



United Nations Environment Programme

**GRID** Warszawa

Global Resource Information Database



**PROGRAM GLOBE**

MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE

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



## **SCRC in Poland**

### **Students Climate Research Campaign**

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

***Magdalena Machinko-Nagrabecka***  
***Polish GLOBE Country Coordinator***  
***magda@gridw.pl***



United Nations Environment Programme

**GRID** Warszawa

Global Resource Information Database



**PROGRAM GLOBE**

MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE

**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

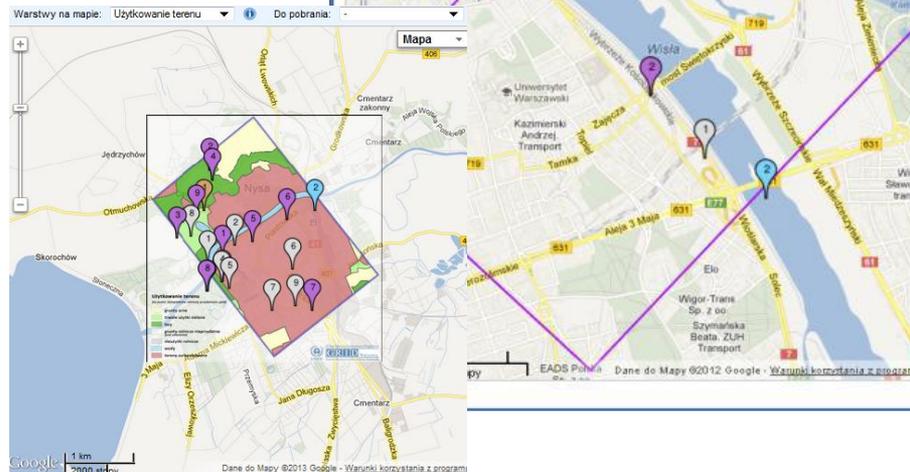
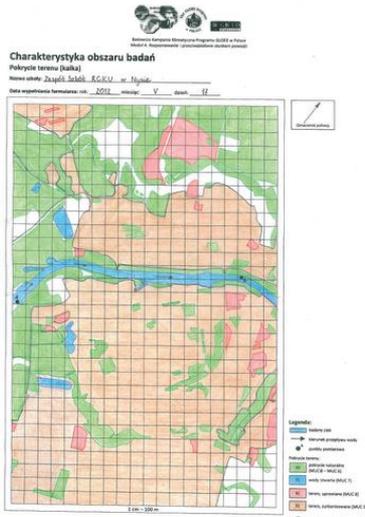
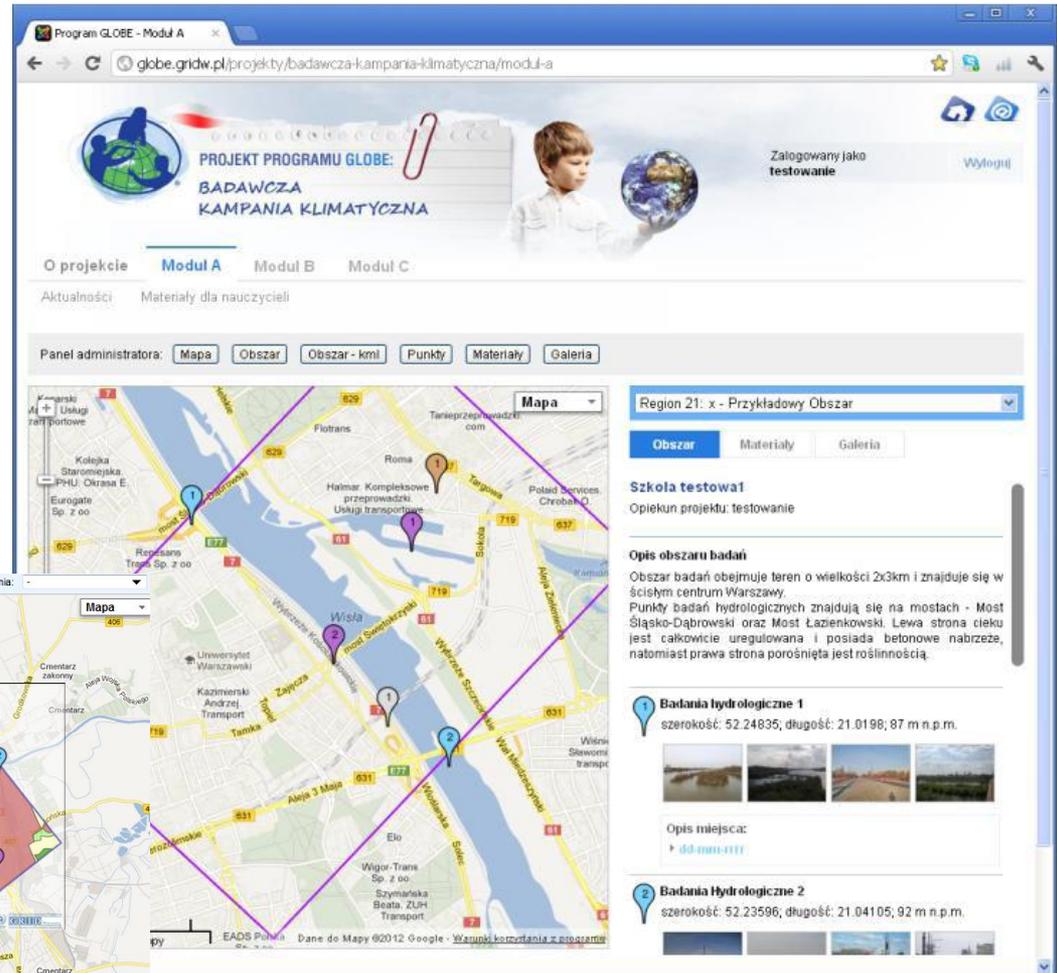
**Module B. The study contamination of the atmosphere**

