



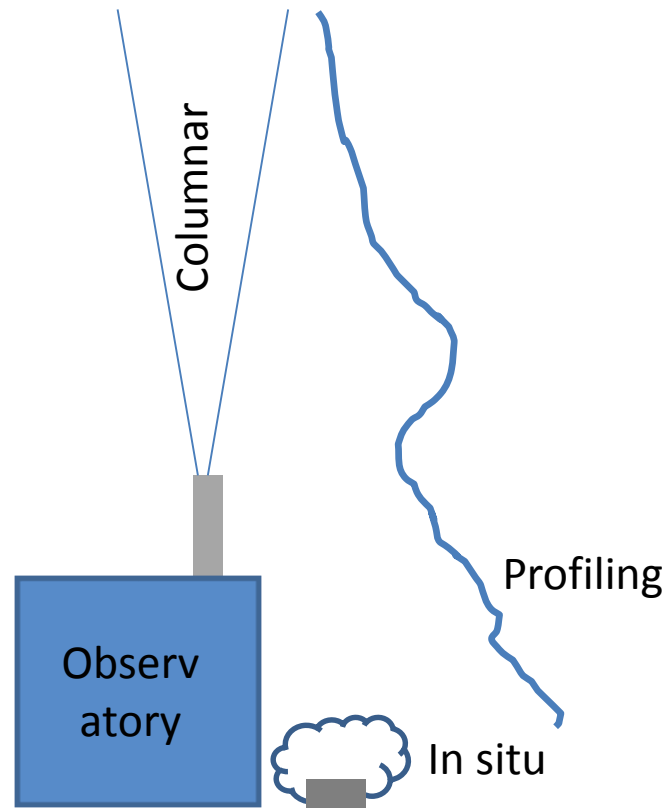
InDust

Dust observations – an overview

Lucia Mona (*CNR-IMAA, Italy*)

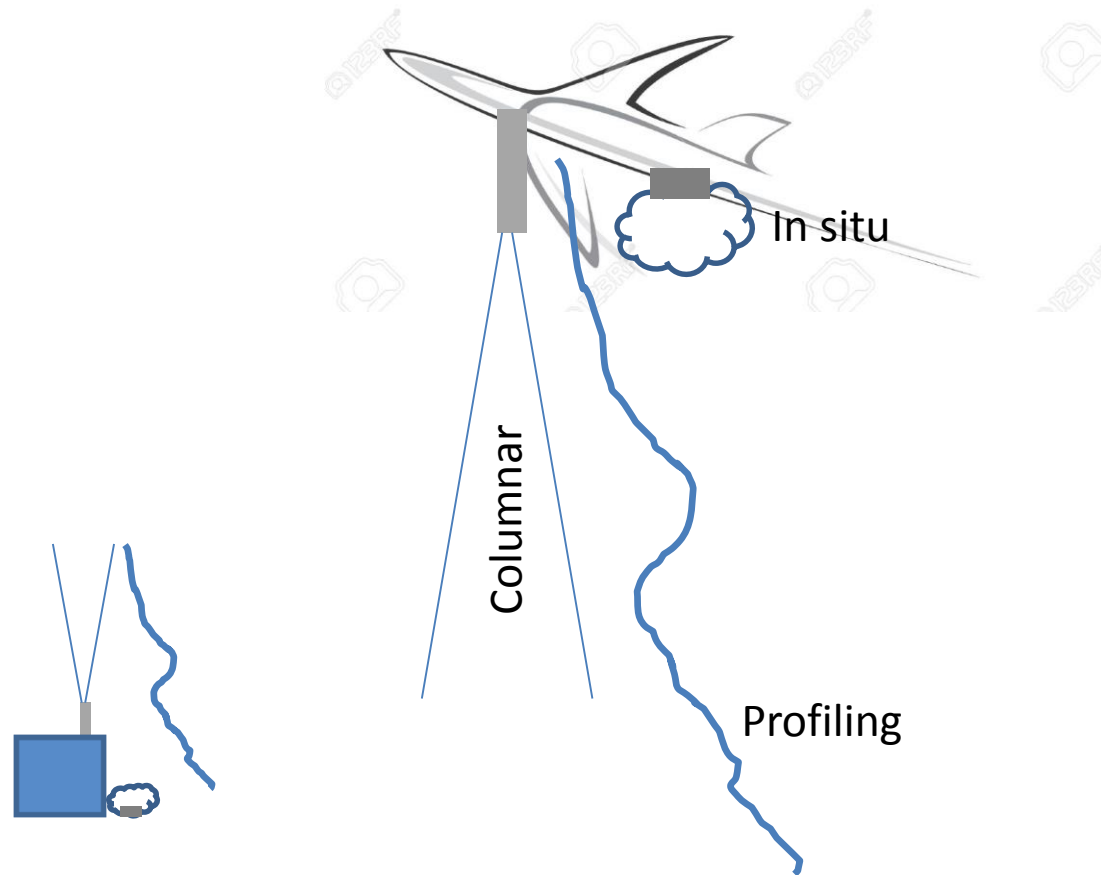
Observations of atmospheric aerosol

Atmospheric aerosol presence and properties can be inferred through a **plethora of techniques** mounted on **different platforms**



