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New Satellite Will Help NASA Keep PACE with Earth Systems

On 8 February, NASA launched a new satellite tasked with monitoring microbes in the ocean and aerosols in the atmosphere. The mission, called PACE (Plankton, Aerosol, Cloud, ocean Ecosystem), will improve scientists' understanding of the carbon cycle.

The satellite houses three instruments: the Ocean Color Instrument (OCI) and two polarimeters to measure the atmosphere's aerosol composition.

Unlike other remote sensing satellites, which measure five to seven colors, the OCI measures the brightness of more than 200 colors, from ultraviolet to infrared. Scientists use the ocean's color to identify the abundance of phytoplankton, which live in the upper 200 meters of the water column. Greener waters typically mean that more of these chlorophyll-containing microbes are present.

Before now, scientists struggled to distinguish between different taxonomic groups of phytoplankton. The ability of the OCI to distinguish so many different colors promises to remedy that.

"The amount of light at each wavelength is directly impacted by how much of each type of plankton is in the water," explained Alison Chase, an optical oceanographer at the University of Washington and a member of the NASA PACE Science and Applications Team. This is because different pigments (like yellow to orange carotenoids) and cell structures absorb and scatter light differently, she said.

Different types of phytoplankton interact with the ocean and atmosphere in varying ways, said Jeremy Werdell, a project scientist for PACE and an oceanographer at NASA. Ultimately, however, phytoplankton "form the base of the aquatic food chain. They are responsible for bringing carbon dioxide out of the atmosphere," he said.

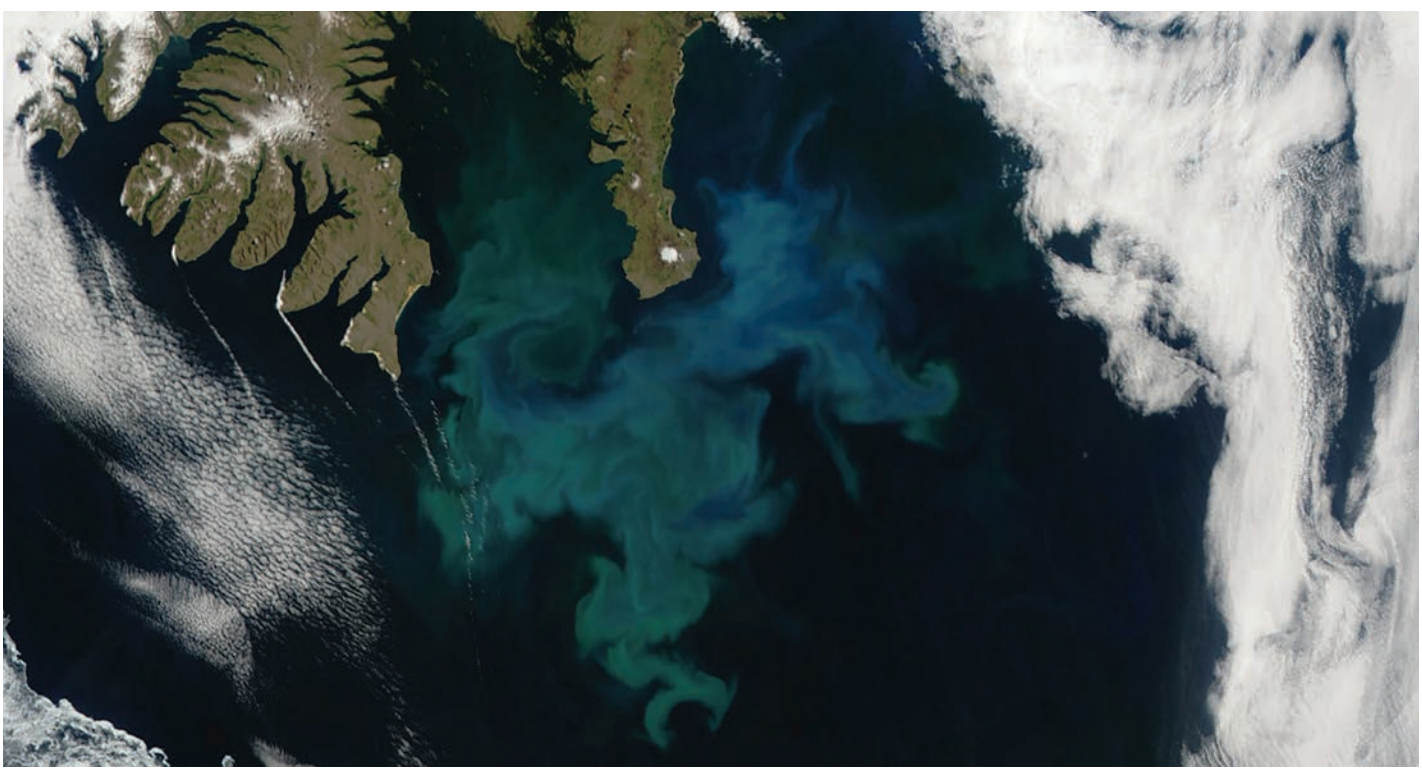
PACE could also help answer questions about the role of phytoplankton in the carbon cycle as the world warms. "We certainly don't know a lot yet about how different phytoplankton community groups at the surface impact carbon flux on large spatial scales," Chase said.

Larger phytoplankton species such as diatoms live in the upper ocean but rely on cold, nutrient-rich water that upwells from the deep, for example. Warming waters could affect ocean currents, limiting the flow of nutrients. If these conditions occur, "big phytoplankton won't have what they need to grow," Chase said.

