



Consiglio Nazionale delle Ricerche



# **EARLINET status, short term plans and long term vision as a component of ACTRIS**

## **Research Infrastructure**

**Lucia Mona<sup>1</sup>, G. D'Amico<sup>1</sup>, D. Nicolae<sup>2</sup>, U. Wandinger<sup>2</sup>, P. Laj<sup>4</sup>,  
and G. Pappalardo<sup>1</sup>,  
and many others**

<sup>1</sup>CNR-IMAA Potenza, Italy <sup>2</sup>INOE, Bucharest, Romania

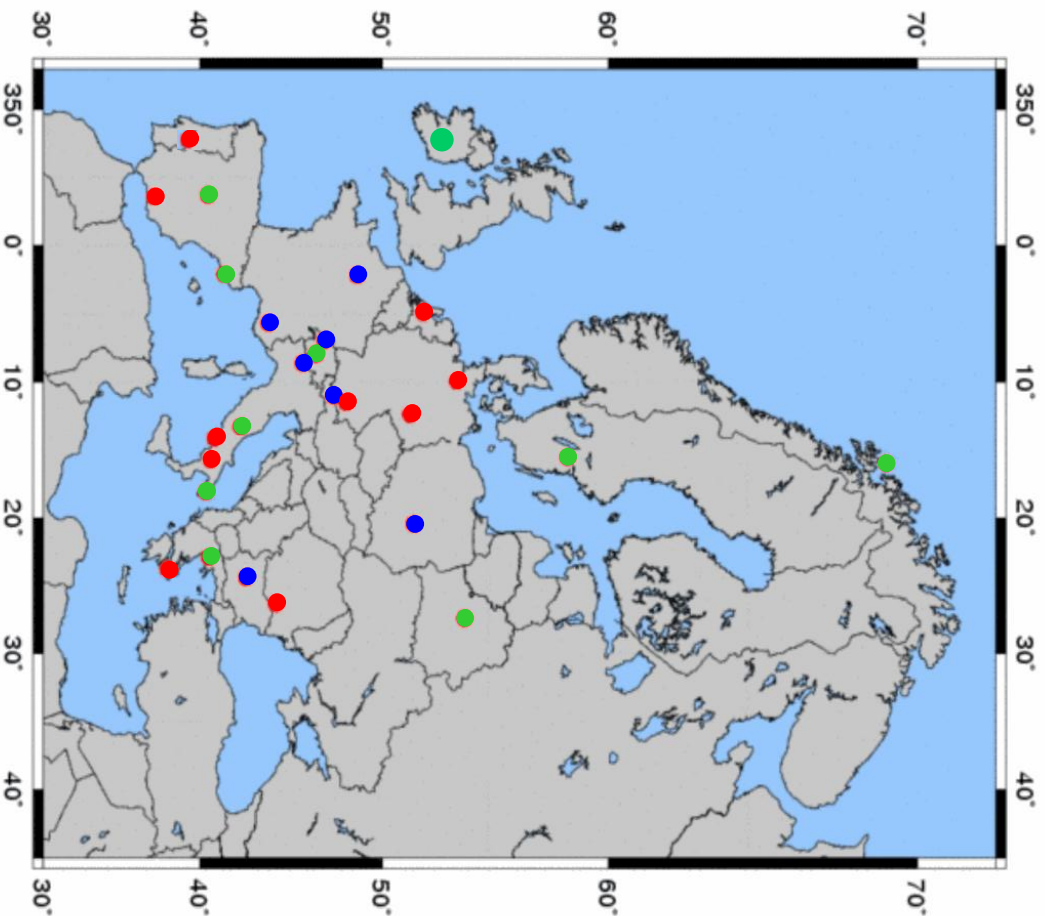
<sup>3</sup>TROPOS, Leipzig, Germany <sup>4</sup>CNRS, Grenoble, France,



# Outline



- **What EARLINET is**
- **EARLINET evolution history**
- **EARLINET in ACTRIS**
- **Actual EARLINET status**
- **EARLINET database vision**
- **New products design**
- **EARLINET in ACTRIS RI**
- **Conclusions**



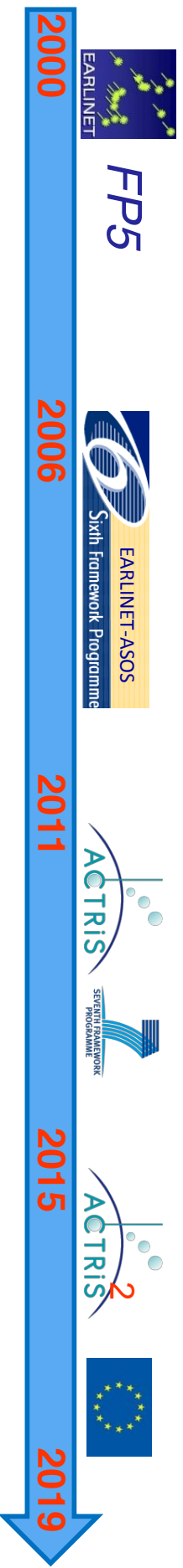
[www.earlinet.org](http://www.earlinet.org)

- since 2000
- 27 lidar stations
  - 10 multiwavelength Raman lidar stations
  - 10 Raman lidar stations
  - 7 single backscatter lidar stations
- comprehensive, quantitative, and statistically significant data base
- Continental and long-term scale

Pappalardo et al., AMT 2014



# EARLINET funding history



- EU funded EARLINET since the beginning in 2000
- no funds in 2003-2006 → voluntary basis
- no funds for performing measurements but for:
  - Improving network procedures
  - Harmonizing data flow
  - Finding new instrumental solutions
  - Sharing expertise within the network



# EARLINET



**Different  
set-up and  
procedures**

## EARLINET

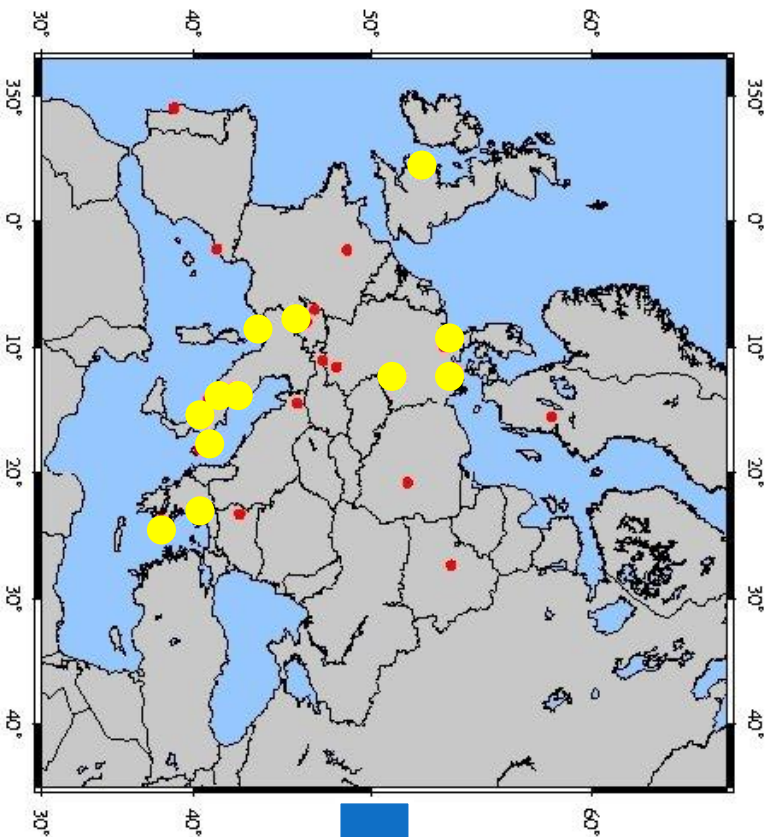
- ✓ **Quality assurance**
- ✓ **Optimization of the instruments**
- ✓ **Optimization of the data processing**
- ✓ **Centralized measurements scheduling**

