Regional Aerosol Optical Depth Trends and Interannual Variability

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2013 October 30

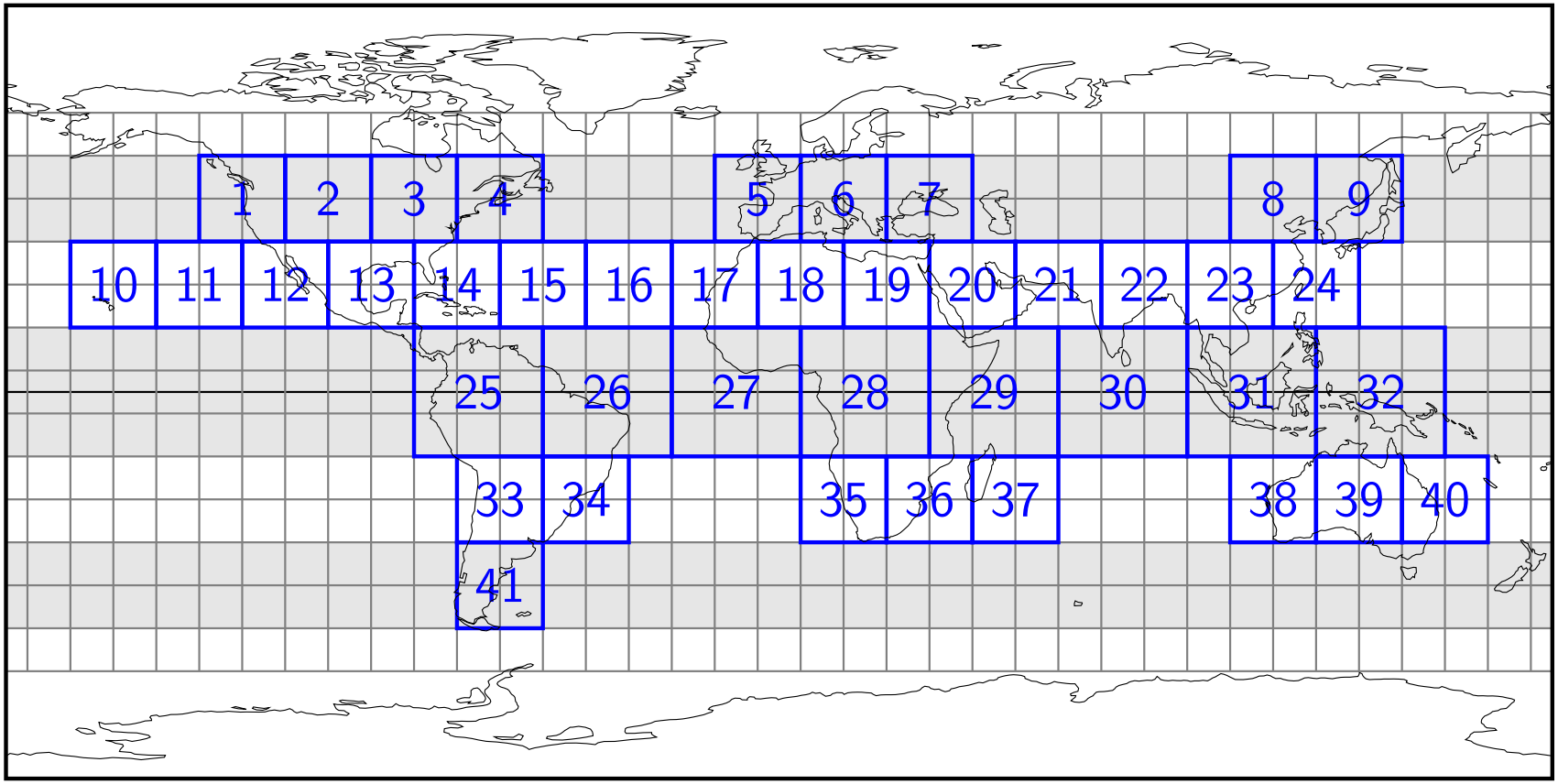
CERES Science Team Meeting
Scripps Institution of Oceanography
La Jolla, California

MATCH Edition 4 Status

- Edition 2 processing continues
  2000 March - 2013 June.
- Edition 4 *daily mean* output will continue
  2000 March - 2012 December.
- Edition 4 *hourly* output
  full record 2000 March - present to commence next week $\pm$ 1 week.

MATCH News

- MODIS Collection 5 Dark Target AOD Land $\pm(0.05 + 15\%)$
  Petrenko and Ichoku [Petrenko]
  estimate AOD uncertainty for each CERES surface type.
- Have SEVIRI 2010 January - 2012 December AOD v2.3
  will evaluate diurnal dust cycle in MATCH *hourly*.
- AeroCom HTAP (source region) experiment [HTAP].
  Initial meeting San Francisco December 5 - 6 prior to AGU.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Arabian Peninsula

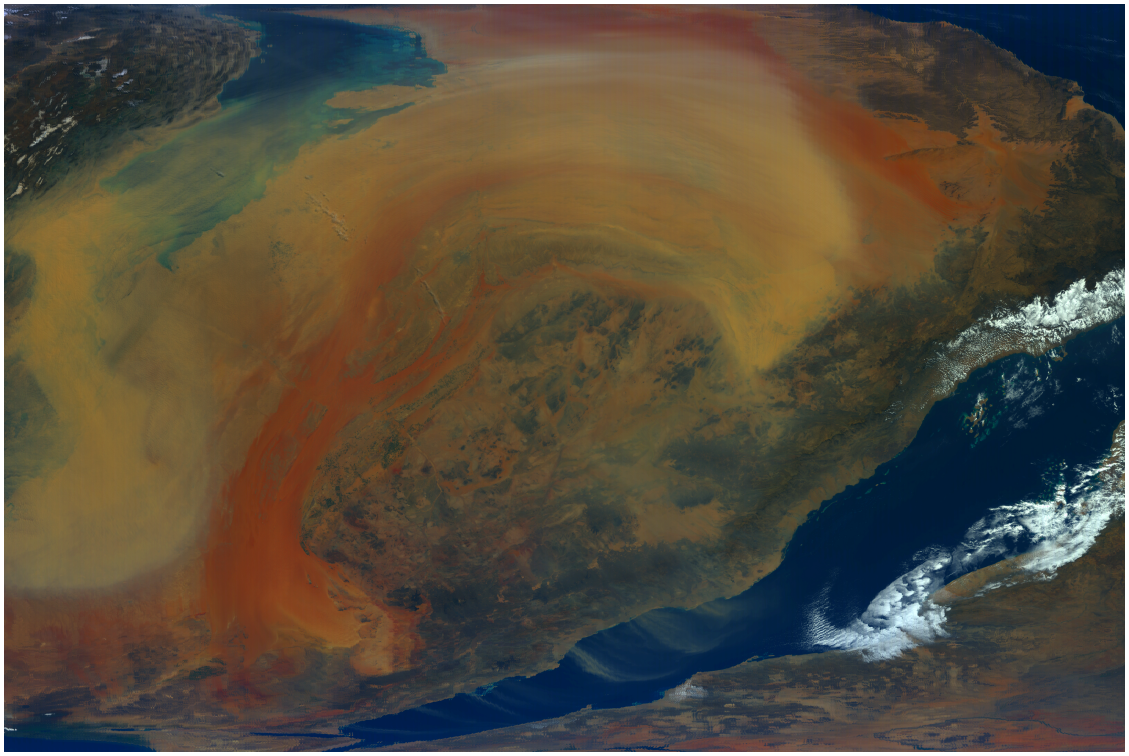
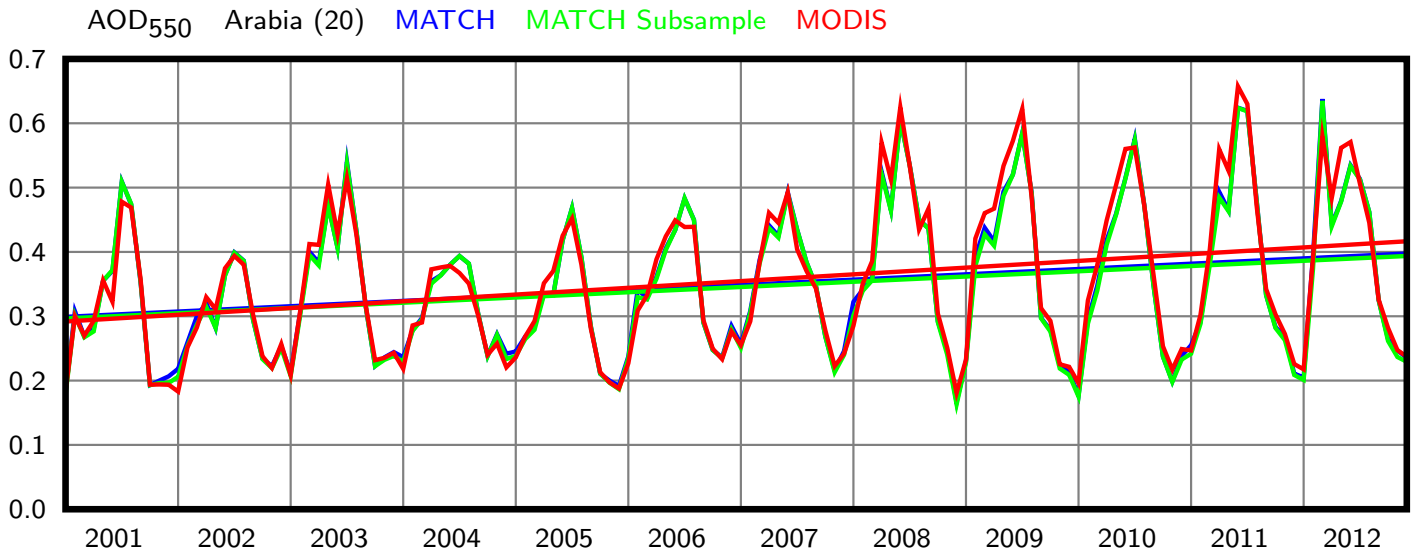


Figure 1 : A massive sand storm engulfs the Arabian Peninsula and the Persian Gulf. The data for this enhanced color image was acquired by the MODIS instrument on the NASA Terra satellite on 18 March 2012. The image has been rotated to better match the layout of this document. In the above image geographic north is to the left.


AOD550 Arabia (20) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
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2007
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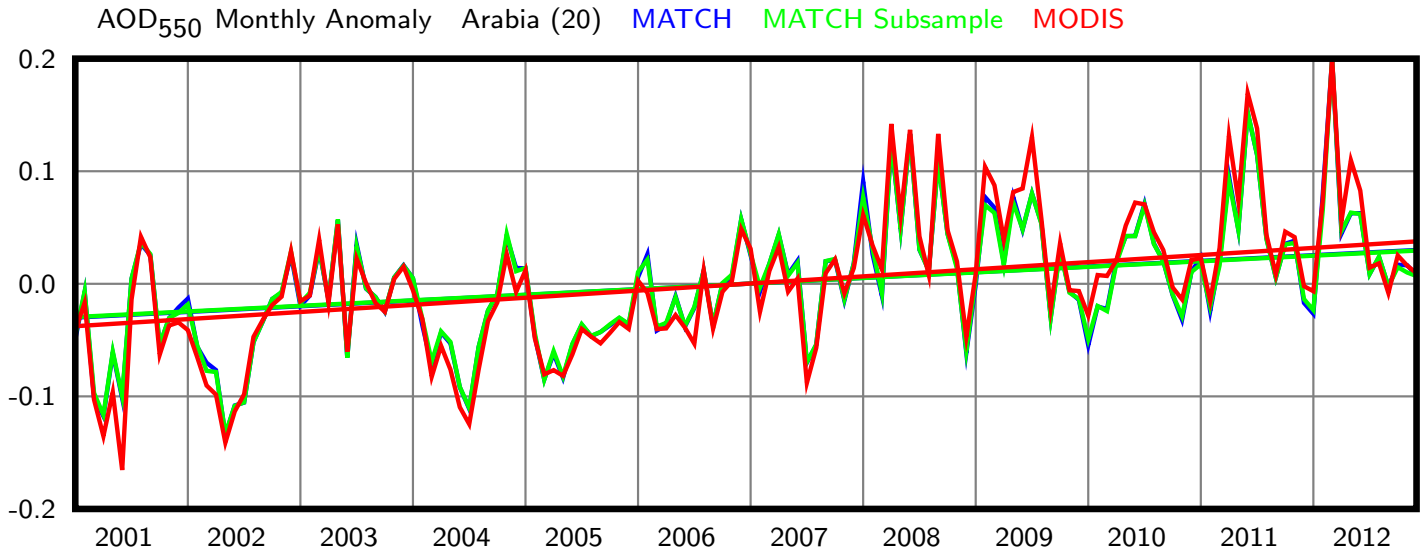
2012


AOD550 Monthly Anomaly Arabia (20) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
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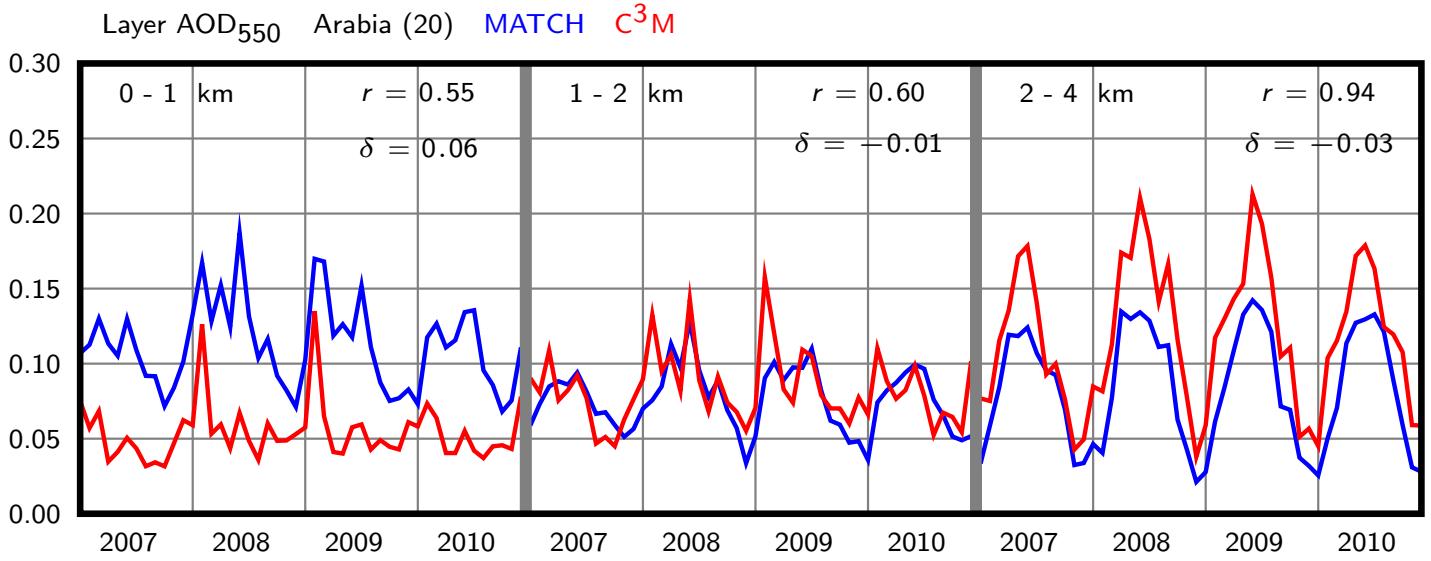
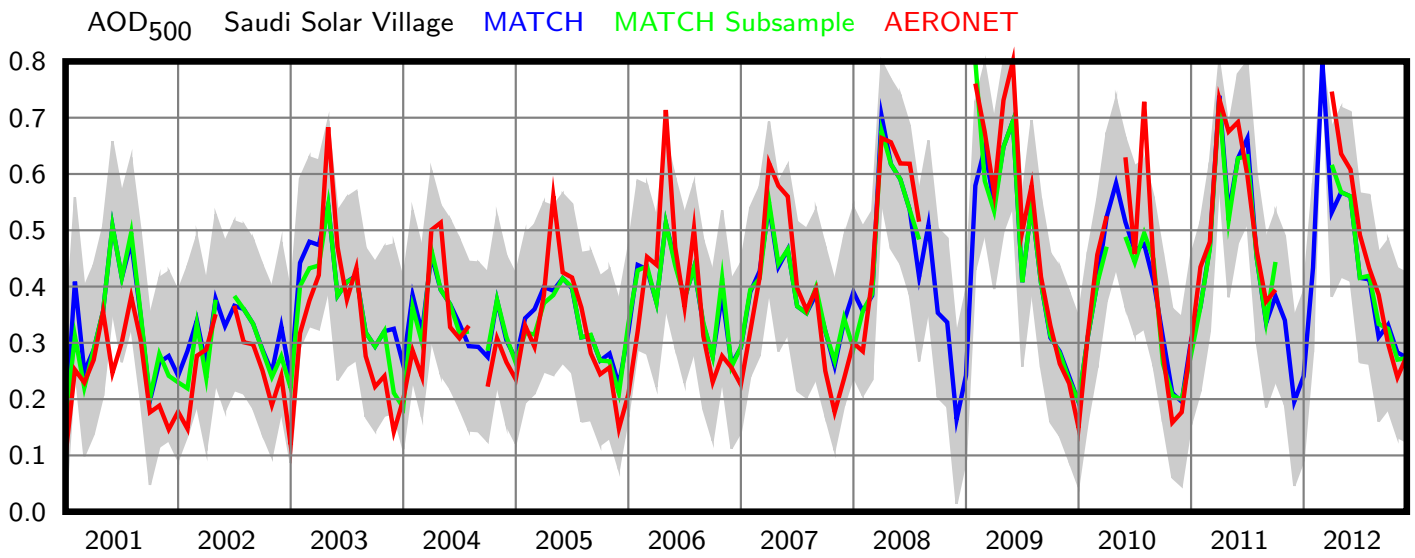
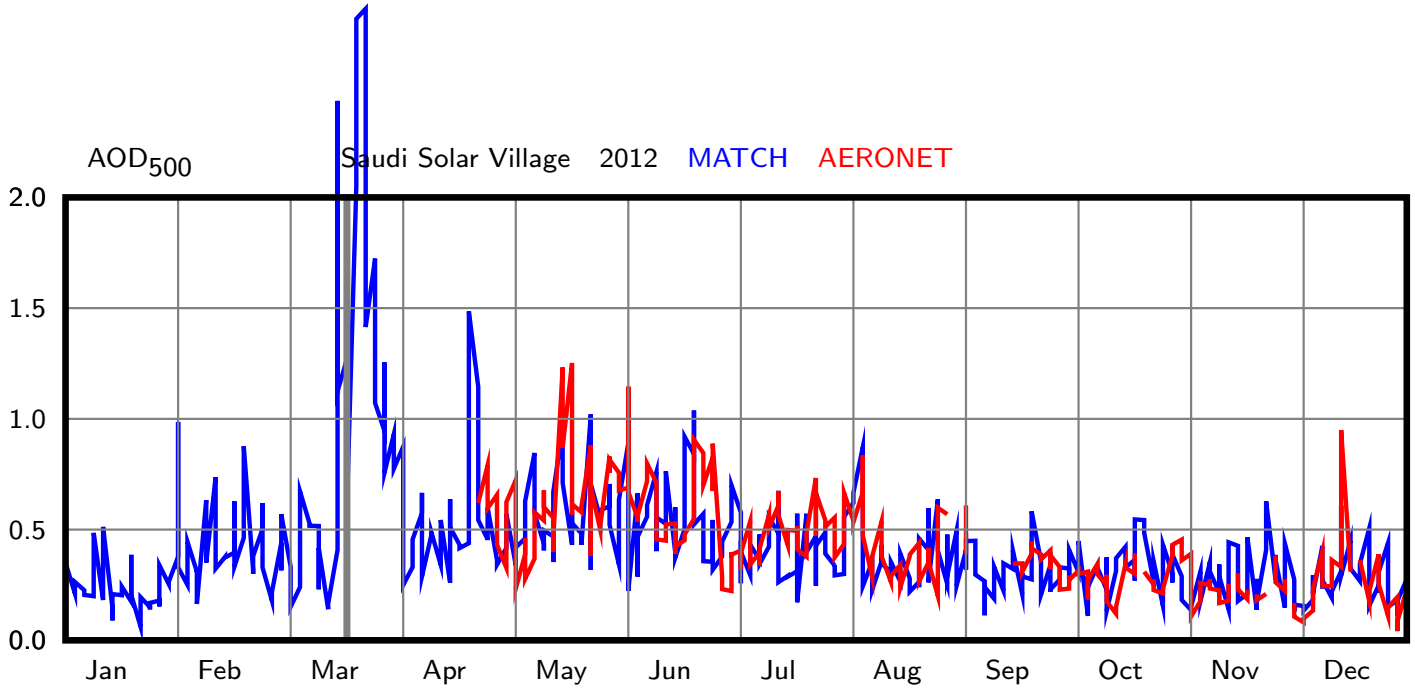
2006
2007
2008
2009
2010
2011
2012



Arabia (20)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.083	0.299	0.258	0.002	0.000
MATCH Subsample	0.081	0.297	0.252	0.002	0.000
MODIS	0.105	0.292	0.310	0.000	0.000

Table 1 : $\mathrm{AOD}_{550} = b\ t + a$


AOD500
Saudi Solar Village
MATCH
MATCH Subsample
AERONET
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012


AOD500
Saudi Solar Village
2012
MATCH
AERONET
2.0
1.5
1.0
0.5
0.0
Jan
Feb
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May
Jun
Jul
Aug
Sep
Oct
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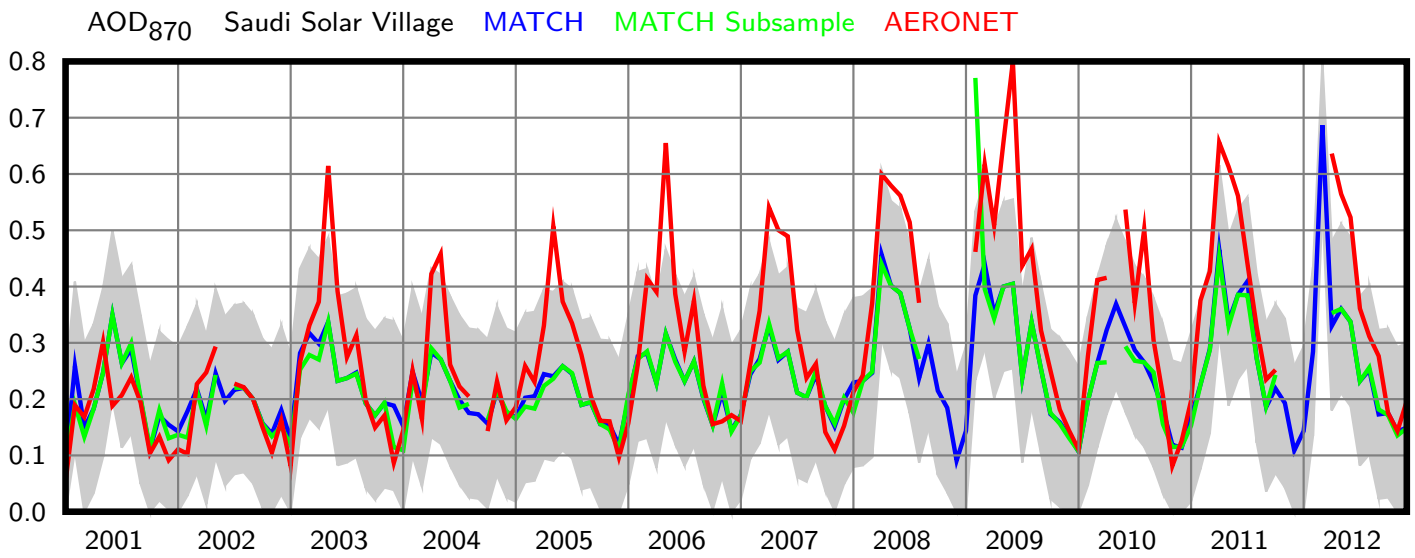
Dec


AOD870
Saudi Solar Village
MATCH
MATCH Subsample
AERONET
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
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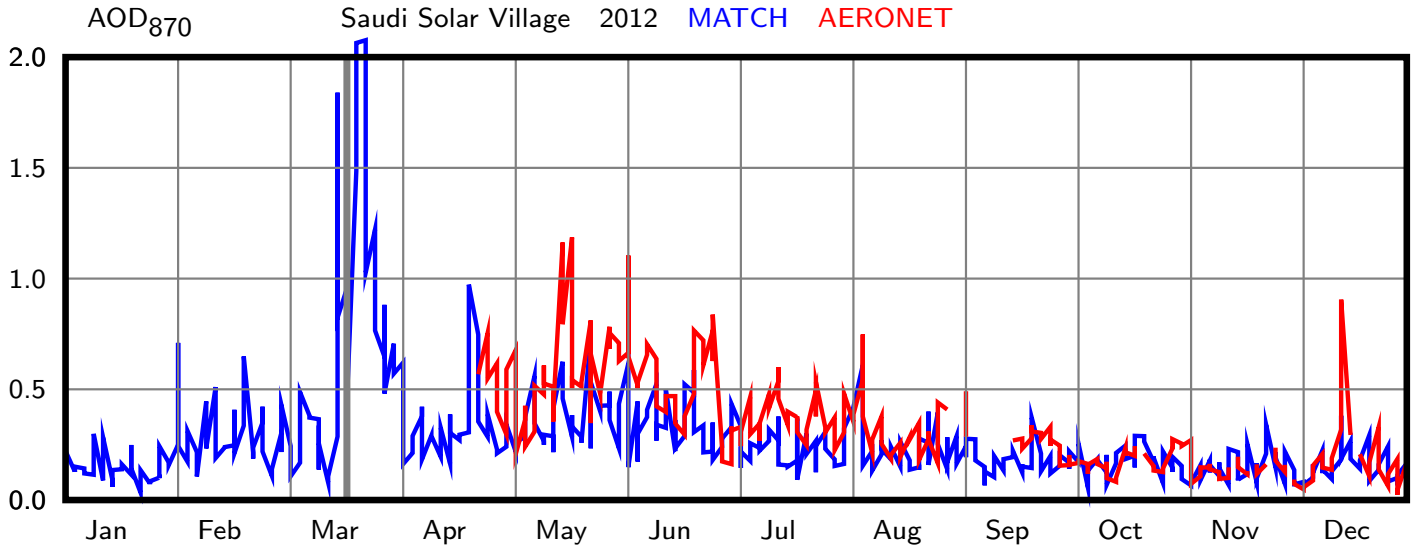
2011
2012


AOD870
Saudi Solar Village
2012
MATCH
AERONET
2.0
1.5
1.0
0.5
0.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

- C^3M and AERONET validation is ongoing.
- For some regions C^3M issues remain
  and warrant a further analysis.
- Next GOES5.9.1 aerosol diagnostics.
- SatelliteDL IDL aerosol + more diagnostic package (with Mike Galloy)
  will be ready for AGU poster December 9 $\pm$ 5.
- VIIRS AOD assimilation,
  diagnostics and [ACTRIS] database (aerosol absorption)
  a good topic for next SBIR I.

[Chin] 2013 - Chin, Diehl, Tan, Prospero, Kahn, Remer, Yu, Sayer, Bian, Geogdzhayev, Hoben, Howell, Huebert, Hsu, Kim, Kucsera, Levy, Mishchenko, Pan, Quinn, Schuster, Streets, Strode, Torres, Zhao
Multi-decadal variations of atmospheric aerosols from 1980 to 2009: sources and regional trends
Atmospheric Chemistry and Physics, 13, 1975119835, 2013
http://www.atmos-chem-phys-discuss.net/13/19751/2013/acpd-13-19751-2013-discussion.html

[Petrenko] 2013 - Petrenko and Ichoku
Coherent uncertainty analysis
of aerosol measurements from multiple satellite sensors
Atmospheric Chemistry and Physics, 13, 4637-4685, 2013
http://www.atmos-chem-phys-discuss.net/13/4637/2013/acpd-13-4637-2013.html

[MAPSS] Multi-sensor Aerosol Products Sampling System
http://giovanni.gsfc.nasa.gov/mapss/

[AeroStat] Statistical Intercomparison of Aerosols
http://giovanni.gsfc.nasa.gov/aerostat/

[NASA] National Aeronautics and Space Administration
http://www.nasa.gov/

[GMAO] Global Modeling and Assimilation Office
http://gmao.gsfc.nasa.gov/

[NOAA] National Oceanic and Atmospheric Administration
http://www.noaa.gov/

[NWS] National Weather Service
http://www.weather.gov/

[EPA] Environmental Protection Agency
http://www.epa.gov/

[NCAR] National Center for Atmospheric Research
http://ncar.ucar.edu/

[CGD] Climate and Global Dynamics
http://www2.cgd.ucar.edu/

[EOS] Earth Observing System
http://eospso.gsfc.nasa.gov/

[NPP] Suomi National Polar-orbiting Partnership
http://npp.gsfc.nasa.gov/

[GOES] Geostationary Operational Environmental Satellite
http://www.goes.noaa.gov/

[MODIS] Moderate Resolution Imaging Spectroradiometer
http://modis.gsfc.nasa.gov/

[VIIRS] Visible Infrared Imager Radiometer Suite
http://npp.gsfc.nasa.gov/viirs.html

[CERES] Clouds and the Earth's Radiant Energy System
http://ceres.larc.nasa.gov/

[ARM] Atmospheric Radiation Measurement
http://www.arm.gov/

[AeroNet] Aerosol Robotic Network
http://aeronet.gsfc.nasa.gov/

[IMPROVE] Interagency Monitoring of Protected Visual Environments
http://vista.cira.colostate.edu/improve/

[ACTRIS] Aerosols, Clouds,
and Trace gases Research InfraStructure Network
http://www.actris.net/

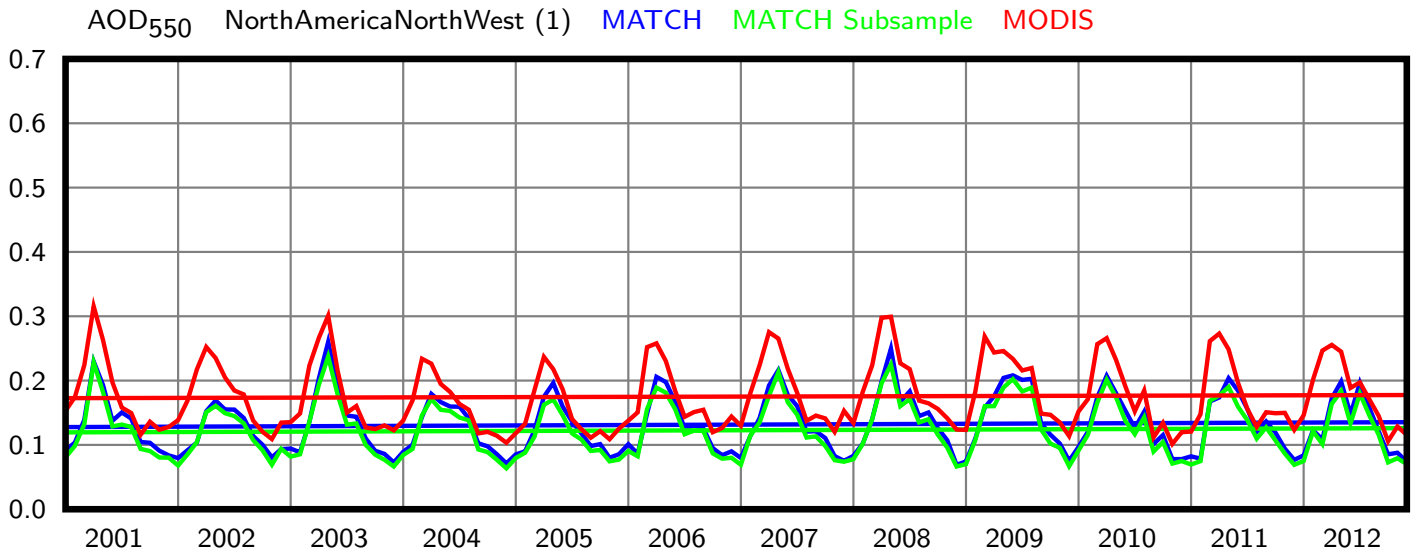
[AeroCom] Aerosol Comparison between Observations and Models
http://aerocom.met.no/

[HTAP] Hemispheric Transport of Air Pollution
http://www.htap.org/

[GEOS-5] Goddard Earth Observing System Model
http://gmao.gsfc.nasa.gov/systems/geos5/

[MERRA] Modern Era Retrospective Analysis
http://gmao.gsfc.nasa.gov/merra/

[MATCH] Model for Atmospheric Transport and Chemistry
https://github.com/davidfillmore/MATCH/


AOD550 NorthAmericaNorthWest (1) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
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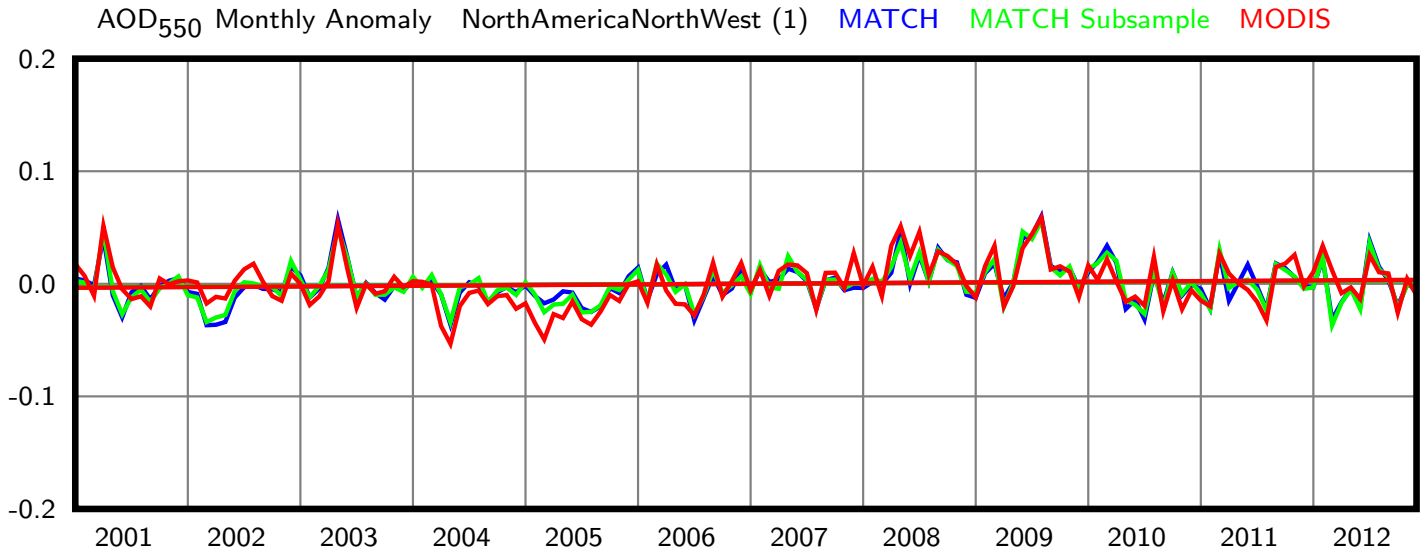
AOD550 Monthly Anomaly NorthAmericaNorthWest (1) MATCH MATCH Subsample MODIS
0.2
0.1
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-0.1
-0.2
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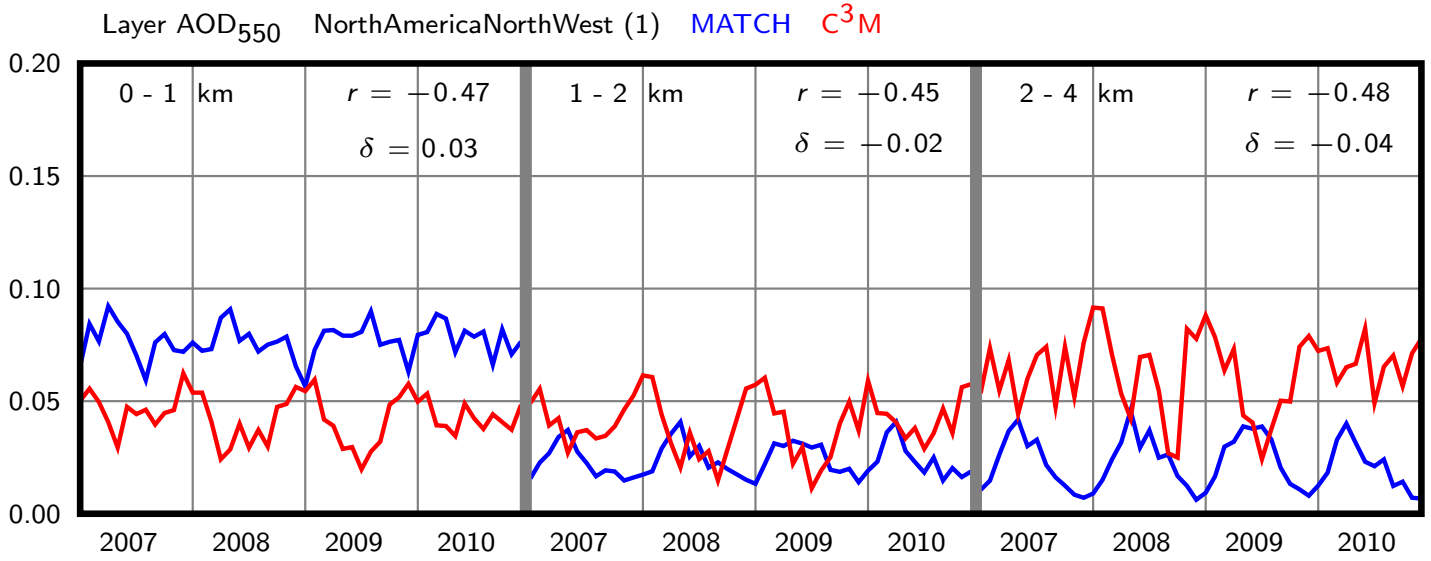
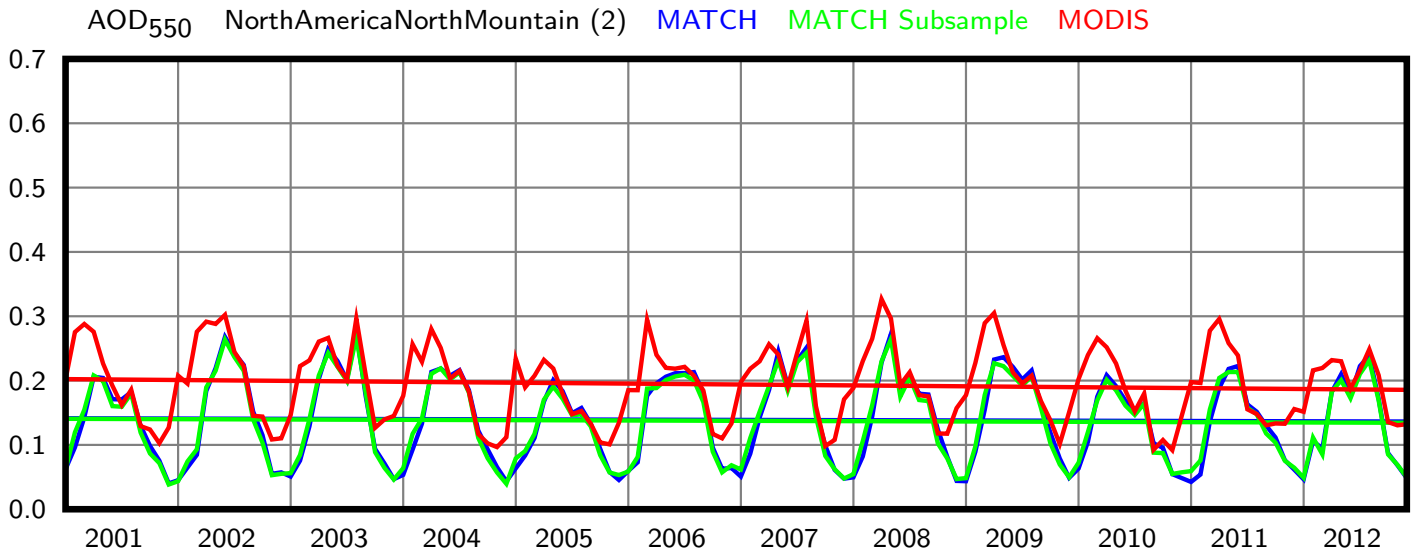


NorthAmericaNorthWest (1)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.006	0.128	0.051	0.546	0.000
MATCH Subsample	0.006	0.119	0.046	0.587	0.000
MODIS	0.004	0.173	0.027	0.748	0.000

Table 2 : $\mathrm{AOD}_{550} = b\ t + a$


AOD550 NorthAmericaNorthMountain (2) MATCH MATCH Subsample MODIS
0.7
0.6
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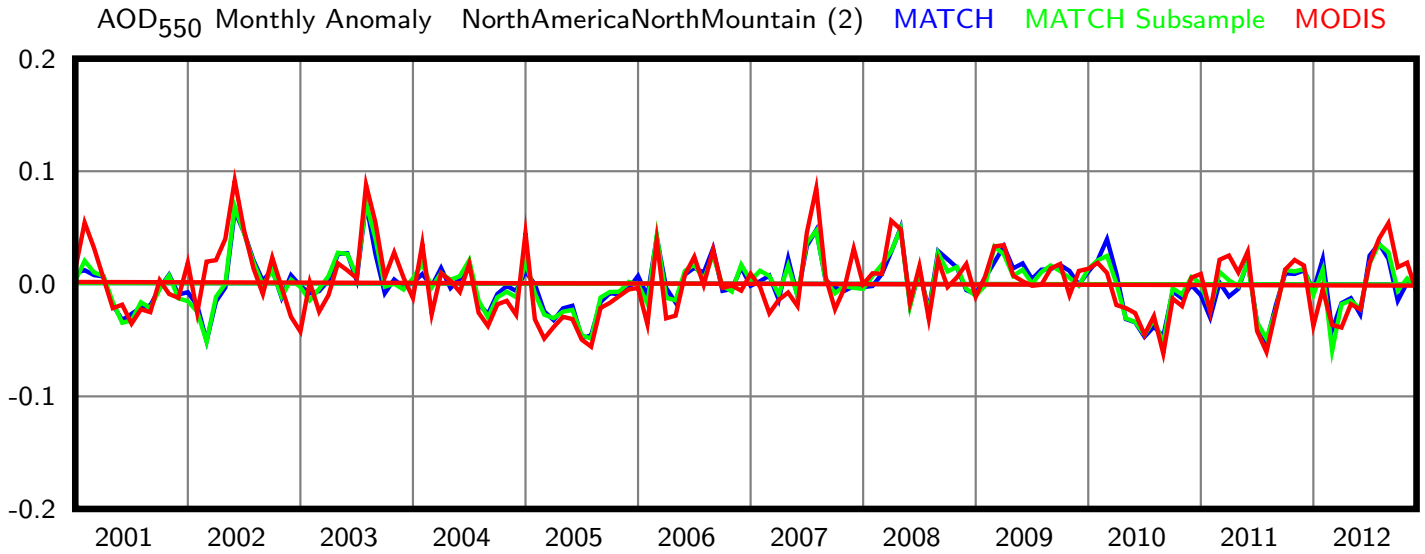
AOD550 Monthly Anomaly NorthAmericaNorthMountain (2) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
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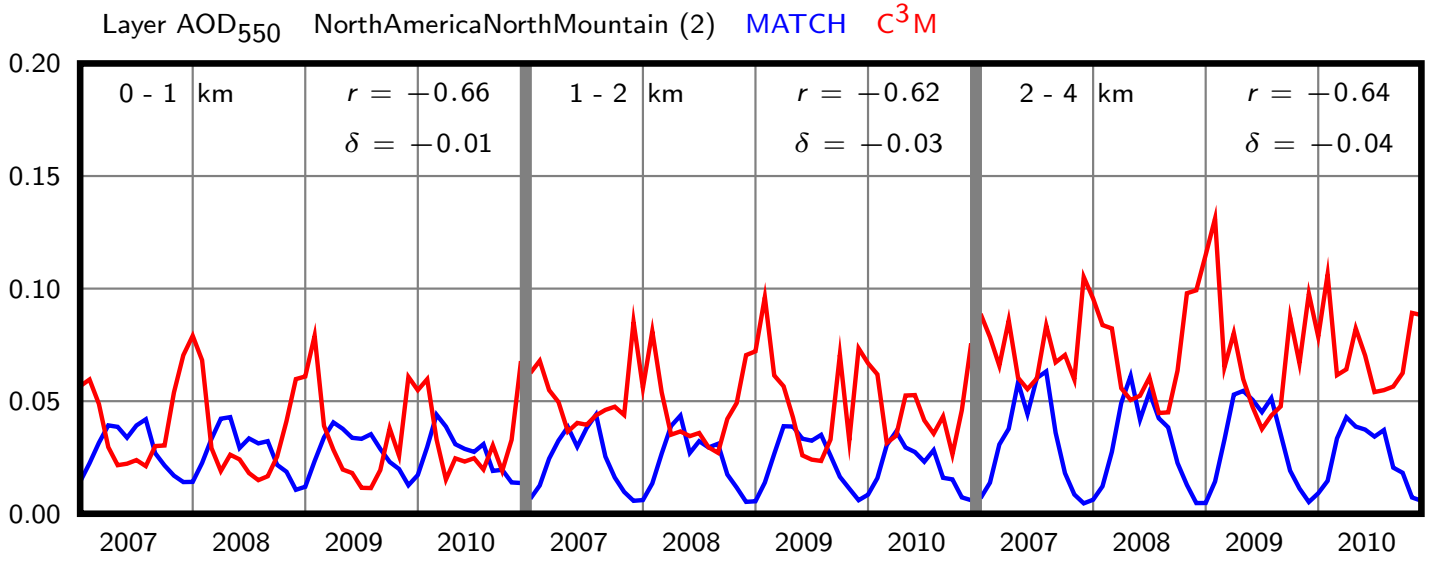
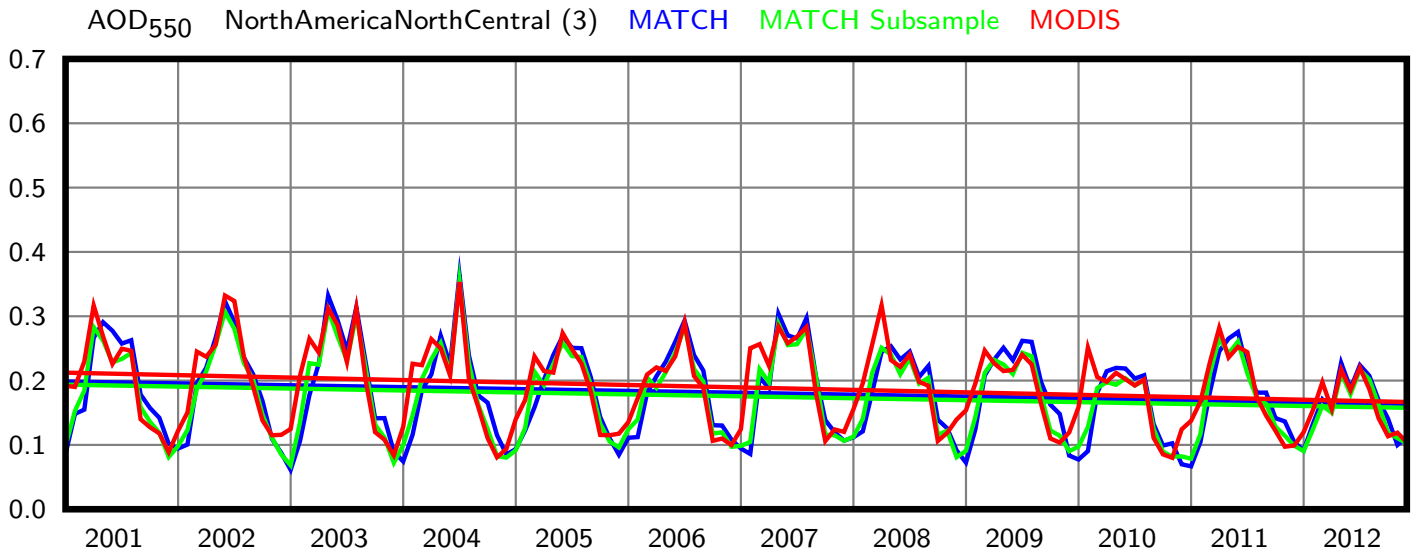


