

Methods for measuring plastic transport in large rivers and downstream of hydropower plants

Liedermann, M.^{1,2},
Gmeiner, P.¹, Pessenlehner, S.¹, Habersack, H.¹

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¹ Institute of Hydraulic Engineering and River Research (IWA)
Department of Water, Atmosphere and Environment

University of Natural Resources and Life Sciences, Vienna, Austria

² Christian Doppler Laboratory for Sediment Research and Management

Email: marcel.liedermann@boku.ac.at; Phone: +43 1 47654-81914

Outline

1. Introduction
2. Sampling methods
3. New device for sampling plastic
4. First results for the Danube
5. Research question at HPP
6. Conclusions



Introduction

- 40 kg of plastics are produced for each human being every year (PlasticsEurope, 2018)
- 80% of marine plastic origins from land-based sources (Umweltbundesamt, 2015)
- Rivers are mayor transport pathways; the 10 top-ranked rivers transport 88–95% of the global load to the sea: Jangtse, Indus, Yellow River (Schmidt et al., 2017)
- The majority of research to date focuses on the marine environment (Horton et al., 2017)



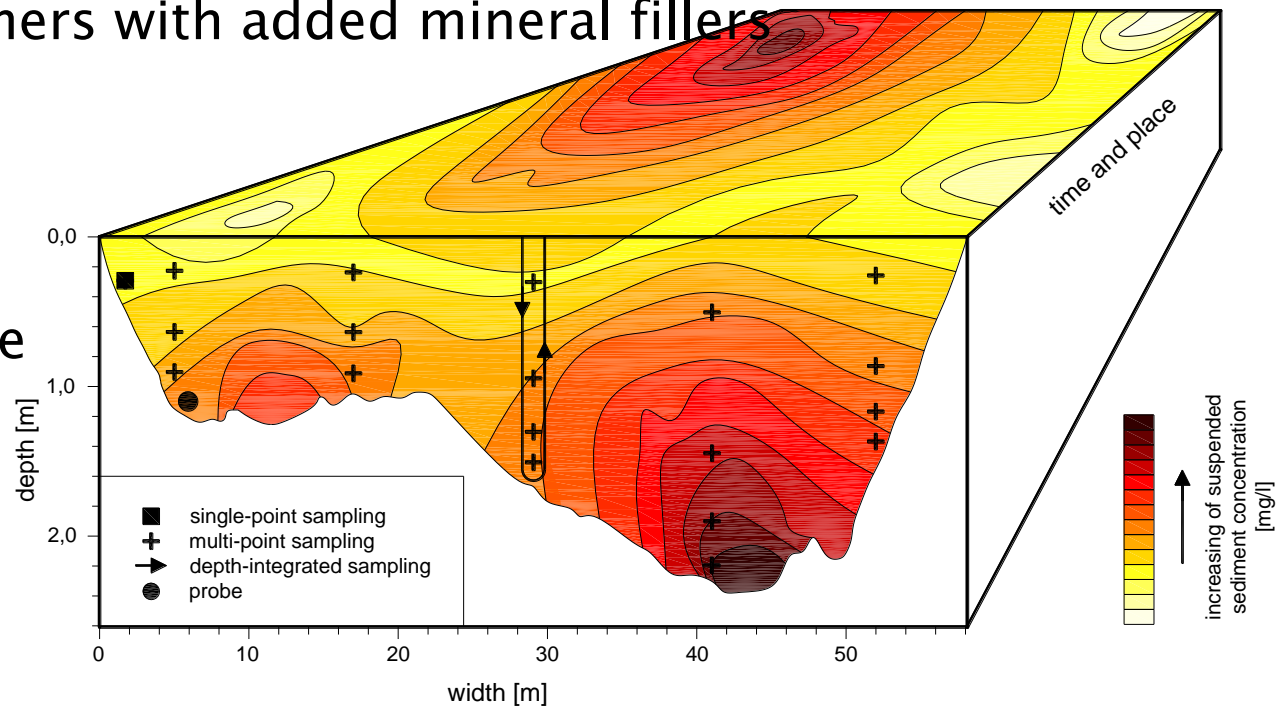
Methods

- Most studies so far used a device called “Manta trawl”
- Only addressing the uppermost layer of the sea/river



