风云三号MERSI气溶胶反演定量能力评测

杨磊库

yanglk@hpu.edu.cn / leiku.yang@foxmail.com

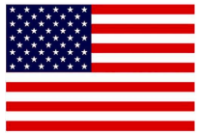
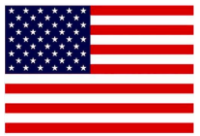
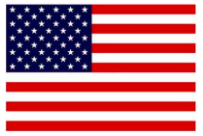
河南理工大学

遥感科学与技术系

提纲：

1. 研究背景
2. 反演算法构建
3. 反演结果验证
4. 月平均结果对比
5. MERSI-II反演初步

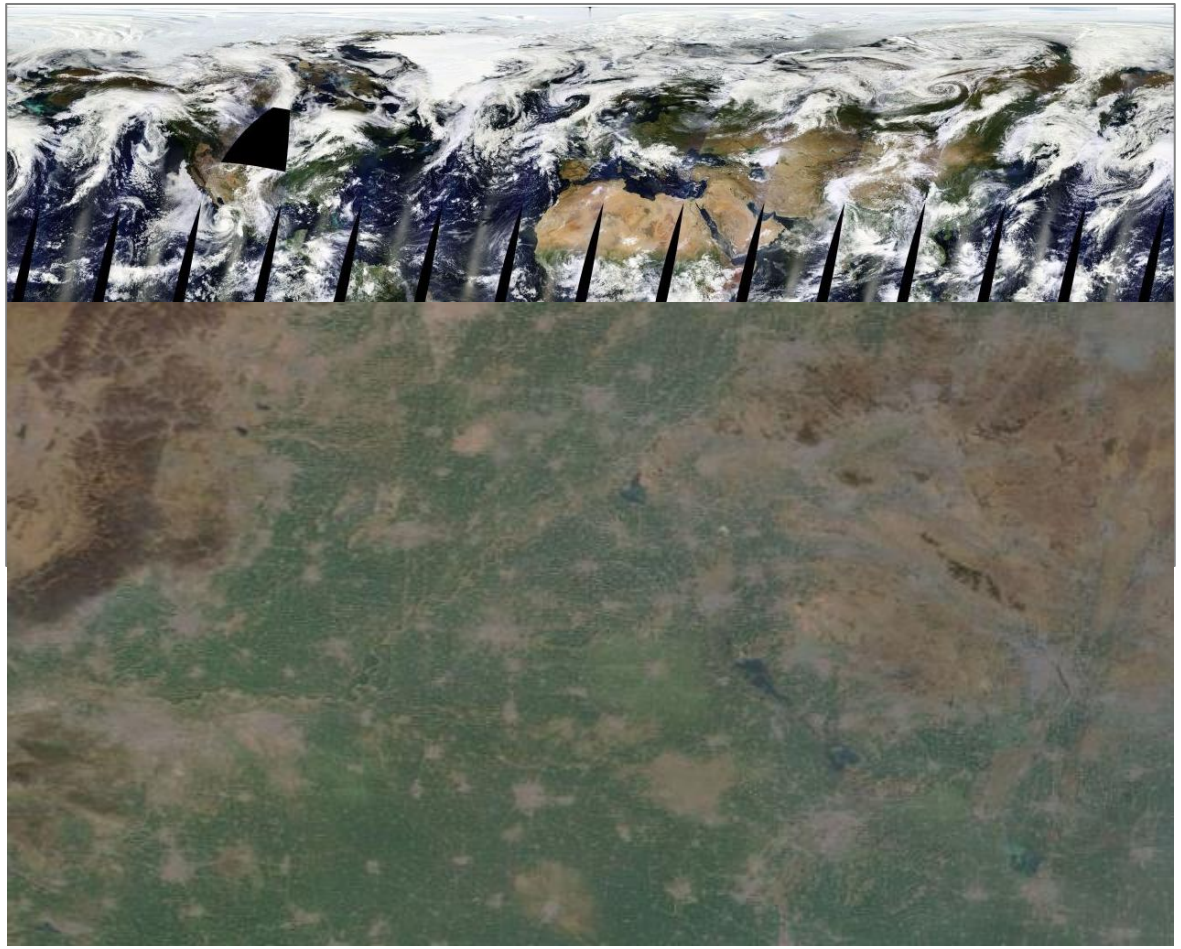
1.研究背景

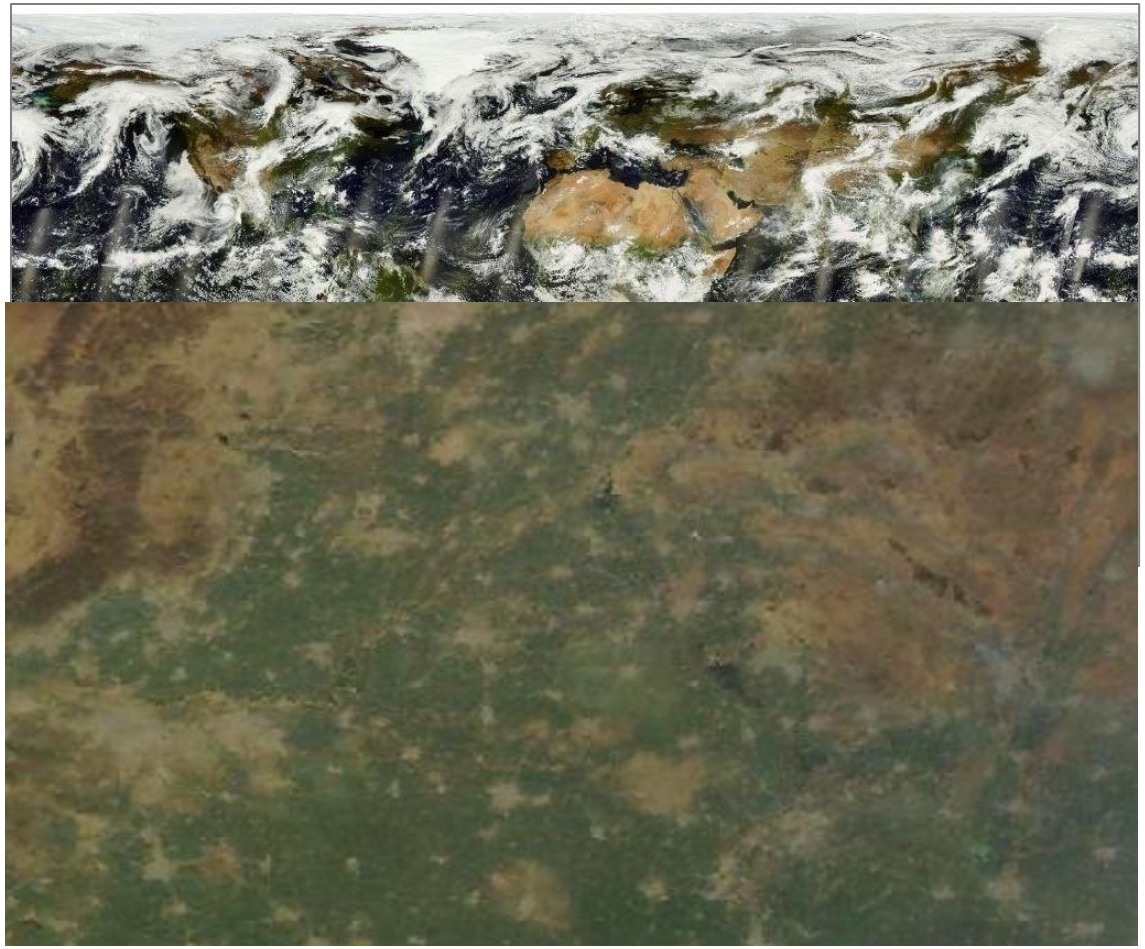
Satellite	TERRA	AQUA	S-NPP	FY-3C	FY-3D
Orbit altitude	705km	705km	825km	836km	836km
Equator crossing time	10:30	13:30	13:30	10:30	13:30
Sensor	MODIS	MODIS	VIIRS	MERSI-1	MERSI-2
Swath width	2330km	2330km	3040km	2916km	2916km
Sensor zenith angle range	±64°	±64°	±70°	±55.4°	±55.4°
Country					

1. 研究背景

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	5	1.38	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	19	1.03	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. 研究背景



