Niamey Dust Product from AOS and MFRSR Measurements

ARM STM 2008 Norfolk, VA

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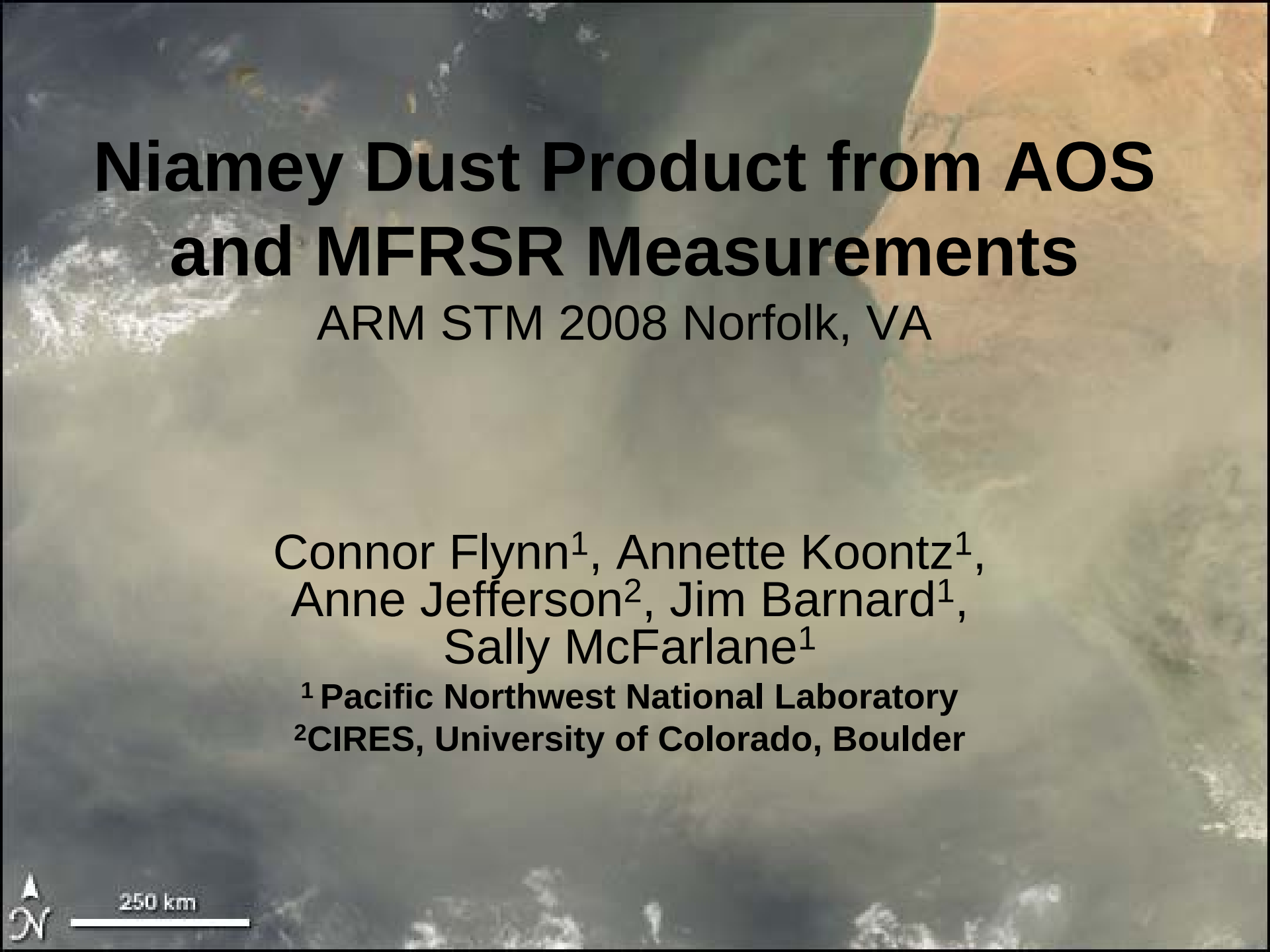
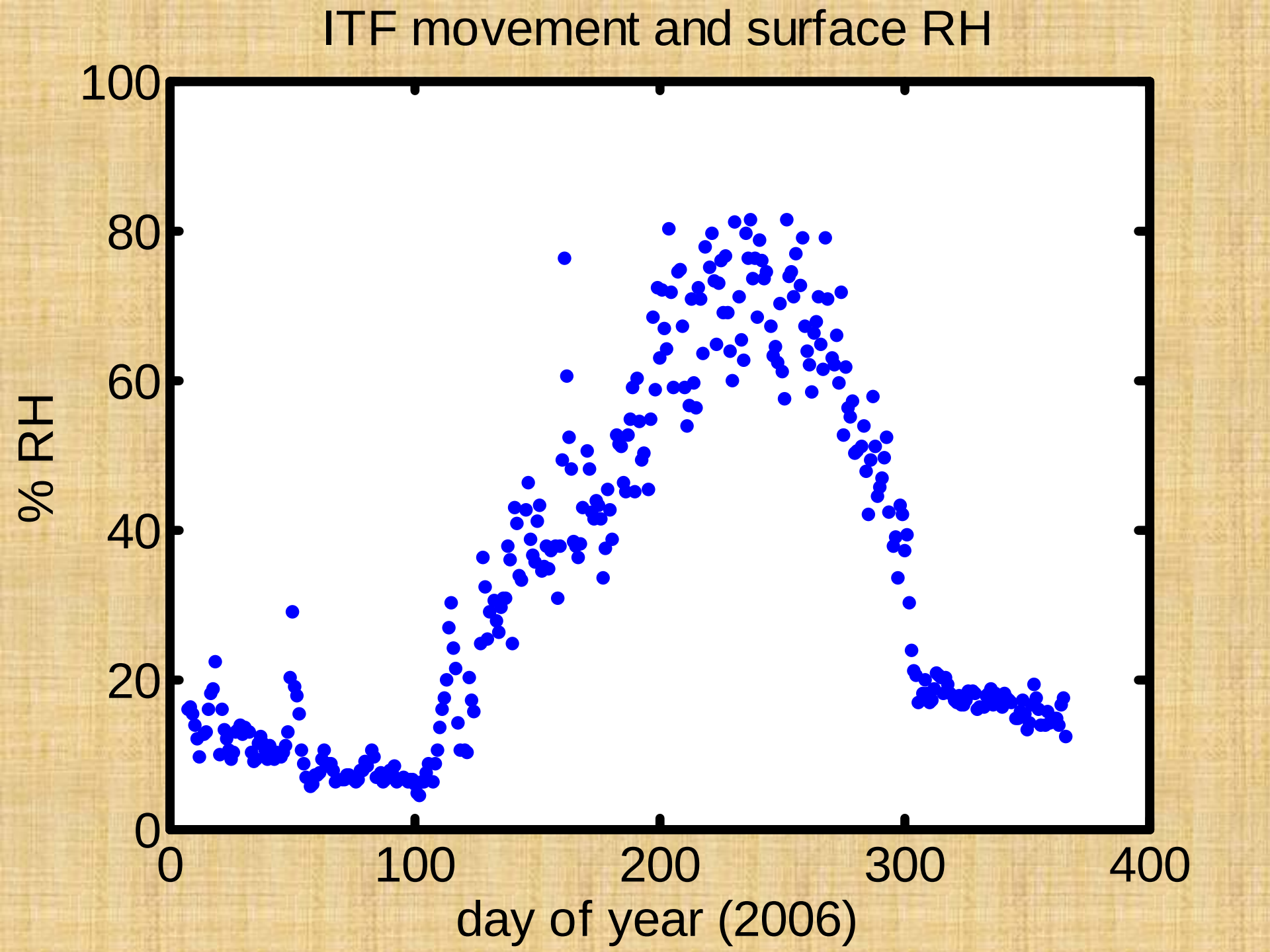
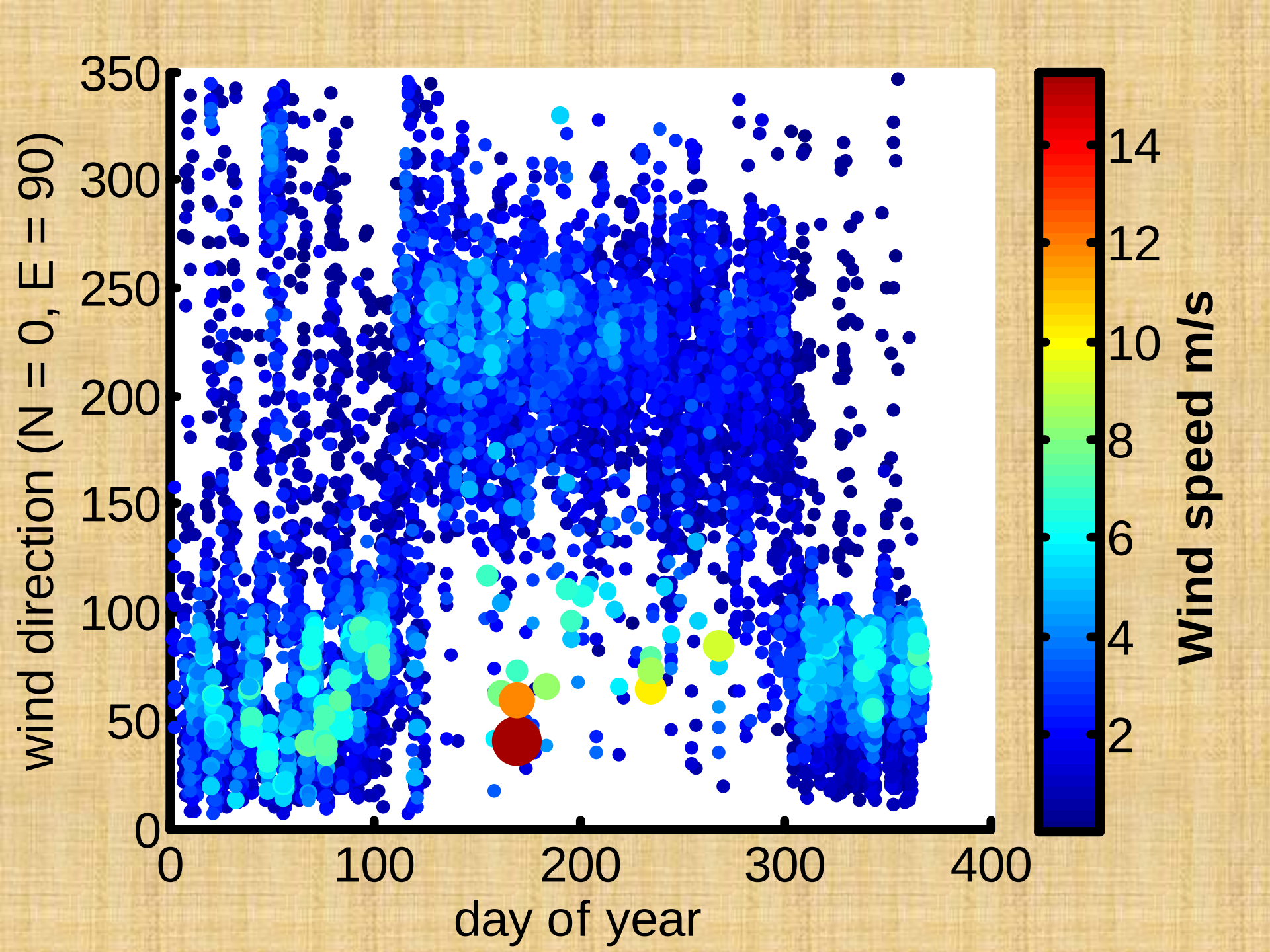


