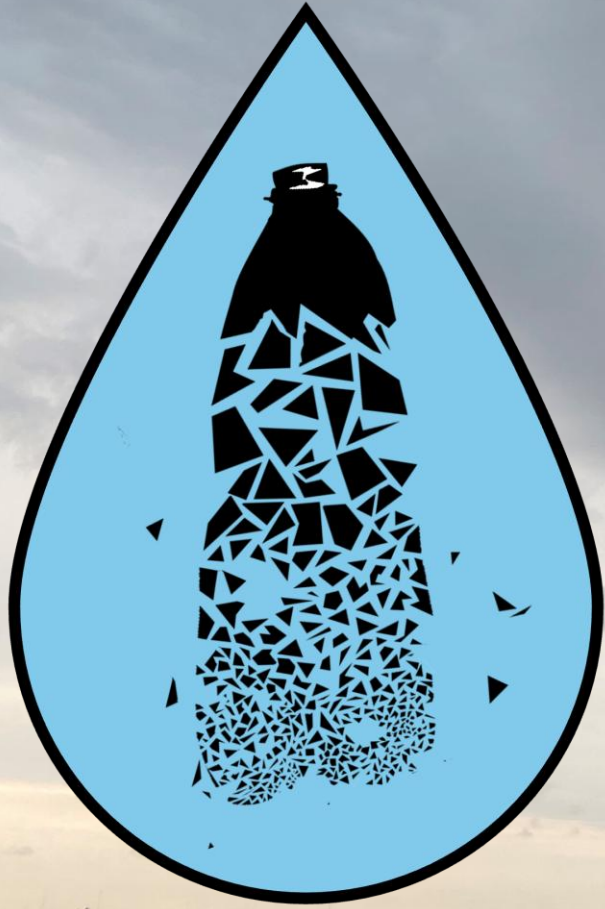


Microplastics in Tampa Bay: what we know



Lyndsey “Zee” Grossmann
PhD student, College of Marine Science
University of South Florida



Outline

- Defining microplastics
- Why they are a problem
- How they are being studied in Tampa Bay
- Results from a recent study
- Future work



**Microplastics found near Everest's peak,
highest ever detected in the world**

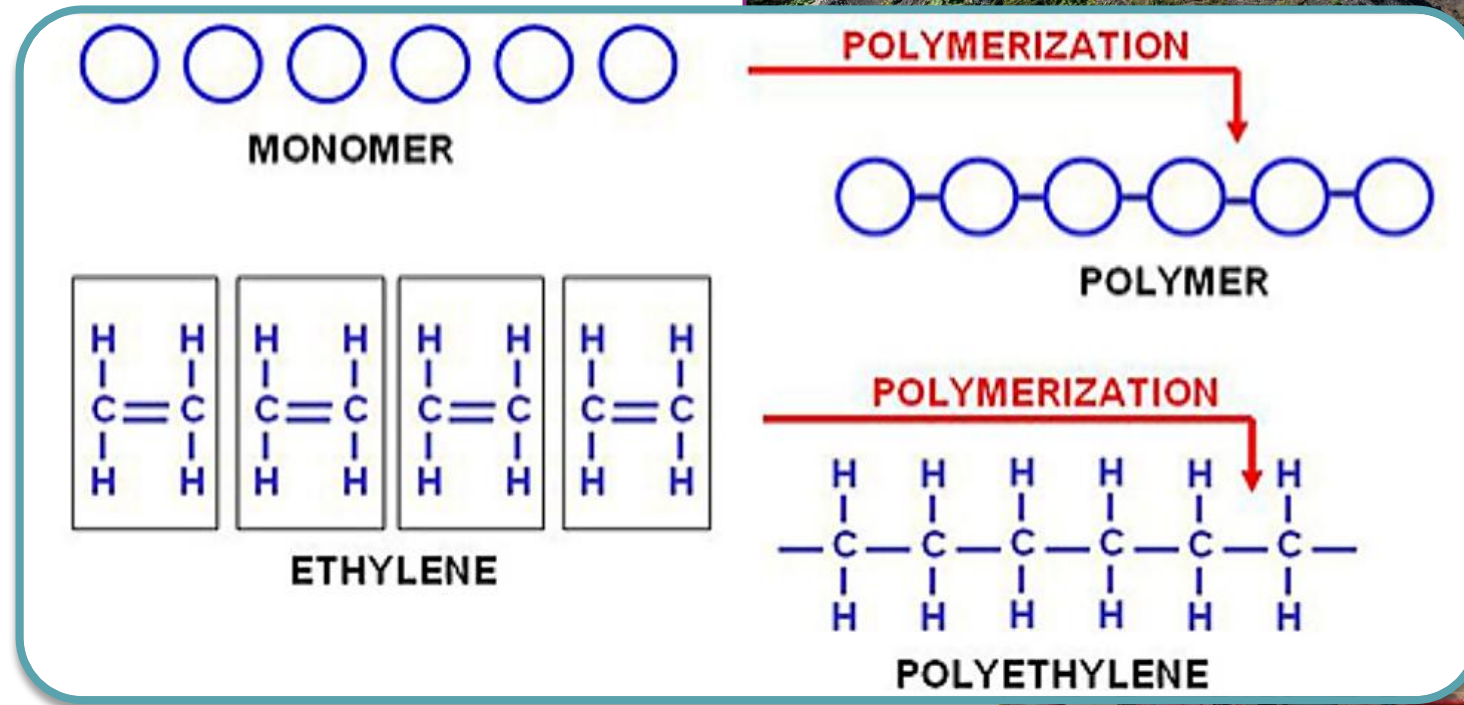
LIVING IN THE PLASTIC AGE

Life is plastic, and it's not fantastic.
It is plastic, including in our food
and bottled water

**Billions of microplastic are on the Ocean
Floor**

What is plastic?

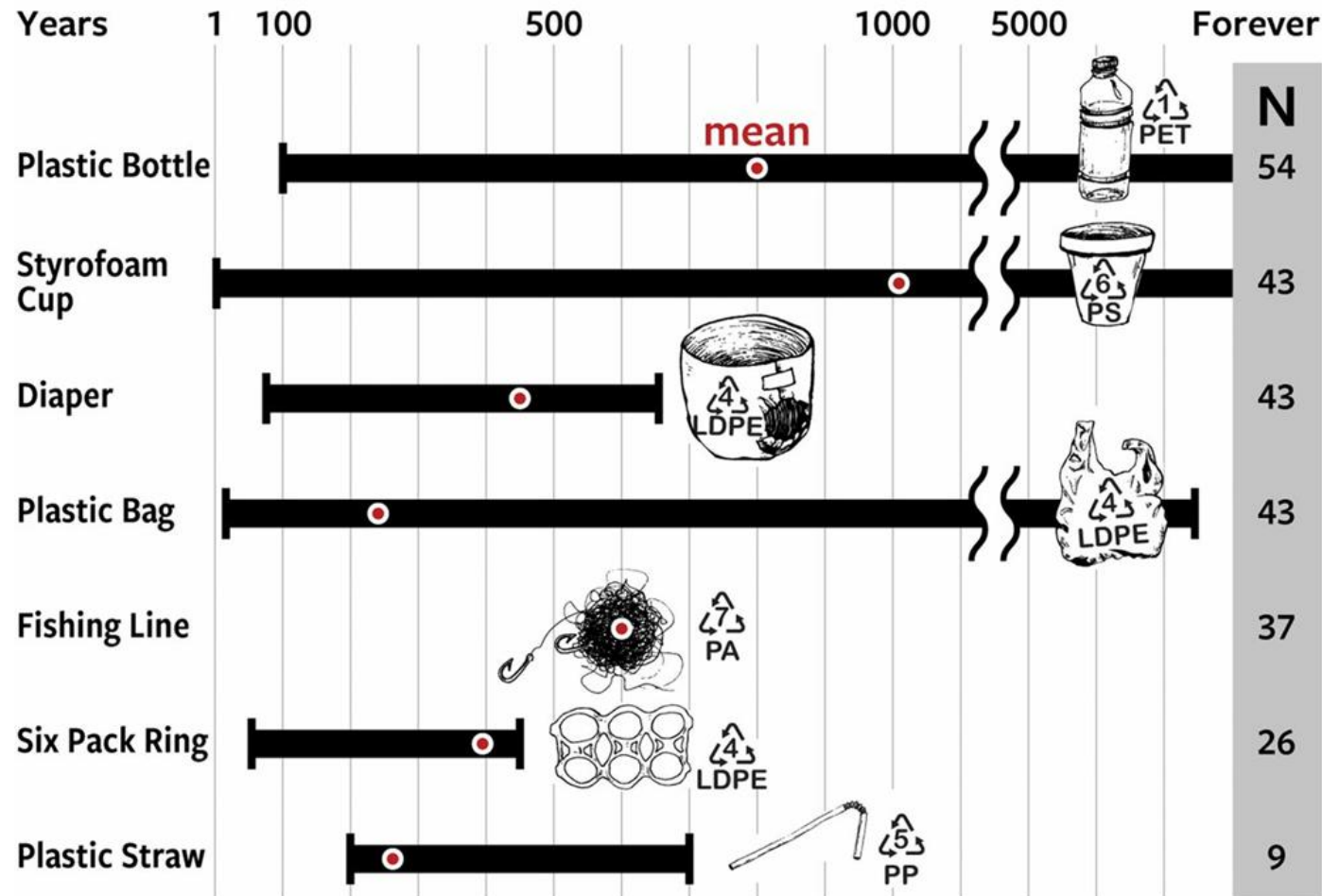
- Petrochemicals (**98%**)
- Plasticity = malleable
- Durable, lightweight,
CHEAP
- “Synthetic polymers”



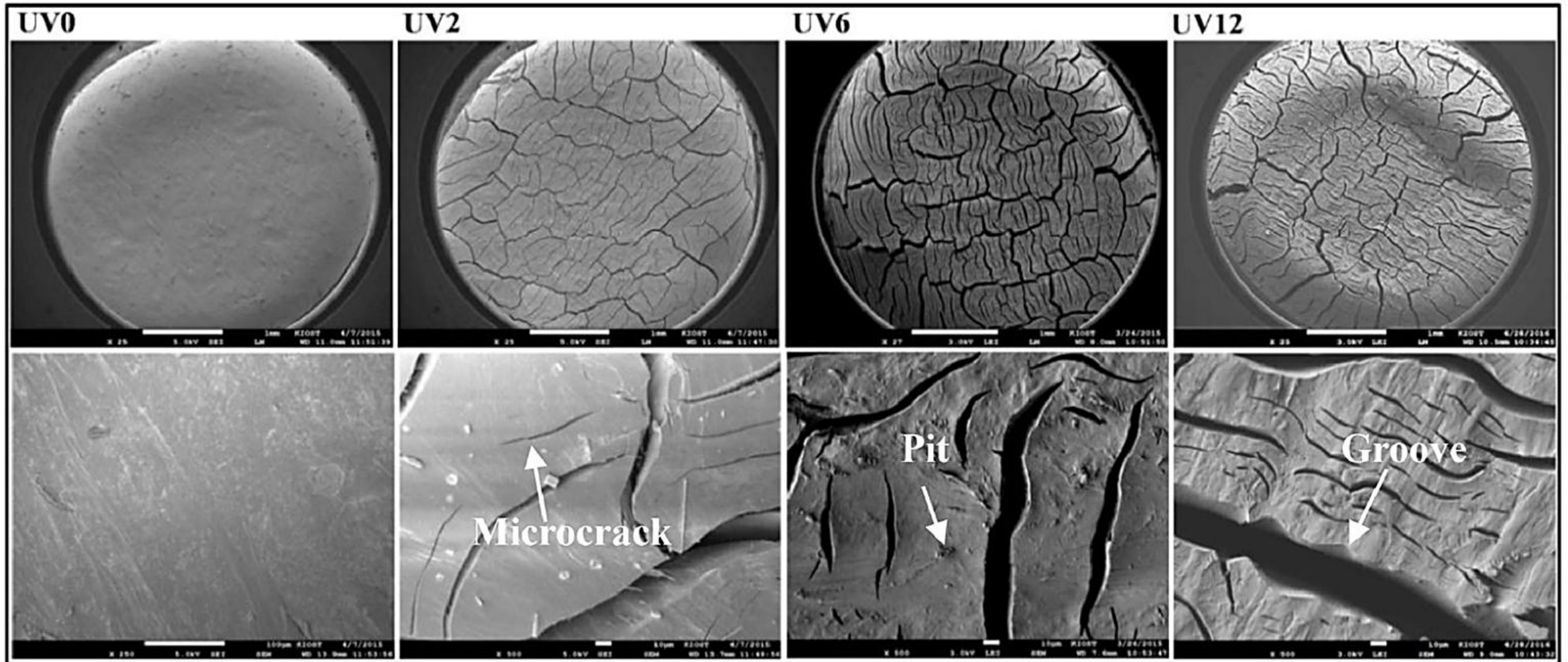
PETE	HDPE	PVC	LDPE	PP	PS	OTHER
Polyethylene terephthalate	High-density polyethylene	Polyvinyl chloride	Low-density polyethylene	Polypropylene	Polystyrene	Other plastics
						
						

Plastic “end of life”?

Reported Environmental Lifetimes



Plastic → microplastic



Plastic → microplastic



Microplastics (MPs) defined

Classification of plastic litter

<1 μm 5 mm 2.5 cm >1 m

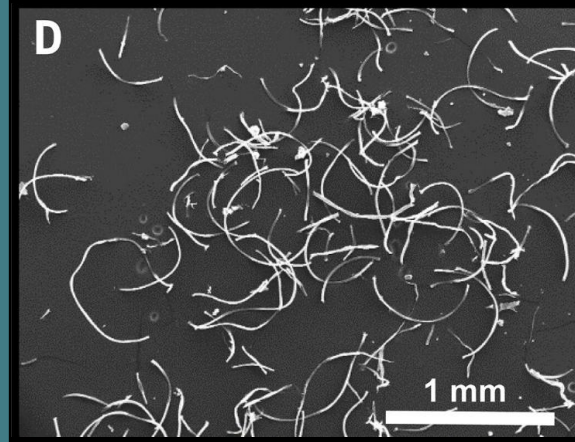
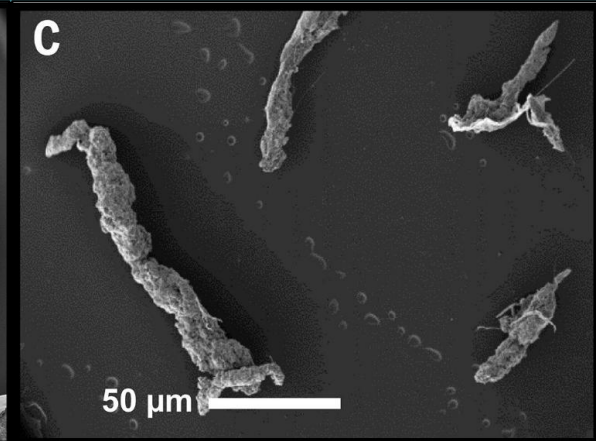
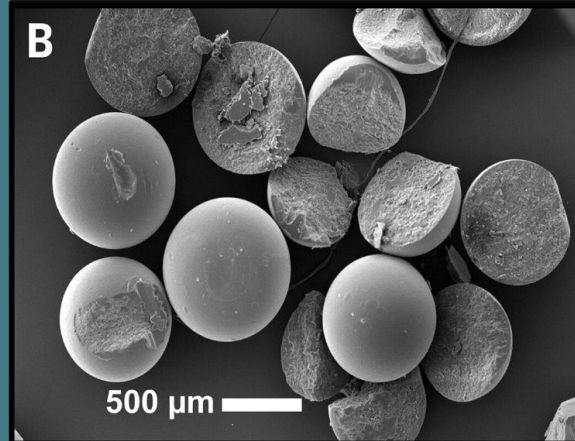
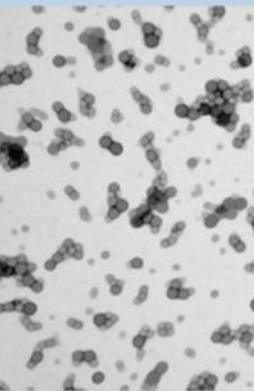
nano

micro

meso

macro

mega



Alexander Kunz (Microplastic Research in Taiwan)

THE RELATIVE SIZE OF PARTICLES

From the COVID-19 pandemic to the U.S. West Coast wildfires, some of the biggest threats now are also the most microscopic.

A particle needs to be 10 microns (μm) or less before it can be inhaled into your respiratory tract. But just how small are these specks?

