GOBIERNO DE ESPAÑA
VICEPRESIDENCIA TERCERA DEL GOBIERNO
MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA Y EL RETO DEMOGRÁFICO

AEMet Interreg MAC 2014-2020 Cooperación Territorial

MACCLIMA

Installation et utilisation d'instrumentation

26/01/2022

Installation and performance of instrumentation

Dr. África Barreto

PI Aerosol Group

Izaña Atmospheric Research Center – AEMET

Actividad 2.1.2 Incrementar la capacitación técnica y humana de los actores responsables de la observación meteorológica y oceanográfica del fenómeno del cambio climático en el espacio de cooperación, enmarcada en el Proyecto MAC- CLIMA (MAC2/3.5b/254) aprobado en el marco del Programa de Cooperación Territorial INTERREG V-A-Madeira-Azores-Canarias (MAC) 2014-2020, cofinanciado en un 85% con fondos FEDER

INTRODUCTION TO ATMOSPHERIC AEROSOLS AND SUN PHOTOMETRY

Natural and Anthropogenic

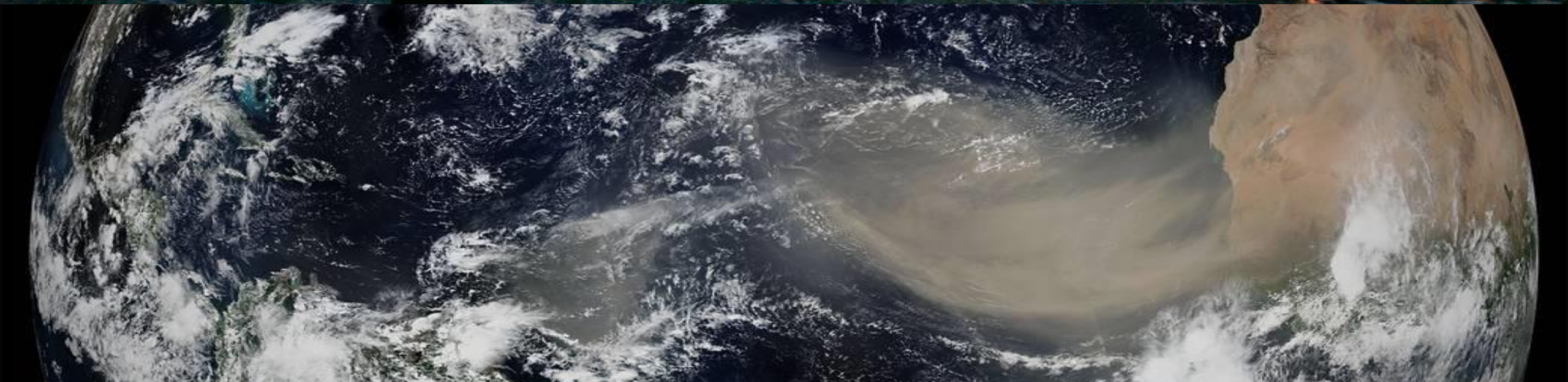
90 % in mass of **natural origin**

(e.g. sea salt, mineral dust, volcanic eruptions, bacteria, viruses, pollens)

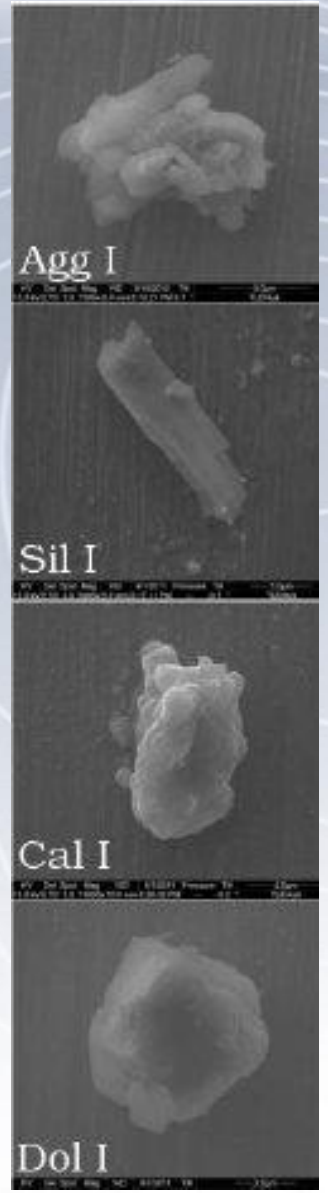
10 % in mass of **anthropogenic origin**

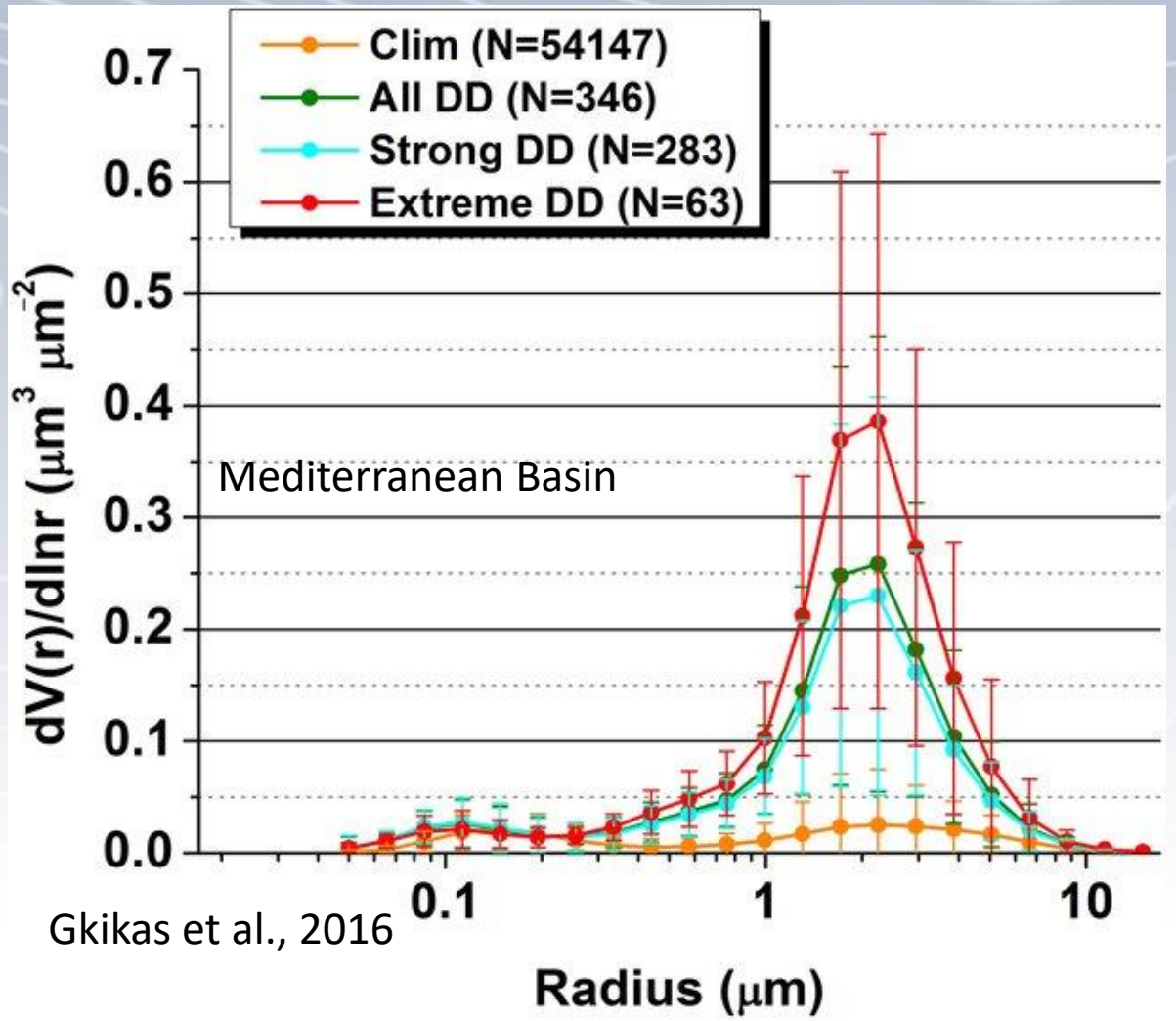
(e.g. industrial emissions, vehicle exhaust, agricultural and forest burns)

Natural – Mineral dust



Lindqvist et al. (2014)



