Aerosol Clouds, and Trace gases Reserch InfraStructure Network

The Future of ACTRIS

Paolo Laj (CNRS),

ACTRIS COORDINATION

ACTRiS

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Integration studies in ACTRIS WP3: Challenges for AEROCOM community

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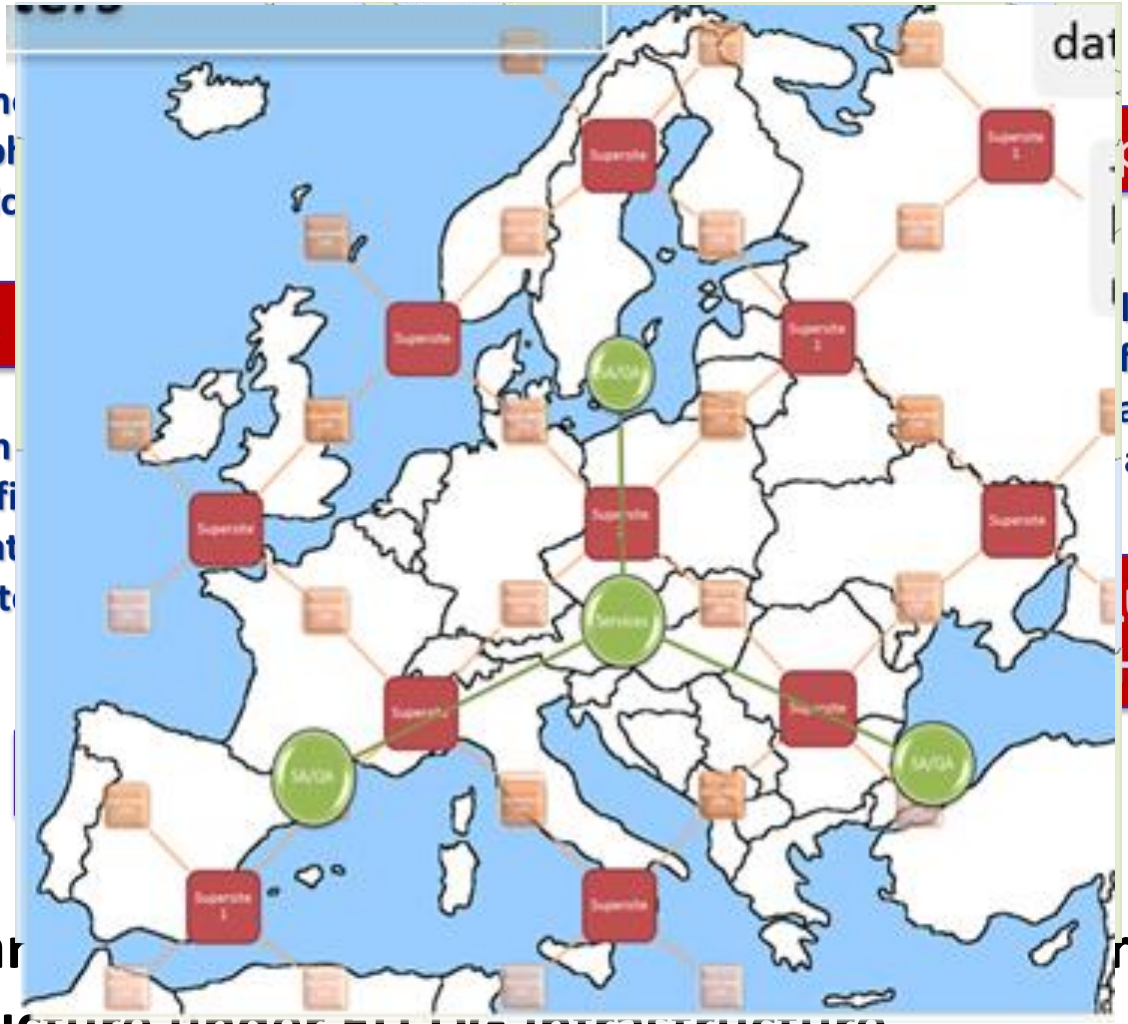
ACTRIS : coordinated long-term atmospheric observations in Europe



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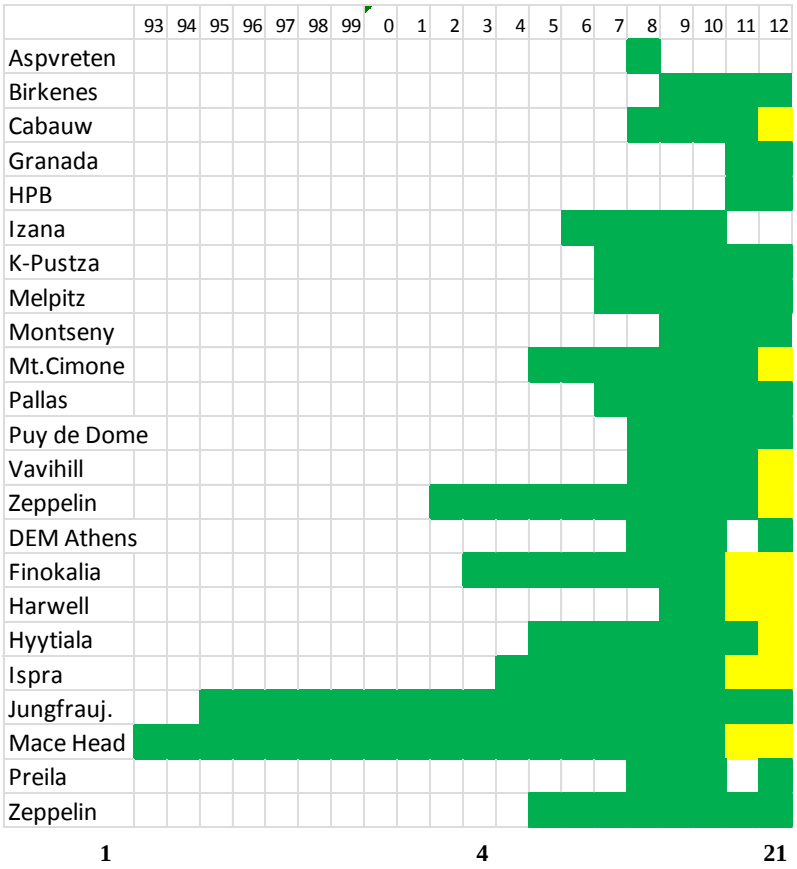
infrastructure under EU DG Infrastructure

