New remote sensing-based methodologies and parameters for the optimization of BEYOND atmospheric services in the Eastern Mediterranean

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Cyprus University of Technology, Limassol, Cyprus

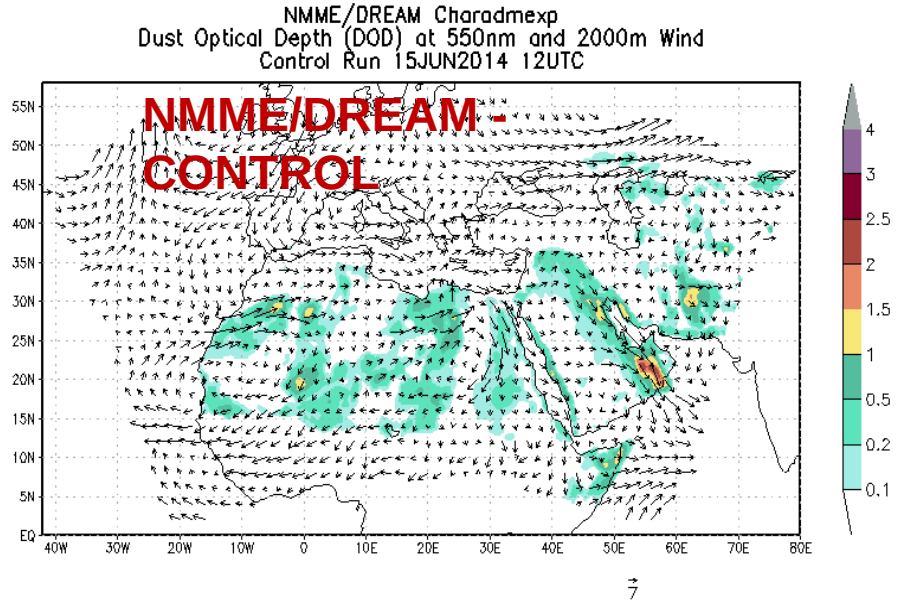
1. Eastern Mediterranean, aerosol sources and types
2. Atmospheric remote sensing techniques
3. BEYOND activities and methodologies
4. Aerosol Optical Properties
5. From AOP to aerosol related concentrations

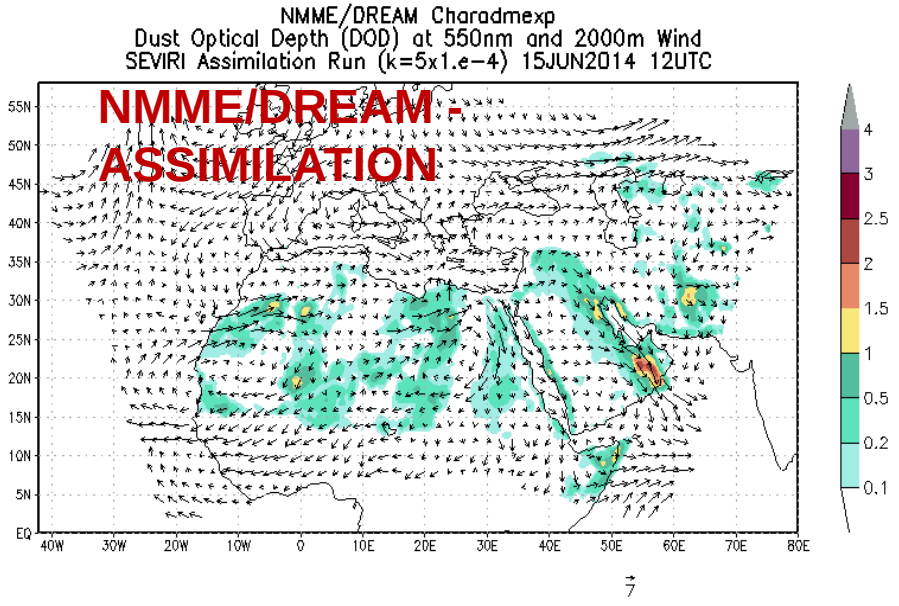
   mass, volume, surface, ice nuclei
6. BEYOND applications

   from observations to simulations

   from ground to space
7. beyond……BEYOND

Desert dust modeling and forecasting





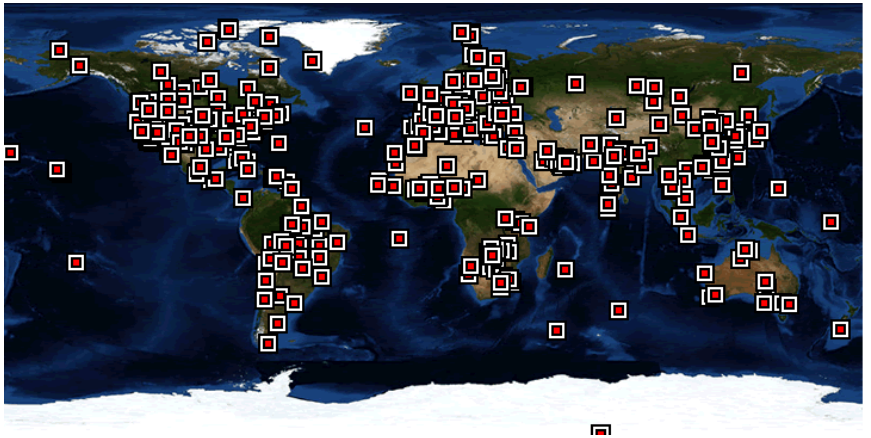
Assimilation Effects

- Cuts dust production over Arabian Peninsula
- Saharan dust sources are represented in finer detail
- Dust increases over Iberian Peninsula
- Sahel sources may be too strong

Eastern Mediterranean: an atmospheric cross path


BE ND
Building a Centre of Excellence
for EO-based monitoring of Natural Disasters
IAASARS
Haze and fire smoke
Anthropogenic pollution
Cyprus
Middle East dust
Saharan mineral dust
Intense events and
complex aerosol mixtures in the Eastern Mediterranean

Cyprus Atmospheric Remote Sensing station: April 2010-present



Cyprus University of Technology

LM EARLINET station

δ_{532nm}

β_{532nm} , β_{1064nm}

a_{532nm}

CUT-TEPAK #611 AERONET

8 channels from 340 to 1640 nm wavelength

BEYOND
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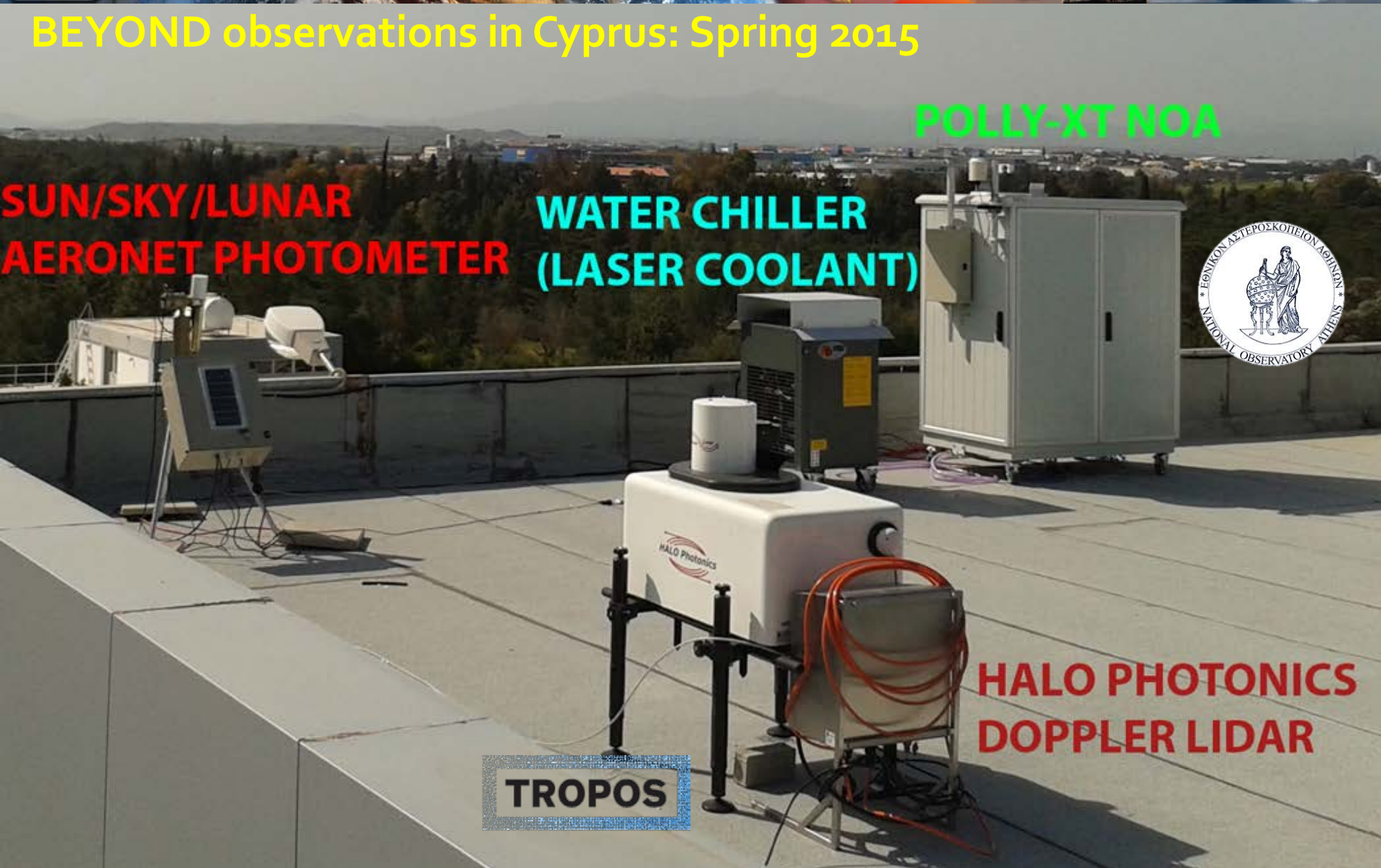
IAASARS