Here's a look at the relative sizes of some familiar particles ↘



SOURCES Greenstreet, Denise Laverby, EPA, Financial Times, News Medical, Science Direct, SCMR, Susan Sokolowski, Patrocinio, U.S. Dept. of Energy
COLLABORATORS RESEARCH + WRITING: Carmen Ang, Inan Ghosh | DESIGN + ART DIRECTION: Harrison Schell

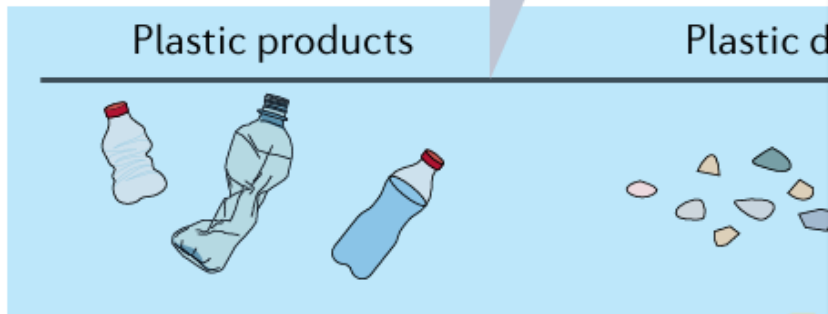
VISUAL CAPITALIST

[f](#) [/visualcapitalist](#) [@visualcap](#) [visualcapitalist.com](#)

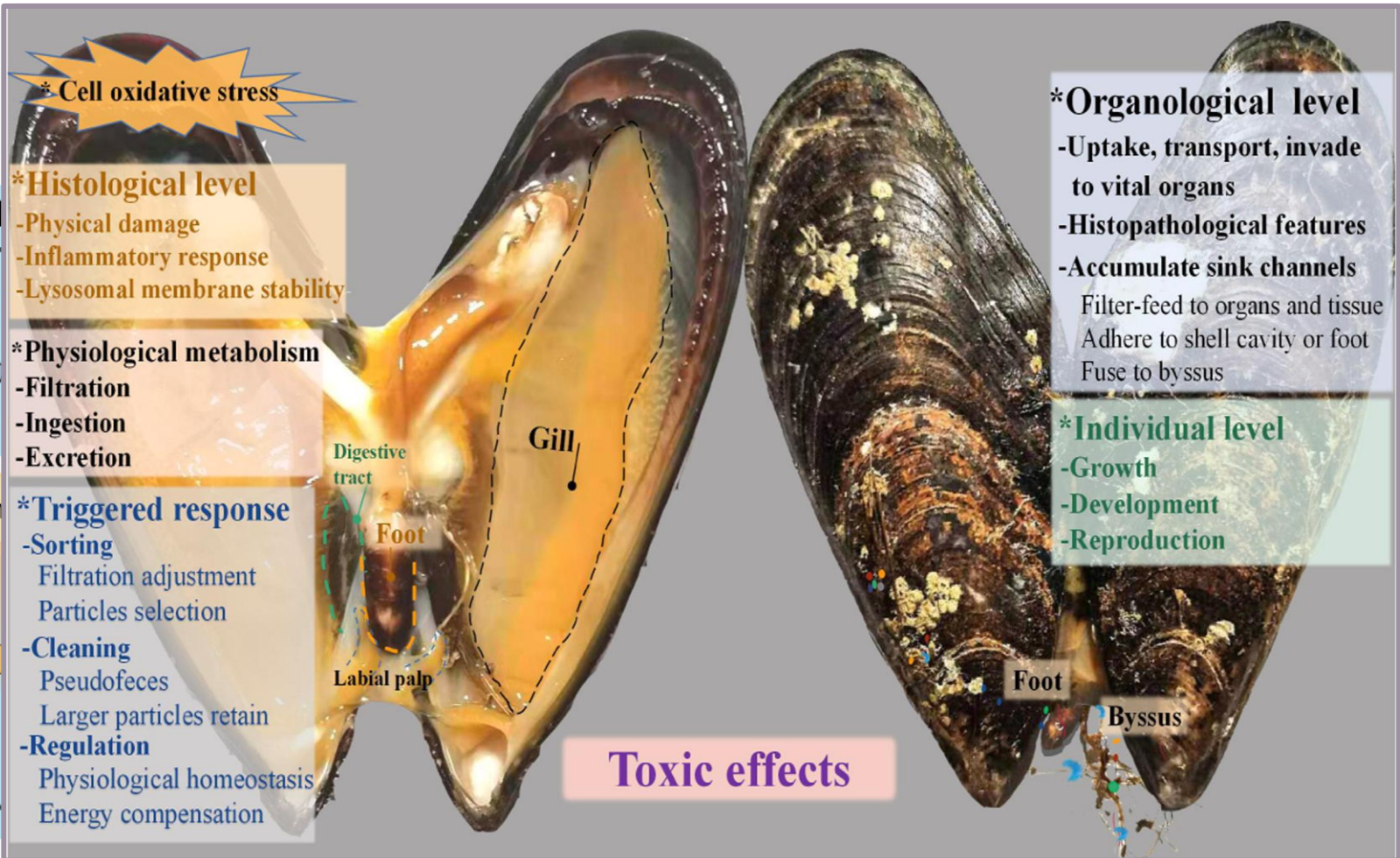
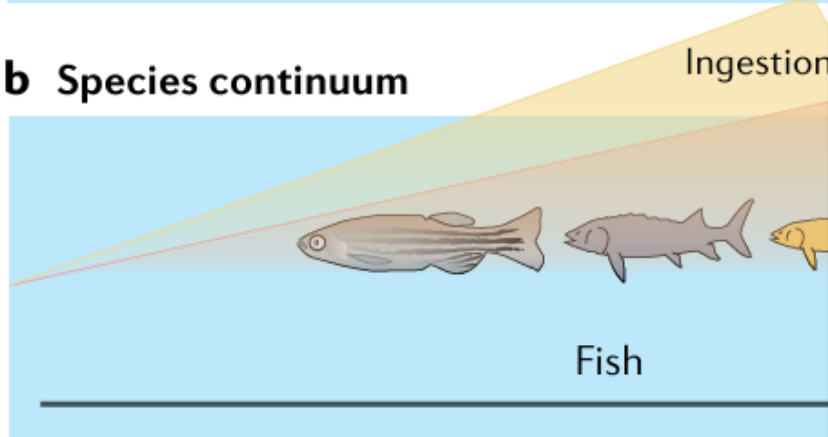
Small particles, small problems?

a Plastic continuum

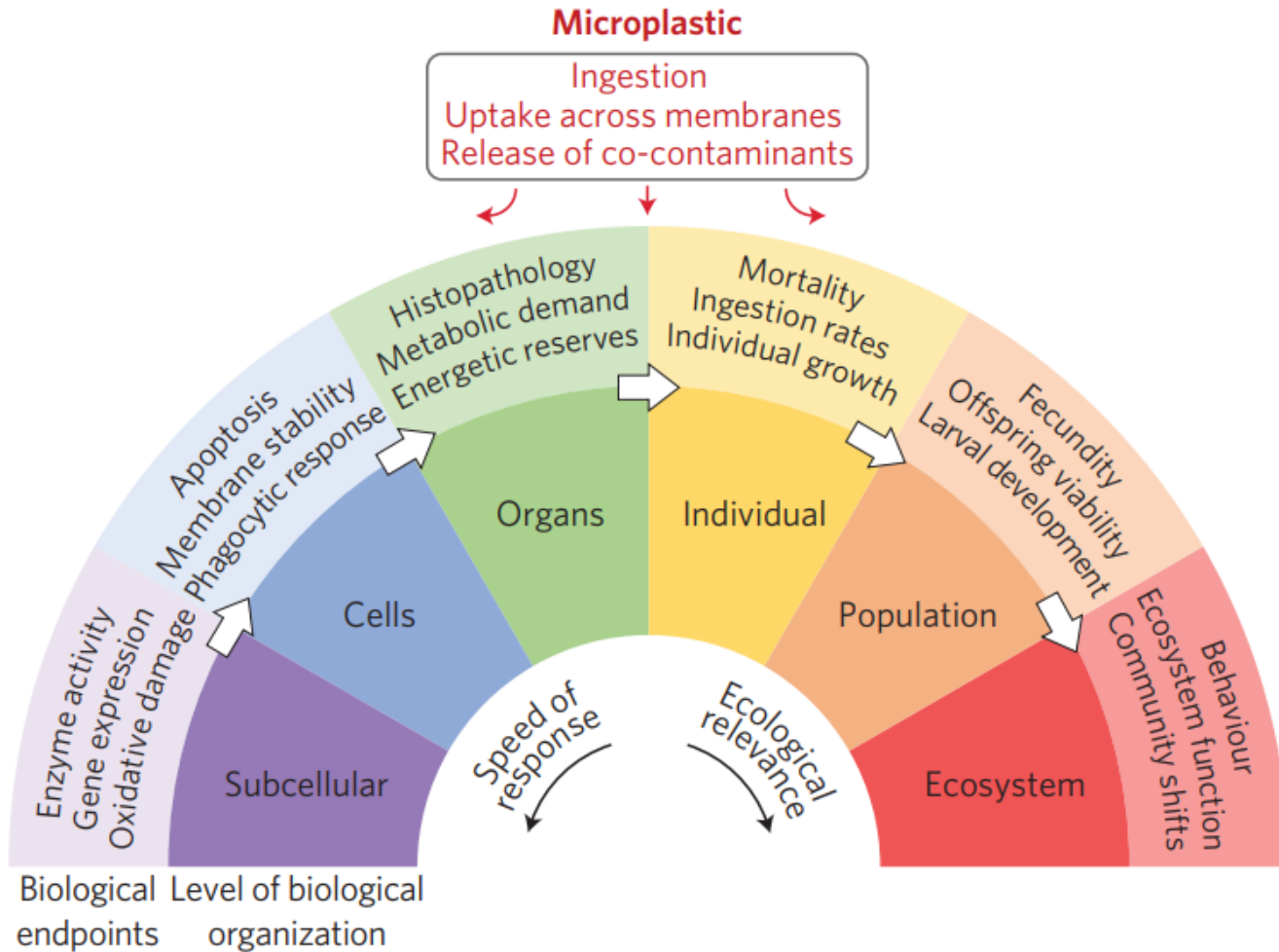
Erosion and fragmentation



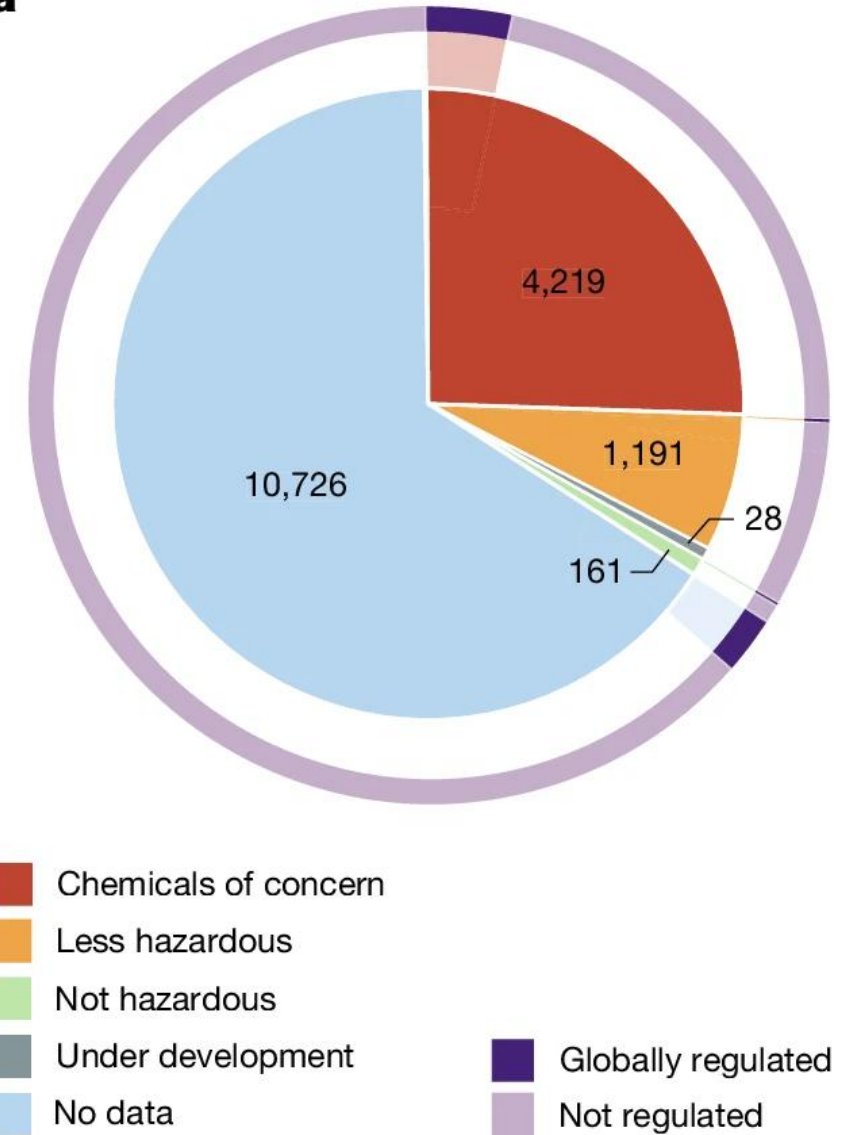
b Species continuum



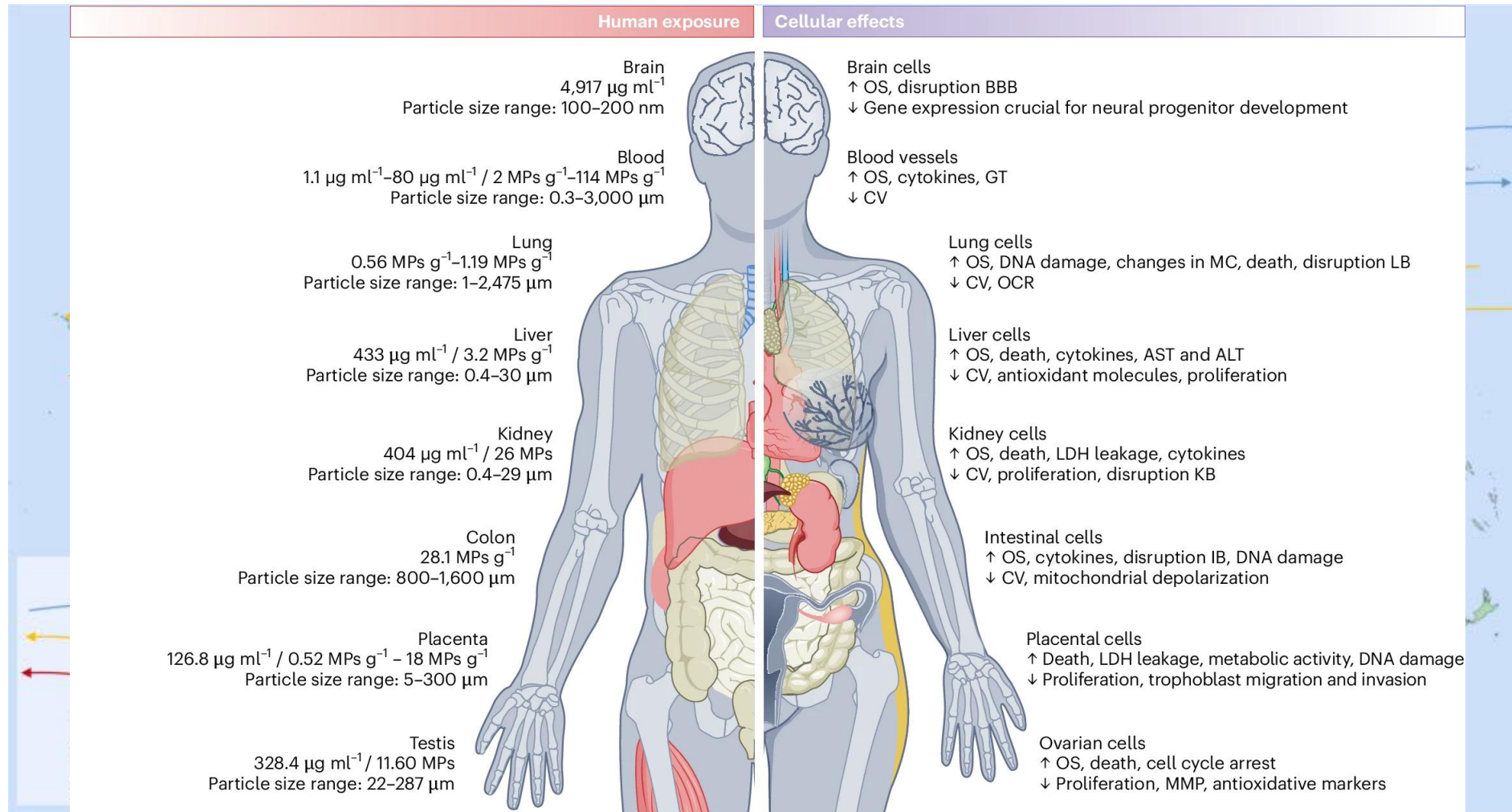
From organisms to ecosystems



a



Microplastic is ubiquitous



Microplastics in Tampa Bay

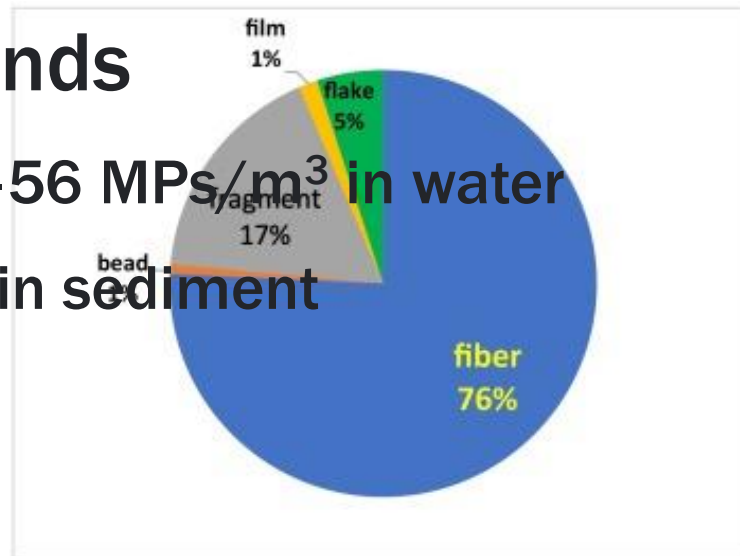
Microplastic Sampling Stations in Tampa Bay

