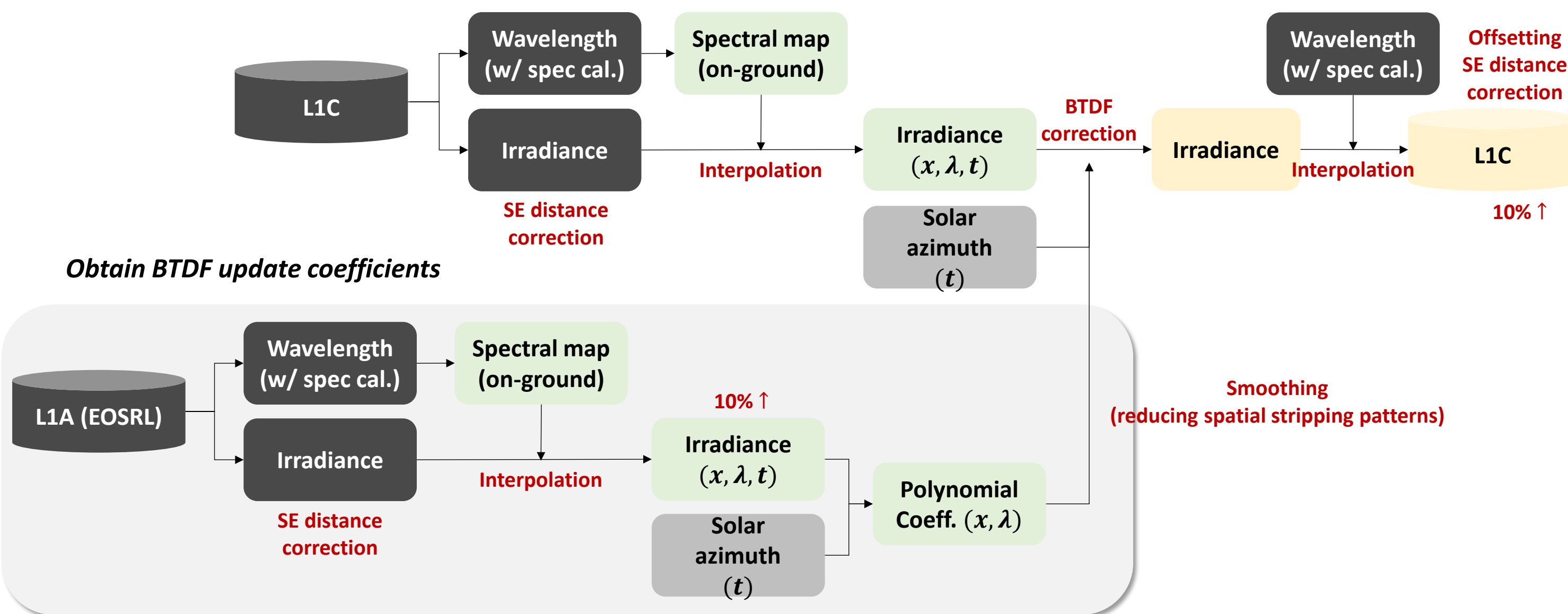


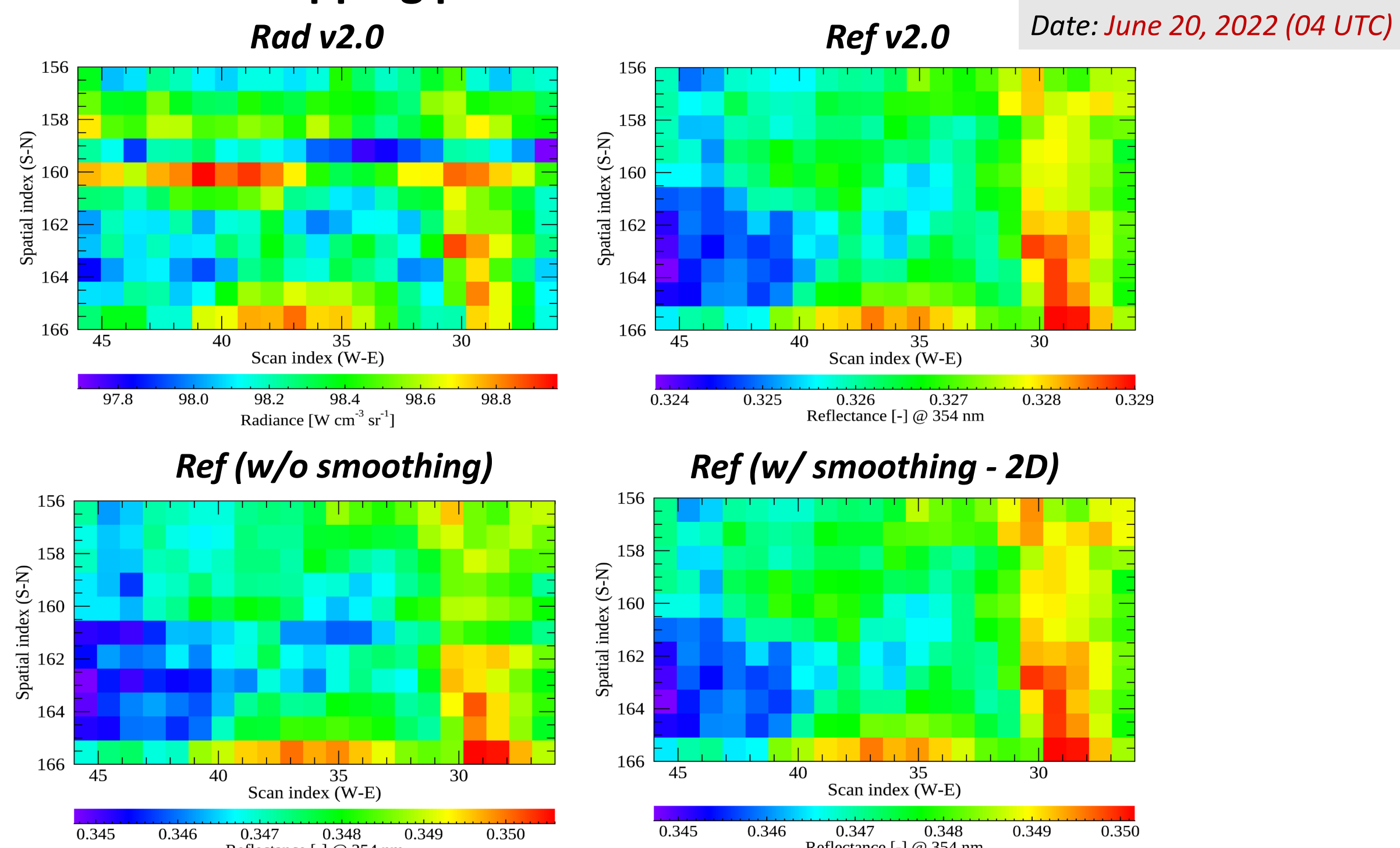


## Current Status of GEMS Level 1B

### ✓ BTDF update for solar irradiance (EOSRL 2024)



### ✓ Main issues resolved – stripping patterns in Reflectance



### ✓ GEMS Level 1B Status

Prominent issues	Level 1B Products			Effect	NIER L1C V2.0	EOSRL 2024
	IRR (F)	RAD (I)	REF (R)			
Diffuser N-S dependence	O	X	O (I/F)	Systematic bias along the N-S direction	+	Reduced (<2%, REF)
Diffuser BTDF	O	X	O (I/F)	Negative bias in IRR	+	10% ↑
Diffuser degradation	O	X	O (I/F)	Higher degradation in ~300 nm	+	+
Optics degradation	O	O	X	Systematic decrease in overall signal	+	+
Radiometric cal. coefficient	O	O	X	Systematic bias depending on WV	+	+
Stripping pattern	O	O	X	Artificial patterns (~2%)	+	+
Stray light	-	O	O	Higher signals @~300 nm	+	In process

## Q. How significantly have the GEMS L1B changed since the IOT and How to assess the GEMS L1B through inter-calibration techniques?

