

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 to 890 m depth, 3 x an hour for ~3 months in 2023.

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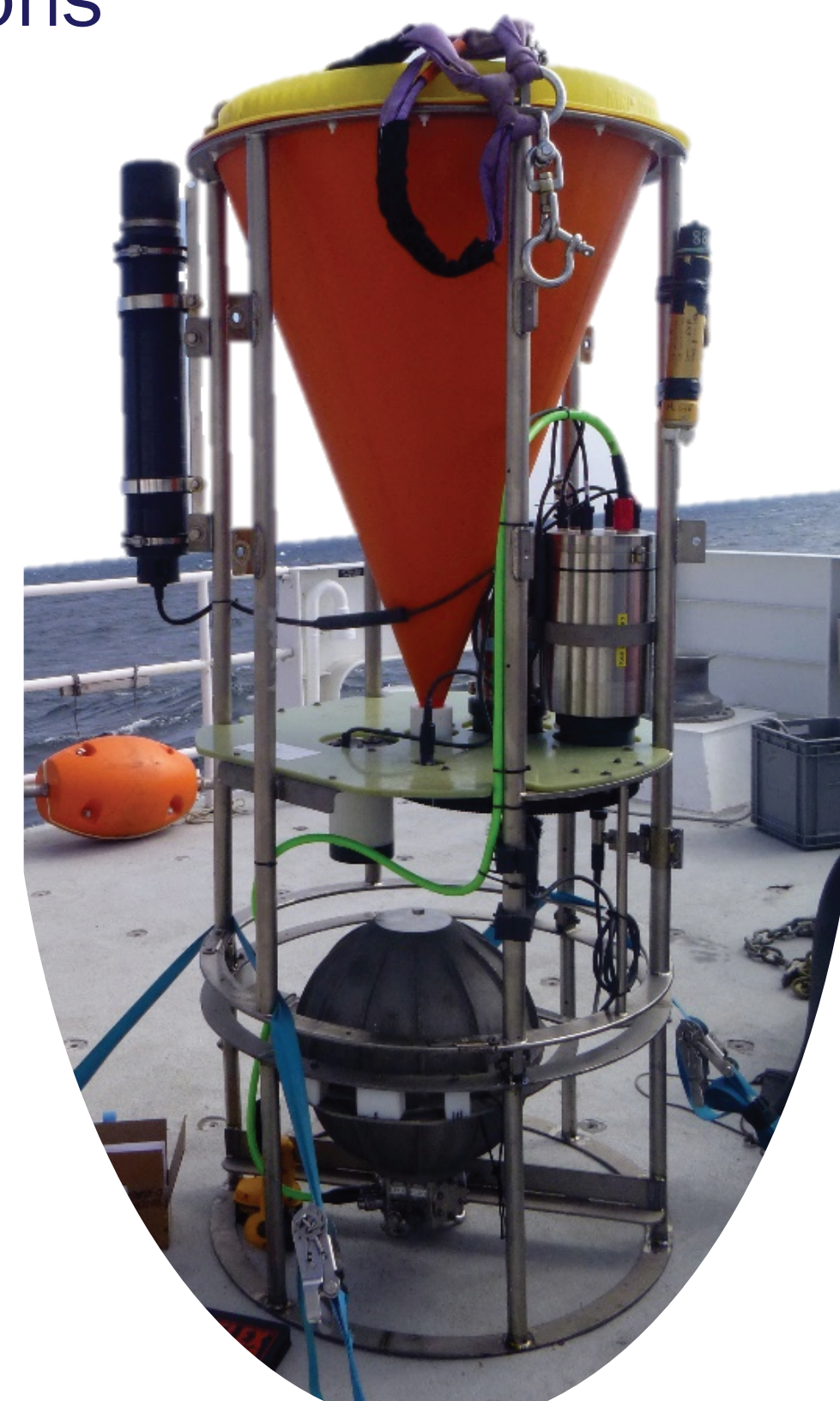
How does carbon reach the deep sea?

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.

