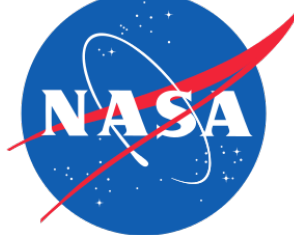


# Constraining global aerosol emissions from satellite observations



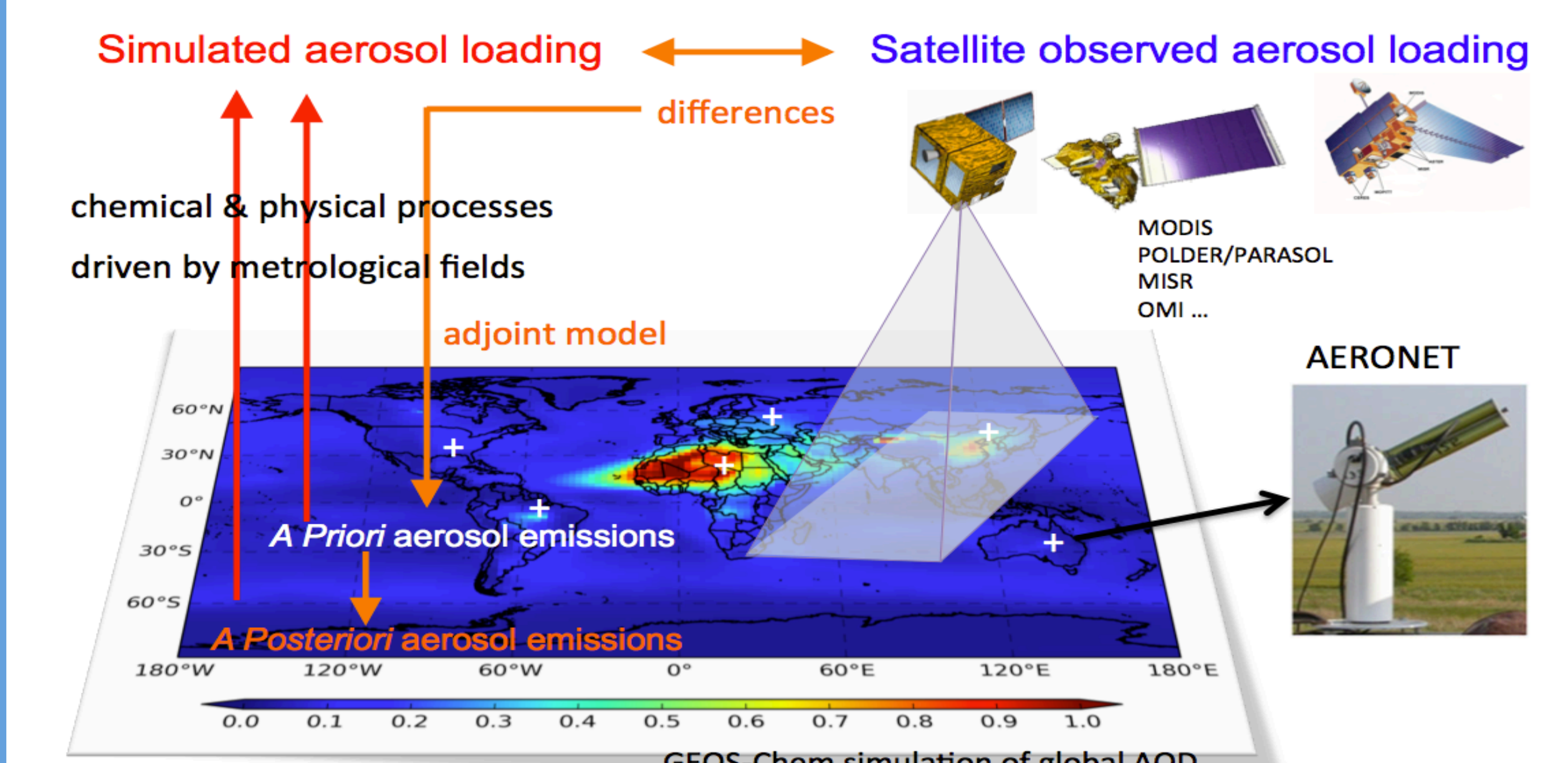
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## Introduction

- One of the most important factors affecting the aerosol model simulation is adopted data for **aerosol emissions**.
- Aerosol climate effects evaluation is affected by not only aerosol extinction **AOD** but also aerosol absorption (**AAOD**) and particle size (Ångström Exponent, **AExp**).
- We develop **GEOS-Chem** based inverse modeling algorithm for retrieving desert dust (**DD**), black carbon (**BC**) and organic carbon (**OC**) aerosol emission sources simultaneously from recent aerosol data retrieved from the polarimetric POLDER/PARASOL produced with the **GRASP** algorithm (Chen et al., 2018; Dubovik et al., 2008, 2011, 2014; Henze et al., 2007).