**Harmonized  
network and  
standardized  
measurements**

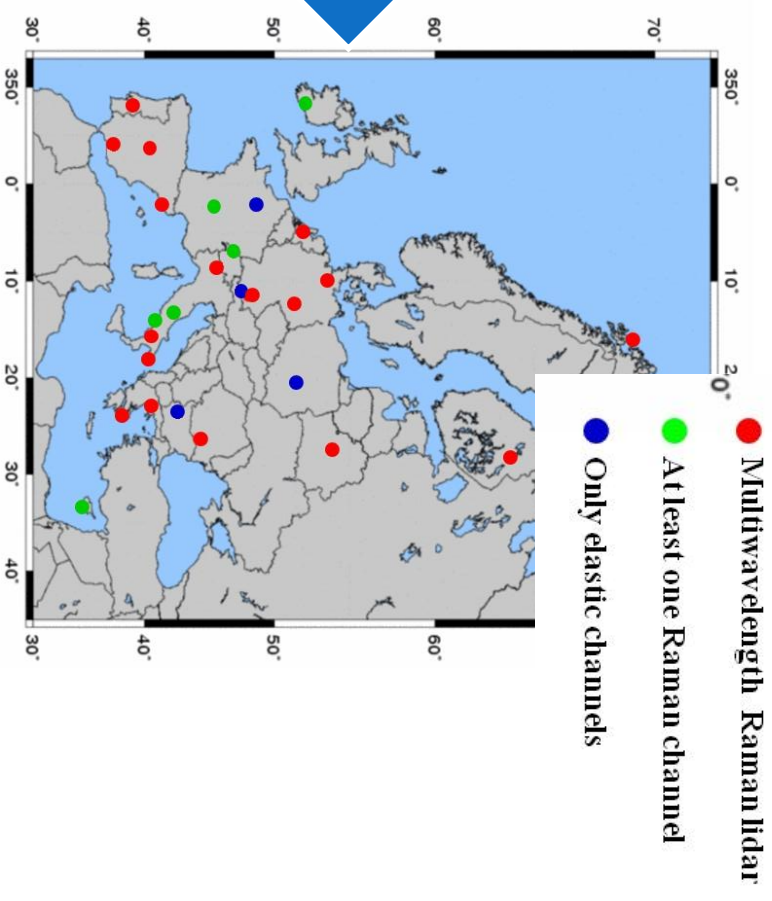




# Raman stations



# 12  
May 2000

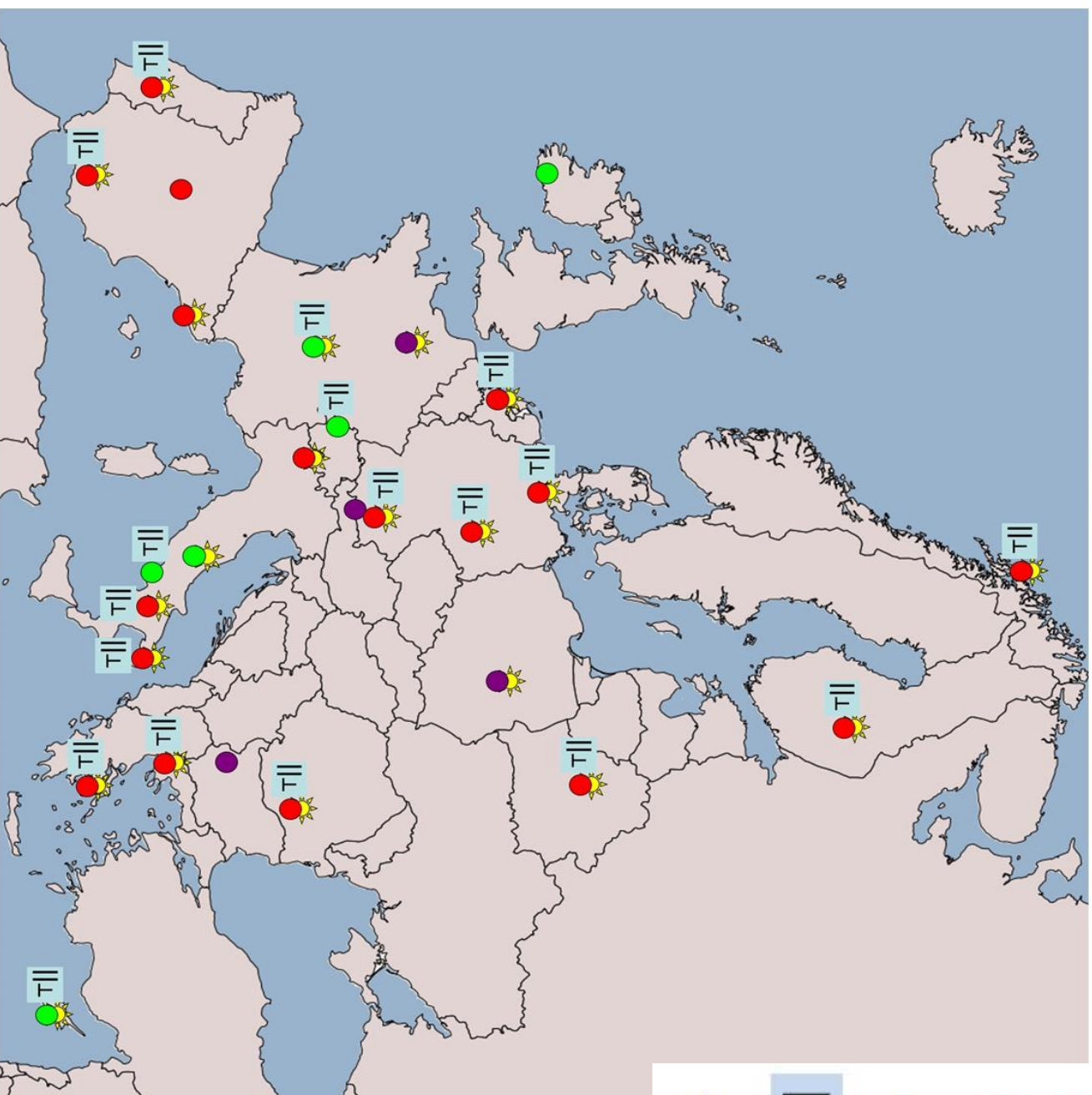


# 23  
Mar2015

Observing capabilities improved thanks to discussion on experimental setup and proposed solutions



# Depolarization



● Multiwavelength Raman lidar

● At least one Raman channel

● Only elastic channels

☐ ⊥ Depolarization measurements

☀ Sunphotometer (AERONET)