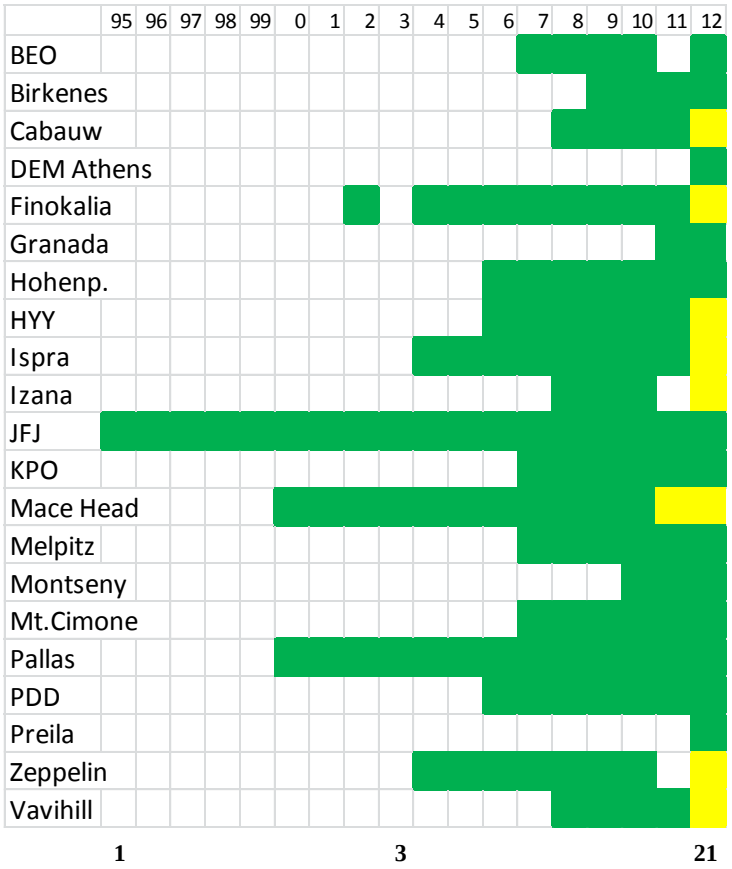
WP4: legacy from EUSAAR

Leadership in Europe for standardization of

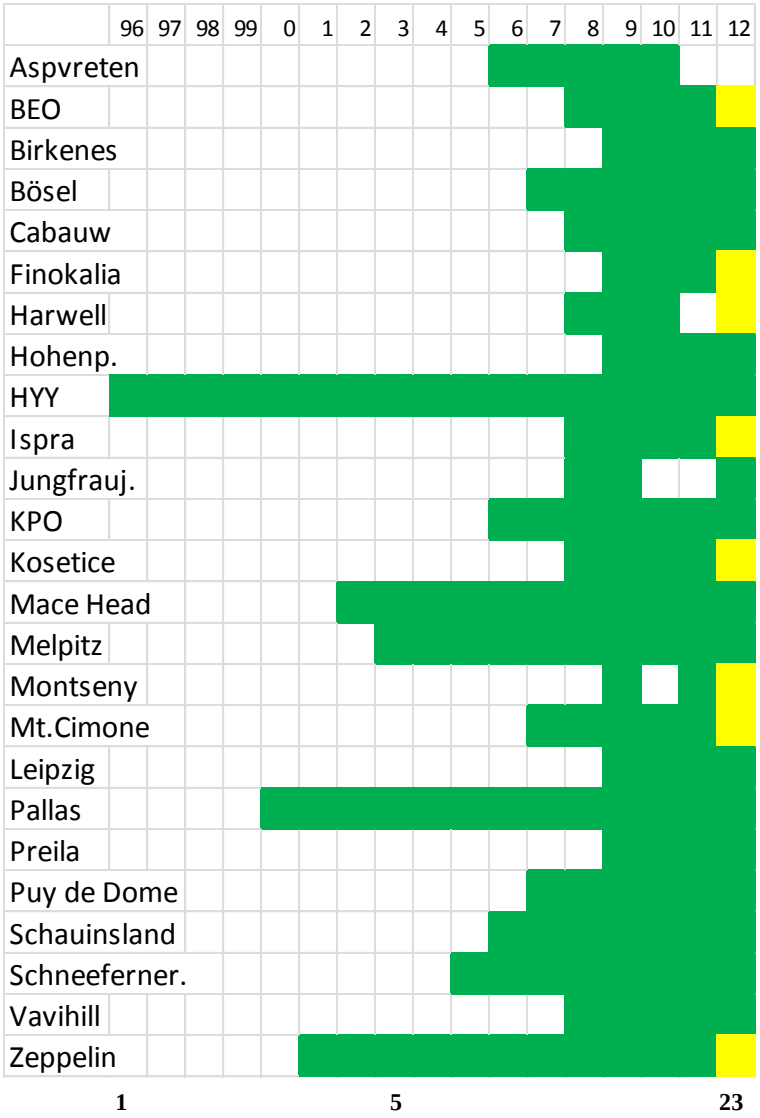
- **Aerosol size and Number (Wiedensohler et al., 2013)**
- **Aerosol scattering and absorption (Muller et al, 2010)**
- **Organic / Elemental carbon (Cavalli et al., 2010)**
- **Cloud Condensation nuclei (not yet)**
- **Aerosol Mass Spectrometers (JRA2) (not yet)**
- **Organic tracers (not yet)**

