MISR Science

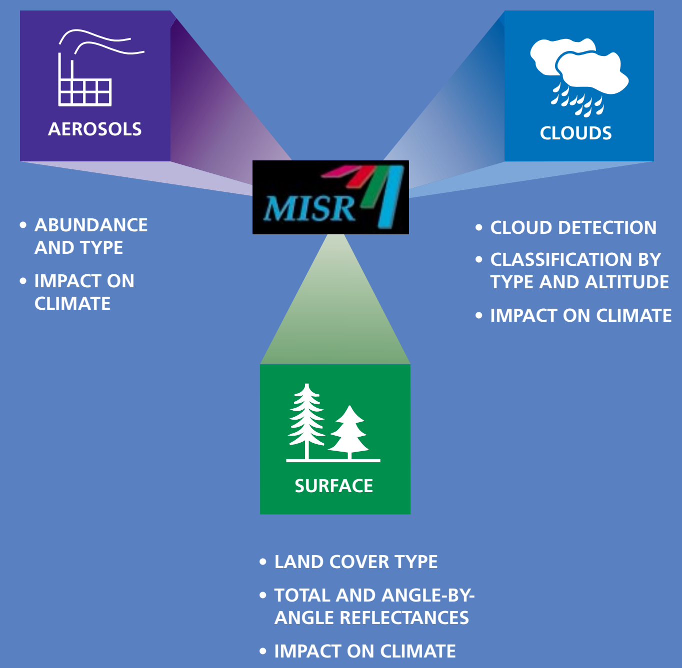
MISR can distinguish different types of clouds, atmospheric particles, and surfaces. Over time, MISR will monitor trends in

- The amount and types of aerosols (tiny particles floating in the air) — those formed by natural processes and by human activity.
- The amounts, types, and heights of clouds.
- The distribution of vegetation types and other land-surface cover.

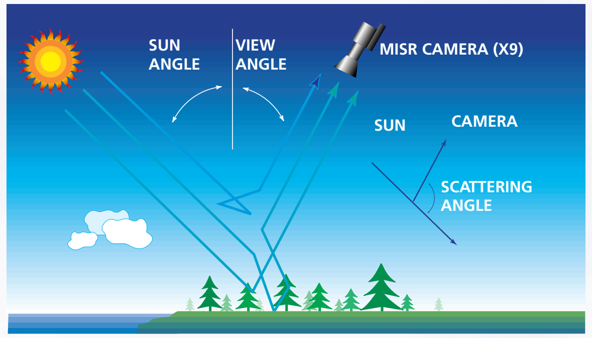
Aerosols tend to cool the surface below them, because most aerosols are bright particles that reflect sunlight back to space, reducing the amount of sunlight that can be absorbed at the surface. The magnitude of this effect depends on the size and composition of the aerosols, and on the reflecting properties of the underlying surface. Aerosol cooling may partially offset the expected warming due to increases in the amount of atmospheric carbon dioxide from human activity. But key details about aerosol properties needed to calculate even their current effect on surface temperatures are not known. MISR data will make it possible to determine global aerosol amounts with unprecedented accuracy, and to estimate particle size and composition.

Because they are very common, clouds play a major role in controlling Earth's climate. Clouds may warm or cool the Earth, depending on their thickness and location. Since clouds are so variable, their effect on global climate is difficult to measure — it is currently the leading uncertainty in climate-prediction models. Stereo images from MISR will provide new data about cloud-top heights. The multiangle observations will also yield information about the structure of clouds, the properties of cloud particles, and the way clouds reflect incoming solar energy.

Earth's land surface is constantly changing. There are natural variations, such as the progression of seasons, as well as changes caused by human activities, such as deforestation and desertification in overgrazed regions. And because we care about climate, the amount and manner in which surfaces around the globe reflect sunlight matters to us too. MISR will characterize in detail the reflection properties of Earth's surface. From these observations, we will be able to tell where and how the surface is changing, as well as what effect these changes are likely to have on Earth's climate.



