



**Vassilis Amiridis**

**BEYOND ground-based remote sensing and cal/val activities**

IAASARS, National Observatory of Athens

Greece

**ONE step BEYOND workshop, 15 October 2015**

**ESA - Frascati, Italy**



FP7-Regpot-2012-23-1



## BEYOND Infrastructure

1. One UV-MFR radiometer and one CIMEL sunphotometer, part of the NASA global network AERONET (<http://aeronet.gsfc.nasa.gov/>)
2. The ESA-EMORAL mobile lidar system: IAASARS is responsible for the operation of this system.
3. Development of a sophisticated multi-wavelength lidar system (PollyXT) for systematic operation in Crete. Join EARLINET, ACTRIS



# BEYOND

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## Mobile Lidar Station



The **EMORAL mobile lidar station** is a combined backscatter/Raman lidar, which is a property of ESA. Through BEYOND, NOA operates the system which is deployed for dedicated experimental campaigns of ESA.

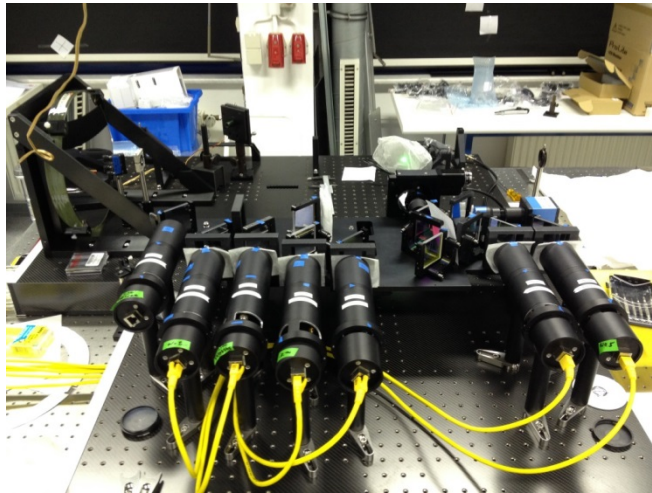






## PollyXT Lidar System

In BEYOND, we developed a sophisticated multi-wavelength backscatter/Raman/depolarization lidar in collaboration with TROPOS Institute in Leipzig, Germany, the so-called **PollyXT lidar**







## PollyXT Lidar System

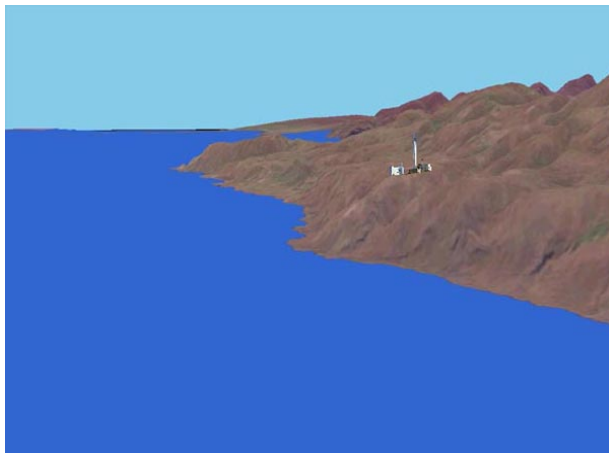


The system operates currently in the NOA premises in Thiseion (Athens center), collocated to the sunphotometric station.

This is a test mode operation, where we perform consistency and quality assurance tests for the 24/7 system operation and calibration.







Latitude =  $35.34^{\circ}\text{N}$  - Longitude =  $25.67^{\circ}\text{E}$  - Elevation = 252 a.s.l.





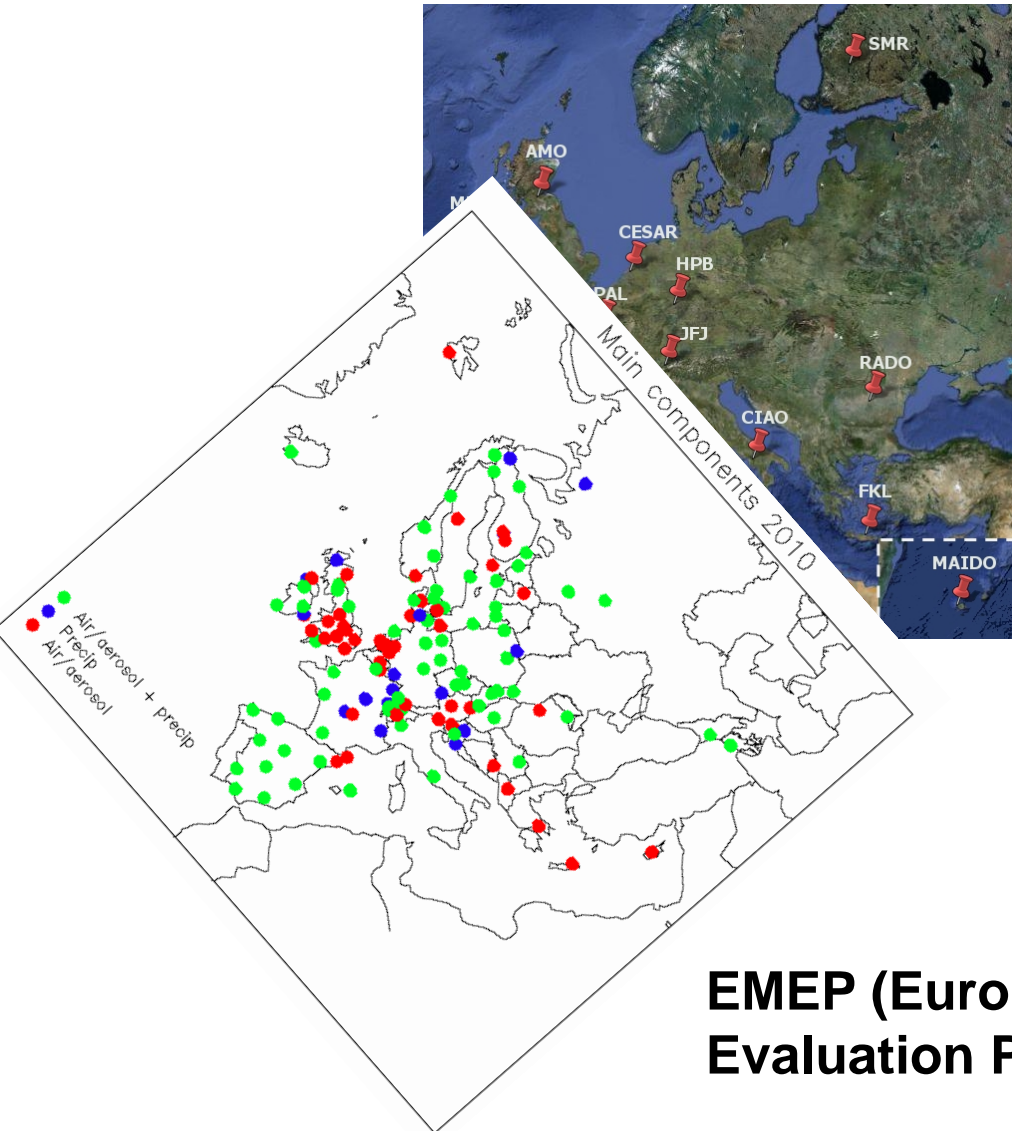




Finokalia station

**ACTRIS**

**ICOS (Integrated Carbon Observation System)**



**EMEP (European Monitoring and Evaluation Programme)**



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CHARADMEExp

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## CHARADMEExp campaign

Characterization of Aerosol mixtures of Dust And Marine origin



### The campaign

The CHARADMEExp campaign aims to derive optical, microphysical and chemical properties of marine component and its mixture with dust, employing sophisticated instrumentation installed on an appropriate site. Specifically, aerosol characterization will be established by ground-based active/passive remote sensing techniques, surface in-situ measurements and airborne UAV observations.