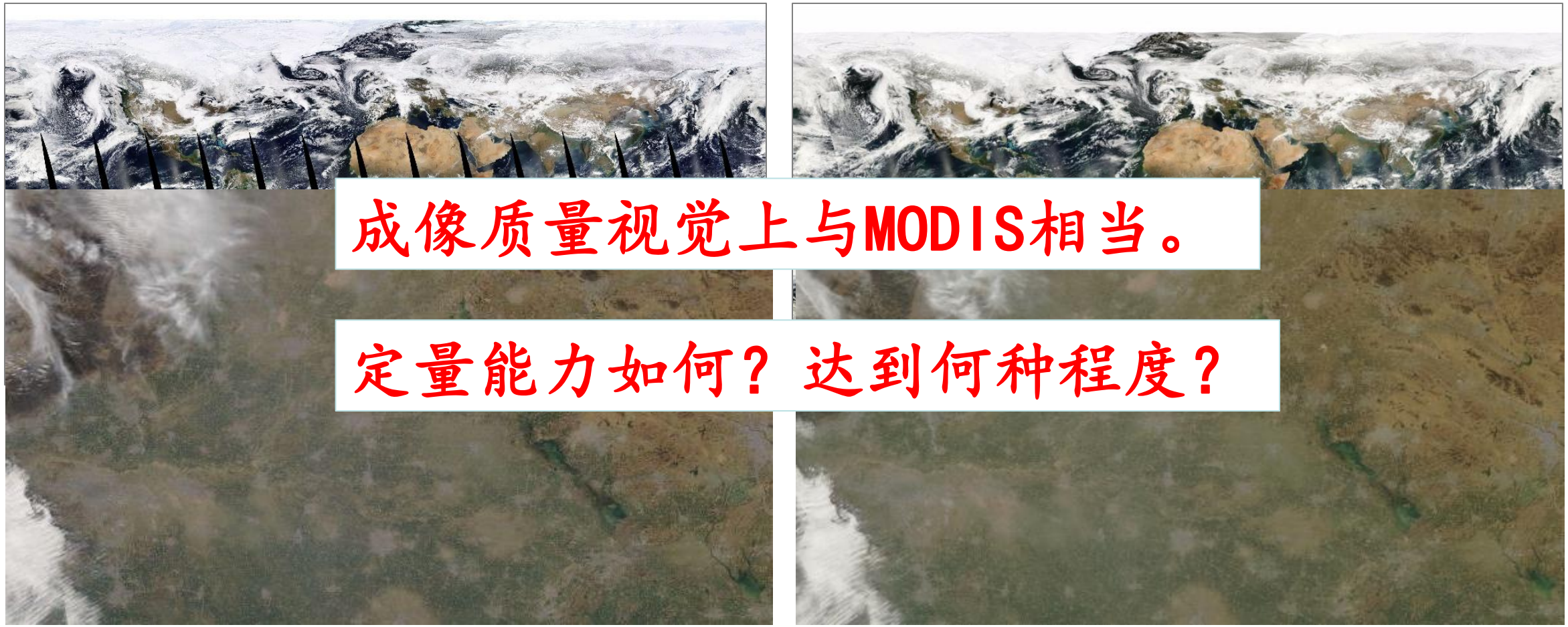


MODIS/TERRA

Sep 05 2014

MERSI/FY3C

1. 研究背景



成像质量视觉上与MODIS相当。

定量能力如何？达到何种程度？

MODIS/AQUA

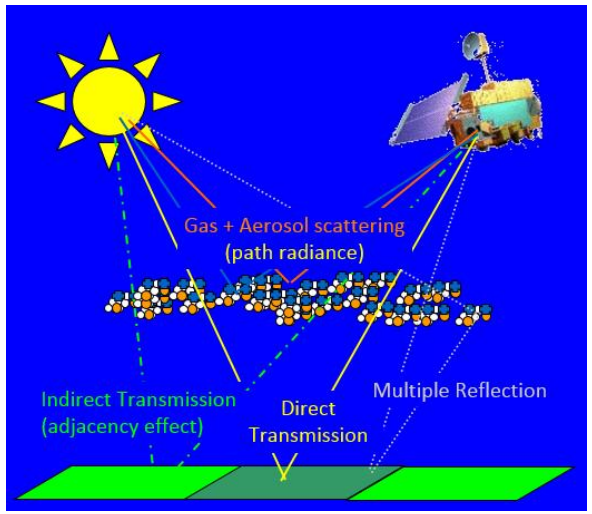
Mar 11 2018

MERSI-II/FY3D

2. 反演算法构建

模型：

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



1）气体吸收订正

2）各种掩膜处理

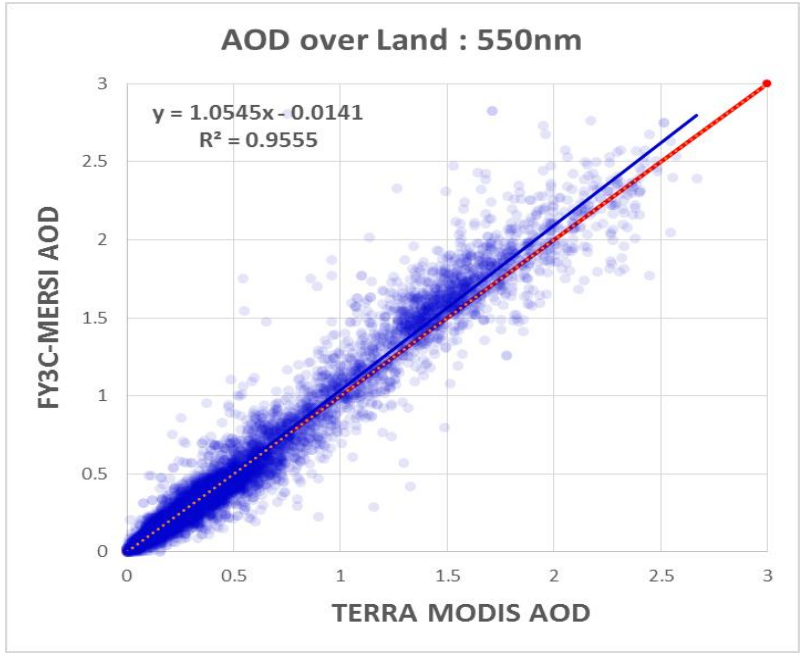
3）地表估计模型

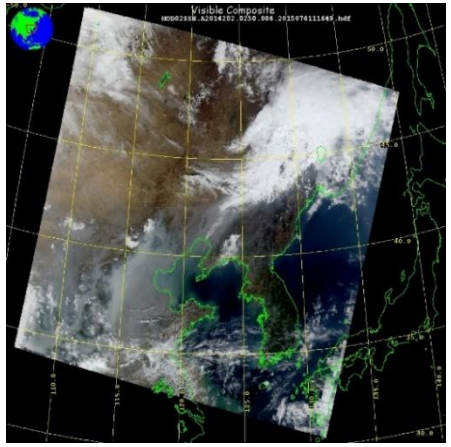
4）查找表的构建

目前尽量与MODIS DT算法保持一致，以便增加可比性

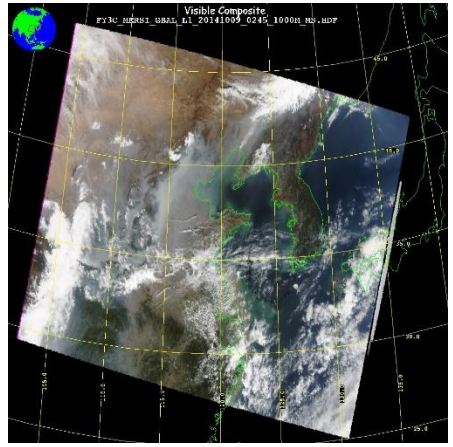
3. 反演结果验证

3.1 单景反演示例

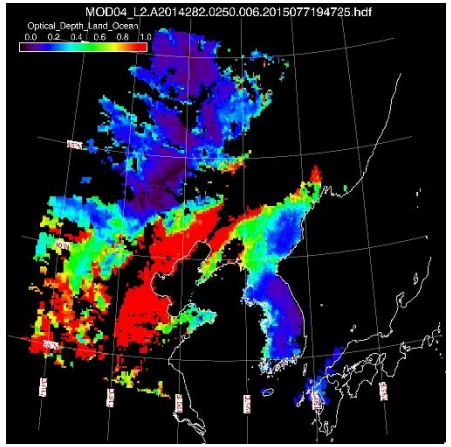




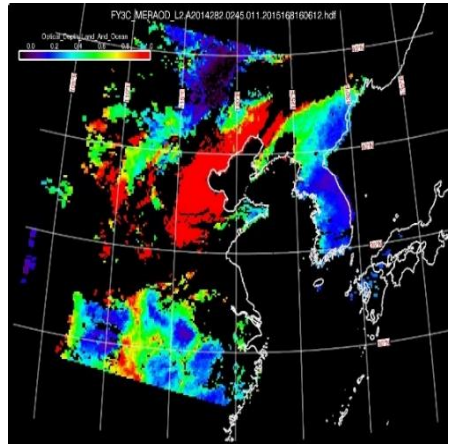
MODIS RGB



MERSI RGB



MODIS AOD



MERSI AOD

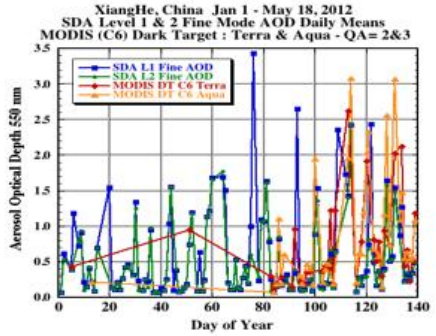
日期： 2014.10.09

3. 反演结果验证

3.1 单景反演示例

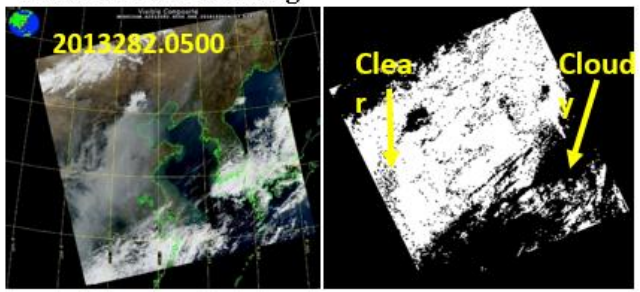
Improving coverage (1)

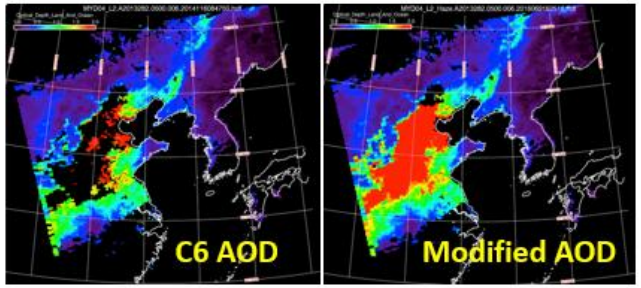
MODIS (C6) misses many AOD events during winter months (AERONET confirms not cloud)



Instead it is the "In-land water mask" that is preventing retrieval over Beijing.

Case study over Beijing area shows that our cloud mask is working





Q: Can we relax masks, but not degrade global retrieval?
A: Maybe: Testing during current KORUS experiment (Korea)

Leiku Yang and Yingxi Shi

参见Robert Levy报告2016

NNH17ZDA001N-TASNPP **Enhanced dark-target aerosol retrieval algorithm**

Enhanced dark-target aerosol retrieval algorithm: The consistent, long term aerosol data record from MODIS, VIIRS and beyond

Proposal submitted to NASA in response to the Research Announcement ROSES 2017, NNH17ZDA001N-TASNPP: Science of Terra, Aqua and Suomi-NPP National Aeronautics and Space Administration, Washington D.C.