## Methodology

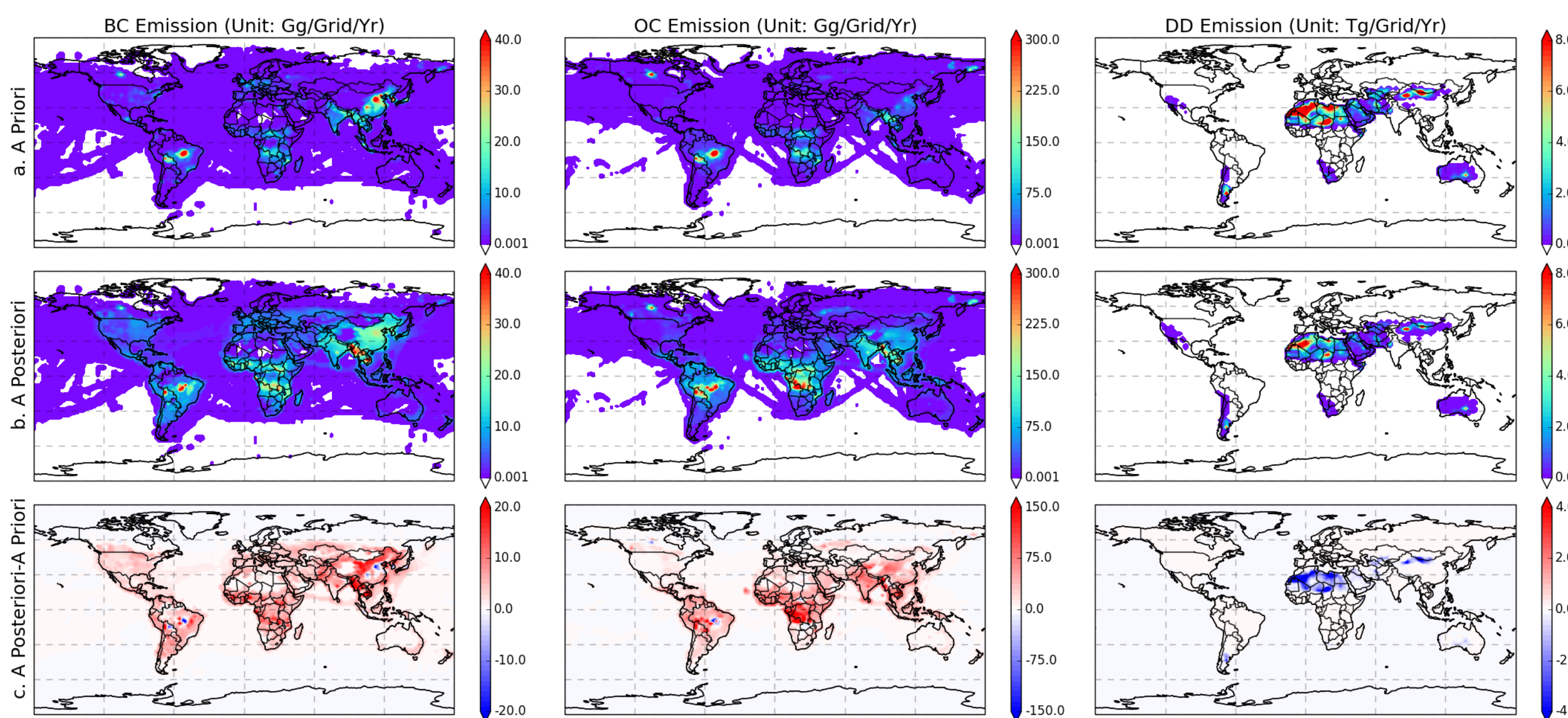


$$\text{Cost function: } J(S) = (f(S) - f_{\text{obs}})^T C_{\text{obs}}^{-1} (f(S) - f_{\text{obs}}) + \gamma_r (S - S_a)^T C_a^{-1} (S - S_a)$$

$$p\text{-th Source correction: } \Delta S^p = K_{\text{obs}}^T C_{\text{obs}}^{-1} \Delta f^p + \gamma_r C_a^{-1} (S^p - S_a)$$