- Surface water and bay sediment

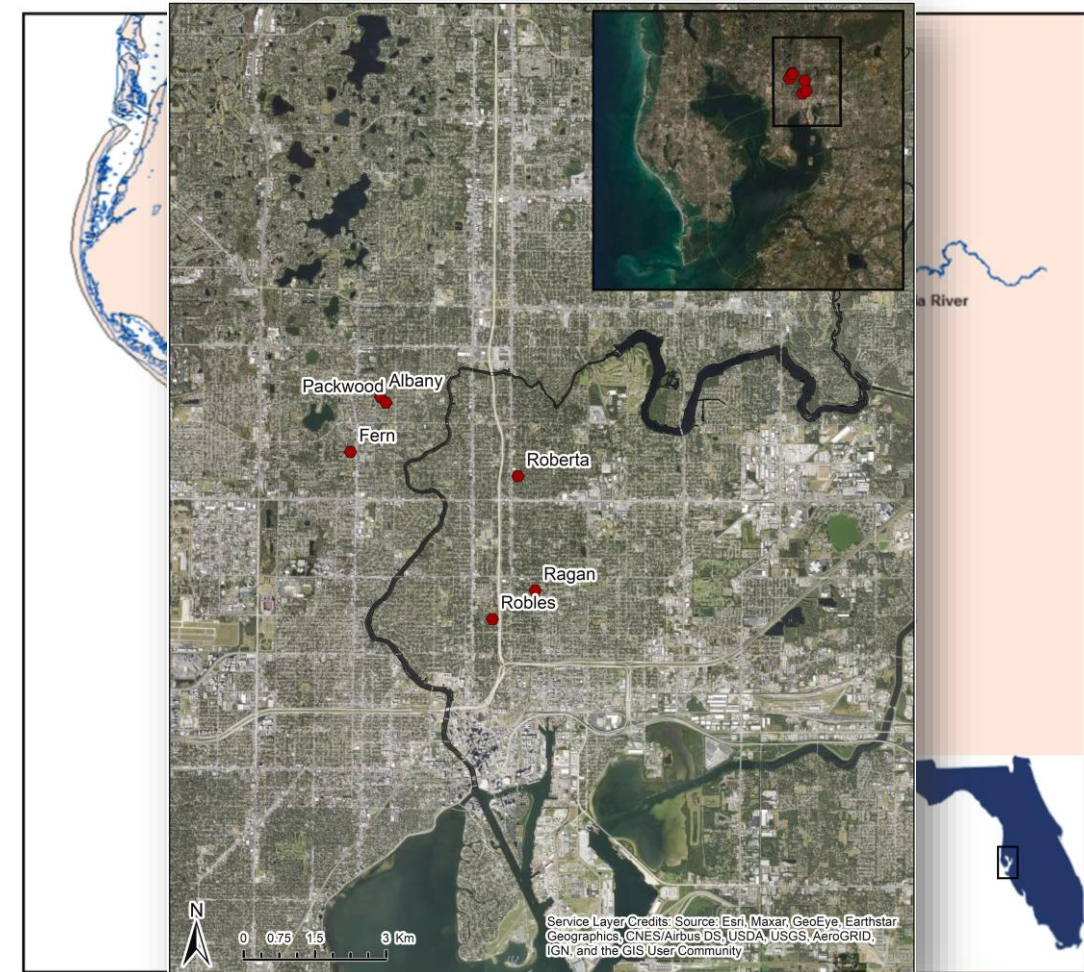
- 1 MPs/L in water
- 280 MPs/kg in sediment

- Stormwater ponds

- Ranged from 0–56 MPs/m³ in water
- 3–203 MPs/kg in sediment



a: Type of microplastics: Discrete samples.



Microplastics in organisms in Tampa Bay

Copepods

15 MPs/1000 copepods



Oysters

14 MPs/oyster



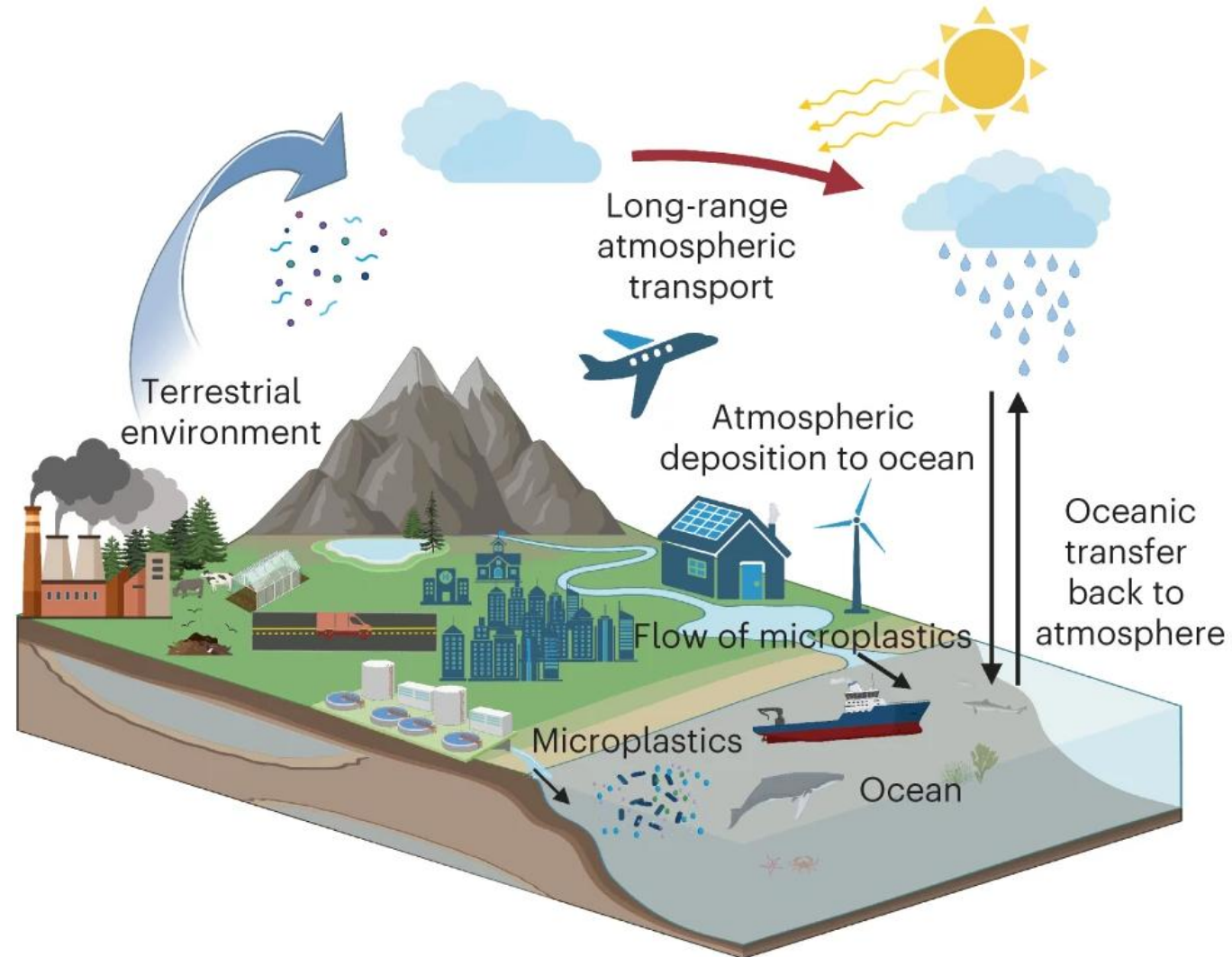
Manatees

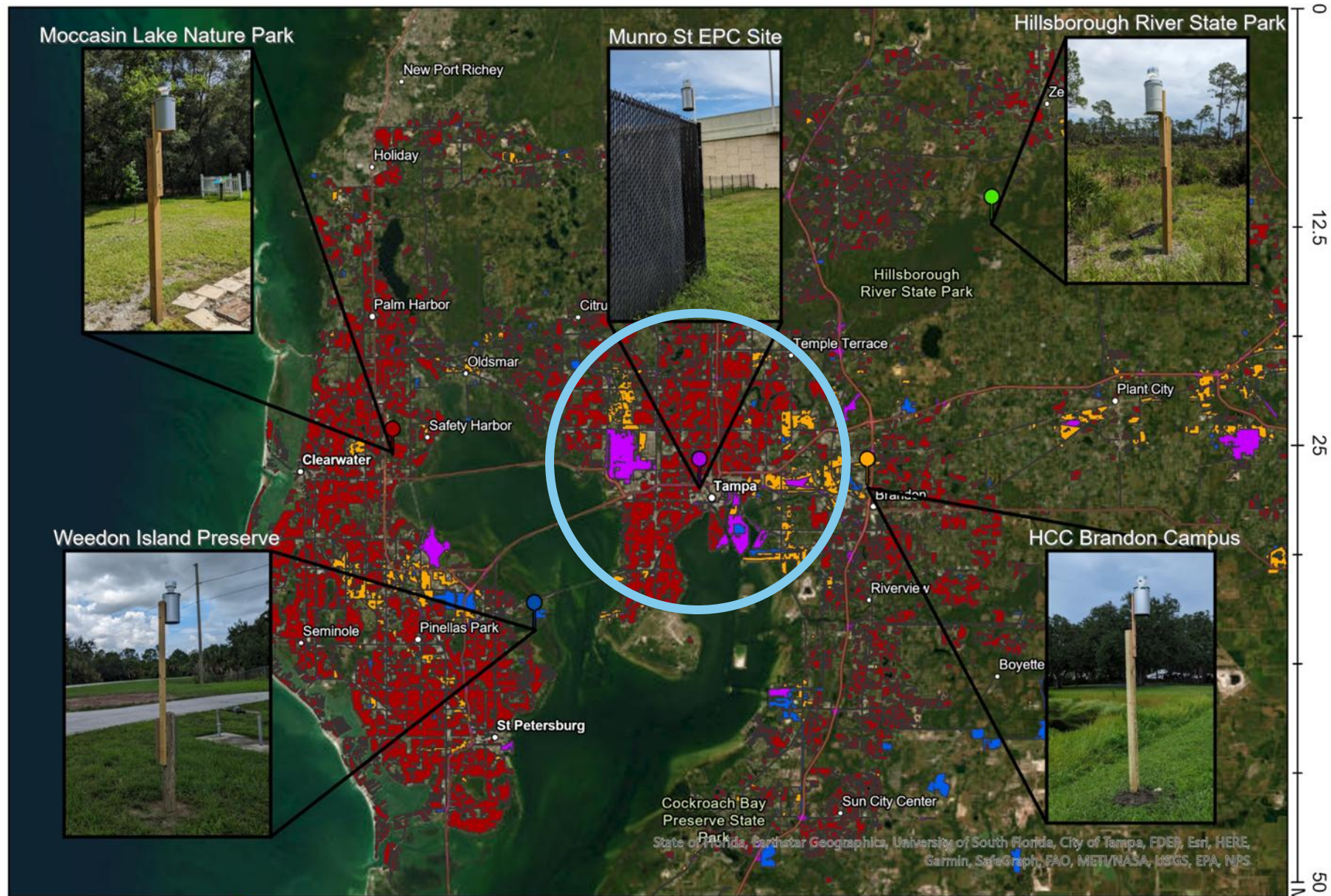
73% MPs present
5 MPs/kg wet weight



Microplastic transport in Tampa Bay

- Tampa Bay has high concentrations of microplastics, but where are they coming from?
 - Hillsborough River
 - 1 ton plastic/yr
 - **Atmosphere?**





Land use type

Residential

Utility

Transportation

Industrial

Control

Air sampling sites

Atmospheric microplastic study area

Microplastic in the air

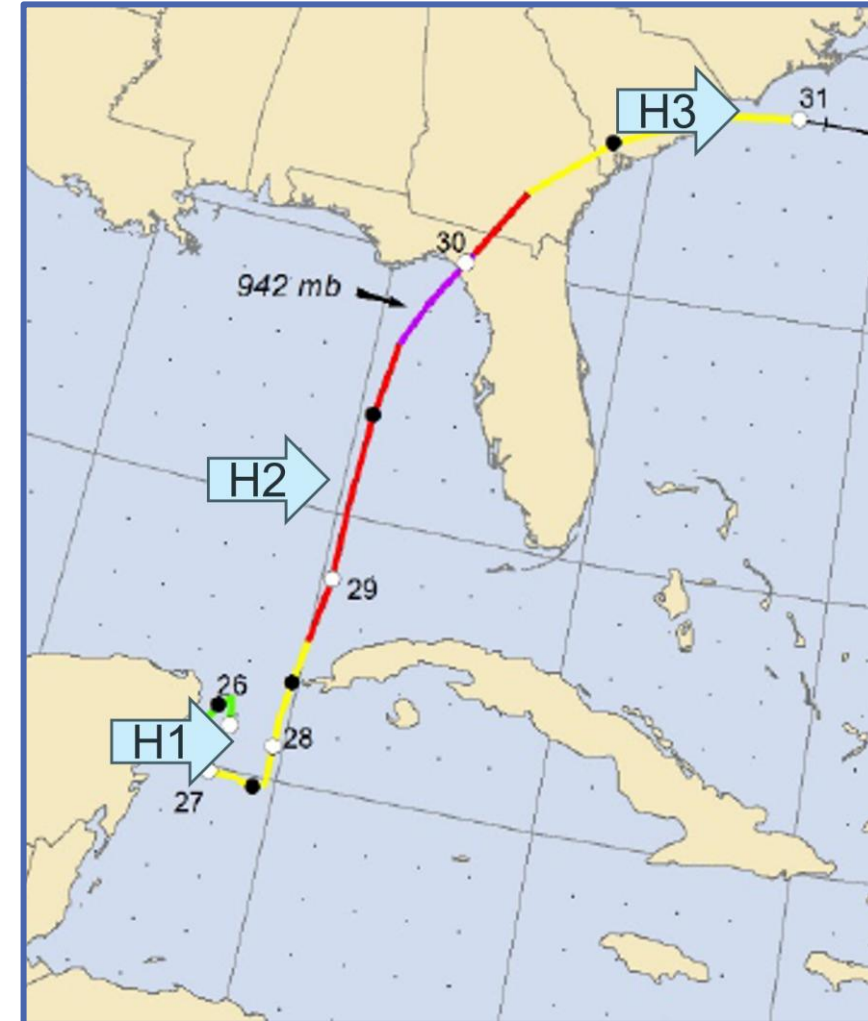


Hurricane Idalia forms...

