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AeroSAT

AeroCom

Comparison of multi-spectral satellite AOD

Plenary session 9 : Spectral dependence of AOD / constraining aerosol type

With contribution to

Breakout session 7 : Aerosol type

Breakout session 8 : Not just AOD

10.10.2020   **Larisa Sogacheva, FMI**

Objectives

- Satellite retrieved AOD_{550} and AE are the main aerosol characteristics used in the aerosol modelling community.

- AOD_{550} product is in general of good quality. However, uncertainties exist in AOD, which are compounded in AE calculations, which lower considerably the AE quality.

- During AEROCOM/AEROSAT 2019, the initial suggestion was made about using retrieved spectral optical depth at multiple wavelengths rather than AE as an indicator of additional information about aerosol properties beyond mid-visible AOD.

- The exercise has been initiated to study multi-spectral AOD retrieved from satellites.

- The outcome of the exercise will be recommendations for modelling community on the usage of the satellite products with providing corresponding validation results.

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multi-spectral AOD AEROSAT exercise

Main steps:

- Step 1 : data collection
- Step 2 : validation/evaluation
- Step 3 : recommendations to modelers

With iterations with data providers, discussions about the data available in the official products, new (testing) products, discussions with modelers, debates at AEROCOM/AEROSAT…

Publicly available Satellite products included into analysis (Sept 2020)

Satellite	product/res	res	Algo
MODIS Terra	MxD_04_3K	3km	DT
	MxD_04_L2	10km	DT
			DB
			DT&DB
	MxD_08_D3	1 deg	DT
			DB
			DT&DB
VIIRS	L2	1 deg	DT
			DB
	L3		DB
MISR	L2	4.4km	
	L3	0.5 deg	
S3A, SLSTR (ATSR)	SU D3	1 deg	SU
POLDER	L2	0.055 deg	

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NOTE: the content of the tables shown on the next slides needs to be revised by data providers

AOD (wl), products

* - global coverage
corr – corrected
eff – effective
QF – quality flag
unc - uncertainty

NOTE: the content of the tables needs to be revised by data providers

	res	Algo	AOD 412	443	470	480	488	490	550	565	660	670
MODIS												
MxD_04_3K	3km	DT			land corr, ocean eff				* (QF),corr		land corr, ocean eff	
MxD_04_L2	10km	DT			land corr, ocean eff				* (QF),corr		land corr, ocean eff	
		DB	land		land				land *(QF), best est(+unc)		land	
		DT&DB							*(QF)			
MxD_08_D3	1 deg	DT							*			
		DB	land		land				land		land	
		DT&DB							*			
		?			ocean				ocean		ocean	
VIIRS												
L2	1 deg	DT				corr, eff			*,corr,eff, image			corr, eff
		DB							* (QF land/ocean),best est			
		DB	land				land,ocean		land,ocean			land, ocean
L3		DB	land				land,ocean		*			land,ocean
MISR												
L2	4.4km								*			
L3	0.5 deg								* (4bands)			
SLSTR/(A)ATSR												
D3	1 deg	SU							* (+unc)			*(+unc)
POLDER												
L2	0.055 deg			*				*		*		*

	res	Algo	860	865	870	1020	1240	1600	1630	1610	2130	2250	AOD scaling coef
MODIS													
MxD_04_3K	3km	DT	ocean eff				ocean eff		ocean eff		ocean eff		
MxD_04_L2	10km	DT	ocean eff				ocean eff		ocean eff		ocean eff		
		DB											
		DT&DB											
MxD_08_D3	1 deg	DT											
		DB											
		DT&DB											
		?	ocean				ocean		ocean		ocean		
VIIRS													
L2	1 deg	DT			eff		eff	eff				corr, eff	
		DB											
		DB		ocean			ocean			ocean		ocean	
L3		DB		ocean			ocean			ocean		ocean	
MISR													
L2	4.4km												for 400-900 nm
L3	0.5 deg												*
SLSTR/(A)ATSR													
D3	1 deg	SU				*(+unc)			*(+unc)				
POLDER													
L2	0.055 deg				*		*						

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AE (wl), products

	res	Algo	AE									
			412/470	412/488	490/670	470/650	550/860	550/865	550/870	665/865	860/2130	?
MODIS												
MxD_04_3K	3km	DT					ocean				ocean	
MxD_04_L2	10km	DT					ocean				ocean	
		DB	bright surf			veg						
		DT&DB										
MxD_08_D3	1 deg	DT					*				*	
		DB	land									
		DT&DB										
		?					ocean hist				ocean hist	
VIIRS												
L2	1 deg	DT					ocean				ocean	
		DB	land, best est					ocean, best est				DB/SOAR
		DB										
L3		DB		land arid	land veg			ocean				land/ocean
MISR												
L2	4.4km						*					
L3	0.5 deg						*					
SLSTR/(A)ATSR												
D3	1 deg	SU							*			
POLDER												
L2	0.055 deg									*		

NOTE: the content of the tables needs to be revised by data providers

TUTE

Aerosol types (flags)

	Aerosol types	MODIS DT	MODIS DB	VIIRS DT	VIIRS DB L2	VIIRS DB D3	Polder
						mode, hist	
				land			
1	Continental	*		*			
2	Moderate absorption Fine	*		*			
3	Strong absorption Fine	*		*			
4	Weak absorption Fine	*		*			
5	Dust Coarse	*		*			
0	Dust		*		*	*	
1	Smoke		*		*	*	
2	High altitude Smoke		*		*	*	
3	CbFg clouds		*		*	*	
4	non-smoke Fine		*		*	*	
5	Mixed		*		*	*	
6	Background		*		*	*	
7	Fine dominated				ocean	*	

Polder: size distribution, sphere function

TUTE

Aerosol types (AOD)

	res	Algo	AAOD	FM AOD	Dust AOD	Coarse AOD	Small/med/Large mode AOD	Non-sph AOD	AOD
				550	550				per mixtire
MODIS									
MxD_04_3K	3km	DT		land(fraction)			ocean(small, large), 7wl		
MxD_04_L2	10km	DT		ocean(fraction)			ocean(small, large), 7wl		
		DB							
		DT&DB							
MxD_08_D3	1 deg	DT							
		DB							
		DT&DB							
		?							
VIIRS									
L2	1 deg	DT							
		DB		ocean, best est					
		DB							
L3		DB		ocean					
MISR									
L2	4.4km		550				*	before screening	before screening
L3	0.5 deg		* (4bands)				*	*	
SLSTR/(A)ATSR									
D3	1 deg	SU	550	*	*				
POLDER									
L2	0.055 deg		6 wl (as AOD)	6 wl		6 wl			

NOTE: the content of the tables needs to be revised by data providers

Other (SSA, SR)

	res	Algo	SSA	Surf refl	Surf refl Cox-Munk param	DHR	Land BRDF Ross_Li BRDF
MODIS							
MxD_04_3K	3km	DT					
MxD_04_L2	10km	DT		land, 470, 660, 2130			
		DB	land, 412,470,660	land, 412,470,660			
		DT&DB					
MxD_08_D3	1 deg	DT					
		DB	land 412,470,660				
		DT&DB					
		?					
VIIRS							
L2	1 deg	DT					
		DB	412,488,669	412,488,668			
		DB					
L3		DB					
MISR							
L2	4.4km		446,558,672,867,before screening				
L3	0.5 deg						
SLSTR/(A)ATSR							
D3	1 deg	SU	550				
POLDER							
L2	0.055 deg		6wl		1 for 5wl, 3 for 670	6 wl	*

