Extension of **KOSC** Atmospheric correction to **OLI** and **MSI**

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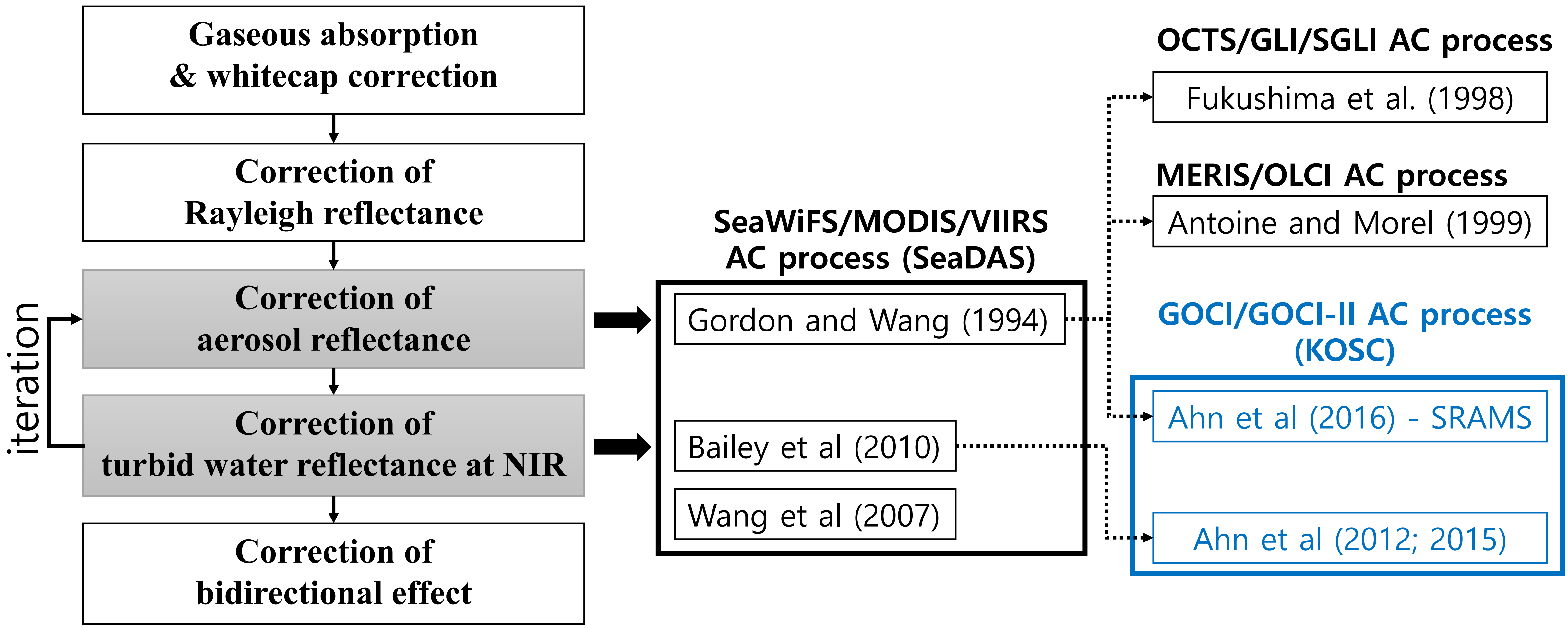
Differences between SeaDAS and KOSC AC algorithm



Overview of KOSC atmospheric correction algorithm

- KOSC AC algorithm developed for GOCI/GOCI-II
  - KOSC AC is implemented in Ocean Data Processing Subsystem (ODPS) of GOCI-II Ground Segment (G2GS) → ODPS interface is developed based on **SNAP**
  - The algorithm is **based on the SeaDAS AC** and **partially modified**

Issues on the previous aerosol correction scheme

3.2.2 Extrapolating the atmospheric path reflectance from the near IR to the visible

One of the main assumptions allowing the present-day algorithms to be applied is that the mixing ratio that can be determined from the near IR bands remains unchanged in the visible so that the extrapolation from the former to the latter is feasible. This "mixing ratio" (X; see above) is obtained by bracketing the observed aerosol signal in the near IR by choosing the aerosol models that will reproduce the more appropriately the observed aerosol signals (using precomputed LUTs).