The campaign will take place from **20th of June until 10th of July** at the Finokalia site, Crete, Greece.

### The site

The site for the campaign is the monitoring station of [Finokalia](#), Greece where only marine and dust particles are present 95% of the time (smoke can be advected as well during the August-September forest fire period). Finokalia station is located at a remote coastal site in the northeast of the island Crete, Greece, in the Eastern Mediterranean (35.338°N, 25.670°E, 252 asl). The station is located at the top of a hilly elevation (150m above sea level), facing the sea within a sector of 270° to 90°. No touristic or other human activities can be found at a distance shorter than 20 km within the aforementioned sector. In-situ measurements are performed in Finokalia continuously for the last 20 years.

### Recent activity

#### News

- [ITaRS participation in CHARADMEExp](#) (Jul 10th)
- [UAV measurements \(video\)](#) (Jul 1st)
- [Cyprus Institute UAVs are heading to Sitia's airport](#) (Jun 28th)
- [Saharan dust is approaching](#) (Jun 24th)
- [Getting prepared for UAV flights over Crete](#) (Jun 23rd)

#### Uploaded data

- [HALO realtime](#) (Sep 9th)
- [FLEXPART](#) (Jul 31st)
- [WRF WIND](#) (Jul 31st)
- [WRF WIND](#) (Jul 31st)
- [WRF WIND](#) (Jul 31st)

<http://charadmexp.gr/>





- 3 backscatter channels (355, 532, 1064 nm)
- 2 extinction Raman channels (387, 607 nm)
- 2 depolarization channels (355, 532 nm)
- 1 water vapor channel (407 nm)
- 1 near-range channel (532, 607 nm)



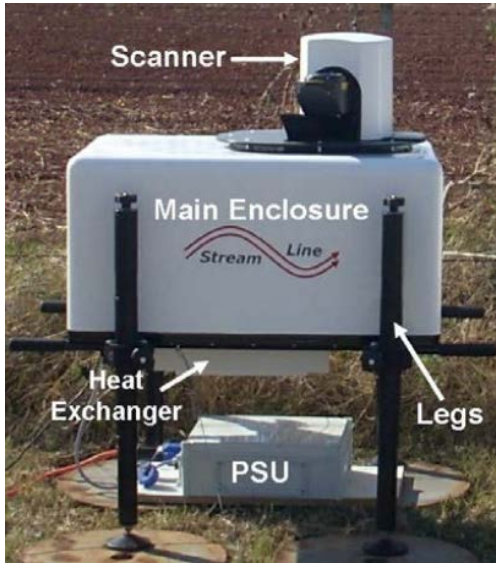




- 2 backscatter channels (355, 532 nm)
- 1 extinction Raman channel (387 nm)
- 2 depolarization channels (355, 532 nm)







- 1 backscatter channel (1.5  $\mu\text{m}$ )
- Doppler lidar capable of providing wind speed and direction and turbulence





## MicroWave Radiometer HATPRO

Measures the brightness temperatures in the range between 2.7K (cosmic background) and ambient temperature

*Capable of providing:*

1. Liquid Water Path (LWP)
2. Integrated Water Vapor (IWV)
3. Temperature and RH profiles within the PBL (for CHARADMexp, the synergy with the lidars will be utilized to derive WV profiles)





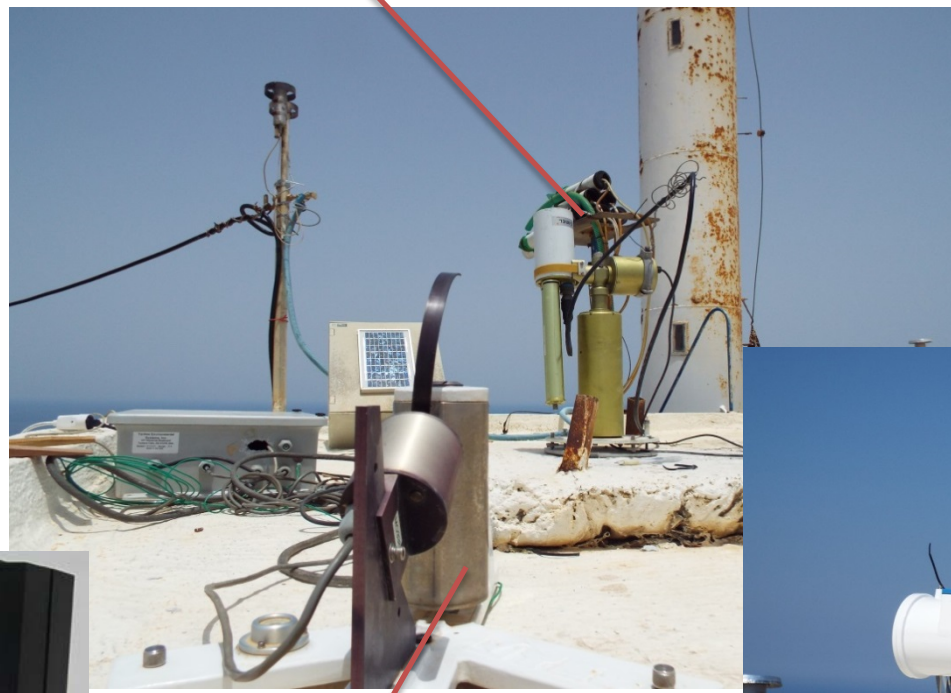


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AERONET-CIMEL



PSR



Microtops II



UV-MFR





Black carbon (aethalometer)

Ground Control Unit



Ozone (UV absorption)

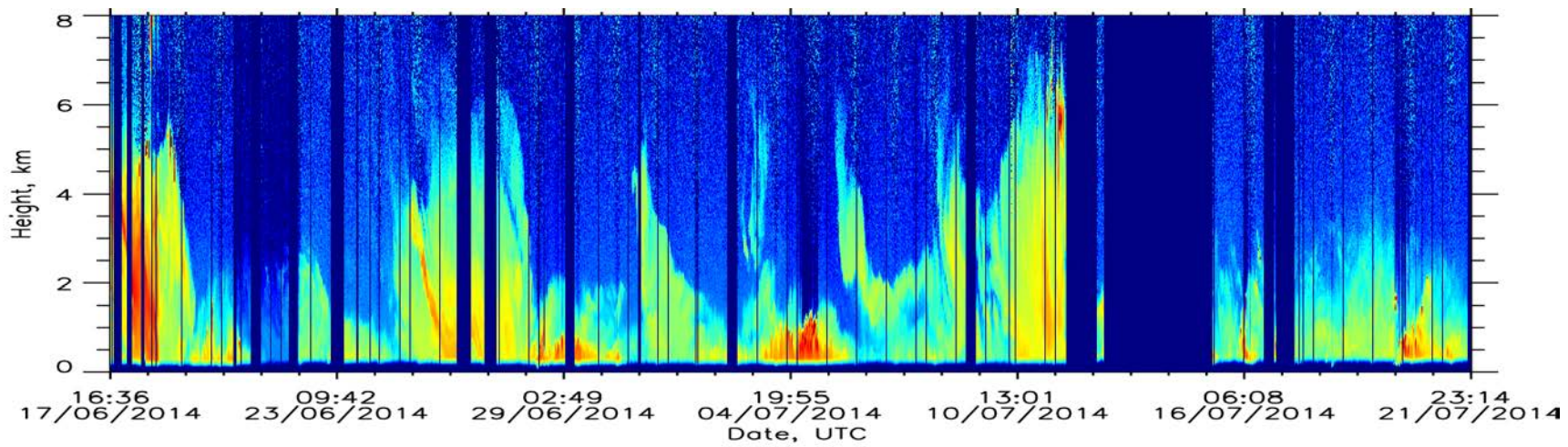


Condensation Particle Counter (CPC)