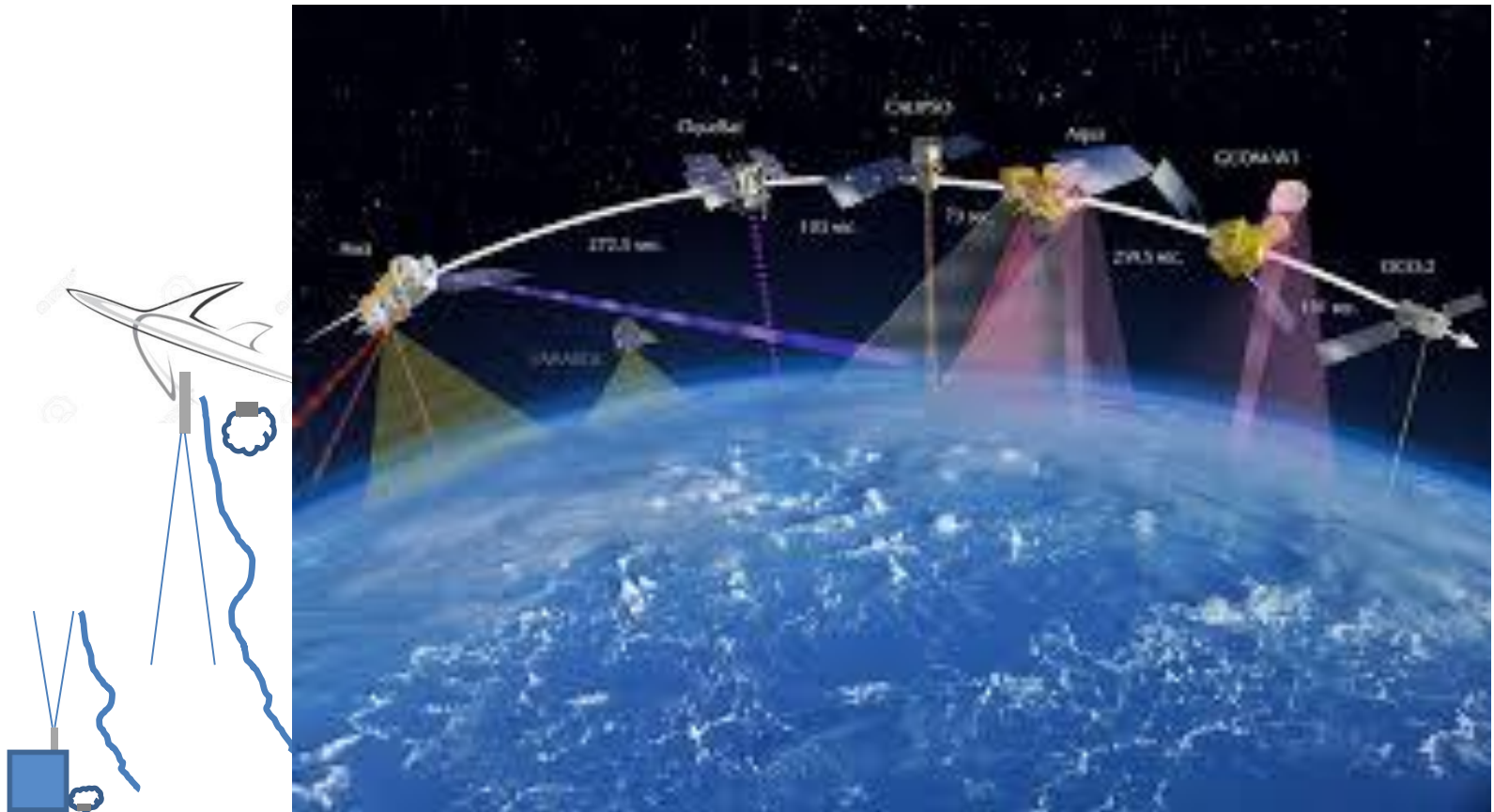
Observations of atmospheric aerosol

Atmospheric aerosol presence and properties can be inferred through a **plethora of techniques** mounted on **different platforms**



Observations of atmospheric aerosol

Atmospheric aerosol presence and properties can be inferred through a **plethora of techniques** mounted on **different platforms**



Main issue

Discriminating and quantifying the dust contribution to the total aerosol content

Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2018-42>
Manuscript under review for journal Atmos. Chem. Phys.
Discussion started: 27 February 2018
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Atmospheric
Chemistry
and Physics
Discussions
Open Access
EGU

Status and future of Numerical Atmospheric Aerosol Prediction with a focus on data requirements

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*The problem of constraining the **aerosol species** in the model has become more important with user demand of products related to single aerosol types.....*

*Wherever **direct speciation measurements** are possible, those would be the **best suited to be used** to correct model prediction of a given aerosol species.*

Starting point

- ❑ World Data Center for Remote Sensing of the Atmosphere (WDC-RSAT, http://wdc.dlr.de/data_products/)
- ❑ WMO Observing Systems Capability Analysis and Review tool (OSCAR) database (<https://www.wmo-sat.info/oscar/satellites>)



- ❑ Recent efforts of the scientific community in this direction for addressing specific problems

Catalogue of DESERT DUST observations



The project **EUNADICS-AV** undertakes to develop and test a unique system to **provide consistent and coherent information to aviation authorities, airlines and pilots** in the event of a natural disaster affecting the airspace.

Inventory of available information within the consortium for **Ash, Desert Dust, Forest fires and nuclide particles**

Catalogue of DESERT DUST observations



DustClim will produce and deliver and assess an advanced dust regional model reanalysis for Northern Africa, Middle East and Europe and will develop dust-related services tailored to specific socio-economic sectors.

Review Dust observations suitable for **assimilation** and **evaluation** of the model reanalysis.

Catalogue of DESERT DUST observations

Building on this, InDust aims to provide a comprehensive catalogue of Desert Dust observations on Global Scale.

The logo for InDust features the word "inDust" in a bold, black, sans-serif font. The letters "in" are lowercase, while "Dust" is uppercase. The letter "D" is significantly larger than the other letters and is filled with a black-to-white gradient of dots, creating a halftone or stippled effect.

The idea is to realize a **dynamical catalogue** which can be easily updated and that will reply to the expressed need of *speciated* measurements for Dust particles.

A **White Paper on Dust Observations** is in preparation reflecting this work (to be published on BAMS 2019)

The Dust Catalogue

How is it organized?

