



Status update about combining in-situ and remote sensing measurements

Athens field campaign

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Scope



JRA1:

Improving the accuracy of aerosol light absorption retrievals

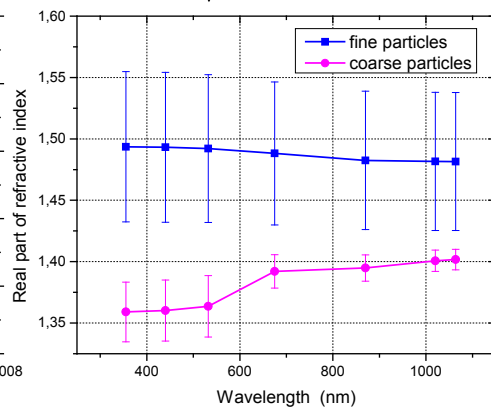
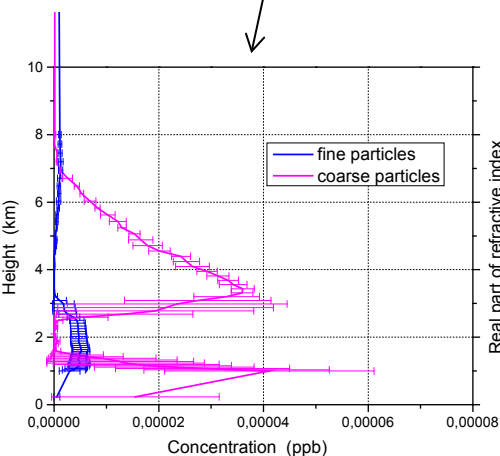
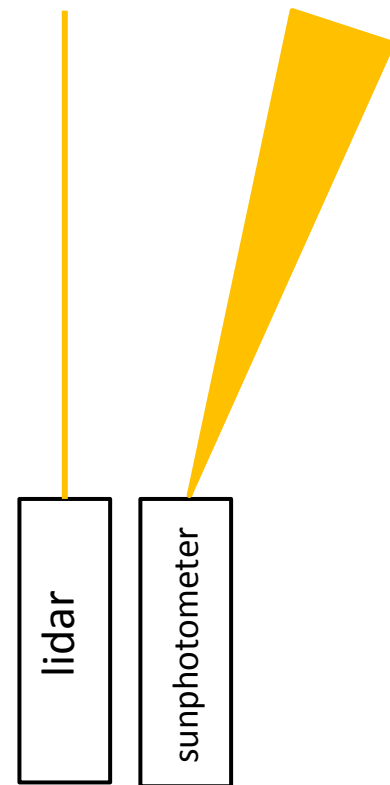
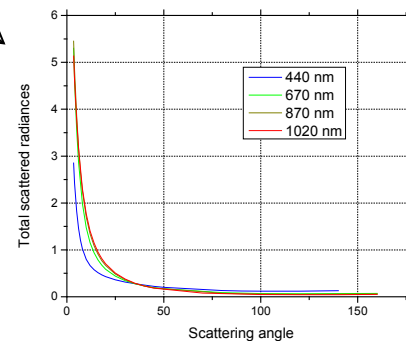
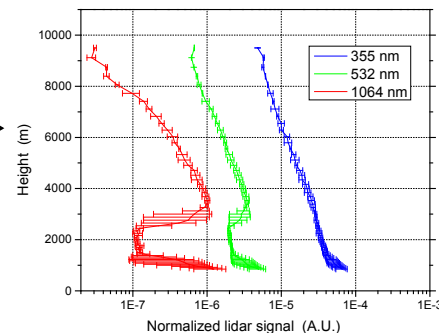
NOA task:

Evaluate the remote sensing retrievals of absorption coefficient and SSA profiles using collocated vertically-resolved in-situ measurements (deploying tethered balloons and drones –to be determined)

