

Earth Observation Education in the Hindu Kush-Himalayan Region, an ESA Initiative

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Abstract

In the framework of the commitments for education made by the European Space Agency (ESA) at the UNISPACE II conferences and renewed at UNISPACE III, several initiatives have been realized and are now a corporate asset for ESA. Among those is Eduspace, a multilingual website for Earth observation in secondary schools. This website is now well established in the teaching community, with over 2000 registered educational entities worldwide supposed to be used on a regular basis. ESA's prime objective is to provide teachers and students with a modern and stimulating teaching and learning tool. ESA endeavours to further enhance this website and enrich it with additional pedagogical material linked to satellite image applications. Along this line, several new modules have been realized, among them "ENVISAT for Schools" and "Africa from Space" and the educational image processing software LEOworks. With the latest module "Himalaya from Space", a new approach has been adopted for the production of educational material. In an Announcement of Opportunity addressed mainly to Universities and educational institutions in the Hindu Kush-Himalayan Region, proposals were requested for so-called Case Studies. These are pedagogically reworked results of investigations on the application of spaceborne remote sensing data to socially relevant topics.

KEY WORDS: Education, earth observation applications, ESA, Eduspace, Himalaya

1. Introduction

ESA and its National and Industrial Partners have developed this Website under the umbrella of EURISY. It aims to provide students and teachers of Europe with a new 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 and training. It shall inspire teachers to incorporate Earth observation in their curricula and it provides for in-service training. It encourages teachers to use Earth Observation data by providing ready-made projects. It shall stimulate the curiosity of students with attractive spaceborne images and further resources and tools, amongst which there is the educational image processing software LEOWorks. The site also includes means to facilitate collaborative work with other schools, especially within the geographical region.

Unlike many educational sites for schools, it is the intention of the Education Office of the European Space Agency managing EDUSPACE to provide a complete view of Earth observation applications to schools, covering most of the application subjects well-known to scientists and operational entities



Figure 1: The EDUSPACE entry page.

2. A Site for Beginners and Experts

The development and operational team of EDUSPACE has recognized that for introducing Earth observation the subjects to be address 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 likewise 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 from satellites. Several databases are available, among them is a series of view-

graphs, ready to download both in a light form, but also as Powerpoint presentation, often including small animations. It is thought that a teacher can use this material equally for the different classical subjects, such as Geography, Science and Environment, Physics, Chemistry, Computer Science, and even in Arts. In this sense material or images can well be used as a motivating teaser starting a lecture. Likewise it can be used in culminating a lecture in demonstrating the real-live aspect on a satellite image.

Project ideas and relevant material presented in the website can be adapted in the preparation and the delivery of just one or of a series of lessons but also can be taken as a basis for a full-scale project in the class or by a specially motivated student for a maturity thesis. It is also suggested to make Earth observation to become part of the school programme, as a recurring theme within the yearly curricula, whereas the tasks to be addressed by the students are to be adapted to the degree i.e. increasing every year in their complexity. As an example, a first year activity could concentrate of building up the necessary knowledge in space-related matters culminating in a well-prepared presentations delivered in Powerpoint. The second year could address data collection of a site of interest (e.g. the school town) and aspects of archiving and statistical evaluation, while the 3rd year would deal in applying satellite data, in digital image processing and the construction of a Geographical Information System, using the tools available in EDUSPACE.

3. Access to EDUSPACE

All material in EDUSPACE is free of charge. Although the Website has no access restrictions and thus can be freely used by everybody, the download of most satellite data as well as of the image processing software is restricted to educational entities and their teachers and students and is only possible after registration. The industrial partners who have kindly providing data and other type of support have imposed this. Equally under the same conditions the cost of the software license to produce a freeware version could be drastically reduced. For having access to these restricted zones, a user has to register and the registration has to be accepted by the EDUSPACE Operations Team after it could be identified that the requester as a educational entity (school, university, educational or research institution). It is only then that this user can also register the class (or any specific user within the educational entity) and define his personal login and password, which eventually will be validated by the webmaster. After having accepted also this class-registration the website all the areas are accessible.

