



**Vassilis Amiridis**  
**BEYOND atmospheric services**  
IAASARS, National Observatory of Athens  
Greece

**ONE step BEYOND workshop, 15 October 2015**  
**ESA - Frascati, Italy**



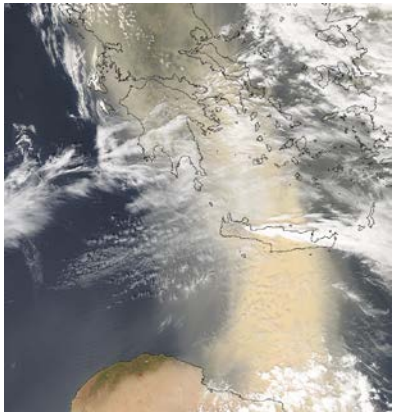
FP7-Regpot-2012-23-1

## Examples of systematic atmospheric hazards

Forest Fire Smoke



Saharan Dust





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Smoke dispersion

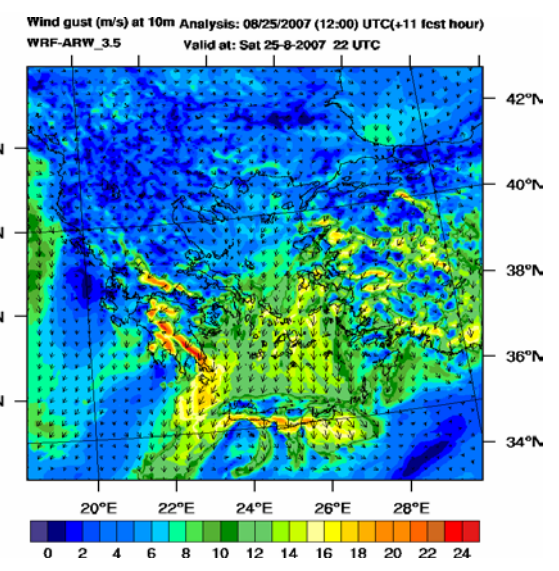
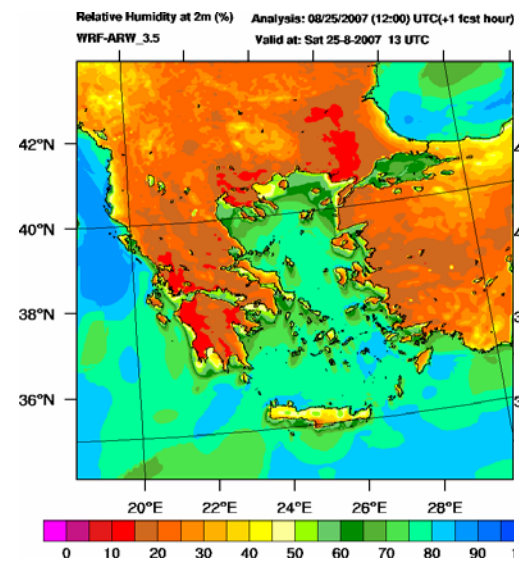
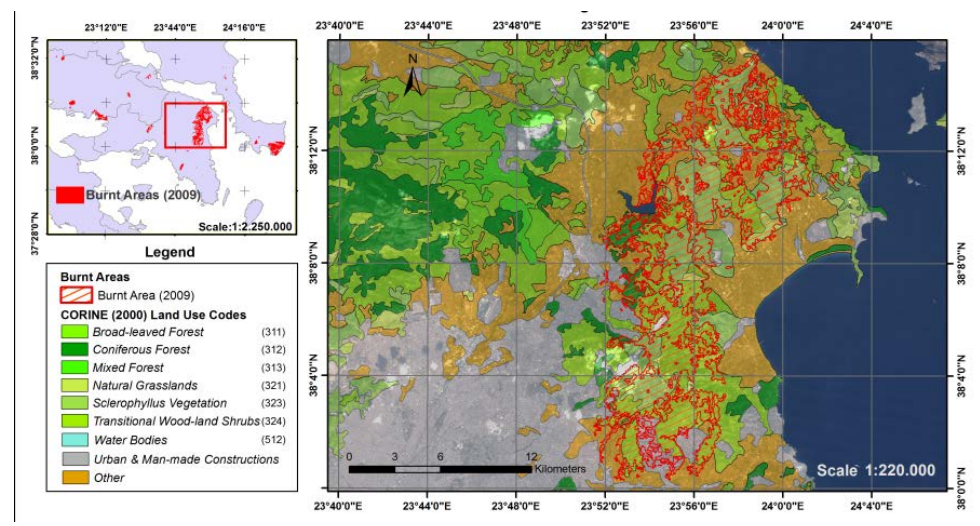


Remote sensing information:

Burnt area  
Fuel type  
Fire Radiative Power

+

Modeling:  
Meteorology





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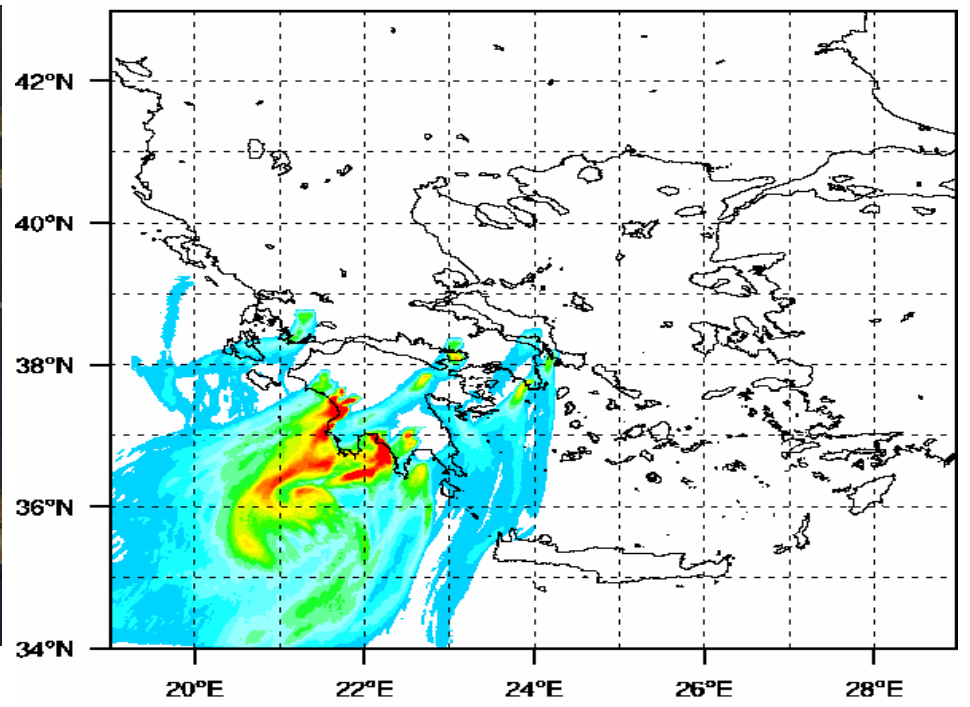
## Smoke dispersion



### FLEXPART - NOA Biomass Burning (Organic Carbon -OC)

## Wild fire smoke dispersion

valid date:26-08-2007 0900UTC  
Model layer: Integrated Column (ng m<sup>-3</sup>)



