastics in the Baltic Sea?

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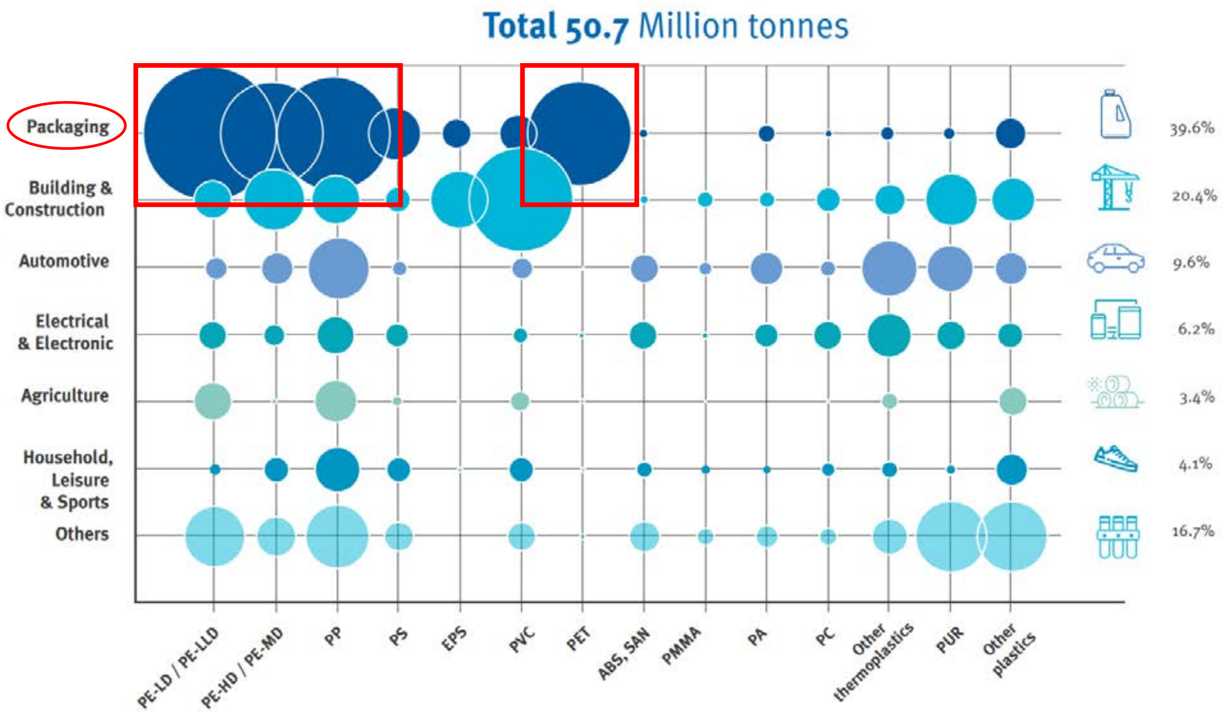
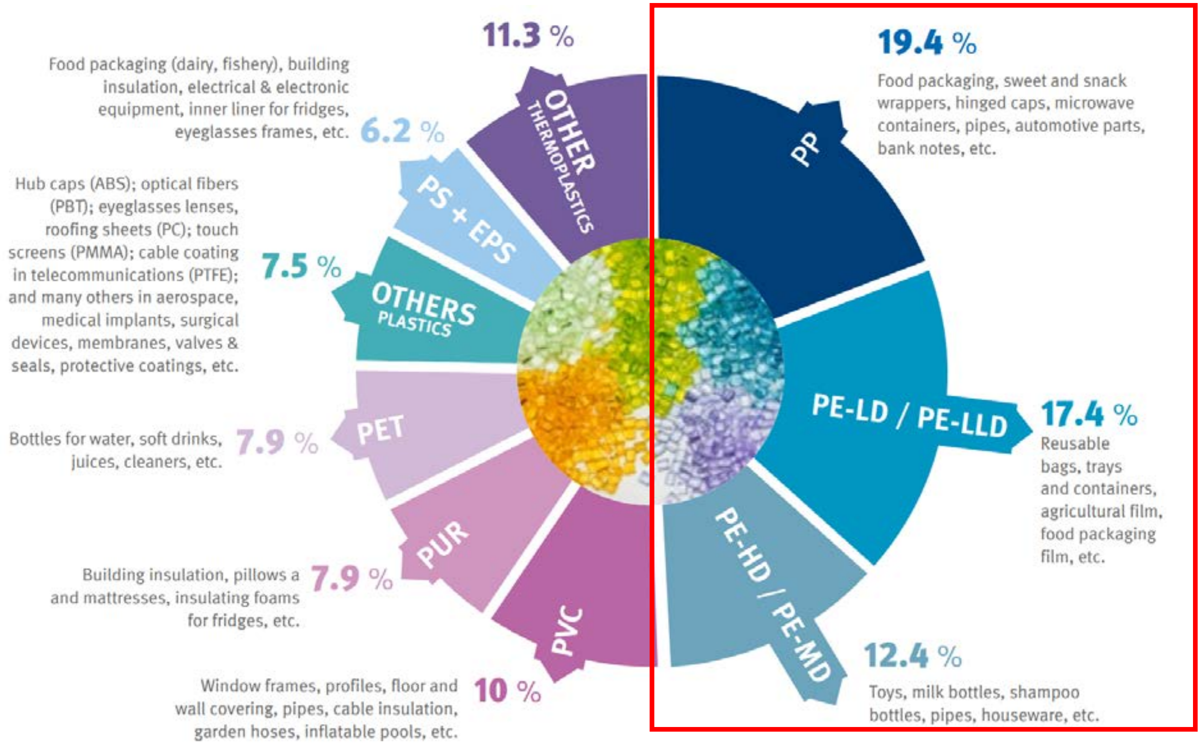
