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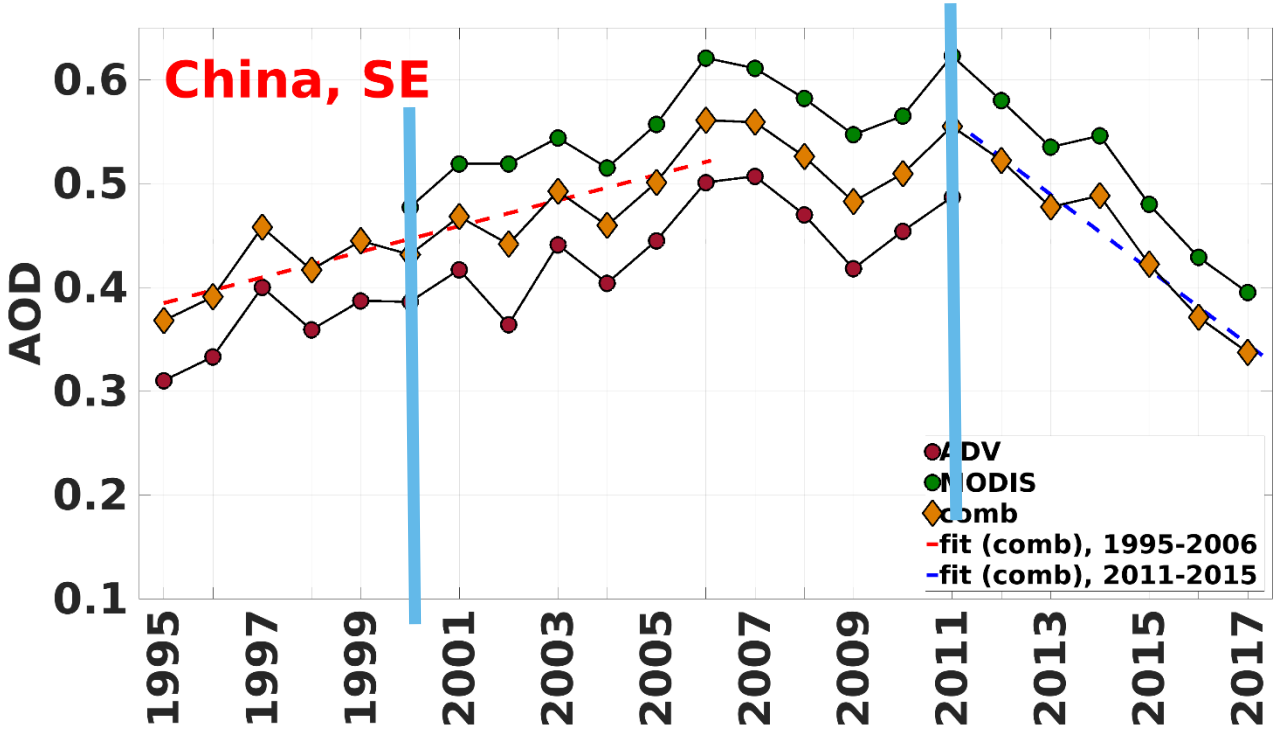
Merging aerosol optical depth (AOD) and AOD trend estimation from multiple satellite missions for the last four decades

Larisa Sogacheva + AEROSAT team

AEROSAT, 18th October 2018

Objectives

- 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.

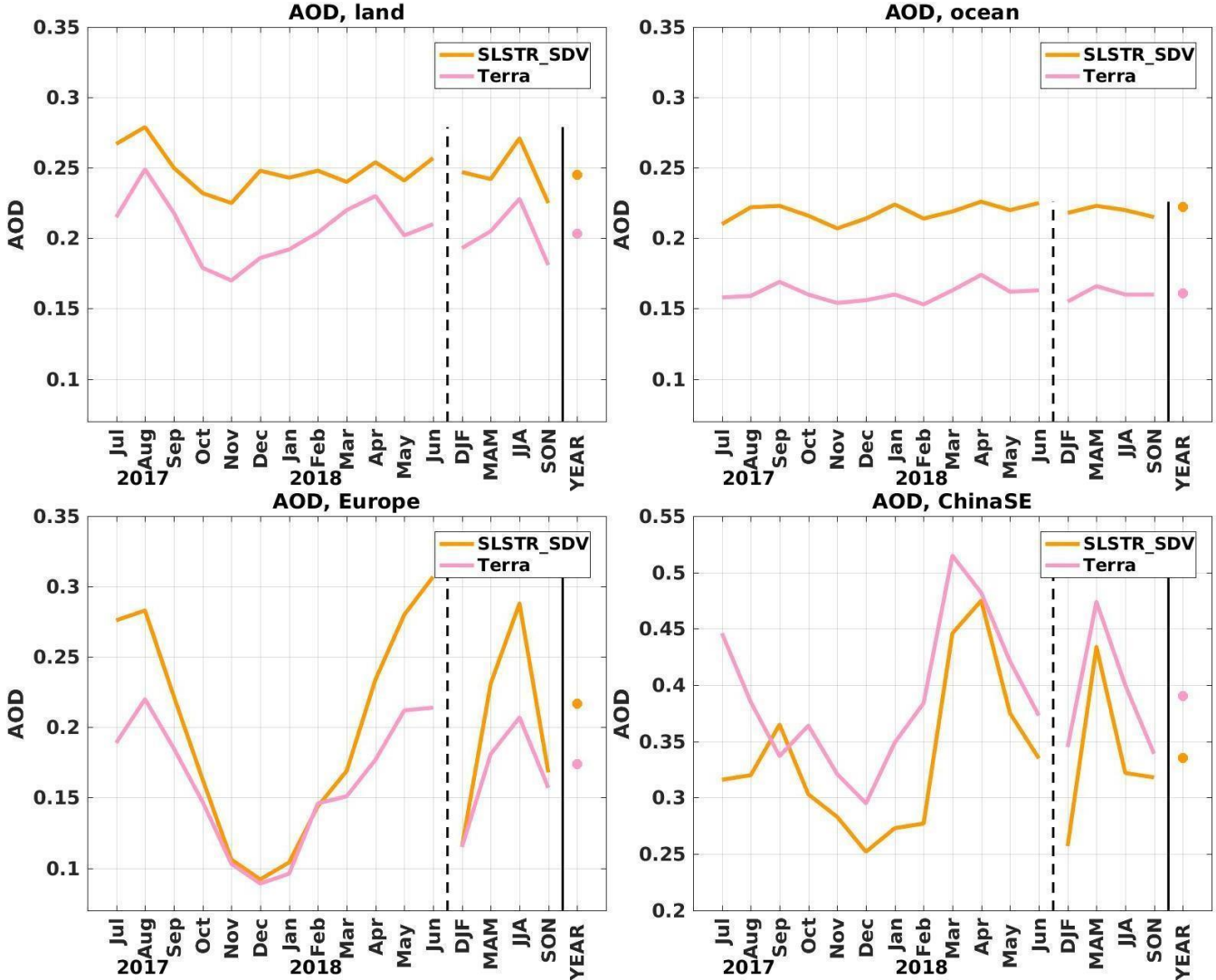


Sogacheva et al., ACPD 2018

Instruments/Algorithms

Instrument	period	Algorithm	coverage	Version
TOMS	1979-2001, gaps	OMAER	**land / ocean (parts)**	Sept. 2018
OMI	2005-2016	OMAER	**land / ocean (parts)**	Sept. 2018
AVHRR	1991-2011, gaps	SOAR	**land / ocean**	001
SeaWiFS	1996-2010	SOAR	**land / ocean**	1.0
VIIRS	2012->	SOAR	**land / ocean**	Summer 2018
ATSR2/AATSR	1995-2002-2012	ADV	**land / ocean**	2.31
		SU	**land / ocean**	4.3
		ensemble	**land / ocean**	2.6
MODIS, Terra	2000->	NASA	**land / ocean**	6.1
		MAIAC	**land / ocean (parts)**	Sept. 2018
MODIS, Aqua	2000->	NASA	**land / ocean**	6.1
		MAIAC	**land / ocean (parts)**	Sept. 2018
MISR	2000->		**land / ocean**	2.3
PARASOL	2005-2013	GRASP	**land**	Summer 2018
EPIC	2016->	MAIAC	**land**	Sept. 2018
	To be included : SLSTR, Himawari, …			

SLSTR SDV AOD, 07.2017-06.2018 comparison with Terra AOD



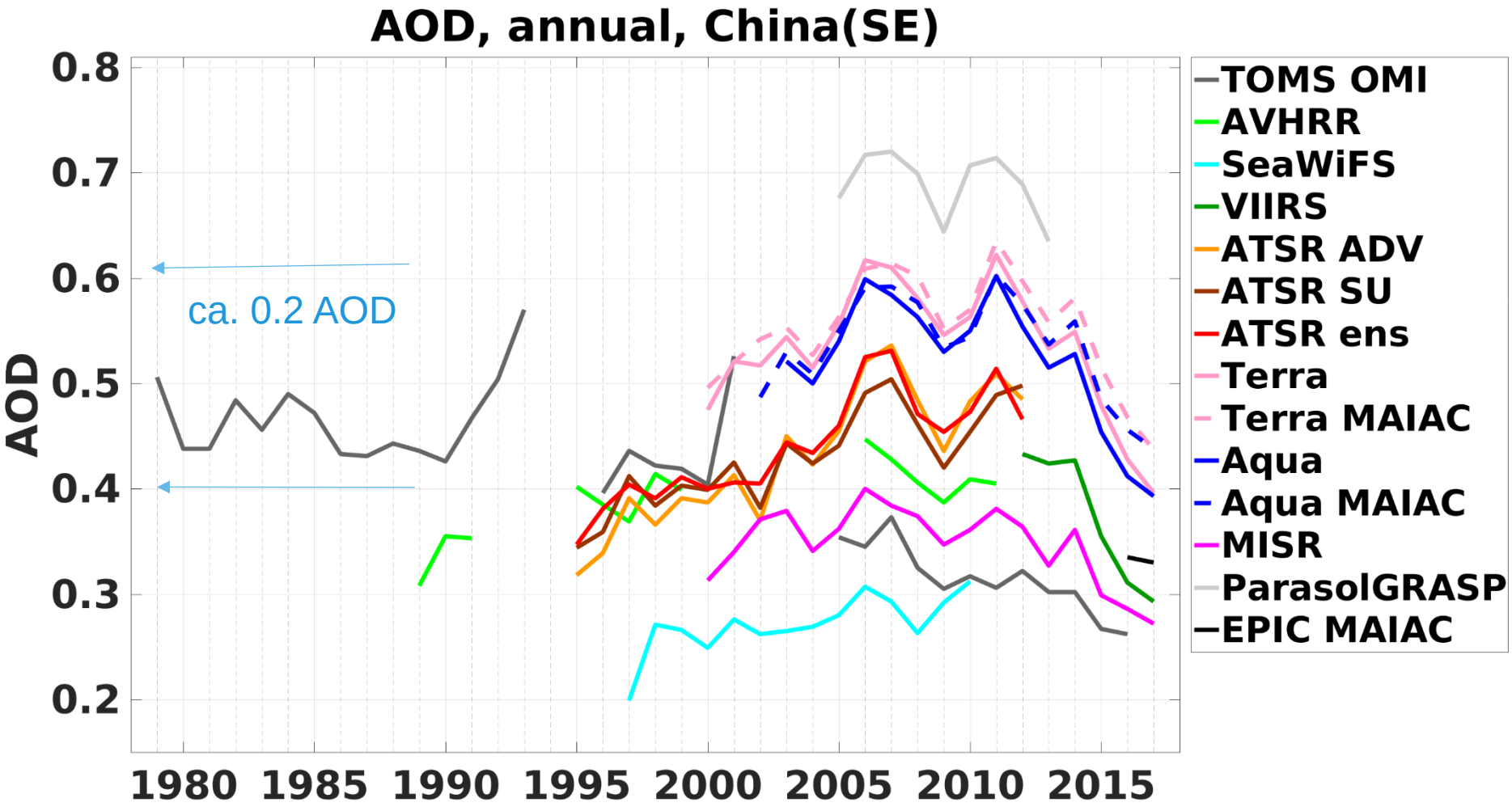
AOD data specification

- AOD monthly L3 (1ºx1º resolution), global
- AOD monthly-> seasonal, AOD monthly-> yearly
- AOD uncertainties – to be included