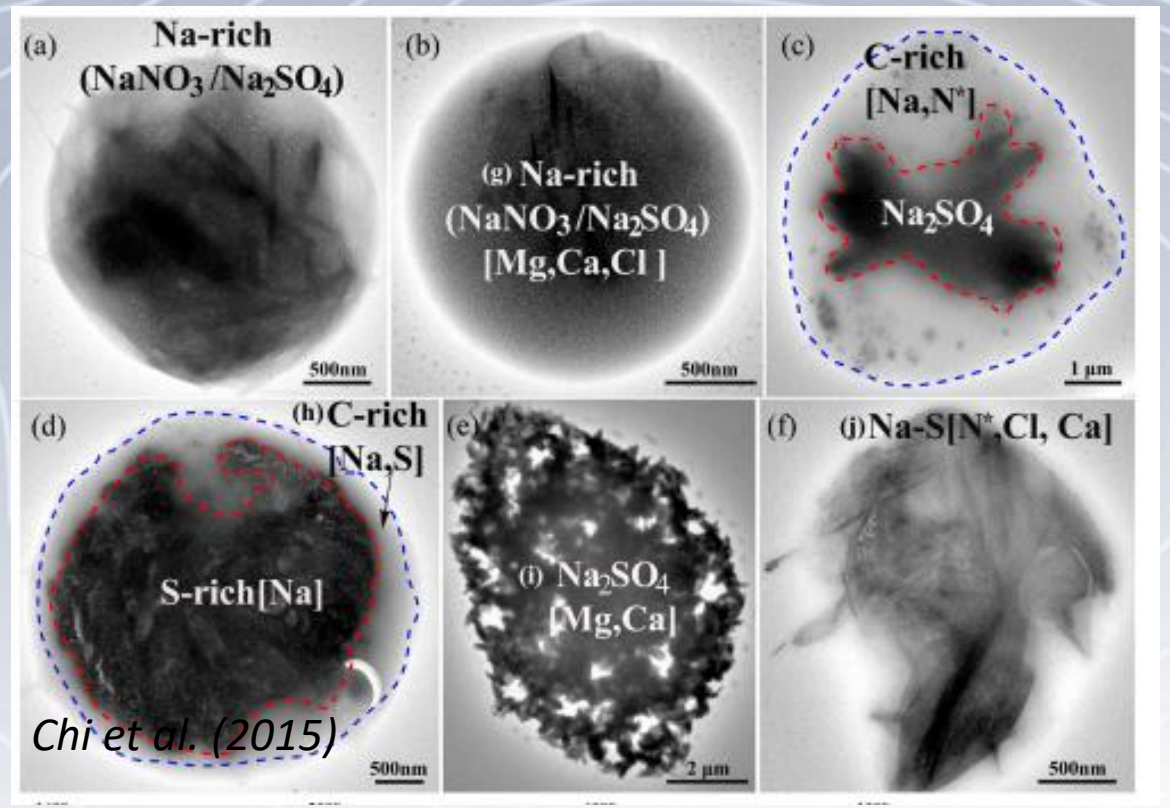


Mediterranean Basin

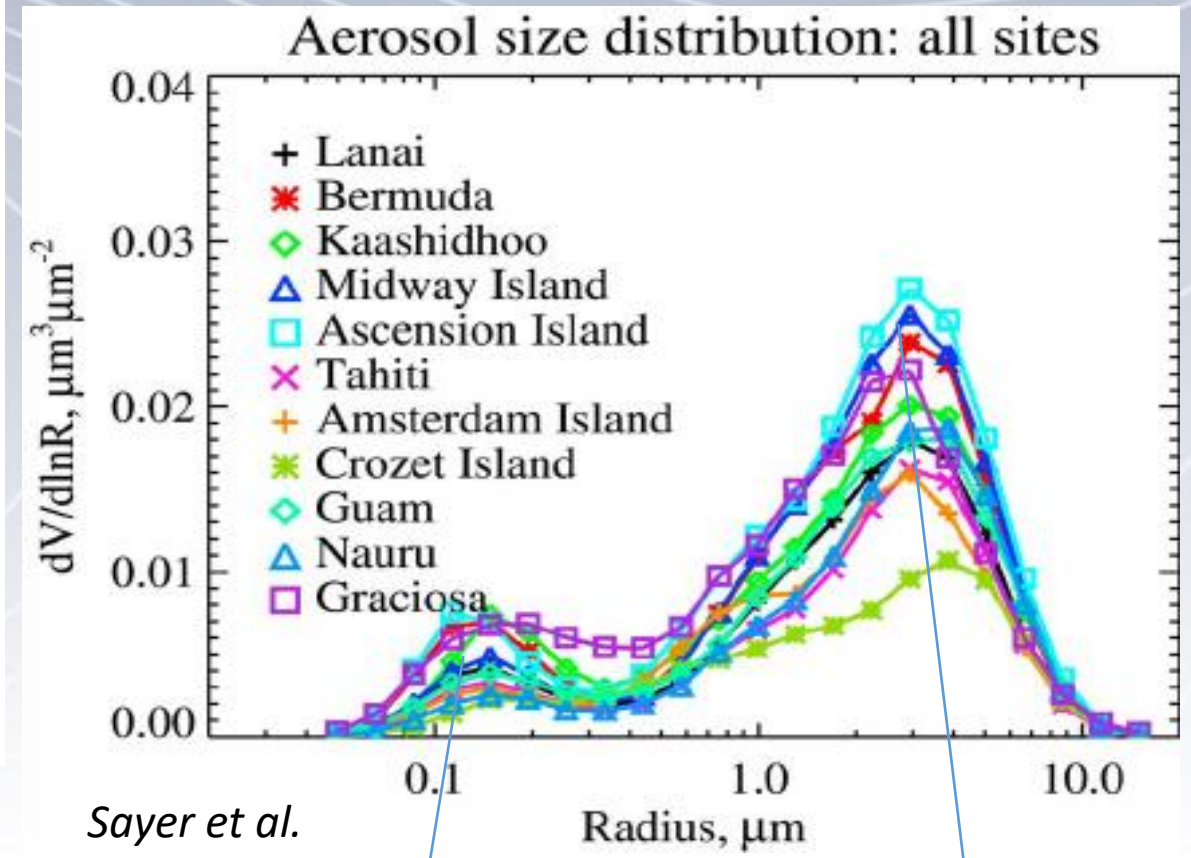
Gkikas et al., 2016

coarse mode increased by factors ≈10

Natural – Marine aerosols



Chi et al. (2015)



Sayer et al. (2012)

