Aerosol retrieval based on combination use of POLDER and GLI data

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- Algorithm description for aerosol retrieval
- Retrieved results derived from POLDER
- (Preliminary) results of combination use of POLDER and GLI
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Background

Aerosols : One of the most variable components of the atmosphere

for radiative transfer models (Atmos. Corr.)

for GCM models

for air quality index

etc.

SGLI ≈ POLDER + GLI

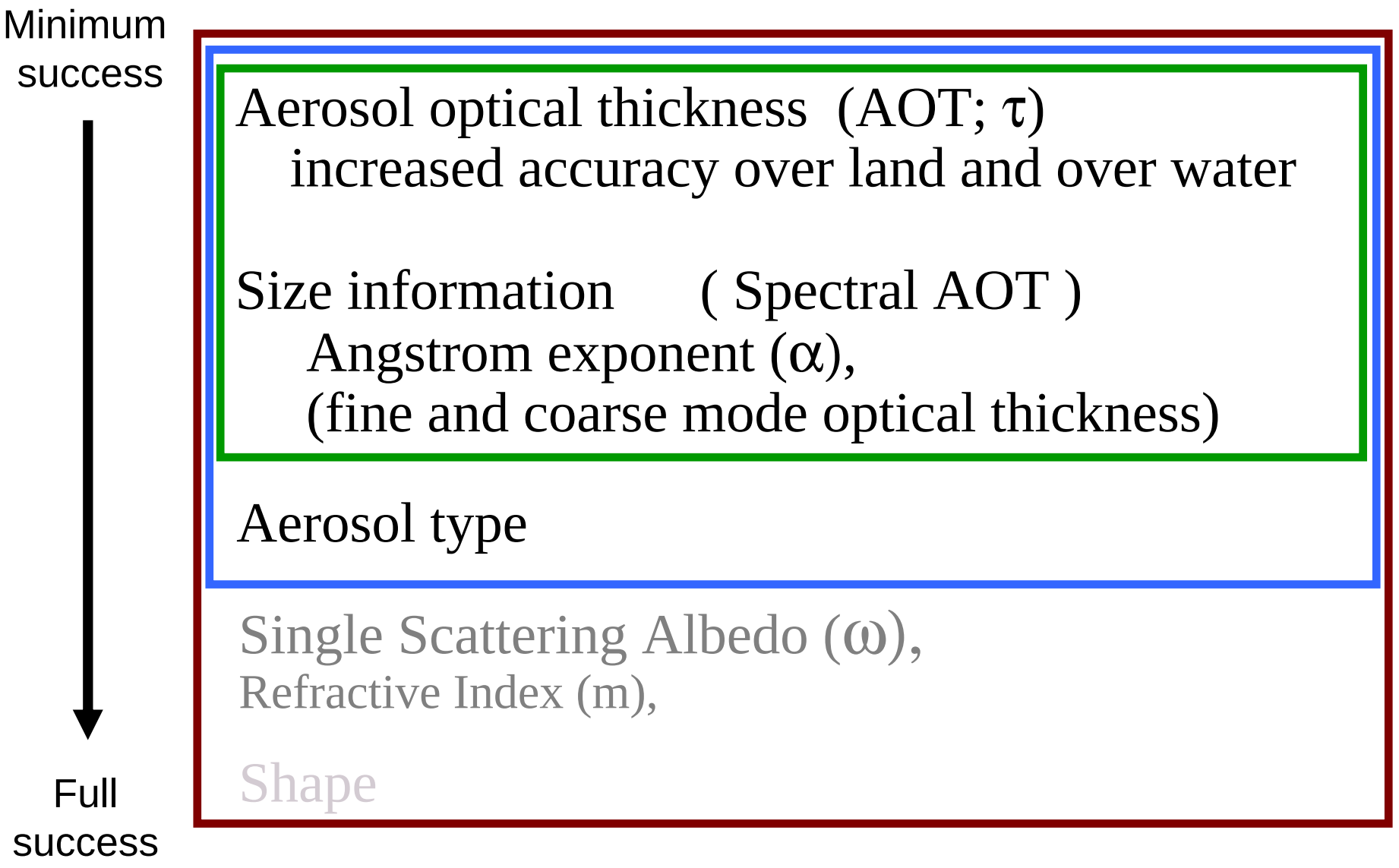
- Stokes parameter
  I, Q, U : (0 – 60 –120 position angles)
  at 0.67 and 0.86 μm channels (POLDER)

- Near UV and violet data
  at 0.38 and 0.40 (0.41) μm channels (GLI)

- Large tilting angle
  ± 45 degrees about nadir in the along-track direction (POLDER)

- Fine resolution
  1 km (GLI) cf. 6×7 km (POLDER)

Aerosol information from SGLI



Algorithm for aerosol retrieval

1. Four-channel algorithm over ocean

2. Two-channel algorithm over ocean and land

3. Two-channel algorithm over land

Retrieval algorithm for aerosols (over ocean)

1. Four-channel algorithm
   (by Higurashi and Nakajima):
   - Retrieval of τ, α, and absorptivity in blue over ocean:
   - 0.412, 0. 443, 0.670, and 0.865 μm (Blue, VIS, NIR)
   - Species
     ; soil dust, carbonaceous, sulfate, and sea salt

Retrieval algorithm for aerosols (ocean/land)

2. Two-channel method (by R. Hoeller et al.);

– Retrieval of τ and ω (land and ocean)
– 0.380 and 0.412 μm (UV-absorbing and Blue);

Species
; soot and dust (absorbing) and
sulfate (non-absorbing)

Retrieval algorithm for aerosols (over land)

