Globe Annual Conference for Europe & Eurasia 2013
08.4.2013 – 12.4.2013, Tallinn, Estonia

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PROGRAM GLOBE
MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE

SCRC in Poland

Students Cimate Research Campaign

http://globe.gridw.pl/projekty/badawcza-kampania-klimatyczna/o-projekcie

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2012-2014

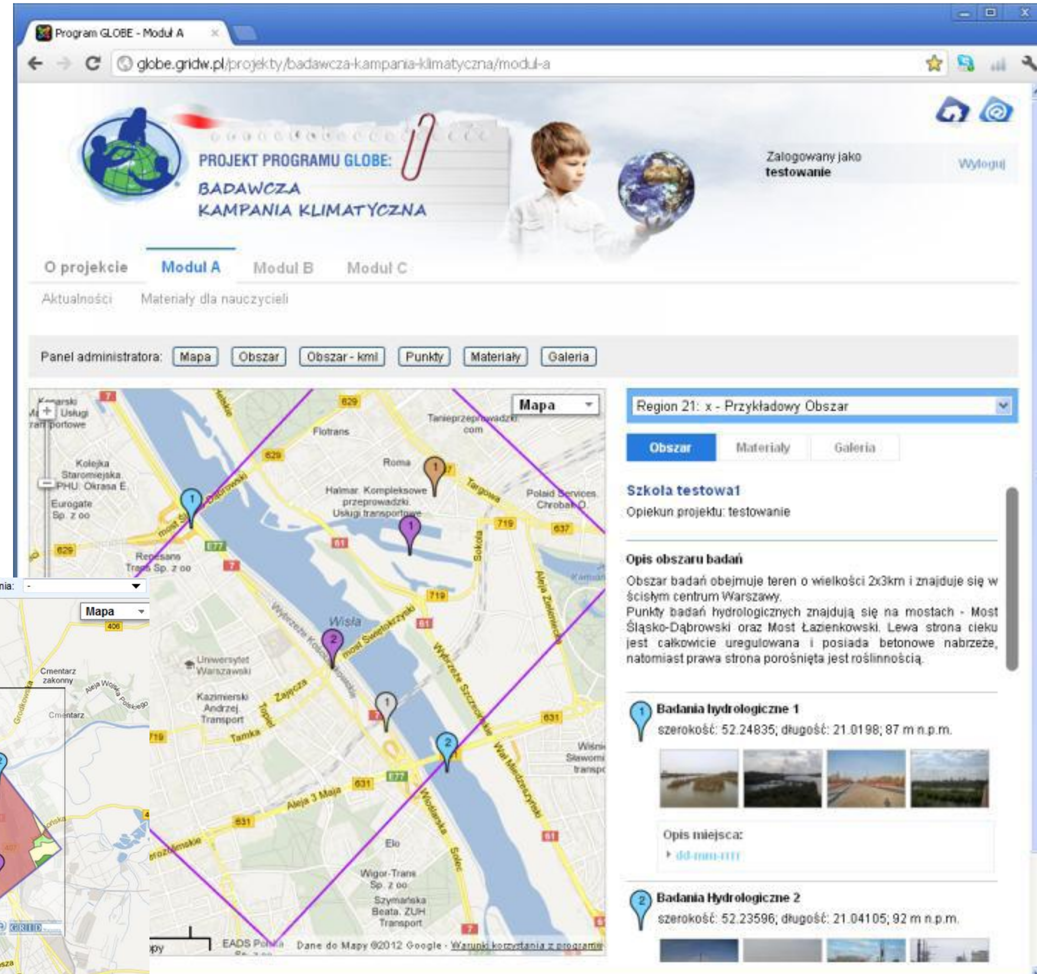
- extension of the GLOBE Program formula, **additional educational activities,** fit perfectly in the GLOBE Student Climate Research Campaign (SCRC), designed in Poland
- collaboration with **scientists** to extend previous studies of students under 3 modules:

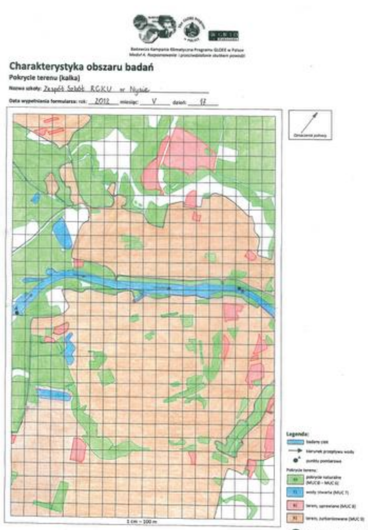
Module A. Diagnosis and counteracting the effects of flooding