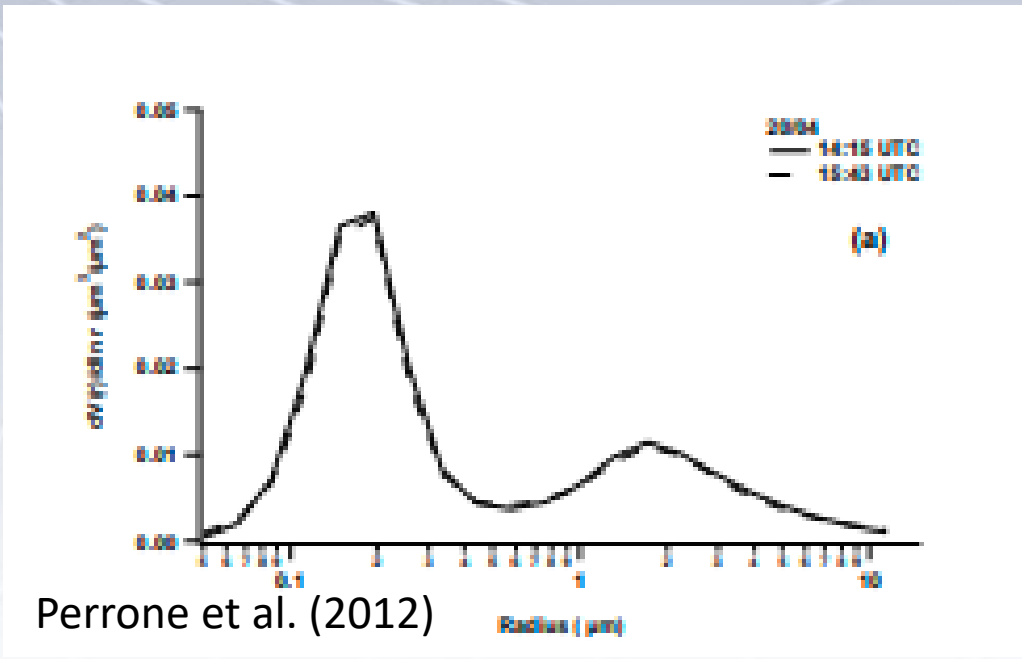
sulphates and fine Sea Salt

large Sea Salt particles and nitrates

Natural – Volcanic aerosols

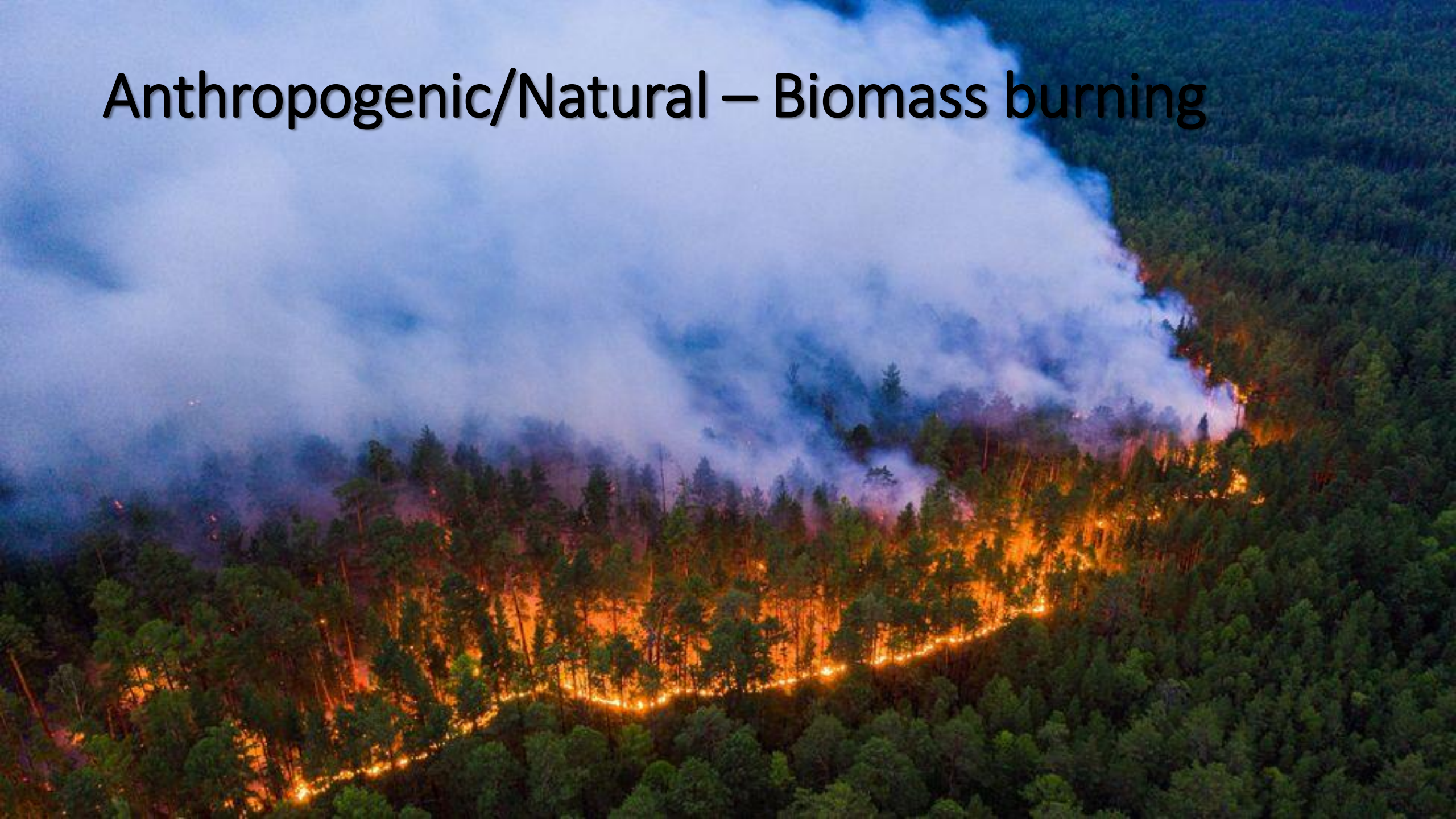
ASH

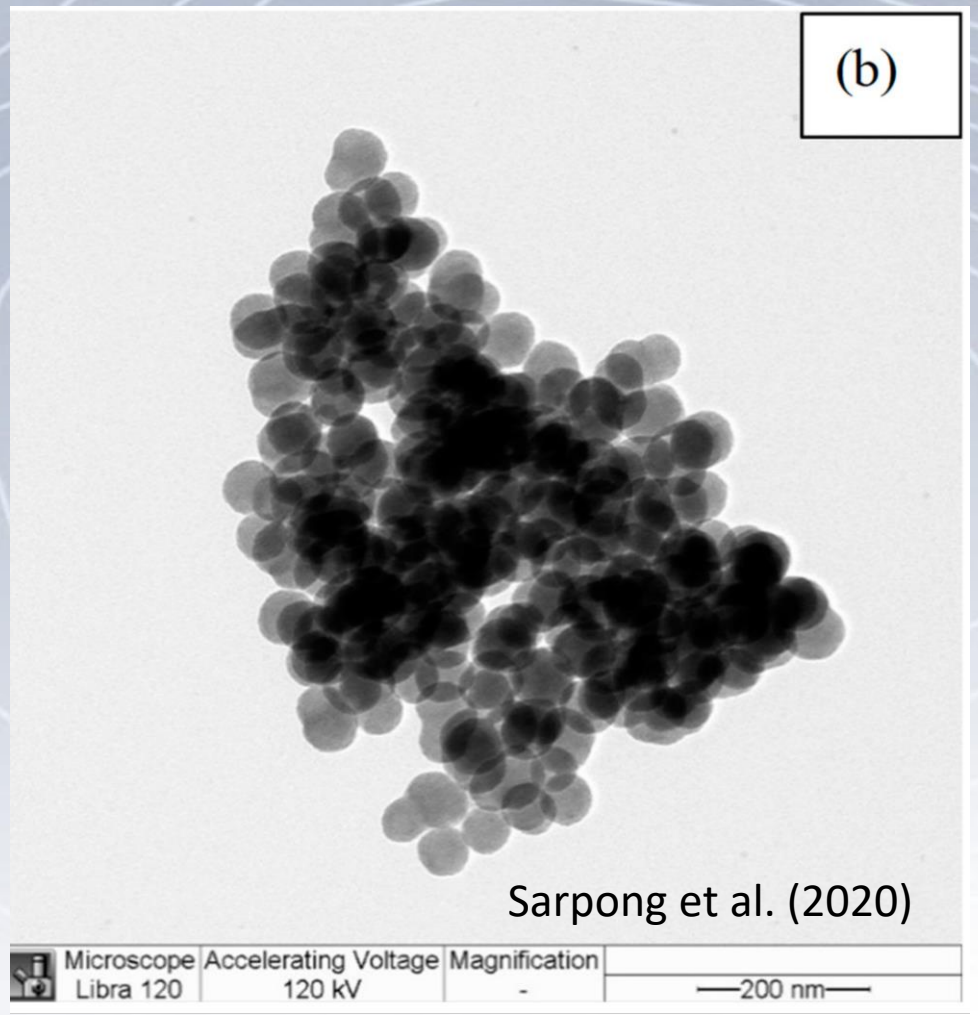
SULPHATES + ASH



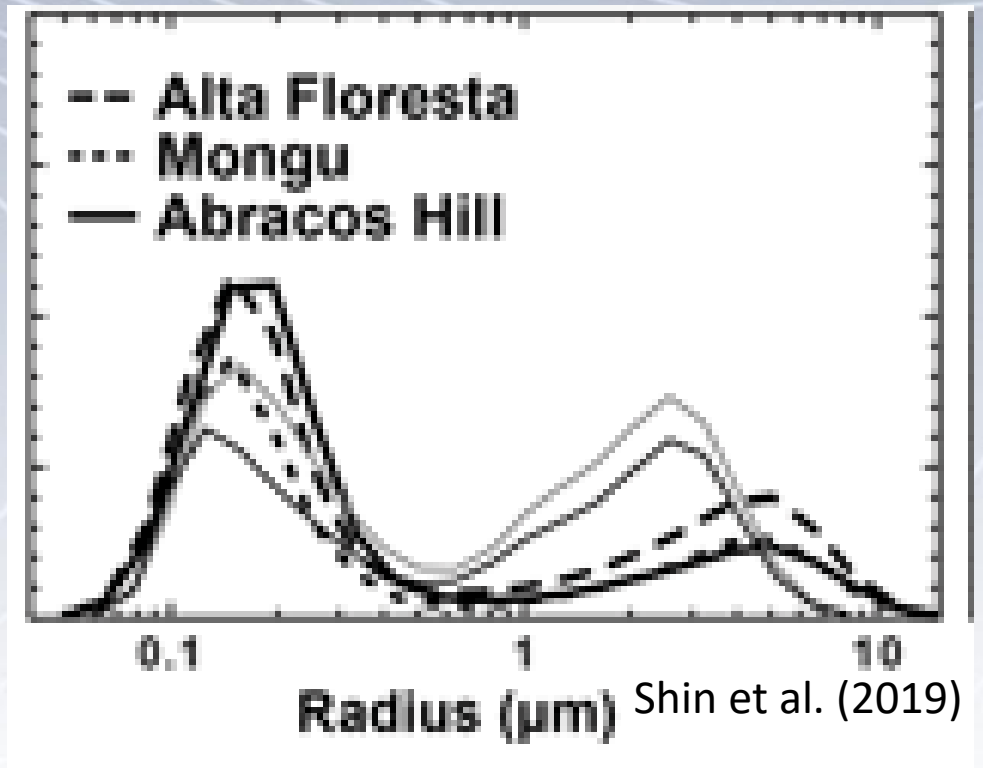
Perrone et al. (2012)

Anthropogenic/Natural – Biomass burning



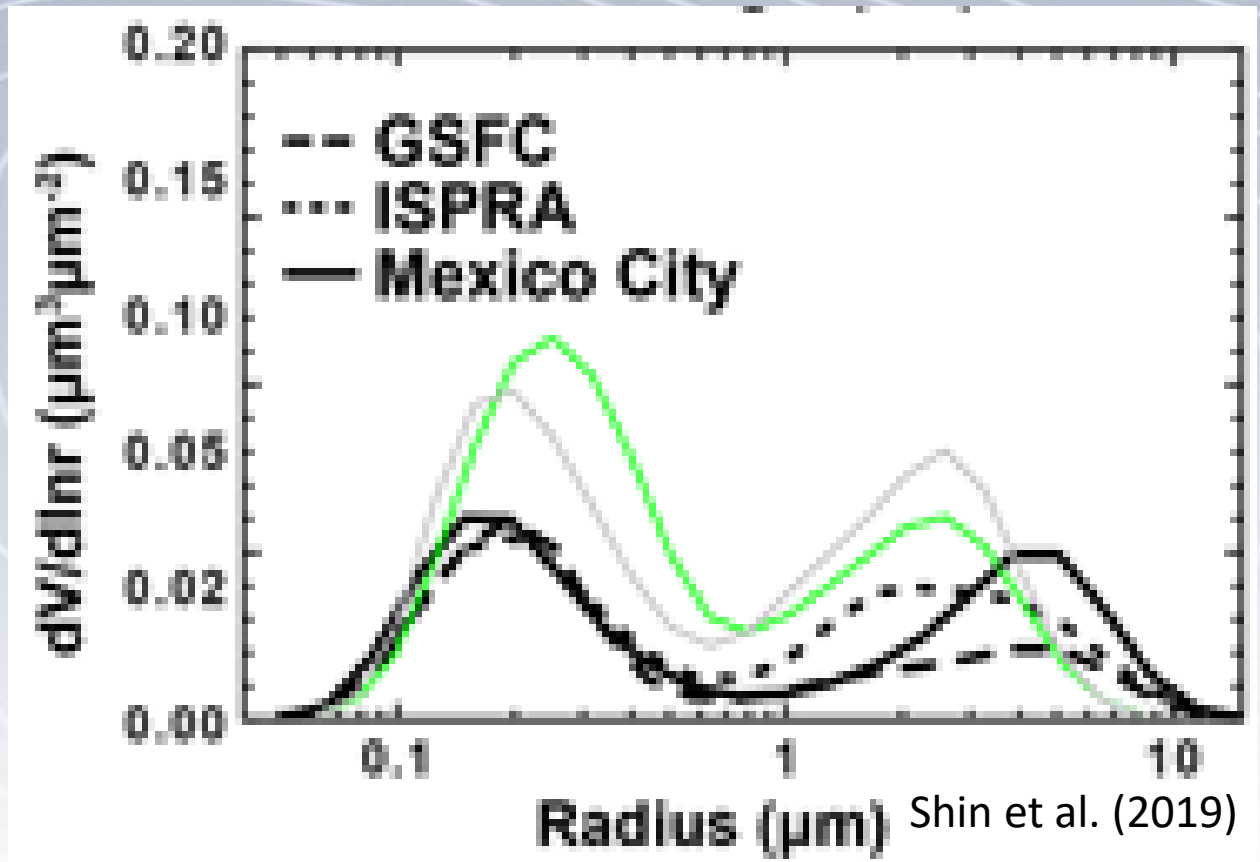


Sarpong et al. (2020)



Shin et al. (2019)

Anthropogenic – Industry and Traffic



Shin et al. (2019)

Fine mode: suphates, nitrates and carbonaceous

Aerosols and Health

- Particles suspended in the air enter our body when we breathe
- Associated hazard depend on chemical composition and where they deposit within the respiratory system
- These effects includes **infectious diseases** (meningitis and valley fever), **respiratory problems** or **cardiovascular diseases**, sometimes even leading to cancer

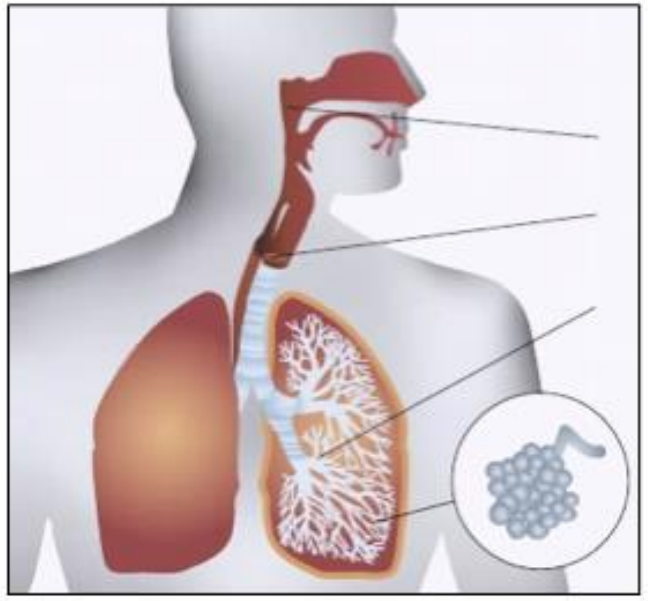
5-10 µm

3-5 µm

2-3 µm

1-2 µm

0.1-1 µm



Areas of attack

Nose and throat area

Windpipe

Bronchia
Bronchial

Alveolen (Lung bubbles)

Aerosols and Visibility

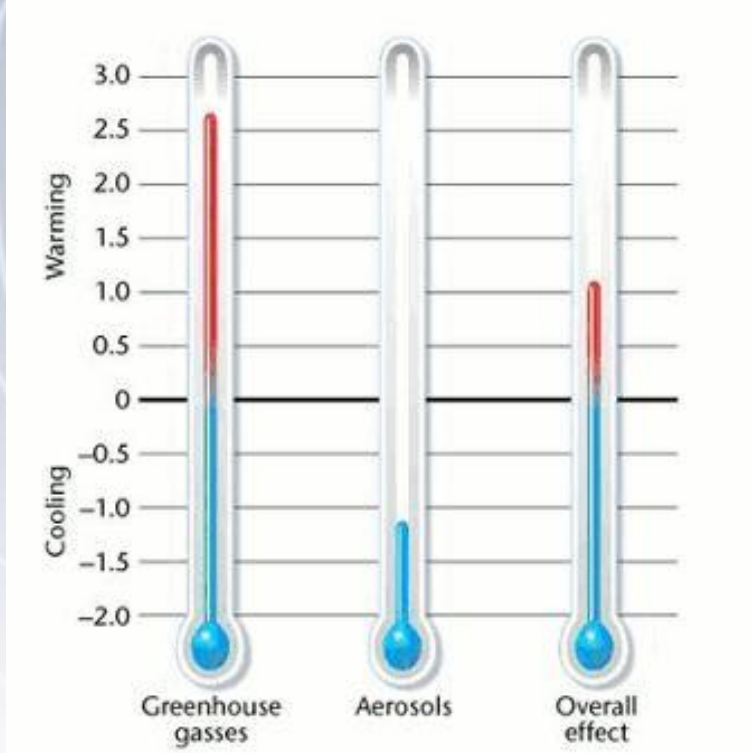
- Aerosol particles cause a degradation of visibility due to the extinction of light produced when light passes through the atmosphere

A country landscape view near Marrakech, Morocco.

