The new version of ESA Eduspace website: A multi-lingual Earth Observation resource for secondary and tertiary education

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ABSTRACT

The ESA Eduspace website was developed to introduce Earth observation techniques and applications to secondary school students, although some material is also suited for undergraduate university level. Since its launch in 1998, it has provided an invaluable educational resource, by making available catalogues of Earth imagery and a sophisticated image processing software package called LEOWorks, which enables satellite imagery to be manipulated and analysed on school computers. The cornerstones of the website are the case studies. They provide teachers and students with examples of in-depth analysis within a particular theme. The background information and varied exercises provide a valuable source of ideas on how to introduce Earth observation from space into the classroom. Eduspace is currently available in nine languages: English, French, German, Danish, Dutch, Italian, Spanish, Portuguese and Greek.

Keywords: ESA, Eduspace, website, Earth observation, education

1. INTRODUCTION

With its origin dating back to 1998, the European Space Agency (ESA) (url1) Eduspace multi-lingual website (Fig. 1, url2) is a corporate activity run by the ESA Education Office. The main objective of Eduspace is to provide attractive material and tools to teachers and students, which can support their teaching and learning of topics in Geography, Physics, Environmental Science or related subjects, enhancing the learning process and outcome.

To this end, Earth Observation (EO) and associated technology are used, in order to stimulate the students' curiosity for science and technology. Terms and complex concepts are explained in easy words and with intuitive examples that can trigger the students' interest.

The main value of Eduspace lies in the practical nature of its e-learning content. The website not only explains didactically the theory and applications of EO, but also provides practical examples of EO utilisation in the form of case studies. These case studies are produced by a team of scientists and experts, in cooperation with ESA consultants with extensive didactical expertise. In each case study, students are presented with a particular real-world problem, which they need to address through hands-on processing of EO data, using dedicated ESA educational software (LEOWorks 4).

Apart from secondary education, which is the main target audience, and depending on the selected topic/case study complexity and level of students, Eduspace can be particularly

useful in both undergraduate university education, as well as at post-graduate level (the latter for non-specialists in EO). Of course, access to the website and to its full content is free of charge for anyone interested, with no restrictions or prerequisites, while ESA provides regular and ad-hoc Eduspace-based training sessions for students and teachers worldwide.

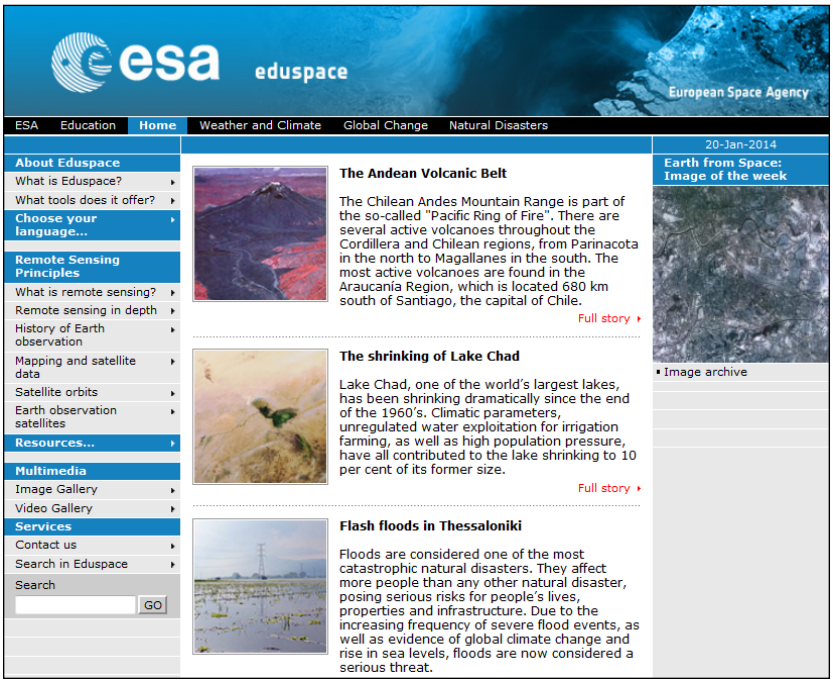

Figure 1. Homepage of the ESA Eduspace website (url2).

