Status and future trends of eLearning in natural science using remote sensing

Rainer Reuter

A hypothesis

Recommendation from an educational workshop
held at ESA/Frascati in Nov. 2014:

„…to develop a Roadmap for future education activities
which would allow European institutions involved in Earth observation
to deliver effective education and training suitable for anyone
involved in providing or using information from Earth observation
satellites in the future."

Yes.
And what else could be a goal for E&T in Remote Sensing?

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1. The environmental data scientist

➢ Often coming from a more specific discipline, e.g. geography

➢ Uses bio-geo-chemical, ecological, physical and social data

➢ Uses „big data", statistics and models

➢ Must be able to connect those data to a transdisciplinary image

➢ Needs a network of other experts and data providers

➢ Employed at scientific institutes, geo-related companies, public media, etc.

➢ Consultants providing information for decision support (politics, administration, authorities etc.)

1. The environmental data scientist

Example: German Advisory Council on Global Change
http://www.wbgu.de/

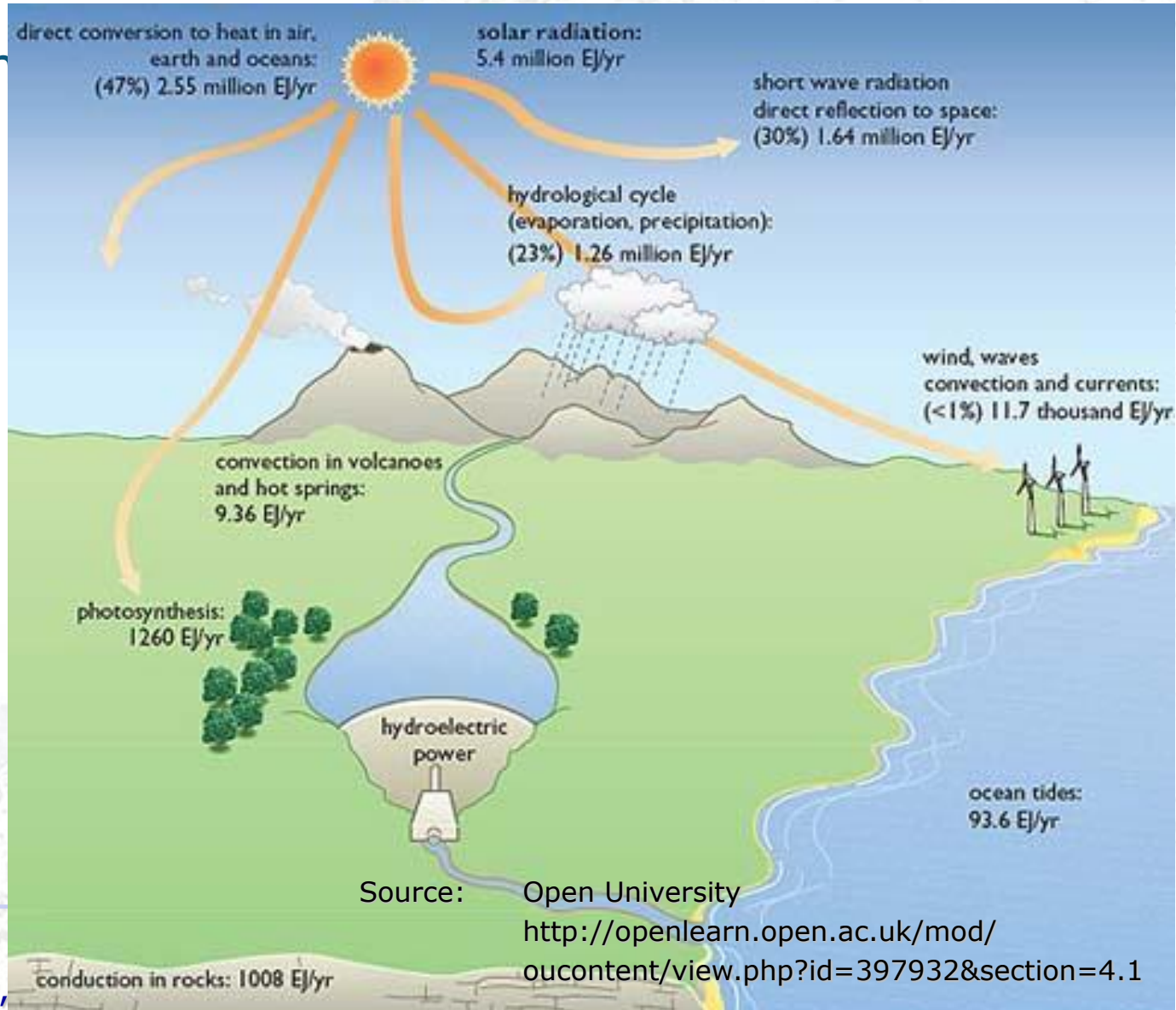| EJ:10^{18} J	Theoretical Potential EJ/year	Technical Potential EJ/year	Sustainable Potential EJ/year	Production 2008 EJ
Biomass	2,400	800	100	50.3
Geothermal	41,700,000	720	22	0.4
Hydropower	504,000	160	12	11,6
Solar Energy	3,900,000	280,000	10,000	0.5
Wind Energy	110,000	1,700	>1,000	0.8
Total	46,000,000	283,500	>11,000	64

