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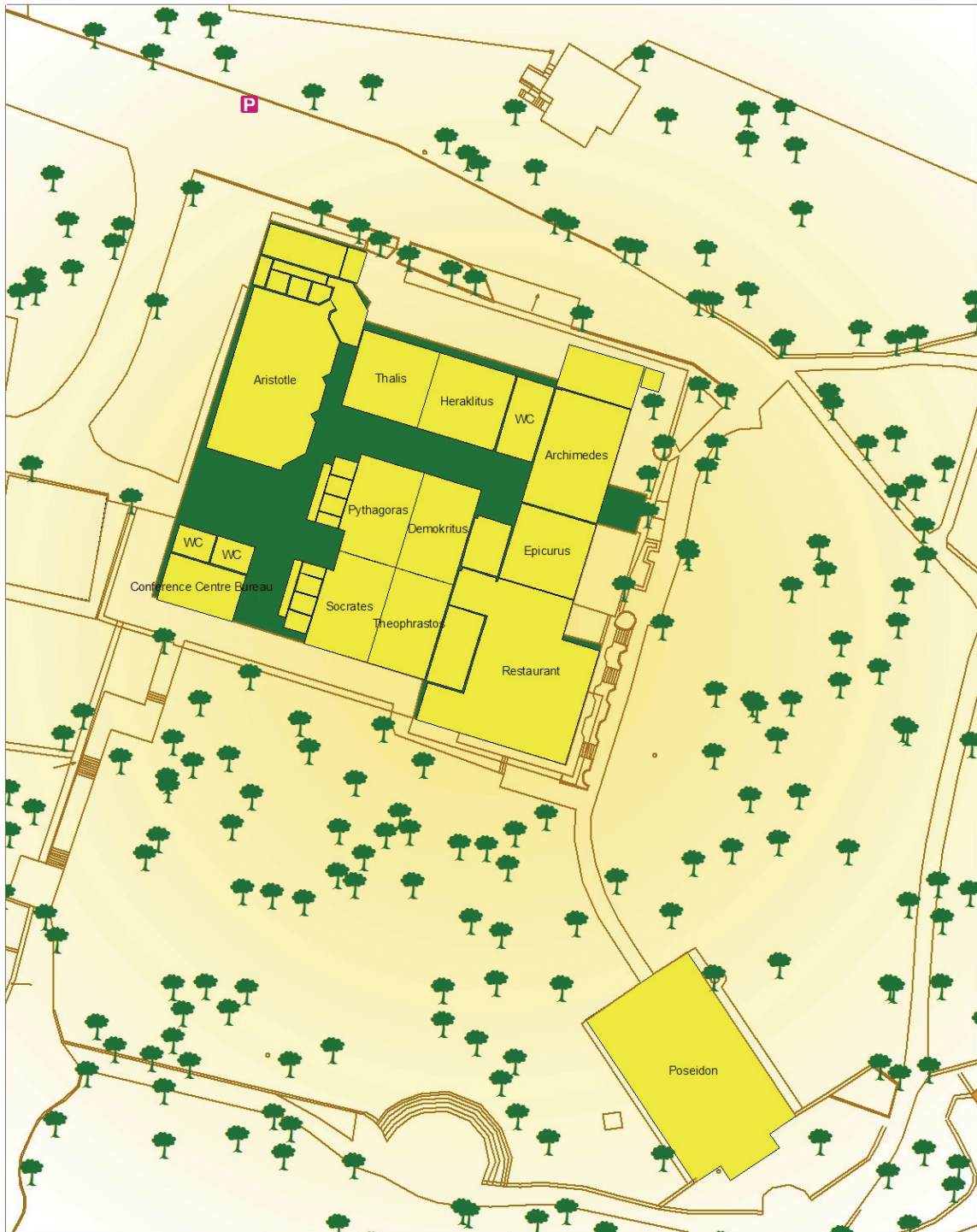rainer.reuter@eproceedings.org

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Abstract Book

Education Activities in the frame of the Earth Observation Programme of ESA

Francesco Sarti
francesco.sarti@esa.int

Steffen Dransfeld
Steffen.Dransfeld@esa.int

Abstract: Earth Observation (EO) from satellites is increasingly important for the understanding of the Earth's system and its processes, especially within the context of climate change.

The European Space Agency (ESA) is an international organization consisting of 18 Member States developing and executing space programmes in cooperation with European industry. In the area of EO, after the first successful launch of Meteosat in 1977, ESA designed, developed and launched a series of meteorological satellites, including Meteosat Second Generation and METOP (all operated by EUMETSAT). In 1991, ESA launched its first EO satellite with a synthetic aperture radar payload, ERS-1, followed by ERS-2 (1996) and Envisat (2002), the former being the largest EO satellite ever launched and with a variety of different sensors for the observation of land, ocean, cryosphere and atmosphere. Data issued by ERS-2 and ENVISAT payload are presently transferred to ground stations, collected and distributed worldwide to around 1200 scientific teams, as well as to an increasingly larger number of operational and commercial users.

On top of these, ESA is preparing some scientific Earth Observation missions called Earth Explorers, dedicated to the study of scientific challenges identified by the science community. GOCE (measuring the Earth's gravity field), SMOS (determining soil moisture and ocean salinity), CryoSat (observing continental ice sheets and marine ice cover) are the next satellites of this series.

Other important issues are the observation and fast response in case of natural disasters and all environmental hazards. In this context, GMES (Global Monitoring for Environment and Security), a joint initiative of the European Space Agency ESA and the European Union, aims to monitor the state of the environment on land, at sea and in the atmosphere and to deliver policy-relevant EO information that can be used to improve the security of the citizens. The success of this initiative will be achieved largely through a well-engineered Space Component for the provision of Earth-observation data to turn into services for monitoring the environment and supporting civil security. This Space Component comprises five types of new missions called Sentinels, so-called Contributing Missions from Member States and other organisations, with their associated Ground Segment infrastructure, developed by ESA specifically to meet the needs of GMES. The Sentinel missions include radar and super-spectral imaging for land, ocean and atmospheric monitoring. The first three Sentinels are currently under industrial development, with Sentinel-1 planned to launch in 2011.