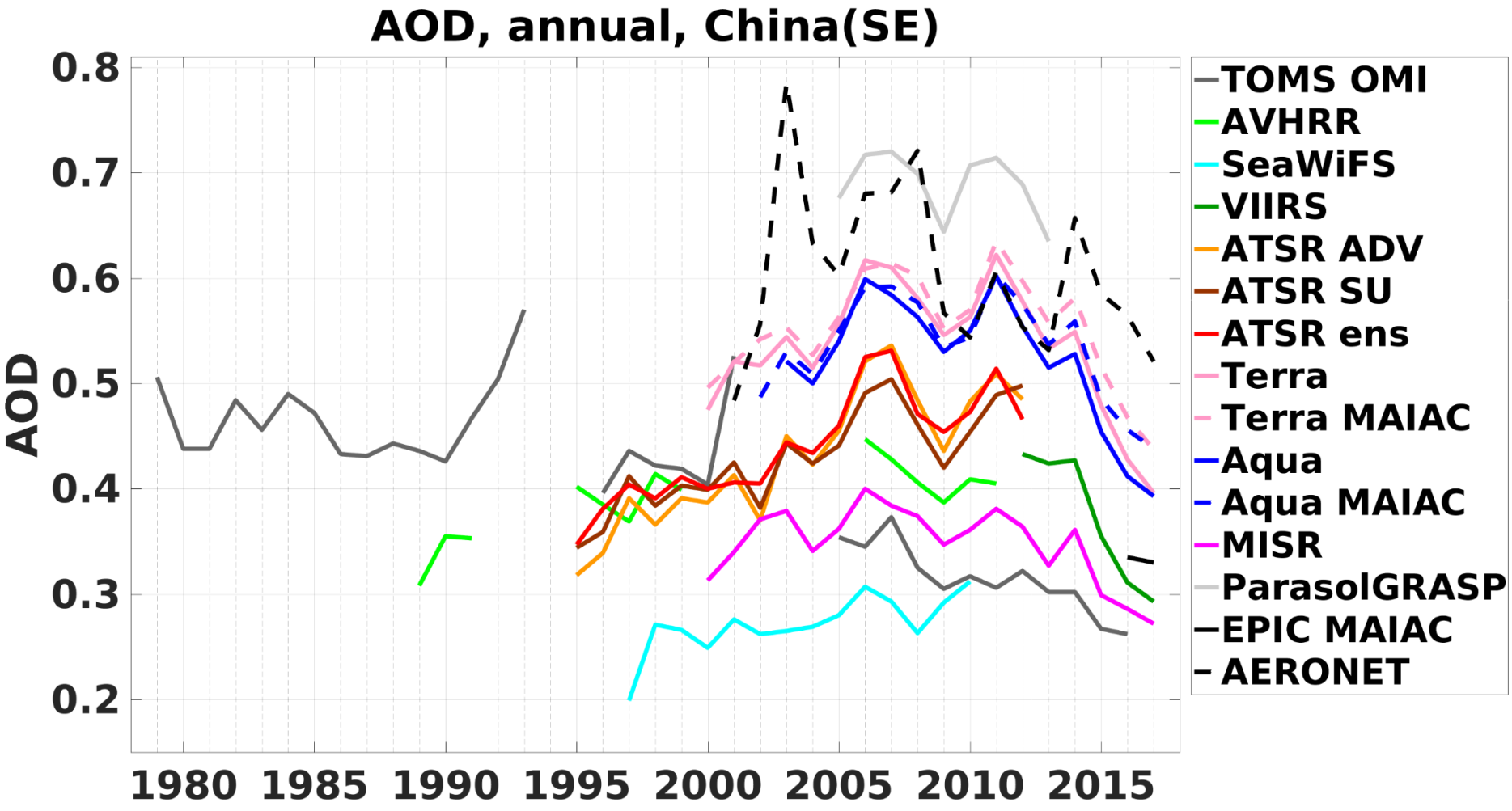
AOI

- China, SE
- Europe
- Global, land
- Global, ocean
- tbd

SE China: AOD time series, annual



SE China: AOD time series, annual



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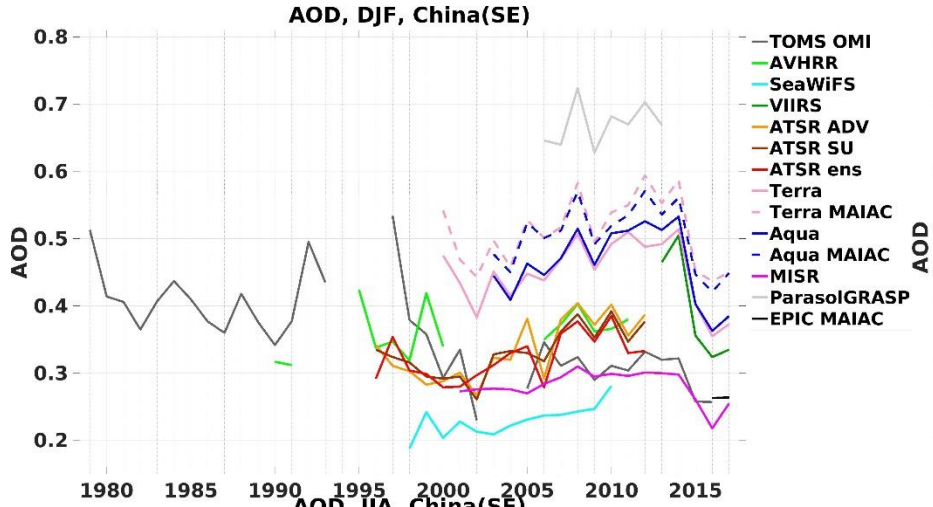
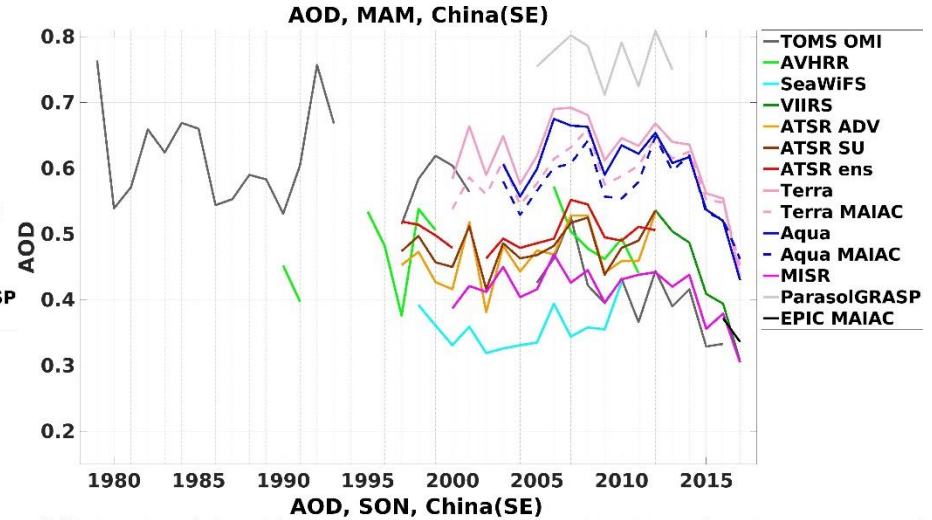
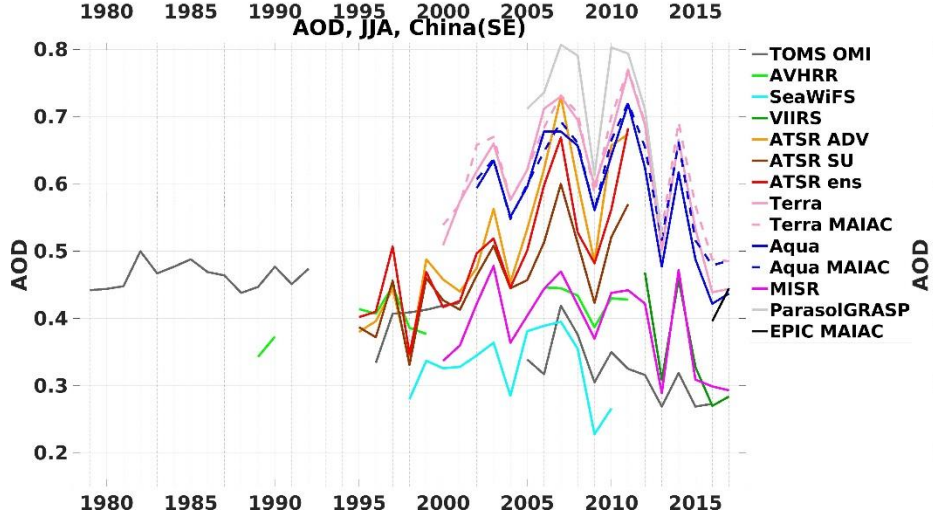
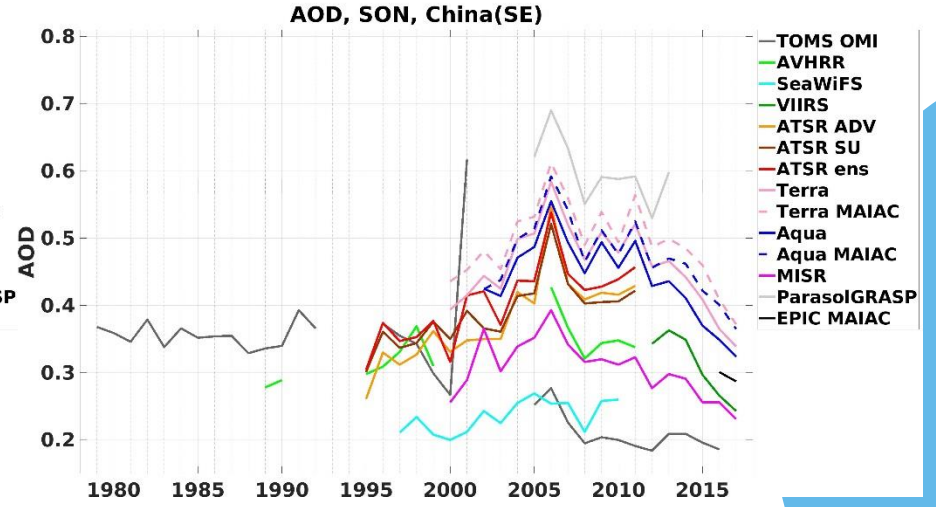
SE China: AOD time series, seasonal