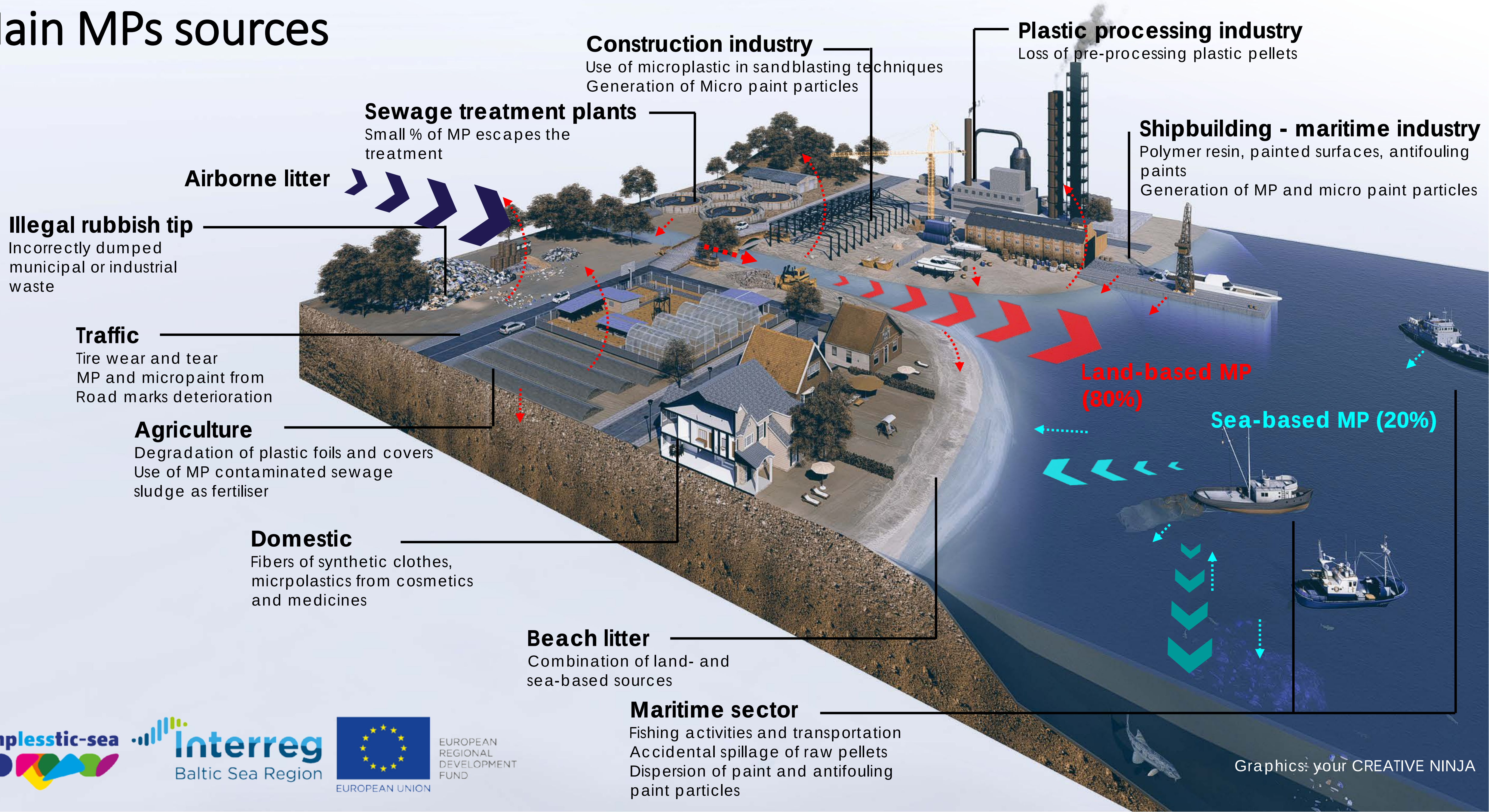
Plastic demand by segment and polymer type and its distribution (2019)





- Olefins (PP, PE) → 49.2 % of total EU polymer demand → Packaging!

