„Plastik in der Umwelt – Quellen, Senken, Lösungsansätze“ 17./18. Oktober 2017, Berlin

Defining the BASElines and standards for Microplastics ANalyses in European Waters (BASEMAN)

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Defining the BASElines and standards for Microplastics ANalyses in European Waters (BASEMAN)

(meanwhile) 28 partners from 10 countries (AWI in lead)

- WP 1 **Defining baselines** for all relevant identification approaches
- WP 2 Preparation of **standardized test samples** for inter-lab comparisons
- WP 3 **Inter-lab and inter-method comparisons**
- WP 4 **Sampling methodologies** for MPs in the marine environment: standardization, suitability and **intercomparison**
- WP 5 Coordination, Integration and Synthesis

WP1 Defining baselines for all relevant identification approaches

Participating institutions

UBAY, **UGOT**, **UDC**, AWI, ICBM, NILU, GEOMAR, Rap-ID, IMMM, CNR-IAMC, IVL, CNRS-LOV

Tasks

- 1.1 **Development** of a **MP reference kit** and definition of **methodological baselines** (Lead: P6 (UBAY))
- 1.2 **Development** of analysis methods for **sub-micron and nanoscale plastic particles** and exploring appropriate lower size limits (Lead: P16 (UGOT))
- 1.3 **Evaluation** of the capability of the analytical methods to assess the **weathering of microplastics** (Lead: P14 (UDC))

WP 2 Preparation of standardized test samples for inter-lab comparisons

Participating institutions

AWI, ICBM, NIFES

Tasks

- 2.1 Preparation of **standardized sediment samples** (Lead: P5 (ICBM))
- 2.2 Preparation of **standardized plankton samples** (Lead: P1 (AWI))
- 2.3 Preparation of **standardized biota samples** (Lead: P17 (NIFES))

WP 3 Inter-lab and inter-method comparisons

Participating institutions

AWI, **ICBM**, **UBAY**, **NIFES**, NIVA, GEOMAR, CNRS-LOV, TUT, IEO, UGOT, VUT, SYKE, Rap-ID, IMMM, CNR-IAMC, NOVA.ID FCT, IVL, IPMA, UDC, UL

Tasks

- 3.1 **Interlab comparison of standardized test samples** and environmental samples (Lead: P1 (AWI), contribution from all partners)
- 3.2 Inter-method **comparison of extraction approaches** (Lead: P5 (ICBM) & P6 (UBAY))
- 3.3 Inter-method **comparison of purification approaches** (Lead: P5 (ICBM), P6 (UBAY), P1 (AWI) & P17 (NIFES))

WP 4 Sampling methodologies for MPs in the marine environment: standardization, suitability and intercomparison

Participating institutions

IEO, **GMIT**, NIVA, UBAY, OGS, CNRS-LOV, AWI, ICBM, IMMM, CNR-IAMC, NOVA.ID FCT, TUT, IVL, IPMA, SAHFOS, UDC

Tasks

- 4.1 **Evaluation of sampling methods** for **seawater** (water column), **sediments and biota** (Lead: P13 (IEO))
- 4.2 Standardization and **intercalibration of sampling methods** (Lead: P8 (GMIT))

WP 5 Coordination, Integration and Synthesis

Participating institutions

AWI & all

Tasks

- 5.1 Project coordination (Lead: P1 (AWI), contribution from all WP leaders)
- 5.2 **Critical synthesis of analytical approaches** (Lead: P1 (AWI), contribution from all WP leaders)
- 5.3 **Critical synthesis of sampling approaches** (Lead: P1 (AWI), contribution from all WP leaders)
- 5.4 **Recommendation** for MP sampling and analysis of environmental (marine) samples (Lead: P1 (AWI), contribution from all WP leaders)

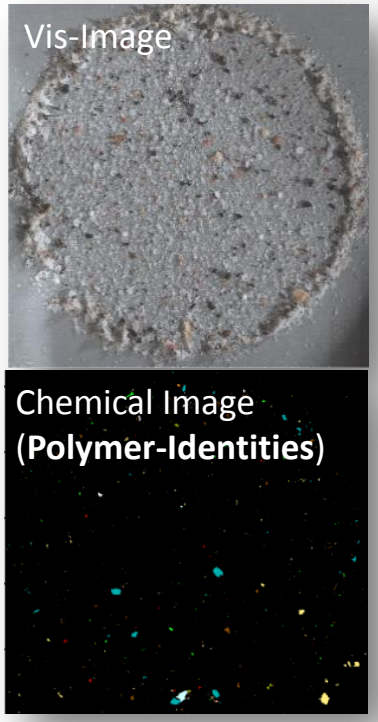
Current status, first findings & deliverables/products

