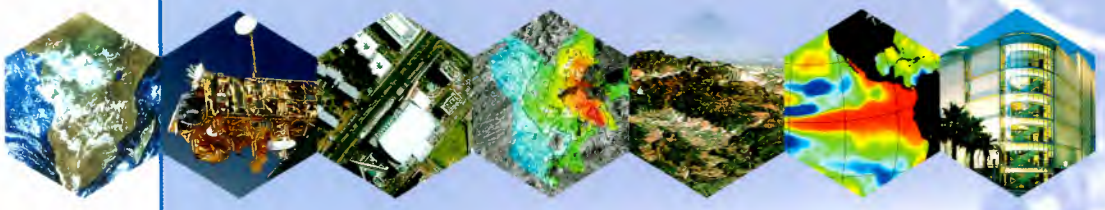
Sustainable Development
The Space Contribution

From Rio to Johannesburg – Progress over the last 10 years

CEOS
Committee on Earth Observation Satellites



Satellite Applications in Support of World Summit Topics

World Summit on Sustainable Development – Implementing Agenda 21

The World Summit on Sustainable Development holds the key to our planet's future.

The Summit aims to turn plans into action, to assess the results achieved since the 1992 Earth Summit and to evaluate the obstacles to further implement Agenda 21. The Summit brings together tens of thousands of participants, including heads of State and Government, national delegates, leaders from non-governmental organisations and businesses.

Space applications contribute to sustainable development

On 11th February 2000 the United Nations General Assembly adopted resolution 54/68 endorsing the recommendations of UNISPACE III. The UNISPACE III Resolution defines specific elements to address global challenges, and requests **"to develop and implement the Integrated Global Observing Strategy (IGOS) so as to enable access to and the use of space-based and other Earth observation data"**.

This information guide illustrates how the space community is working to fulfil the aims of the World Summit 2002 in topics such as:

- **Poverty Eradication and Sustainable Livelihoods**
- **Protecting and Managing the Natural Resource Base**
- **Sustainable Development Initiatives for Africa**
- **Sustainable Development of Small Island Developing States**
- **Means of Implementation**

Sustainable development – The space contribution

- Detecting urban sprawl
- Kyoto carbon sink verification
- African resource protection
- Crisis and disaster assistance
- El Niño forecasting
- Desertification monitoring
- Hazard protection of small islands

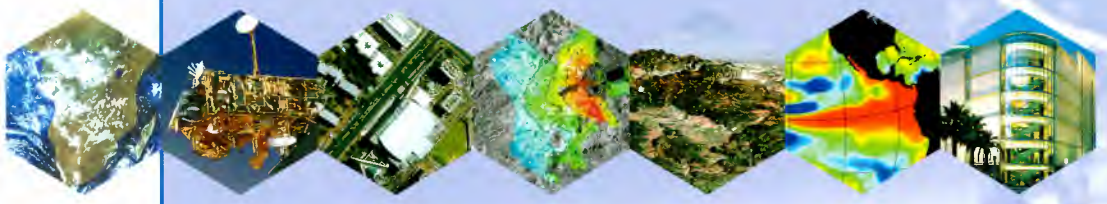
"100+" – Progress in satellite earth observation since Rio

Mapping the Earth's surface:	**100+** times more accurate than 10 years ago
Measuring the sinking of cities:	**1/100+** of a metre accuracy in surface subsidence
Predicting El Niño:	**100+** days early warning
Storms and floods:	**100+** hours advance risk warning
Earth check-up:	**100+** new satellite sensors for sustainable development

Johannesburg Sandton Convention Centre

Street view

Space view
as seen by a civilian very high resolution satellite



Poverty Eradication and Sustainable Livelihoods

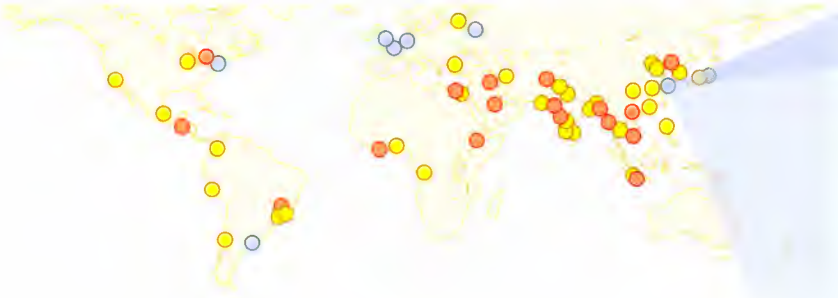
Habitat Agenda – Infrastructure needed for supporting massive populations is in many cases not keeping up with urban expansion

The Habitat Agenda aims to reduce the disastrous results of uncontrolled urban sprawl. The UN Agenda addresses issues such as improper land use, anarchic spread of informal and squatter settlements, insecure land tenure and settlement on disaster-prone areas – as well as the key problem of food shortage.

MegaCities – Uncontrolled growth means more poverty

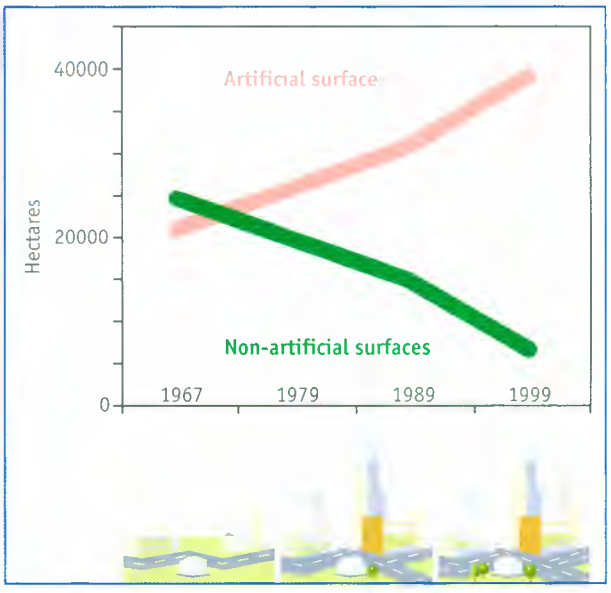
Currently there are 20 cities of more than 10 million people. By 2030 it is expected that 60 percent of the world population will live in cities with most urban growth occurring in less developed countries.