Main MPs sources



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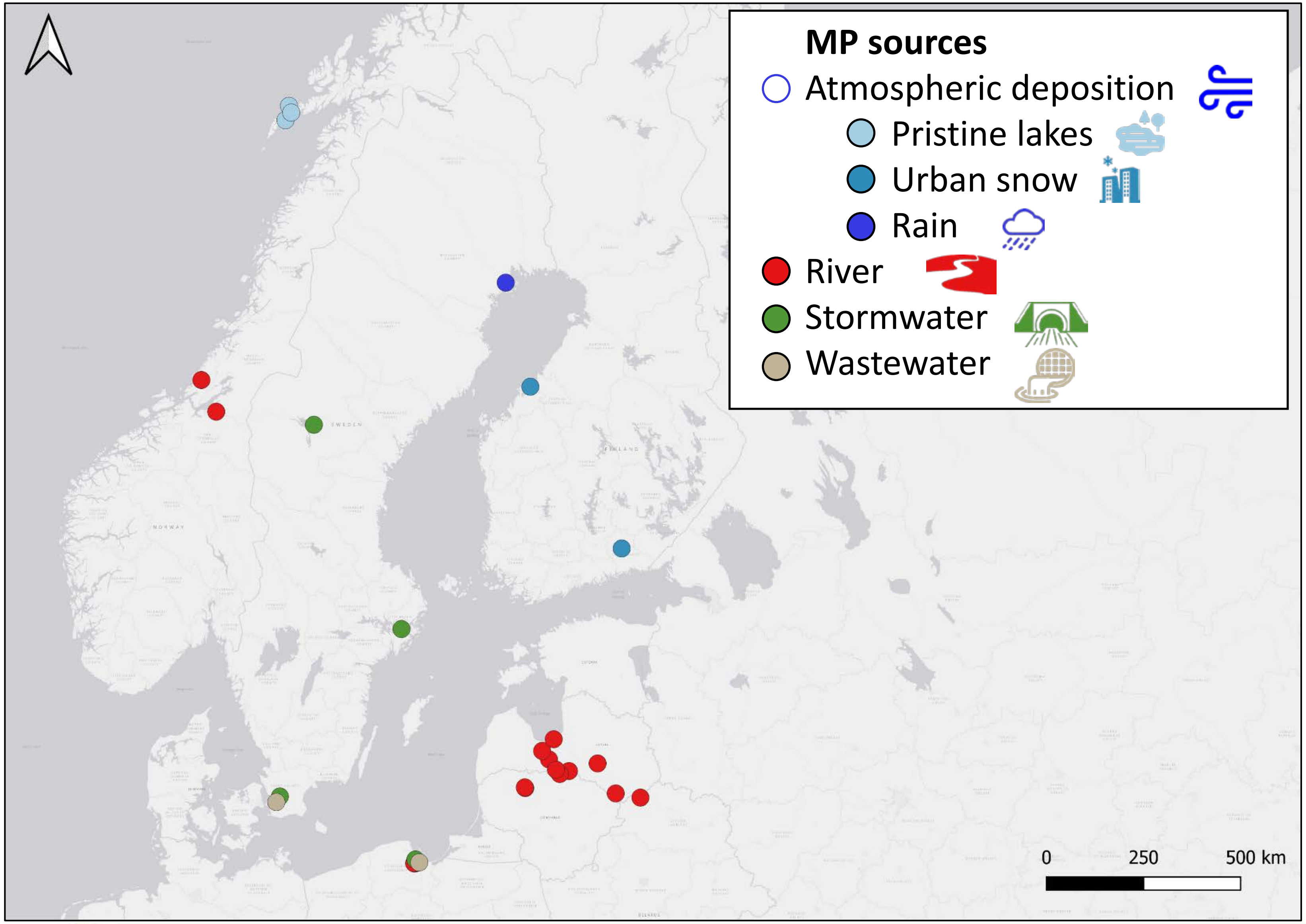
Study area

- Atmospheric deposition
  - Pristine lakes (NO) → SALT
  - Rain, rooftop (SWE) → LTU
  - Urban snow (FI) → LUKE
- Stormwater
  - Aggregated stormwater → SWR
  - Parking lot → LTU
  - Road run-off → LTU
  - Stormwater → GW
  - Stormwater pond → LTU
- Waste water
  - Raw waste water (PL) → GIWK
  - WWTP outlet (PL) → GIWK
  - WWTP outlet (SWE) → SWR
  - WWTP outlet (LT)→ SCICC
- Rivers
  - Agricultural (LV) → LIAE
  - Industrial (LV) → LIAE
  - Urban (PL) → GW
  - Close to WWTP outlet (LT) → SCICC
  - Close to artificial turfs (NO) → SALT