**27 stations**

**17 multi-wavelength  
Raman**

**18 with depolarization  
capability (typ 532nm)**

**22 co-located  
sunphotometer**





# Harmonization of the network



Measurements of trigger delay and distortion by pulse generator

*Electronic disturbances*

Rayleigh fit

*Far range alignment*

Dark measurements

*background*

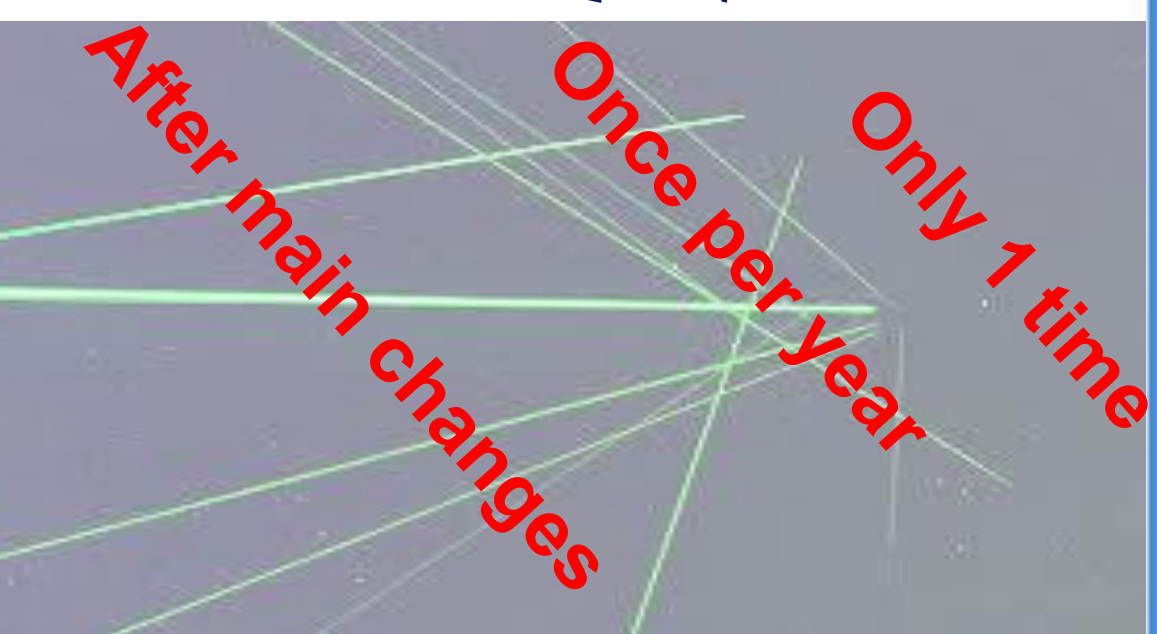
Telecover test

*Near range alignment + overlap*

Direct comparison vs EARLINET reference systems

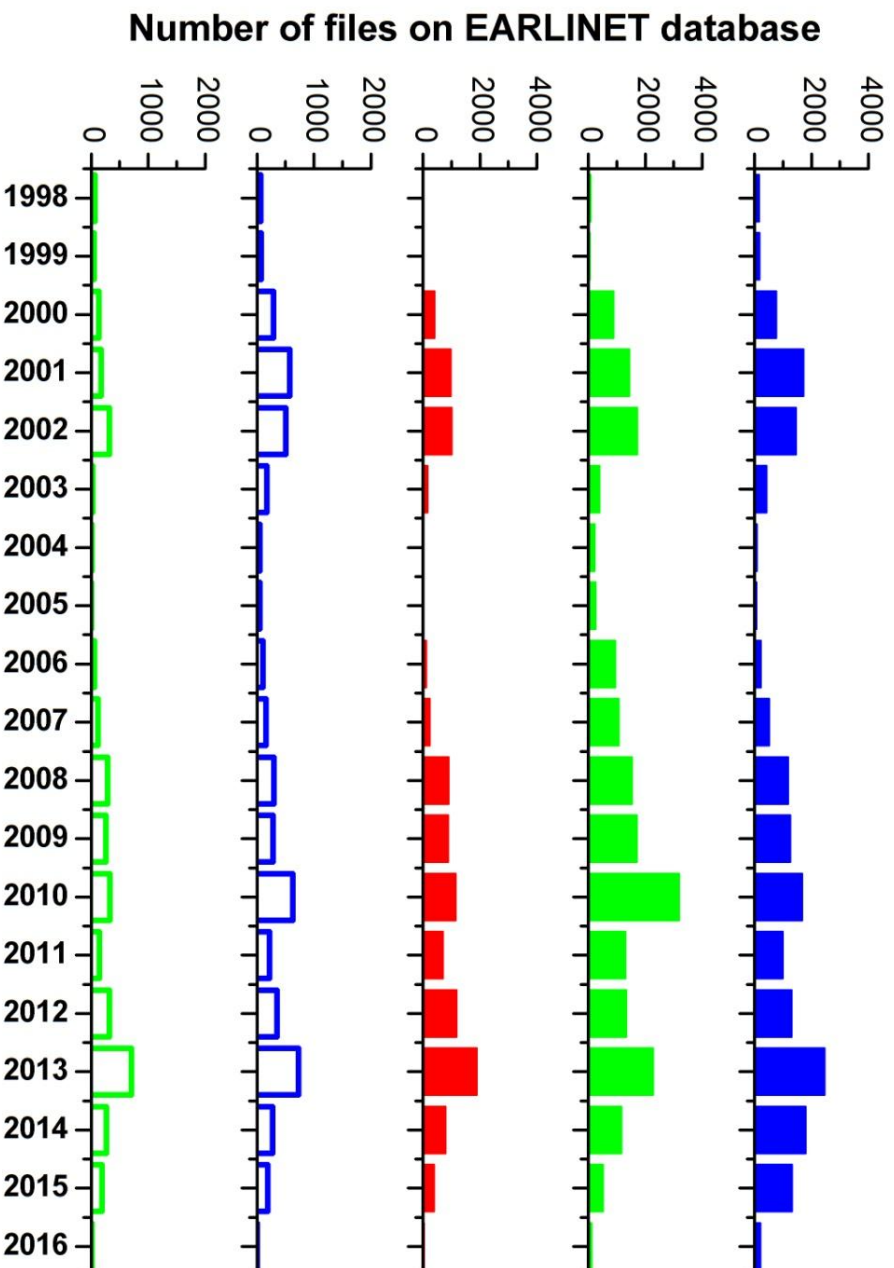
*Overall performances*

+ Development of new checks/protocol (e.g. for new products depolarization)





## Data on the database



The numbers  
of the files  
increase for:

**6532**

**61064**

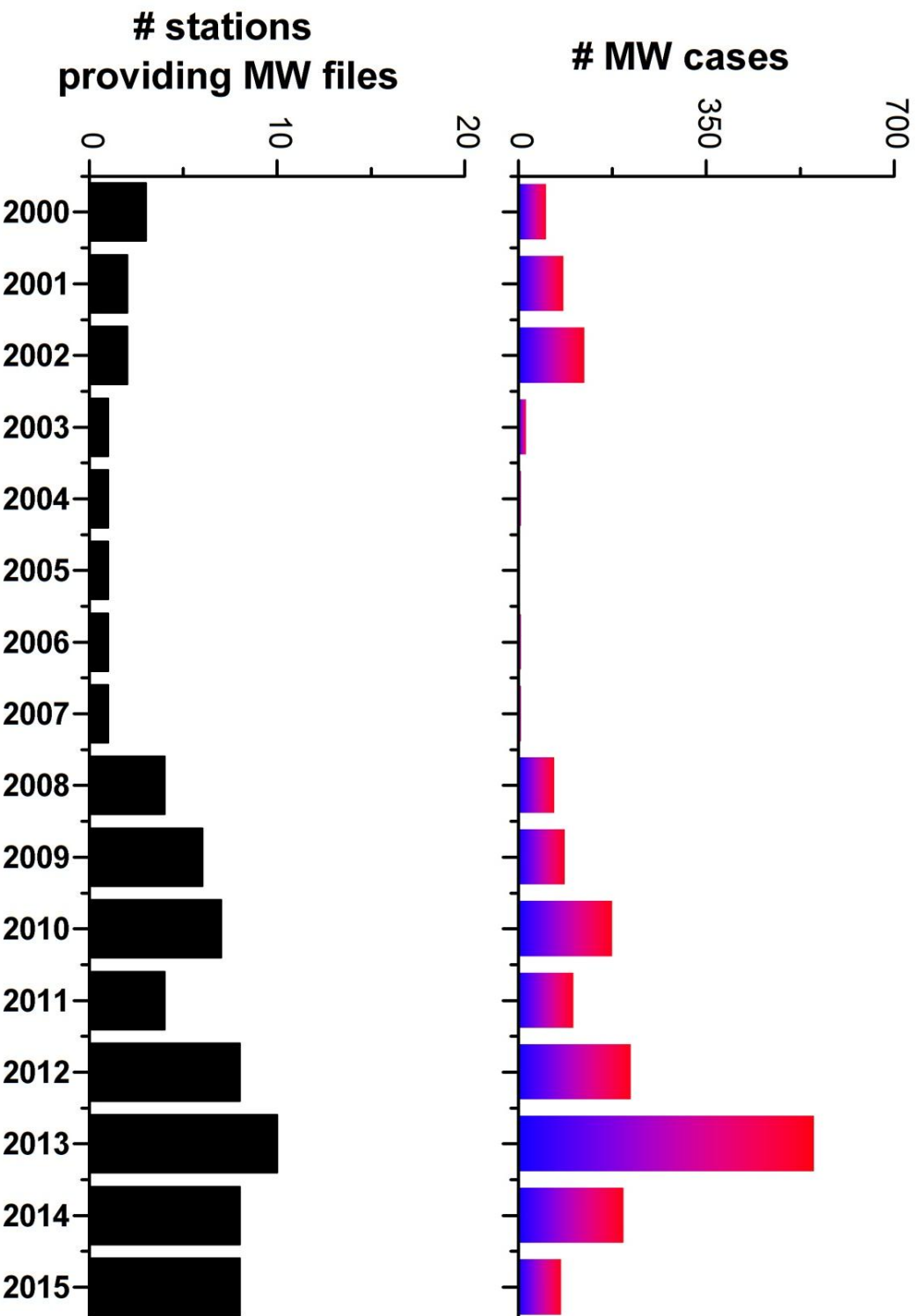
**6532**



## Data on the database



# Multiwavelength capability

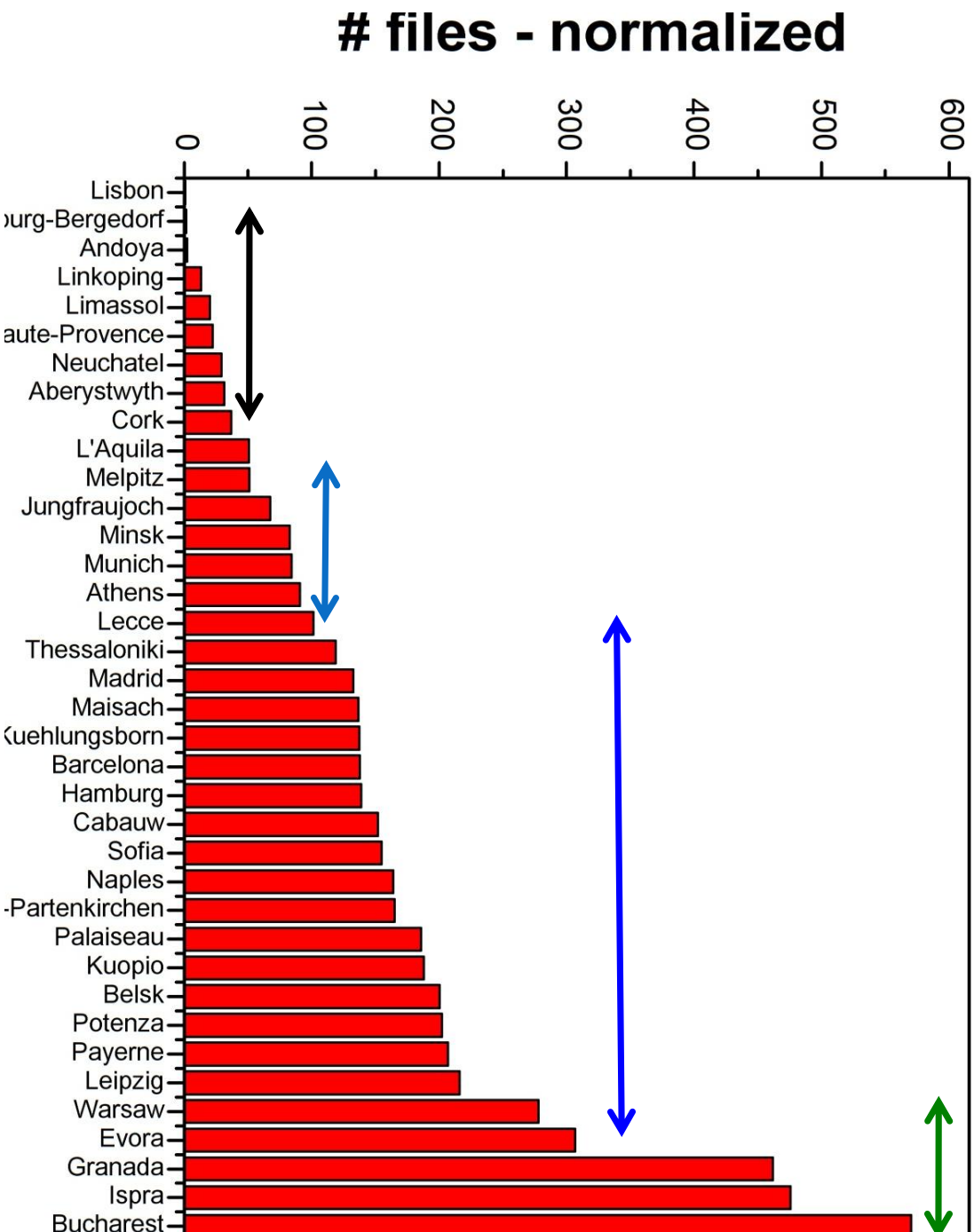


**MW files  
significantly  
increases with  
the years.**

**This  
corresponds to  
larger number  
of stations  
providing these  
datasets.**



# Data on the database



Normalizing the # files to the 15 years of network operation we see 4 classes:

No active stations (old +new) (<50)

50-100 files/y (less available wavelength)

Majority of the stations in the 100-400 range (median around 150)

Automatic processing (>400)



# EARLINET in ACTRIS

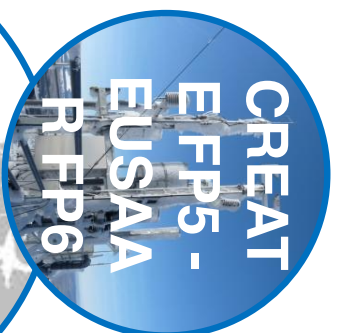


Harmonized  
measurements  
of physical, chemical and  
optical aerosol properties

**Climate Change**

Observation of  
vertical profiles  
of important cloud  
parameters

**Radiative Forcing**



**Long-range transport**



**Air Quality & Health**



Measurement of  
atmospheric precursor  
compounds

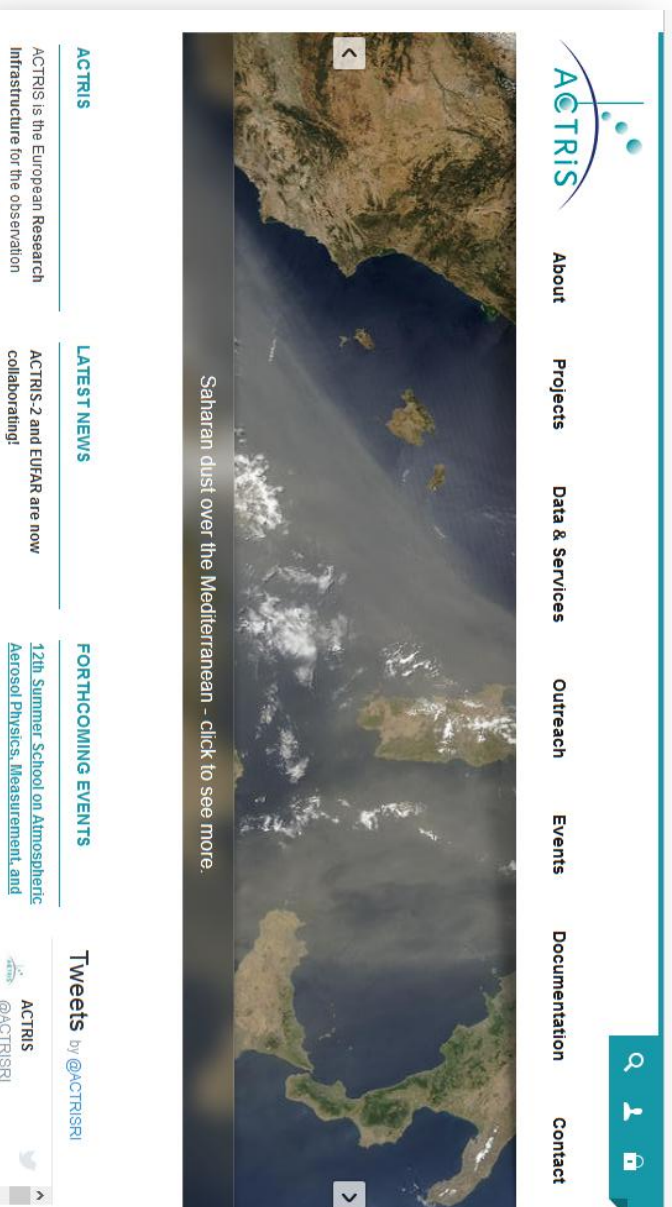


# EARLINET in ACTRIS



## Aerosols, Clouds, and Trace Gases Research Infrastructures Network

ACTRIS is composed of **observing stations**, **exploratory platforms**, **instruments calibration centres**, and a **data centre**. ACTRIS serves a vast community working on models and forecast systems by offering high quality data for atmospheric gases, clouds, and trace gases.



[www.actris.eu](http://www.actris.eu)



## EARLINET in ACTRIS



**ACTRIS is a network of networks / Federation of existing networks**

**Each network operates with a rigorous QA program for both instrument and data processing**

**Observation strategy**

**Standardization of data and metadata**

**Integration is the added value**

- **at instrument level: exploiting the synergies among different sensors and providing integrated advanced products**
- **at data base level: providing open access to a central data portal**



# ACTRIS2



**HORIZON 2020**

**WORK PROGRAMME 2014 – 2015**

*4. European research infrastructures (including e-Infrastructures)*

**INFRAIA-1-2014/2015: Integrating and opening existing national and regional research infrastructures of European interest**

|             |   |              |  |               |   |
|-------------|---|--------------|--|---------------|---|
| WP1/<br>NA1 | Management of the project, including management of TNA        | WP6/<br>TNA1 | Lidar Calibration Centre (LiCal)               | WP11/<br>JRA1 | Improving the accuracy of aerosol light absorption determinations |
| WP2/<br>NA2 | Profiling of aerosols and clouds                              | WP7/<br>TNA2 | AERONET-Europe Calibration Centre              | WP12/<br>JRA2 | The surface exchange and vertical transport of aerosols           |
| WP3/<br>NA3 | Near-surface measurements of aerosols, clouds and trace gases | WP8/<br>TNA3 | European Centre for Aerosol Calibration (ECAC) | WP13/<br>JRA2 | Model evaluation, assimilation and trend studies                  |
| WP4/<br>NA4 | ACTRIS Innovation Platform                                    | WP9/<br>TNA4 | Physical access to advanced ACTRIS stations    |               |   |
| WP5/<br>NA5 | ACTRIS-2 training, outreach and sustainability actions        | WP10/<br>VA1 | ACTRIS Data Centre                             |               |   |

- Starting from ACTRIS
- Consolidation and better integration (NAs)
- Innovation
- Sustainability
- More access (Calibration centers, TNAs, Data Center)
- JRAs to improve the RI

**4 years project (2015-2029)**

**31 partners / 20 Countries**

**EC budget about 10 M Euros**





## EARLINET in ACTRIS2



### **Optimization of aerosol profiling**

Innovative and sustainable advancement of aerosol lidar observations within EARLINET

- **Implementation of new data products and optimization of the processing chain**
  - a) Development of homogeneous open and freely accessible quicklook database**
  - b) Improvement of Level 2 data**
  - c) Implementation of new advanced Level3 data products**



### **Optimization of aerosol profiling**

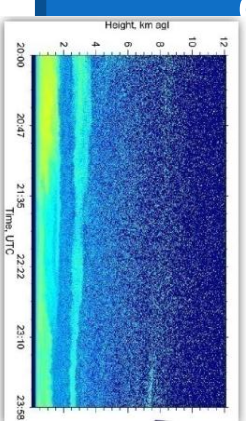
- **Improvement of instrumentation, standardization and quality assessment**
  - a) Implementation of new measurements capabilities**
    - Polarization capability at 2 or more wavelenghts**
    - Raman daytime capabilities**
  - b) Optimization of instruments for long-lasting operation**
  - c) Protocols and quality check procedures**
- **Implementation of new data products and optimization of the processing chain**



## EARLINET products



**Quicklooks** available at <http://www.meteo.physik.uni-muenchen.de/~stlidar/quicklooks/European-quicklooks.html>



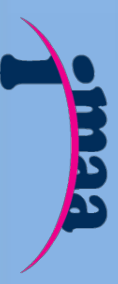
**e & b files** available at earlinet.org (and through ACTRIS data portal) and organized into categories