NOTE: the content of the tables needs to be revised by data providers

JTE

AOD

Satellite   Date   Product/Res   Product
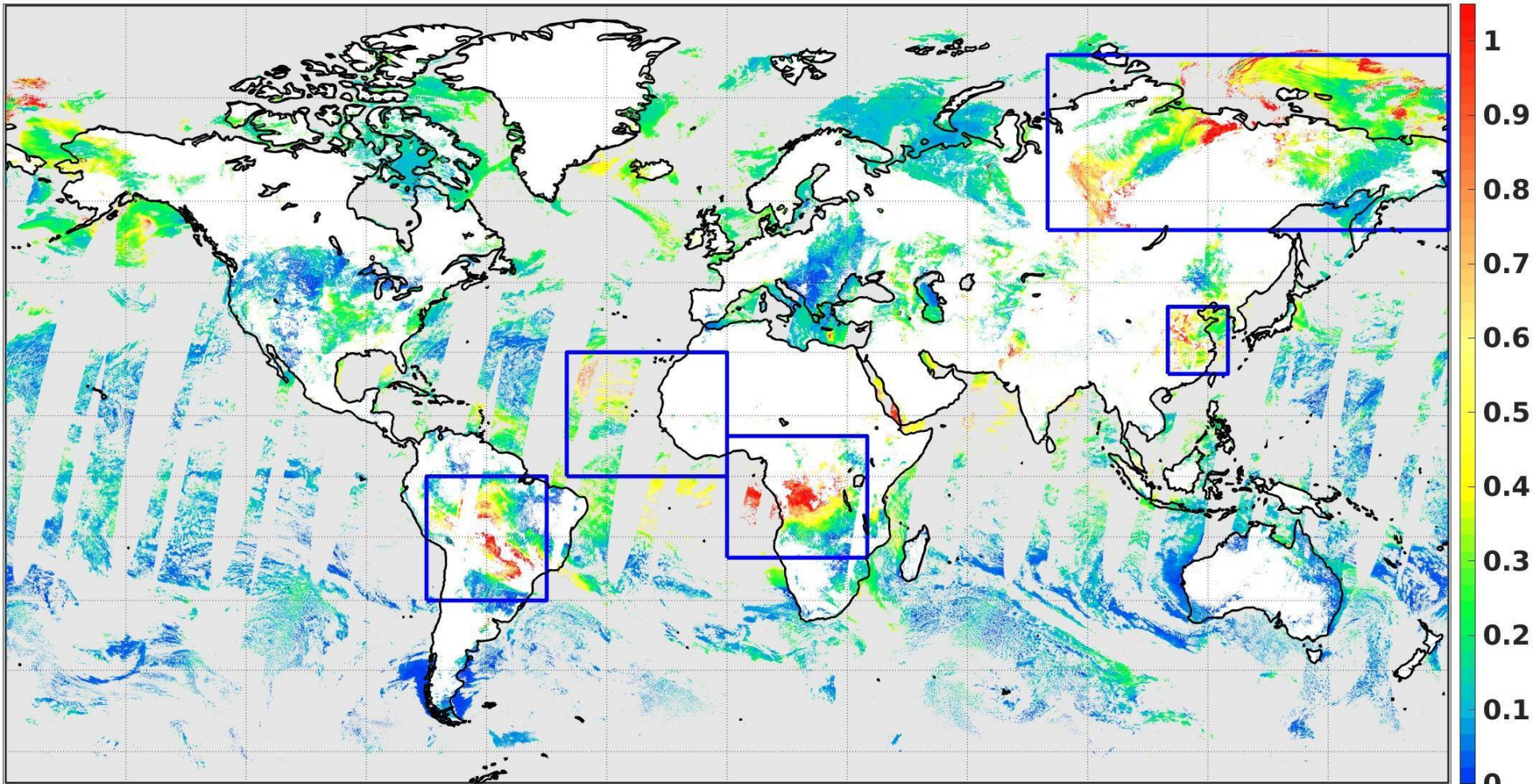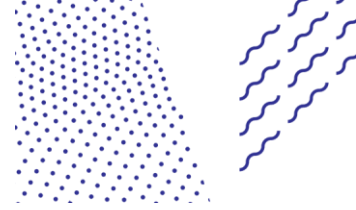
MODIS Terra   2019-08-19   04_3K   AOD_550

5 areas **were chosen for products inter-comparison**

AOD
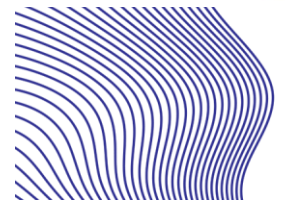
MODIS Terra 2019-08-19 04_L2   AOD_550, DT