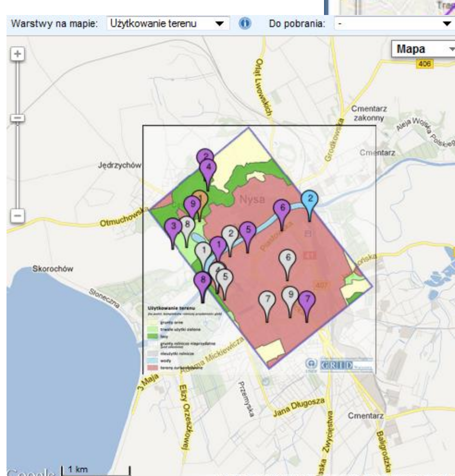
Module B. The study contamination of the atmosphere

Module C Satellite climate lesson (by teachers) http://globe.gridw.pl/projekty/badawcza-kampania-klimatyczna/

Interactive website dedicated to the GLOBE Climate Research Campaign in Poland



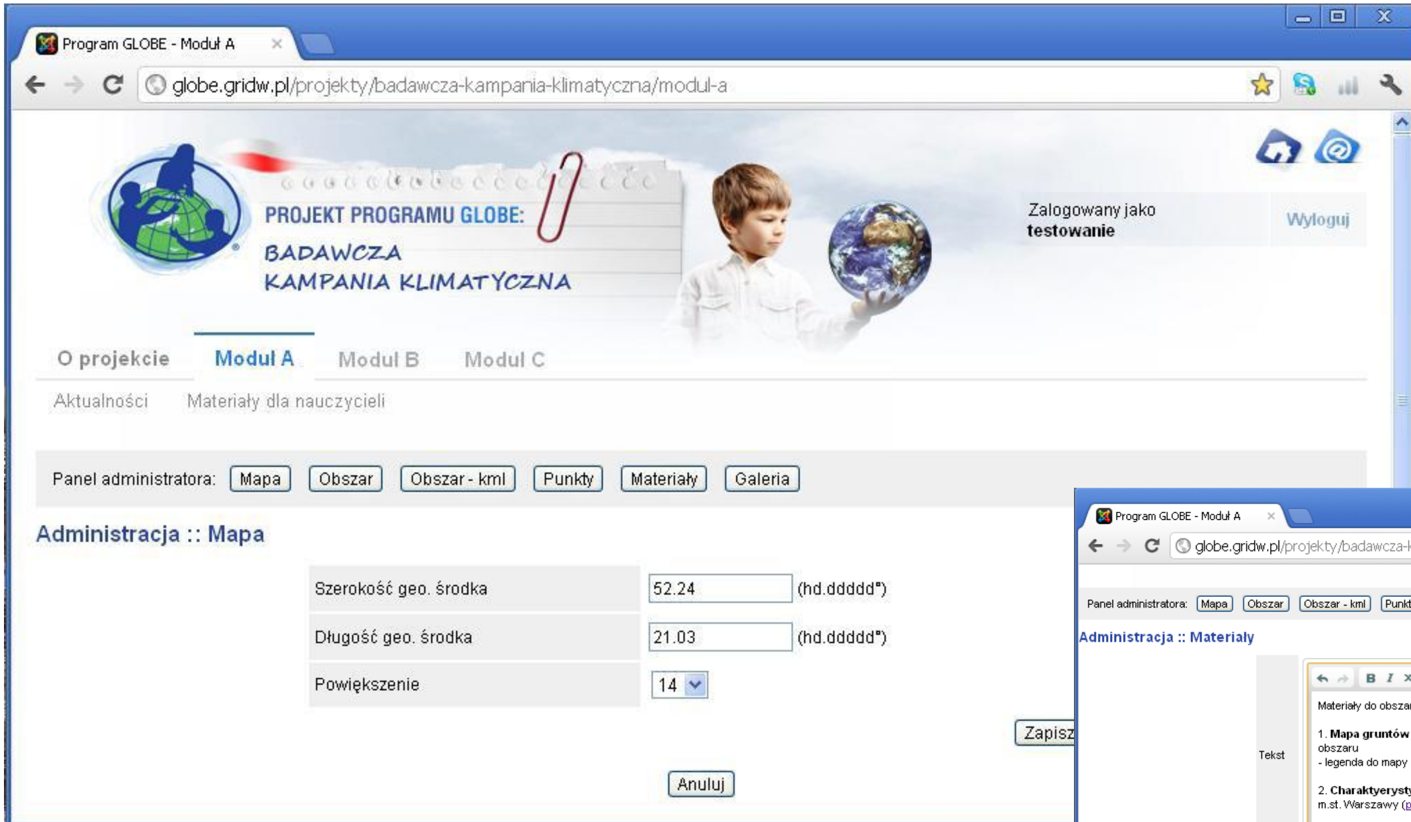


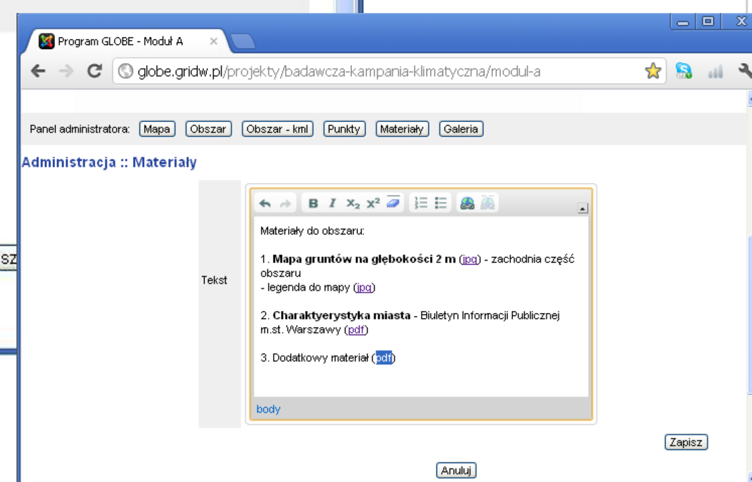


Developed by Magdalena Machinko-Nagrabecka, UNEP/GRID-Warsaw, Environmental Education Unit

Administration panel for teachers

Panel administratora: Mapa | Obszar | Obszar - kml | Punkty | Materiały | Galeria





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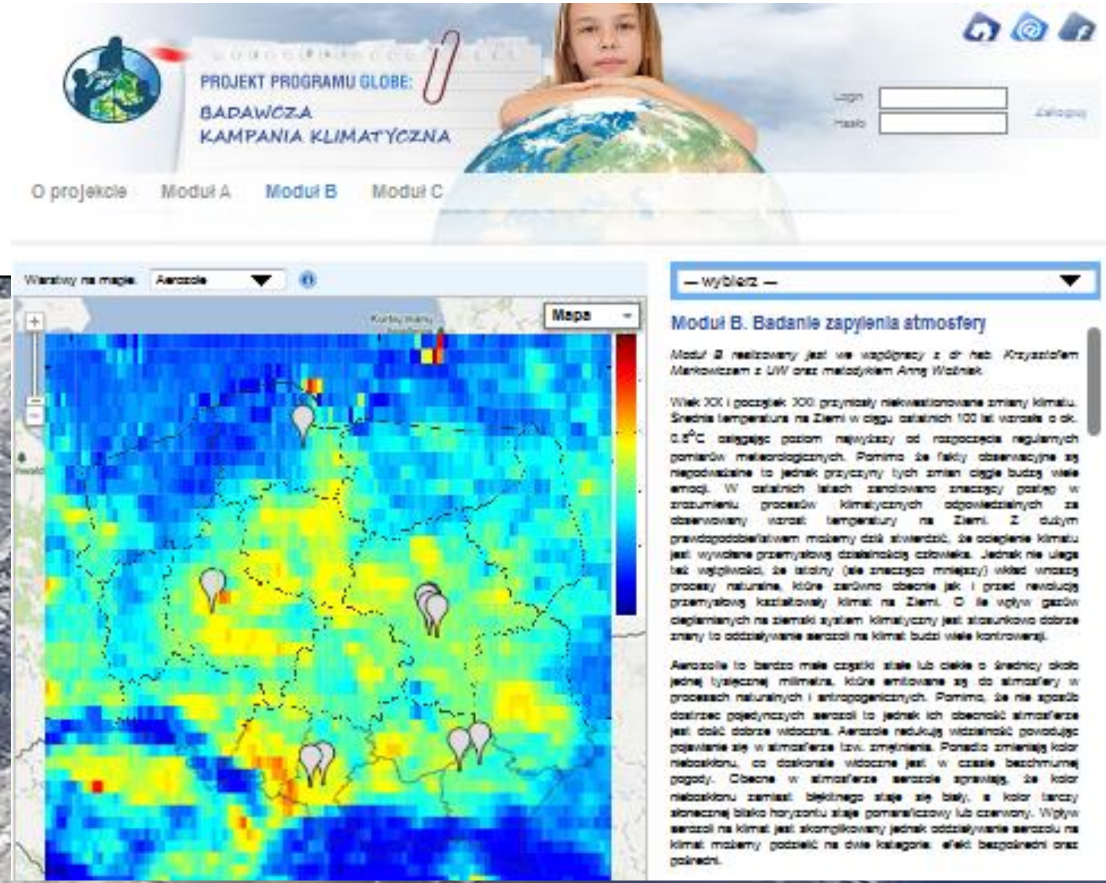

Module B

Atmosphere contamination with aerosols investigation

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General information on the project

- Project will join the efforts of GLOBE students with that of local research scientists
- The main objective of this activity is to conduct high-quality measurements of atmospheric aerosols on Polish territory
- Extension of the monitoring of pollutants (aerosols) on the Polish (Extension of the PolandAOD network)

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AOD - sun photometer network

http://www.polandaod.pl

Existing scientific measuring stations:

1.IGF UW (CIMEL,MFR-7)

2.IO PAN Sopot (MFR-7)

3.SolarAOT Strzyżów (MFR-7)

4.IGF PAN Belsk (CIMEL, PREDE)

5.IMGW Legionowo (CIMEL)

2. Research Station at the Institute of Oceanology of the Polish Academy of Sciences Sopot

1. Institute of Geophysics Physics Department of the Universit
Warsaw

3. Research Station for the stu
Radiative Transfer in Strzyzow
scientist).

4. Radiative Transfer Laboratory at the Institute of Geophysics, Physics Department of the University of Warsaw,

5. Institute of Meteorology and Water Management

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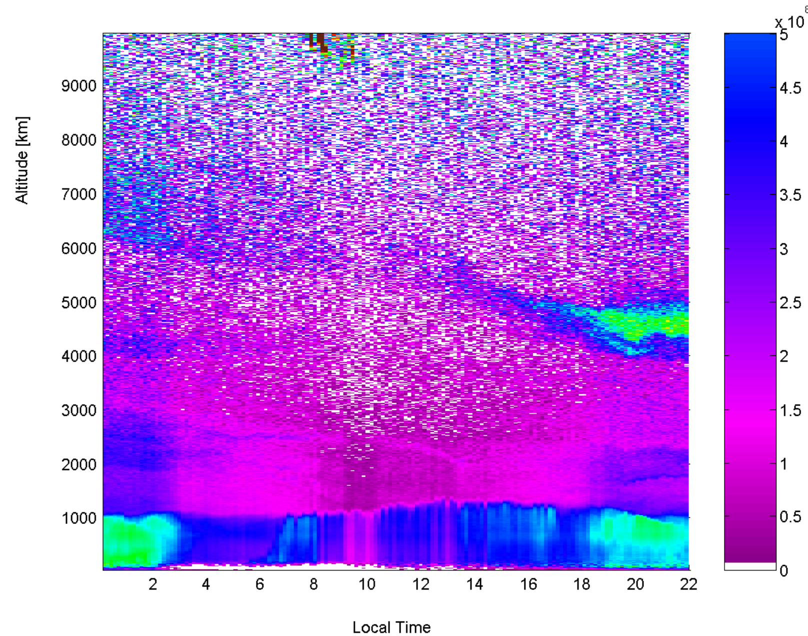
Scientific objectives of the project

- analysis inflows desert aerosols, volcanic pollutants, emitted during fires
- study of spatial variability of aerosols
- validation of contaminant transport model and satellite observations



Desert Dust
May 29, 2008 over Warsaw

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What we do

The study climate processes

- conducting experiments to illustrate the physical phenomena
- discussion of results

Regular studies of aerosols

- measurements
- sending data
- study non-standard situations
- analysis of the results
- preparation of air quality status report

The stages of project

Stage I. Characteristics of the study area and conducting experiments (learning activity) illustrate the physical phenomena physical phenomena related to the topic

- terrain, location of the main sources of pollution emission, carrying out simple exercises with climate processes

Stage II. Regular air pollination study

- measurements. alerts measurement points associated with meteorological situations

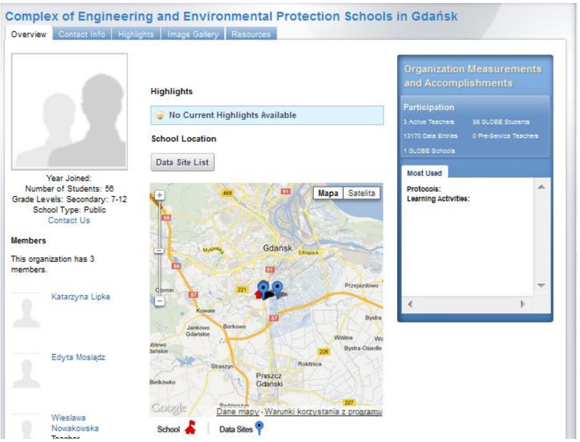
Stage III. Regular testing contamination of the atmosphere and summary

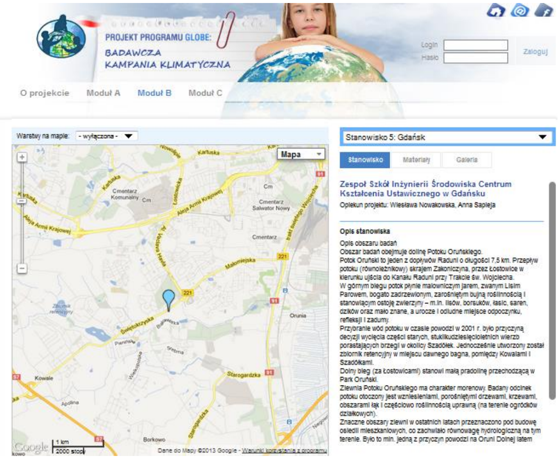
- students will analyze the cases of smog, continued measurements and analysis of the data and information available satellite

Stage I. Characteristics of the study area

Schools participating in the project **have already set up an ATM site** - most of the measurements performed during Module B can be made there.

