SPACE SOLUTIONS for the World's Problems

How the United Nations family uses space technology for achieving development goals

UNITED NATIONS

WHAT IS SPACE TECHNOLOGY AND **WHY IS IT USEFUL?**

Most satellites point inwards rather than outwards!

Almost all satellites are launched in order to provide services to people on Earth. Satellites are routinely used to support sustainable development as well as to manage natural resources and emergency situations. Satellites are mainly used as a source of information for decision-making or to transmit information. This publication describes some of their most important applications.

Spatial Data and Information Management and Exchange

Sustainable development requires an up-to-date and comprehensive information base to support planning and decision-making. Spatial data, acquired by either space- or ground-based means, is an increasingly important part of this information base. The Internet and satellite communication services allow for dynamic information sharing and exchange between partners in sustainable development within and outside the United Nations system, thus enhancing the benefits of complementary activities. With active participation from international and national partners, the United Nations family is actively working towards internationally standardized interoperability for sharing and exchanging spatial data and information, often using open source software capacities. This has already significantly enhanced inter-agency cooperation, reduced duplication of efforts and achieved tangible benefits within the United Nations family and for its stakeholders.

Navigation satellites

Global navigation satellite systems (GNSS), including the Global Positioning System (GPS) of the United States, the Global Navigation Satellite System (GLONASS) of the Russian Federation, and the future European Galileo and their augmentations, are a new global utility with increasing benefits in people's daily lives. They have extremely high accuracy and global coverage, and they can operate in any weather.

Benefits of GNSS are growing in areas such as aviation, maritime and land transportation, mapping and surveying, precision agriculture, power and telecommunications networks and disaster warning and emergency response.

The atomic clocks in GPS satellites provide the timing for the Internet. The clocks also provide the utilities industry with the reliable, precise time standard that is necessary to log line disturbances and synchronize events.

GPS and GLONASS are used to track fishing vessels, vehicles transporting goods or hazardous materials, and even wild animals ("GPS collars").

Navigation satellites can also be used to measure atmospheric temperature and humidity, which is important for our understanding of global climate and weather.

Navigation satellites are an essential part of satellite mapping, telling us what area the map refers to.

Remote sensing satellites

Remote sensing satellites are used to monitor the land surface, the oceans and the atmosphere, and how they change over time. Remote sensing satellites are now routine and essential tools in supporting efforts to protect the global environment.

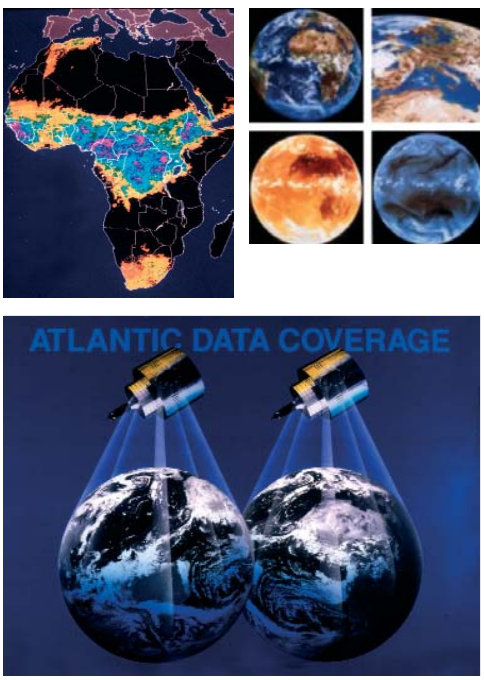
What is unique about them?

Coverage: Most remote sensing satellites cover the whole globe, making them important for the study of large-scale phenomena like ocean circulation, climate, deforestation and desertification. They are also important for cost-effective monitoring of remote or dangerous areas.

Repetition: Satellites repeatedly view the same area over long periods of time. This makes it possible to monitor environmental change, including the impacts of humans and natural processes. This also provides an indication of how trends observed in the past (such as deforestation and desertification) will continue in the future.

Speed: Many satellites can provide data and derived information rapidly in emergencies. This is very important, especially in an area hit by an earthquake, flooding or forest fires, where there may not be enough time to assess the damage through conventional ground or aerial surveys.

Consistency: All of the data collected by a particular sensor on a particular satellite is collected in the same way, meaning it is consistent. This makes it easier, for instance, to detect subtle changes in land use over a period of years.



Accuracy: Satellite images and global positioning systems can support developing countries in obtaining accurate maps. Having accurate maps is the first basic tool to initiate any planning for development.

Low cost: A satellite can be used for a large number of activities for a long time. In the long run, the cost of launching and operating a satellite is offset by the benefits it provides.

Communications satellites

Just like any other kind of telecommunication, communication satellites are used to transmit information from one point to another. Unlike ground-based communications, however, people sending or receiving information through satellites do not have to be connected to a ground network. Communication satellites can reach people in remote villages, ships on the high seas and areas where infrastructure on the ground is not available or has been temporarily damaged by an earthquake. They can also help to improve education, health care and the standard of living, and have special potential for the poorest and most devastated areas. Together with ground-based networks, they provide access to the World Wide Web.