NorthAmericaNorthMountain (2)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.004	0.141	-0.022	0.793	0.000
MATCH Subsample	-0.005	0.141	-0.028	0.738	0.000
MODIS	-0.014	0.202	-0.083	0.320	0.000

Table 3 : $\mathrm{AOD}_{550} = b\ t + a$


AOD550 NorthAmericaNorthCentral (3) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
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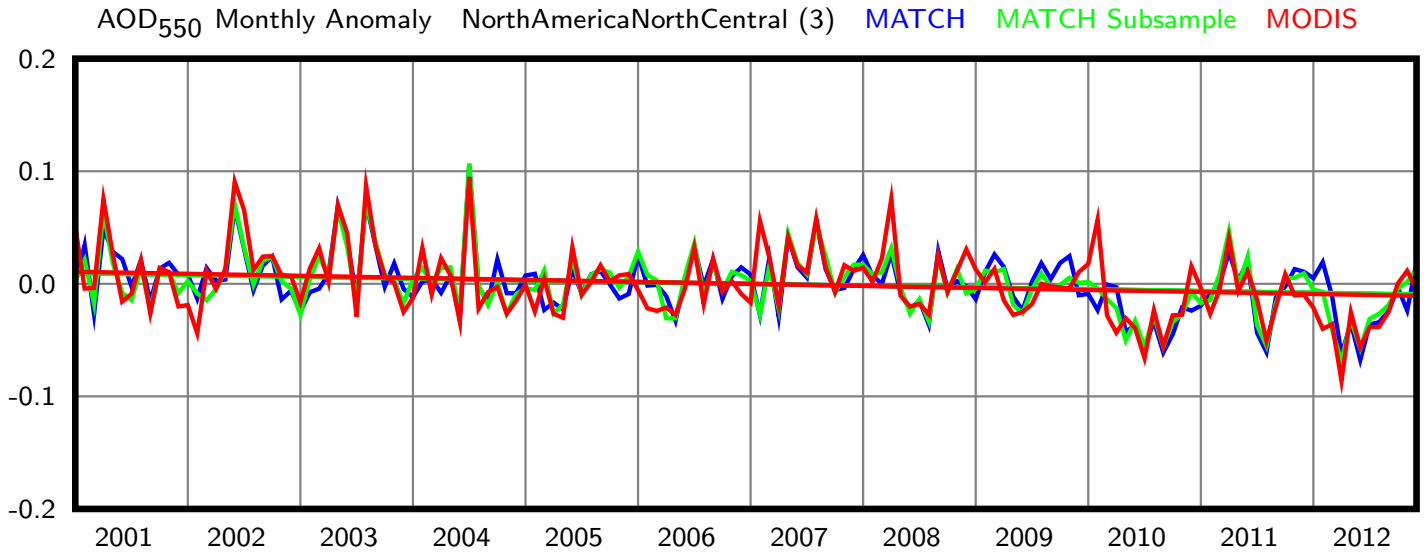
AOD550 Monthly Anomaly NorthAmericaNorthCentral (3) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
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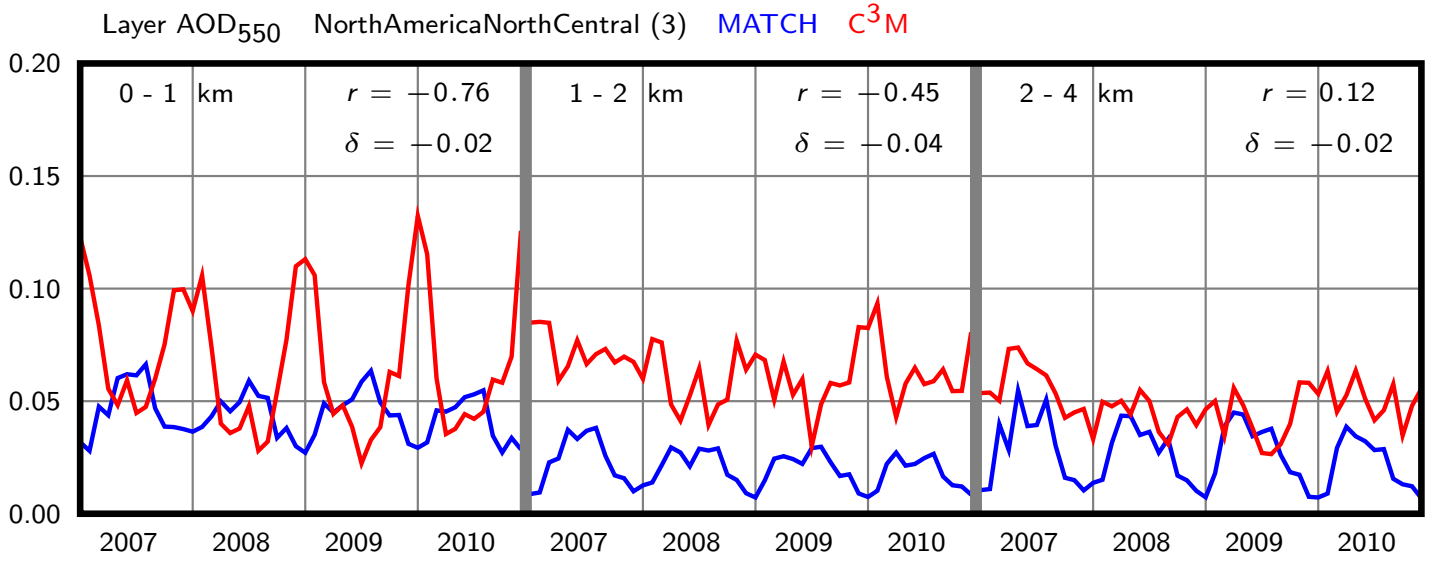
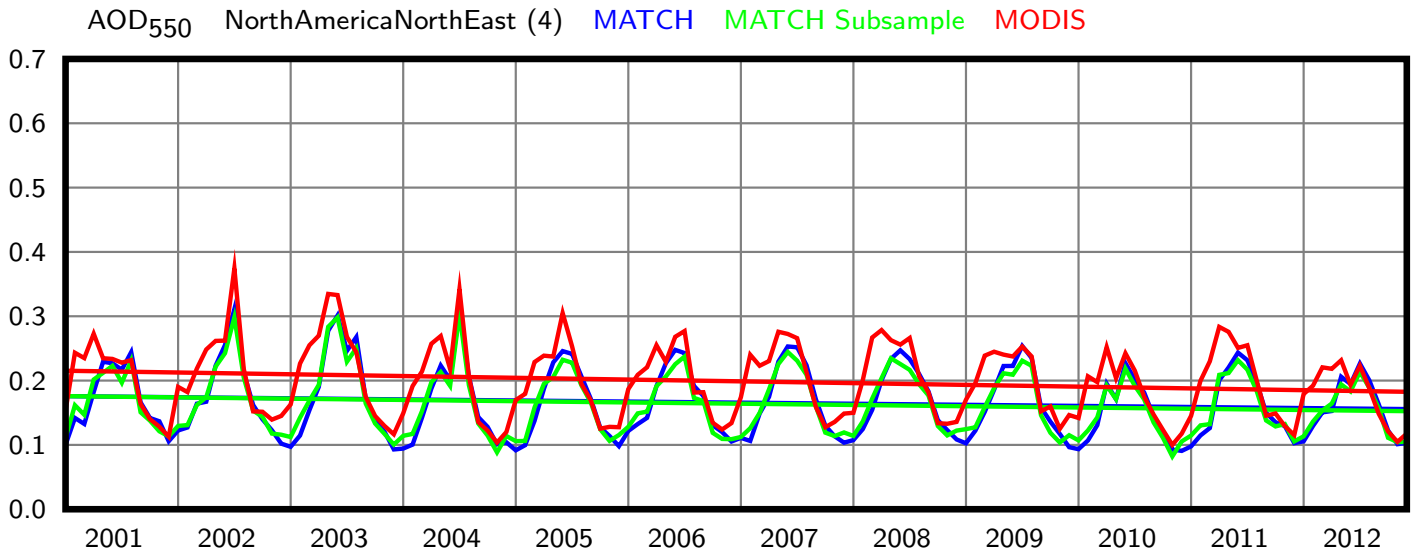


NorthAmericaNorthCentral (3)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.029	0.199	-0.146	0.081	0.000
MATCH Subsample	-0.030	0.194	-0.162	0.052	0.000
MODIS	-0.038	0.212	-0.207	0.013	0.000

Table 4 : $\mathrm{AOD}_{550} = b\ t + a$


AOD550 NorthAmericaNorthEast (4) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
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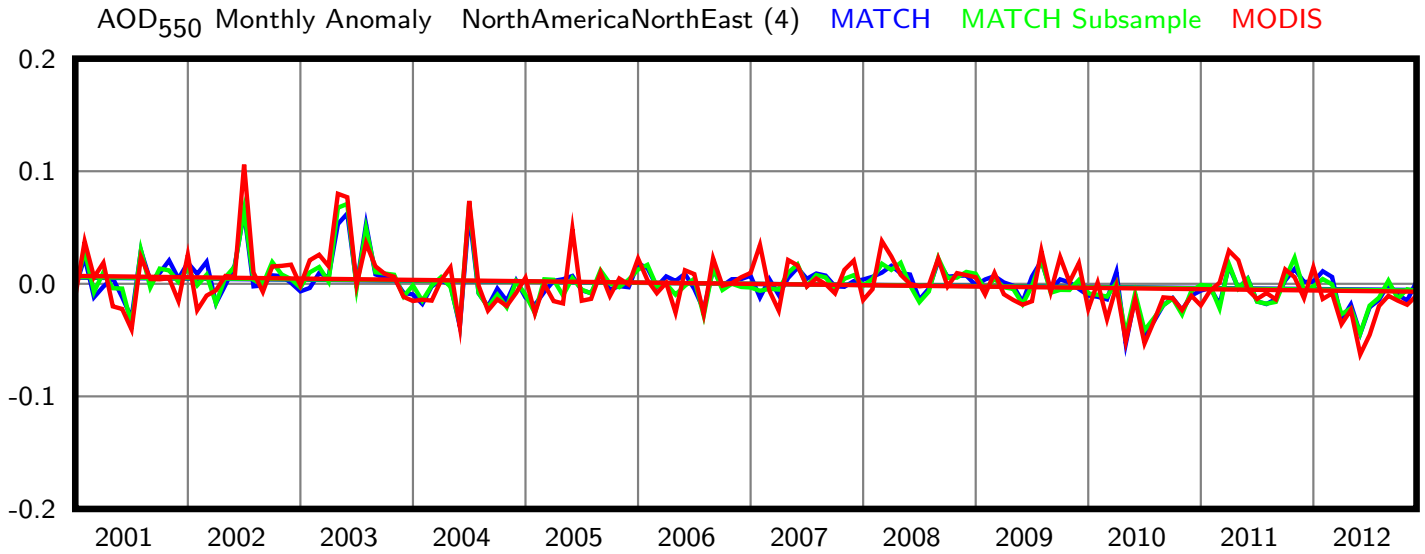
AOD550 Monthly Anomaly NorthAmericaNorthEast (4) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
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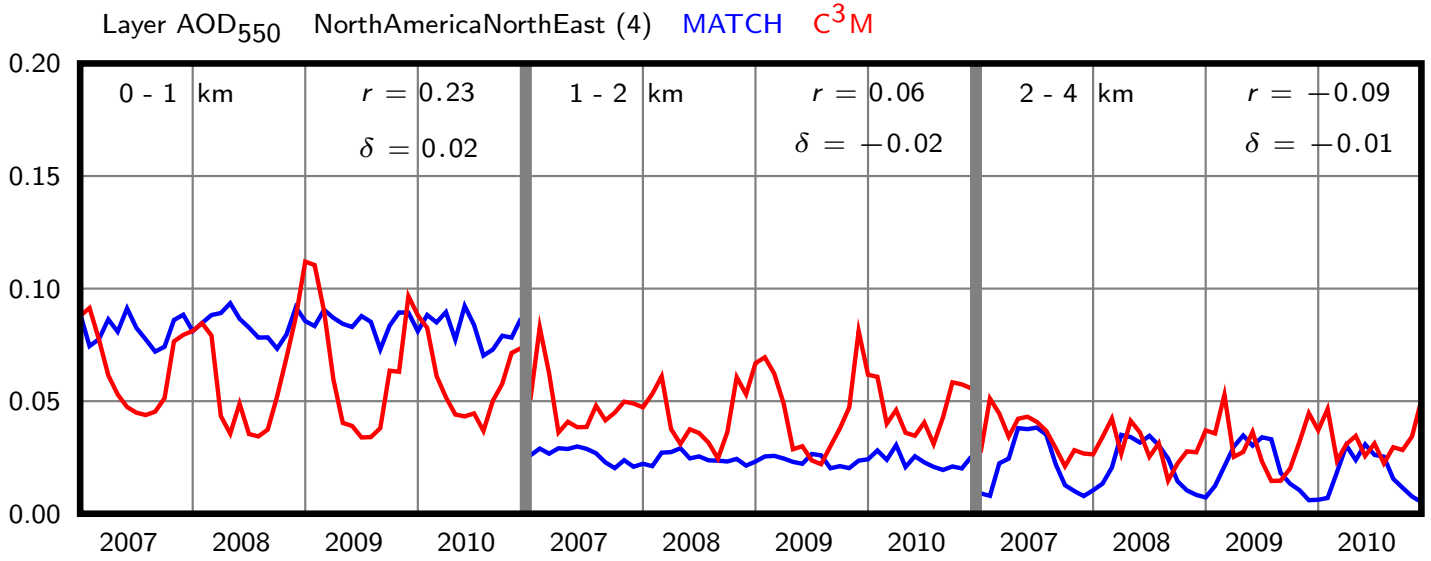
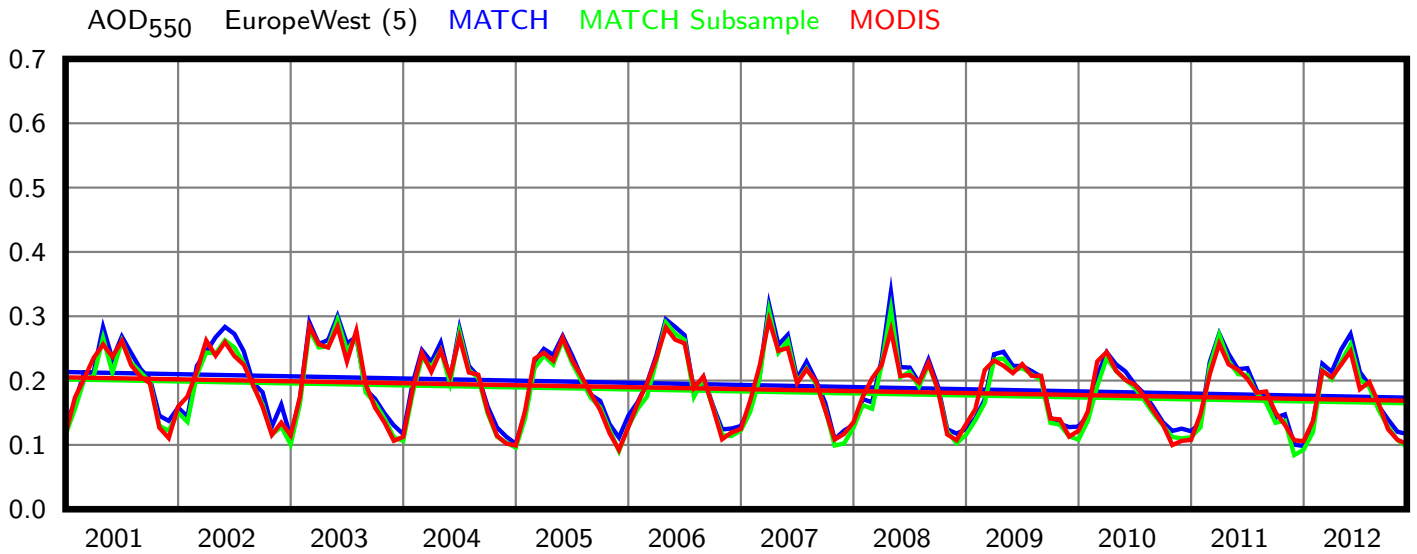


NorthAmericaNorthEast (4)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.017	0.176	-0.106	0.204	0.000
MATCH Subsample	-0.020	0.176	-0.139	0.096	0.000
MODIS	-0.027	0.215	-0.166	0.047	0.000

Table 5 : $\mathrm{AOD}_{550} = b\ t + a$


AOD550 EuropeWest (5) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
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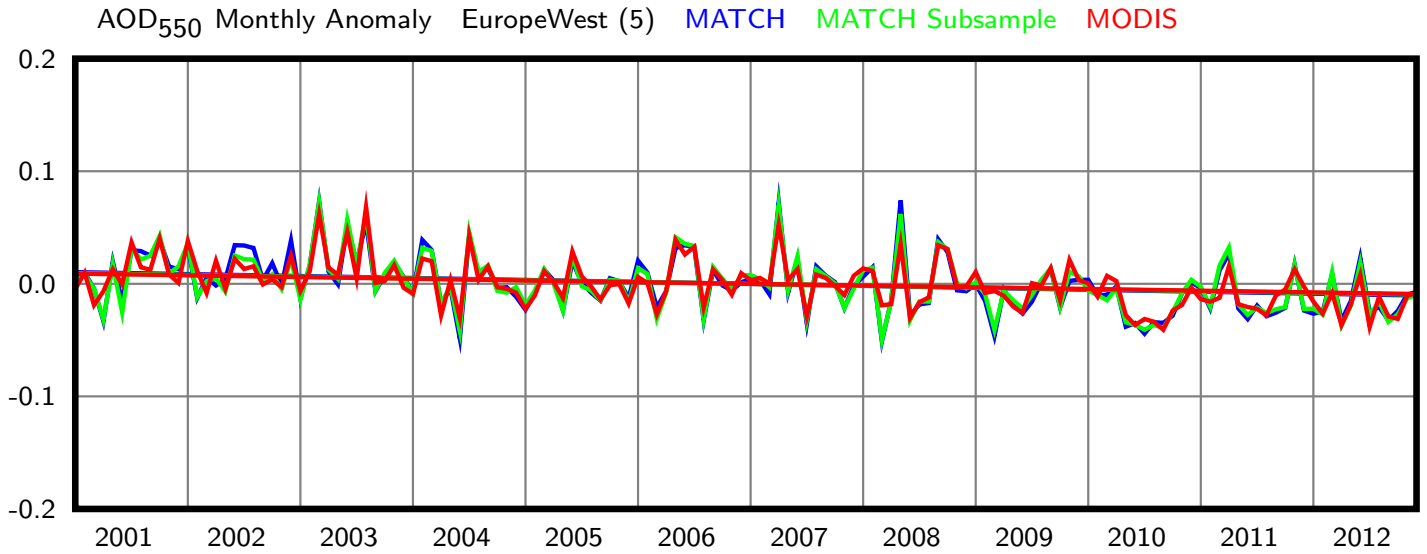
AOD550 Monthly Anomaly EuropeWest (5) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
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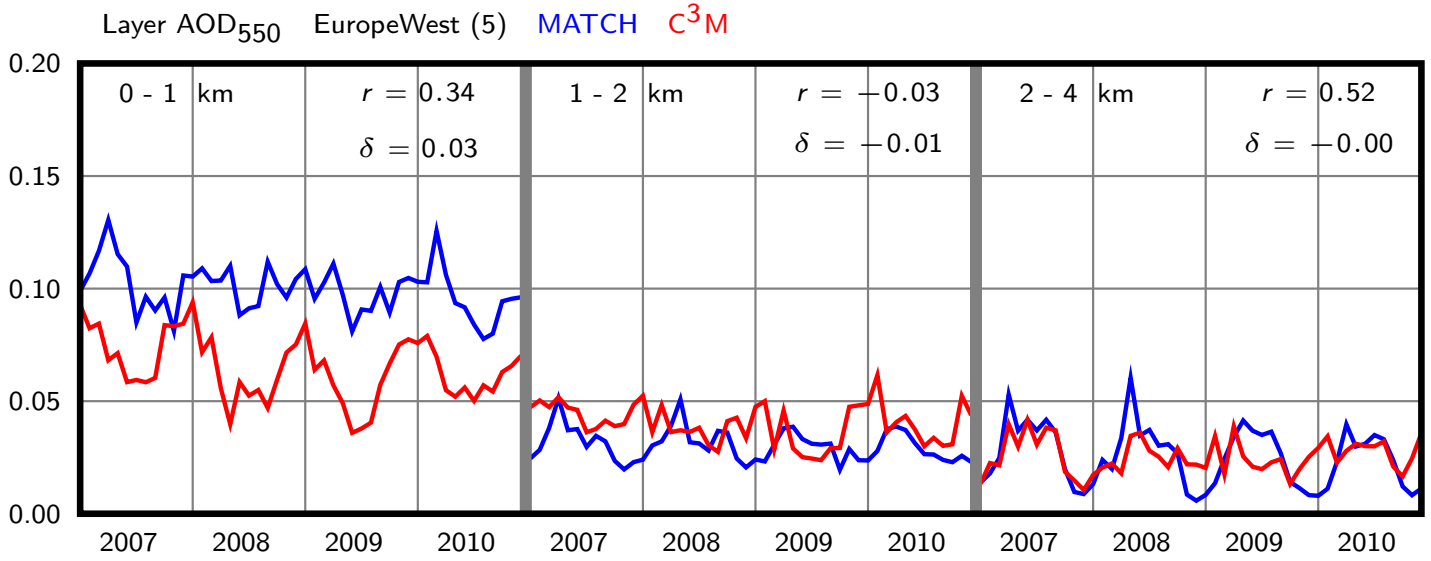
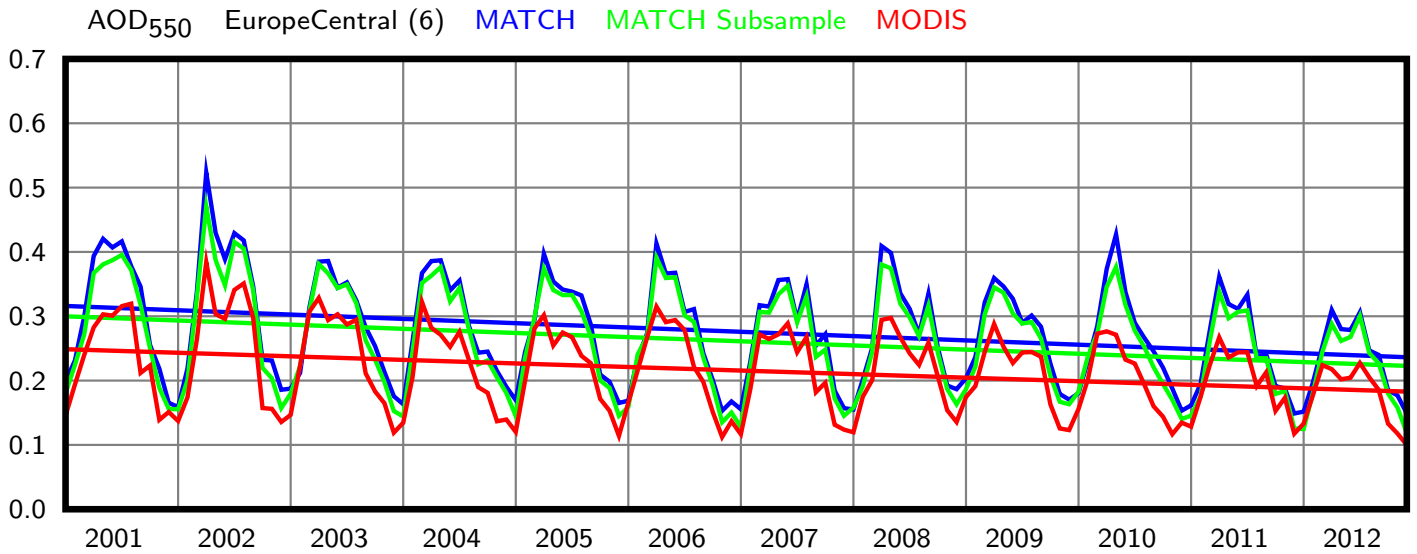


EuropeWest (5)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.033	0.213	-0.209	0.012	0.000
MATCH Subsample	-0.031	0.202	-0.194	0.020	0.000
MODIS	-0.031	0.205	-0.200	0.016	0.000

Table 6 : $\mathrm{AOD}_{550} = b\ t + a$


AOD550 EuropeCentral (6) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
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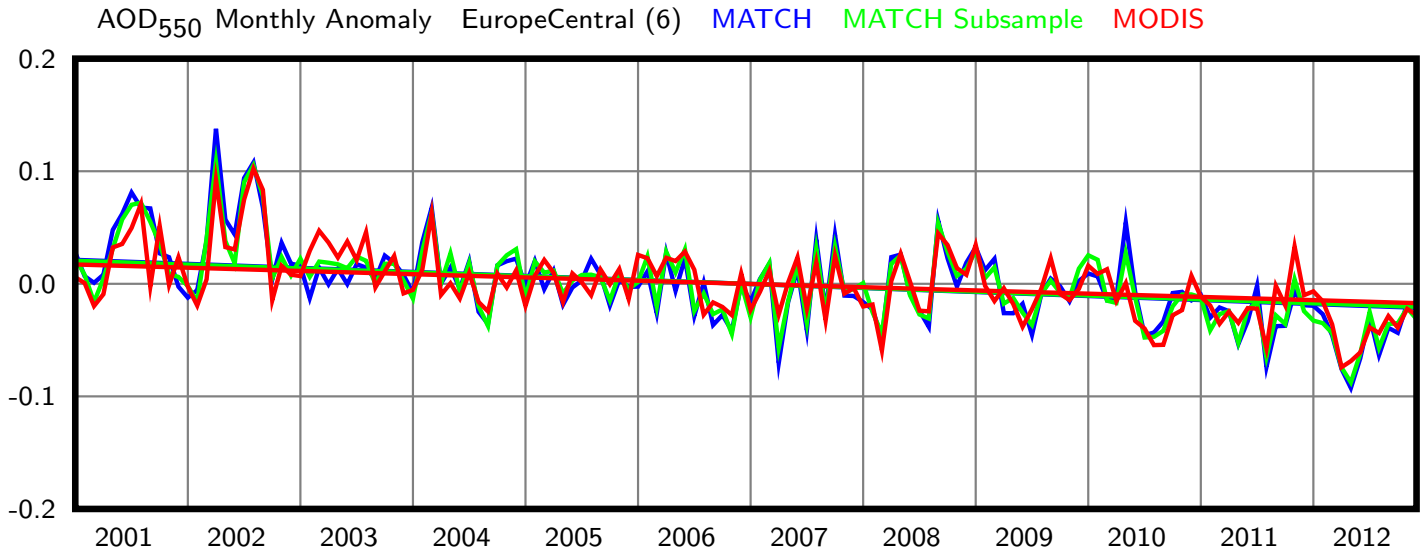
2011
2012


AOD550 Monthly Anomaly EuropeCentral (6) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
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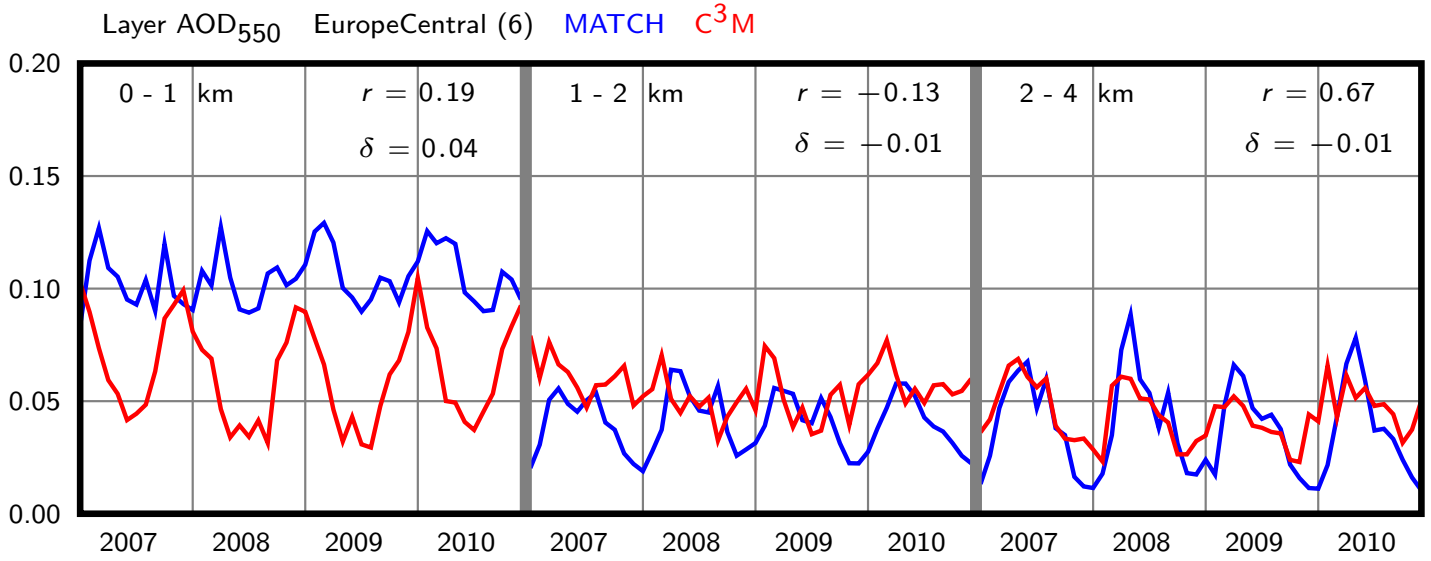
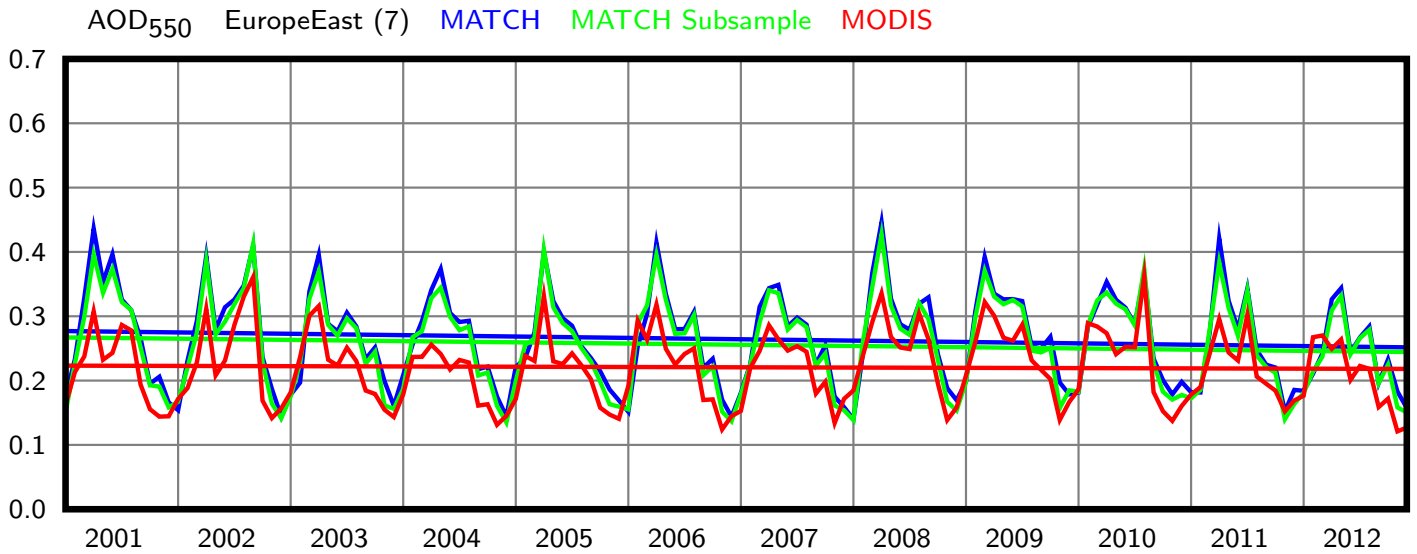
2012



EuropeCentral (6)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.067	0.316	-0.283	0.001	0.000
MATCH Subsample	-0.065	0.300	-0.281	0.001	0.000
MODIS	-0.055	0.249	-0.298	0.000	0.000

Table 7 : $\mathrm{AOD}_{550} = b\ t + a$


AOD550 EuropeEast (7) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
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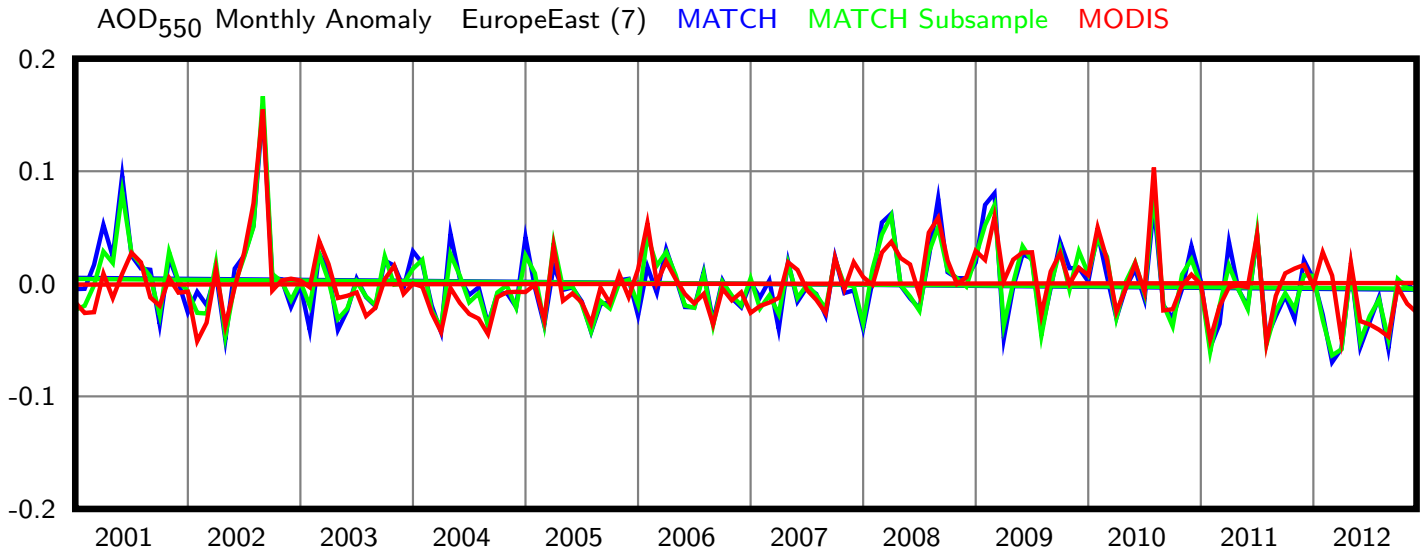
2010
2011
2012


AOD550 Monthly Anomaly EuropeEast (7) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
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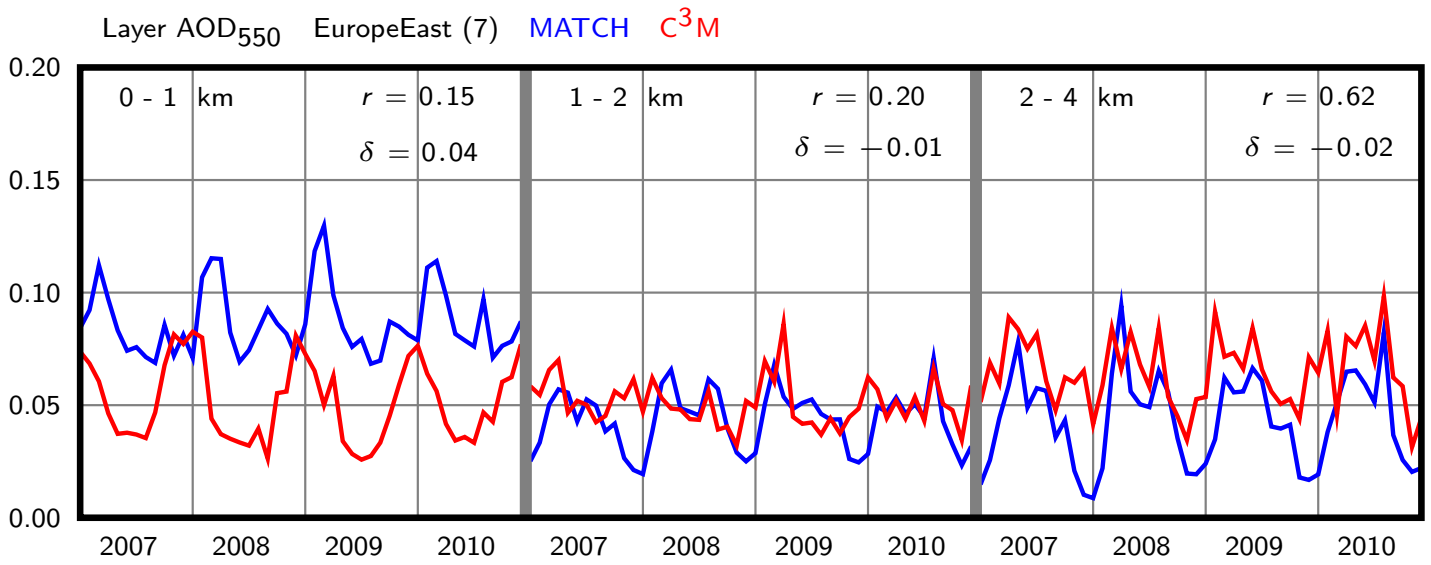
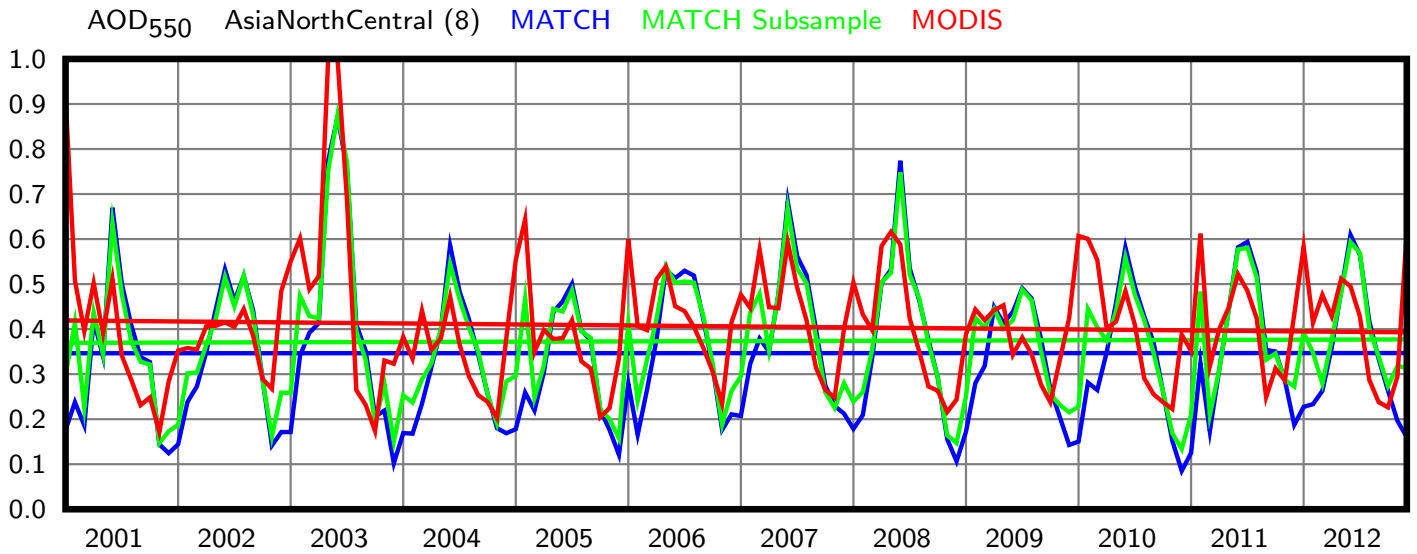
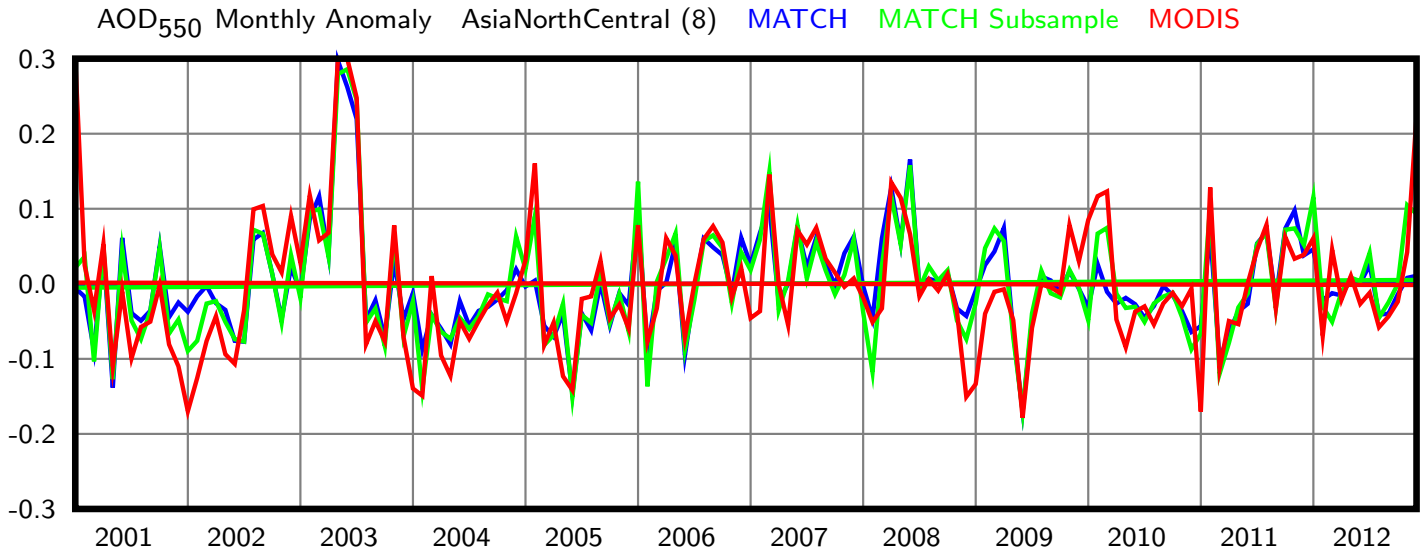
2010
2011
2012

