REDAT aerosol typing database

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Aerosol Typing WG

The Working Group was set up in 2014 with the following aim:

The exchange of expertise and the communication among satellite (and ground-based) measurement communities about this topic is fundamental for improving long-term datasets consistency, and for reducing the uncertainties on aerosol types distribution. *[WG definition on AERO-SAT website]*
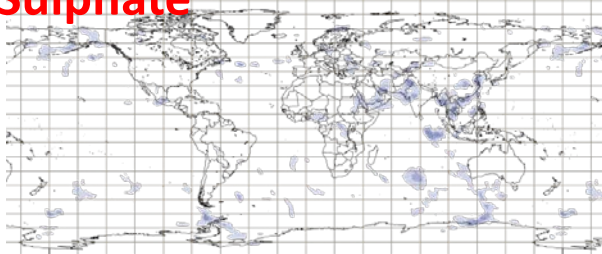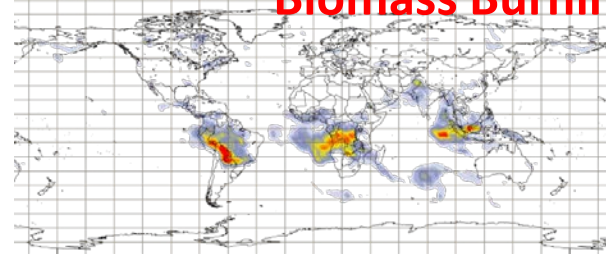
Aerosol Typing WG

IMPORTANCE

- **impact of the different aerosol sources on climate, precipitation and air quality.**

- **aerosol emissions policies**
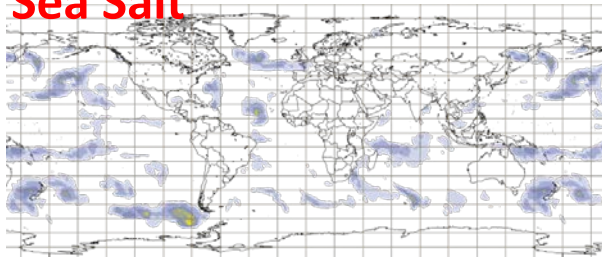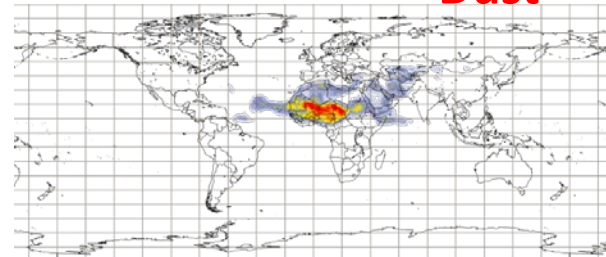
- **local authorities and hazards**

Sulphate

Biomass Burning

Sea Salt

Dust

Aerosol Typing WG

ISSUES

inhomogeneity among satellite (and not only) aerosol **typing schemes decreases** fundamental long-term datasets (multi sensors) **consistency**

AIM

Harmonization efforts and **translating rules** would lead to integration of the existing aerosol type datasets in a **coherent and consistent global datase**t **of the aerosol types** 4D distribution on a global scale.

Needs

- **Making clear the variety of typing meanings, names, procedures**

- **Review the differences and try to explain them**

- **Identify gaps and further needs**

- **Comparing algorithms**

- **Overcoming limitation in reference datasets**

How?

3 main steps (and level of detail)

❑ Review of the typing methods

❑ Comparison of mean properties

❑ Link among the typing procedures

Reference database for aerosol typing (REDAT)

- **The idea**: collecting information about aerosol typing from each sensor for each aerosol type and each algorithm.

- A set of pure aerosol components + their mixtures

- Labeled and identified with sensor typing procedures and grouping them in big categories.

Its development could provide a common platform for in-depth investigation well beyond our current knowledge.