3. Two-channel Polarization method

- Retrieval of τ, and α, on a global scale

- 0.678 and 0.865 μm

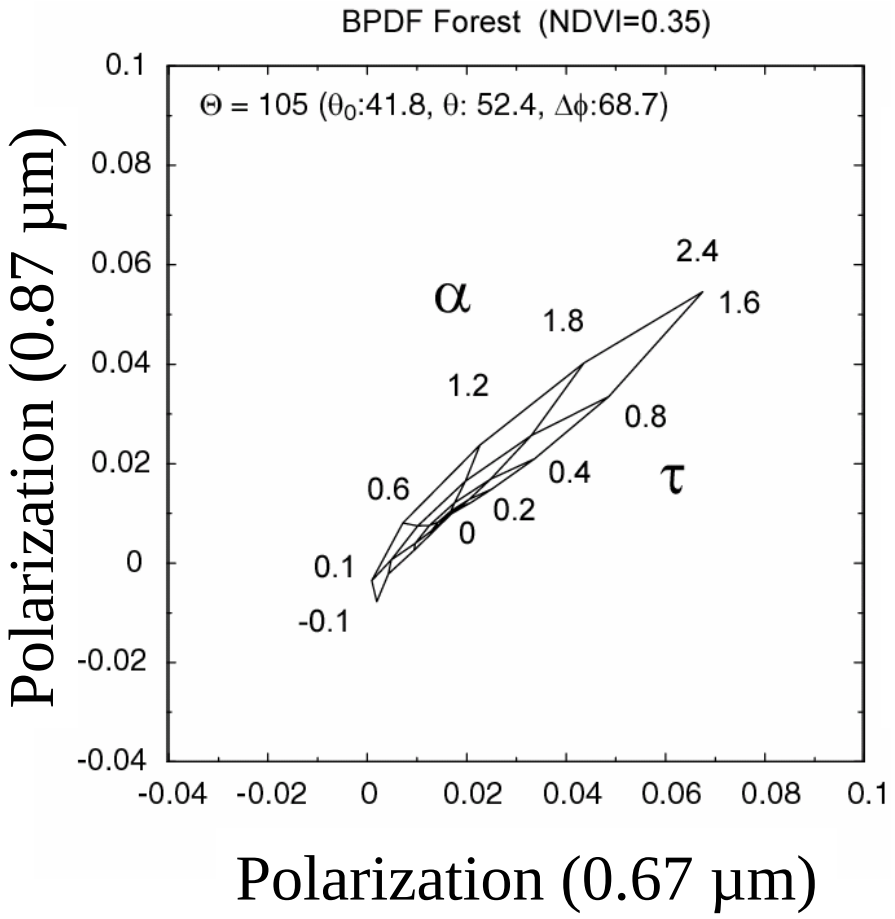
(Polarization and Directionality)

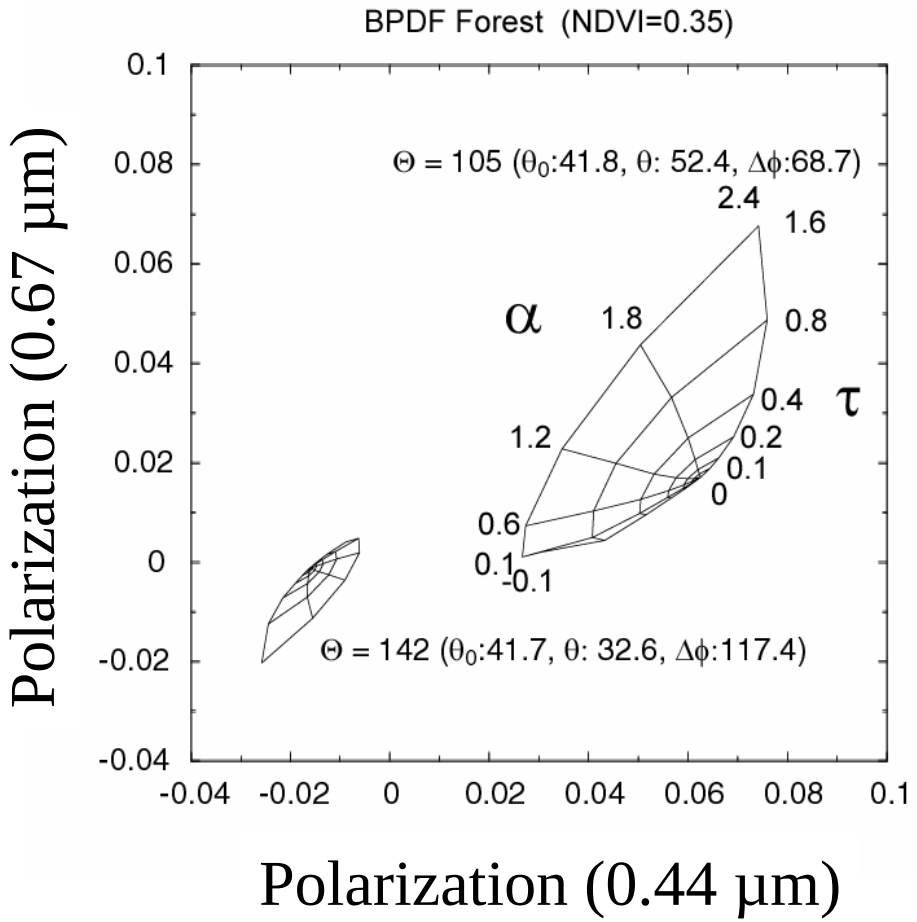
4. Two-channel Polarization method with UV-V channel method

Aerosol models

- Spherical shape
- Size distribution (Bi-modal log-normal)
  - Modal radius of fine and coarse are chosen from aerosol climatology based on AERONET (Dubovik, 2002).
  - Fine mode (rg_f, cg_f) = (0.135, 0.430 µm)
    - Urban, Industrial and Biomass burning aerosols
      - (GSFC, Paris, Mexico, and Maldives)
  - Coarse mode (rg_c, cg_c) = (2.365, 0.630 µm)
    - Dust and Oceanic aerosols
      - (Bahrain, Solar-Villeage, Cape Verde, and Lanai Island)
- Complex Refractive Index (n, k)
  - 1.40-0.000i, 1.45-0.0005i, 1.50-0.001i, 1.55-0.010i

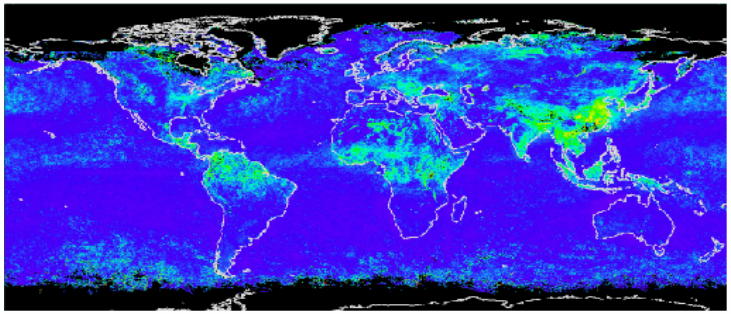
Look up table for aerosol retrieval over land