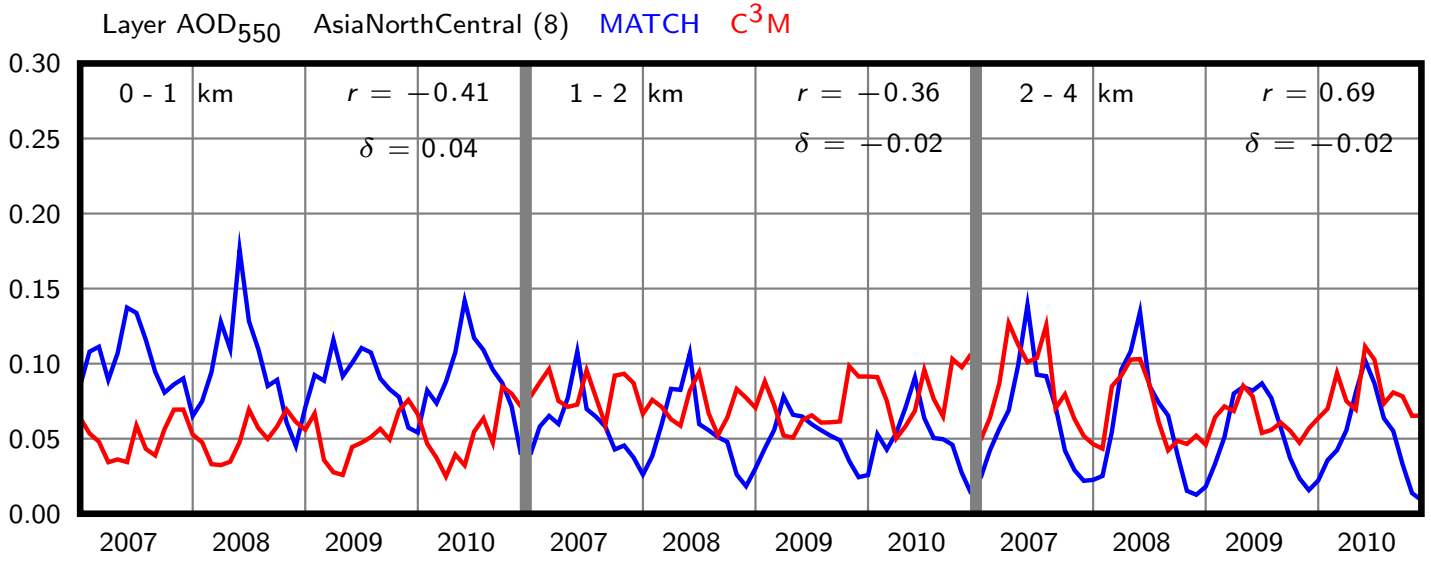


EuropeEast (7)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.021	0.277	-0.102	0.224	0.000
MATCH Subsample	-0.019	0.267	-0.092	0.271	0.000
MODIS	-0.004	0.223	-0.027	0.751	0.000

Table 8 : $\mathrm{AOD}_{550} = b\ t + a$

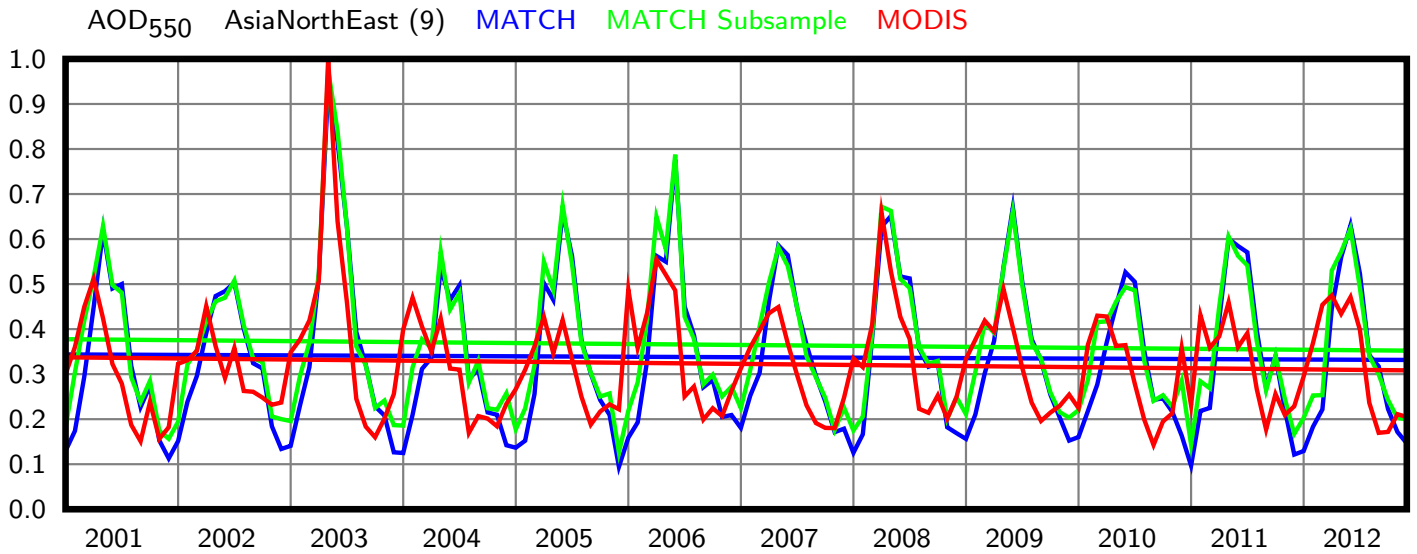

AOD550 AsiaNorthCentral (8) MATCH MATCH Subsample MODIS
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

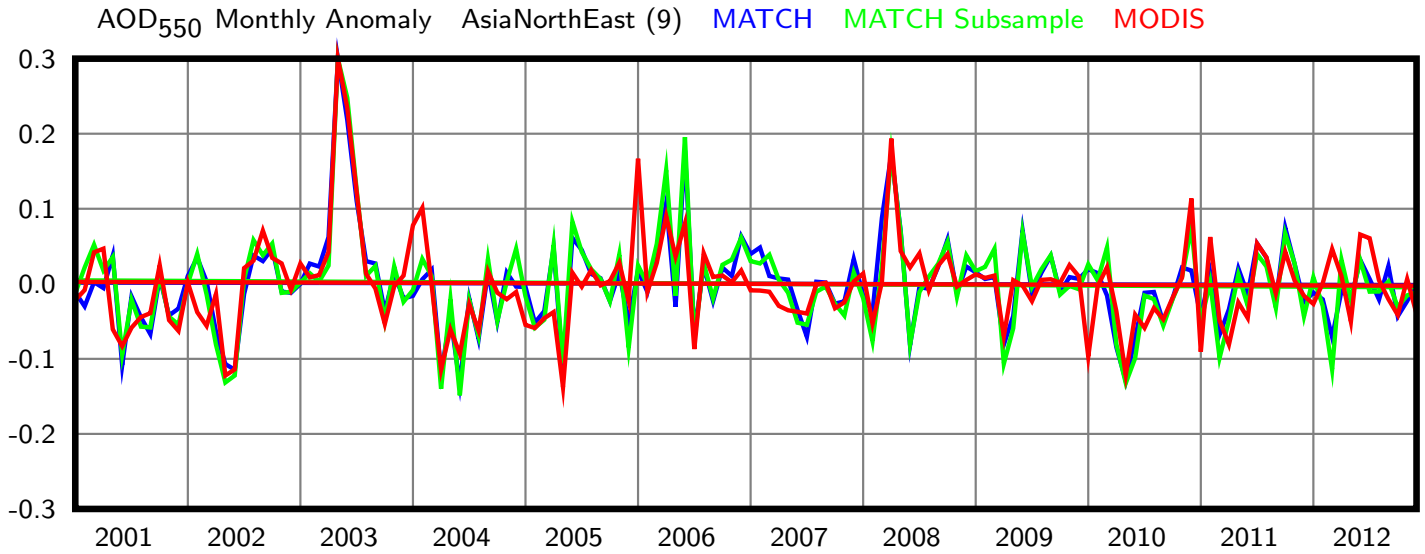

AOD550 Monthly Anomaly AsiaNorthCentral (8) MATCH MATCH Subsample MODIS
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

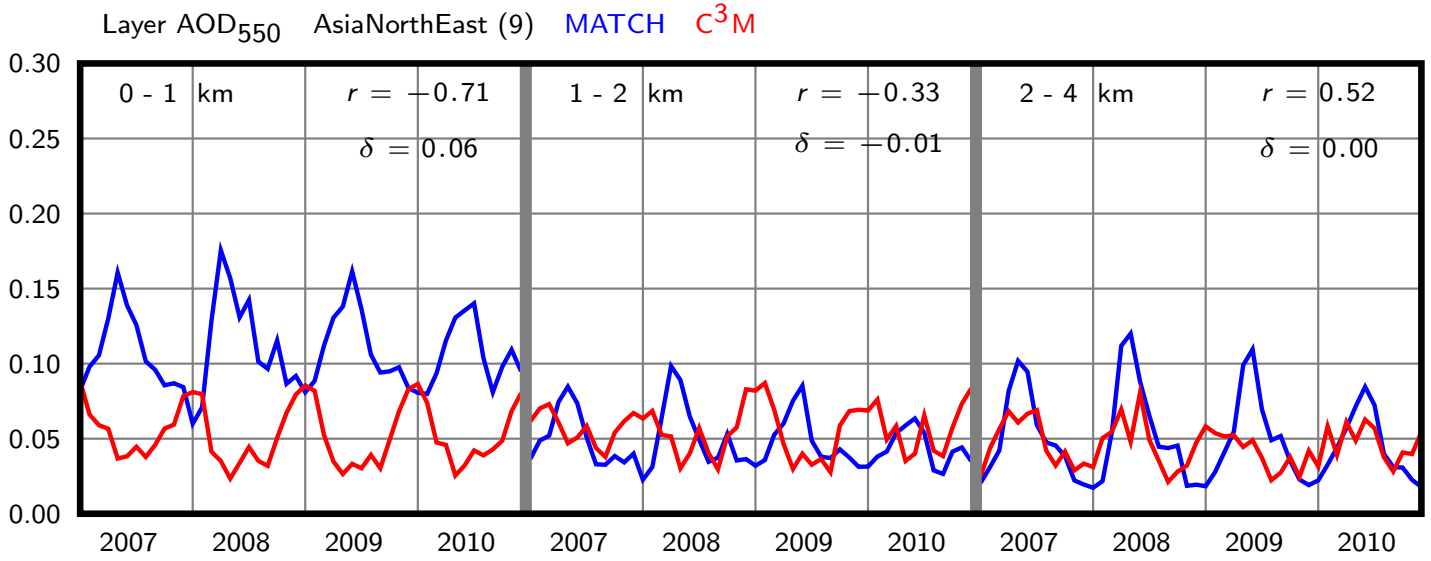


AsiaNorthCentral (8)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.000	0.346	0.001	0.992	0.000
MATCH Subsample	0.006	0.370	0.016	0.847	0.000
MODIS	-0.022	0.419	-0.054	0.518	0.000

Table 9 : $\mathrm{AOD}_{550} = b\ t + a$

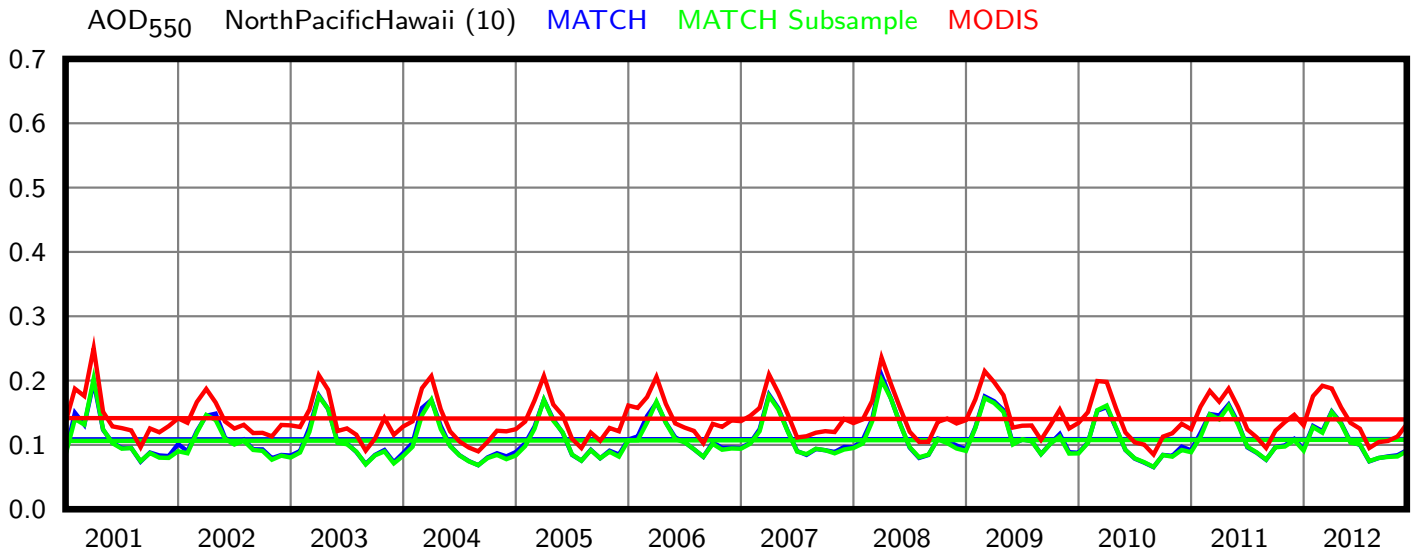

AOD550 AsiaNorthEast (9) MATCH MATCH Subsample MODIS
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

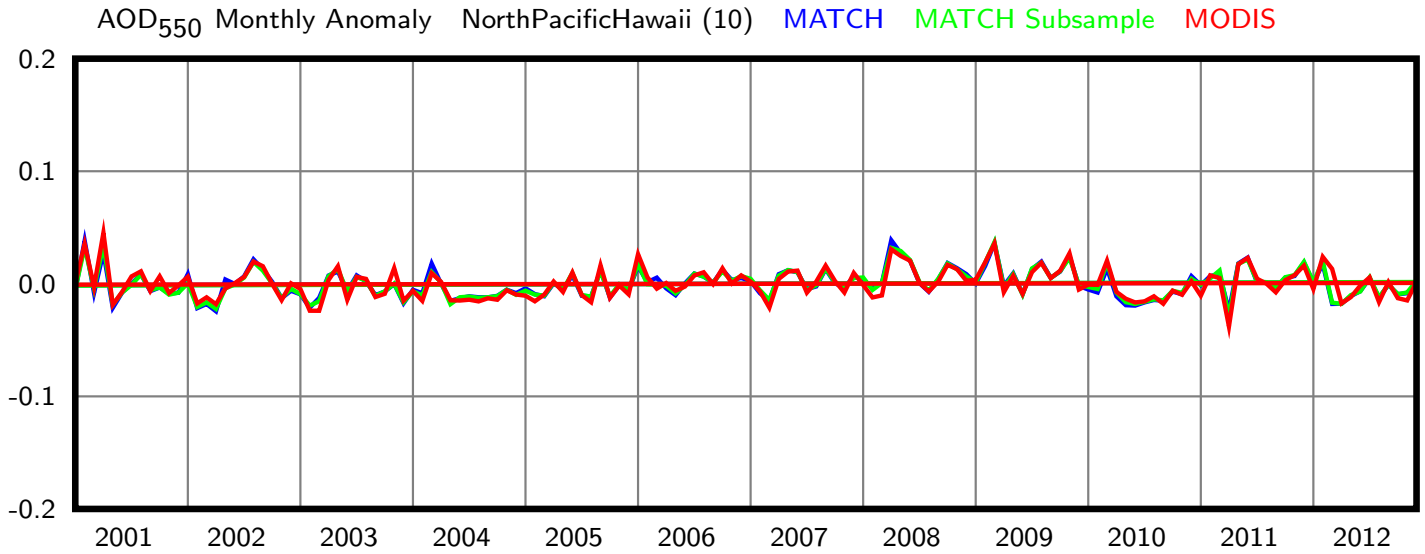

AOD550 Monthly Anomaly AsiaNorthEast (9) MATCH MATCH Subsample MODIS
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

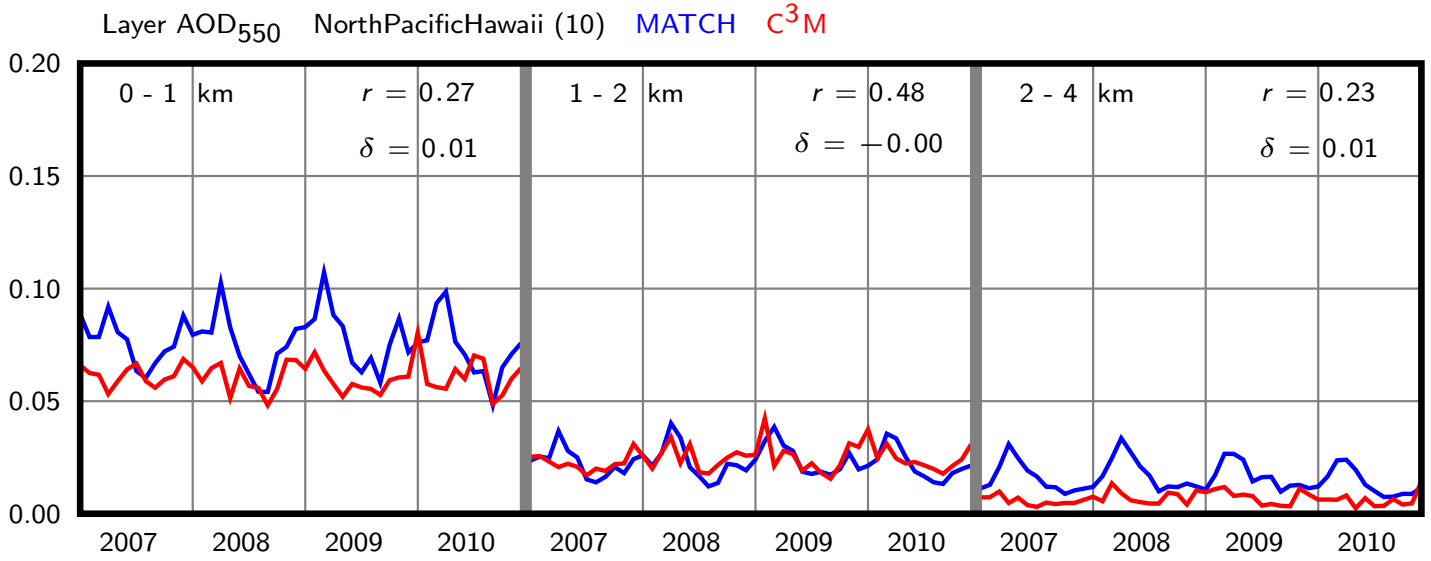


AsiaNorthEast (9)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.010	0.344	-0.021	0.803	0.000
MATCH Subsample	-0.021	0.378	-0.047	0.572	0.000
MODIS	-0.024	0.337	-0.069	0.414	0.000

Table 10 : $\mathrm{AOD}_{550} = b\ t + a$

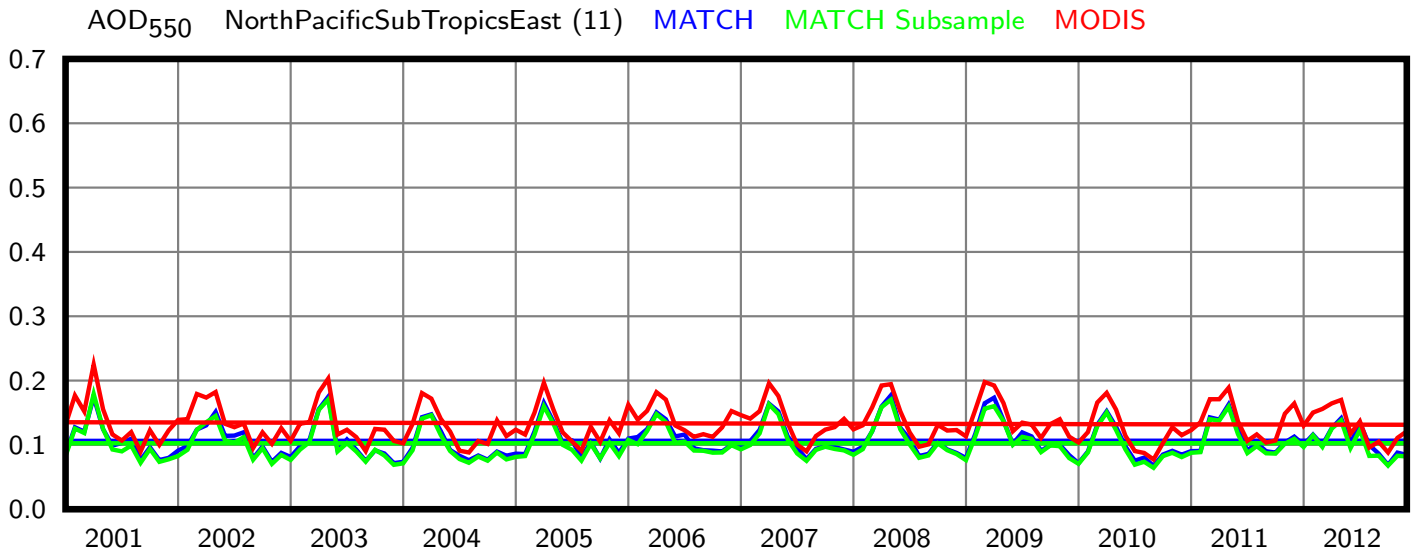

AOD550 NorthPacificHawaii (10) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

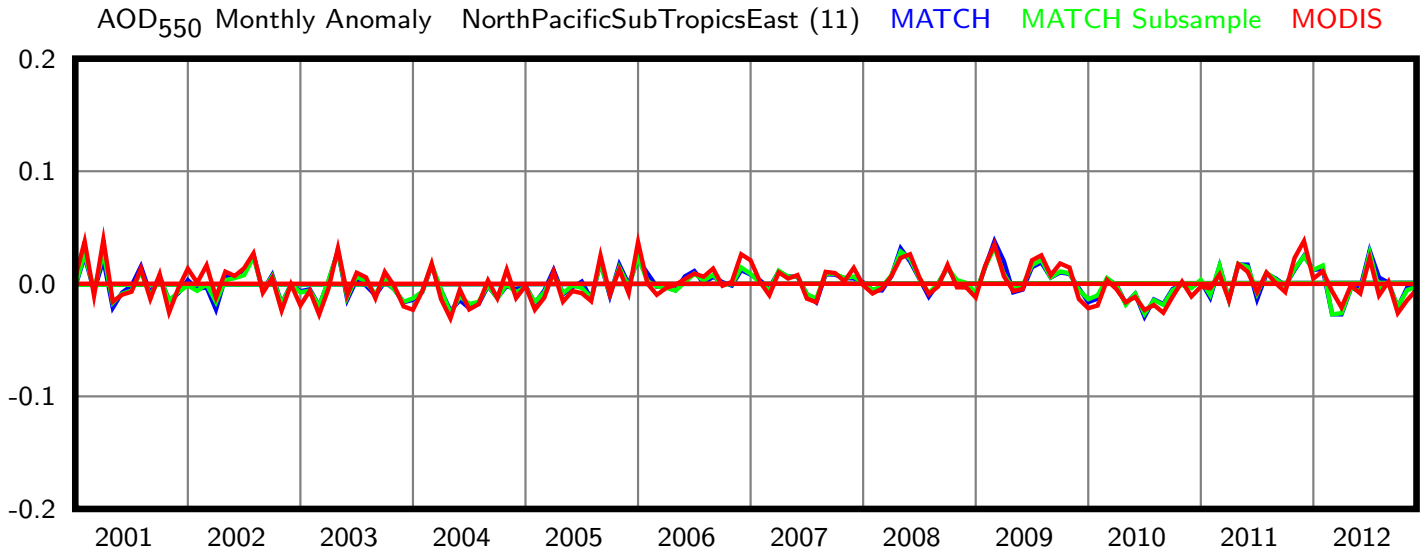

AOD550 Monthly Anomaly NorthPacificHawaii (10) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

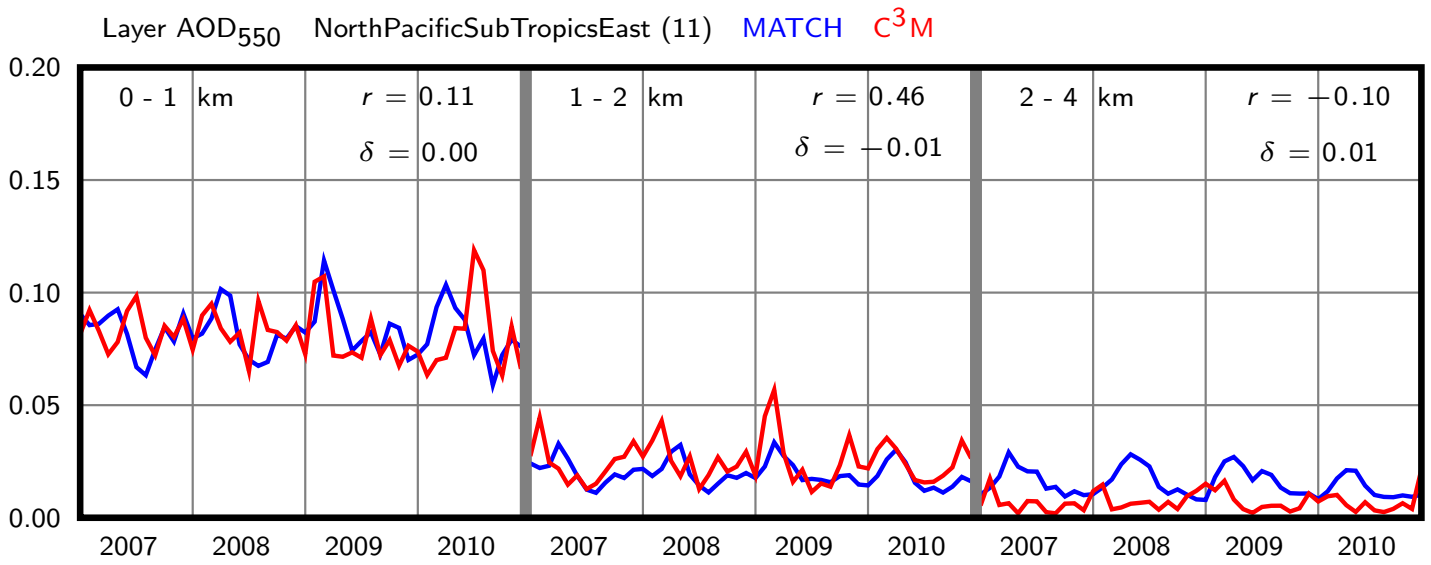


NorthPacificHawaii (10)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.000	0.109	0.004	0.965	0.000
MATCH Subsample	0.001	0.106	0.017	0.842	0.000
MODIS	-0.002	0.142	-0.018	0.827	0.000

Table 11 : $\mathrm{AOD}_{550} = b\ t + a$

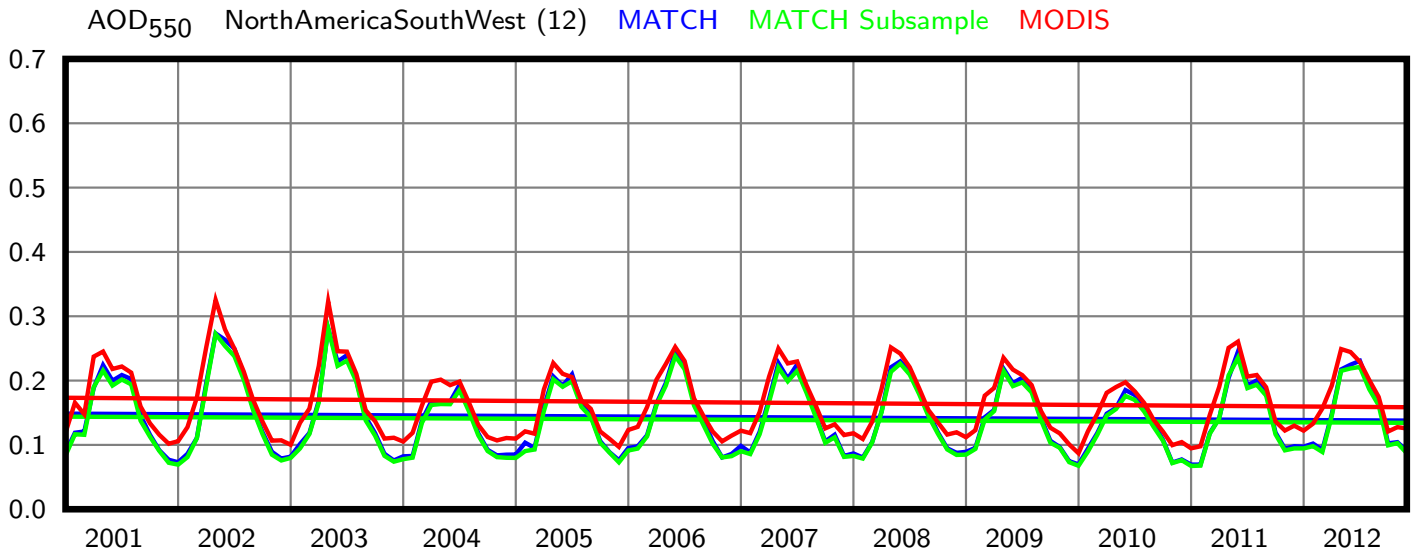

AOD550 NorthPacificSubTropicsEast (11) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

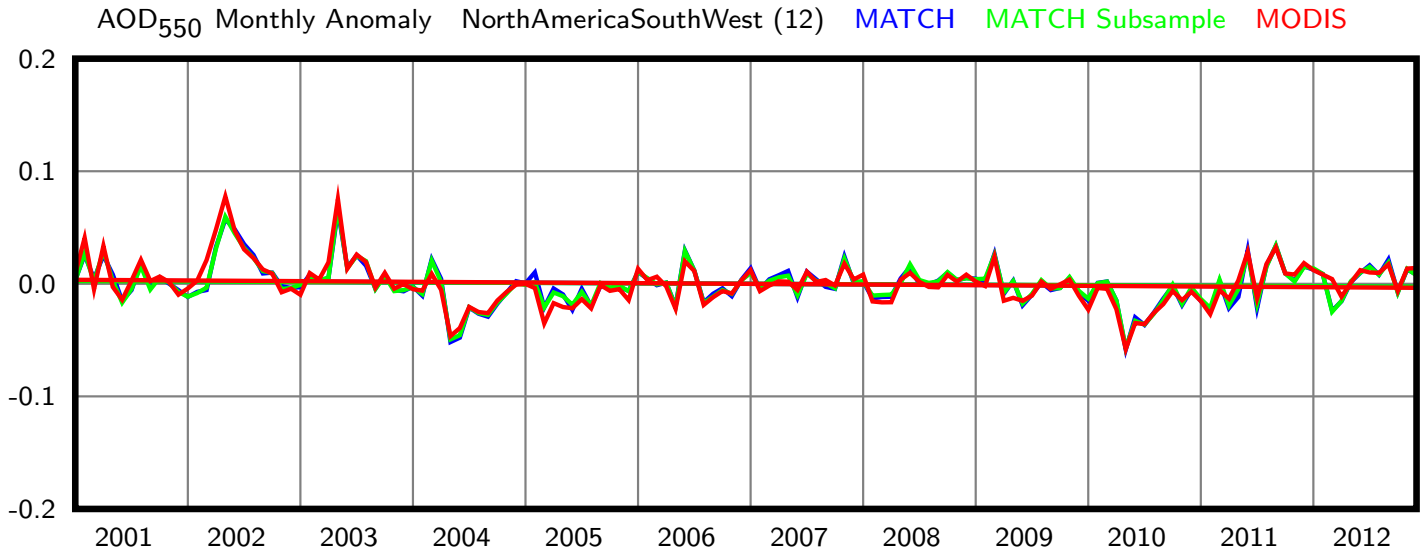

AOD550 Monthly Anomaly NorthPacificSubTropicsEast (11) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

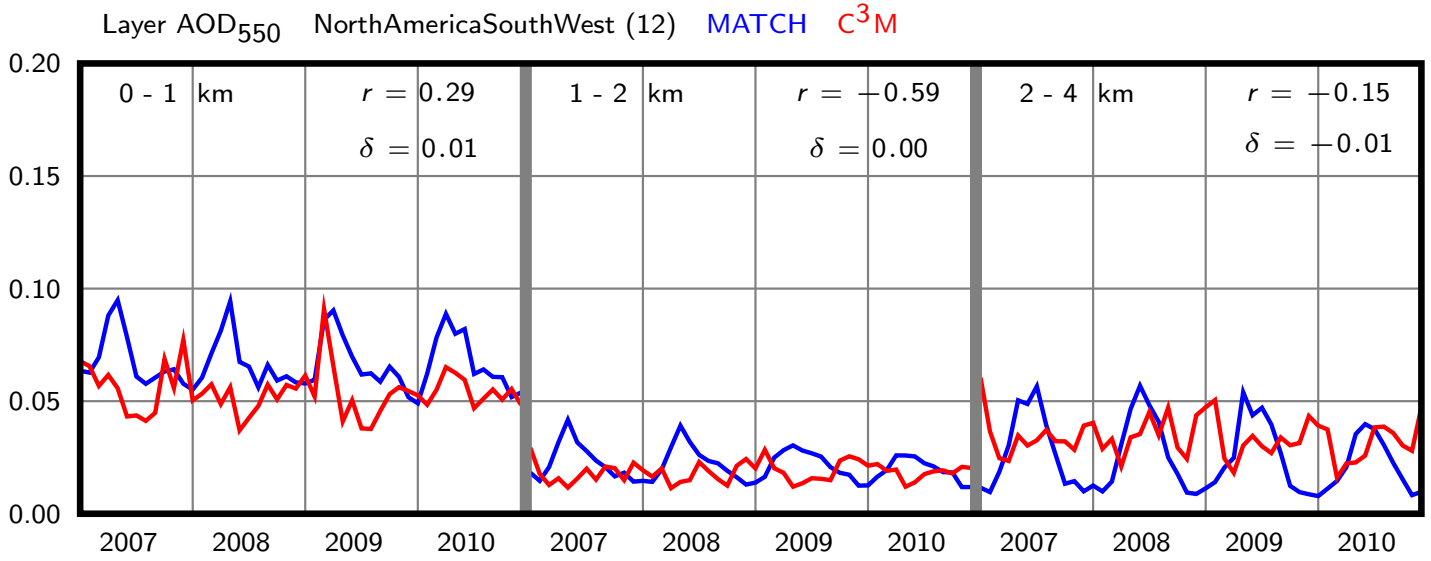


NorthPacificSubTropicsEast (11)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.000	0.106	0.003	0.971	0.000
MATCH Subsample	0.000	0.103	0.001	0.990	0.000
MODIS	-0.003	0.135	-0.039	0.647	0.000

Table 12 : $\mathrm{AOD}_{550} = b\ t + a$

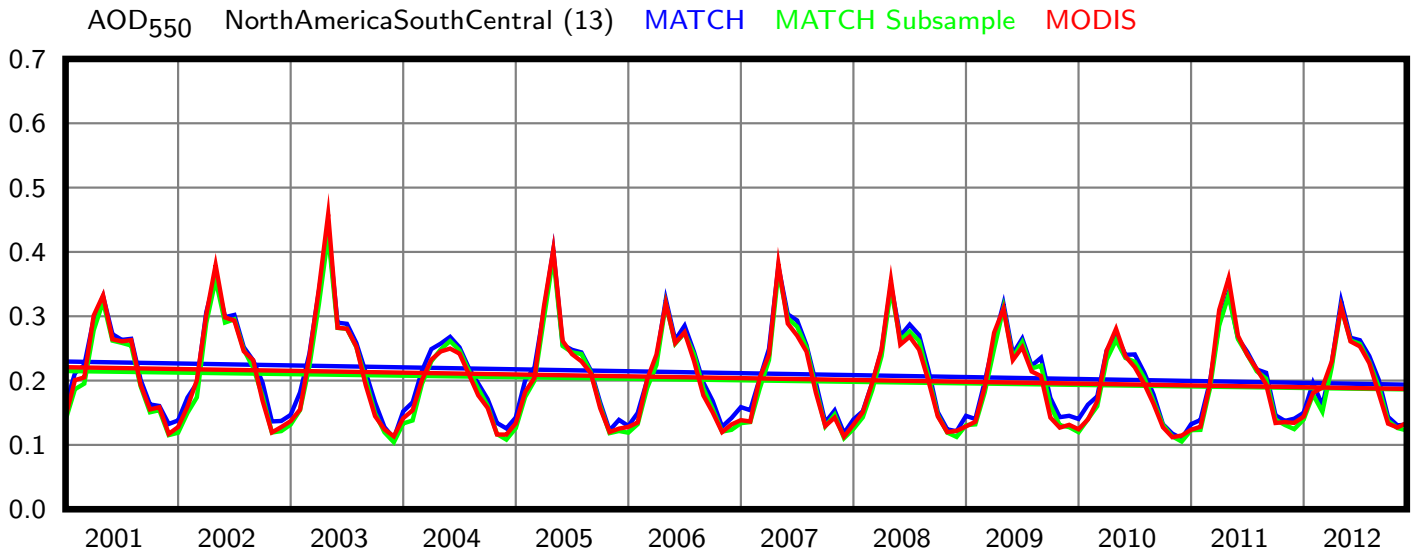

AOD550 NorthAmericaSouthWest (12) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

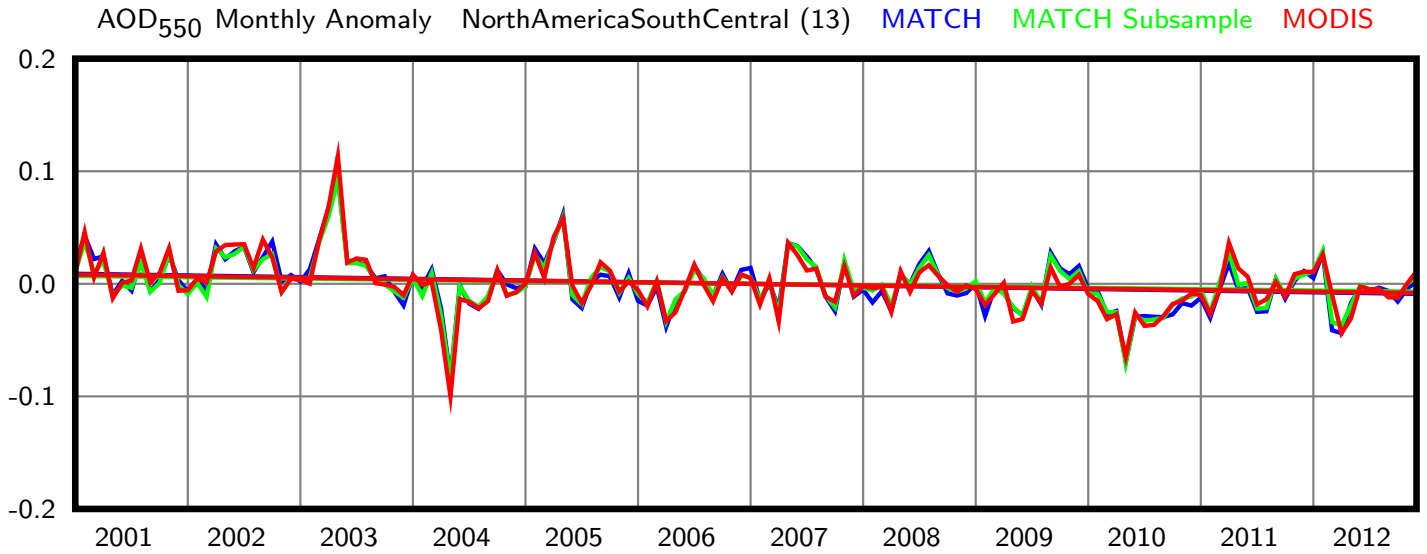

AOD550 Monthly Anomaly NorthAmericaSouthWest (12) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

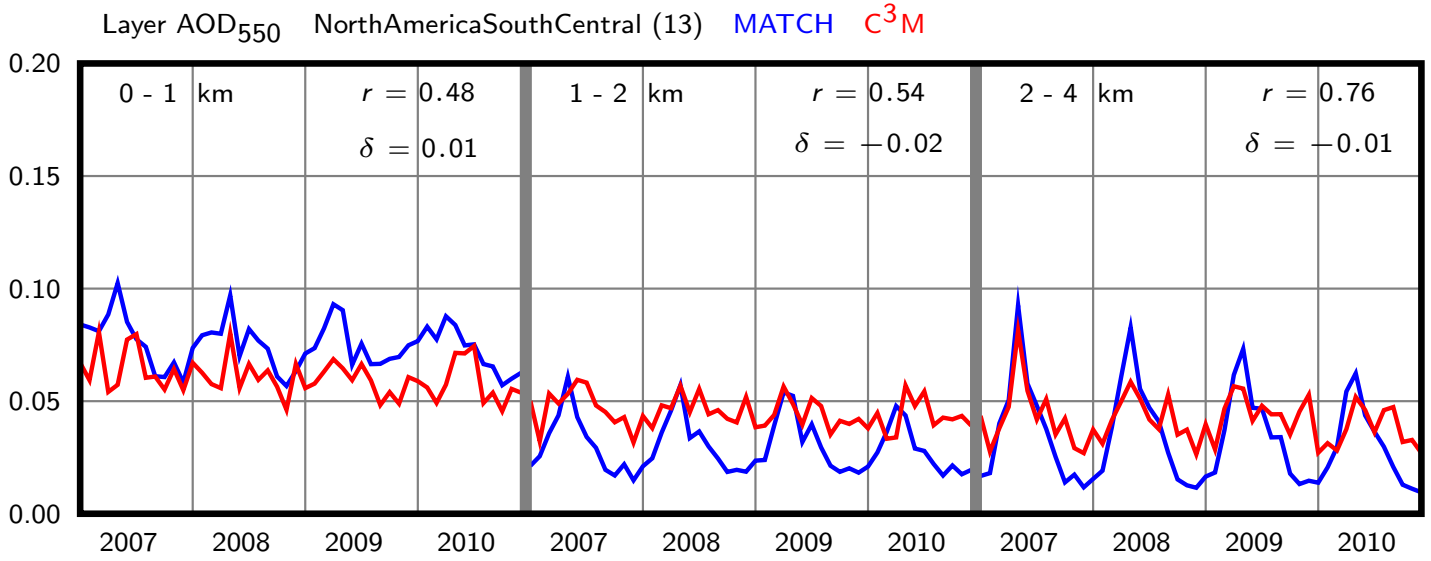


NorthAmericaSouthWest (12)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.009	0.149	-0.058	0.492	0.000
MATCH Subsample	-0.008	0.144	-0.052	0.534	0.000
MODIS	-0.012	0.173	-0.082	0.328	0.000

