

Periodic sedimentation rates revealed by high-temporal-resolution view of biological carbon pump



We used an optical sediment trap to observe the biological carbon pump at 890 m depth, 3 x an hour for ~3 months in 2023.

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Context and aims

Sinking biological particles bring important quantities of carbon to the deep sea.

Our goal is to reveal mechanisms of the biological carbon pump that can be used to improve deep-sea carbon sequestration models.

Methods

- The Sedimentation Event Sensor (SES) is a 4000 m-depth-rated, low-power optical sediment trap that images sinking particles, and then discards them.

- The SES was deployed on the seafloor at 890 m depth, near Monterey Bay, California, USA. Here we present data from May–August 2023.

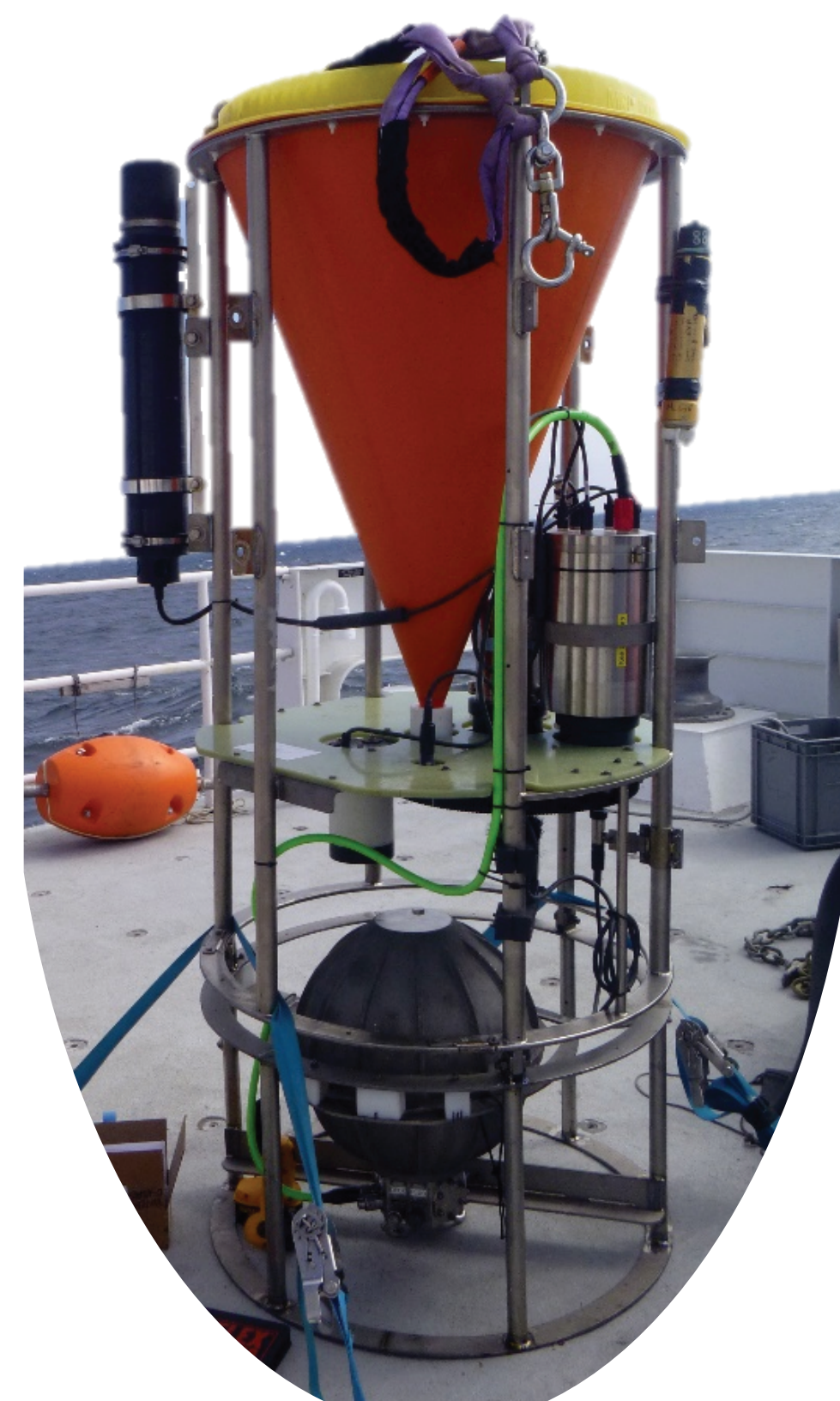
- The SES collected and imaged 3 samples/h (5 minute collections followed by a 15 minute flow-through period).

