GLOBESINK – constraining the biological carbon pump with a global dataset of particle size and concentration from BGC Argo

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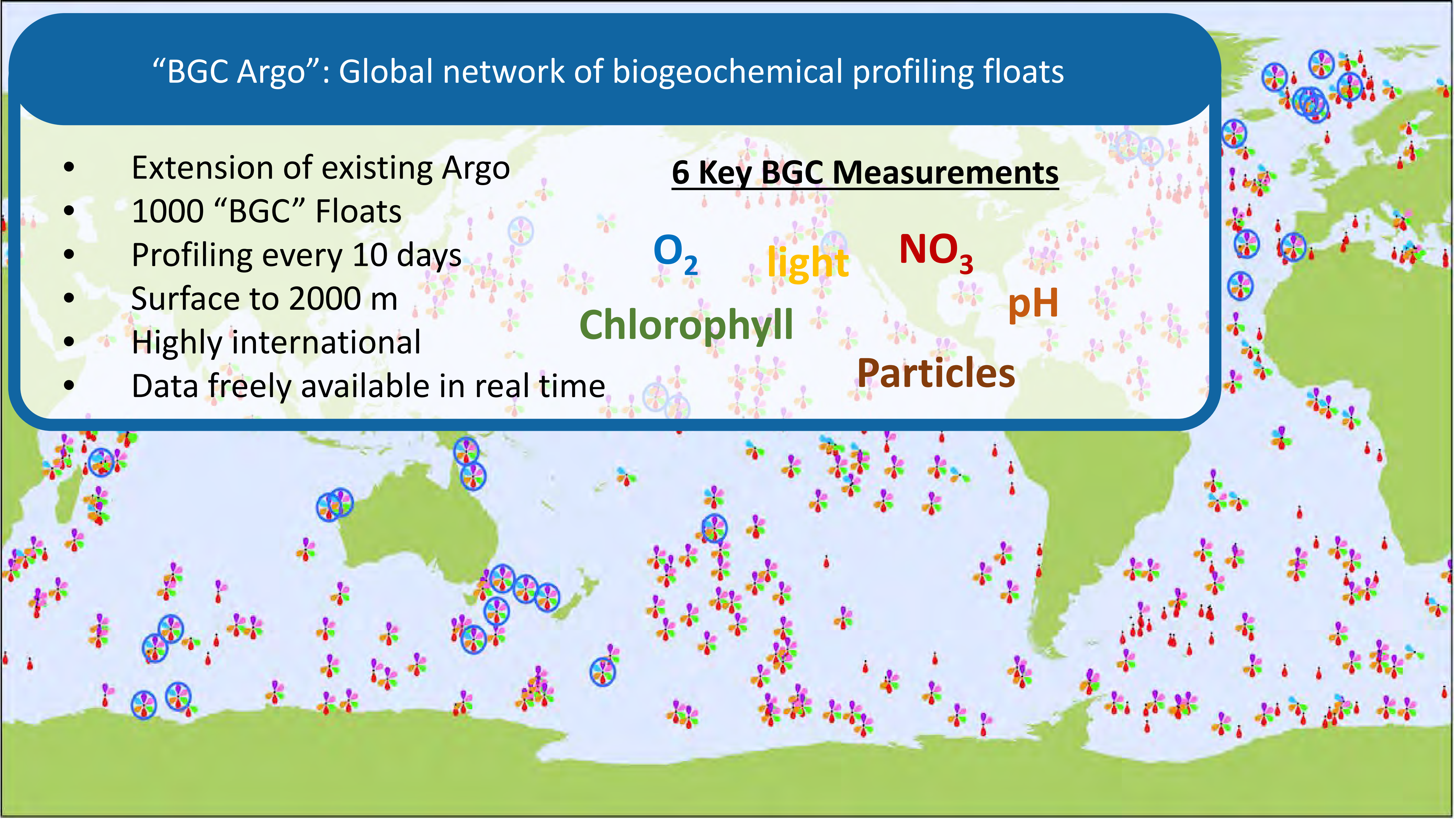
“BGC Argo”: Global network of biogeochemical profiling floats

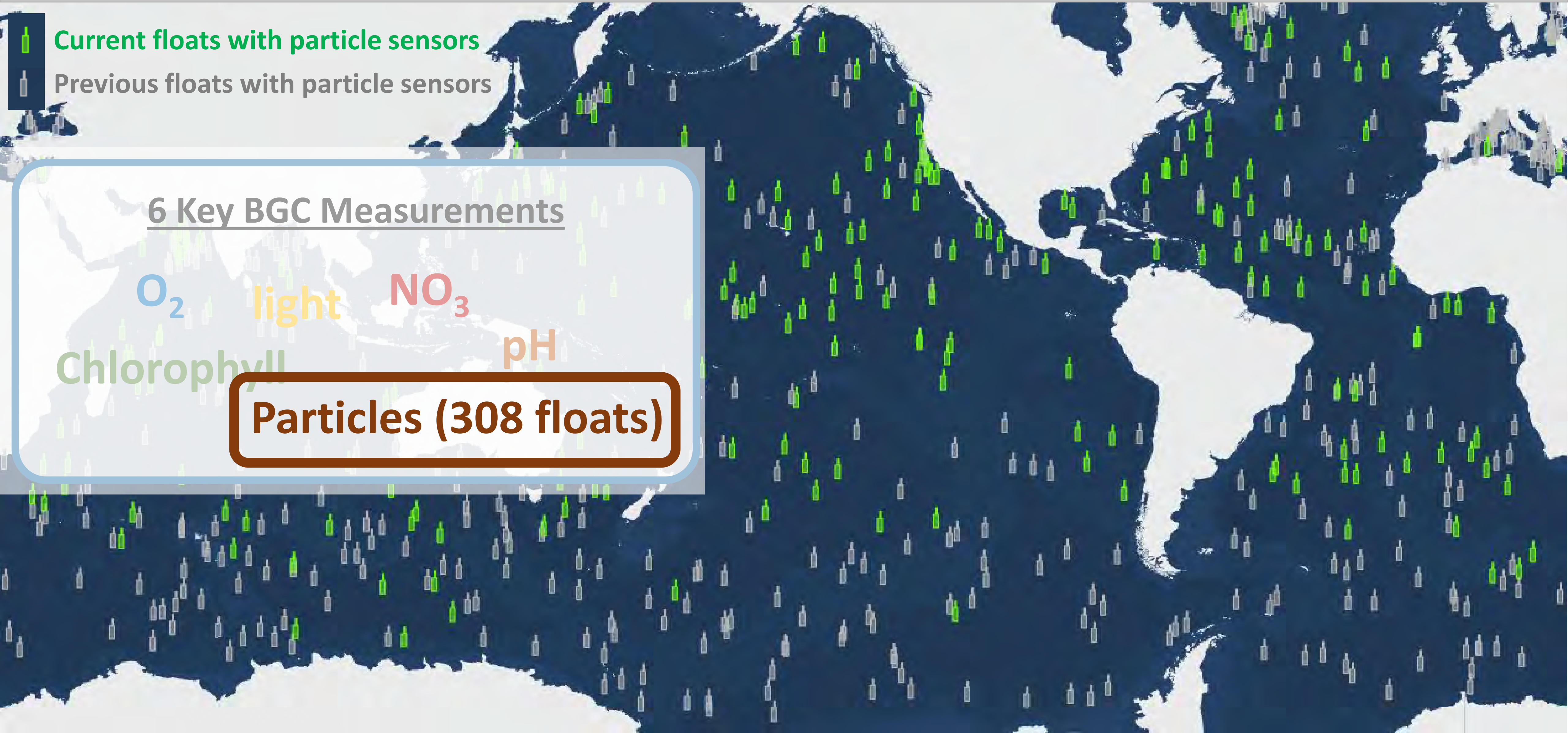
- Extension of existing Argo
- 1000 “BGC” Floats
- Profiling every 10 days
- Surface to 2000 m
- Highly international
- Data freely available in real time

6 Key BGC Measurements

O_2 light NO_3 pH Chlorophyll Particles

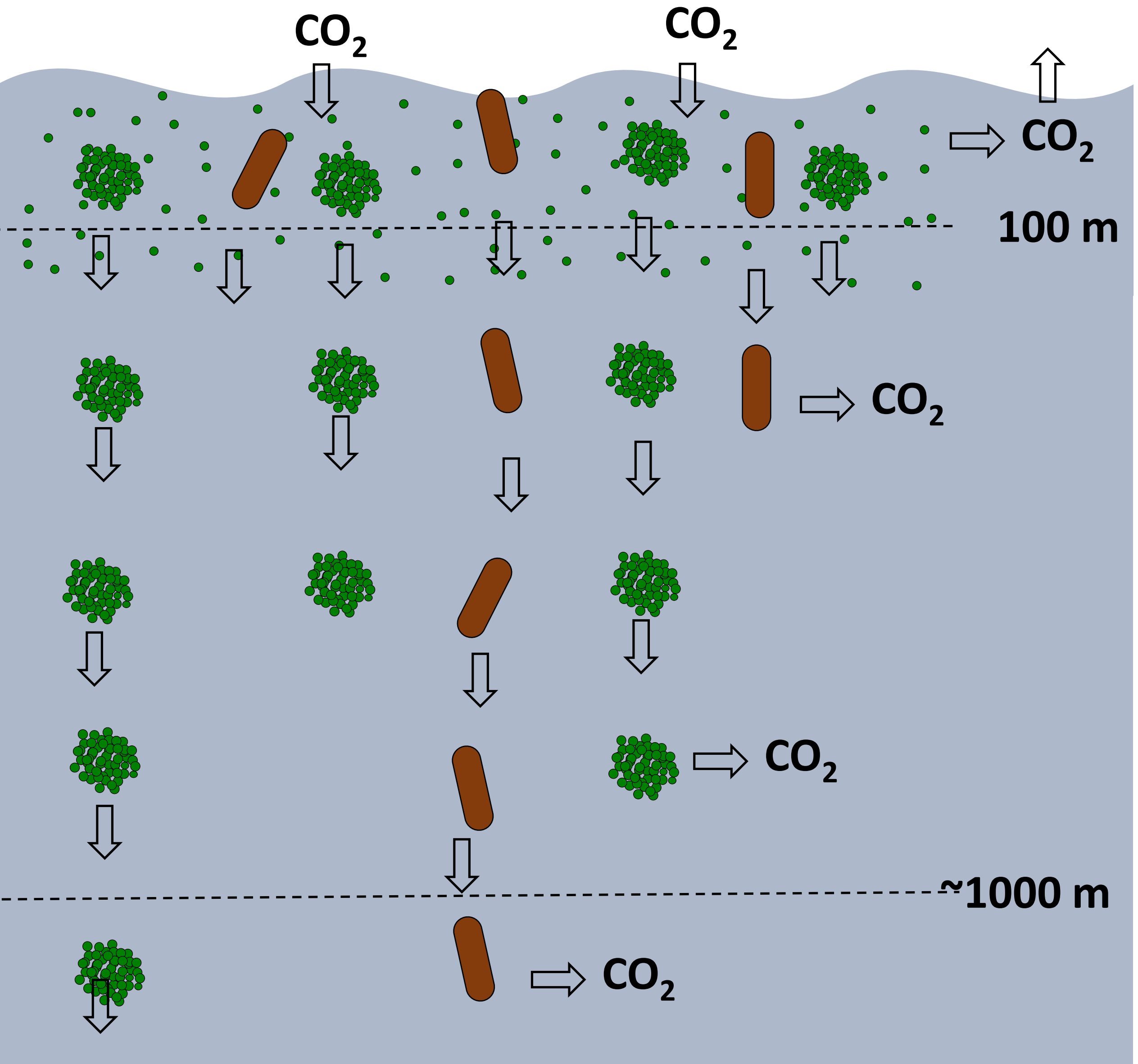


GLOBESINK project – leveraging BGC Argo particle measurements to constrain global drivers the biological carbon pump