**Secondary products** as Eyja relational database available on request at earlinet.org

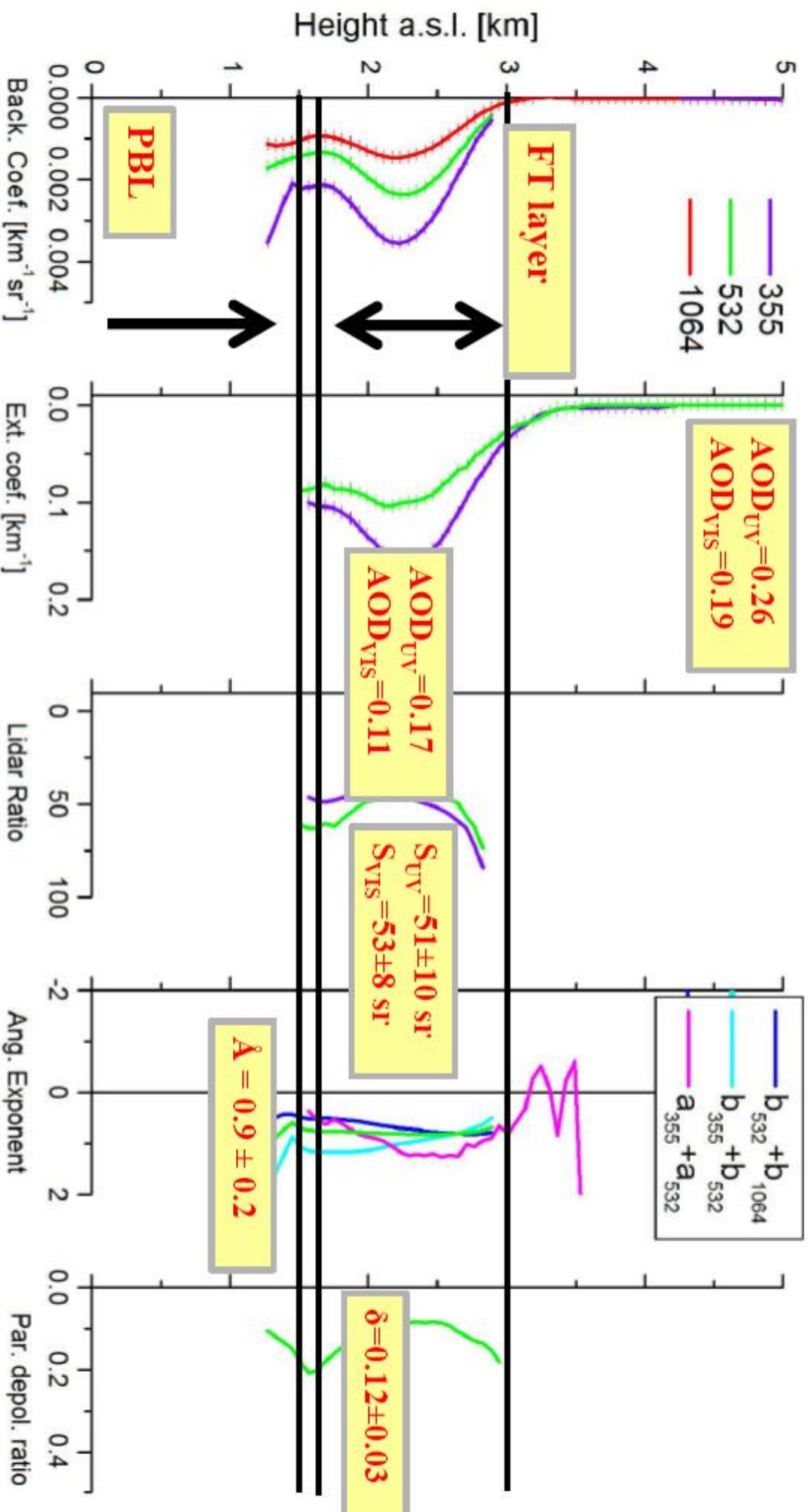
**Situation before ACTRIS2**



# EARLINET products



Potenza, Italy, (40.60°N, 15.73°E), 05 July 2012, 19:43- 21:31 UTC





## New EARLINET database design



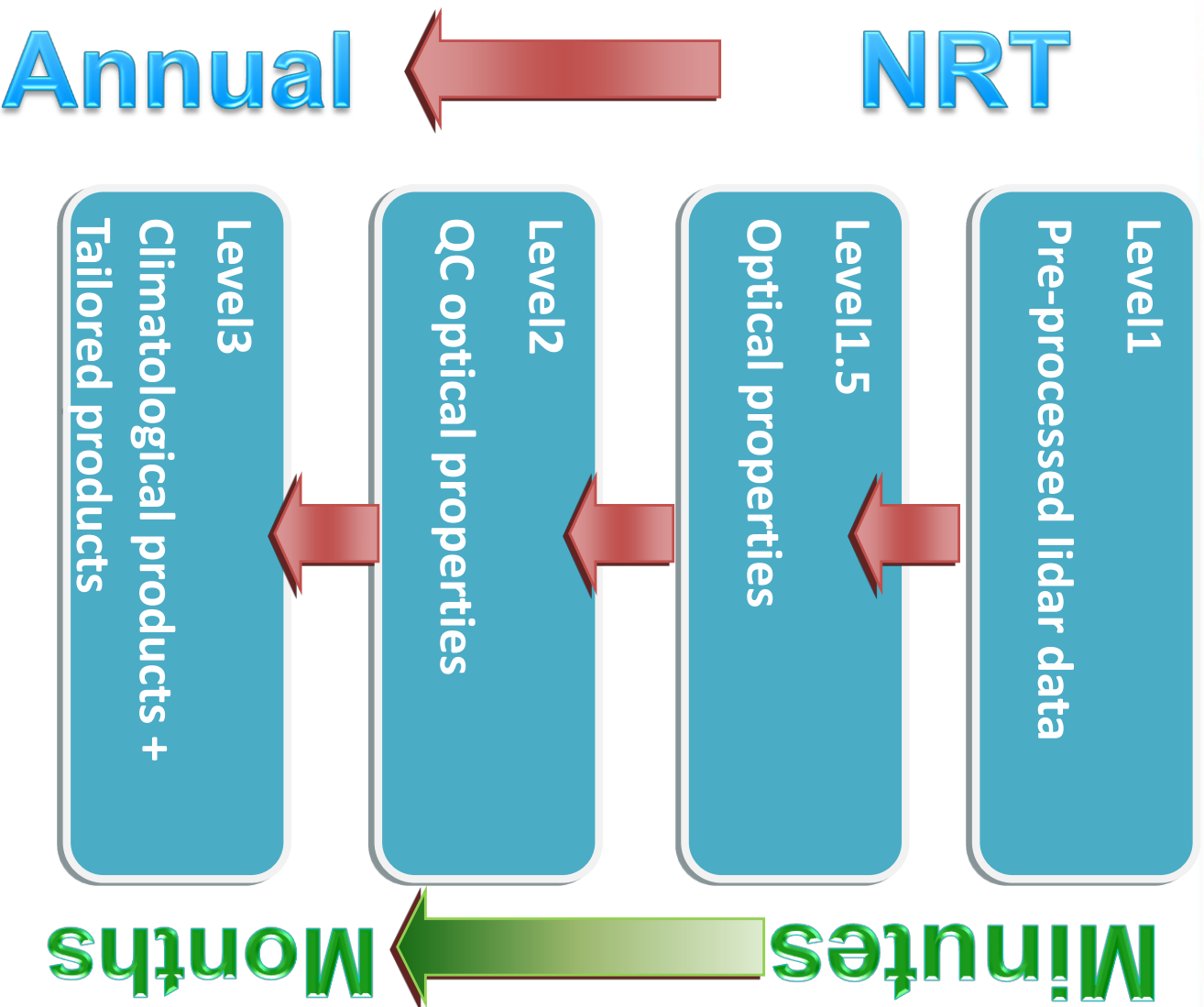
**Level structure going from low level and fast delivered data towards more advanced and correspondingly later released data.**

*As for CALIPSO, data are organized in levels corresponding to different steps in the data analysis procedure.*

*As for the AERONET database, the number of quality check procedures increases with the level of the data.*



