In NASA's exploration quest, Earth science is the foundation for not only understanding and protecting our home planet, but for searching for life beyond.

Exhibit 1-- Earth and Planetary Science

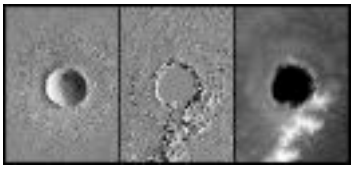
Earth and planetary science complement each other. JPL is one of the few institutions in the world with the expertise to do both.
Landforms on Earth that resemble those on Mars provide accessible field sites to study natural processes that apparently occur on both planets.

Olympus Mons, Mars
Mars' Olympus Mons is a dormant volcano about 600 kilometers in diameter, and the summit caldera rises about 24 kilometers above the surrounding plains. Bigger than any volcano on Earth, it is taller than Mt. Everest and wider than the Hawaiian island chain.
http://photojournal.jpl.nasa.gov/catalog/PIA02982

Viking 1

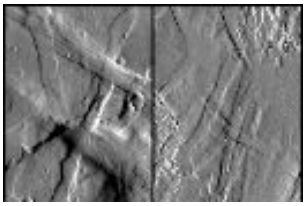
Chiliques Volcano, Chile
With an elevation of 5,778 meters and a 500-meter-diameter circular summit crater, Chiliques in Chile is a simple stratovolcano composed of alternating layers of lava and ash. This image was created with three of the Advanced Spaceborne Thermal Emission and Reflection Radiometer's 14 spectral bands, which range from the visible to the thermal infrared. The dark spot at the volcano's summit is a crater lake.
http://photojournal.jpl.nasa.gov/catalog/?IDNumber=PIA03493

Advanced Spaceborne Thermal Emission and Reflection Radiometer



Elysium Planitia, Mars (left); Bosumtwi Crater, Ghana, Africa (middle, right)
An unnamed impact crater on Mars' northern Elysium Planitia (left) has a similar pattern to the Bosumtwi Crater in Ghana (center and right). The Mars' crater's smooth ejecta blanket suggests it may have contained water (ejecta is the material blown out of the crater by the impact). The view in the center is an elevation model shaded to simulate the sun shining from the east to match the Mars image. In the right image, brightness represents height to help distinguish the ejecta blanket. http://photojournal.jpl.nasa.gov/catalog/PIA02084

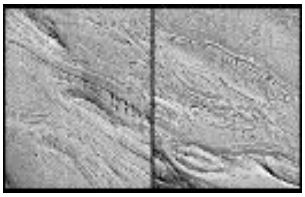
Mars Global Surveyor
Shuttle Radar Topography Mission



Crosscutting Grabens
Faulting has produced elongated down-dropped blocks called grabens both on Mars and Earth. Grabens subside as fairly rigid and unbroken pieces

between two parallel bounding faults. On Earth, they occur in places where Earth's crust is being pulled apart, such as the Afar Triangle (right) at the northern end of Africa's Rift Valley. Something similar may happen on Mars to produce a similar pattern at Tempe Terra (left).
http://photojournal.jpl.nasa.gov/catalog/PIA04471

Mars Odyssey
Shuttle Radar Topography Mission

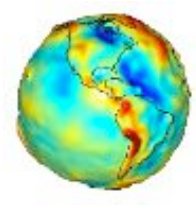


Candor Chasma, Valles Marineris, Mars (left), Qaidam Basin, China (right)
Earth and Mars both have places where sediments have been deposited in layers, folded and hardened, and then eroded by wind. Candor Chasma (left) is one of the troughs of Valles Marineris, Mars' largest canyon. The Qaidam Basin of western China (right) is a hyperarid desert.
http://photojournal.jpl.nasa.gov/catalog/PIA04785

Mars Global Surveyor
Shuttle Radar Topography Mission

Exhibit 2-- The Global Perspective

Each remote sensing satellite is a pair of eyes on Earth, revealing new insights about how our planet works. Looking at Earth from space gives us the big picture.



This is the most accurate map to date of Earth's long wavelength gravity field. It shows how much Earth's actual gravity field departs from "normal," as defined by a simplified model that assumes Earth is a perfectly smooth and featureless sphere. Blue represents areas of weak gravity, green and yellow are normal, and red areas show where gravity is stronger.
http://www.csr.utexas.edu/grace/gallery/gravity/ggm01_americas.html

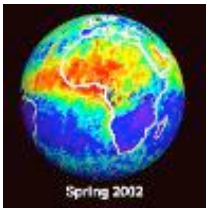
Gravity Recovery and Climate Experiment

In this elevation map, colors relate to topographic height, with green at the lower elevations, rising through yellow and tan, to white at the highest elevations. Elevation data are from the Shuttle Radar Topography Mission, which collected detailed elevation data over more than 80 percent of Earth's landmass.
http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia03394

