

Maritime Aerosol Network (MAN) as a component of AERONET – current status and comparison with satellite retrievals and global aerosol transport models



AEROCOM 2010, Oxford, United Kingdom, Sep 27-30



Maritime Aerosol Network (MAN) as a component of AERONET ...

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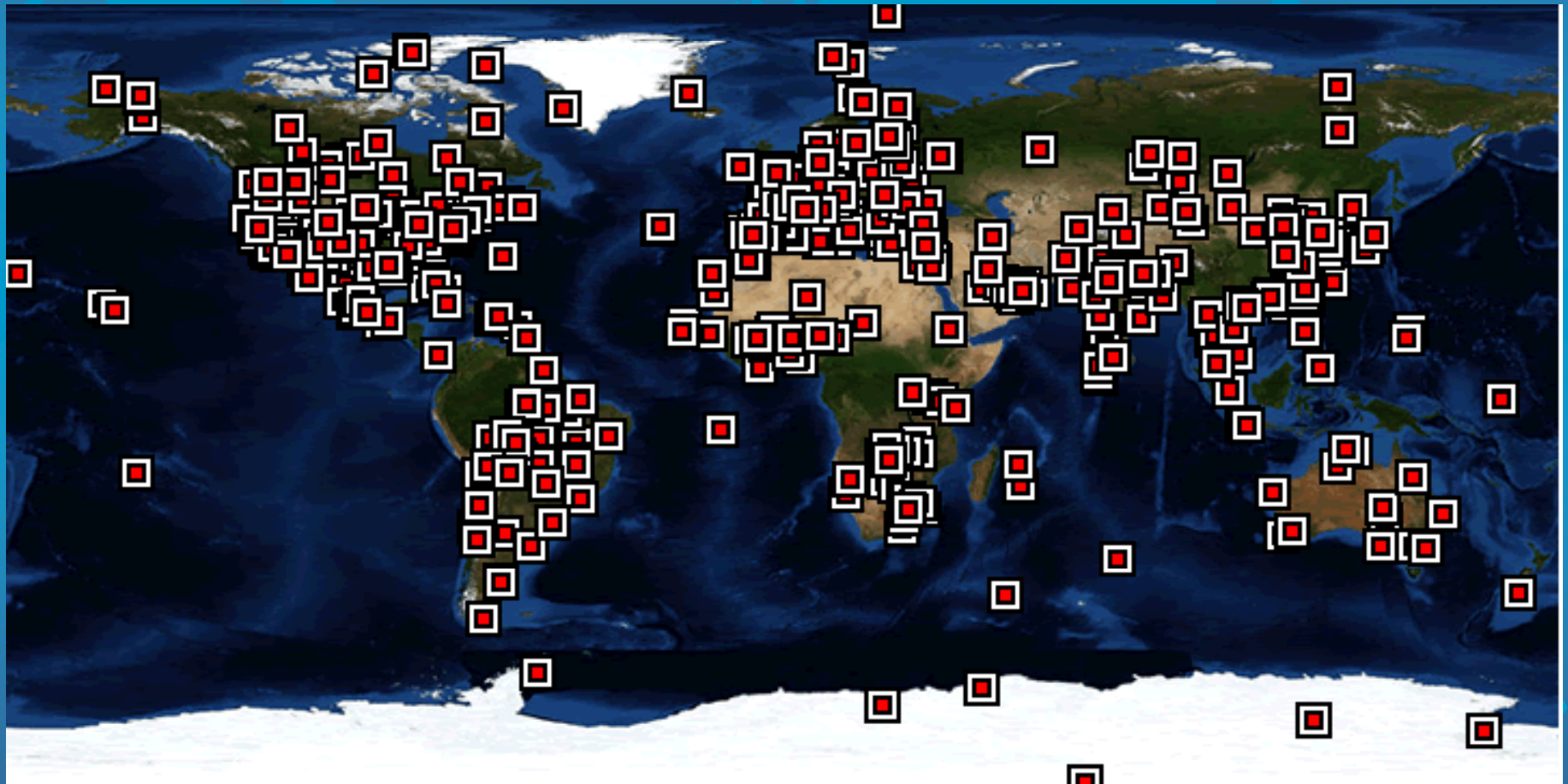
NASA Goddard Space Flight Center, Greenbelt, Maryland, USA

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Many thanks to:

- M.Sorokin, A.Scully, A.Tran, P.Kenny, D.A.Siegel, T.Ackerman, K.Voss, P.Quinn, N.Nelson, N.Nalli, E.Joseph, D.Siegel, R.Dunn, A.Proshutinsky, L.Logan, M.Reynolds, D.Hamilton, L.Rainville, H.Gomes, L.Bariteau, A.Jayakumar, S.Schick, D.Menzies, P. Schoessow, E.Emry, M.Conley, A.Flores, C.Swan, K.G.Fairbarn (**USA**); S.Sakerin, V.Radionov, S.Gulev, M.Panchenko, O.Kopelevich, A.Sinitsyn, D.Kabanov, A.Kalsin, S.Terpugova, V.Polkin (Sr), A.Tikhomirov, Yu.Turchinovich, N.Vlasov, A.Gubin, V.Polkin (Jr) (**Russia**); G.Milinevsky (**Ukraine**), A.Macke, P.Croot, B.Quack, Y.Zoll, T.Dinter, A.Wassmann, M.Heller, A.Tessendorf, M.Schlundt, C.Schlosser, T.Hanschmann, B.Pospichal, K.Lonitz, F.Wittrock (**Germany**); P.Goloub, R.Losno, J.Sciare, F.Jourdin, L.Blarel, C.Petus, S.Triquet, J.Nicolas, S.Devidal, L.Martinon, M.Failot, P.Hernandez, P.Ricaud, J.-F.Ternon, P.Sangiardi, A.Kartavtseff, T.Lecointre, S.Barataud, F.Gabarrot, V.Duflot (**France**); T.Smyth, A.Baker, C.Powell, C.Gallienne (**UK**); N.O'Neill, A.Royer, P.Larouche, S.Belanger, E.Horne, G.Lazin, C.Bourgeault-Brunelle, M.Palmer (**Canada**); M.Harvey, H.Power, T.Bromley, R.Martin, G.Brailsford (**New Zealand**); T.Zielinski, J.Piskozub, J.Kowalczyk, M.Darecki, A.Ponczkowska, B.Lednicka, K.Zielinski, P.Makuch, J.Pasnicky (**Poland**); S.Piketh, D.Williams, B.Kuyper, E.Robertson (**South Africa**); K.Krishna Moorthy, K.Niranjan, S.Babu, V.S.Nair, S.N.Beegum (**India**); R.M.Castillo (**Spain**), G.Stenchikov (**Saudi Arabia**), R.Mitchell, T.Schroeder, P.Daniel, N.Chelukuru (**Australia**); Y.Derimian, A.Karnieli, V.Karalnik (**Israel**); G.Lin, B.-J.Tsuang, C.Chen, Y.Chang (**Taiwan**); G.Zibordi, L.Jankowski, R.Matarrese (**Italy**)

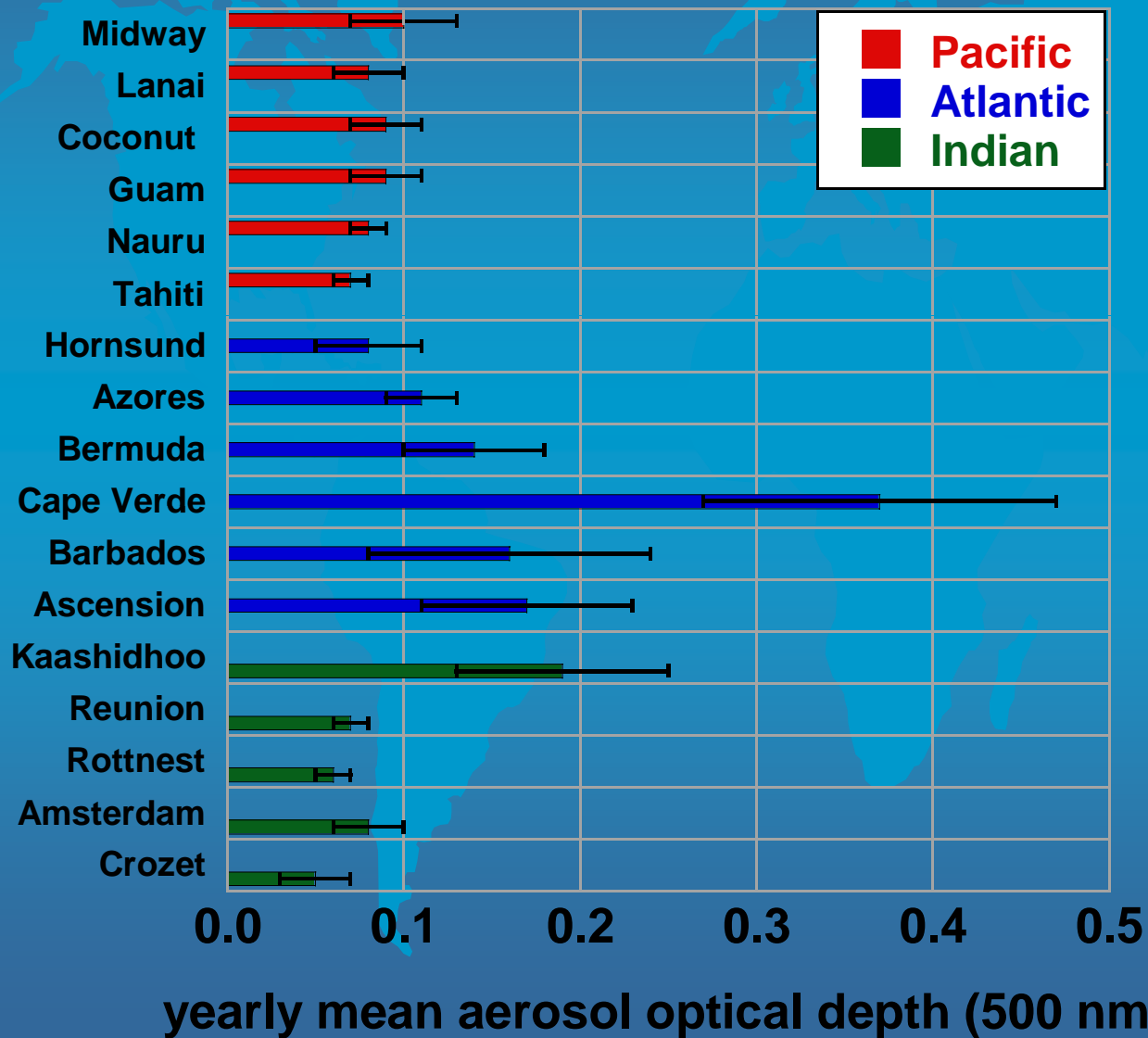
AERONET site distribution



Distribution of island-based AERONET sites



Aerosol optical depth over the oceans (AERONET island-based measurements)



Globally averaged

$$\tau_a (500 \text{ nm}) = 0.11$$

$$\sigma = 0.04$$

$$\alpha (440-870 \text{ nm}) = 0.60$$

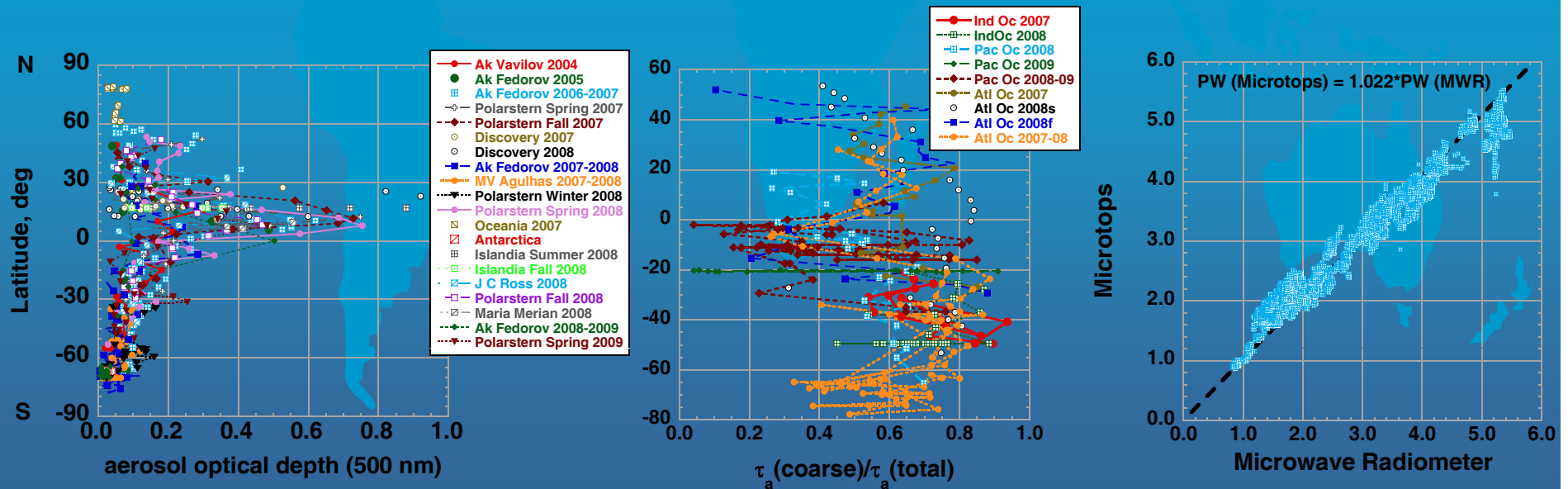
$$\sigma = 0.16$$



05/14/2007

MAN products:

- Aerosol optical depth (Level 1; Level 1.5; Level 2)
- Water vapor content (Level 1; Level 1.5; Level 2)
- Aerosol optical depths: fine (sub-micron) and coarse (super-micron) at 500 nm (the spectral deconvolution algorithm by O'Neill et al. 2003)





AERONET

MARITIME AEROSOL NETWORK



- + AEROSOL OPTICAL DEPTH
- + AEROSOL INVERSIONS
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- + MARITIME AEROSOL**

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- + AEROSOL/FLUX NETWORKS
- + COLLABORATORS
- + DATA
- + NASA PROJECTS
- + PUBLICATIONS
- + STAFF
- + SYSTEM DESCRIPTION

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- + Data Display
- + Download Tool
- + Download All Sites
- + Climatology Tables
- + Climatology Maps
- + V2 L2 Data Availability

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- + Data Display
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- + Data Display

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- + Data Display

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- + All Lists

MARITIME AEROSOL NETWORK (MAN)

The Maritime Aerosol Network (MAN) component of AERONET provides ship-borne aerosol optical depth measurements from the Microtops II sun photometers. These data provide an alternative to observations from islands as well as establish validation points for satellite and aerosol transport models. Since 2004, these instruments have been deployed periodically on ships of opportunity and research vessels to monitor aerosol properties over the World Oceans.



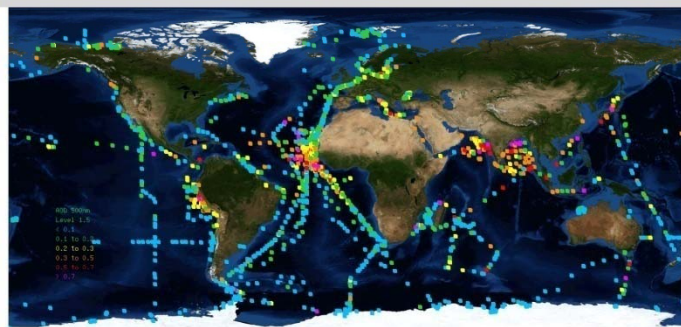
Microtops instruments currently in the network have five channels but they may have one of two configurations: 340, 440, 675, 870, 936nm or 440, 500, 675, 870, and 936nm. In addition, the instrument has built-in temperature and pressure sensors as well as the ability to log accurate time and geographical position using a GPS. The Microtops instruments are calibrated at the NASA Goddard Space Flight Center (GSFC) calibration facility via a transfer calibration procedure between the Microtops and the master Cimel sun photometer at GSFC, which has a calibration traceable to a Langley calibration of a Cimel sun photometer on Mauna Loa, Hawaii. In general, the estimated uncertainty of the aerosol optical depth in each channel does not exceed plus or minus 0.02, which is slightly higher than the uncertainty of AERONET field (not master) instruments.

Additional information on data processing and quality may be found by choosing the "Data" link in the left column.

MAN Publication Reference:

Smirnov, A., B. N. Holben, I. Slutsker, D. M. Giles, C. R. McClain, T. F. Eck, S. M. Sakerin, A. Macke, P. Croot, G. Zibordi, P. K. Quinn, J. Sciare, S. Kinne, M. Harvey, T. J. Smyth, S. Piketh, T. Zielinski, A. Proshutinsky, J. I. Goes, N. B. Nelson, P. Larouche, V. F. Radionov, P. Goloub, K. Krishna Moorthy, R. Matarrese, E. J. Robertson, and F. Jourdin (2009), **Maritime Aerosol Network as a component of Aerosol Robotic Network**, *J. Geophys. Res.*, 114, D06204, doi:10.1029/2008JD011257.

CRUISES



Level 1.5 | Level 2.0


The table below provides information for past, ongoing and planned cruises. The Ship column provides links to the information and data for each cruise. The Region column provides a KML file to view the cruise in Google Earth.

Year	Ship	Region	Status
2004	RV Akademik Sergey Vavilov	Atlantic Ocean Transect, Southern Ocean	Completed
2005-2006	RV Akademik Fedorov	Atlantic Ocean Transect, Antarctica	Completed
2006-2007	RV Akademik Fedorov	Atlantic Ocean Transect, Antarctica	Completed
2007	Ecklonia	Atlantic Ocean near South African Coast	Completed
2007	RV Polarstern	Atlantic Ocean Transect	Completed
2007	RV Urania	Mediterranean Sea	Completed
2007	Trans Future 5	Pacific Ocean Transect	Completed
2007	RV Oceania	Baltic, Norwegian, Greenland Seas	Completed
2007	RV Aranda	Gulf of Bothnia	Completed
2007	CCGS Louis St. Laurent	Beaufort Sea	Completed
2007	Roger Revelle	Arabian Sea	Completed
2007	RV Oceania	Baltic Sea	Completed
2007	Roger Revelle	Arabian Sea	Completed
2007	University of Bari	Adriatic Sea	Completed
2007	RV Polarstern	Atlantic Ocean Transect	Completed
2007	RRS Discovery	Canary-Cape Verde	Completed
2007	RV Marion-Dufresne	South Indian Ocean	Completed
2007-2008	NOAA Ronald H. Brown	Pacific Ocean Transect	Completed
2007-2008	MV SA Agulhas	Southern Ocean	Completed
2007-2008	RV Akademik Fedorov	Atlantic Ocean Transect, Antarctica	Completed
2008	RRS Discovery	Canary-Cape Verde	Completed
2008	RV Polarstern	Southern Atlantic	Completed
2008	RV Knorr 2008	North Atlantic Ocean	Completed
2008	Trans Future 5	Pacific Ocean Transect	Completed
2008	RV L'Atalante	Gulf of Lion	Completed
2008	RV Polarstern	Atlantic Ocean Transect	Completed
2008	MV Akbar 2008	Bay of Bengal	Completed
2008	RV Islandia	Cape Verde	Completed
2008	USCGC Healy	Bering Sea	Completed
2008	CCGS Amundsen	Beaufort Sea	Completed
2008	Trans Future 5	Pacific Ocean Transect	Completed
2008	RP FLIP	Santa Barbara Basin	Completed
2008	NRV Alliance	Ligurian Sea	Completed
2008	RRS James Clark Ross	Atlantic Ocean Transect	Completed
2008	RV Islandia	Cape Verde	Completed
2008	NOAA Ronald H. Brown	Caribbean Sea, Pacific Ocean	Completed
2008	RV Polarstern	Atlantic Ocean transect	Completed
2008	RV Maria S. Merian	Central and Tropical Atlantic	Completed
2008	RV Marion-Dufresne	South Indian Ocean	Completed
2008	RV Meteor	Pacific Ocean	Completed
2008-2009	RV Sagar Kanya	Bay of Bengal	Completed
2008-2009	RV Akademik Fedorov	Atlantic Ocean transect	Completed
2009	Norwegian Sun	Southern Atlantic and Pacific	Completed
2009	R/V Marcus G. Langseth	Tropical Pacific	Completed
2009	FORV Sagar Sampada	Arabian Sea	Completed
2009	RV Hesperides	Pacific Ocean	Completed
2009	NRV Alliance	Ligurian Sea	Completed
2009	RV Oceania	Baltic Sea	Completed
2009	RV Baruna Jaya IV	Java Sea	Completed
2009	RV Marion Dufresne	South Indian Ocean	Completed
2009	RV Polarstern	Atlantic Ocean Transect	Completed
2009	RV Akademik	Black Sea	Completed
2009	RV Islandia	Cape Verde	Completed
2009	RRS Discovery	Canary-Tropical Atlantic	Completed
2009	RV Oceania	Baltic Sea	Completed
2009	RV Jan Mayen	Norwegian, Greenland Seas	Completed
2009	RV Kilo Moana	North Pacific Ocean	Completed
2009	NOAA Ronald H. Brown	Tropical Atlantic	Completed
2009	RV Oceania	Norwegian, Greenland Seas	Completed
2009	CCGS Amundsen	Beaufort Sea	Completed

2009	RP FLIP	Tropical Pacific	Completed
2009	RV Marion Dufresne	South Indian Ocean	Completed
2009	RV Polarstern	Northern Greenland Sea	Completed
2009	RV Oceania	Baltic Sea	Completed
2009	RV Sonne	Pacific Ocean	Completed
2009	Trans Future 5	Pacific Ocean	Completed
2009	RV Polarstern	Atlantic Ocean transect	Completed
2009	RV Antea	South Indian Ocean	Completed
2009	RRS James Cook	Atlantic Ocean transect	Completed
2009	RV Akademik Ioffe	Atlantic Ocean transect	Completed
2009	RV Marion Dufresne	South Indian Ocean	Completed
2009	RV Meteor	Tropical Atlantic	Completed
2009-2010	RV Marion Dufresne	South Indian Ocean	Completed
2009-2010	RV Melville	South Pacific Ocean	Completed
2009-2010	RV Astrolabe	South Pacific and South Ocean	Completed
2009-2010	RV Akademik Fedorov	Atlantic Ocean transect, South Ocean	Completed
2009-2010	RV Ocean Watch	Around the Americas	Completed
2010	Prince Albert II	Southern Atlantic and South Ocean	Completed
2010	RV Astrolabe	South Ocean	Completed
2010	FORV Sagar Sampada	Arabian Sea	Completed
2010	RV 1	South China Sea	Completed
2010	CCGS Hudson	North Atlantic Ocean	Completed
2010	NOAA Ronald H. Brown	Tropical Atlantic	Completed
2010	RV Southern Surveyor	Indian Ocean	Completed
2010	RV Antea	Indian Ocean, Mozambique Channel	Completed
2010	RV Marion Dufresne	Indian Ocean	Completed
2010	RV Polarstern	Atlantic Ocean transect	Completed
2010	NOAA Ronald H. Brown	Tropical Atlantic	Completed
2010	MV Zim Iberia	Pacific Ocean, Indian Ocean, Arabian Sea	Completed
2010	RV Oceania	Baltic Sea	Completed
2010	RV Atlantis	West Coast US	Completed
2010	RV Knorr	Tropical Atlantic	Completed
2010	RV Marion Dufresne	South China Sea, Sea of Japan	Completed
2010	RV New Horizon	Gulf of California	Completed
2010	RV Melville	Tropical Pacific	Ongoing
2010	RV Marion Dufresne	Equatorial Pacific, Ceram Sea	Ongoing
2010	CCGS Amundsen	Labrador Sea	Ongoing
2010	Trans Future 5	Pacific Ocean	Planned
2010	RV Sarmiento de Gamboa	Atlantic Ocean	Planned
2010	RV Oceania	Norwegian, Greenland Seas	Planned
2010	RV Polarstern	Atlantic Ocean transect	Planned
2010-2011	RV Hesperides	South Atlantic, South Indian Ocean	Planned



R/V Akademik Fedorov 2007-2008 cruise


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MARITIME AEROSOL NETWORK (MAN)

2007-2008 RV Akademik Fedorov Cruise

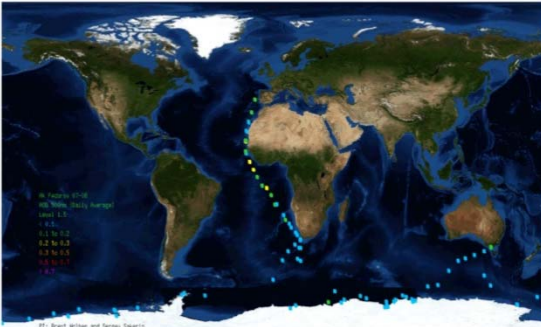


22.02.2008

R/V Akademik Fedorov belongs to the Arctic and Antarctic Research Institute (Saint Petersburg, Russia) of the Federal Service for Hydrometeorology and Environmental Monitoring of Russian Federation. The cruise started in November 2007 and ended in May 2008. The cruise area included an Atlantic transect from North Sea to Cape Town and then crossing into the South Atlantic to Antarctica, measurements in Antarctica, transect to Australia and back to and around Antarctica, crossing to Cape Town, back to Antarctica and a transect back from Southern Ocean to Baltic Sea and Saint Petersburg, Russia. Five hundred thirty five (535) measurement series spanning 95 days were acquired.

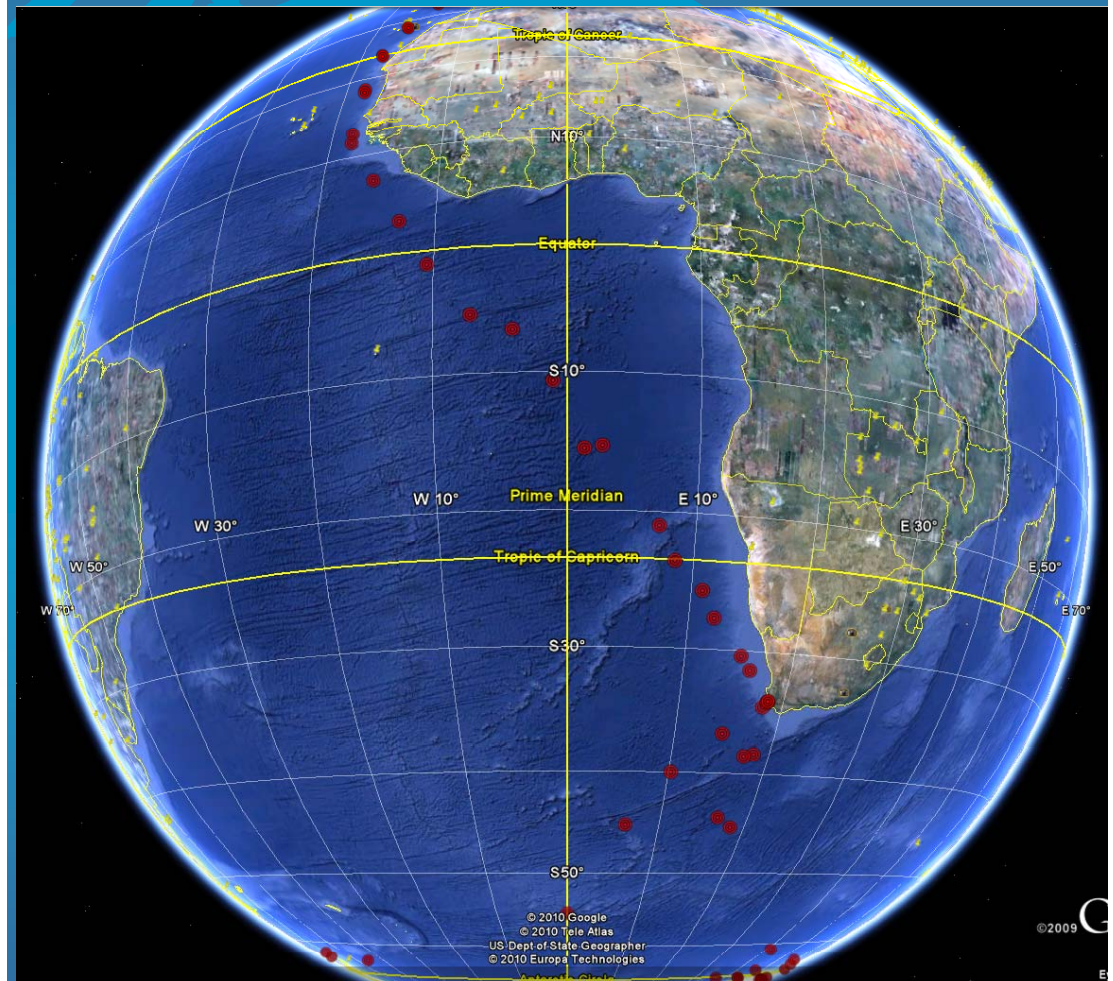
Dr. Sergey M. Sakerin from Institute of Atmospheric Optics, Siberian Branch of Russian Academy of Sciences (Tomsk, Russia) was a Principal Investigator for aerosol optical measurements in collaboration with Dr. Vladimir F. Radionov (Arctic and Antarctic Research Institute, St.Petersburg, Russia). Dr. Svetlana Terpujova from Institute of Atmospheric Optics and Dr. Victor Polkin from same institution operated sunphotometer onboard and at the Antarctic station.

DATA



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 US Dept of State Geographer
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R/V Akademik Fedorov 2007-2008 cruise

CRUISE PHOTOS



Measurements onboard by Dr. Svetlana Terpugova



Measurements onboard by Dr. Svetlana Terpugova



Dr. Viktor Polkin



Antarctica Observers

PUBLICATIONS

Terpugova, S.A., V.V. Polkin, S.M. Sakerin, D.M. Kabanov, B.N. Holben, I.A. Slutsker, A.V. Smirnov, and V.F. Radionov, Study of atmospheric aerosol and columnar water vapor in Antarctic region during 53 Russian Antarctic expedition in 2007-2008, European Aerosol Conference, Karlsruhe, Germany, September 6-11, 2009 (Abstract T160A09).

Sakerin S.M., D.M.Kabanov, V.F.Radionov, I.A.Slutsker, A.V.Smirnov, S.A.Terpugova, and B.N.Holben, About investigation results on the atmosphere aerosol optical depth in circumnavigation around Antarctica (the 53d RAE), *Atm.Ocean.Optics*, 21(12), 900-904, 2008.

Sakerin, S.M., D.M.Kabanov, V.V.Polkin, A.V.Smirnov, I.A.Slutsker, B.N.Holben, and V.F.Radionov, Studies of aerosol optical thickness during the second stage of the 53d Russian Antarctic Expedition, XV Workshop on Siberian Aerosols, Tomsk, Russia, November 25-28, 2008.

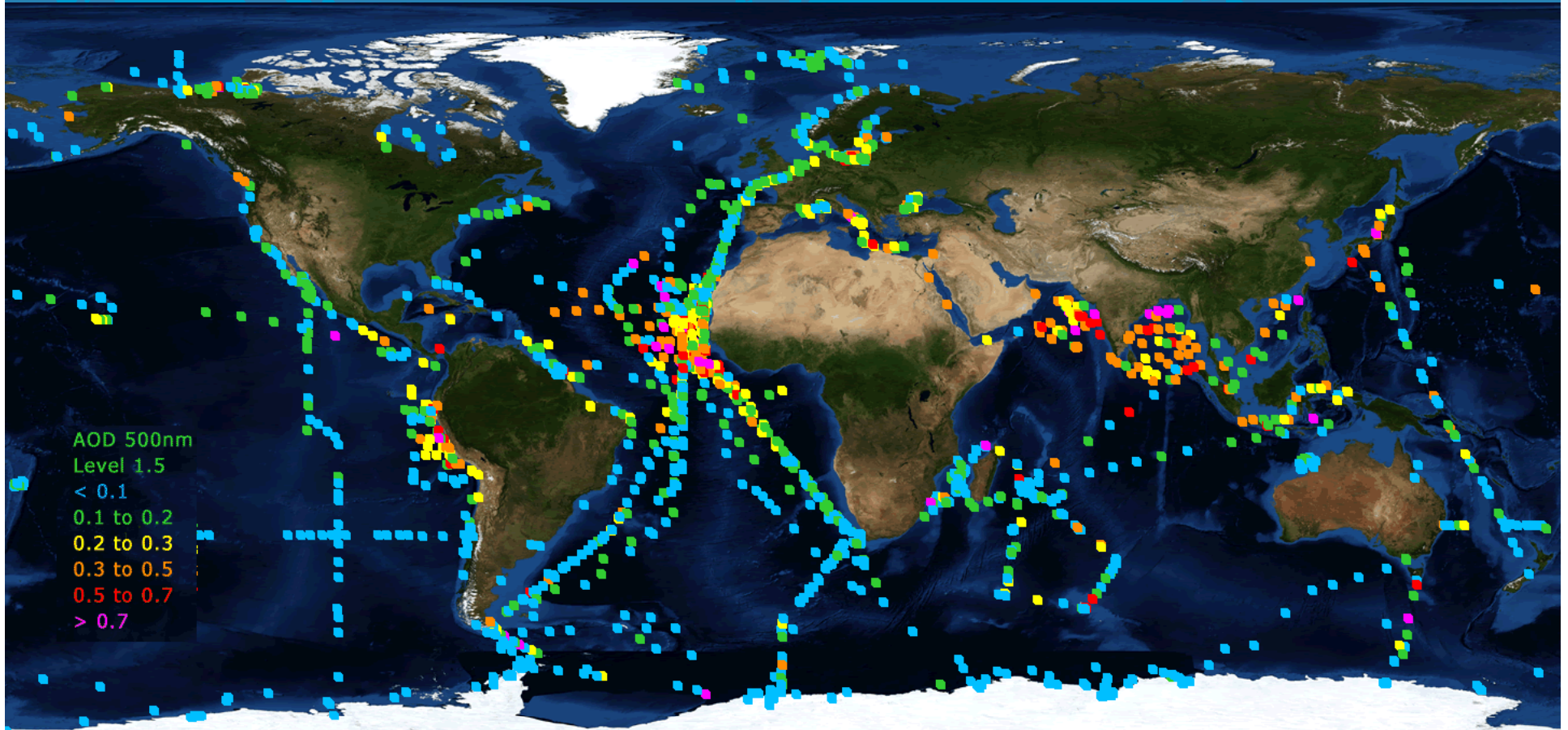
Sakerin, S.M., B.N.Holben, D.M.Kabanov, V.F.Radionov, I.A.Slutsker, A.V.Smirnov, and S.A.Terpugova, Preliminary results of measurements of atmospheric aerosol optical depth in the 53d Russian Antarctic expedition, XV Joint International Symposium Atmospheric and Ocean Optics, Atmospheric physics, Krasnoyarsk, Russia, June 22-29, 2008.