2. RECENT DEVELOPMENTS

2.1 Overview

The developments foreseen in Delvoye et al. (2010) and many more have now been implemented. In March 2010, a completely new version of Eduspace was published. The new version has been modernised with an entirely new interface, structure and programming architecture. The majority of the old content has been removed or significantly adapted. Since then, more than twenty new case studies, each of around ten pages, have been published on Eduspace, while significant changes and restructuring of existing content has taken place. The new case studies published in the last three years include: four focused on disaster monitoring topics: storm surges, floods and volcanoes (“Hurricane Katrina”, “Flash floods in Thessaloniki”, “Nyiragongo and Nyamuragira”, “Etna”); three on applications related to weather and climate (“El Niño”, “The shrinking of Lake Chad”, “The Gulf Steam”); a number of case studies related to specific events in South America, particularly in the Andean region (“Lost in the Andes”, “Vegetation in South America”); two case studies on the remote sensing of glaciers (“Glacier Ice Flow”, “Climate change and glaciers”); some more on change detection (“Danube Delta change detection”, “Urban sprawl in Cordoba”, “Deforestation in Rondonia”); and finally, an interactive case study on the interpretation of near real-time Meteosat images, with the possibility to upload weather observations and to compare with those of other students around Europe.

In September 2011, the Greek translation of Eduspace was completed, increasing the number of available languages to nine (English, German, French, Spanish, Italian, Danish, Dutch, Portuguese and Greek).

In early 2013, the content of Eduspace has been re-structured to categorise material and case studies into three major thematic areas: (a) weather and climate (b) elements of global change and (c) natural disasters. This new structure, with new headers at the top dividing the case studies into the three themes, was published on-line at the end of June 2013.

2.2 Image catalogue

In June 2013, following development which began in 2011, the Eduspace Image Catalogue (Fig. 2, url3) was published on Eduspace. This online tool provides Eduspace users with a multi-mission catalogue of EO data over Europe. The main objectives of the catalogue are to enable teachers and students to obtain data for use in Eduspace case studies and to adapt (personalise) case studies with EO data from user specific areas of interest. The catalogue can also be considered a useful source of free data for anyone requiring pre-processed geocoded imagery in a format that can be readily used in software such as LEOWorks (see §2.3).

The sensors supported by the Eduspace Image Catalogue include: Landsat/TM and ETM+, ERS-2 SAR, Envisat\MERIS and ASAR, as well as ALOS\AVNIR-2. Seamless European coverage is provided for all supported sensors. Imagery can be downloaded in geocoded geotiff format, as full scenes or as subsets. An intuitive interface enables searches to be performed based on sensor, date and area. Searches via area are facilitated by an interactive map with user specified background layers: by default, these include a global MERIS mosaic with vectors and labels (in increasing detail at progressive zoom levels) showing national borders, country names, major cities, water bodies etc. Downloading of data is performed in a dedicated section ("basket"), where users can specify a spatial or band subset or else download the entire product. Users can also select the coordinate reference system of image products from the entire list of Coordinate Reference Systems (Geographic Lat/Lon, WGS84 by default).

The Eduspace Image Catalogue is constantly being enriched with more data and improvements are regularly made to the interface. Some of the key milestones in the development of the Image Catalogue in 2013 include: addition of seamless European coverage of Envisat ASAR IMP IS2 and ALOS AVNIR-2 (on-going), improved background map (MERIS RR, selection of vector layers to visualise at each zoom level), creation of a quick-start tutorial and reprocessing of Landsat data (to fix bugs related to image bands, improve geocoding and default coordinate reference system). In 2012, the main developments included the insertion of seamless European coverages of Envisat MERIS FR and ASAR WS and improvements to the search and download interfaces. In 2011 the focus was on the customisation of the catalogue interface and georeferencing of Landsat/TM, ETM+ and ERS-2 SAR data, for insertion in the catalogue as a first dataset.

