Ship-based aerosol optical depth measurements in the Atlantic Ocean, comparison with satellite retrievals and GOCART model

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Alexander = Sasha

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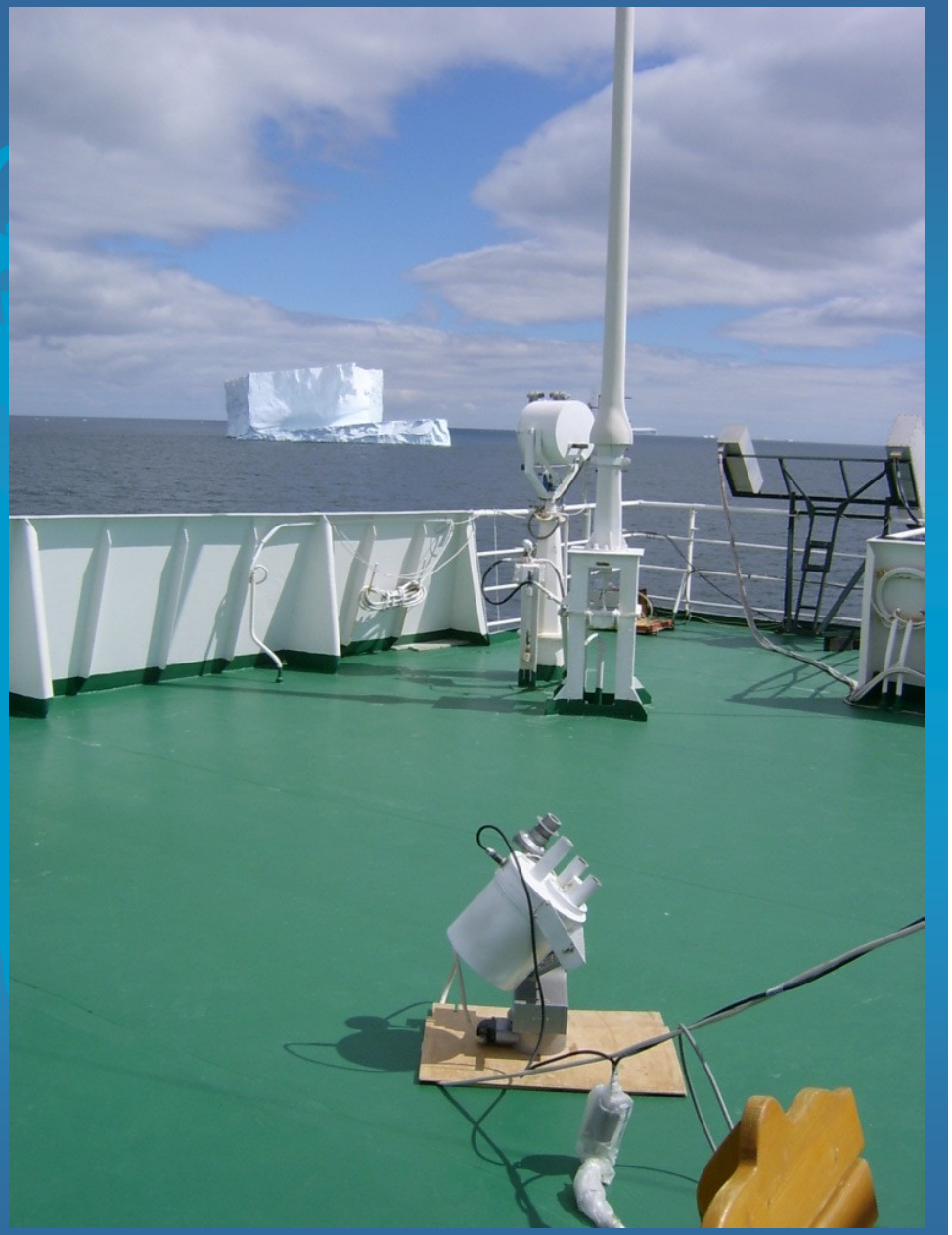
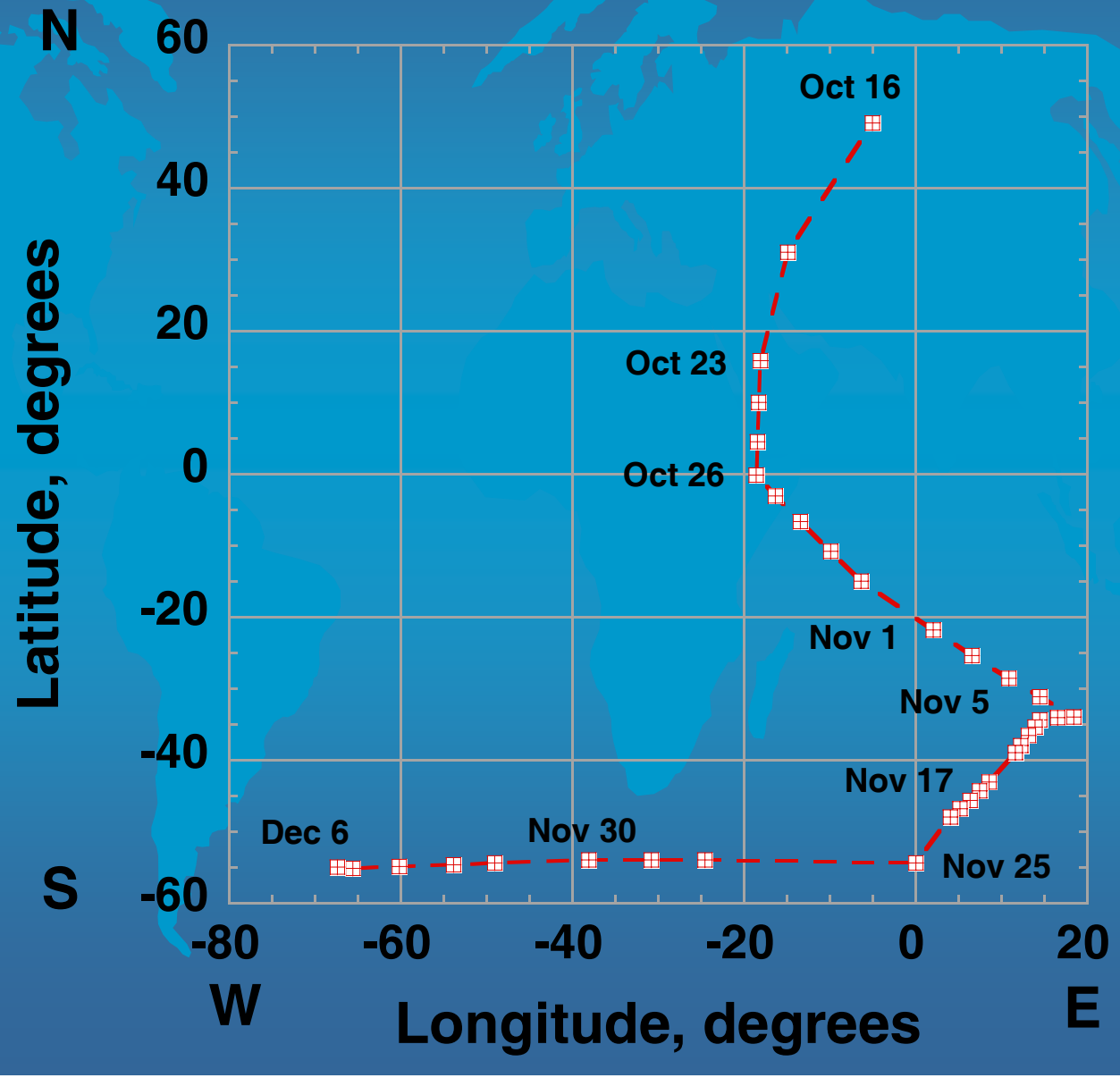
R/V “Akademik Sergey Vavilov”



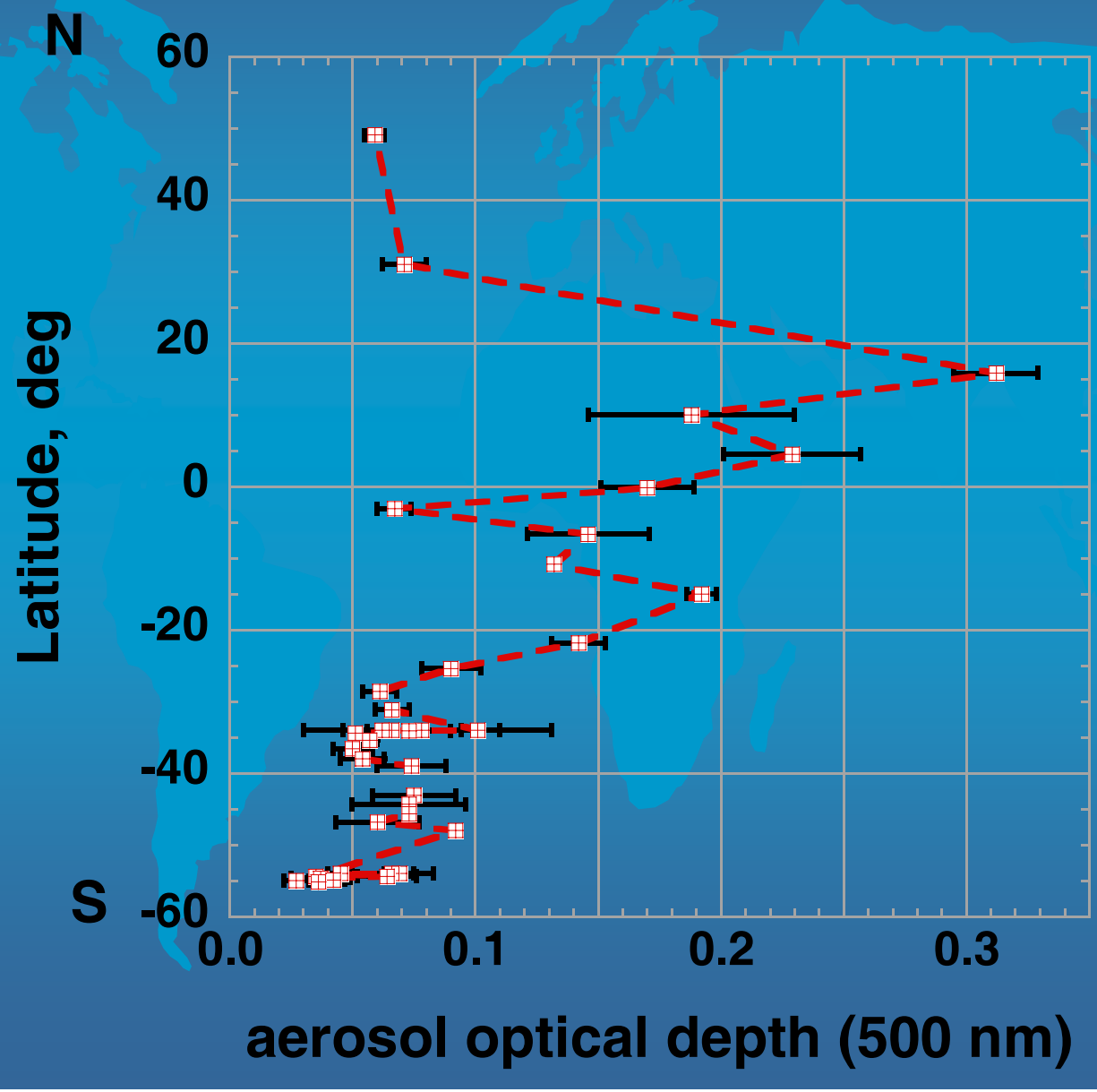
Microtops

- Hand-held sunphotometer
- Sun - λ=340, 440, 675, 870, 940 nm
- Calibration against AERONET Master-CIMEL
- Cloud screening – human observer
- AERONET Version 2 processing