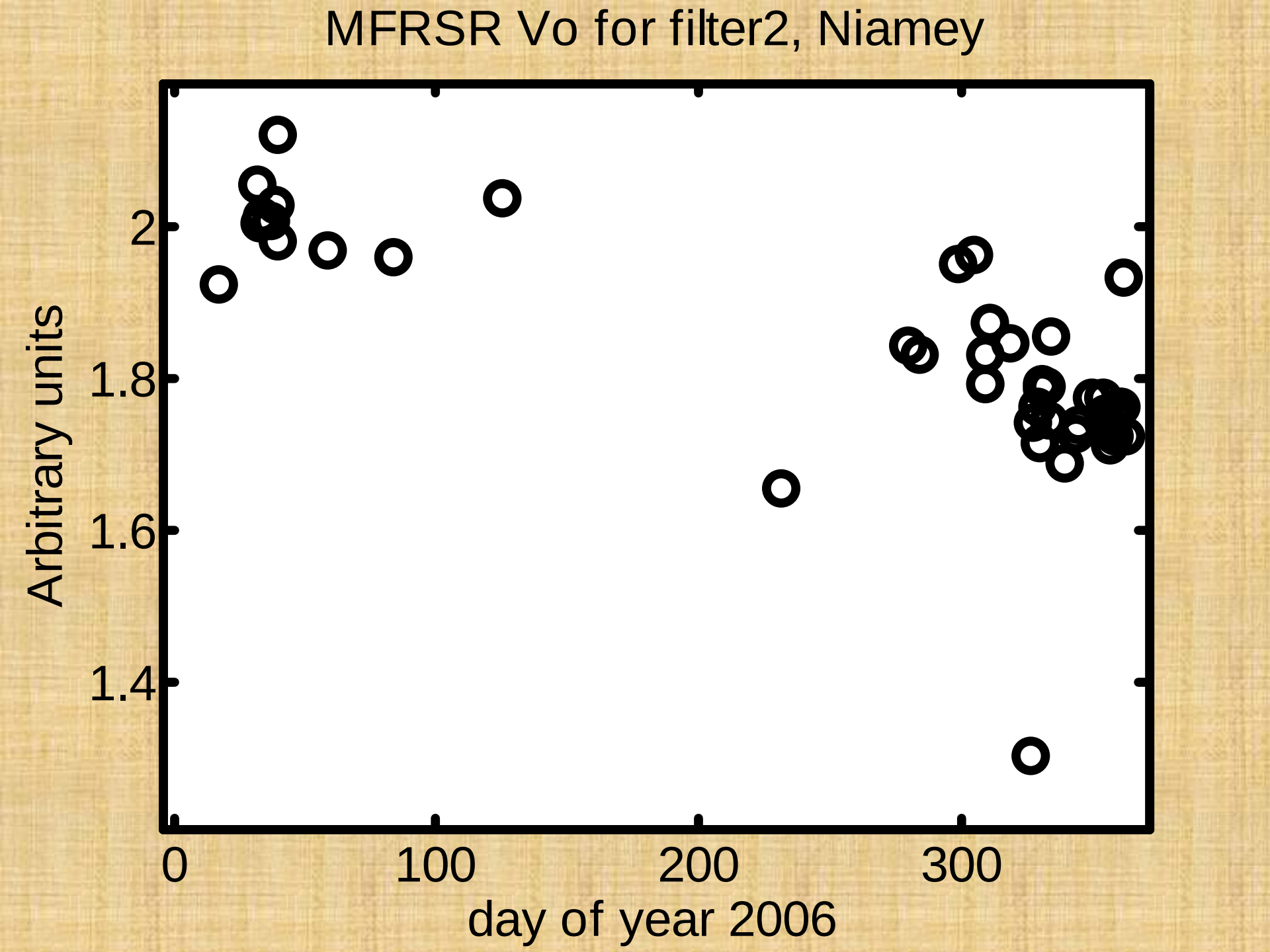
Progress towards ARM DOE 2008 Performance Metric 3 & 4

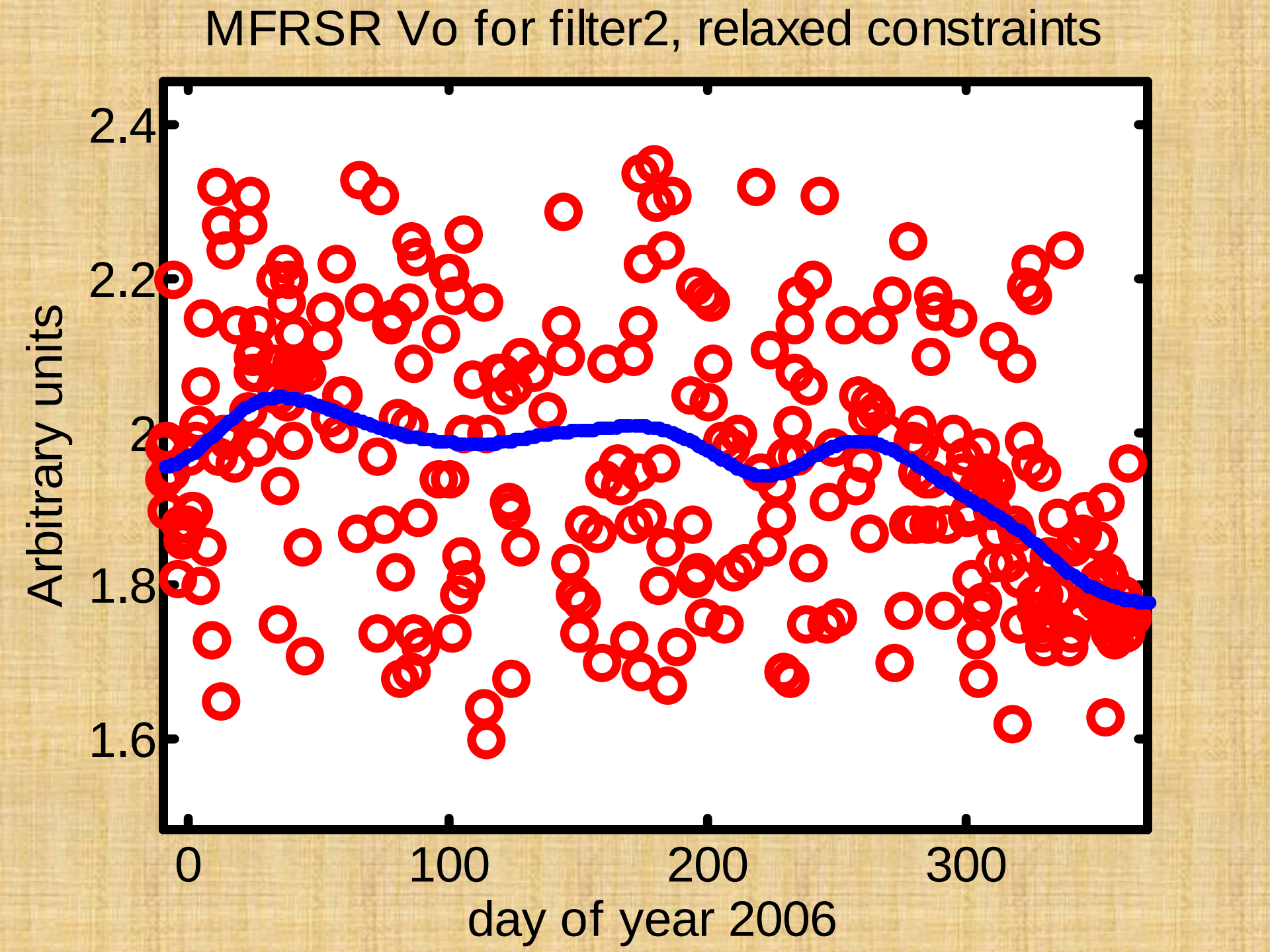
- **Produce and make available new continuous time series of aerosol total column depth, based on results from the AMF deployment in Niger, Africa.**

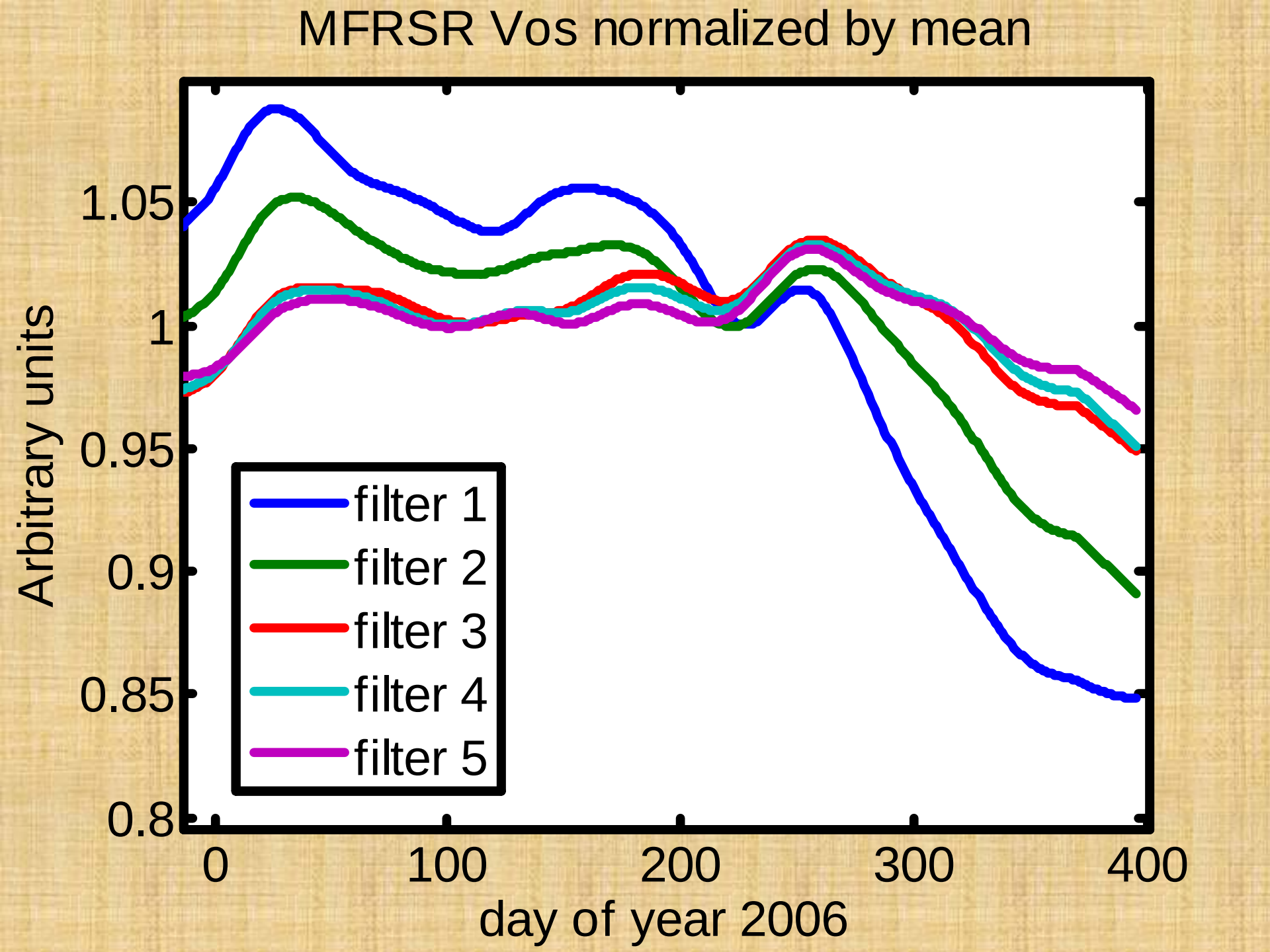
- **Produce and make available new continuous time series of retrieved dust properties, based on results from the AMF deployment in Niger, Africa.**