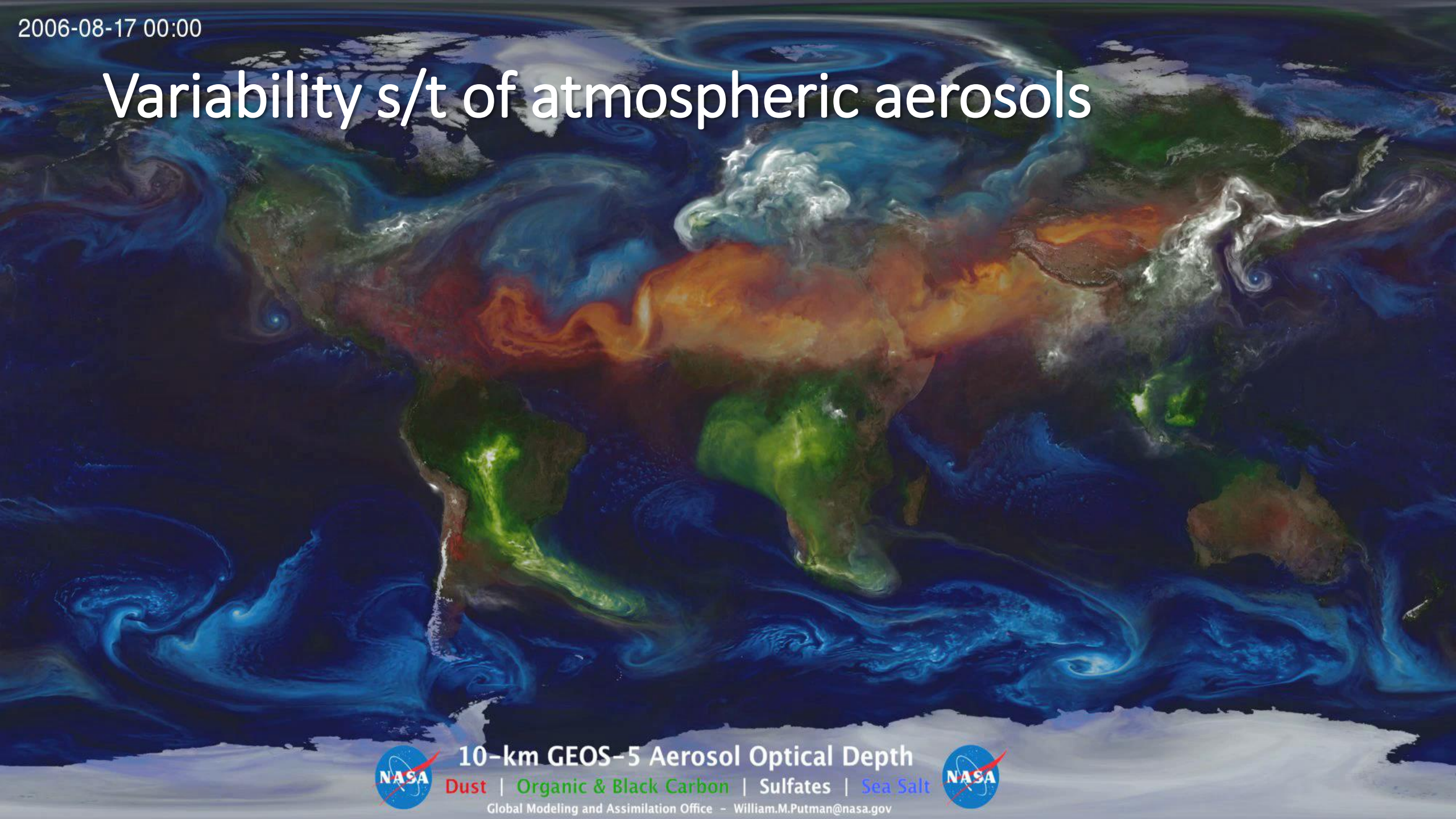
Aerosols and Socio-economic Impacts

- Including negative effects on ground transport, aviation, agriculture and generation of solar energy

Aerosol Effect on Climate – Global Scale



- On global scale, aerosol pollution induce a **cooling** of the planet
- partly counteract the famous global **warming** effect of greenhouse gases


2006-08-17 00:00
Variability s/t of atmospheric aerosols
10-km GEOS-5 Aerosol Optical Depth
Dust | Organic & Black Carbon | Sulfates | Sea Salt
Global Modeling and Assimilation Office - William.M.Putman@nasa.gov

Summarizing…

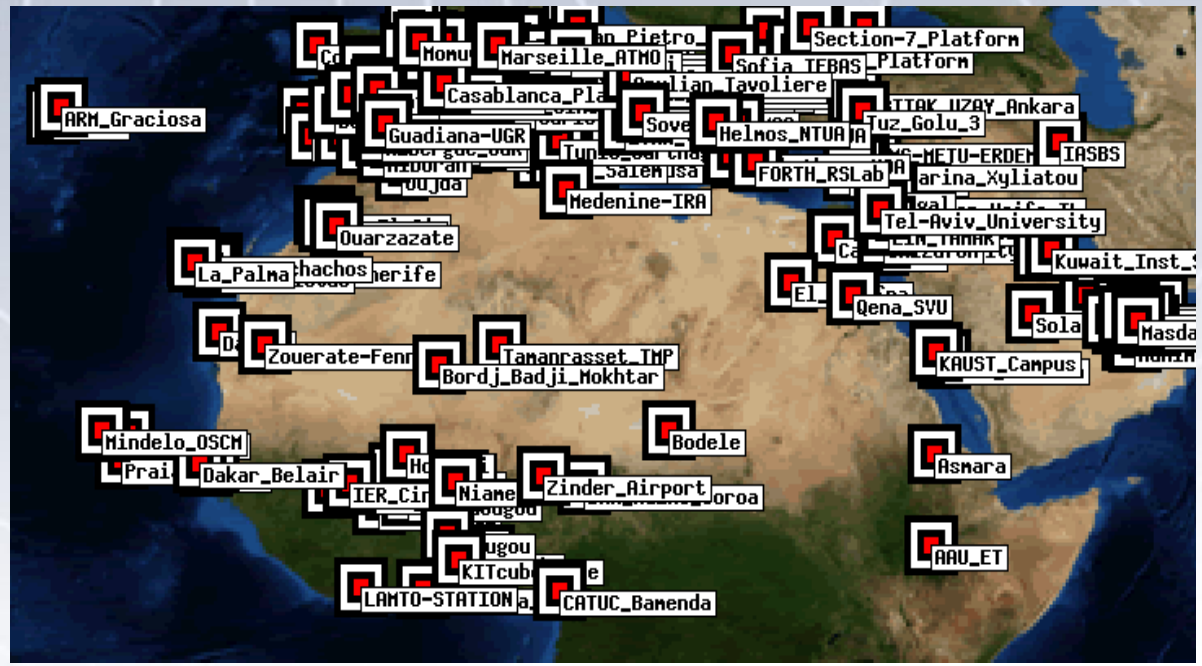
Lack of information:

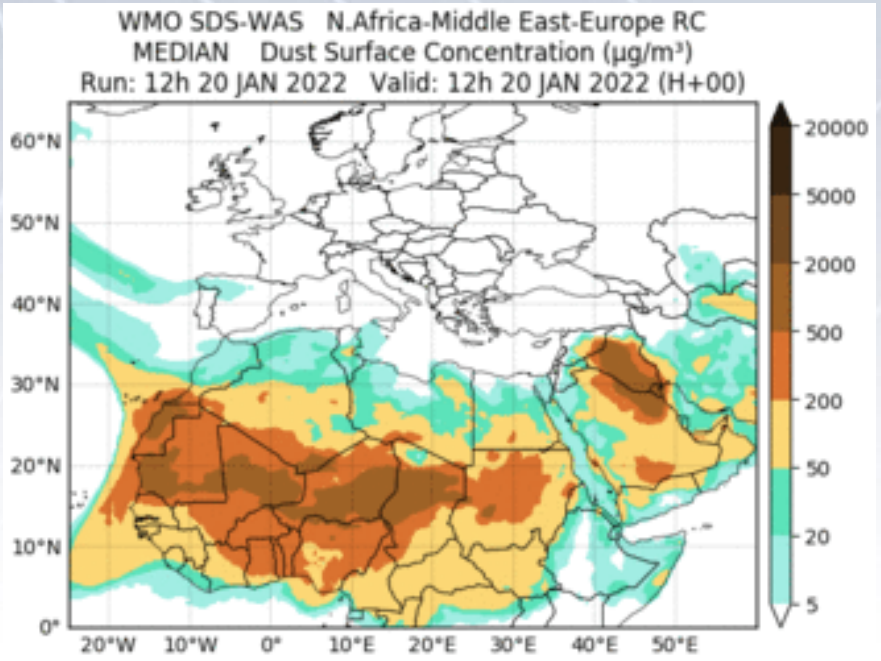
1) To extend our knowledge on the effect of aerosol on climate and its role in the climate system

2) To validate the current aerosol forecasts and therefore the numerical weather prediction models

MORE MEASUREMENTS IN STRATEGIC SITES!!!!!

