Volcanoes and life

Thanks to

Nova “Earth from Space”

https://www.youtube.com/watch?v=aU0GhTmZhrs

NASA

And the

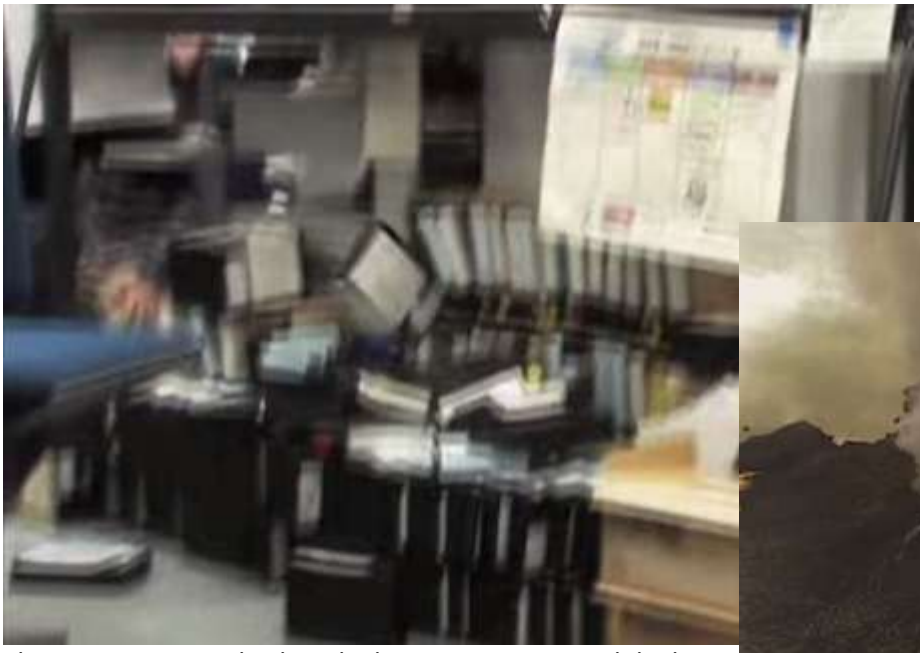
European Space Agency

Starting new picture emerging of Earth from Space

Earth is one huge system all linked though space and time.

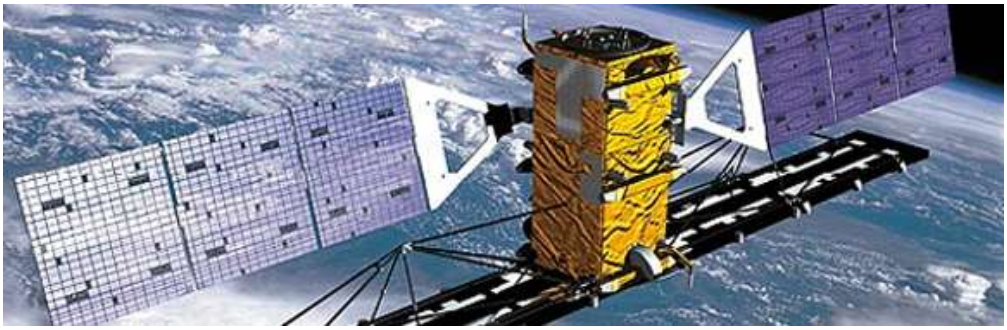
Over the last dozen years, NASA has launched a series of satellites – known collectively as the Earth Observing System (EOS) – that has provided critical insights into the dynamics of the entire Earth system: clouds, oceans, vegetation, ice, solid Earth and atmosphere. Now NASA is helping to create a new generation of satellites to extend and improve upon the Earth system data records established by EOS.

Beneath the earth are forces that shape the earth. A hidden mechanism is driven by often ceaseless activity. In Japan two recent examples a magnitude 9 earth quake strikes and moves an entire section of the country 8.5 feet towards north America.



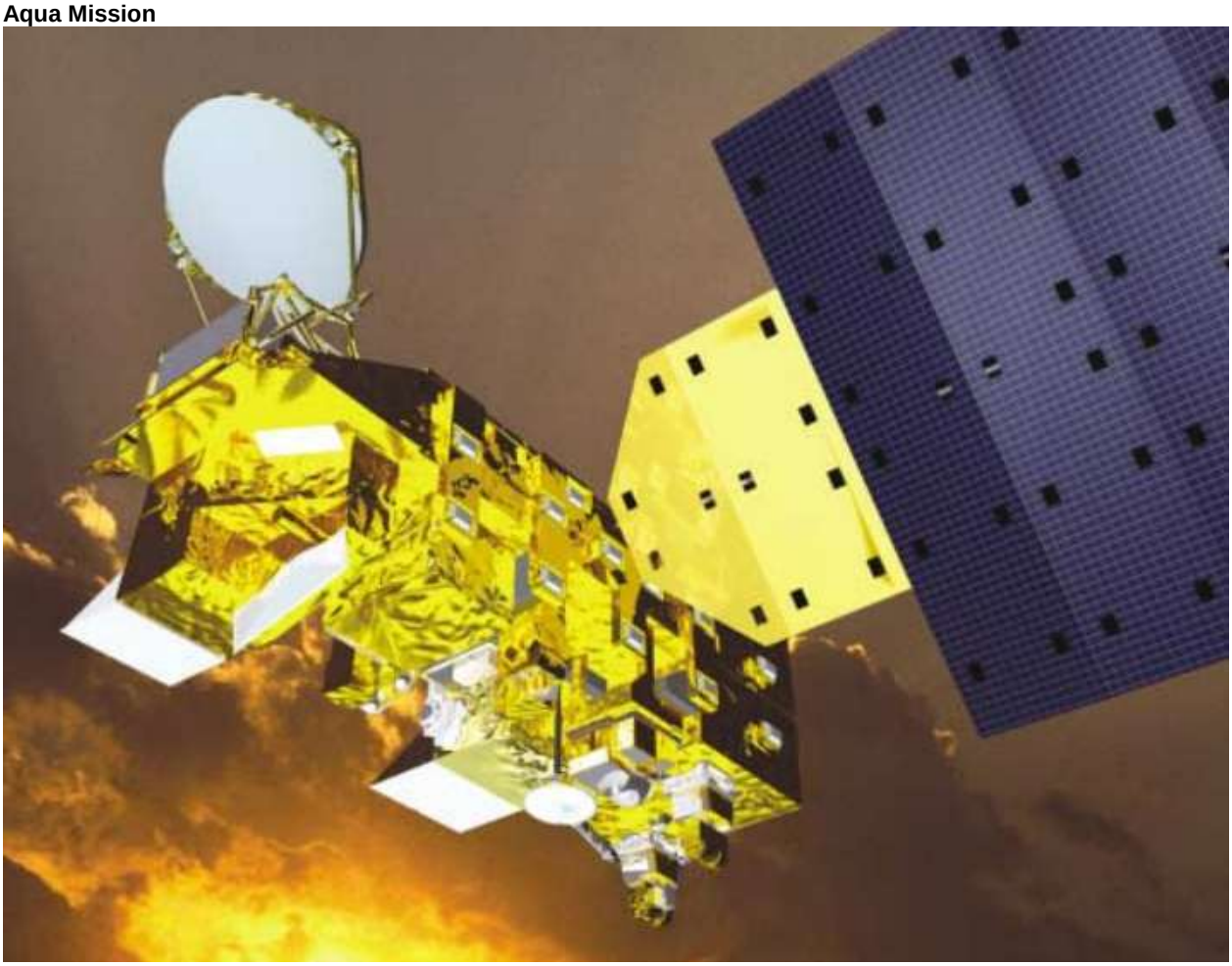
A year earlier in Papa way New Guinea the volcano Rabaul erupts and fires a vast plume of ash high in the atmosphere.