Dispersion of smoke, MODIS 26 August 2007 09:30 UTC

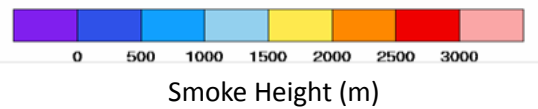
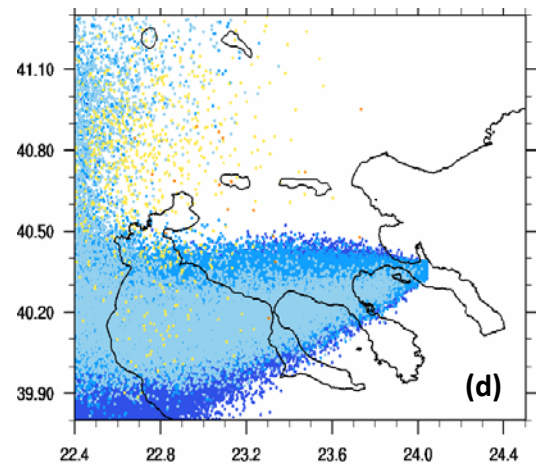
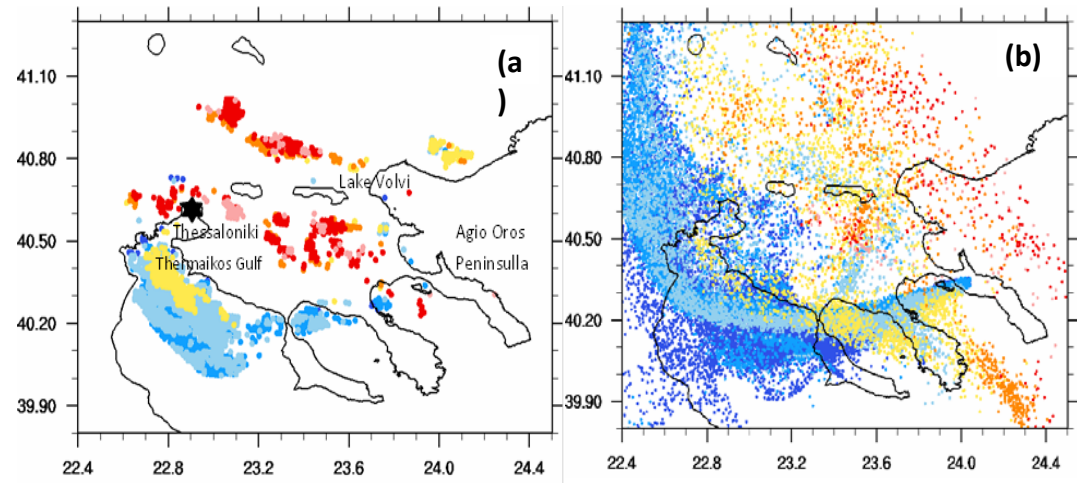


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## Smoke dispersion



The FLEXPART-NOA smoke dispersion modeling system is operational and provides 3D forecast fields in Greece.

The system is a part of the FireHub service and is utilized automatically from the fire detection online system.

*Solomos et al., 2015, Atm. Environment*



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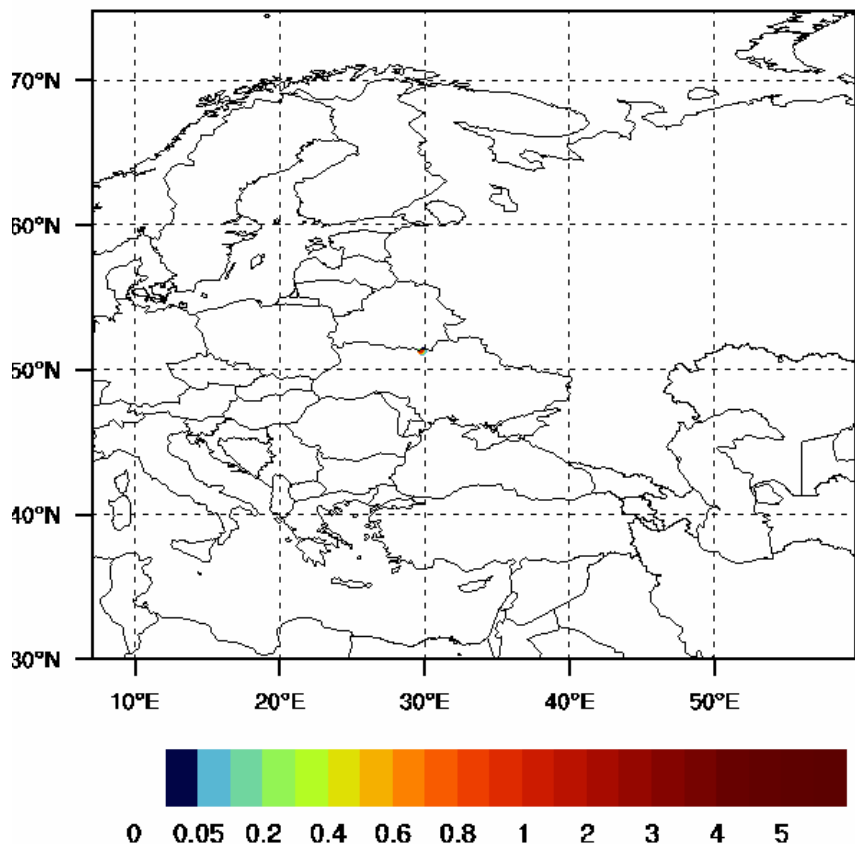
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## Industrial accident smoke dispersion



**BEYOND / NOAA FLEXPART valid:29-04-2015 1500 UTC**  
**Smoke Aerosol Integrated Column (mg m<sup>-3</sup>)**



Early-warning system is stand by also for Europe. The example shows the simulation performed when we had a warning from our colleagues in Romania for the presence of biomass burning aerosols during the fires in Chernobyl – Ukraine in May 2015