Role/importance of sun photometry





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AOD Observations at your site: Sun Photometry

Beer's Law

$$I_\lambda = I_{0,\lambda} \cdot e^{-\tau_\lambda \cdot m}$$

$$(I_\lambda < I_{0,\lambda})$$

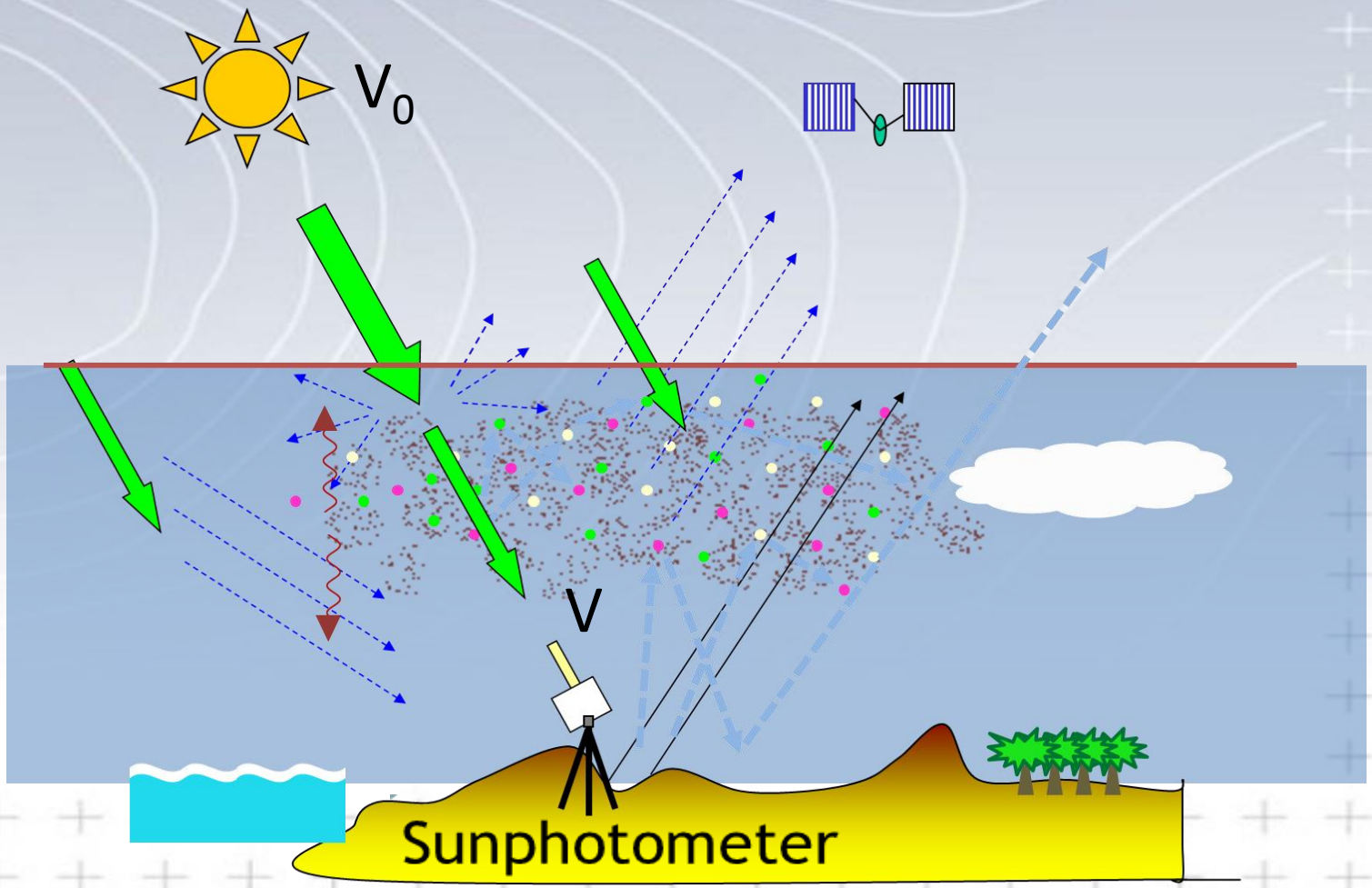
$$\tau_\lambda = AOD_\lambda$$

Angstrom Eq.

$$\tau_\lambda = \beta \cdot \lambda^{-\alpha}$$

α = Angstrom Exponent

α↓ large particles
α↑ fine particles



More aerosols in the atmosphere cause more extinction and less energy transmitted to the surface. AOD is the degree to which aerosols prevent the transmission of light.

Typical AOD ranges

Sky conditions	500 nm	870 nm
Extremely clear (pristine)	0.03 - 0.05	0.02 - 0.03
Clear	0.05 - 0.10	0.03 - 0.07
Somewaht hazy	0.10 - 0.25	0.07 - 0.20
Hazy	0.25 - 0.5	0.20 - 0.40
Extremly hazy	> 0.5	> 0.4

Note that red AOD values are typically less than green AOD values. This is due to the fact that typical aerosols scatter green light more efficiently than red light.

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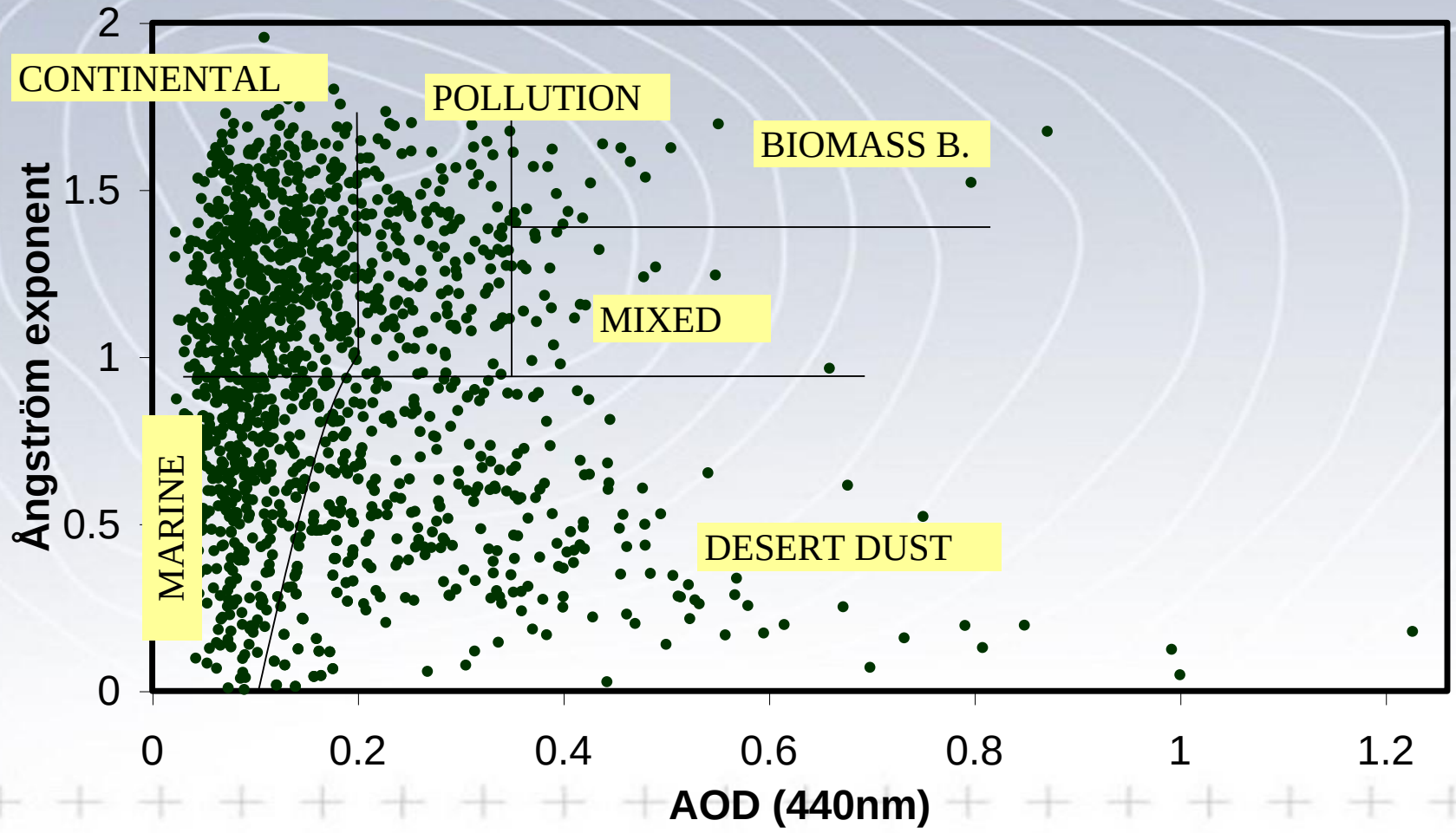
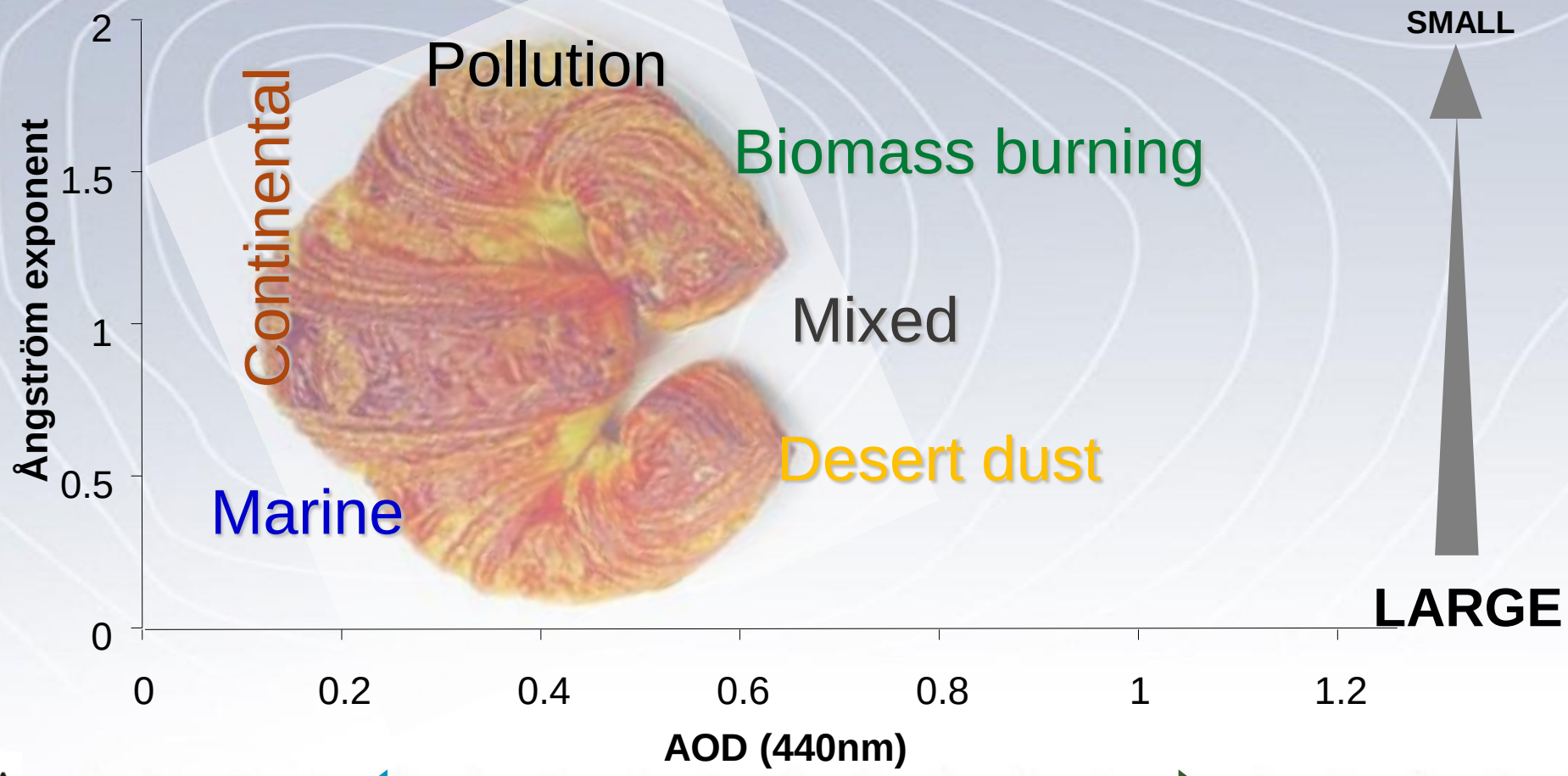
Aerosol Type with diagram AOD-α



Aerosol Type with diagram AOD-α



CLEAN

TURBID

INSTRUMENTAL DESCRIPTION

Photometry: Calitoo handheld sun photometer

Reconsidering hand-held sunphotometers for reporting dust AOD?