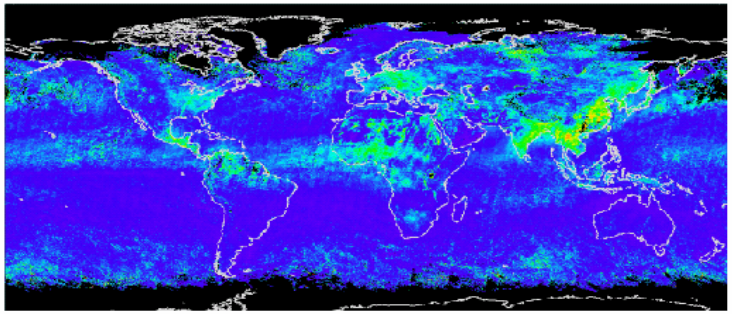


Annual change of AOT (1997, 2003)

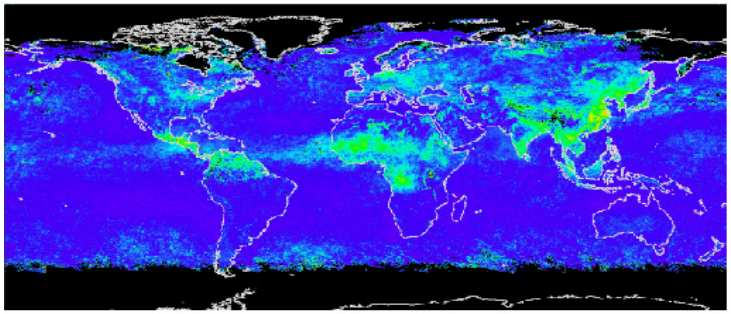
(a) April, 1997



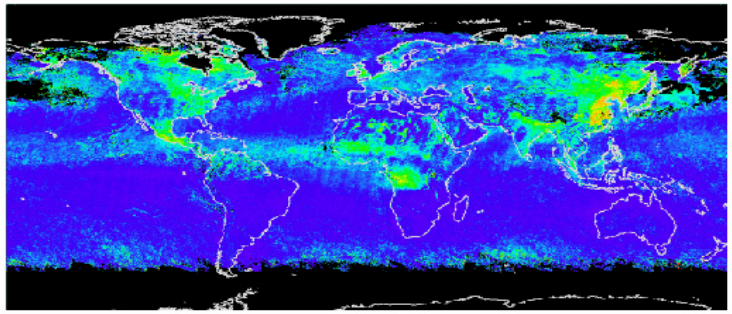
(a') April, 2003



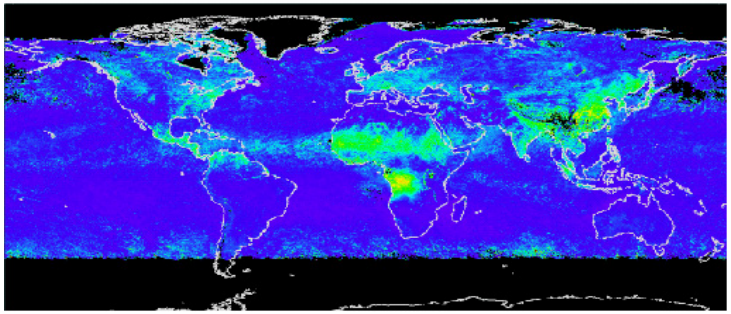
(b) May, 1997



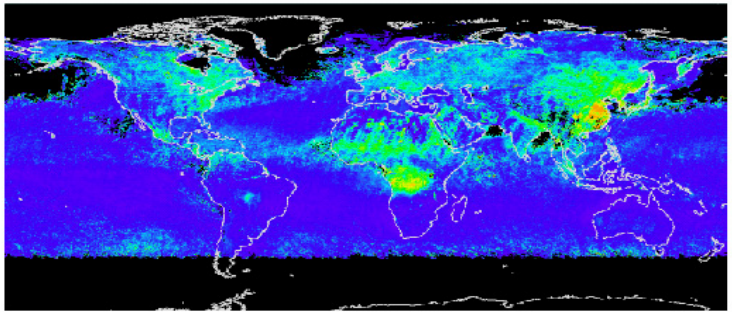
(c') May, 2003

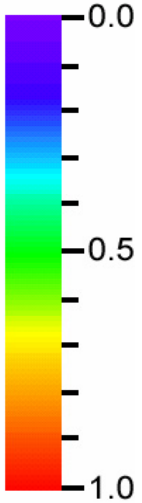


(c) June, 1997



(c') June, 2003



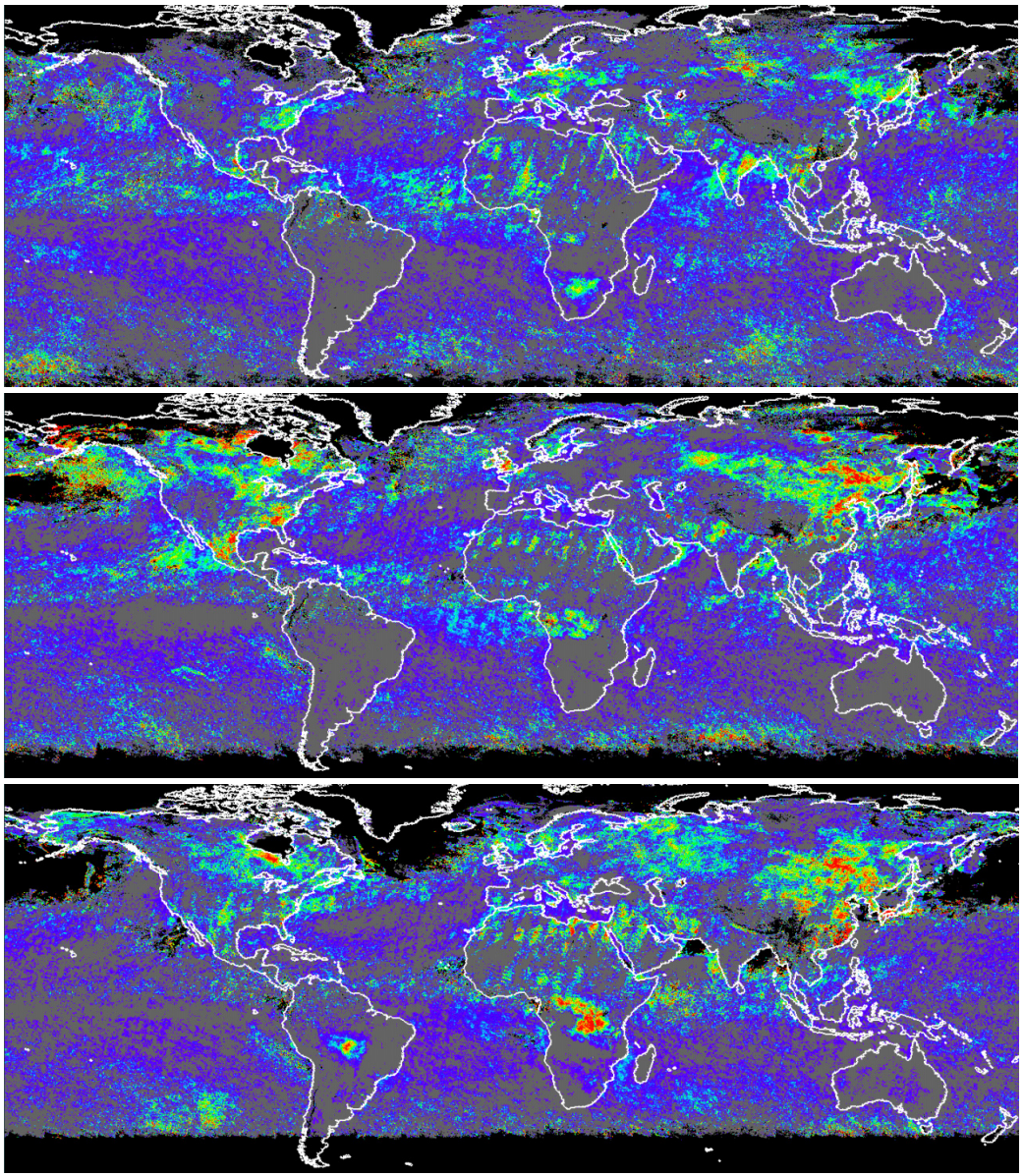


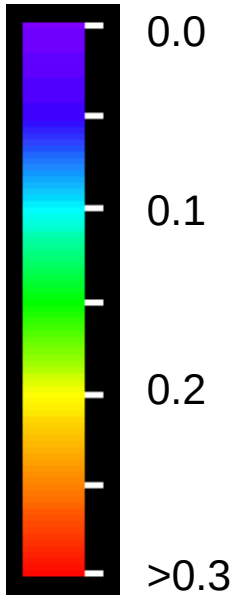
Annual change of AOT (difference 2003–1997)