Shuttle Radar Topography Mission

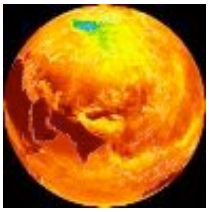
In this false-color radar image, orange indicates the fastest ocean winds and blue the slowest. White streamlines indicate wind direction. Over land, the lightest green areas correspond to the largest radar return. In the polar region portion, white corresponds to the largest radar return, while purple is the lowest.
http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia02458

SeaWinds



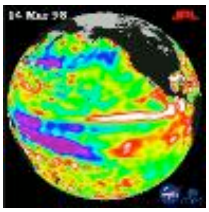
This map shows the amount and distribution of aerosols around the globe during the northern hemisphere spring, 2002. The progression from blue-green-yellow-red indicates increasing aerosol amounts. In general, airborne particles come from multiple sources, including burning of vegetation, desert dust, sea spray, and urban pollution. Large amounts of dust blowing off the Sahara desert in Africa are visible in this map.
http://www-misr.jpl.nasa.gov/gallery/galhistory/2003_jun_04.html

Multi-angle Imaging SpectroRadiometer



This infrared image shows the average temperatures of Earth's surface or intervening clouds in April 2003. Similar to a photograph of the planet taken with the camera shutter held open for a month, stationary features are captured while those obscured by moving clouds are blurred. The yellow band encircling the equator is the Intertropical Convergence Zone, a region of persistent thunderstorms and high, cold clouds.
http://airs.jpl.nasa.gov/multimedia/image_releases/2004/april03_globe_asia.html

Atmospheric Infrared Sounder



Global measurements of sea surface height indicate where heat is stored in the oceans. This image shows sea surface height relative to normal. The red and white areas to the north and south of the equator indicate higher than normal sea levels and are the remnants of an El Niño. Green indicates normal conditions.
http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia01449

Topex/Poseidon

Exhibit 3-- Developing New Ways to "See"

JPL brings together the latest technology with the most critical science needs, developing new ways to "see" Earth. Data images are scientific snapshots of what is happening to our planet. The data are used to improve our understanding of natural hazards such as earthquakes and floods.

Amu Darya River, Uzbekistan and Turkmenistan
This false-color image shows the Aral Sea and the wide delta created by the Amu Darya River in the western deserts of Uzbekistan and northeastern Turkmenistan. The river waters are used intensively to irrigate cotton and other crops. Data from the near-infrared, red and blue spectral bands of the Multi-angle Imaging SpectroRadiometer's downward-viewing (nadir) camera are displayed as red, green and blue, respectively, causing highly vegetated areas to appear red. http://photojournal/catalog/PIA04323

Multi-angle Imaging SpectroRadiometer

Drought and Burn Scars in Southeastern Australia
The results of massive fires and very dry conditions appear in this false-color image of southeastern Australia. Healthy vegetation appears red and burnt areas appear as dark brown. Pale yellow-brown shows underlying soils exposed by drought.
http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia04321

Multi-angle Imaging SpectroRadiometer

Anti-Atlas Mountains, Morocco
In this image of Morocco's Anti-Atlas Mountains, short wavelength infrared bands are combined to highlight different rock types and illustrate the complex folding. The yellowish, orange and green areas are limesteones, sandstones and gypsum; the dark blue and green areas are underlying granitic rocks.
http://photojournal/catalog/PIA03893

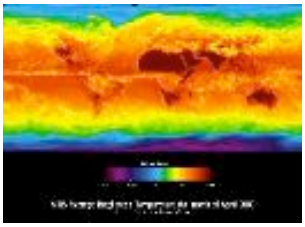
Advanced Spaceborne Thermal Emission and Reflection Radiometer

Andes Mountains, South America
Visible and infrared data have been enhanced to exaggerate the color differences of different materials in this view of the Andes Mountains along the Chile-Bolivia border. This image is dominated by the Pampa Luxsar lava complex. On the left are the Olca and Paruma stratovolcanoes, which appear blue due to lack of vegetation (Vegetation is colored red in this composite).
http://asterweb.jpl.nasa.gov/gallery/gallery.htm?name=Andes

Advanced Spaceborne Thermal Emission and Reflection Radiometer

Exhibit 4-- Sorting out the Atmosphere

Data from JPL instruments help improve weather and climate forecasts.