- Satellite
- Ground based remote sensing
- Near surface
- Airborne/campaign

Which information ?

Extensive list of information for replying to the different “users” needs.

1	Data availability	Spectral range	Unit	Retrieval method	Temporal Resolution	Overpass time (quarter)	Spatial resolution
2	2002-2012	VIS SWIR TIR	km	stereoscopic correlation method	3 days at mid latitudes	10:30	10 km ²
3	2004	512 nm	km ¹	Lidar Level 2 Aerosol extinction coefficient	0.05 seconds	1:30 LT (a-train constellation)	30 km horizontally, 60 m vertically
4	2004	No Spectral Range	No Units	Lidar Level 1 Vertical Feature Mask	0.05 seconds	1:30 LT (a-train constellation)	30 km horizontally, 60 m vertically
5	2006	532 nm	km-lac-1	Lidar Level 1B attenuated backscatter	0.05 seconds	1:30 LT (a-train constellation)	30 km horizontally, 60 m vertically
6	2006	532 nm/1064 nm	km-lac-1	extinction product of the volume backscatter coefficient and the	0.05 seconds	1:30 LT (a-train constellation)	3 km horizontally - range ranging 10-30 m vertically
7	2006	532 nm/1064 nm	km-lac-1	inverted elastic lidar signals	1.92 seconds	1:30 LT (a-train constellation)	3 km horizontally, 60 m vertically
8	2006	532 nm	No Units	ratio of the perpendicular and parallel components of the aerosol	1.92 seconds	1:30 LT (a-train constellation)	3 km horizontally, 60 m vertically
9	2006	532 nm/1064 nm	km-l	inverted elastic lidar signals	1.92 seconds	1:30 LT (a-train constellation)	3 km horizontally, 60 m vertically
10	2006	532 nm/1064 nm	No Units	Integration of aerosol extinction coefficient profiles	1.92 seconds	1:30 LT (a-train constellation)	3 km
11	2006	No Spectral Range	No Units	ang backscatter intensity, volume depolarization, and surface	0.14 seconds	1:30 LT (a-train constellation)	3 km horizontally, 60 m vertically
12	2004	VIS	dimensionless	OMAAERO algorithm (L1)	Once per day	13:45 (asc)	10x10 km ² , 2000 km wide swath
13	2004	LTV	dimensionless	OMAAERO algorithm	Once per day	13:45 (asc)	10x10 km ² , 2000 km wide swath
14	2007 (DustOp-A)	TIR	dimensionless	stereoscopic correlation method	monthly mean	09:30	10x10 km ²
15	> 2007 (DustOp-A)	LTV	residue	AAI LUT algorithm	once per day	09:30	10x10 km ²
16	> 2007 (DustOp-A)	LTV	residue	AAI LUT algorithm	once per day	09:30	10x10 km ²
17	> 2011 (DustOp-B)	LTV	image	IR	1 hour	Geo	3 x 3 km ² @SSP
18	2005 (ocean), 2012 (land)	VIS, NIR	dimensionless	AERUS-GEO algorithm	daily	Geo	3 km x 3 km
19	2005 (ocean), 2012 (land)	VIS, NIR	dimensionless	AERUS-GEO algorithm	17 min	Geo	3 km x 3 km
20	2005 (ocean), 2012 (land)	VIS, NIR	dimensionless	CISAR	hourly	Geo	3 km x 3 km
21	2002	VIS, NIR	AOI	MODIS Deep Blue algorithm	1:30 (Asc), 10:30 (Desc)		
22	2002	VIS, NIR	AOI	MODIS Dark Target algorithm	1:30 (Asc), 10:30 (Desc)		
23	March 2002-October 2013	550 nm	dimensionless	The inversion scheme uses radiances in the 865 nm and 670 nm	1.6hr orbit	1:30 LT (a-train constellation)	1.6 degree
24	March 2002-October 2013	865 nm - 670 nm	dimensionless	The inversion scheme uses radiances in the 865 nm and 670 nm	1.6hr orbit	1:30 LT (a-train constellation)	1.6 degree
25	March 2002-October 2013	4-band	dimensionless (valid range 0.0-2.4)	The inversion scheme uses radiances in the 865 nm and 670 nm	1.6hr orbit	1:30 LT (a-train constellation)	1.6 degree
26	March 2002-October 2013	4-band	dimensionless (valid range 0-1)	The inversion scheme uses radiances in the 865 nm and 670 nm	1.6hr orbit	1:30 LT (a-train constellation)	1.6 degree
27	March 2002-October 2013	4-band	dimensionless	The inversion scheme uses radiances in the 865 nm and 670 nm	1.6hr orbit	1:30 LT (a-train constellation)	1.6 degree
28	March 2002-October 2013	4-band	dimensionless	The inversion scheme uses radiances in the 865 nm and 670 nm	1.6hr orbit	1:30 LT (a-train constellation)	1.6 degree
29	March 2002-October 2013	440-1020 nm (0-3)	dimensionless	The inversion scheme uses radiances in the 865 nm and 670 nm	1.6hr orbit	1:30 LT (a-train constellation)	1.6 degree
30	March 2002-October 2013	440-1020 nm (0-3)	dimensionless	The inversion scheme uses radiances in the 865 nm and 670 nm	1.6hr orbit	1:30 LT (a-train constellation)	1.6 degree
31	March 2006-October 2013	440-1020 nm (0-3)	dimensionless	GRASP Algorithm	Daily	1:30 LT (a-train constellation)	1.18 degree
32	March 2006-October 2013	440-1020 nm (0-3)	dimensionless	GRASP Algorithm	Daily	1:30 LT (a-train constellation)	1.18 degree
33	March 2006-October 2013	865 nm - 670 nm	dimensionless	GRASP Algorithm	Daily	1:30 LT (a-train constellation)	1.18 degree
34	March 2006-October 2013	865 nm - 670 nm	dimensionless	GRASP Algorithm	Daily	1:30 LT (a-train constellation)	1.18 degree