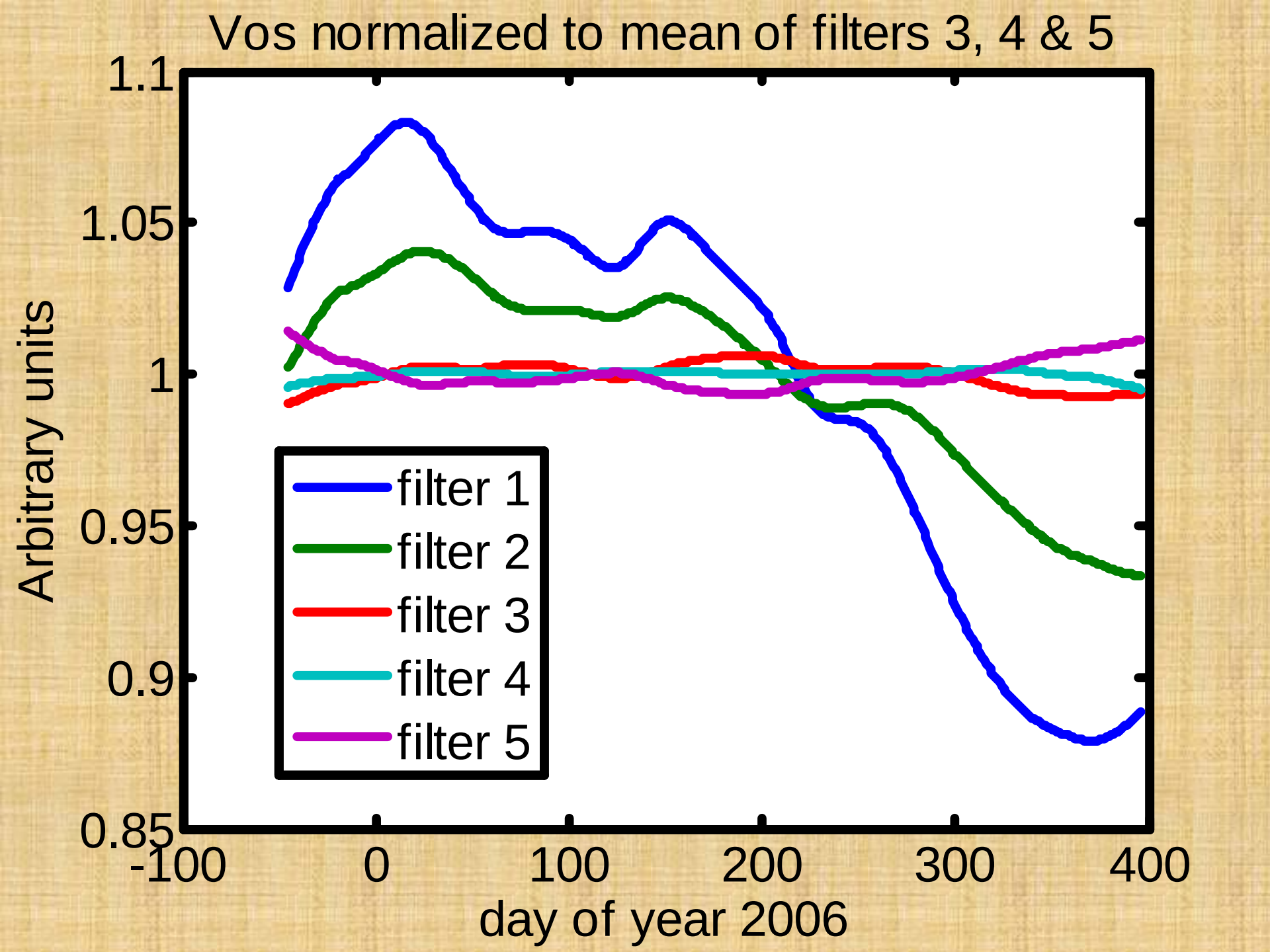

ITF movement and surface RH
100
80
60
40
20
0
% RH
0
100
200
300
400
day of year (2006)

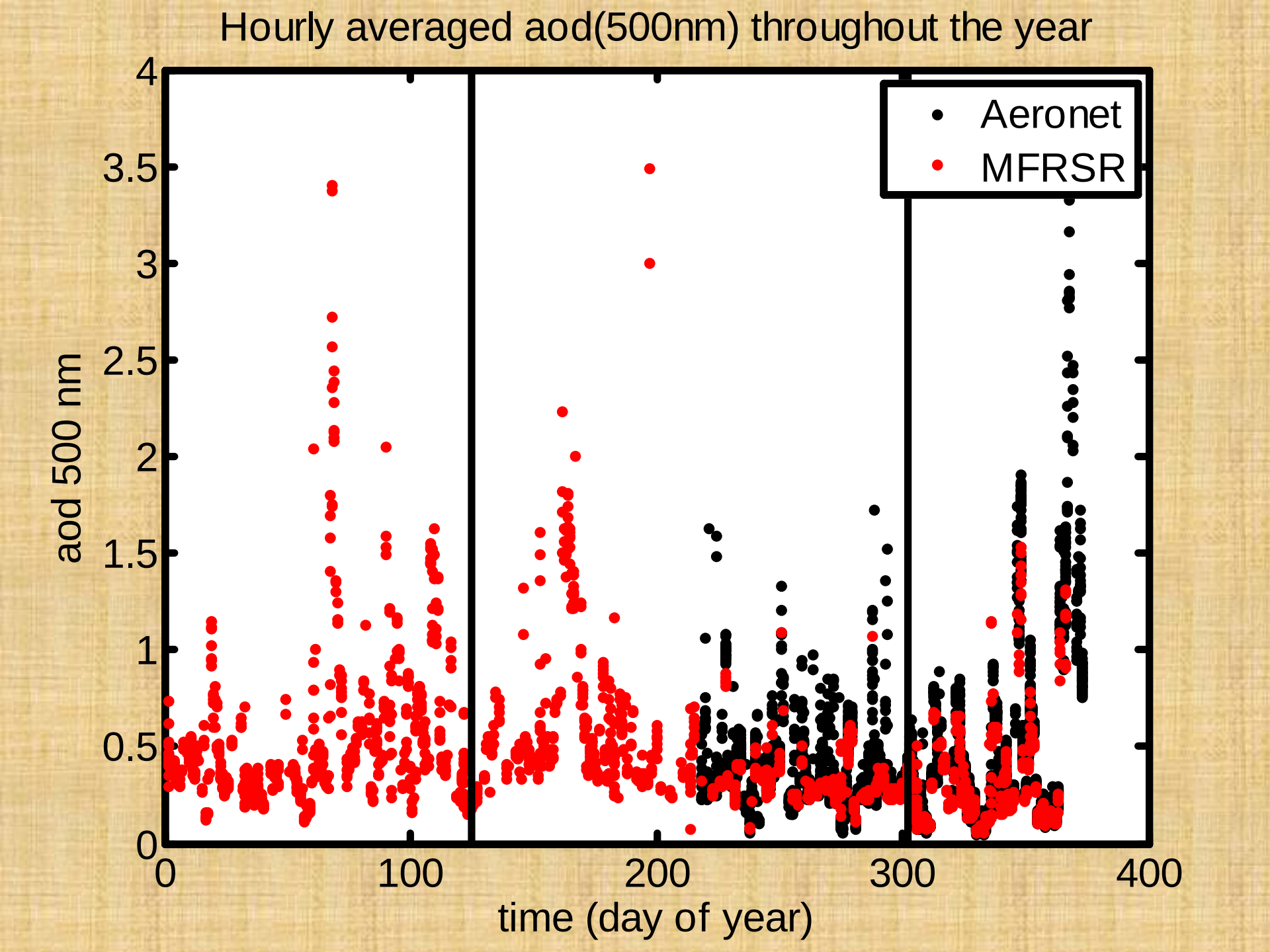

wind direction (N = 0, E = 90)
350
300
250
200
150
100
50
0
0
100
200
300
400
day of year
14
12
10
8
6
4
2
Wind speed m/s