Global, all-season coverage of particle measurements achieved (excluding Arctic)

GLOBESINK project focus – “large”, fast-sinking particles that drive carbon storage



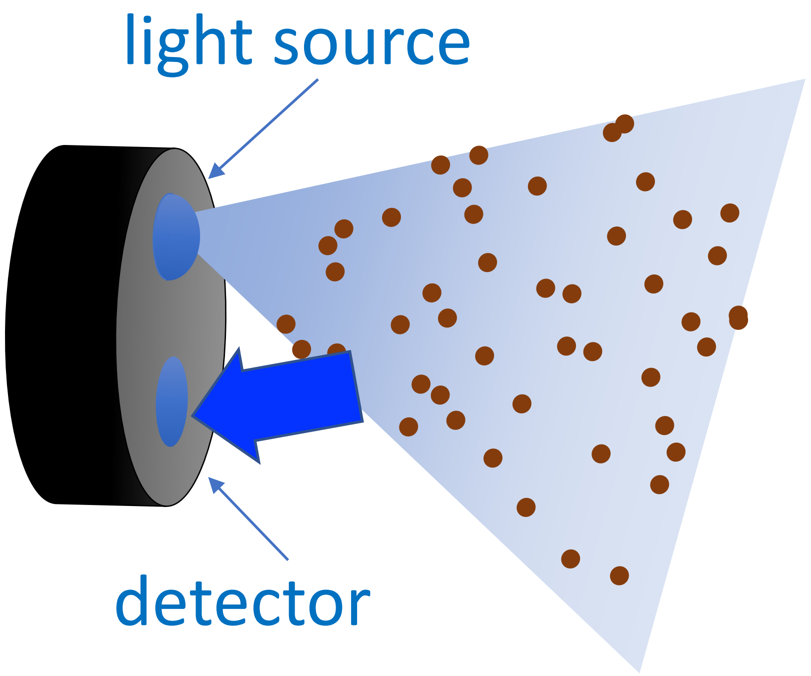
Carbon fixed in surface by photosynthesis

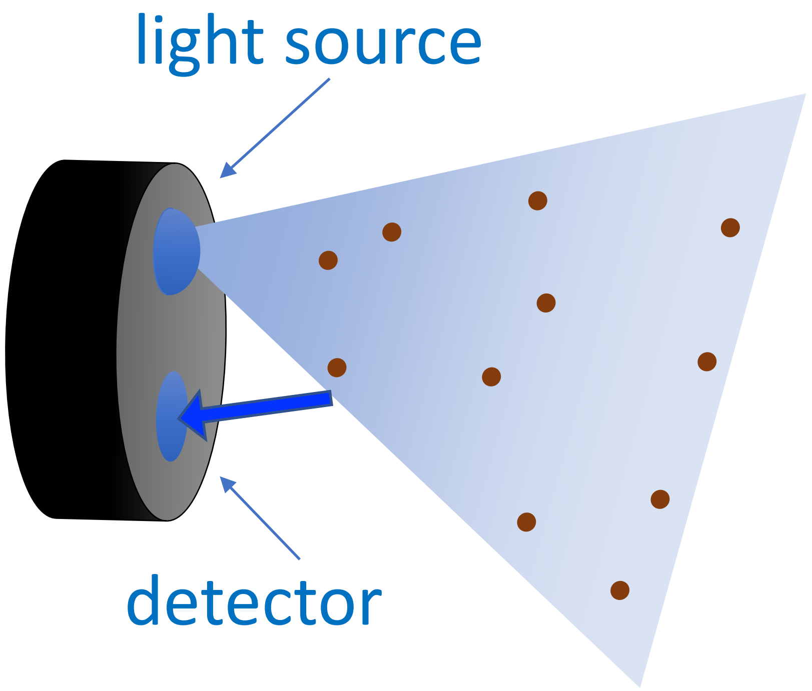
Carbon repackaged into sinking particles

Carbon sequestered (atmospheric CO_2 removed)

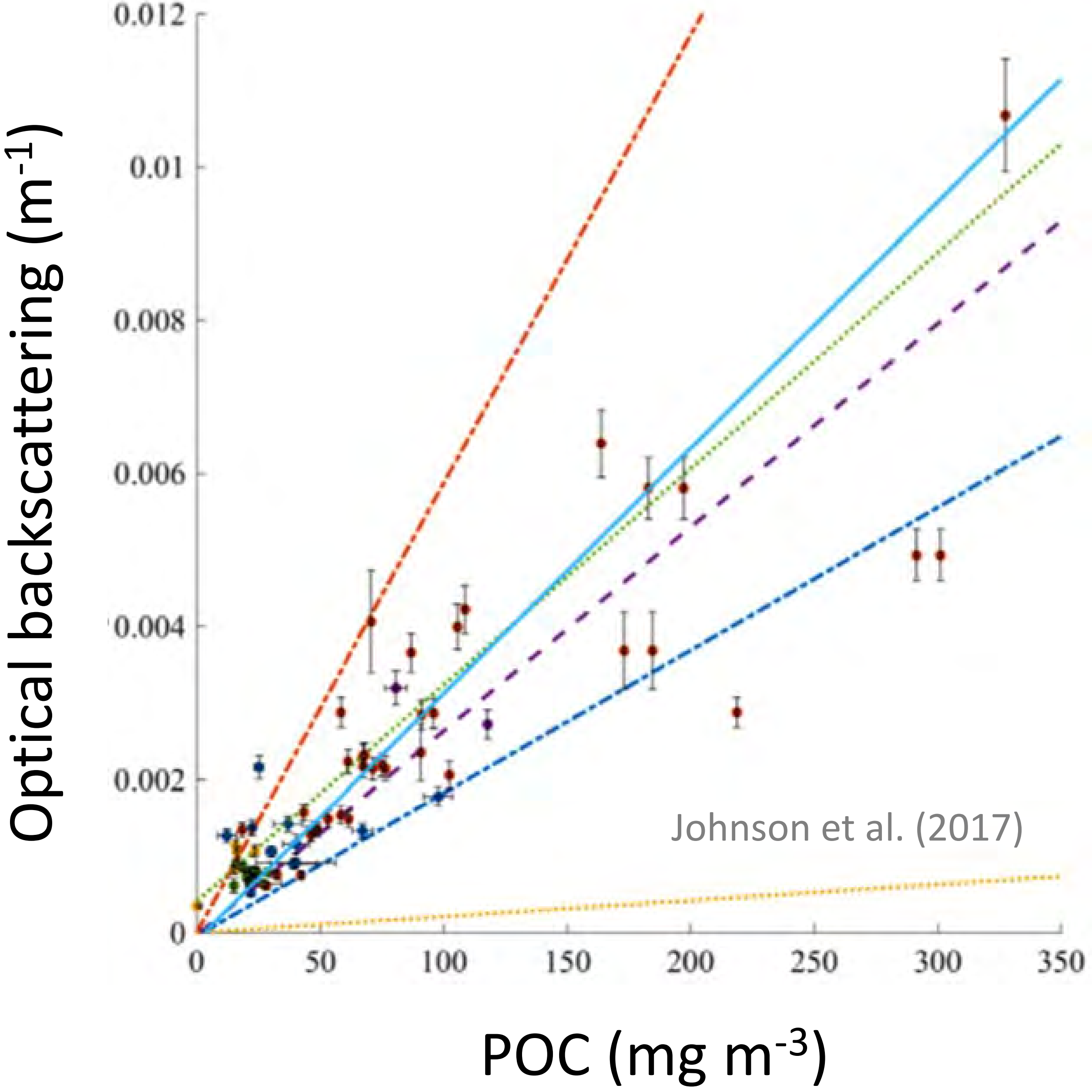
How does GLOBESINK “large” particles? – Brief sensor intro