Associated to this challenging programme of Earth Observation, ESA is carrying out a programme of EO Education, in cooperation with other national space agencies and with international bodies, like UNESCO or the Committee on Earth Observation Satellites (CEOS) and its Working Group for Education. In this frame, dedicated tools for schools, such as Eduspace, have been developed with the objective to create awareness about the potential of Earth Observation from space among young generations and to bring 'space' closer to youngsters. A variety of different tools have been developed and a series of training courses at different levels (university, post-doc, scientific or professional-oriented) are provided by ESA and other institutes cooperating with ESA.

SEOS: A World of Images

Science Education through Earth Observation for High Schools: Module 1

Caroline Dandois Dutordoir
caroline.dandois@belspo.be
1. Belgian Science Policy Office, Earth Observation Platform, Brussels
Belgium
http://eo.belspo.be

Keywords: remote sensing, earth observation, education, high school, SEOS

Abstract: SEOS is an initiative for using remote sensing in science education curricula in high schools funded under the 6th Framework Programme of the European Commission (EC). Based on current research results, 15 internet-based eLearning tutorials are developed by 11 different partners from several European countries in cooperation with the European Space Agency (ESA).

The introductive module "A World of Images" is meant to provide an overview of the current usage of remote sensing so as to enthuse students about the capability of this technology for the management and maintenance of Earth resources. In close connection to the other modules, this module was constructed around a set of selected remote sensing applications to demonstrate the usefulness of different image types for different purposes from local to global scales.

Each application is presented on a one-screen basis where a central image acts as an "eye-catcher". Text is voluntarily kept concise; however an information button allows a short comment on the image to be displayed. Inside the image comment, a few links and questions lead to additional information pages and to the other SEOS modules.

The navigation was designed to be intuitive. The module opens with a short animation offering a flyby inside the solar system until reaching Earth. The animation ends on a screen covered with images' quicklooks leading to the different applications (see table 1). Each quicklook pairs off with a stylised icon illustrating at a glance the issue covered by each remote sensing application. Furthermore, a menu organises the applications into 5 themes (air, water, land, climate and human impact).

A "teachers' corner" is also available. This section contains general information about the module, worksheets and quizzes for use in class as well as a list of class activities related to remote sensing and the various topics treated in "A World of Images".

The module has been tested in several European high schools. Teacher and pupils gave very enthusiastic feedback and their comments were used to improve the content of some pages and the navigation inside the module.

For more informations please visit http://www.seos-project.eu

Table 1. List of main pages

Weather forecast Storms Air quality Ozone Global change El Nino and la Nina Biodiversity Vegetation status Land cover Natural World Heritage Sites Volcanoes Deserts Deforestation Geology Global biosphere 3D models Coastal zones Coral reefs Ocean currents Floods Ice melting Oil spills Blooms Coastal upwelling Man-made structures Cities Agriculture Precision farming Cultural World Heritage Sites

EURAC junior

Earth observation schoollab at the European Academy in Bolzano/Italy

Uta Fritsch
uta.fritsch@eurac.edu
Italy

Matthias Mühlberger
matthias.muehlberger@eurac.edu
Italy

Philipp Rastner
philipp.rastner@eurac.edu
Researcher
Italy

Christian Steurer
christian.steurer@eurac.edu
Project Manager
http://www.eurac.edu

Keywords: schoollab, science education, young researcher

Abstract: With the project EURAC junior the European Academy Bolzano/Italy establishes an interface between schools and science. In this framework EURAC junior offers together with the research institute for Applied Remote Sensing a three hours schoollab that introduces high school kids to the topic of earth observation. Students take part in a well balanced program that combines theory and practical experience. In several short picturesque presentations students receive background information on satellite systems and the basics of remote sensing as well as the current research activities of the institute. The practical part includes the use of technical instruments, the application of a remote sensing software and an exercise with pictures of different illumination situations of the earth that have to be assigned to the correct time of day and seasonal date. The students experience a scientific working atmosphere and get the opportunity to approach scientists directly. The set up of the schoollab highlights links to school subjects like Math, English, Geography, Physics and Ecology. Students understand the importance of integration for the different disciplines and the knowledge as the key to applied remote sensing and science. The activity of EURAC junior has the vision of building a vivid platform in South Tirol for initiatives that propose current research topics for teachers and students in all level of education. This opens new opportunities for the teachers to enhance their teaching tool kit and their own education. Students benefit not only through the diversification of teaching methods, but the contact to science might motivate them for their own career. The gain for the research institute is expected to be seen in a higher reputation in society and in the support to determine the myth of science being in an ivory tower. EURAC junior is using this win-win situation as an opportunity to offer different formats to schools. Besides schoollabs, we offer a visit of scientists at schools, intermediate-term roll-playing and an initiative called "young researchers wanted". This initiative is not restricted to the topic of applied remote sensing but wants to establish suitable activities for the ten different research institutes of the European Academy in Bolzano.