Methods

- Plastics consist of different polymers that can be buoyant, neutral, or sink (Anderson et al., 2016; Cole et al., 2011)
- Higher density polymers with added mineral fillers
- Plastic particles change in size and density by aggregation or by the growth of biofilms
- → A Methodology addressing multiple depths is needed (comparable to suspended sediment sampling)



(Haimann et al., 2014)

New device

- New device was constructed for collecting measurements in medium- and large-sized natural streams
- High flow velocities and turbulence provide a demanding environment especially when handling large-sized nets
- Adapted basket sampler (BfG sampler) currently used by the Federal Institute of Hydrology in Koblenz, Germany



New device

- (b) steel rope and shackles
- (c) buoyant body (surface skimming)
- (d) long fin and inclination rack
- (e) centred single net
- (f) upright position when inside the water,
- (g) sampling container
- (i) mechanical flow

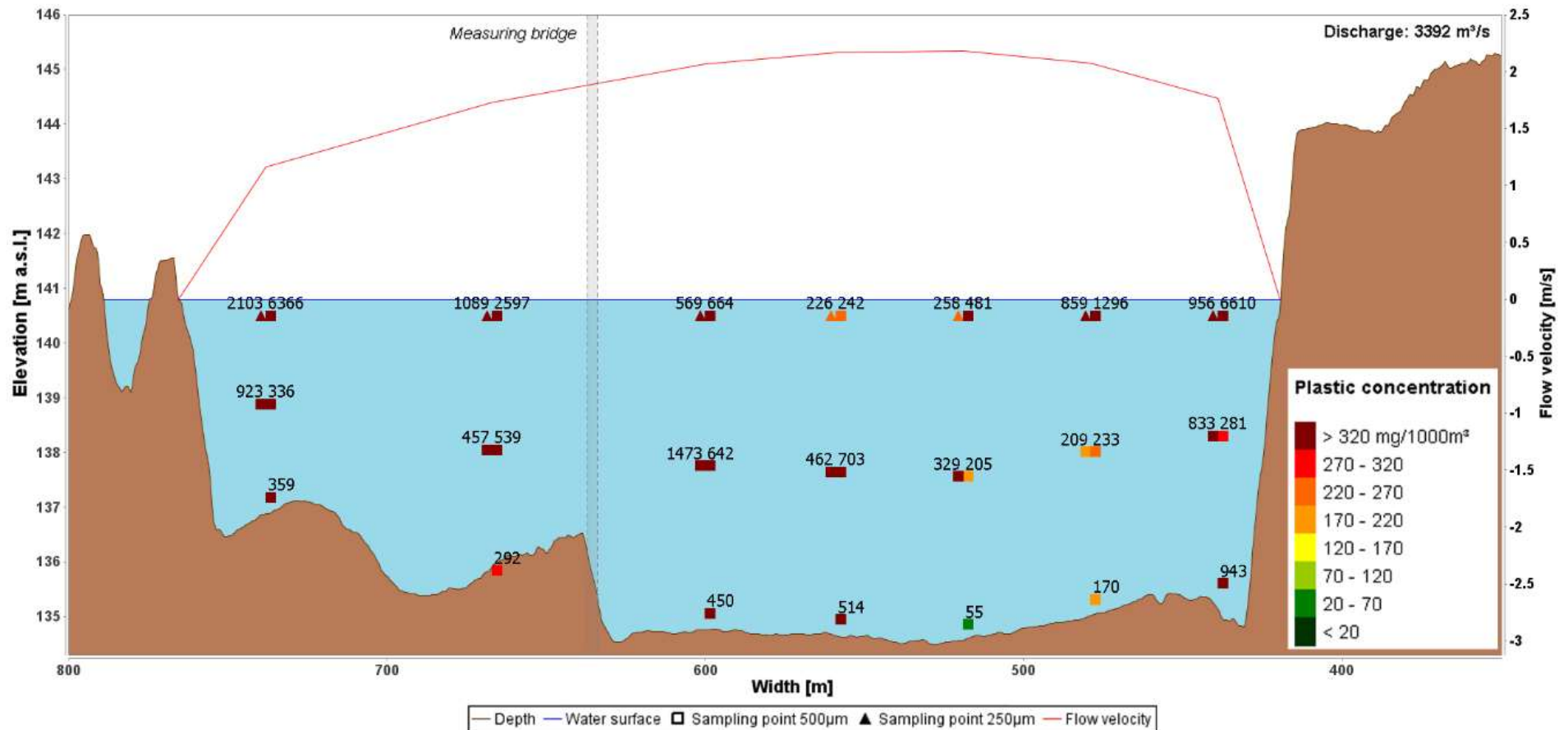




- Organics: hydrogen peroxide



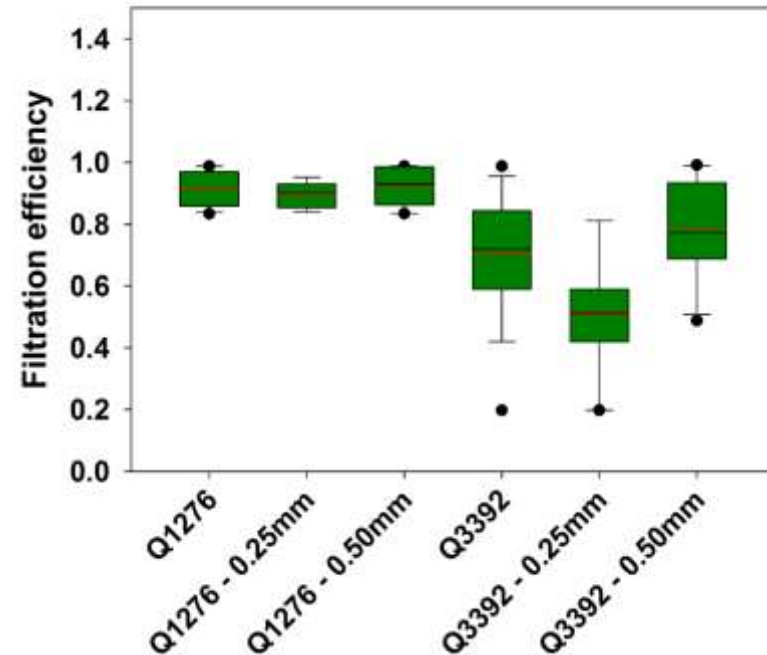
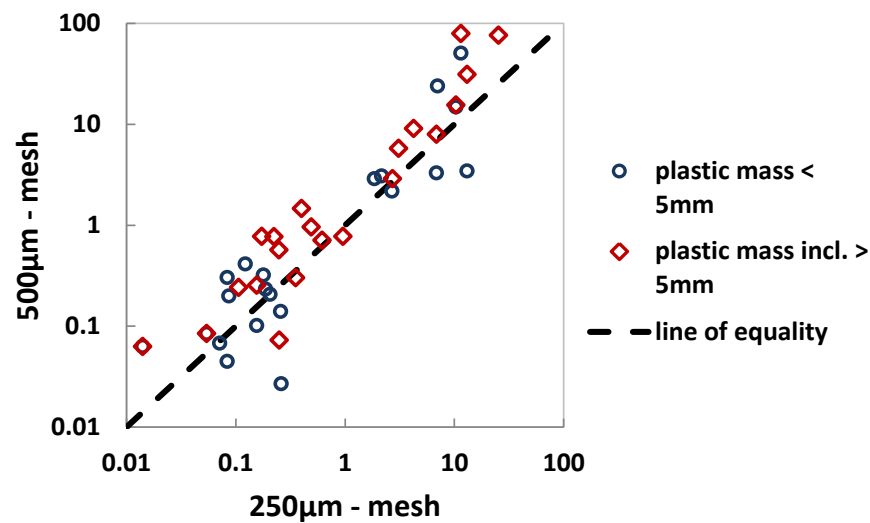
First measurements at the Danube



- Example multi-point measurement (Danube, Hainburg); 13.01.2015 at a discharge of 3.392 m³ s⁻¹; Plastic conc. [mg/1000m³] is displayed for each net