## Result

### Satellite-derived Global Emission Database

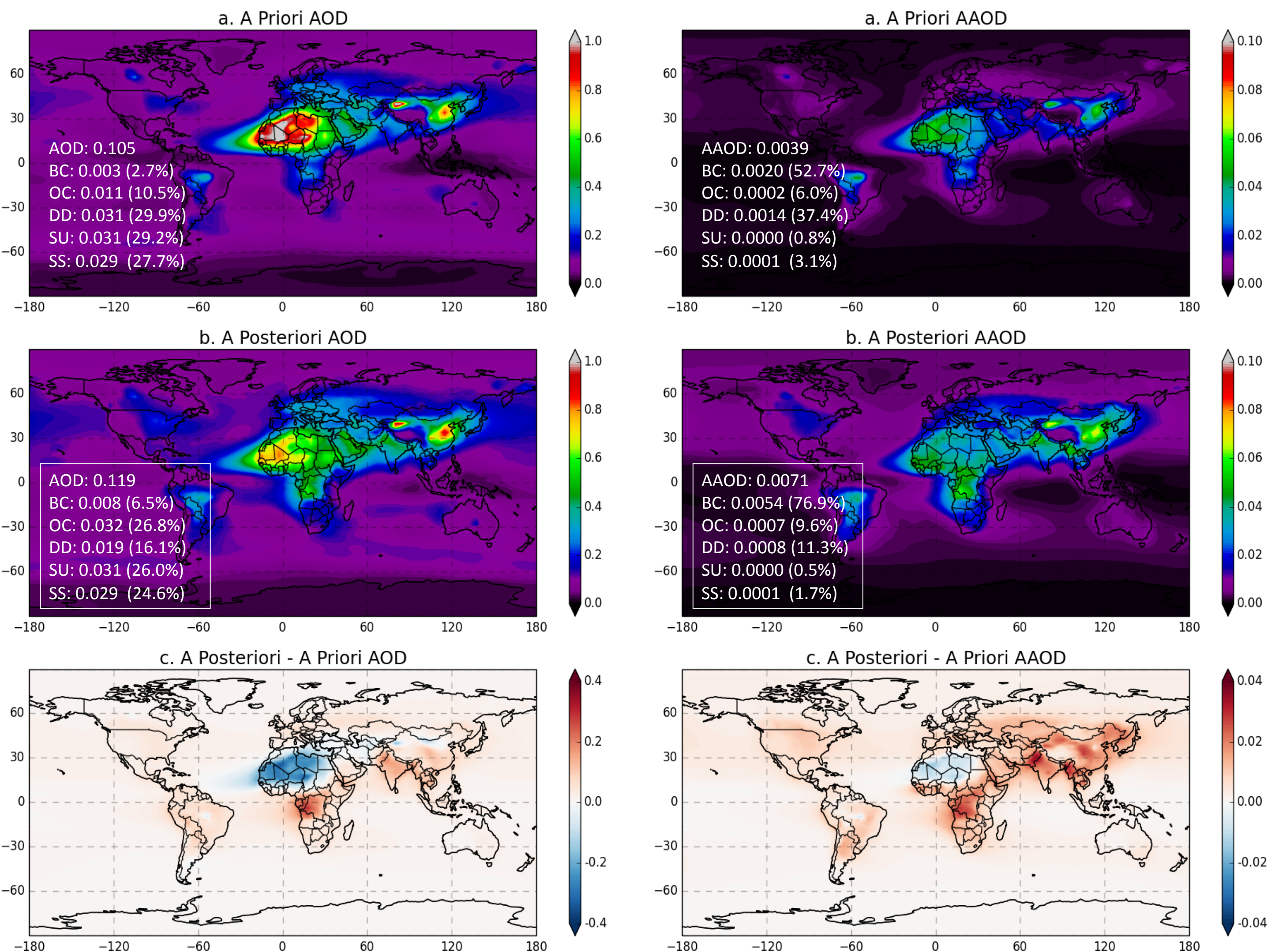


Global aerosol emission flux (Tg/yr) in year 2010

|                     | DD     | BC   | OC    | SO <sub>2</sub> | SS     |
|---------------------|--------|------|-------|-----------------|--------|
| <i>A Priori</i>     | 1269.4 | 6.9  | 38.7  | 87.9            | 3540.3 |
| <i>A Posteriori</i> | 731.6  | 18.4 | 109.9 | 87.9            | 3540.3 |

