Atmospheric Correction and Aerosol Retrieval for DSCOVR EPIC

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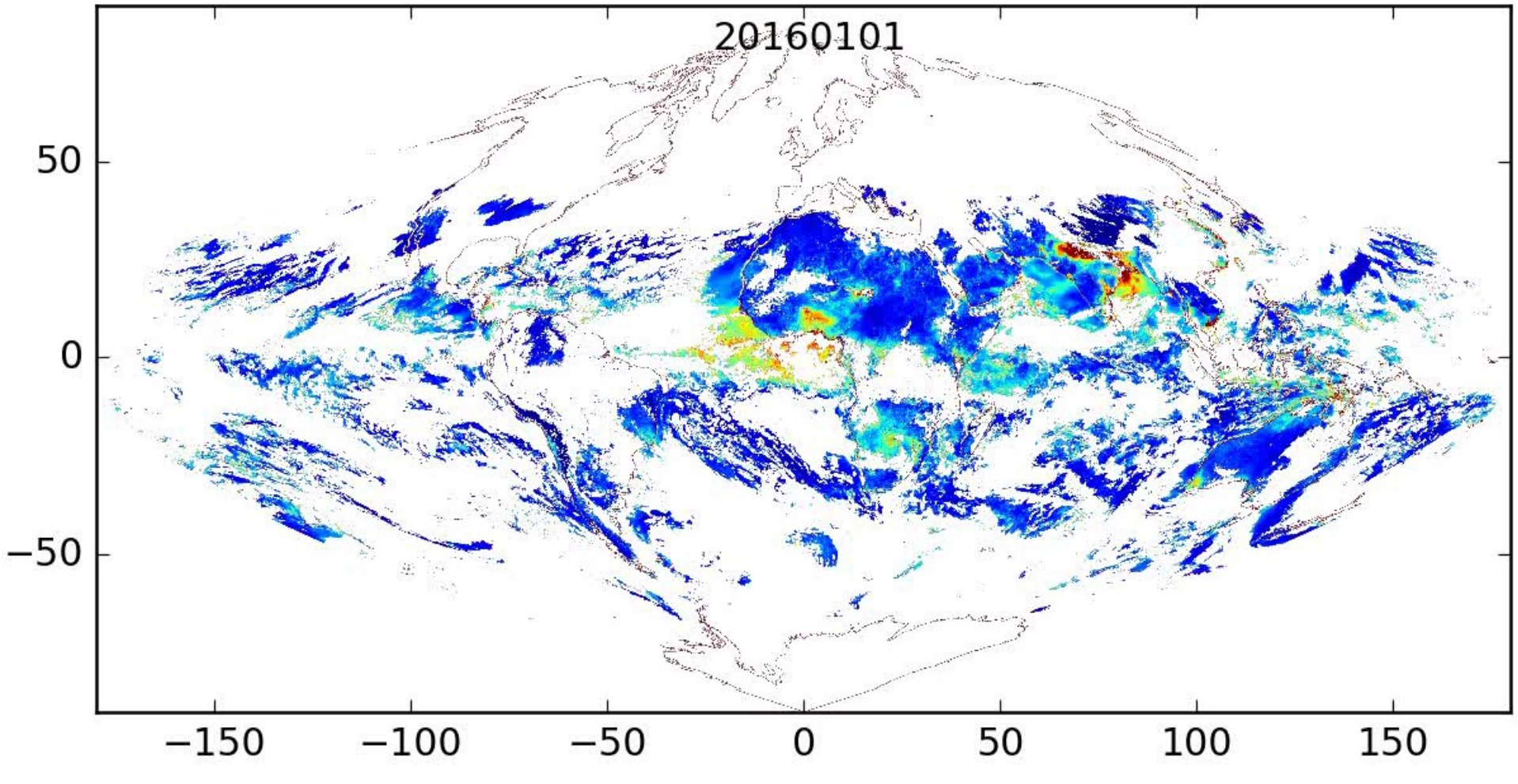
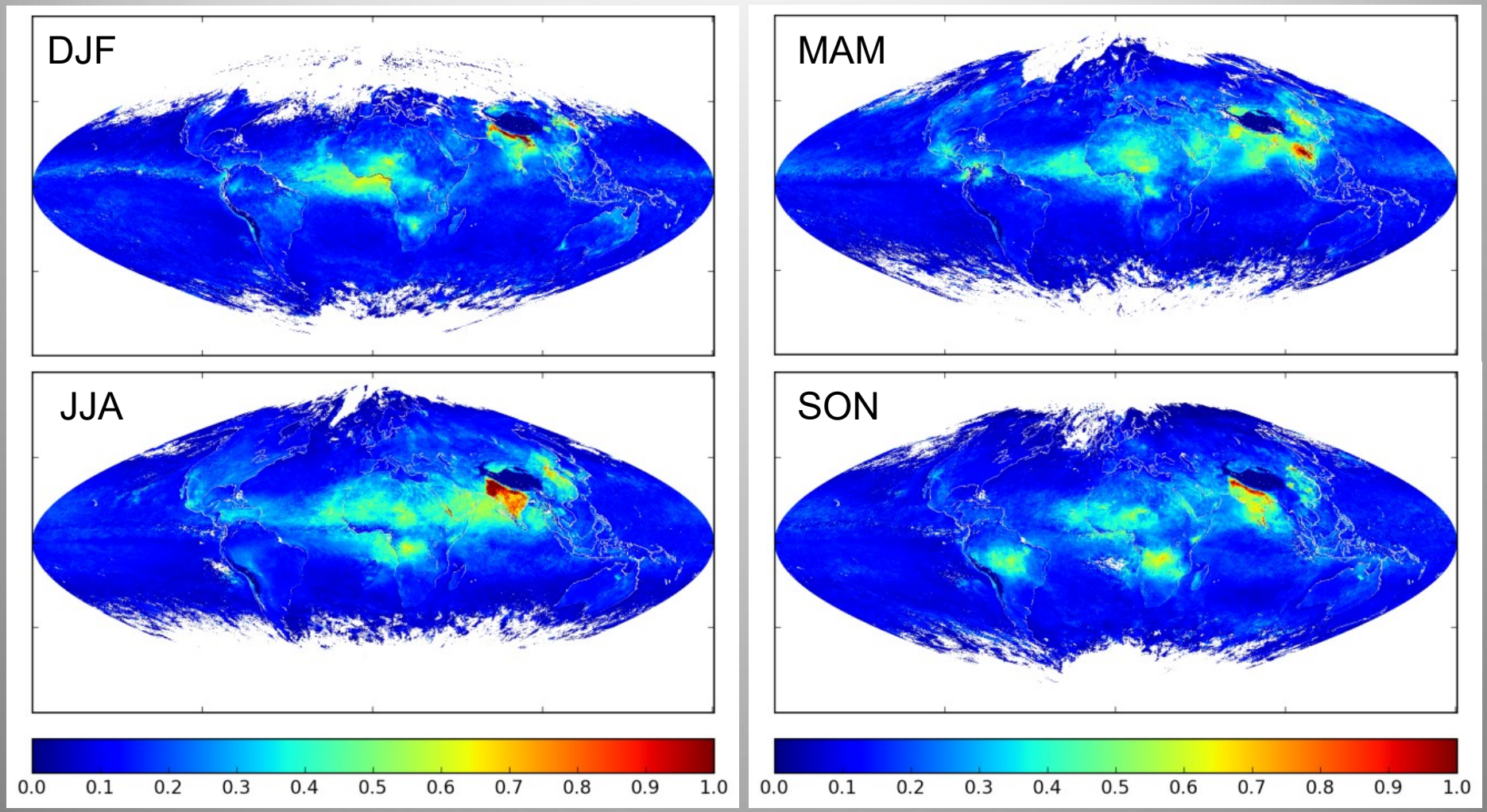
Project Overview

- 2015 – 2018 data released
- Reported products: CM, QA, $AOD_{0.44}$, spectral BRF, and BRDF model parameters
  - Also available: enhanced geolocation
  - Intermediate and final products stored in the HDF5 format, therefore reduced storage requirement by more than one order in magnitude
- Systematic validation using multi-year AERONET data
  - RMSE, bias, r-square evaluated at local (site) and regional scales
  - Plausible seasonality in atmospherically corrected surface reflectance
- UV bands to improve the identification and retrieval of absorbing aerosols in the upcoming V3 reprocessing