These are catastrophic hugely disruptive events with high costs in human life. But the natural forces behind this also provide materials we and other living organisms need to survive.

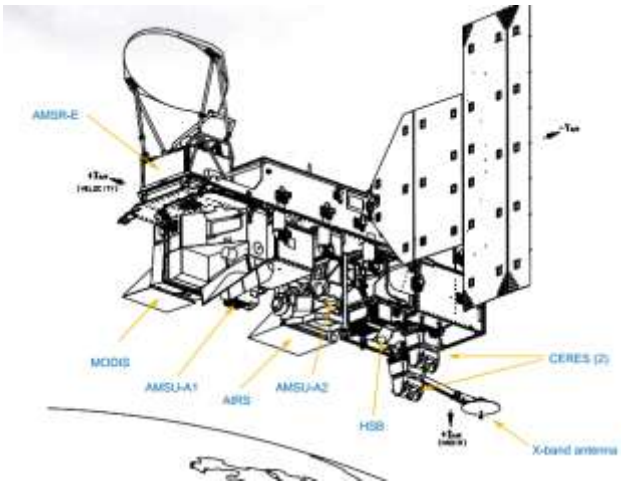


Canada's RADARSAT-2 Satellite is one of several that map the earth's surface in 3 dimensions. They can measure the height of the earth's surface every day to within a quarter of inch accuracy. Over time we can see the earth moving due to sub surface forces. We can see bulges and dips where the magma is moving underground. When a volcano erupts the ground swells recede. Every day dozens of volcanoes erupt while 4000 earth quakes shake the ground and some of this has a vital impact on life.

Aqua Mission



Aqua is a major international Earth Science satellite mission centered at NASA. Launched on May 4, 2002, the satellite has six different Earth-observing instruments on board and is named for the large amount of information being obtained about water in the Earth system from its stream of approximately 89 Gigabytes of data a day. The water variables being measured include almost all elements of the water cycle and involve water in its liquid, solid, and vapor forms. Additional variables being measured include radiative energy fluxes, aerosols, vegetation cover on the land, phytoplankton and dissolved organic matter in the oceans, and air, land, and water temperatures.



Line drawing of the deployed Aqua spacecraft, with the six Earth-observing instruments and the X-band antenna labeled. As indicated, the Advanced Microwave Sounding Unit (AMSU) has two physically separated parts, the AMSU-A1 and the AMSU-A2; these work together as a single unit. Also, the solar array in the upper right portion of the drawing extends outward much farther, about 14 m, when fully deployed. (Line drawing courtesy of TRW, with labels added later.)

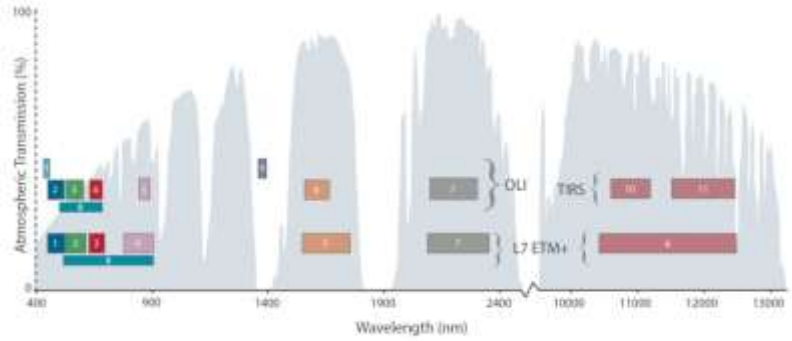
Landsat 8 Overview

Landsat 8 launched on February 11, 2013, from Vandenberg Air Force Base, California, on an Atlas-V 401 rocket, with the extended payload fairing (EPF) from United Launch Alliance, LLC. The Landsat 8 satellite payload consists of two science instruments—the Operational Land Imager (OLI) and the Thermal Infrared Sensor (TIRS). These two sensors provide seasonal coverage of the global landmass at a spatial resolution of 30 meters (visible, NIR, SWIR); 100 meters (thermal); and 15 meters (panchromatic).

Landsat 8 was developed as a collaboration between NASA and the U.S. Geological Survey (USGS). NASA led the design, construction, launch, and on-orbit calibration phases, during which time the satellite was called the Landsat Data Continuity Mission (LDCM). On May 30, 2013, USGS took over routine operations and the satellite became Landsat 8. USGS leads post-launch calibration activities, satellite operations, data product generation, and data archiving at the Earth Resources Observation and Science (EROS) center.