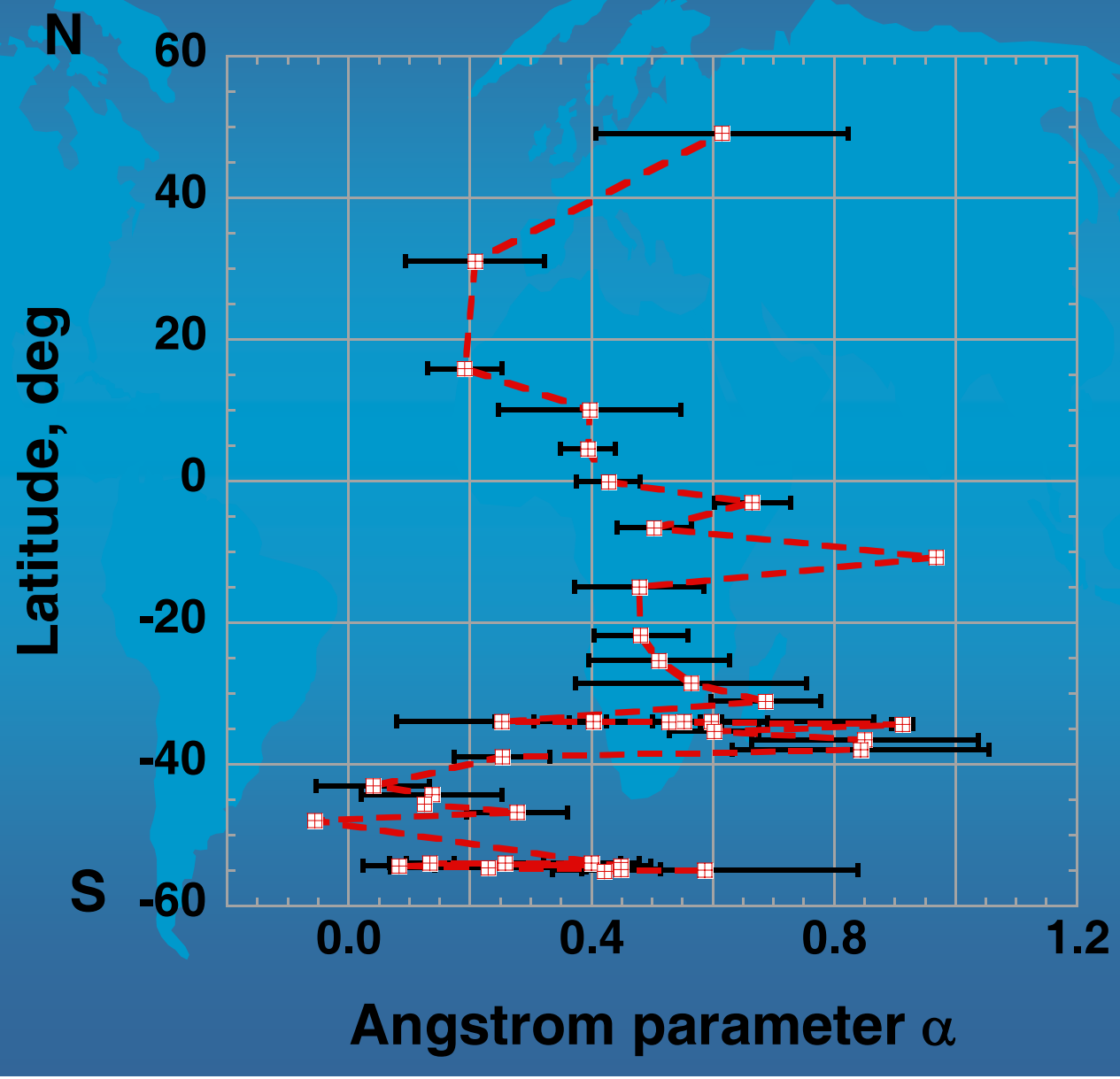
Track of R/V “Akademik Sergey Vavilov”



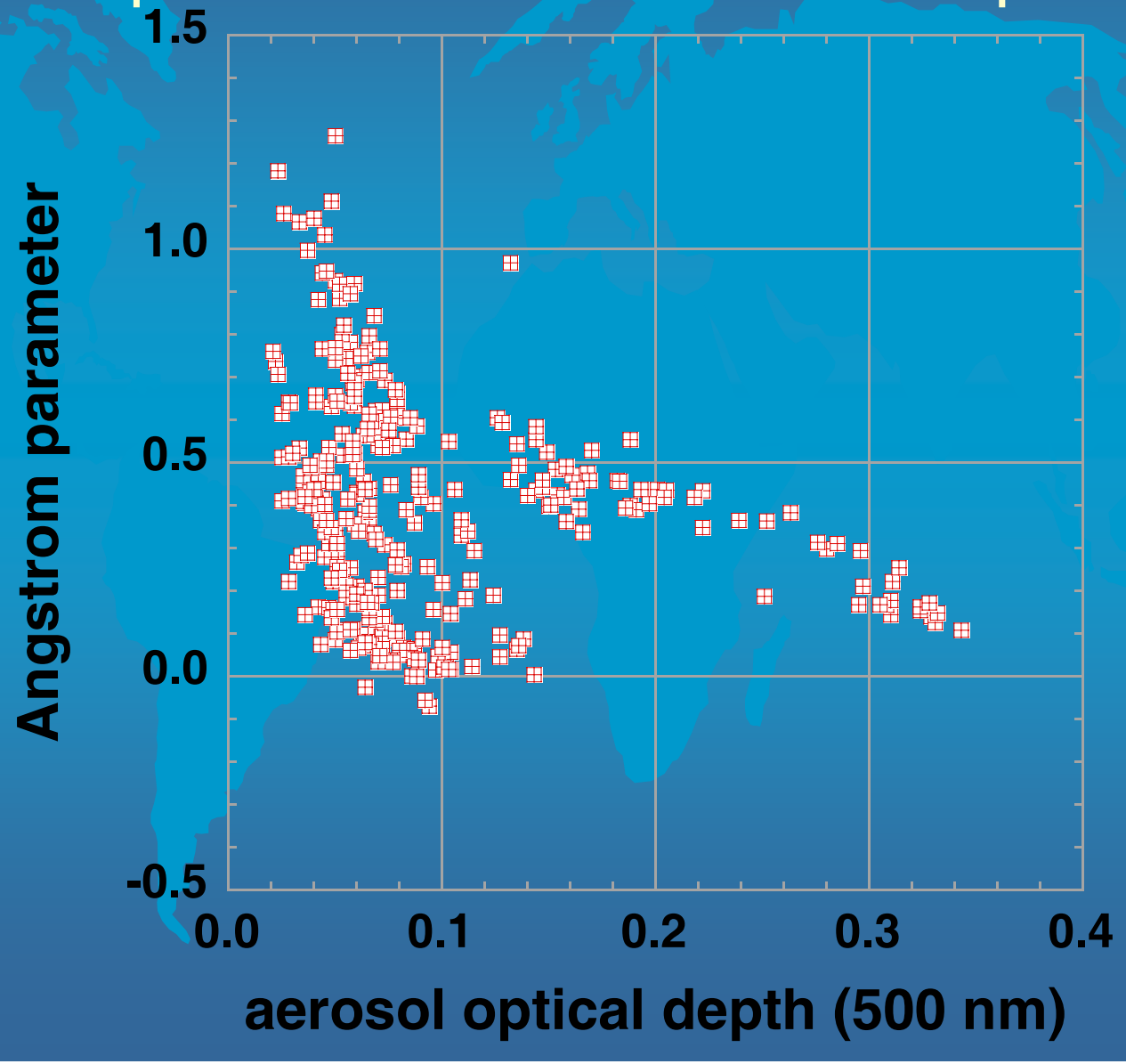
Latitudinal distribution of τ_a(500 nm)

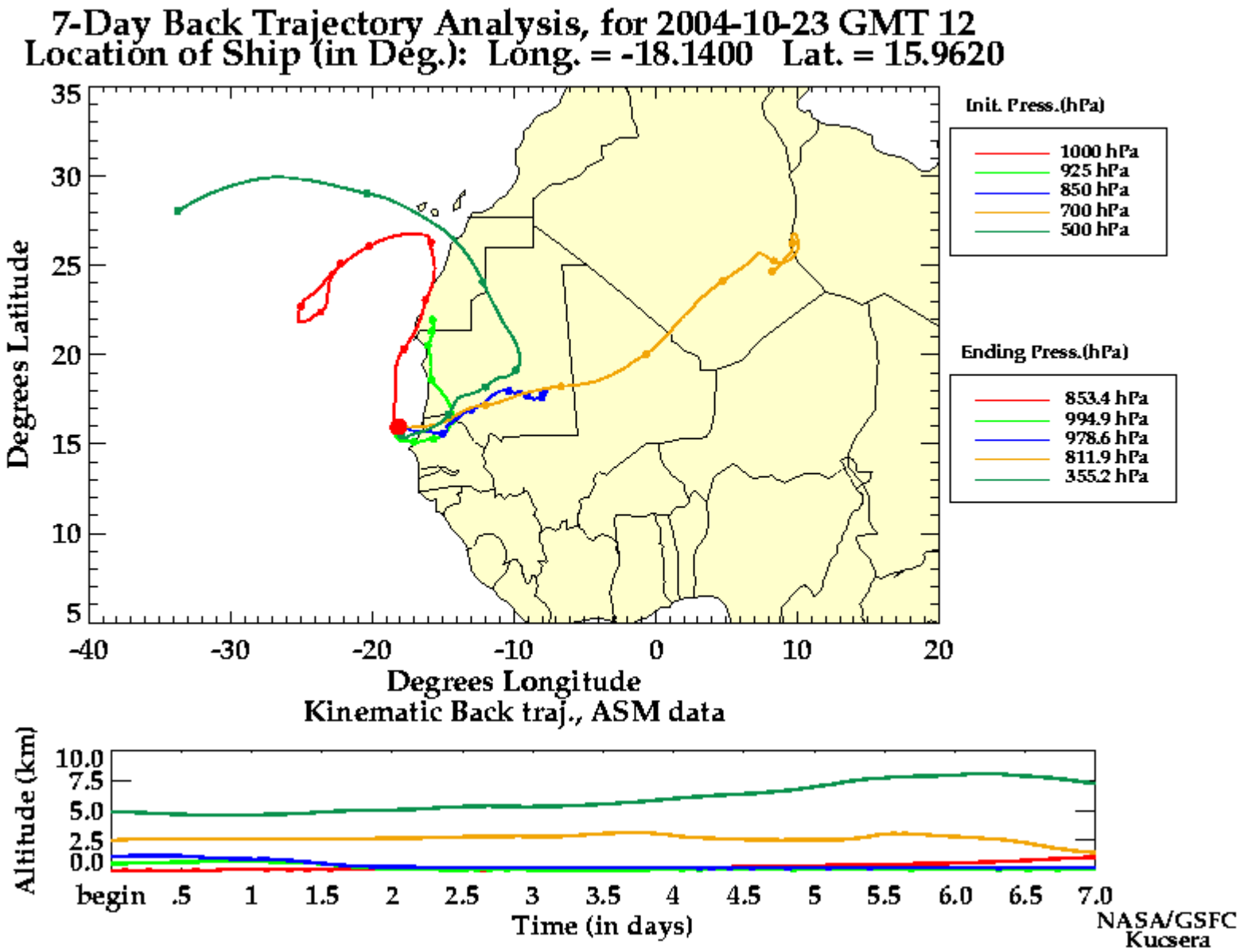


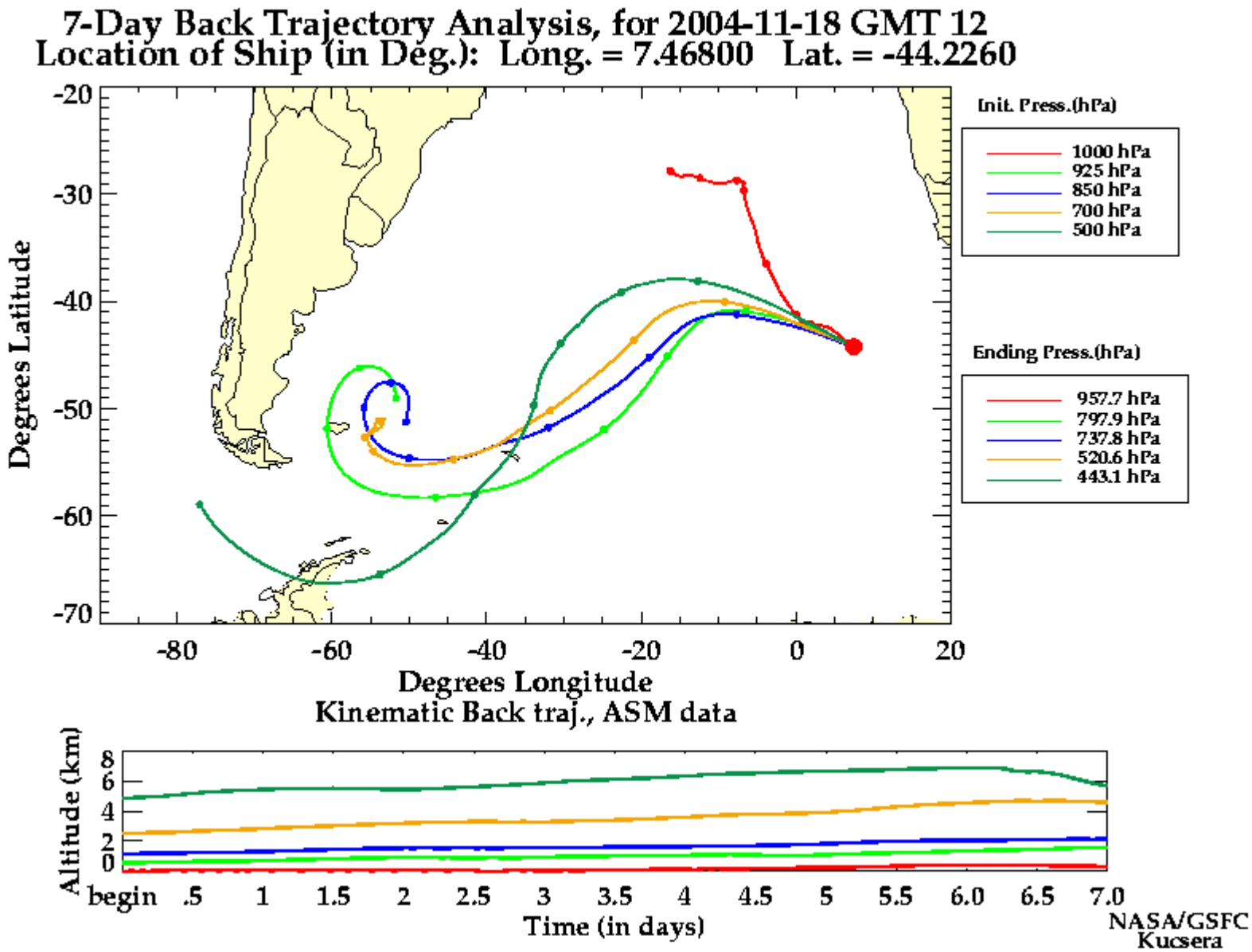
Latitudinal distribution of the Angstrom parameter