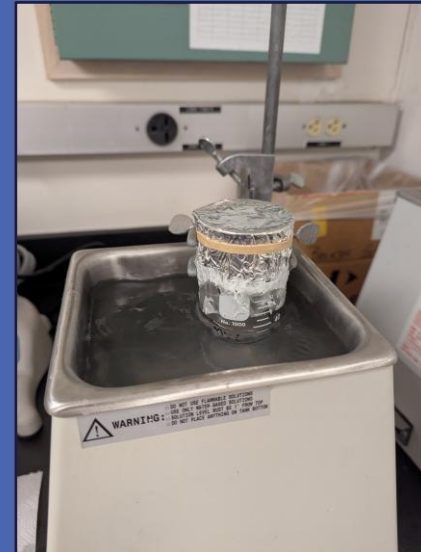
Sample name	Sample collection date	Sampling period (days)	Sampling period (hours)	Sampling site				
				Moccasin Lake	Weedon Island	Munro Street	HCC Brandon	Hills. River State Park
1	08/08/23	7	168	X	X	X	X	X
2	08/15/23	7	168	X	X	X	X	X
3	08/22/23	7	168	X	X	X	X	X
H1	08/28/23	6	144		X	X	X	X
H2	08/29/23	1	24			X	X	
H3	08/31/23	2	48	X		X	X	X
H4	09/05/23	5	120	X	X	X	X	X
4	09/12/23	7	168	X	X	X	X	X
5	09/19/23	7	168	X	X	X	X	X
6	09/26/23	7	168	X	X	X	X	X

Sample collections affected by Hurricane Idalia

Hurricane Idalia passes Tampa Bay



Sample processing

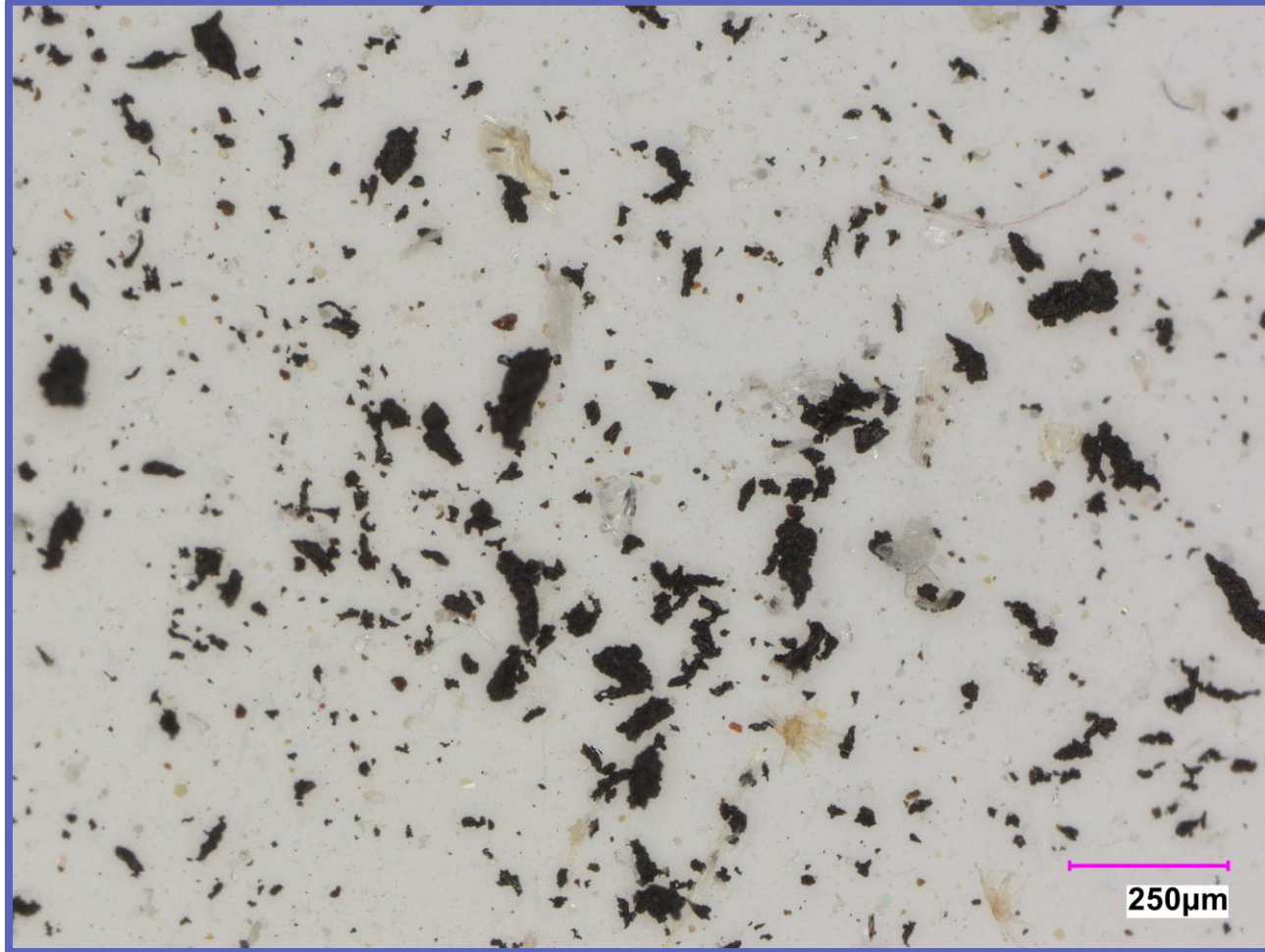


Reduce water volume

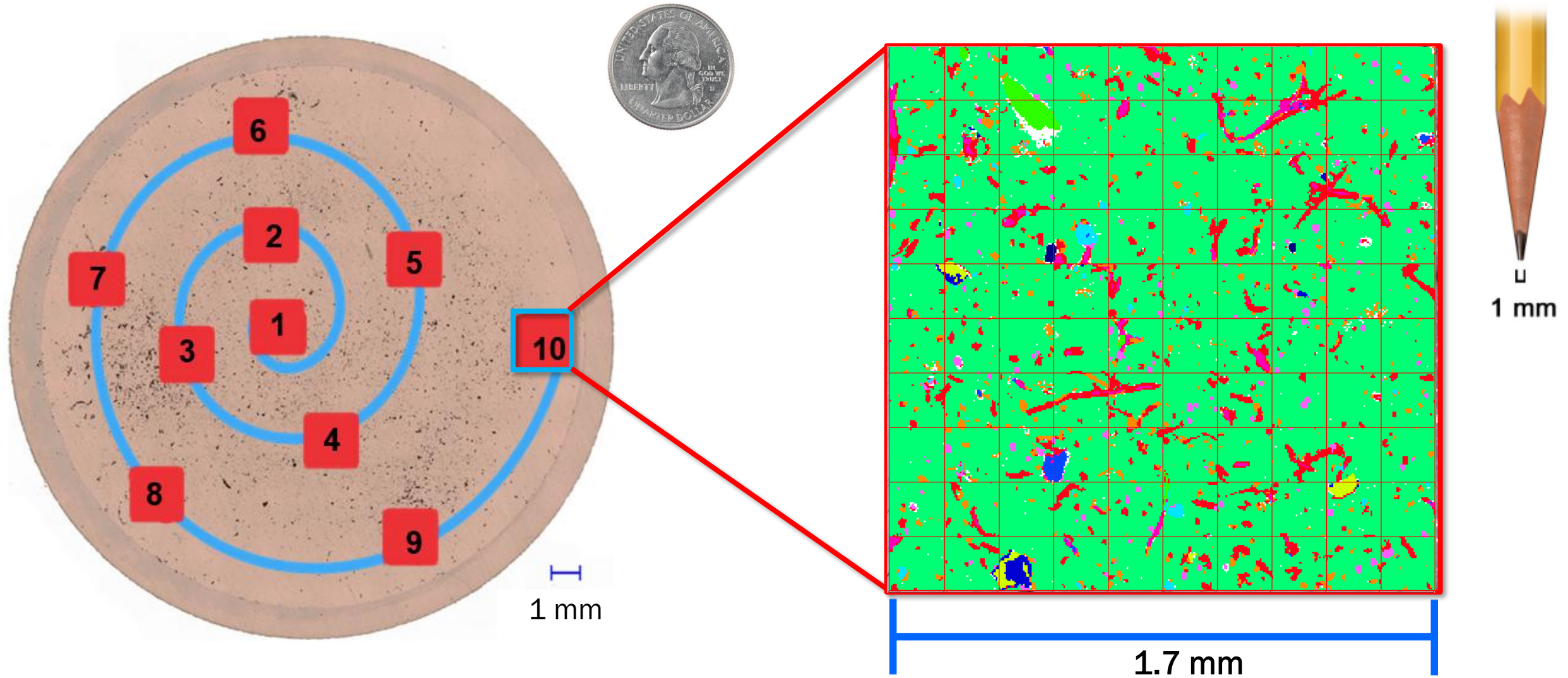
Heat (digest)

Concentrate on filter

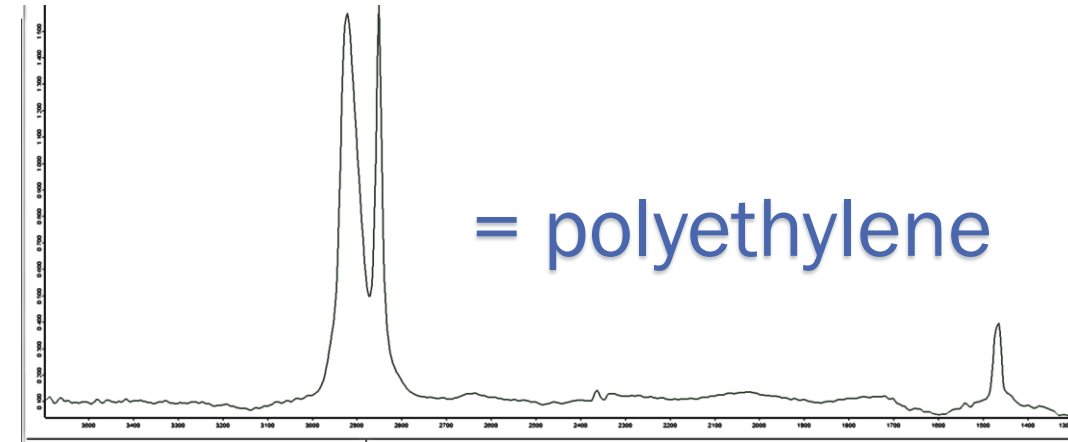
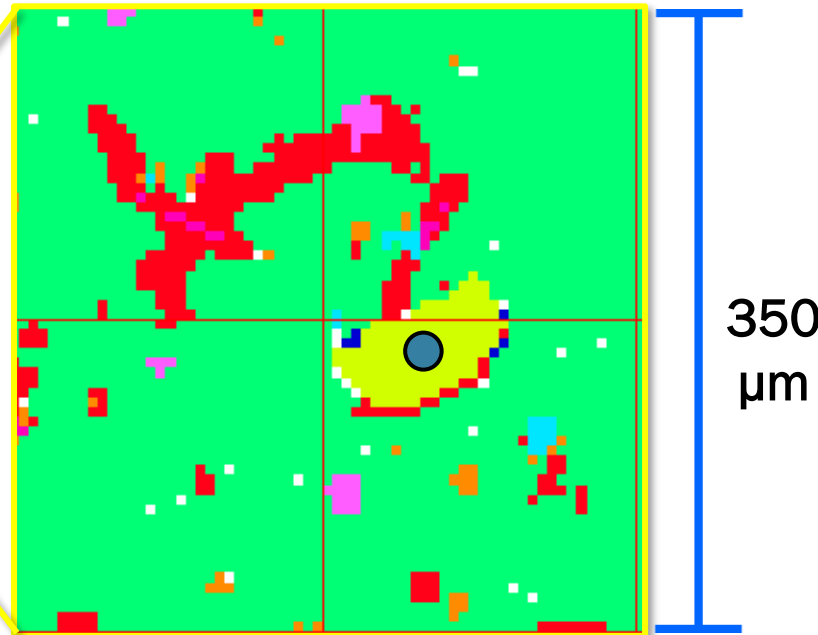
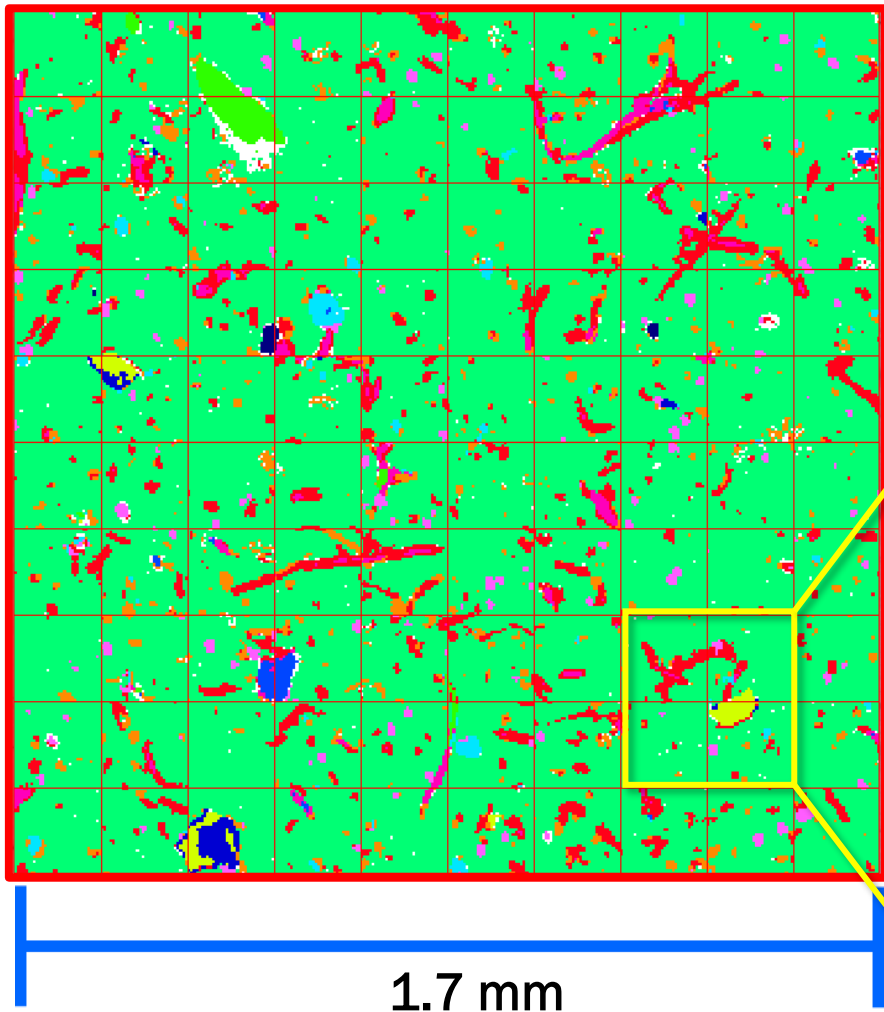
Is it plastic?