Microtops-II, Calitoo-Tenum...

Many observations at airports (even in remote regions)
Operated by meteorological observers
Easy data transmission through WMO GTS/WIS communication system

NRT data for model evaluation and data assimilation
NRT data for satellite evaluation
NRT data for dust nowcasting

Photometry: Calitoo handheld sun photometer

Technicals characteristics:

- Light channels: 465 (B), 540 (G) and 619 (R) nm
- Possible 999 measures stored in memory
- AOD calculated in real-time
- USB data download
- 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 to 55°C

http://www.calitoo.com

How to use it?
https://www.youtube.com/watch?v=4wCzw4rY9Hs

Photometry: Calitoo handheld sun photometer

Products:

AOD @ 465, 540 et 619 nm

Angstrom Exponent

Calibration provided!!!

(at Izaña testbed)

First pilot experiments at:

Tamanrasset GAW Station (Algeria)

Tehran (Iran)

Aminabad Mt. Firoozkoh GAW station (Iran)

Photometry: Calitoo handheld sun photometer

Measurements

The measurement principle is to point the Sun and search for the maximum reading. The photometer keeps only the maximum measured and then calculated the optical depth.

The Sun alignment is done manually. It is facilitated by the sighting device located above the display of the Calitoo.

The calculation of optical depth use raw brightness measurements, calibration coefficients, date and GPS position as well as atmospheric pressure.

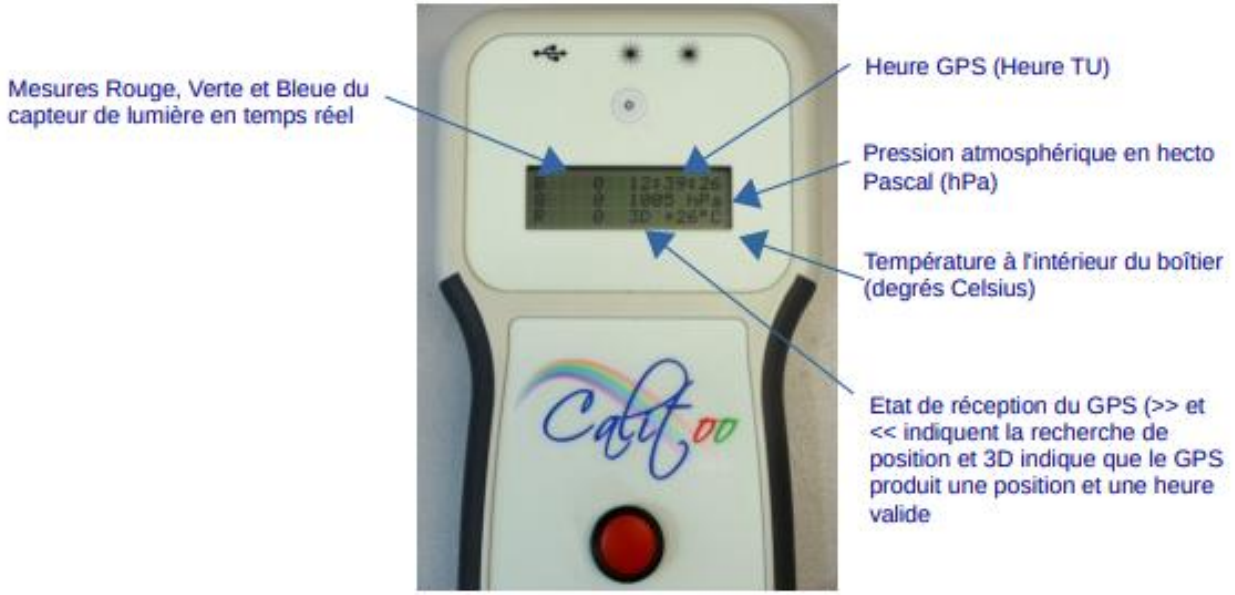
How to use it?
https://www.youtube.com/watch?v=4wCzw4rY9Hs

How to take measurements? Pag 10-15 http://www.calitoo.fr/uploads/documents/fr/usermanual_2020_fr.pdf

Power ON by pressing for a few seconds on the red button

1.3 Premières mesures

Après la mise sous tension et la page de présentation passée, le photomètre indique qu'il est en mode mesure et affiche les informations de base :



Dès que le GPS du photomètre est en 3D, vous pouvez commencer les mesures.

Si le GPS n'est pas en 3D, vous ne pouvez pas faire de mesure enregistrable

How to use it?
https://www.youtube.com/watch?v=4wCzw4rY9Hs

How to take measurements? Pag 10-15 http://www.calitoo.fr/uploads/documents/fr/usermanual_2020_fr.pdf

1.4 Pointage du Soleil

Le pointage du photomètre est manuel, il est facilité par le dispositif de visée situé au dessus de l'afficheur.

Tutoriel video sur YouTube : How to measure aerosols ?

Vous devez vous positionner face au Soleil de manière stable et amener rapidement le point lumineux au milieu de la cible du pointeur et de l'y maintenir le temps des mesures.

Le Soleil est au centre de la cible : le photomètre est pointé.

How to use it?
https://www.youtube.com/watch?v=4wCzw4rY9Hs

How to take measurements? Pag 10-15 http://www.calitoo.fr/uploads/documents/fr/usermanual_2020_fr.pdf

1.5 Maximum

Le but est d'obtenir la valeur maximale en RVB en environ 1 minute de pointage.

Cliquez sur le bouton du photomètre et vous passez à la page des maximums des mesures (nous supposons bien sûr que vous étiez restés sur la page de base décrite précédemment).

Tout en ayant un œil sur la cible, vous surveillez les valeurs numériques maximales mesurées sur l'afficheur. Lorsqu'elles ne changent plus, au bout d'environ une minute, vous procédez à la mémorisation des mesures.

How to use it?
https://www.youtube.com/watch?v=4wCzw4rY9Hs

How to take measurements? Pag 10-15 http://www.calitoo.fr/uploads/documents/fr/usermanual_2020_fr.pdf

1.6 Affichage des AOT

Après la page des maximums, en appuyant une nouvelle fois sur le bouton rouge, le Calitoo réalise les calculs d'AOT et les affiche sur son écran.

Si les mesures vous paraissent aberrantes, vous pouvez choisir alors de ne pas les enregistrer à l'étape 1.8.

1.7 Affichage du Alpha

Cliquez sur le bouton une nouvelle fois et vous voilà sur la quatrième page qui est celle du Alpha ou Coefficient d'Angström.

Ce coefficient, dont le calcul est expliqué en Annexe 4.2, permet de caractériser le type des particules détectées.

Le R2 est un indice de confiance. 1.00 c'est une total confiance dans le Alpha calculé alors que 0,50 représente 50 % de confiance.

Le calcul de R2 est détaillé en Annexe 4.2.

How to use it?
https://www.youtube.com/watch?v=4wCzw4rY9Hs

How to take measurements? Pag 10-15 http://www.calitoo.fr/uploads/documents/fr/usermanual_2020_fr.pdf

1.8 Mémorisation

Cliquez sur le bouton une nouvelle fois et vous voilà sur la cinquième page qui est celle des enregistrements. La séquence complète des opérations liées au bouton est décrite en Annexe 4.6.

Le photomètre vous demande si vous voulez enregistrer (les mesures).

Be sure you store the measurement!!!

Si c'est la cas, il vous faudra appuyer toujours sur le bouton mais cette fois-ci en le maintenant enfoncé jusqu'à ce que le message **Recorded!** apparaisse en bas de l'écran.

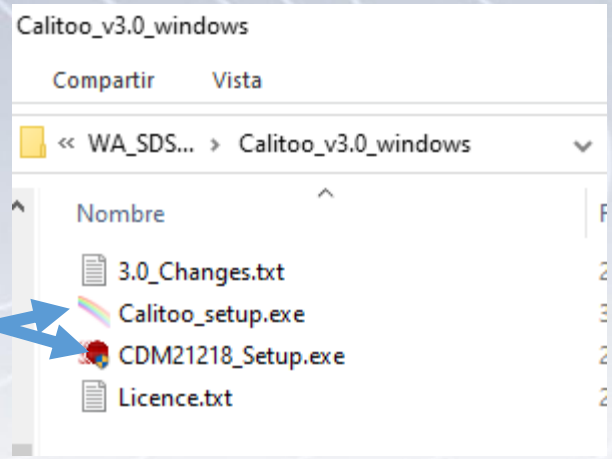
Vous relâchez alors le bouton et vous vous retrouvez sur la page de base pour un nouveau cycle de mesures.

Si vous n'êtes pas satisfait de votre mesure et que vous ne voulez pas l'enregistrer, un simple clic annule l'opération et vous vous retrouvez de nouveau sur la page de base pour un nouveau cycle de mesure.

How to upload data?
First, software download: http://www.calitoo.fr/index.php?page=software

1º execute (install)

2º execute (install)



Data Visualization

How to upload data?
Plug calitoo to PC in “Reading mode” with USB cable and open the Calitoo software

