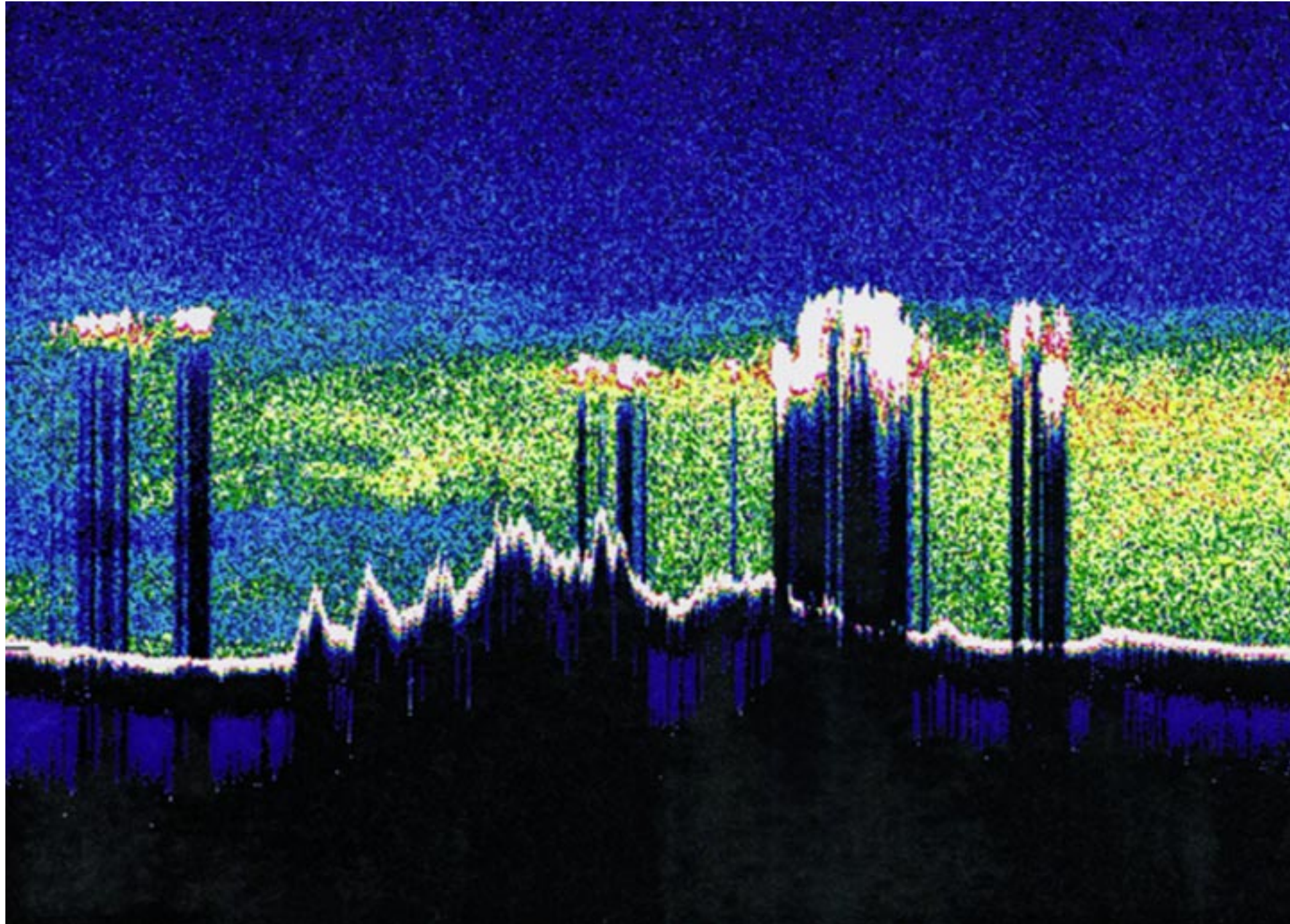




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Lasers for Remote Sensing





Lasers in Space: A Tool to See Our Atmosphere

Now you see it.