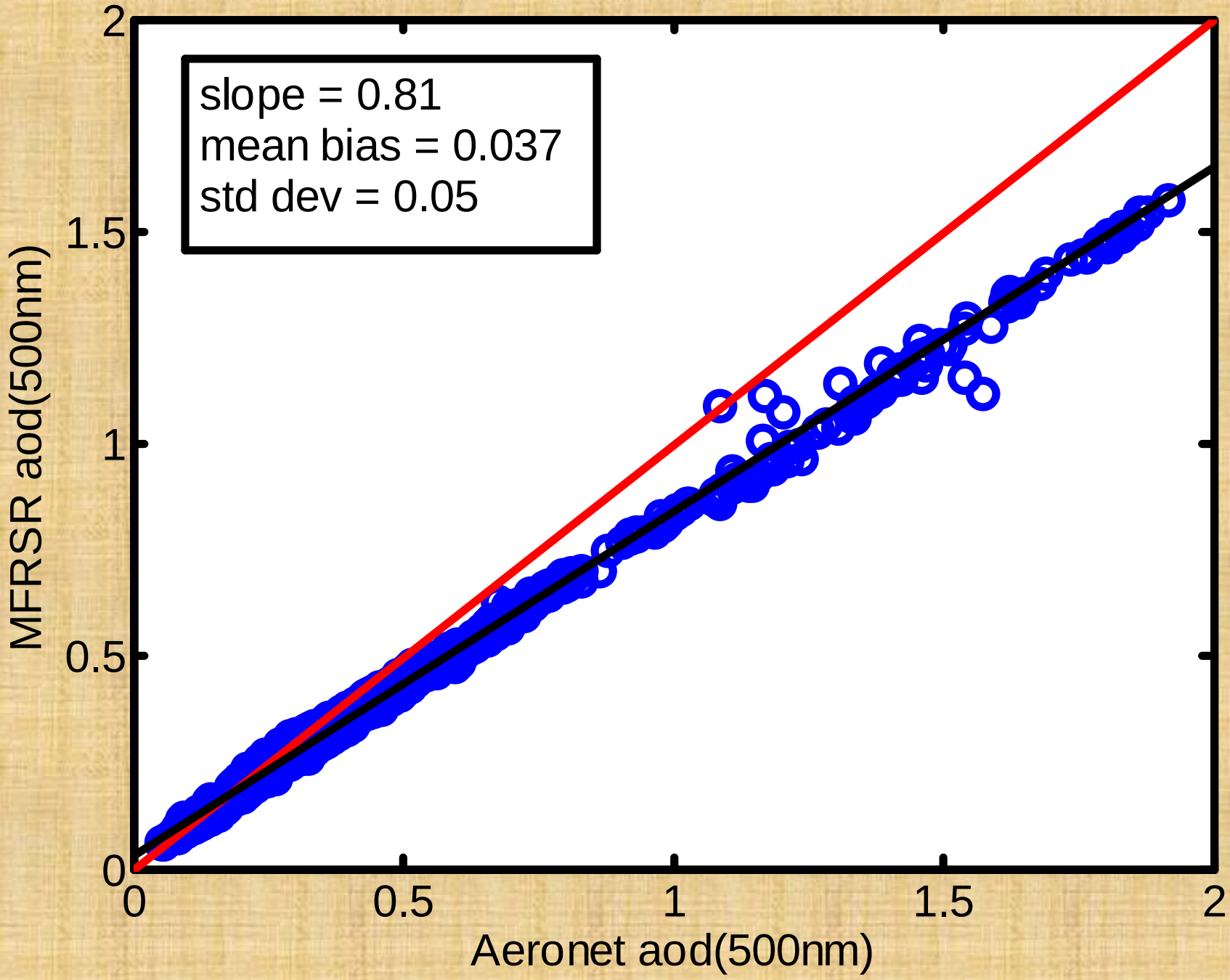

MFRSR Vo for filter2, Niamey
Arbitrary units
2
1.8
1.6
1.4
0
100
200
300
day of year 2006


MFRSR Vo for filter2, relaxed constraints
2.4
2.2
2
1.8
1.6
Arbitrary units
0
100
200
300
day of year 2006


MFRSR Vos normalized by mean
Arbitrary units
1.05
1
0.95
0.9
0.85
0.8
0
100
200
300
400
day of year 2006
filter 1
filter 2
filter 3
filter 4
filter 5


Vos normalized to mean of filters 3, 4 & 5
1.1
1.05
1
0.95
0.9
0.85
Arbitrary units
-100
0
100
200
300
400
day of year 2006
filter 1
filter 2
filter 3
filter 4
filter 5


Hourly averaged aod(500nm) throughout the year
Aeronet
MFRSR
aod 500 nm
time (day of year)
0
0.5
1
1.5
2
2.5
3
3.5
4
0
100
200
300
400


slope = 0.81
mean bias = 0.037
std dev = 0.05
MFRSR aod(500nm)
Aeronet aod(500nm)
0
0.5
1
1.5
2

Persistent scale factor

- Exists throughout dry season 1, wet season, and dry season2.
- Exists on comparable level at different ch.
- Exists at similar scale at Banizoumbou

- Using highest data level of each so processing level is not the issue.

Progress towards ARM DOE 2008 Performance Metric 3 & 4

- Produce and make available new continuous time series of aerosol total column depth, based on results from the AMF deployment in Niger, Africa.

- **Produce and make available new continuous time series of retrieved dust properties, based on results from the AMF deployment in Niger, Africa.**

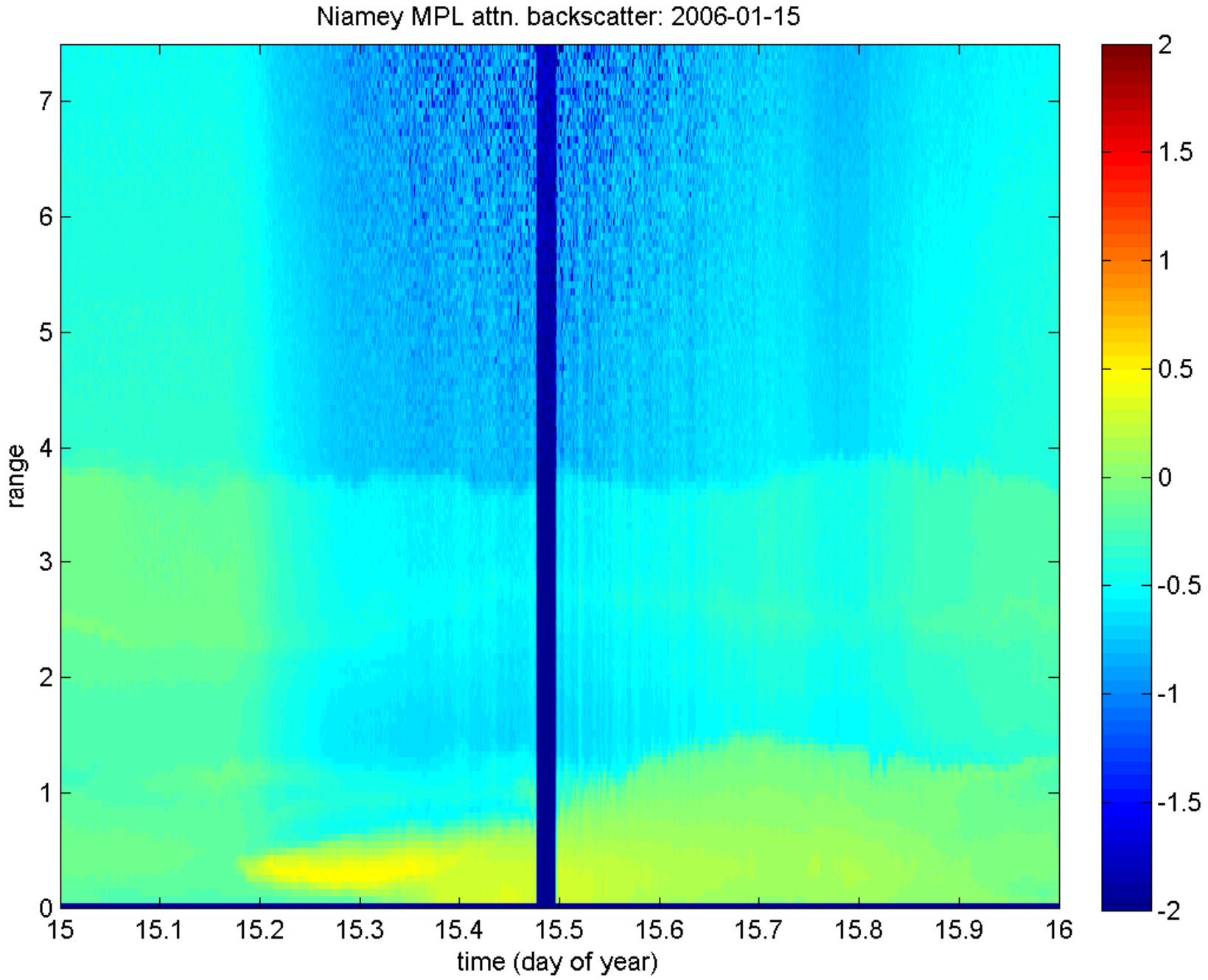
Lidar data survey

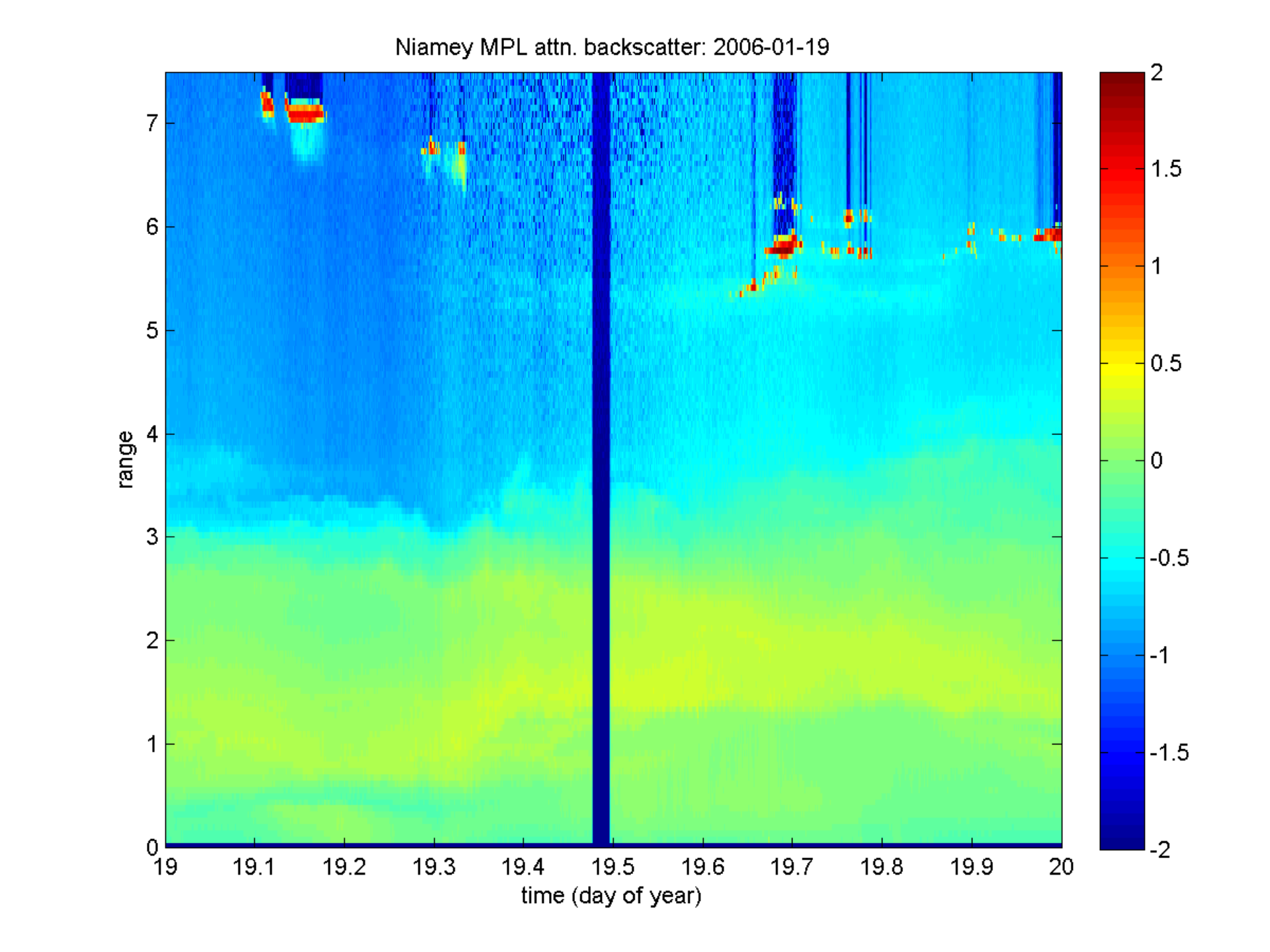
Lidar profiles: fully-corrected MPL attenuated backscatter profiles for entire year