21	Unconstrained atmospheric composition constraints	N	ELMUNET E-profile	Automatic Lidars and Colimeters				Gradient, variable
22	Aerosol layer altitude	N	AERONET	Sun photometer	340nm / 380nm / 440nm / 500nm / 670nm / 870 nm / 1020nm	No Units	um	
23	Aerosol Optical Depth	N	AERONET	Sun photometer	340nm / 380nm / 440nm / 500nm / 670nm / 870 nm / 1020nm	um ⁻¹	um ⁻¹	Hourly sky scans in the principal and/or
24	Aerosol Size Distribution	N	AERONET	Sun photometer	440nm / 670nm / 870 nm / 1020nm	No Units	um	
25	Single Scattering Albedo	N	AERONET	Sun photometer	440nm / 670nm / 870 nm / 1020nm	No Units	um	Aerosol
26	Refractive Index (real part)	N	AERONET	Sun photometer	440nm / 670nm / 870 nm / 1020nm	No Units	um	Aerosol
27	Refractive Index (imag part)	N	AERONET	Sun photometer	440nm / 670nm / 870 nm / 1020nm	No Units	um	Aerosol
28	Asymmetry Factor	N	AERONET	Sun photometer	440nm / 670nm / 870 nm / 1020nm	No Units	um	Aerosol
29	Aerosol Optical Depth	N	AERONET	Sun-Sky-Lunar photometer	340nm / 380nm / 440nm / 500nm / 670nm / 870 nm / 1020nm	No Units	um	
30	Aerosol Optical Depth	N	SKYNET	PREDE Sun-photometer	340nm / 380nm / 440nm / 500nm / 670nm / 870nm / 1020nm	No Units	um	

Basic info

- Name of the platform (instrument/network/campaign)
- Measured Parameter
- Responsible institution
- Data period availability
- Spatial coverage
- Spectral range
- Unit
- Measurements schedule
- Collocation with other instruments
- Literature reference
- Link to product overview

Resolution and uncertainty

- Retrieval method
- Accuracy
- Detection limit
- Errors due to clouds
- Other limitations
- Temporal resolution
- Overpass time
- Spatial resolution
- Vertical resolution
- Comments on errors
- QA programs

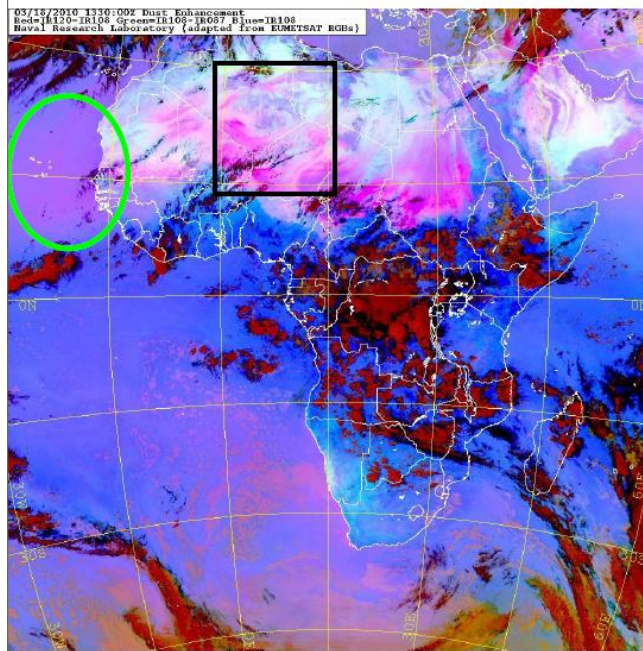
Data Accessibility

- Time delay for delivery
- Offline data available for validation (Yes/No)
- Data availability
- Data format
- Open data? (Yes/No)
- Dissemination via / Link to data
- Data repository

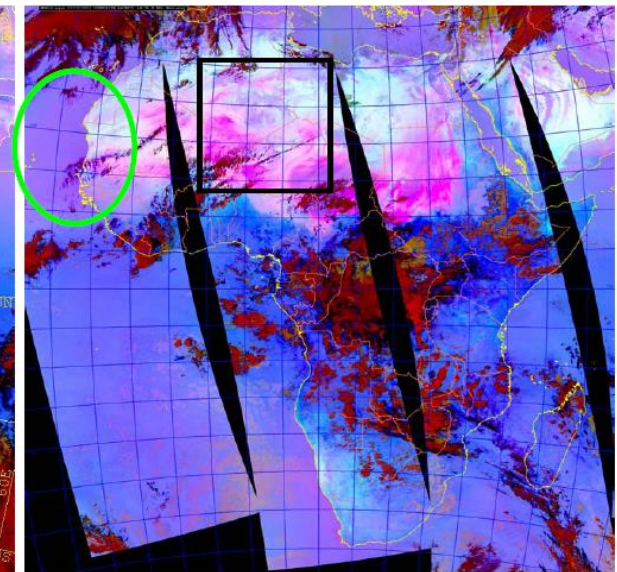
Some HIGHLIGHTS - Satellite

SEVIRI

- 15 min/5 min temporal resolution
- Coverage
- Dust product: IR8.7, IR10.8 and IR12.0
- Available NRT



