Overview on Aerosol Typing

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Why this WG?

- The **inhomogeneity** among satellite aerosol **typing schemes decreases** fundamental long-term datasets (multi sensors) **consistency**

- Knowledge of the 4d distribution of the aerosol types at these scales is essential for understanding the **impact of the different aerosol sources on climate, precipitation and air quality**.

- This information is also needed to help plan the next-generation **aerosol emissions policies** at continental and global scales and **local authorities** for hazard (e.g aviation, health, sola plants).

Overview of typing procedures

- **21 aerosol typing procedures included in the review**

- **15 classify particles in source classes with an interpretative scheme**

- **6 stays with the optical observables**

Step 1 - Results

- 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

Nomenclature issue

The nomenclature is very heterogeneous among different platforms.
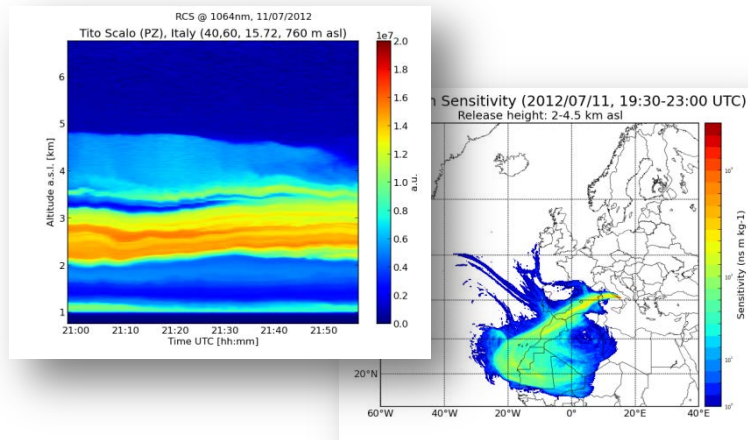
Nomenclature issue

The nomenclature is very heterogeneous among different platforms.

6 main classes could be identified grouping the different nomenclatures.
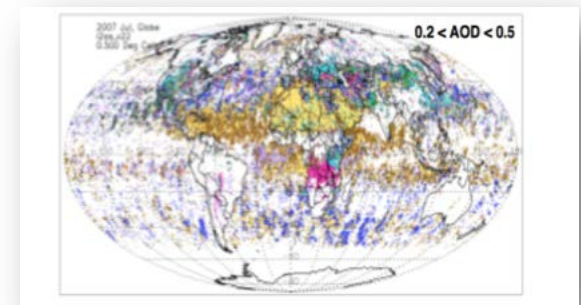
Optical classification scheme

- **GB observation + info for source determination allows for clustering observed optical properties respect to the source**

- **Unique "assured" information are ones related to optical measured properties**
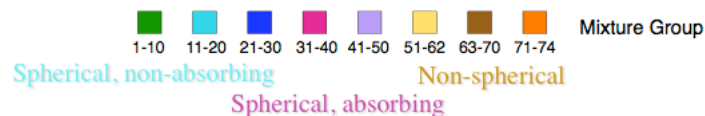
- **Satellite retrievals often rely on inferred types**

Which were the plans?

- Reference database for aerosol typing **(REDAT)**

- **The idea**: collecting a set of measurements from each sensor for each aerosol type.

- **A set of pure aerosol components + their mixtures**

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

REDAT

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

- **Comparing typing procedures**

       (for this we should probably try to start from ground-based measurements, which are limited datasets, and check for satellite matches)

-Providing a reference dataset and a **link with the modeling community**

       (also models typing and outputs could be relevant for this kind of database)