Principal Investigator:
Robert Levy (NASA/GSFC/613)
Robert.c.levy@nasa.gov; (301)614-6123

Co-Investigators:
Lorraine Remer, UMBC/GSFC/613
Yingxi Shi, USRA/GSFC/613
Pawan Gupta, USRA/GSFC/614
Falguni Patadia, MSU/GSFC/613
Yaping Zhou, MSU/GSFC/613
Jun Wang, Univ. of Iowa

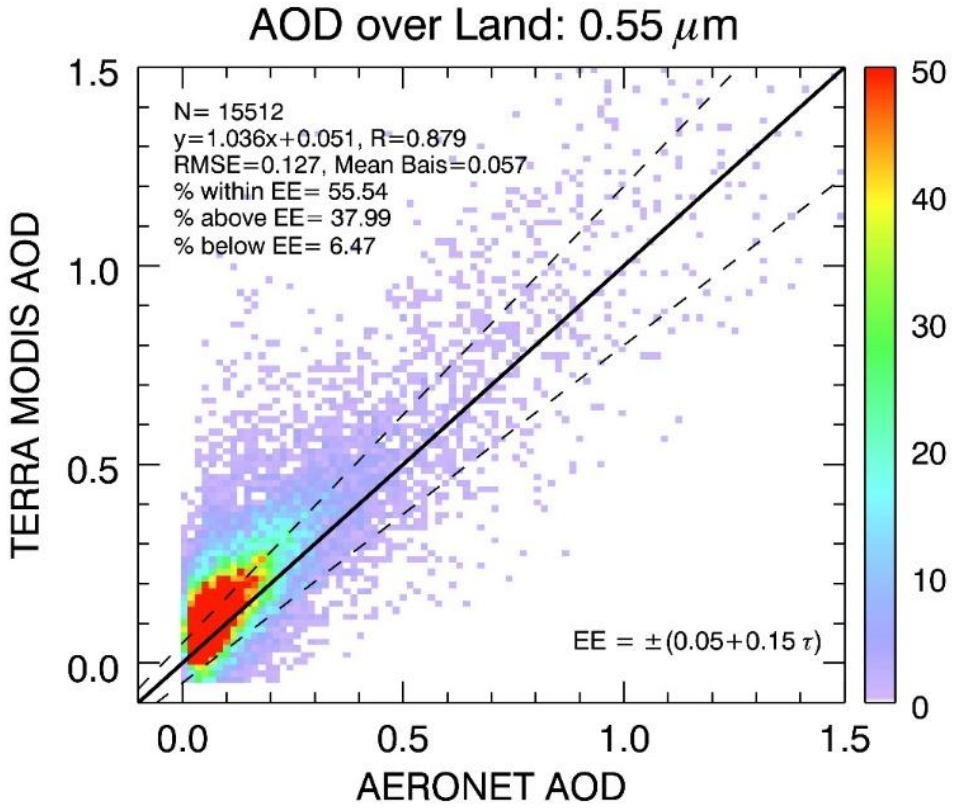
Programming/Support Staff
Shana Mattoo, SSAI/GSFC/613
Virginia Sawyer, SSAI/GSFC/613
Richard Kleidman, SSAI/GSFC/613

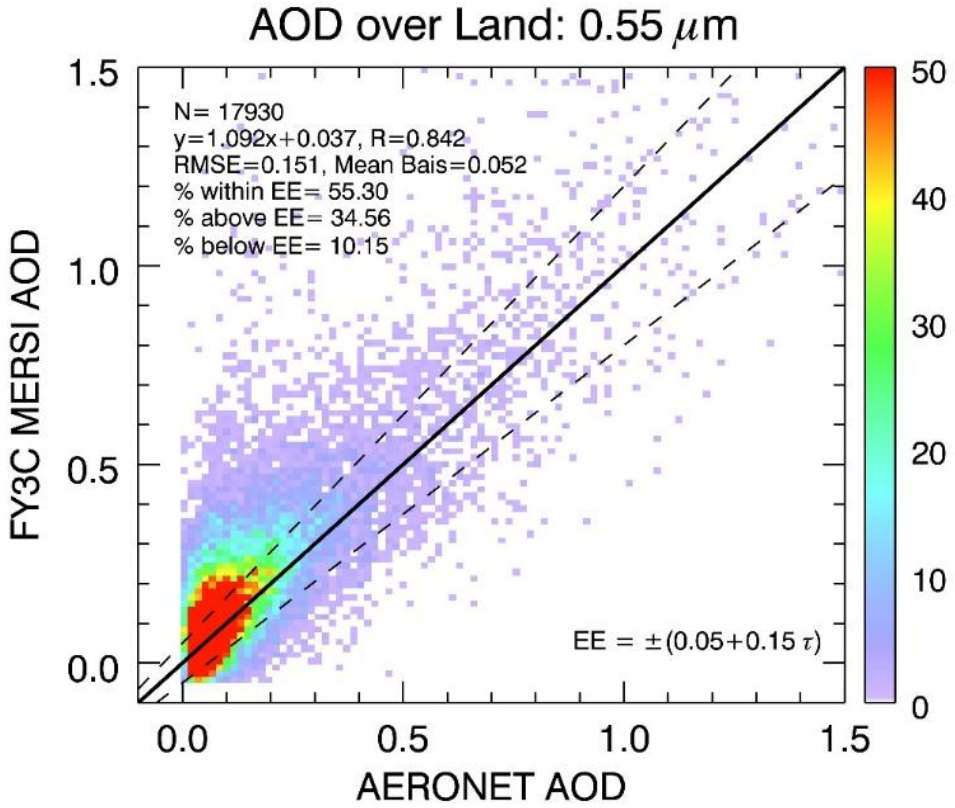
Collaborators:
Alexander Marshak, GSFC/613
Steven Platnick, GSFC/610
Jennifer Wei, ADNet/GSFC/610.2
Thomas Eck, USRA/GSFC/618
Xiaoxiong Xiong, GSFC/618
Edward Masuoka, GSFC/619
Robert Holz, Univ. of Wisconsin-Madison
Oleg Doubovik, University of Lille, France
Antti Lipponen, Finnish Meteorological Institute, Finland
Leiku Yang, Henan Polytechnic University, China