MSG 13:30 GMT



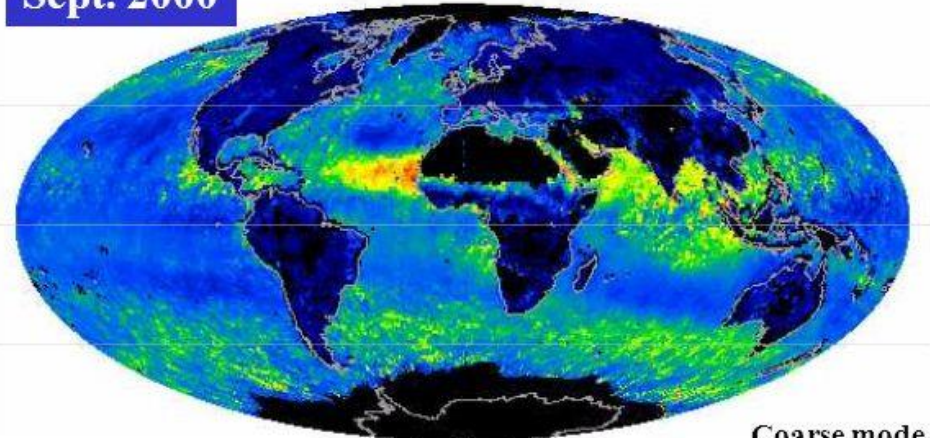
14:00 – 14:35Z 12:40 – 13:00Z 11:00 – 11:25Z

Aqua composite: 5 min granules

Some HIGHLIGHTS - Satellite

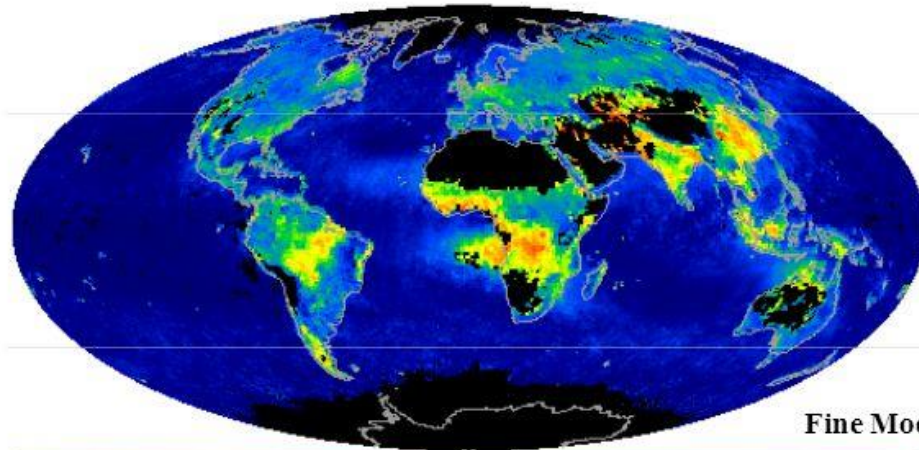
MODIS

Sept. 2000



Coarse mode
Aerosol optical thickness (AOD)

0.0 0.1 0.2 0.3 0.4

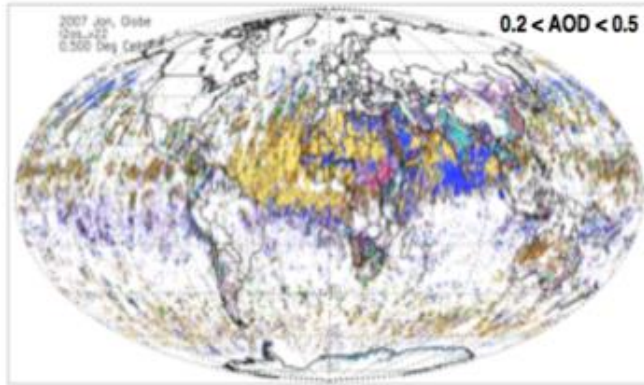


Fine Mode

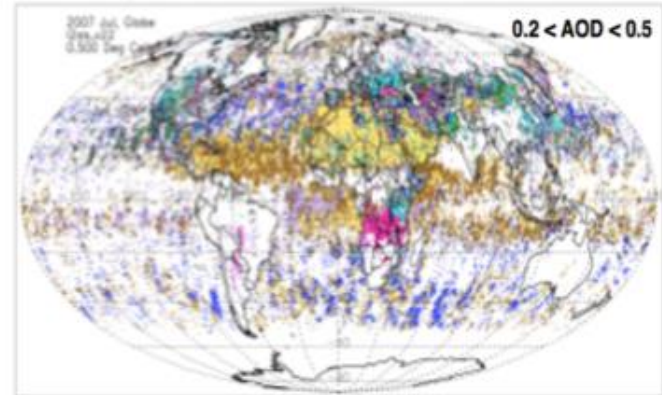
0.0 0.15 0.3 0.45 0.6

Some HIGHLIGHTS - Satellite

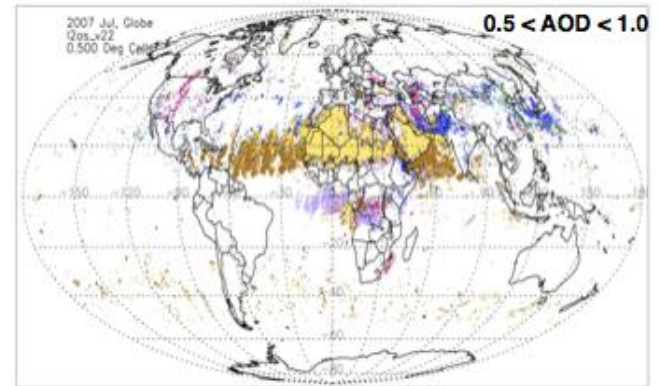
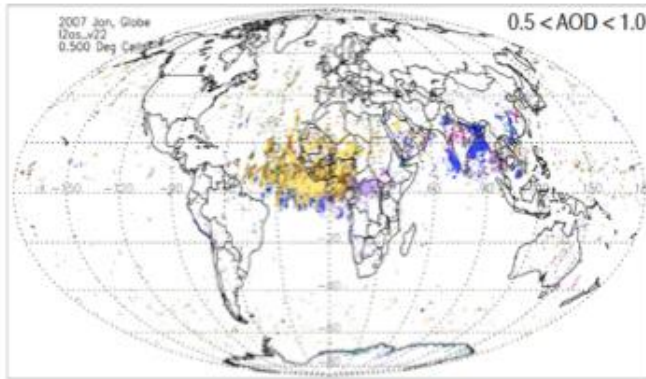
MISR