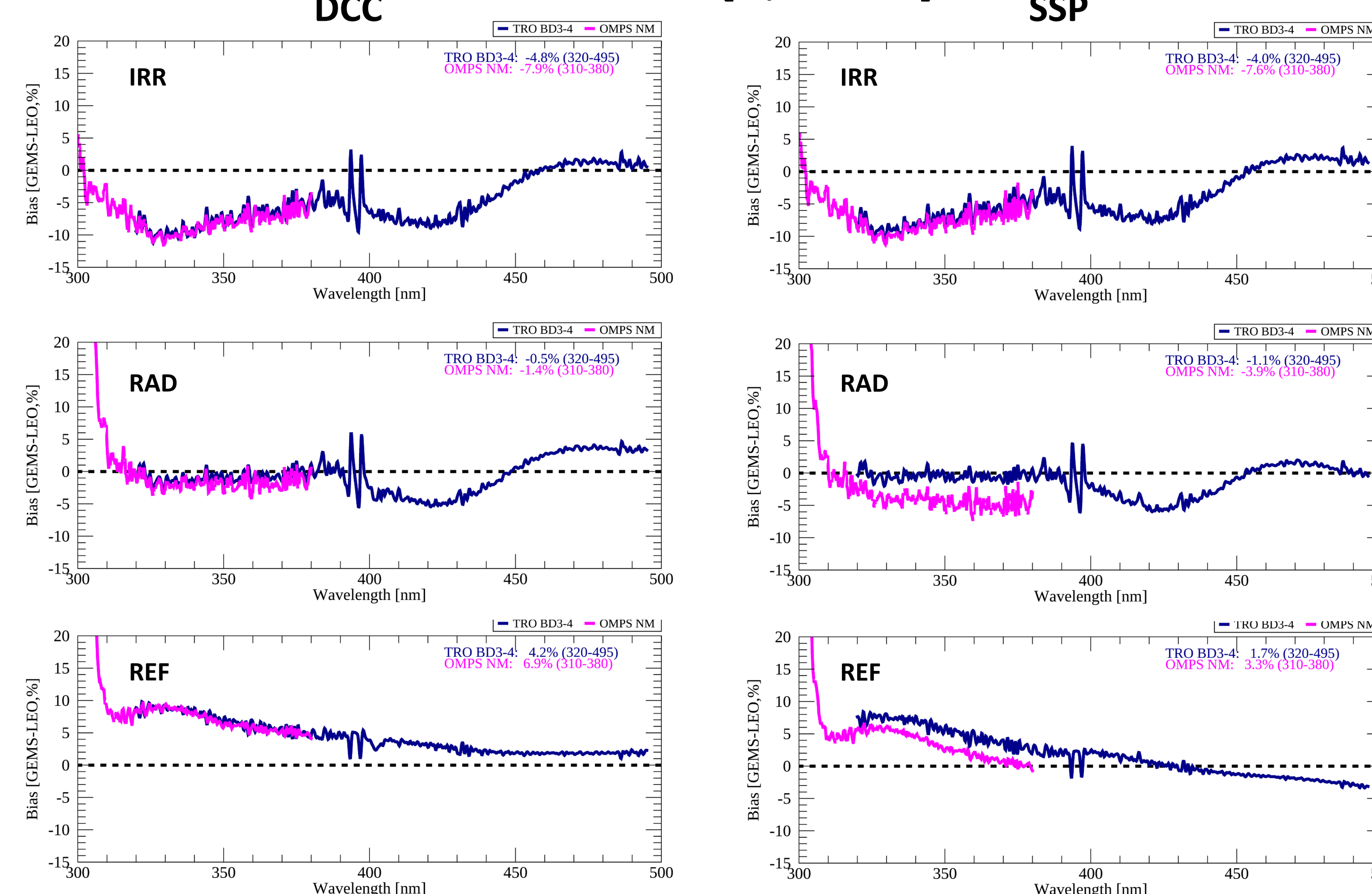
### GEO-LEO (GEMS vs. TROPOMI & OMPS)