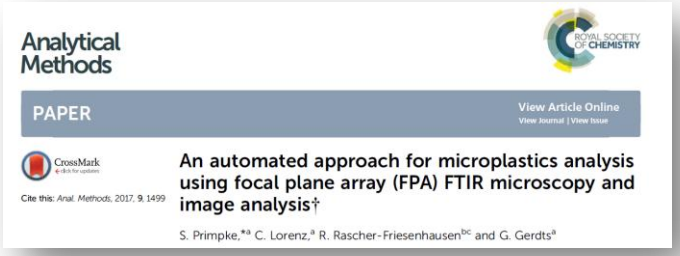
WP1 Defining baselines for all relevant identification approaches

- Task 1.1 **Development** of a **MP reference kit** and definition of methodological baselines (Lead: P6 (UBAY))
- **Objective: To develop and provide a MP reference kit**
  - **9 Polymers** (LDPE, HDPE, PP, PC, PVC, PET, PS, PMMA, PA66)
    - Physico-chemical characterization
    - **3 size fractions**: "→20 µm", "→100 µm", "→1 mm"
      - Grinding/milling & sieving
      - Size distribution
  - **Preparation and provision of "MP kits"** (X Polymers – X numbers- X sizes) for WP2/WP3 - Inter-lab and inter-method comparisons
  - **Provision of single polymers** and MP-kits for JPI-O BASEMAN for WP3 - Inter-lab and inter-method comparisons
  - **Evaluation of transfer efficiency** "MP-kit"→ sample (for WP2/WP3)

WP1 Defining baselines for all relevant identification approaches

- Task 1.1 **Development** of a MP reference kit and definition of **methodological baselines** (Lead: P6 (UBAY))