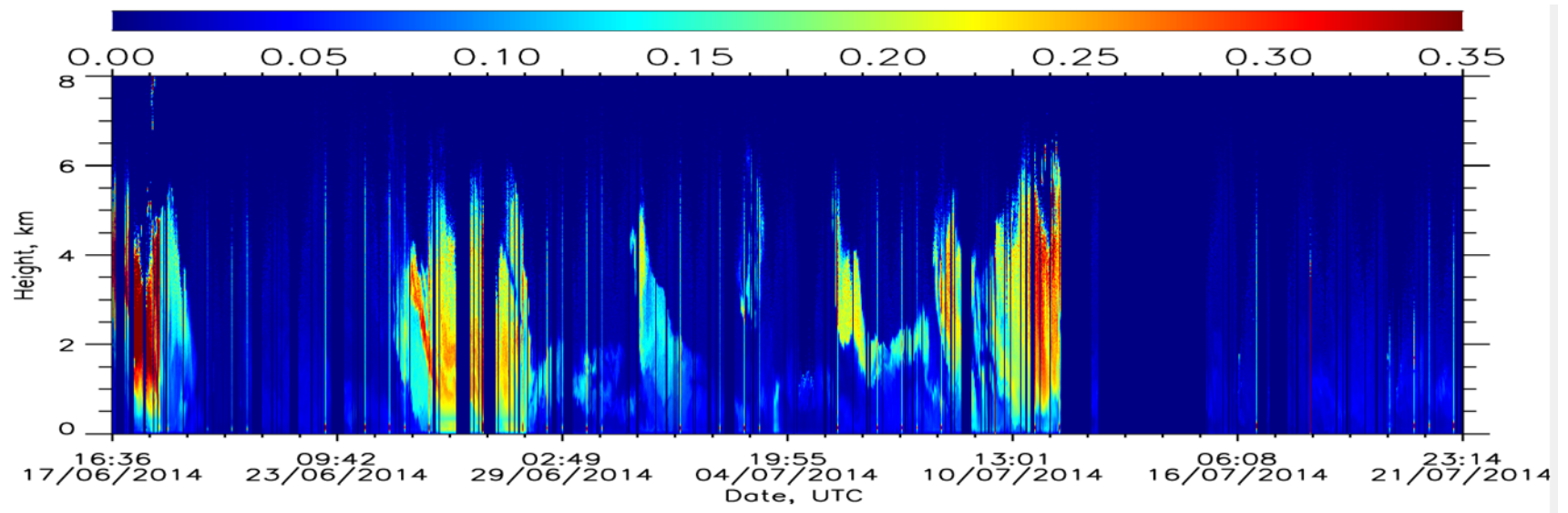


## Retrieval examples

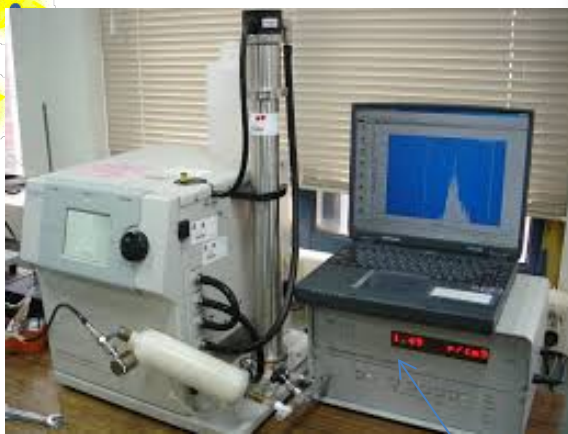
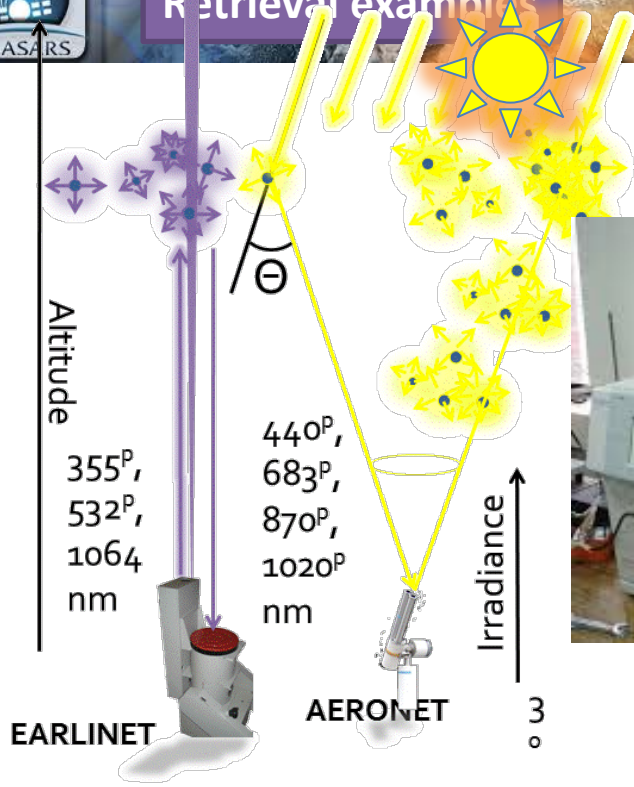
Range corrected  
signal at 1064nm



