Program workshop Air Quality

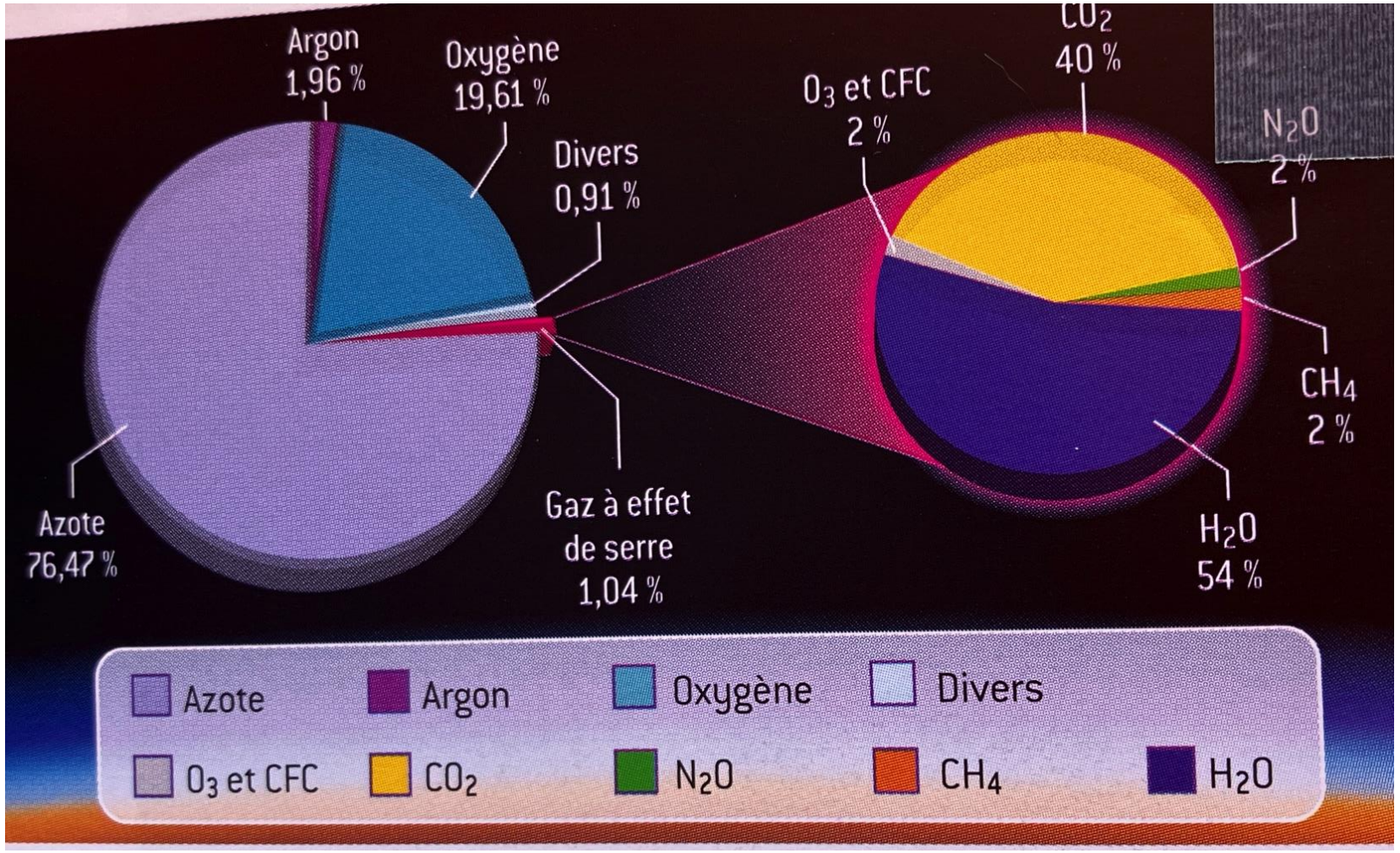
Time	Activity
16.00	Introduction Air Quality and Air Pollution
16.15	Recognizing aerosols
16.20	Explanation measurement tools
16.45	Activity – explore tools
17.05	Data analysis
17.15	Pitch participants: finding+implementation
17.25	Wrap up/questions
17.30	END

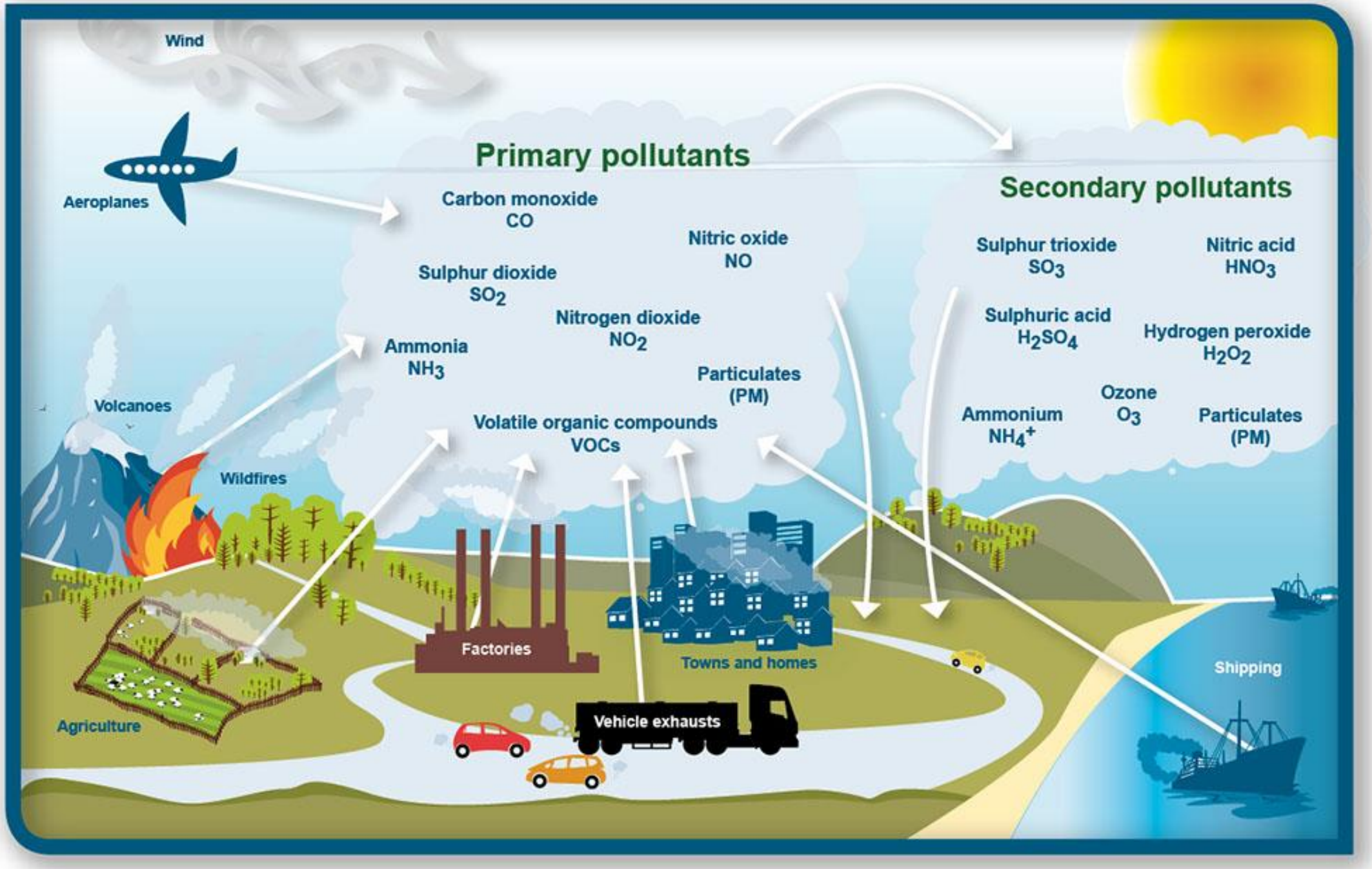
In this workshop you will:

1. Learn about Air Pollution
   A. Surface-level Particulate matter – Air pollution
   B. Atmospheric aerosols – Air pollution
   C. Surface-level NO_2 – Air pollution
2. Explore different sensors to measure: PM Sodaq Air & PM Sensorkit (surface-level), Aerosols
3. Think about Air Pollution projects in your class

What is air quality?

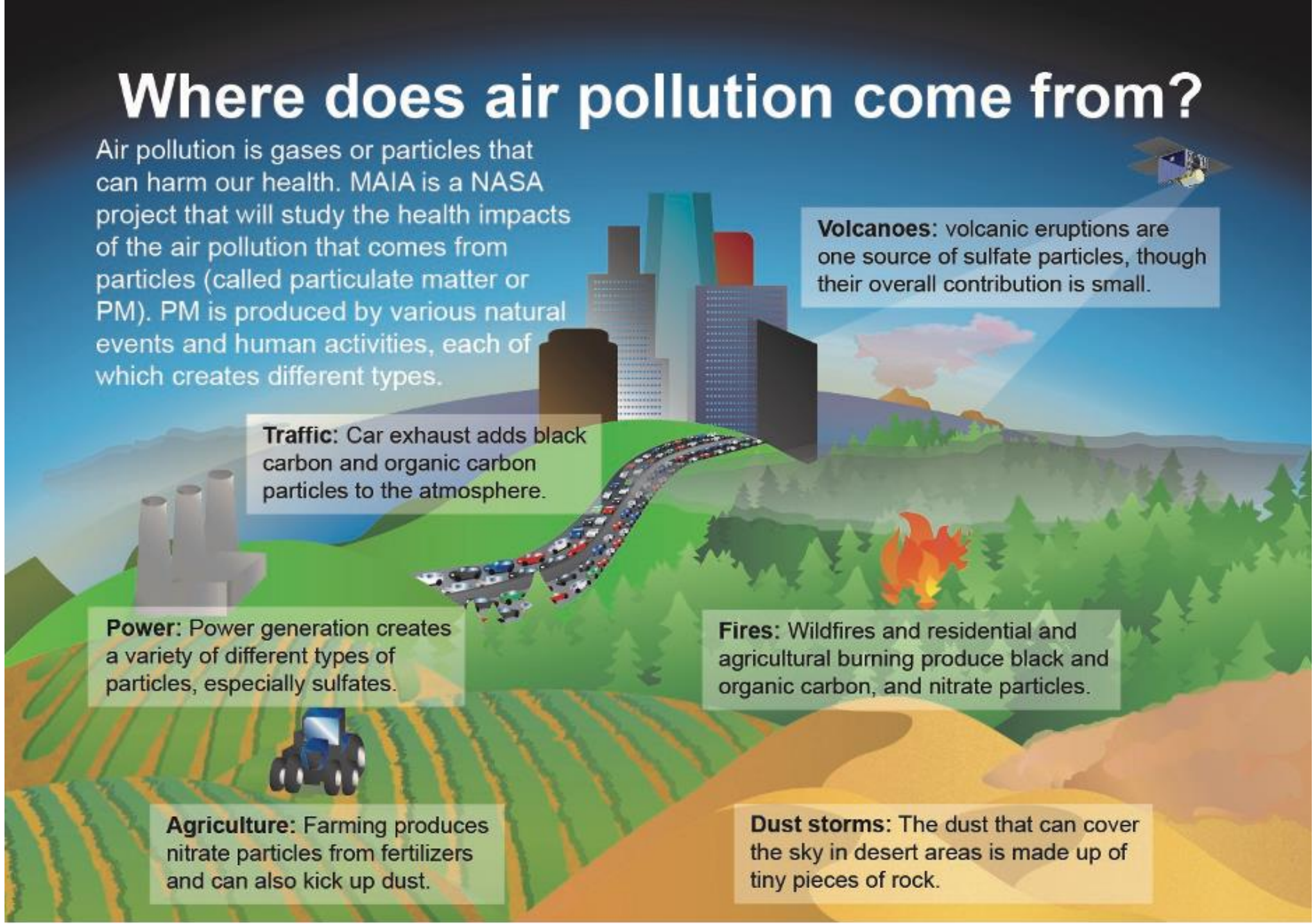
AIR Components




Wind
Aeroplanes
Primary pollutants
Carbon monoxide
CO
Nitric oxide
NO
Sulphur dioxide
SO_2
Nitrogen dioxide
NO_2
Ammonia
NH_3
Particulates
(PM)
Volatile organic compounds
VOCs
Secondary pollutants
Sulphur trioxide
SO_3
Nitric acid
HNO_3
Sulphuric acid
H_2SO_4
Hydrogen peroxide
H_2O_2
Ozone
O_3
Ammonium
NH_4^+
Particulates
(PM)
Volcanoes
Wildfires
Factories
Towns and homes
Vehicle exhausts
Agriculture
Shipping

Where does air pollution come from?

