Maritime Aerosol Network (MAN) as a component of AERONET – current status

GSFC Aerosol Update, March 29, 2011

Atmos. Meas. Tech., 4, 583–597, 2011
www.atmos-meas-tech.net/4/583/2011/
doi:10.5194/amt-4-583-2011
© Author(s) 2011. CC Attribution 3.0 License.

Atmospheric Measurement Techniques

Maritime aerosol network as a component of AERONET – first results and comparison with global aerosol models and satellite retrievals

A. Smirnov[1,2], B. N. Holben[2], D. M. Giles[1,2], I. Slutsker[1,2], N. T. O'Neill[3], T. F. Eck[2,4], A. Macke[5], P. Croot[6], Y. Courcoux[7], S. M. Sakerin[8], T. J. Smyth[9], T. Zielinski[10], G. Zibordi[11], J. I. Goes[12], M. J. Harvey[13], P. K. Quinn[14], N. B. Nelson[15], V. F. Radionov[16], C. M. Duarte[17], R. Losno[18], J. Sciare[19], K. J. Voss[20], S. Kinne[21], N. R. Nalli[22], E. Joseph[23], K. Krishna Moorthy[24], D. S. Covert[25], S. K. Gulev[26], G. Milinevsky[27], P. Larouche[28], S. Belanger[29], E. Horne[30], M. Chin[31], L. A. Remer[32], R. A. Kahn[32], J. S. Reid[33], M. Schulz[19], C. L. Heald[34], J. Zhang[35], K. Lapina[34], R. G. Kleidman[32,36], J. Griesfeller[19], B. J. Gaitley[37], Q. Tan[4,31], and T. L. Diehl[4,31]

[1]Sigma Space Corporation, Lanham, Maryland, USA
[2]Biospheric Sciences Branch, NASA Goddard Space Flight Center, Greenbelt, Maryland, USA
[3]CARTEL, Université de Sherbrooke, Sherbrooke, Québec, Canada
[4]Goddard Earth Sciences and Technology Center, University of Maryland, Baltimore County, Baltimore, Maryland, USA
[5]Leibniz Institute for Tropospheric Research, Leipzig, Germany
[6]Leibniz Institute of Marine Sciences at the University of Kiel (IFM-GEOMAR), Kiel, Germany
[7]L'Observatoire de Physique de l'Atmosphère de la Réunion (OPAR), Université de la Réunion, Saint Denis de la Réunion, France
[8]Institute of Atmospheric Optics, Russian Academy of Sciences, Siberian Branch, Tomsk, Russia
[9]Plymouth Marine Laboratory, Plymouth, UK
[10]Institute of Oceanology, Polish Academy of Sciences, Sopot, Poland
[11]Institute for Environment and Sustainability, Joint Research Centre, European Commission, Ispra, Italy
[12]Bigelow Laboratory for Ocean Sciences, West Boothbay Harbor, Maine, USA
[13]National Institute of Water and Atmospheric Research, Wellington, New Zealand
[14]NOAA Pacific Marine Environmental Laboratory, Seattle, Washington, USA
[15]Institute for Computational Earth System Science, University of California, Santa Barbara, California, USA
[16]Arctic and Antarctic Research Institute, Saint Petersburg, Russia
[17]IMEDEA (CSIC-UIB), Instituto Mediterráneo de Estudios Avanzados, Esporles (Mallorca), Spain
[18]Laboratoire Interuniversitaire des Systèmes Atmosphériques, Université de Paris 7 et Université de Paris 12, Creteil, France
[19]Laboratoire des Sciences du Climat et de l'Environnement, Gif-sur-Yvette, France
[20]Physics Department, University of Miami, Coral Gables, Florida, USA
[21]Institute for Meteorology, University of Hamburg, Hamburg, Germany
[22]NOAA/NESDIS Center for Satellite Applications and Research (STAR), Camp Springs, Maryland, USA
[23]Department of Physics and Astronomy, Howard University, Washington, DC, USA
[24]Space Physics Laboratory, Vikram Sarabhai Space Centre, Trivandrum, India
[25]Department of Atmospheric Sciences, University of Washington, Seattle, Washington, USA
[26]P. P. Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow, Russia
[27]Space Physics Laboratory, Taras Shevchenko National University of Kyiv, Kyiv, Ukraine
[28]Institut Maurice-Lamontagne, Mont-Joli, Québec, Canada
[29]Département de biologie, chimie et géographie, Université du Québec à Rimouski, Rimouski, Québec, Canada
[30]Bedford Institute of Oceanography, Bedford, Nova Scotia, Canada
[31]Atmospheric Chemistry and Dynamics Branch, NASA Goddard Space Flight Center, Greenbelt, Maryland, USA
[32]Climate and Radiation Branch, NASA Goddard Space Flight Center, Greenbelt, Maryland, USA
[33]Marine Meteorology Division, Naval Research Laboratory, Monterey, California, USA
[34]Department of Atmospheric Science, Colorado State University, Fort Collins, Colorado, USA
[35]University of North Dakota, Grand Forks, North Dakota, USA
[36]Science Systems and Applications, Inc., Lanham, Maryland, USA
[37]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, USA

Received: 21 December 2010 – Published in Atmos. Meas. Tech. Discuss.: 8 January 2011
Revised: 11 March 2011 – Accepted: 15 March 2011 – Published: 21 March 2011
Published by Copernicus Publications on behalf of the European Geosciences Union.

