BNSC's 'Window on the World' CD-ROM

In this course, we will use this CD-ROM as a teaching aid, reinforcing many of the ideas and practical techniques that we will meet in the lectures and practicals. You should consider it as an interactive textbook accompanying this part of the module. We will mainly be interested in its Education aspects (we will ignore Business aspects for now), specifically the ''Learn about Earth Observation' section. The Learn about Earth Observation Launchpad includes the following modules or 'topics':

Q. How do I access it?

1. On the Network

The BNSC Earth Observation CD-ROM can be accessed on the Brunel University internal network, via the Geography & Earth Sciences Software. To access it the first time, you should go to the **Departmental Software** menu and select **Install Geography software**. This will then reinstall the full set of Geography & Earth Sciences. Thereafter, it will permanently appear within your Geography & Earth Sciences courseware folder on your H:/ account.

On clicking on the CD-Rom, you will be presented with a text cover sheet. Click on the highlighted **Explore** link to open the package.

2. On your home PC

If you have a PC with Windows 95 (or a Mac with the Mac OS System 7.5), then you can install a copy of the CD-Rom on your PC. If you ask the Module Leader, then he will arrange for you to have a copy of the CD-Rom for the duration of the module. It is a teaching resource, and therefore, should be returned at the end of the remote sensing section of the module. Your computer must have internet access to access web sites, but it can be used as a stand-alone resource as well.

About the CD-ROM

This CD-ROM is essentially 2 CDs in 1, with sections dealing with Business and Education. The information is arranged in a tree-like structure with hyperlinks connecting one area to another so that it is easy to move around. The lefthand / vertical menu throughout the Education section has been organised so that the buttons containing 256 colour sketches signify general subject matter, whilst the buttons containing photographs will lead to actual case studies. The general idea behind these buttons is that the user is encouraged to 'click and see'. Some browsers will display a word bubble identifying the page title when the mouse pointer is placed over each button. The support buttons (across the top of the screen) remain constant to indicate that you are in the Education area, although backgrounds may change to signal different sections.

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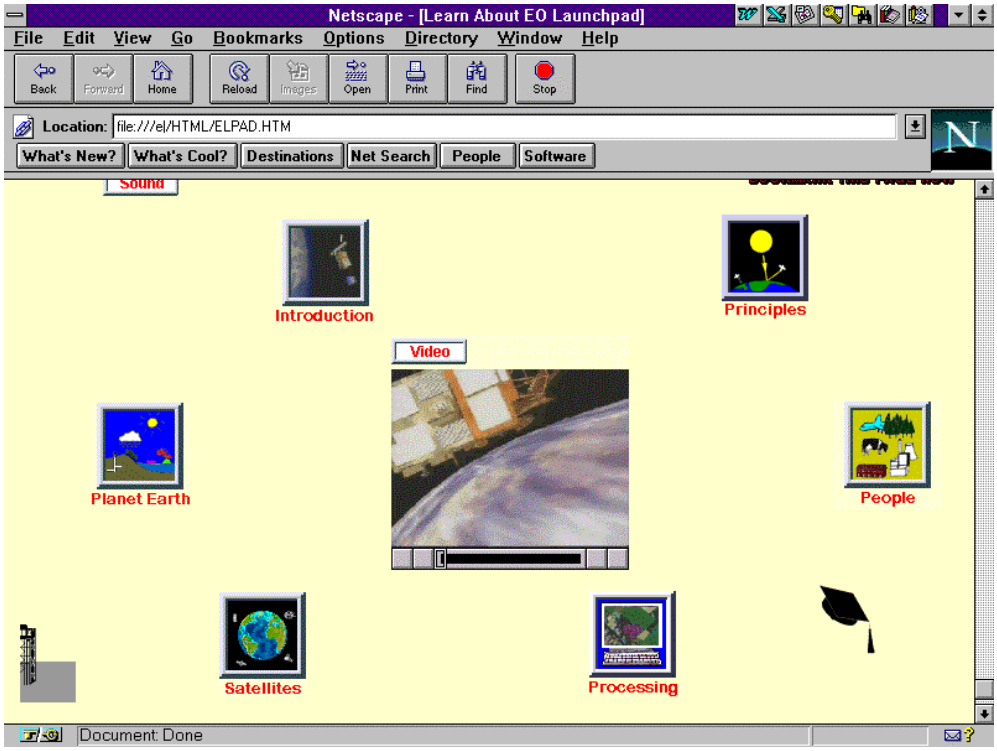