Measuring particles sinking to the deep sea

- 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.



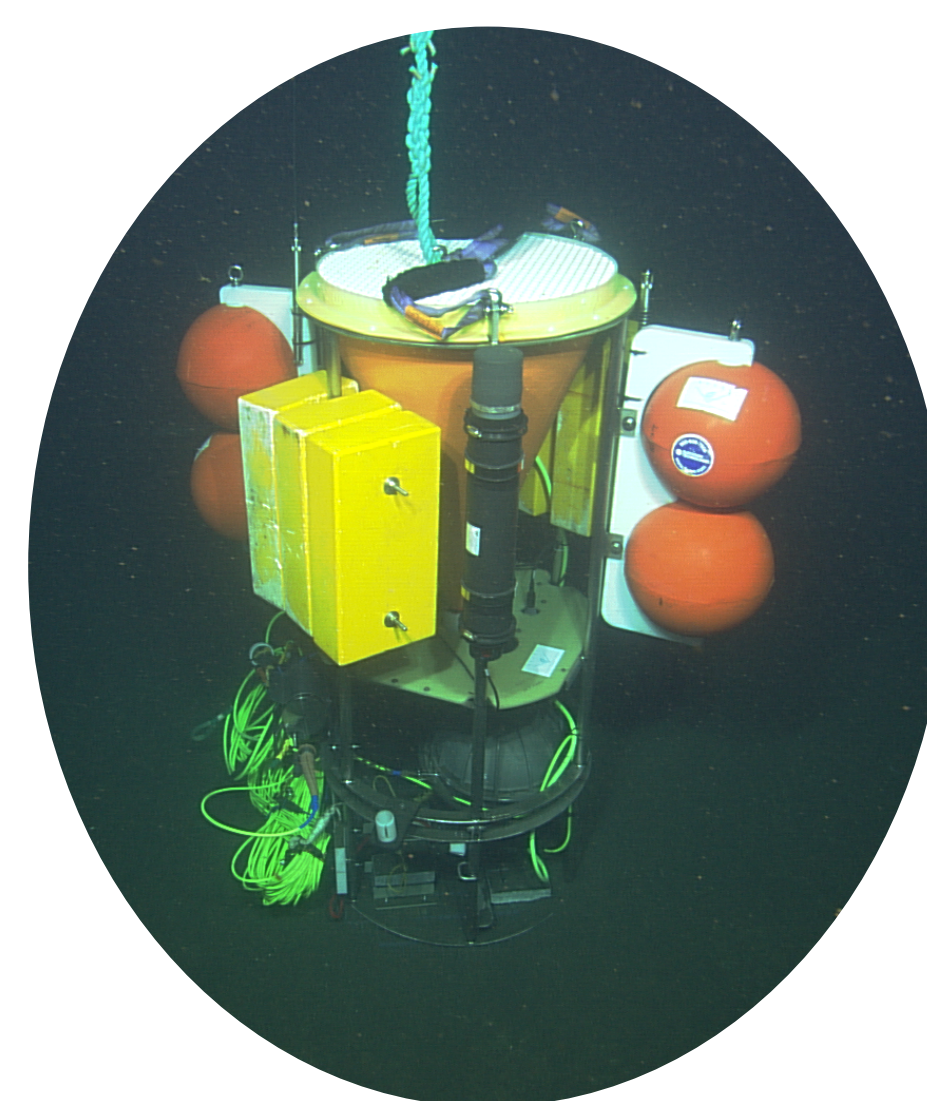
SES on deck



SES image



Detected particles