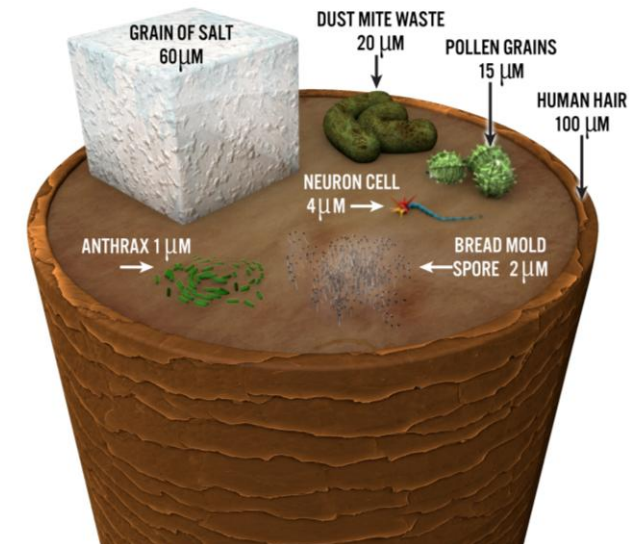
Chemical imaging



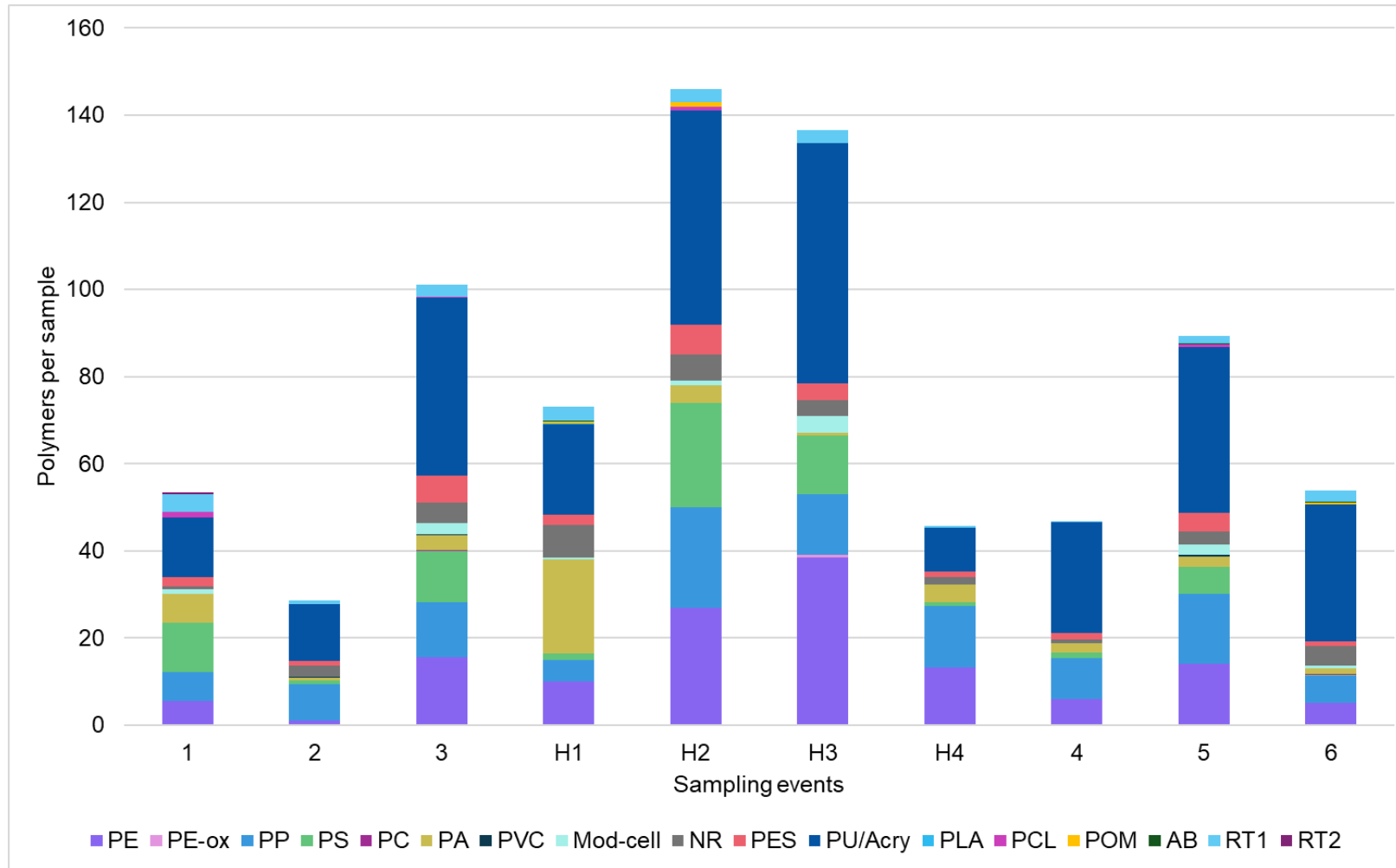
Chemical imaging



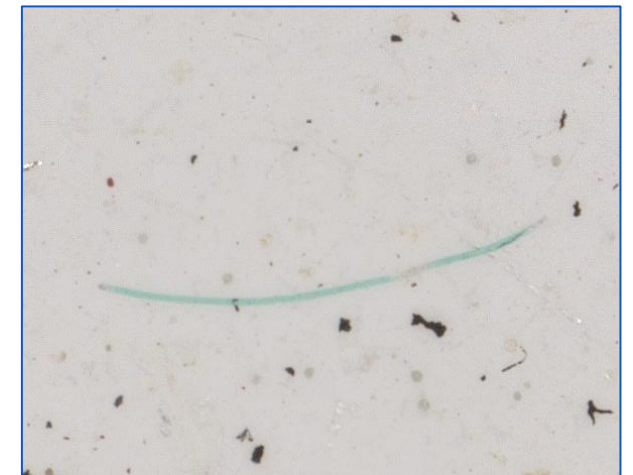
OBJECTS AT MICRON SCALE



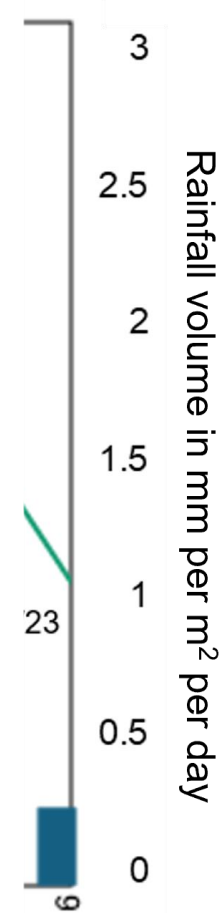
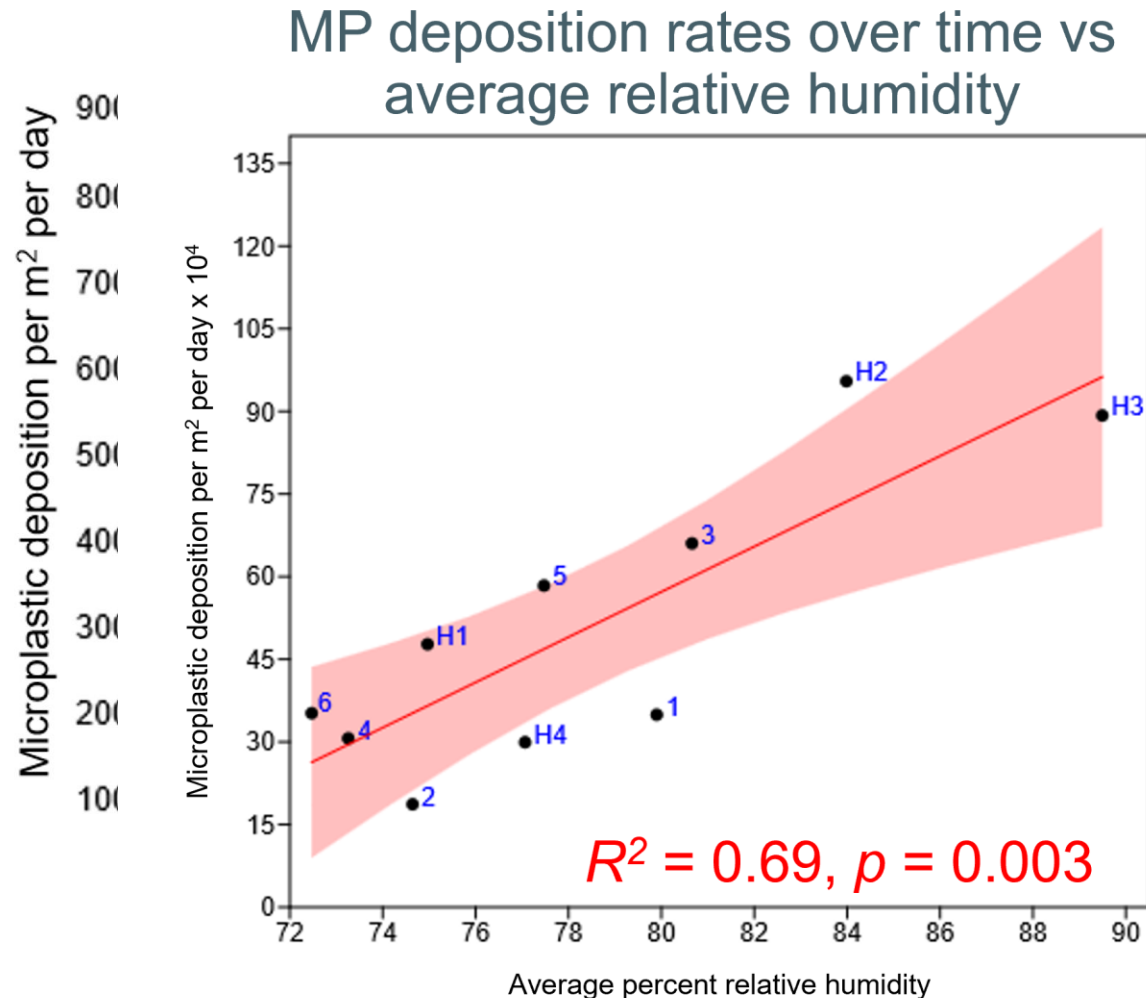
Microplastic characteristics



Particles: 89.9% Fibers: 10.1%



Microplastic hurricane?



Max: 95,456 MP/m²/day

**Average:
50,624 MP/m²/day**

Min: 18,680 MP/m²/day

— = MP deposition rate

■ = rainfall

Results



Positive correlation between MP deposition and rainfall volume



Relative humidity significantly correlated with MP deposition

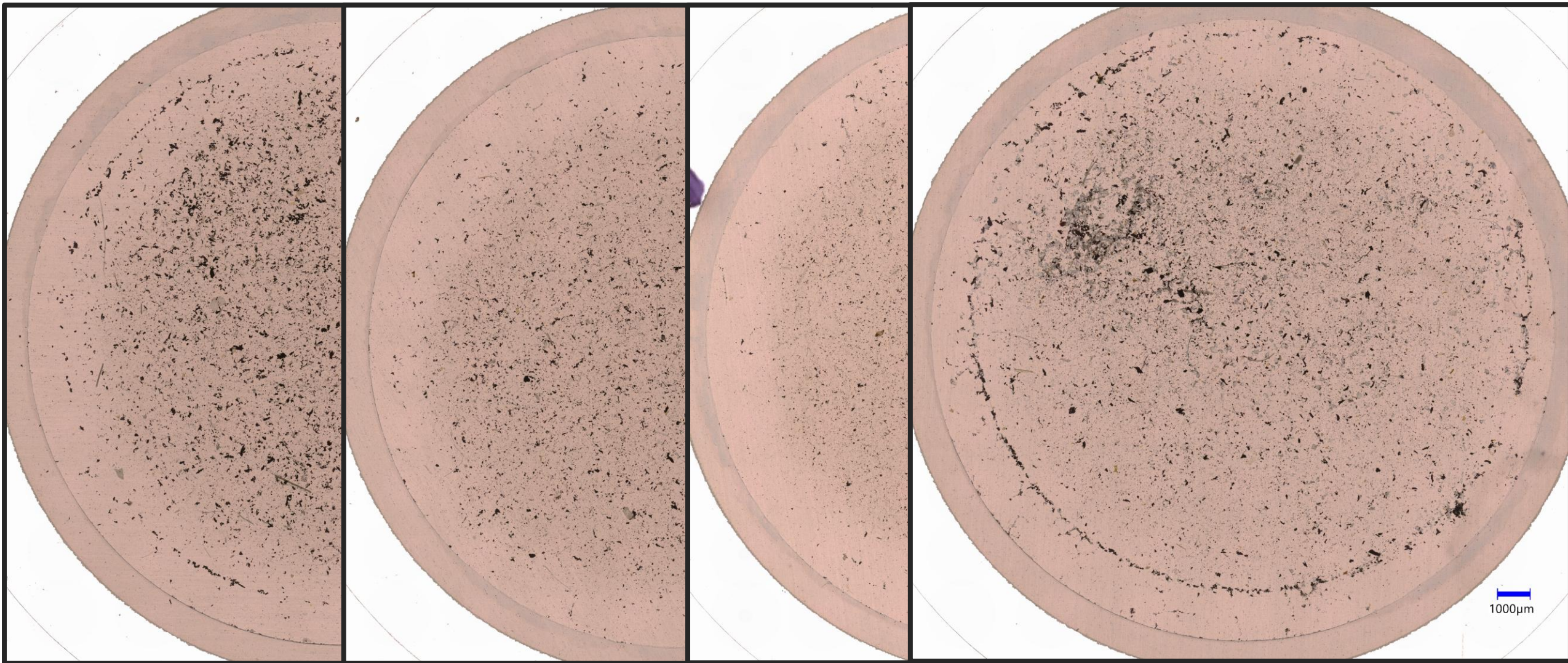


Large storms transport atmospheric MPs

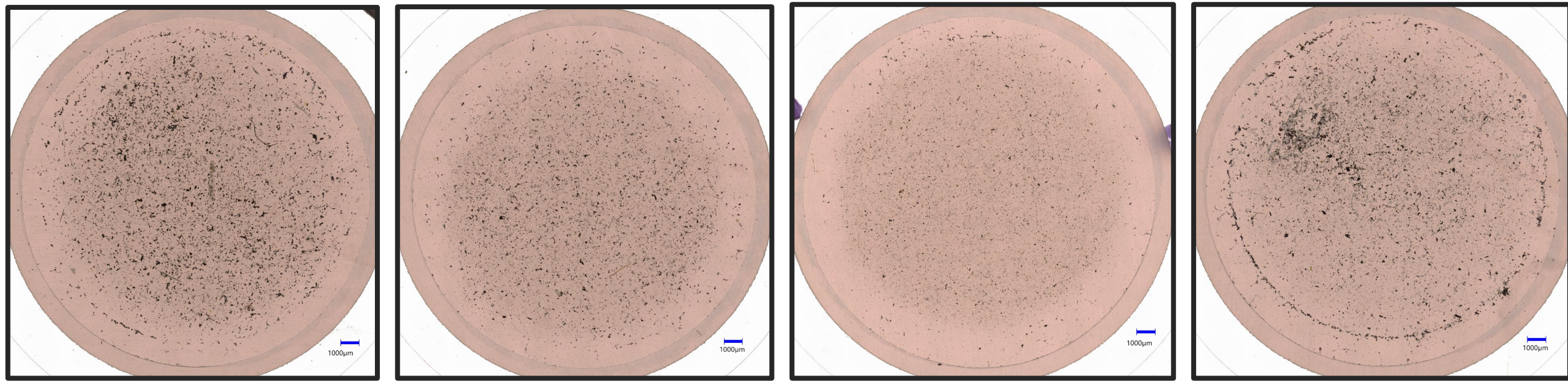


At least one hotspot of MP pollution in Tampa Bay

Future work



Future work



21,937

23,819

20,877

16,403

Sum = 83,806

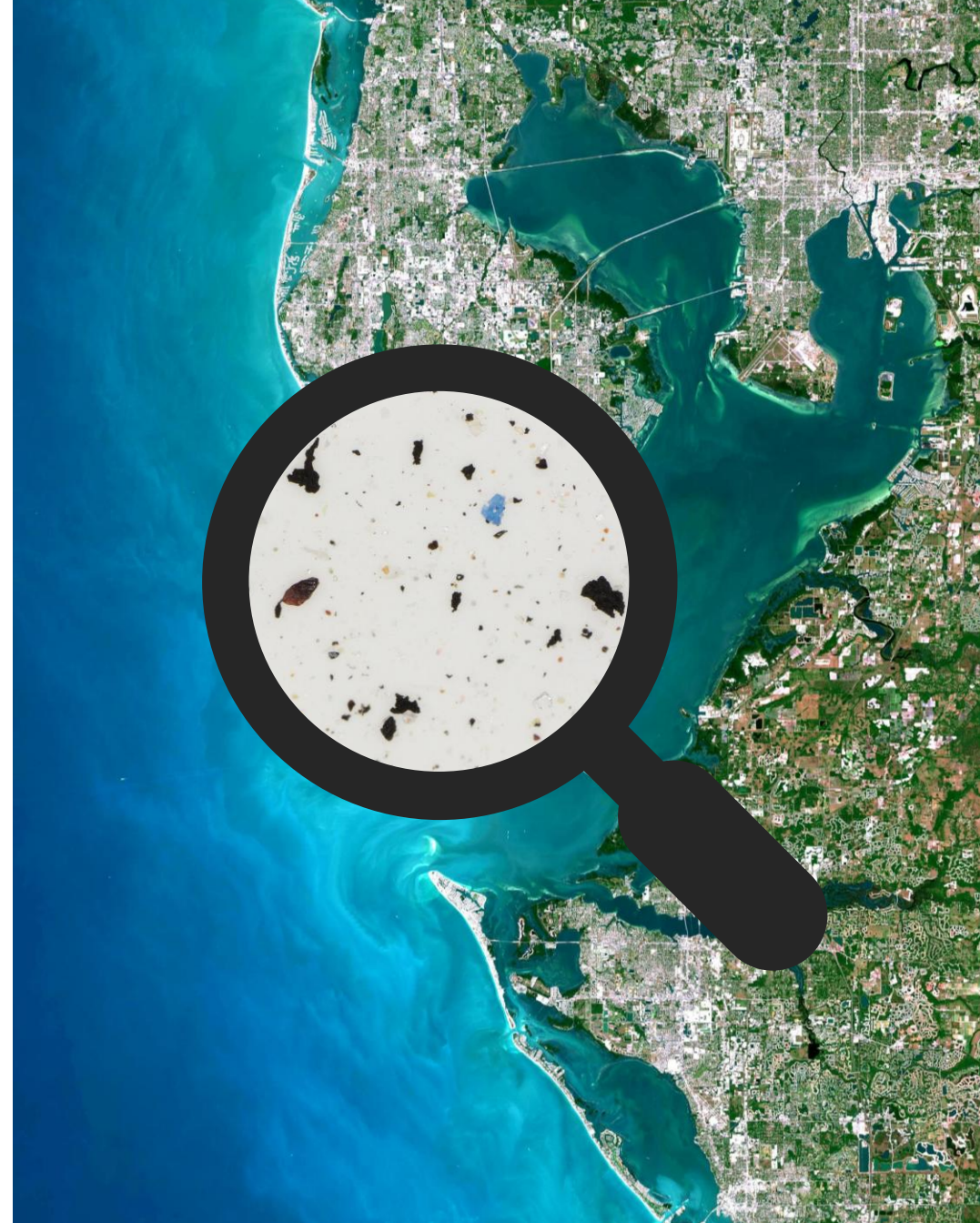
Deposition rate = 855,173 particles/m²/day

Future work

Microplastic working group:

- Capacity building → monitoring
- Holistic look at Tampa Bay
- Standardize methods and reporting
- Identify sources and prevent pollution

Marine MPs and tire wear particles



Questions?

