Comparing ECMWF UV Processor and aerosol scheme with ground-based measurements

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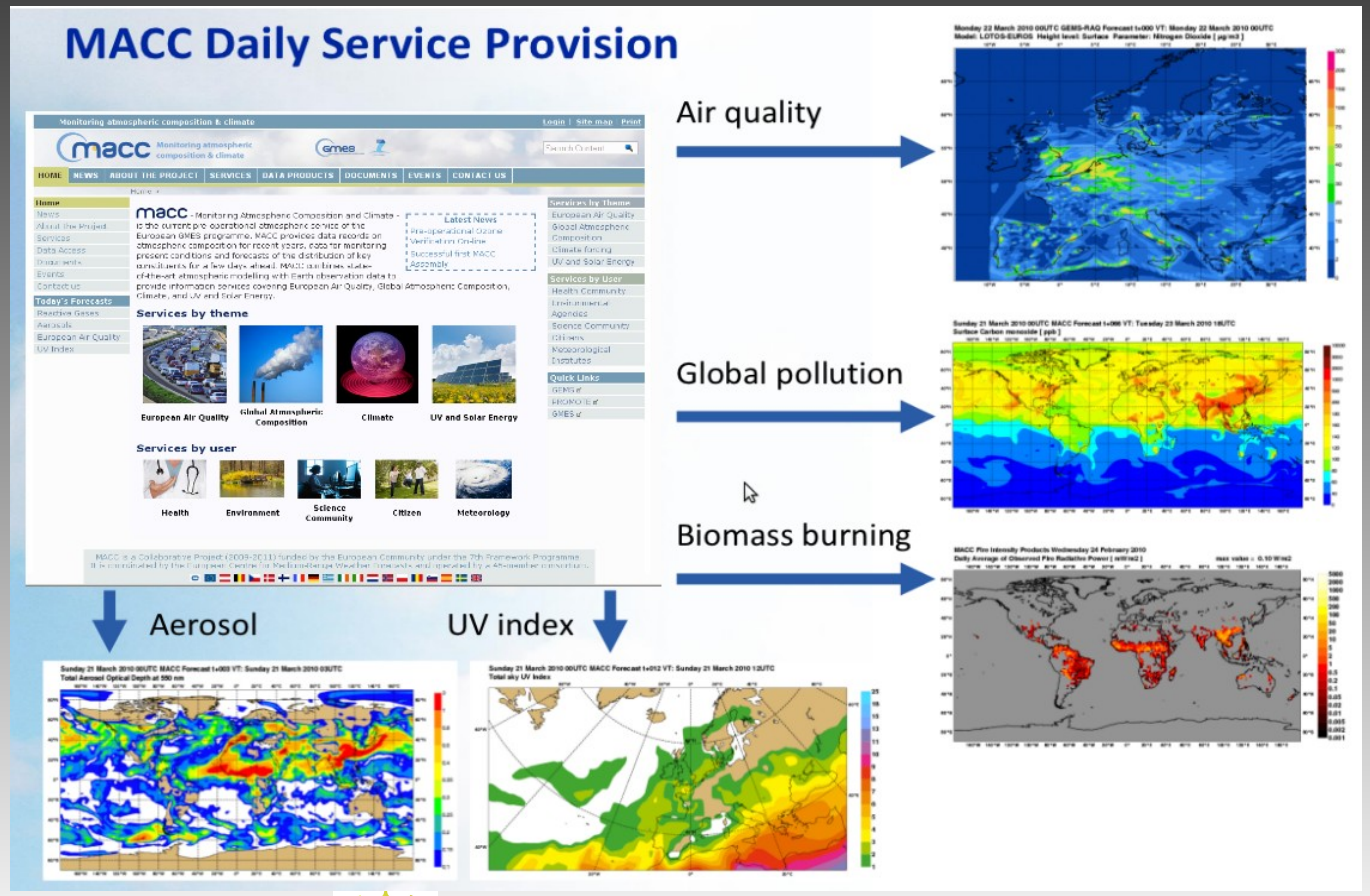

European Centre for Medium-Range Weather Forecasts (ECMWF)

- the main weather forecasting model;
- aerosols are included since 1989;
- prognostic aerosols: SS, DU, OM, BC, SO4;
- coverage of UV wavelengths in the SRT scheme;

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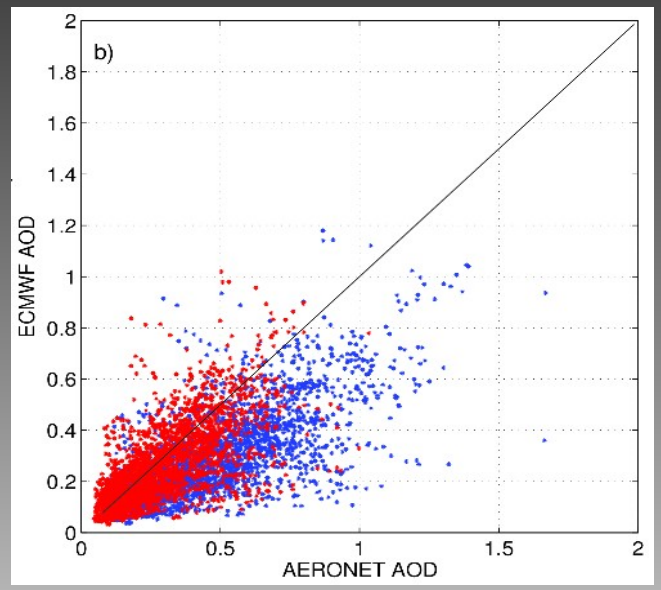
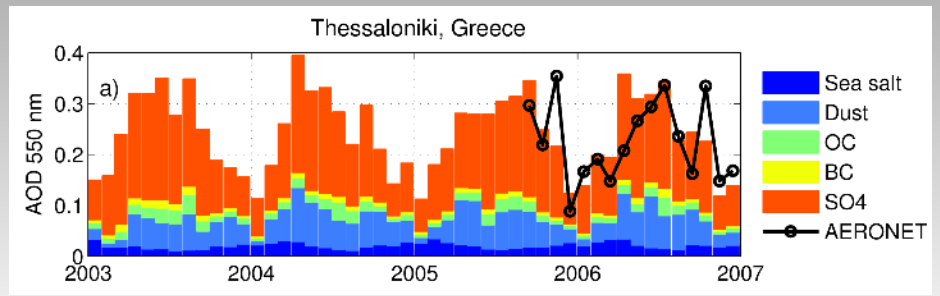
AOD

- Sites
- Method
- Results
- Conclusions





UV

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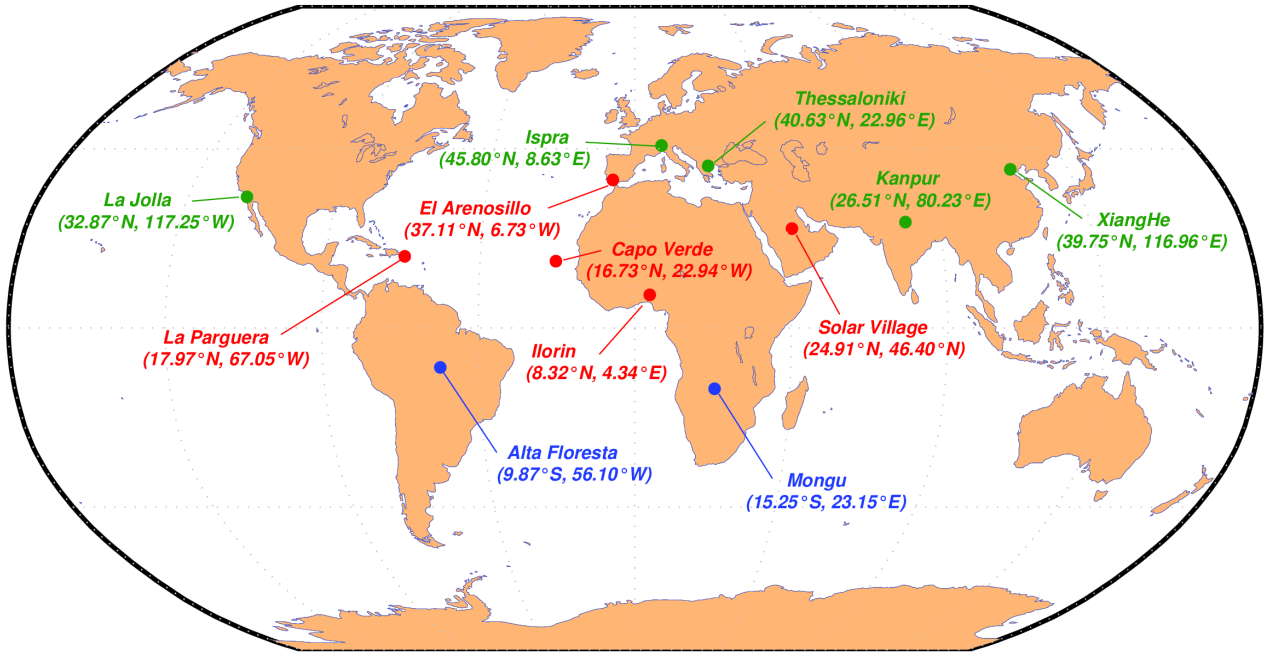
AOD