*Collaboration with INOE and Doina Nicolae*

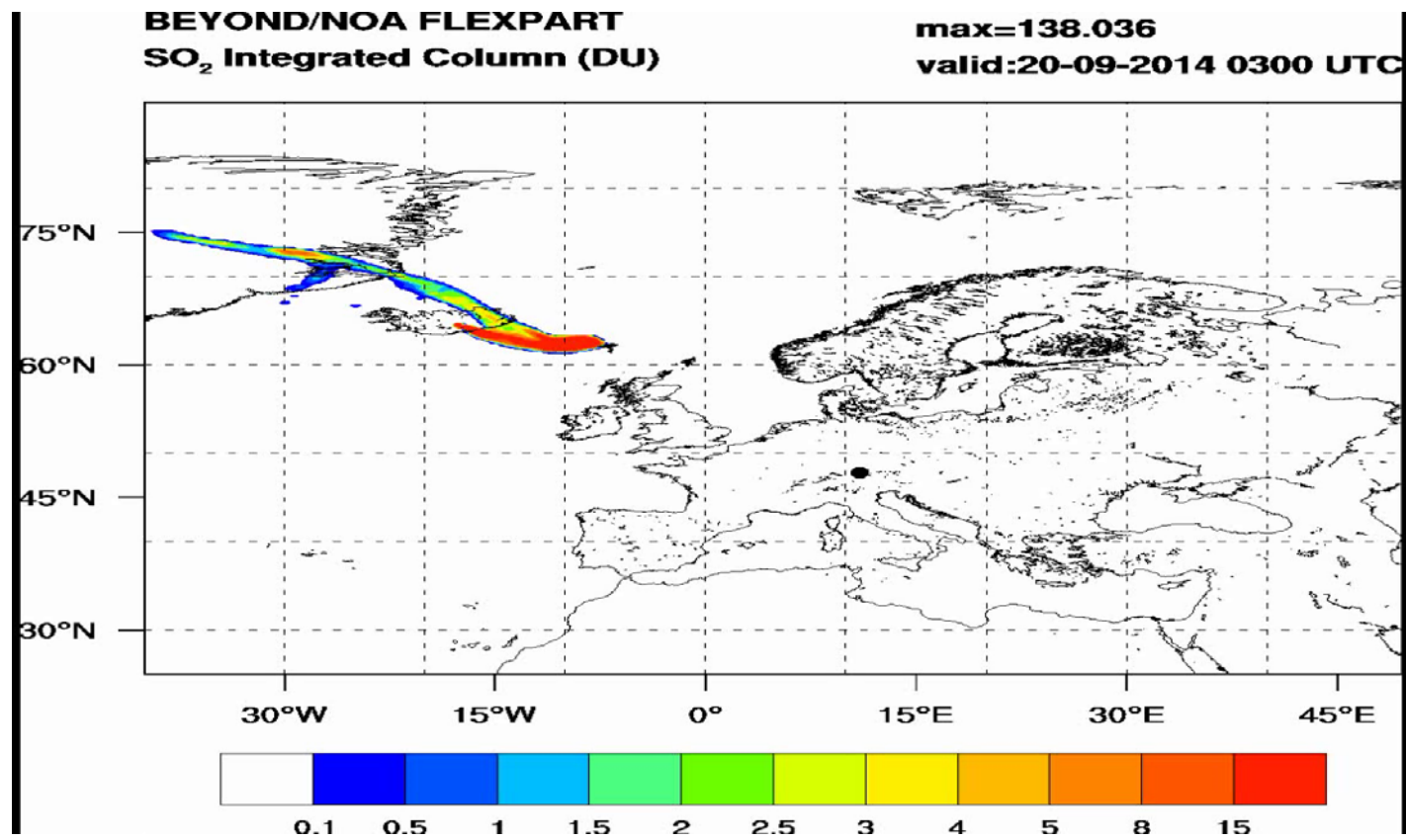


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## Volcanic ash dispersion



*Amiridis et al., 2015, ESA-ATMOS Conference*



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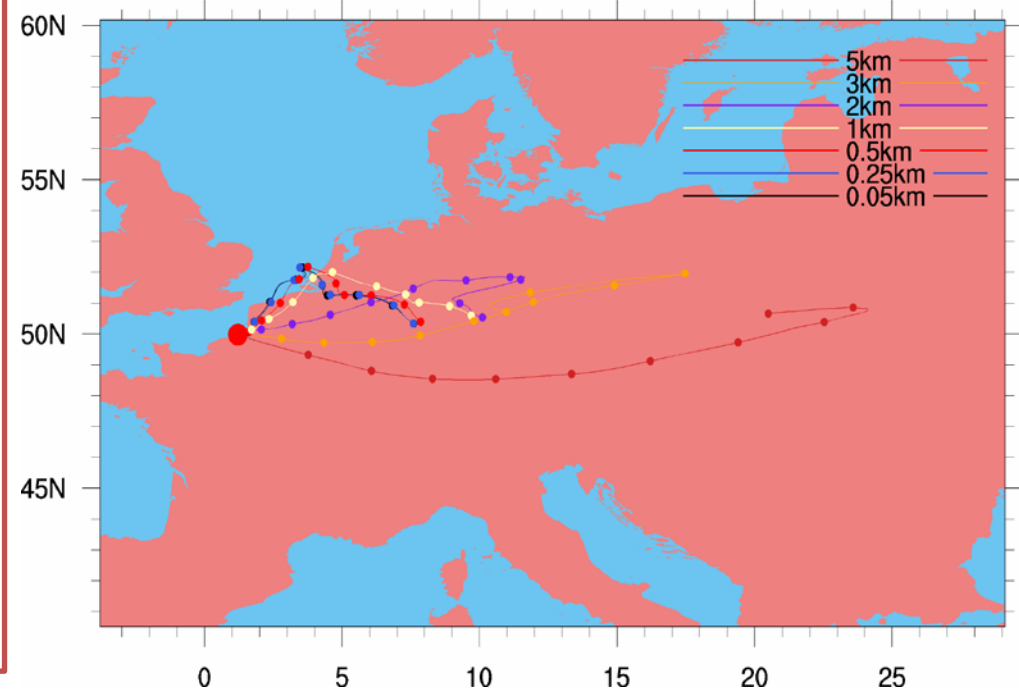


## Nuclear accident release

### BEYOND / NOAA Industry Accident Release (demo)

WRF / FLEXPART forward trajectories starting at: 20140824 120000 UTC  
Markers every 6h - Colors denote trajectory height

- Prognostic forward trajectories for a conceptual scenario of nuclear accident over Europe.
- The big red dot indicates the location of the release.
- Different color lines indicate various height releases.
- When one knows the actual (observed) height of gas or particle releases the plume path is estimated from the corresponding trajectories.







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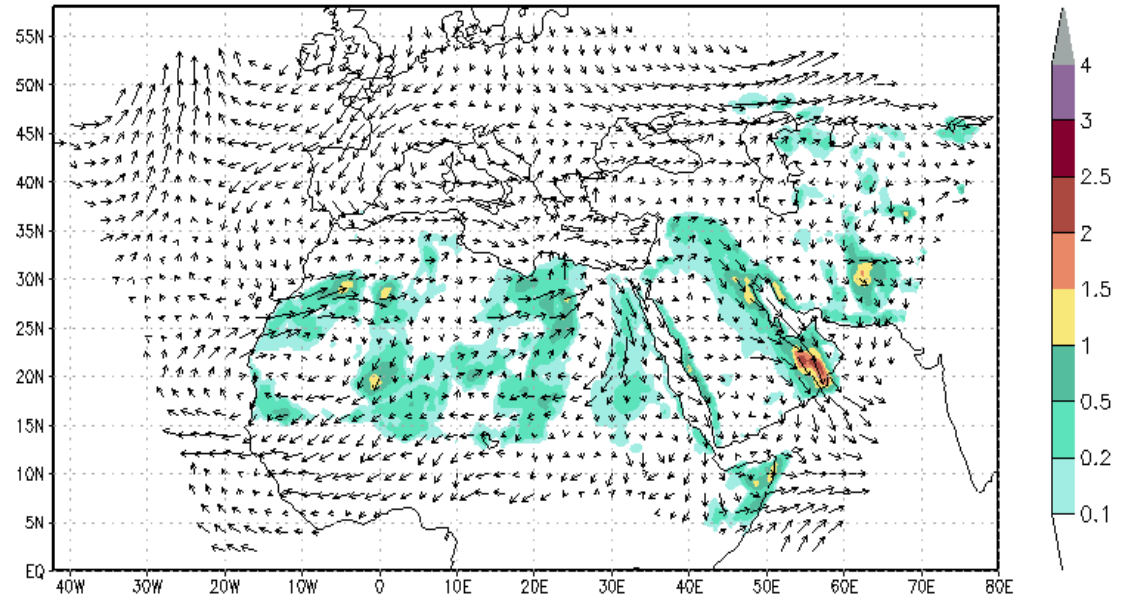
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## Desert dust modeling and forecasting



NMME/DREAM Charadmexp  
Dust Optical Depth (DOD) at 550nm and 2000m Wind  
Control Run 15JUN2014 12UTC



7



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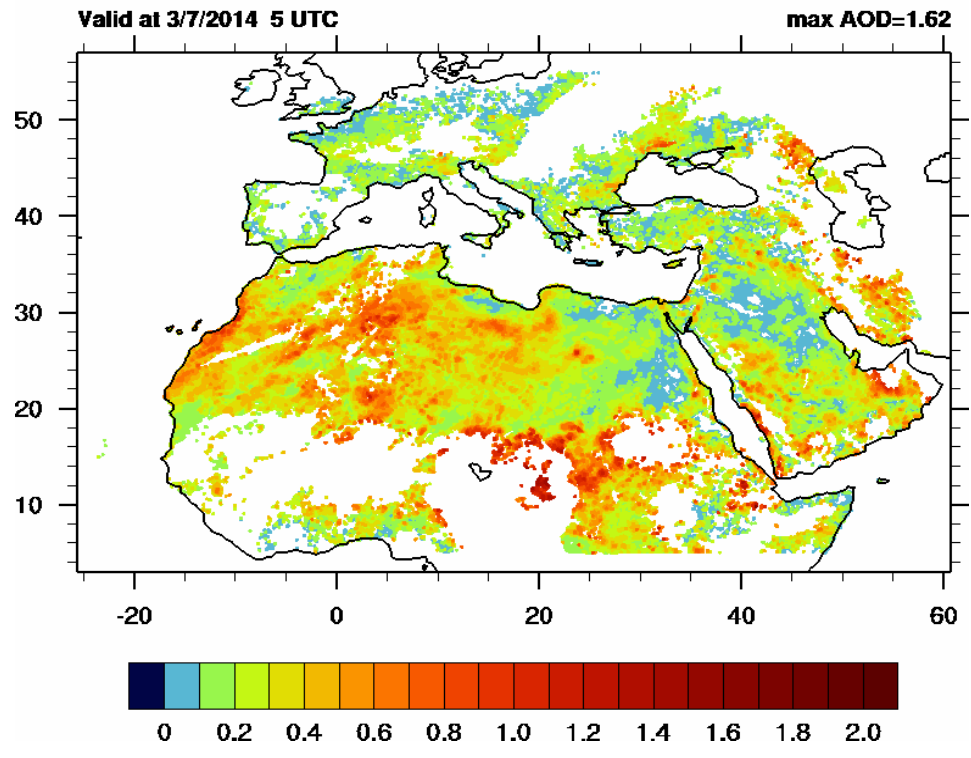
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## Desert dust modeling and forecasting



### MSG SEVIRI Dust Optical Depth ( $\tau_{550}$ )



Dust Optical Depth from the UK Met Office SEVIRI retrieval algorithm  
(Data provided by Yash Pradhan for the CHARADMEExp campaign)