3. 反演结果验证

3.2 全球验证

data：201406~201505



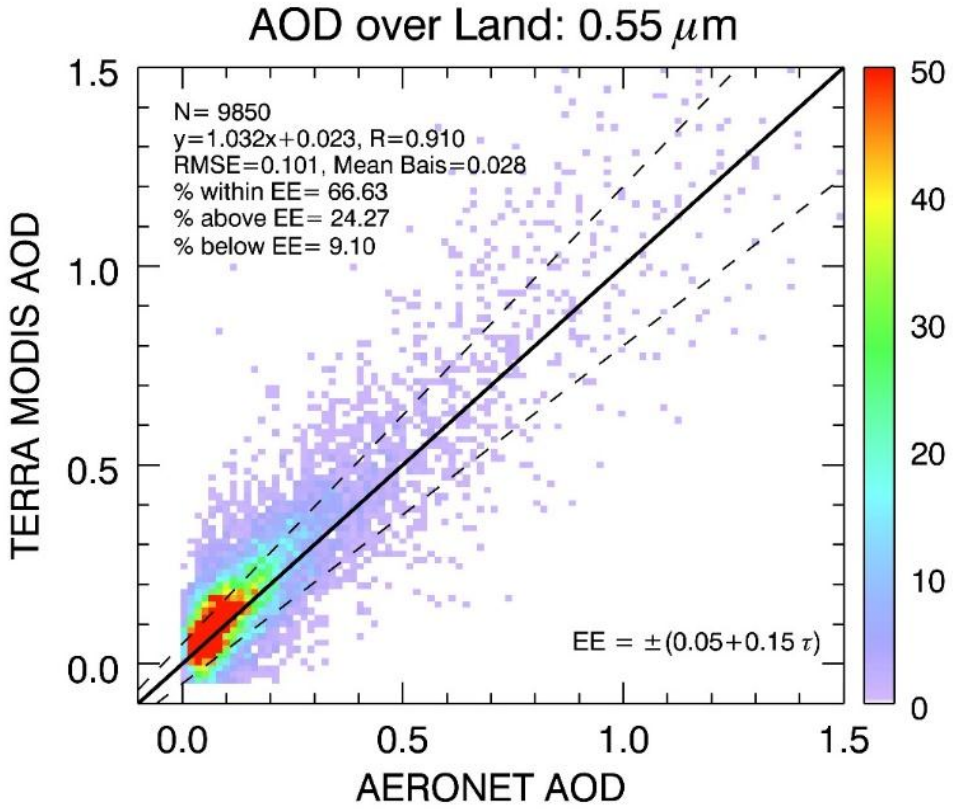


MODIS/TERRA C6　　**QA=All**　　**MERSI/FY3C**

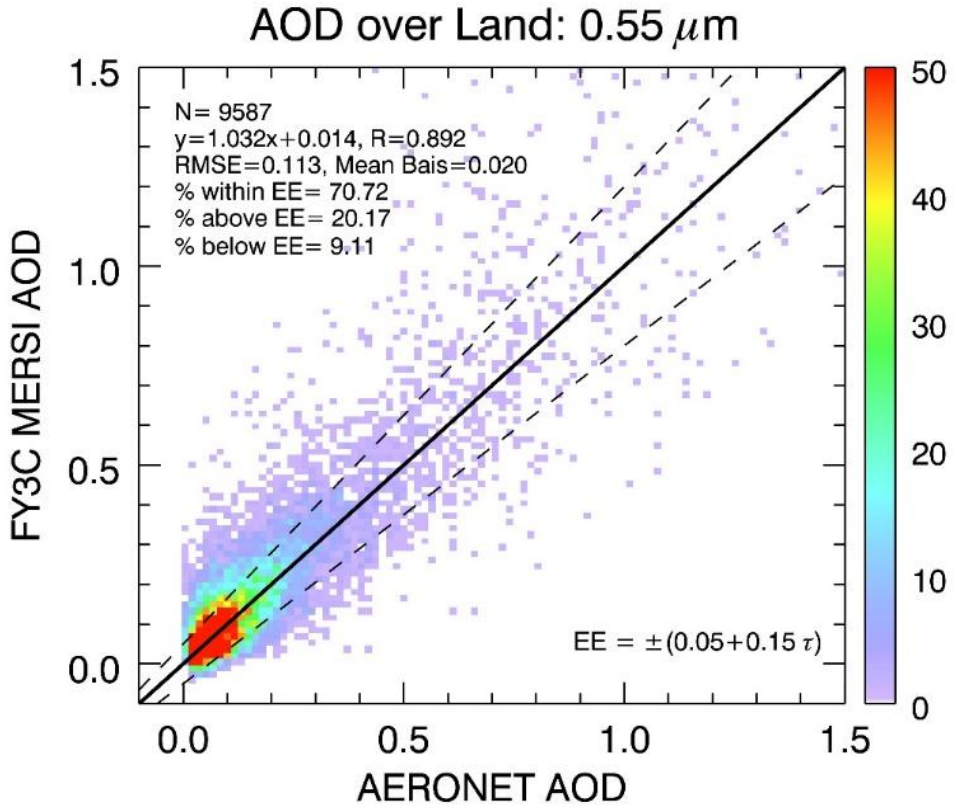
3. 反演结果验证

3.2 全球验证

data：201406~201505



MODIS/TERRA C6



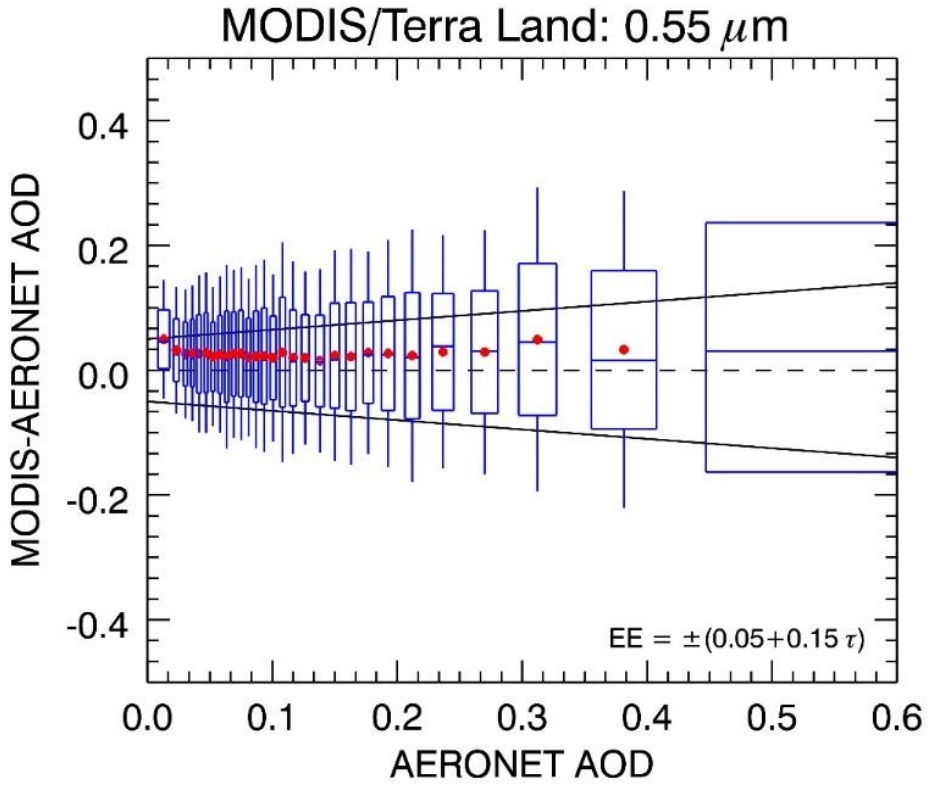
MERSI/FY3C

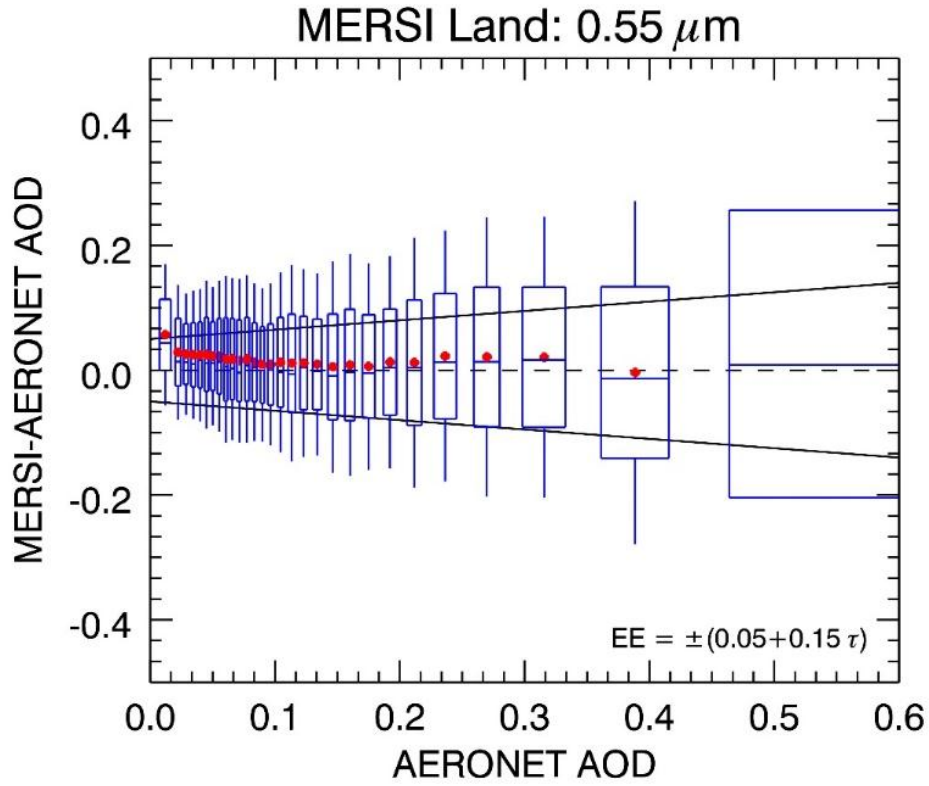
QA=3

3. 反演结果验证

3.2 全球验证

data：201406~201505

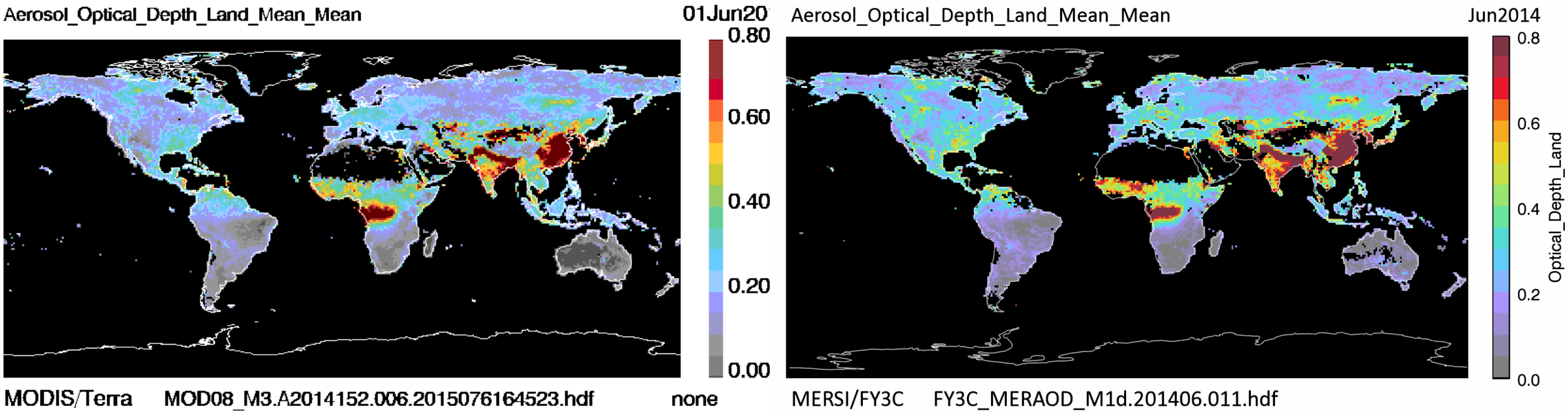




MODIS/TERRA C6 **QA=3** **MERSI/FY3C**

4. MERSI与MODIS月平均对比

1）AOD_Month_Mean (有动画…)



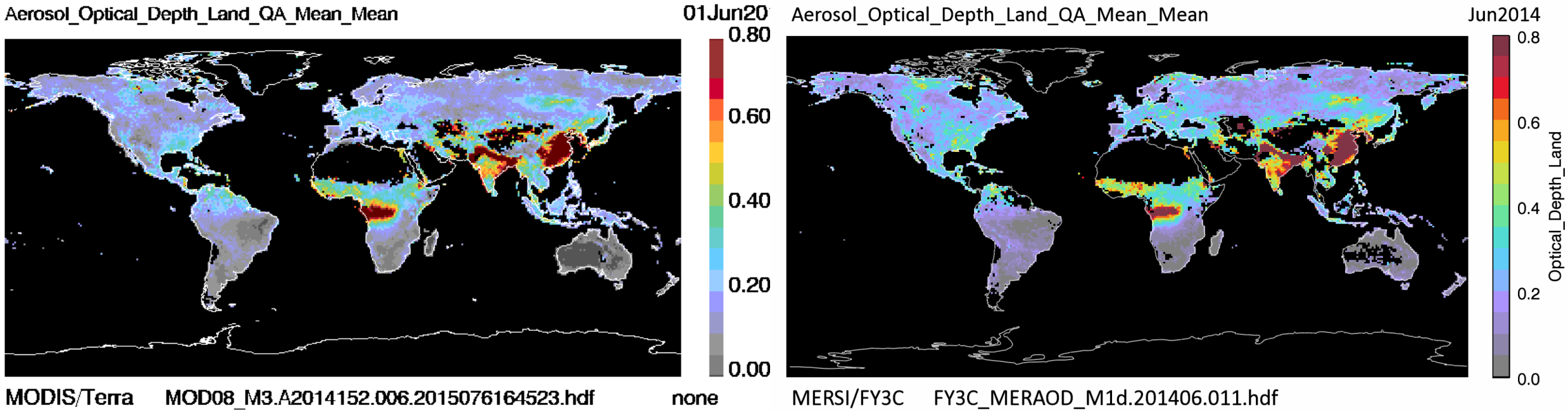
MODIS/TERRA

MERSI/FY3C

QA=All

4. MERSI与MODIS月平均对比

2）AOD_Month_QA_Mean (有动画...)