April

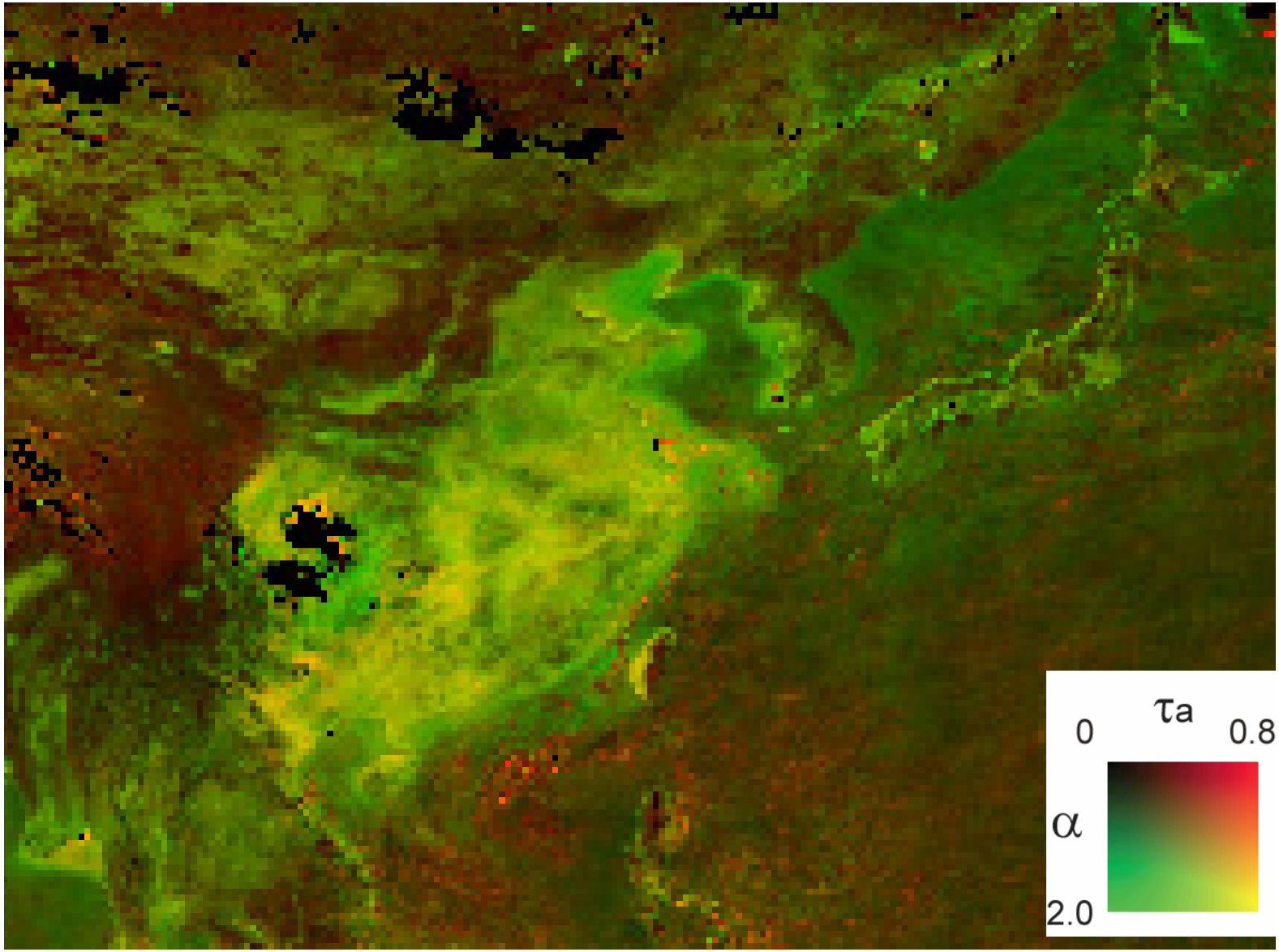
May

June





Aerosols over East Asia : November, 1996



Accuracy of AOT retrieval

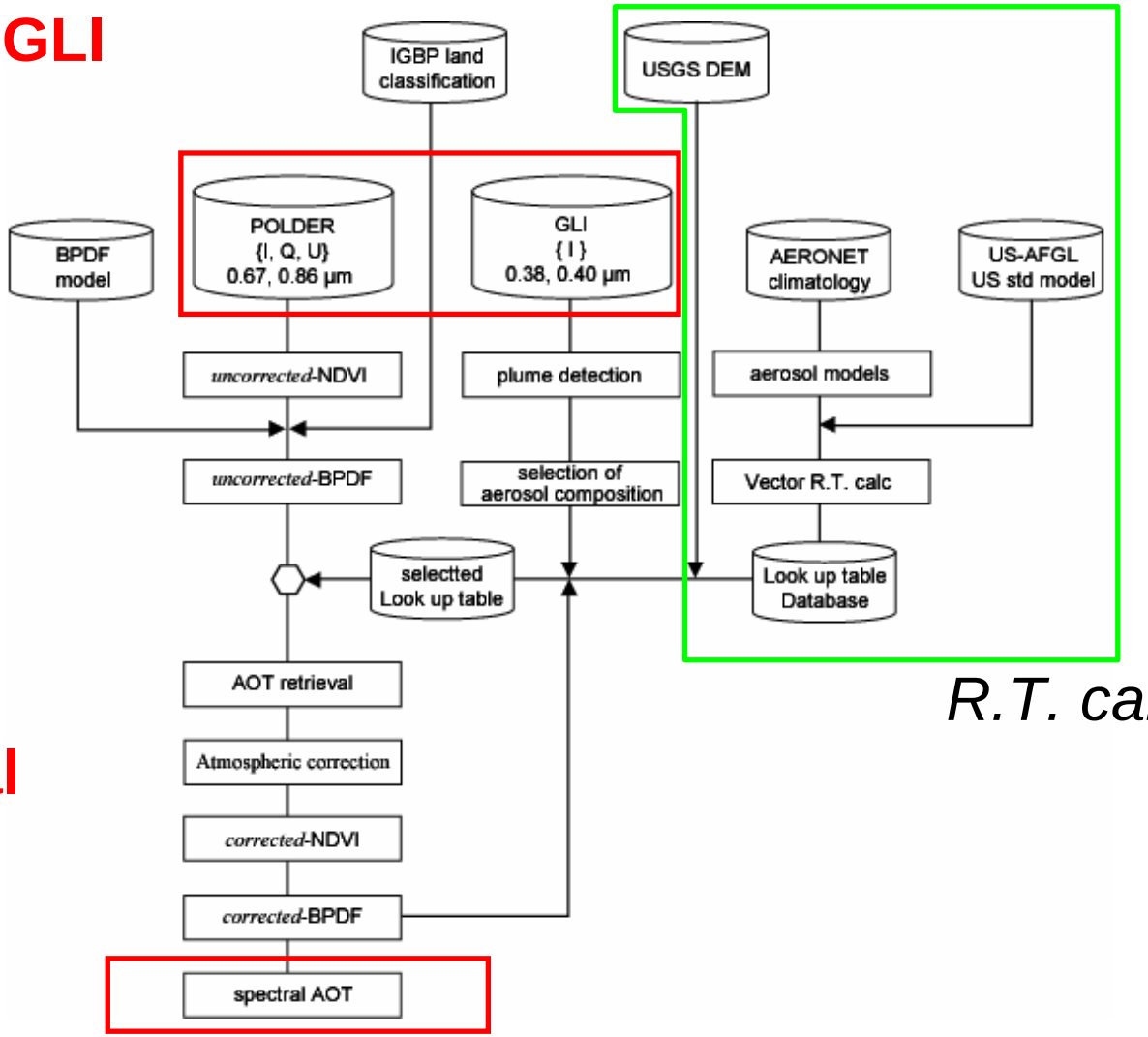
Aerosol optical thickness (τ)

RMS error ~ 0.11 (POLDER-1)

~ 0.17 (POLDER-2)