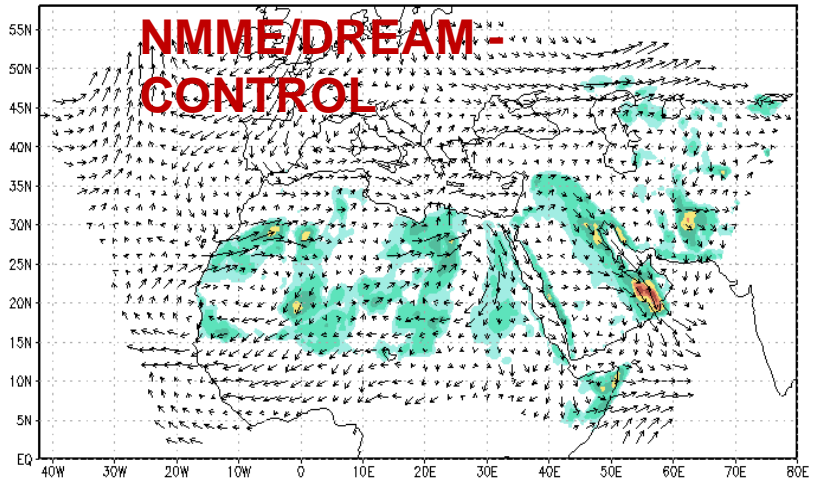
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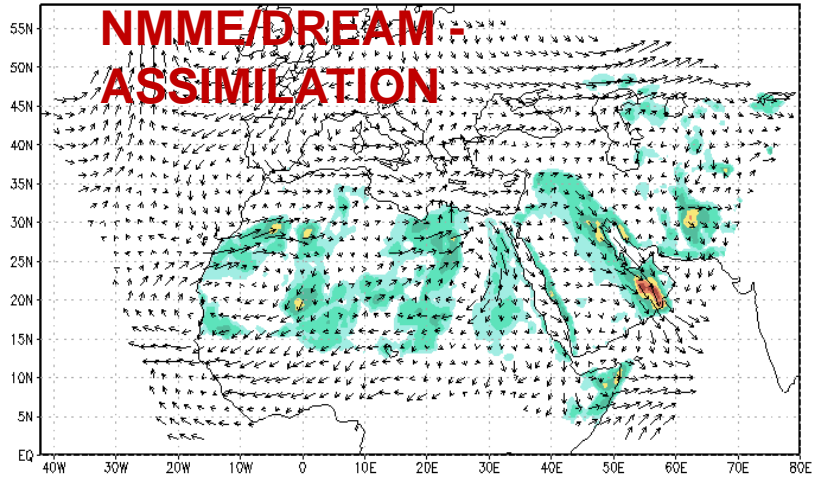
## Desert dust modeling and forecasting

NMME/DREAM Charadmexp  
Dust Optical Depth (DOD) at 550nm and 2000m Wind  
Control Run 15JUN2014 12UTC



7

NMME/DREAM Charadmexp  
Dust Optical Depth (DOD) at 550nm and 2000m Wind  
SEVIRI Assimilation Run ( $k=5 \times 10^{-4}$ ) 15JUN2014 12UTC



7

GRADS: COLA/IGES

GRADS: COLA/IGES

### 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



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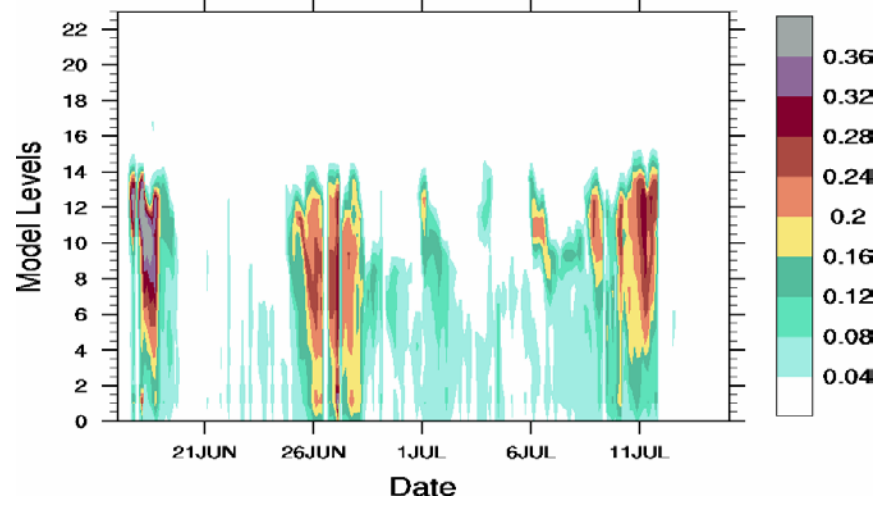
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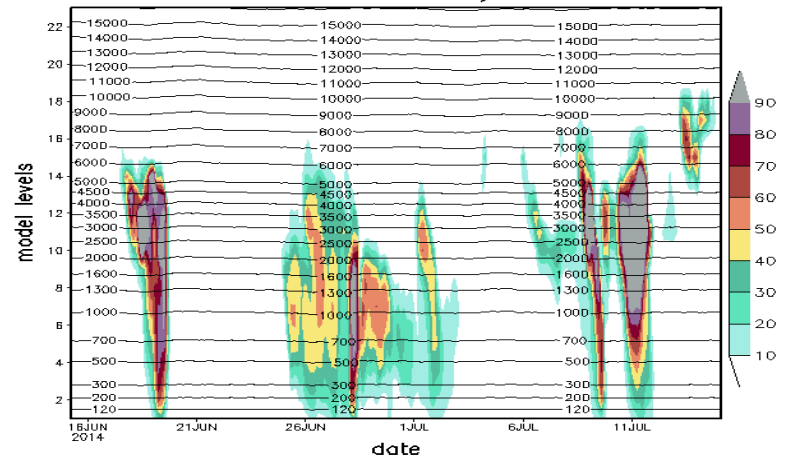
## Desert dust modeling and forecasting



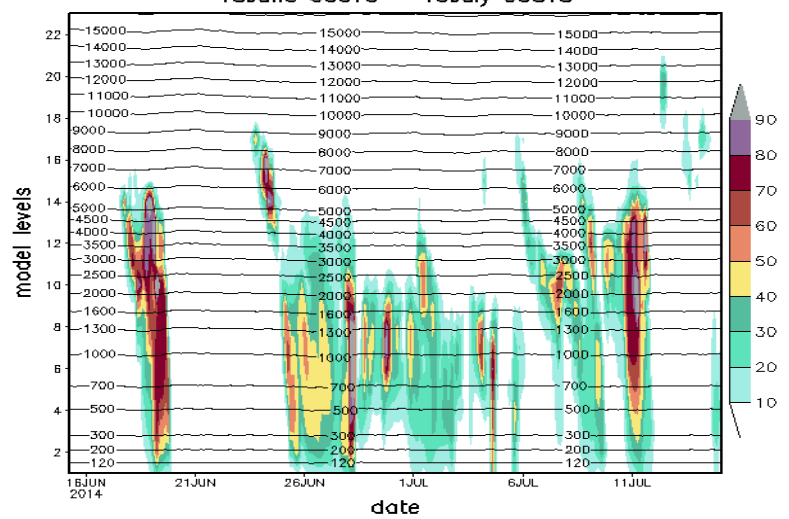
Volume depolarization ratio  
Pollyarielle, Finokalia, Crete, Greece  
17June2014 00UTC - 15July2014 03UTC



NMME/DREAM Charadmexp Control Run  
Total dust concentration [ $\mu\text{g}/\text{m}^3$ ] and geop. height (m)  
15June 06UTC - 15July 03UTC



NMME/DREAM Charadmexp MSG dust Assimilation Run  $k=5 \times 10^{-4}$   
Total dust concentration [ $\mu\text{g}/\text{m}^3$ ] and geop. height (m)  
15June 06UTC - 15July 03UTC