Sites

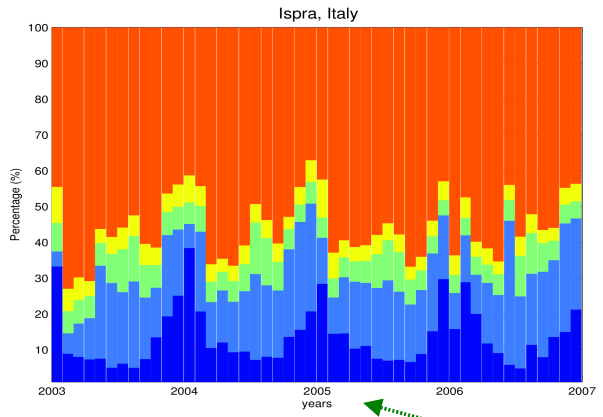
dust

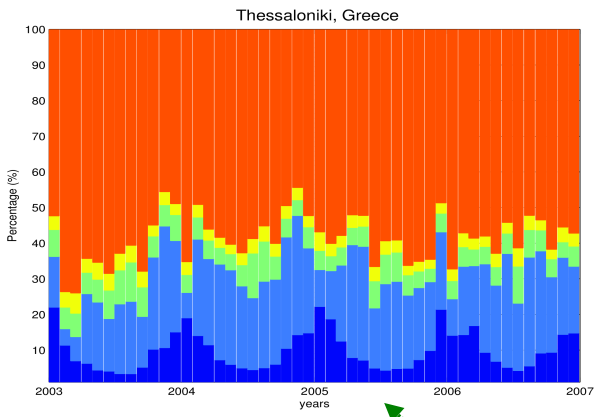
biomass burning

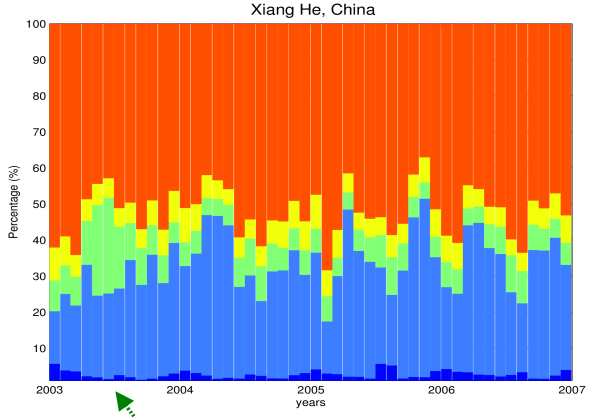
urban/anthropogenic



V. Cesn[illegible] [illegible]nd







AOD

Sites

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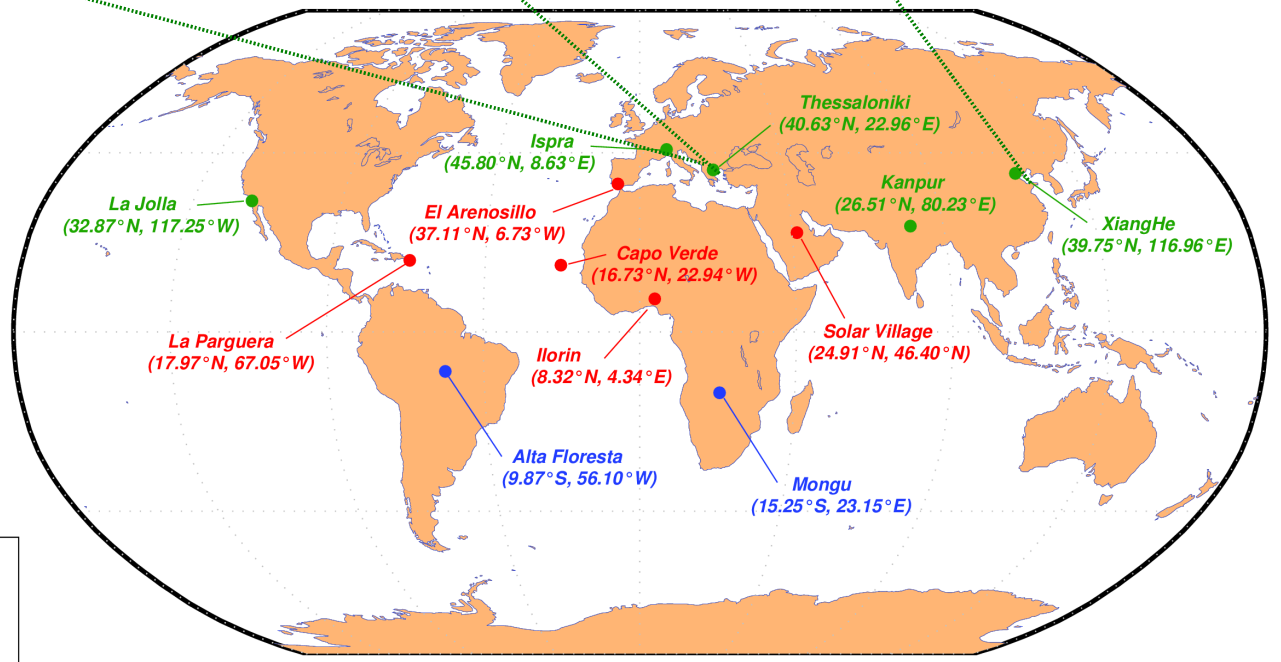
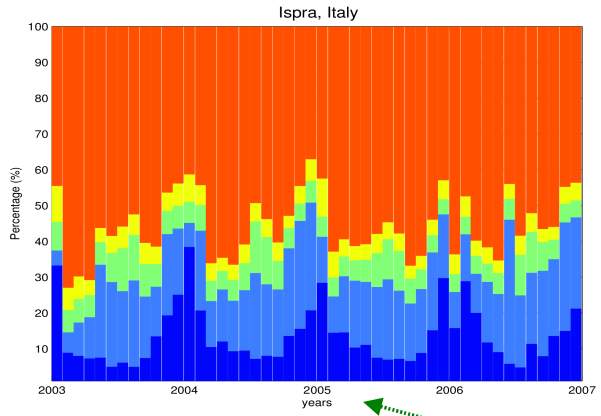
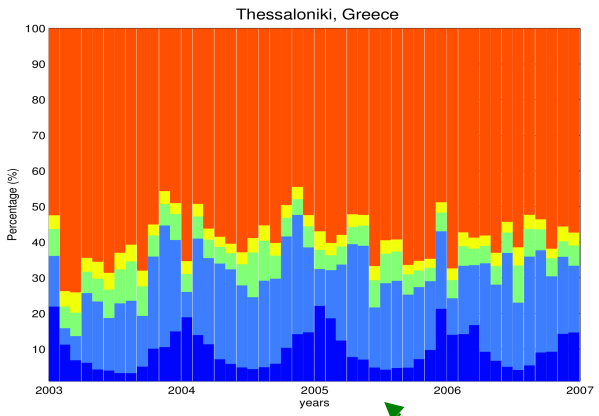
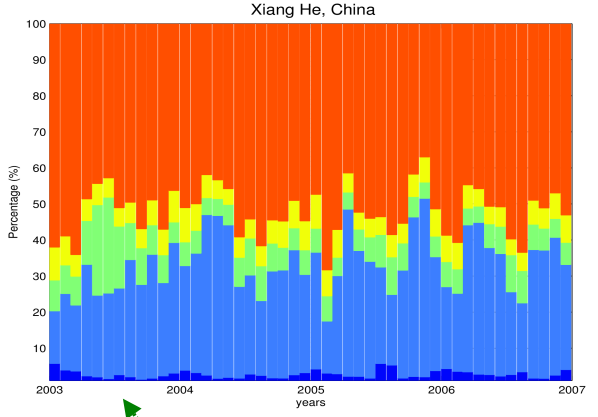
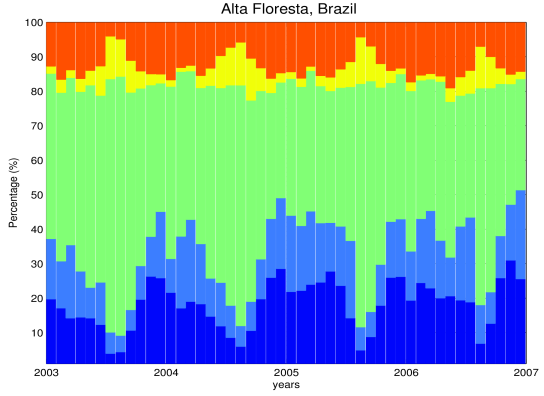


