FY-3/TOU inter-comparison with MetopB/GOME-2 and NPP/OMPS

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1 Introduction

TOU: 2008(FY-3A), 2010(FY-3B), and 2013(FY-3C)

Band	Central wavelength (nm)	Band width (nm)
1	308.727	1.164
2	312.638	1.152
3	317.652	1.171
4	322.464	1.156
5	331.375	1.159
6	360.253	1.140

Spatial resolution:~ 50 km×50 km

NPP/OMPS-NM

Spatial resolution:~ 50 km×50 km

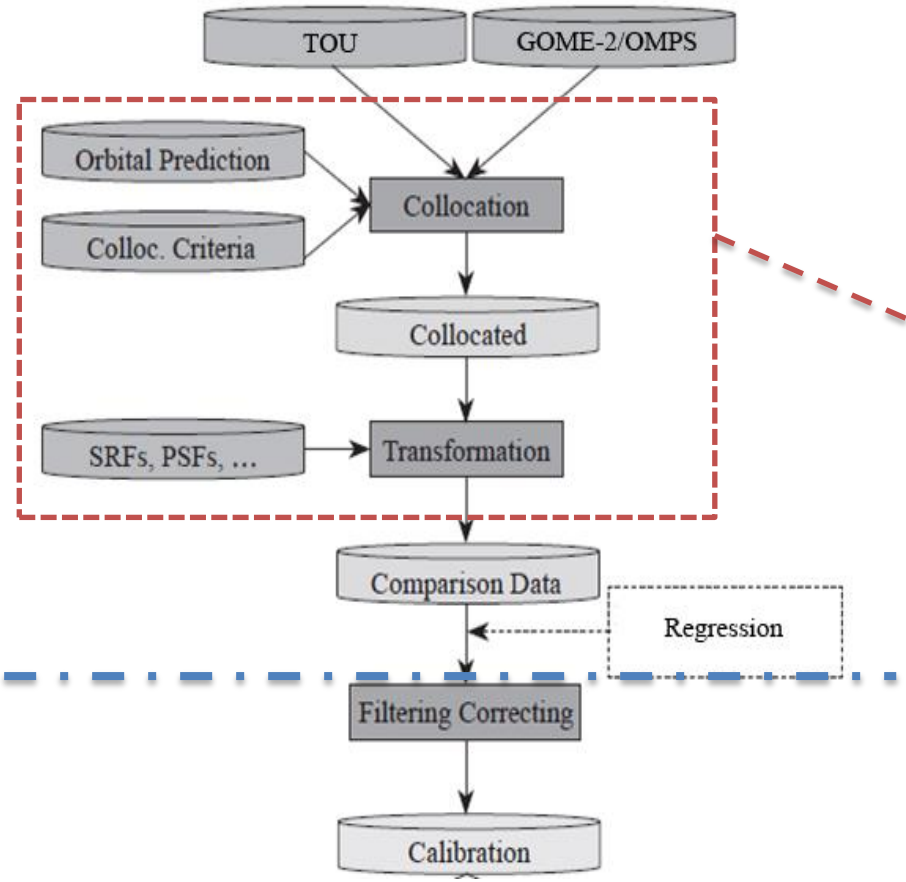
Band	Range (nm)	FWHM (nm)	Sample (nm)
1	300-380	1	0.4

MetopB/GOME2

Spatial resolution:~ 40 km×80 km

Band	1A	1B	2A	2B	3	4	PDM 5/6
Spectral range (nm)	240-383	283-309.7	--	309.8-397.7	397.7-598.4	598.4-790	290-790
Resolution (nm)	0.29	0.29	0.28	0.28	0.55	0.5	2.9-37
Sample interval (nm/pixel)	0.07	0.07	0.09	0.09	0.2	0.2	4

2 Methodology



(1) Orbit Forecast (SGP): < 5 min — Satellite

(2) Temporally Concurrent: <5 min — Pixel observation time

(3) Location Matching: <25 km — Pixel center

(4) Geometrically Aligned — Viewing geometry

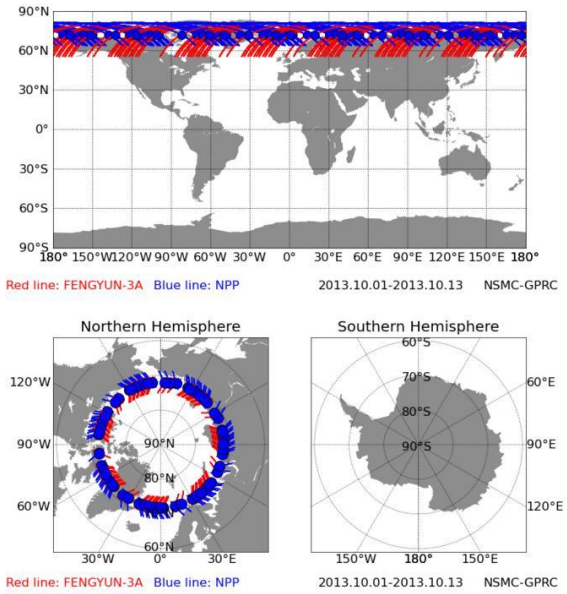
(5) Spatial Collocated (Uniformity estimation)

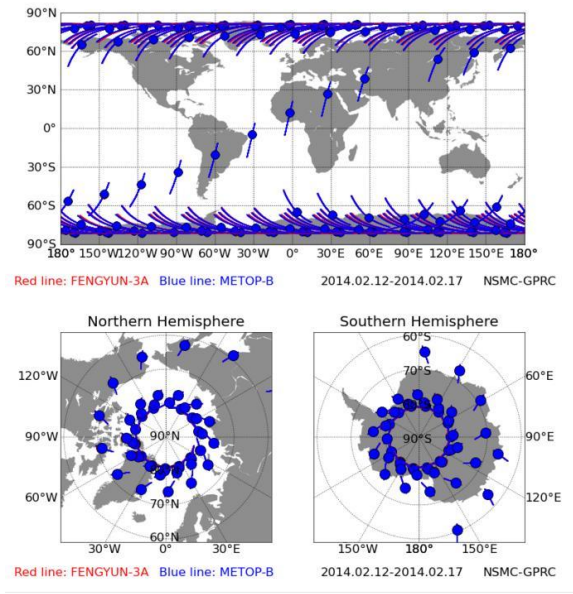
(6) Spectral Consistent — Convolution

2 Methodology

(1) Orbit Forecast (SGP model：Simplified General Perturbations): <5 min

Data: 20130930-20161231





TOU vs OMPS

- Crossing period :~ 5 months

TOU vs GOME2

- Crossing Circle: 40-50 days
- Points number:~ 50-60

2 Methodology

(2) Temporally Concurrent

- Compute observation time for each pixel of TOU, OMPS, and GOME-2
- Difference of observation time between two pixel <5 min

(3) Location Matching

- Compute central location for each pixel of TOU, OMPS, and GOME-2
- Distance between two pixel <25 km (half pixel)

(4) Geometrically Aligned

$$\left|\frac{\cos(\theta_1)}{\cos(\theta_2)} - 1\right| < 0.01 \leftrightarrow \text{<0.5 pixel}$$