Remote sensing retrievals

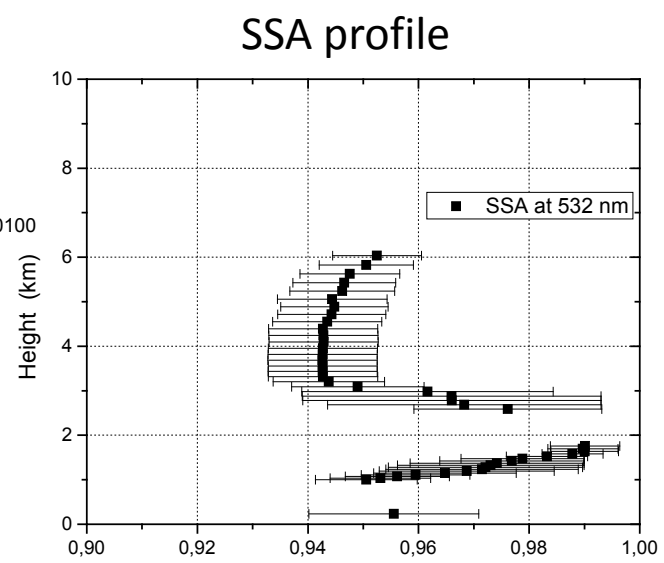
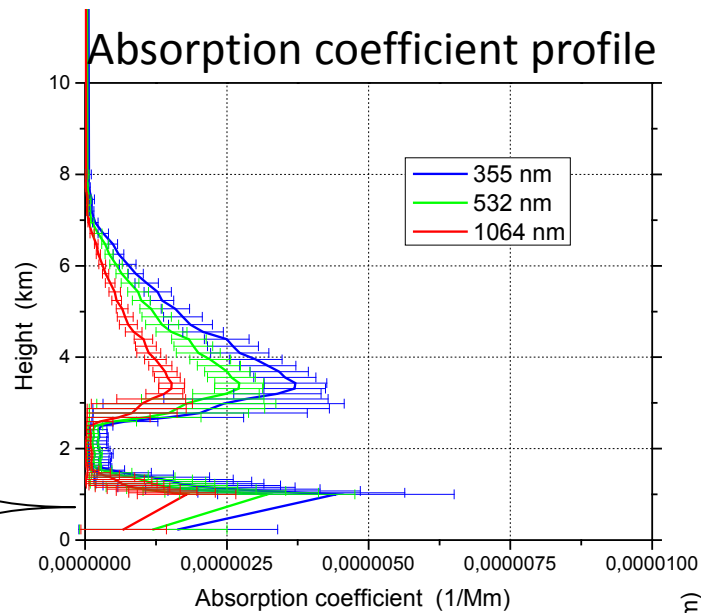
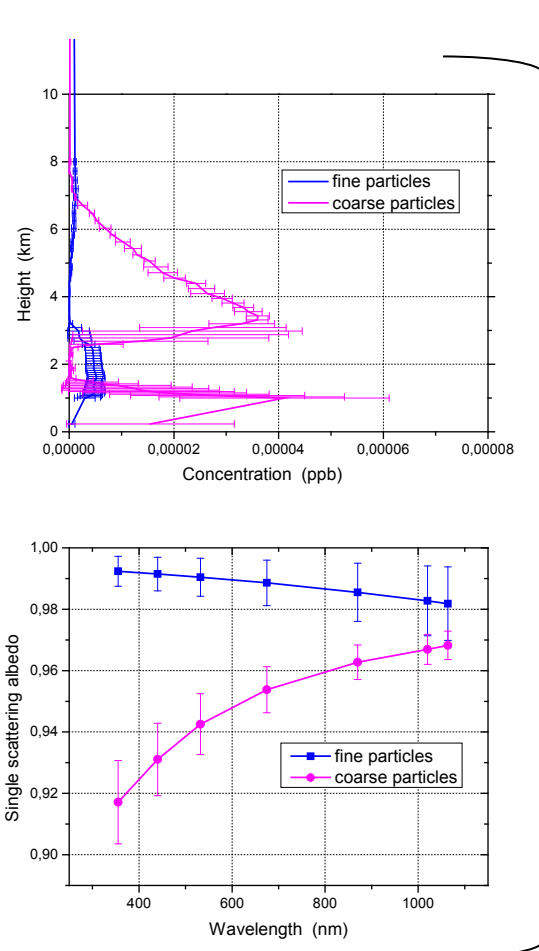
ACTRIS GARRLiC retrieval algorithm: combines lidar/sunphotometer measurements

GARRLiC	
Input	<ul style="list-style-type: none"> Lidar backscatter signal at 355, 532, 1064 nm Sunphotometer AOTs and total scattered radiances at 440, 670, 870, 1020 nm
Output	<ul style="list-style-type: none"> Concentration profiles Column-averaged size distribution, refractive index and spherical particle fraction, different for fine and coarse particles



GARRLiC absorption profile outputs

Although GARRLiC provides the column-averaged microphysical properties for fine and coarse particles, varying mixture of fine and coarse particles along the column produce varying profile information



What we need to validate GARRLiC?



GARRLiC profiles should be compared with independent source of data like airborne in-situ observations at different heights



Tethered balloon with instrumentation package
(Source: Ferrero et al., 2014)



Drones

Aerosol absorption campaign in Athens



Athens JRA1 campaign will be implemented on
1 December 2015 – 29 February 2016



PSR sunphotometer in the Thiseion site

The campaign focuses on urban aerosols and the **“smog” phenomenon** caused by wood-burning for heating purposes.

Remote sensing instrumentation as well as surface in-situ instrumentation has been located in Thiseion already, while more sensors, along with a tethered balloon and drones are expected to join.