Daily variation of global EPIC AOD: movie also available on EPIC website

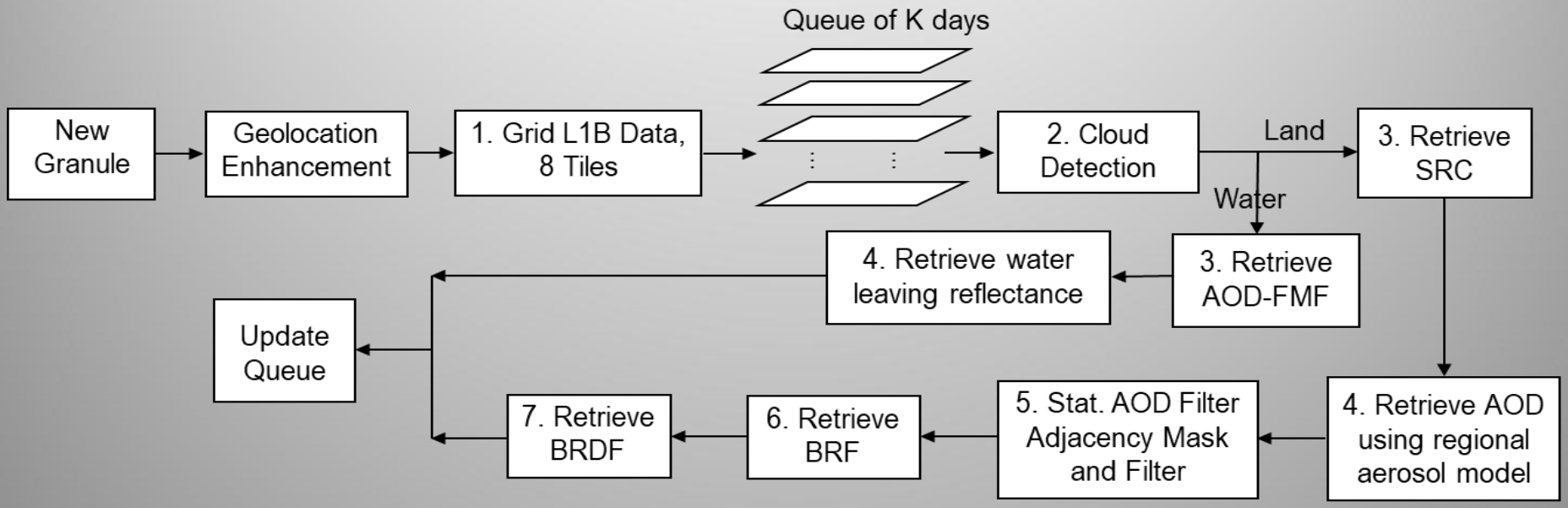


EPIC AOD – seasonal composite

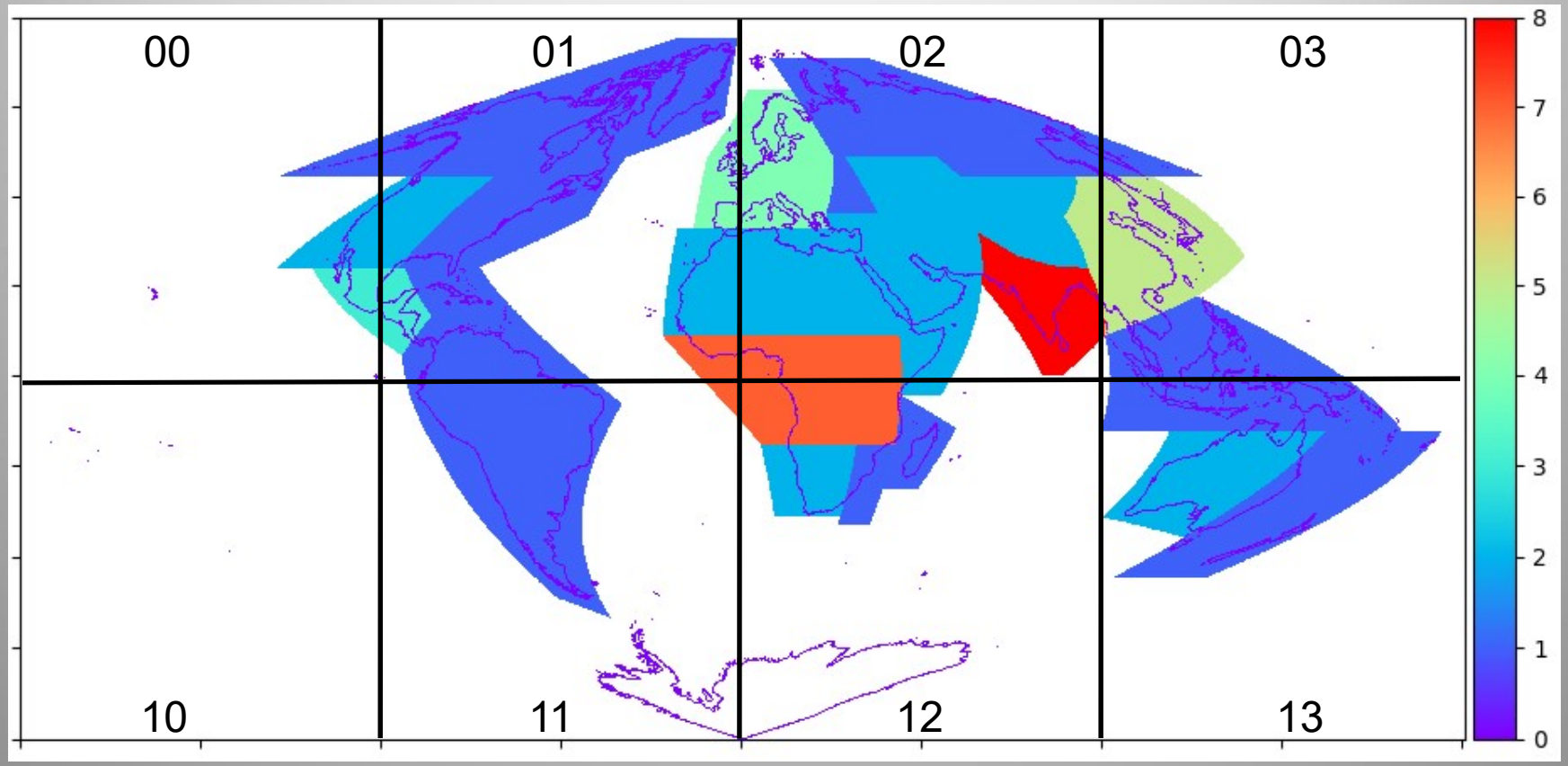


EPIC MAIAC algorithm: input and output

EPIC MAIAC algorithm: block-diagram



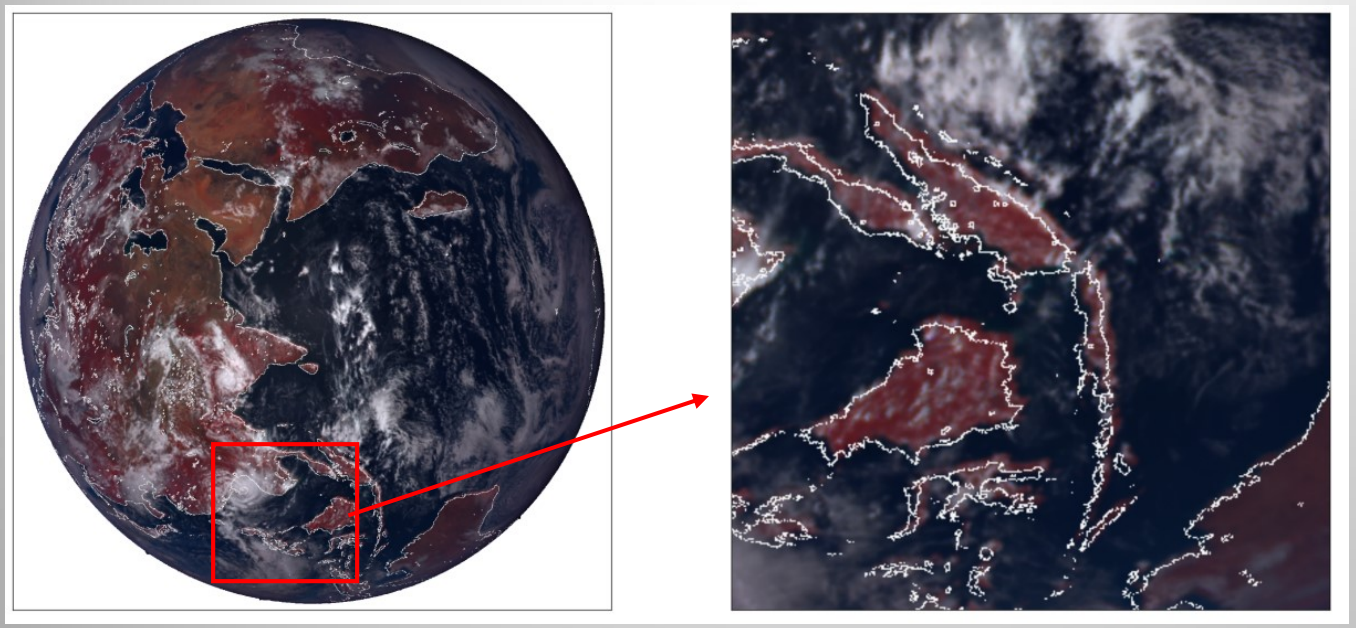
Nine aerosol models



The algorithm needs to match EPIC observations with land/water mask, aerosol model map, and background band ratio map. Require accurate geolocation!

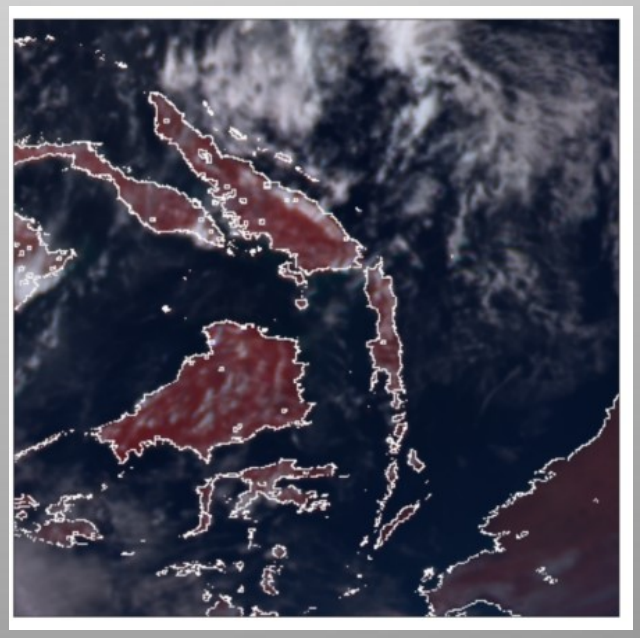
Two-step geolocation enhancement

- Preprocessing stage (60-70% of total computer time)
  - Determine a set of parameters by minimizing the difference between EPIC coast lines and a static coast line map derived using MODIS data
- Internal enhancement
  - Perform retrievals by shifting each pixel up to 20 km in all directions
  - Select the retrieval with minimum spatial variance in each 5x5 moving window



V2 EPIC
L1B geolocation

Based on coast-line matching analysis of two-day-worth of V3 geolocation, for about 70% of images, geolocation enhancement may no longer be required due to large improvements in the V3 geolocation (thanks to Karin).