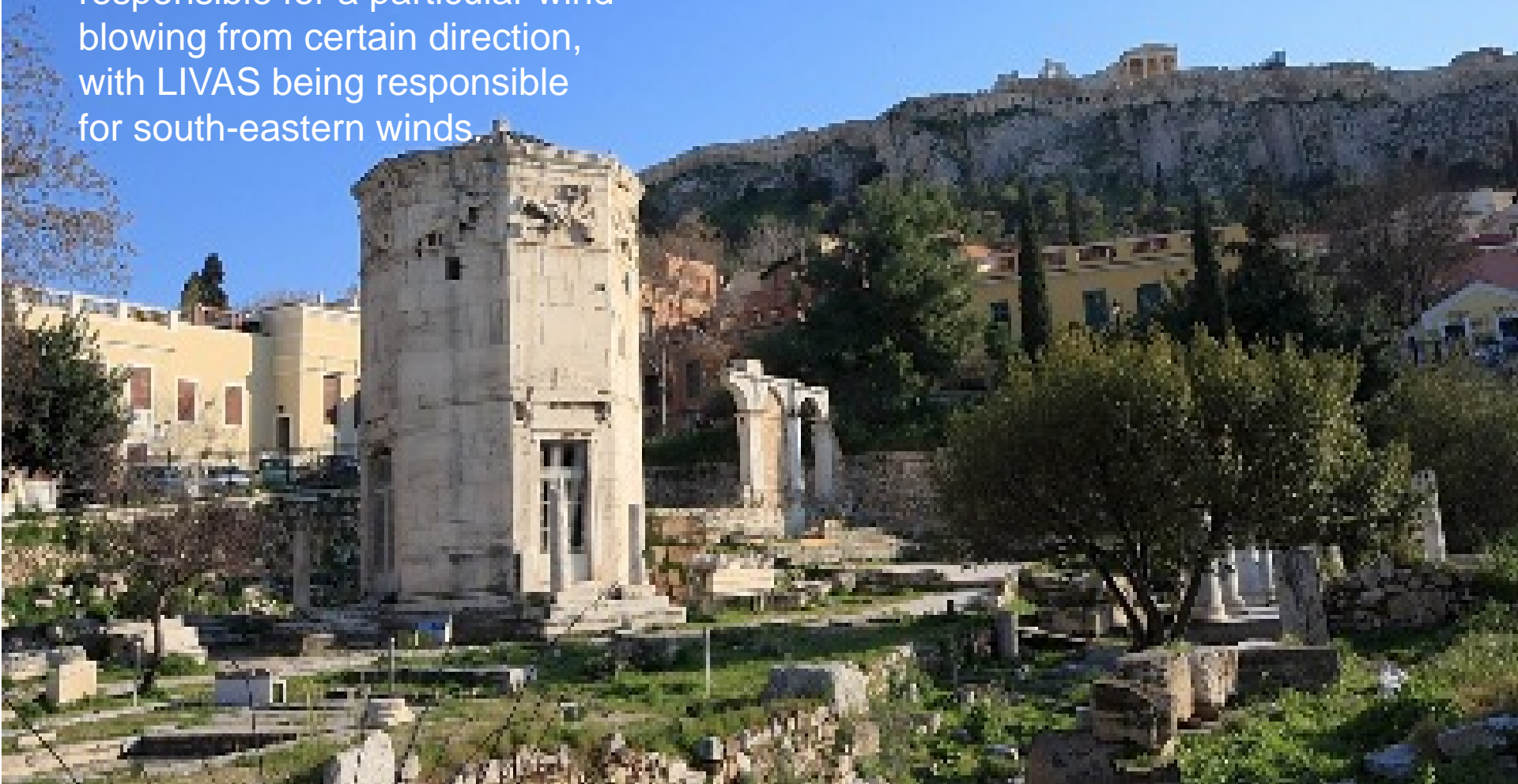


In collaboration with Slobodan Nickovic  
Nickovic et al., 2015 (in preparation)

# Aeolus and Livas

In Greek mythology, Aeolus was the 'keeper of the winds'.

Aeolus ruled over 8 gods, each responsible for a particular wind blowing from certain direction, with LIVAS being responsible for south-eastern winds.





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## LIVAS dust product

<http://lidar.space.noa.gr:8080/livas/>

[Home](#)   [About](#)

### LIVAS

**LIVAS Product**  
Aerosol Extinction @532nm Per Type for cell with centroid: Lat= 44.5°, Lon= 11.5°

**General Statistics:**

Surface Elevation:			
Mean	0.0013	Min	0.001
Max	1.178		
Number of overpasses: 167			
Number of profiles examined: 3000			
Aerosol Statistics:			
Samples averaged (after filtering):			
Total	345438	Aerosol	31136
Clear	915333	Air	
Aerosol subtype occurrence:			
CM	0	PC	0
CC	0	PD	0
S	12.4092	All	26.928
Aerosol Optical Depth at 532 nm:			
Mean	0.1231	Median	0.02793
StdDev	0.26102		

Category	Product	Wavelength	Partial Products
Aerosol	Extinction	532nm	Per Type
		532nm	
Cloud	Backscatter	1064nm	Per Season
		1572nm	
Stratospheric	Depolarization	2950nm	
		2950nm	

Save to ASCII   Save to NetCDF

Grid Selector

**Product Selector**

Navigate to the desired final product by hovering over the menu from left to right and then press in order to inspect charts and data.

Read more >

LIVAS

NOA

Products

> Regional and Seasonal Statistics

> Selected Scenes

ABOUT

> About page



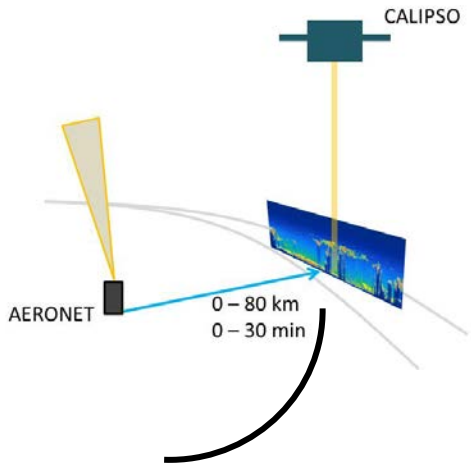
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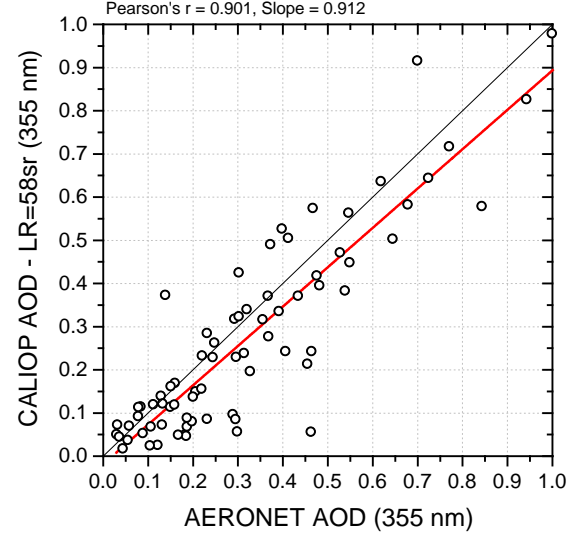
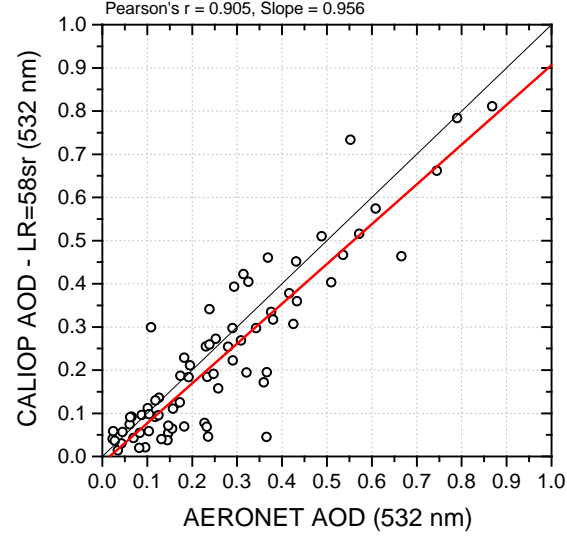
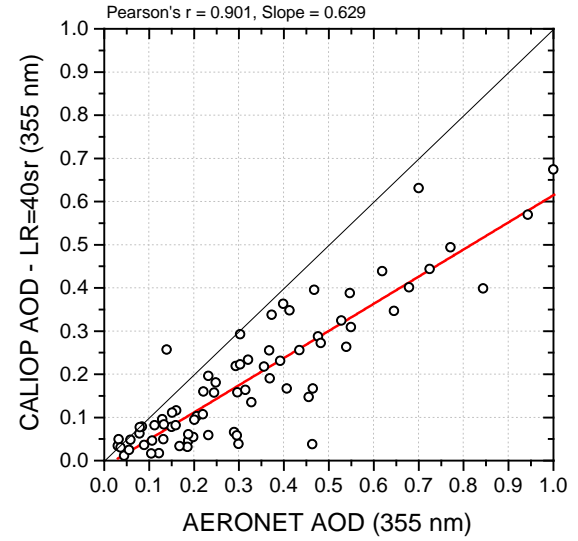
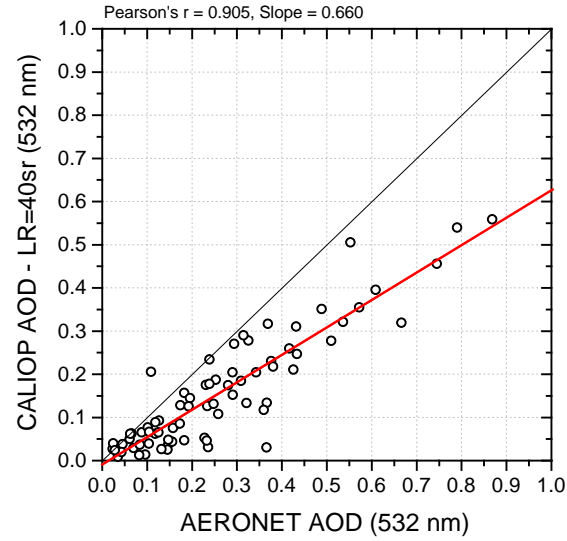