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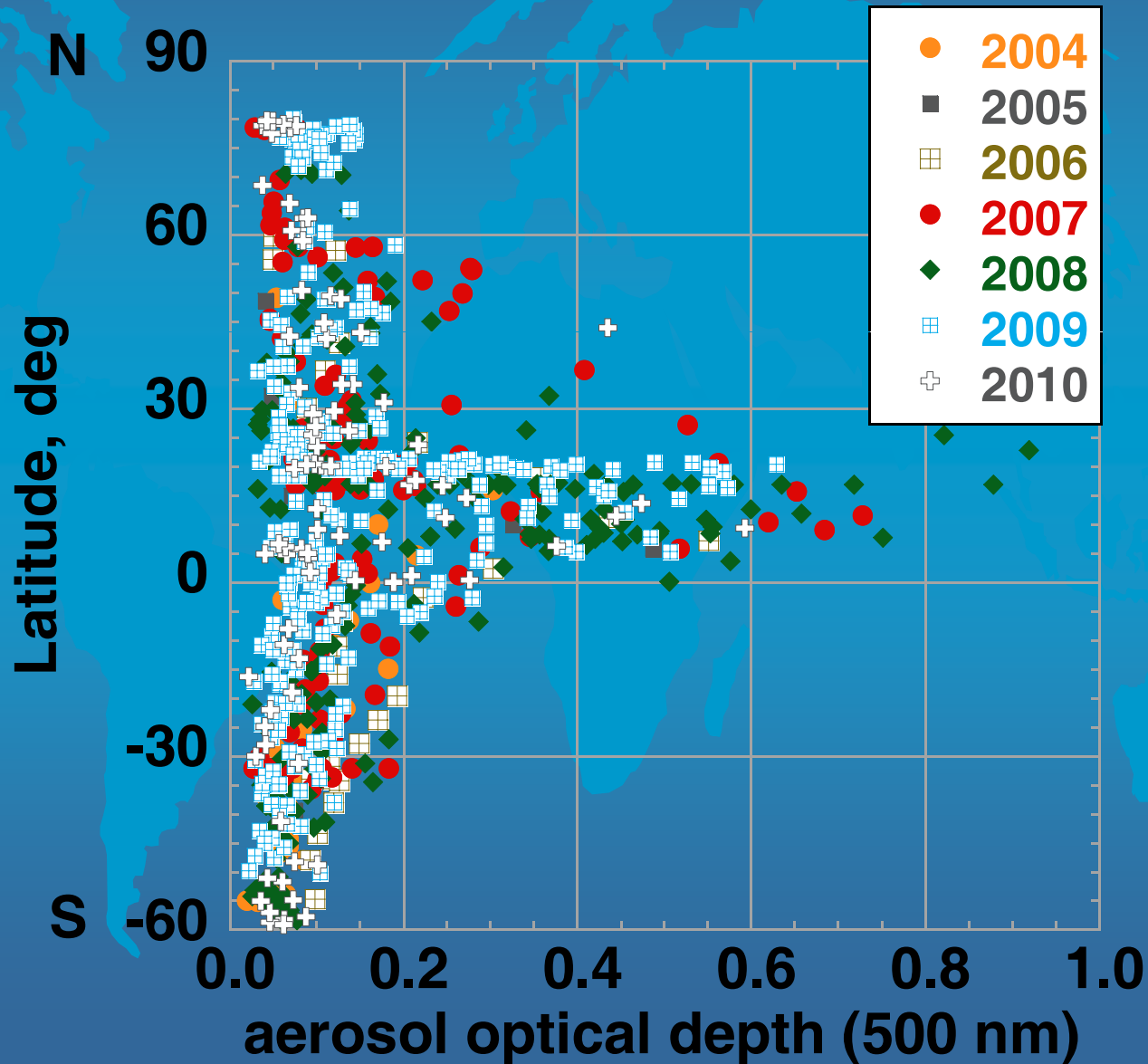


Curator: [David M. Giles](#)
NASA Official: [Brent N. Holben](#)
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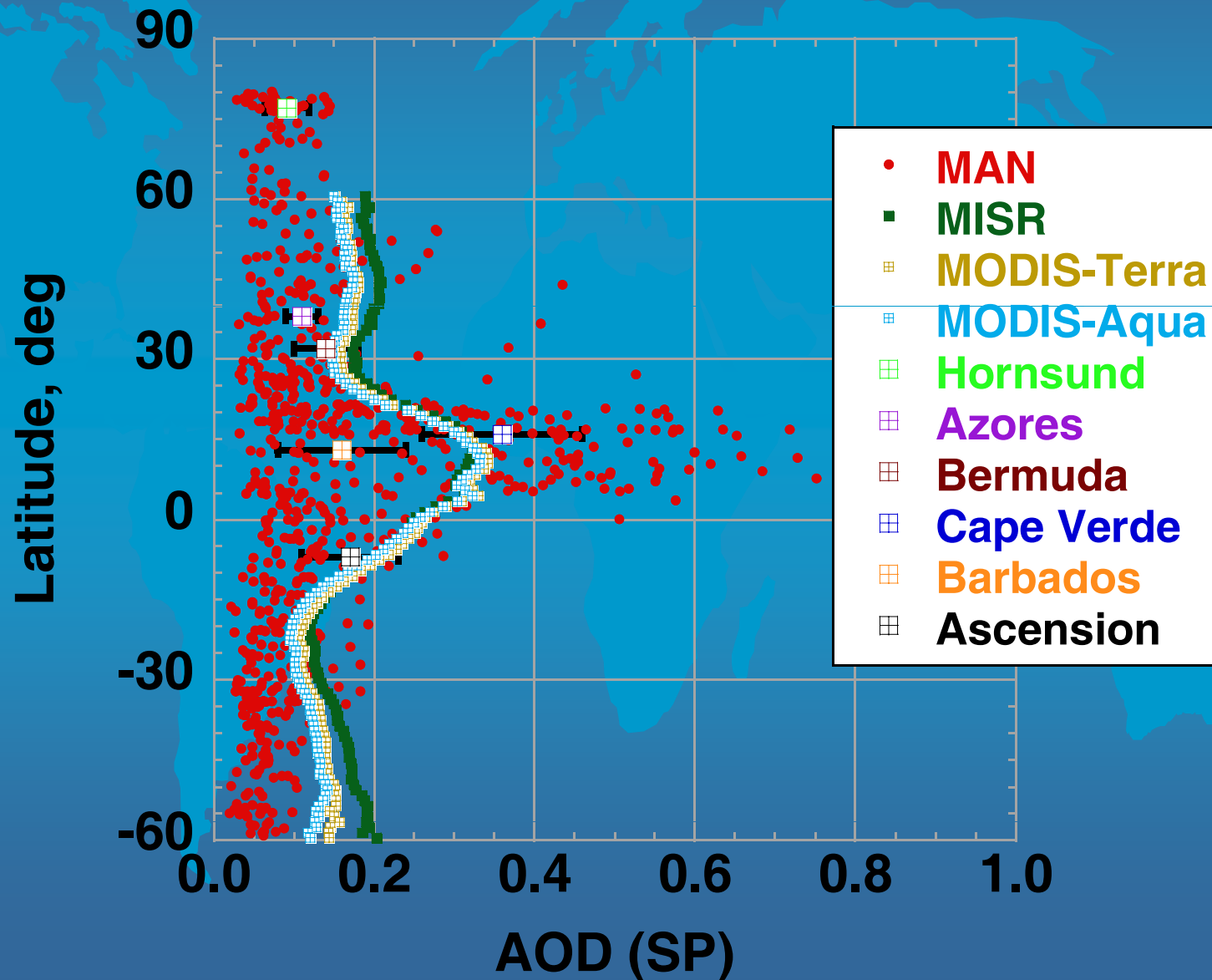
Maritime Aerosol Network global coverage



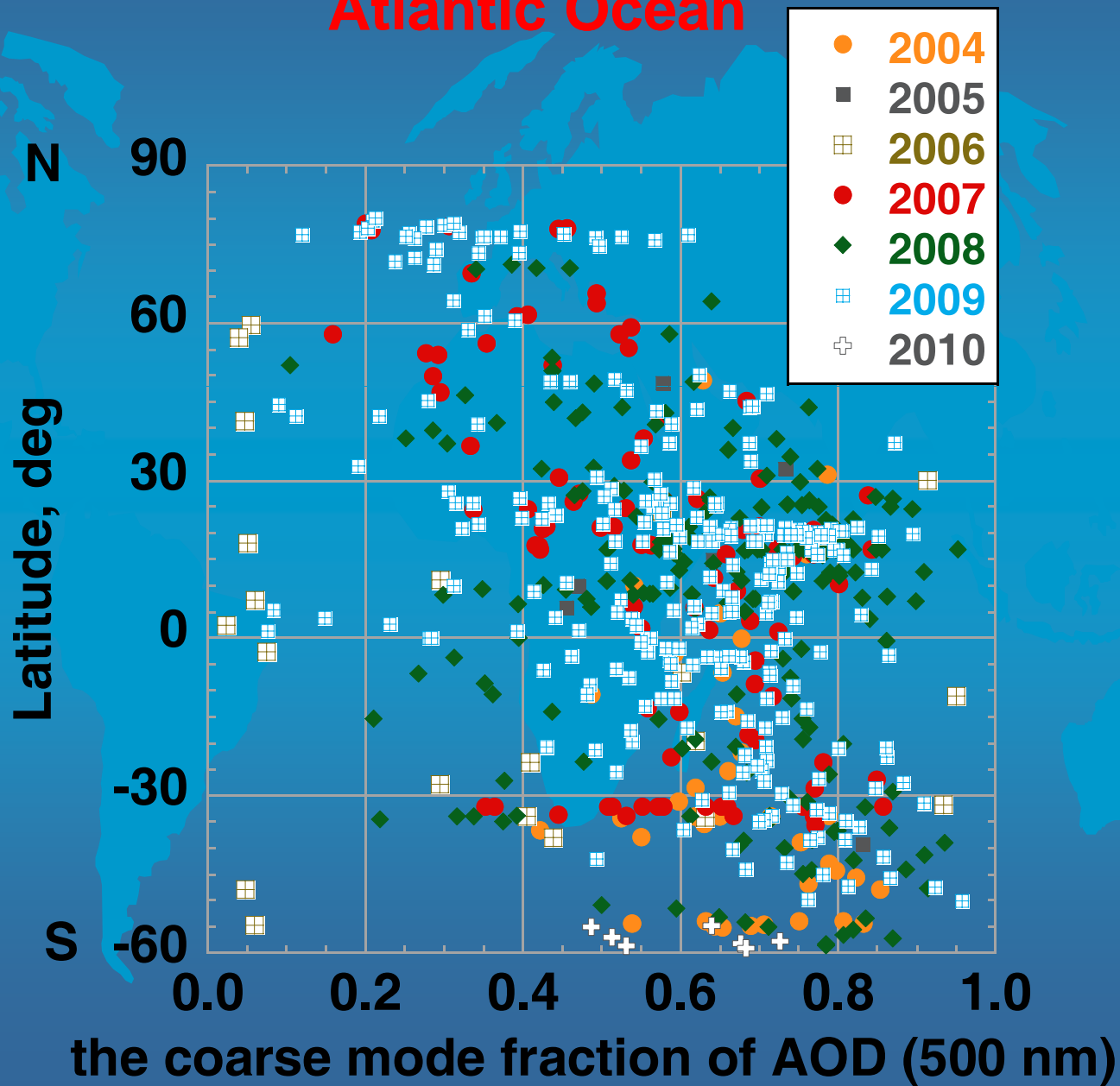
Latitudinal dependence of aerosol optical depth in the Atlantic Ocean



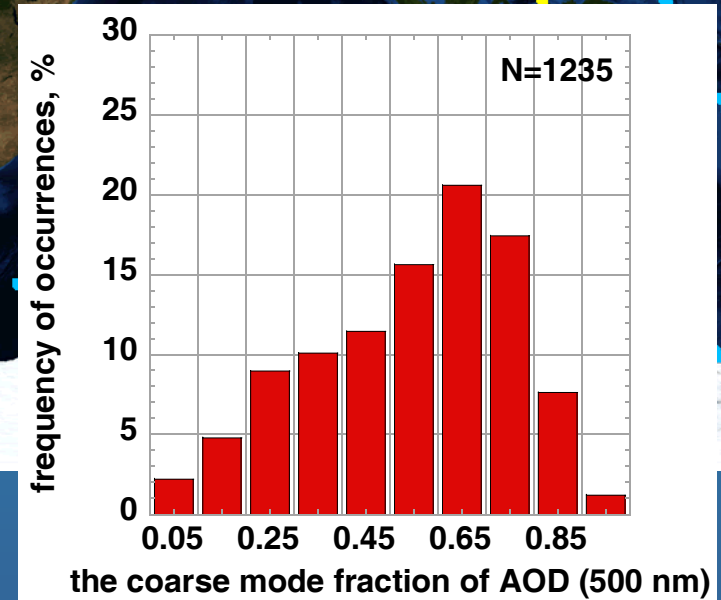
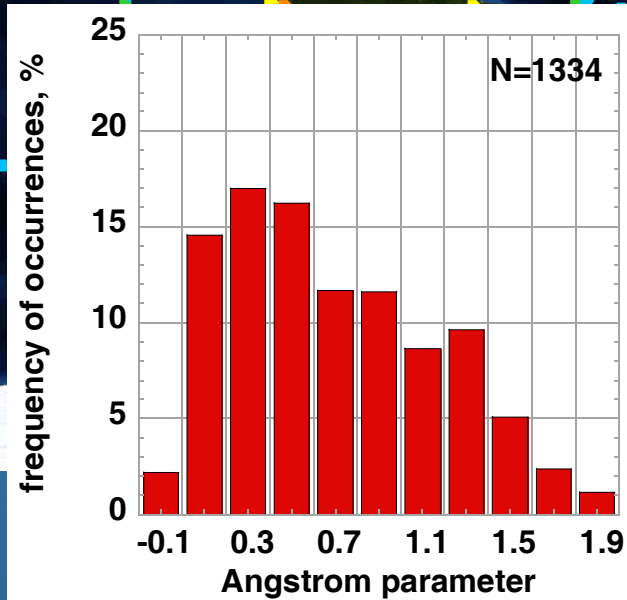
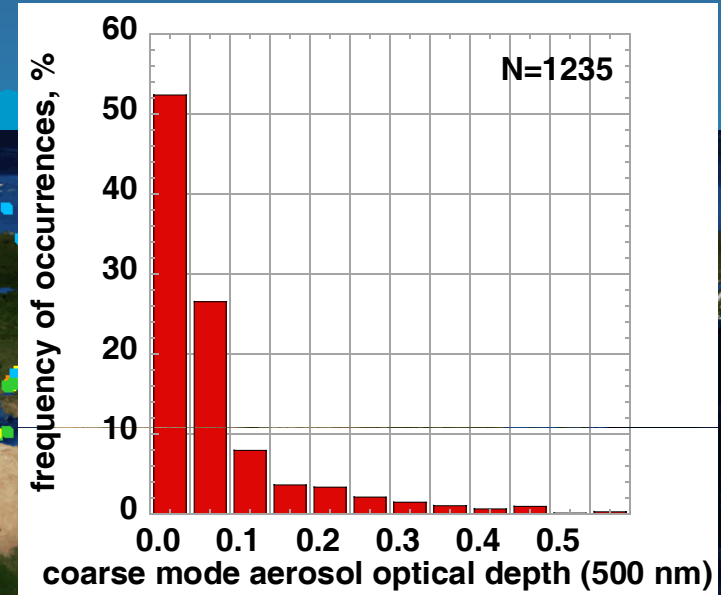
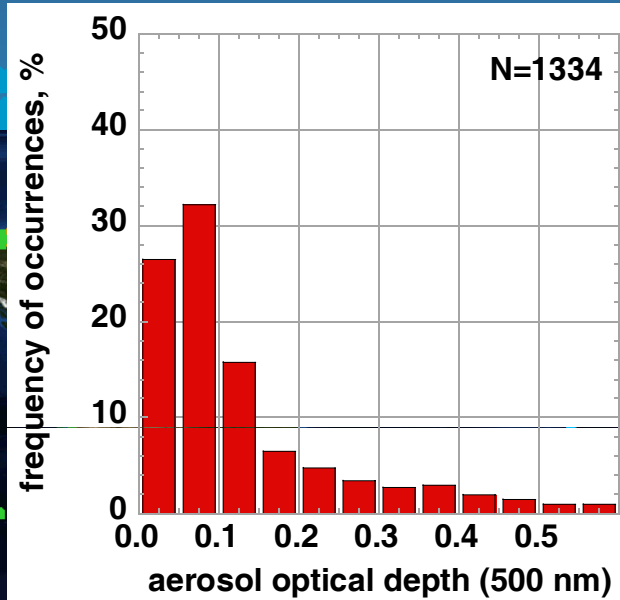
Latitudinal dependence of aerosol optical depth in the Atlantic Ocean



Latitudinal dependence of the $\tau_a(\text{coarse})/\tau_a(\text{total})$ ratio Atlantic Ocean