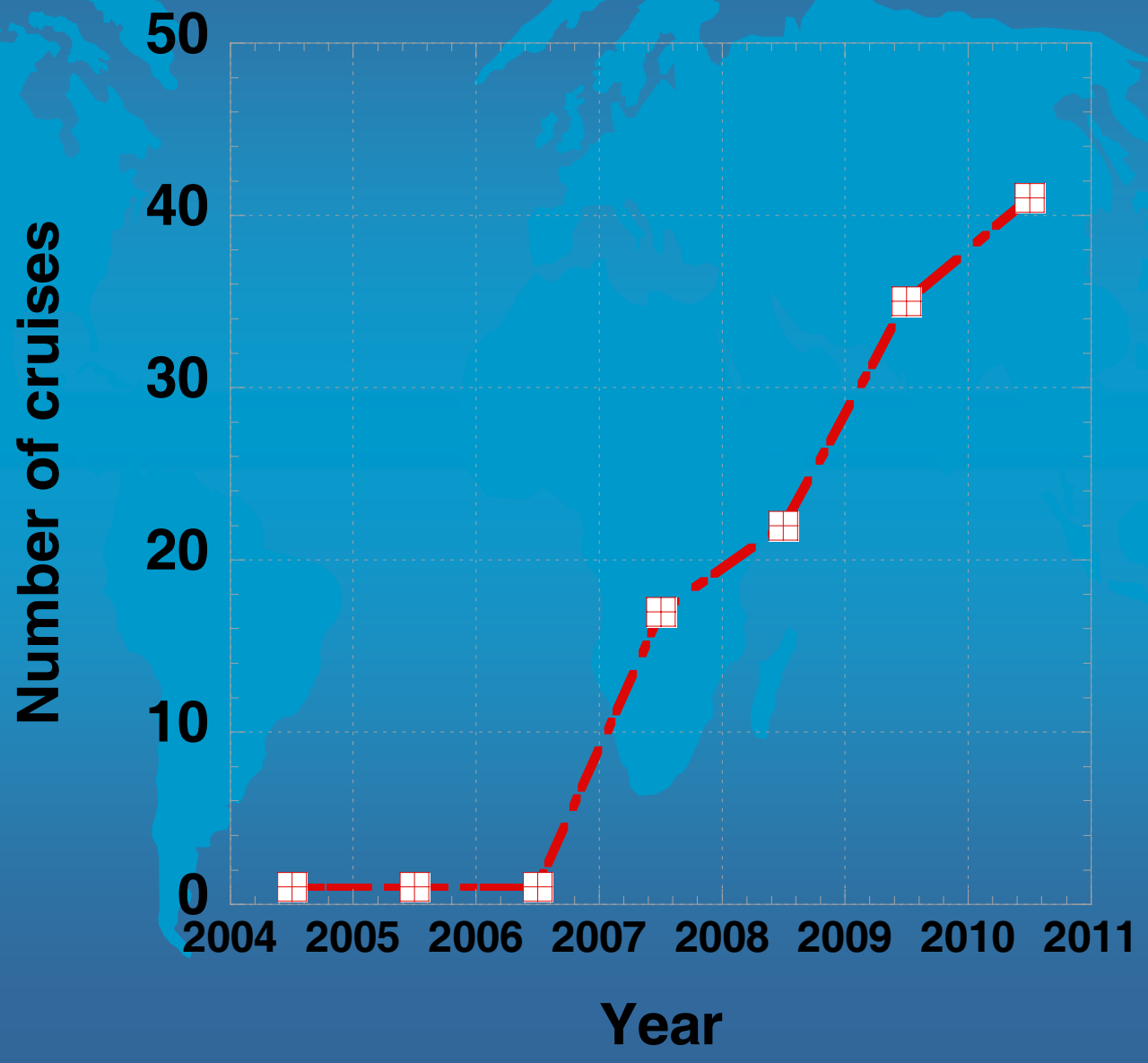
Presenter – Alexander (Sasha) Smirnov

e-mail: Alexander.Smirnov-1@nasa.gov

Andrew Sayer, GEST and NASA/GSFC

GPS
GPSmap 60CSx
GARMIN
SOLAR LIGHT CO.
NASA
MICROTOPS II
Ozone Monitor - Sunphotometer
Sun target
PROPERTY NASA U.S. GOVERNMENT
Incr.
Decr.
On/Off
Scan
Escape
Menu
Enter
Made in USA
05/14/2007

Number of cruises completed



http://aeronet.gsfc.nasa.gov/new_web/maritime_aerosol_network.html

"It is very difficult, Sasha, to run free of charge network"

Dr. Michael King, January 2009

GODDARD SPACE FLIGHT CENTER | + Visit NASA.gov

AERONET
MARITIME AEROSOL NETWORK

+ AEROSOL OPTICAL DEPTH | + AEROSOL INVERSIONS | + SOLAR FLUX | + OCEAN COLOR | + MARITIME AEROSOL

+Home
+AERONET Home

Maritime Aerosol

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

AERONET DATA ACCESS

AEROSOL OPTICAL DEPTH
+ Data Display
+ Download Tool
+ Download All Sites
+ Climatology Tables
+ Climatology Maps
+ V2 L2 Data Availability

AEROSOL INVERSIONS
+ Data Display
+ Download Tool
+ Download All Sites

SOLAR FLUX
+ Data Display

OCEAN COLOR
+ Data Display

CLOUD MODE
+ Data Display

DATA SYNERGY TOOL
+ Data Display

AERONET Site Lists
+ Text Format
+ Google Earth Format
+ 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.

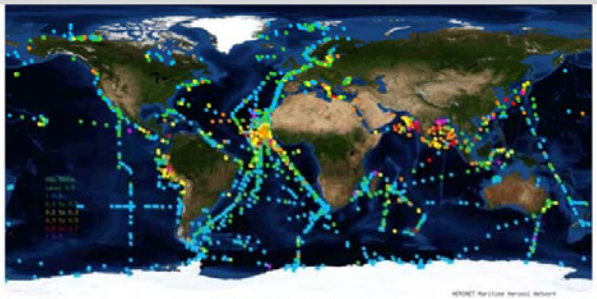
Microtops instruments currently in the network have five channels but they may have one of two configurations: 340, 440, 675, 870, 936nm or 440, 500, 675, 870, and 936nm. In addition, the instrument has built-in temperature and pressure sensors as well as the ability to log accurate time and geographical 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.

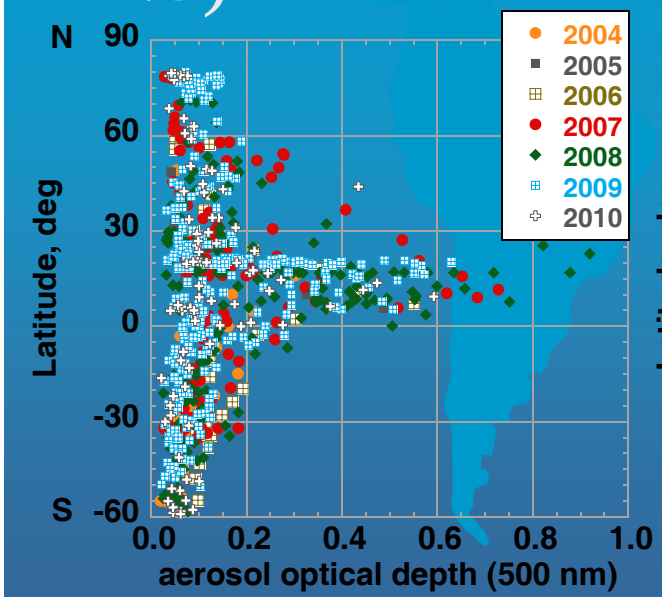
Year	Ship	Region	Status
2004	RV Akademik Sergey Vavilov	Atlantic Ocean Transect, Southern Ocean	Completed
2005-2006	RV Akademik Fedorov	Atlantic Ocean Transect, Antarctica	Completed
2006-2007	RV Akademik Fedorov	Atlantic Ocean Transect, Antarctica	Completed
2007	Ecklonia	Atlantic Ocean near South African Coast	Completed
2007	RV Polarstern	Atlantic Ocean Transect	Completed

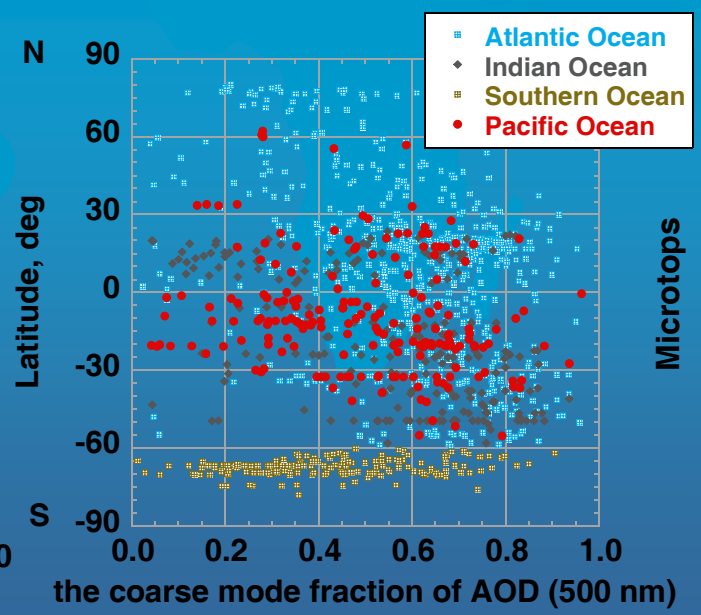
2007	RV Urania	Mediterranean Sea	Completed
2007	Trans Future 5	Pacific Ocean Transect	Completed
2007	RV Oceania	Baltic, Norwegian, Greenland Seas	Completed
2007	RV Aranda	Gulf of Bothnia	Completed
2007	CCGS Louis St. Laurent	Beaufort Sea	Completed
2007	Roger Revelle	Arabian Sea	Completed
2007	RV Oceania	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	Carribean 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	Completed
2010	RV Marion Dufresne	Equatorial Pacific, Ceram Sea	Completed
2010	CCGS Amundsen	Labrador Sea, Hudson Bay	Completed
2010	RV Marion Dufresne	Indian Ocean	Completed
2010	RV Oceania	Norwegian, Greenland Seas	Completed
2010	MV Zim San Diego	South China Sea, Gulf of Siam	Completed
2010	NRV Alliance	Ligurian Sea	Completed
2010	RV Marion Dufresne	South Indian Ocean	Completed
2010	RV Akademik Ioffe	Northern Atlantic	Completed
2010	HC Maria	Atlantic Ocean	Completed
2010	RV Marion Dufresne	South Indian Ocean	Completed
2010	RV Roger Revelle	North Pacific Ocean	Completed
2010	RV Marion Dufresne	South Indian Ocean	Completed
2010	RV Meteor	Tropical Atlantic	Completed
2010	RRS Discovery	South Atlantic Ocean	Completed
2010	RRS James Cook	Atlantic Ocean transect	Completed
2010	RV Polarstern	Atlantic Ocean transect	Completed
2010	RV Marion Dufresne	South Indian Ocean	Completed
2010	RRS James Cook	South Atlantic Ocean	Completed
2010	RV Southern Surveyor	Tasman Sea	Completed
2010-2011	RRS James Clark Ross	South Atlantic Ocean	Completed
2010-2011	RV Hesperides	South Atlantic, South Indian Ocean	Ongoing
2010-2011	RV Akademik Fedorov	Atlantic Ocean transect, Southern Ocean	Ongoing
2010-2011	NP Almirante Maximiano	South Atlantic Ocean	Ongoing
2011	RV Kilo Moana	North Pacific Ocean	Completed
2011	RV Tangaroa	South Pacific Ocean	Completed
2011	RV Melville	South Atlantic Ocean	Completed
2011	RV Astrolabe	Southern Ocean, South Pacific	Completed
2011	RRS Discovery	Tropical Atlantic	Ongoing
2011	Trans Future 5	Pacific Ocean	Planned
2011	RV Laurence M. Gould	South Atlantic Ocean	Planned
2011	RV Maria S. Merian	Tropical Atlantic	Planned
2011	RV Polarstern	Atlantic Ocean transect	Planned
2011	RV Melville	South Atlantic Ocean	Planned

