MERSI onboard Chinese Fengyun-3: quantitative ability for aerosol retrieval

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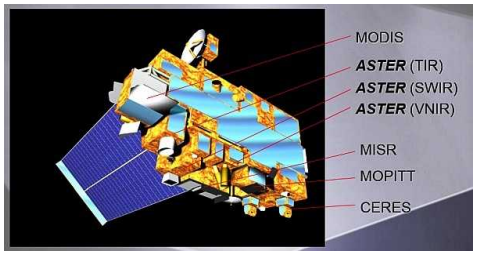
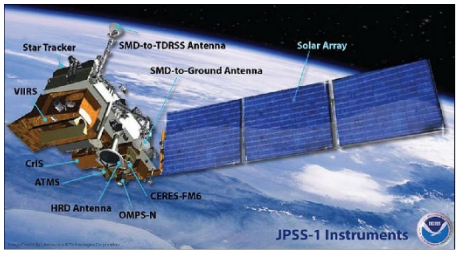
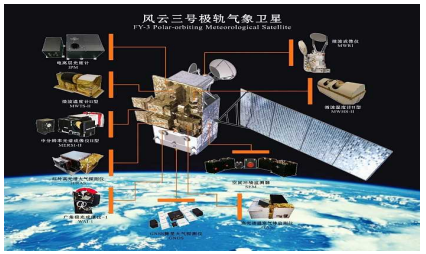
Lille, Nov. 04, 2019

Outline :

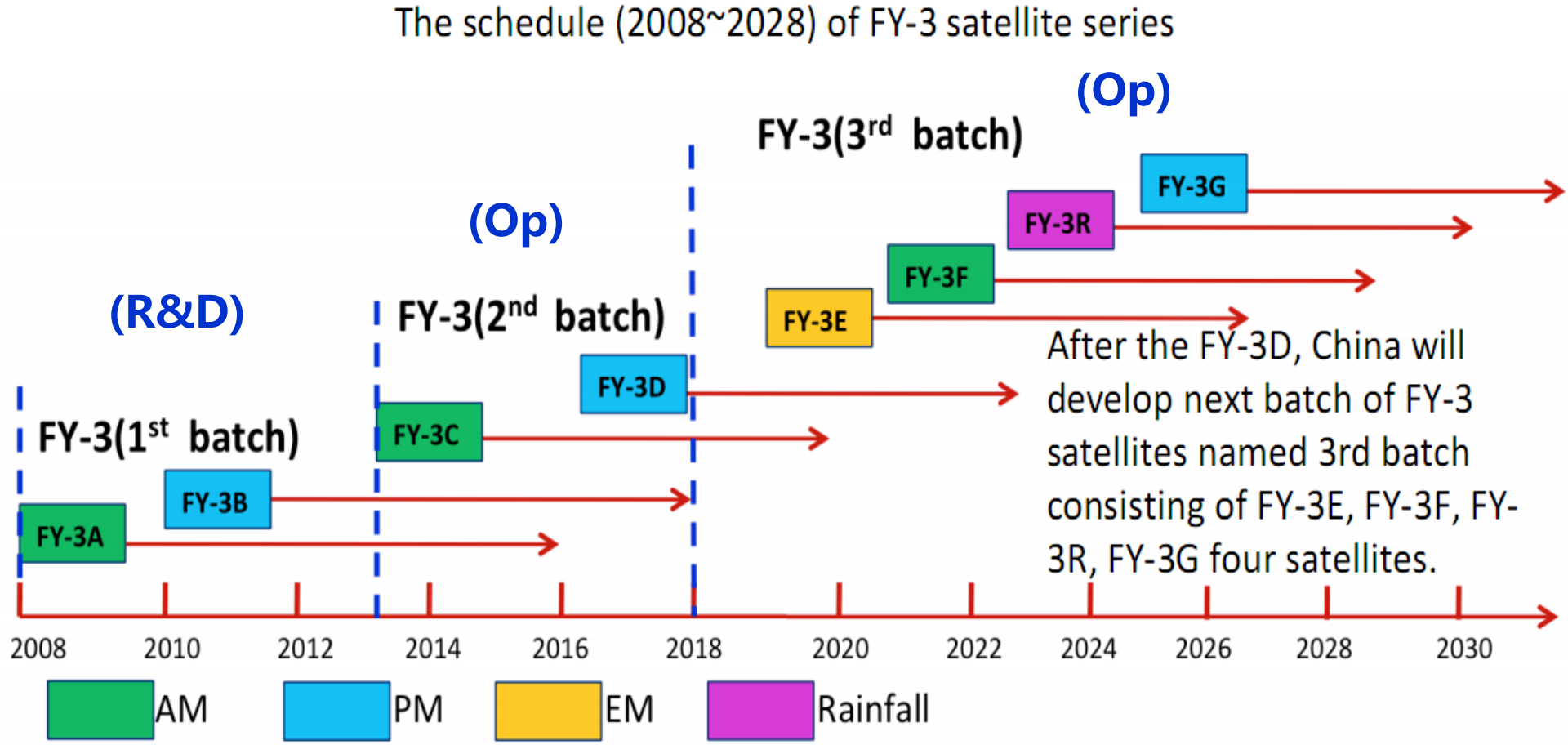
1. Satellite/Senor
2. Aerosol Algorithm
3. Result & Validation
4. Month Mean
5. Test with MERSI-II

FY-3C MERSI-I

1. Satellite/Senor

	MODIS	VIIRS	MERSI
Polar-Orbit			
Onboard:	Terra Aqua	S-NPP JPSS-1 JPSS-x	FY-3A FY-3B FY-3C FY-3D FY-3x