10 YEARS OF IMAGING THE EARTH: SPOT VEGETATION

A SERIES OF 7 POSTERS

Caroline Dandois Dutordoir
caroline.dandois@belspo.be
1. Belgian Science Policy Office, Earth Observation Platform, Brussels
Belgium
http://eo.belspo.be

Martine Stélandre
stel@belspo.be
1. Belgian Science Policy Office, Earth Observation Platform, Brussels
Belgium
http://eo.belspo.be

Keywords: Earth observation, remote sensing, SPOT, Vegetation, poster, education,

Abstract: Since April 1998, the VEGETATION mission allows daily monitoring of terrestrial vegetation at regional and global scale. The VEGETATION programme is a joint initiative of the European Commission, the Belgian Science Policy (BE), CNES (FR), SNSB (SE) and ASI (IT).
To celebrate the 10th anniversary of the SPOT VEGETATION instruments onboard satellites SPOT-4 and SPOT-5, the Belgian Science Policy and UCL-Geomatics have collaborated to design 7 posters, a global one and one for each continent (except Antartica).
Each poster is a unique composite of all daily images recorded for 10 years by the VEGETATION instruments and processed to highlight at best the diversity of the areas. The bathymetry and the polar areas are derived from the Blue Marble Next Generation.
For each continent 5 very visual insets underline some of the main processes experienced in the last 10 years in the continent. The selected themes for Africa are for example desertification, refugees, water resources, population boom and food security.
Finally a website (http://eoedu.belspo.be/vgt10) was developed to provide online acces to the posters and a complement of information about each one of the posters' insets. The website will be available in English, French and Dutch.
These materials (posters and website) were designed for the general public, including high schools. Posters will be printed in a limited number of specimens and put at disposition of interested teachers via Belgian associations of geography teachers and the ESERO desk in Brussels.

Bringing Geo-Spatial Technologies into schools, problems and solutions

The Remote Sensing part

Wolfgang Sulzer

wolfgang.sulzer@uni-graz.at

University

Austria

http://www.uni-graz.at/geowww

Keywords: Remote Sensíng, secondray school, teacher education, Austria

Abstract: This paper/presentation documents the Remote Sensing part of the curriculum within the teacher education curriculum for secondary schools at the Institute for Geography and Regional Science University of Graz, Austria. Remote Sensing topic is embedded in the subject "Geo-Spatial Technologies". These 3 hours/per week/semester (6 ECTS) lasting lesson includes the GIS and Remote Sensing techniques and should give an applied introduction into their capabilities for teaching in secondary schools. This paper gives an overview about the content of teaching (outweighed balancing between technology transfer and applications). The lesson is divided into a theoretical part (introduction, goals and aims of the lesson, Remote Sensing technologies and scholar syllabus, introduction into RS methodologies: RS topics - history, electro magnetic spectrum, term "resolution", platforms and sensors, applications) and practice (introduction in working with an atlas and analogue data, digital image processing with visualization, import, classification, interpretation and integration in school lessonspsy"BC). The experiences with 3 generation of students will be given as a central issue of the presentation. The lack between demands and effective knowledge of students in combined Remote Sensing and (geographical) thematic aspects are main limiting factors for the integration and effective use of Remote Sensing techniques in schools.

SEOS: Coral Reefs and 3D Models

Science Education through Earth Observation for High Schools, Modules 3 and 10

Marijke Temmerman
Marijke.Temmerman@Ugent.be
Belgium

Rudi Goossens
Rudi.Goossens@Ugent.be

Caroline Dandois
Caroline.DANDOIS@belspo.be

Therese Ongena
Therese.Ongena@Ugent.be

Keywords: Remote sensing; Coral reefs; SEOS-project, educational webpage

Abstract: The module on coral reefs is one of the 15 modules in de SEOS project, an european initiatiative for using remote sensing in science education curricula in high schools.

Interactive web pages with remote sensing images, animations, educational games and worksheets are guiding 16 to 18 years old pupils through different topics concerning corals and coralreefs. Teachers can use this material in different ways. They can use it for discussions or for interactive work at home or in the classroom.

Using the first chapter, pupils can understand the characteristics of the corals. The second chapter helps them to understand the importance of these treasures of the sea and the third chapter is dealing with the different threats. Coral bleaching, a topic which is nowadays very important for the study of the surface temperature of ocean water, is studied in a separate chapter. Last but not least a final chapter is dedicated to the importance of remote sensing in the study and the conservation of the coral reefs throughout the world.

The module on 3D models is the 10th of 15 modules in de SEOS project that will guide 16 to 18 year old pupils through the amazing 3D world.

Displaying and interpreting topography on 2D documents such as maps and satellite images isn't alsways easy. In many cases 3D models can be of great help but how can we construct a 3D model out of a flat satellite image?

The module starts with a short introduction in the world of 3D. After that, the basic principles of elementary photogrammetry are explained. These principles like parallax and relief displacement are needed to understand the different 3D applications like fly over, anaglyphs and orthophotos. Images and photographs, games, exercises and worksheets will help the students to get to know how 3D works.

SEOS: Agriculture and Natural Resource Management

Science Educaion through Earth Observation for High Schools: Modules 4 and 11

Chariton Kalaitzidis
chariton@maich.gr
Department of Environmental Management, Mediterranean Agronomic Institute of Chania
Greece

Ioannis Manakos
manakos@maich.gr
Department of Environmental Management, Mediterranean Agronomic Institute of Chania
Greece

Konstantinos Perakis
perakis@prd.uth.gr
Department of Planning and Regional Development, University of Thessaly
Greece

Alata Elatawneh
alataaa@yahoo.com
Department of Environmental Management, Mediterranean Agronomic Institute of Chania
Greece

Keywords: science education, high schools, agriculture, natural resource management

Abstract: Young people in the EU already have to deal with geospatial data handling in their everyday lives, especially with Earth Observation (EO) data, and this is expected to increase in the future. The SEOS project (Science Education through Earth Observation for High Schools) aims to introduce a variety of applications of Earth Observation data to high school students and other interested parties, by providing a complete teaching curriculum, consisting of fifteen thematic eLearning modules.

This study addresses the topics of the use of Earth Observation data in Agriculture and Natural Resources Management. Subtopics of Remote Sensing applications have been developed within these modules, which address crop identification, monitoring of crop health status and yield estimation, precision agriculture, assessment of soil quality, erosion and desertification, forest management, water resources, urban planning and waste management.