Table 13 : $\mathrm{AOD}_{550} = b\ t + a$

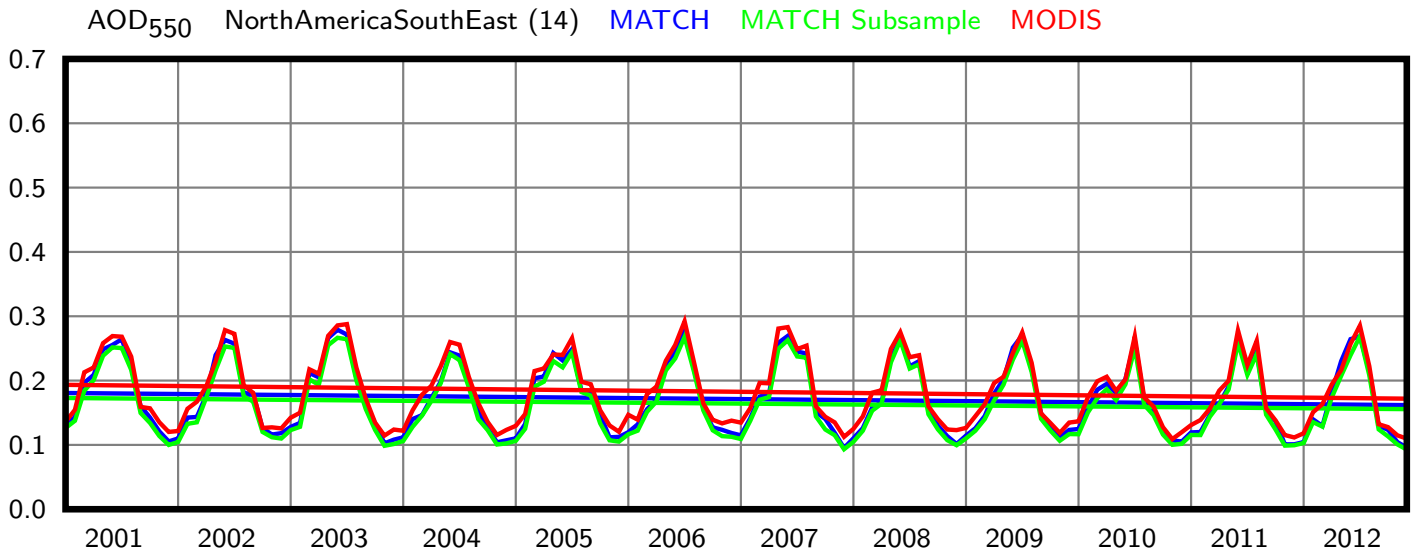

AOD550 NorthAmericaSouthCentral (13) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

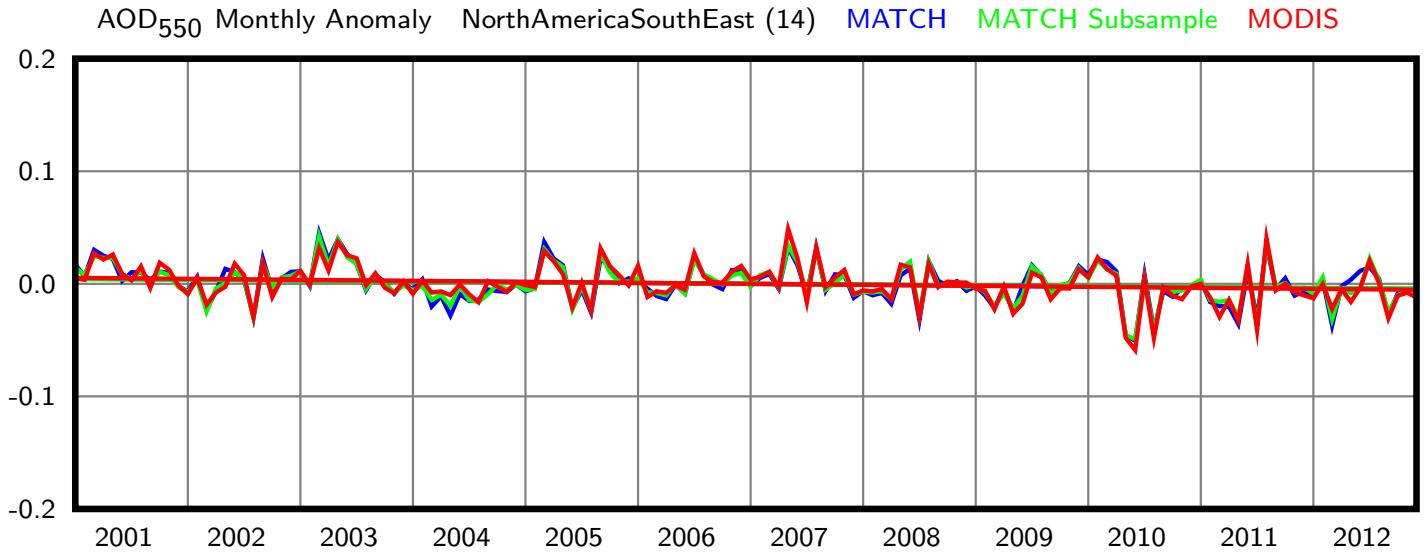

AOD550 Monthly Anomaly NorthAmericaSouthCentral (13) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

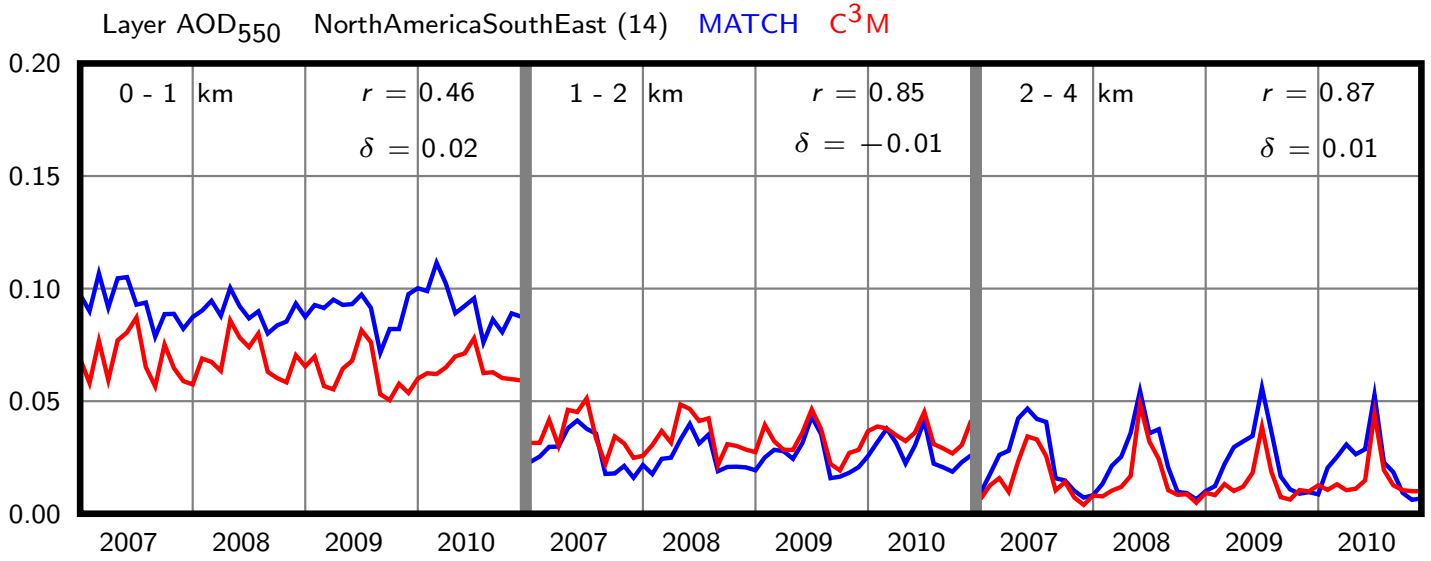


NorthAmericaSouthCentral (13)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.030	0.230	-0.153	0.067	0.000
MATCH Subsample	-0.024	0.215	-0.118	0.158	0.000
MODIS	-0.028	0.221	-0.136	0.104	0.000

Table 14 : $\mathrm{AOD}_{550} = b\ t + a$

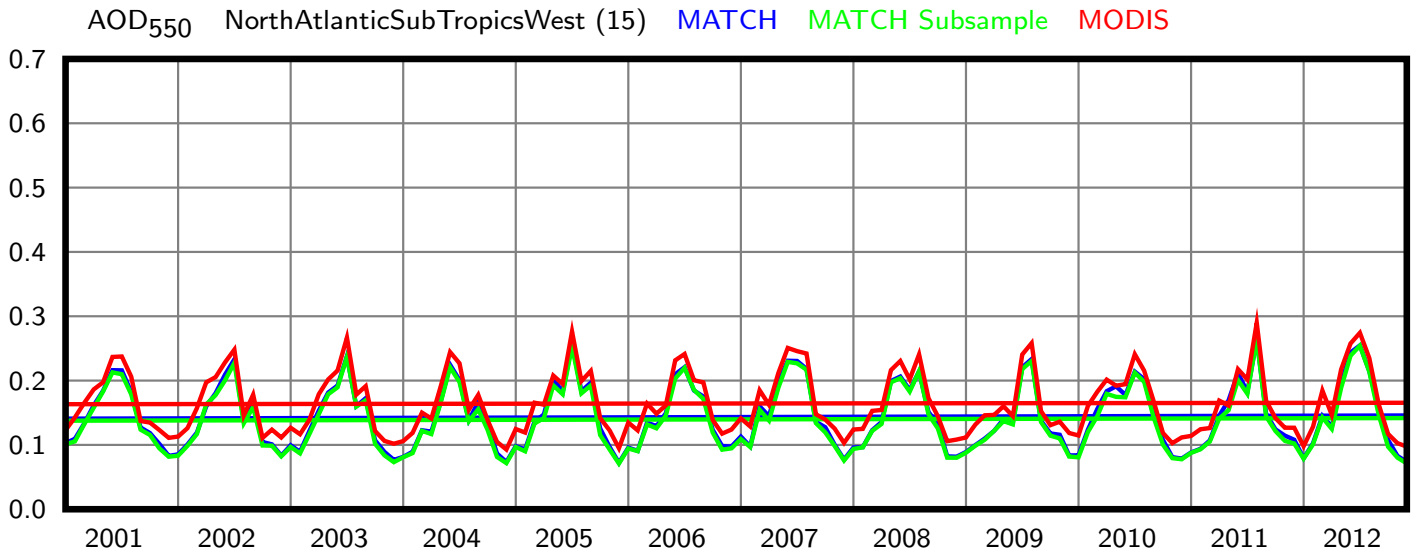

AOD550 NorthAmericaSouthEast (14) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

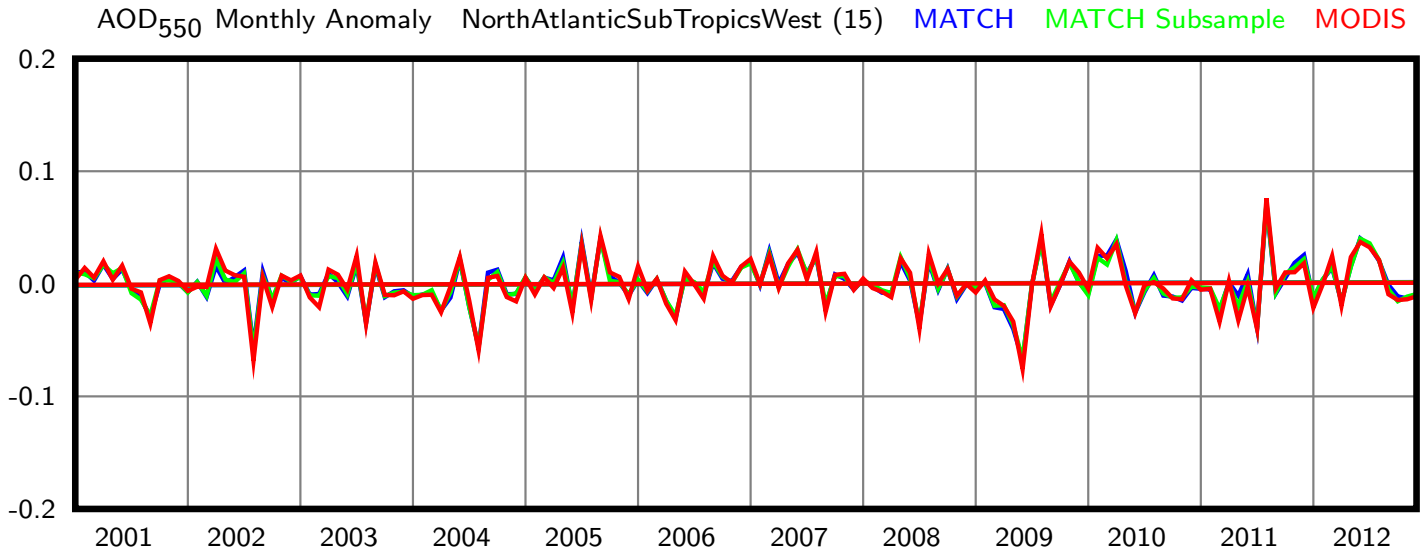

AOD550 Monthly Anomaly NorthAmericaSouthEast (14) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

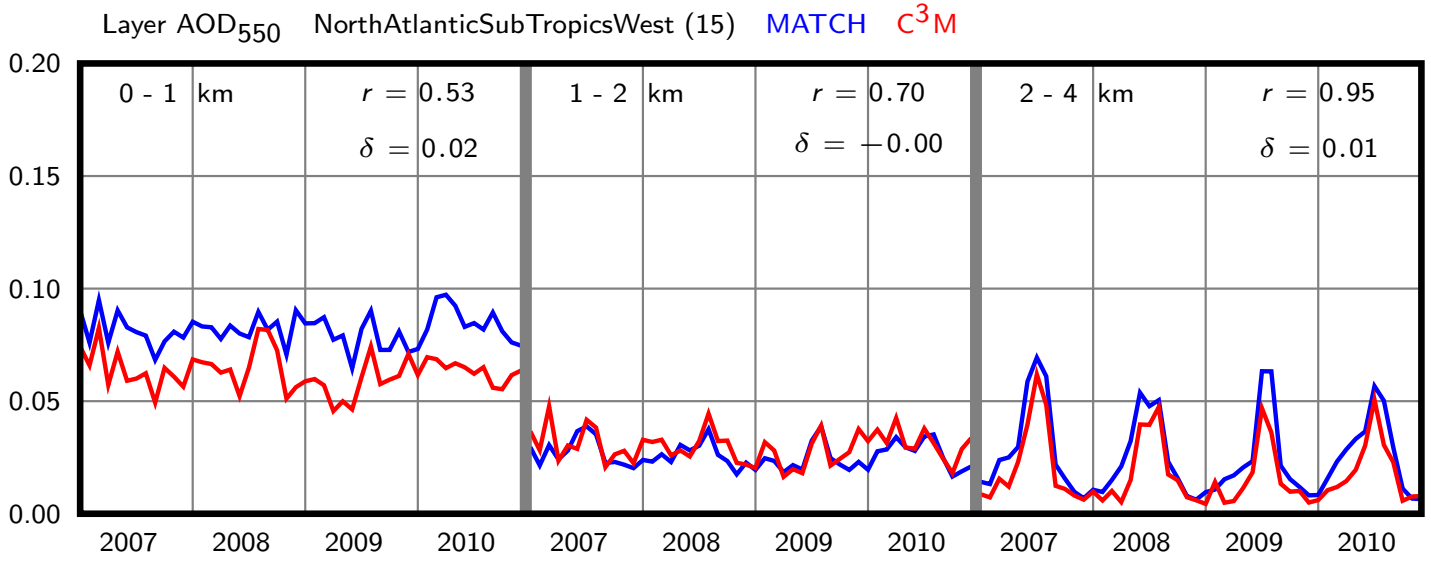


NorthAmericaSouthEast (14)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.016	0.181	-0.101	0.228	0.000
MATCH Subsample	-0.015	0.173	-0.095	0.256	0.000
MODIS	-0.018	0.193	-0.118	0.161	0.000

Table 15 : $\mathrm{AOD}_{550} = b\ t + a$

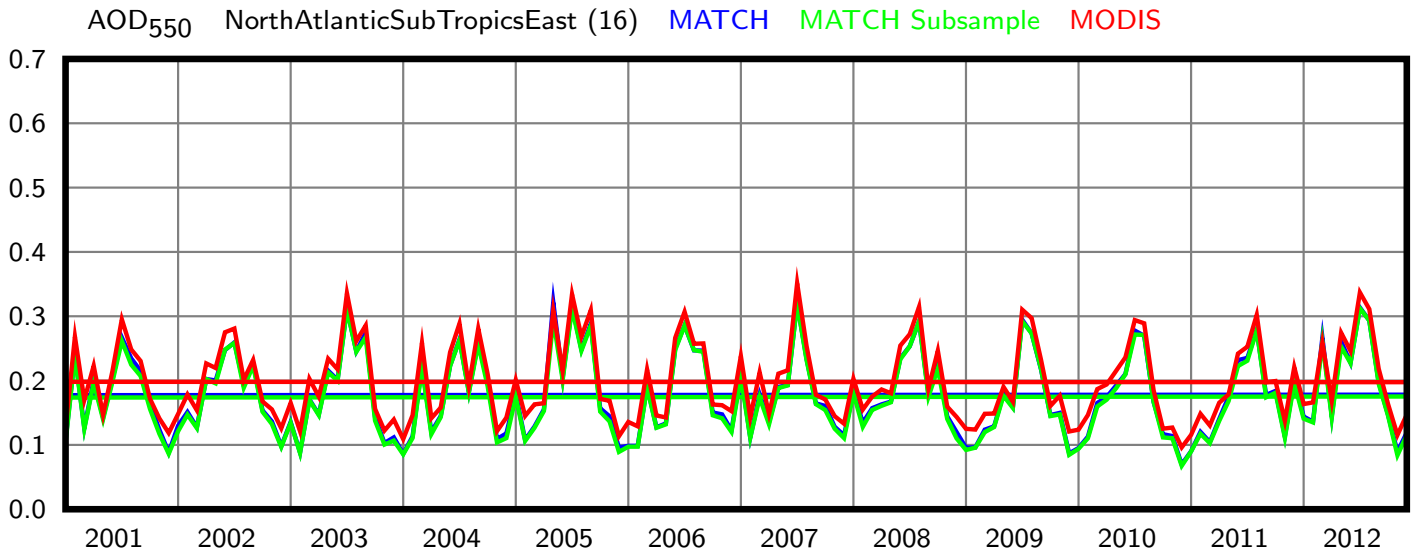

AOD550 NorthAtlanticSubTropicsWest (15) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

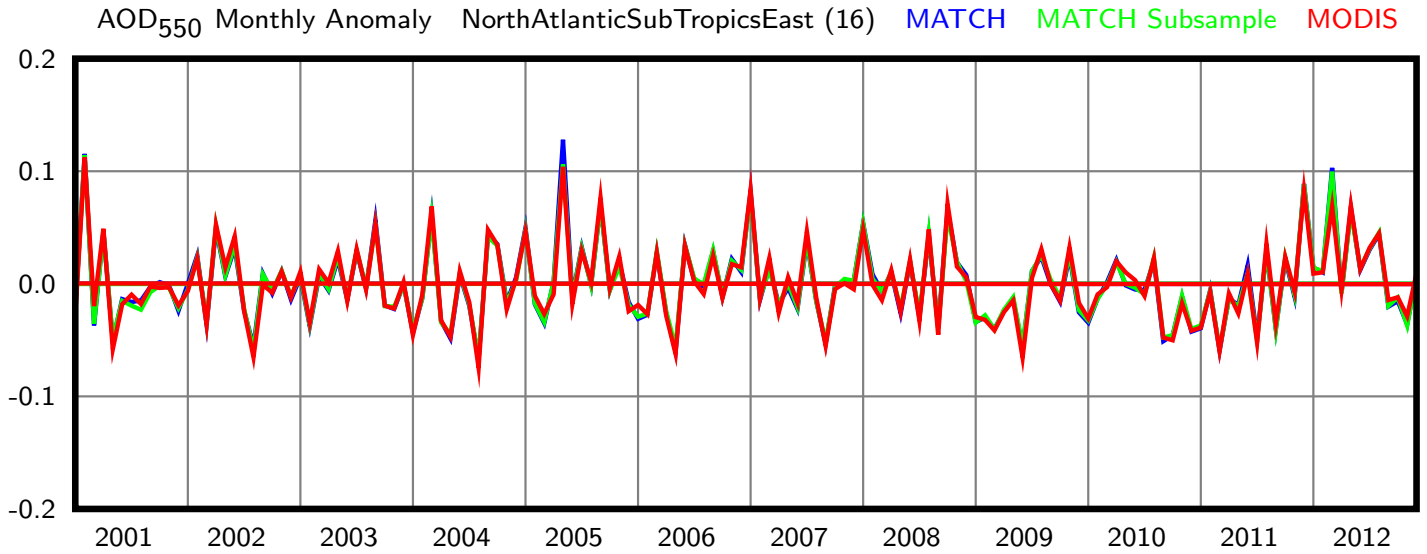

AOD550 Monthly Anomaly NorthAtlanticSubTropicsWest (15) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

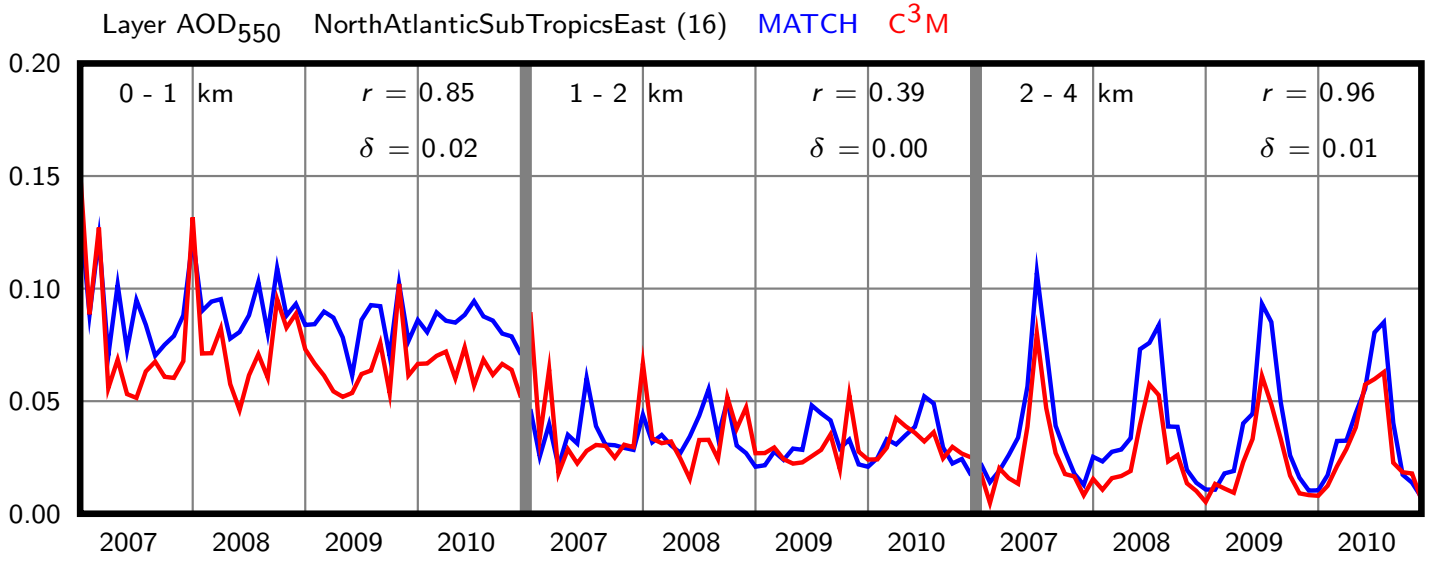


NorthAtlanticSubTropicsWest (15)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.004	0.141	0.029	0.731	0.000
MATCH Subsample	0.003	0.138	0.024	0.774	0.000
MODIS	0.002	0.163	0.013	0.873	0.000

Table 16 : $\mathrm{AOD}_{550} = b\ t + a$

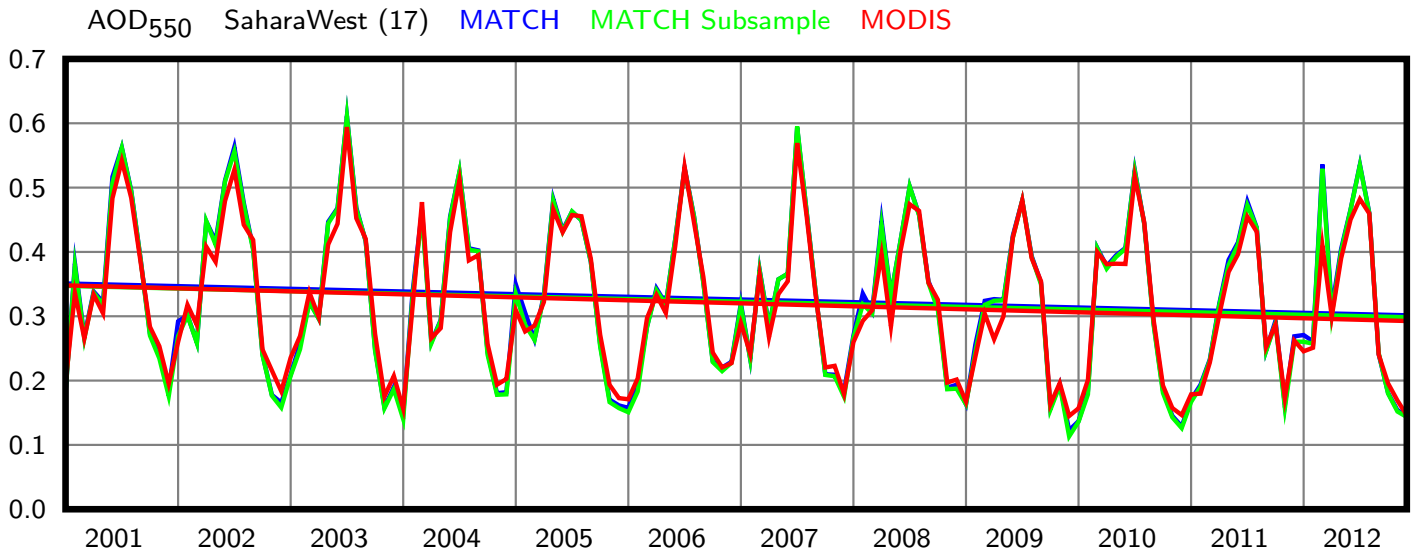

AOD550 NorthAtlanticSubTropicsEast (16) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

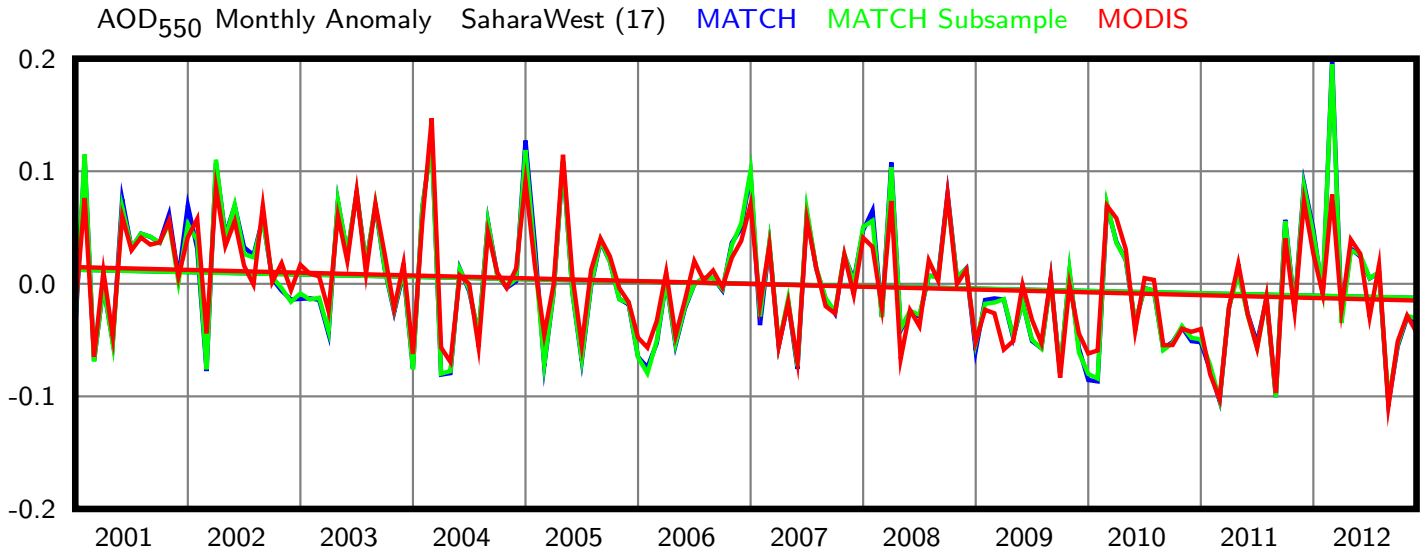

AOD550 Monthly Anomaly NorthAtlanticSubTropicsEast (16) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

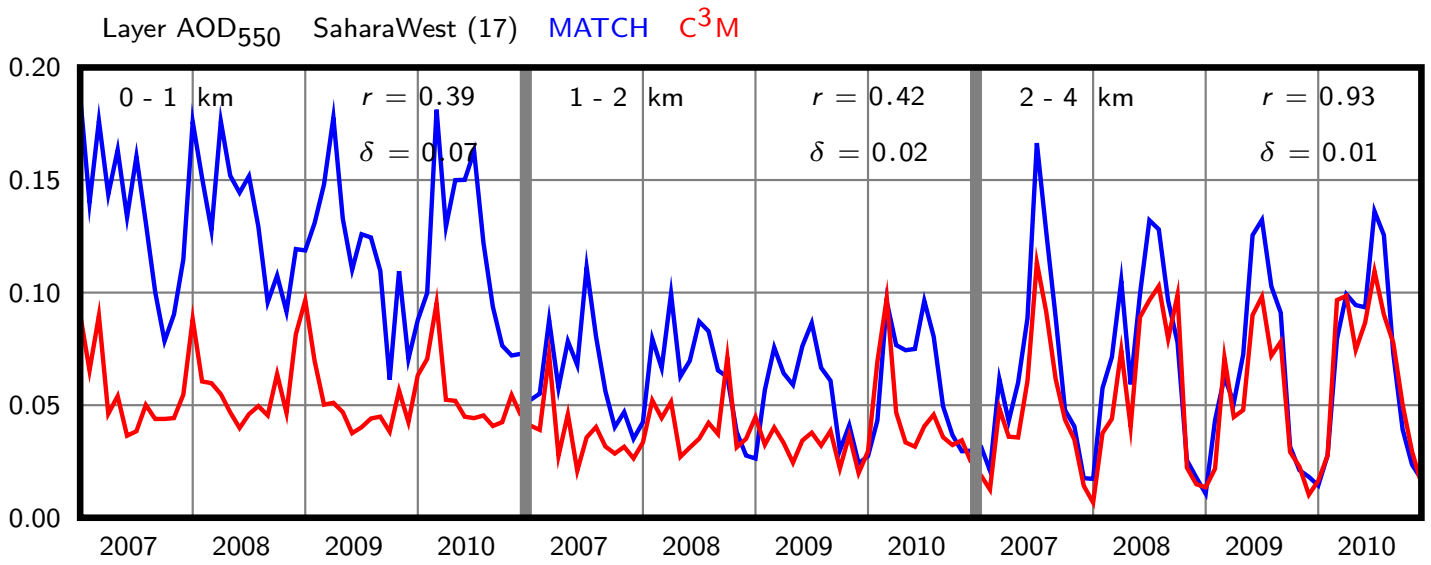


NorthAtlanticSubTropicsEast (16)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.001	0.177	0.003	0.967	0.000
MATCH Subsample	0.001	0.174	0.008	0.928	0.000
MODIS	-0.000	0.198	-0.003	0.974	0.000

Table 17 : $\mathrm{AOD}_{550} = b\ t + a$

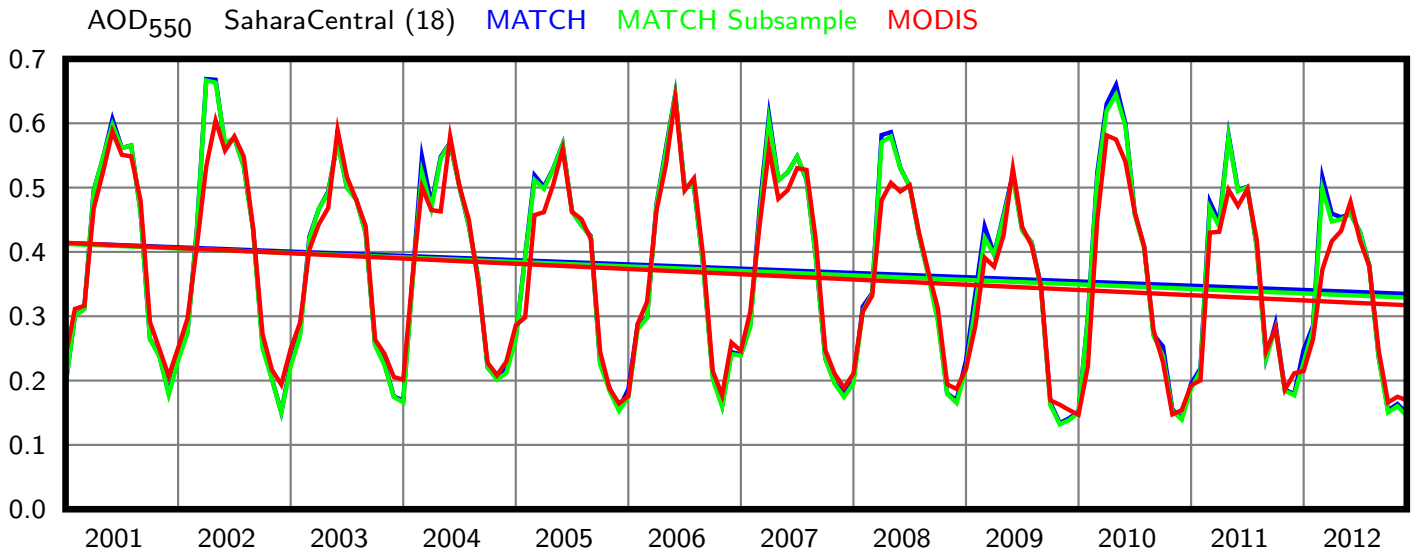

AOD550 SaharaWest (17) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

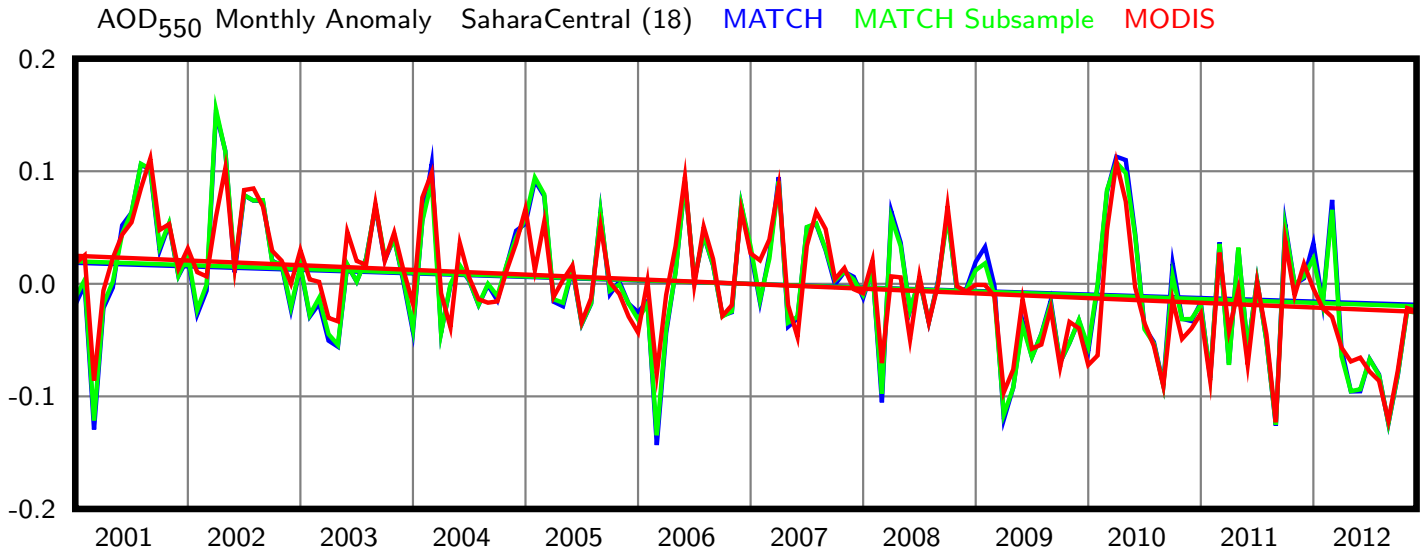

AOD550 Monthly Anomaly SaharaWest (17) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

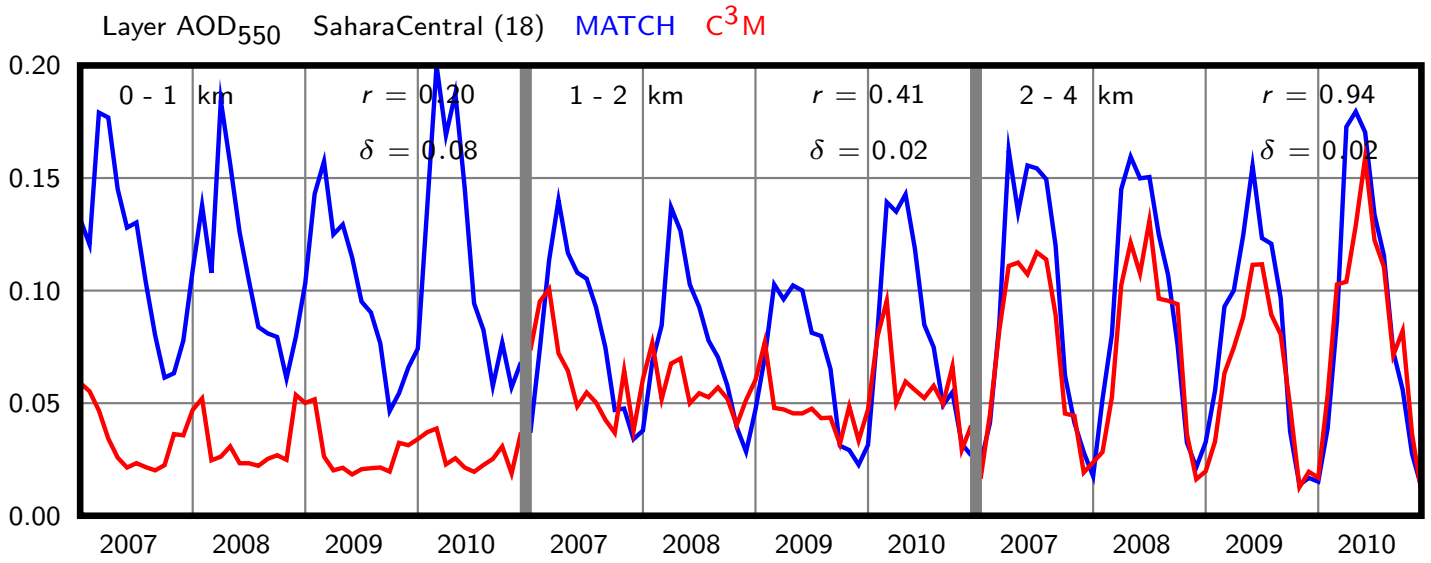


SaharaWest (17)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.042	0.351	-0.120	0.152	0.000
MATCH Subsample	-0.041	0.347	-0.117	0.161	0.000
MODIS	-0.046	0.348	-0.148	0.077	0.000

Table 18 : $\mathrm{AOD}_{550} = b\ t + a$

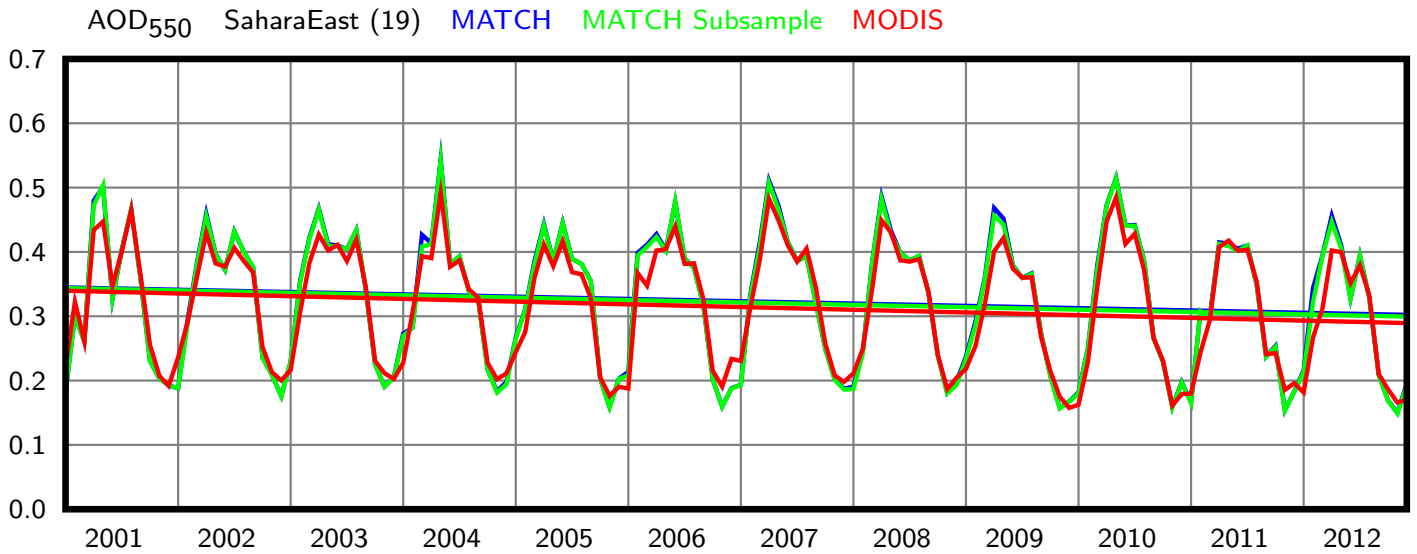

AOD550 SaharaCentral (18) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

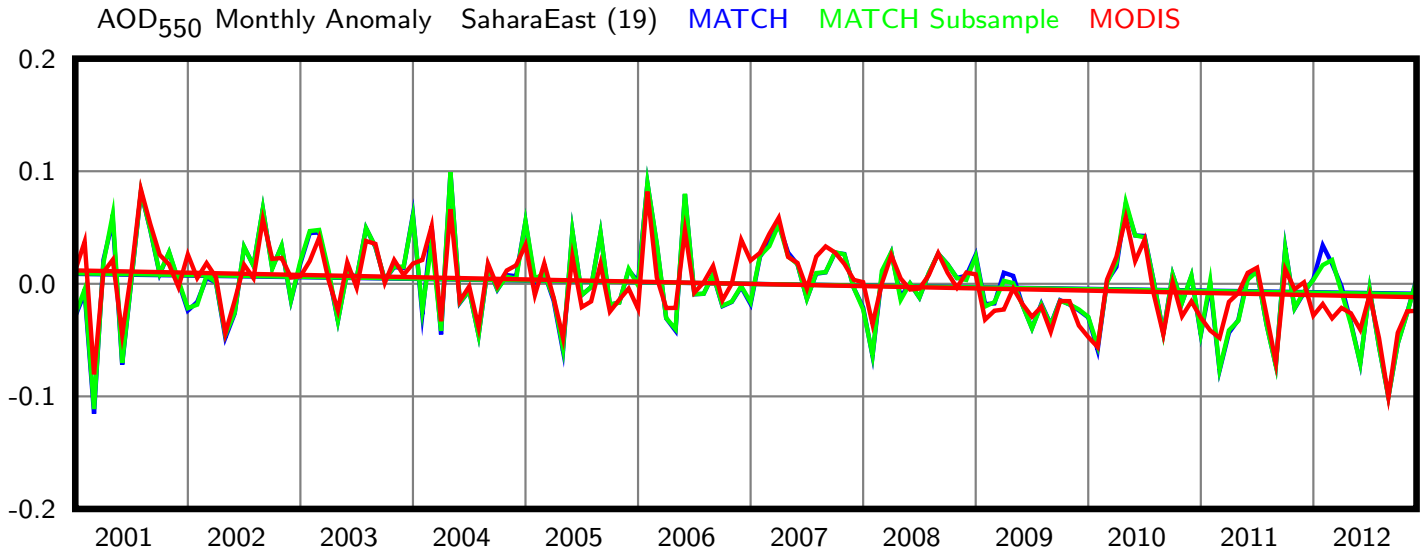

AOD550 Monthly Anomaly SaharaCentral (18) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