LIVAS dust product

## CALIPSO-AERONET Collocation



In pure Dust cases from CALIPSO typing



Amiridis et al., 2013, ACP

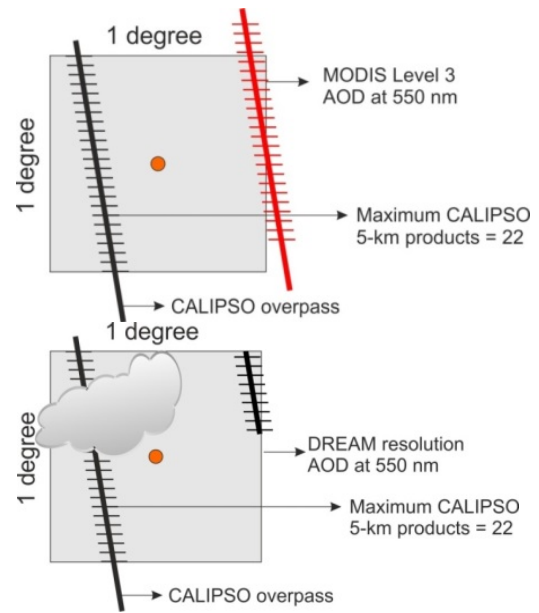


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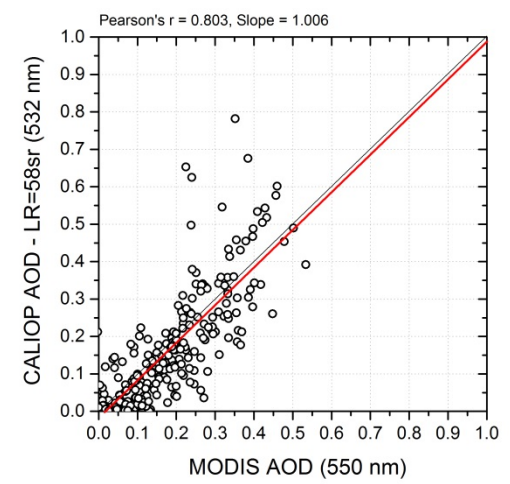
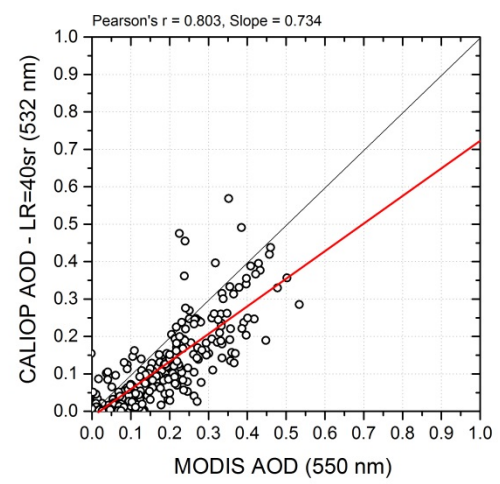
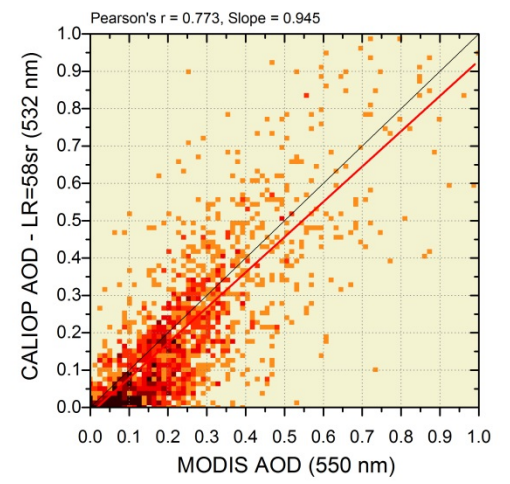
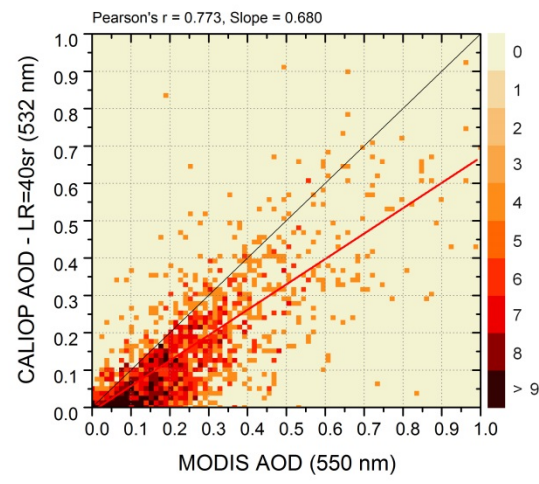
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## CALIPSO-MODIS Collocation



Red overpasses rejected

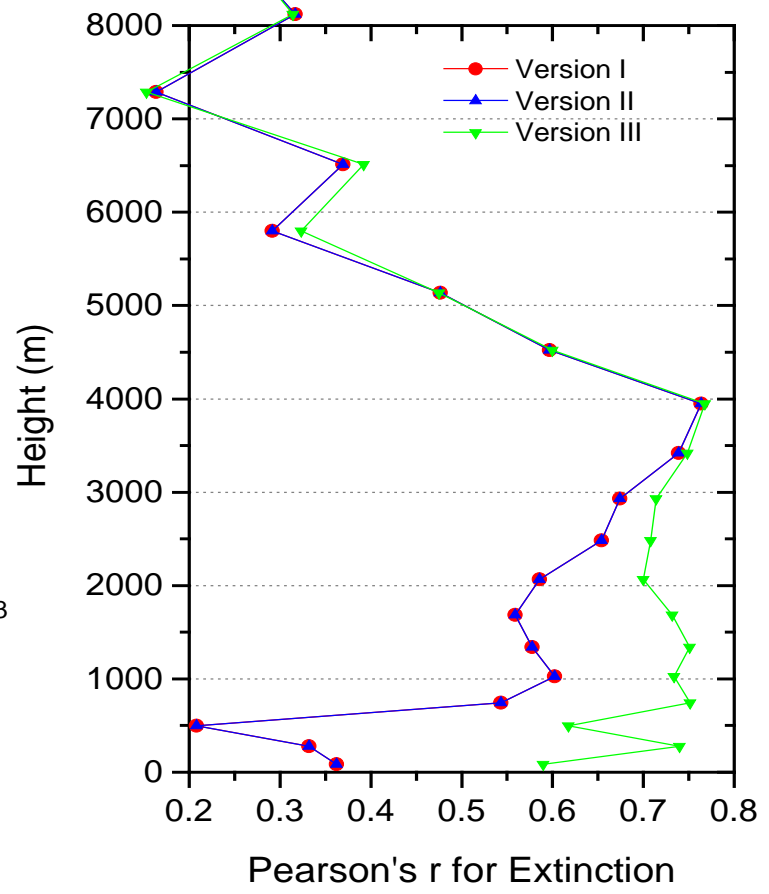
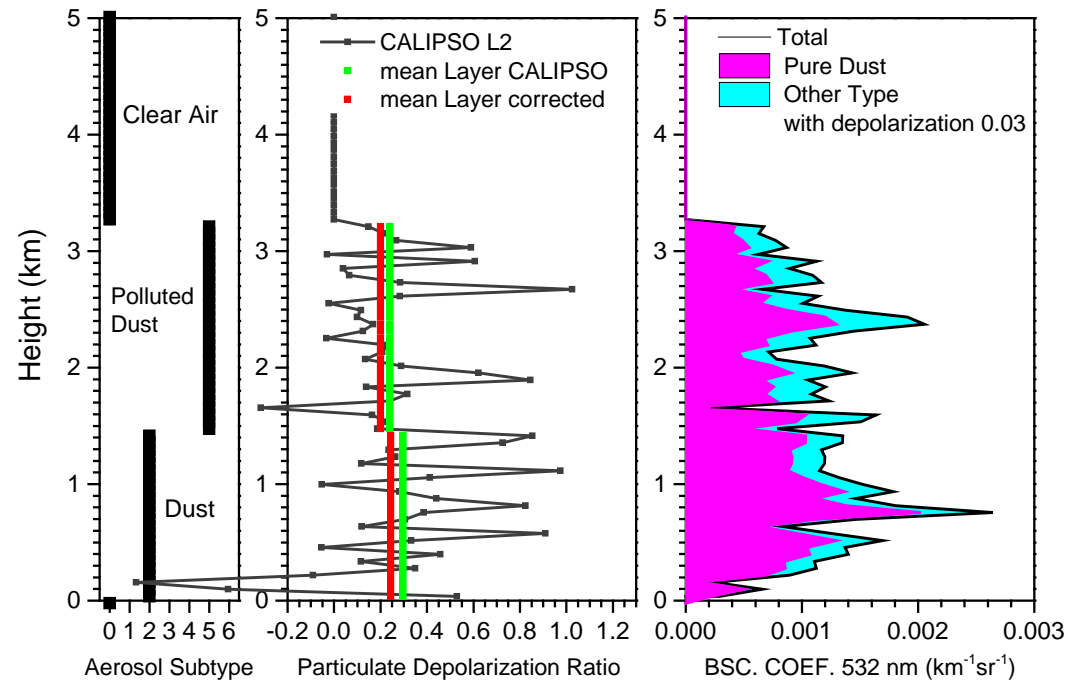






