

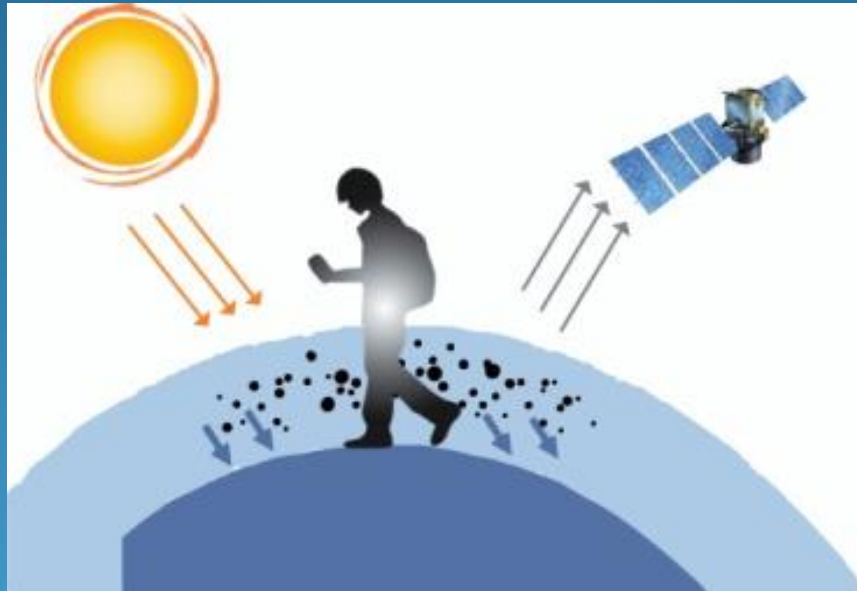


Aerosols Measurement campaign : Why and Results.

Eric ABGRALL

19 july 2016

Aerosols Measurement campaign : Why and Results.



Contents

- Aerosols / Air pollution / Climate
- Measurements/observations in the classroom
- Aerosols Measurement Campaigns

Aerosols Measurement campaign : Why and Results.

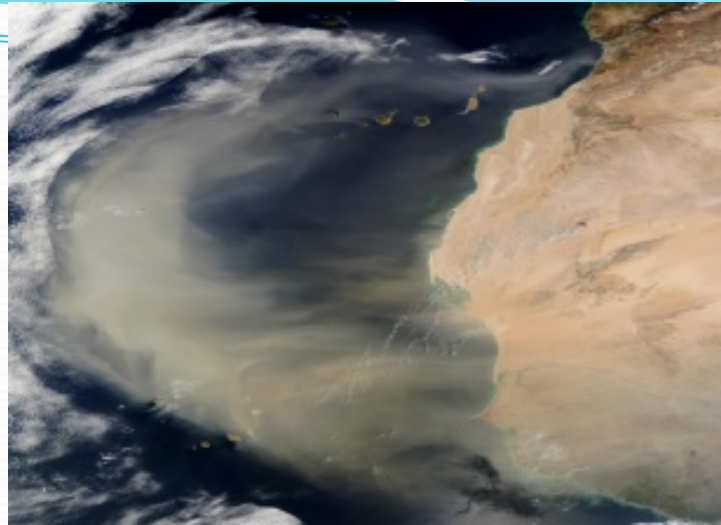


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African dust



View from space



**Volcanic Eruption
Mont Pinatubo**

A very dusty Atmosphere ...



Pollution Hong Kong

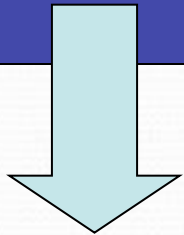


Fires in California (2003)

View from space

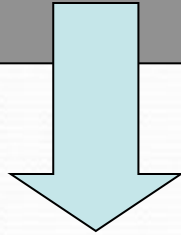
Aerosols are tiny solid particles or liquid droplets that remain suspended in the atmosphere

SEA SPRAY



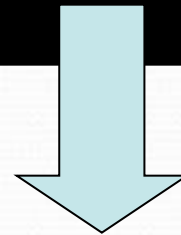
OCEAN

**SULFATE
AEROSOLS**



VOLCANO

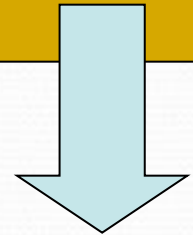
**BLACK CARBON
or
Carbonaceous
Aerosols**



