Plastic export from rivers into the oceans
Technologies for Observing and Monitoring Plastics in the Oceans
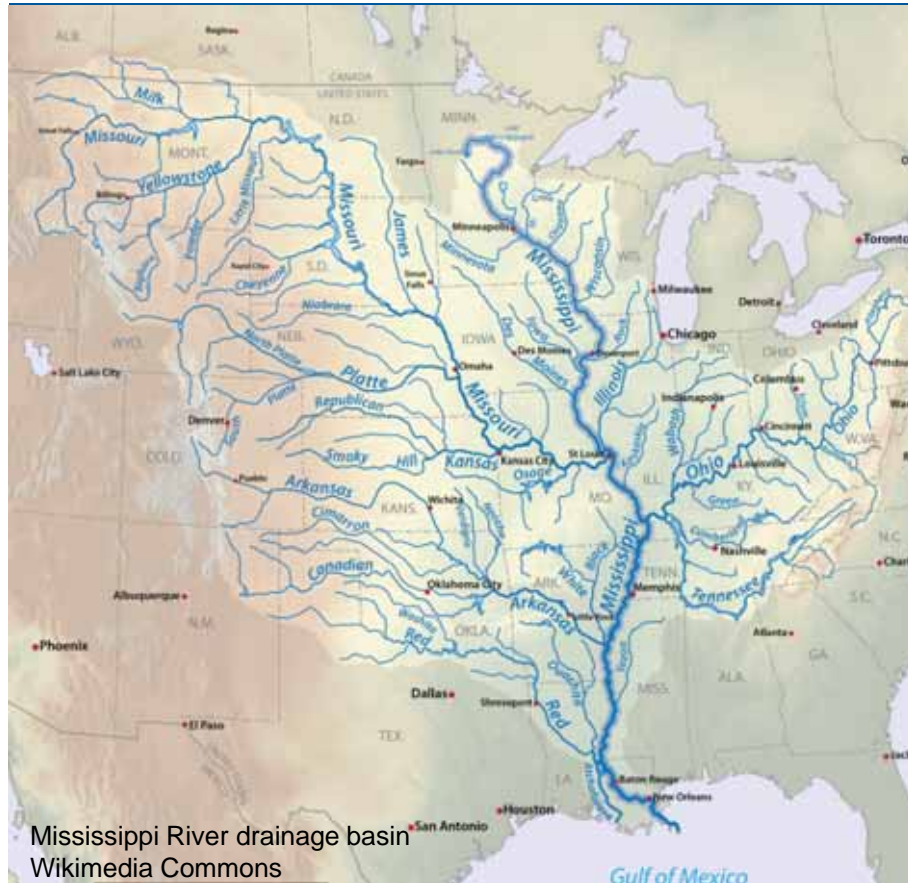Nov. 26th 2018

Christian Schmidt

Rivers connect land and ocean

Mississippi River drainage basin
Wikimedia Commons

Rivers are major transport pathways from land to ocean

- Connect the majority of land surface with the ocean
- Naturally transport large amounts of sediments and solutes into the oceans.

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Rivers connect land and ocean

Mississippi River drainage basin
Wikimedia Commons

- Suspended sediment load: 13.5 x 10^9 tons pear year (95% of total sediment inputs)[1]

- Organic carbon load: 430 million tons C per year[2]

- Additional anthropogenic net N-input on land ~ 200 million tons per year→ 25% are exported into the oceans by rivers[3]

[1]Milliman and Meade 1983
[2]Schlünz and Schneider 2000
[3]Gruber and Galloway 2008

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Rivers connect land and ocean

Midwestern farmers are tied to a Gulf dead zone

By Annie Baxter

ons pear year

per year

land ~ 200

ed into the

https://www.marketplace.org/2017/10/09/sustainability/midwestern-farmers-are-tied-gulf-dead-zone

Mississippi River dr
Wikimedia Commons

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Rivers as a source for marine litter