Cities with over 5 million inhabitants



- 5 million and over – 1950
- 5 million and over – 1951-2000
- 5 million and over – 2001-2015 (projected)

Shanghai – The rise of a MegaCity

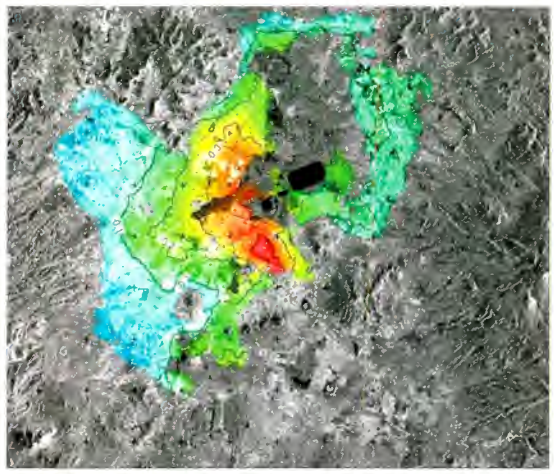


Increases in built-up areas between 1967 to 1999 as detected by satellites – Negative effects of urban sprawl were largely avoided in Shanghai due to careful urban planning

Today, vertical movements of a few millimetres can be "seen" from 800 kilometres above

Continuous radar measurements from satellites can detect the "sinking of cities" due to natural or man made causes. In Mexico City these data helped to identify endangered areas and buildings which are subsiding at a rate of up to 47 cm per year.

The sinking of Mexico City



The different colours show land subsidence as observed from satellites

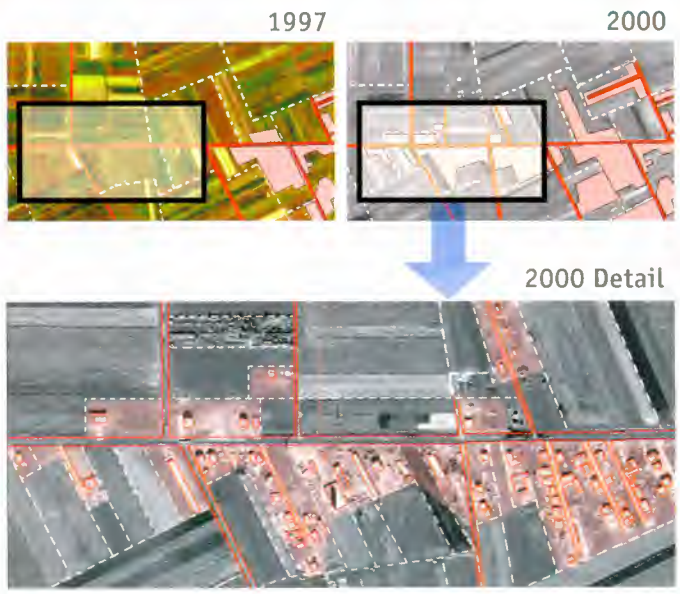
Today, satellites can "see" urban developments as small as one metre

Upgrading of squatter and informal settlements is a serious task for urban administrations. Information derived from very high-resolution satellites can help to plan new housing developments. In Belgrade, the city administration used these data to detect urban change and informal settlements for establishing a new Urban Master Plan.

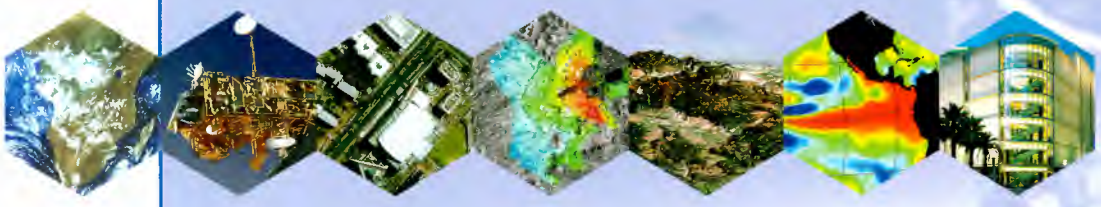
Squatter and informal settlements in selected cities

City	Country	Percent of households
Ulaanbaatar	Mongolia	48.40%
Monrovia	Liberia	42.00%
Lima	Peru	18.80%
Bangkok	Thailand	17.90%
San Salvador	El Salvador	9.50%
Buenos Aires	Argentina	5.70%
Belgrade	Yugoslavia	2.30%
Valparaiso	Chile	1.67%
Kuwait	Kuwait	0.80%
Ljubljana	Slovenia	0.10%

Belgrade – settlement and informal built-up developments detected by satellites

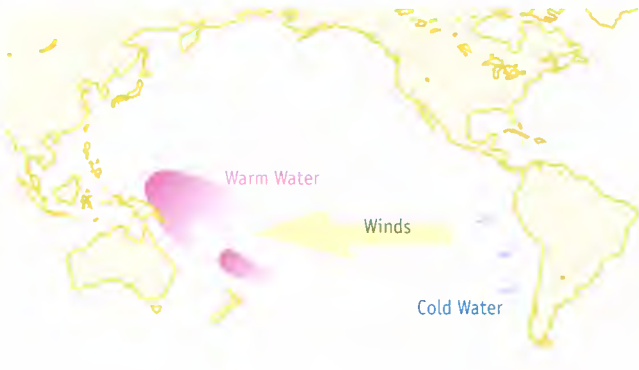


The images show housing developments in Belgrade as seen from high-resolution satellites

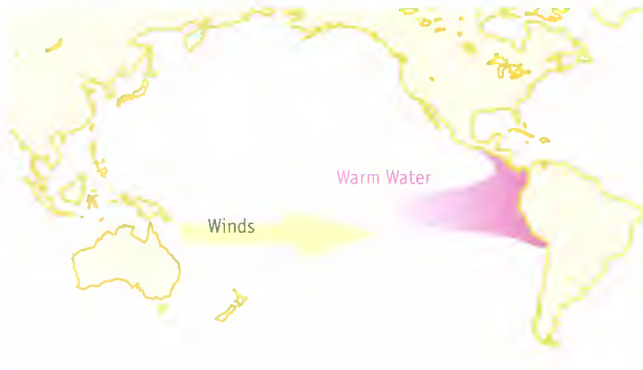


Protecting and Managing the Natural Resource Base

El Niño



Normal conditions



El Niño conditions

Understanding El Niño

El Niño events cause a huge temperature shift in the Pacific Ocean. In normal years warm ocean currents flow west towards the Asian continent and cold nutrient rich water rises along the Pacific coast of the Americas.

In El Niño years this trend reverses. The nutrient rich up-welling water along the coast of the Americas is suppressed, trade winds dwindle and sometimes reverse direction as the ocean temperature warms.

El Niño causes major weather disturbances, from drought and abnormally warm periods, to unusually high rainfall in various locations around the entire planet.