Evolutionary Advances

Landsat 8 instruments represent an evolutionary advance in technology. OLI improves on past Landsat sensors using a technical approach demonstrated by a sensor flown on NASA's experimental EO-1 satellite. OLI is a push-broom sensor with a four-mirror telescope and 12-bit quantization. OLI collects data for visible, near infrared, and short wave infrared spectral bands as well as a panchromatic band. It has a five-year design life. The graphic below compares the OLI spectral bands to Landsat 7′s ETM+ bands. OLI provides two new spectral bands, one tailored especially for detecting cirrus clouds and the other for coastal zone observations.



The OLI collects data for two new bands, a coastal band (band 1) and a cirrus band (band 9), as well as the heritage Landsat multispectral bands. Additionally, the bandwidth has been refined for six of the heritage bands. The Thermal Instrument (TIRS) carries two additional thermal infrared bands. *Note: atmospheric transmission values for this graphic were calculated using MODTRAN for a summertime mid-latitude hazy atmosphere (circa 5 km visibility).* Graphic created by L.Rocchio & J.Barsi.

TIRS collects data for two more narrow spectral bands in the thermal region formerly covered by one wide spectral band on Landsats 4–7. The 100 m TIRS data will be registered to the OLI data to create radiometrically, geometrically, and terrain-corrected 12-bit data products.

Landsat 8 is required to return 400 scenes per day to the USGS data archive (150 more than Landsat 7 is required to capture). Landsat 8 has been regularly acquiring 550 scenes per day (and Landsat 7 is acquiring 438 scenes per day). This increases the probability of capturing cloud-free scenes for the global landmass. The Landsat 8 scene size is 185-km-cross-track-by-180-km-along-track. The nominal spacecraft altitude is 705 km. Cartographic accuracy of 12 m or better (including compensation for terrain effects) is required of Landsat 8 data products.

Meteosat satellites are spin-stabilised with instruments designed to provide permanent visible and infrared imaging of the Earth.

When operating in geostationary orbit, 36,000 km above the equator, the satellites spins counter-clockwise at 100 rpm around their longitudinal axis, which is aligned with the Earth's rotational axis.

METEOSAT SECOND GENERATION SPACECRAFT

The MSG body is a cylindrical-shaped solar drum, 3.2 m in diameter and 2.4 m high.

ORBIT TIME	REPEAT CYCLE	MASS IN ORBIT	IMAGER MASS	IMAGER GROUND SAMPLING DISTANCE	
24 hour (geostationary)	15-mins (full disc) Rapid Scan 5-mins (Europe)	1,200 kg	260 kg	1 km Ch 12 (HRV) 3 km Ch 1–11 (VIS, IR, WV)	600 W average

Meteosat Second Generation spacecraft technical details

The satellite itself is built in a modular way around three main sub-assemblies:

- Spinning Enhanced Visible and Infrared Imager (SEVIRI) instrument in the central compartment.
- GERB scanning radiometer in the central compartment.
- Mission Communication Payload (MCP), including antennas and transponders, in the upper compartment.
- The platform support sub-systems, in the lower compartment.

For its initial boost into geostationary orbit, as well as for station keeping, the satellite uses a bi-propellant system. This includes small thrusters, which are also used for alttitude control. The MSG solar array, built from eight curved panels, is wrapped around the satellite body.

Approximately the size of a small school bus, the **Terra satellite** carries five instruments that take coincident measurements of the Earth system:
Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER)
Clouds and Earth's Radiant Energy System (CERES)
Multi-angle Imaging Spectroradiometer (MISR)
Measurements of Pollution in the Troposphere (MOPITT)
Moderate Resolution Imaging Spectroradiometer (MODIS)
Terra is in a circular sun-synchronous polar orbit that takes it from north to south (on the daylight side of the Earth) every 99 minutes.

Quick Facts:

Launch Date: December 18,1999
Size: the spacecraft bus is 6.8 m long and 3.5 m across.
Weight: 5,190 kg (11,442 lbs.) at launch.
KSC-99PP-1412_web

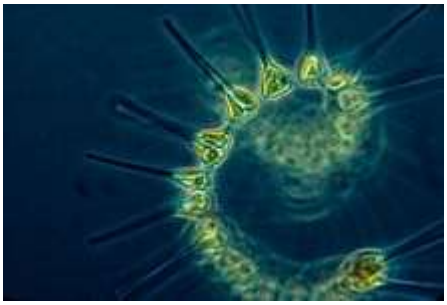
Orbit Quick Facts:

Altitude: 705 kilometers (438 miles) above Earth's surface
Inclination: 98.5 degrees
Period: 99 minutes (16 orbits per day)
Equatorial crossing: 10:30 a.m., descending node
Terra Status:

Operating instruments: ASTER, CERES, MODIS, MISR, and MOPITT are operating well. ASTER Short Wave Infrared (SWIR) data is unavailable and MISR is currently offline.
Current life expectancy: Terra has far exceeded its design life and has a strong chance of operating successfully into the early 2020s.
Current systems issues: None.
Processed Terra data are available through several NASA data centers.

