Living Planet Symposium Prep – Reframing the K12 Strategy

ESA, DLR et al.
WGCapD-5 Agenda Item #35
Working Group on
Capacity Building & Data Democracy
Hampton, Virginia, USA
March 29th – April 1st, 2016
## EO School Lab - General Concept

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<th>Instructor</th>
<th>Process</th>
<th>Product</th>
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Main efforts

• Increase awareness for EO data at the secondary school level
• Provide practical educational tools addressing remote sensing techniques and methods to analyse and process remote sensing data
• Provide access to practical Earth observation education facilities managed by participating Agencies
• Establish practical education showcases at international conferences
• Create and deliver educational toolboxes, including software, Earth observation data, and tutorials for user-friendly image processing at the secondary school level, as well as the lower university level
• Provide practical demonstrations for schools based on real experiments (e.g. use of spectrometers, radiometers, radar devices)
• Educate the general public about the benefits/applications of EO
Realization #1

EO @ School
in Germany
- supported by
DLR Space Directorate
FIS – Remote Sensing in Schools
FIS – Remote Sensing in School Lessons

Learning Portal on Remote Sensing

Remote Sensing in Schools

Welcome...

to the website of the FIS Learning Portal. The „Remote Sensing in Schools” project is part of the Remote Sensing Research Group which is situated at the Department of Geography of the University of Bonn. The projects aim is to integrate remote sensing topics into school education.

Learning with digital images.

On our pages you will find plenty of digital material like e-learning modules and research tools as well as a vast range of background information and didactic Commentaries on satellite based remote sensing.

We hope you will enjoy working with our materials.
FIS – Remote Sensing in School Lessons

Teaching Materials

Satellite images are more and more easily accessible. The increasing number of different sensors is paralleled by the spatial and temporal resolution of remote sensing data. Therefore, current topics such as natural disasters, climate change or urbanisation can be illustrated by informative imagery. Our learning modules and analysis tools help the pupils analyse these images in a problem-oriented and active fashion.
FIS – Remote Sensing in School Lessons
Teaching Materials – Floods-Dealing with a Constant Threat
Columbus Eye –
Live Videos of the ISS in Schools
HDEV – High Definition Earth Viewing
4 HD-Video-Cameras on the Columbus External Payload Adapter

- Mounted on ESA Columbus Laboratory on 30 April 2014
- Ground resolution: ~ 280m
- On-Orbit-Test of 4 commercial HD-Video-Cameras
- During operating time the cameras are tested according to image quality
- 2 backward-, 1 forward- and 1 nadir-looking
HDEV – High Definition Earth Viewing
Four Cameras – Three Perspectives

Panasonic – Aft View (Florida)

Sony – Aft View (overexposed)

Toshiba – Nadir View (Cuba)

Source: NASA
Columbus Eye – HDEV in Schools
Learning Tools on HDEV-Images of the ISS
Columbus Eye – HDEV in Schools
Communication within the Columbus-Eye project

Columbus Eye team (Univ. Bonn)

HDEV cameras

program

exchange

create

create?

use

Secondary schools in Germany

Graduate students (Univ. Bonn)

Data, teaching material, features

Road Show

request

request

create

exchange

Columbus Eye – HDEV in Schools
Communication within the Columbus-Eye project
Space Education & digital Geomedia
Fields of Competence & Applications
of the Research Group for Earth Observation – ˈgeo

Prof. Dr. Alexander Siegmund
University of Education & University Heidelberg
Dept. of Geography, Research Group for Earth Observation – ˈgeo
Best Practice: Remote Sensing – from Elementary to Secondary

- **On the way: Adaptive Learning on EO**
  - Web-based learning Environment: “Space4Geography”

- **Learning with original Satellite Data**
  - (pre-processing, analysing, classification etc.)
  - Web-based software: “BLIF”

- **Learning with pre-processed Satellite Data**
  - (true/false color composites etc.)
  - Web-based Learning Platform: “GLOKAL Change”

- **Learning on a Game Level**
  - Web-based Learning Game: “SILC” – Satellite Image Learning Center
Nationwide analysis of curricula and definition of relevant topics