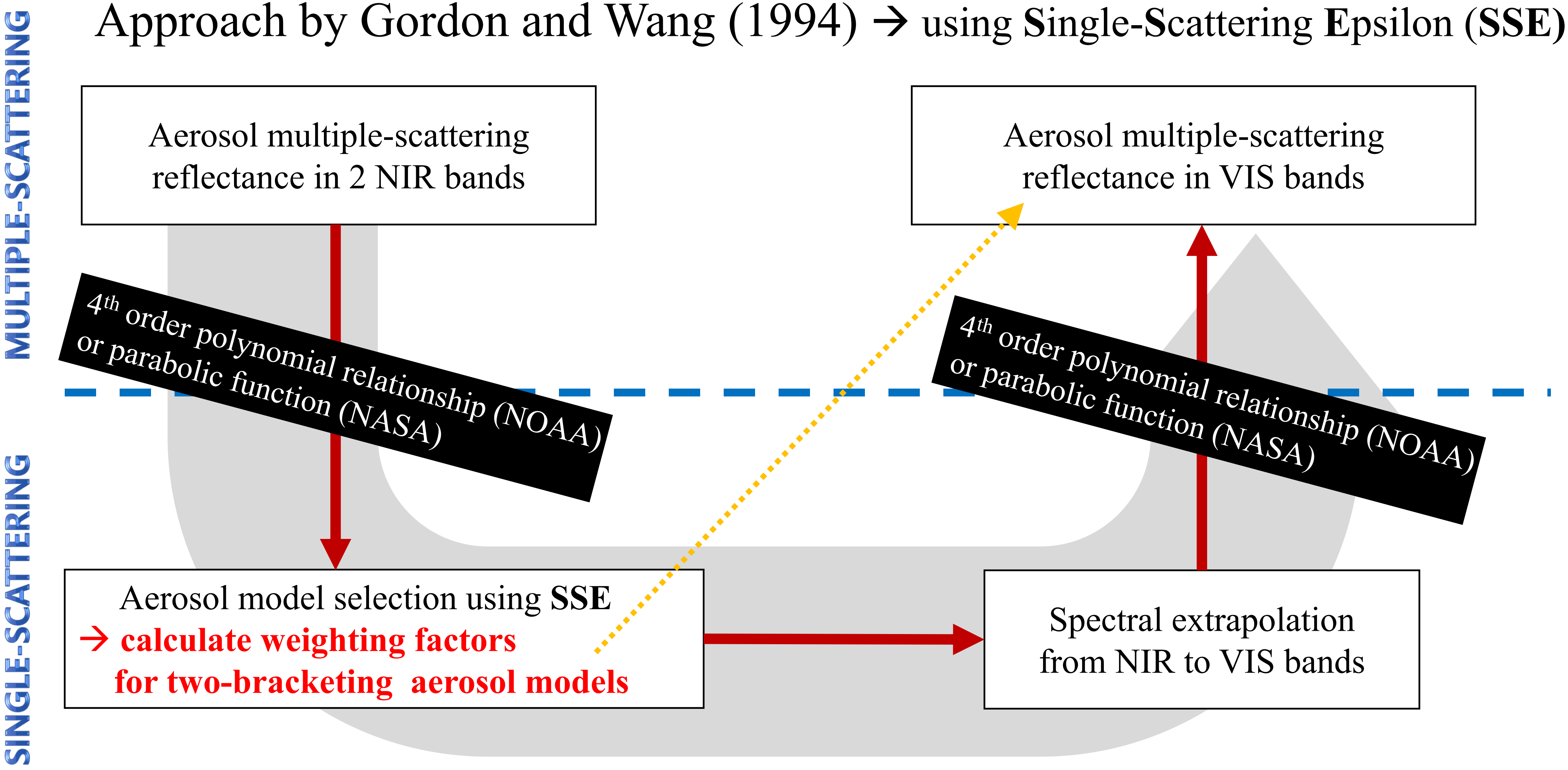
The assumption that X is spectrally invariant actually does not hold, and this is likely one important source of uncertainty in the nearIR-to-visible extrapolation process.