MAIAC enhanced geolocation

Land algorithm highlight: SRC-based algorithm

- Rationale:

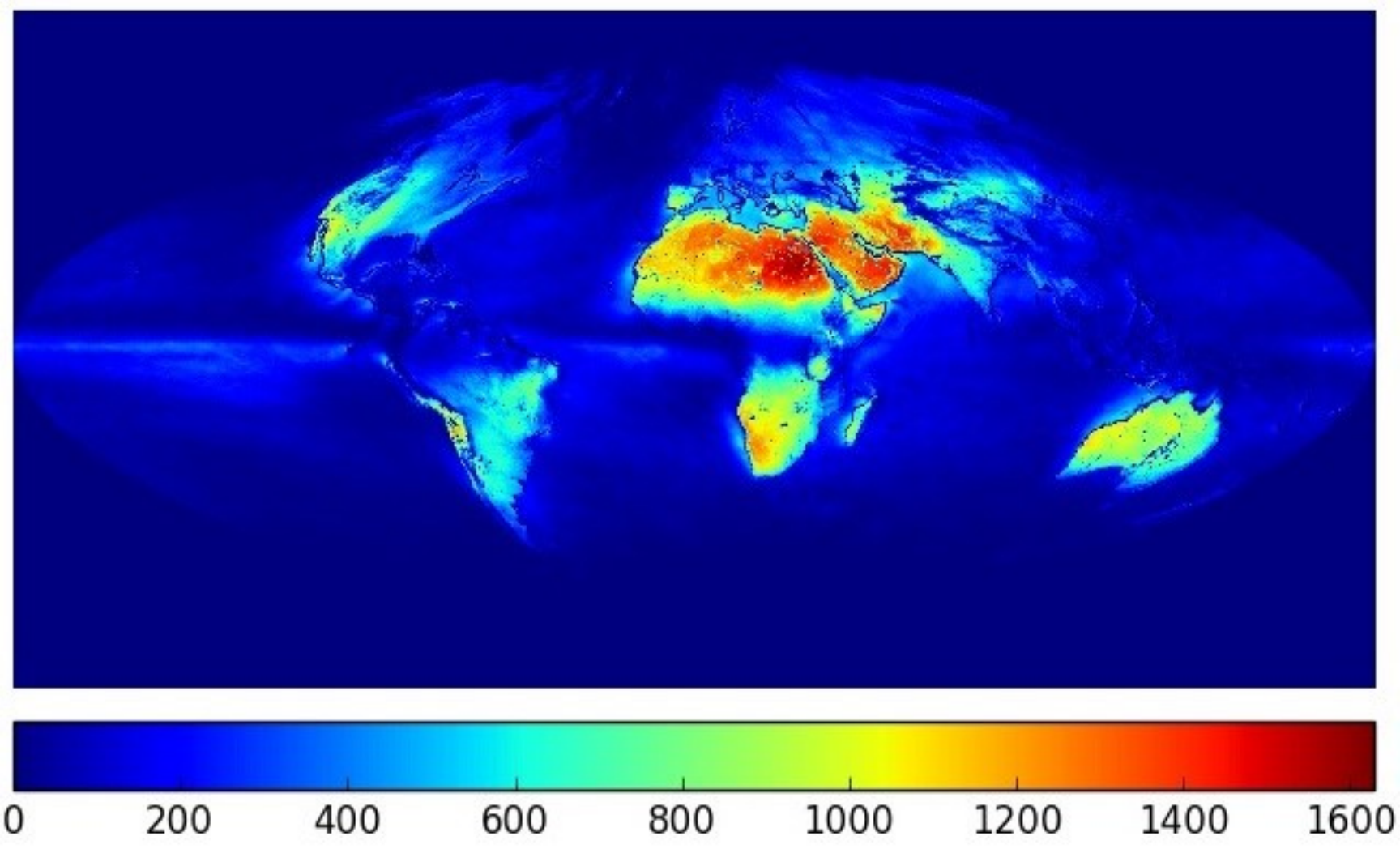
  Surface: change slowly in time but dramatically in space

  Aerosol: change fast in time but smooth in space

  Cloud: change fast both in time and in space

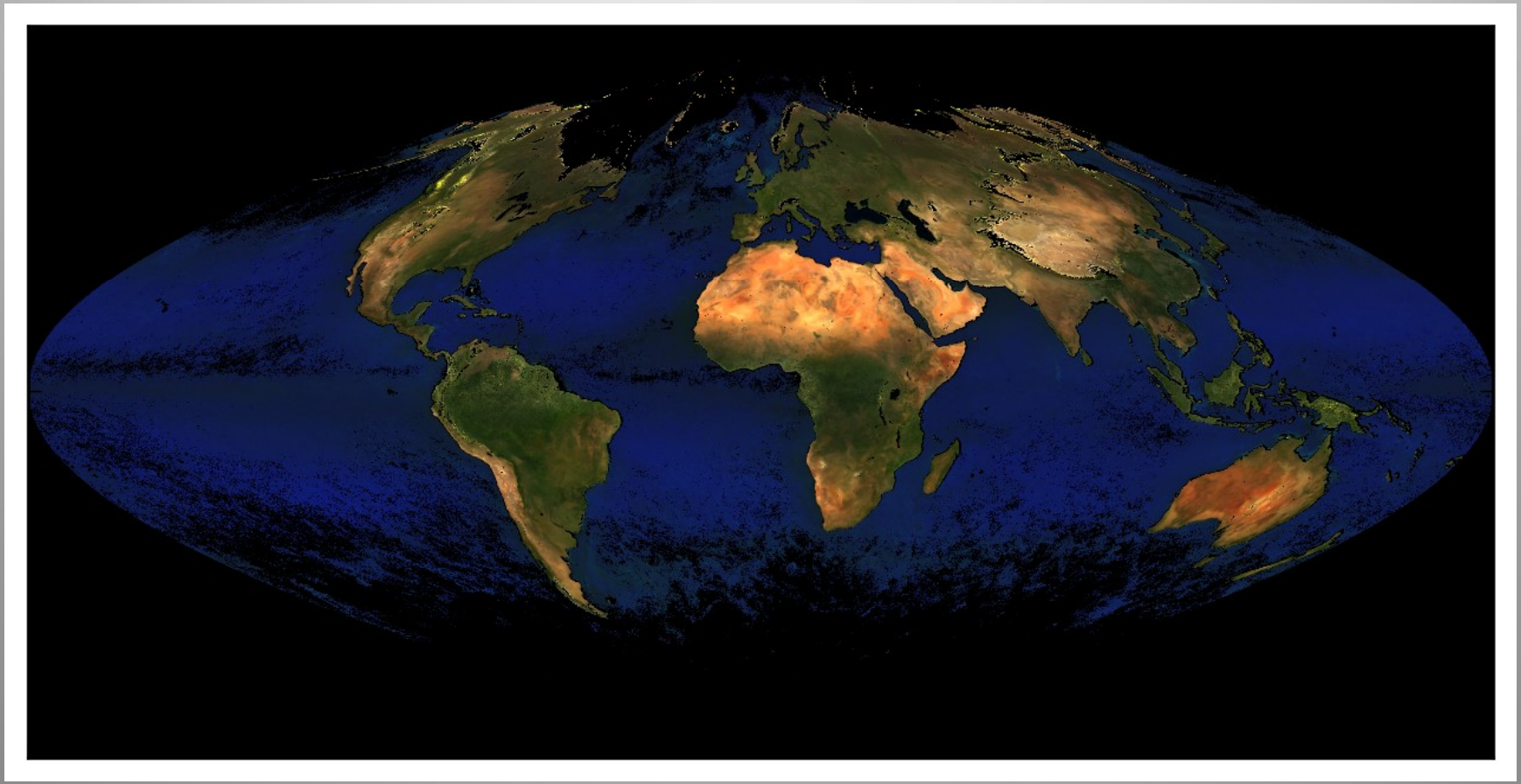
- Aerosol retrievals are based on the minimum reflectance criterion and dynamically updated spectral surface reflectance ratio (SRC)
- Spatial and time-series analysis improves cloud screening
- … and cloud differentiation from high-load aerosol

EPIC MAIAC data availability
(# of retrievals in one year)