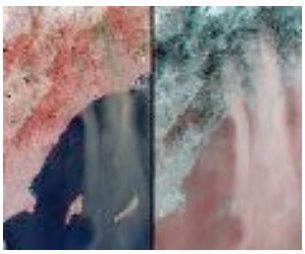


Global Average Brightness Temperature for April 2003
This image shows average temperatures in April 2003 observed in an infrared wavelength that senses either Earth's surface or any intervening clouds. Many continental features stand out boldly, such as our planet's vast deserts, and India, shown here at the end of its long, clear dry season. Also obvious are the high, cold Tibetan plateau to the north of India, and the mountains of North America. The band of yellow encircling the planet's equator is the

Intertropical Convergence Zone, a region of persistent thunderstorms and associated high, cold clouds.
http://airs.jpl.nasa.gov/multimedia/image_releases/2003/april03_avg_brtns_temp.html

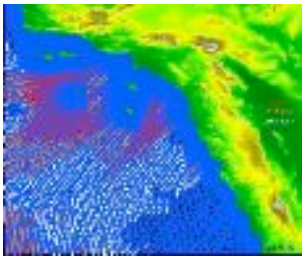
Atmospheric Infrared Sounder

Exhibit 5-- Catching the Wind



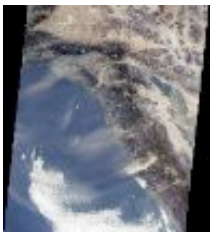
Airborne Dust and Ash over Southern California
The Santa Ana winds that typically blow through Southern California during late fall and winter swept large amounts of dust and ash across the skies of San Diego and over the Pacific Ocean in 2003-2004. In the left-hand image, burnt areas appear in brown hues and highly vegetated areas appear red. The right-hand image is a stereo anaglyph, which provides a 3-D view of the scene. Red/blue glasses, with the red filter over your left eye, are needed to view the stereo image.
http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia04348

Multi-angle Imaging SpectroRadiometer



Santa Ana Winds Over Los Angeles
This image illustrates the strength of Santa Ana winds, The colored arrows represent various ranges of wind speed, which are well in excess of 30 knots (34 miles per hour). Santa Ana winds are offshore and down-slope winds unique to Southern California. These winds extend more than 500 kilometers (310 miles) offshore before changing direction to flow along the shore.
http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia03892

SeaWinds



Dusty Skies Over Southern California
This image shows the pattern of airborne dust stirred up by the Santa Ana winds on February 9, 2002. Southeast of the Los Angeles Basin, a swirl of dust, probably blown through the Banning Pass, curves toward the ocean near Dana point. The largest dust cloud occurs near Ensenada, in Baja California.
http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia03445

Multi-angle Imaging SpectroRadiometer

Exhibit 6-- California from Space

California
This image combines two visualization methods: shading and color coding of topographic height. North facing slopes appear bright, while south facing slopes appear dark. Color coding is directly related to topographic height, blue and green at

the lower elevations, rising through yellow and brown to white at the highest elevations. The sideways "V" in the southern part of the state is the intersection of the Garlock and San Andreas faults. http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia03347

Shuttle Radar Topography Mission

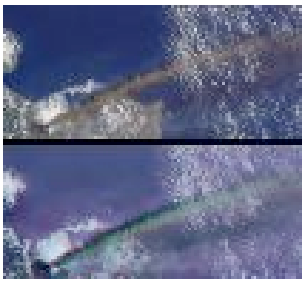
San Andreas Fault, Southern California
This topographic image displays California's famous San Andreas Fault along the southwestern edge of the Mojave Desert, 75 kilometers (46 miles) north of downtown Los Angeles. Each cycle of colors from pink through blue back to pink represents an equal amount of elevation difference (400 meters, or 1300 feet) similar to contour lines on a standard topographic map. http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia02714

Shuttle Radar Topography Mission

Pasadena, California
This image was created from three datasets: the Shuttle Radar Topography Mission (SRTM) supplied the elevation data; the Landsat data provided the land surface color, and the U.S. Geological Survey digital aerial photography provided the image detail. JPL is the cluster of large buildings north of the Rose Bowl at the base of the mountain. Portions of the cities of Altadena and La Canada-Flintridge are also shown. http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia02718

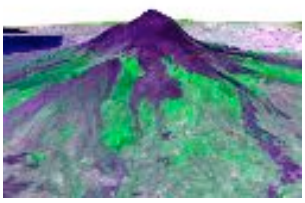
Shuttle Radar Topography Mission, Landsat

Exhibit 7-- Monitoring and Studying Volcanoes



Mt. Etna, Italy
These images captured by the Multi-angle Imaging SpectroRadiometer (MISR), show the eruption of Sicily's Mt. Etna volcano on October 29, 2002. The three-dimensional structure of several plumes are viewable in the stereo anaglyph (bottom image). Red/blue glasses, with the red filter over your left eye, are needed to view the stereo image.
http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia03733

Multi-angle Imaging SpectroRadiometer



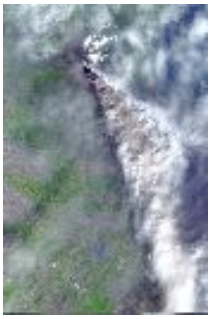
Mt. Etna, Italy
This perspective view of Mt Etna illustrates the dark lava flows from the 1600s (center) to 1981 (long flow at lower right). This Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) image is overlaid using topography data from the Shuttle Radar Topography Mission (SRTM).

