Atmospheric correction for SGLI ocean color data

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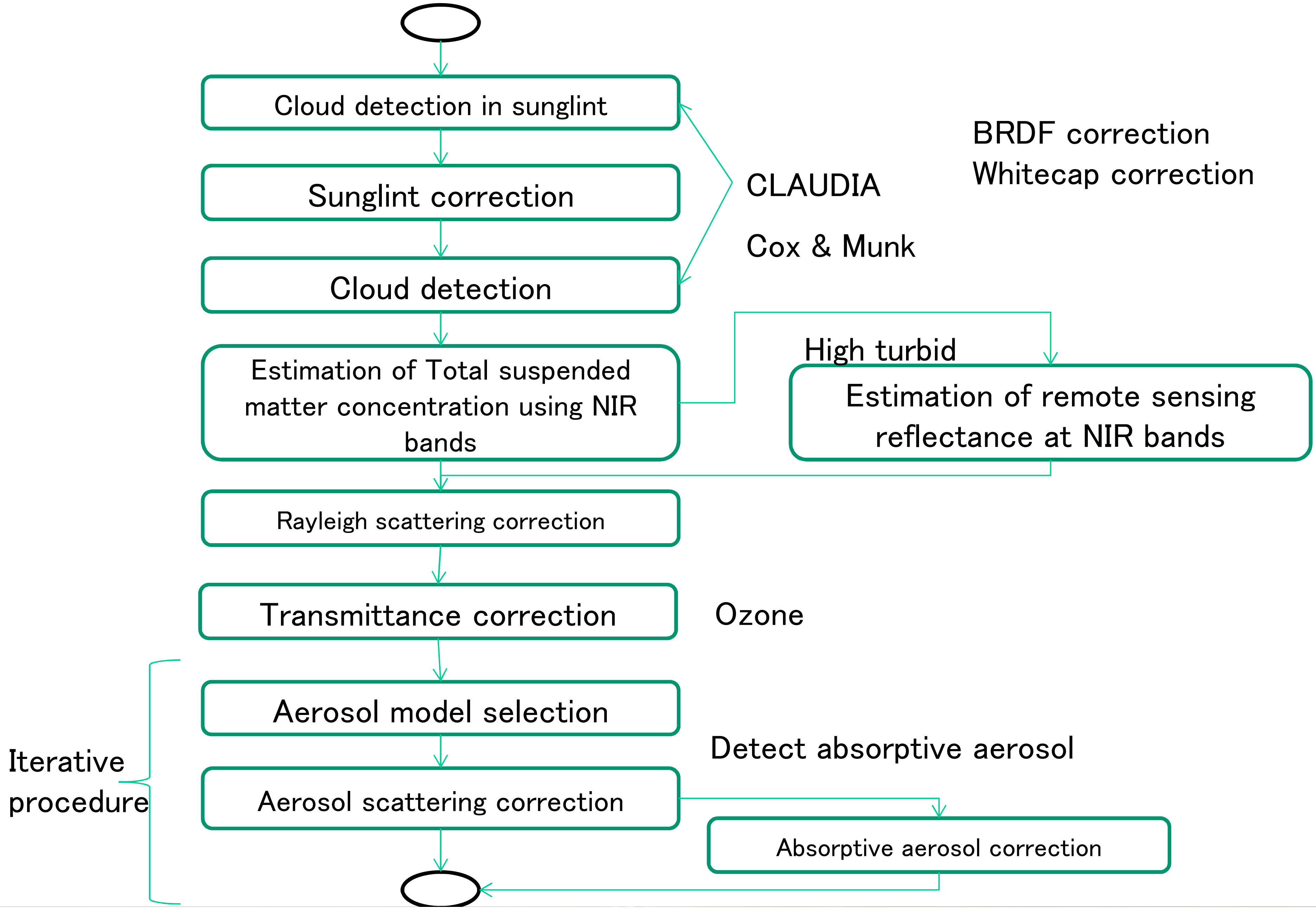
- Overview of atmospheric correction
- Spectral dependency of aerosol optical thickness
  - Relationship between Angstrom exponent aerosol type
- Aerosol model to make look-up tables for aerosol reflectance correction
  - Proposal model and sensitivity test of aerosol parmeters
- Cloud detection in cloud edge
  - Performance of Inter-band Radiance Combination index method (IRC)

Overview of atmospheric correction for SGLI

- Based on
  - Wang and Gordon (1994) for SeaWiFS
  - Siegel et al.(2000)
  - Stumpf et al.(2003)
  - Toratani et al.(2007) for GLI

  - Correction of absorptive aerosol
  - Consideration of high turbid area

Flowchart of atmospheric correction scheme



Comparison simulated-aerosol with ground observation

Aerosol simulation CFORS

Several type aerosol concentration

Comparison

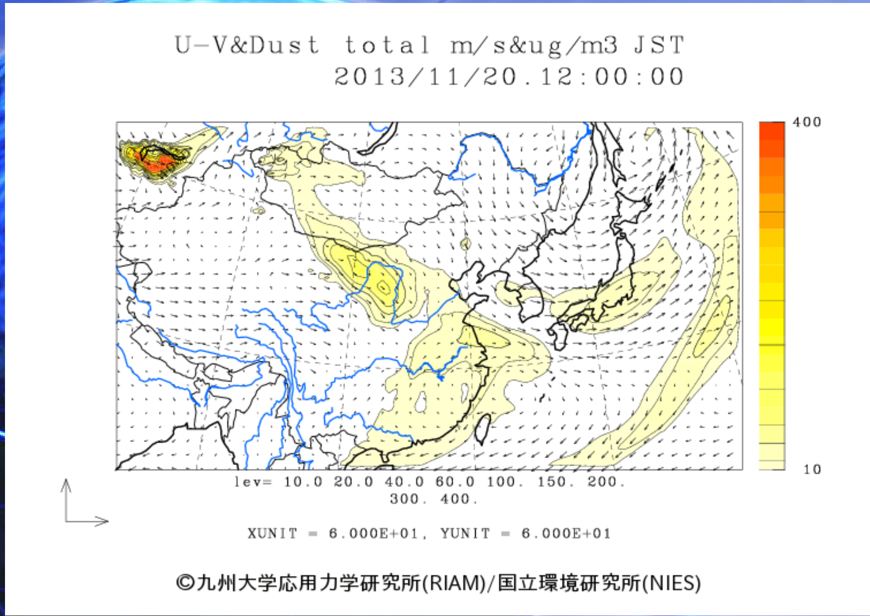
Ground observation

Aerosol optical thickness

Angstrom exponent

RIAM-CFORS

- **Chemical weather FORecasting System**
- based on 3D on-line regional scale chemical transport model fully coupled with RAMS (Regional Atmospheric Modeling System)



DUST

Sulfate : SO_4

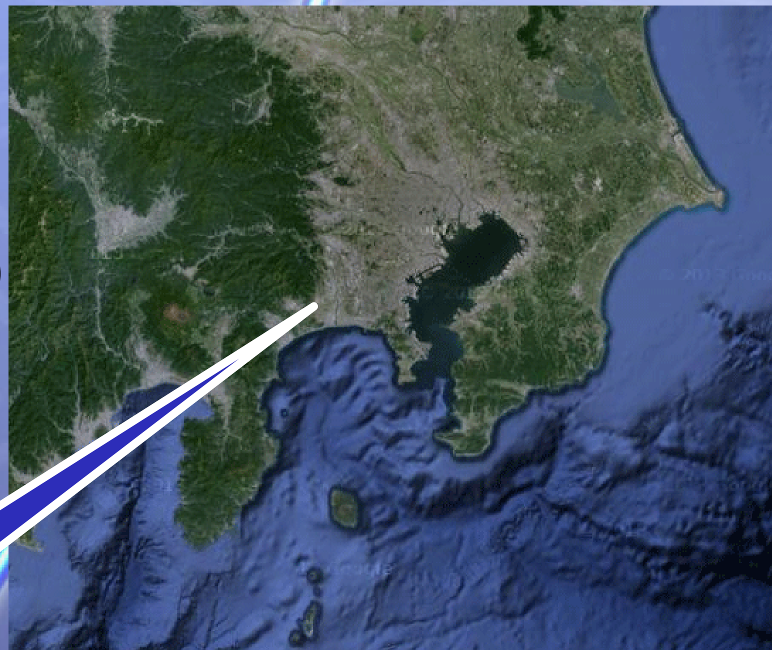
Black Carbon: BC

Organic Carbon : OC

http://www-cfors.nies.go.jp/~cfors/outline.html

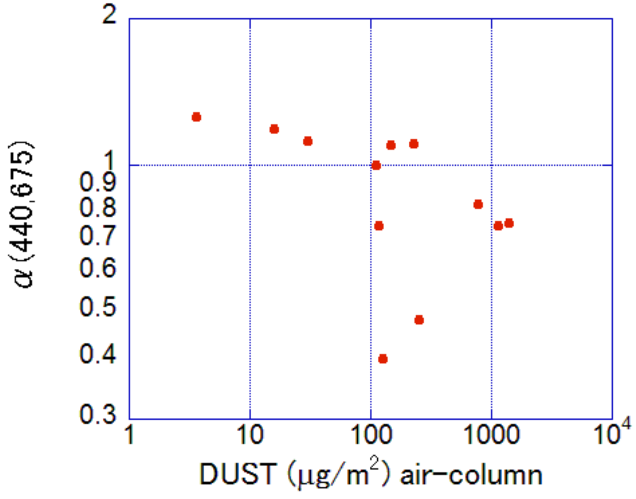
Microtops 2 Observation

- 2013/2/26-7/8
- 12 fine days
  - Dust : 7 days
- Wavelengh
  - 380, 440, 675,
  - 870, 1020nm
- Calculate α(440, 675)

