ABSTRACT

Eduspace is a multi-lingual Earth Observation website providing learning and teaching tools. It is managed by the European Space Agency and is co-sponsored by the European industry. Its aim is to provide teachers with easy-to-use material and to increase awareness amongst youngsters about space technology, in particular space-borne Earth observation, and its applications. For that reason, a teacher is part of the Implementation Team and a group of teachers provides feedback about its use.

It is an entry point to Earth observation data provided by satellites and their applications. It is conceived for both self-study and classroom teaching. It encourages teachers to use such data in their curriculum by providing ready-made material. The proposed exercises, projects and case studies are of various sizes, ranging from engaging a class for just a few lessons, to research work covering a full school cycle and across different disciplines (Chemistry, Physics, Geography, Geology, Environmental Sciences, Computer Sciences, etc.) or to a cross-border inter-school project, encouraging inter-disciplinary collaboration.

Eduspace contains educational material focusing on remote sensing techniques, as well as some background in physics and computer processing. Image enhancement, analysis and interpretation become an attractive task thanks to LEOWorks, an educational image processing software. LEOWorks includes an exhaustive tutorial and offers several modules for image manipulation serving both students and experienced teachers. The website also includes an image catalogue, where data covering a given area of interest can be found. The site will undergo an important refurbishment, whose main goals are to give to Eduspace an external look more similar to the ESA portals, to make it even more attractive and to ensure its long term life by moving it in the ESA consolidated operational context.

1. INTRODUCTION

The Eduspace initiative stemmed from one of the three recommendations that concluded the Eurisy workshop on Education, held at ESA-ESRIN, Italy in 1998. The initial development was carried out under the umbrella of Eurisy by ESA and by some of its national and industrial partners at that time (the Danish Ministry of Education, the Norwegian Space Centre (NSC), the British National Space Centre (BNSC), Eurimage and Geospace).

Eduspace aims to provide European students and teachers with a novel learning and teaching tool, which offers an entry point to space image data and in particular to a wide-spread visibility of Earth observation applications for education, training and capacity building. It inspires teachers to incorporate Earth observation in curricula; it provides for in-service training as well as ready-made projects; it stimulates students’ curiosity with attractive space-borne images and further resources and tools, amongst which there are a wide image database, currently covering already the whole of Europe with optical and microwave image scenes, and the educational image processing software LEOWorks. The site also includes means to facilitate collaborative work with other schools, especially within their geographical region of interest.
2. A CURRICULUM ORIENTED WEBSITE

Considerable care has been taken in the development of the Eduspace content to ensure that the material is directly applicable in European classrooms and relevant to the curricula. In fact, a school teacher is part of the Implementation Team and a group of European teachers advises ESA about site content from the user viewpoint. Project ideas and relevant material presented in the website can be adapted in the preparation and delivery of just one or several lessons. Alternatively, it can be taken as a basis for a full-scale project in the class or by an especially motivated student for a small (end of school year) research work. Through Eduspace, it is aimed that Earth observation becomes part of the school programme, as a recurring theme within the yearly curricula. The tasks to be addressed by the students should then be adapted to their degree, e.g. by increasing every year their complexity.

It was recognised that, in order to introduce Earth observation, the subjects to be addressed had to include also satellites, sensors, information technology, digital images, etc., and that the presented material had to cover different levels of complexity. Novices are therefore encouraged with an easy and pleasant-to-follow approach and at the same time expert teachers can find interesting material to work with. Special attention is given to include a solid basis of self-learning modules to the principles of remote sensing from space. The proposed approach is richly illustrated and also covers the different aspects about how electromagnetic energy is used to sense the Earth by making use of satellite sensors. Several databases are available; among them is a series of viewgraphs, ready for downloading both in printable and digital format, often including small animations. A teacher could use this material equally for different classical subjects, such as Geography, Science and Environment, Physics, Chemistry, Computer Science, and even in Arts. In this sense, material or images can be used as introduction to a lecture. Likewise, it can be used in the core of a lecture, analysing thoroughly the satellite image, interpreting and relating it to “real-life” aspects.

Through the inclusion of information about regions outside ESA’s Member States (currently in particular Africa and the Himalayan region), Eduspace offers a global overview, while also not forgetting to illustrate local problems, highlighting both natural and man-made circumstances. The ‘humanistic’ approach to science through individual case studies is aimed to increase students’ interest in scientific topics.

Finally, there was a strong requirement from several countries to provide at least parts of the website content in their native language. To date translations into French, German, Danish, Italian and Spanish of the full content have been realised and translations into Dutch and Portuguese are being verified for final implementation.

3. CONTENT AND STRUCTURE OF THE WEBSITE

3.1 Structure

Eduspace is currently based on a tree structure with the following main branches:
Continents or Regions (Europe, Africa, Himalaya, etc.) from Space, with sub-themes such as Cities, Landscapes, Weather and Climate

Global Change, including the sub-themes Atmosphere, Land, Ocean

Disaster Monitoring, currently dealing with hurricanes and tropical storms, floods, earthquakes, volcanoes and oil pollution

Remote Sensing Principles, with a two level approach for a more reader-oriented introduction to the techniques

Image Processing, holding freeware and tutorials

News, Helpdesk and Links

Registration and Login

Each sub-theme has further deeper layers including for example resources, project-ideas and fully developed case studies.

∞ Resources consist of databases of satellite images from different sensors, ready for selection and downloading. In some cases the data is not resident but can be retrieved from other sites.