Legend
- Microplastic
- Micro+ Macroplastic
- Total Plastic
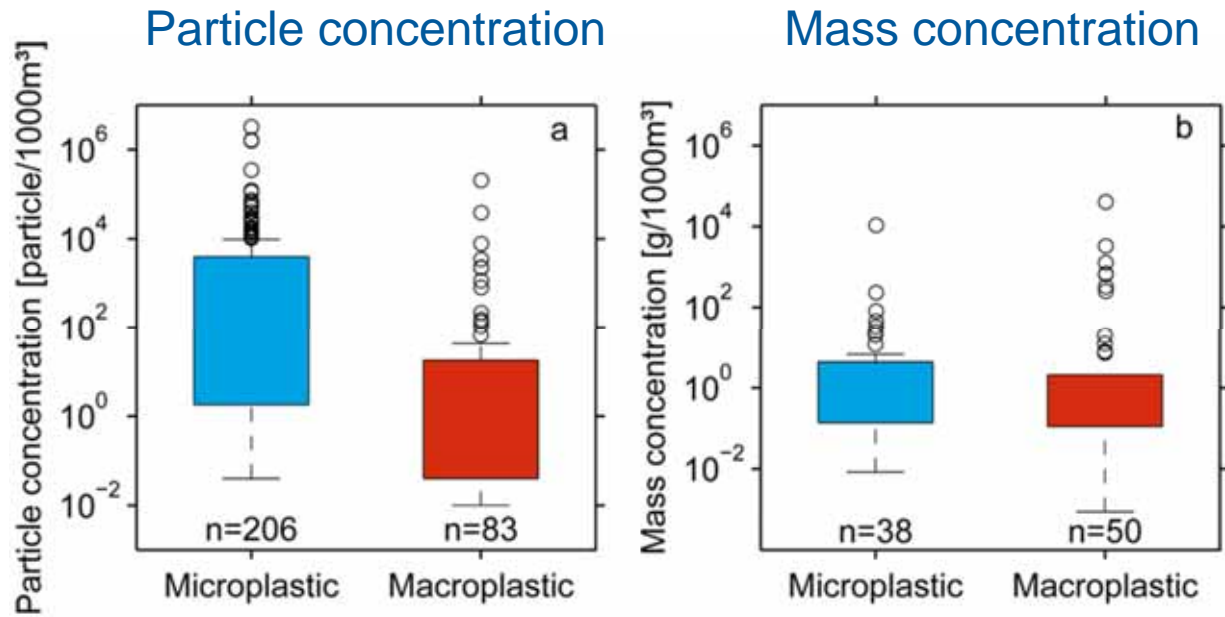
Database:
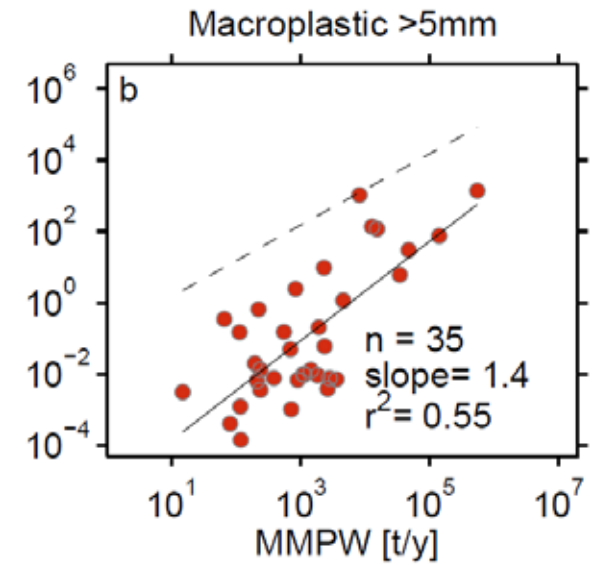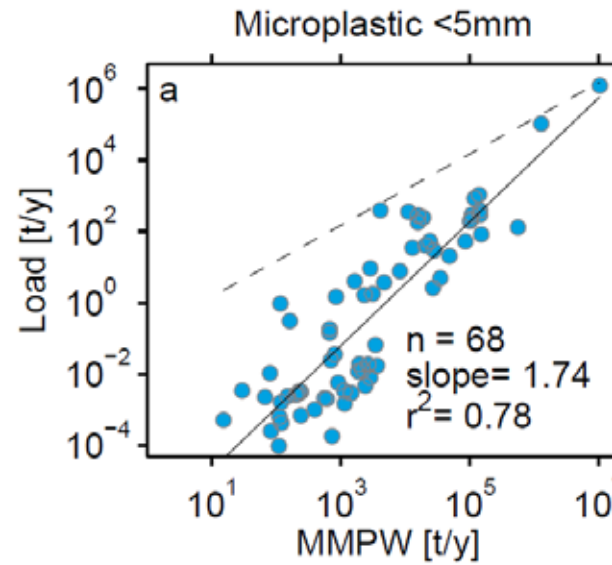79 sampling sites
57 rivers