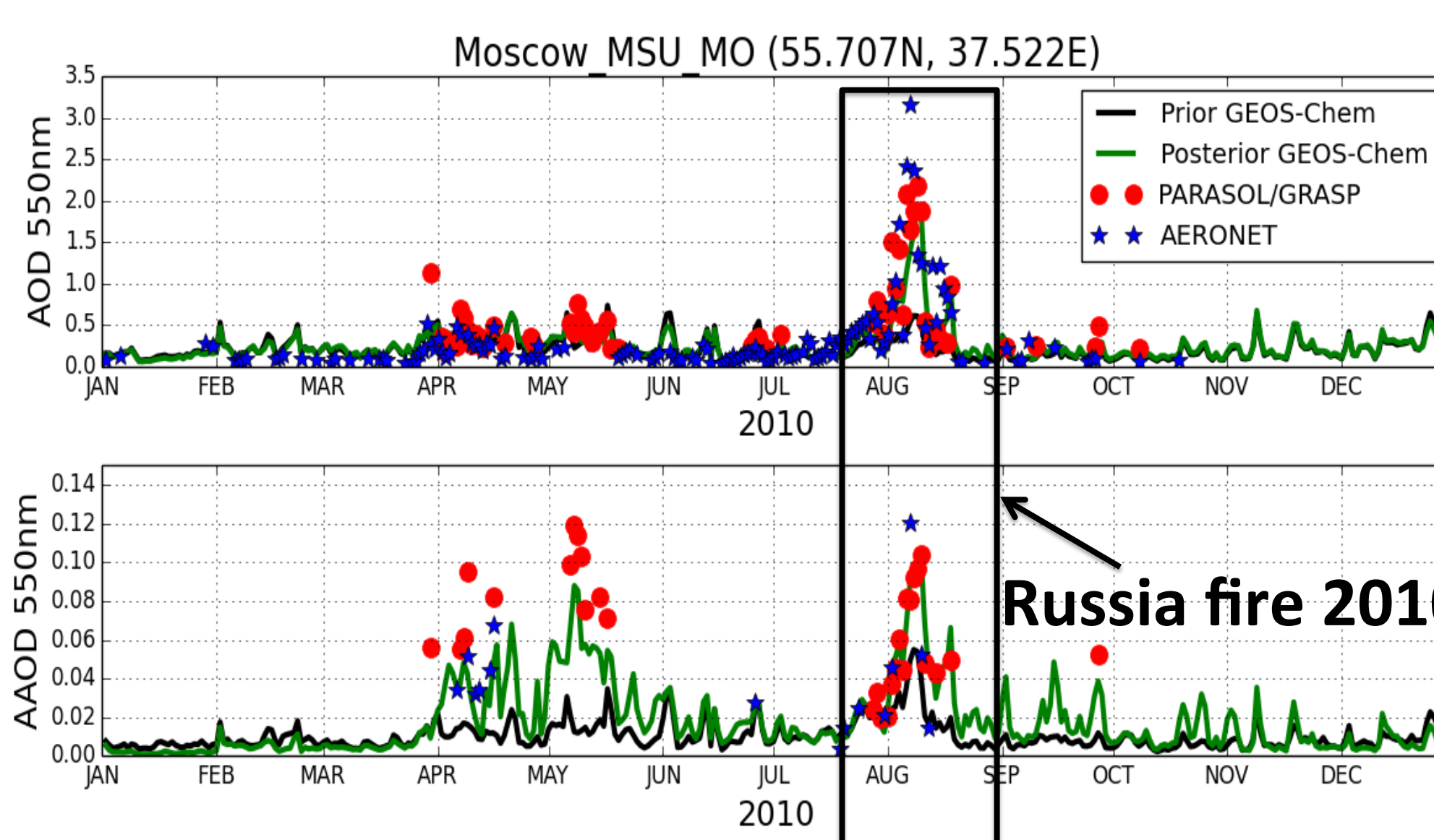
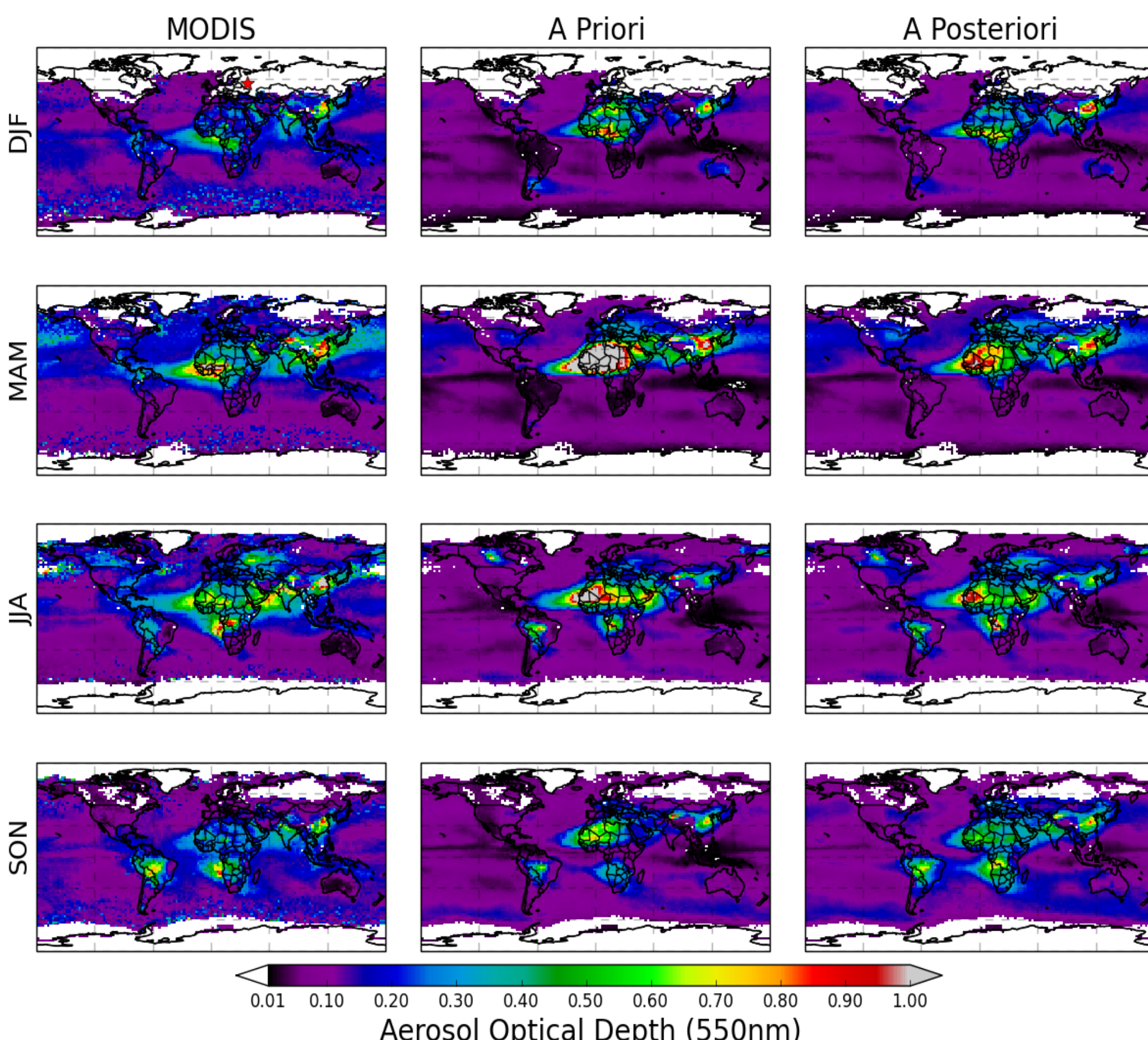
*A Priori*: HTAP V2 and GFED 4s Emission inventory; *A Posteriori*: This study.