The material in the website can be used in many different ways and will hopefully satisfy many of the require-

ments of students and teacher. There is the curiosity of a student to be considered, how he browses through the themes, makes his own studies, goes through the proposed and relevant exercises and makes it a success to him. But there is also the teacher who can use the material to prepare his lesson or to propose to his student a teamwork over a period of time ending in a presentation to their classmates. As data and software is quite heavy to download this should be done during the preparation, and the data put on the school-server or distributed to the students' PC prior to the lesson. The website shall also function as portal to other educational sites and links in specific areas might help to find further background information. Moreover the site shall be also a communication vehicle, to get in touch with the EDUSPACE helpdesk for specific questions or to post such questions to the forum. The access to the addresses of all registered schools is facilitated through several ways and invites schools to communicate with each other on specific themes.

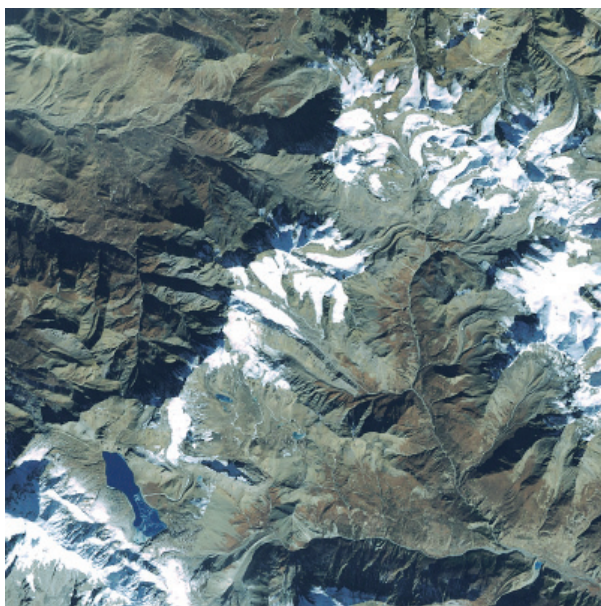


Figure 2: One of the many images provided to students to work with: the Annapurna in the Himalayas.

4. Contents and Structure of the Website

EDUSPACE consists of a tree structure with the following main branches:

- The Continents (Europe, Africa, etc.) from Space, with sub-themes such as Cities, Landscapes, Weather and Climate. In addition Europe from Space holds a huge image catalogue, a seamless coverage of ERS and LANDSAT data
- Global Change, including the sub-themes Atmosphere, Land, Ocean

- Disaster Monitoring, dealing with Tropical cyclones, Floods, Earthquakes, Volcanoes and Oil pollution
- Remote Sensing Principles with a two level approach to be introduced to the techniques
- Image Processing Tools holding freeware and tutorials
- School Network managing the addresses of the registered schools and a Discussion Forum,
- News, Helpdesk and Links

Each sub-theme has further deeper layers including e.g. resources, background information, 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 activity needs 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 imply the use of tools and data available in the Website, others can be further developed requiring teamwork or it can be envisaged to seek collaboration with other schools throughout Europe or worldwide.

Case Studies are collections 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 and geographically independent. Case Studies include rich 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 PC-based software, called LEOWorks is provided. A particular emphasis is put to the use of Geographic Information Systems (GIS). Related to this technique the site includes complete integrated data sets for some of the Cases Studies.

Background: Whenever appropriate or needed, more illustrated information related to the Case Study is provided.

Links: Specific links can be activated to retrieve further information and material from other sources worldwide. This will help students to collect facts and methods to work in proper areas of interest.

5. Example of a Project Ideas

One of the many project-ideas is named "My Home Town Seen from Space". Students are requested to work

on a project resulting in a detailed interpretation of a satellite image of the area where their school is located. Tiles of satellite images are included on the site and are available. Projects of different size are suggested, either to produce a well-annotated postcard size satellite map of the hometown to be mailed/emailed to friends or to a collaborating school, or to start a larger project involving more time and resources. EDUSPACE holds satellite images and descriptions of many cities worldwide with the idea that a school class would produce a much-improved caption as a result of a project. Such reports are greatly welcome and will be put on-line together with the names of the authors!

6. New Approach for Case Studies from the Himalayas

With the latest module “Himalaya from Space”, a new approach has been adopted for the production of educational material. In an Announcement of Opportunity addressed mainly to Universities and educational institutions in the Hindu Kush-Himalayan Region, proposals

were requested for so-called Case Studies. These are pedagogically reworked results of investigations on the application of spaceborne remote sensing data to socially relevant topics.

Case Studies shall present ideas how to apply Earth observation data in general and for specific problems and should demonstrate this in one particular case.