El Niño causes global havoc

D indicates drought

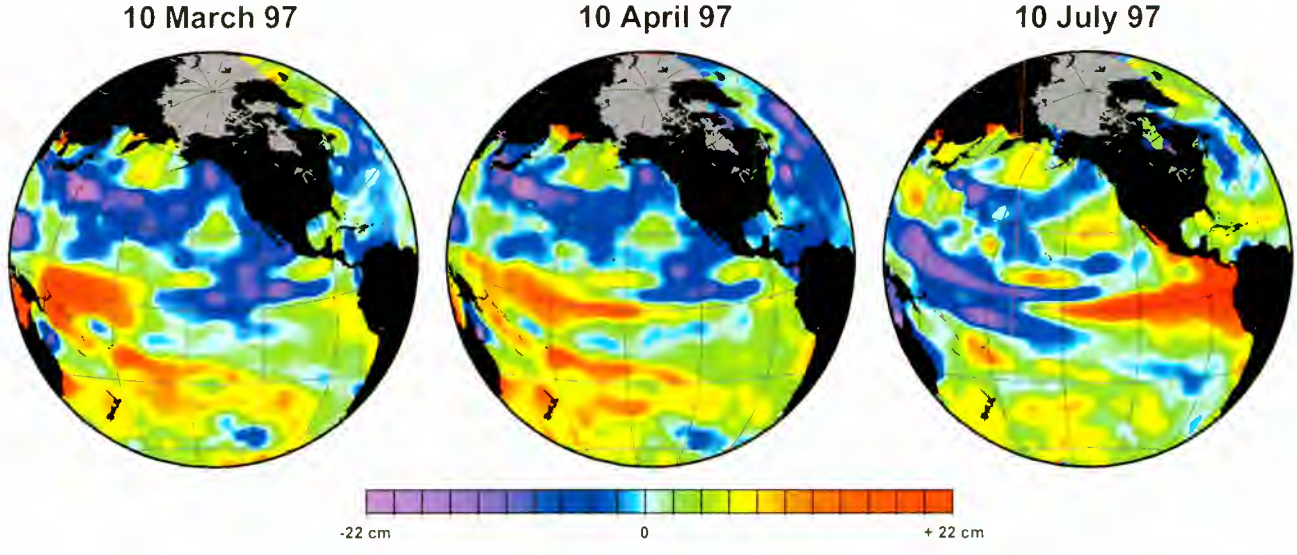
R indicates unusually high rainfall

W indicates abnormally warm periods

Today, satellites assist in predicting El Niño events 3 - 6 months before they actually occur

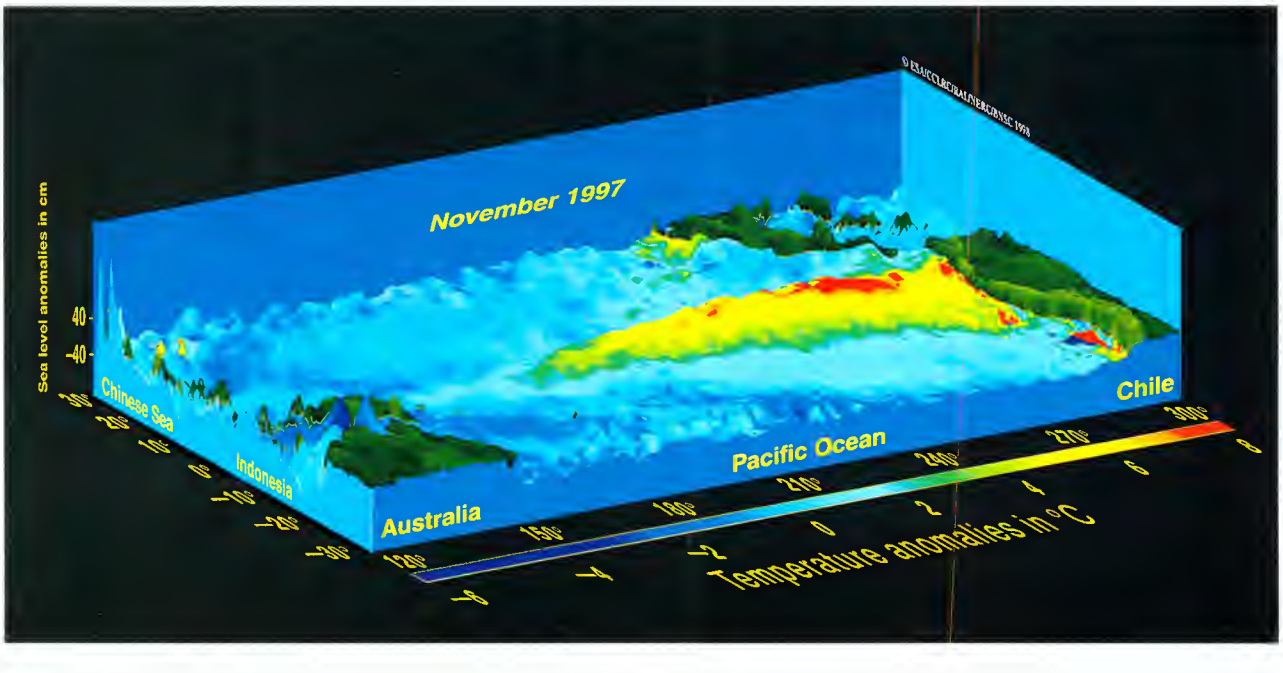
Continuous measurements from satellites, together with surface measurements and data from long term archives, allow accurate detection of the early warning signs of El Niño.

Information on sea level height and temperature anomalies derived from satellites is crucial for predicting El Niño and for the timely adoption of appropriate agricultural practices in Latin America.

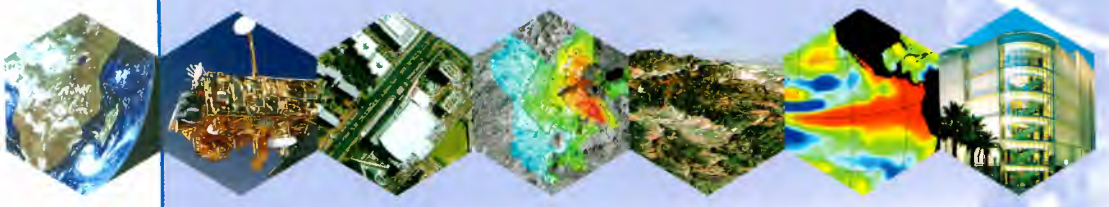


Mean sea level height anomalies during El Niño observed from satellite

El Niño at its peak



Sea level height and temperature anomalies as measured from satellite



Protecting and Managing the Natural Resource Base

Kyoto Protocol – Average of 5.2% emission reduction from 1990 levels, to be achieved by 2012

The Kyoto Protocol and the Marrakech Declaration originate in the Framework Convention on Climate Change, which calls on nearly 40 industrial Annex 1 countries to reduce their emissions of greenhouse gases – primarily carbon dioxide.