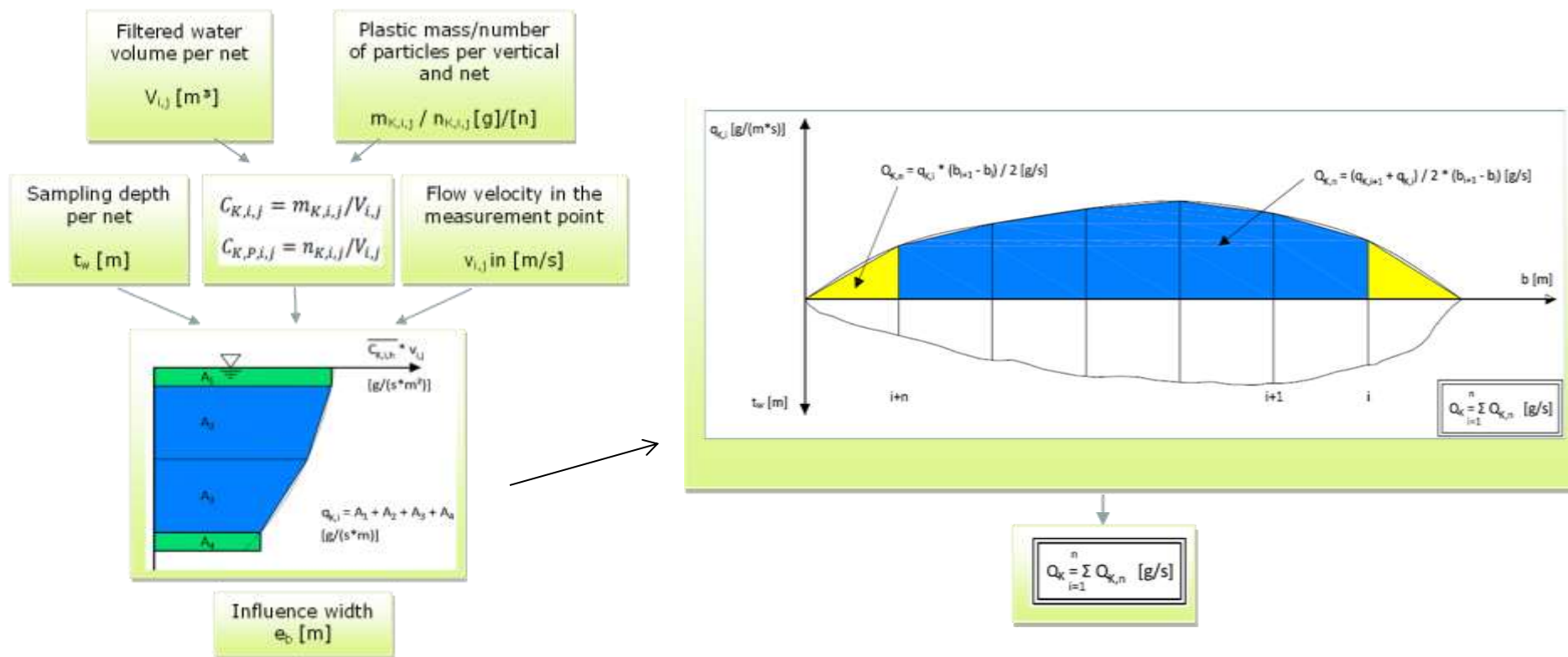
Comparison of different net types

- Especially the comparison of the plastic mass of particles exceeding 5 mm in size shows that more material is sampled with 500 μm
- Filtration efficiency calculated by comparing ADCP measurements to the values of the flow meter mounted in the center of the nets