Several of these 'modules' are directly relevant to the taught and practical course, and they are discussed in more detail below.

Principles

The purpose of this topic is to explain the principles of Earth observation by Remote Sensing. Here, the term Remote Sensing means obtaining information about the Earth's surface or atmosphere from a distance. Most of the instruments used in Remote Sensing record electromagnetic energy.

There are 4 sections to this topic.

1. In the section, 'Energy and The Electromagnetic Spectrum', some of the principles or remote sensing are explained.
2. The section 'Getting Into Orbit' explains how satellites are placed in orbit.
3. In 'Satellites and Sensors Monitoring Planet Earth' the most important satellite missions are described and the main types of sensors explained.
4. For a quick comparison of three of the main image types (and associated case study material) click on 'Comparison of three Sensors'.

Sections 1 and 3 are most relevant to the Introductory lecture in the Remote Sensing section of the module and indeed the lecture is designed around these two sections so you should ensure that you have completed these by Week 2.

Section 4 will be used during the Practical in Week 1.

Planet Earth

In this section there is a general introduction explaining some of the ways we can monitor the Earth and a number of sub-sections that include background information and case studies That illustrates the use of remote sensing. The sub-sections are:

- Lithosphere (Solid Earth)
- Atmosphere (Weather and Climate)
- Hydrosphere (ice, fresh water and oceans)
- Biosphere (ecosystems)
- Environmental Change
- Hazards and Disasters

People

In this section a general introduction explains the relevance of remote sensing to economic Activities. A number of sub-sections include background information with some case studies illustrating the use of remote sensing. The sub-sections are:

Farming	Fishing	Forestry	Mining
Transport	Energy	Making Maps	Settlement and the Built Environment

Satellites

Satellites are probably known to most people in association with the tele-communications industry but you may not know of the many other types of satellites that are in orbit around the Earth and the spacecraft that are sent to distant parts of the Solar System. In this section the main uses of satellites are introduced:

Communications	Space exploration	Military applications
Predicting the weather	Earth observation	Global positioning

Processing

This section introduces concepts concerning the way raw image data from a sensor are processed; including

⇒ Image correction
⇒ Image enhancement
⇒ Information extraction
⇒ Integration of image data into Geographical Information Systems (GIS)
⇒ The basic principles of Global Positioning Systems (GPS)

During the IDRISI for Windows practicals, you will have practical training in image correction, image enhancement and image extraction, so you should read these sections carefully to prepare.

Finding your way around

Finding your way around this CD-ROM can at times be confusing. For this reason, you should **Bookmark** the **Contents** page, which you can load via the **Search** button along the upper menu (Note the Contents button on this upper menu gives only a very general contents listing).

In addition, support options on the CD-ROM also include:

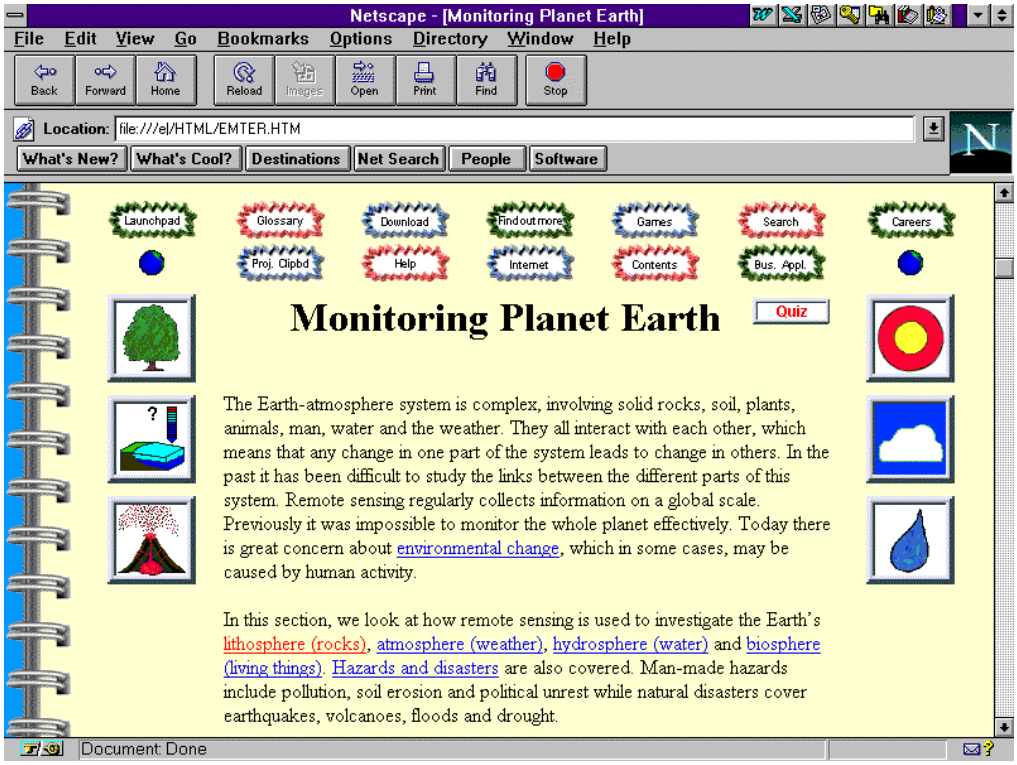
* Launchpad - return to the Education Launchpad
* Glossary - explanation of terms
* Project Clipboard - useful to copy and paste information and images from the CD.
* Download Zone - for additional software files
* Help
* Internet - web addresses and hotlinks
* Contents - also a Keyword Search
* Search

Practical A: What's the use of Remote Sensing ?

Click on the 'Planet Earth' topic.

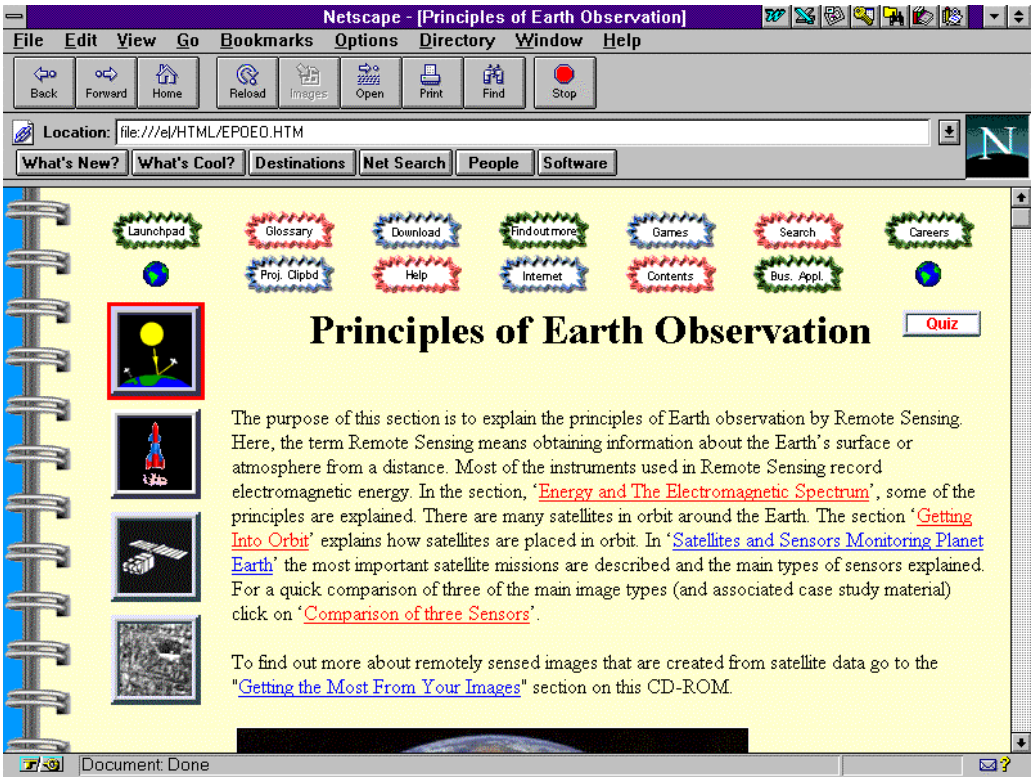
This provides a brief overview of some earth Observation applications in several areas of Geography & Earth Sciences.