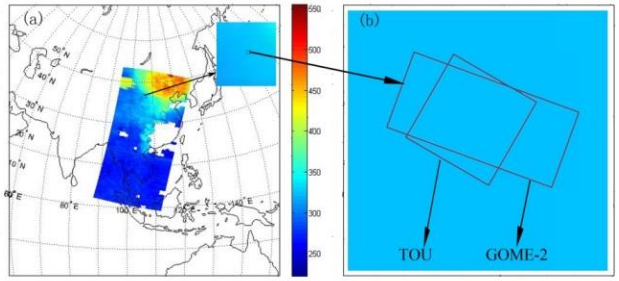
θ_1: view zenith angle of TOU

θ_2: view zenith angle of OMPS or GOME2

2 Methodology

(5) Spatial Collocated (Uniformity estimation)

$$\left|\frac{\sigma}{a_{ve}} - 1\right| < 0.01$$



σ: standard deviation of 3×3 radiance

a_{ve}: average of 3×3 radiance

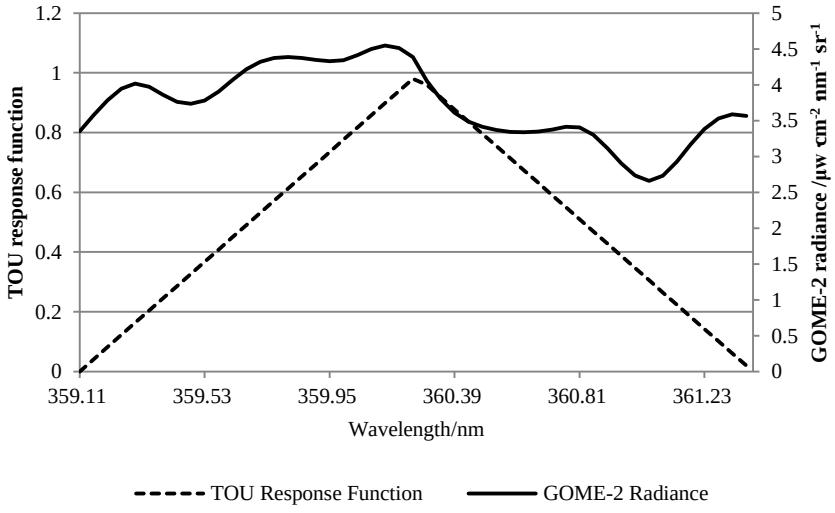
Window: 3 pixel×3 pixel

(6) Spectral Consistent

$$S_{imTOU} = \frac{\int R_{GOME2} \cdot S_{TOU} d\lambda}{\int S_{TOU} d\lambda}$$

S_{TOU}: spectral response function

R_{GOME2}: GOME-2 measurements



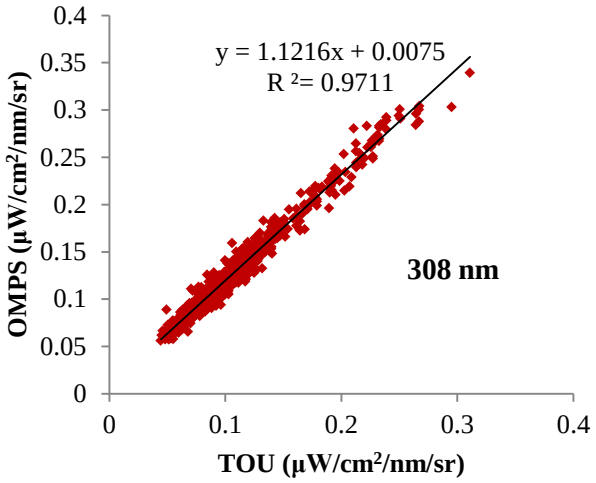
(7) Regression Analysis

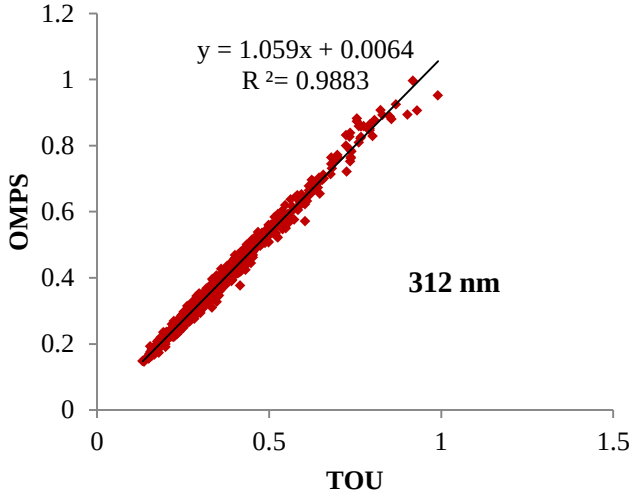
$$S_{imTOU} = a \times M_{TOU} + b$$

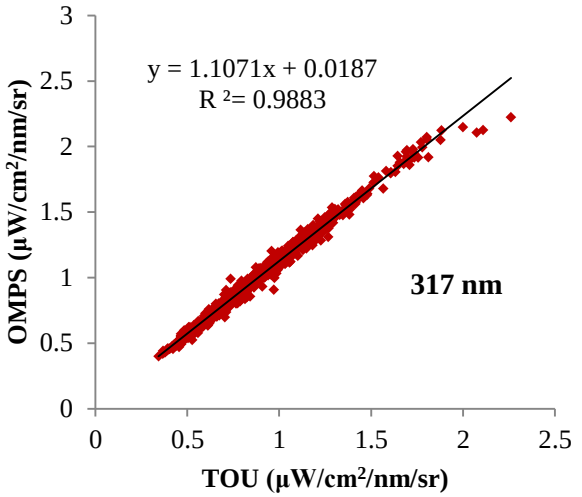
3 Results

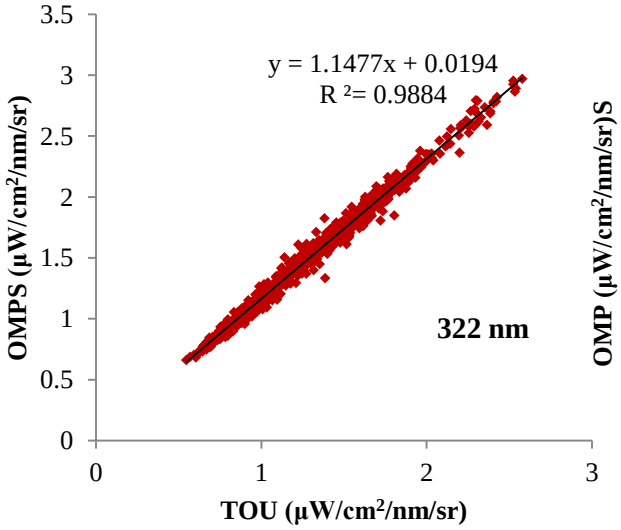
Data: 2013.10.1-2016.12.31

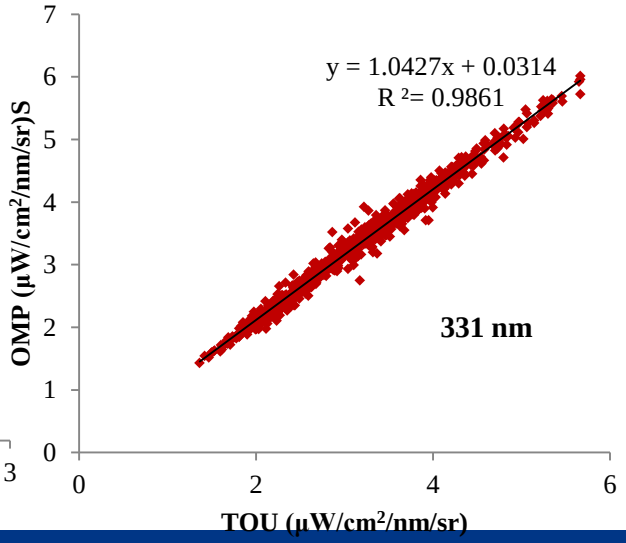
FY-3A/TOU vs NPP/OMPS L1B (2013.10.1-13）