Air pollution is gases or particles that can harm our health. MAIA is a NASA project that will study the health impacts of the air pollution that comes from particles (called particulate matter or PM). PM is produced by various natural events and human activities, each of which creates different types.



Volcanoes: volcanic eruptions are one source of sulfate particles, though their overall contribution is small.

Traffic: Car exhaust adds black carbon and organic carbon particles to the atmosphere.

Power: Power generation creates a variety of different types of particles, especially sulfates.

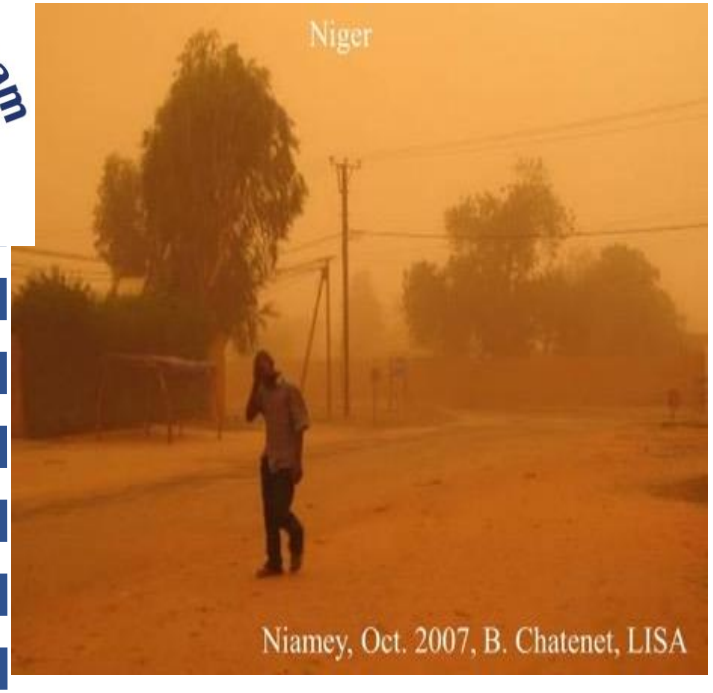
Fires: Wildfires and residential and agricultural burning produce black and organic carbon, and nitrate particles.

Agriculture: Farming produces nitrate particles from fertilizers and can also kick up dust.

Dust storms: The dust that can cover the sky in desert areas is made up of tiny pieces of rock.

What we can measure with GLOBE		
	Pollution	Climate change
NO_2	x	
CH_4		
(O_3)		
CO_2		x
H_2O		
Aerosols (incl. surface PM)	x	x

AEROSOLS



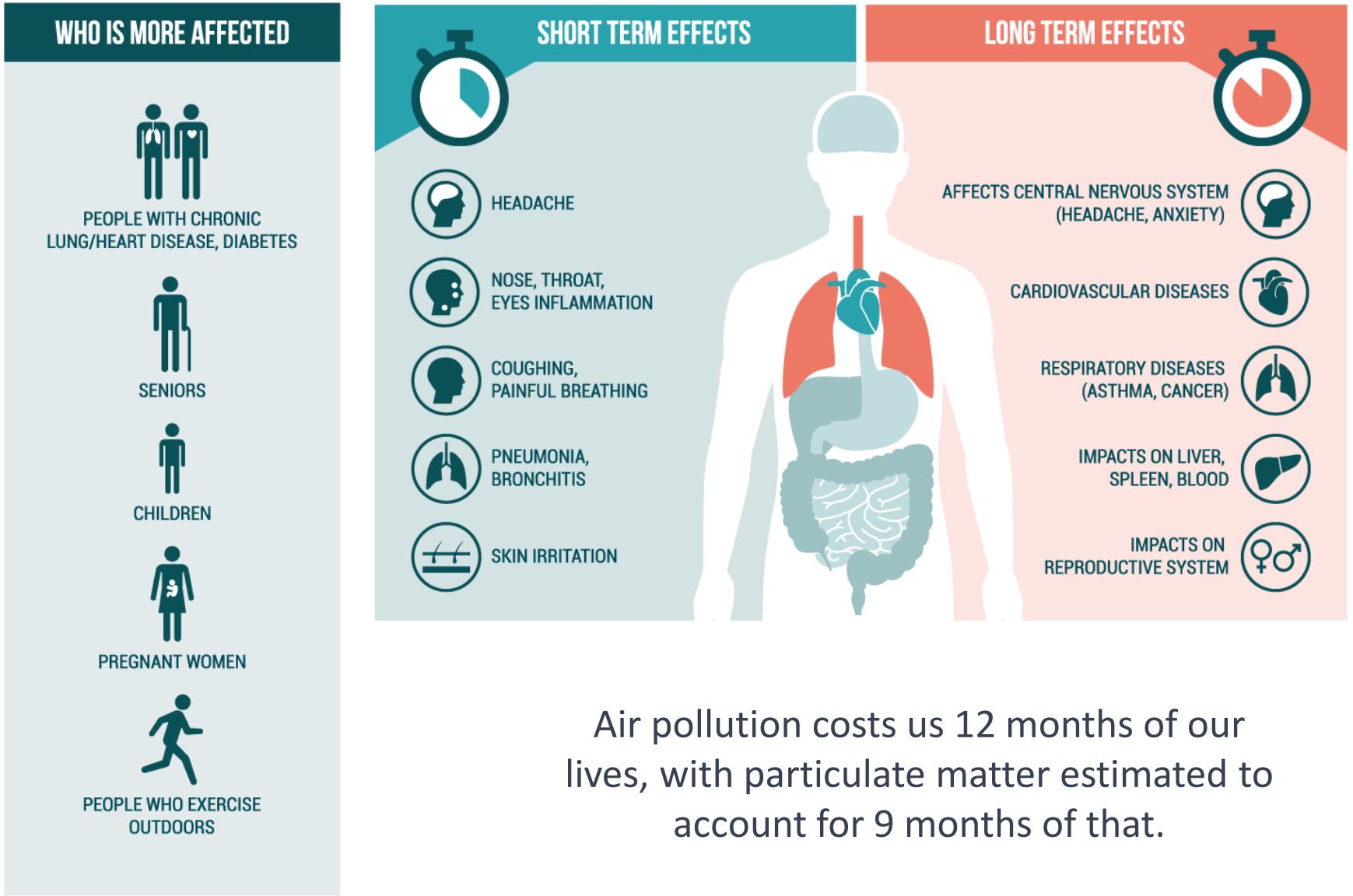
Solid particles

Liquid Droplets

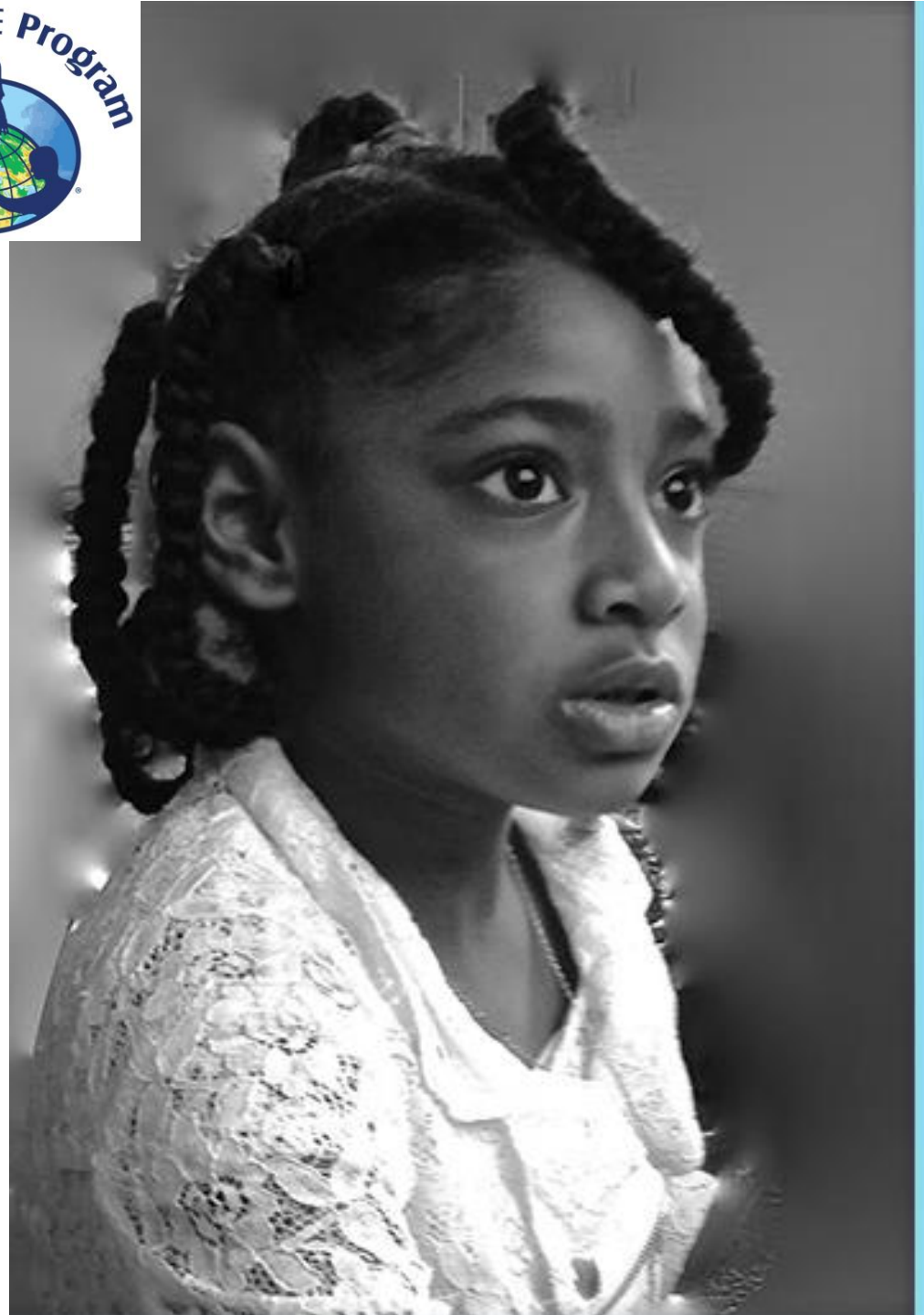
10% ANTHROPOGÉNIC

90% NATURAL

Health effects Air pollution



Air pollution costs us 12 months of our lives, with particulate matter estimated to account for 9 months of that.



