CERES SARB Ed5 CAM6 MAM4 Aerosol

David Fillmore and Antonio Viudez-Mora

NCAR ACOM and CERES SARB

May 10, 2023

NCAR | NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

CAM6 MAM4 Ed5

Aerosol Inputs for SARB Surface Flux Products

- MATCH **Ed4** with Terra + Aqua MODIS C6.1 AOD (Model for Atmospheric Transport and Chemistry)
  - *bulk* scheme (SO4, OC, BC, DU, SS)
- CAM6 MAM4 **Ed5** (adapted for SARB at Langley) with MODIS C6.1 AOD $\rightarrow$ MODIS C7/N20 VIIRS AOD (Community Atmosphere Model - Modal Aerosol Module)
  - *modal* scheme
  - aitken (SOA, SU, DU, SS)
  - accumulation (BC, POM, SOA, SU, DU, SS)
  - coarse (SU, DU, SS), primary carbon (BC, POM)

1. AOD *Nudging*, tendency term AOD(obs) - AOD(model)
2. AOD *Optimal Interpolation*
3. AOD *Forcing*, AOD(model) = AOD(obs)

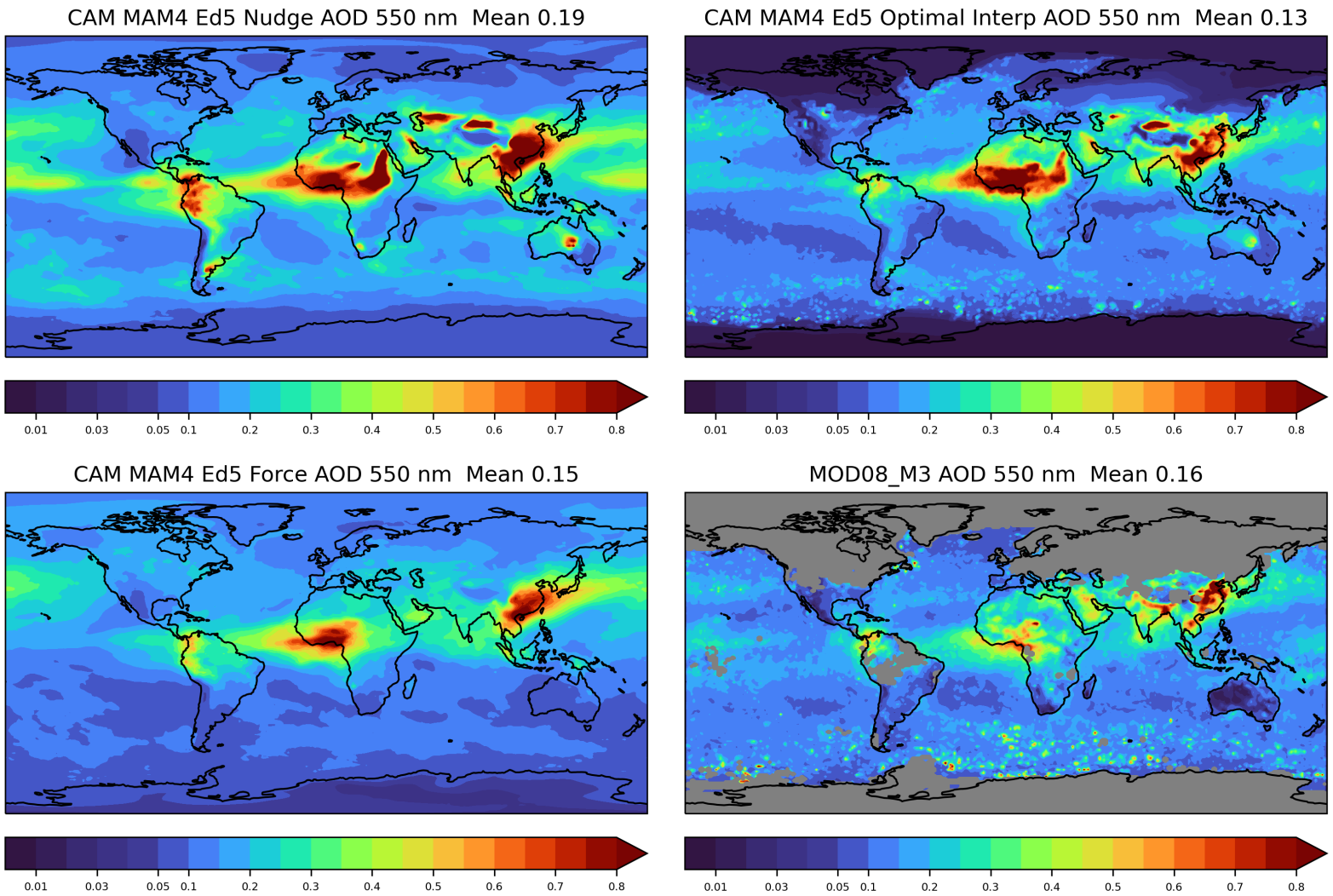
Overview

- meteorological fields $1.25^\circ \times 0.9^\circ$, 32 vertical levels, MERRA2, 2000 Jan - 2023 Mar $\rightarrow$ GEOS-IT (MATCH $\sim 2.5^\circ$)
- will also evaluate GMAO aerosol re-analyses MERRA2, 2000 Jan - 2023 Mar $\rightarrow$ GEOS-IT
- CAM6 MAM4 *Nudging* and *Forcing* running on CERES machines for $\sim$ 2 week, 2010 Jan - Aug
- CAM6 MAM4 base model and *Optimal Interpolation* on NCAR machines, 2000 - 2020
- CMIP6 emissions (through 2014)
- CAMSv5.1 (Copernicus Atmosphere Monitoring Service)
- FINN2.5 (Fire Inventory from NCAR, currently through 2021)
- up-to-date fire emissions from GMAO? QFED? (Quick Fire Emissions Dataset)

Why a SARB aerosol product?

- consistent MODIS/VIIRS data inputs
  with other CERES products
- MERRA2 assimilates MISR (Terra only)
  and AeroNet (SARB uses for surface validation)
- improved modal aerosol representation
  (mode-by-mode corrections with multi-wavelength AOD)