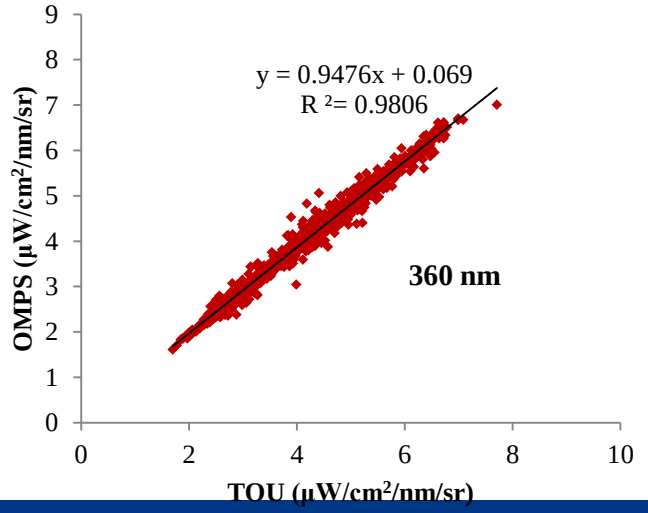






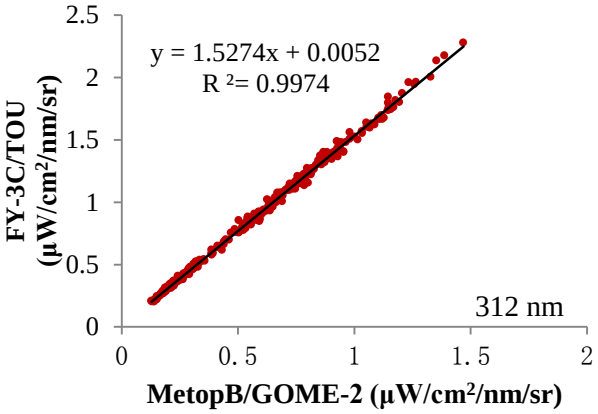


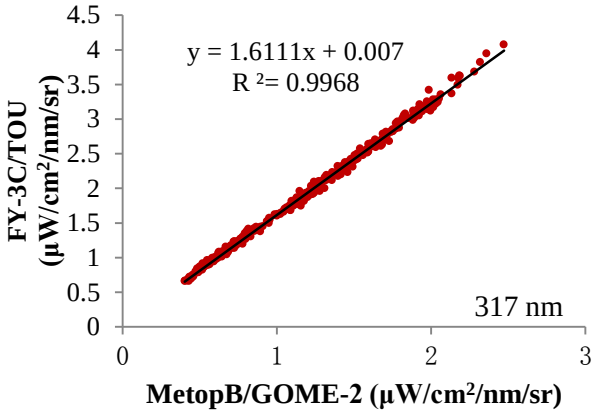


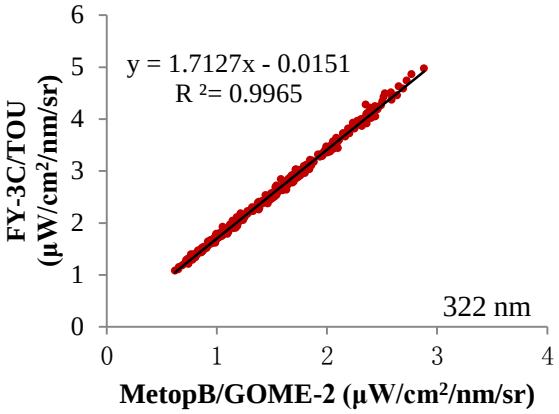


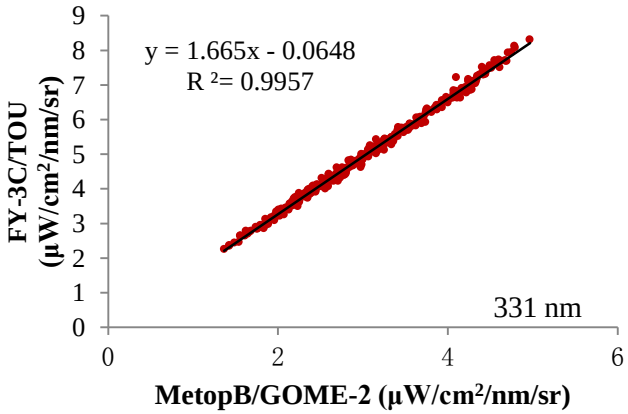
3 Results

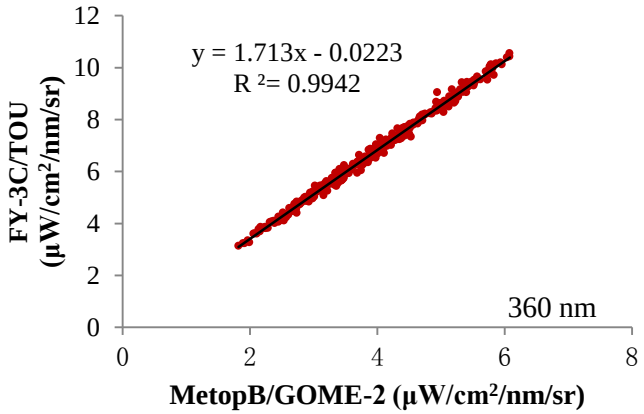
FY-3C/TOU vs Metop-B/GOME-2 L1B (2016.11.1-5)