- Automated image analysis detected particles for calculations of light attenuation by material on the slide. The more material on the slide, the higher the attenuation.

- Light attenuation calculated from SES images can be considered a proxy for particulate organic carbon (POC) flux. Higher light attenuation means higher POC flux.**

- Two Lowell tilt current meters were deployed nearby.

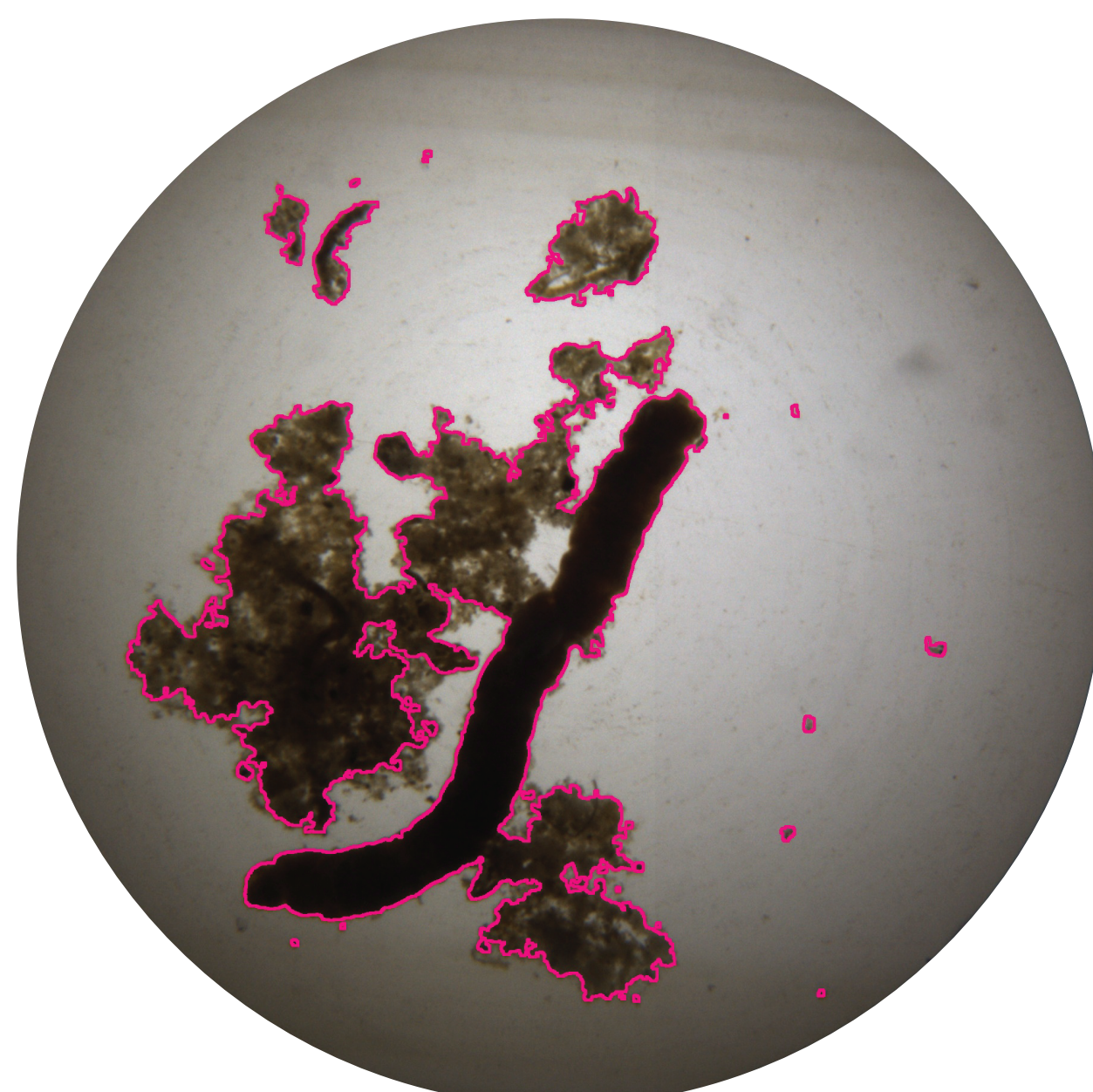
- Data were averaged hourly.