The aim of this stage is to determine and characterize atmospheric research area with **particular emphasis on the factors that affect emissions, proliferation and deposition of pollutants, emission sources**;





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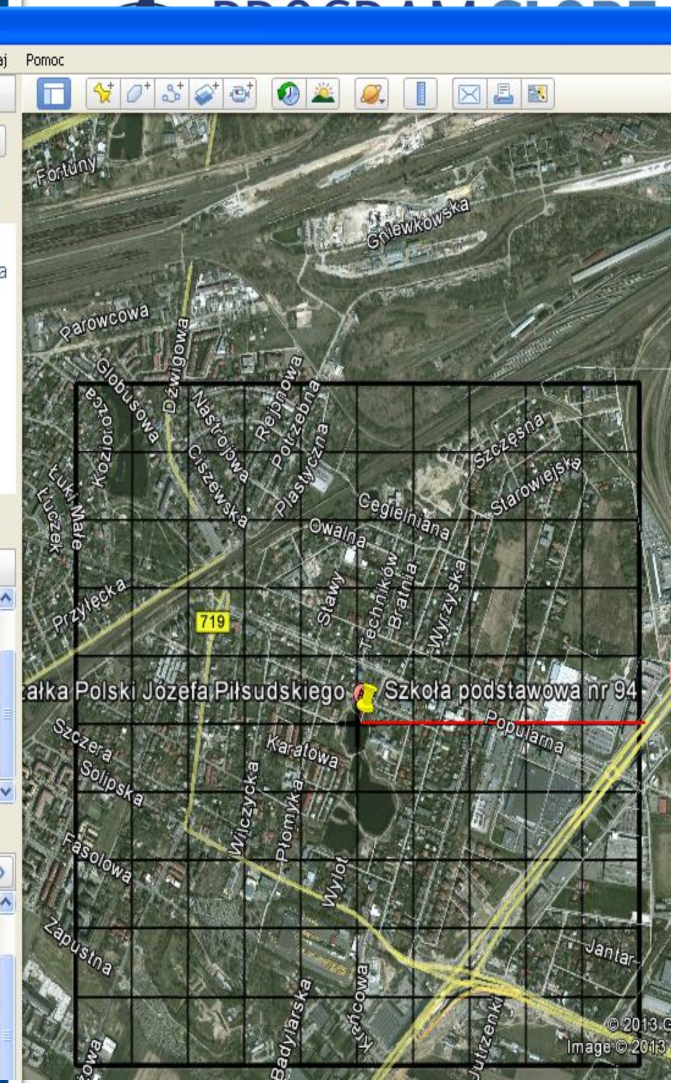
Stage I. Characteristics of the study area



The first task given to students is the **investigation of the ATM site surroundings.** On the basis of observation, satellite data (Google Earth) and other information sources (internet, maps etc.)

In 2x2km and 20x20km squares surrounding the ATM site students:

•describe the lay of the land, elevation Profile

•describe the land cover (natural and developed), estimate the contribution of each type of land cover