Air pollution, we can't see it…

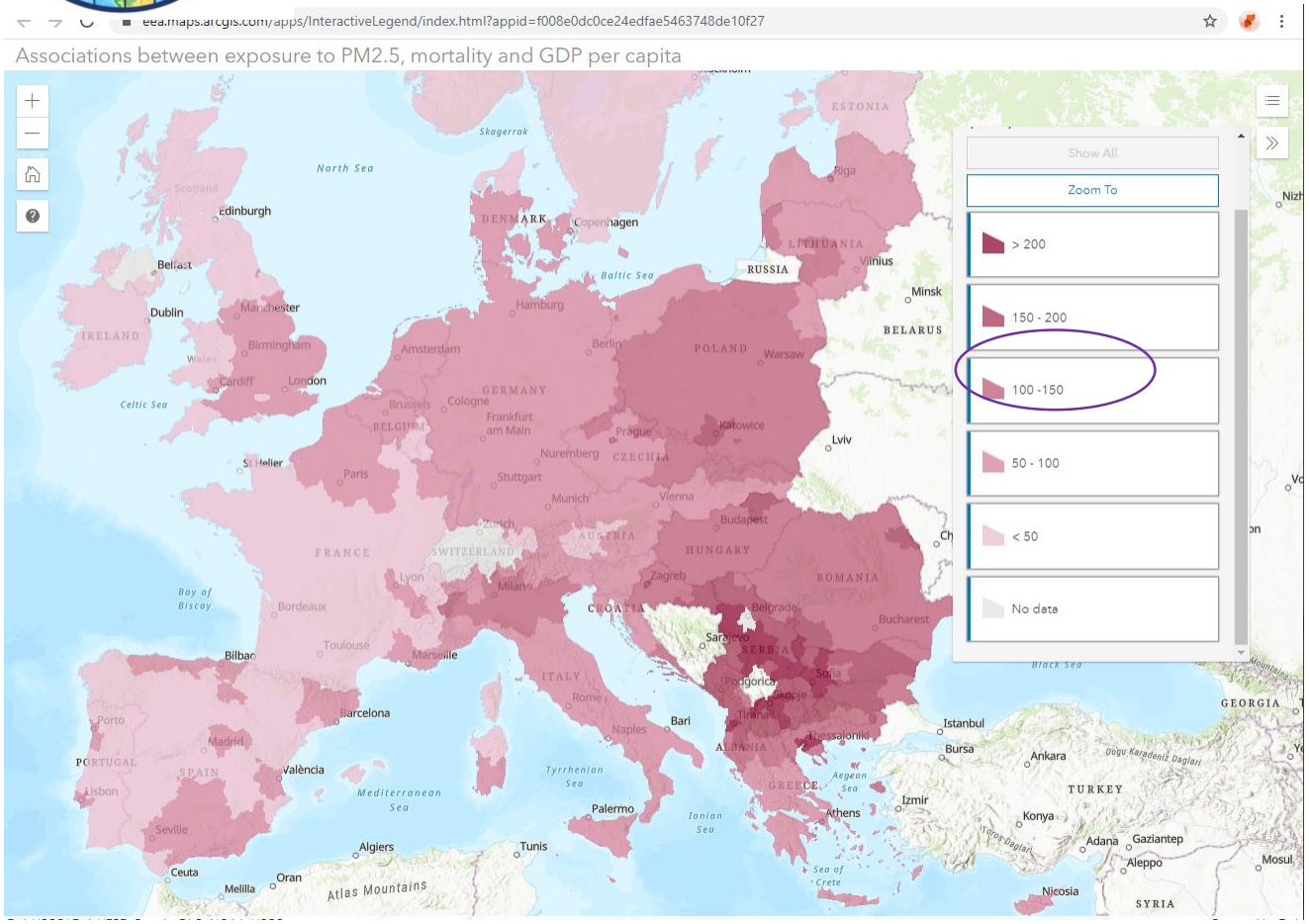
"Ella Kissi-Debrah may be the first person in history to have her cause of death listed as "air pollution."

She was 9 years old when she passed away, because of lung failure and severe asthma

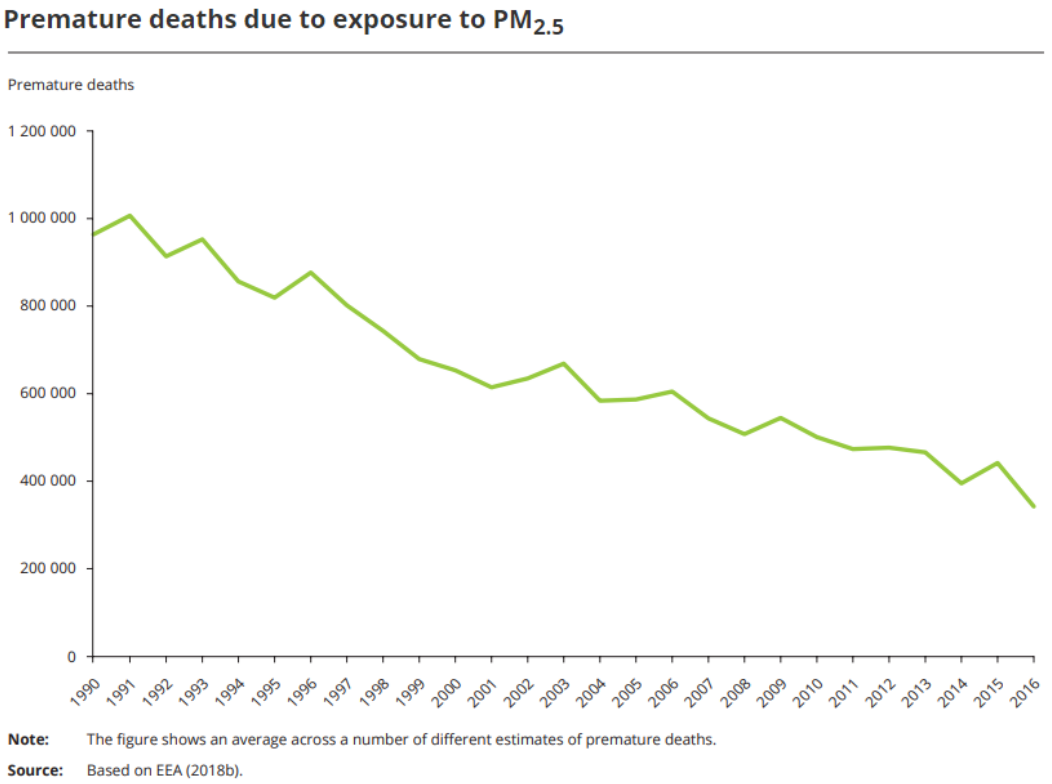
In this workshop you will:

1A. Learn about surface-level Particulate matter – Air pollution

PM – Health effects



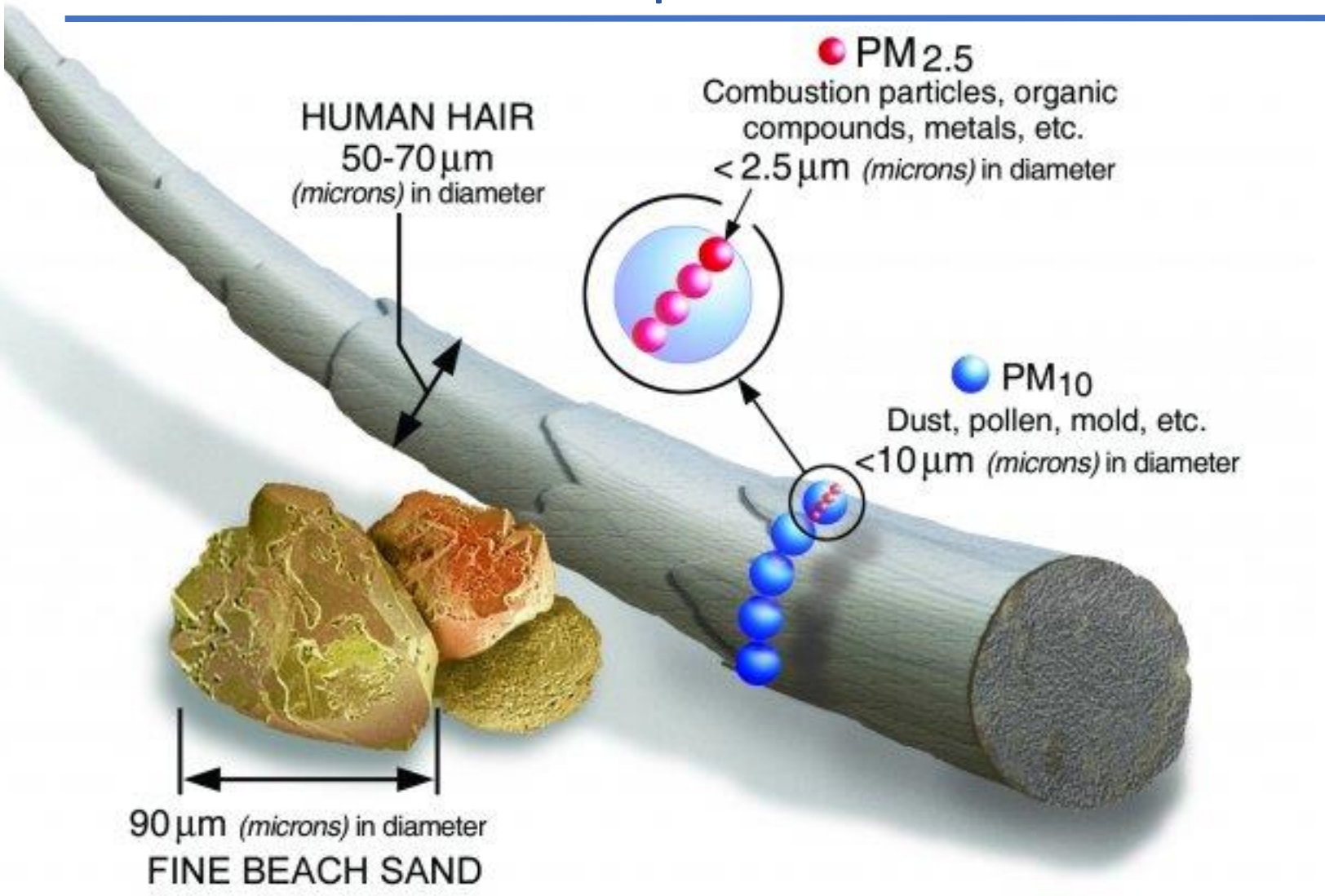
Premature mortality per 100,000 residents due to PM2.5 particulate matter (2018)



In 2018, 379,000 cases of premature mortality in the EU

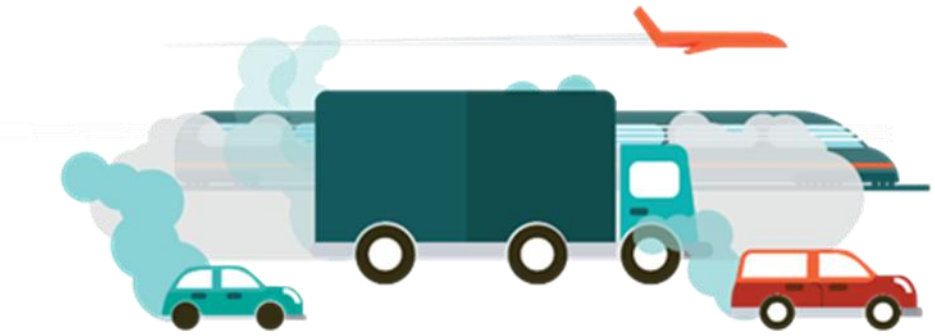
But... in the 1990s, it was twice as high