Depolarization:  
cross/total @ 532nm

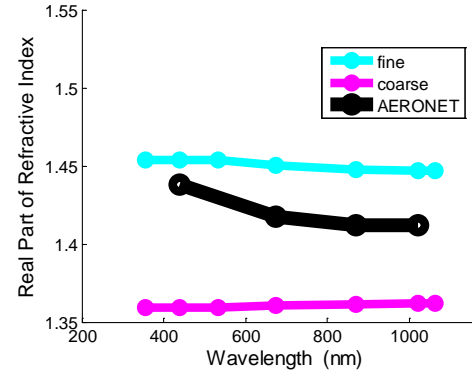


## Retrieval examples

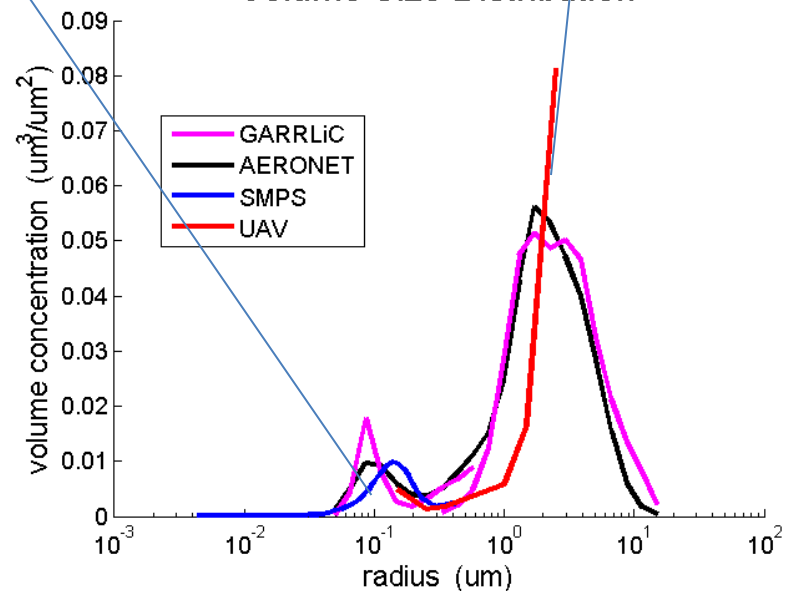
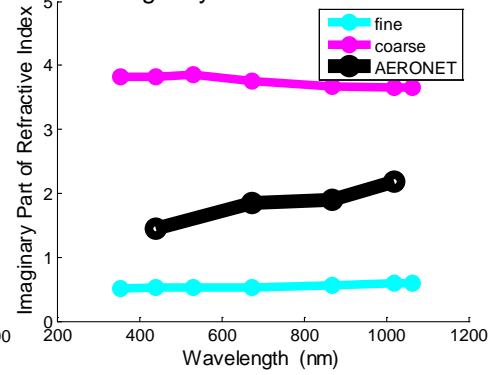


Volume Size Distribution

Real Part of Refractive Index



Imaginary Part of Refractive Index





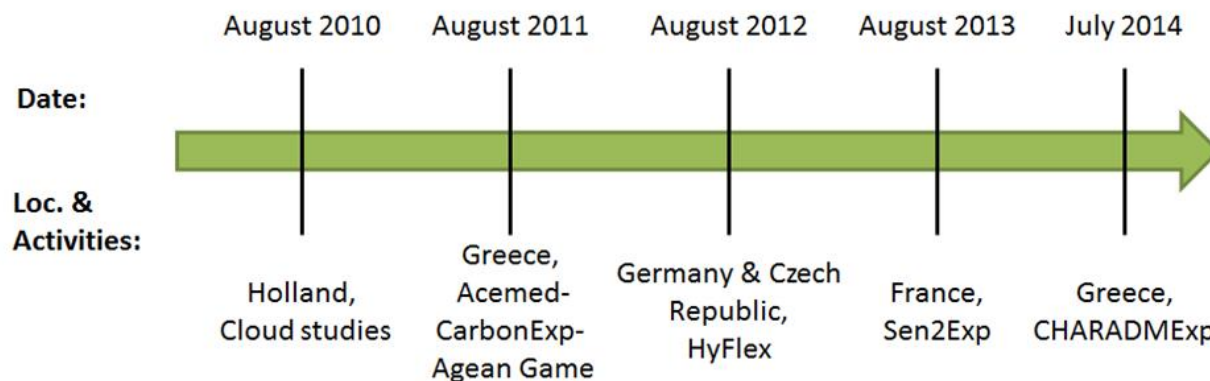


## EMORAL (Esa's Mobile RAmAn Lidar)



### Products:

- Aerosol Extinction Profile, at 355 nm and 532 nm
- Aerosol Backscatter Profile, at 355 nm and 532 nm
- Linear particle depolarization ratio, at 355 nm

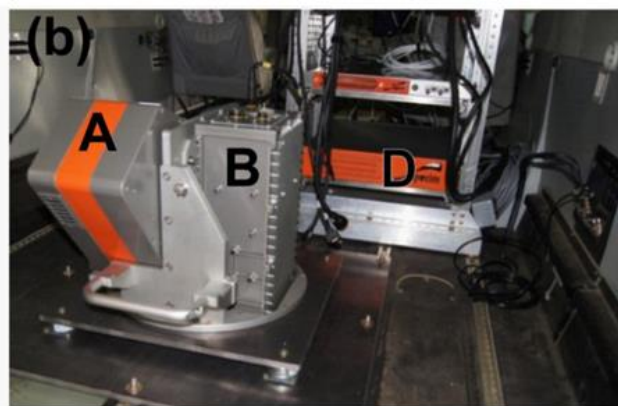
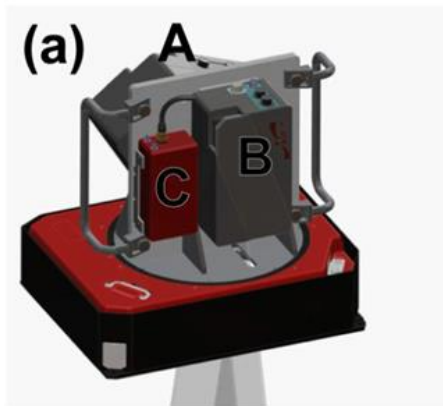


Utilization of EMORAL lidar during HYFLEX campaign, for the evaluation of atmospheric correction and sun-induced fluorescence retrieval methods



## OBJECTIVES:

1. operate and verify the new HyPlant sensor through airborne measurement activities over agricultural and forest areas.
2. calculate maps of sun-induced fluorescence using the proposed approaches of the space-borne FLEX mission and to validate these maps by ground based measurements of top-of-canopy sun-induced fluorescence.
3. compare airborne fluorescence estimates over agricultural and forest areas to ground measurements and model simulations.