Lyndsey “Zee” Grossmann

Lgrossmann@usf.edu

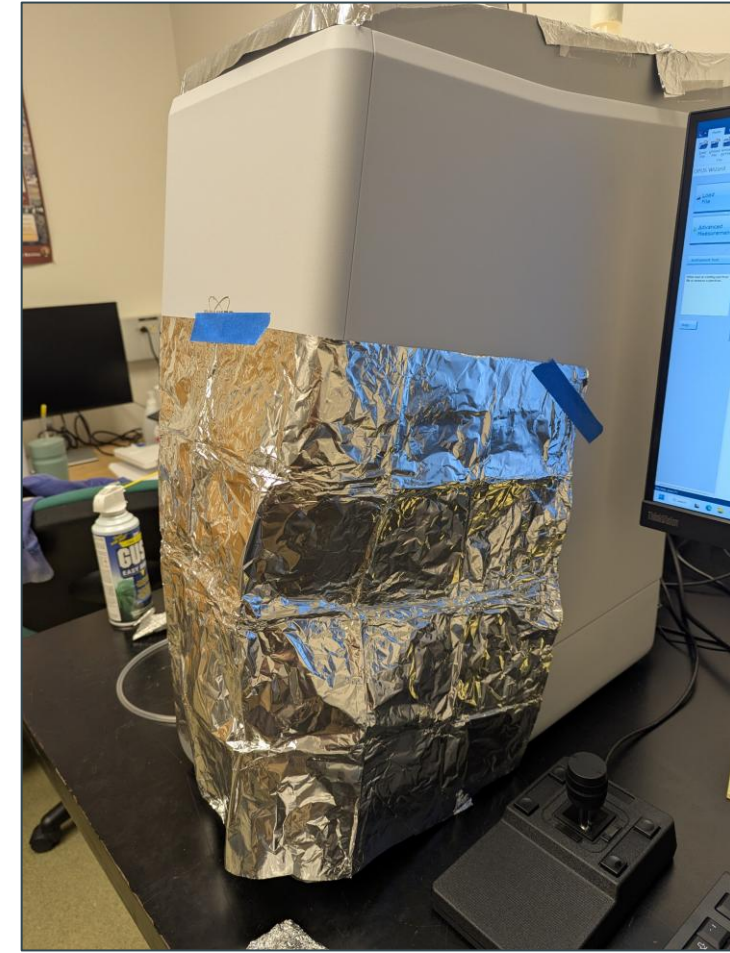
College of Marine Science

University of South Florida



Background → Methods → Results → Future work

Reducing contamination



Background → Methods → Results → Future work

Recap: Deposition flux of atmospheric microplastics in Tampa Bay before, during, and after Hurricane Idalia, 2023.

H1: High rates of precipitation increase atmospheric MP fallout by colliding with and weighing down large MPs, hastening their deposition.

- ✓ Prediction: Positive correlations between rainfall volume and both MP particle count and MP particle size.

Relative humidity significantly correlated with MP deposition.

H2: Hurricane winds increase sea spray that can entrain marine particulate pollution into the atmosphere, transport it long distances, and deposit in new places.

- ✓ Prediction: Increase in diversity of polymer types and novel MP community during Hurricane Idalia.

Background → Methods → Results → Future work

H1: High rates of precipitation increase atmospheric MP fallout by colliding with and weighing down large MPs, hastening their deposition.

Table 3. Independent variables tested for correlation with deposition in MP particle counts/m²/day using ordinary least squares regression. Significant correlations indicated by *. Tests that were significant after Bonferroni correction indicated by **. Std error *a* and Std error *b* refer to slope and intercept, respectively.

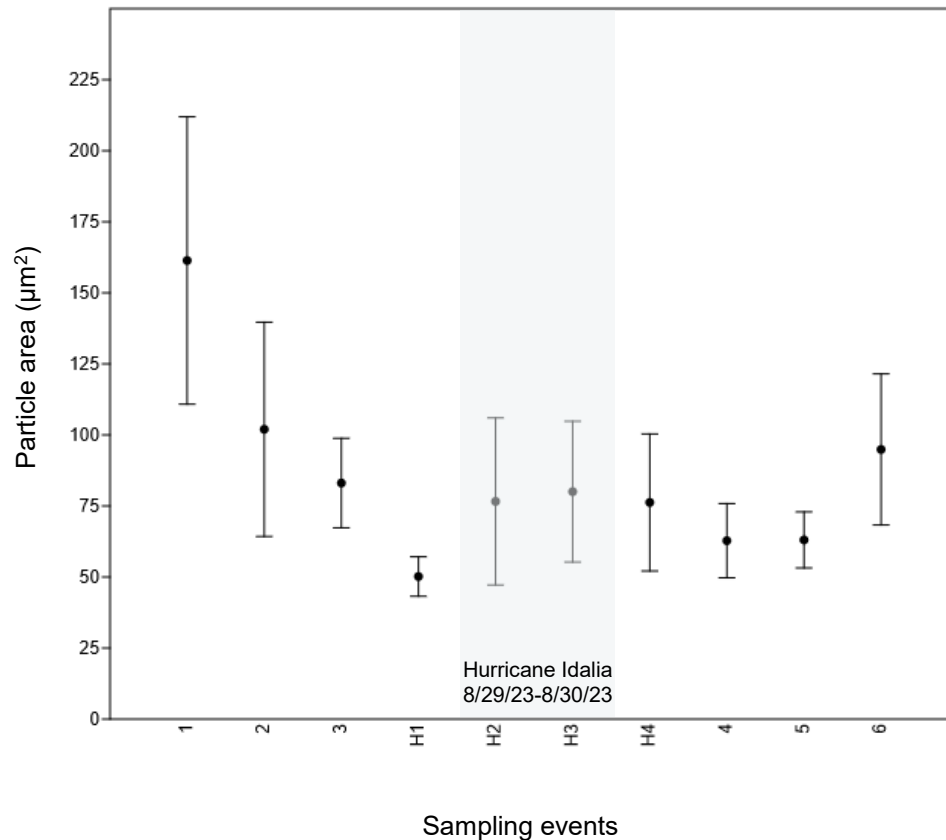
Independent variable	<i>p</i> -value	<i>R</i> ²	Std error <i>a</i>	Std error <i>b</i>
Average percent relative humidity	**0.003	0.69	1.0	76.0
Rainfall volume in mm/m ² /day	*0.007	0.61	6.8	7.2
Average wind speed in knots	*0.049	0.40	2.9	16.7
Average vapor pressure in Pa	0.496	0.06	0.0	126.1
Average wind direction in degrees	0.808	0.08	0.2	27.3
Average PM2.5 in µg/m ³	0.501	0.06	5.2	40.2
Percentage of days with precipitation	0.453	0.07	0.3	13.5
Percentage of county area in drought	0.443	0.08	1.3	50.7
Maximum wind gust in knots	0.580	0.04	1.3	35.9
Average maximum wind speed in knots	0.213	0.19	1.7	24.5

p-value
0.05 → 0.005

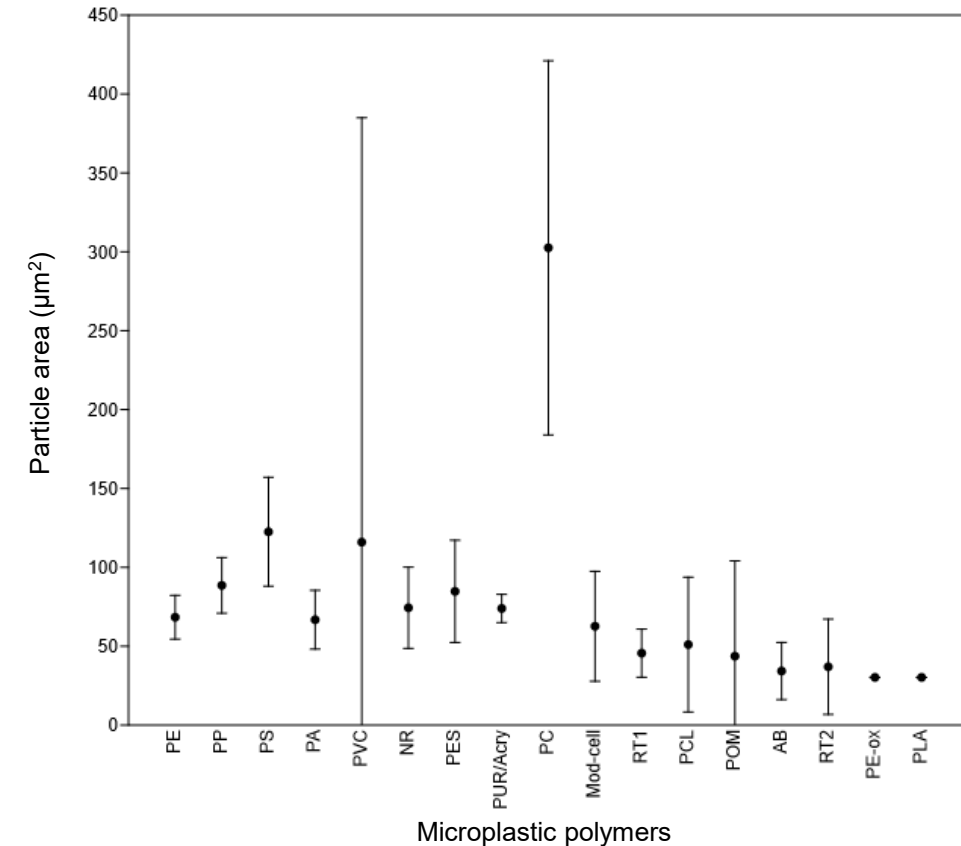
Background → Methods → Results → Future work

H1: High rates of precipitation increase atmospheric MP fallout by colliding with and weighing down large MPs, hastening their deposition.

Average particle size in μm^2 over time



Average particle size in μm^2 per polymer



Background → Methods → Results → Future work

Recap: Deposition flux of atmospheric microplastics in Tampa Bay before, during, and after Hurricane Idalia, 2023.

H1: High rates of precipitation increase atmospheric MP fallout by colliding with and weighing down large MPs, hastening their deposition.

- ✓ Prediction: Positive correlations between rainfall volume and both MP particle count and MP particle size.

Relative humidity significantly correlated with MP deposition.

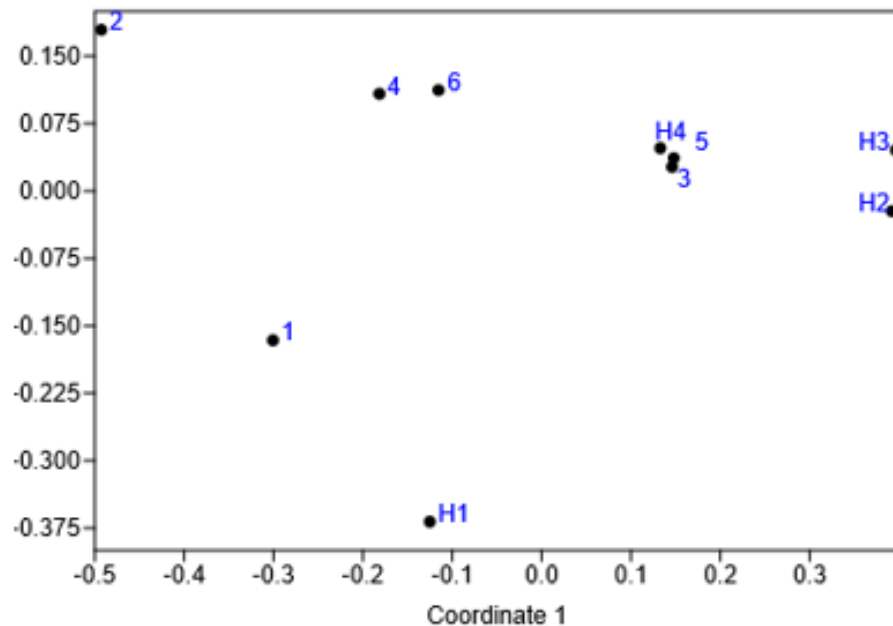
H2: Hurricane winds increase sea spray that can entrain marine particulate pollution into the atmosphere, transport it long distances, and deposit in new places.

- ✓ Prediction: Increase in diversity of polymer types and novel MP community during Hurricane Idalia.

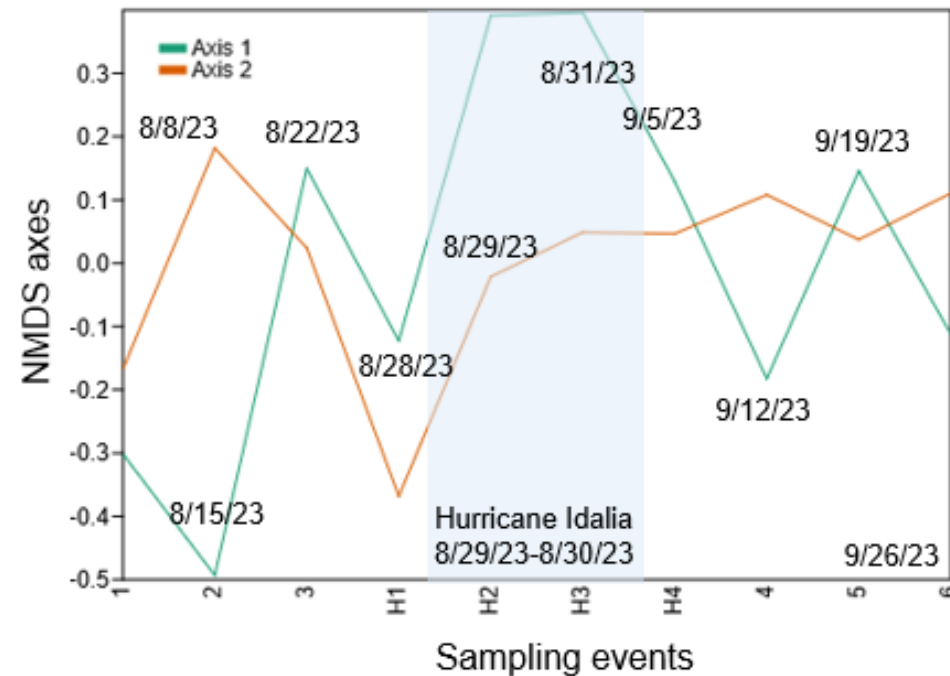
Background → Methods → Results → Future work

H2: Hurricane winds increase sea spray that can entrain marine particulate pollution into the atmosphere, transport it long distances, and deposit in new places.