Global energy demand in 2008:	492

GmbH

1. The environ

Incoming:
5.4·10^6 EJ/year

Demand today:
500 EJ/year

Exajoule (EJ): 10^{18} J

direct conversion to heat in air, earth and oceans:
(47%) 2.55 million EJ/yr

solar radiation:
5.4 million EJ/yr

short wave radiation
direct reflection to space:
(30%) 1.64 million EJ/yr

hydrological cycle
(evaporation, precipitation):
(23%) 1.26 million EJ/yr

wind, waves
convection and currents:
(<1%) 11.7 thousand EJ/yr

convection in volcanoes
and hot springs:
9.36 EJ/yr

photosynthesis:
1260 EJ/yr

hydroelectric
power

ocean tides:
93.6 EJ/yr

conduction in rocks: 1008 EJ/yr

Source: Open University
http://openlearn.open.ac.uk/mod/
oucontent/view.php?id=397932&section=4.1

3rd Student
Kaliningrad,

1. The environmental data scientist

The European Wind Atlas:

Now in preparation,
based on remote sensing of wind

Ø 150 m

Ø 126 m

Ø 80 m

Ø 65 m

Ø 12 m

1985   87   89   91   93   95   97   99   01   03   04   10

Diameters at times of market launch
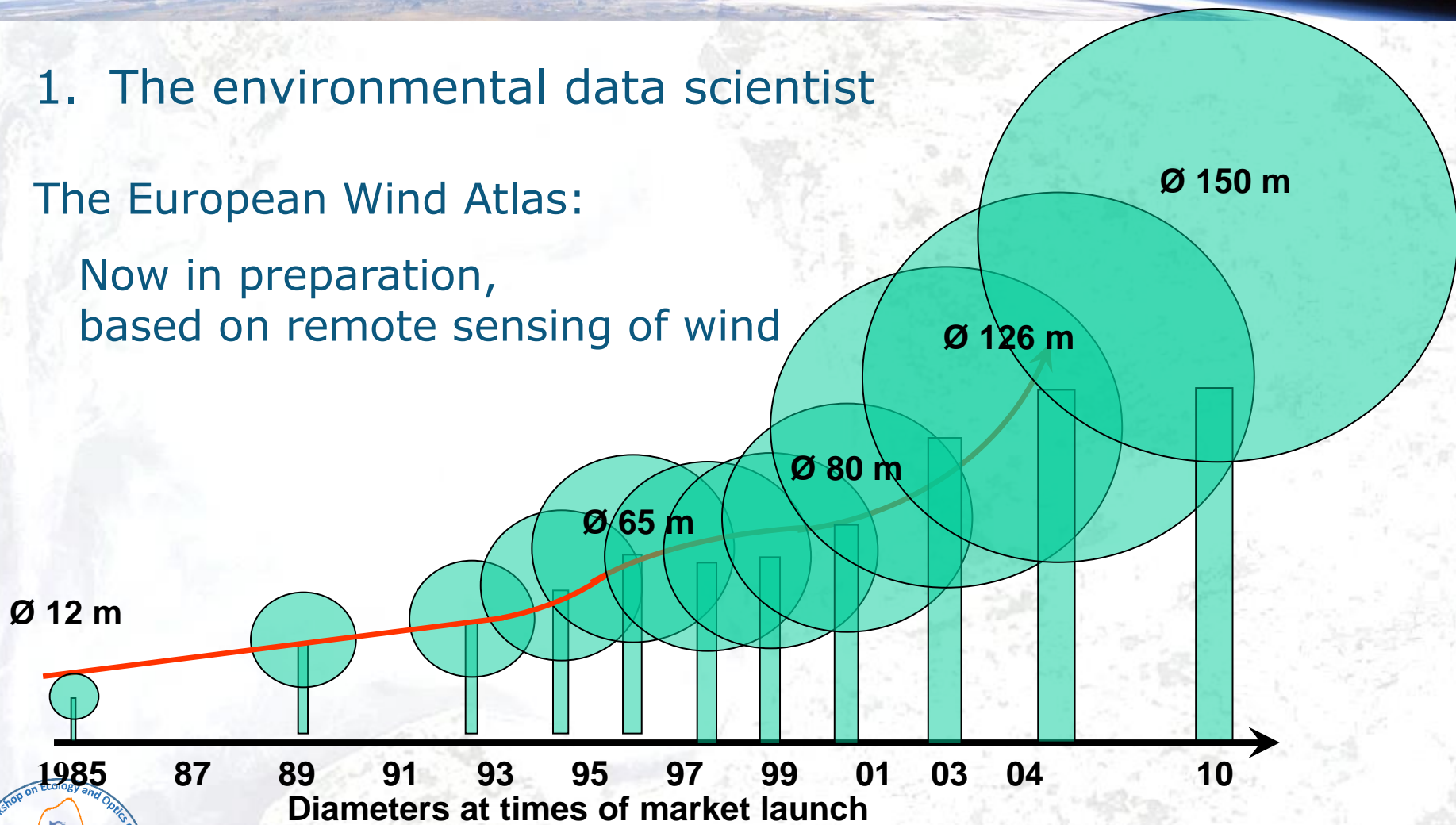
1. The environmental data scientist

