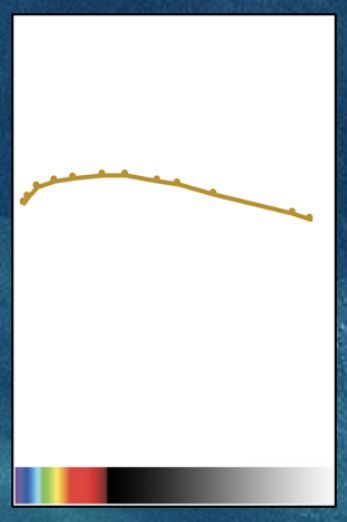
PACE Card Game Overview

During the PACE Card Game, players learned how PACE's Ocean Color Instrument (OCI) will collect spectral data that scientists can use to study different types of matter. This data will provide key information about our ocean and atmosphere. Keep reading for an overview of all that was learned!

DUST

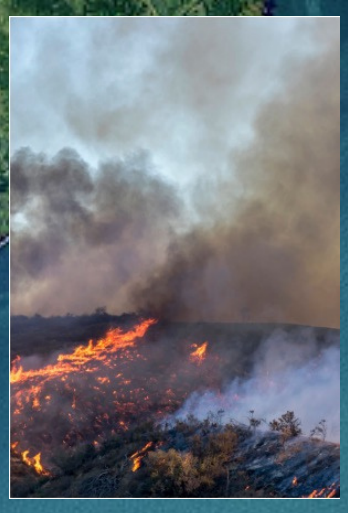
PACE will provide key information on airborne dust, which is found where soil is blown loose by the wind, such as at deserts, dry lake beds, or glaciers. While organisms in the ocean can use the nutrients delivered by dust to grow, humans and animals can suffer respiratory issues when dust particles are inhaled.

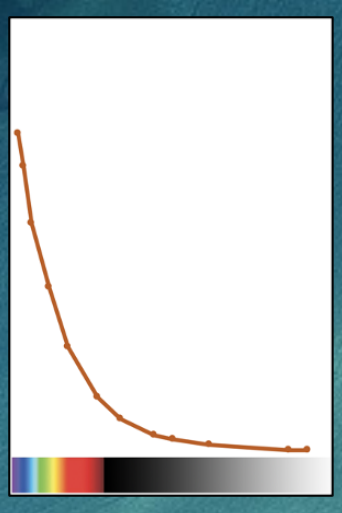
Dust reflects strongly over a wide range of the electromagnetic spectrum from visible (left) to infrared (right) wavelengths because minerals scatter light strongly, and dust storms can contain a lot of minerals. Data from PACE's instruments will help determine the height of dust storms. This information is key for hazard avoidance and predicting how dust storms will move. Other researchers will use PACE data to investigate links between the availability of nutrients from dust and the growth of phytoplankton.



Details on the Spectra

The orange-red color commonly associated with dust is because it tends to preferentially absorb blue light. This is seen in a plot of Reflectance vs. Wavelength from data based on Lee et al. (2017) and Hess et al. (1998).





Details on the Spectra

Smoke's spectral signature has a distinct downward slope moving from the visible colors to longer wavelengths. This slope is seen from left to right in a plot of Reflectance vs. Wavelength from Sayer et al. (2014).

SMOKE

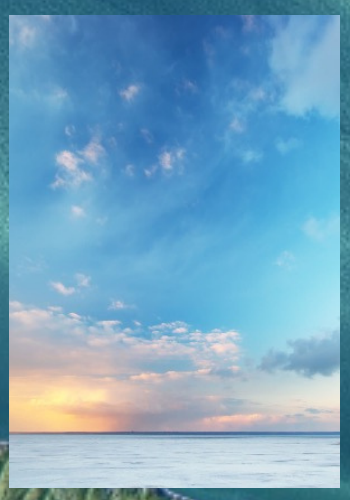
As wildfires burn, large amounts of fine particulate matter are released into the atmosphere and mix with gases to become *aerosols*, tiny particles suspended in our atmosphere. To study these particles, PACE's Ocean Color Instrument will collect data like the spectrum shown on the right. PACE's multi-angle polarimeters, SPEXone and HARP2, will provide key data on the size of the smoke particles in Earth's atmosphere.