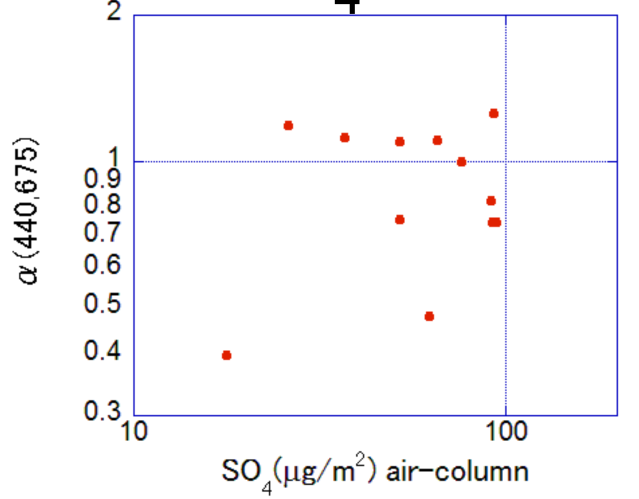


Angstrom exponent vs Aerosol concentration

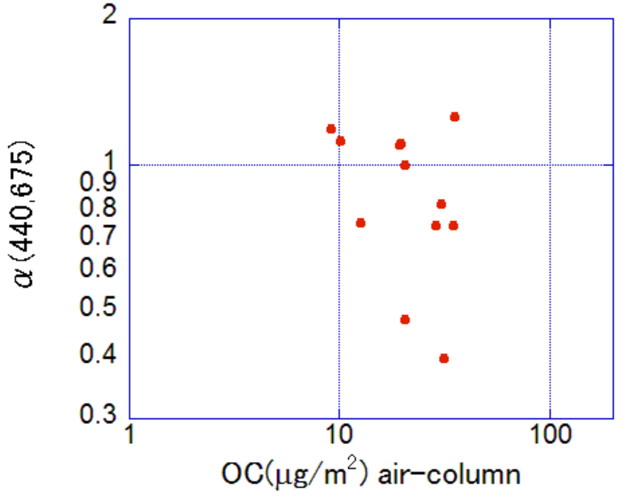
DUST



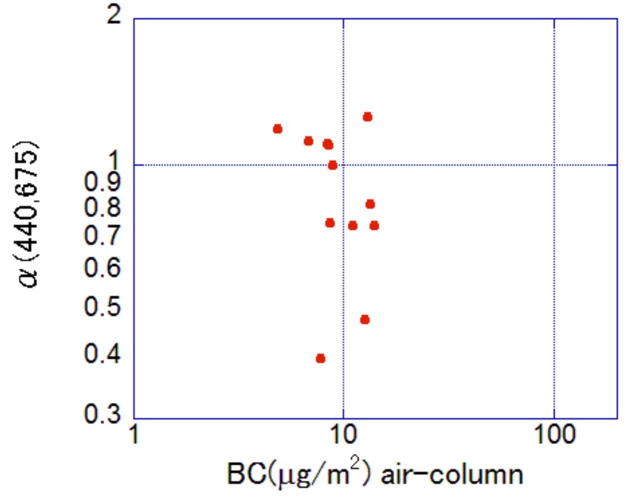
SO_4



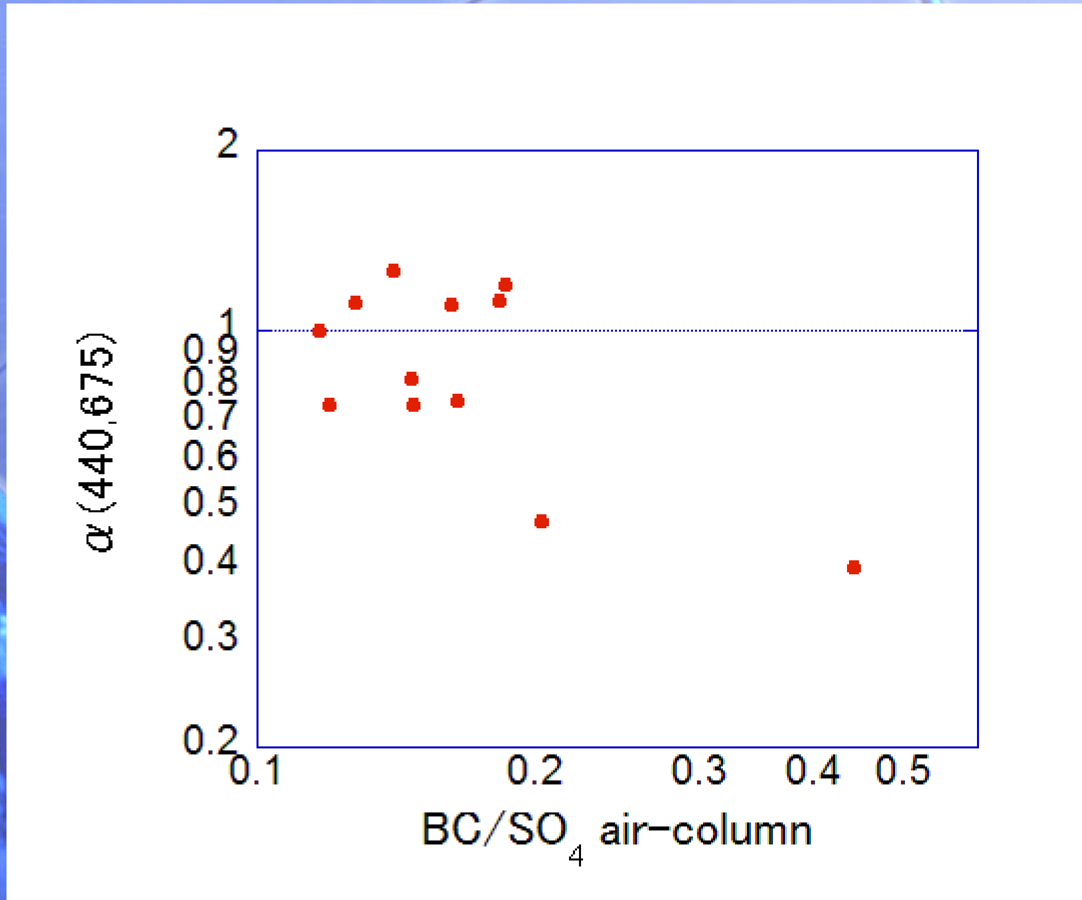
OC



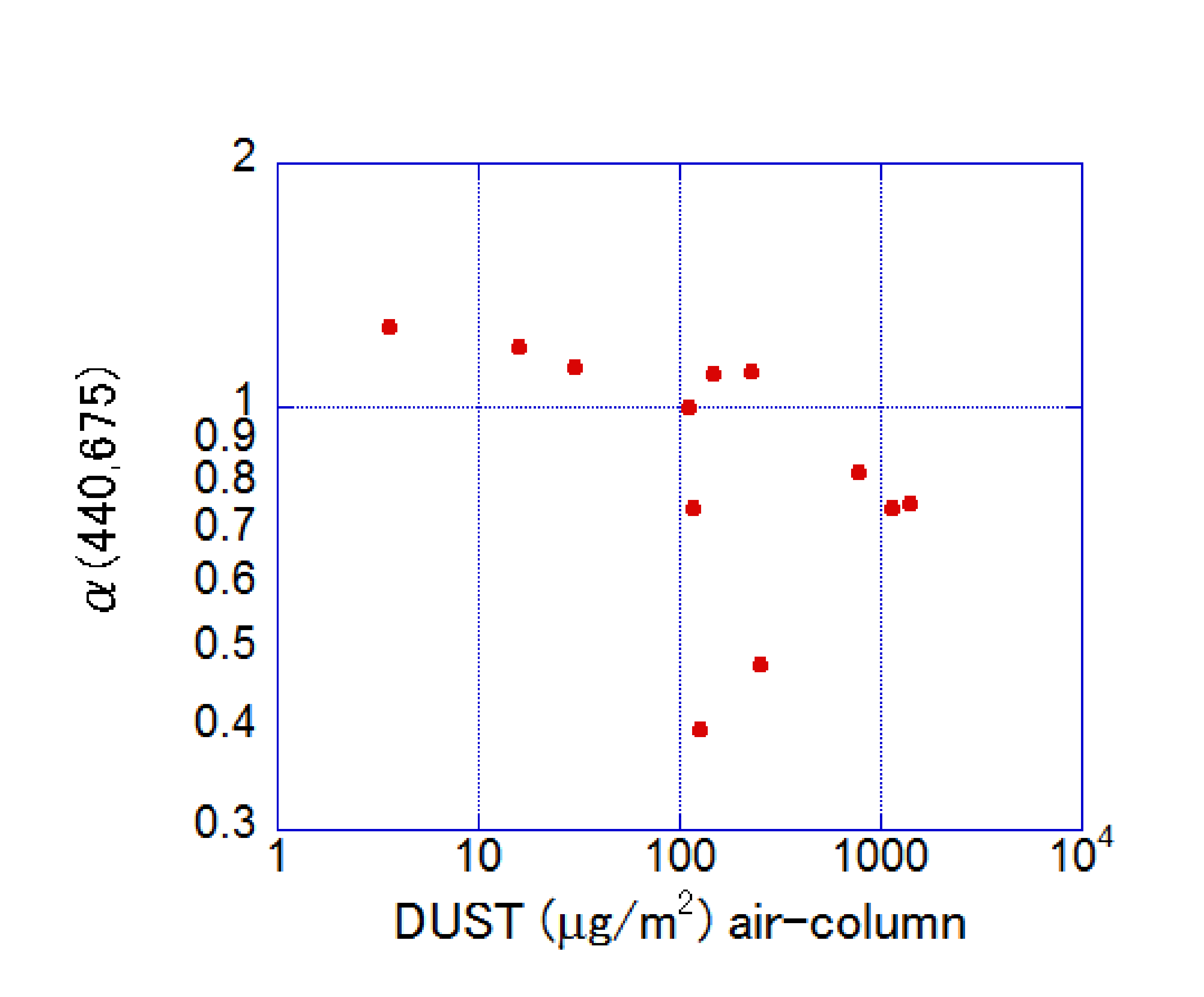
BC



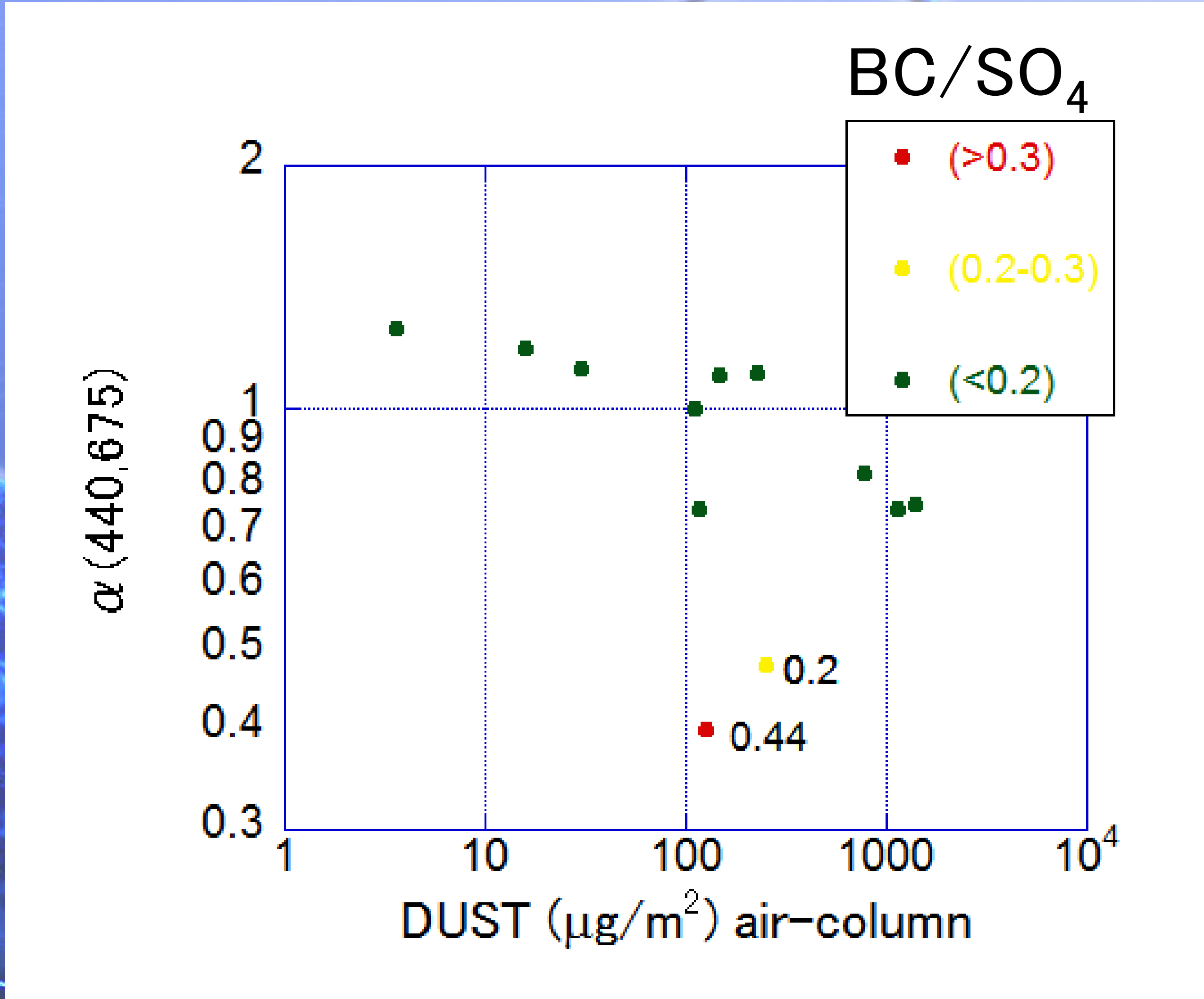
Relationship between α and BC/SO_4



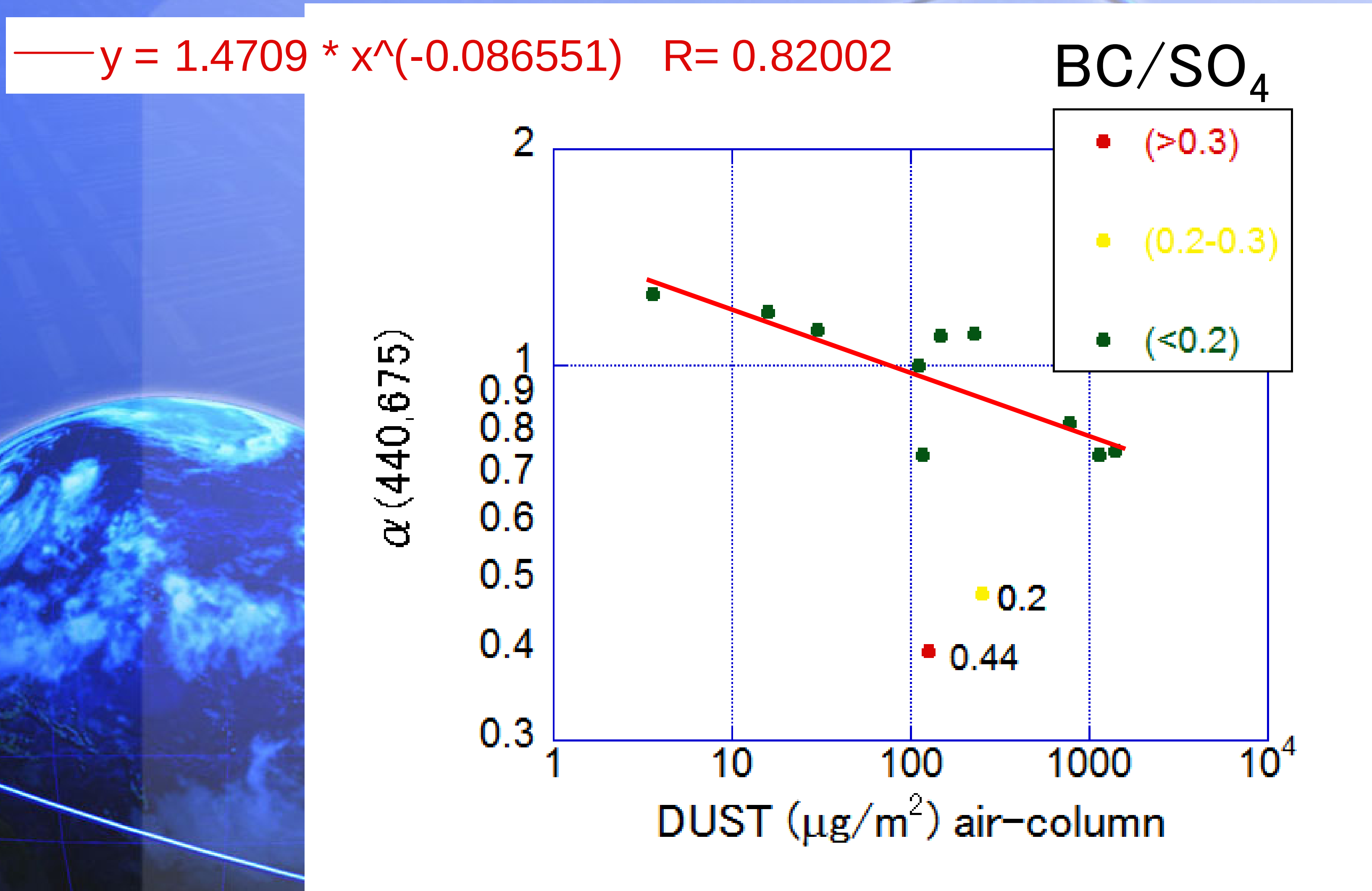
Relationship between α and DUST



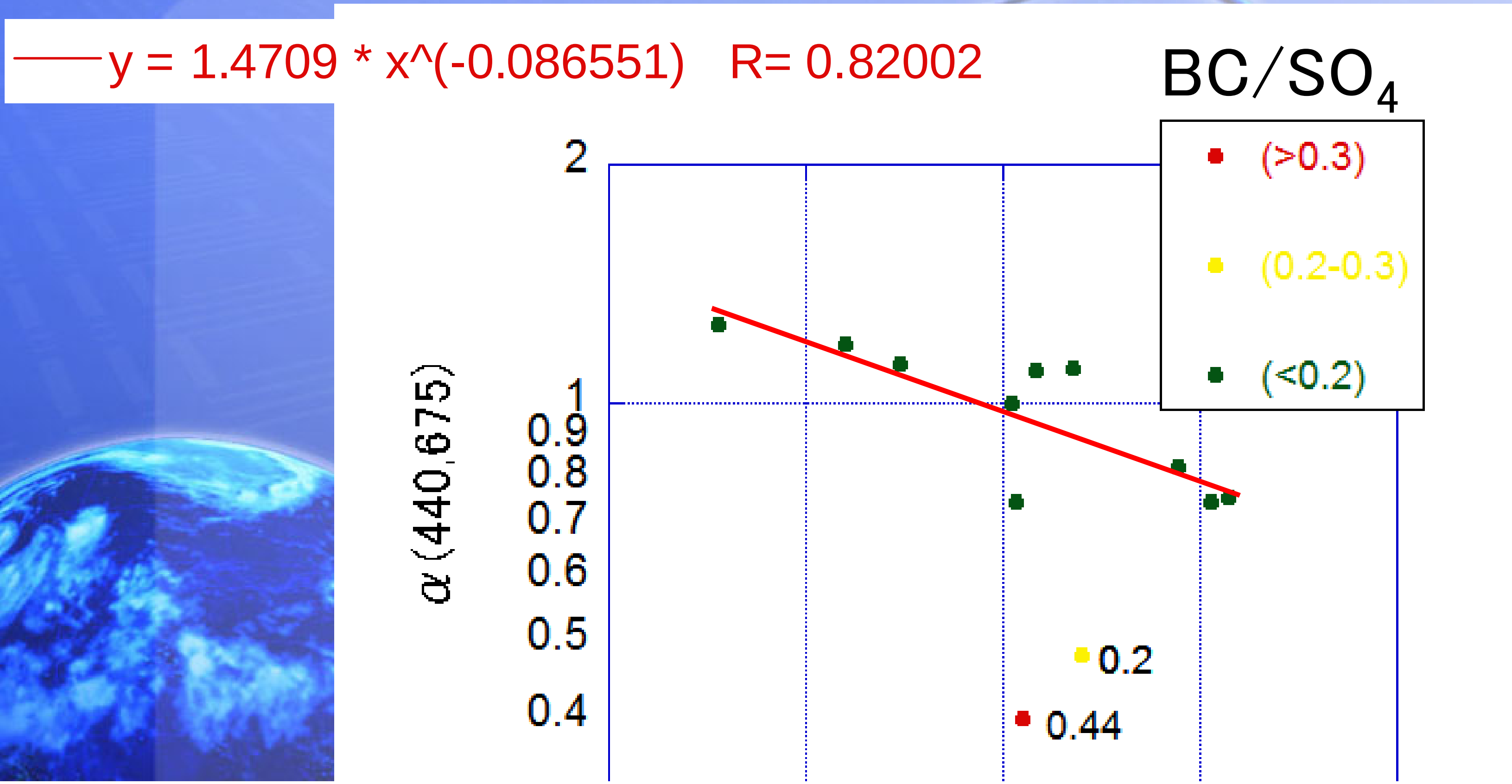
Relationship between α and DUST



Relationship between α and DUST