1. Satellite/Senor



From Z. Yang,2018

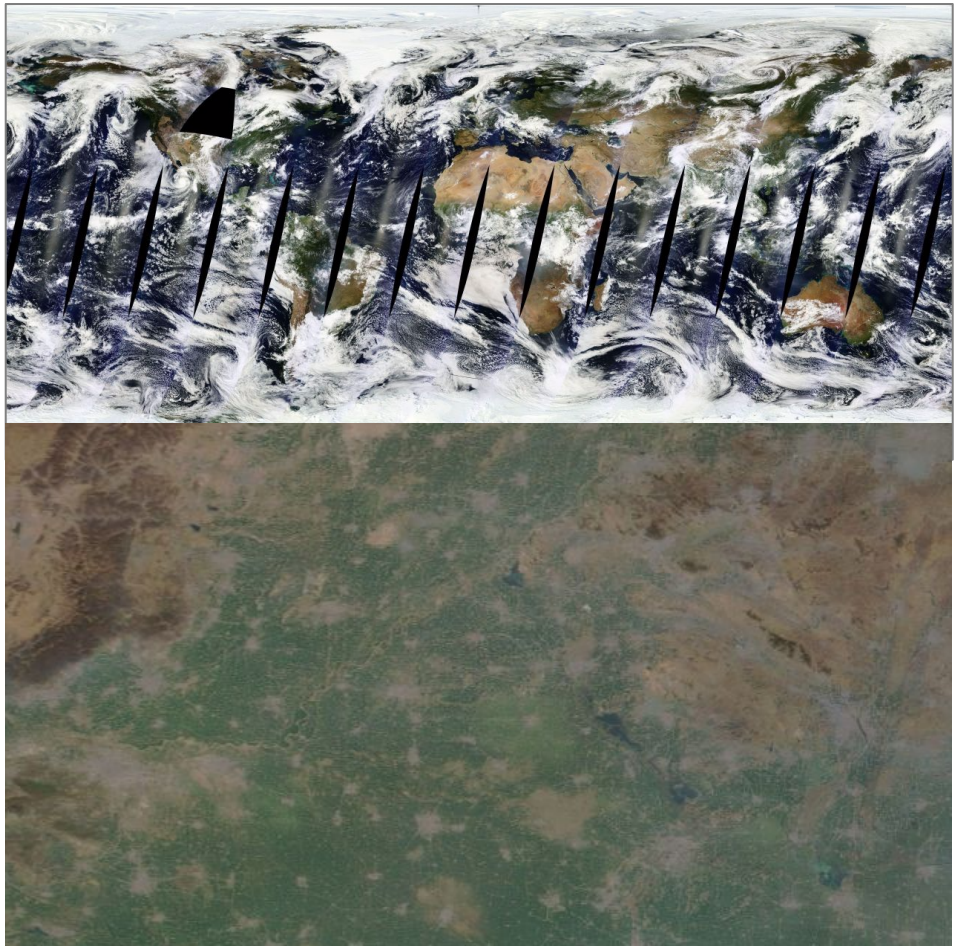
1. Satellite/Senor

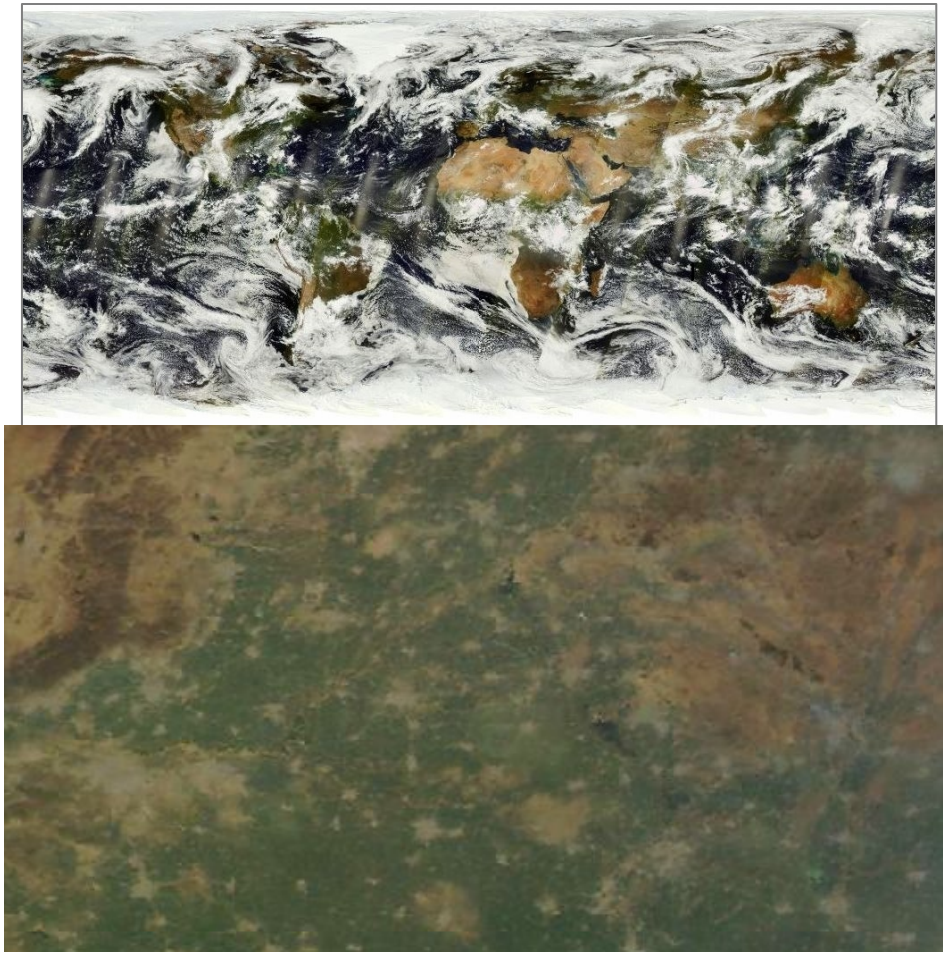
Satellite	TERRA	AQUA	S-NPP	JPSS-1	FY-3C	FY-3D
Orbit altitude	705km	705km	825km	825km	836km	836km
Equator crossing time	10:30	13:30	13:30	13:30	10:30	13:30
Sensor	MODIS	MODIS	VIIRS	VIIRS	MERSI-1	MERSI-2
Swath width	2330km	2330km	3040km	3040km	2916km	2916km
Sensor zenith angle range	±64°	±64°	±70°	±70°	±55.4°	±55.4°
Launch Date	1999	2002	2011	2017	2013	2017

1. Satellite/Senor

MODIS			VIIRS			FY-3C MERSI (-I)			FY-3D MERSI-II		
Band	Central Wavelength (*μm*)	Spatial Resolution (m)	Band	Central Wavelength (*μm*)	Spatial Resolution (m)	Band	Central Wavelength (*μm*)	Spatial Resolution (m)	Band	Central Wavelength (*μm*)	Spatial Resolution (m)
3	0.466	500	M3	0.488	750	1	0.476	250	1	0.471	250
4	0.554	500	M4	0.555	750	2	0.552	250	2	0.555	250
1	0.645	250	M5/I1	0.672	750/375	3	0.650	250	3	0.654	250
2	0.856	250	M7/I2	0.865	750/375	4	0.861	250	4	0.869	250
5	1.24	500	M8	1.24	750	20	1.03	1000	19	1.03	1000
6	1.63	500	M10/I3	1.61	750/375	6	1.64	1000	6	1.64	1000
7	2.11	500	M11	2.25	750	7	2.13	1000	7	2.13	1000
8	0.412	1000	M1	0.412	750	8	0.412	1000	8	0.411	1000
9	0.443	1000	M2	0.445	750	9	0.443	1000	9	0.444	1000
26	1.38	1000	M9	1.378	750		no	no	5	1.38	1000
31	11.0	1000	M15/I5	11.45	750/375	5	11.3	250	24	10.8	250
32	12.0	1000	M16	12.01	750		no	no	25	12.0	250