The accepted proposals include topics such as recurrent floods in valleys and plains, glacial lake outbreaks, man-animal conflict in and around protected areas, habitat observations in National Parks, environmental impact of industrial exploitation, air-pollution over large cities in air-trapped situations and uncontrolled urban development. As a result all Case Studies are presented in a unified form, including an introduction, a background and a worksheet section. The latter is divided into a more simple approach to work on paper-prints, while a more enhanced section deals with digital image data, in some cases also incorporated in a GIS. Mostly ENVISAT data, but also some other high-resolution data are used.

Techniques proposed to be applied are kept simple and

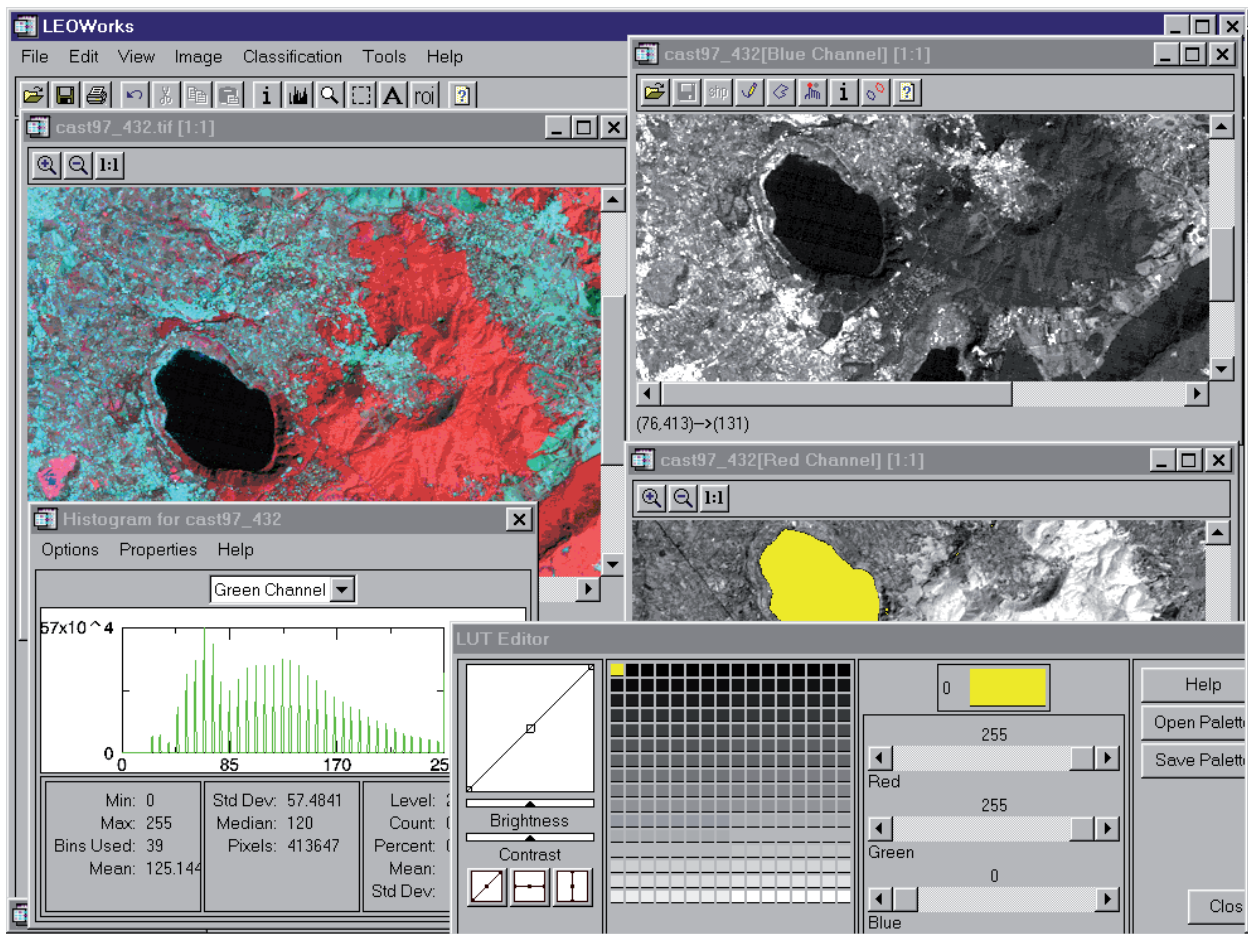


Figure 3: The Image processing software LEOWorks allows novices to make first steps in image data understanding and expert to do a full-scale image analysis.

in line the curricula of higher secondary schools in most countries. All material can be downloaded and is ready for use in the classroom. There are two principles of applying remote sensing techniques, the more simple analogue approach and the digital approach. In the analogue approach text and images for a specific exercise can be downloaded and printed, and used by individual students or by a student team for analysis following the instructions. In the digital part, the available imagery is geocoded and software is available free for schools to work with. In both cases exhaustive questions at each learning step assure that the student can follow the sequence of the exercise. The image processing software on which all the digital exercises are built is described below. It can be freely downloaded by registered schools.