Anteile der erneuerbaren Energien in den Sektoren Strom, Wärme und Verkehr
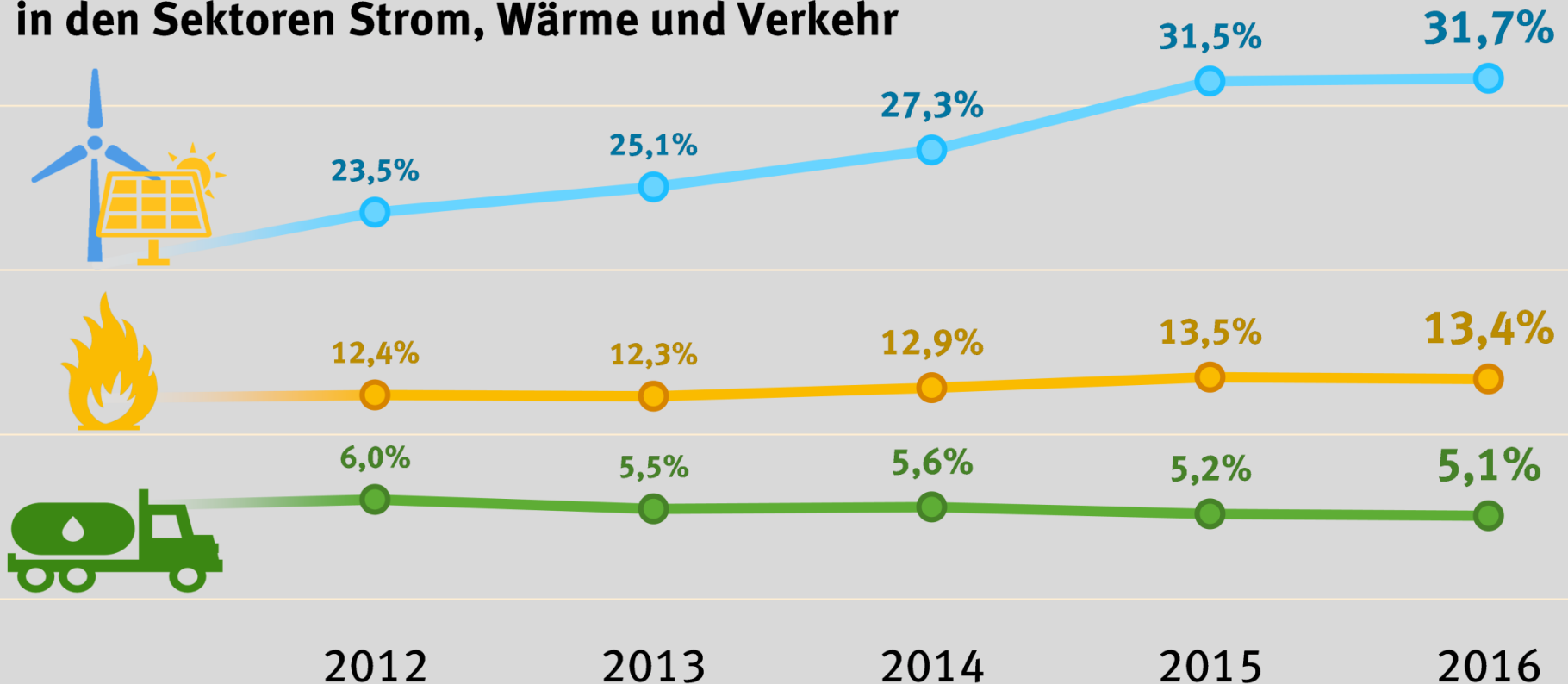
2. University lecturers and scientists