BEYOND observations in Cyprus: Spring 2015



BEYOND

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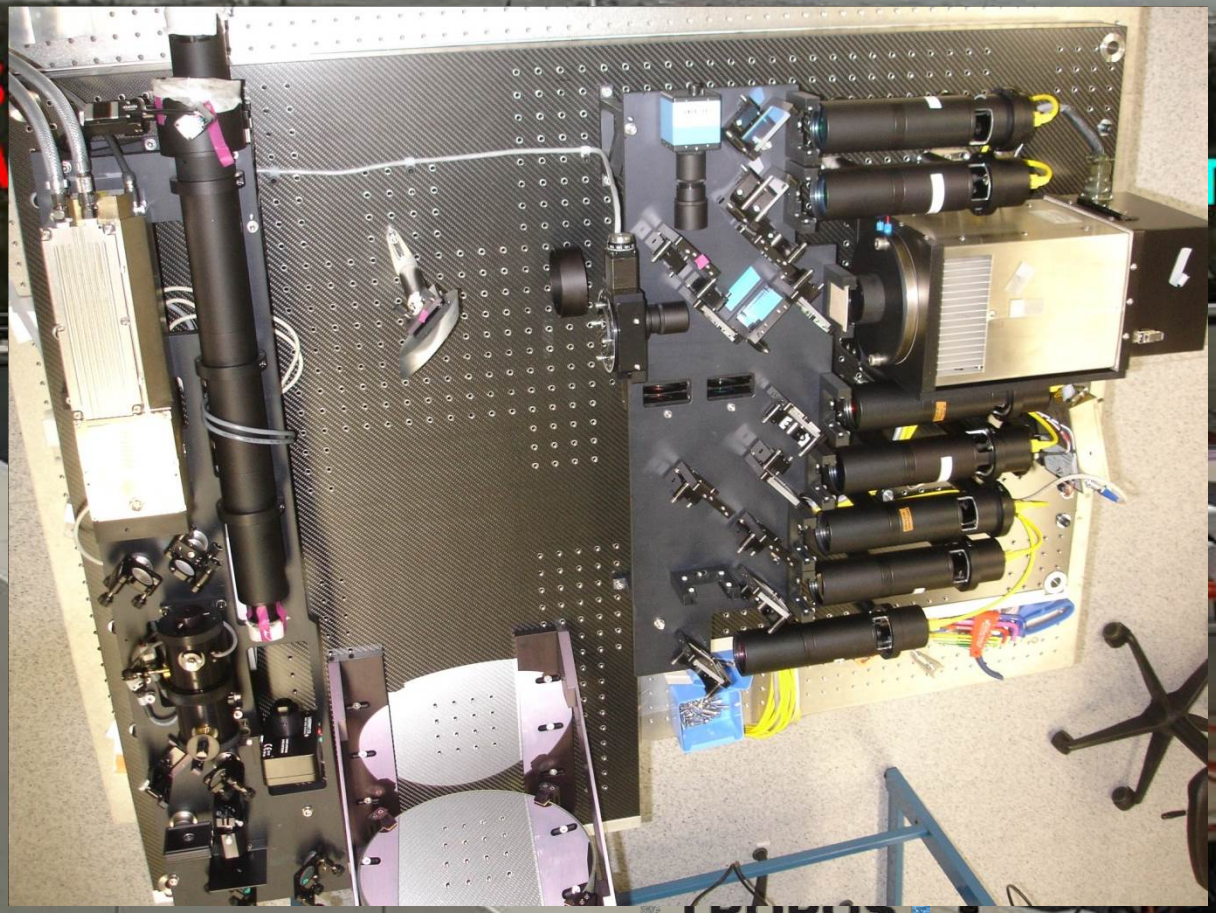
for EO-based monitoring of Natural Disasters

IAASARS

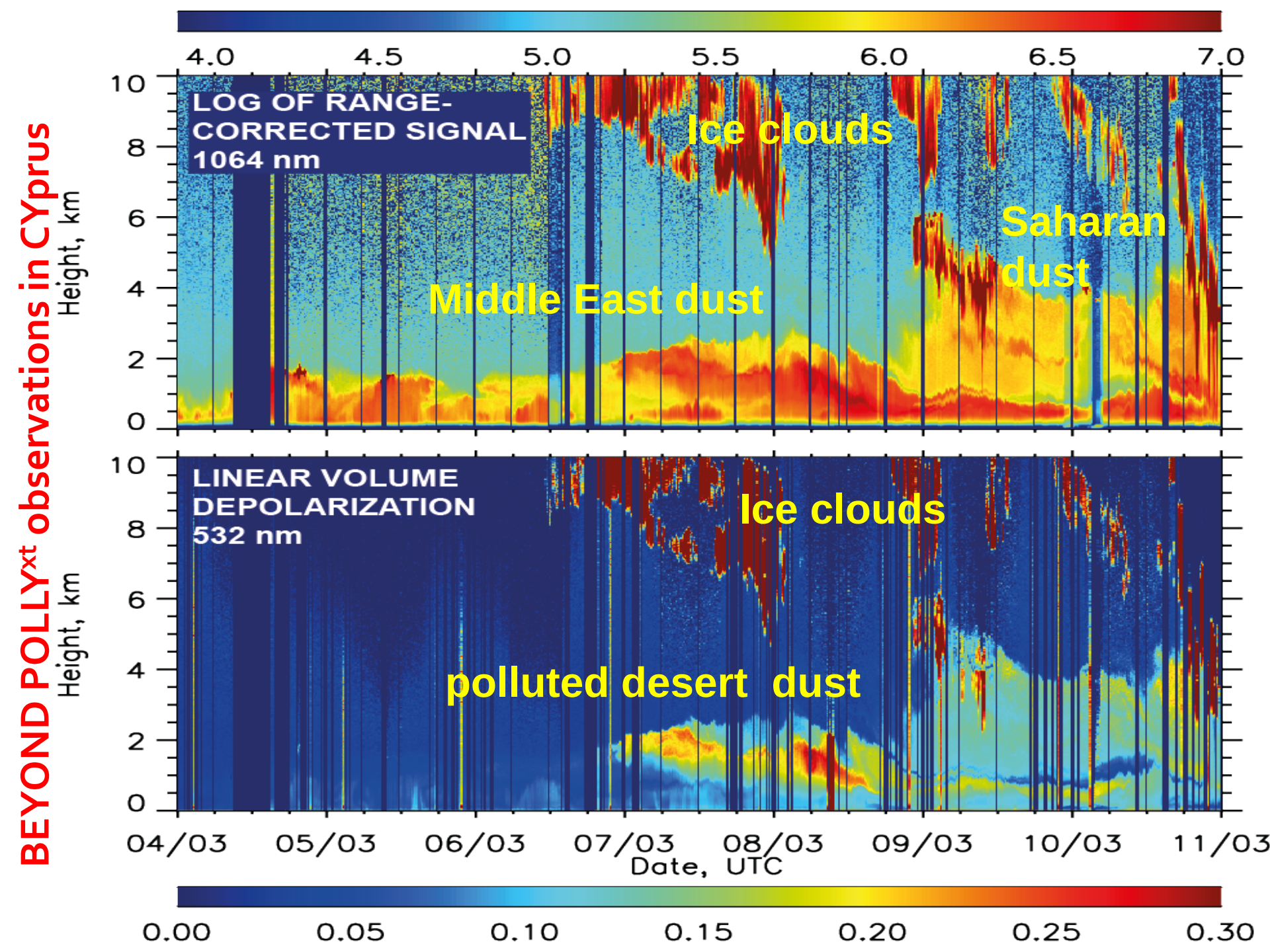
BEYOND POLLY^{xt} 8-λ depolarization-Raman lidar



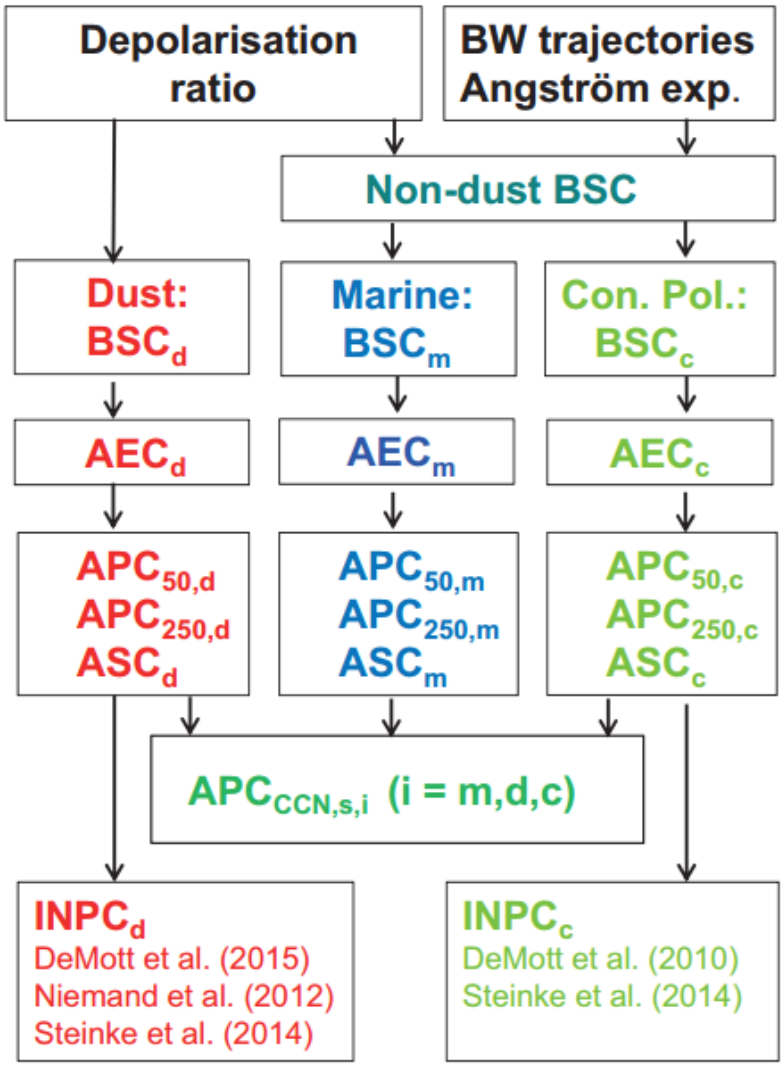
POLLY-XT NOA

HALO PHOTONICS
DOPPLER LIDAR

TROPOS


BEYOND POLLY^xt observations in CYprus
LOG OF RANGE-CORRECTED SIGNAL 1064 nm
Ice clouds
Saharan dust
Middle East dust
LINEAR VOLUME DEPOLARIZATION 532 nm
Ice clouds
polluted desert dust
Height, km
Date, UTC
04/03
05/03
06/03
07/03
08/03
09/03
10/03
11/03
4.0
4.5
5.0
5.5
6.0
6.5
7.0
0.00
0.05
0.10
0.15
0.20
0.25
0.30