Each country is assigned target and reporting obligations

The accord commits Annex 1 countries not only to reduce their carbon emissions but to perform national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases. Accounting of carbon "sinks" – forests, grassland and other vegetation which absorb carbon dioxide – will be a critical element in each country reaching its emission reduction target.

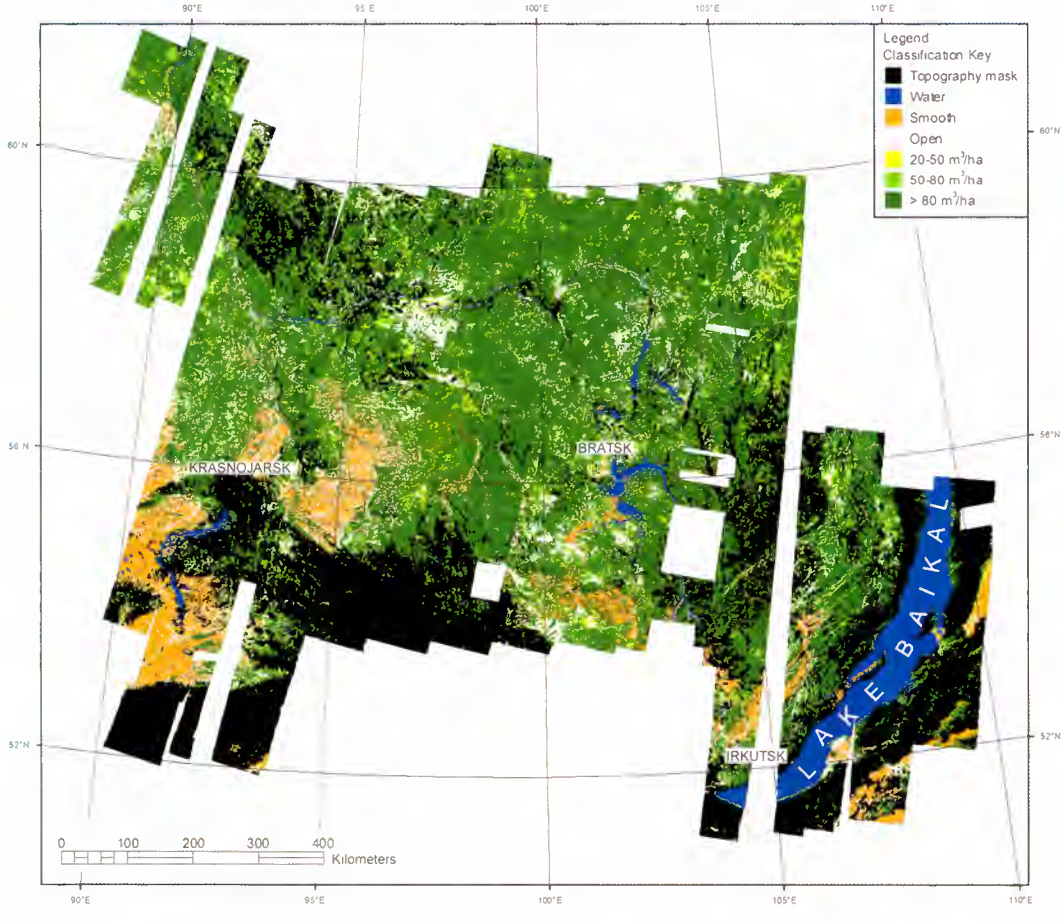
Today, satellites can contribute to Kyoto carbon sink verification

Satellite derived products can be used to verify Annex 1 Country Reports, to quantify above ground biomass stocks and changes therein, to update obsolete forest inventory data and to monitor forest disturbances and recovery.

Data and sensor capabilities have improved significantly over the last decade, with a wide array of optical and radar satellites enabling local to global applications.

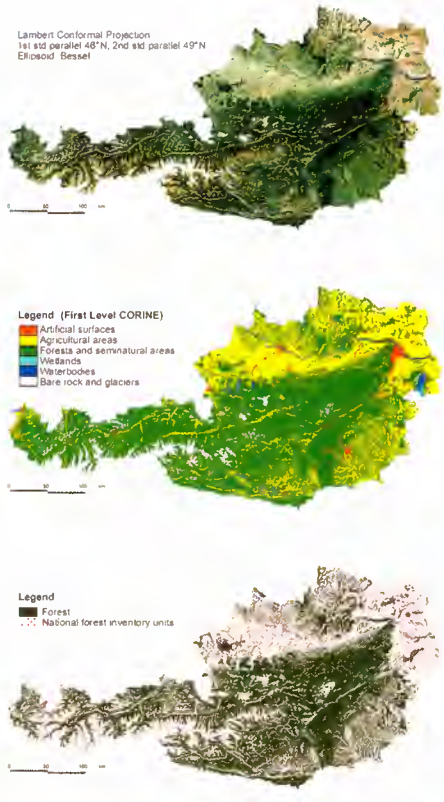
Kyoto carbon sinks – Satellites contribute to regional mapping and national reporting

Forest stem volume and land cover map of Siberia

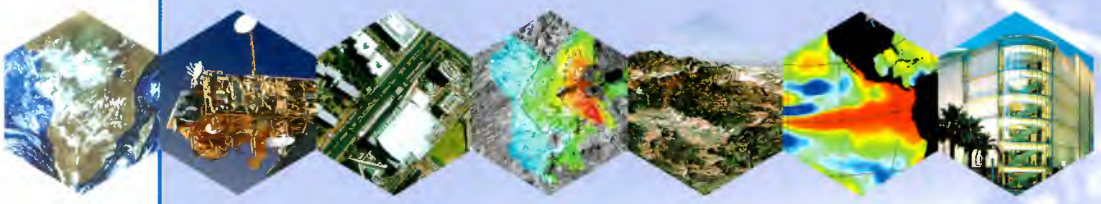


The map of Siberia was produced from over 1400 satellite images – the different green colours represent different forest stem volumes

Austria land cover and forest map



The images show a satellite mosaic and derived land cover and forest maps of Austria



Protecting and Managing the Natural Resource Base

UN Convention to Combat Desertification - Fighting back the expanding deserts

Increased desertification costs about US $ 42bn a year with serious social and economic consequences in the affected zones. In the immediate sub-Saharan Sahel region, experts put the death rate from the related impact on living conditions and food security at 200,000 people per year.

Causes of Desertification

Climate

Wind

Drought

Flood

Human

Overcultivation

Overgrazing

Deforestation

Poor irrigation practices

A billion people at risk

UN experts estimate that the spread of barren land has already had an impact on over 250 million people, and could eventually threaten over one billion.