It is, therefore, likely that the central issue for atmospheric corrections of ocean colour observations is in the improvement of the extrapolation procedure.

"OLCI clear water atmospheric correction ATBD", Antoine (2010)

Issues on the previous aerosol correction scheme

Approach by Gordon and Wang (1994) → using **S**ingle-**S**cattering **E**psilon (**SSE**)



Alternative aerosol correction scheme used by KOSC algorithm

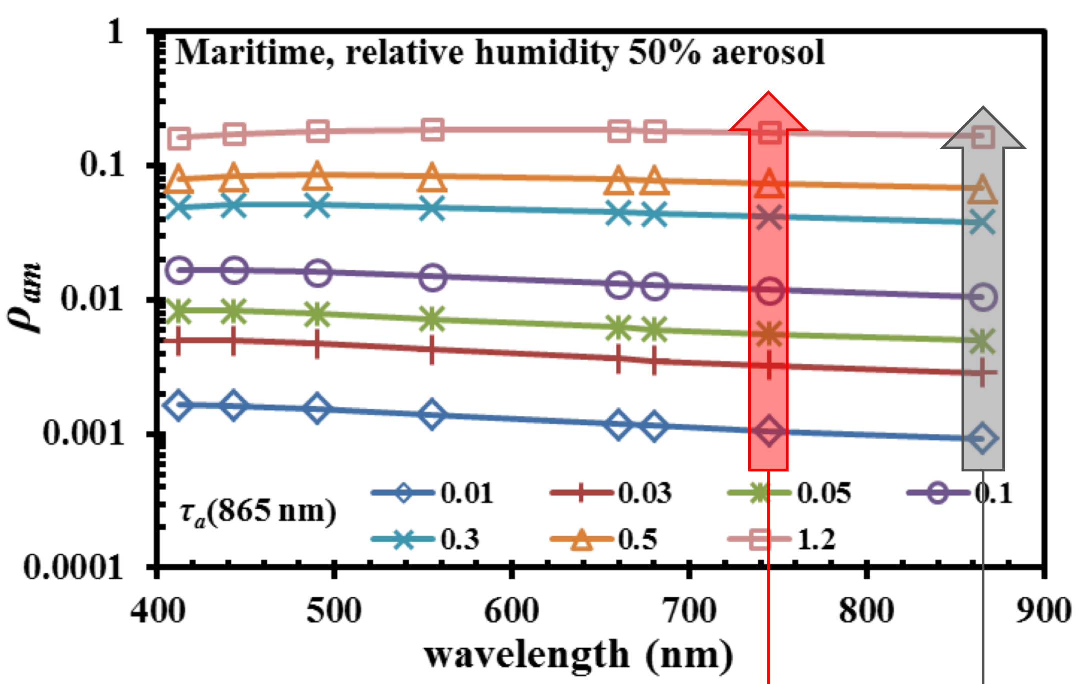
- It estimates aerosol reflectance fraction of the two models **in the multiple scattering domain directly** while the **SSE** method is going through the **single scattering domain**

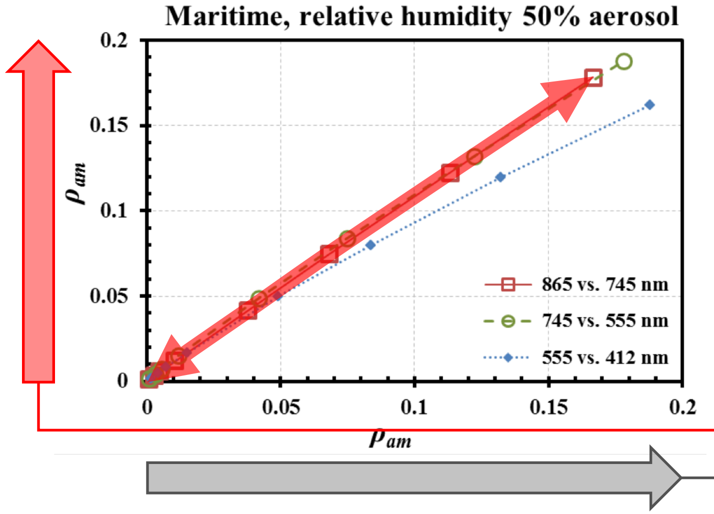
- It considers **spectrally variant aerosol reflectance fraction** of two-bracketing aerosol models