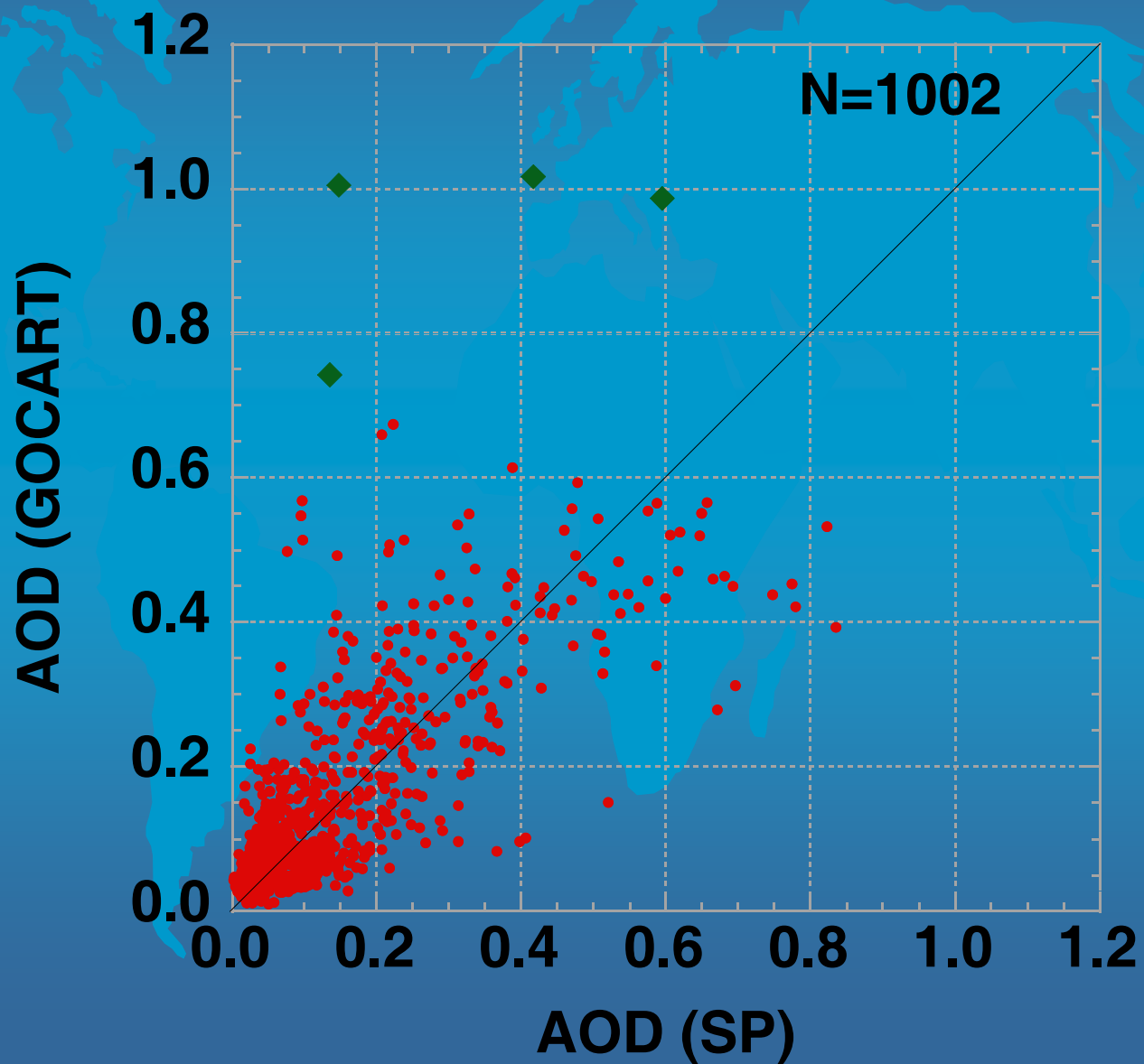


Overall statistics for oceanic areas

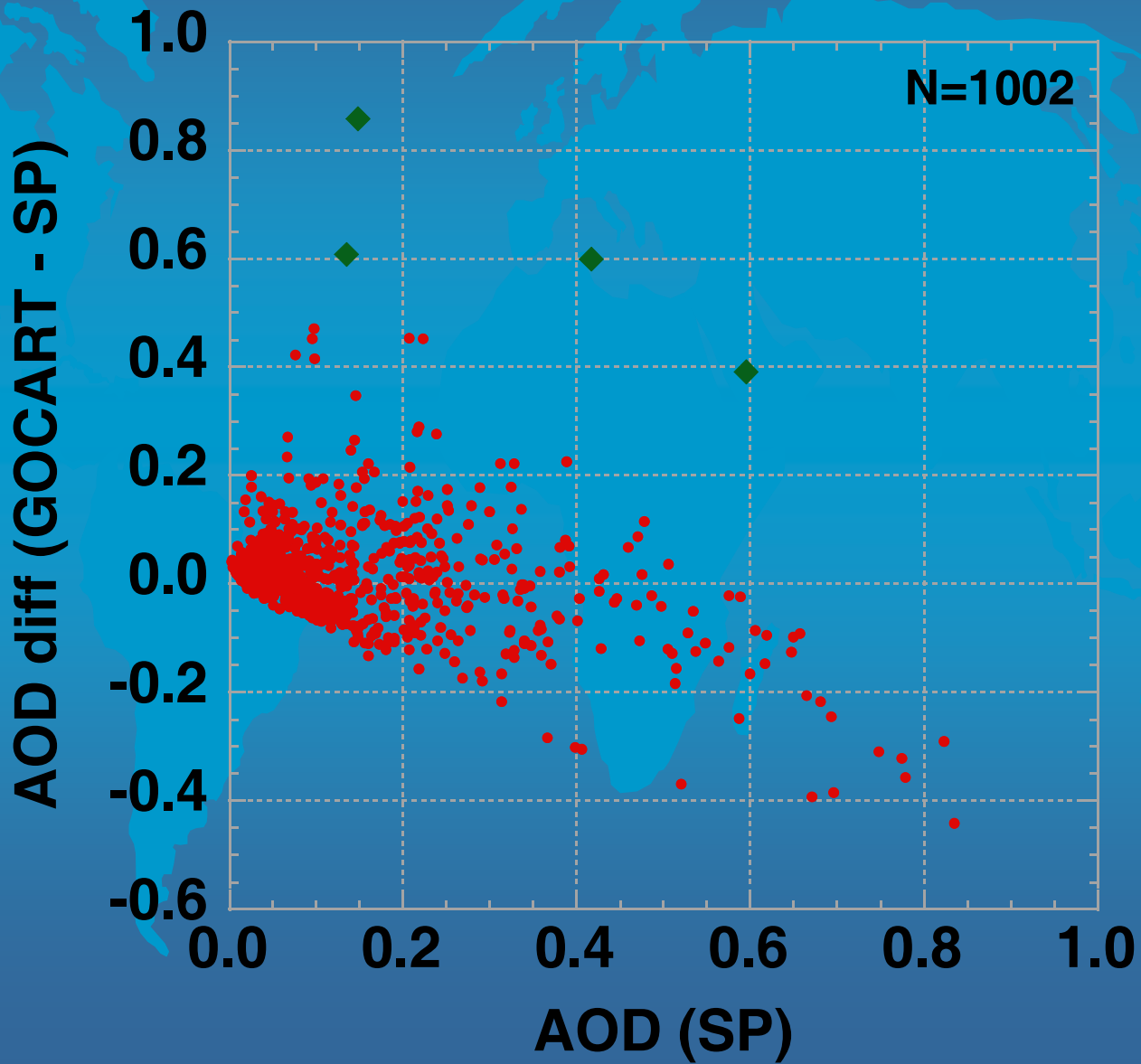


AOD 500nm
Level 1.5
< 0.1
0.1 to 0.2
0.2 to 0.3
0.3 to 0.5
0.5 to 0.7
> 0.7

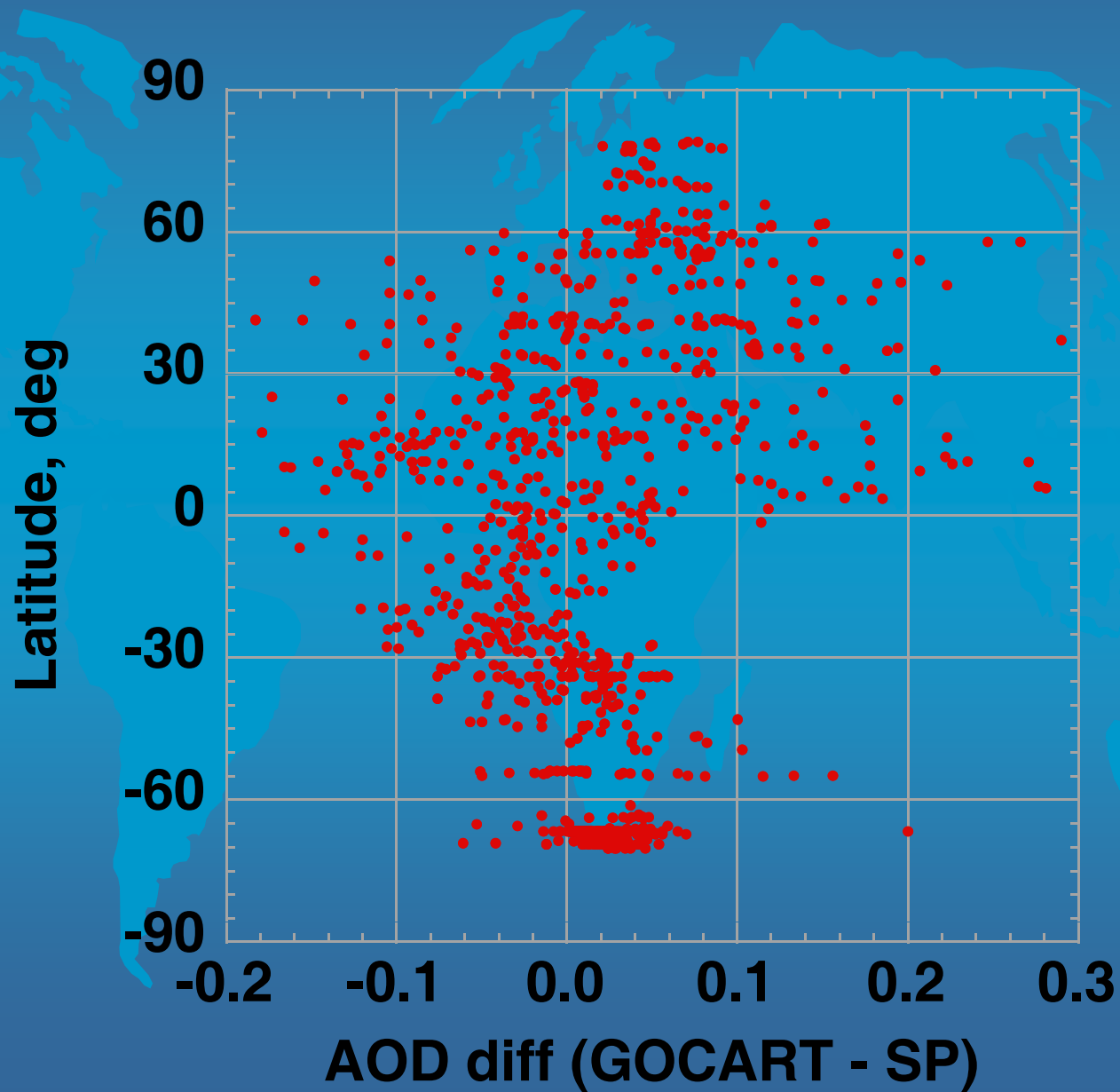
GOCART vs MAN - 2007



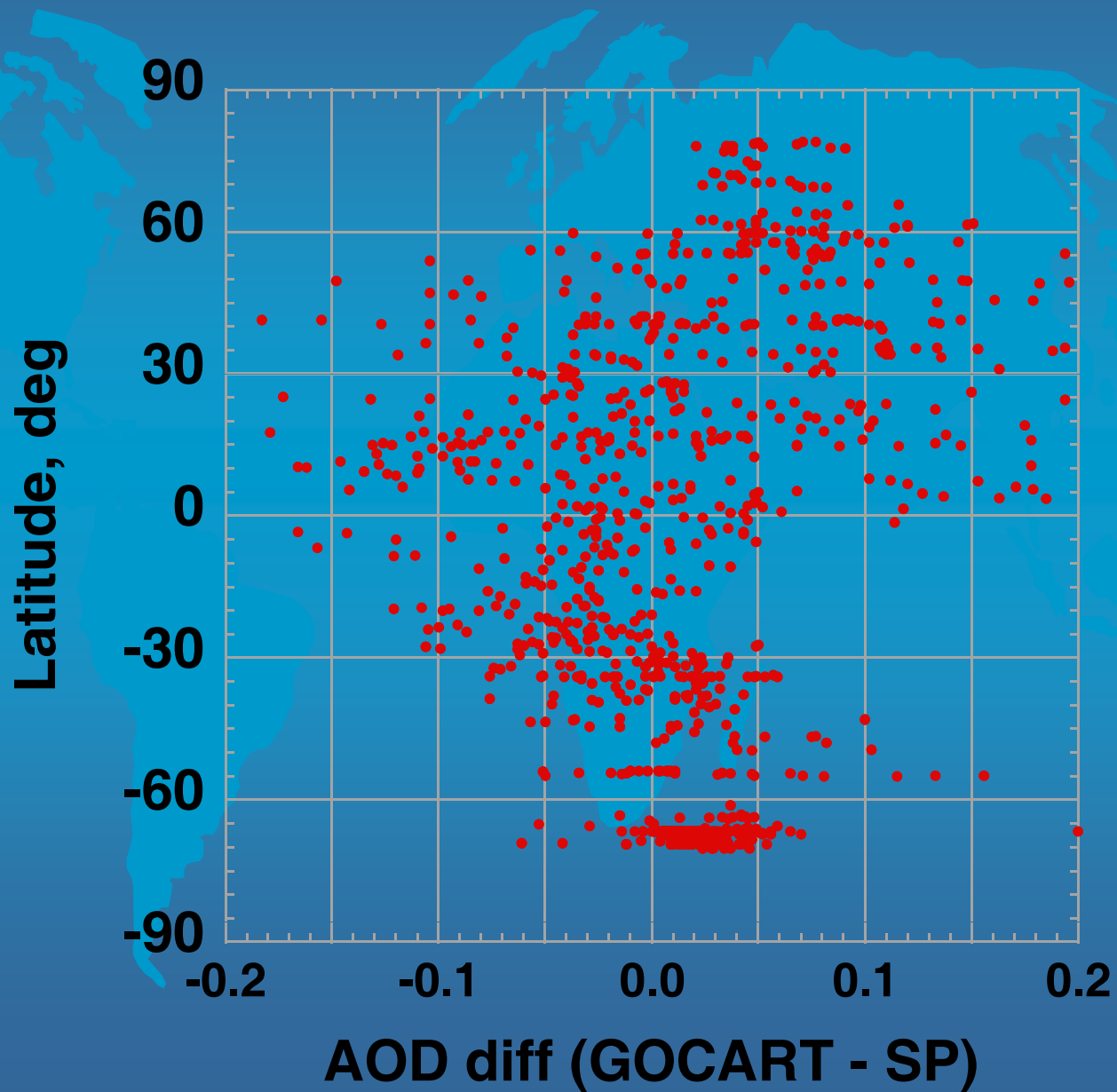
GOCART vs MAN - 2007



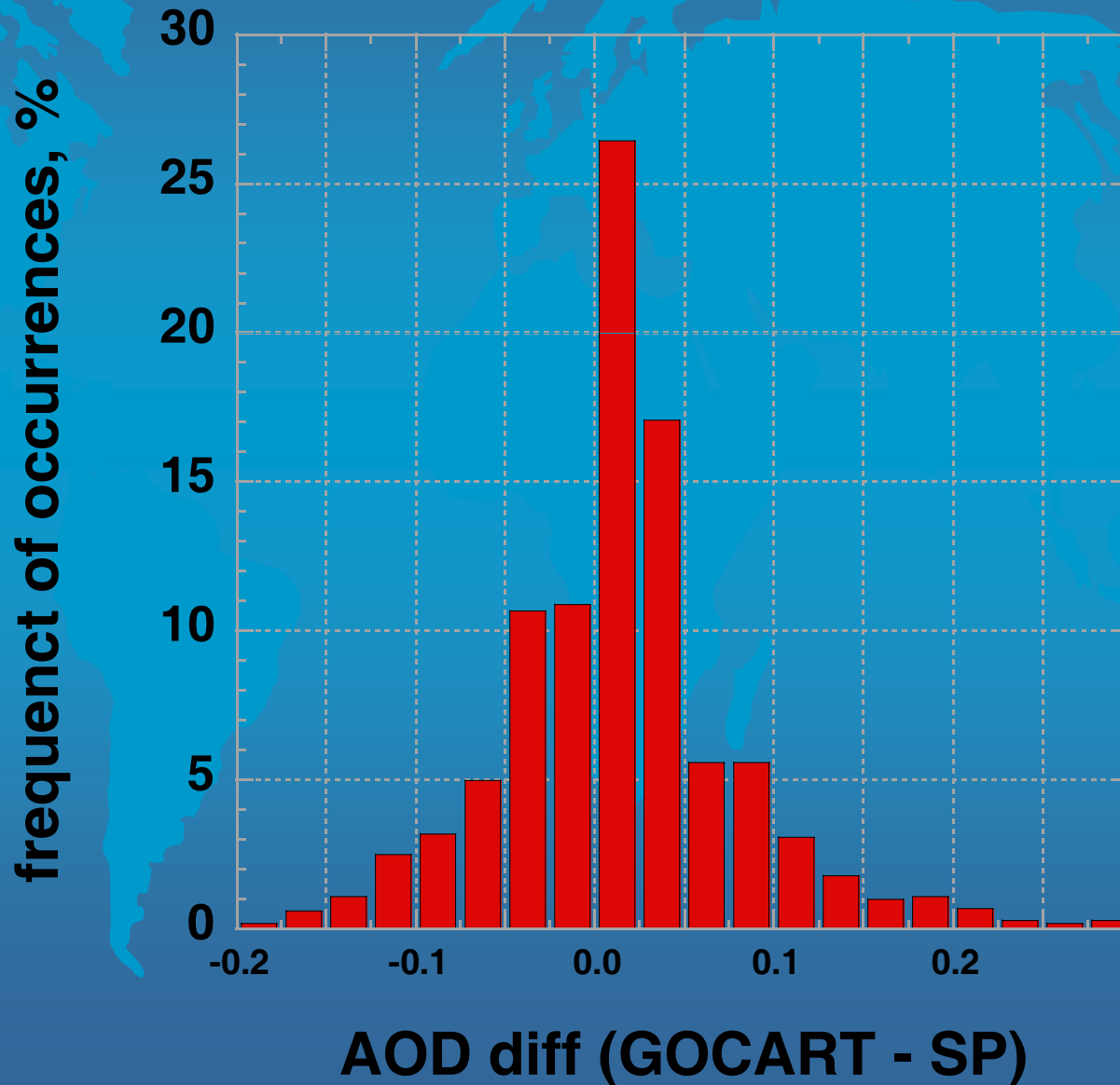
GOCART vs MAN - 2007



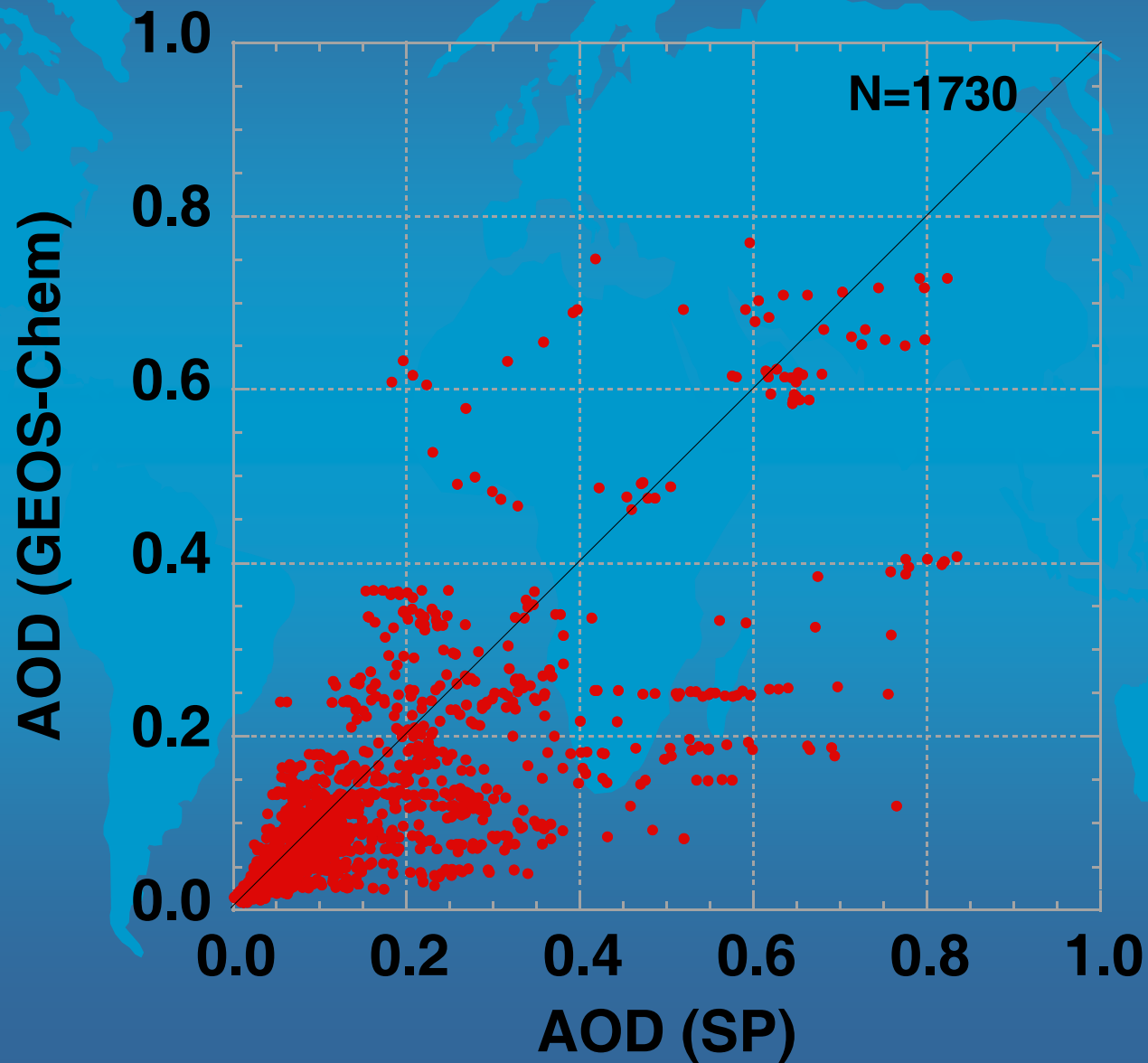
GOCART vs MAN - 2007



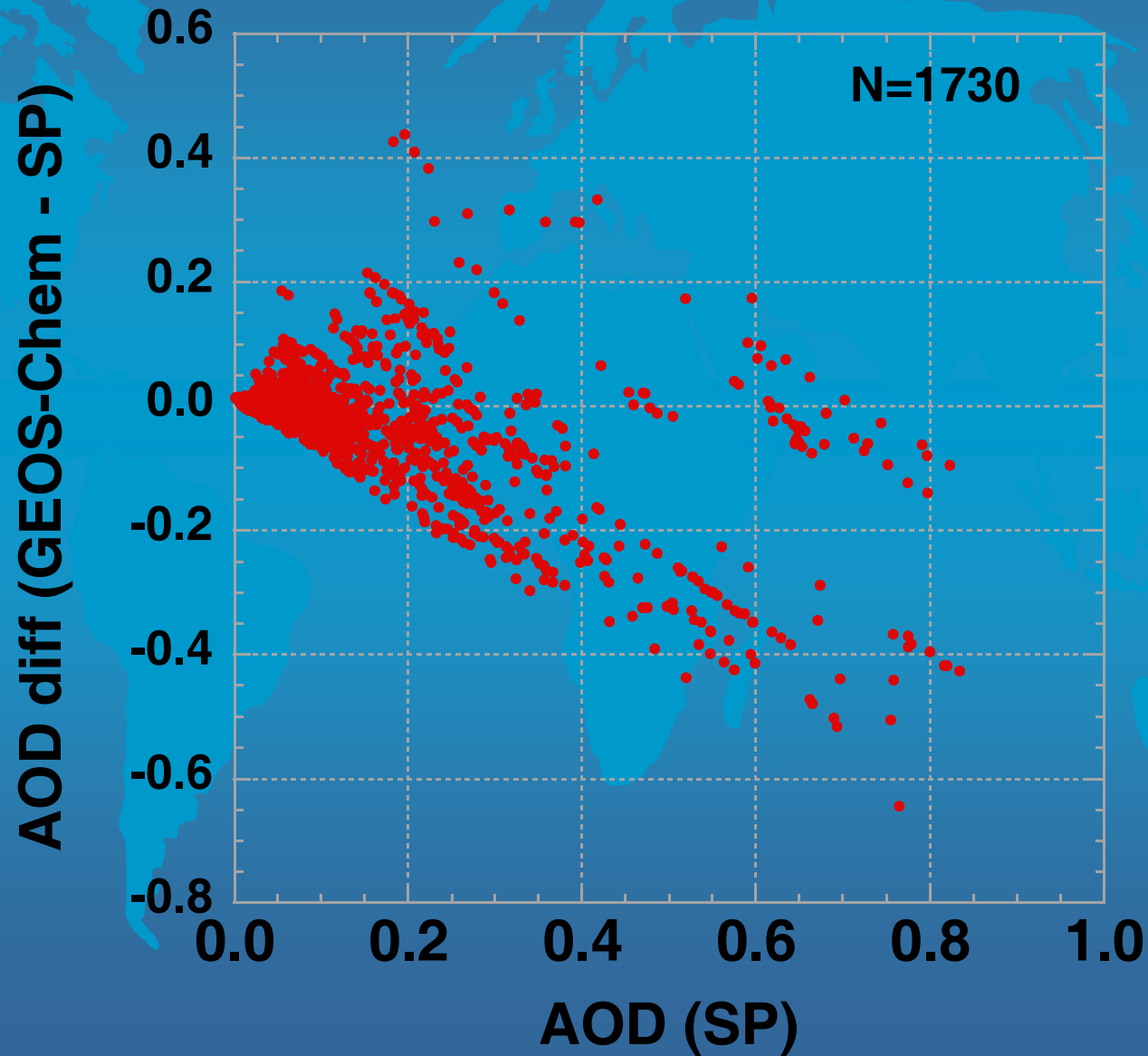
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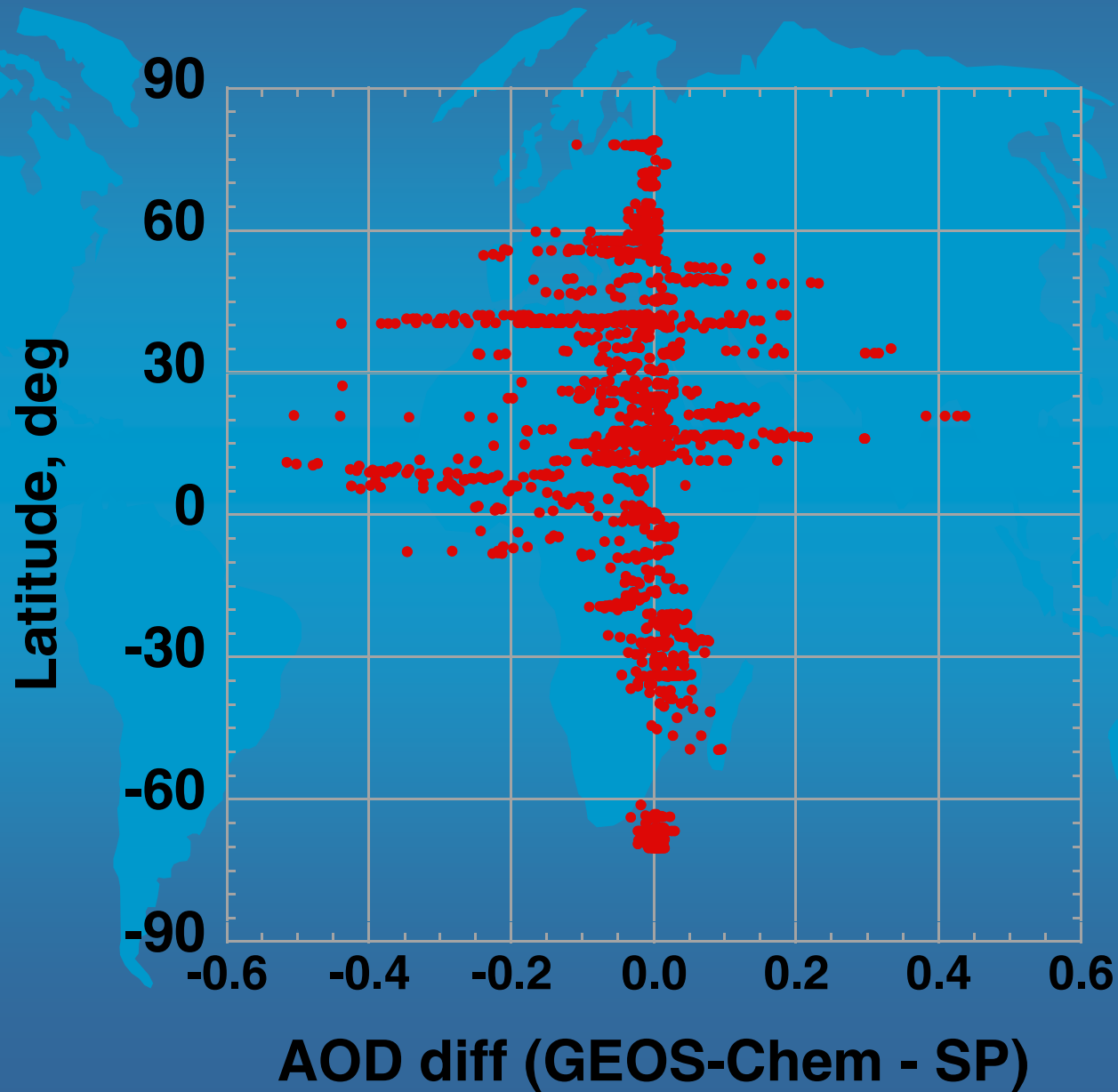
GEOS-Chem vs MAN - 2007



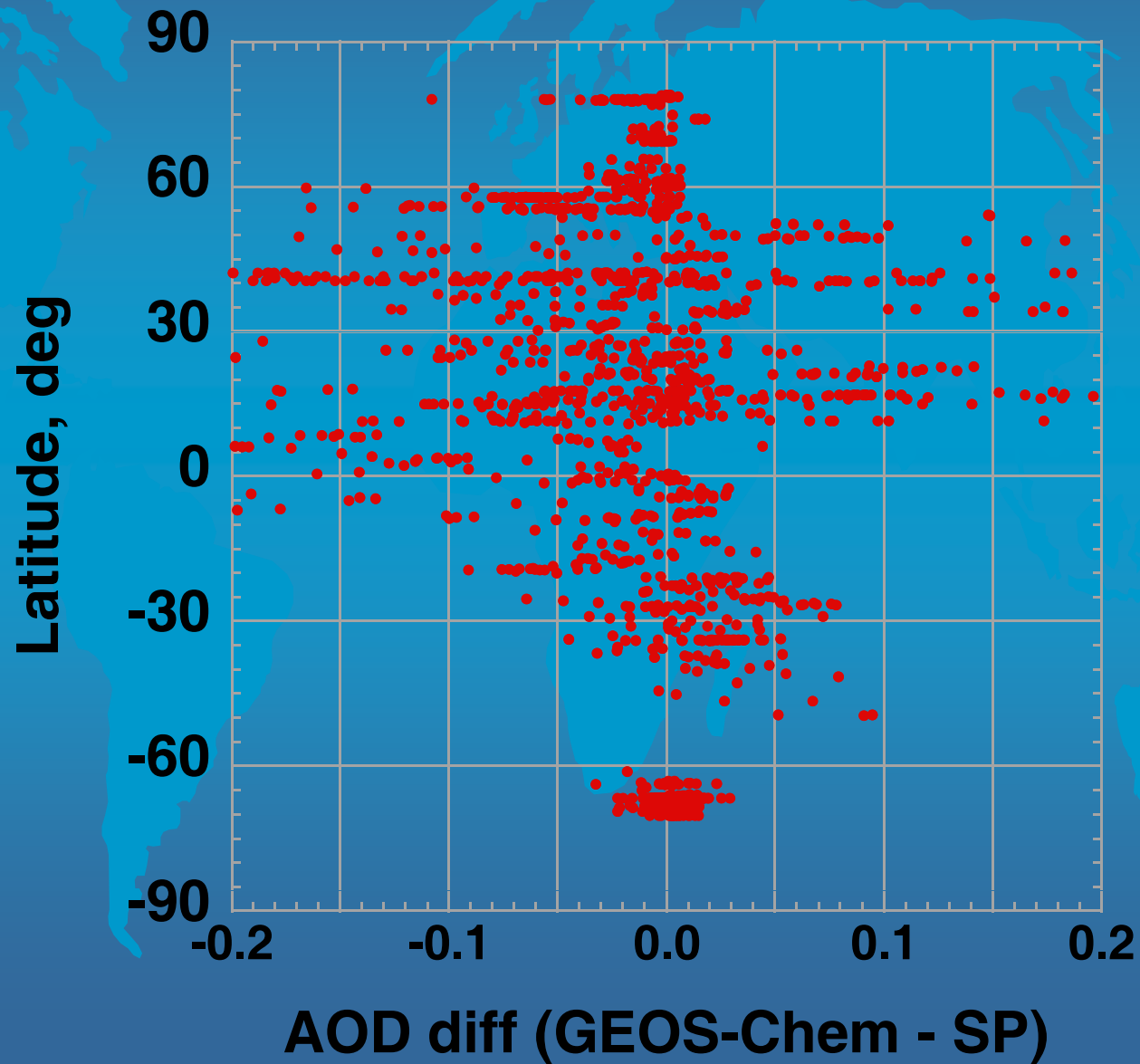
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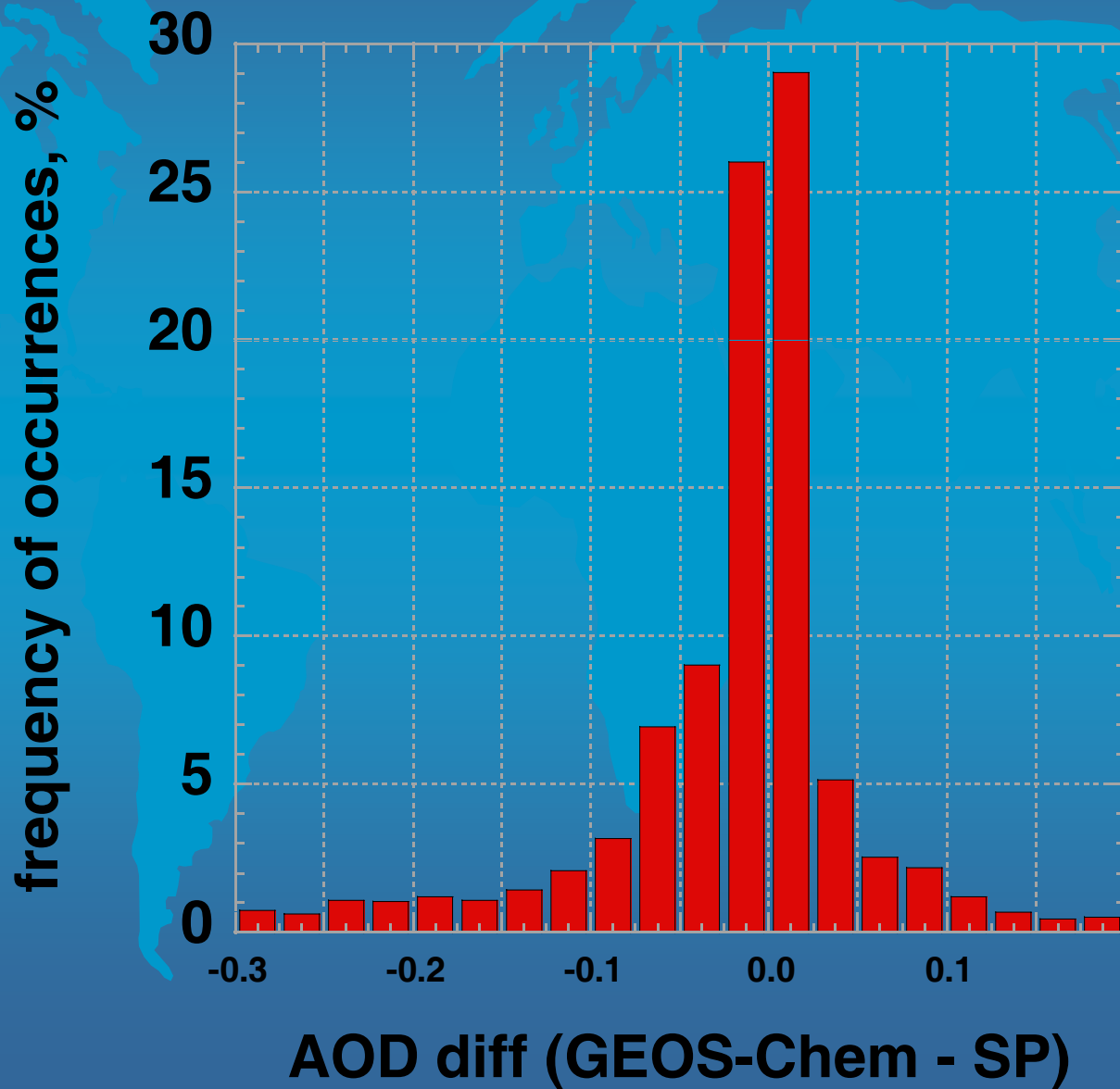
GEOS-Chem vs MAN - 2007