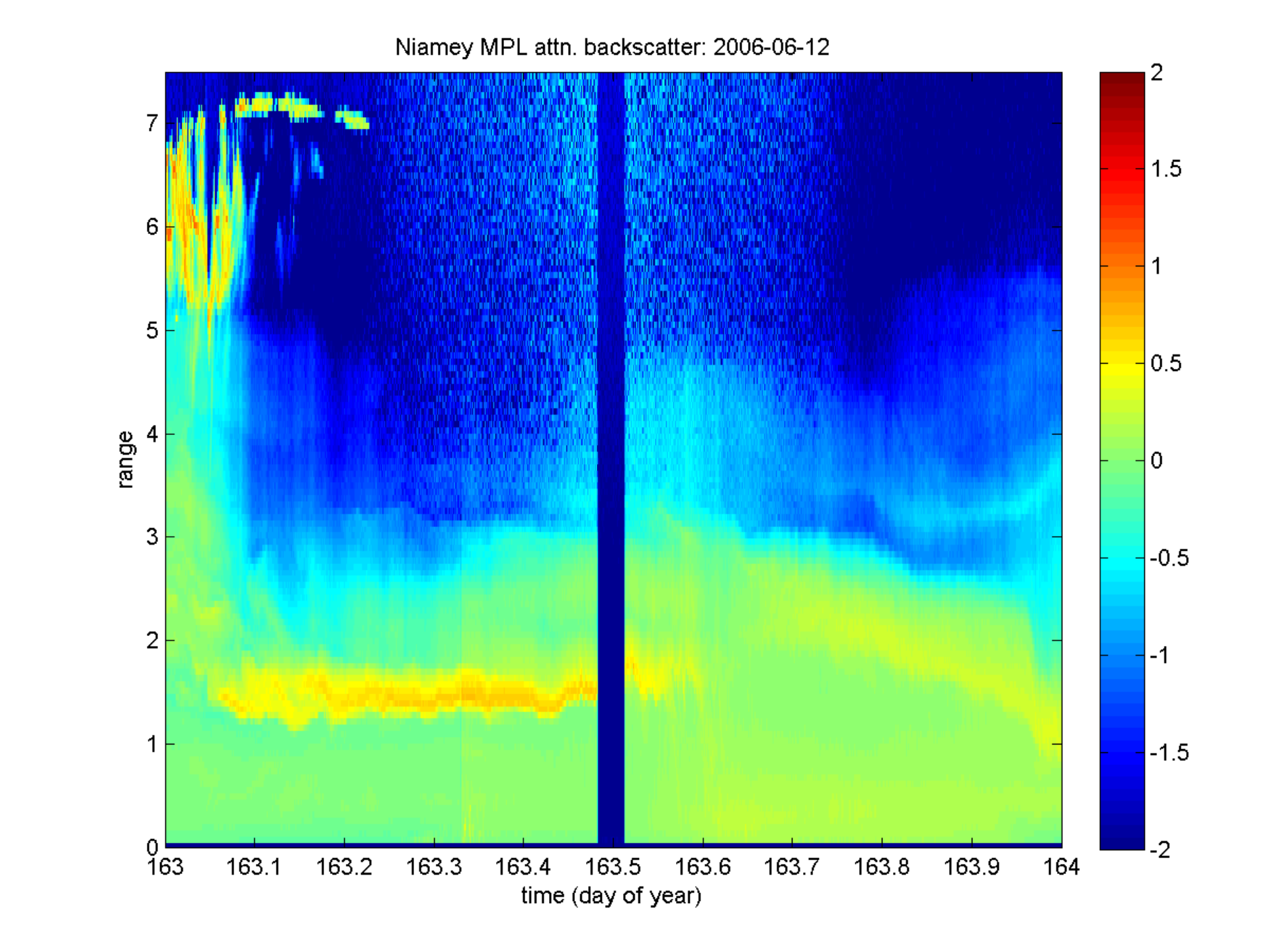
Conducted a subjective assessment of lidar profiles over the course of the year.

Assigned each day a value of 0-3 according to the degree attenuation due to dust observed in the backscatter image. A value of -1 was used to flag events with elevated attenuating elevated aerosols that didn't contact the ground.

- 57 days out of the year were judged to be dominated by dust based on the lidar profiles.


Niamey MPL attn. backscatter: 2006-01-15
range
time (day of year)
0
1
2
3
4
5
6
7
15
15.1
15.2
15.3
15.4
15.5
15.6
15.7
15.8
15.9
16
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2


Niamey MPL attn. backscatter: 2006-01-19
range
time (day of year)
0
1
2
3
4
5
6
7
19
19.1
19.2
19.3
19.4
19.5
19.6
19.7
19.8
19.9
20
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2


Niamey MPL attn. backscatter: 2006-06-12
range
time (day of year)
0
1
2
3
4
5
6
7
163
163.1
163.2
163.3
163.4
163.5
163.6
163.7
163.8
163.9
164
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2

1-minute and hourly grid:

MFRSR: τ at 5 λ, Å 500nm/870nm

AOS: β_{ap}, β_{bp}, β_{bsp} (3λ,1μm,10μm)

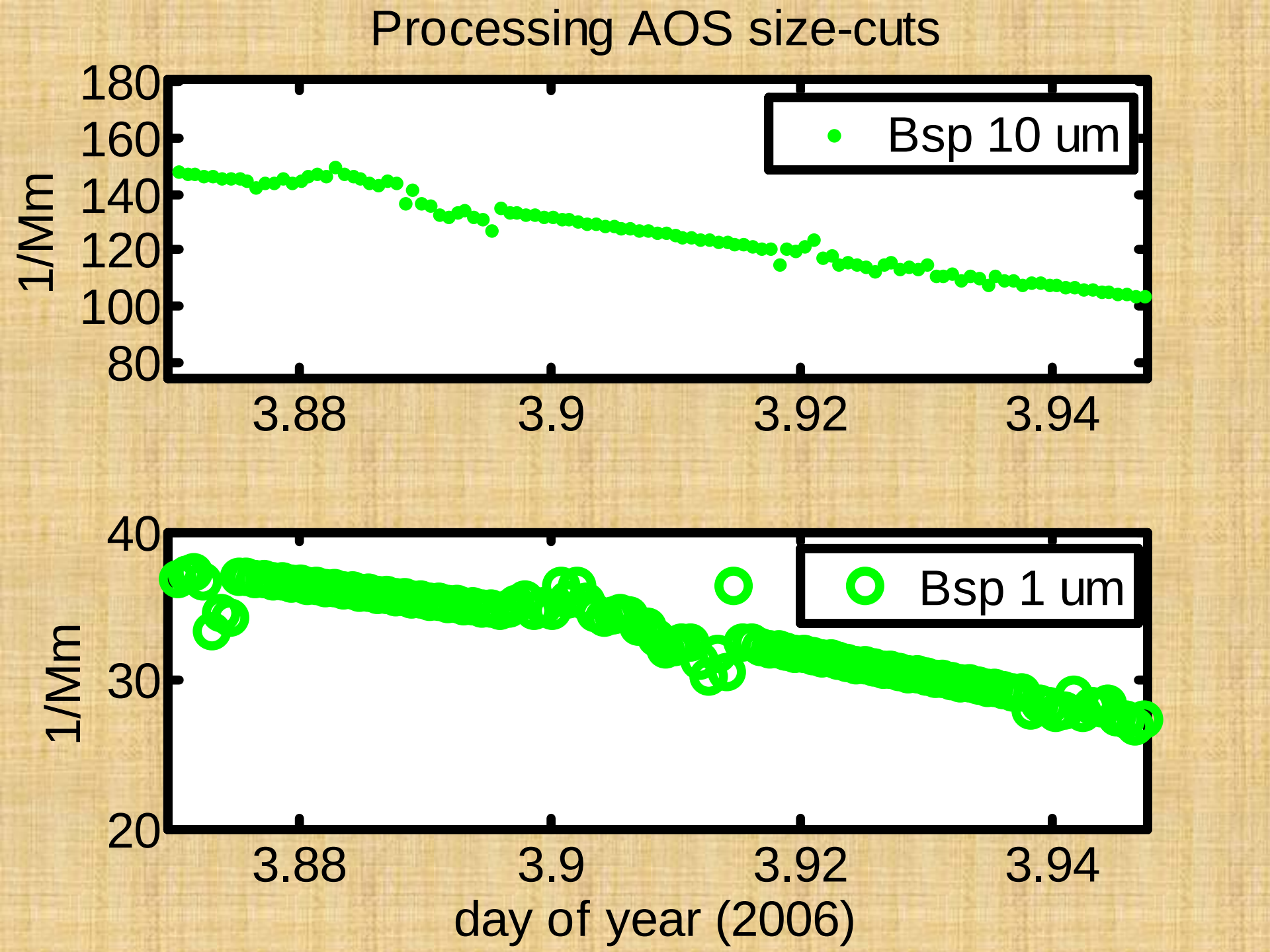
$å_{BG}$, $å_{BR}$, $å_{GR}$(1μm,10μm) for both abs.and scat.

SSA(3λ,1μm,10μm), bf (3λ,1μm,10μm), g(3λ,1μm,10μm)

submicron frac (3λ) for both abs.and scat.

CN, CCN/CN fraction (%SS) in hourly files.

Surface Met: T, P, RH, sfc winds, rain rate, vis.