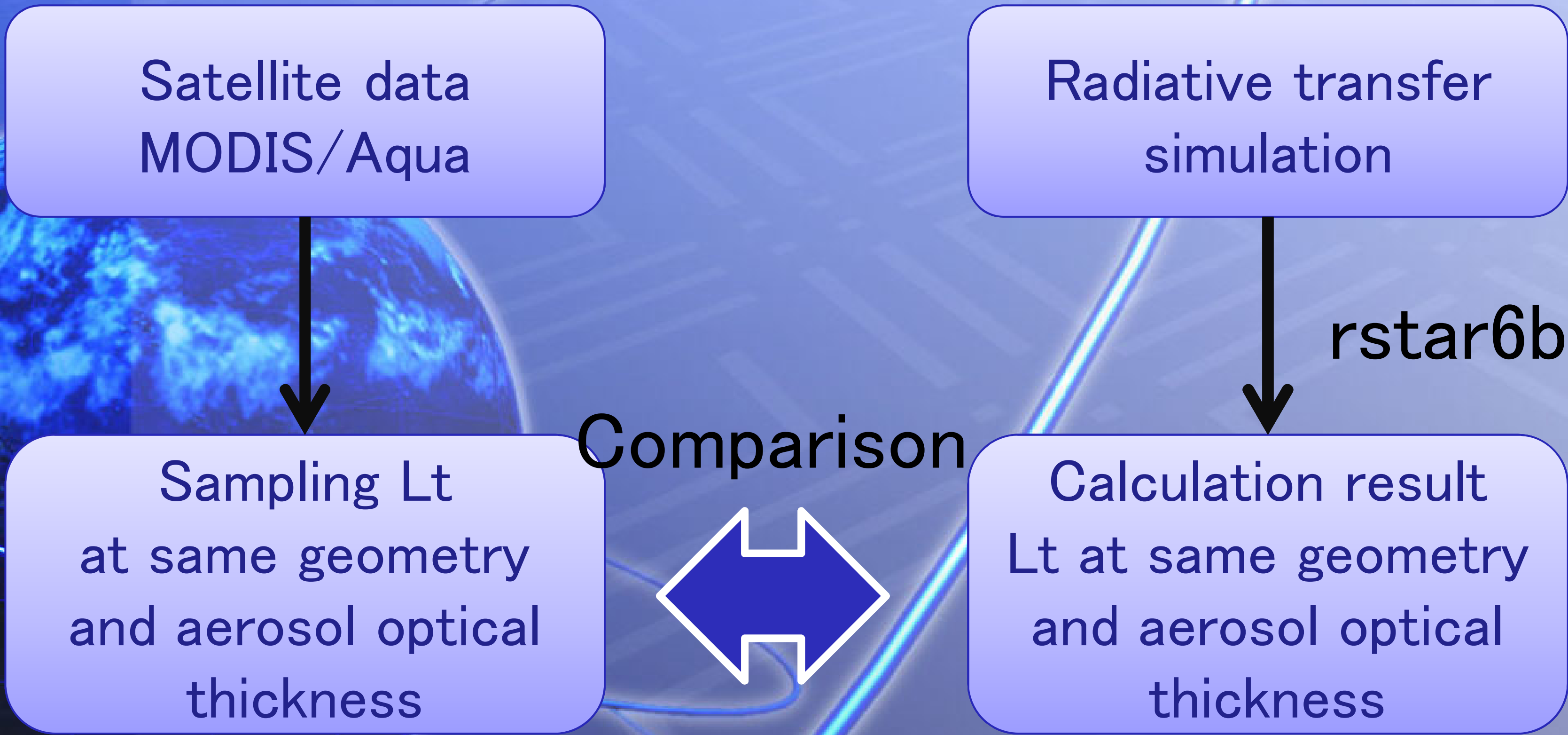
Relationship between α and DUST



Dust quantity related α(440,675) except for the ratio BC/SO_4 was higher (>0.2). Requiring attention of component of fine mode, especially absorptive aerosol such as black carbon.

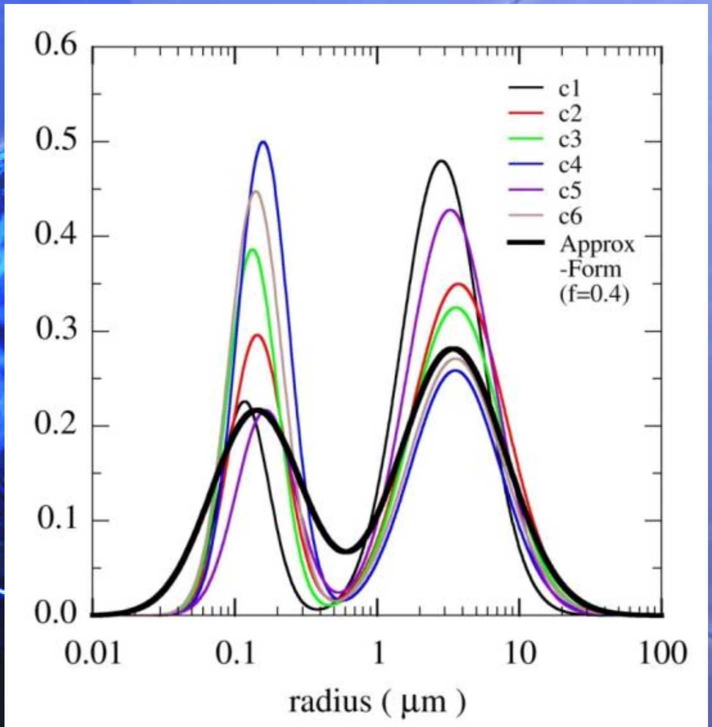
Comparison MODIS data with Radiative transfer simulation

- We need to fix aerosol model to make lookup tables for aerosol reflectance and transmittance correction



Aerosol model

- Bimodal model
  - Aerosol model provided by atmosphric group