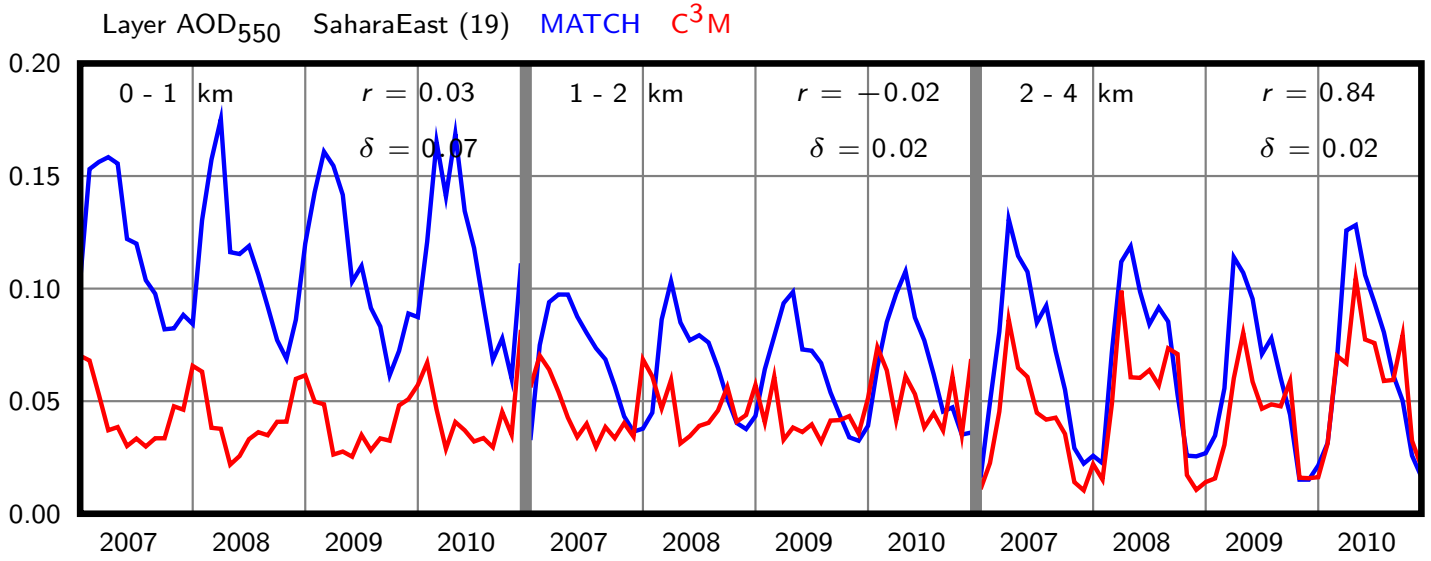


SaharaCentral (18)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.066	0.414	-0.152	0.069	0.000
MATCH Subsample	-0.070	0.412	-0.160	0.055	0.000
MODIS	-0.081	0.414	-0.209	0.012	0.000

Table 19 : $\mathrm{AOD}_{550} = b\ t + a$

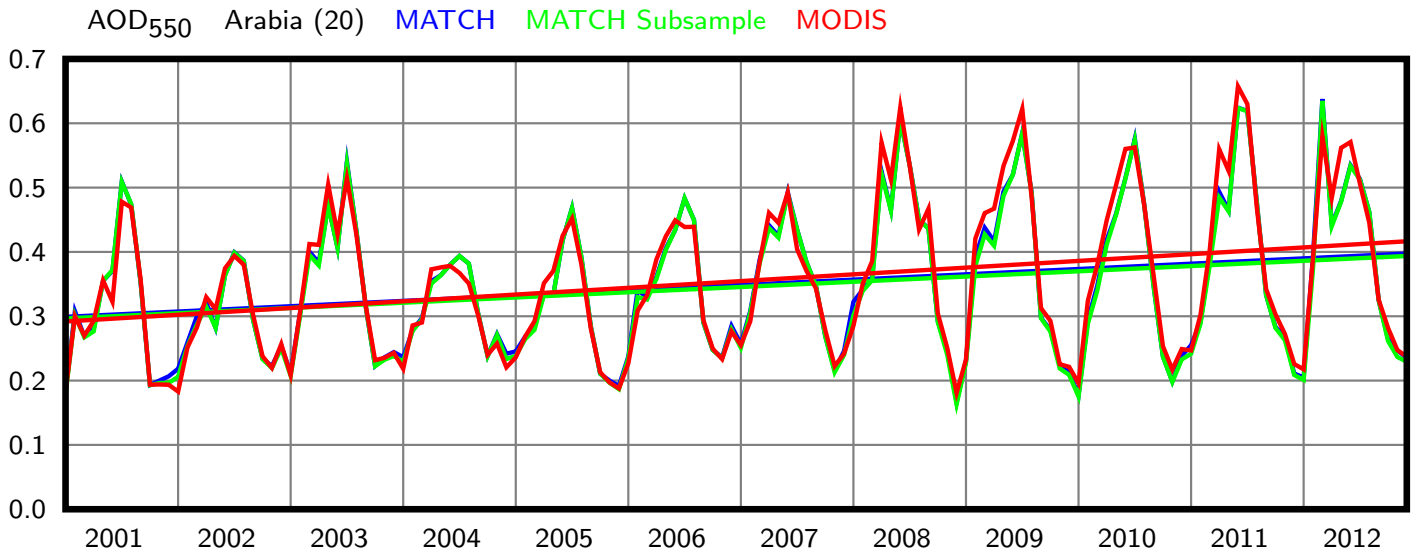

AOD550 SaharaEast (19) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

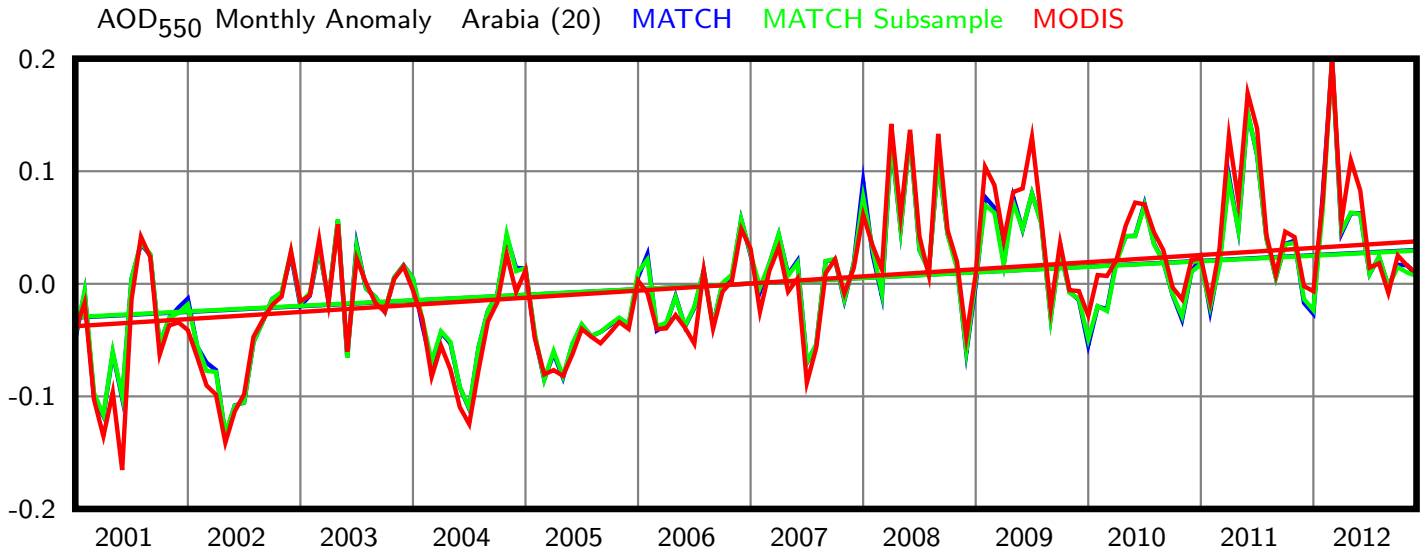

AOD550 Monthly Anomaly SaharaEast (19) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

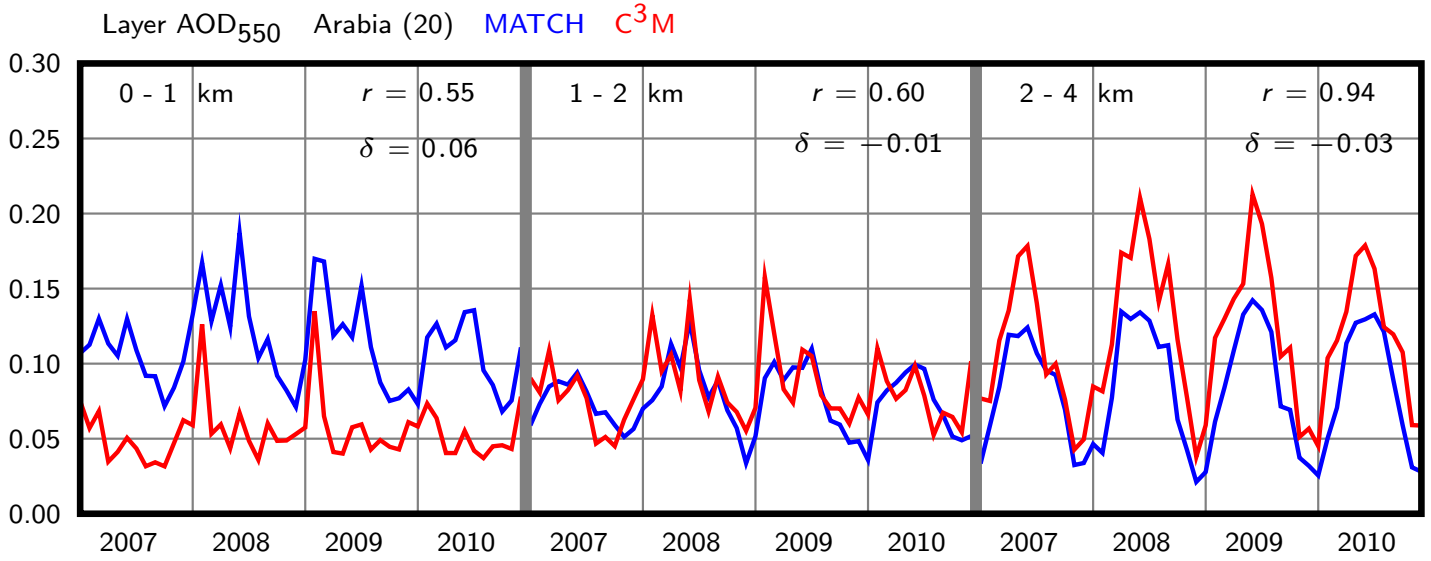


SaharaEast (19)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.036	0.345	-0.120	0.153	0.000
MATCH Subsample	-0.037	0.344	-0.125	0.136	0.000
MODIS	-0.042	0.340	-0.159	0.057	0.000

Table 20 : $\mathrm{AOD}_{550} = b\ t + a$

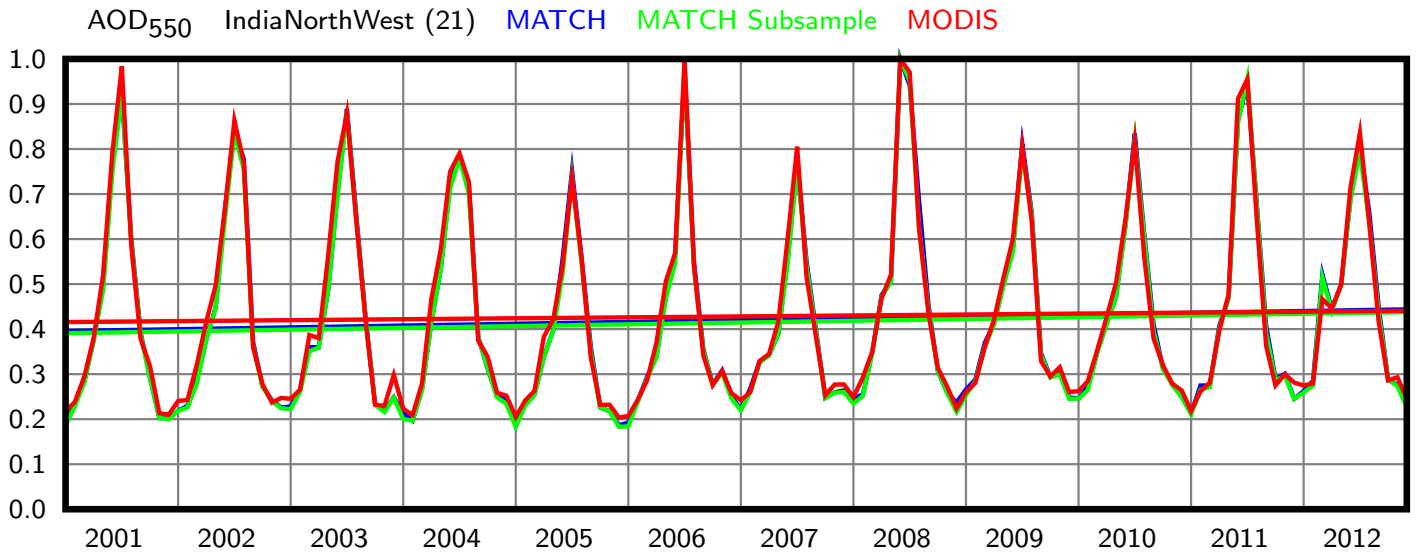

AOD550 Arabia (20) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

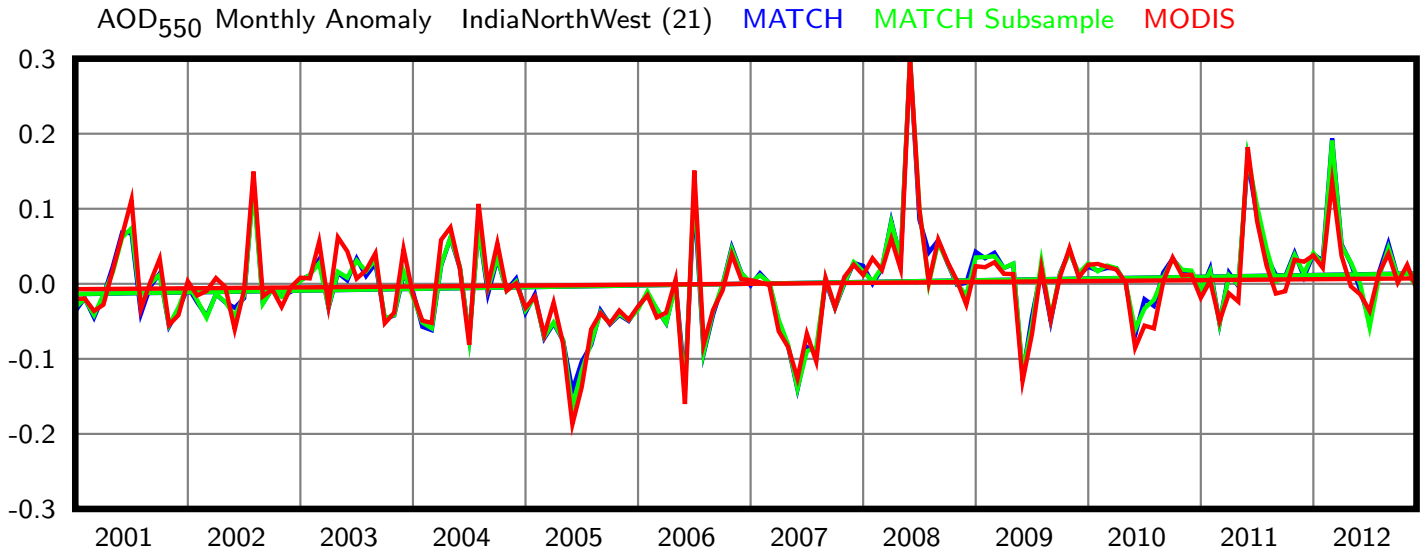

AOD550 Monthly Anomaly Arabia (20) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

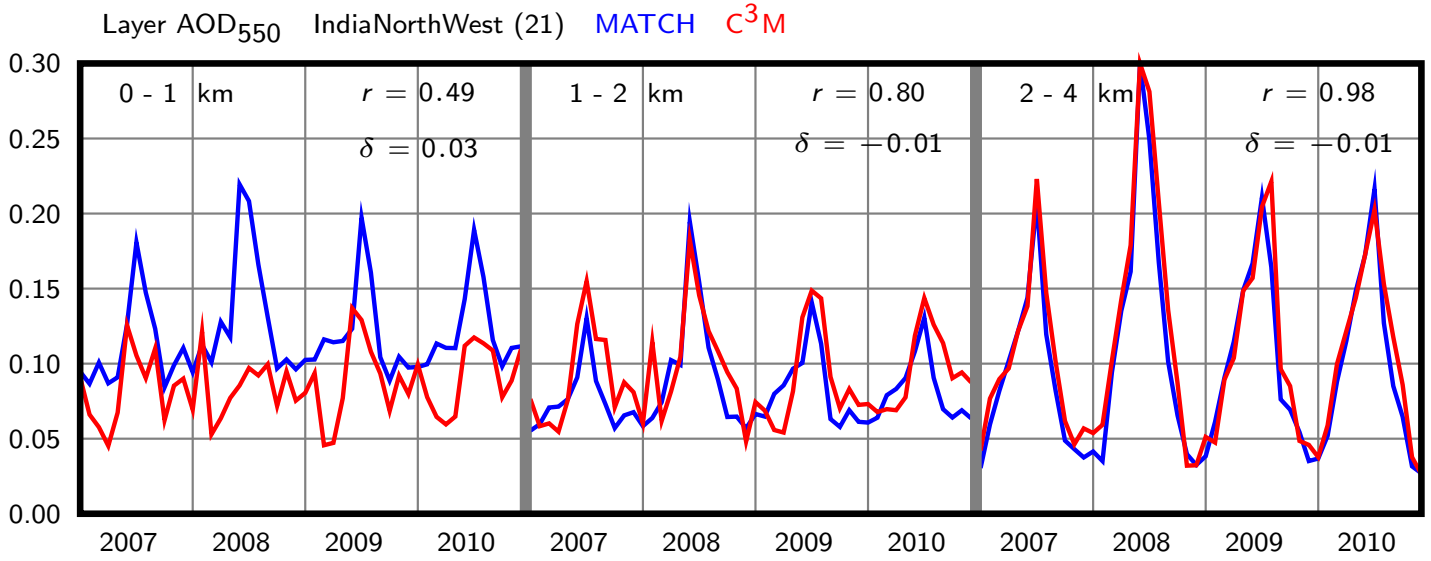


Arabia (20)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.083	0.299	0.258	0.002	0.000
MATCH Subsample	0.081	0.297	0.252	0.002	0.000
MODIS	0.105	0.292	0.310	0.000	0.000

Table 21 : $\mathrm{AOD}_{550} = b\ t + a$

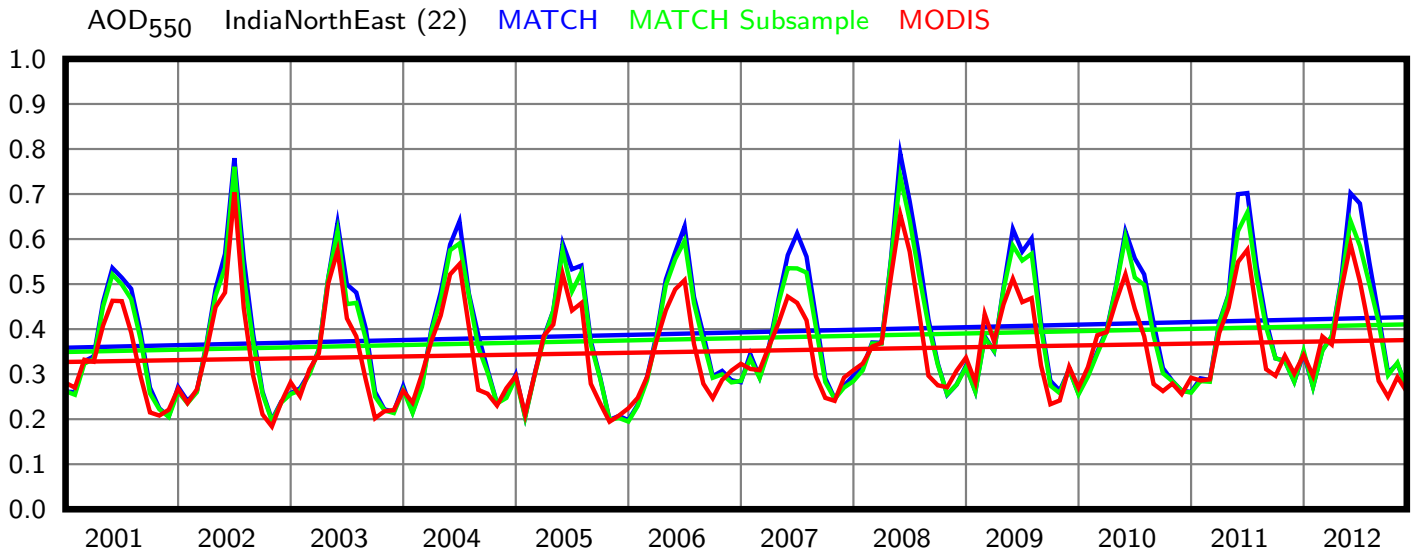

AOD550 IndiaNorthWest (21) MATCH MATCH Subsample MODIS
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

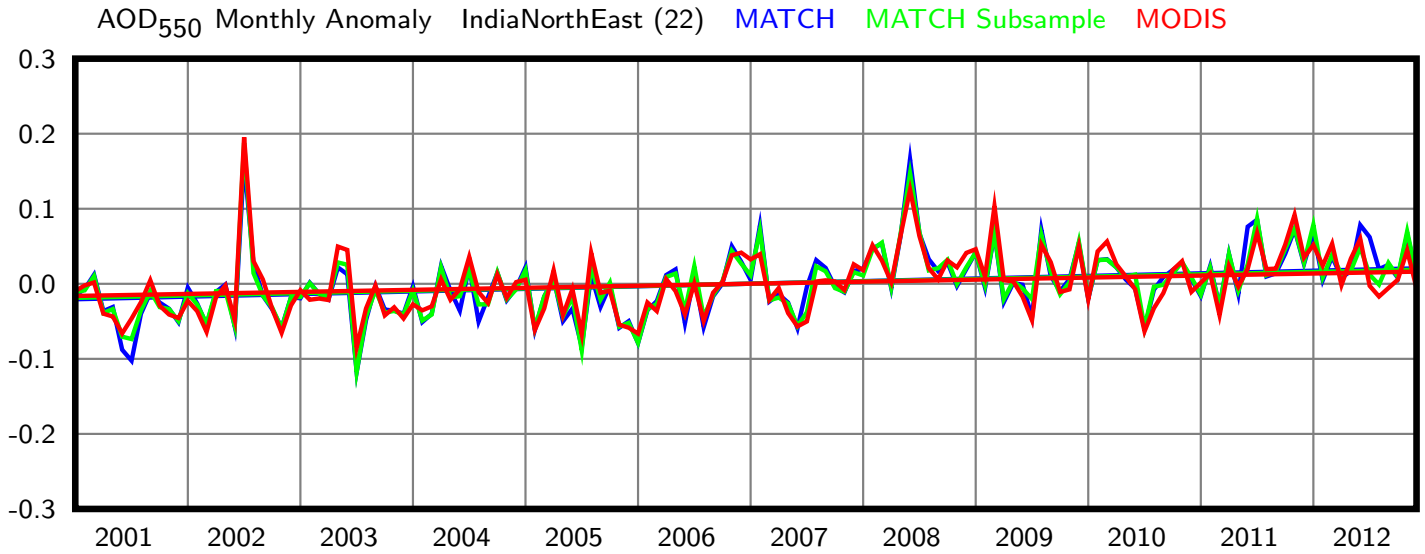

AOD550 Monthly Anomaly IndiaNorthWest (21) MATCH MATCH Subsample MODIS
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

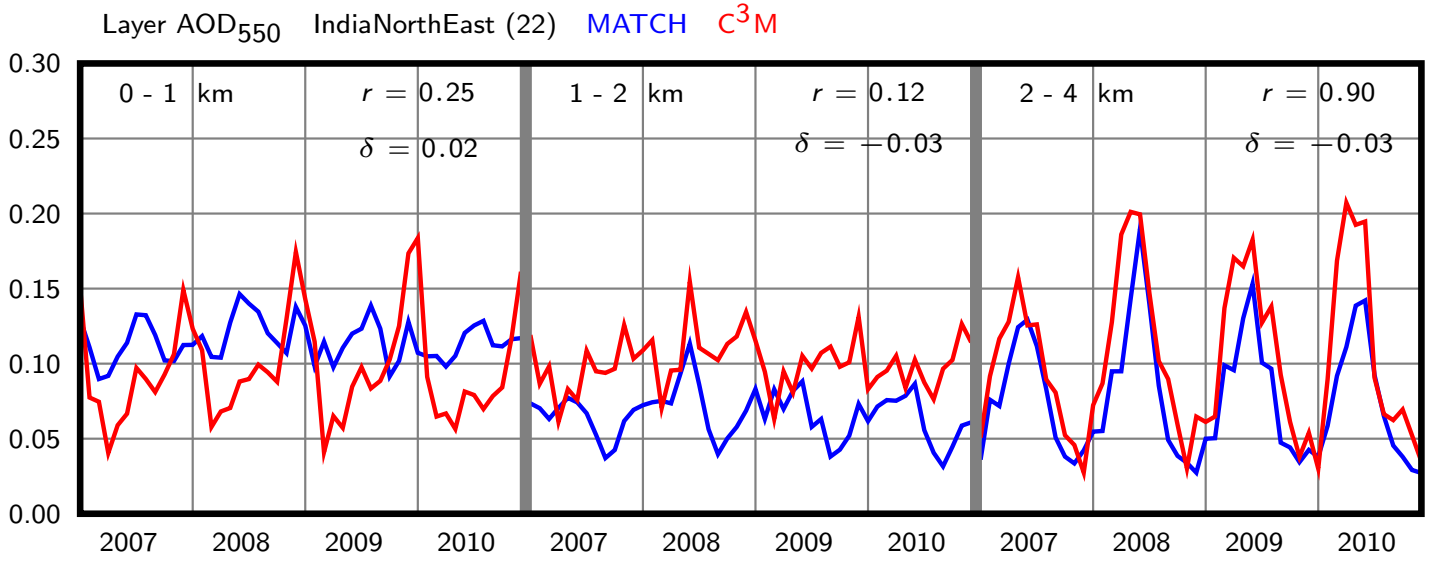


IndiaNorthWest (21)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.040	0.396	0.067	0.424	0.000
MATCH Subsample	0.039	0.391	0.066	0.432	0.000
MODIS	0.021	0.416	0.034	0.684	0.000

Table 22 : $\mathrm{AOD}_{550} = b\ t + a$

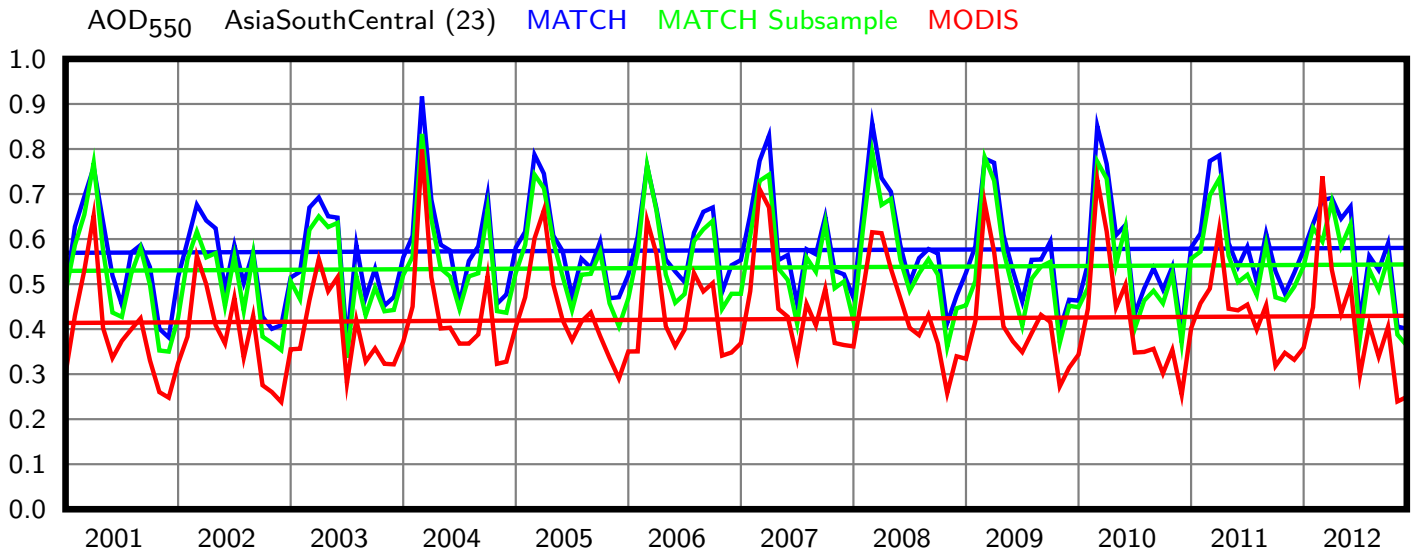

AOD550 IndiaNorthEast (22) MATCH MATCH Subsample MODIS
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

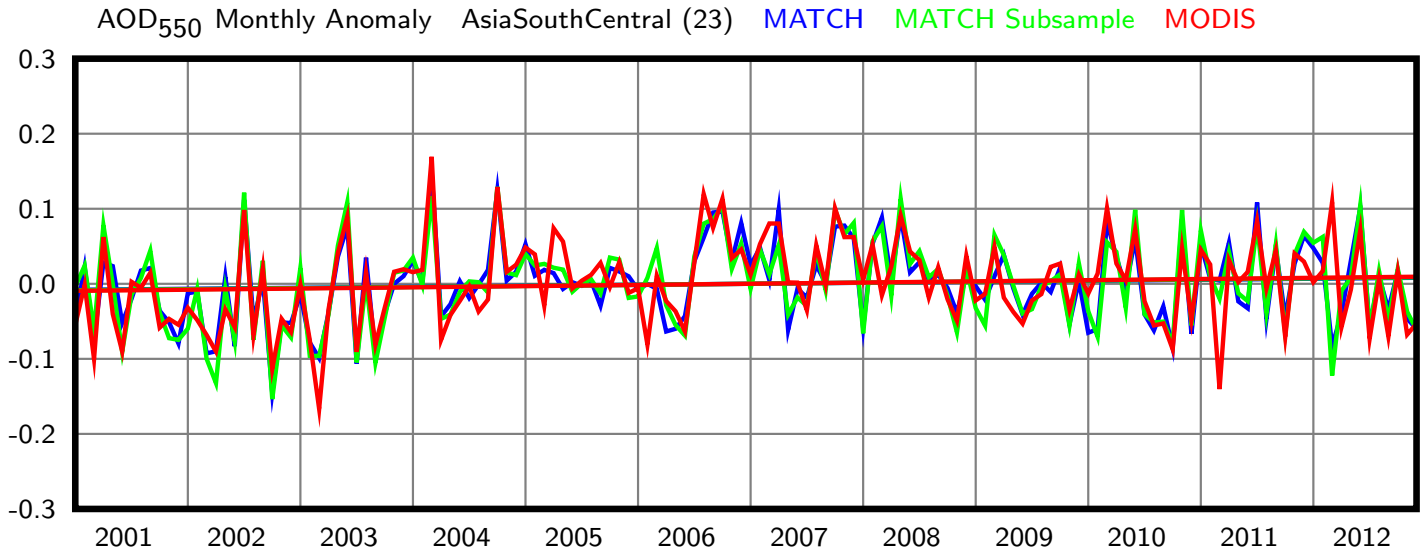

AOD550 Monthly Anomaly IndiaNorthEast (22) MATCH MATCH Subsample MODIS
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

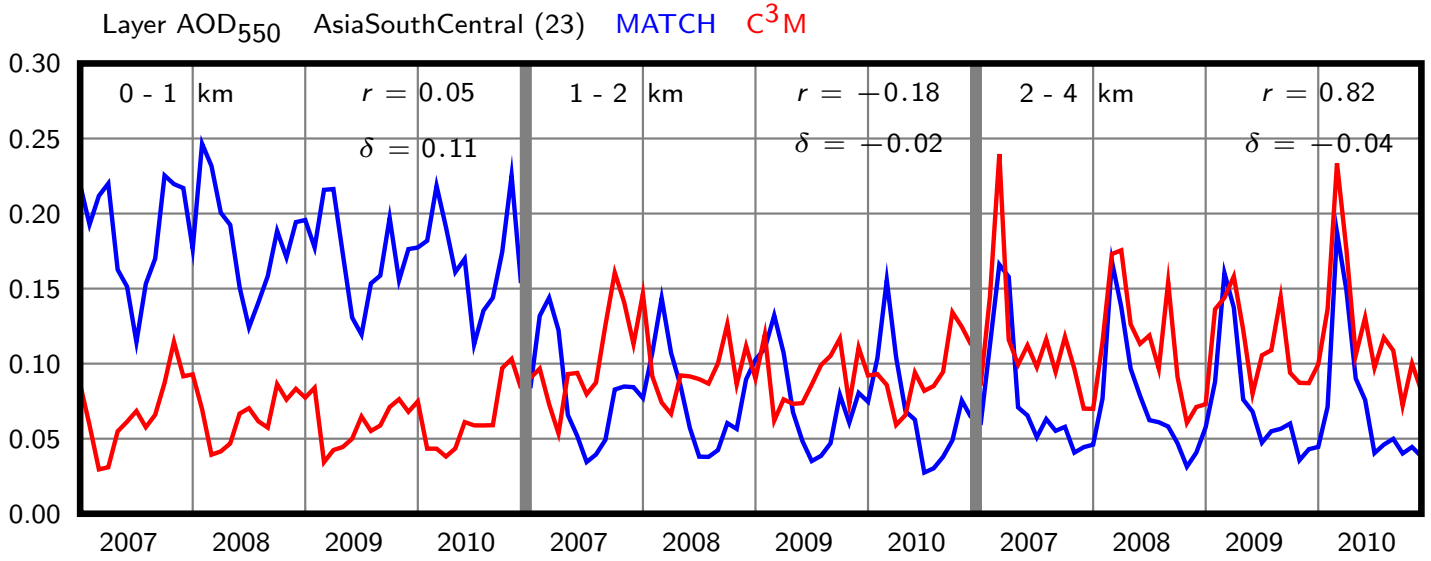


IndiaNorthEast (22)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.057	0.359	0.141	0.093	0.000
MATCH Subsample	0.051	0.349	0.139	0.097	0.000
MODIS	0.041	0.327	0.134	0.110	0.000

Table 23 : $\mathrm{AOD}_{550} = b\ t + a$

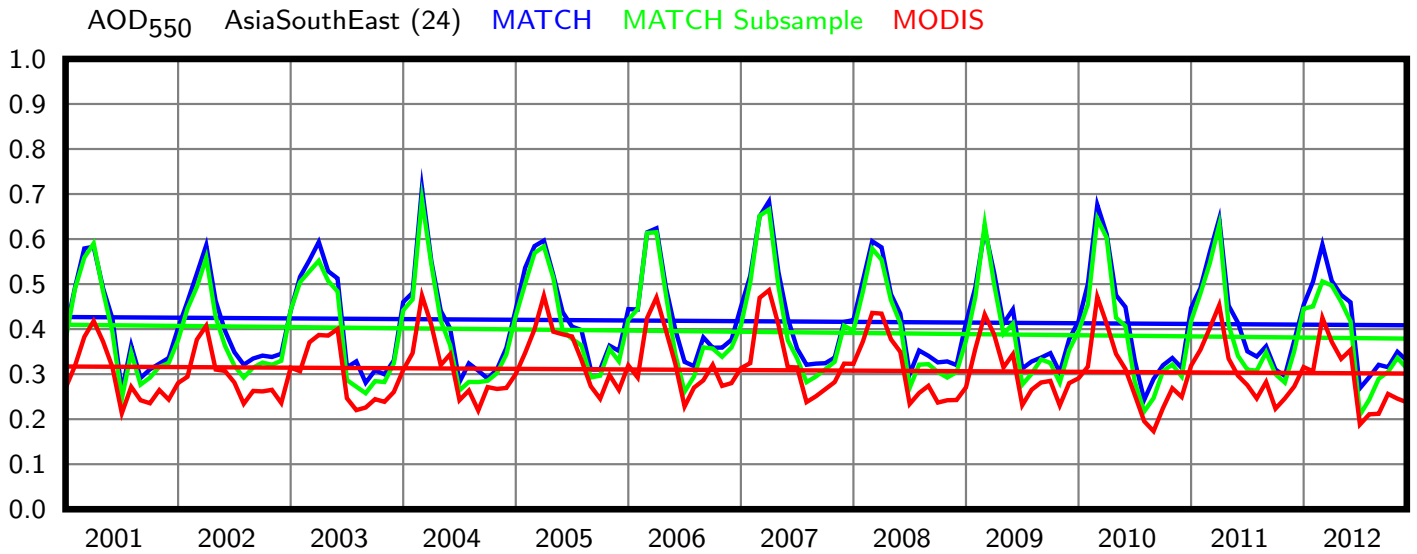

AOD550 AsiaSouthCentral (23) MATCH MATCH Subsample MODIS
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

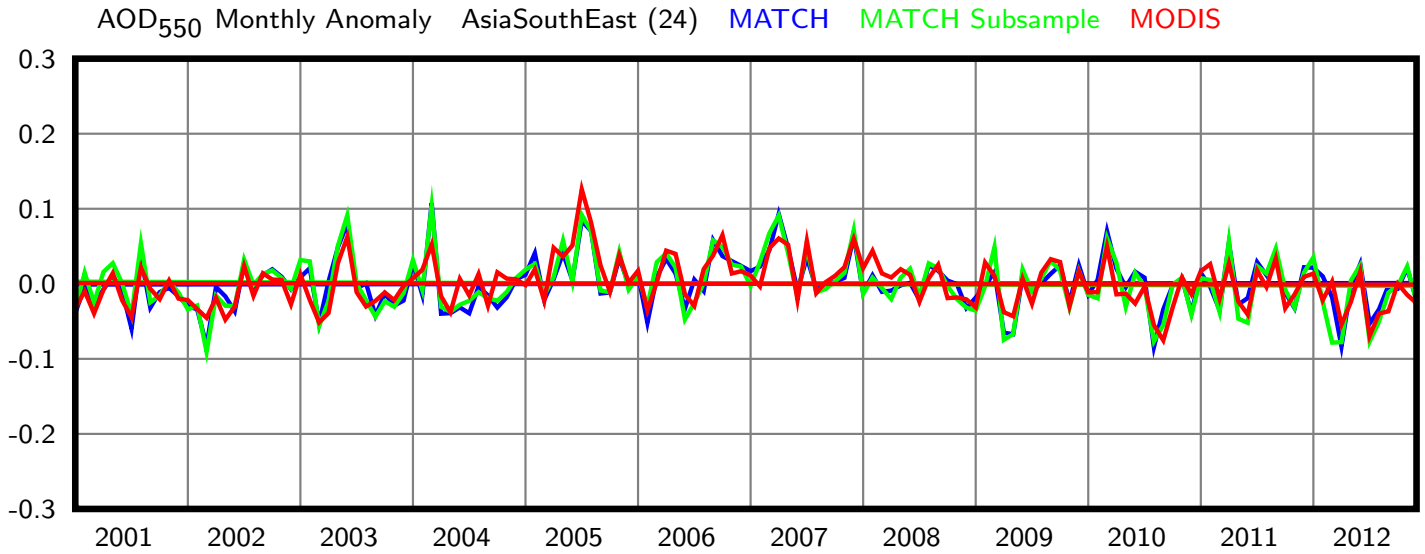

AOD550 Monthly Anomaly AsiaSouthCentral (23) MATCH MATCH Subsample MODIS
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

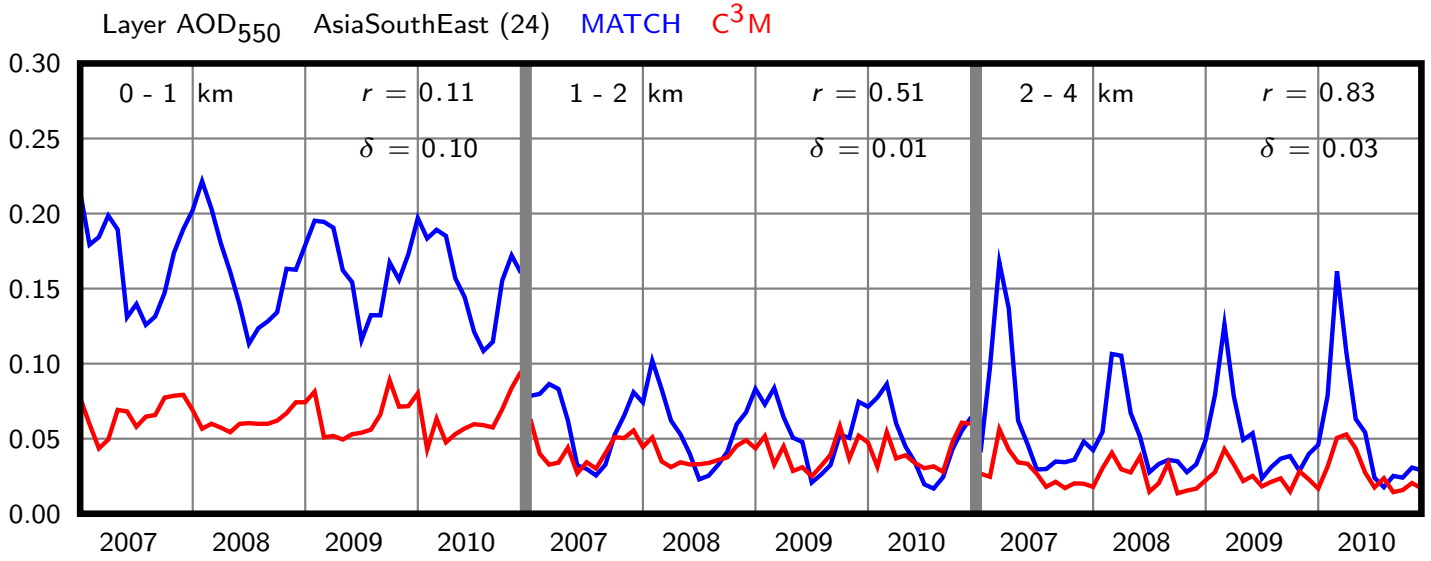


AsiaSouthCentral (23)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.009	0.569	0.029	0.727	0.000
MATCH Subsample	0.012	0.529	0.039	0.642	0.000
MODIS	0.013	0.414	0.042	0.617	0.000

Table 24 : $\mathrm{AOD}_{550} = b\ t + a$

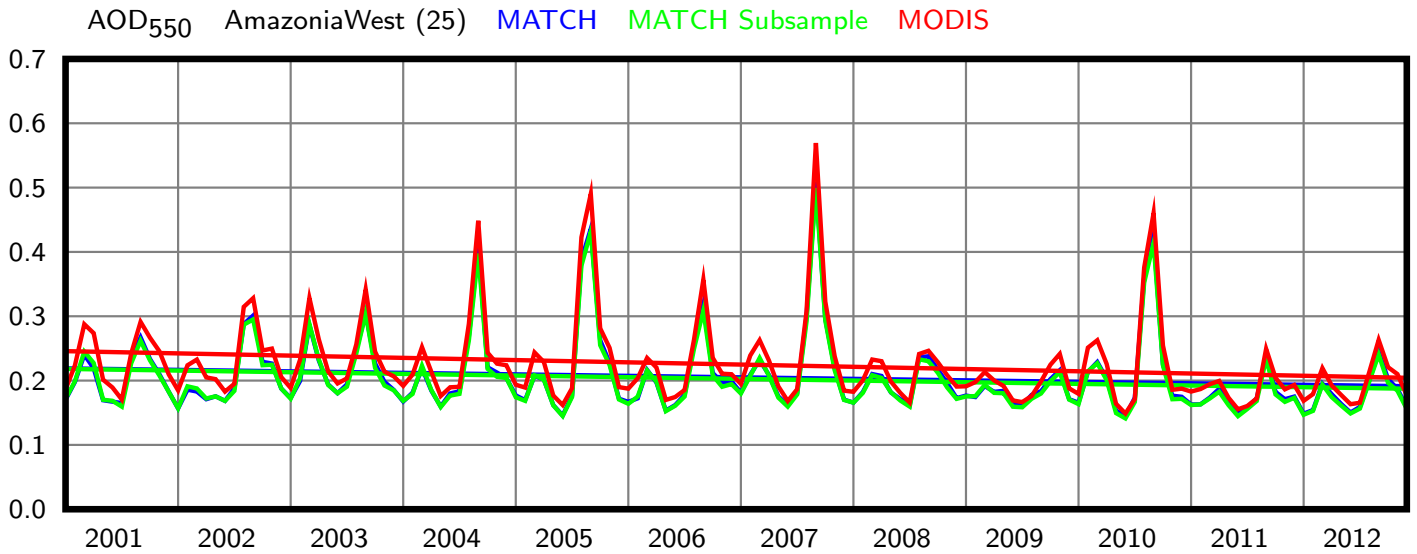

AOD550 AsiaSouthEast (24) MATCH MATCH Subsample MODIS
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