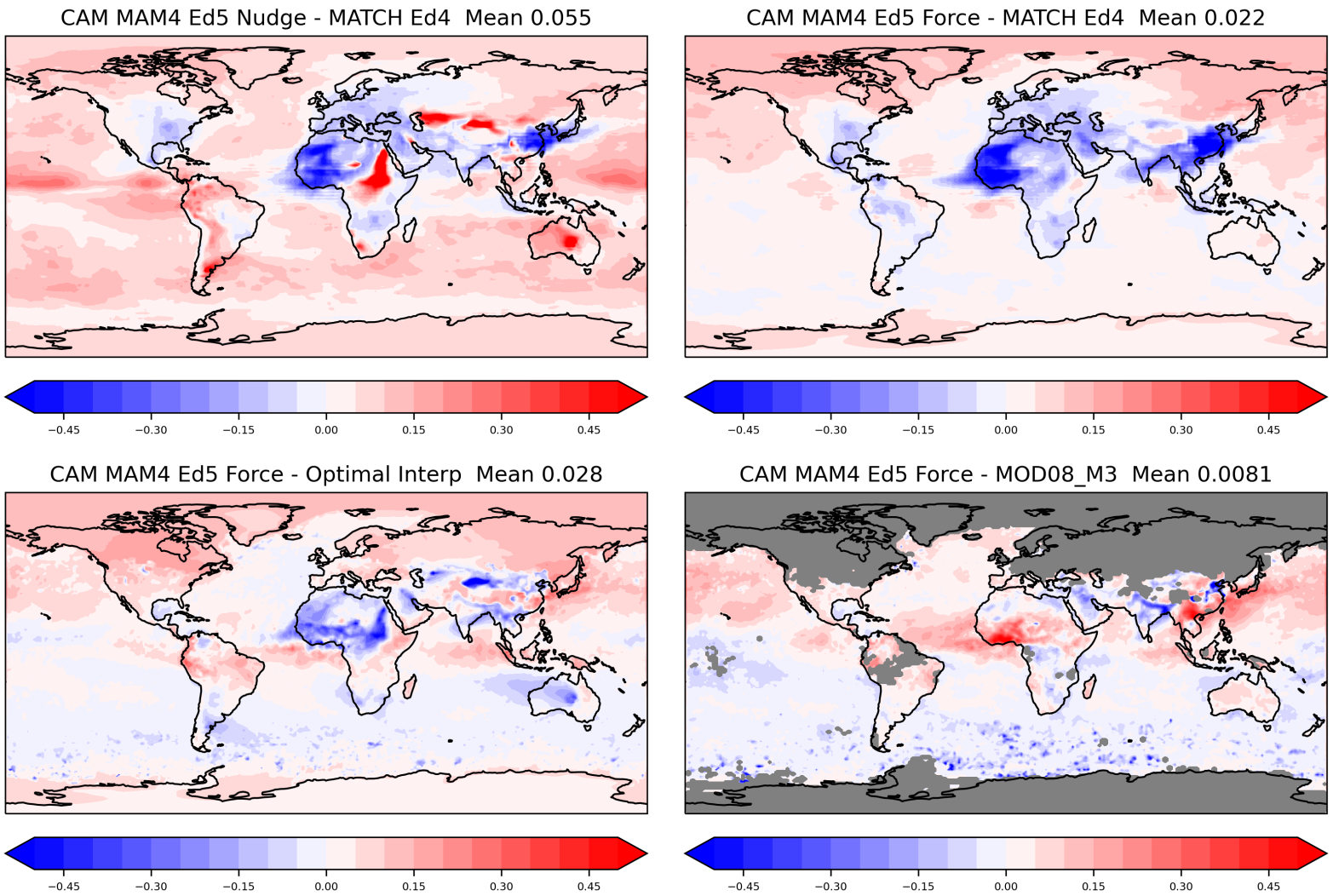
AOD 550 nm Mar 2010



AOD 550 nm Mar 2010

CERES SARB Ed5 CAM6 MAM4 Aerosol

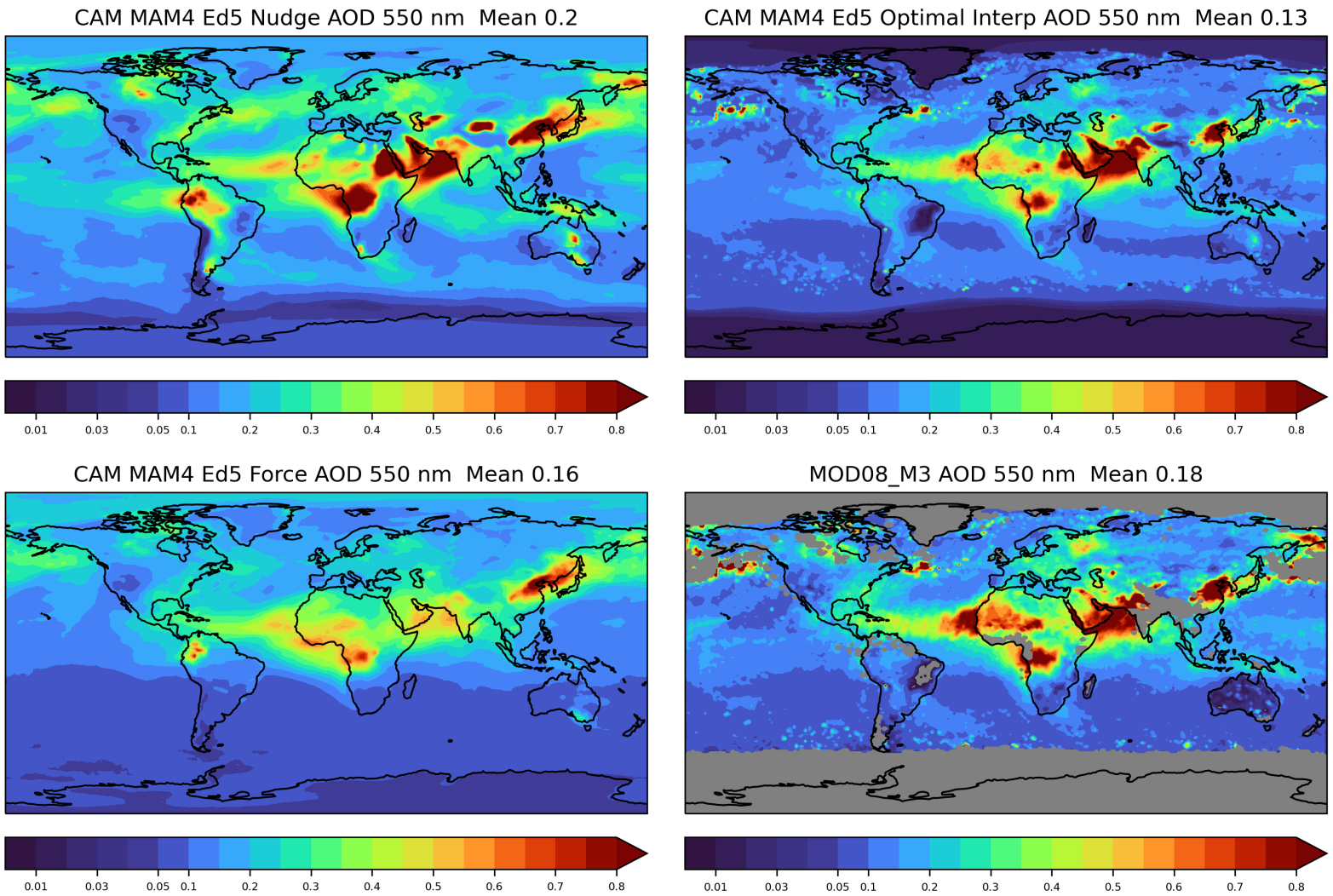
Fillmore, Viudez-Mora



AOD 550 nm Jul 2010

CERES SARB Ed5 CAM6 MAM4 Aerosol

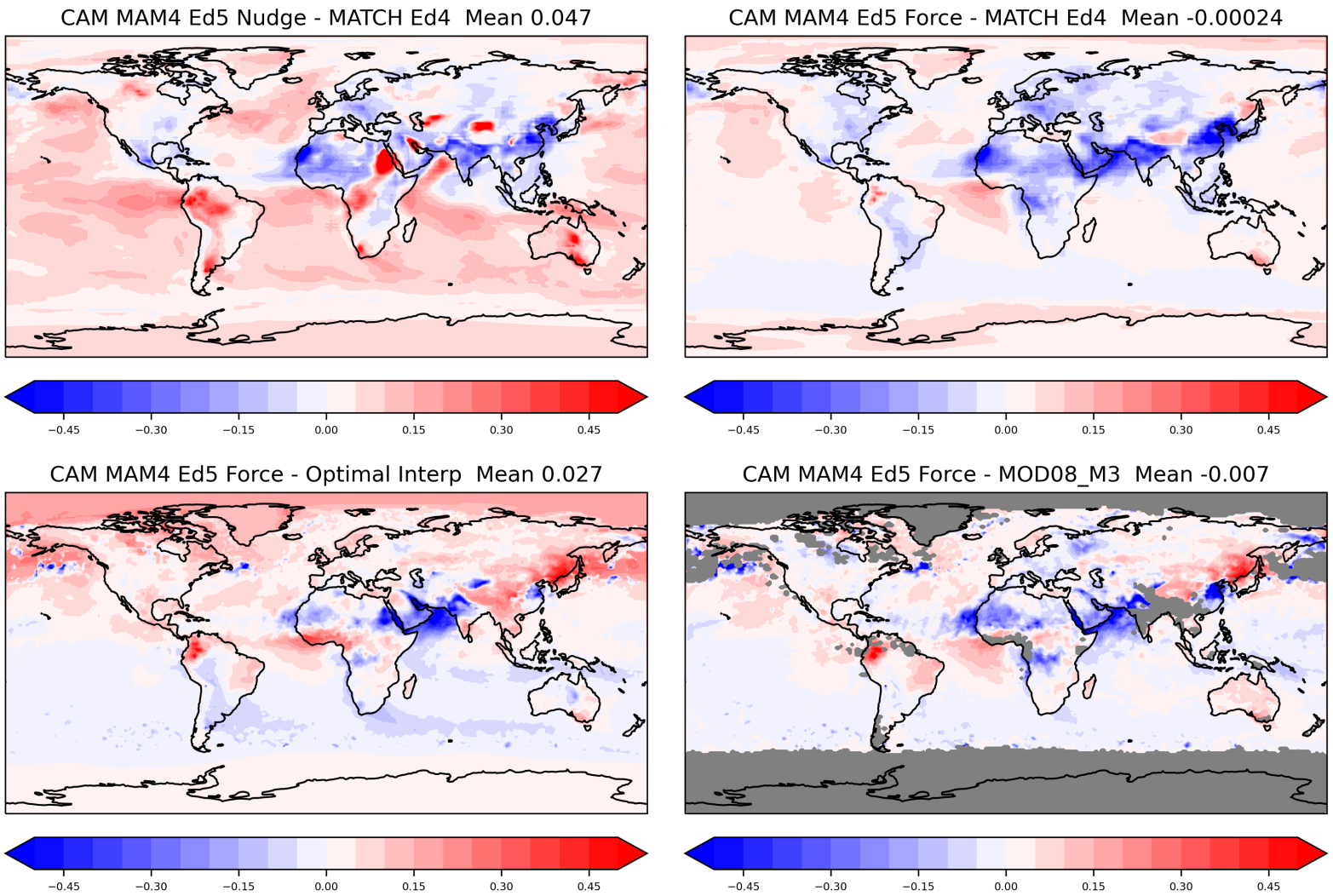
Fillmore, Viudez-Mora



AOD 550 nm Jul 2010

CERES SARB Ed5 CAM6 MAM4 Aerosol

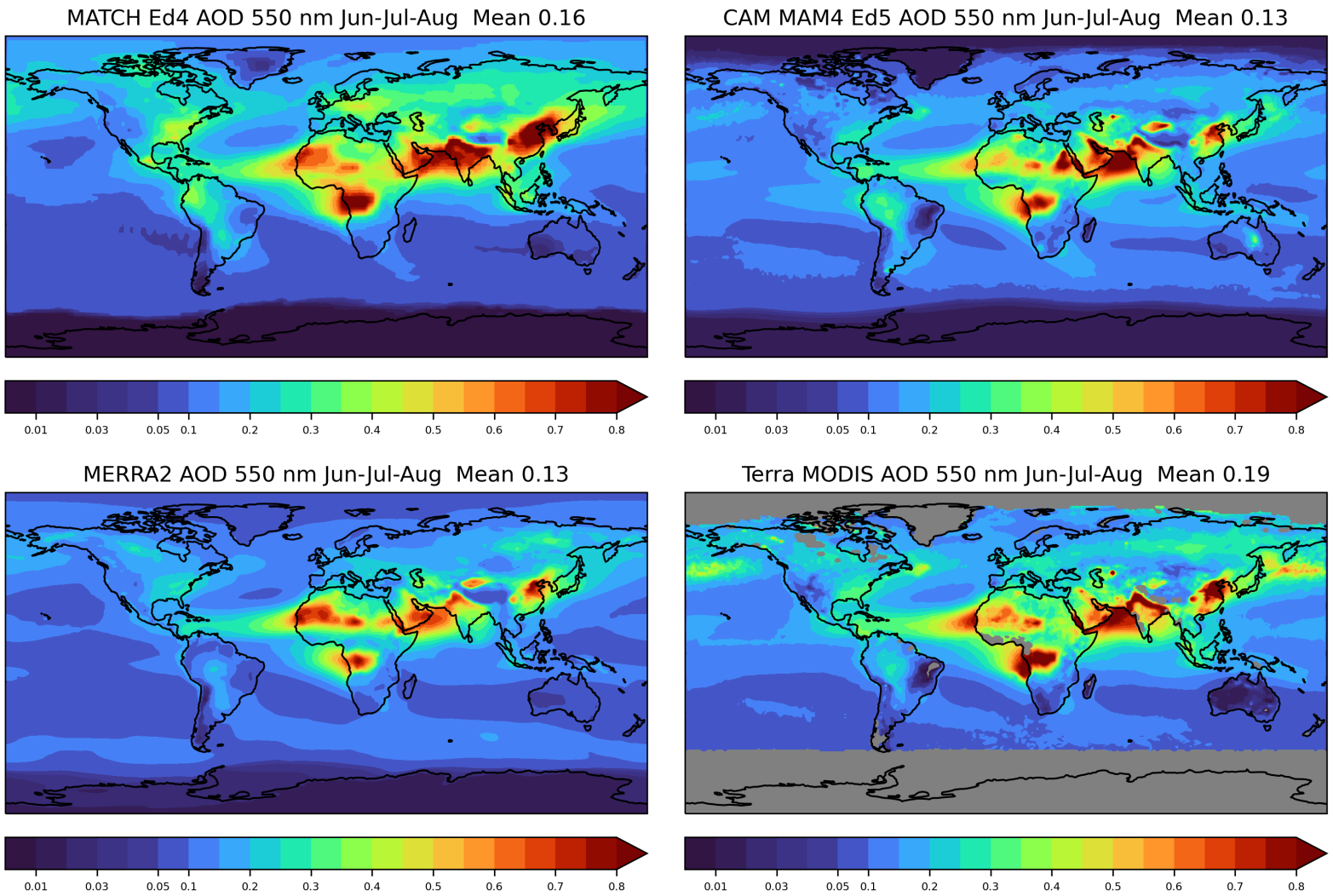
Fillmore, Viudez-Mora



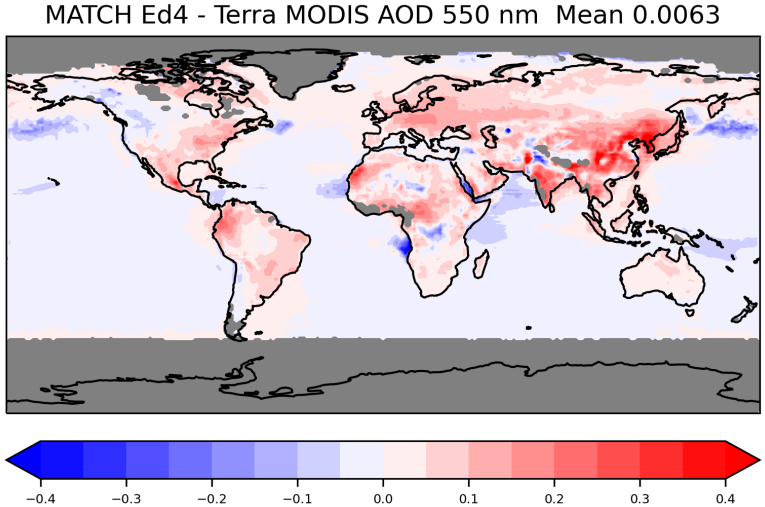
AOD 550 nm Jun Jul Aug 2000 - 2022

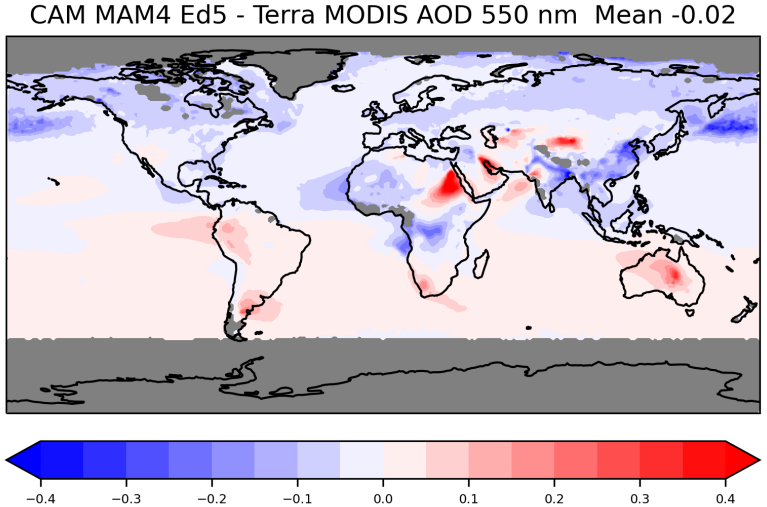
CERES SARB Ed5 CAM6 MAM4 Aerosol