new combined techniques



LIDAR

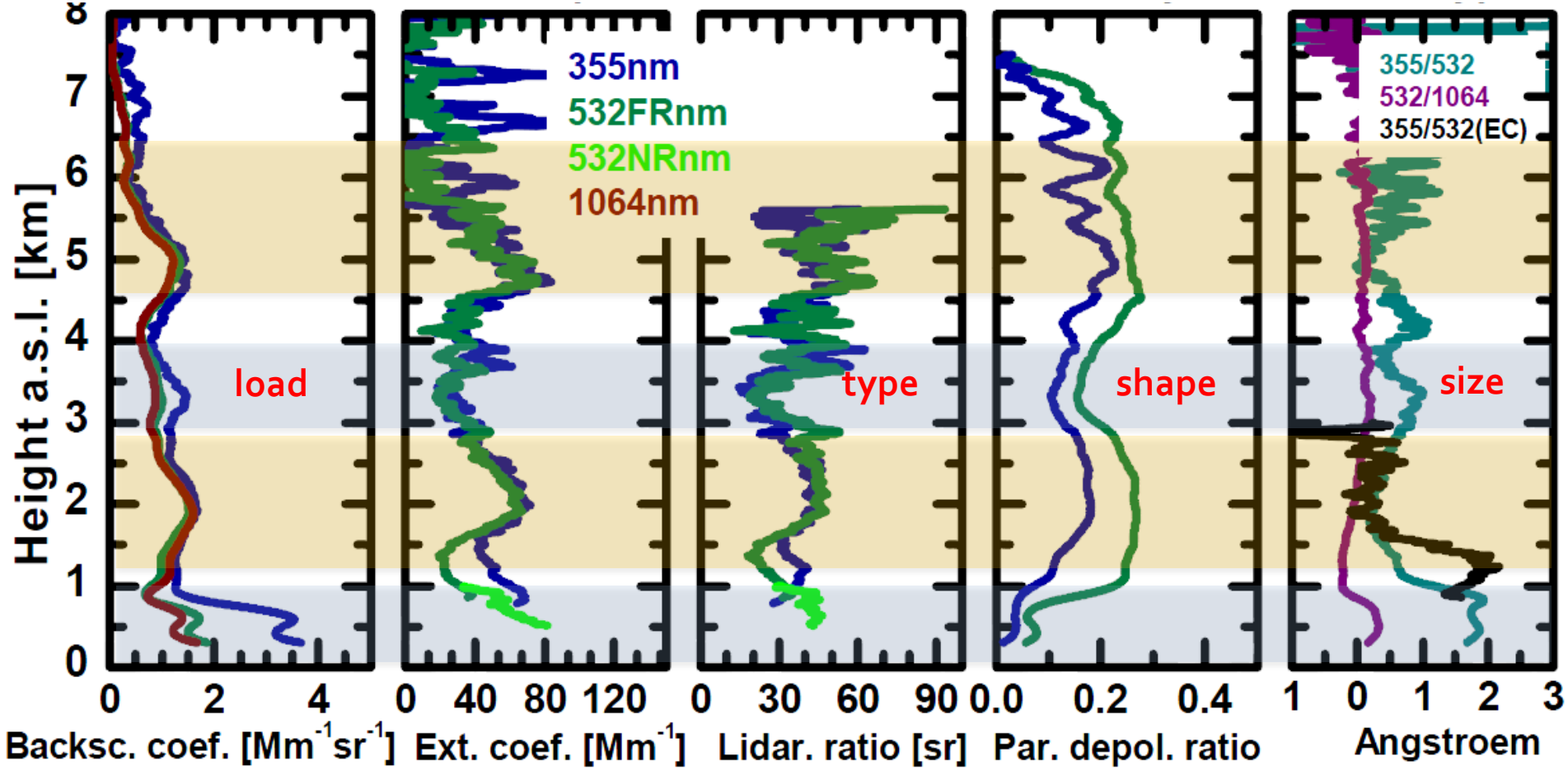
Mamouri and Ansmann, 2014

AERONET

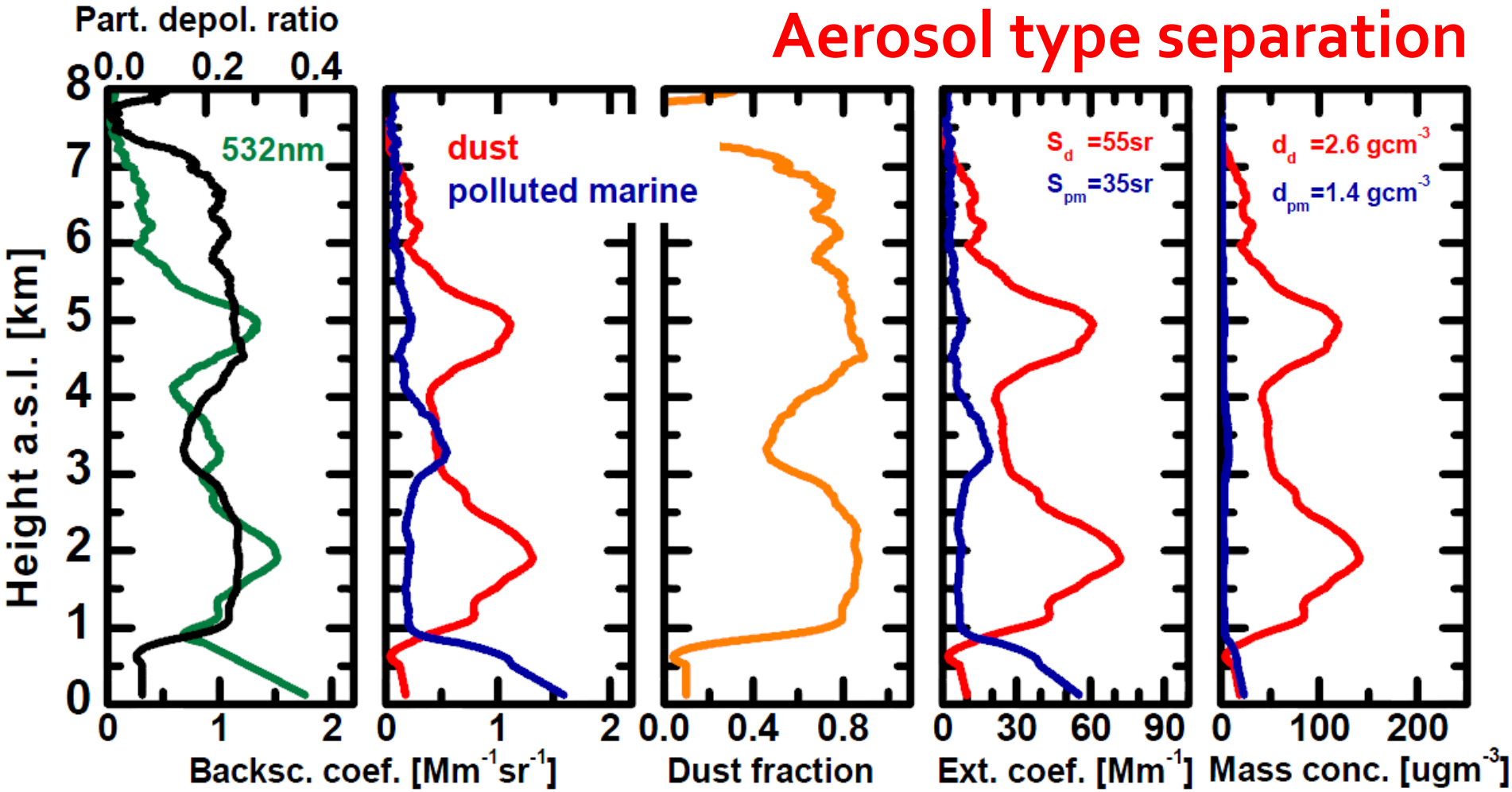
Mamouri and Ansmann, 2016
to be submitted to ACPD