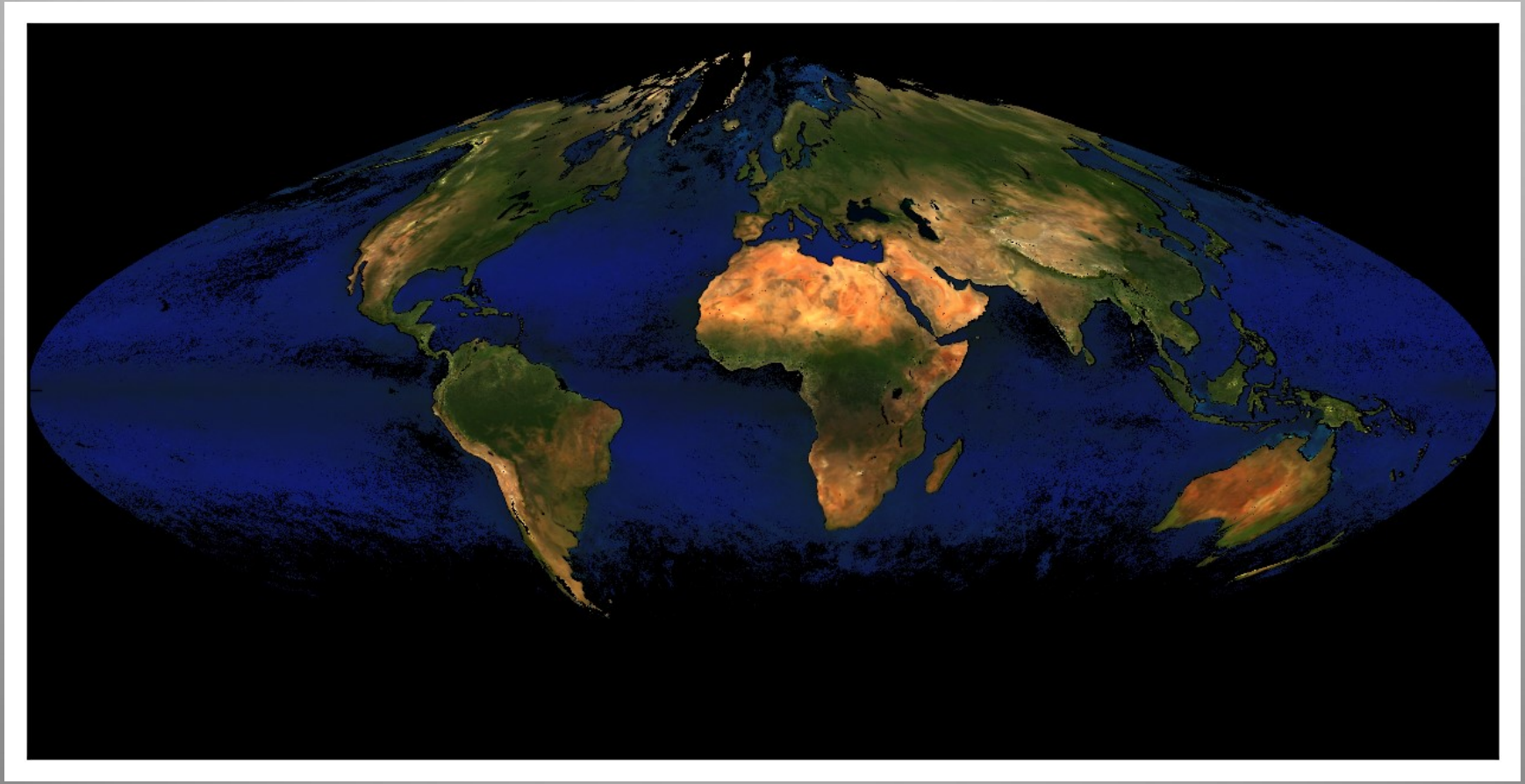


Atmospherically corrected image, DJF

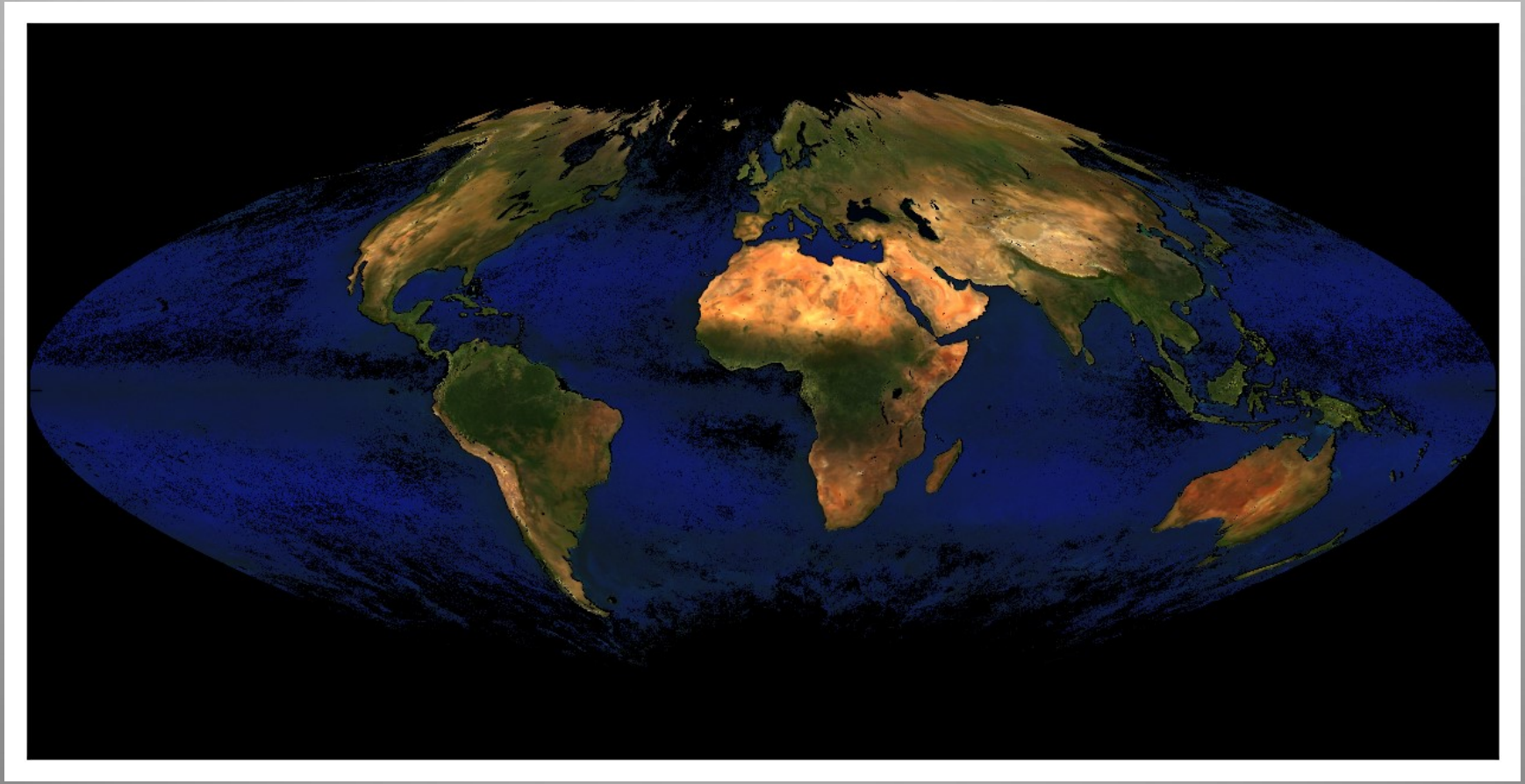
Atmospherically corrected image, MAM



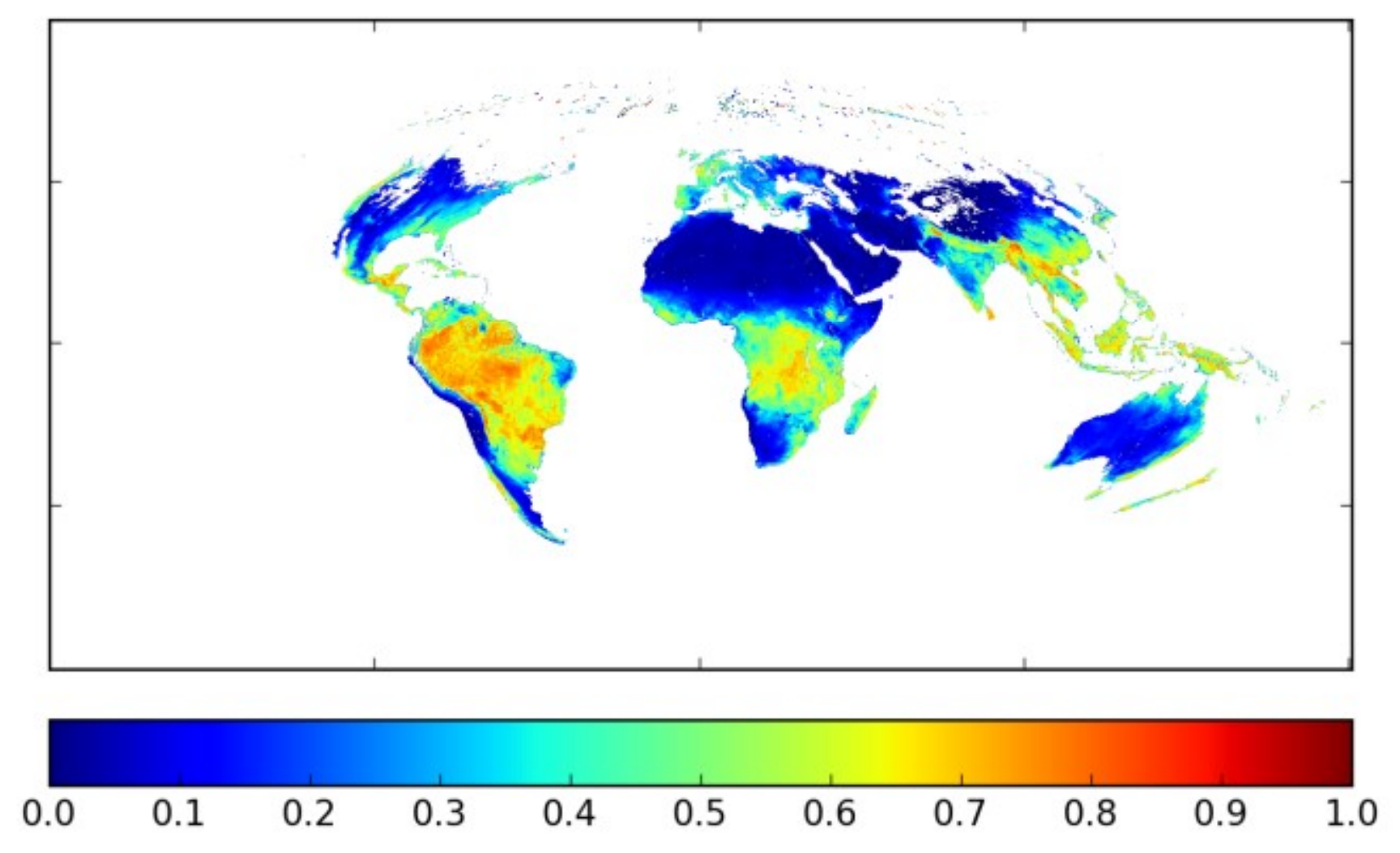
Atmospherically corrected image, JJA



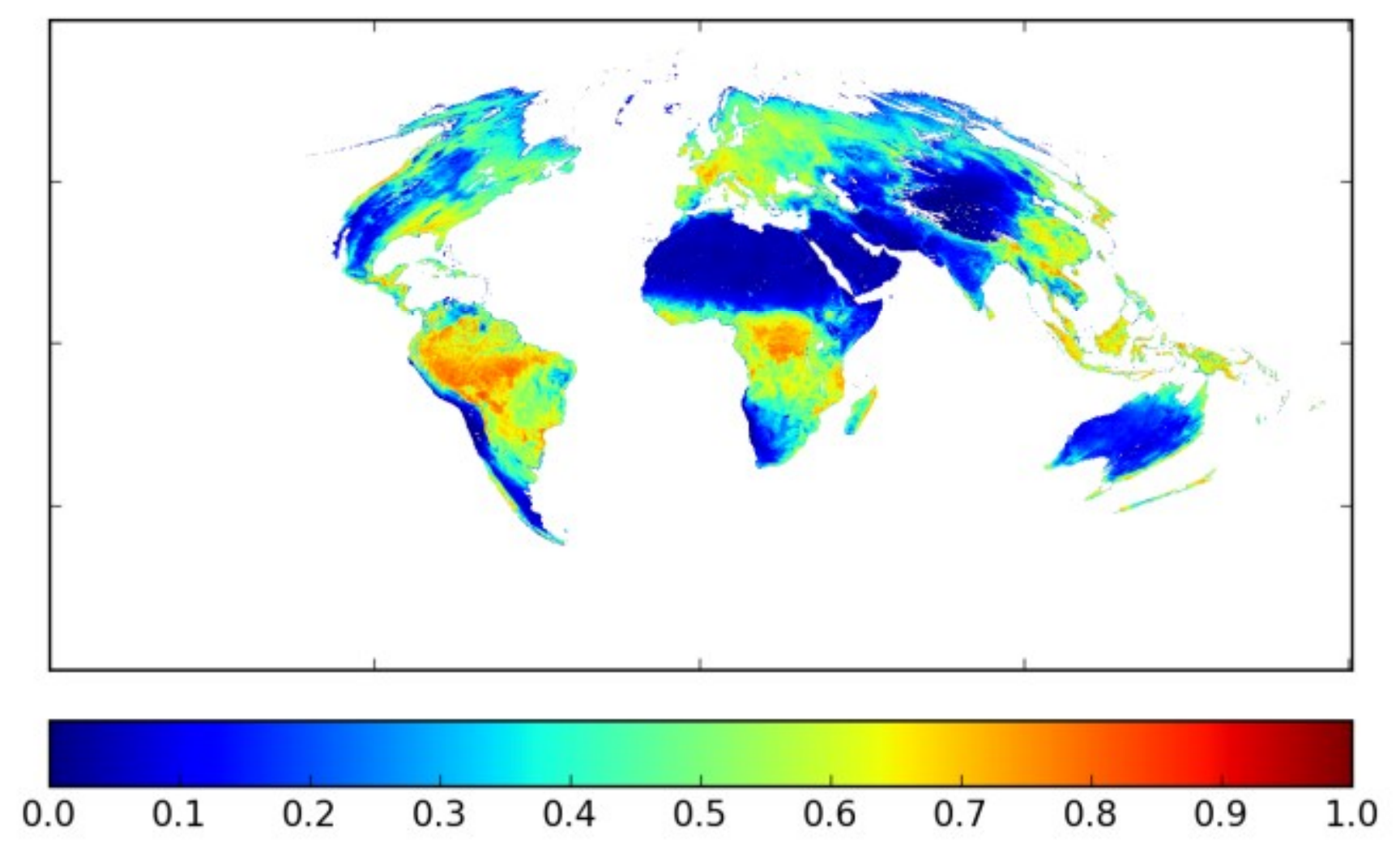