Under the ocean's surface in deep water

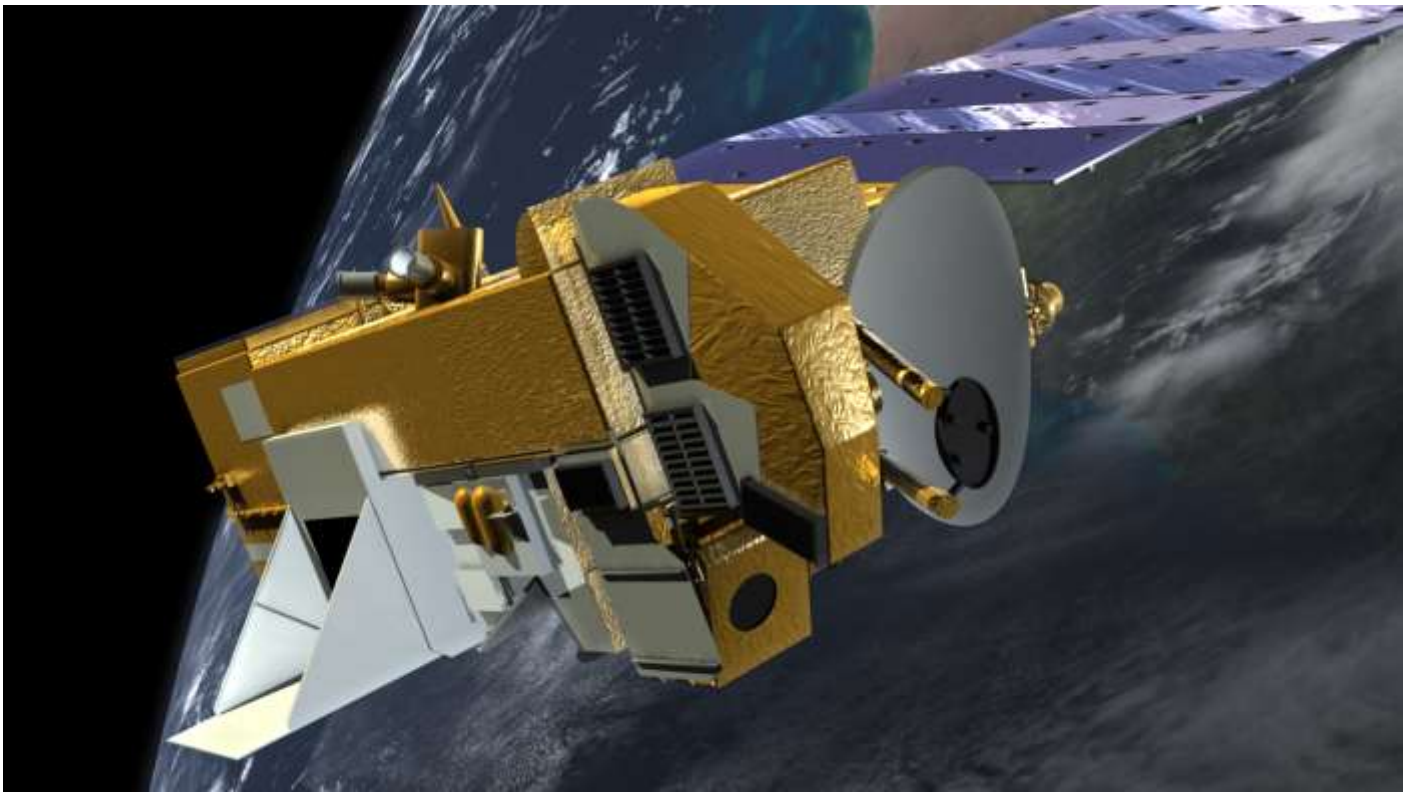
volcanoes erupt. The Jason satellite sea surface radar shows the interaction between volcanoes and cold water. A submarine also named Jason took this photo of an underwater volcano erupting. Lava and super-heated gases hits the cold water. A magma chamber heats water to 700 F. The dense salty water dissolves the solid rock producing minerals of sulfur and iron need by organisms in the ocean, by the shrimp, tube worms and plankton. The deep oceans current carry the nutrients away, leading to an explosion of life. The Aqua Satellite's MODIS scanner detects temperature changes and color of the water. Looking down at the Pacific Ocean east of Peru detects and upwelling of cold water and a shade of green Chlorophyll – phytoplankton a distinctive green color and they replicate very fast can double each day and cover hundreds of kilometers of the ocean's surface 800 thousand tons of food for the base of the food chain for the oceans. Trillions of anchovies and sardines feed on the plankton larger fish area attracted, sharks and birds and human fishermen too. Phytoplankton provides the vital link between energy of volcanoes to food for much life on earth. The most important plant life is plankton. Plankton is short lived so their blooms rapidly expand and fade. They sink to the ocean floor when they die taking with them nutrients, leaving thick carpet miles deep on the ocean floor.



The Sahara Desert in North Africa is one tenth of the area of Africa. The Bodélé Depression of the Sahara was once a lake. The floor of the Bodélé is covered with diatomite (ancient plankton). NASA's Landsat 8 studies rocks on earth and sweeps the Bodélé showing the diatomite. We can see the entire extent of the sediment diatomite. Diatomite is rich nutrient with phosphorous. To reenter the chain of life the wind sweeps up diatomite into the air and is fractured into a fine power and dust storms. The European weather satellite Meteosat looks down and records the dust rising from the Bodélé each day at noon. The dust cloud is over a hundred stories high and 2 hundred miles wide. It heads west on an epic journey. Seen from space the dust is blown across Africa. At the Atlantic coast it is drawn up high and heads south west 3000 miles. A much as 7,000 tons of dust is airborne at a time. Destination is the Amazon. High above the rain forest the minerals in the dust dissolve into the rain and fall to fertilize the amazon jungle. The amazon soils are depleted and are short of phosphorous. The effect of this is

clearly seen by Tera the twin of the Aqua satellite which studies the life on earth. Tera observes the distinctive change to green by the rain and the nourishment of dolomite from halfway around the world.

The migration of dust from the bodele is just one story of how the world is connected in interesting ways. The exchange of nutrients from the land is going on all over the earth every day. The Great plains of North America are rich in minerals eroded from the Rocky Mountains vital to grow wheat and corn. The Ganges delta is rich in iron from river sediments ideals to grow rice. These minerals are the basis for life on land including us.



Aura (Latin for breeze) obtains measurements of ozone, aerosols and key gases throughout the atmosphere using technologically innovative space instrumentation. Scientists use these data to gain revolutionary insights into the chemistry of our atmosphere.

Aura's Launch

The Aura spacecraft was successfully launched on July 15, 2004 aboard a Delta II 7920-10L, a two stage expendable rocket, from the Vandenberg Western Test Range. What is a Delta 7920-10L? The 7 refers to the Delta series, 9 is the number of solid motors, 2 is the type of second stage and 0 is the type of third stage, in this case none. Fairing is the covering that protects the Aura spacecraft during launch and its trip into orbit. 10L describes the fairing; in Aura's case the fairing is 10 ft, (3 m) in diameter and is 'stretched' approximately 3 ft. longer than the fairing on the 7920-10.