#### ✓ Collocation conditions (GEO-LEO)

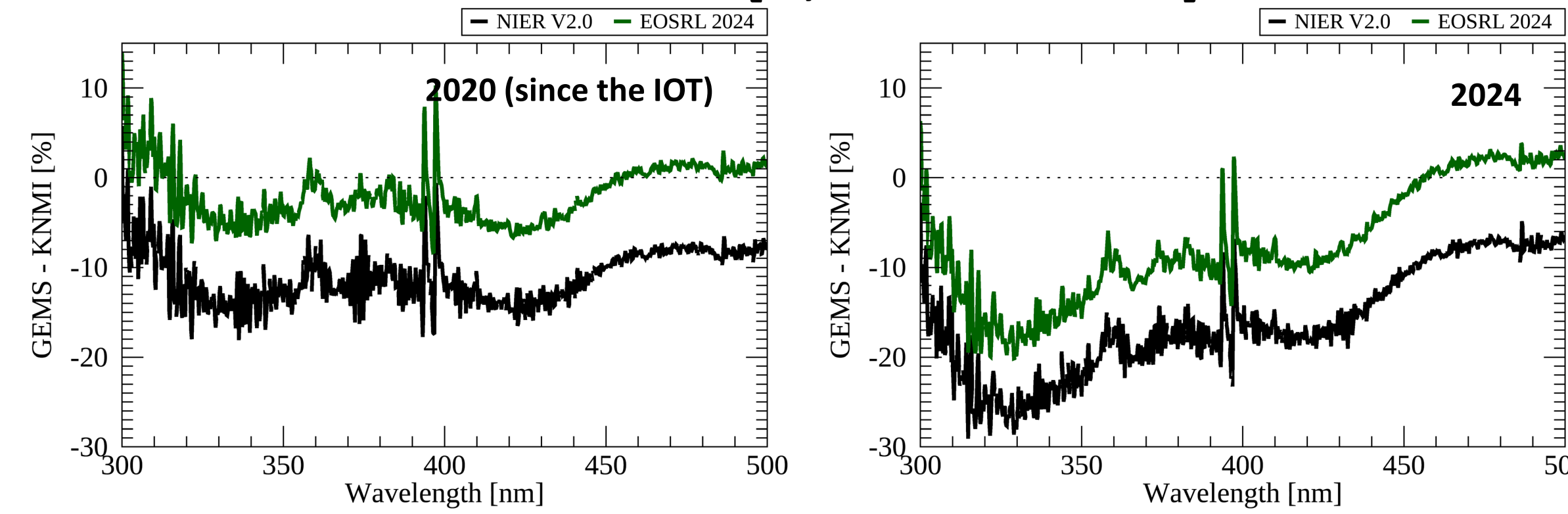
Sensor	Target (# /month)	Δt	Δx	ΔVZA	V(S)ZA	σ(R <sub>354 nm</sub> )	R <sub>354 nm</sub>
TROPOMI (δ=1~3%)	DCC (~4000)	< 15 min.	< 1.8 km (The half of LEO FOV)	< 1%	< 40°	< 3%	> 0.75
	SSP (~500)		Within 0.5° grid box from (128.25°E, 5°S)		-		-
OMPS (δ=2%)	DCC (~100)	< 15 min.	< 25 km (The half of LEO FOV)	< 1%	< 40°	< 3%	> 0.75
	SSP (<30)		Within 0.5° grid box from (128.25°E, 5°S)		-		-

\* SSP: Sub-satellite position (Ref. EGU 2024, Dr. Pepijn Veefkind)

#### ✓ GEMS - LEO [% , in 2021]



#### ✓ GEMS - KNMI [% , in 2020 & 2024]



## GEO-GEO (GEMS vs. AMI) onboard twin satellites

Sub-nadir points of GK-2A & 2B = 128.2°

<Methodology>

Reference QR. Lee et al. (GRL 2024)

