Particles at the ocean surface and seafloor aren't so different

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An Oceanic Flux Program time series sediment trap deployed at 3,200-meter depth comes on board the R/V Atlantic Explorer. Credit: J. C. Weber

Although scientists often assume that random variations in scientific data fit symmetrical, bell-shaped normal distributions, nature isn't always so tidy. In some cases, a skewed distribution, like the log-normal probability distribution, provides a better fit. Researchers previously found that primary production by ocean phytoplankton and carbon export via particles sinking from the surface are consistent with log-normal distributions.

In a new study, Cael et al. discovered that fluxes at the seafloor also fit log-normal distributions. The team analyzed data from deep-sea sediment traps at six different sites, representing diverse nutrient and oxygen statuses. They found that the log-normal distribution didn't just fit organic carbon flux; it provided a simple scaling relationship for calcium carbonate and opal fluxes as well.

Uncovering the log-normal distribution enabled the researchers to tackle a longstanding question: Do nutrients reach the benthos—life at the seafloor—via irregular pulses or a constant rain of particles? The team examined the shape of the distribution and found that 29% of the highest measurements accounted for 71% of the organic carbon flux at the seafloor, which is less imbalanced than the 80:20 benchmark specified by the Pareto principle. Thus, although high-flux pulses do likely provide nutrients to the benthos, they aren't the dominant source.

The findings will provide a simple way for researchers to explore additional links between net primary production at the ocean surface and deep-sea flux.

More information: B. B. Cael et al, Open Ocean Particle Flux Variability From Surface to Seafloor, *Geophysical Research Letters* (2021). DOI: 10.1029/2021GL092895

B. B. Cael et al, Can Rates of Ocean Primary Production and Biological

Carbon Export Be Related Through Their Probability Distributions?, *Global Biogeochemical Cycles* (2018). DOI: 10.1029/2017GB005797

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