  - It derived from AERONET data



Proposed model

Fine mode

$r=0.14 \quad \sigma=1.86$

Coarse mode

$r=3.42 \quad \sigma=2.34$

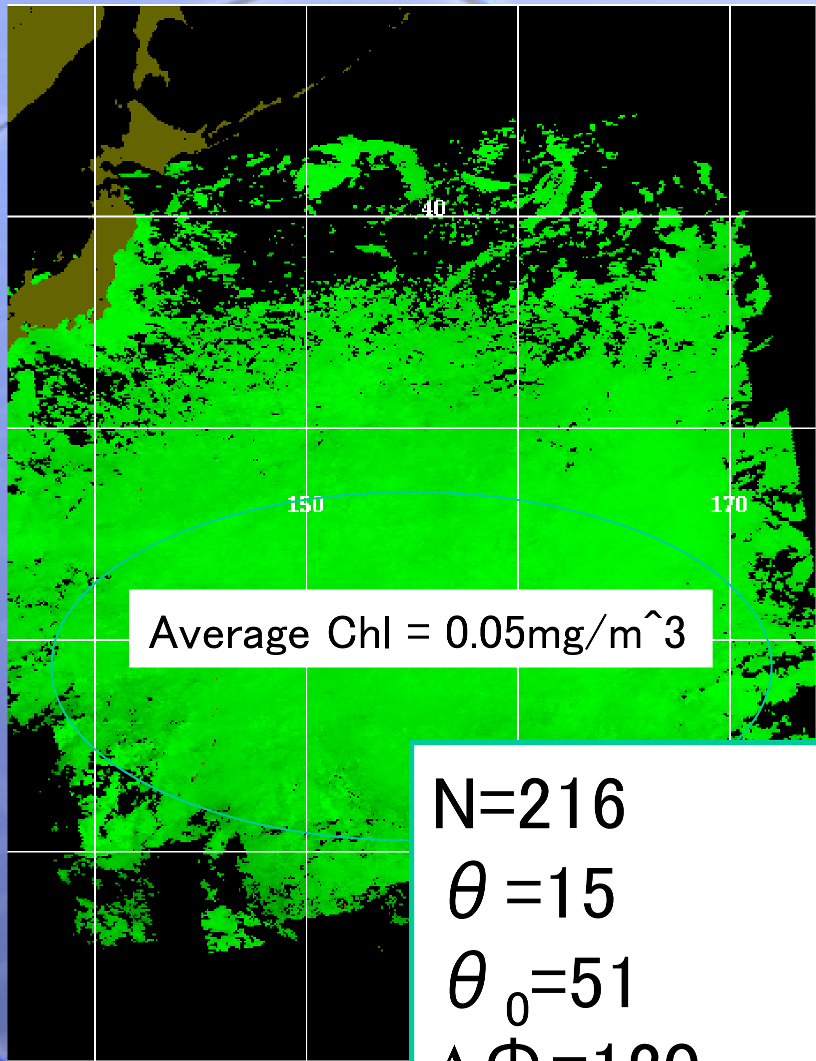
Aerosol type

mixture model

Tropospheric:Sea spray=40：60

Sampling Lt from MODIS/Aqua data

- Data in Jan. in 2013
- A2013003031000
- A2013005030000
- A2013007024500
- A2013008033000
- A2013009023500
- A2013010032000
- A2013015033500
- A2013016024000
- A2013017032500
- A2013019031000
- A2013021030000
- A2013024033000
- A2013027022500