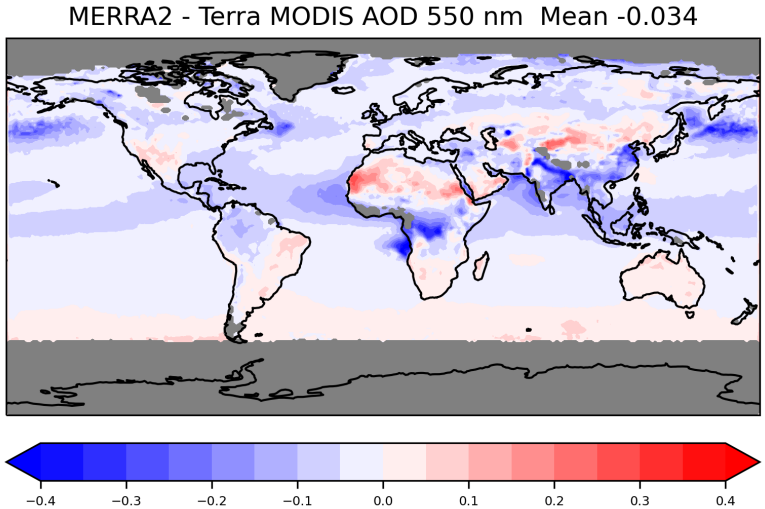
Fillmore, Viudez-Mora



AOD - MODIS AOD Jun Jul Aug



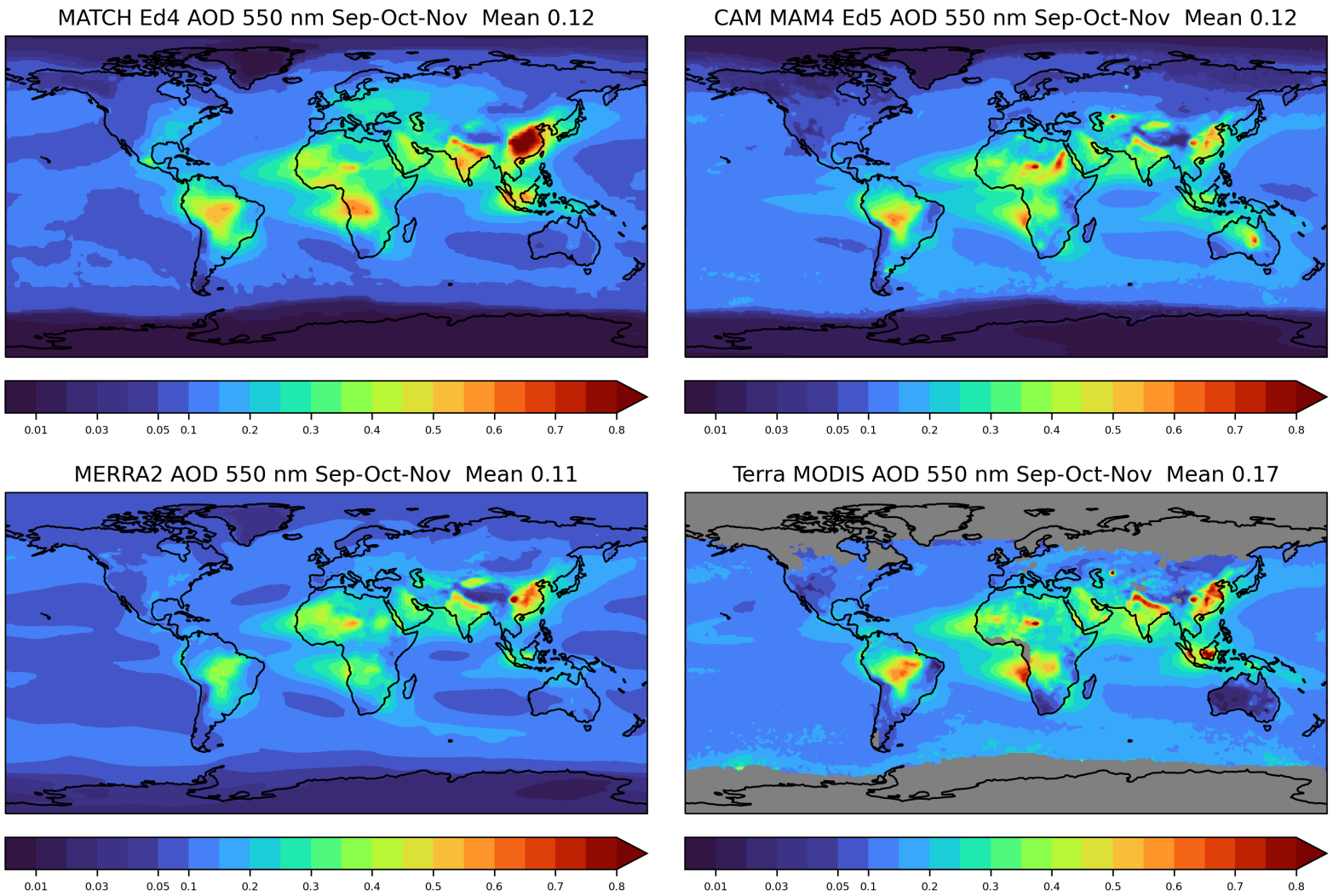




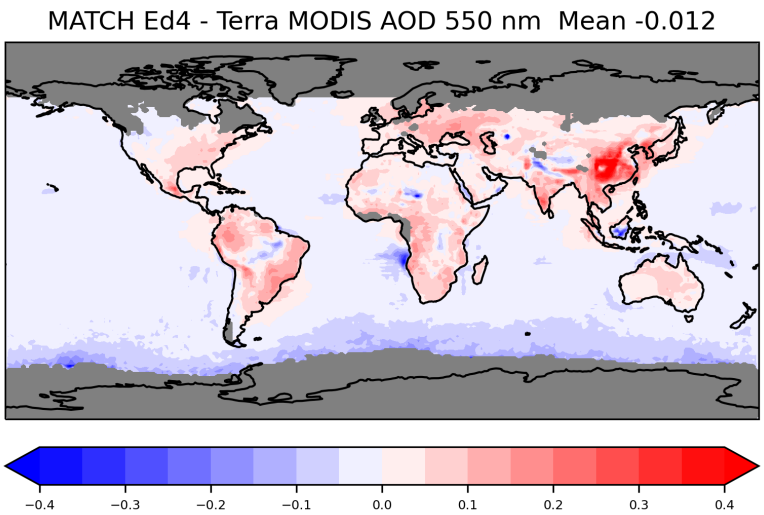
AOD 550 nm Sep Oct Nov 2000 - 2022

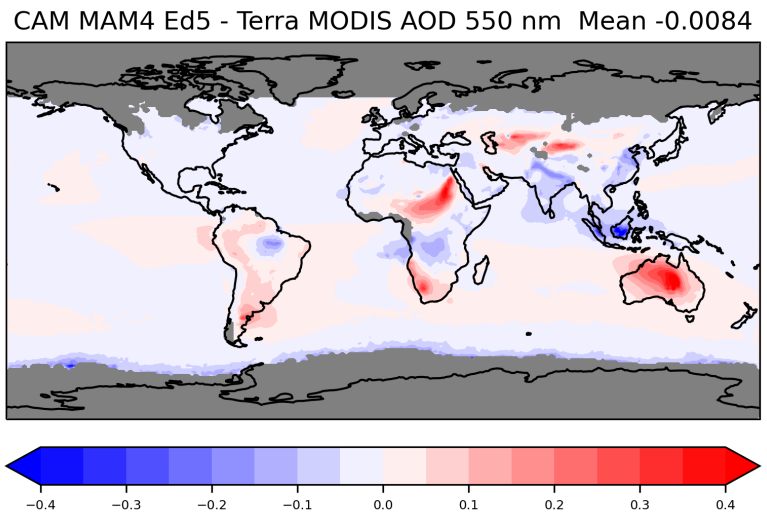
CERES SARB Ed5 CAM6 MAM4 Aerosol

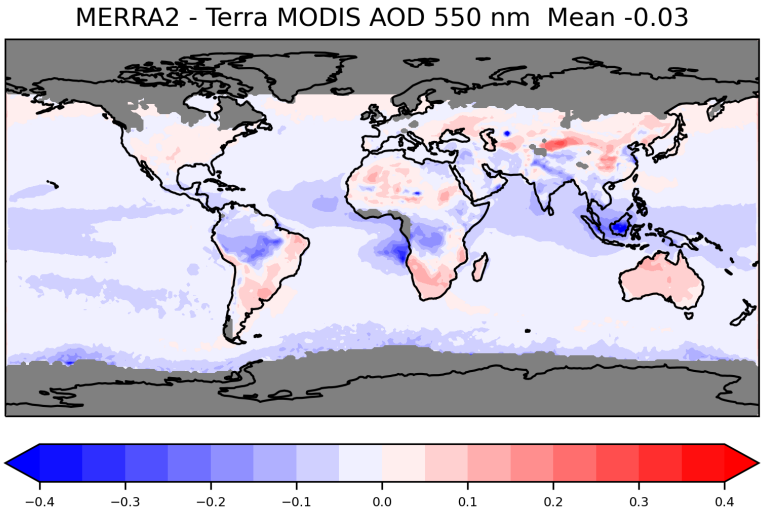
Fillmore, Viudez-Mora



AOD - MODIS AOD Sep Oct Nov



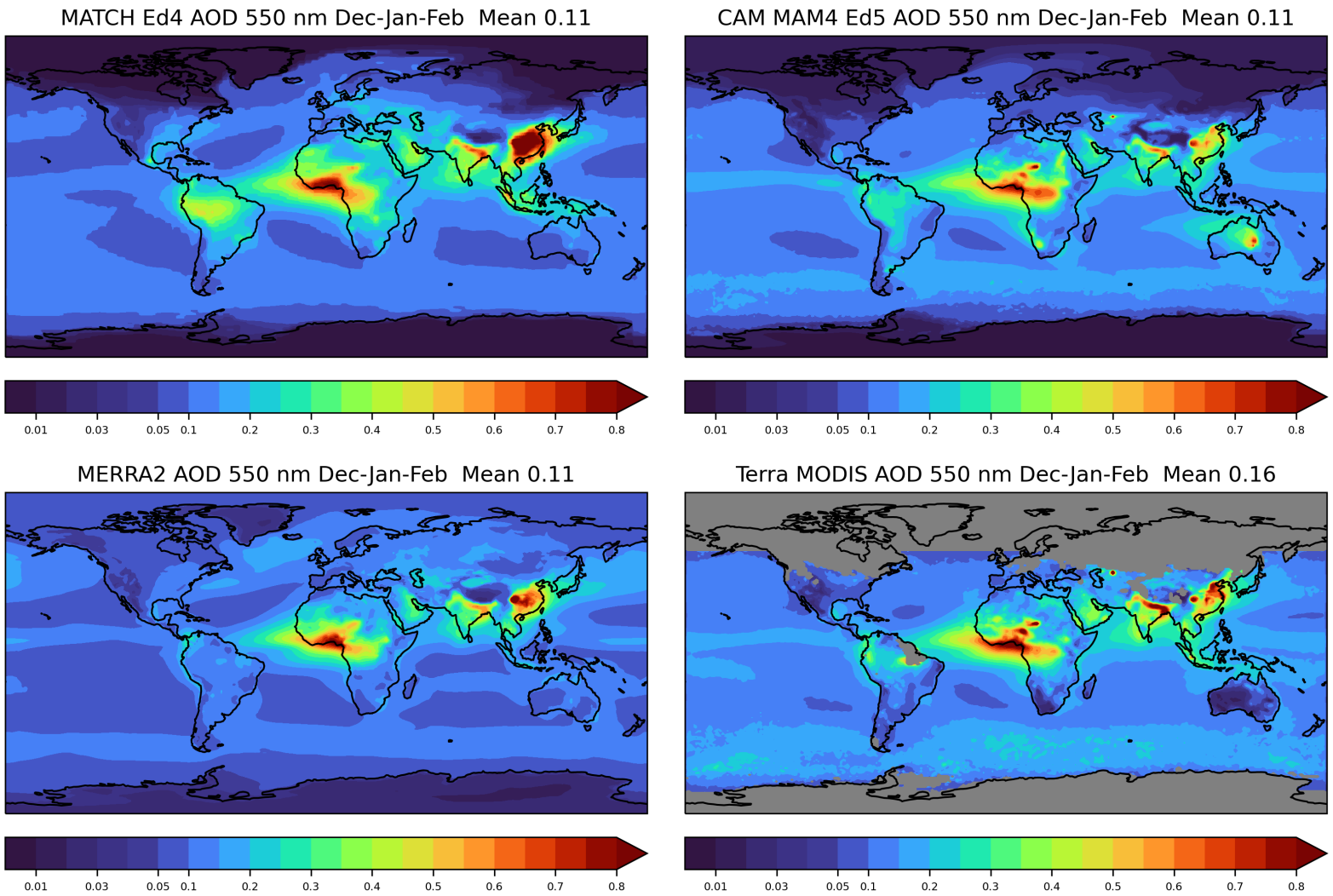




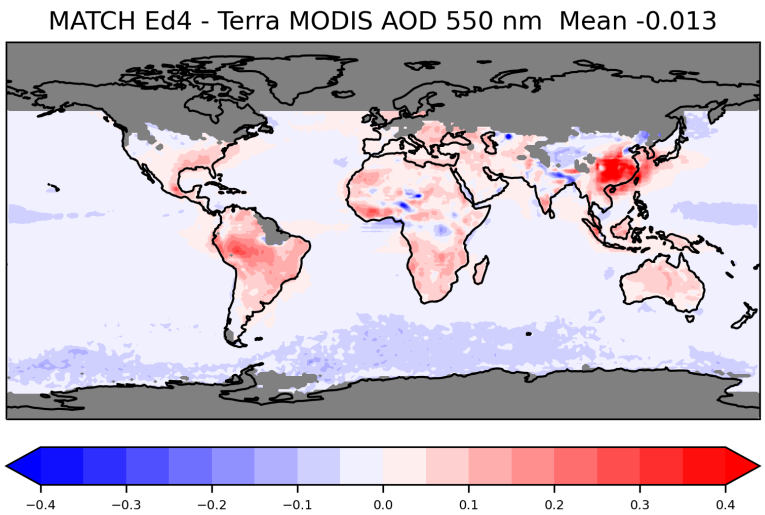
AOD 550 nm Dec Jan Feb 2000 - 2022

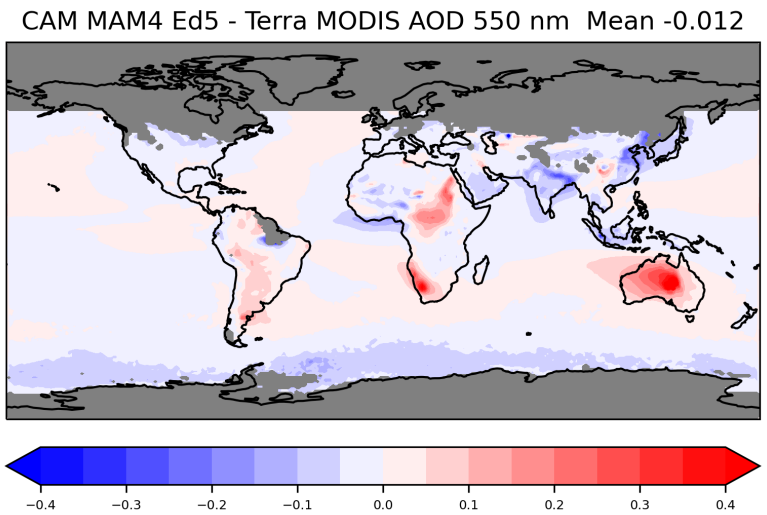
