Coastal scientists spend a lot of time studying sediment — mud, sand and other materials suspended in the water or layered on the ocean’s floor. Questions swirl surrounding where sediment comes from and where it ends up, how much moves and how much accumulates.

Coastal oceanographer Emily Eidam has so many questions about sediment movement in so many places that she and her colleagues developed a low-cost, open-source, DIY sensor to measure the concentration of sediment suspended in the water in coastal systems. These fairly simple optical backscatter sensors can be built in her lab out of off-the-shelf parts for about $200 each, a fraction of the thousands of dollars she would have to spend on commercial versions.

Because they are inexpensive and easy to build, her so-called OpenOBSs can be deployed in great numbers in remote places. She is particularly interested in Alaskan ecosystems, from tidewater glaciers to rivers. The questions she can answer are nearly endless. In many systems, suspended sediment carries contaminants along with it — how do these potential toxins move in the environment? How does sea level rise impact erosion of shorelines, and how fast? Glacial moraines help stabilize glaciers — how does sediment move in the moraine and how does that movement relate to climate change?

The simplicity of the OpenOBS platform has inspired Emily to use them in outreach projects as well as in her own research. For example, her team worked with students at the rural and largely Indigenous Nenana City School in central Alaska to build their own sensors and collect data in the nearby Tanana River.

The OpenOBS has been through many iterations; Eidam and her team are always improving and innovating, as well as taking advantage of technological advancements. The instrument depicted here is one of the early and more complex generations of the OpenOBS.

1. Battery: The OpenOBS runs on a regular AA battery, one of its many simplicities that makes it easy and cheap to build and deploy. Eidam can also ship the OpenOBS to colleagues easily, as they can buy their own batteries!
2. Micro SD card: Data is stored on a tiny but powerful SD card.
3. Microprocessor: This microprocessing chip, an easily accessible and inexpensive Arduino Nano, is the brain of the OpenOBS. It translates the voltage data collected by the light receiver into information about the size and concentration of particles, and it can be programmed to tell the OBS to sample at varying intervals — say, once per hour for ten minutes at a time.
4. Endcap: This custom cap is 3-D printed to hold the infrared components of the OBS. It was important for the endcap to be black to reduce the phenomenon of light signals bouncing in all directions as they return to the sensor. The endcap is fitted to the tubular case with a watertight seal.
5. Infrared light emitter: Now we come to the magic of the OpenOBS. Using essentially the same technology that operates automatic soap dispensers that sense your hand and give you a dollop of soap, the OpenOBS detects particles suspended in the water around it. It does so by emitting a ray of infrared light, from here, which bounces off particles in the water and ...
6. Infrared light receiver: ... the infrared light rays bounce back to this receiver. The OBS records voltage, based on how much light is reflected back to the sensor, which is used to calculate size and concentration of particles based on reference samples measured by scientists. This whole sensor can be bought off the shelf.
7. Case: In keeping with the goal of building these instruments cheaply, the case that protects the circuitry is a simple length of PVC pipe. Depending on the model, the case itself can be as small as six inches long and about an inch in diameter.
8. Iridium card: Some versions of the OpenOBS use an Iridium satellite link to send data to scientists in real time in addition to storing it on the Micro SD card. This data transmission allows scientists to keep an eye on the data and the function of the instrument from the comfort of their lab, but also ensures that data is not lost if the OBS itself is damaged or washed away.