LITERATURE

BEYOND multi-λ lidar: Full set of optical properties

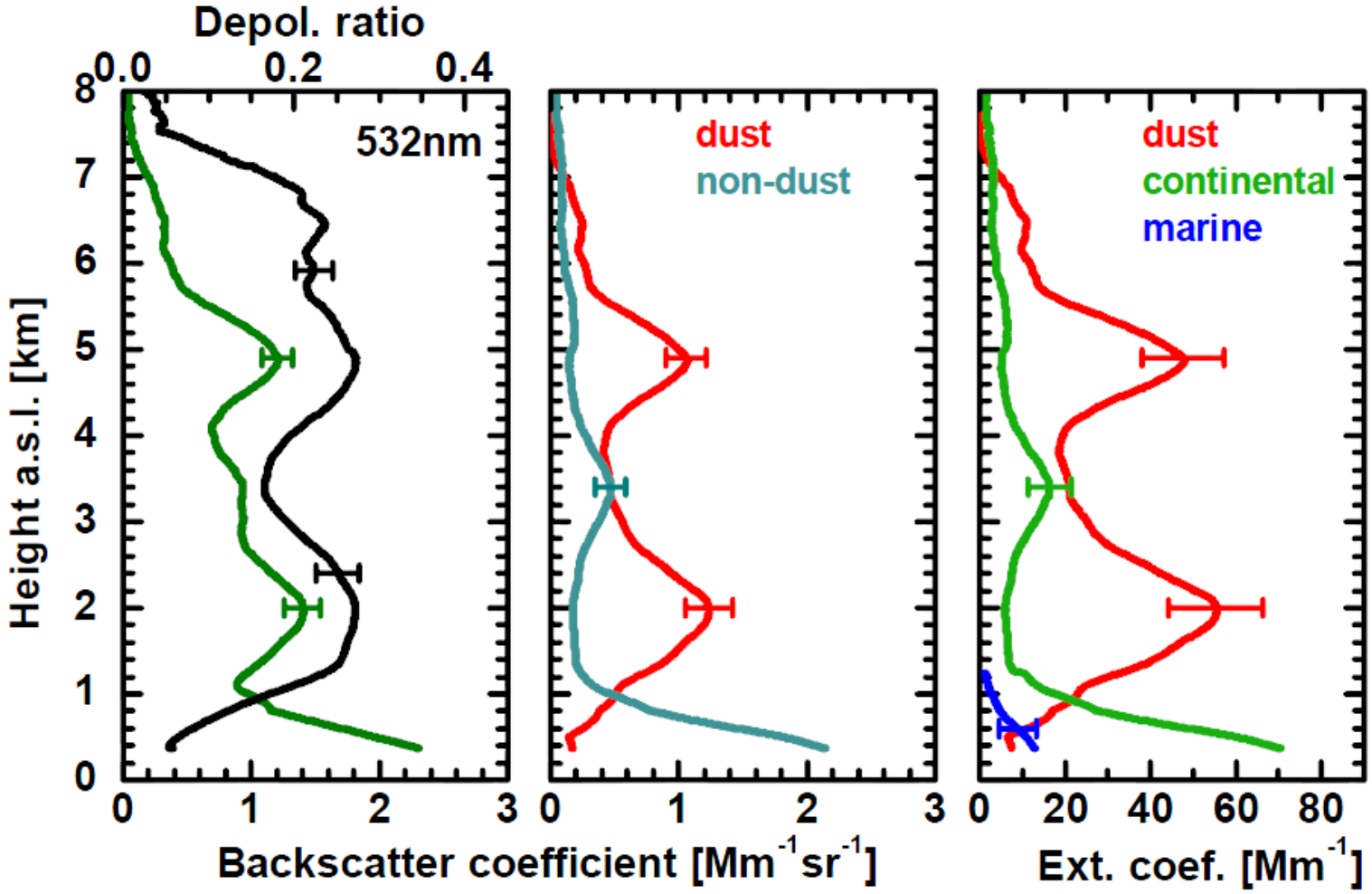


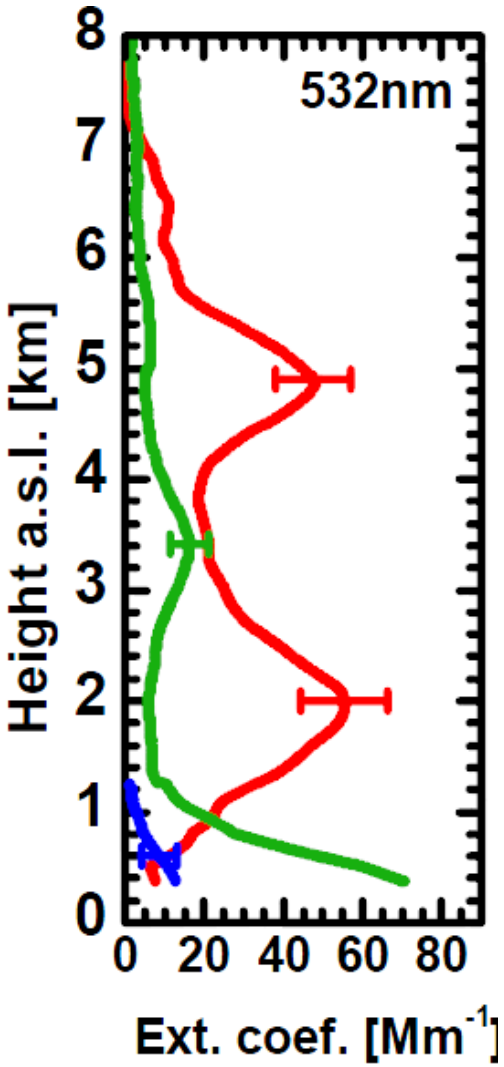
Aerosol type separation

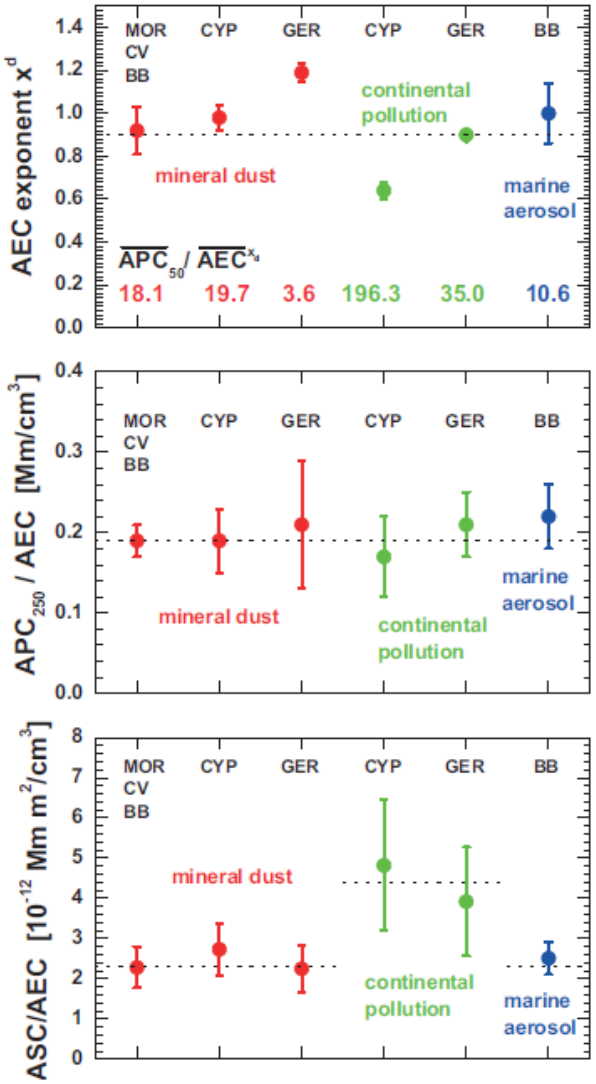


Aerosol separation

POLIPHON-method

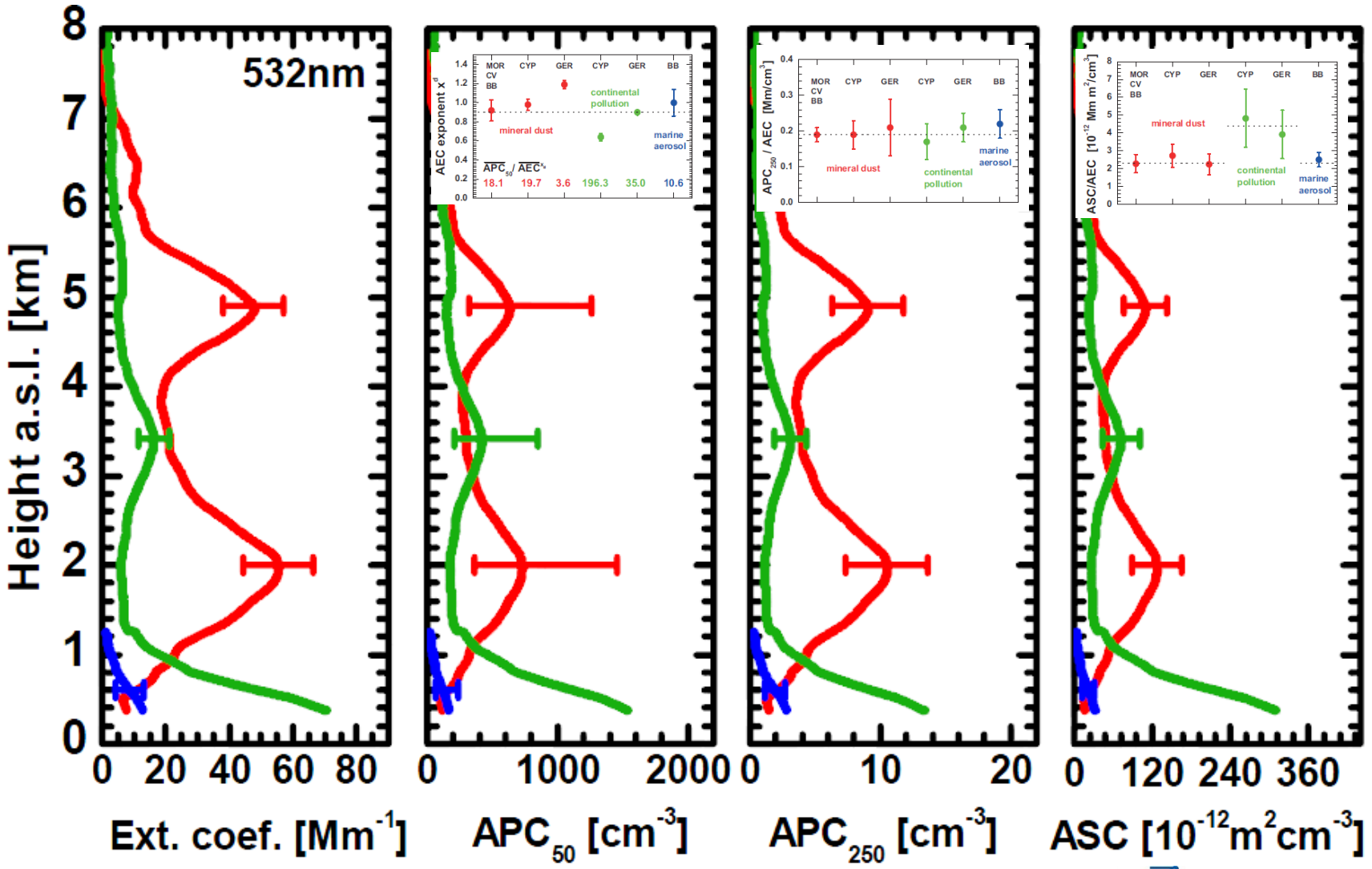

Depol. ratio
0.0
0.2
0.4
532nm
dust
non-dust
dust
continental
marine
Height a.s.l. [km]
0
1
2
3
4
5
6
7
8
0
1
2
3
0
1
2
3
0
20
40
60
80
Backscatter coefficient [Mm-1sr-1]
Ext. coef. [Mm-1]