- It uses **S**pectral **R**elationships in the **A**erosol **M**ultiple-**S**cattering reflectance between different wavelengths **(SRAMS)**

  → Empirical polynomial relationship established through radiative transfer simulation

Inter-band relationship of multiple scattering aerosol reflectance



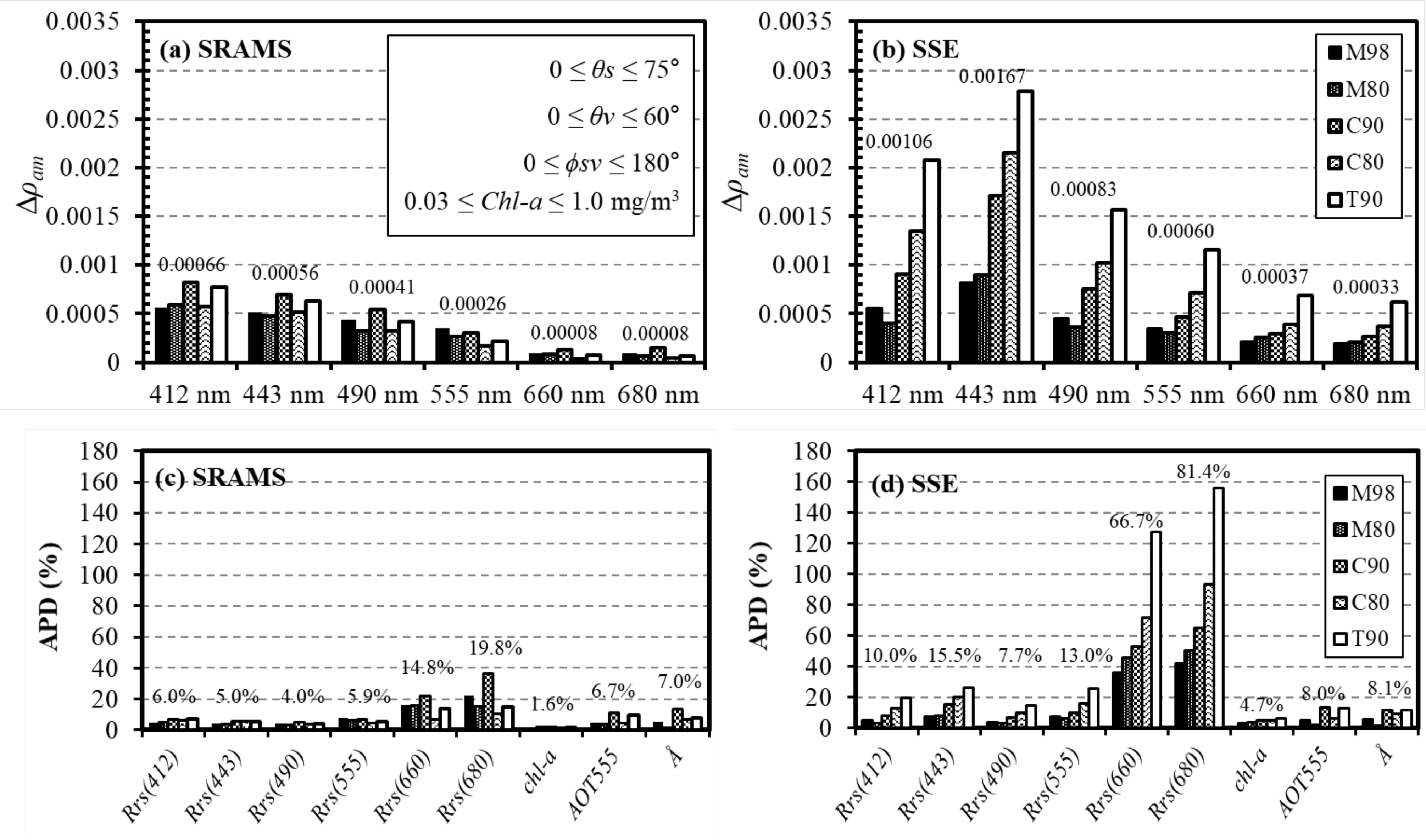


$$\rho_{am}(\lambda_2) = \sum_{n=1}^{D} k_n \rho_{am}(\lambda_1)^n$$

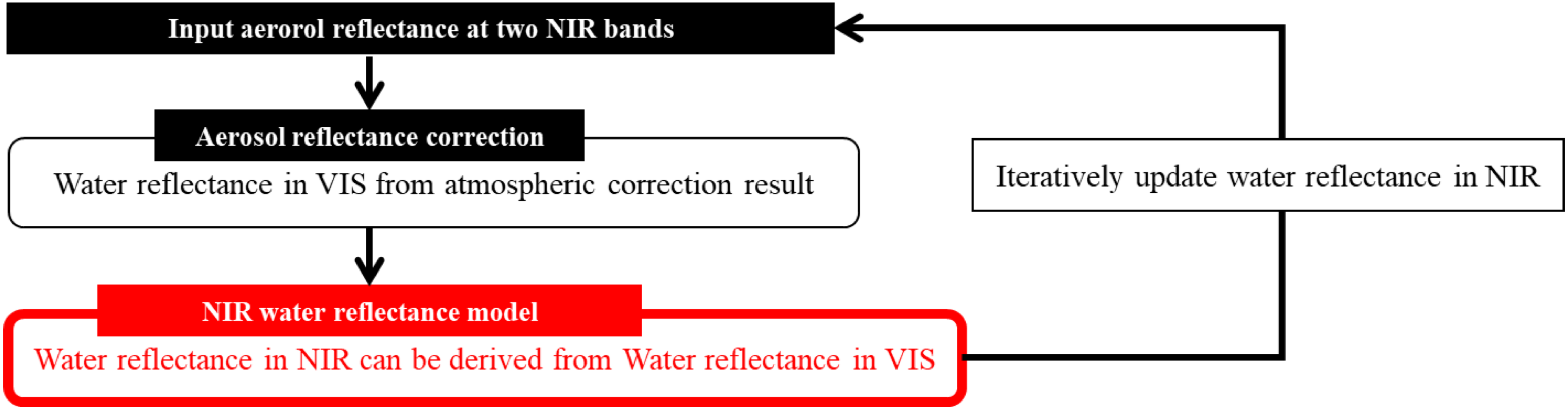
where k_n is the coefficient for specific aerosol model

λ_1 (nm)	865	745	745	745	555	555	555
λ_2 (nm)	745	680	660	555	490	443	412
D	2	3	3	4	4	4	4

Verification of SRAMS aerosol reflectance correction method (Ahn et al., 2016)



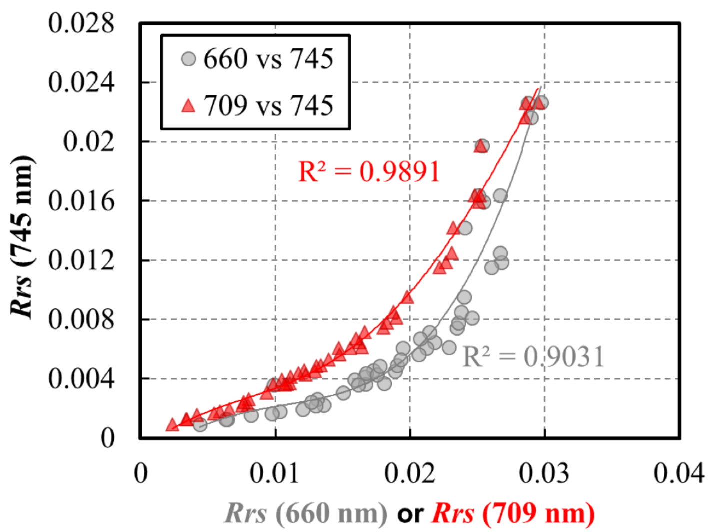
Iterative NIR aerosol reflectance estimation scheme over turbid water



SeaDAS : Bailey et al. (2010)
KOSC : Ahn et al. (2012; 2015)