The Internet is making it much easier to find and spread information. A lot of the information you access over the Internet has been relayed by a telecommunications satellite.

Satellite telecommunications have potential as a source of information for rural and remote areas, and may help countries to "leapfrog" stages in development. They can contribute to sustainable development by giving people access to information and helping members of the public to participate in decision-making, or more generally by improving education and health services and promoting favourable conditions for environmental protection.

SPACE TECHNOLOGIES FOR PROTECTING THE EARTH'S ENVIRONMENT AND MANAGING ITS RESOURCES

Environmental Assessment

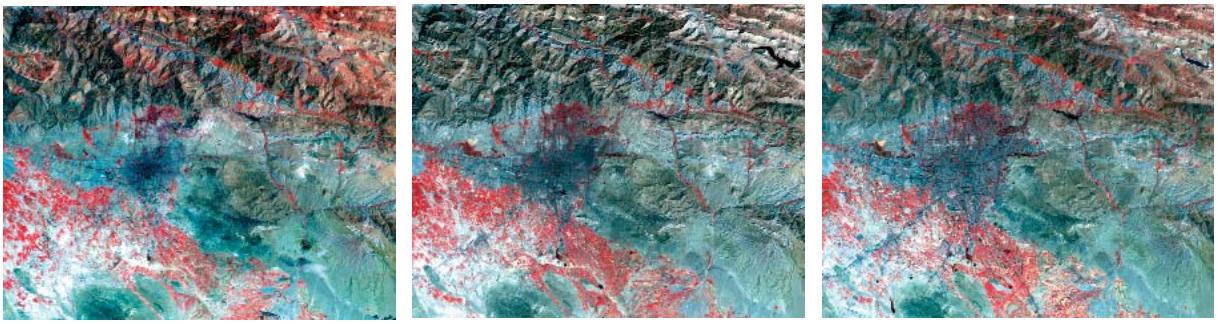
Images obtained from Earth observation satellites offer a wealth of information to policy makers, scientists and the general public about the planet's changing environment. Satellite images provide information about:

- Land cover and land use
- Remote and difficult-to-access areas like dense forests, glaciated areas, deserts and swamps
- Areas undergoing rapid environmental change, including loss or fragmentation of ecosystems and related loss of biodiversity
- Effects of natural disasters such as floods, droughts, forest fires and volcanic eruptions
- Wide-ranging impacts of pollution, from depletion of the ozone layer to tracing oil spills and photochemical smog
- War-torn regions and the environmental impacts of armed conflicts

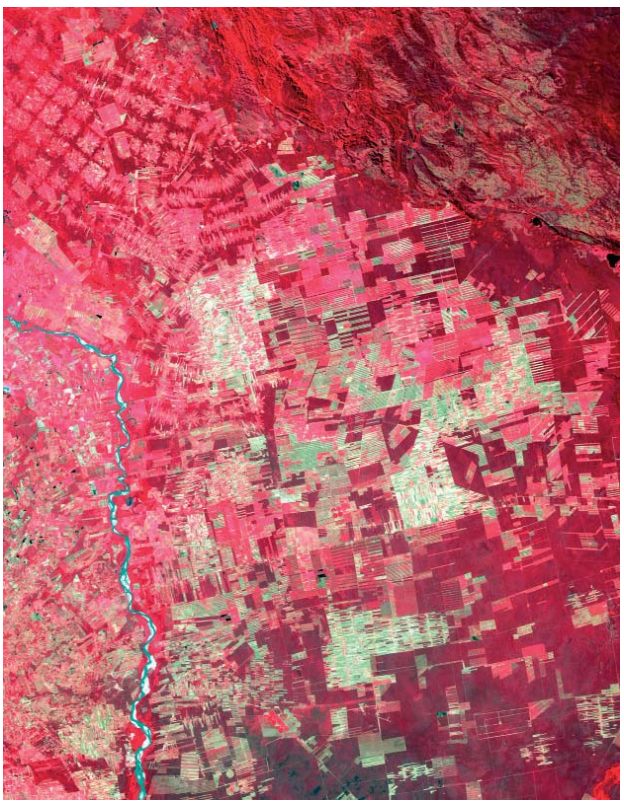
The collection of satellite imagery compiled over the years allows environmental change to be monitored in a geographical area of interest. Phenomena studied include deforestation, urban sprawl, glacial retreat and loss of wetlands. Dramatic satellite images are also a powerful communication tool for decision makers, providing "hard evidence" about environmental threats and problems that are obvious even to the untrained eye.