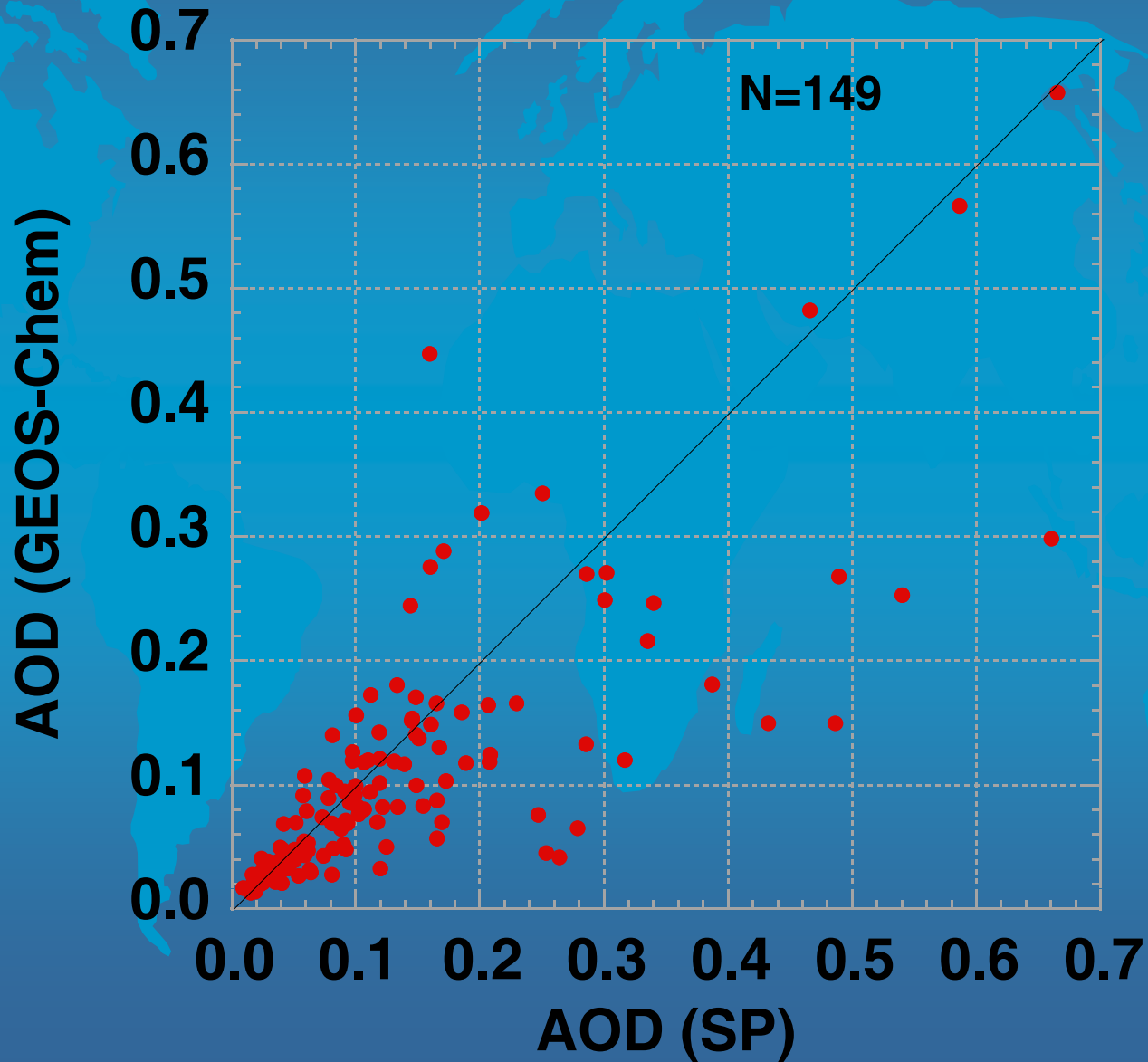
GEOS-Chem vs MAN - 2007



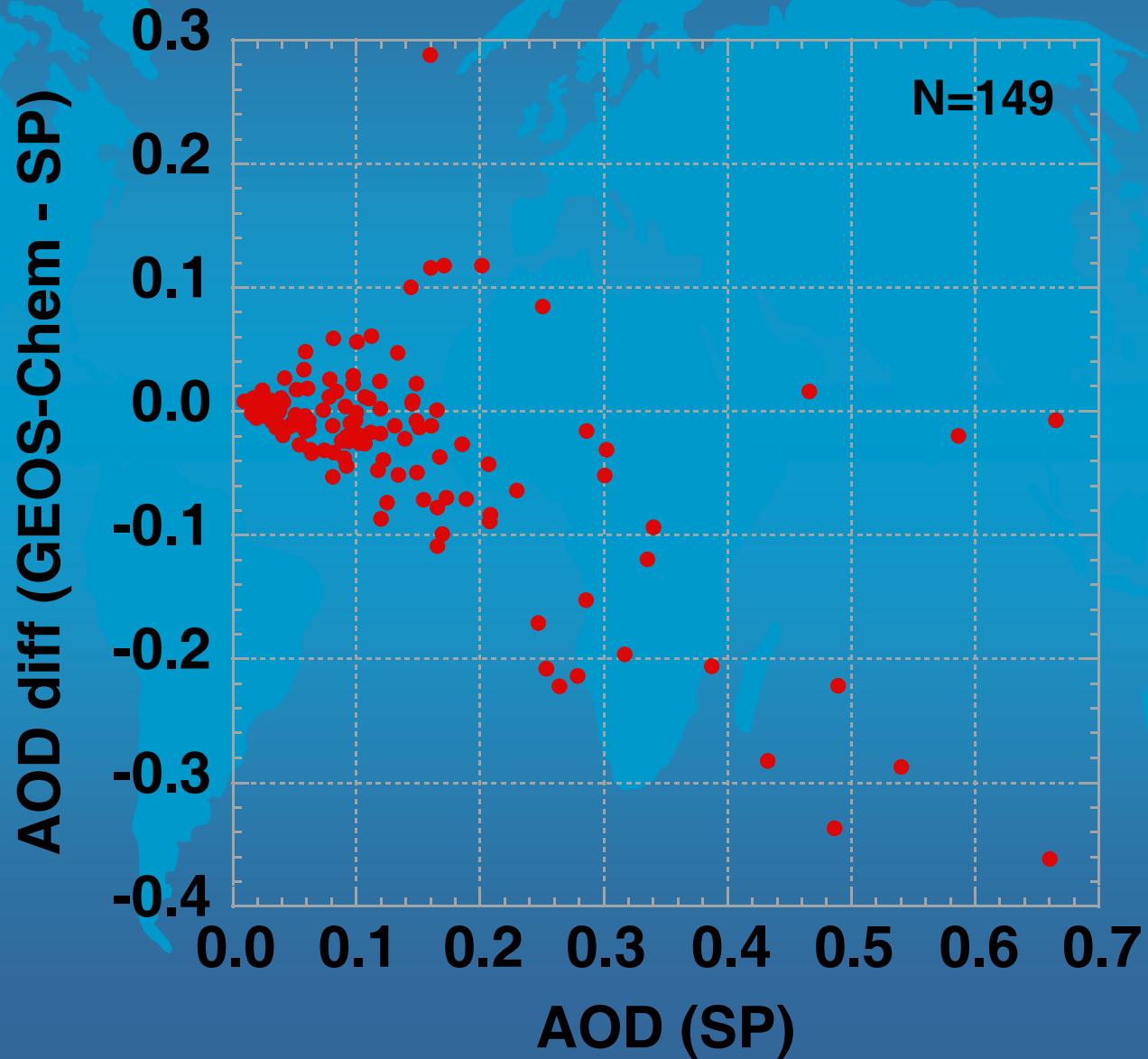
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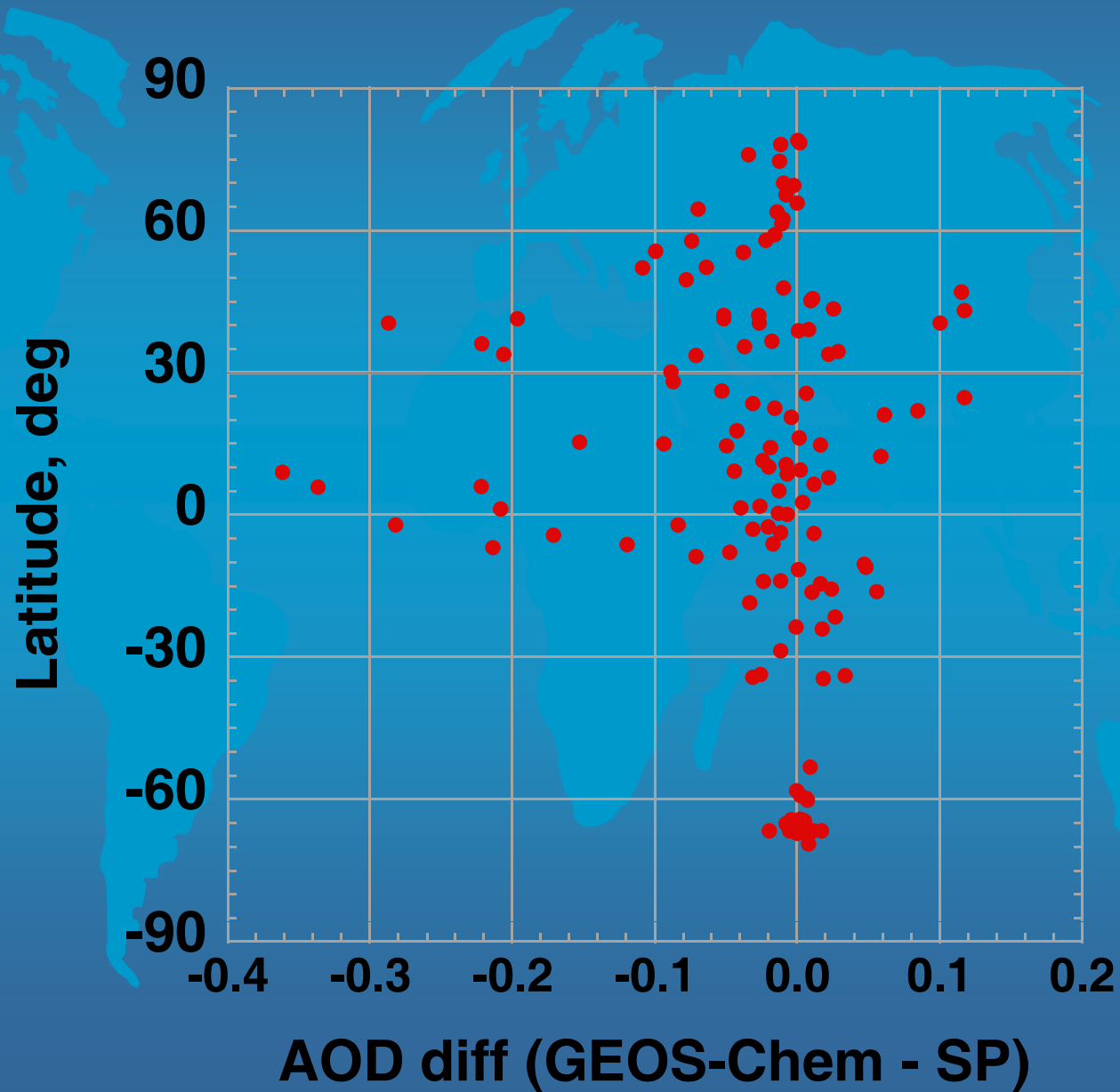
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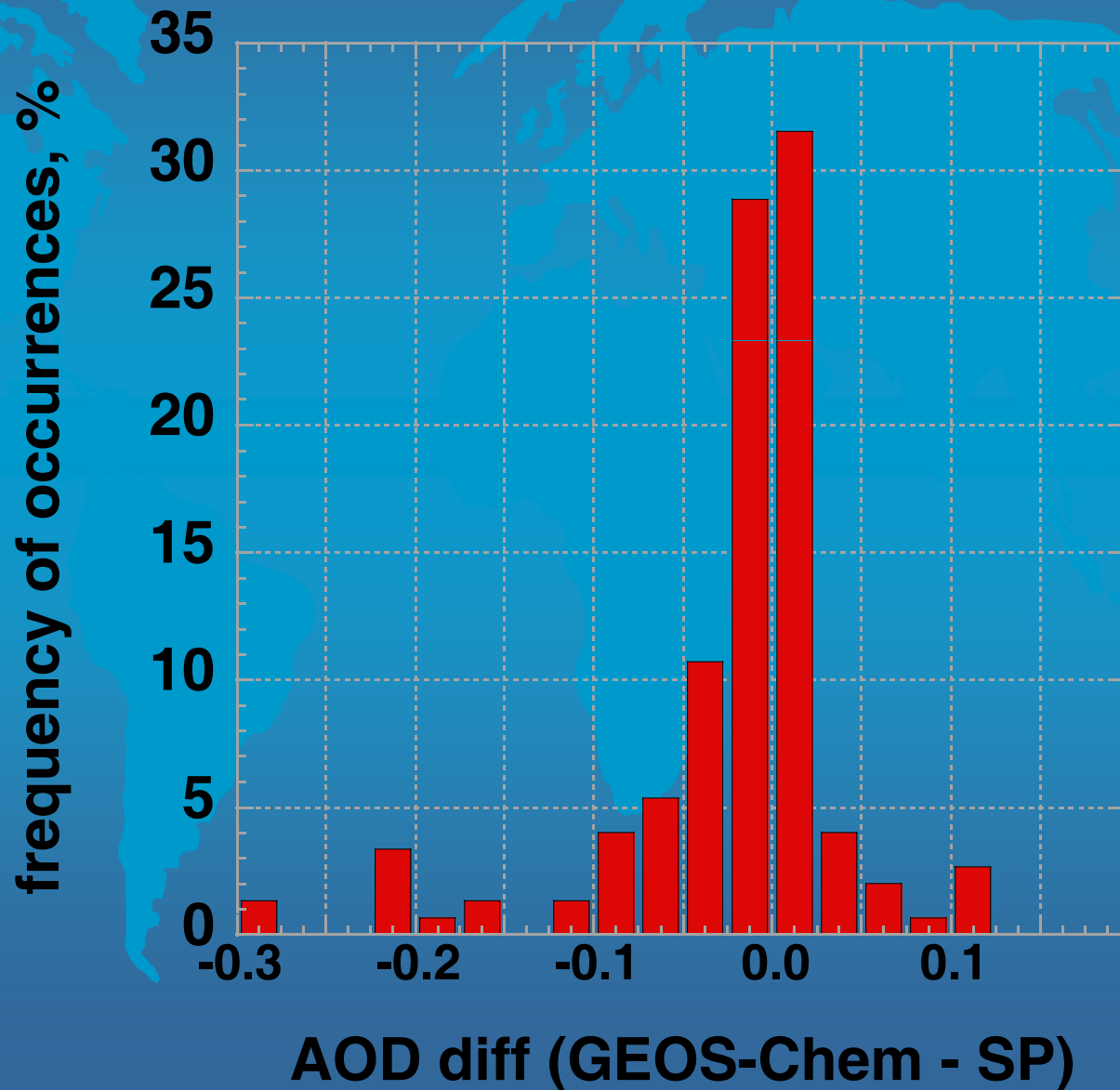
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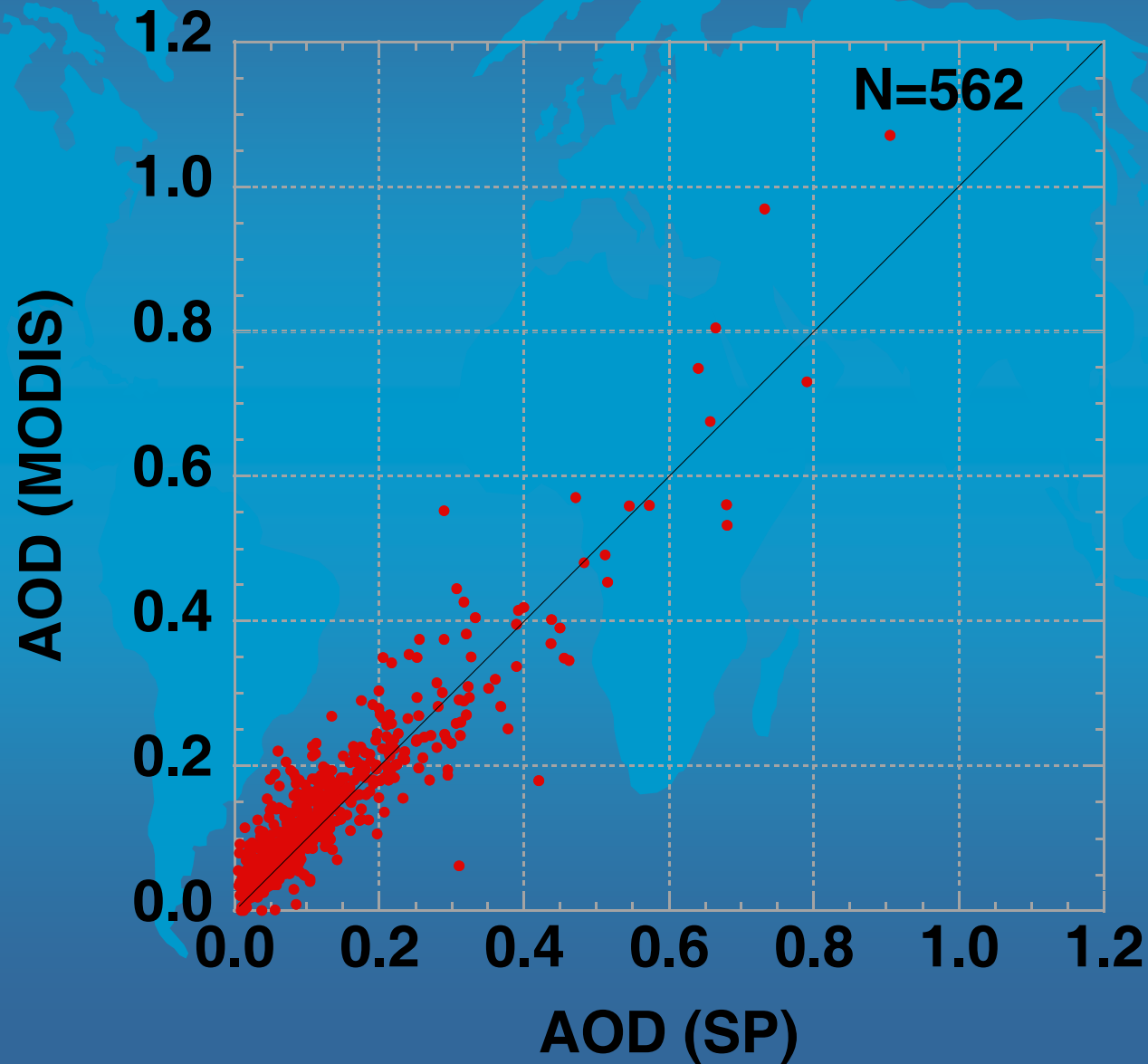
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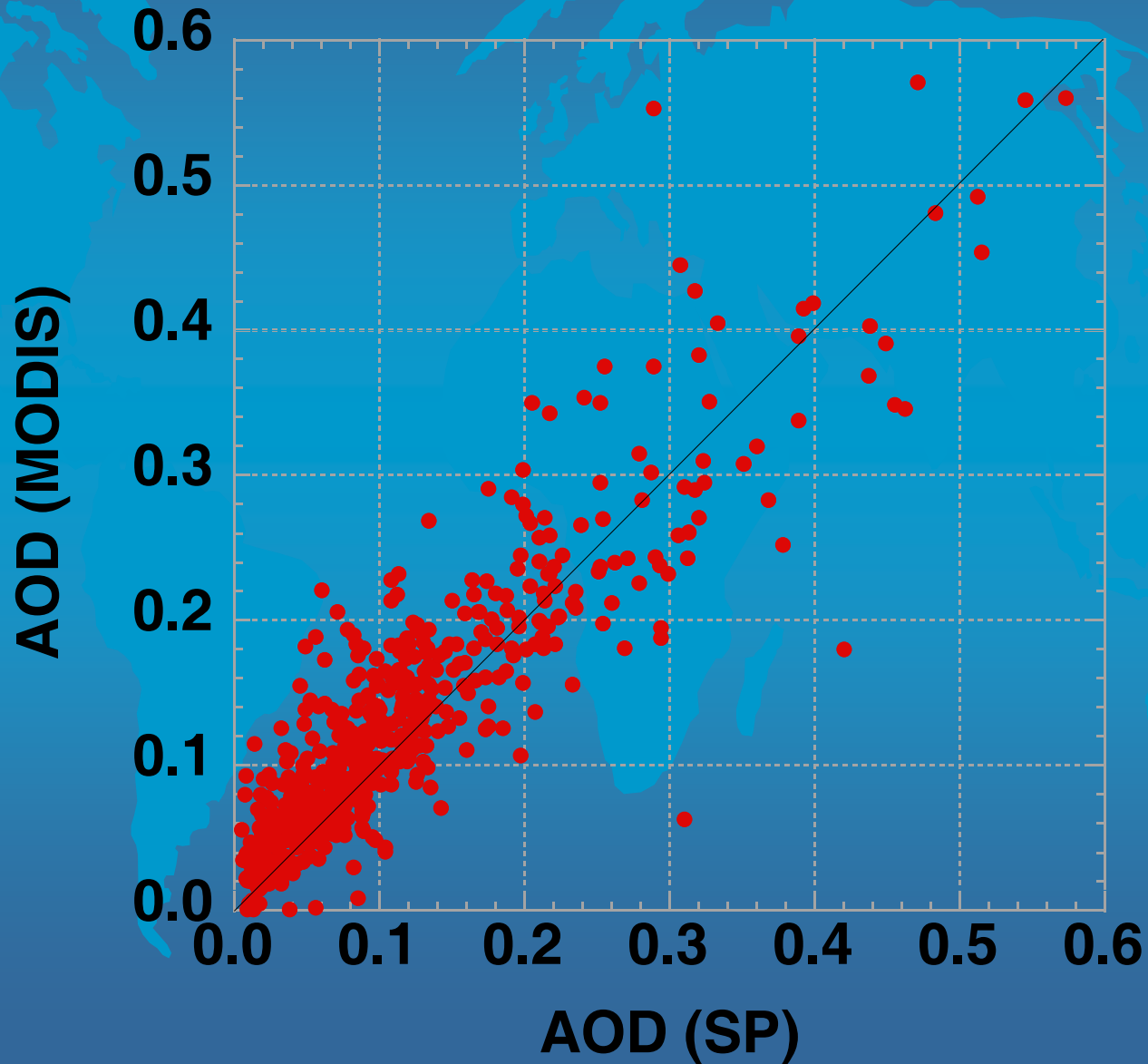
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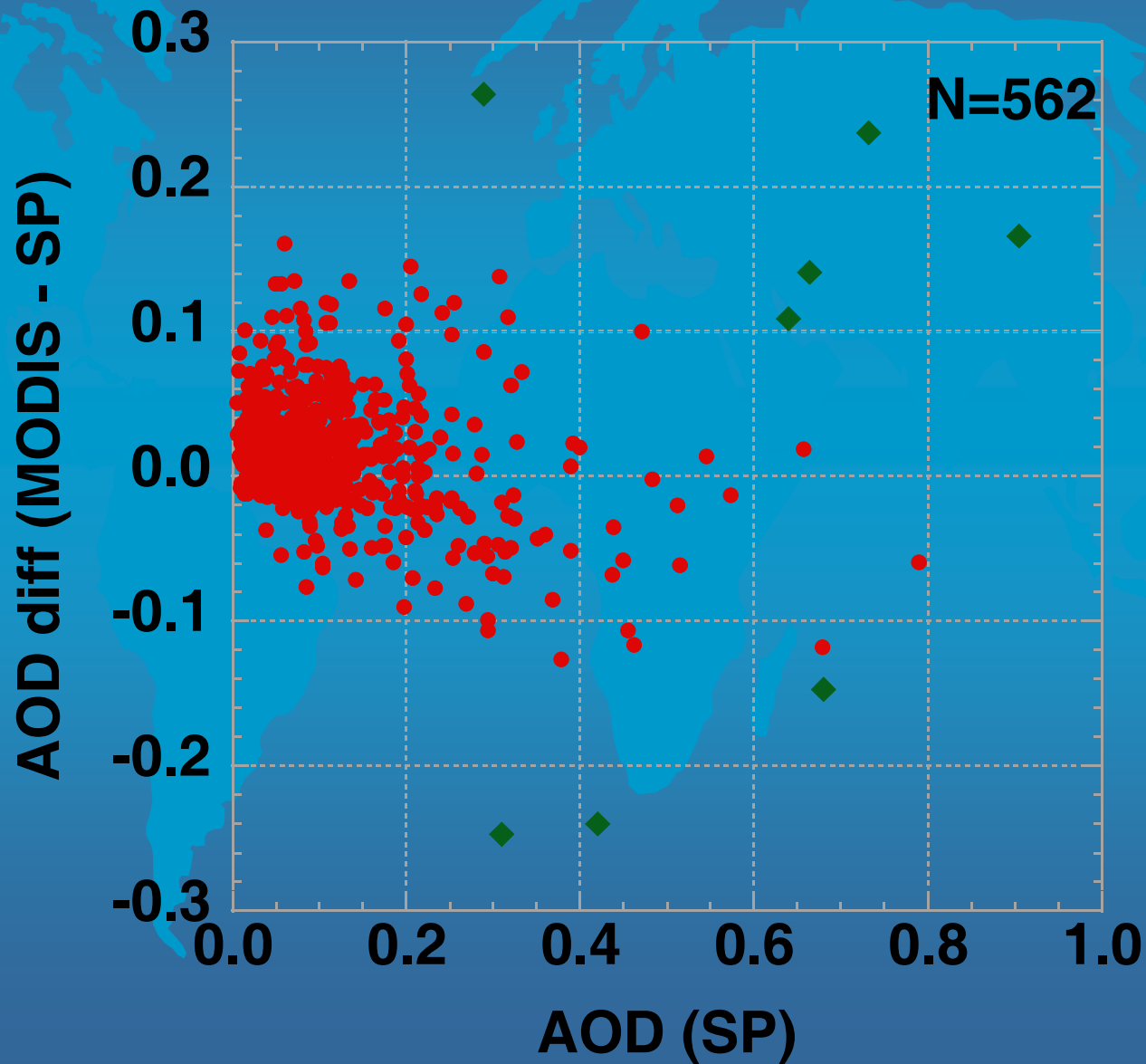
MODIS (Kleidman et al. 2010) vs MAN