FIRES

DESERT DUST

*Major source of aerosols
= 45% of global emissions*



EARTH

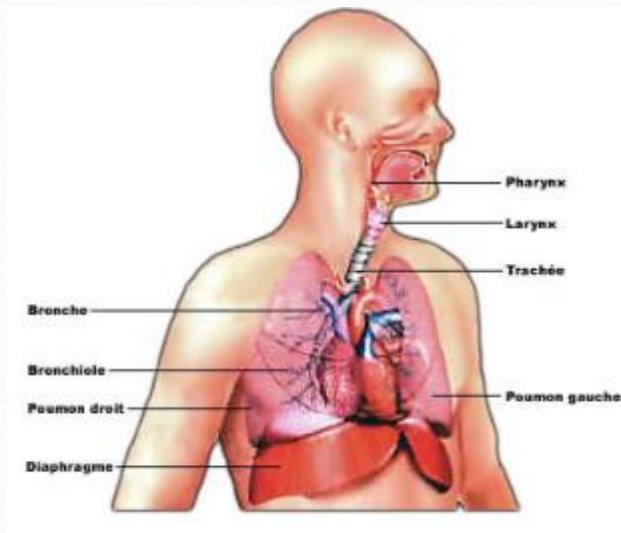
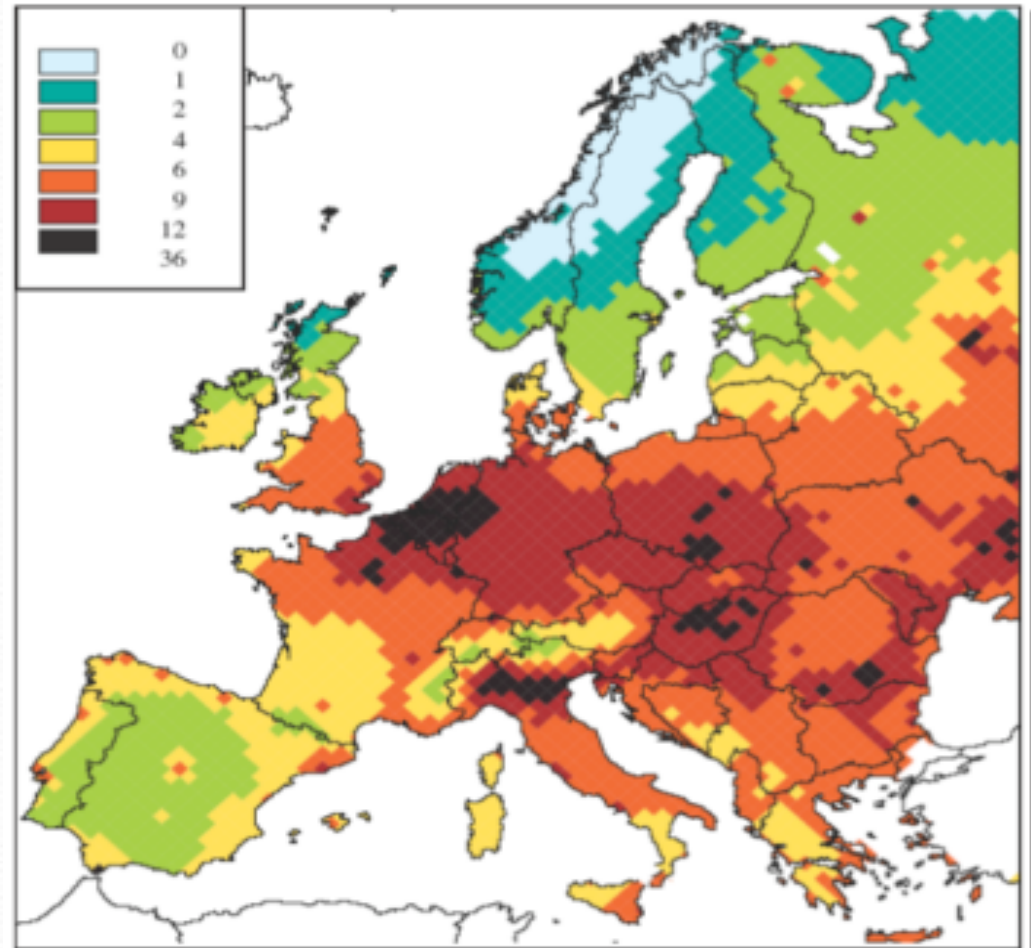


+ HUMAN ACTIVITIES

Health impacts (*local scale*) :



Loss in statistical life expectancy that can be attributed to identified anthropogenic PM_{2.5} (in month, after Aman 2004)



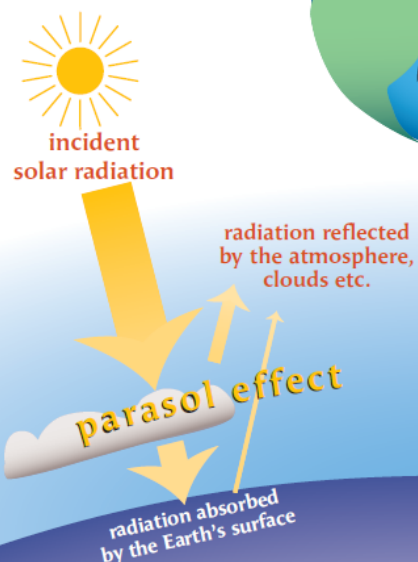
WHO : 7 million deaths per year worldwide.
almost 600 000 in Europe

When the climate 'goes wrong'

Climate in equilibrium

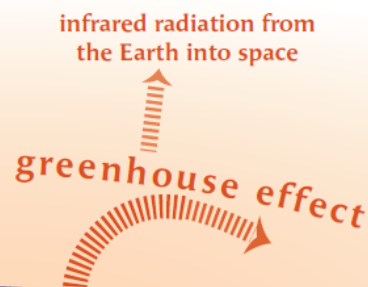
The PARASOL effect

By blocking solar radiation, aerosols and clouds act like a parasol and tend to cool the Earth-atmosphere system



The greenhouse effect

Inversely, by blocking the infrared radiation emitted by the Earth, the greenhouses gases and the clouds tend to heat up the system.