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
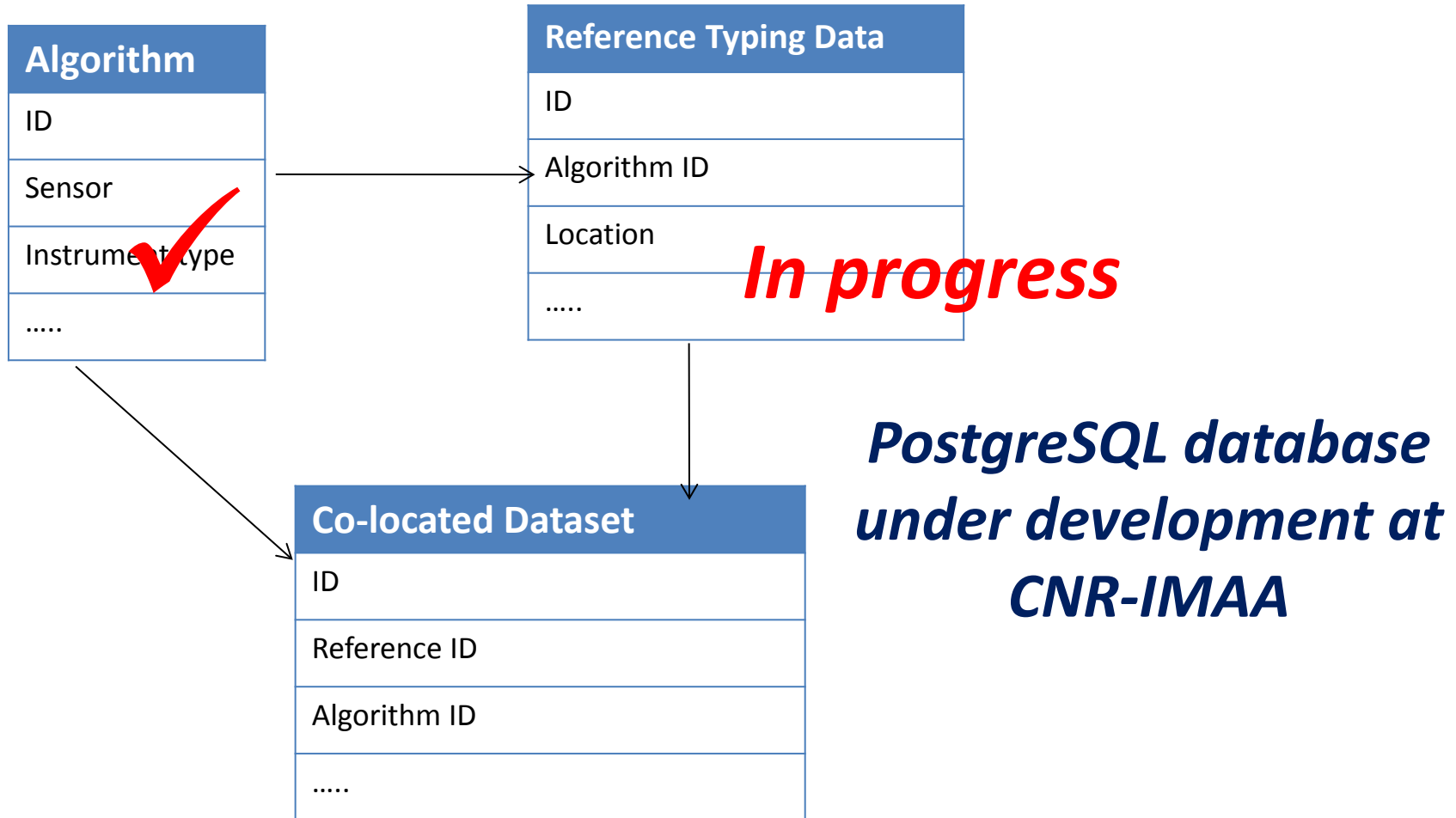
Design

- Indentified **needs**:

❑Hierarchical structure

❑Flexibility for accommodating substantially different data

❑Pointing to the specific typing algorithm and procedures

REDAT

Status at 2016

Algorithm

ID
Sensor
Instrument type
.....

Reference Typing Data

ID
Algorithm ID
Location
.....

In progress

Co-located Dataset

ID
Reference ID
Algorithm ID
.....