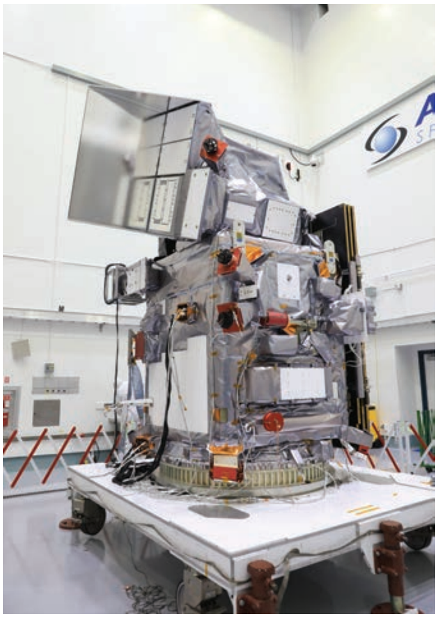
PACE will help scientists monitor these communities across entire ocean regions. Chase explained that those data can then be used to estimate carbon flux and predict what may happen to carbon levels if those communities change.

From Ocean to Sky

The ocean, clouds, and aerosols interact to modulate temperature in the atmosphere, Werdell said, and the PACE mission is monitoring Earth's skies as well as its seas. PACE's polarimeters measure how light is



The PACE (Plankton, Aerosol, Cloud, ocean Ecosystem) satellite monitors the ocean's color to identify phytoplankton such as this bloom swirling off the coast of western Iceland in June 2010. Credit: NASA/Goddard Space Flight Center/Jeff Schmaltz/MODIS Land Rapid Response Team



Scientists and engineers test PACE before its launch. Credit: Kim Shiflett/NASA

polarized as it passes through the atmosphere, which can indicate the amount, size, and shape of suspended particles and other properties of clouds.

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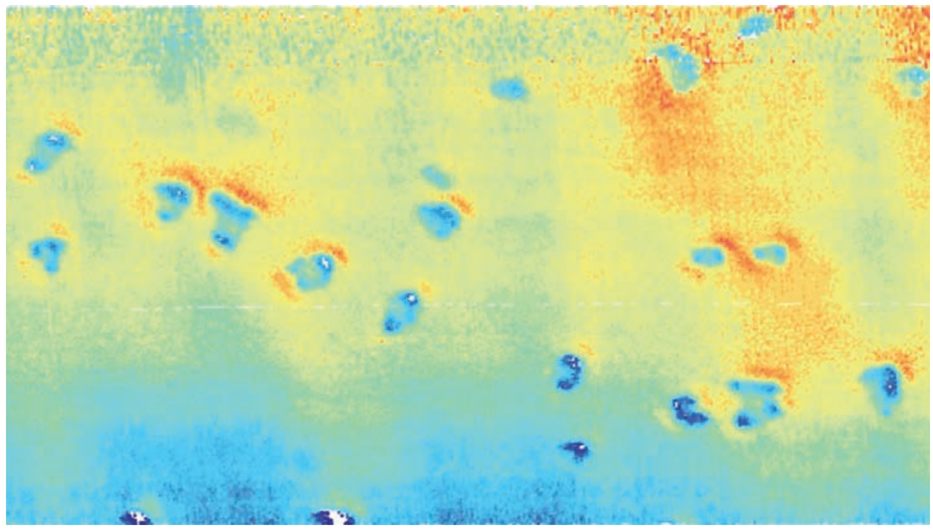
"Our understanding of those interactions is really one of the largest uncertainties in our ability to interpret [climate] models," said Werdell.

PACE will produce so much information that it will be a challenge to use it all at first, Werdell said. "The beauty of this mission, in my mind, is that it's information we can grow into in order to understand the interconnectedness of this full Earth system."

By **Emily Shepherd** (@emilyshep1011), Science Writer

Mysterious Seafloor Pits May Be Made on Porpoise



Seafloor pits like these may not have been created by methane leaks. Credit: Jens Schneider von Deimling

In the murky waters of the North Sea, shallow divots dot the seafloor. The pits are round or oval and range in width from a few meters to more than 60 meters, but they are consistently only 11 centimeters deep. Some pits appear to have merged, creating oblong Venn-diagram-shaped depressions.

Such pits usually form when fluids containing methane or other groundwater bubble out of the sediment. But new research published in *Communications Earth & Environment* suggests that thousands, and perhaps millions, of pits in the North Sea and elsewhere might actually be the work of foraging porpoises (bit.ly/porpoise-pockmarks). The work showed that these and other megafauna may play a large role in shaping the seafloor.

For years, geoscientist Jens Schneider von Deimling of Kiel University was skeptical that the North Sea pits were made by leaking methane. The floor of the North Sea is made of porous sand and has strong currents, which aren't conducive to methane accumulating in sediment.

"I didn't really see any mechanisms that accumulate methane," Schneider von Deimling said. Out on the water during a research cruise, he and his colleagues confirmed his suspicion. Mapping studies designed to detect methane in the sediment using a sub-bottom echo sounder, which is a form of sonar that bounces sound off the seafloor to image the shallow subsurface, turned up nothing. "We mined thousands of miles of data for shallow gas, and simply didn't find that," he said.

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To get a better look at the pits, the team used a multibeam echo sounder that allows for surveys of the seafloor in high resolution. Whereas older multibeam technologies can miss pits entirely, this multibeam tool allowed the researchers to scrutinize the shape of the pits down to the centimeter scale.

"They had the opportunity to collect this really, really high resolution data, which is great because it means you can closely examine the structures," said Jess Hillman, a marine geoscientist at GNS Science in New Zealand who wasn't involved in the study.