Concept of the web-based learning environment

- **Learning modules**
  - 10 geographical key topics
  - Examplary application of remote sensing
  - Problem-oriented web-based learning
  - Interactive multimedia content, e.g. 3D-visualisations and animations prepared in cooperation with DLR/DFD

- **Web-based remote sensing software**
  - Image processing and analysis (BLIF)

- **Geo-Mapserver**
  - Satellite image database (*RapidEye, TerraSAR-X, Landsat 5/7/8*)

Testing phase (DLR_School_Lab Oberpfaffenhofen, GIS-Station)

Nationwide dissemination (promotion and training of multipliers)
Geographical Topics & Environmental Challenges

- Sek I + II Geography
- Close link to the curricula
- Topics: land use conflicts, urbanization, natural hazards, renewable energies, urban climate, deforestation, glaciers, agriculture,…

Remote Sensing Image Analysis

- ...with the integrated educational remote sensing software BLiF
- Provision of original satellite data: RapidEye, TerraSAR-X, Landsat, …
- Processing chain:
  a. data import & AOI definition
  b. image enhancement
  c. band composites
  d. vegetation indices
  e. image classification & change detection

E-Learning Educational Approach

- Multicodal & interactive
- Individual learning: adapts and personalizes learning content to meet individual skills, needs and preferences of the learners
- Instant feedback for the learners
- Learning transfer & problem-oriented learning
- Course management functions

… – Prof. Dr. Alexander Siegmund

Space4Geography
Active RS-Data: Analysing urban footprint with TerraSAR-X
Realization #2

ESA Activities
Secondary Schools -
Training and Education
in the Frame
of International Cooperation
Creation of **Tools for secondary schools:**

- Books and posters (also for **general public**)
- Atlases, i-books (also for **general public**)
- Apps for Tablets (also for **general public**)

- Multilingual web-based tools (EDUSPACE),
- educational SW package for Image Processing and GIS (LeoWorks),
- School Lab
- Collection and distribution within ESERO project (European countries / curricula)
Eduspace: ESA web-based EO
Educational tool for secondary schools

About Eduspace
What is Eduspace?
What tools does it offer?
Languages...

Remote Sensing Principles
What is remote sensing?
Remote sensing in depth
History of Earth observation
Mapping and satellite data
Satellite orbits
Resource satellites
Weather satellites
Resources...

Multimedia
Image Gallery
Video Gallery
МИРАВИ: Earth live

Services
About Eduspace
What is Eduspace?
What tools does it offer?
Choose your language
Remote Sensing Principles
What is remote sensing?
Remote sensing in depth
History of Earth observation
Mapping and satellite data
Satellite orbits
Earth observation satellites
Resources...

Multimedia
Image Gallery
Video Gallery
Services
Contact us
Search in Eduspace

Earth from Space
Image of the week

Flash floods in Thessaloniki
Floods are considered one of the most cataclysmic natural disasters. They affect more people than any other natural disaster, posing serious risks for people’s lives, properties and infrastructure. Due to the increasing frequency of severe flood events, as well as evidence of global climate change and rise in sea levels, floods are now considered a serious threat.

The Gulf Stream
The Gulf Stream is a warm, fast flowing current that forms the western boundary of the North Atlantic Gyre. During its course, its temperature gradually drops as it releases heat into the atmosphere.

Climate change and glaciers
Detecting and quantifying glacier retreat and advancement, glacier area changes, and glacier ice thickness is one of the most important contributions satellite technology can make to further our understanding of climate change. For a large number of glaciers, especially those found in remote places, satellite remote sensing is the only method scientists have to study them.
LEOWorks 4.0

- View images, histogram, pixel values, header info
- Crop, invert, stretch, layer stack, etc
- Image arithmetic, filters
- Classification, PCA, geometric correction, pan sharpening
- Radar and optical module (multimission, including Sentinel data)
- GIS tool
- Open-source, Java-based
Satellite Data: Landsat TM
Available at Glovis / USGS
Ötztal Alpes, Austria
September 1986

Landsat TM, RGB 5/4/3

Gepatsch reservoir
Gepatschferner
Vernagtferner
Hintereisferner
Ötztal Alpes, Austria
September 2003