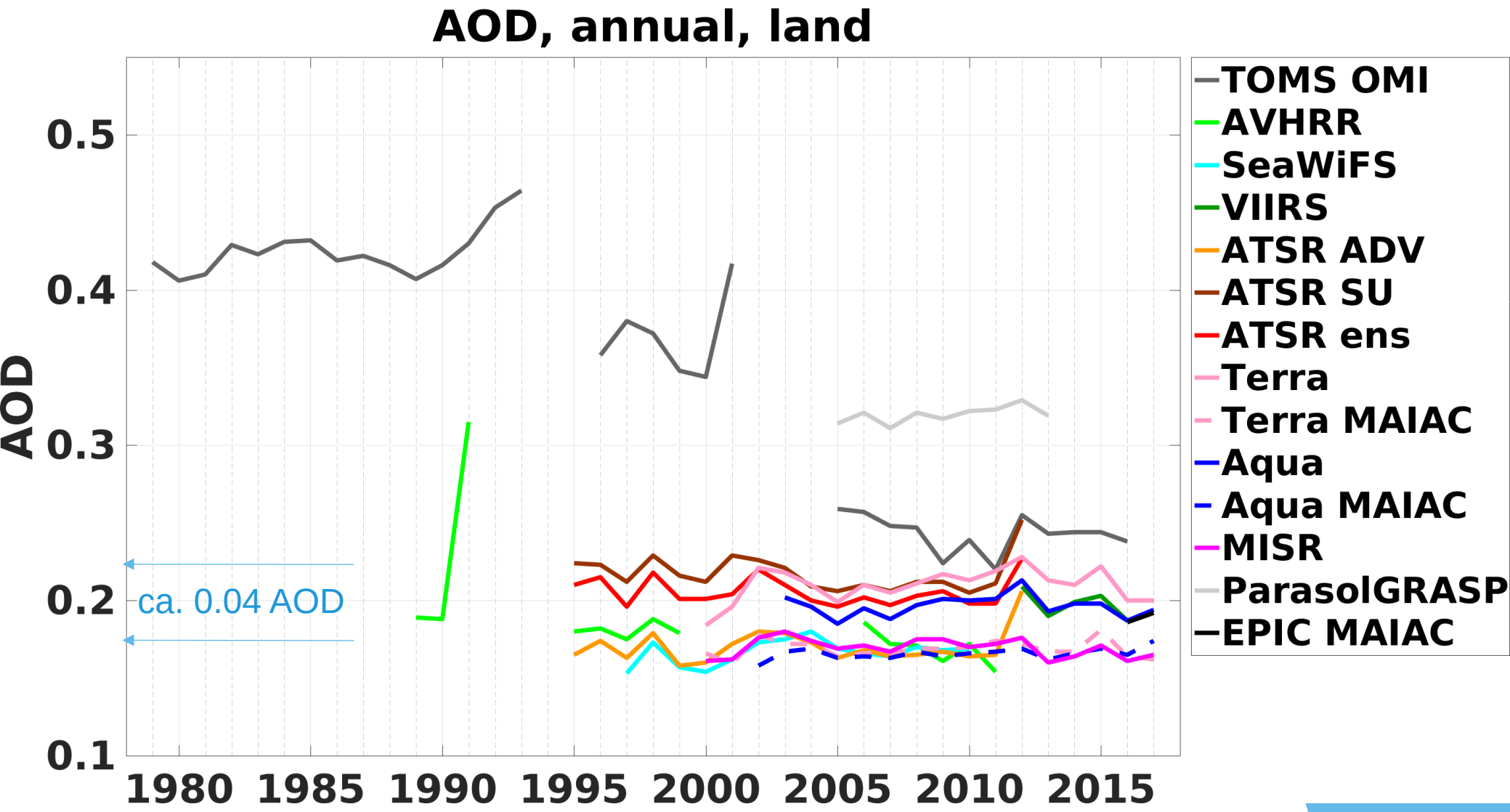




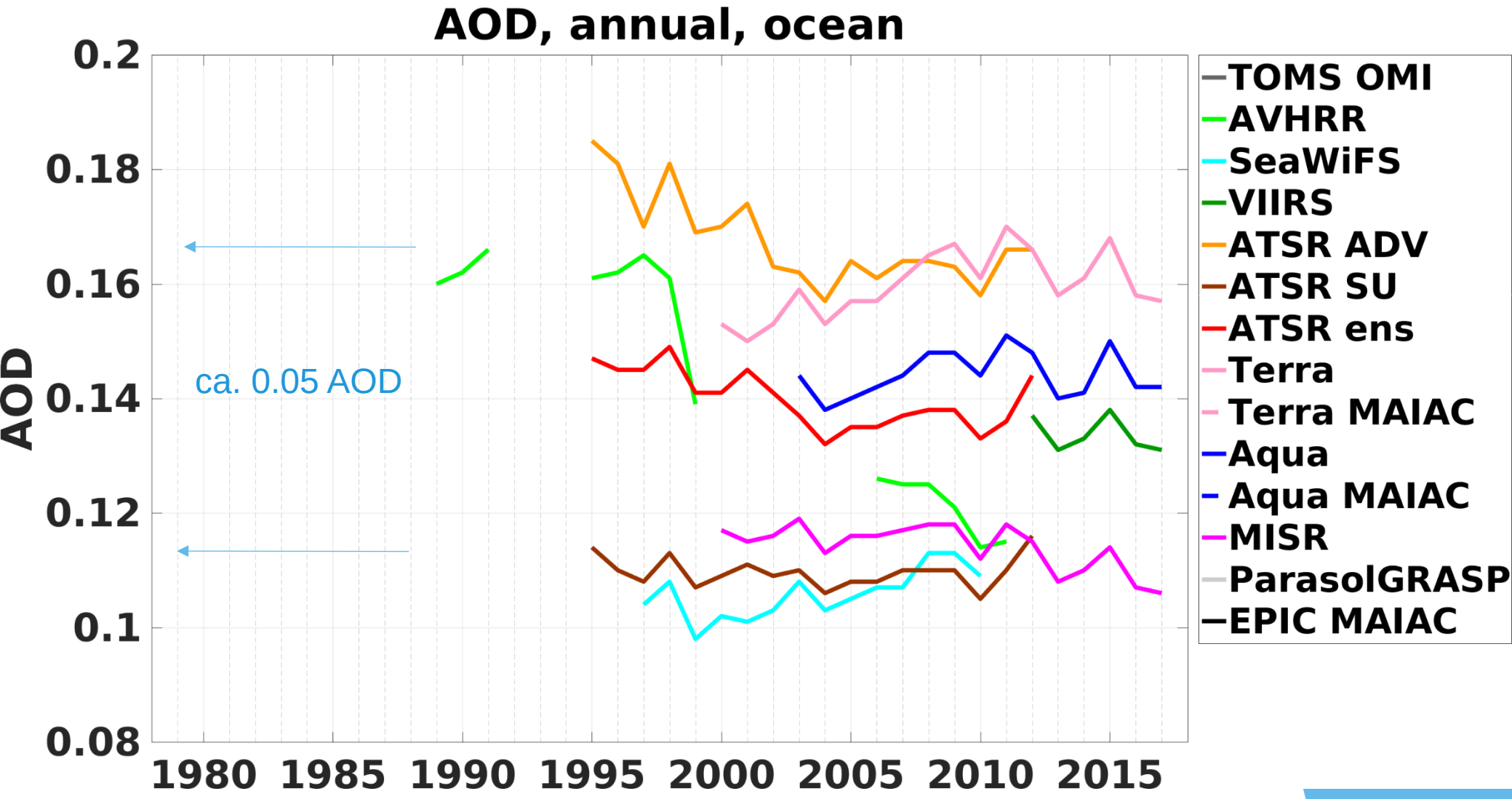




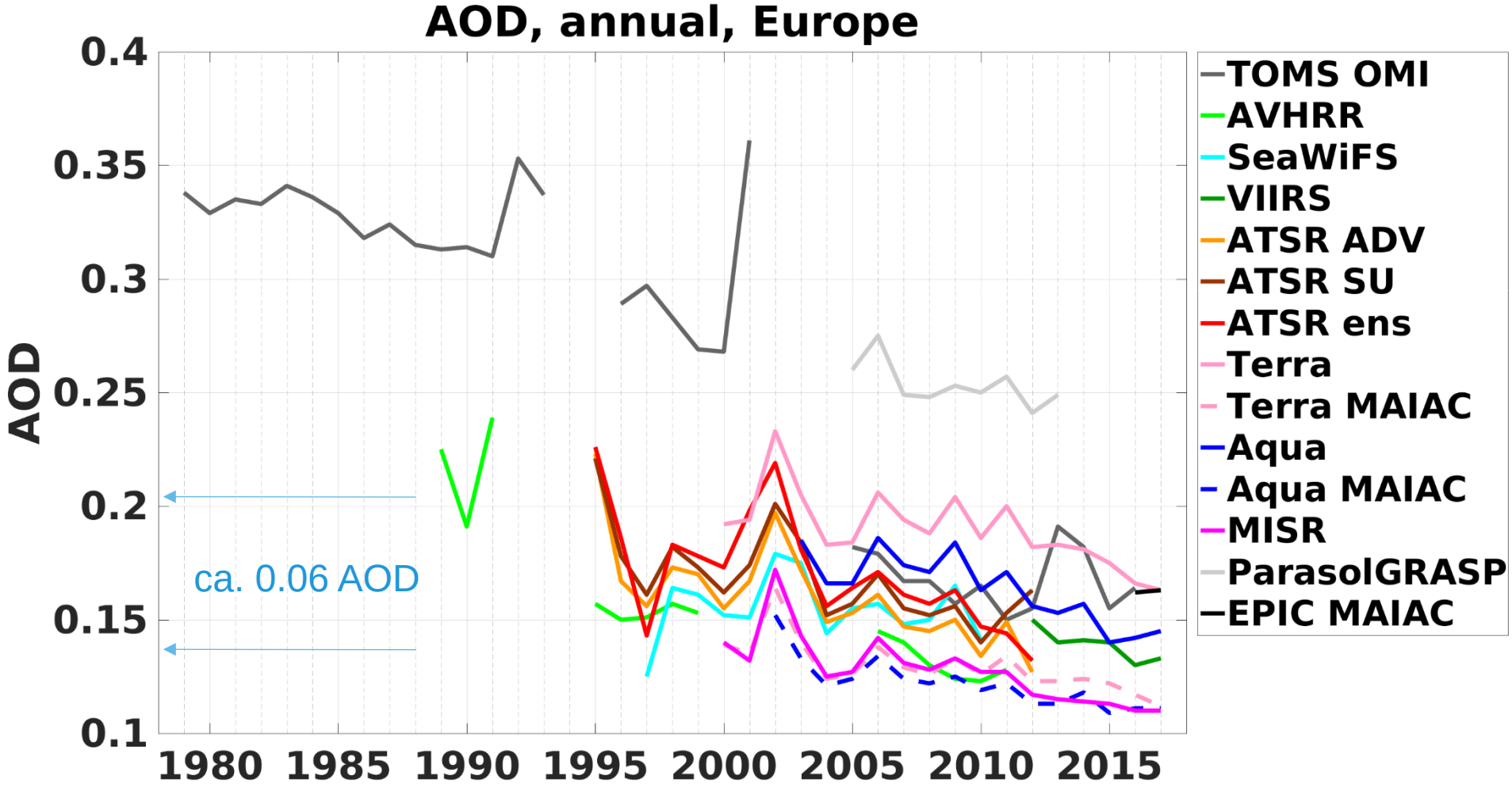
AOD time series, annual, land



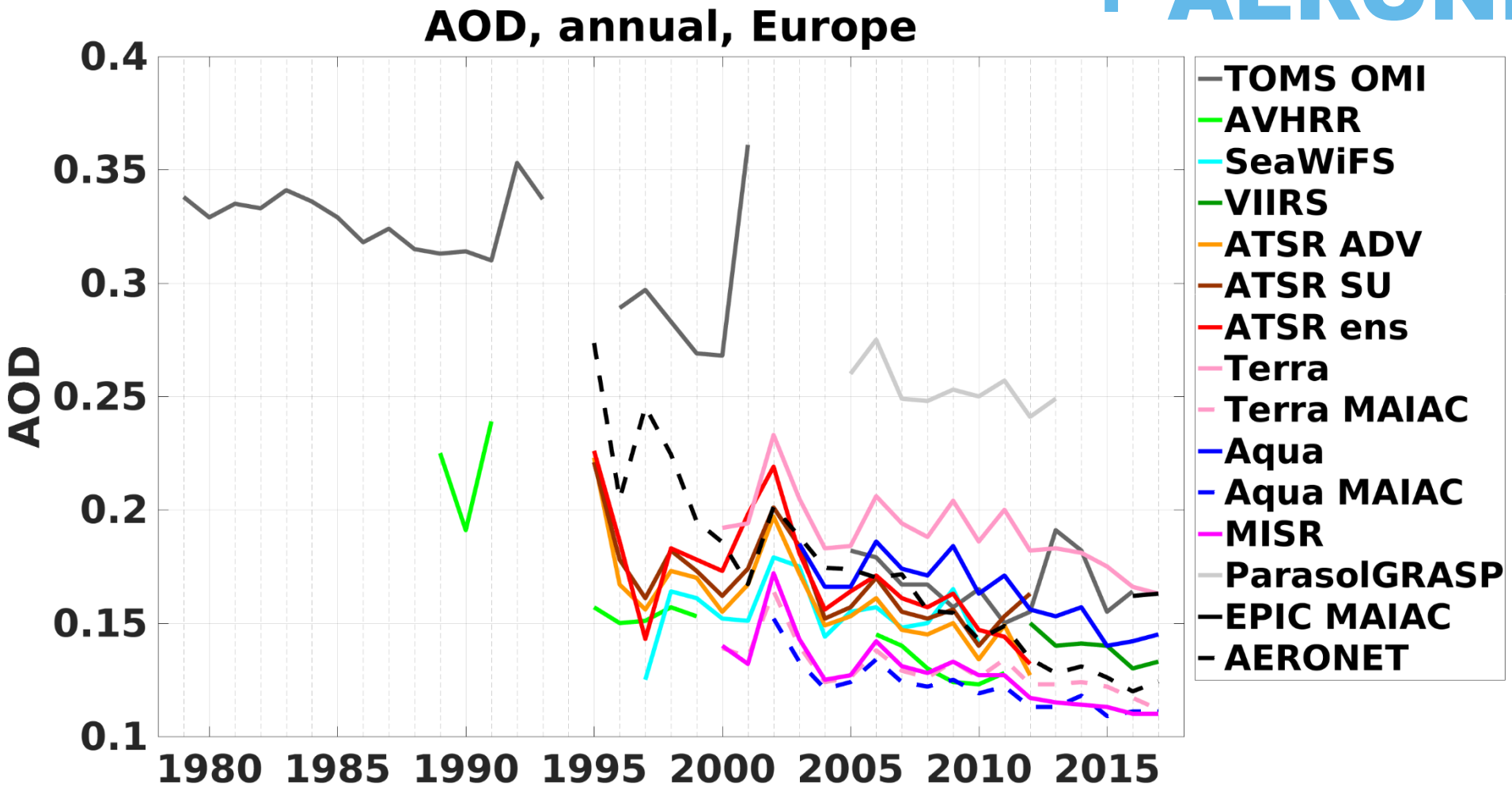
AOD time series, annual, ocean



AOD time series, annual, Europe



AOD time series, annual, Europe + AERONET



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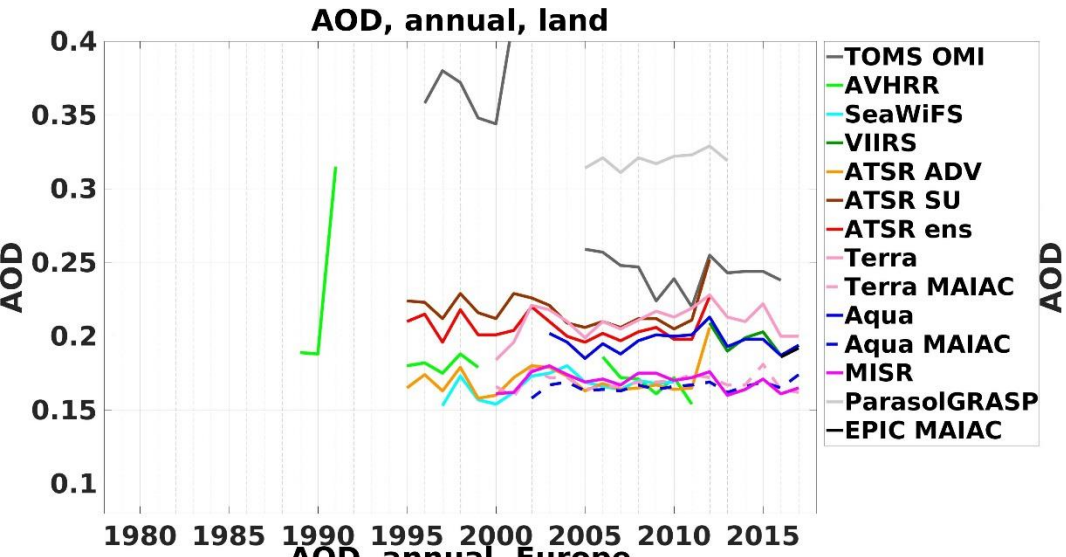
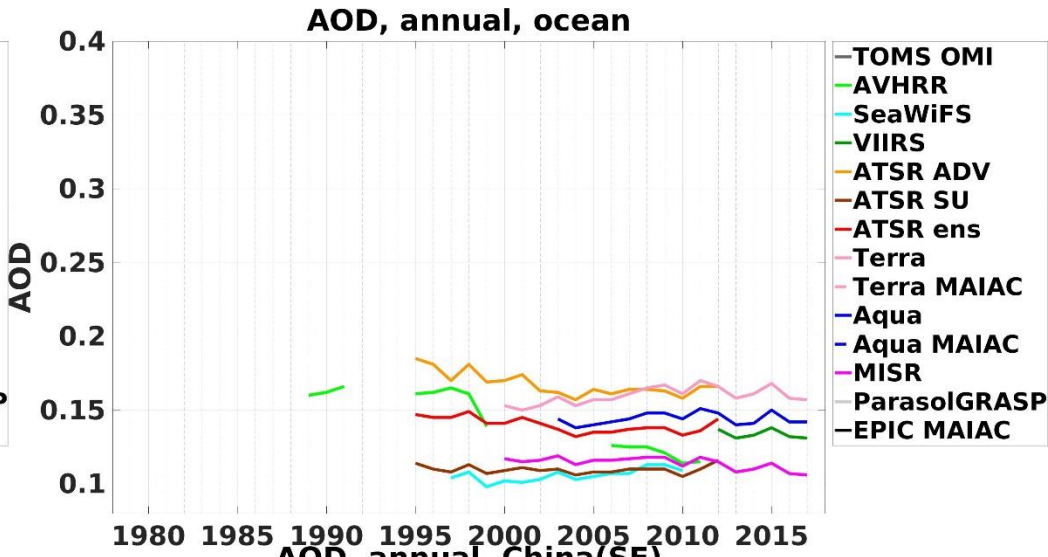
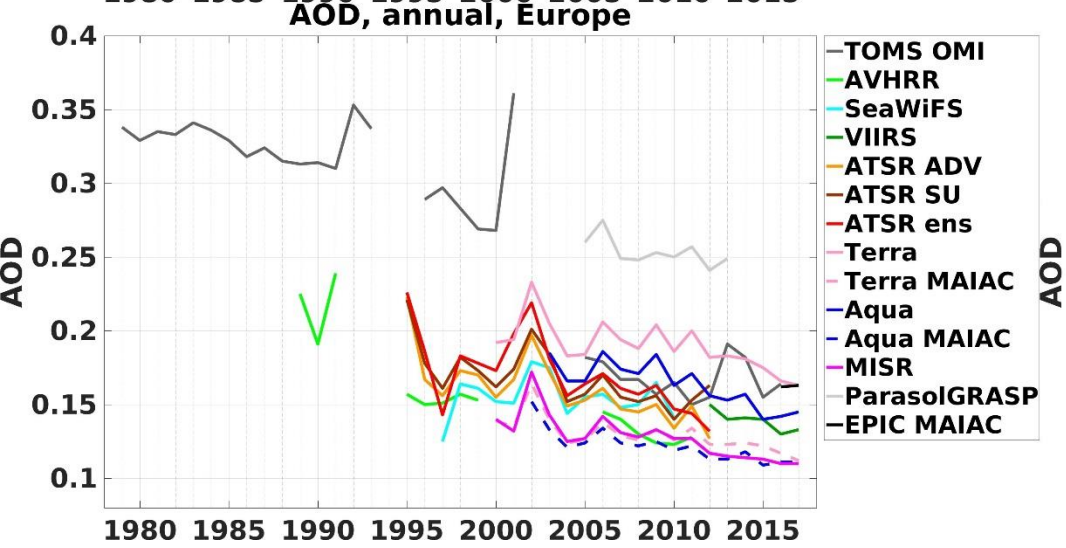
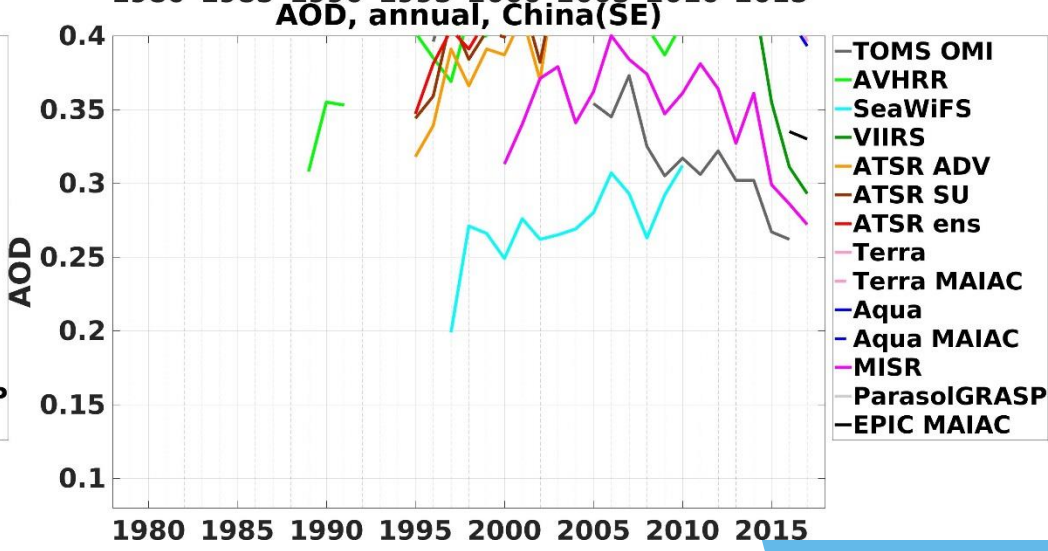
AOD time series, annual