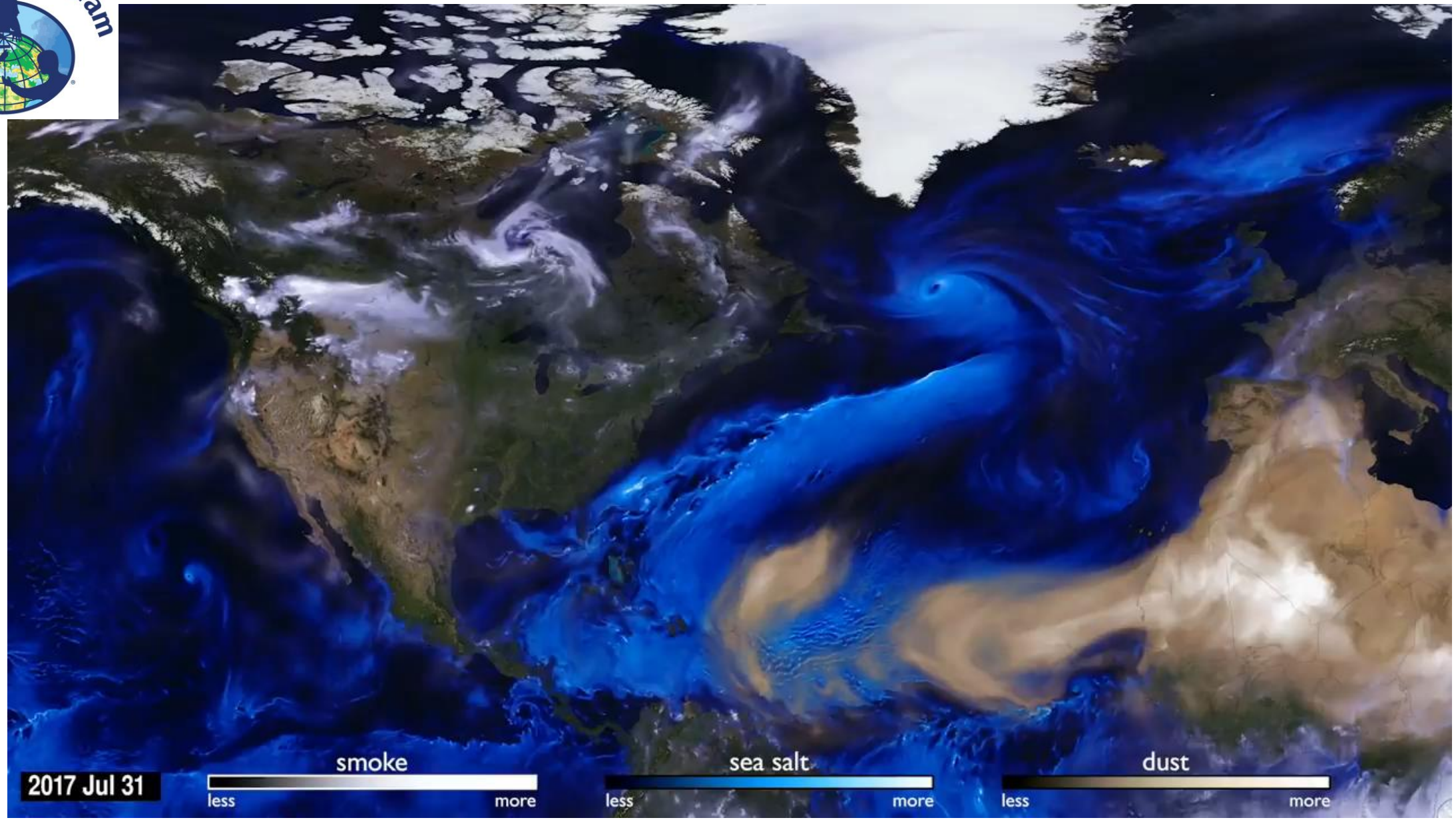
PM – Small solid particles smaller than 10 microns



In this workshop you will:

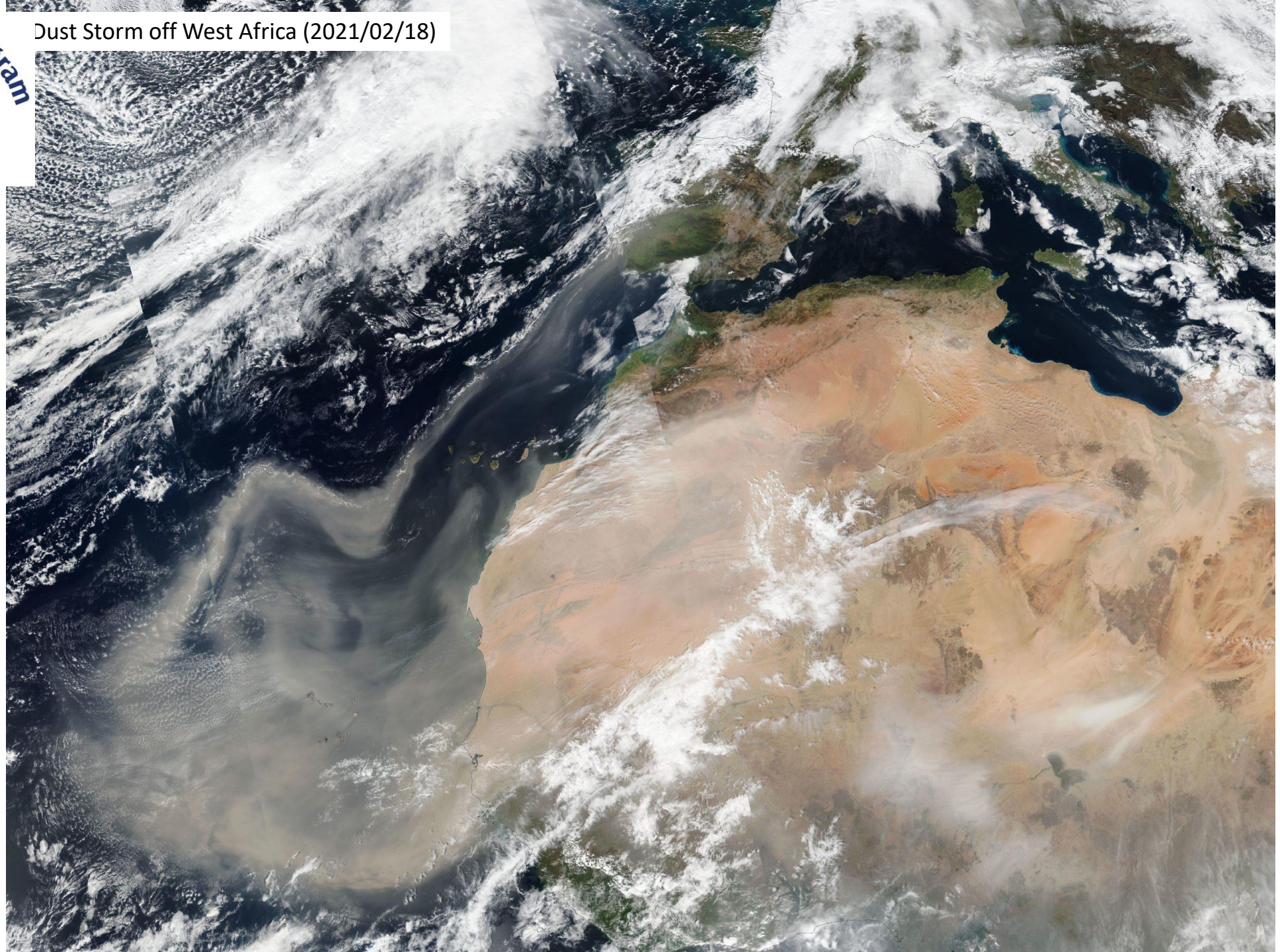
1B. Learn about Atmospheric aerosols – Air pollution



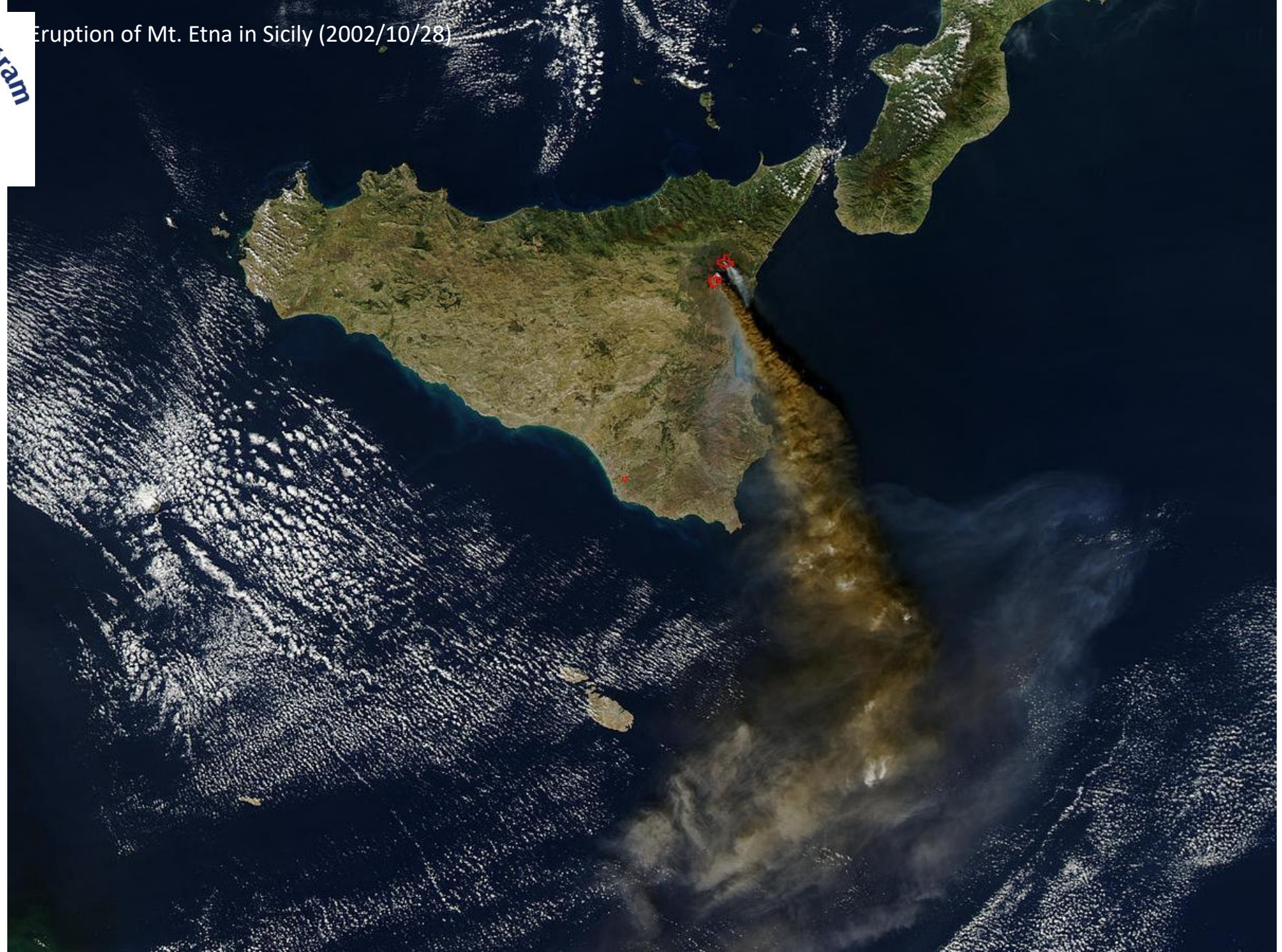

2017 Jul 31
smoke
less
more
sea salt
less
more
dust
less
more

Pollution in Northern Italy
(2005/03/17)