+ Get large version of Launch poster
+ View Launch Movie (MPG)

Aura was launched into a sun-synchronous, near polar (98.2 degree inclination) orbit. It orbits 705 km (438 miles) above the Earth with a sixteen-day repeat cycle and 233 revolutions per cycle. The ascending node is in daylight and crosses the equator at approximately 1:45 PM. The Aura spacecraft is flying in formation with other Earth observing satellites called the A-Train.

How Does Aura Work?

Aura's instruments measure trace gases in the atmosphere by detecting their unique spectral signatures. **MLS** observes the faint microwave emissions from rotating and vibrating molecules. **HIRDLS** and **TES** observe the infrared thermal emissions also due to molecular vibrations and rotations. **OMI** detects the molecular absorption of backscattered sunlight in the visible and ultraviolet wavelengths.

Aura's remote sensing geometry is shown on the left. Horizon viewing (limb) instruments (MLS, TES and HIRDLS slice through the atmosphere, profiling gases. Down-looking instruments (OMI and TES) stare at the Earth. Since MLS looks out the front of the spacecraft, it is the first to profile the atmosphere. The OMI and TES instruments then look at the same air mass as it passes beneath the spacecraft. As the spacecraft then moves on in its orbit, HIRDLS and TES profile the atmosphere again.

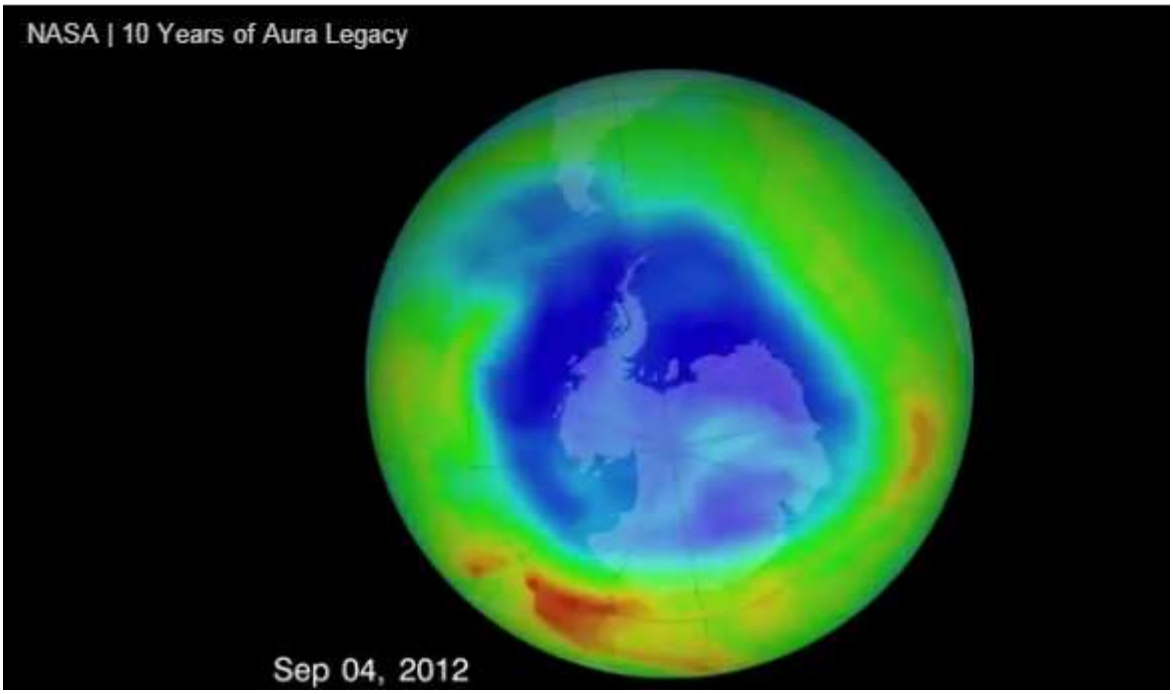
This unique observing geometry allows the Aura instruments to combine their measurements to get a better picture of the atmospheric chemistry. The chart below shows all the chemicals measured by Aura instruments and the altitude range of those measurements.

Aura and the "A-train"

Aura flies in formation about 15 minutes behind Aqua in the "A-Train" satellite constellation which consists of several satellites flying in close proximity. Each individual mission has its own science objectives; all will improve our understanding of aspects of the Earth's climate. The synergism that is expected to be gained by flying in close proximity to each other should enable the overall science results of the Afternoon Constellation to be greater than the sum of the science of each individual mission.

Data taken by the satellite instruments are stored on board until broadcast to a downlink facility through the spacecraft's high speed data link. Because polar orbiting satellites frequently pass over the Arctic and Antarctic, the data downlink facilities are located at high latitudes. NASA's major downlink facilities are Poker Flat, Alaska, McMurdo Base, Antarctica and Svalbard, a Norwegian archipelago in the Arctic Ocean north of mainland Europe. The Svalbard downlink antenna domes are shown below. Once the data are received at the downlink facility, they are sent via optical fiber network to processing facilities at NASA's Goddard Space Flight Center. The raw data are then distributed to the instrument teams for processing into geophysical measurements. Processed data are sent to NASA Data Active Archive Centers, where they are made available to users.

The Aura satellite also has direct broadcast capability through a smaller downlink antenna. This capability allows an investigator to receive data nearly instantly. The small building with the dome (on the upper right) is the Finnish direct broadcast station that receives OMI data as the satellite passes overhead. The direct broadcast data are processed at the Finnish Meteorological Institute FMI and distributed shortly after the Aura overpass.



Less than a quarter of the air is composed of oxygen. Oxygen is vital to metabolism for life on earth. NASA's Aura satellite can analyze the atmosphere and can show the movement of oxygen around the earth. We can see cycles of oxygen rising during the day and at night carbon dioxide rises. Plants convert carbon dioxide to oxygen by breathing in the carbon dioxide and expelling oxygen. Before plants there was not oxygen on the earth.