CERES SARB Ed5 CAM6 MAM4 Aerosol

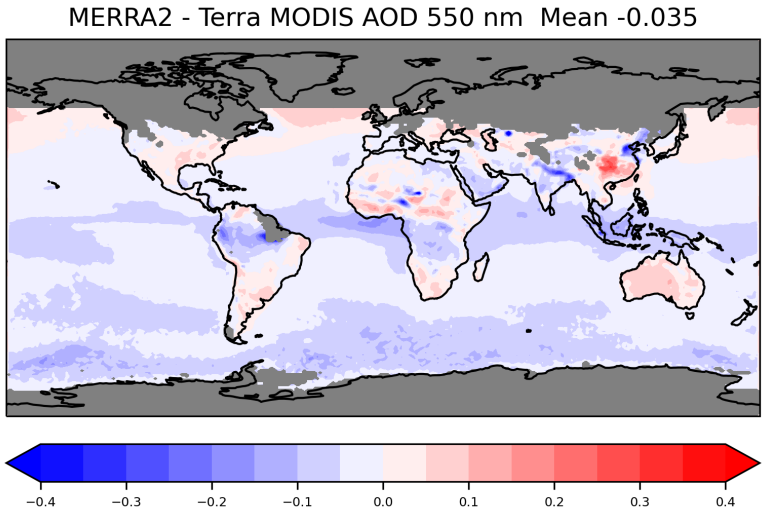
Fillmore, Viudez-Mora



AOD - MODIS AOD Dec Jan Feb



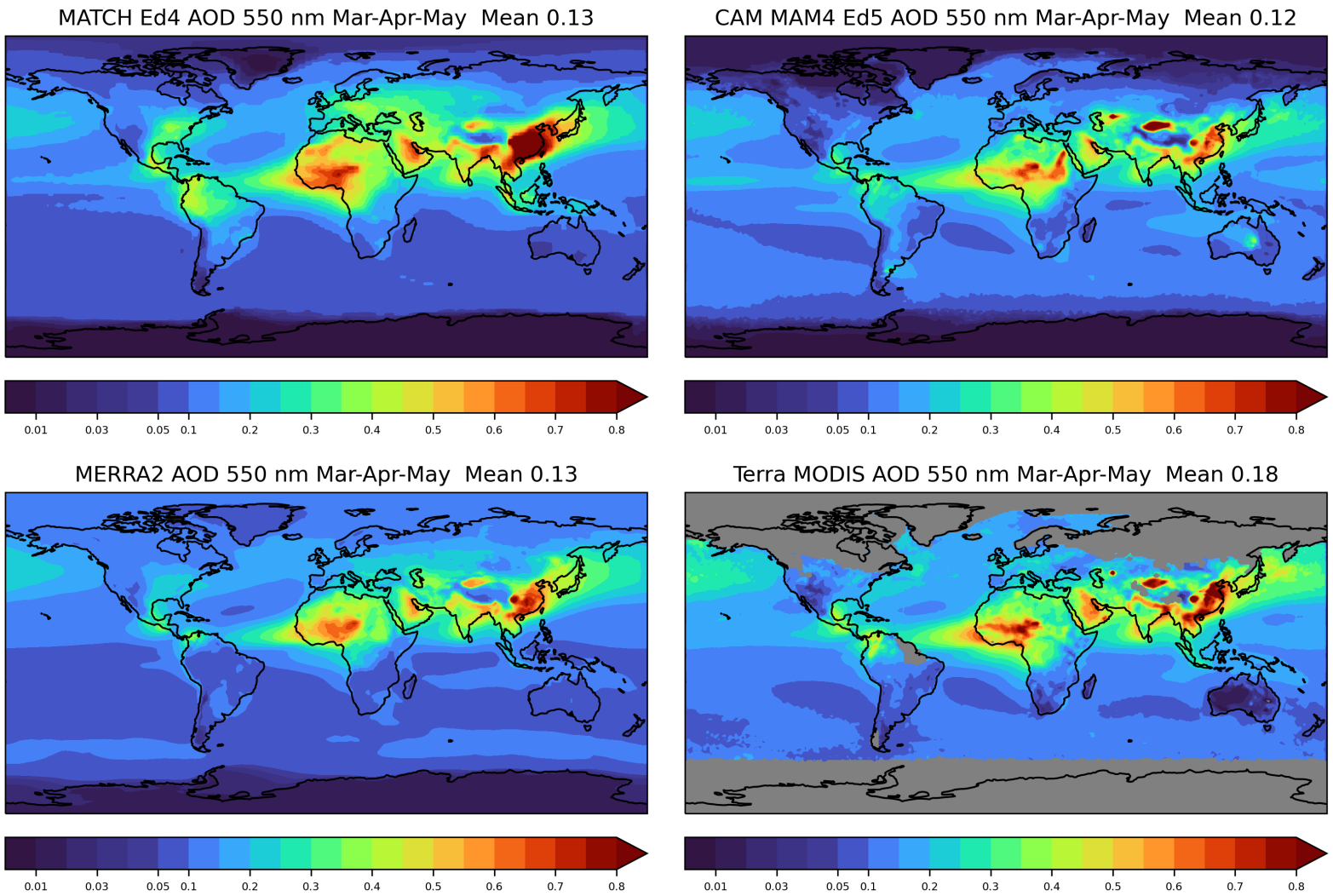




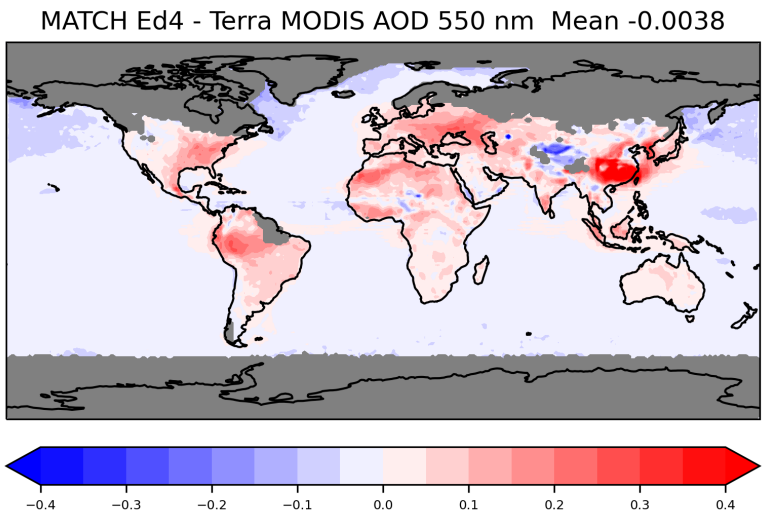
AOD 550 nm Mar Apr May 2000 - 2022

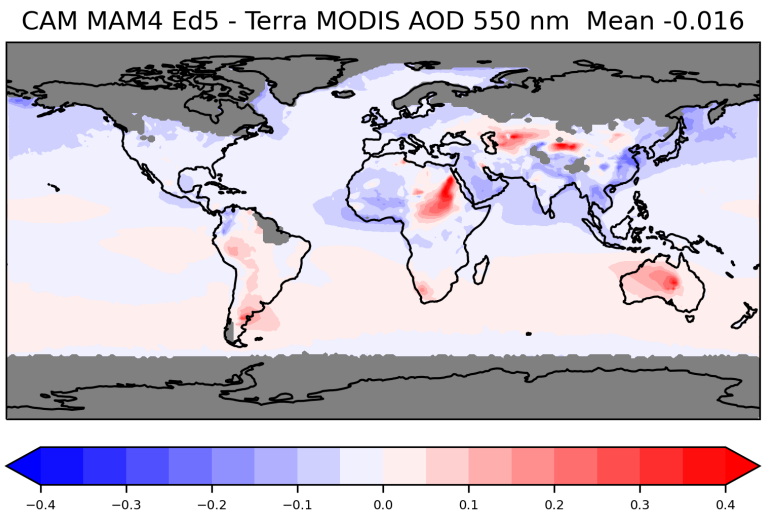
CERES SARB Ed5 CAM6 MAM4 Aerosol

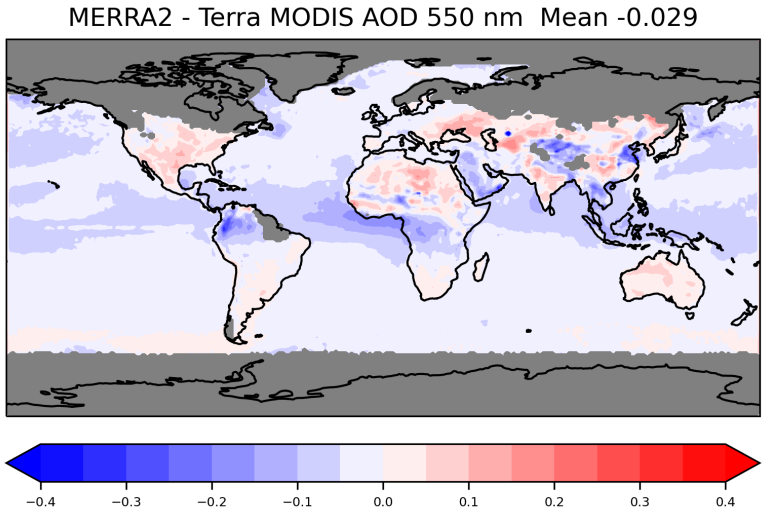
Fillmore, Viudez-Mora



AOD - MODIS AOD Mar Apr May



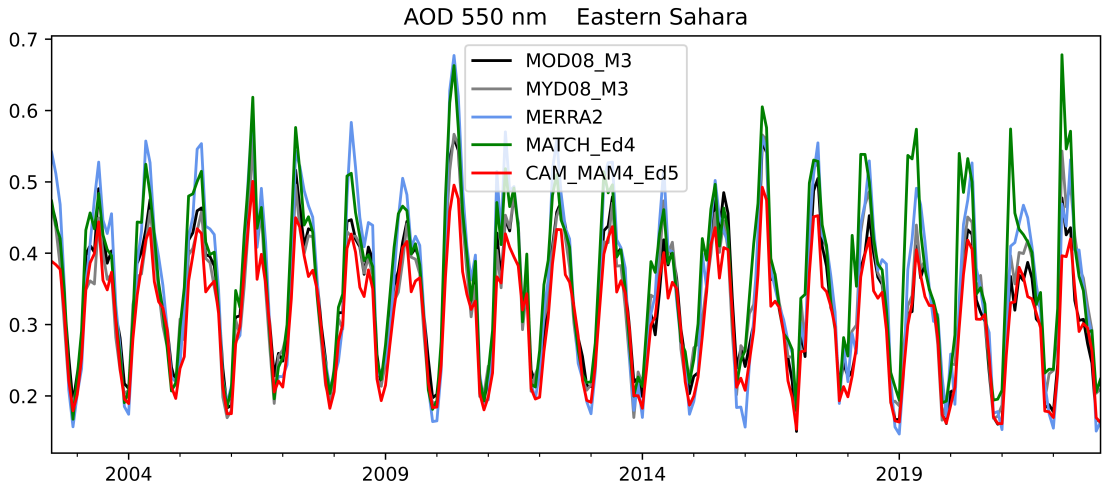


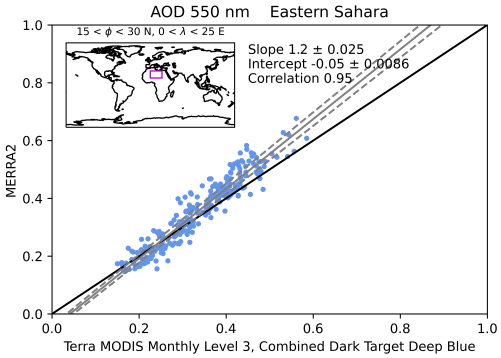


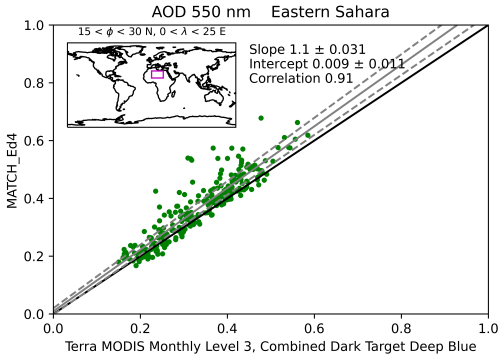
Eastern Sahara