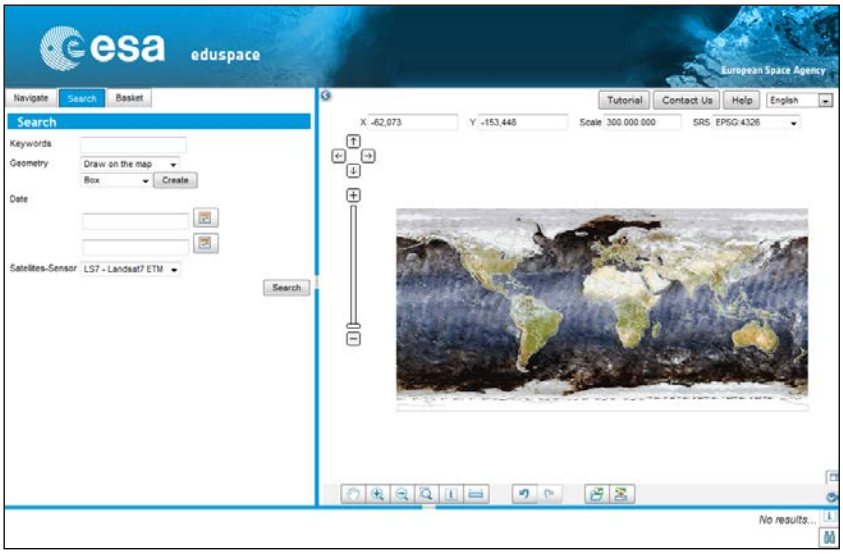

Figure 2. The Eduspace Image Catalogue main interface (url3).

2.3 LEOWorks 4.0

For the past few years, on behalf of ESA, Advanced Studies and Research Center (ASRC, Romania) has been developing the upgrade of LEOWorks from version 3 to version 4 (url4). This progress has resulted in a beta version of LEOWorks 4 published on Eduspace in March 2013, while a final version will be released under a General Public License (GPL) within 2014. Compared to LEOWorks 3 (developed in IDL), much has changed, since the user interface has been updated, not only to have the "look and feel" of contemporary software, but also to resemble the interface of ESA professional toolboxes, such as BEAM and NEST. The new LEOWorks version, developed in Java, is platform independent, performing equally well on all families of operating systems (e.g. Windows, Mac OS, Linux) and including modern Geographical Information Systems (GIS) functionalities, in an overall user-friendly environment (Fig.3).

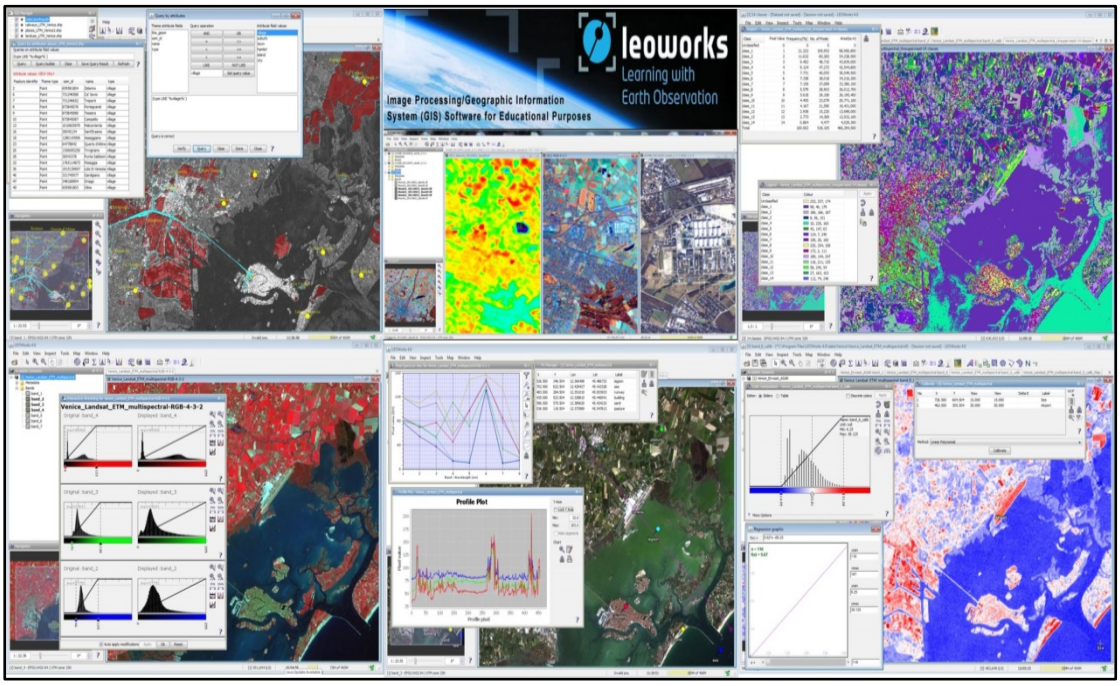

Figure 3. Snapshots of LEOWorks 4.0 interface and functionalities.