N=216

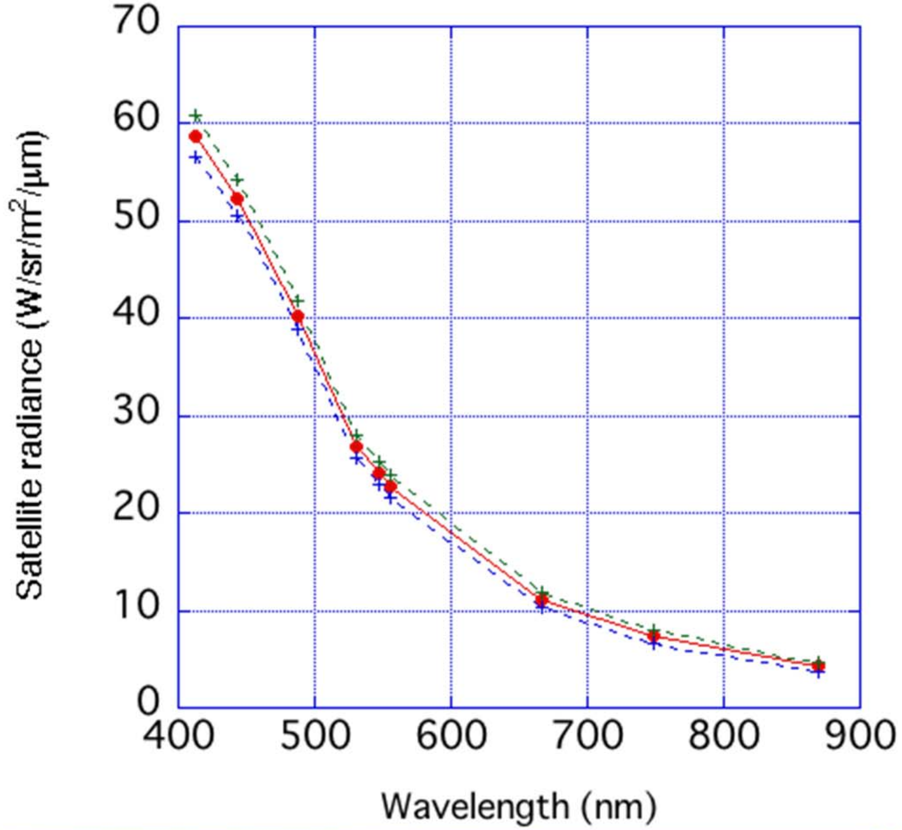
θ =15

θ_0=51

$\Delta\Phi$=120

τ_A(869)=0.15

Satellite radiance from MODIS/Aqua Jan. in 2013 on Pacific ocean



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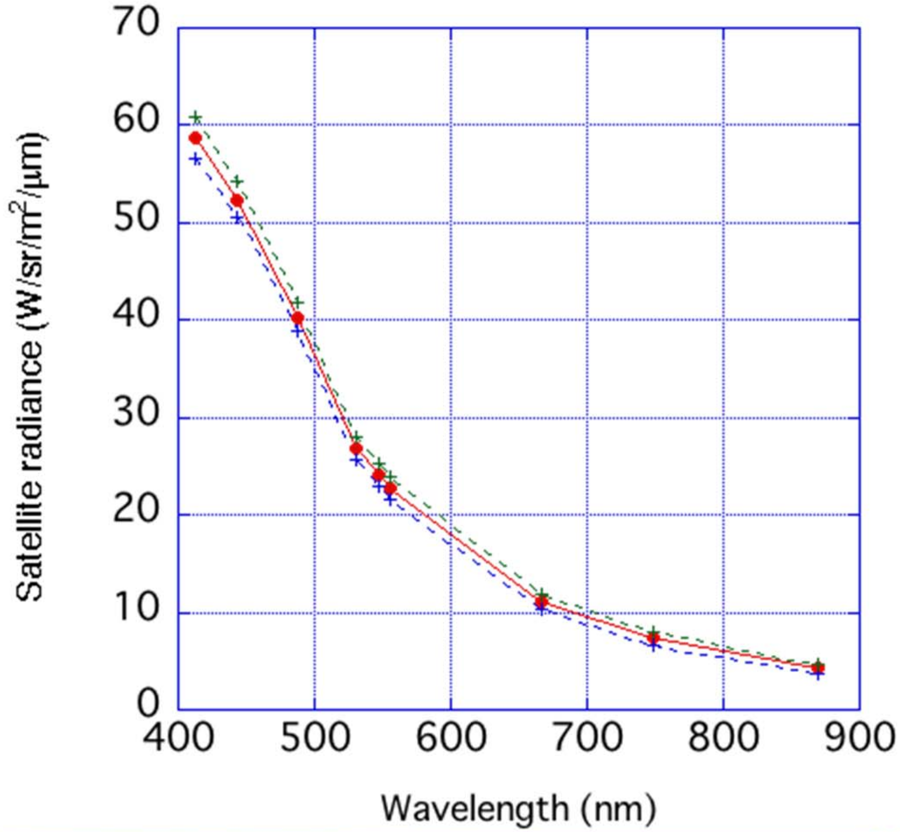
Lt(869) : 4.25

Std.dev.: 0.45

(W/(m^2・sr・μm)

Satellite radiance from MODIS/Aqua
Jan. in 2013 on Pacific ocean



N=216
θ =15
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$\Delta\Phi$=120
τ_A(865)=0.15

Lt(869) : 4.25
Std.dev.: 0.45
(W/(m^2・sr・μm)

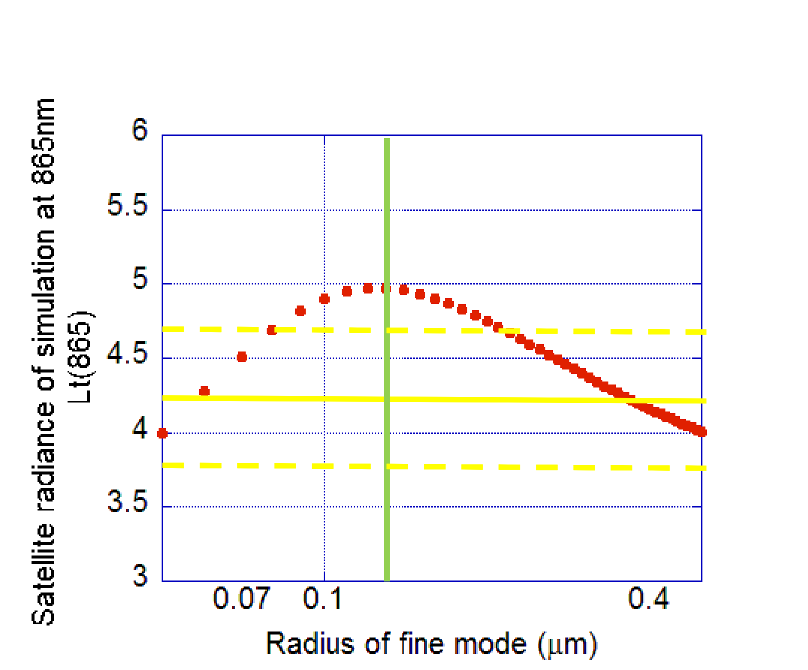
Simulation result　Lt(869) =4.96
(W/(m^2・sr・μm)

Aerosol model

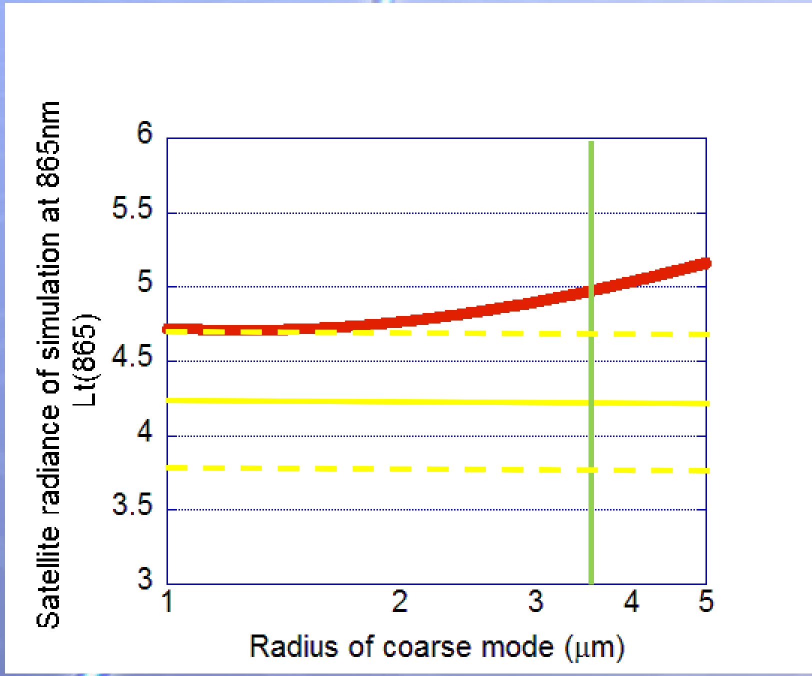
- Initial model was not applicable.
- Sensitivity test of Parameters
  - Small particle radius
  - Std.Dev. of small particle
  - Large particle radius
  - Std.Dev. of large particle
  - Ratio of volume size
  - Wind speed
  - Relative humidity
- Comparison Lt(865)