BGC Argo measures particles using simple optical backscattering sensors

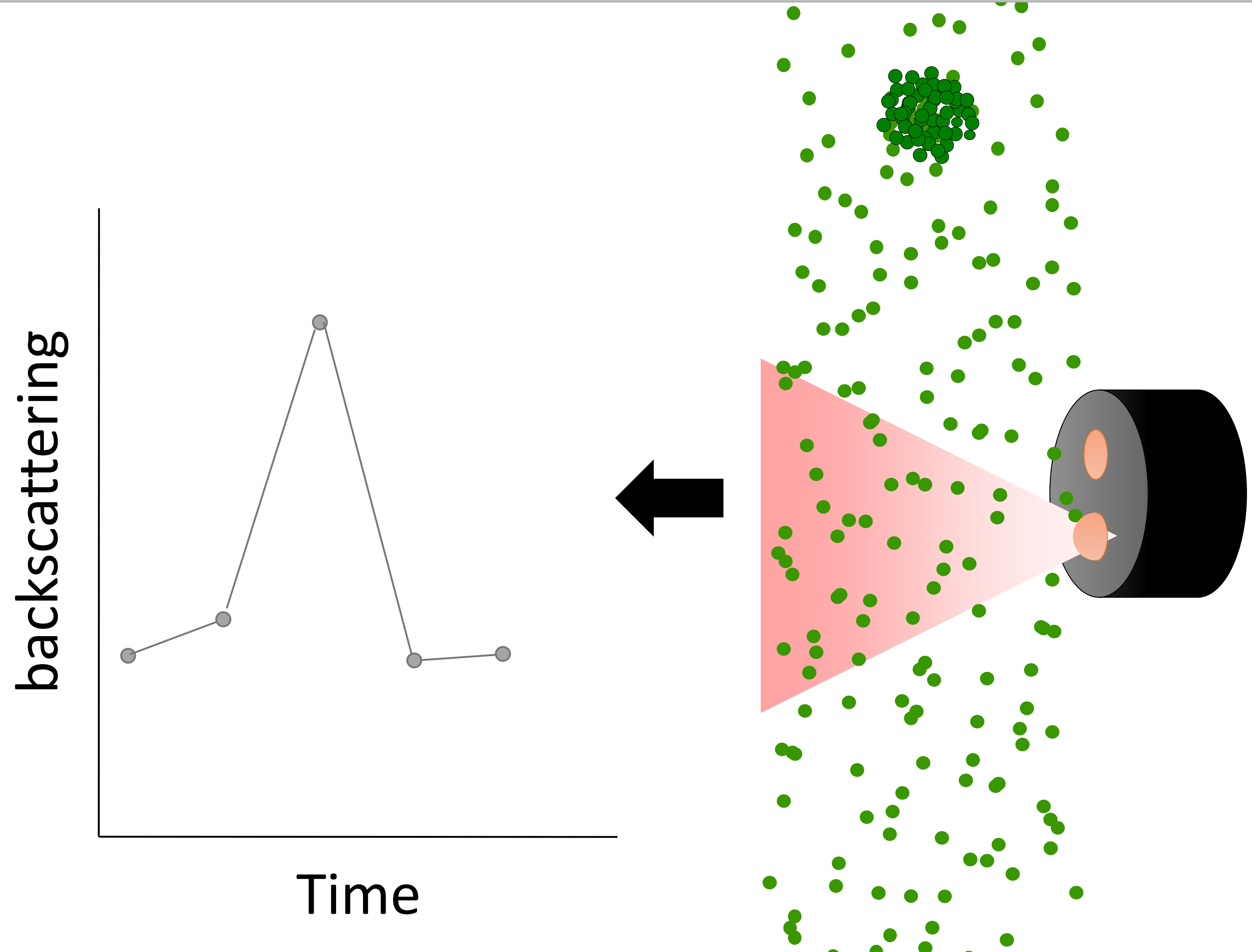




Optical backscattering empirically related to POC in open ocean



Large particles (>100 µm) cause backscattering spikes



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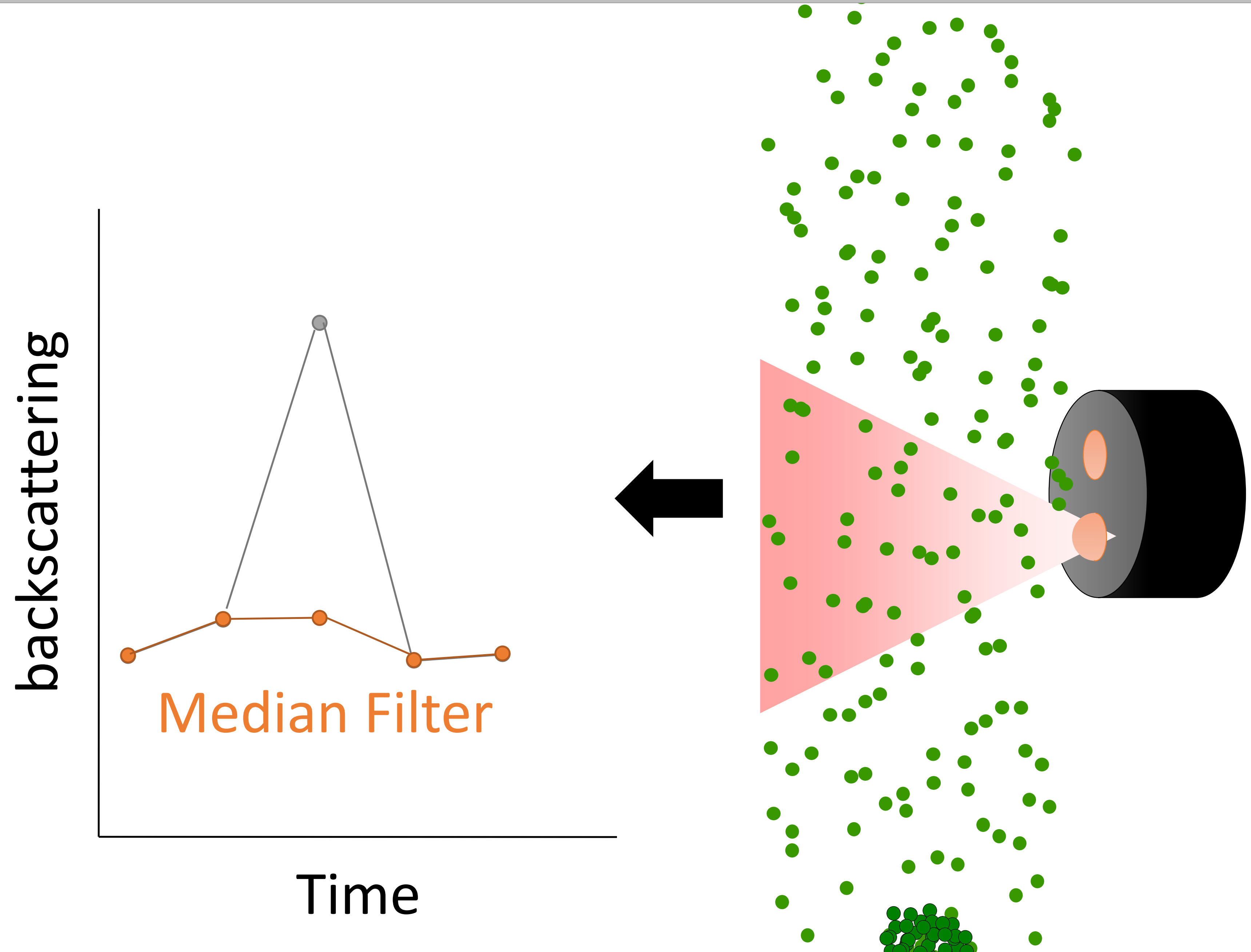

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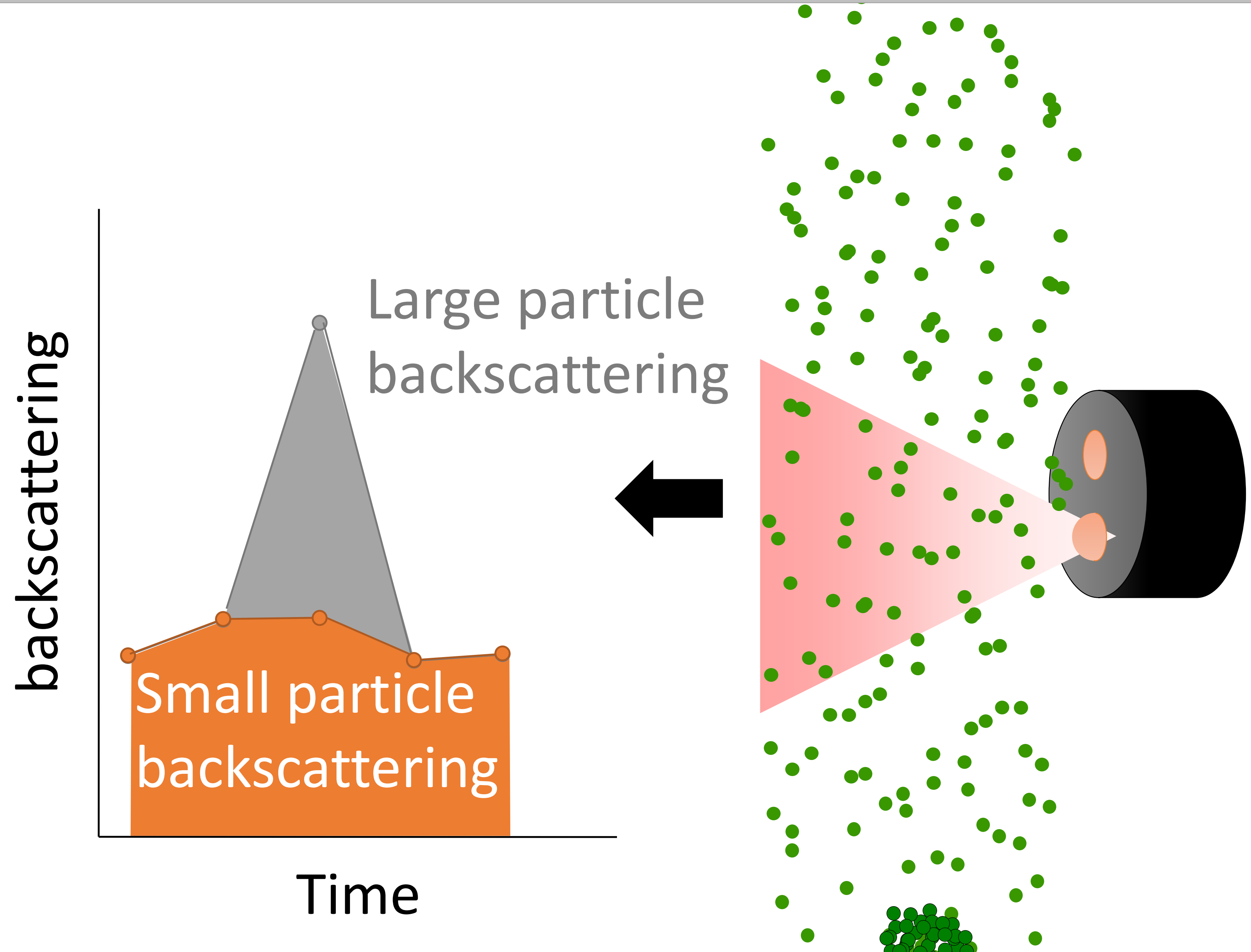
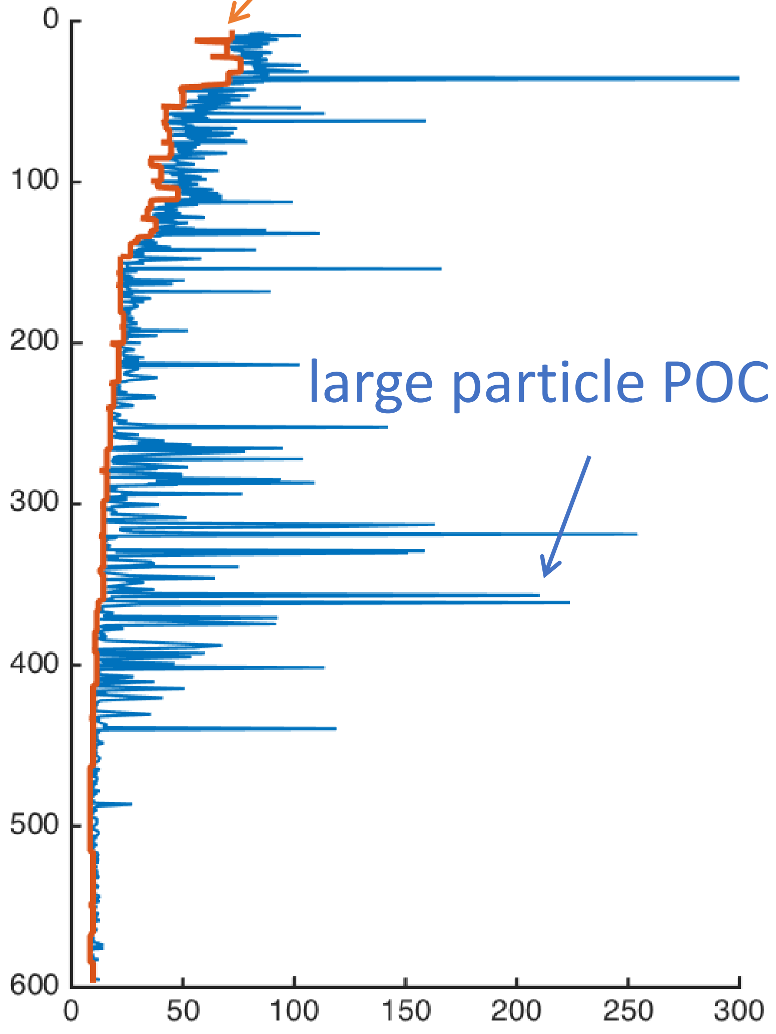


