THE INTERNATIONAL CHARTER "Space and Major Disasters"

As part of science and technology, this supplement is a teaching aid for the study of the manifestations of the Earth's activity. It is designed to enable pupils to think about the attitude to adopt in the event of a major risk, earthquake or volcanic eruption. The subject may be tackled in connection with current events, be based on the use of documents (photographs, magazines, audiovisual and multimedia documents) or be taught in the framework of activities involving initiation to geography.

PURPOSE

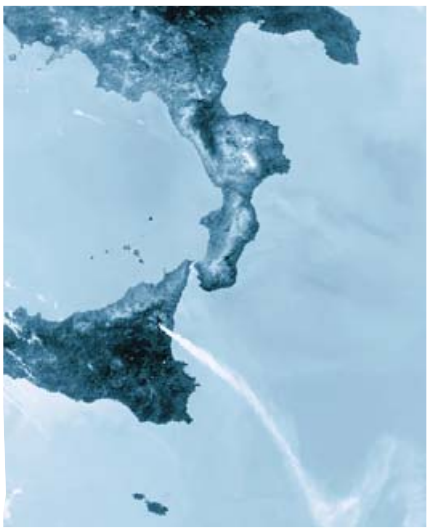
The International Charter aims at providing a unified system of space data acquisition and delivery in the event of a natural or man-made disaster. Each member agency has agreed to provide satellite information, thereby helping to reduce the effects of disasters, particularly on human populations.

MEMBERS

Following the UNISPACE III Conference held in Vienna in July 1999, the European Space Agency (ESA) and the French CNES (national centre for space studies) established the International Charter "Space and Major Disasters". Since then, other countries have become members of the Charter: the Canadian Space Agency (CSA) in 2000, the National Oceanic and Atmospheric Administration (NOAA) in the United States and the Indian Space Research Organisation (ISRO) in 2001, the Argentine Space Agency (CONAE) in 2003 and more recently the Japan Aerospace Exploration Agency (JAXA), in 2005.

OPERATION

Since 1 November 2000, an authorised user has been able to call a single telephone number to request the mobilisation of space and ground resources and obtain data and information on a disaster. Day and night, an operator is available to receive calls and, after checking the identity of the requester, passes the request on to an emergency on-call officer. This person analyses the request and prepares a plan for new data acquisition using available satellites and archive material, taking into account the type of disaster. A project manager will then be assigned to assist the user in processing and applying the data provided.



Etna, ERS-2 image, July 2001

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THE CHARTER IN PRACTICE

In a visible effort at international cooperation, the Charter aims to make space facilities more easily accessible for managing natural or technological disasters. Space technologies for Earth observation, telecommunications, meteorology and global positioning are all of obvious interest for rescue, civil protection and security bodies, in order to assist them in providing the best help to disaster victims.
The Charter is composed of a preamble and eight articles.

Interview with Jérôme Béquignon, Programme Coordinator, Executive Representative of ESA (European Space Agency) in the International Charter "Space and Major Disasters".

La Documentation par l'image: What role does ESA play in the Charter?
ESA was one of the three founding members of the Charter in 2000, along with the CNES (French national centre for space studies) and the Canadian Space Agency. Like the other members, ESA contributes to the system. It makes available the ERS-2 and ENVISAT satellites launched in 1995 and 2002 respectively. Both these satellites use Synthetic Aperture Radar (SAR) which allows images to be taken through cloud cover and at night-time. ESA takes part in the round-the-clock monitoring through an operator located at the Frascati site in Italy. In addition, ESA provides an emergency on-call officer for a period of one out of every eight weeks, as well as a project manager in the event that the Charter is activated in Europe or by a European requester.

La Documentation par l'image: How did ESA intervene at the time of the tsunami in December 2004?
On 26 December, the emergency on-call officer was from India. ESA contributed in several ways. Firstly ESA program-

THE EUROPEAN SPACE A

The ESA Education Department is in charge of developing educational materials for classrooms to increase the interest of primary and secondary school pupils in science and technology. These tools are based on space projects conducted by ESA (exploration of the solar system and the universe, Earth observation, telecommunications and navigation, manned spaceflight, launchers, technology). Teachers are involved in their design so that they are in line with educational requirements. The materials are intended for teachers in all disciplines.