Analytical Methods

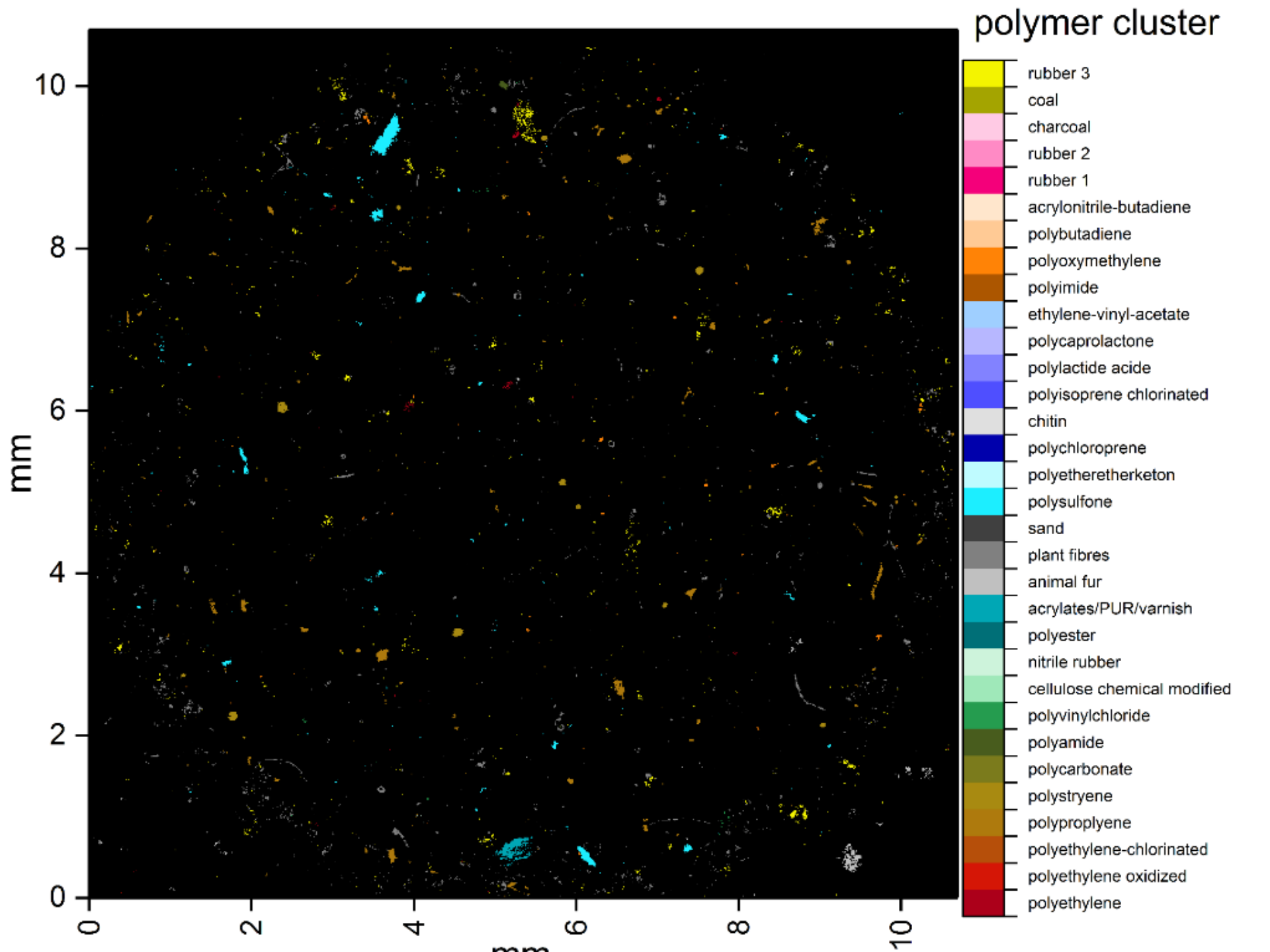
PAPER

View Article Online

An automated approach for microplastics analysis using focal plane array (FPA) FTIR microscopy and image analysis†

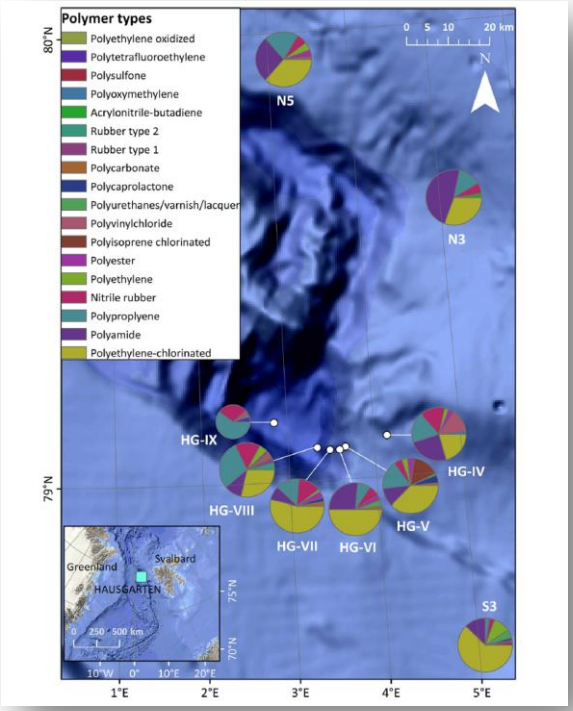
S. Primpke, C. Lorenz, R. Rascher-Friesenhausen and G. Gerdts

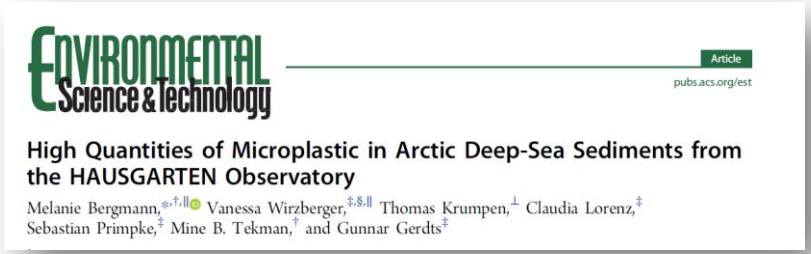
- Pipeline for **automated identification, counting and sizing** of MP
- **Size limit: ~11 µm**
- Currently under development…
  - "Platform" independent database comparison
  - Identification/enumeration/sizing of fibers
- **Open source (code and "curated" database)**

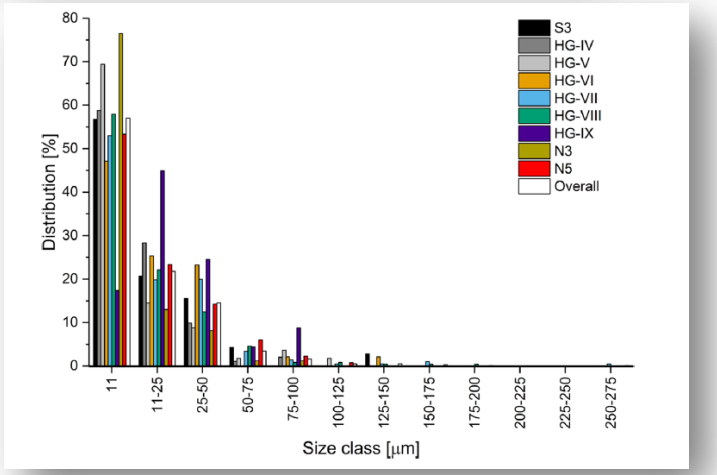

polymer cluster
rubber 3
coal
charcoal
rubber 2
rubber 1
acrylonitrile-butadiene
polybutadiene
polyoxymethylene
polyimide
ethylene-vinyl-acetate
polycaprolactone
polylactide acide
polyisoprene chlorinated
chitin
polychloroprene
polyetheretherketon
polysulfone
sand
plant fibres
animal fur
acrylates/PUR/varnish
polyester
nitrile rubber
cellulose chemical modified
polyvinylchloride
polyamide
polycarbonate
polystryene
polyproplyene
polyethylene-chlorinated
polyethylene oxidized
polyethylene
mm
0
2
4
6
8
10
mm