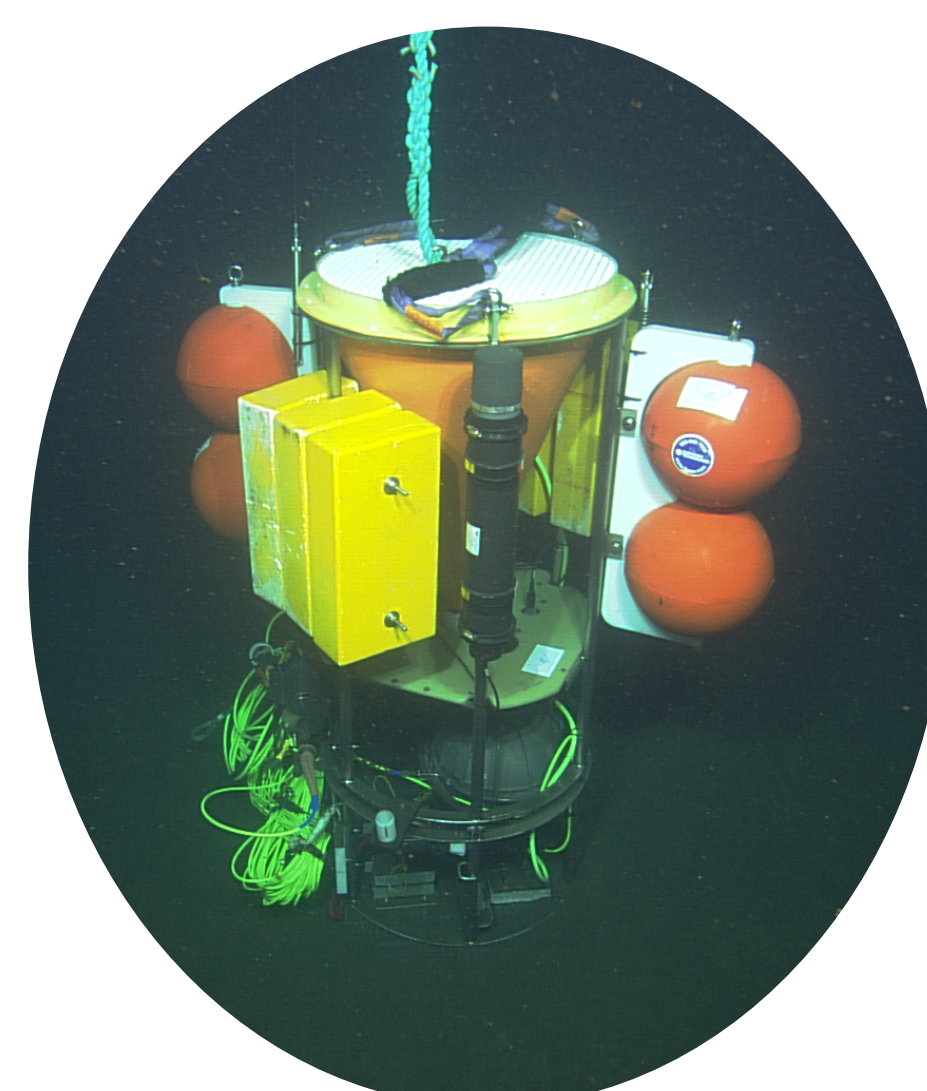
SES on deck



SES image



Detected particles

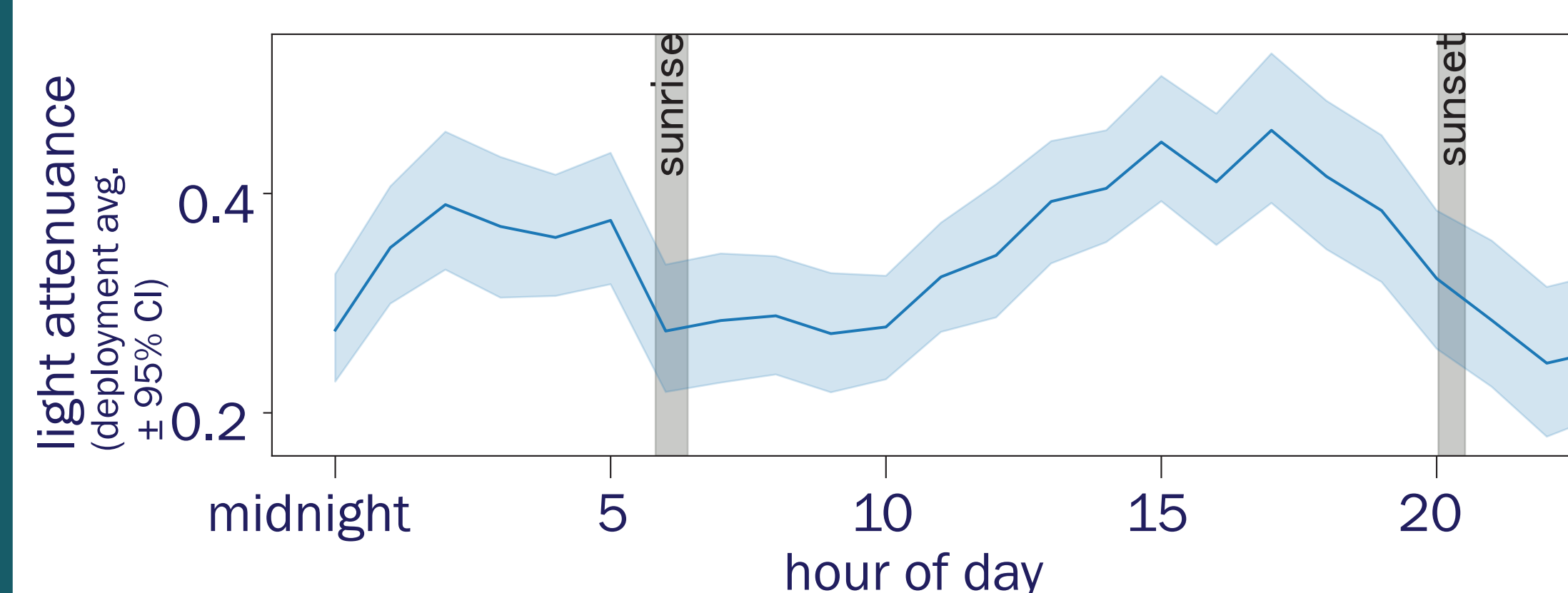