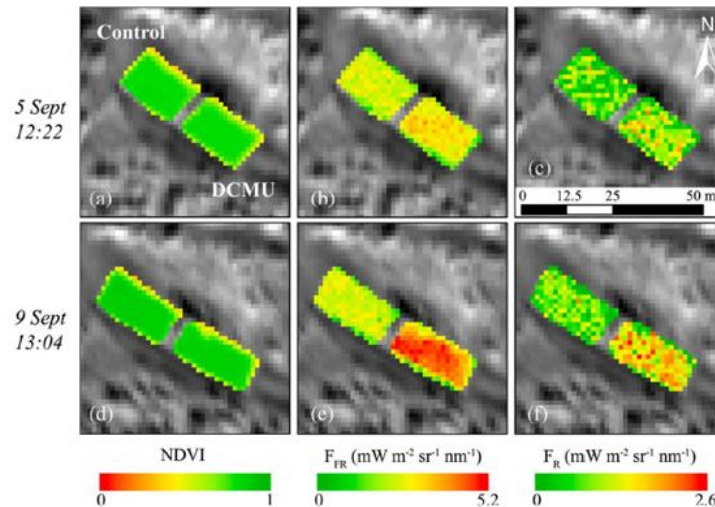




## 05 and 09 September 2012

Clean aerosol days: models succeed to make atmospheric corrections

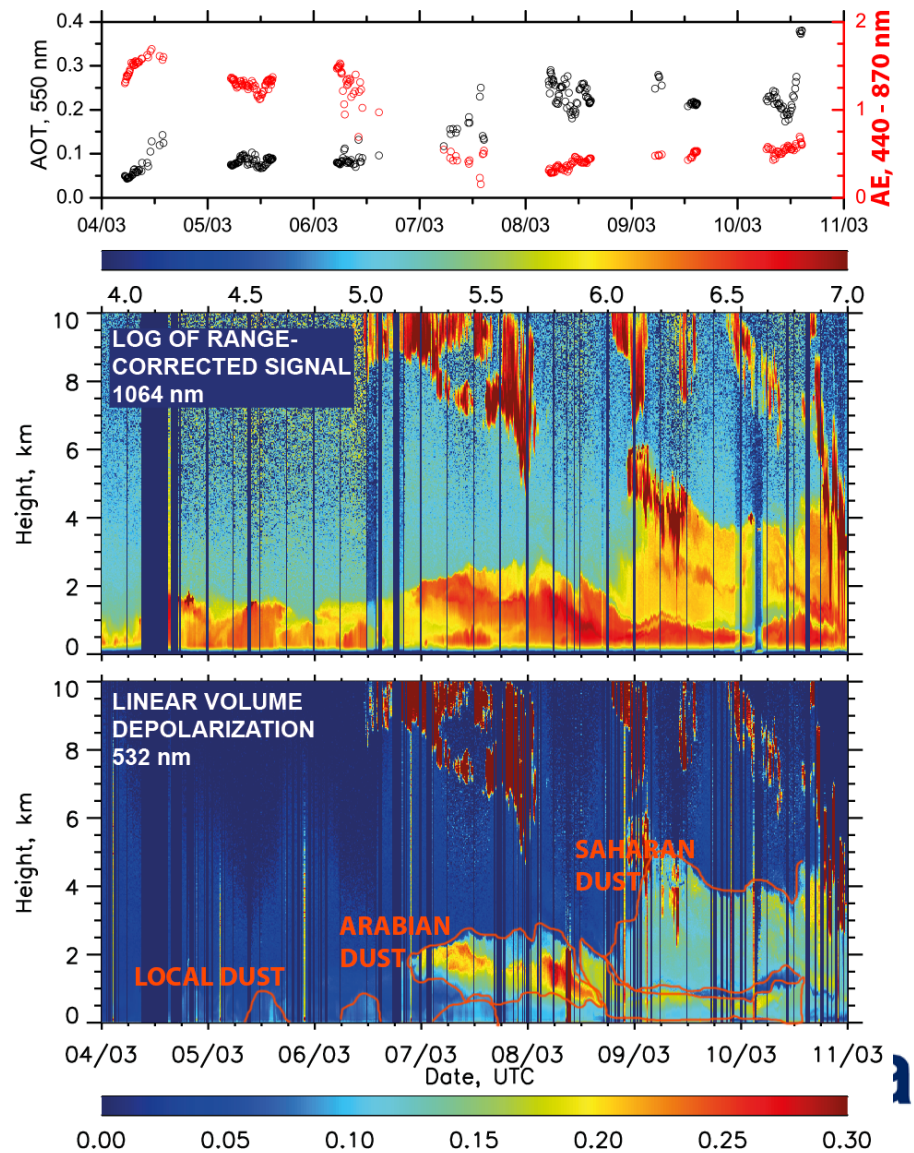
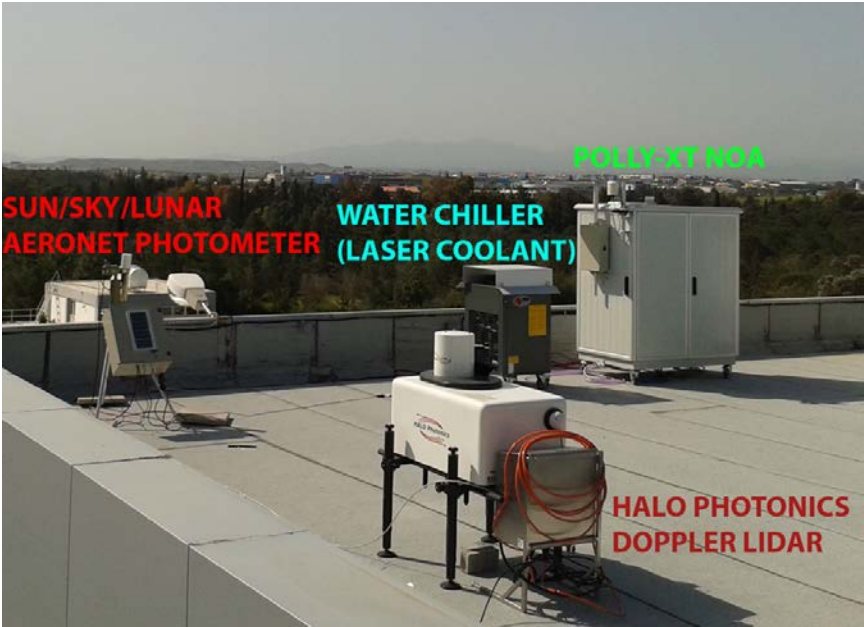
High aerosol days: the implementation of EMORAL'S aerosol extinction profiles into models was necessary for successful atmospheric corrections



**Figure 2.** Control (left) and DCMU-treated (right) grass plots in airborne images. (a, d) Normalized difference vegetation index (NDVI). (b, e) Far red chlorophyll fluorescence ( $F_{FR}$ ). (c, f) Red chlorophyll fluorescence emission ( $F_R$ ). The dates and hours (CEST) on the left indicate the data acquisition time.

\* Rossini et al., Red and far red  
Sun-induced chlorophyll  
fluorescence  
as a measure of plant  
photosynthesis, Geophysical  
Research Letters,  
10.1002/2014GL062943, 2014

Campaign performed in Cyprus by TROPOS, NOA and Cyl for adding information on Arabian dust properties. *(already presented by Ms. Mamouri)*