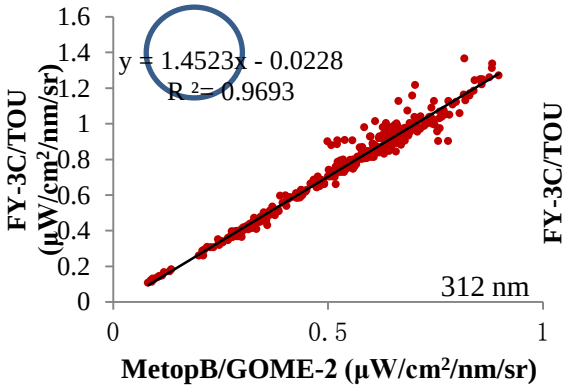


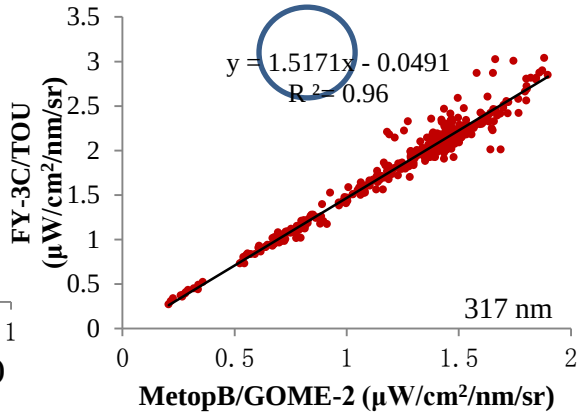


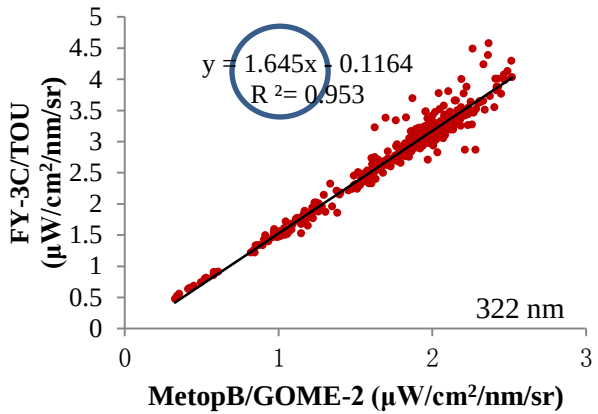


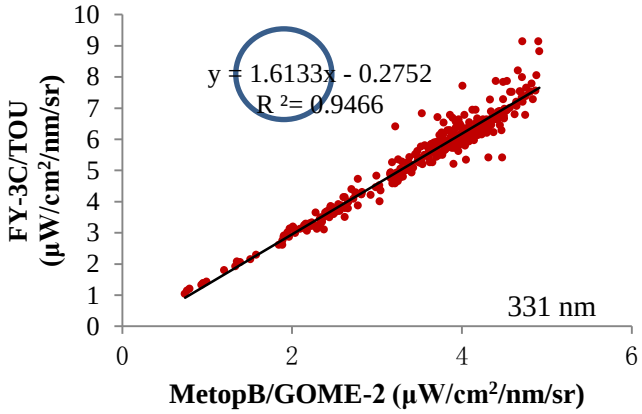
3 Results

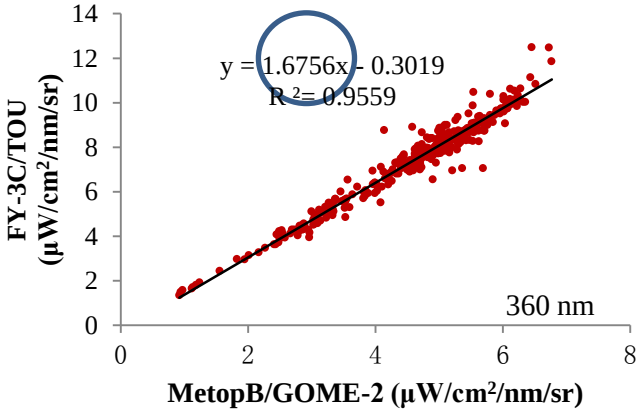
FY-3C/TOU vs Metop-B/GOME-2 L1B (2016.7.15-20)