The Vast amazon rain forest is often called the lungs of the earth but the real picture is more complex. The Amazon rainforest is the largest natural preserve of life on land thousands of species. So dense is the jungle it has an impact on the air above. Photosynthesis converts carbon to sugar for energy and releases oxygen. Each tree releases hundreds of cubic meters of oxygen. The amazon produces one fifth of the words oxygen but we breathe almost none of it. The oxygen is reabsorbed at night into the Amazon.

The Amazon dose contributes to the oxygen we breathe through an extra step. Rain in the Amazon falls 250 days per year washing the soil into the river 200 million tons of sediment per day traveling east 4000 miles to the amazon delta.

TRMM Tropical Rainfall Measuring Mission

One of the great challenges facing mankind in the 21st century is the threat of global warming due to increased levels of carbon dioxide and other greenhouse gases in the atmosphere. Is the threat real? Computer models that predict the future climate still differ in some very substantial ways with some models predicting little or no warming while others predict temperature increases that would substantially alter our way of life. Without more data and better understanding of the current climate system, there is little hope that we can understand the differences among our current models and both sides in the environmental debate will continue to press for their viewpoints.

TRMM is a research satellite designed to help our understanding of the water cycle in the current climate system. By covering the tropical and semi-tropical regions of the Earth, TRMM provides much needed data on rainfall and the heat release associated with rainfall. It will not single-handedly provide the solution to the climate change debate - it will, however, contribute to our understanding of how clouds affect climate and how much energy is transported in the global water cycle. In coordination with other satellites in NASA's Mission to Planet Earth, TRMM will begin the process of understanding the interactions between water vapor, clouds and precipitation that is central to regulating the climate system.

The energy balance of the global atmosphere shows that only about one fourth of the energy needed to drive the global atmospheric circulation comes from direct solar energy. The other three fourths of the energy is transferred to the atmosphere by evaporating water - mainly from the ocean. As the water vapor rises from the surface, it carries with it the energy it takes to turn liquid water into water vapor - the "Latent Heat of Evaporation". Most of this latent heat is released into the atmosphere in huge equatorial cloud clusters when the vapor condenses to form cloud- and raindrops. The latent heat energy contained in the clouds cannot be seen or measured directly. Rainfall, however, is the product of the release of this energy, and rainfall can be measured. Responsible for three quarters of the energy that drives the global atmospheric circulation, tropical rainfall can be said to Drive the Climate Machine. Unfortunately, there are still uncertainties of as high as 50% in the amount of tropical rainfall. Unless we can better define the amount of rainfall and the energy released when rain occurs, we stand little chance of putting the climate models through the rigorous tests we need to gain confidence in their predictions.

TRMM Instruments:

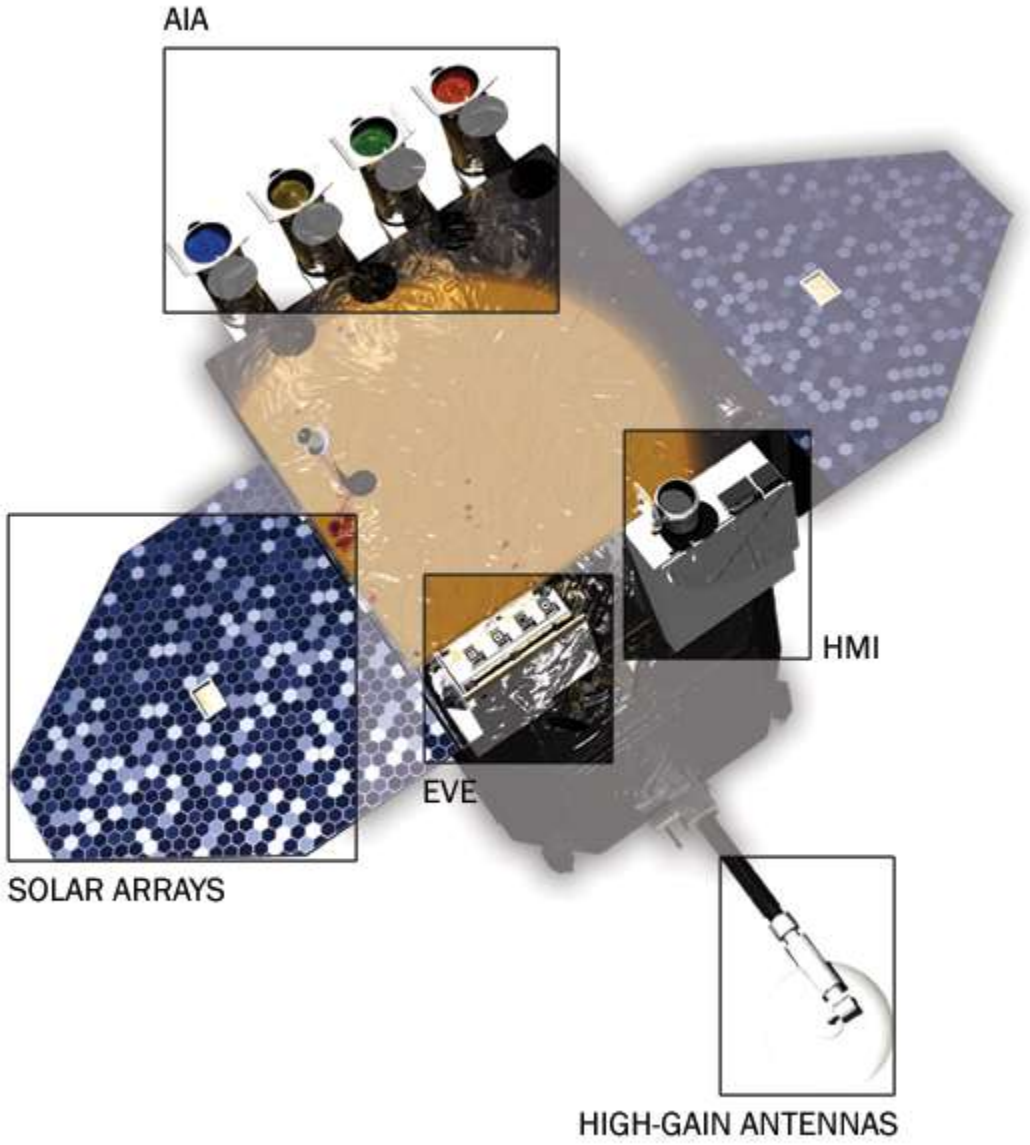
- Precipitation Radar (PR)
- TRMM Microwave Imager (TMI)
- Visible and InfraRed Scanner (VIRS)
- Cloud and Earth Radiant Energy Sensor (CERES)
- Lightning Imaging Sensor (LIS)