Desertification around the world

Today, satellites contribute to drought early warning systems for the saving of lives

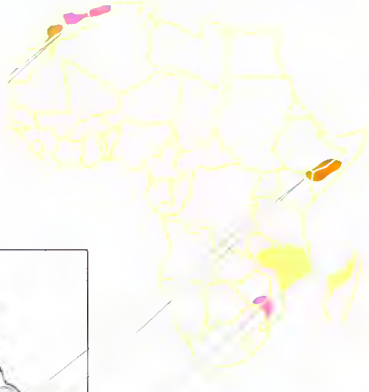
More than 30 years of satellite data enable detection and continuous monitoring of the effects related to desertification. Today these satellites deliver key information for threat assessments and contribute to drought early warning systems operated by the UN and other agencies.

Satellites monitor desertification around the world

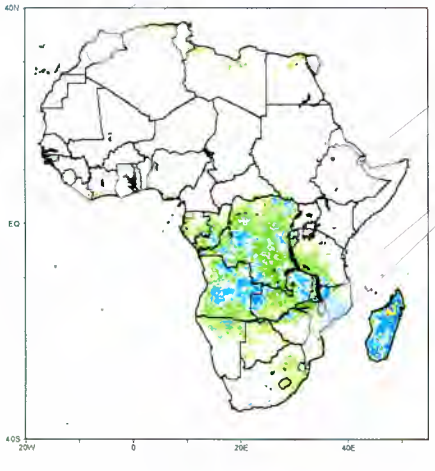
Western Africa: *Satellites contribute to desertification risk zone mapping*

African threat assessment

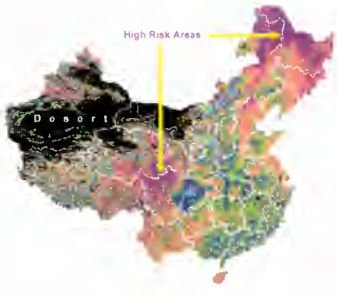
- Heavy precipitation
- Long term drought
- Dryness



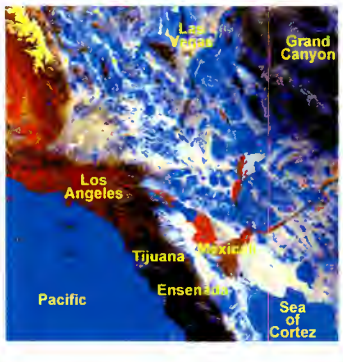
Precipitation estimate



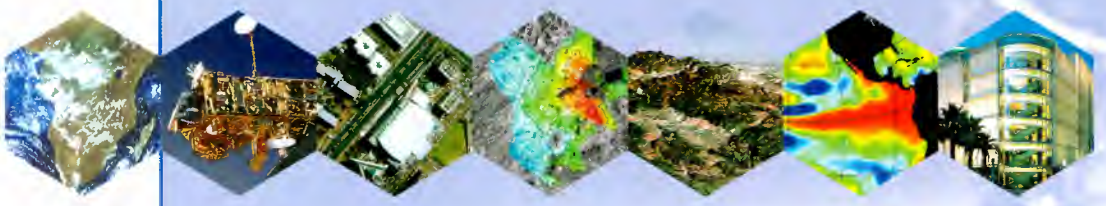
Africa – Famine Early Warning System
Satellite data are combined with data from more than 1000 meteorological stations to generate precipitation estimates and to assess the threat of drought and famine



China
Operational drought detection at an early stage based on satellite data



North America and Mexico
Wind erosion vulnerability map based on satellite data



Sustainable Development for Africa

Africa in today's world – Between poverty and prosperity

When the New Partnership for Africa's Development (NEPAD) was unveiled in July 2001, Africa had already suffered a decline in prosperity with 34 of the continent's nations ranked among the world's least developed countries, compared with 27 in 1996. As of today, only 58% of all African people have access to safe drinking water and half of its population lives on less than US $ 1 per day.

Africa – An indispensable resource base

NEPAD calls for the reversal of this abnormal situation and sets out a strategy for nurturing Africa's resources and using them for the development of the continent, while at the same time, preserving them for all mankind.

Africa's resources – The 4 NEPAD components

Component I
Mineral, oil and gas deposits

Component II
Rain forests

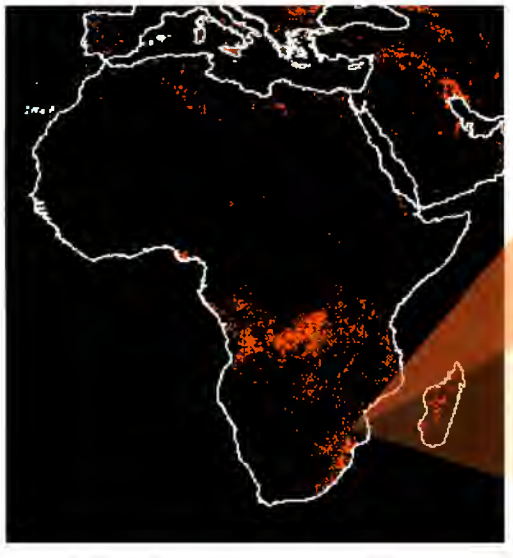
Component III
Natural habitats

Component IV
Africa's culture

Today, information from satellites can be used as real time input for preserving the resources of Africa

From large scale monitoring of the African rainforests to local habitat monitoring, from mineral exploration to cultural heritage site management – information derived from satellites can effectively contribute to the NEPAD components. Much of this information can be supplied in near real time as direct input for decision making.

