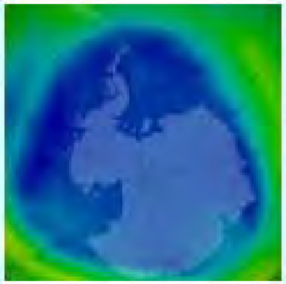
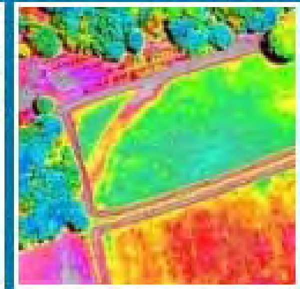
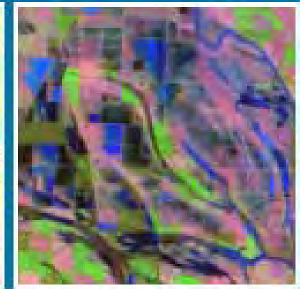


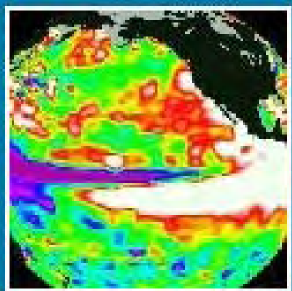
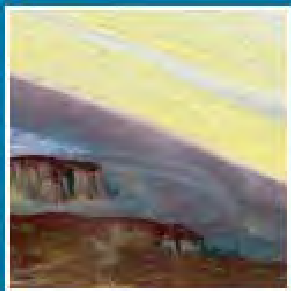
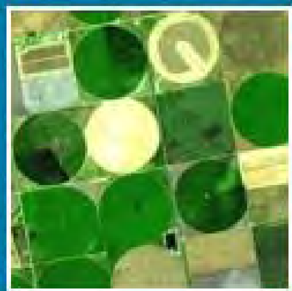



Satellite Images for Science Education in Schools

The SEOS -Project

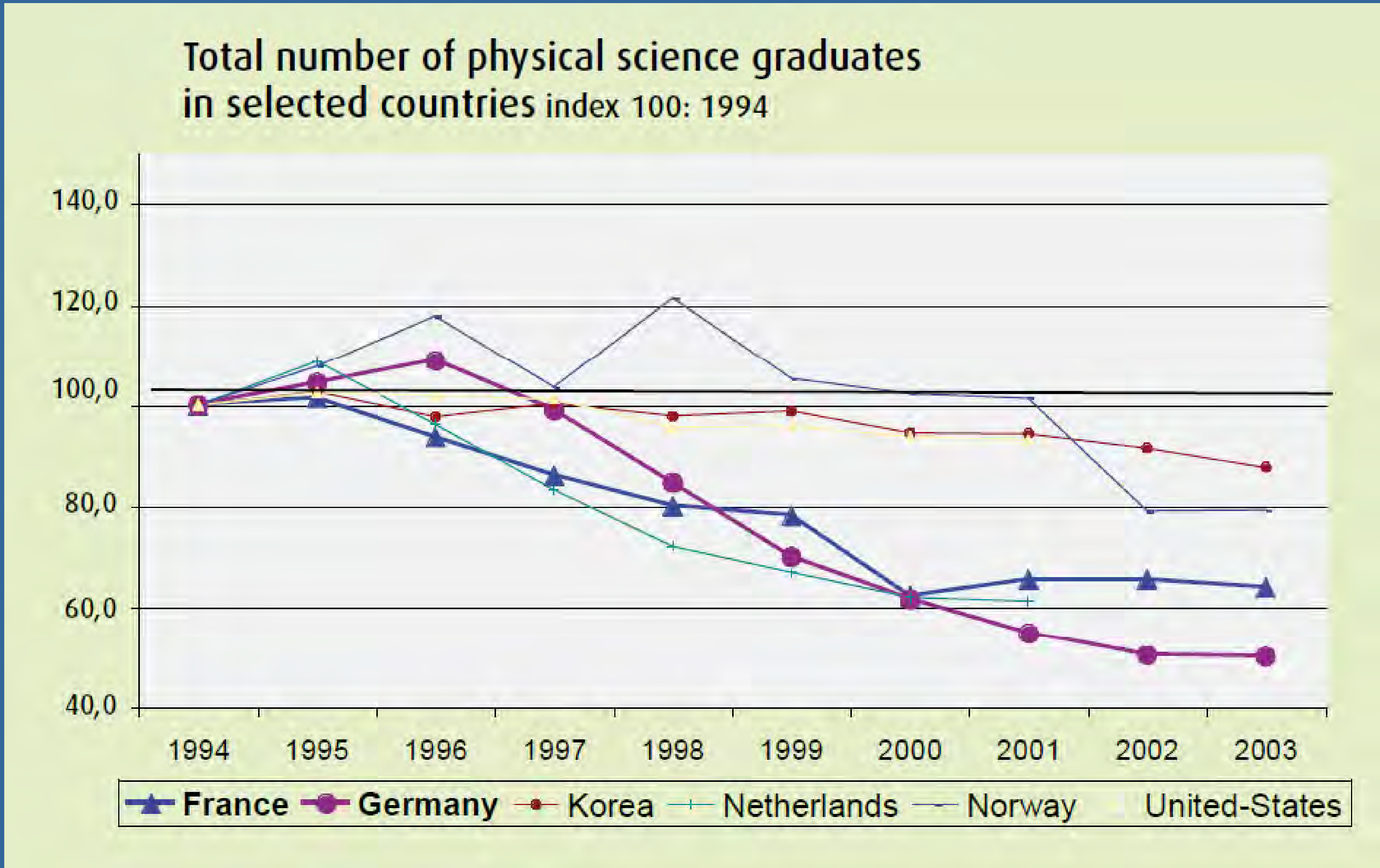
Christina Klose, University of Oldenburg, Germany