Rivers as a source for marine litter
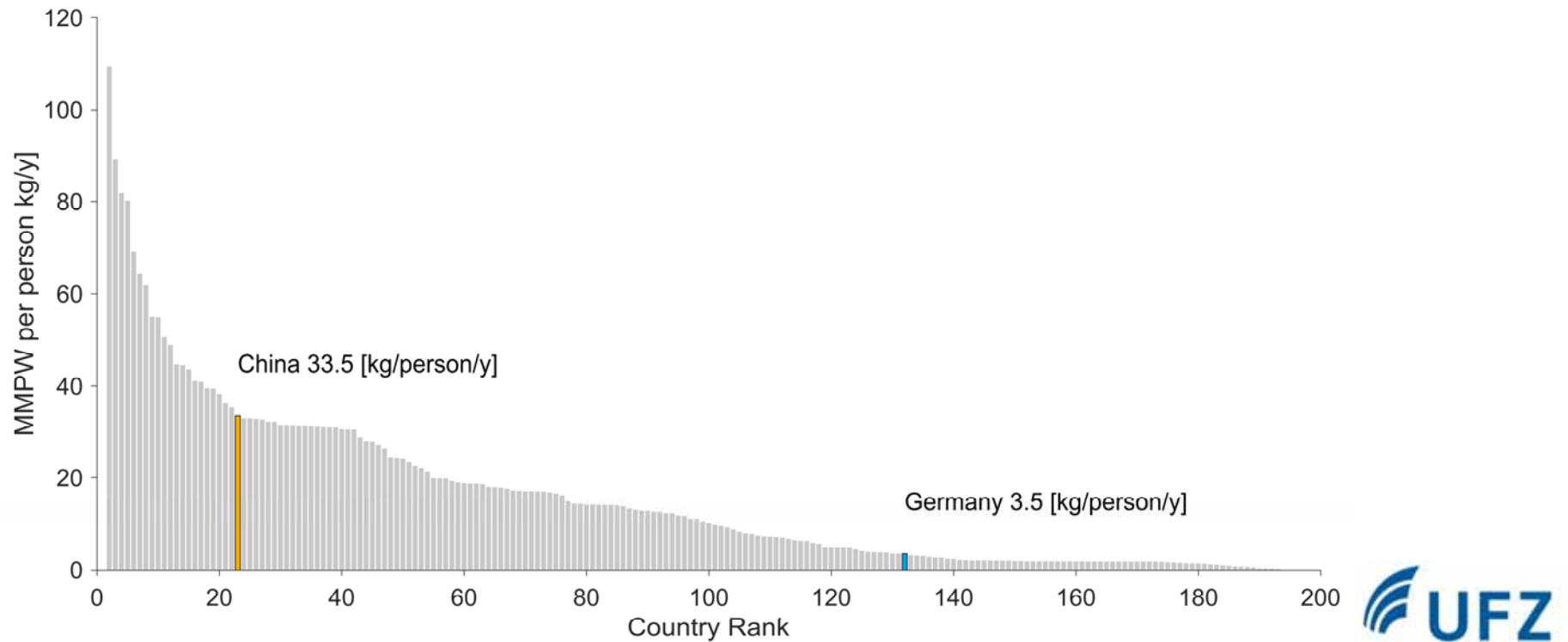
Rivers as a source for marine litter