Fires over Africa



Fire damage assessment

Before

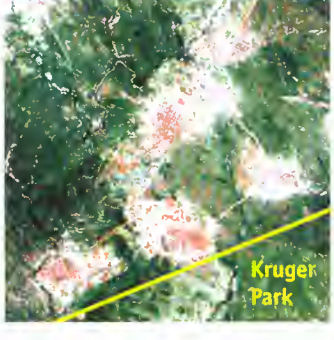
After

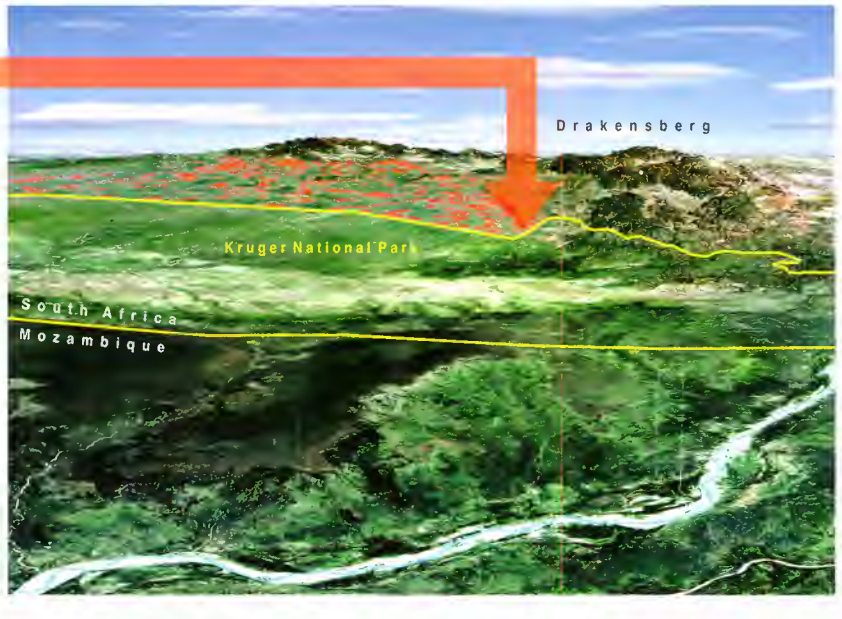
Burnt areas

Burnt areas

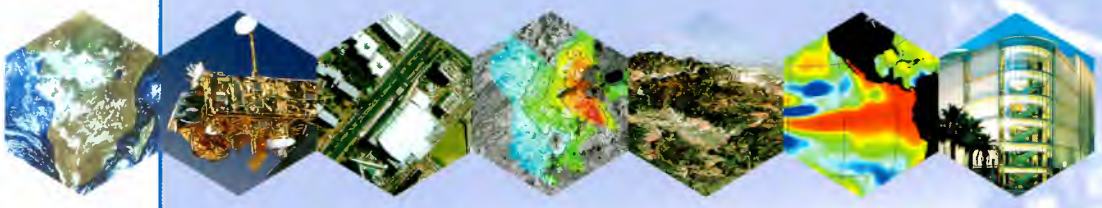
The images show operational hot-spot fire mapping from satellites (World Fire Atlas) on a continental scale and a damage assessment at local scale in the Kruger National Park (South Africa)

Raising awareness – Importance of protecting natural reserves and habitats





Satellite data were used for generating this 3 dimensional view of the Kruger National Park. The images show intact landscapes inside and intense human activities outside the park borders



Sustainable Development of Small Island Developing States

Islands under threat

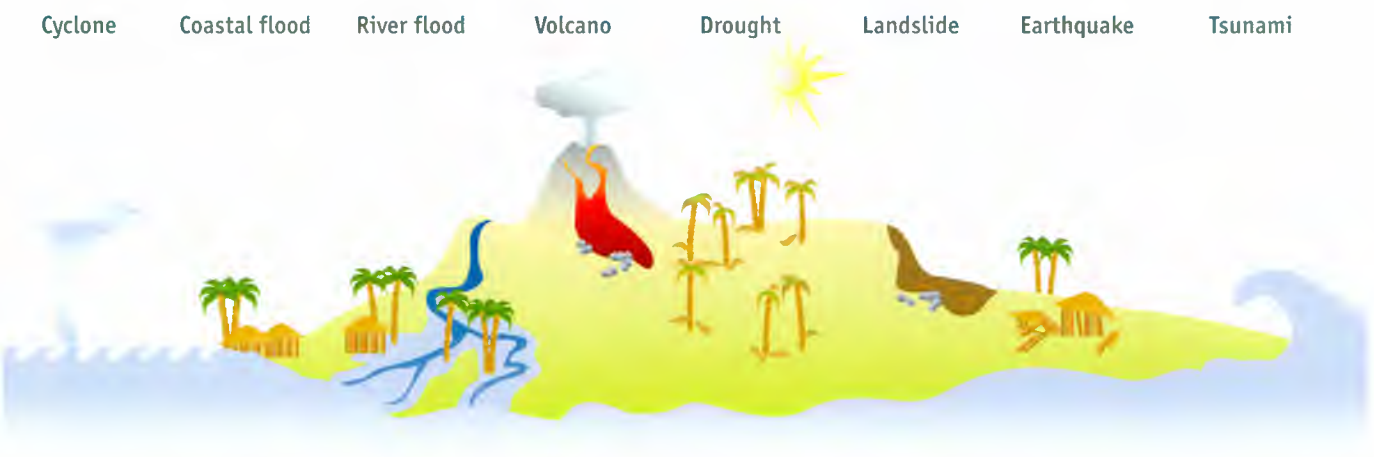
The Small Islands Developing States (SIDS) of the world contribute less than 1% of all global warming pollution, but are suffering disproportionately. The anticipated consequences of global warming for SIDS are expected to be a rise in the sea-level, an increase in climate related extreme events, shortage of freshwater and serious disruption in agricultural productivity.

"Sea-level rise is not a fashionable scientific hypothesis – It is a fact" says President Gayoom of the Maldives

The cost of fighting the consequences of global warming is prohibitively large for the SIDS. For example, the building of a temporary sea wall for one Marshall Island atoll would cost more than double their annual domestic product.

Organisations such as the South Pacific Applied Geoscience Commission (SOPAC) – comprising 18 South Pacific countries – work together with Canada, China, France, Japan, South Korea, the United States of America, the European Union and others to cope with these challenges.

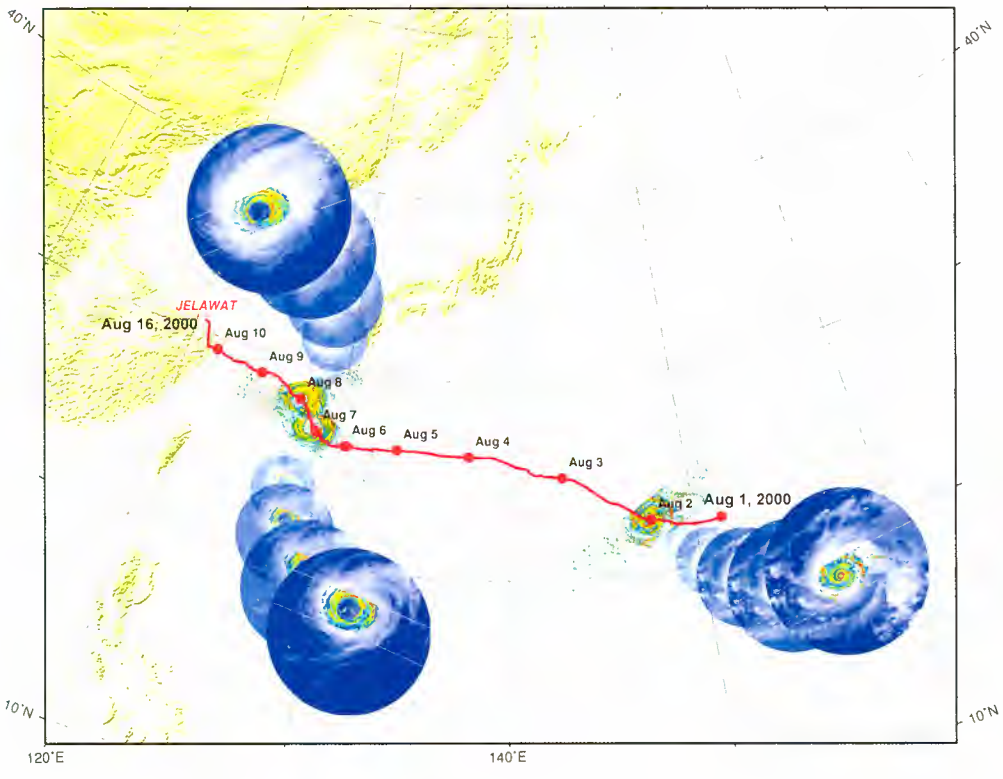
Pacific SIDS - Extreme vulnerability to natural hazards