➢ Environmental Science, a new discipline:
   Needs the full set of information sources

➢ More traditional disciplines like   - geography, biology
   - physics, mathematics
   - engineering
   - social sciences, economy

➢ Needs selected data and information in support of
   research and teaching

➢ Easy access to analysed data and information
   without need of in-depth processing and modelling

➢ Online lectures and courses presented by experts

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2. University lecturers and scientists

Distant teaching with Open Online Courses

Examples:

➢ http://www.academicearth.org/

➢ https://www.edx.org/courses

➢ https://www.coursera.org/

But no courses on remote sensing yet!

3. Teachers and students in school

➢ Level of information and educational approach
is highly dependent on school level

➢ High School:

➢ Support of disciplines like
- geography, biology
- physics, mathematics
- social sciences, economy

➢ Shall make teaching more relevant and exciting

➢ Shall motivate students to enquiry-based learning

➢ Material shall be linked to national curricula

➢ Online tool for lesson outlines

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Users of E&T

3. Teachers and

Examples:
ESA eduspace

➢ to inspire teachers to incorporate Earth observation into their curricula

➢ to provide tools and Earth observation data for educational purposes

http://www.esa.int/eduspace

ESA eduspace website

esa — eduspace — European Space Agency

ESA   Education   **Home**   Weather and Climate   Global Change   Natural Disasters

24-Sep-2013

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   ▶
Search
[   ] GO

Flash floods in Thessaloniki

Floods are considered one of the most catastrophic 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.

Full story ▶

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.

Full story ▶
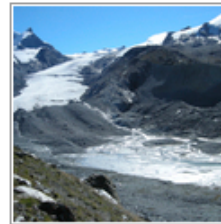
Climate change and glaciers

Detecting and quantifying glacier retreat and advancement, glacier area changes, and glacier lake changes 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.