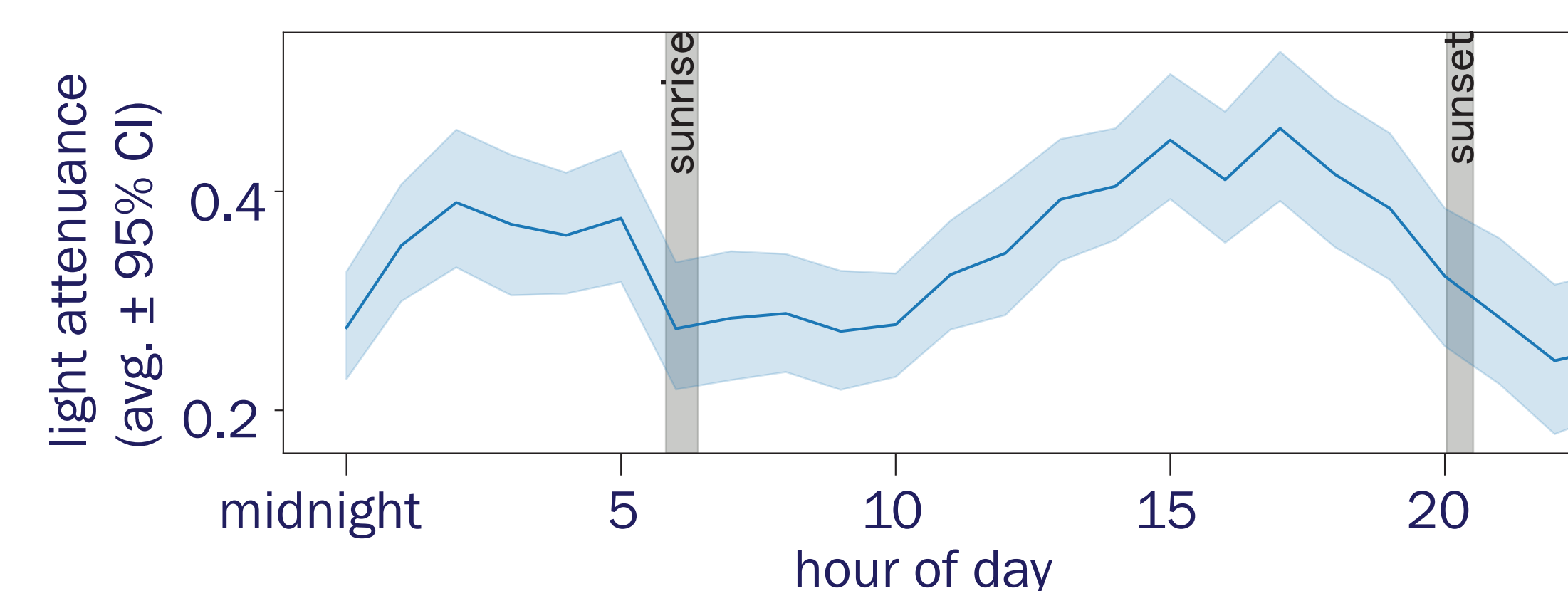
SES on seafloor

POC flux to 890 m depth was driven by biology

Timing of light attenuation peaks suggests zooplankton migrations controlled POC flux.