WP4: legacy from EUSAAR and CREATE

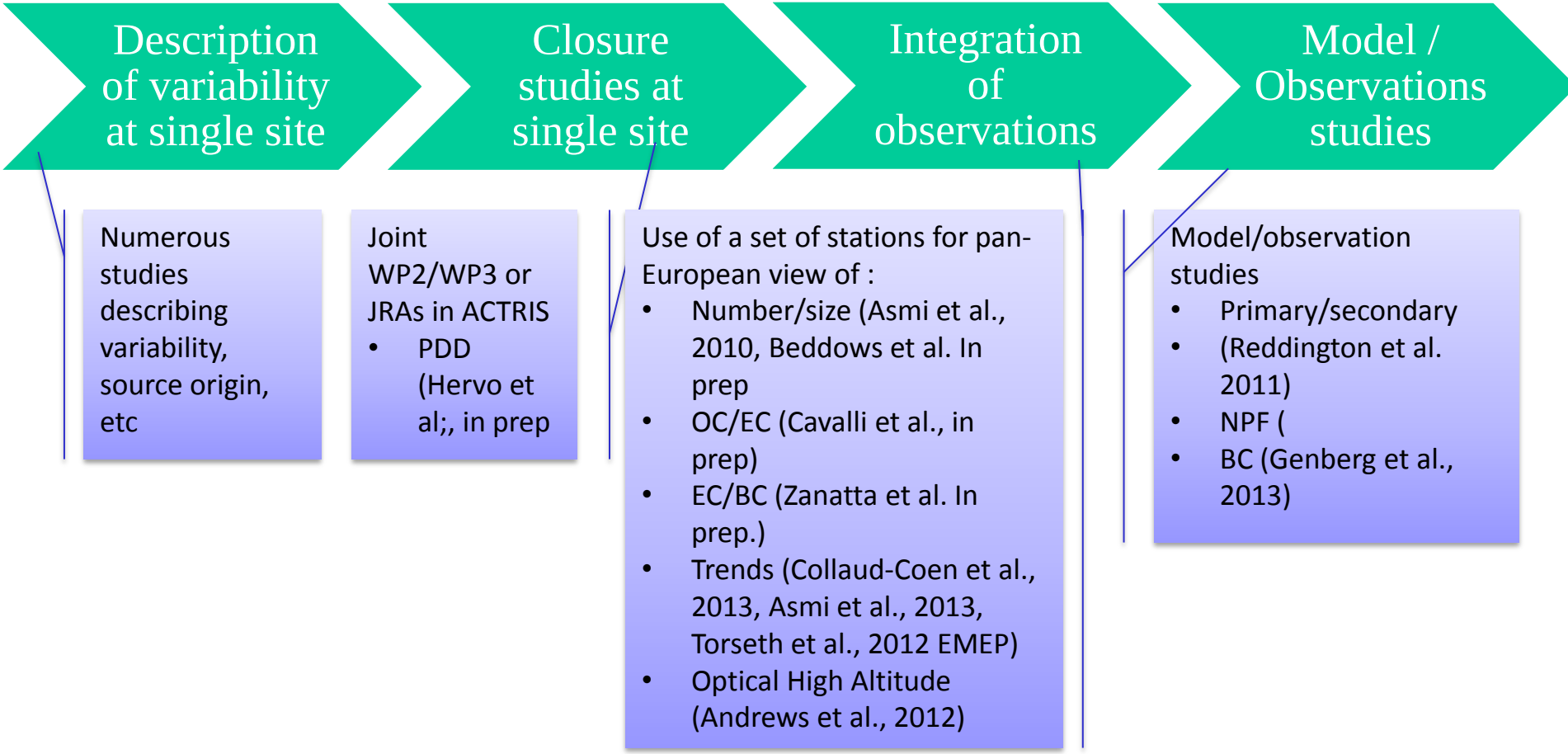




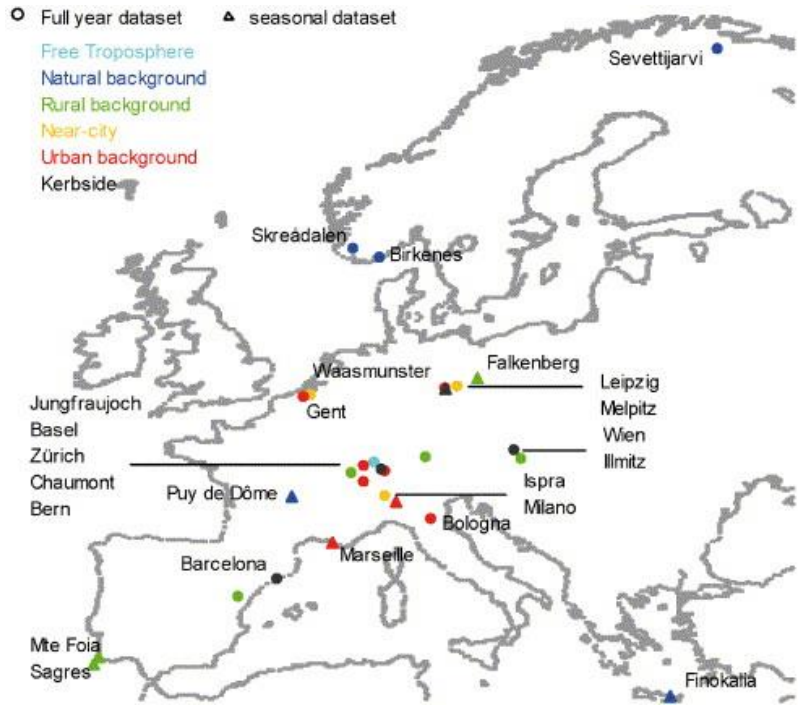
WP4: legacy from EUSAAR and CREATE



The ACTRIS publication chain



Pre-ACTRIS Knowledge: aerosol phenomenology 1, 2 and 3



Putaud et al., 2004, 2010, Van Dingenen et al., 2004

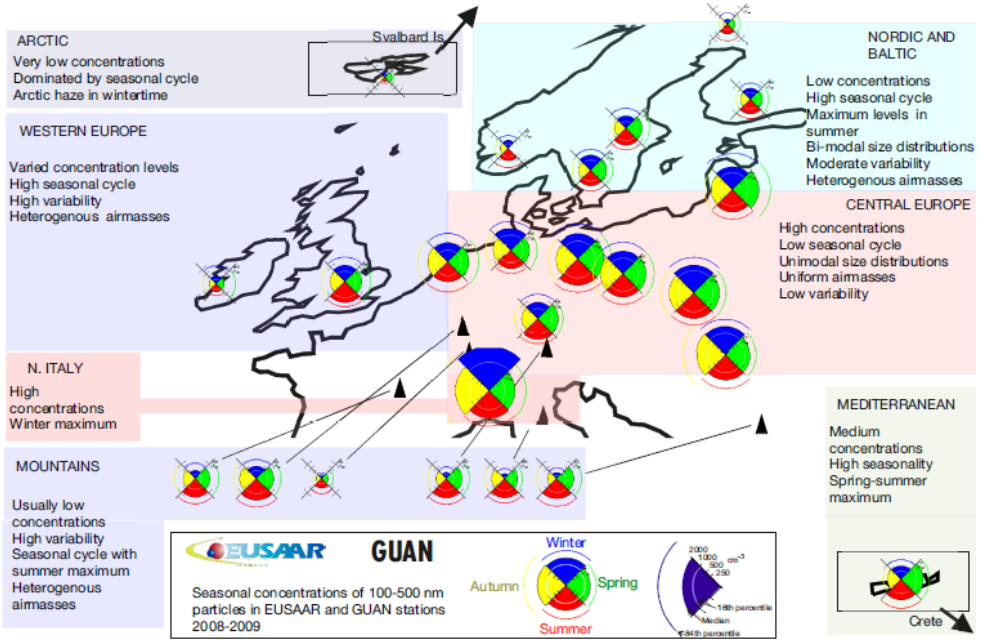
Very often referenced but

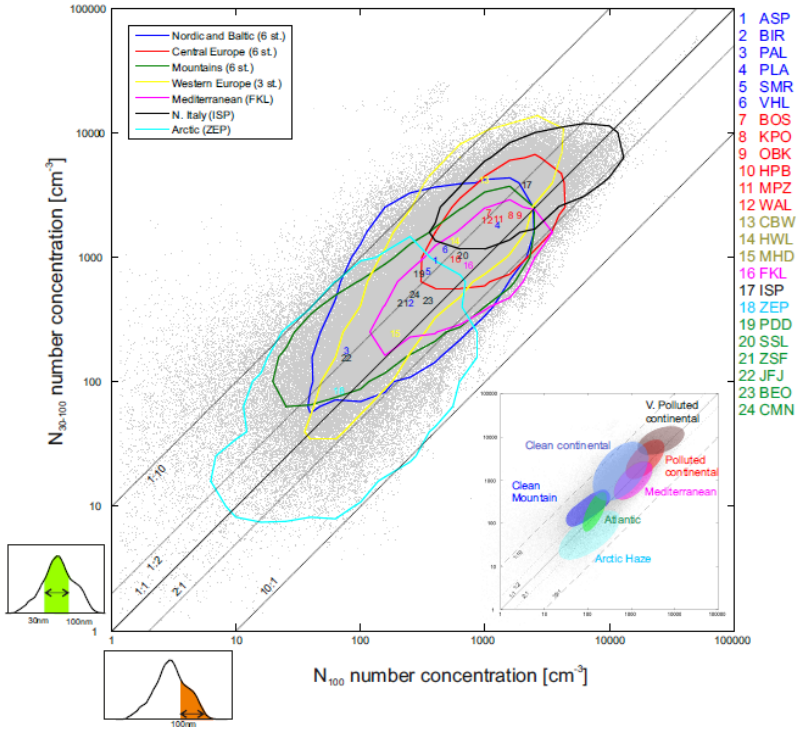
- Mostly PM/inorganic oriented
- Integration performed prior to any standardization work
- Long-term trend in SO_4^{2-} and NO_3^- concentrations only (EMEP)
- Many measurements derived from campaign-based studies (low representativity)
- Referenced but data base is not used