<http://actris.eu/Events/Eventsdescriptions/WP3nov2015.aspx>

Remote sensing instrumentation

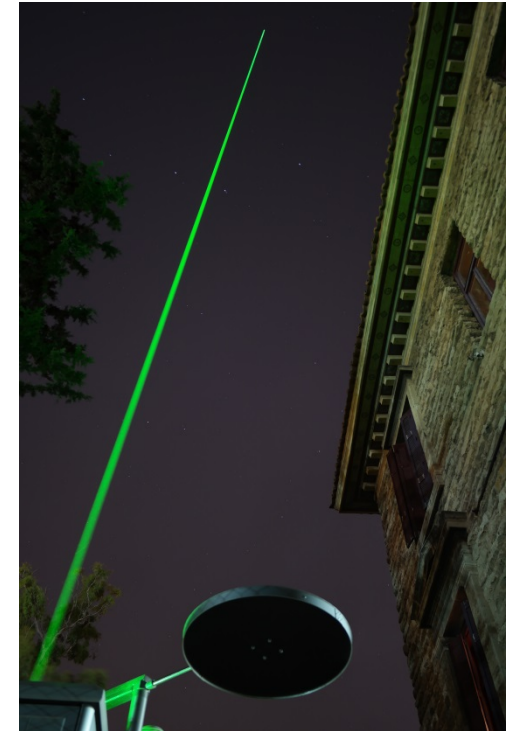
- PollyXT multi-wavelength lidar
- CIMEL sunphotometer
- PANDORA sunphotometer
- Precision solar array spectroradiometer (PSR)



PANDORA sunphotometer



CIMEL sunphotometer and PollyXT lidar in the Thiseion site



In-situ instrumentation

Drones

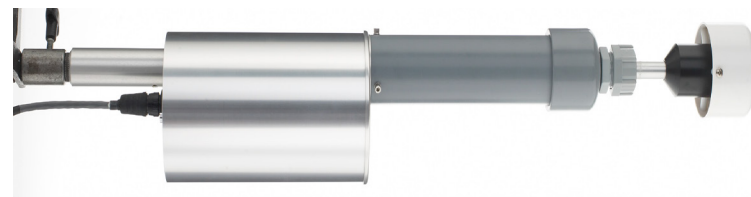
- scattering
- Met One 212 OPC
- Miniature black carbon aethalometer (TSI AE51)
- Meteorological data

Tethered balloon:

- 1.107 Environcheck Grimm OPC
- MiniDiSC (total number concentration)
- Miniature black carbon aethalometer (TSI AE51)
- Cascade impactor
- Meteorological data

Surface in-situ:

(V. Gerasopoulos presentation)



Met One 212 OPC



Miniature Black Carbon Monitor AE51

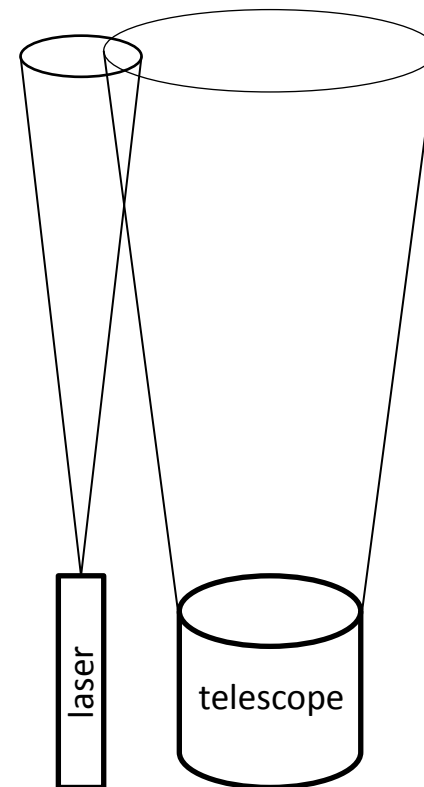
Problems in validating GARRLiC with in-situ data

- The lidar measurements are “blind” up to 700 m (the sunphotometer measurements start from the ground)
- The drones fly up to max 1000 m
- The tethered balloon reaches 2000 m, but needs big storage space

Also:

- The available in-situ instruments do not sample particles in ambient conditions
- The available OPCs do not sample all particle sizes
(will be CPC available?)

Lidar overlap effect



What we have/ what we need

What we need

- AMBIENT particle size distribution over the range 0.01-30 μm
- AMBIENT refractive index
- AMBIENT absorption and scattering coefficients
- At heights: 0 -6 km

What we have

- DRY particle size distribution over the range 0.5-10 μm
- DRY absorption
- (Scattering coefficients ?)
- At heights 0-2 km?