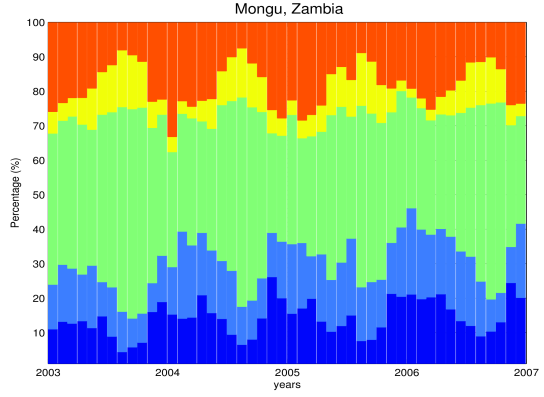
V. Cesn nd

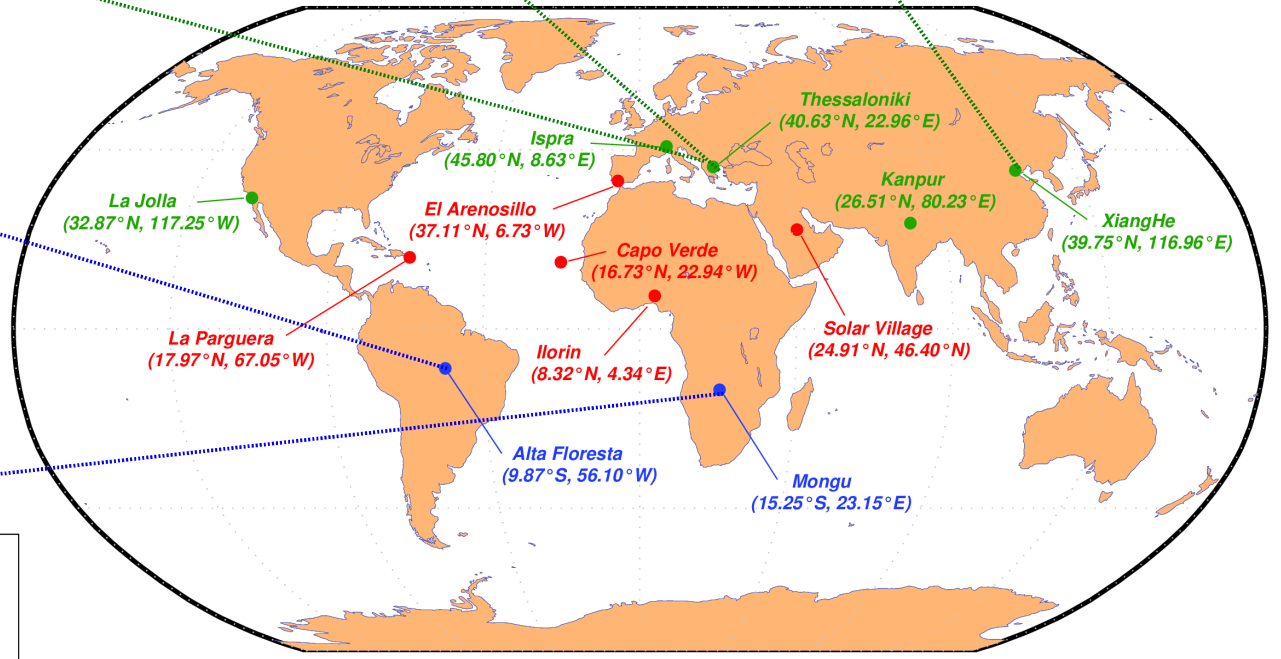

Ispra, Italy
Percentage (%)
years

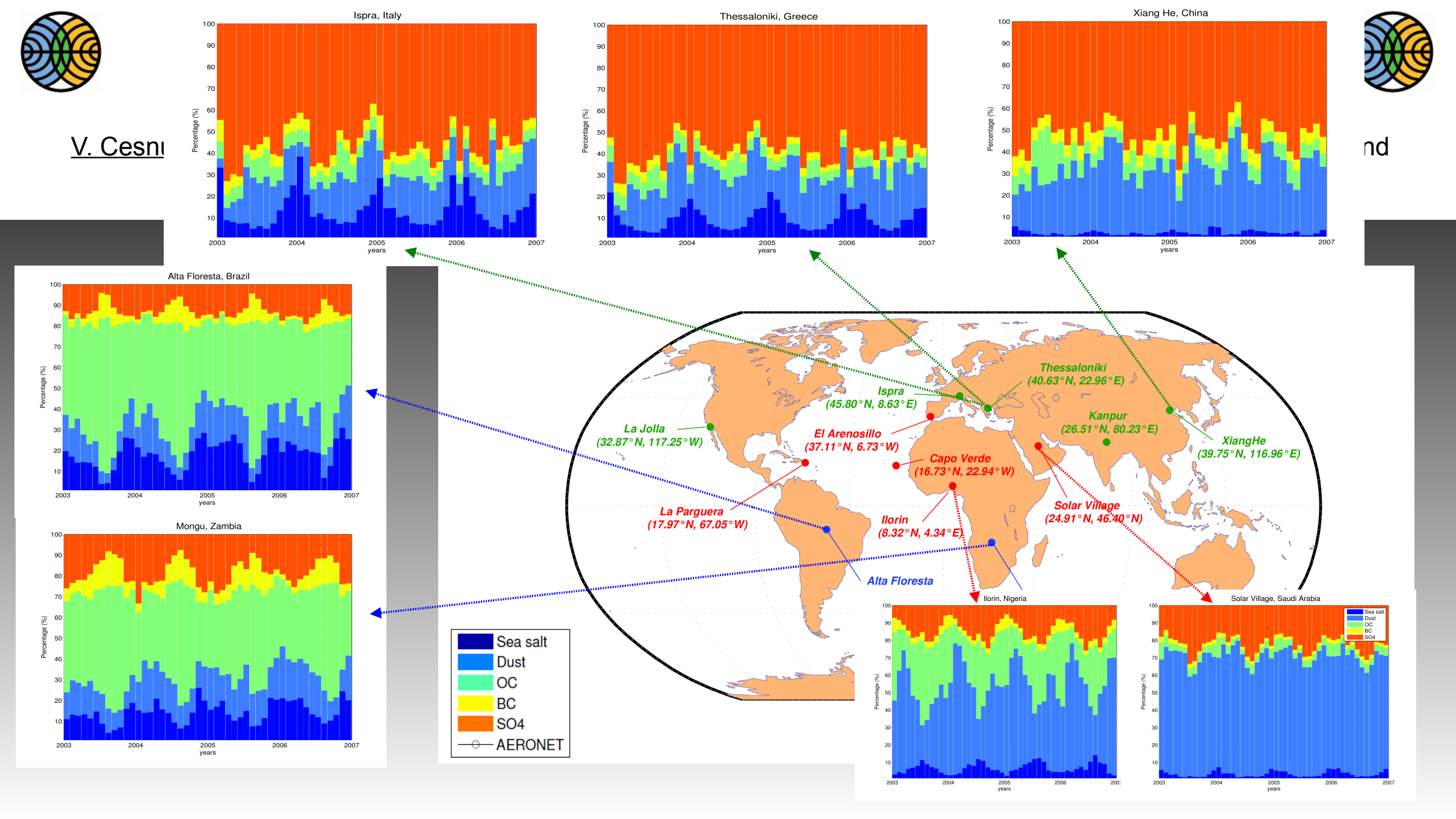

Thessaloniki, Greece
Percentage (%)
years


Xiang He, China
Percentage (%)
years


Alta Floresta, Brazil
Percentage (%)
years


Mongu, Zambia
Percentage (%)
years


Thessaloniki (40.63°N, 22.96°E)
Ispra (45.80°N, 8.63°E)
Kanpur (26.51°N, 80.23°E)
XiangHe (39.75°N, 116.96°E)
La Jolla (32.87°N, 117.25°W)
El Arenosillo (37.11°N, 6.73°W)
Capo Verde (16.73°N, 22.94°W)
Solar Village (24.91°N, 46.40°N)
La Parguera (17.97°N, 67.05°W)
Ilorin (8.32°N, 4.34°E)
Alta Floresta (9.87°S, 56.10°W)
Mongu (15.25°S, 23.15°E)
Sea salt
Dust
OC
BC
SO4
AERONET


Ispra, Italy
Thessaloniki, Greece
Xiang He, China
Alta Floresta, Brazil
Mongu, Zambia
Percentage (%)
years
Thessaloniki (40.63°N, 22.96°E)
Ispra (45.80°N, 8.63°E)
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Alta Floresta
Ilorin, Nigeria
Solar Village, Saudi Arabia
Sea salt
Dust
OC
BC
SO4
AERONET

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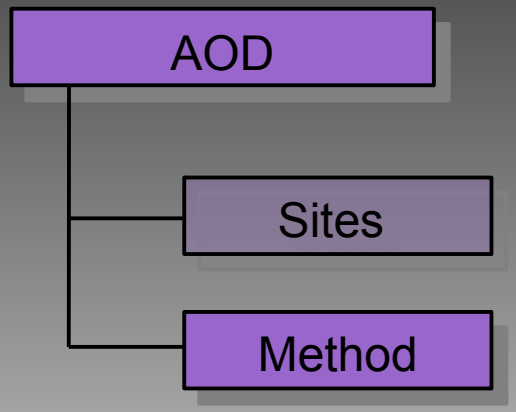
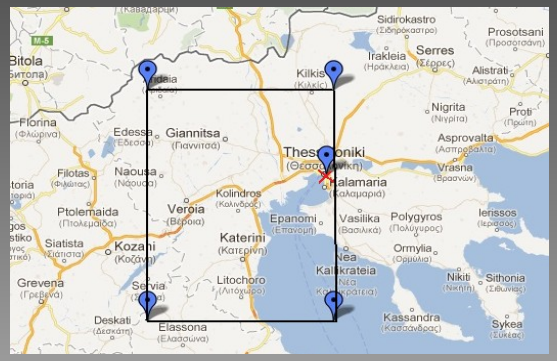


ECMWF



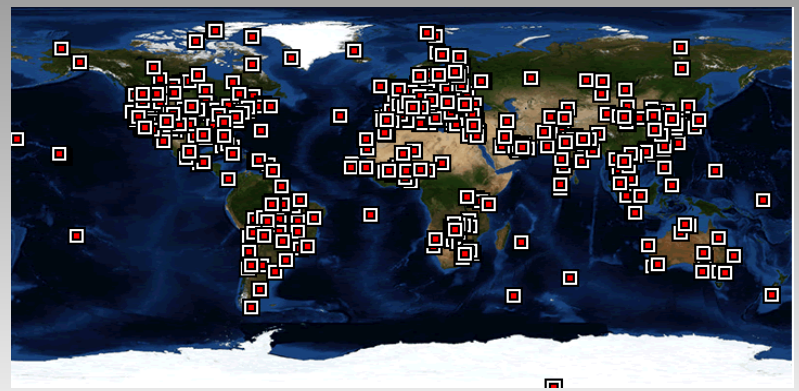
gridbox ~80 x 80 km

340, 380, **UV**
440, **500**, 670, **Visible**
870, 940, 1020 nm
Infrared

period 2003-2006

1 h, 30 d

AERONET



~500 sites over the globe

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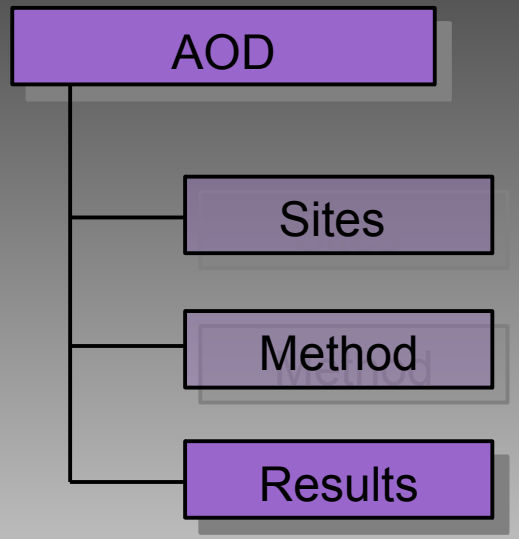

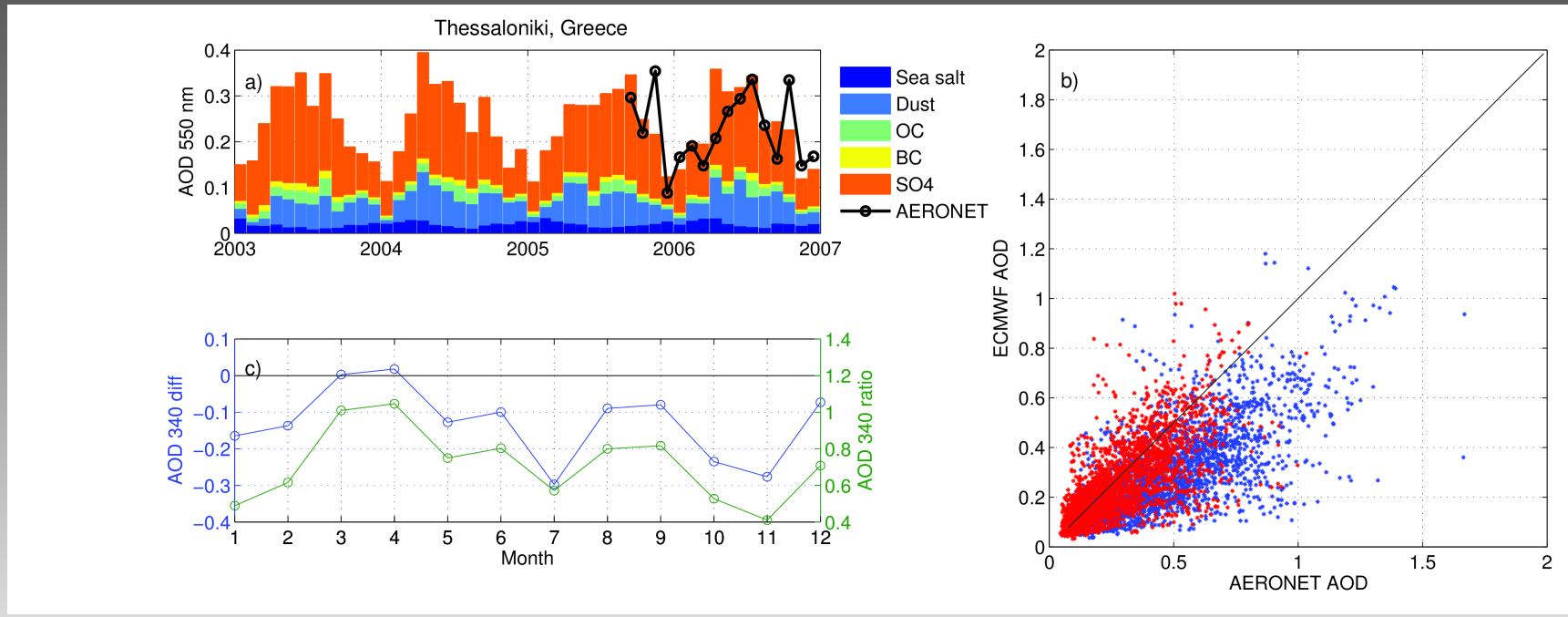

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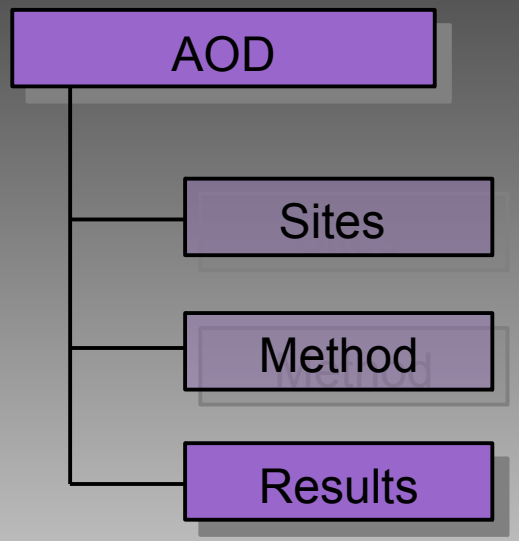