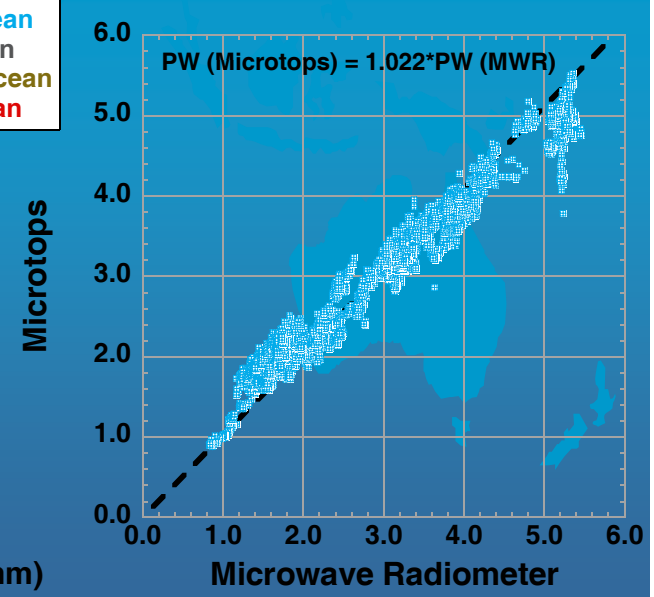
Curator: David M. Giles
NASA Official: Brent N. Holben
Last Updated: July 16, 2009

MAN products:

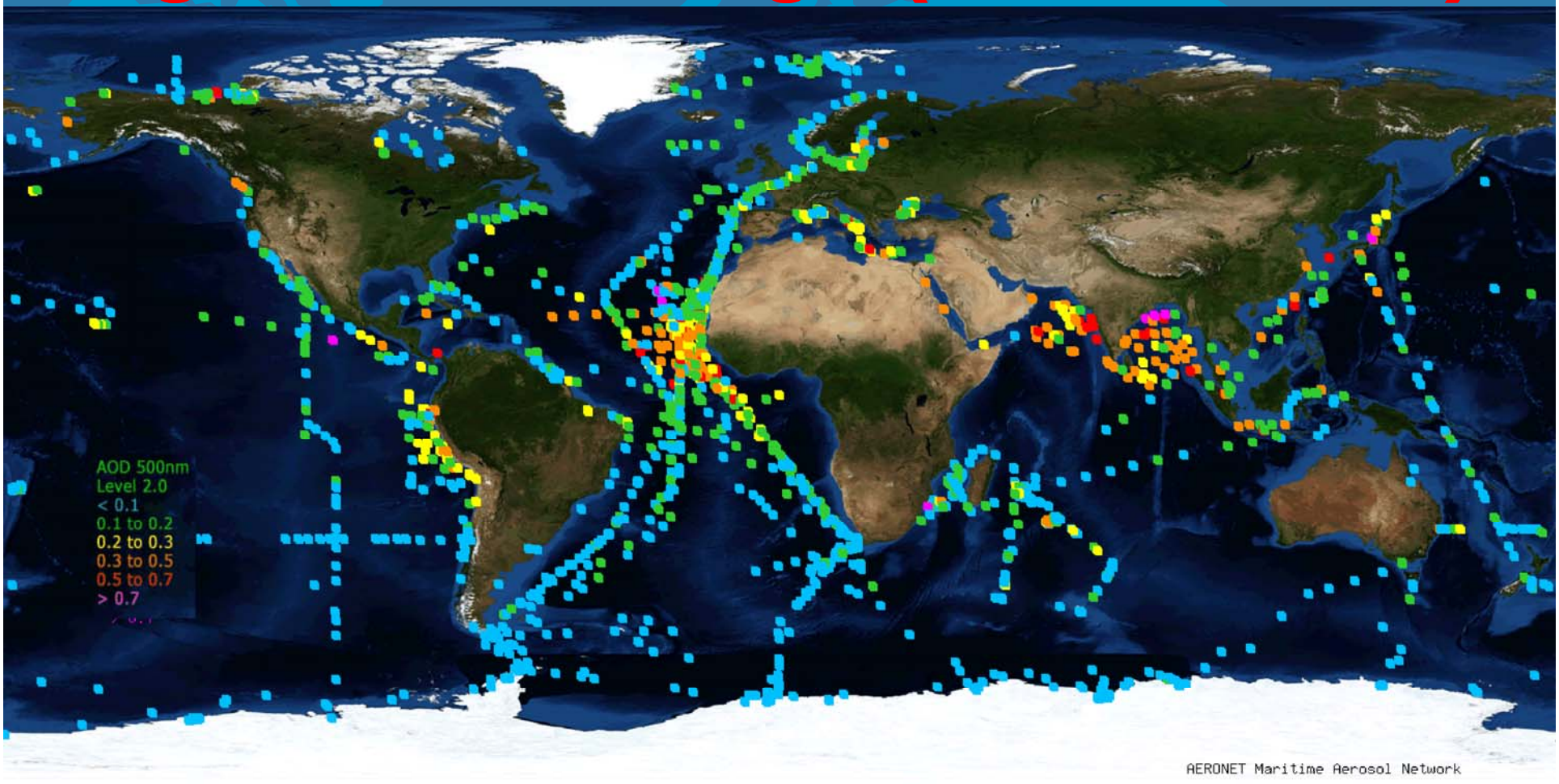
- Aerosol optical depth (Level 1; Level 1.5; Level 2)
- Water vapor content (Level 1; Level 1.5; Level 2)
- Aerosol optical depths: fine (sub-micron) and coarse (super-micron) at 500 nm (Level 1; Level 1.5)