Processing AOS size-cuts
180
160
140
120
100
80
1/Mm
Bsp 10 um
3.88
3.9
3.92
3.94
40
30
20
1/Mm
Bsp 1 um
3.88
3.9
3.92
3.94
day of year (2006)

Flag dust events as any times meeting these criteria:

- Bsp_G_10um > 200 1/Mm

AND

- Ang_Bs_B_G_10um < 0.5

AND

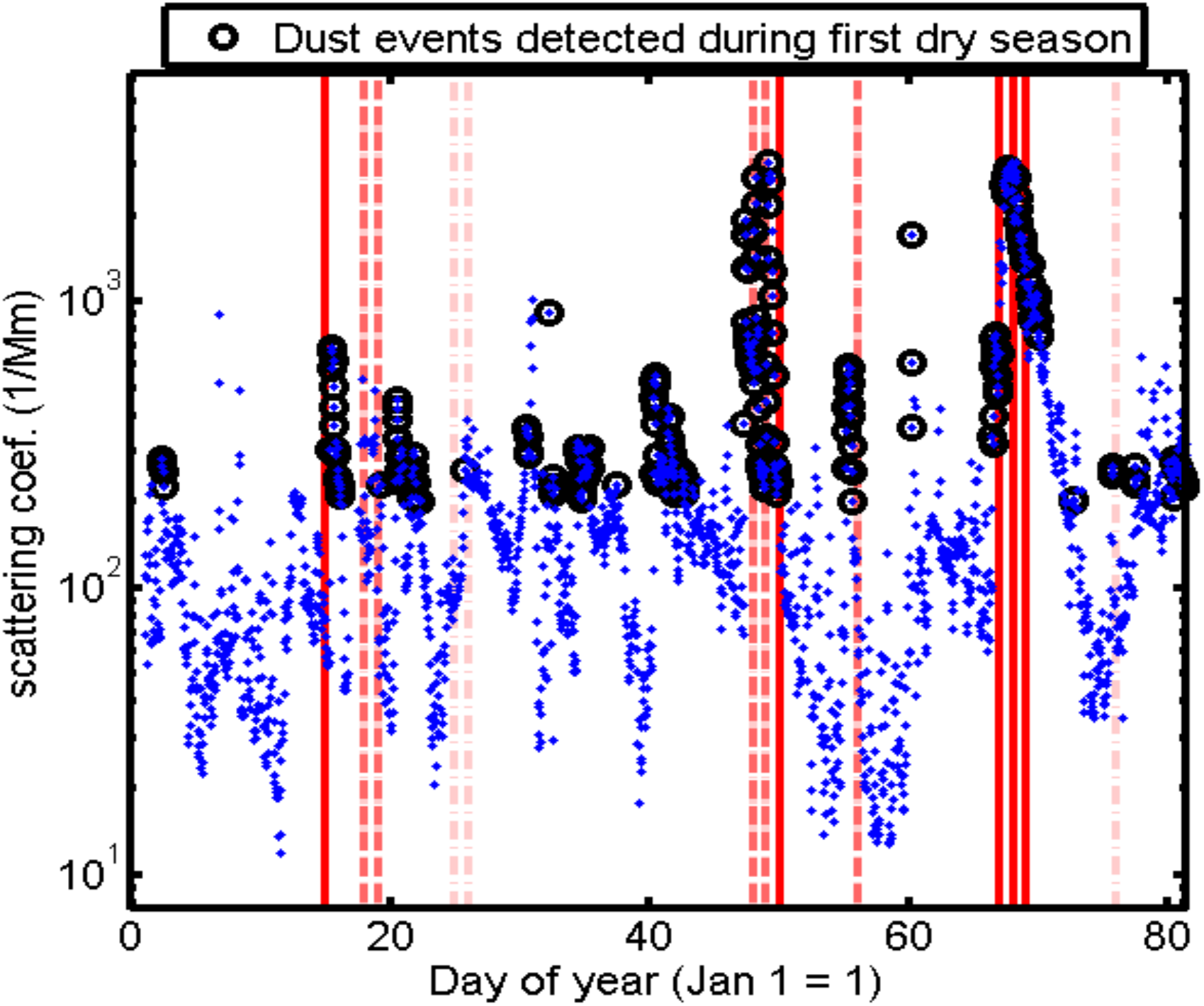
- Ang_Bs_B_G_1um <1