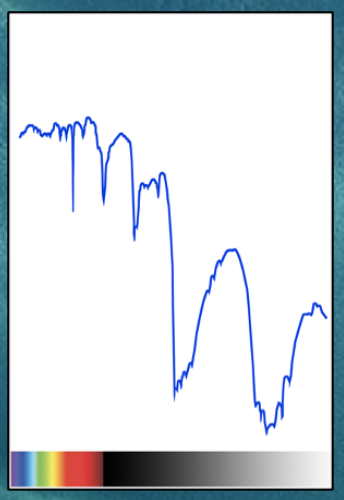
PACE's science instruments will provide information on the atmospheric concentration of wildfire-related aerosols. These particles can significantly reduce air quality, leading to asthma and respiratory distress among vulnerable people. Over the long term, smoke aerosols absorb and reflect different fractions of sunlight, affecting how much energy Earth absorbs from the sun.

CLOUDS

Predicting climate involves long-term studies of clouds, which both reflect and absorb sunlight. Clouds can interact with tiny, suspended particles known as *aerosols* in many complex ways that are not well understood. Clouds are also complex and constantly changing, meaning that different types of clouds have different spectral "signatures" that depend on their composition, size, shape, and altitude.

PACE will measure the size of cloud drops and ice crystals, improving the ability to differentiate between ice and water clouds. It will observe the ocean, clouds, and aerosols together to better understand how they interact. These interactions affect how much heat is trapped by Earth's atmosphere and thus are vital for accurate weather and climate prediction.





Details on the Spectra

Cloud spectra have many "ups and downs" because of variation in absorption among different forms of water: liquid, vapor, and ice. This is seen in a plot of Reflectance vs. Wavelength from data based on Dierssen (2019).

MICROCYSTIS

Found in freshwater, Microcystis can form colonies and become large floating blooms by producing gas-filled bubbles. If consumed by mammals (including humans), Microcystis can cause numbness, nausea, dizziness, vomiting, and lead to liver damage or death.

The bright color of Microcystis is captured as a narrow peak in the visible color spectrum at green-yellow wavelengths. The organisms' form and size – colonies made up of round cells large enough to been by the naked eye – also contribute to its spectral signature. PACE will contribute to an "eye-in-the-sky" early warning system, helping to alert the public and local officials when dangerous waters may be in bloom.

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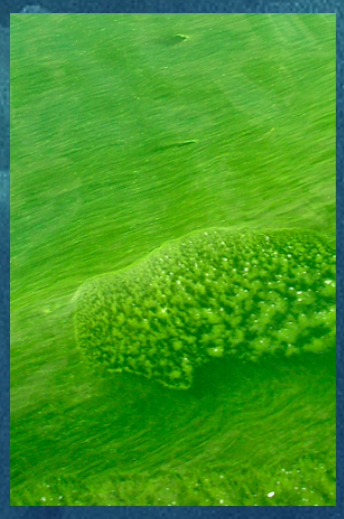
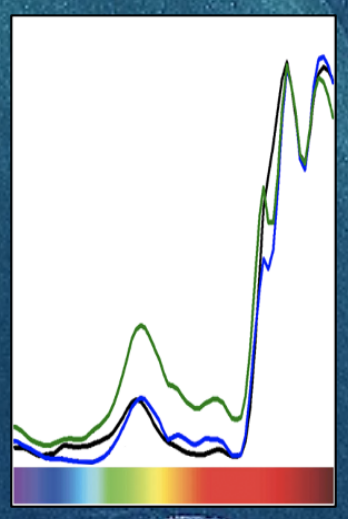
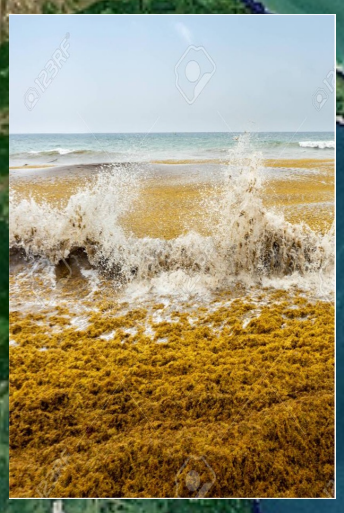
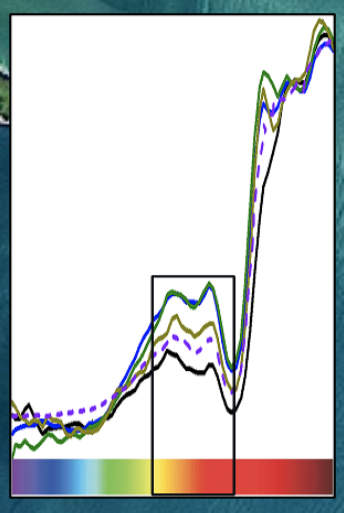




