Land

Our Changing Earth

Land and ecosystems cover nearly 30% of the Earth's surface. The land surface changes over days, seasons, decades, and longer. Vegetation boundaries shift, cities grow, rain forests and farm lands shrink, amounts of trace chemicals in the air increase and decrease, rivers flood, forests burn, and volcanoes erupt. Activities of the growing human population cause or influence many of these changes.

Space provides an excellent vantage point from which to observe and record land surface changes, especially at a global scale. NASA has embarked on an ambitious effort to measure the effects of changes on our planet and to understand the roles that human activities play in them. A suite of Earth-observing satellites measures different aspects of the land and builds a global picture of change, one location at a time.

The globe above shows data from the MODIS instrument on the Terra satellite. Data from the Enhanced Thematic Mapper Plus (ETM+) instrument on the Landsat 7 satellite. Data from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the Terra satellite.

The images above show the location of the Three Gorges Dam on China's Yangtze River, the longest river in Asia. Evident here are the changes to the landscape caused by the construction. The images on the left were acquired on April 17, 1987, well before the dam project had begun. The right-hand image was acquired on November 7, 2006, after the completion of the dam's main wall. Combined satellite imagery and computer models seem to indicate that the creation of the huge reservoir of water behind the dam has altered precipitation patterns in the area, decreasing variations in downstream flooding of the Yangtze River and its tributaries.

The image above shows the location of the Irvine Ranch in Irvine, California. The light image shows the extent of land that burned in the fires of October 2007, while the right-hand image was acquired on November 2, 2000. The left-hand image was acquired on April 17, 1987, well before the dam project had begun. Combined satellite imagery and computer models seem to indicate that the creation of the huge reservoir of water behind the dam has altered precipitation patterns in the area, decreasing variations in downstream flooding of the Irvine Ranch and its tributaries.

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Our Changing Earth

A Land of Carbon

On Earth, carbon cycles between the land, the atmosphere, and oceans and rivers. In the past century, the growing demand for energy and materials has increased the movement of carbon from the Earth’s surface to the atmosphere and back to the Earth’s surface.

The major exchange of carbon with the atmosphere occurs in a natural gas called methane. As the Earth’s climate warms, methane is more easily released into the atmosphere, where it can be detected by satellites.

When forests are cleared away and replaced by cleared land, they become hotter and drier, and the change in vegetation is a major contributor to global warming. Scientists can now provide global maps to ascertain changes in vegetation type, extent and productivity. MODIS can also be used to monitor the extent of frost or drought damage to croplands over large areas. Such maps are also needed to determine the overall health and productivity of the Earth’s vegetation.

In the future, the Earth’s climate will continue to change, and the Earth’s vegetation will continue to change in response. The rate and pattern of change will depend on the extent to which humans alter the Earth’s climate.

Shapes of Things to Come

Life in the Big City

One of the more interesting applications of the Moderate Resolution Imaging Spectroradiometer (MODIS) for urban areas is its ability to infer the health and vitality of neighborhoods. MODIS can also be used to study the spread of these diseases. As vegetation responds to both of these factors, the changes can be monitored with a greater sensitivity, making the Moderate Resolution Imaging Spectroradiometer (MISR) a useful tool for monitoring changes in vegetation.

The map shows that in the future, the Earth’s vegetation will continue to change in response to climate change. The rate and pattern of change will depend on the extent to which humans alter the Earth’s climate.

Our Changing Earth: A Mission Sampler

Terra

Terra is the first mission, launched on December 1999, carried by instruments, three of which provide significant contributions to land studies: the Moderate Resolution Imaging Spectroradiometer (MODIS), the Multiangle Imaging SpectroRadiometer (MISR), and the EOS Cross Calibration Spectrometer (ECCS).

The Moderate Resolution Imaging Spectroradiometer (MODIS) is a multispectral visible, near-infrared, and shortwave infrared scanner. It can measure the reflectance of the Earth’s surface and develop images of cloud water, cloud ice, and other cloud properties. MODIS can also be used to study the spread of diseases from several decades.

MODIS provides a continuous set of global observations every 1 to 2 days of most regions and can be used to study vegetation changes and their impacts on the Earth’s climate.

ECCS, the third of the three instruments, is a radiation spectrometer that can measure the spectral reflectance of the Earth’s surface. It can be used to study the spread of diseases from several decades.

The Multiangle Imaging SpectroRadiometer (MISR) is a hyperspectral imager that measures the amount of sunlight that is scattered in different directions under natural conditions, using nine cameras mounted at different angles. MISR can also be used to study the spread of diseases from several decades.