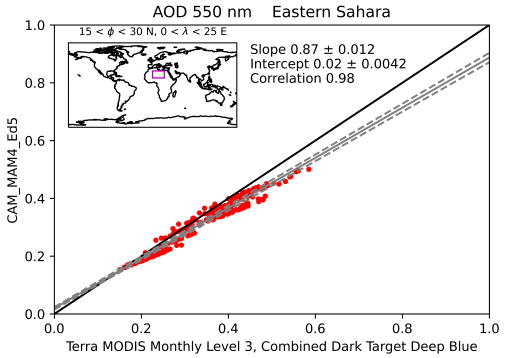
CERES SARB Ed5 CAM6 MAM4 Aerosol

Fillmore, Viudez-Mora

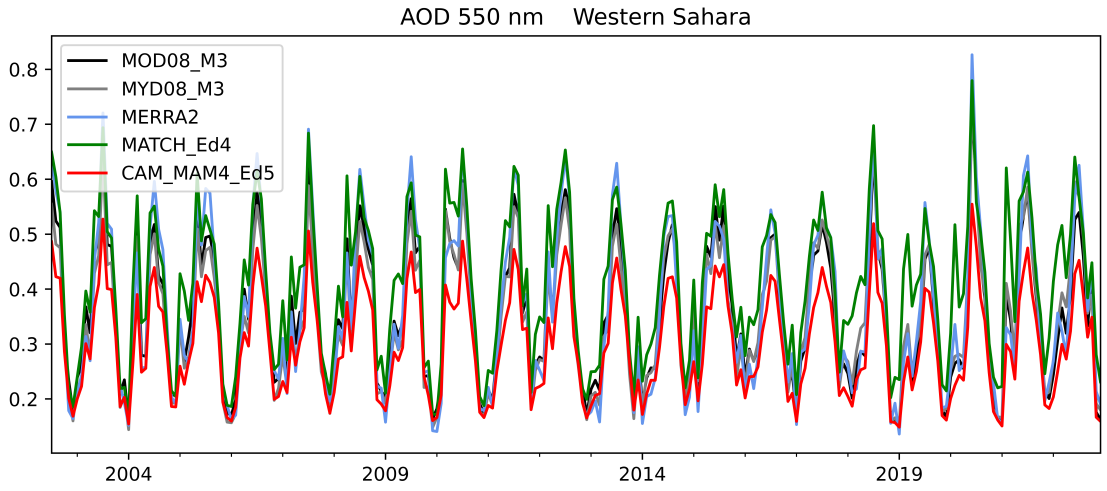


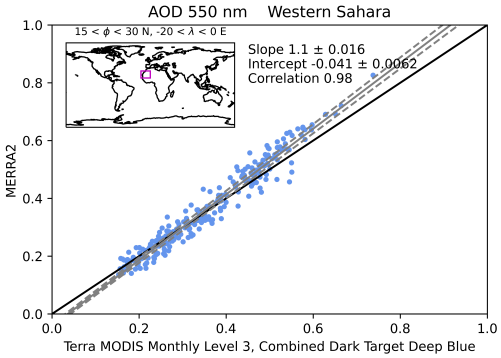


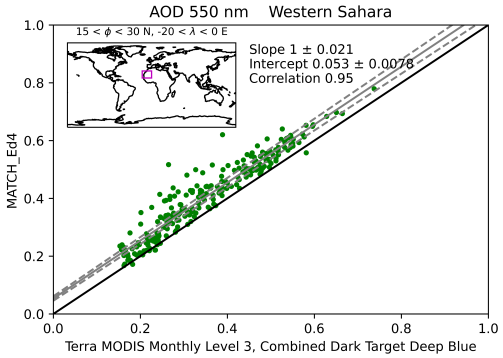


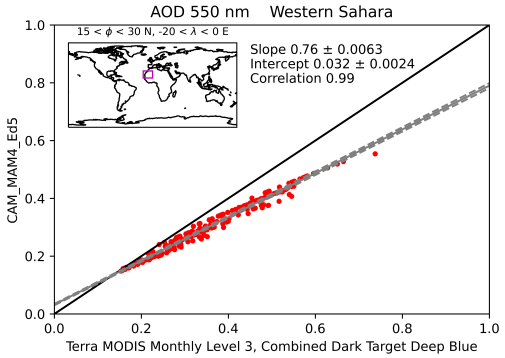


Western Sahara





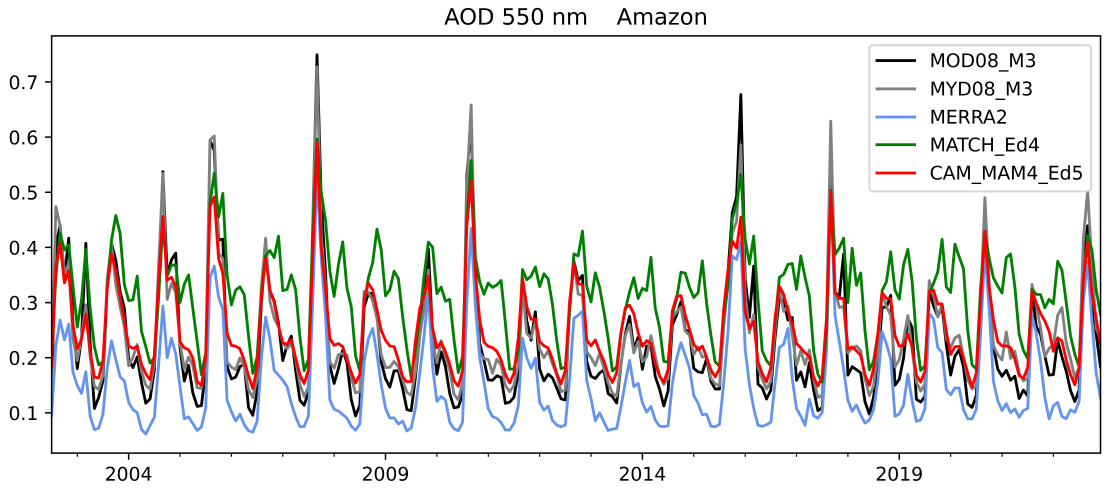


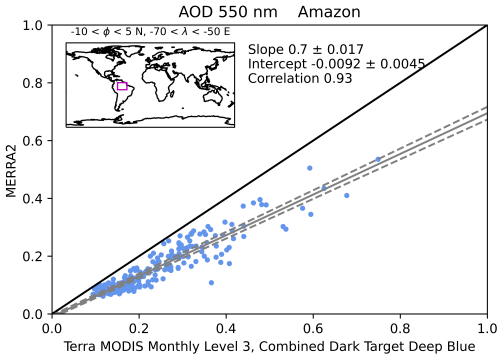


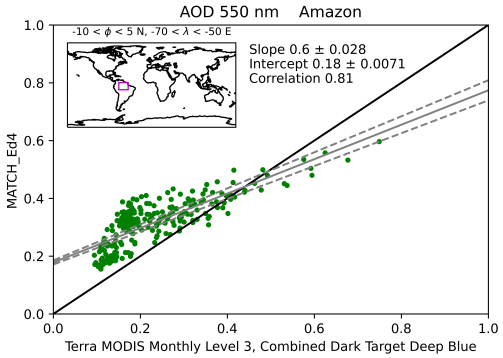
Amazon

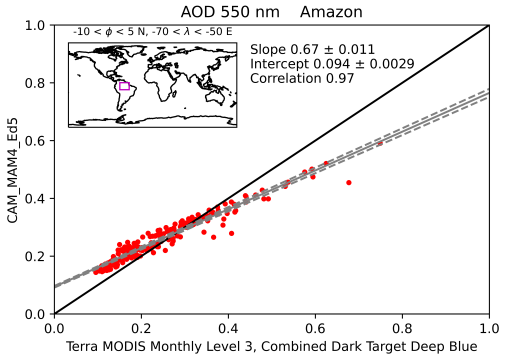
CERES SARB Ed5 CAM6 MAM4 Aerosol

Fillmore, Viudez-Mora





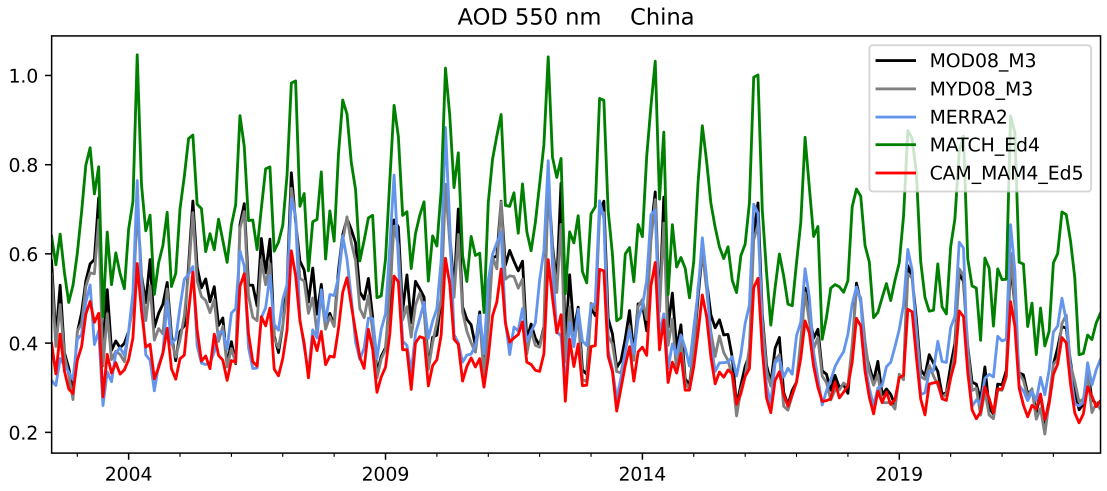