Example of spike "filter" to divide POC into two size classes

small particle POC (< 100 µm)



large particle POC (100 µm - ~1 mm)

POC (mg m^{-3}) from backscattering

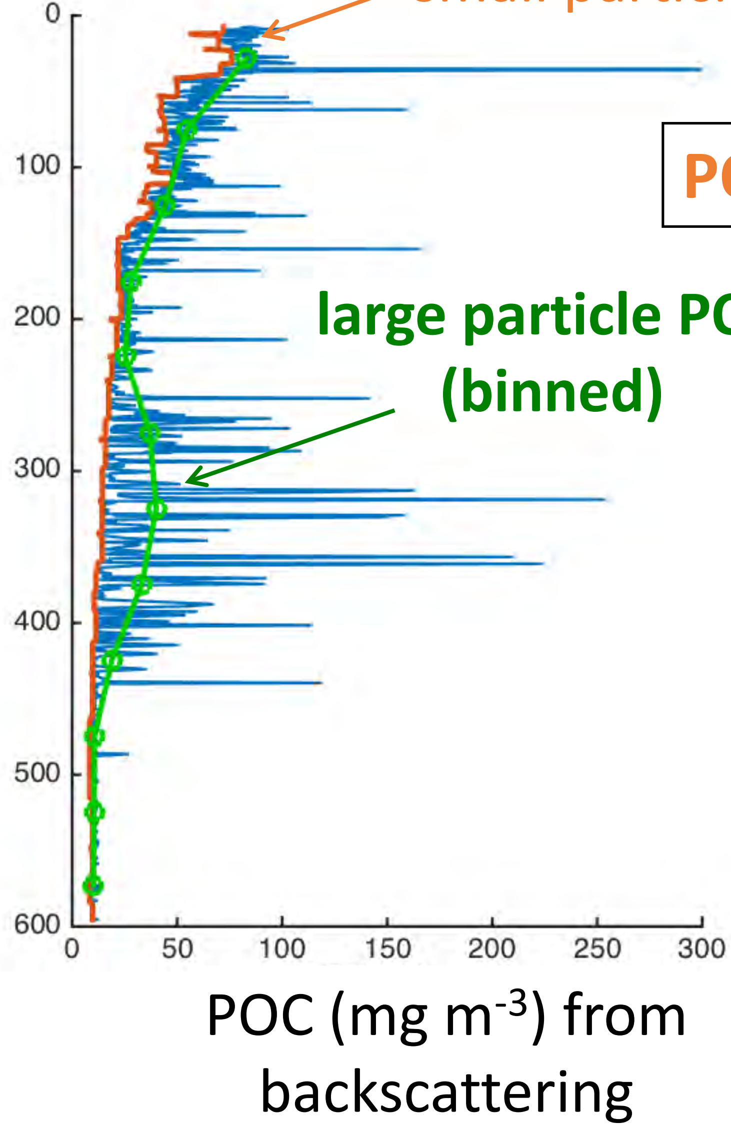
Using size-specific sinking speeds, we can convert POC concentration to flux

small particle POC

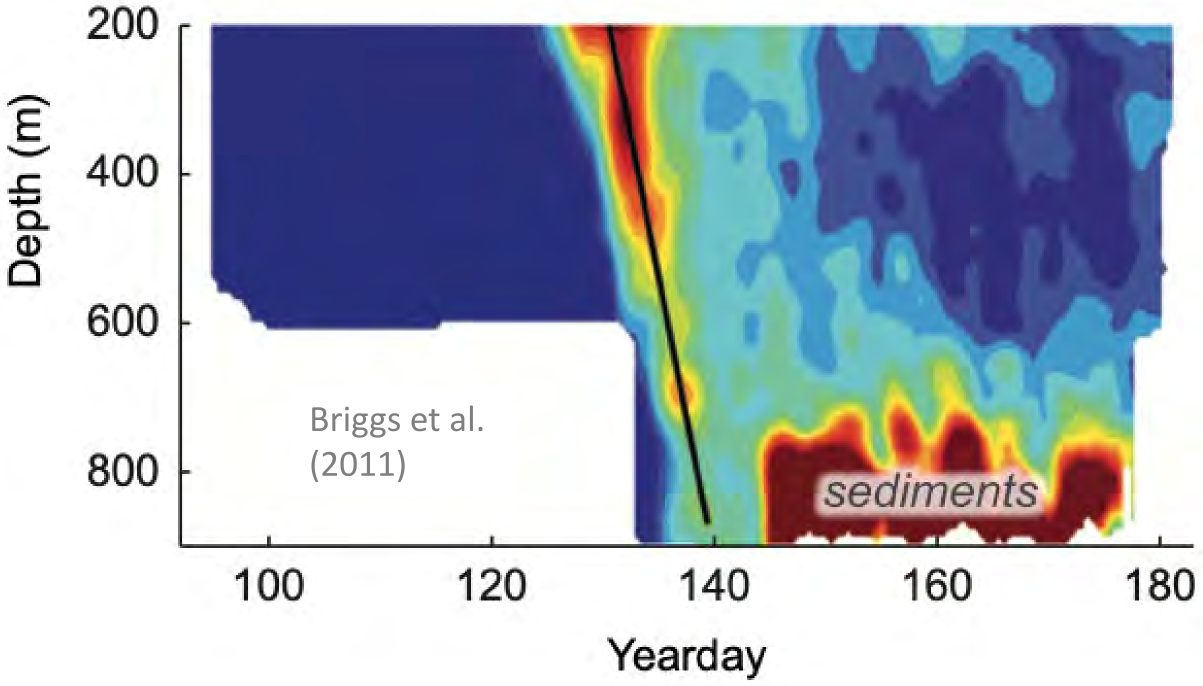
sinking speeds

$$POC_s * w_s + POC_l * w_l = \text{POC Flux}$$

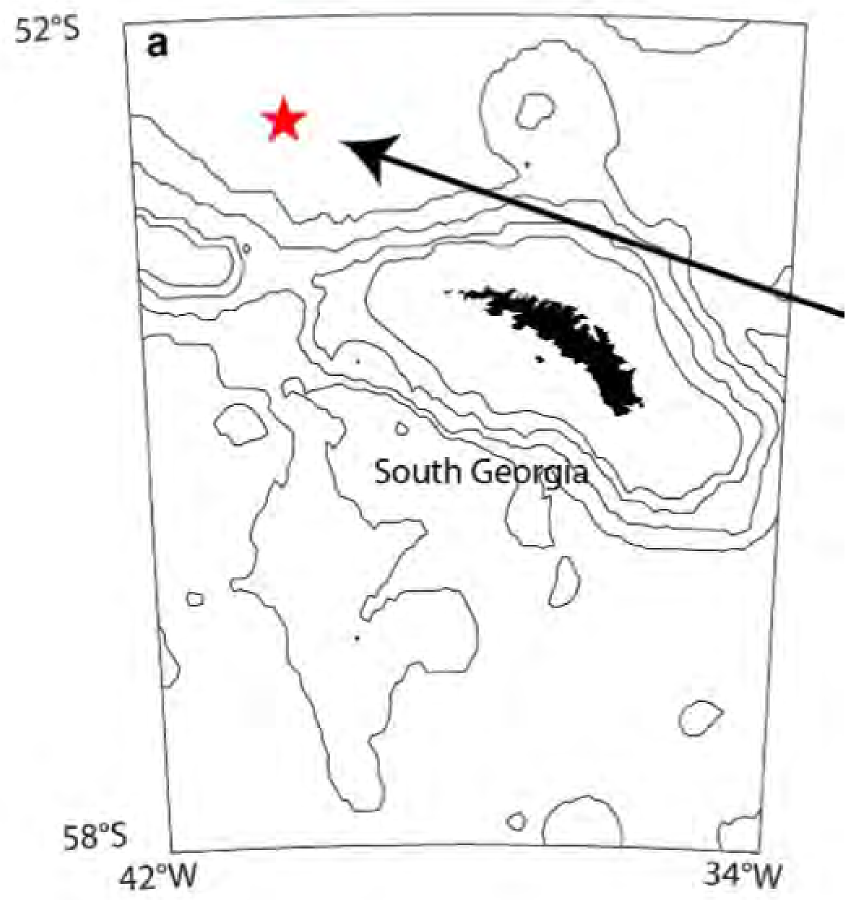
large particle POC (binned)