The problem

- **Not enough height range** from airborne in-situ measurements
- **Humidity corrections** to retrieve ambient particle parameters from the dried in-situ measured properties

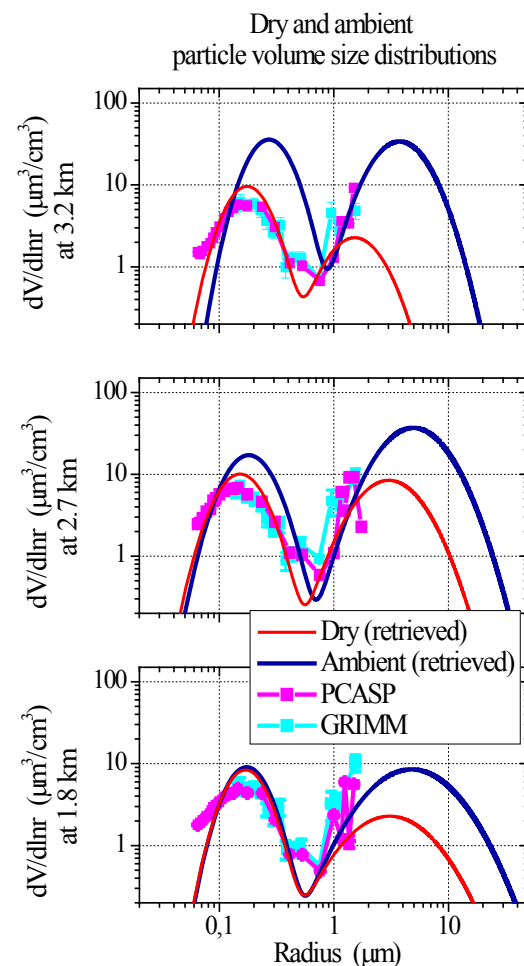
What we plan to do



The aerosol absorption coefficient and SSA profile retrievals from GARRLiC will be compared to a number of different in-situ techniques: Tethered balloons and drones will be employed, measuring:

- Absorption and scattering coefficients with multi-wavelength aethalometers, nephelometers
- Particle size, with particle sizers

What about the humidity correction?
Maybe model the hydration with ISORROPIA model?