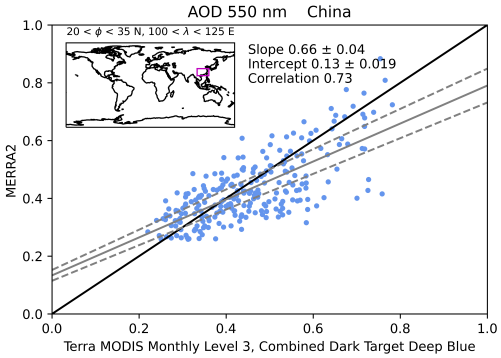


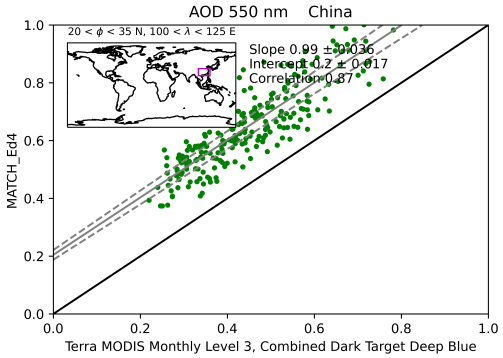
China

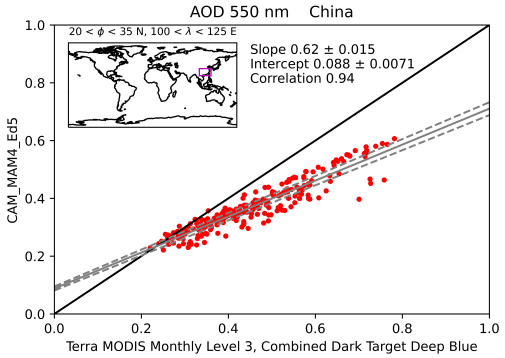
CERES SARB Ed5 CAM6 MAM4 Aerosol

Fillmore, Viudez-Mora





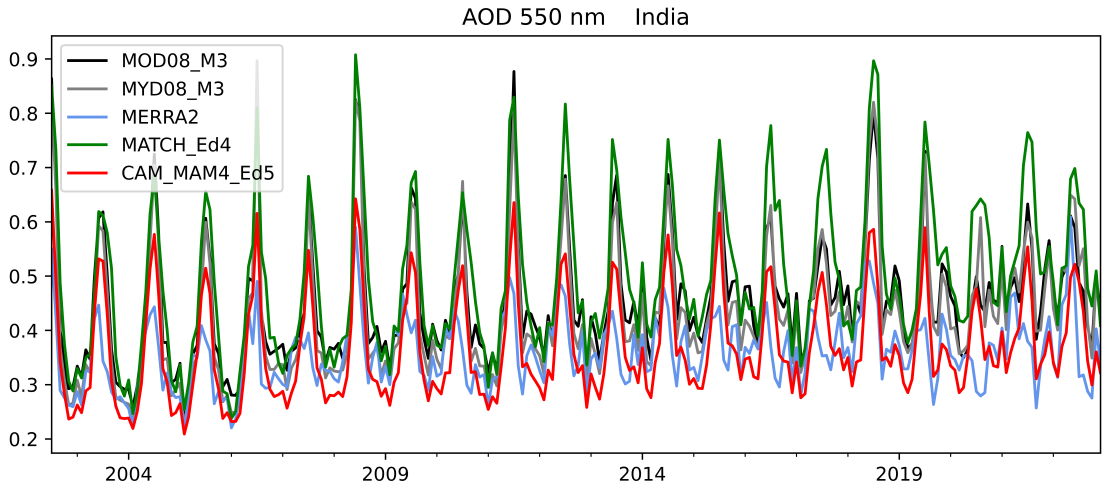


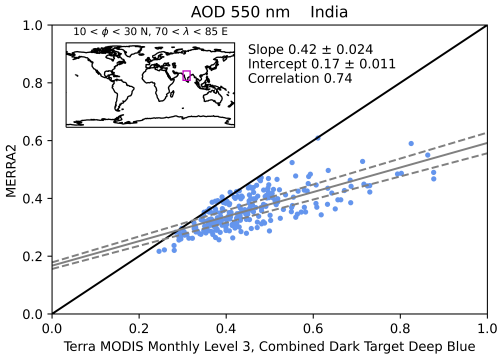


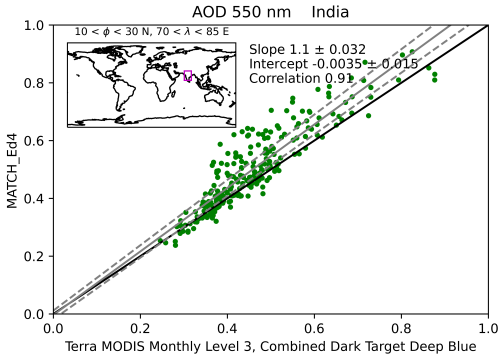
India

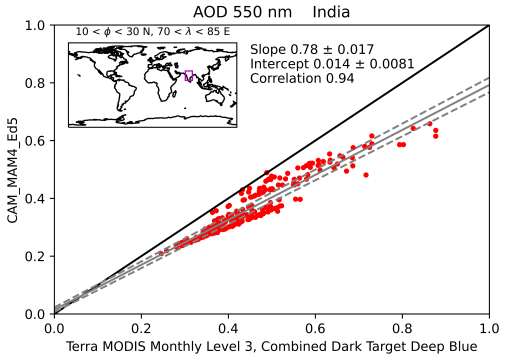
CERES SARB Ed5 CAM6 MAM4 Aerosol

Fillmore, Viudez-Mora

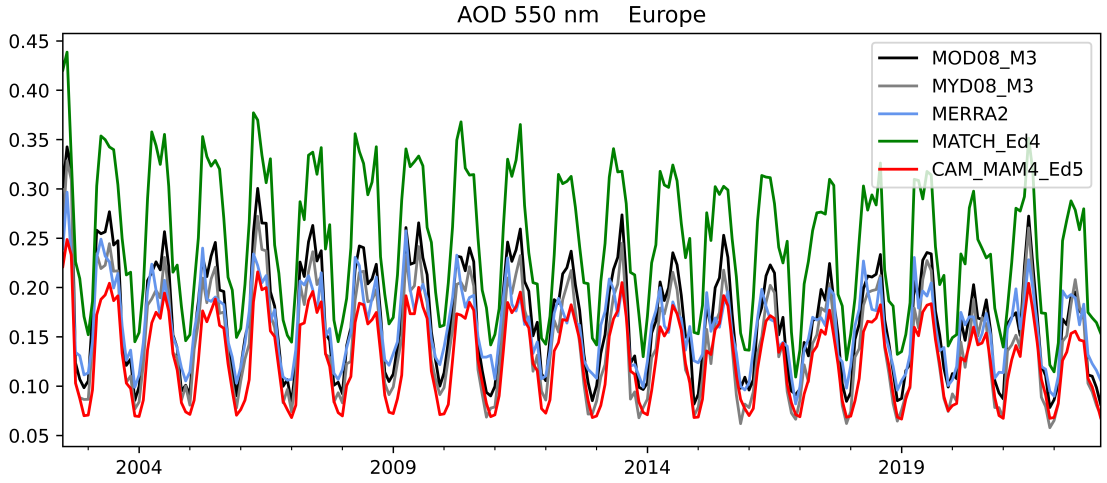


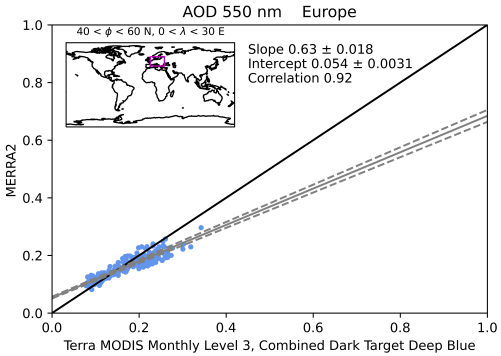


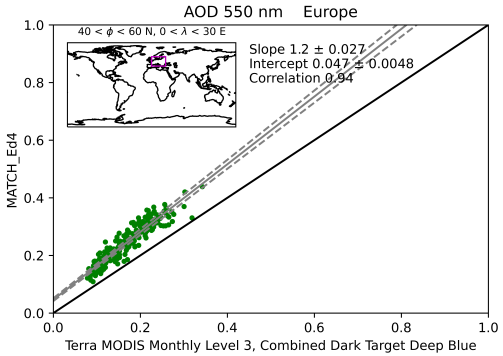


