Understanding the Fate of Microplastics in Sea Ice

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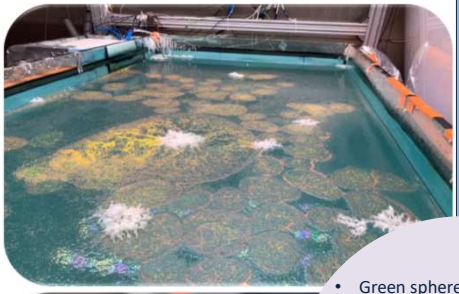
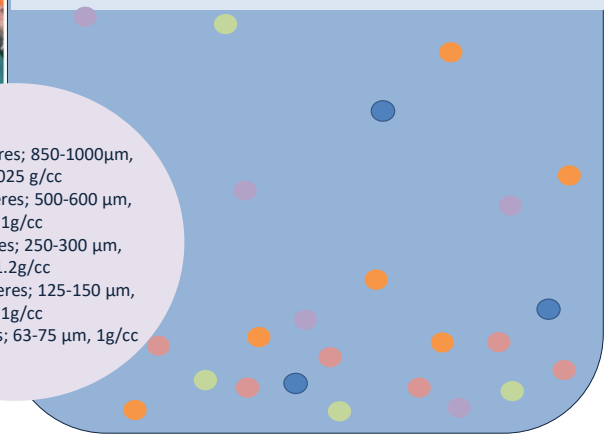
- **Microplastics** (dia. <5mm - ~0.1µm) have been discovered in **surface** and **sub-surface** marine waters, demonstrating they are readily available to **sea ice**, which has been identified as **a sink** for microplastic particles.
- Currently, there's a lack of knowledge concerning the **processes** and **rates** of microplastic **incorporation** within **sea ice**, and their possible effect on sea ice properties
- The purpose of this experiment was to provide a **mechanistic understanding** of plastic particle **uptake and behaviour** in forming sea ice; experiment at the Roland von Glasow Air-Sea-Ice Chamber (RvG-ASIC) at the University of East Anglia, UK

Experiment Outline

- 35 kg of salt was added to the tank to create **artificial seawater.**
- **Blanks** were taken prior to 'spikes' being introduced to the tank to determine **background contamination** associated with the sea ice chamber.
- **Microplastic "spikes"**, which included fluorescent polyethylene microspheres with densities ranging from 1 – 1.2 g/cc and sizes from 65 µm – 1000 µm, were added to the tank and left to mix for 24 hours (with pumps on high).
- Two **'freeze-thaw'** experiments were conducted
- **Salinity** and **temperature** were monitored throughout the experiment.



- Green spheres; 850-1000µm, 1.025 g/cc
- Yellow spheres; 500-600 µm, 1g/cc
- Red spheres; 250-300 µm, 1.2g/cc
- Orange spheres; 125-150 µm, 1g/cc
- Blue spheres; 63-75 µm, 1g/cc

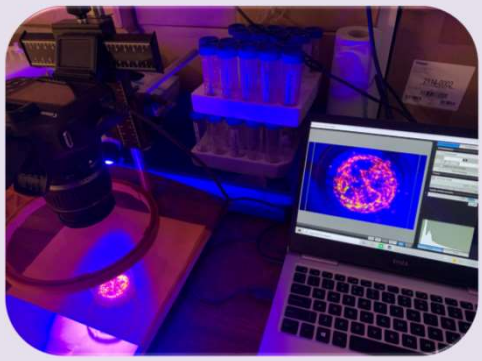


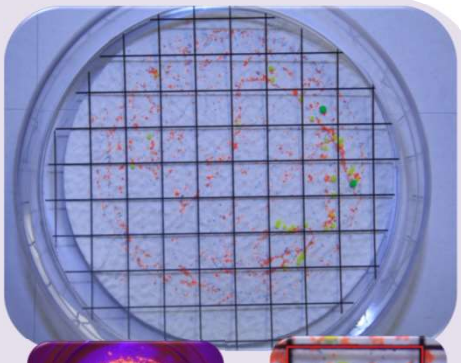
Sampling methods

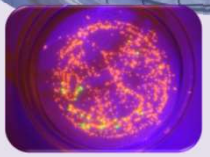
- Initial microplastic samples were taken from both the **surface (top 2 cm)** and **sub-surface (80 cm)** layer using a custom glass sampling pipe.
- Once ~**15 cm of ice** had formed (3 days freezing), more surface and sub-surface seawater samples were taken.
- After this, **sea ice cores** were taken from across the tank.
  - The cores were randomly **'bulked'** to give 3 replicates of ice across the tank – which were split into 5 ~3 cm **layers.**
  - After a two-day **melting period** (melting @ ~30 °C), surface and sub-surface samples of the meltwater were taken to determine **particle distribution post-melt.**
  - A **second freezing** period of three days at -35 °C was undertaken for the second round of sampling.

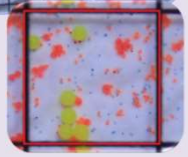
Processing Methods

- Samples were processed onto 47 mm Whatman GF/F filter papers.
- **UV light** was used to track particle loss. Particles left on the filtration system were rinsed into a beaker and filter after each batch of replicates.
- **Images** were taken of all filters, both with and without UV, and with a grid for counting.









- Preliminary results show sea ice formation results in the **entrainment** of these **microplastics into the ice**.
- The **highest particle concentrations** were observed in the **uppermost layer** of sea ice (ice – atmosphere interface), with **lower particle concentrations** in the **base of the ice** and the surrounding seawater (surface and sub-surface).
- **Microplastic release** during simulated **sea ice thaw** was also tracked, with evidence of particle accumulation in a buoyant, lower-saline meltwater layer **beneath the ice**.

I would love to hear your feedback/questions! Please email me at h.ball@Lancaster.ac.uk or message me @_HBall