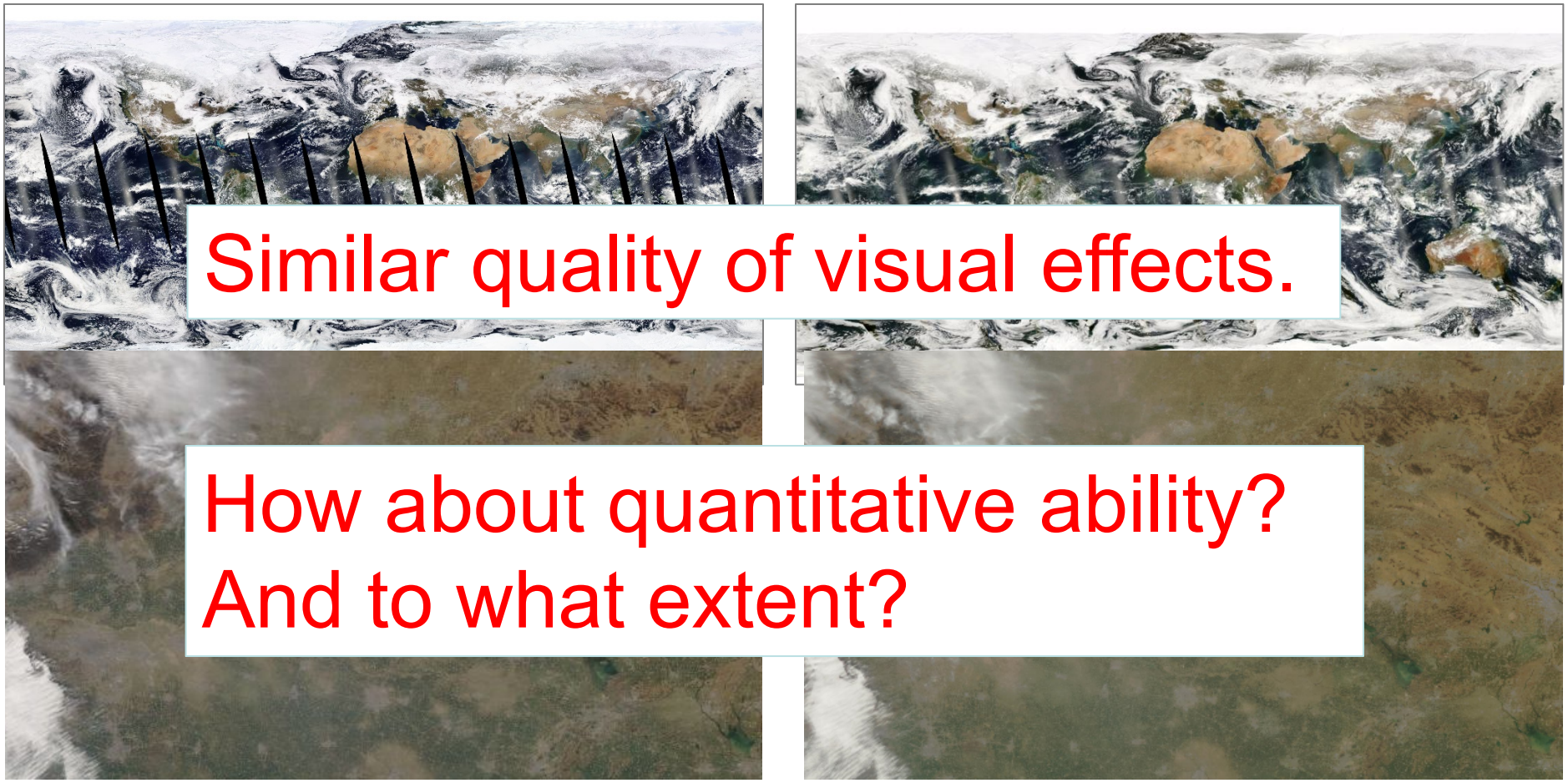
1. Satellite/Senor





MODIS/TERRA Sep 05 2014 MERSI/FY3C

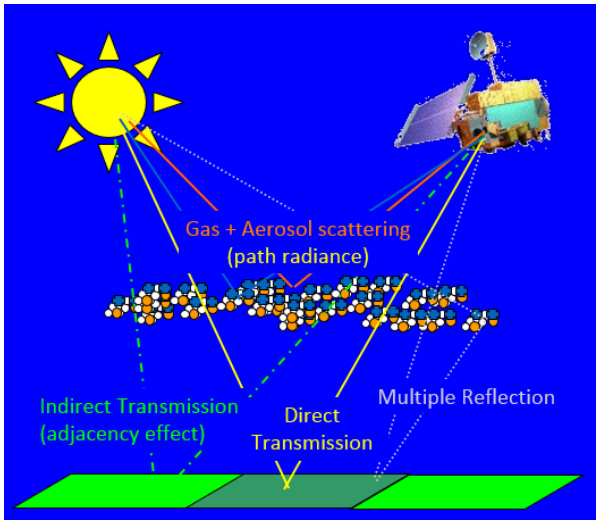
1. Satellite/Senor



MODIS/AQUA Mar 11 2018 MERSI-II/FY3D

2. Algorithm

$$\rho^{*} = T_g \cdot \left(\rho_{R+a} + \frac{T_{R+a}^{\downarrow} \rho T_{R+a}^{\uparrow}}{1 - \rho S} \right)$$



1) Gas absorption correction

2) Cloud mask

3) Pixel aggregation

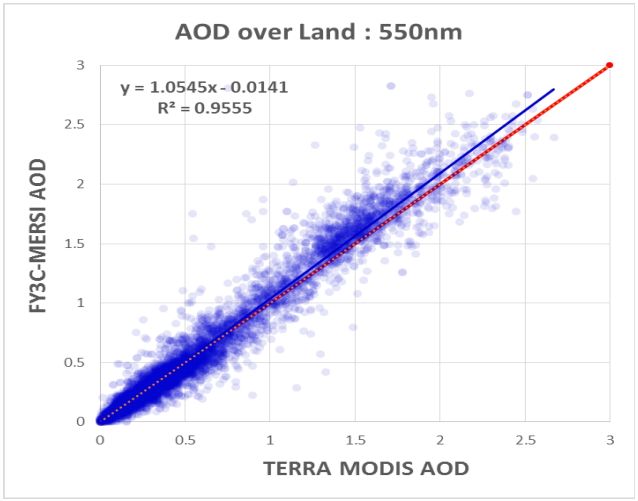
4) Surface estimation

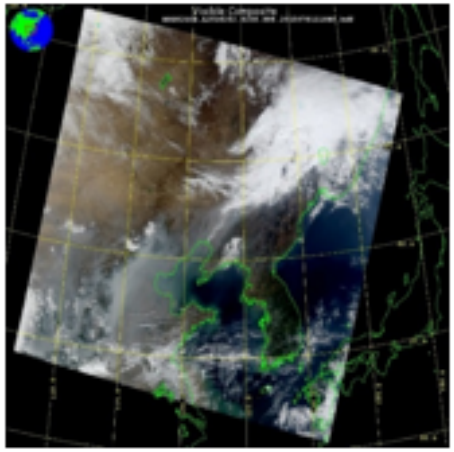
5) Look-Up table

Our algorithm keep consistent as much as Dark Target (DT).