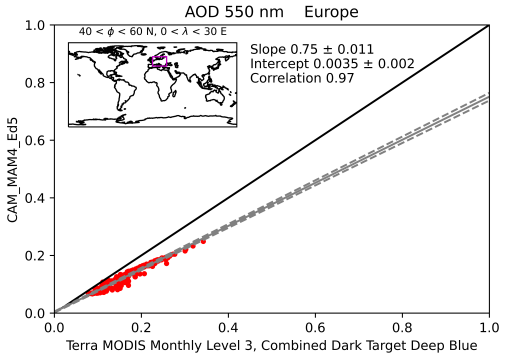


Europe


AOD 550 nm Europe
MOD08_M3
MYD08_M3
MERRA2
MATCH_Ed4
CAM_MAM4_Ed5
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
2004
2009
2014
2019


AOD 550 nm Europe
40 < ϕ < 60 N, 0 < λ < 30 E
Slope 0.63 ± 0.018
Intercept 0.054 ± 0.0031
Correlation 0.92
MERRA2
Terra MODIS Monthly Level 3, Combined Dark Target Deep Blue

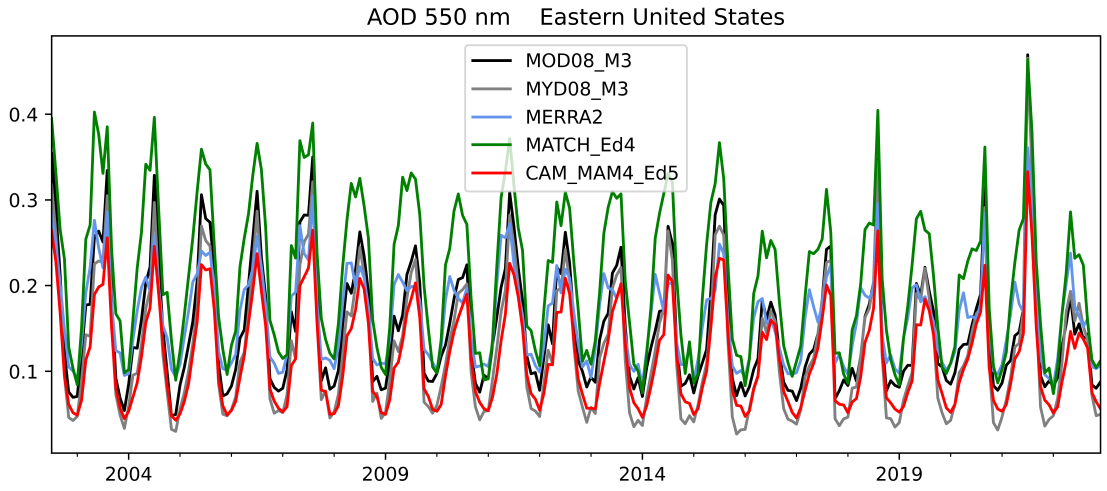

AOD 550 nm Europe
40 < ϕ < 60 N, 0 < λ < 30 E
Slope 1.2 ± 0.027
Intercept 0.047 ± 0.0048
Correlation 0.94
MATCH_Ed4
Terra MODIS Monthly Level 3, Combined Dark Target Deep Blue