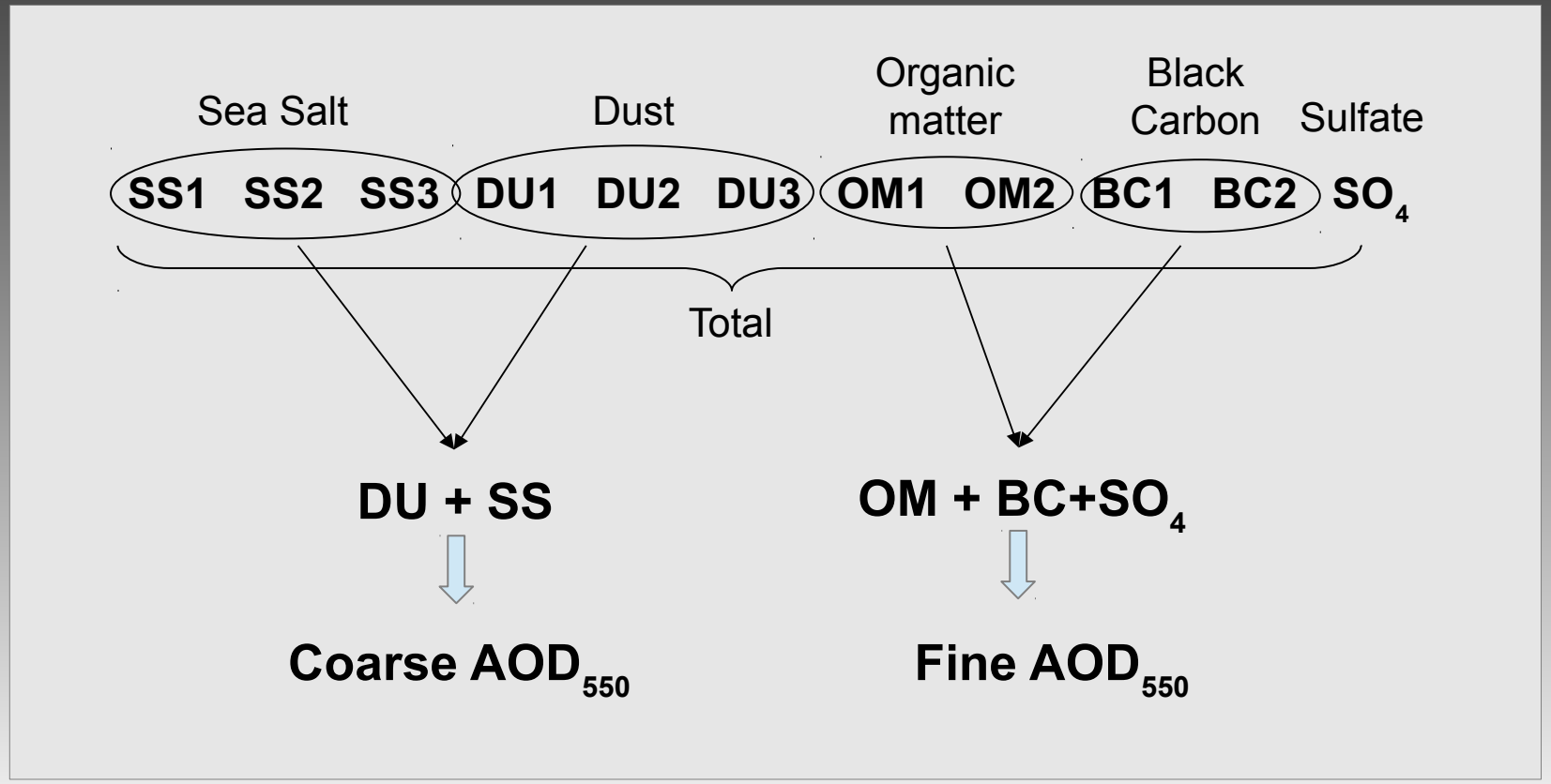

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- AOD
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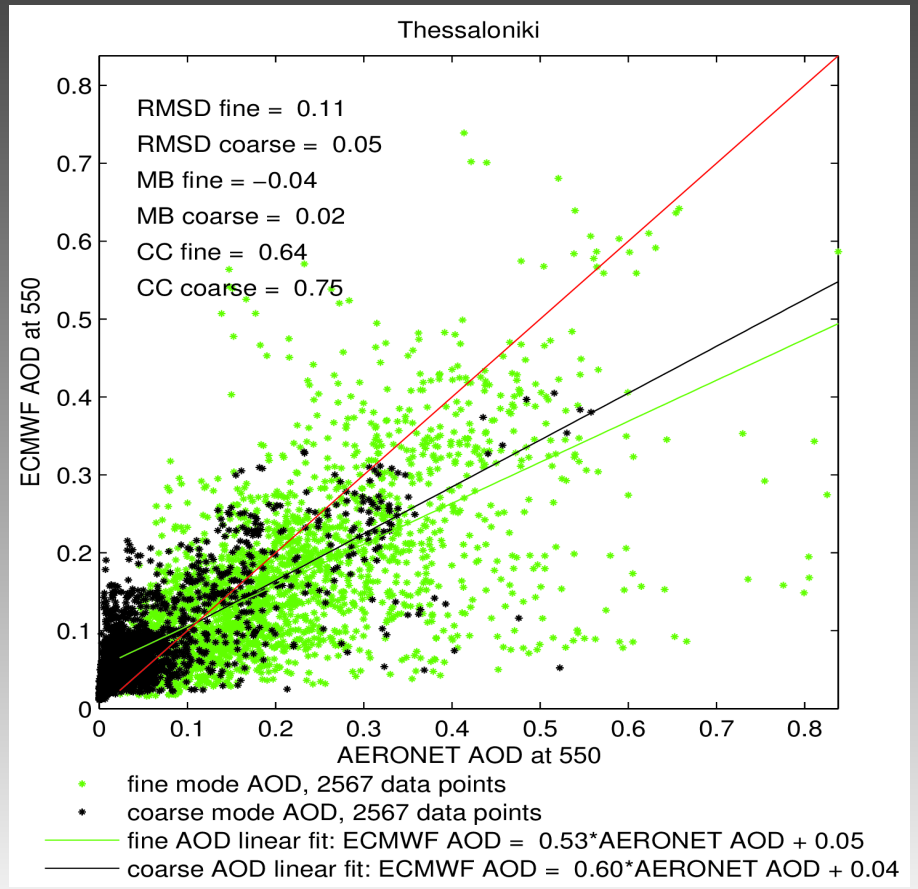

Too much dust (coarse) and too little fine particles.

This combination contributes to the effective size being shifted towards larger particles.

$$AOD_{aer,550} = AOD_{aer,500} \cdot \left(\frac{550}{500}\right)^{-\alpha}$$

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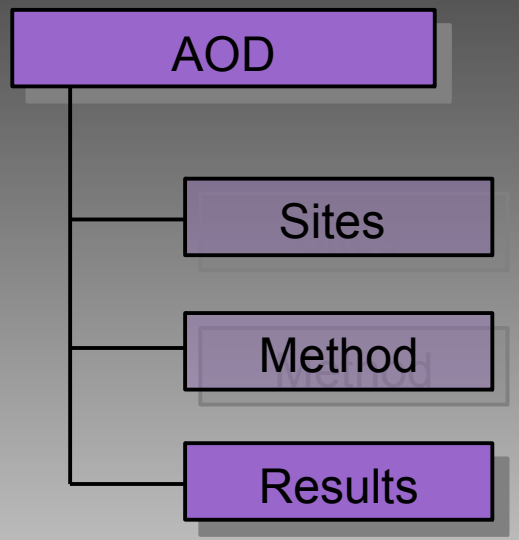

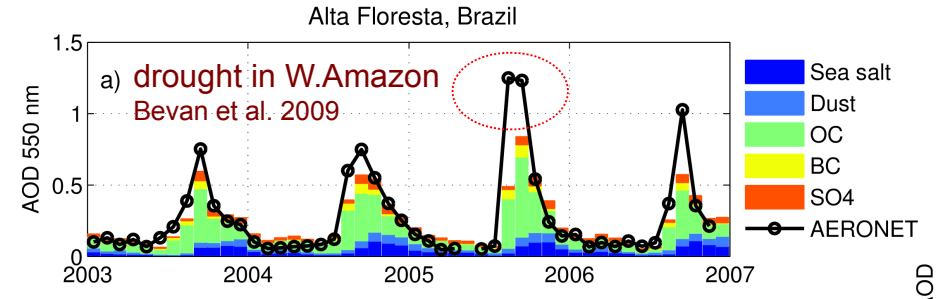

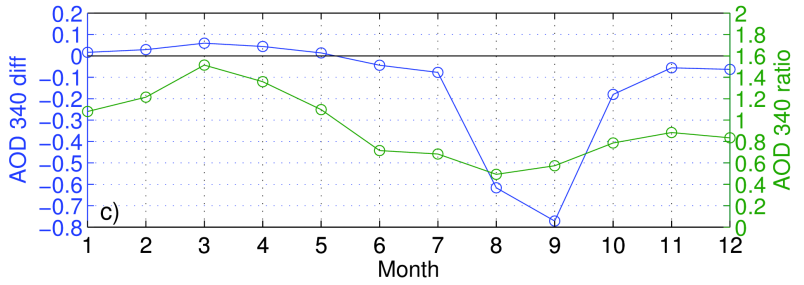

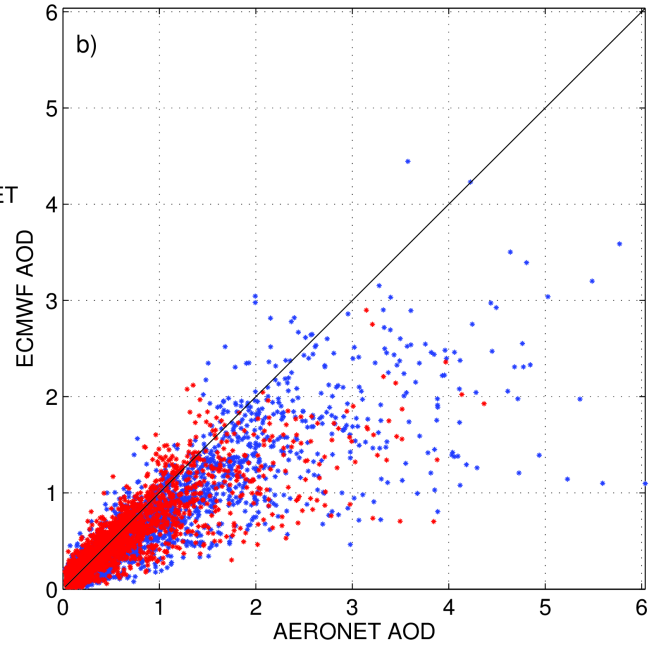

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- AOD
  - Sites
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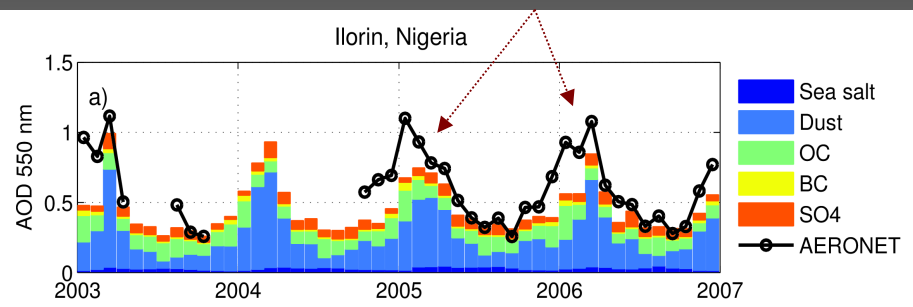
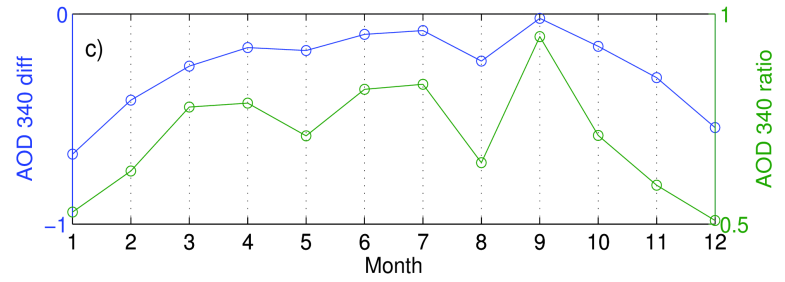
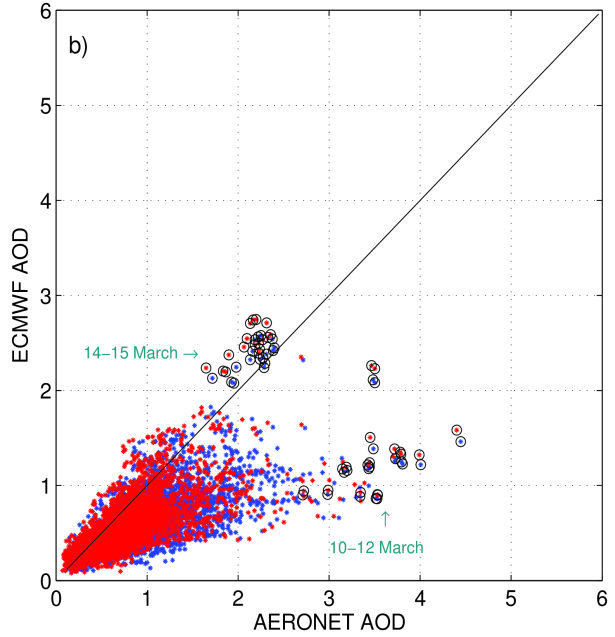
Highest AOD in spring ← high intensity of dust events in May







