Temporal and spatial characteristics of aerosol chemical composition retrieved from satellite observations by POLDER/PARASOL polarimeter

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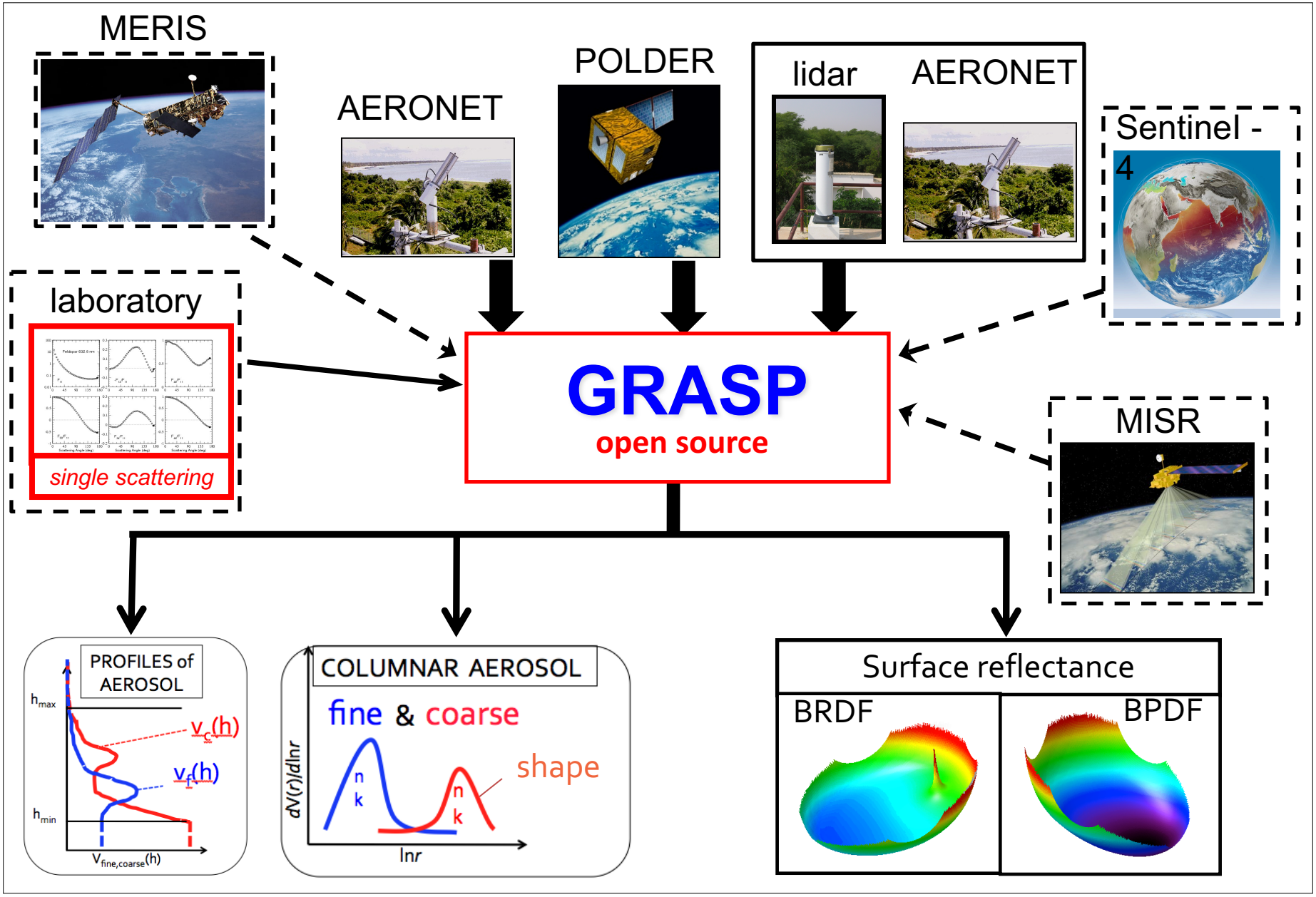
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l'Europe s'engage en Nord-Pas-de-Calais avec le FEDER
Le projet labex CaPPA est cofinancé par l'Union Européenne.

Région Nord Pas de Calais - Picardie

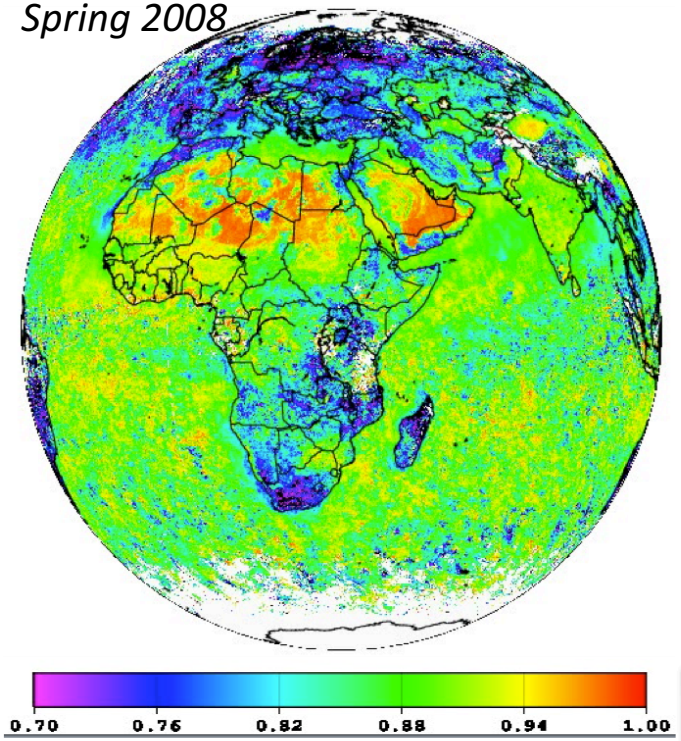
Include chemical conversion model into GRASP algorithm

GRASP: Generalized Retrieval of Aerosol and Surface Properties



Today GRASP provides aerosol absorption properties on a global scale *(aerosol Single Scattering Albedo)*