NIR water reflectance model - 1

- Using Spectral Relationship of Remote-Sensing Reflectance between red and two NIR wavelengths (**SRR_{RS}709**)
  - Ahn et al. (2012; 2015)
  - GOCI: 660, 745, and 865 nm
  - GOCI-II: 709, 745, and 865 nm



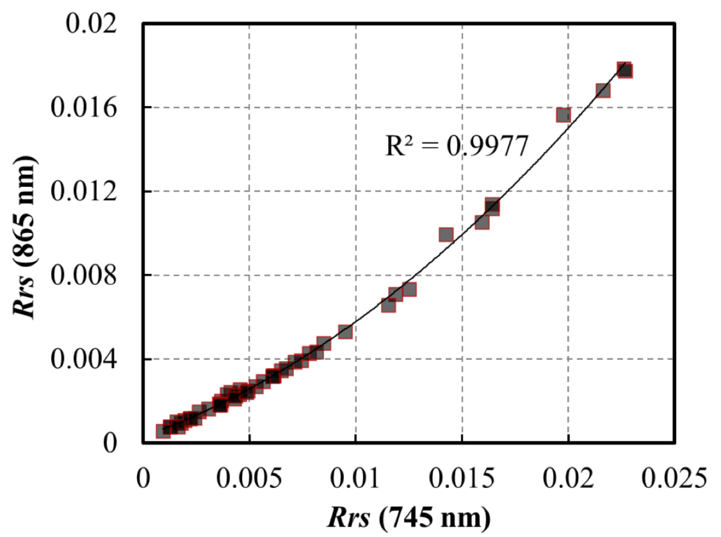


Fig. Relationships between $R_{rs}(red)$ and $R_{rs}(NIR)$. R_{rs} dataset is acquired from *in situ* radiometric measurements.

NIR water reflectance model - 2

- Using spectral relationship of IOP between red and two NIR wavelengths (**SRIOP**)
  - GOCI-II: 620, 709, 745, and 865 nm