They are offered in several languages and may be used freely in the classroom.

med its own satellites to cover India and provided images starting on 27 December. In total some 100 images from the European satellites ENVISAT, ERS-2 and also Proba were acquired over the following three weeks. Secondly ESA asked its partners within the scope of the GMES (Global Monitoring for Environment and Security) Earth Watch programme to process the images, adding further geographical detail such as town names, and to also highlight the areas which seemed the worst affected, as required by the coordinating aid agencies. The European Space Agency thus played its role as a Charter member at the time of the disaster, offering support to civil protection units, specialised UN organisations and various NGOs, such as the German Red Cross.

La Documentation par l'image: Where was ESA most recently involved?

In May 2005, during the floods in Romania, ESA provided satellite images that were used to produce maps showing the extent of the affected region. Such maps are very useful when disasters affect extensive areas, as they indicate where aid should go first. In this example concerning floods, the maps can also show where ground resources such as pumps should be positioned, thus allowing the excess water to be removed in the quickest possible time. ESA also made a contribution at the time of the severe storms in southern Sweden in February 2005, a disaster that took a number of lives and caused serious damage to forests and to electrical and airport equipment.

La Documentation par l'image: Are there other bodies or countries that want to become members of the Charter and if so, which ones? What are their reasons for wishing to join?

The latest country to ratify the Charter is the Japan Space Exploration Agency, in February 2005. The DMC (Disaster Monitoring Constellation), which combines the space resources of the United Kingdom, Algeria, Turkey and Nigeria, has expressed interest in joining the Charter. A discussion is also under way with China, a country that has the most ambitious space programme for Earth observation, including the launch of numerous satellites planned in the coming years. In every case, the aim is to increase the resources possible that can be used for disaster response and thus maximise the benefits that could be provided by the Charter. ■

International Charter "Space and Major Disasters"

EXTRACTS

Article I - Definitions

The term "natural or technological disaster" means a situation of great distress involving loss of human life or large-scale damage to property, caused by a natural phenomenon, such as a cyclone, tornado, earthquake, volcanic eruption, flood or forest fire, or by a technological accident, such as pollution by hydrocarbons, toxic or radioactive substances . […]

The term "crisis" means the period immediately before, during or immediately after a natural or technological disaster, in the course of which warning, emergency or rescue operations take place.

The term "space data" means raw data gathered by a space system […], and transmitted or conveyed to a ground receiving station;

The term "parties" means the agencies and space system operators that are signatories to the Charter. […]

Article II – Purpose of the Charter

In promoting cooperation between space agencies and space system operators in the use of space facilities as a contribution to the management of crises arising from natural or technological disasters, the Charter seeks to pursue the following objectives:

- supply during periods of crisis, to States or communities whose population, activities 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;
- participation, by means of this data and of the information and services resulting from the exploitation of space facilities, in the organisation of emergency assistance or reconstruction and subsequent operations.

Article III – Overall organisation of cooperation

[…]

3.4 The authorities and bodies concerned in a country affected by a disaster (beneficiary bodies) should request the intervention of the parties either directly through the rescue and civil protection, defence and security bodies of the country to which one of the parties belongs or of a State belonging to international organisations that are parties to the Charter (associated bodies) or where appropriate via a cooperating body acting in partnership with an associated body. […]

Article VII – Entry into force, expiry and withdrawal

[…]

7.2 […] the Charter shall remain in force for a period of five years from the date of its entry into force, and shall be automatically extended for subsequent periods of five years. […]

GENCY (ESA) AND EDUCATION

ESA has two education websites:

► The "Education" website, www.esa.int/education, which offers on its "teachers/classroom tools" pages all the educational materials developed or coordinated by the Department – websites, booklets, CDs, DVDs, etc.

► The "Kids" website, http://kids.esa.int (intended for children aged 8-12 if they consult it in their mother tongue), in six languages, offers many short articles on space. New extracts from the main ESA website are adapted and posted on it every week. Don't forget ESA's main website, www.esa.int, which will tell you all about ESA, its programmes and its achievements.

In the field of Earth observation, ESA offers teachers "Eduspace" at www.esa.int/education/eduspace. The website is free of charge, available in eight languages (by end-2005), with registration necessary to access all the data. It discusses global changes (atmosphere, oceans and land), monitoring disasters (cyclones, earthquakes, floods, volcanoes, marine oil spills) and the principles of remote detection and devotes a chapter to Europe (cities, the Alps, weather) and Africa (continent, cities and landscapes). Leoworks image processing software for the class can be downloaded free of charge.