Aerosol retrieval based on POLDER and GLI

GCOM / SGLI

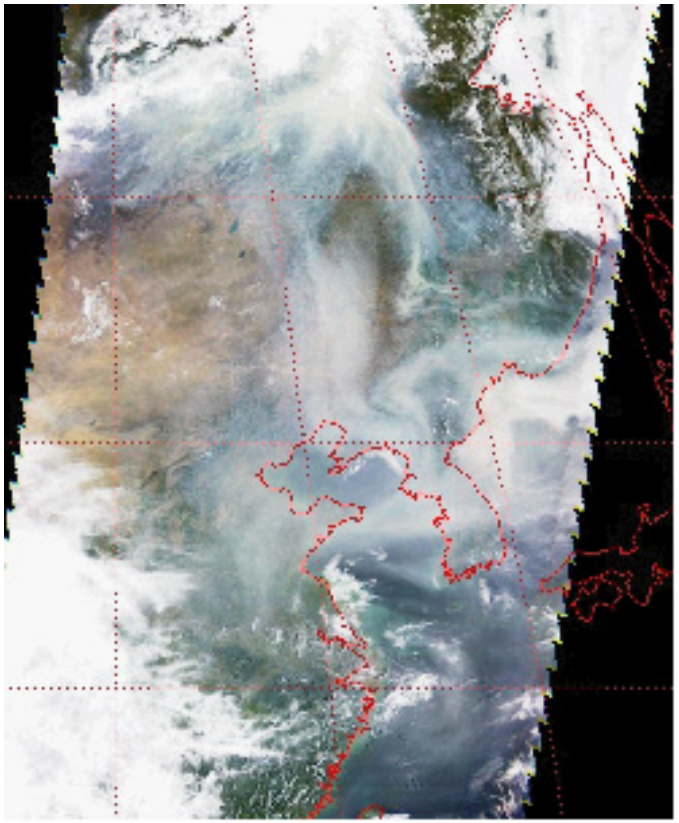


Spectral AOT

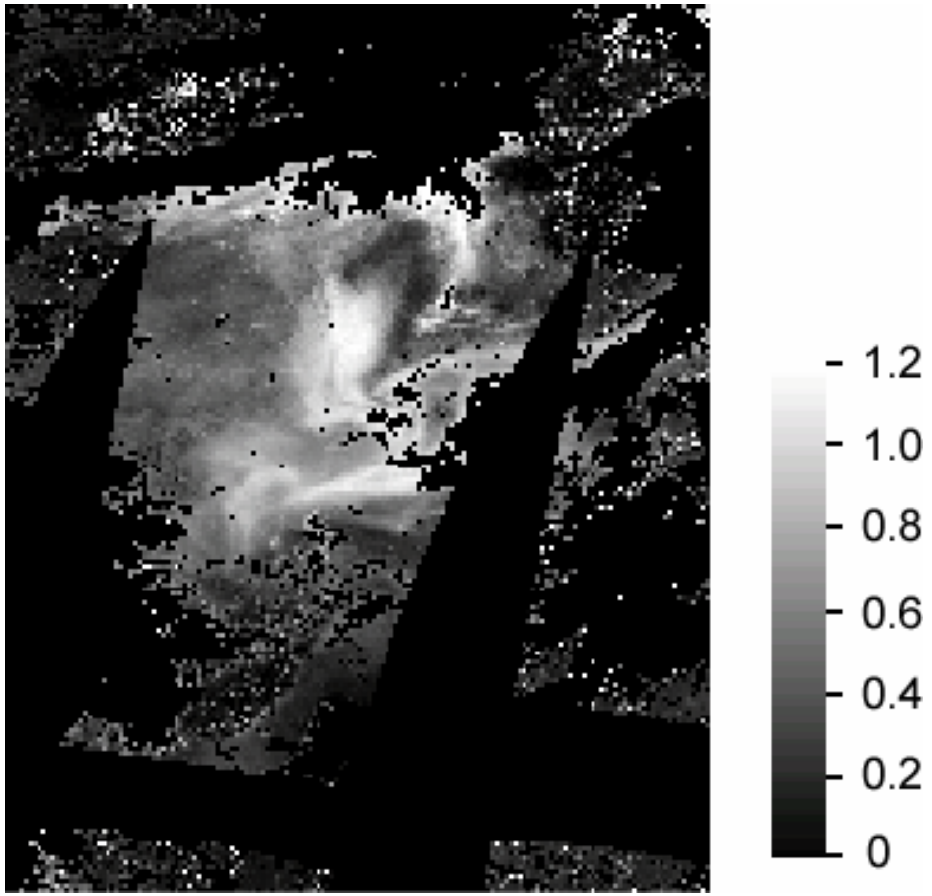
A system flow of aerosol retrieval based on combination use of POLDER and GLI data.

Detection of biomass burning plume by GLI

Composite (POLDER)