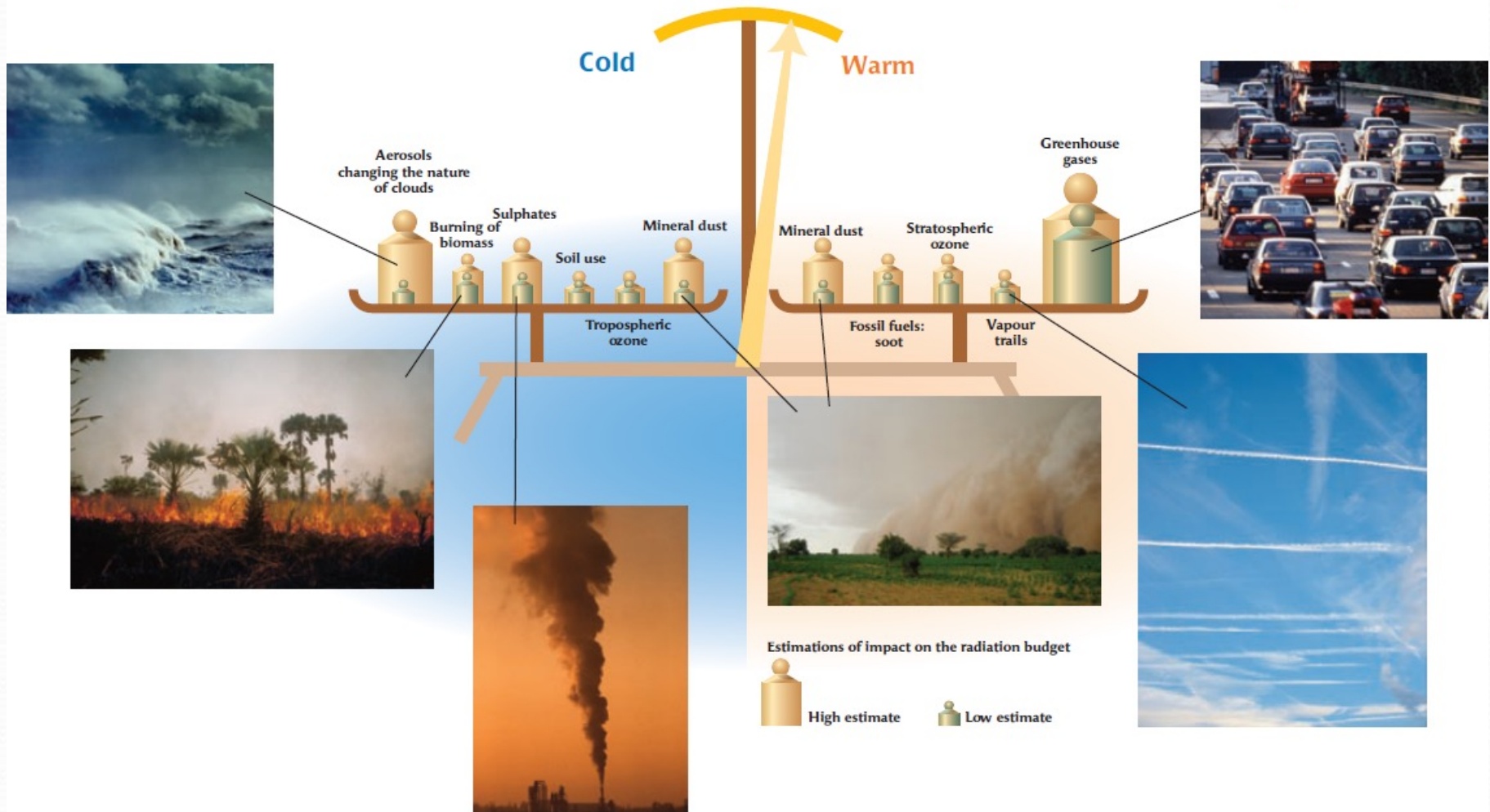


Mean temperature (in equilibrium) 15°C



An uncertain radiation budget
 We now understand the role of greenhouse gases, but the influence of aerosols and clouds on climate change remains a major unknown.

Perturbations due to human activity



The multiple effects of aerosols

the direct effect



Solar radiation backscattered into space (cooling) by sulphates, organic compounds etc.

The semi-direct effect



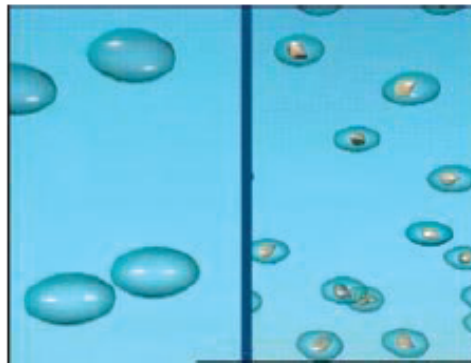
Solar radiation absorbed (warming) by carbon, soot, dust etc.



Aerosols diffuse and absorb sunlight and also modify the reflective power of clouds, so they can affect climate in several ways.

the first indirect effect

Aerosols act as **condensation nuclei** during cloud formation. The higher density of aerosols in air pollution will cause a larger number of smaller water droplets, thus making the cloud more reflective.



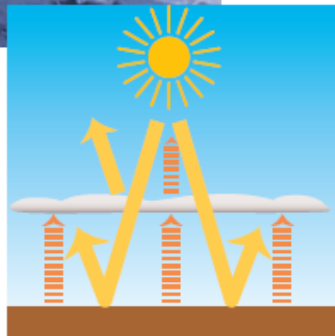
the second indirect effect

Recent research has shown that aerosols have a considerable effect on the **vertical development of clouds** and also influence **precipitation**.

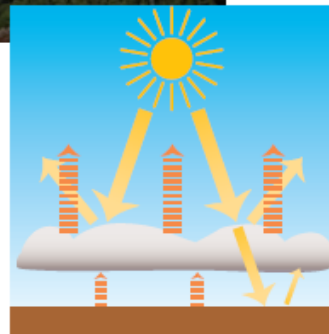
WHAT EFFECT DO CLOUDS HAVE: greenhouse or parasol?

How clouds affect radiation

Low clouds have a considerable parasol effect and a weak greenhouse effect. High, thin clouds have the opposite effect.