Results

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



Conclusions

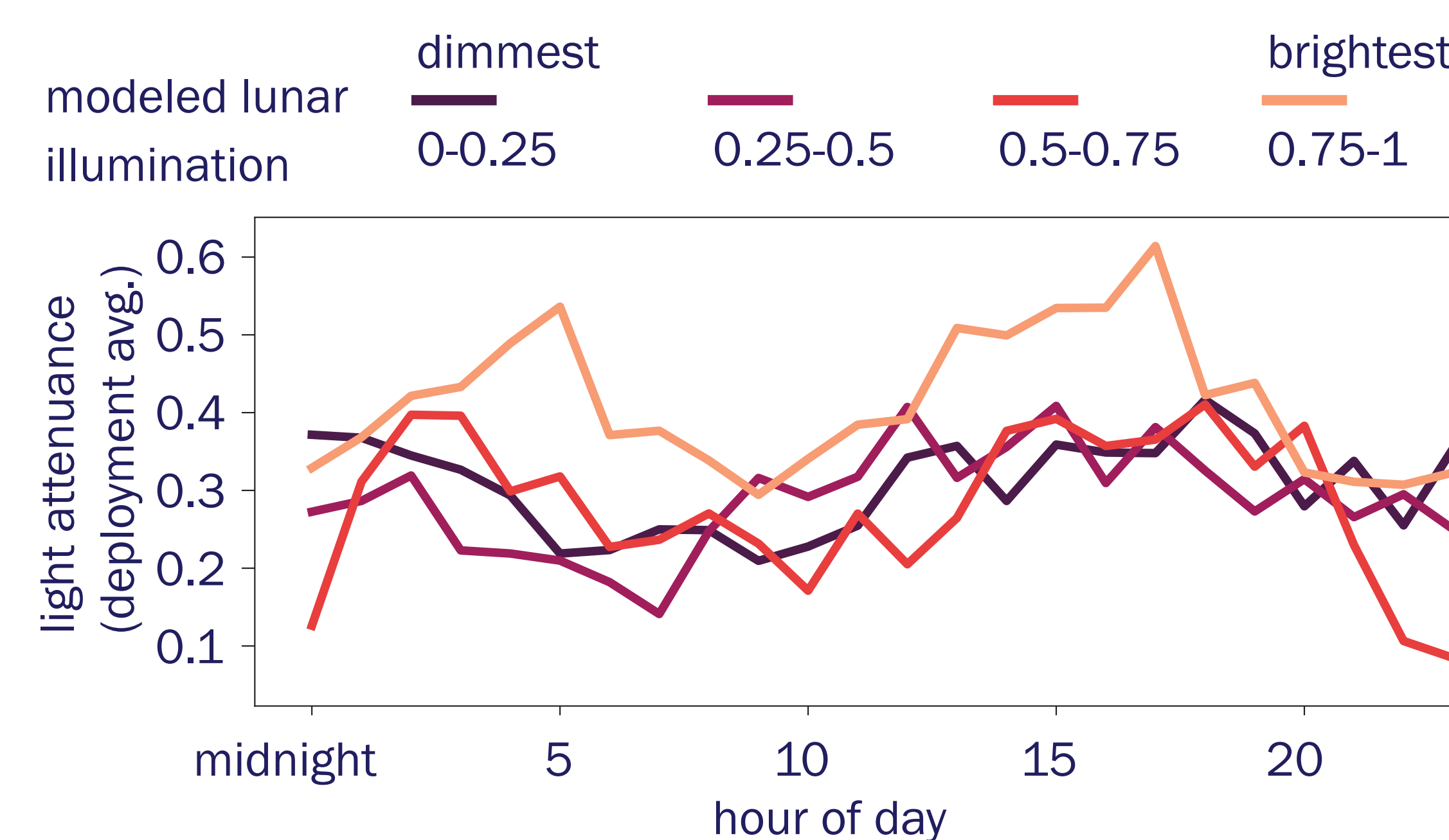
Twice-daily attenuation peaks suggest the SES mainly detected particles produced by zooplankton that migrate to the surface at night, and to depth during the day.

Light attenuation was higher during full moon. Full moon peaks may indicate enhanced feeding by zooplankton, deeper fecal pellet production during suppressed migration, or booth.