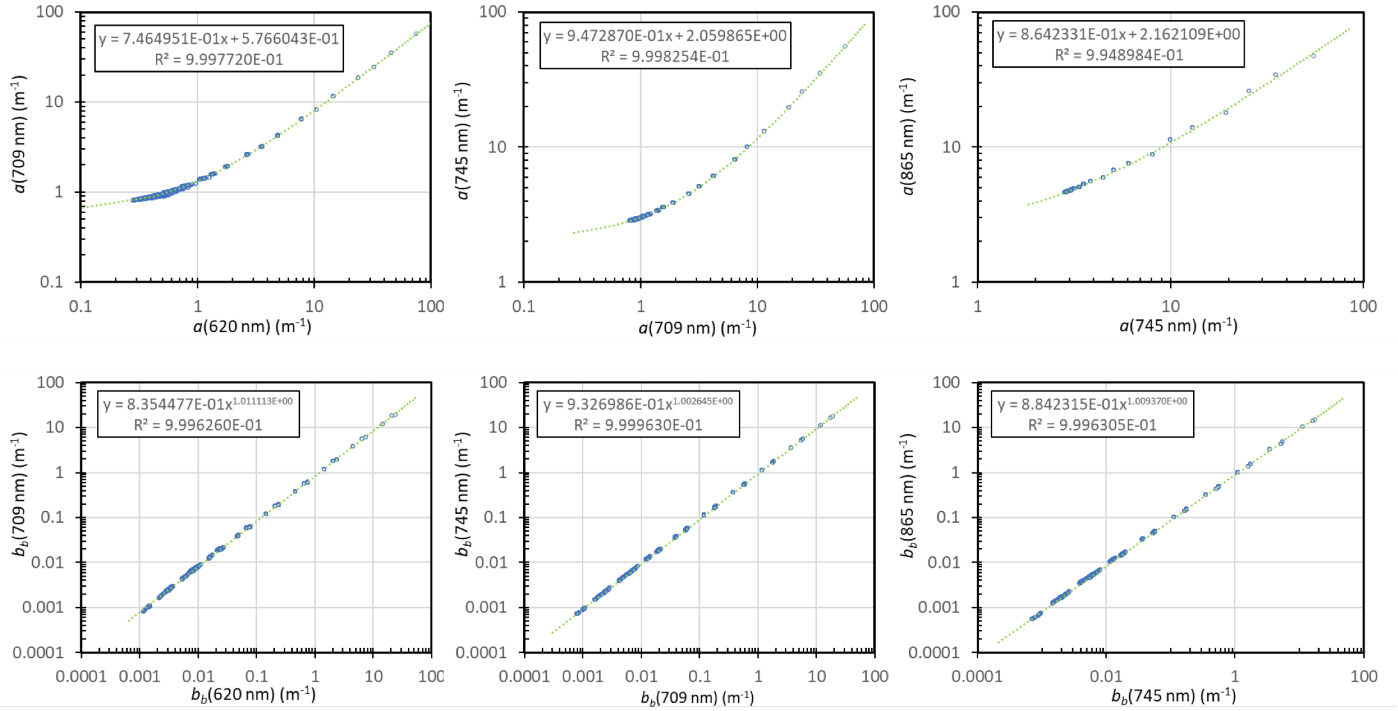


Fig. Relationships of IOPs between different wavelengths (620 nm, 709 nm, 745 nm, and 865 nm)

$$\Omega(\lambda) = \frac{b_b(\lambda)}{a(\lambda) + b_b(\lambda)}$$

Method

- 4 Unknowns : *a*(620 nm), *a*(709 nm), b_b(620 nm), b_b(709 nm)
- 2 Knowns : Ω(620 nm), Ω(709 nm)
- 2 Constraints