EGU-GIFT Workshop, 22 April 2009, Vienna

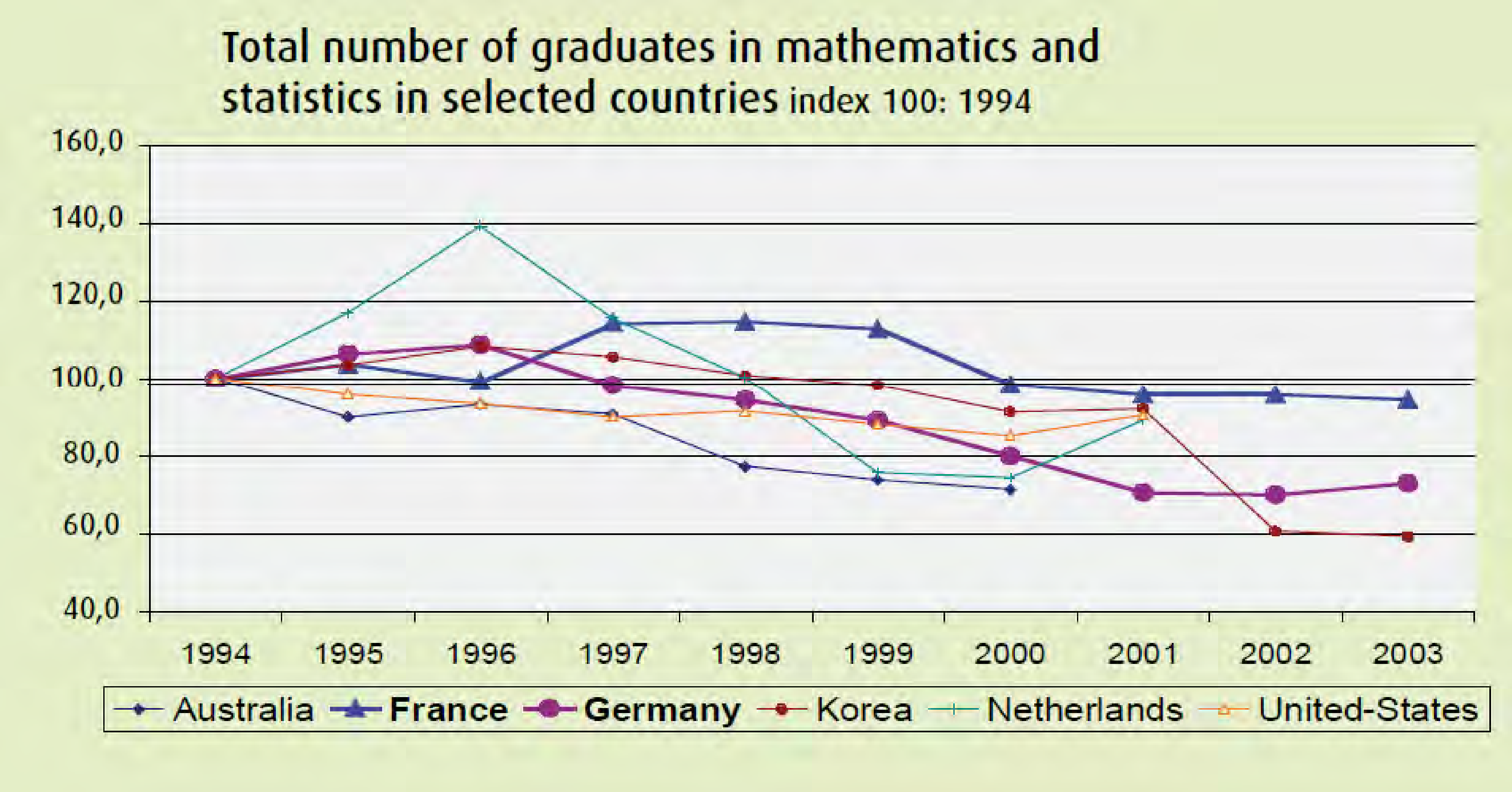





Project Partners:

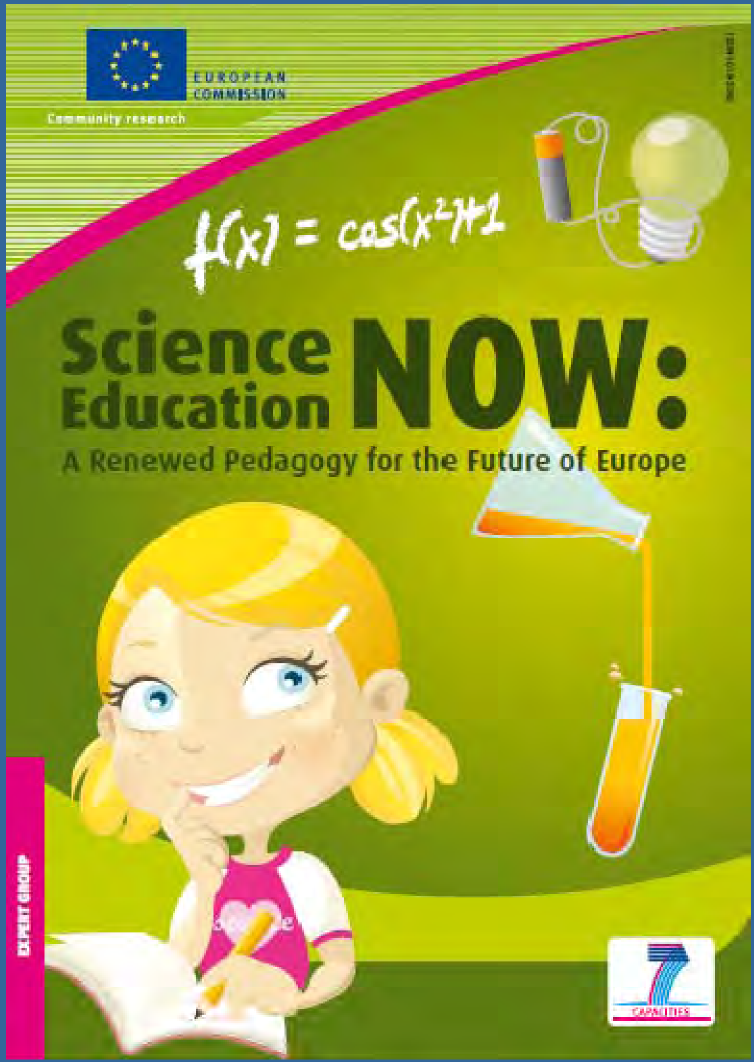
1. University of Oldenburg, D
2. EARSeL, Int.
3. United Nations Educational, Scientific and Cultural Organization (UNESCO), Int.
4. Mediterranean Agronomic Institute of Chania (MAICh), Crete, GR
5. Institute for Science Networking Oldenburg GmbH (ISN), D
6. Ghent University, B
7. Vrije Universiteit Amsterdam, NL
8. University of Aarhus, DK
9. Belgian Science Policy Office (BELSPO), B
10. National Oceanography Centre, Southampton (NOCS), UK
11. University of Education Heidelberg, D
12. European Space Agency (ESA), Int.



Rocard Report 2007



Rocard Report 2007



http://ec.europa.eu/research/science-society/document_library/pdf_06/report-rocard-on-science-education_en.pdf

Die so erhaltene Beziehung (1890/91), die eine Korrektur auf die Dichte des Mediums enthält, heißt nun aber nicht, wie in der Elektrodynamik üblich, Clausius-Mosottische Beziehung, sondern **Lorentz-Lorenzsche Beziehung,** benannt nach H. A. Lorentz und dem dänischen Physiker L. Lorentz (1829–1891).