Non-metric multidimensional scaling

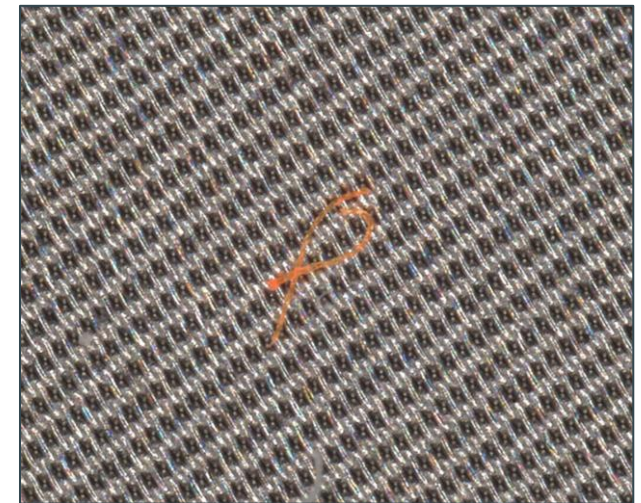
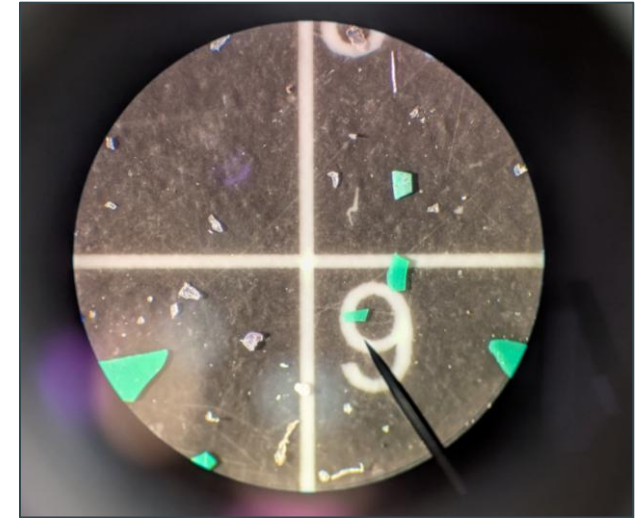


NMDS axes 1 and 2



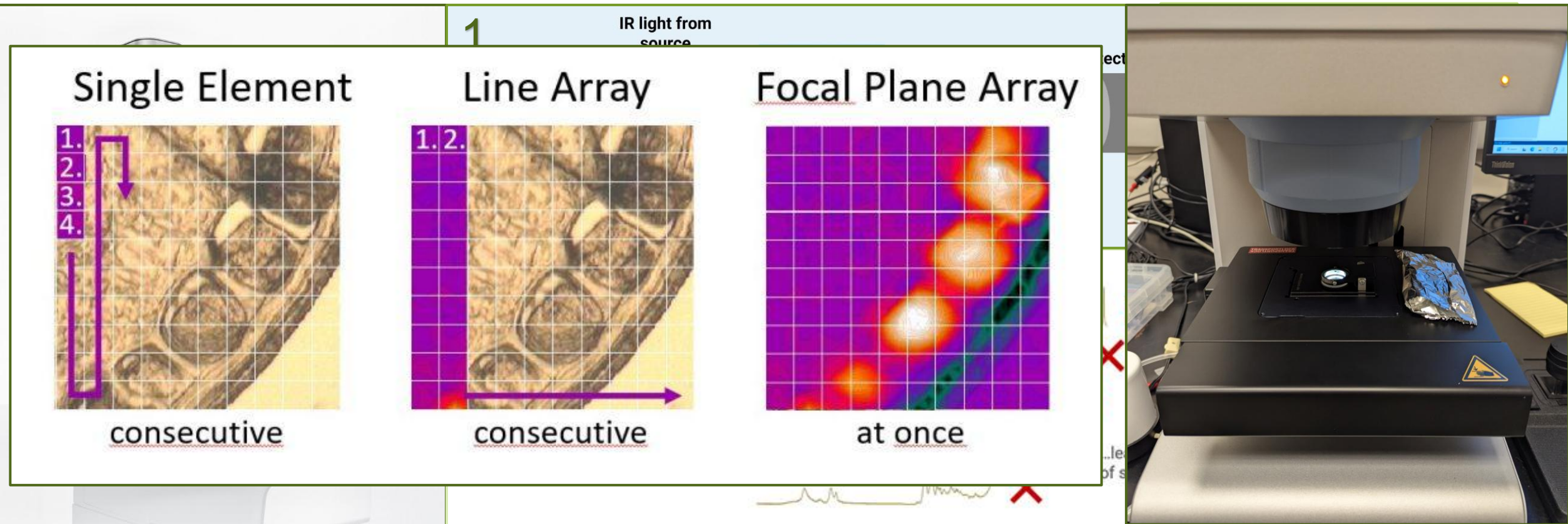
Supplemental

Recovery tests



Background → Methods → Results → Future work

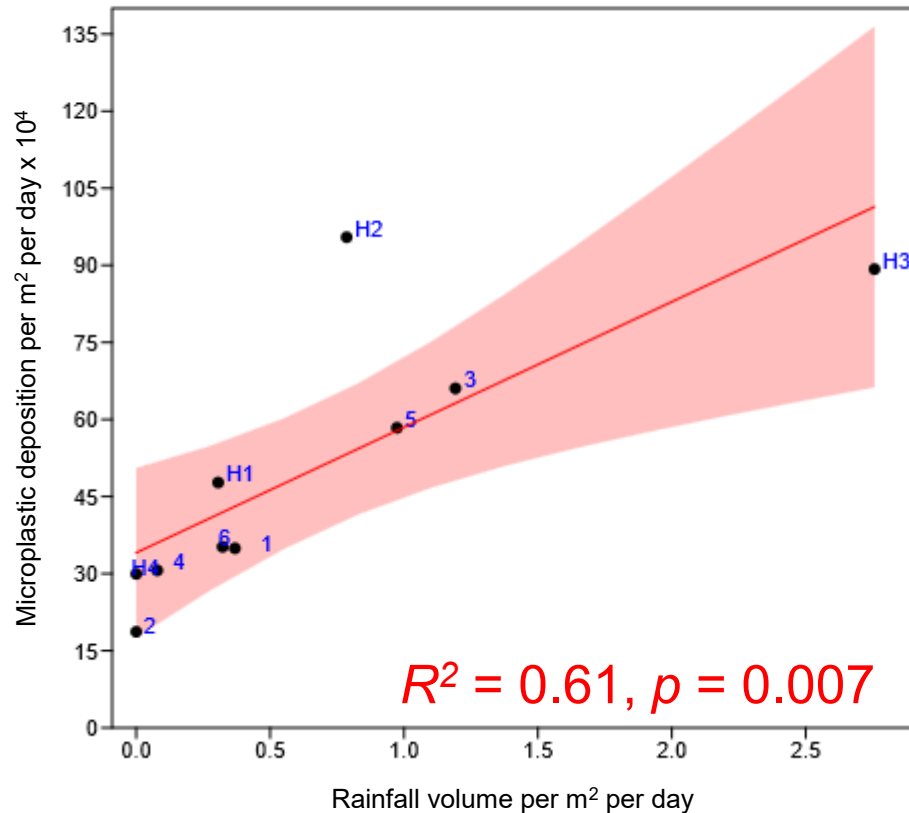
μFTIR FPA imaging with a Bruker LUMOS II microscope



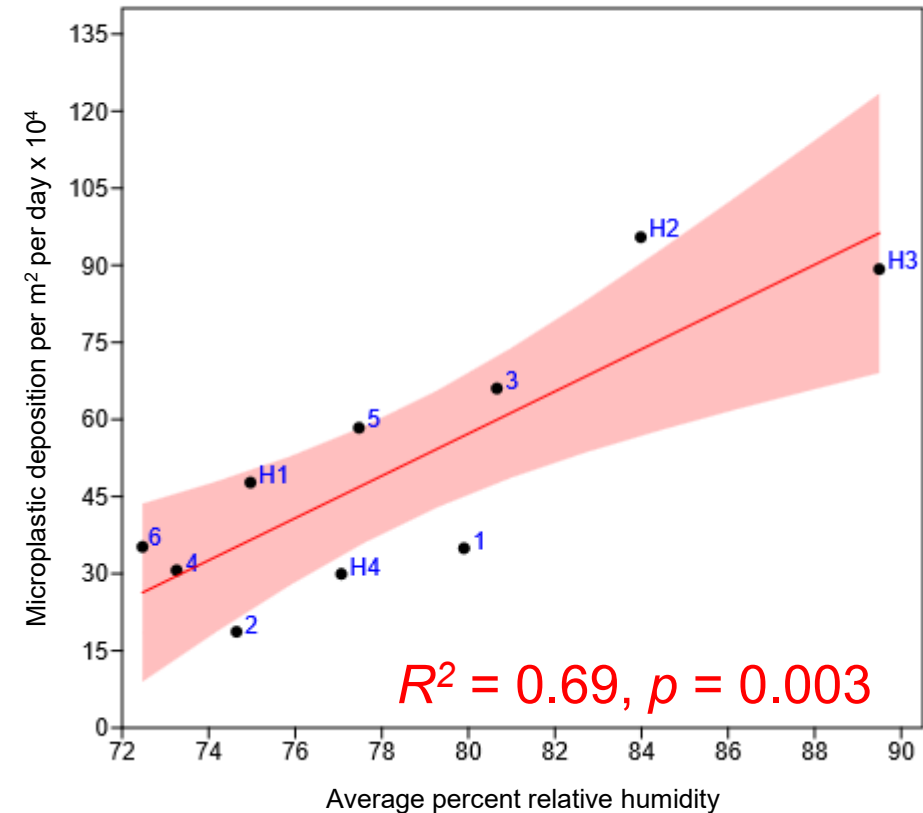
Background → Methods → Results → Future work

H1: High rates of precipitation increase atmospheric MP fallout by colliding with and weighing down large MPs, hastening their deposition.

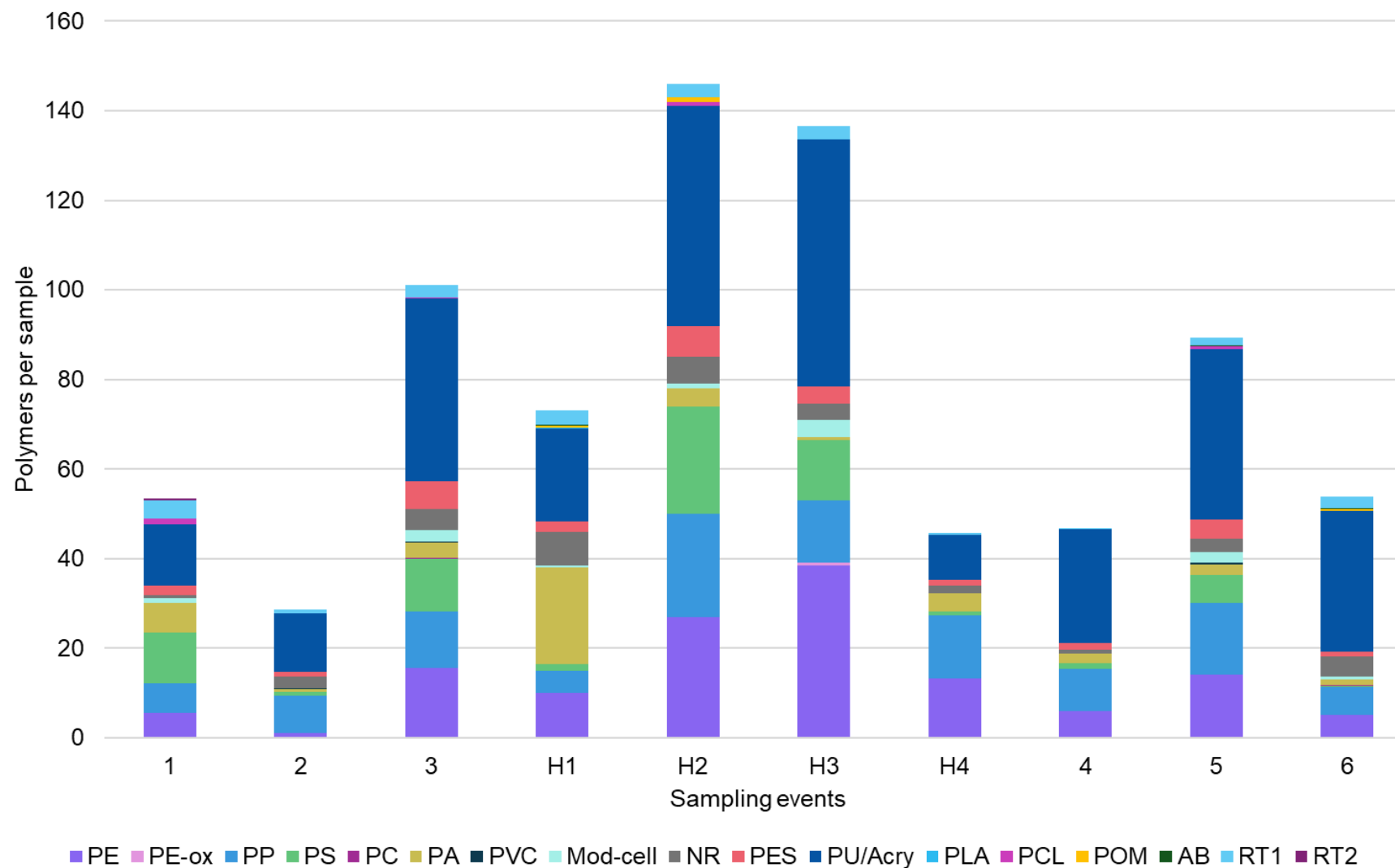
MP deposition rates over time vs rainfall



MP deposition rates over time vs average relative humidity



Background → Methods → Results → Future work



Particles: 89.9% Fibers: 10.1%



THE RELATIVE SIZE OF PARTICLES

From the COVID-19 pandemic to the U.S. West Coast wildfires, some of the biggest threats now are also the most microscopic.

A particle needs to be 10 microns (μm) or less before it can be inhaled into your respiratory tract. But just how small are these specks?

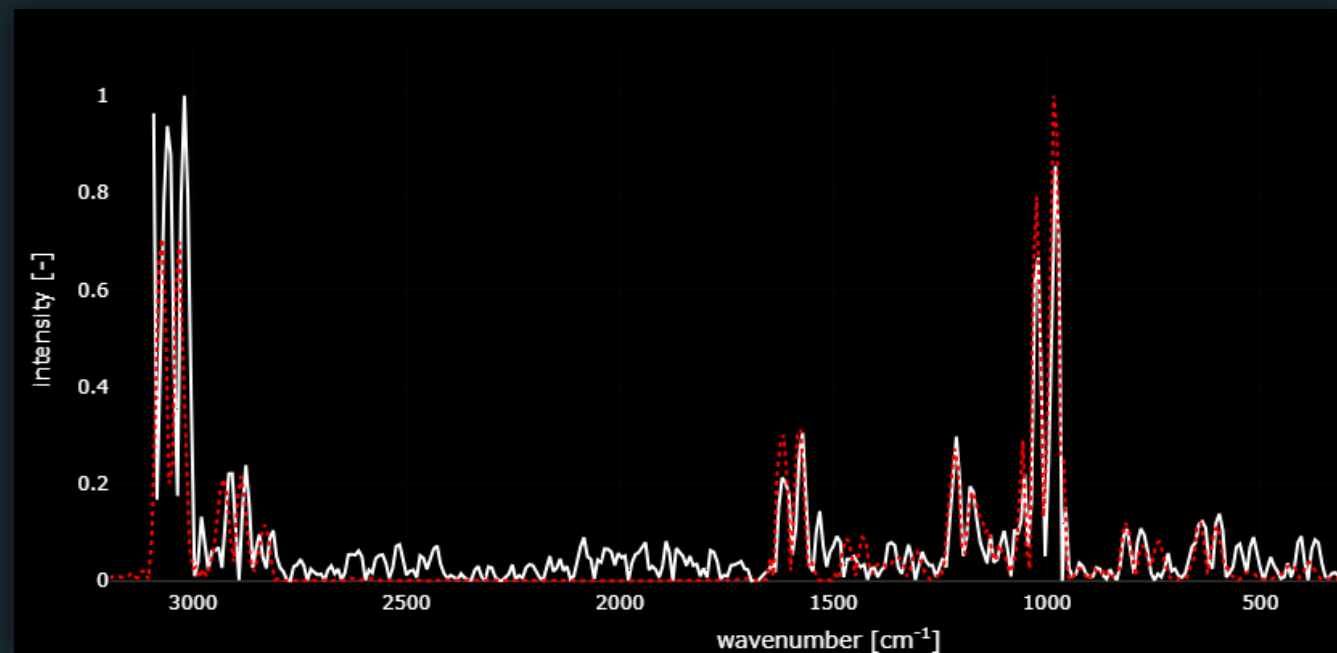
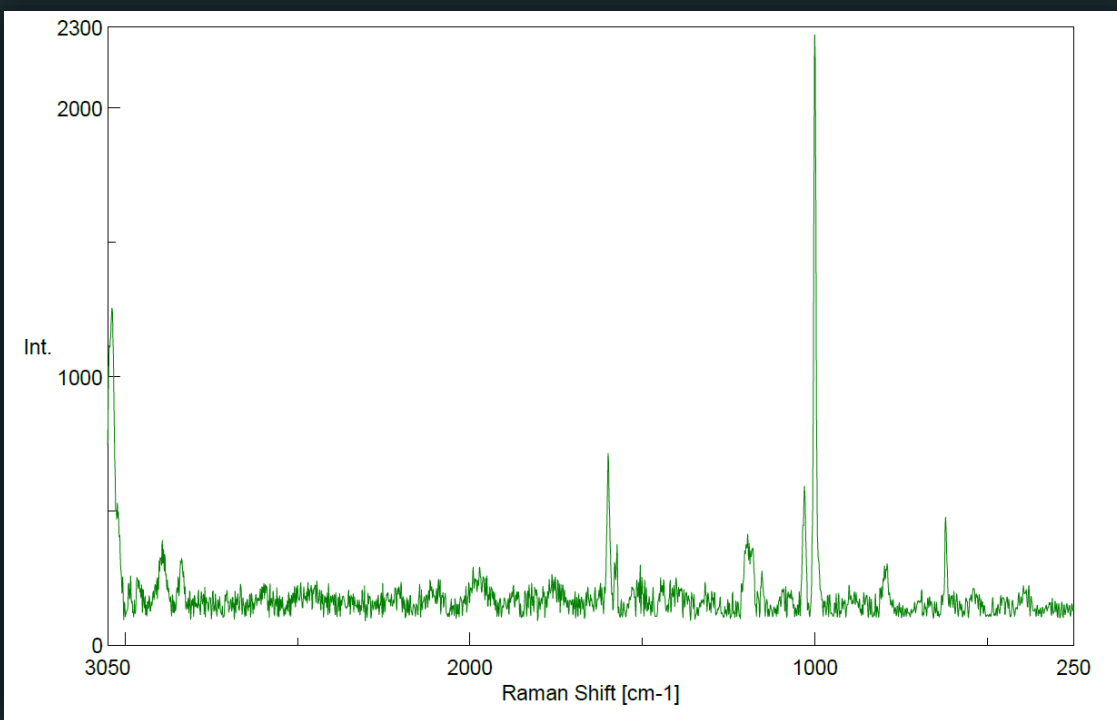
Here's a look at the relative sizes of some familiar particles »