Result of sensitivity test

Radius of fine mode

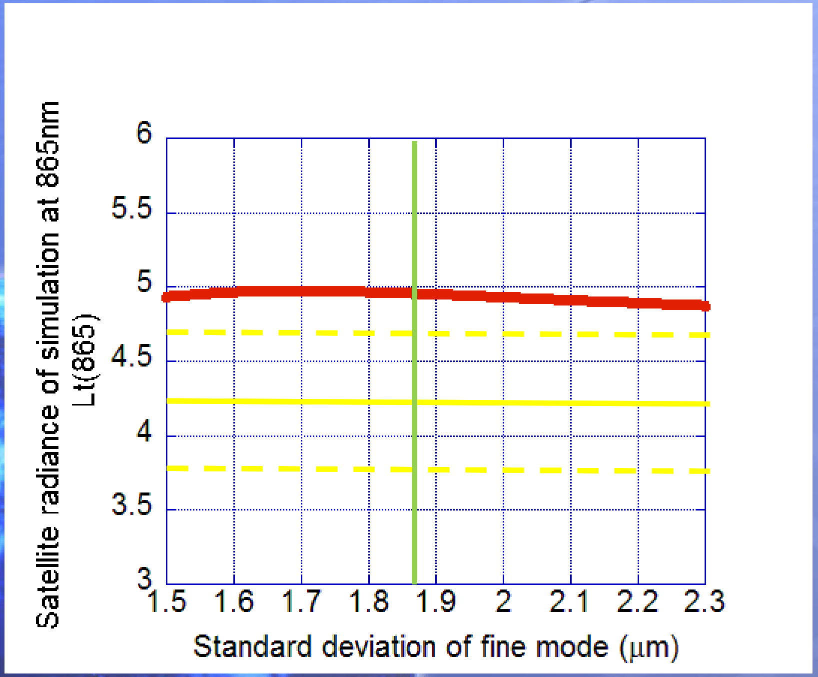


Radius of coarse mode

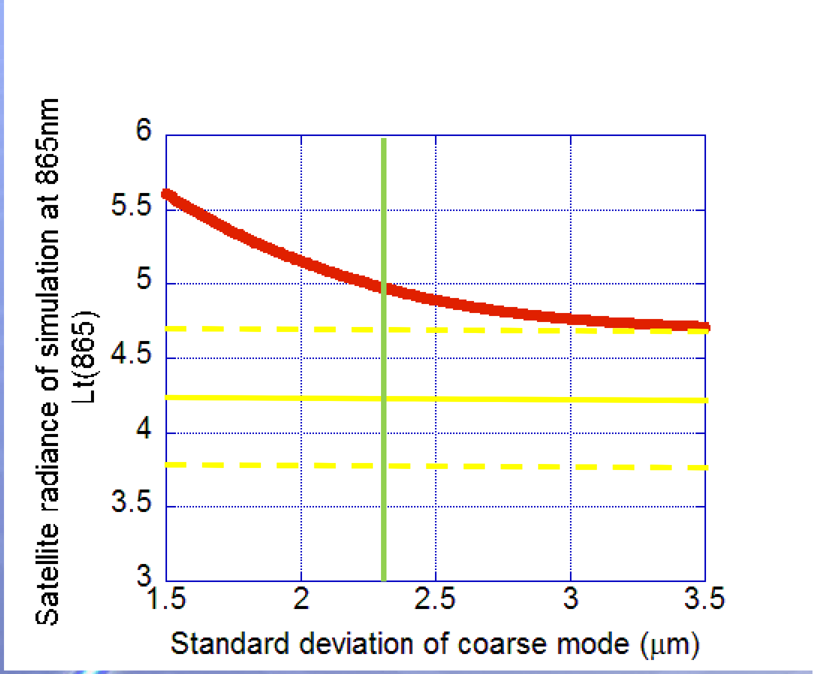


Result of sensitivity test

Std.dev. of fine mode



Std.dev. of coarse mode



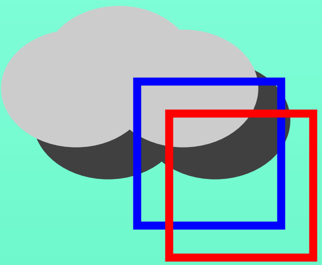
Sensitivity test of aerosol parameters shows that average radius of fine mode is sensitive.

Cloud screening problems

- Highly turbid water
  - may trip the cloud mask

Manageable by two-step masking

- Sub-pixel cloud (incl. cloud edge)
  - may affect atmospheric correction
- Cloud shadow
  - “low Rrs555” mask may not enough



cause erroneous L2 pixel value

Bigger effect when

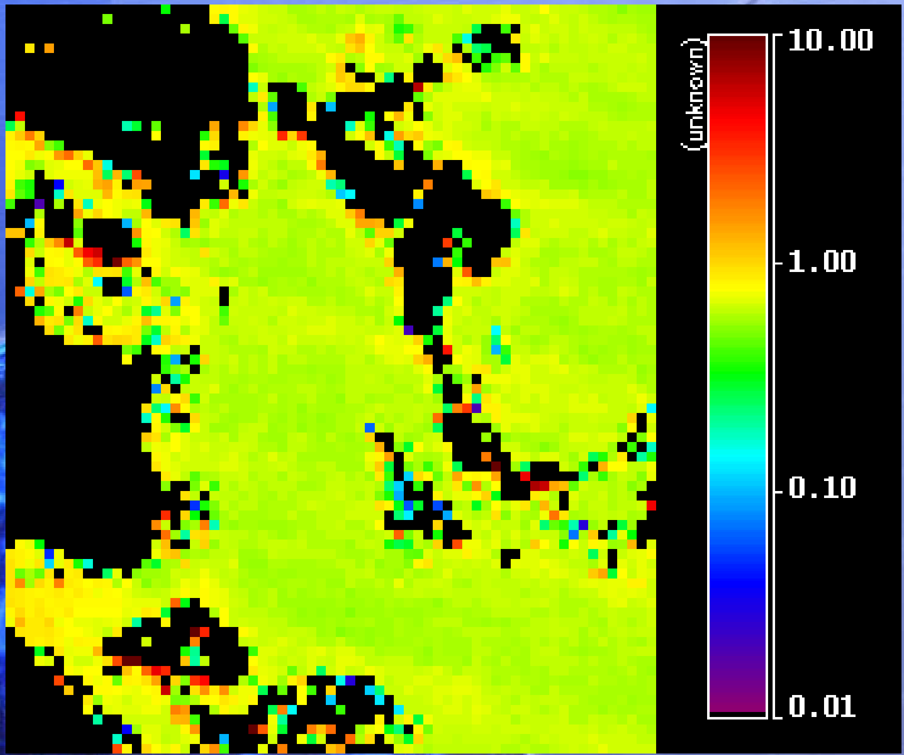
- inter-band registration is not perfect
- or
- inter-band time difference is large

GLI, SGLI,…

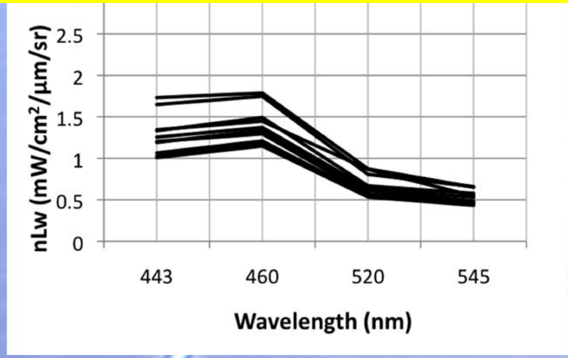
GOCI, …

Anomalous features around cloud edge pixels

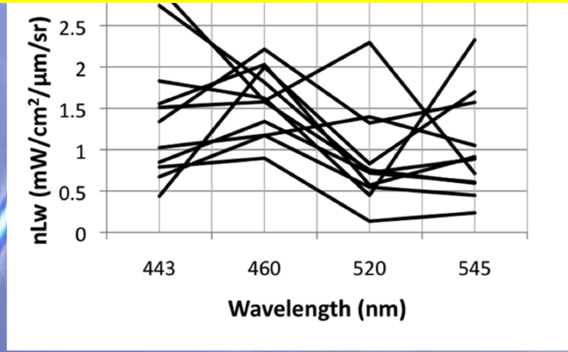
(from GLI chl-a image of May 24, 2003, south of Japan)



nLw in "Cloud-free" area

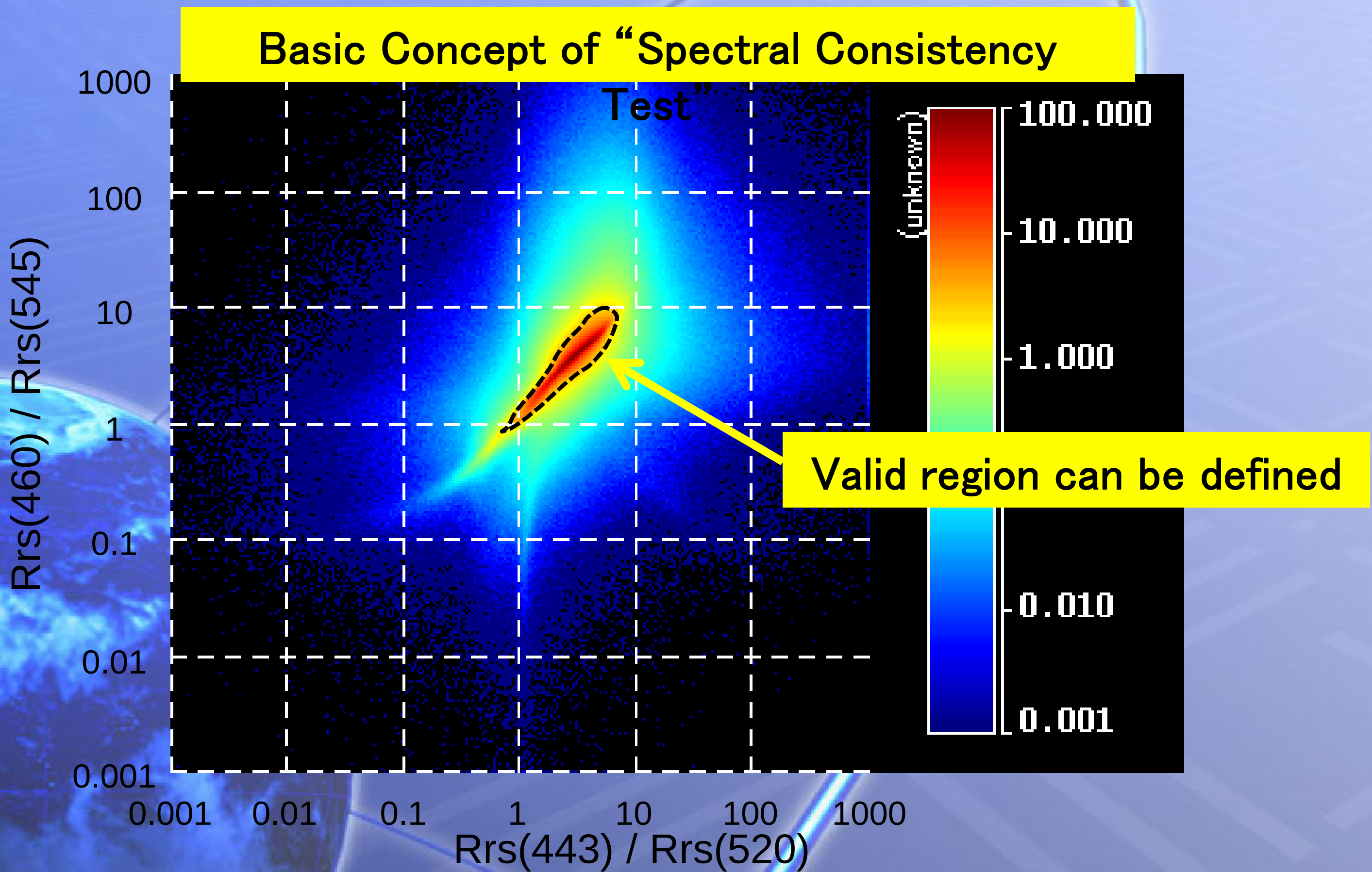


nLw in at "Cloud-edge"



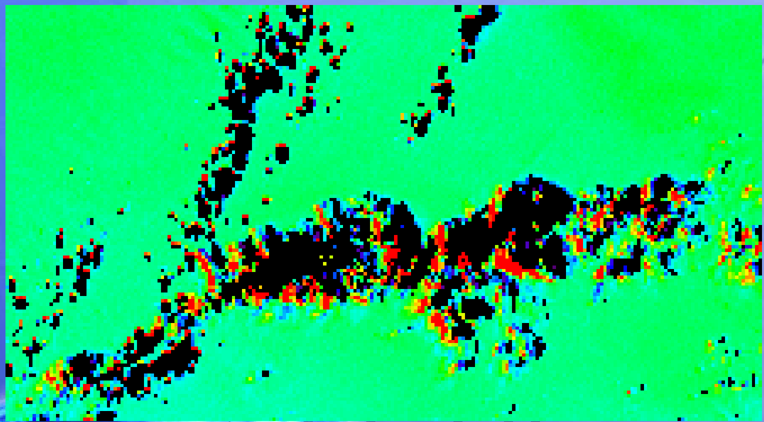
Normalized water-leaving radiance at 4 GLI bands.
a) Pixels sampled at cloud-free area, and
b) sampled at cloud-adjacent pixels with anomalous concentration estimate.