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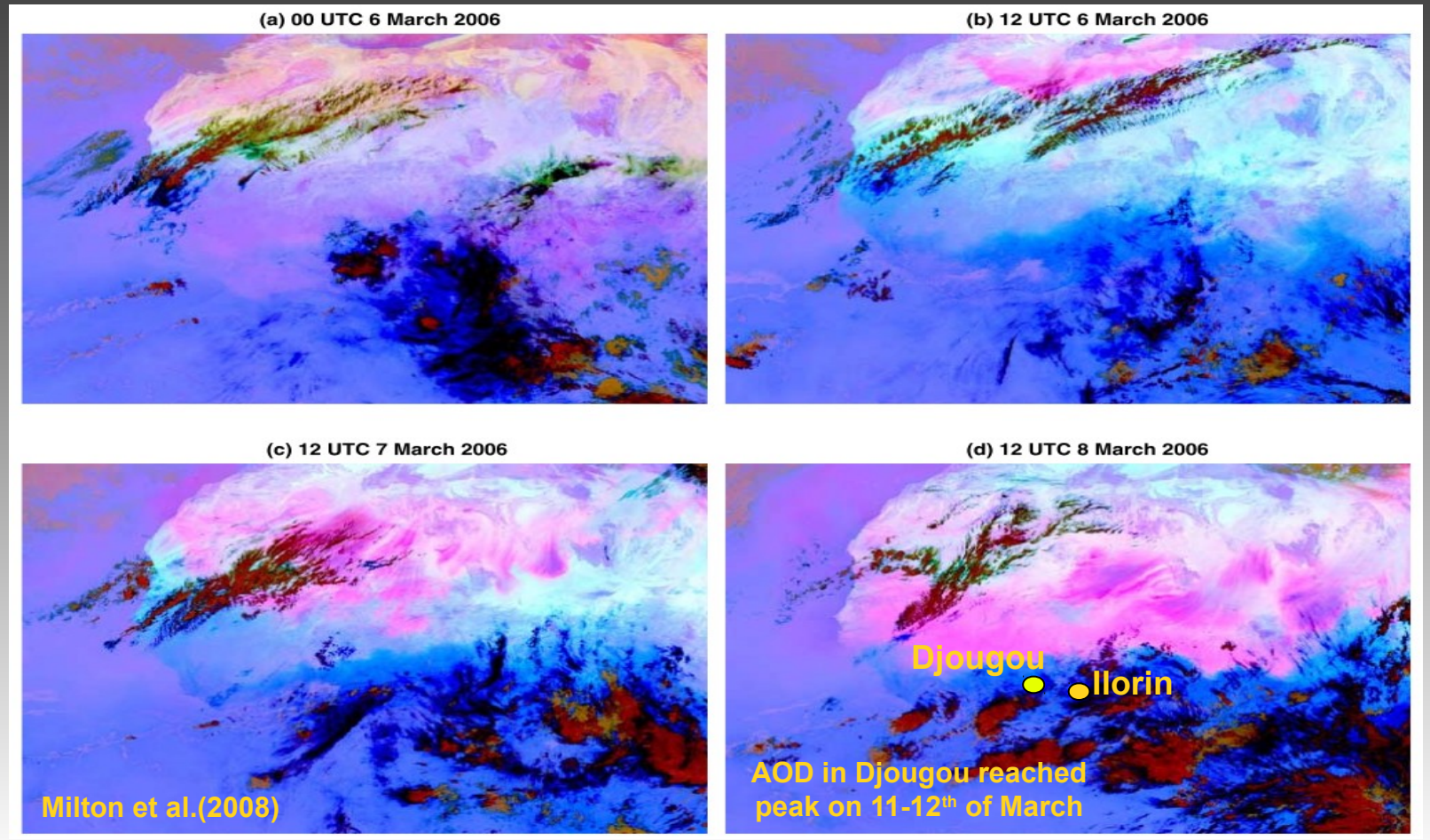

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AOD

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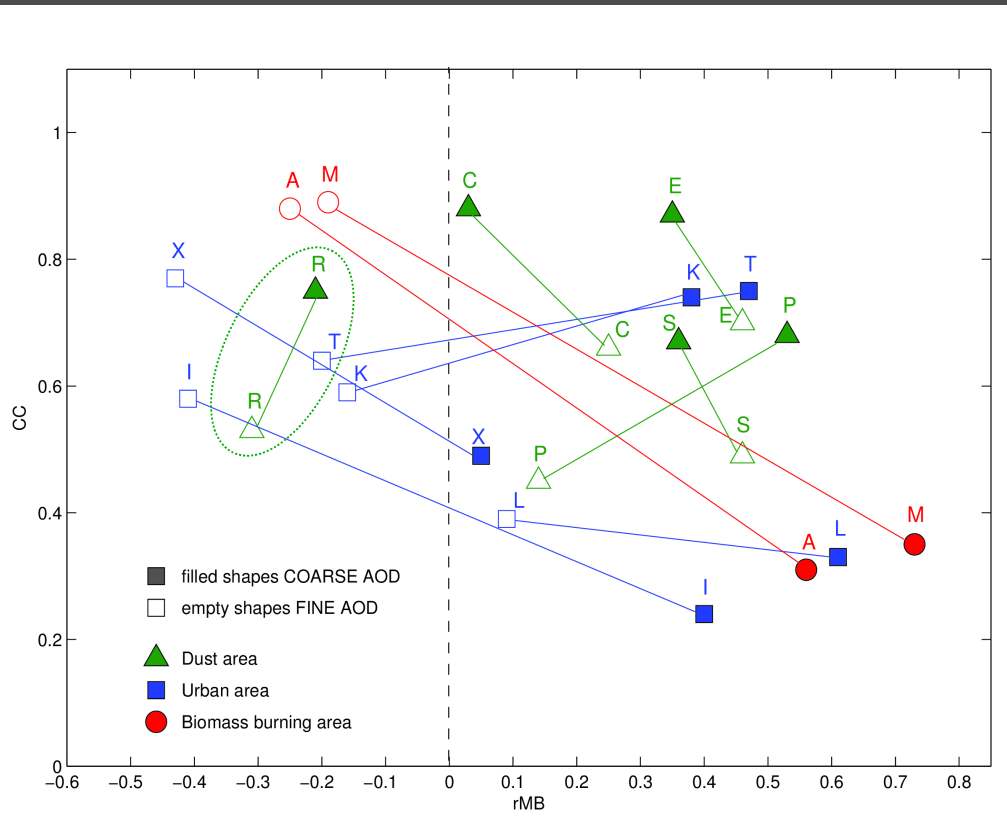
I – Ispra, M – Mongu, R – Ilorin, P – La Parguera, C– Capo Verde, K – Kanpur, E– El Arenosillo, S – Solar Village, A – Alta Floresta, L – La Jolla, T – Thessaloniki, X - XiangHe.

URBAN: fine – underestimation, coarse - overestimation

Too much coarse, too little fine particles

BIOMASS BURNING: even stronger effect



DUST: mixed behavior

ILORIN: overall underestimation ← model parametrization of dust sources ← no MODIS retrievals over Sahara

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AOD

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strongest understimation at **UV**

I – Ispra,
M – Mongu,
R – Ilorin,
P – La Parguera,
C – Capo Verde,
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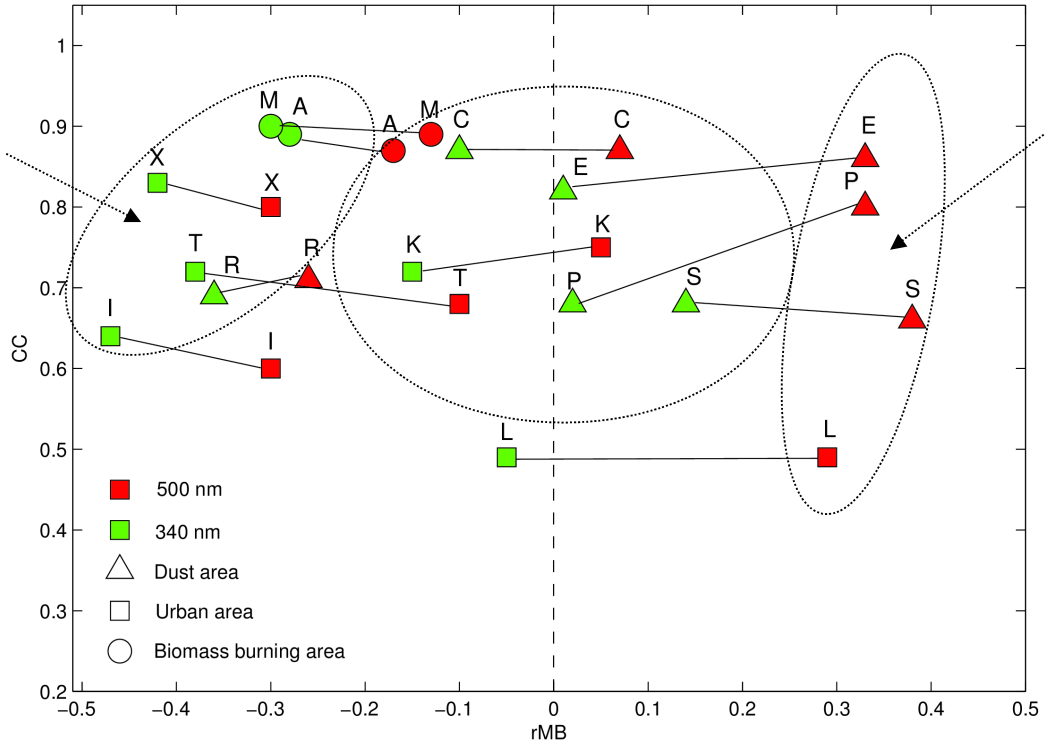

strongest overestimation at **visible**

rMB always smaller for **340nm** than **500nm**

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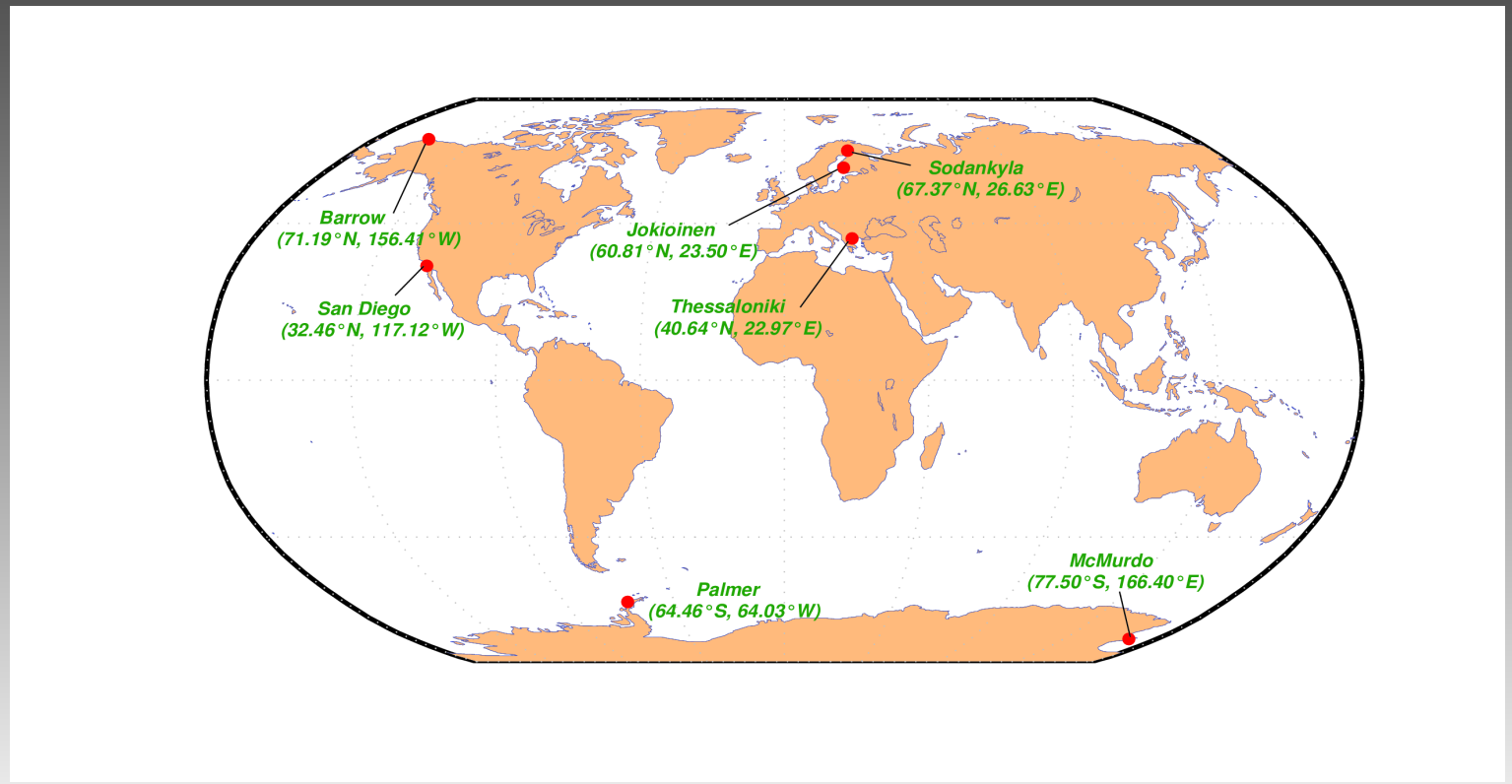