Landsat TM, RGB 5/4/3
Change Detection
Combination – transparent overlay
Change Detection
export image to Google Earth
Educational App for EO

- For iOS tablets (iPad, iPad mini)
- Can be used as presentation tool and as support to school or educational lab classes
- Not available on the online stores at the moment
Sentinel App

For iPhone and iPad

- Will be also on Google Play (Android phones, tablets) in April

- See where the Sentinel satellites are in real-time
- See the last and next time they have been and will be over your location; Move them to the time of the last data transmission and smoothly move them back to their current location over the 3D globe
- Explore the Sentinel satellite 3D models
- Get information and news about the Copernicus Programme
- Get information about access to Sentinel data
- Set Notifications to be warned when satellites are flying by.
Creation of posters for schools

WHAT IS REMOTE SENSING?

"Remote sensing" is defined as the acquisition of information about an object without being in physical contact with it. A photographer taking a photo of a landscape is doing remote sensing, using a camera as a sensor.

When the target is far away from the sensor, as in the case of satellite remote sensing, we need more sophisticated instruments.

A sensor is a device that measures the amount of electromagnetic radiation, it receives and transform it in an electric signal which is then tested and used to ground.

By means of satellite uplinks, both active and passive, we observe the Earth and measure important geophysical parameters, in order to monitor the status and the "health" of our planet.

SATELLITE ORBITS

Satellites in space follow trajectories called orbits. The orbits of planets, so called natural satellites, were described by J. Kepler at the beginning of 17th century. Artificial satellites placed into space by humans follow the same laws of planetary motion. These laws are based on the principle of universal gravitation formulated by I. Newton in the end of the 17th century.

Near Polar Sun-Synchronous Orbits

There are a nearly circular orbits, almost perpendicular to the equatorial plane, orbiting the Earth. On a sun-synchronous orbit, a satellite passes over the same geographical areas at the same local times each day, a few days apart. This allows consistent monitoring of Earth's surface. After that period, they cover different parts of Earth at the same time, which is very useful for scientific purposes.
Introduction to ESA; Earth Observation; Global Overview; Continental Overview; the Natural Sphere; The Cultural Sphere.

Annex: Teachers’ Handbook, DVD-ROMs with the original bands of the satellite data, handbook content and exercises, connected to Eduspace and its SW Leoworks.
Long-term cooperation in organising joint Workshops for Secondary School teachers with Earsel (European Association of Remote Sensing Laboratories)

Recent Earsel Workshop and Training in ESRIN on RS for Archaeology (Nov 2015)

Preparing Bonn (June 2016), Beijing (July 2016) and Krakow (Sept 2016)

Earsel training events
Target: European students starting from an early age (primary and secondary education)

Goal: using the space context to make the teaching and learning of STEM subjects more attractive

ESERO offers an annual series of national or regional training sessions for both primary and secondary school teachers, offered in collaboration with national partners

Presently located in:
- **Belgium**: Planetarium of the Royal Observatory of Belgium in Brussels
- **Czech Republic**: Prague, with Charles University of Prague and others
- **UK**: based at the National STEM Centre in York
- **Ireland**: Dublin, with the Science Foundation Ireland
- **Netherlands**: at the Nemo Science Learning Centre in Amsterdam,
- **Nordic ESERO**: Denmark, Finland, Sweden and Norway (based at NAROM),
- **Poland**: in the Copernicus Science Centre in Warsaw,
- **Portugal**: in the Knowledge Pavilion, Lisbon,
- **Romania**: based in the Romanian Space Agency
The content of most training courses can be linked from the central web page for ESA EO Education and Training:

https://earth.esa.int/web/guest/EO-education-and-training
Realization #3

DLR_School_Lab
Promoting the Next-Generation Scientists
DLR Site
Oberpfaffenhofen

Employees: Approx. 1,700
Size of site: 245 000 m²
Research institutes and facilities:

- Microwaves and Radar Institute
- Institute of Communication and Navigation
- Institute of Atmospheric Physics
- Remote Sensing Technology Institute
- Institute of Robotics and Mechatronics
- Institute of System Dynamics and Control
- German Remote Sensing Data Center
- Space Operations and Astronaut Training
- Galileo Control Center
- Flight Experiments
Experiments @ DLR_School_Lab Oberpfaffenhofen
Represent the Research of All 10 DLR Institutes