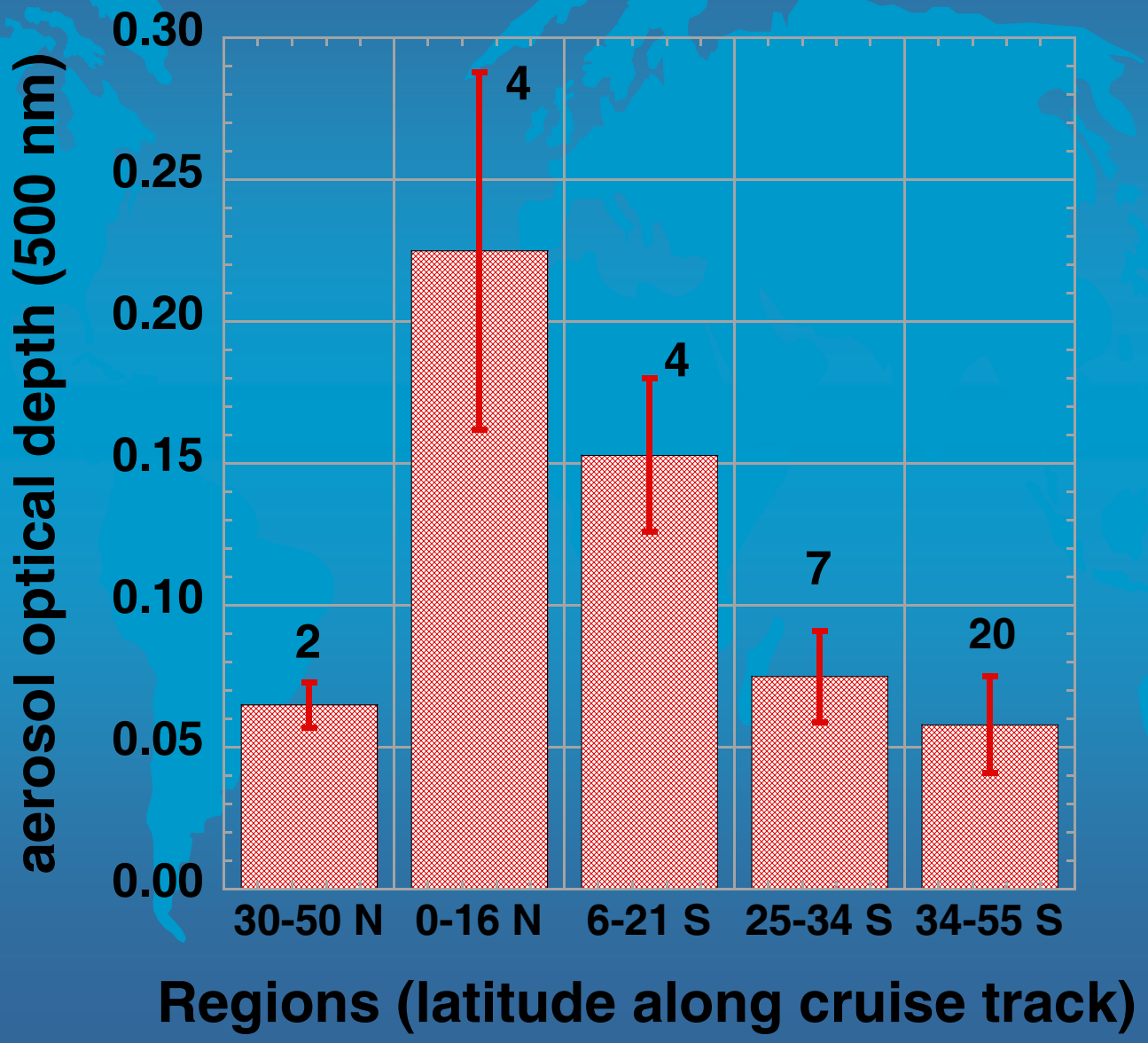
Scattergram of the instantaneous values of Angstrom parameter versus aerosol optical depth



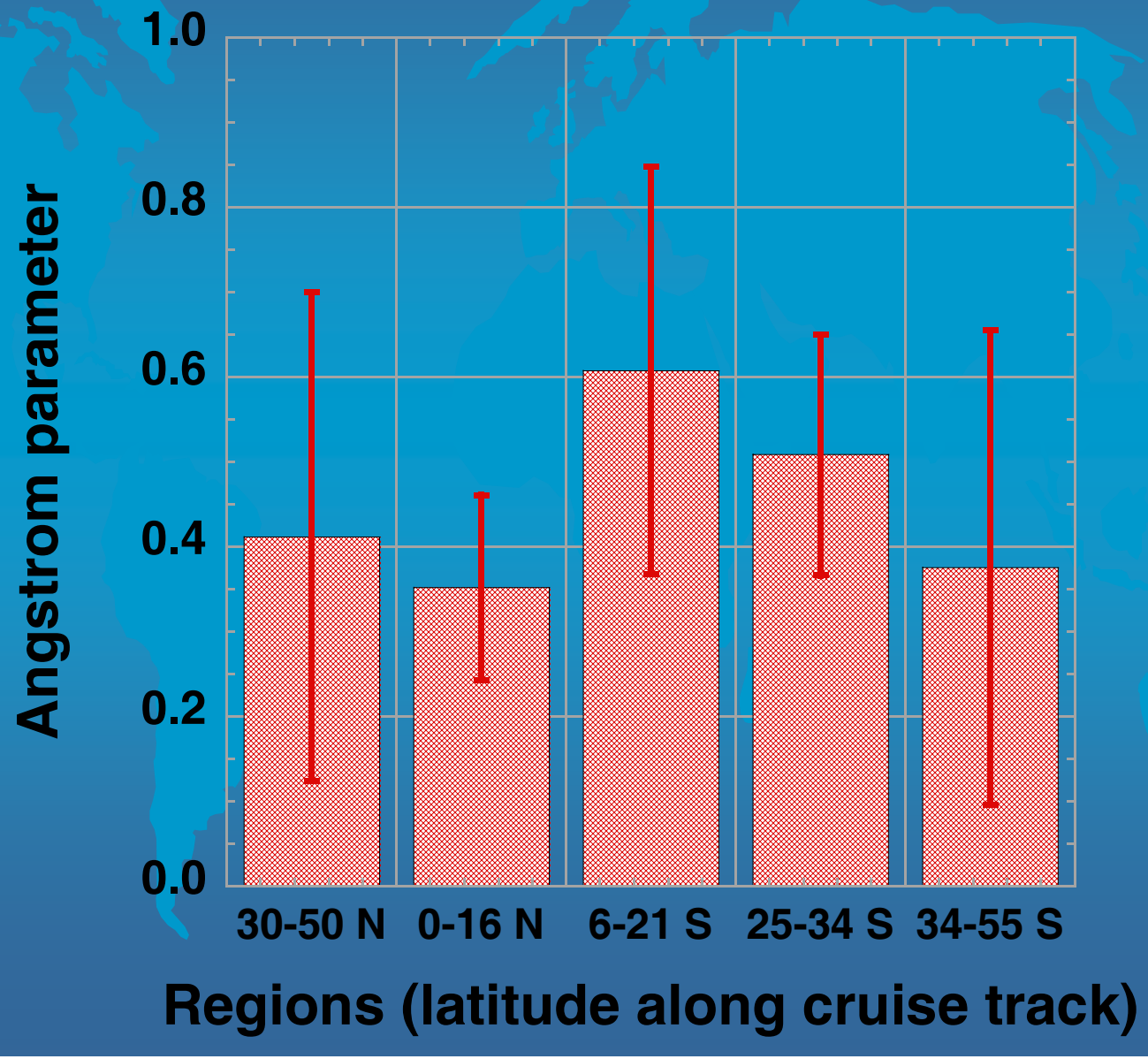

7-Day Back Trajectory Analysis, for 2004-10-23 GMT 12
Location of Ship (in Deg.): Long. = -18.1400 Lat. = 15.9620
Degrees Latitude
35
30
25
20
15
10
5
-40
-30
-20
-10
0
10
20
Degrees Longitude
Kinematic Back traj., ASM data
Init. Press.(hPa)
1000 hPa
925 hPa
850 hPa
700 hPa
500 hPa
Ending Press.(hPa)
853.4 hPa
994.9 hPa
978.6 hPa
811.9 hPa
355.2 hPa
Altitude (km)
10.0
7.5
5.0
2.5
0.0
begin
.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6.0
6.5
7.0
Time (in days)
NASA/GSFC
Kucsera


7-Day Back Trajectory Analysis, for 2004-11-18 GMT 12
Location of Ship (in Deg.): Long. = 7.46800 Lat. = -44.2260
Degrees Latitude
-20
-30
-40
-50
-60
-70
-80
-60
-40
-20
0
20
Degrees Longitude
Init. Press.(hPa)
1000 hPa
925 hPa
850 hPa
700 hPa
500 hPa
Ending Press.(hPa)
957.7 hPa
797.9 hPa
737.8 hPa
520.6 hPa
443.1 hPa
Kinematic Back traj., ASM data
Altitude (km)
8
6
4
2
0
begin
.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6.0
6.5
7.0
Time (in days)
NASA/GSFC
Kucsera

Mean regional τ_a(500 nm)