Inter-band Reflectance Consistency over a Weekly Global GLI Data

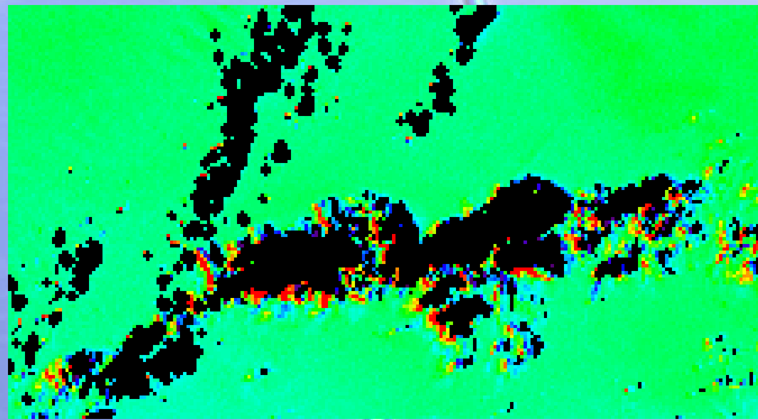


ADEOS-II / GLI
June 10-17, 2003
8day data set

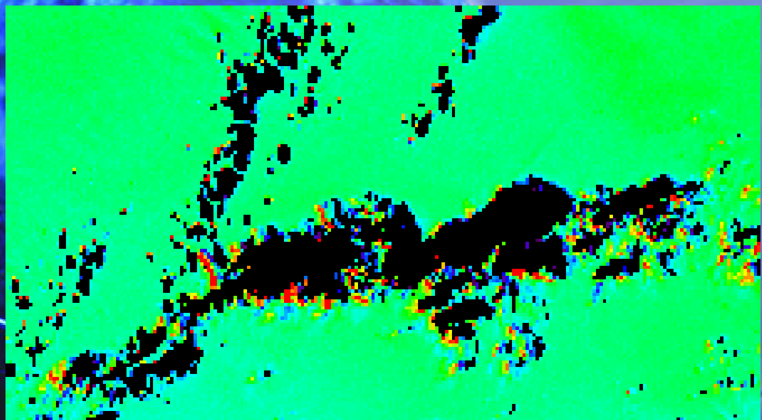
Sub-scene 1 (Typhoon case)



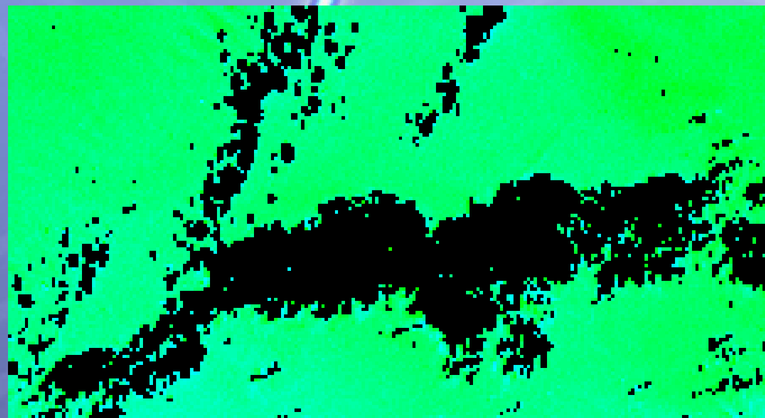
simple threshold



GOCI standard

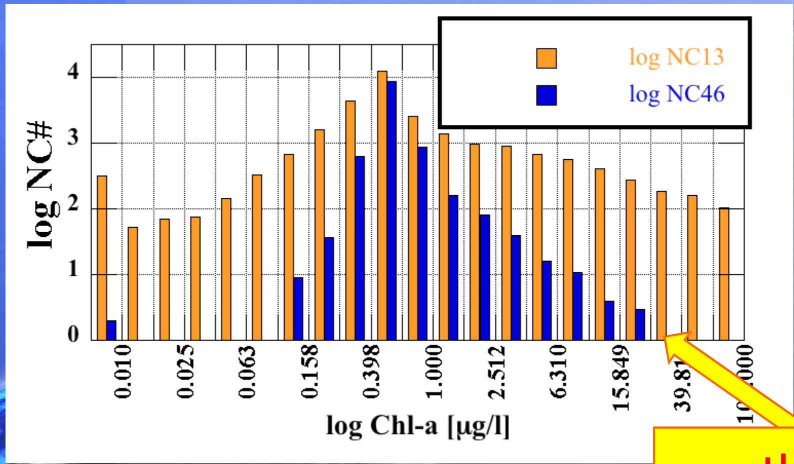


8-band threshold



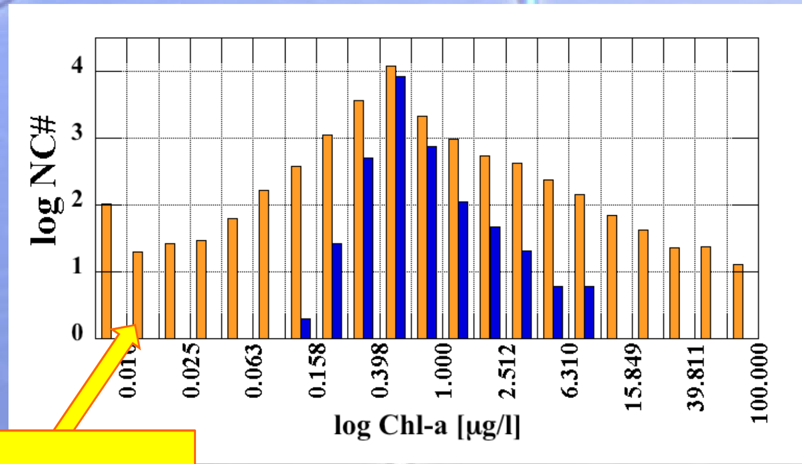
IRC

CSP Histogram for Typhoon Scene



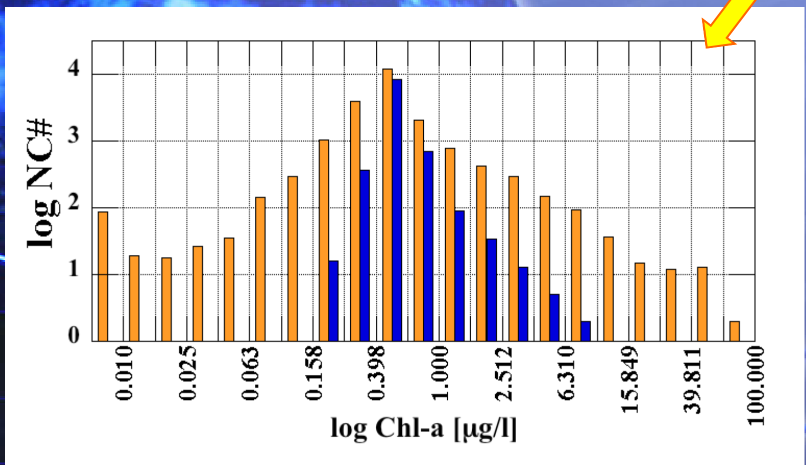
simple threshold

rather poor

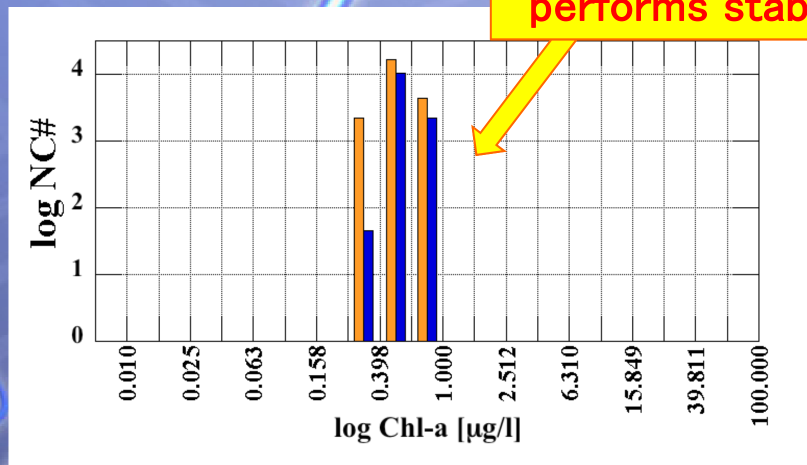


GOCI standard

performs stable



8-band threshold



IRC

Summary

- Spectral dependency of aerosol optical thickness
  - relationship between Angstrom exponent aerosol type
  - Dust quantity related α(440,675) except for the ratio BC/SO_4 was higher (>0.2).
  - Requiring attention of component of fine mode, especially absorptive aerosol such as black carbon.