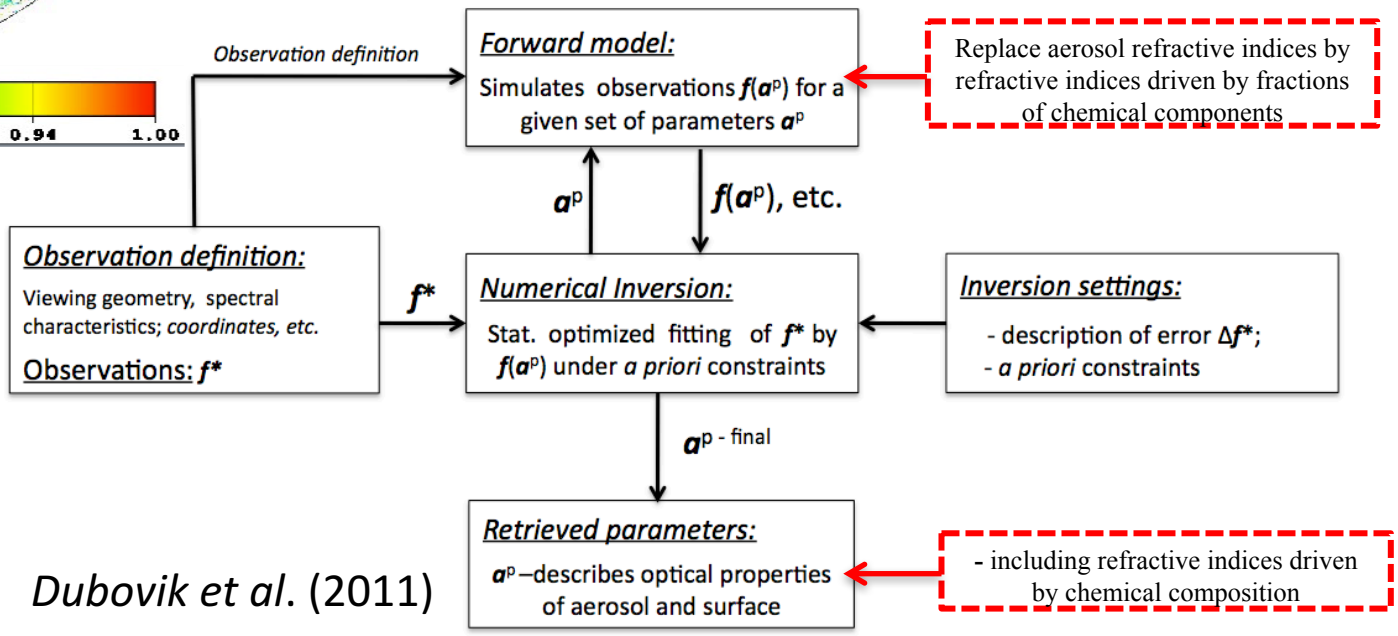
PARASOL/GRASP, SSA at 440 nm Spring 2008



Indeed, Spectral scattering and absorption are related to aerosol chemistry. In our work, we attempt to provide chemical fraction and concentration of optically active aerosol on the global scale.

We add new elements and modify the forward model.

General structure of inversion algorithm



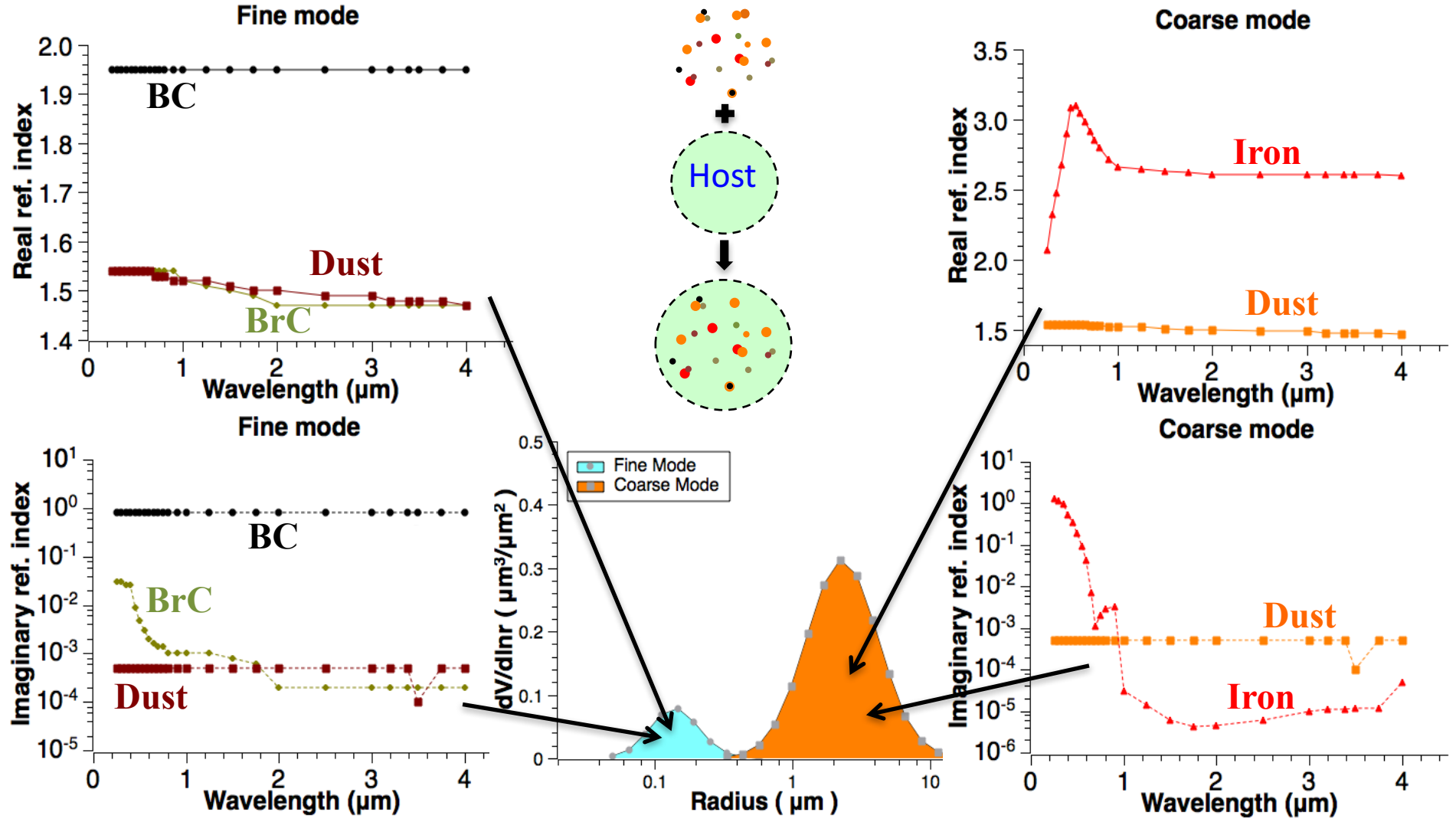
More detail information:

S1.4 Oleg Dubovik
S4.2 Pavel Litvinov
P02 Anton Lapatsin
P09 Xin Huang
P21 David Fuertes

Dubovik et al. (2011)

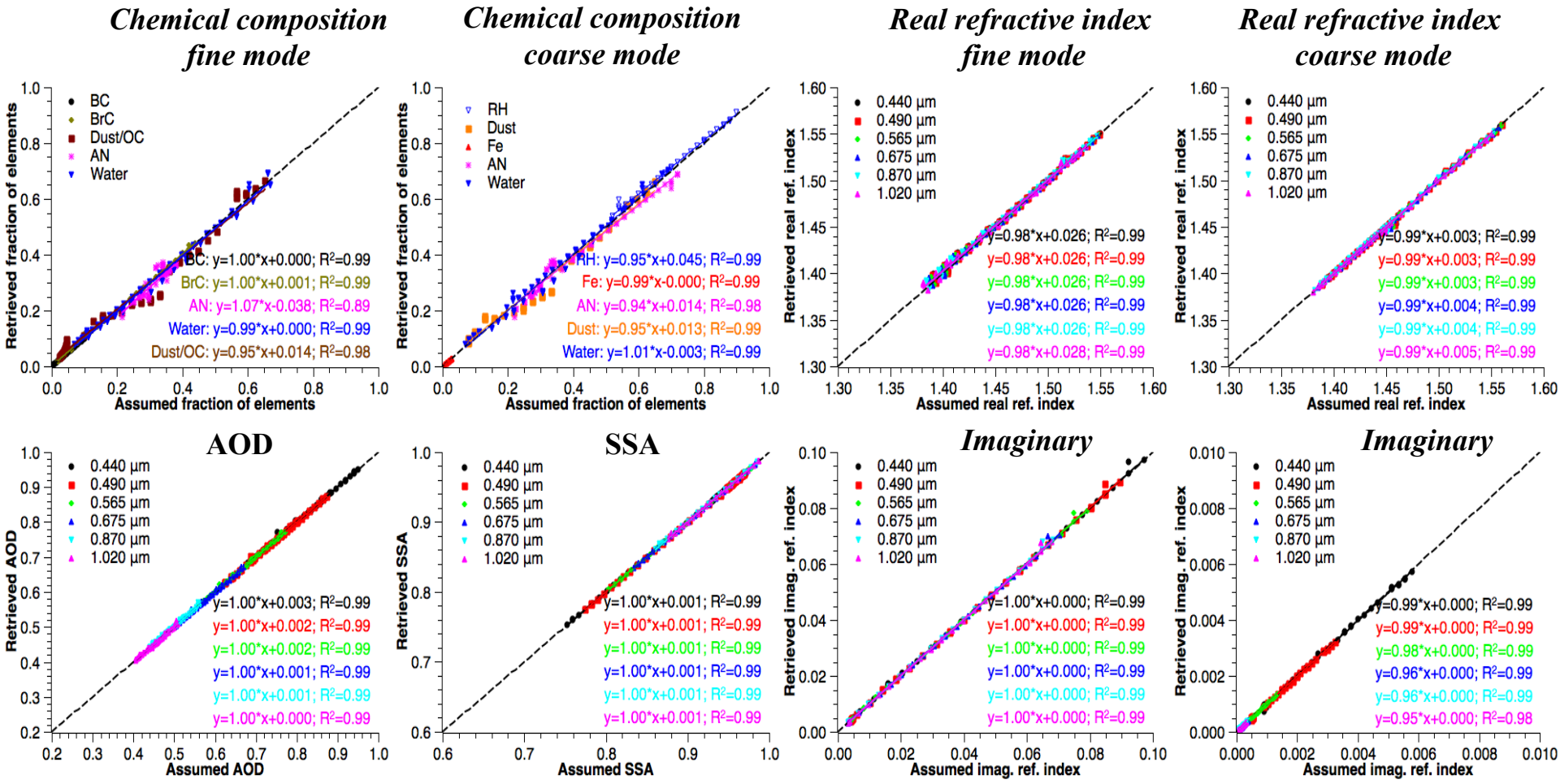
Maxwell-Garnett conversion model

Assumed ***size dependent*** composition: **BC, BrC, Dust, Host (ammonia nitrate + water)** in ***fine mode*** and **Iron oxide, Dust, Host (ammonia nitrate + water)** in ***coarse mode***. Maxwell-Garnett mixing rule is used for the mixture of BC, BrC, Dust and Iron; Partial molar theory is used for the host of ammonia nitrate and water.