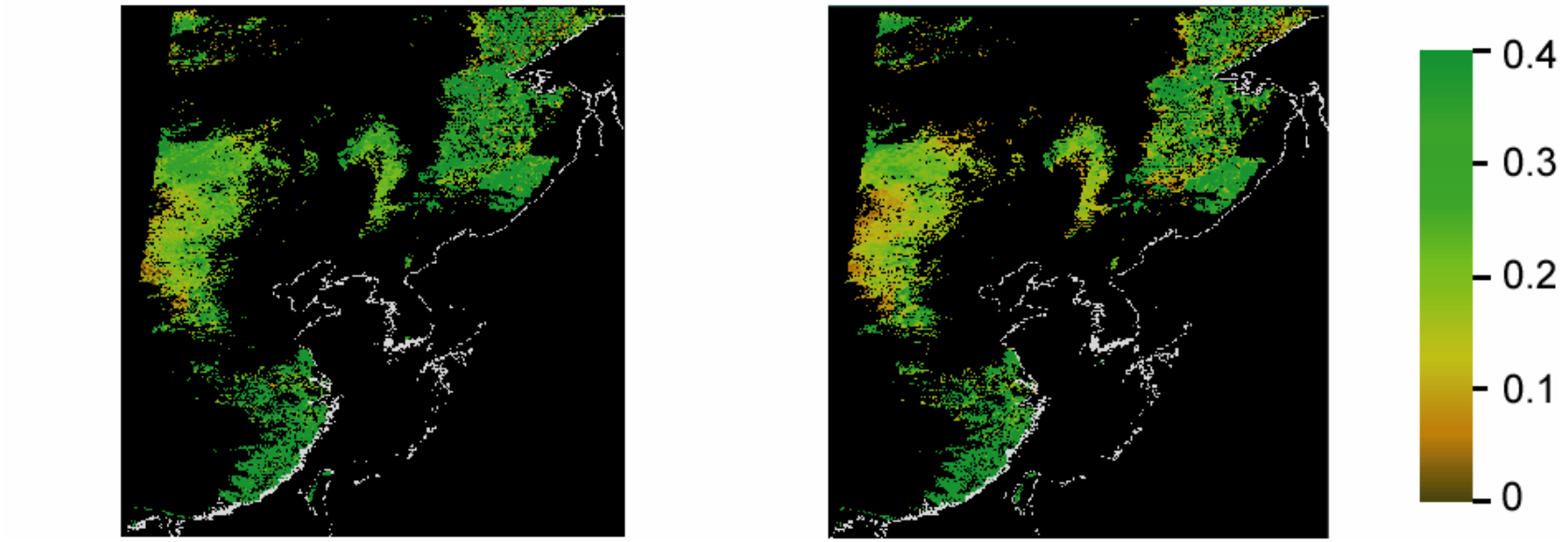


GLI Radiance ratio (0.40 μm / 0.38 μm)

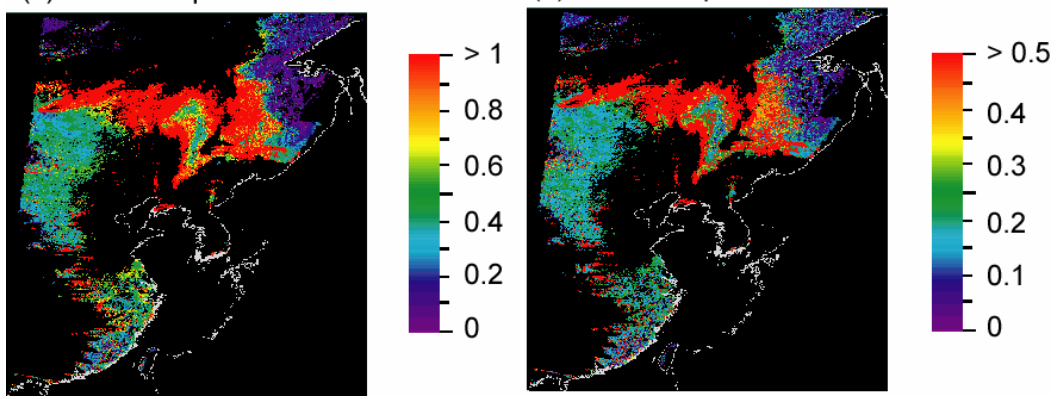


NDVI images
after and before atmospheric correction

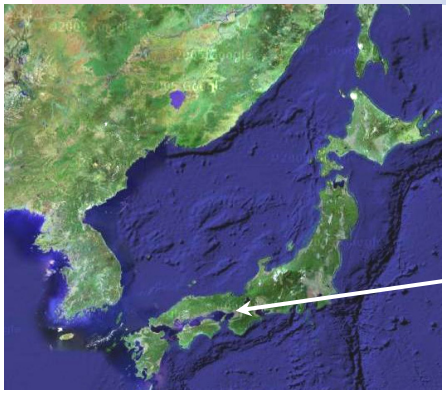
(a) NDVI (after atmospheric correction) (b) NDVI (before atmospheric correction)