Model the particle hydration with ISORROPIA for ACEMED campaign

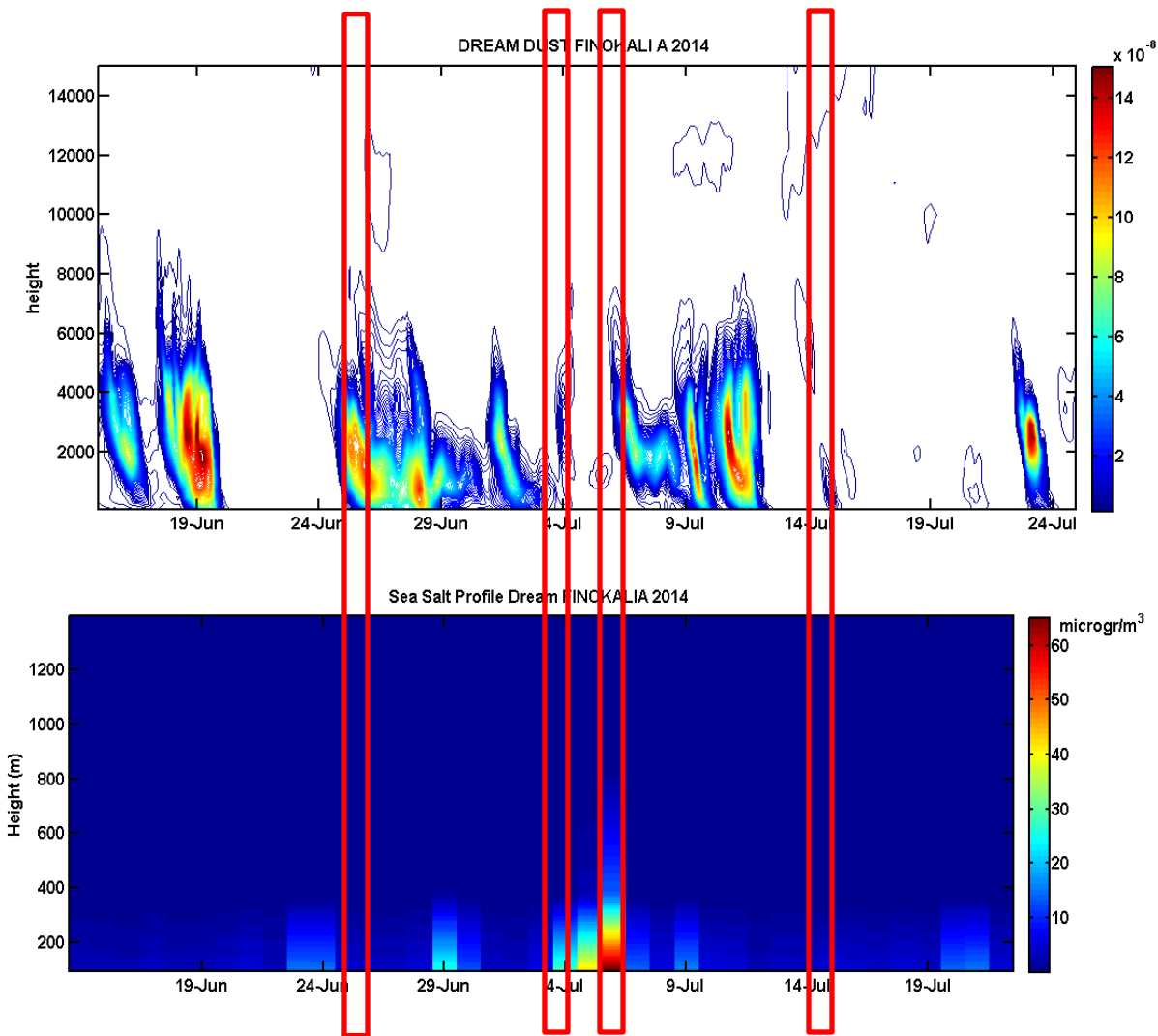
ESA-CHARADMExp campaign



Characterization of Aerosol mixtures of Dust And Marine origin
20/6-10/7/2014 Finokalia ACTRIS site, Creta, Greece