WP1 Defining baselines for all relevant identification approaches

- Task 1.1 **Development** of a MP reference kit and definition of **methodological baselines** (Lead: P6 (UBAY))







WP1 Defining baselines for all relevant identification approaches

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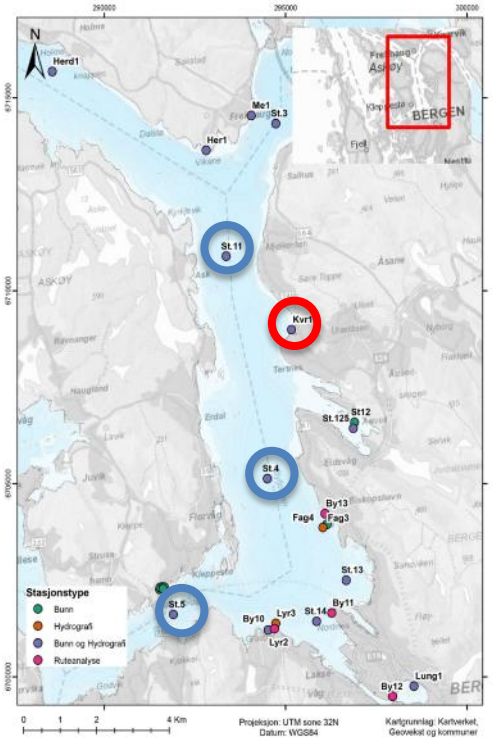
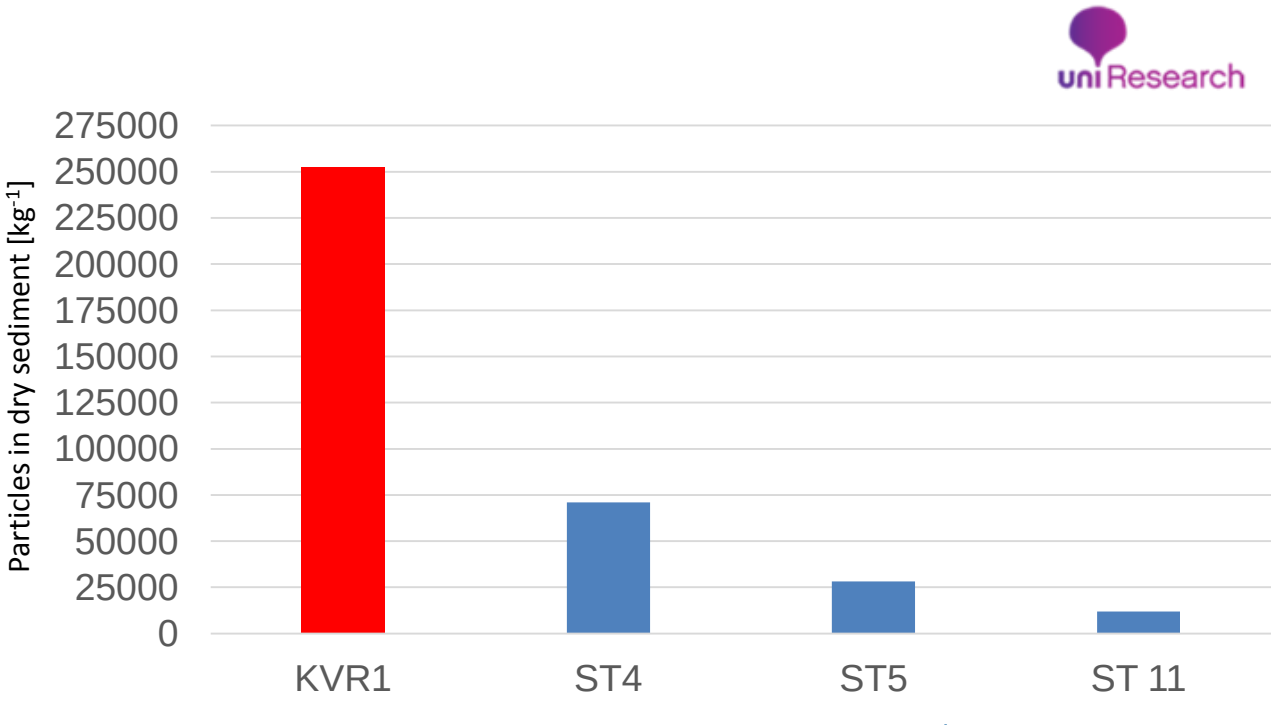
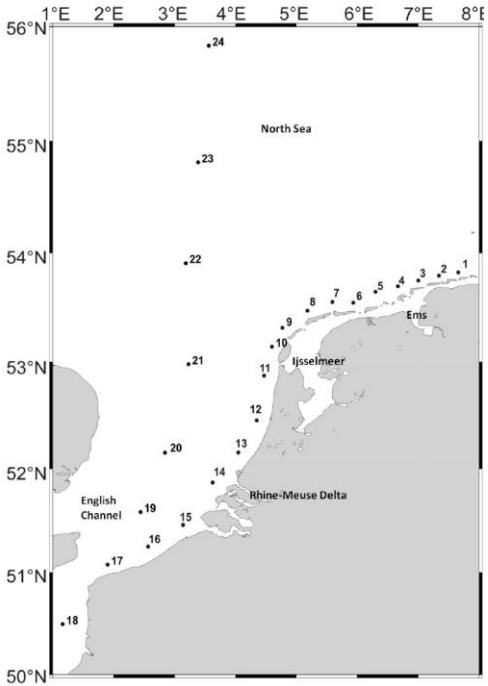