2.4 Interactive Meteosat

Today's meteorologists rely heavily on data sent back by satellites, including Europe's Meteosat and MetOp. However, many people are not aware of how the satellite data are analysed and contribute to the daily forecasts.

The new "Interactive Meteosat" section covers many different aspects of weather forecasting – something that affects all of our lives. It includes introductory pages on weather and climate, and a selection of images of Europe sent back from Meteosat.

The case study also includes four worksheets with various exercises related to satellite images taken at different wavelengths. These enable students to analyse the images, locate weather systems and recognise differences in atmospheric conditions. The final worksheet brings everything together, by asking students to make their own measurement and their forecast.

The Interactive Meteosat on-line application (Fig. 4) - a new online tool that shows satellite data combined with student measurements - has been developed as an Eduspace module along with a relevant case study (url5) on the interpretation of Meteosat images.

Every day, a Meteosat image of Europe acquired at 09.00 UTC is shown on the Interactive Meteosat online application (url6). Students from participating schools can observe the

weather and upload their meteorological observations to the application. The observations are then overlain in real time on the satellite image.

When many schools participate and upload their measurements, the application shows a more detailed picture of the weather situation throughout Europe and enables a better interpretation of the daily Meteosat image.

With the aid of these observations, the Meteosat image and other meteorological information, students can draw a weather map and predict the weather in their region and elsewhere.

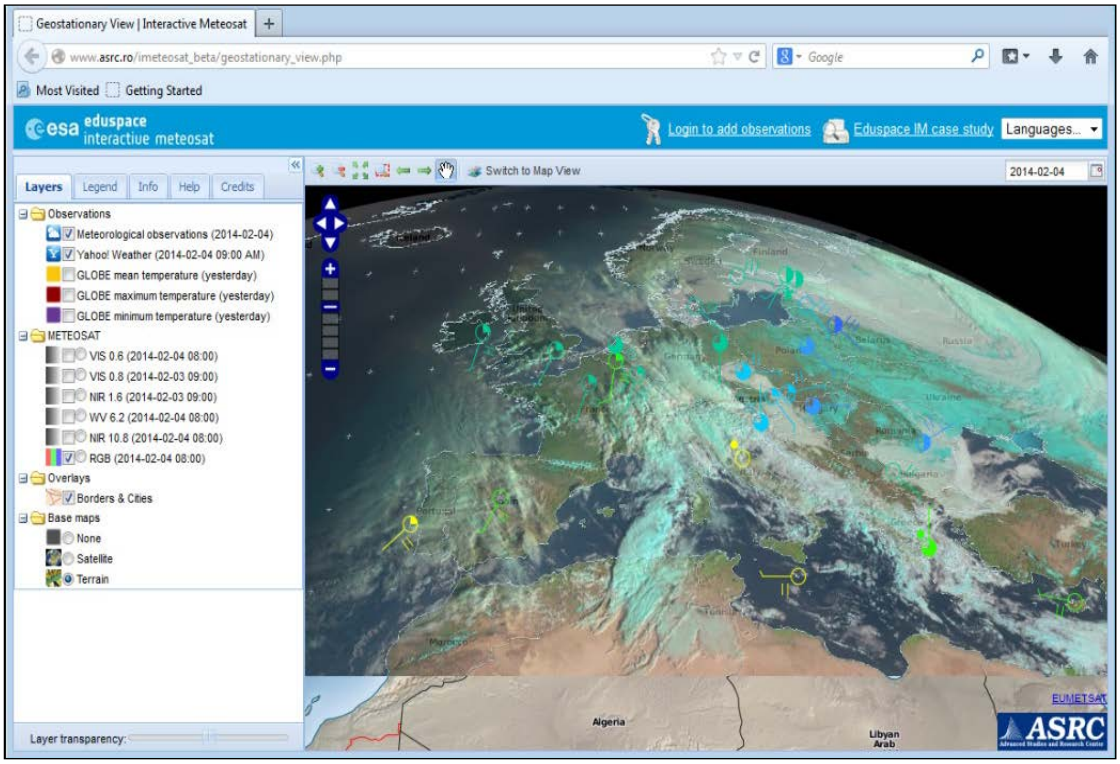

Figure 4. Snapshot from the Interactive Meteosat on-line application (url6).