Atmospherically corrected image, SON



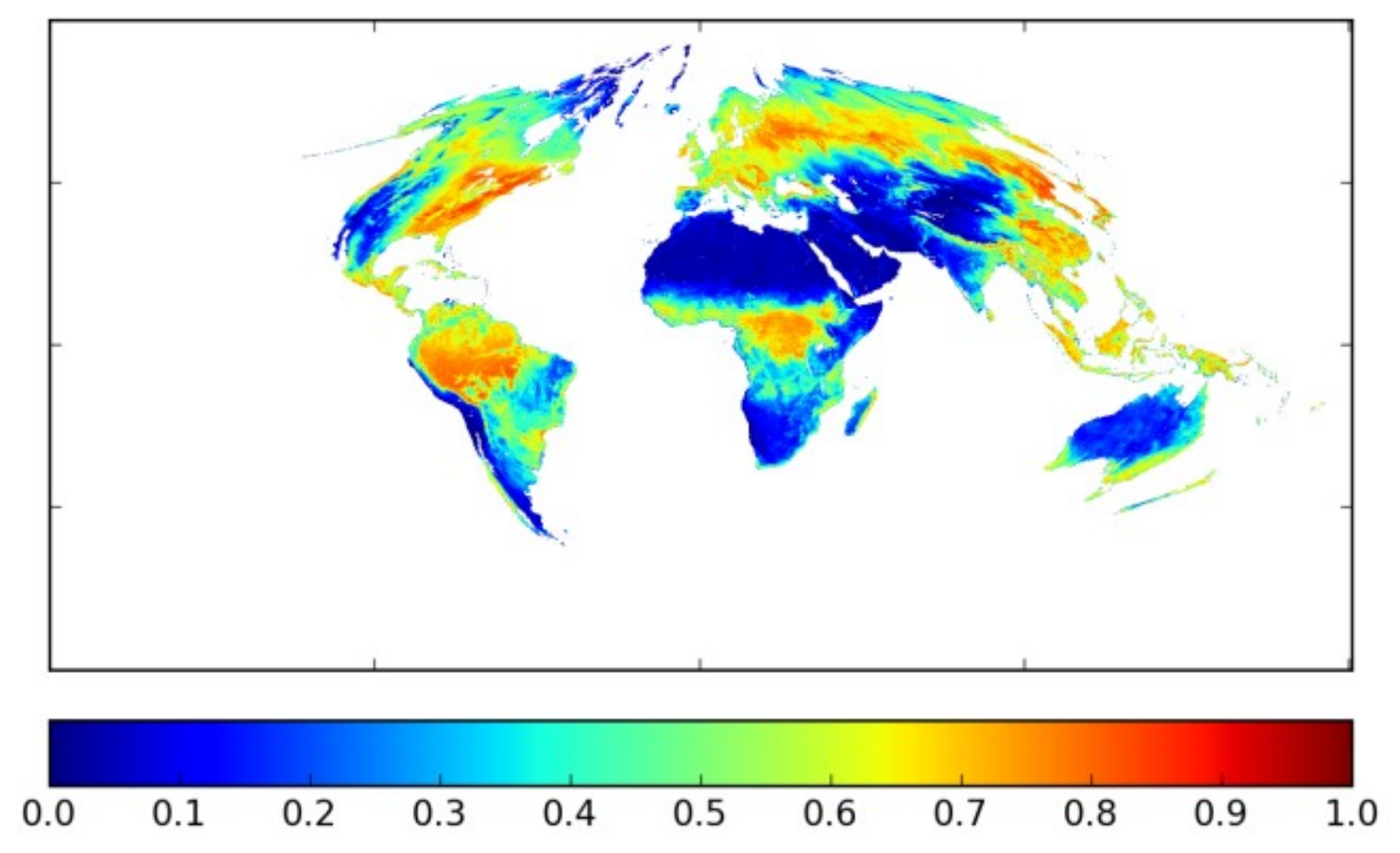
Seasonal composite of EPIC NDVI, DJF



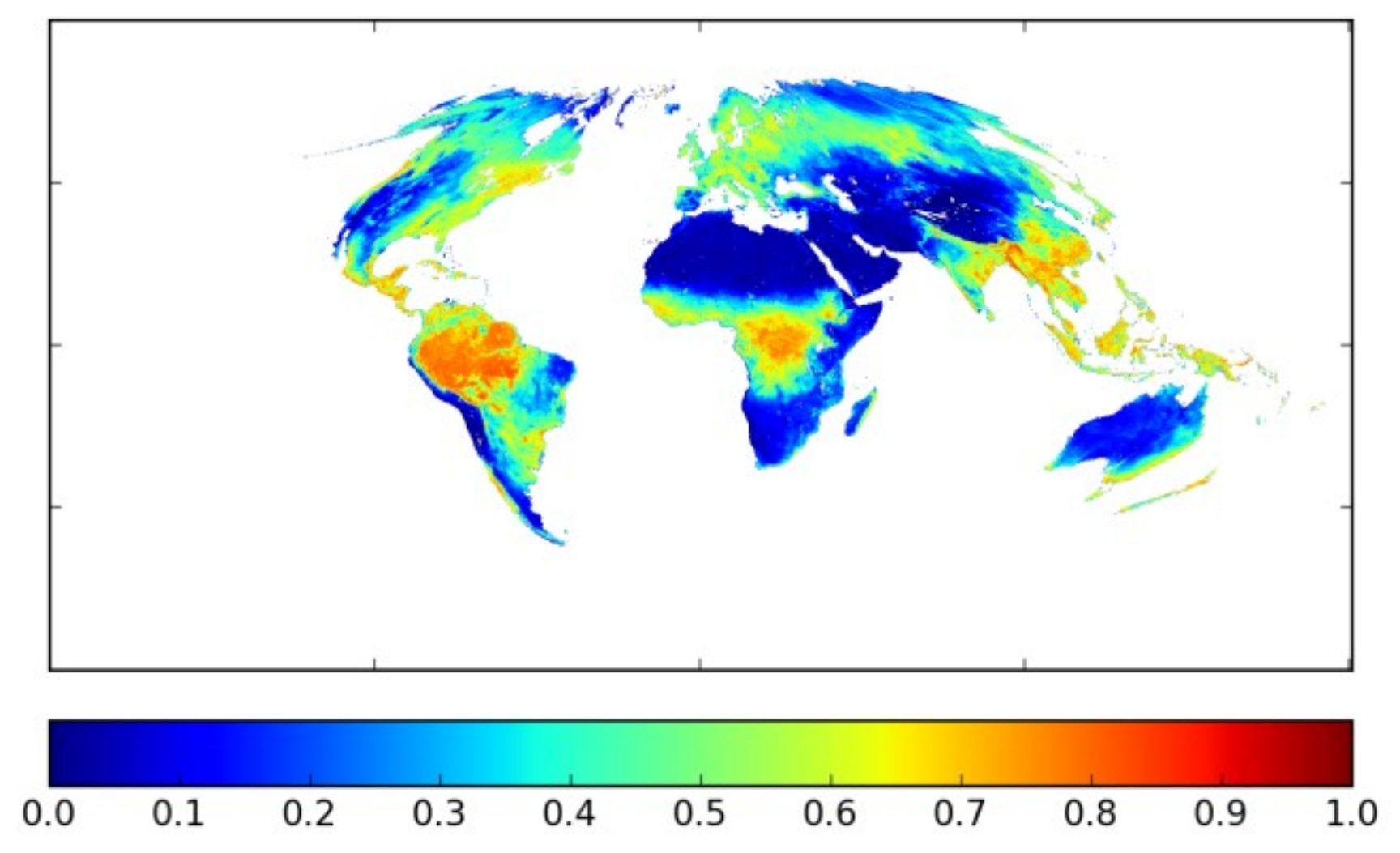
Seasonal composite of EPIC NDVI, MAM



Seasonal composite of EPIC NDVI, JJA



Seasonal composite of EPIC NDVI, SON