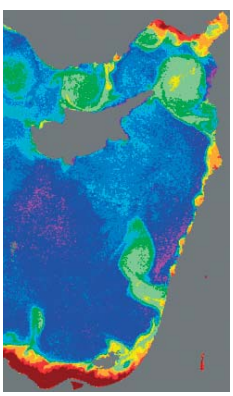
This evidence, employed with the assistance of such technologies as Geographic Information Systems (GIS), is increasingly gathered and applied in decision-making processes by many developed and developing countries throughout the world. Satellite imagery is, therefore, a key information source for assessing and reporting progress made towards the United Nations Millennium Development Goal of ensuring environmental sustainability by 2015, in particular, in protecting land areas to slow the loss of biodiversity.

◀ *Post-conflict impacts can be documented, such as bomb damage (indicated in red) and pollution spills (indicated in yellow). The impacts are highlighted in this high-resolution image of Pancevo, Yugoslavia, that was taken by an Indian remote sensing satellite during the Kosovo conflict in 1999.*



▲ *Satellite images taken in 1975, 1988 and 2000 were used to study the adverse impact of sharp population growth and rapid urban expansion in Tehran on the environment.*





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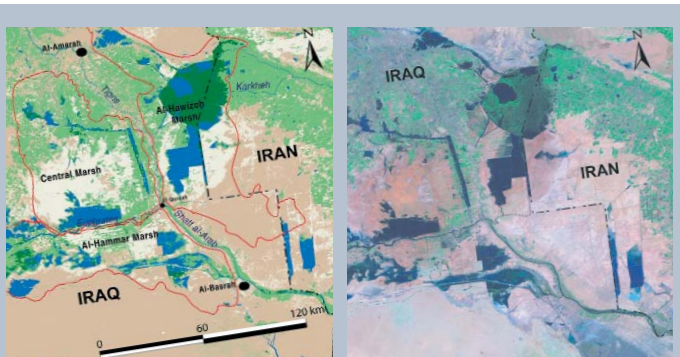
◀ *Earth observation satellites have also been used to map coastal pollution (chlorophyll concentration) in the Eastern Mediterranean and to monitor human encroachment in forested areas surrounding Santa Cruz, Bolivia.*



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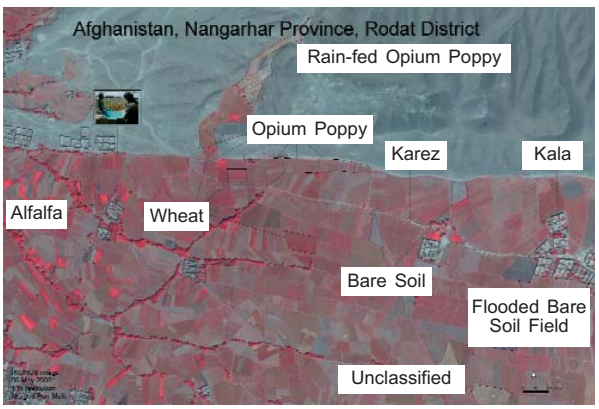
The Landsat archive was used to document the destruction of the Mesopotamian marshlands in southern Iraq and Iran, an otherwise inaccessible area. Landsat data are now also used for rehabilitation of the marshlands.

A new publication released in 2005, **"One Earth, Many People: images of change"** provides a remarkable panorama of the "human footprint" on the global environment by focusing on more than 100 "hot spots" of environmental change.

Agriculture and land use



▲ *The United Nations system is helping countries such as Colombia and Afghanistan to use satellite images to map areas of illicit drug cultivation. Remote sensing can be used to detect and map areas where specific illicit crops, like the coca bush and the opium poppy, are being grown.*

Monitoring agricultural crop development from space can help predict an area's agricultural output well in advance. This information is often crucial in helping authorities to anticipate food shortages and famines, giving them enough lead time to take preventative action.

Monitoring and forecasting weather by satellites are of crucial importance to farmers. Satellites are an important complement to the ground-based weather stations for predicting storms, flooding and frost.

Rainfall and evapotranspiration assessments from satellites help farmers plan the timing and amount of irrigation for their crops. Such assessments can also contribute to improving food security.

Satellites can detect, through environmental factors, areas at risk from—or already affected by—pests like locusts, crop and livestock diseases, tsetse fly activity and animal trypanosomiasis.

The Tigris-Euphrates is an international river system shared by seven countries. It has attracted growing international attention in recent years owing to the serious water stress facing the region, which is compounded by surging populations and ambitious development plans. A satellite-based study of land cover focuses on two hot spots that have experienced the greatest changes in the last decade. These are the headwater region in Turkey, where valleys have been inundated by a series of large dams; and the Mesopotamian marshlands of Iraq and Iran, which have been devastated by massive drainage schemes.

Precision farming techniques use information from remote sensing and navigation satellites to produce accurate, up-to-date maps of features like the exact distribution of pest infestations or areas of water stress on a farm. This may allow pesticides, water and fertilizers to be targeted to areas where they are needed the most, which not only saves money but also may reduce the environmental impact.