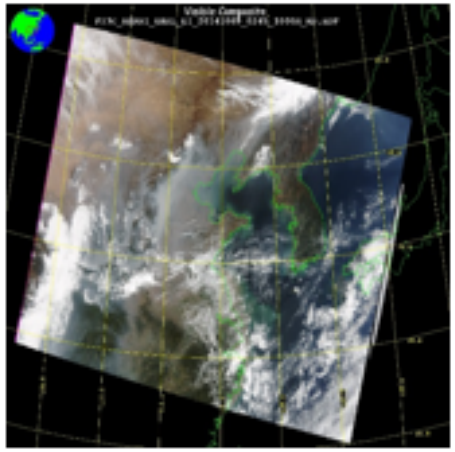
3. Result and validation

3.1 Example of One granule Retrieval

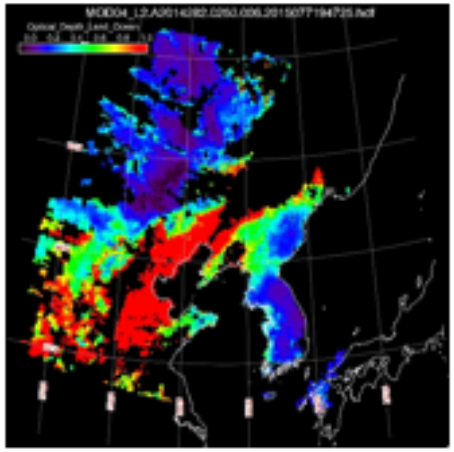




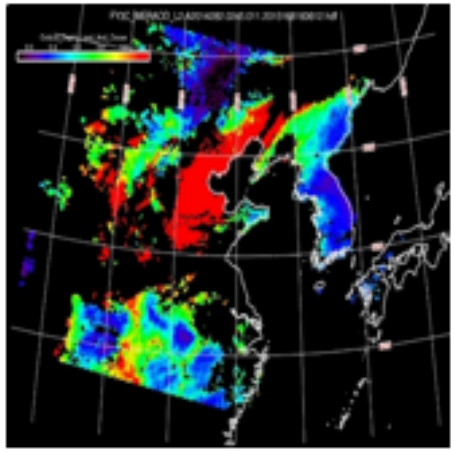
MODIS RGB



MERSI RGB



MODIS AOD



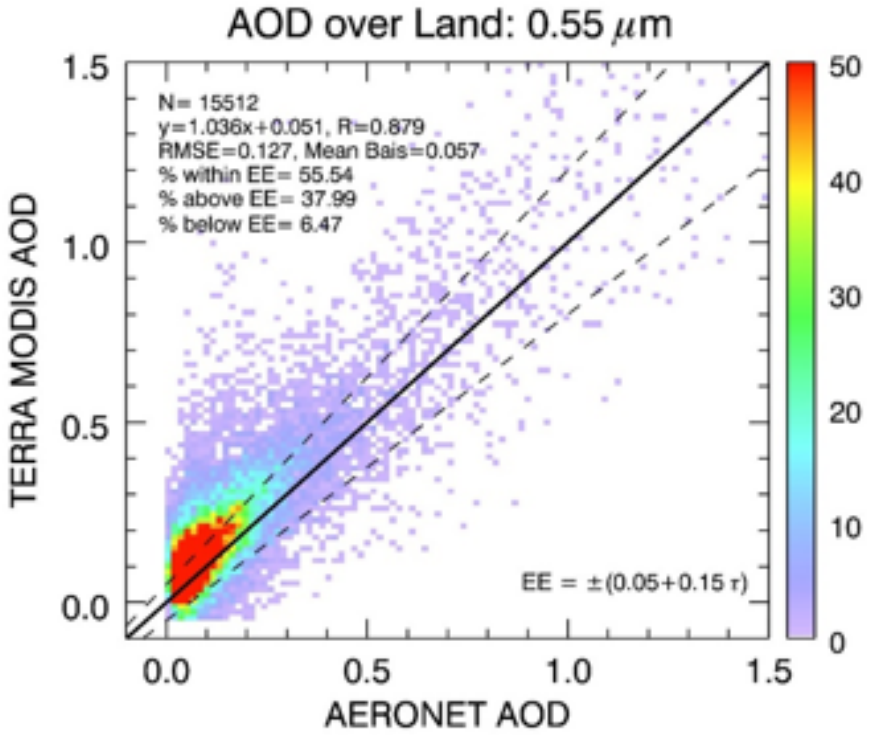
MERSI AOD

Date： 2014.10.09

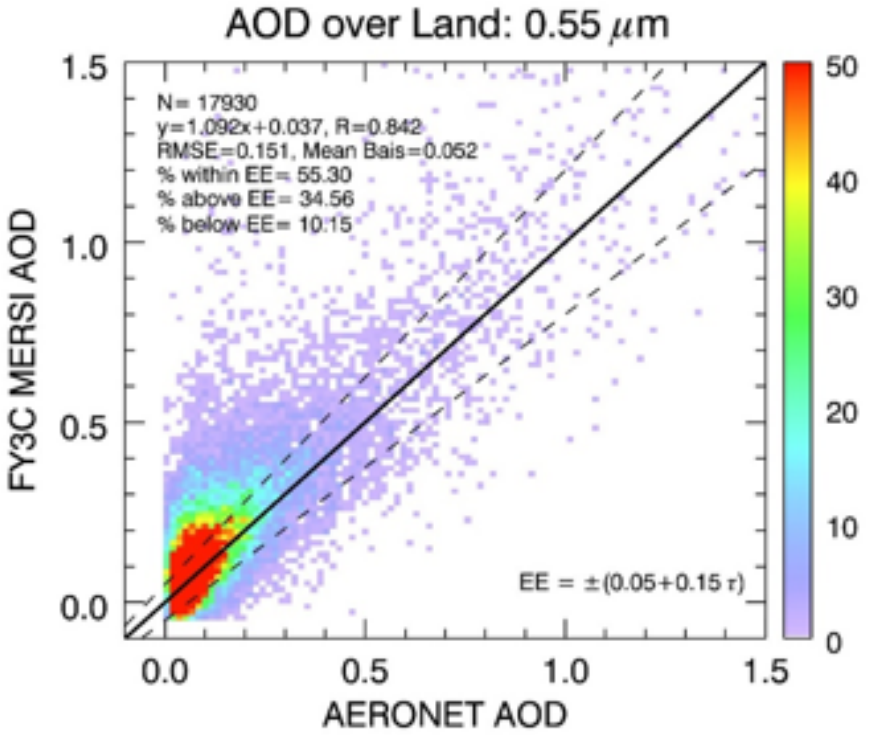
3. Result and validation

3.2 Global validation

data：201406~201505



MODIS/TERRA **C6**



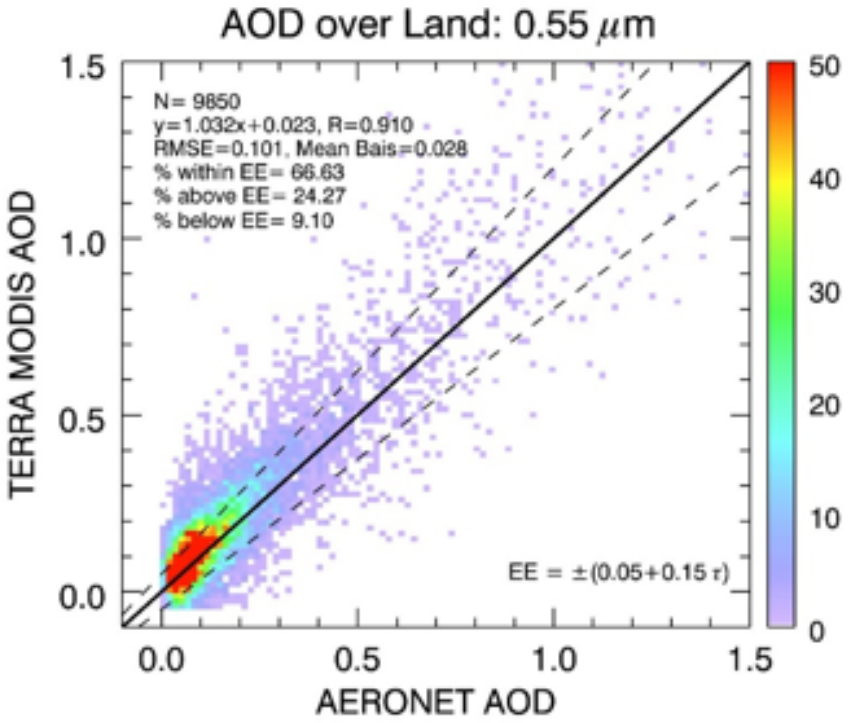
MERSI/FY3C