Viewing Geometry for a Satellite Camera Looking at Earth



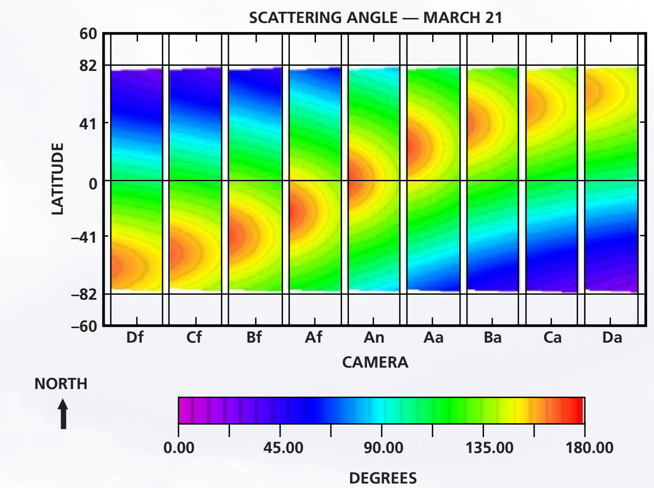
This figure shows how the positions of the Sun, surface, and atmosphere, and any one of the nine MISR cameras, are related. Remember that the true situation is three-dimensional. MISR views Earth at a number of angles simultaneously.

The Range of Scattering Angles Observed by the Nine MISR Cameras

The scattering angle is the angle between the direction of incoming light and the viewing direction. Most of the information about clouds, haze, and dust particles in the air, and much of what remote-sensing instruments can learn about the surface, comes from studying observations taken at different scattering angles.

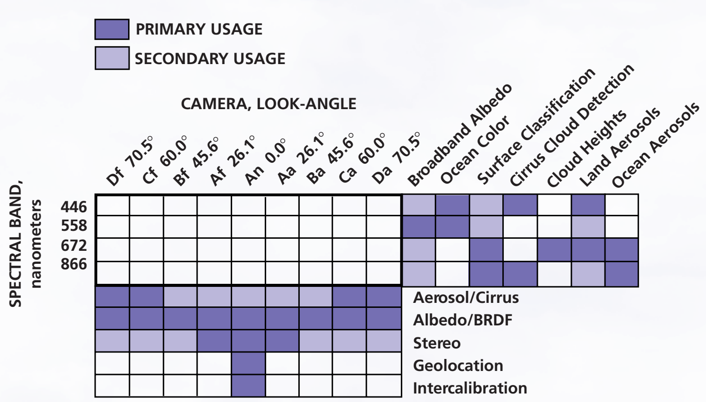
The scattering angle MISR observes is different for each camera, and also changes with the geographic latitude of the satellite (vertical axis in the figure) and the location across the MISR image (horizontal axis). Each swath is 360 kilometers (224 miles) wide. This illustration shows the situation for March 21 and the nominal EOS AM-1 satellite orbit. Imaging extends to 82 degrees latitude. The pattern remains nearly the same, but shifts poleward during the solstice seasons.

MISR is unique as a satellite instrument because it covers such a wide range of scattering angles.



How We Will Use Our Nine Cameras and Four Bands

This diagram illustrates the roles played by each of the nine cameras and four color bands (36 combinations) in MISR science. Each MISR camera corresponds to one labeled column. In the lower part of the figure, colored boxes indicate that the corresponding camera is used for the science objective to the right. For example, the "An" camera (which looks straight down) is needed to geolocate MISR images, and for "intercalibration" with other instruments. The terms "Albedo" and "BRDF" refer to ways that a surface reflects light.



Each of the MISR color bands corresponds to one of the labeled rows in the figure. On the right side, colored boxes indicate that the corresponding color band is needed for the science objective at the top. For example, the 672-nanometer (red) and 866-nanometer (near-infrared) bands are used to detect aerosols over the ocean, since the ocean surface is darkest in these bands, making bright aerosols easier to see.