The rationale behind such Case Studies is to stimulate teachers and youngsters to become confident with the basics of remote sensing and eventually adopt a similar approach for a study in an area of their country, suffering e.g. from a similar problem. In such cases the Eduspace Team will help a school on a best effort basis to get the necessary remote sensing data.

7. The Educational Image Processing Tool LEOWork

This specially generated piece of software is conceived in such a way to permit to introduce teachers and students to the world of digital image processing, in an intuitive manner. Although it offers nearly all possibilities and options of any professional software of that kind it can well just be used to play with digital images in order to explore the means to manipulate image data.

Working through the exhaustive tutorial a beginner is entirely guided and more advanced student are asked in progressive steps to analyse the image data and finally be able to improve the visual impression such as the contrast for a better interpretation of an image. A user finds modules allowing grey tone and colour manipulation and even perform an automatic classification. There are tools for geocoding an image and for image annotation (to construct a satellite image map) and for extracting image information (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 interrogated in order to derive new findings - and visualise them for a report or a presentation.

LEOWork has been constructed with much care so to give the schools many options to input images, to 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 is

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 step by step. 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 school or educational institution can download the executable file as well as an exhaustive tutorial.

8. A Network of Schools

EDUSPACE aims at stimulating the contacts between schools of Europe. After a school and a class has registered the information becomes available to all visitors of the site. Of course, the list of participating schools can be easily browsed and email addresses eventually extracted. It is hoped that such an opportunity might strengthen contacts between school or give a possibility to make new contacts. Within certain projects such as the "Interactive Meteosat", to be found in the chapter "Weather of Europe", a possible partner will be immediately visible, since the location and name of all schools having submitted a weather observation on a specific day will be included in the relevant METEOSAT image. For the search of partners for other projects the use of the Forum might be the appropriate mean.

EDUSPACE also provides for a Helpdesk function (eduspace@esa.int) where teachers could mail their questions or suggestions, and eventually, also educational material they or their classes have produced. The EDUSPACE Team will be happy to accommodate it in the Website.

9. EDUSPACE in different Languages

Although in Secondary Schools English language teaching is already largely introduced there is still 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 realized. The structure of the Website allows accommodating many more languages and as well facilitates on-line translation. More languages are therefore welcome and will be logistically supported if financially secured by partners.

10. A Council of teachers

ESA has called especially active teachers in applying and promoting space imagery in the school for advising the EDUSPACE Team how to improve and enrich the Website. These voluntary teachers make available a limited amount of time to the project and will gradually built up a network of focal and contact points for Earth observation data ap-

plication in European schools. This Council has started to becoming a viable platform not only for exchanging news and latest developments in periodical meetings but also to disseminate ideas and educational material.

11. Outlook

The EDUSPACE Team will continue its effort to manage and to populate the Website with more satellite data and teaching material. The series of animated viewgraphs will also be enriched, and more case studies and project ideas will be added. The more structured access to the different content has to be put in place. Different modules are ready to be uploaded. They will become visible in short, such as the aforementioned case studies for the Himalaya from Space module.

There are ongoing activities which includes especially the environmental data from ENVISAT. Eduspace follows in the educational project "Satellite Eye on Galathea3" an expedition ship around the world with daily new images provided in near real-time. All activities are well guided by teachers and scientists. The different disciplines (sea surface temperature, chlorophyll content, sea ice monitoring and many others) are introduced in illustrated documents with exercises.

There is also an ESA Satellite Image Atlas for schools in development. It will include a text book with an introduction, image descriptions and exercises for teachers, as well as a DVD with the full content as digital files, in part also geocoded to be used in exercises. This very rich and novel teaching tool is conceived as a supplementary to the conventional school atlas and will be available in late 2006. The content of the DVD is made for being uploaded in Eduspace as a further module.

It is envisaged to include an introduction to the GPS-world and the forthcoming European Satellite Navigation System GALILEO with its many practical applications.

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

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