Atmospheric deposition

Sources

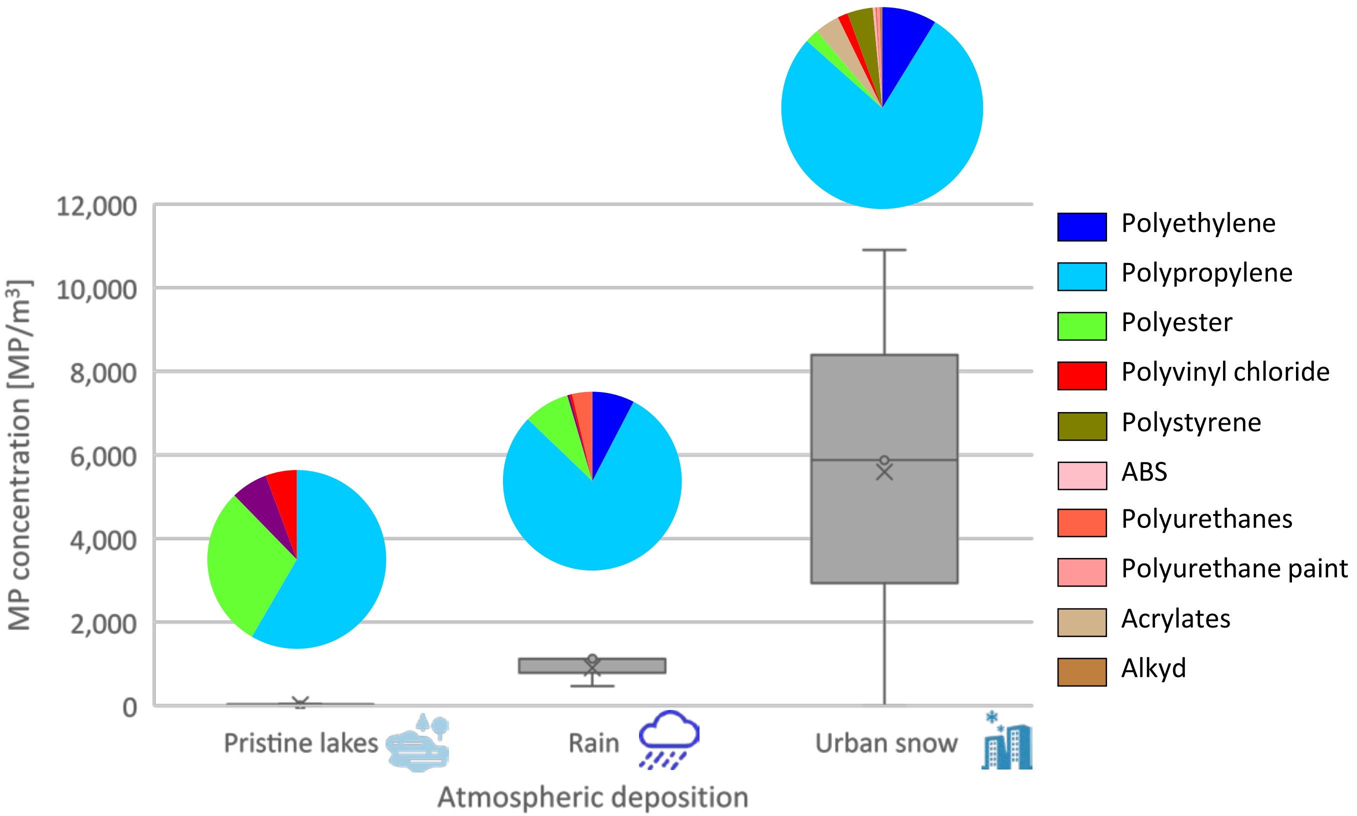
Pristine lakes, Lofoten (NO) → SALT (n = 6)
Rain, rooftop, Luleå (SWE) → LTU (n = 3)
Urban snow, Kokkola/Kouvola (FI) → LUKE (n = 3)

Conclusions

- MP background concentrations (pristine lakes) are low (0–45 MP/m^3)
- Av. MP concentrations in collected rain water ($9x10^2$ MP/m^3) one order of magnitude lower than in urban snow ($6x10^3$ MP/m^3)
- Bergmann et al. 2019 reported higher concentrations for European snow (up to $154x10^3$ MP/L)
- Atmospheric deposition with low polymer diversity (n=10) dominated by polypropylene (PP) followed by polyester and polyethylene (PE)