Validation of EPIC AOD with AERONET data

Data used:

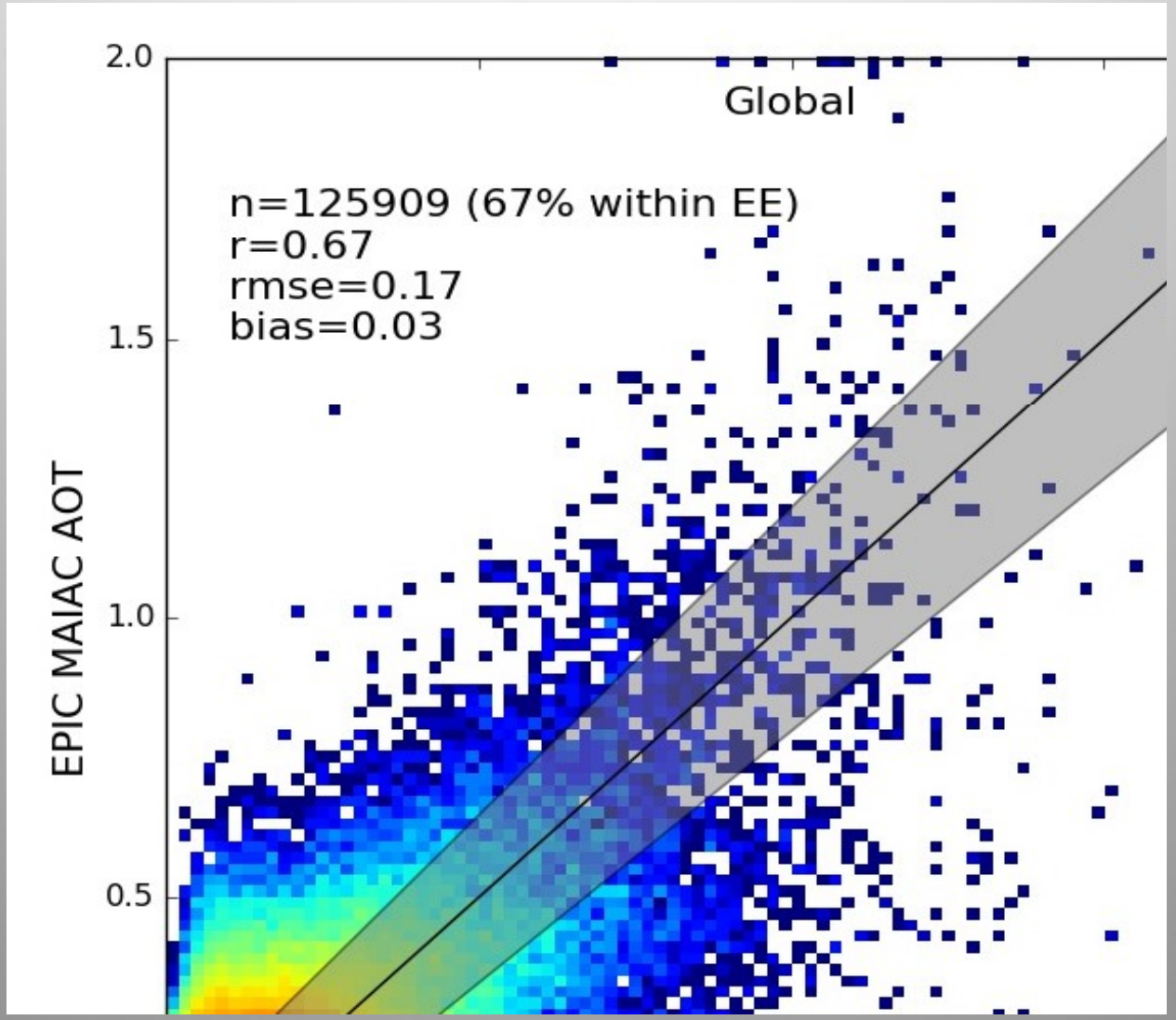
- EPIC MAIAC AOD, 2016-2017
- AOD from more than 1000 AERONET sites collected within 30 min of EPIC observation, and scaled to EPIC wavelength using the AERONET Angstrom exponent

Metrics examined:

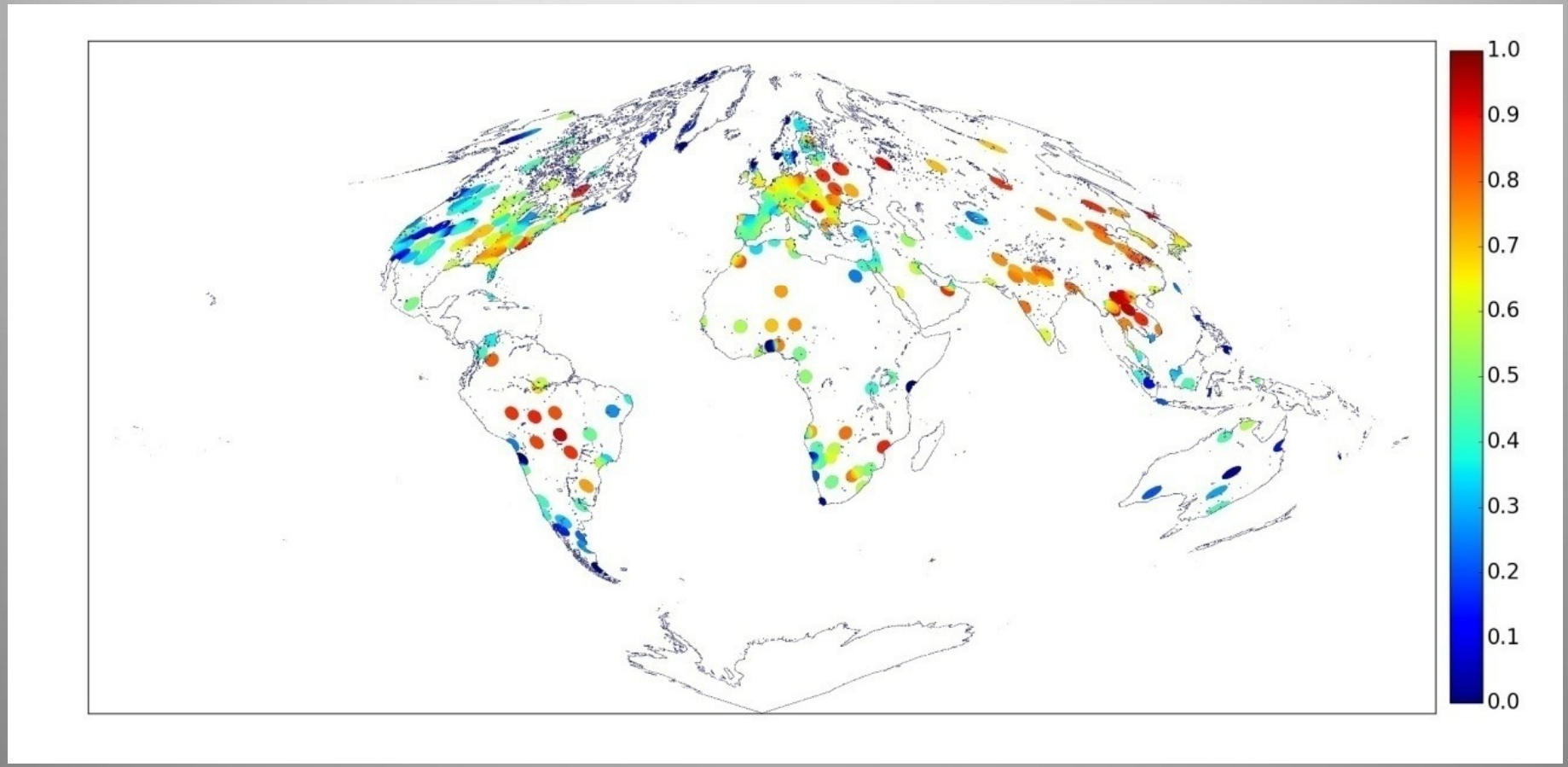
- Root Mean Squared Error (RMSE)
- Bias
- Correlation
- % of data points within expected error range (defined as 0.1+10%*AOD)

Seasonal analysis also performed to gauge the time-dependence of MAIAC performance

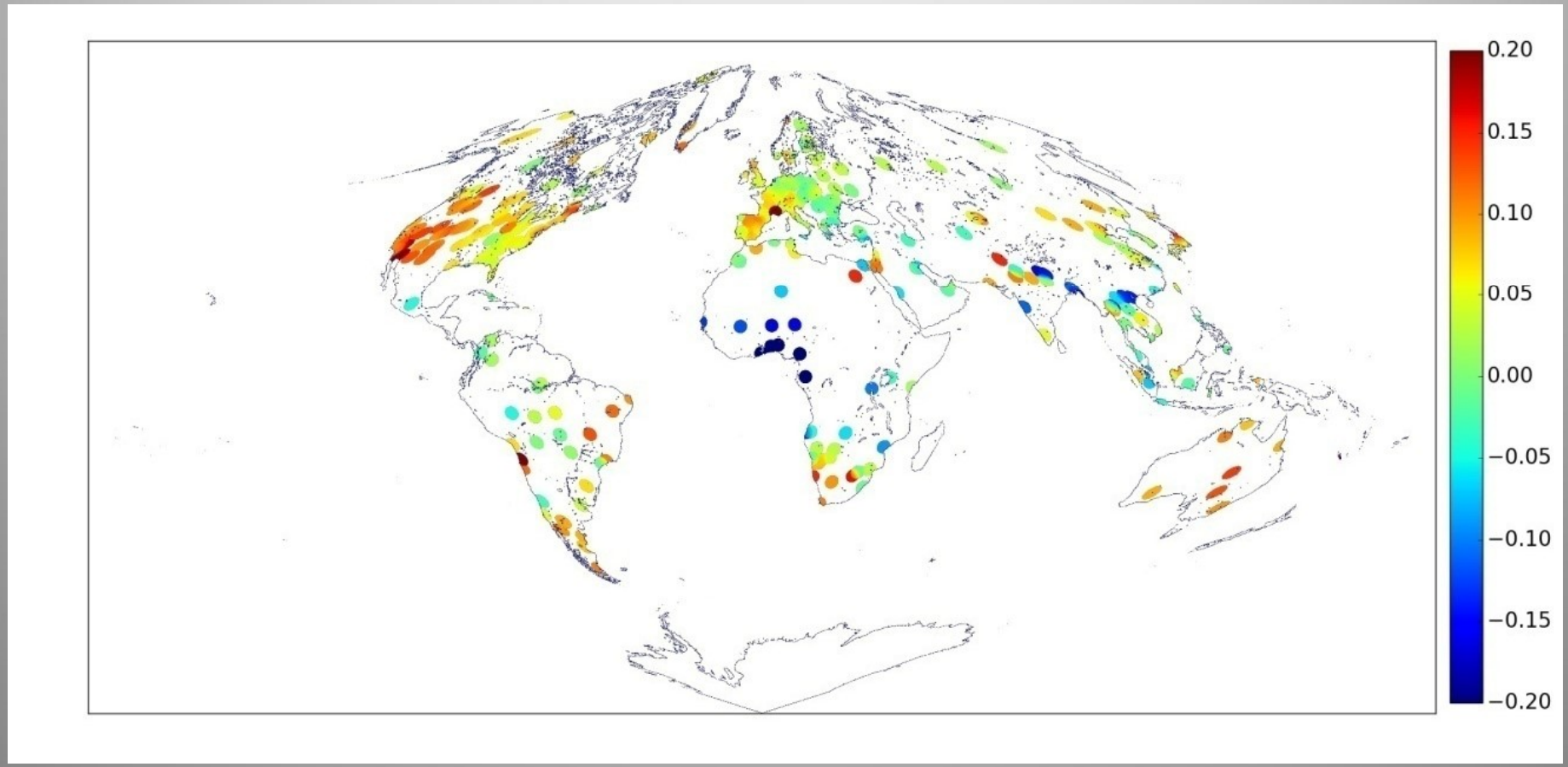
EPIC-Aeronet AOD scatter plot, global



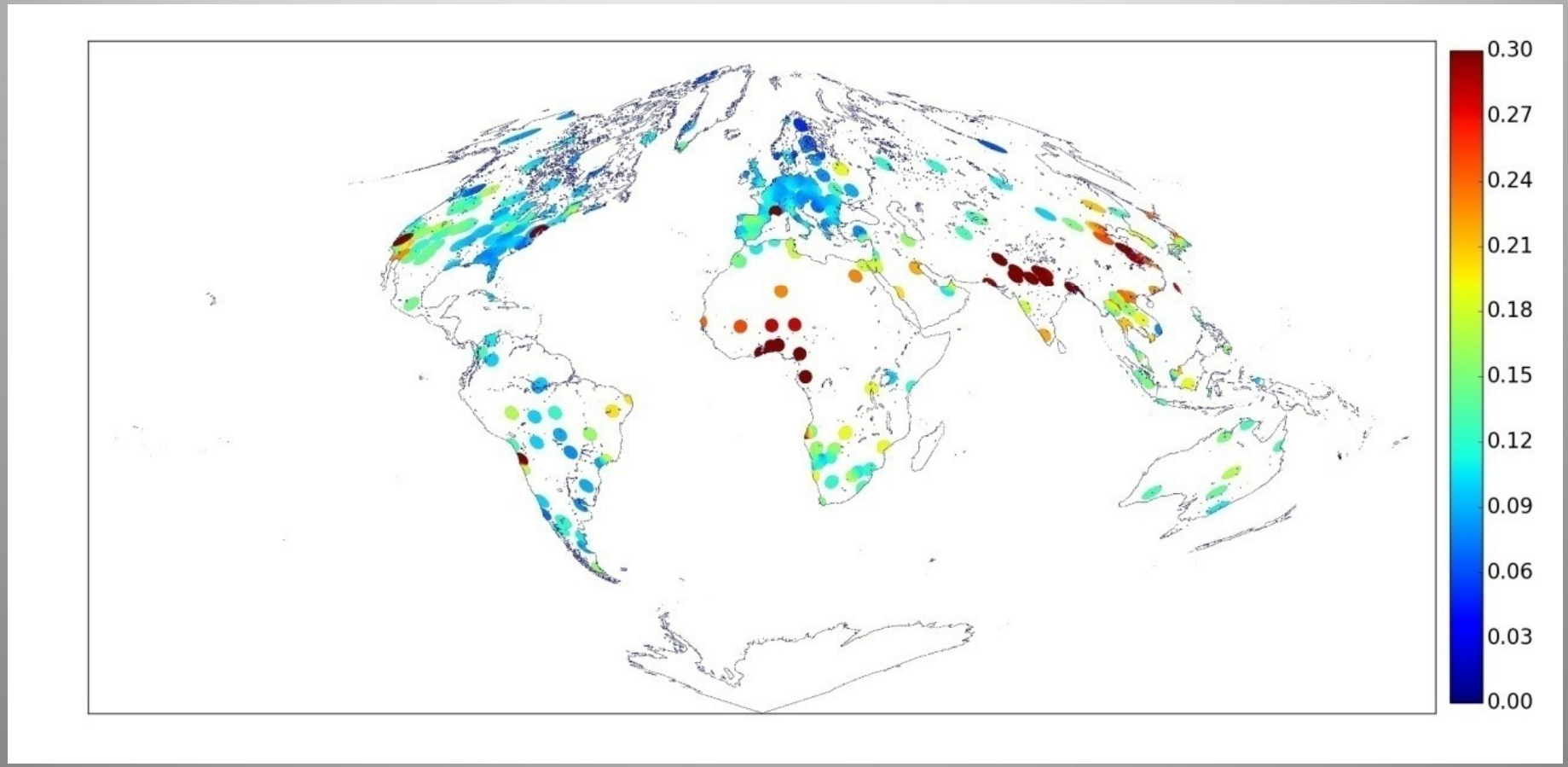
Correlation beween EPIC and Aeronet AODs