For further information on ESA educational activities:

• Write to the Education Department, ESA, 8-10 rue Mario-Nikis, F-75738 Paris Cedex 15 or send an email to: education@esa.int

• Subscribe to the newsletter Edunews (in English) by request at education@esa.int (specify "paper version" or "electronic version"). Don't forget to send us your comments on these information sheets and our tools!

To go into greater depth in the classroom

SATELLITES AND SATELLITE IMAGES

➤ Located about 35,800 km from the Earth above the Equator, **geosynchronous satellites** orbit at the same speed as our planet and remain in a permanent vertical position over the same place. They enable continuous monitoring of a region of the globe and can be used as either communication satellites or in monitoring the weather such as performed by the satellite 'Meteosat'.

➤ **Low-earth orbit satellites** revolve around the Earth at lower altitudes (around 500-800 km) going over the poles and passing over any given point of the Earth at the same time every few days. In this way, they sweep across the entire surface of the globe. They play a part in providing observation and knowledge of the Earth, like the French satellite SPOT or the European satellite ENVISAT.

➤ Two types of remote sensor are used aboard satellites.
– **Multi-spectral sensors** measure the radiation reflected and emitted by the Earth. They are capable of recording certain wavelength ranges separately and thus providing an image of the Earth's surface for both the visible and infrared spectra.
– **Radar** sensors operate in conjunction with a transmitter that emits a train of waves towards the Earth's surface, which are then transmitted back in the form of echoes. Thus, they can determine, for example, the altitude of a point on the surface of the globe by knowing the time it takes for a radar wave to travel to the point and back again.

➤ The images obtained from the surface analysed by the sensor vary depending on the altitude of the satellite and the type of device that receives the radiation. Radiometers, spectrometers and other multi-spectral sensors measure the radiation reflected by each part of the covered surface and form spots or pixels. The eventual image produced by the satellite is made up of millions of pixels and is sent in a digital format from a transmitter situated on the satellite to a base station on the ground. The visualisation of a **satellite image** consists in assigning a level of grey to the digital value of each pixel, where the intensity varies according to the particular value. To create an image in colour, three images are required in levels of grey. The three images corresponding to wavelengths of red, green and blue are combined to create what is called a "true colour" image.
The term "false colours" is used when producing images created from a different set of three wavelengths. The most common images in "false colours" discard the wavelength corresponding to blue and instead use near-infrared, red and green. For example, the SPOT satellite records three images of the same area at every pass. Its XS1 sensors pick up green rays, XS2 red rays and XS3 near-infrared rays. However, the colours obtained on these coloured compositions of satellite images do not usually correspond to the colours observed by the human eye.

For each specific application, the choice of processing must be suited to the image. Consequently, there are as many types of processing as there are uses. As satellite coverage enables pictures to be taken at different periods, it is possible to measure the evolution of the surfaces under consideration not just over a geographical frame but also over time.
Thanks to the reception of satellite data, a navigation system such as GPS (Global Positioning System) or Galileo, the future European system, can measure ground levels to within a centimetre. These measurements when taken over time periods can prove very useful in trying to predict landslides or earthquakes. Ongoing observation of the Earth by satellites makes it possible to detect active volcanoes,

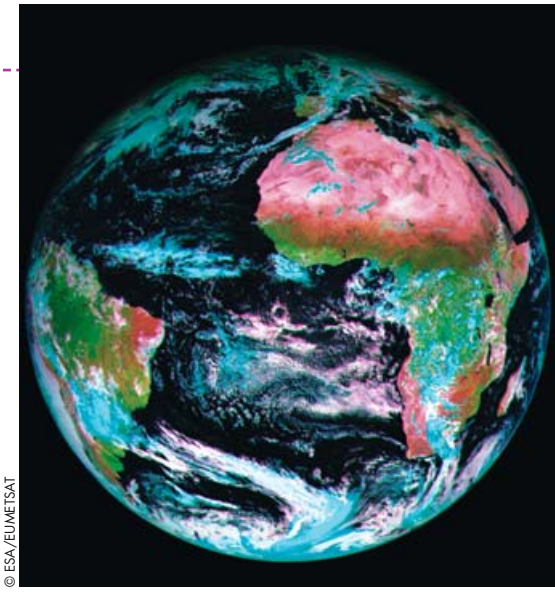

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Image of a portion of the Earth observed by the weather satellite MSG-1. This image, in "false colours", distinguishes the oceans and desert areas from those covered with vegetation.