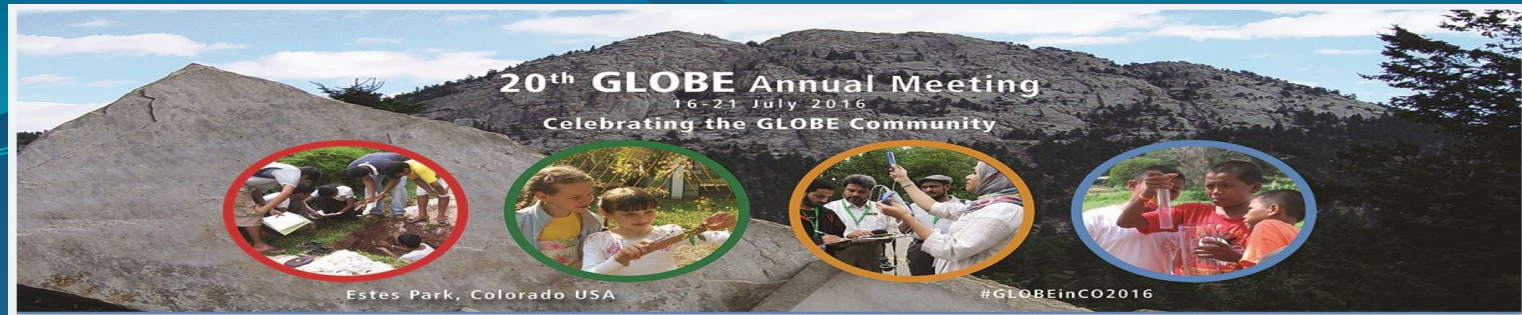
*High cloud (Cirrus):
Low parasol effect
High greenhouse effect*



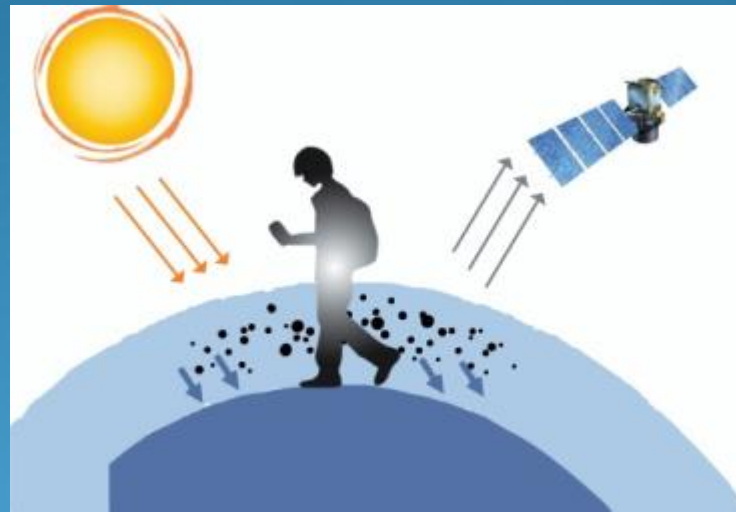
*Low cloud (Strato-
Cumulus):
High parasol effect
Low greenhouse effect*



*Cloud with strong
vertical development
(Cumulonimbus):
High parasol effect
High greenhouse
effect*



Aerosols Measurement campaign : Why and Results.



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by Eric ABGRALL

First step :

❑ Weather parameters : (GLOBE Protocols)

- T° (temperature)
- P (pressure)
- % of relative humidity
- ...

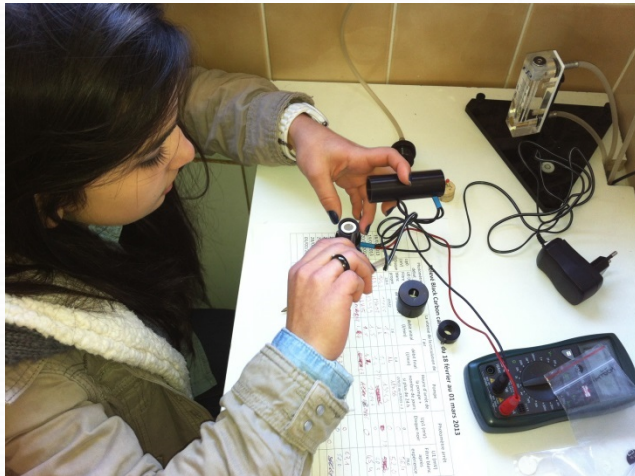
❑ Observations : (GLOBE Protocols)

- Clouds
- Sky color
- Visibility
- ...



Advanced :

☐ Sun-Photometer – Aerosols

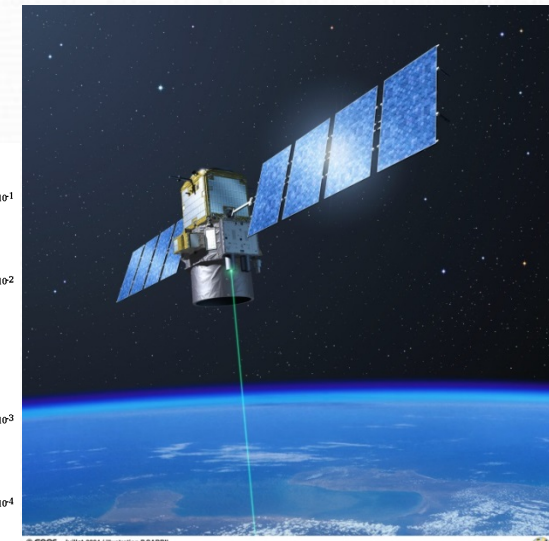
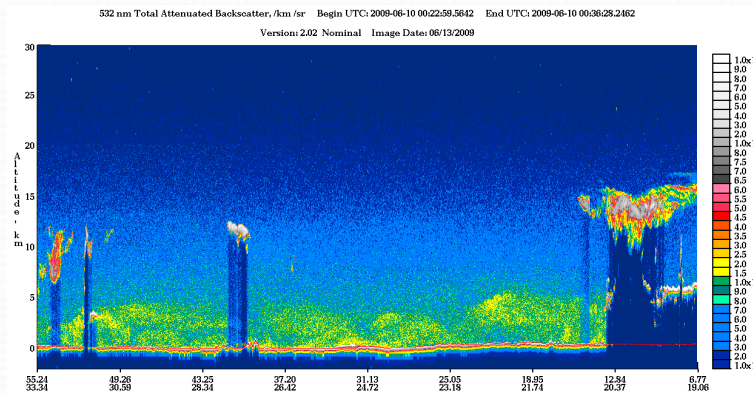