SES on seafloor

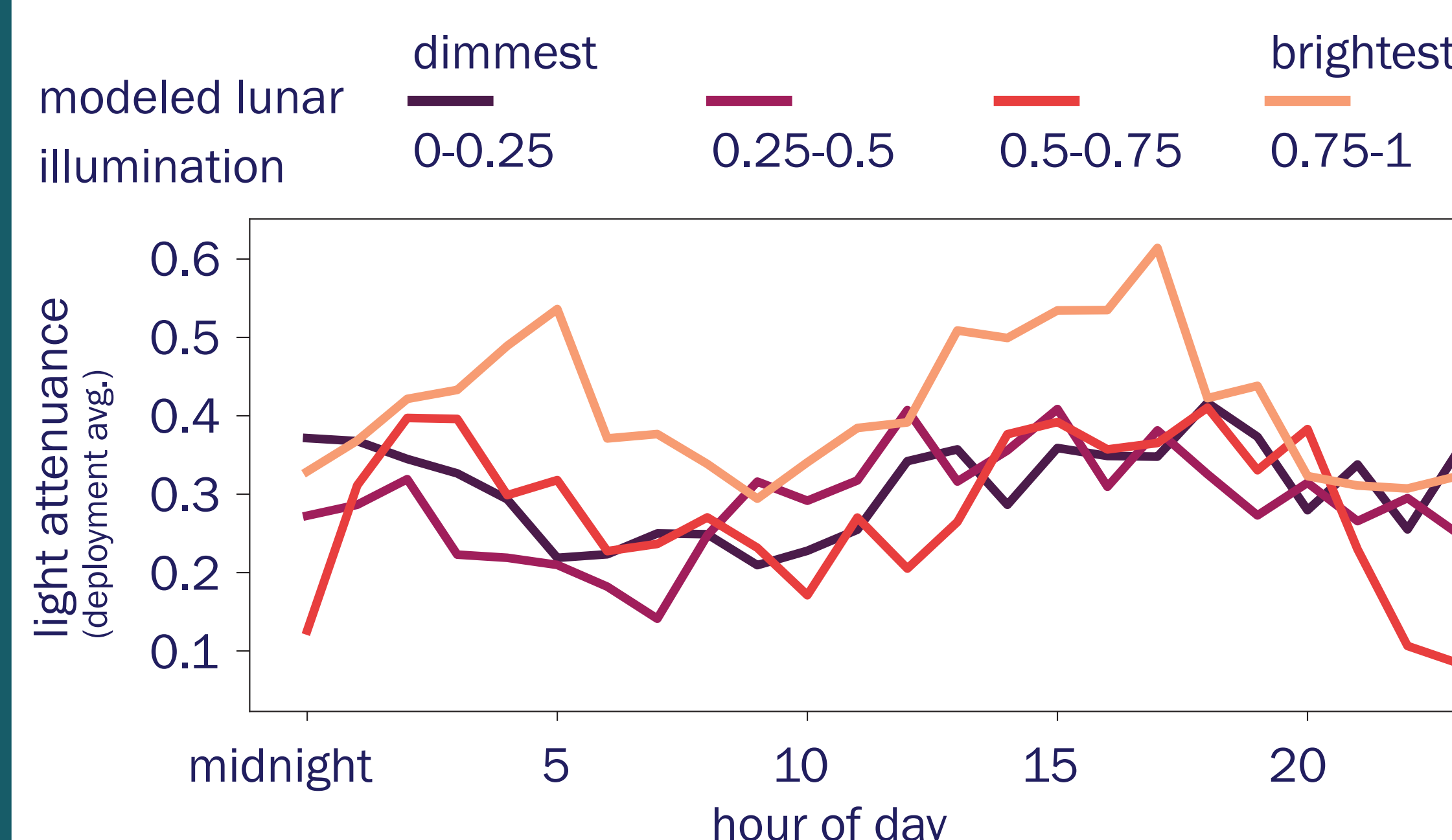
Results: Biological drivers

Timing of attenuation peaks suggests biological sources of variability.