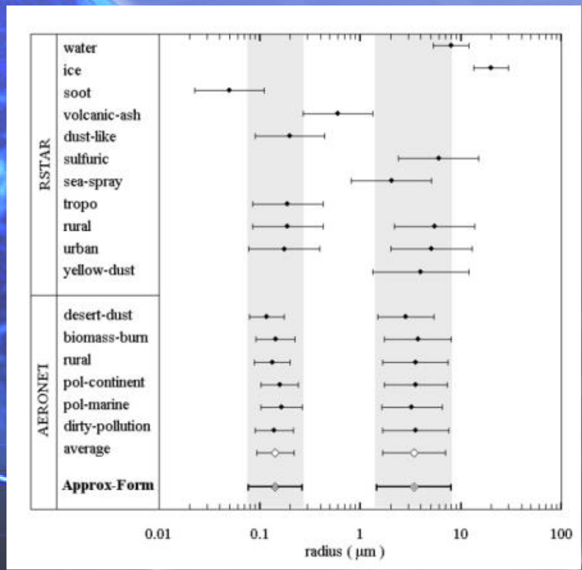
Summary

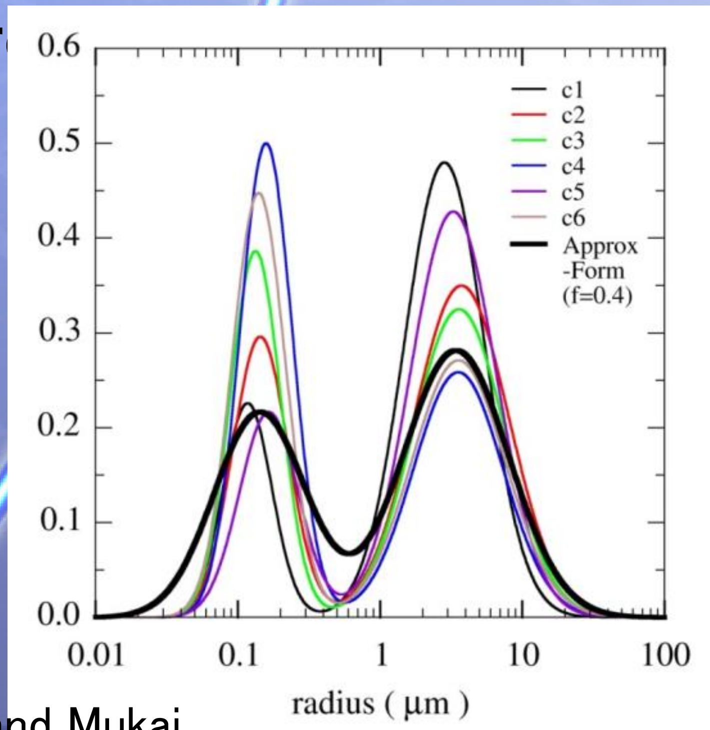
- Aerosol model to make look-up tables for aerosol reflectance correction
  - Proposed aerosol model was not applicable in this study.
  - Proposal model and sensitivity test of aerosol parmeters
    - Sensitivity test of aerosol parameters shows that average radius of fine mode is sensitive.
- Inter-band Radiance Consistency method for cloud masking had good performance.

Backup slide

Aerosol correction

- Now we are making aerosol look-up table.
  - Aerosol model provided by atmosphere group
  - it derived from AERONET data
  - Rstar6b (Radiative transfer code)
- Absorptive aerosol corr



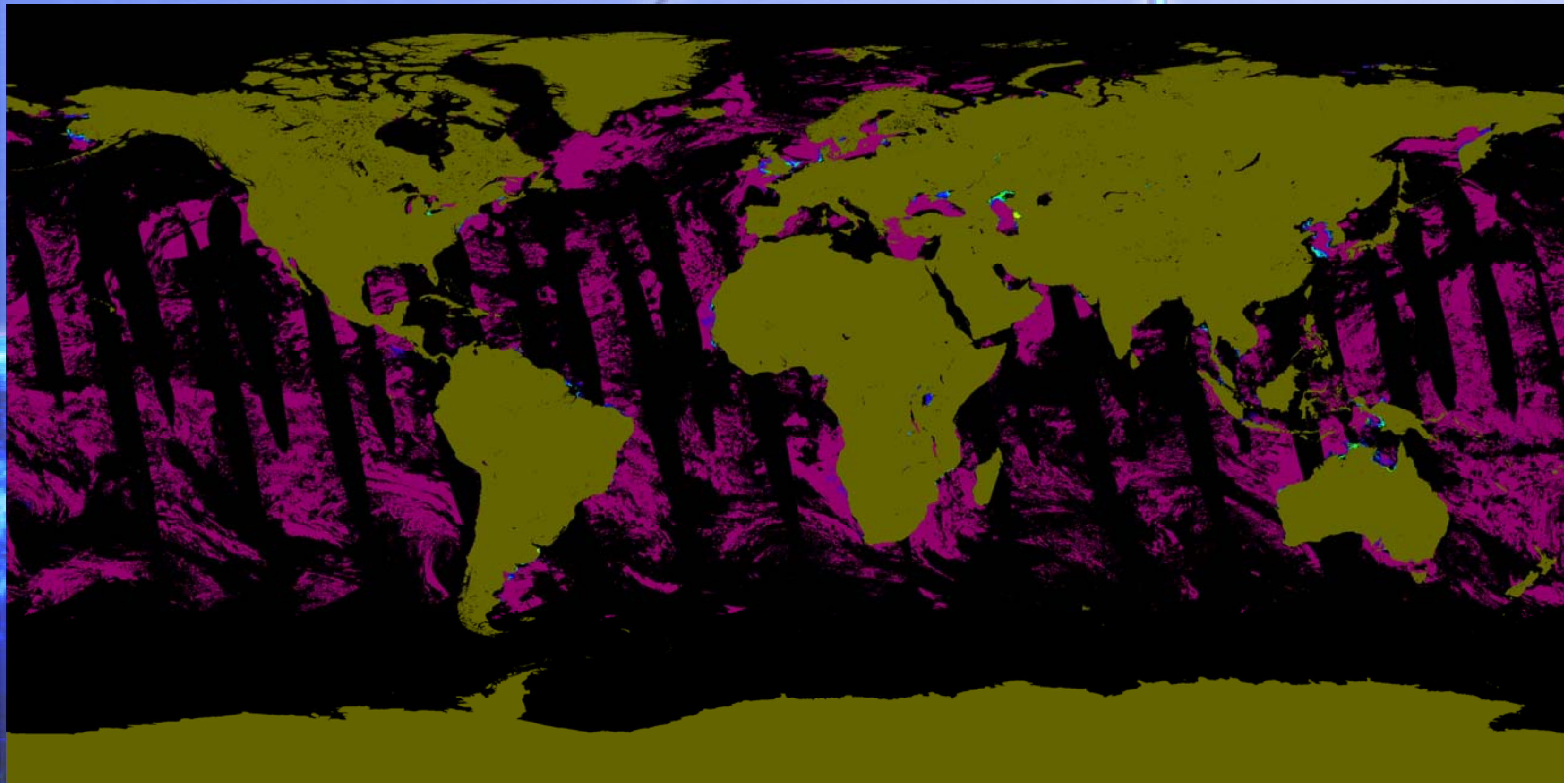


Provided by Nakata, Sano and Mukai
(Kinki university)

Atmospheric correction for high turbid area

- Detection of high turbid area
  - Threshold of total suspended matter concentration (TSM)
  - We developed simultaneously estimation algorithm of TSM concentration, AOT and Angstrom exponent using three bands at NIR.

2013/5/3 TSM from MODIS three NIR bands



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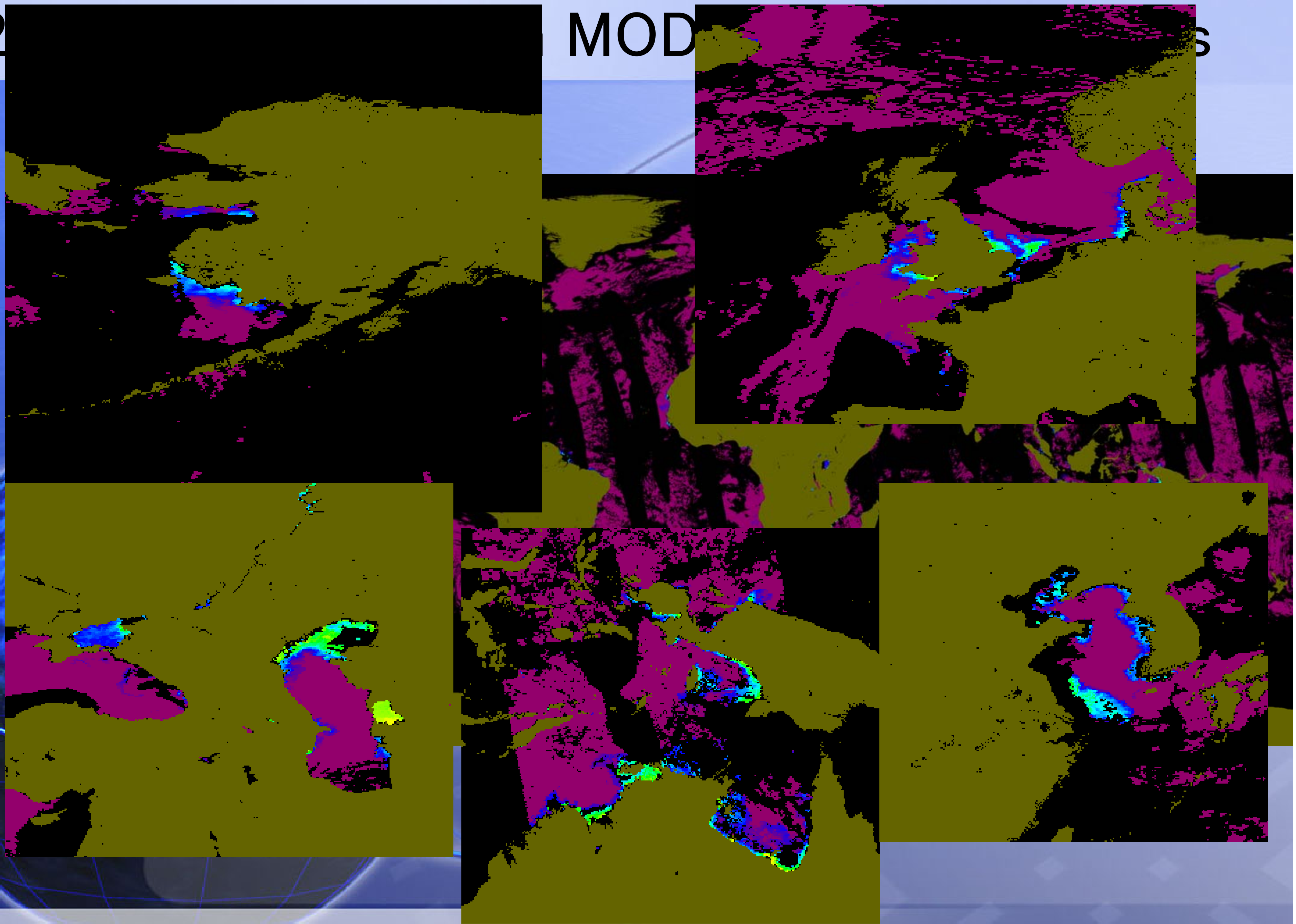

Problem for SGLI

- SGLI has three NIR bands (670, 765, 865).
- It is difficult to use 765nm band because of oxygen absorption.

- Consider for Oxygen absorption correction
- Or use constant of angstrom exponent
- Laughly TSM estimation