Click on **ONE** of the boxes (or its accompanying underlined title in the text, e.g. Biosphere) to view these applications in an area of your particular interest. We'll outline some further applications of remote sensing in the 'Remote Sensing of the Environment' lecture in Week 2.

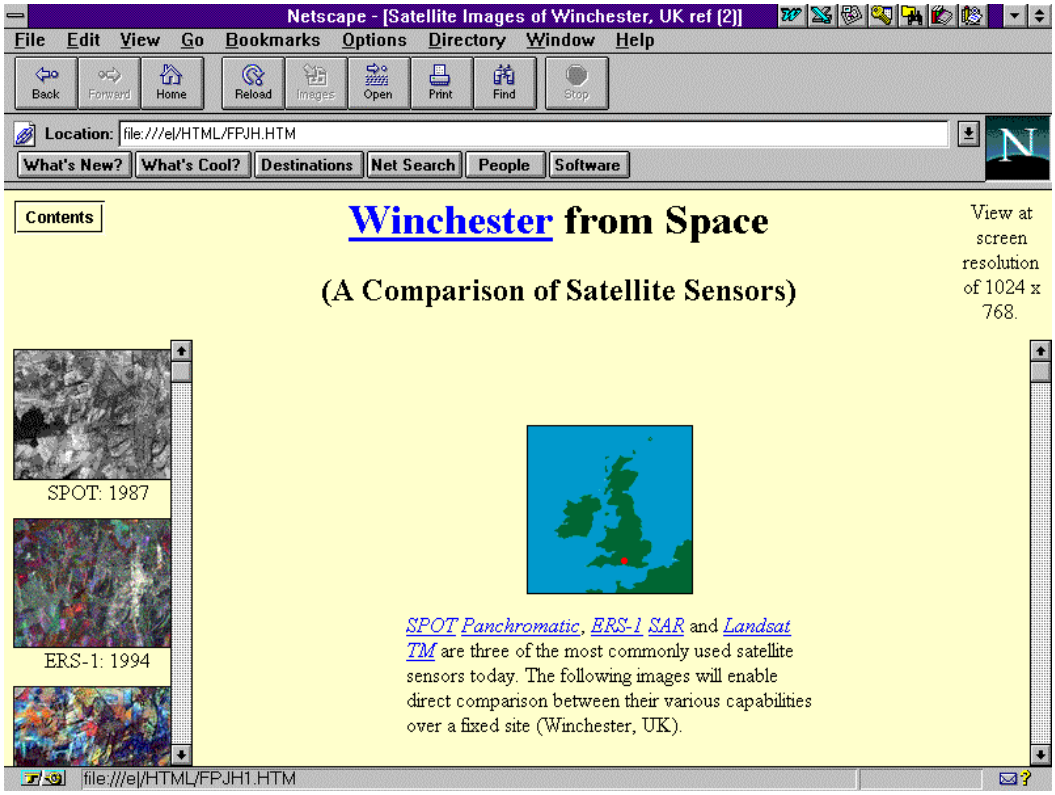


Practical B: Comparison of different satellite systems

Go to the Case Study by accessing the Principles of Earth Observation ('Principles') topic and then clicking the 4th button (showing a minature satellite scene - see below).