Following the completion of the initial module development, an evaluation procedure was initiated at collaborating high schools across Europe. Feedback was received by the high school teachers and the pupils who used the modules, which provided insight on their requirements, preferences and aversions on the design and content of the modules. By taking these opinions under consideration, the modules were further improved, in order to maximize their efficiency in conveyance of knowledge and making their use a welcoming experience. In order to reach a wider European public, the modules are being translated in more than five EU languages.

SEOS: Marine Pollution

Science Education through Earth Observation for High Schools: Module 12

Christina Klose

christina.klose@uni-oldenburg.de

University of Oldenburg, Institute of Physics, Marine Physics

Germany

http://las.physik.uni-oldenburg.de/klose/

Valborg Byfield

valborg@noc.soton.ac.uk

National Oceanography Centre Southampton

United Kingdom

Rainer Reuter

rainer.reuter@uni-oldenburg.de

University of Oldenburg, Institute of Physics, Marine Physics

Germany

Colette Robertson

ycr@noc.soton.ac.uk

National Oceanography Centre Southampton

United Kingdom

Abstract: The aim of the eLearning tutorial presented here is to increase awareness among high school students of the damage done by marine pollution, and what may be done by individuals and society to protect valuable marine environments. Through carefully selected examples, students will understand how the state of the oceans may impact their everyday lives, even if they live many hundred kilometres away from the coasts and don't eat fish. The tutorial covers the main sources of marine pollution, the impact of different pollutants, methods to detect pollution, and ways in which pollution may be prevented and environmental damage minimised. There are sections on oil pollution, harmful algal blooms, litter, invasive species, and invisible pollutants such as chemicals, heavy metals, and thermal pollution. Throughout the main focus is on the monitoring of different types of marine pollution using a range of remote sensing techniques, each with their own strengths and limitations.

Oil spills, for example, can be detected using radar images from satellites, In the case of larger spills, a suite of airborne sensors at microwave, infrared and optical wavelengths may be used to provide information about the position and extent of a spill, its relative thickness and potentially, the composition of the oil. Eutrophication arising from anthropogenic input of nutrients such as nitrogen compounds and phosphate may be monitored with ocean colour sensors. Thermal pollution from the input of cooling water from industry and power stations may also be monitored using a range of infrared and microwave satellite sensors. Carefully selected case studies demonstrate how the different sensors are used, individually and in synergy, to provide a thoroughly modern system for monitoring pollution and its impacts on the marine environment.

Investigating active volcanoes through remote sensing and teaching geography students how to analyze spatial images

Vasile Loghin
vloghin2003@yahoo.com
Valahia University of Targoviste

George Muratoreanu
muratoreanug@yahoo.com
Valahia University of Targoviste
Romania

Abstract: This article deals with two aspects of the study of active volcanoes: 1) the role of remote sensing in investigating active volcanoes; 2) teaching geography students how to analyze spatial images of active volcanoes. As far as the role of remote sensing in investigating active volcanoes is concerned, we will be examining the following aspects: the morphology of active volcanoes, with the changes that occur after each eruptive episode; identifying the signs that precede a volcanic eruption; monitoring volcanic eruptions and their impact on the environment and on the natural habitat. Regarding the methods used to teach geography students how to analyze, in laboratory conditions, satellite images of active volcanoes (of areas with active volcanoes), the present article includes computer-aided demonstrations performed on different categories of images (visible, thermal infrared, radar, composite, 3D) and of volcanoes. The aim of these demonstrations is to prove the importance of satellite data in investigating active volcanoes and their relationship with the environment, as well as the fact that geography students should learn and apply appropriate methods in analyzing satellite images.

Implementing Remote Sensing Software Functionalities in Interactive Learning Applications

Henryk Hodam

h.hodam@geographie.uni-bonn.de

Remote Sensing Research Group, Department of Geography, University of Bonn

Roland Goetzke

r.goetzke@geographie.uni-bonn.de

Remote Sensing Research Group, Department of Geography, University of Bonn

Germany

Kerstin Voss

k.voss@geographie.uni-bonn.de

Remote Sensing Research Group, Department of Geography, University of Bonn

Keywords: remote sensing, schools, education, interactive learning applications

Abstract: To fully benefit from the range of possibilities when working with remote sensing in schools visual interpretation of satellite images is not sufficient. Although looking at those images and describing them can add to the pupils' understanding of spatial processes on earth's surface, their full potential is only accessible by analysing them as what they are: digital data. This implies the use of remote sensing software but even the solutions produced especially for the use in schools are still not easy to handle and therefore not appropriate for the everyday use in classes. Also the installation and administration of such software often is an obstacle. An alternative can be interactive learning applications which are the preferred solution regarding a survey of teachers participating in the FIS-project(1).

To facilitate the introduction of remote sensing methods in schools the interactive lessons produced within the FIS – Project set the focus on only those features from remote sensing software that are needed. The functionalities are redesigned to lower their complexity and are accessible through software that runs independently from installation and is directly connected with the lesson. The technical realisation of those interactive lessons is based on the far spread Flash – technology and its programming language Actionscript 3.0 allowing a vast range of possibilities on a controllable level of complexity compared to other software developing methods. By now, the concept has been used to realise lessons for physics, informatics and geography while the work for a biology lesson is in progress. The way it is implemented into the interactive lessons can be exemplarily described as following:

-The tools are always used in the context of a simulated microworld where they can produce the result asked for in the lesson but also any other possible result.

-The tools are embedded in the interactive learning applications and therefore not designed for multi-purpose use. They are intrinsically tied to the lesson itself and the images used.

While the tools themselves are not meant for multi-purpose use, the methods used to create them can of course be employed to create new lessons with different images.

The method shows that there are possibilities to use digital remote sensing data in schools and therefore not restricting oneself to visual interpretation. The use of software still is to be preferred in situations where there is more time for preparation and introduction but when it comes to every day use implemented remote sensing functionalities provide an alternative.