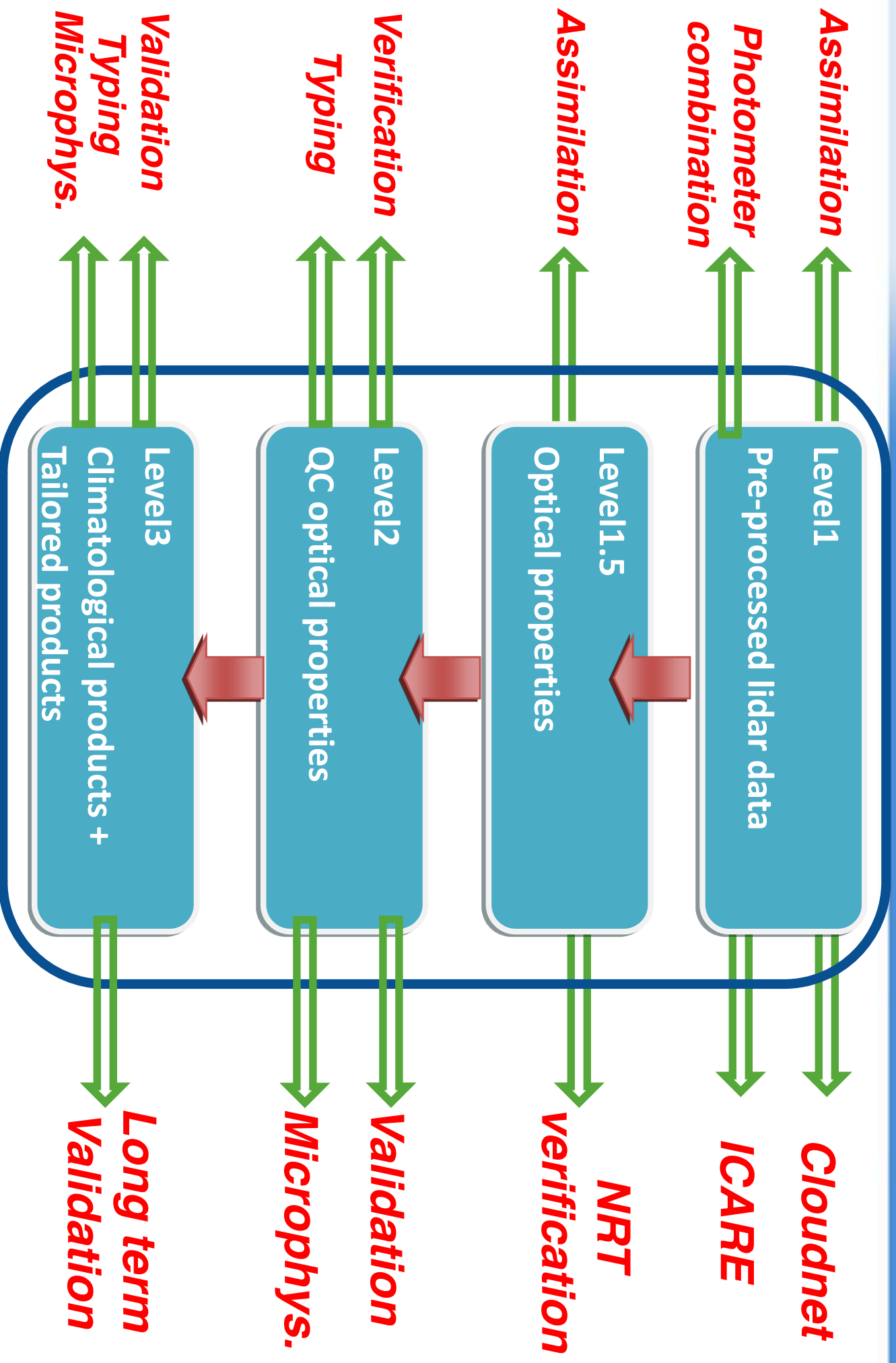
# Time delivery



# Resolution



# New EARLINET database design





# QC procedures



**QC based on previous experience on visual inspection of the data for the first volume of published data (more than 36000 profiles)**

**Check up list of common problems to be converted in automatic procedure feedback procedure with Pis**

**Two main categories:**

- **technical checks**
- **scientific content checks**





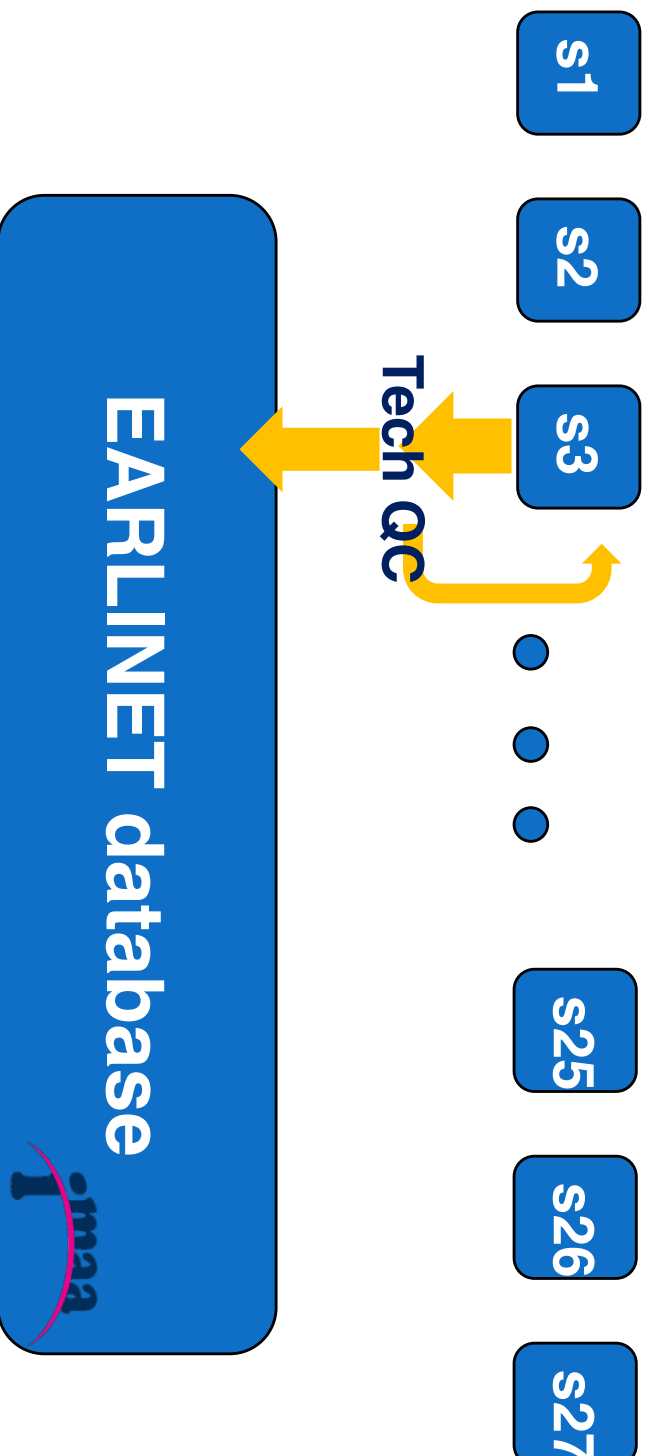
# QC procedures



**Technical checks** are procedures for the control of the file content respect to the file structure as defined in the EARLINET database.

This set of checks have been already designed, developed and tested.

The procedure will be implemented and will work on fly during the data submission phase (Nov 2016).





# QC procedures



**Content checks** at both single file and multi file level in terms of:

- Optical properties
- Intensive properties
- Comments
- Additional info provided
- Consistency among different optical properties profiles
- Temporal consistency

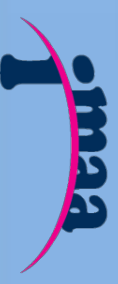
**Implementation phase**

**QC procedures already designed, but still to be tested.**

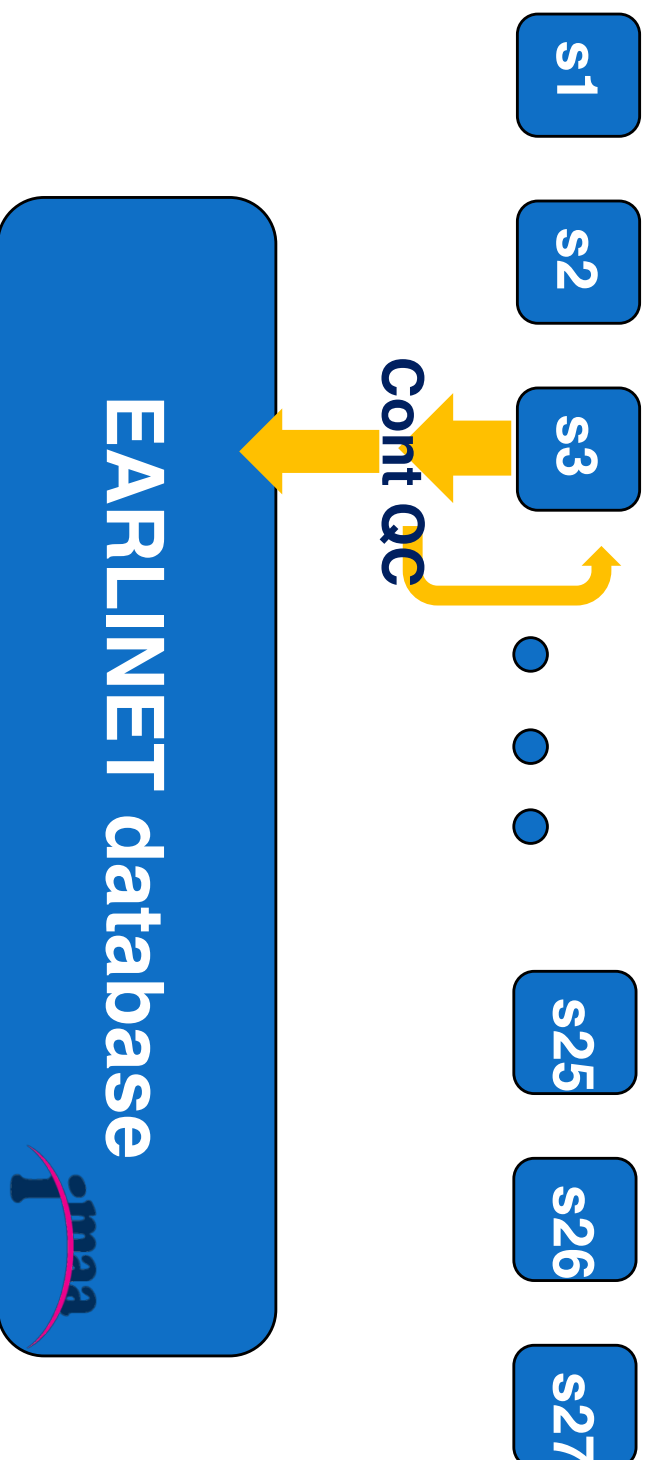
**First Release of QC dataset expected by Sept 2016.**



# QC procedures



Also for **Content checks** a feedback mechanism to the station is planned.