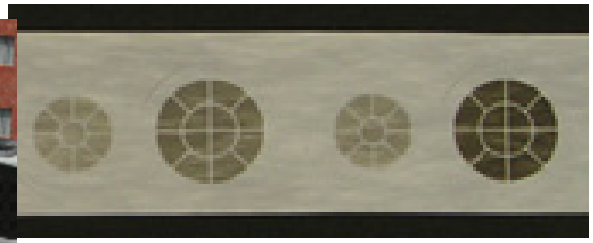
(a) AOT 0.50 μm (b) AOT 0.86 μm



Air quality study by $PM_{2.5}$ and AOT



（Osaka site）
AERONET, SKYNET

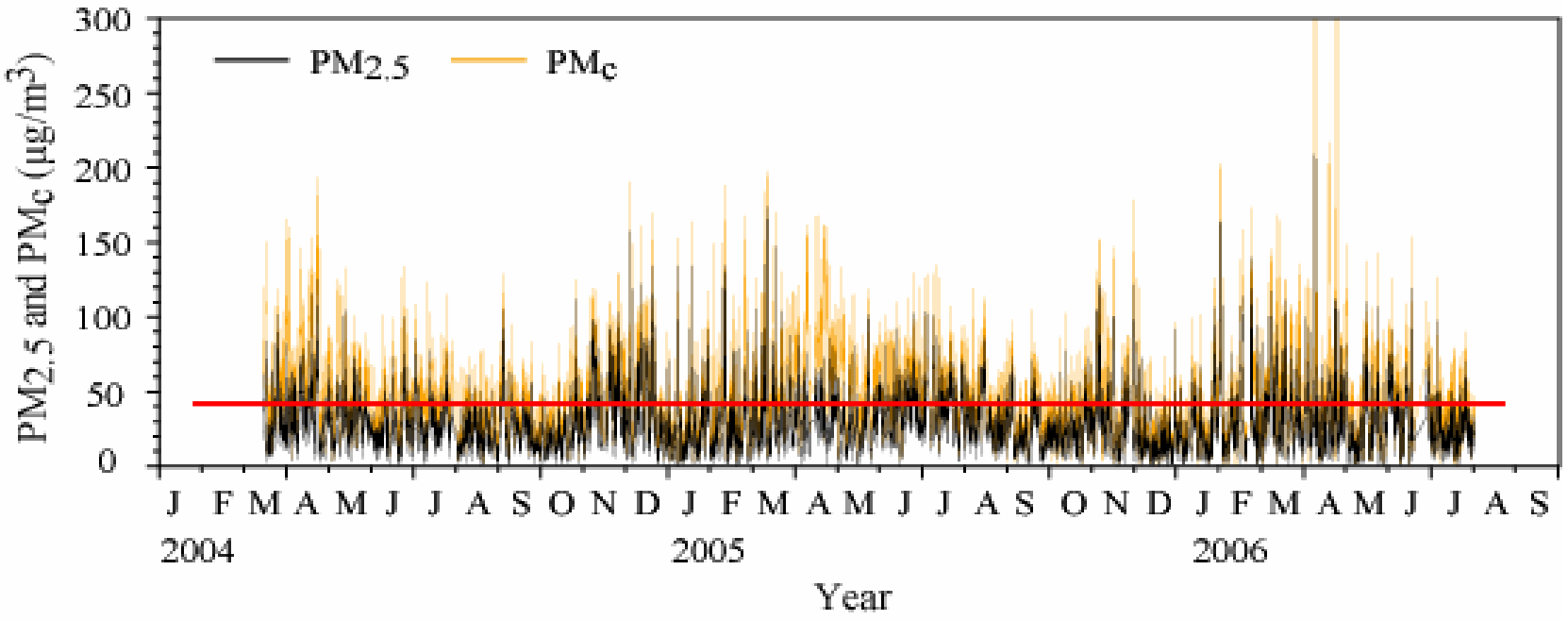


Filter sample of SPM613D

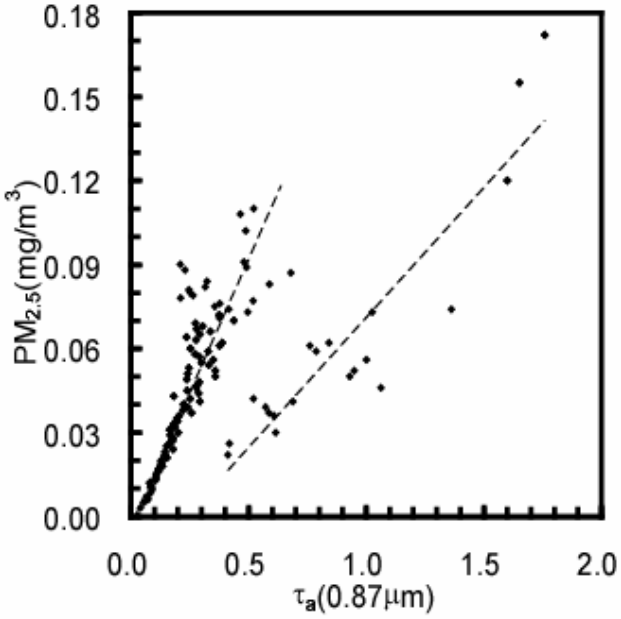
⇒ PM_c,
$PM_{2.5}$,
OBC

PM_1 (2006/12-

$PM_{2.5}$ & coarse Measurements

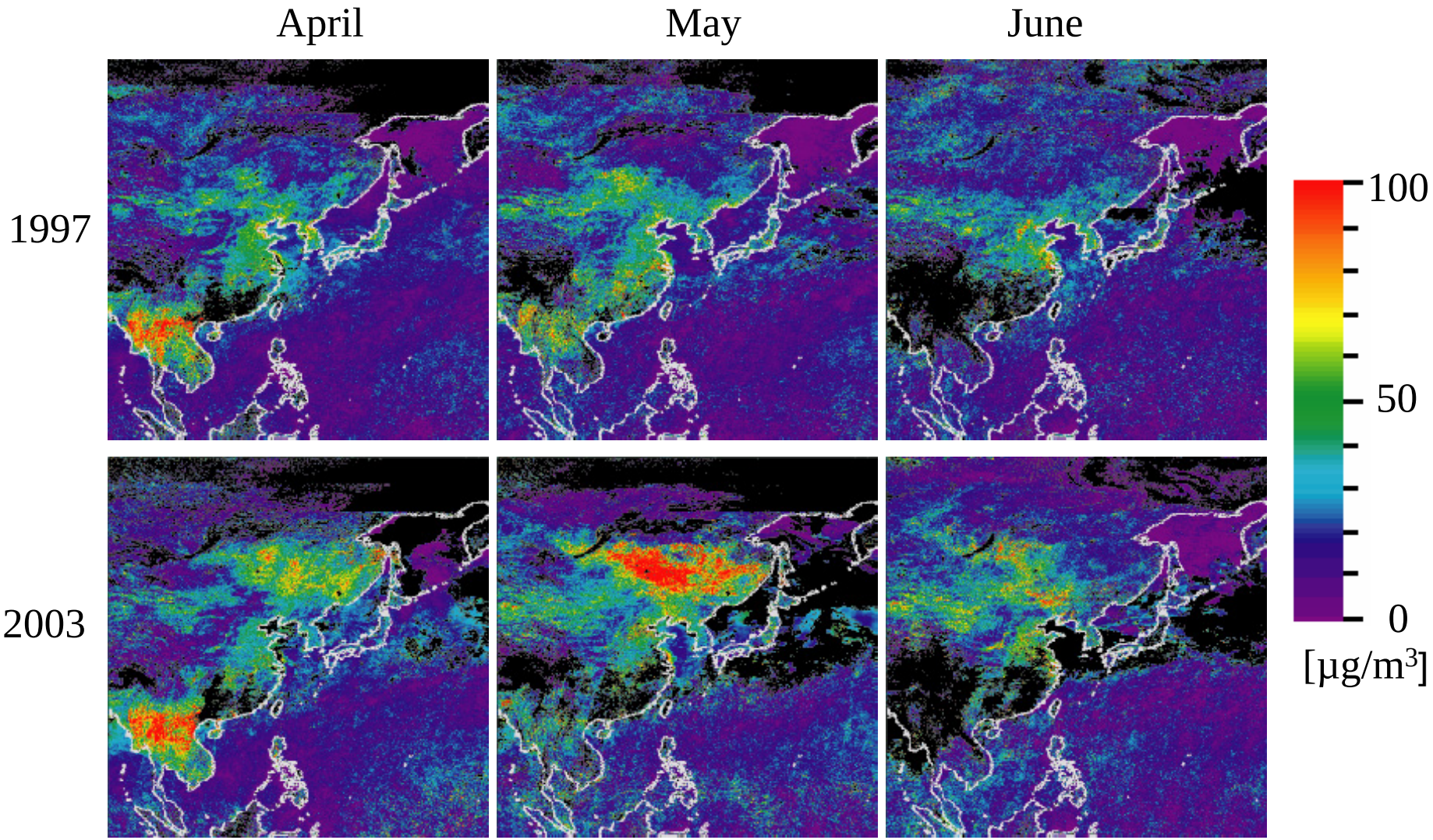


Regression analysis between PM and sun photometry

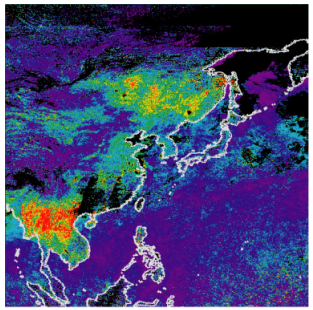


$$PM_{2.5} = \begin{cases} 0.092\,\tau_a(0.87) - 0.021 & \text{for dust events,} \\ 0.294\,\tau_a(0.87) - 0.014 & \text{for other days.} \end{cases}$$