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Developement of a web-based remote sensing software for schools

Raimund Ditter
ditter@ph-heidelberg.de
university of education Heidelberg
Germany
http://rgeo.ph-heidelberg.de/

Alexander Siegmund
siegmund@ph-heidelberg.de
university of education Heidelberg
Germany
http://rgeo.ph-heidelberg.de/

Keywords: webbased software, modern learning, intuitive usability, technical features, newest didactical achievements, self learning experience, spatial behavior competence

Abstract: An international comparative study about the using of satellite images in schools has shown that there is a huge pedagogical potential in working with remote sensing systems in school. Most of the pupils are very interested in using satellite images. They are highly motivated to take a look on the earth from an upper position, as they know it from surfing with Google Earth. But what about processing and analyzing geospatial imagery by their own? The independent work with satellite images improves various geographical and methodological skills, as they are demanded in German curricular. There are many software solutions for professional users, such as ERDAS, ENVI or eCognition. These computer applications offer nearly boundless possibilities to advanced users, but they are unsuitable to be used in school, because of their nonintuitive utility and their high acquisition cost. The project, introduced as „Blickpunkt Fernerkundung (BLIF)" offers a way to establish remote sensing more frequently in school as a digital kind of modern learning. Going this progressive way, "BLIF" is providing a new and modern method to use the potential of satellite images in school. To establish the ´new way of learning´ into school with the chance of success, it is necessary to have an appropriate software solution for pupils. This software is going to be developed and integrated into a didactical main concept within the project of research and development, called "BLIF".

Characteristic features of this application, developed on the newest didactical achievements of remote sensing and technical standards, will be its intuitive usability according to the pupils age. It will be possible to have several special settings, depending on what kind of geographical question pupils want to explore and depending on their knowledge in using remote sensing systems. Because of that, the software can be used by a wide range of user – starting from a beginner level at the end of primary school up to an experienced user in secondary school (or senior high school).

The technical features range from normal basic features (like importing and exporting files, zoom function or the changing of vector files to image files and vice-versa), to the possibilities of image improvement (e.g. regulation of brightness, contrast settings or stretching) up to several kinds of supervised classifications and georeferencing.

The situations in which it is useful to work with this software application are numerous. Not only could it be used in a Geographical context, but also in Environmental Science, Mathematics, Information Technologies and in a lot of exercises which combines the mentioned or additional subjects. There is a wide range of relevant themes, like desertification, the development of cities, the agricultural and industrial land use or the exploration of natural resources. The first priority on handling satellite images will always be to encourage and motivate pupils to solve a geographical or Environmental Science problem on their own, while they are acting independent and feeling useful and important. To support them, the teachers and pupils will find in addition to the software, a tutorial and a selection of representative exercises which will give the pupils and also the teachers' helpful hints on how to use the software and how to interpret the results.

The development and the consistent testing of this web based software has still been done in co-operation with the a software company. After evaluating the software, by having an appropriate number of pre- and post-tests on several selected groups of pupils and comparing and analysing these test results with control groups, the application is available to all schools free of charge.

LEOWorks 4 for teaching Earth Observation – Current State and Future Upgrades

Steffen Dransfeld
steffen.dransfeld@esa.int
European Space Agency

Juerg Lichtenegger
jlichtenegger@bluewin.ch
European Space Agency consultant
Switzerland

Peter Brøgger Sørensen
peter@peterbrogger.dk
EduGIS, Denmark
Denmark

Francesco Sarti
francesco.sarti@esa.int
European Space Agency
Italy

Florin Serban
florin.serban@asrc.ro
Advanced Studies Research Centre, Romania
Romania

Vasileios Kalogirou
Vasileios.Kalogirou@esa.int
RSAC Ltd.

Abstract: As part of its educational mandate the European Space Agency ESA is maintaining the Eduspace website for learning, teaching and demonstrating Earth Observation techniques to secondary schools. At the heart of Eduspace lies the LEOWorks software which began as a simple but effective educational image processing tool, including only the most basic functions for viewing and processing imagery. Over the years the software has expanded in line with increasing availability of satellite imagery and algorithms for image processing. In its current version (LEOWorks 3) this package is able to perform more advanced processing operations including data analyses, data manipulation and filtering, image classification, geometric correction, image calibration and image animation. Moreover, it contains GIS tools that enable the user to display and query ESRI-based files in connection with images and generate additional layers among various other specific GIS operations. In the geospatial software domain, it is becoming increasingly more popular to follow an open source philosophy and Java implementation enabling widely spread code sharing and assuring platform independence at the same time. As LEOWorks 3 is based on IDL, the extent for future development is somewhat limited and it was hence decided for version 4 to be open source and implemented in Java. LEOWorks 4 benefits greatly from the existing ESA toolboxes BEAM and NEST, for optical and radar image processing respectively, that are also programmed in Java and open source. The additional functionality of LEOWorks 4 with respect to LEOWorks 3 will indeed combine optical and radar remote sensing as well a more extensive GIS module in a didactically presented package. Users will be able to directly import optical and radar satellite data from ESA's Envisat and other satellite missions (like ESA Third Party Missions) and perform filtering, band

mathematics, classifications, calibrations or coregistrations amongst many other complex functions. Besides the use for secondary school teaching, the more complex functionality of LEOWorks also targets the university entry level for EO education in order to provide an introduction to scientific EO data exploitation before users start scientifically complex processing using software packages such as BEAM or NEST. While this opens up a new user audience, LEOWorks 4 will keep a simple user-friendly interface, appropriate for its key use in secondary school classrooms. LEOWorks 4 is a project of 3-year duration which started in September 2008 with support from the developers responsible for the implementation of BEAM and NEST. This presentation will demonstrate the first major release to the user audience, who will be able to access LEOWorks 4 over the Eduspace Portal.