**QC release expected once per year.**



# Data Format



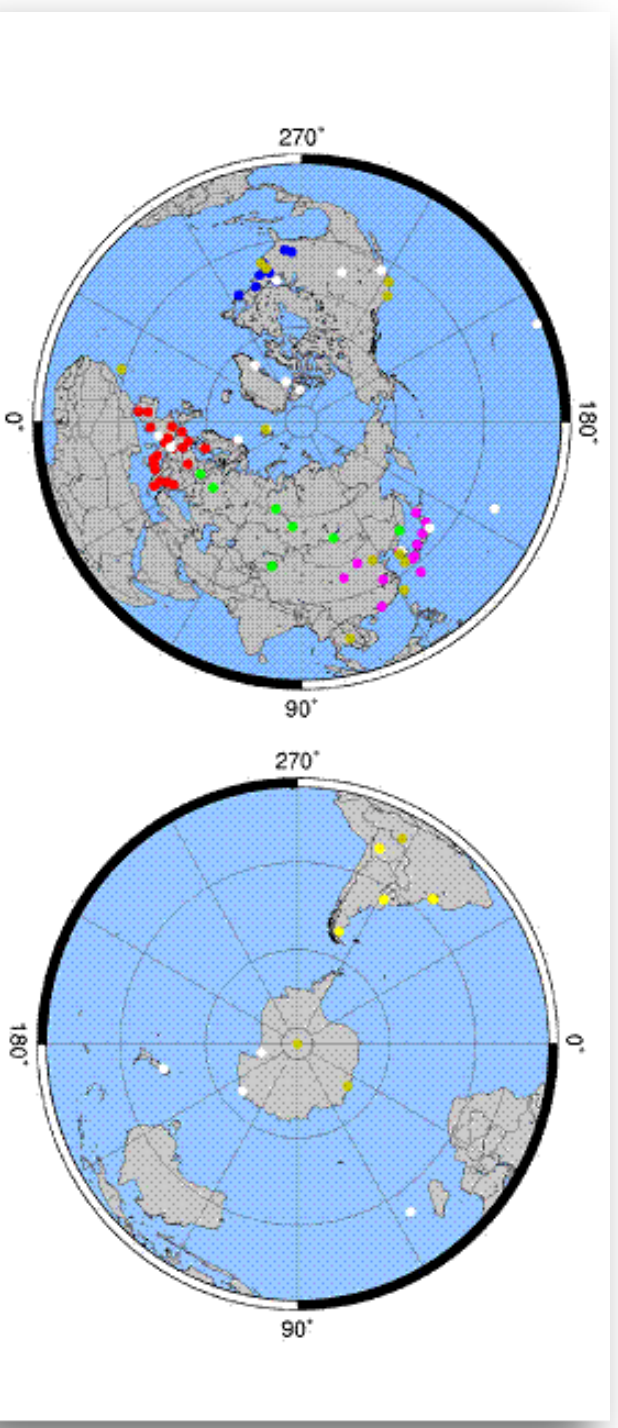
netCDF 3 data

CF compliant (as much as possible)

Request of new standard names for CF standards

*Implementation of THREDDS Data Server (TDS) protocol (web server that provides metadata and data access for scientific datasets)*

Link to other  
**GALION**  
components





# Publication with doi



<http://cera-www.dkrz.de/WDCC/ui/>

The screenshot shows a web browser window with the URL <http://cera-www.dkrz.de/WDCC/ui/SearchBy/Name.jsp?query=earlinet>. The page header includes the DKRZ logo (Deutsches Klimarechenzentrum) and the World Data Center for Climate in Hamburg. Below the header, it states "Found 13 entries matching 'earlinet%'" and lists three search results:

| Acronym / Name  |
|---|
| <input type="checkbox"/> <b>All_2000-2010_all_stations</b><br>All 2000-2010: all data from all EARLINET stations: various variables in b-files or e-files     |
| <input type="checkbox"/> <b>Calipso_2006-2010_all_stations</b><br>Calipso 2006-2010: data from all EARLINET stations: various variables in b-files or e-files |

At the bottom right of the table, there is a "Sort by Acronym" dropdown menu.

**First volume 2000-2010**

**Second volume May 2000 – April 2015**



# The Vision for the future

## RI – Research Infrastructure



The screenshot shows a webpage from the European Commission. At the top, there is a navigation bar with the text 'European Commission > Research & Innovation > Research infrastructures > What are RIs?'. Below this, the page features the European Union flag and the text 'RESEARCH & INNOVATION Infrastructures'. A central graphic shows a 3D structure of interconnected cubes with arrows, labeled 'Research Infrastructures'. Below this, there is a yellow button with the text 'WHAT ARE RIs?' and a section titled 'Tools for science' with a paragraph of text: 'Research infrastructures (RIs) play an increasingly important role in the advancement of knowledge and technology. They are a key instrument in bringing together a wide diversity of'.

The term ‘research infrastructures’ refers to **facilities, resources** and **related services** used by the scientific community to conduct top-level research in their respective fields

RIs are at the centre of the **knowledge triangle** of research, education and innovation, producing knowledge through research, diffusing it through education, and applying it through innovation.



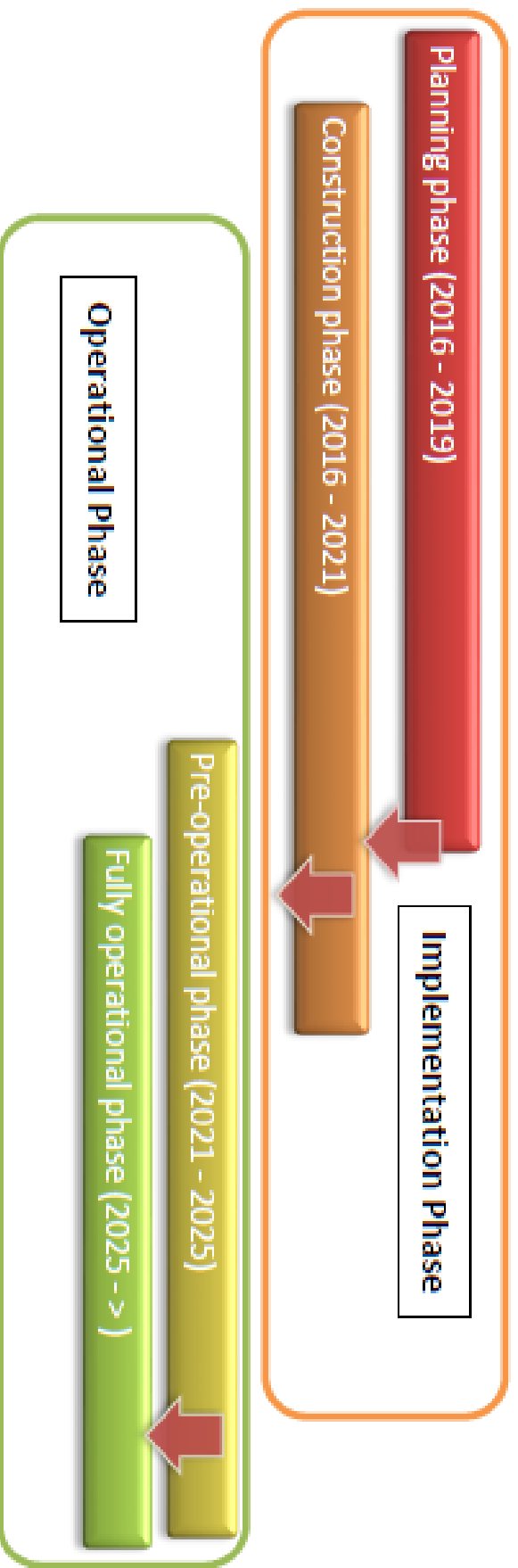
# ACTRIS RI status



ACTRIS has been selected for the ESFRI roadmap in 2016.

