Development of a Web-based Remote Sensing Software for Schools

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ABSTRACT

The project „Blickpunkt Fernerkundung (BLIF)" provides a way to implement remote sensing more frequently in schools as a digital form of modern learning. "BLIF" is offering a new and modern method to use the potential of satellite images in school.

To establish the ´new way of learning´ in schools with a chance of success, it is necessary to have an appropriate software solution for the pupils.

This software is 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, are its intuitive usability according to the pupils' age. It is 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 this, the software can be used by a wide range of users – 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) and up to several kinds of supervised classifications and georeferencing.

INTRODUCTION

The use of remote sensing systems is becoming more and more open to the public. In the daily routine we approach numerous uses of this modern technology in the known manner. Generally remote sensing is supposed to be of great importance in the future in our community (ALBERTZ 20071). But in spite of that, the use of satellite images in schools offers an enormous didactical potential. (BRUCKER 20062, Siegmund & Menz 20053). An international comparative study confirmed the huge pedagogical potential of working with remote sensing systems in schools. It is obvious, that most pupils are highly motivated and fascinated with working with satellite images (WOLF & SIEGMUND 20074, VOß 20075).

The importance and presence of remote sensing is reflected in the German curricular and national educational standards for geography.

A basic competence, written in curricular, is the ability to win, interpret and reflect geographic information by using digital remote sensing. But how can it be possible to fulfil these demands, without having an appropriate software solution to enable students to work with satellite images? There exist several applications, such as ENVI, ERDAS, Idrisi, or eCognition, for professional users, but they are inapplicable to be implemented in schools. The mentioned software has one evidential commonality – they are too complex to be used by students (Voß et al. 20096). Disregarding the deficit of usability, most of the professional software tools are highly priced and the majority of schools cannot afford to purchase them. According to these facts, "BLIF" was started to close this structural gap by providing well qualified software free of charge to schools. Its main intention is to offer students motivating imaging software for the analysis of satellite imagery and for implementing remote sensing more frequently in education. The intuitive handling of the application demonstrates the possibilities of a problem-and action-oriented use of remote sensing in a modern way of open learning (Kollar et al. 20087).

CONCEPTION

Based on providing remote sensing software particularly suitable to be used in the daily school routine and from the students personal computer at home, we decided to develop a web based application that enables usage from everywhere, without any installation.

To enhance the geographical value of using this software, the tool is integrated into a didactical main concept, which offers many teaching aids to use the application purposefully and activity-based. All of the learning aids conform to the requirements of the German curriculum and consider common didactical principles.

The characteristic features of this application, designed on the newest didactical achievements of remote sensing and technical standards, will be its intuitive usability according to the students' age.

At first the users are supposed to acquaint themselves with navigation of the software. To that avail the software offers an "Assistant-Mode", which leads the user step by step routing through BLIF. There are three levels available, starting with the beginner mode for students, who are new in dealing with remote sensing, the advanced learner's mode for confident users and the professional mode for experienced students. Passing all the levels successfully, the students will get used to the program procedure and learn how to process satellite images efficiently.