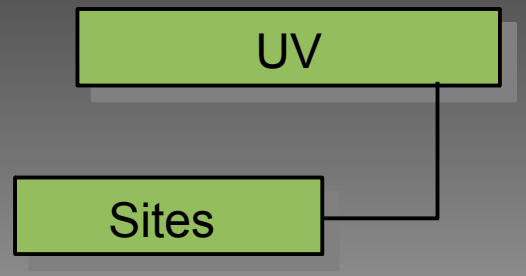

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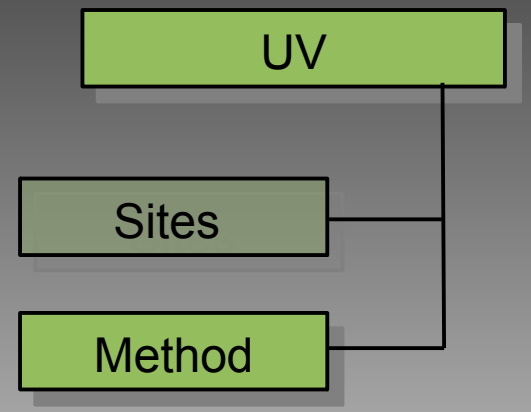
UV Processor

- It uses a two-stream Delta-Eddington formalism similar to that of the ECMWF SW code (*Fouquart and Bonnel,1980; Morcrette, 2002*), but applied to 24/120 600 spectral intervals of width 5/1/0.2 nm to describe the radiative transfer over the spectral band 280-400 nm.
- analysis of integrated broadband fluxes for UVB (290-320 nm) and UVA (320-400 nm) separately
- EUVDB/NSF vs. ECMWF



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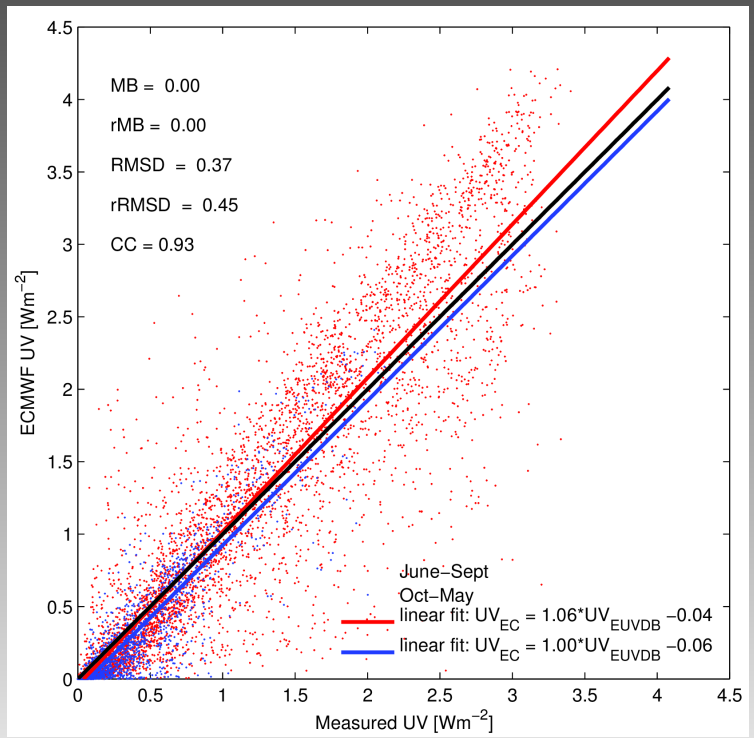
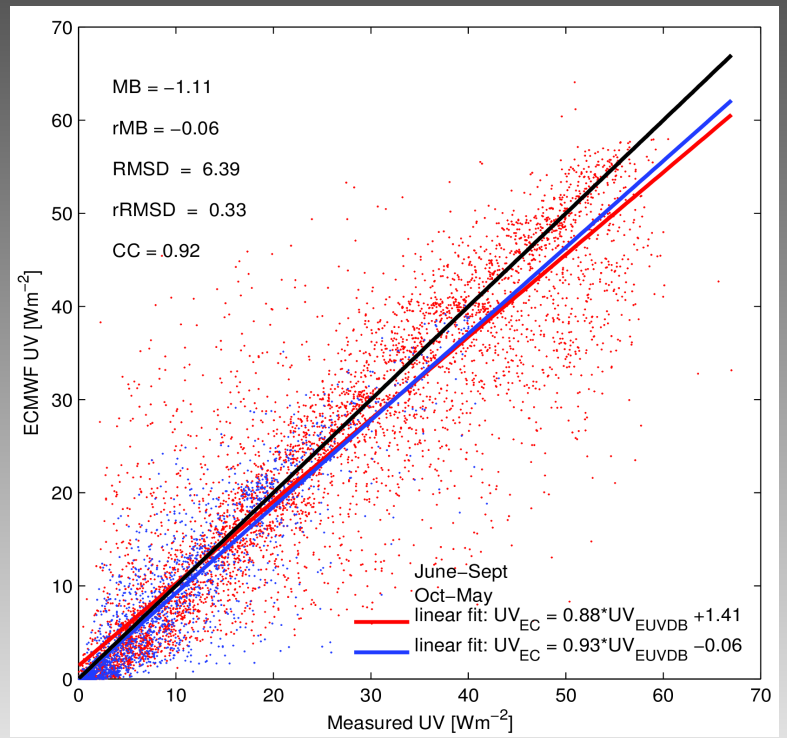
[1]Finnish Meteorological Institute, Kuopio, Finland; [2]University of Eastern Finland, Kuopio; [3]ECMWF, Reading, UK

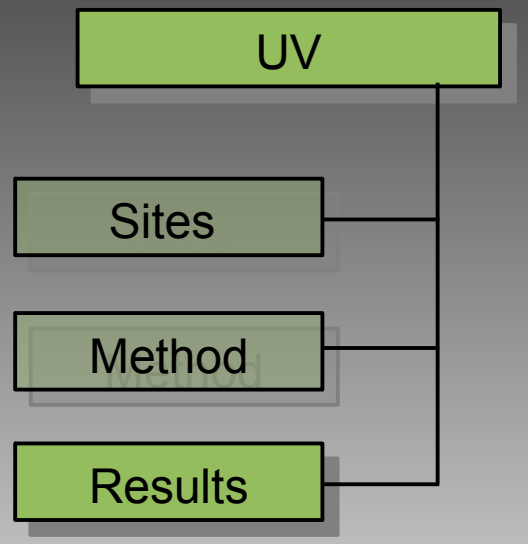
Thessaloniki, Greece



UVB (290-320 nm)



UVA (320-400 nm)



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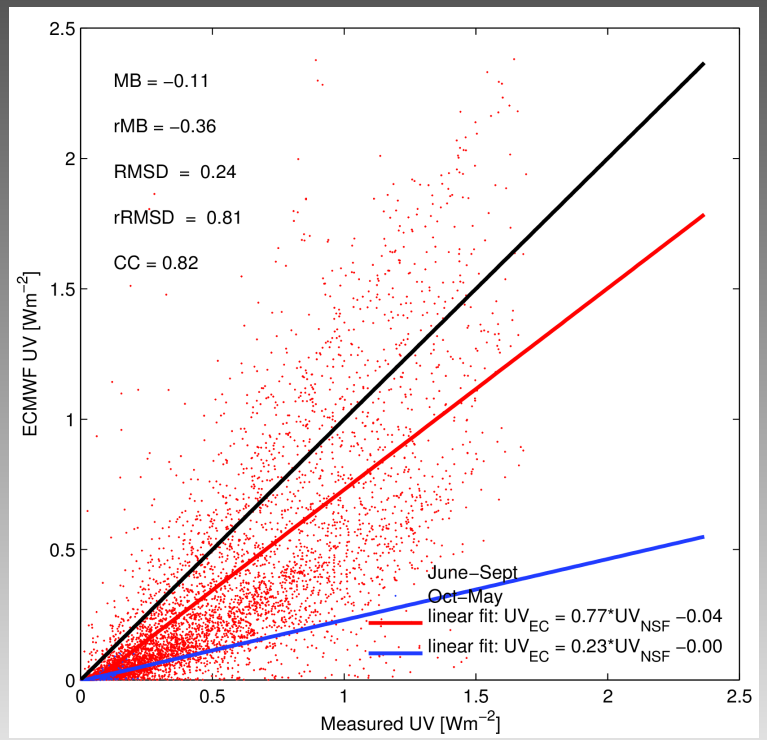
Barrow, Alaska



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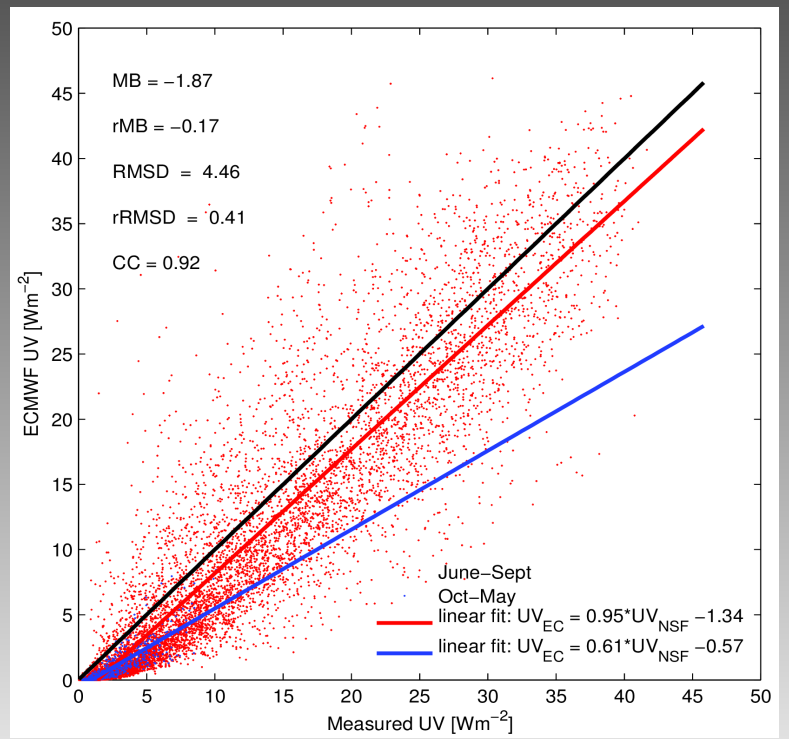
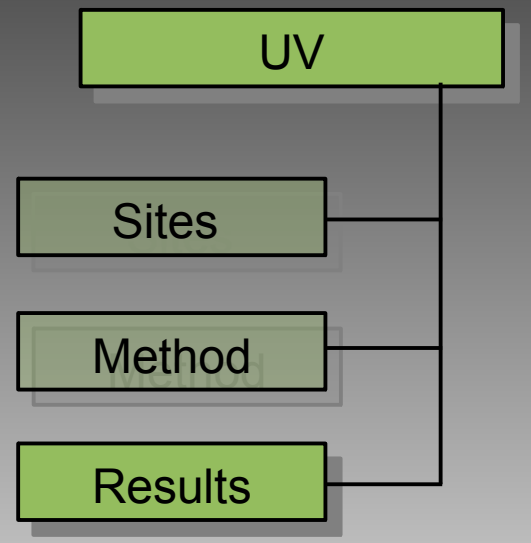