The H2020 ACTRIS PPP (Preparatory Phase Project) proposal was submitted to the EC on June 22, 2016.

ACTRIS PPP aims to bring ACTRIS to the level of organizational, operational, and strategic maturity that is required for its implementation to become a fully operational pan-European Research Infrastructure.





# The Vision



ACTRIS data products  
ACTRIS VRE for tools  
and computing

## ACTRIS Data services



Calibration Centres



Instrument calibration

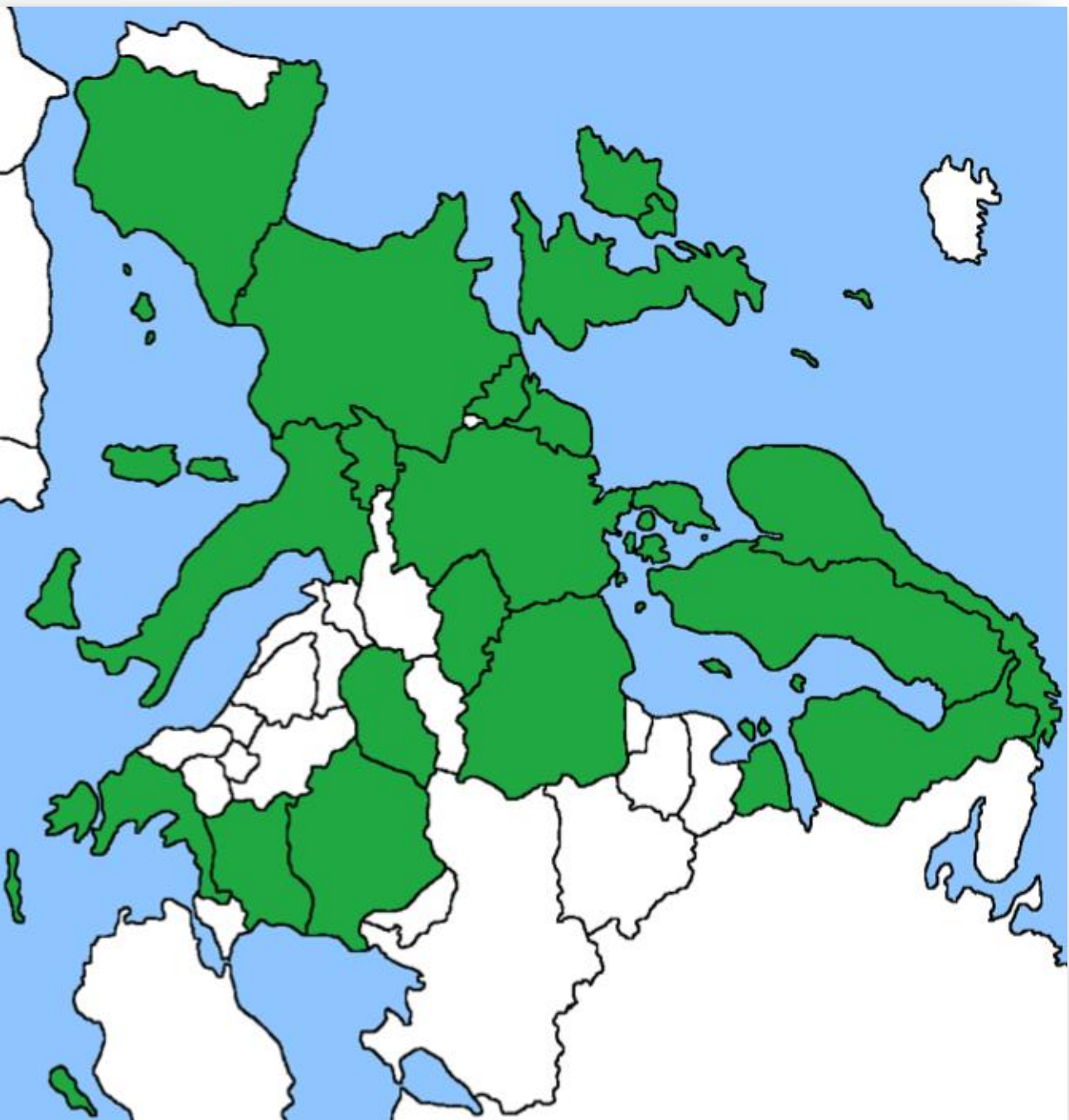
NE aerosol, cloud and trace gas variables







# The Vision



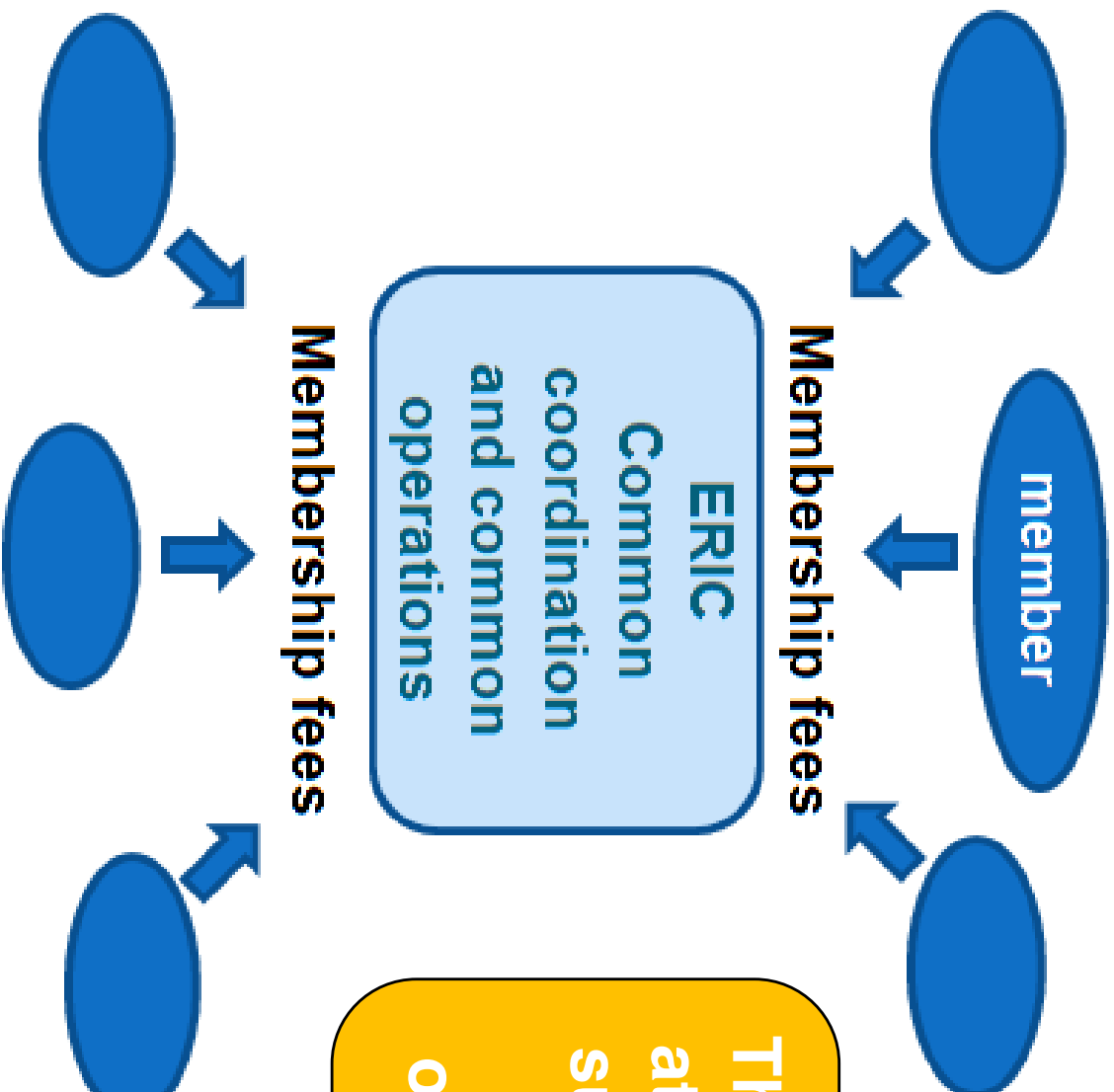
**The ACTRIS  
Community unites  
partners from 21  
countries across  
Europe and involves  
more than 100  
research  
institutes and  
organisations.**



# The Vision



contributions (in-kind) and operations at national level



The contribution at National level supports on the long term the observations!!!

contributions (in-kind) and operations at national level



- **EARLINET from research network to Infrastructure**
- **Providing data as services to users**
- **Stringent and documented QA and QC**
- **Building sustainability for long term observations**
- **More and more data will be available thanks to this process**



# Acknowledgments



**The financial support for this activity in the ACTRIS Research Infrastructure Project by the European Union's Horizon 2020 research and innovation programme under grant agreement no. 654169 and previously under grant agreement no. 262254 in the Seventh Framework Programme (FP7/2007–2013) is gratefully acknowledged.**



**Thanks for your  
attention**