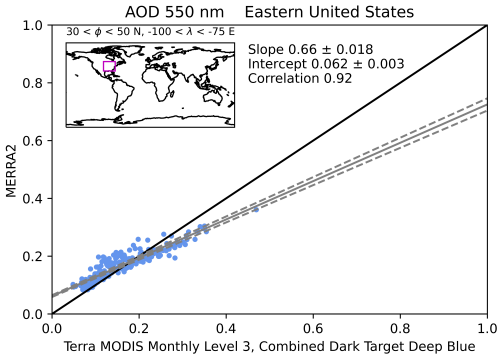

AOD 550 nm Europe
40 < ϕ < 60 N, 0 < λ < 30 E
Slope 0.75 ± 0.011
Intercept 0.0035 ± 0.002
Correlation 0.97
CAM_MAM4_Ed5
Terra MODIS Monthly Level 3, Combined Dark Target Deep Blue

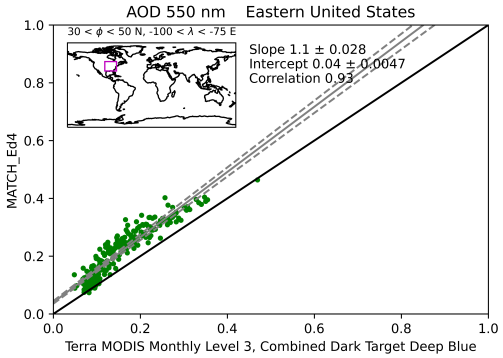
Eastern United States

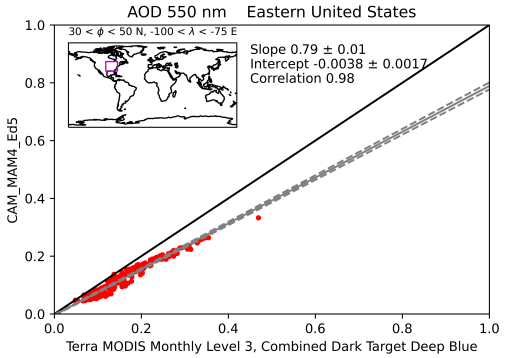
CERES SARB Ed5 CAM6 MAM4 Aerosol

Fillmore, Viudez-Mora





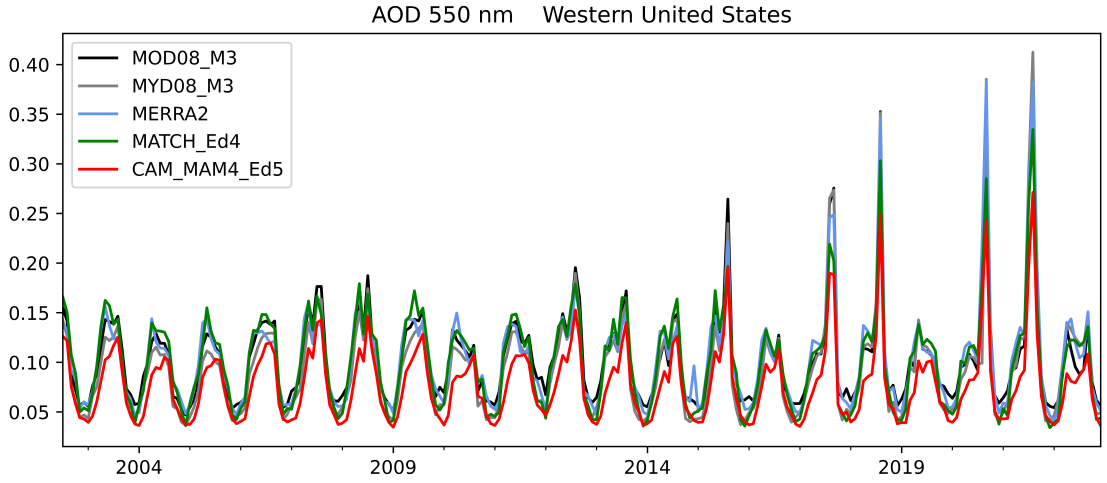


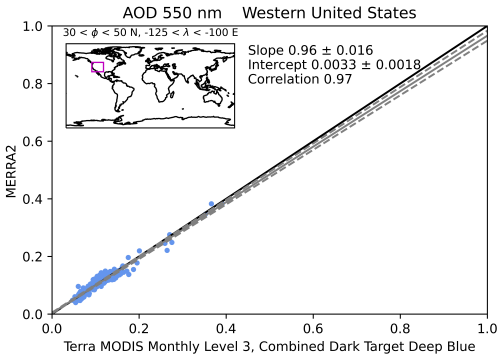


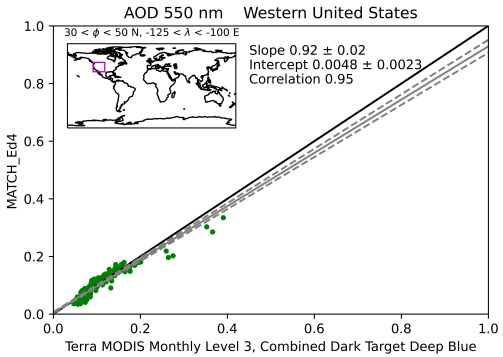
Western United States

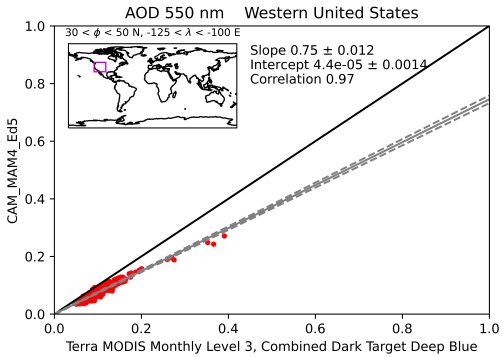
CERES SARB Ed5 CAM6 MAM4 Aerosol

Fillmore, Viudez-Mora





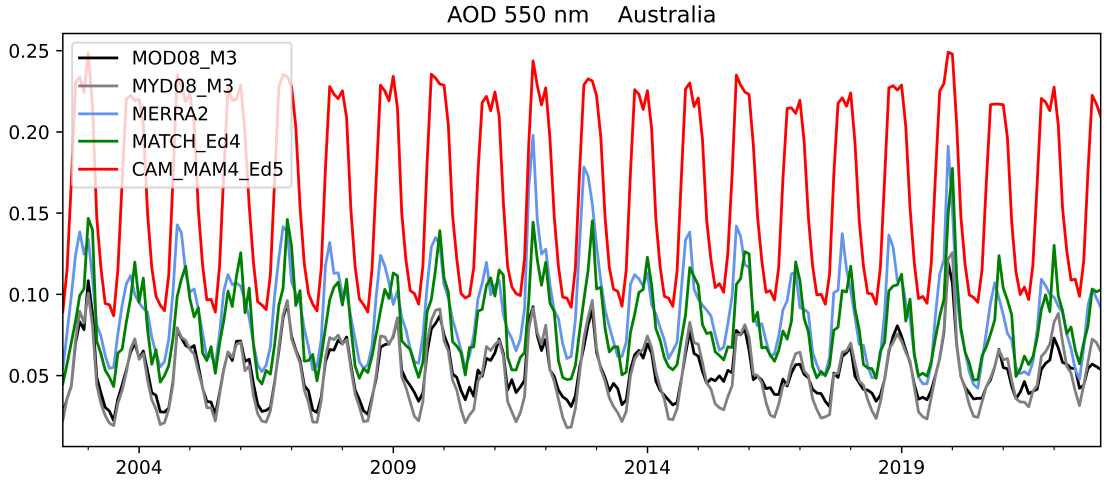


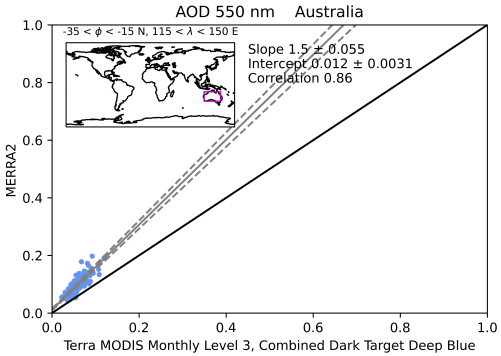


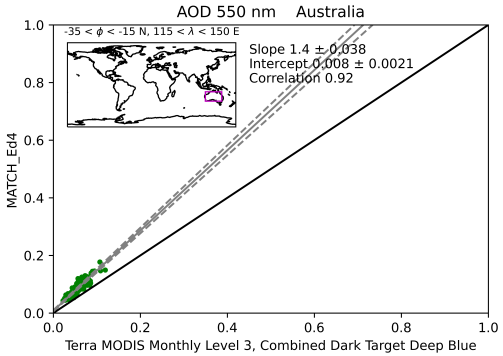
Australia

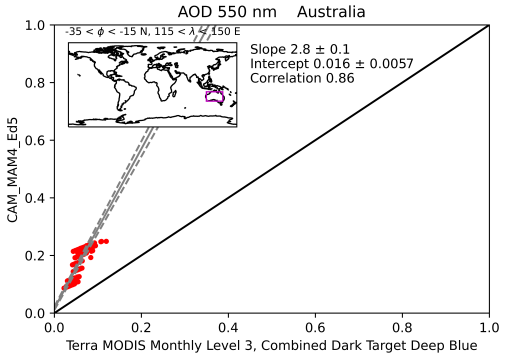
CERES SARB Ed5 CAM6 MAM4 Aerosol

Fillmore, Viudez-Mora









Summary

1. CAM6 MAM4 has been customized for SARB aerosols
2. mulit-year preliminary results will be available within a few weeks

Next Steps

1. switch to GEOS-IT meteorology
2. determine model spin-up
3. evaluate options for aerosol sources
4. begin surface network validation
5. prepare CAM6 radiative properties output for SARB Fu-Liou
6. transition from MODIS AOD to VIIRS AOD