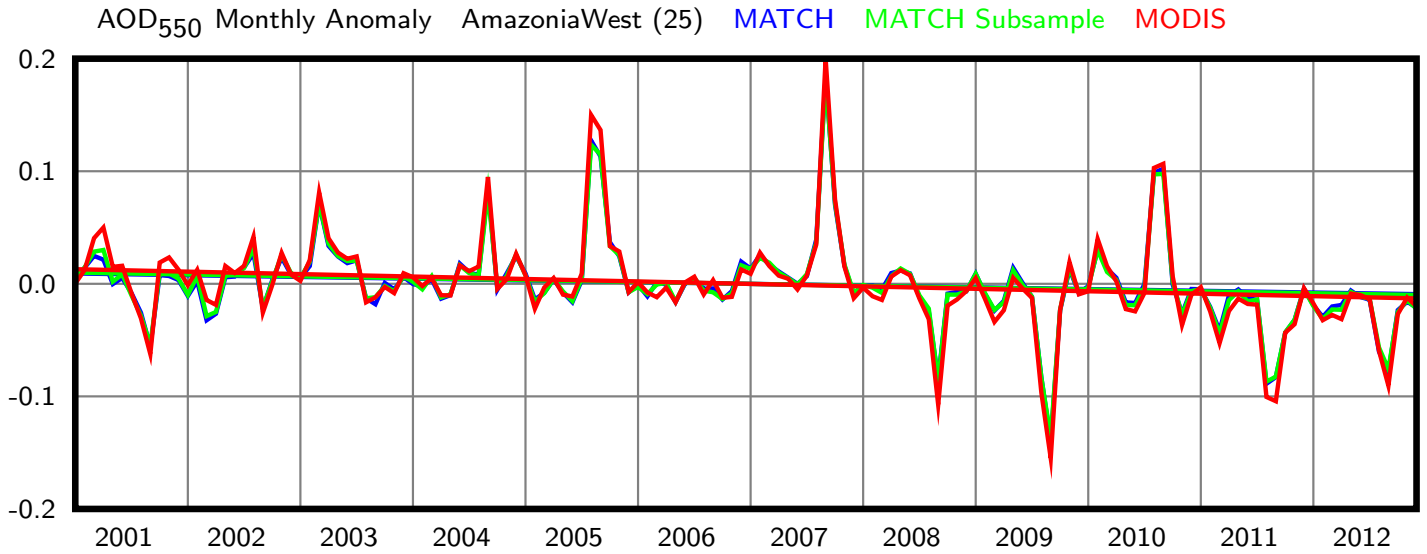

AOD550 Monthly Anomaly AsiaSouthEast (24) MATCH MATCH Subsample MODIS
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

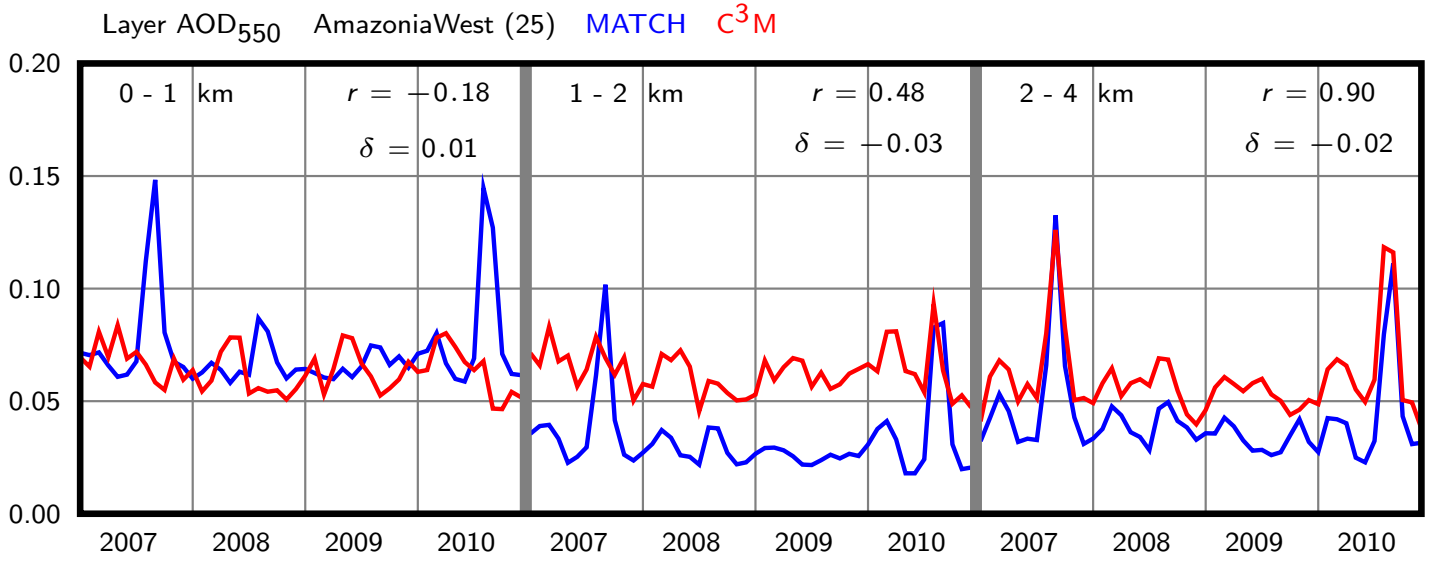


AsiaSouthEast (24)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.015	0.427	-0.050	0.552	0.000
MATCH Subsample	-0.026	0.410	-0.082	0.328	0.000
MODIS	-0.013	0.317	-0.065	0.441	0.000

Table 25 : $\mathrm{AOD}_{550} = b\ t + a$

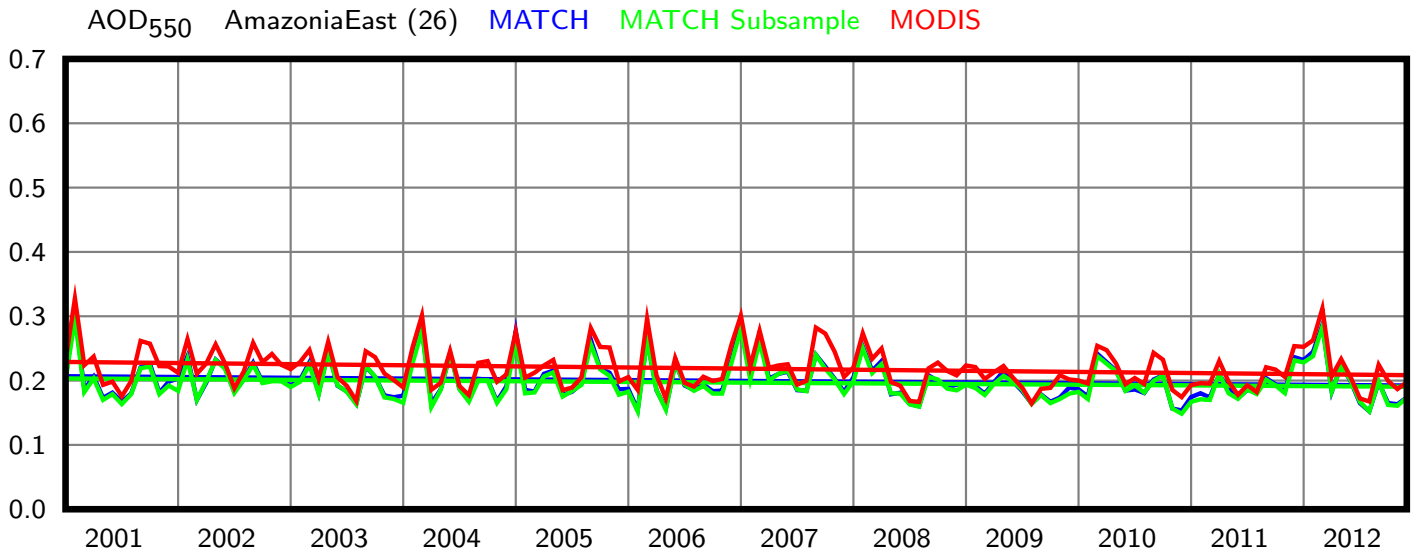

AOD550 AmazoniaWest (25) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

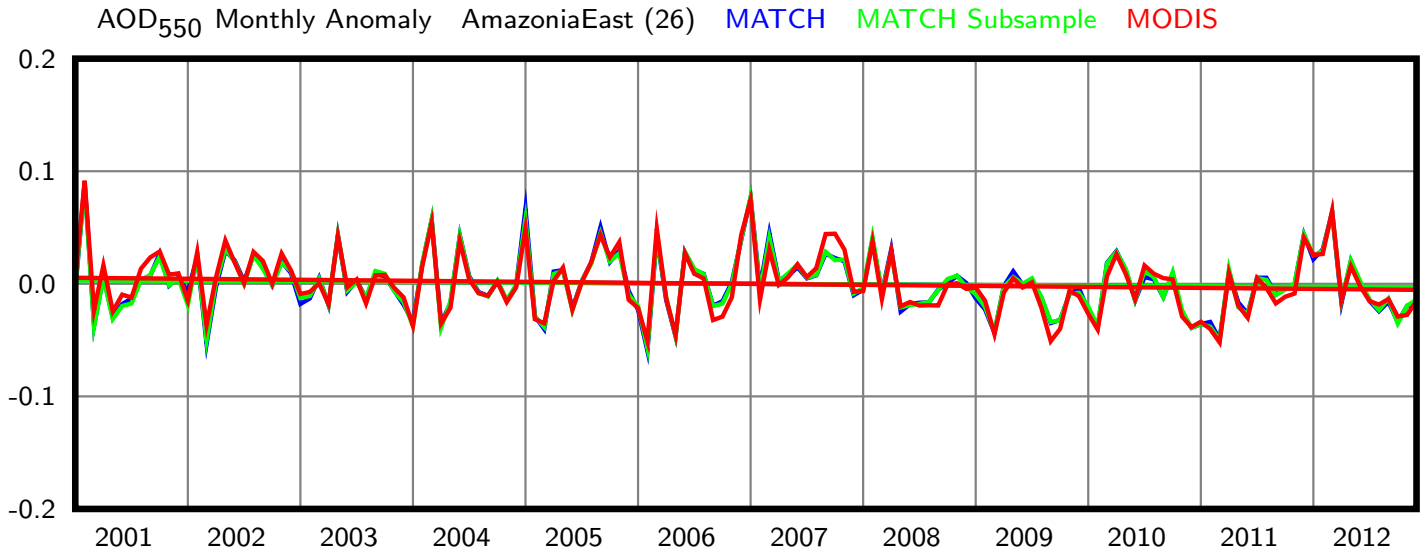

AOD550 Monthly Anomaly AmazoniaWest (25) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

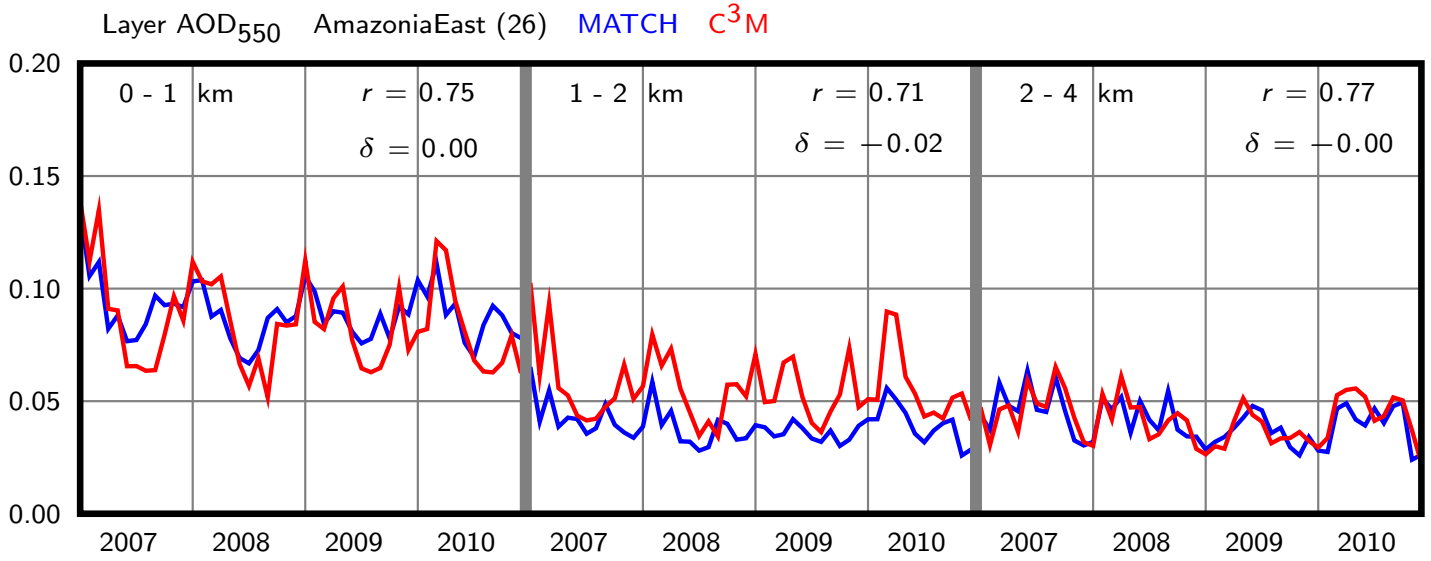


AmazoniaWest (25)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.023	0.219	-0.139	0.098	0.000
MATCH Subsample	-0.026	0.218	-0.158	0.059	0.000
MODIS	-0.035	0.246	-0.186	0.025	0.000

Table 26 : $\mathrm{AOD}_{550} = b\ t + a$

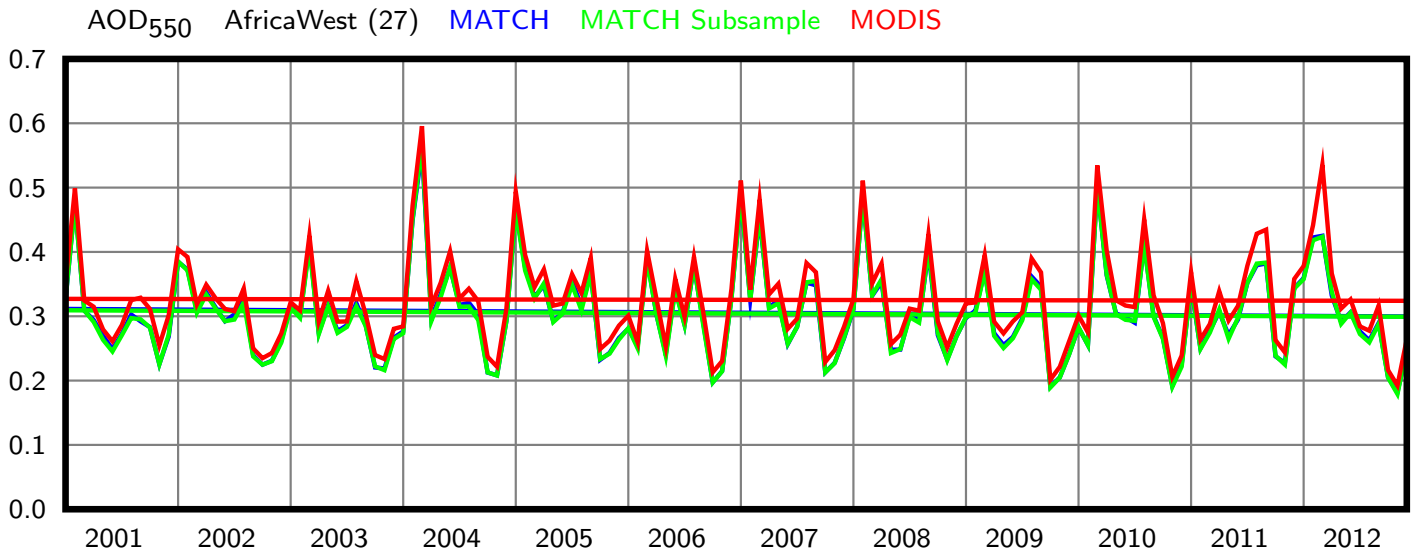

AOD550 AmazoniaEast (26) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

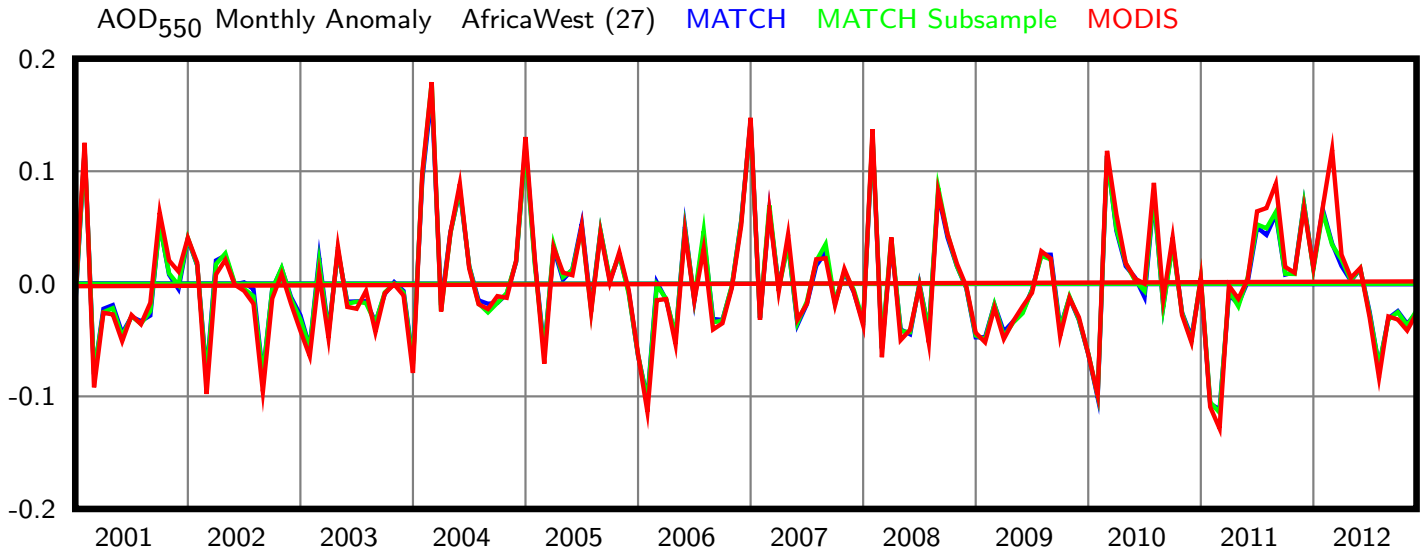

AOD550 Monthly Anomaly AmazoniaEast (26) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

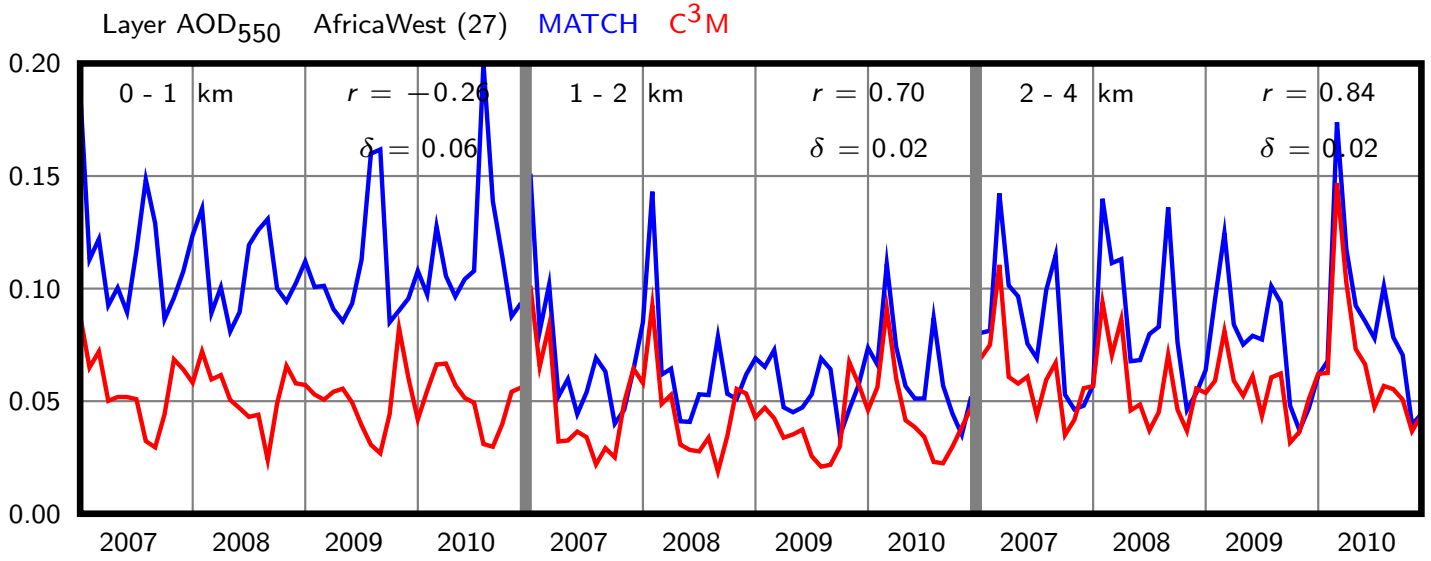


AmazoniaEast (26)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.012	0.207	-0.143	0.087	0.000
MATCH Subsample	-0.011	0.203	-0.131	0.118	0.000
MODIS	-0.017	0.229	-0.188	0.024	0.000

Table 27 : $\mathrm{AOD}_{550} = b\ t + a$

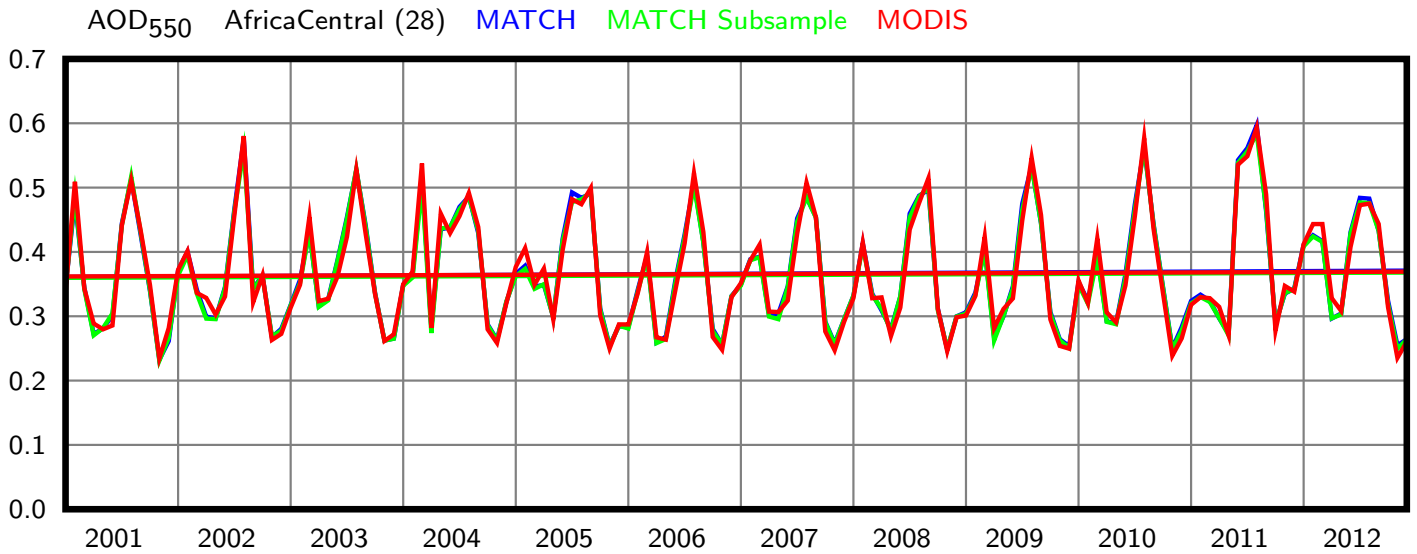

AOD550 AfricaWest (27) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

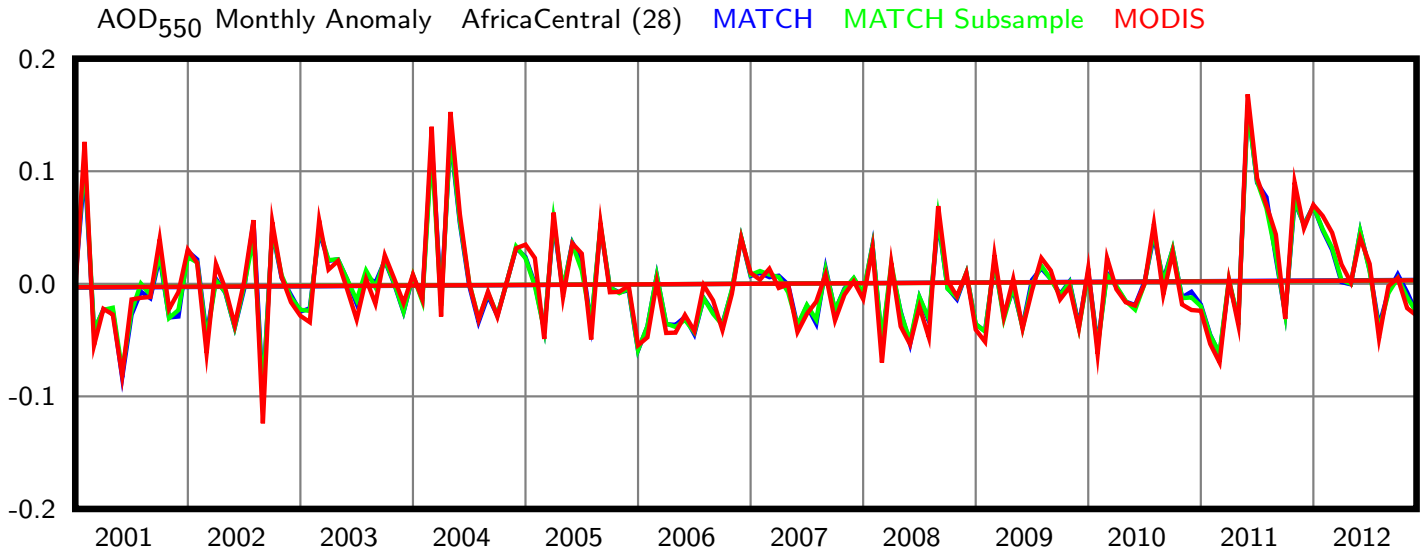

AOD550 Monthly Anomaly AfricaWest (27) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

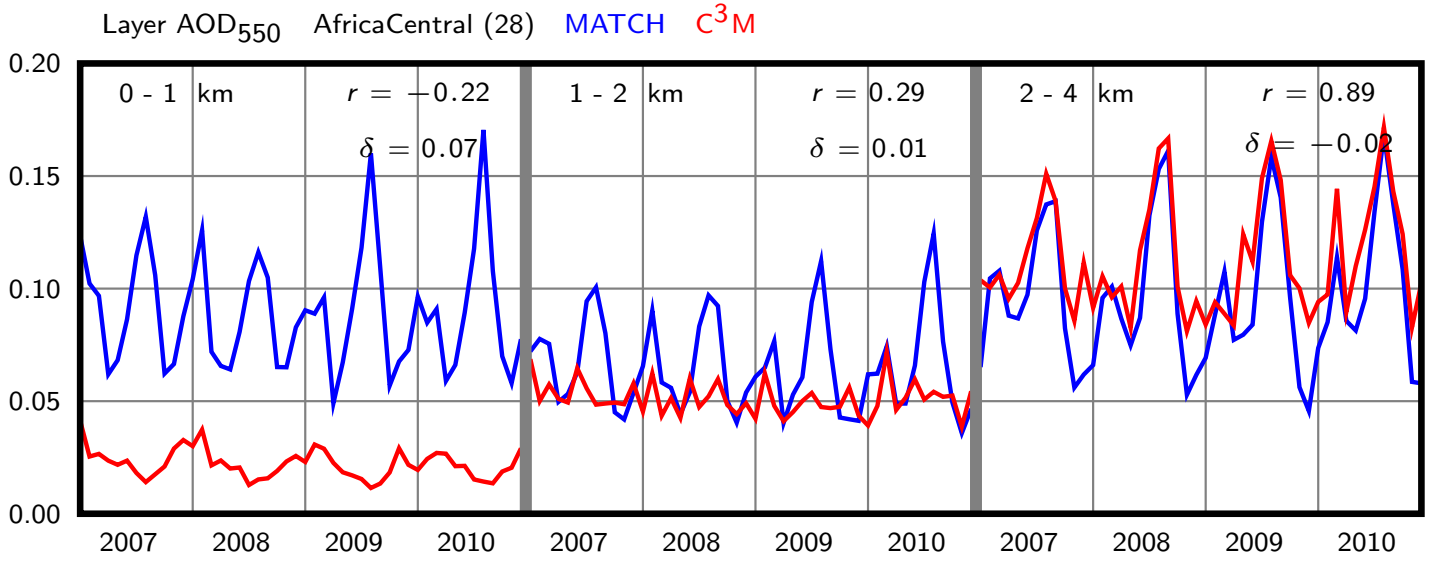


AfricaWest (27)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.010	0.311	-0.050	0.552	0.000
MATCH Subsample	-0.008	0.309	-0.043	0.610	0.000
MODIS	-0.003	0.327	-0.012	0.886	0.000

Table 28 : $\mathrm{AOD}_{550} = b\ t + a$

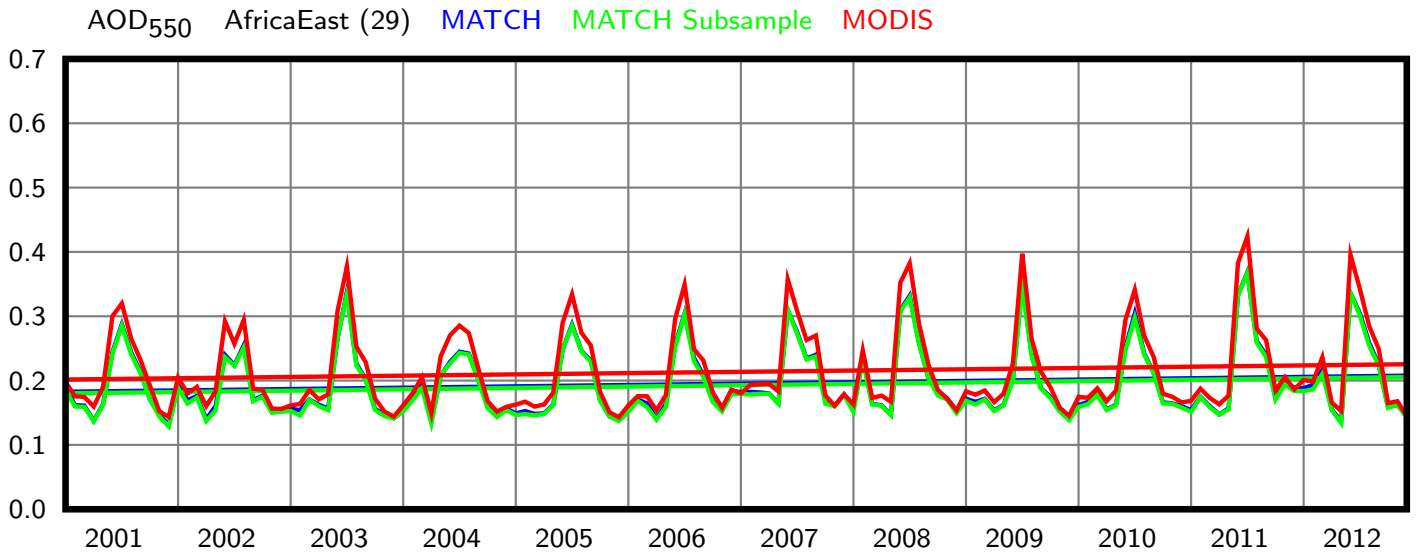

AOD550 AfricaCentral (28) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

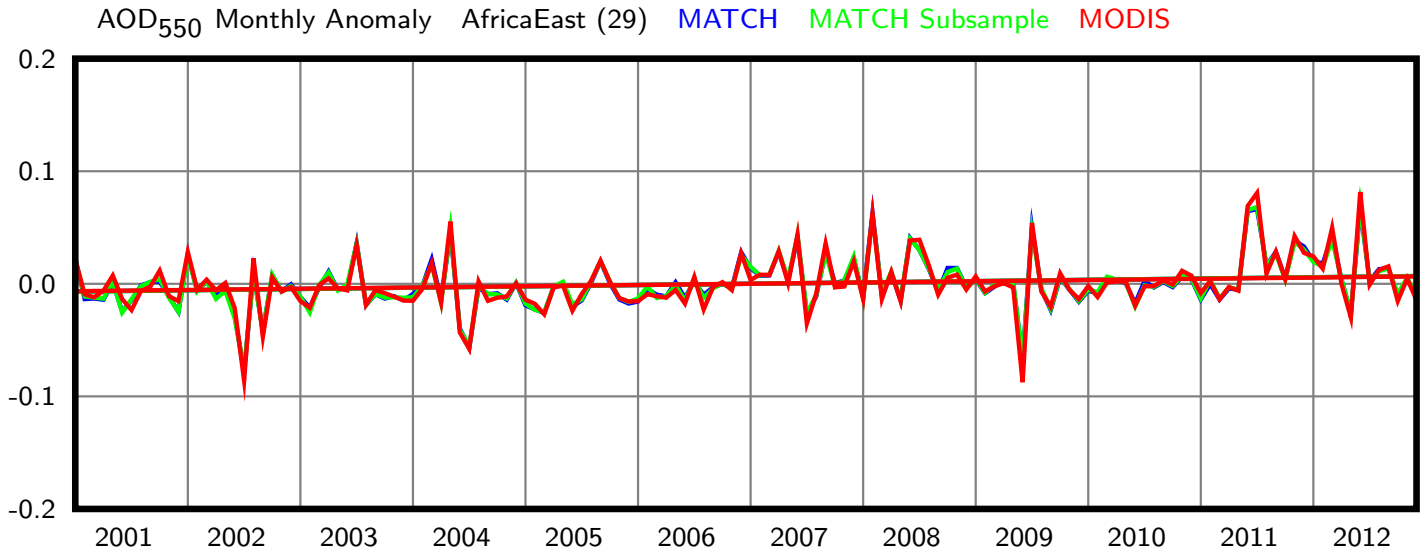

AOD550 Monthly Anomaly AfricaCentral (28) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

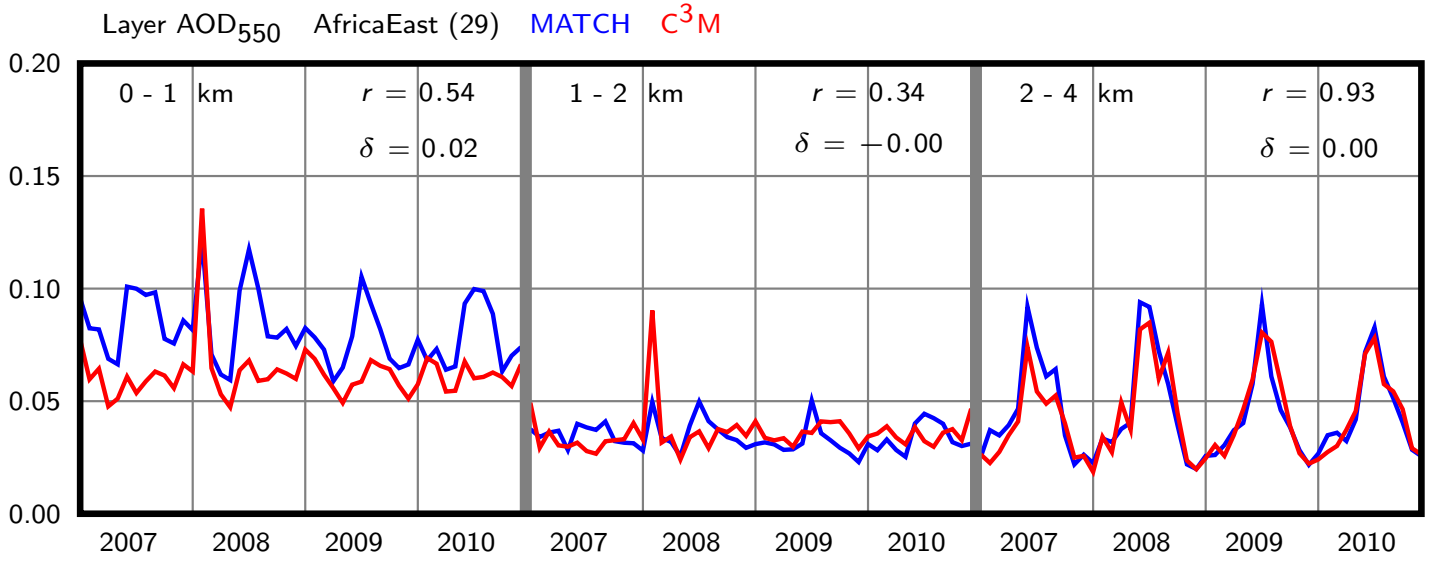


AfricaCentral (28)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.008	0.361	0.034	0.690	0.000
MATCH Subsample	0.007	0.360	0.028	0.737	0.000
MODIS	0.006	0.362	0.025	0.766	0.000

Table 29 : $\mathrm{AOD}_{550} = b\ t + a$

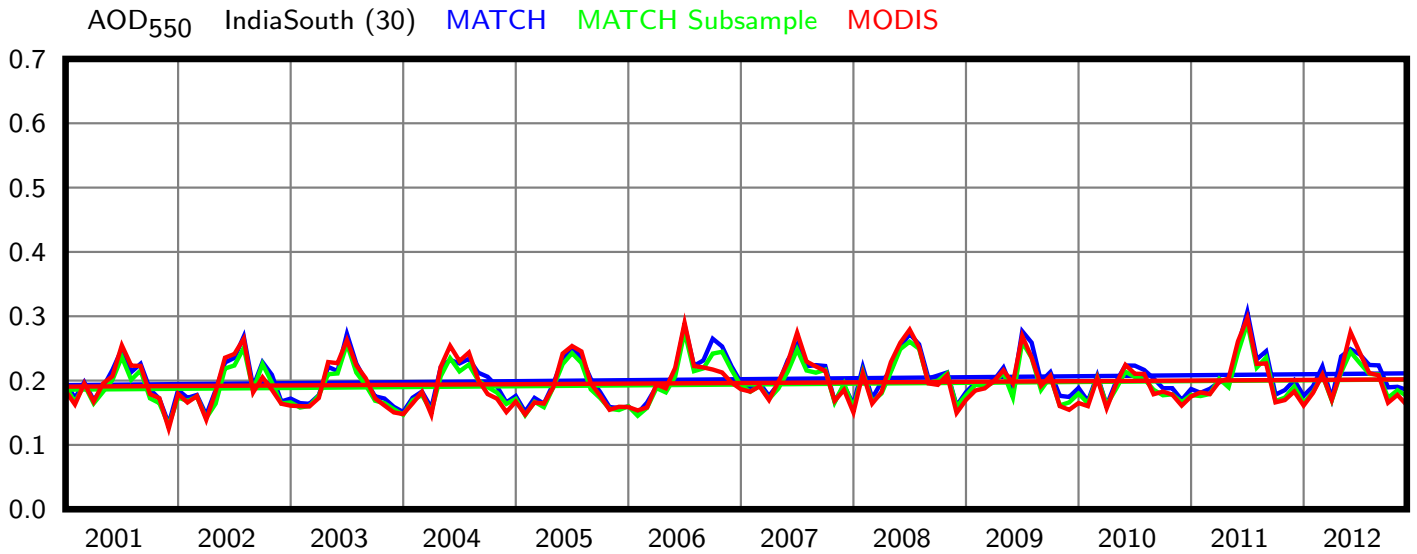

AOD550 AfricaEast (29) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

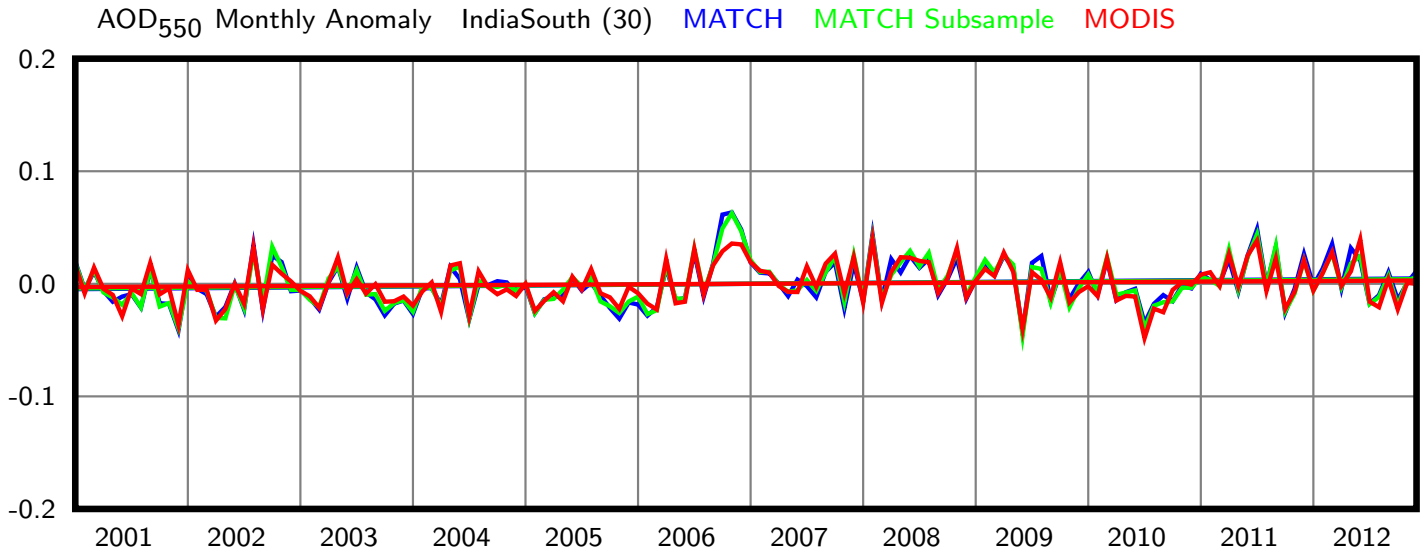

AOD550 Monthly Anomaly AfricaEast (29) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

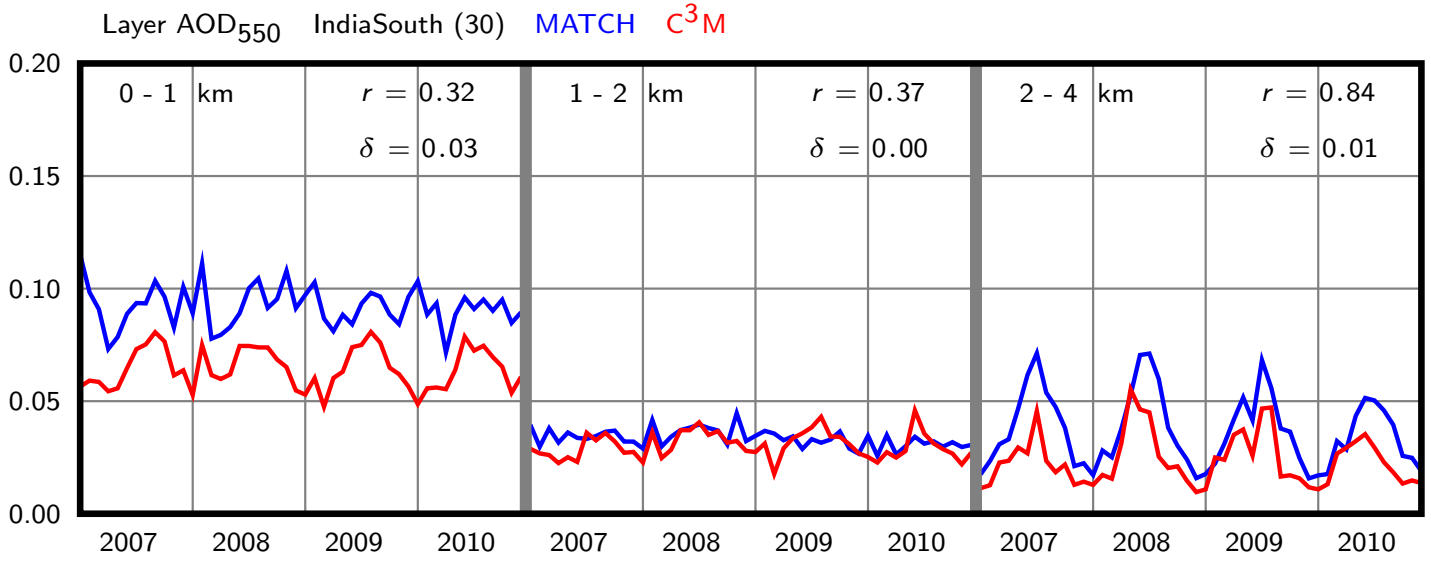


AfricaEast (29)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.021	0.183	0.138	0.100	0.000
MATCH Subsample	0.021	0.180	0.139	0.096	0.000
MODIS	0.020	0.202	0.106	0.204	0.000