## Large scale experimental campaign in Eastern Mediterranean – April 2017

**NOA:**  
Replicate LACROS  
@ Crete



**DLR:**  
50 flight-hours  
over East.Med.  
(ERC project A-LIFE)



**TROPOS:**  
LACROS @ Cyprus



## Scheduled future activities

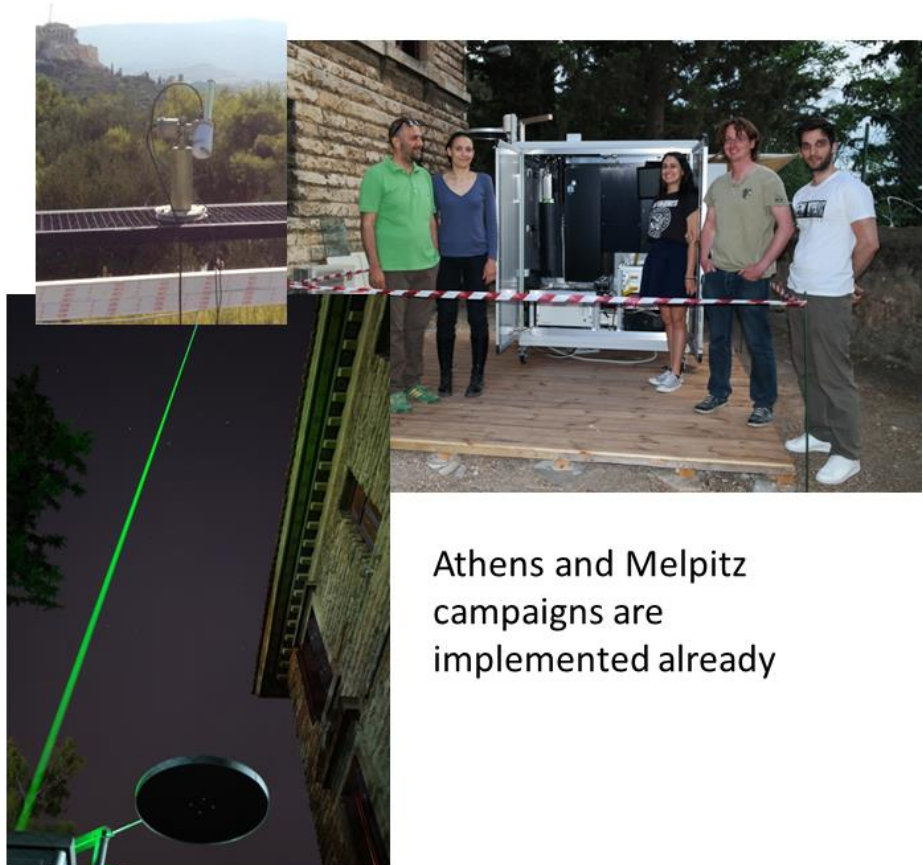
**ACTRIS-2 campaigns: NOA will organize 4 experimental campaigns @ Athens, Crete, Granada, Melpitz**

Night-time retrievals with sun/lunar/star photometer and Raman lidar



CIMEL sunphotometer   Polly<sup>XT</sup> OCEANET lidar

In-situ measurements with  
Unmanned Aerial Vehicles (UAVs)  
and/or tethered balloons



Athens and Melpitz  
campaigns are  
implemented already



## Scheduled future activities



### Proposal to ESA: VADAM: Validation of ADM-Aeolus L2 aerosol and cloud product employing advanced ground-based lidar measurements





# BEYOND

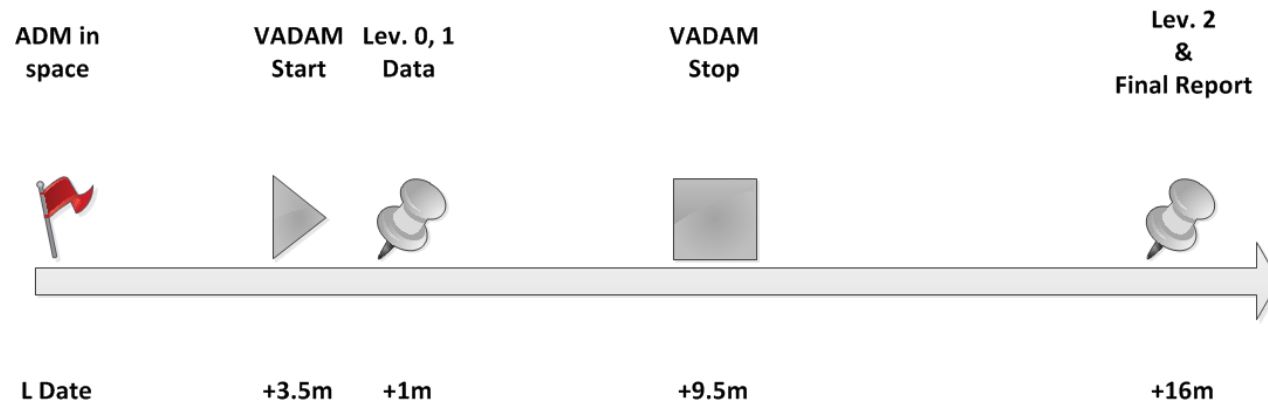
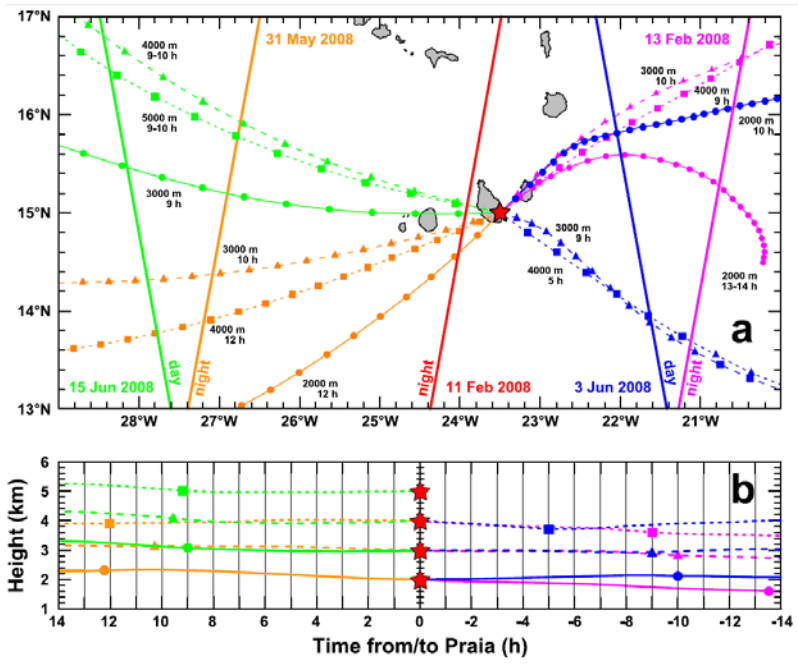
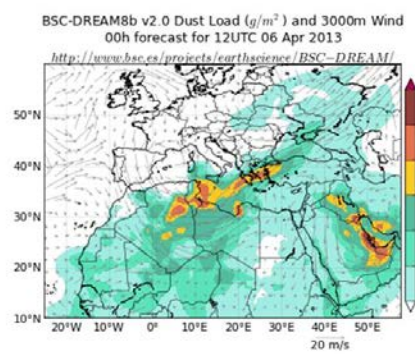
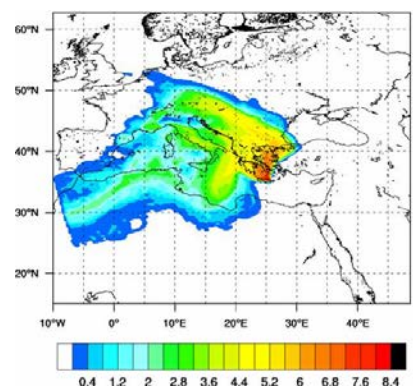
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## Scheduled future activities