AFRICOVER, ASIACOVER and the GLOBAL LAND COVER NETWORK (GLCN) PROJECTS

The United Nations family has been involved in the AFRICOVER project, whose goal is to establish a digital geo-referenced database on land cover and a geographic referential (a type of reference map which includes place names, roads and water distribution). The project is based on Landsat TM and ancillary data for 10 African countries—Burundi, the Democratic Republic of the Congo, Egypt, Eritrea, Kenya, Rwanda, Somalia, Sudan, Uganda and United Republic of Tanzania.

The methodological results of AFRICOVER are the basis for a Global Land Cover Network (GLCN) initiative, which was launched by the United Nations family in 2002. The GLCN is a global alliance for standard multi-purpose land cover data production to improve the availability of global information on land cover and to develop international standards for data collection. International standards are important because they ensure that the same data can be used by different organizations around the world.

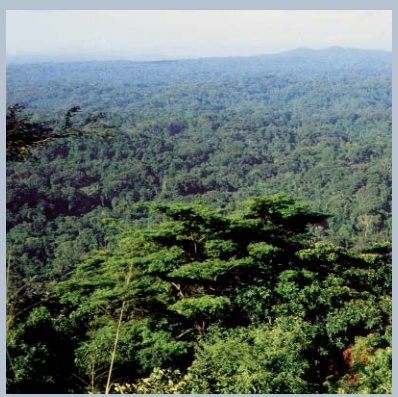
An extension of the work completed for the AFRICOVER project is the ASIACOVER project. The aim of the ASIACOVER project is to prepare a regional, standardized land cover database, integrated with socio-economic information to serve as a decision-making tool for food security and sustainable development in South-East Asia.

Forests

Remote sensing satellites provide global coverage and are an essential tool for forest assessments, especially global assessments such as the periodic "Forest Resources Assessment" and "Assessment of the Status of the World's Remaining Closed Forests" carried out by the United Nations. They can map inaccessible locations—where most of the world's undisturbed forests grow—just as easily and routinely as populated areas.

Remote sensing satellites gather data quickly on the status of forests in an area, making it useful, among other things, for:

- Detecting forest cover change and degradation
- Locating forest fires
- Mapping new roads, settlements and logging



People can see light in the "visible" part of the radiation spectrum wavelength. Visible light provides useful, basic information on the location of forests. For instance, when looking down from a plane, we can often distinguish areas of forest, fields, deserts and buildings. But remote sensing can also detect different types of radiation, such as infra-red, which can be used to detect much more subtle features of forests, such as:

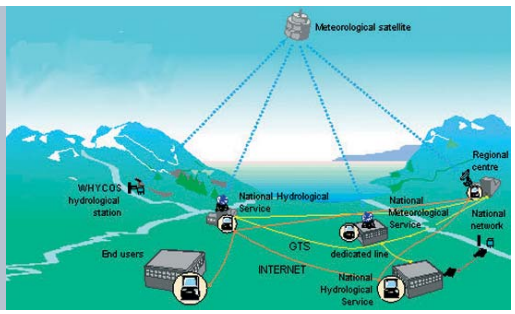
- Distinguishing primary or virgin forest from areas of secondary forest (which have regrown after being logged)
- Providing data for mapping areas where forest is under stress, for instance from pest infestations or drought

Water

Measurements from satellites improve our understanding of the various stages of the water cycle.

The World Hydrological Cycle Observing System (WHYCOS) is a global programme aimed at improving information on the world's water. It comprises observing systems that monitor specific basins, such as the Mediterranean. Among other things, the programme provides developing countries with hardware that enables them to collect data on the water cycle from meteorological satellites.

The World Water Assessment Programme and other United Nations programmes are using space technology to map water distribution and availability, measure the impact of droughts and floods, and collect information on how water is used in areas such as forestry and agriculture.



Weather and Climate

Meteorological satellites are the major source of information for our daily weather forecasts. They complement the ground-based network of weather stations. Among other things, meteorological satellites can warn us about tropical cyclones, tornadoes, severe storms and extreme temperatures, particularly in areas where ground network coverage is not comprehensive, such as over the oceans, in remote areas and in many developing countries. The global coverage and consistency in space and time of meteorological satellites make them ideal for monitoring the global climate, including regular events such as El Niño and longer-term phenomena such as global climate change.

World Weather Watch

Modern weather forecasting demands an almost instantaneous exchange of information on weather across the globe. World Weather Watch is a unique system, linking institutions around the world that collect, process and transmit information on the weather.

Combating Marine Pollution

The United Nations family uses space technology to help combat marine pollution. Some of the projects aimed at reducing marine pollution include:

- Monitoring the marine environment in the north-west Pacific Ocean
- Monitoring pollution and vegetation in the South China Sea
- Monitoring eutrophication in the Po Estuary, Italy
- Assessing risk of red tides in Bantry Bay, Ireland
- Studying fisheries in the northern Aegean, Greece
- Training activities on how to use remote sensing in marine studies
- Maintaining a communications network to help monitor seawater quality off Tunisia
- Conducting a comprehensive assessment of the marine and coastal environment in Western Asia, including mapping of marine pollution off the coast of Lebanon
- Compiling an atlas and a database of the coastal and marine environment in Eastern Africa
- Strengthening information on the coastal and marine environment in Western Africa.