Table 30 : $\mathrm{AOD}_{550} = b\ t + a$

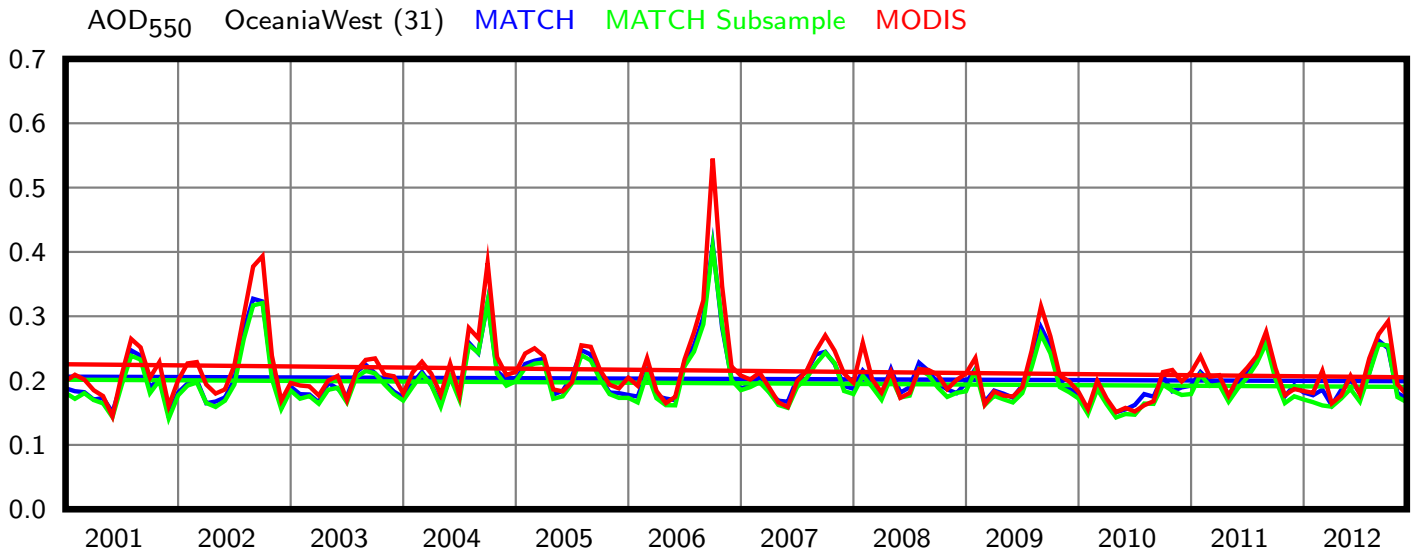

AOD550 IndiaSouth (30) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

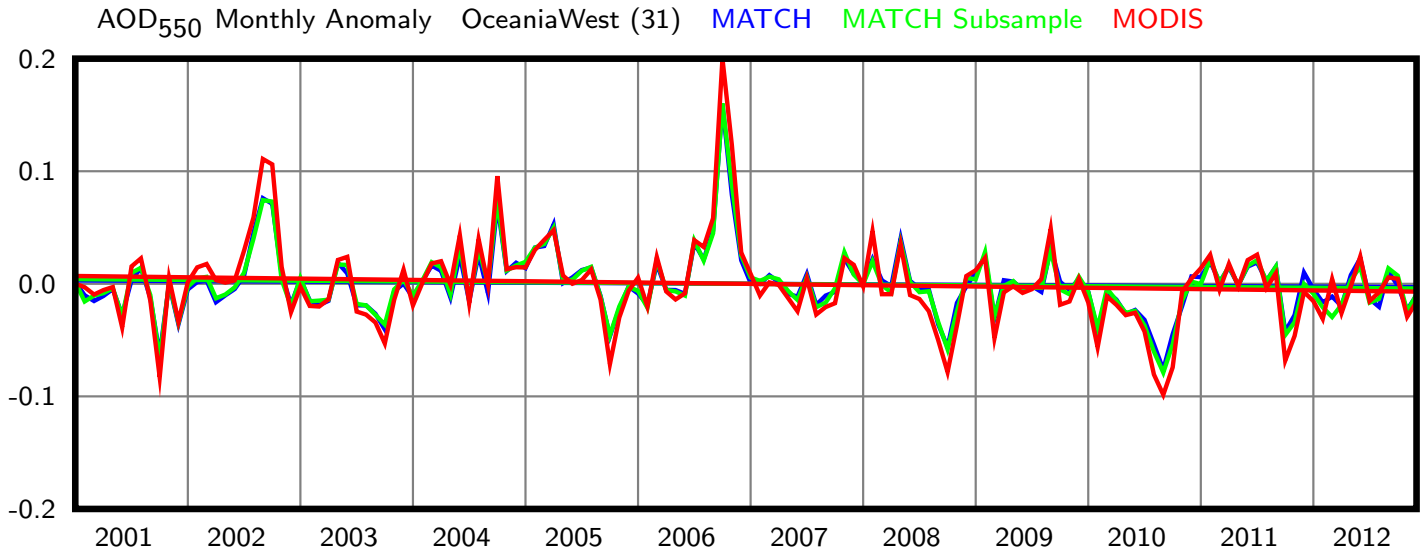

AOD550 Monthly Anomaly IndiaSouth (30) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

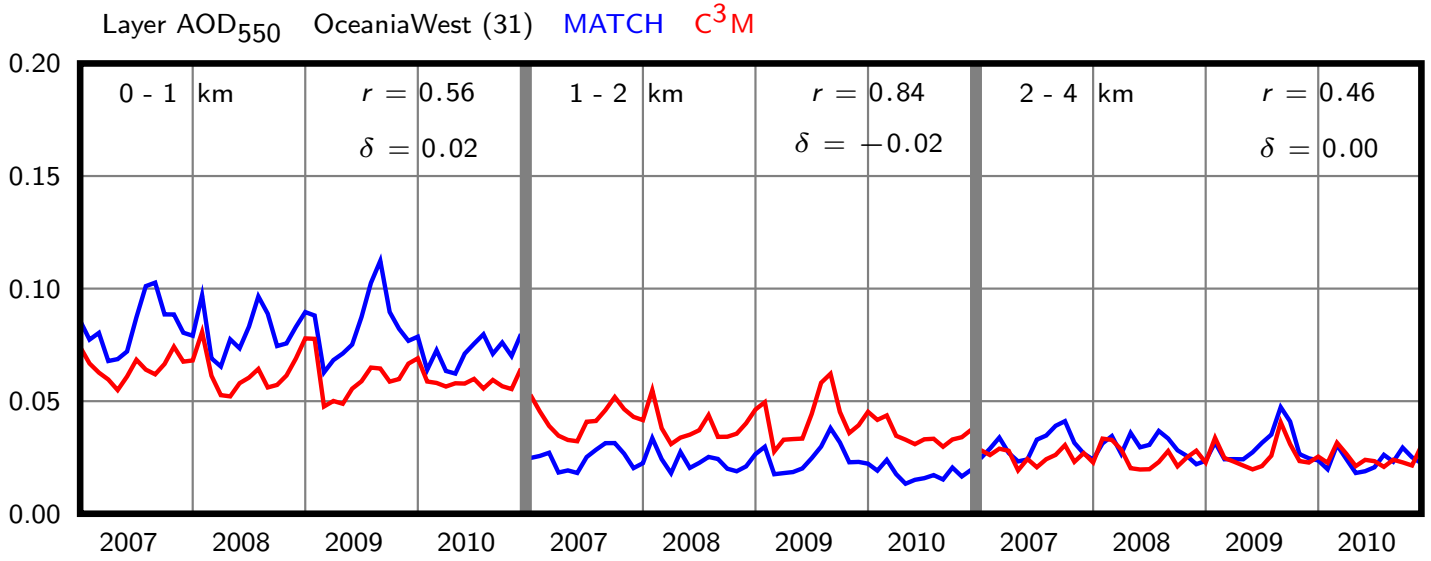


IndiaSouth (30)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.015	0.193	0.164	0.049	0.000
MATCH Subsample	0.013	0.186	0.153	0.068	0.000
MODIS	0.009	0.191	0.094	0.264	0.000

Table 31 : $\mathrm{AOD}_{550} = b\ t + a$

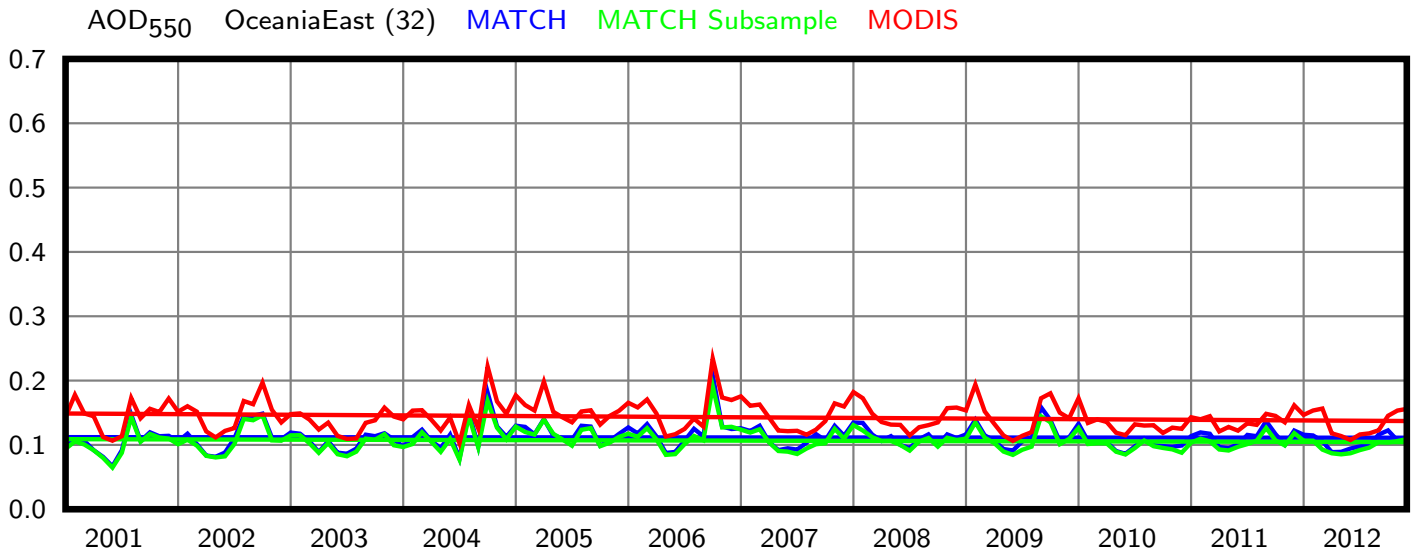

AOD550 OceaniaWest (31) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

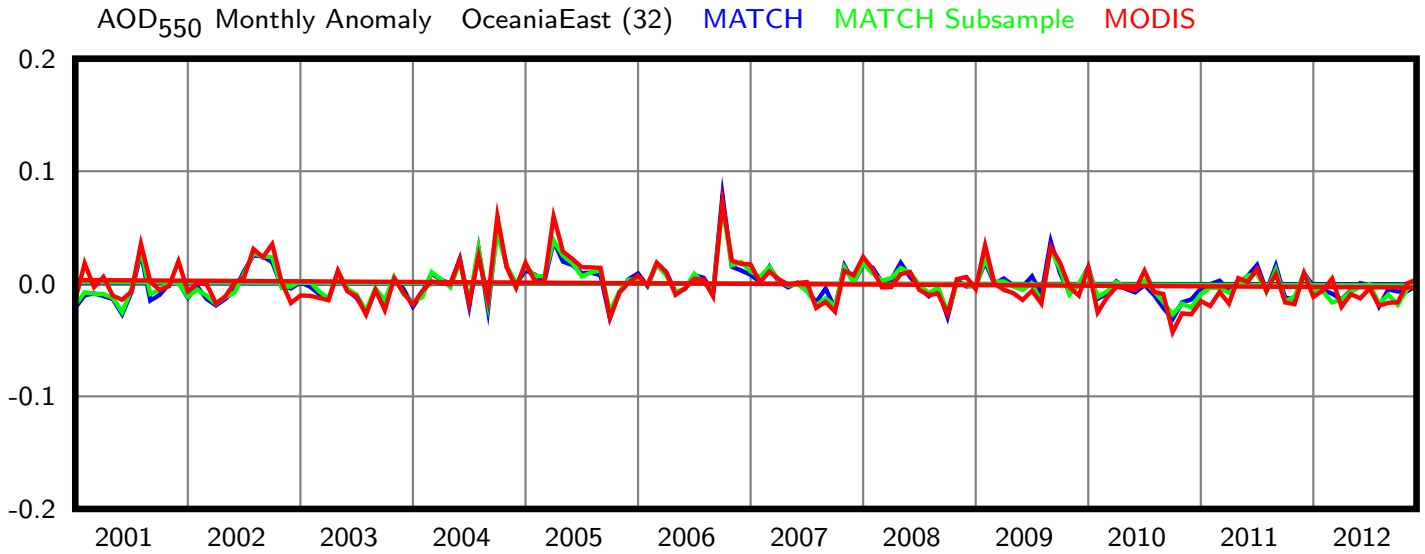

AOD550 Monthly Anomaly OceaniaWest (31) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

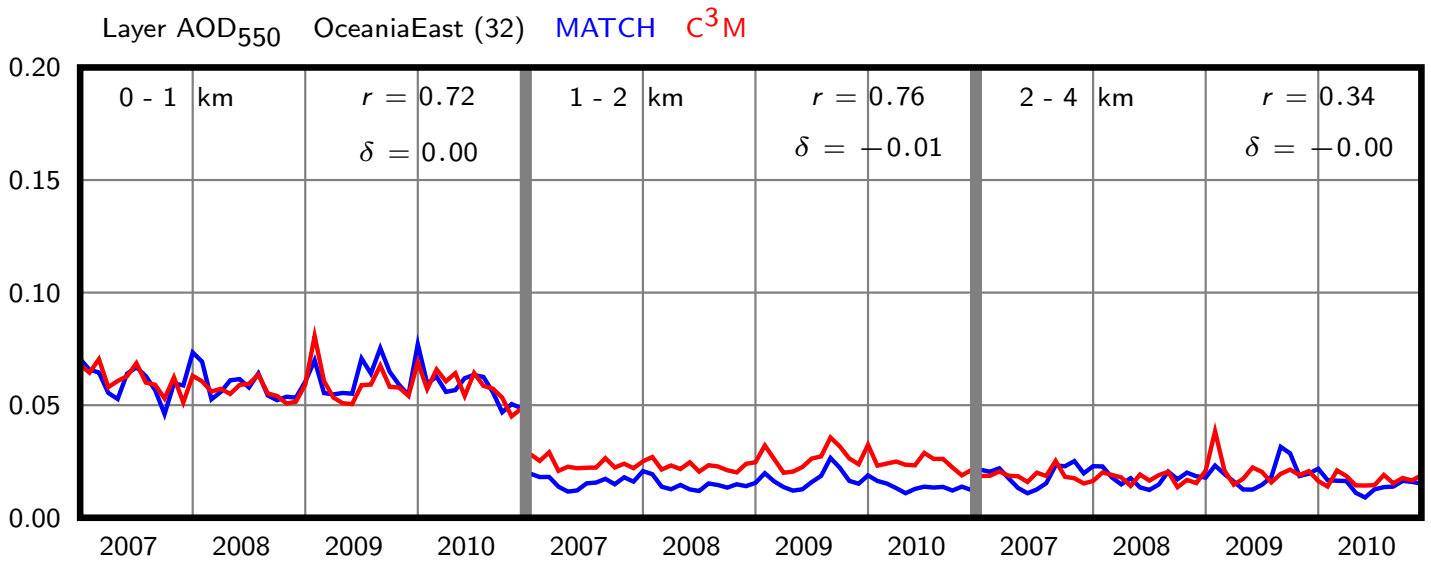


OceaniaWest (31)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.006	0.206	-0.054	0.523	0.000
MATCH Subsample	-0.009	0.201	-0.084	0.316	0.000
MODIS	-0.017	0.225	-0.114	0.172	0.000

Table 32 : $\mathrm{AOD}_{550} = b\ t + a$

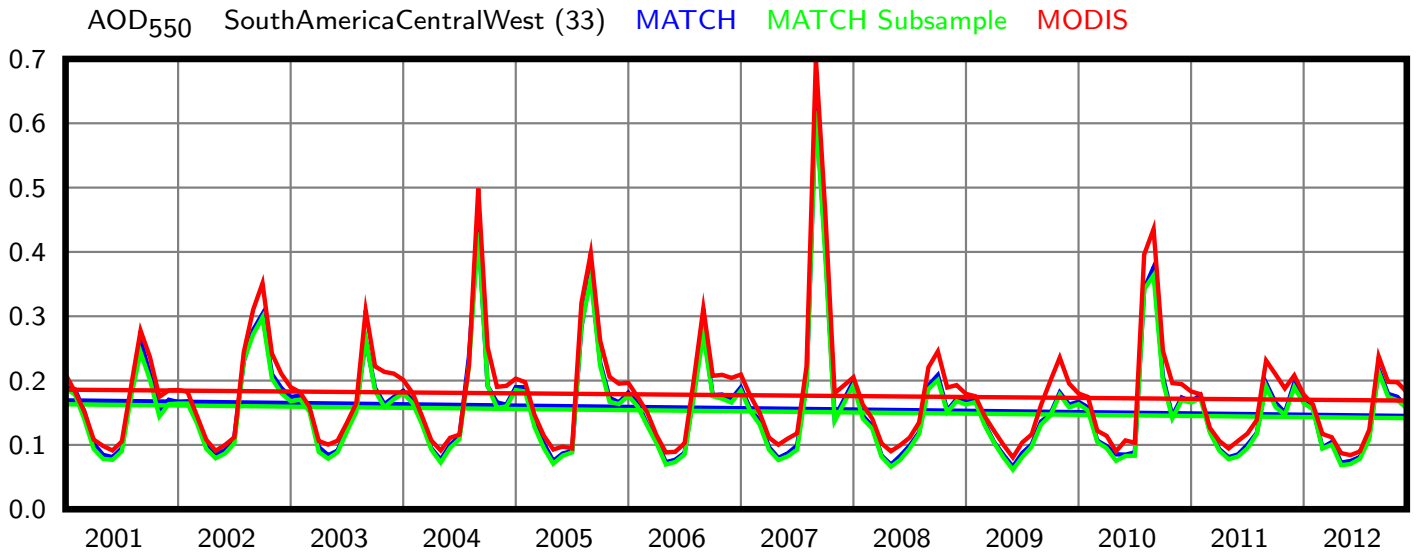

AOD550 OceaniaEast (32) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

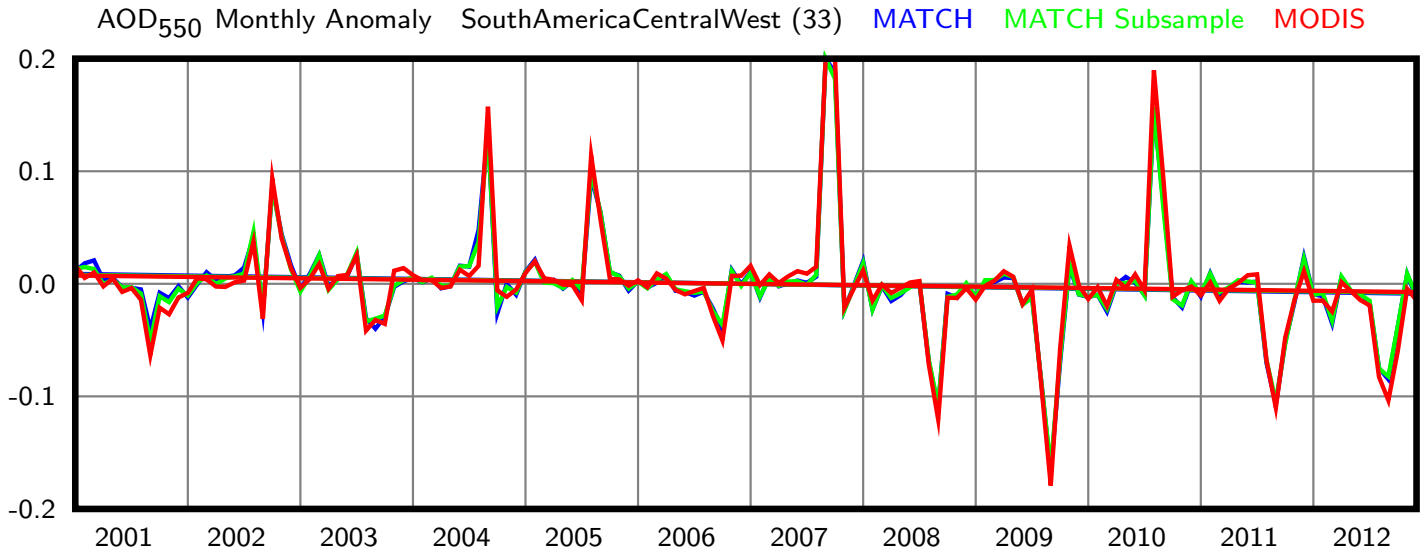

AOD550 Monthly Anomaly OceaniaEast (32) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

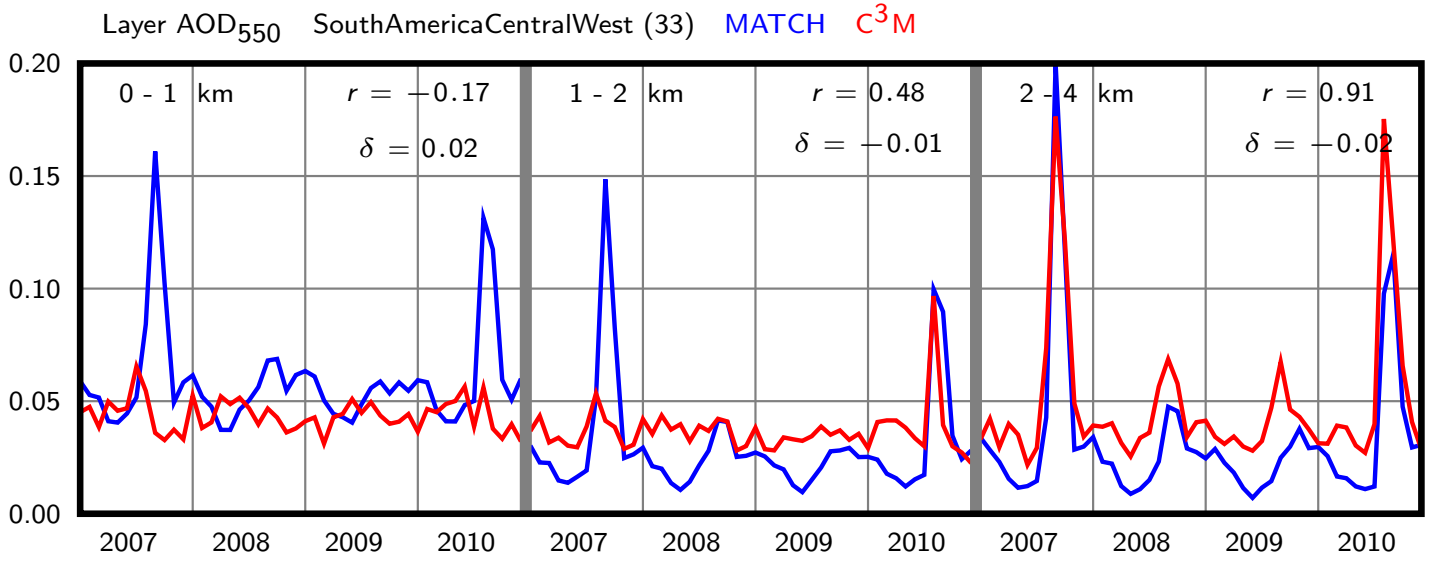


OceaniaEast (32)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.001	0.112	-0.014	0.868	0.000
MATCH Subsample	-0.004	0.109	-0.075	0.374	0.000
MODIS	-0.010	0.149	-0.149	0.075	0.000

Table 33 : $\mathrm{AOD}_{550} = b\ t + a$

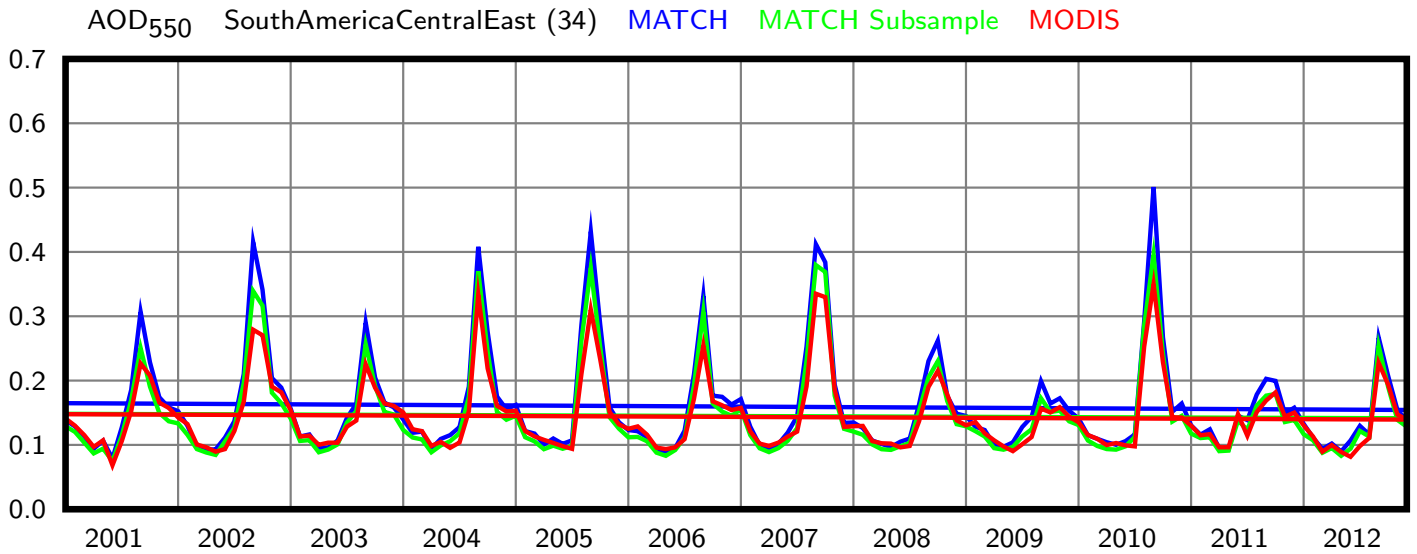

AOD550 SouthAmericaCentralWest (33) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

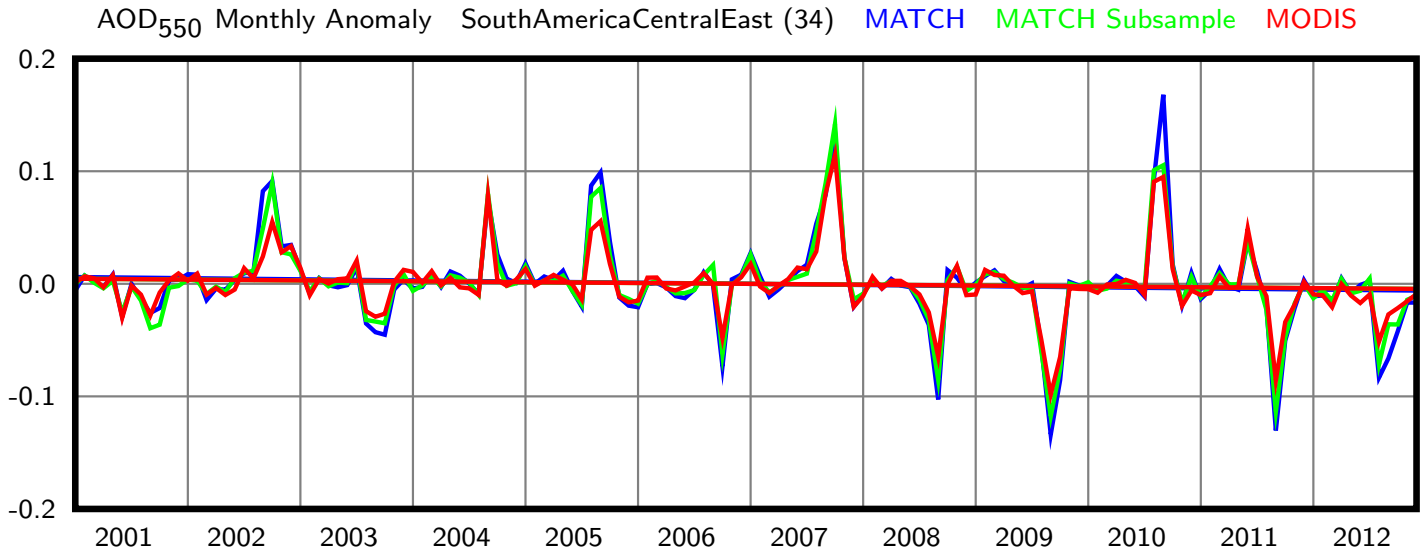

AOD550 Monthly Anomaly SouthAmericaCentralWest (33) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

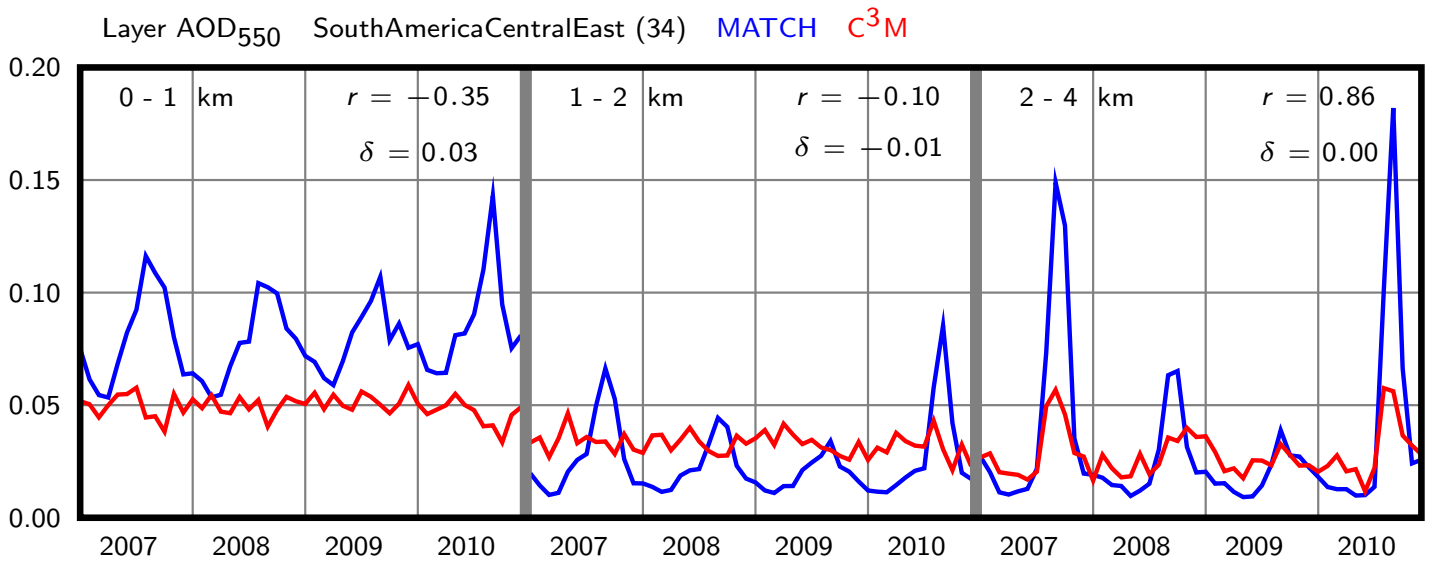


SouthAmericaCentralWest (33)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.020	0.169	-0.090	0.283	0.000
MATCH Subsample	-0.018	0.163	-0.081	0.334	0.000
MODIS	-0.014	0.186	-0.056	0.504	0.000

Table 34 : $\mathrm{AOD}_{550} = b\ t + a$

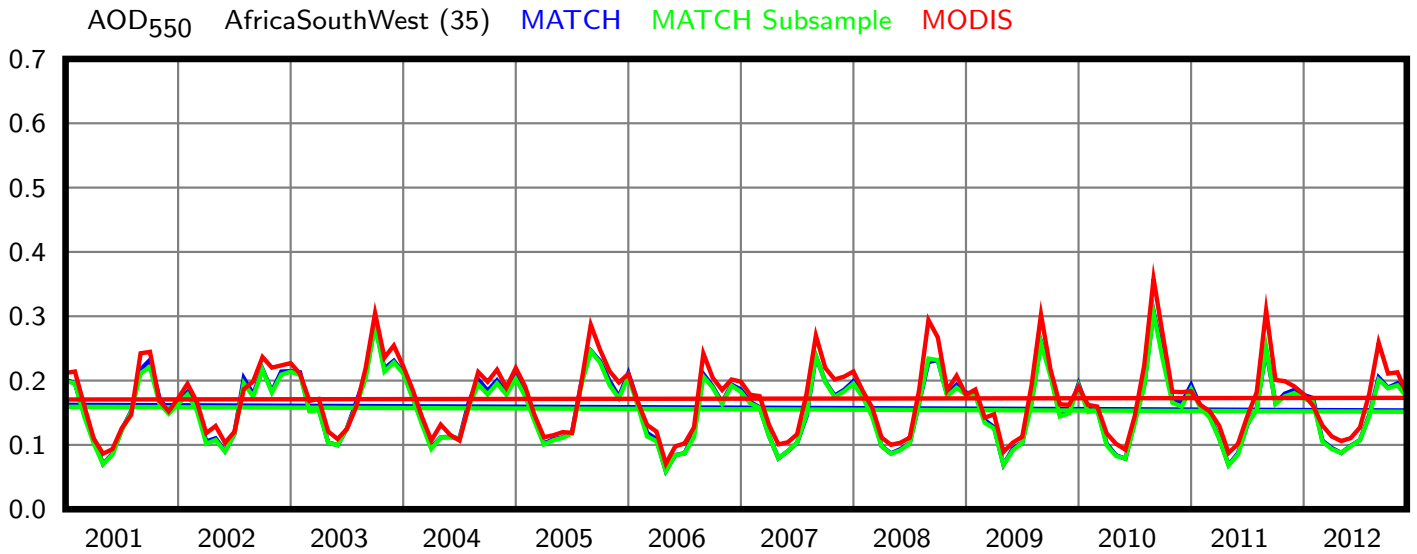

AOD550 SouthAmericaCentralEast (34) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

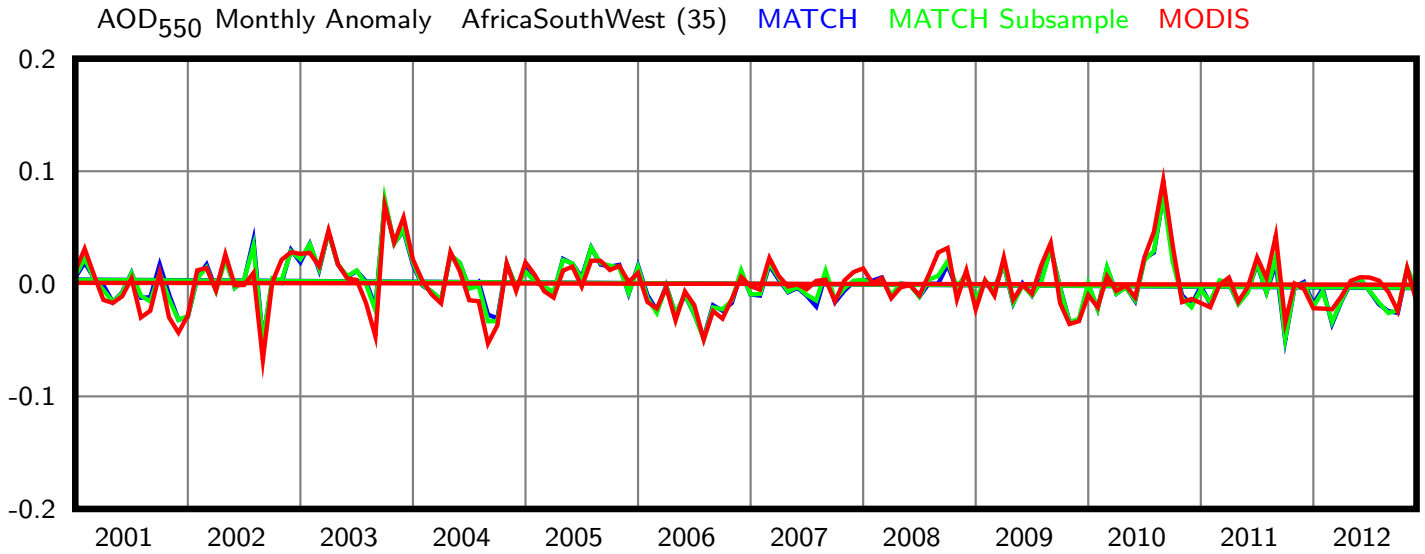

AOD550 Monthly Anomaly SouthAmericaCentralEast (34) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

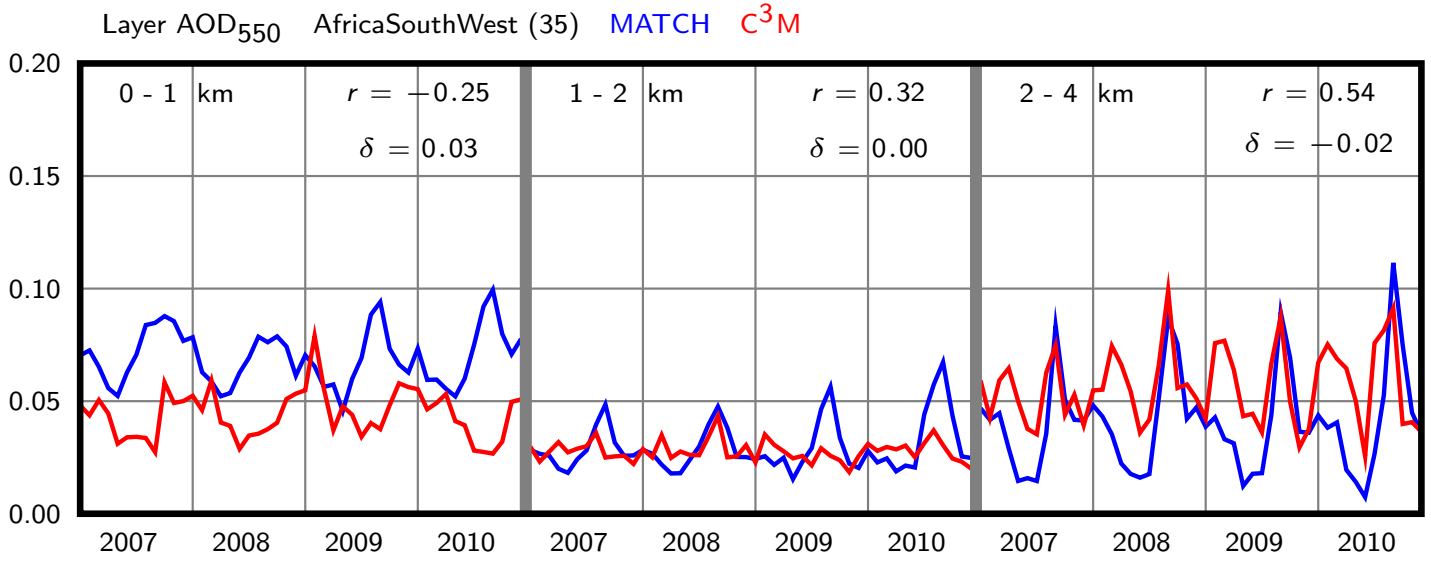


SouthAmericaCentralEast (34)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.009	0.165	-0.039	0.639	0.000
MATCH Subsample	-0.006	0.148	-0.030	0.722	0.000
MODIS	-0.007	0.148	-0.044	0.596	0.000

Table 35 : $\mathrm{AOD}_{550} = b\ t + a$

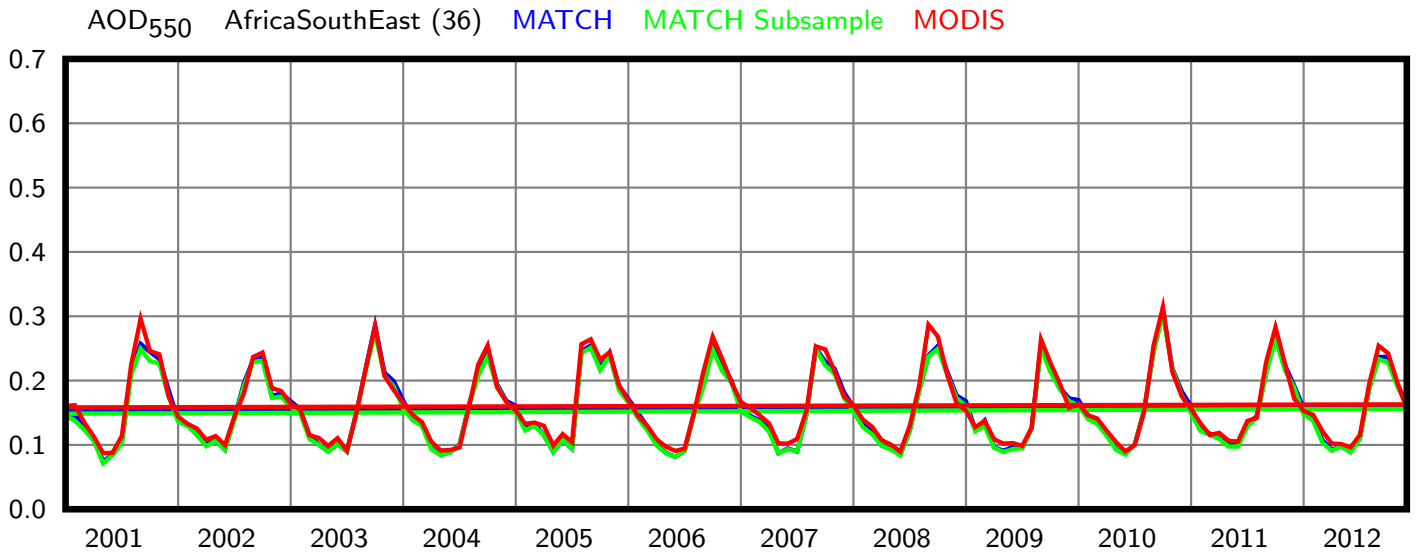

AOD550 AfricaSouthWest (35) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

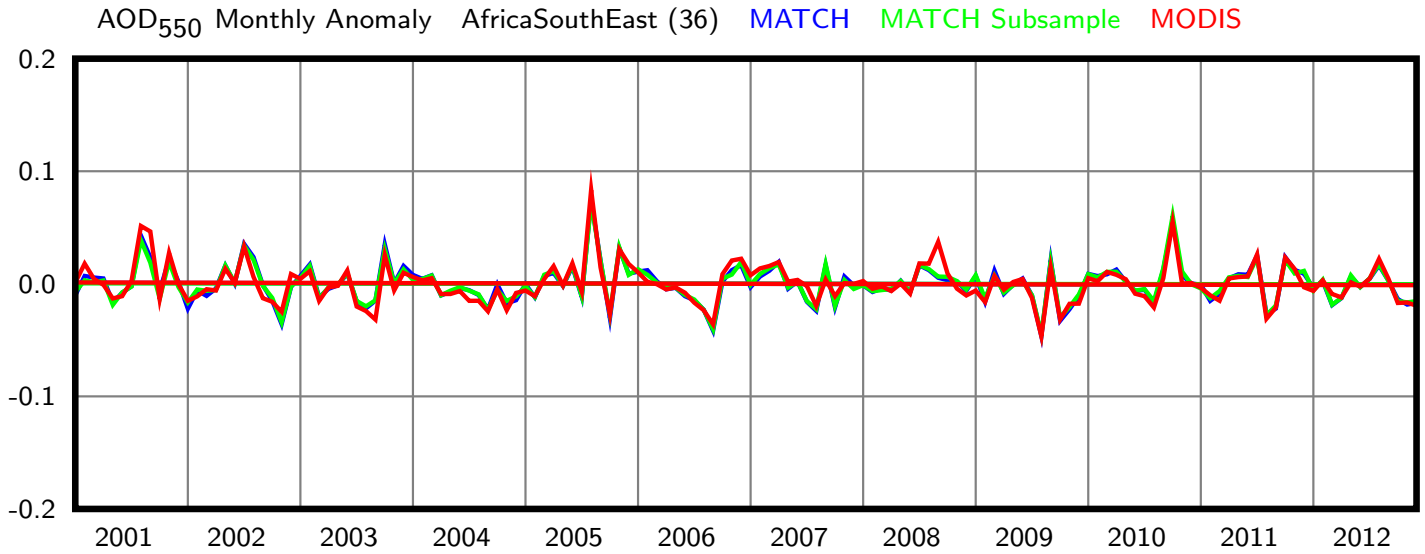

AOD550 Monthly Anomaly AfricaSouthWest (35) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