Bias of EPIC AOD



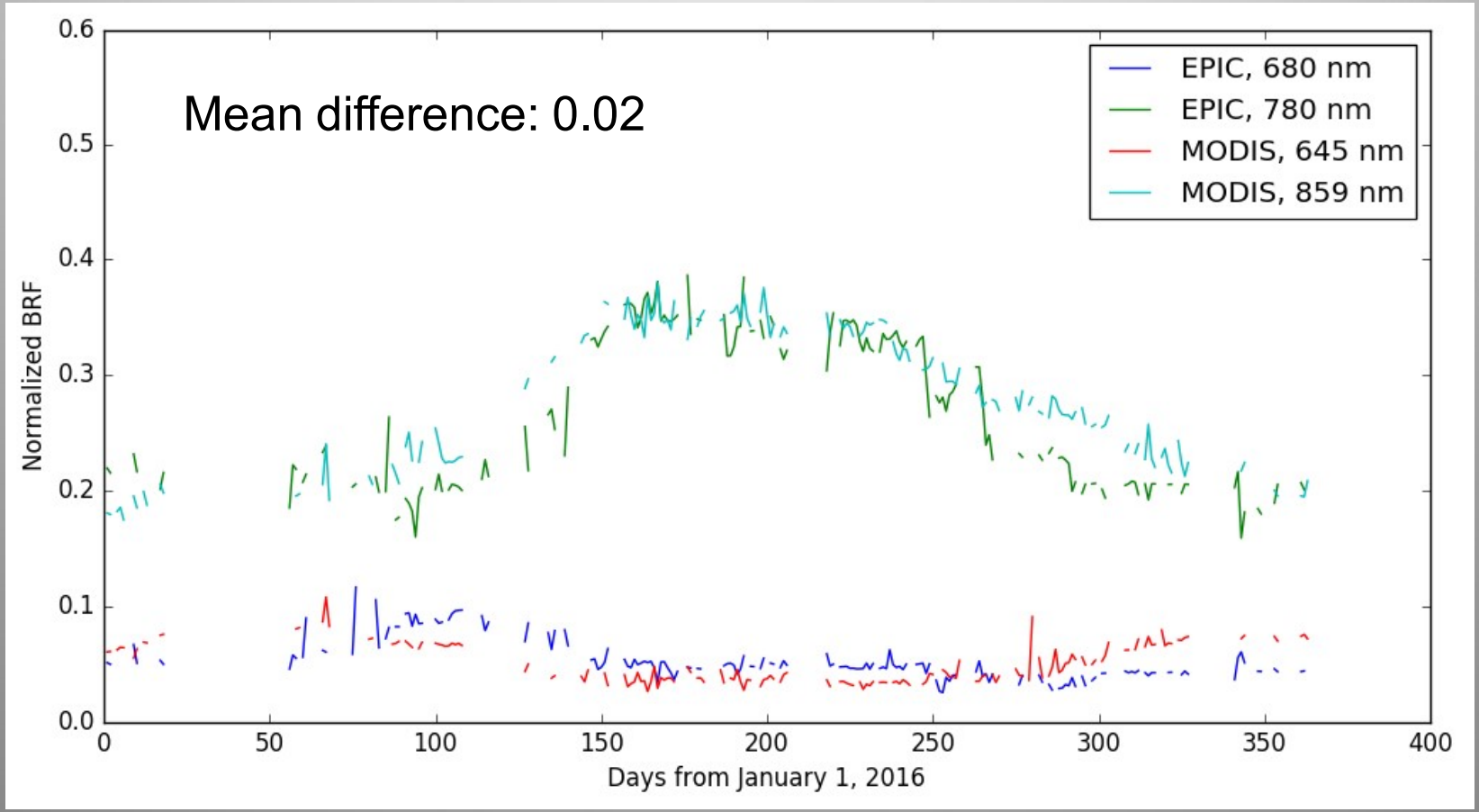
RMSE of EPIC AOD



EPIC BRF compared with MODIS: vegetation

BRFs are normalized to SZA=20^{o}, VZA=0^{o}

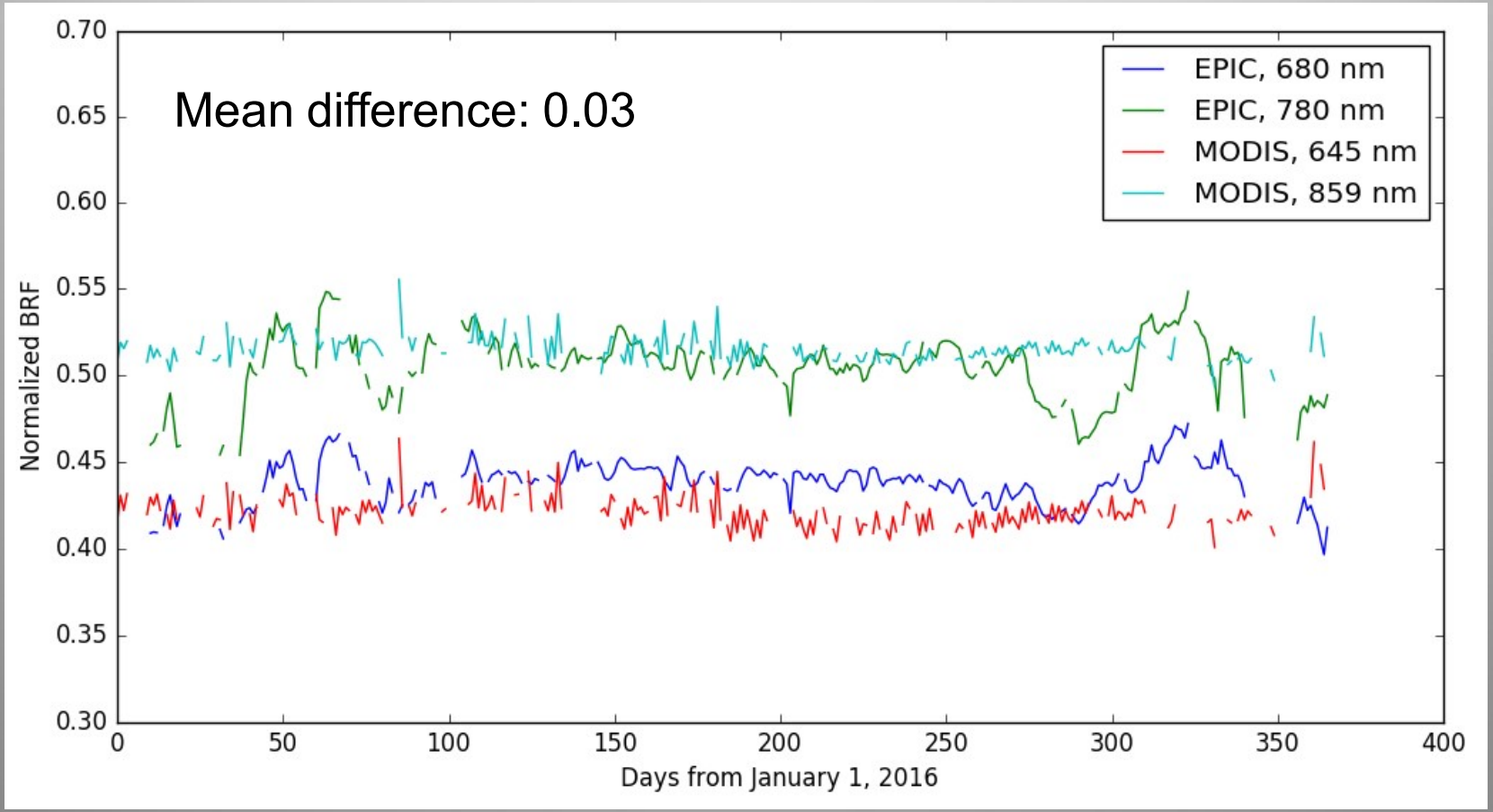
100x100 km vegetated patch in Eastern USA



EPIC BRF compared with MODIS: desert

BRFs are normalized to SZA=20^{o}, VZA=0^{o}

100x100 km desert patch in central Sahara



Concluding remarks

- Performed global validation of MAIAC aerosol product: Good agreement of EPIC AODs with AERONET data
- Regional aerosol retrieval bias will be corrected in V3
- Good agreement between EPIC and MAIAC MODIS BRFs
- Atmospheric correction enables higher level science analysis over land (Knyazikhin) and ocean (Lyapustin, science talk)

Future steps

- Tune aerosol models to remove regional AOD biases
- Improve diurnal cycle of EPIC AOD for air quality applications
- Add (Torres et al., 1998) detection of absorbing aerosols to characterize strong smoke and dust event (currently masked as clouds sometimes)
- Correct spectral dependence of AOD over ocean (Lyaputin: science talk)
- Add full BRDF models for atmospheric correction, we will explore the Ross-Li BRDF model as well as dedicated hotspot models