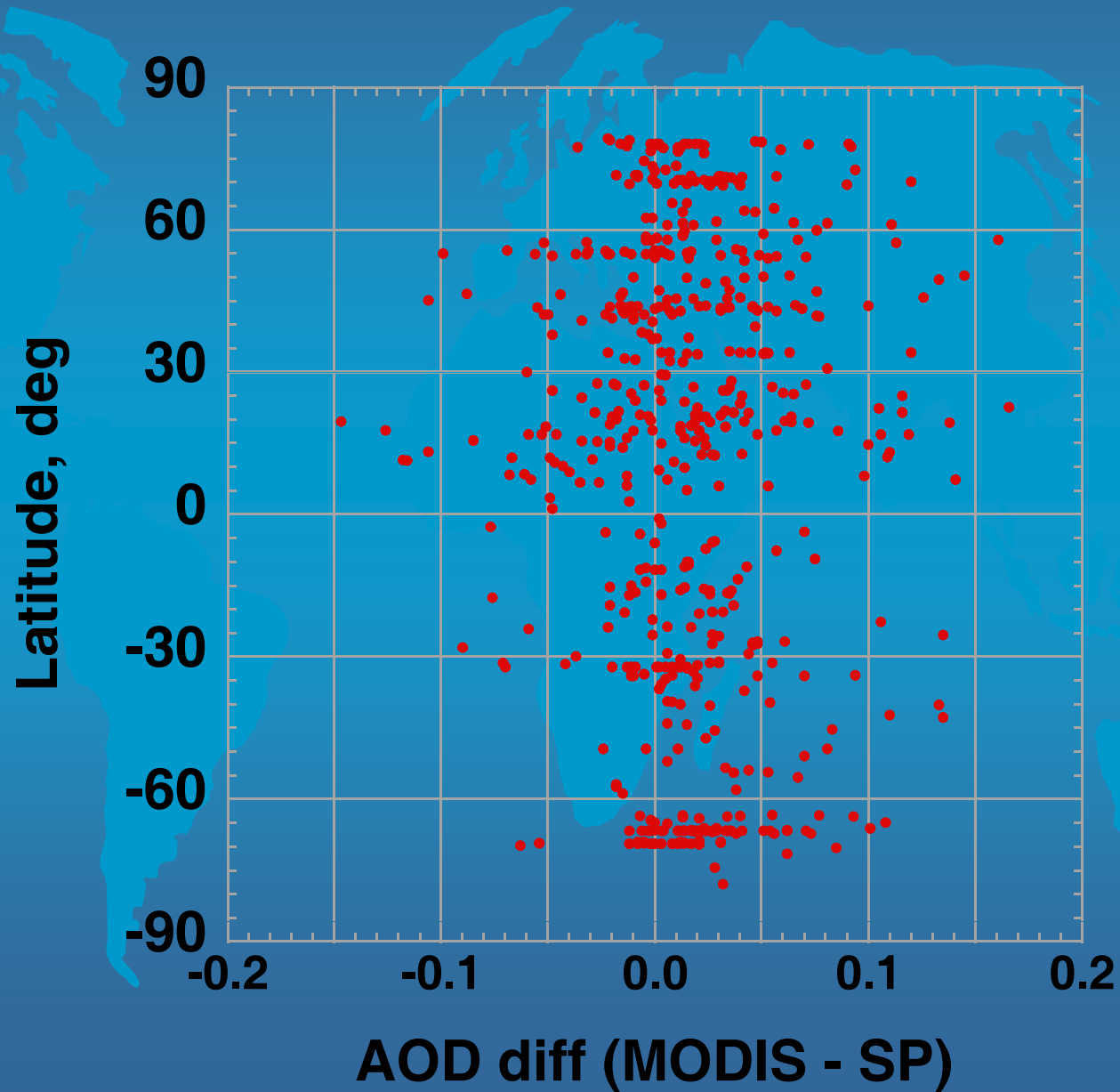
MODIS (Kleidman et al. 2010) vs MAN



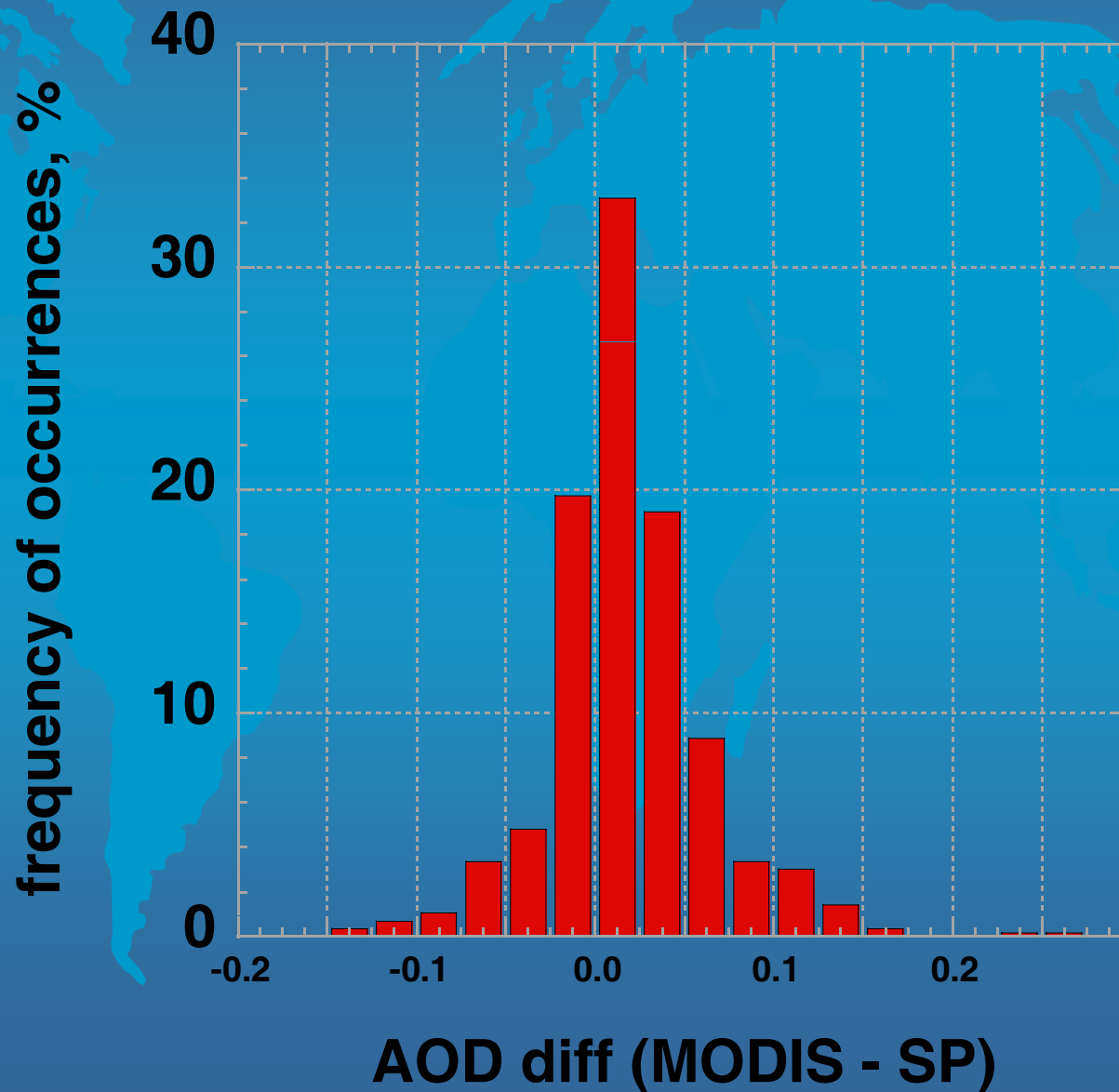
MODIS (Kleidman et al. 2010) vs MAN



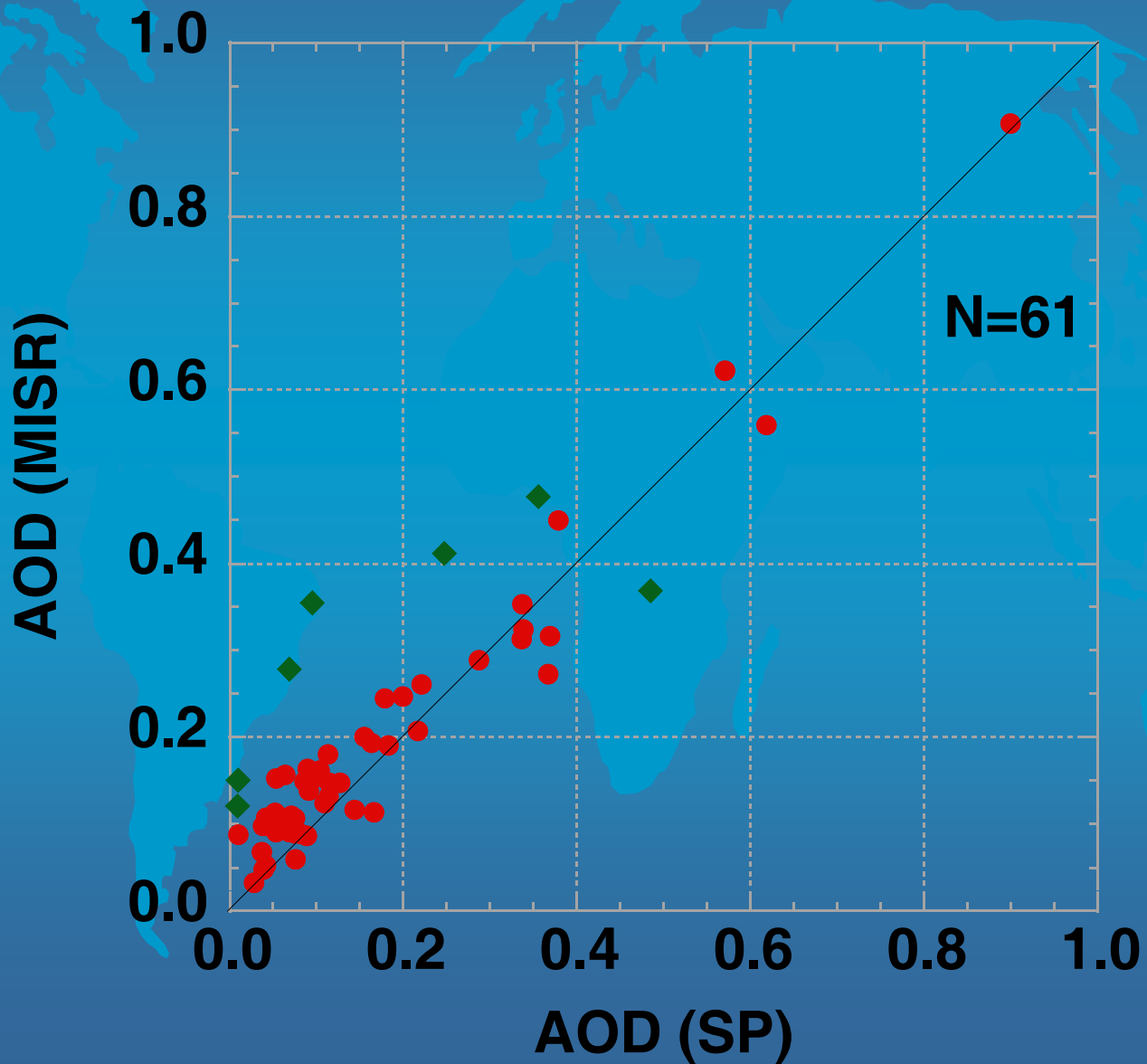
MODIS (Kleidman et al. 2010) vs MAN



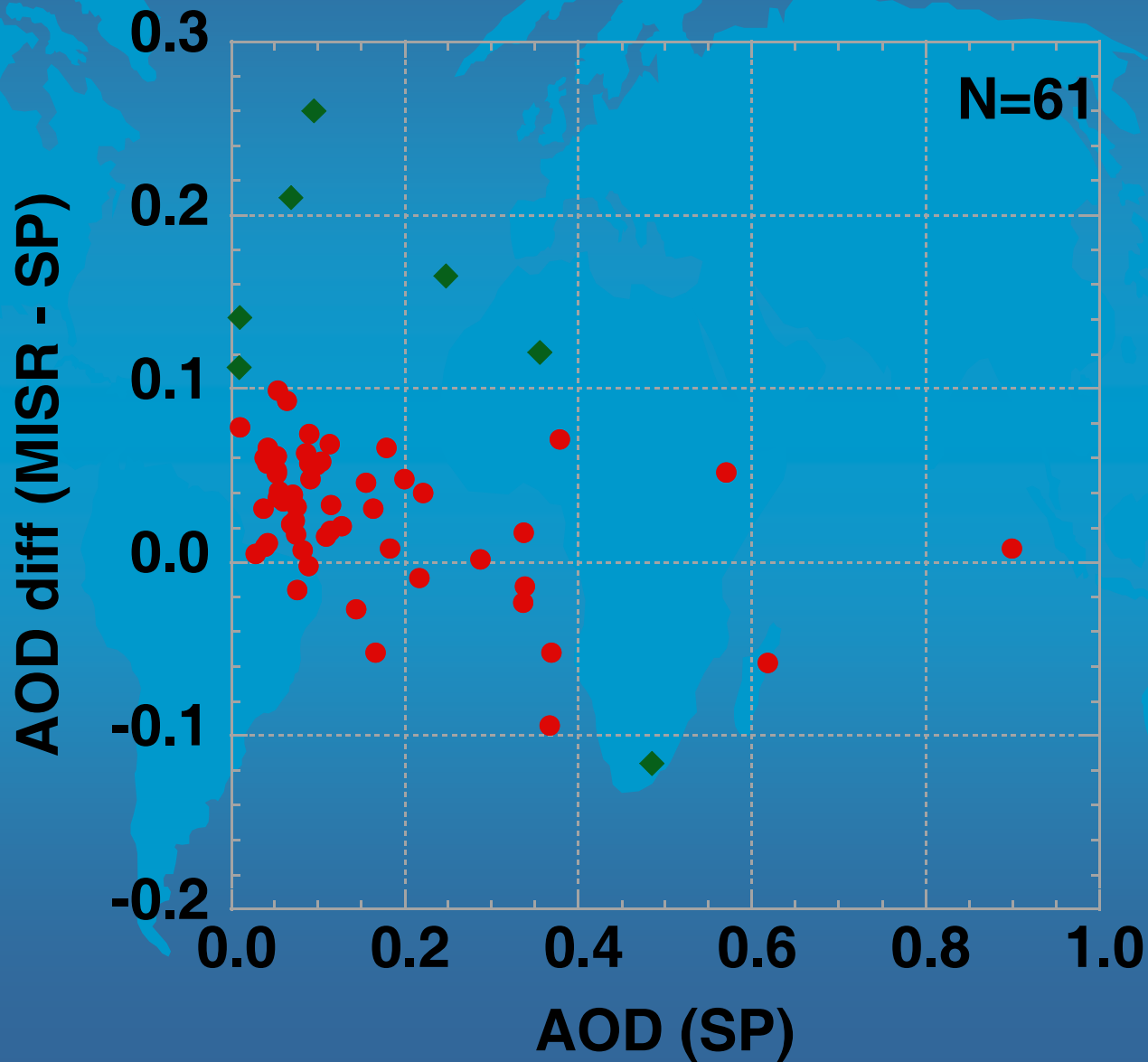
MODIS (Kleidman et al. 2010) vs MAN



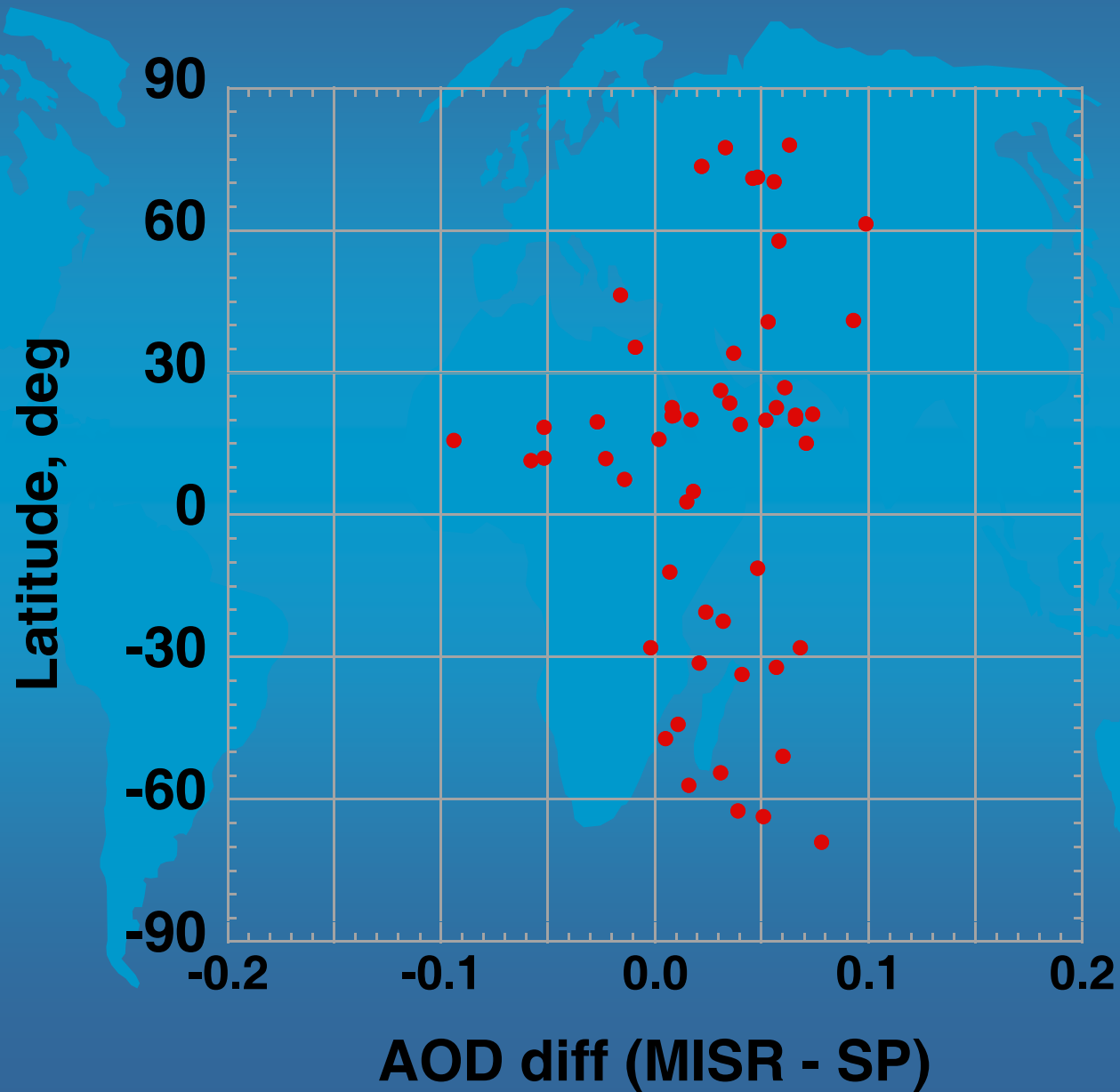
MISR (Kahn et al. 2010) vs MAN



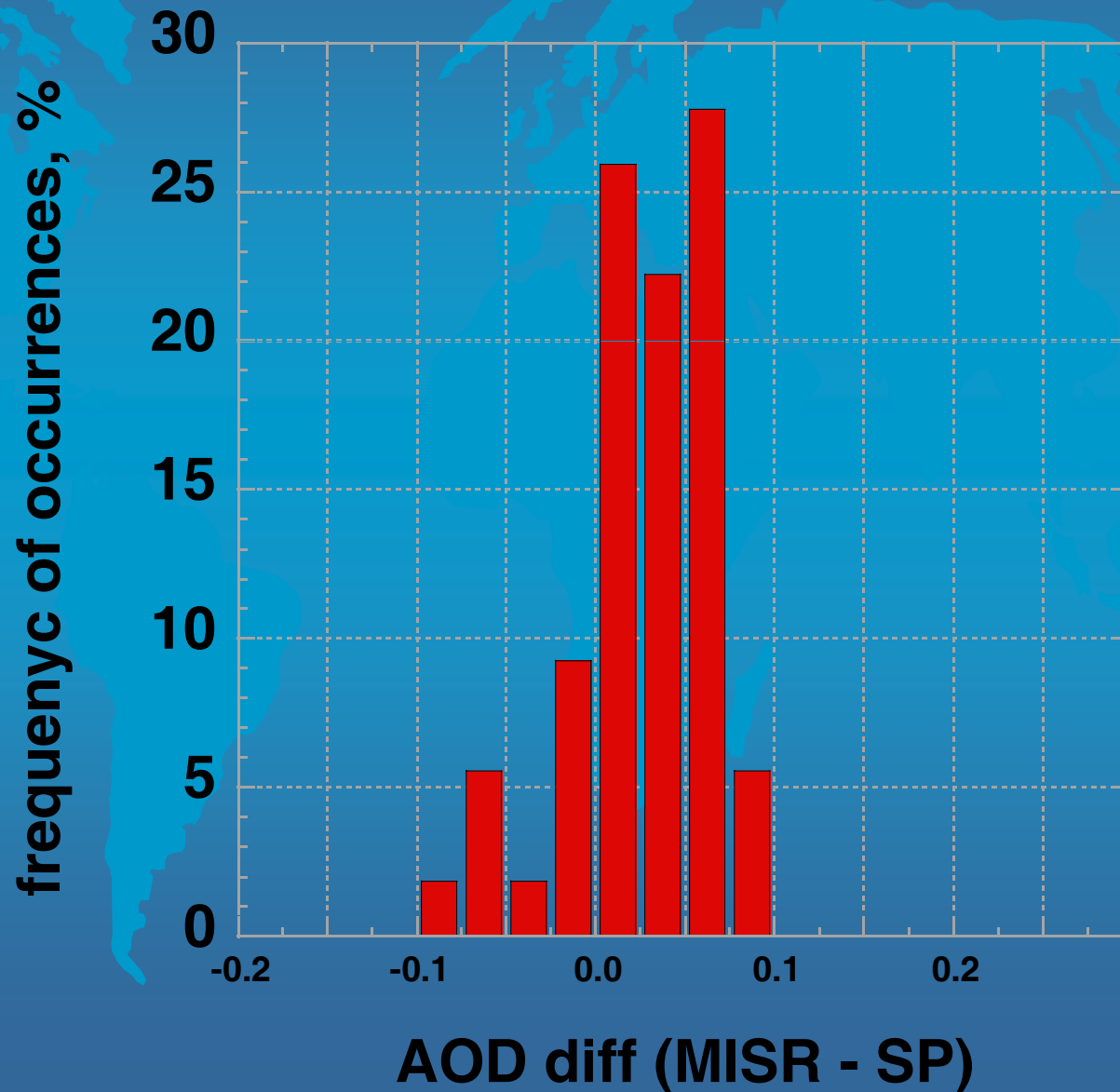
MISR (Kahn et al. 2010) vs MAN



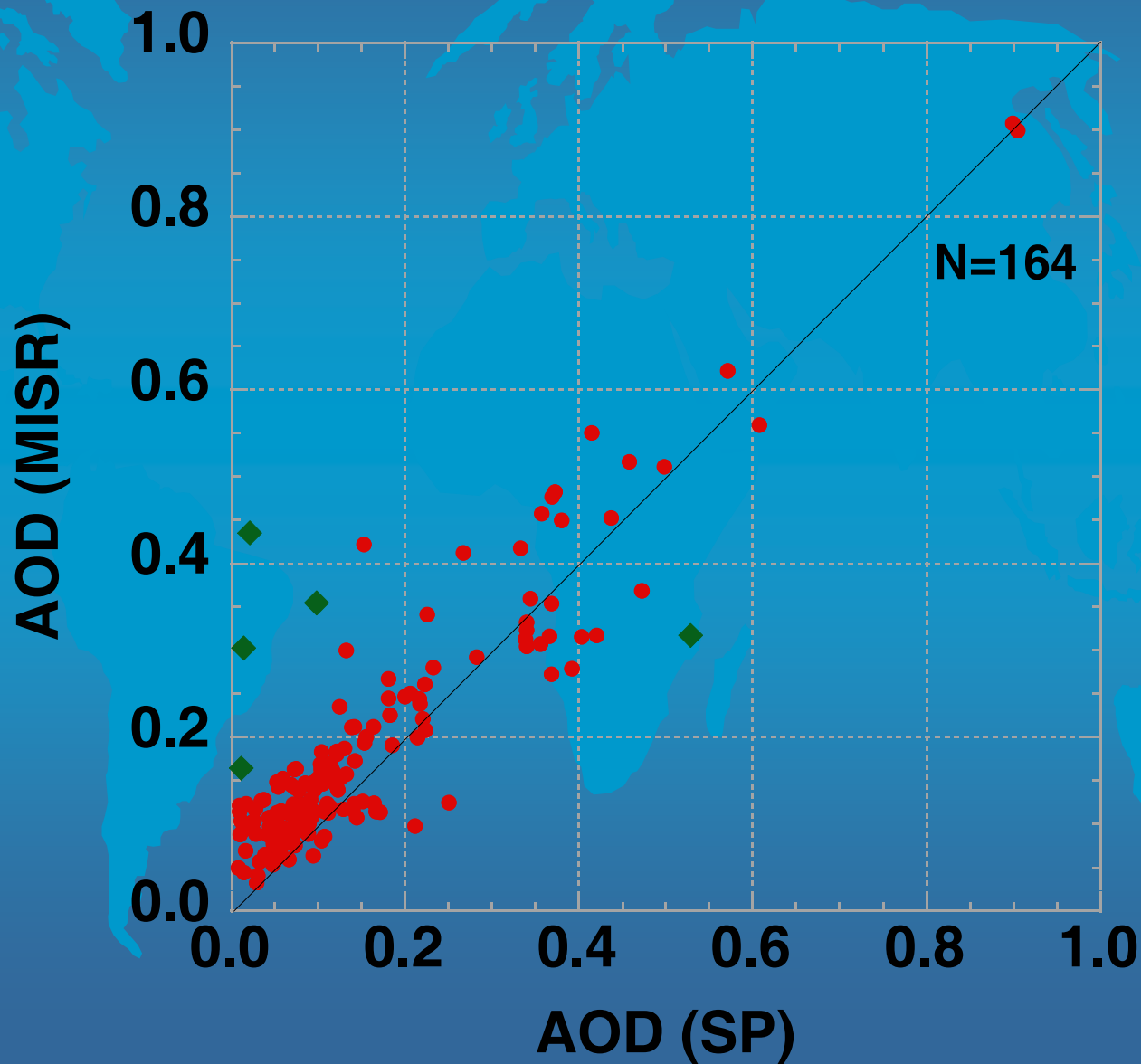
MISR (Kahn et al. 2010) vs MAN



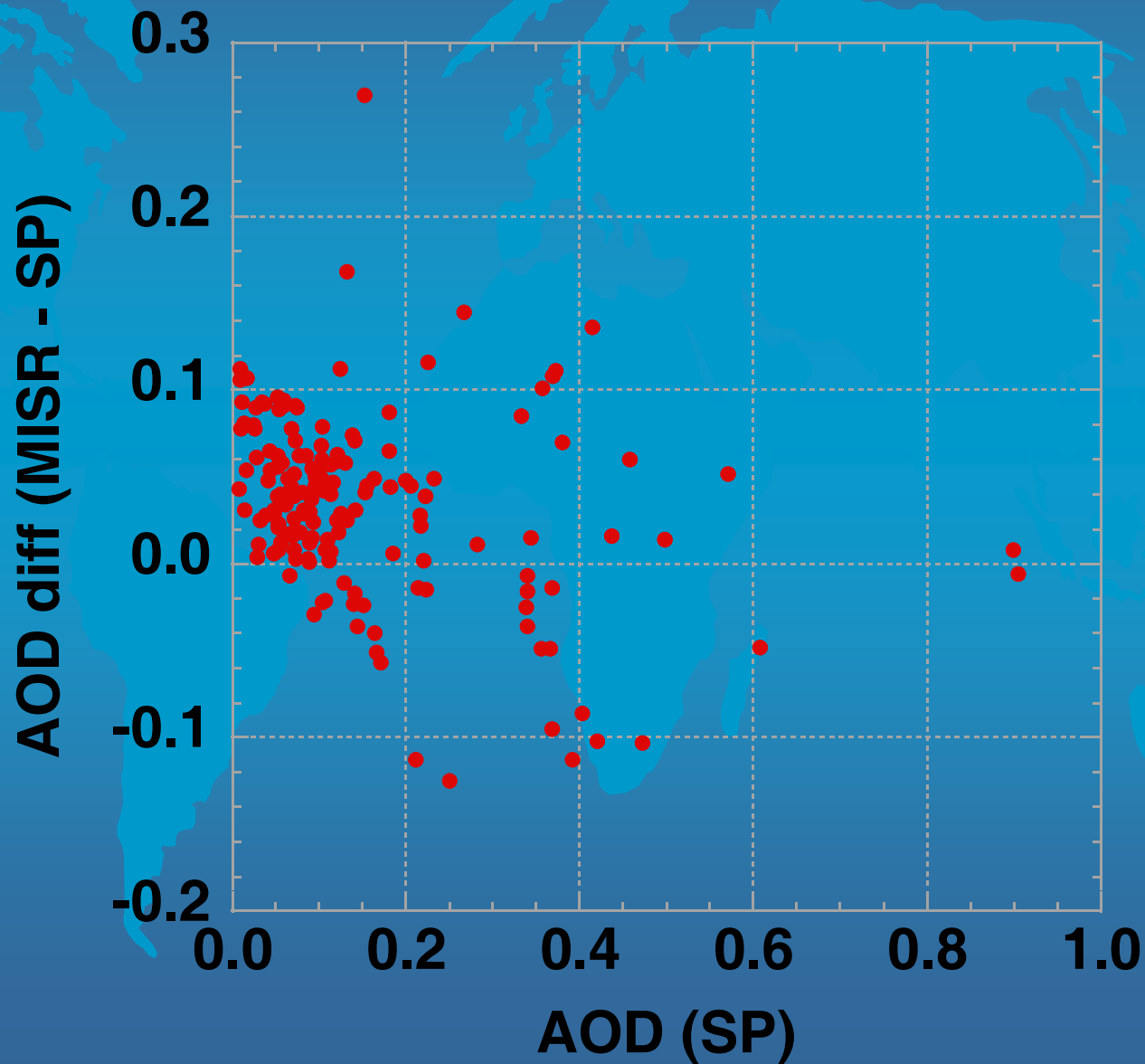
MISR (Kahn et al. 2010) vs MAN



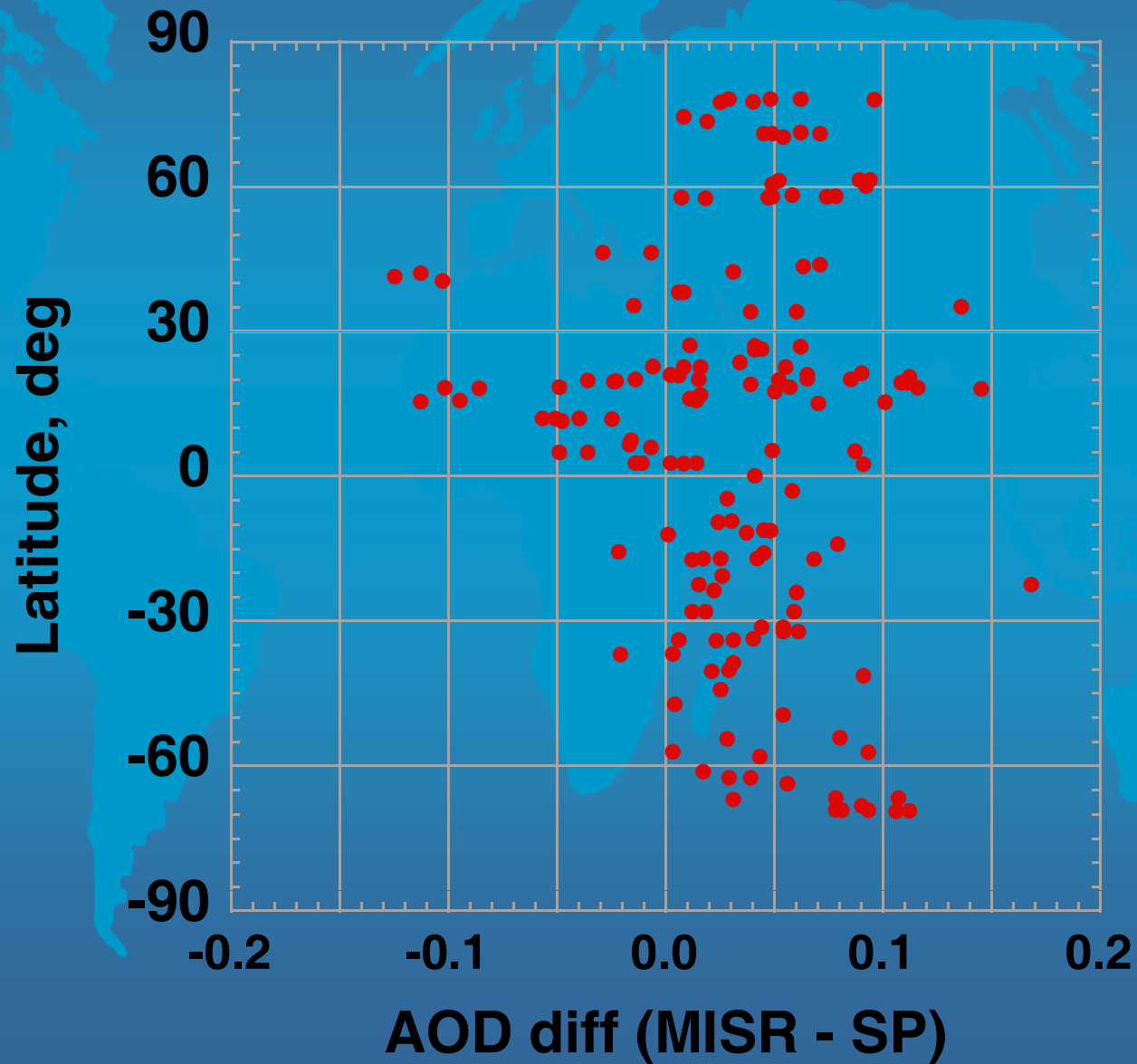
MISR (Reid & Zhang) vs MAN



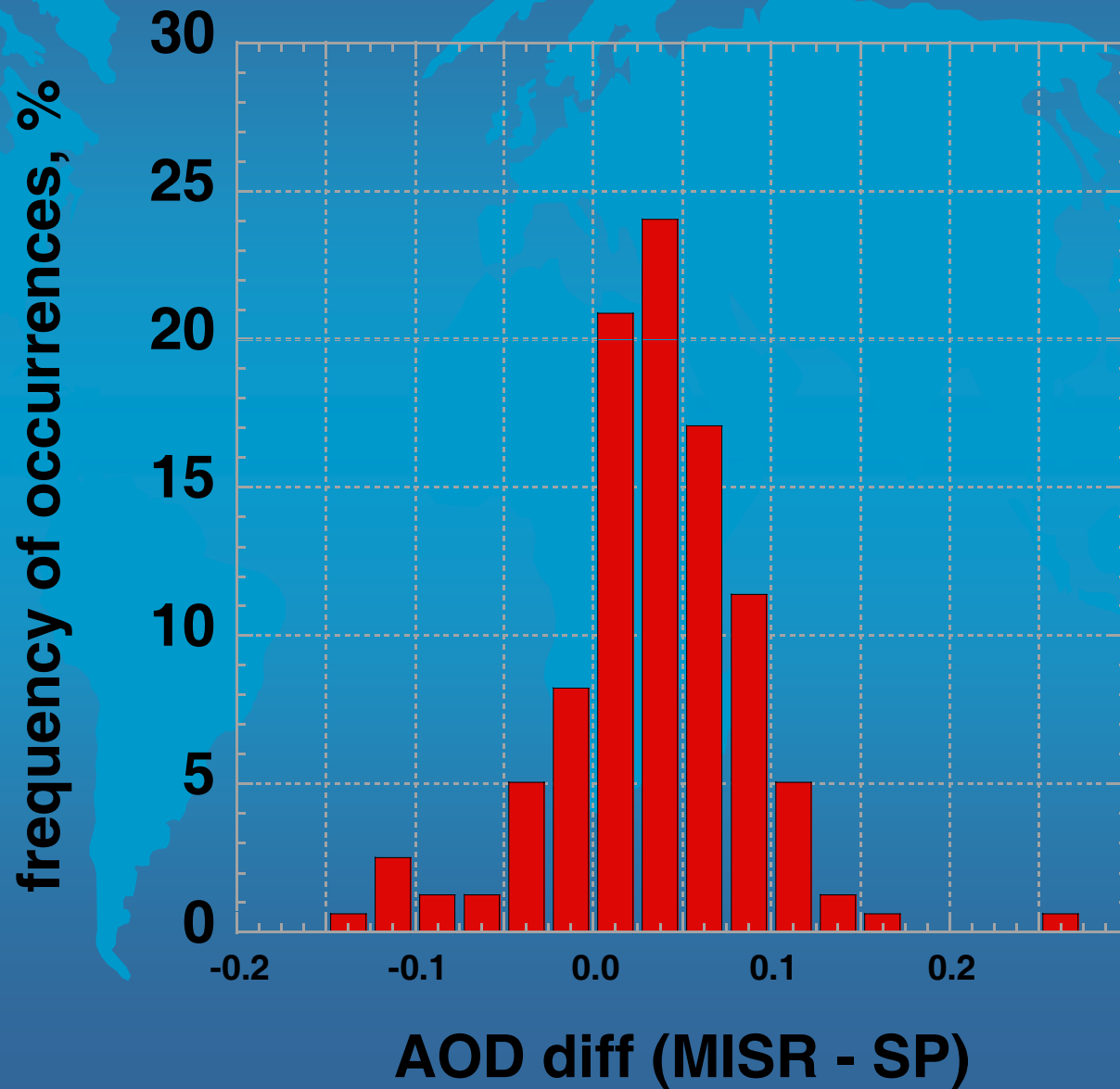
MISR (Reid & Zhang) vs MAN



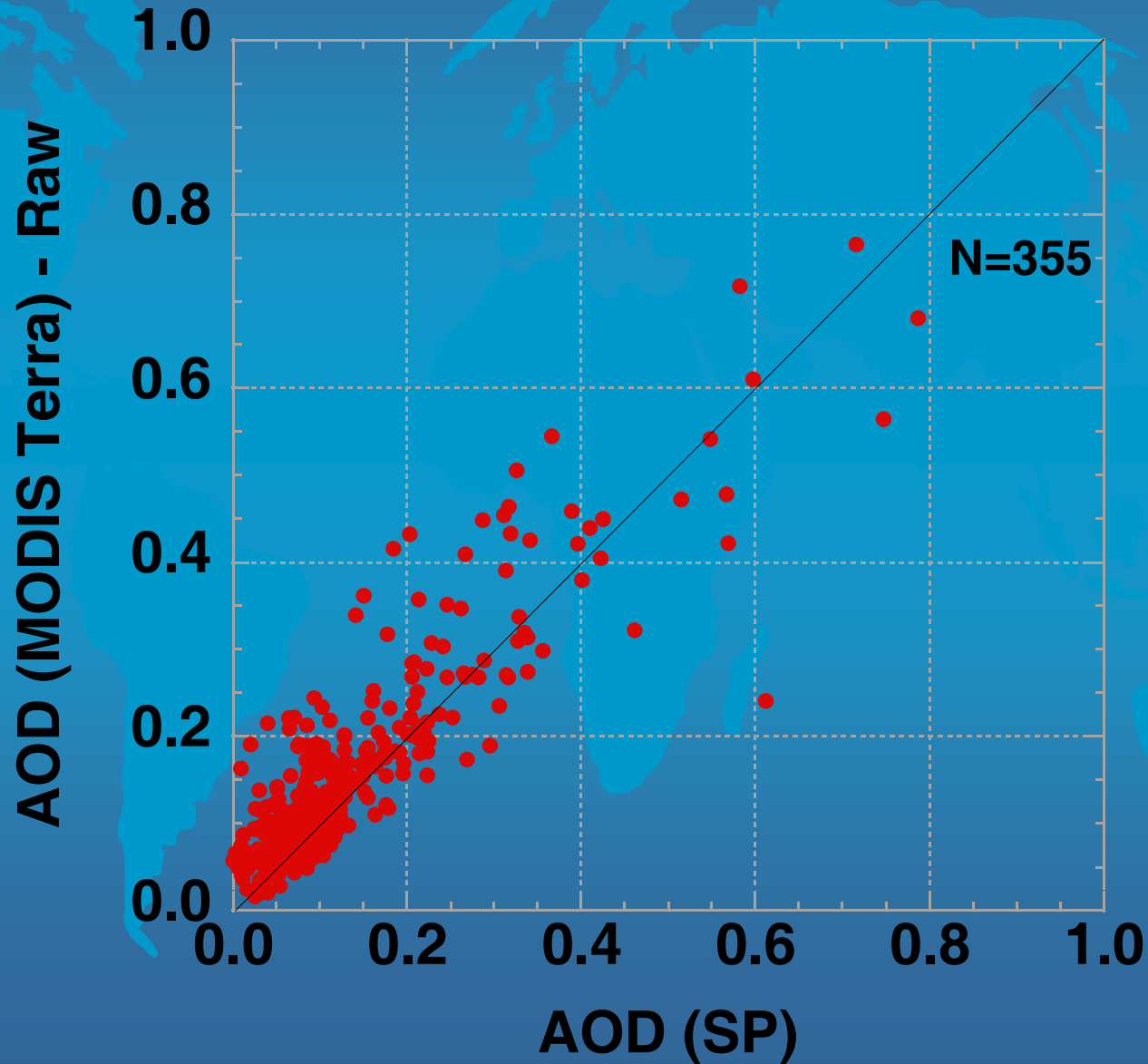