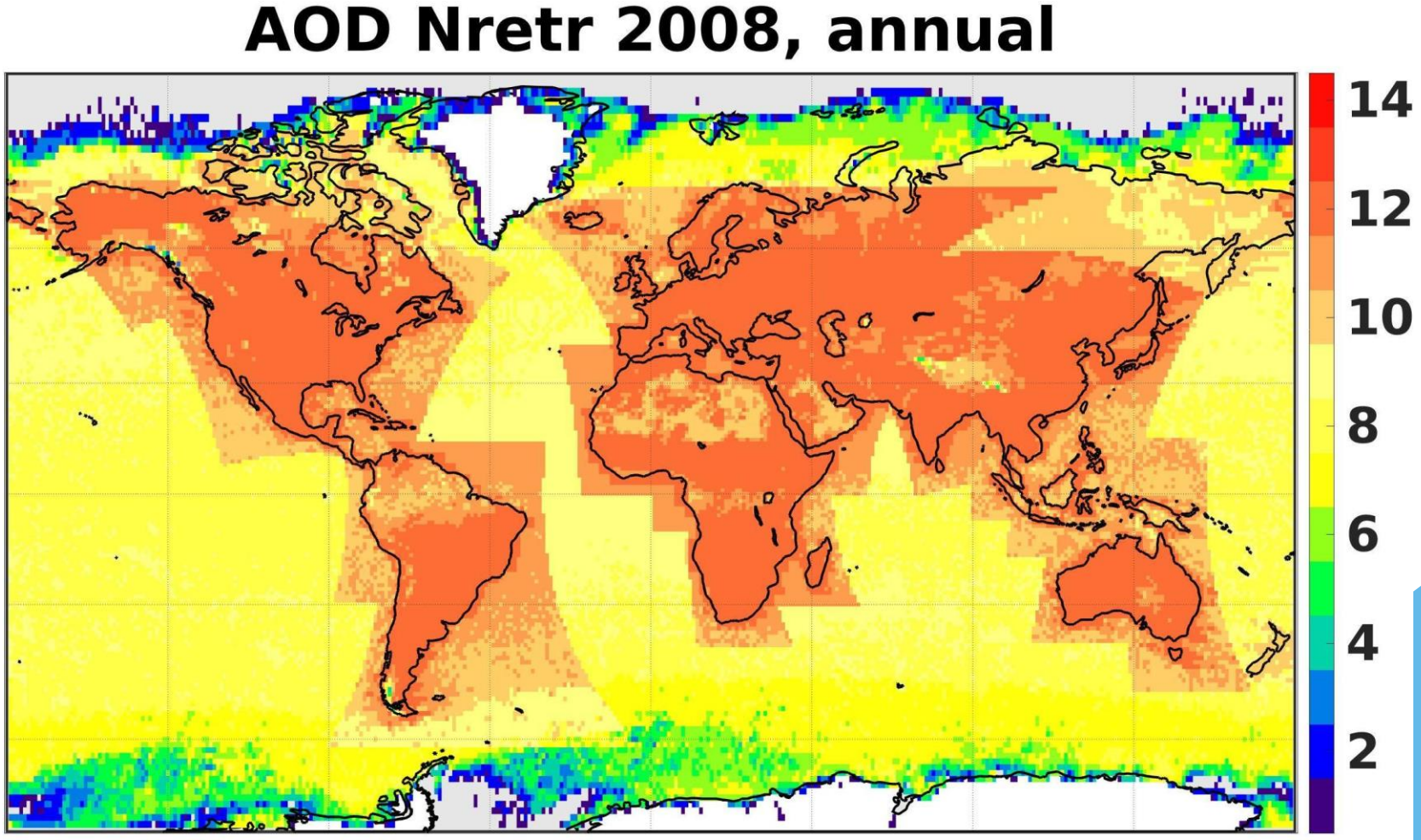








Year 2008: coverage



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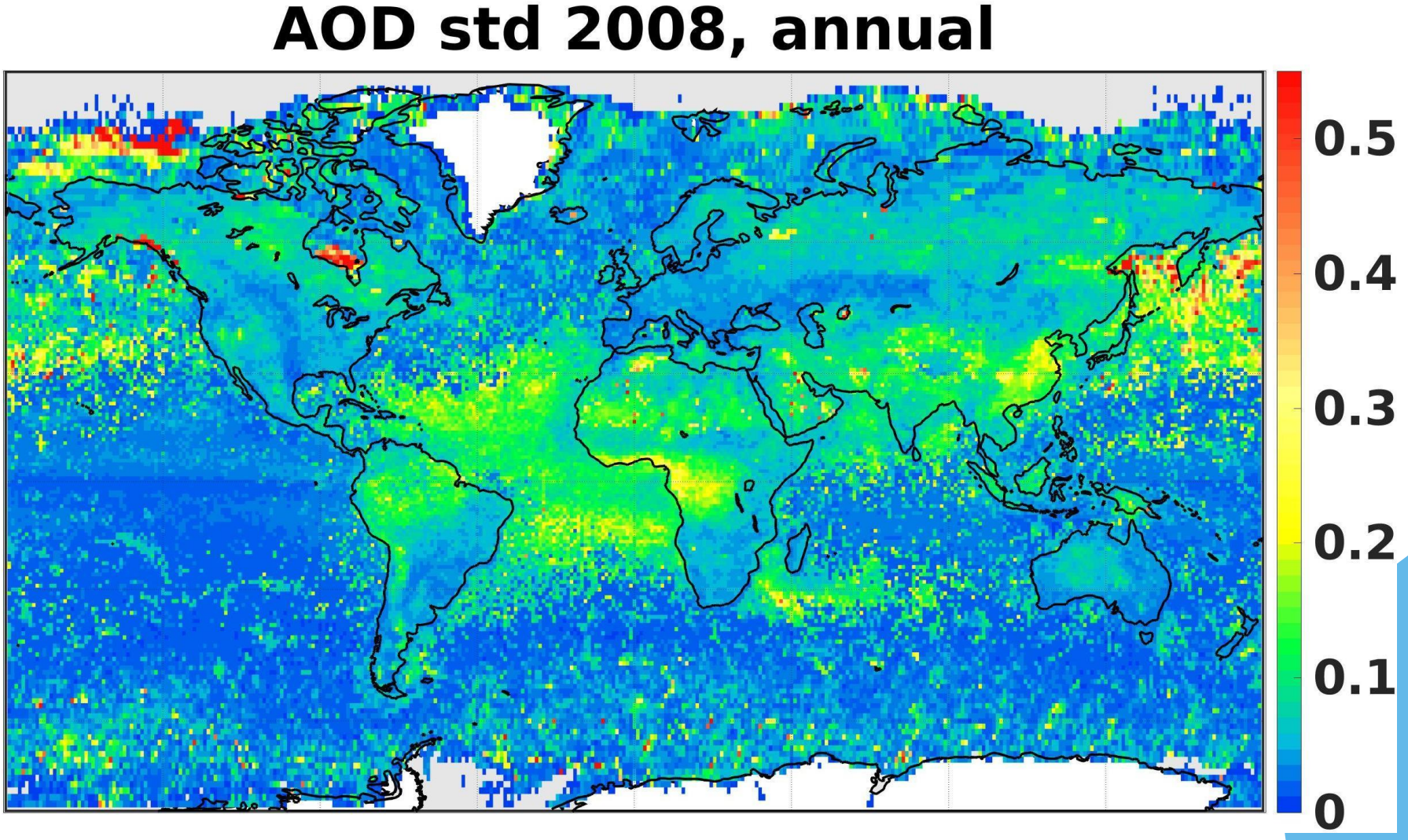
Year 2008: AODstd (all data sets)



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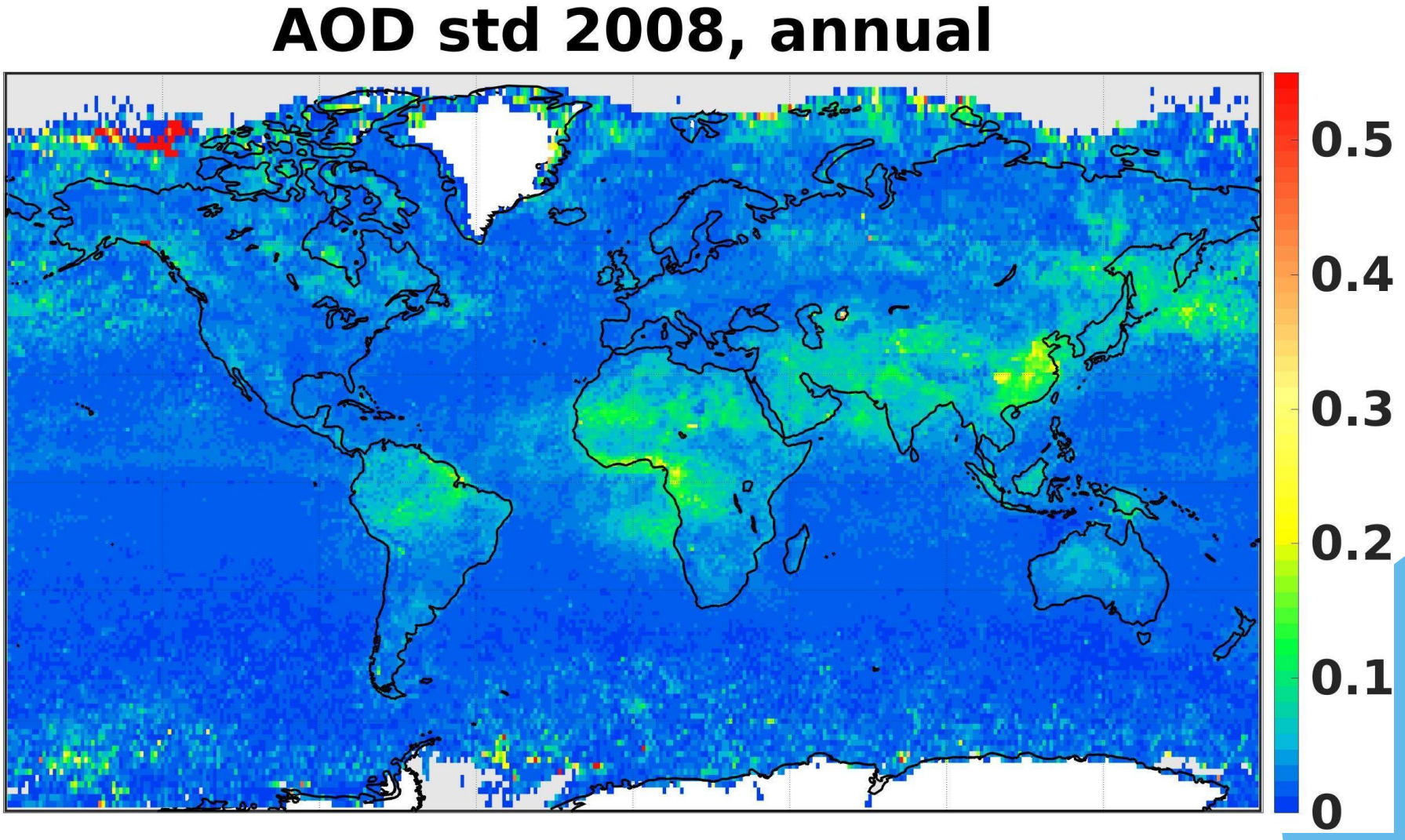
Year 2008: AODstd (min&max out)



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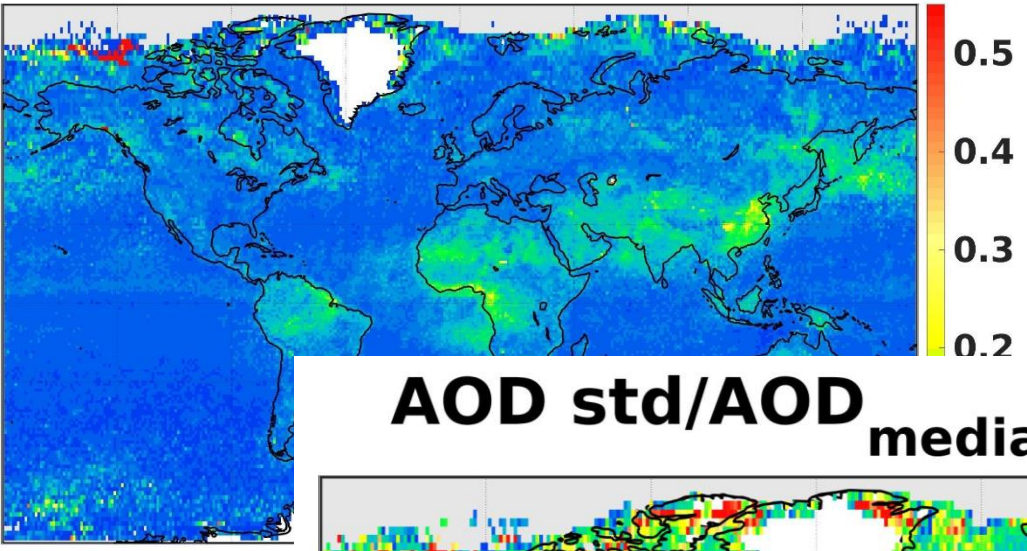
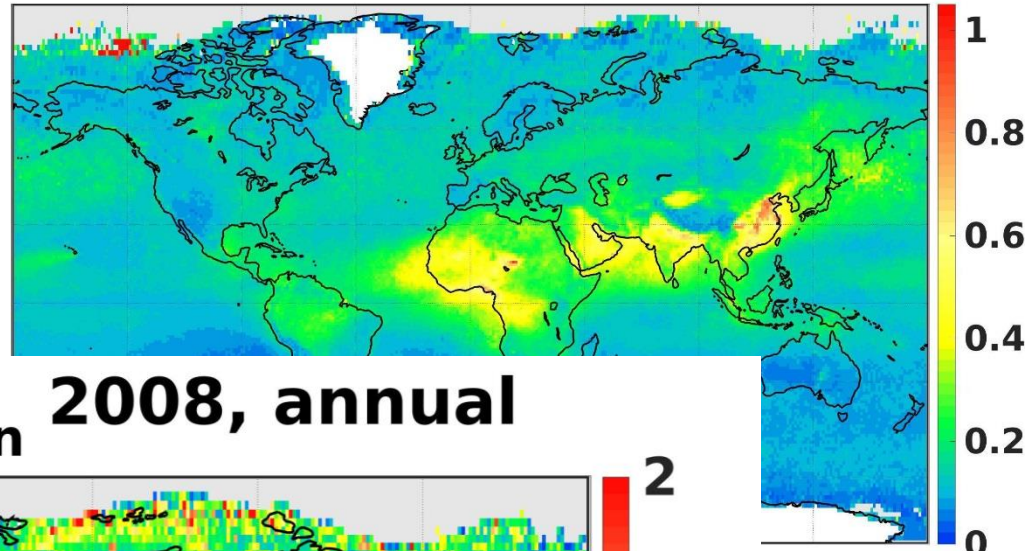
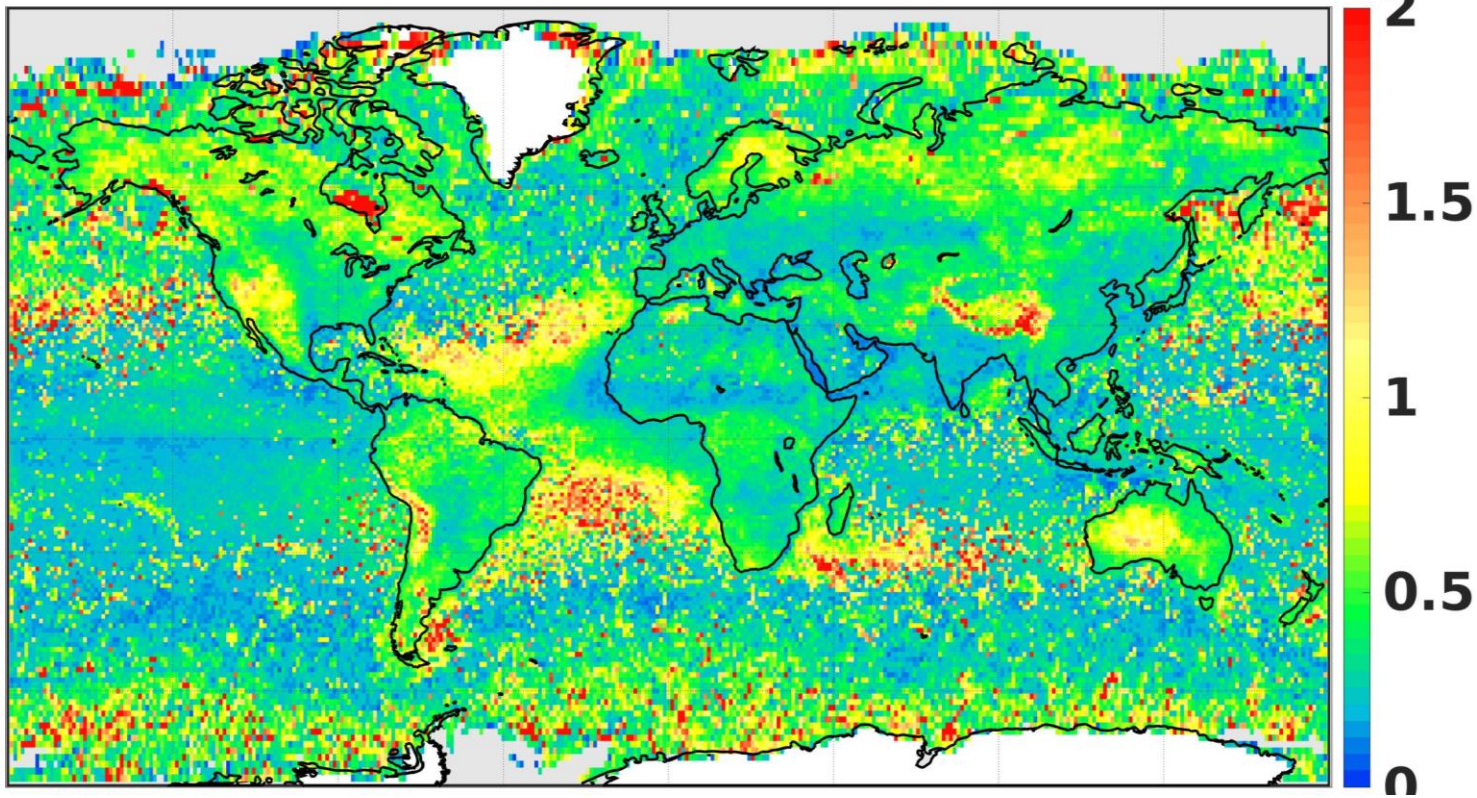
AOD std 2008, annual