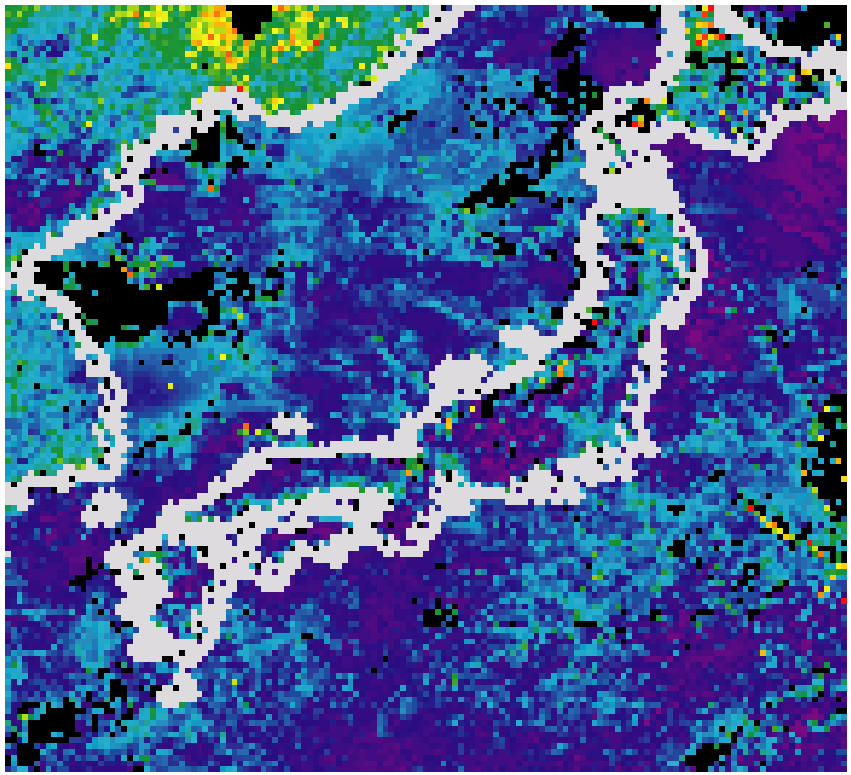
$PM_{2.5}$ maps in 1997, 2003

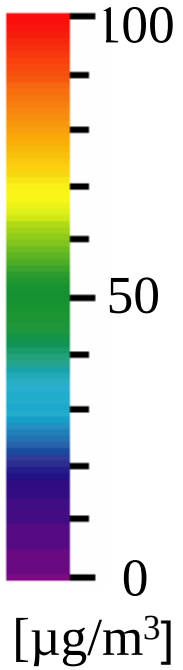


An enlarged map of $PM_{2.5}$ over Japan



April, 2003





Summary

- Aerosol properties, e.g., *spectral AOT* and *aerosol type* (*absorbing aerosols*) are derived from combination use of POLDER and GLI data.

  These data are useful to correct the atmospheric effect.

- *Air quality* ($PM_{2.5}$) is evaluated from the derived relationship between AOT and SPM.