Dust and dust/marine cases

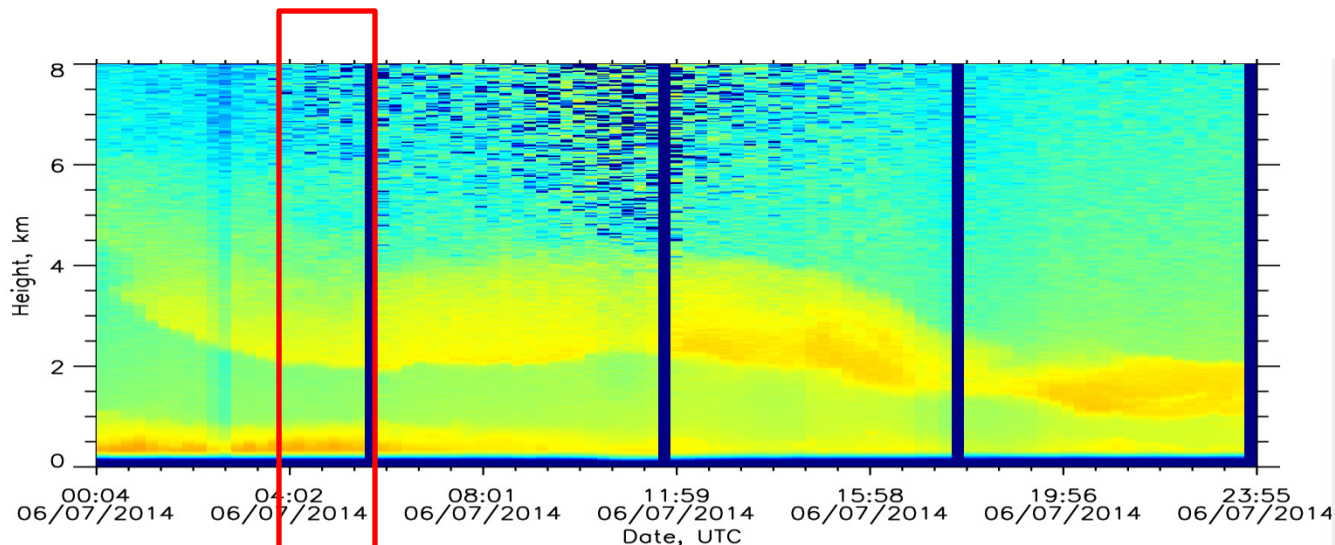


- 26/6: Dust
- 4/7: Dust and marine
- 6/7: Dust and marine
- 15/7: Marine

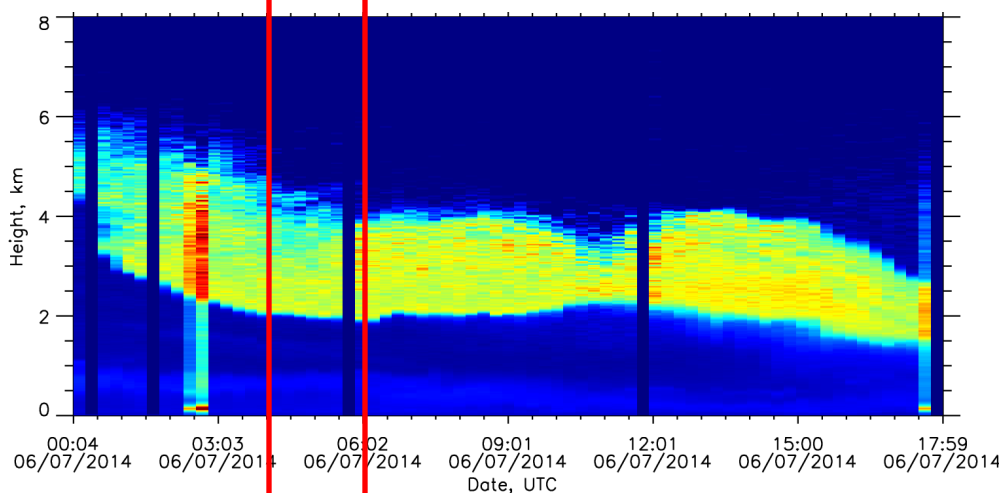
Dust+marine case 06/07/2014

Lidar quicklooks

Range-corrected signal
at 1064 nm (log)



Volume Depolarization
Ratio 532 nm

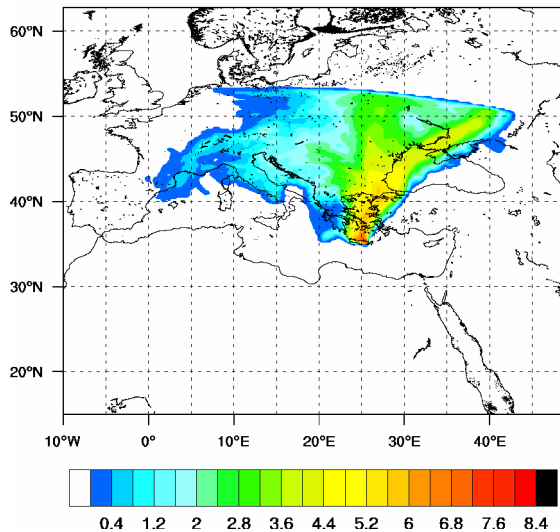


All day 2 (mostly)
distinct layers of
dust particles at 3-6
km and marine
particles at 0-1 km.

Emission sensitivity modelling

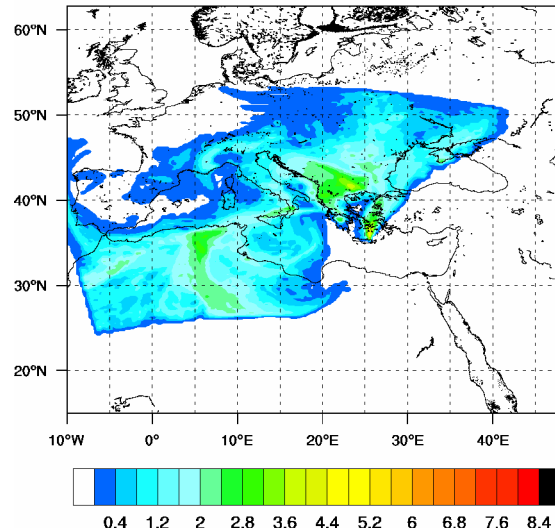


0-1 km



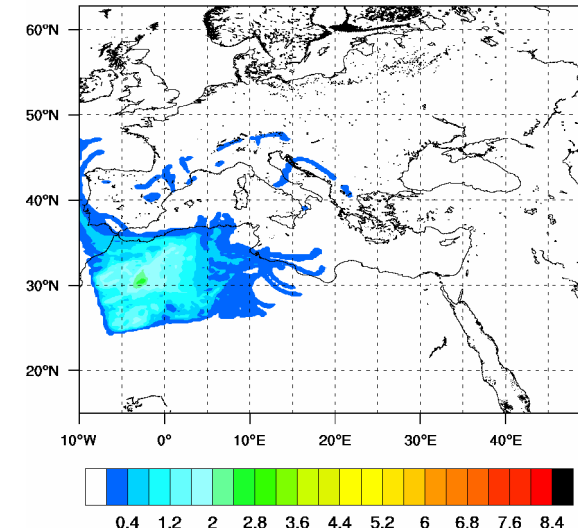
(log) [s m³ kg⁻¹]

2-3 km



(log) [s m³ kg⁻¹]