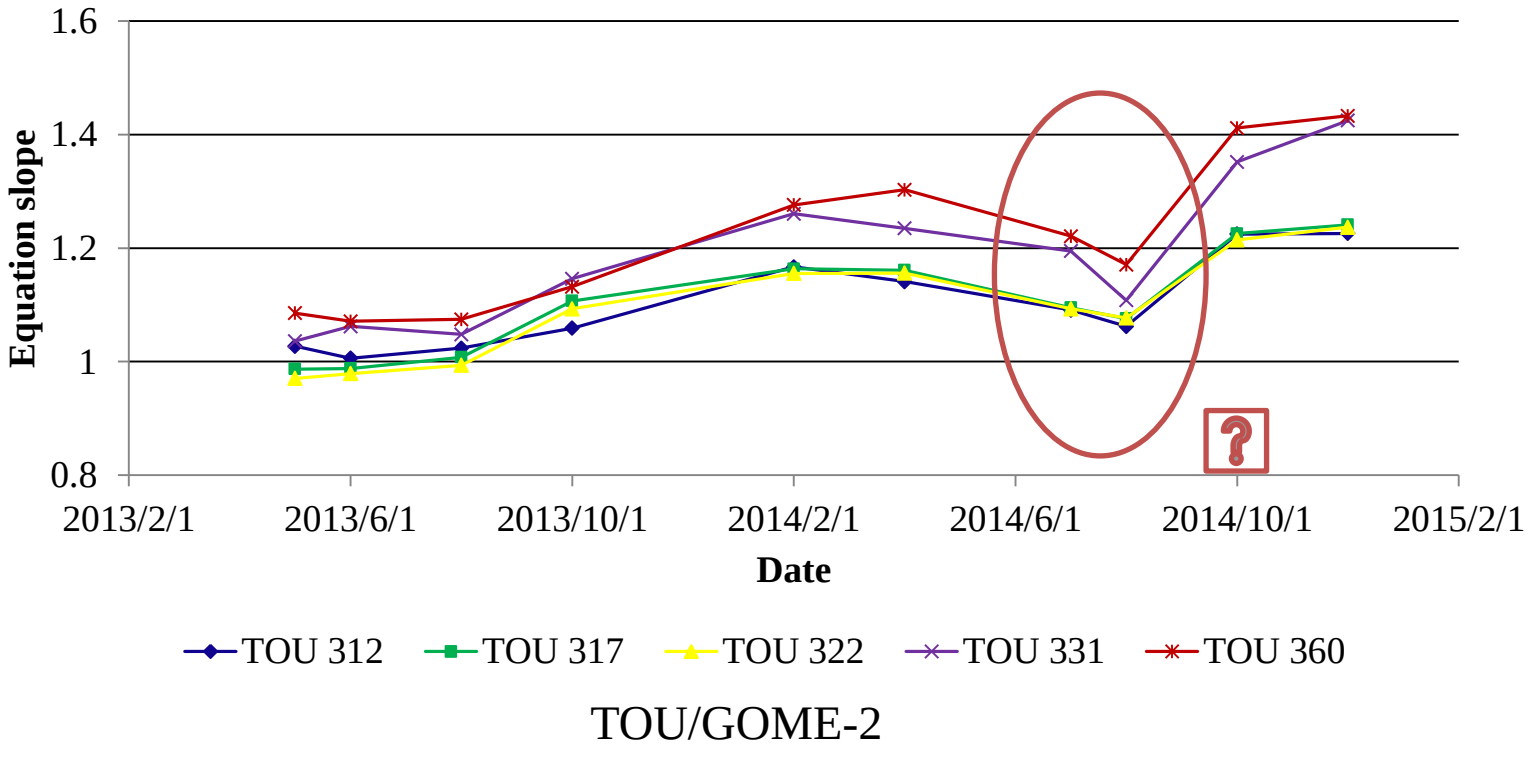


Almost all R^2>0.95

3 Results

(1) FY-3A/TOU vs Metop-B/GOME-2

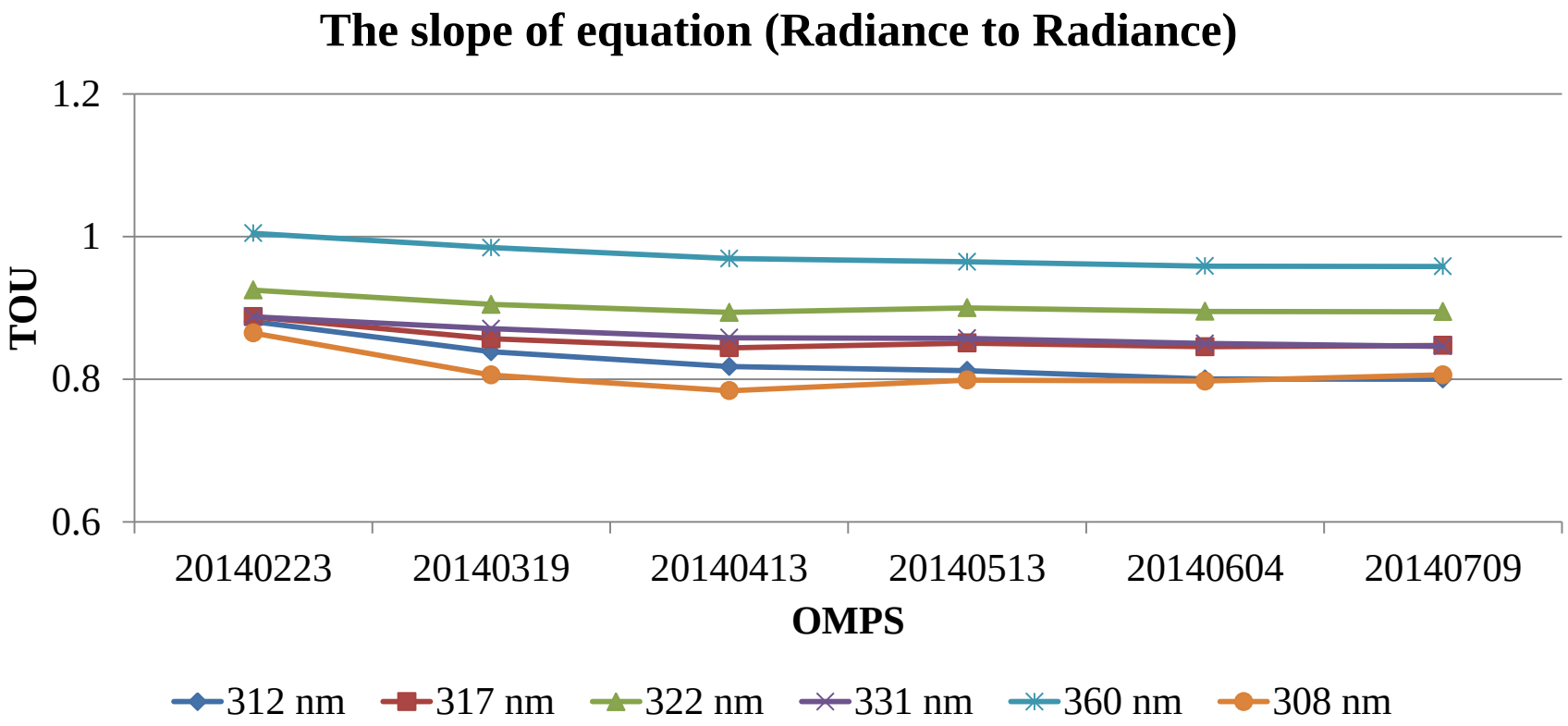
< 6.6 μW/cm^2/nm/sr



TOU/GOME-2

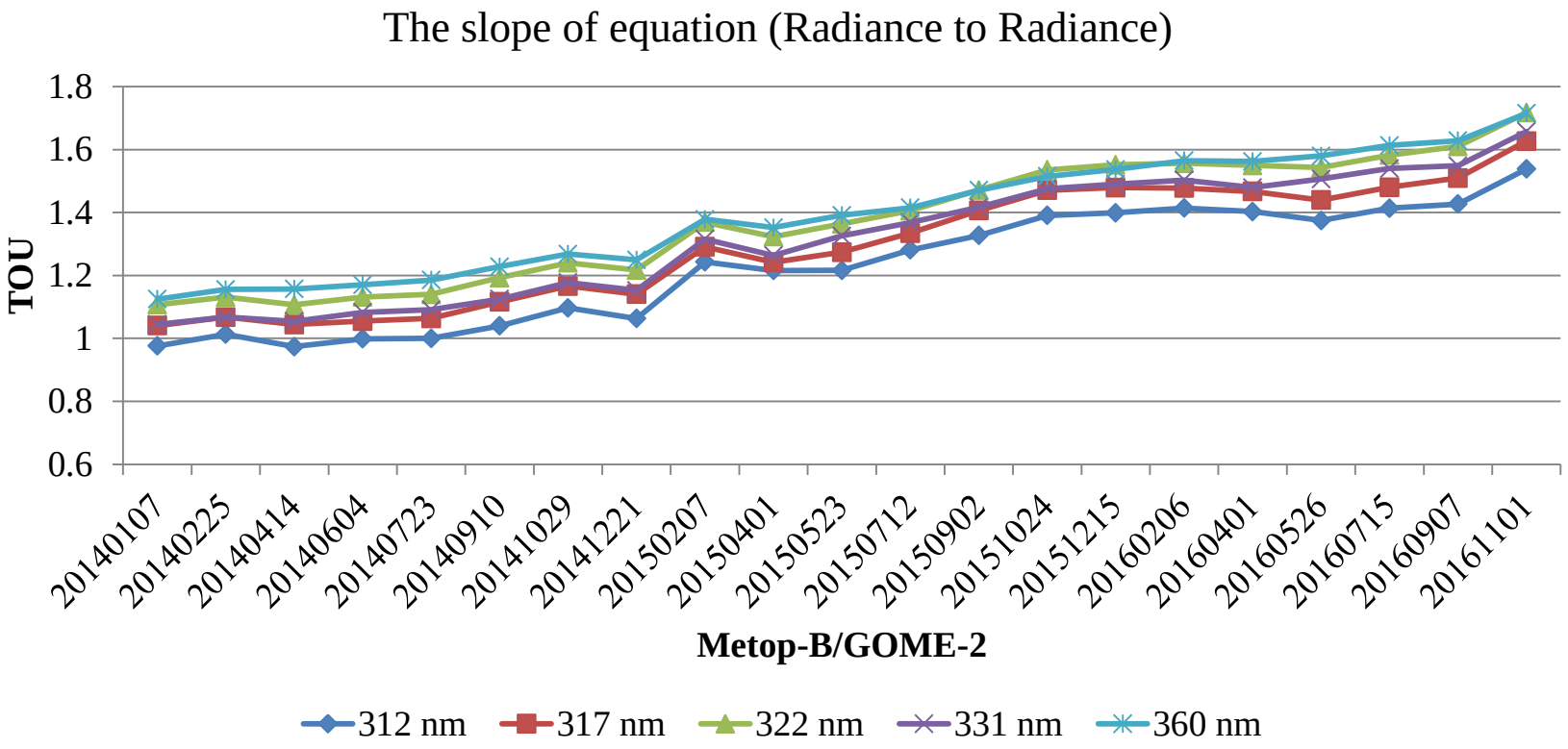
3 Results

(2) FY-3C/TOU vs NPP/OMPS



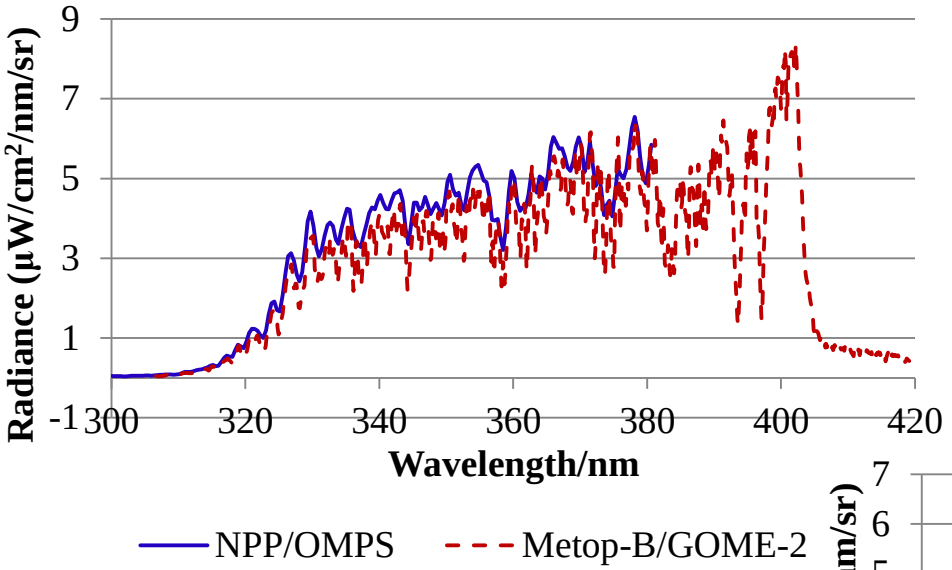
3 Results

(3) FY-3C/TOU vs Metop-B/GOME-2

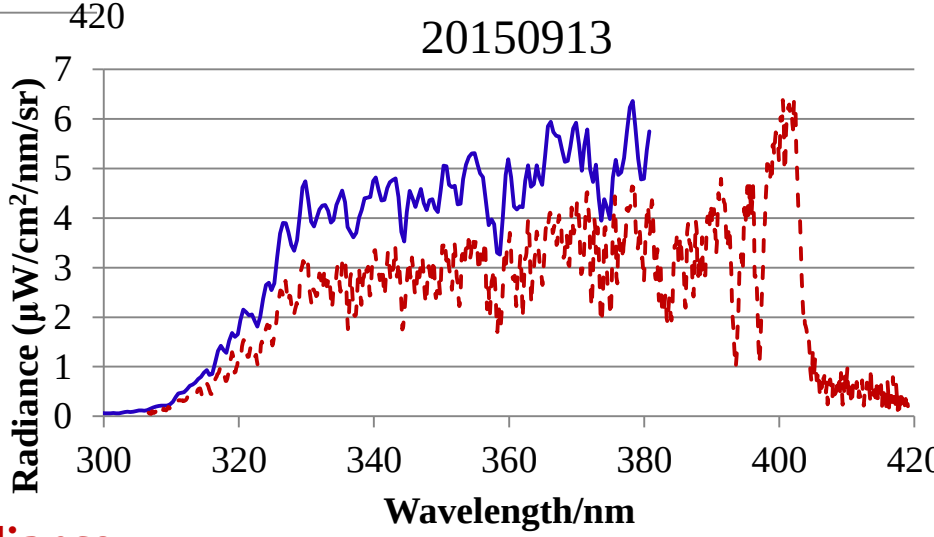