REDAT

- REDAT could provide the opportunity for

❑ Finding matching / **translating rules** (which will be non-unique) between words belonging to a "controlled vocabulary"

❑ Providing an indication of typing products **reliability**

❑ Overcoming the "small" dataset limitation

❑ Construction of a **multi-dimensional** and **multi-platform** space of characteristic optical properties

Design

REDAT is now being building up. Hosted at CNR-IMAA, designed in hierarchical and flexible structure.
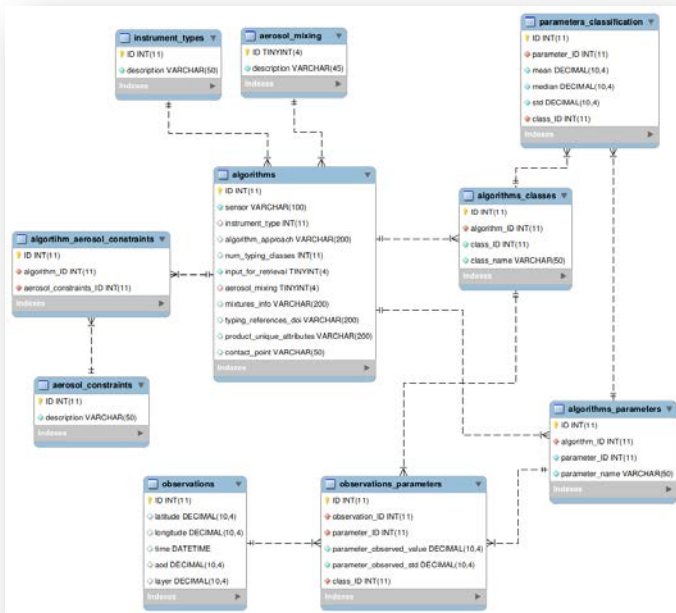
❑ Review

❑ Mean properties

❑ Translating rules

Typing procedures - Review

- Confusing and misleading **nomenclature**

- Remote-sensing can provide **optical constraints** interpreted as **particle size, shape, and indices of refraction**

- A further **interpretative step**, entailing additional assumptions, reports particle **Source/Chemical Composition**

- **Validation Data** for aerosol type are very **limited**

- **Model** simulations and **in situ** measurements can help

24 aerosol suborbital and satellite based **typing procedures** are at the time being included in REDAT.

Included algorithms

In the meantime the importance of including models has been recognized, so the database has been modified for accommodating the model needs.
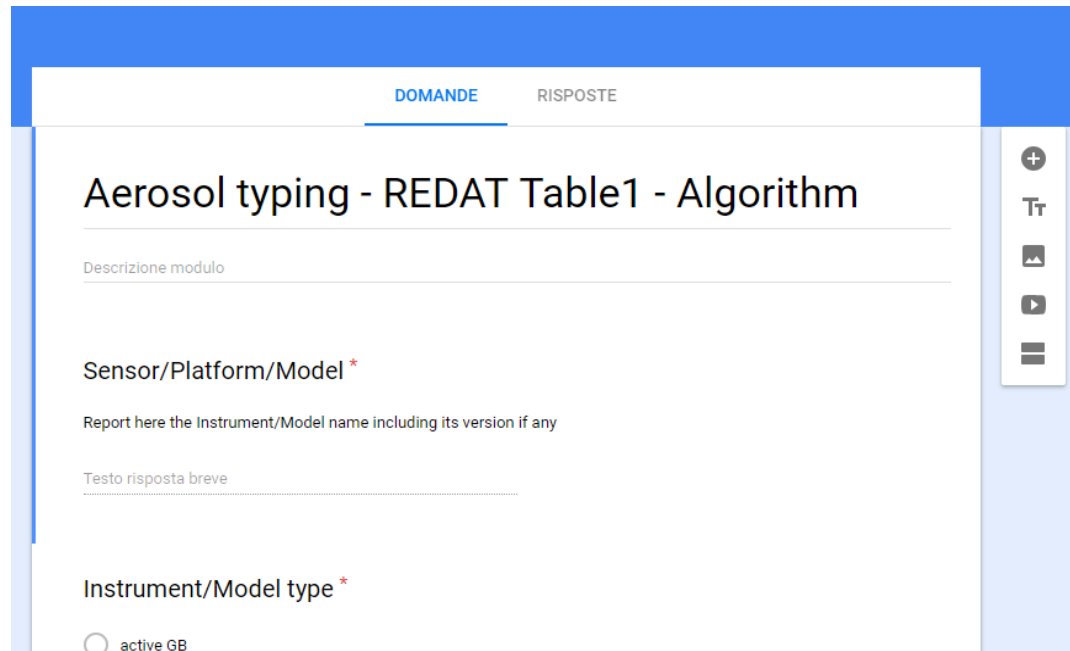
To be done:

Adding models typing + other algorithms

Google form module set up for this purpose

Definition of the properties for each class of each algorithm

❑ Aerosol class

❑ Characteristics of the class in term of each one of typing properties:

Mean , std, median, 10-90 percentile

or

Thresholds used in the typing decision tree

❑ For models, source info used and which one

Reference datasets used for the different algorithms can be stored here and these scene ingested in the other algorithms when possible for finding translating rules

❑ Location in space and time

❑ Observed typing properties for the different typing procedures

❑ Additional observed properties

This set could become a reference dataset for the whole community and will provide opportunities for:

-Comparing typing procedures

-Providing a reference dataset and a link between observational and modeling community

Comparison among typing procedure done for 2 methods applied within EARLINET.
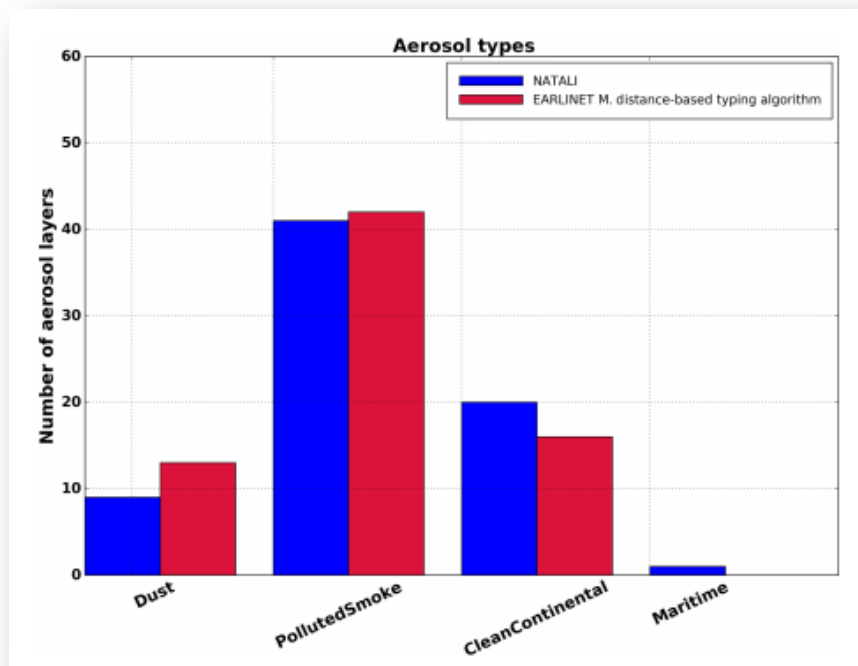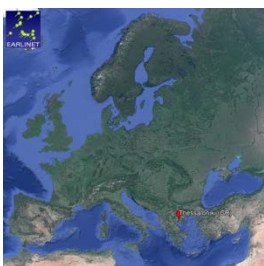
Neural network based NATALI

(support of the model)

EARLINET Mahanalobs distance methods

(Observation only)