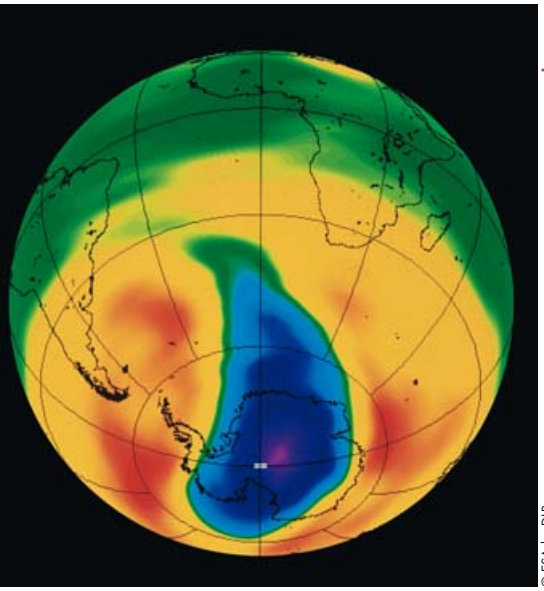
and also watch over threatened areas by monitoring dust plumes and gas projected into the atmosphere.

Modern technologies also permit the detection of wild-fires from infrared imagery. All the satellite data can be collected automatically from ground stations and then distributed in real time through email networks to laboratories for analysis.

TEACHING SUGGESTIONS

➤ The proposed worksheets are designed to help pupils discover for themselves the International Charter website located at the following address: **www.disasters-charter.org/main_f.html** (website in French and English).

➤ It is therefore an opportunity to check on pupils' skill in the use of certain multimedia tools and the internet or in modern languages through documentary research on the study of major risks and the conditions for their prevention.
As part of training in the use of information and communication technologies, these worksheets offer an opportunity to discuss and check the following items:
"Mastery of the basics of computer



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The "hole" in the ozone layer, image in "false colours" from the ERS-2 satellite.

technology."
"Adopt a socially responsible attitude towards the information provided by the internet."
"Research and documentation using a multimedia product (internet site.)"
"Understand and interpret a text in a foreign language."

PROPOSED ORDER

➤ For the first worksheet, the pupil requires access to the various pages of the Charter's website to answer the questions. The aim is to explore the site and gain a basic understanding of the goals of the Charter. This worksheet can be used along with Poster 3 of *La Documentation par l'image* no.149 on natural disasters ("Les Catastrophes naturelles", in French).

➤ The second worksheet focuses on the website page "Activating the Charter". The pupil must be able to go to the page from the table of contents, and then, using the mouse, go through the diagram to discover the various steps in the activation process and find the answers to the questions.

➤ The third worksheet enables more in-depth study of satellites and how the data from satellite images is interpreted. It can be supplemented by work on the worldwide distribution of earthquakes. Some websites, such as the Réseau national de surveillance sismique in France (http://renass.u-strasbg.fr/), the CSEM (Centre Sismologique Euro-Méditerranéen) in Europe (http:// www.emsc-csem.org/) or the USGS (United States Geological Survey) in the world (http://neic.usgs.gov/neis/qed/qed.html) communicate daily the list of earthquakes that occurred in the world over the past 24 hours. The site also communicates the approximate locations of these earthquakes on a planisphere. In the classroom, pupils can then locate each earthquake on a wall map (using its latitude and longitude). If this is done once a week, for example, over a period of 2-3 months, a map of worldwide earthquake distribution can gradually be developed and perhaps related to that of the volcanoes situated on the earth's tectonic plates.
In the absence of available computers for the pupils or other technical problems, the teacher may print out the pages corresponding to each worksheet ahead of time and the pupils can then use them to answer the questions.

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WORKSHEET ANSWERS

Teaching sheet 1

1. Charter: fundamental rules of an official organisation.

2. a) It entered into force in November 2000. **b)** Canada, France, India, Argentina and Japan have ratified the Charter, along with ESA's Member States through ESA. **c)** ESA stands for European Space Agency. **d)** In the event of a natural disaster, ESA can implement space facilities for observation, meteorology, positioning technologies, telecommunications and television broadcasting.