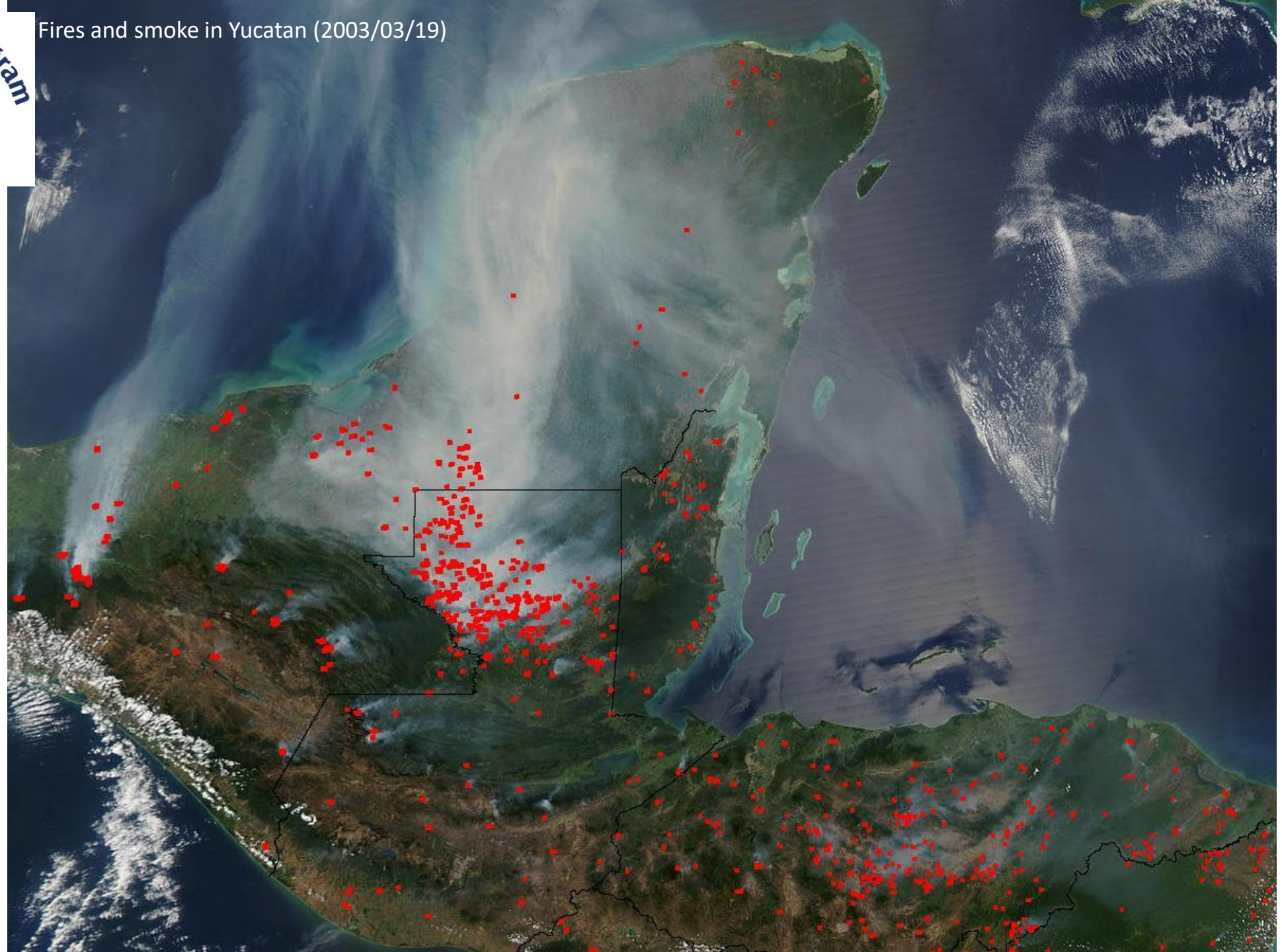
Dust Storm off West Africa (2021/02/18)

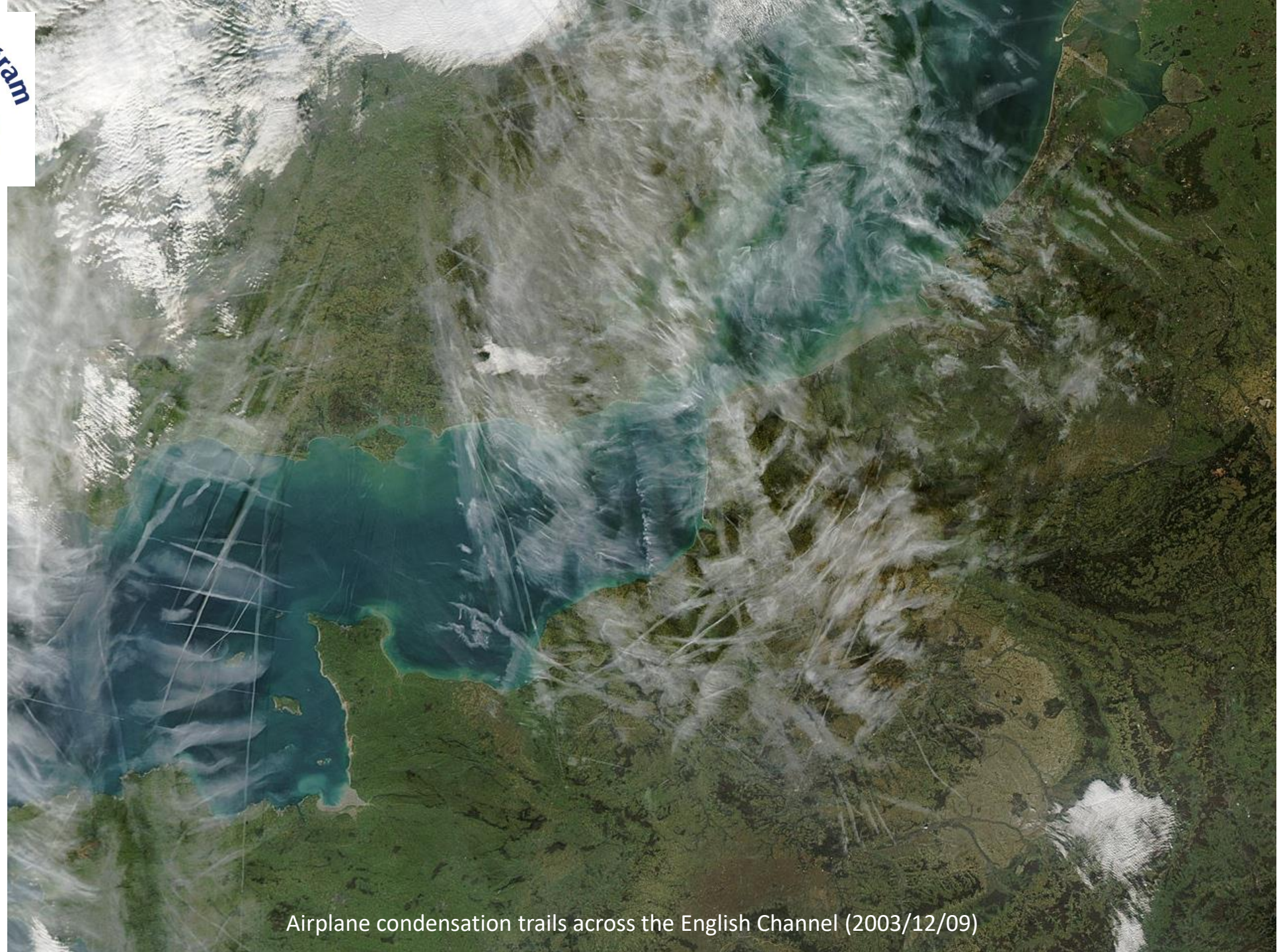


Eruption of Mt. Etna in Sicily (2002/10/28)

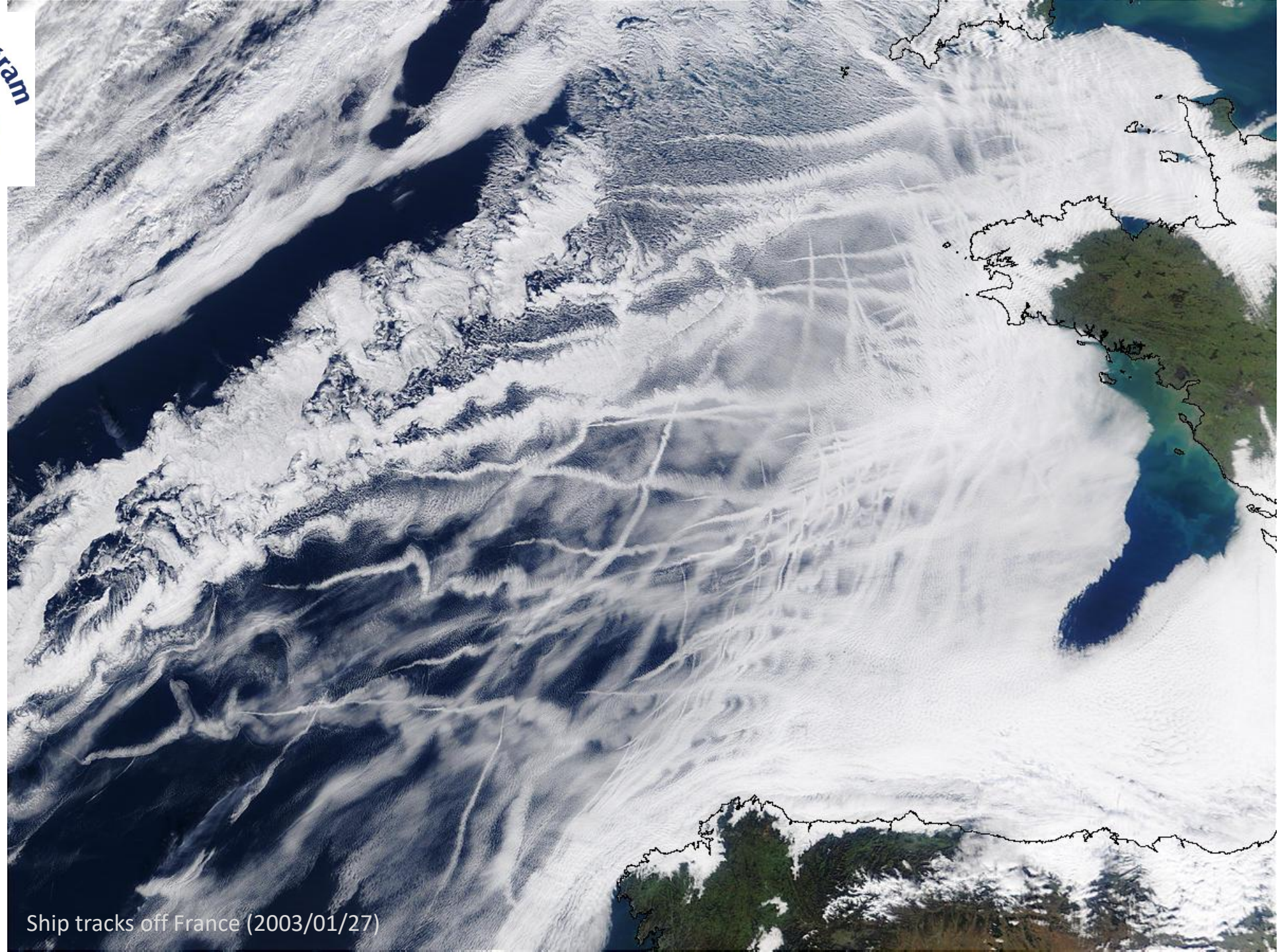


Fires and smoke in Yucatan (2003/03/19)