# BEYOND

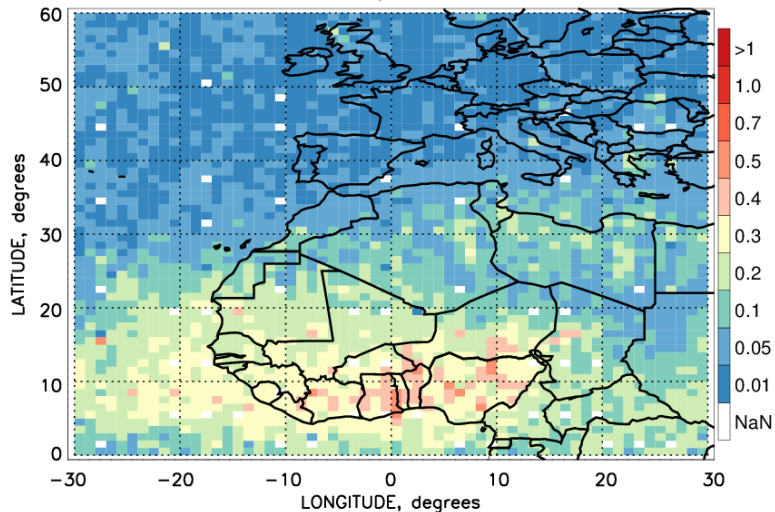
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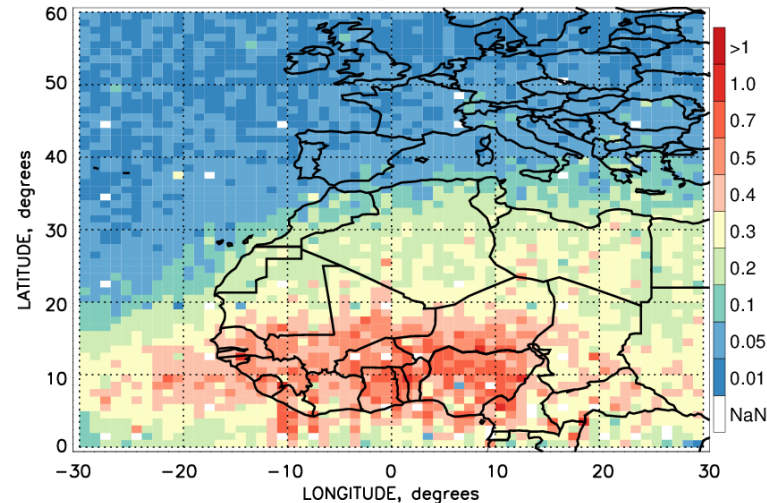
$$\beta_1 = \beta_t \frac{(\delta_p - \delta_2)(1 + \delta_1)}{(\delta_1 - \delta_2)(1 + \delta_p)}$$