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





# Administration panel for teachers



**PROGRAM GLOBE**

Panel administratora:

Mapa

Obszar

Obszar - kml

Punkty

Materiały

Galeria

Program GLOBE - Moduł A

globe.gridw.pl/projekty/badawcza-kampania-klimatyczna/modul-a

**PROJEKT PROGRAMU GLOBE:**  
**BADAWCZA KAMPANIA KLIMATYCZNA**

Zalogowany jako **testowanie** [Wyloguj](#)

O projekcie **Moduł A** Moduł B Moduł C

Aktualności [Materiały dla nauczycieli](#)

Panel administratora: [Mapa](#) [Obszar](#) [Obszar - kml](#) [Punkty](#) [Materiały](#) [Galeria](#)

**Administracja :: Mapa**

Szerokość geo. środka	<input type="text" value="52.24"/>	(hd.ddddd*)
Długość geo. środka	<input type="text" value="21.03"/>	(hd.ddddd*)
Powiększenie	<input type="text" value="14"/>	

[Zapisz](#) [Anuluj](#)

Program GLOBE - Moduł A

globe.gridw.pl/projekty/badawcza-kampania-klimatyczna/modul-a

Panel administratora: [Mapa](#) [Obszar](#) [Obszar - kml](#) [Punkty](#) [Materiały](#) [Galeria](#)

**Administracja :: Materiały**

Materiały do obszaru:

- 1. [Mapa gruntów na głębokości 2 m \(png\)](#) - zachodnia część obszaru - legenda do mapy (png)
- 2. [Charakterystyka miasta - Biuletyn Informacji Publicznej m.st. Warszawy \(pdf\)](#)
- 3. [Dodatkowy materiał \(scd\)](#)

body

[Zapisz](#) [Anuluj](#)



United Nations Environment Programme  
**GRID** Warszawa  
 Global Resource Information Database



**PROGRAM GLOBE**  
 MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE



Warszawa na mapie: Aerosole

—wybierz—

### Moduł B. Badanie zapylenia atmosfery

Moduł B realizowany jest we współpracy z dr hab. Krzysztofem Markowiczem z UW oraz meteorologiem Anng Woźniak.