MODIS/TERRA

MERSI/FY3C

QA=1、2、3

国际评价

Re: Recent work: FY-3C MERSI Land Aerosol Retrieval Using DTalgorithm ☆

发件人：**Robert Levy** <robert.c.levy@nasa.gov>
时　间：2017年10月12日(星期四) 凌晨1:56
收件人：Leiku Yang <leiku.yang@foxmail.com>
抄　送：Shi, Yingxi <yingxi.shi@nasa.gov>
附　件：1 个 (FY3C_MERSI_AOD_Leiku.yang.ppt)　　纯文本 |

HI Leiku,

I decided to also share with Yingxi.

That is awesome! I am impressed you got things to agree so well. When we try to port algorithm to other sensors, we get offsets. Even just Terra vs Aqua. But your MERSI looks less biased than our Terra, which also agrees better than Aqua. Our current collocation methods maybe a little different (what are yours?) but I think we will get the same result. (Terra doesnâ€™t quite meet EE over land).

The global maps are consistent as well. Except there appear to be a few more â€œholesâ€ in the MERSI output than MODIS (South America, Asia). What is the spatial resolution of the Level 2 product?

Do you do over-ocean as well?

-Rob

向你们致敬！

为风云卫星付出的全体(几代)同仁

5. MERSI-II反演初步

5. MERSI-II反演初步

5.1 算法调整

1）Snow/Ice mask: $NDSI_{0.86\sim2.13} < 0.05 \ and \ Temp1100 < 285K$

2）Cirrus mask: 1.38μm加入

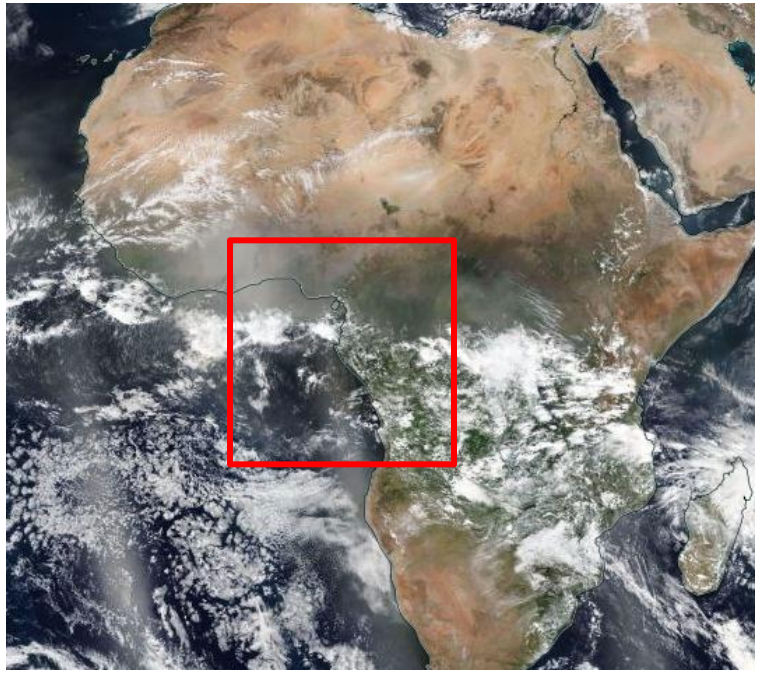
$$\rho^{*}_{1.38} > 0.03 \ or \ \sigma_{1.38} > 0.003$$

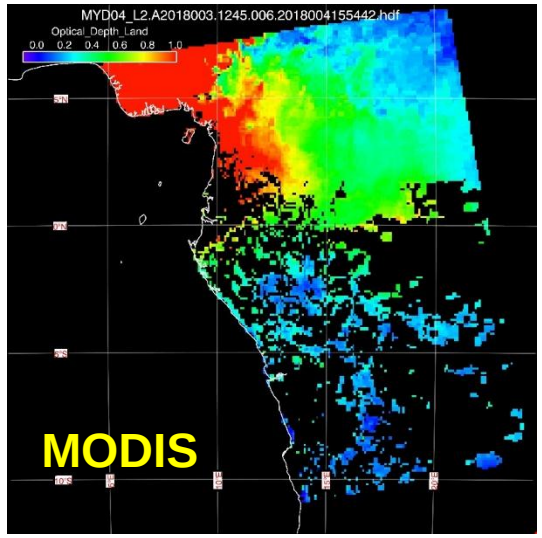
3）地表比值模型:

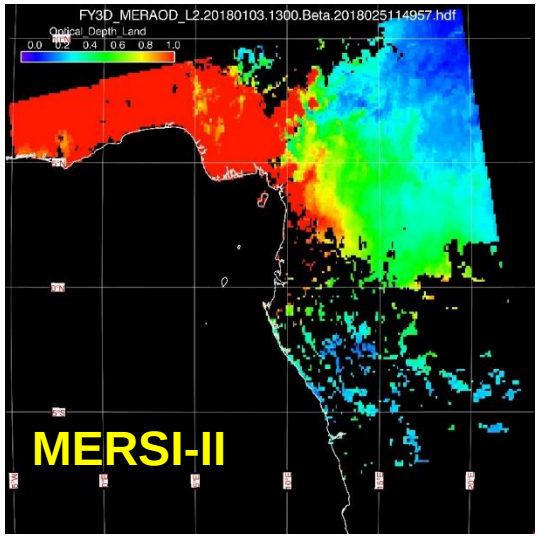
$$\begin{cases} \rho^{s}_{0.65} = f(\rho^{s}_{2.12}) = 0.5 * \rho^{s}_{2.12} \\ \rho^{s}_{0.47} = g(\rho^{s}_{0.65}) = 0.5 * \rho^{s}_{0.65} \end{cases}$$