Unsere Ausdrücke, obwohl schon etwas unübersichtlich, sind noch nicht vollständig. Bisher haben wir angenommen, daß nur eine einzige Resonanz auftritt. Meist haben wir es jedoch mit *mehreren Resonanzen* zu tun, über die wir dann *summieren* müssen. Aus den Gleichungen (2.56) und (2.57) wird bei s Resonanzen, wie unmittelbar ersichtlich,

$$n = n(\omega) = 1 + \frac{1}{2\varepsilon_0} \sum_1^s \frac{n_0^{(k)} q_k^2}{m_k \sqrt{(\omega_k^2 - \omega^2)^2 + \gamma_k^2 \omega^2}}$$

bzw.

$$n = n(\omega) = \sqrt{1 + \sum_1^s \frac{\dfrac{n_0^{(k)} q_k^2}{\varepsilon_0 m_k \sqrt{(\omega_k^2 - \omega^2)^2 + \gamma_k^2 \omega^2}}}{1 - \dfrac{1}{3} \dfrac{n_0^{(k)} q_k^2}{\varepsilon_0 m_k \sqrt{(\omega_k^2 - \omega^2)^2 + \gamma_k^2 \omega^2}}}}\,, \qquad (2.58)$$

wobei ω_k die Resonanzfrequenz ω_0 für die k-te Resonanz ist und sich auch sonst der Index k auf die k-te Resonanz bezieht. Der Kuriosität halber sei mitgeteilt, daß ein ganz analoger Effekt bei der Streuung von π-Mesonen an Atomkernen vorkommt, die ja auch ein dichtes Medium sind; hier heißt er aber Ericson-Ericson-Effekt, nach dem schwedischen Physiker T. Ericson (geb. 1930) und der spanischen Physikerin M. Ericson (geb. 1929) (oder in umgekehrter Reihenfolge).

Abb. 2.124 zeigt eine gemessene Dispersionskurve.

2.9.3 Vertiefende Behandlung der Totalreflexion

Bisher haben wir die *Totalreflexion* aus der *geometrischen Optik* gewonnen und uns dabei des Snelliusschen Brechungsgesetzes bedient, vgl. Abschn. 1.2.2. Da wir dieses Gesetz abgeleitet haben, und zwar mit dem (ebenfalls abgeleiteten) Fermatschen Prinzip, befinden wir uns auf sicherem Boden. Überdies haben wir das Brechungsgesetz aus dem (allerdings postulierten) Huyghensschen Prinzip hergeleitet. Das hat unserer Anschauung geholfen. Dennoch werden wir, wenn wir etwas tiefer über die Vorgänge der Totalreflexion mit Berücksichtigung des im vorigen Abschnitt Gesagten nachdenken, auf gewisse Verständnisschwierigkeiten stoßen.

Bisher haben wir die Grenzfläche zwischen zwei Medien 1 und 2 als einen abrupten Übergang angesehen und insbesondere vorausgesetzt, daß die Eigenschaften des Materials in der Oberflächenschicht 3 dieselben sind wie in Bereichen weiter davon entfernt. Das ist bei realen Materialien, wenn wir uns in Schichtdicken der Größenordnung der Lichtwellenlängen bewegen, fast nie der Fall. Glas ist z. B. immer von einer Wasserschicht überzogen, die mehrere Moleküllagen dick ist. Wie man sich leicht überlegt, bricht die Oberflächenschicht 3 das Licht

by the fission decay of internal radioactive elements, the **kinetic energy** of molecular motion (heat), and stresses mostly near surface spheres (crust). Without the sun's energy the Earth would sooner or later become an ice planet, with surface temperatures approaching absolute zero (−273.15°C or −459.67°F), the point at which molecular motion, and thus heat, ceases. The heat energy produced by Earth's internal forces, along with gravity, is responsible for great pressures that alter the structure of both internal and surface spheres. Some degree of stability in the composition of elements, minerals, rocks, and their structures is achieved over millennia, but since the Earth and its systems are dynamic, complete stability can never be permanently achieved as long as there is some heat inside the Earth and the universe. Heat and other forms of energy create forces that drive processes responsible for the dynamic nature of the Earth. The force of gravity creates stresses and continuously mixes and separates rocks and other matter into layers according to their densities. The rotation or spinning of the Earth eastward on its axis creates **angular momentum**, with **centripetal forces** being counteracted by the somewhat artificial **centrifugal force**.