•identify potential aerosol sources,

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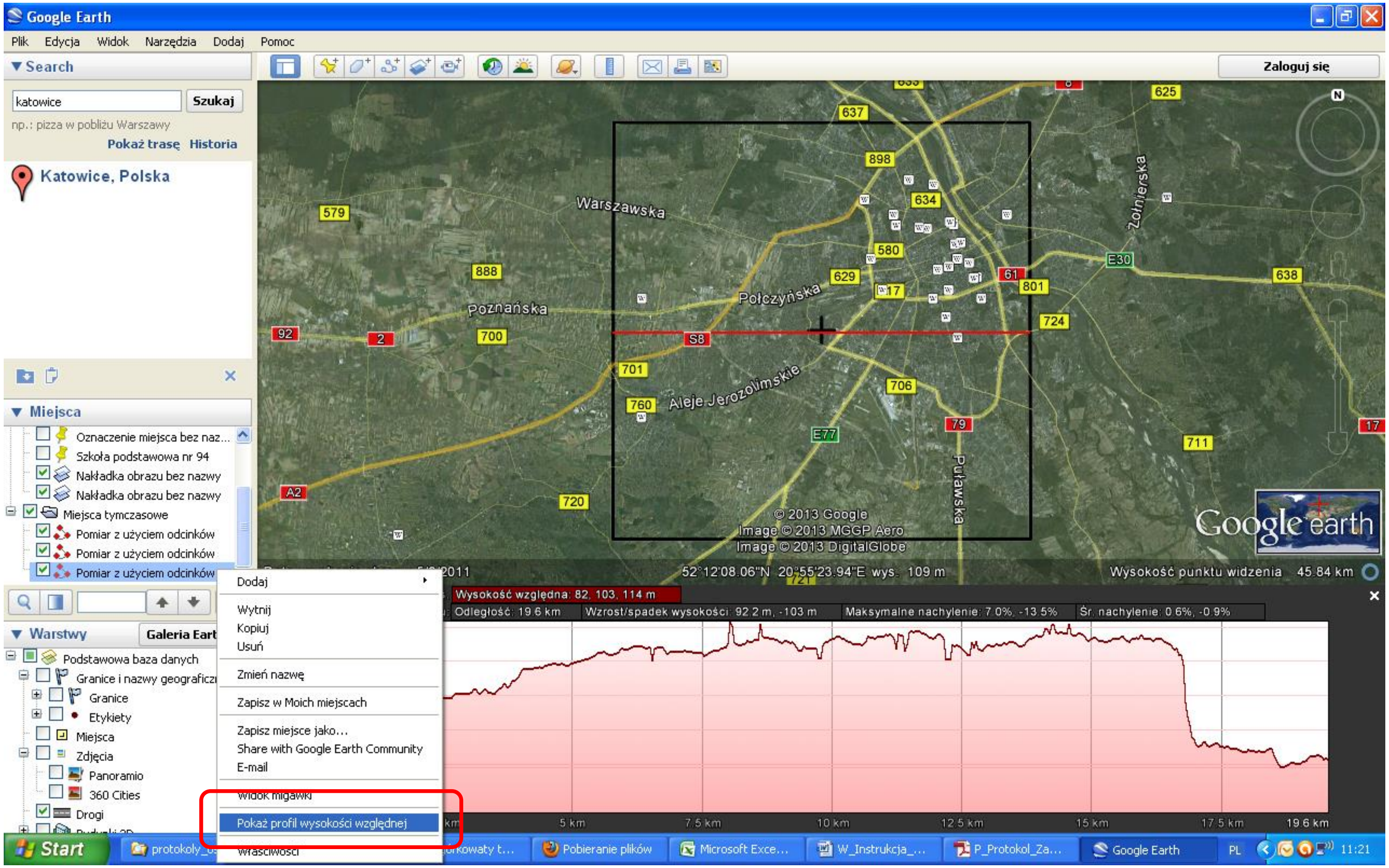
Elevation Profile



Stage I. Conducting experiments (learning activity)

1. Earth's radiation balance and surface albedo,
2. Greenhouse effect,
3. Aerosol effect,
4. Relative air mass,
5. Cloud temperature and base.

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1. Earth's radiation balance and surface albedo

In our learning activity, we ask students to measure the components of radiation balance for the surface and combine them in **the Earth's radiation balance equation**:

$$B = F_s^{\downarrow} + F_{IR}^{\downarrow} - (F_s^{\uparrow} + F_{IR}^{\uparrow})$$

downward solar (shortwave, visible) radiation (measured with a lux meter pointing up),

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1. Earth’s radiation balance and surface albedo

- downward atmospheric (longwave, infrared) radiation (calculated on the basis of temperature measured with an infrared thermometer **pointing up**),
- upward longwave radiation emitted by Earth’s surface (calculated on the basis of temperature measured with an infrared thermometer **pointing down**).

Students can also calculate **surface albedo** (ratio of radiation reflected by the surface to incident radiation), which is a key factor in Earth’s radiation balance.
Students can compare measurements performed during different cloud conditions and over different surfaces (e.g. grass, snow).

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2. Greenhouse effect

To demonstrate the greenhouse effect to students, we perform solar radiation measurements using the lux meter and infrared radiation of atmosphere and Earth’s surface using infrared thermometer.

Additionally, **we perform the same measurements, inserting a plexiglass plate between the instrument and sky/Earth’s surface.** The plate simulates the presence of greenhouse gases

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3. Aerosol effect

To demonstrate aerosol effect to students, we use the lux meter and **two glass plates (one clear, one blackened with smoke).**

The blackened plate simulates and aerosol layer

and the clear plate - atmosphere without aerosols.

Students compare measurements performed with the lux meter through both plates to find out, to what degree solar radiation is reflected by aerosols.

4. Relative air mass

Our relative air mass learning activity **is similar to classic GLOBE learning activity** – students set up a gnomon and measure its height together with the length of its shadow or the distance between gnomon's top and the farthest point of the shadow.

Additionally, we ask students to compare their measurements to the results take from **on-line solar elevation** and angle and relative air mass calculators.

t_d

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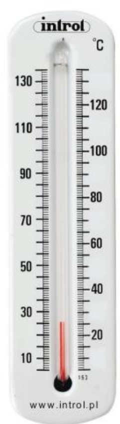
5. Cloud temperature and base

Cloud temperature measurements with the infrared thermometer, air temperature near surface – with a standard thermometer.