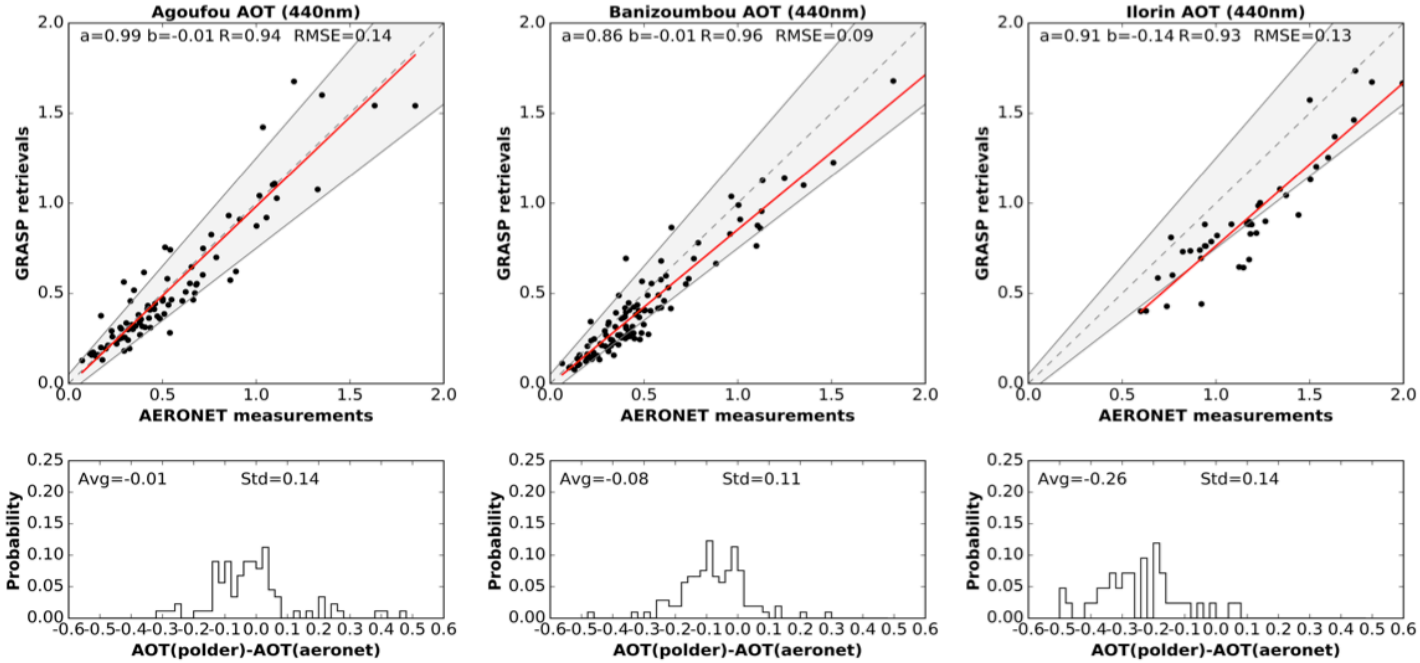


Sensitivity tests

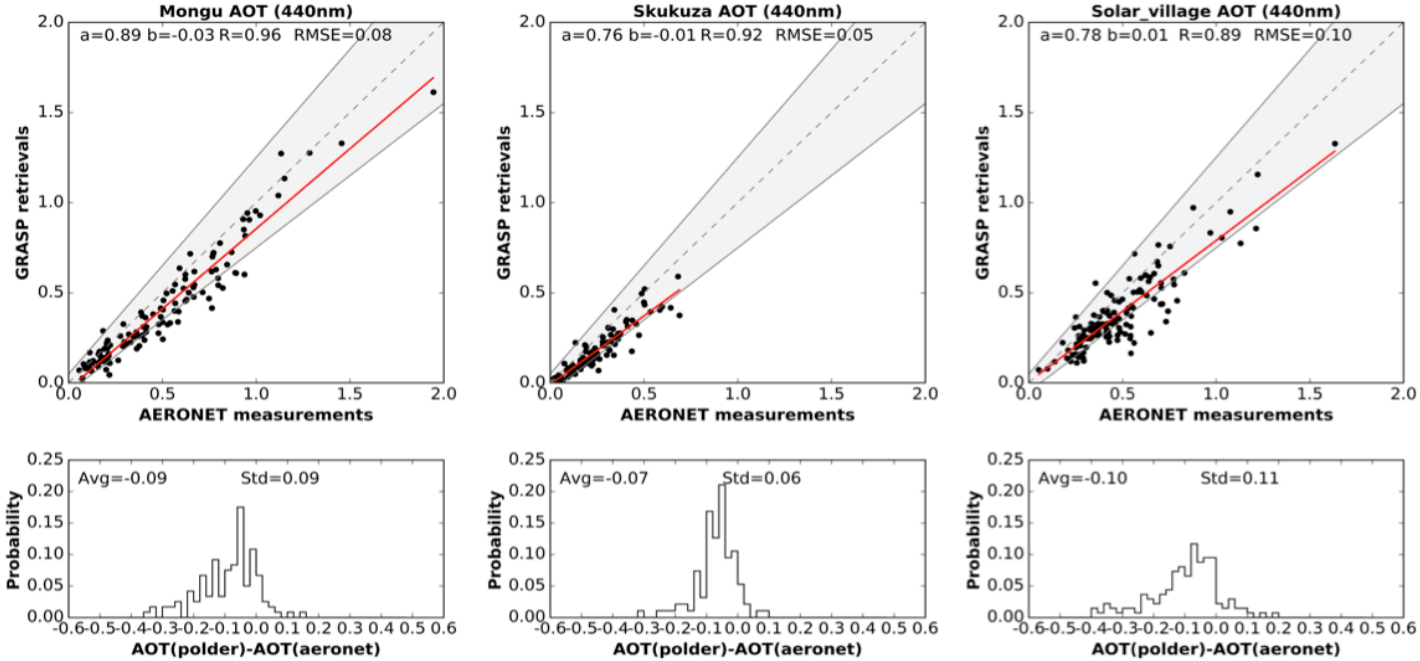
A series of sensitivity tests are conducted for chemical conversion model using the synthetic POLDER/PARASOL data. Results show that utilization of **the size-dependent Maxwell-Garnett** conversion model allows the retrieval to distinguish amongst the assumed chemical compositions.