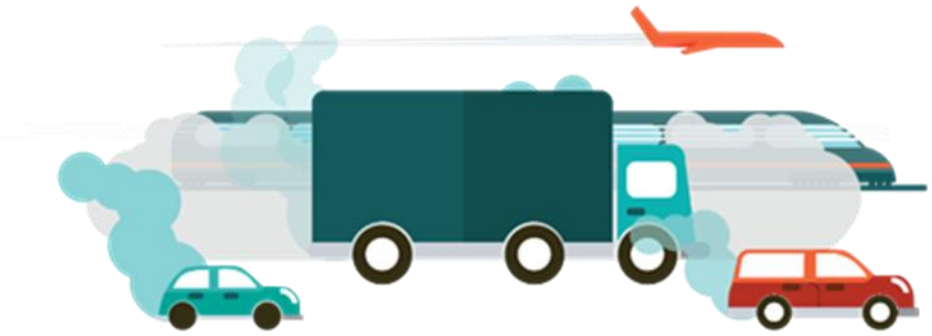
Airplane condensation trails across the English Channel (2003/12/09)



Ship tracks off France (2003/01/27)

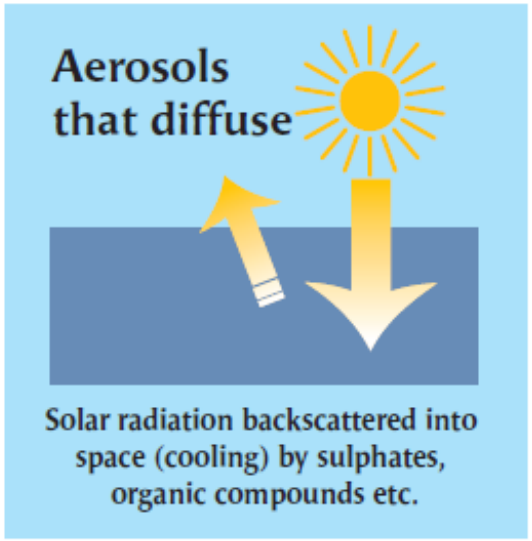
In this workshop you will:

1B. Learn about Atmospheric aerosols - Impact on Climate change

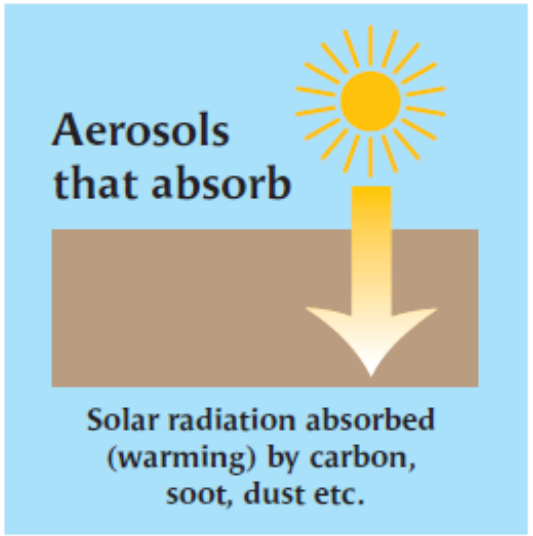


The multiple effects of aerosols

the direct effect



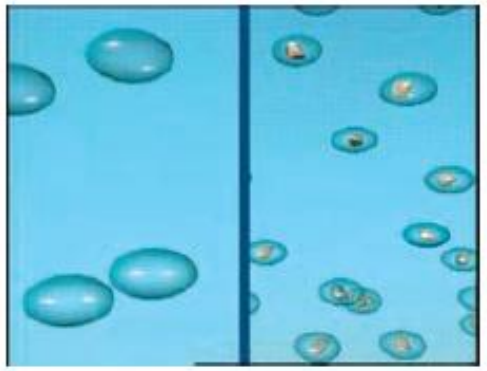
The semi-direct effect



Aerosols diffuse and absorb sinlight 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**.

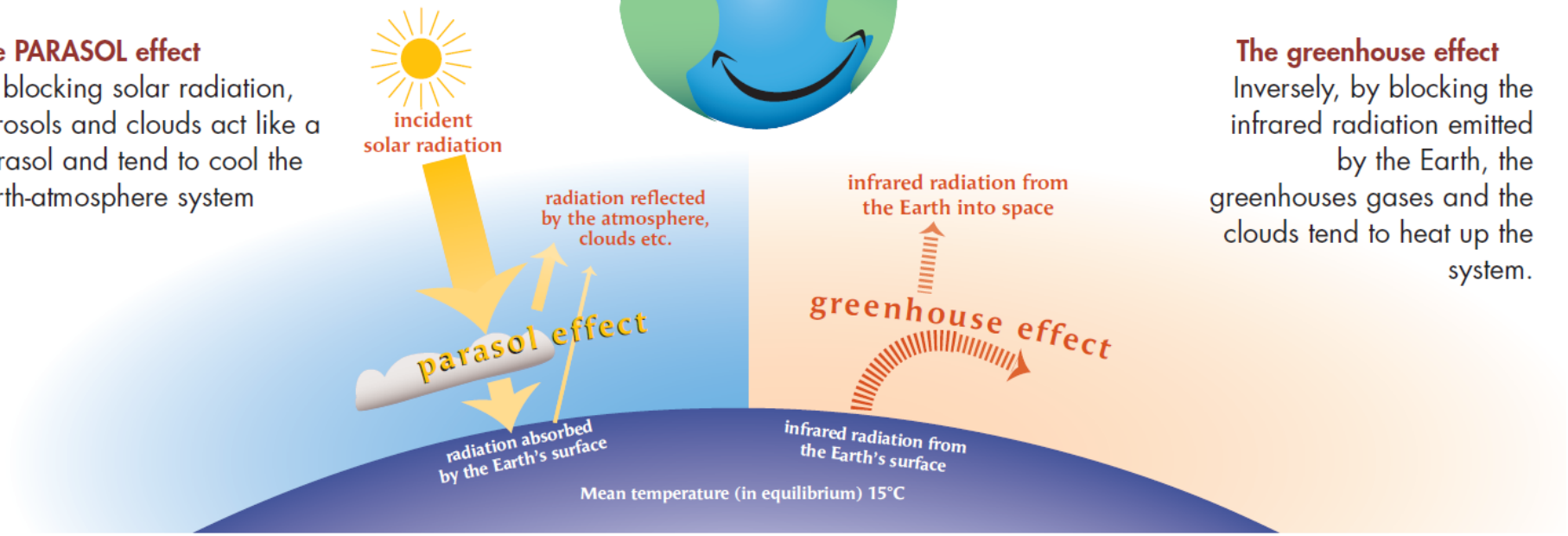
CENTRE NATIONAL D'ÉTUDES SPATIALES

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

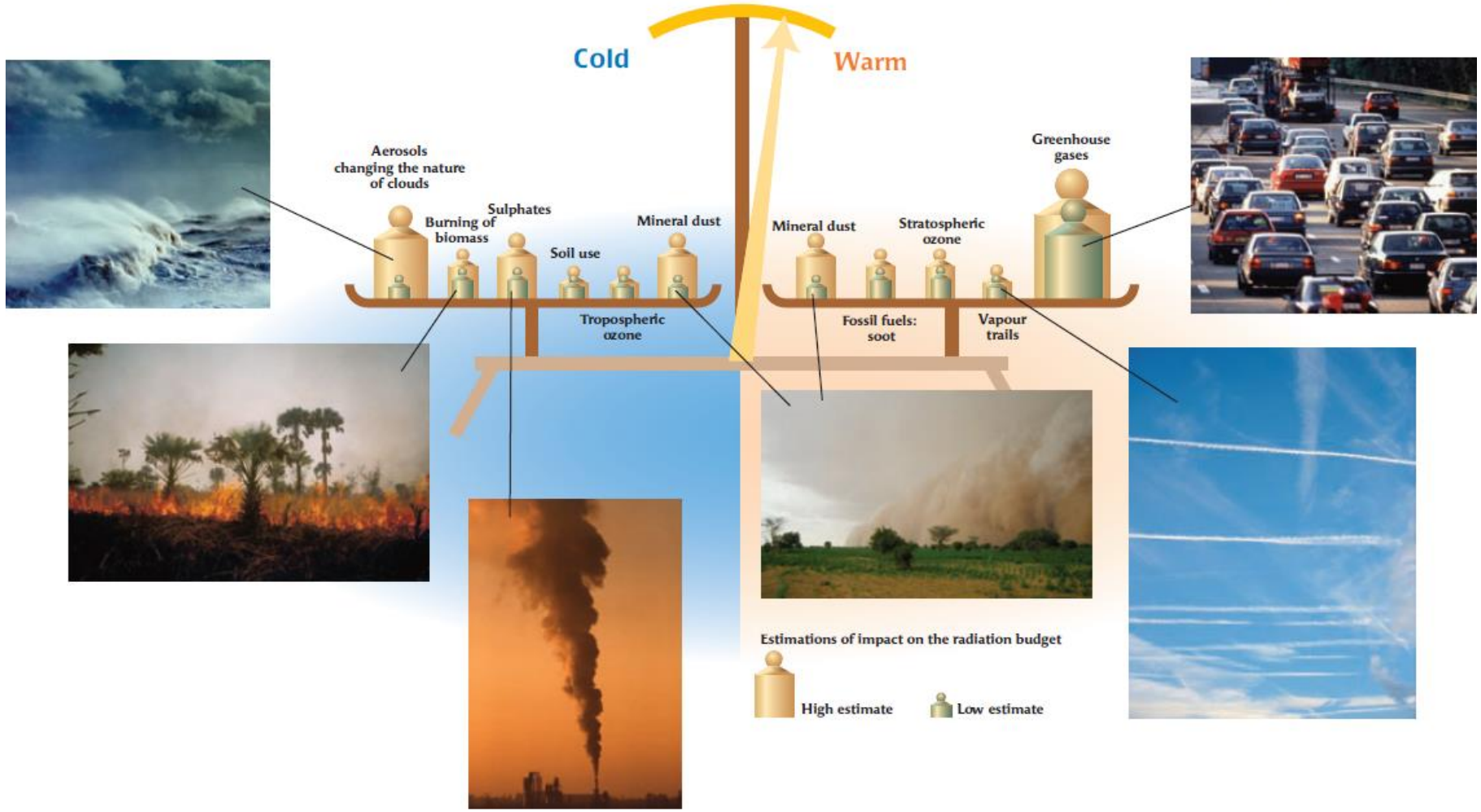
The greenhouse effect
Inversely, by blocking the infrared radiation emitted by the Earth, the greenhouses gases and the clouds tend to heat up the system.



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.