World Heritage Sites

The World Heritage Convention was adopted in 1972 to preserve sites of outstanding natural beauty or of special importance to nature, culture, history, science or conservation. A new initiative aims to use remote sensing and space technology to assist developing countries to monitor the World Heritage sites, in particular the less developed countries where approximately 300 of the 788 sites are located. The United Nations currently implements several projects, for example, the use of remote sensing to obtain cartographical information for the World Heritage sites in Central Africa and to detect changes in gorilla habitats in Central African World Heritage sites.

Endangered Species

Many endangered species are closely associated with a particular habitat. The vanishing tropical rainforests are especially rich in biodiversity, and the many species that depend on them disappear when the forest is felled or burned. Remote sensing can be used to map not only forest but also to detect changes that take place inside the forest. For example, by identifying primary forest and other types of vegetation, we can estimate the ranges of species that depend on them.

SPACE APPLICATIONS FOR HUMAN SECURITY, DEVELOPMENT AND WELFARE

Disasters

Information from satellites helps to identify areas at risk from disasters, enabling us to take action in advance to reduce the harm that disasters can cause.

Satellite weather forecasting helps to predict disasters that are caused by extreme weather, such as droughts, forest fires, storms and floods.

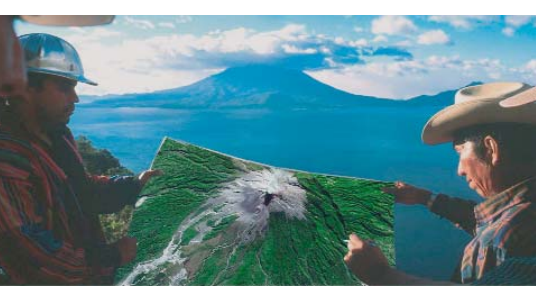
Data from satellites provide real-time and accurate information for monitoring, mapping and managing hazards of geological origin such as earthquakes, volcanic eruptions, landslides and ground instability. Satellite communications can help warn people who are at risk, especially in remote areas, and can be essential following an earthquake, when telephone networks on the ground may be damaged or destroyed.

Information derived from satellite images is used to assess damage resulting from disasters such as floods, fires, oil spills, earthquakes, volcanic eruptions and landslides. Maps created from satellite image processing are used to plan and support relief efforts. Up-to-date information is distributed quickly to local authorities and relief personnel on the ground.

Specific programmes of the United Nations family are aimed at incorporating the use of space technologies into operational disaster management programmes around the world. This is achieved by bringing together the existing users of space technology with those responsible for dealing with disaster management and space technology in developing countries. Related activities include training and pilot projects for the benefit of educating disaster managers and decision makers about the benefits of space technology.

International Charter "Space and Major Disasters"

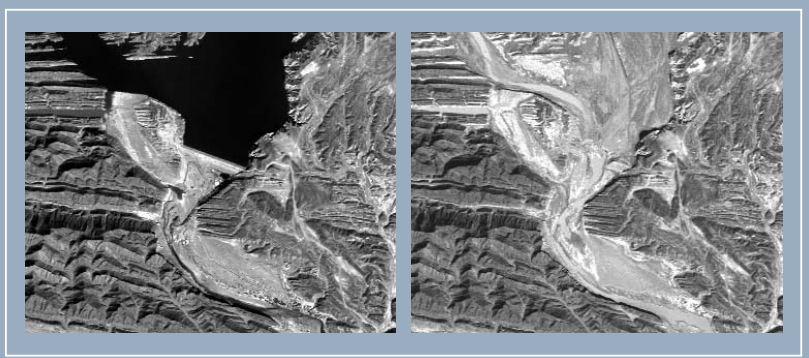
An initiative that has recently been established between various space agencies and the United Nations is aimed at providing the United Nations with satellite imagery free-of-charge on a priority basis for major disasters. The imagery can then be analysed by the United Nations agencies to determine the best way to manage the disaster. This means that countries or regions that do not have access to satellite imagery can obtain satellite

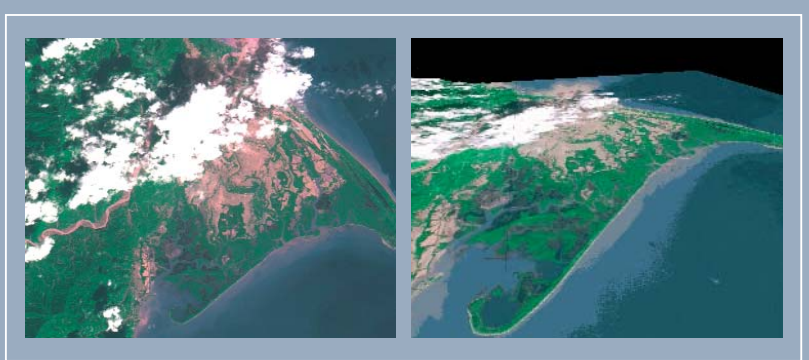


Post-Crisis Recovery and Development

Satellite imagery collected during an emergency can later be used for post-crisis recovery and development. Images collected on different dates can be compared in order to monitor progress and plan further assistance.