Many forces are responsible for the way the Earth is structured and its dynamic nature. This not only includes internal structures but surface features and our environment. Chapter 2 addresses the causes and effects of these forces and processes on the spheres of the Earth.

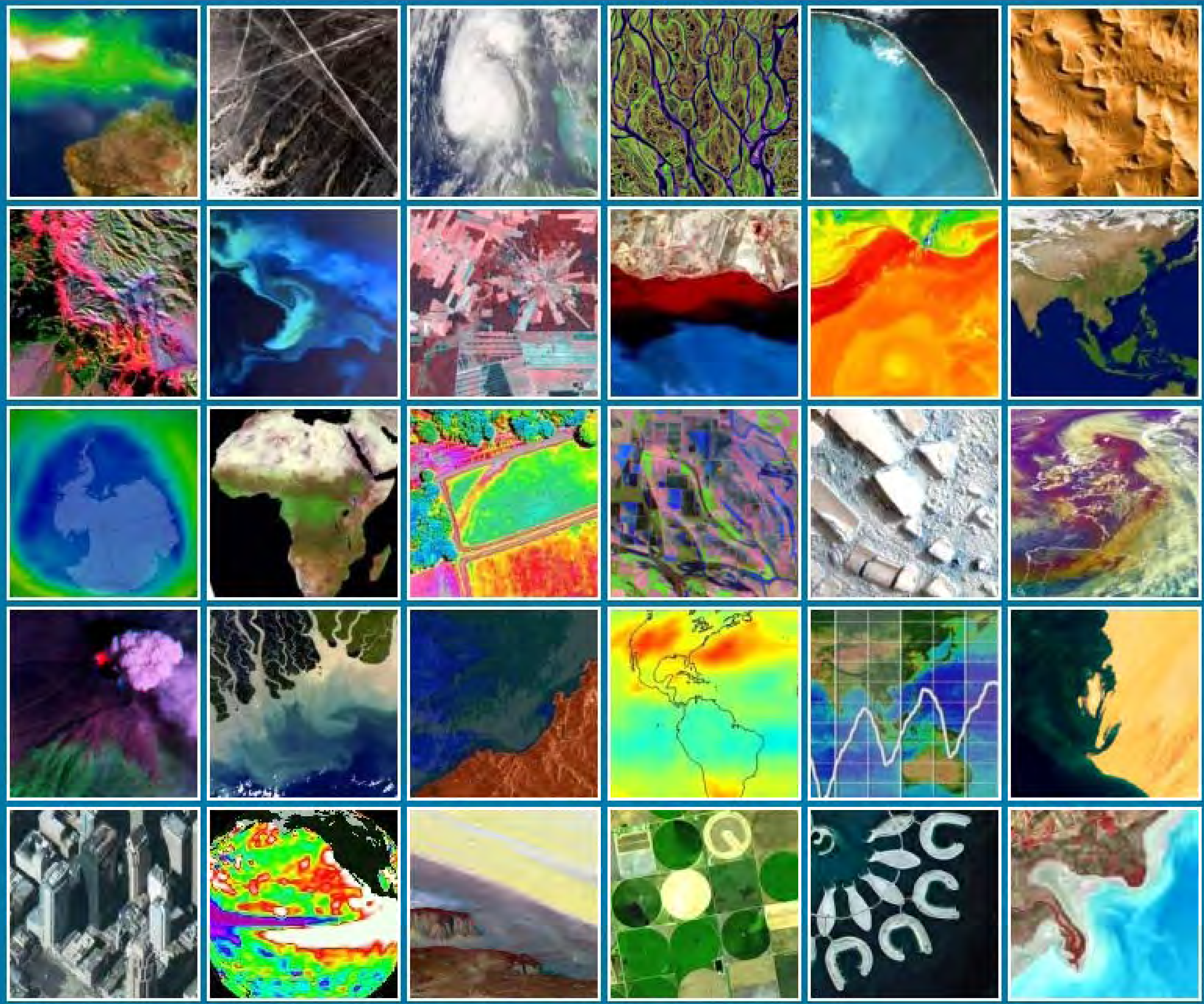
Physical Forces

Force, as defined by Sir Isaac Newton's second law of motion, is based on mass as a fundamental unit in motion within an absolute system consisting of two **vector** units. The equation for force is $F = ma$, where F is force, m is mass, and a is acceleration (speeding up or slowing down of motion). "F" and "a" are both vectors. A force is the *push* or *pull* that gives acceleration to mass—in other words, a force is the applied energy that makes things move. In this book the term "force" is also used in a broader sense as the energy that drives processes, systems, and cycles. There are many physical push and pull forces related to the structure, geology, biology, and chemical and physical systems of the Earth.