The Terra mission, launched in December 1999, provided a continuous set of global observations every 1 to 2 days of most regions and can be used to study vegetation changes and their impacts on the Earth’s climate.

Landsat 7

Landsat 7 is the latest in a series of satellite missions that provide a comprehensive set of global observations every 16 to 24 days of most land regions and can be used to study vegetation changes and their impacts on the Earth’s climate. The Landsat program was started in the 1970s and has been providing a continuous set of global observations every 16 to 24 days of most land regions since then. The program has been providing a continuous set of global observations every 16 to 24 days of most land regions since then.

The Landsat 7 mission was launched on May 12, 2003, using six instruments, three of which provide significant contributions to land studies: the Enhanced Thematic Mapper Plus (ETM+), the Multispectral Scanner (MSS), and the Thermal Mapper (TM).

The Enhanced Thematic Mapper Plus (ETM+) is a multispectral visible, near-infrared, and shortwave infrared scanner. It can measure the reflectance of the Earth’s surface and develop images of cloud water, cloud ice, and other cloud properties. ETM+ can also be used to study the spread of diseases from several decades.

The Multispectral Scanner (MSS) is a multispectral visible, near-infrared, and shortwave infrared scanner. It can measure the reflectance of the Earth’s surface and develop images of cloud water, cloud ice, and other cloud properties. MSS can also be used to study the spread of diseases from several decades.

The Thermal Mapper (TM) is a multispectral visible, near-infrared, and shortwave infrared scanner. It can measure the reflectance of the Earth’s surface and develop images of cloud water, cloud ice, and other cloud properties. TM can also be used to study the spread of diseases from several decades.

The ERTS-1 mission was launched on July 1972 using six instruments, three of which provide significant contributions to land studies: the Thematic Mapper (TM), the Multispectral Scanner (MSS), and the Thermal Mapper (TM).

The Thematic Mapper (TM) is a multispectral visible, near-infrared, and shortwave infrared scanner. It can measure the reflectance of the Earth’s surface and develop images of cloud water, cloud ice, and other cloud properties. TM can also be used to study the spread of diseases from several decades.

The Multispectral Scanner (MSS) is a multispectral visible, near-infrared, and shortwave infrared scanner. It can measure the reflectance of the Earth’s surface and develop images of cloud water, cloud ice, and other cloud properties. MSS can also be used to study the spread of diseases from several decades.

The Thermal Mapper (TM) is a multispectral visible, near-infrared, and shortwave infrared scanner. It can measure the reflectance of the Earth’s surface and develop images of cloud water, cloud ice, and other cloud properties. TM can also be used to study the spread of diseases from several decades.

Red Eye

Red Eye is the second mission, launched on November 19, 2003, using six instruments, three of which provide significant contributions to land studies: the MODIS, the Multiangle Imaging SpectroRadiometer (MISR), and the EOS Cross Calibration Spectrometer (ECCS).

The Moderate Resolution Imaging Spectroradiometer (MODIS) is a multispectral visible, near-infrared, and shortwave infrared scanner. It can measure the reflectance of the Earth’s surface and develop images of cloud water, cloud ice, and other cloud properties. MODIS can also be used to study the spread of diseases from several decades.

The Multiangle Imaging SpectroRadiometer (MISR) is a hyperspectral imager that measures the amount of sunlight that is scattered in different directions under natural conditions, using nine cameras mounted at different angles. MISR can also be used to study the spread of diseases from several decades.

The EOS Cross Calibration Spectrometer (ECCS) is a radiation spectrometer that can measure the spectral reflectance of the Earth’s surface. It can be used to study the spread of diseases from several decades.

On December 19, 2003, the Terra mission was launched using six instruments, three of which provide significant contributions to land studies: the MODIS, the Multiangle Imaging SpectroRadiometer (MISR), and the EOS Cross Calibration Spectrometer (ECCS). The Moderate Resolution Imaging Spectroradiometer (MODIS) is a multispectral visible, near-infrared, and shortwave infrared scanner. It can measure the reflectance of the Earth’s surface and develop images of cloud water, cloud ice, and other cloud properties. MODIS can also be used to study the spread of diseases from several decades.

The Multiangle Imaging SpectroRadiometer (MISR) is a hyperspectral imager that measures the amount of sunlight that is scattered in different directions under natural conditions, using nine cameras mounted at different angles. MISR can also be used to study the spread of diseases from several decades.

The EOS Cross Calibration Spectrometer (ECCS) is a radiation spectrometer that can measure the spectral reflectance of the Earth’s surface. It can be used to study the spread of diseases from several decades.