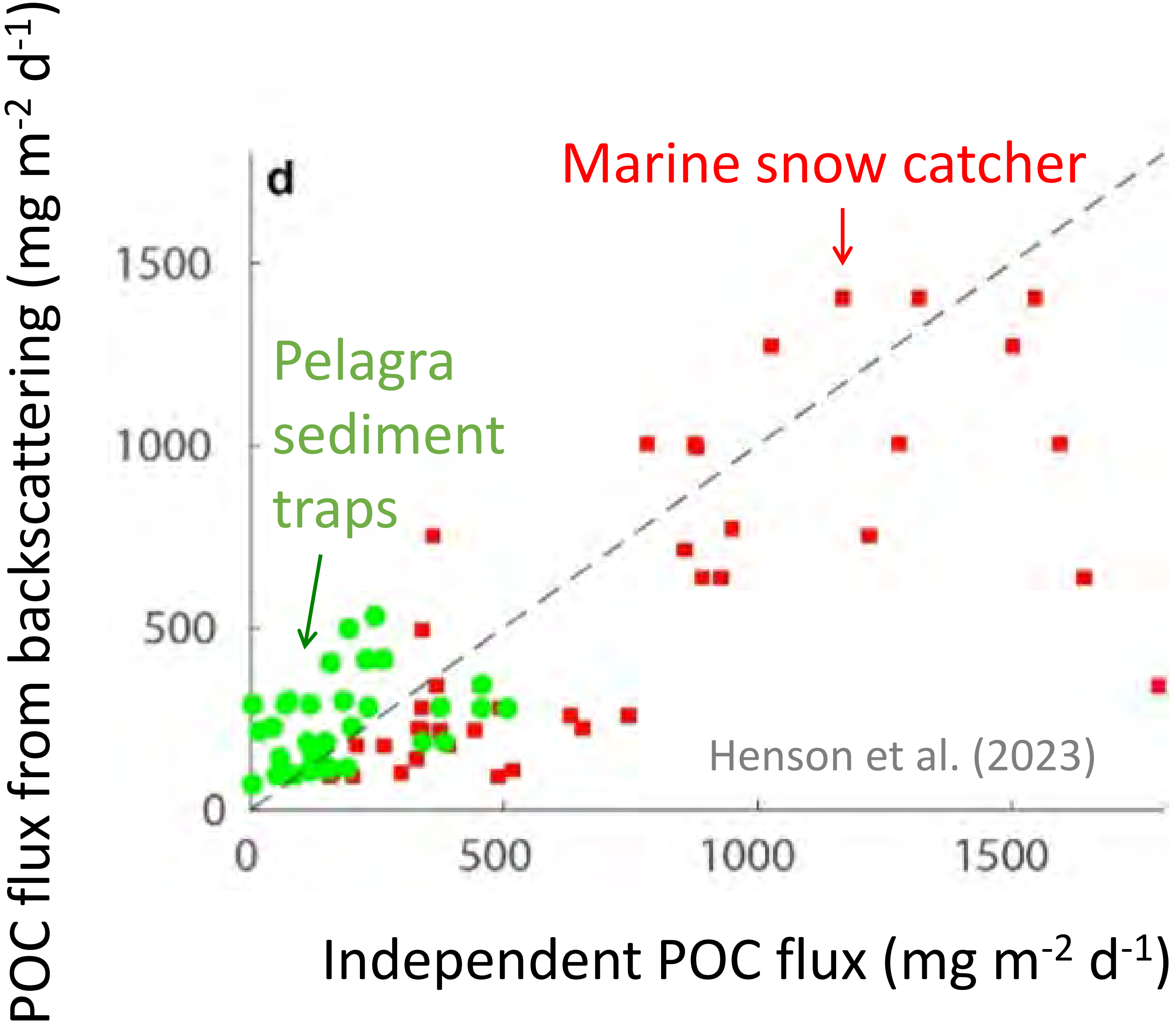


POC flux timeseries from autonomous glider



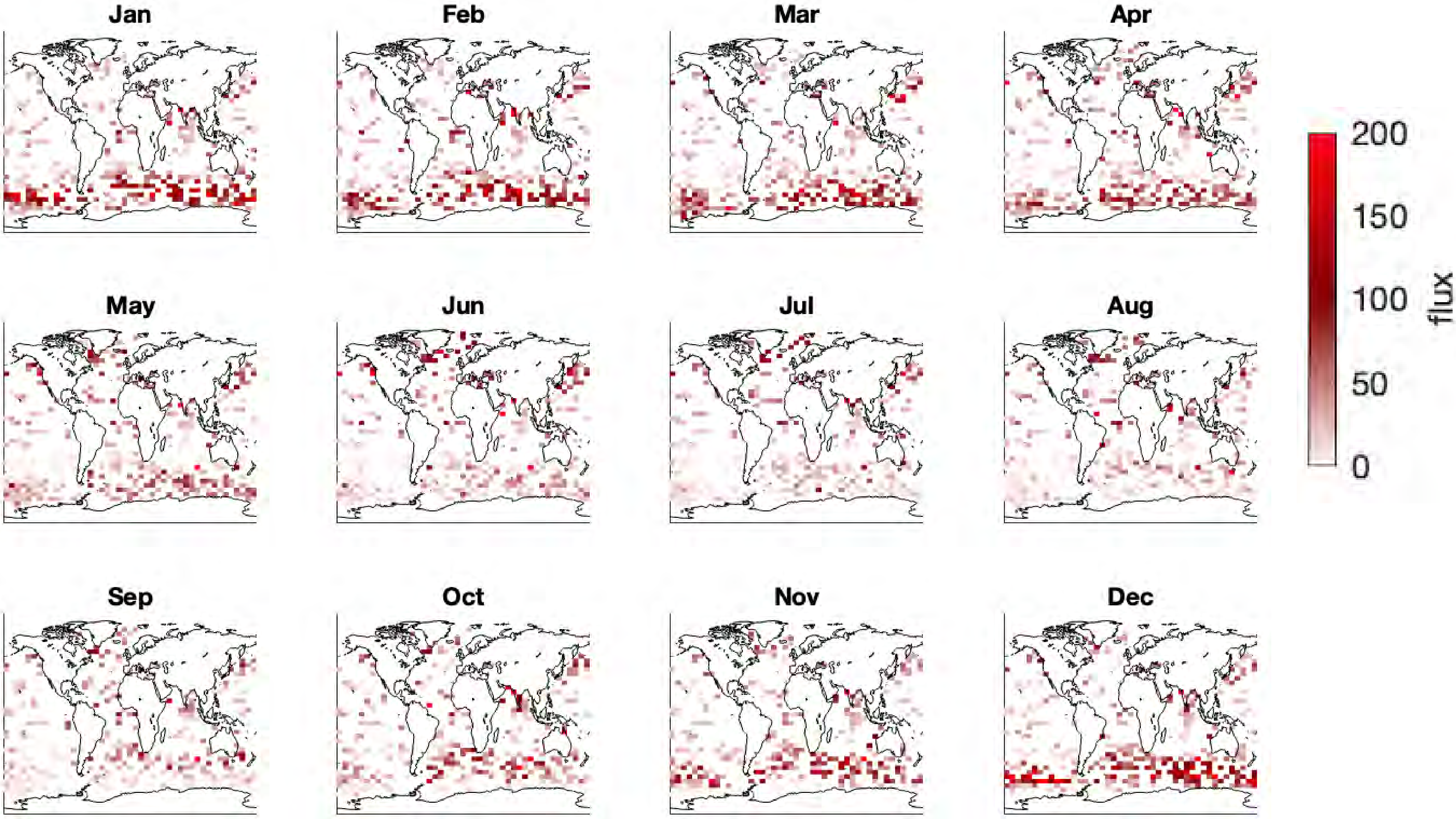
Preliminary (local) validation of POC flux from optical backscattering