AOD

MODIS Terra 2019-08-19 08_D3   AOD_550, DT

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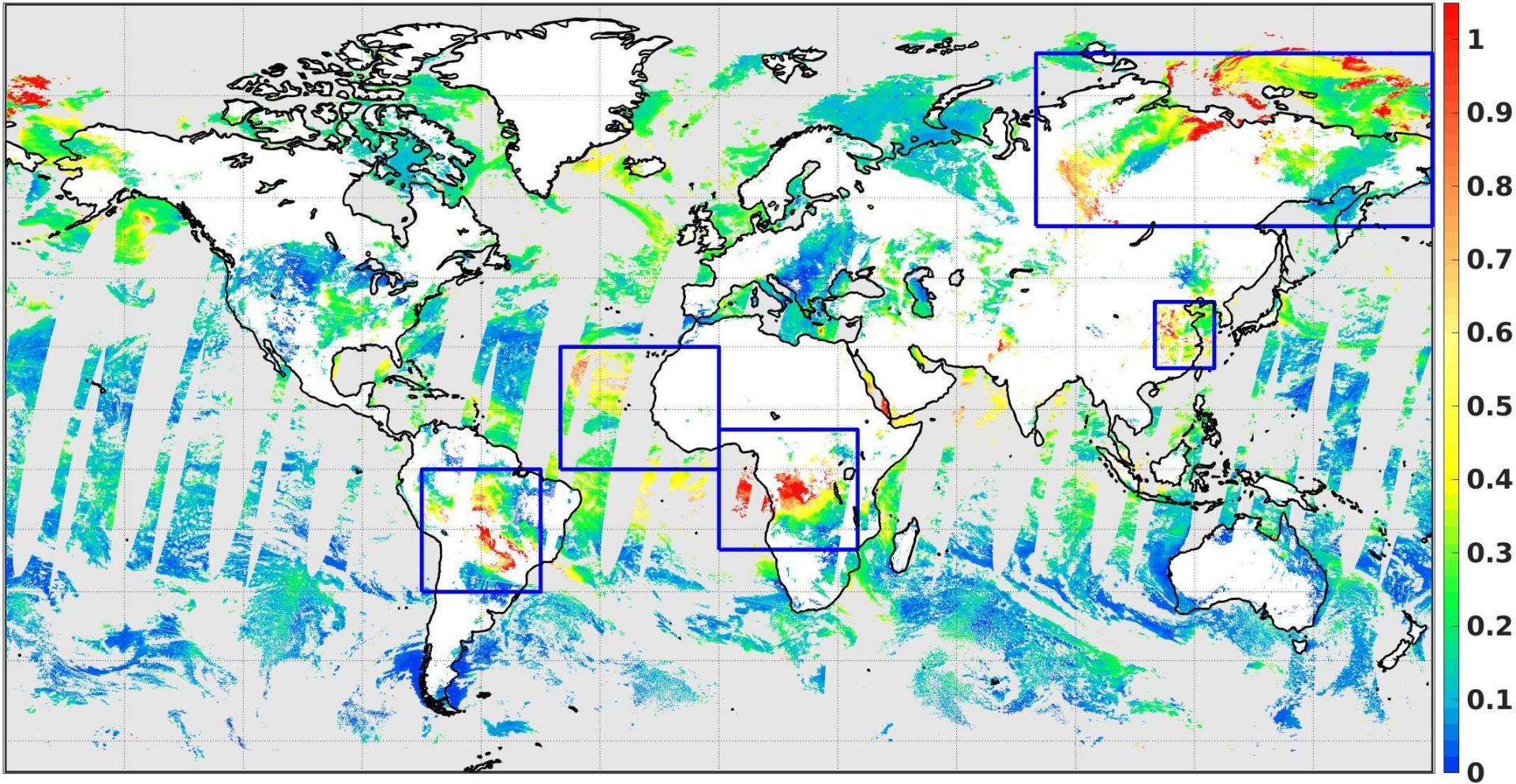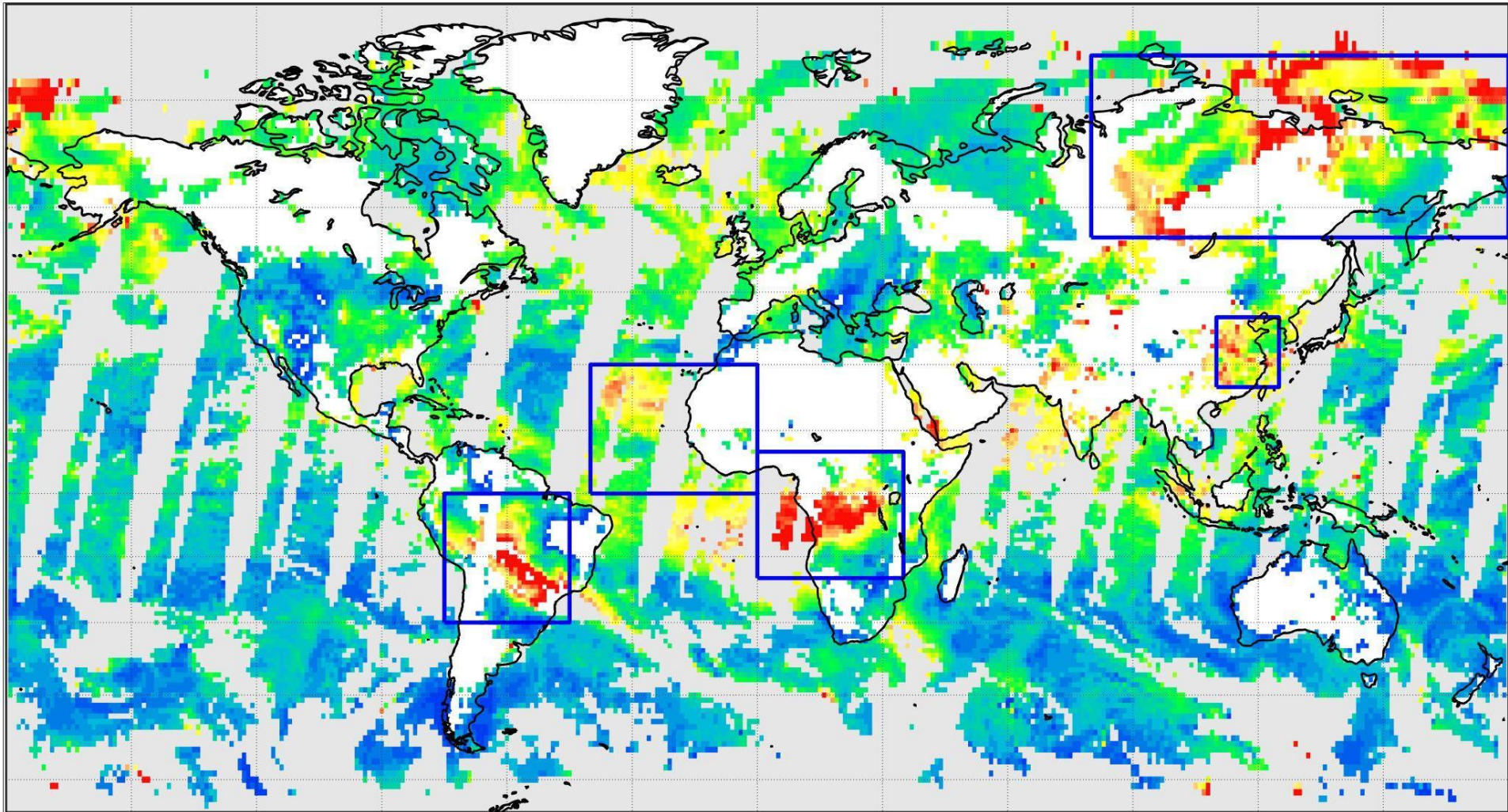
AOD

Same product, different resolution China

MODIS Terra 2019-08-19 04_3K   AOD_550, DT   MODIS Terra 2019-08-19 04_L2   AOD_550, DT   MODIS Terra 2019-08-19 08_D3   AOD_550

mean = 0.486   mean = 0.481   mean = 0.503

AOD
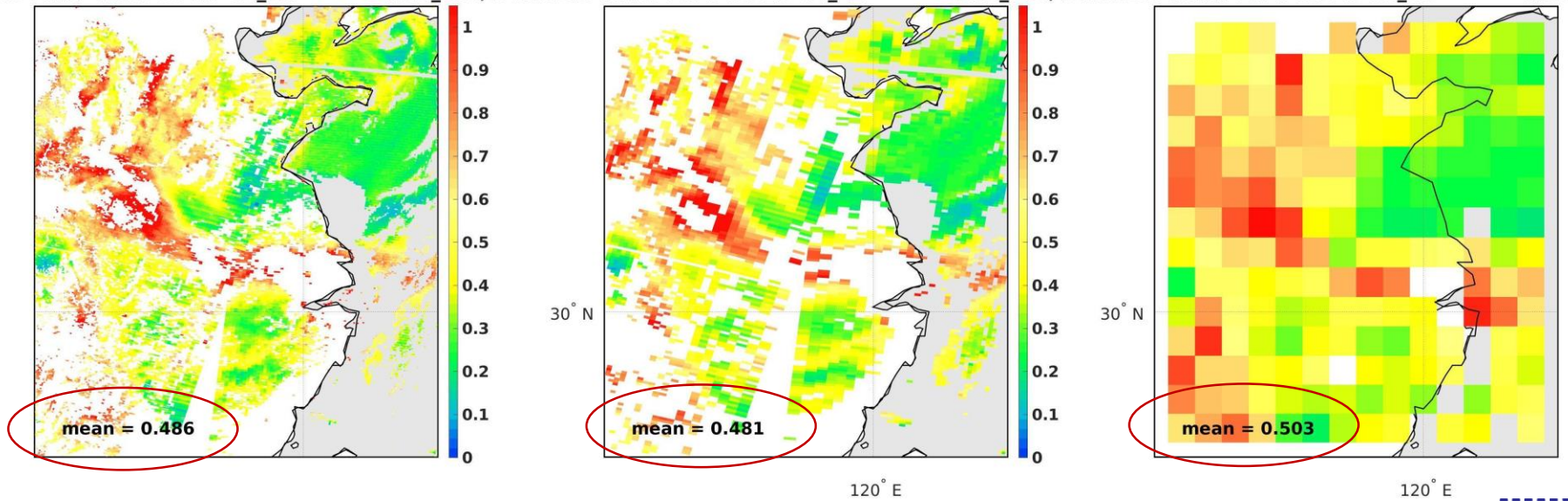
MODIS Terra 2019-08-19 08_D3   AOD_550, DT&DB
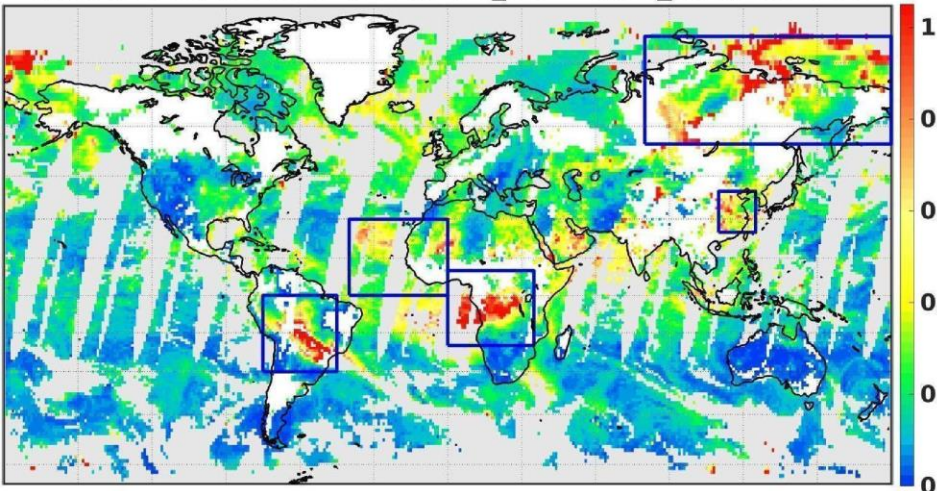
VIIRS AERDB 2019-08-19   D3   AOD_550
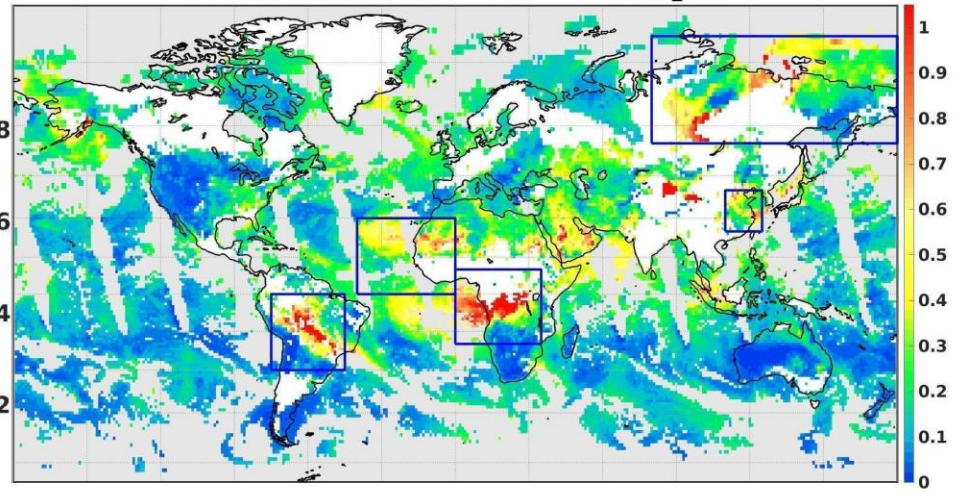
MISR 2019-08-19   D3   AOD_550