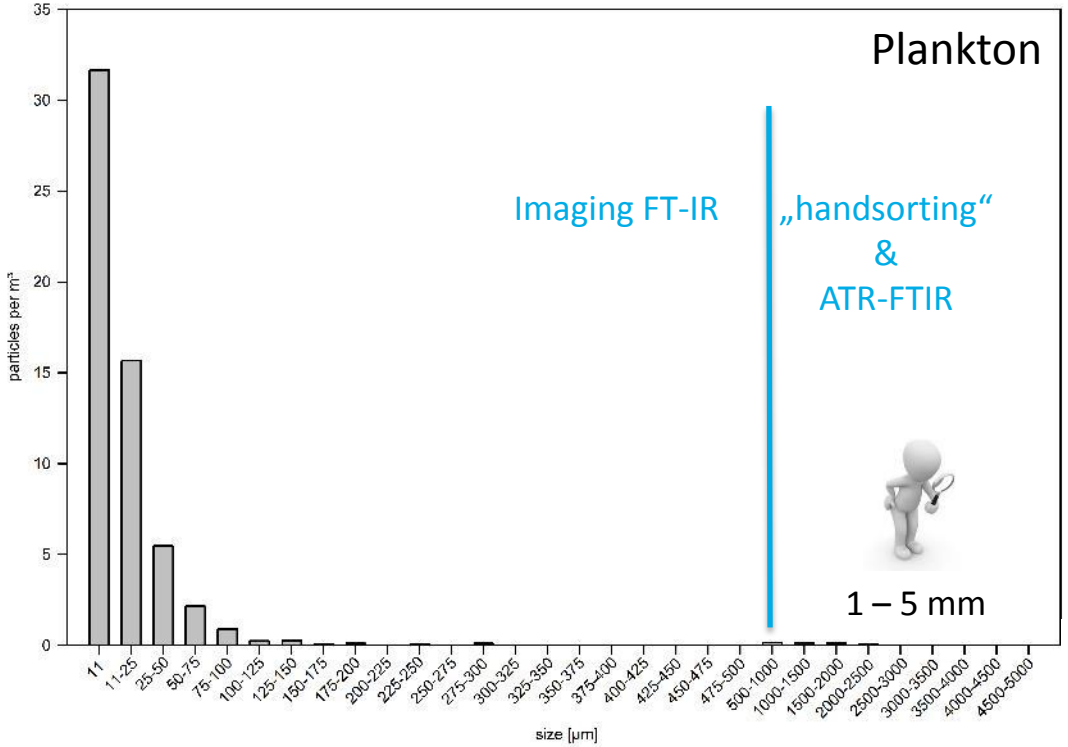


Haave et. al. (in prep)

WP1 Defining baselines for all relevant identification approaches

- Task 1.1 **Development** of a MP reference kit and definition of **methodological baselines** (Lead: P6 (UBAY))





Roscher (2017)
Lorenz et al. (in prep)

WP1 Defining baselines for all relevant identification approaches

- Task 1.1 **Development** of a MP reference kit and definition of **methodological baselines** (Lead: P6 (UBAY))