When a crisis situation has calmed down and the immediate needs are met, the process of recovery, reconstruction and development begins. The United Nations uses a wide variety of satellite imagery to better manage its post-emergency projects for the benefit of the local population. The United Nations facilitates the re-utilization and hand-over of satellite imagery and information from one agency to the other.





Top left: images taken before and after dam burst in Pasni, Pakistan, February 2005.

Top right: image of Banda Aceh, Indonesia, after December 2004 tsunami.

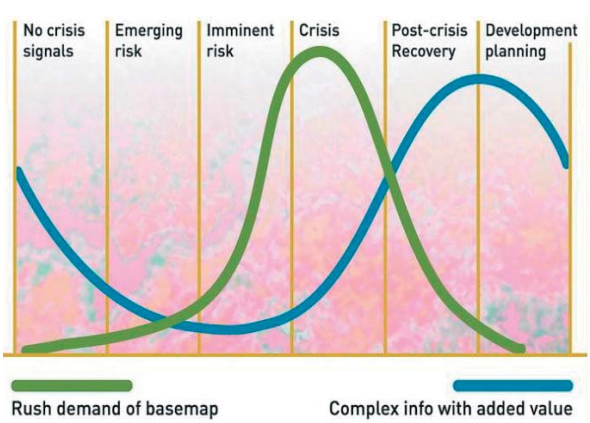
Left: images of floods in Philippines, November 2004.

The images were provided through the International Charter "Space and Major Disasters".

images free-of-charge for relief operations in cases of major disasters. The satellite imagery can be used for such purposes as developing an evacuation strategy during periods of flooding or developing a strategy for fighting forest fires. It is under this initiative that various United Nations and other relief agencies obtained, within days of the disaster, satellite imagery of the areas affected by the tsunami that hit the coastline of the Indian Ocean in December 2004. Those images helped the relief workers quickly assess the damage and determine ways to assist the recovery of the affected region.

In the Asia-Pacific region, the United Nations is promoting the development of regional cooperative mechanisms to use space technology for disaster management. Those mechanisms would assist national disaster management authorities to work with space technology supporting agencies to integrate space technology into national disaster management strategies.

By combining satellite imagery with the use of Geographic Information Systems (GIS) and Digital Elevation Models (DEM), local decision makers and United Nations staff now have access to advanced tools for complex decision-making. For example, these tools can be used to help decide where to establish safe housing areas for victims of landslides and earthquakes.



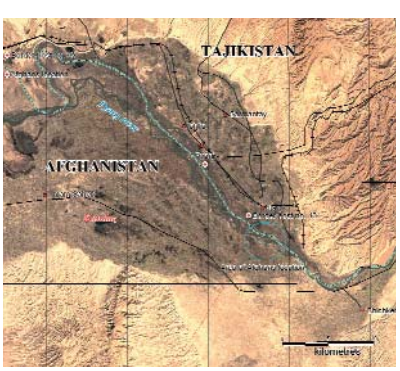
Refugees

United Nations agencies are increasingly using space technologies in their refugee operations.

The United Nations family is using applications of space technology such as Remote Sensing, Geographic Information Systems (GIS) and the Global Navigation Satellite System (GNSS) within its operations in the field during humanitarian emergencies.

The main operations where space technology has been used to improve the lives of refugees in emergency situations are:

- The Iraq situation
- The Afghan crisis
- The civil war in Sierra Leone
- The on-going humanitarian emergencies in West Africa, the Horn of Africa and the Great Lakes region
- The Kosovo operation
- The Timor crisis
- Central and South America



Based on new types of images, which allow objects on the ground that are more than half a metre in size to be distinguishable, methods for counting and registering refugees are being developed. Refugee population information gathered at the field level and with satellite images is combined within a Geographical Information System (GIS) and helps in the daily management of refugee camps.

Satellite images are used during humanitarian emergencies for a wide range of applications.

Landsat and Spot images have been used since the mid-1990s to assess and monitor environmental degradation and assist in rehabilitation programmes around refugee camps.

During emergencies, satellite imagery like Landsat, Spot and high resolution Ikonos or QuikBird images are used for refugee camp planning and monitoring in combination with other sources of information such as GPS information collected in the field. In some cases the technology can detect concentrations of refugees.

Images are also used to obtain up-to-date information on the progress of operations as humanitarian crises generally occur in poorly mapped areas.

In particular operations, such as the Kosovo emergency, aerial photos and satellite imagery have been used to quickly estimate housing damage in order to assist the return of refugees and assess their needs.