Asmi et al., ACP, 2011

2008-2009 data from 24 sites

- Standardized instruments
- Seasonal variations of N30 and N100 and size distribution
- Classification according to geography
- N30 versus N100 intensive properties

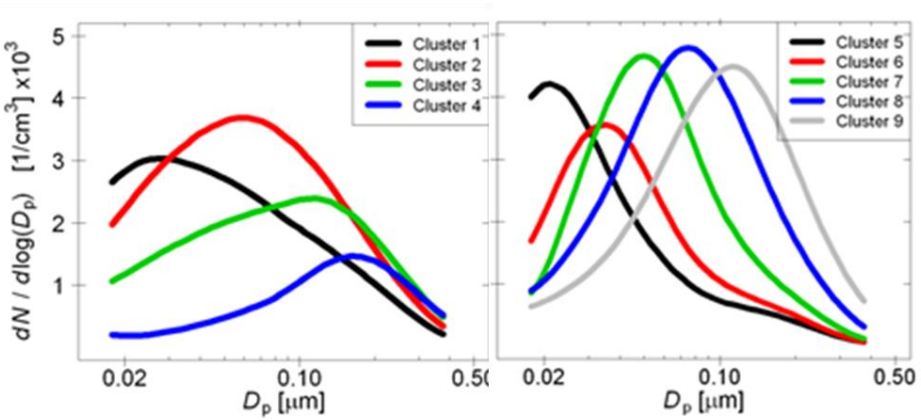


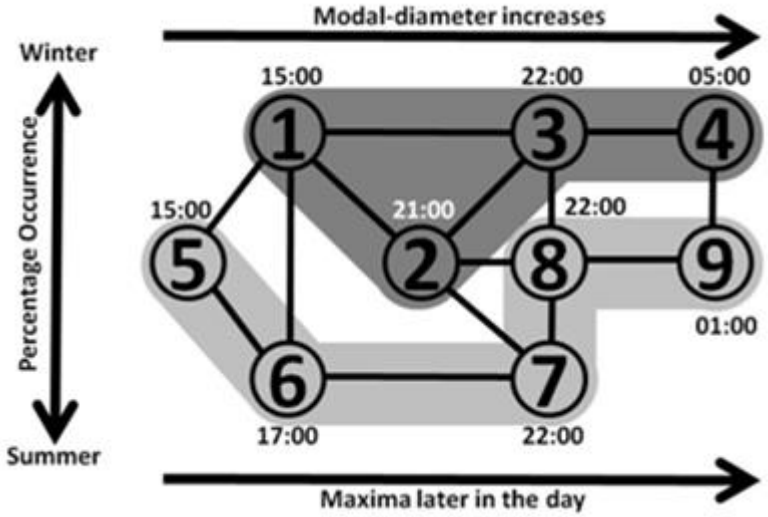


Beddows et al., to be submitted

Uses data set of Asmi et al., 2011

- Further classification into 9 clusters
- Considers evolution of size distribution
- Summer/winter and day/night variability
- Cluster frequency at each site