Teaching Remote Sensing for lectors at University level. A project at the University of Kisangani in Congo

Rudi Goossens
rudi.goossens@ugent.be

Therese Ongena
therese.ongena@ugent.be
University of Gent Geography department

Jean-Pierre Maté
jpmate2@yahoo.fr
Congo, the Democratic Republic of the

Keywords: teaching remote sensing university Congo

Abstract: End of 2007 a project started to set up a remote sensing laboratory at the University of Kisangani and training staff members. The project was funded by the « VLIR » (Flemish Inter-University Council) for an amount of 100.000 Euro. With this amount computers (4), air-conditioning (2), generator, current stabilisator, hand-held GPS, printer etc. where bought and shipped to Kisangani, all basic materials for a modest remote sensing laboratory. Also the renovation of an old building was paid for. The projects aims to give formation to staff members of the agronomy faculty in order that the can start with own remote sensing projects and to give on the long term education in remote sensing themselves. A first session in formation in remote sensing took place in January 2009 and a second will take place in September 2009. The enthusiasm of the participants is overwhelming, since for them it is very rare to have such an education for free in the hart of Africa. The contribution will show that it is worth to invest in the education on university level in Africa.

World of spreading cities seen from space – an example chapter of the SEOS project

Isabelle Kollar
kollar@ph-heidelberg.de
University of Education Heidelberg
Germany

Alexander Siegmund
siegmund@ph-heidelberg.de
University of Education Heidelberg
Germany

Keywords: SEOS project, remote sensing, high schools, mega cities, urbanization

Abstract: Cities are increasing in size and number all over the planet and especially in the developing countries. The growth of mega cities and settlements can be visualized and analysed with the help of modern remote sensing methods and time series of various satellite systems. Bringing this global and current topic vividly into schools is the aim of one module chapter in the European remote sensing project called "Science Education through Earth Observation for High Schools" (SEOS, Activity Code AERO-2005-2.3.2.1e). In this project altogether 15 interactive learning modules in five areas are under development at eleven European partners. The Department of Geography at the University of Education Heidelberg is developing two modules, one about the basic methodology of remote sensing and one module about using satellite images monitoring land use changes where the topic of urbanization processes is presented. The aim of the second module is to build awareness for the problems of land cover, land use change and land consumption in example areas with the help of satellite images in different landscape zones. An understanding for the local and global causes of land cover and land use change should be created through using satellite images and interactive learning modules. The focus of the presentation will be on analysing global urbanization processes, the increase of million and mega cities and on a case study city. The users should, after working with the module, be able to evaluate the ecological and economical consequences of land cover and land use changes and should analyse the future of urban areas.

Training for Decision Support Systems based on earth observation

Capacity Building Progrqam for Remote Sensing applications

Jan-Peter Mund

jan-peter.mund@dlr.de

German Aerospace Center DLR

Germany

http://www.dlr.de/caf/en/desktopdefault.aspx/tabid-4670/7729$_read - 11913/$

Keywords: Capacity building, Decision support systems, Continuous education, Remote sensing applicaton

Abstract: Increasing intensity and cumulative occurrences of natural and man-made hazards all over the world require detailed and up-to-date information on environmental parameters and processes. International projects and initiatives like GMES and GEOSS have been implemented to face lack of information in fields of environment and mankind. One of the projects' outcomes is the continuous development and implementation of Remote Sensing and Earth Observation (EO) technologies to monitor such hazards and disasters. New sensors and semi-automated EO-applications deliver continuous improving information to face these requirements. To make efficient use of the technical capabilities, the demand for a constant development of professional knowledge and Capacity Building (CB) is increasing rapidly. Furthermore a permanent documentation and management of the existing knowledge is a growing demand. This paper provides an overview about the DLR capacity building strategy for EO decision support systems as well as experiences of several Capacity Building activities of different intercultural learning environments. Projects such as WISDOM, GITEWS and others, provide tailor made decision support systems (DSS) based on EO-technologies to regional authorities and governments for early warning and adjusted disaster management. In case of WISDOM an Information System for the Mekong Delta, containing information from the fields of hydrology, sociology, information technology and earth observation was designed and implemented. Within GITEWS a DSS has been developed by DLR that disburdens decisions in case of Tsunamis by incorporating measurements from multiple kinds of sensors. The critical issue and key for a successful usage of such decision support systems after the project's end are continuous training and intercultural adapted capacity building measures. As an unconditional need, the officers in charge need profound knowledge of methods and information management, geospatial data handling and earth observation techniques. These capacities offer them comprehensive assessment, interpretation and establishment of various up-to-date Earth observation and GIS data sets. Subsequently new spatial information products function as inherent data sources for further management and decisions making processes. Naturally the Environment and Security Section of the German Remote Sensing Data Center of DLR offers customised trainings and tailor made course programs as an integral part of their project contribution to WISDOM and GITEWS. These Capacity Building instruments comprises of modules and continuous education programmes for remote sensing scientists and PhD students, personnel of international projects as well as affiliates of national EO-Institutions and other partner organisations. The overall ambition is to strengthen the competencies of scientists, decision makers and team leaders, as well as constant support for expanding the technical, administrative and institutional capacities and structures.

SEOS: A Learning Management System for Remote Sensing

Presentation on technical results of the SEOS Project

Thomas Severiens
severiens@isn-oldenburg.de
Germany

Eike Bernhardt
bernhardt@isn-oldenburg.de
Germany

Abstract: Within the SEOS (Science Education through Earth Observation for High Schools) project a learning management system for schools was developed. Here, we present the results of this development, which brings together the content modules of the project with distributed high value content from the web into a closed and controlled framework of a virtual classroom.