MISR (Reid & Zhang) vs MAN



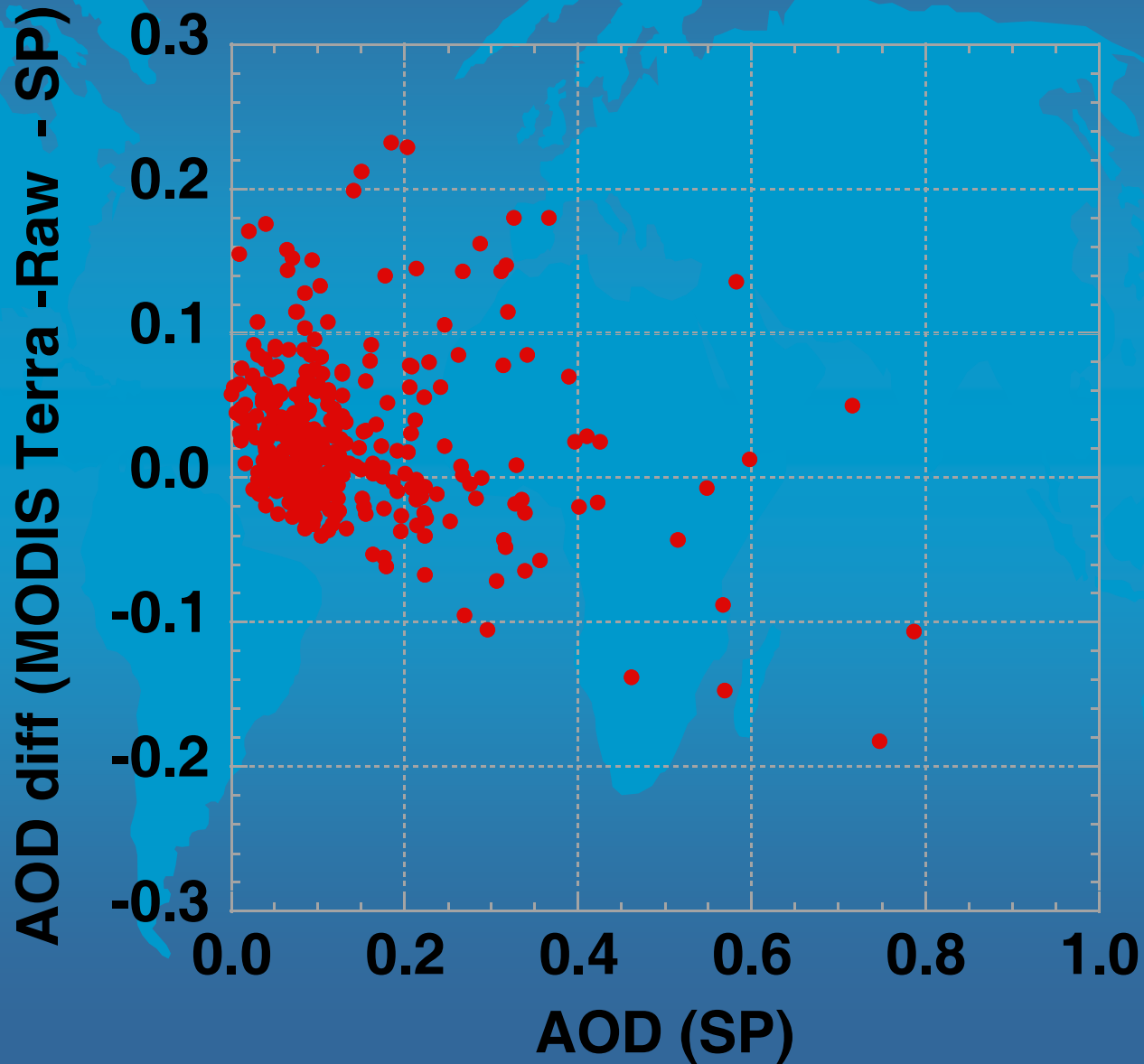
MISR (Reid & Zhang) vs MAN



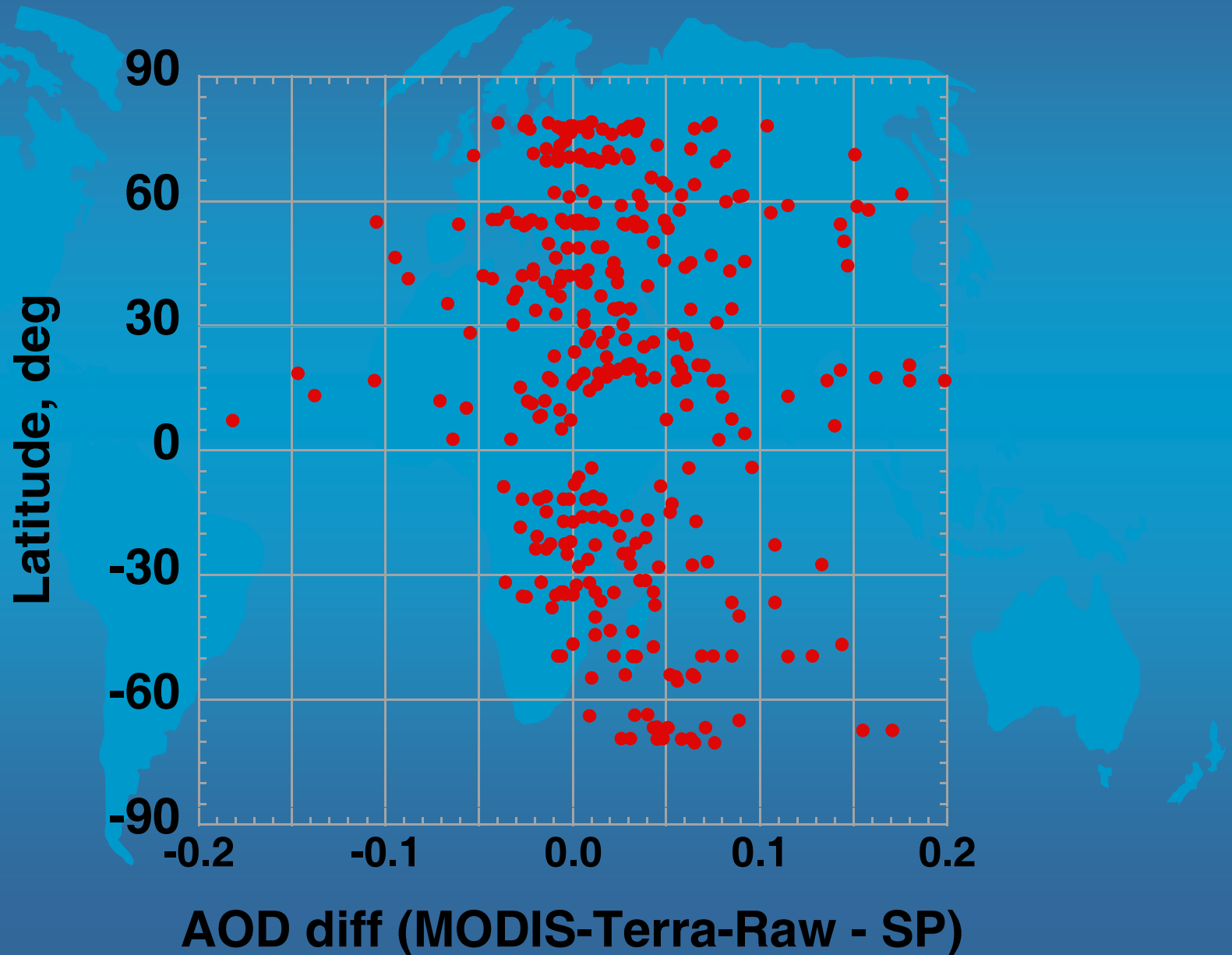
MODIS Terra - Raw (Reid & Zhang) vs MAN



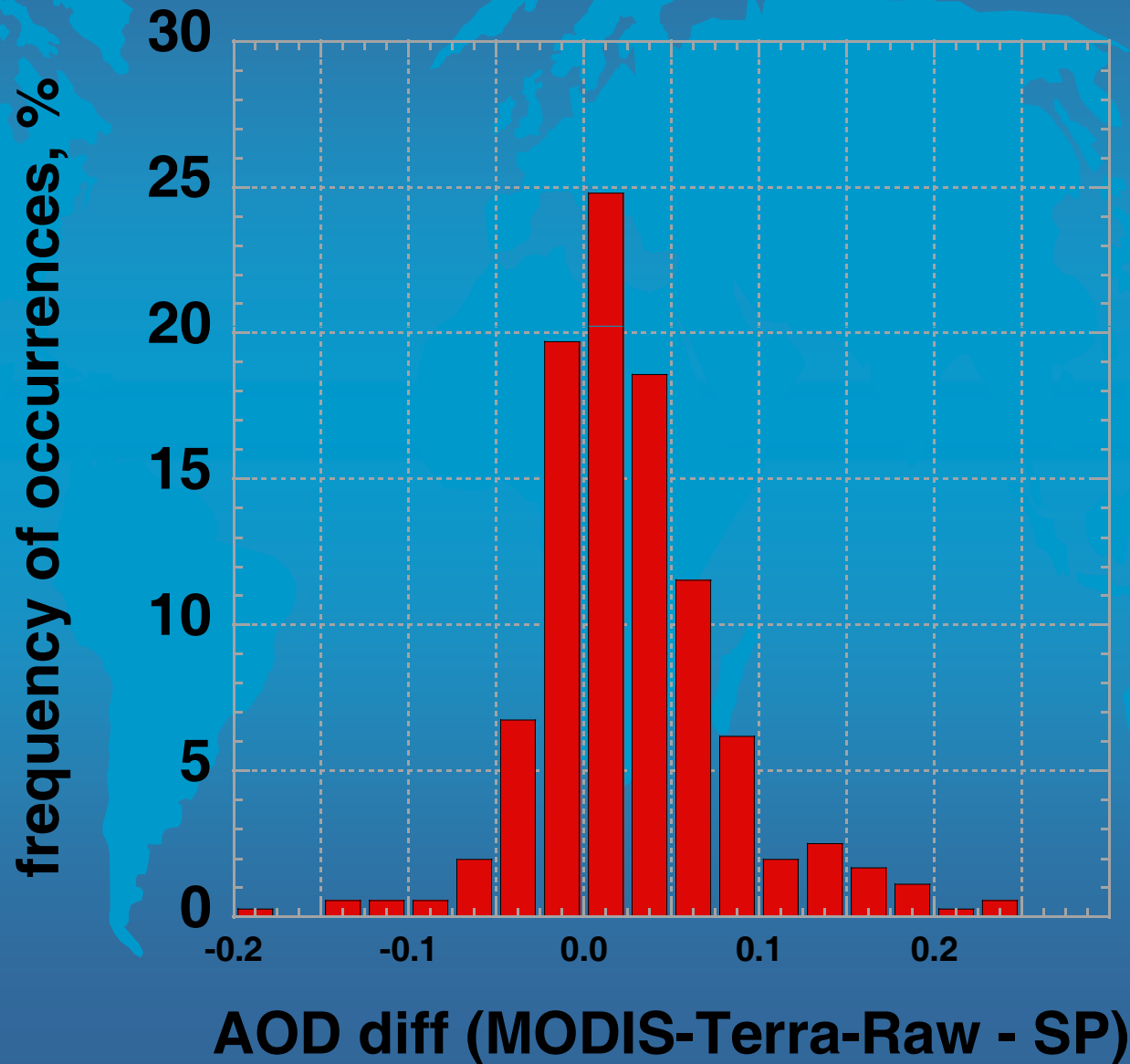
MODIS Terra - Raw (Reid & Zhang) vs MAN



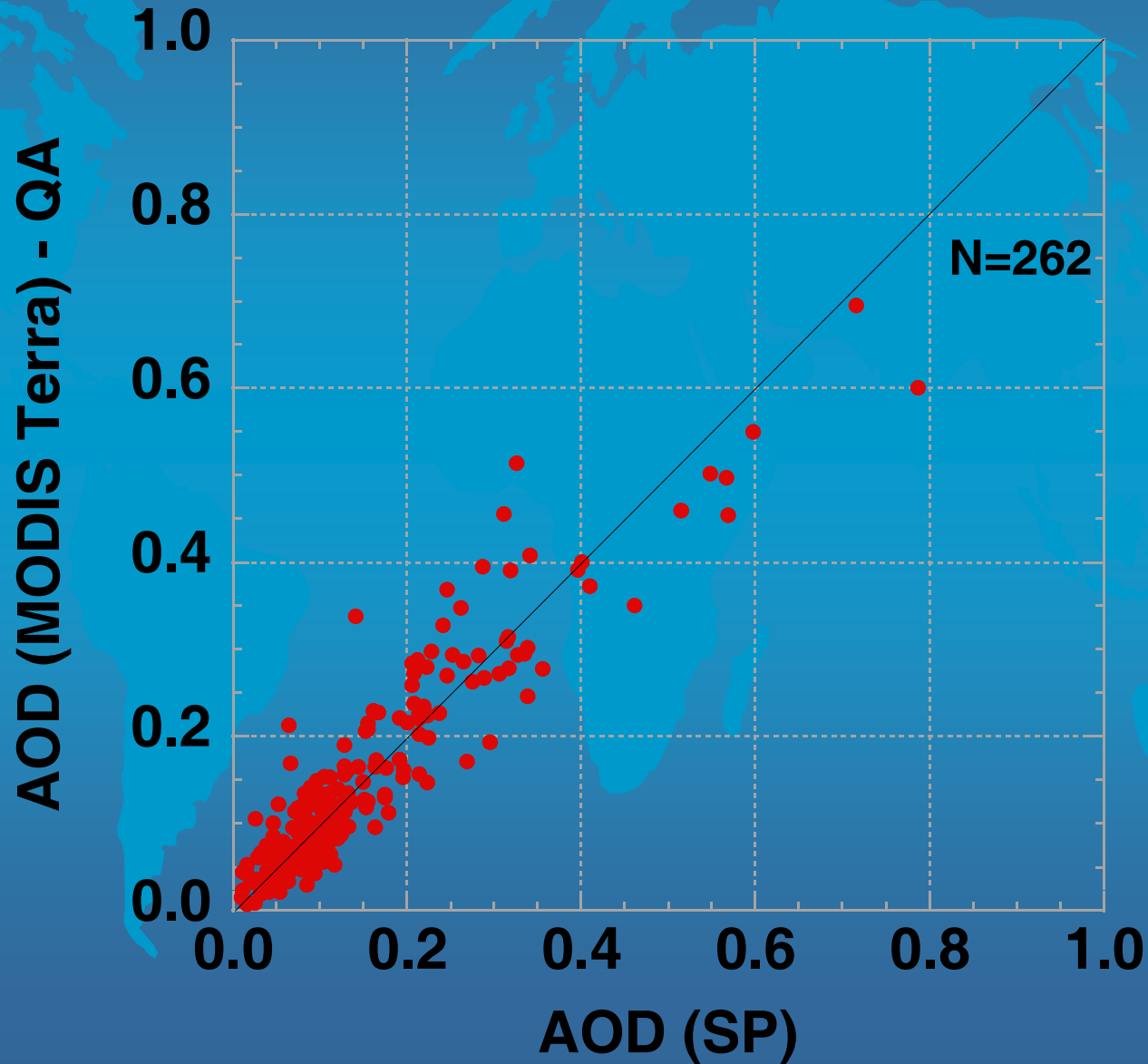
MODIS Terra - Raw (Reid & Zhang) vs MAN



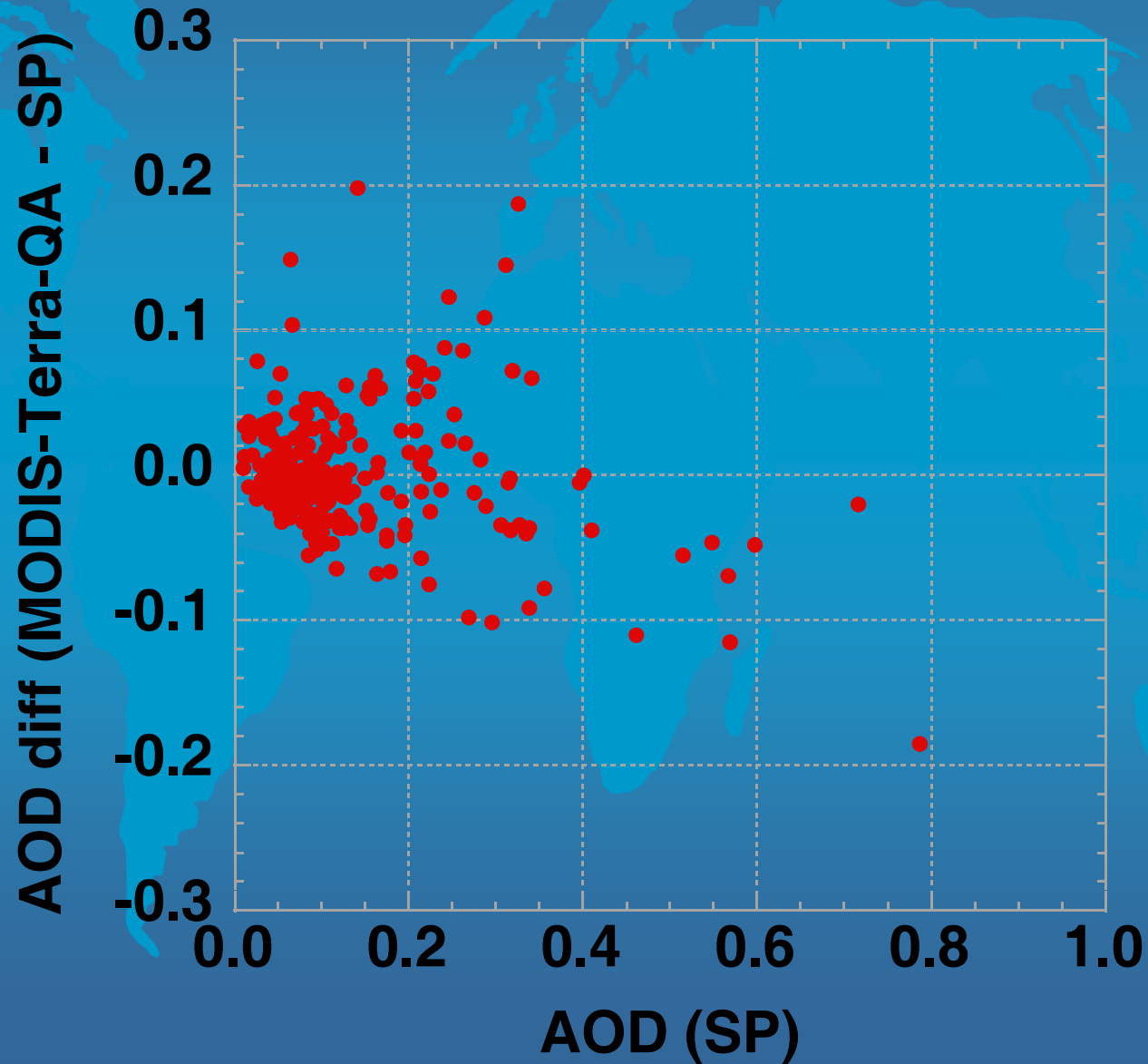
MODIS Terra - Raw (Reid & Zhang) vs MAN



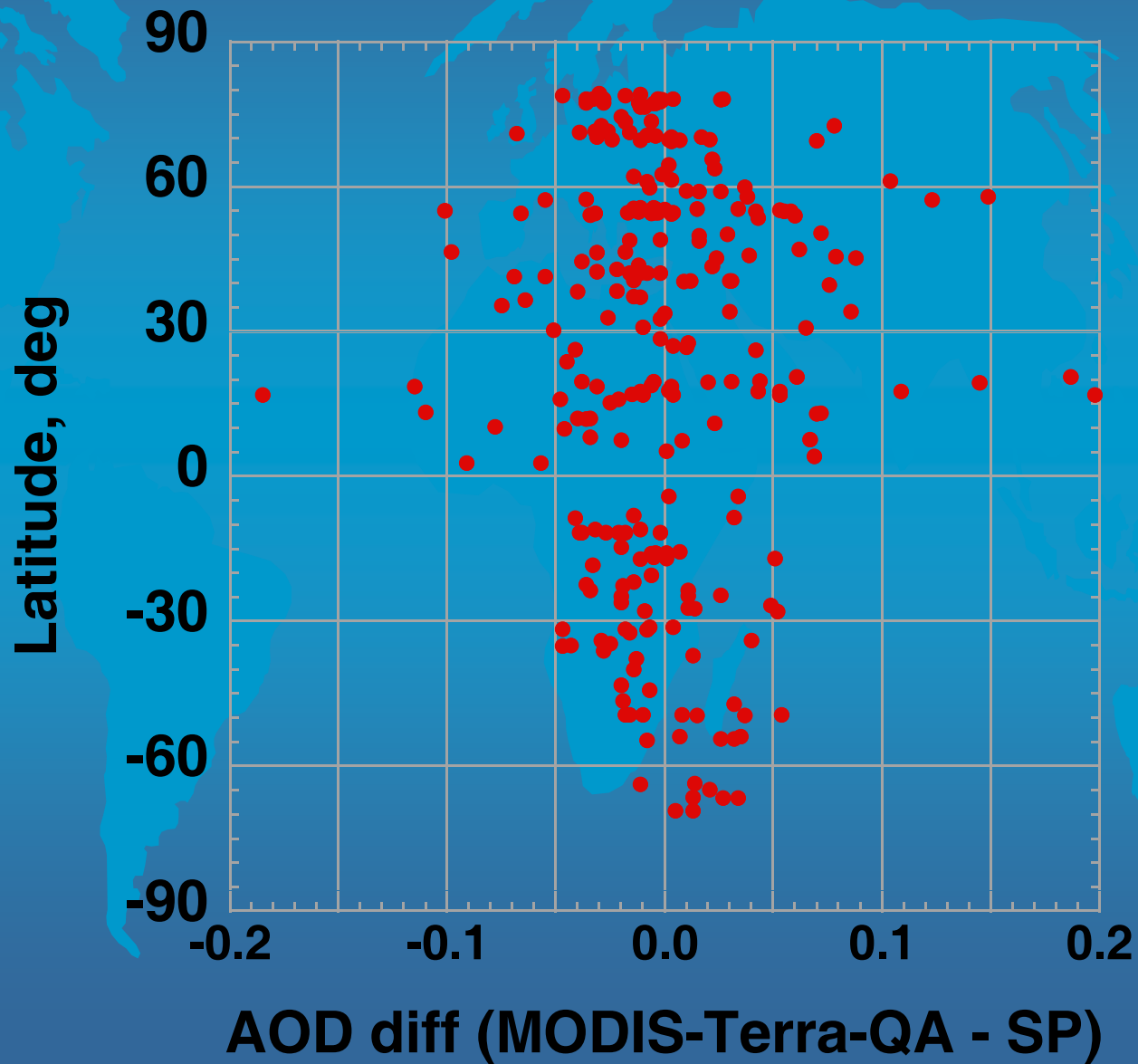
MODIS Terra - QA (Reid & Zhang) vs MAN



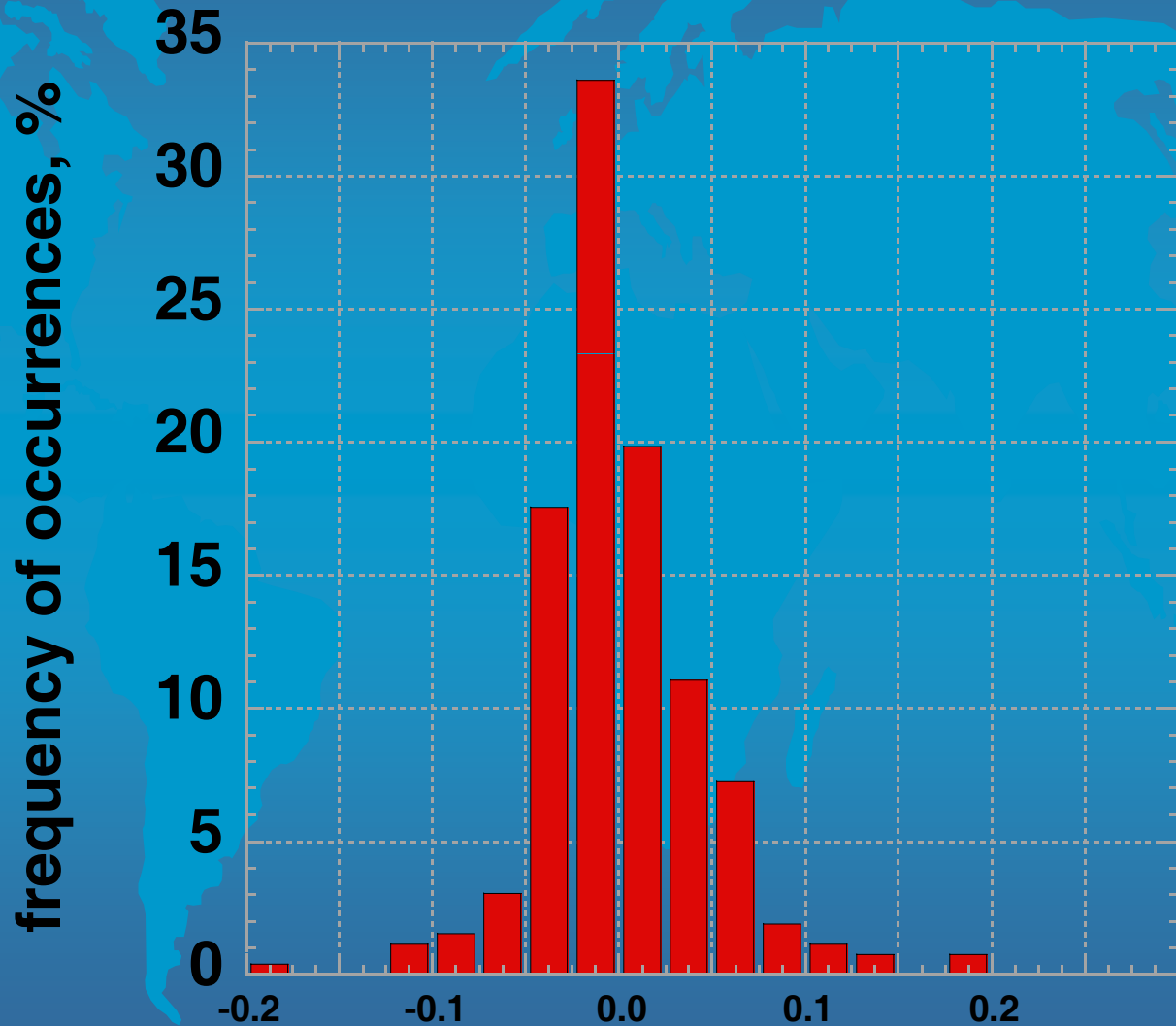
MODIS Terra - QA (Reid & Zhang) vs MAN



MODIS Terra - QA (Reid & Zhang) vs MAN

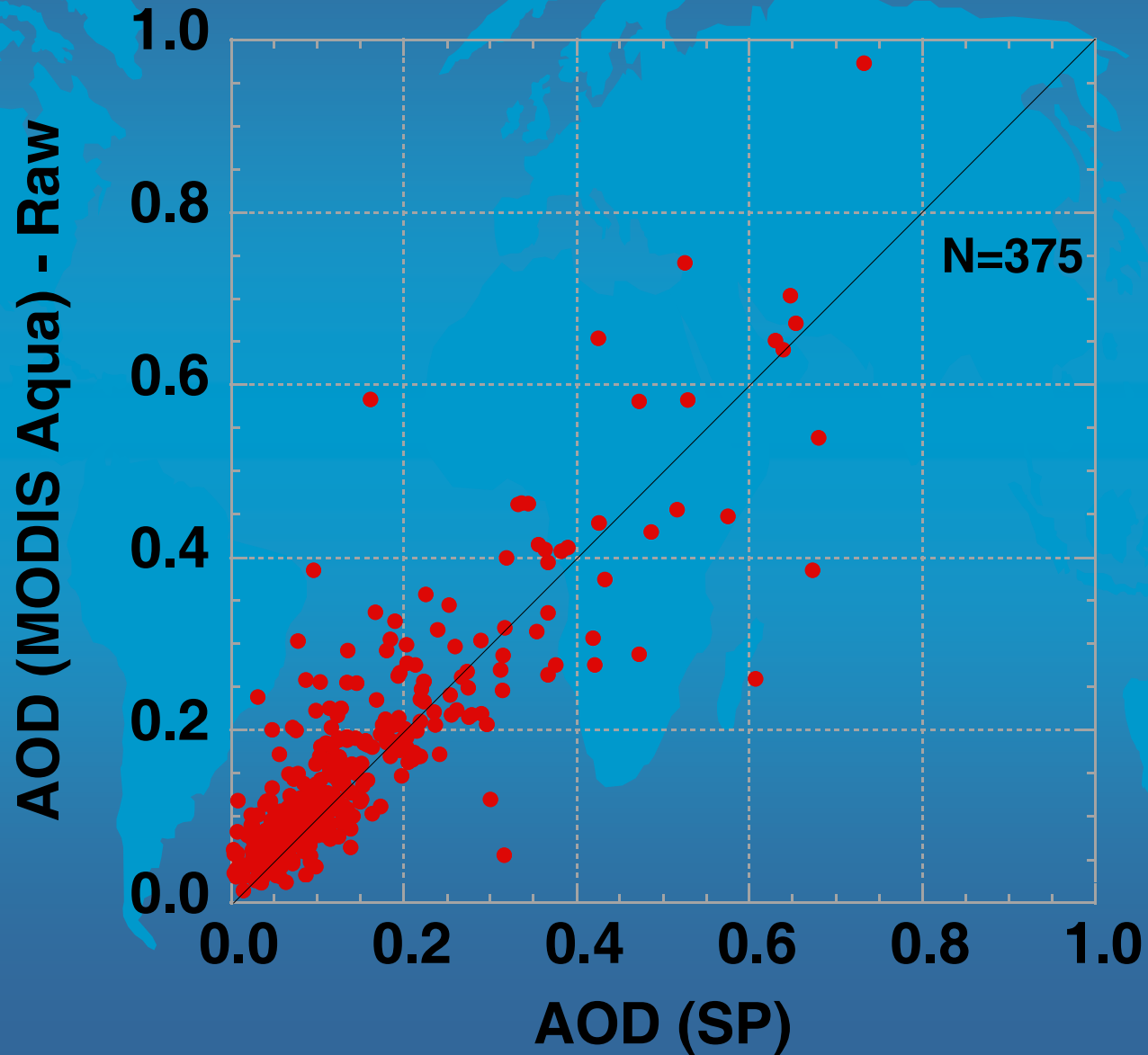


MODIS Terra - QA (Reid & Zhang) vs MAN

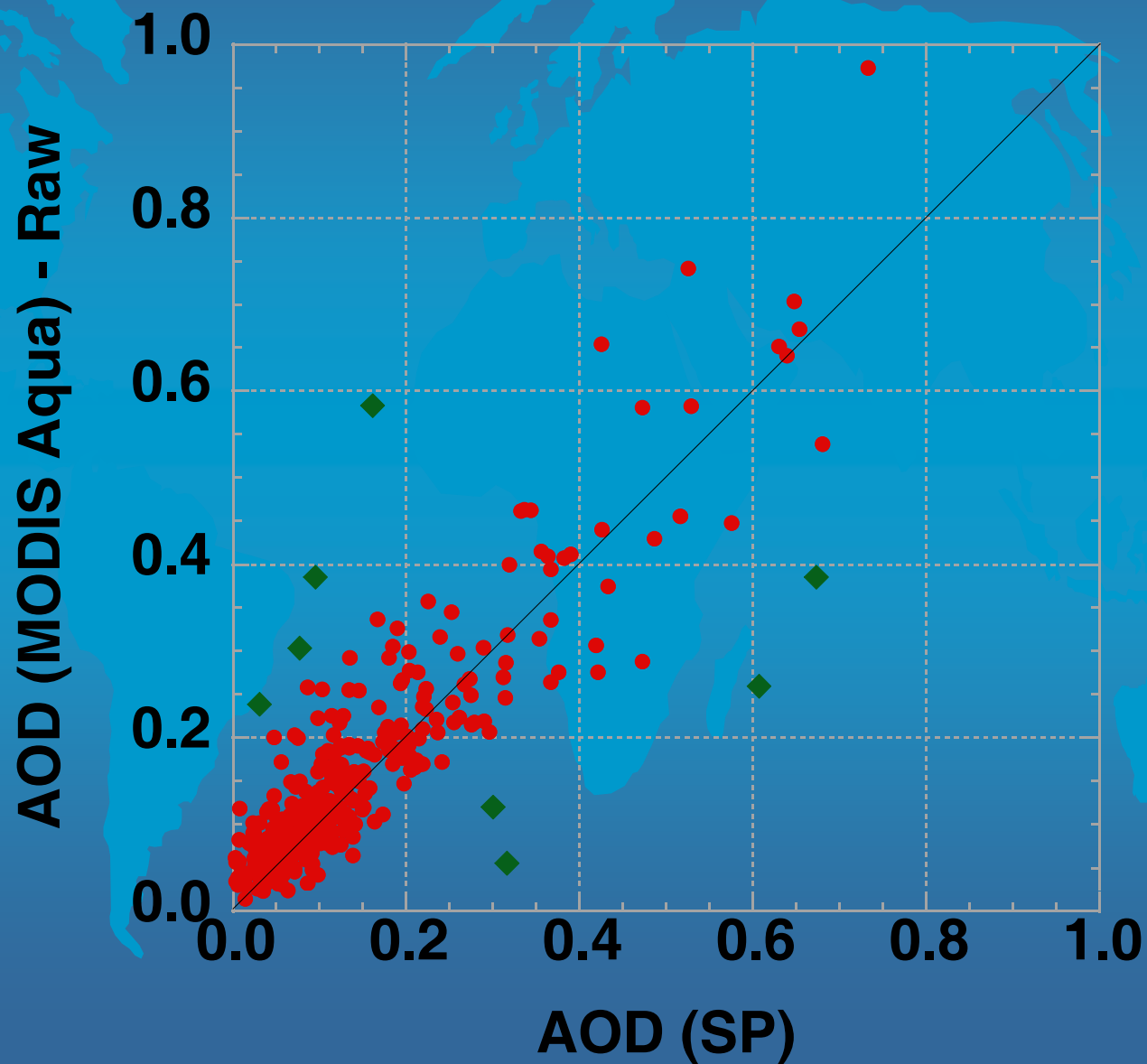


AOD diff (MODIS-Terra-QA - SP)