Full story ▶

More News

23 January 2013   Glacier Ice Flow
30 October 2012   Lost in the Andes
29 August 2012   Urban sprawl in Córdoba

News Archive ▶

Earth from Space: Image of the week

· Image archive

3. Teachers and

Examples:
ESA eduspace

➢ Remote sensing principles, physics and engineering

➢ Case studies: weather & climate, global change, natural disasters

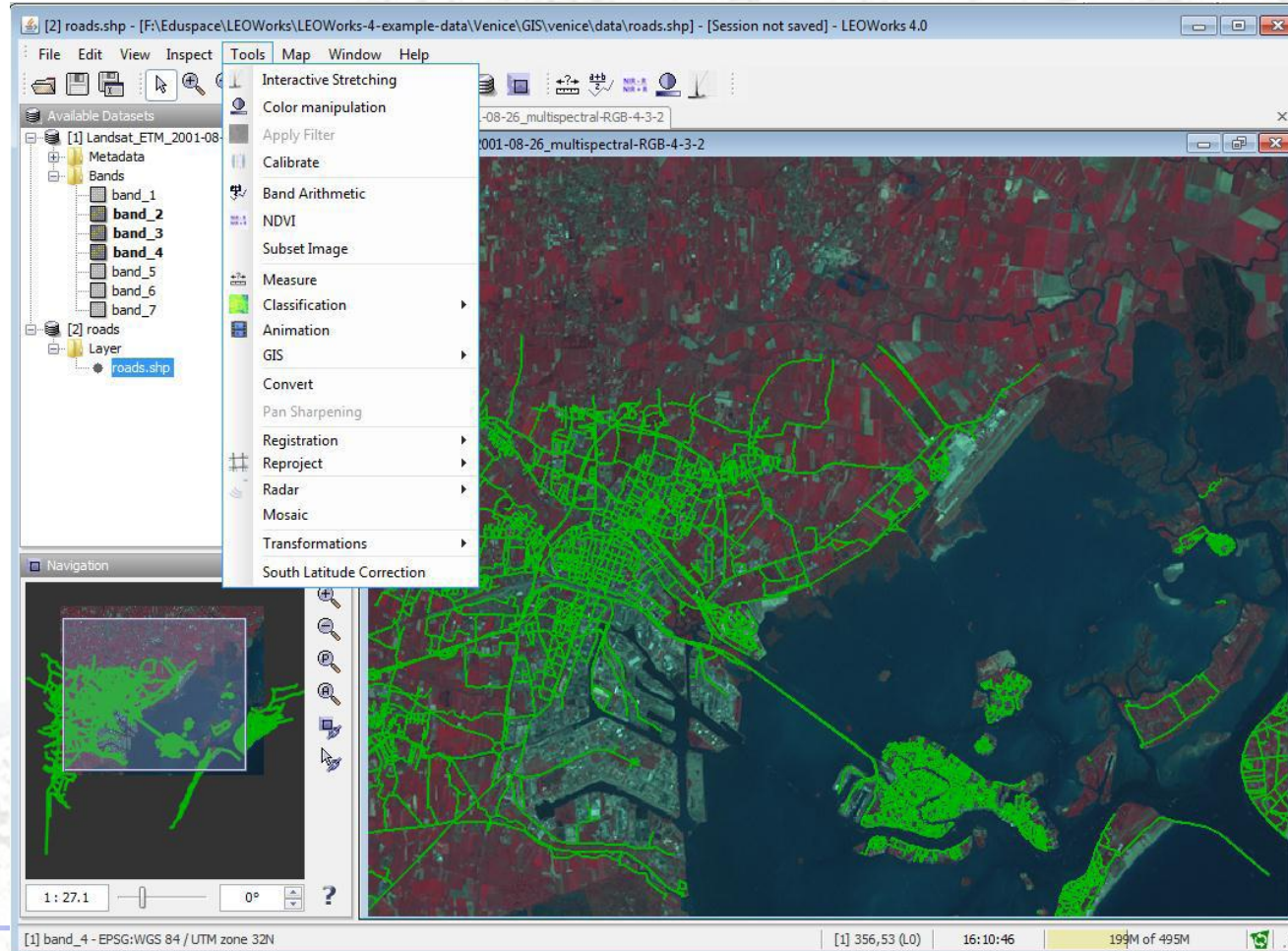➢ Educational image processing software and catalogue