AOD median 2008, annual

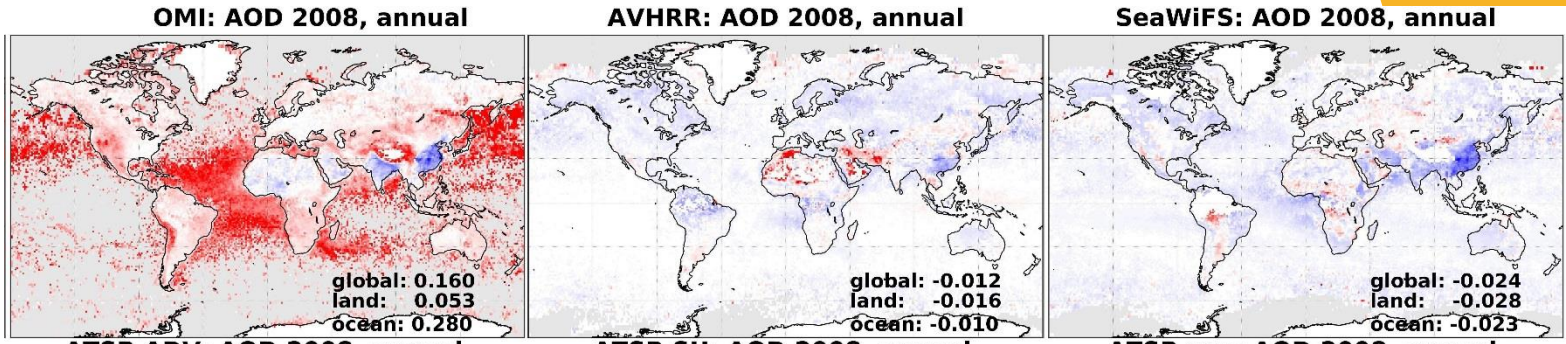


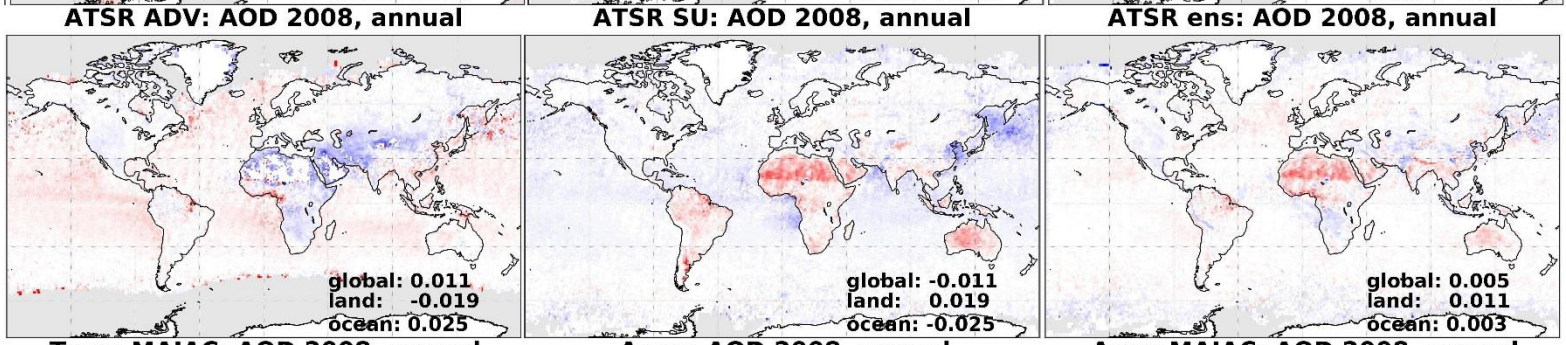
AOD std/AOD$_{median}$ 2008, annual

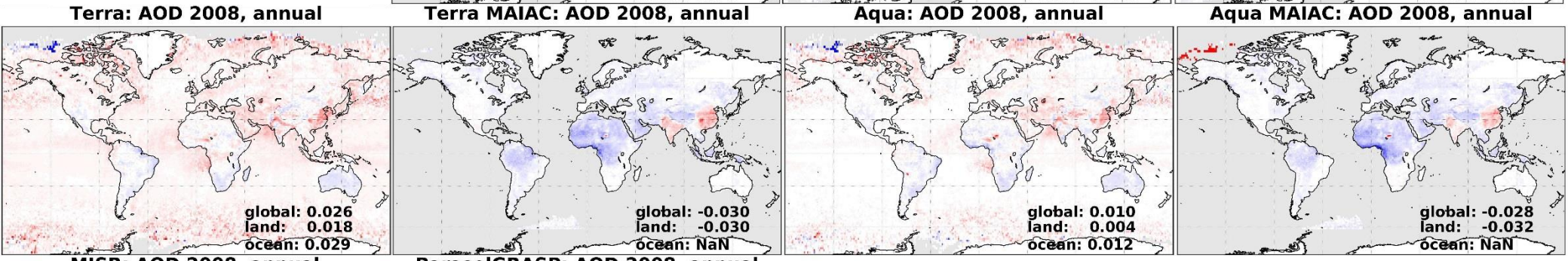


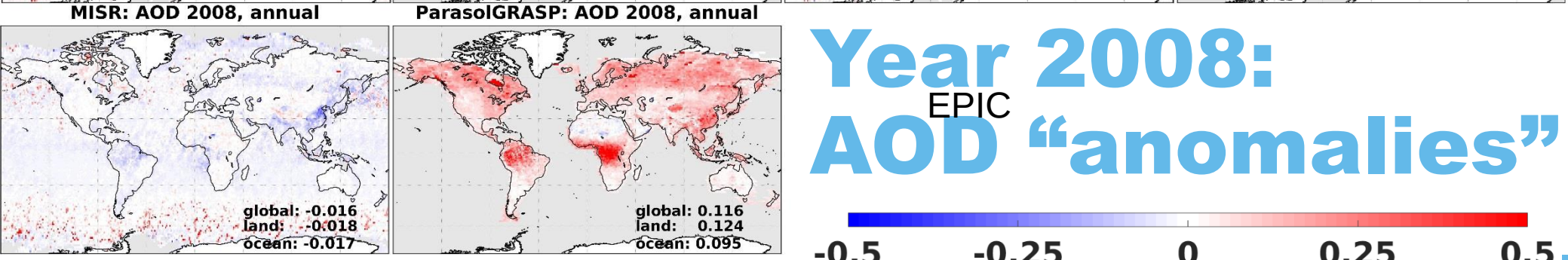
TOMS

VIIRS









Year 2008: AOD "anomalies"

EPIC

-0.5 -0.25 0 0.25 0.5

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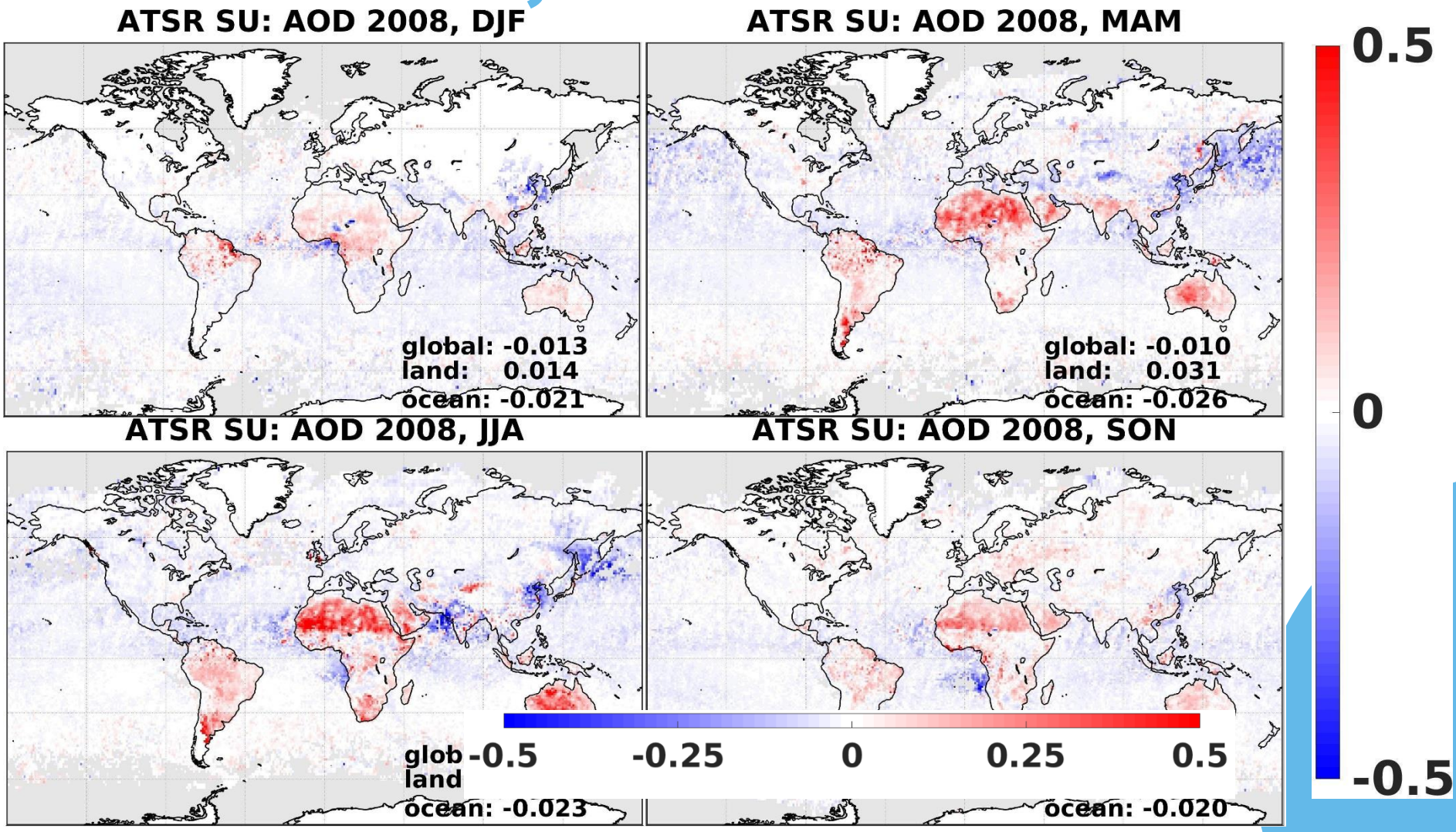
Year 2008: AOD seasonal “anomalies”, ATSR SU



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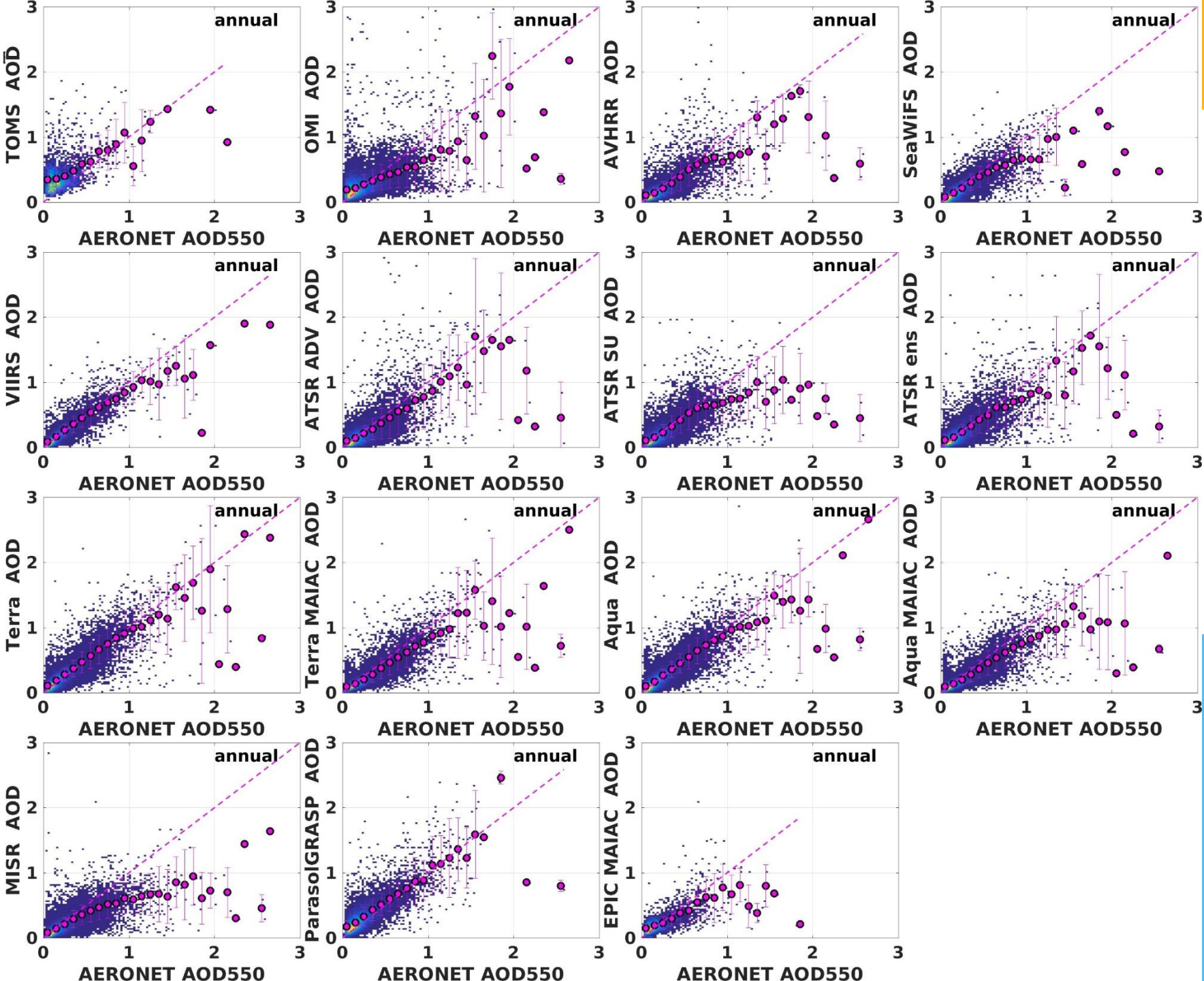
AODmm comparison with AERONET



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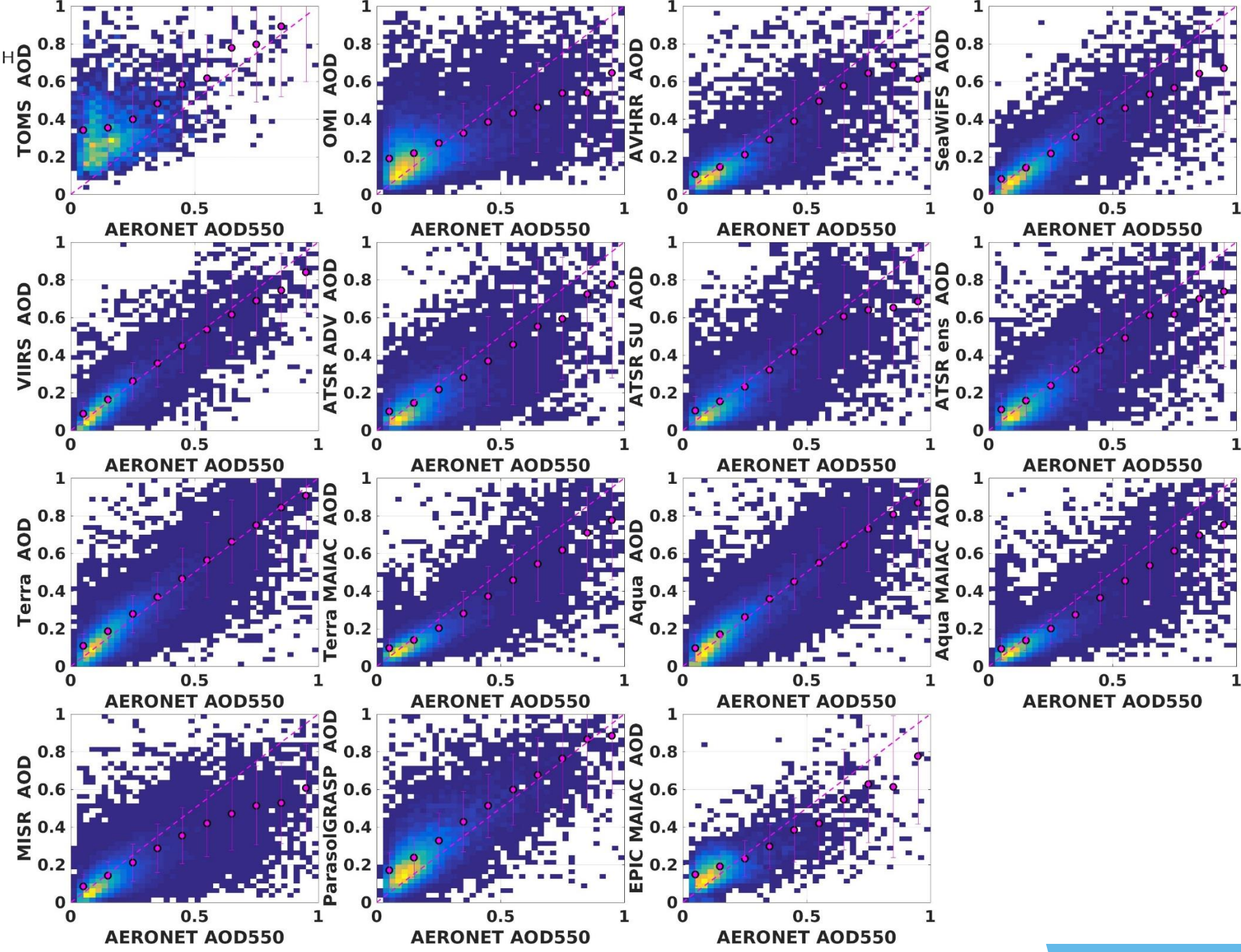
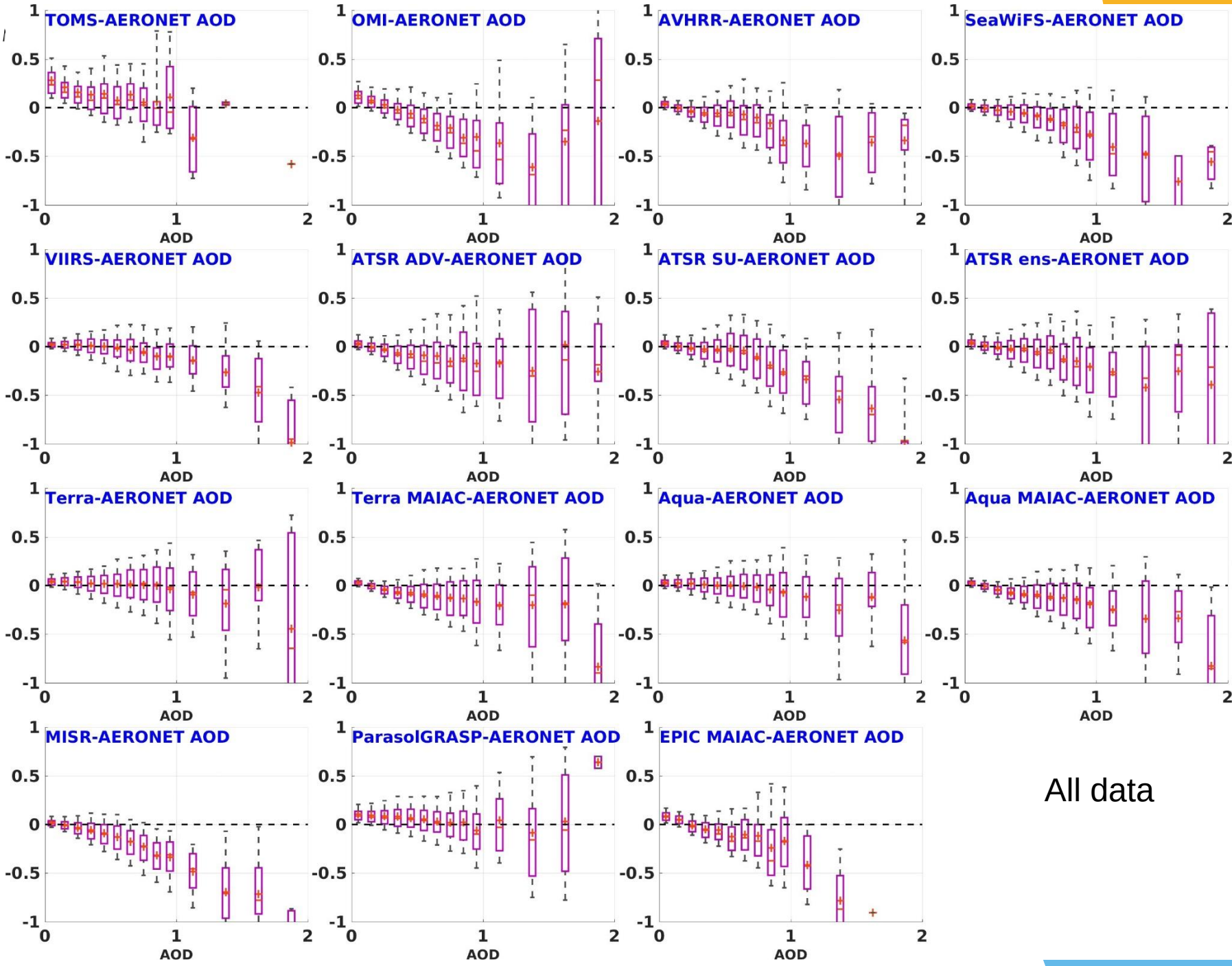
AODmm comparison with AERONET