S3A 2019-08-19   D3   AOD_550

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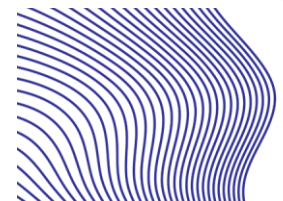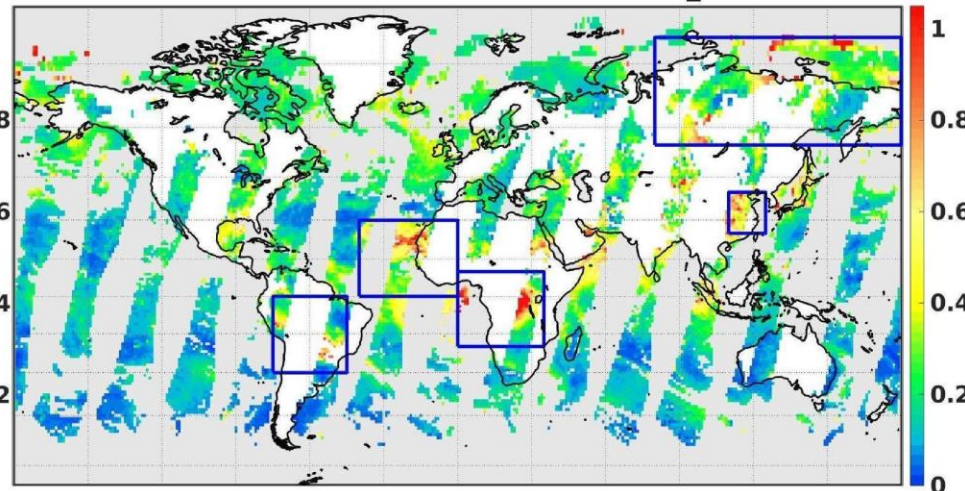
AAOD

MISR 2019-08-19 L2 AAOD
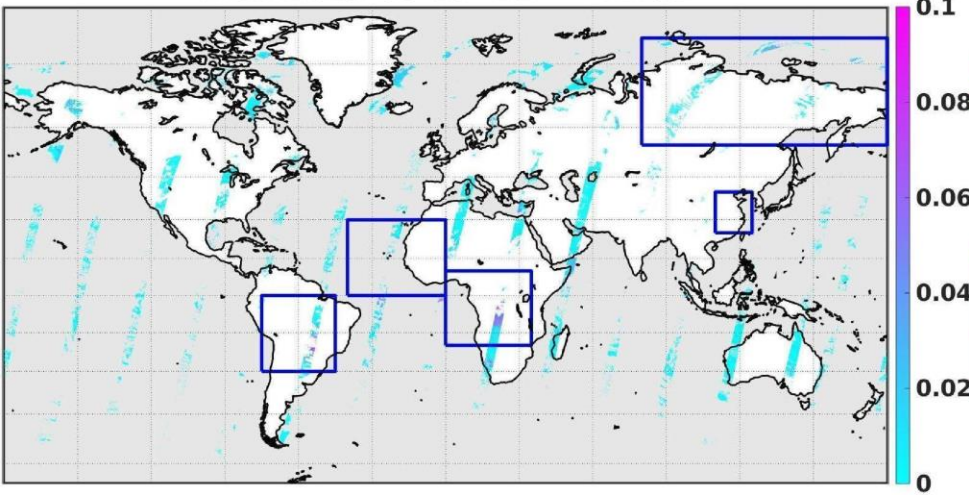
S3A 2019-08-19 D3 AAOD
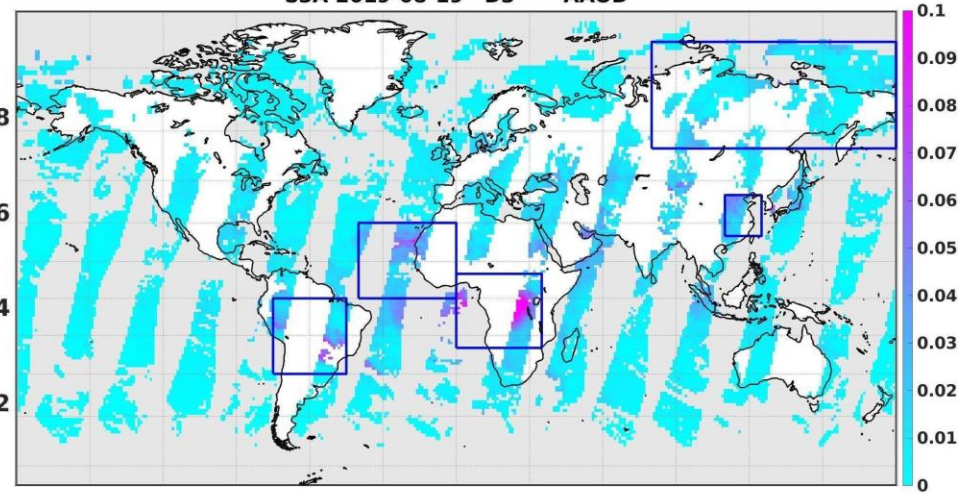
Aerosol types