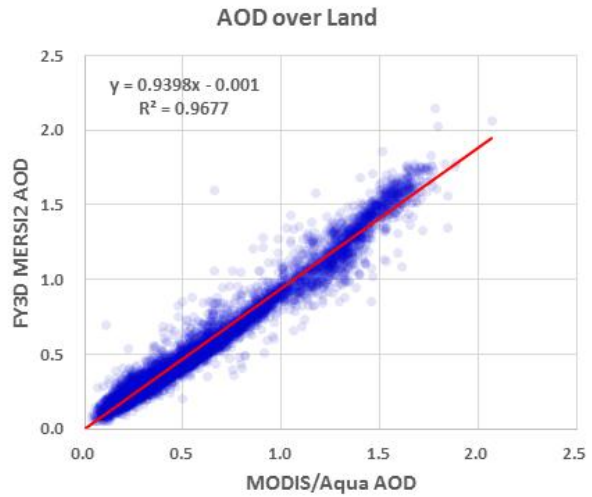
5. MERSI-II反演初步

5.2 单景反演示例-1



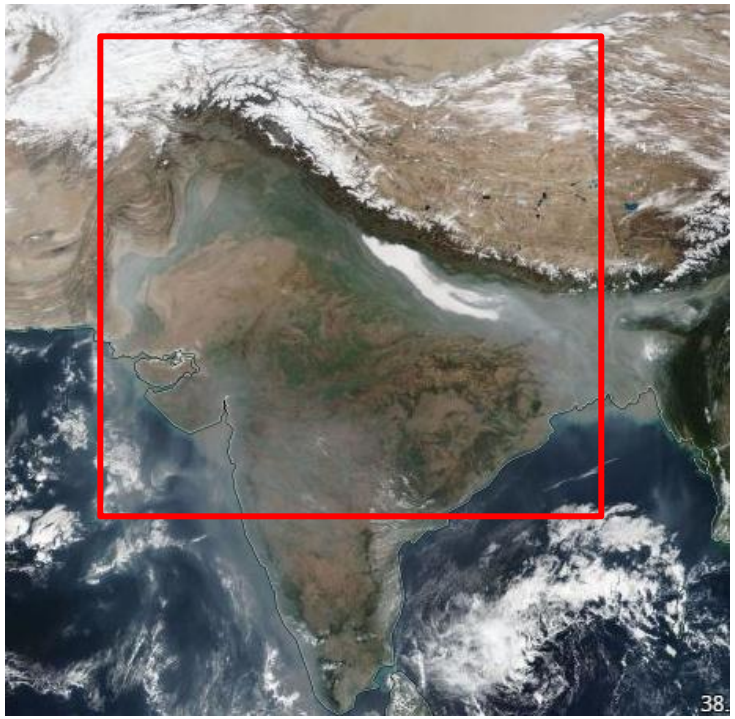


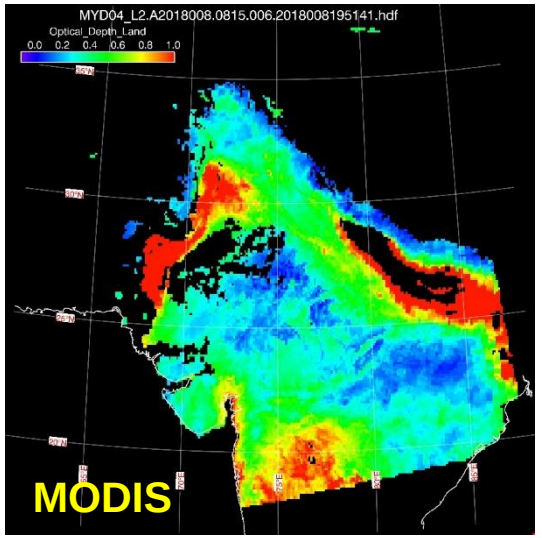


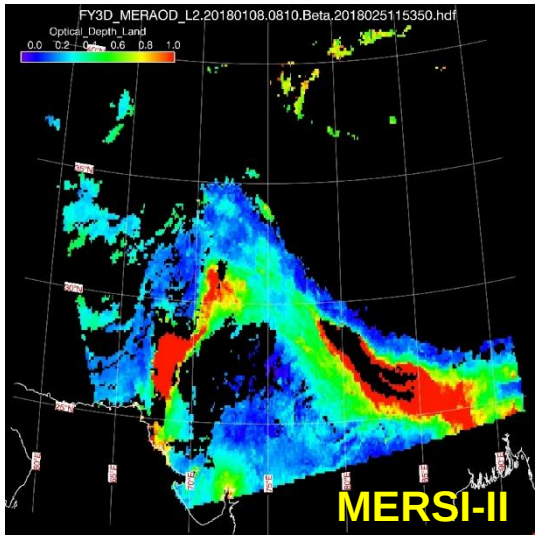


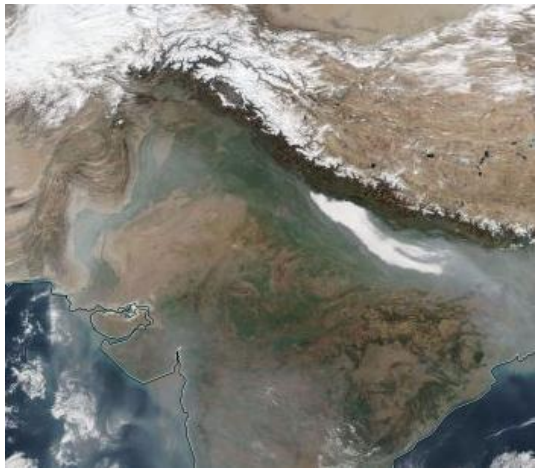
5. MERSI-II反演初步

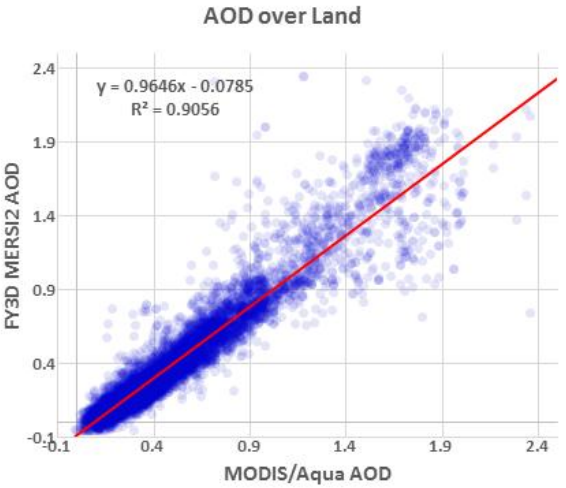
5.2 单景反演示例-2







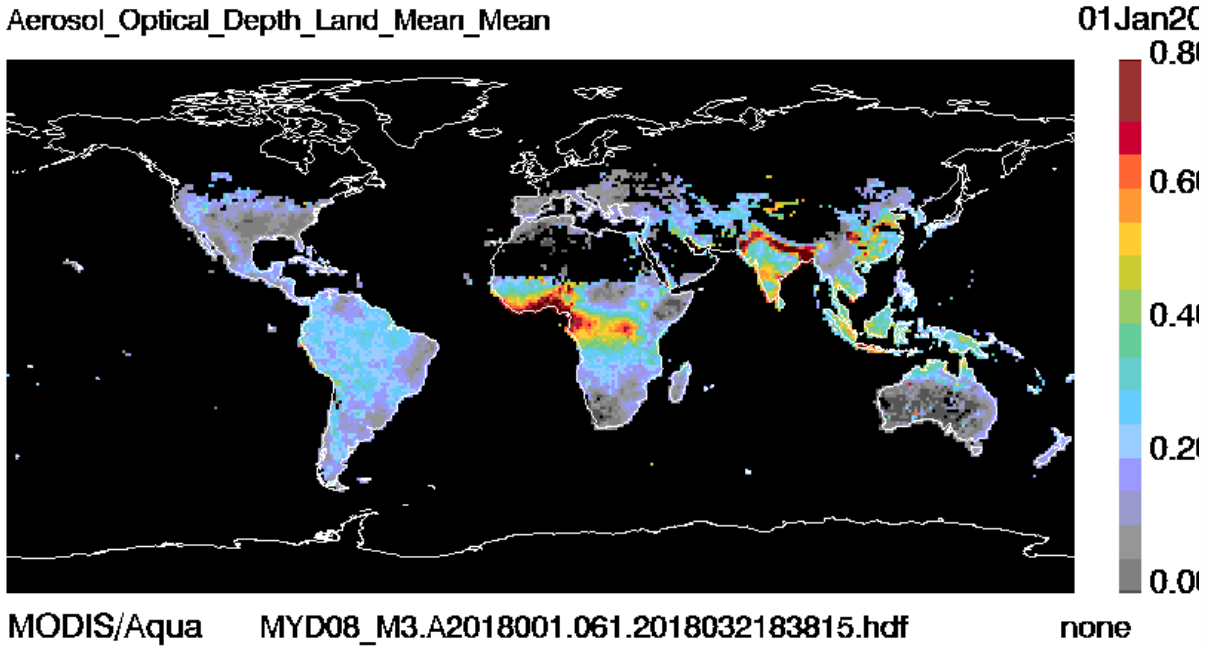


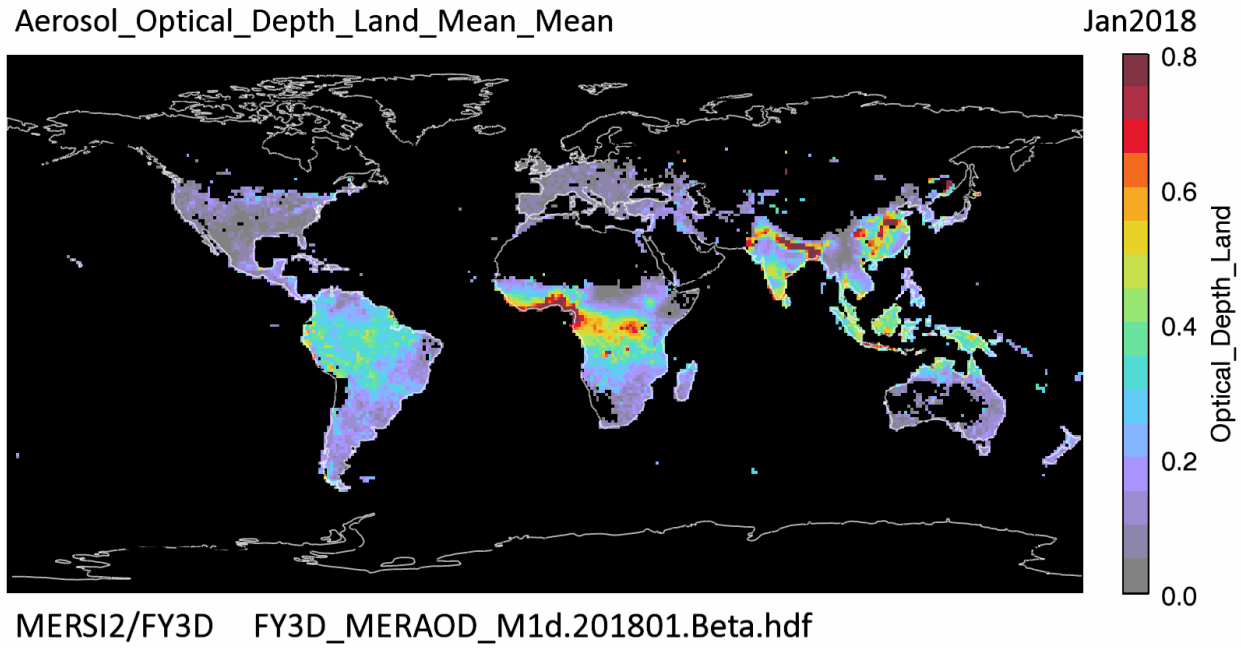


5. MERSI-II反演初步

5.3 月平均结果对比

data：201801~05





MODIS/Aqua C61