Have you ever noticed little bits of dust floating through a ray of sunlight coming through a window? You couldn't see the dust without the sunlight, right? So it is in Earth's atmosphere. There is not only dust but other suspended particles called aerosols, that include molecules of water vapor, cloud particles and a gas called ozone, none of which we can see.

Scientists at NASA's Langley Research Center believe these atmospheric particles and gas molecules are changing our climate and affecting us at the Earth's surface. They have devised a way to use laser light to see and measure these particles in the atmosphere. Determining the composition of the Earth's atmosphere will help us to understand our changing climate and the health of our planet.

What is light?

Light is made up of tiny waves. Visible, or white, light is the mixture of different wavelengths which represent the colors and combination of colors we can see. In the 1960s, a German scientist, Theodore Maiman, discovered that he could separate and concentrate specific wavelengths of light, setting the stage for the lasers we use today.

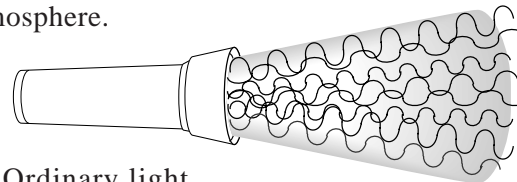
What is a lidar?

NASA scientists use lasers in a special instrument called a "lidar." Lidar stands for **L**ight **D**etection **A**nd **R**anging and is like radar, only it uses light waves instead of radio waves. Using a lidar, scientists fire the laser beam into the atmosphere from ground locations as well as from airplanes and now even from space. The laser beam reflects, or bounces, off whatever it hits. It may be particles of dust over the Sahara Desert or a cloud over the

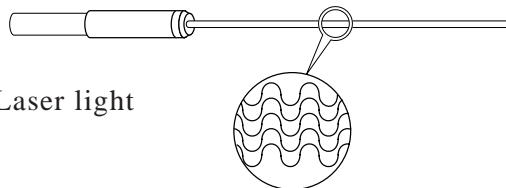
ocean. The reflected light comes back to a telescope where the amount of light is measured. Laser beams can be tuned to measure a specific kind of molecule or particle and identify what it is and how much is there. Also, unlike light from other sources, the laser beam remains steady and strong even after traveling a large distance.

What is LITE?

In September 1994, NASA Langley scientists tested their laser instruments in space for the first time. The LITE (**L**idar **I**n-space **T**echnology **E**xperiment) was sent into orbit for 12 days aboard the Space Shuttle Discovery. Discovery passed over 24,775 miles of the planet's surface every 90 minutes. The 53 hours of LITE data represent 35 orbits of the Earth. LITE showed how clouds vary with altitude in the atmosphere and tracked various kinds of aerosols. With the success of the first LITE mission, NASA Langley hopes to get lidars into space on satellites to continue the study of our atmosphere.



Ordinary light



Laser light

Light waves from the flashlight are different colors and different lengths; however, the laser light waves are all the same wavelength and hence only one color.

Activities for the Classroom

1. Research other uses for lasers, for example, in medicine, in stereo equipment, in the automobile industry, at a rock concert.
2. Go to a large room (like a gymnasium) or go outside at night and see how far your flashlight will shine.
3. Draw a diagram of a laser system starting with its light source. Your encyclopedia can help you.

Who cares what's out there?

We all need to care. What's in our atmosphere affects all of us. It affects our weather. It affects the ozone which protects us by absorbing harmful ultraviolet radiation. Global pollution affects the air we breathe and the amount of sunlight which reaches us. Dust storms and volcanic eruptions also alter our atmosphere. If we can more accurately forecast natural occurrences, like the weather, we can be better prepared. If we can actually see the results of what we may be doing to hurt our planet's atmosphere, we can change our bad habits before it's too late.

About the Image

This LITE data shows the atmosphere above the Atlas Mountains of Morocco (the black triangles) near the Atlantic Ocean. White indicates clouds and yellow/red indicates desert dust aerosols.