3. EDUSPACE STATISTICS

Using Google Analytics™, monthly statistics of Eduspace visits and page views are extracted. The results are positive and most importantly, show a constant annual improvement over the past years (Fig. 5 & 6).

Based on the increase of visits and page views that has been witnessed during the year, these endeavours have been particularly successful. The statistics reflect school usage: during the summer the statistics go down (as is expected, since the website is mainly used by teachers/students/schools), they then begin to increase again from September. The statistics from 2013 show increased Eduspace usage than in previous years.

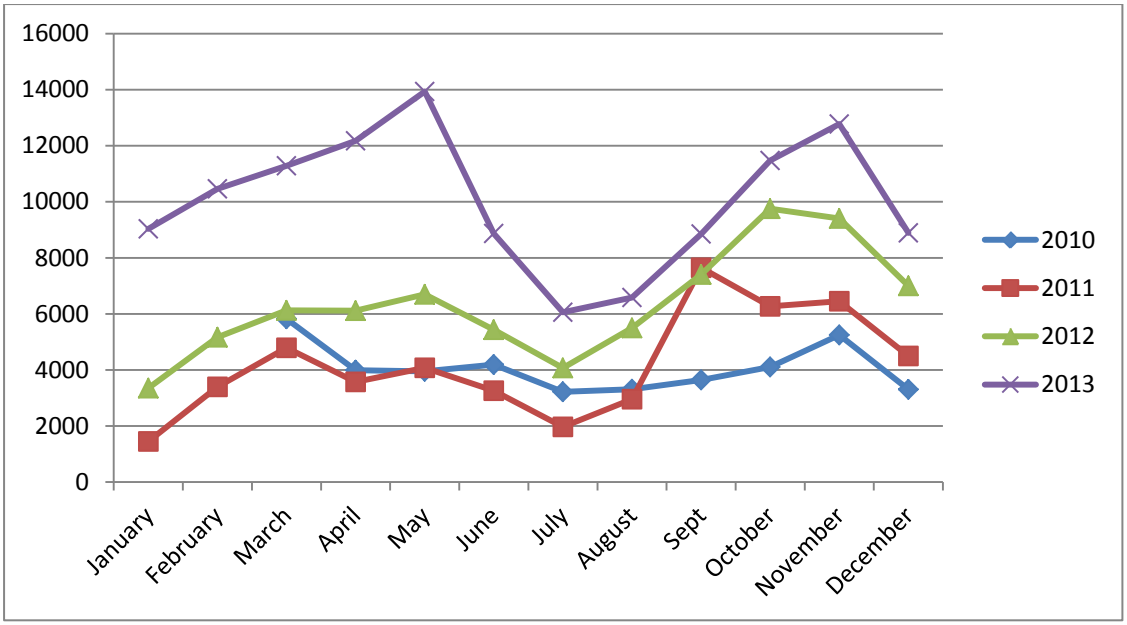

Figure 5. Number of visits to Eduspace (2010-2013). A "visit" corresponds to a person going in and visiting the website. Note that "visit" is not the same as "visitor". This means that one person (visitor) can make multiple visits to the website within the same month. In such a case, it would be one visitor, but four visits (Source: Google Analytics™).