PostgreSQL database under development at CNR-IMAA

Using published and full characterized data

1. **CALIPSO- EARLINET dataset**

2. **Eyja volcanic eruption EARLINET dataset**

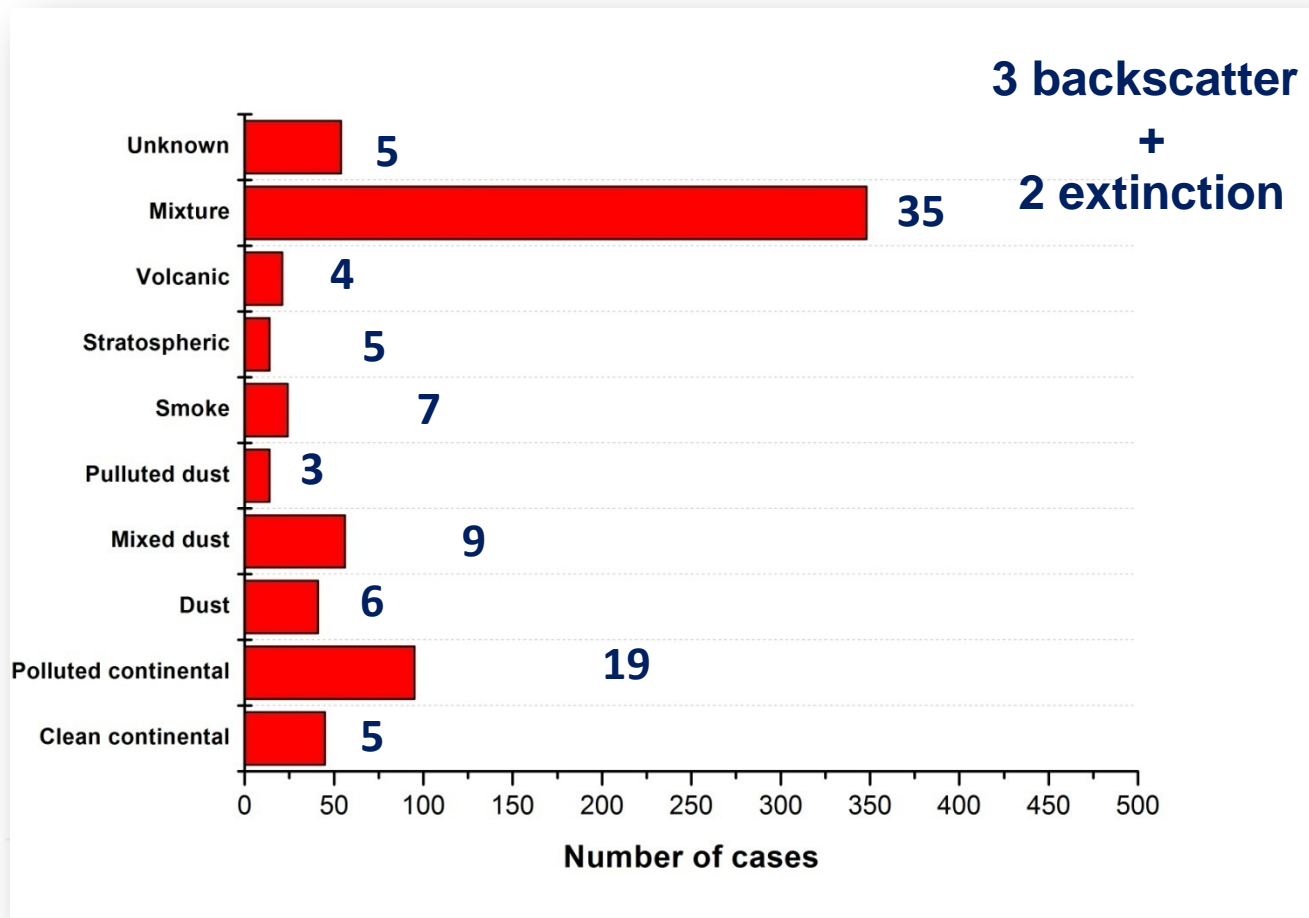3. **ACTRIS summer 2012 campaign**
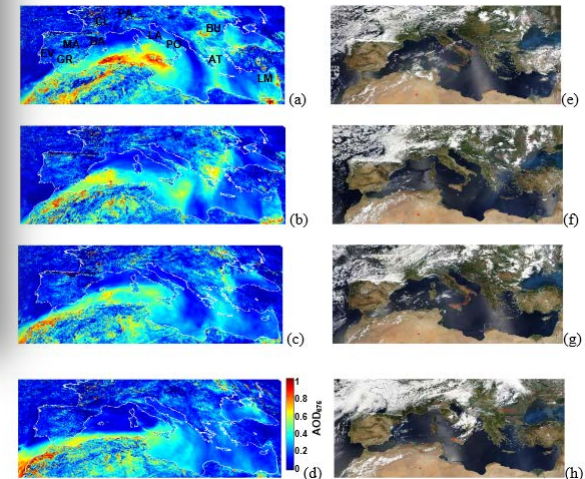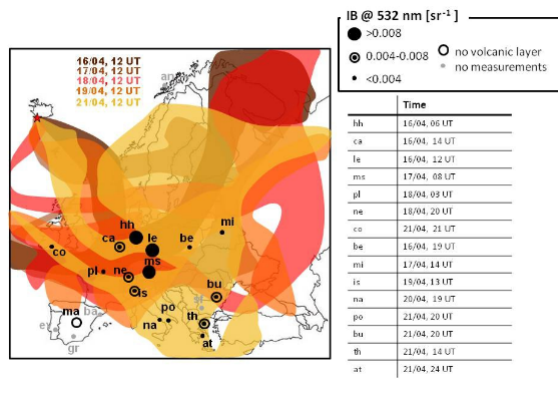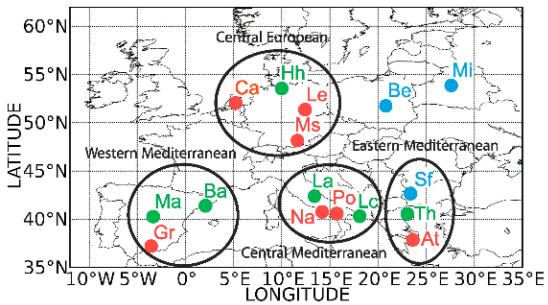
1. Pappalardo et al., JGR 2010