AOT Intercomparison POLDER/GRASP vs. AERONET



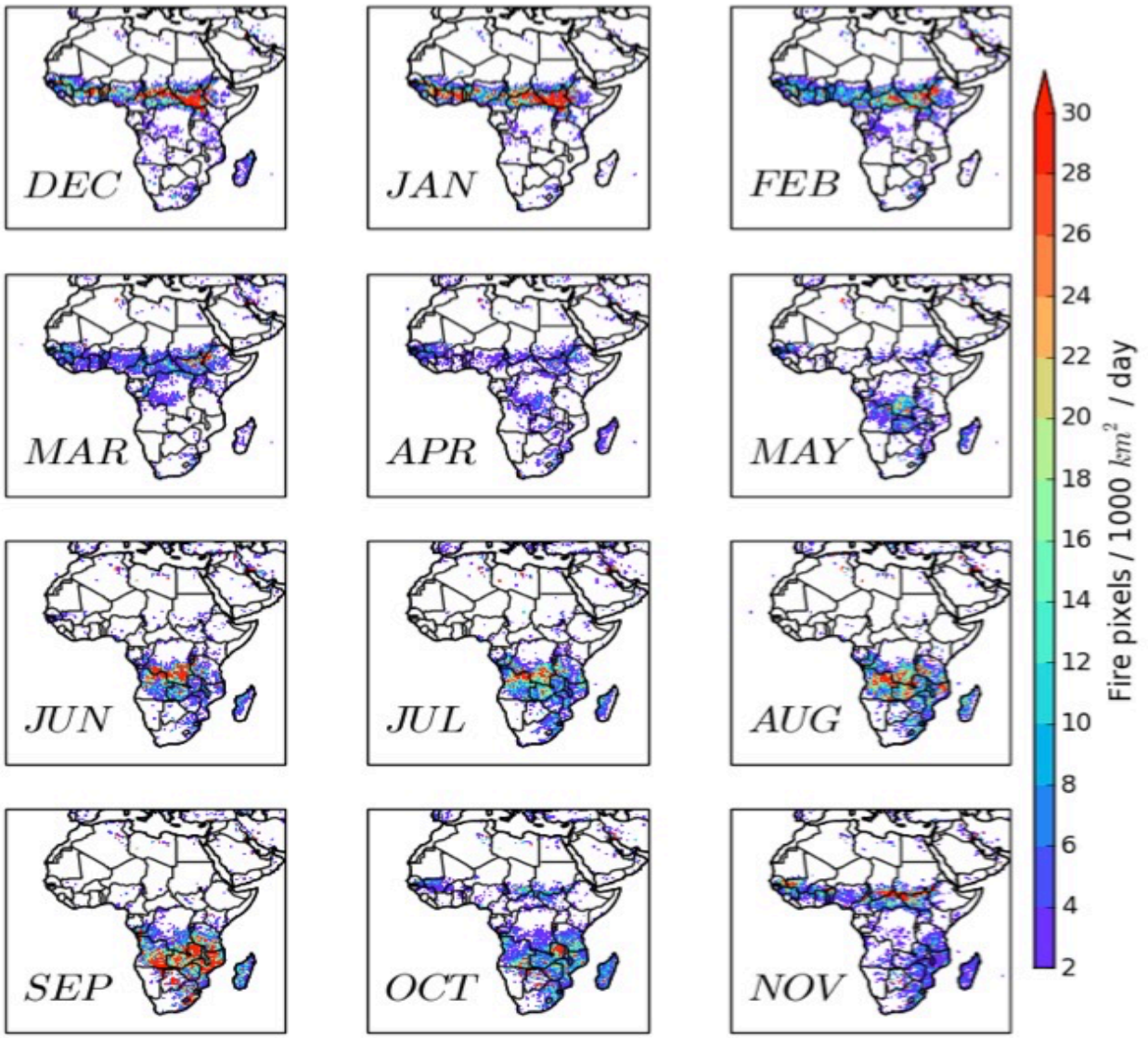
The comparisons of GRASP retrievals with the corresponding values provided by AEROENT at six sites: Agoufou, Ilorin, Banizoumbou, Mongu, Skukuza, and Solar village.

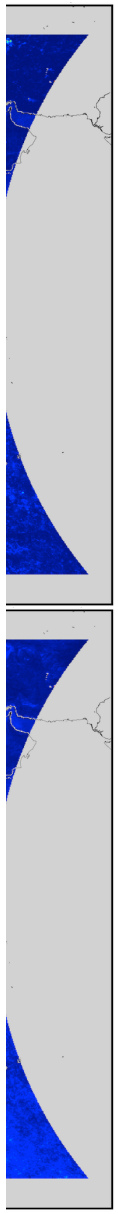


Results obtained from real PARASOL data demonstrated good agreement with the optical characteristics provided by AERONET (e.g., R of 0.9 even larger for aerosol optical thickness).

Black carbon volume concentration (mm^3/m^2) (2006-2008)