Details on the Spectra

Microcystis reflects in the green-yellow part of the visible color spectrum.This is seen in a plot of Reflectance vs. Wavelength for three samples (Hu, 2022).





Details on the Spectra

Sargassum reflects strongly in the yellow and orange parts of the visible color spectrum. This is seen in a plot of Reflectance vs. Wavelength for five samples (Hu, 2022)

SARGASSUM

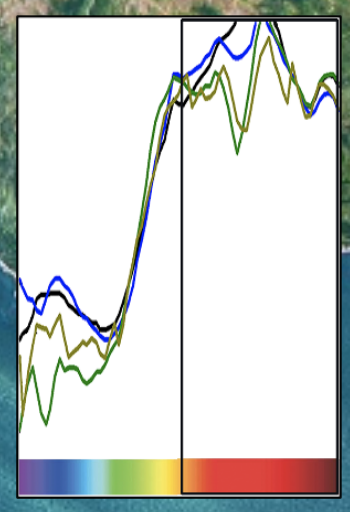
This floating seaweed, called Sargassum, is a type of "macroalgae," that has been shown to provide shelter to over 100 different species. Many organisms have specialized patterns and colors that mimic the golden-brown color of Sargassum, allowing them to be camouflaged in their environment. However, Sargassum has recently become a nuisance along many coasts. Huge quantities have been washing ashore in rotting piles, impeding normal fishing activities and driving away tourists.

PACE's Ocean Color Instrument (OCI) will cover our global ocean, providing unprecedented opportunities to detect, differentiate, and quantify various types of floating matter such as Sargassum. OCI data will contribute to products such as the Sargassum Floating Algal Index, developed by the University of South Florida, whose goal is tracking large blooms in near-real time.

NOCTILUCA

Noctiluca is a type of microscopic algae that is among the most abundant "red tide" organisms. Unlike other phytoplankton, Red Noctilua lacks a red-edge feature on the spectrum, possibly because they are "heterotrophs" and therefore do not contain pigments unless they were to feed on other algae as an "autotroph" would.

Noctiluca is non-toxic, but large blooms – which occur worldwide – can be harmful when they die and deplete oxygen from ocean habitats, posing a significant threat to coastal resources, water quality, public health, and tourism. Data from PACE will help accelerate the process of developing Noctiluca-specific ocean color computer algorithms. These algorithms may aid better prediction of blooms, improving our ability to better forecast fish kill events and other harmful impacts.



Details on the Spectra

This species of Noctiluca reflects strongly in the orange and red parts of the visible color spectrum. This is seen in a plot of Reflectance vs. Wavelength for four samples (Hu, 2022).

For more information, visit
https://pace.oceansciences.org

Background photo: Collected by Landsat 8 on September 24, 2021.