QA=All

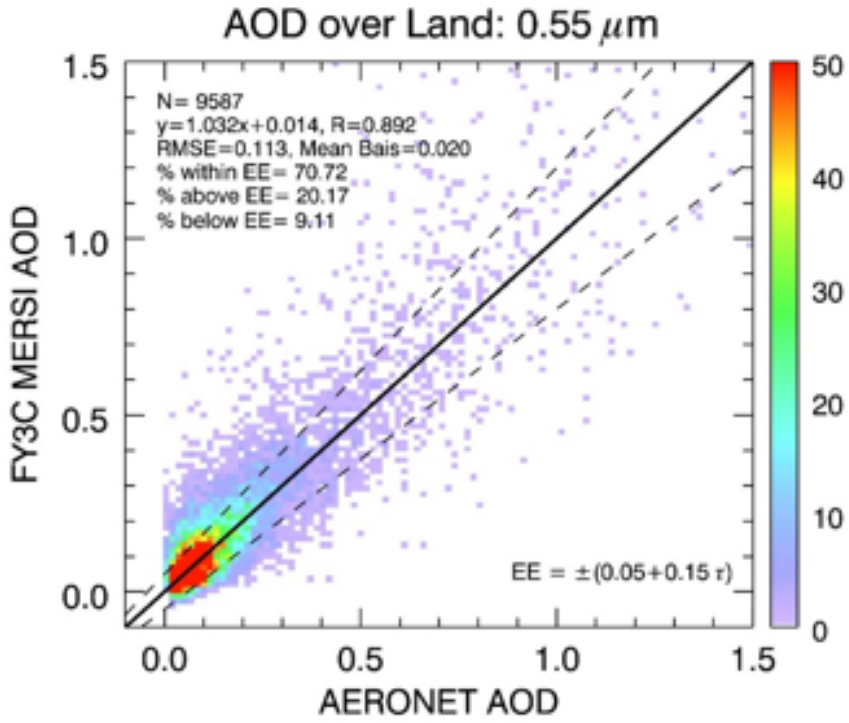
3. Result and validation

3.2 Global validation

data：201406~201505



MODIS/TERRA **C6**



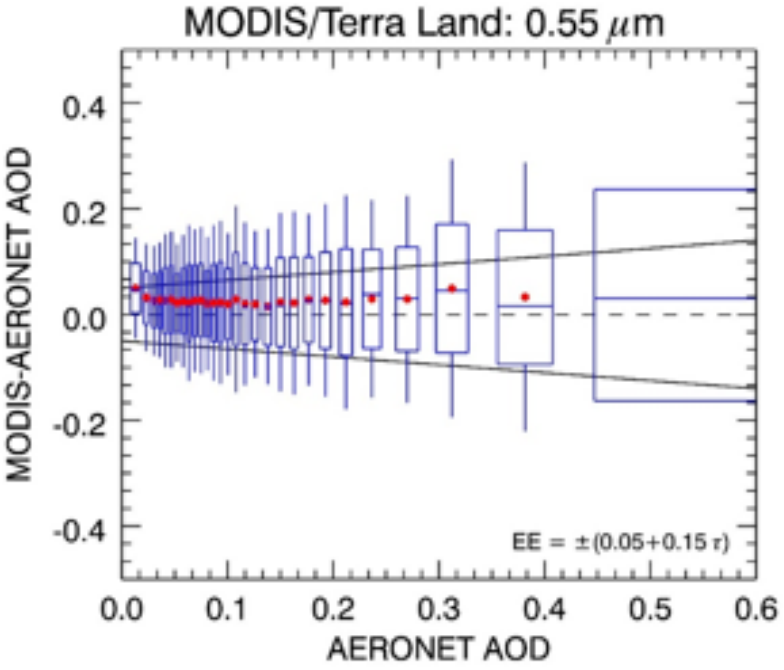
MERSI/FY3C

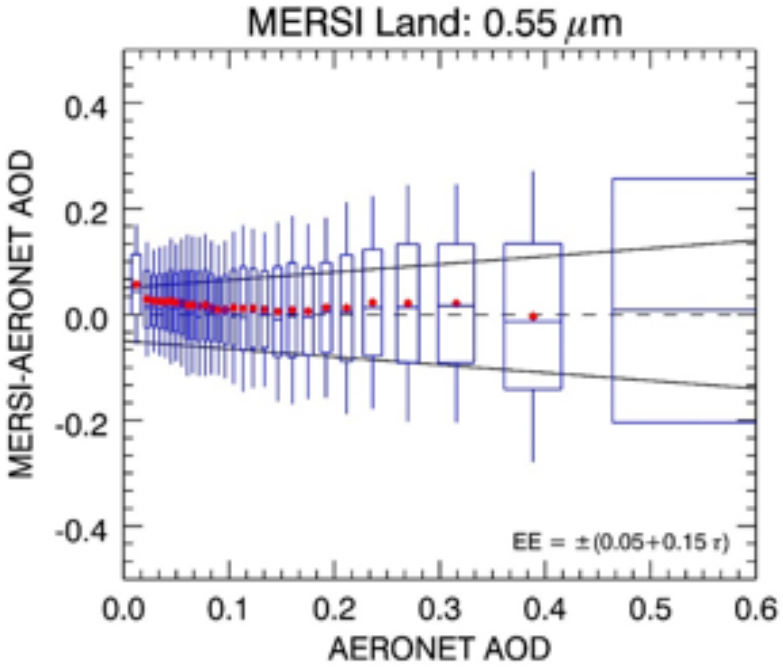
QA=3

3. Result and validation

3.2 Global validation

data：201406~201505





MODIS/TERRA **C6**

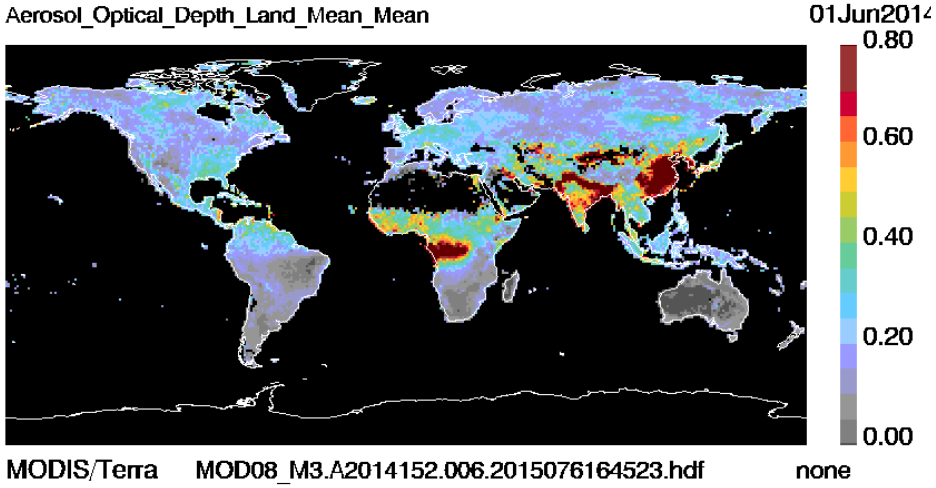
QA=3

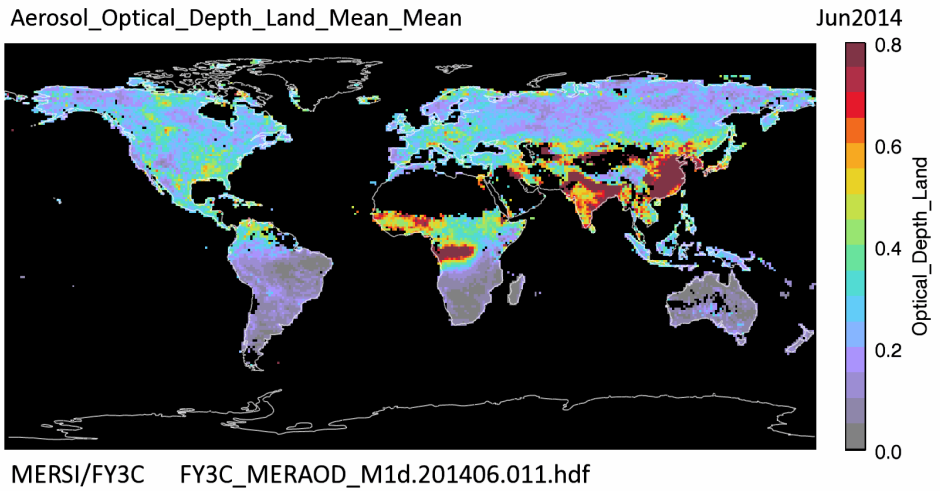
MERSI/FY3C

4. Month mean

1 ） AOD_Month_Mean (wait gif…)