UVA (320-400 nm)



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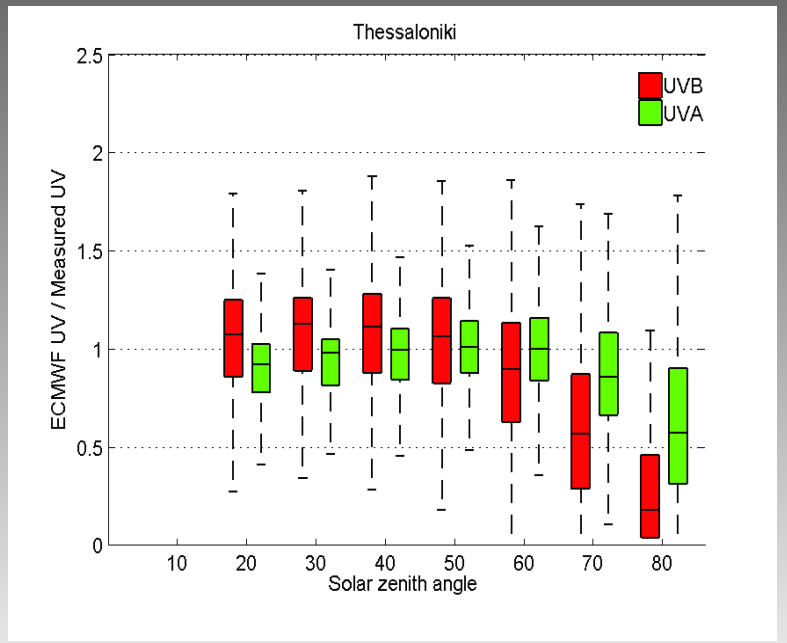
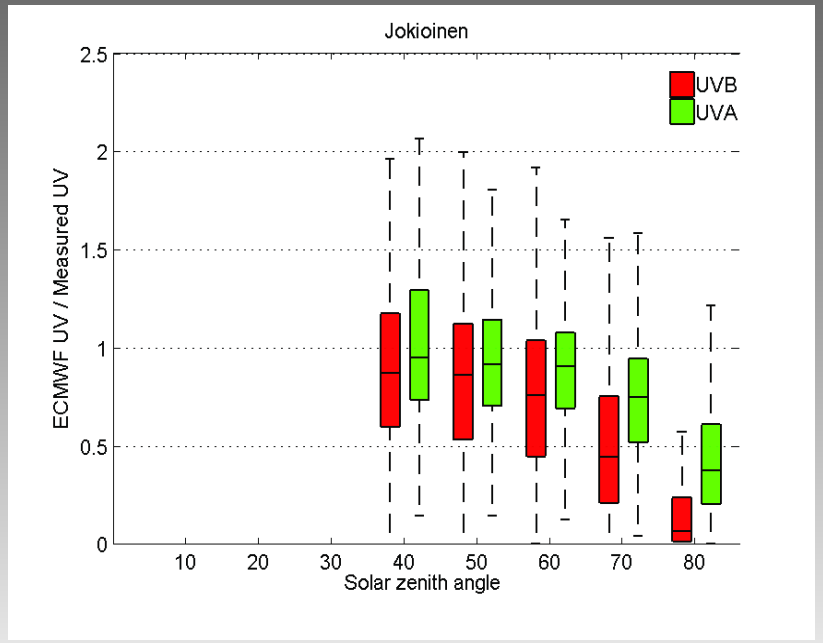
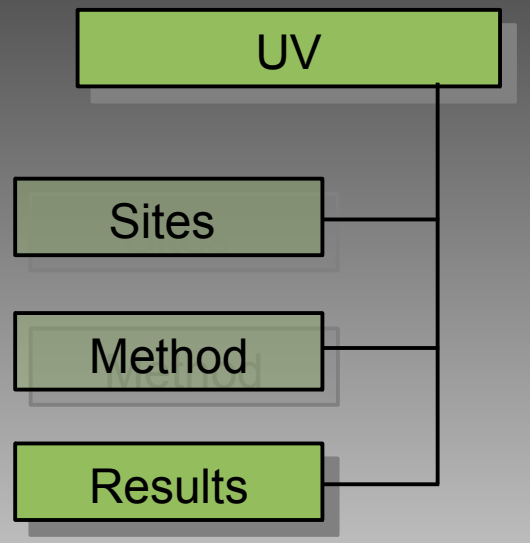


Jokioinen, Finland





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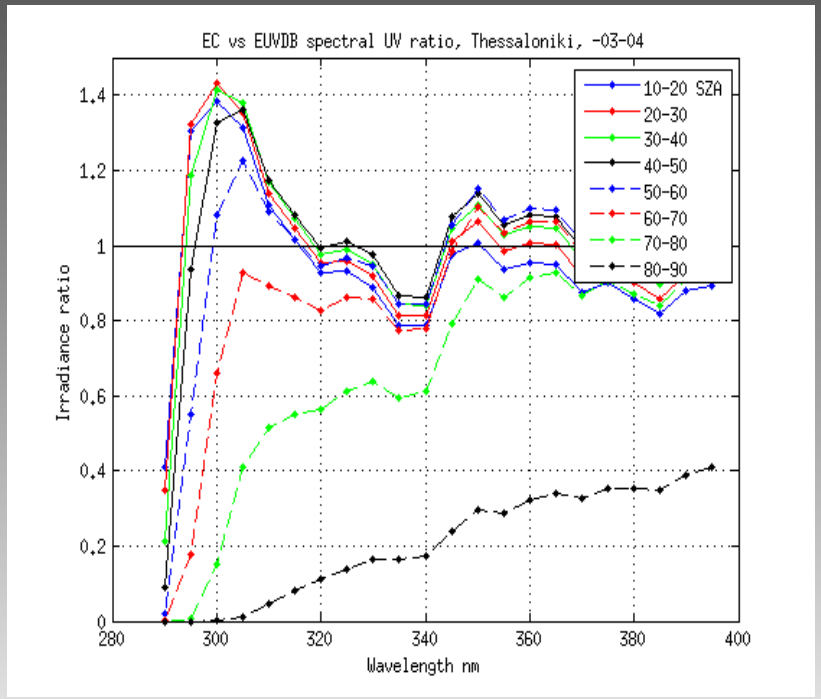
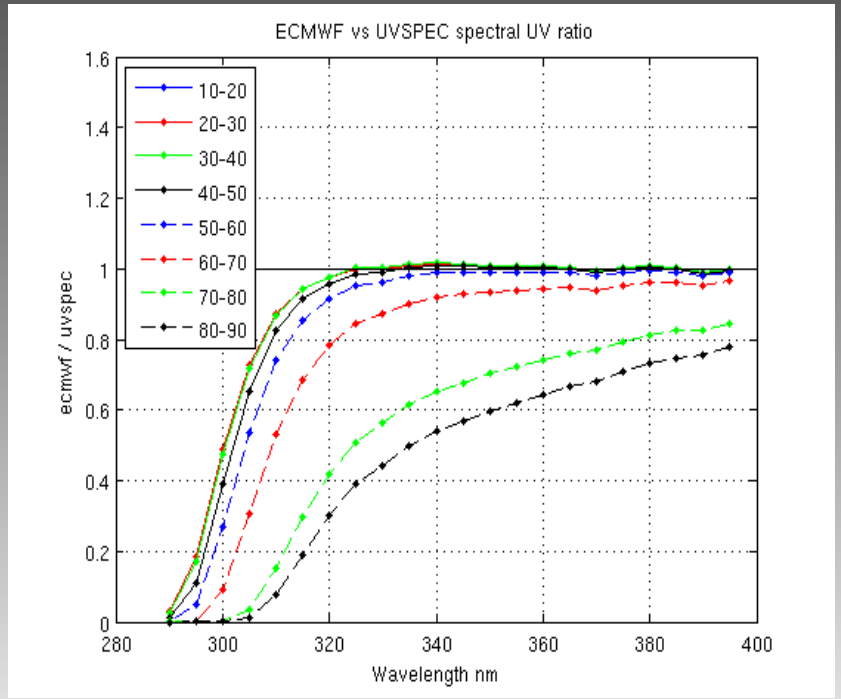
Thessaloniki, Greece, 2003-2004



ECMWF vs. EUVBD

SGP, USA, 1999 03-04



ECMWF vs. LibRadtran

UV

Sites

Method

Results

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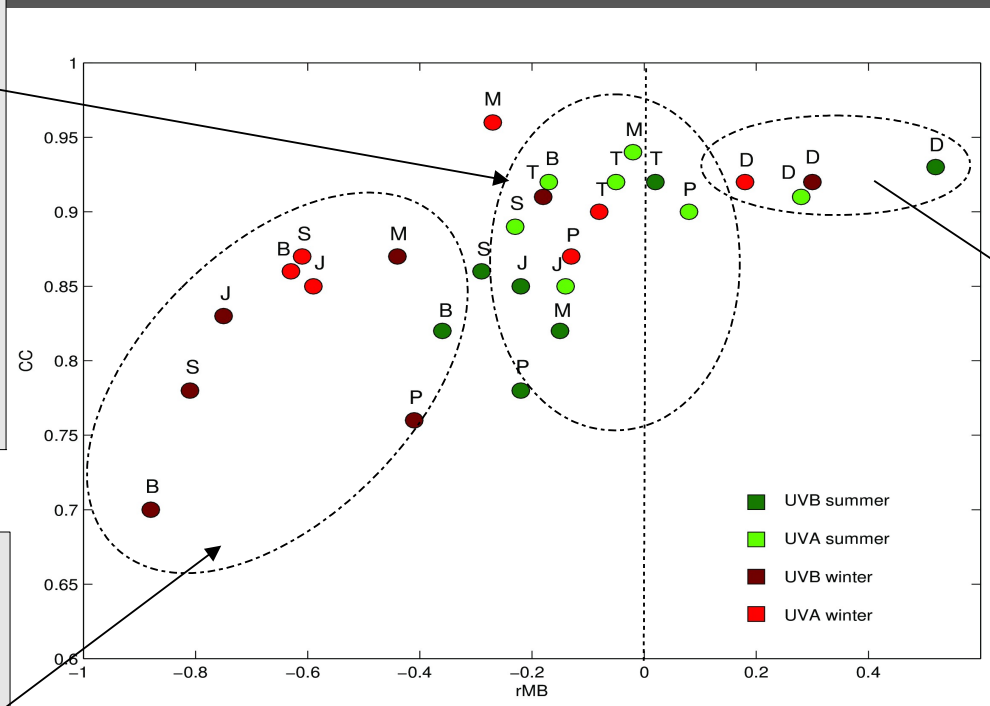
– the best model-measurements agreement between **±20%** over/underestimation

– **UVA for summer** period dominates



strongest overestimation for **San Diego**

strongest underestimation at **UVB** (290-320 nm) for **winter** period

J – Jokioinen,
S – Sodankylä,
B – Barrow,
M – McMurdo,
P – Palmer,
T –Thessaloniki,
D – San Diego