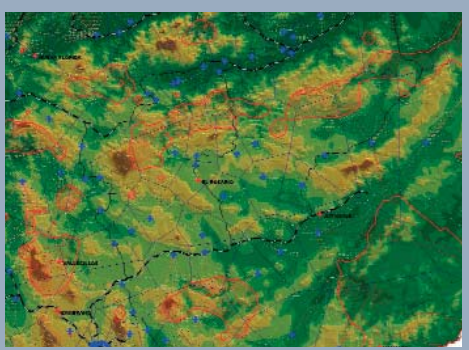
Satellite imagery is particularly useful for obtaining up-to-date information on areas where maps are poor or non-existent and areas that can be dangerous or difficult to visit.

Together with satellite imagery, GNSS devices are used in refugee operations worldwide. GNSS satellites are essential to the collection of crucial operational information. The types of information that are essential for effective management of refugee operations include:

- Locations of refugees on the move during emergencies
- Locations of refugee camps and settlements
- Logistical information (roads, airports, etc)
- Water resources
- Environmental conditions

Telecommunication satellites may be the only way to keep in touch with refugee camps in remote areas or in difficult situations.

Health



Communication, remote sensing and navigation satellites are regularly used for the management of complex public health problems.

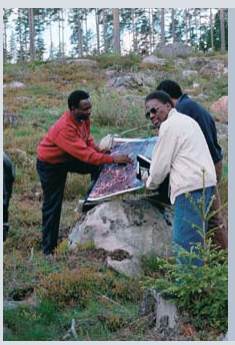
In West Africa, communication satellites are successfully used in public health. Onchocerciasis (river blindness) has virtually been eliminated from seven countries where the Onchocerciasis Control Programme (OCP) has been applied. This was achieved through hydrological monitoring to support targeted spraying that killed off the larvae, which are the main transferee of the disease. Data from 150 water gauges were transmitted in real time to the operational centres with the help of telecommunication satellites . This made it possible to considerably improve the effectiveness of killing larvae, thus eliminating the risk of onchocercal blindness for 9 million children born within the original OCP area since programme operations started. Furthermore, 30 million people are protected from the disease, 100,000 have been prevented from going blind and 1.25 million have been cured.

Images from remote sensing satellites are used in combination with the Geographic Information Systems (GIS) technology in various projects. For example, remotely sensed images are used in Viet Nam to identify the relationship between environmental factors and malaria transmission. A malaria risk map was developed using a mathematical model and remote sensing data obtained from "SPOT", "LANDSAT" and "TERRA" satellites. The results will be used to develop tools for monitoring, assessing and predicting malaria in Viet Nam.

Remote sensing images are used to determine accessibility to primary health care points. For example, in Honduras, the Pan-American Health Organization (PAHO) set up a project to restructure health resources for the disadvantaged. Areas with poor accessibility to health resources and where basic health needs are not met were examined. The results showed that more than 500,000 people (9 per cent of Hondurans) reside in critical accessibility areas: remote and hilly areas where the scarce health infrastructure had been closed or where nurses were the only health staff available. Based on the results of this analysis, solutions for the relocation of health resources have been proposed.

Finally, navigation and positioning satellites are used on a daily basis to collect the geographic component of health related information for surveys, monitoring programmes or interventions in the field.

EDUCATION, TRAINING AND CAPACITY BUILDING



Making effective use of space technology requires different levels of expertise. The general public may need training to use Internet services, tele-health or tele-education facilities. At a more advanced level, decision makers and managers in local governments need to be informed and aware of how products derived from satellite images can be useful for such purposes as urban development, crisis prevention and disaster recovery. Institutions are then in a better position to communicate with remote sensing and thematic experts who are responsible for selecting appropriate sources of data, translating it into understandable information and delivering useful products to the institutions.

Many organizations of the United Nations system conduct capacity development activities, particularly in developing countries, in the field of space science and technology. Some programmes focus on the specific needs of a region by promoting regional cooperation and facilitating equitable sharing of the benefits of space technology applications by all the countries of that region. Some of those programmes also promote technology transfer. Other programmes comprise training courses and workshops in subjects such as remote sensing, satellite communications, satellite meteorology, satellite-aided search and rescue, basic space science and satellite navigation. Some of the United Nations agencies also provide distance-learning courses through the Internet on "the use, benefits and applications of remote sensing in developing countries". By offering such e-learning opportunities, the United Nations reaches more people and can easily educate and train them in the latest tools and techniques available from the rapidly developing space industry.

The Regional Centres for Space Science and Technology Education affiliated to the United Nations and operating in India, Morocco, Nigeria, Brazil and Mexico—provide courses in space science and technology for post-graduates from Asia and the Pacific, Africa, and Latin America and the Caribbean.

Activities associated with the United Nations Decade on Education for Sustainable Development (2005-2014) will contribute to educating the general public, especially the youth, on benefits of using space technology for sustainable development.

In addition, the United Nations promotes ethical principles to guide present and future human activities for the safe and peaceful use and exploration of outer space.

How space can help education in developing countries

World Space Week is an annual event held from 4 to 10 October that raises awareness about how space improves people's lives around the world and is linked to various educational activities. Education about space is important because the subject appeals to children and can attract them to careers in science and engineering.