3. "Natural or technological disasters" designates a situation of great distress involving loss of human life or large-scale damage to property caused by a natural phenomenon, such as a cyclone, tornado, earthquake, volcanic eruption, flood or forest fire, or by a technological accident, such as pollution by hydrocarbons, or toxic or radioactive substances.

4. b) It was activated on 26 December 2004. The magnitude of the earthquake was 8.9 on the Richter scale. The proposed animations show satellite images of the region of the tsunami.

Worksheet 2

1.

1 : 
2 : 
3 : 
4 : 

5 : 
6 : 

2. They use the telephone.

3. a) They are available 24 hours a day, 7 days a week. **b)** They are available because a natural or technological disaster can occur at any time.

4. a) They designate space facilities (satellites). **b)** They are transformed into images.

Teaching sheet 3

1. Satellite: a body that gravitates around a planet or star.

2. a) A: low-earth orbit satellite; B: geosynchronous satellite. **b)** A; B.

3. Black - cities; blue – canals of the Nile delta; green - vegetation; yellow - deserts.

WORKSHEET 1

Family name _____

First name _____

Class _____

The "Space and Major Disasters" Charter

1 Look up the definition of the word *Charter* in the dictionary and write it down.

.....

2 Use the internet address given by your teacher to find the homepage of the International Charter "Space and Major Disasters" (in French and English) and then answer the questions.

a) In what year did the Charter enter into force?.....

b) Name two countries whose space agencies signed the Charter.

.....

c) What does the acronym "ESA" stand for? .....

.....

d) How can information be obtained, through the Charter, when a natural disaster occurs?

.....

.....

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Typhoon in South Korea, ENVISAT image

3 In the left-hand column, use the mouse to place the cursor on the "The Charter". When you access this new page, you will find the full text of the Charter signed by the various countries. Look for the definition of "natural and technological disasters" given in the Charter and copy it out or translate it.

.....

.....

.....

4 In the left-hand column, click on "The Charter in Action". On this new page, you will find information on "Charter Activations Around the World".

a) What was the latest disaster recorded? Fill out the chart.

Type of disaster	Location (country)	Date of activation of the Charter

b) What was the date on which the Charter was activated at the time of the tsunami in Southeast Asia? Fill out the chart

.....

.....

What was the magnitude of the earthquake associated with this tsunami?

.....

.....

WORKSHEET 2

Family name _____

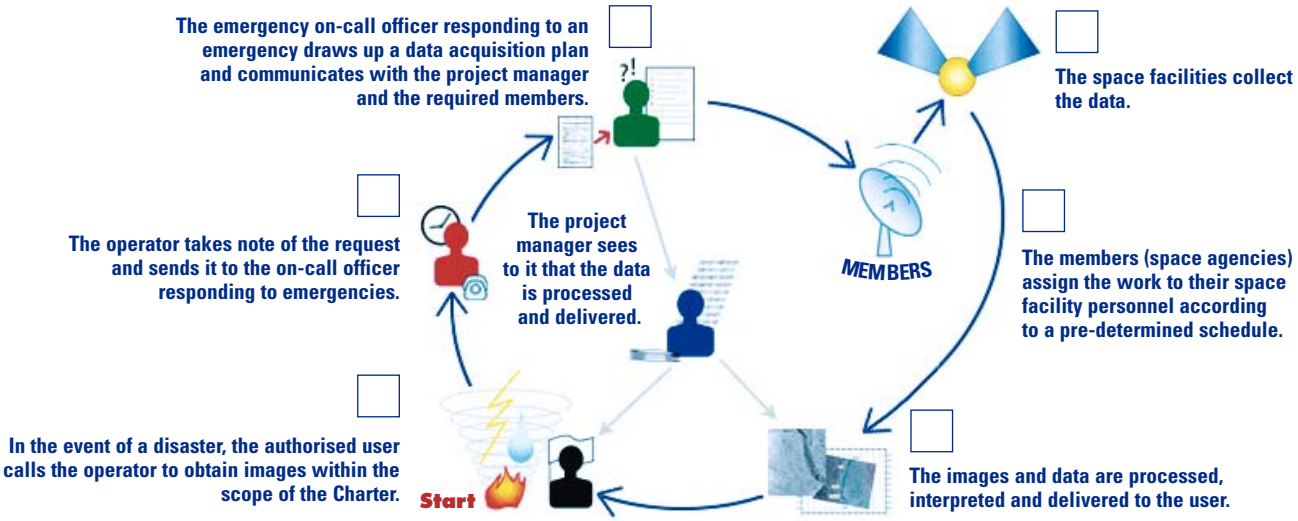
First name _____

Class _____

"Activating the Charter"