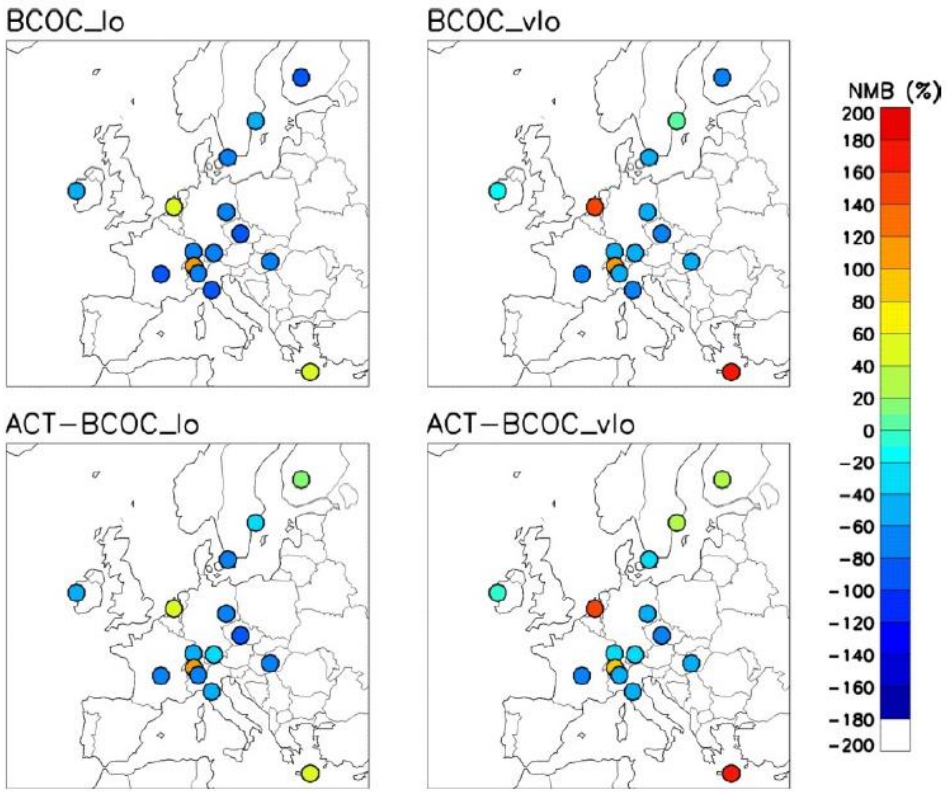




Reddington et al., ACP, 2011; Manninen et al., 2010

Uses EUCAARI/ACTRIS/EMEP IOP of May 2008

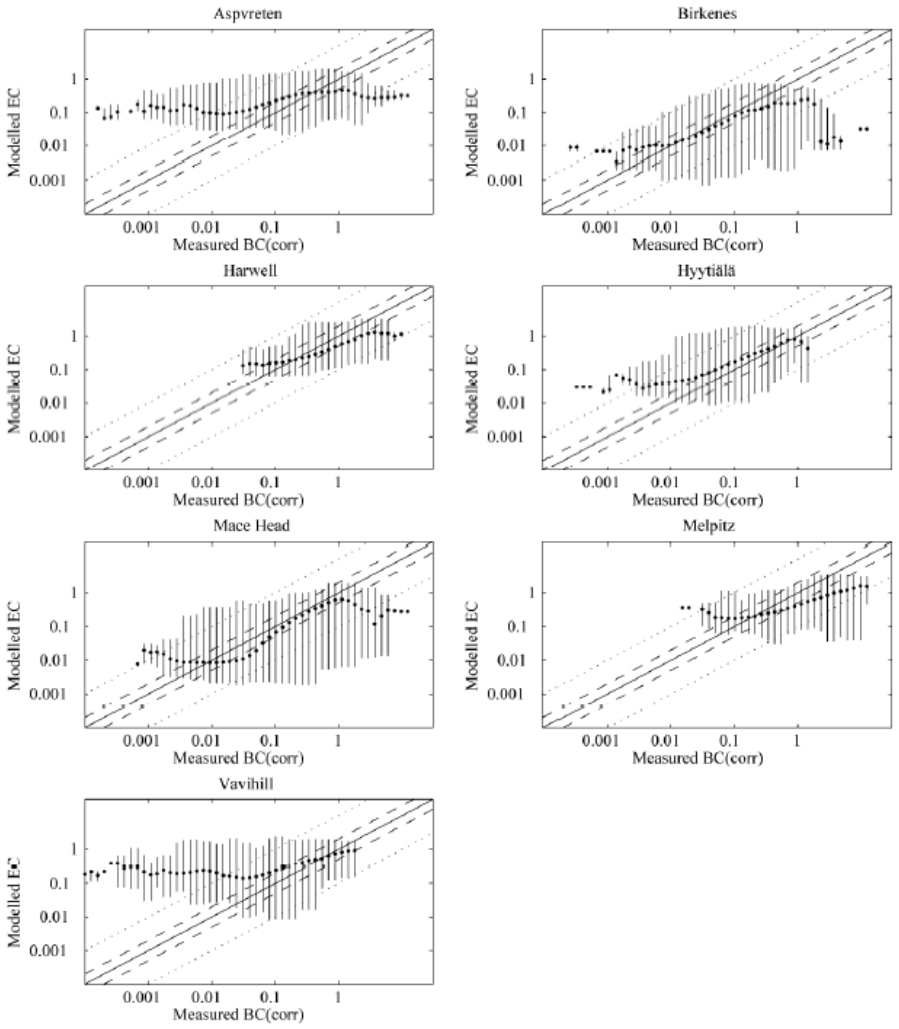
- Ground-based + aircraft
- Investigate impact of BL NPF
- Large Model/measurement discrepancy without BL nucleation
- Importance of NPF to simulate CN50 or CN100



Genberg et al., ACP, 2013

Model (EMEP) / observation using 5 Nordic stations + MPZ + MHD (2008-2010)

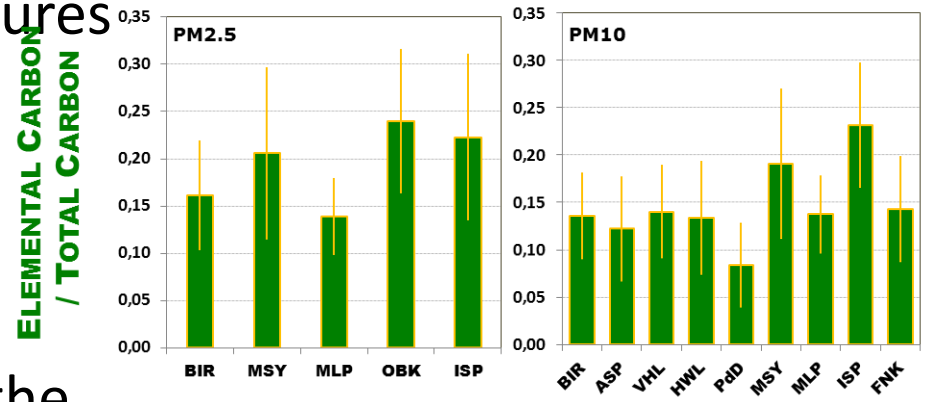
- EC (filter) and BC (abs. Photometer)
- No harmonization but normalization EC to BC
- MAC 5 to 45 m^2g^{-1} (fairly high)
- Model/obs. discrepancy 20%
- Wood burning as a main source

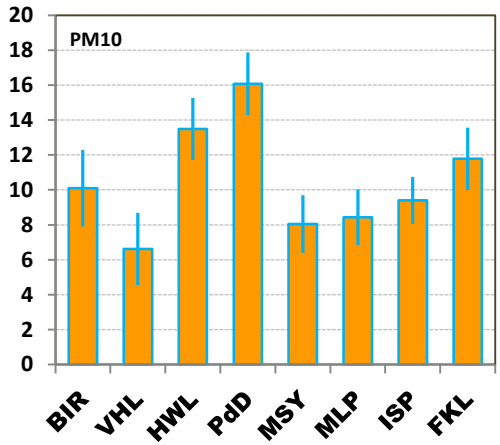


Cavalli et al., in prep; Zanatta et al., in prep

10 ACTRIS stations providing EC (fliters) and eqBC (Abs. Photometers)

- Standardized correction procedures for eqBC (and harmonization)
- 4 years of data for most sites
- Annual mean for EC, eqBC, OC, Abs.Coeff and ratio
- Least carbonaceous aerosol at the Mediterranean sites: 0.11 - 0.14
- Most carbonaceous aerosol in Ispra: 0.30 - 0.40
- For the majority of the sites, fairly homogeneous Total Carbon / Mass ratio: 0.16 - 0.24