MODIS Terra 2019-08-19 04_L2   Aerosol Type
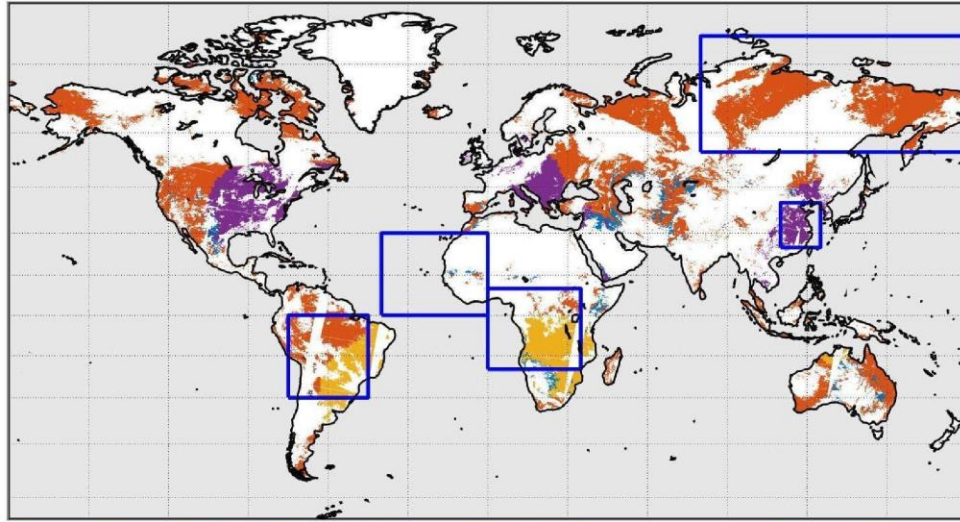
Continental   moderate abs Fine   strong abs Fine   weakly wbs Fine   Dust Coarse

VIIRS AERDB 2019-08-19   D3   Aerosol Type, mode
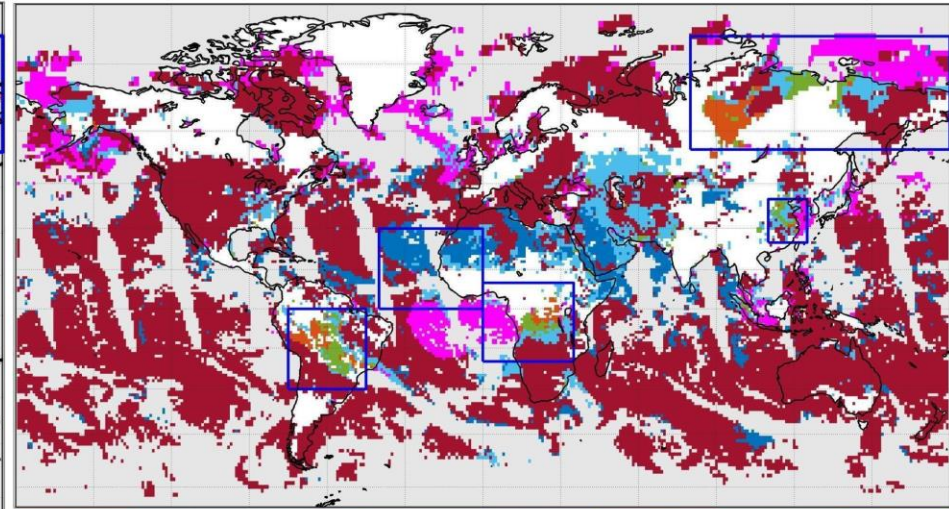
Dust   Smoke   h/a Smoke   clouds   n/smoke Fine   Mixed   Background   Fine

VIIRS AERDT 2019-08-19   L2   Aerosol Type Land
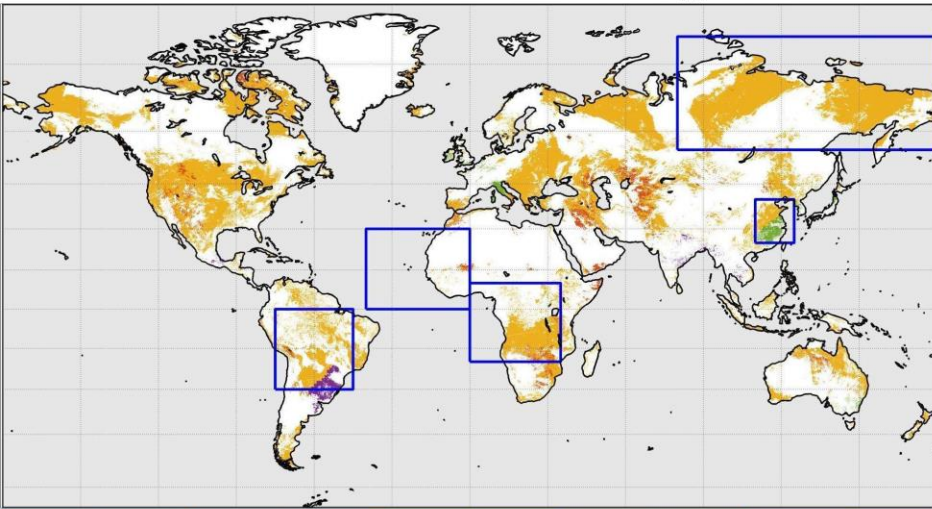
Continental   moderate abs Fine   strong abs Fine   weakly wbs Fine   Dust Coarse

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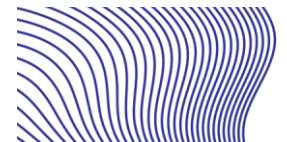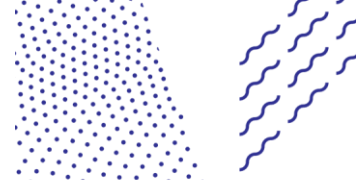
Aerosol types (AOD)

MISR 2019-08-19 D3 Small AOD (r<0.35micron)
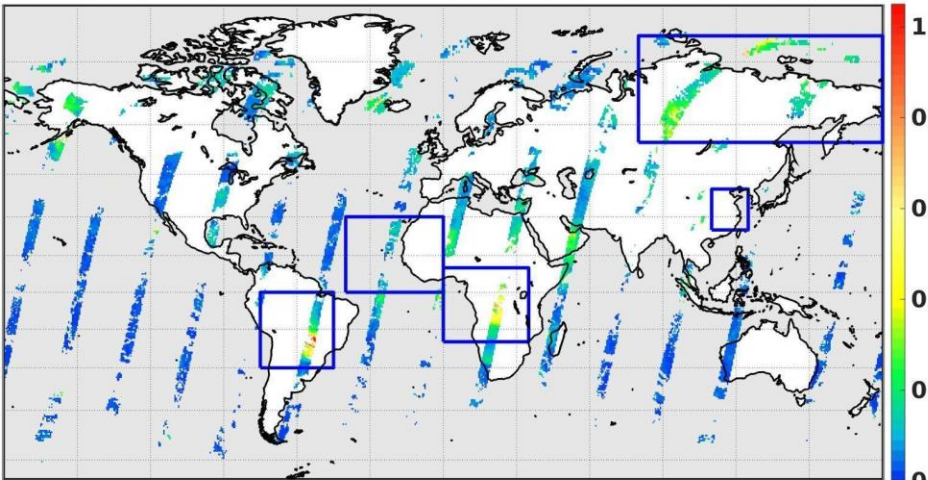
MISR 2019-08-19 D3 Medium AOD (r=0.35-0.7micron)
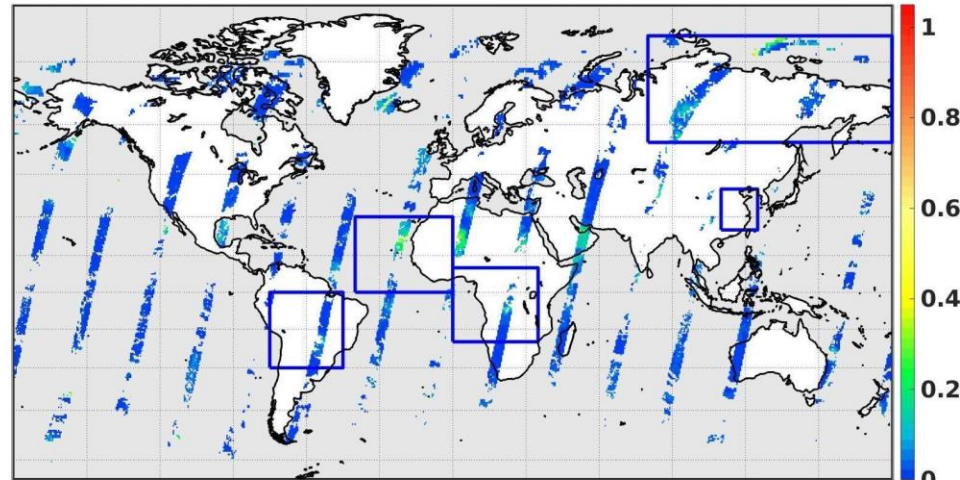
MISR 2019-08-19 D3 Large AOD (r >0.7 micron)
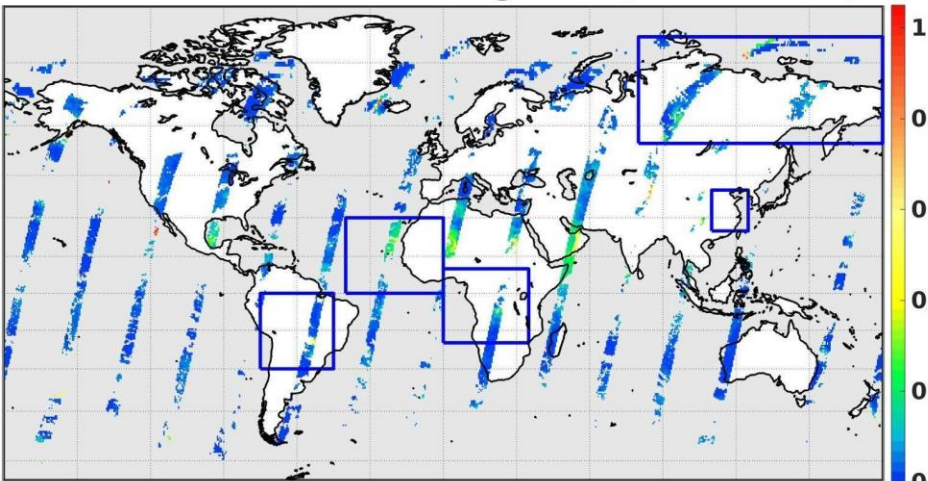
MISR 2019-08-19 D3 Nonspherical AOD