GLOBESINK Preliminary monthly global POC export at 200 m

Not calibrated with local sinking speeds or organic carbon richness



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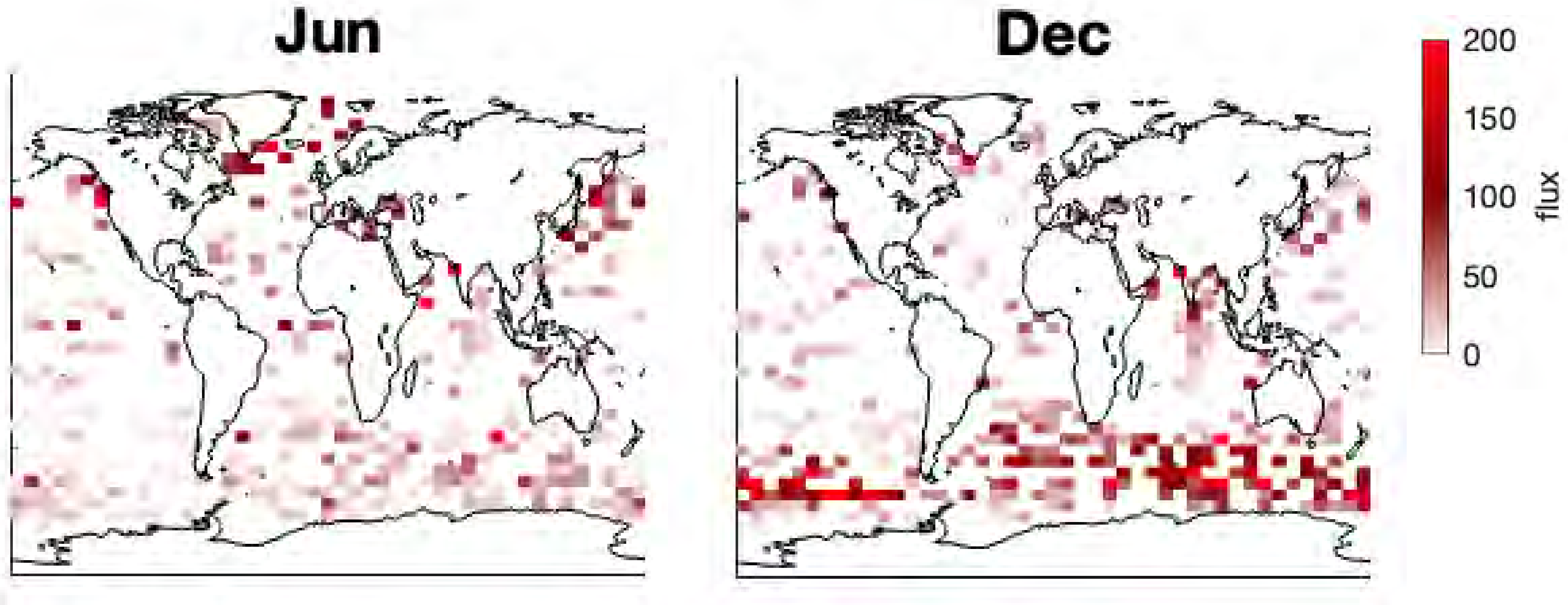
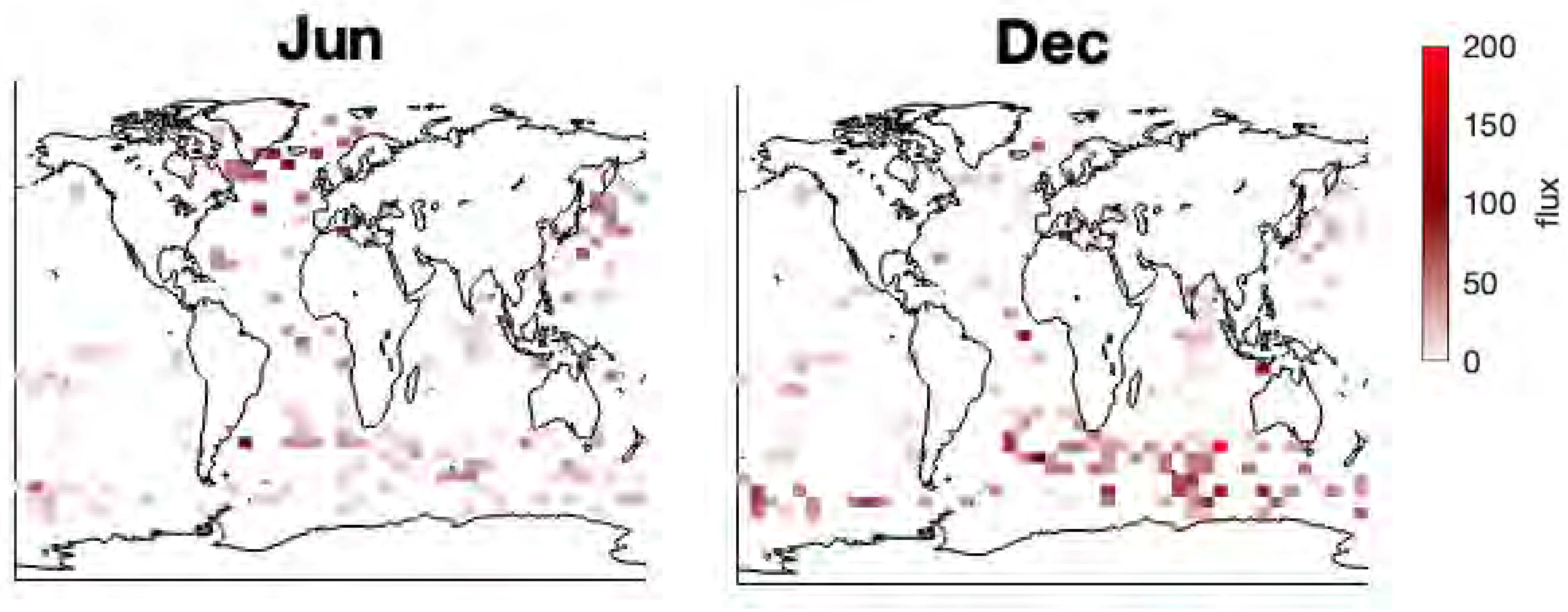
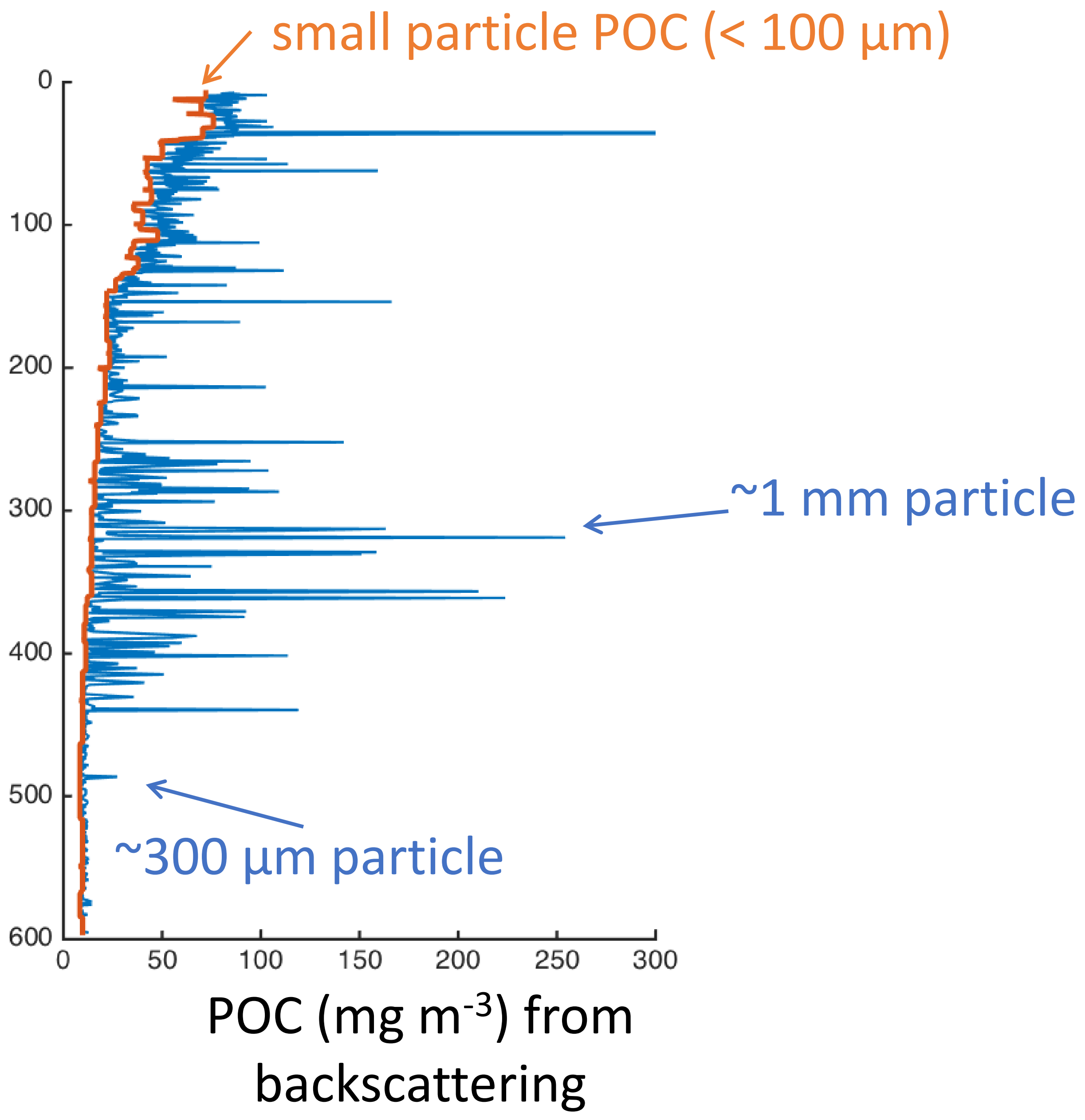


GLOBESINK Preliminary monthly global POC **storage** at 600 m

Not calibrated with local sinking speeds or organic carbon richness

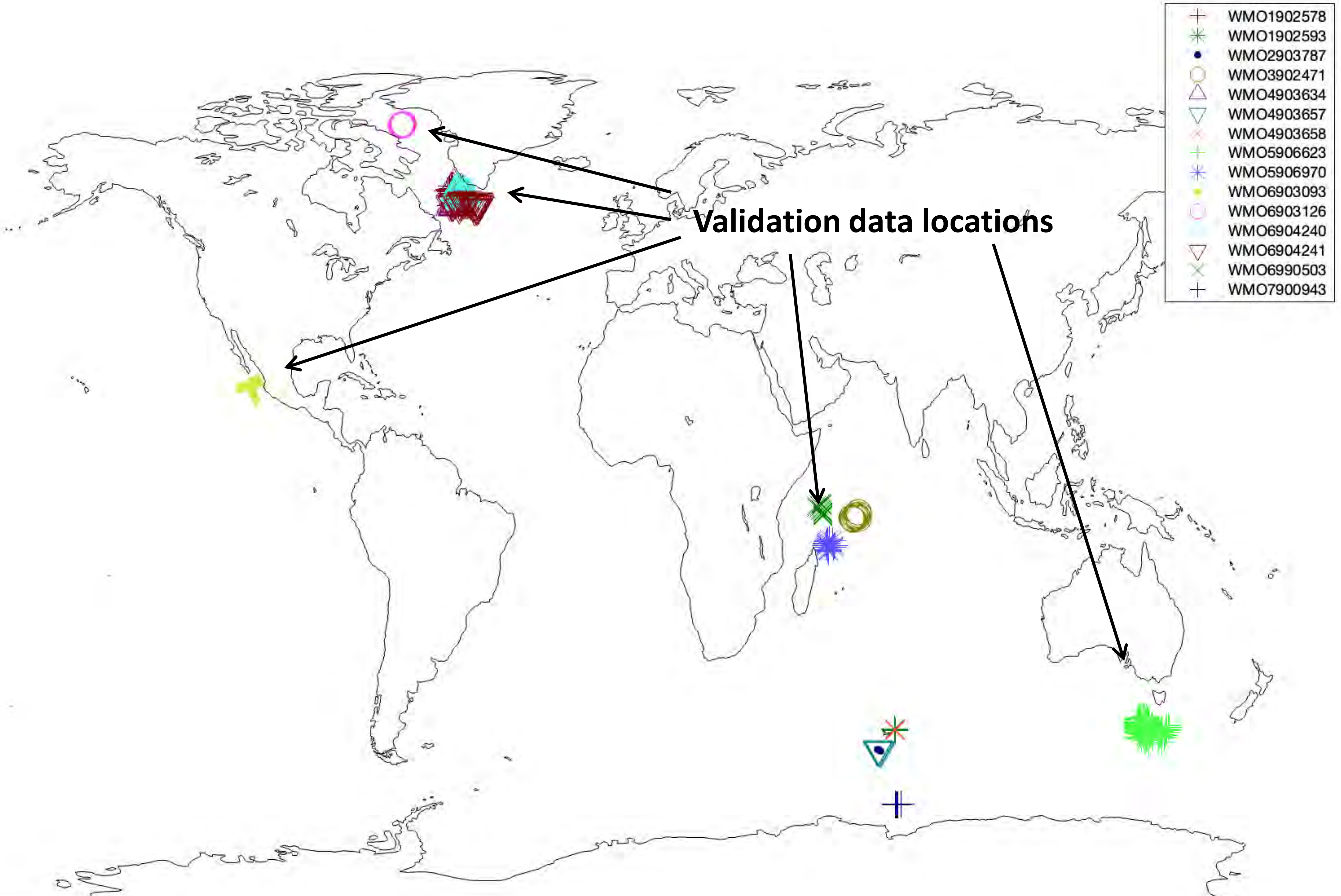


“Large” particles can be further divided by spike height



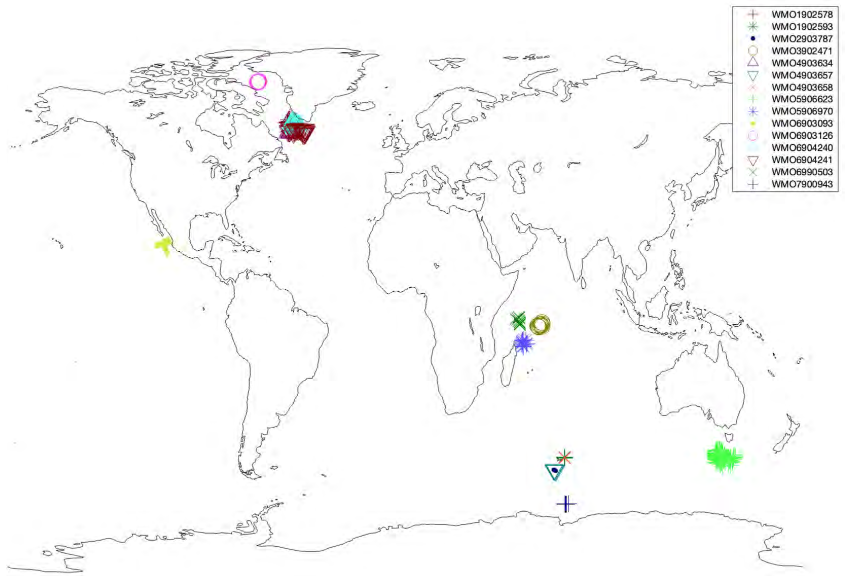
Widespread validation of particle size from optical backscattering