Wiek XX i początek XXI przyniosły niekwestionowane zmiany klimatu. Średnia temperatura na Ziemi w ciągu ostatnich 100 lat wzrosła o ok. 0,5°C odlegając poziom najwyższy od rozpoczęcia regularnych pomiarów meteorologicznych. Pomimo że fakty obserwacyjne są niepodważalne to jednak przyczyny tych zmian ciągle budzą wiele emocji. W ostatnich latach zainicjowano znaczący postęp w zrozumieniu procesów klimatycznych odpowiedzialnych za obserwowany wzrost temperatury na Ziemi. Z dużym prawdopodobieństwem możemy dziś stwierdzić, że ocieplenie klimatu jest wywołane przemysłową działalnością człowieka. Jednak nie ulega już wątpliwości, że zmiany (nie znacząco mniejszy) wkład wnoszą procesy naturalne, które zarówno obecnie jak i przed rewolucją przemysłową kształtowały klimat na Ziemi. O ile wpływ gazów cieplarnianych na zmiany system klimatyczny jest stosunkowo dobrze znany to oddziaływanie aerozoli na klimat budzi wiele kontrowersji.

Aerozole to bardzo małe cząstki stałe lub ciekłe o średnicy około jednej tysięcznej milimetra, które emitowane są do atmosfery w procesach naturalnych i antropogenicznych. Pomimo, że nie sposób dokładnie pojedynczych aerozoli to jednak ich obecność w atmosferze jest dość dobrze widoczna. Aerozole redukują widzialność powodując pojawienie się w atmosferze tzw. zmęglenia. Ponadto zmieniają kolor niebo, do całkowicie widocznej jest w czasie bezchmurnej pogody. Obecne w atmosferze aerozole sprawiają, że kolor nieba bliżej horyzontu staje się biały, a kolor nieba przy słońcu i blisko horyzontu staje pomarańczowy lub czerwony. Wpływ aerozoli na klimat jest skomplikowany jednak oddziaływanie aerozoli na klimat możemy podzielić na dwie kategorie: efekt bezpośredni oraz pośredni.

# Module B

# Atmosphere contamination with aerosols investigation



United Nations Environment Programme

**GRID** Warszawa

Global Resource Information Database



**PROGRAM GLOBE**

MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE

## 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)



# 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 University of Warsaw

3. Research Station for the study of Radiative Transfer in Strzyżów (by the physicist).

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

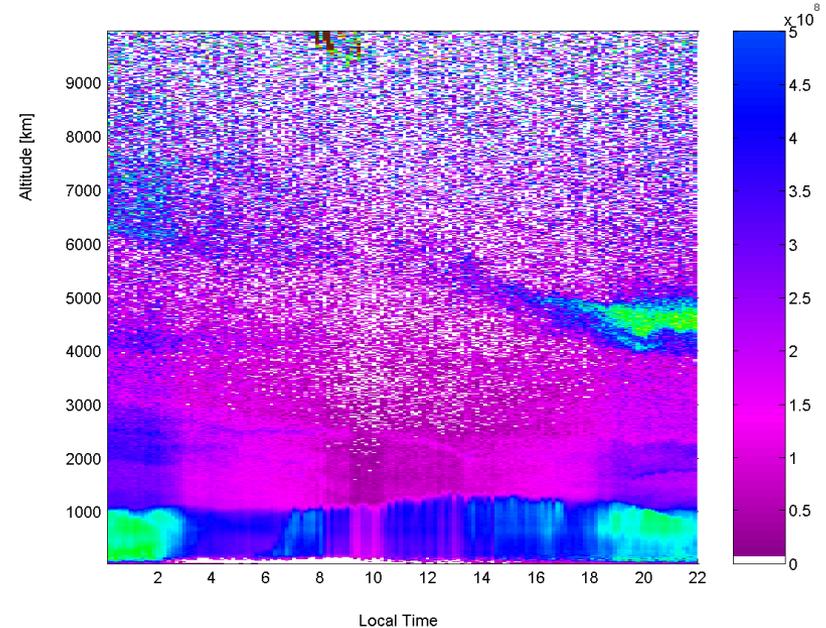
5. Institute of Meteorology and Water Management