  - Relationship between *a*(620 nm) and *a*(709 nm)
  - Relationship between b_b(620 nm) and b_b(709 nm)

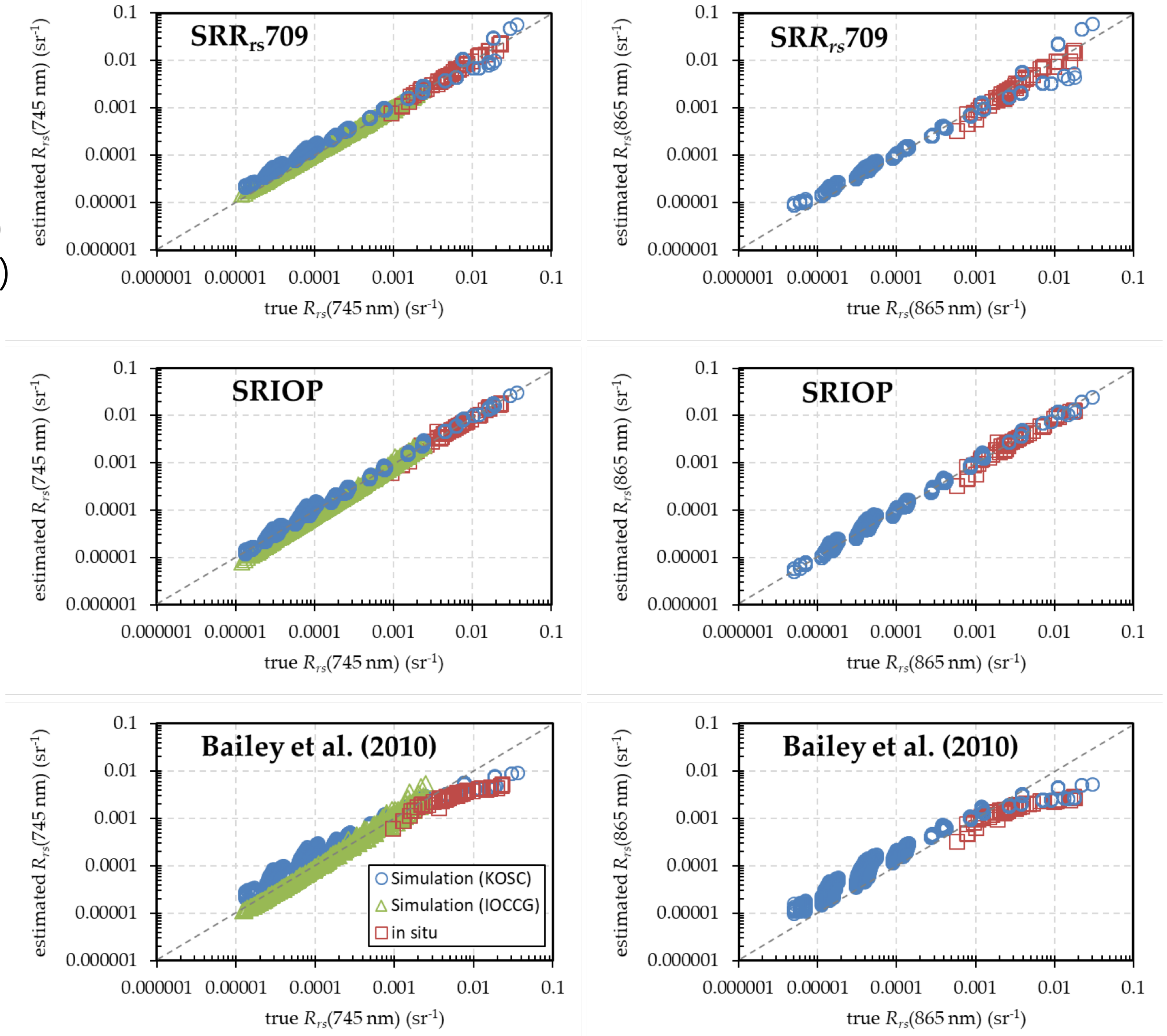
➔ Solve $\frac{1.11916[1.0 - \Omega(709\text{ nm})]}{\Omega(709\text{ nm})} b_b(620\text{ nm})^{1.011113} + \left\{1.0 - \frac{1.0}{\Omega(620\text{ nm})}\right\} b_b(620\text{ nm}) - 0.772415 = 0$

