

#### Merging Aerosol Optical Depth (AOD) from multiple satellite missions from the last four decades

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 AEROSAT (https://aero-sat.org/) is an international consortium of experts on aerosol remote sensing from ground, aircraft and space.

•Main goals are

 to accelerate the exchange of ideas and concepts both within the aerosol remote-sensing community, and in conjunction with the aerosol modeling (e.g., AeroCom) and in situ aerosol-measuring efforts

 to advance and coordinate the capabilities of satellite sensor aerosol retrieval products, which are needed to constrain aerosol processing and assist in evaluating global modeling.





•The expected lifetime of the satellites is about 10-15 years. To study the longer trends of the substances using satellites, the information from different satellites should be combined.



Sogacheva et al., ACP 2018a,b

Instrument	period	Algorithm	coverage	Version
TOMS	1979-2001, gaps	OMAER	land / ocean (parts)	0.1.3
OMI	2005-2016	OMAER	land / ocean (parts)	1.8.9.1
AVHRR	1991-2011, gaps	SOAR	land / ocean	1
AVHRR NOAA	1981-2017		ocean	
SeaWiFS	1996-2010	SOAR	land / ocean	1
VIIRS	2012->	SOAR	land / ocean	1
ATSR2/AATSR	1995-2002-2012	ADV	land / ocean	2.31
		SU	land / ocean	4.3
		ensemble	land / ocean	2.7
MODIS, Terra	2000->	NASA	land / ocean	6.1
		MAIAC	land / ocean (parts)	6
MODIS, Aqua	2000->	NASA	land / ocean	6.1
		MAIAC	land / ocean (parts)	6
MISR	2000->		land / ocean	23
PARASOL	2005-2013	GRASP	land	1
EPIC	2016->	MAIAC	land	1
	To be included : S3A, S3B, new product versions			



### **AOD data specification**

AOD monthly L3 (1°x1° resolution), global
AOD monthly-> seasonal, AOD monthly-> yearly
AOD uncertainties – to be included ?







-0.25 0.25 -0.5 0 0.5



#### **Regions of interest**





#### AOD time series, annual, Europe



# Monthy/seasonal AOD 2008



# AOD monthly mean evaluation with AERONET



1 TOMS 3 AVHRR\_NOAA 7 ATSR\_ADV 10 Terra DT&DB 14 MISR 2 OMI 4 AVHRR\_DT/SOAR 8 ATSR\_SU 11 Terra MAIAC 15 POLDER 5 SeaWiFS 9 ATSR\_ens 12 Aqua DT&DB 16 EPIC 6 VIIRS 13 Aqua MAIAC M Merged product Sogacheva et al., ACP 2020



### **AOD merging scheme**





### Weighted AOD

 Weights were obtained for different aerosol types based on AERONET statistics

10 bins, ranks from 1-10

•R,
•Number of pixels in GE,
•Offset,
•Rms,
•AOD mean bias for 0.35<AOD<1,</li>

[0.5 1] [0 0.5] [0 0.2] [0 0.15] [-0.5 0]



### **Ranking results**







### **AOD merged time series**





#### Merged AOD evaluation (a) and validation (b-d)







#### Offset between time series from merged L3 product and merged time series







## Annual AOD merged with different methods





# Merged AOD, monthly time series



-AOD median  $\pm 1\sigma$ \_AOD<sub>shifted</sub> median . TOMS shifted AVHRR<sub>shifted</sub> -AOD merged time series AOD merged L3 Sogacheva et al., ACP 2020



#### **Application: modelled AOD** evaluation



Pearson correlation coefficients (R) computed from the monthly collocated data for each model (columns) and observation /variable combination (rows). For the 5° ×5° satellite products, area weights were applied to the monthly values.

#### Gliss et al., 2019, submitted to ACPD



#### Conclusions

 Monthly L3 global AOD merged product has been created for 1995-2017 and evaluated with AERONET

 Quality of the merged product is as good as that of the individual products

•AOD merged product can be used for verification of the modelled AOD

•AOD merged product is an open-access product. Data can be downloaded from https://nsdc.fmi.fi/data/data\_aod after registration

#### Next

AOD trend analysis

•Include new products (Sentinel 3A and 3B)

Study reasons for offsets between the products ← analyze L2
 AOD products

