How to Spy on Stuff You Can't Touch

Radars and lidars are used to study the atmosphere

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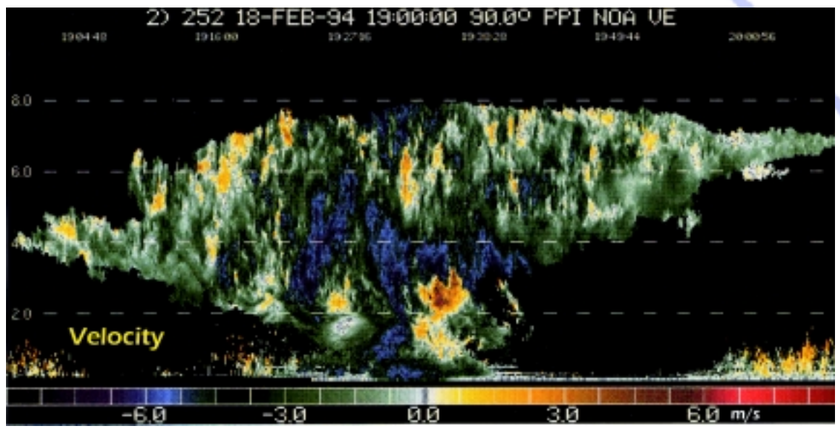
An active remote sensor sends out pulses of energy (for example, light or radiowaves) to *sense* what is happening at *remote* locations. It consists of two parts, a transmitter which sends out a signal and a receiver which detects the part of the signal which scatters back from distant objects. This is like a flash camera in a dark room which sends out light that reflects off objects and is then recorded by film.

Two types of active remote sensors are radars (Radio Detection and Ranging) and lidars (Light Detection and Ranging). These two instruments work in similar ways, but use energy pulses at different wavelengths. Measurements by these instruments are used to forecast the weather and to study air pollution.

Radar

Radars use radiowaves to probe the atmosphere. Radar wavelengths range from millimeters to many meters; they are about 1 million times longer than the wavelengths of light.

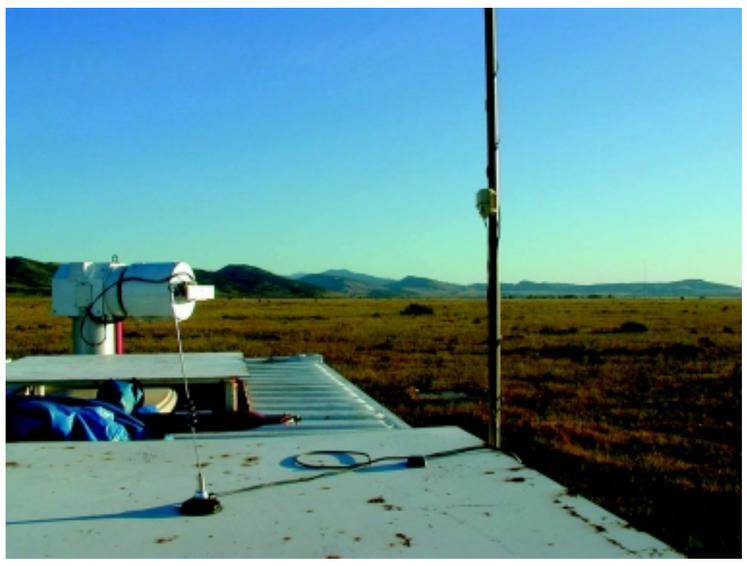
This NOAA radar is used to observe clouds. In the atmosphere, the long-wavelength radar pulses interact with water droplets and ice crystals in clouds.



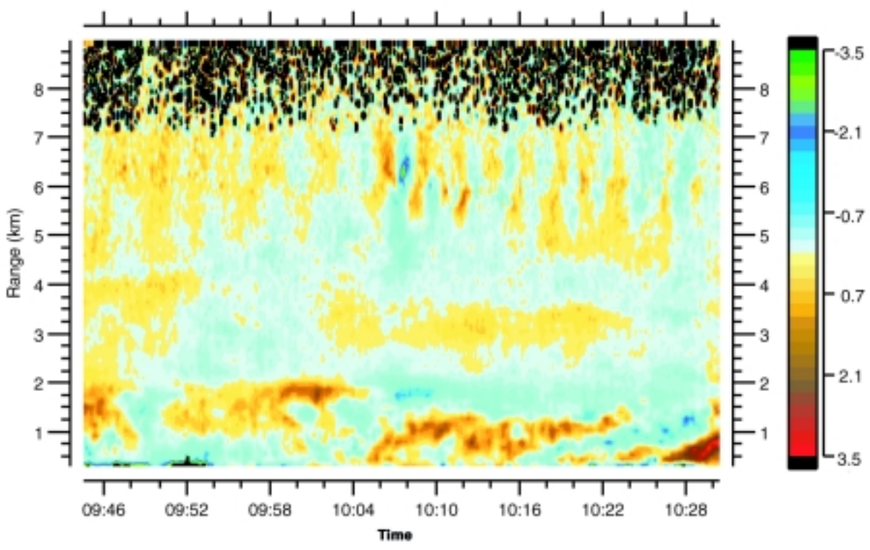
ETL scientists used a radar to make this picture of motion within a cloud. The side of the plot shows the height (range) of the cloud in kilometers and the color bar at the bottom shows the velocity (Doppler shift). From the colors, you can see that different parts of the clouds are moving at different speeds.

Lidar

Lidars send pulses of laser light into the atmosphere where they are scattered by dust particles. The light which scatters back is measured by the lidar. From these measurements, scientists learn about the wind, pollution, and humidity.



This NOAA lidar can measure wind velocities in clear air out to ranges of more than 10 km.



This picture shows a Doppler wind measurement made with a lidar pointing up at the sky. The side of the plot shows the height (range) and the color bar shows the velocity (Doppler shift) of the dust particles carried by the wind. See how complex the motion of the atmosphere is!

Ariel (graduate student) and **Mike** (college student) work on the electronics circuit for the Doppler display.

Richard (ETL optical engineer) and **Sherlyn** (graduate student) test the range sensor. Isn't science fun?

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