Mean regional Angstrom parameter

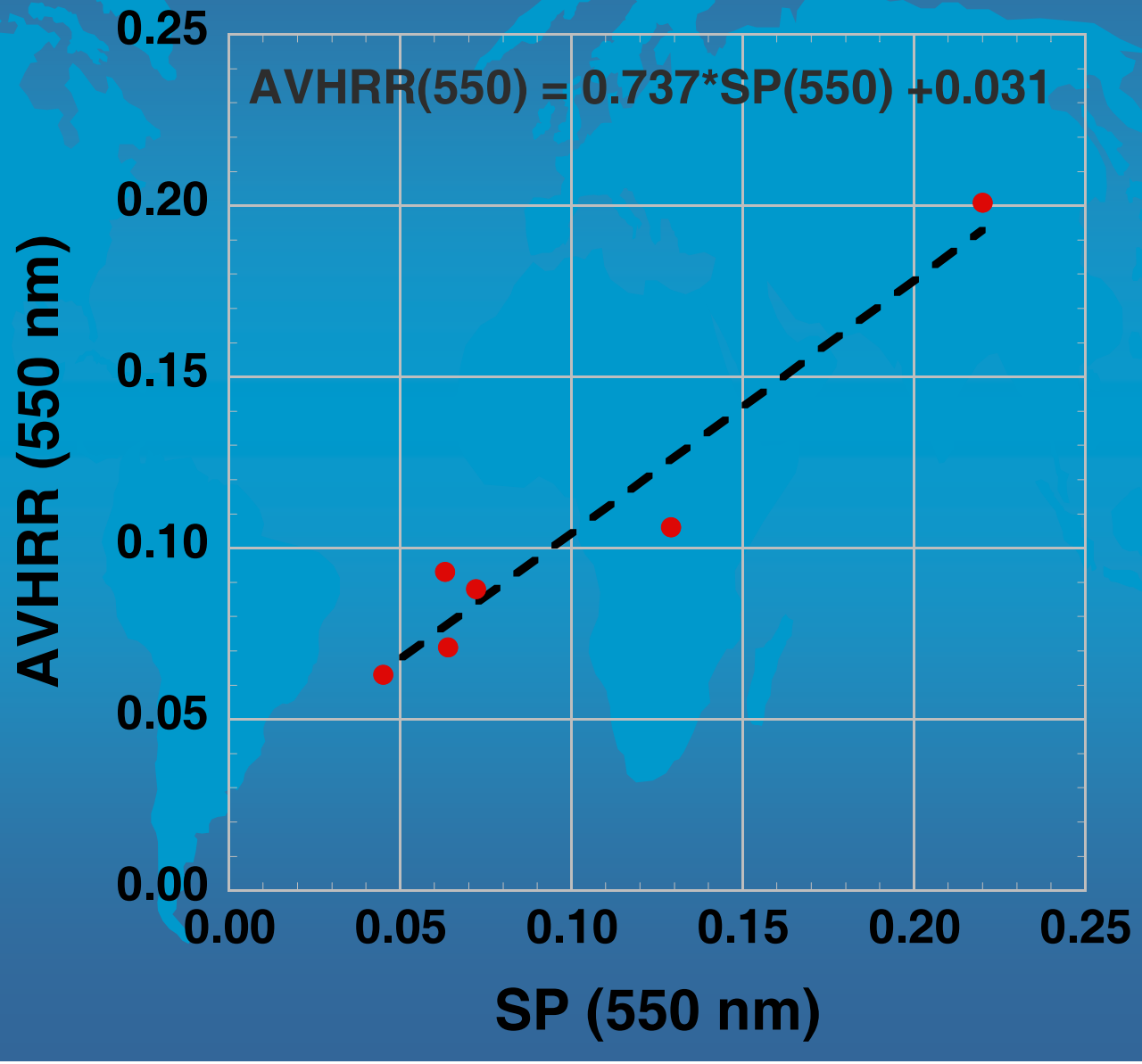


Mean optical characteristics of various air mass source regions

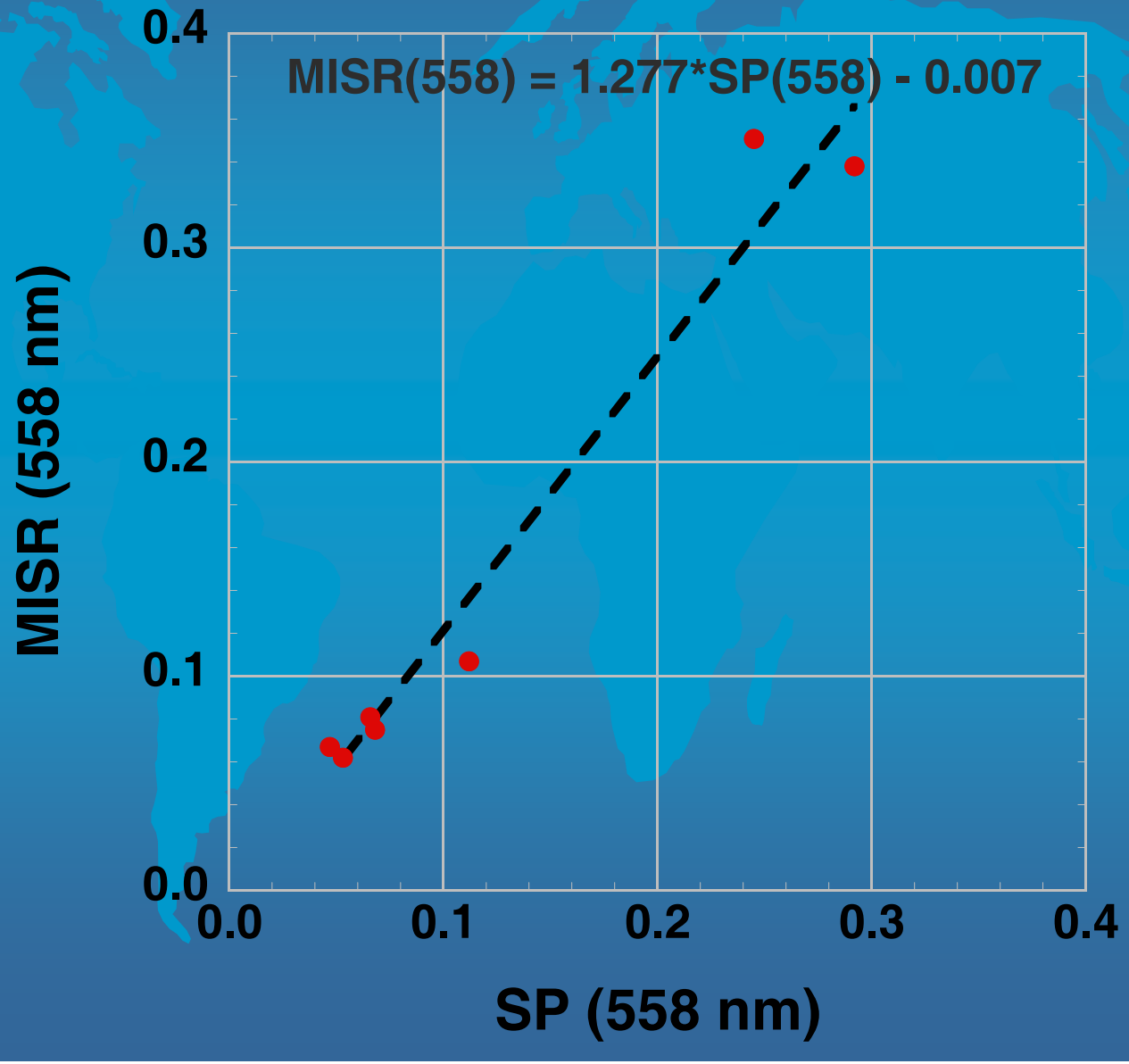
Air Mass Source Region	τ_a(500 nm)	σ	α	σ_α	*wvc*	σ_{wvc}	N
North Atlantic polar marine (30º-50º N)	0.07	0.01	0.41	0.29	2.19	1.08	2
African dust (0º-16º N)	0.23	0.06	0.35	0.11	4.58	1.01	4
Modified South Atlantic tropical marine (6º-21º S)	0.15	0.03	0.61	0.24	2.96	0.97	4
South Atlantic subtropical marine (25º-34º S)	0.08	0.02	0.51	0.14	1.88	0.58	7
South Atlantic polar marine (34º-55º S)	0.06	0.02	0.38	0.28	1.31	0.80	20

τ_a(500), average of aerosol optical depth at a wavelength 500 nm; σ, standard deviation of the aerosol optical depth; α, average of the Angstrom parameter; σ_α, standard deviation of the Angstrom parameter; *wvc*, average of the columnar water vapor content; σ_{wvc}, standard deviation of the columnar water vapor content; N, number of days.

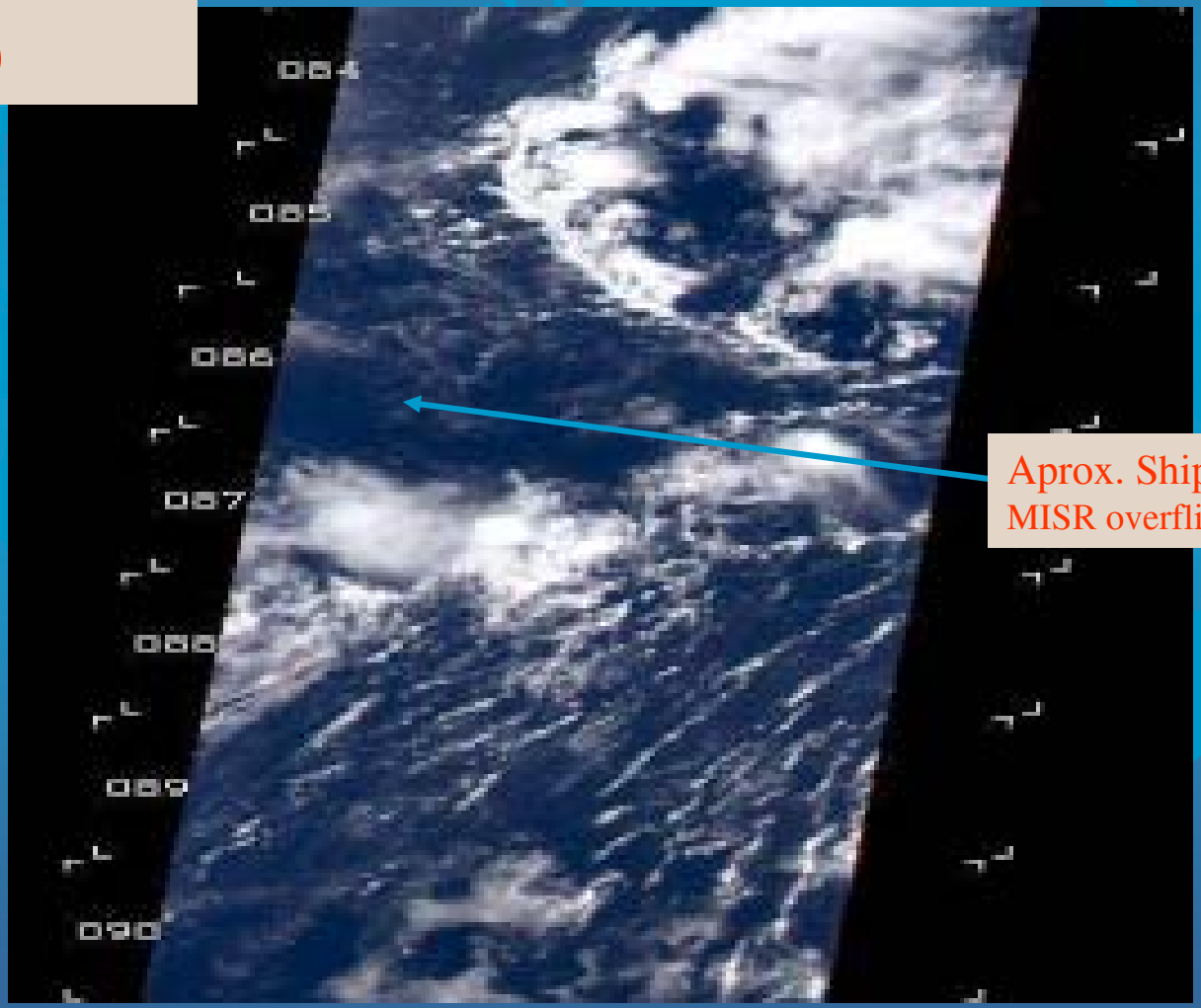
GISS Methodology



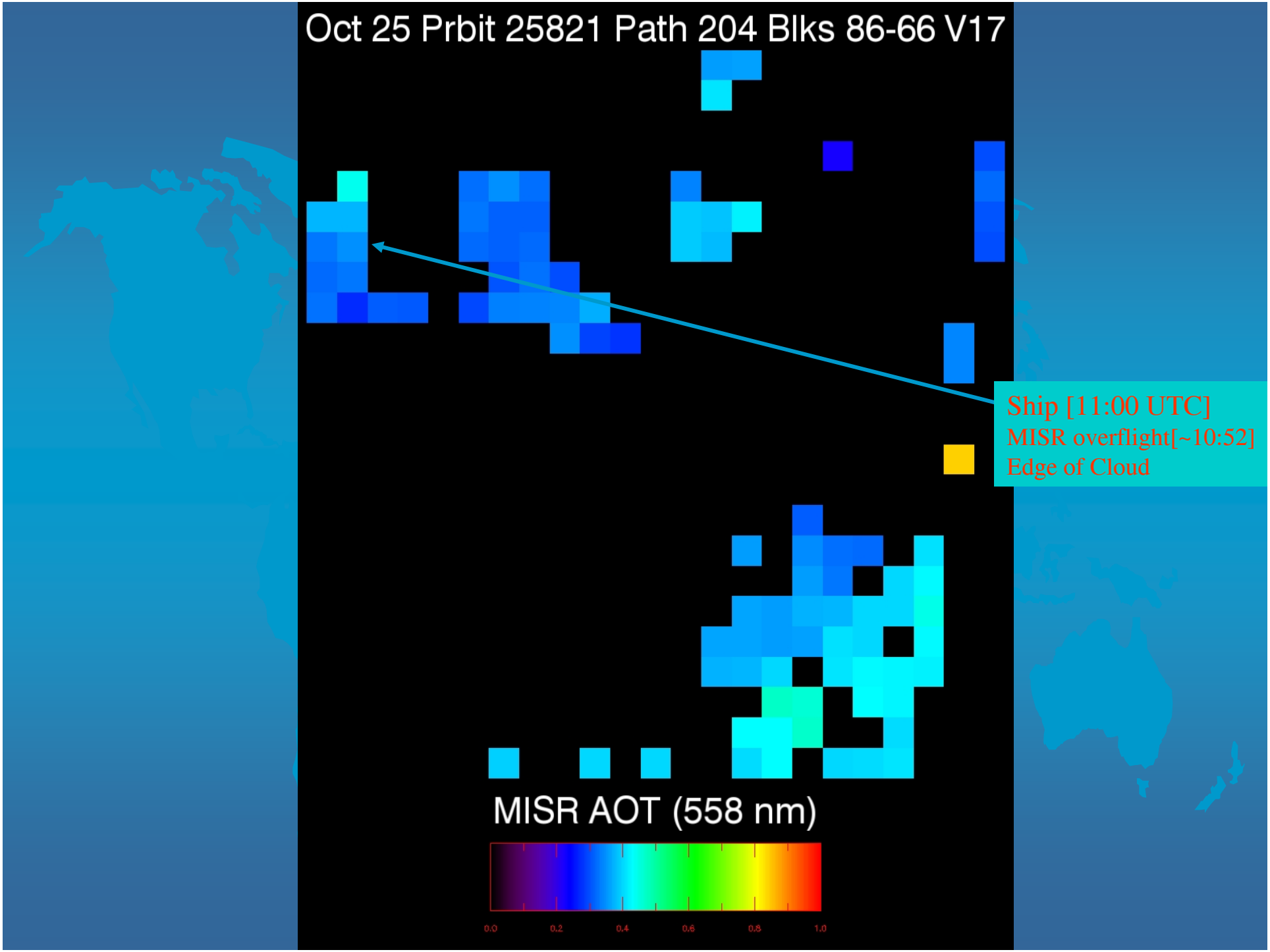
MISR Retrievals (V15)