If dew temperature measurements are available, cloud base calculation results may be compared to alternate calculations using an equation:

$$H = 120(t_a - t_d)[m]$$

where t_d is dew point in °C.



Measurement protocols – Meteorological observations

- All observations performed in the frame of Module B should be accompanied by **standard meteorological observations** of temperature, cloud cover, cloud types, precipitation and humidity.

Additional observations include mainly:

- the presence of clouds near sun disk (which may affect sun-photometer measurements),
- wind speed and direction (which may help to identify sources of observed aerosol).

Measurement protocols – Visibility and sky color

Sky color and visibility are strongly connected with atmospheric aerosols' concentrations, therefore we decided to develop the GLOBE learning activity *Observing Visibility and Sky Color* into a protocol.

Sky Color

As in the original GLOBE activity, we **ask students to observe the sky color,** and mark it as deep blue, blue, light blue, pale blue or milky. The more aerosol in the atmosphere, the more milky the sky seems to be.

Measurement protocols – Visibility and sky color

Visibility

2 methods of evaluating visibility in kilometers (as opposed to only describing the transparency of air as unusually clear, clear, somewhat hazy, very hazy, extremely hazy).

1st method is a traditional meteorological technique

- human observer determines it by identifying objects and landmarks at known distances around the observation point.
- observers must establish a list of landmarks which may be seen from the ATM site in good weather and their distances from the ATM site.
- estimation of visibility consists in noting the distance to the farthest visible landmark.

Measurement protocols – Visibility and sky color

Visibility

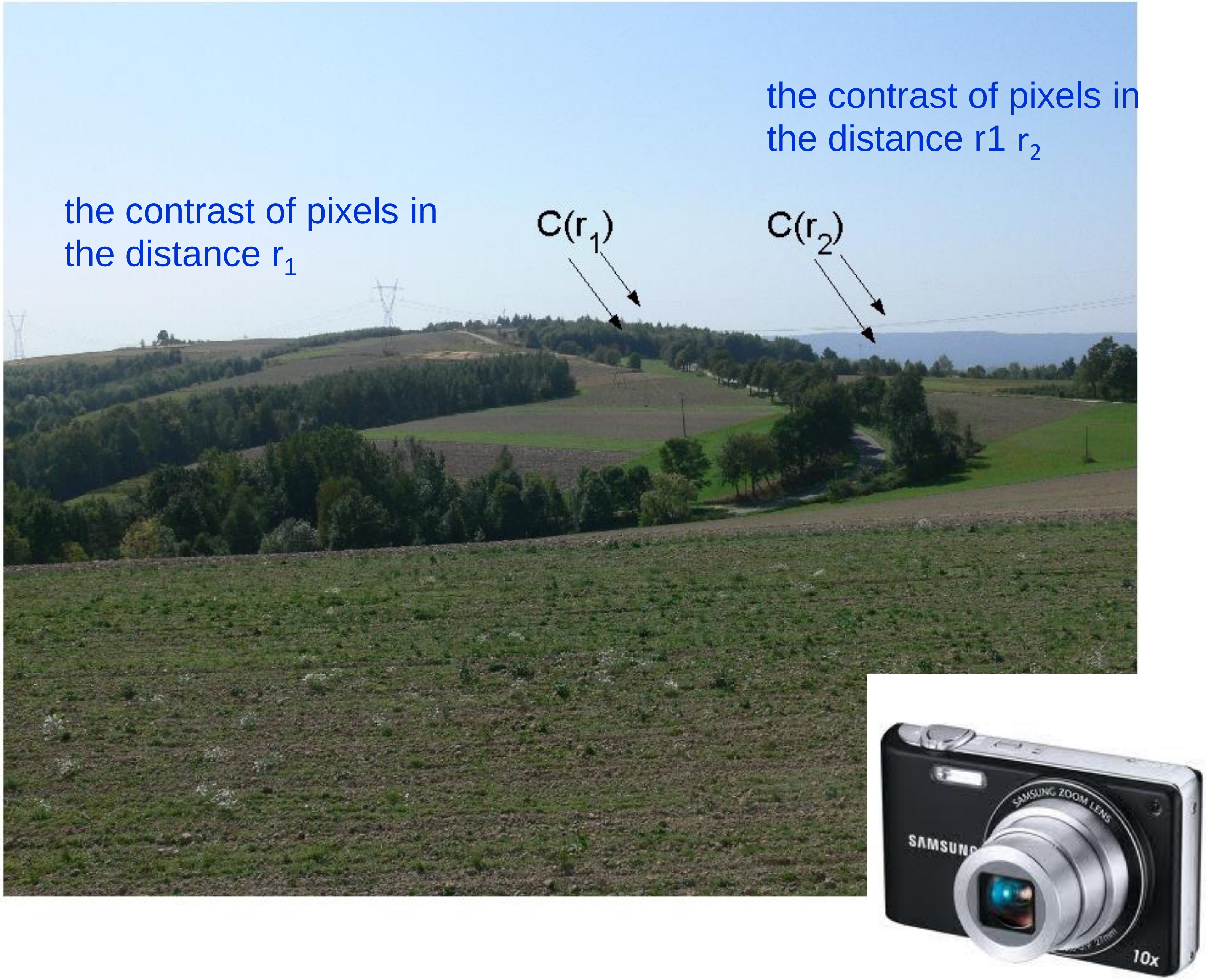
2nd, more modern method use of a digital camera and a dedicated computer program.