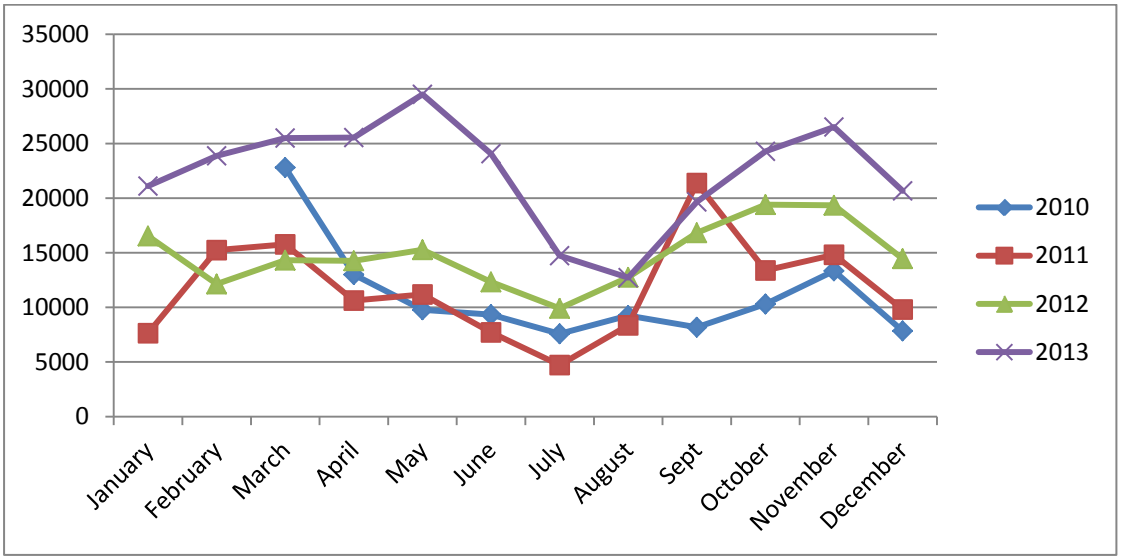

Figure 6. Number of Eduspace page views (2010-2013). "Page views" correspond to the number of pages a person clicks on and sees (Source: Google Analytics™).

4. DISCUSSION AND FUTURE PROSPECTS

Eduspace has served secondary education for more than 15 years and the lessons learned from this experience have significantly assisted in the improvement of the website's structure and content. Nevertheless, maintenance and periodical updates (especially the development of new case studies connected to contemporary real-world phenomena) are always necessary, in order to keep students and teachers interested and motivated.

Concerning the image catalogue, near-future developments shall include the finalisation of a seamless European coverage of ALOS AVNIR-2 and a potential new coverage of ALOS PRISM (2.5m panchromatic). Meanwhile, a discussion is under-way on the possibility to expand the catalogue to provide global coverage of some products, which may include not

only EO pre-processed imagery, but also derived products, such as classified images, vegetation maps etc.

LEOWorks 4 shall remain the basic image processing and GIS educational software of Eduspace for the next years. Any updates shall mainly be focused on the compatibility with respect to the new image formats from new sensors (e.g. the Sentinels).

Finally, several dedicated trainings on the use of Eduspace in the classroom have been delivered to teachers and students throughout the years and this effort shall be carried on. More focus shall be given on "training the trainers", in order to optimize the use of ESA Education human resources and maximise the efficiency of such activities.

ACKNOWLEDGMENTS

This paper is dedicated to the memory of Birgit Strømsholm, a good colleague and friend, who passed away unexpectedly on February 26th 2014. Birgit started working for the Norwegian Centre for Space-related Education (NAROM) in 2003 and had also been active in international collaboration to develop educational resources for students and teachers all over Europe. Birgit had since 1989 been involved in space related education for students and teachers. She had also been part of the Eduspace group from its start in 1998; for all her excellent contributions, enthusiasm and friendship, she shall always be remembered as the "mother of Eduspace" with the best of our memories.

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Delvoye, E., Sarti, F., Stewart, C., Dransfeld, S., Belen Ruescas Orient, A., Moser, L., Lichtenegger, J., Brøgger Sørensen, P. (2010). The new Eduspace, ESA's online educational tool for Earth observation, Proceedings of the 61st International Astronautical Congress, 27 September - 1 October 2010, Prague, Czech Republic, IAC-10-E 1.1, 4p.

Internet links:

url1: www.esa.int (European Space Agency)
url2: http://www.esa.int/SPECIALS/Eduspace_EN/ (ESA Eduspace)
url3: http://www.esa.int/SPECIALS/Eduspace_EN/SEMLK0F1EHH_0.html (Eduspace Image Catalogue)
url4: http://www.esa.int/SPECIALS/Eduspace_EN/SEMHA60P0WF_0.html (LEOWorks)
url5: http://www.esa.int/SPECIALS/Eduspace_Weather_EN/SEMTOGJ37SG_0.html (Interactive Meteosat case study)
url6: http://www.asrc.ro/imeteosat_beta/map_view.php (Interactive Meteosat on-line application)