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<th>Experiment</th>
<th>Institute</th>
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<td>Remote Sensing Technology</td>
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<tr>
<td>2. Laser Technology</td>
<td>Physics of the Atmosphere</td>
</tr>
<tr>
<td>3. Radar Technology</td>
<td>Microwave and Radar Technology</td>
</tr>
<tr>
<td>4. Optical Remote Sensing</td>
<td>Remote Sensing Data Center</td>
</tr>
<tr>
<td>5. Weather and Climate</td>
<td>Physics of the Atmosphere</td>
</tr>
<tr>
<td>6. Satellite Data Analysis</td>
<td>Remote Sensing Data Center</td>
</tr>
<tr>
<td>8. Robotics</td>
<td>Robotics and Mechatronics</td>
</tr>
<tr>
<td>9. Virtual Mechanics</td>
<td>System Dynamics and Control</td>
</tr>
<tr>
<td>10. Flight Team Simulator</td>
<td>Flight Operations</td>
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<tr>
<td>11. Mobile Rocket Basis</td>
<td>Space Operations</td>
</tr>
<tr>
<td>12. ASUROnaut</td>
<td>Robotics and Mechatronics</td>
</tr>
<tr>
<td>13. Tunnel Boring Machine</td>
<td>Technical University Munich</td>
</tr>
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13 High Tech Experiments

Competent Mentoring

Authentic Ambience
Experimental Concept

...Representing the DLR-Institutes’ Competence

⇒ Authenticity

...Didactical Transfer

⇒ Inquiry-Based Science Education
DLR_School_Lab
Oberpfaffenhofen

- 13 years
- 30,000 secondary school students
- 3,000 teachers
- 3,500 MINT talents
- 300 teachers of the gifted
Realization #4

EO School Lab
@ International Conferences
- an ESA-DLR Initiative
Our Goals

• Attract (young) people to EO
  – Technology
  – Missions
  – Software
  – Data
  – Applications

• Create awareness for the usefulness of EO – especially in developing countries

• Demonstrate advantage of combined expertise
Joint DLR/ESA EO Education stand at IGARSS 2012 in Munich

Combined lab experiments, training sessions and 3D Demonstrations
The DLR School Lab experiments presented at IGARSS.

The School Lab was combined with ESA lectures and computer practicals based on Eduspace
(http://www.esa.int/SPECIALS/Eduspace_EN/) in a joint ESA/DLR EO Education stand for school visits
EO training sessions for high schools delivered by ESA.

(More info at: http://www.esa.int/SPECIALS/Eduspace_EN/)
Living Planet Symposium 2013
Edinburgh, United Kingdom, 09 - 13 September

→ a DLR/ESA/UK Space Agency EO education stand based on IGARSS 2012

The 2013 European Space Agency Living Planet Symposium follows the previous successful symposia held in Bergen (2010), Montreux (2007) and Salzburg (2004).

The event will be held in Edinburgh, United Kingdom from 9 to 13 September 2013 and is organised with the support of the UK Space Agency.

A first call for abstracts has been released, with a deadline for abstract submission on 15 February 2013. All received abstracts will be reviewed by a Scientific Committee, notification of acceptance will be provided in May 2013. Full papers for accepted contributions shall be provided at the event and will be published as ESA Special Publication.
LPS School Lab

Edinburgh International Conference Centre
10 - 13 September 2013

Learn about the science and technology behind Earth Observation through half day sessions of lab experiments and demonstrations. Includes an exhibition tour at a major science conference.

Suitable for:
• Groups of ~15 students at S5 or S6 level*
• CPD sessions available for educators

* Includes content that complements the Biology, Chemistry Geography, Physics Higher and Advanced Higher and provides a clear example of interdisciplinary science

For FREE registration and information visit:

Image credit: ESA and DLR
Living Planet Symposium 2016

The 2016 European Space Agency Living Planet Symposium follows the previous successful symposia held in Edinburgh (2013), Bergen (2010), Montreux (2007) and Salzburg (2004).