data：201406~201505





MODIS/TERRA

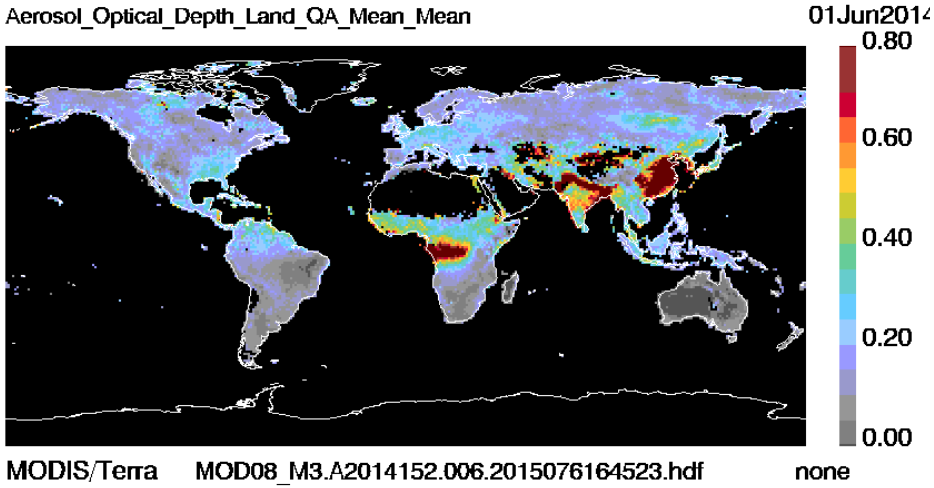
MERSI/FY3C

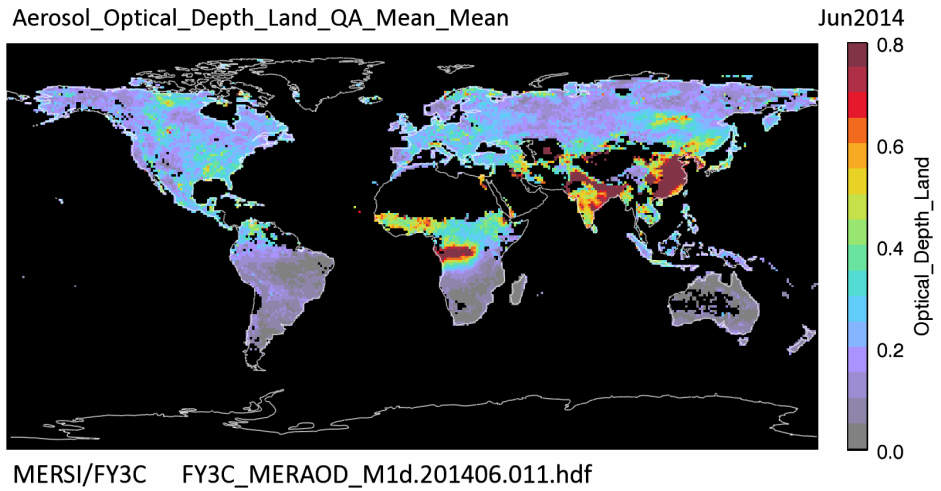
QA=All

4. Month mean

2） AOD_Month_QA_Mean (wait gif…)

data：201406~201505





MODIS/TERRA

MERSI/FY3C

QA=1、2、3

5. Preliminary test with MERSI-II

Onboard FY-3D

Since Dec., 28, 2017

5. Preliminarily test with MERSI-II

5.1 Algorithm

FY-3C MERSI (-I)			FY-3D MERSI-II		
Band	Central Wavelength (*μm*)	Spatial Resolution (m)	Band	Central Wavelength (*μm*)	Spatial Resolution (m)
1	0.476	250	1	0.471	250
2	0.552	250	2	0.555	250
3	0.650	250	3	0.654	250
4	0.861	250	4	0.869	250
20	1.03	1000	19	1.03	1000
6	1.64	1000	6	1.64	1000
7	2.13	1000	7	2.13	1000
8	0.412	1000	8	0.411	1000
9	0.443	1000	9	0.444	1000
	no	no	5	1.38	1000
5	11.3	250	24	10.8	250
	no	no	25	12.0	250

1) Cirrus mask: With 1.38μm

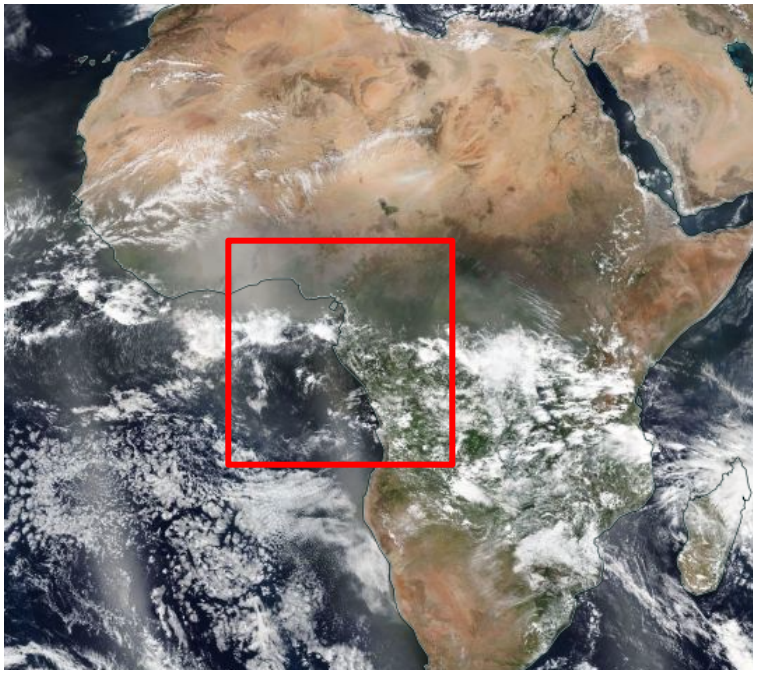
$$\rho^{*}_{1.38} > 0.03 \ \ or \ \ \sigma_{1.38} > 0.003$$

2) surface band ratio:

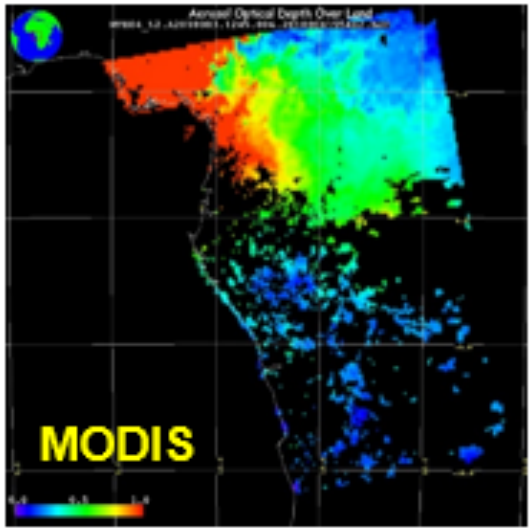
$$\begin{cases} \rho^{s}_{0.65} = f(\rho^{s}_{2.12}) = 0.5 * \rho^{s}_{2.12} \\ \rho^{s}_{0.47} = g(\rho^{s}_{0.65}) = 0.5 * \rho^{s}_{0.65} \end{cases}$$