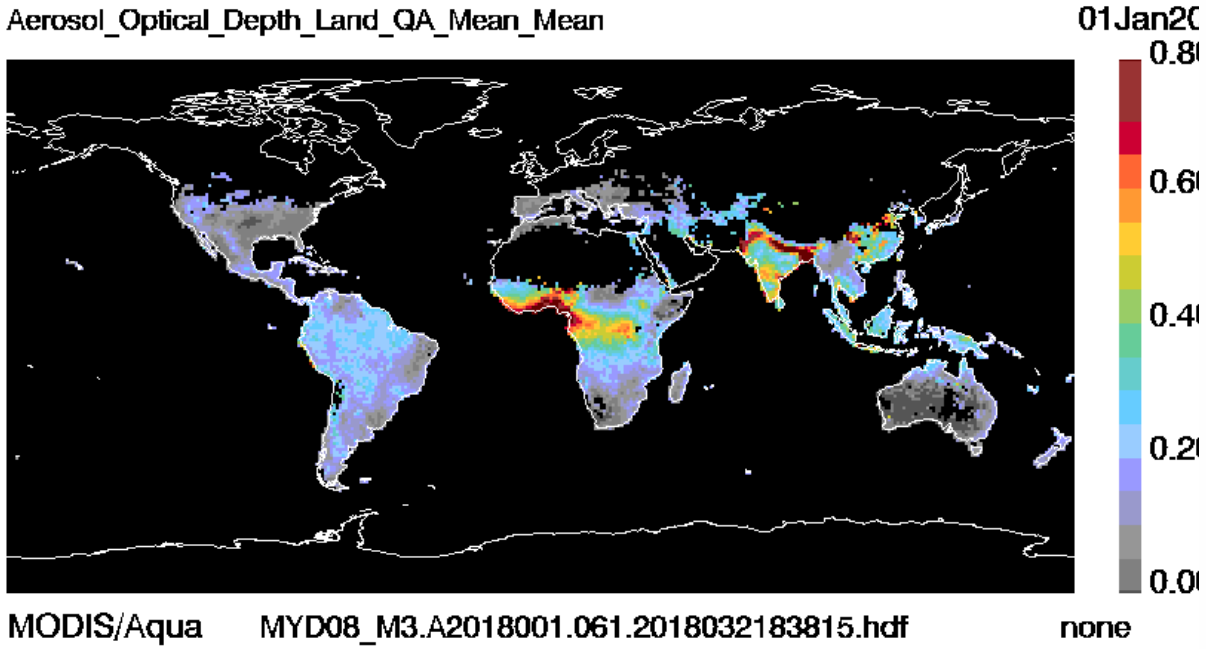
MERSI-II/FY3D

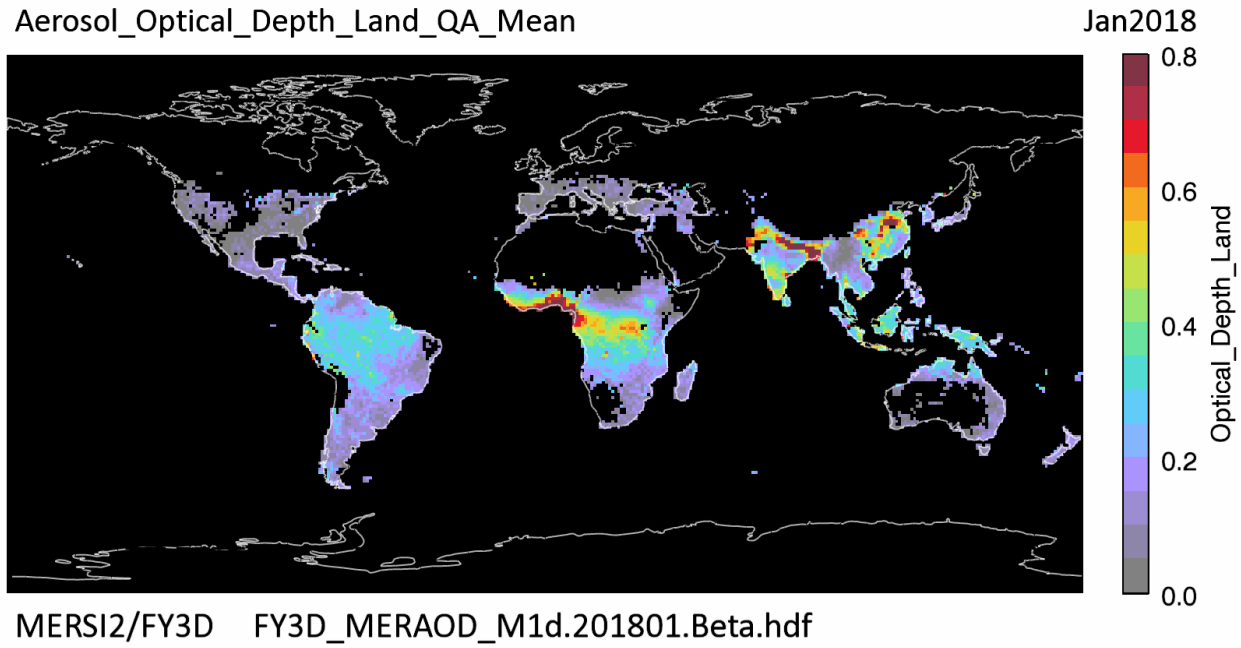
QA=All

5. MERSI-II反演初步

5.3 月平均结果对比

data：201801~05





MODIS/Aqua C61

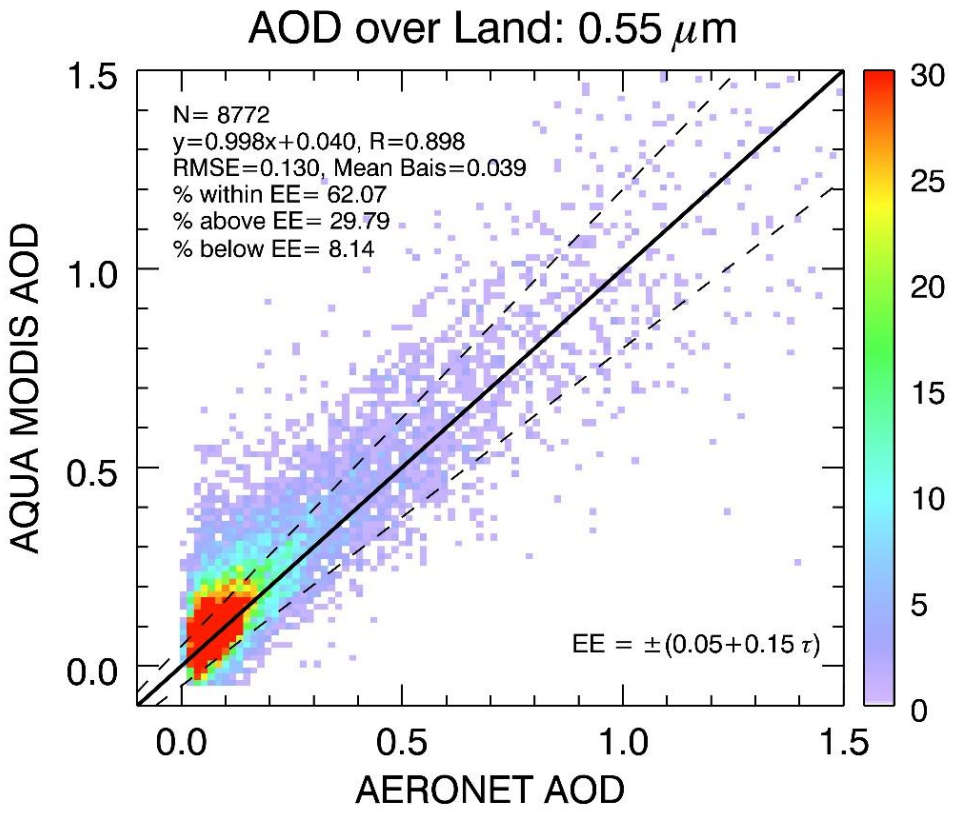
MERSI-II/FY3D

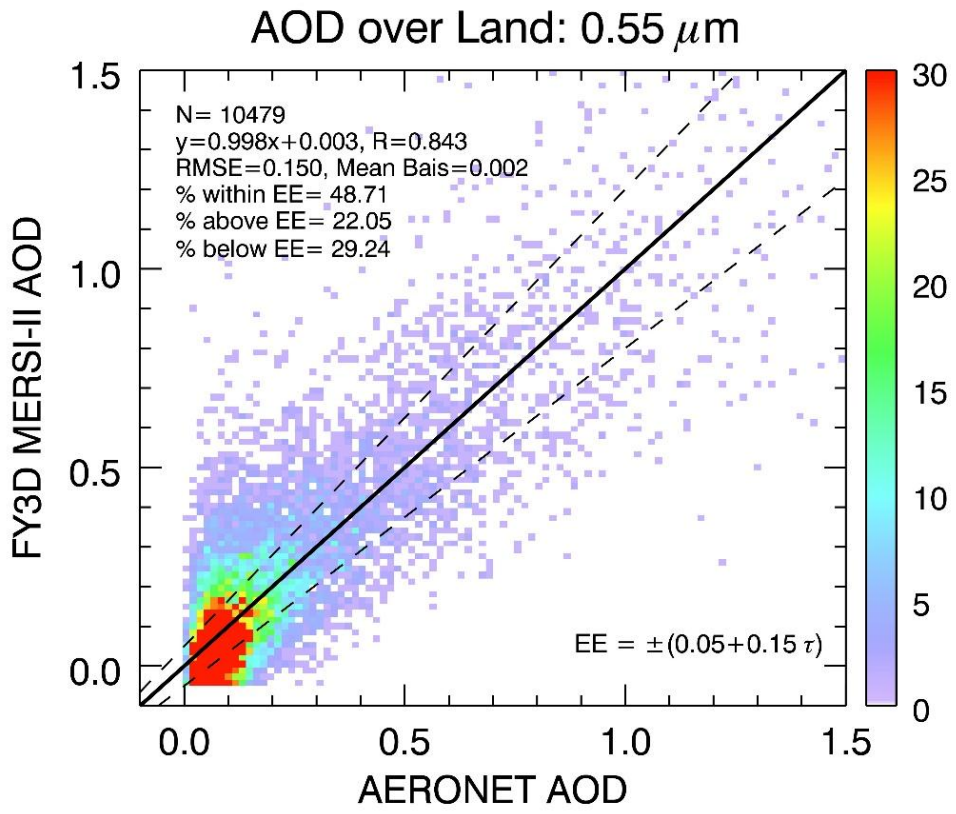
QA=1、2、3

5. MERSI-II反演初步

5.4 全球结果初步验证

data：201801~05



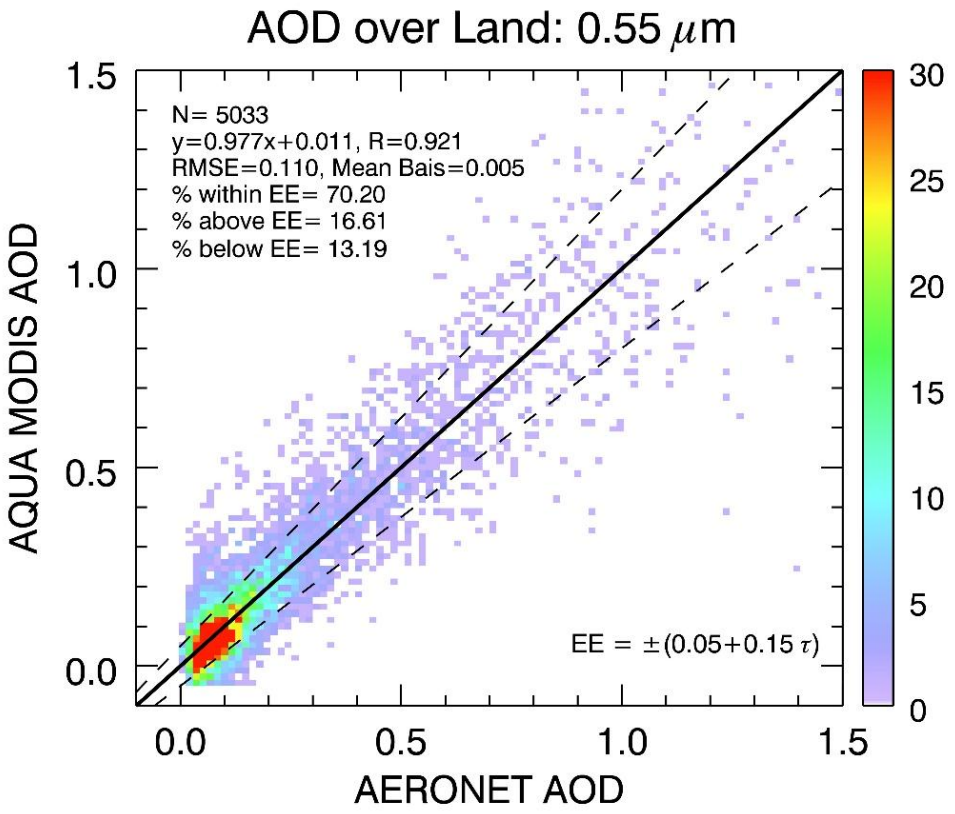


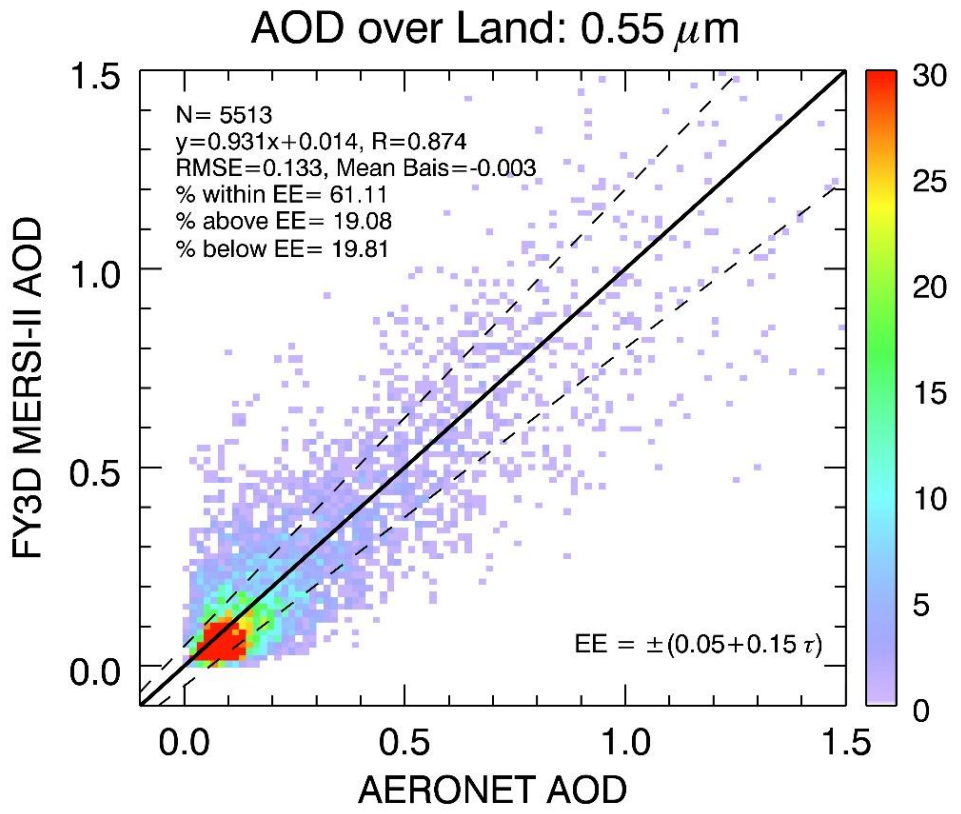
MODIS/Aqua C61 **QA=All** **MERSI-II/FY3D**