☐ Black Carbon

measurement system developed by Estonia, not yet a Globe protocol

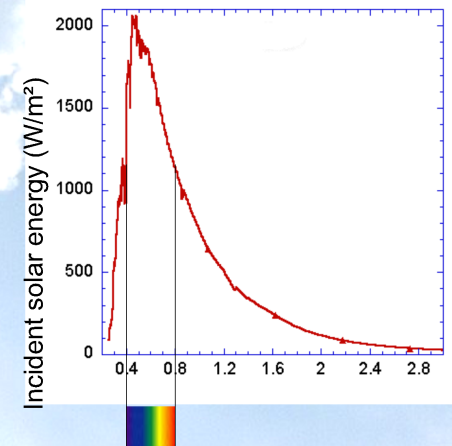
☐ Satellite data

- Modis and Calipso data
- Back-trajectories



HOW TO MEASURE AEROSOLS ?

Energy source : the Sun



The integral over the entire solar spectrum gives us : 1367 W/m² (at the top of the atmosphere)

$AOD_{OZONE}^{(1)}$ (0.00 to 0.016)

$AOD_{RAYLEIGH}$ (0.05 to 0.20)

AOD_{CLOUD} (0.5 to 50)

$AOD_{AEROSOL}$ (0.01 to 5)

$$AOD_{TOTAL} = AOD_{AEROSOL} + AOD_{CLOUD} + AOD_{RAYLEIGH} + AOD_{OZONE}$$

Measured parameter
Data measured in 3
lengthwaves to determine
aerosol size

Search parameter
Depends on particle size
quantity and particle size

Null parameter
Measurements are
made during sunny
cloudless weather

Known parameter
Depends on wavelength.

Red = 0.06281
Green = 0.10637
Blue = 0.19490

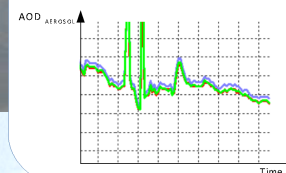
Known parameter
Given by satellite data.

Red = 0.0154
Green = 0.0128
Blue = 0.0

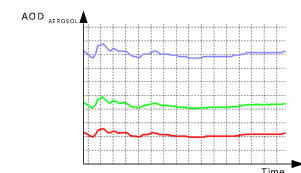
AOD_{TOTAL}

How to determine aerosol sizes ?