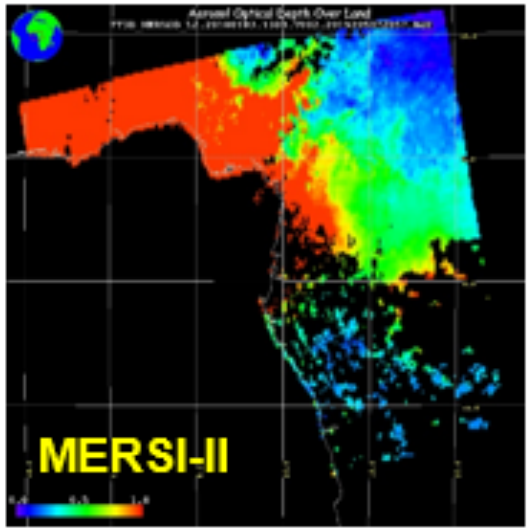
5. Preliminarily test with MERSI-II

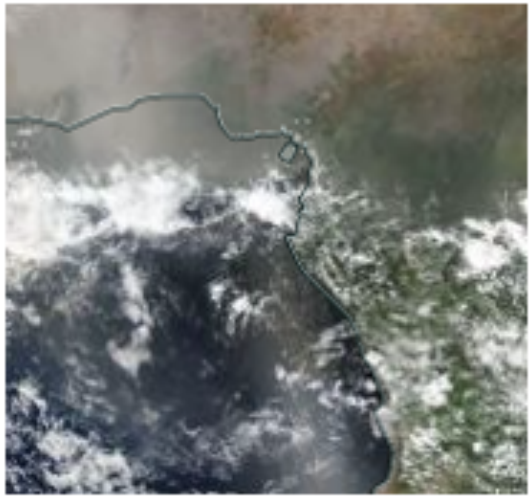
5.2 Example of One granule Retrieval -1

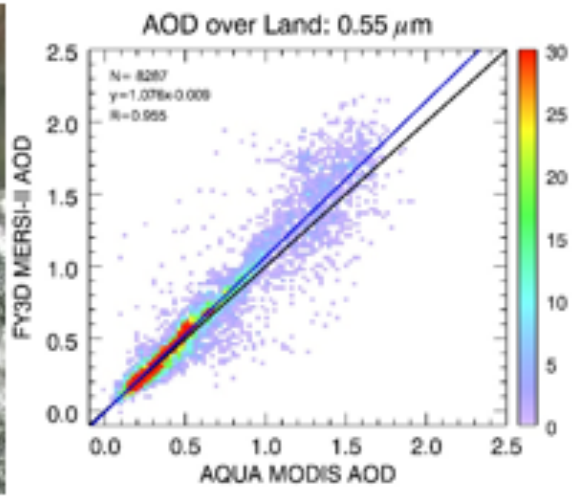


Feb.,03,2018, west Africa



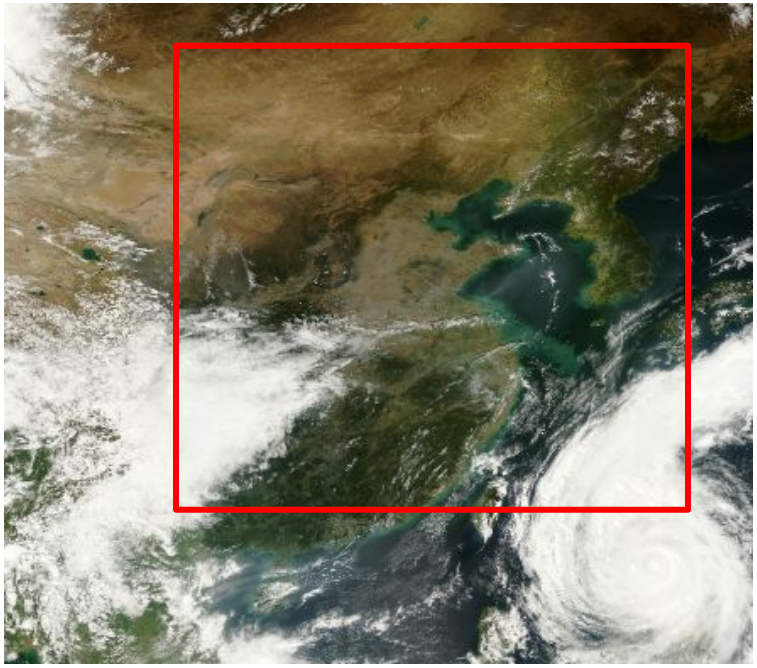


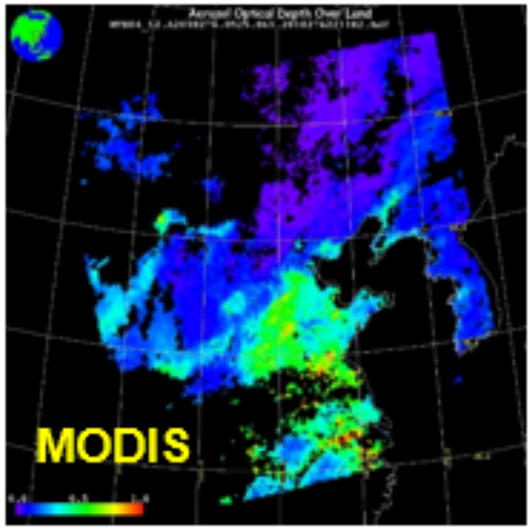


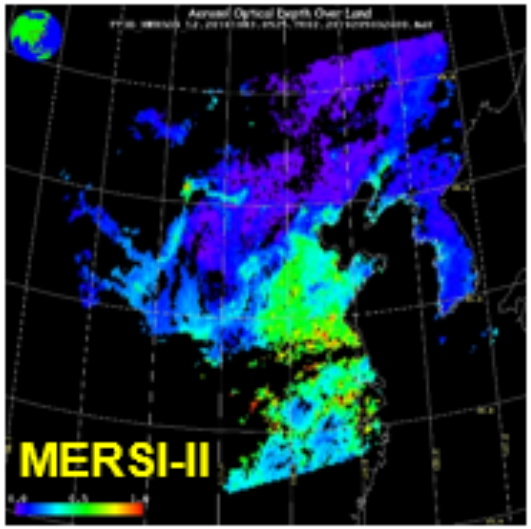


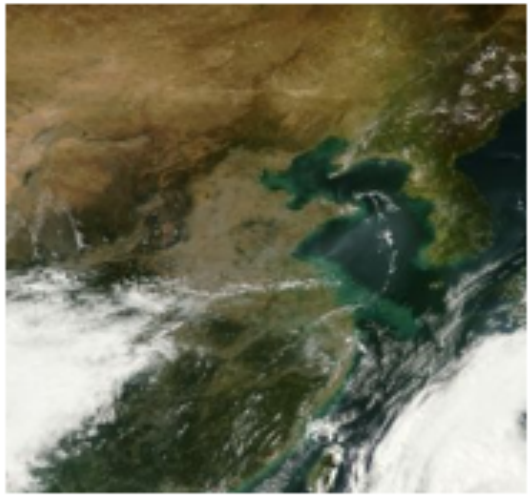
5. Preliminarily test with MERSI-II

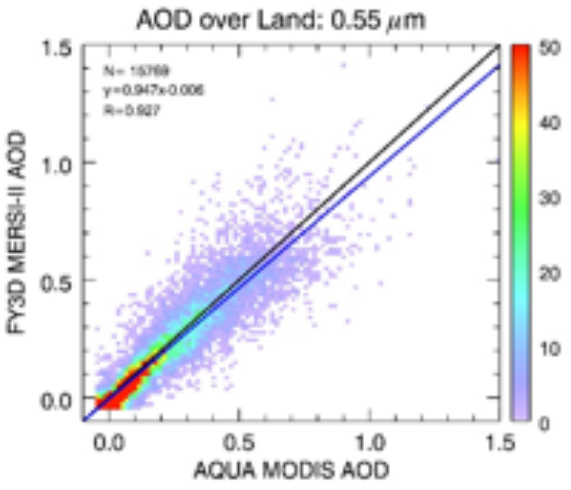
5.2 Example of One granule Retrieval -2









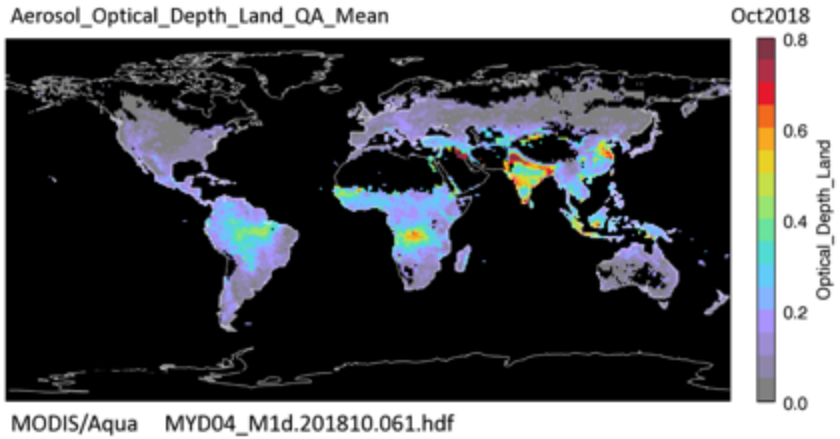


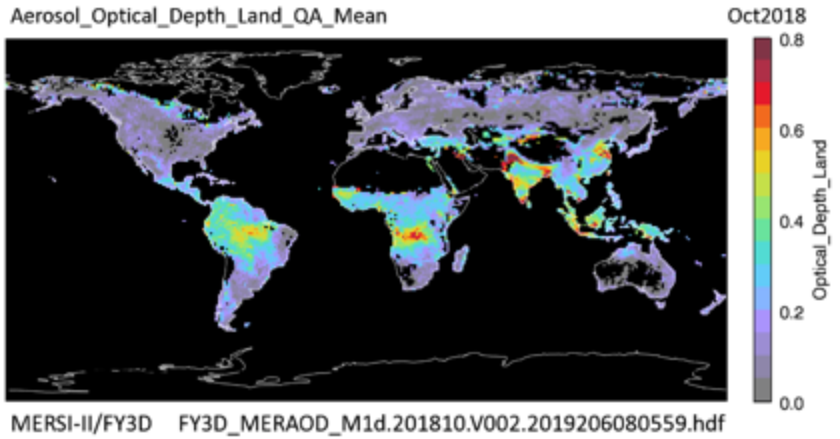
Oct.,03,2018, east China

5. Preliminarily test with MERSI-II

5.3 Month mean

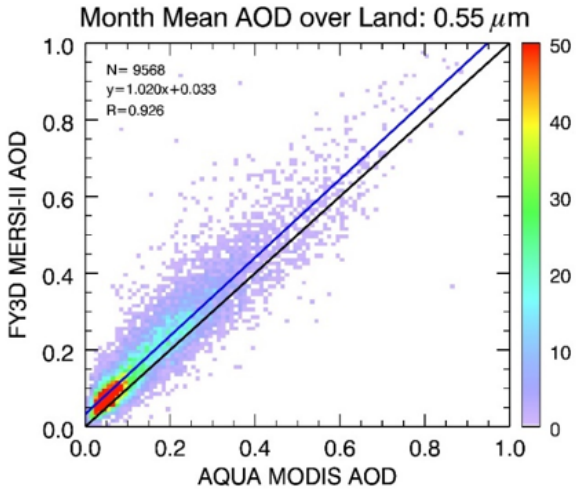