Mississippi River drainage basin
Wikimedia Commons

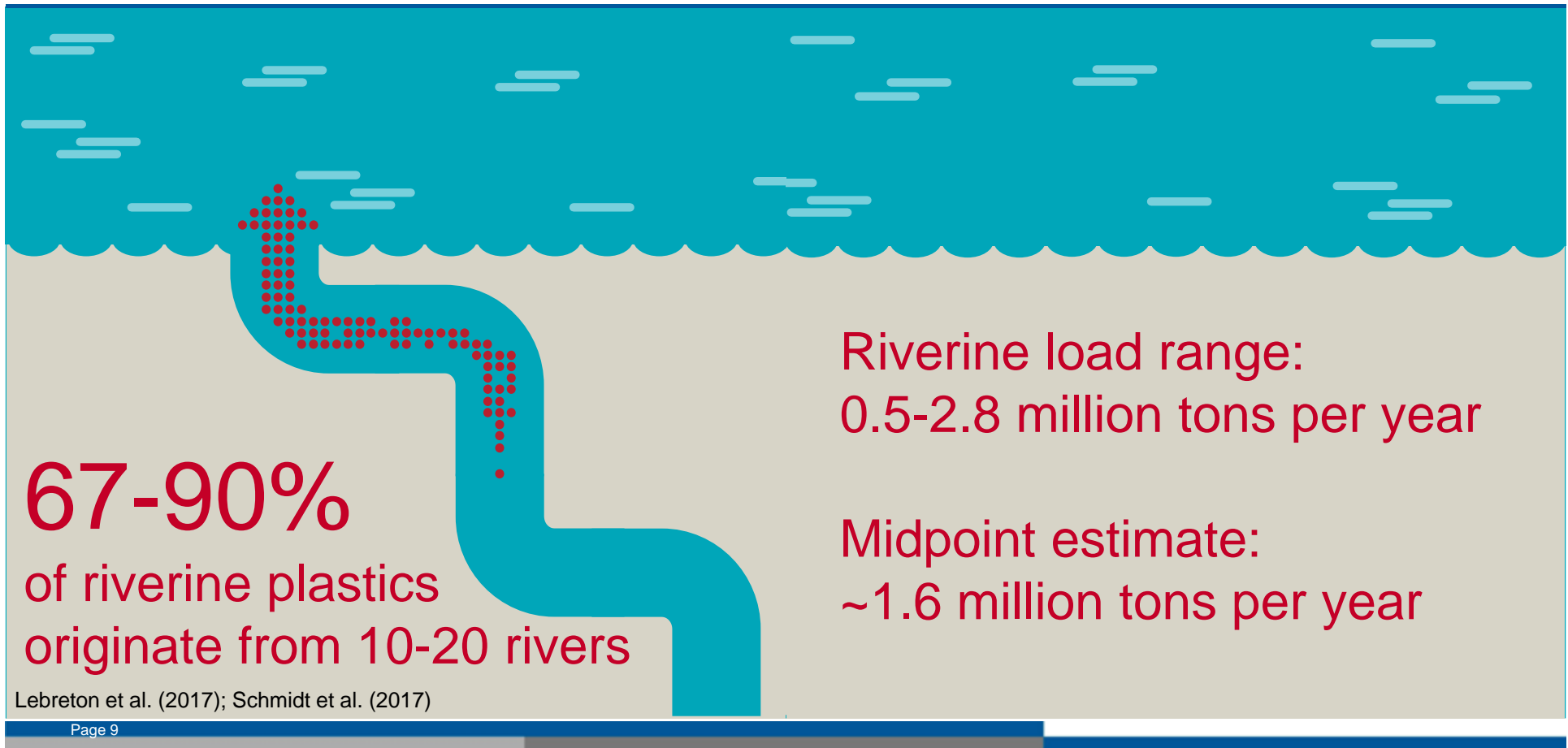MMPW data from Jambeck et al. 2015

Microplastic <5mm
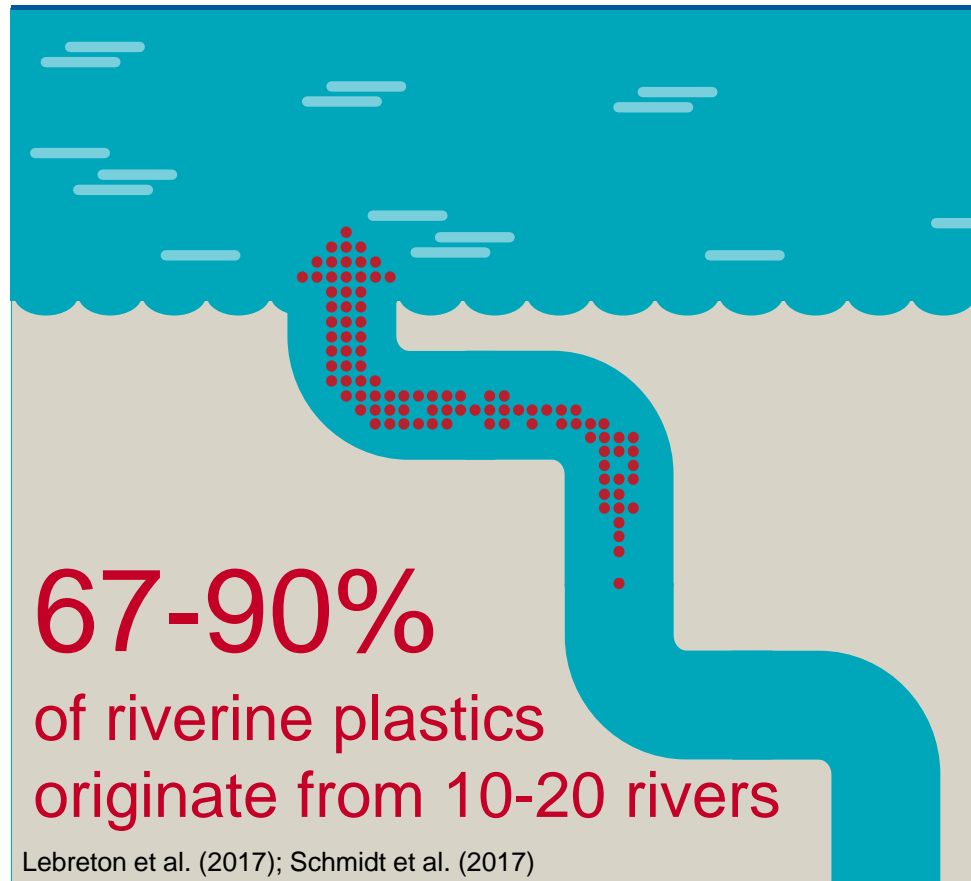
n = 68
slope= 1.74
$r^2 = 0.78$

Macroplastic >5mm

n = 35
slope= 1.4
$r^2 = 0.55$

Load [t/y]

MMPW [t/y]

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Mismanaged Plastic Waste

Mismanaged Plastic Waste (Jambeck et al. 2015)

Rivers as a source for marine litter

67-90%
of riverine plastics
originate from 10-20 rivers

Lebreton et al. (2017); Schmidt et al. (2017)

Riverine load range:
0.5-2.8 million tons per year

Midpoint estimate:
~1.6 million tons per year

Rivers as a source for marine litter

67-90%

of riverine plastics
originate from 10-20 rivers

Lebreton et al. (2017); Schmidt et al. (2017)

Which rivers transport high plastic loads?

- Large population in the river basin
- High fraction of mismanaged plastic wastes
- Large rivers transport plastic more efficiently than smaller rivers
- Preferential occurrence of settlements at large rivers