Plankton near the surface thrives on the nutrients and the populations explode and act like plants taking in carbon dioxide and releasing oxygen. This vast area is a boom of oxygen production made available to the entire planet. The massive scale of oxygen production by plankton blooms can be seen by aqua. A similar explosion for microscopic life happens all over the earth. What plankton dose is providing oxygen for us over half the oxygen we breathe.

Another way we get oxygen is from lightning. From orbit the whole earth buzzes with electricity. You can be seen a thousand miles worth of lightning flashes and they seem to set them self's off bang bang bang…. NASA's Trim satellite has a high speed camera able to track lightning across the earth.

40 strikes occur every second. 3 million strikes a day. Lighting is created by sunlight and water vapor, creating thunder clouds that turn water vapor into ice particles and as Ice and water vapor collide at high speed static electricity is built up. A typical lightning bolt has enough energy to power a city like Denver for 10 hours. A bolt is no thicker than a human thumb yet is five times the temperature of the surface of the Sun. As it burns though the atmosphere it breaks apart the nitrogen in the atmosphere into single nitrogen atoms which then seek to change and may bond with oxygen creating nitrate. Nitrate falls to the ground in rain. Nitrates are fertilizers which are absorbed by plants and moves though the creatures on earth though food. Nitrate is essential for all living things. But nitrate is not the only way lightning helps.

Solar Dynamics Observatory



Details

The total mass of SDO at launch was 3000 kg (6620 lb); instruments 300 kg (660 lb), spacecraft 1300 kg (2870 lb), and fuel 1400 kg (3090 lb).

Its overall length along the sun-pointing axis is 4.5 m, and each side is 2.22 m.

The span of the extended solar panels is 6.25 m.

Total available power is 1500 W from 6.6 m2 of solar arrays operating at an efficiency of 16%

The high-gain antennas rotate once each orbit to follow the Earth.

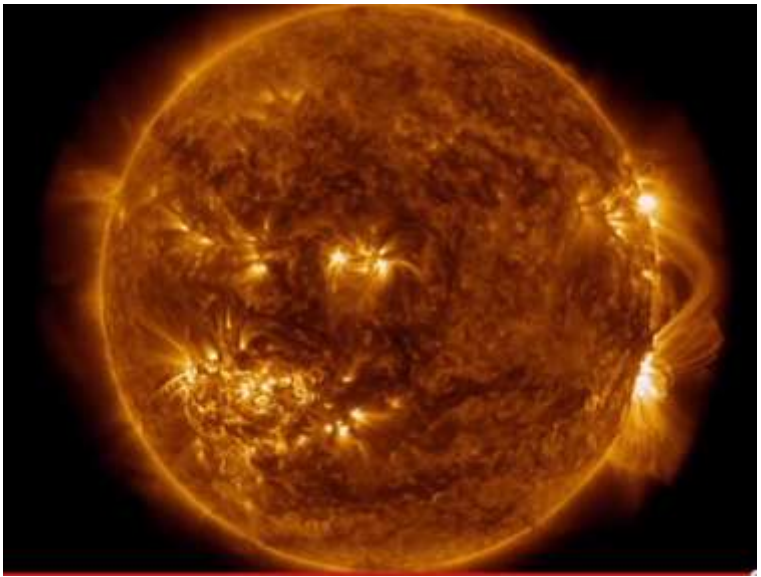
Forest fires are often started by lightning bolts. Vast areas of forest are burned which is another way life is formed. Forest fires monitored by Tera satellite create live maps of forest fires for the globe. This reveals the renewal of life though fire. In northern Canada dead and diseased trees which lock up nutrients. Trees take decades to decompose to return the nutrients. Fire shortens the cycle to a matter of hours. The oxygen feeds the fire. The nutrients from the trees end up in the ash. Also dead animals are converted to ash. Tera can see the healthy growth of new vegetation in areas if fire. Wild fires are essential to the cycle of life.

Fire is like a blender of the nutrients of life. Fires decompose material quickly, to feed the next generation of plant life. Forest fires accelerate the cycle of death and rebirth.

Solar cycles on Earth

Above all life's major driver is the energy from the sun. As the plant turns in 24 hours our planet responds to the sun. Over 1 million Terra Watts reaches the earth from the sun more than 700,000 times the output of all electrical generation on earth. This triggers a wave of activity around the globe. At dawn plants on land and in the sea begin photosynthesis. Also we respond as our skin cells create essential vitamins. While the sun nurtures all life on earth it also has the power to destroy.

We can monitor the sun with the solar dynamics laboratory a satellite that looks at the Sun 24 hours a day where space weather is borne.