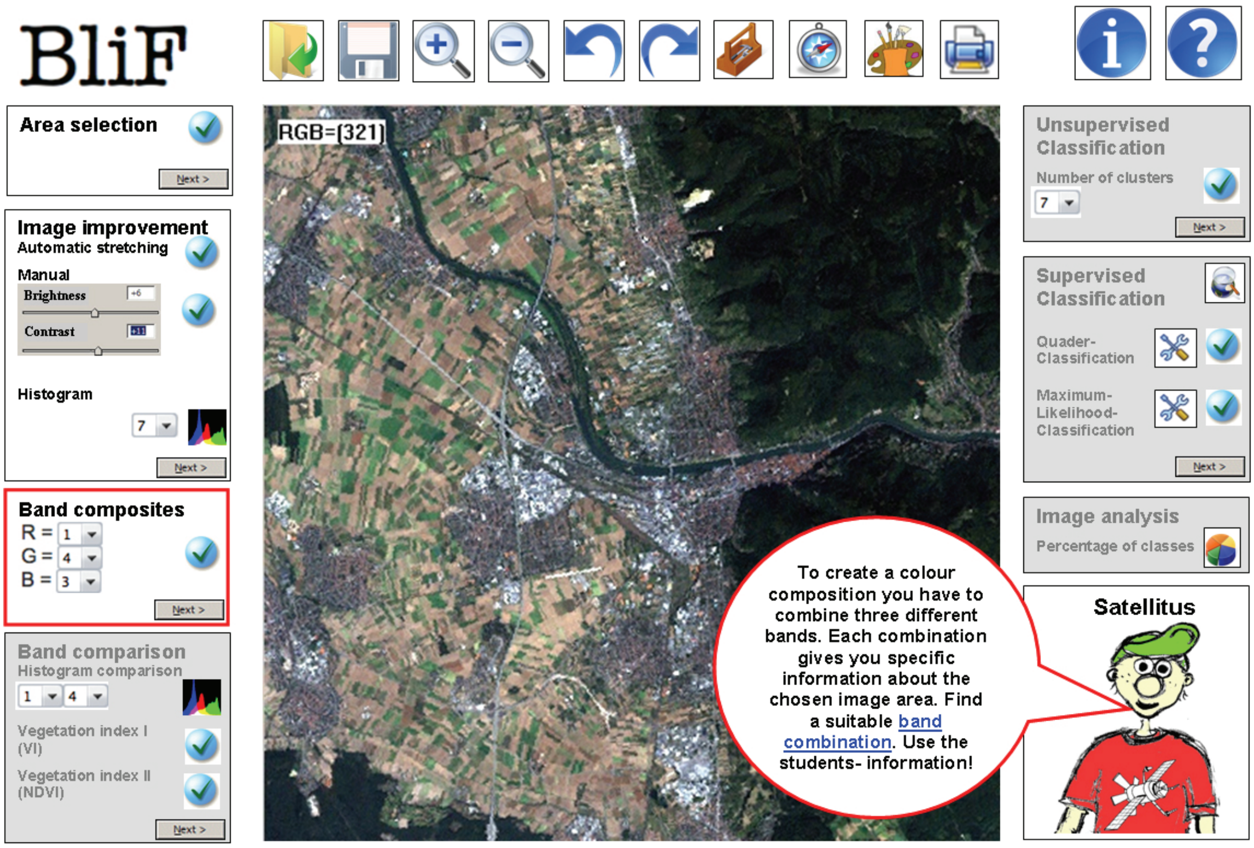

Fig. 1: Screenshot of BLIF-assistant-mode ("expert- modus"; stage of development: 25.05.2009)

BLIF generally has two modes: the first one is the "Assistant- Mode", as described below and the second being the "open-use- mode". The second mode offers a complete range of software features to the user- he/she can choice each of the unlocked processing frames.

The user interface of both modes will be similar- but it will be possible to have several special settings, depending on the chosen user level. Because of that, the software can be used by a wide range of users – starting from a beginner level at the end of primary school up to an experienced user in secondary school (or senior high school)

The BLIF user interface falls into three categories. The first one is the chosen satellite image area in the centre of the front panel. Each modification or transformation of the satellite image during the work with BLIF is displayed there. The second important category is the BLIF menu bar above the image.

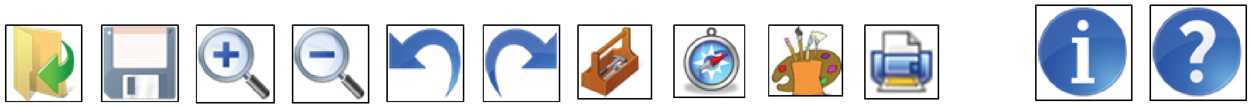

Fig. 2: BLIF menu bar (Icons source: *http://www.visualpharm.com*)