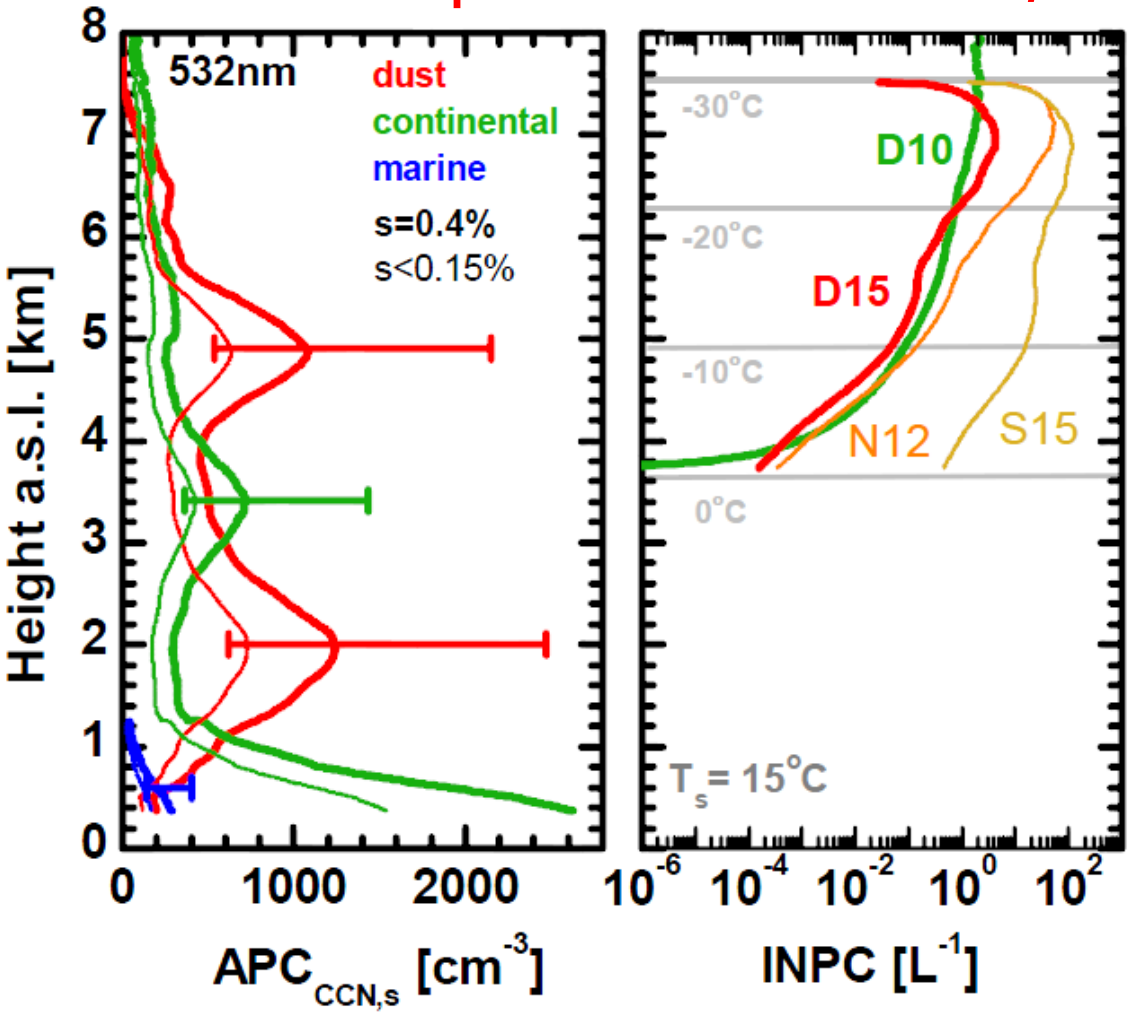


Mamouri and Ansmann, 2016
under preparation for ACPD

Conversion factors from AERONET datasets


532nm
Height a.s.l. [km]
Ext. coef. [Mm^{-1}]
APC$_{50}$ [cm^{-3}]
APC$_{250}$ [cm^{-3}]
ASC [10^{-12}m^{2}cm^{-3}]
AEC exponent x^{d}
$\overline{APC_{50}}$ / $\overline{AEC^{x_d}}$
18.1 19.7 3.6 196.3 35.0 10.6
APC$_{250}$ / AEC [Mm/cm^{3}]
ASC/AEC [10^{-12} Mm m^{-2}/cm^{-3}]
MOR CV BB
CYP
GER
CYP
GER
BB
mineral dust
continental pollution
marine aerosol

...more dust related products for AEROSOL/CLOUD interaction studies

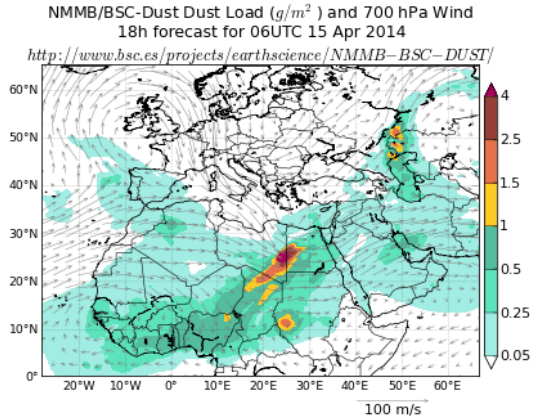


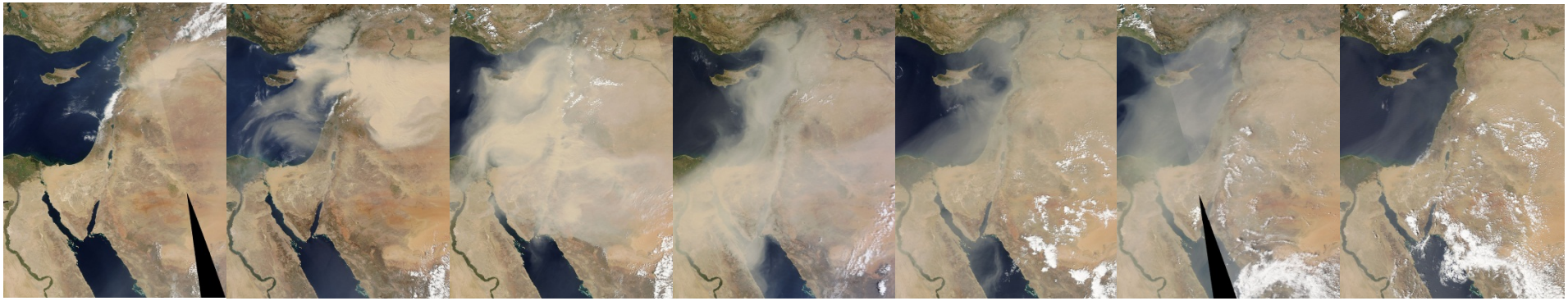
INPC=f(APC,T)

BEYOND products optimization….

Validation & new products for satellite missions

Optimization of model simulations

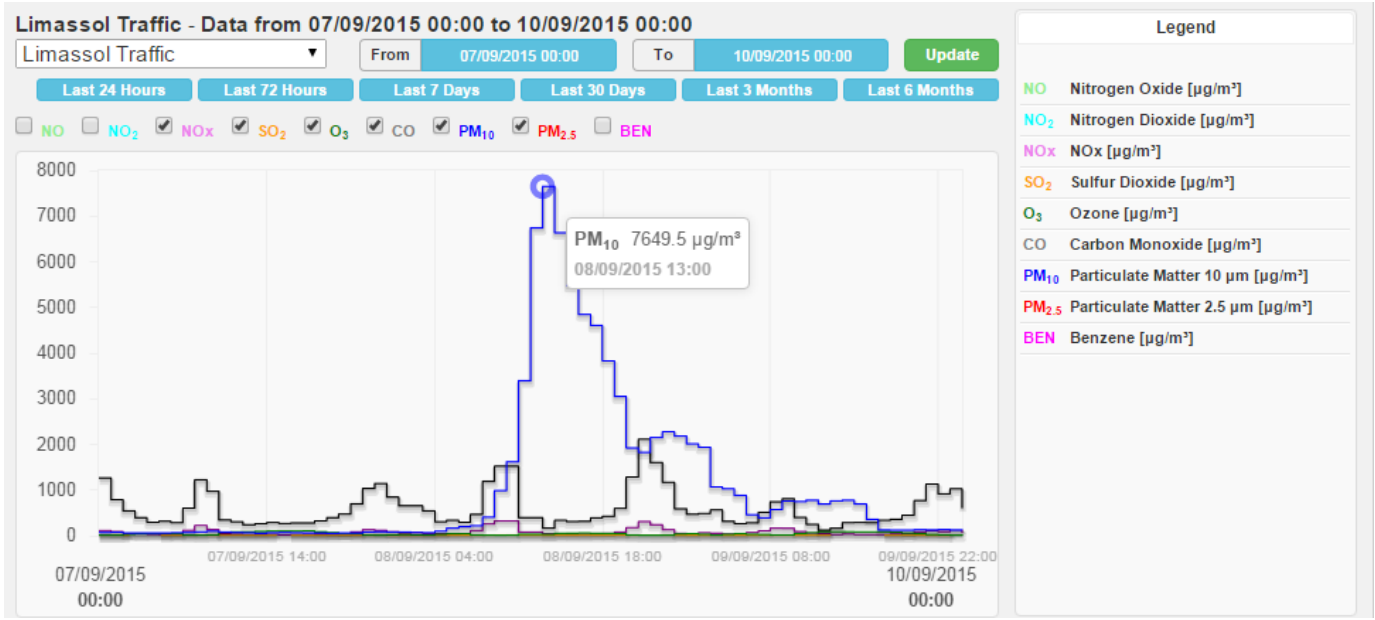


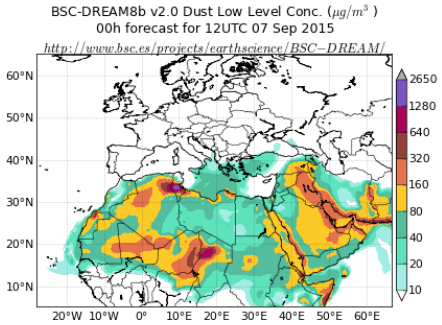


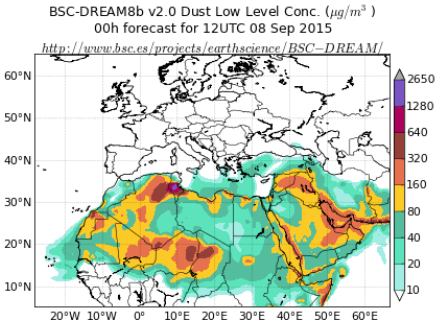
ONE MONTH AGO……6-12 September 2015

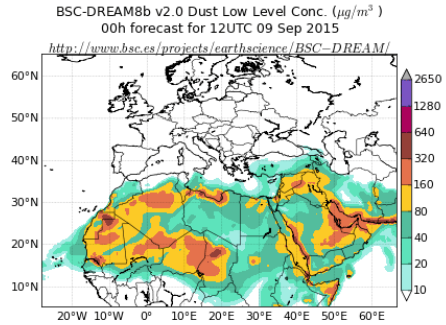
Visibility below 500m

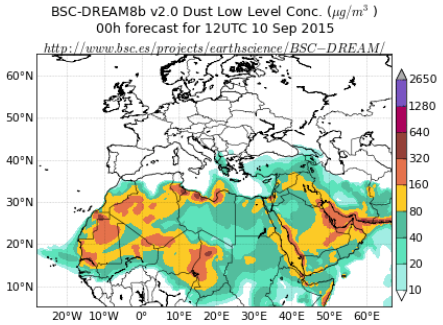
Model's simulations fails under extreme events.