GK-2: Geostationary Korea Multi-Purpose Satellite-2

Advantages of GEO-GEO inter-calibration: Wide spatial & temporal coverage

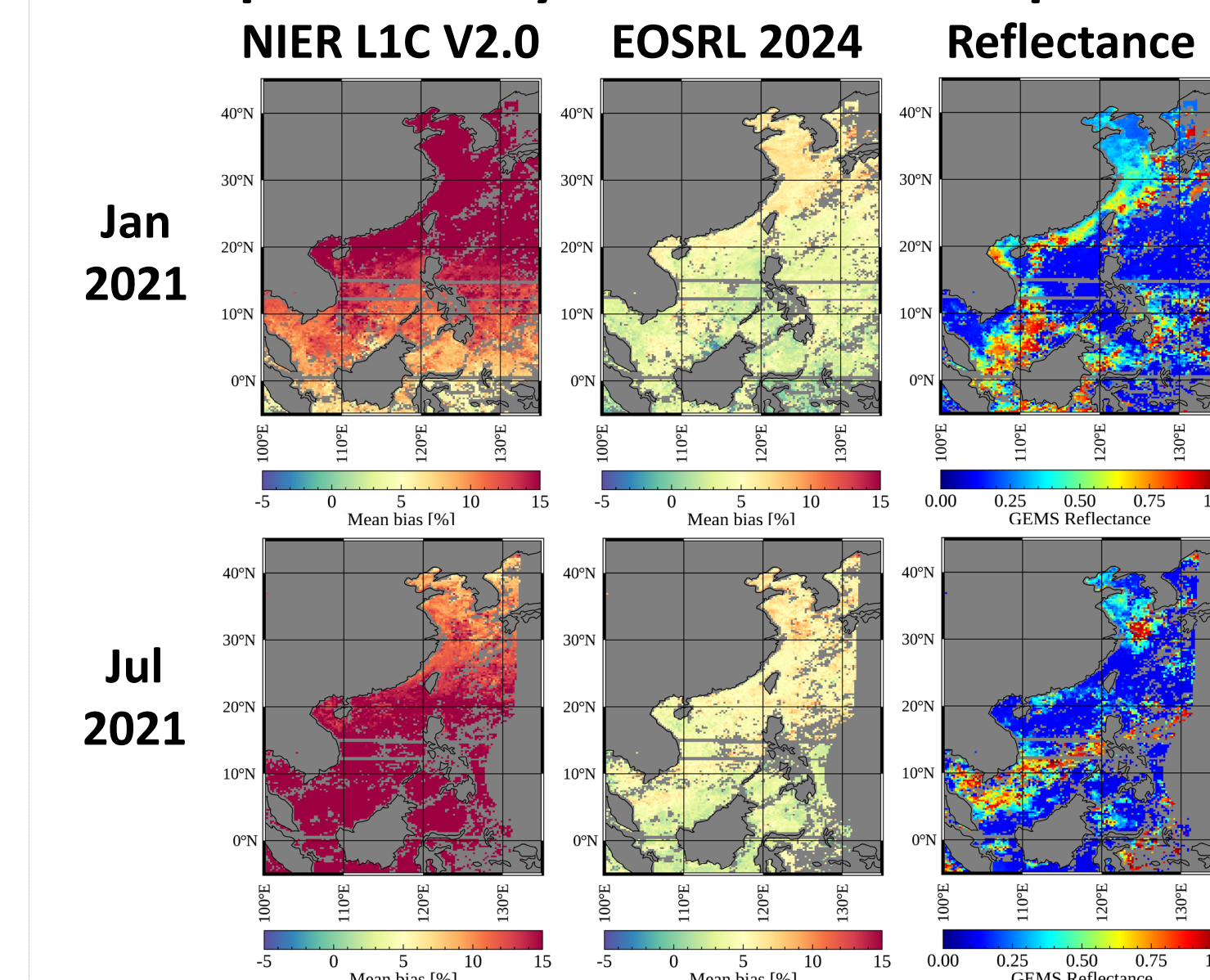
Ray-matching (GEO-GEO)  
✓ Elimination of sun-glint & land pixels  
✓ SZA & VZA < 60°  
✓ Spatial homogeneity: Scene STD < 5%

$$L \otimes f = \frac{\int_{\lambda_i}^{\lambda_f} L_{\lambda} \cdot f_{\lambda} d\lambda}{\int_{\lambda_i}^{\lambda_f} f_{\lambda} d\lambda}$$