January 2007



July 2007



Spherical, non-absorbing

Non-spherical

Spherical, absorbing

Aerosol typing from AOD and absorbing properties

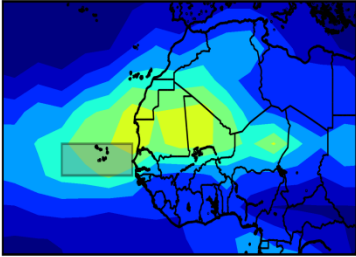
Kahn & Gaitley JGR 2015

Some HIGHLIGHTS - Satellite

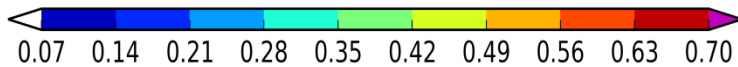
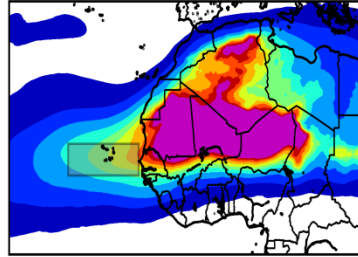
MISR

Dust climatology

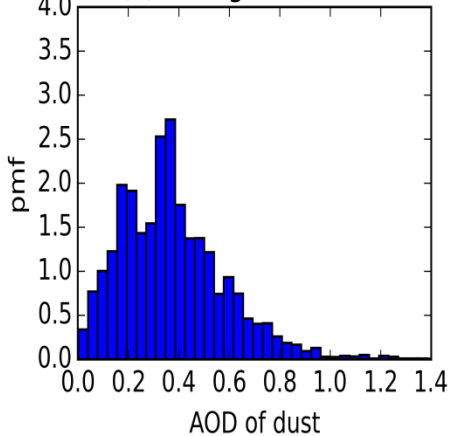
(a) combined dust [MISR]



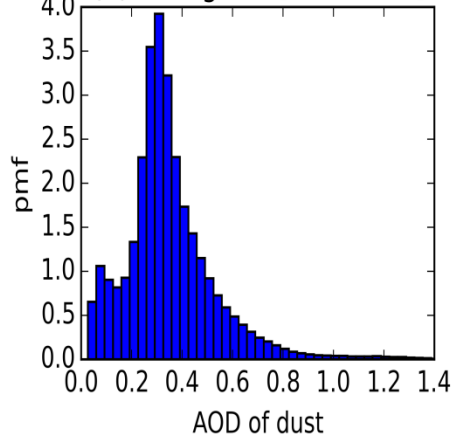
(b) dust [SPRINTAS]



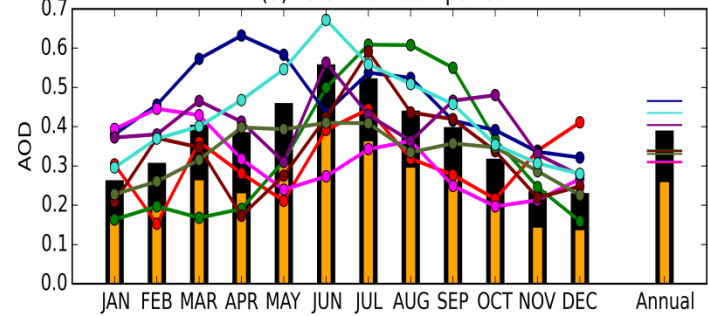
(c) histogram [MISR]



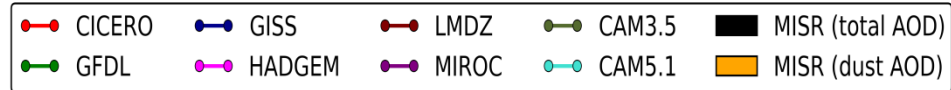
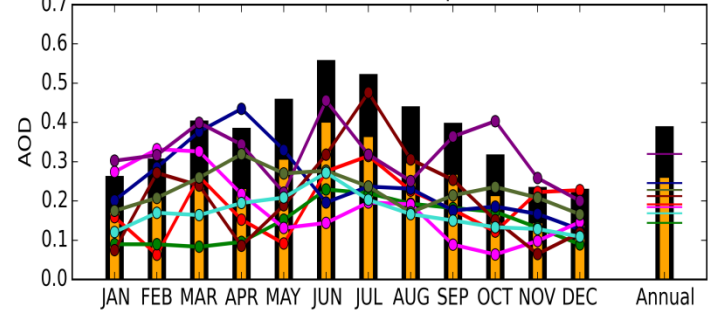
(d) histogram [SPRINTAS]