AODmm comparison with AERONET



All data

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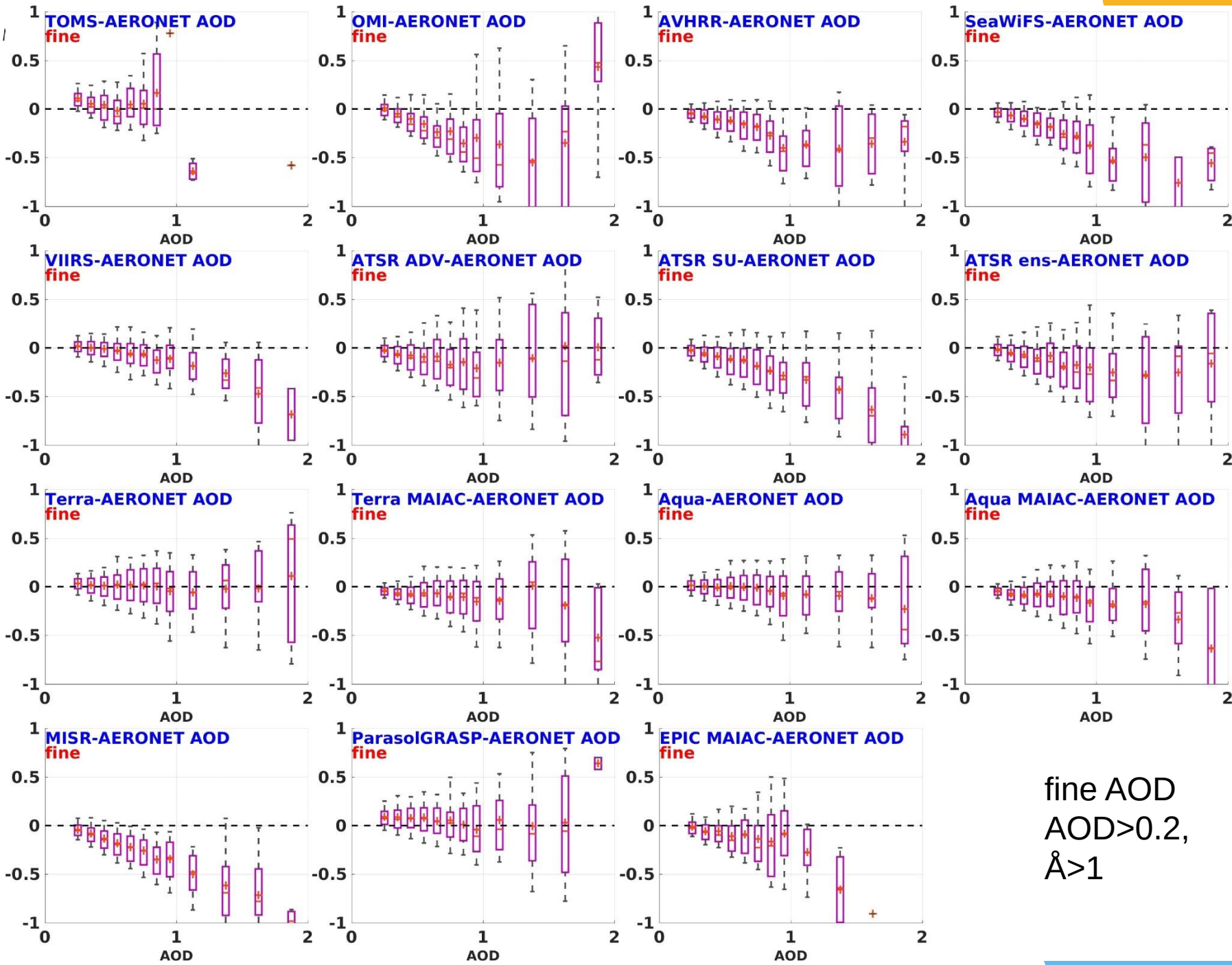
AODmm comparison with AERONET



fine AOD
AOD>0.2,
Å>1

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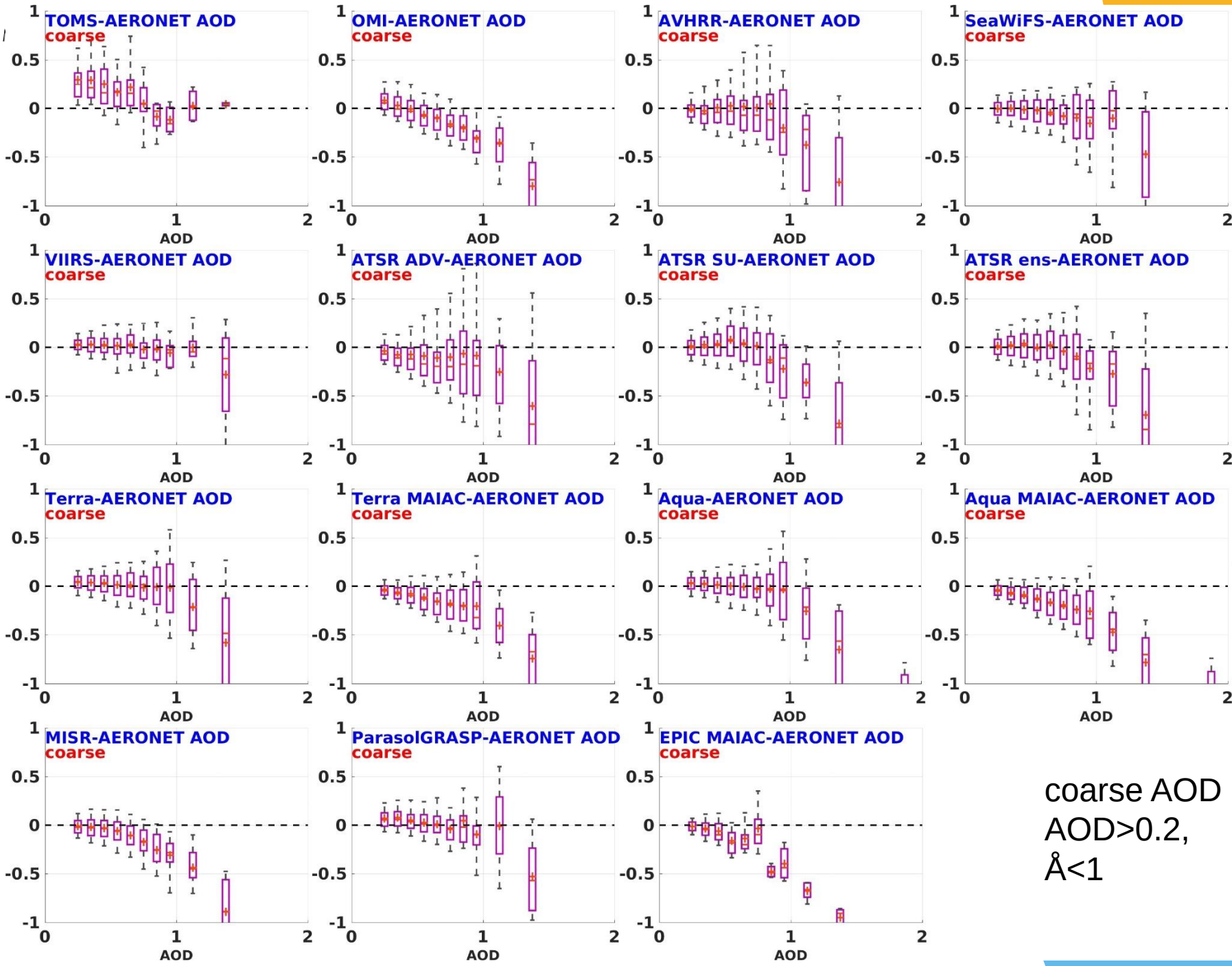
AODmm comparison with AERONET



coarse AOD
AOD>0.2,
Å<1

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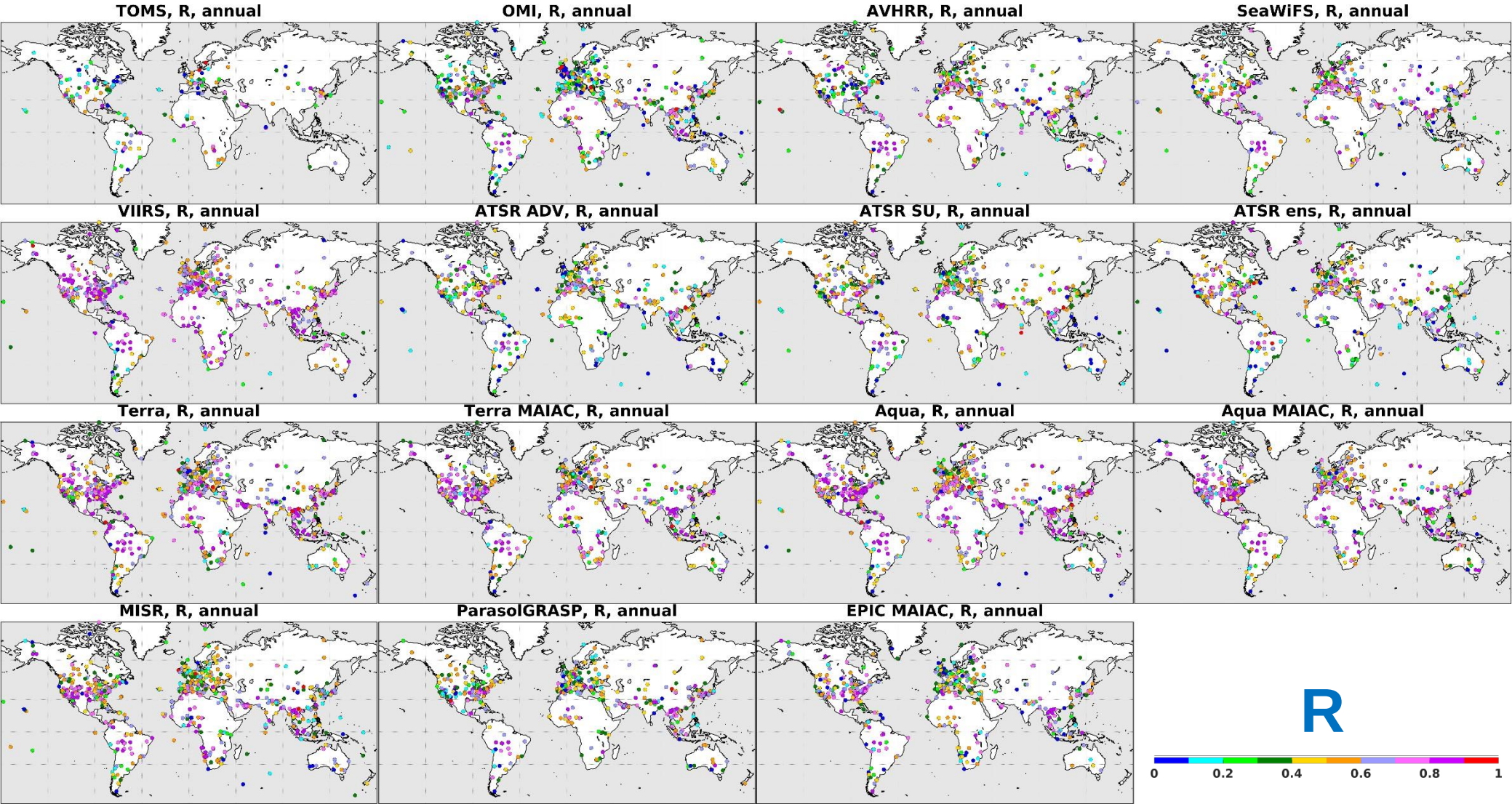
AODmm comparison with AERONET



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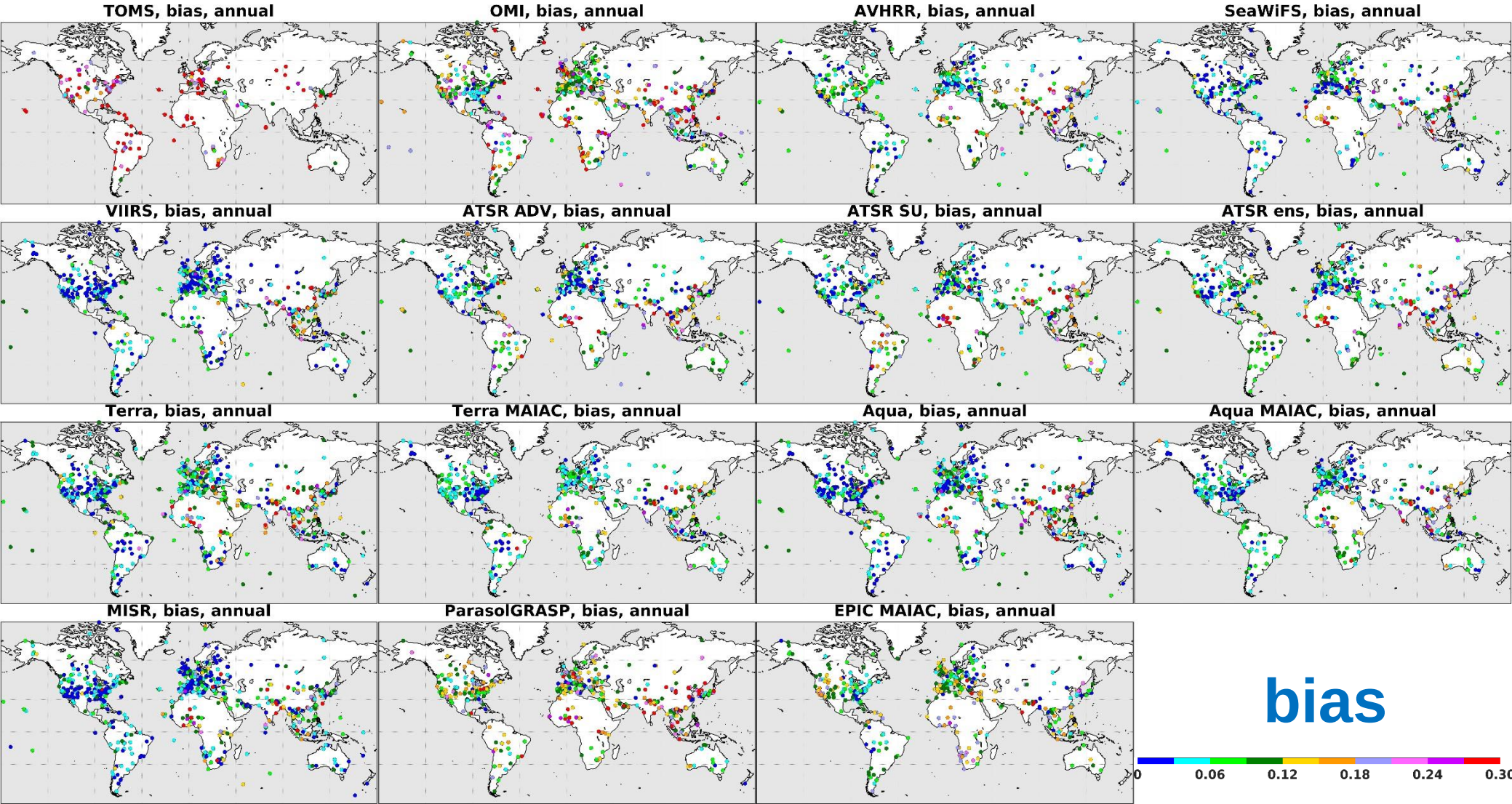
AODmm comparison with AERONET