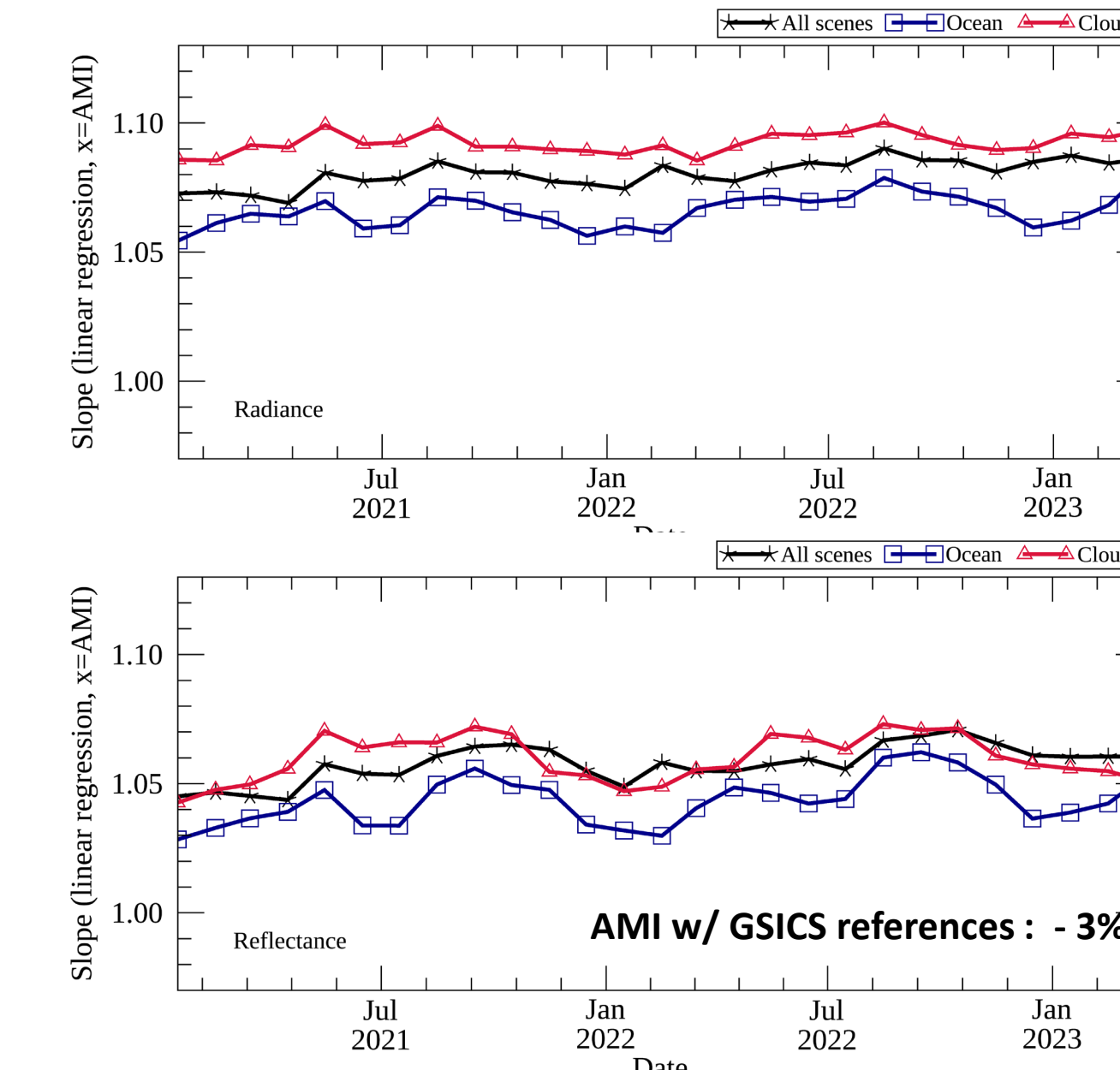
L(λ): GEMS spectral data  
f(λ): AMI SRF

SRF convolution  
Δt < 5 minutes  
Spatial average (0.25° or GEMS grid)

#### ✓ Spatial analysis for the N-S dependence



#### ✓ Trend analysis



### Short Summary & future works

Systematic biases of the GEMS Level 1B compared to GEO & LEO are:

OMPS IRR: -8.0% / RAD: -0.5% / REF: 7.0% (DCC, 310-380 nm)

TROPOMI IRR: -5.0% / RAD: -1.4% / REF: 4.4% (DCC, 320-495 nm)

AMI IRR: - / RAD: 8.1% / REF: 5.7% (@470 nm)

- The BTDF 2024 update resolves the intensified stripping patterns in Level 2 products, successfully reducing the N-S dependence.
- Some issues remain especially in terms of long-term aspects, including optics & diffuser degradation, and the increased variances along the spatial direction.