The event will be held in Prague, Czech Republic from 9-13 May 2016 and is organised in cooperation with the Ministry of Transport, Ministry of Environment and Ministry of Education, Youth and Sports of the Czech Republic and the local support from Charles University in Prague.

A first announcement has been released, with a deadline for abstract submission on 16 October 2015. Authors can check here their submitted abstracts. All received abstracts have been reviewed by a Scientific Committee. Notification of acceptance has been provided in early February 2016. Registration to attend the event (free of charge) has been opened in February 2016 with deadline on 22 April, after the publication of the preliminary programme. We thank our Sponsors for the support.

Full papers for accepted contributions shall be provided at the event and will be published as ESA Special Publication. An Exhibition will be running from 9 to 12 May 2016. Before the official opening on Monday 9 May, keynote presentations are scheduled.

Latest News

23-March-2016: A School lab is organised during LPS16!
LPS School Lab
Prague Conference Centre
9 - 12 May 2016

Learn about the science and technology behind Earth Observation through half day sessions of lab experiments and demonstrations. Includes an exhibition tour at a major science conference.

Suitable for:
• Groups of up to 40 secondary school students
• Sessions available for educators

* Includes content that complements Biology, Chemistry Geography, Physics and provides a clear example of interdisciplinary science

For FREE registration and information visit: http://www.xxxxxx...
Plan of the School Lab zone with areas assigned to each agency. The WELCOME area is planned for the introduction (first 15 minutes of each session) and for the feedback collection (last 15 minutes of each session).
Creation of joint School Labs with ESA, DLR, UKSA and UK national space academy, Charles University.

Such as IGARSS 2012 and LP Symposium 2013 and LP Symposium in May 2016. Demonstrating RS to schools using instruments such as: Field Spectrometer, Thermal camera, UV light, Stereo Optical Camera, possibly enriched by many other experiments and 3D / oculus technology.
1) Global Issues from Above (EO tablet app)

For Android (now) and iOS (July 2016)

Czech and English,
other languages possible

Introduction to EO
and Global issues
applications
2) Two textbooks and 18 educational programmes for basic and secondary schools
Thank you
USEFUL ADDRESSES

- ESA education portal: www.esa.int/education
- to order EO material: education@esa.int or eohelp@esa.int
- Eduspace: www.esa.int/eduspace
- ESA EO Education web page: http://eo-edu.eo.esa.int
- DLR_School_Lab:
Remote Sensing
(introduction to principles and function)

True and false colours
Choose a surface type and drag the bar across the image to see how false colours make the surface type stand out.

When processed by special software, satellite images can be displayed in true or false colours. A true-colour image shows surfaces the same way as the human eye sees them. By converting an image into a false-colour image, we can highlight things that are not distinguishable in a true-colour image, such as different types of vegetation.

In a true-colour image a forest looks completely uniform. In a false-colour image we can, for example, tell a coniferous forest from a deciduous one, or distinguish the height of the trees.

Orbits
Geostationary orbit
A geostationary orbit is an orbit above the Earth's equator. Since satellites in such an orbit move at the same speed and in the same direction as the Earth's rotation, they seem to hang in the sky above the same place on the Earth's surface (always above the equator). These satellites monitor the same area all the time, being unable to “see” the opposite hemisphere of the polar region.

Polar orbit
Satellites in a polar orbit fly in a plane that is approximately perpendicular to the equator. When the Earth's rotation they monitor a different area on each of their orbits and are thus able to cover the whole surface of the planet over time. However, they are not able to monitor one place on a continuous basis.

Why observe the Earth with satellites?
By clicking on the small satellite/eye, you can change the referred question. At the bottom, you can switch between a forest and a bus.

The human eye is only capable of detecting some of the infrared electromagnetic radiation – the visible light. Satellites or, more precisely, the instruments carried by satellites are able to record other parts of the electromagnetic spectrum as well (such as ultraviolet and infrared radiation), thus collecting more information than humans, after they are launched, they still the Earth for many years, sending out huge amounts of data without the need for human intervention.
► Global issues – EO applications

Diminishing tropical forests

Ocean pollution

Desertification

(Human stupidity)
4) E-learnings for basic and secondary schools