∞ Projects are presented in the form of suggestions to teachers and students. They refer to activities connected with satellite image interpretation. Such activities need to be supported by adequate terrain information (maps, documents) and further collection of “ground truth” is stimulated, either through fieldwork or by a bibliographic search. Some projects are considered as exercises that need the use of tools and data available on the website, others can be further developed requiring teamwork or can be considered to seek collaboration with other schools throughout Europe or worldwide.

∞ Case Studies are collection of material for more in-depth studies of a selected area, addressing regional or local geography or a complex global theme. The topic is often of general nature and the case can be seen as an example of a practical application of environmental issues, geographically independent. Case studies include illustrations, satellite images, texts and links. The material can be used either following traditional working methods or can be downloaded, visualised and studied in a computer environment for which a dedicated software, called LEOWorks is provided. A particular emphasis is given to the use of Geographic Information Systems (GIS). In relation to this technique, the site includes complete integrated data sets for some of the case studies.

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Working through the exhaustive tutorial, a beginner is entirely guided and more advanced students are asked in progressive steps to analyse the image data and finally be able to improve the radiometry for a better interpretation of an image. A user finds modules allowing grey tone and colour manipulation and even perform automatic classifications. There are tools for geocoding images and for image annotation (to construct a satellite image map) and for extracting image information content (thematic information such as the perimeter of a town or the roads), which can be saved as layers of a Geographical Information System. Such layers together with satellite images can then be combined and analysed in order to derive new findings - and visualise them for a report or a presentation. Sets of thematic slides are made available to Eduspace users for downloading.

Figure 5: Screenshot from the LEOWorks software

LEOWorks has been built with much care implementing a very clear educational approach: make the users think before they act, that is to say that users are supposed to know what they are doing and why the next processing step is taken or the next action is started, discouraging a sort of automated sequential “key pushing” approach. This dedicated software package is meant to give schools many options not only to input and edit images, but also to visualise digital values. Special emphasis is also given to understand and alter the histogram, including many options, some of which are unique. There are a variety of filters implemented and there is also a module to superimpose images of different origin. With respect to the well-known commercial software, processing is not optimised but has to be done manually. This is done on purpose in order to preserve the educational value of how digital images can be manipulated. The LEOWorks software is free and any registered user can download the set-up file as well as an extensive tutorial.

3.3 The Eduspace Image Catalogue Viewer

Through the Eduspace Catalogue Viewer application, teachers and students can perform multi-mission inventory searches on the main ESA supported missions data. They can view a satellite image alongside the corresponding map and download a limited amount of data as a section of the image. At present, the image data bank contains full coverage of Europe with Landsat TM and ERS SAR; Envisat ASAR and MERIS data will follow.

It is available free of charge only to registered users.

Figure 6: Screenshot of the Eduspace Image Catalogue Viewer

The Image catalogue viewer is an application that, once installed, can run independently of the Eduspace website.

In recent years, satellite data of the Earth has become widely used in classrooms and images are easily available from the Internet – Google Earth being the best known example. The key advantage of Eduspace compared to such large databanks is that material which is interesting for education purposes has been pre-selected and presented in such a way that it facilitates a better understanding and more effective use of the material in a classroom situation. For instance, the projection used and the coordinates of the image are given when data is downloaded using the Eduspace Image Catalogue Viewer. Furthermore, Eduspace can be used in conjunction with external sites (like Google Earth), as the LEOWorks tool can be used even to process images which teachers have downloaded from other sources.

3.4 A Network of Schools

Eduspace aims at stimulating contacts among schools.
Figure 7: Example of multi-school participation to a same project: “Interactive Meteosat”

In fact, within certain projects, such as the “Interactive Meteosat” that can be found in the chapter “Weather of Europe”, a possible partner will be visible immediately, since location and name of all schools having submitted a weather observation on a specific day will be included in the relevant METEOSAT image.

In addition, Eduspace provides a helpdesk function where teachers can mail their questions or suggestions, and possibly also some educational material that they or their classes have produced.

4. ACCESS TO EDUSPACE

All material in Eduspace is free of charge. Although the website has no access restrictions and can thus be freely used by anyone, the download of most satellite data as well as of the image processing software is restricted to educational entities. To access these restricted zones, a teacher or a student has to register and the registration has to be accepted by ESA.

Figure 8: Eduspace login window

5. OUTLOOK

ESA will continue its efforts to manage and populate Eduspace with more satellite data and teaching material. Additional material is already being checked in the development environment and will be moved soon to the publically accessible operational version. A face-lift of the website is also considered.

Among the developments foreseen in the near future by the Agency, therefore, it is worth mentioning:

- the availability of a complete module dedicated to the Envisat satellite – it shall include new case studies (e.g. regarding the International Polar Year), adequate information about the various instruments and the data retrieved from them,
- the enrichment of the image catalogue with Envisat data available for downloading,
- the availability of Eduspace in Dutch and Portuguese languages (new others, e.g. Greek, are considered),
- the addition of several case studies in the “Himalaya from Space” section,
- the availability of LEOWorks version 3, which will include a GIS tool and allow to import GPS points,
- further development of LEOWorks, in particular to permit the use of other platforms (e.g. Macintosh).

Figure 9: The ESA School Atlas cover

ESA is also developing a Satellite Image Atlas for schools. It will include a text book for teachers as well as a DVD with the full content in digital format. This teaching tool is conceived as a supplement to the conventional school atlas.

The website address is: www.eduspace.esa.int

* Google Earth - http://earth.google.com - offers medium resolution imagery and terrain data of the whole world, as well as high-resolution imagery of many major cities in North America and Western Europe.