2. Pappalardo et al., ACP 2013
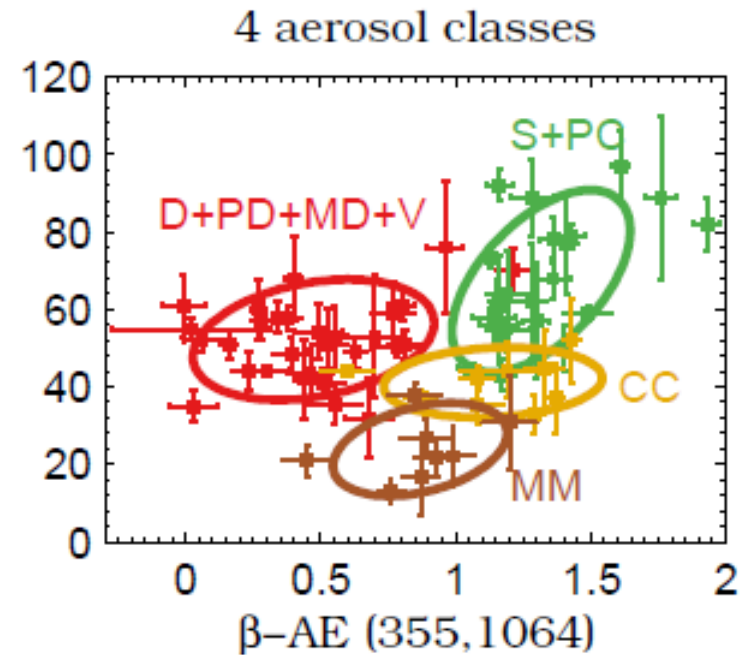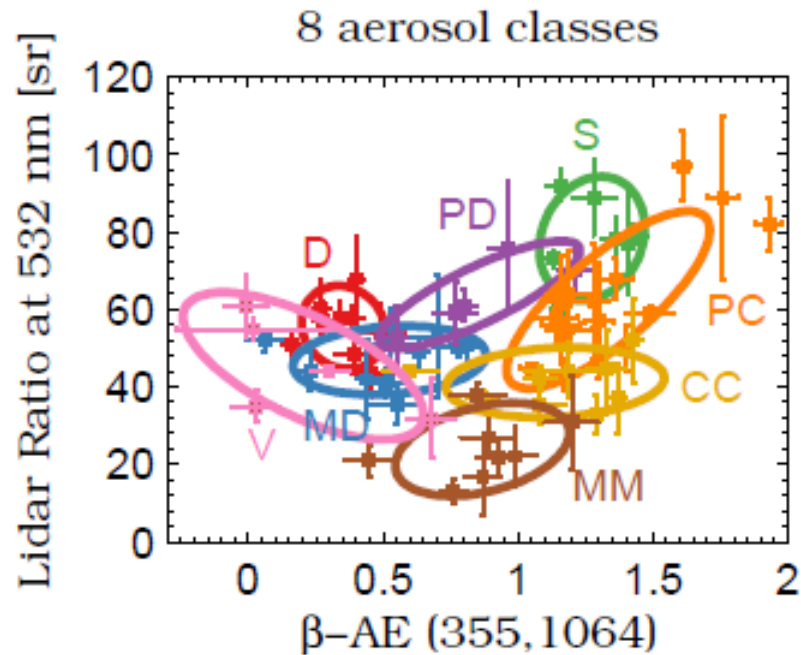
3. Sicard et al., AMT 2015