Geologists studying Mars find these data useful as an analog to Martian landforms and geologic processes. http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia03371

Advanced Spaceborne Thermal Emission and Reflection Radiometer

Mt. Etna, Italy
This Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) image illustrates advancing lava flow on the southern flank of Mt. Etna above the town of Nicolosi. Also visible are glowing summit craters above the main flow, and a small fissure eruption. The bright puffy clouds were formed from water vapor released during the eruption.
http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia02677

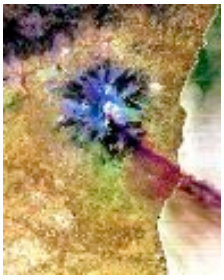
Advanced Spaceborne Thermal Emission and Reflection Radiometer



Mt. Etna, Italy
This image was captured on November 3, 2002, by the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) instrument. The plume is seen blowing toward the south-southeast, over the city and airport of Catania, Sicily. The previous day, the plume was blowing toward the northwest and posed no hazard to Catania.

Some of the applications using ASTER data include: monitoring glacial advances, monitoring potentially active volcanoes, identifying crop stress, wetlands evaluation, thermal pollution monitoring, coral reef degradation, and surface temperature mapping of soils and geology. http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia03881

Advanced Spaceborne Thermal Emission and Reflection Radiometer



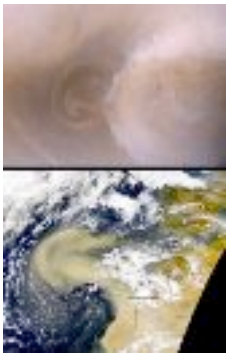
Mt. Etna, Italy
This Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) image shows the sulfur dioxide plume (in purple) originating from the summit, drifting over the city of Catania, and continuing over the Ionian Sea.

ASTER's unique combination of multiple thermal infrared channels and high spatial resolution allows the determination of the thickness and position of the plume.
http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia02678

Advanced Spaceborne Thermal Emission and Reflection Radiometer

Exhibit 8-- Exploring the Solar System

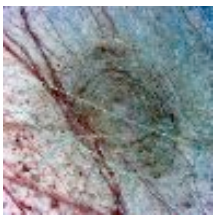
Within the solar system are time capsules of what Earth was like, what Earth may become, and what Earth could have been. When we explore and study other planets in the solar system, we often start by comparing features with those we find on Earth.



Mars and Earth Dust Storms Compared
These images are a comparison of dust storms on Mars (top) and Earth (bottom). The top shows a Martian north polar dust storm, the bottom a terrestrial dust storm off the coast of northwest Africa. Dust storms play an important role in governing the climate of Mars. They alter the planet's total heat balance and greatly affect the distribution of water vapor. On Earth, dust storms are recognized as contributing to environmental change, potentially influencing seasonal meteorology and the health of biological communities.
http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia02807

Mars Global Surveyor

SeaWifs



Ancient Impact Basin, Europa
This "bulls-eye" feature on Europa appears to be a 140-kilometer (86-mile) wide impact scar (about the size of Hawaii). The scar most likely formed as the surface was fractured minutes after a mountain size asteroid or comet slammed into the surface. The red lines areas are probably a mixture of dirty water and ice. The blue-green lines appear to be ridges that formed after the crater. The impact is known as the "Tyre" structure. http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia00702

Galileo

Richat Structure, Mauritania
This prominent circular feature in the Sahara desert of Mauritania has attracted attention since the earliest space missions. The structure which has a diameter of almost 50 kilometers (30 miles) was initially interpreted as a meteorite impact structure because of its high degree of circularity. It is now thought to be a symmetrical uplift (circular anticline) that has been laid bare by erosion.
http://asterweb.jpl.nasa.gov/gallery/gallery.htm?name=Richat

Advanced Spaceborne Thermal Emission and Reflection Radiometer

Titan Haze
This image shows the layers of haze covering Titan. Saturn's largest moon. The upper level of thick aerosol above the satellite's limb appears orange. The divisions in the haze occur at altitudes of 200, 375, and 500 kilometers (124, 233 and 310 miles) above the limb of the moon.
http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia01533

Voyager 1

This research was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.