(a) Total AOD comparison



(b) Dust AOD comparison

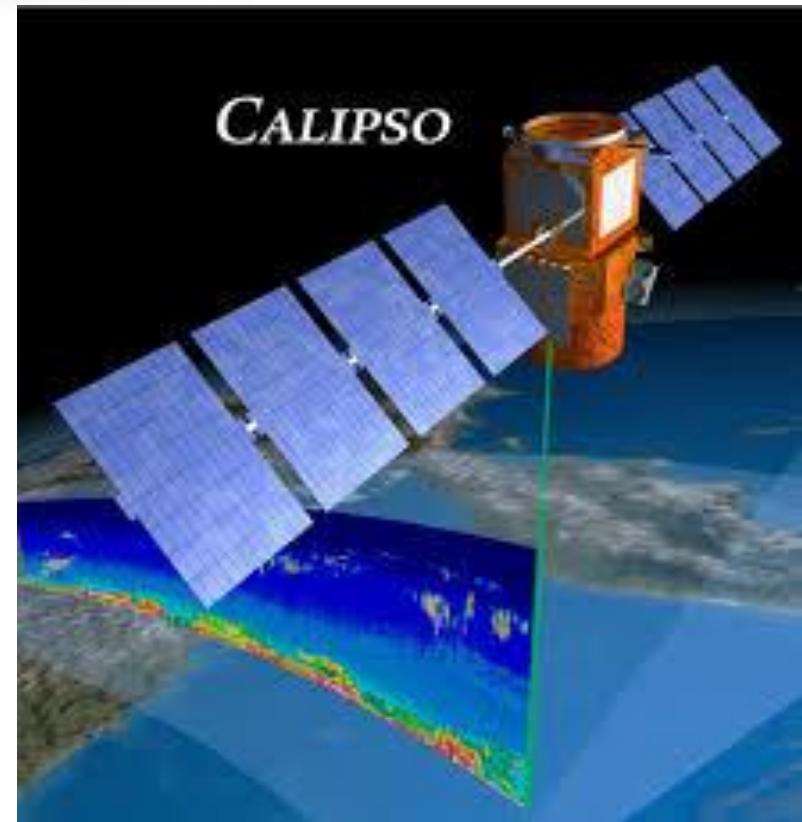


Some HIGHLIGHTS - Satellite

CALIPSO

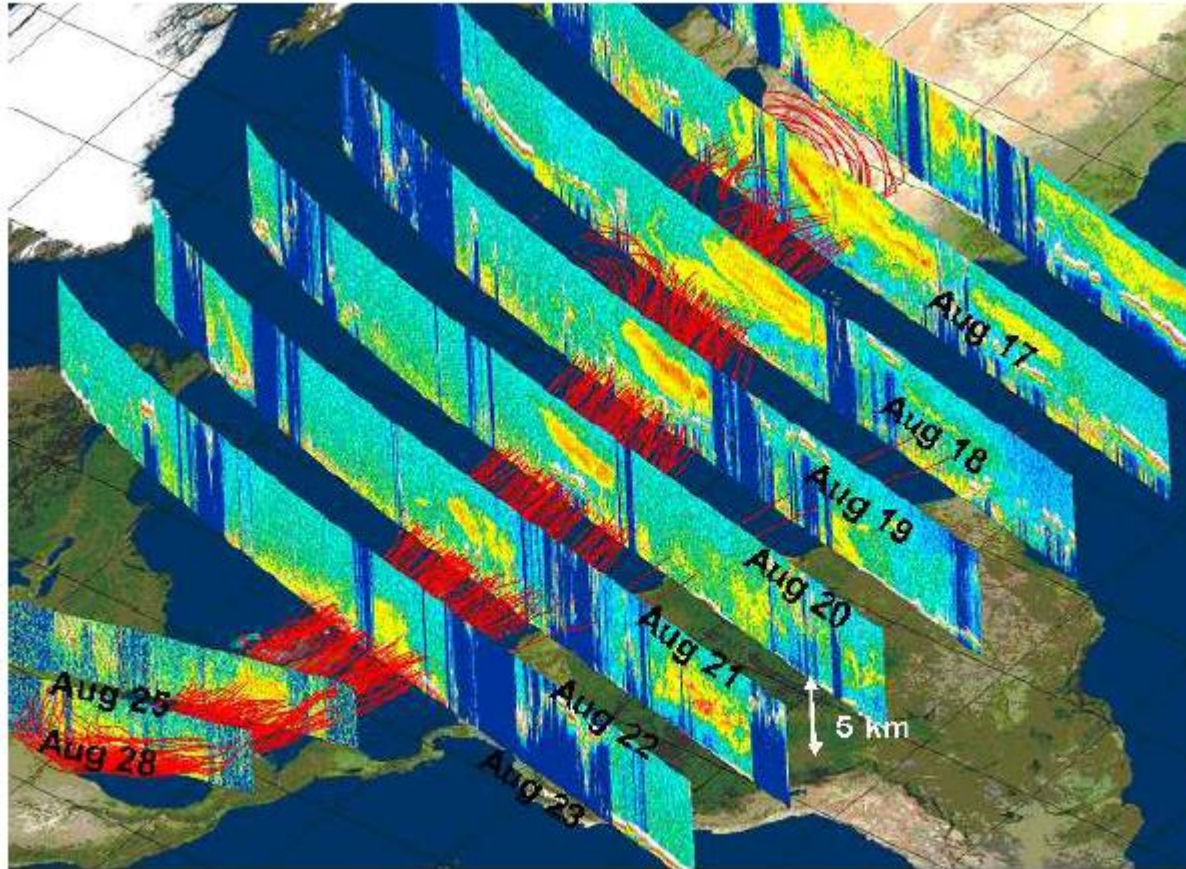
First lidar in space for studying aerosols.