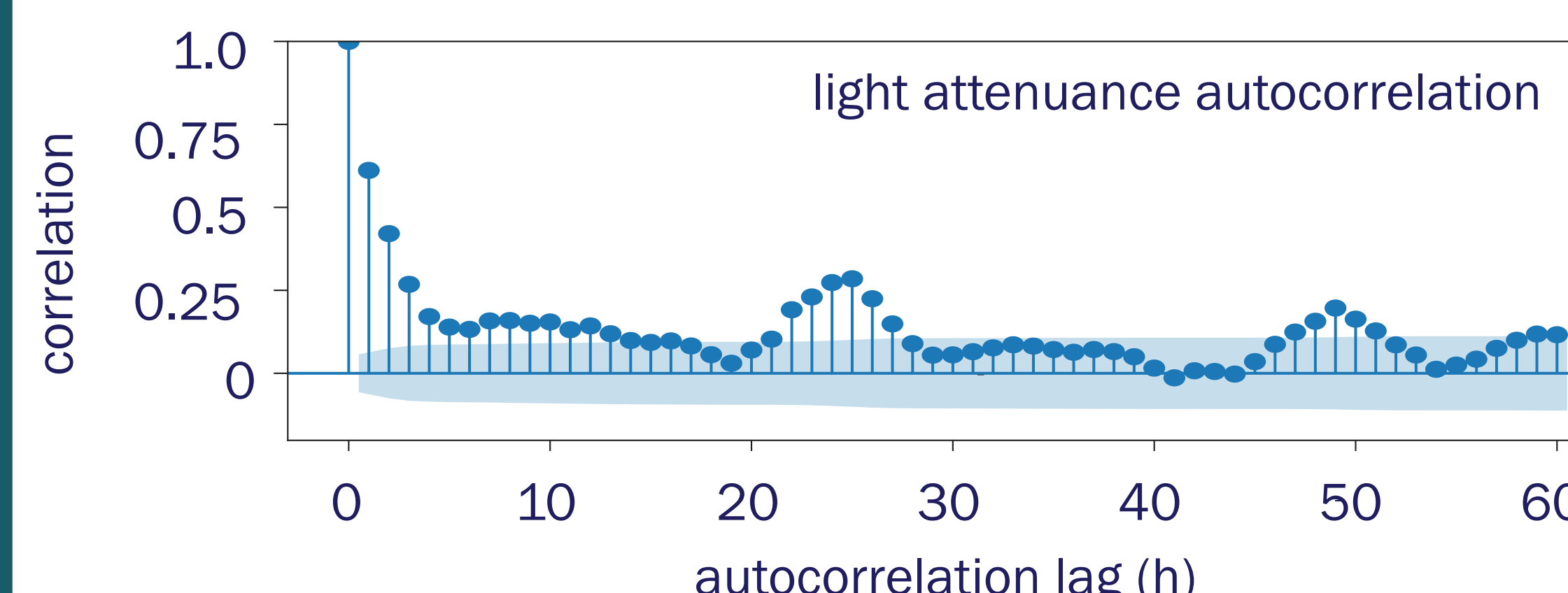
- Light attenuation of images taken at 890 m depth peaked before sunrise and sunset.