UV

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- AOD
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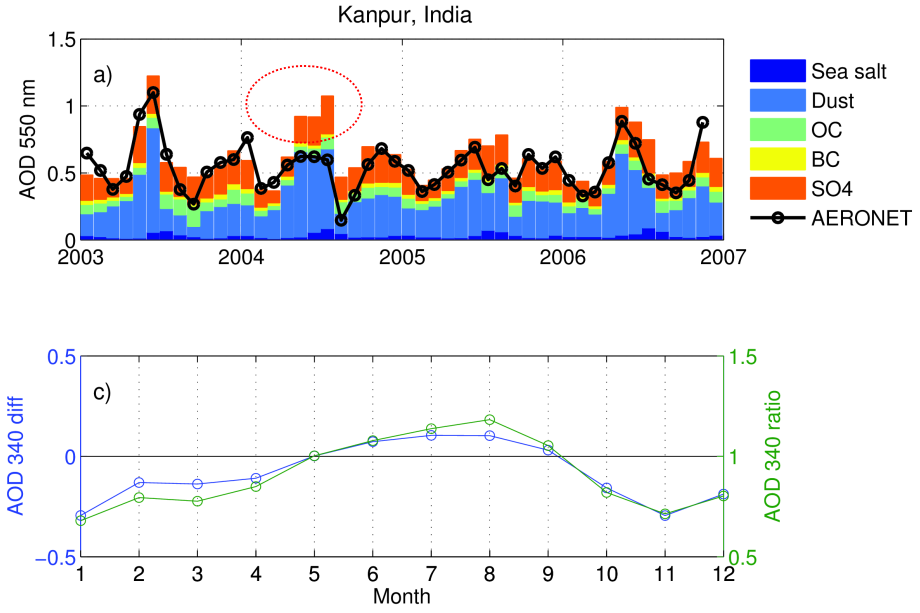

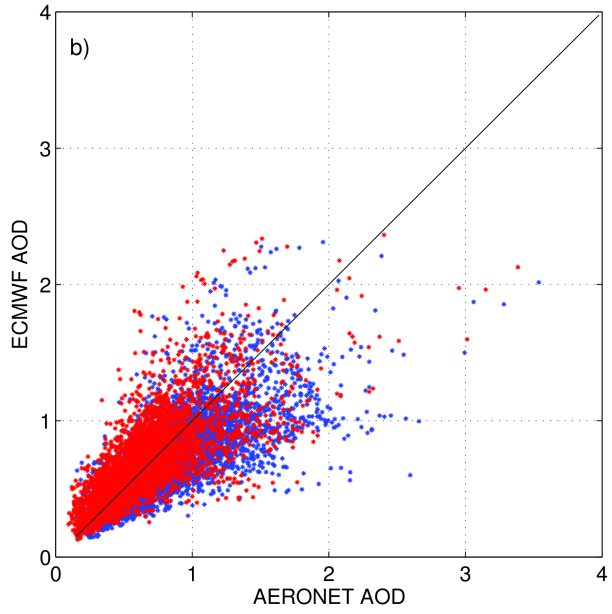

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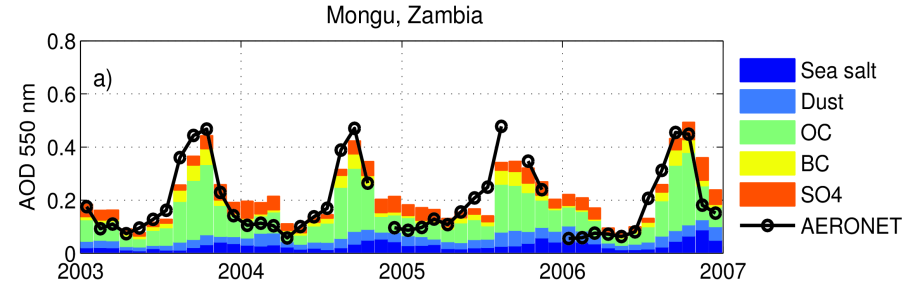
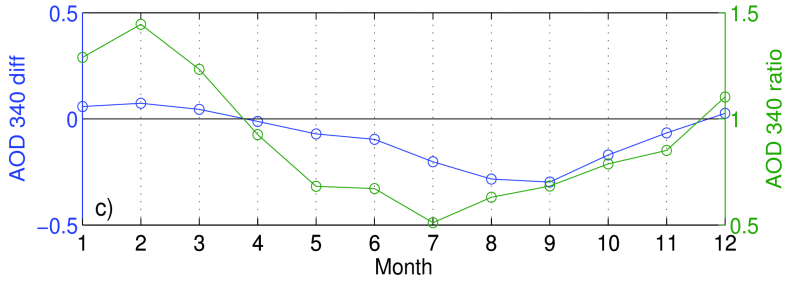
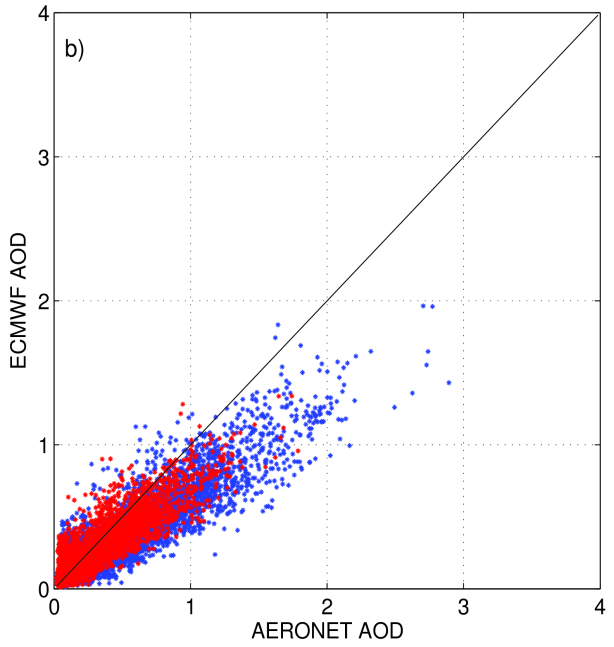


Longer burning season





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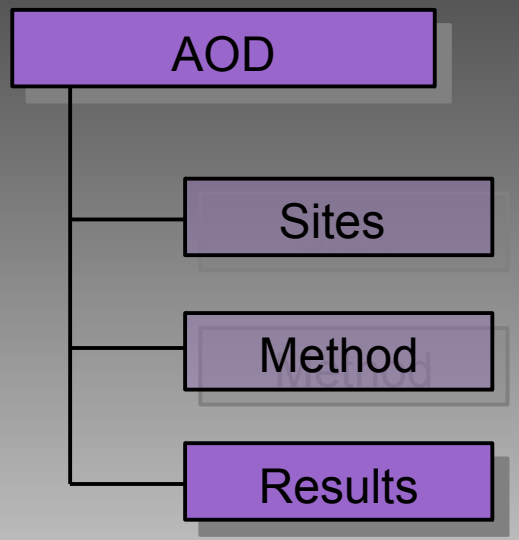

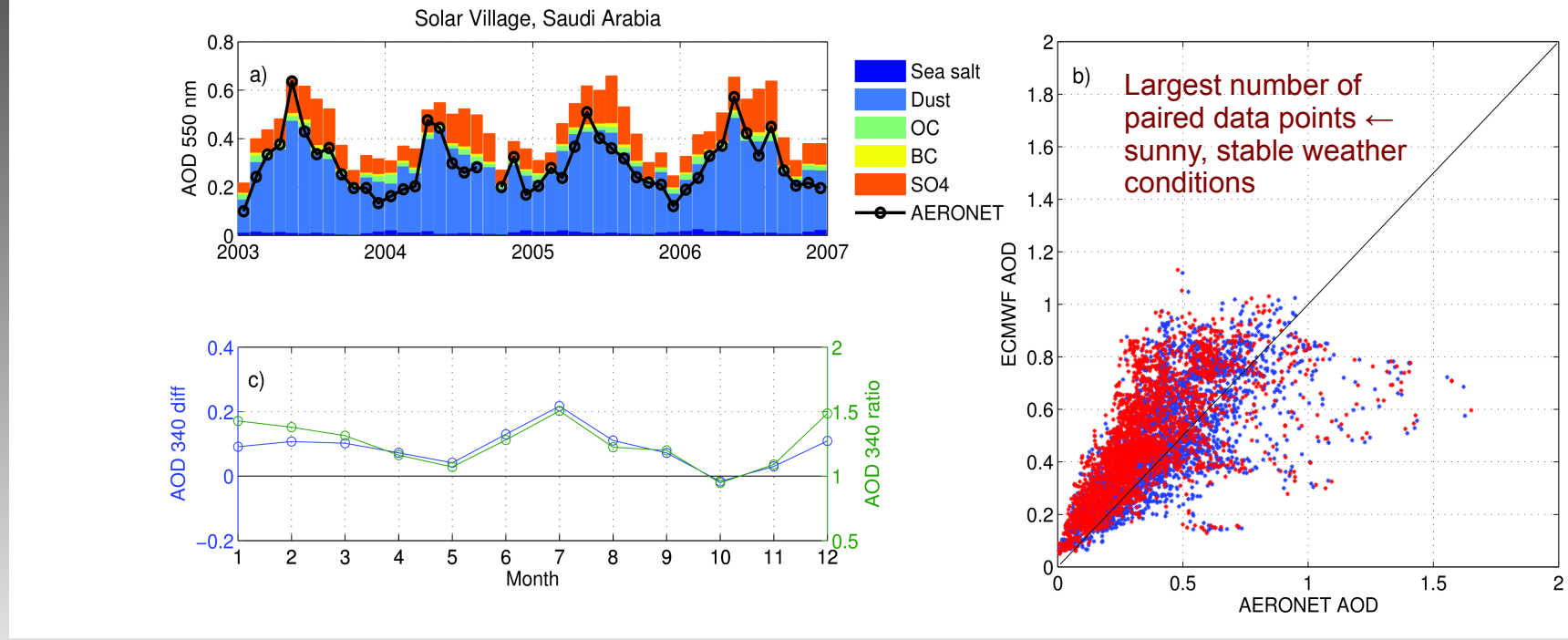

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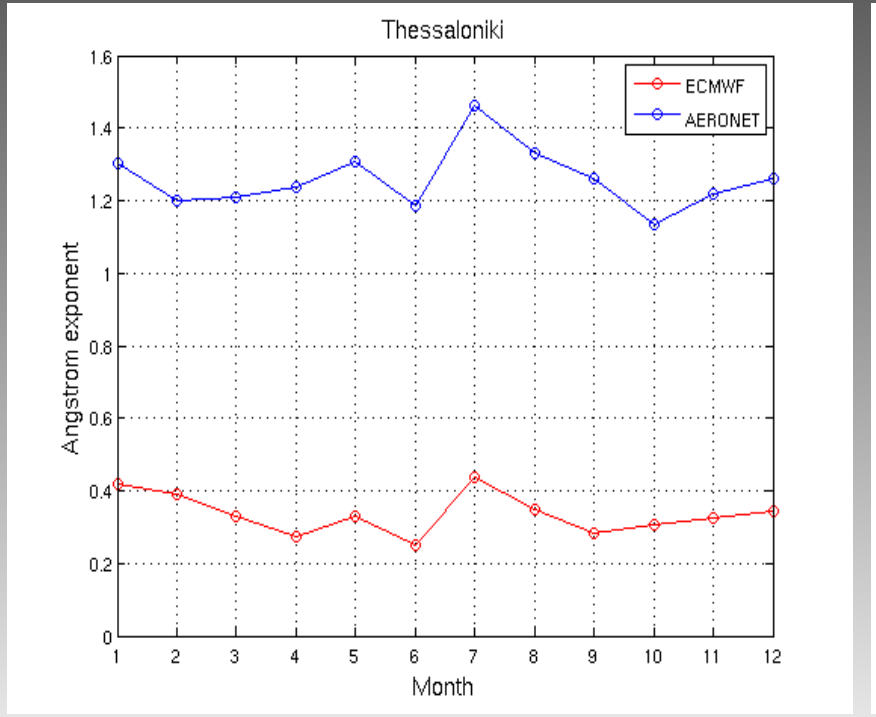

Ilorin, Nigeria