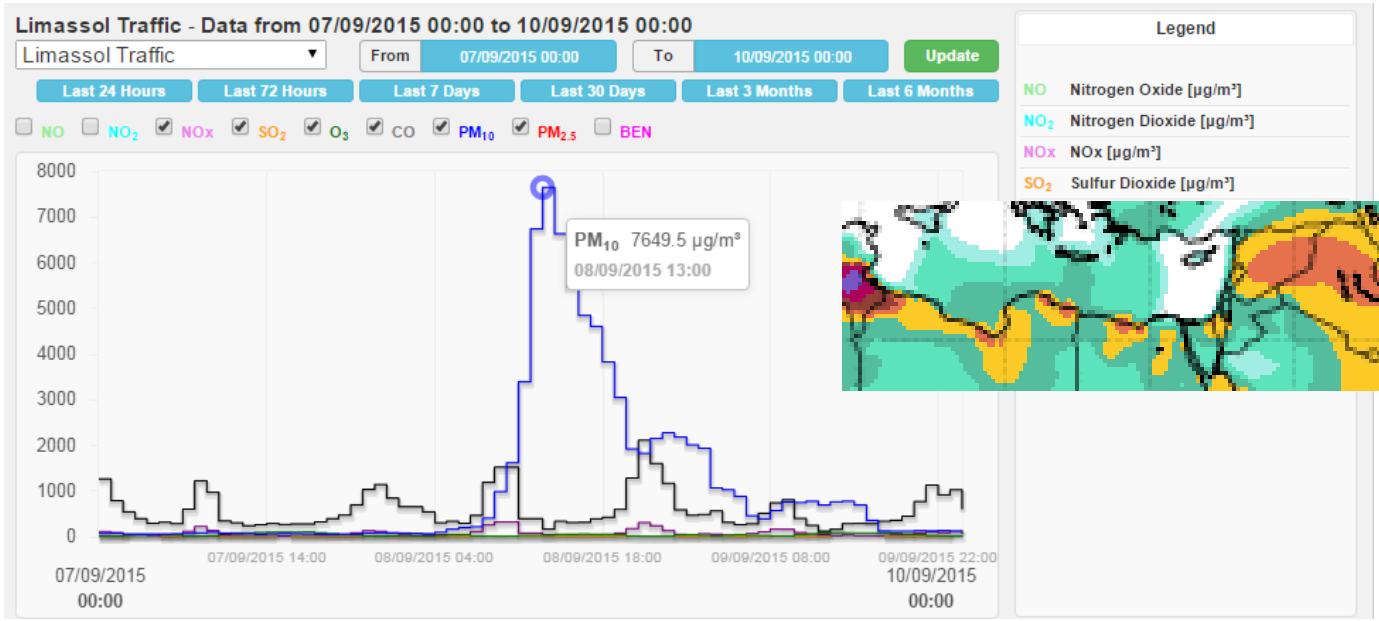


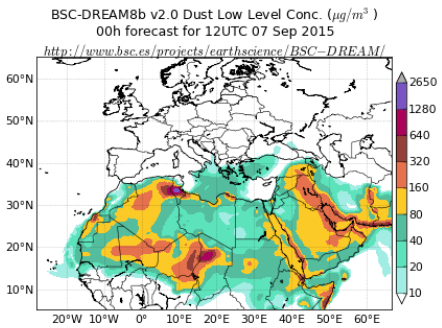


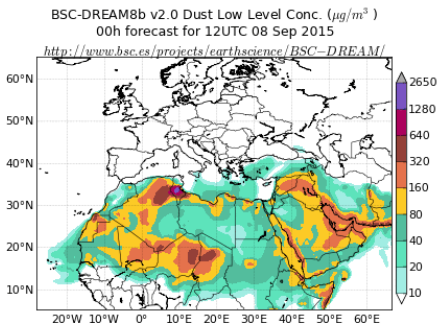


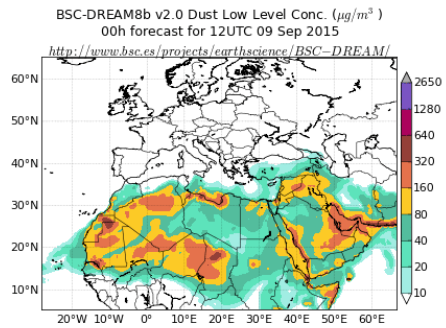
Especially for dust intrusion from Middle East.

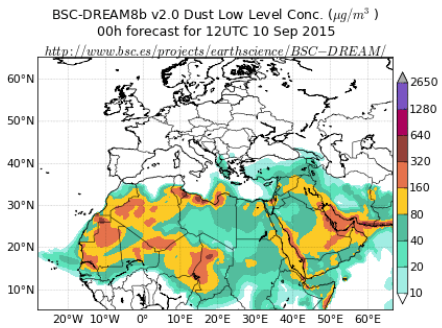
Model's simulations fails under extreme events.







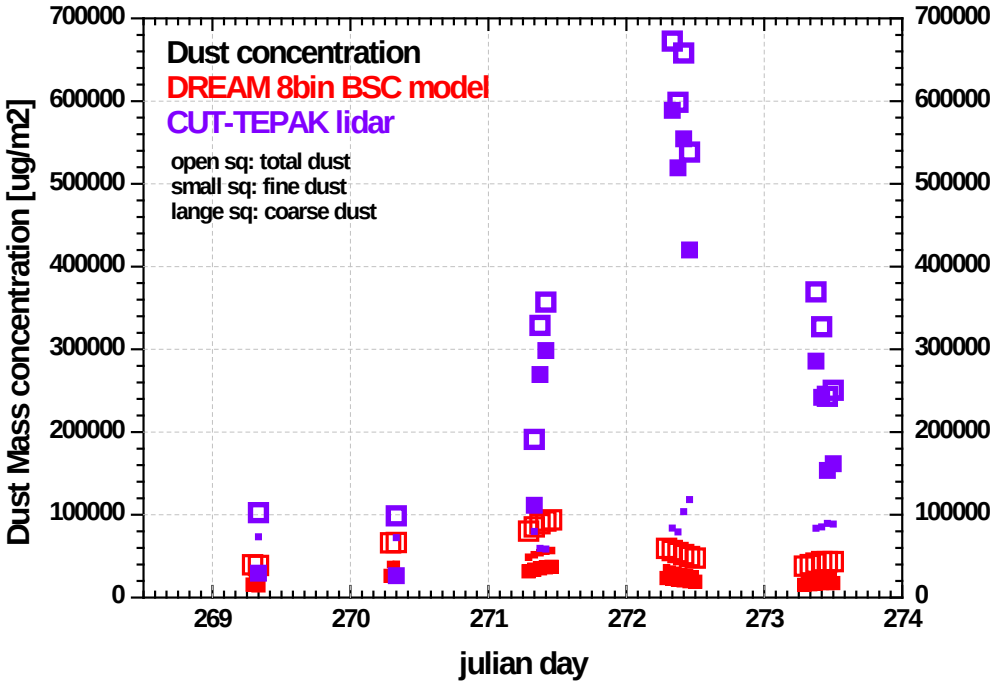


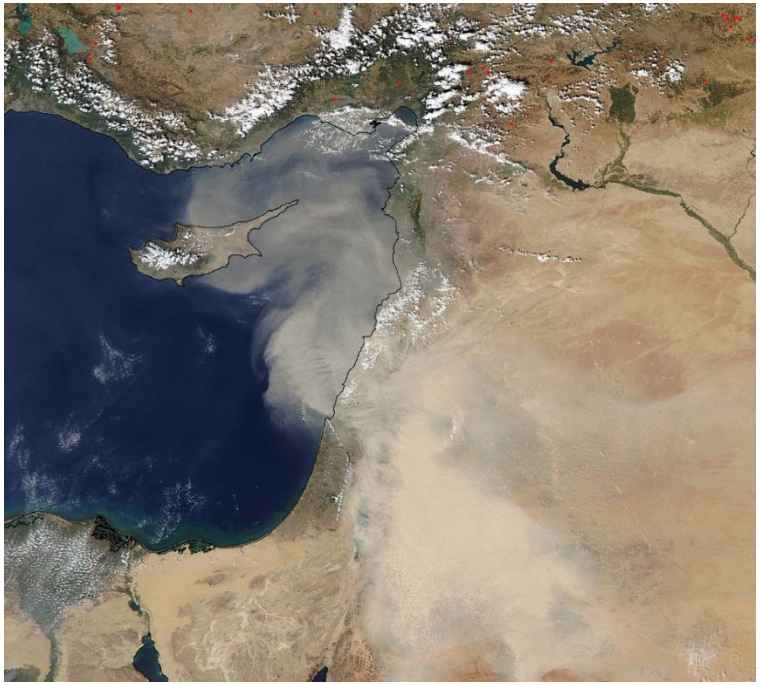


Especially for dust intrusion from Middle East.

FOUR YEARS AGO……26-29 September 2011

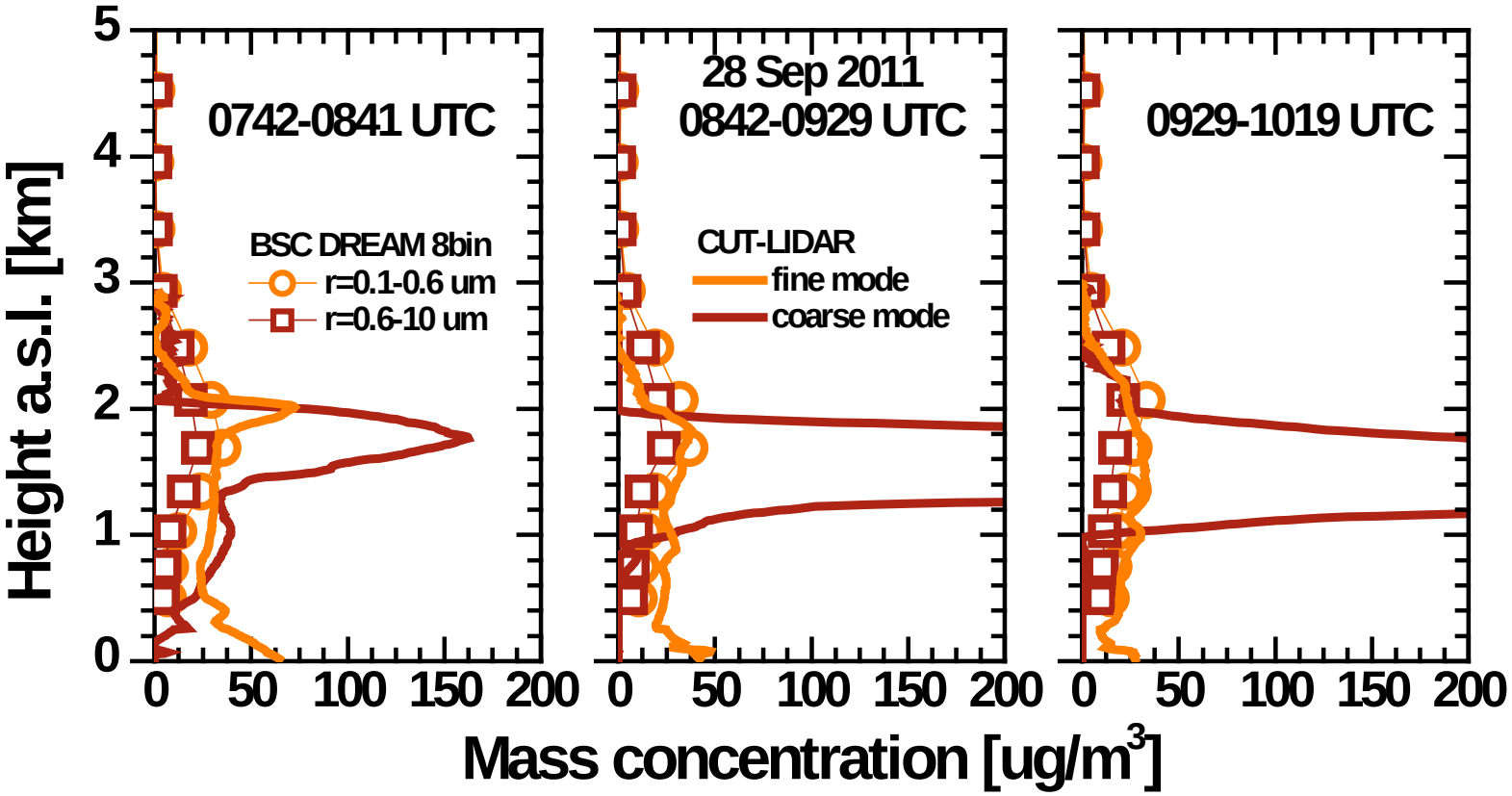
Model's simulations usually fails under extreme events.
Both in columnar values and vertical profiles.