3 Results

(4) Radiance: NPP/OMPS vs Metop-B/GOME-2



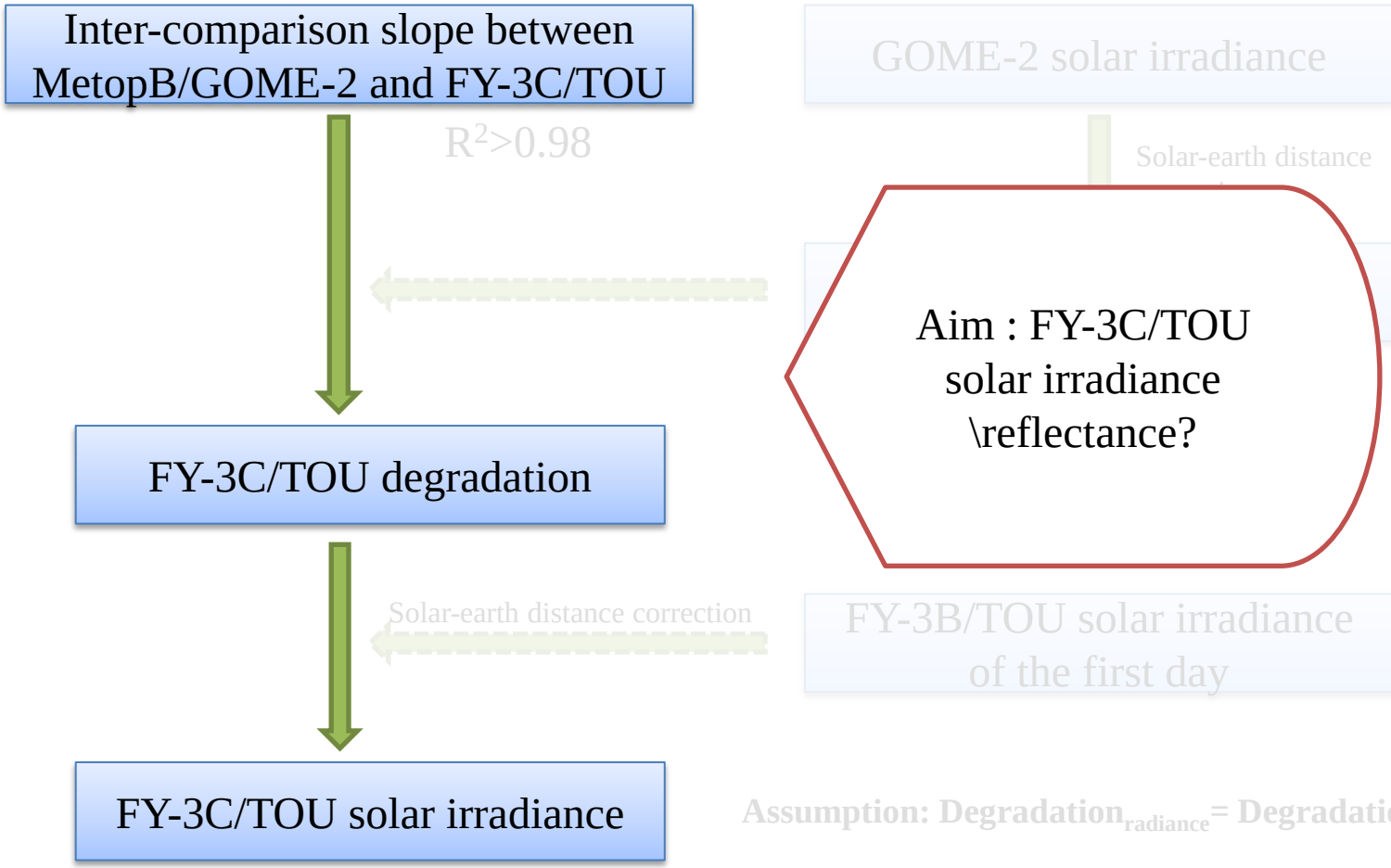
20140225



Conclusion: $Radiance_{OMPS}$> $Radiance_{TOU}$ >$Radiance_{GOME2}$

4 Plan

FY-3C/TOU solar Irradiance estimation



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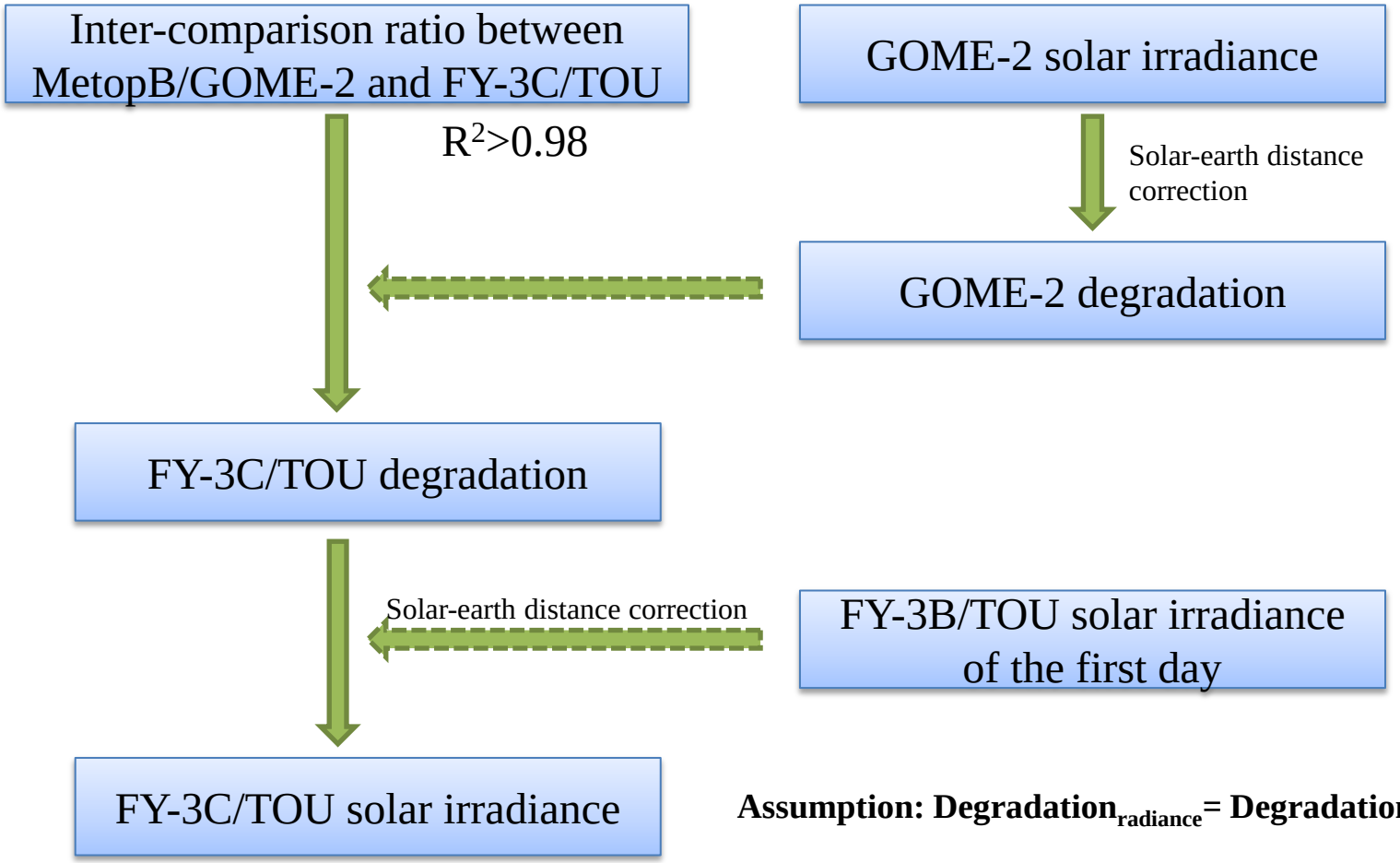
FY-3C/TOU solar Irradiance estimation