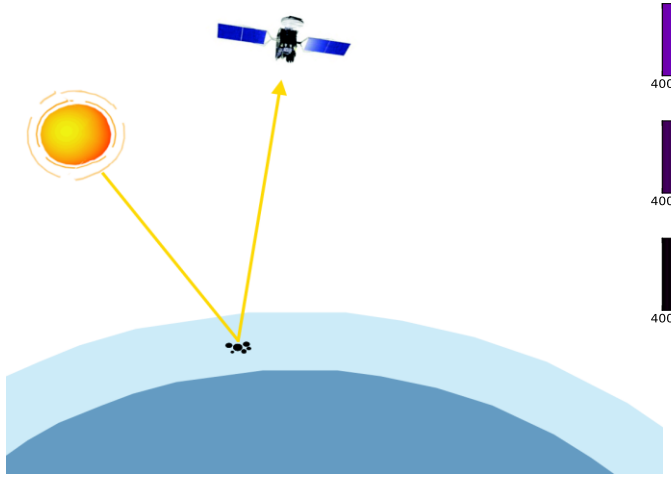
Perturbations due to human activity

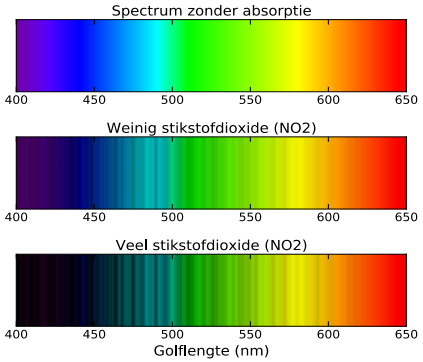


In this workshop you will:

1C. Learn about Surface-level NO_2 – Air pollution

NO_2 - TROPOMI





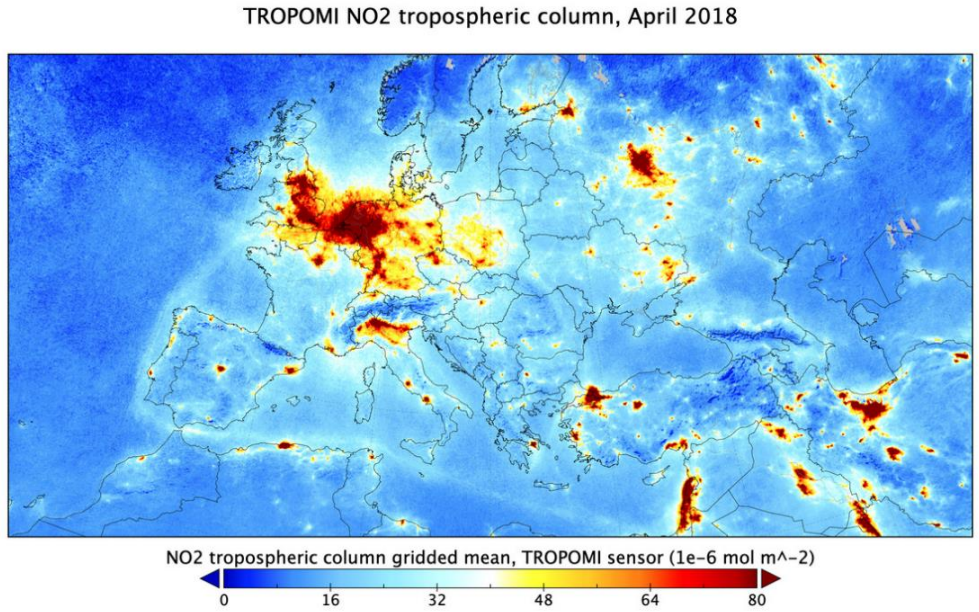
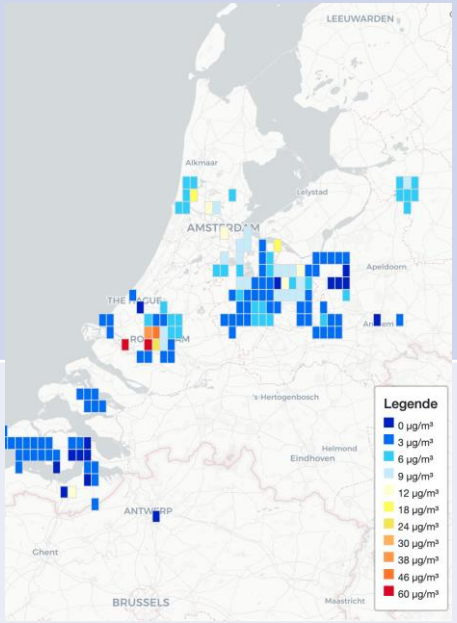
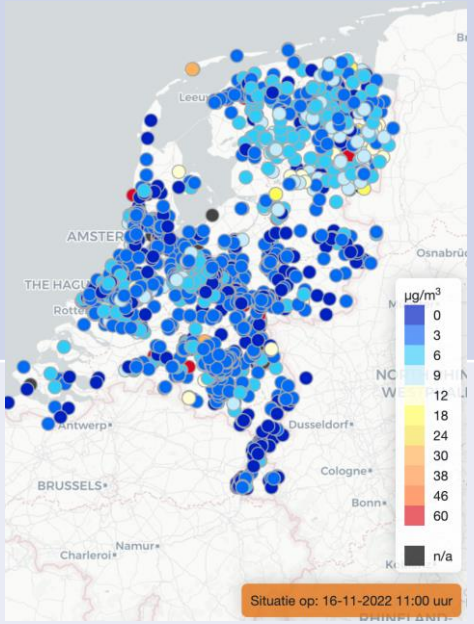


Figure 1: Monthly average distribution of tropospheric NO_2 columns for April 2018 over Europe based on TROPOMI data, derived with processor version 1.2.0.

In this workshop you will:

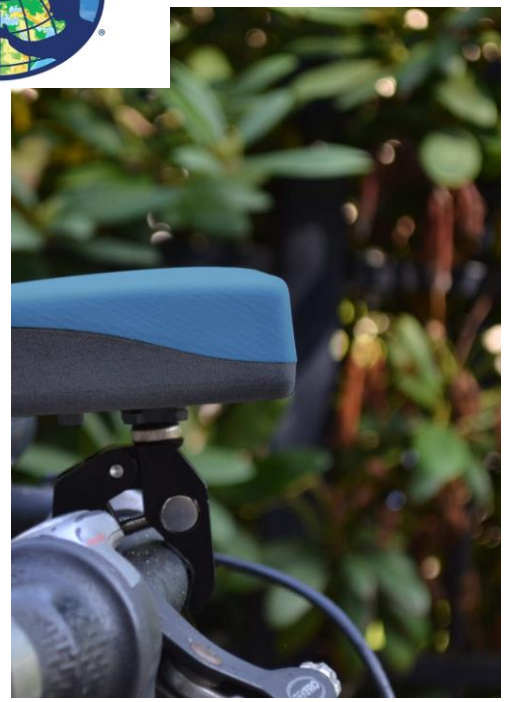
2. Explore different sensors to measure: PM Sodaq Air, PM sensorkit, aerosols,

Sodaq air	PM kit
 	  
knowyourair.net Needs: LTE-M of NB-IoT netwerk	samenmeten.rivm.nl
Stationary -> outside school (use shelter) Mobile -> on a bike	Stationary -> outside school (weather station) or for experiments

It is important to <u>monitor</u> the air pollution, so we can identify hotspots and <u>work together</u> to reduce emissions

Dutch students like biking ☺

Perfect way to check air quality is by bike

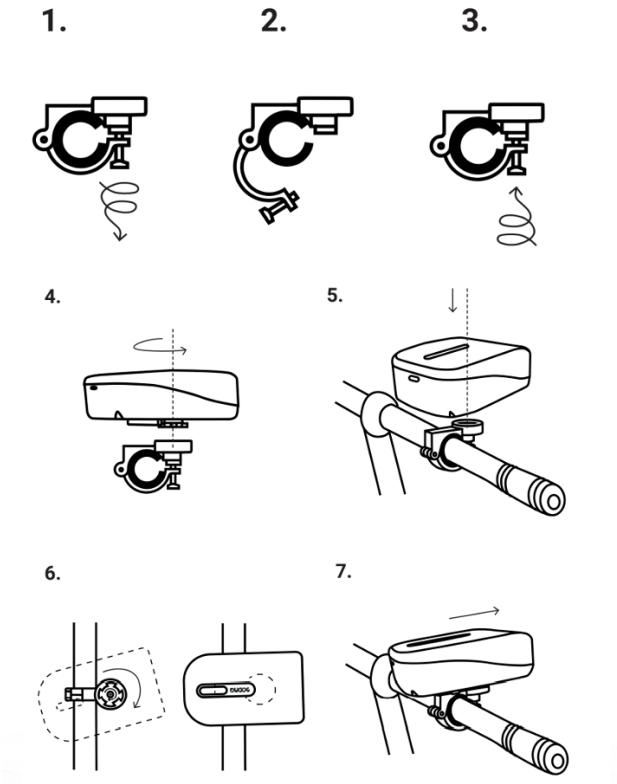


This sensor measures PM Sodaq Air: Snifflerbike

Explore - Sodaq air

Explore - Sodaq air

- Install the mount by twisting
- Keep moving!

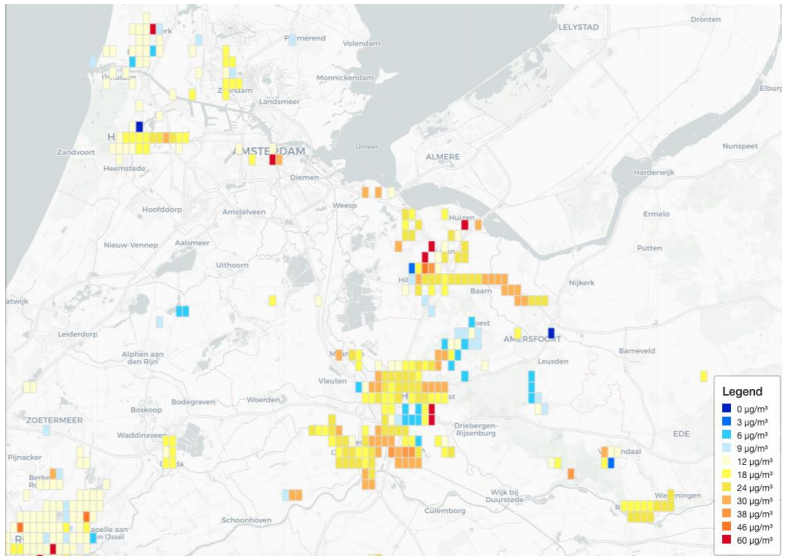


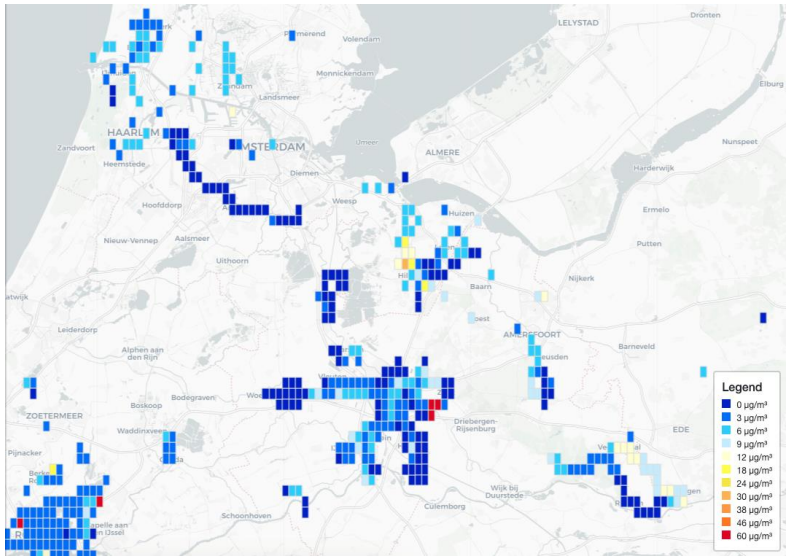
LED

BLUE LED This means that the air quality was checked with a PM (Particulate matter) Sensor from 0.3 to 2.5 microns and it is below 9 µg/m3 (further detailed information is shown on knowyourair.net)	
YELLOW LED This means that the air quality was checked with a PM (Particulate Matter) Sensor from 0.3 to 2.5 microns and it is between 9 to 24 µg/m3 (detailed information is shown on knowyourair.net)	
ORANGE LED This means that the air quality was checked with a PM (Particulate Matter) Sensor from 0.3 to 2.5 microns and it is between 24 to 60 µg/m3 (detailed information is shown on knowyourair.net)	
RED LED This means that the air quality was checked with a PM (Particulate Matter) Sensor from 0.3 to 2.5 microns and it is above 60 µg/m3 (further detailed information is shown on knowyourair.net)	