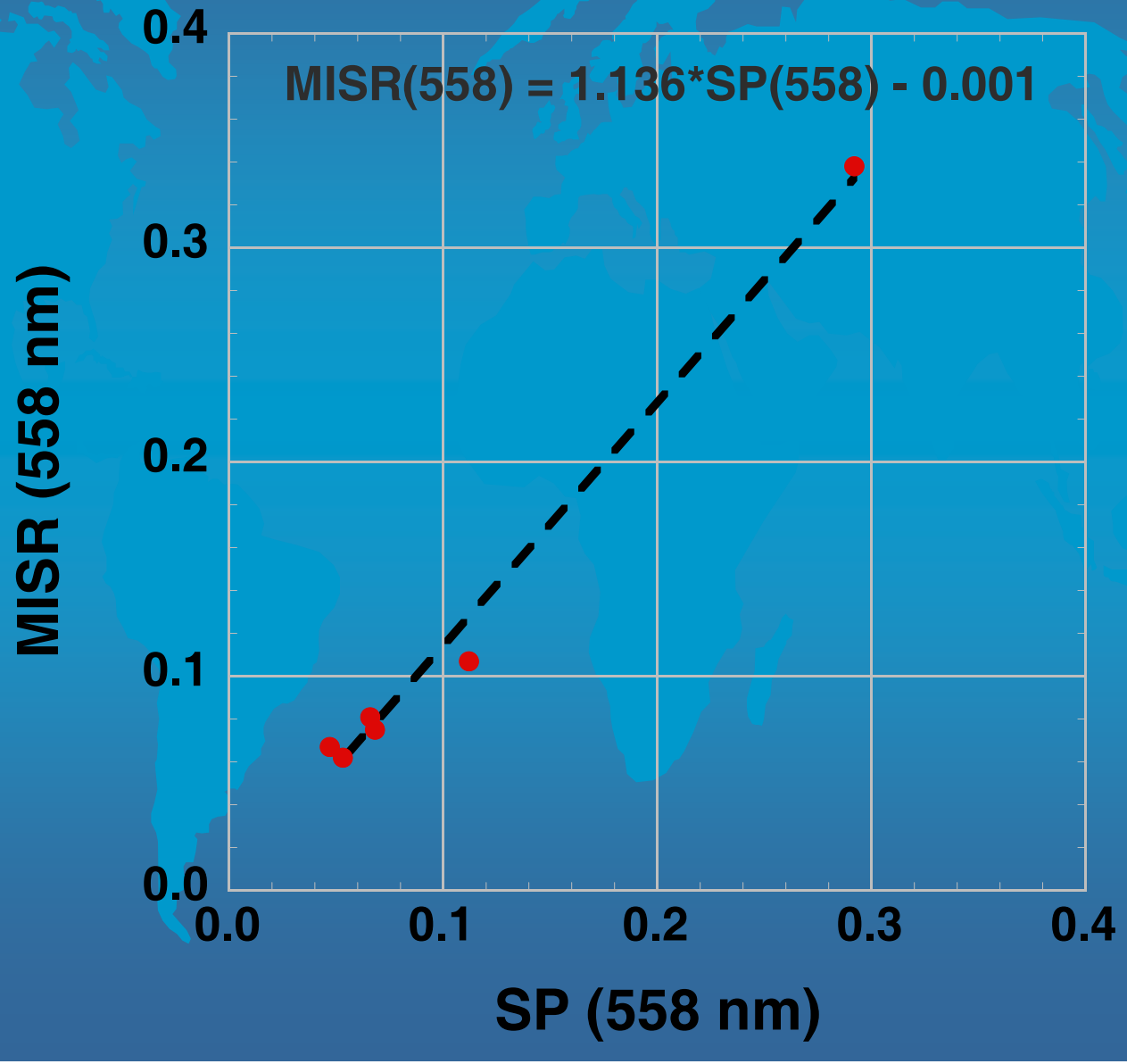
MISR AA (26° Aft)
Browse 1B2 RGB
Oct 25, 2004
Orbit 25821
Blocks 84-90



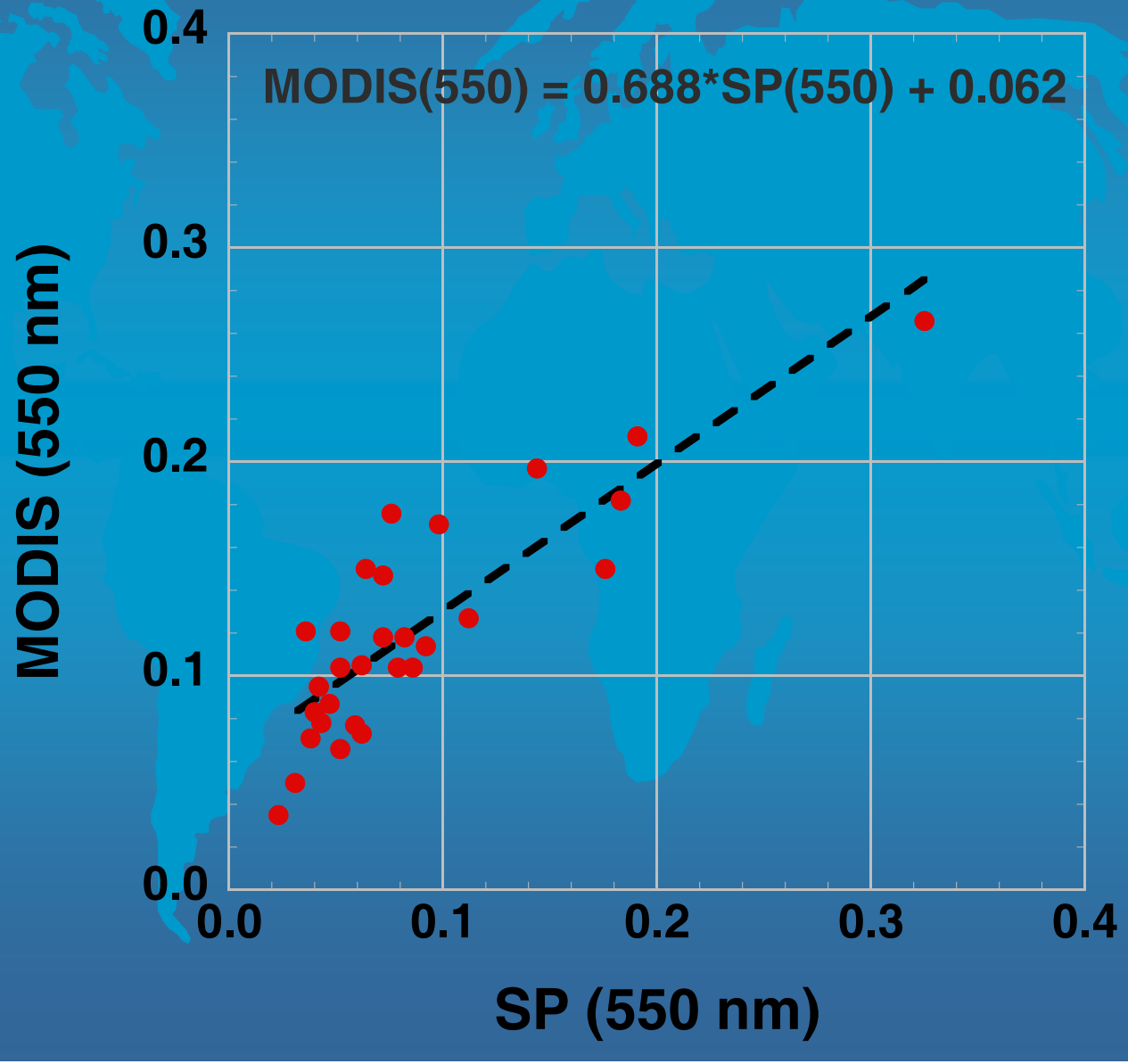
Aprox. Ship [11:00 UTC]
MISR overflight[~10:52]


Oct 25 Prbit 25821 Path 204 Blks 86-66 V17
Ship [11:00 UTC]
MISR overflight[~10:52]
Edge of Cloud
MISR AOT (558 nm)
0.0
0.2
0.4
0.6
0.8
1.0