Poster

Numbers…

- ***"Automated Analysis and Quantification of Microplastics by FTIR Imaging"*** (Sebastian Primpke, Marisa Wirth, Claudia Lorenz, Richard Rascher-Friesenhausen & Gunnar Gerdts)
- ***"Identifying microplastics in the North Sea: From extraction to detection"*** (Claudia Lorenz, Lisa Roscher, Linn Speidel, Sebastian Primpke & Gunnar Gerdts)

Mass…

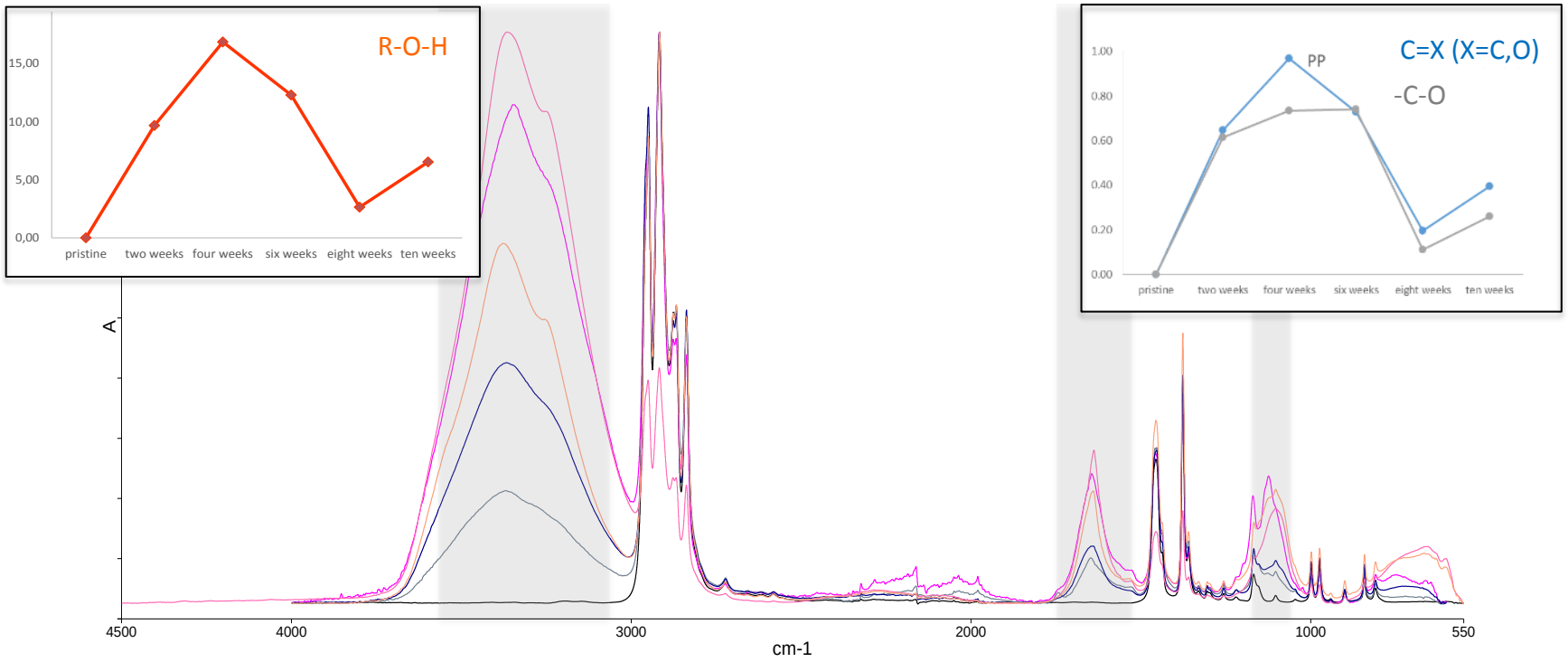
- **"Qualitative ans quantitative analysis of microplastics in the marine Environment - pyrolysis-GC/MS as a sensitive tool„ (**Marten Fischer & Barbara Scholz-Böttcher)

WP1 Defining baselines for all relevant identification approaches

- Task 1.3 Evaluation of the capability of the analytical methods to **assess the weathering of microplastics** (Lead: P14 (UDC))
- Objective: To characterize the **effects of artificial/natural weathering** on reference MPs
  - 9 Polymers (2 sizes fractions: “100 – 500 µm”; “1 mm”) provided by UBAY (WP1)
  - dry/wet weathering
  - Weathering: 2 UV/Vis metal halide lamps, 25O W/each (continuous irradiation); 10 weeks
  - Characterization: ATR-FTIR