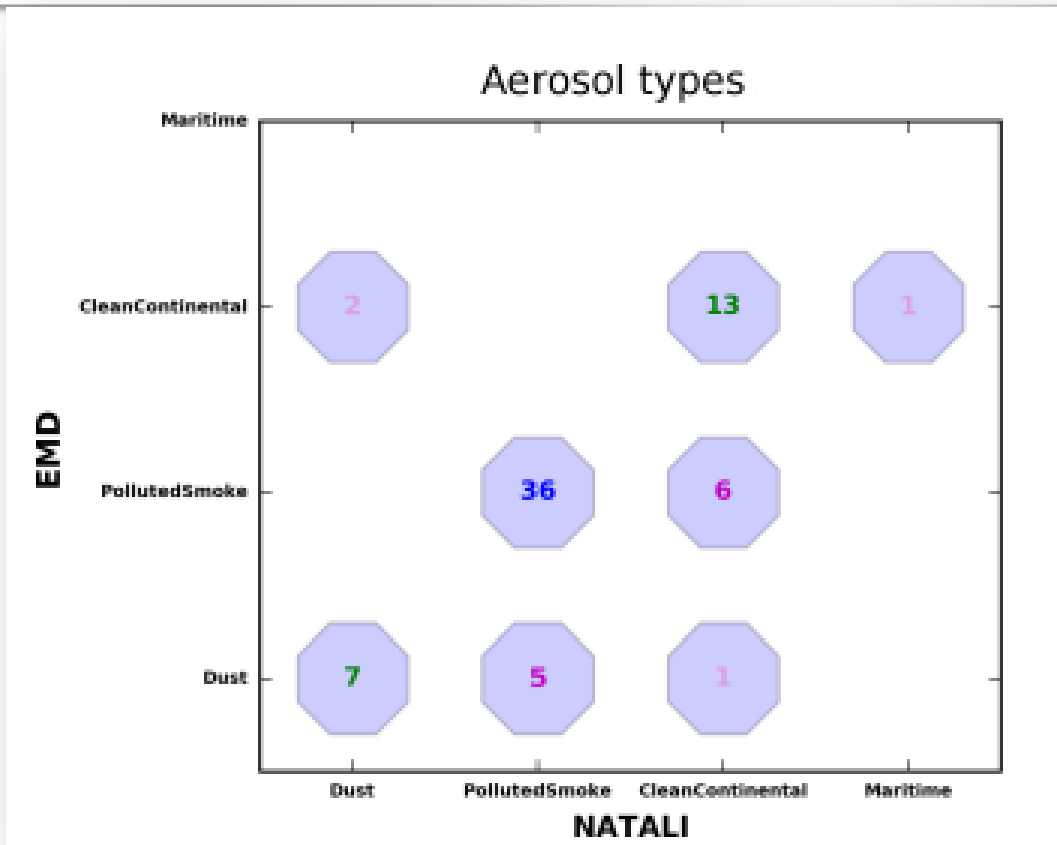Systematic comparison of the 2 EARLINET algorithms on
- 71 Raman lidar cases of aerosol measurements
- Thessaloniki
- period 2012-2017

Classes rearranged for doing the "comparison"

Vodouri et al., ACP 2019

Comparing Aerosol typing in EARLINET/ACTRIS

Aerosol types

**When compared on real observations**
(71cases)

Vodouri et al., ACP 2019

Results:

- Very good result on the most polluted classes

- A not satisfactory agreement is observed for the Maritime, which is the aerosol type less encountered over Thessaloniki. Dual interpretation is found for Maritime / Clear continental cases, this can be ascribed to the different aerosol type definition.