# 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*



United Nations Environment Programme

**GRID** Warszawa

Global Resource Information Database



**PROGRAM GLOBE**

MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE

## 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





United Nations Environment Programme

**GRID** Warszawa

UNEP

Global Resource Information Database



**PROGRAM GLOBE**

MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE

## 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 pollution 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



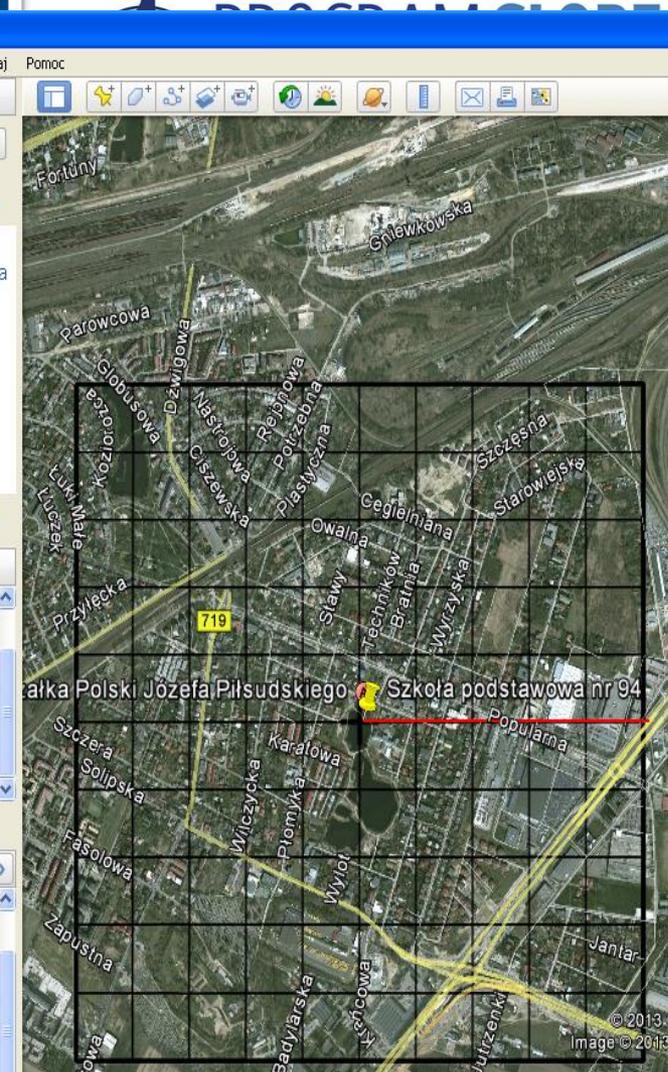


# Stage I. Characteristics of the study area

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,





United Nations Environment Programme

**GRID** Warszawa

Global Resource Information Database



**PROGRAM GLOBE**

MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE

# Elevation Profile

The screenshot shows the Google Earth interface with a map of Katowice, Poland. A red line on the map indicates the path for the elevation profile. The profile graph below the map shows the elevation in meters along the path. The graph starts at approximately 109 meters and drops sharply to about 45.84 meters at the end. A context menu is open over the profile, with the option 'Pokaż profil wysokości względnej' highlighted in blue. Other options in the menu include 'Widok trójgłówny', 'Wyrnij', 'Kopiuj', 'Usuń', 'Zmień nazwę', 'Zapisz w Moich miejscach', 'Zapisz miejsce jako...', 'Share with Google Earth Community', and 'E-mail'.

Distance (km)	Elevation (m)
0	109
5	103
7.5	103
10	103
12.5	103
15	103
17.5	103
19.6	45.84