An interactive learning tool for the instruction of remote sensing at a University level

Nektaria Eleni Adaktilou
nadak@phys.uoa.gr
Research Assistant

Costas Cartalis
ckartali@phys.uoa.gr
Associate Professor
Greece

George Kalkanis
kalkanis@primedu.uoa.gr
Professor
Greece

Keywords: remote sensing, learning platform, blended learning, collaborative practices, scientific method

Abstract: The goal of this study is to present the development of a learning platform as a tool for the instruction of Remote Sensing at a University level. The platform allows students who have access to use the learning material that has been created for the Remote Sensing course and to perform main processing procedures using the ERDAS Imagine Software and following step-by step instructions. The platform has been designed so as to include pedagogic principles. The learning activities for the students follow the Scientific Method steps, while collaborative practices are very well-supported by the nature of the tool itself. A holistic approach of the thematic area is attempted and students may access interesting links with resources and news and use a forum or the e-mail to exchange views on the course with fellow students or instructors. The platform has undergone a rather thorough formative evaluation by a group of students of the Physics Department of the University of Athens. Existing indices were incorporated in the evaluation framework, while others were created in order to assess the platform's effectiveness and potential usability, from its technological, scientific and pedagogical aspect. The scores achieved indicated that the platform may be integrated in a blended learning environment in an effective way. It may enhance the students' learning processes as a more diversified and flexible tool and provide efficient ways to communicate knowledge to students and facilitate more in depth understanding of Remote Sensing principles.

Theory Guided Development of Interactive Learning Environments for Imparting Remote Sensing Knowledge

Testing Simulated Microworlds in the Teaching of Remote Sensing

Henryk Hodam

h.hodam@geographie.uni-bonn.de

Remote Sensing Research Group, Department of Geography, University of Bonn

Germany

Keywords: remote sensing, teaching, interactive, simulated microworlds, 3D,2D

Abstract: Teachers of geography at university level often meet difficulties when it comes to conveying principles of remote sensing to students. Generally, there is no previous knowledge to build up on and due to its interdisciplinary nature and the strong influences of physics, maths and informatics, students may be discouraged and lose interest in a scientific and industrial branch that is of ever growing importance. Computer supported interactive lessons can provide an alternative and may be the key to overcome those starting difficulties. During the course of this PhD - work different interactive learning environments are to be developed and investigated regarding their effectiveness to convey differently characterised learning topics.

Regarding interactive media remote sensing in German universities is mostly unexplored territory. Its richness of different topics to teach as well as the absence of previous knowledge among its students could make remote sensing a good proving ground for measuring the effectiveness of different kinds of interactive media.

Simulated microworlds present the top level of interactivity. The learner is confronted with a working model of the principle to be taught. He can freely change the parameters of this model to get results that are not necessarily right or wrong but results helping him to construct a model on his own. A mental model that is directly derived from the interactive model he is working with. Although there are examples for interactive learning environments in remote sensing in Germany none of them provide such a level of interactivity.

At present the technological possibilities to construct interactive lessons range from simple control navigation to complex 3d simulation. Not a lot is known about how those technologies influence the knowledge construction of the user. For a better understanding of those influences this work will concentrate on the issue of 3d and 2d display technologies to find out whether one of those technologies has advantages in imparting remote sensing knowledge of abstract or concrete nature. A general footprint of how this is to be achieved as well as first proceedings in the development of the interactive media itself will be presented.

Eduspace

Eduspace - the European Earth Observation Web Site for Secondary Schools

Peter B Sørensen
peter@peterbrogger.dk
EduGIS
Denmark

Juerg Lichtenegger
jlichtenegger@bluewin.ch
Switzerland

Francesco Sarti
francesco.sarti@esa.int
ESA
Italy

Ana B Ruescas
ana.belen.ruescas.orient@esa.int
ESA
Italy

Linda Moser
moser.linda@gmail.com
ESA

Chris Stewart
chris.stewart@esa.int
ESA

Steffen Dransfeld
steffen.dransfeld@esa.int
ESA
Italy

Birgit Strømsholm
birgit@rocketrange.no
NAROM
Norway

Florin Serban
florin.serban@asrc.ro
ASRC

Keywords: Eduspace, EO, Earth, Observation, education, LEOWorks

Abstract: Eduspace is the web site for Earth Observation (EO) enabling secondary schools to bring EO into the classroom for teaching and learning. The content is structured with relevant projects based on EO data, analysed with the help of appropriate tools and guidelines for both students and teachers. The content is developed with the co-operation of EO specialists and experienced teachers to ensure that the projects are both scientifically correct and relevant for the classroom. Eduspace projects can be used in the teaching and learning of several subject areas such as human geography,

physical geography, environmental sciences, physics, biology and computer science. Many projects can form the basis for cross-curricular work involving two or three subjects. Each project concentrates on a specific theme such as weather systems, climate and climate change, glacier dynamics, deforestation, a national park, a world heritage site, urban expansion and agricultural patterns. There are examples from almost all continents. The goal is to put the students in the centre of the learning process, working with real EO data using semi-professional tools, guided by the project description with more or less detailed exercises and questions. In the classroom, access to relevant data is important. Eduspace has collections of data from Europe, Africa, South America and the Himalayan region covering both landscapes and city areas. In many cases the study can be based on a series of images of the same location, to study changes over time. The Eduspace Image Catalogue has full coverage of Europe with ERS, Landsat 5 and Landsat7 images, with MERIS and ASAR data to come. Registered Eduspace users can search and download images of 1000x1000 pixels size. These satellite data can then be visualised and analysed using the image processing software LEOWorks developed especially for Eduspace. LEOWorks is a simple yet very powerful tool. It has been designed for the dual purpose of usefulness in the classroom and as an introduction to image processing. Working with multispectral images, it is possible to combine single bands into colour images, to make measurements of lengths, to make both unsupervised and supervised classifications based on selection of training fields, to calculate NDVI and to make an animation to mention a few of the tools available. In addition to this, LEOWorks has a GIS module that can read industry standard GIS files as well as enabling the students themselves to create GIS layers as part of their work with Eduspace projects. A project is divided into four parts: introduction; background information; exercises with or without the use of LEOWorks; and a list of useful external links. The projects can be used as they are or can form the basis of the teacher's own plan for teaching the specific theme. The projects focus on visualisation of the raw EO data by stressing the importance of the pixel value. This means that the students can analyse the images with this knowledge and therefore understand many of the operations used in image processing analyses. Although the projects are aimed at secondary and upper secondary school students, some of the projects can be used in EO introduction courses at university level. Currently Eduspace is available in the following languages: English, German, French, Spanish, Italian, Danish, Dutch and Portuguese.