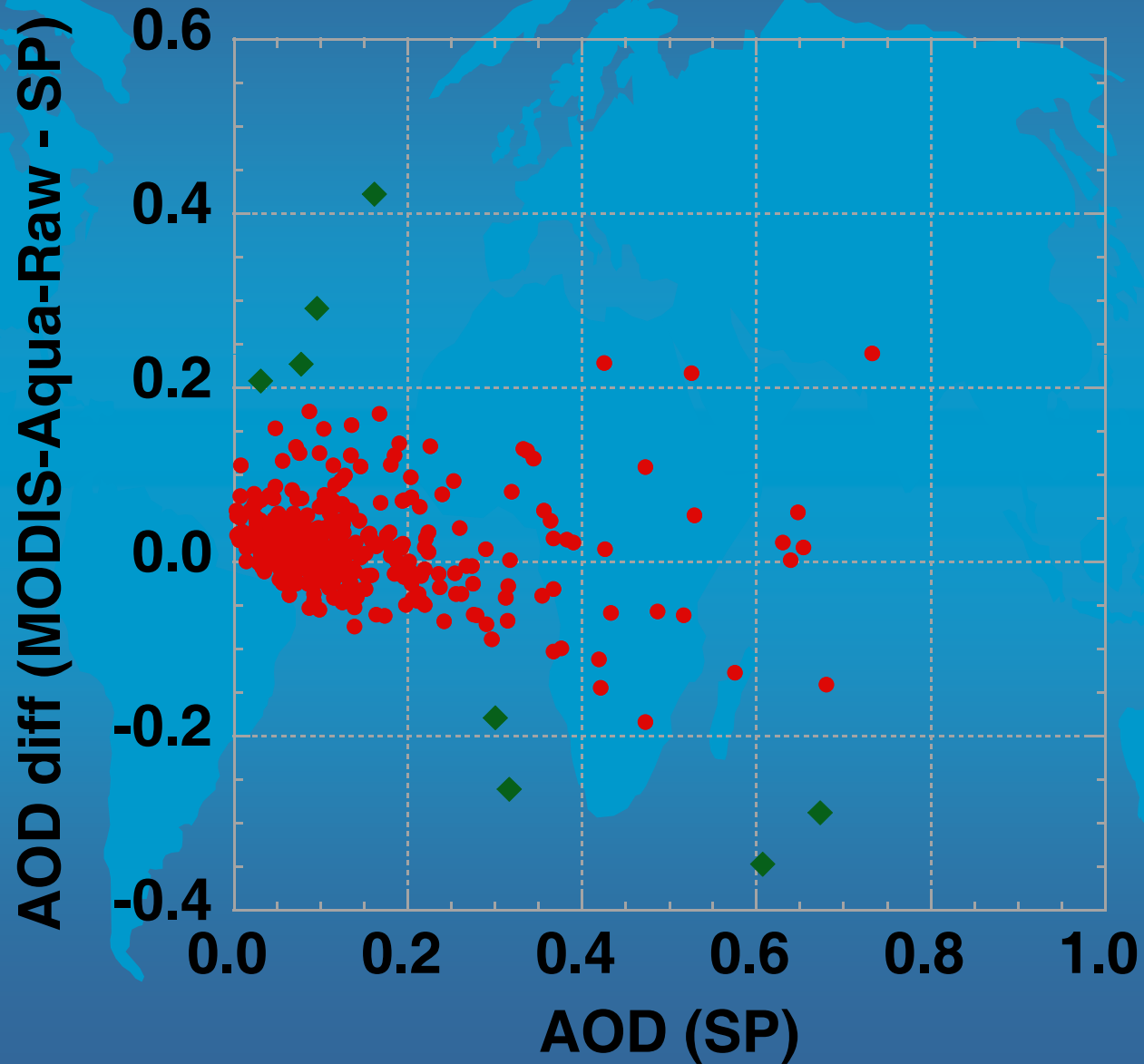
MODIS Aqua - Raw (Reid & Zhang) vs MAN



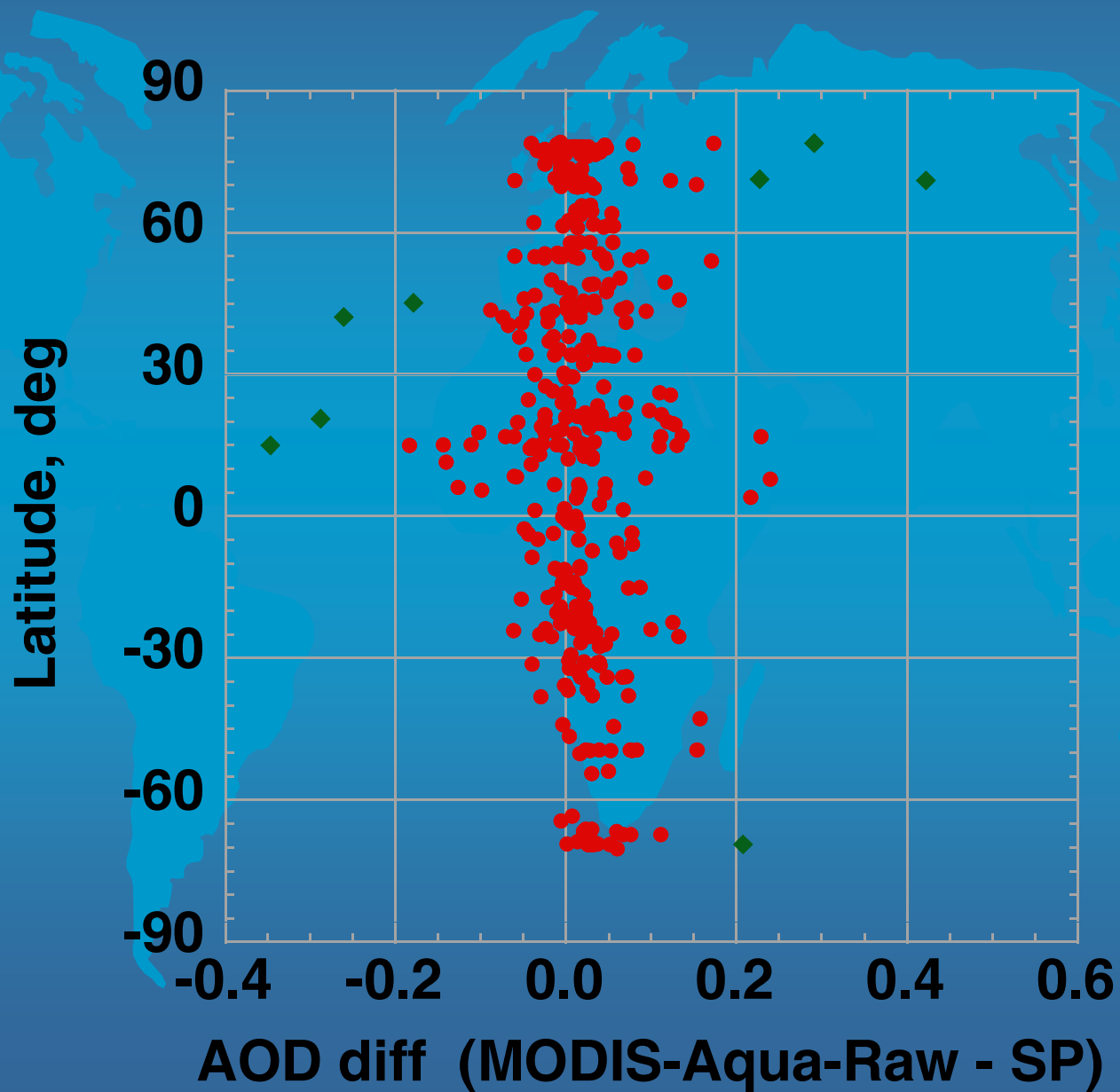
MODIS Aqua - Raw (Reid & Zhang) vs MAN



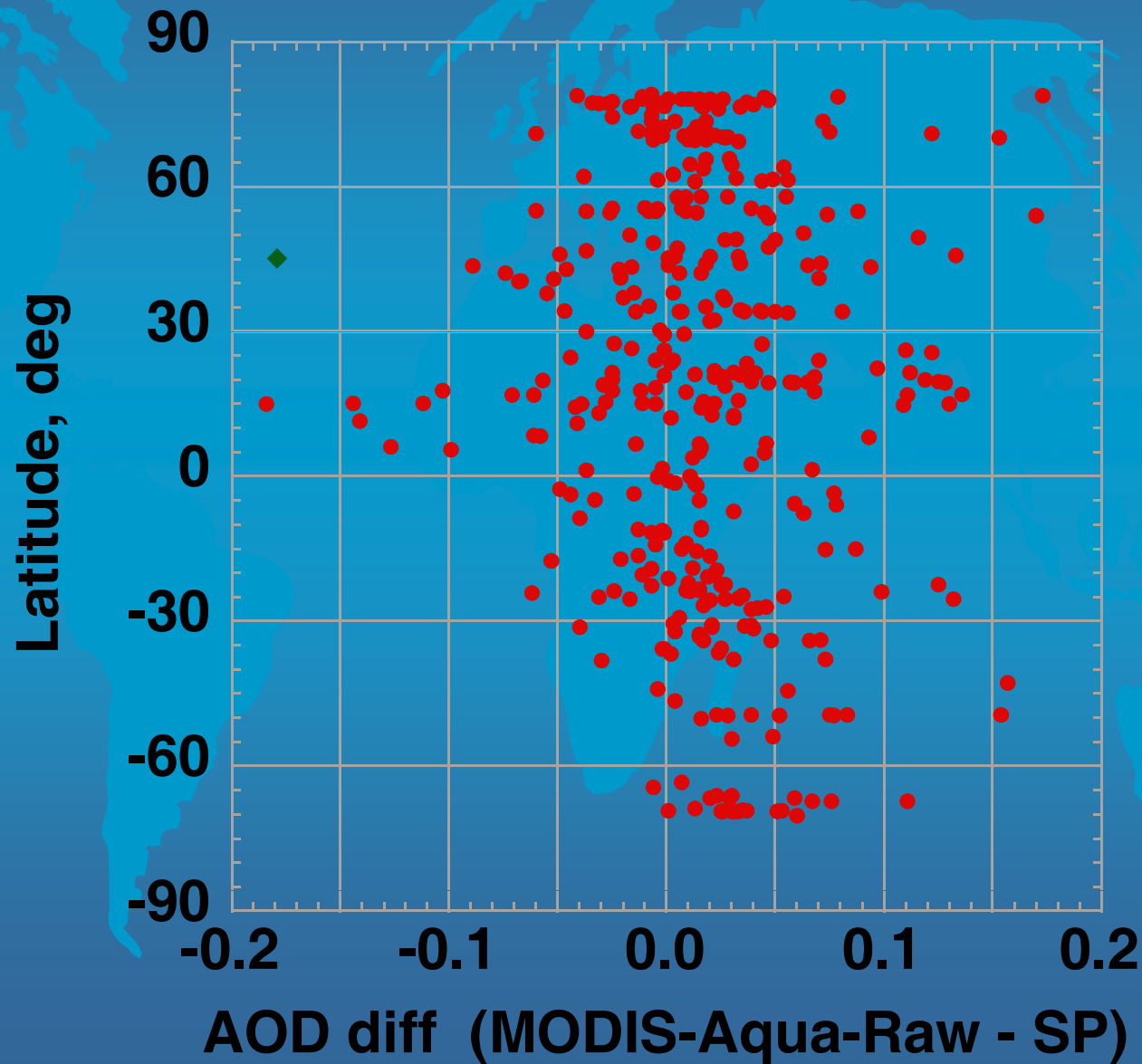
MODIS Aqua - Raw (Reid & Zhang) vs MAN



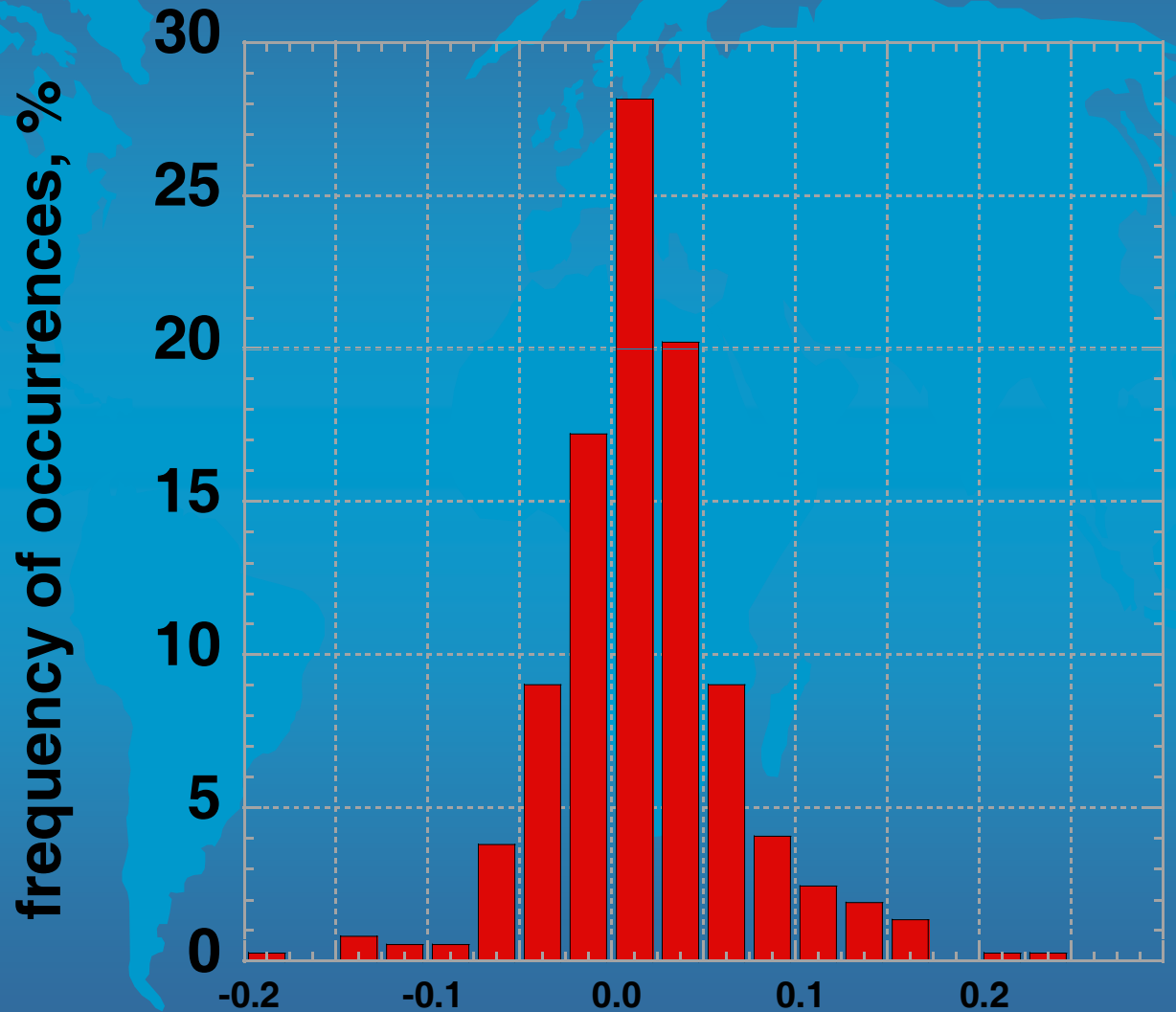
MODIS Aqua - Raw (Reid & Zhang) vs MAN



MODIS Aqua - Raw (Reid & Zhang) vs MAN

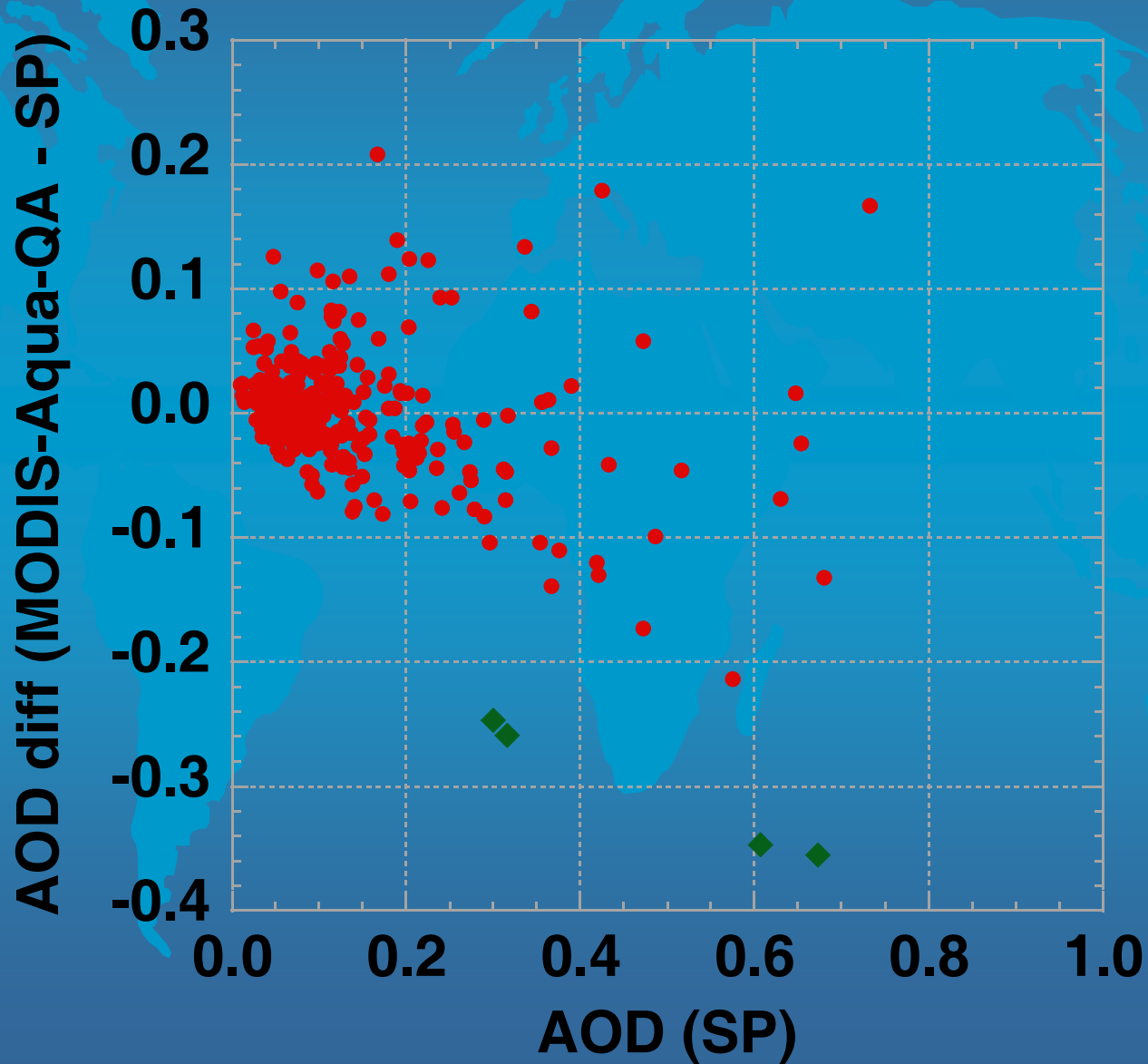


MODIS Aqua - Raw (Reid & Zhang) vs MAN

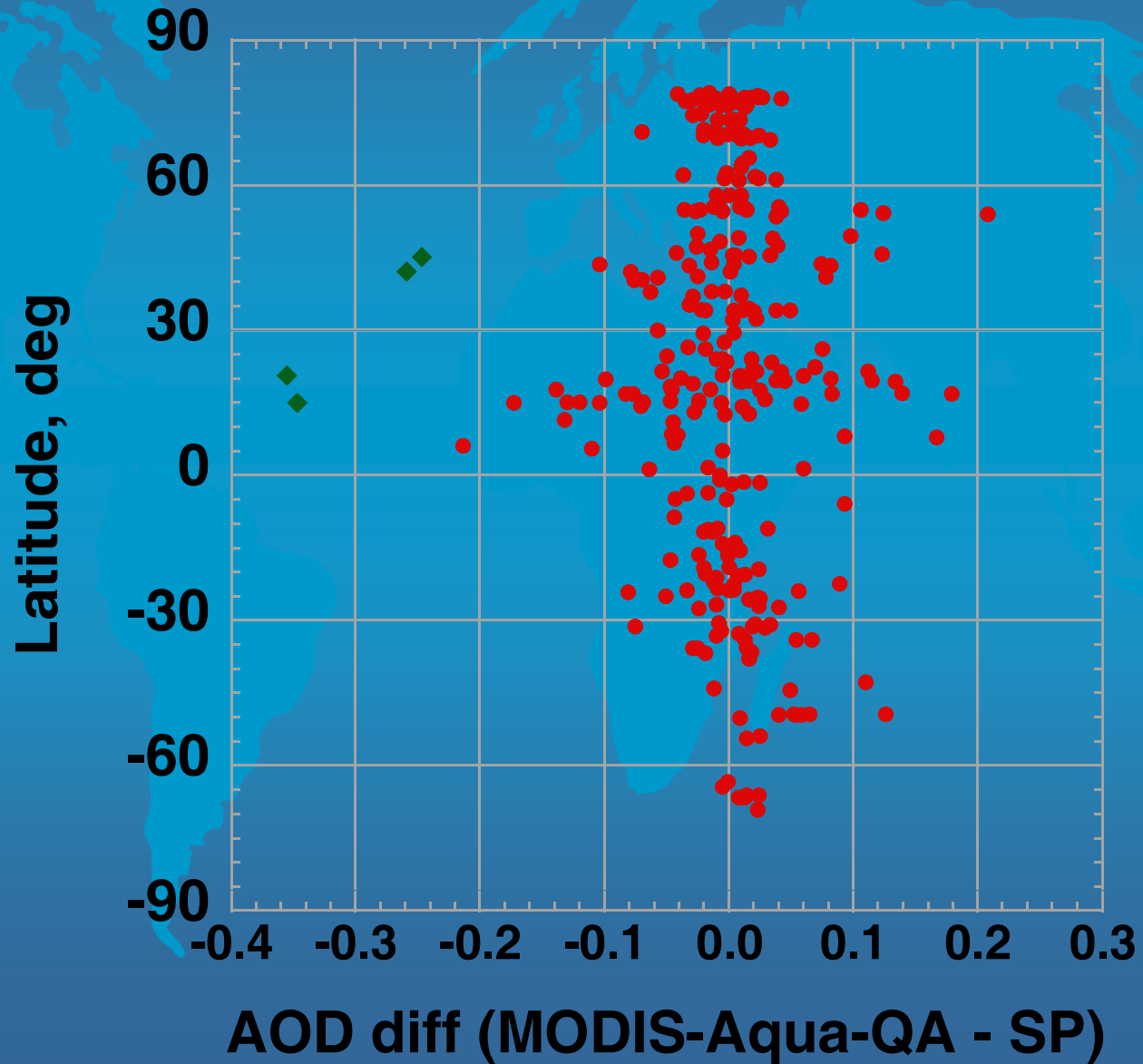


AOD diff (MODIS-Aqua-Raw - SP)

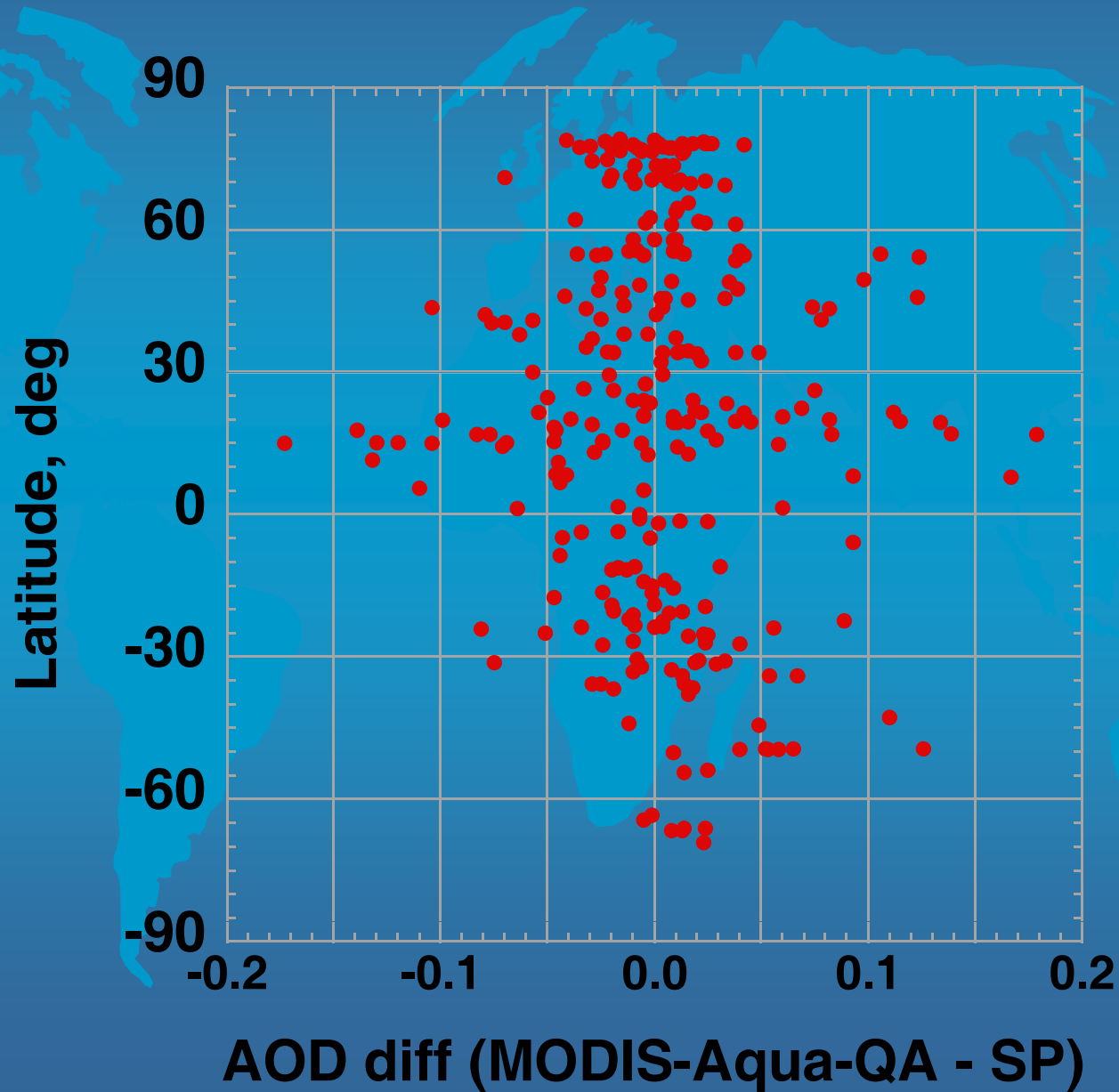
MODIS Aqua - QA (Reid & Zhang) vs MAN



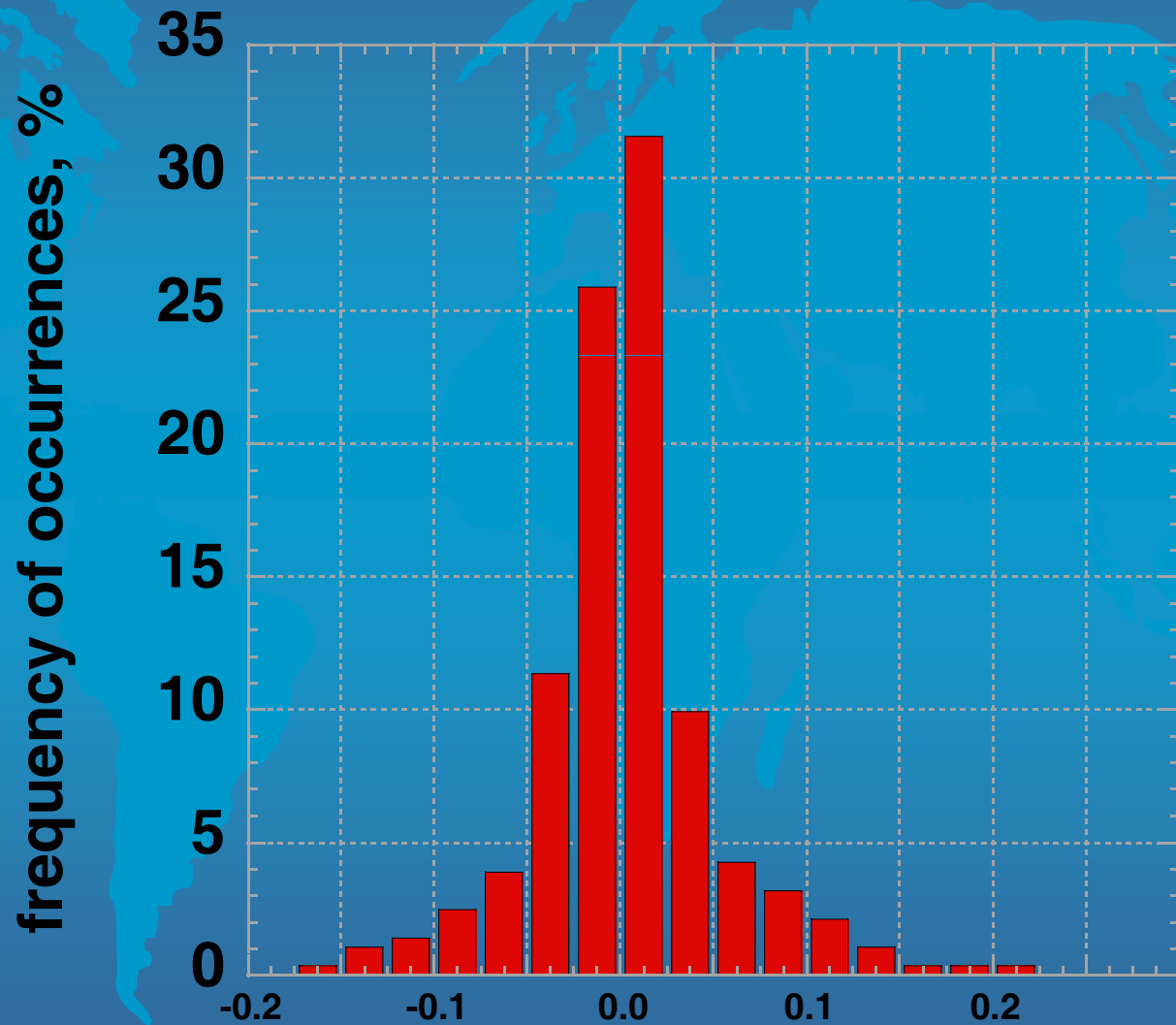
MODIS Aqua - QA (Reid & Zhang) vs MAN



MODIS Aqua - QA (Reid & Zhang) vs MAN

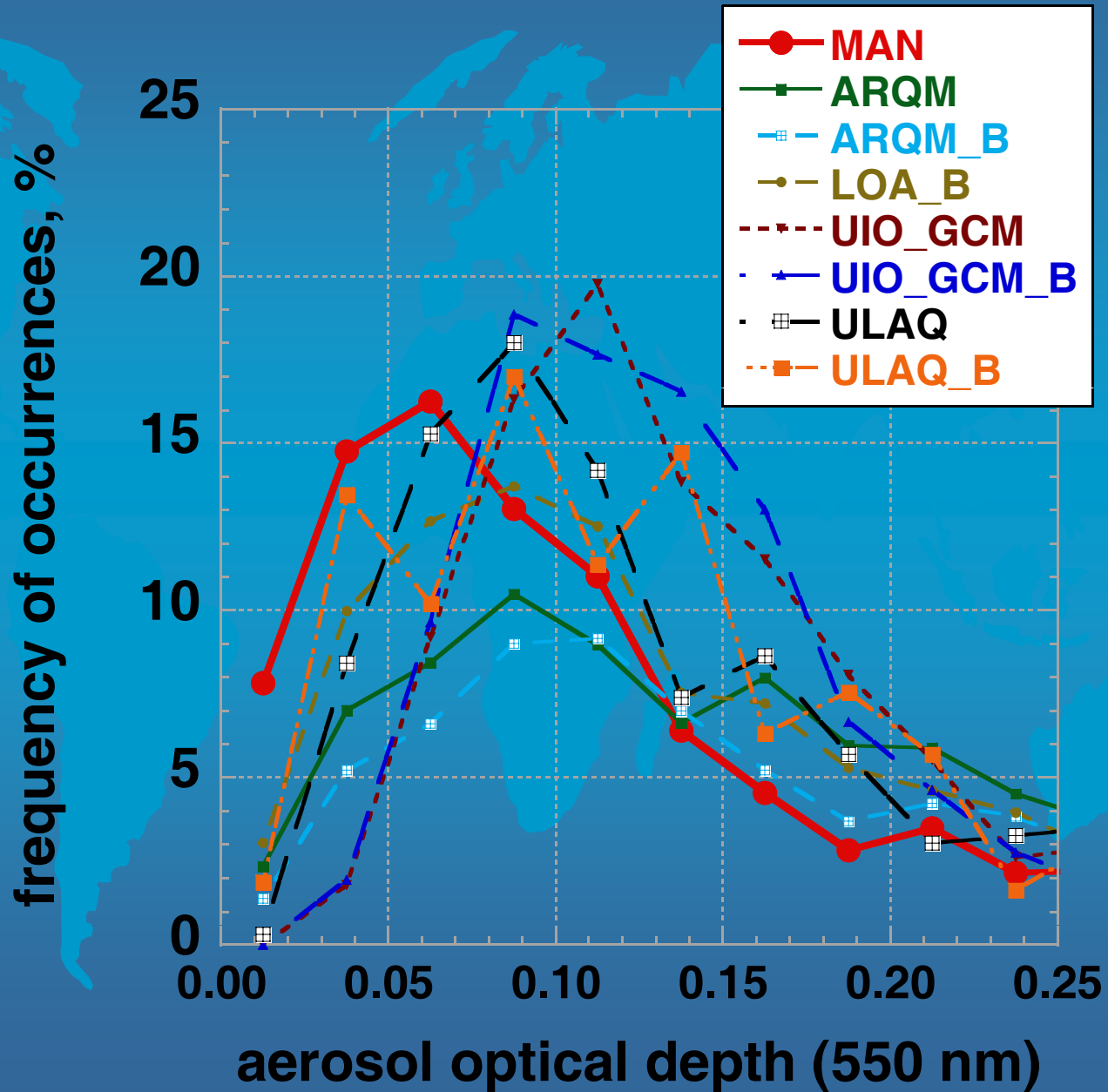


MODIS Aqua - QA (Reid & Zhang) vs MAN



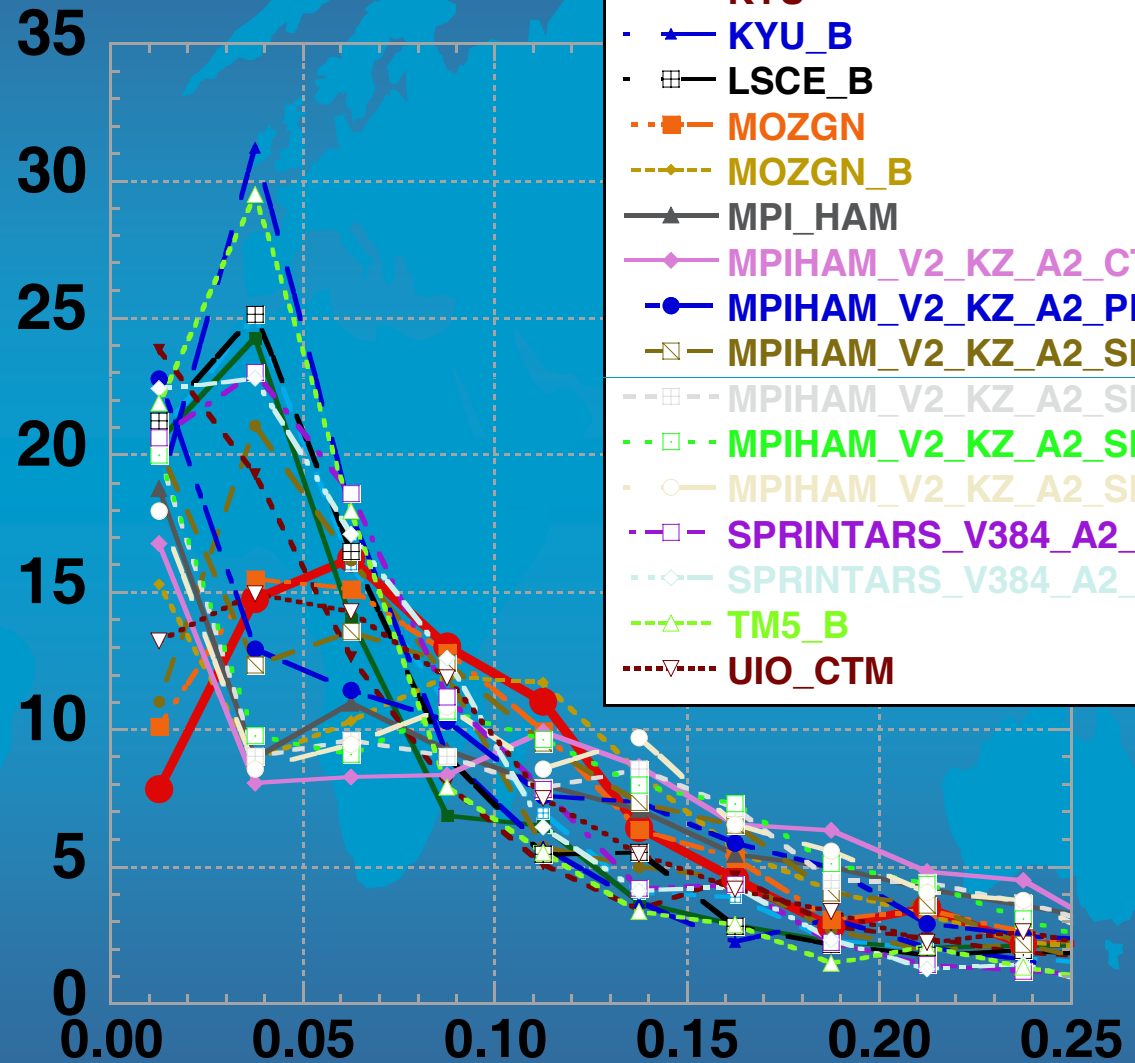
AOD diff (MODIS-Aqua-QA - SP)