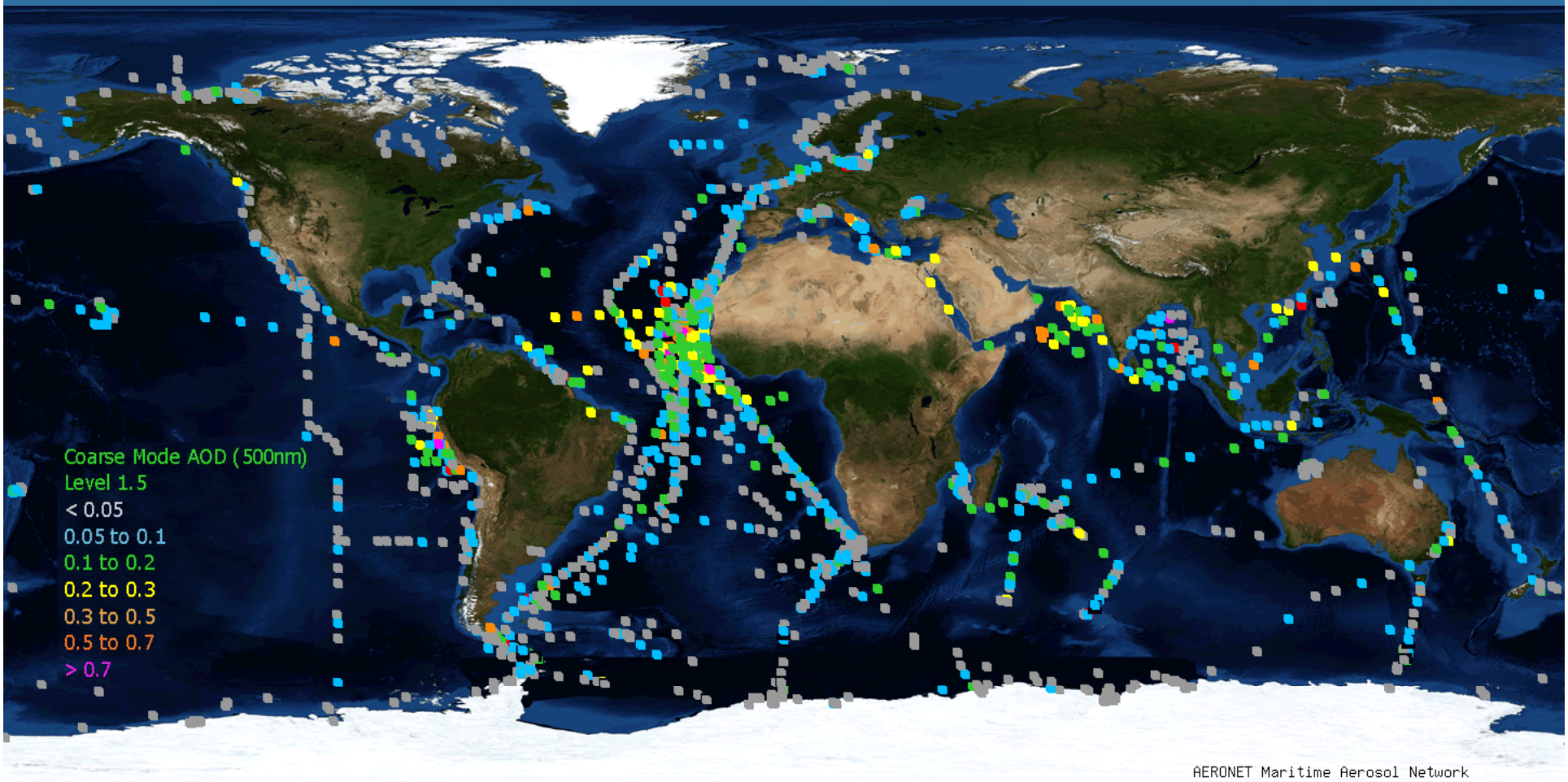


Maritime Aerosol Network global coverage (March 2011)



Cruise tracks and daily averages of aerosol optical depth at 500 nm (squares are colored with respect to AOD values, i.e. blue – AOD<0.10, green – 0.1≤AOD<0.2, yellow – 0.2≤AOD<0.3, orange – 0.3≤AOD<0.5, red – 0.5≤AOD<0.7, purple – AOD≥0.7).

Coarse mode AOD

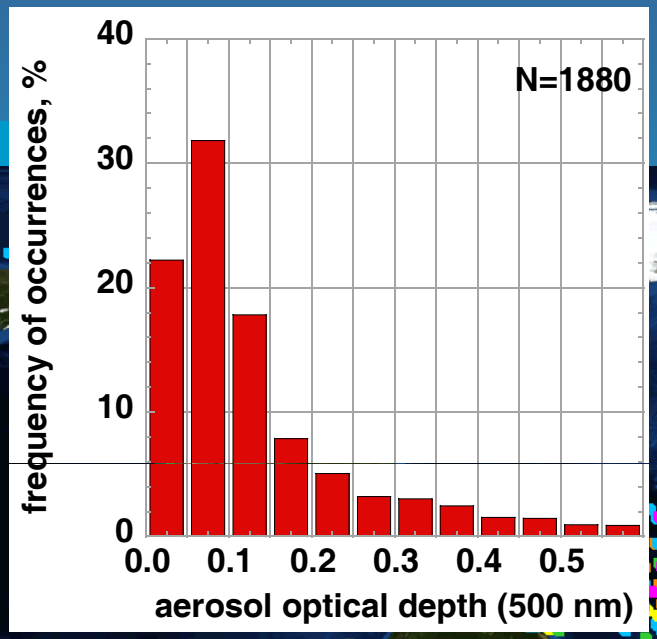


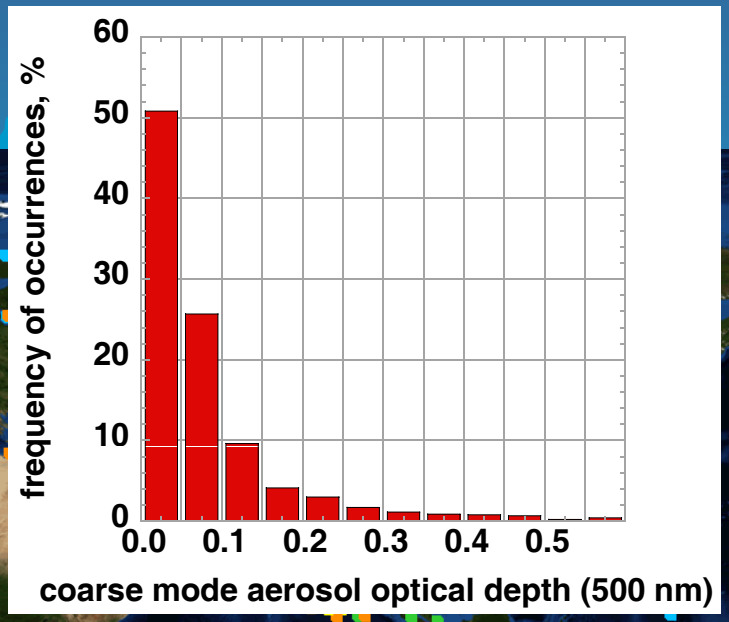
Cruise tracks and daily averages of coarse mode aerosol optical depth at 500 nm (squares are colored with respect to coarse AOD values, i.e. grey – AOD<0.05, blue – 0.05<AOD<0.10, green – 0.1≤AOD<0.2, yellow – 0.2≤AOD<0.3, orange – 0.3≤AOD<0.5, red – 0.5≤AOD<0.7, purple – AOD≥0.7).

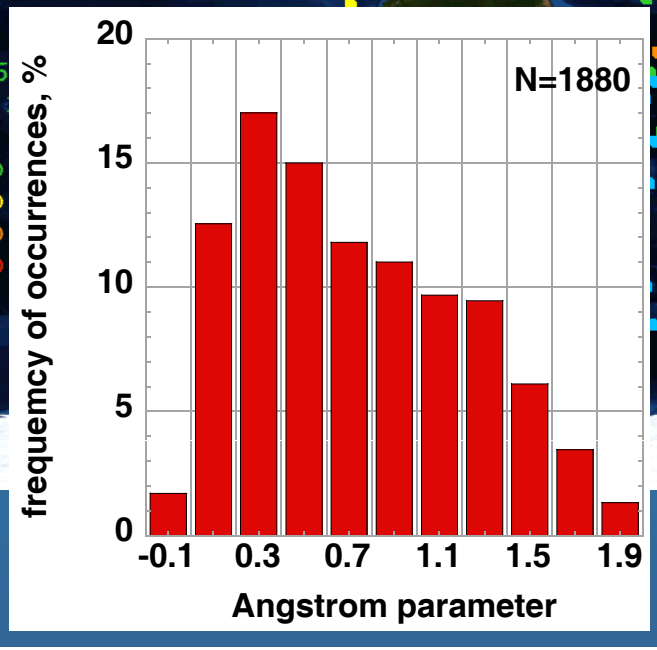
Summary

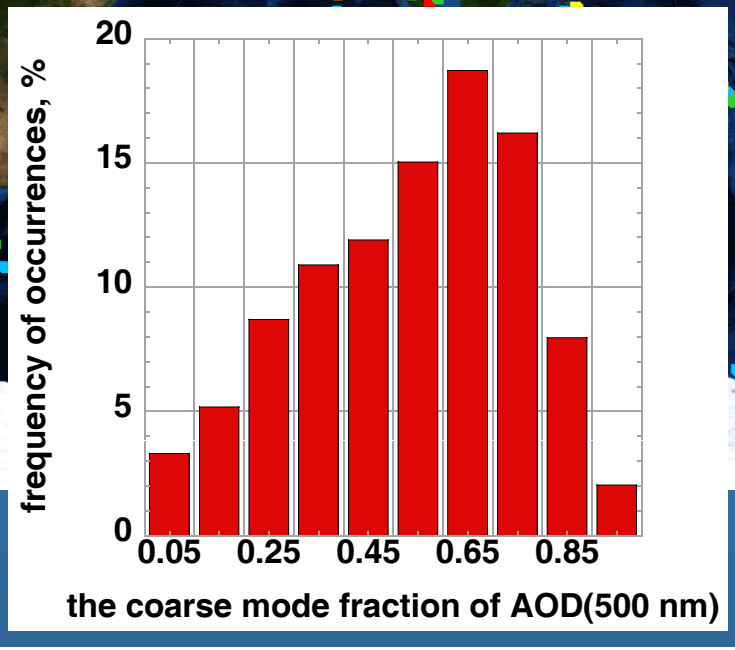
- Number of cruises completed – 121
- Number of measurement days –>2300
- Number of measurement series->13600
- Number of ongoing cruises – 5
- Number of planned cruises - 11