Use the internet address given by your teacher to find the home page of the International Charter "Space and Major Disasters" website (in French and English). Click in the left-hand column on "Activating the Charter". On this page, you can observe the chart that represents the process set in motion when a country in crisis calls the Charter. Move your mouse onto the diagram to follow the steps of the process and then answer the questions.

1 On the diagram below, indicate by numbers the order of the various steps.



2 Step 1

What means of communication do authorised users employ to call the Charter services?

.....

3 Steps 2 and 3

a) Complete the following sentence by checking the two correct answers among those presented below.

The operator and the emergency on-call officer are available:

❑ only in the morning ❑ 24 hours a day

❑ Mondays through Fridays only ❑ 7 days a week

c) In your opinion, why? .....

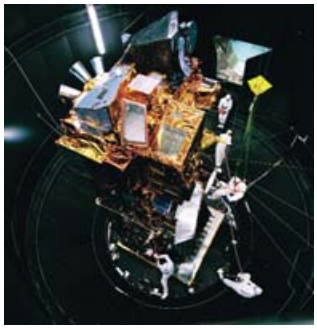
.....

4 a) What does the icon  in the diagram designate?

.....

b) What is the data from satellites transformed into?

.....



ENVISAT

WORKSHEET 3

The Earth seen from space

Family name _____

First name _____

Class _____

1 Look up the definition of the word *Satellite* in the dictionary and copy it out.

.....

2 Read the text below carefully.

There are two types of satellites.
– Geosynchronous satellites: located at about 36,000 km from the Earth above the Equator, they orbit at the same speed as the Earth and therefore "hover" constantly over the same place.
– Low-earth orbit satellites: closer to the Earth, they go over the poles and pass over a given point of the Earth at the same time every few days. They sweep across the entire surface of the globe.

a) Observe the two satellites on the document opposite, then specify to which type of satellite each one corresponds.

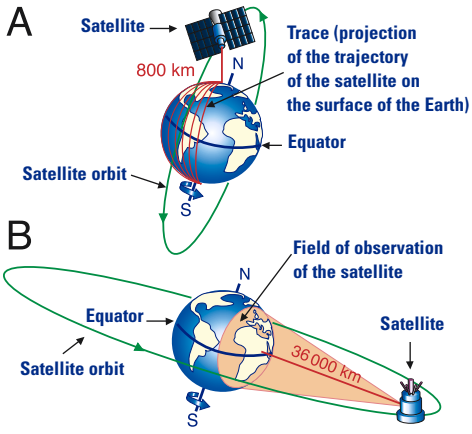
A : .....

B : .....

b) Which one enables observation of the whole Earth in a few days? .....

Which one transmits information on a specific region?

.....



3 The images of the Earth provided by satellites may be in "false colours", i.e. the colours of these images do not correspond to those observed by the human eye.

Compare the satellite image and the photograph of the Nile delta. Determine what the "false colours" correspond to and fill in the chart below.

Photograph in "true colours" taken from the space shuttle Atlantis

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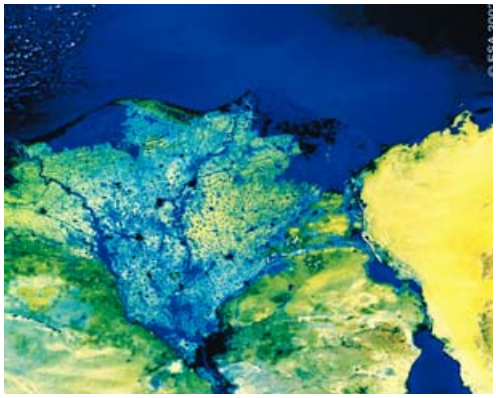

ENVISAT satellite image in "false colours"

© ESA

"False colours" of the ENVISAT image	Geographical region
Black	.....
Blue	.....
Green	.....
Yellow	.....

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THE INTERNATIONAL CHARTER

"SPACE AND MAJOR DISASTERS"

FREE SUPPLEMENT

esa Nathan