It provides since 2006
Layering and vertical profiles of
optical properties
+
typing



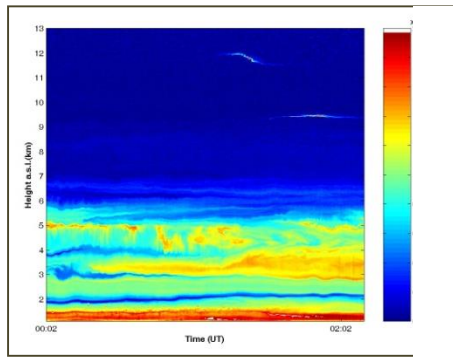
Some HIGHLIGHTS - Satellite

CALIPSO

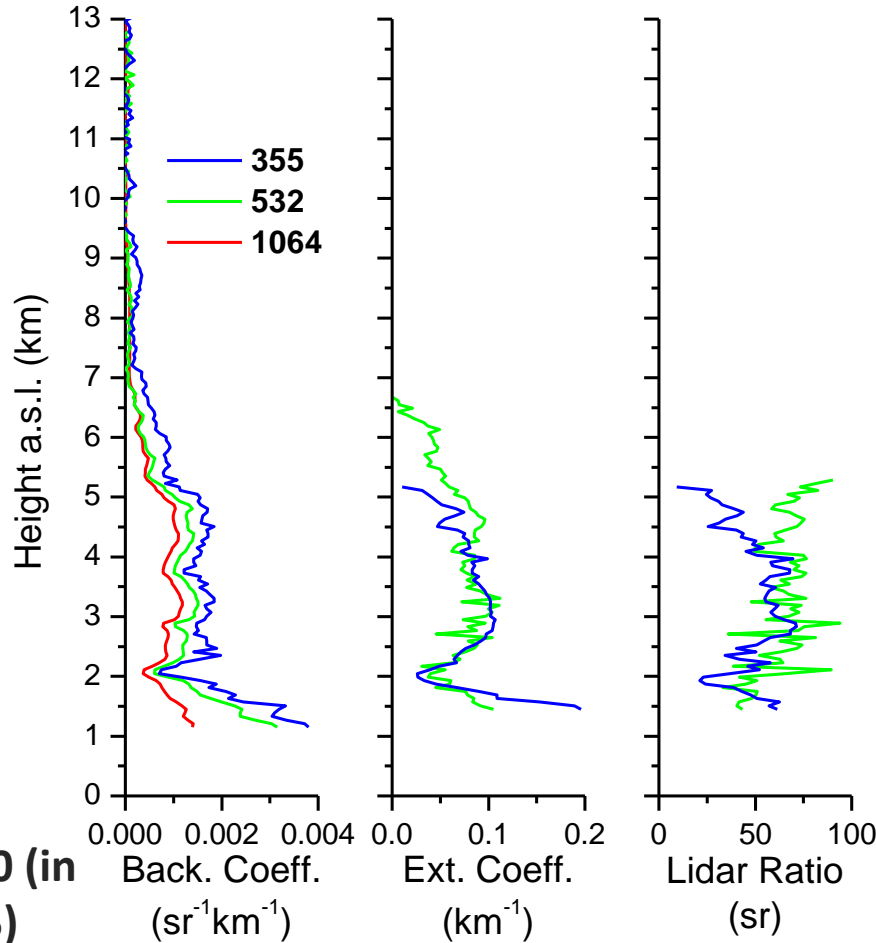


Observing transport path into details

Some HIGHLIGHTS – Ground Based Lidar



Potenza, Italy, (40.60°N, 15.73°E), 26 June 2006



Potenza, Lidar

AOD@532 nm = 0.30 (in the dust layer = 0.25)

AOD@355 nm = 0.33 (in the dust layer = 0.25)

Layer: top base CoM

Columnar integrated quantities (like AOD)

Mean values in the layers

Layer integrated quantities (like AOD)

Layer typing

Dust back and ext

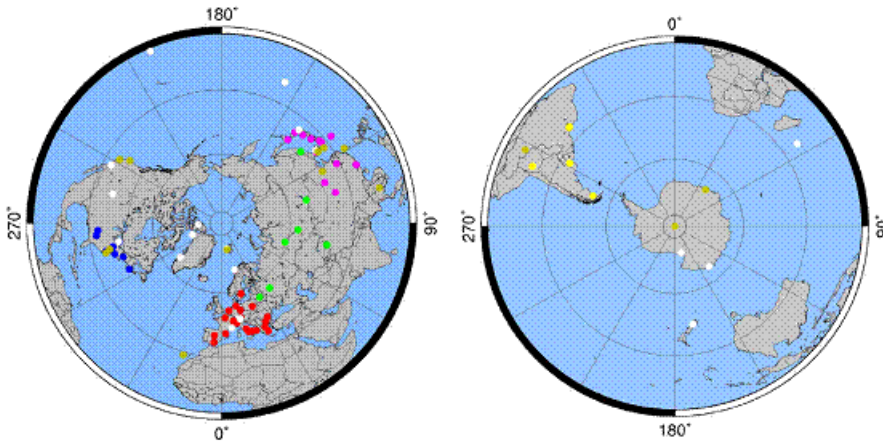
Dust concentration

Fine and mode concentration

IN concentration

Some HIGHLIGHTS – Ground Based Lidar

**GALION is a federated network of existing lidar networks that
Contributes to GAW initiative of WMO**



Micropulse Lidar Network (MPL-Net)
<http://mplnet.gsfc.nasa.gov/>

**European Aerosol Research Lidar
Network (EARLINET)** www.earlinet.org

Asian Dust Network, (AD-Net) [www-
lidar.nies.go.jp/AsiaNet](http://www-lidar.nies.go.jp/AsiaNet)

**Latin America Lidar Network (LALINET
a.k.a ALINE)** <http://www.lalinet.org/>

Cooperating networks

**NOAA Cooperative Remote Sensing Science and
Technology (CREST) Lidar network**
**Network for the Detection of Atmospheric
Composition Change (NDACC)**

**Different techniques /approach
working together for gaining better
insight**

Some HIGHLIGHTS – Ground Based Lidar



*Global map of operational
ceilometers www.dwd.de/ceilomap
with colors corresponding to
manufactures*

**Operative 24h system
widely distributed**



**Eya eruption showed
ceilometer potentials in
monitoring aerosol
intense events**



**Needs for cross
calibration with lidars**



**Integrated actions ongoing
within EUNADICS_AV and
ACTRIS**

Thanks for your attention!

ACKNOWLEDGMENTS

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