data：Oct., 2018





MODIS/Aqua C61

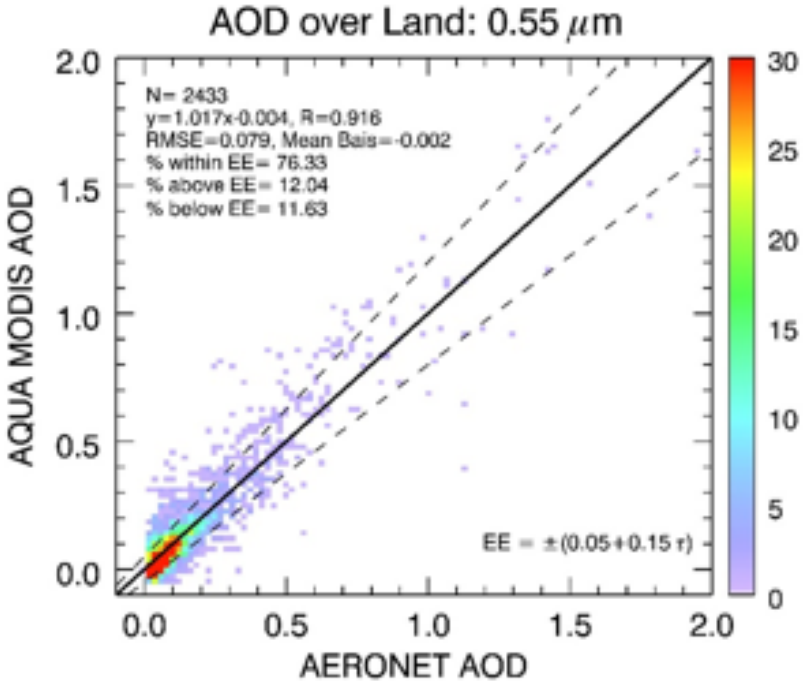
MERSI-II/FY3D

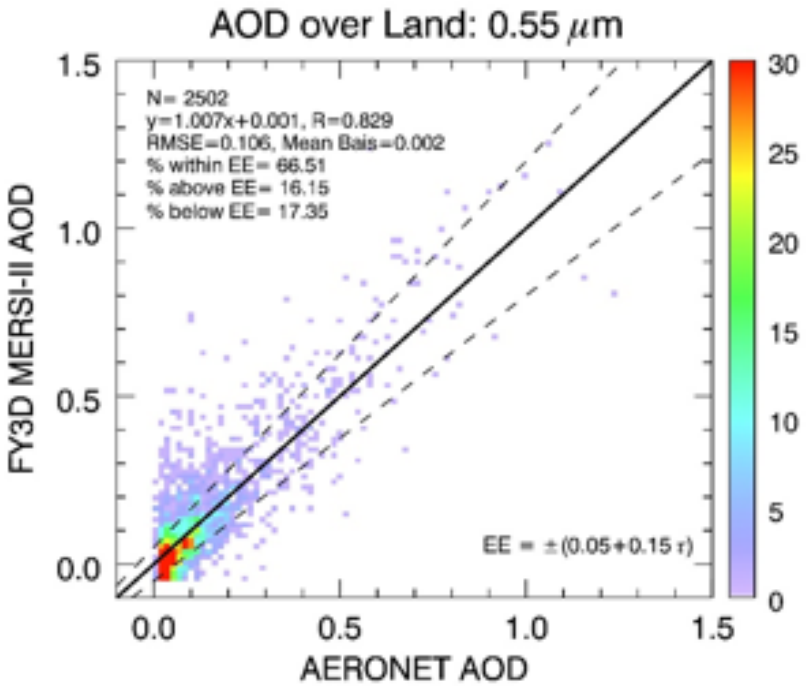


5. Preliminarily test with MERSI-II

5.4 Global validation

data：Oct., 2018





MODIS/Aqua C61

QA=3

MERSI-II/FY3D

Summary

- How about the quantitative ability of MERSI? What do you think about?
- The validation result of AOD from MERSI-I/FY-3C is close to MODIS.
- More efforts are needed for the new sensor MERSI-II/FY-3D, especially calibration and new surface reflectance band ratio. Can MERSI-II catch up with MODIS?

Advancement of PLoarimetric Observations: calibration and improved aerosol retrievals

Merci de votre attention!!!

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Lille, Nov. 04, 2019