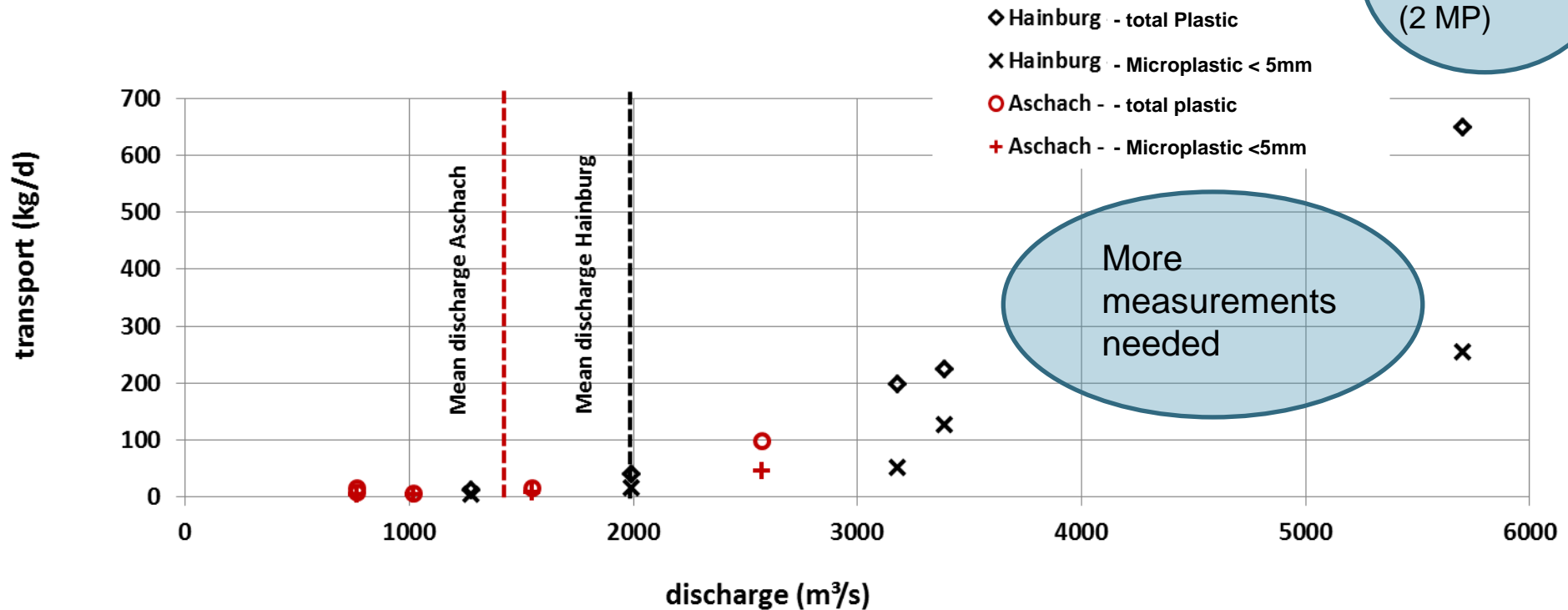


Workflow of macro plastic quantification

Similar as for suspended sediment sampling



Plastic Transport

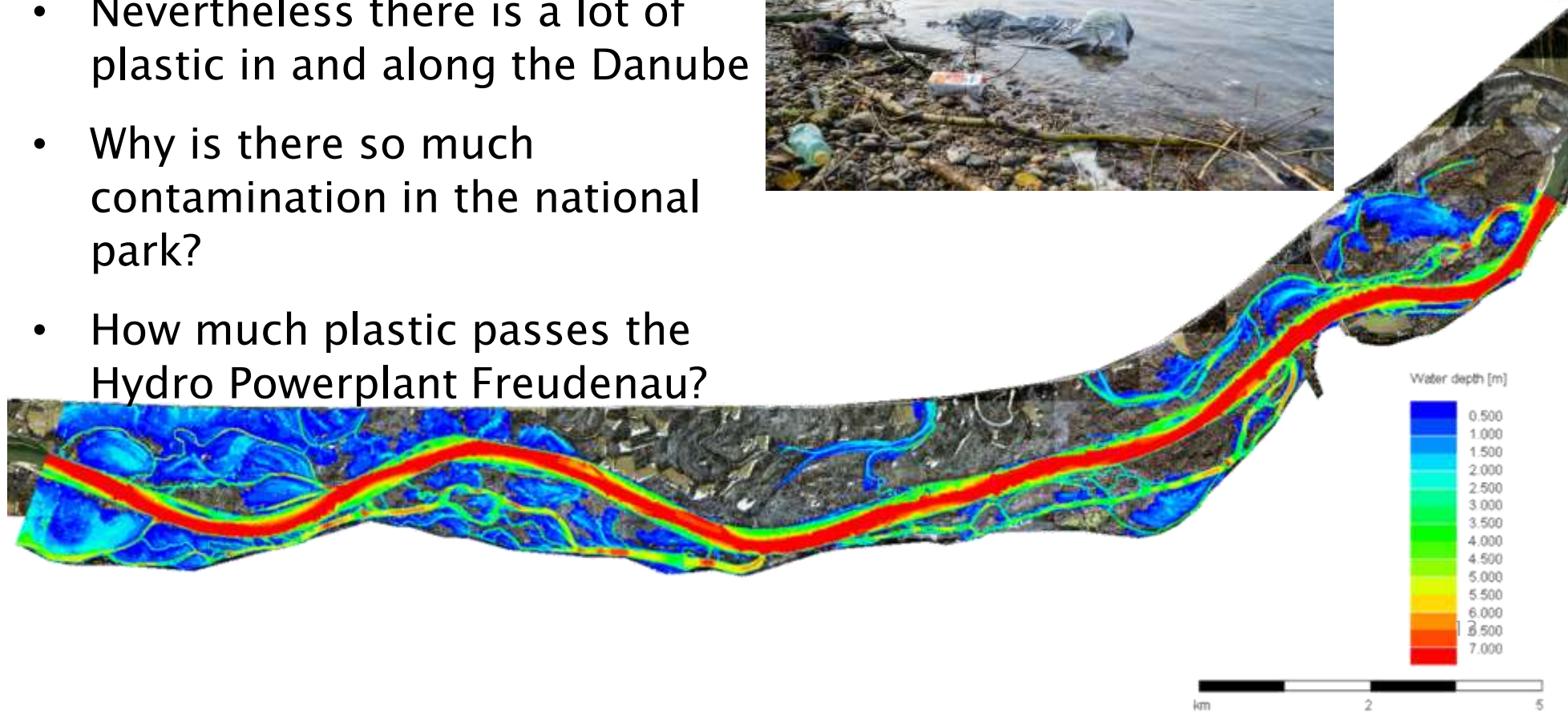


- Plastic transport at Hainburg at an average of 15 to 80 kg / day
- Yearly loads at Hainburg (total plastic without makro) in an average year < 40 t/a



PlasticFreeDanube Project

- Austria has quite good waste management system
- Nevertheless there is a lot of plastic in and along the Danube
- Why is there so much contamination in the national park?
- How much plastic passes the Hydro Powerplant Freudenu?



PlasticFreeDanube – WP 4

Plastic measurements at the Hydro Powerplant Freudenau

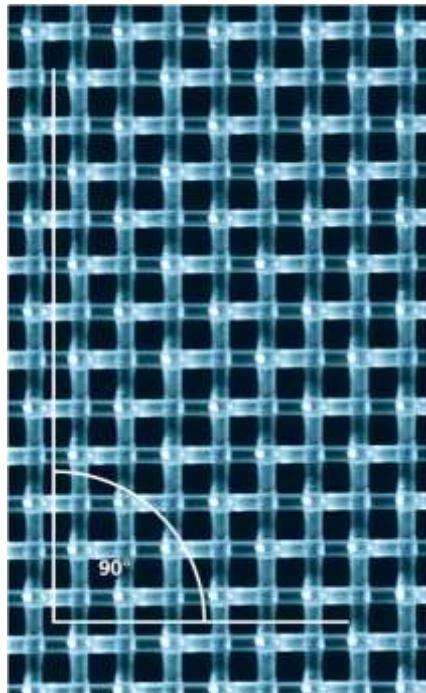


How much plastic passes Freudenau?

Tasks and Methods – WP4

Development of a measurement device

Mesh size



Frame size
depending on
open area ratio
of net



Device



Conclusions

- A device was developed for measuring plastic transport at multiple depths in medium and large natural streams
- The methodology is applicable and leads to profound results (Liedermann et al., 2018)
- Comparably measured data from other Rivers would be interesting
- Plastic transport at the Danube varies between 15 to 80 kg / day
- Yearly loads at Hainburg (total plastic without makro) in an average year < 40 t/a
- Next research question: How much plastic passes a Hydro Powerplant?



Thanks for your attention!