The most commonly used tools are located there. The first one, the "open-folder" to import the requested satellite image, the saving button to store the individual processing results, the zoom buttons for zooming in and out, the undo and forward button, the toolbox to open several special application features, the compass for georeferencing the chosen satellite image, the layout button to design the individual's results, and at last, the print button.
Using the info button will give further information about the satellite image, like path and row, sensor type, pixel size, wavelength, date of photography, sky overcast and map info. The help button will open a help box, from which the user can get help tips.
The third characteristic element of BLIF is the framed processing elements beside the image (see Fig.3).
The students are introduced to the navigation of BLIF by following the assistant's instructions. The operational sequence goes in the same repeating routine. At first the user gets necessary information, including special working instructions from the assistant guide, named "Satellitus". His advice is short and succinct- all important terms are linked internally and offer further explanations about several remote sensing topics. The students follow the instructions and deal with the satellite image. The respective frame is highlighted, to visualize the processing level (see Fig. 3).
In the case of Fig.1 the students have chosen a Landsat 7 image (path:195 / row:026) from BLIF server. With the next step they selected Heidelberg as their investigation area. Then they were introduced to different possibilities of improving their chosen image. By clicking on the "next-button", the students have finished this step and activated the next frame with a new instruction (see Fig.3). In this processing step, the students have to create a suitable band composition- the frame "band composites" are pointed out in red.
The user is now able to combine three different image bands. By pushing the "OK-button", BLIF displays the according composite. Even now it is necessary to use the linked information about "band combination", to be able to evaluate the large number of combinations useful in this context. It is certainly possible to check all combinations in every possible way – the selection will only be confirmed when clicking on the "next-button".

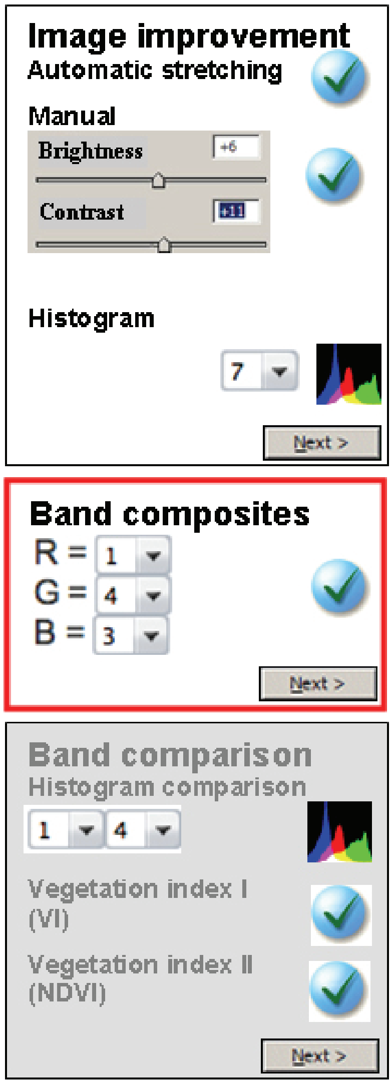

Fig. 3: BLIF processing frame (cut out)

BLIF offers various processing options according to the user-level settings at the beginning. Depending on the level setting, different software features are displayed on the user interface. The "beginner" for example will not be able to improve the satellite image by using the histogram. Furthermore the beginner will not be able to make a histogram comparison or generate a "Normalized Differenced Vegetation Index" (NDVI) (see Fig.3). The advanced learner will be able to use the same features as the "beginner"- he/she will find them at the same position on the user interface. In addition, the advanced learner has some extra tools available, such as doing the unsupervised and supervised classification. "Experts" have the opportunity to use all the software features, described below.

The common utilities of remote sensing systems are implemented in BLIF. There are a large 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 (regulation of brightness, contrast settings and stretching) up to the possibilities of georeferencing. Another group of features contains treating the image as well as several forms of unsupervised and supervised image classifications. Here, the pupils are able to build different band composites (see Fig. 4). By combining the information of certain spectral bands, the pupils can get helpful information for an efficient interpretation of the classification results. The software application also gives young scientists the ability to get different standard indices, like the NDVI, to explore the vitality of the vegetation (see Fig. 4). At last, it will be possible to evaluate the classified image and publish it with several standard layout elements, like title, scale, north arrow, and legend.