5. MERSI-II反演初步

5.4 全球结果初步验证

data：201801~05

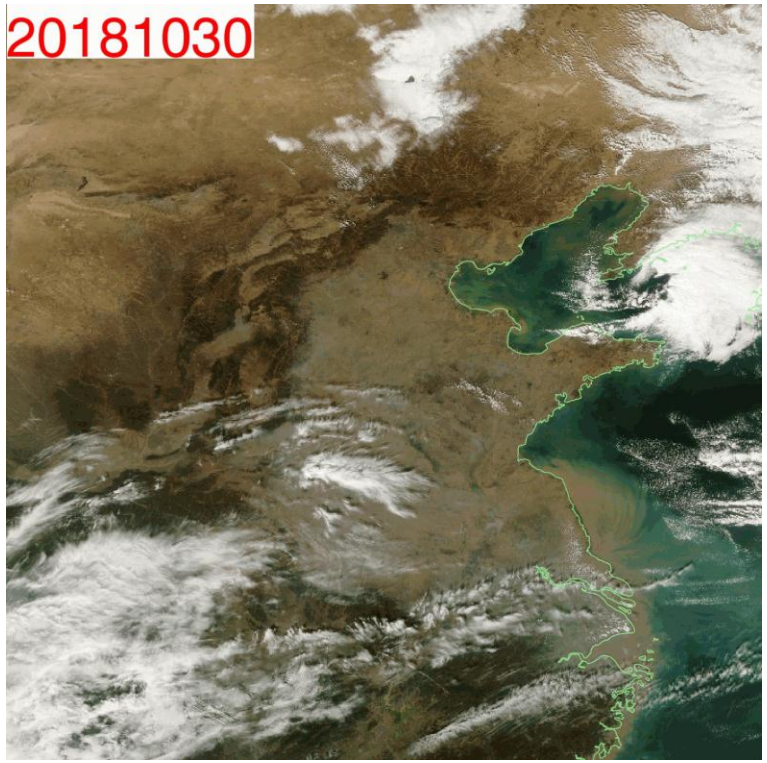




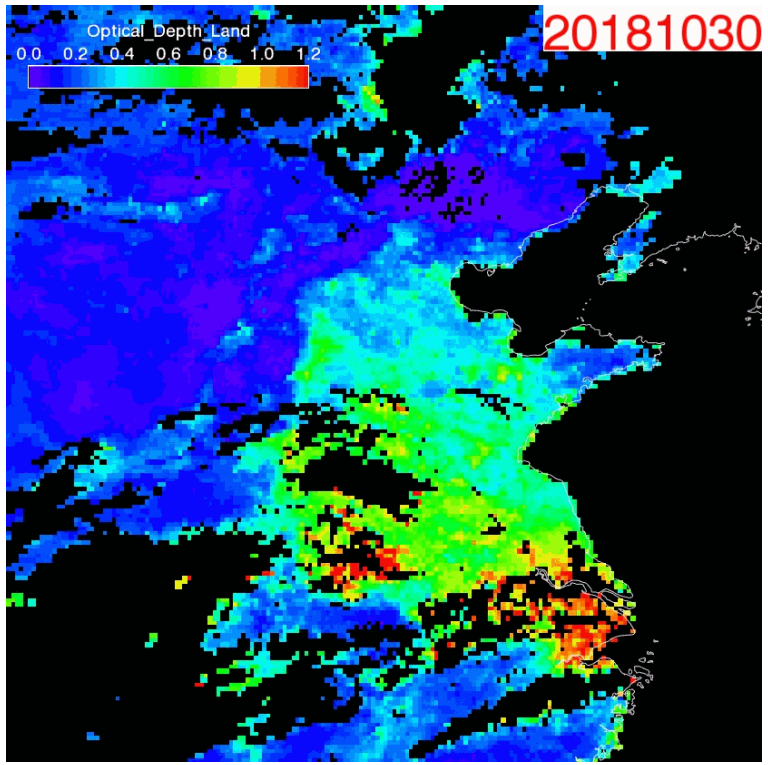
MODIS/Aqua C61 **QA=3** **MERSI-II/FY3D**

5. MERSI-II反演初步

最近的一次雾霾事件（10.30～11.03）

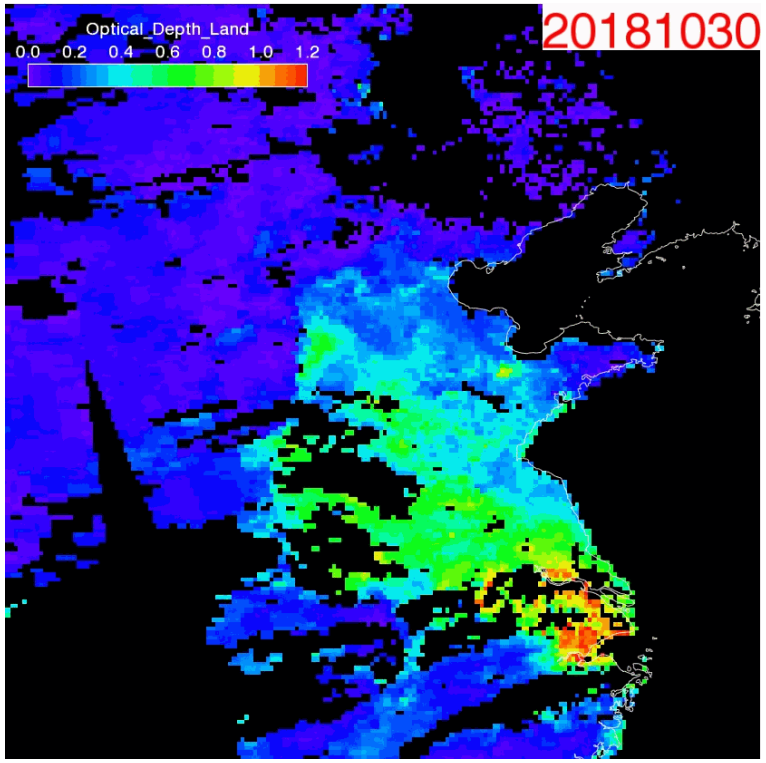


MERSI-II/FY3D RGB



MERSI-II/FY3D AOD

11.4号成图



MODIS/AQUA AOD

产品上线时间11.7上午

总结与一点感想

- 仪器性能+算法→产品。。。
- 科学→技术。。。
- 发挥国产。。。

目标、使命、责任

让我们一起携手!

杨磊库

yanglk@hpu.edu.cn / leiku.yang@foxmail.com

河南理工大学

遥感科学与技术系