The sun emits constant light, heat, and other forms of radiation and dangerous bursts of charged particles. These charged particles travel at 1 million miles per hour and are superheated called a coronal mass ejection. Charged particles are Super-heated to 10's of millions of degrees F. The coronal mass ejections are equivalent to 14 million Hiroshima bombs. The cloud of particles is millions of miles wide heading towards earth. Without protection it would strip the earth of atmosphere and cause the oceans to dry up leaving

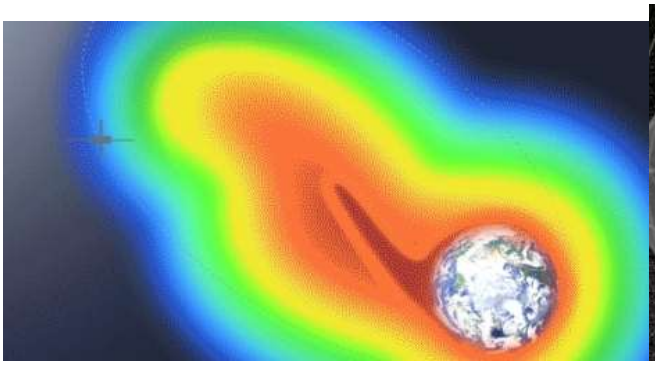
THEMIS understanding Space Weather

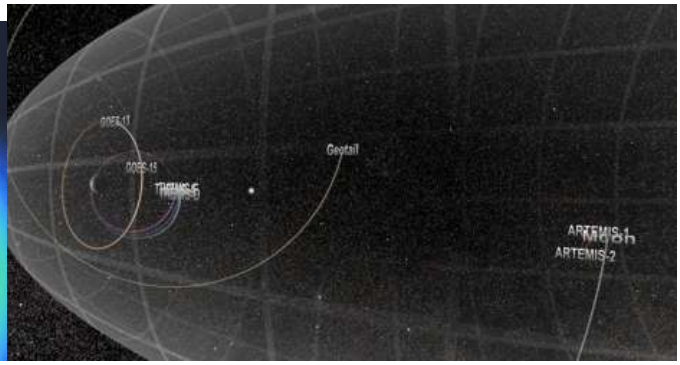
Mission Overview

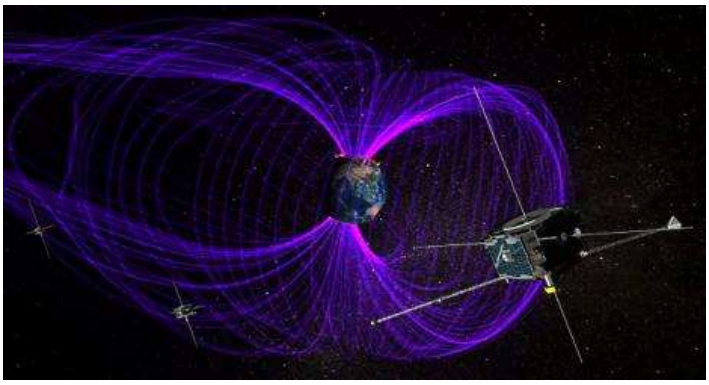
The Time History of Events and Macroscale Interactions during Substorms, or**THEMIS**, is a mission to investigate what causes auroras in the Earth's atmosphere to dramatically change from slowly shimmering waves of light to wildly shifting streaks of color. Discovering what causes auroras to change will provide scientists with important details on how the planet's magnetosphere works and the important Sun-Earth connection.

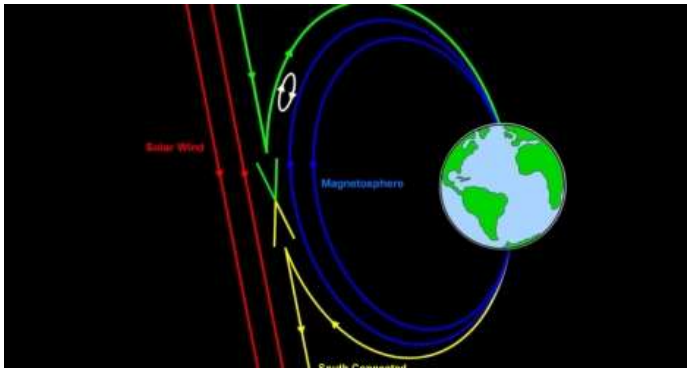
› Read more

ARTEMIS stands for “Acceleration, Reconnection, Turbulence and Electrodynamics of the Moon’s Interaction with the Sun”. The ARTEMIS mission uses two of the five in-orbit spacecraft from another NASA Heliophysics constellation of satellites (THEMIS) that were launched in 2007 and successfully completed their mission earlier in 2010. The ARTEMIS mission allowed NASA to repurpose two in-orbit spacecraft to extend their useful science mission, saving tens of millions of taxpayer dollars instead of building and launching new spacecraft.









behind a planet much like mars. Fortunately the earth has an invisible shield a magnetic field. Orbiting earth is a set of THEMIS satellites detect the magnetic fields around the earth showing its structure and how it operates. THEMIS reveals how the magnetosphere is distorted into a tear shape protecting the earth and deflecting solar particles. When a coronal ejection happens the first layer is penetrated but the earth has a second layer of magnetic fields that protects the earth and directs the energy towards the poles and triggers the northern and southern lights called the Arora. The radiation strikes the atmosphere at extreme speed it excites the air molecules and makes it glow oxygen glows red and green and the nitrogen red and blue.

These charged particles from the sun get trapped in the atmosphere and create the auras. The auras are reminders of how the suns lethal energy is dissipated in the upper atmosphere and how the earth protects us. The magnetosphere has shielded the earth for billions of years.

Human kinds' impact on earth

Our human footprint is so large that we are having a global influence. Our success has resulted in rapid population growth we now cover 80% of the land mass of the earth. Looking for signs of pollution the AURA satellite reveals the atmospheres chemical fingerprint. We manufacture twice the nitrite that lightning does much of it used for fertilizer and explosives. Our factory's release more sulfur than all the earths volcanoes our industry and transportation produce more carbon dioxide than the amazon can absorb our cities generate dust that trigger electrical storms and effect the rain fall. Our earth is changing on a path to somewhere and our ability to understand that path is critical to our survival.

The real power of satellites is that they can show us the changes that are happening to the earth in an objective truth. Not what we would like it to be or fear it to be but what it actually is. Satellites show that the oceans are slowly warming. In the past 30 years the temperature of the ocean's surface has risen by ½ a degree. Models suggest this increases the violence and frequency of storms around the world and sea ice at the poles is diminishing at an alarming rate. Our release of greenhouse gasses is the driving force.

Satellites do not last forever. Many of the current fleet of satellites is nearing the end of their lives. It is predicted that from 20 to fewer than 10 will remain at the end of the decade. If we fail to replace these satellites we would not be aware of the changes happening to the processes of the earth.