Total number of cases: **712**

Type of aerosols

3 backscatter + 2 extinction

Type	Number of cases
Unknown	5
Mixture	35
Volcanic	4
Stratospheric	5
Smoke	7
Pulluted dust	3
Mixed dust	9
Dust	6
Polluted continental	19
Clean continental	5

Number of cases

Papagiannopoulus et al., in preparation, ACP 2017

Aerosol typing within EARLINET/ACTRIS

A lidar stand-alone procedure has been realized in harmonization efforts with aerosol typing from HSRL lidar in US.

Method:
a distance-based multivariate analysis depending only on lidar intensive properties [Burton et al., 2012].

The method is set up using a training dataset and then results of the method are compared vs manual typing of the data (backtrajectories analysis + model inputs + satellite images).

Aerosol typing within EARLINET/ACTRIS

Backscatter Angstrom 355/1064 nm + Lidar Ratio at 355nm
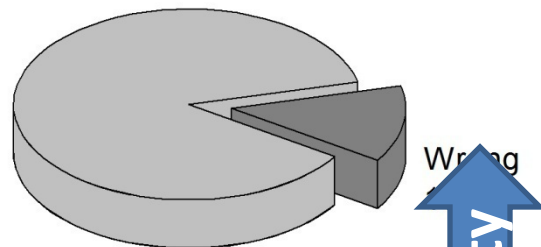## + Ratio of lidar ratio 355/532 nm

4 clusters

Clean continental   Mixed marine   Absorbing particles   Dust & dusty mixture
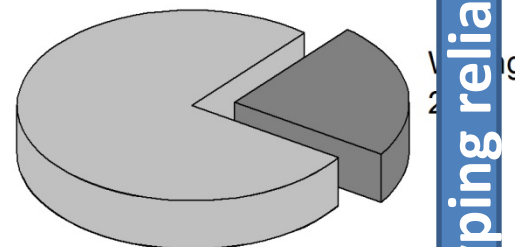
Good 87%
Wrong

6 clusters

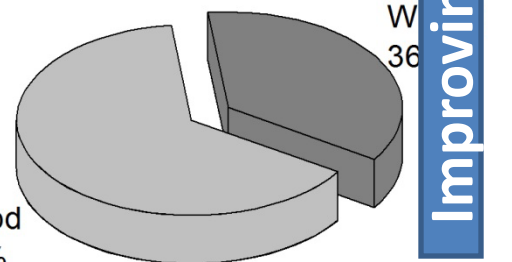Clean continental   Mixed marine   Absorbing particles   Dust Polluted dust Mixed dust

Good 77%
Wrong

7 clusters

Clean continental   Mixed marine   Polluted continental Smoke   Dust Polluted dust Mixed dust
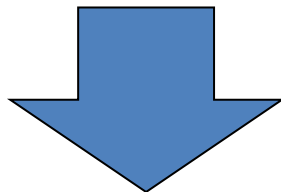
Good 64%
Wrong

Improving insight

Improving typing reliability

Different procedures within EARLINET ACTRIS:

This stand-alone method

Neural network based on observations trained on real data and modelled data

Cluster identification based on obs +models

Comparisons for improving reliability knowledge

Aerosol typing in EARLINET/ACTRIS

Next steps:

- **ACTRIS aerosol remote sensing data will be automatically processed through GARRLIC (a GRASP component)**

- **A further link/ contact point between pure observations and modeling component**

Discussion AEROSAT 2016

- **REDAT has the potentiality for addressing our Open Questions on aerosol type.**

- **Difficulties to work on this - voluntary basis**

- **CNR volunteered for working on EARLINET data for Table 2**

- **Suggestions to stay only at the inventory step**

Future plans - 2018

1. **Drafting a BAMS like paper about the issue of aerosol typing (focus on inventory + nomenclature)**

   (Michael suggestion)

2. **Made inventory available (first to AEROSAT members for review and then externally – hosted by CNR)**

3. **Working on first exercise for comparison/translating rules**

NEED: set up a core group.

- **Lucia and Ralph , Thomas, Kostas who else?**

1. **+ Michael?**

2. **+ contact person for each typing procedure**

3. **+ US component for GB (HSRL)+ in situ people (AERONET + ACTRIS/EMEP/GAW) + satellite (CALIPSO MISR POLDER MODIS)**