Models vs MAN – biased high



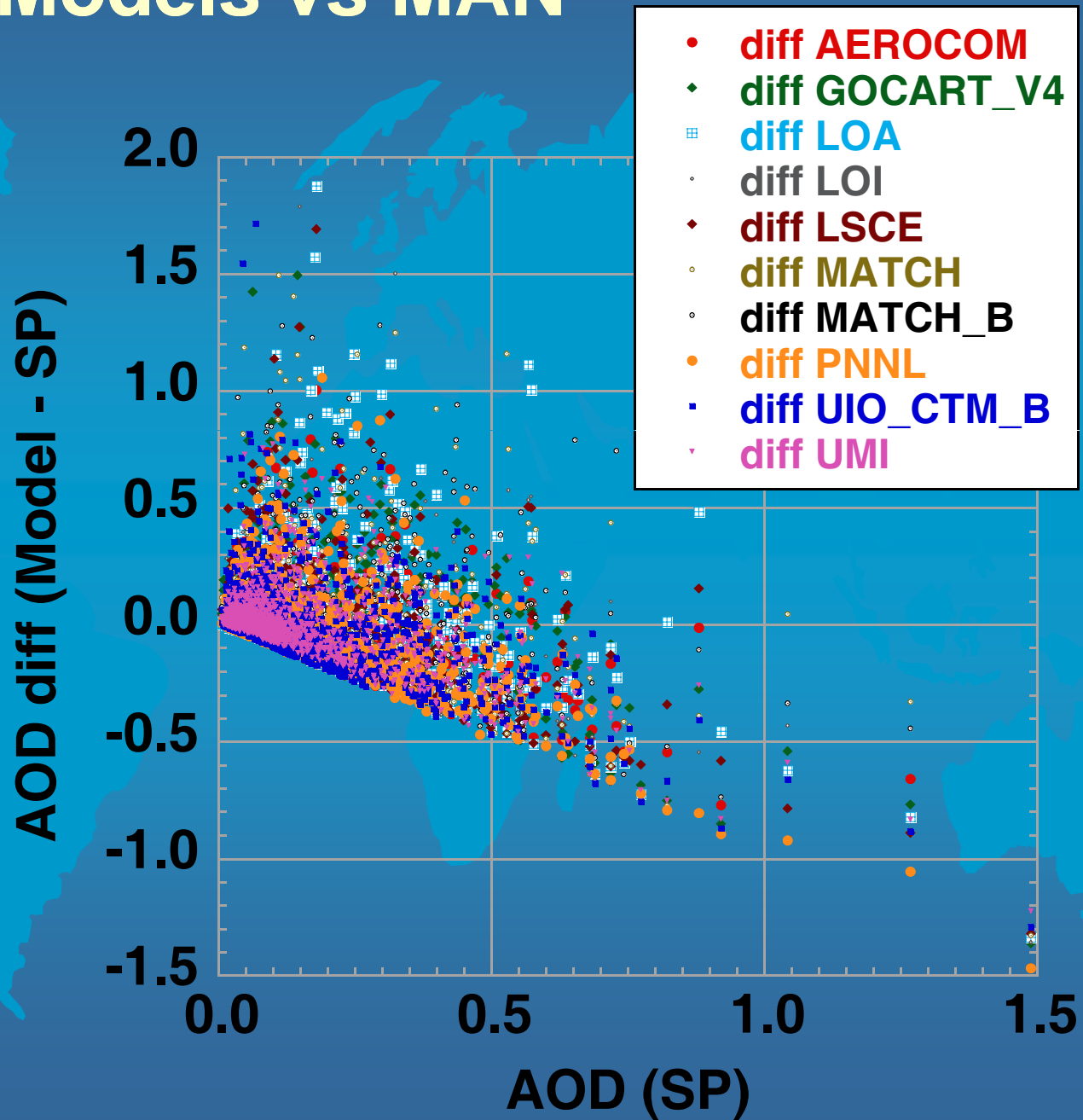
Models vs MAN biased low

frequency of occurrences, %

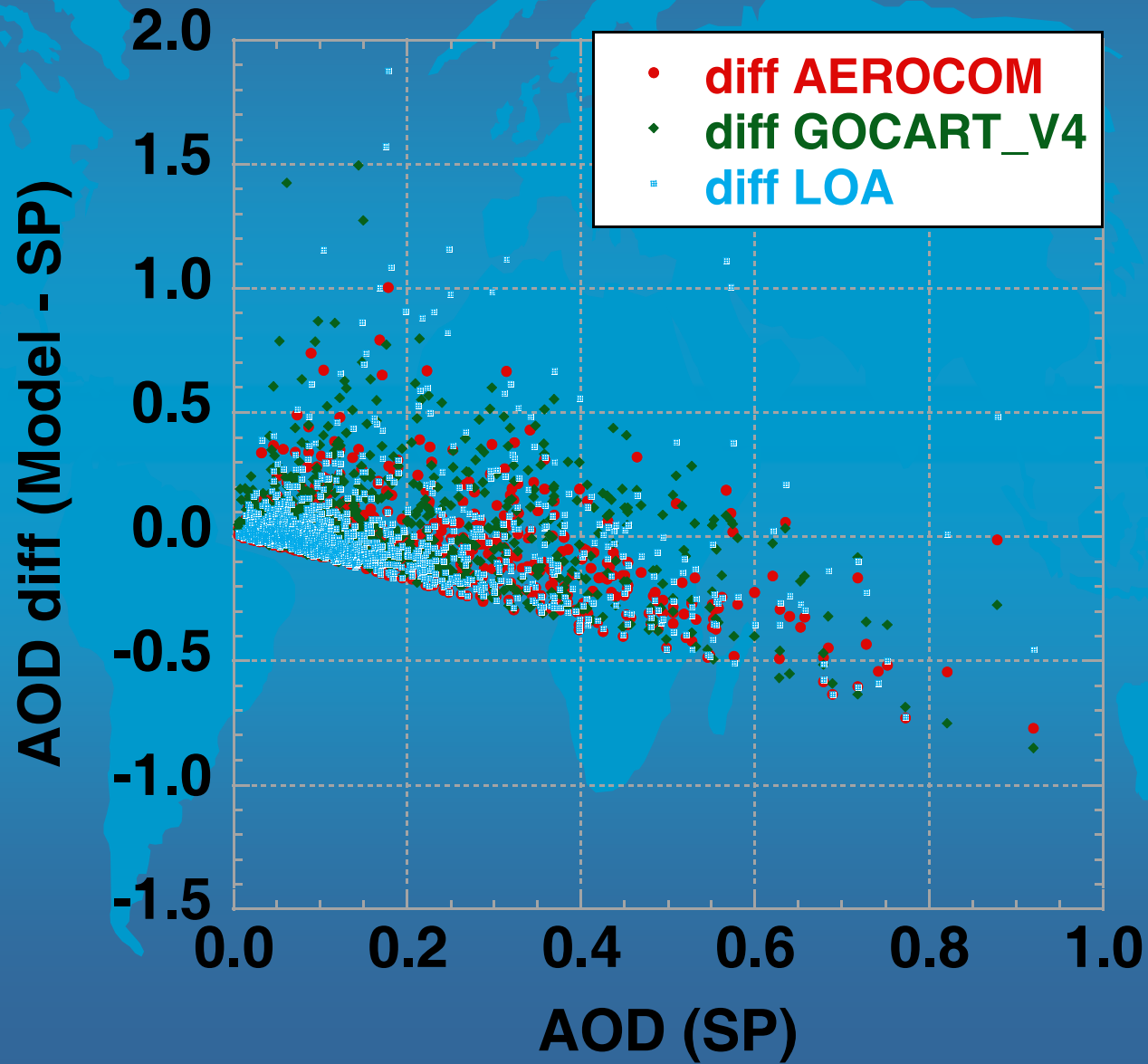


- MAN
- CAM
- ECMWF_FAOK
- GOCART
- KYU
- KYU_B
- LSCE_B
- MOZGN
- MOZGN_B
- MPI_HAM
- MPIHAM_V2_KZ_A2_CTRL
- MPIHAM_V2_KZ_A2_PRE
- MPIHAM_V2_KZ_A2_SIZ1
- MPIHAM_V2_KZ_A2_SIZ2
- MPIHAM_V2_KZ_A2_SIZ3
- MPIHAM_V2_KZ_A2_SIZ4
- SPRINTARS_V384_A2_CT
- SPRINTARS_V384_A2_HC
- TM5_B
- UIO_CTM

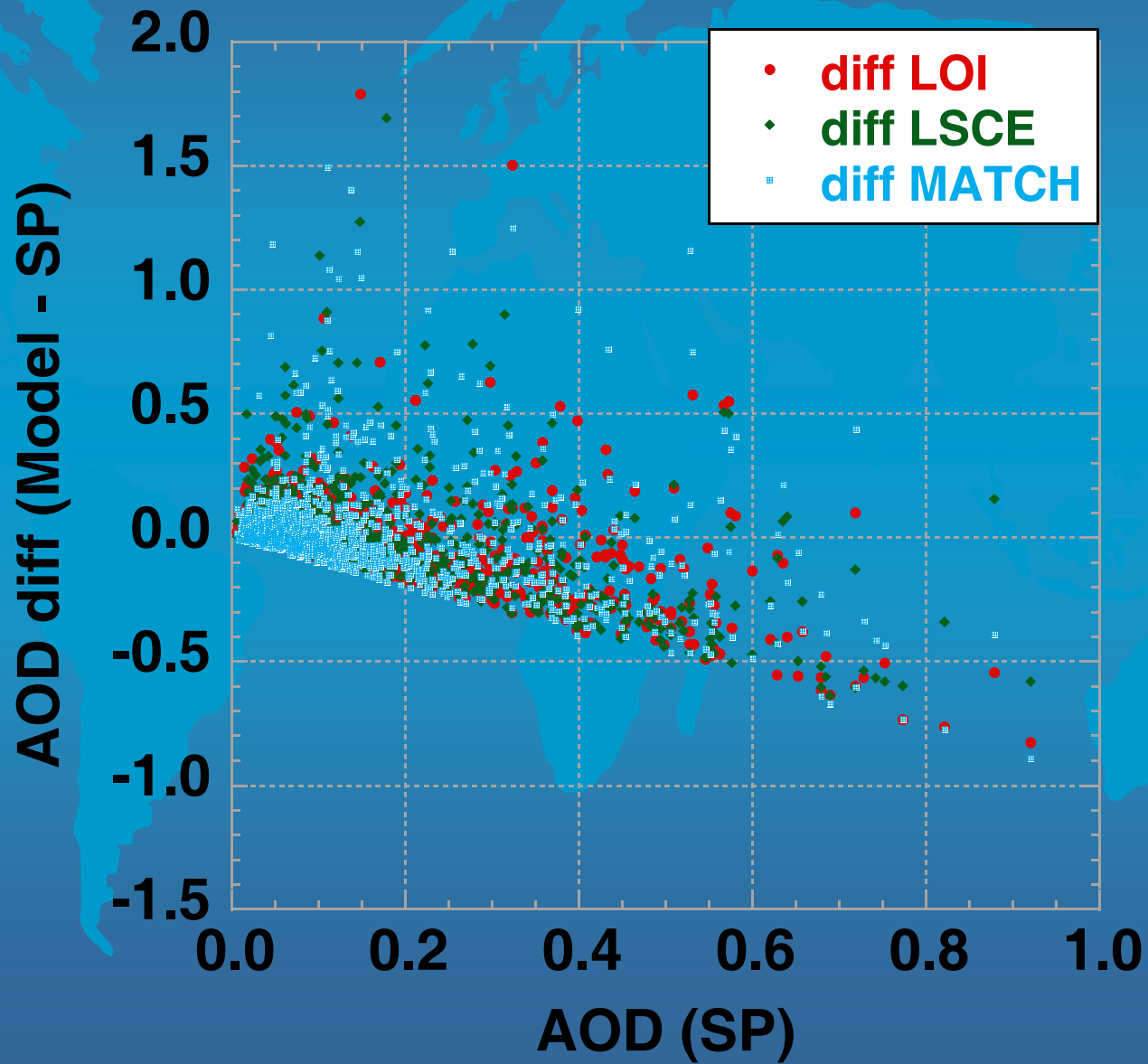
Models vs MAN



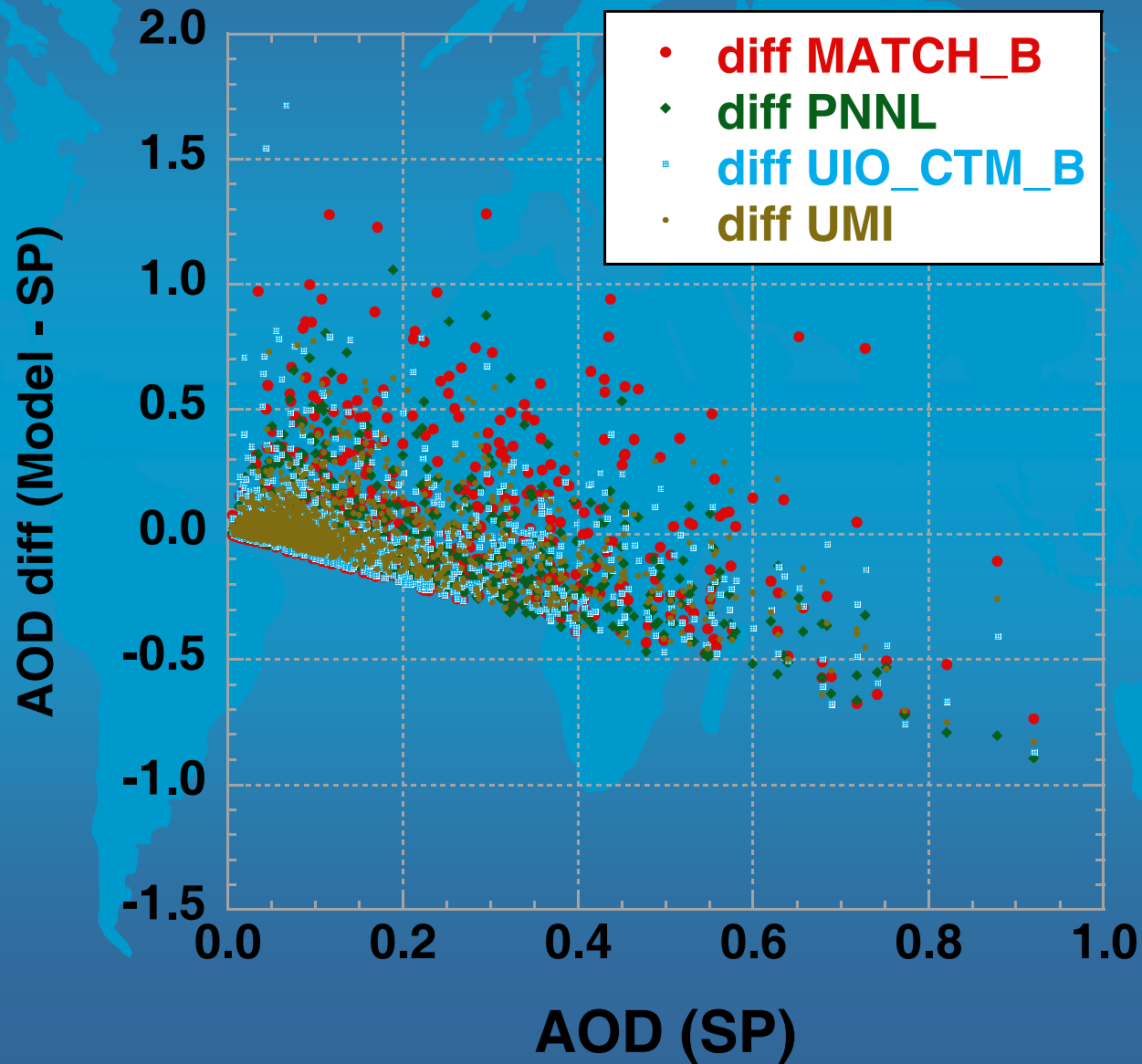
Models vs MAN



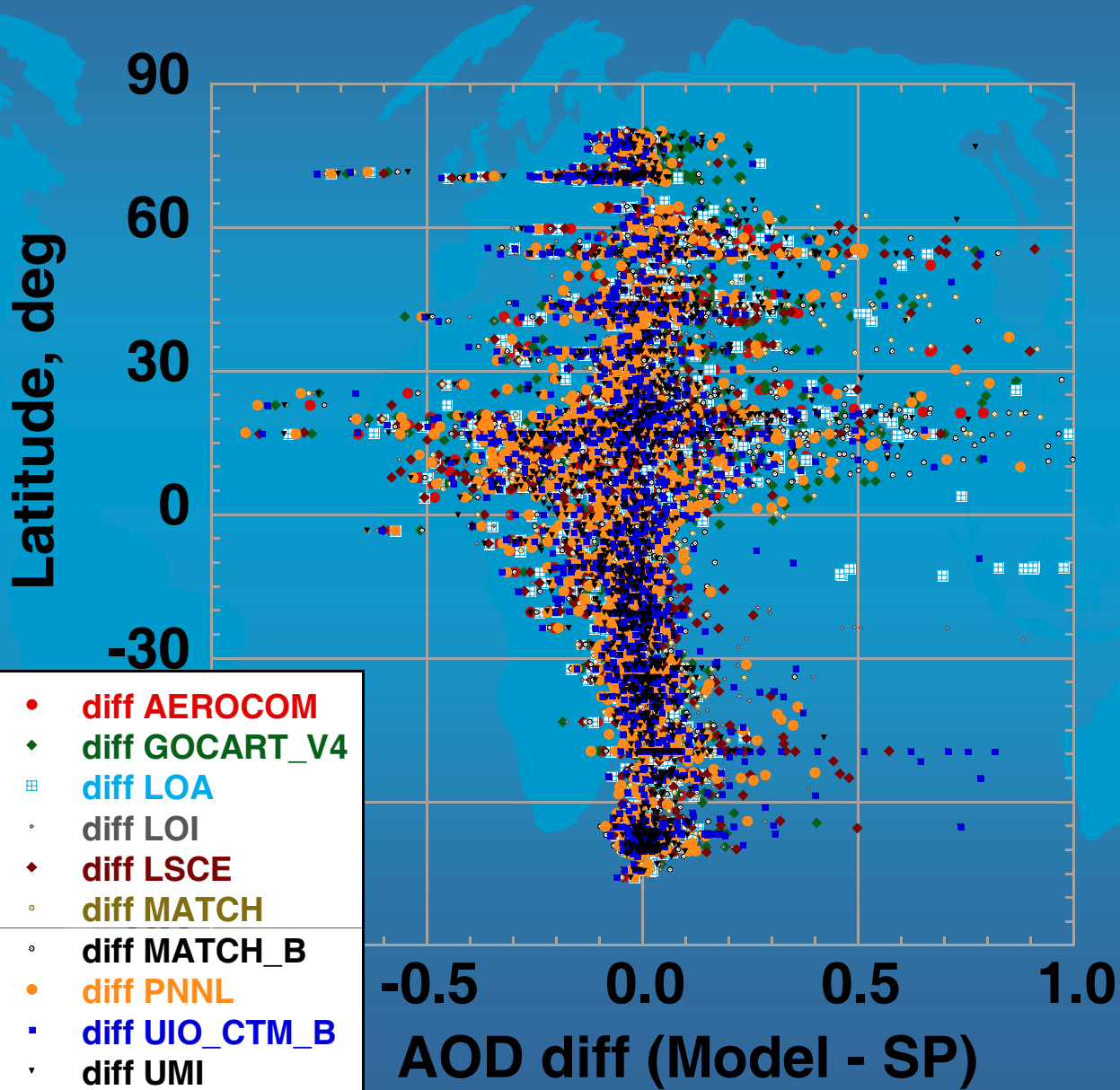
Models vs MAN



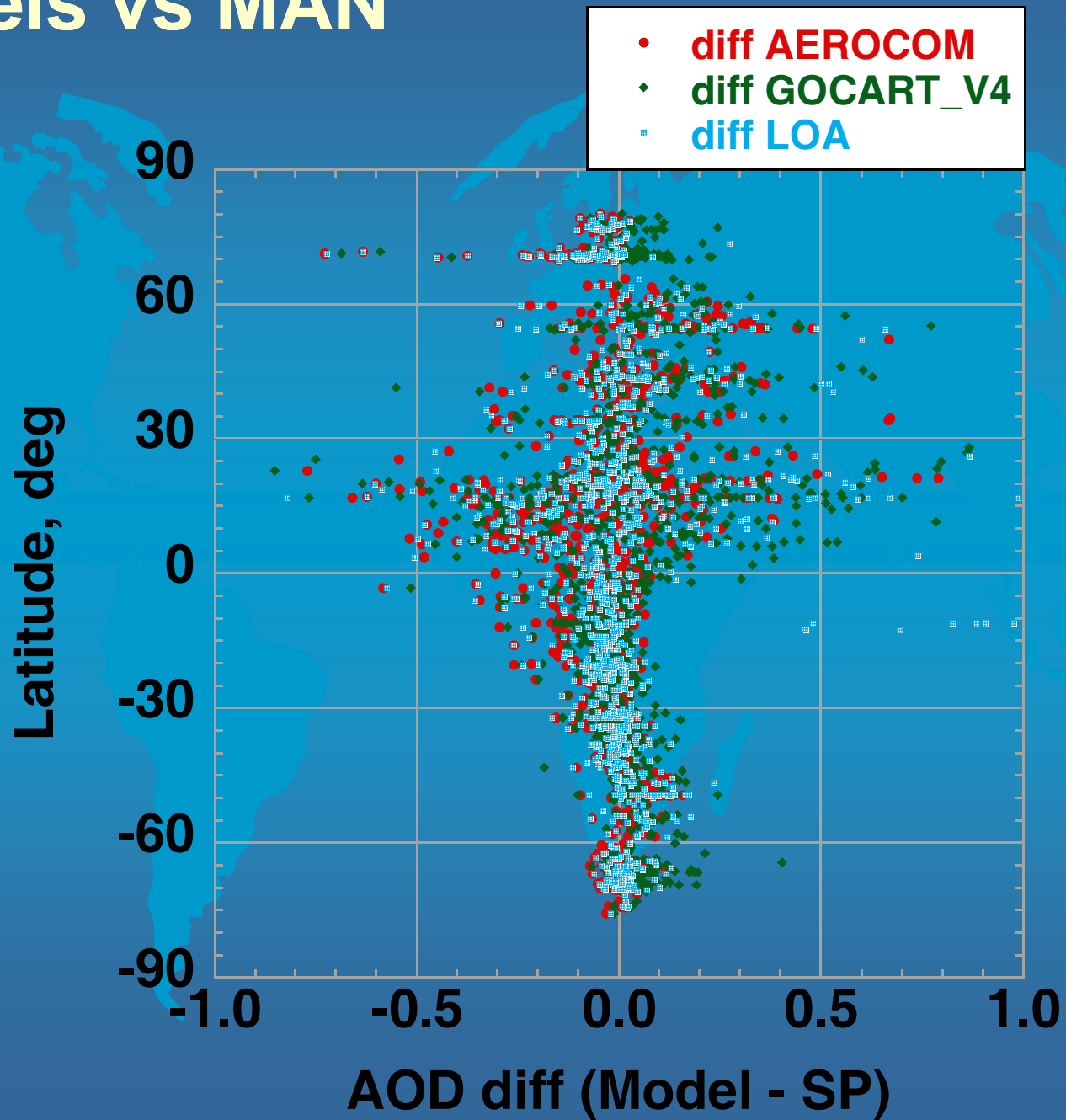
Models vs MAN



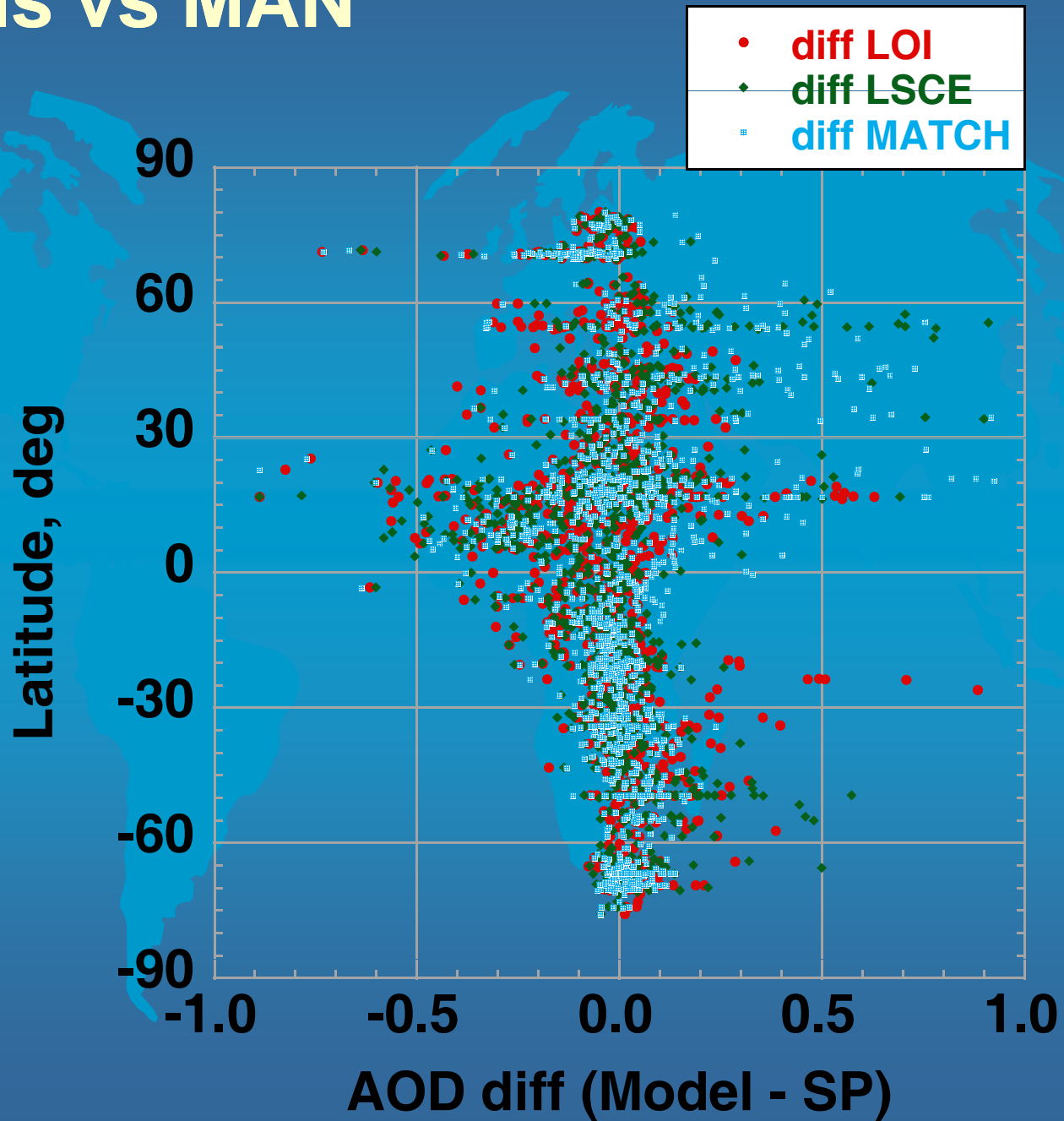
Models vs MAN



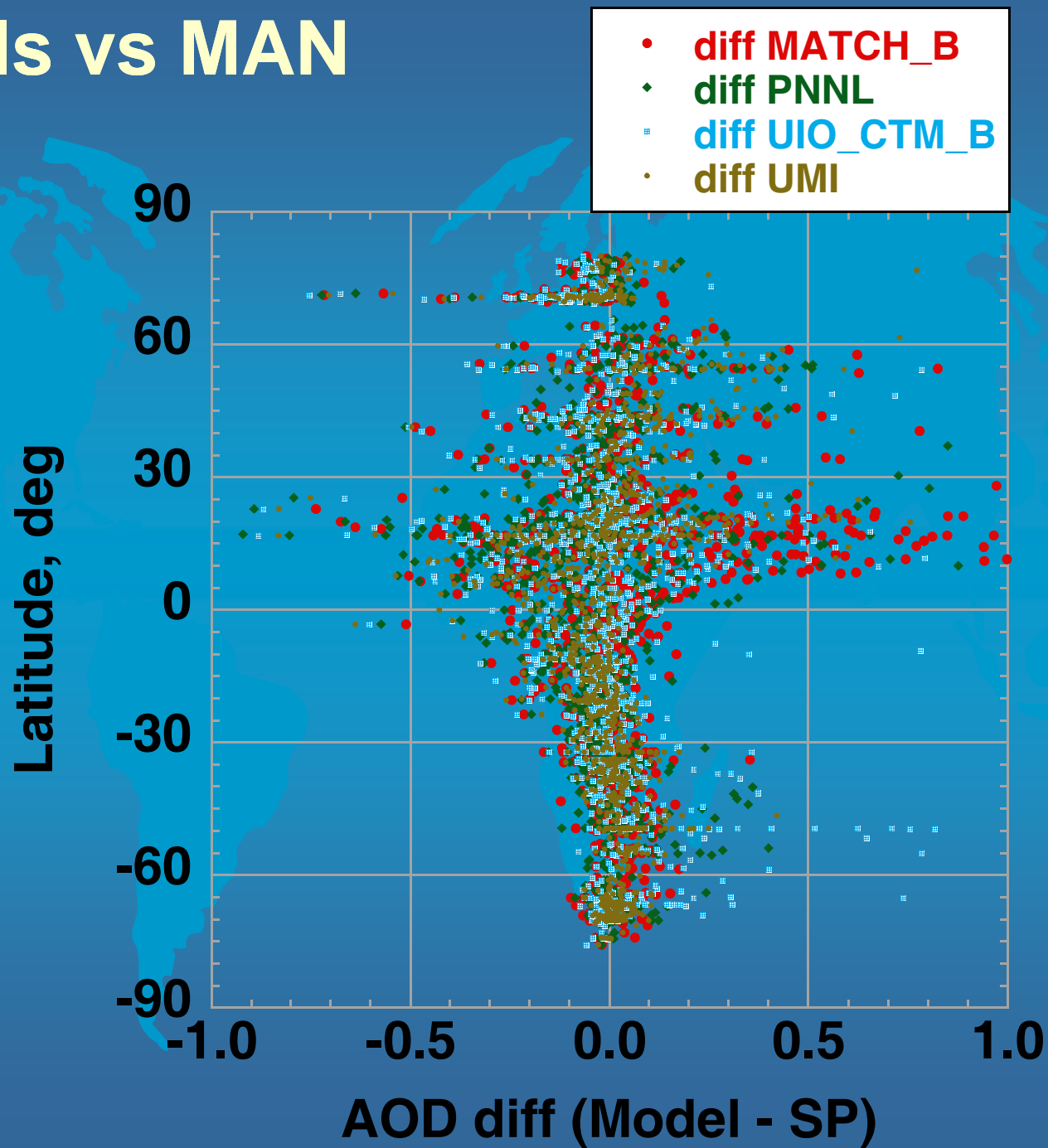
Models vs MAN



Models vs MAN



Models vs MAN



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- We thank Dr. Hal Maring of the NASA Headquarters for his support of AERONET