SEOS: Ocean Currents

Science Education through Earth Observation for High Schools: Module 8

Valborg Byfield
valborg@noc.soton.ac.uk
National Oceanography Centre, Southampton
United Kingdom
http://www.noc.soton.ac.uk

Colette Robertson
ycr@noc.soton.ac.uk
National Oceanography Centre, Southampton
United Kingdom
http://www.noc.soton.ac.uk

Paolo Cipollini
cipo@noc.soton.ac.uk
National Oceanography Centre, Southampton
http://www.noc.soton.ac.uk

Abstract: Ocean waters are always on the move. The flow of ocean currents carry warm water from the tropics warming high latitudes, and return cold water from the poles towards the equator. Water evaporating over the oceans interact with prevailing winds to influence rainfall patterns across the continents, sometimes creating droughts or floods. Through their influence on global and regional climate, ocean currents have a profound effect on our daily lives, both now and in the future.

The role of the ocean in the Earth's climate system is not the only reason for studying ocean currents. The flow of currents also help to create fertile fishing grounds where they mix deep water up to the surface in coastal upwelling regions, current eddies and in fronts where water from different currents meet and mix in ocean fronts.

The SEOS module on ocean currents aims to increase awareness of how the ocean impacts our daily lives, even if we live a long way from the sea. Each of the six main chapters include interactive material designed to stimulate student understanding. The first deals with the most important reasons for studying ocean currents, including their influence on climate, food security, maritime transport and leisure activities. This is followed by chapters giving more details of the wind driven surface currents, the global heat conveyor - a system of surface and deep currents, the influence of currents on life in the ocean, and the role of local currents in connection with tidal energy and the transport of pollutants such as oil. The last chapter deals with the many ways in which we can study ocean currents, with particular emphasis on measurements by a range of satellite instruments used to study ocean currents - from altimeters and SAR to sea surface temperature and ocean colour.

SEOS: Ocean Colour in the Coastal Zone.

Science Education through Earth Observation for High Schools: Module 7

Hendrik Jan van der Woerd

hans.van.der.woerd@ivm.vu.nl

IVM

Netherlands

http://www.vu.nl/ivm

Marieke A. Eleveld

IVM

Netherlands

http://www.vu.nl/ivm

Irene Kingma

IVM

Netherlands

http://www.vu.nl/ivm

Rainer Reuter

UOL Oldenburg

Germany

Keywords: Primary production, Light, Ecosystems, Eutrophication

Abstract: We will present the module on coastal water quality that is being developed within the Science Education through Earth Observation for High Schools (EU-SEOS) project. The aim of this module is to learn important functional aspects of the coastal zone by analysing ocean colour images. Sensors like MERIS (ESA) and MODIS (NASA) on recently launched satellites are especially designed for observations of coastal waters since they can cope with complex spectral signals. It is now possible to create maps showing the distribution of algal pigments, suspended material and transparency and solar photo-synthetically active radiation (PAR) available for phytoplankton growth. In this module the students will experience that our European coastal waters are frequently observed from space and that relevant information is available on-line. The module will contribute significantly to an understanding of coastal resources: coastal water quality is a complicated issue affected by a large number of parameters including human activities (river-run-off, fisheries) and numerous consumer products are produced in coastal areas. The presented module will introduce the relation of biodiversity to eutrophication and the need for monitoring coastal waters: · Light and life: Students will start to understand the role of light in water. A link is made to growth, in particular the available light for algae and water plants to grow · Ecosystems: Understanding and visualisation of human impact on coastal eco-systems, in particular eutrophication. · Health: Increase the capabilities to monitor harmful algal blooms in coastal waters and the potential risk for the quality of products such as shellfish.

SEOS: Optics, Spectroscopy and Laser Remote Sensing

Science Education through Earth Observation for High Schools: Modules 6 and 9

Rainer Reuter
rainer.reuter@uni-oldenburg.de
University of Oldenburg
Germany
http://las.physik.uni-oldenburg.de

Christina Klose
University of Oldenburg
Germany

Hans van der Woerd
Free University of Amsterdam
Netherlands

Keywords: SEOS, e-Learning modules, physics curriculum, high school teaching

Abstract: Teaching physics in high schools is not always straightforward. Students are confronted with a series of formulas and theories that are often difficult to understand and to relate to every-day life. Therefore, two tutorials address topics of physics curricula where interest of students can be attracted with Earth observation data: 'Understanding Spectra from the Earth' and 'Laser Remote Sensing'.

In the first instance both tutorials aim at teaching optics, spectroscopy and elements of electricity and magnetism. This includes themes such as geometrical and wave optics, spectra of light and radiation, electromagnetic waves and photons, vibrations and waves, physics of light sources including lasers, optical instruments for measuring light and radiation intensity and imagery. These themes are presented with examples from the student's daily life. But the focus is given on remote sensing data of the earth surface, the atmosphere and the oceans, to the spectral information included therein and to the methods used to measure spectral images onboard satellites.

Further to these aspects the modules shall emphasize interdisciplinary and integrative approaches in the curricula of schools. Indeed, remote sensing data used in these modules have a unique potential for interdisciplinary education. Beyond optical phenomena which are evident in satellite images, they include information relevant to topics of other science disciplines such as land cover and vegetation, environmental hazards, ocean currents and temperature, atmospheric constituents and weather phenomena, and many others. They also link these topics to actual themes such as climate change. This will help building bridges between physics and the other science disciplines in high school education.