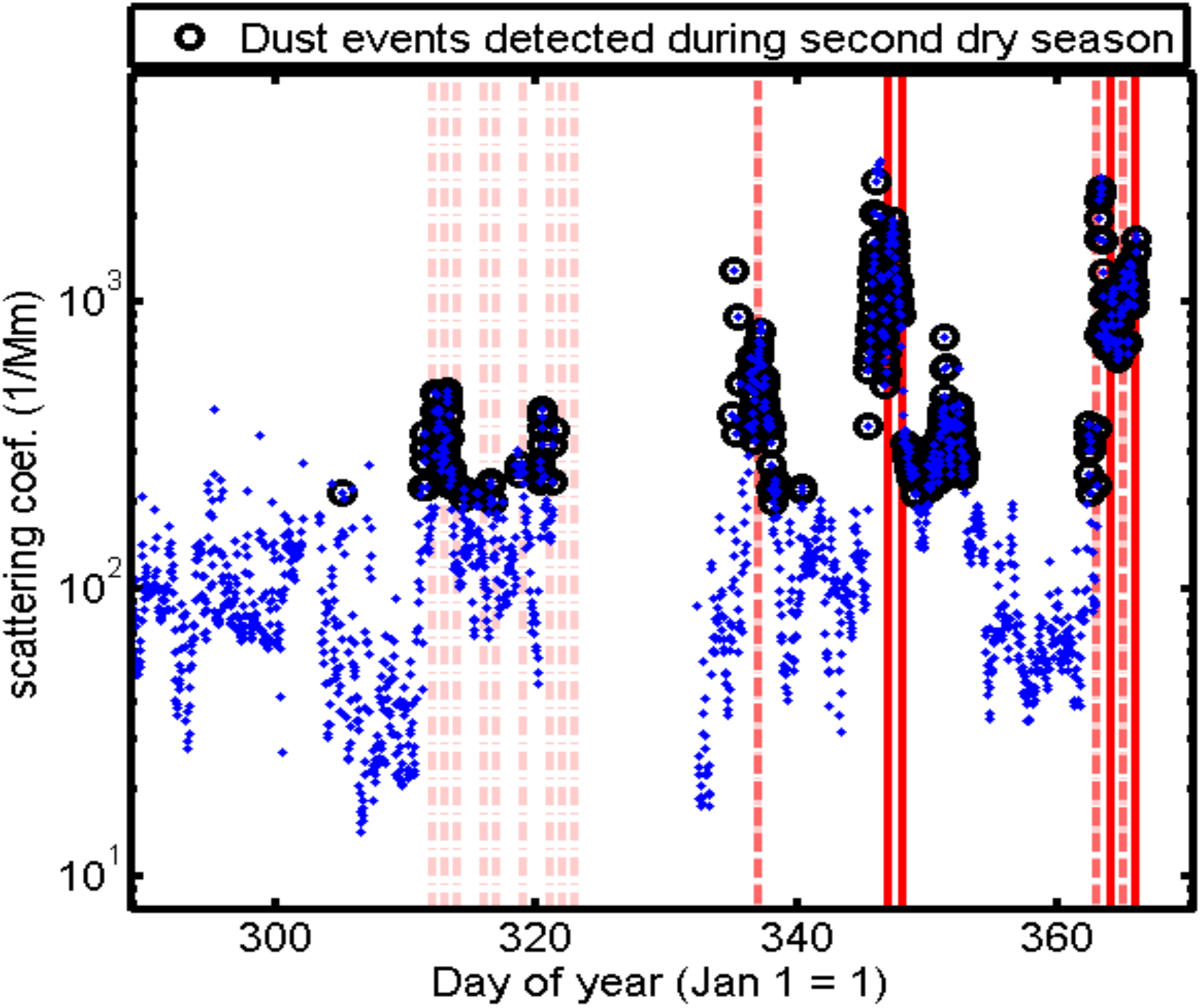
AND

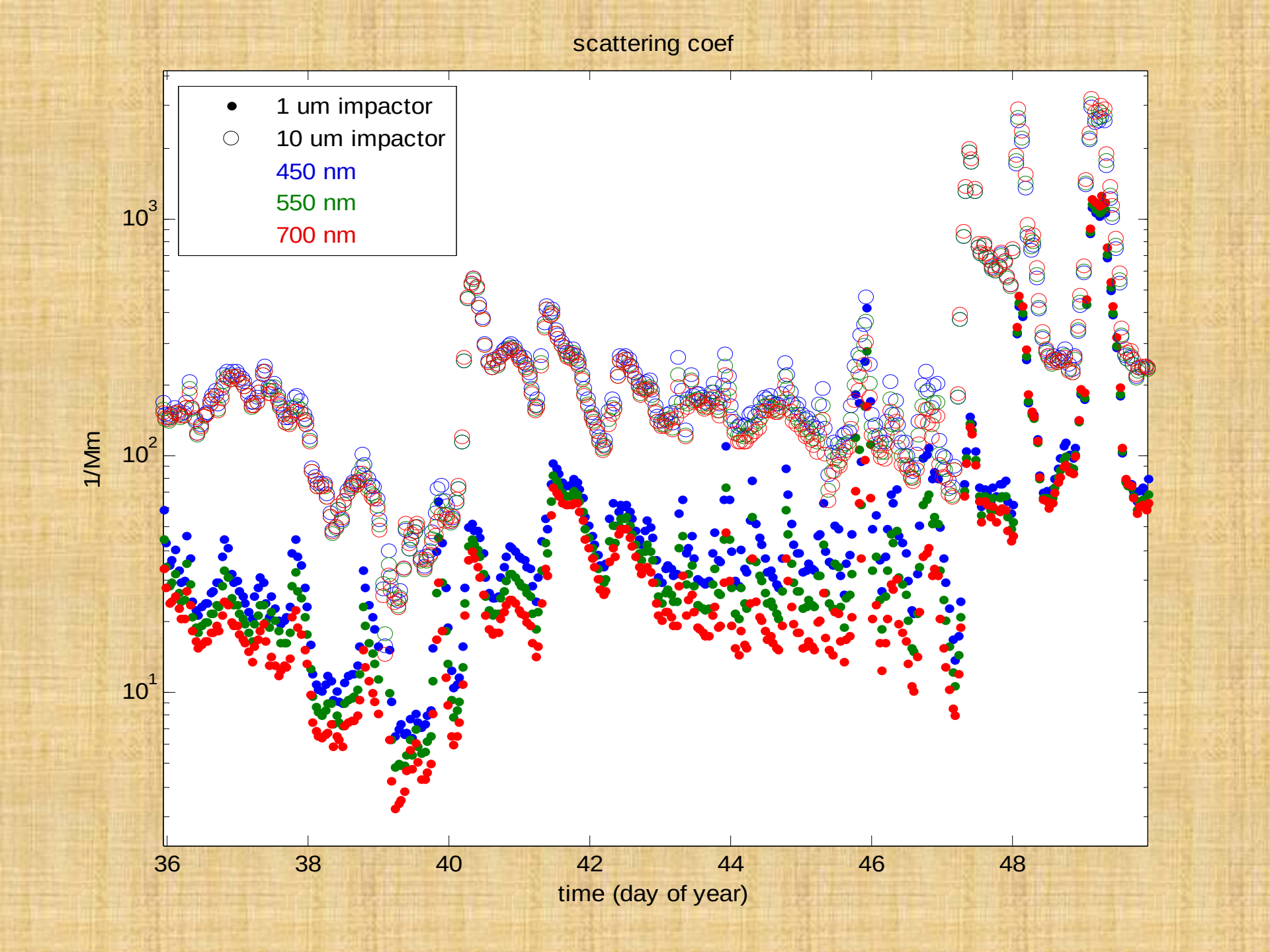
- (Submicron Bsp< 0.25) OR

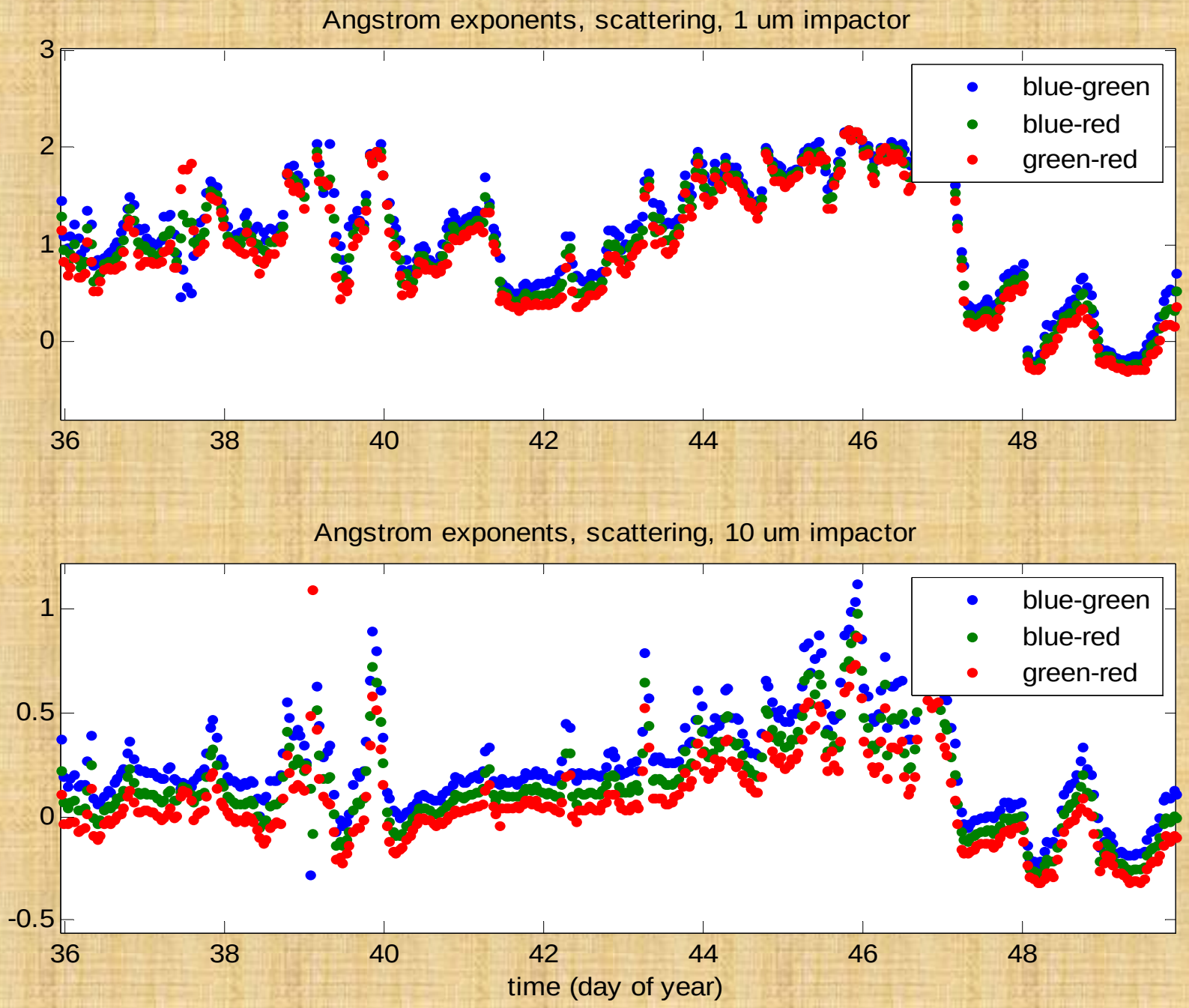
(0.25 < Submicron Bsp < 0.7) & (SSA_10um > 0.89)

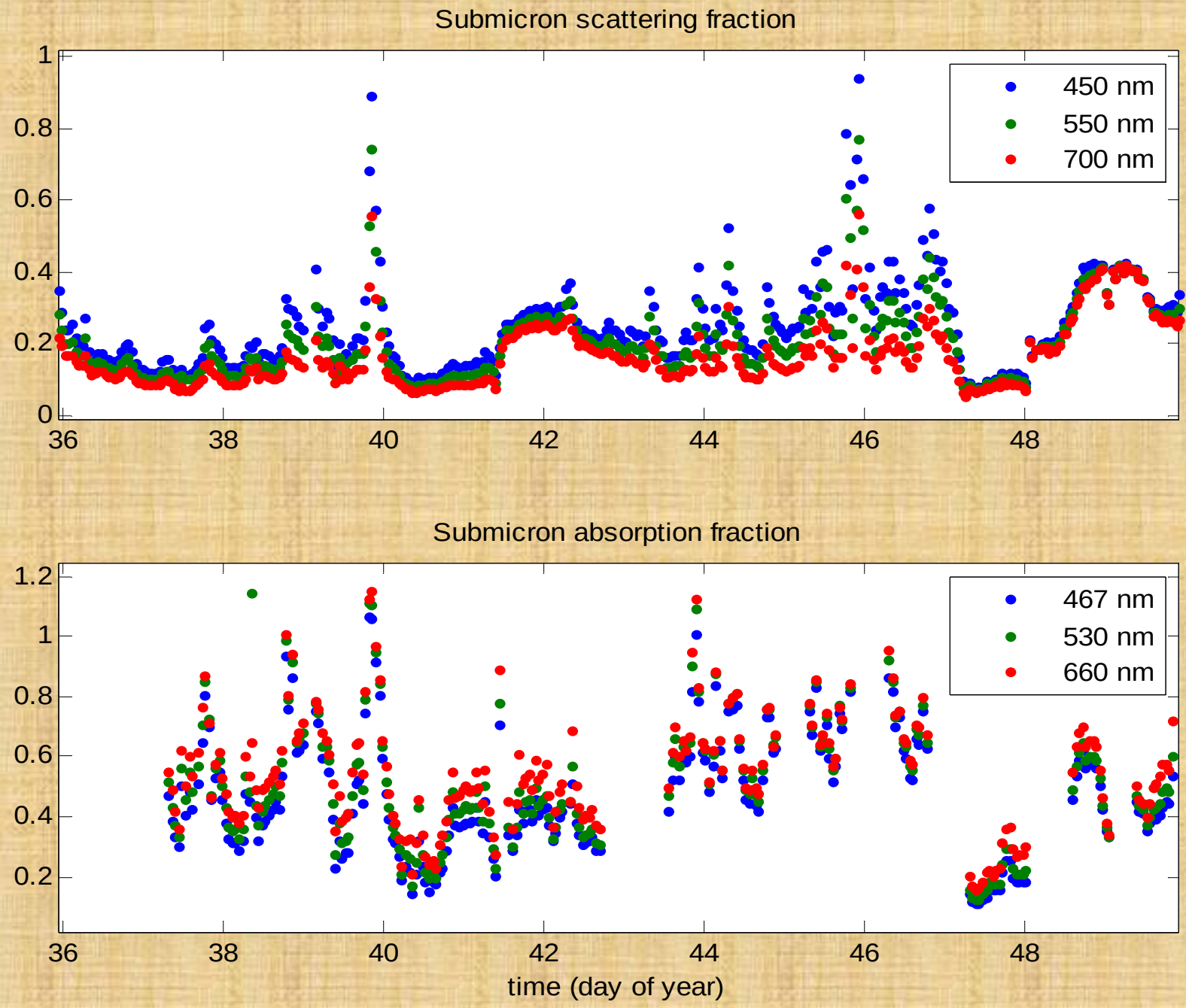
Yields 58 days dominated by dust. Not bad, but they aren't all the same days.