Verification of NIR water reflectance model

(1) KOSC simulation data
- Radiative transfer code: HYDROLIGHT 5.4
- Range of in-water properties
  - *Chl-a* : 0.1~30 mg/m3 (0.125 interval in log10-space)
    - *TSM* : 0.1~3162.3 g/m^3 (0.5 interval in log10-space)
    - 4 sediment types : YC, RC, BE, CS (Ahn, 1992)
    - a_{DOM}(440 nm) : 0.01~1.78 m^{-1} (0.25 interval in log10-space)

(2) IOCCG simulation data
- Recently updated by Z. Lee

(3) In situ data
- Above water radiometric measurements from shipboard when wind speed is very low
  - Period : year 2015 and 2016
  - Location : Gyeong-gi Bay, Yeong-san Estuary



Extension of KOSC AC to OLI and MSI

- GOCI-II
  - Estimation of aerosol reflectance
  - 380, 412, 443, 490, 510, 555, **620**, 660, 680, **709**, **745**, and **865** nm
  - Estimation of NIR water reflectance (SRIOP or SRRrs)
- OLI
  - Estimation of aerosol reflectance
  - 443, 482, 561, **655**, **865**, **1609**, and 2201 nm
  - Estimation of NIR water reflectance (SRRrs)
- MSI
  - Estimation of aerosol reflectance
  - 443, 490, 560, 665, **705**, **740**, **783**, 842, **865**, 940, 1375, 1610, and 2190 nm
  - Estimation of NIR water reflectance (SRIOP or SRRrs)

※ Note. Wavelength for the algorithm can be changed

Issues on KOSC algorithm

- Need clarification of the system vicarious calibration strategy
- It does not consider the bright pixel adjacency effect
- It does not considers absorptive aerosols
- Further investigation on IOP of suspended sediments is required
  - Accuracy on the measurement of IOP and AOP in NIR is not sufficient currently

Conclusion

- KOSC AC is developed based on the SeaDAS AC and partially modified in terms of..
  - Aerosol reflectance correction scheme
    - Use spectral relationship of aerosol multiple-scattering reflectance between different wavelengths (SRAMS)

      → SRAMS considers spectrally variant aerosol reflectance fraction
  - Turbid water reflectance correction in NIR
    - Use spectral relationships of Rrs or IOP between red and NIR wavelengths

THANK YOU

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