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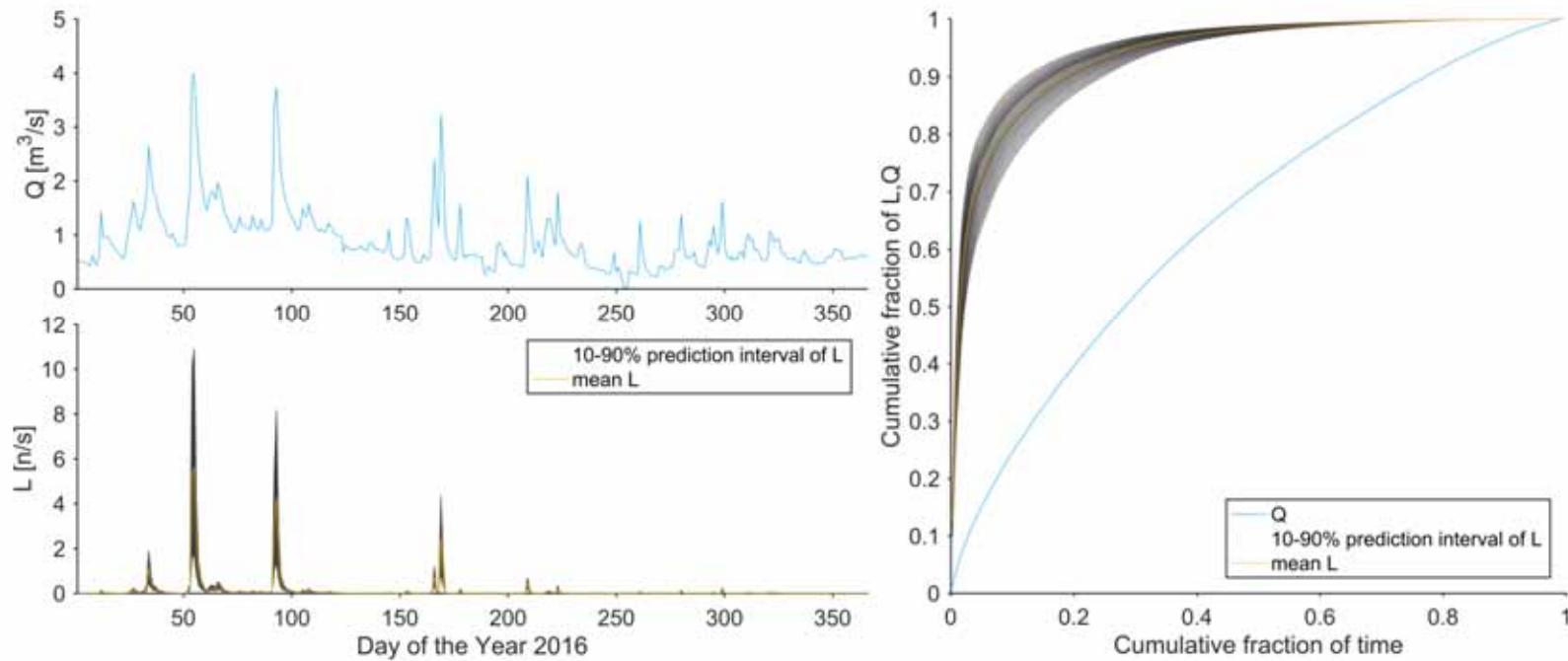# Flow variability influences plastic transport

Flow variability influences plastic transport
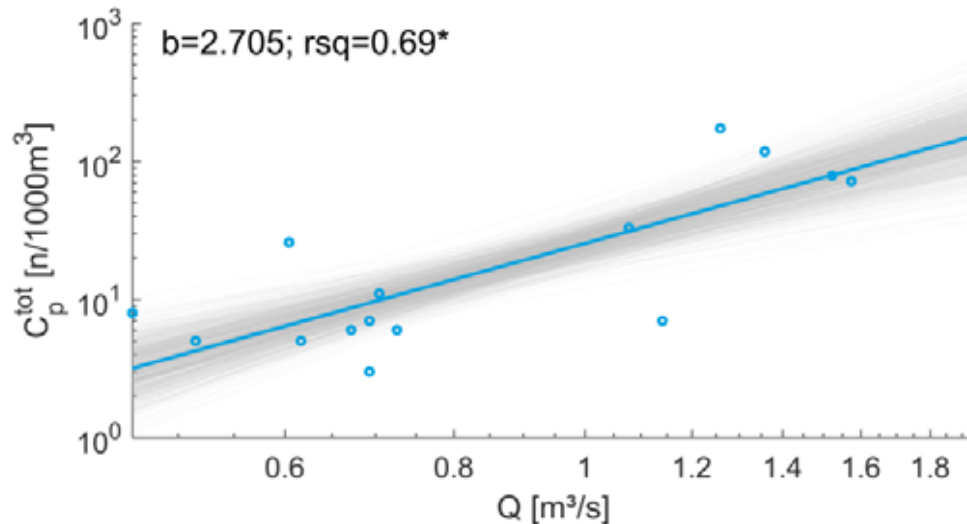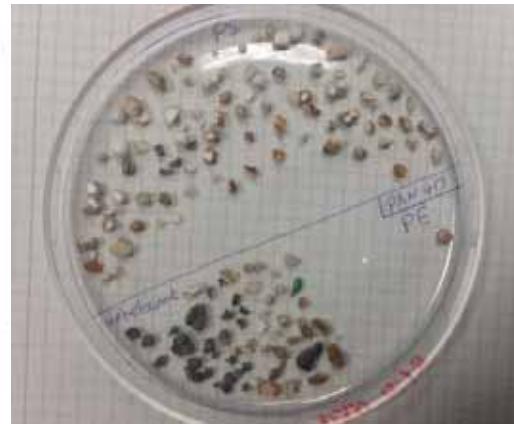