Automatic recognition

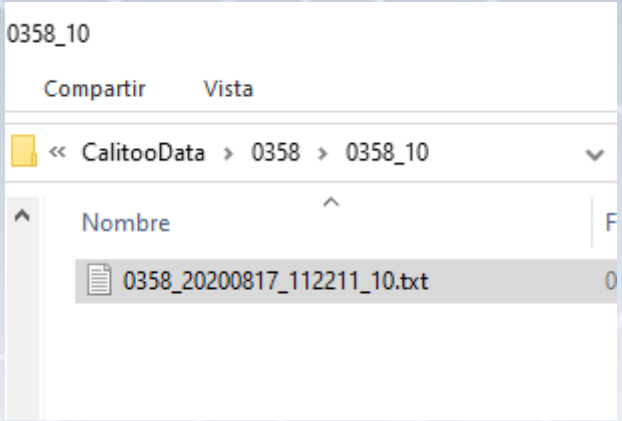
Go to “Data” label

Press the Green row to downlado data (in this case 11 measurements

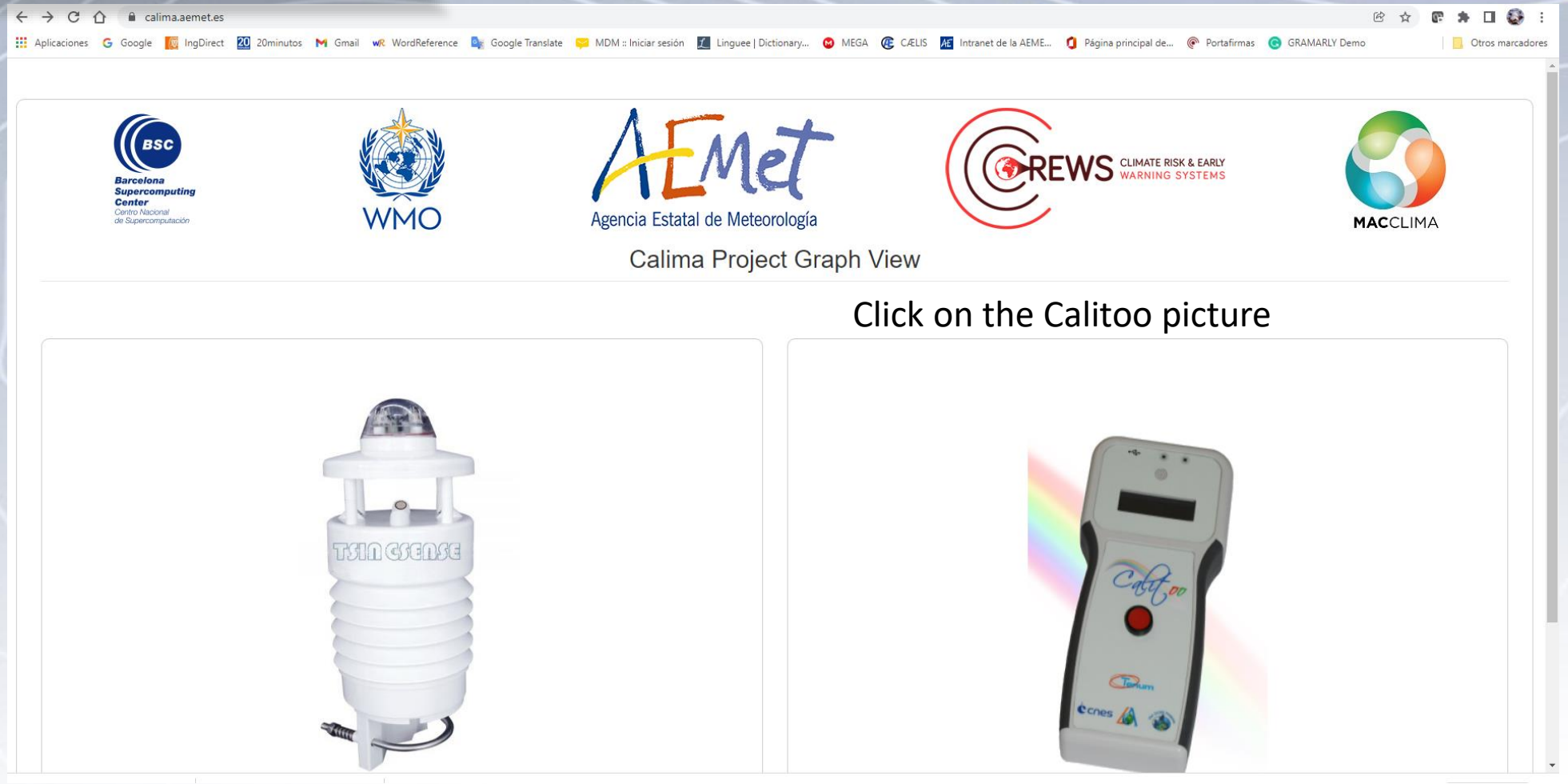
Data Visualization

How to upload data?
Where are the data?

You need to look for the “CalitooData” folder, and there you will find .txt files with downloaded data



How to upload data?
Go to https://calima.aemet.es/



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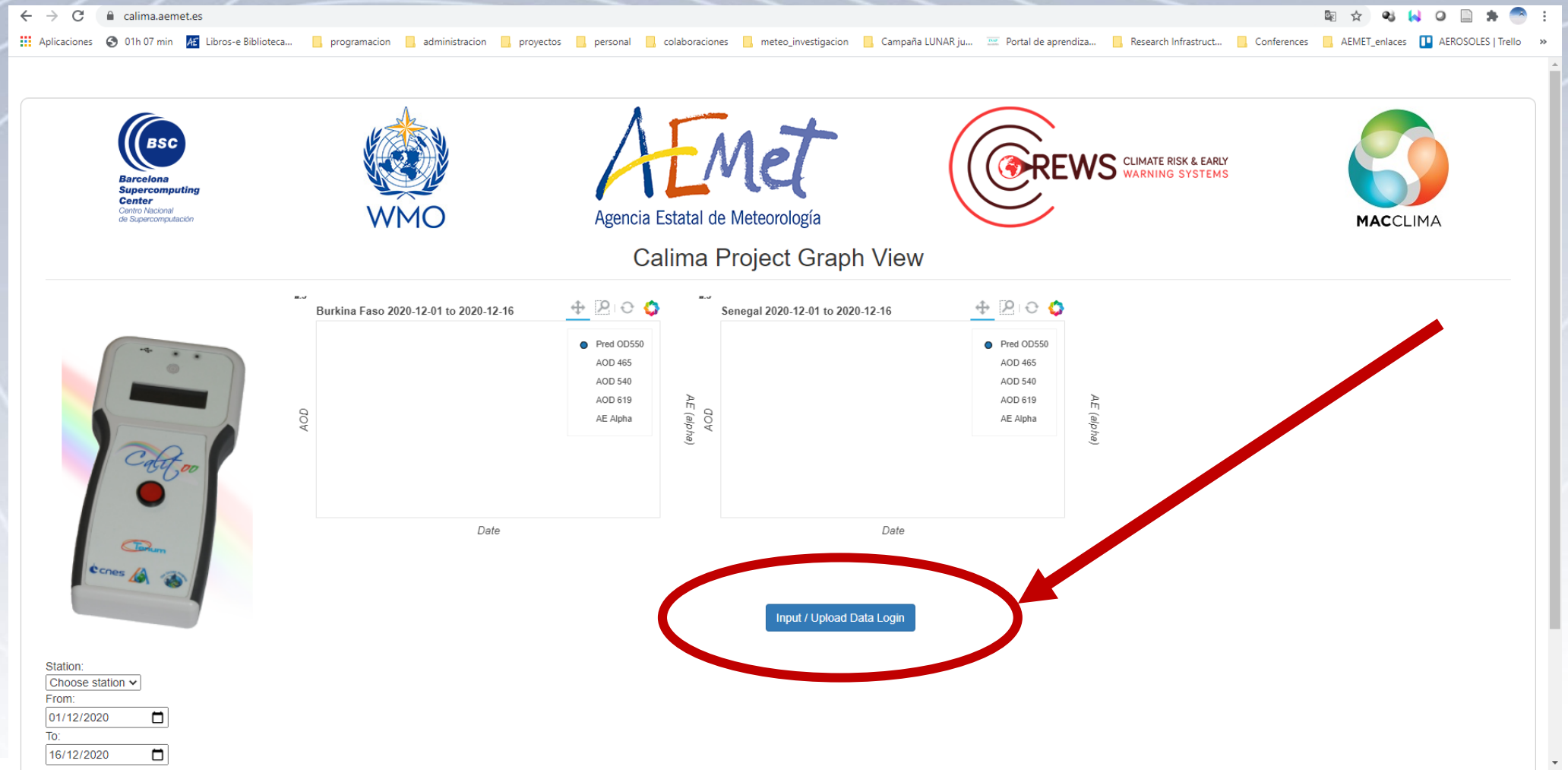
How to upload data?
Go to https://calima.aemet.es/

Input / Upload Data Login

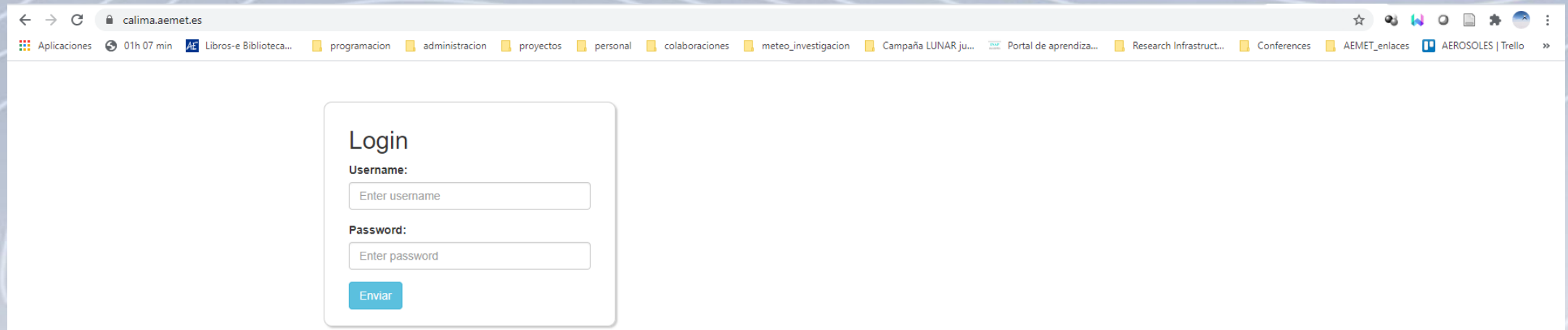
Click on “Input/Upload Data Login”



MACCLIMA

How to upload data?

Enter username and password



User: mauritania

Password: M4ur1t@21

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How to upload data?

Click on “Click to upload Calitoo TXT data file”

Calima Project

Senegal

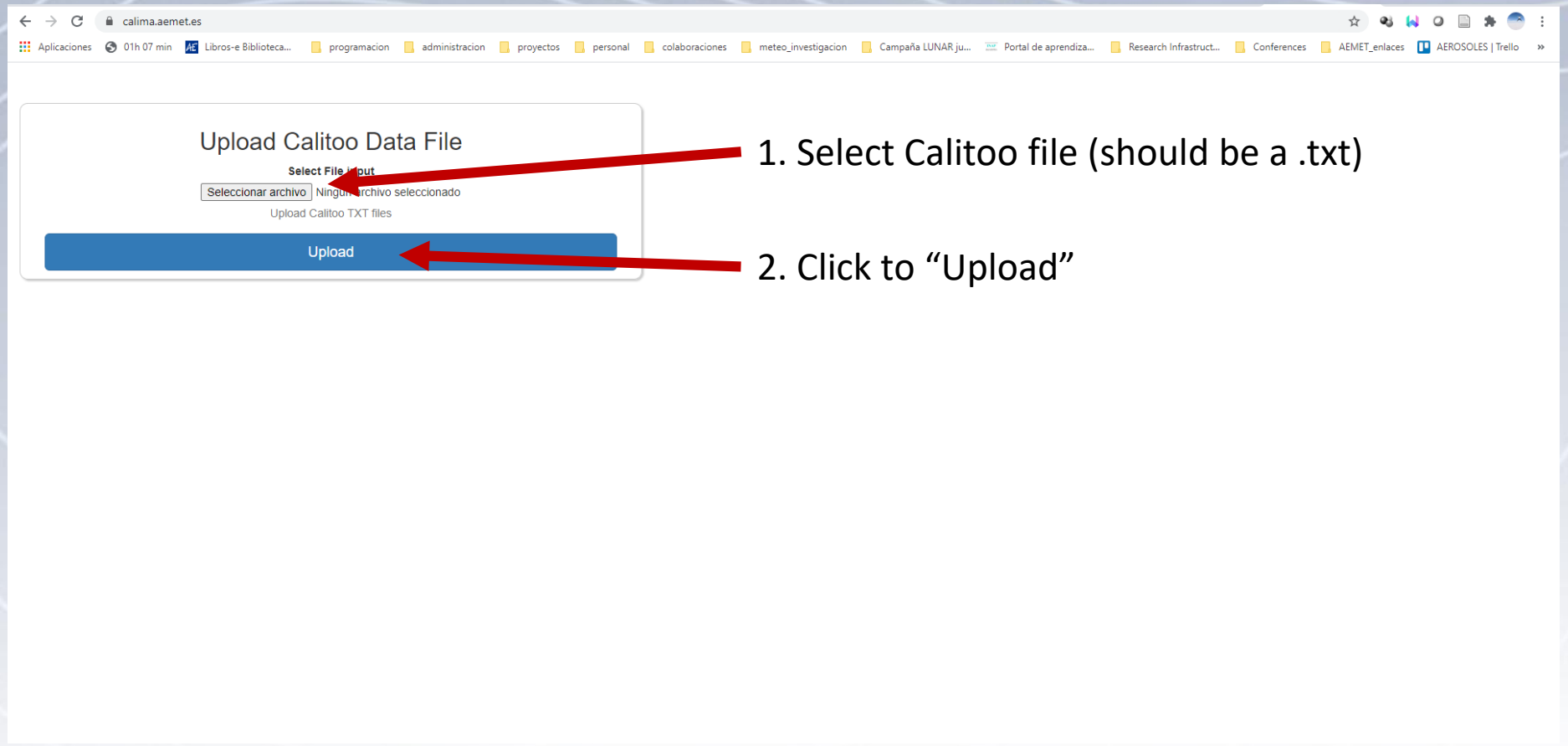
Last data:

Date	dd/mm/aaaa
Time UTC	--:--
Atmospheric Pressure hPa	Enter pressure
AOD Blue 465	Value between 0 and 3
AOD Green 540	Value between 0 and 3
AOD Red 619	Value between 0 and 3
Alpha	Value between 0 and 4

Submit

Click to upload Calitoo TXT data file

How to upload data?