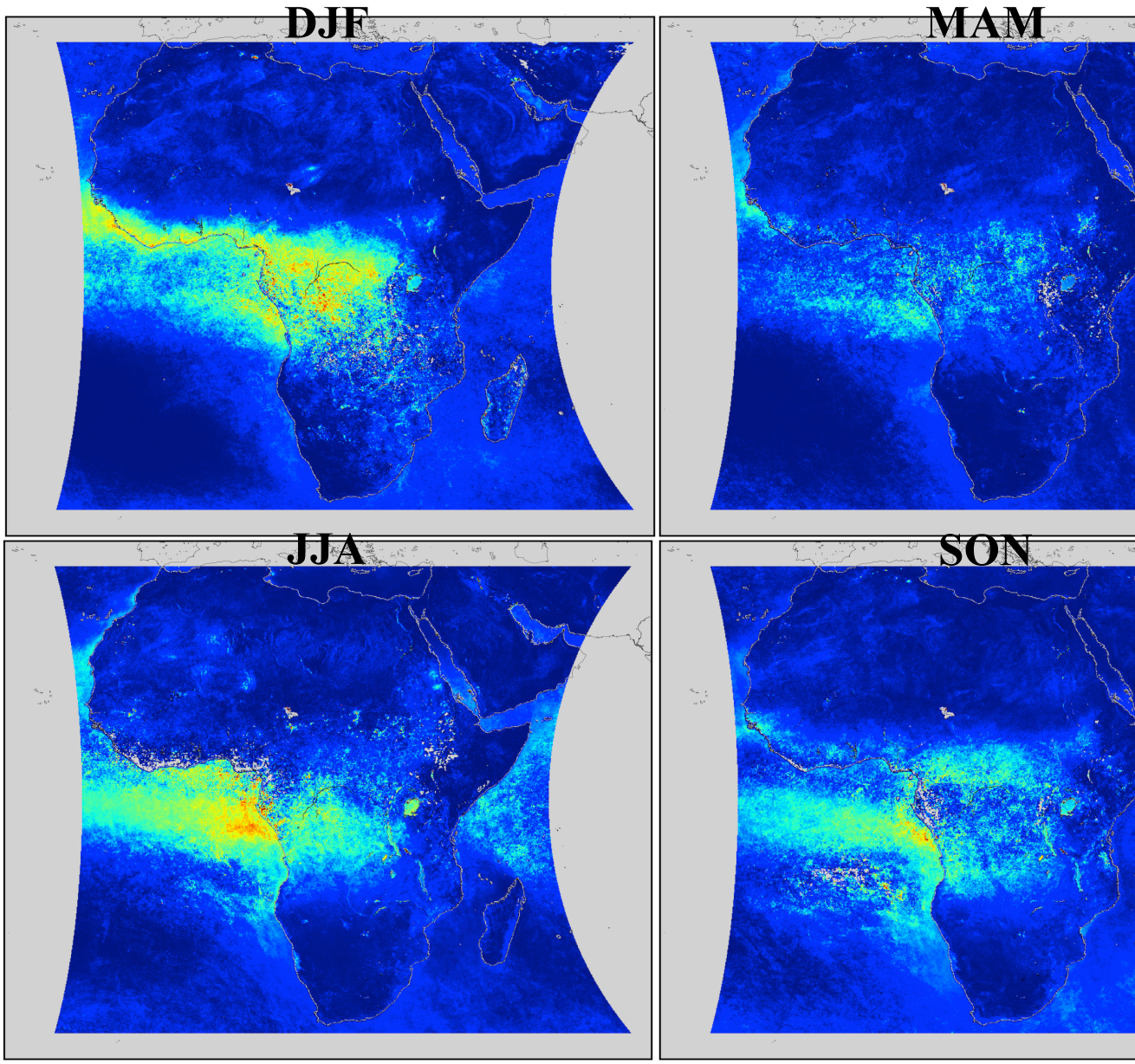
Monthly fire maps obtained from MODIS





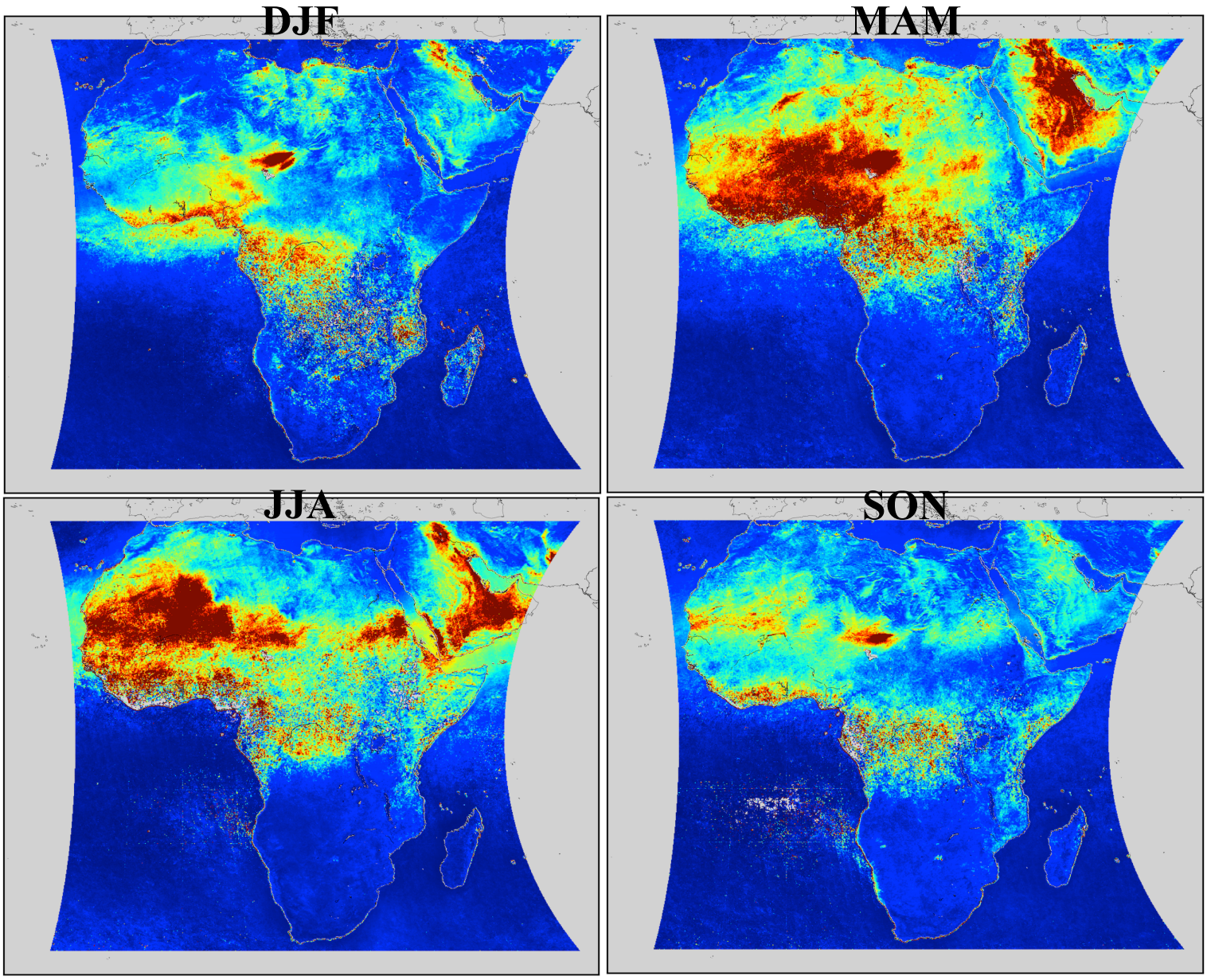
Season	Mean
DJF	0.60
MAM	0.24
JJA	0.48
SON	0.60

Brown carbon volume concentration (mm^3/m^2) (2006-2008)



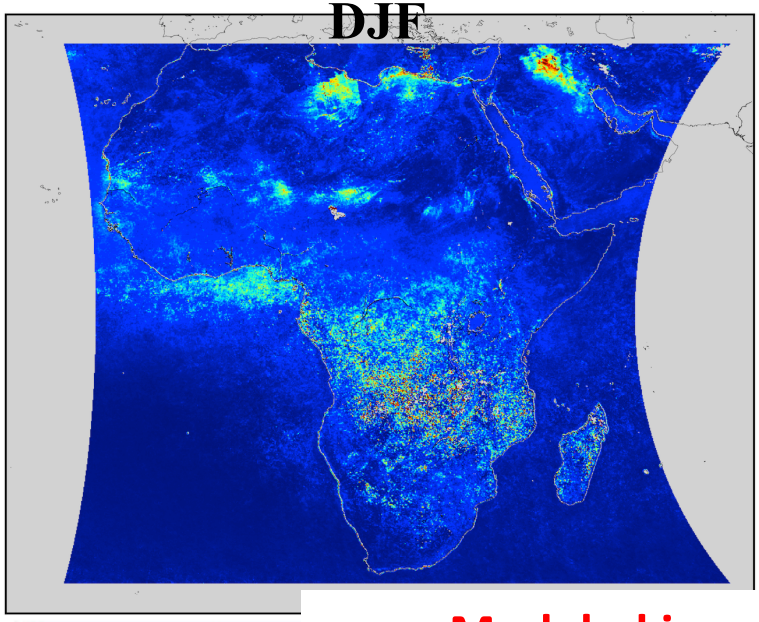
Season	Mean
DJF	6.55
MAM	3.94
JJA	6.12
SON	6.04