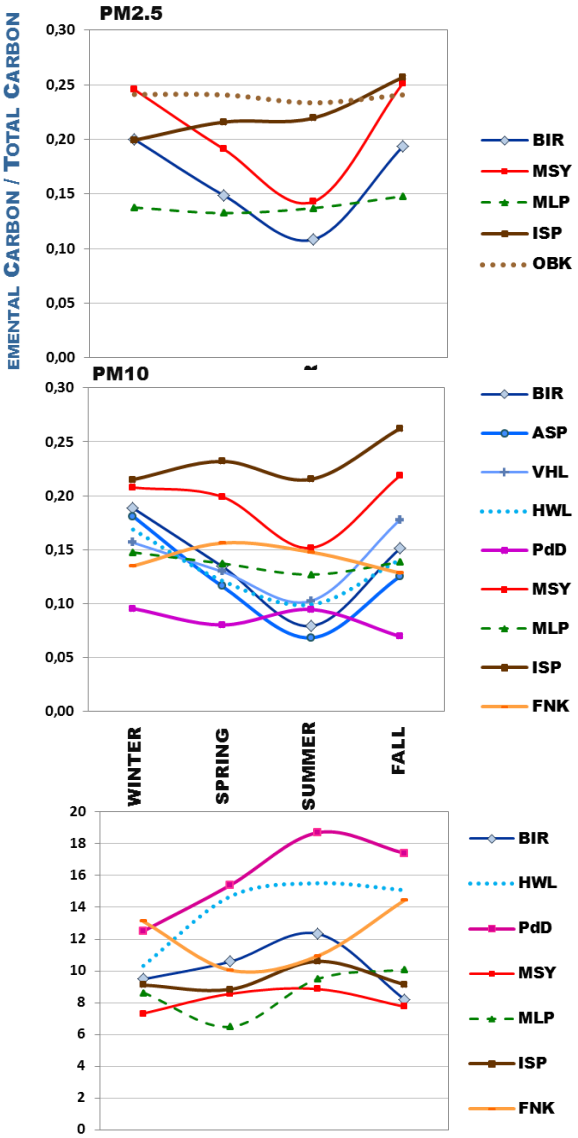




Cavalli et al., in prep; Zanatta et al., in prep

10 ACTRIS stations providing EC (fliters) and eqBC (Abs. Photometers)

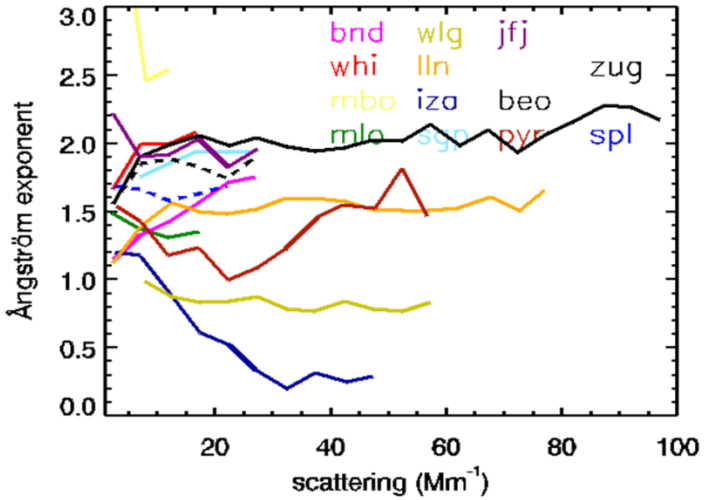
- Seasonnal averages for EC, eqBC, OC, Abs.Coeff and ratio
- Most carbonaceous aerosol in winter-fall due to domestic heating
- Biogenic aerosol peaks in summer
- Least carbonaceous aerosol in spring
- Enhancement of MAC by the thicker Organic Carbon coating

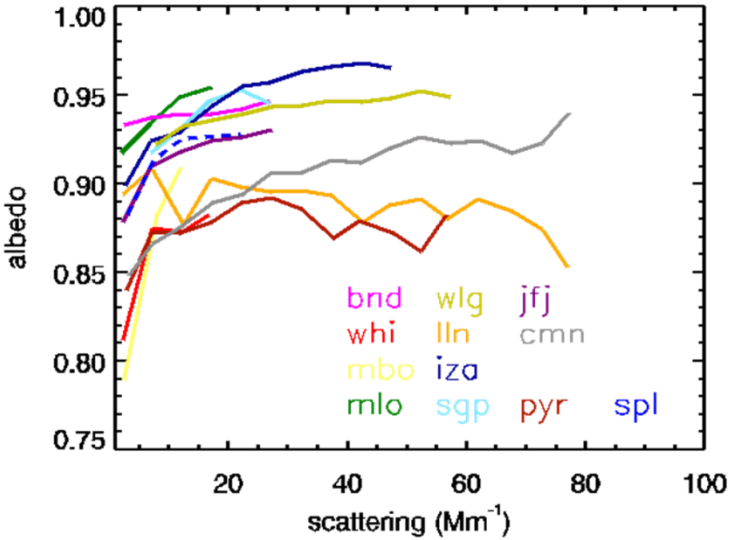


Andrews et al., Atmos. Res, 2012

Selected sites Worldwide above 2000 m asl. , all data

- Absorption, Scattering, extinction coef. And single scatt. Albedo
- Monthly means showing maxima in spring or summer
- Most sites show lower single scattering albedo values for clean air (low scattering).
- Identify sites strongly impacted by regional dust.

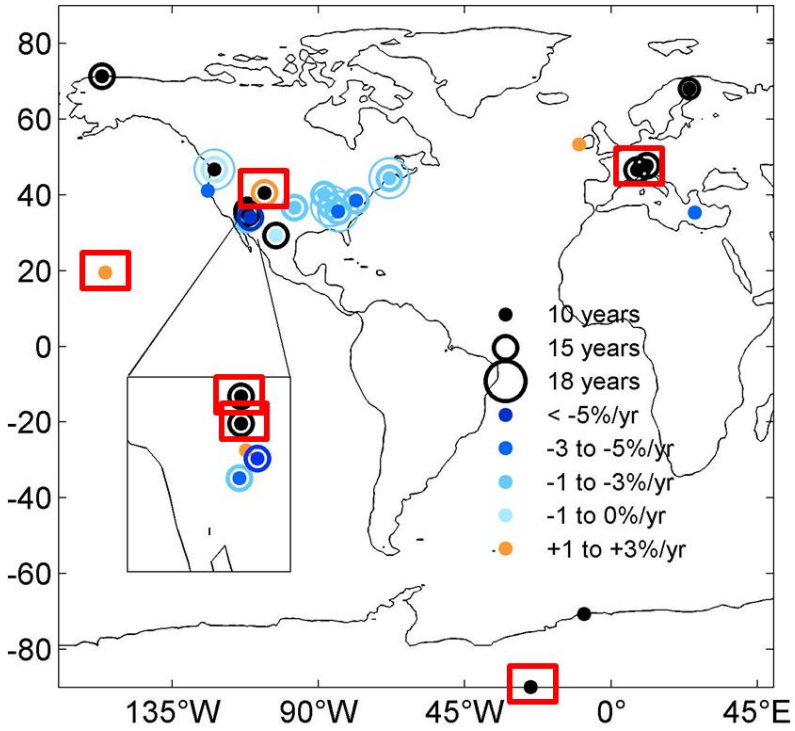




Collaud Coen et al., ACP, 2013 and Asmi et al., ACP, 2013, Torseth et al., 2013

Long-term trends in optical properties and aerosol number

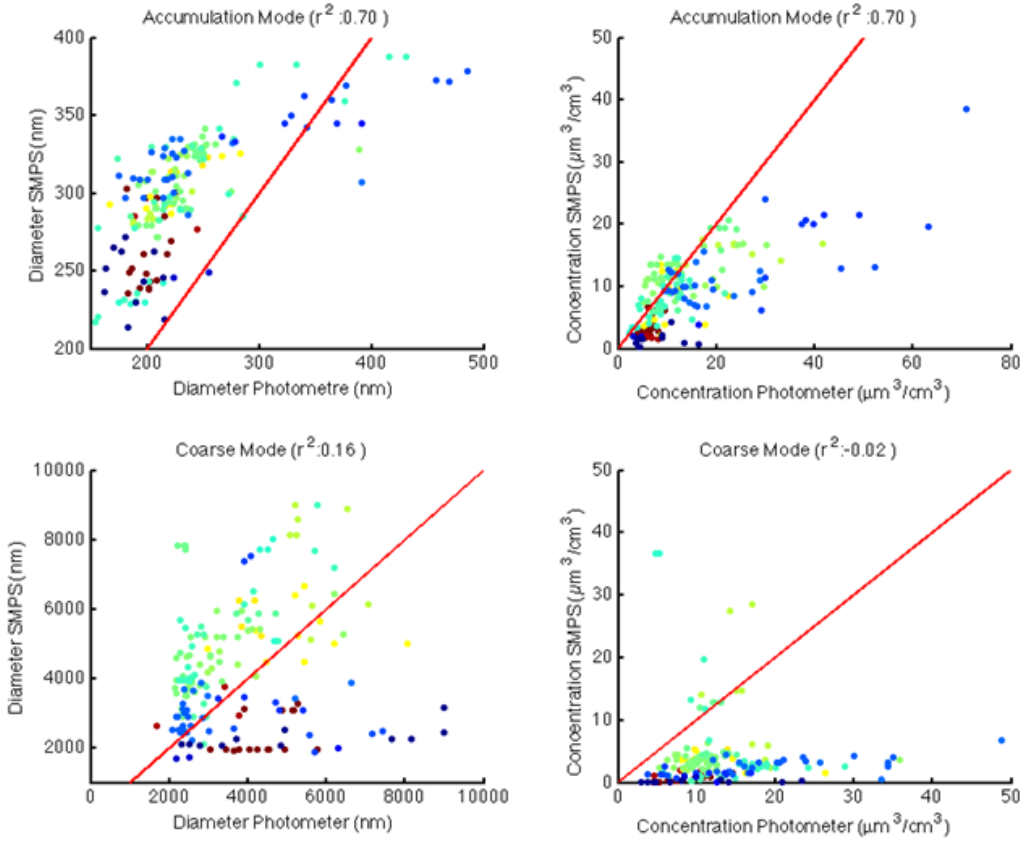
- Use ACTRIS, GAW, IMPROVE stations with record >8 years (up to 2010)
- No clear behaviour in Europe
- Signigficant decreasing trend observed by Torseth et al. For chemistry
- At the end of ACTRIS (2015), 6/9 sites will provide >10 yr record