When the three AOD curves are close together, we have large particles



When the three AOD curves are spaced away, we have small particles



(1) AOD : Atmospheric Optical Depth

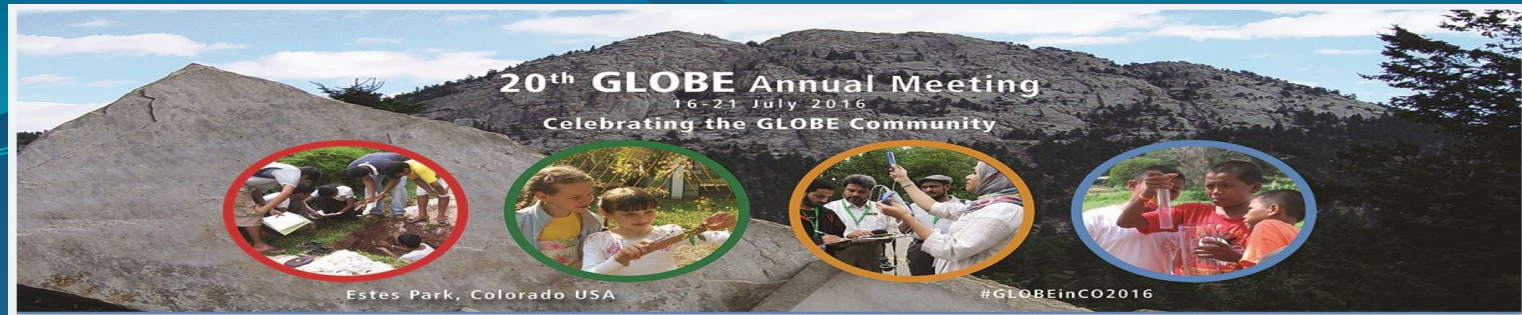


Demonstration

Banizoumbou

N 13°32'28", E 02°39'53", Alt 250 m,





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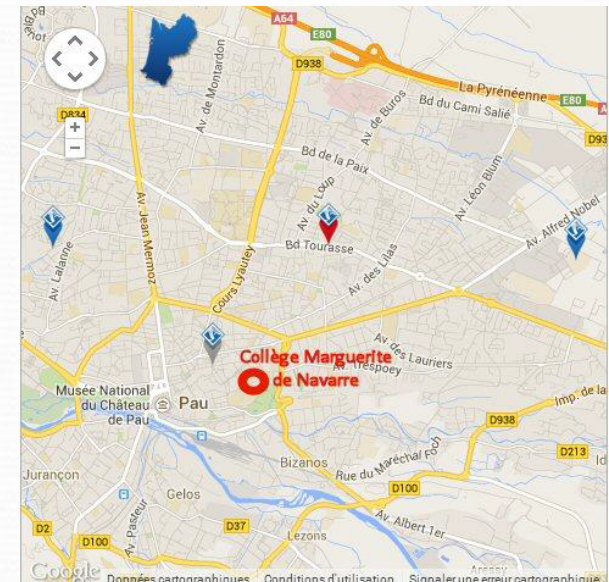
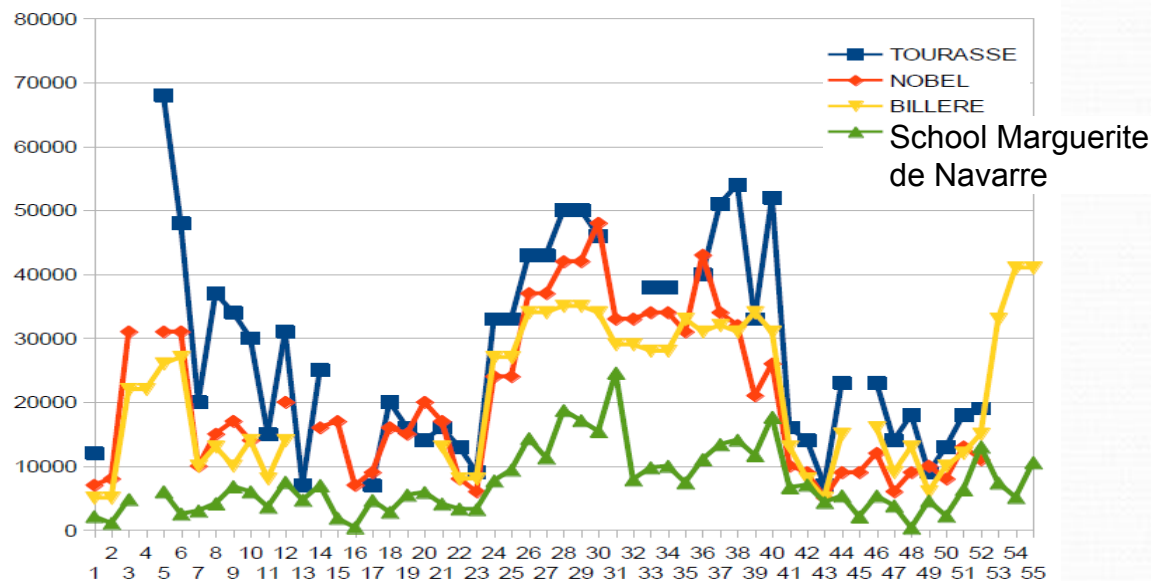
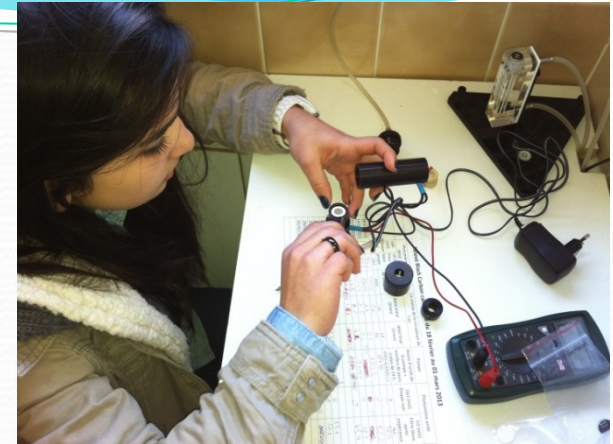
by Eric ABGRALL

Measurement campaigns, why ?

Local pollution :

- **Black carbon at Pau**

date	Elevation measurment 1 m	Elevation measurment 10 m
26 nov 2013	938 (ng/m ³)	728
27 nov 2013	1431	1128
28 nov 2013	1871	1712
03 dec 2013	2456	786
04 dec 2013	976	997



Comparison, on 50 measures of our data and those of AIRAQ sensors.

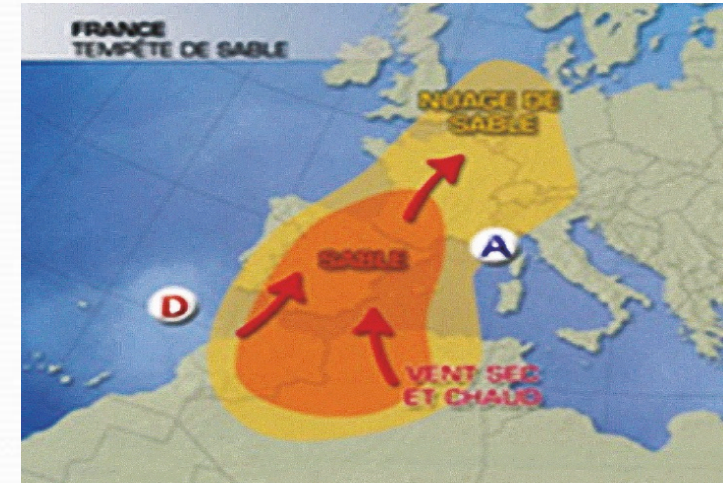
Measurement campaigns, why ?