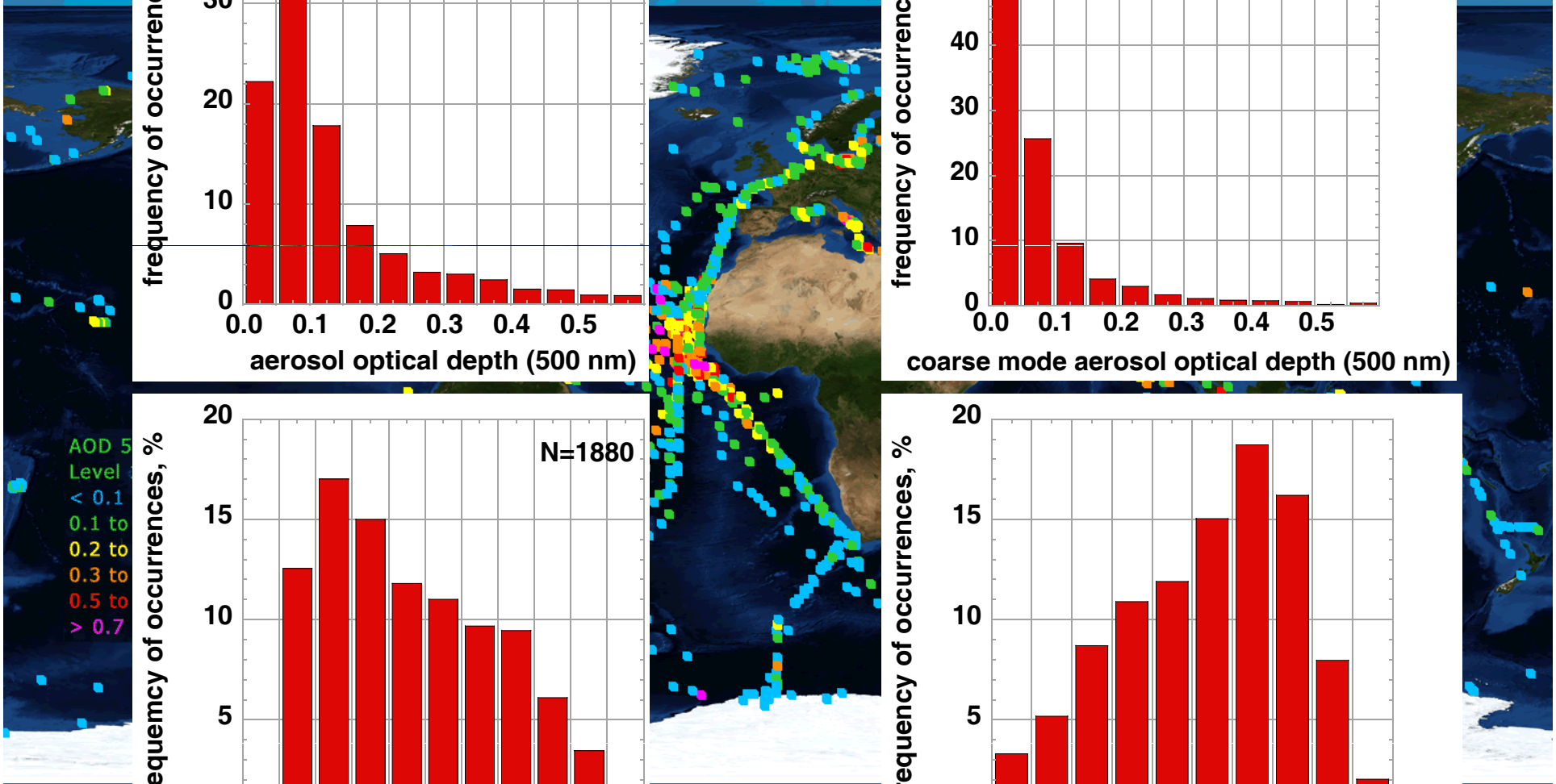
Overall statistics for oceanic areas



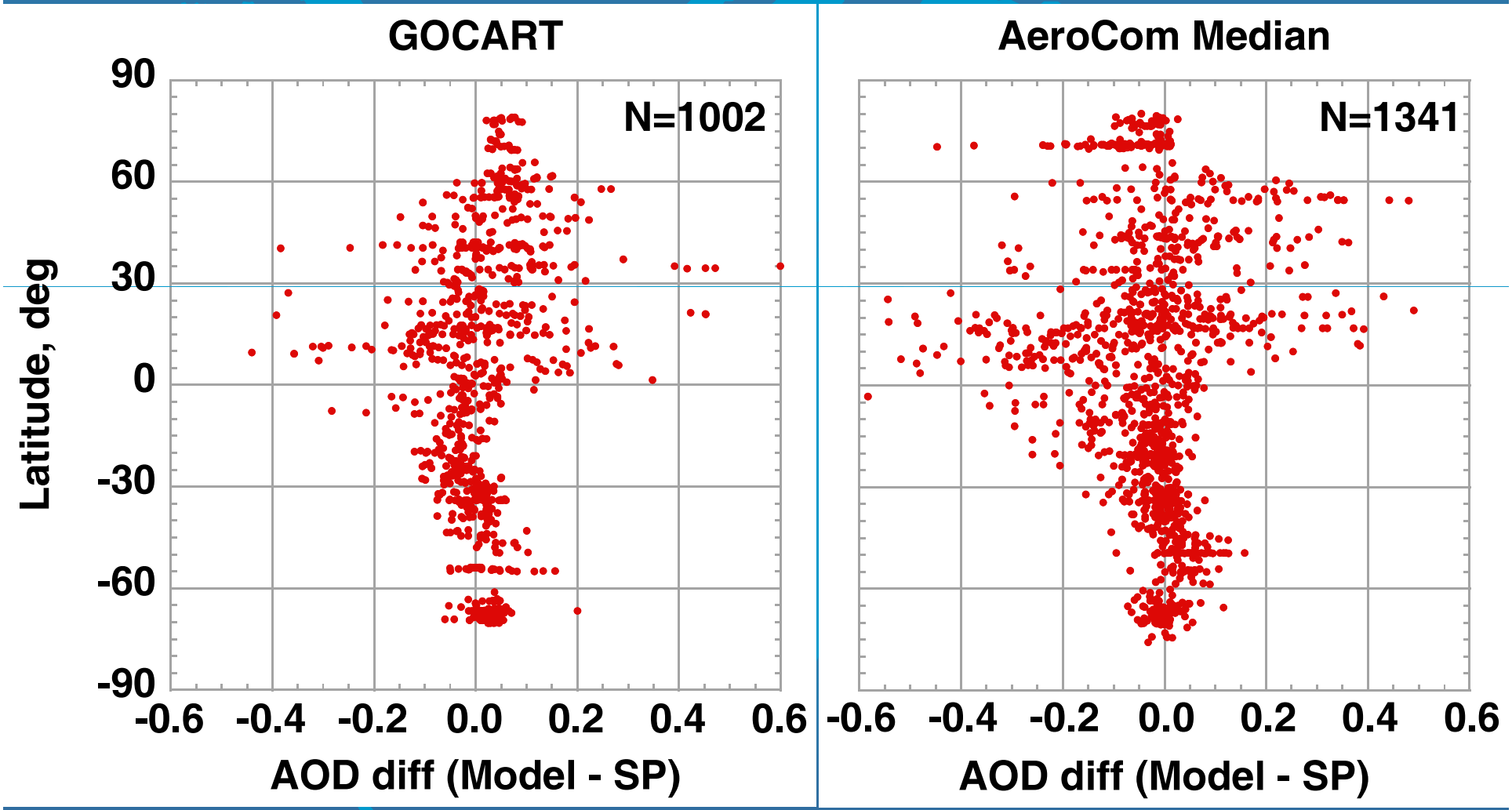




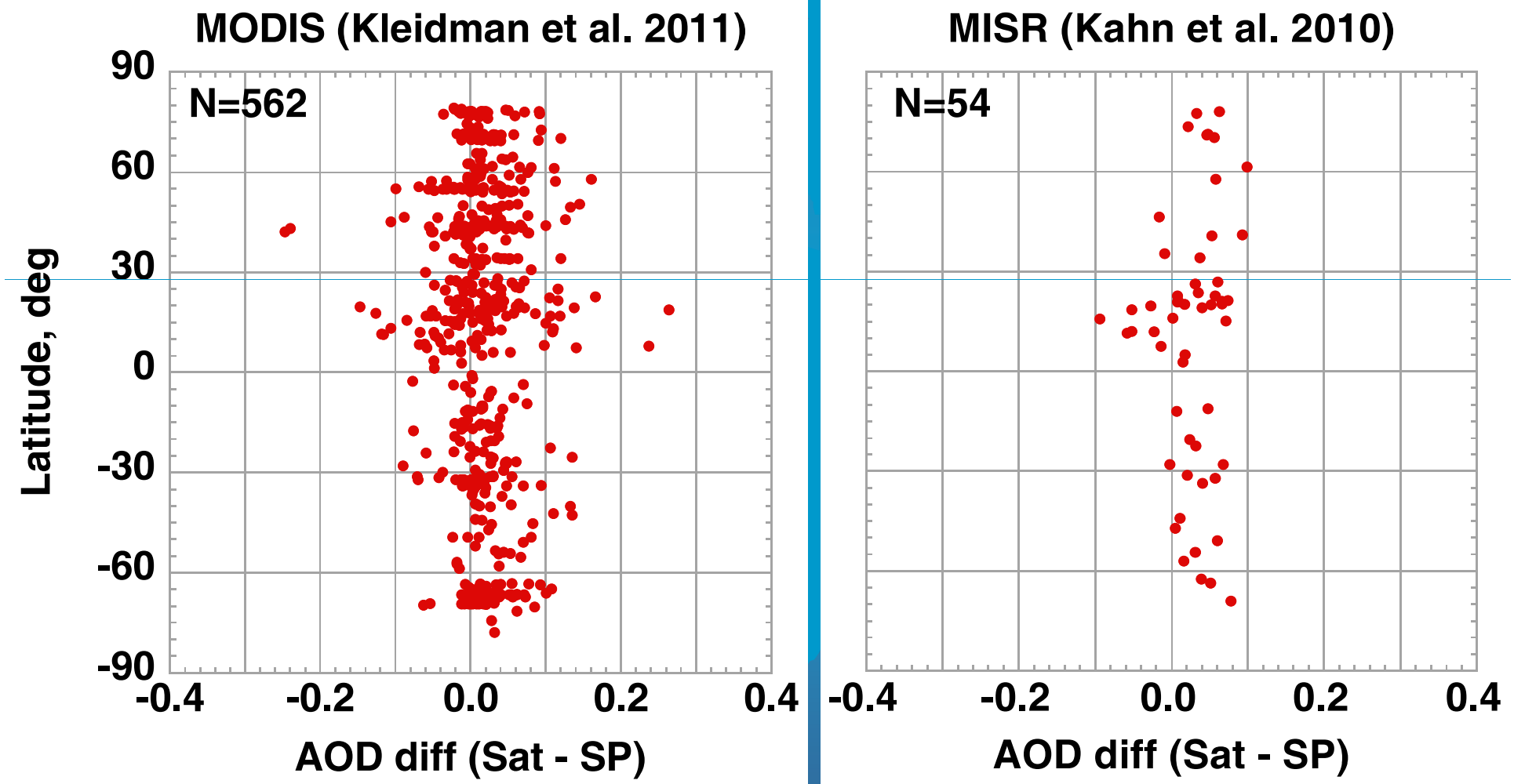




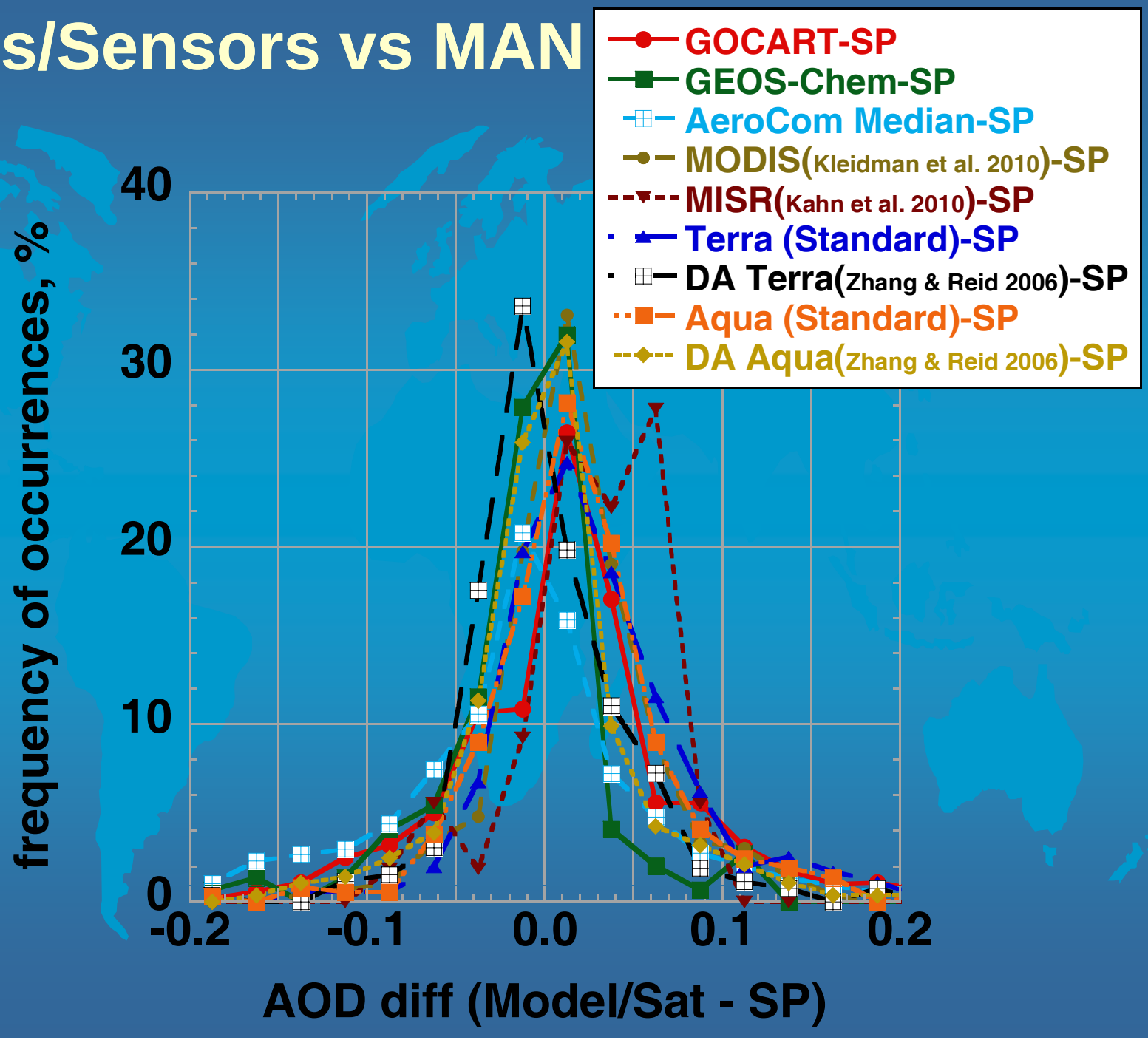
Comparison with global aerosol models

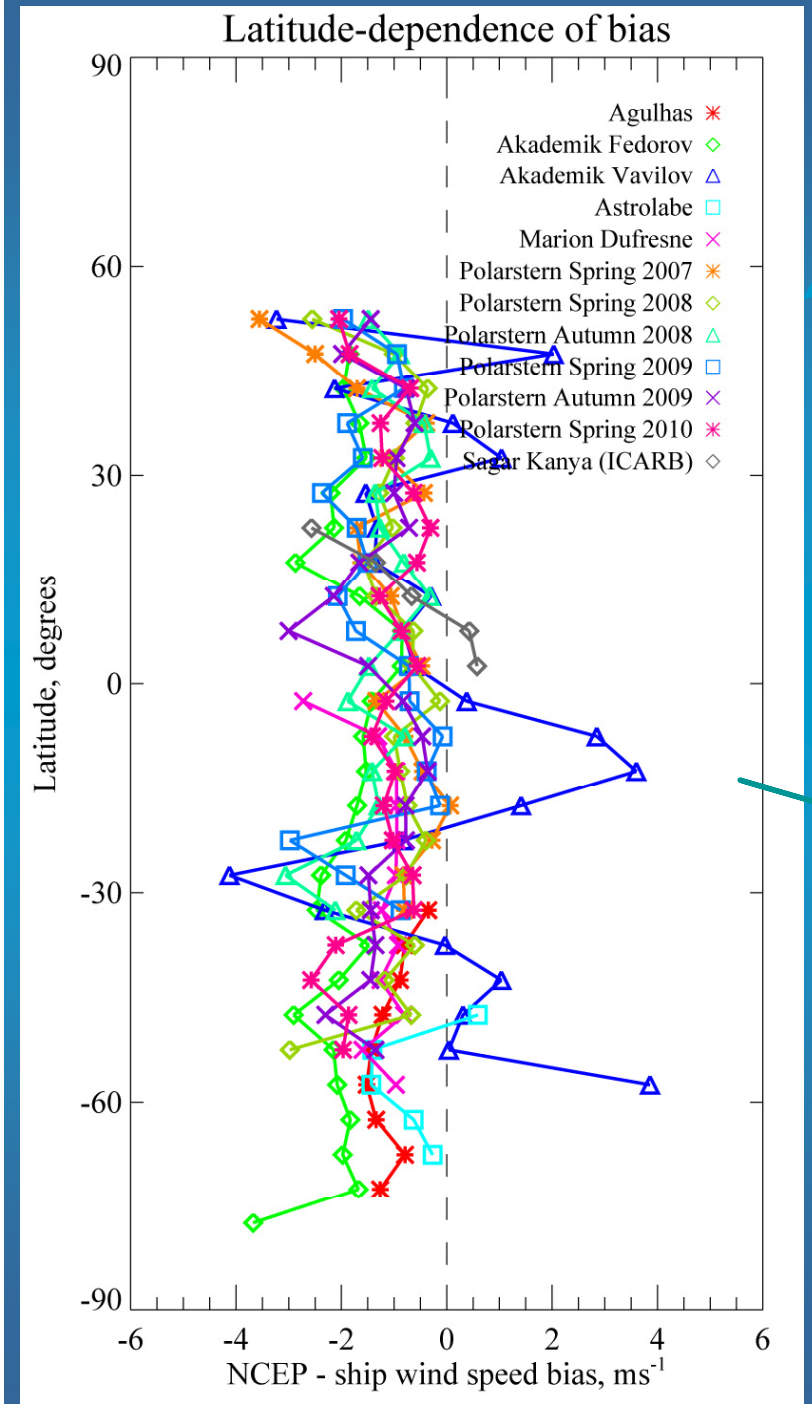