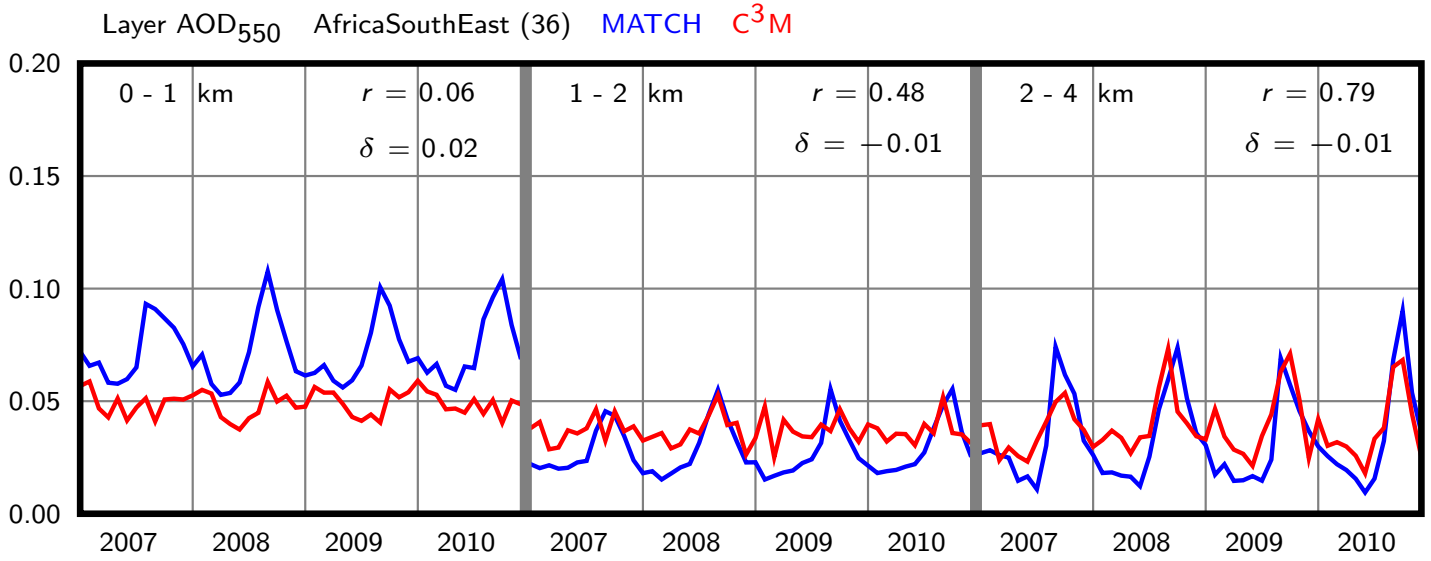


AfricaSouthWest (35)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.007	0.162	-0.051	0.542	0.000
MATCH Subsample	-0.006	0.159	-0.045	0.590	0.000
MODIS	0.002	0.171	0.014	0.870	0.000

Table 36 : $\mathrm{AOD}_{550} = b\ t + a$

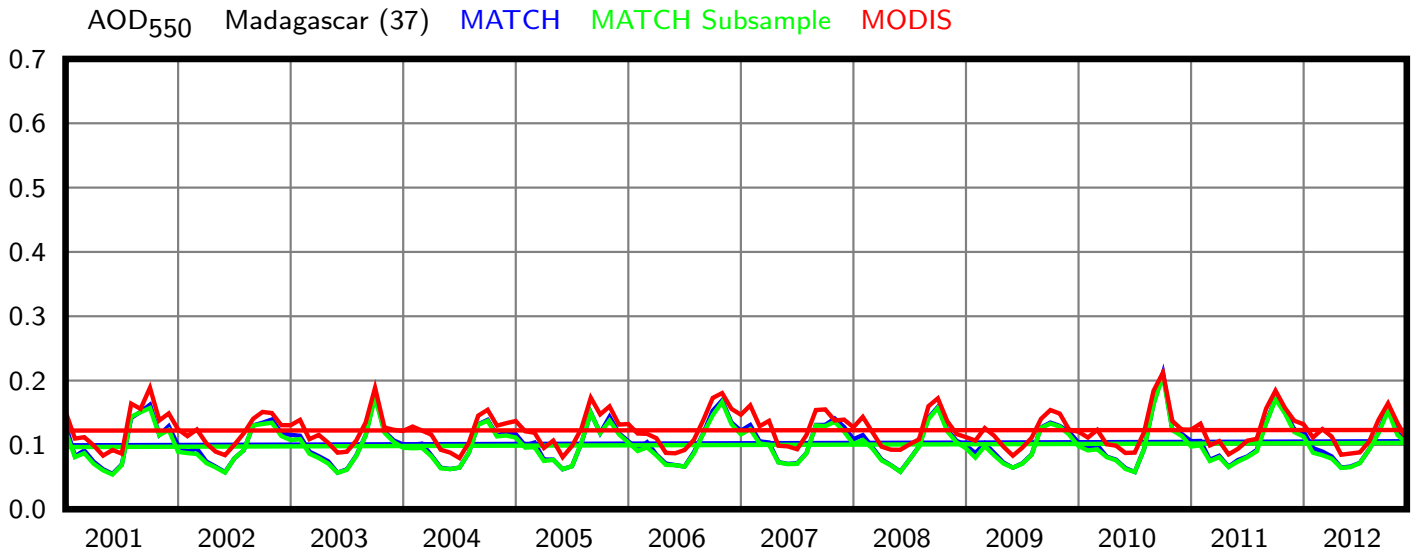

AOD550 AfricaSouthEast (36) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

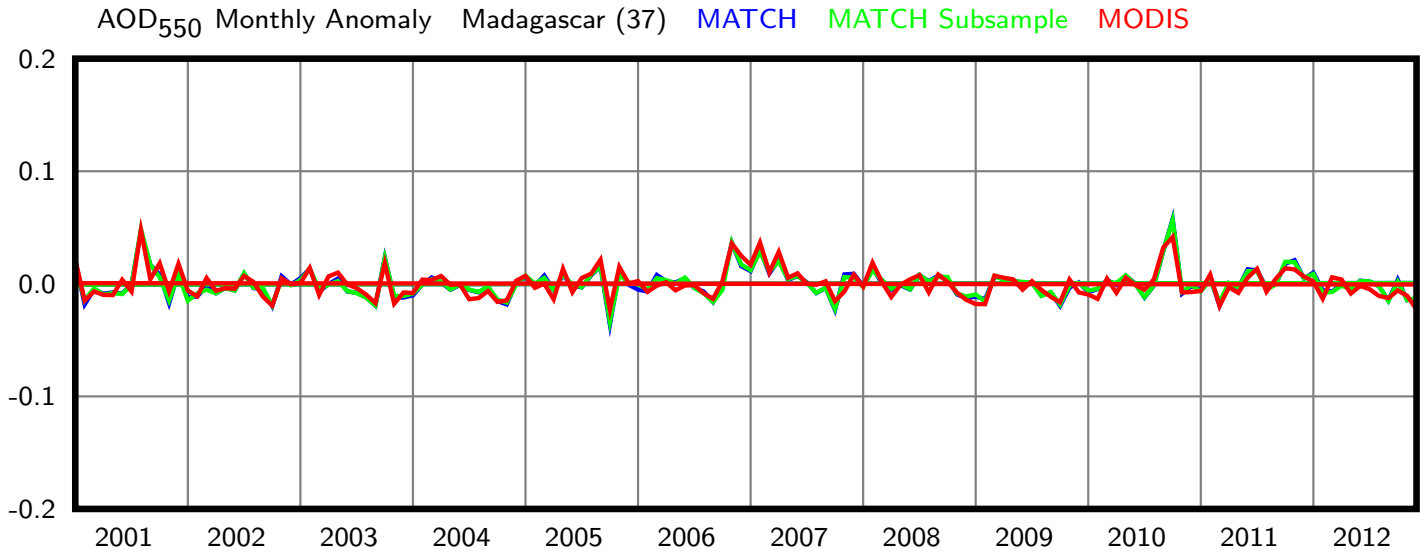

AOD550 Monthly Anomaly AfricaSouthEast (36) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

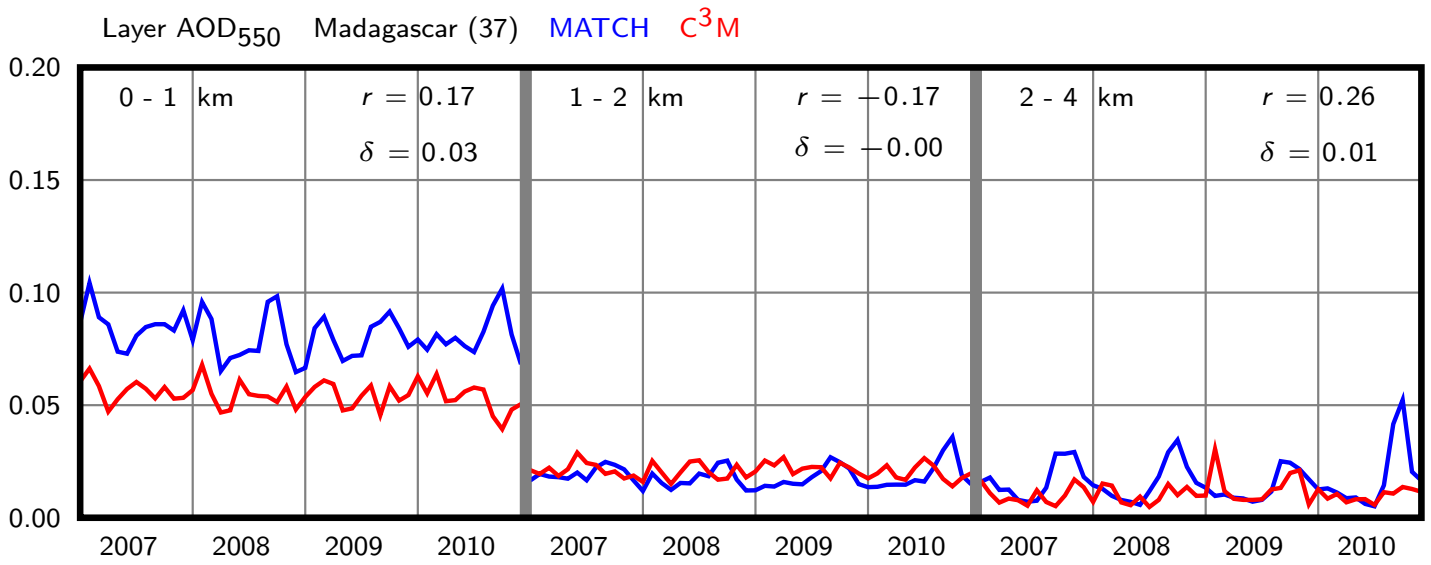


AfricaSouthEast (36)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.005	0.153	0.032	0.700	0.000
MATCH Subsample	0.006	0.149	0.041	0.627	0.000
MODIS	0.004	0.158	0.025	0.769	0.000

Table 37 : $\mathrm{AOD}_{550} = b\ t + a$

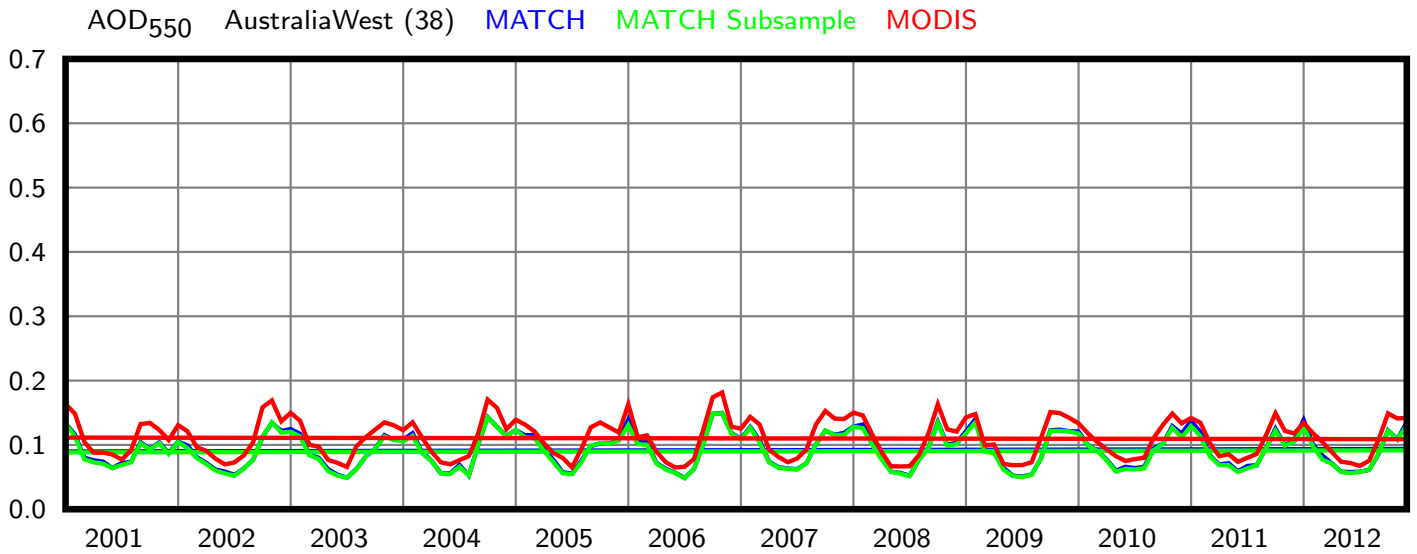

AOD550 Madagascar (37) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

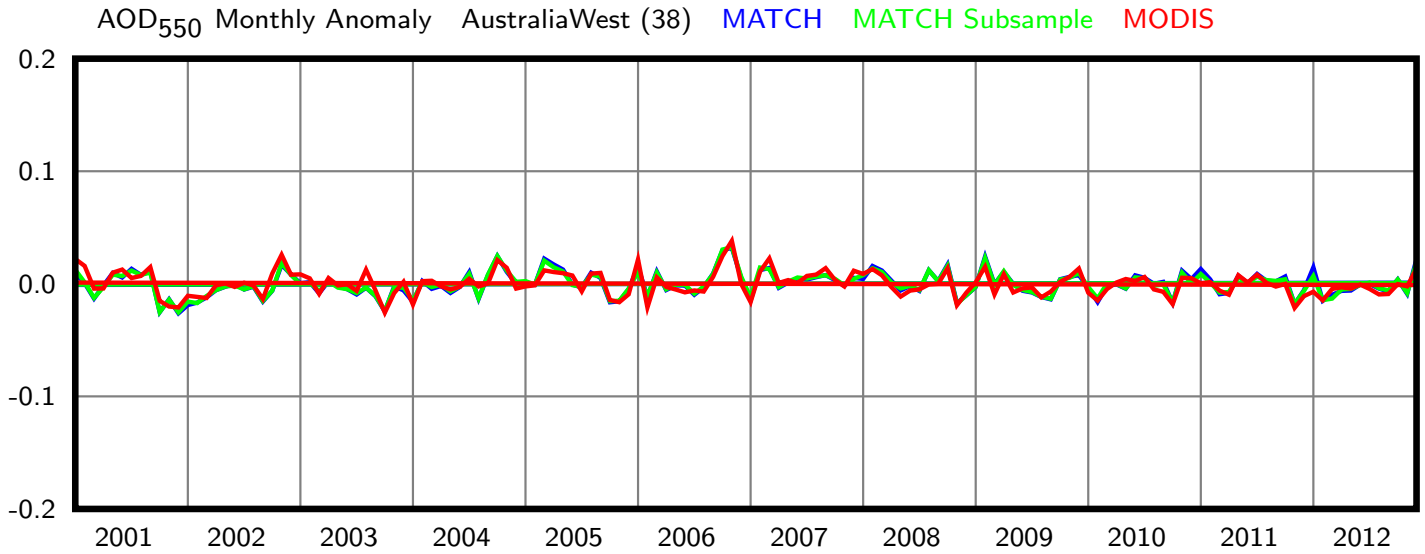

AOD550 Monthly Anomaly Madagascar (37) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

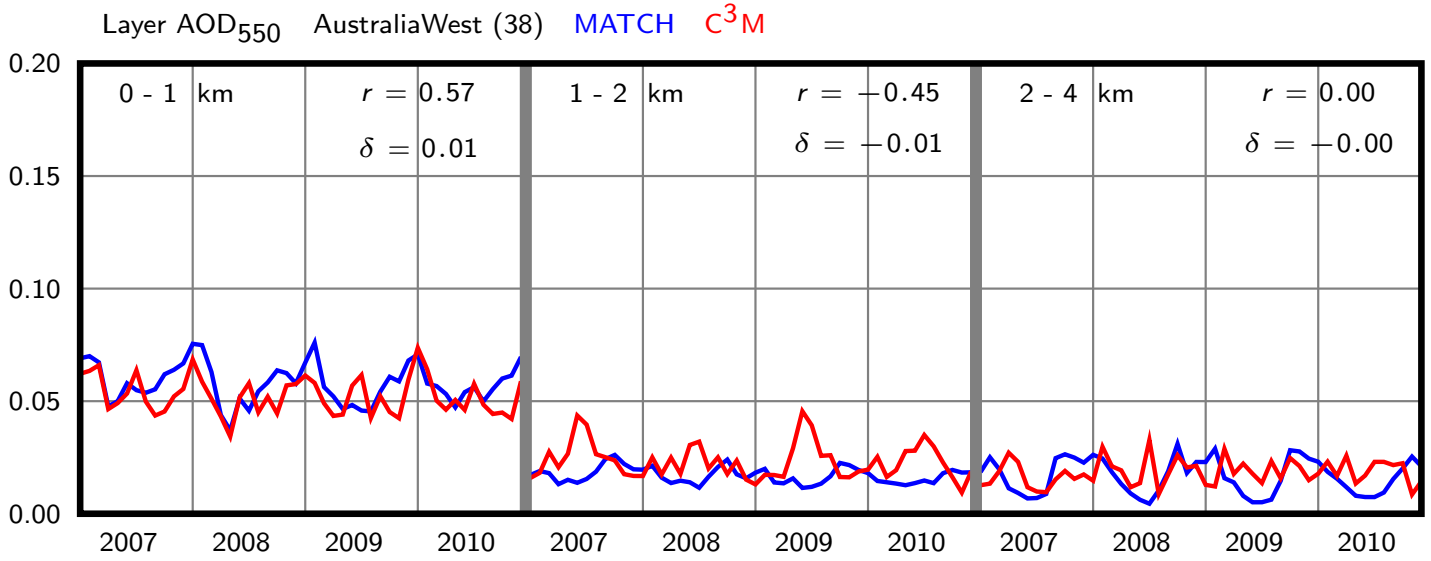


Madagascar (37)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.005	0.099	0.061	0.467	0.000
MATCH Subsample	0.005	0.097	0.063	0.450	0.000
MODIS	0.001	0.122	0.009	0.913	0.000

Table 38 : $\mathrm{AOD}_{550} = b\ t + a$

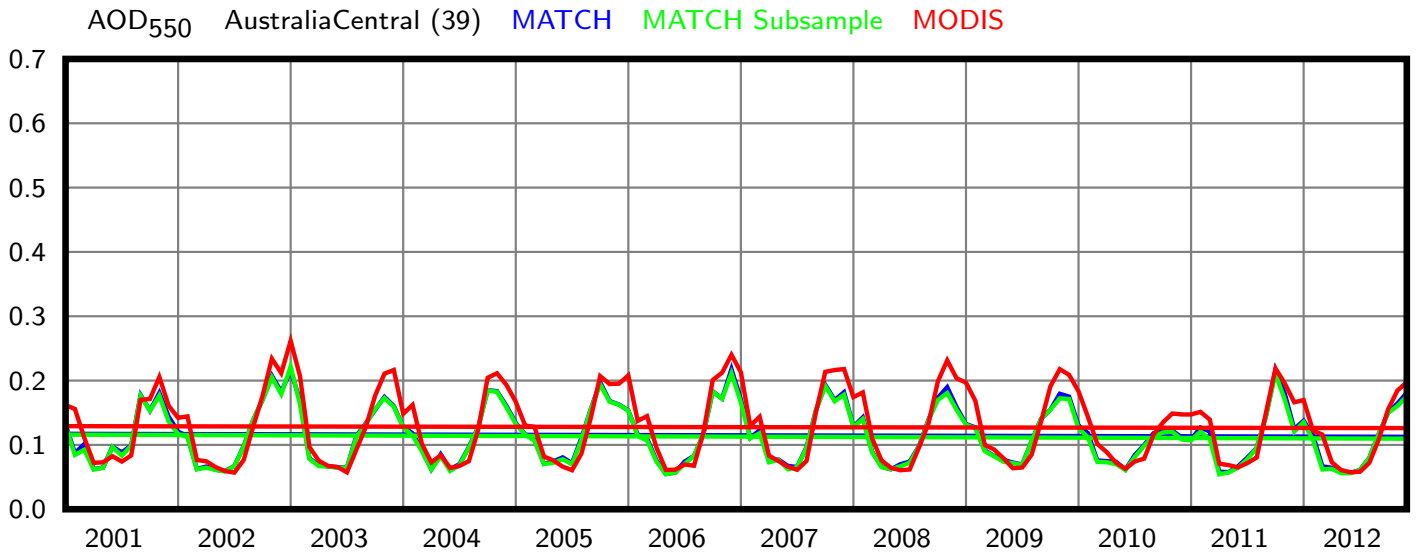

AOD550 AustraliaWest (38) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

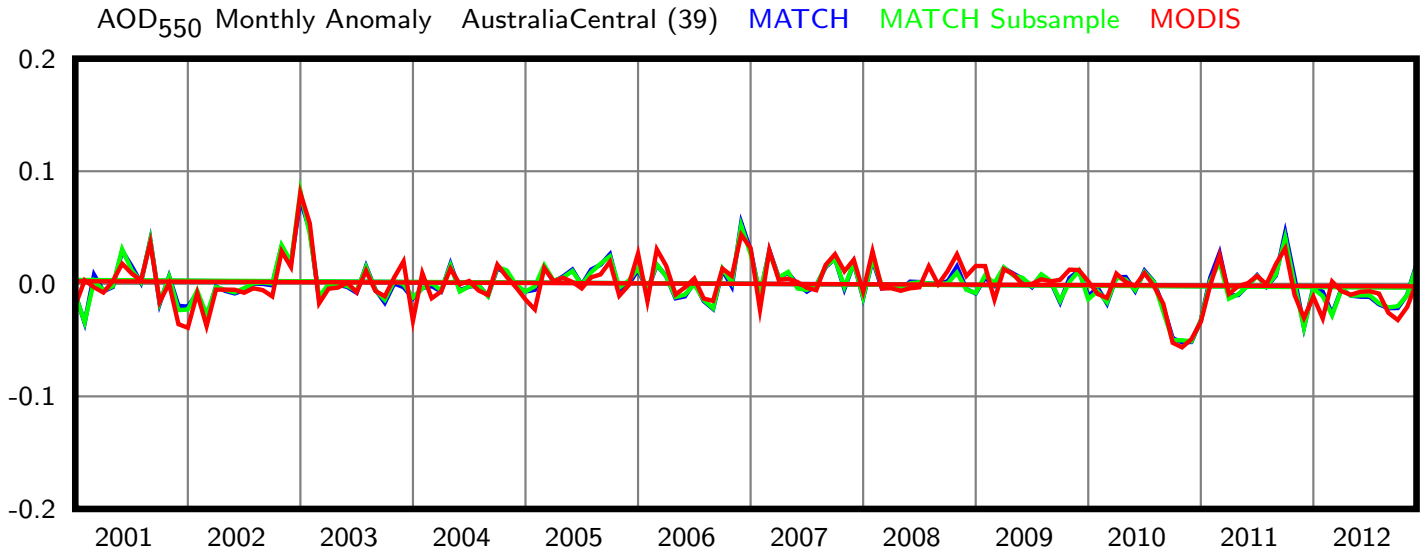

AOD550 Monthly Anomaly AustraliaWest (38) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

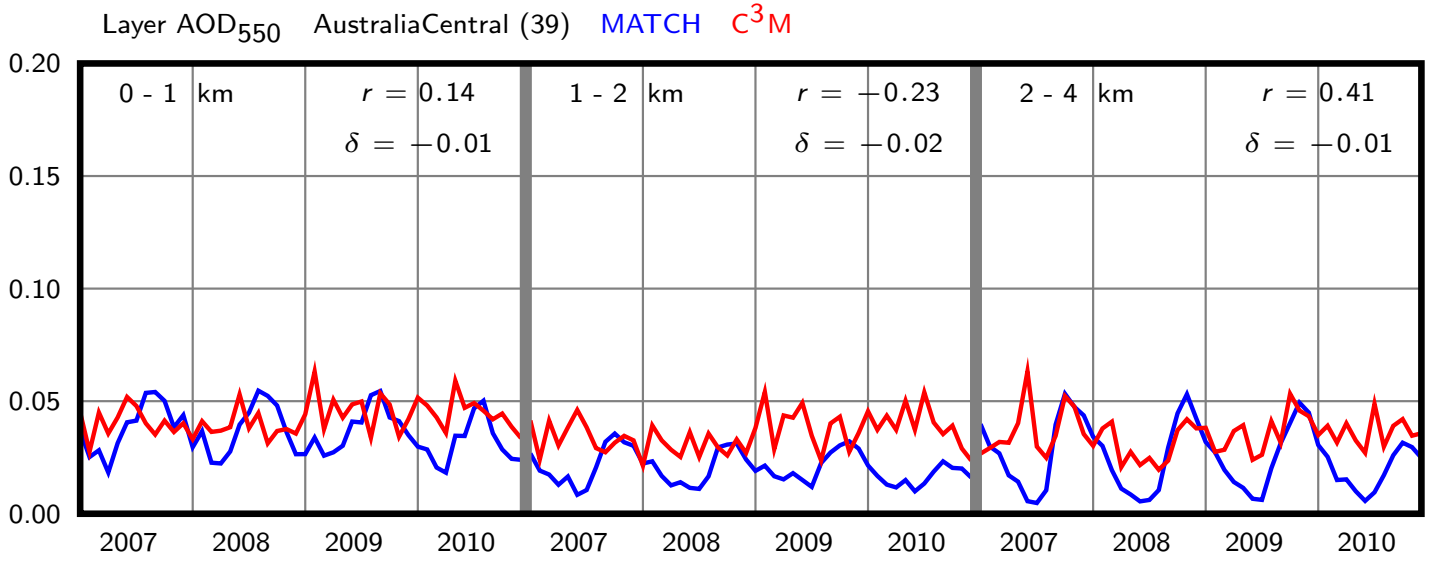


AustraliaWest (38)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.003	0.090	0.043	0.610	0.000
MATCH Subsample	0.003	0.088	0.034	0.684	0.000
MODIS	-0.002	0.111	-0.024	0.780	0.000

Table 39 : $\mathrm{AOD}_{550} = b\ t + a$

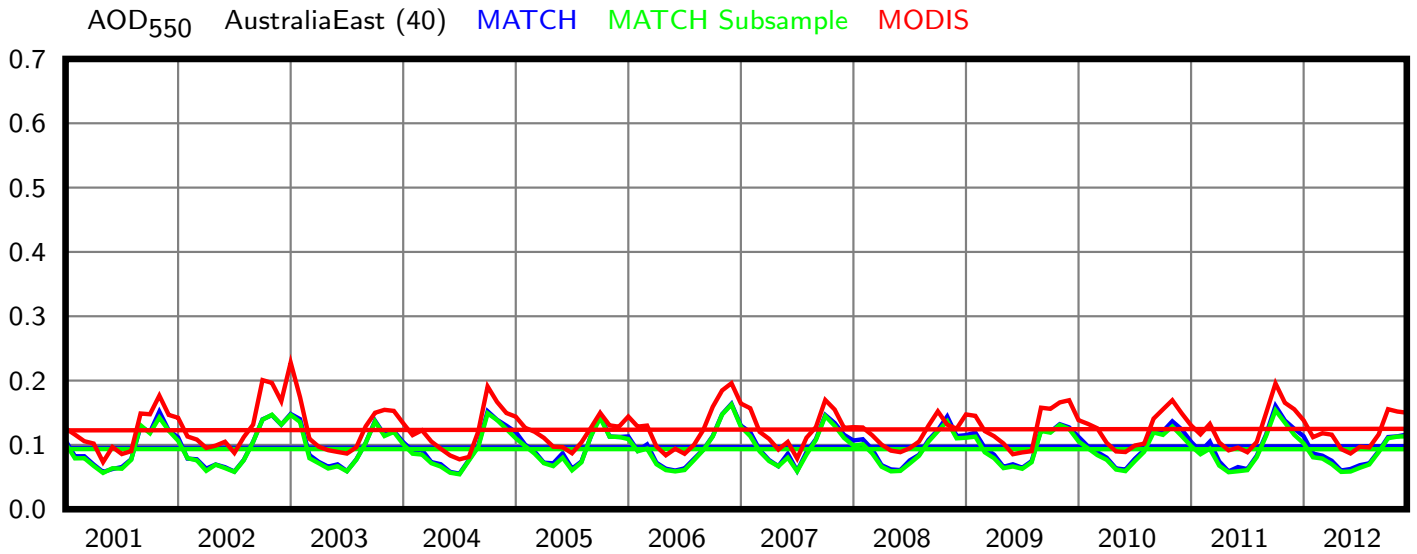

AOD550 AustraliaCentral (39) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

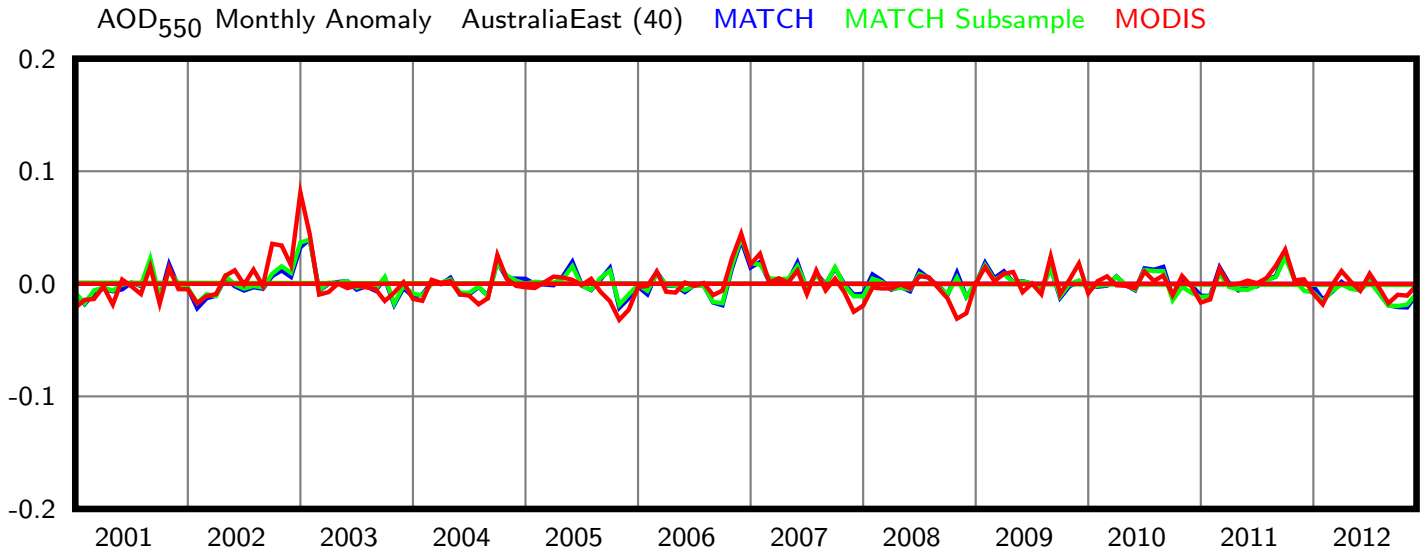

AOD550 Monthly Anomaly AustraliaCentral (39) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

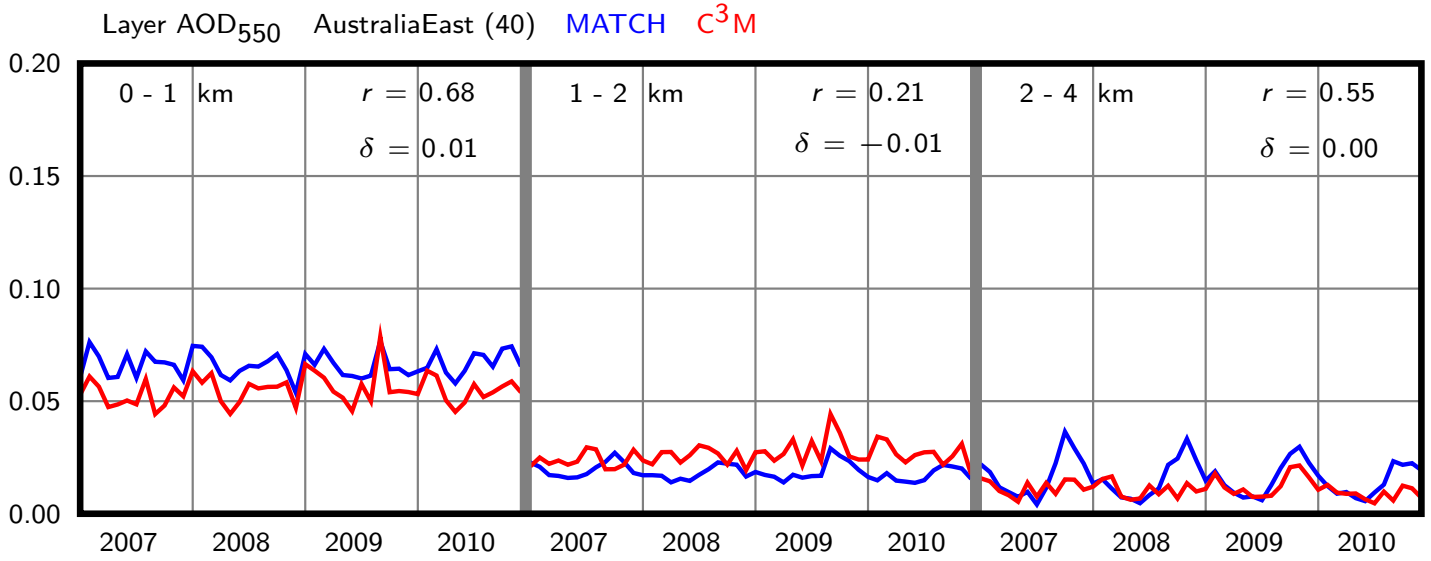


AustraliaCentral (39)	b (decade^{-1})	a	r	p	ϵ
MATCH	-0.004	0.117	-0.030	0.717	0.000
MATCH Subsample	-0.005	0.116	-0.042	0.619	0.000
MODIS	-0.003	0.129	-0.015	0.854	0.000

Table 40 : $\mathrm{AOD}_{550} = b\ t + a$

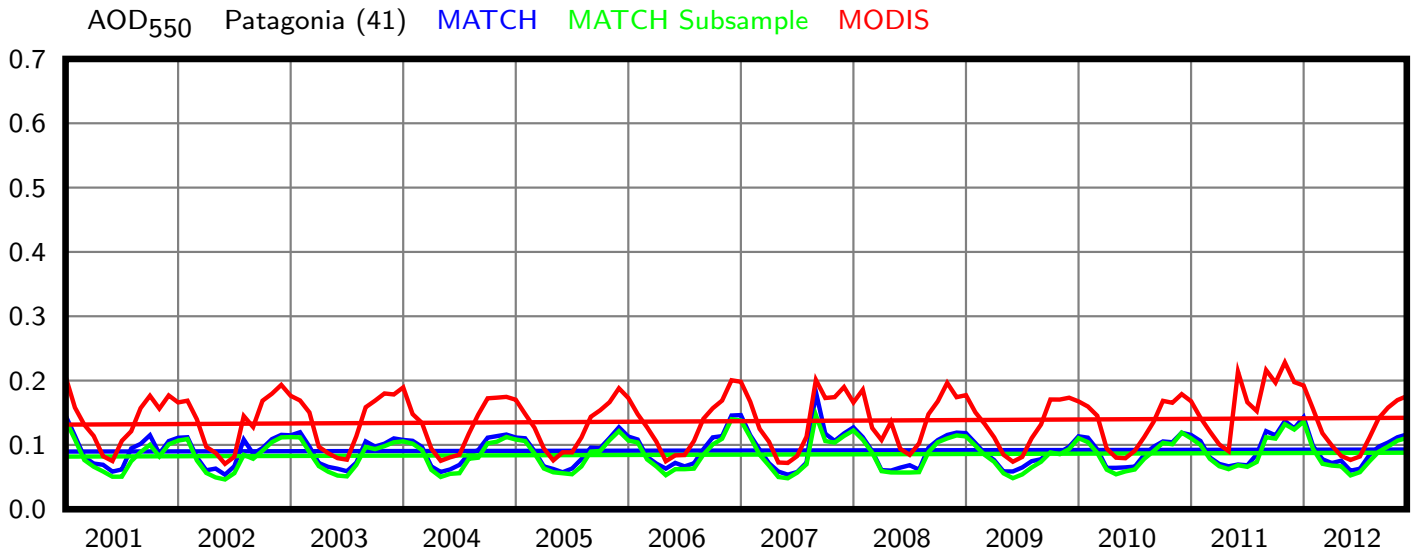

AOD550 AustraliaEast (40) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

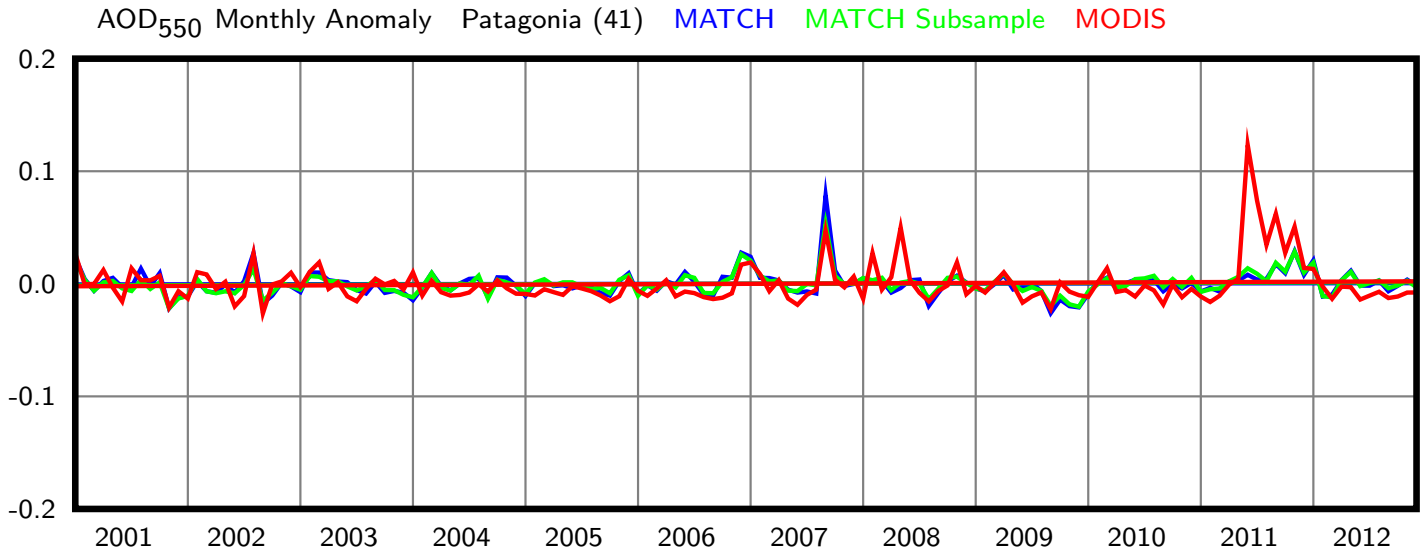

AOD550 Monthly Anomaly AustraliaEast (40) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

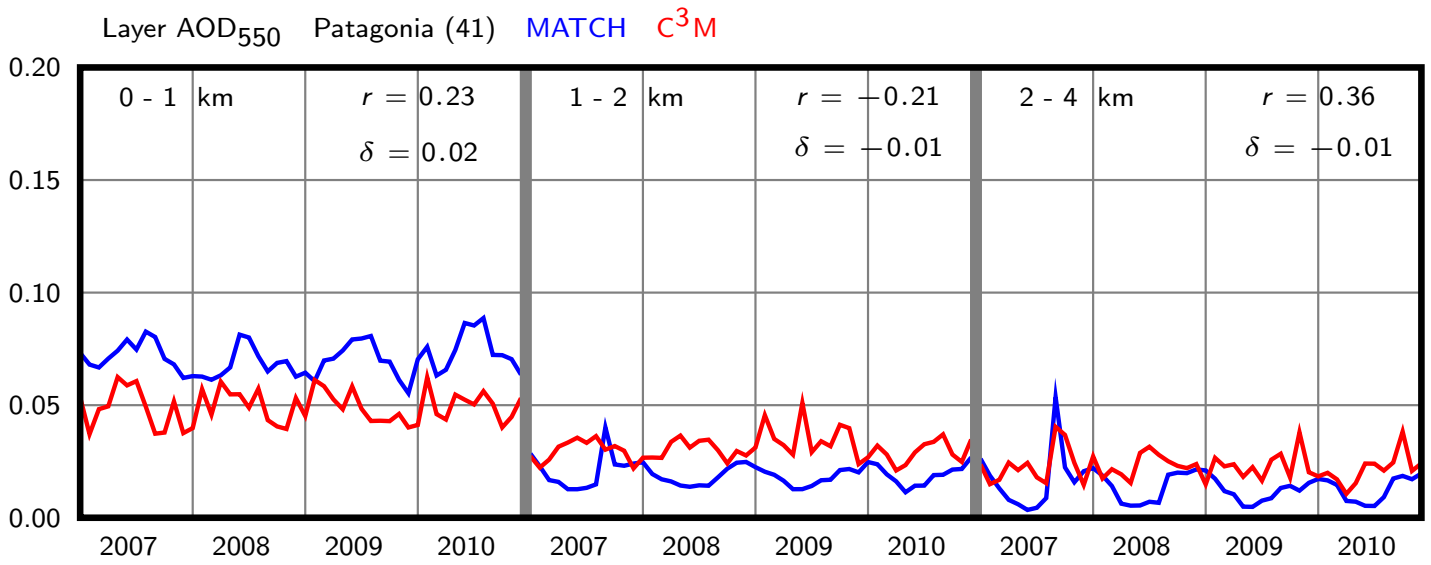


AustraliaEast (40)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.002	0.095	0.030	0.723	0.000
MATCH Subsample	-0.000	0.094	-0.002	0.977	0.000
MODIS	0.002	0.123	0.022	0.790	0.000

Table 41 : $\mathrm{AOD}_{550} = b\ t + a$


AOD550 Patagonia (41) MATCH MATCH Subsample MODIS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012


AOD550 Monthly Anomaly Patagonia (41) MATCH MATCH Subsample MODIS
0.2
0.1
0.0
-0.1
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012



Patagonia (41)	b (decade^{-1})	a	r	p	ϵ
MATCH	0.003	0.090	0.037	0.661	0.000
MATCH Subsample	0.005	0.082	0.072	0.390	0.000
MODIS	0.009	0.132	0.076	0.368	0.000

Table 42 : $\mathrm{AOD}_{550} = b\ t + a$