The Earth is a dynamic structure that was formed by a number of physical forces, and it is still being slowly altered by those same forces. The sections that follow provide a few examples of these physical forces.

Gravity and Gravitation

Gravity and gravitation are not exactly the same things. The term "gravitation" refers to a *universal* phenomenon, whereas gravity refers to a *local* manifestation of gravitation, such as the attraction of a mass to the surface of a planet, which is also considered to be the weight of a mass. In both cases the phenomenon is a force that acts on all matter at a distance. On Earth we are mostly concerned with gravity where its force is greatest at the surface and decreases toward the center of the mass. At one time in history it was considered impossible for a force to act over a distance, which meant that the force had to actually touch the object in order to make it move, such as moving a rock by pushing it. Galileo (1564–1642) was one of the first scientists to conduct experiments with falling bodies to arrive at a concept of how a force affects the acceleration of falling bodies. He developed a concept of gravity but did not develop it into a theory. Sir Isaac Newton (1642–1727), who developed several laws of motion, derived the formula to explain

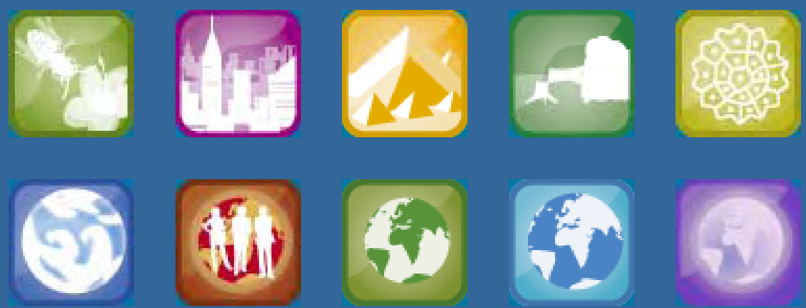


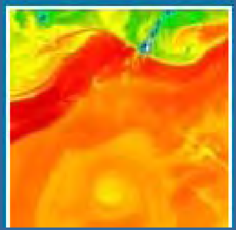
Science Education through Earth Observation for High Schools

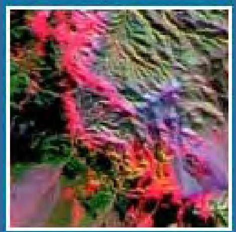
Science Education through **E**arth **O**bservation for High **S**chools

A computer based platform with 15 e-learning tutorials covering different topics and disciplines including

- Biology
- Earth Science
- Environmental Studies
- Geography
- Mathematics
- Physics







Objectives:

- To awaken interest for science
- To promote environmental awareness
- To convey Earth Observation methods using satellites
- To make science education more interesting and appealing

Target Group: ~ 16-18 year old students

The tutorials will be available in several European languages and can thus be used in **bilingual education**

Tutorials:

Remote Sensing for Earth Observation

1 – A world of images

Geography & Biology

2 – Conservation of natural and cultural heritages
3 – Coral reefs
4 – Remote sensing and geo-information in agriculture
5 – Landuse and landuse change

Physics & Monitoring Technology

6 – Understanding spectra from the earth
7 – Ocean colour in the coastal zone
8 – Currents in the ocean measured from space
9 – Remote sensing using lasers

Tutorials:

Environmental Science, Hazards & Environmental Management

10 – 3D models based upon stereoscopic satellite data

11 – Natural resource management

12 – Marine Pollution

Mathematics, Statistics & Modelling

13 – Classification algorithms and methods

14 – Modelling of environmental processes

15 – Time series analysis

Partners Schools:

- Sint Laurensinstituut ASO, Zelzarte
- Kunsthumaniora Muziek-Dans, Ghent

- Middelfart Gymnasium, Middelfart

- Peter Symonds College, Winchester
- King Edward Sixth School, Southampton

- Helene-Lange-Schule, Oldenburg
- Hermann Lietz-Schule Spiekeroog
- Gymnasium zu St. Katharinen Oppenheim
- Freie Evangelische Bekenntnisschule Bremen

- UNESCO’s Associated Schools Project Network (ASPNet)

Where can the tutorials be found?

www.seos-project.eu

→ Free access for everybody once the tutorials completed (around Oct/Nov 2009)

→ Until then you have to register for some of the tutorials