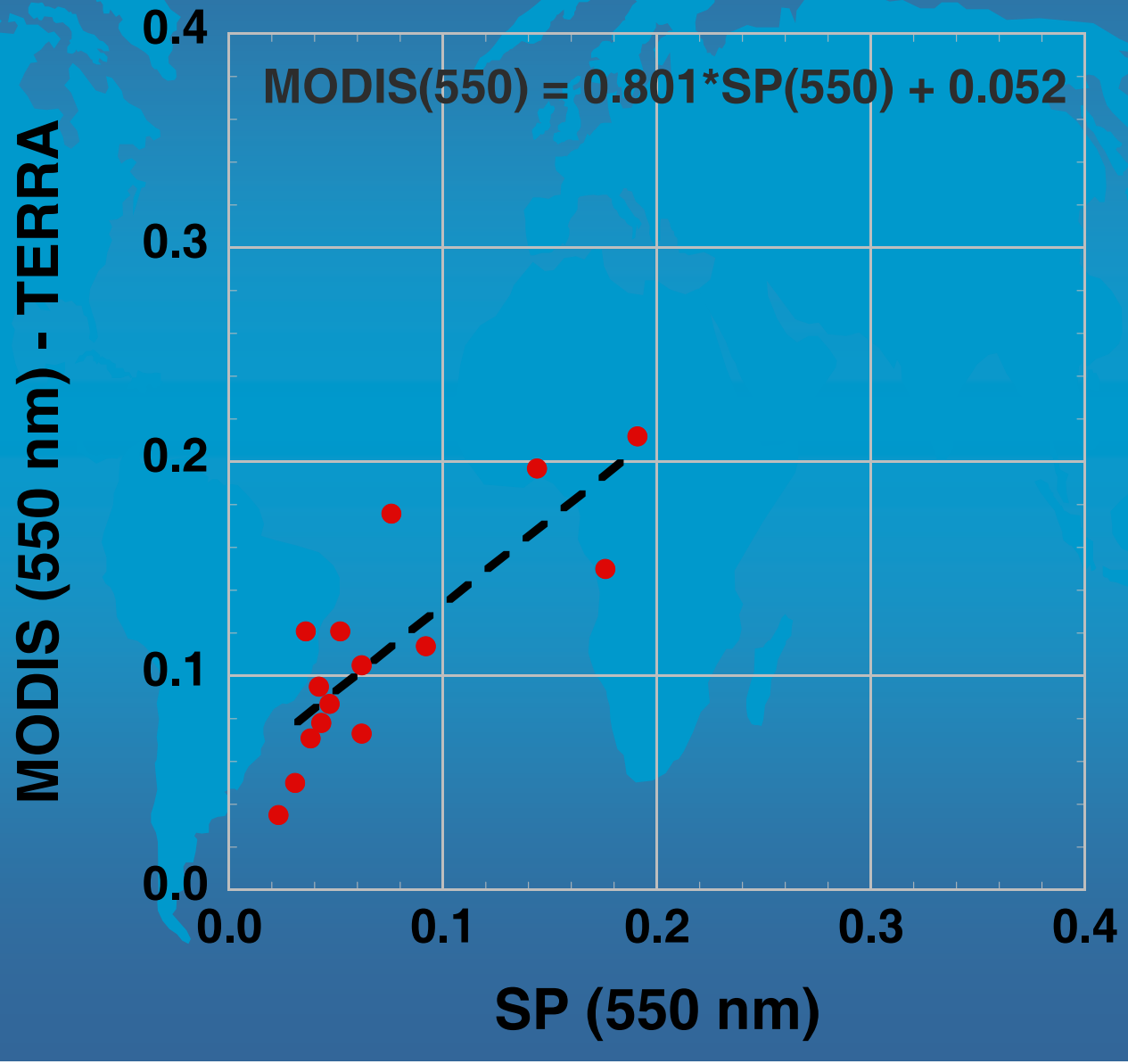
MISR Retrievals



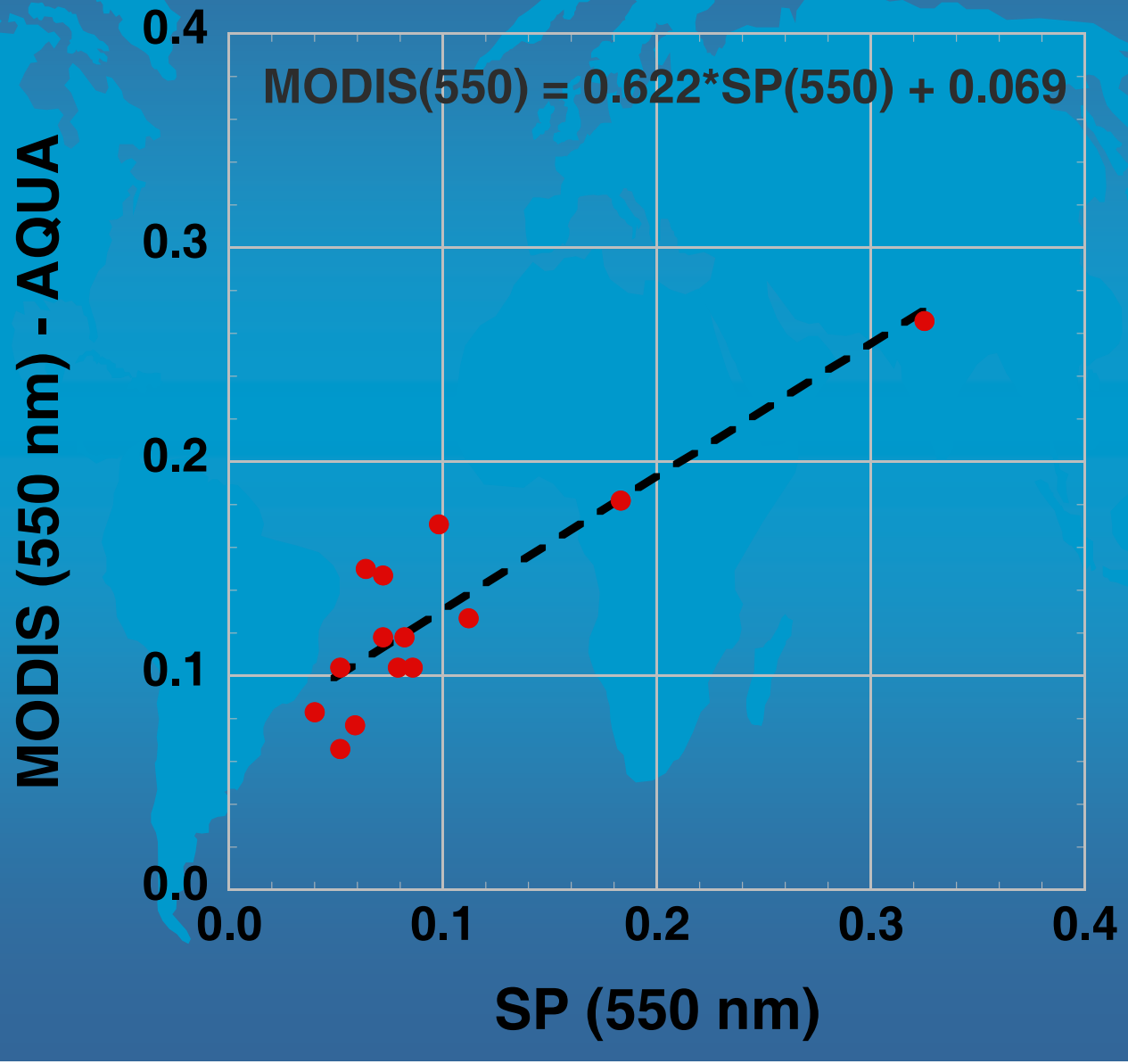
MODIS Retrievals



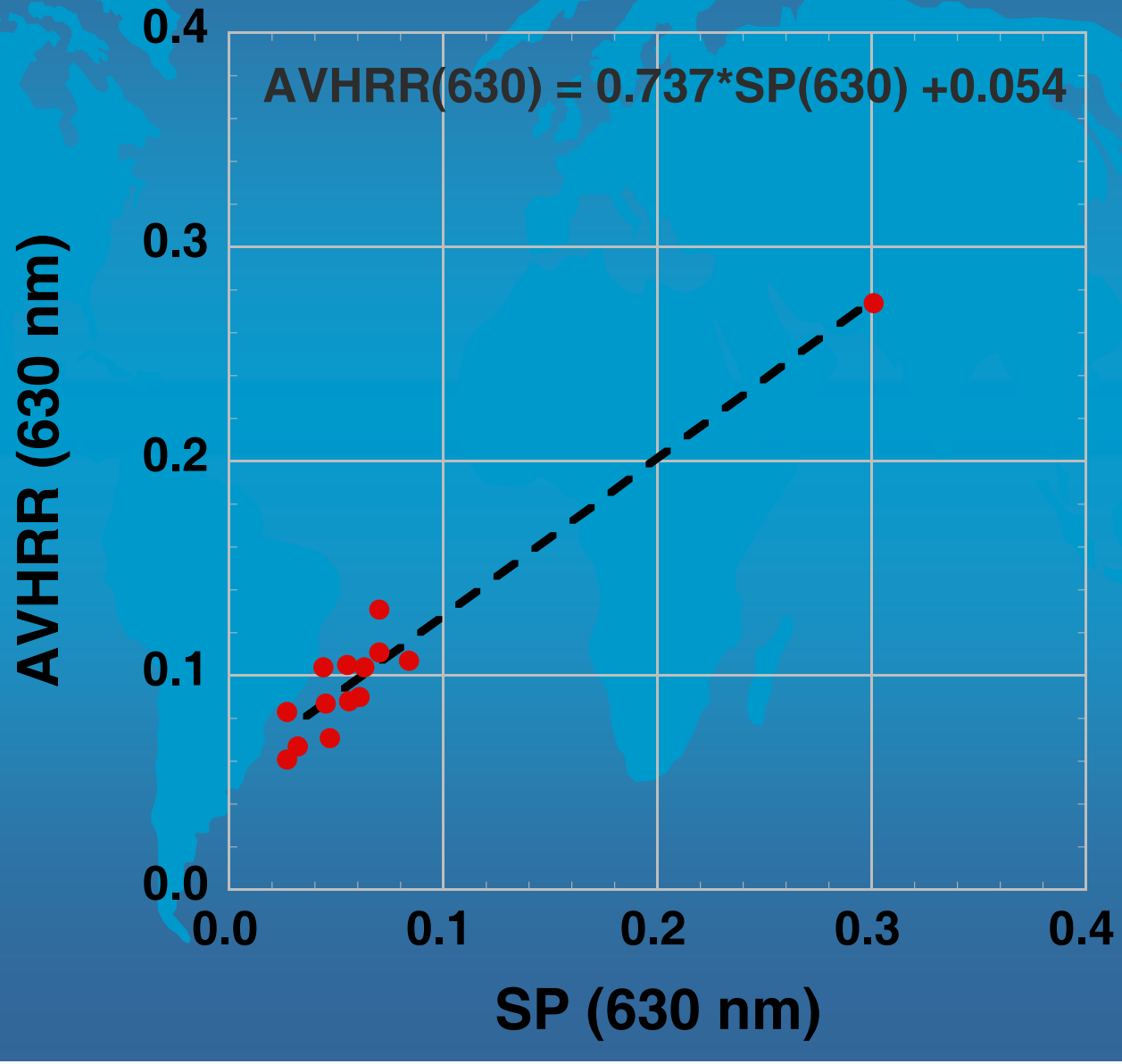
MODIS Retrievals - TERRA



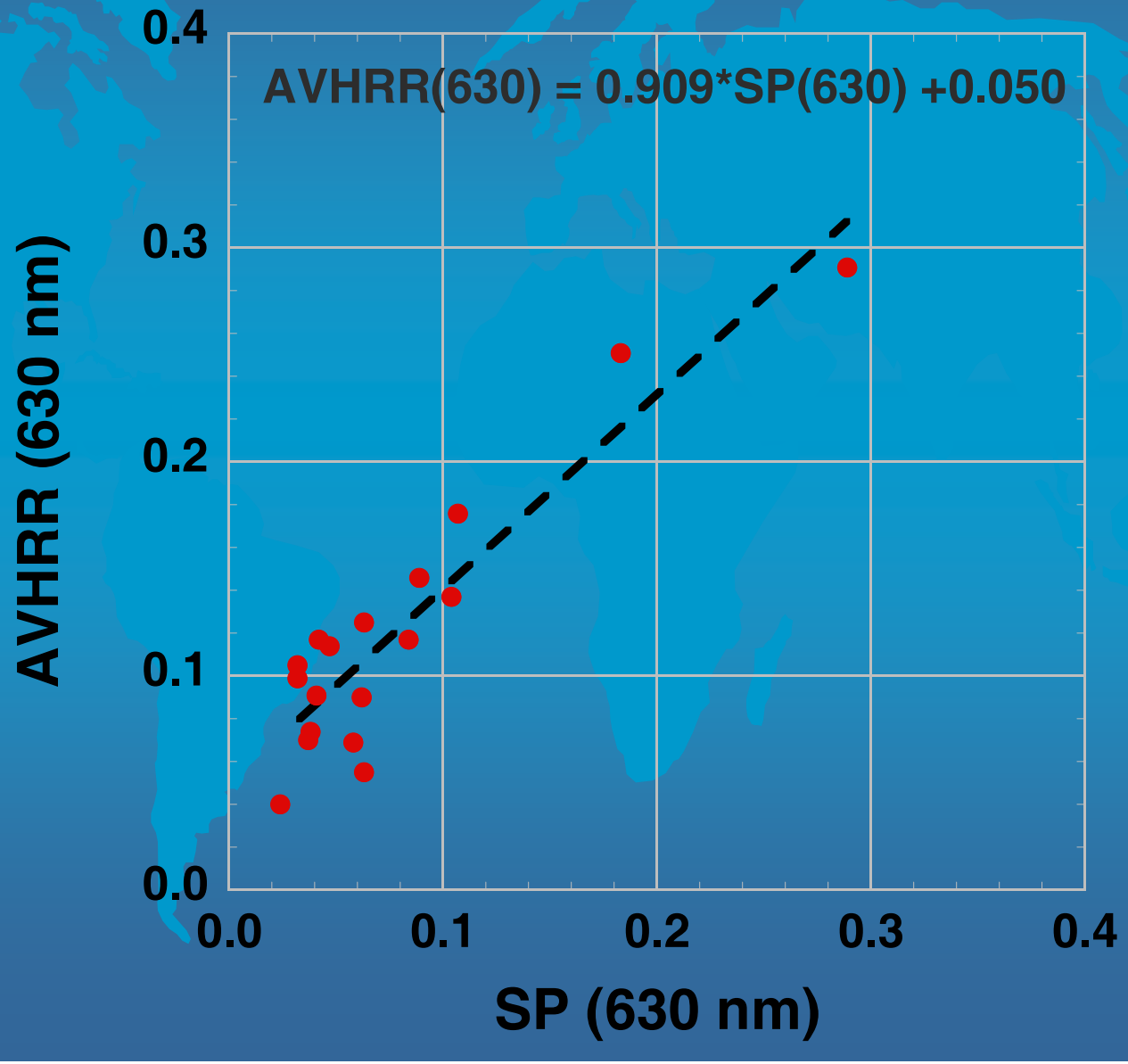
MODIS Retrievals - AQUA



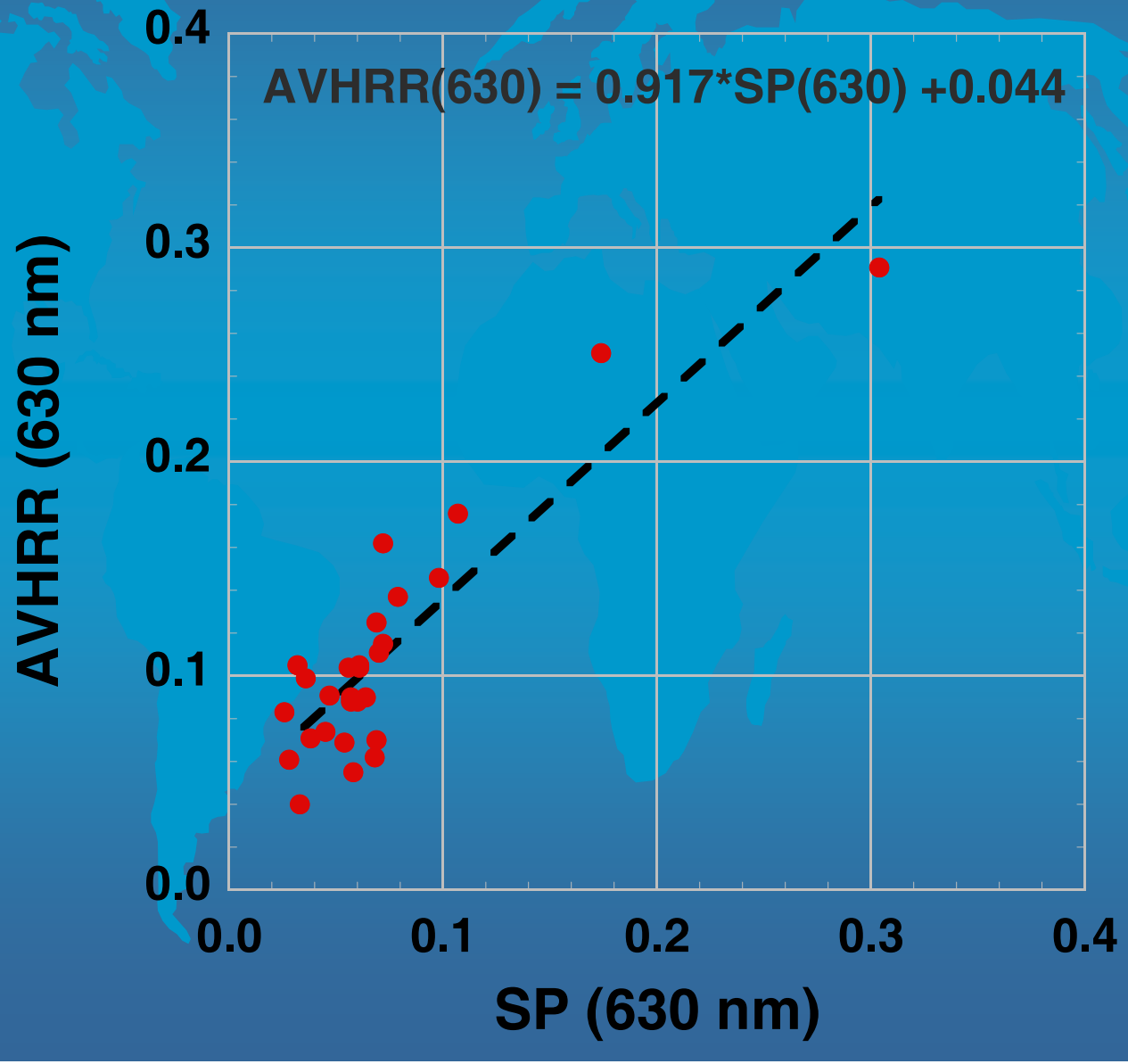
NOAA - 16


AVHRR(630) = 0.737*SP(630) +0.054
AVHRR (630 nm)
SP (630 nm)
0.0
0.1
0.2
0.3
0.4
0.0
0.1
0.2
0.3
0.4