Amiridis et al., 2013, ACP

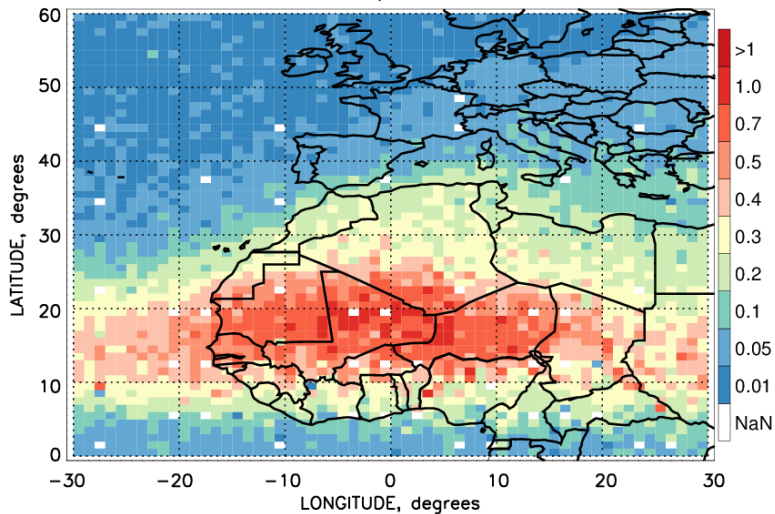
CALIPSO Mean Dust AOD, 2007–2013 D–J–F



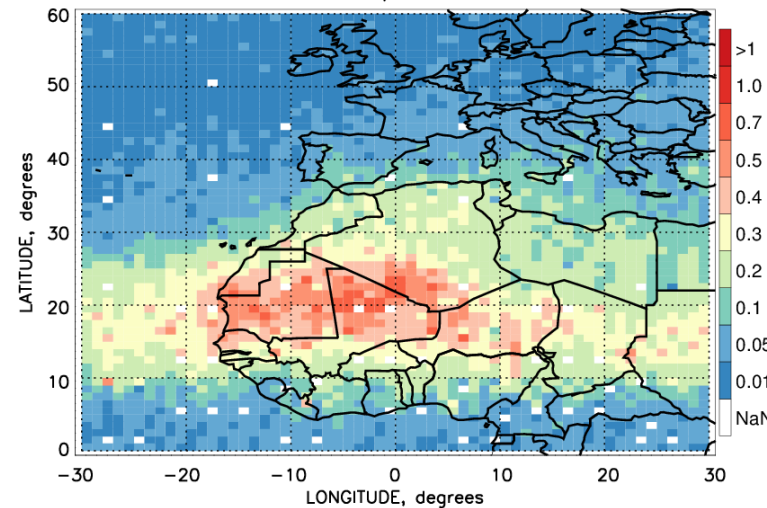
CALIPSO Mean Dust AOD, 2007–2013 M–A–M



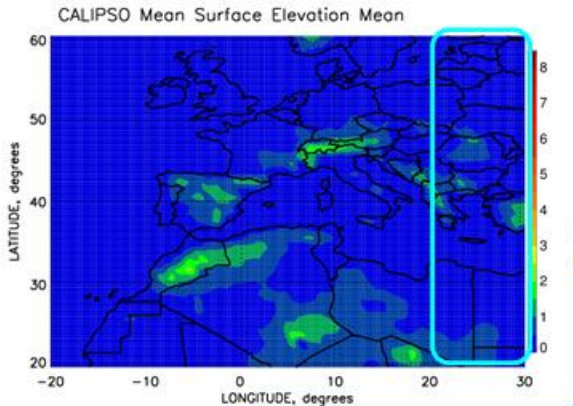
CALIPSO Mean Dust AOD, 2007–2013 J–J–A



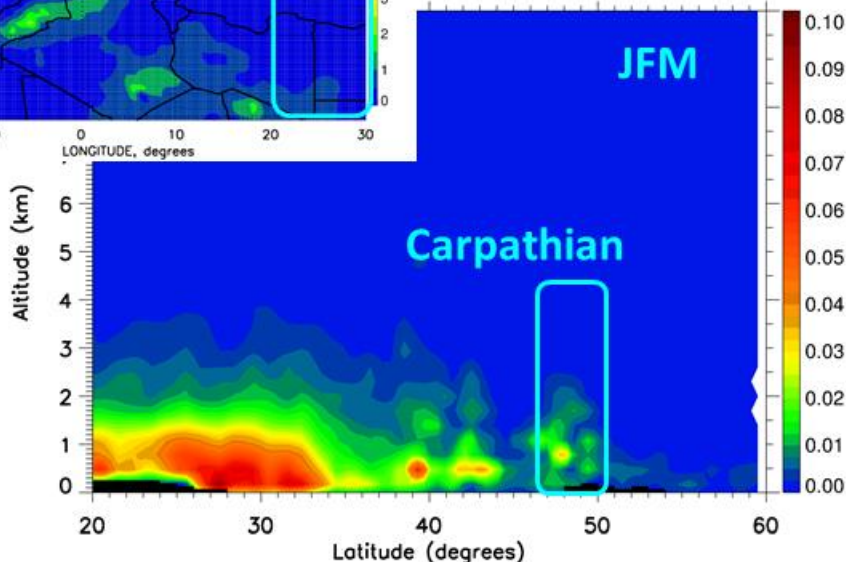
CALIPSO Mean Dust AOD, 2007–2013 S–O–N



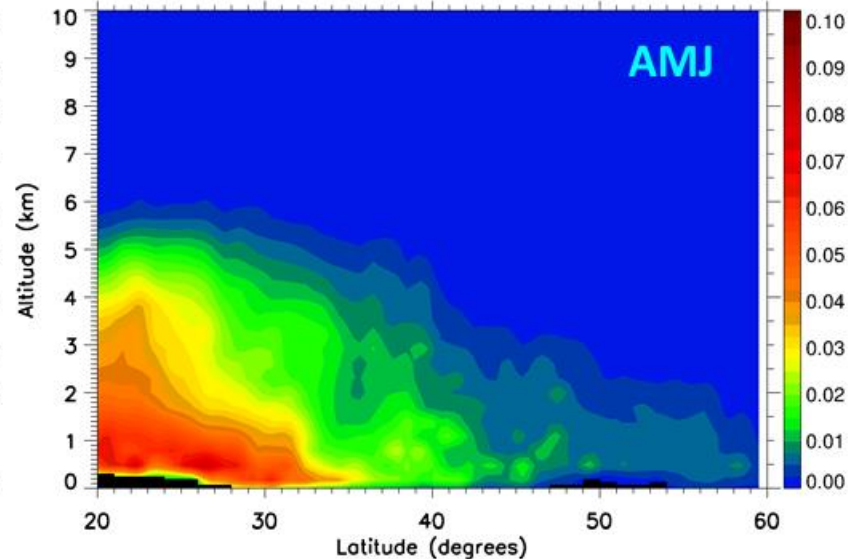
# Extinction Coefficient 20-30 deg Longitude



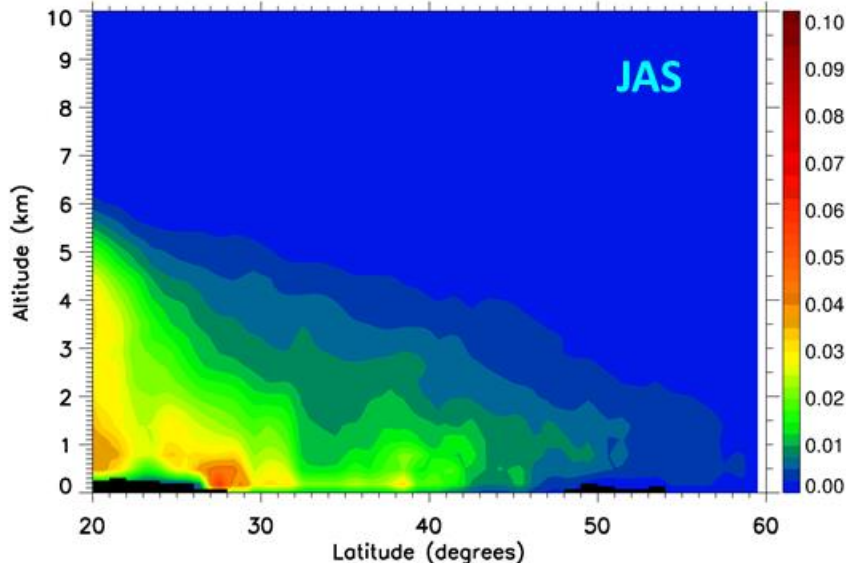
Dust Extinction 532nm, CALIPSO 2007to2014 Lons:20-30deg JFM



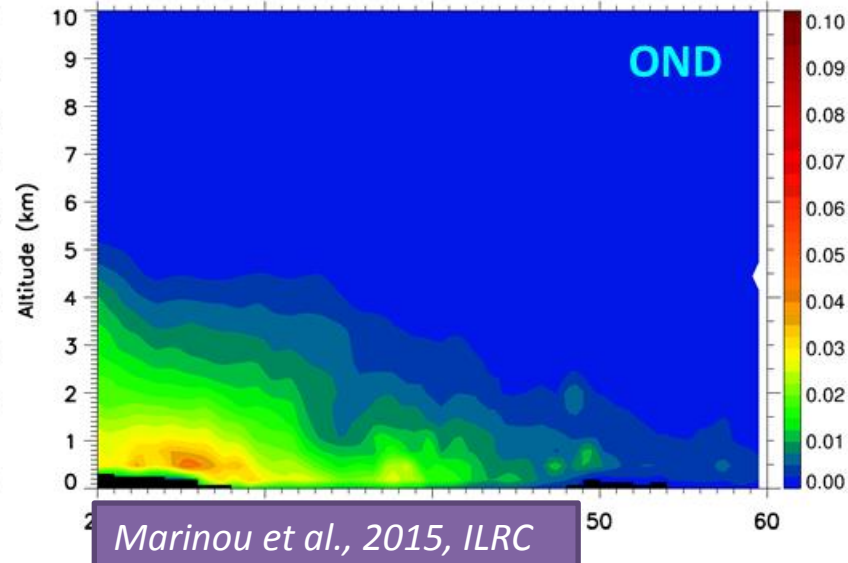
Dust Extinction 532nm, CALIPSO 2007to2014 Lons:20-30deg AMJ



Dust Extinction 532nm, CALIPSO 2007to2014 Lons:20-30deg JAS



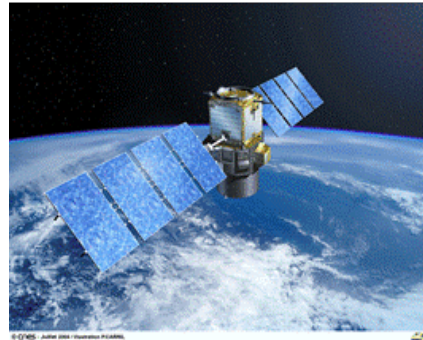
Dust Extinction 532nm, CALIPSO 2007to2014 Lons:20-30deg OND



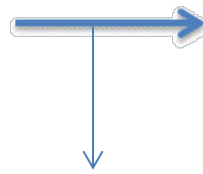


Starting from DUST and expanding to other aerosol types, the final BEYOND product in UV is envisioned to serve as the link between CALIPSO and EarthCARE, in order to bridge the missions for the provision of a multi-decadal harmonized climatic record.

**From CALIPSO**



**EARLINET**



**To EarthCARE**

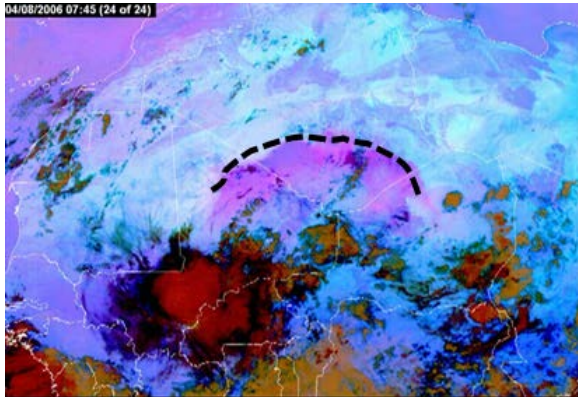


**ADM-Aeolus??**



## End-Users for BEYOND Atmospheric Services

- Climate Change Agencies
- Health Sector
- Hazard Mitigation Policies
- Risk Assessment
- Military Applications





## Conclusions

1. Langrangian atmospheric models (FLEXPART) utilized in the BEYOND in conjunction with RS data to provide smoke and volcanic ash dispersion forecasts.
2. Eulerian state-of-the-art models (NMME/DREAM) were utilized to simulate the atmospheric desert dust cycle. Assimilation of MSG dust retrievals showed to improve forecasts when compared to ground-based lidar profiles.
3. Assimilation of 3D fields from CALIPSO dust LIVAS product of BEYOND is under development. For this development we aim to use UV dust extinction wavelengths in order to be consistent with future ESA missions (ADM-Aeolus and EarthCARE).



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