- at the ATM site students take a picture of two objects in 5-25 km distance from the site.
- The objects should be in different distances from the site, but both fit into one photo.

The dedicated computer program calculates extinction coefficient in atmosphere and Meteorological Optical Range (objective measure of visibility) on the basis of a difference in contrast between the two objects and their background.

the contrast of pixels in
the distance r1 r_2

the contrast of pixels in
the distance r_1



Measurement protocols – Solar radiation measurements

students use the lux meter and measure the **total solar radiation** and the **direct radiation**.

- a long tube is put on the lux meter sensor to protect it from the scattered radiation.
- scattered radiation intensity is calculated as a difference between total and direct radiation intensity.

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Very serious scientific measurments

Sun photometer and miniature aethalometer

- Both instruments are built at the Department of Physics, University of Warsaw.
- At this stage of the prototype device is tested

Sun photometer - built professional device includes sensors and software to answer the procedery to simplify measurement.

Athelometr is used to measure the concentrations of carbon and the molecular absorption coefficient.

Aethalometer for measuring the concentration of absorbing aerosols

The system consists of:

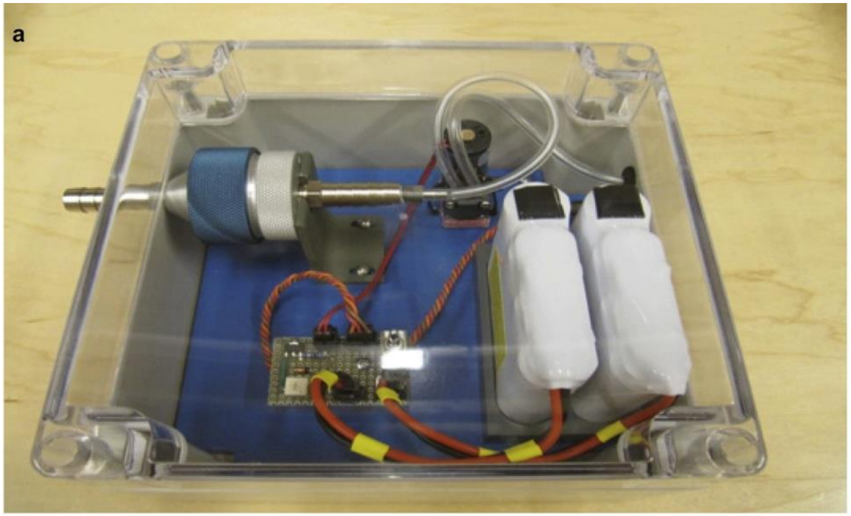
air pump

power supply

filter holder

filters

digital Camera

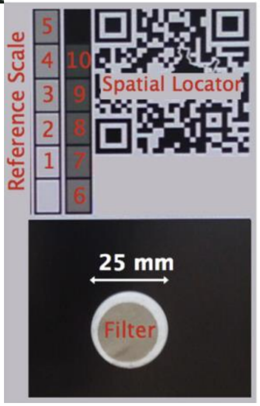


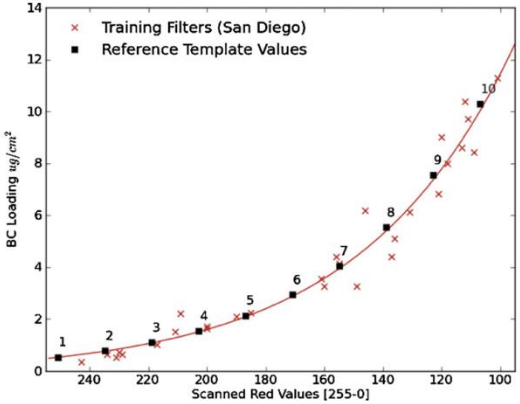
The measurement is based on a photograph dirty filter

Determining the concentration of aerosols based on the degree of gray filter

Unit cost around 500 Euro

Sample Filters





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Sun photometer – 1000 Euro

New

Sun photometer –
1000 Euro

Regular air pollination study

The purpose of this step of research is to obtain at least a one-year data series. This is due to the fact that the degree of contamination of the atmosphere has an annual cycle, and thus conclusions about the temporal changes of atmospheric pollution requires data covering at least the period of time.