Hervo et al., in prep

6-Months at PDD with SMPS, Lidar, Sunphotometer

- Account for hygroscopic growth
- Significant difference in modes
- Similar temporal evolution
- Similar work at other mountains sites of ACTRIS and GAW



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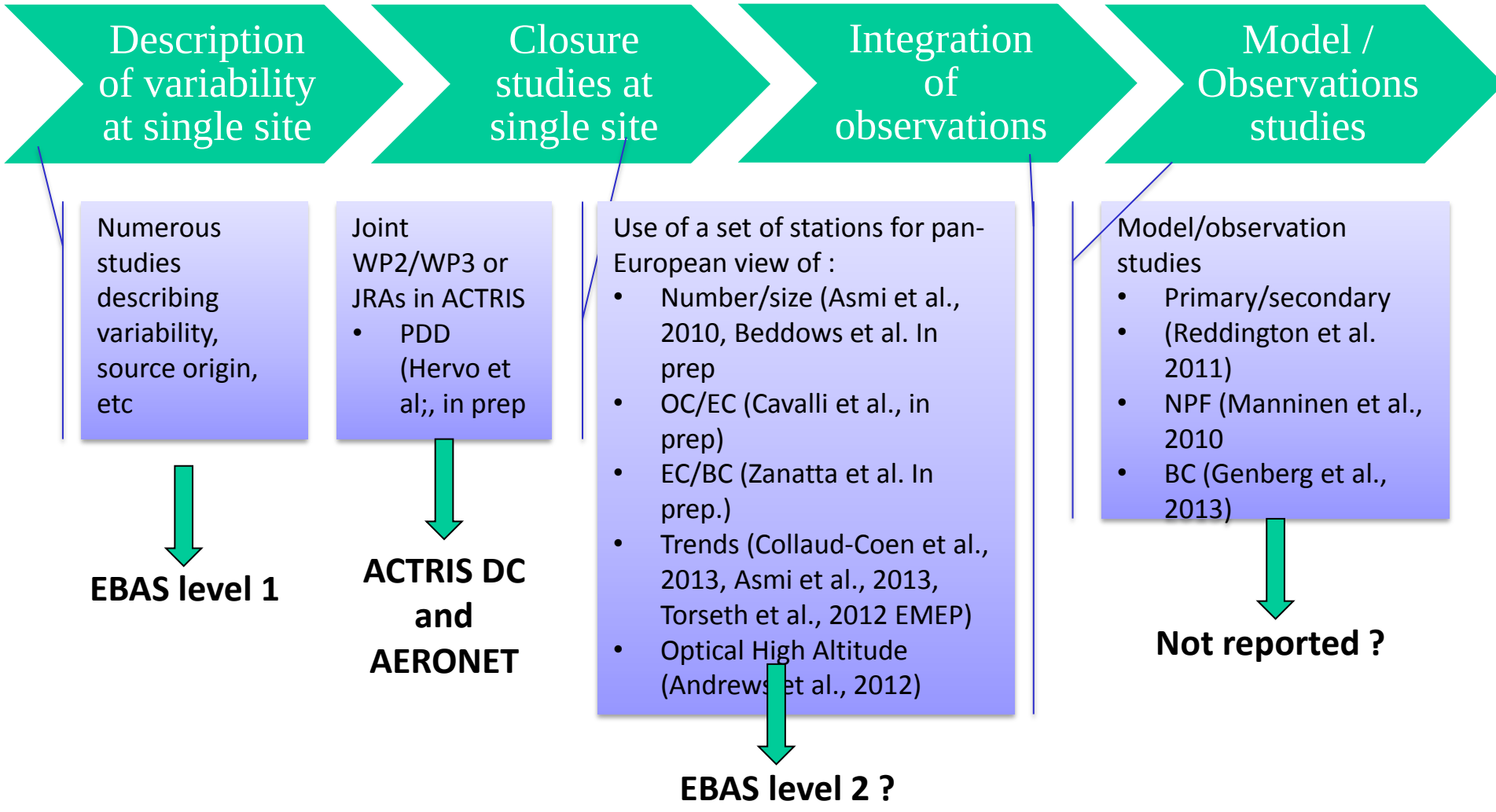
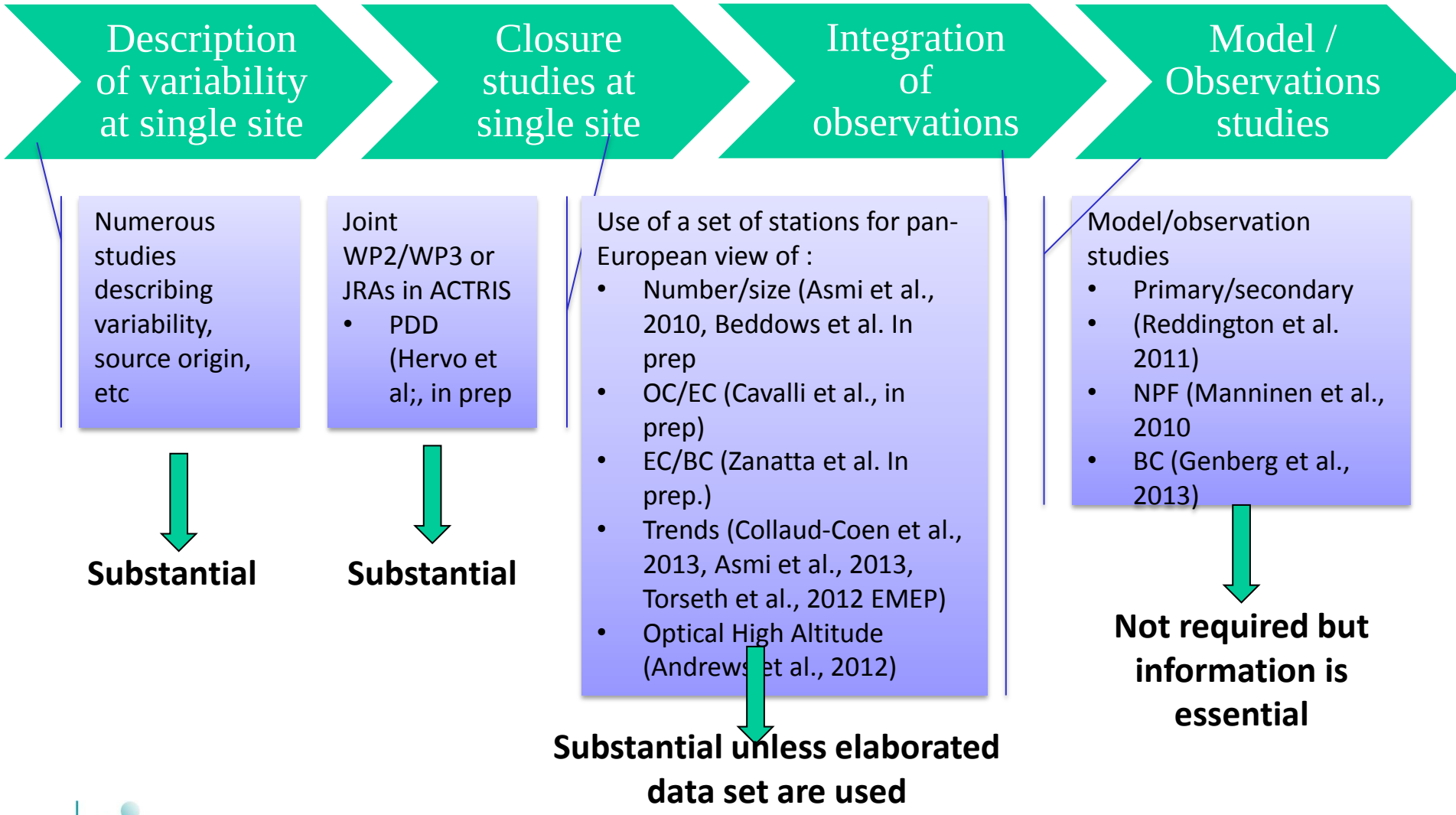