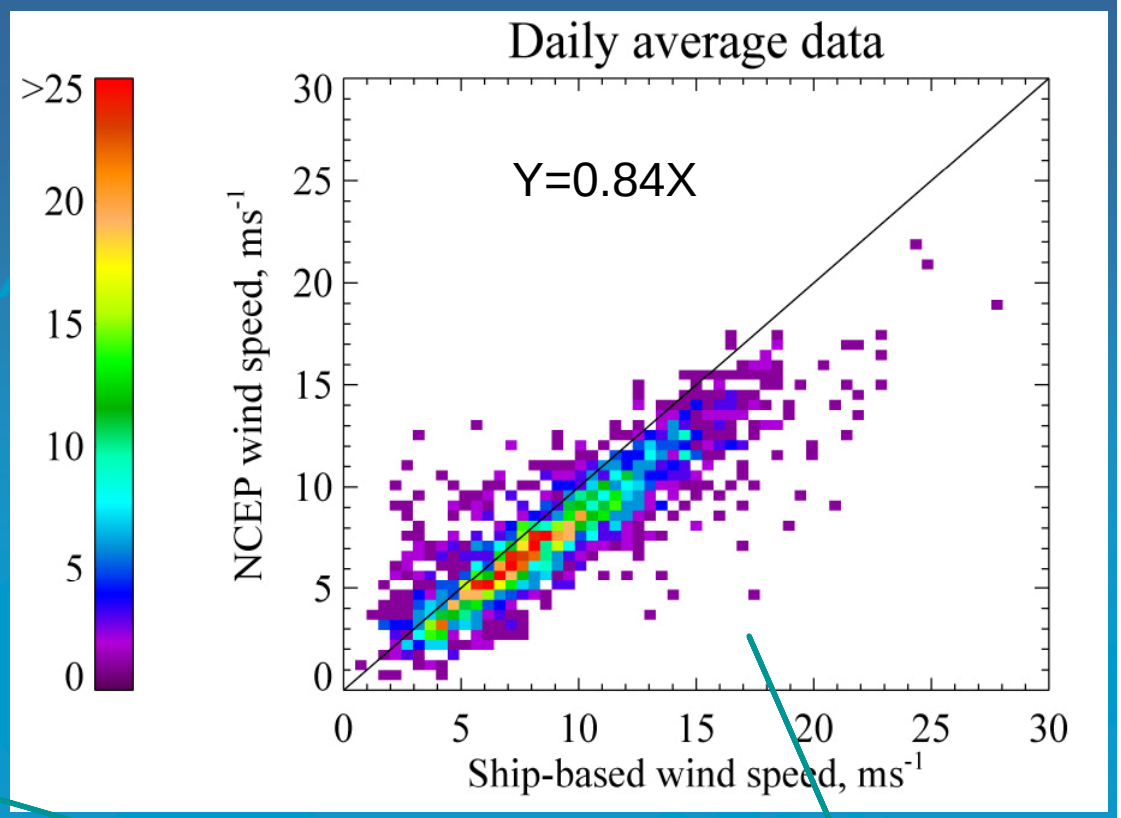
Comparison with satellite retrievals

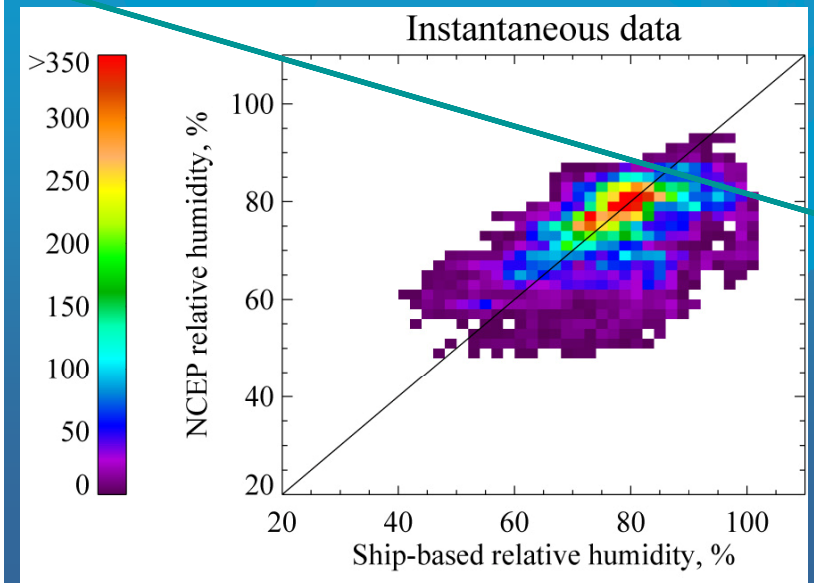


Models/Sensors vs MAN

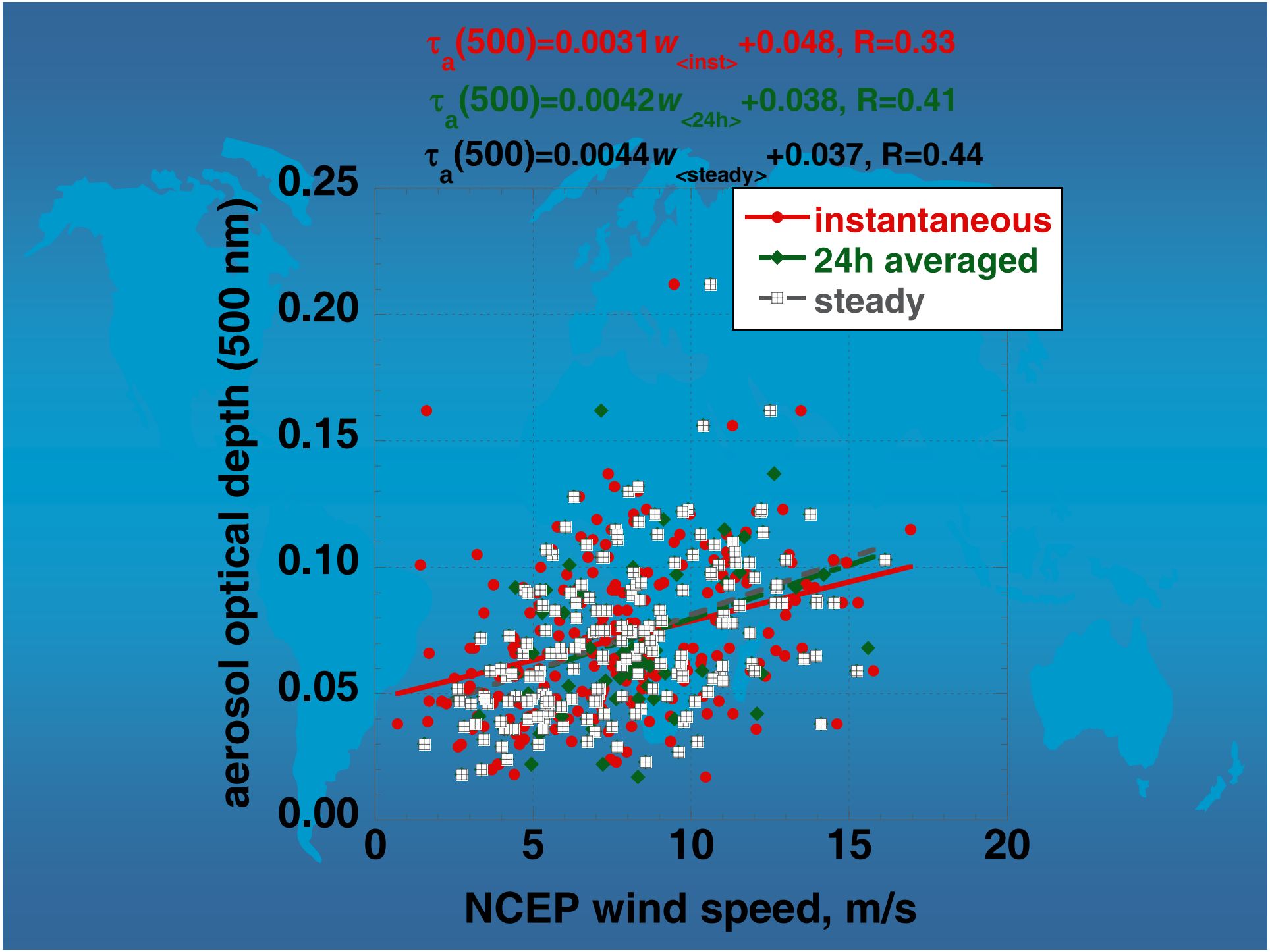


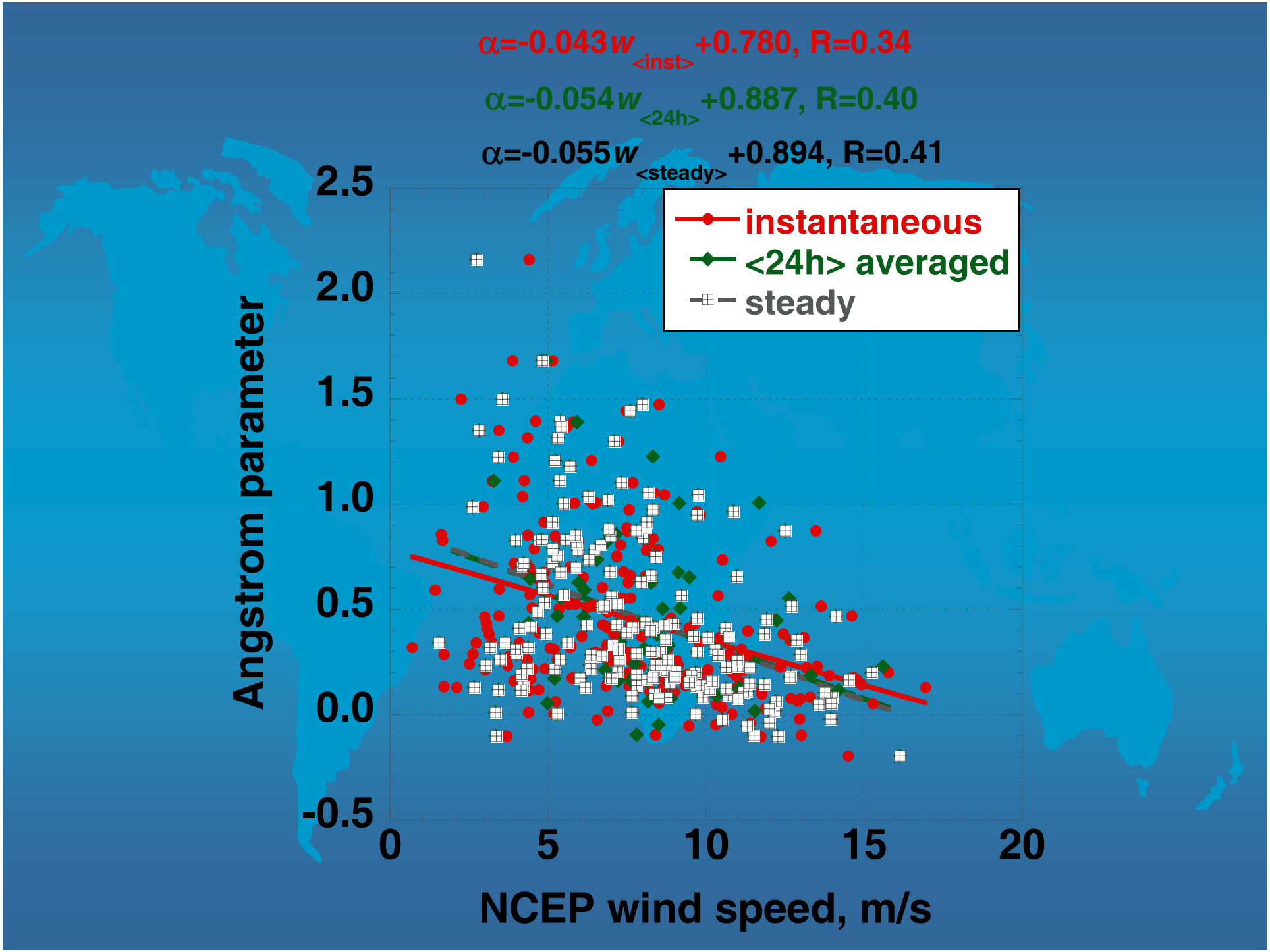






Andrew Sayer, GEST and NASA/GSFC


τa(500)=0.0031w<inst>+0.048, R=0.33
τa(500)=0.0042w<24h>+0.038, R=0.41
τa(500)=0.0044w<steady>+0.037, R=0.44
instantaneous
24h averaged
steady
aerosol optical depth (500 nm)
0.25
0.20
0.15
0.10
0.05
0.00
0
5
10
15
20
NCEP wind speed, m/s


α=-0.043w<inst> +0.780, R=0.34
α=-0.054w<24h> +0.887, R=0.40
α=-0.055w<steady> +0.894, R=0.41
instantaneous
<24h> averaged
steady
Angstrom parameter
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
0
5
10
15
20
NCEP wind speed, m/s

Acknowledgments

- We thank the EOS Project Science Office and Cal/Val Program for their support
- We thank Dr. Hal Maring of the NASA Headquarters for his support of AERONET