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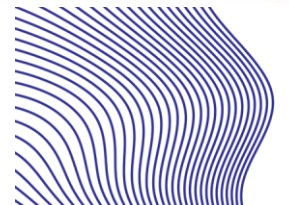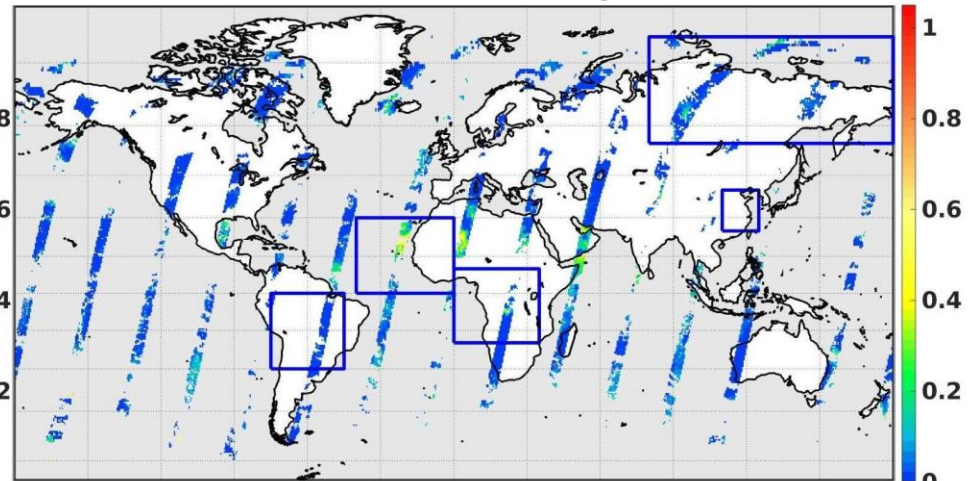
Aerosol types (AOD)
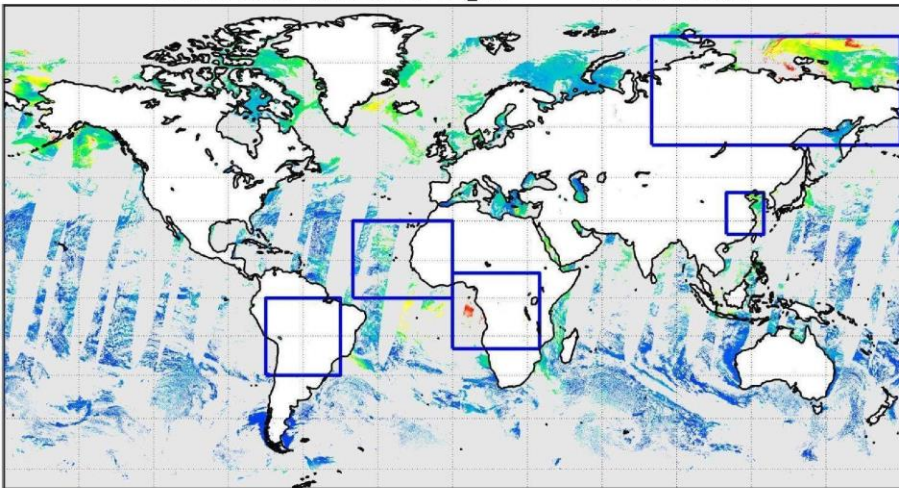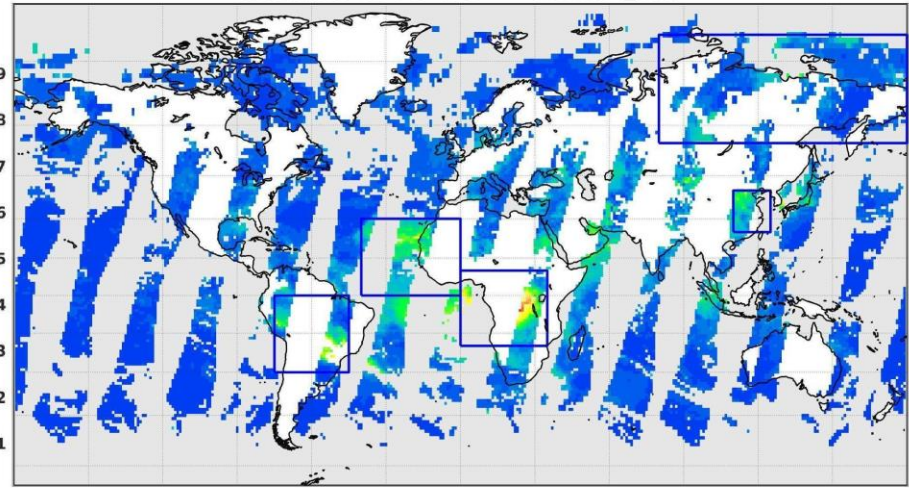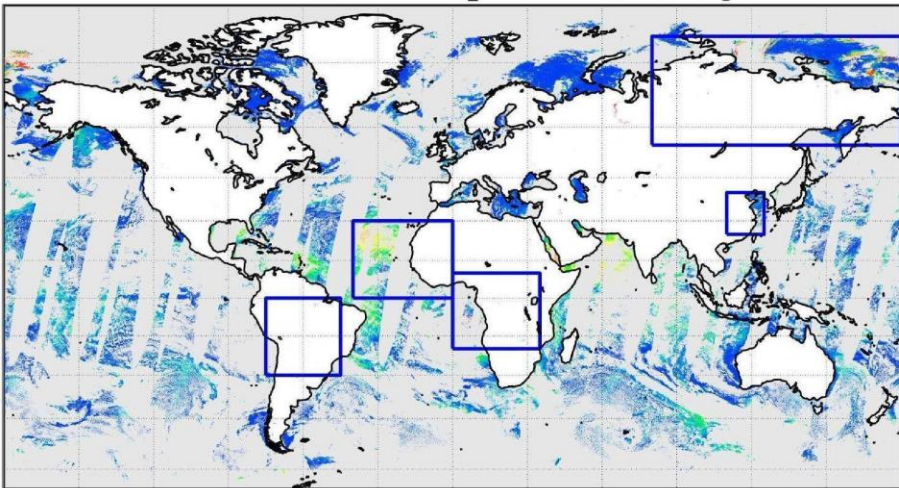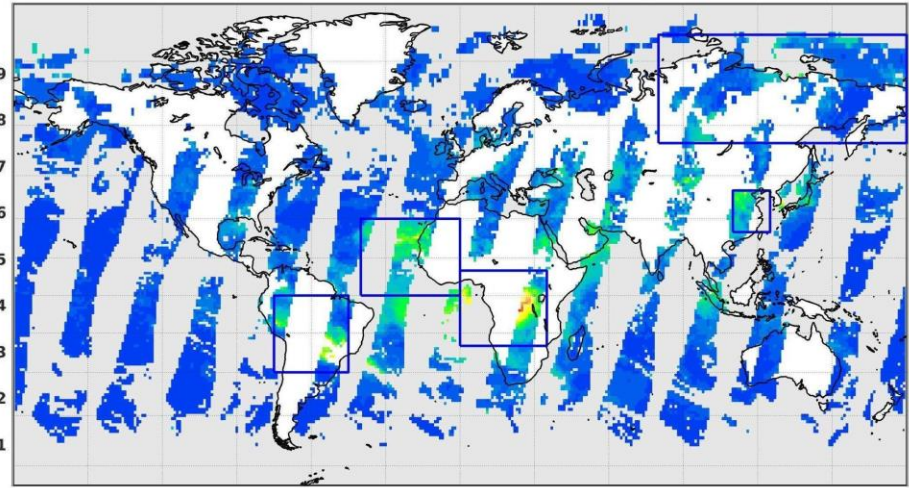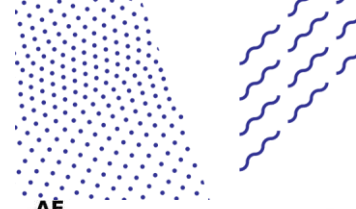
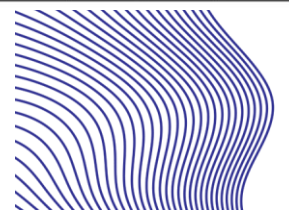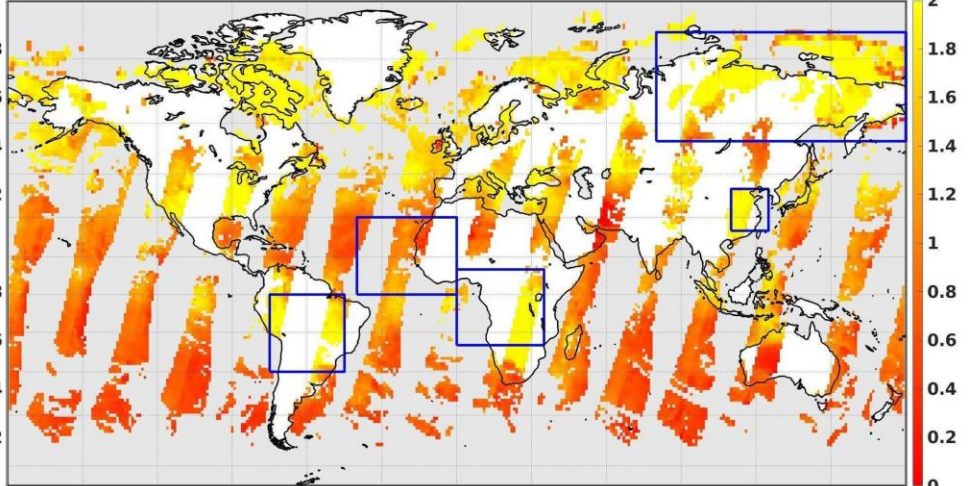MODIS Terra 2019-08-19 04_L2   AE 550/860nm
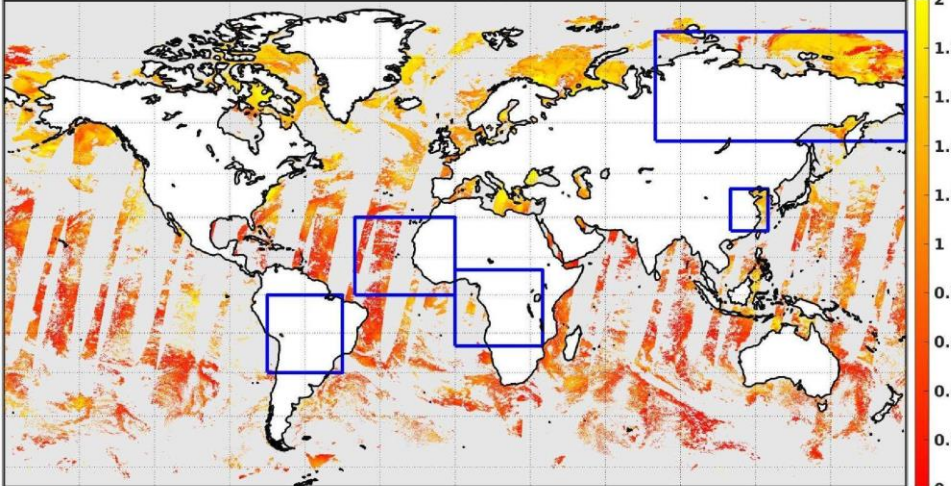
VIIRS AERDB 2019-08-19 L2   AE
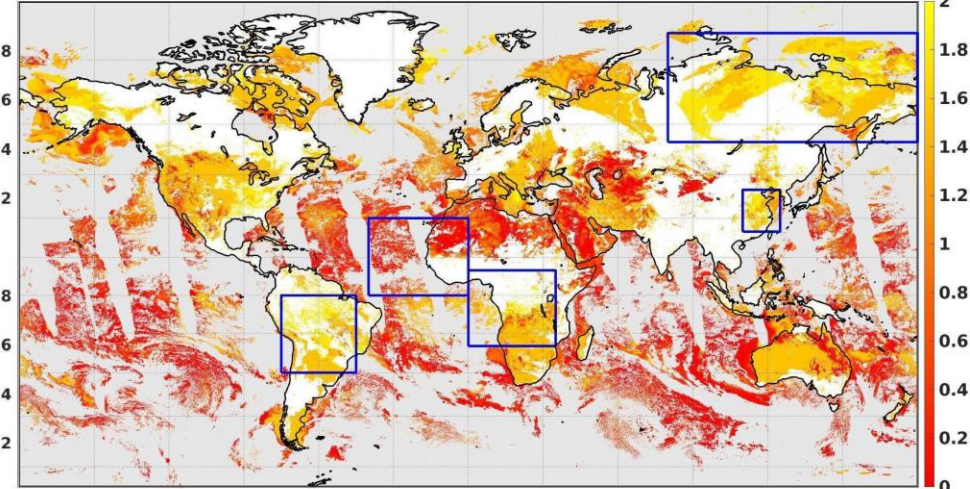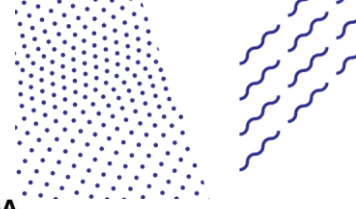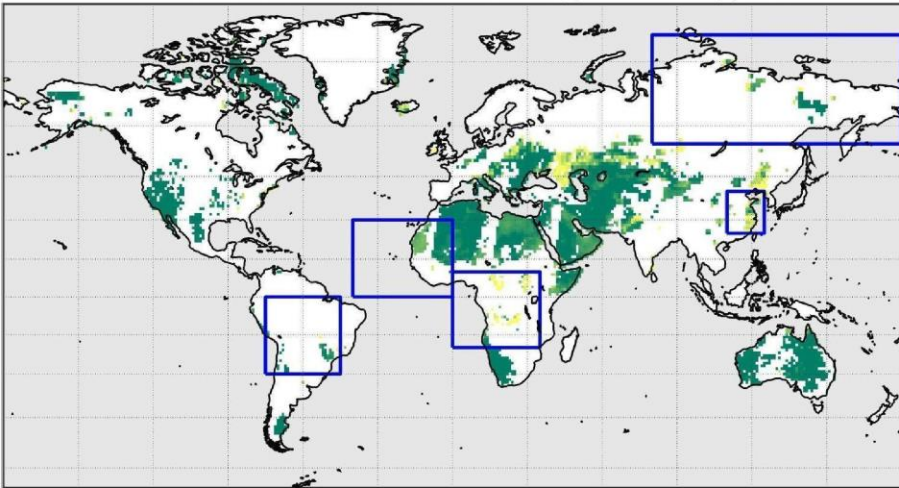