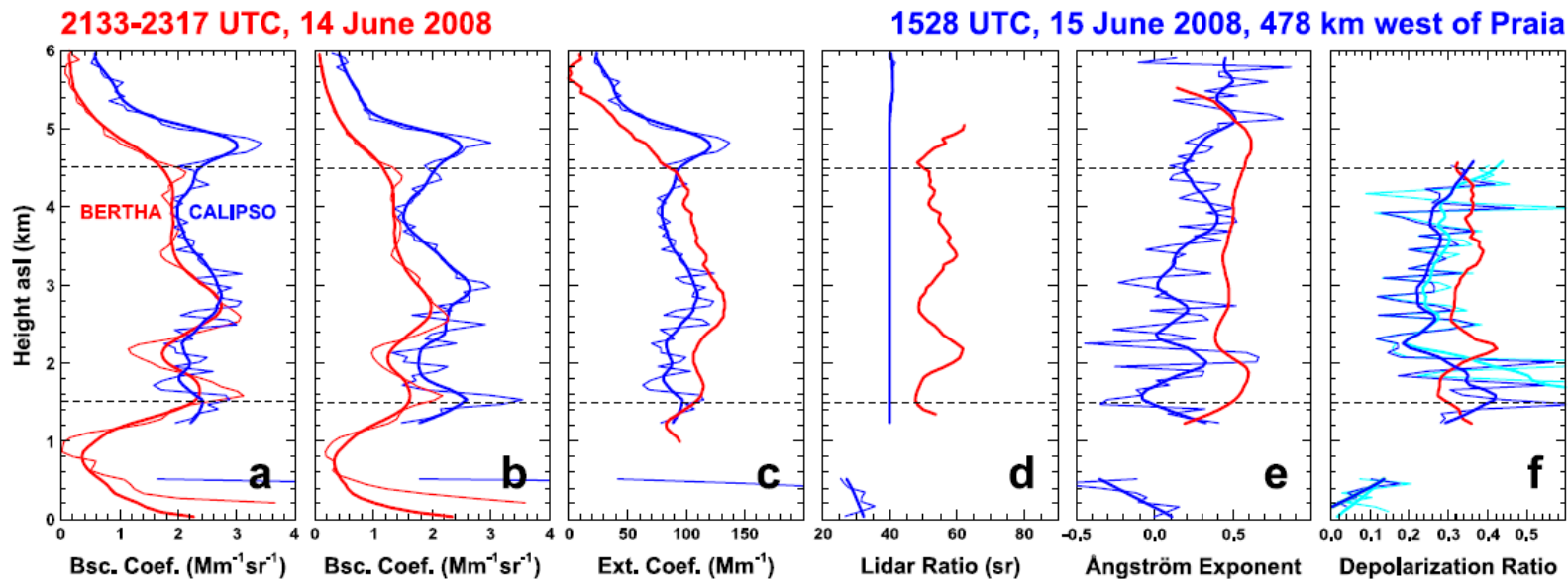
BEYOND and twining partners (TROPOS, FMI) became members of the Aeolus Product Validation and Evolution Team (APVET)

## VADAM cal/val approach

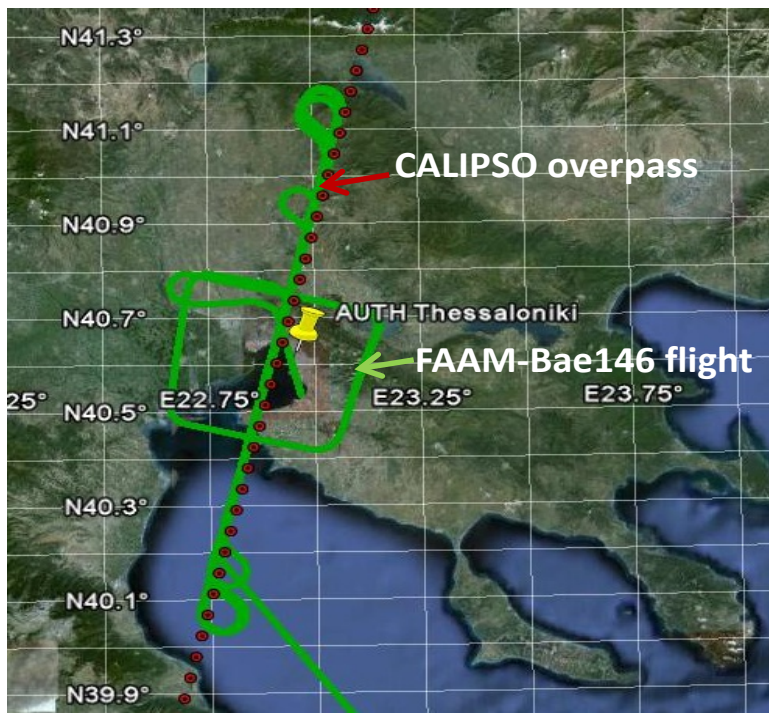




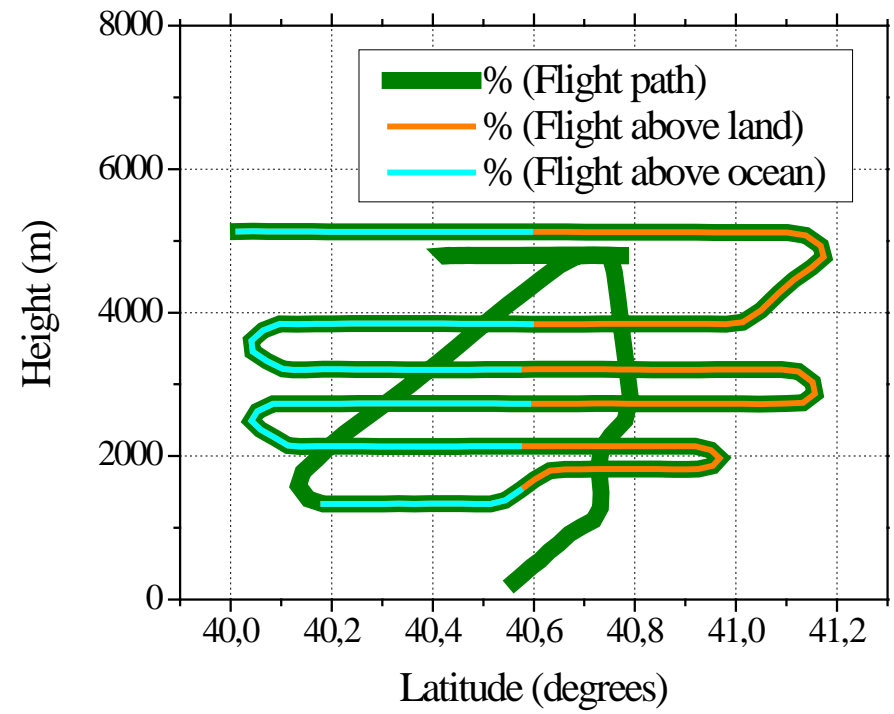
*Tesche et al., Ground-based validation of CALIPSO observations of dust and smoke in the Cape Verde region, JGR, 118, 2889-2902, doi:10.1002/jgrd.50248, 2013*