### Satellite-constrained aerosol specification

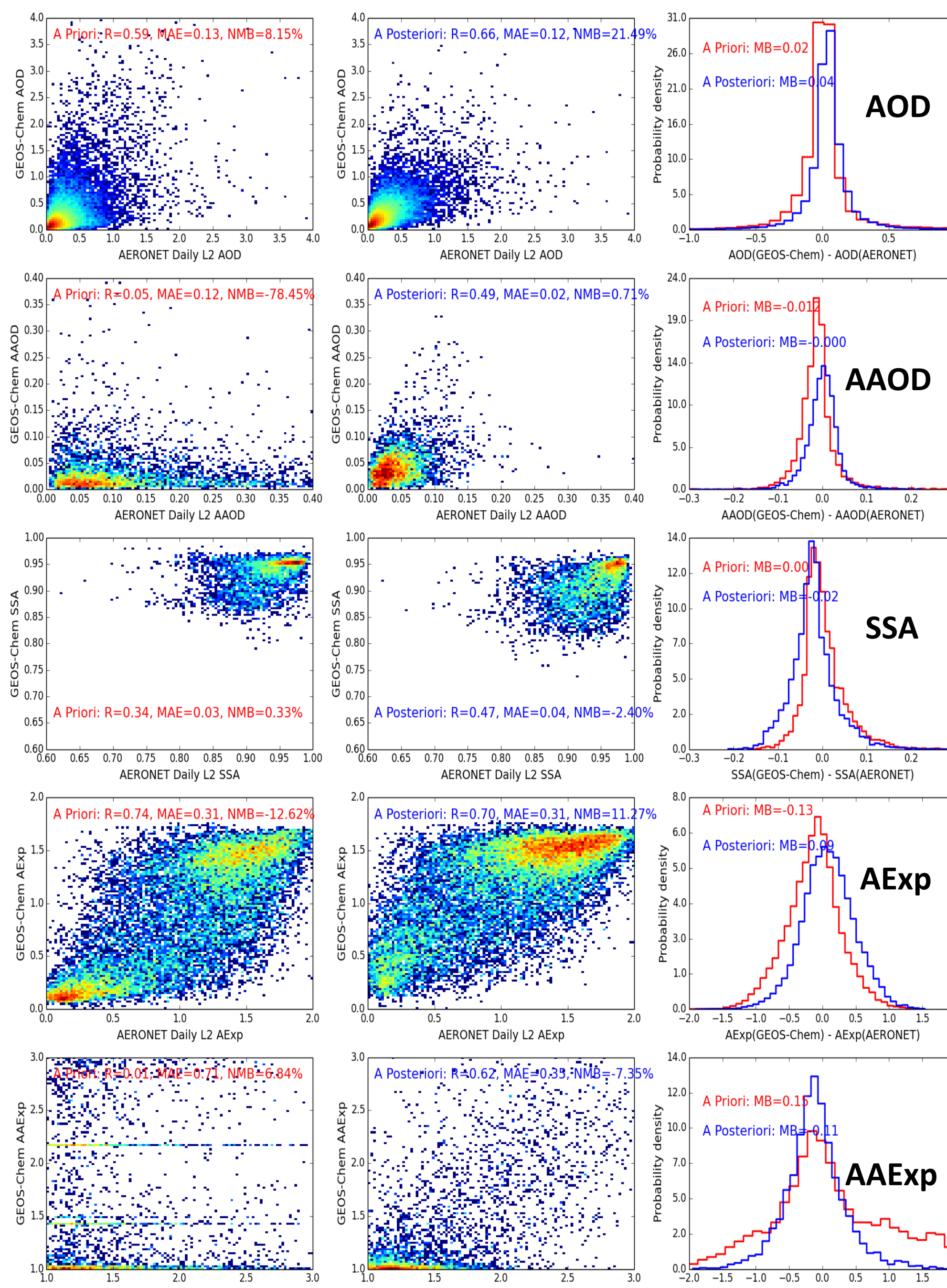


## Evaluation

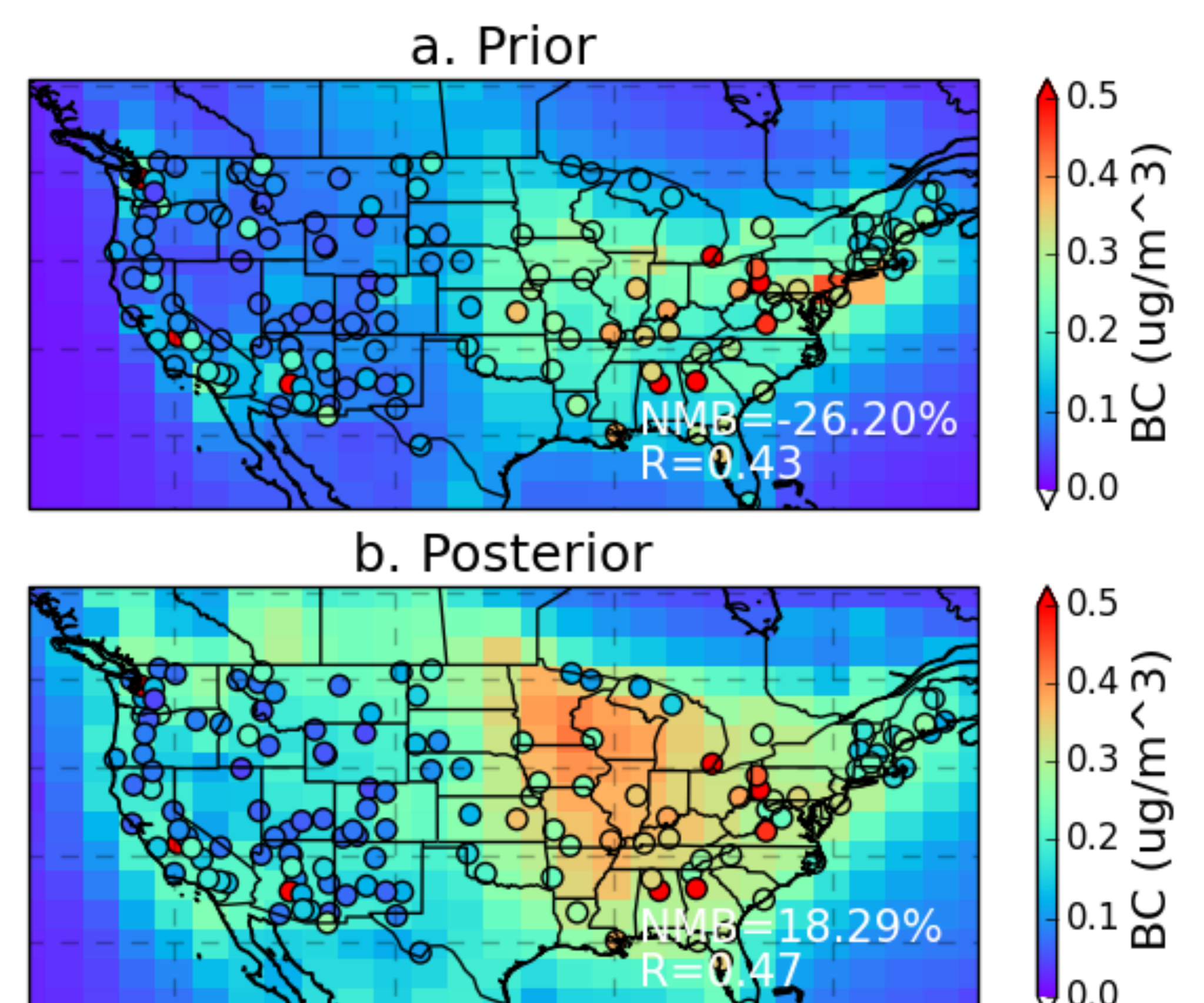
### Seasonal GEOS-Chem AOD vs. MODIS



### Daily GEOS-Chem vs. AERONET



### GEOS-Chem Surface BC vs. IMPROVE network



## Summary

- ✓ Satellite-derived global absorbing aerosol emission database (DD, BC and OC)
- ✓ Satellite-constrained global aerosol specification
- ✓ Improve CTMs aerosol simulation (e.g. AOD, AAOD, SSA, AExp, AAExp, concentration, etc.)

Chen, C., Dubovik, O., Henze, D. K., Laponak, T., Chin, M., Ducos, F., Litvinov, P., Huang, X., and Li, L.: Retrieval of desert dust and carbonaceous aerosol emissions over Africa from POLDER/PARASOL products generated by the GRASP algorithm, *Atmos. Chem. Phys.*, 2018.

Chen, C., Dubovik, O., Henze, D. K., Chin, M., Laponak, T., Schuster, G. L., Ducos, F., Fuertes, D., Litvinov, P., Li, L., Lopatin, A., Hu, Q., and Torres, B.: Constraining global aerosol emissions using POLDER/PARASOL satellite remote sensing observations, *Atmos. Chem. Phys.*, 2019.