SOURCES Greenstreet, Denise Laverby, EPA, Financial Times, News Medical, Science Direct, SCMR, Susan Sokolowski, Petrock, U.S. Dept. of Energy
COLLABORATORS RESEARCH + WRITING: Carmen Ang, Inan Ghosh | DESIGN + ART DIRECTION: Harrison Schell

**VISUAL
CAPITALIST**

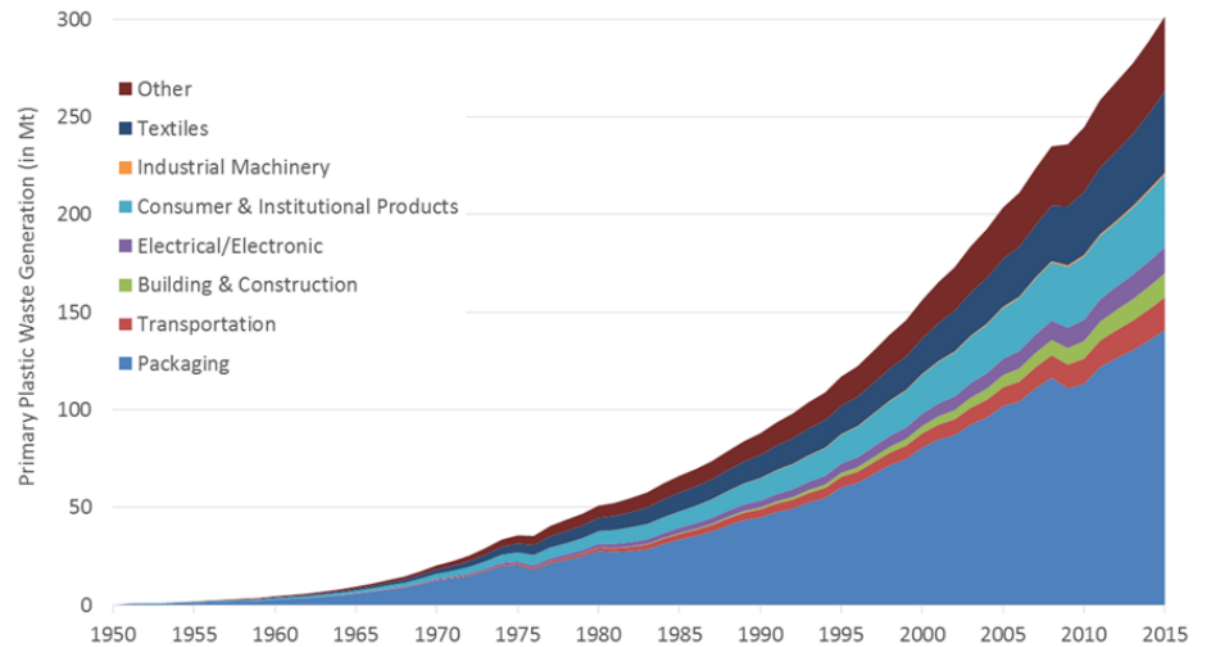
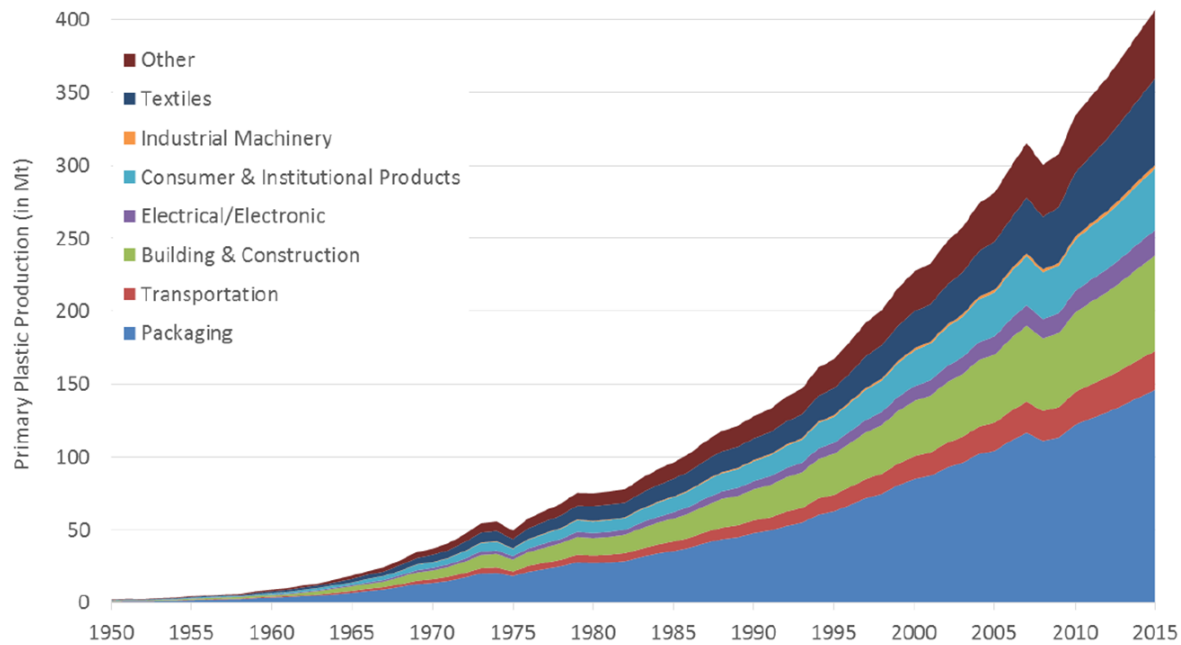
[f](#) [/visualcapitalist](#) [@visualcap](#) [visualcapitalist.com](#)



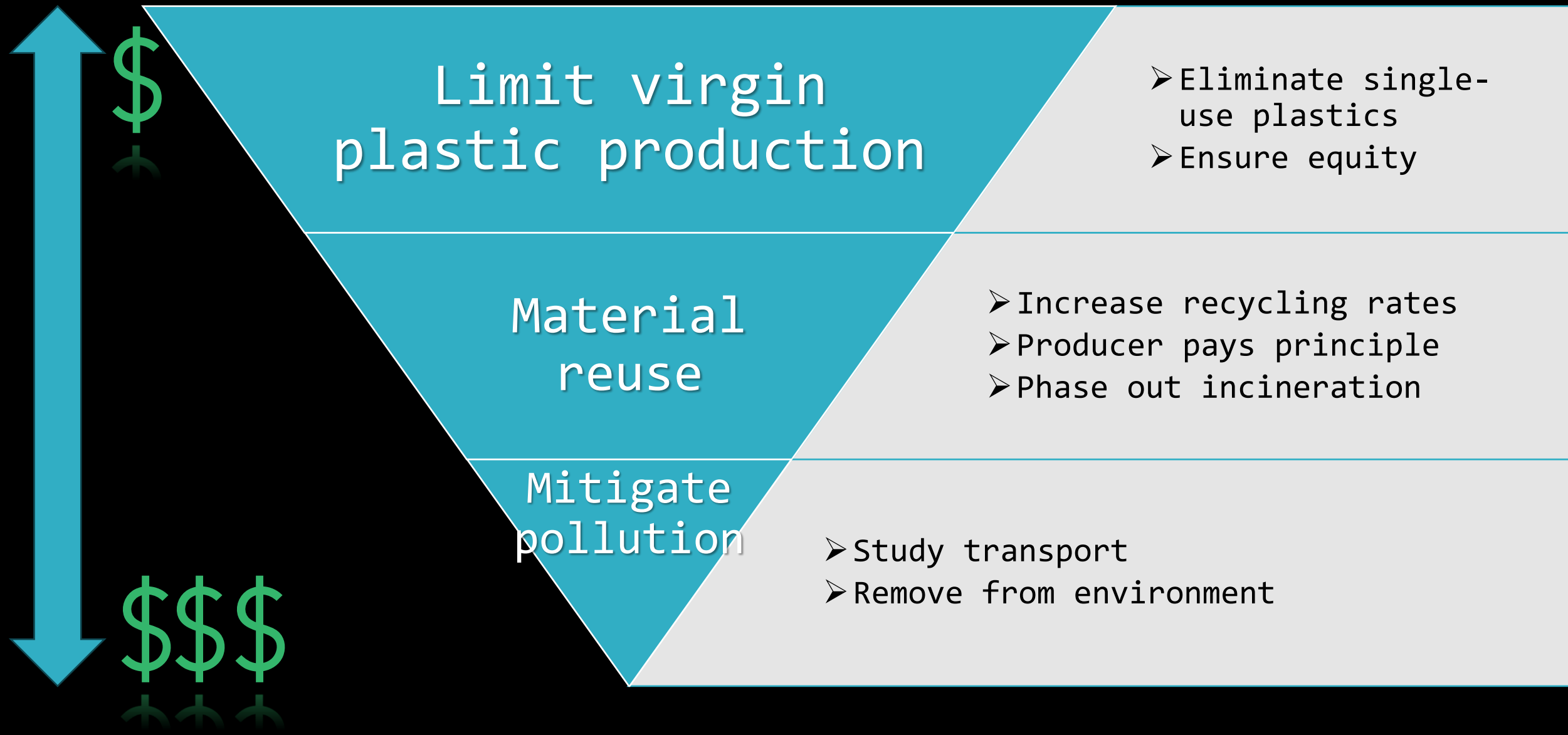
Plastic production



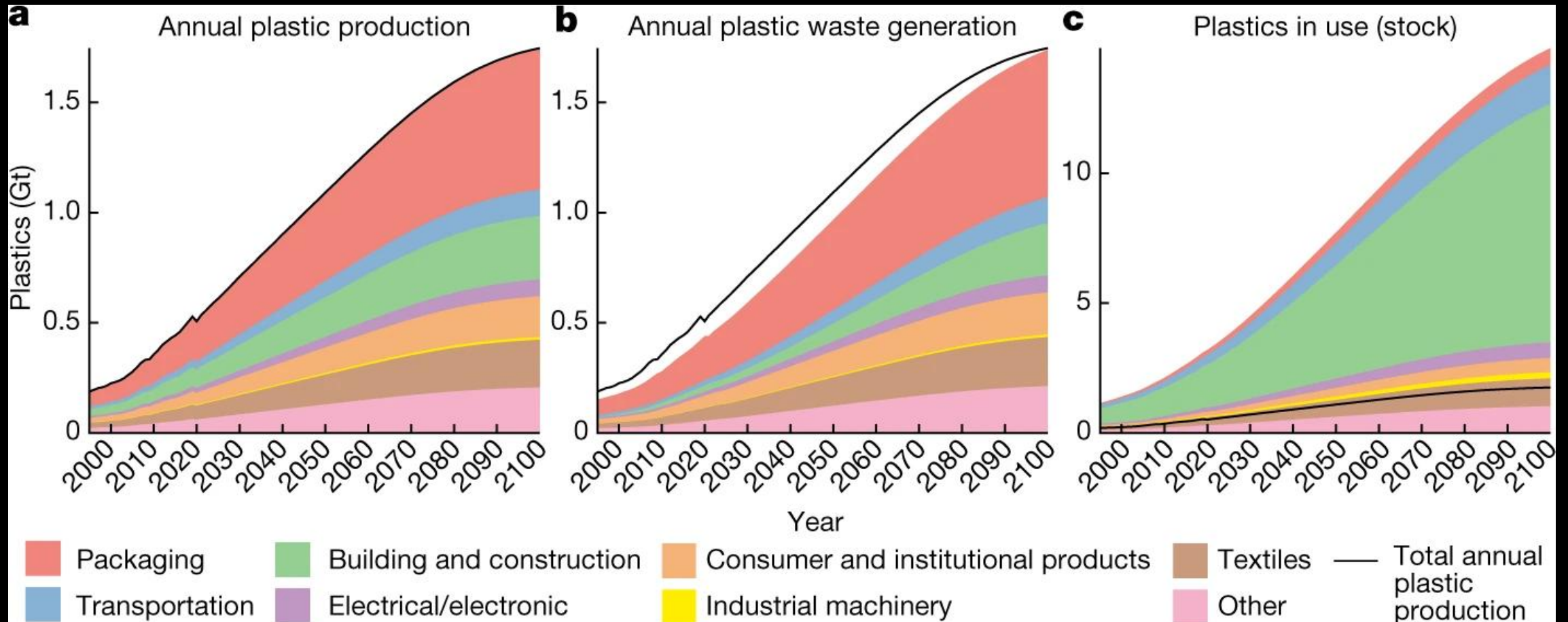
Plastic waste



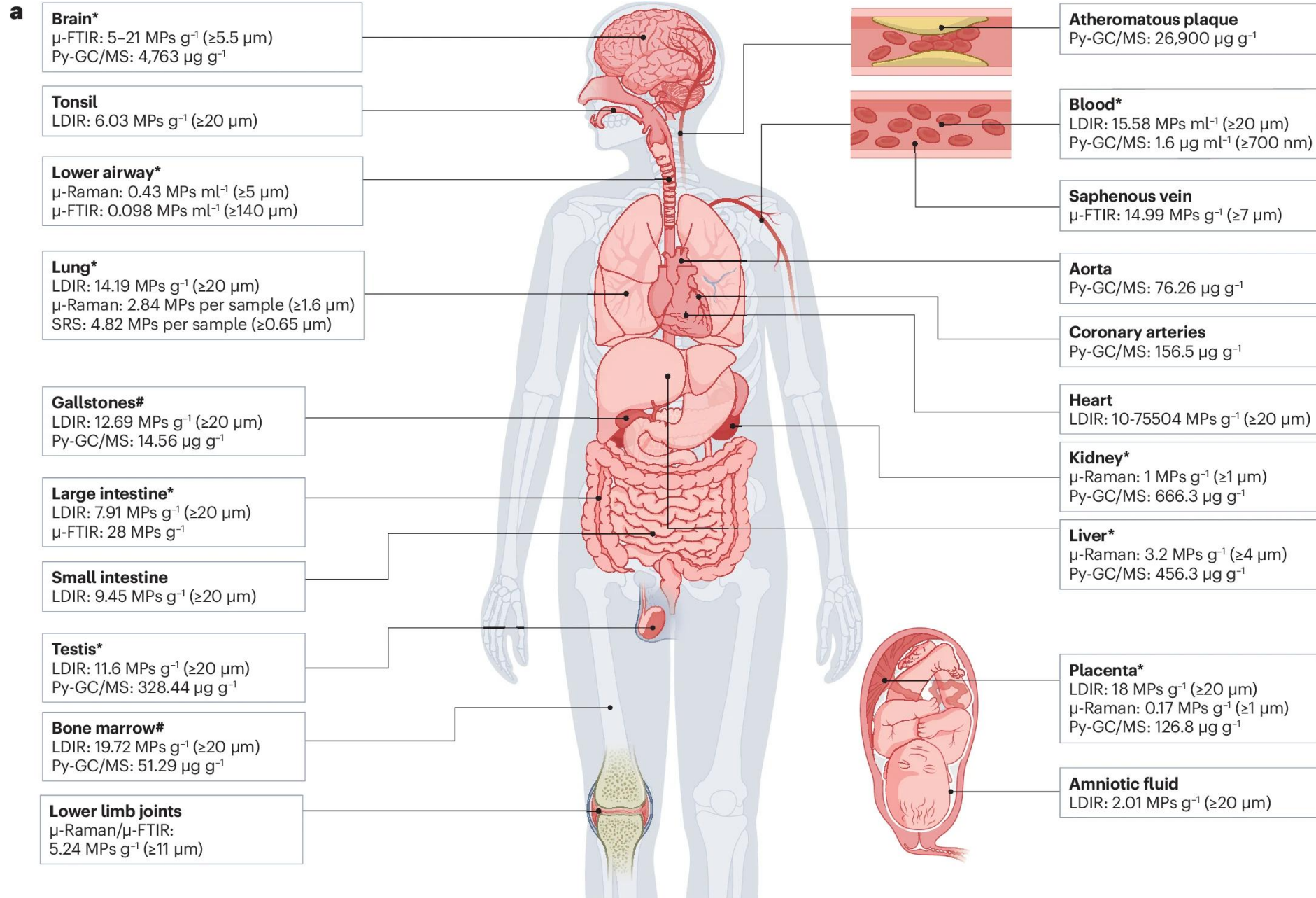
Plastic policy



Plastic future: SSP projections



Human



Plastic “end of life”?



Recycling

9%



Incineration

19%



Landfill

50%



22%

Chemical Fallout: It's raining plastic in Tampa Bay

Lyndsey Grossmann

PhD student

College of Marine Science

University of South Florida



Life is plastic, and it's not fantastic.