Today, satellites help to protect the SIDS

Today we can observe and measure the weather, rainfall, ocean temperature as well as sea level rise of a few centimetres directly from space. These satellite measurements can help to predict global climate change, weather anomalies and natural disasters, which may affect small islands.

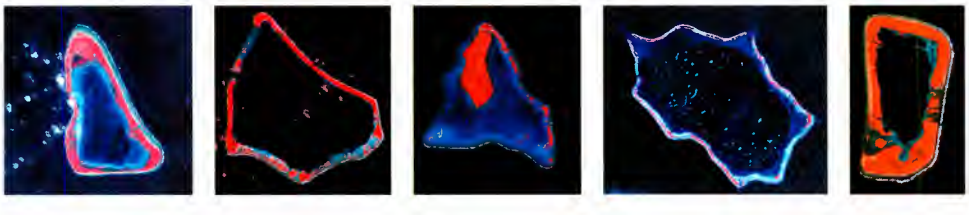
Tracking of tropical storms



Satellite based observation of the Jelawat Typhoon

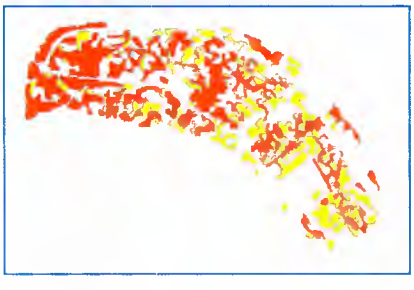
Monitoring of remote islands from space

Higher resolution satellites – "seeing" features as small as single palm trees – can be used for terrestrial monitoring applications related to vegetation, housing and infrastructure mapping.

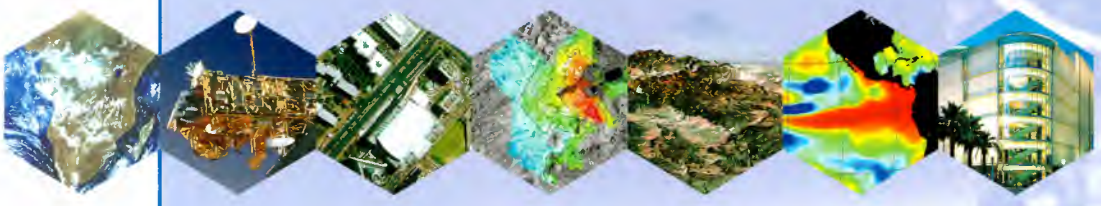


The Pacific islands of Rannawani Kiribati, Manihiki, Aitutaki, Penrhyn, Rakawanga as seen from satellite. Healthy vegetation appears in red and reefs are shown in a light blue colour

Vegetation monitoring in Rita, Pacific Majuro Atoll



Areas in red show the actual vegetation; areas in yellow the loss of vegetation over the last 15 years as observed in satellite and aerial images



Means of Implementation

Implementing Agenda 21

Agenda 21 recognised that implementation of programmes it called for, would require a substantial increase in effort, financial resources, transfer of technology, education and training, and capacity building.

Information for decision making – The International Charter on Space and Major Disasters

The International Charter on Space and Major Disasters, initiated under the auspices of UNISPACE III, can – among many other initiatives – be regarded as a successful response of the space community to the Agenda 21 request. The Charter provides co-ordinated access to space means during times of crisis and supplies information to civil defence and protection agencies world-wide. The Charter was founded by the following agencies:

European Space Agency (ESA)

Centre National d'Etudes Spatiales (CNES, France)

Canadian Space Agency (CSA, Canada)

As of today, the Charter – being an open initiative – has been joined by further participants:

National Oceanic and Atmospheric Administration (NOAA, United States)

Indian Space Research Organisation (ISRO, India)

PURPOSE

"to supply during periods of crisis, to States or communities whose population, activity or property are exposed to an imminent risk, or are already victims, of natural or technological disasters, data providing a basis for critical information for the anticipation and management of potential crises."

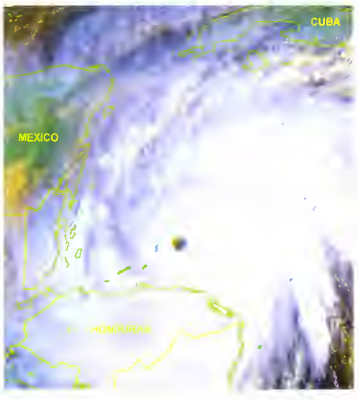
International Charter Space & Major Disasters
Charte Internationale Espace et Catastrophes Majeures

cyclone | tornado | earthquake | volcanic eruption | flood | forest fire | technological accident

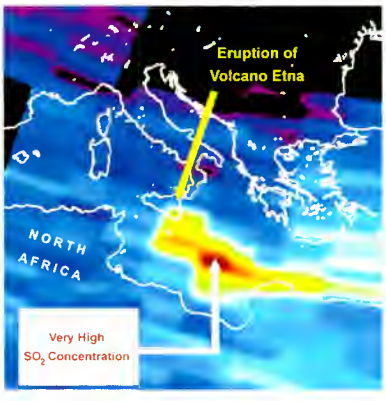
Today, satellites assist in disaster prevention, preparedness, mitigation and relief

Satellites of the participating agencies are truly complementary – covering areas of continental scale down to local scales of a metre. Radar technology allows imaging of the Earth's surface by day and night whatever the weather conditions.

