DLR

DLR_School_Lab

Oberpfaffenhofen

Earth Observation with Satellites

A Satellite View of Our Earth

Environmental disasters such as forest fires, floods and cyclones are increasing in number worldwide. Once fertile landscapes are turning into deserts and what used to be eternal ice is constantly melting. Global change has many aspects. Earth observation satellites help to record these phenomena in all their dimensions and aid in their understanding. They measure ice thickness and the speed of glacier flow. They determine how the chemistry of the atmosphere is changing and monitor how people are permeating natural areas and conspicuously leaving behind their "footprints" worldwide.

At the German Remote Sensing Data Center (DFD) vast quantities of data from national and international satellite missions are being received, processed and archived. They make it possible to obtain the most up-to-date information for determining values like ocean temperatures, as well as for documenting long-term changes.

Earth Observation with Satellites

Fig. 1: Aerial view of the DFD building in Oberpfaffenhofen

The Earth Observation Experiment

The School_Lab experiment supervised by DFD shows why earth observation with satellites is important and how to handle current satellite images in a practical way. The experiment has two parts:

Theoretical Part
The preparatory, theoretical part deals with three core questions:

- Why is satellite remote sensing needed, and what all can be observed with satellites?
- How can satellites "see" much more than we can?
- How can the data which is obtained be analyzed, and how is this information used in practice?

Practical Part
The practical part of the exercise will give an impression of the wide variety of applications for satellite remote sensing.

1. Producing a satellite image
How does the earth look to a satellite and how can a true-color image be generated from the data received? The exercise gives an example of how to do it and supplies tips for optimizing the result.

Fig. 2: Satellite image of Lake Starnberg, Landsat, 2000

2. Producing a temperature map
We are all familiar with television weather maps and temperature forecasts. The data for such predictions come from satellites which supply images using ranges of the electromagnetic spectrum invisible to human eyes. This exercise reveals how satellite data can be used to measure the temperature of the Mediterranean Sea.

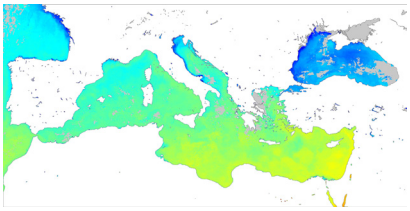

Fig. 3: Water surface temperatures in the Mediterranean, January 2009

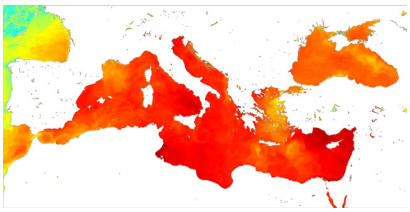

Fig. 4: Water surface temperatures in the Mediterranean, August 2009

3. Video animation of ocean temperature
Dynamic processes and changes can be more easily identified if series of images showing the same region over a period of time are brought together in a video animation.

Using weekly images it is possible to show changes in the surface temperatures of the Mediterranean Sea over the course of a year.

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4. From satellite image to map
Automatic classification of images is an important aspect of image analysis. Test areas for water, human settlements, forests and agricultural land must first be specified in the satellite image. The sorting program then automatically produces a precise map based on statistical methodologies.

5. Correcting satellite images
For geographical investigations, for example when monitoring urban development, scientists usually have a large amount of data and images available. They are likely to be of different scales and raster sizes. Before they can be used in studies, they have to be brought into conformity (e.g., georeferenced).

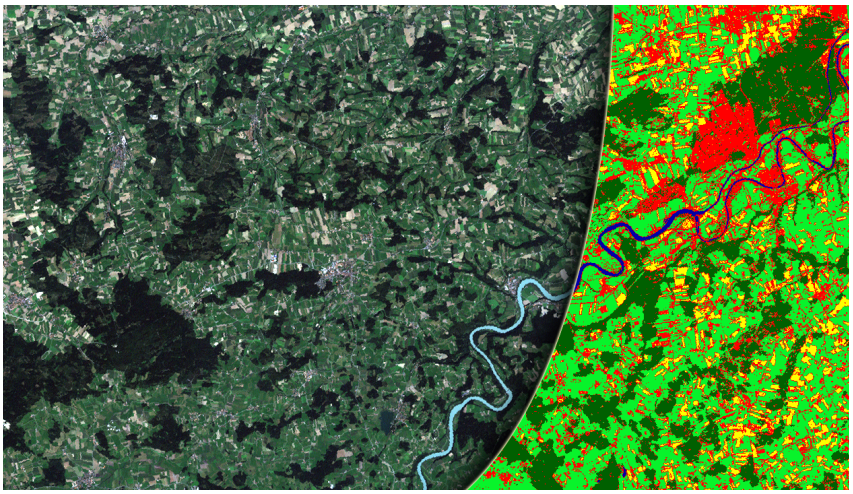

Fig. 6: It is important to rectify remote sensing data so that different data sets can be compared

Fig. 5: It is important to rectify remote sensing data so that different data sets can be compared

Glossary

Spectrum
What people experience as light is only a small part of the so-called electromagnetic spectrum. It includes different types of electromagnetic waves and organizes them by wavelength. The spectrum ranges from gamma rays, which have very short wavelengths, to radio waves, which have comparatively long waves.

Multispectral sensor
Earth observation sensors are designed to detect precisely defined areas of the electromagnetic spectrum. This makes it possible to record phenomena which only occur at those wavelengths.

Landsat
Landsat satellites are a series of civilian earth observation satellites of the U.S. space agency NASA; they are used to remotely sense the earth's surface. Seven satellites have been launched since 1972, the latest in the series being Landsat7-ETM+.

Access to satellite data

Satellite data are not only available to scientists. In addition to high resolution satellite images which must be purchased, much interesting data can also be downloaded free of charge. The experiment shows several ways to obtain archived satellite images at home with a PC and an Internet connection.

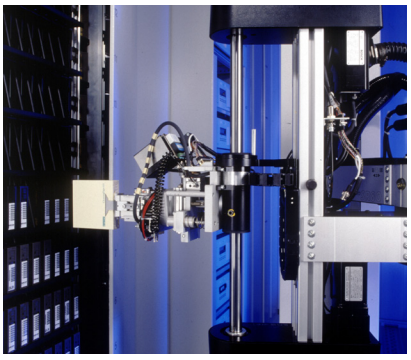

Fig. 7: The DFD robot archive stores huge amounts of data. Its capacity is currently about 300 TeraBytes

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Aerial image; Ortsblatt dated 1861 © Landesamt für Vermessung und Geoinformation Bayern, 4253/09

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German Aerospace Center

DLR at a Glance

DLR is Germany's national aeronautics and space research center. Its extensive research and development activities in the fields of aeronautics, space, transportation and energy are integrated in national and international cooperative ventures. In addition to this research, as Germany's space agency the federal government has given DLR the responsibility to plan and implement the German space program and to represent German interests internationally. DLR is also the umbrella organization for Germany's largest project management agencies.

Approximately 6,500 people are employed at DLR's 13 locations, which include Köln (headquarters), Berlin, Bonn, Braunschweig, Bremen, Göttingen, Hamburg, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Stuttgart, Trauen and Weilheim. DLR also operates offices in Brussels, Paris and Washington D.C.

DLR Oberpfaffenhofen

Aerospace, environment and transportation are DLR's primary fields of interest in Oberpfaffenhofen. Some 1,500 people work there in nine different institutes and facilities, making DLR Oberpfaffenhofen the largest DLR location.

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