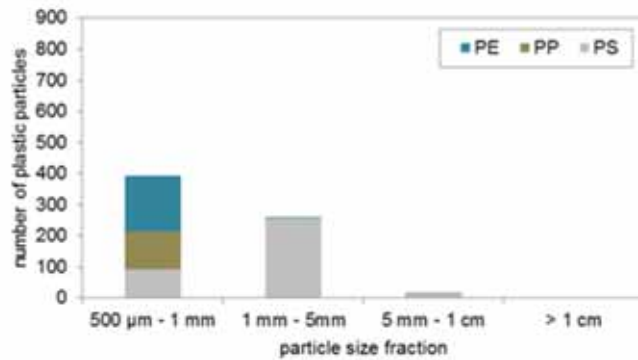## Dynamic connectivity and mobilization

- Concentrations increase with increasing discharge
- Concurrent mobilization of other particulate matter

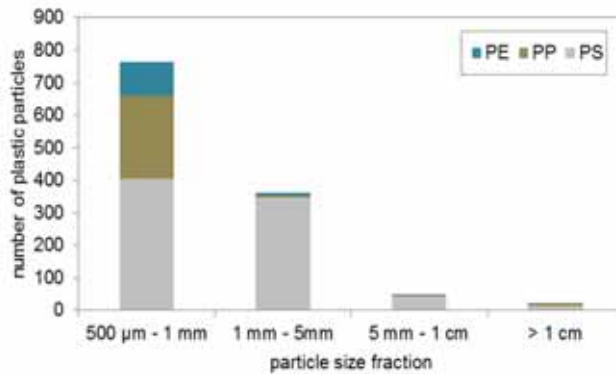# Flow variability influences plastic transport

Wagner et al. in review

Rivers are sentinels for plastic sources

Construction material

Sewer emissions

Methods and technologies for plastic in rivers

- No harmonized sampling and analysis protocol (yet)→ limited comparability between data

- Cameras for observing larger floating objects

- Drifters to monitor transport and travel times

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Intervention technologies

- Collection of (plastic) debris from rivers

- Cost-benefit?

- Opportunity for collecting data

- Opportunity for public awareness and participation

https://www.baltimorewaterfront.com/healthy-harbor/water-wheel/

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Intervention technologies?!?!

https://www.baltimorewaterfront.com/healthy-harbor/water-wheel/

Summary

- Plastic debris comprises only a small fraction of the total particulate material load in rivers

- Discharge and even more loads are highly variable in time. High loads and concentrations occur at high flow

- Highest export from large rivers in Asia and Africa → reducing export here would be highly effective

- Monitoring plastics in rivers still in its infancy

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Thank You for your attention

Rivers as a source for marine litter

Global rank	Top-10 rivers	Global rank	Other major rivers
1	Chang Jiang (Yangtze River)	20	Danube
2	Indus	50	Mississippi
3	Huang He (Yellow River)	53	Rhine
4	Hai He	90	St. Lawrence
5	Nile		
6	Meghna, Bramaputra, Ganges		
7	Zhujiang (Pearl River)		
8	Amur		
9	Niger		
10	Mekong		