Bergmann et al. 2019, DOI: 10.1126/sciadv.aax1157

MP concentration and polymer composition



Stormwater

Sources

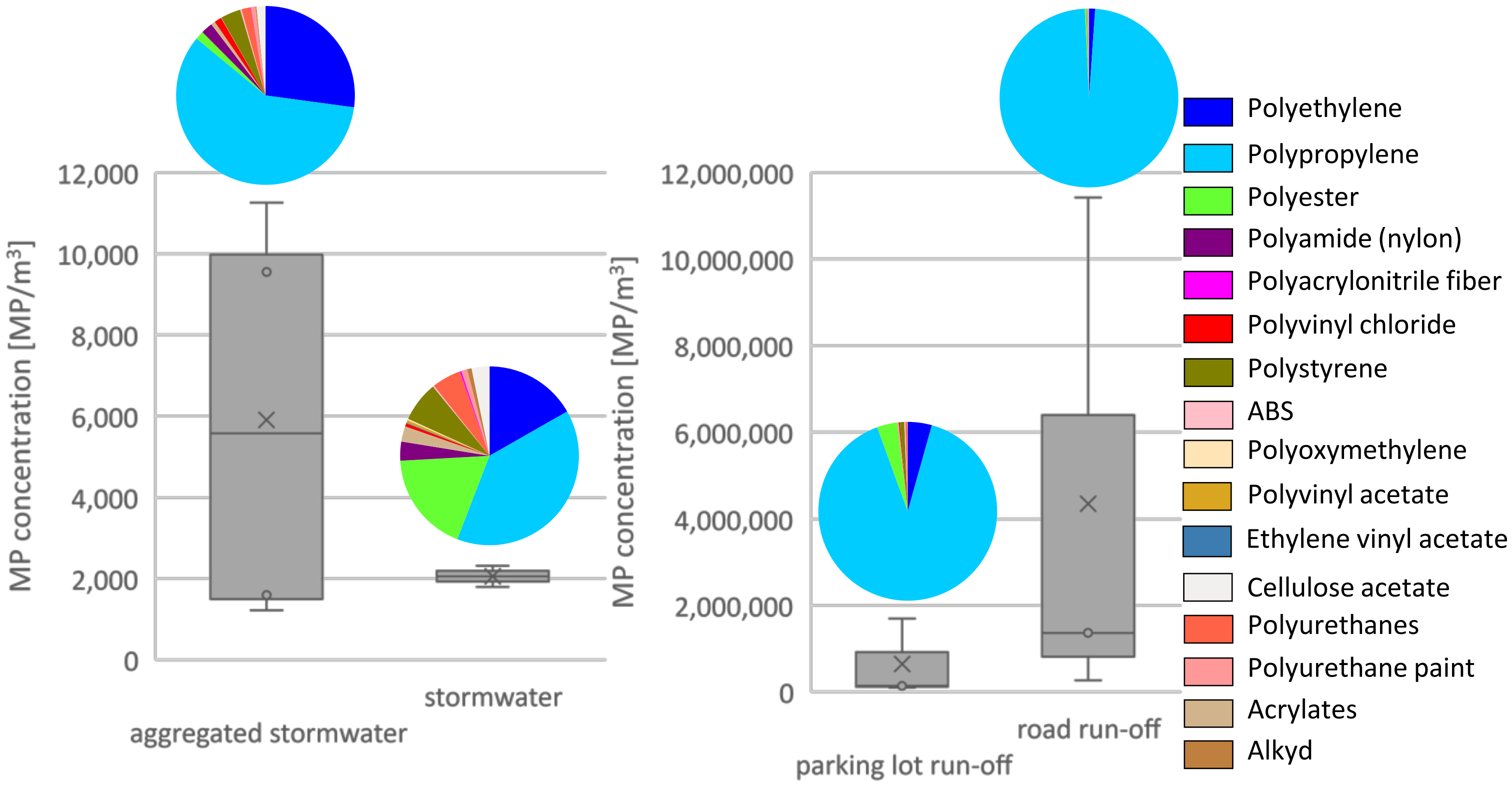
Aggregated stormwater, Eslöv (SWE) → SWR (n = 4)
Parking lot run-off, Luleå (SWE) → LTU (n = 3)
Road run-off, Luleå (SWE) → LTU (n = 3)
Stormwater, Gdansk (PL) → GW (n = 2)

Conclusions

- Av. MP concentrations in aggregated stormwater ($2x10^3$–$6x10^3$ MP/m^3) several orders of magnitude lower than directly from parking lot ($6x10^5$ MP/m^3) and road run-off ($4x10^6$ MP/m^3)
- Liu et al. 2019 reported concentrations in a similar range for stormwater ponds ($5x10^2$–$2x10^4$ MP/m^3)
- Stormwater with high polymer diversity (n=16) clearly dominated by PP followed by PE and polyester