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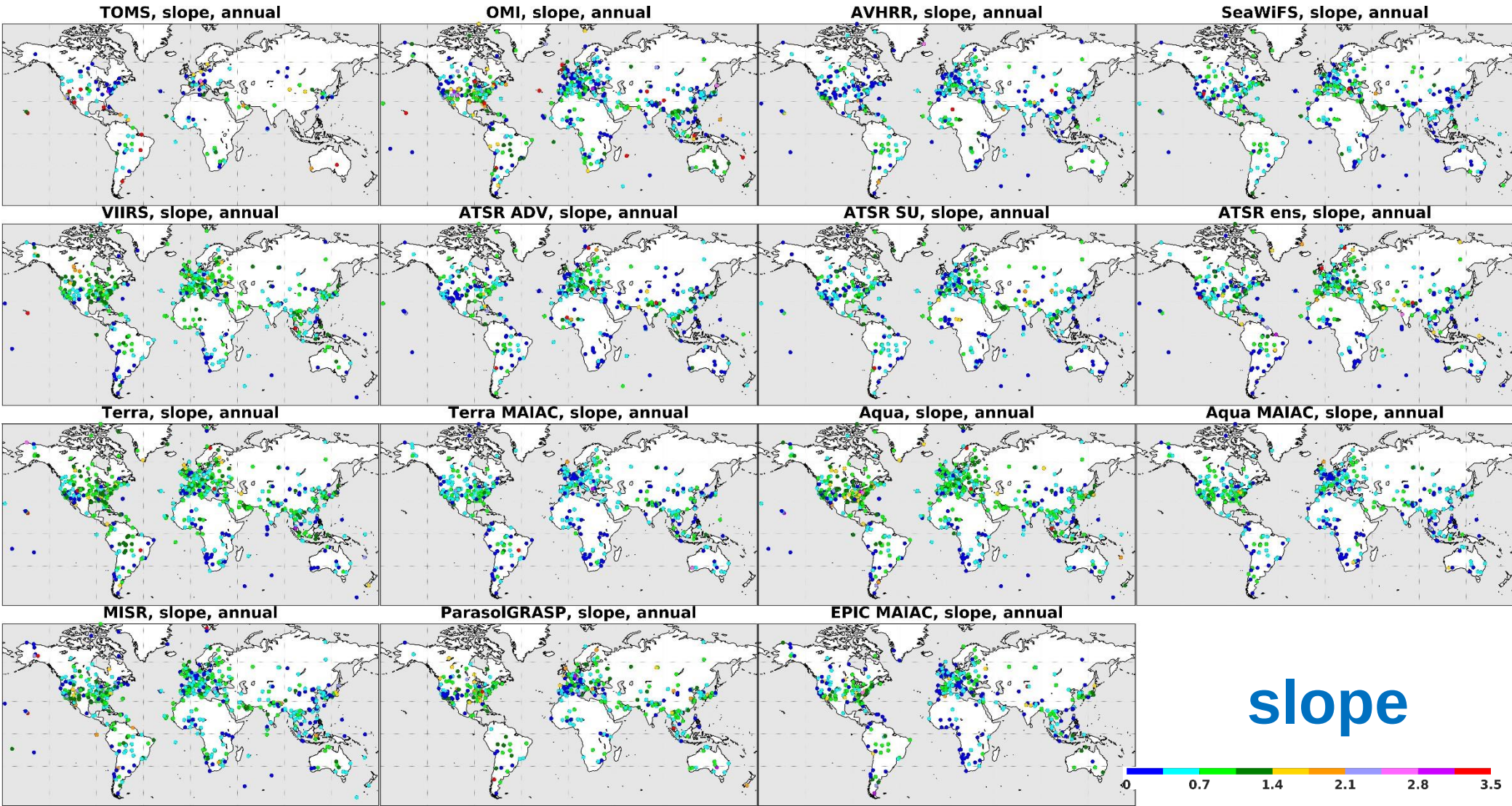
AODmm comparison with AERONET



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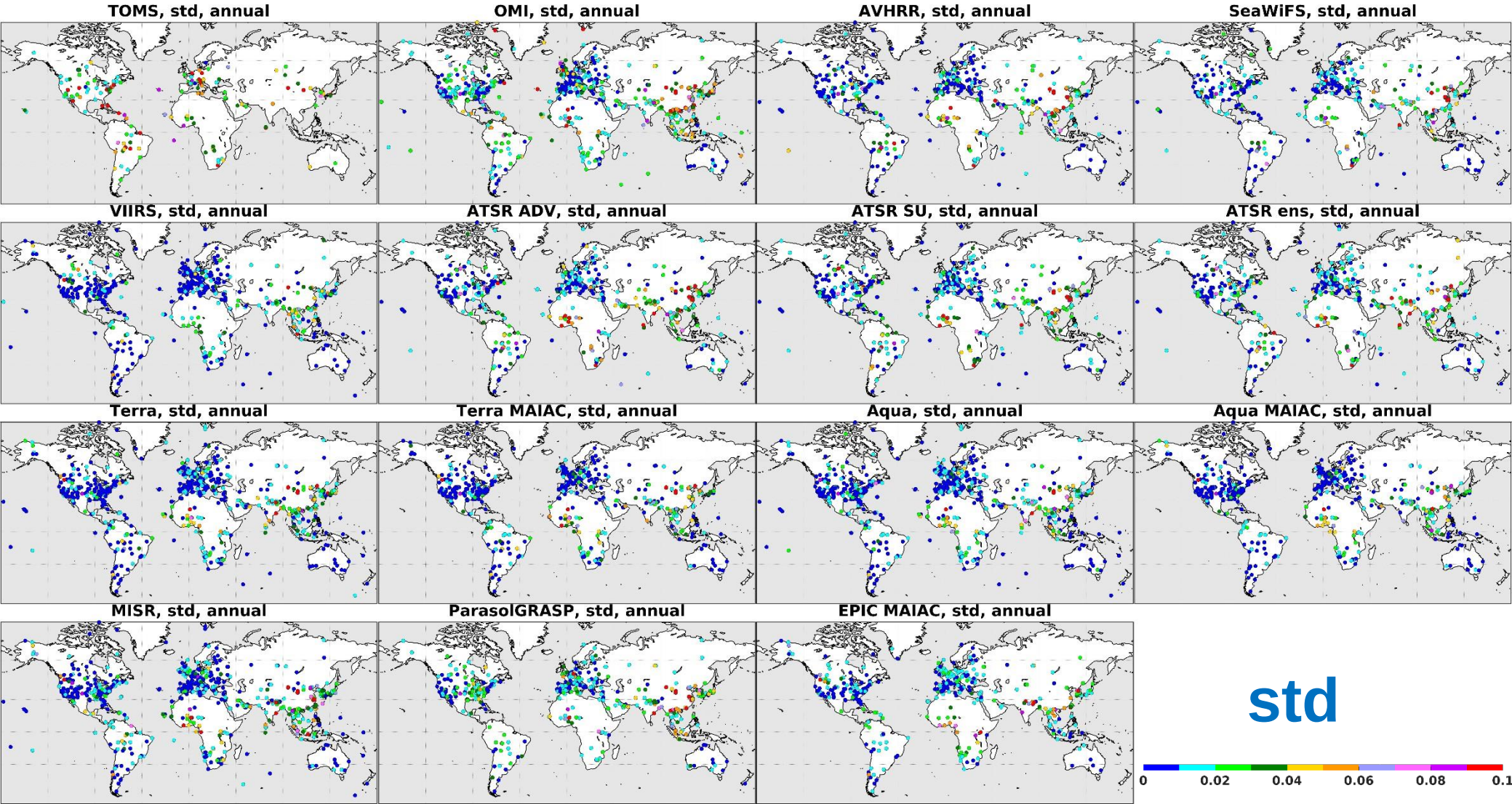
AODmm comparison with AERONET



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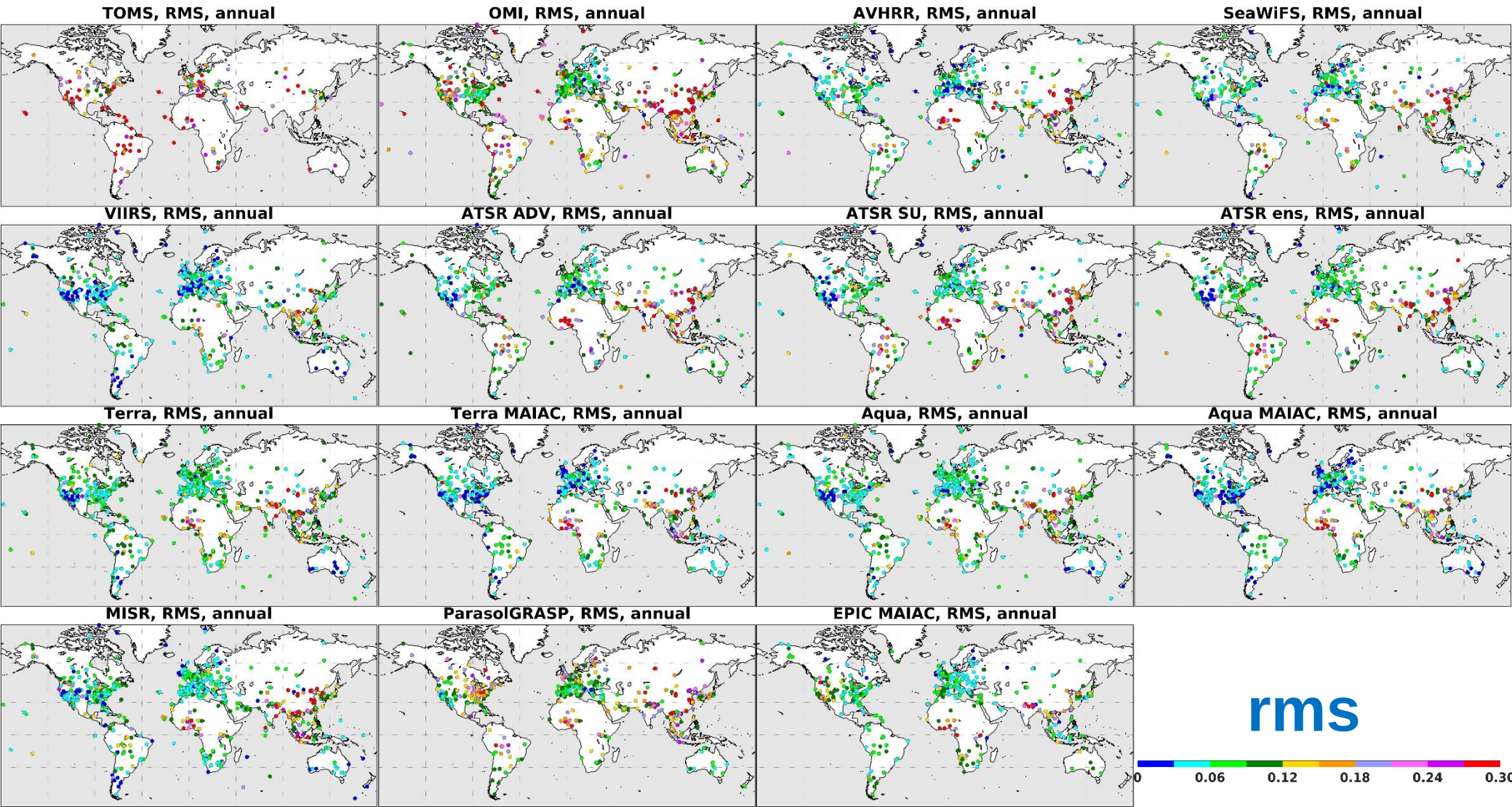
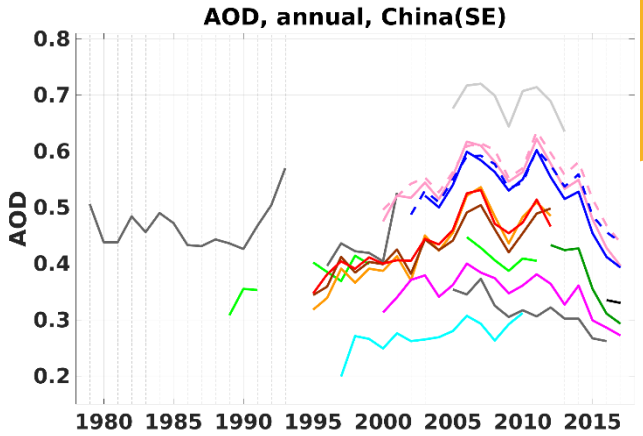
AODmm comparison with AERONET



THANKS for all data providers!

- Please keep me informed about the next version release
- Please, send me key publications, where algorithms/datasets/validation results are discussed
- All figures/results will be in GoogleDrive



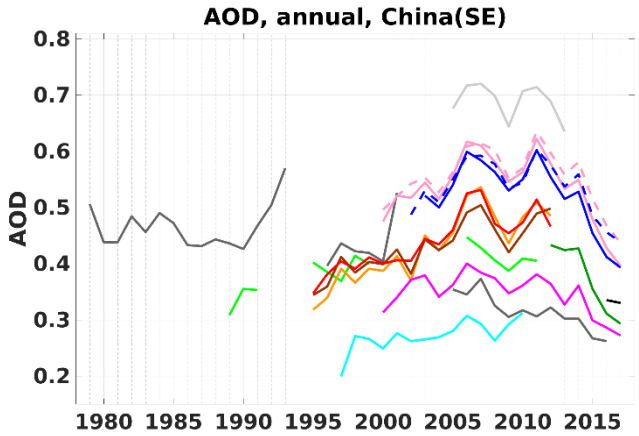
Conclusions

- WORK IN PROGRESS
- Difference (spatial, temporal) between AOD data sets exist
- Roughly (no statistics yet) estimated difference between yearly AOD from different data sets

land	ocean	Europe	China, SE
0.04	0.05	0.06	0.20 (0.30 for seasonal AOD)

- Comparison with AERONET monthly means
  - For AOD>1, both fine and coarse, almost all data sets are lower than AERONET
  - For AOD<1, coarse, Terra and Aqua meet the AERONET best; OMI, SeaWiFS, ATSR SU, MISR are lover than others
  - For AOD<1, fine, TOMS is higher, MISR and MAIAC-family is lower

????????

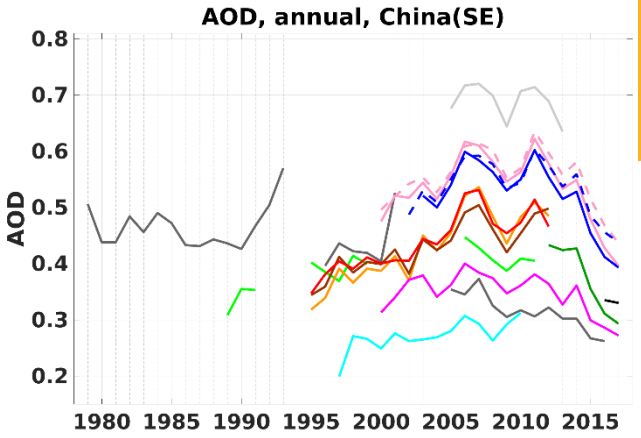


- Should we go to higher time resolution, L3 daily? (needed for modelers). Choose 2 years for the intercomparison (e.g., 2008 and 2018). Funding needed.