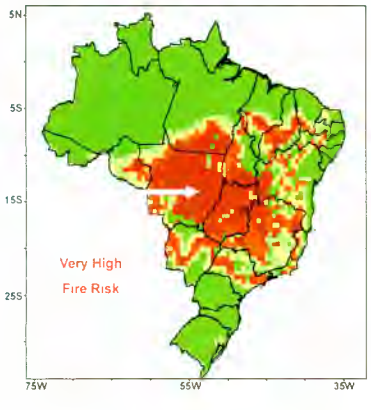
From fires and floods, hurricanes and cyclones to earthquakes and volcanic eruptions – satellites make a vital contribution.



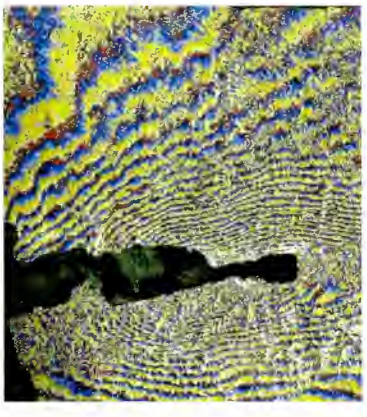
Mexico and Honduras
Satellites observe hurricane development



Sicily and Northern Africa
Satellites detect gases emitted from the volcano Etna

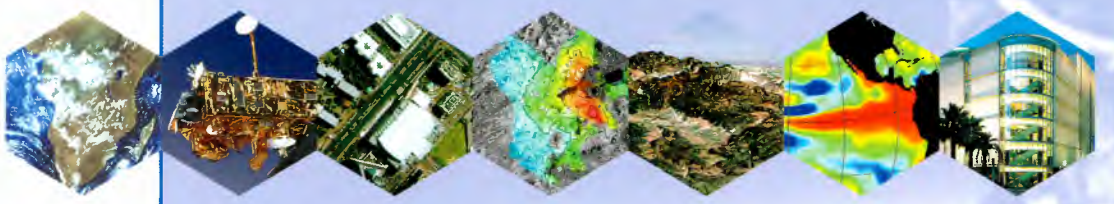


Brazil
Satellite derived fire risk map



Turkey
Earthquake displacement assessment by satellite

Russia
Satellites demarcate flood extent



Committee on Earth Observation Satellites

Committee on Earth Observation Satellites

The Committee on Earth Observation Satellites (CEOS) was created in 1984 and addresses co-ordination of the world's satellite Earth observation programmes run by government space agencies, along with agencies that receive and process data acquired remotely from satellites.

Further information on CEOS can be obtained on the world-wide web: **http://www.ceos.org**

CEOS – IGOS Partnership

CEOS is a key member of the Integrated Global Observing Strategy (IGOS) Partnership. In this partnership CEOS is responsible for the co-ordination of measurements from space.

CEOS Associates

Organisation		Country / Countries
CCRS	Canada Centre for Remote Sensing	Canada
CRI	Crown Research Institute	New Zealand
CSIR	Satellite Applications Centre (SAC)/ Council for Scientific and Industrial Research	South Africa
ESCAP	Economic and Social Commission of Asia and the Pacific	UN
FAO	Food and Agriculture Organization	UN
GCOS	Global Climate Observing System	International Programme
GISTDA	Geo-Informatics and Space Technology Development Agency	Thailand
GOOS	Global Ocean Observing System	International Programme
GTOS	Global Terrestrial Observing System	International Programme
ICSU	International Council for Science Unions	International Programme
IGBP	International Geosphere-Biosphere Programme	International Programme
IOC	Intergovernmental Oceanographic Commission	UNESCO
IOCCG	International Ocean Colour Coordinating Group	International Programme
ISPRS	International Society for Photogrammetry and Remote Sensing	International Programme
NRSC	Norwegian Space Centre	Norway
OSTC	Federal Office for Scientific, Technical and Cultural Affairs	Belgium
UNEP	United Nations Environment Programme	UN
UNOOSA	United Nations Office of Outer Space Affairs	UN
WCRP	World Climate Research Programme	International Programme
WMO	World Meteorological Organisation	UN

CEOS Members

ORGANISATION		Country / Countries
ASI	Agenzia Spaziale Italiana	Italy
BNSC	British National Space Centre	United Kingdom
CAST	Chinese Academy of Space Technology	China
CNES	Centre National d'Etudes Spatiales	France
CONAE	Comisión de Actividades Espaciales	Argentina
CSA	Canadian Space Agency	Canada
CSIRO	Commonwealth Scientific and Industrial Research Organisation	Australia
DLR	Deutsches Zentrum für Luft-und Raumfahrt	Germany
EC	European Commission	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Portugal, Spain, Sweden, United Kingdom
ESA	European Space Agency	Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom
INPE	Instituto Nacional de Pesquisas Espaciais	Brazil
ISRO	Indian Space Research Organisation	India
KARI	Korea Aerospace Research Institute	South Korea
MEXT/NASDA	Ministry of Education, Culture, Sports, Science and Technology / National Space Development Agency of Japan	Japan
NASA	National Aeronautics and Space Administration	United States of America
NRSCC	National Remote Sensing Center of China	China
NSAU	National Space Agency of Ukraine	Ukraine
NOAA	National Oceanic and Atmospheric Administration	United States of America
ROSHYDROMET	Russian Federal Service for Hydrometeorology and Environment Monitoring	Russia
ROSAVIAKOSMOS	Russian Aviation and Space Agency	Russia
SNSB	Swedish National Space Board	Sweden
USGS	United States Geological Survey	United States of America

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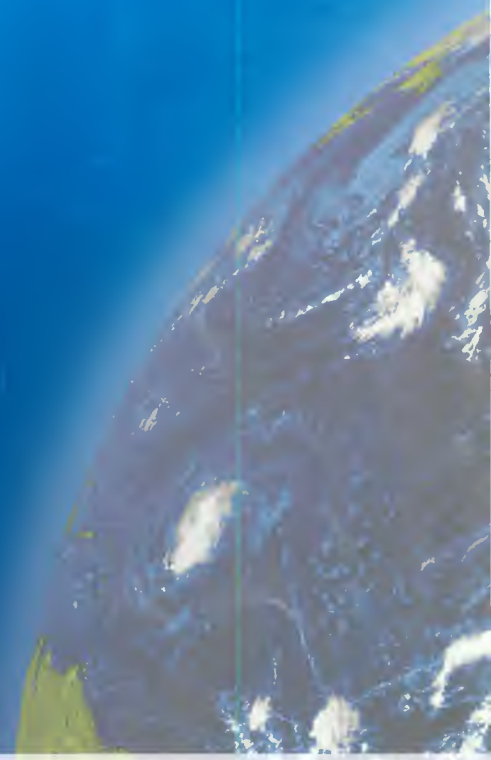
CEOS

Committee on Earth Observation Satellites

Sustainable Development
The Space Contribution

From Rio to Johannesburg –
Progress over the last 10 years



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