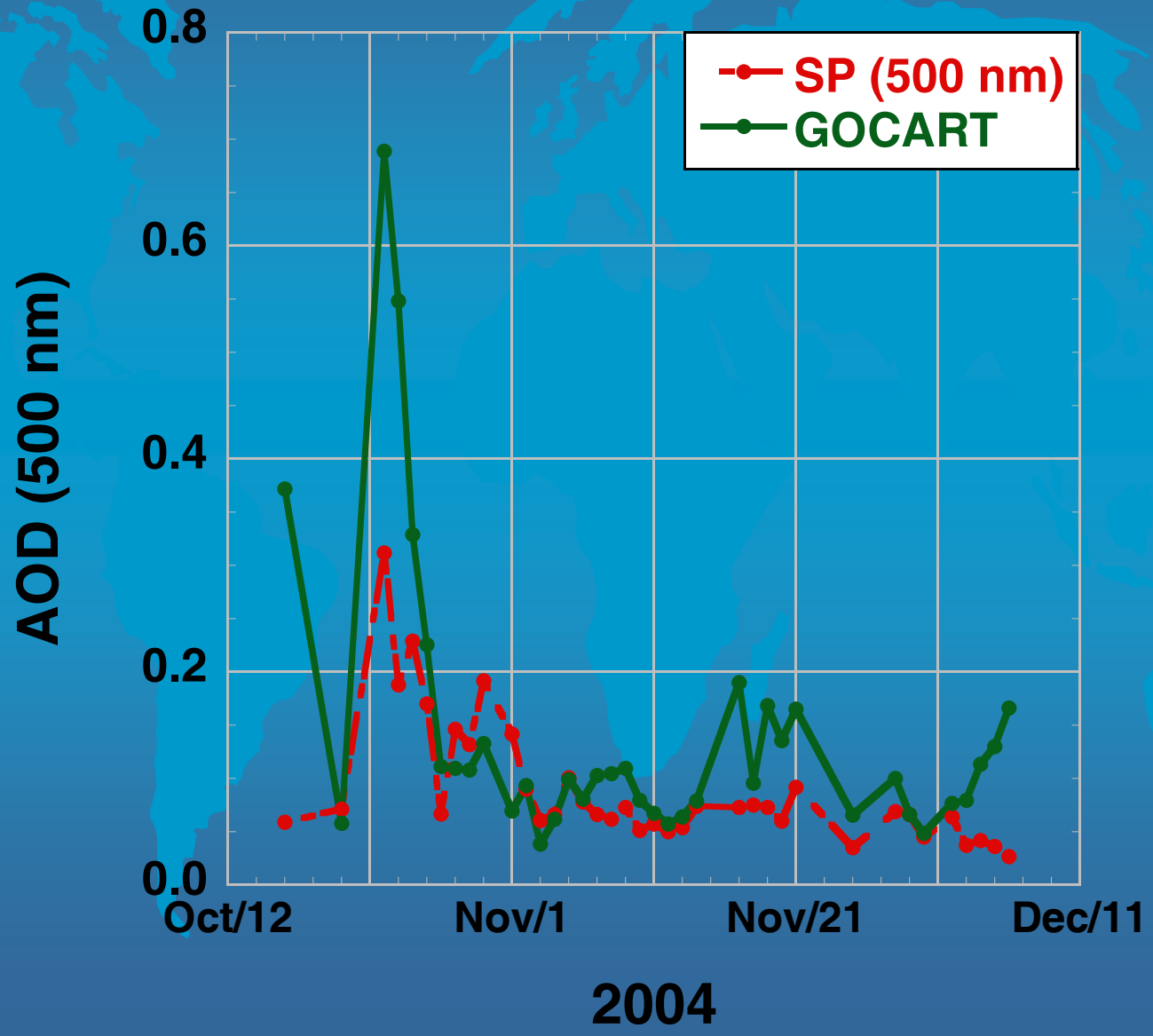
NOAA -17


AVHRR(630) = 0.909*SP(630) +0.050
AVHRR (630 nm)
SP (630 nm)
0.0
0.1
0.2
0.3
0.4
0.0
0.1
0.2
0.3
0.4