Global pollution :

- African Dust at Saillagouse, Pyrénées Mountains

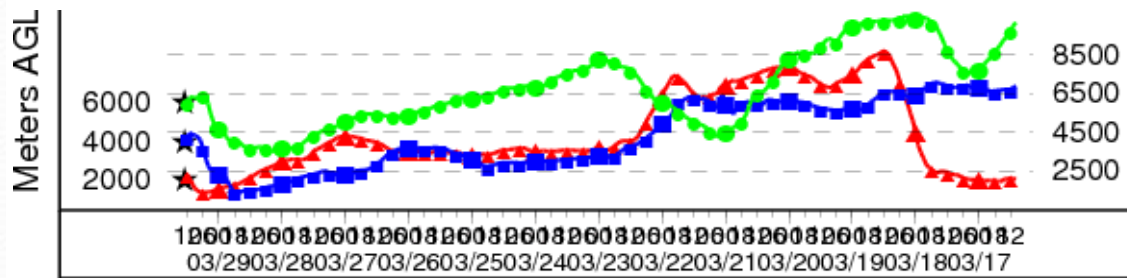


Orange snow ? ... Strange, no ?



Forecast map of a moving cloud of dust

Where are air masses from the observed date :
[back-trajectories](#)



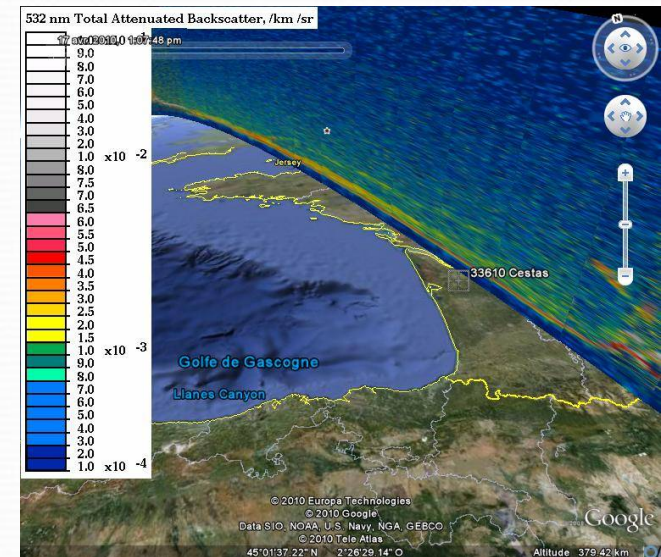
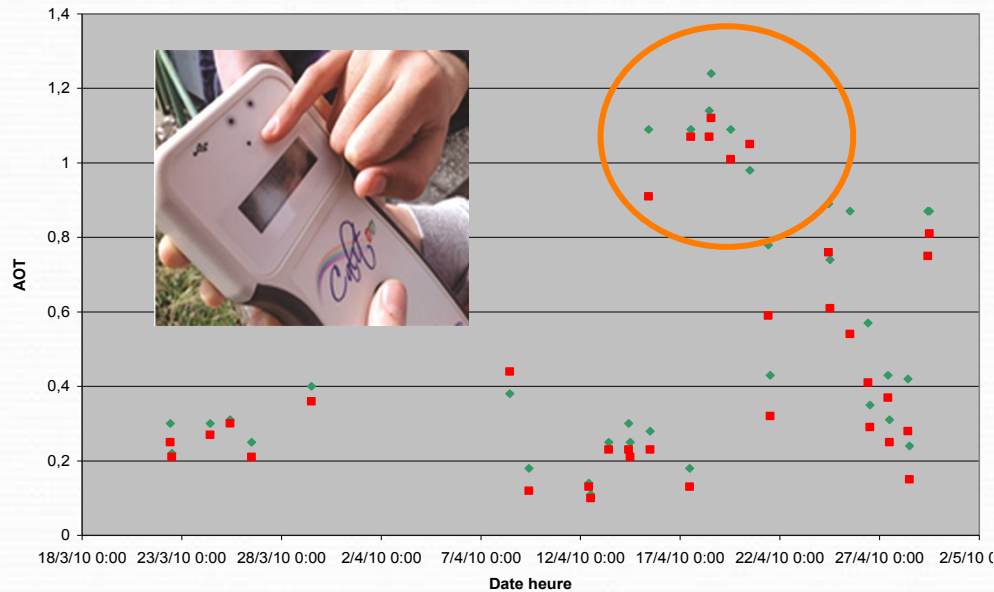
Go to this website : air resources laboratory (NOAA)