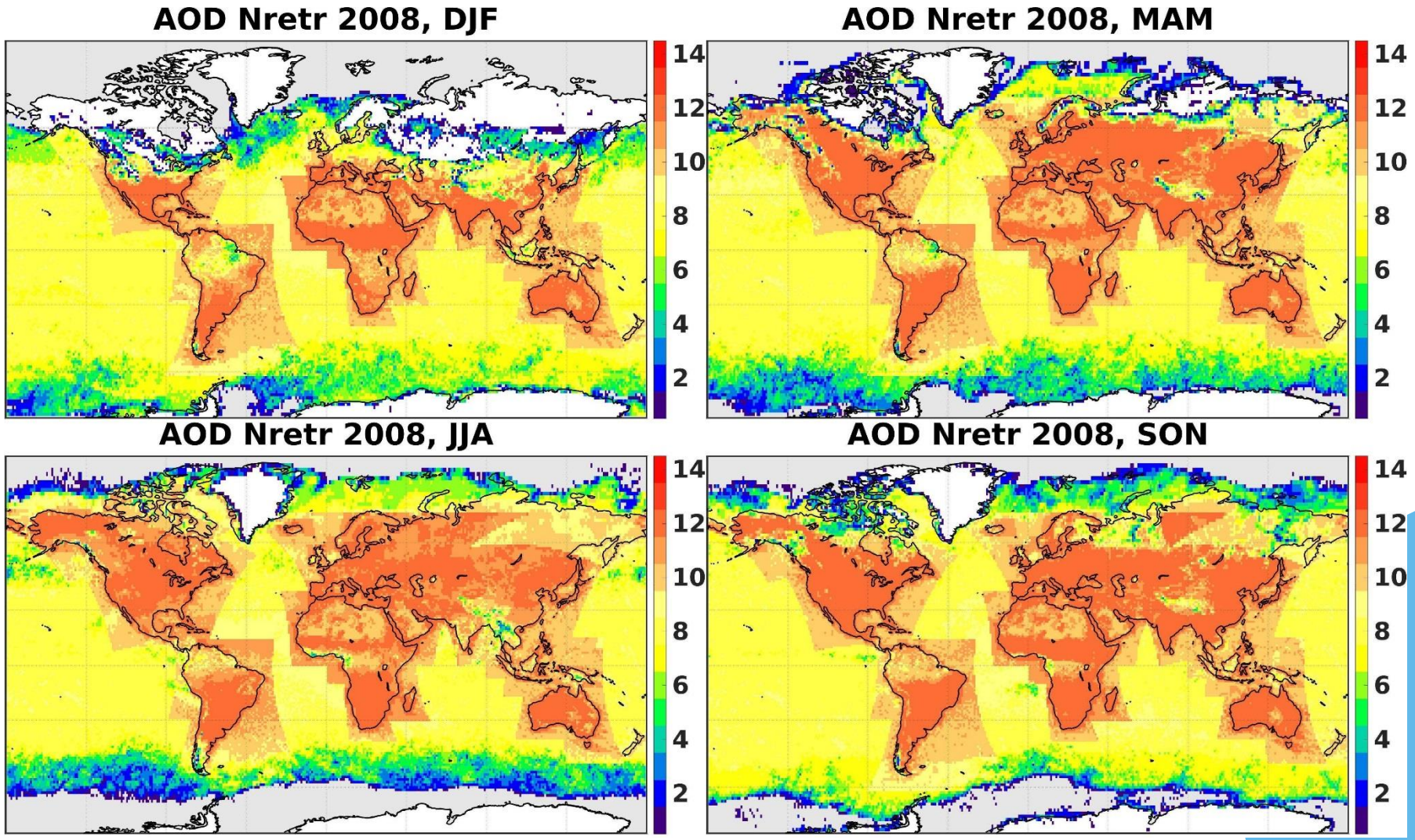
- Is merging needed? Yes, for trends estimation.
- Is seasonal scale is enough?
- Is merging possible? How to proceed further

- AOD trend estimation (after merging, if possible)
- More…

Ideas:


AOD, annual, China(SE)
AOD
0.8
0.7
0.6
0.5
0.4
0.3
0.2
1980
1985
1990
1995
2000
2005
2010
2015

Year 2008: coverage, seasonal



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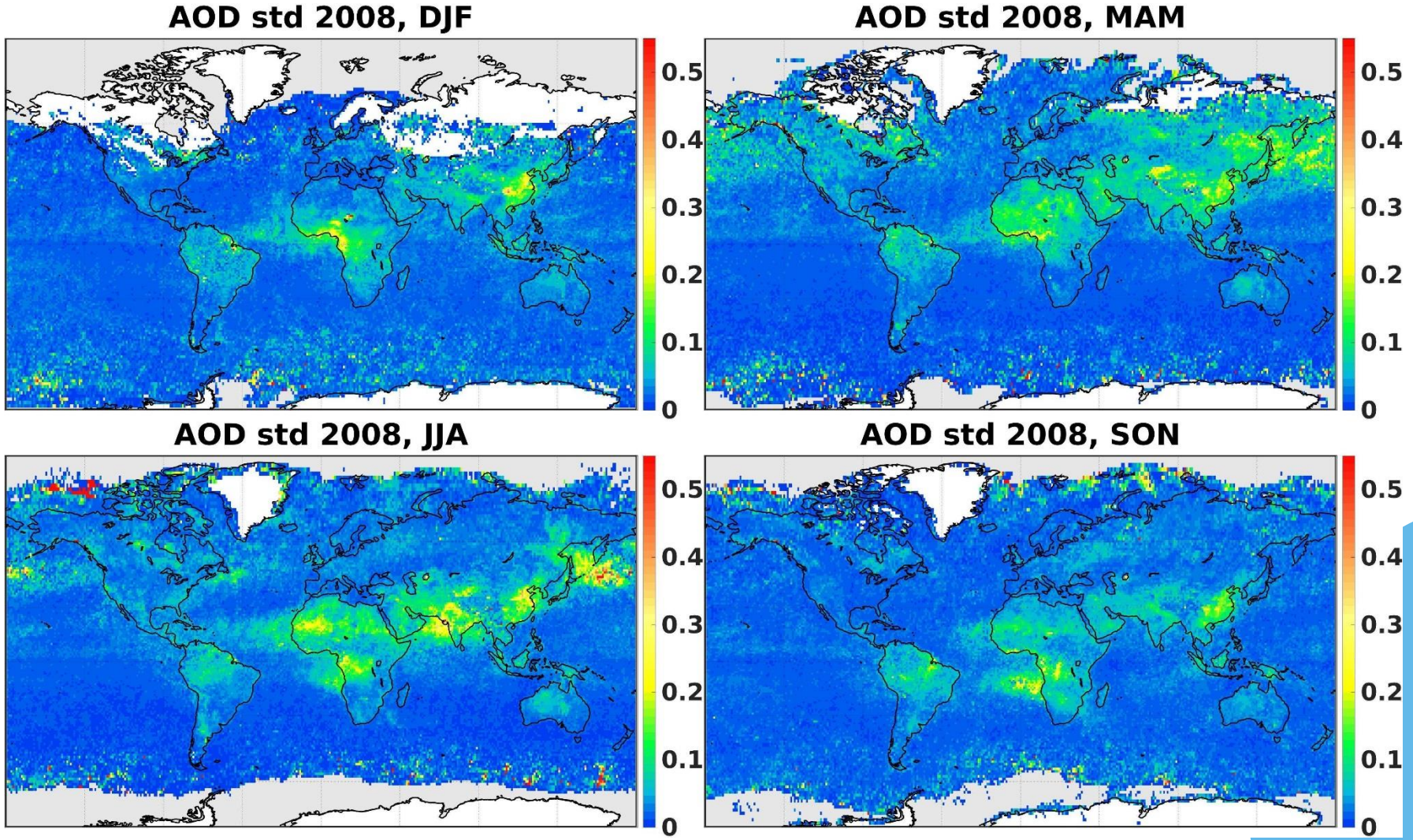
Year 2008: AODstd, seasonal



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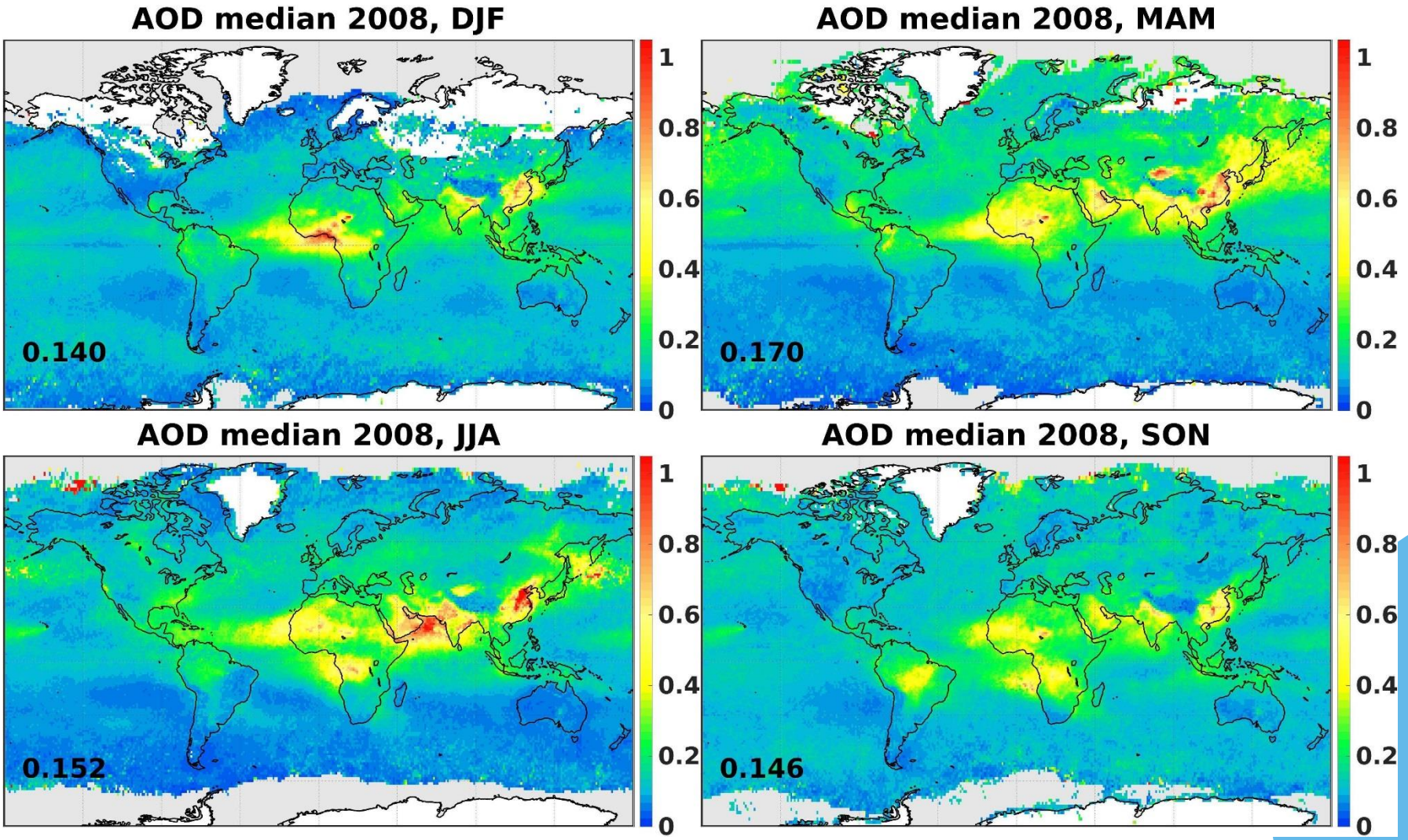
Year 2008: median, seasonal



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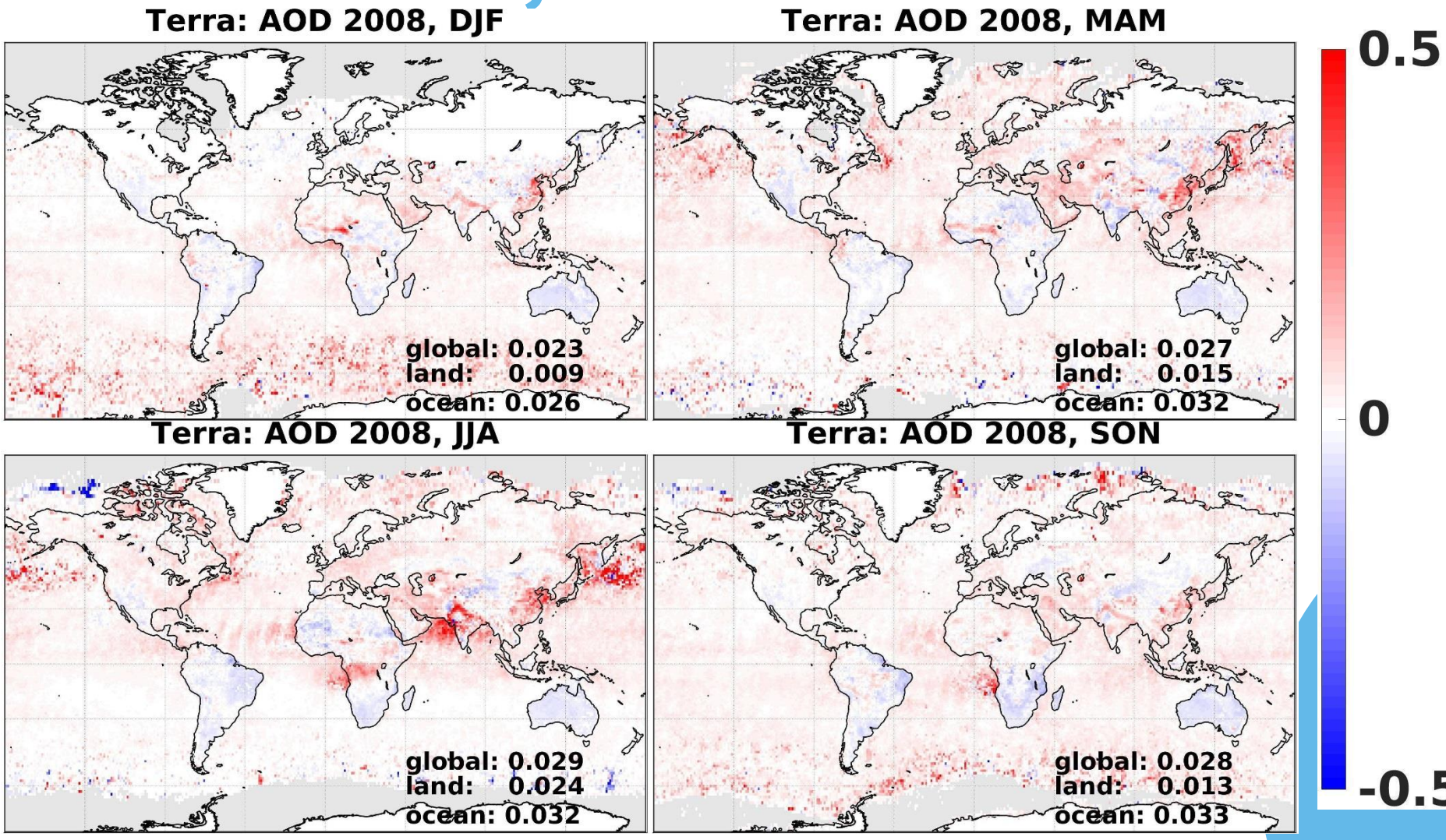
Year 2008: AOD seasonal “anomalies”, Terra



AERONETmm comparison statistics for all pix and AOD<1

	N		R		bias		slope		std		rms	
aodlim	all	<1	all	<1	all	<1	all	<1	all	<1	all	<1
TOMS	2617	2605	0,46	0,44	0,28	0,28	0,61	0,64	0,004	0,004	0,30	0,30
OMI	27919	27694	0,49	0,44	0,15	0,15	0,49	0,49	0,001	0,001	0,21	0,19
AVHRR	13019	12883	0,72	0,70	0,06	0,05	0,69	0,75	0,001	0,001	0,15	0,13
SeaWiFS	14447	14341	0,76	0,79	0,05	0,03	0,65	0,75	0,001	0,001	0,13	0,11
VIIRS	15015	14949	0,86	0,85	0,04	0,04	0,87	0,90	0,001	0,001	0,09	0,09
ATSR ADV	18065	17894	0,67	0,66	0,05	0,04	0,68	0,74	0,001	0,001	0,16	0,14
ATSR SU	18902	18721	0,70	0,73	0,07	0,04	0,66	0,80	0,001	0,001	0,15	0,13
ATSR ens	17975	17801	0,70	0,71	0,07	0,05	0,70	0,79	0,001	0,001	0,15	0,13
Terra NASA	38088	37816	0,82	0,84	0,06	0,05	0,85	0,94	0,001	0,001	0,12	0,11
Terra MAIAC	27255	26994	0,83	0,82	0,04	0,04	0,73	0,75	0,001	0,001	0,11	0,10
Aqua NASA	35192	34923	0,82	0,84	0,05	0,04	0,83	0,92	0,001	0,001	0,12	0,10
Aqua MAIAC	25607	25356	0,82	0,82	0,05	0,04	0,69	0,74	0,001	0,001	0,12	0,10
MISR	37207	36955	0,74	0,75	0,06	0,05	0,58	0,66	0,001	0,001	0,13	0,11
PARASOL Grasp	16276	16121	0,78	0,75	0,11	0,11	0,88	0,89	0,001	0,001	0,16	0,16
EPIC MAIAC	5788	5765	0,69	0,7	0,11	0,1	0,57	0,62	0,002	0,001	0,12	0,12