WP1 Defining baselines for all relevant identification approaches

- To characterize the **effects of artificial/natural weathering** on reference MPs
  - PP wet-weathering



WP1 Defining baselines for all relevant identification approaches

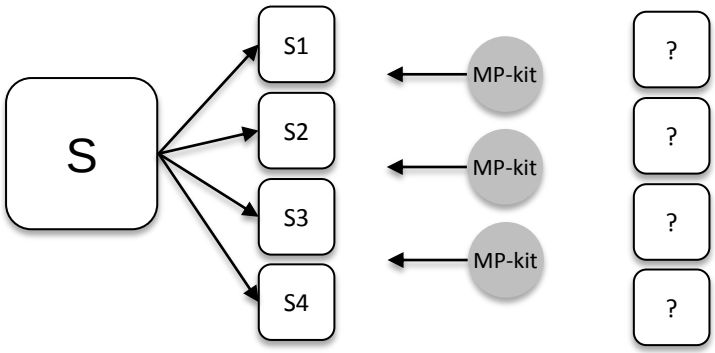
- Objective: To **characterize the effects of artificial/natural weathering** on reference MPs
  - Wet weathering: **no constant increase of weathering** indices
  - **Wet weathering ≠ dry weathering**
  - **Pending**
    - Analysis of natural weathering approaches (and comparison with artificial weathering)
    - Provision of database for weathered MP
    - Multivariate analyses?
    - Assessment of findings (MP age? MP origin?)
    - Merging of JPI-O BASEMAN & JPI-O WEATHERMIC findings

WP 2 Preparation of standardized test samples for inter-lab comparisons

- Task 2.1, 2.2 & 2.3 Preparation of standardized sediment samples (P5 (ICBM)), standardized plankton samples (P1 (AWI)) and standardized biota samples (P17 (NIFES))
- Objective: To **generate and provide standardized MP-spiked test samples** (sediment, plankton, biota) for inter-lab comparisons (feeding into WP3 Inter-lab and inter-method comparisons)
    - Notice: **No classical ring trial!** (no standardized methods)
        - BASEMAN partners represent the **full range of analytical capabilities** (purification, extraction, analyses (visual microscopy to FTIR, Raman & PyGCMS))
        - **Implementation of different matrices** (sediments, tissues, natural polymers)
        - Analysis of **standardized samples**: Evaluation of currently used pipelines

WP 2 Preparation of standardized test samples for inter-lab comparisons

- Task 2.1, 2.2 & 2.3 Preparation of standardized sediment samples (P5 (ICBM)), standardized plankton samples (P1 (AWI)) and standardized biota samples (P17 (NIFES))
  - Sediments: **3 types of sediments** from the wadden sea
  - Biota: soft parts of farmed **blue mussels**, intestines of **farmed salmon** and **wild caught haddock**
  - Plankton: **3 types of plankton** (German Bight) representing different natural polymers (e.g. “silicate” (diatoms), chitin (copepods))
  - “MP kits” (? Polymers ? Numbers ? Sizes) defined by WP1 & WP2



4 samples

- 3 contain the “MP kits”
- 1 natural MP load

WP 2 Preparation of standardized test samples for inter-lab comparisons

- Task 2.1, 2.2 & 2.3 Preparation of standardized sediment samples (P5 (ICBM)), standardized plankton samples (P1 (AWI)) and standardized biota samples (P17 (NIFES))
  - Sediments: **All samples prepared and sent** to the participating labs
  - Biota: **All samples prepared and sent** to the participating labs
  - Plankton: **All samples prepared** but not sent to the participating labs so far

  - **Delay: Problems with transfer of MP-kits to samples (transfer efficiency)**
    - **Evaluation of transfer efficiency** "MP-kit"→ sample
    - **Outcome ±……**

WP 3 Inter-lab and inter-method comparisons

- Task 3.1 Interlab comparison of standardized test samples and environmental samples (Lead: P1 (AWI), contribution from all partners)
  - **Pending**
    - **All analyses still ongoing**

WP 3 Inter-lab and inter-method comparisons

- 3.2 Inter-method comparison of extraction approaches (Lead: P5 (ICBM) & P6 (UBAY))
- Objective: To **optimize the extraction of MP** from sediment

Microplastics Sediment Separator (MPSS)

- 1 kg sediment-sample
- High recovery rate
- Commercially available
- Improvement necessary!
  - 30 L prefiltered $ZnCl_2$ solution (1.8 g cm^{-3})
  - 1 sample in ~24 hours
  - Mixing by stirring (milling..)
  - Geometry
  - intransparent

WP 3 Inter-lab and inter-method comparisons

- 3.2 Inter-method comparison of extraction approaches (Lead: P5 (ICBM) & P6 (UBAY))
- Objective: To **optimize the extraction of MP** from sediment