Information and communication technologies hold a lot of promise for developing countries, and fulfilling this potential is a priority activity for the United Nations system and other organizations. One major initiative that the United Nations supports is the SchoolNet Africa project. The project helps connect teachers and schools across Africa to the Internet by developing greater awareness about information technologies and campaigning for lower Internet access fees for African schools. Another initiative includes reaching disadvantaged groups such as the blind. E-learning projects for the blind have been initiated in Qatar and India using graphic screen radar in Braille.

Space communications can help improve access to the Internet. Satellites are capable of reaching schools in remote areas that are not connected to ground-based networks. Programmes that promote "tele-education" or the provision of education services via satellite are underway. At present, one of the major obstacles to these programmes is cost, including high bandwidth charges.

Bridging the digital divide

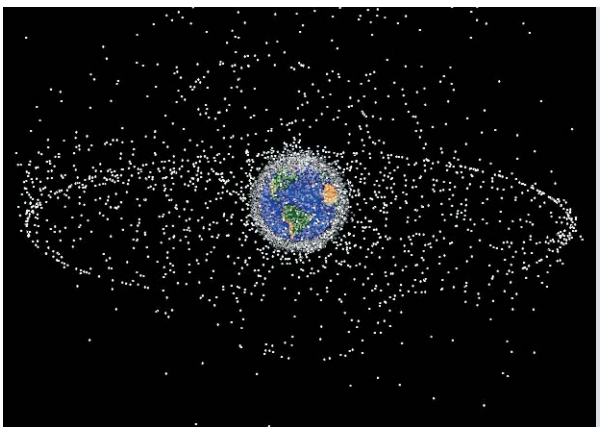
The "digital divide" exists between developed and developing countries and refers to the unequal distribution of telephone, mobile phone, Internet connections and broadcast networks. It also exists between developed and less developed areas within a country.

Today, in order to combat the lack of qualified teachers in less developed areas, communication satellites not only transmit educational television programmes for adult education and training of teachers, but also deliver education programmes to primary and secondary schools. Recent progress in broadband communications further enhanced the importance of communication satellites in bridging the digital divide.

In some parts of the world, satellite broadband service has offered comparable prices with other terrestrial-based broadband access methods. It is providing the opportunity for the less developed countries to extend development oriented information services and applications to communities where there is inadequate land-based communication infrastructure.

PROTECTING THE SPACE ENVIRONMENT

Since the launch of the first satellite and the beginning of the space age in 1957, we have discovered that space, as well as Earth, can be affected by environmental problems.



Space debris

What is space debris?

Space debris is anything that people have put into Earth orbit that no longer serves a purpose and that has not been de-orbited and burned up in the atmosphere or landed back on Earth. This includes entire satellites that no longer function, sections of rockets that have been discarded, parts of satellites that have exploded, astronaut gloves and other items dropped by space explorers. Most numerous of all are tiny particles like paint chips and liquid droplets of potassium and sodium.

What is the environmental problem?

Space debris orbits the Earth at incredibly high speeds, normally several kilometres per second, making even small particles a hazard to space explorers and active satellites.

Are small or large particles more dangerous?

Large particles obviously cause more damage when they hit something—an entire, defunct satellite would almost certainly destroy a satellite or kill a space explorer on impact. But small particles are much more numerous, are nearly impossible to track because of their size and can still cause quite a lot of damage.

Protecting astronomy

Astronomy is mainly an observational science but our ability to observe the Universe is increasingly impeded by interference from light sources (such as city lights) as well as radio waves, in particular from mobile phones and other communications devices.

The Radio Regulations implemented by the United Nations family attempt to address this problem by reserving a part of the electromagnetic spectrum exclusively for radio astronomy.

INTERNATIONAL AND INTER-AGENCY COOPERATION IN THE PEACEFUL USES OF OUTER SPACE

The United Nations provides a forum for countries, international organizations and non-governmental organizations to discuss issues related to the peaceful uses and exploration of outer space. To date, the United Nations organized three United Nations Conferences on the Exploration and Peaceful Uses of Outer Space (UNISPACE).

Since 1959, the United Nations Committee on the Peaceful Uses of Outer Space annually reviews the scope of international cooperation in the peaceful uses of outer space, devises programmes in this field to be undertaken under United Nations auspices, encourages continued research and dissemination of information on outer space matters, and studies legal problems arising from the exploration of outer space. The Committee, its Scientific and Technical Subcommittee and Legal Subcommittee consider such issues as space debris, the use of nuclear power sources in outer space, near-Earth objects, disaster management with the use of space technologies, the use of space technologies in water resource management and telemedicine, as well as many other similar issues.

Since 1975, the United Nations has convened the Inter-Agency Meeting on Outer Space Activities. Comprised of all the United Nations agencies, the Meeting considers ways to increase synergies in space-related programmes implemented by United Nations agencies, to prevent duplication in those programmes and to elaborate new inter-agency initiatives.

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