Explore – Sodaq air - results

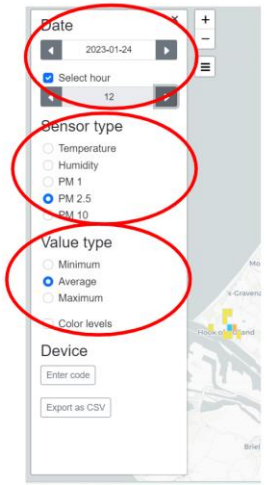
Check your results on www.Knowyourair.net





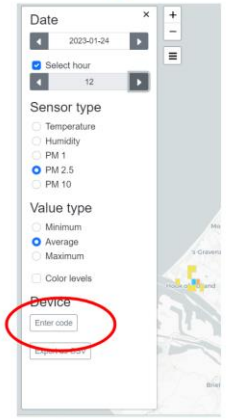
Important: compare your results with average results of same day! For instance, if you find high levels of PM during biking it is not necessarily because of the traffic in that area, can be the result of the wind coming from the industrial area

Knowyourair.net



- Selecteren van datum en tijd
- Sensor type:
  - Temperatuur
  - luchtvochtigheid
  - fijnstof (PM 1, PM 2,5, PM 10)
- Waardes:
  - Minimum
  - Gemiddelde
  - Maximum

Knowyourair.net

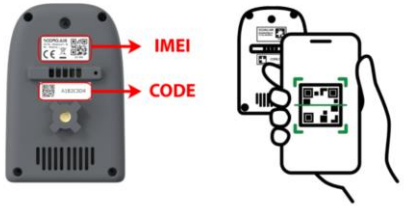


Je eigen gegevens vinden

Invullen van twee codes:

Boven moet je boven invullen

Onder moet je onder invullen



De Snuffelfiets

In this workshop you will:

2. Explore different sensors to measure: PM (Sodaq Air), PM (sensorkit), Aerosols (calitoo)

Sun photometer

Calitoo is a photometer to measure a rate of aerosol in the atmosphere.
For this, the sunlight is measured in three wavelengths. These lights are attenuated depending on the type and quantity of aerosols.

The photometer includes a tri-chromic sensor, a GPS, a pressure sensor and a temperature sensor.

The use of components using the latest technology allows us to produce a portable measuring device specific low cost.

Technicals characteristics

- Light channel : 465, 540 et 619 nm
- Possible 999 measures stored in memory
- AOT calculated in real-time
- Data download thru USB
- Free software on web site.
- Supply : 4 batteries AA (1,5V)
- Dimensions : 210 x 100 x 35 mm
- Weight : 400 g (With batteries)
- Operating temperature : -20°C à 55°C

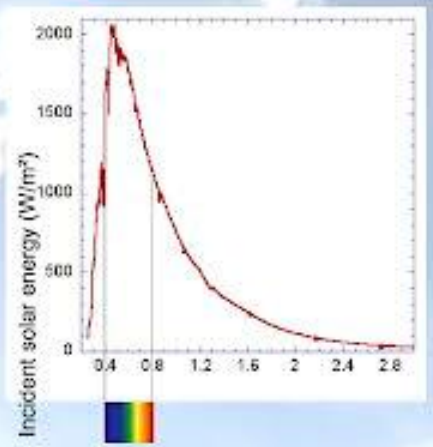
Certification

Calitoo photometer has been qualified by the Laboratoire d'Optique Atmosphérique at Lille (France) in March 2013 .

Each device is sold calibrated in a kit with calibration bulletin and an USB cable.

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}

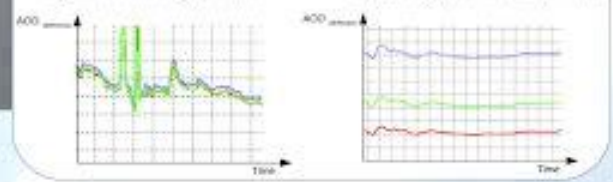
$$AOD_{TOTAL} = AOD_{AEROSOL} + AOD_{CLOUD} + AOD_{RAYLEIGH} + AOD_{OZONE}$$

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 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

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

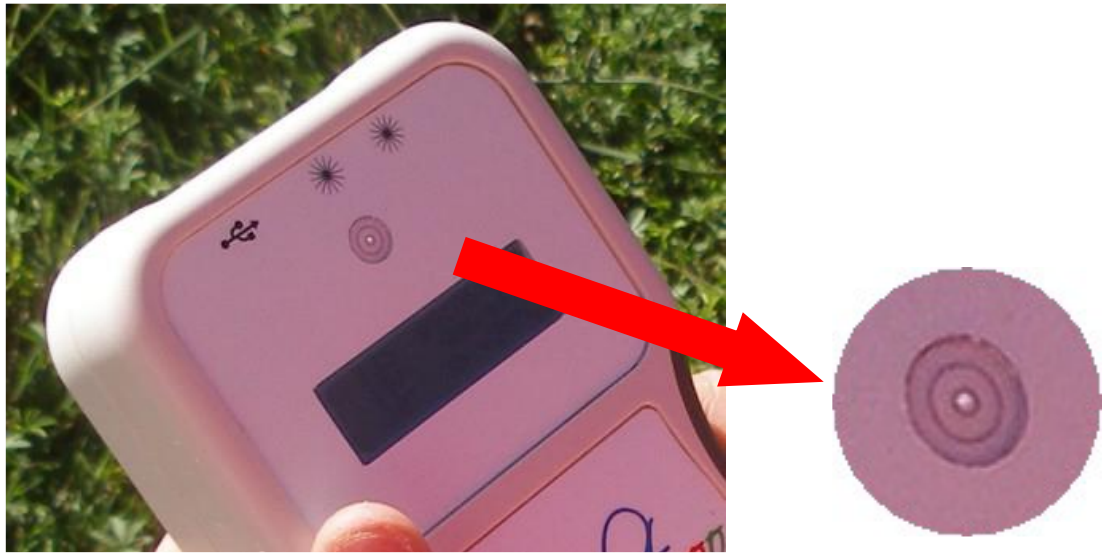


(1) AOD : Atmospheric Optical Depth

Pointing Sun

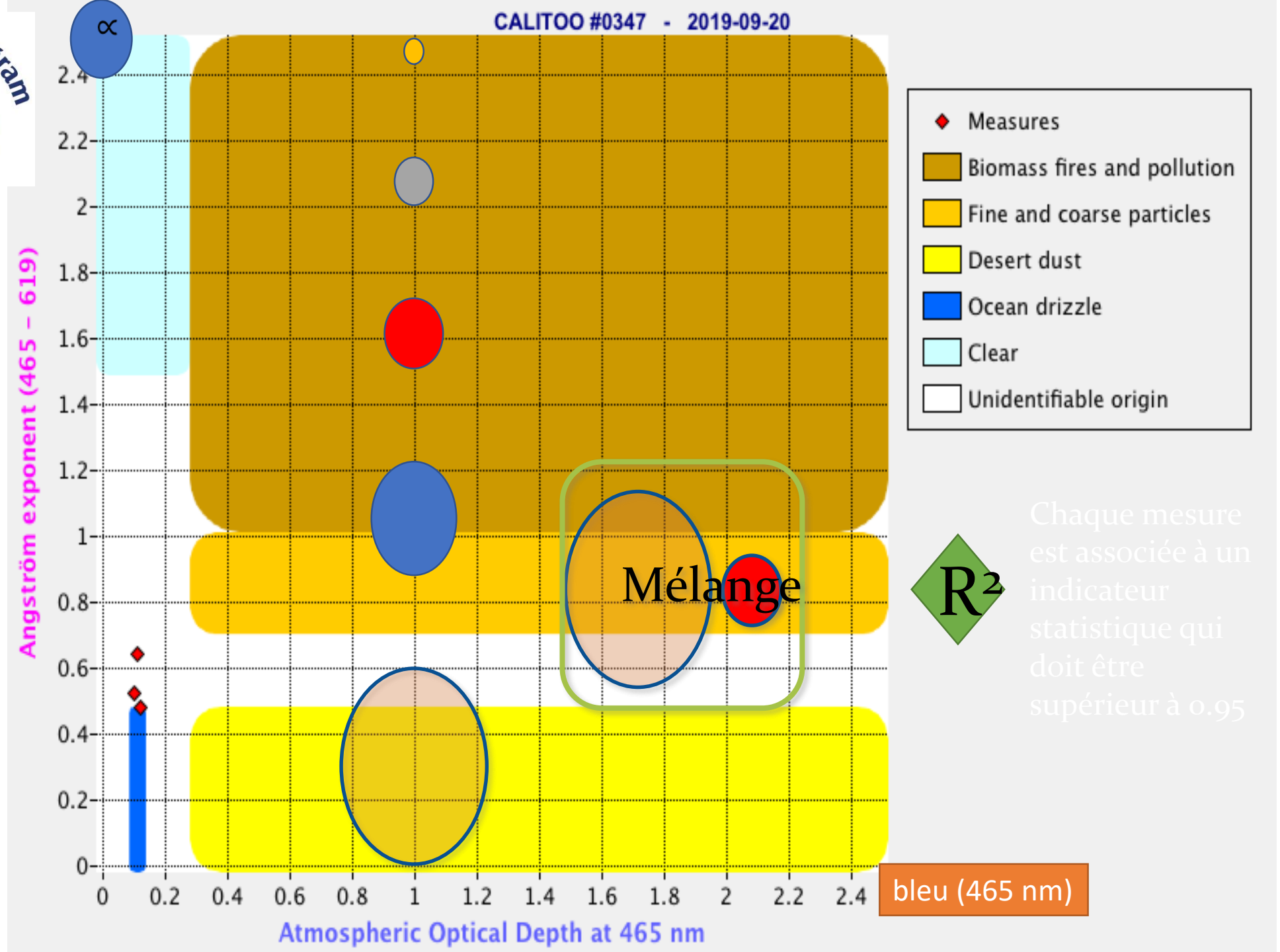
NEVER LOOK DIRECTLY AT THE SUN ! *Even with sunglasses*

Pointing the photometer is manual, it is facilitated by the target located above the display.



Sun at the center of the target:
photometer aligned.

You have to position facing the Sun stably and rapidly bring the bright spot in the middle of the target and maintain during measurement.


CALITOO #0347 - 2019-09-20
Angström exponent (465 – 619)
Atmospheric Optical Depth at 465 nm
Measures
Biomass fires and pollution
Fine and coarse particles
Desert dust
Ocean drizzle
Clear
Unidentifiable origin
Mélange
R²
Chaque mesure est associée à un indicateur statistique qui doit être supérieur à 0.95
bleu (465 nm)

FOTOMETRO SOLARE

SAULĖS FOTOMETRAS

SOLAR FOTOMEETRIT

SUN FOTOMETR

SUN FOTOMETRS

SONNE PHOTOMETER

SOLAR ΦOTOMETP

SUN PHOTOMETER

रवि प्रकाशमापी

Calitoo

FOTÓMETRO SOLAR

太陽光度計

태양 광도계

太陽の光度

PHOTOMETRE SOLAIRE

SUN FOTÔMETRO

In this workshop you will:

3. Think about Air Pollution projects in your class