- Light attenuation of images taken at 890 m depth was higher when modeled lunar illumination at the surface was brightest.



- Diel cycles in light attenuation were consistent.



- Current speed did not correlate with attenuation.

Conclusions

- Diel cycles in light attenuation suggest active transport by migrating zooplankton may drive POC flux to 890 m depth.

- Light attenuation was higher during full moons, reinforcing the view that active transport drives POC flux to 890 m depth.

- Local resuspension did not drive the dominant patterns seen here.

Next steps

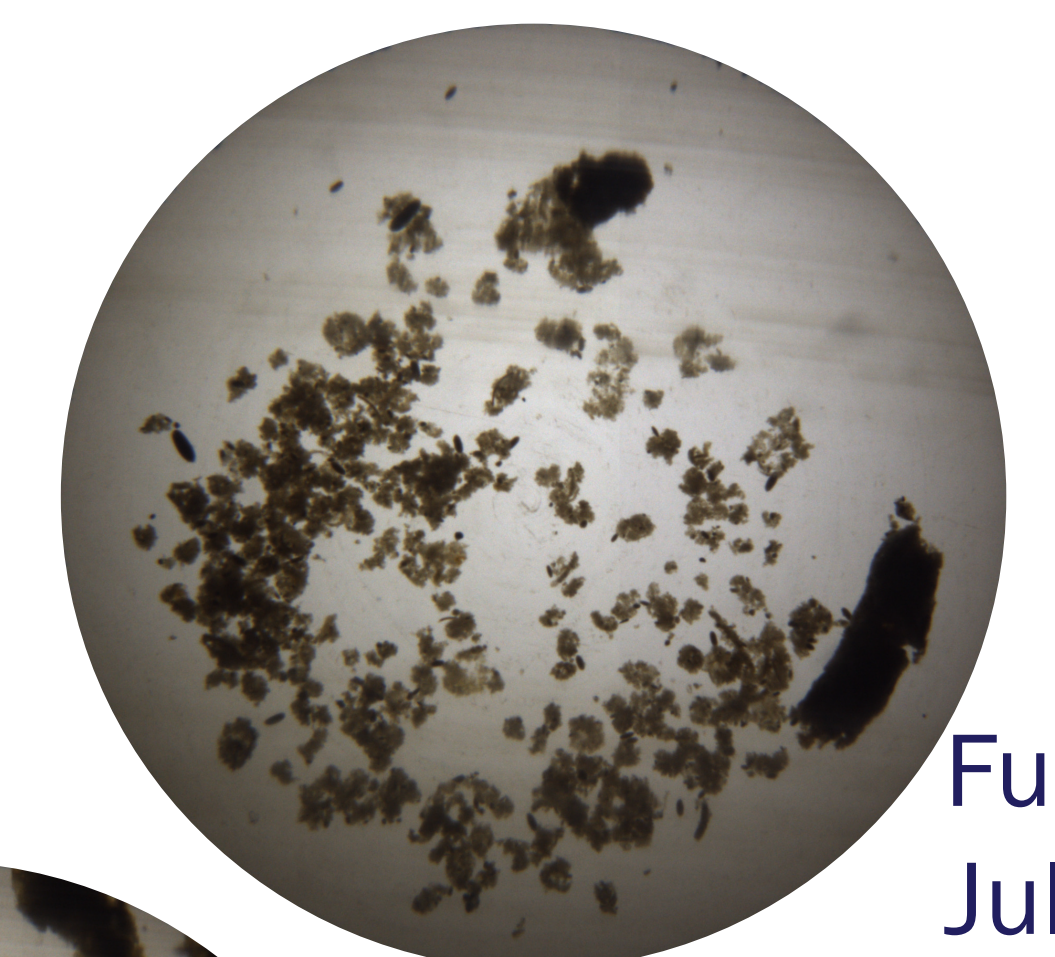
Assess influence of lunar and diel cycles on active transport of carbon to 890 m depth:

a) Identify particle types

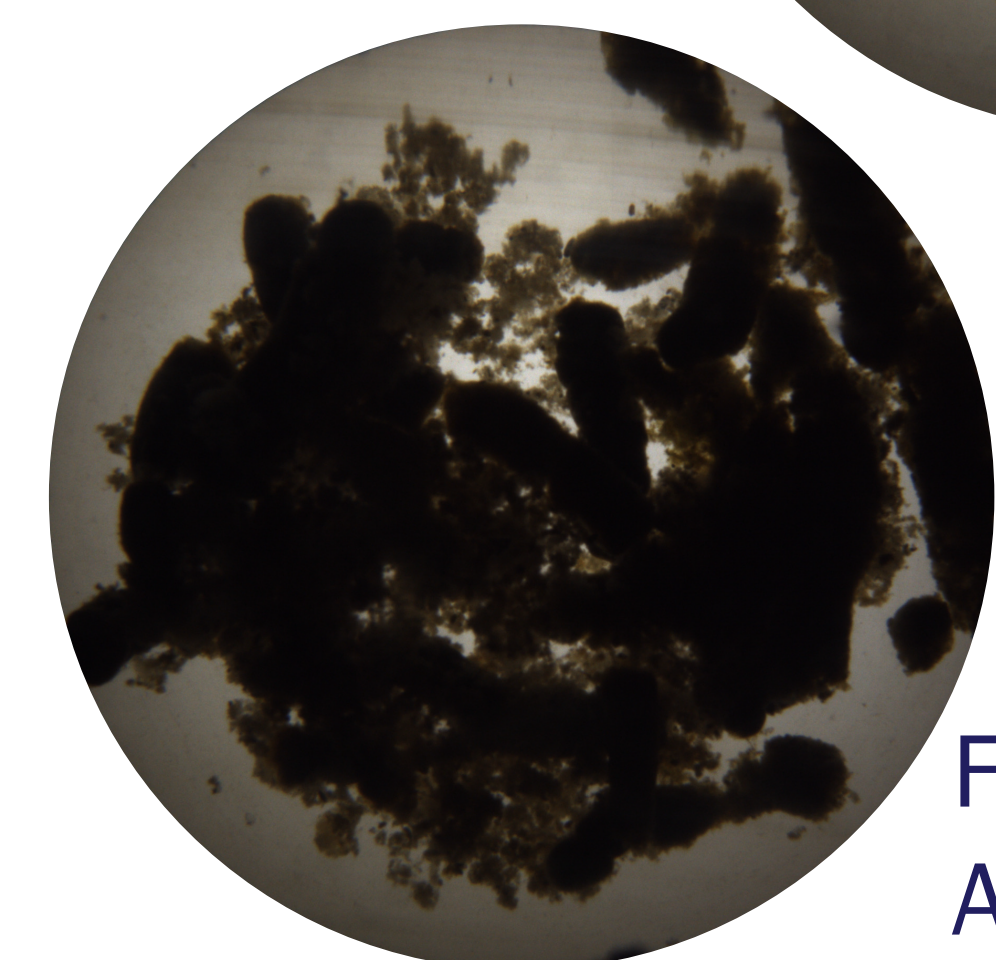
b) Compare to overlying zooplankton vertical migrations, and lunar/diel cycles.

Teaser

While attenuation was higher during full moons than dimmer periods, each full moon was different.



Full moon
July 2023



Full moon
August 2023

Acknowledgements

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Light attenuation: hourly averages