Comparing Aerosol typing in EARLINET/ACTRIS

Aerosol types
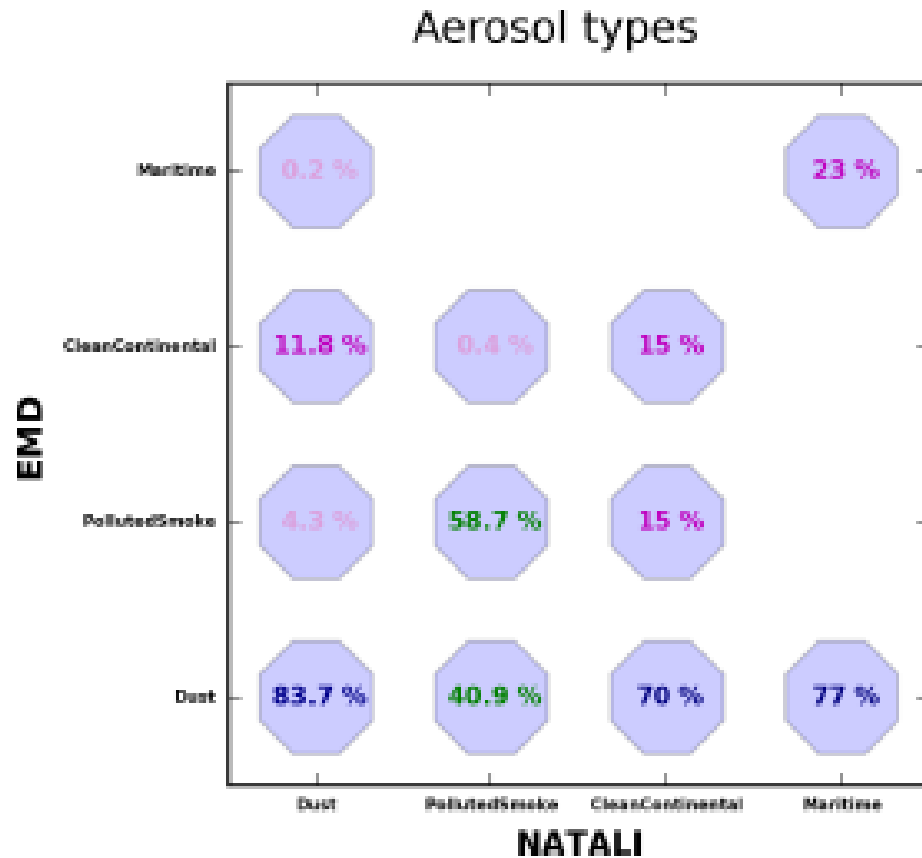
When compared on synthetic data

Vodouri et al., ACP 2019

Result

- Good agreement for Dust class

- Fair for Polluted Smoke: probably there is mixture/pollution for some dust cases not considered here

- A not satisfactory agreement is observed for the Maritime, and Clear continental cases, this can be ascribed to the low number of cases in the training dataset

Some lessons learnt

Comparing algorithm we could have to:

- Modifying classes group

- Performances for real data and synthetic data can give difference score

- Model importance underlined

- But real world could tell us something the models are not considering! Process studies needed here

Tools for fostering progresses

AEROSAT is an initiative based on voluntary participation

Collaborative efforts essential for speeding up the process

Committments and projects stop usually the progresses even if this is one of the most interesting issues
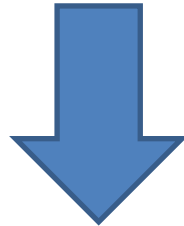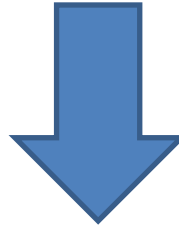
Aerosol typing mailing list set up
aerosol.typing @actris.imaa.cnr.it

Invitation sent to AEROSAT group
Please reply by 15 October so that we have a first rgoup of people on this

Tools for fostering progresses

On line tools for developing the concept

Google form for collecting info about Typing Algorithms

https://docs.google.com/forms/d/e/1FAIpQLScd683t6Lp0rxsom9CIacCkGXd4SWUrHzDSfjaTk0BNf9hUkA/viewform?c=0&w=1

Tool for seeing the current status of the info contained into the database under devlopement at CNR-IMAA

Tools for fostering progresses

Funding scheme for supporting the typing investigation

Shall we go for just one type of aerosol as first experiment?

Is EU framework the right one for acting in this sense?