You should be confronted with the page below.



The idea of this short practical is to click on the various image types available for the Winchester area. the description of the main characteristics of the three images are given below. View the images in the light of these.

Image 1: SPOT Panchromatic (SPOT 1987)

Sensor:	SPOT - PAN
Date:	4th July 1987
Resolution:	10 metres
Applications:	Planning, Transport, Mapping

The first image in this set of three which span ten years shows the high level of detail that is resolvable from a satellite sensor despite having a civilian specification. Hi-Res. satellites due for launch in the next couple of years will have resolutions of 1-3 metres (similar to aerial photographs)! Even on this image which is over ten years old, individual large buildings can be discerned as can the familiar pattern of housing estates. Hedgerows and areas of woodland can also be clearly identified. Even boundaries that have now been removed can be seen in some fields, eg near Sparsholt. Summer images are especially useful for this and often archaeologists use such imagery and aerial photography to locate possible sites of interest.

In the lower right corner, Twyford Down in its pre-M3 extension state can be seen to the southeast of St Catherine's Hill. The transformation of the M3 to A33 occurs to the north-northeast of St Catherine's Hill and the A33 then passes the westward side of the hill.

Image 2: ERS-1 SAR (1994)

Synthetic Aperture Radar (SAR) images are mainly a function of surface roughness and moisture content. Interpretation of multi-temporal images is based on how the proportion of the returned signal changes between acquisition dates (generally due to land use changes). The effects of these changes are shown in the image because each date is represented by a different primary colour enabling interpretation of the resultant image.

For instance, red fields backscattered much more microwave energy on 17th August than on either of the two previous dates. This could be where a grass field (generally backscatters less signal) has been ploughed up between 11th July and 17th August and is now bare soil (generally backscatters more) - although further analysis would have to be undertaken to be certain. Like wise, magenta fields returned similar amounts in June and August, but less in July.

In this image the bands are represented thus:

Red: 17th August 1994 Sensor: ERS-1

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Green: 11th July 1994 Resolution: 30 metres
Blue: 4th June 1994

Applications: Land Use monitoring where 'lower' resolution can be an advantage

SAR images are acquired as a pulse of energy is directed at theEarth's surface and an amount is backscattered towards the sensor. In urban areas, many right-angular (to the orientation of the incoming microwave) surfaces (known as "Corner Reflectors") exist which reflect greater amounts of energy and which therefore record such areas as white on an image. Here we can see the urban area and industrial estate have many corner reflectors, whilst the railway line is also highlighted. Speckly areas are often trees (see Farley Mount) as the precise scattering surface changes between acquisition dates, but the general level of signal returned doesn't.

Other colours within the image are generally due to agricultural land changes during the '94 growing season. One feature of particular interest is near St Catherines Hill where the M3 extension work is taking place. The large cutting which has been carved into the ground bounces energy towards the sensor resulting in the feature seen above. The amount of signal returned differs on each of the dates (so it isn't white), but its extent did not change a great deal between June and August. The existing A33 route can also be discerned.

Image 3: Landsat TM 1997

The last image in this set of three was acquired in 1997 using a combination of reflected visible and infra-red wavelengths (compare visible and infrared bands) which produce a similar type of detail as the SPOT sensor, albeit at a lower resolution. Some detail can be seen of the urban area, but the colours are replicated elsewhere on the image showing that TM imagery is not particularly good for delineation of urban areas unlike the SPOT - XS sensor. Its infra-red capability however, makes it a very useful vegetation mapping tool. Medium level resolution enables large areas to be monitored without the cumbersome creation of huge data files. Nevertheless small variations in field crop cover can still be identified if this is required. The SPOT image reveals historical field boundaries that have been amalgamated into larger fields (eg near Sparsholt) as farming has become more commercialised.