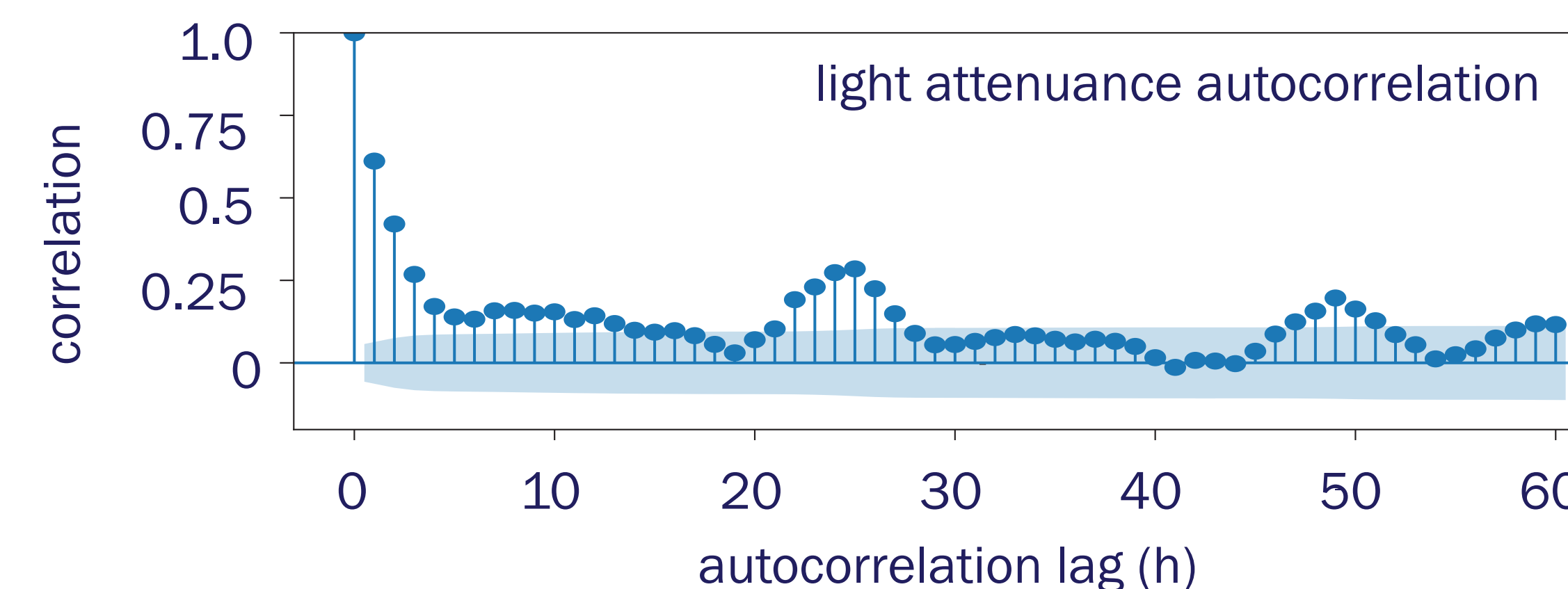
Diel patterns in POC flux may be consistent enough to be modeled.

Local resuspension did not drive the dominant patterns seen here.

- 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.



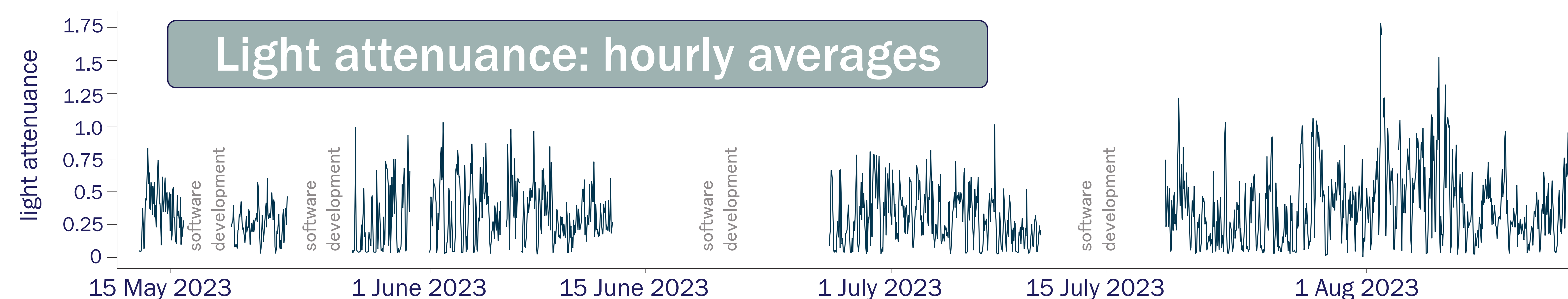
- Current speed did not correlate with attenuation.

Next steps

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

- Identify particle types
- Compare to overlying zooplankton vertical migrations, and lunar/diel cycles.

Light attenuation: hourly averages



Acknowledgements

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