Liu et al. 2019, DOI: 10.1016/j.scitotenv.2019.03.416

MP concentration and polymer composition



Waste water

Sources

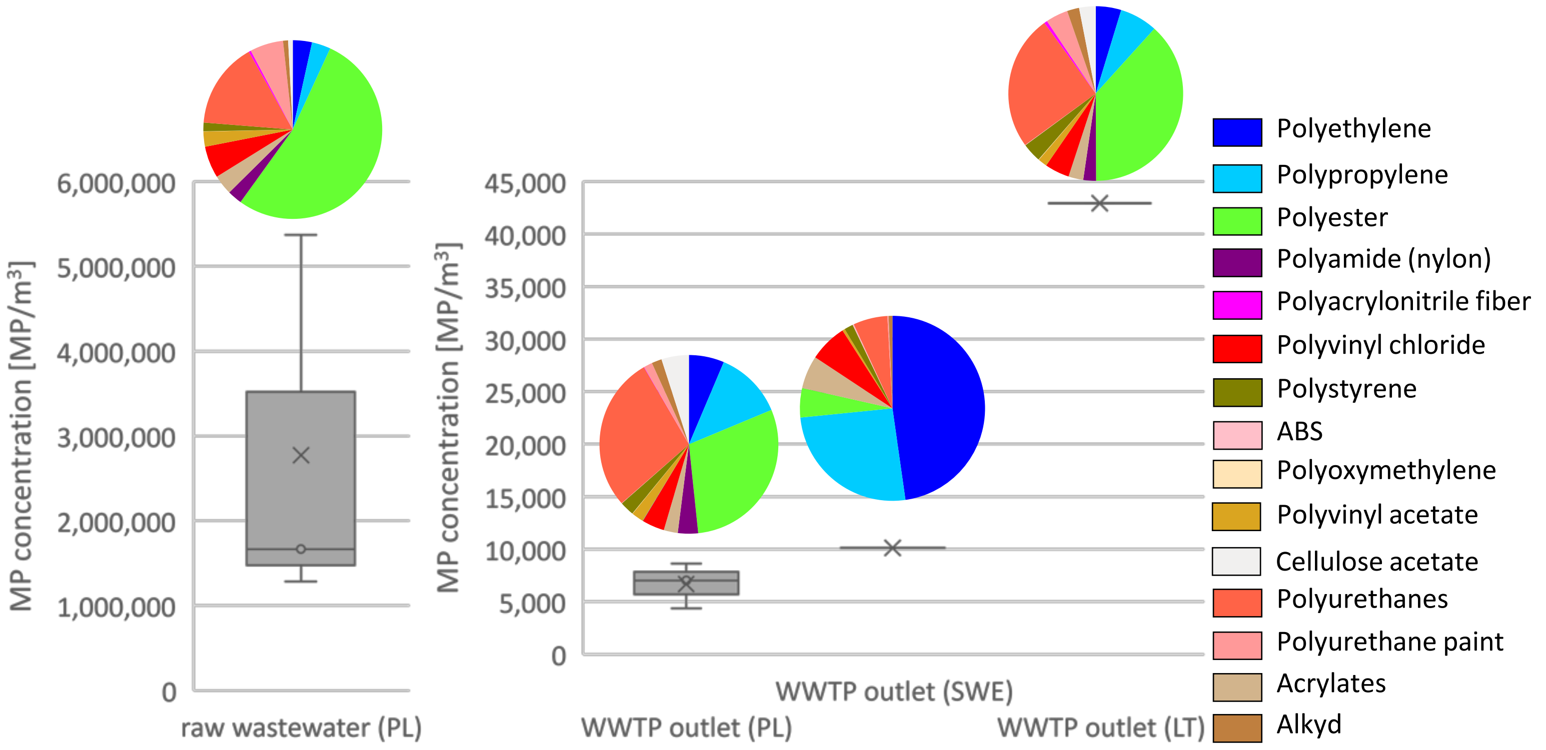
Raw waste water (PL) → GIWK (n = 3)
WWTP outlet (PL) → GIWK (n = 3)
WWTP outlet (SWE) → SWR (n = 1)
WWTP outlet (LT)→ SCICC (n = 1)

Conclusions

- Av. MP concentrations raw waste water ($3x10^6$ MP/m^3) several orders of magnitude higher than in treated waste water ($7x10^3$–$4x10^4$ MP/m^3)
- Simon et al. 2018 reported concentrations in a similar range for raw ($7x10^6$ MP/m^3) and treated waste water ($5x10^4$ MP/m^3)
- Raw and treated waste water with high polymer diversity (n=15) mostly dominated by polyester with high proportions of PE and polyurethanes