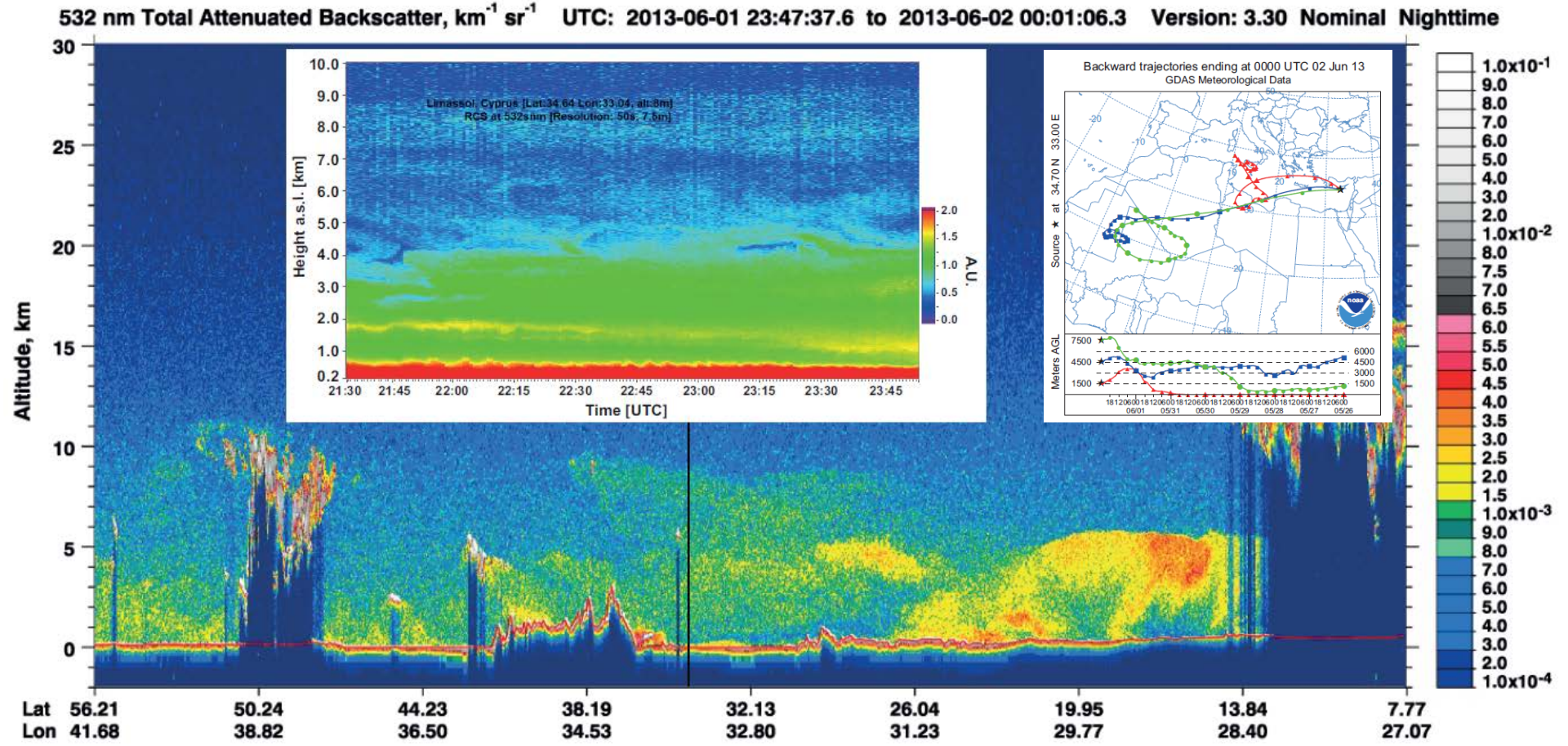
fine and coarse dust contribution for better evaluation and optimization of the models

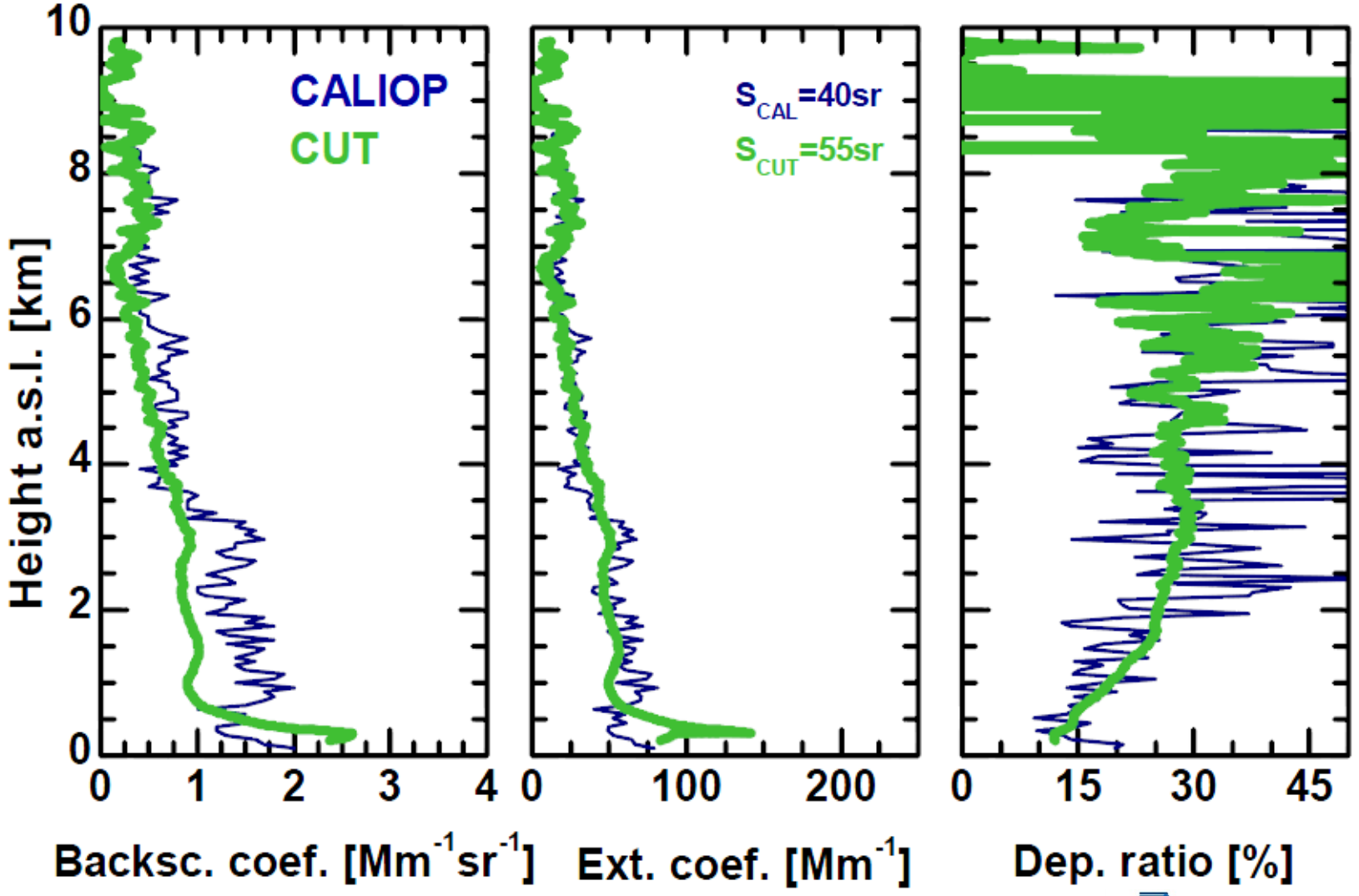
The POLIPHON^{2s} methodology is given in Mamouri and Ansmann, 2014
AMT, 7, 3717-3735, 2014



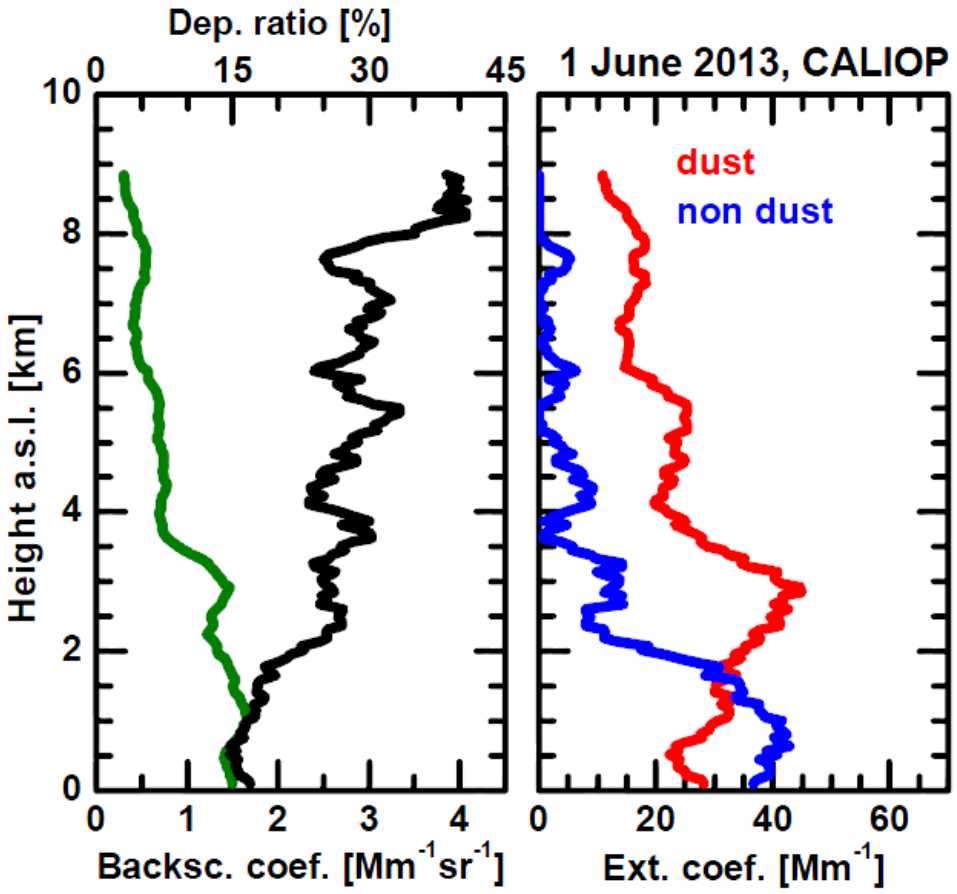
Possibility to compare fine and coarse mode dust profiles for better understanding of the physical processes and causes of failure. Fine mode dust contributes to PM1.0 (health problem, pollution level)