3. Teachers and students in school

LEOWorks

1. Import/Export
2. RGB Composite
3. Histogram Tools
4. Subset
5. Mosaic
6. Calibration
7. Band Maths
8. Filters
9. Classification
10. Animation
11. GIS
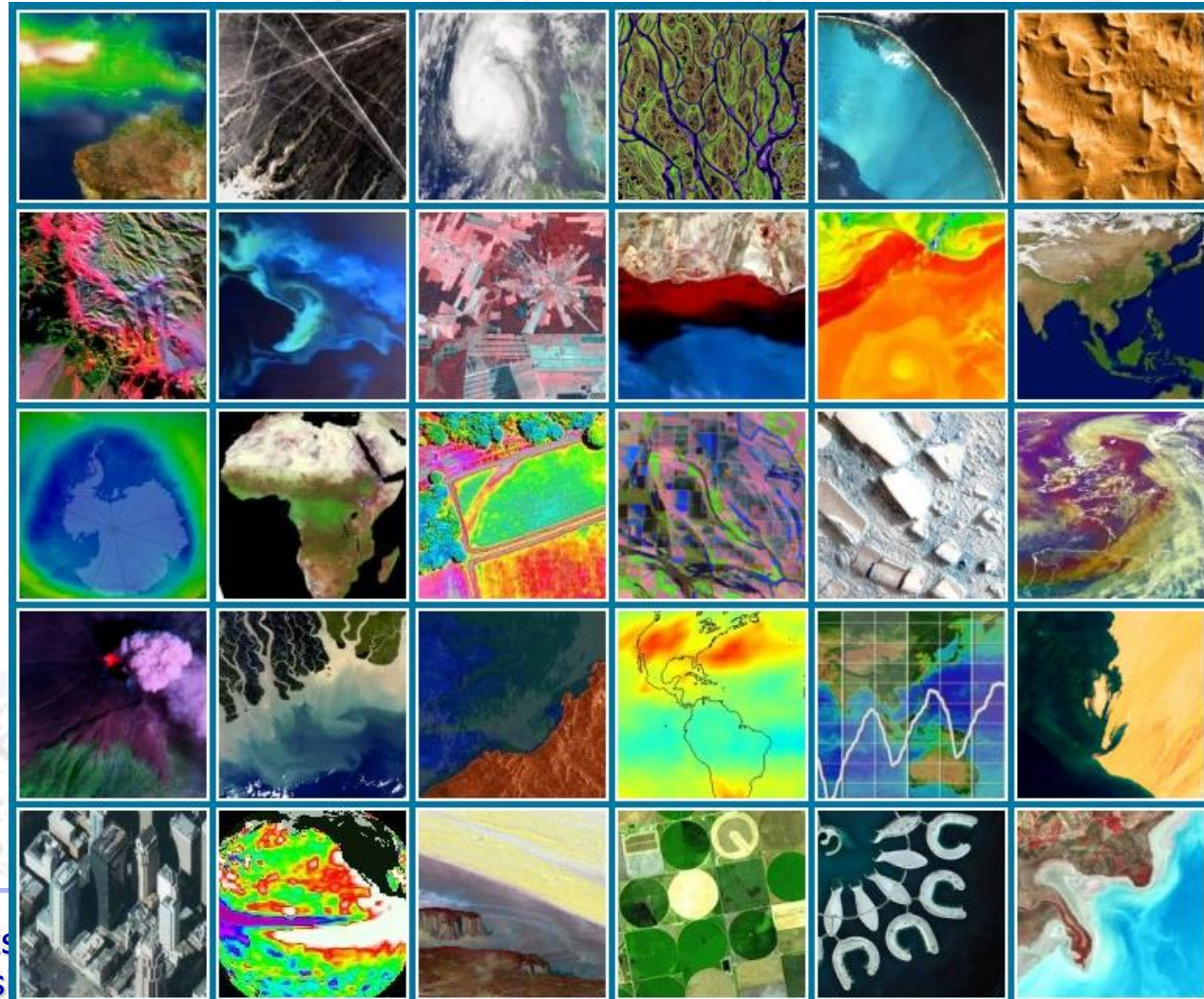12. Geometric correction
13. Radar Tools

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3. Teachers and students in school

Examples:
SEOS

➢ Starts from physics, math, geography, biology, chemistry and engineering

➢ Uses remote sensing to inspire students

➢ Includes high-level pages for university students

www.seos-project.eu

3rd Student Works
Kaliningrad, Russi

3. Teachers and students in school

➢ Level of information and educational approach
                        is highly dependent on school level