Using 15 floats with attached particle cameras

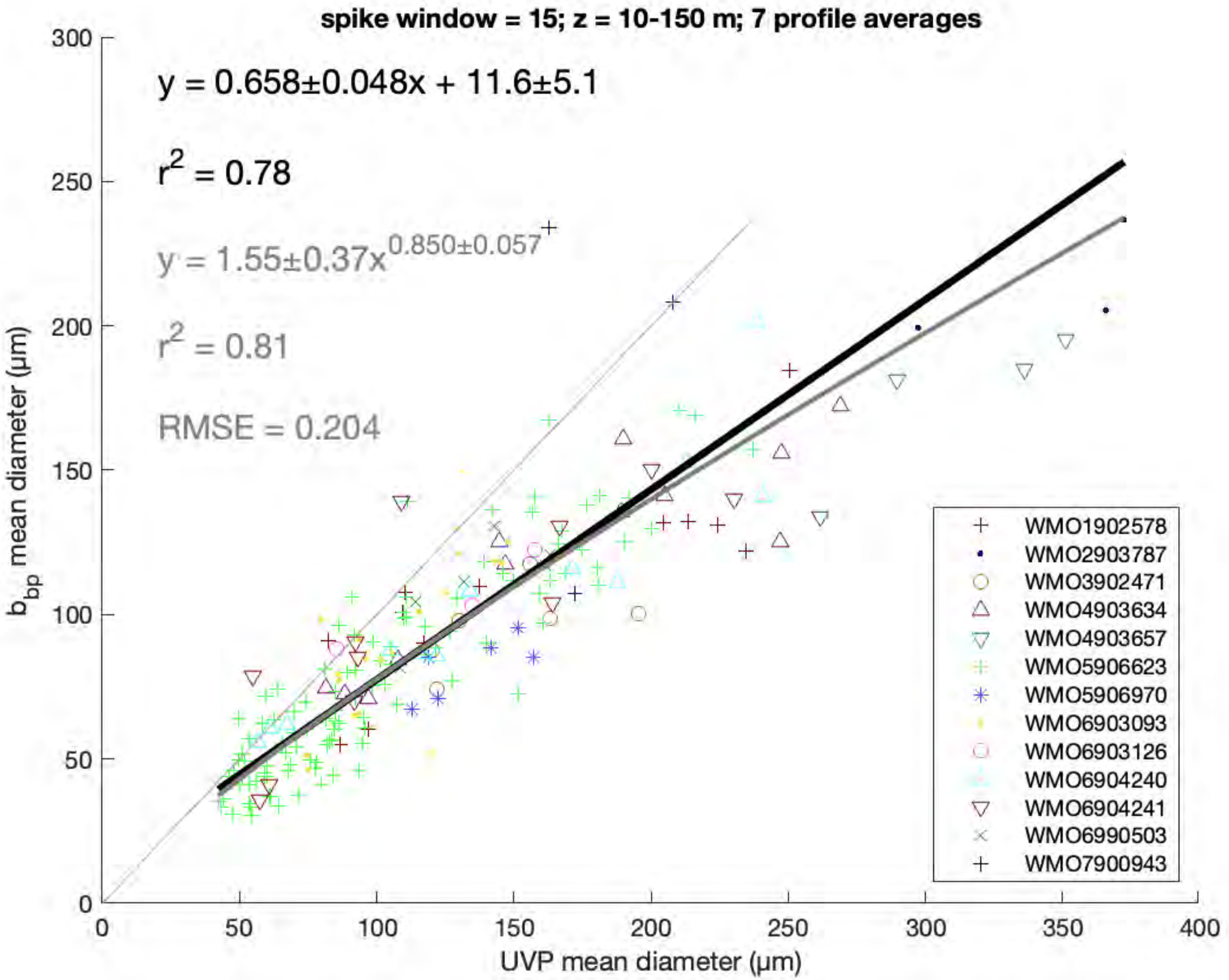


GLOBESINK mean particle diameter in top 150 m – Validation data

Using 15 floats with attached particle cameras

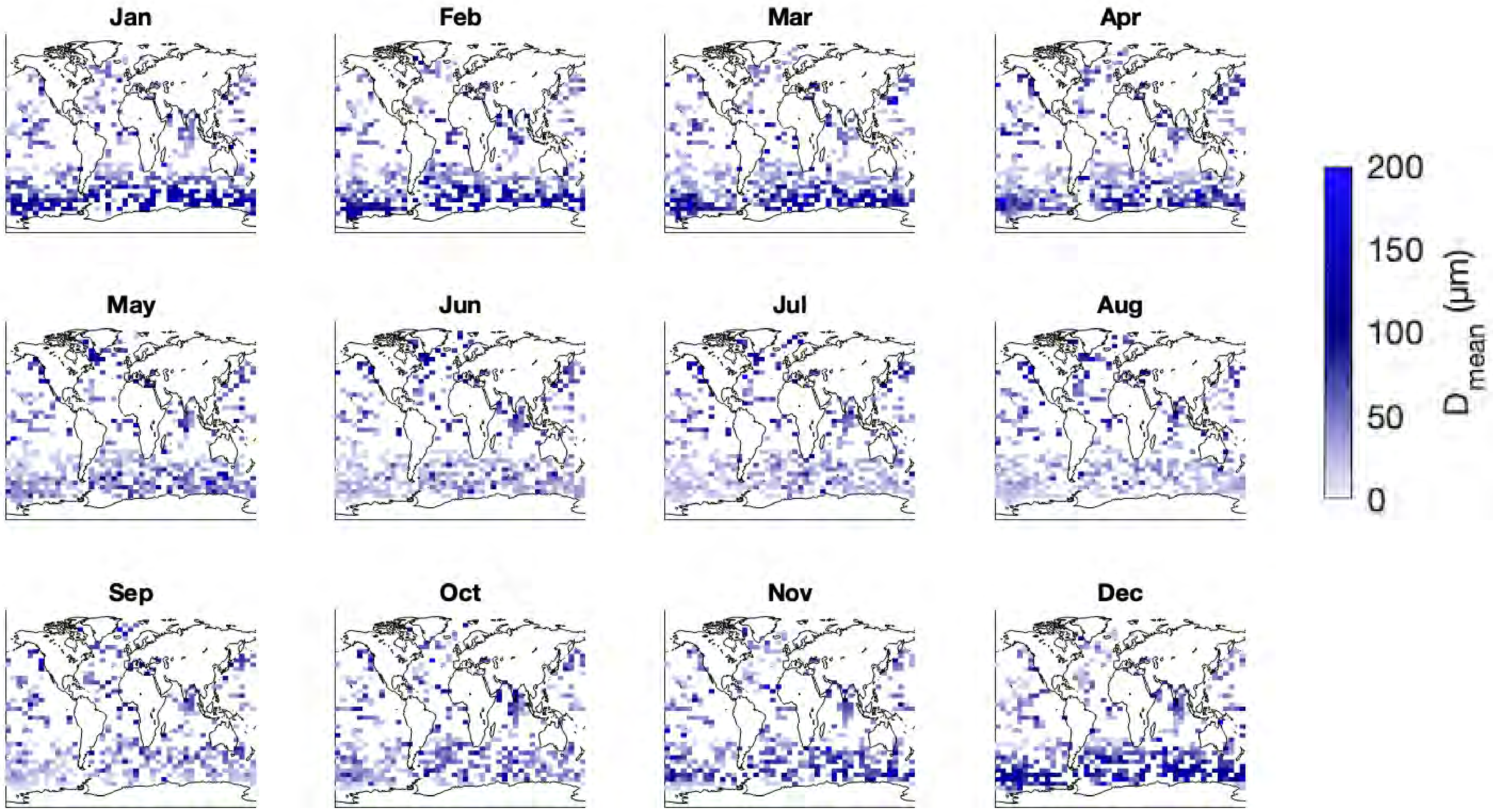


Particle diameter from backscattering

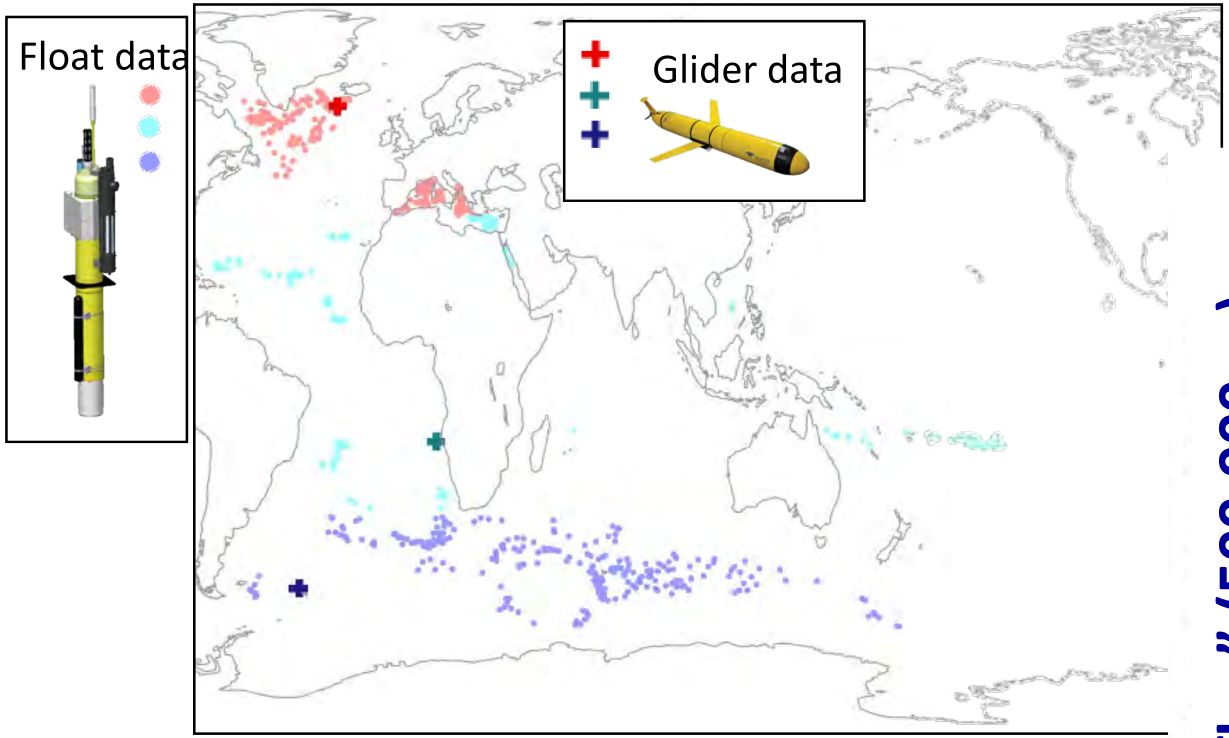


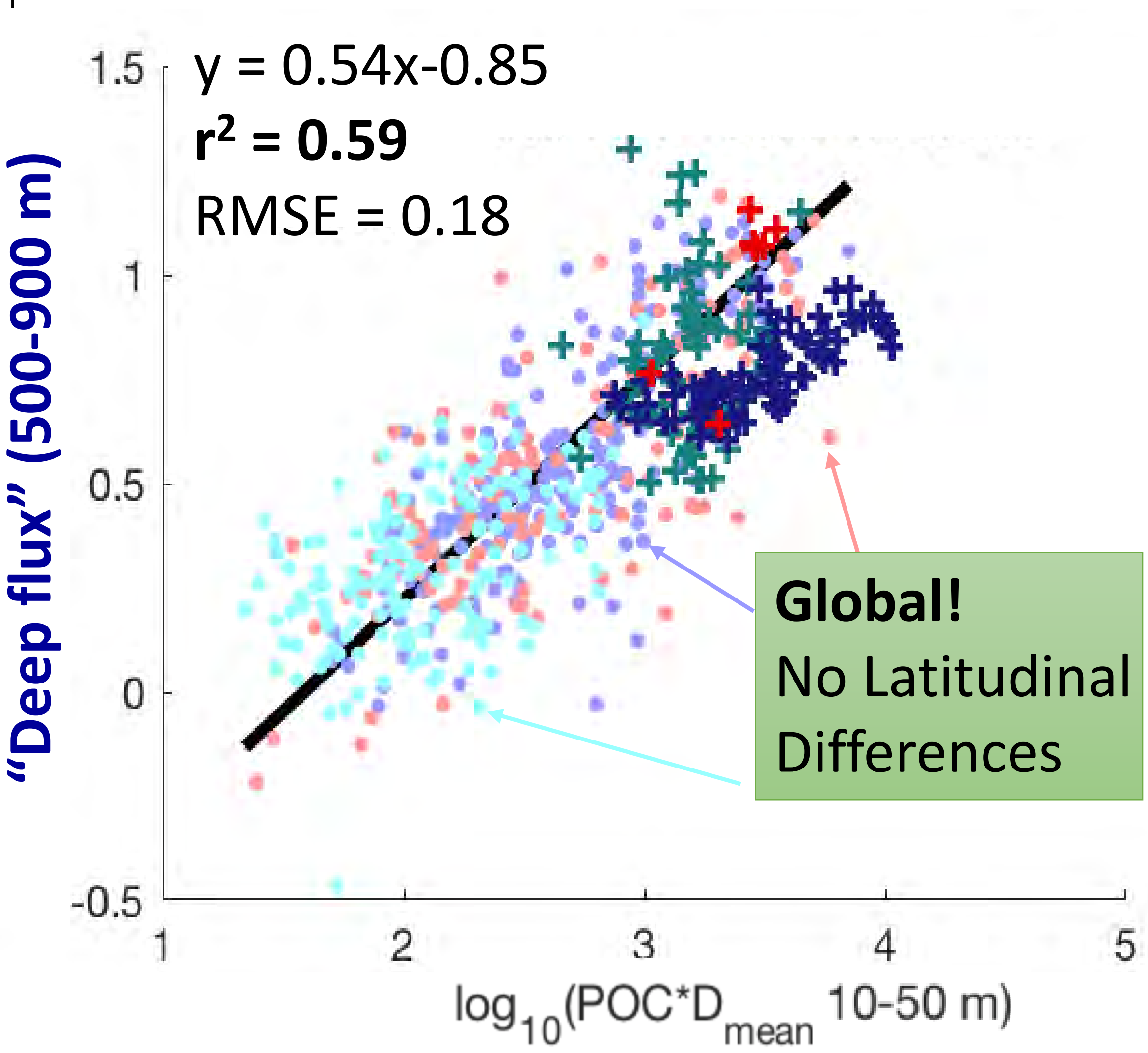
Particle diameter (µm) from in-situ camera

Preliminary monthly global surface particle mean diameter (μm)

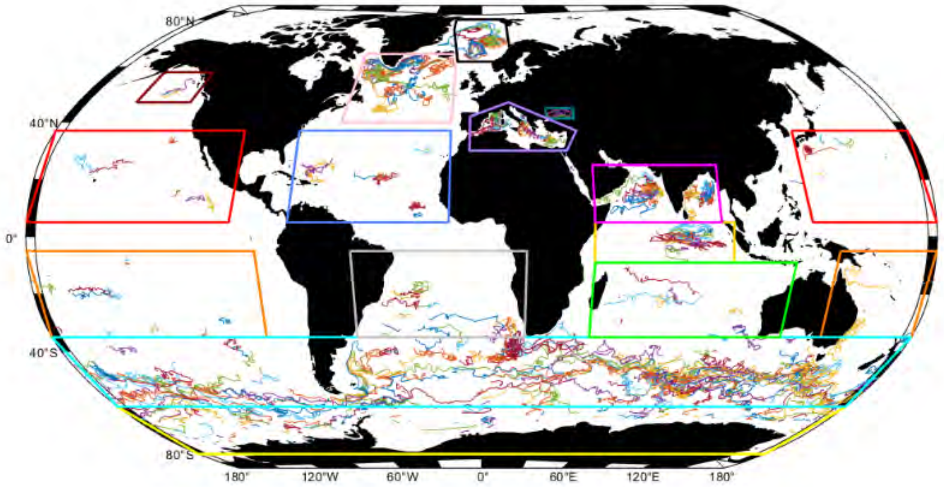


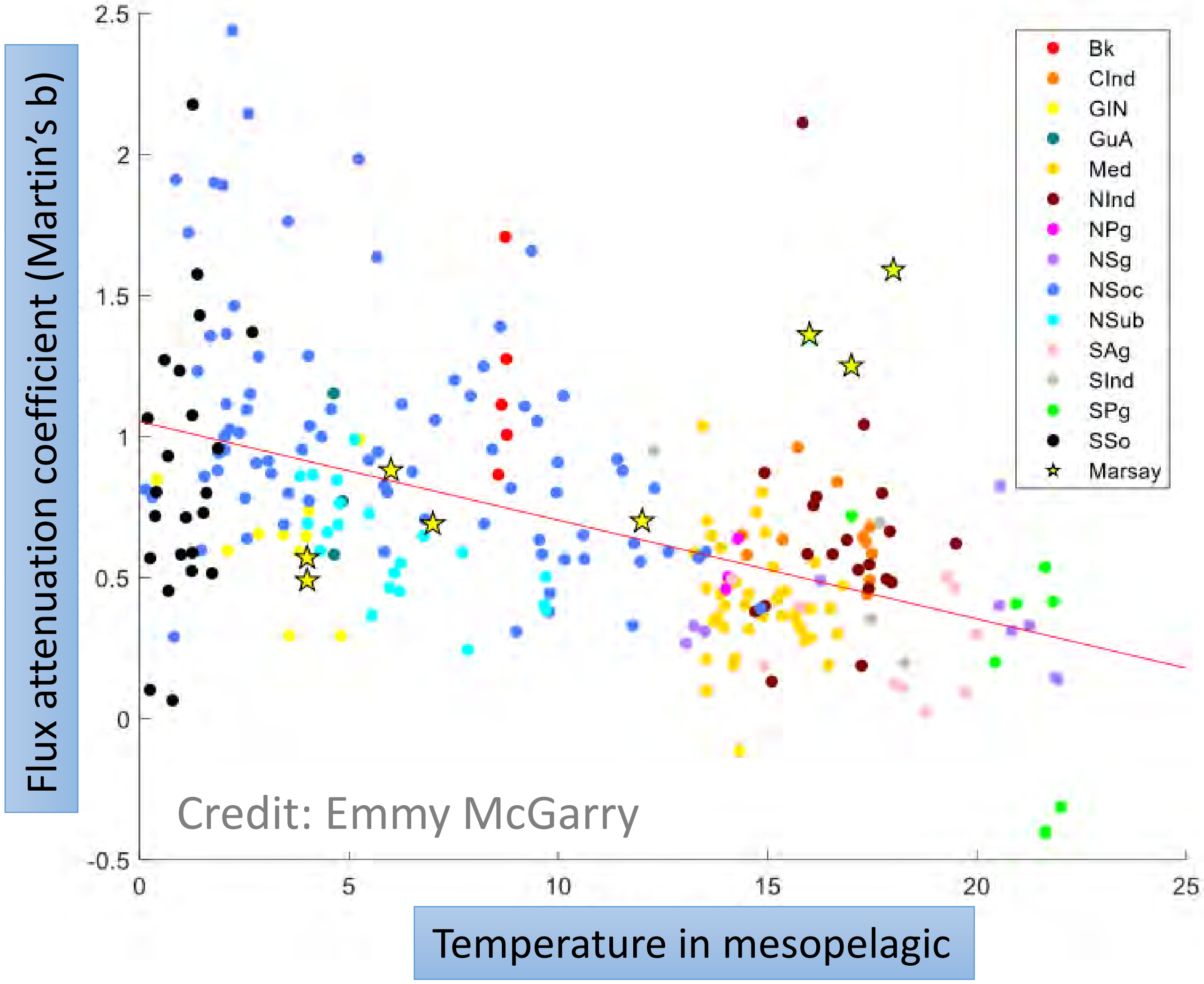
Preliminary empirical results – Surface POC and mean size predict deep flux





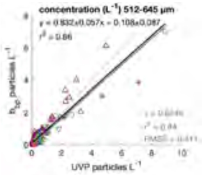
Preliminary empirical results – weak negative relationship between T and b?



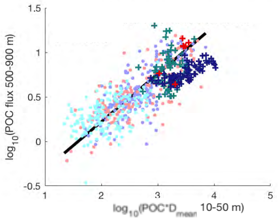


Summary

GLOBESINK project building global, all-season database of **particle size** and **POC flux** from 0-1000 m



Initial validation data are promising



Initial results appear to capture global drivers of flux

Limitations

- Method captures variability in particle concentration, but not sinking speed or carbon richness
- Largest particles may be undersampled due to small sample volume

Future plans

- QC global dataset (2023)
- Broader POC flux validation (2023)
- Create interpolated global product (2023)
- Finalise empirical drivers of carbon storage (2024)

Questions?

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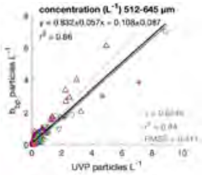

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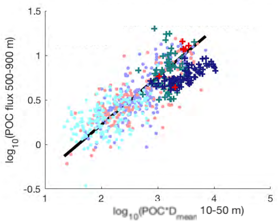

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