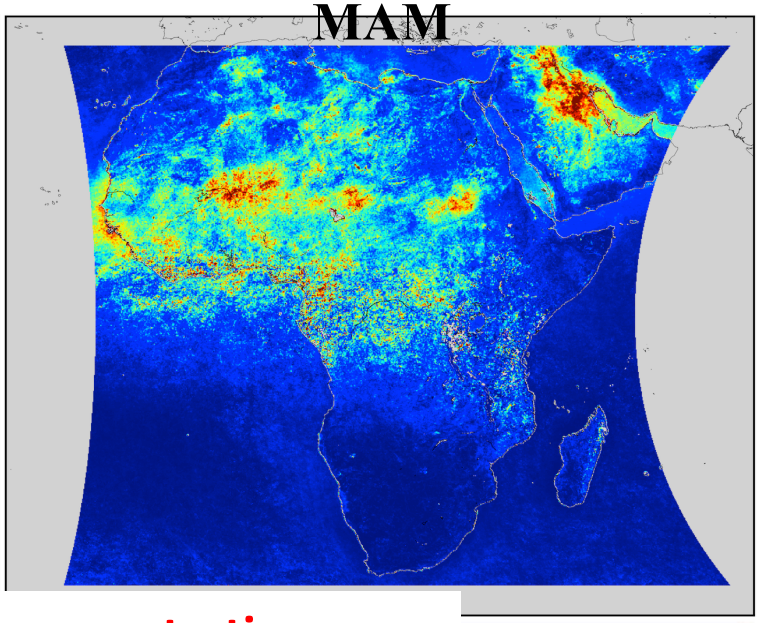
Coarse dust volume concentration (mm^3/m^2) (2006-2008)



Season	Mean
DJF	45.61
MAM	**65.85**
JJA	58.98
SON	**42.21**

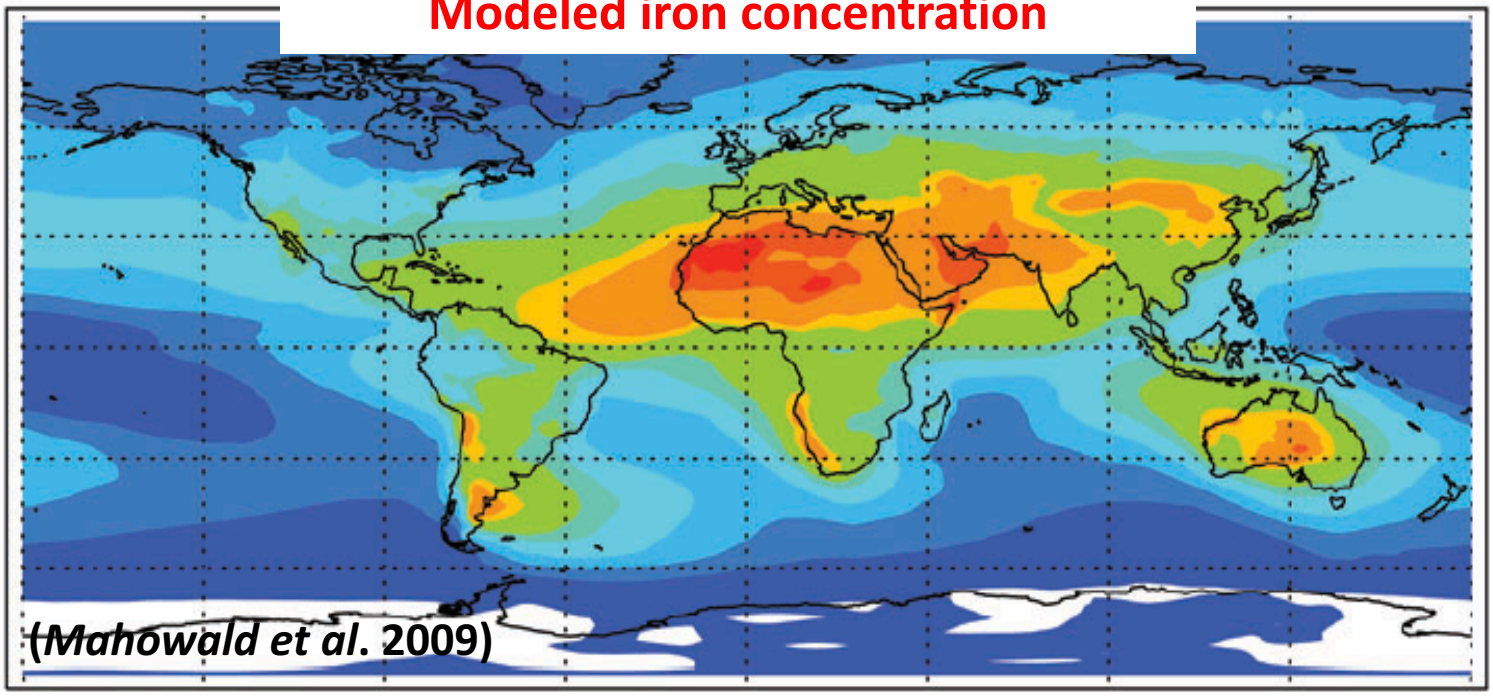
Iron volume concentration (mm^3/m^2) (2006-2008)





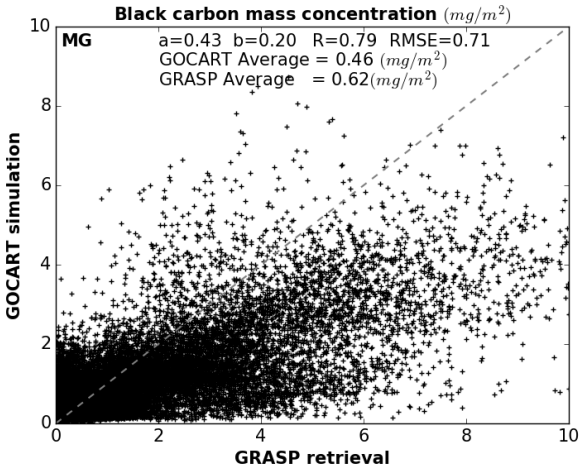
Season	Mean
DJF	0.52
MAM	**0.94**
JJA	0.80
SON	**0.48**

Modeled iron concentration



(*Mahowald et al.* 2009)