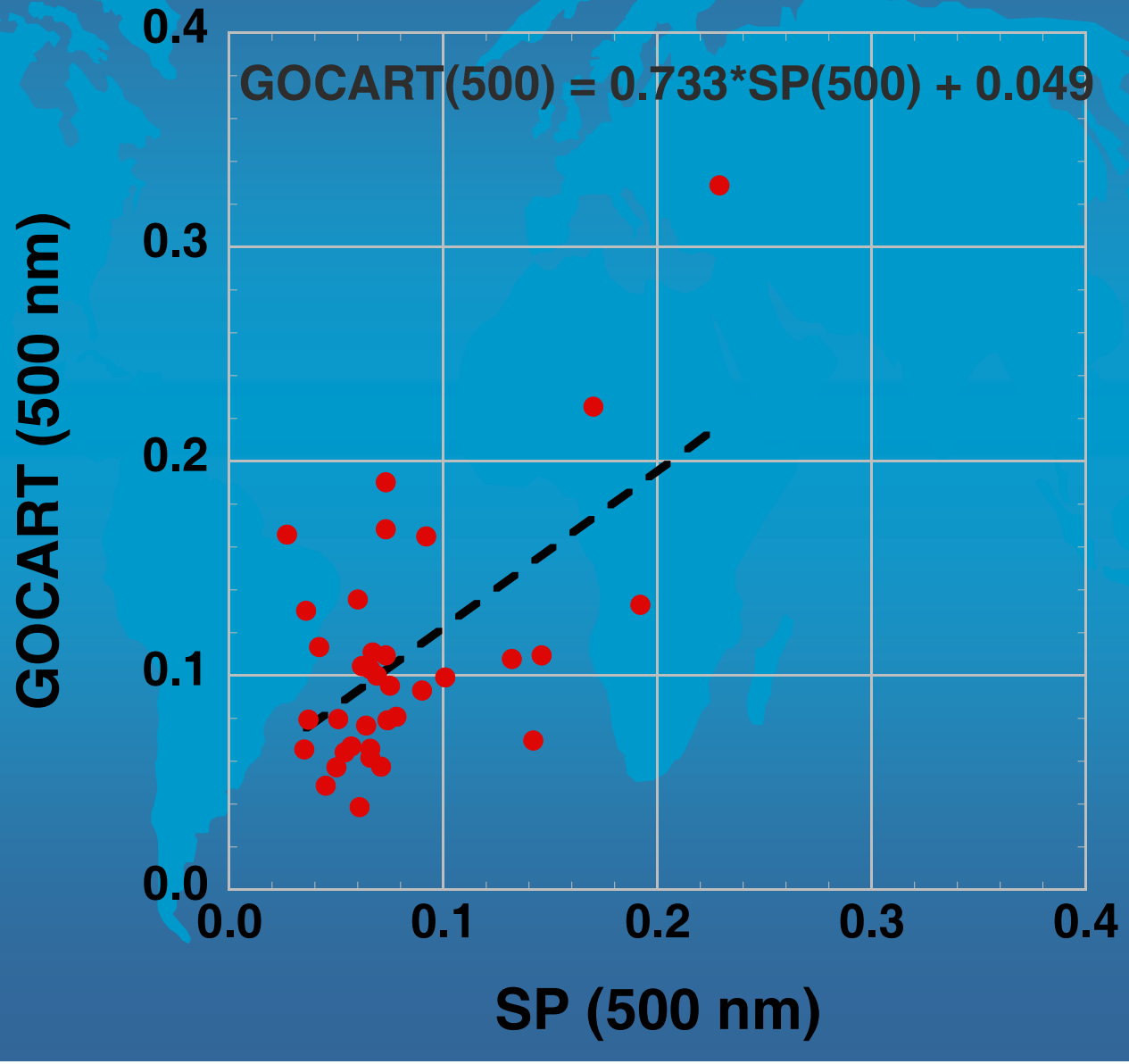
NOAA-16+NOAA-17 vs Daily SP

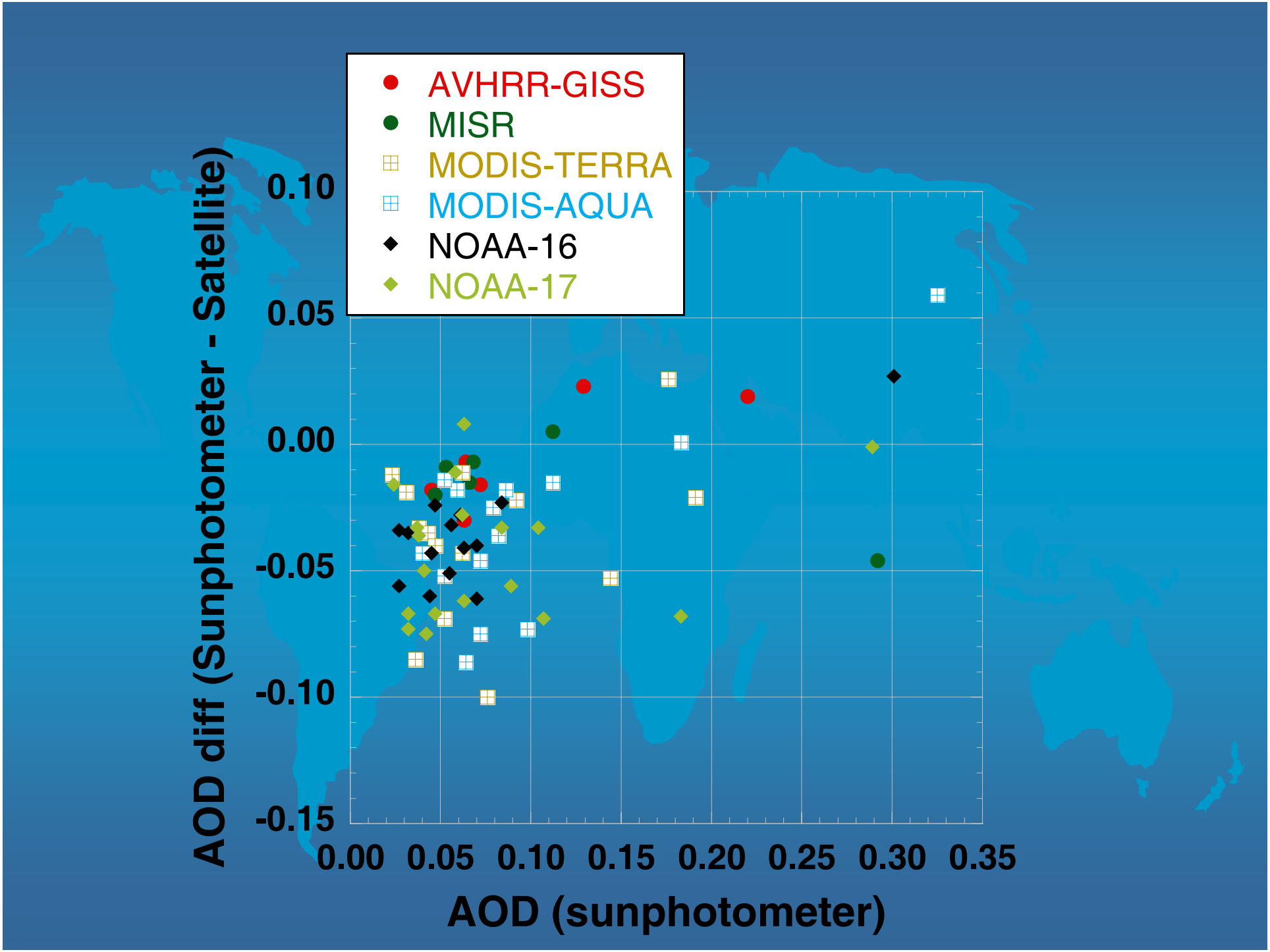


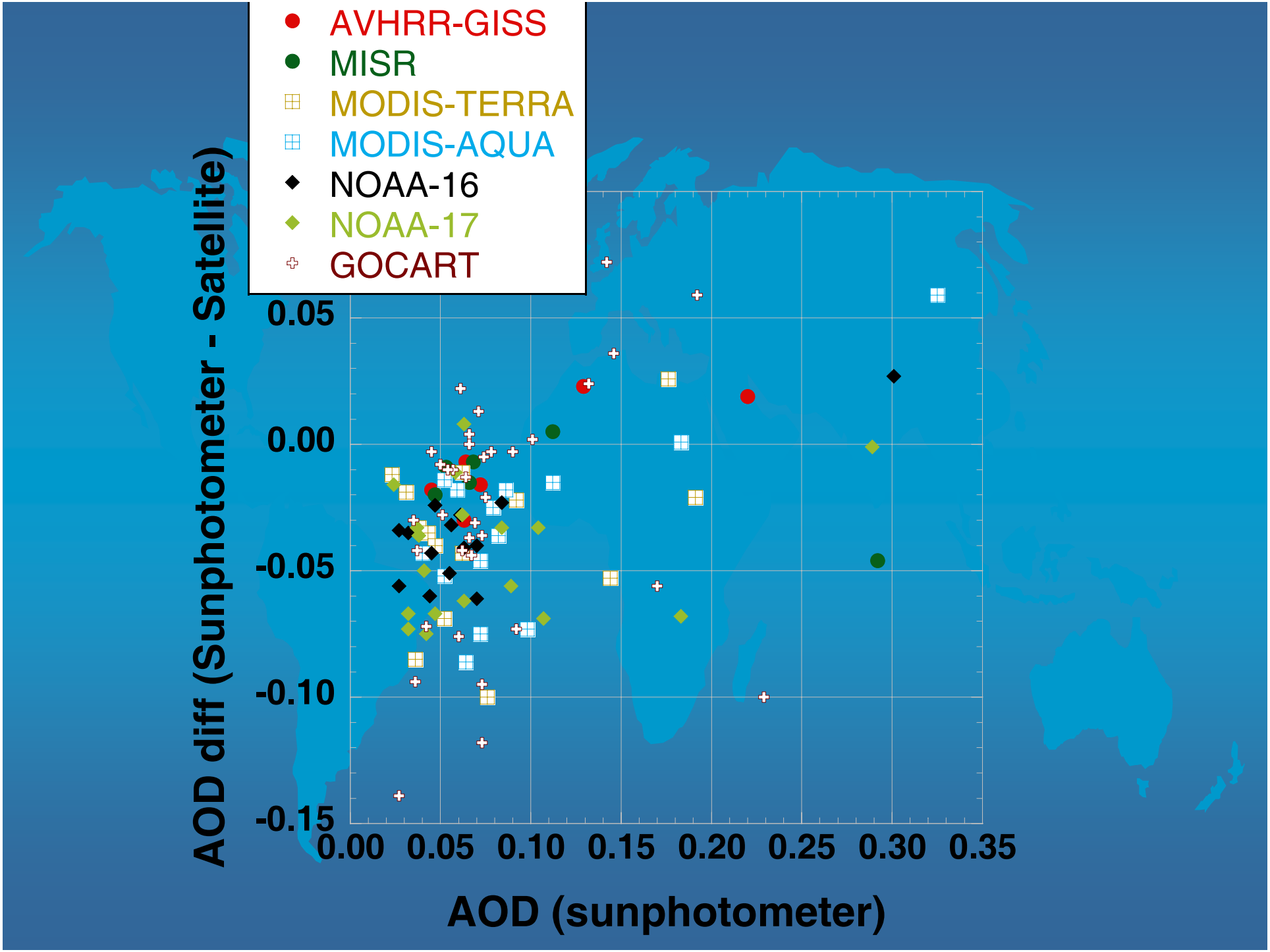
GOCART Simulations

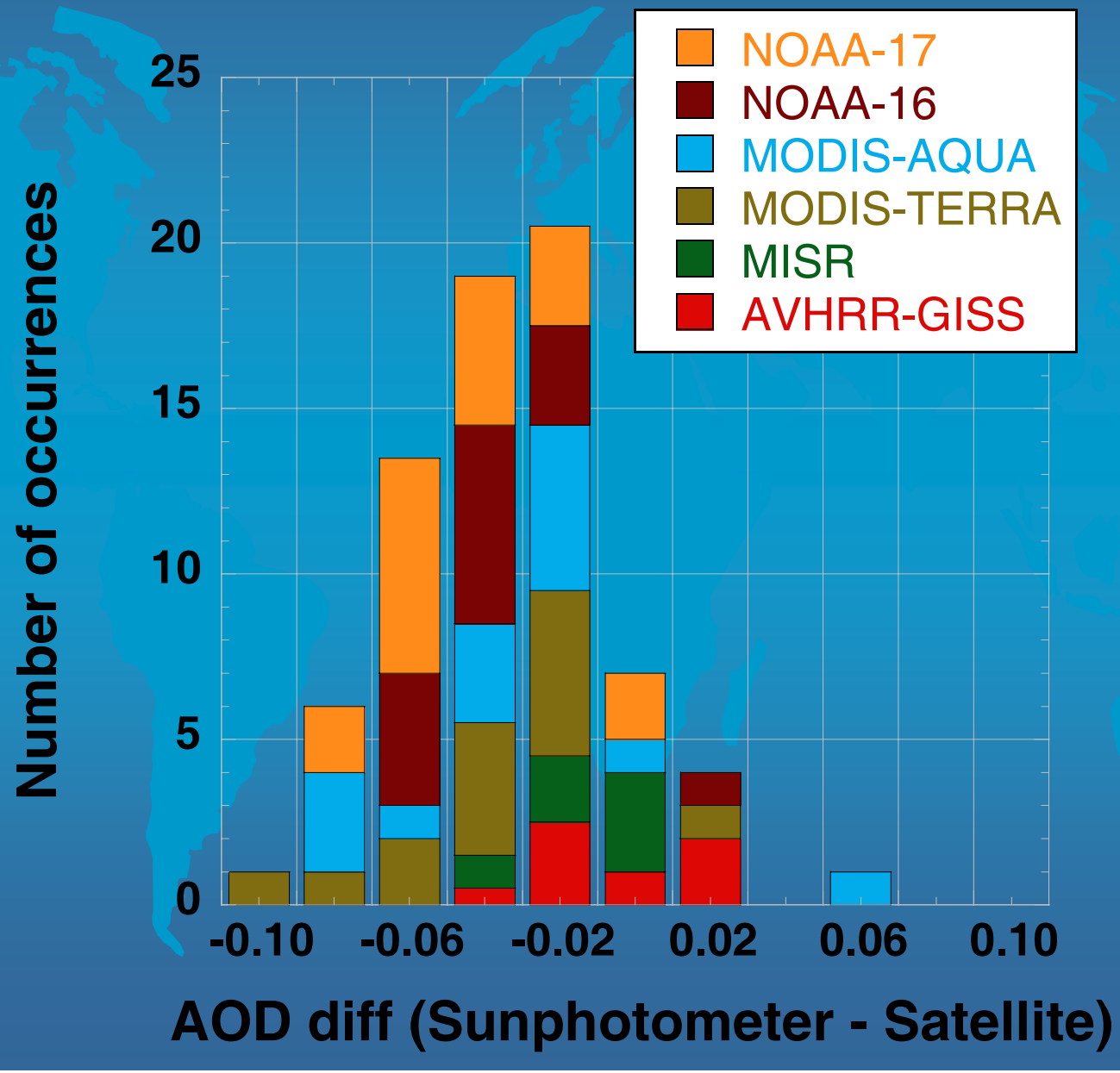


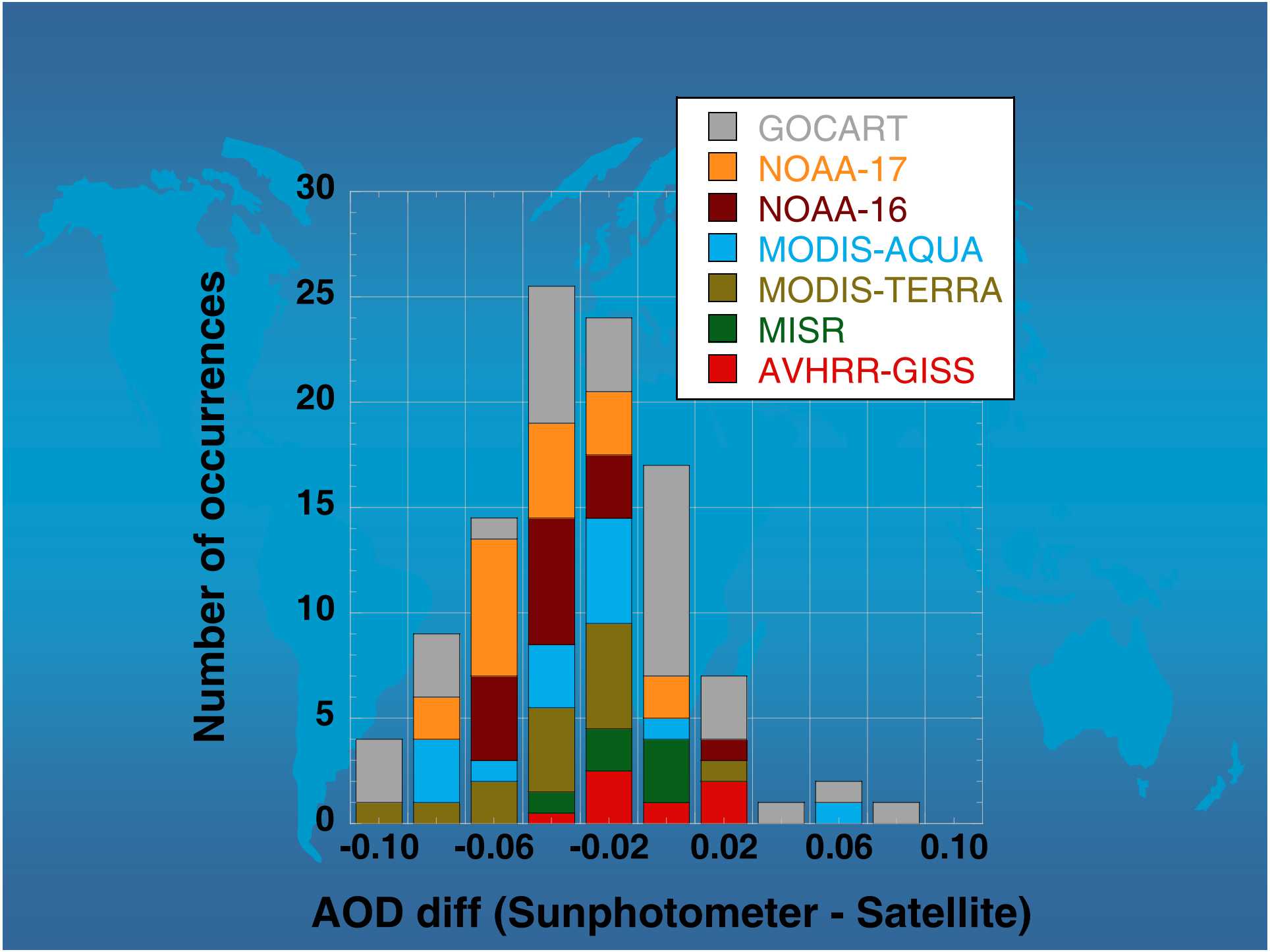
GOCART vs Daily SP



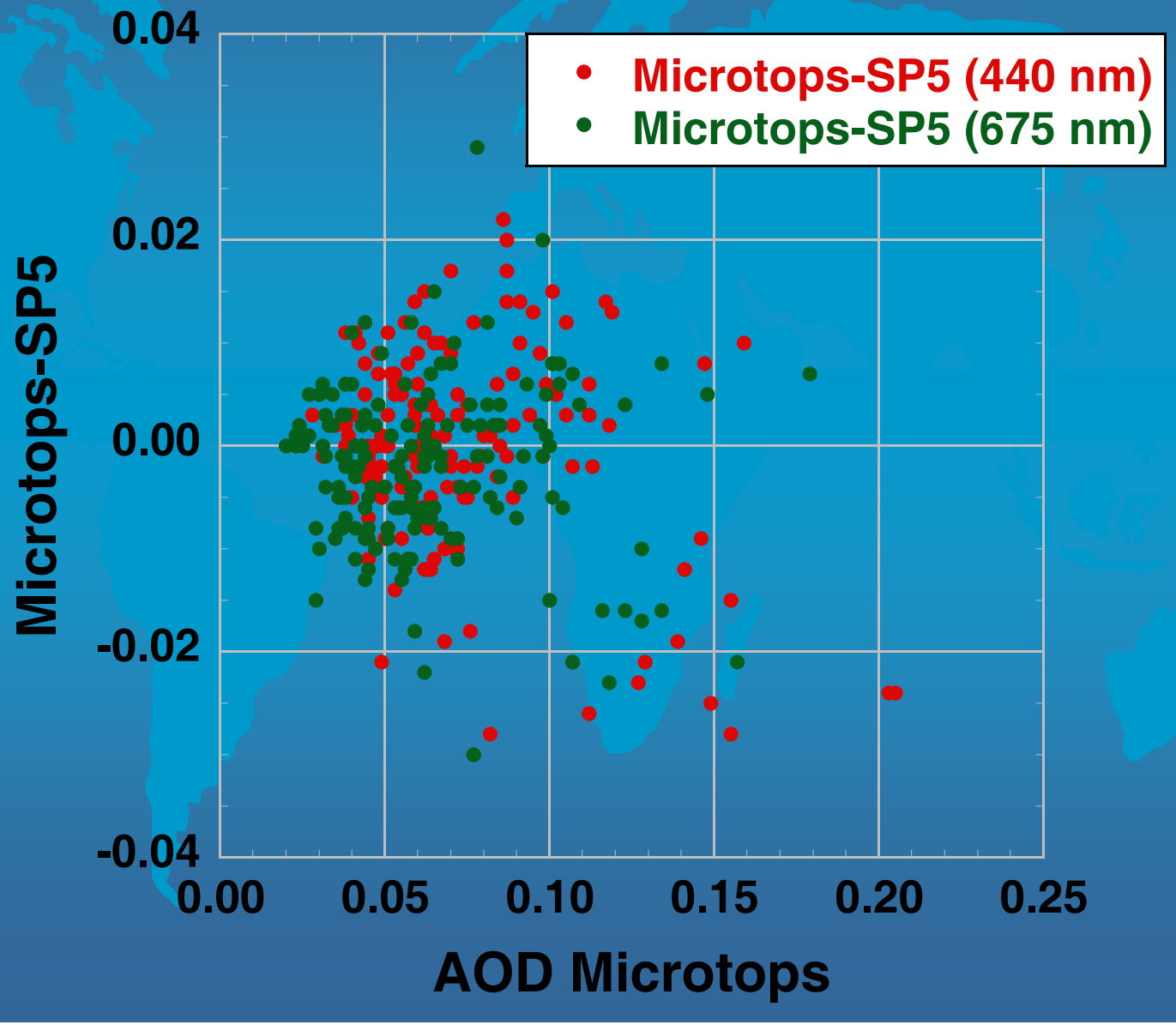

AVHRR-GISS
MISR
MODIS-TERRA
MODIS-AQUA
NOAA-16
NOAA-17
AOD diff (Sunphotometer - Satellite)
0.10
0.05
0.00
-0.05
-0.10
-0.15
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
AOD (sunphotometer)


AVHRR-GISS
MISR
MODIS-TERRA
MODIS-AQUA
NOAA-16
NOAA-17
GOCART
AOD diff (Sunphotometer - Satellite)
0.05
0.00
-0.05
-0.10
-0.15
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
AOD (sunphotometer)


NOAA-17
NOAA-16
MODIS-AQUA
MODIS-TERRA
MISR
AVHRR-GISS
Number of occurrences
25
20
15
10
5
0
-0.10
-0.06
-0.02
0.02
0.06
0.10
AOD diff (Sunphotometer - Satellite)


GOCART
NOAA-17
NOAA-16
MODIS-AQUA
MODIS-TERRA
MISR
AVHRR-GISS
Number of occurrences
30
25
20
15
10
5
0
-0.10
-0.06
-0.02
0.02
0.06
0.10
AOD diff (Sunphotometer - Satellite)

Sunphotometer comparison



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