➢ **Primary and middle School:**

➢ Shall help making pupils aware of their environment

Example:
Satellite Image Learning Center

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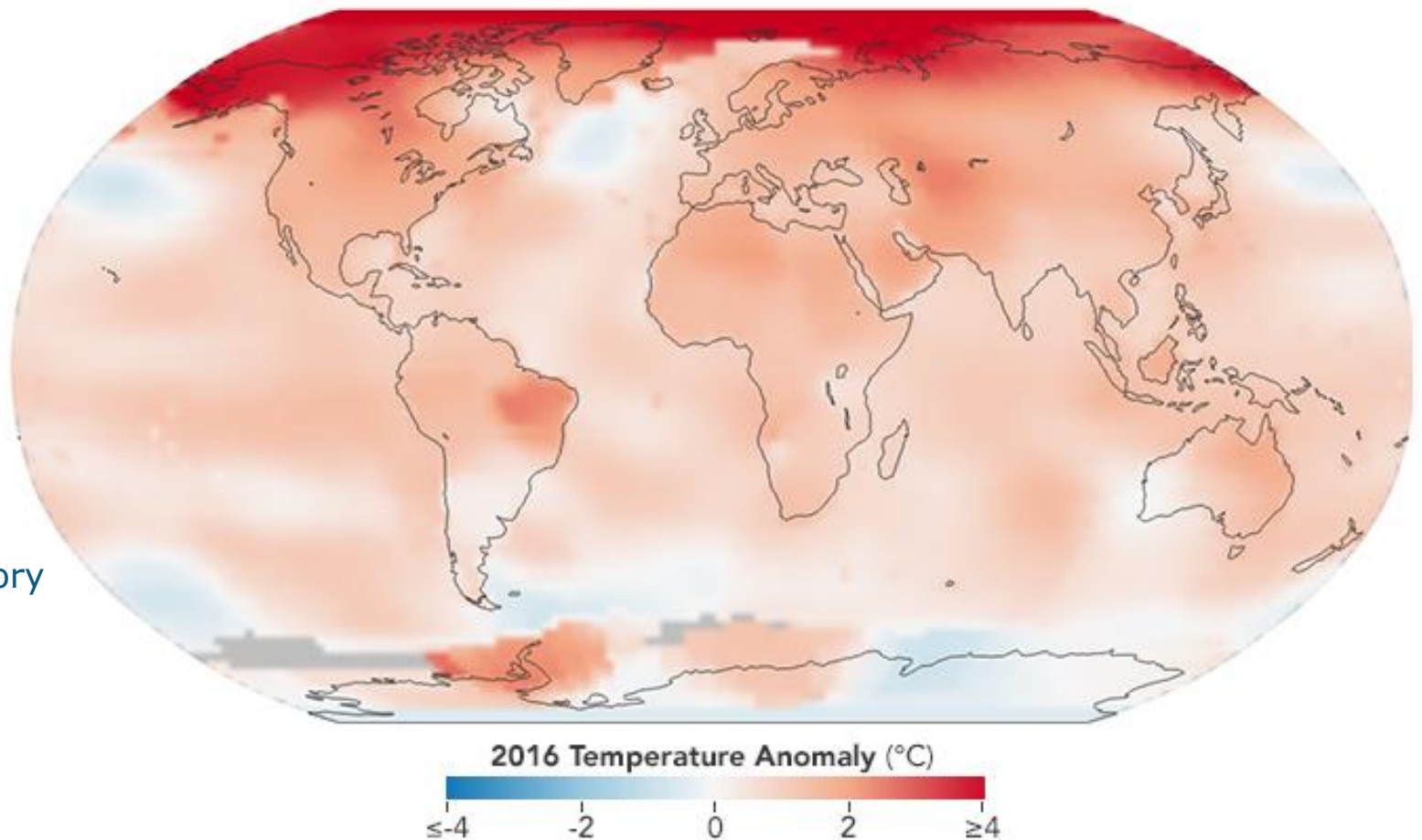3. Teachers and students in school

4. Non-technical users in the wider community

➢ Non-experts, searching for keywords seen in the media

➢ Information needed in a journalistic style, short but precise and relevant

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4. Non-technical users in the wider community

Example: „2016 was the warmest year on record since 1880"

2016 Temperature Anomaly (°C)

NASA
Earth Observatory

Obstacles of E&T using Remote Sensing

➤ Broad user groups with different background

➤ Information required by different user groups must be easily identified on the internet

➤ Information must cover easy-to-understand graphs to very complex data

➤ Resources must be comprehensive, relevant, user-friendly and up-to-date

➤ Users wish to contribute by providing their own material, by testing material provided by others,

➤ Users want to offer/receive advice through online fora

➤ Information shall be available in different languages

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Ideas behind E&T in Remote Sensing

➢ Remote sensing, of value by itself
   - often observed in geography at school
   - focus on case studies
   - not always applicable to other cases

➢ Remote sensing in support of teaching
   more fundamental disciplines
   - tutorials cover essential elements of school curricula
   - remote sensing to emphasise the main subject

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1. Forecast of renewable energy production

2. Grid control (smart grids)

3. Protection of the environment and its ressources

4. Less energy poverty in developing countries

5. Promotion of peace by reducing the dependence on regionally concentrated energy ressources

6. Estimate of benefit / risk for the future climate

Thank you!