Simon et al. 2018, DOI: 10.1016/j.watres.2018.05.019

MP concentration and polymer composition



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Rivers

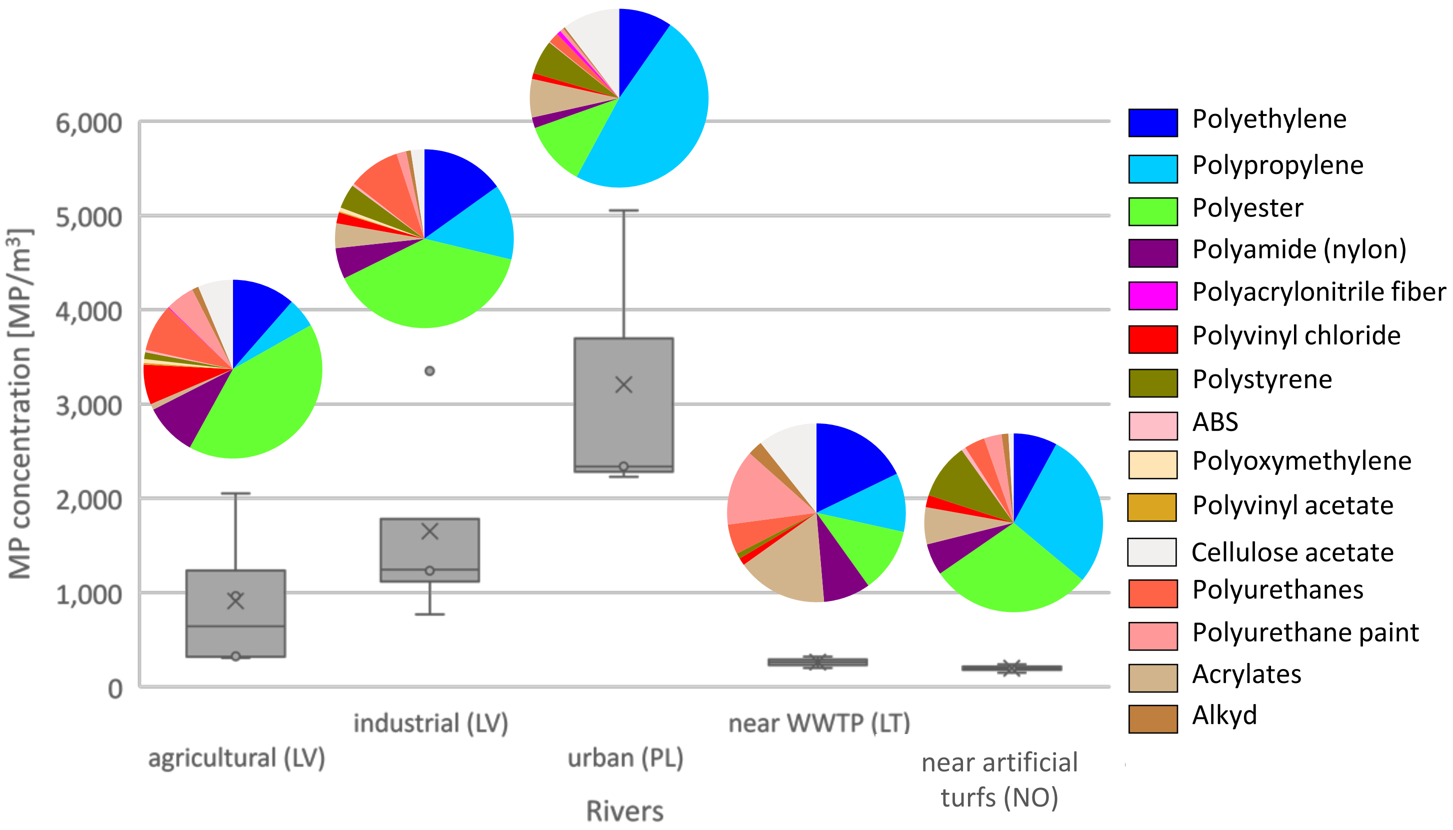
Sources

River, agricultural (LV) → LIAE (n = 4)
River, industrial (LV) → LIAE (n = 4)
River, urban (PL) → GW (n = 3)
River, close to WWTP (LT) → SCICC (n = 2)
River, close to artificial turfs (NO) → SALT (n = 4)