## Evaluation examples (CALIPSO case)

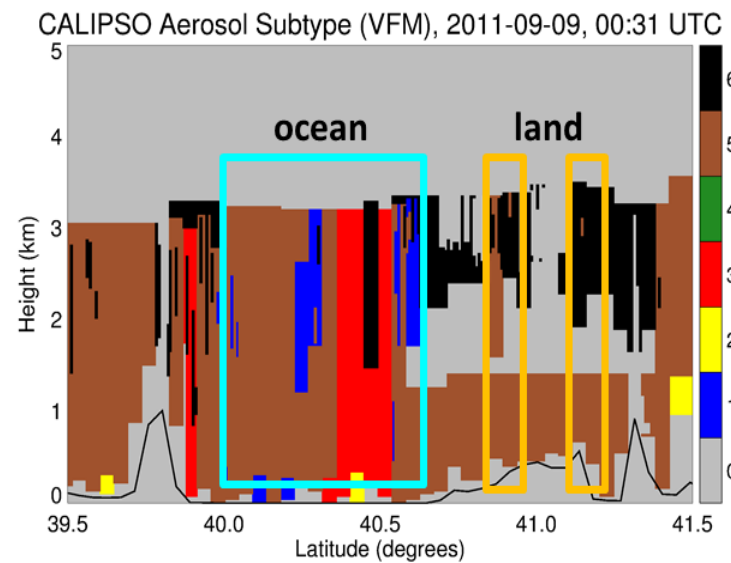
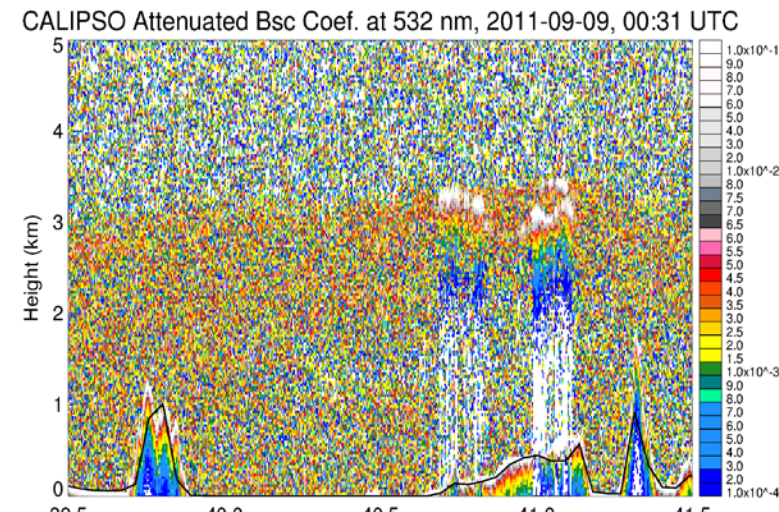
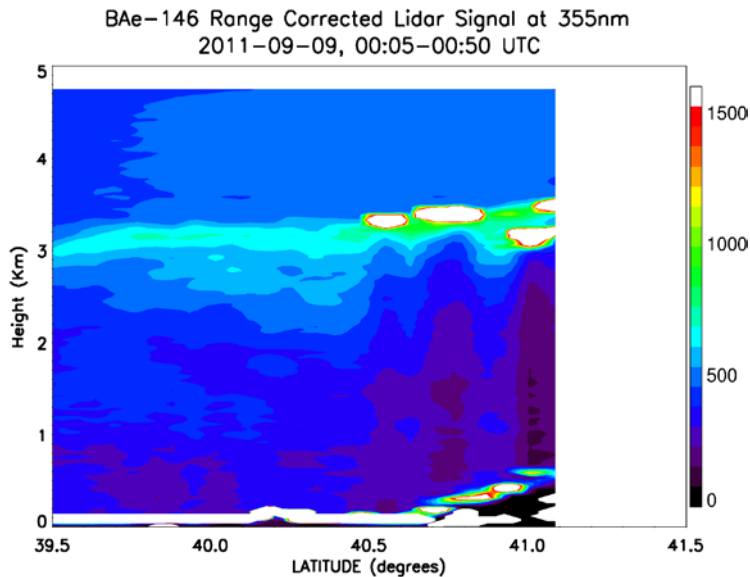


FAAM Bae146 flight path



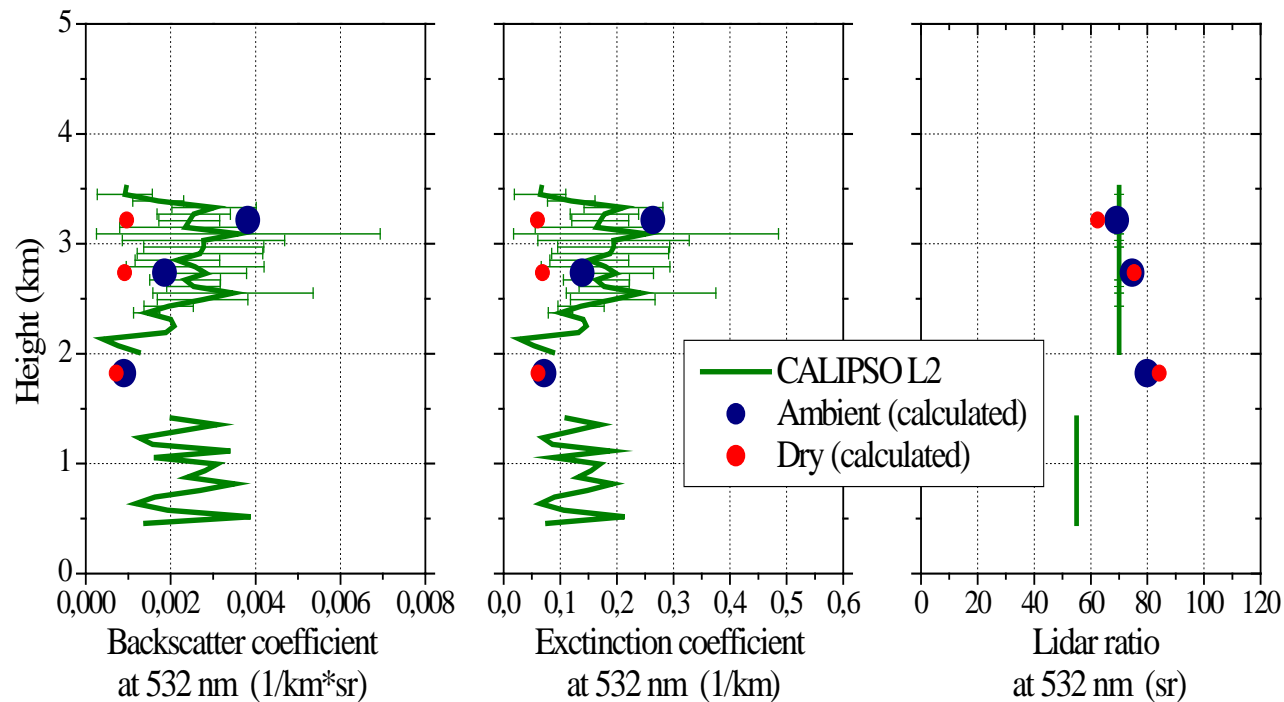


## Evaluation examples (CALIPSO case)



0: Clear Air 1: Clean Marine 2: Dust 3: Polluted Continental  
4: Clean Continental 5: Polluted Dust 6: Smoke

*Tsekeri et al., CALIPSO validation using airborne and ground-based measurements over Mediterranean in the framework of the ACEMED campaign, (under review, AMT)*







## Conclusions

1. Through BEYOND, NOA has acquired sophisticated ground-based instrumentation
2. NOA has already integrated in European Networks like ACTRIS and EARLINET
3. NOA will coordinate 4 experimental campaigns in the framework of ACTRIS.
4. BEYOND participates in large-scale campaigns scheduled for the next 3 years, collaborating with UK MetOffice, ESA, NASA and other highly esteemed Institutions/Agencies (***Namibia-2017, Kuwait-2017, United Arab Emirates-2016, Eastern Mediterranean-2017***).
5. BEYOND aims to utilize the large ground-based dataset from the campaigns for cal/val activities targeting future ESA missions (Sentinels and Earth Explorers).