On Farley Mount, the different reflectance of coniferous and deciduous trees can be clearly seen. Because of the time of year, it is probable that many agricultural fields have low percentage cover resulting in the soil having a dominant effect (many blue fields).

The M3 extension with associated cutting can be clearly seen as light has reflected off the large area of exposed chalk producing a white streak. In the image, the M3 is generally blue, but the low March sun has caused much of the motorway through the cutting to be in shadow, shown by the darker colour of the road through this stretch (see below white streak). At first glance, it appears that the old A33 is still visible in the image. However, by comparing this image with the SPOT - panchromatic image, it is possible to see that the road has indeed reverted to grassland (with the help of landscaping work by the developers), but that its course is still visible, due to existing trees along the route not being felled.

Image 4: Aerial Photograph

Finally, lets compare the satellite images with an aerial photograph. Click on Winchester to do this. In particular, compare the extent of this photograph with that of the SPOT image. This photograph was acquired by Hampshire County Council in 1997 to aid planning for the area. The street plan has changed little since Medieval times, although density of buildings has obviously increased. Nevertheless one can still see that the Cathedral dominates the inner city centre. This effect would have been even greater in historical times when surrounding buildings would have been smaller. The Cathedral would have stood out as a landmark visible from miles away.

Homework !!

Go through the **Principles** topic, in particular reading and taking notes on the Sections 1 and 3, i.e. on the Introduction to the Electromagnetic Spectrum and on the Sensors. We'll spend the first few minutes next week looking back at some of this....

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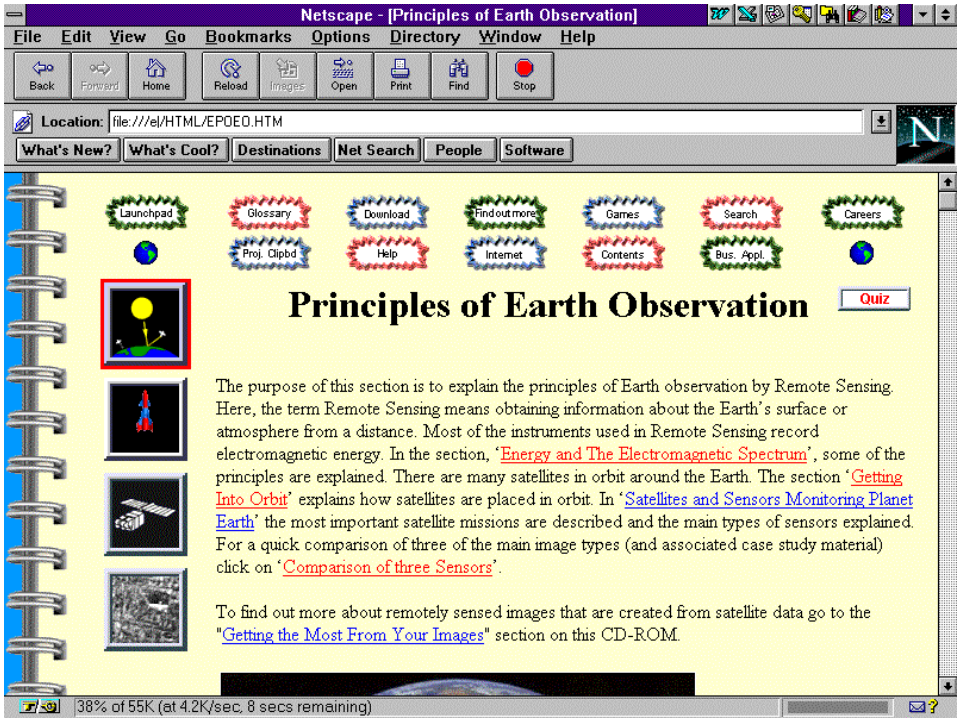

More Info ?

There's lots more about the BNSC CD-Rom at their web site on: http://www.bnsc.org

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