Conclusions

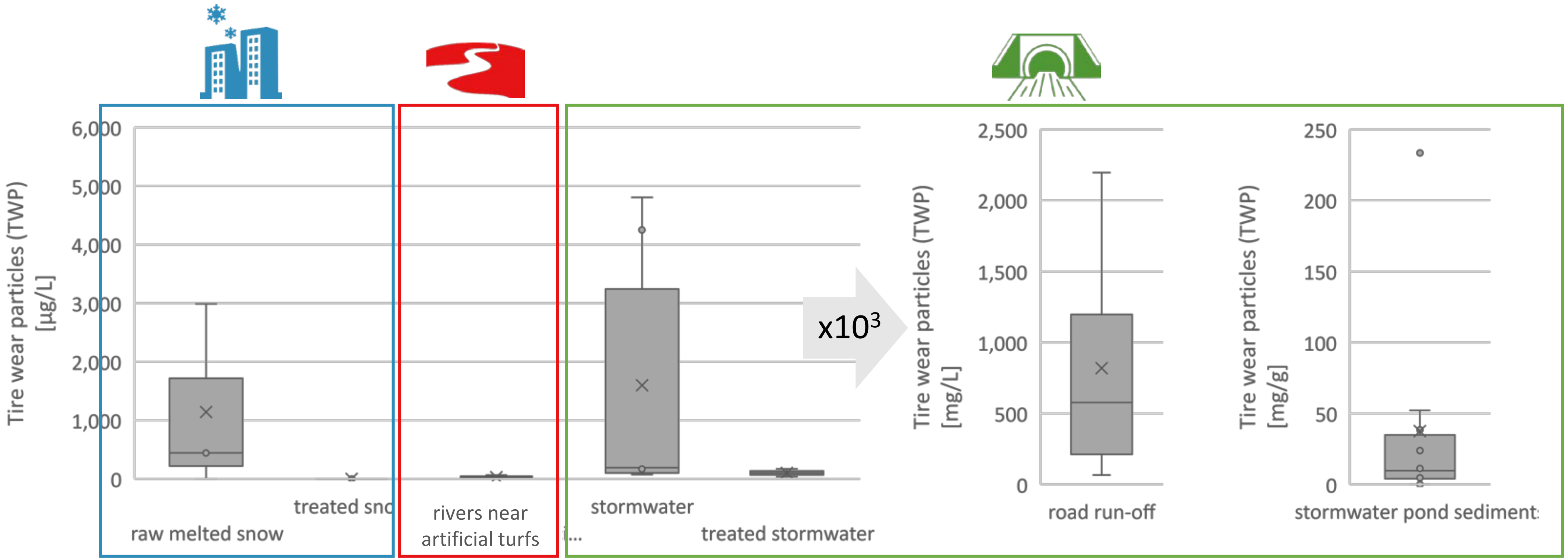
- Av. MP concentrations in several rivers between $2x10^2–3x10^3$ MP/m³ and slightly higher in industrial and urban than rural areas
- Mintenig et al. 2020 and Roscher et al. 2021 reported concentrations in a similar range for rivers discharging into the North Sea ($2x10^1–1x10^4$ MP/m³)
- Polymer diversity was high (n=15) and mostly dominated by polyester and PP with considerable proportions of PE, polyurethanes, polyamides and cellulose acetate (CA)

MP concentration and polymer composition



Mintenig et al. 2020, DOI: 10.1016/j.watres.2020.115723
Roscher et al. 2021, DOI: 10.1016/j.envpol.2021.117681

Car tire contribution in urban environments



Conclusions

- Average concentrations of tire wear particles (TWPs) low in treated snow, rivers close to artificial turfs and treated stormwater (0.0−102.6 µg/L) and medium high in collected urban snow (1.1×10^3 µg/L) and stormwater (1.6×10^3 µg/L)
- Av. TWP concentrations in road run-off samples (8.2×10^5 µg/L) significantly higher than in collected stormwater
- Accumulated TWP concentration in stormwater ponds ranged from 0.0 to 2.3×10^5 µg/g (Average: 3.8×10^4 µg/g)
- Unice et al. 2013 reported TWP concentrations in a similar range for various urban river sediments (26−1.2×10^4 µg/g)

Unice et al. 2013, DOI: 10.1021/es400871j

General conclusions

- Samples related to **atmospheric deposition** showed **low microplastics (MP) concentrations** with only a few different polymer types for pristine lakes and rain and were slightly **higher and more diverse for urban snow**
- Samples related to **stormwater** were clearly dominated by **polypropylene (PP)** and were **highest in road-related run-off** (10^5−10^6 MP/m^3)
- Samples related to the **outlet of WWTPs** showed a **significantly lower MP concentration** (10^3−10^4 MP/m^3) **than in raw waste water** (10^6 MP/m^3) and were generally dominated by **polyester**
- MP concentrations of several rivers discharging into the Baltic Sea similar to some rivers that discharge into the North Sea
- Samples related to **rivers** contained a high diversity of polymer types (n=15) and among these usually **cellulose acetate (CA)**
- Overall, **polypropylene (PP), polyester and polyethylene (PE)**, which are used mainly for packaging, were the dominant polymer types in most of the samples
- Average concentrations of **tire wear particles (TWPs)** were medium high in untreated snow and stormwater and approx. 1000 times higher in road-related run-off (10^5 µg/L)

Thank you!

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