4-6 km



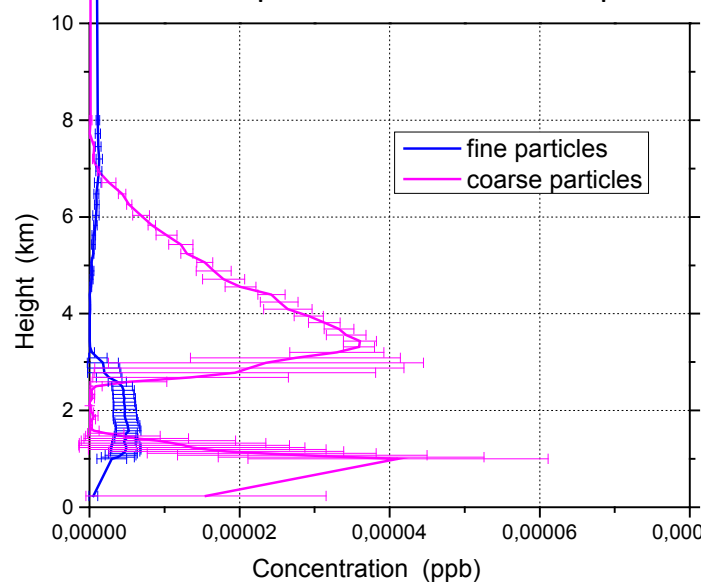
(log) [s m³ kg⁻¹]

- From surface to 1 km mainly marine particles
- Layer at 1-3 km mixture of dust and marine (maybe continental also?) particles
- Above 3 km only dust particles

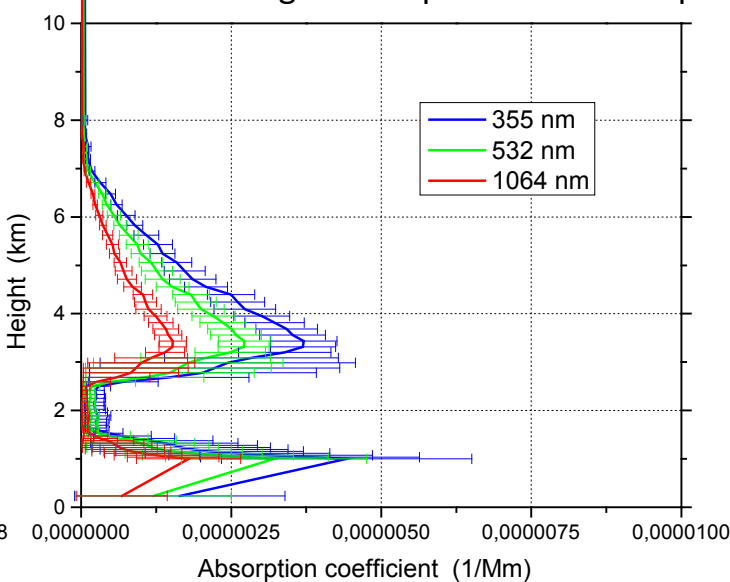
GARRLiC results



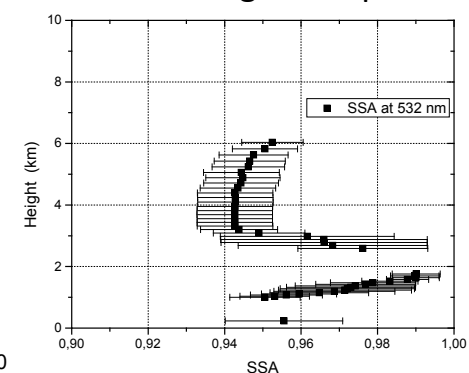
Fine and coarse particle concentration profiles



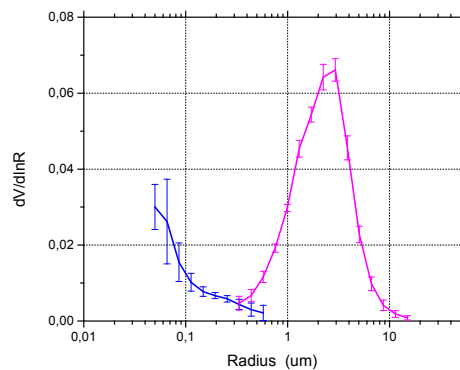
Multi-wavelength absorption coefficient profiles



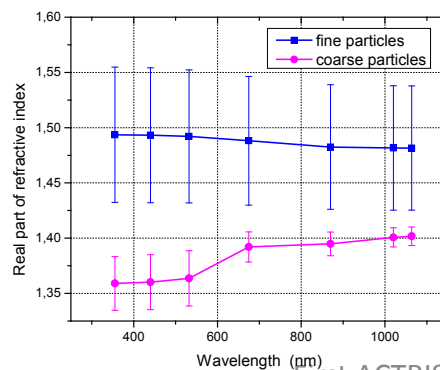
Multi-wavelength SSA profiles



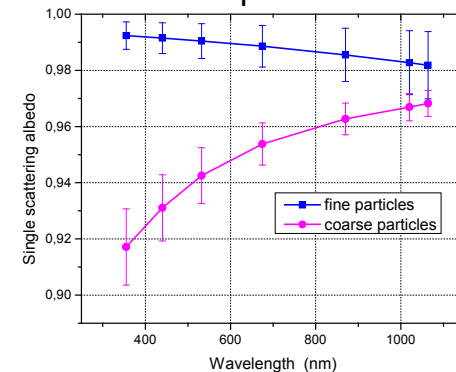
Column-averaged fine and coarse particle size distribution