MISR 2019-08-19 L2   AE 550/860nm
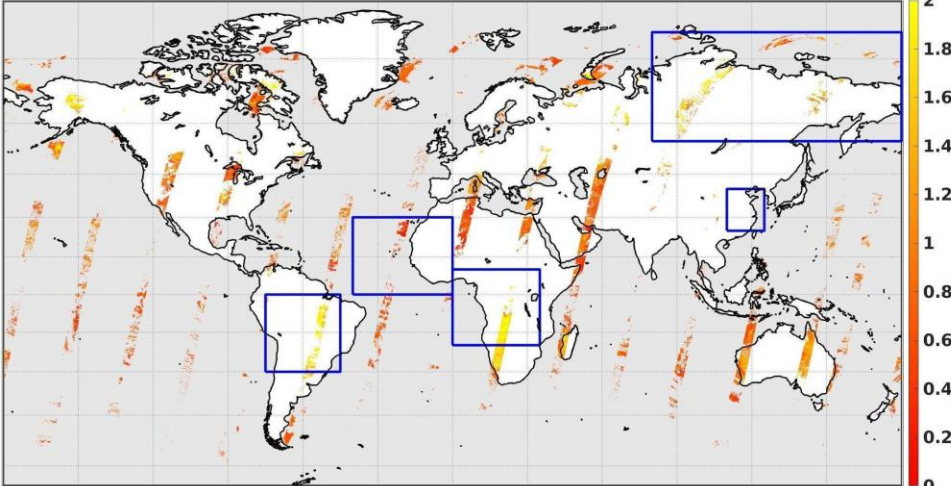
S3A 2019-08-19 D3   AE 550/870nm
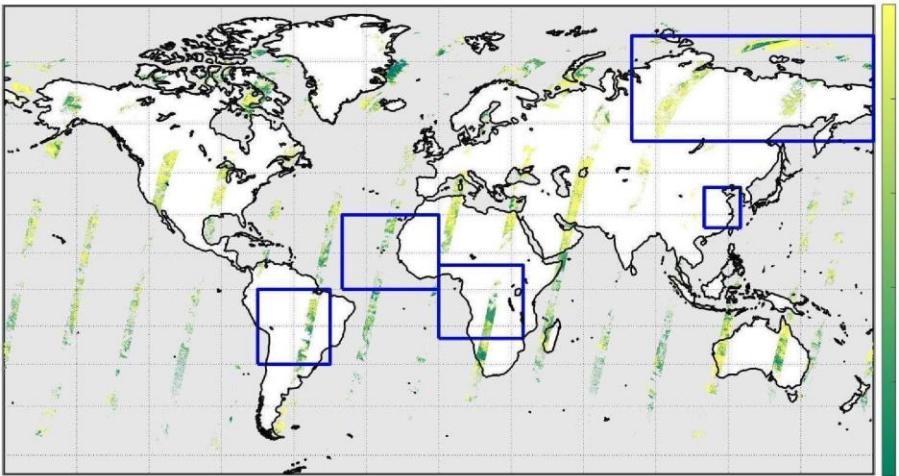
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SSA
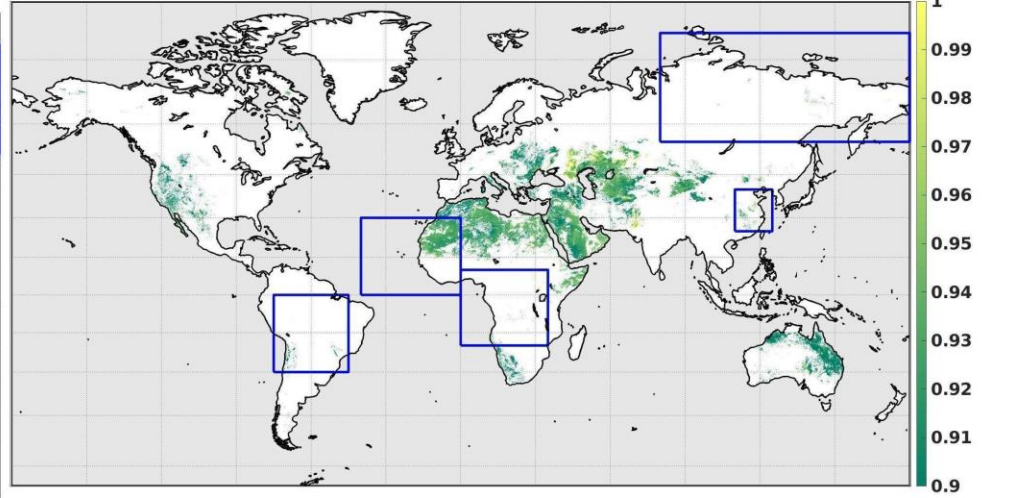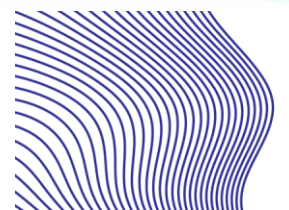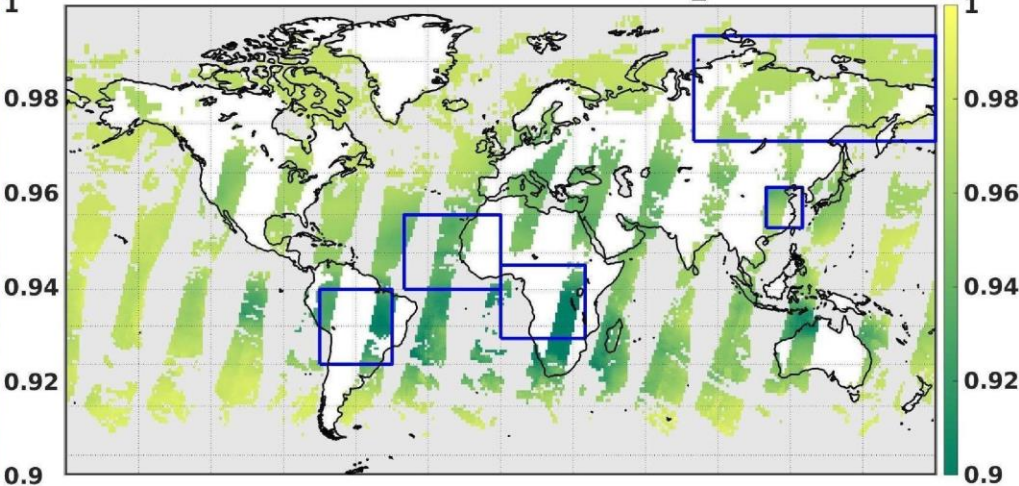
Conclusions

- The content of the AOD official products (MODIS; MISR; VIIRS; Sentinel-3A, POLDER) has been analyzed. Chosen products are summarized in the tables. **To do**:
  - Definitions for aerosol types (and other?) products should be added to the corresponding tables.
  - Content of the tables should be checked by data providers
- Only few products provide other than 550 nm AOD globally
- Aerosol type definitions differ considerably between the products
- 19 August 2019 was chosen for visual inter-comparison of similar products. **To do:**
  - For products not available for that period (POLDER; AATRS), the inter-comparison will be performed for another day (year 2010?)
- **To do:** validation/evaluation of the available products.
- **To do:** ……….. – to be filled after discussions at AEROCOM/AEROSAT 2020

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