Comparison of GRASP retrieval with GOCART simulation

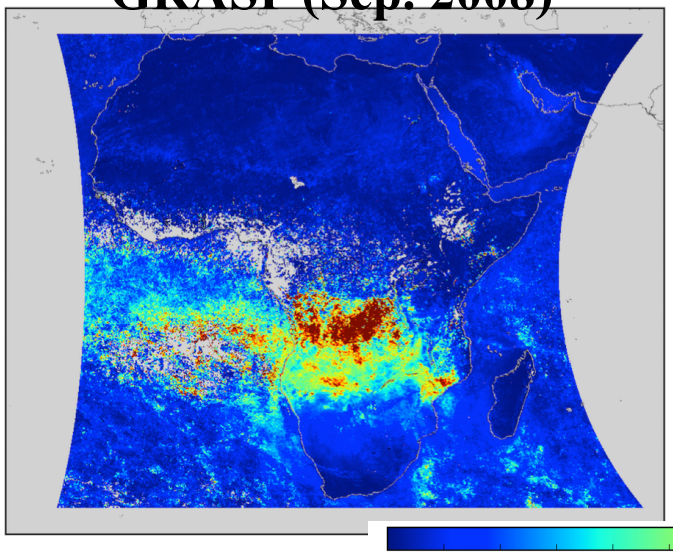


GRASP: 0.62 mg/m^2

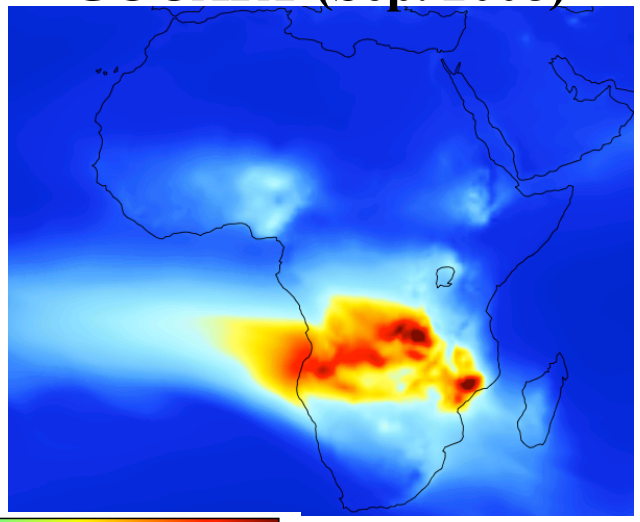
GOCART: 0.46 mg/m^2

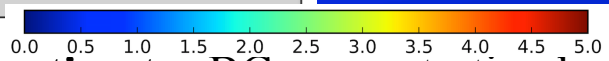
R=0.79

GRASP (Sep. 2008)

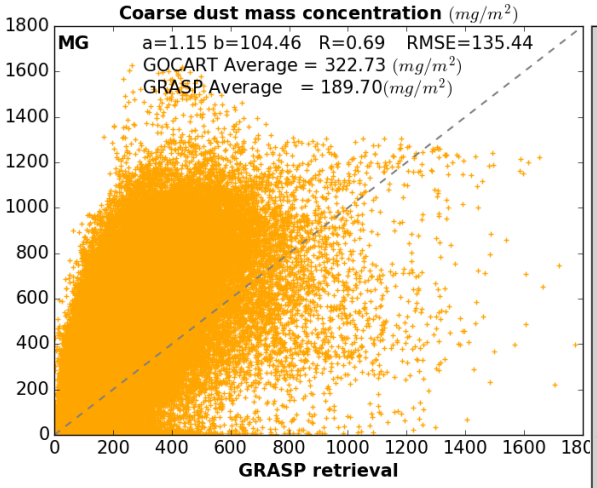


GOCART (Sep. 2008)





GOCART **underestimates** BC concentration by ~ **35%** in 2008.

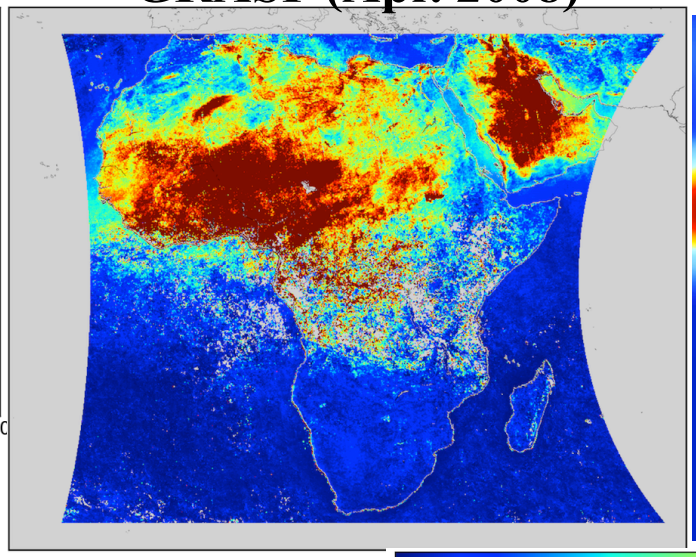


GRASP: 189.70 mg/m^2

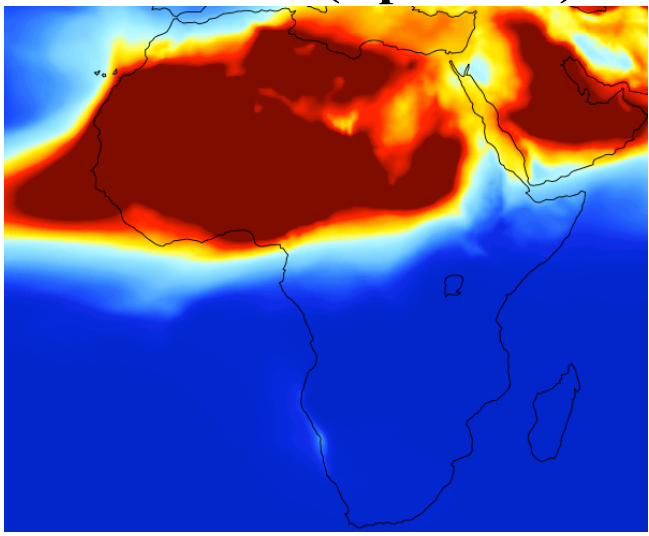
GOCART: 322.73 mg/m^2

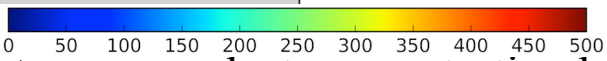
R=0.69

GRASP (Apr. 2008)



GOCART (Apr. 2008)





GOCART **overestimates** coarse dust concentration by ~ **40%** in 2008.

Conclusions

- The sensitivity tests show that utilization of the Maxwell-Garnett conversion model allows the retrieval to distinguish amongst the assumed chemical compositions.

- Results obtained from real PARASOL data demonstrated good agreement with the optical characteristics provided by AERONET (e.g., R of ~ 0.9 or higher for aerosol optical thickness).

- The obtained patterns of chemical component distribution agreed with model simulation and fire map obtained from MODIS.

- The comparisons demonstrated that GOCART mode **underestimates** black carbon concentration in biomass burning regions (northern and southern Africa), but model **overestimates** dust concentration in dust-dominated places (northern Africa and Middle East).