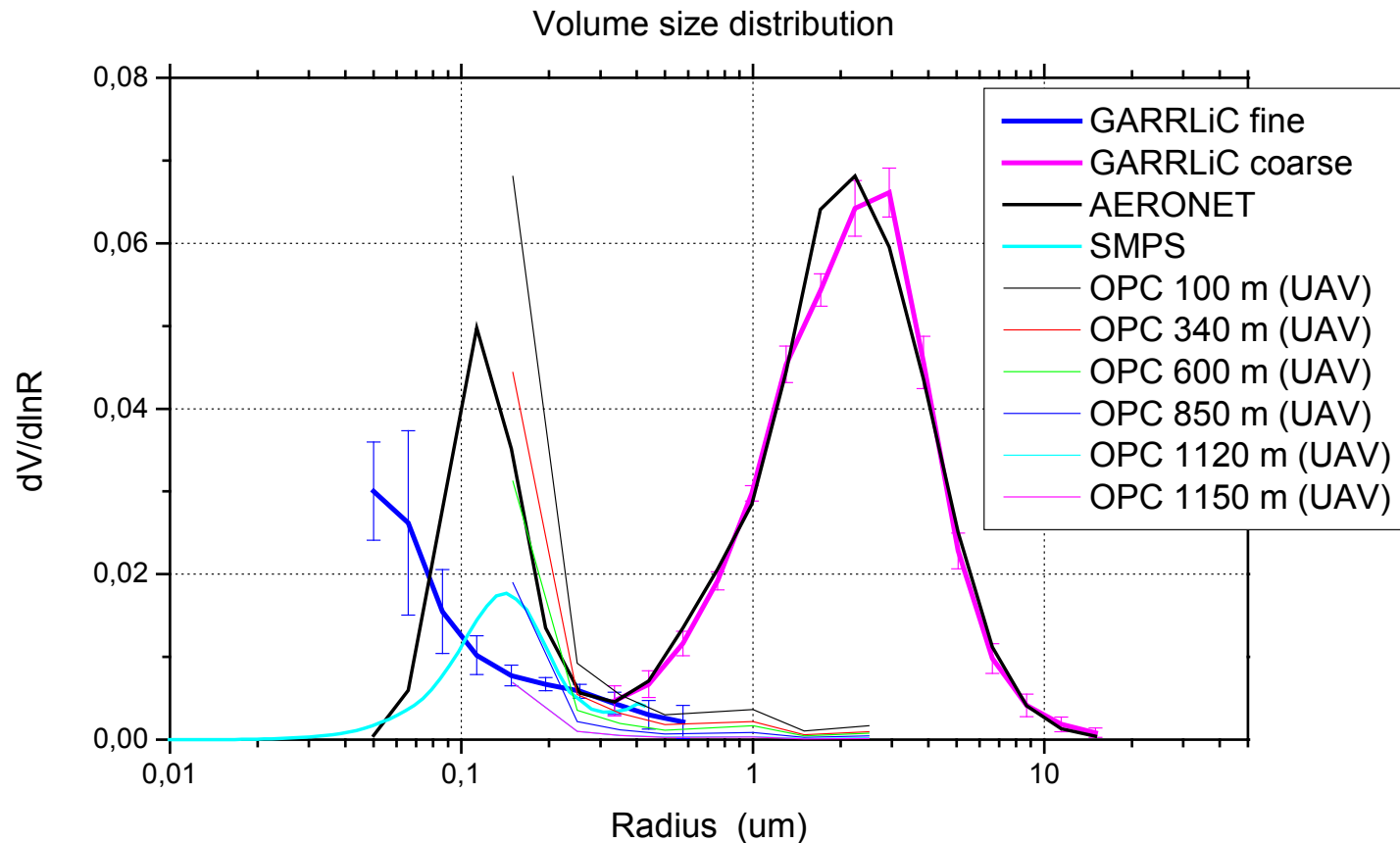
Column-averaged fine and coarse particle refractive index



Multi-wavelength column-averaged fine and coarse particle SSA



GARRLiC SD comparison with surface and UAV in-situ measurements





Overview of the ESA-CHARADMExp results

- GARRLiC provides overall good results even for low AODs (~ 0.2 at 500 nm)
- GARRLiC works well for the more homogeneous cases
- For the case of *separated dust and marine layers* GARRLiC seems to assign *mean* properties of dust and marine particles to both layers
- What will happen for the smoke mixtures in Athens campaign, it remains to be seen...

Discussion



- Combining remote sensing with in-situ data is very crucial for validating the remote sensing retrievals
- What we need from the in-situ community:
 - High-quality in-situ measurements at the max height range possible
 - Ambient aerosol properties (hygroscopic growth correction)

THANK YOU!