United Nations Environment Programme

**GRID** Warszawa

Global Resource Information Database



**PROGRAM GLOBE**

MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE

# 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.



# 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),





# 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).



United Nations Environment Programme

**GRID** Warszawa

Global Resource Information Database



**PROGRAM GLOBE**

MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE

## 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





United Nations Environment Programme

**GRID** Warszawa

Global Resource Information Database



**PROGRAM GLOBE**

MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE

## 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 an 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.





United Nations Environment Programme

**GRID** Warszawa

UNEP

Global Resource Information Database



**PROGRAM GLOBE**

MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE

## 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.



## 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.





United Nations Environment Programme

**GRID** Warszawa

Global Resource Information Database



**PROGRAM GLOBE**

MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE

# 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).



United Nations Environment Programme

**GRID** Warszawa

Global Resource Information Database



**PROGRAM GLOBE**

MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE

# 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.



United Nations Environment Programme

**GRID** Warszawa

Global Resource Information Database



**PROGRAM GLOBE**

MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE

# 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.



United Nations Environment Programme

**GRID** Warszawa

Global Resource Information Database



**PROGRAM GLOBE**

MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE

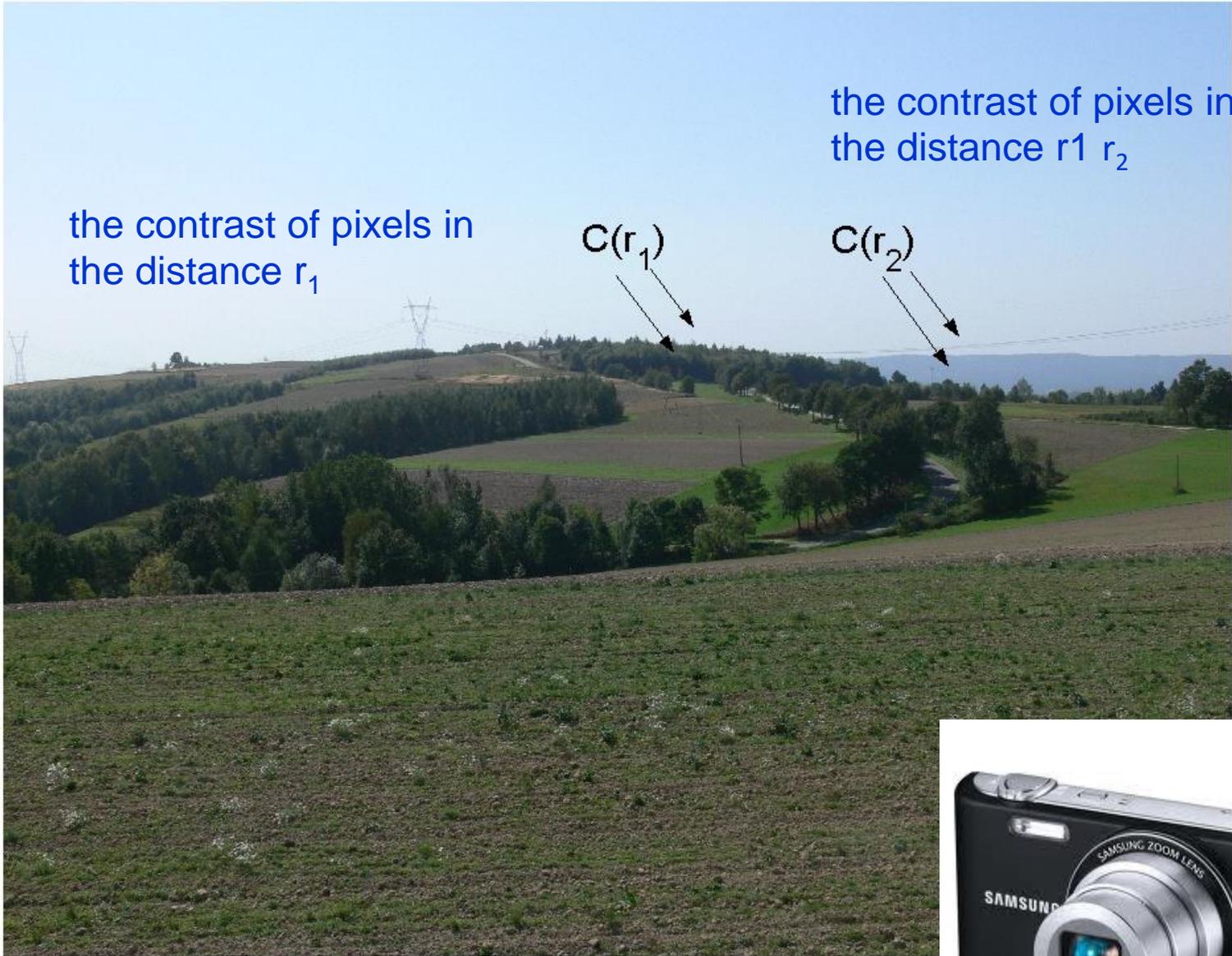
# Measurement protocols – Visibility and sky color

## 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  $r_1$

$C(r_1)$

the contrast of pixels in the distance  $r_2$

$C(r_2)$





# 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.





United Nations Environment Programme

**GRID** Warszawa

Global Resource Information Database



**PROGRAM GLOBE**

MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE

## Very serious scientific measurements

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.