<http://ready.arl.noaa.gov/HYSPLIT.php>

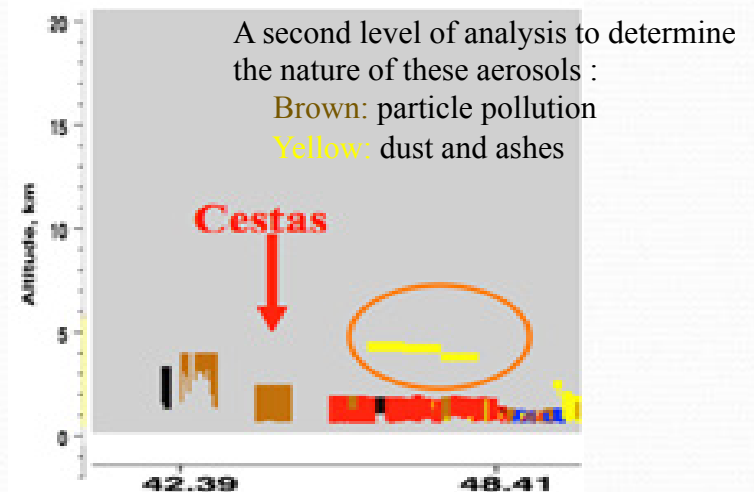
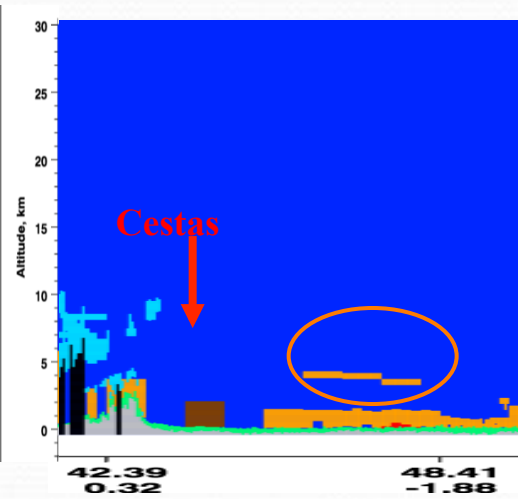
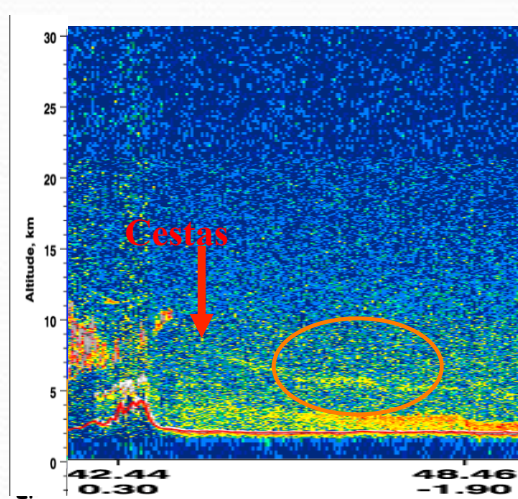
Measurement campaigns

Event Alert :

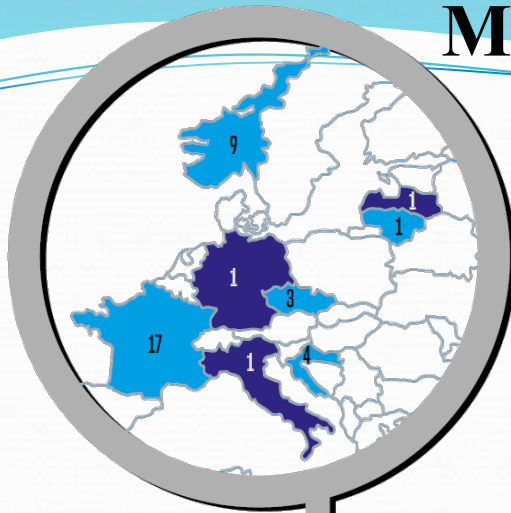
-Ashes from volcan Eyjafjöll at Cestas



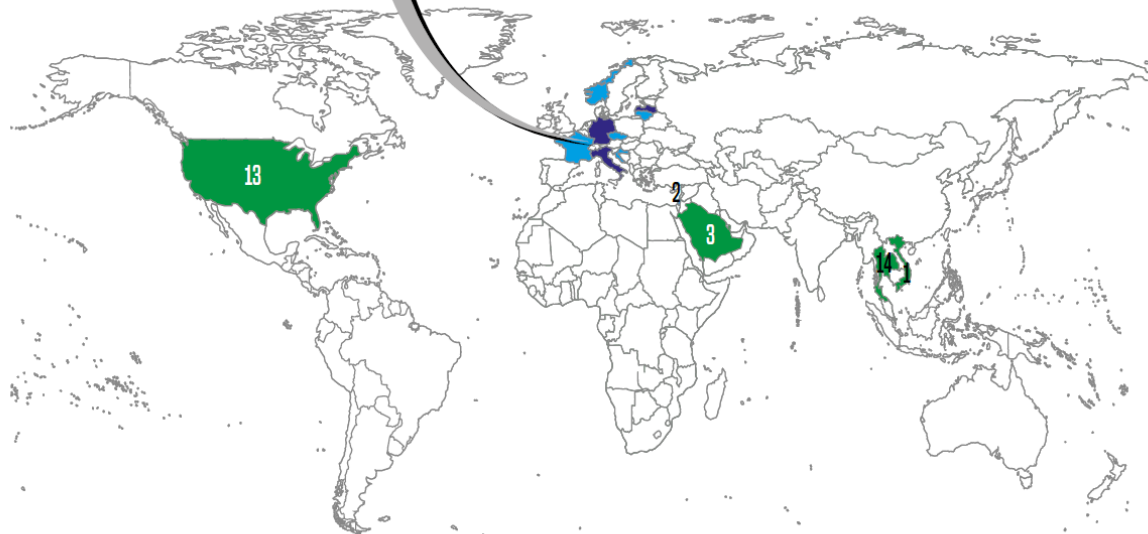
CALIPSO measurment



Measurement campaigns



Spring Measurement campaign 2016 :
(European campaign)



FRANCE: 17
CZECH REP.: 3
LATVIA: 1

THAILAND: 14

TOTAL: 13 COUNTRIES

NORWAY: 9
ISRAEL: 2
LITHUANIA: 1

USA: 13

64 ORGANIZATIONS

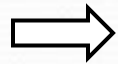
CROATIA: 4
GERMANY: 1
ITALY: 1

SAUDI ARABIA: 3

VIETNAM: 1

Measurement campaigns

Perspectives : measurement campaign with 2 thematic

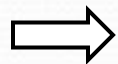


Air quality :

Aerosols (MODIS, CALIPSO)

Ozone (IASI)

Black Carbon



Water cycle :

Aerosols (MODIS, CALIPSO)

Clouds (CLOUDSAT, CERES, ...)

Precipitations (GPM)

Thank you for your attention!