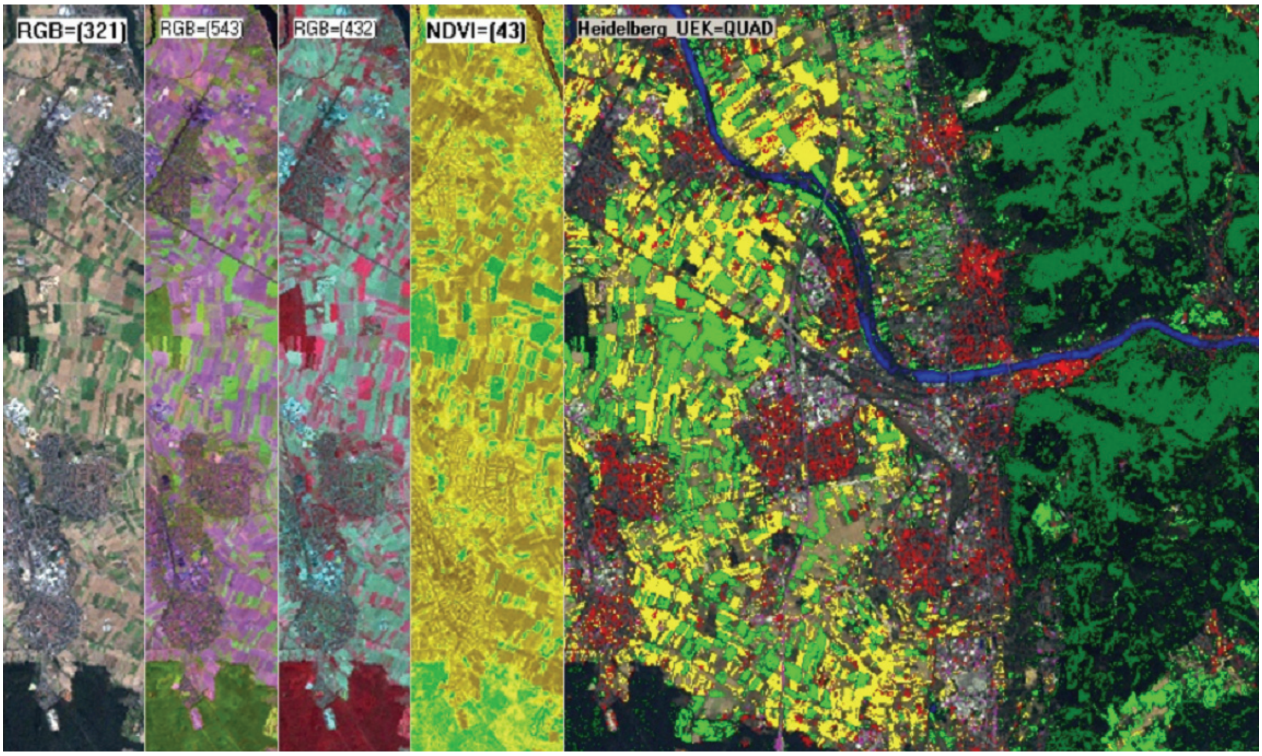

Fig. 4: Choices of some technical features: True-colour-composition (RGB 321), false-colour-composition(RGB 543/432), NDVI (43) and Supervised Classification (based on Landsat images from Heidelberg/Germany)

CONCLUSIONS

There are many situations in the daily school routine when it is useful to work with this software. It can be used in a Geographical context, but also in Environmental Science, Mathematics, Information Technologies and in many exercises which combine the mentioned and additional subjects. The possibility to change the user-level in the presettings, depending on the individual's capabilities using BLIF, offers to provide to a wide range of students.

There are many relevant themes like desertification, development of cities, agricultural and industrial land use and the exploration of natural resources (ALBERTZ 2007[i], JÜRGENS 2003[8], REUSCHENBACH 2007[9]). The first priority with handling satellite images will always is to encourage and motivate pupils to solve geographical and/or environmental science problem on their own, while acting independently and feeling useful and important (GUDJONS 2008[10], KLAFKI 2007[11]). Following this path, BLIF will advance students' self learning experience and change their spatial behaviour competence for a better.

To support the software, the teachers and pupils will find, in addition, a tutorial and a selection of representative exercises that will give the students and teachers helpful hints on using the software and interpreting the results.

The development and the constant testing of this web based software are still running in cooperation with a software company. From summer 2010, after the evaluation of the application, it will be available to all schools free of charge.

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