Conclusions of the Introduction

- Very Robust information available for key aerosol variables (often several year – climatology available at 1h-resolution
- But still some work to do on homogeneizing data sets after downloading from EBAS
- Some nice guys (girls) did that for you and level-2 ACTRIS now available (for aerosol in-situ but also for other variables)
- Opportunities for models comparison

Authorship and substantial use of data



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FROM ACTRIS-I3 TO ACTRIS-RI: 10 QUESTIONS TOWARDS THE ESFRI ROADMAP

Strengthening the ground-based component of the Earth Observing System for key atmospheric variables has been unambiguously asserted in the IPCC Fourth Assessment Report and the EU Thematic Strategy on air pollution. Key climate variables not only concern CO_2 and other greenhouse gases but also the short-lived components driving the interaction between solar radiation and the atmosphere: aerosols and clouds. Their radiative impact and the understanding of their evolution in gas-aerosol-cloud-interactions constitute the main uncertainty in predicting future air quality and climate change. Over the last 10 years, Europe has built a unique infrastructure for the coordination of aerosol, cloud, and trace- gas observations essential to a large community of users for applications such as process studies of physical phenomena in the atmosphere, validation, evaluation, and improvement of climate and numerical weather prediction models, validation and improvement of data products from ground-based, airborne, and space-borne sensors or assimilation of data into numerical weather prediction and air quality models. Continuation of observations and services provided by this infrastructure requires establishing the framework that will organize in the long-term this essential support to research activities of a large atmospheric science community.

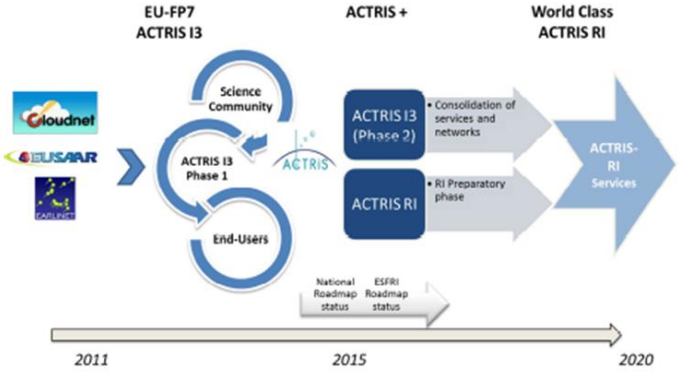
Q1: What is ACTRIS-I3?

A1: ACTRIS-I3[1] is a project funded under the EU Directorate General Infrastructures coordinating and improving long-term observations of reactive gases, aerosol and cloud properties from all multi-instrumented research stations in Europe. ACTRIS is built upon previous EU Framework projects, as EUSAAR, CLOUDNET or EARLINET, to provide common strategies for atmospheric measurements and an access to unprecedented high-quality atmospheric measurements. ACTRIS-I3 functionalities are used by a wide community with numerous users to understand the complex interplay between greenhouse gases, trace gases, aerosols, water vapour, clouds, rainfall, and radiation that constitutes the main uncertainty for predicting future evolution of the Earth climate. ACTRIS-I3 is the essential research component of European and global observational networks as EMEP[2] and GAW[3] ensuring required quality and adequate development. The project ends in 2015 and could be pursued through another I3 project.

[1] The Integrated Infrastructure Initiative (I3) was devised under FP6 for EU projects to combine networking, transnational, and joint research activities within a single contract.
[2] Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP), a programme under the UN Convention on Long-range Transboundary Air Pollution (CLRTAP): http://www.emep.int .
[3] The Global Atmosphere Watch (GAW) programme of WMO

Q2: What is ACTRIS-RI?

A2: ACTRIS Research Infrastructure for atmospheric observations, ACTRIS-RI, is the pan-European framework that will ensure continuity, joint development, and coordination of activities at the high-level supersites and the associated thematic centres. ACTRIS-RI will be the backbone for European research in air quality and climate, recognized as a unique measurement program with sufficient quality for future needs and purposes, and also a major support and guide for the qualification and evolution of Global Atmosphere Watch and other more operational networks. As such, it should be jointly managed by stakeholders within a European framework and maintained in the long-term (>20 years) to preserve its unique potential to define and provide essential and high-quality data for climate and air quality research. ACTRIS-RI should be established within 5 years including a preparatory phase that will define its overall structure



Q3: Why do we need ACTRIS-RI?

A3: The infrastructure is unique to provide the 4D-variability of clouds and of the physical, optical and chemical properties of short-lived atmospheric species. This record can only be achieved in a network of advanced observatories (ACTRIS supersites) that combine *in situ* and *remote sensing* instruments. The *in situ* instruments measure localized properties of the atmospheric constituents and the physical processes they are embedded in, with high accuracy. The *remote sensing techniques* show their strength in observing the spatial extent of atmospheric properties, and are thus able to reveal processes at larger spatial scales. ACTRIS-RI will be the fundamental research component of global, regional, and national observational networks for short-lived atmospheric components guiding the development and operation to fill the future needs for atmospheric observations. Transfer of expertise to support implementation of national networks has been established and will continue to be a fundamental added-value brought by ACTRIS-RI.

Requisite be renewed as an I3 (2015-2020)

- ACTRIS should prove to be an essential tool for users outside its community

- The user community (i.e AEROCOM) should be active in promoting ACTRIS at National and International levels

- Develop further its service activities (DC, AERONET)
- Respond to community needs (Additional variables, faster delivery (GMES), new products, Data Mining, Visualisation, etc..)

- Feedbacks from the modelling community !