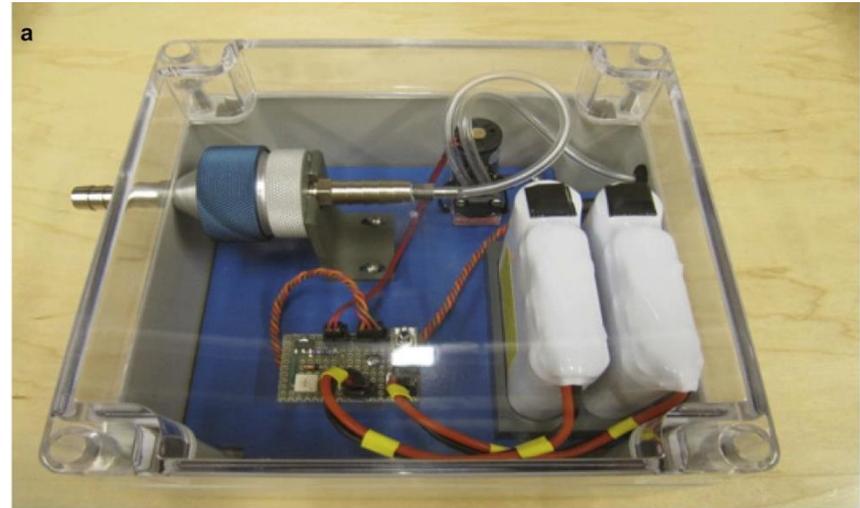


# Aethalometer for measuring the concentration of absorbing aerosols

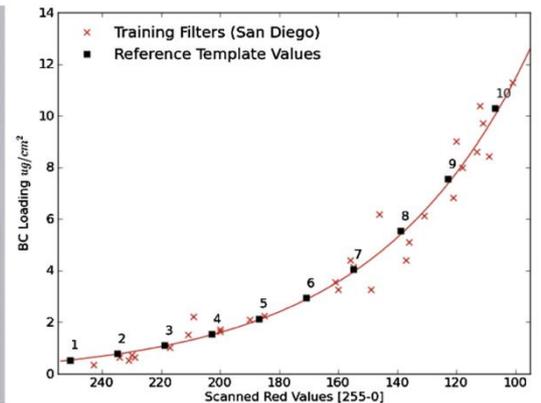
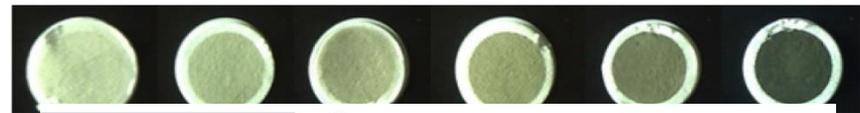
The system consists of:  
 air pump  
 power supply  
 filter holder  
 filters  
 digital Camera

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





United Nations Environment Programme

**GRID** Warszawa

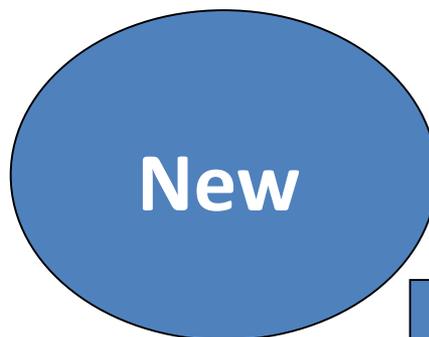
Global Resource Information Database



**PROGRAM GLOBE**

MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE

# Sun photometer – 1000 Euro



Sun photometer –  
1000 Euro





United Nations Environment Programme

**GRID** Warszawa

UNEP

Global Resource Information Database



**PROGRAM GLOBE**

MIĘDZYNARODOWY PROGRAM EDUKACYJNY W POLSCE

## 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.