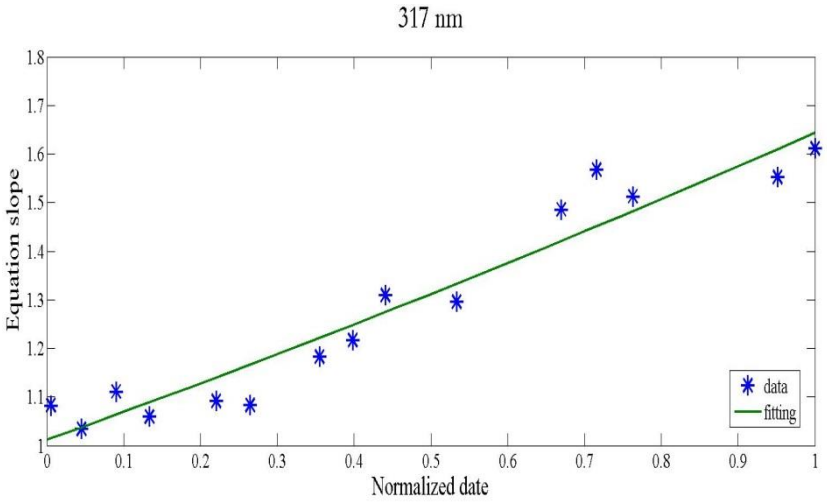


Assumption: $Degradation_{radiance}$= $Degradation_{irradiance}$

4 Plan

FY-3C/TOU solar Irradiance estimation

Inter-calibration ratio between MetopB/GOME-2 and FY-3C/TOU



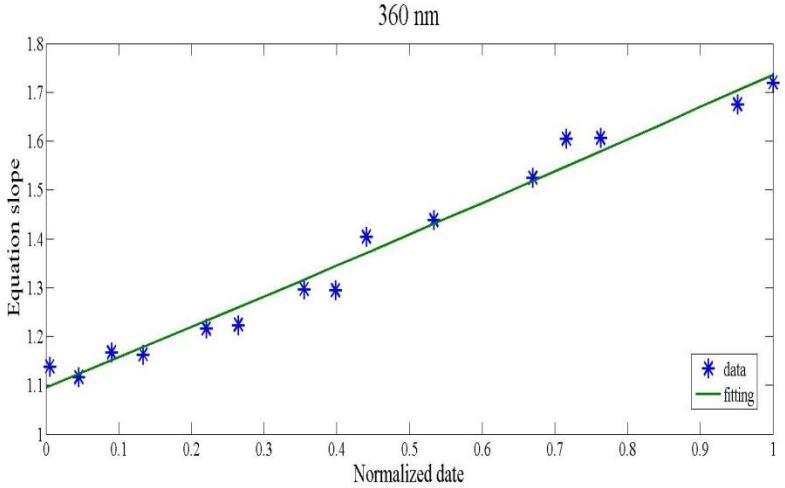
Solar-earth distance correc

FY-3C/TOU solar irradiance

GOME-2 solar irradiance

Solar-earth distance correction

GOME-2 degradation



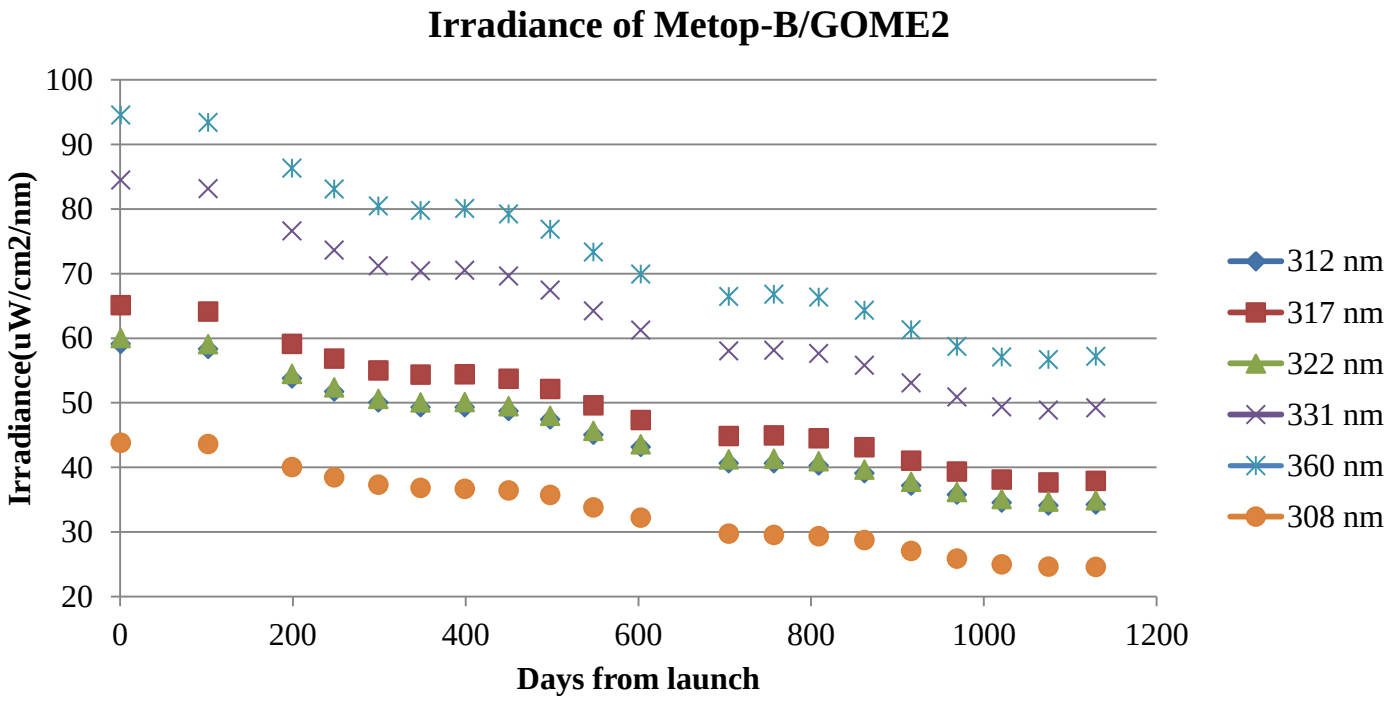
Assumption: $Degradation_{radiance} = Degradation_{irradiance}$