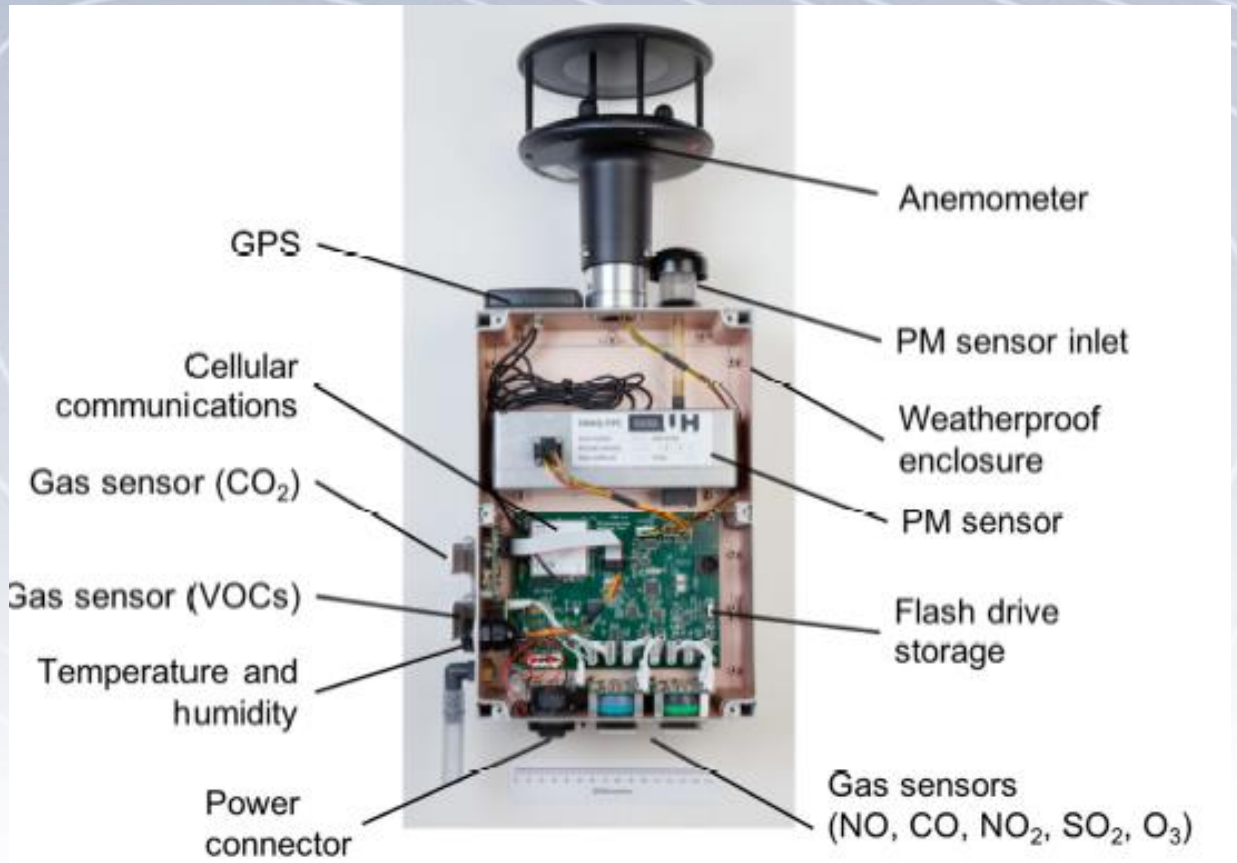
1. Select Calitoo file (should be a .txt)

2. Click to “Upload”

https://calima.aemet.es/

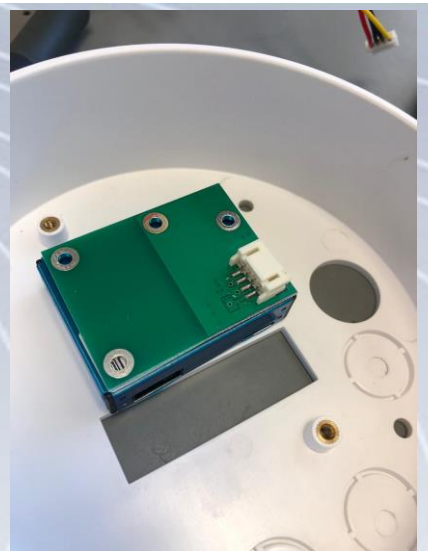
Low Cost PM Sensor (EXPERIMENTAL!!!)

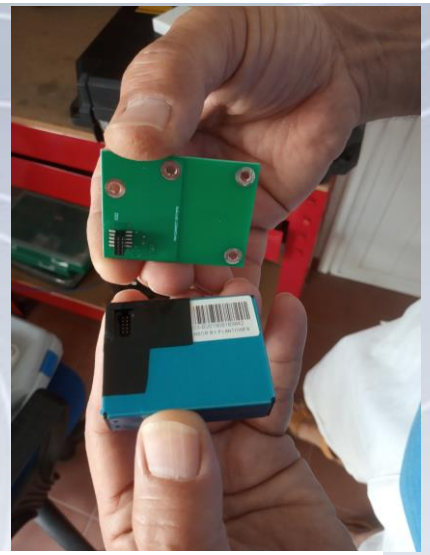
Low-cost sensors for the measurement of atmospheric composition: overview of topic and future applications (WMO, 2018)



Low Cost PM Sensor (EXPERIMENTAL!!!)

IMDS





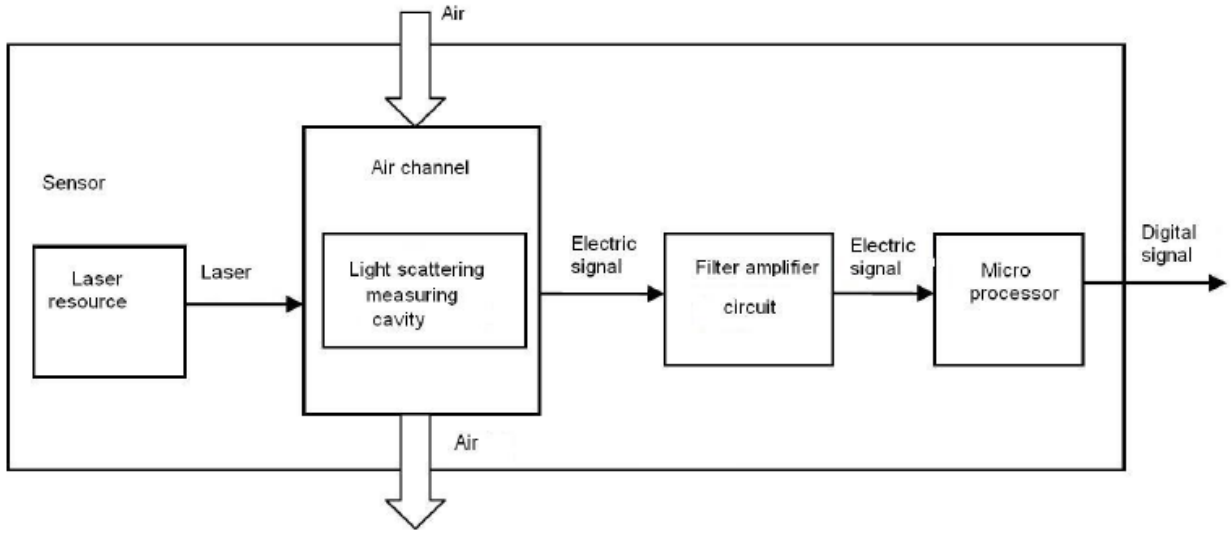


Figure 1 Functional block diagram of sensor

How to install an IMDS sensor?

(measuring PMx concentrations)

Natalia Prats

npratsp@aemet.es

Izaña Atmospheric Research Centre

AEMET

2

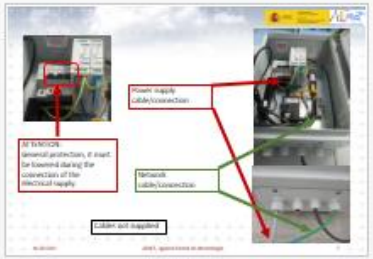
3

4 ★

5 ★

6

7 ★



8 ★

Is it possible to change the PM sensor inside IMDS (some problems have been found in your system) – This video explains how to do it.

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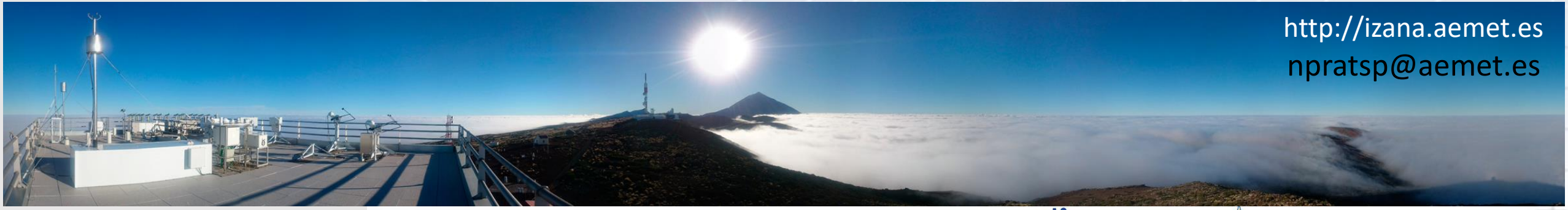
Merci!



http://izana.aemet.es
npratsp@aemet.es

AEMet Agencia Estatal de Meteorología

ANACIM

WORLD METEOROLOGICAL ORGANIZATION