BASEMAN Sediment Separator

- 1 kg sediment-sample
- ~9 L prefiltered $ZnCl_2$ solution (filling from below through 10 µm filter)
- 4 sample in ~24 hours (upscalable)
- Mixing by aeration
- Geometry (straight line)
- transparent
- patented

WP 3 Inter-lab and inter-method comparisons

3.3 Inter-method comparison of purification approaches (Lead: P5 (ICBM), P6 (UBAY), P1 (AWI) & P17 (NIFES))

Objective: To **optimize the purification of MP** from sediment, plankton and biota in respect to matrix disintegration/removal and polymer preservation**….and handling**

BASEMAN MP reactor

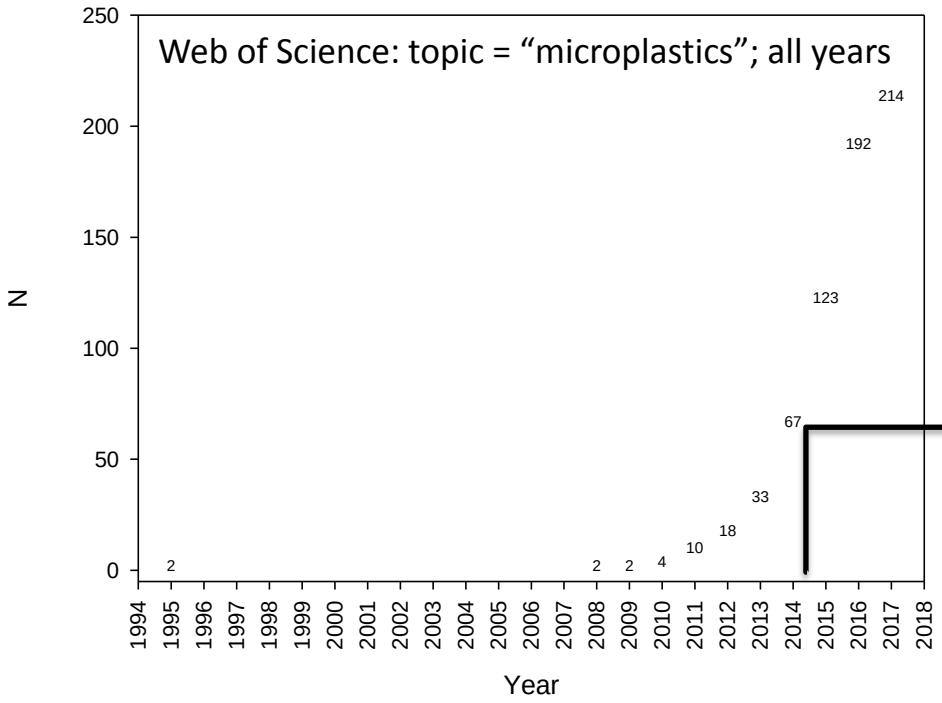
- Very simple design (stainless steel tube)
- Sample stays permanently in the reactor
- Prevention of contamination (10 µm stainless steel meshes (top/bottom)
- Fill/drain of reagents by vacuum/pressure
- upscalable
- patented

WP 5 Coordination, Integration and Synthesis

- Task 5.4 Recommendation for MP sampling and analysis of environmental (marine) samples (Lead: P1 (AWI), contribution from all WP leaders)
- Objectives
  - To provide “best practice” and “best compromises” **SOPs**
  - To **advice stakeholders** with respect to MP sampling, detection & analysis

WP 5 Coordination, Integration and Synthesis

Objective: To **advice stakeholders** with respect to MP sampling, detection & analysis (**or "the standards discussion"**)

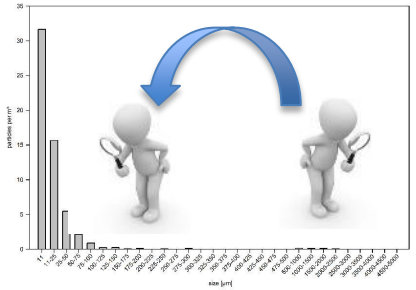


- Emerging and very dynamic topic
- Stakeholders:
  - *When should standards be defined*
  - *…and which?*

BASEMAN
MICROPLASTICS ANALYSES IN EUROPEAN WATERS

WP 5 Coordination, Integration and Synthesis

Objective: To **advice stakeholders** with respect to MP sampling, detection & analysis (**or "the standards discussion"**)



Provide knowledge & new findings

„Authorities & stakeholders" → **Standards: ≠** ←„Academia"

TSG-ML

Open questions, needs

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Thank you for your attention