4 Plan

FY-3C/TOU solar Irradiance estimation

Inter-calibration ratio between MetopB/GOME-2 and FY-3C/TOU

GOME-2 solar irradiance



4 Plan

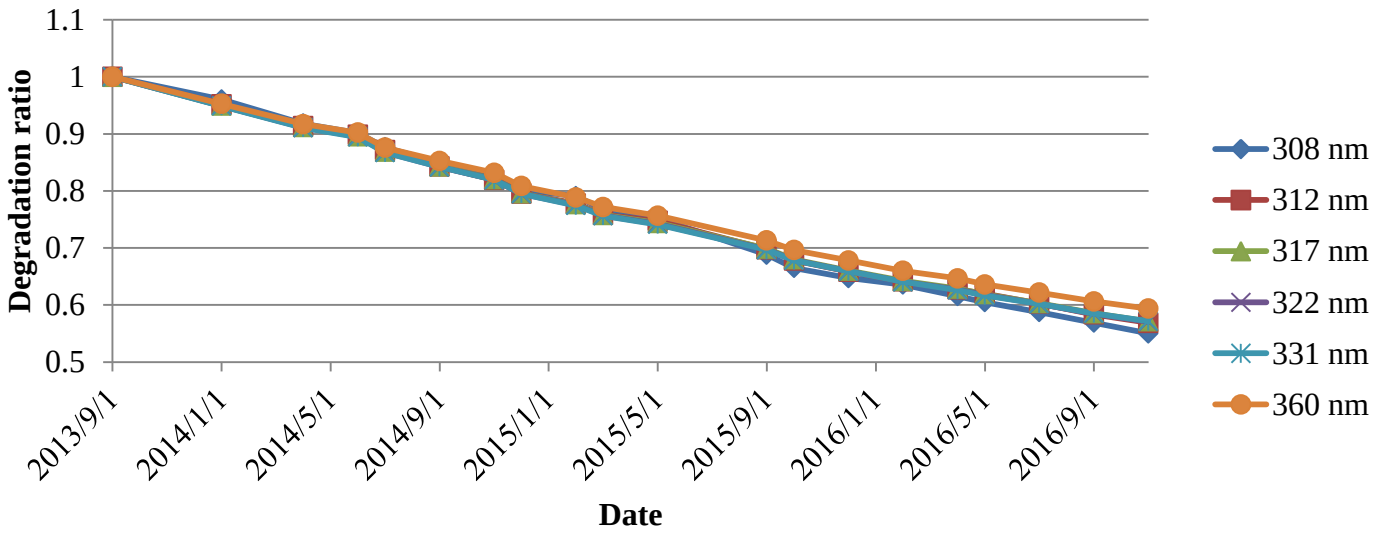
FY-3C/TOU solar Irradiance estimation

Inter-calibration ratio between MetopB/GOME-2 and FY-3C/TOU

GOME-2 solar irradiance

Solar-earth distance correction

GOME-2 degradation



diance

$Degradation_{irradiance}$

4 Plan

FY-3C/TOU solar Irradiance estimation

Inter-calibration ratio between MetopB/GOME-2 and FY-3C/TOU

GOME-2 solar irradiance

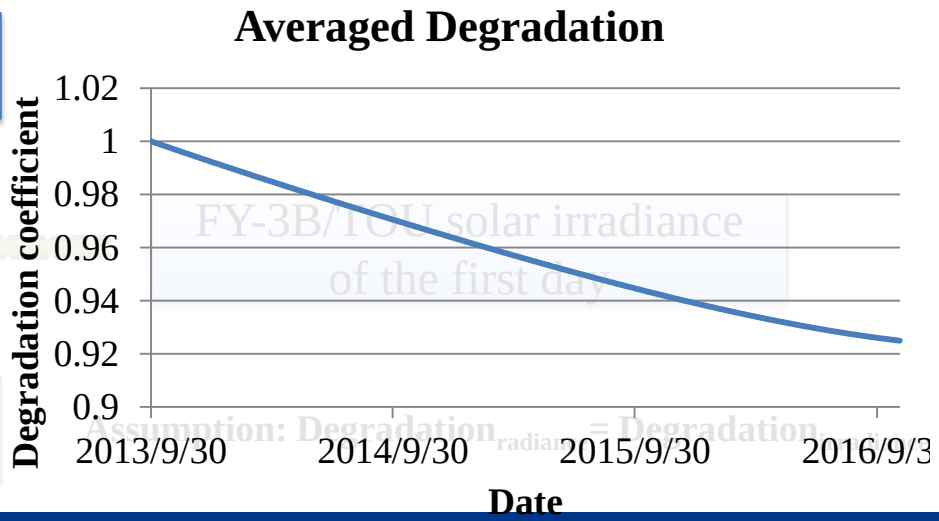
Solar-earth distance correction

GOME-2 degradation

FY-3C/TOU degradation

FY-3B/TOU solar irradiance of the first day

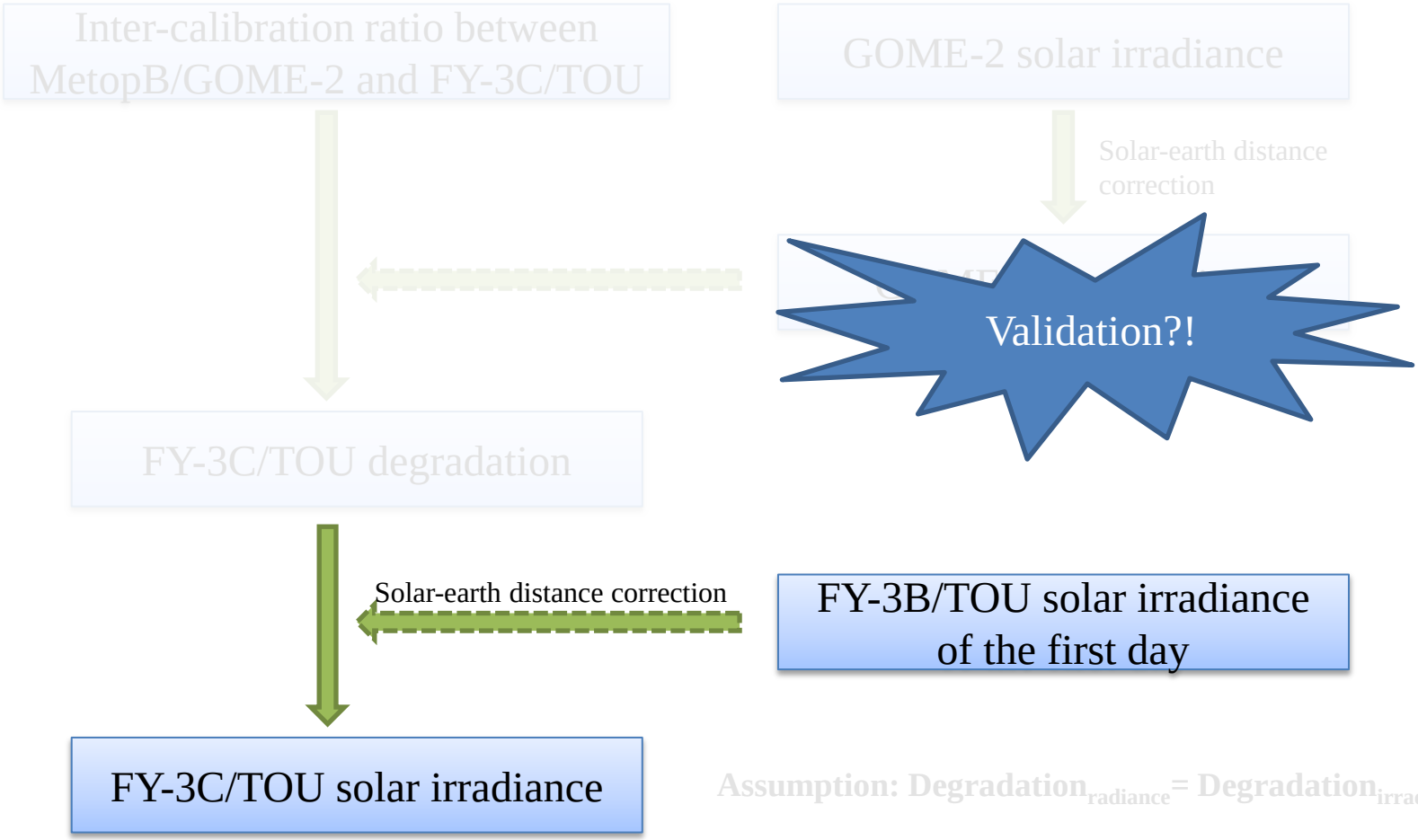
FY-3C/TOU solar irradiance



Assumption: $Degradation_{radiance} = Degradation$

4 Plan

FY-3C/TOU solar Irradiance estimation



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Thank you
for your attention!