Application on Satellite datasets for global datasets



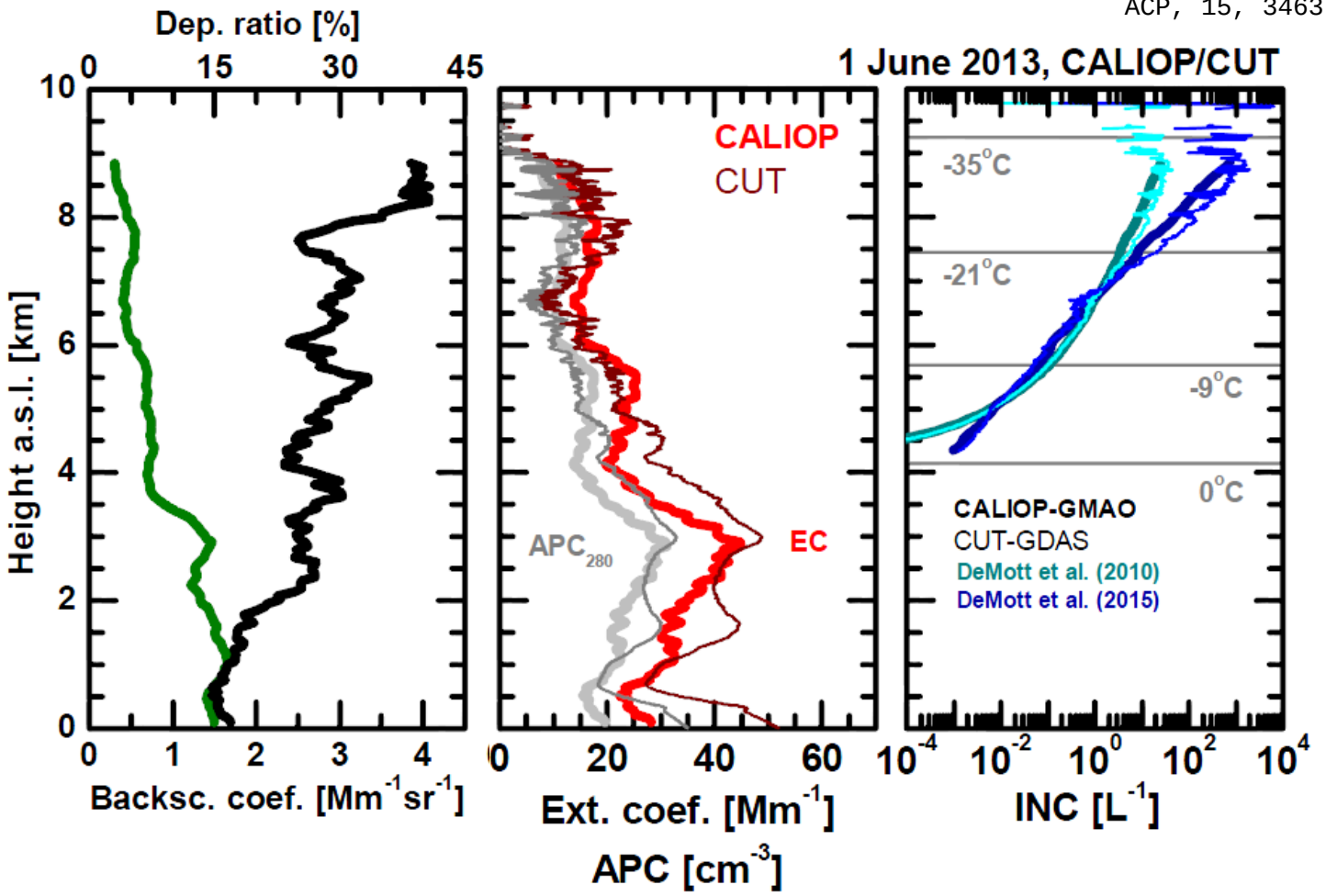

CALIOP
CUT
S_{CAL}=40sr
S_{CUT}=55sr
Height a.s.l. [km]
0
2
4
6
8
10
0
1
2
3
4
0
100
200
0
15
30
45
Backsc. coef. [Mm^{-1}sr^{-1}]
Ext. coef. [Mm^{-1}]
Dep. ratio [%]

Mamouri and Ansmann,2015
ACP, 15, 3463-3477, 2015

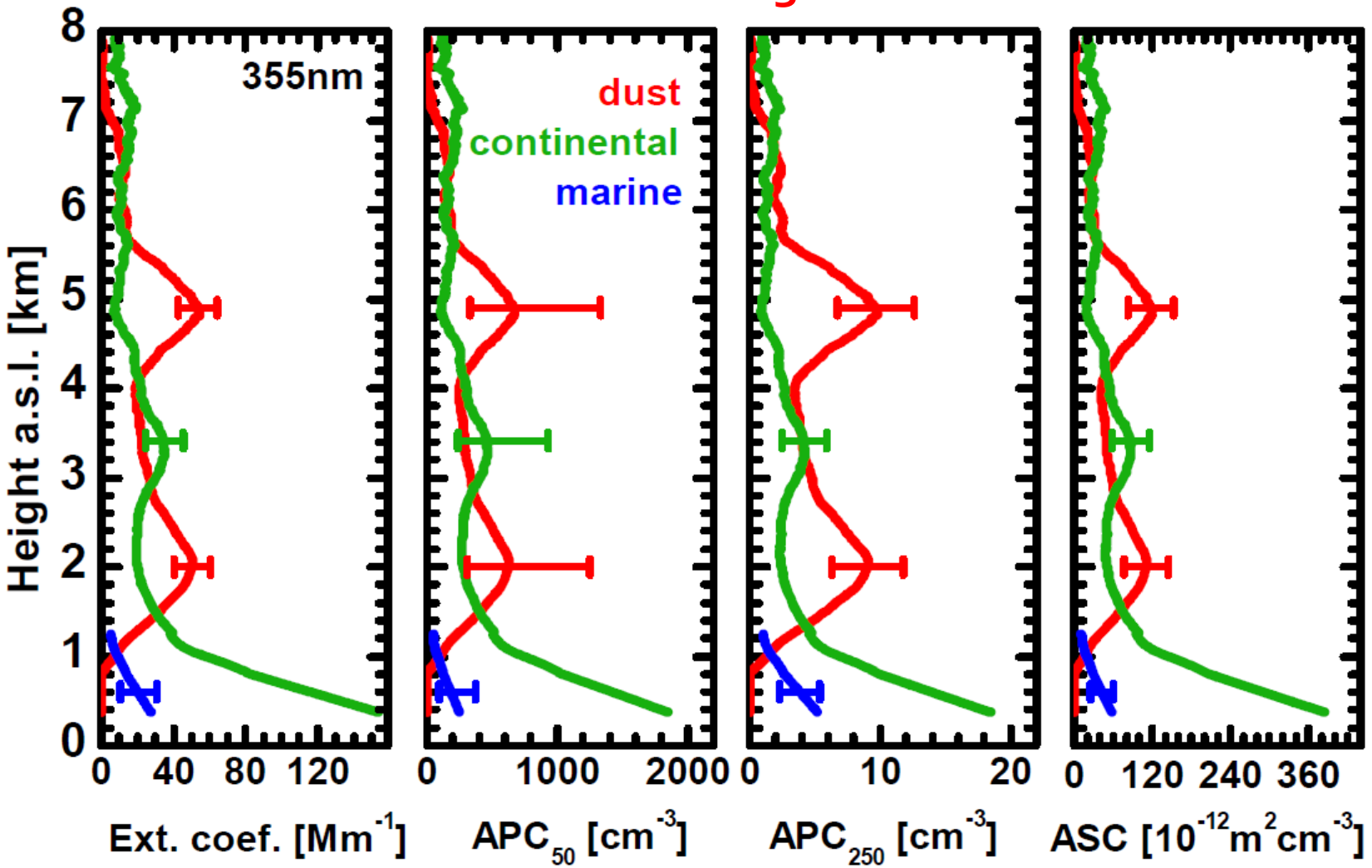


can be applied to LIVAS products.....

Mamouri and Ansmann, 2015
ACP, 15, 3463-3477, 2015



...and can be extend to other wavelengths for future satellite missions



NOA-CUT-TROPOS-DLR closure cooperation

August 2016 to August 2017

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

LACROS @ CUT, Cyprus

NOA-BEYOND:
POLLY^{XT}@ Finokalia, Crete

CUT-TEPAK
EARLINET@ Limassol

to summarize....

Eastern Mediterranean is a unique place for dust observations.

Consistent lidar systems in Crete (mostly influenced by Saharan dust)
and in Cyprus (often influenced by Arabian dust) can provide valuable observations for the optimization of BEYOND dust models.

The Greece, Cyprus and Romania can play an important role to the calibration/validation activities covering different atmospheric scenarios and providing measurements and datasets seldom observed in central Europe.

Acknowledgments

CUT Remote Sensing Laboratory and Team, especially Mrs Argyro Nisantzi and Prof. Diofantos Hadjimitsis.
TROPOS Remote Sensing Team and especially Dr. Albert Ansmann for the close collaboration and support.
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AERONET for high-quality sun/sky photometer measurements in Cyprus, Morocco, Cape Verde, and Barbados.
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The European Regional Development Fund and the Republic of Cyprus through the Research Promotion Foundation (**RPFCy**).
European Union (**EU**) Seventh Framework Programme (FP7/2011–2015) under grant agreement n◦ 1100 262254 (**ACTRIS** project).
EU FP7-ENV-2013 programme impact of Biogenic versus Anthropogenic emissions on Clouds and Climate: towards a Holistic UnderStanding (**BACCHUS**), project number 603445.