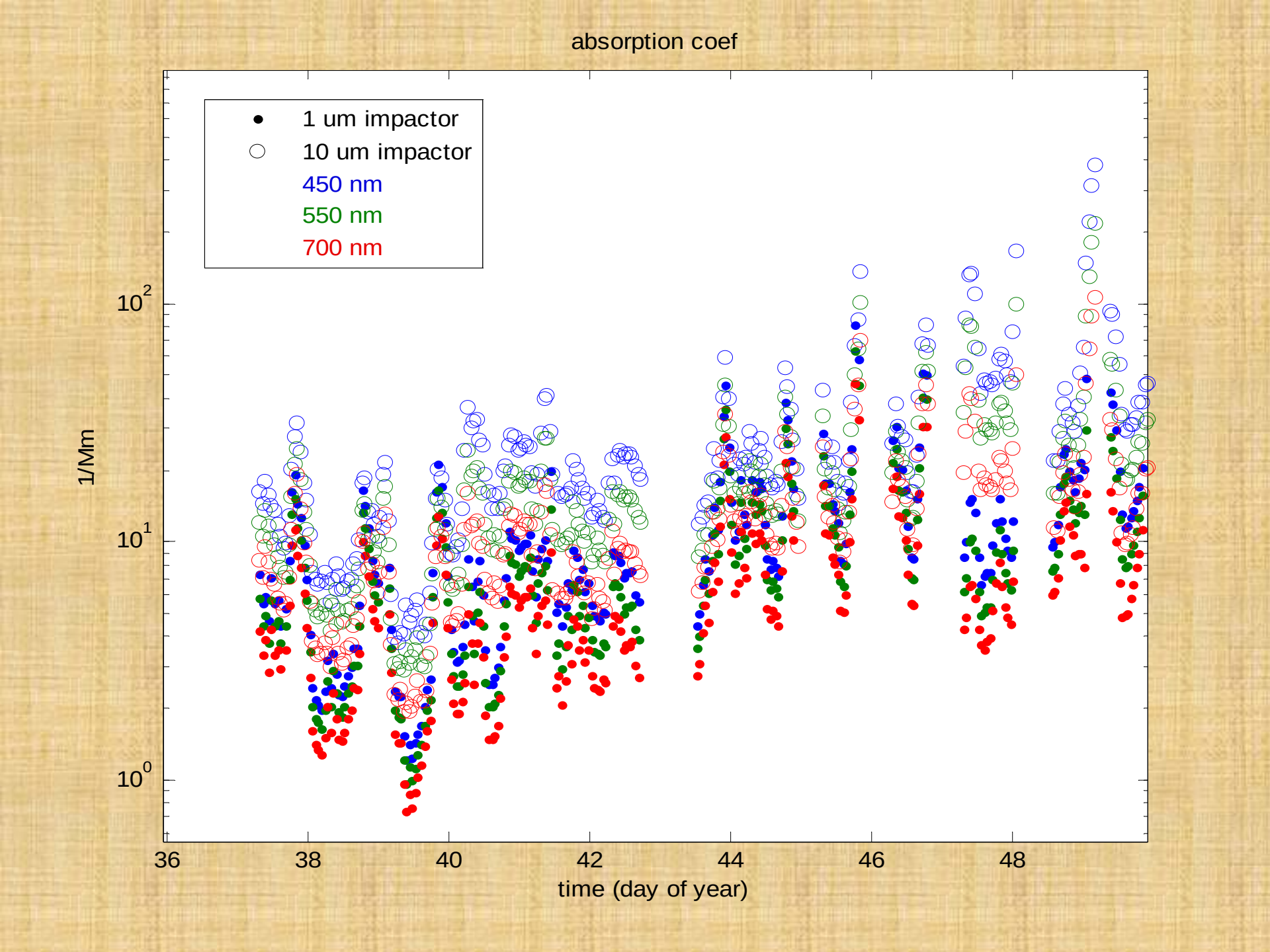

Dust events detected during first dry season
scattering coef. (1/Mm)
10^3
10^2
10^1
0
20
40
60
80
Day of year (Jan 1 = 1)

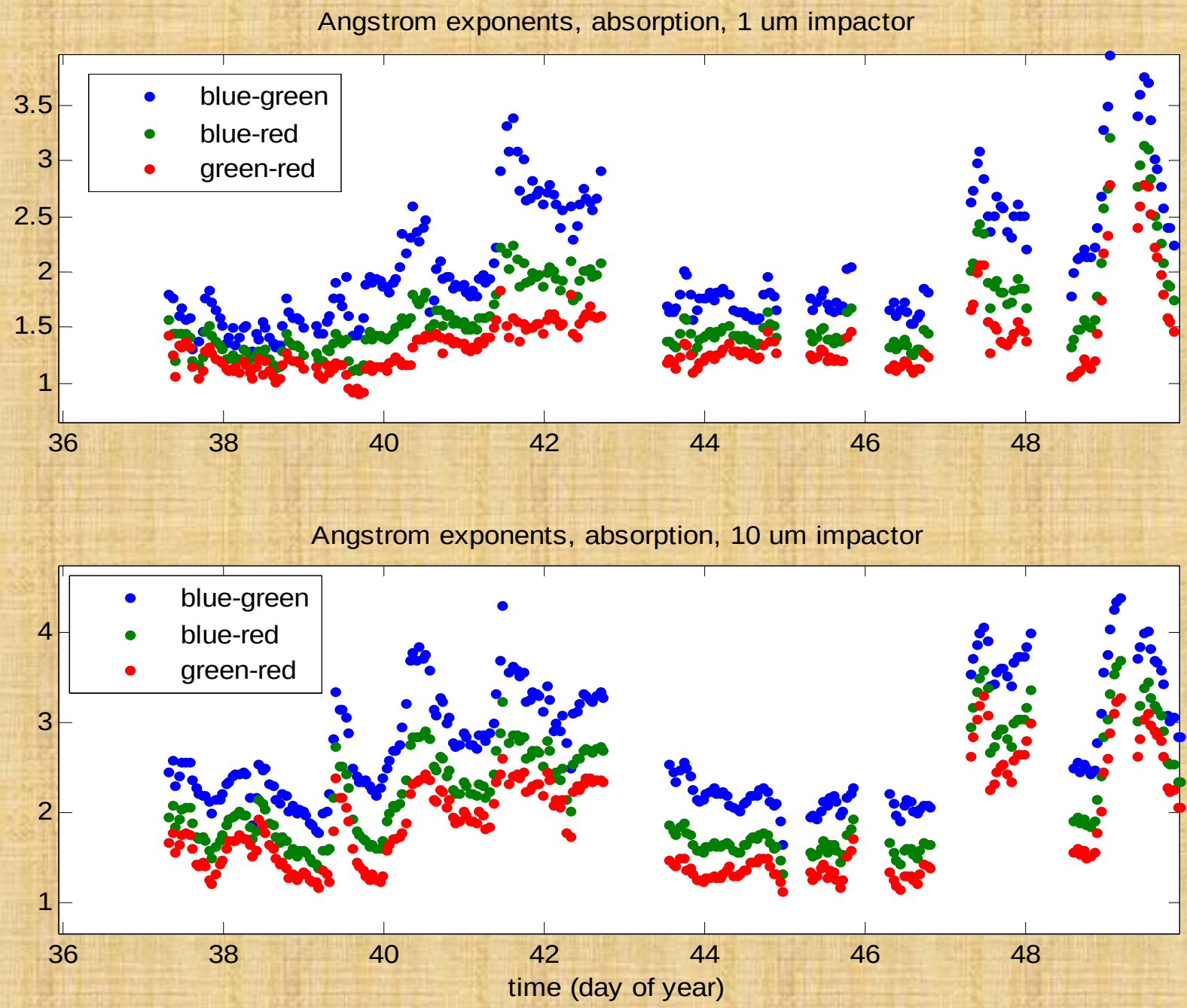

Dust events detected during second dry season
scattering coef. (1/Mm)
10^3
10^2
10^1
300
320
340
360
Day of year (Jan 1 = 1)


scattering coef
1 um impactor
10 um impactor
450 nm
550 nm
700 nm
1/Mm
10^3
10^2
10^1
36
38
40
42
44
46
48
time (day of year)


Angstrom exponents, scattering, 1 um impactor
blue-green
blue-red
green-red
3
2
1
0
36
38
40
42
44
46
48
Angstrom exponents, scattering, 10 um impactor
blue-green
blue-red
green-red
1
0.5
0
-0.5
36
38
40
42
44
46
48
time (day of year)

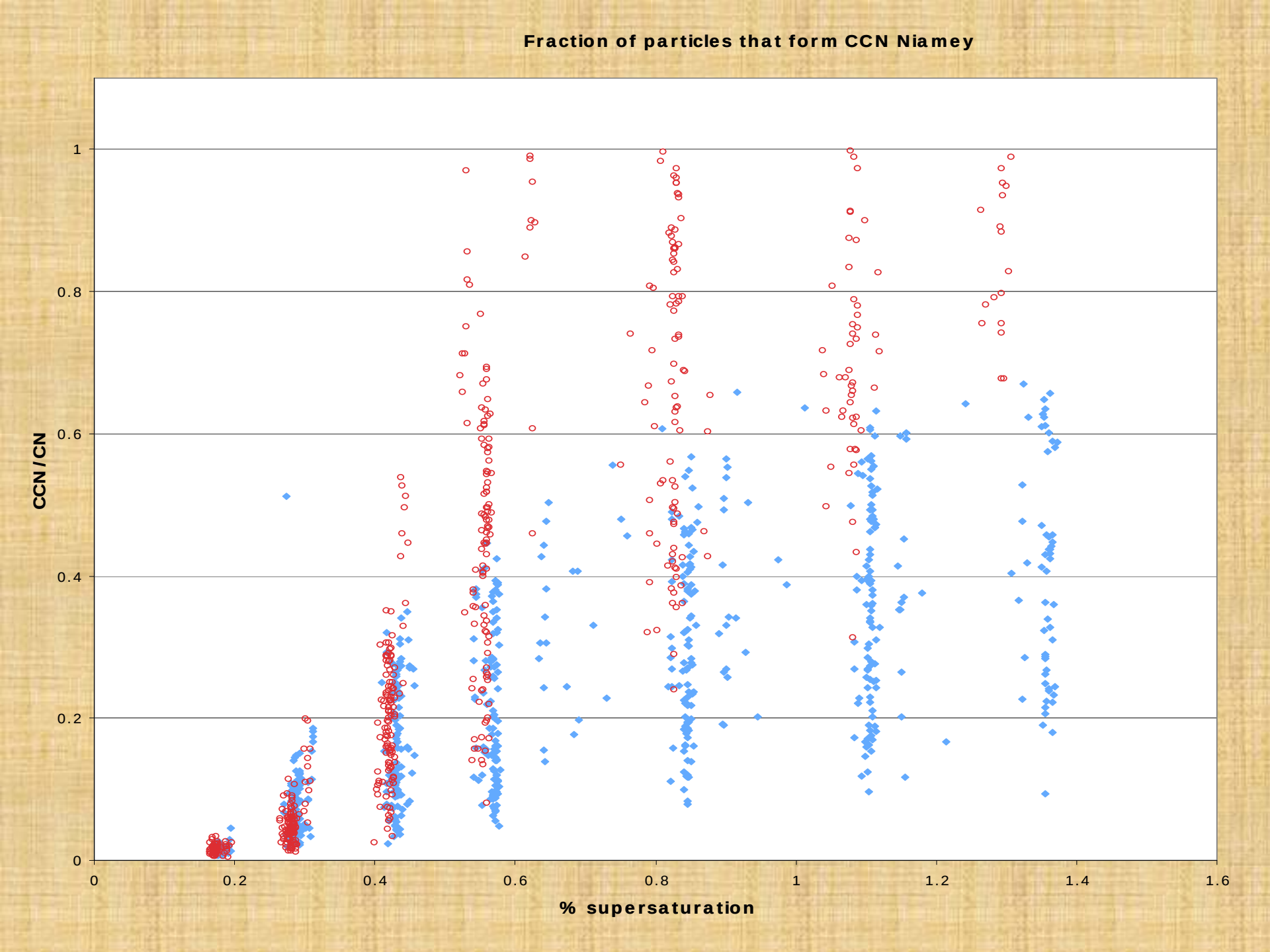

Submicron scattering fraction
450 nm
550 nm
700 nm
1
0.8
0.6
0.4
0.2
0
36
38
40
42
44
46
48
Submicron absorption fraction
467 nm
530 nm
660 nm
1.2
1
0.8
0.6
0.4
0.2
36
38
40
42
44
46
48
time (day of year)


absorption coef
1 um impactor
10 um impactor
450 nm
550 nm
700 nm
10^2
10^1
10^0
1/Mm
36
38
40
42
44
46
48
time (day of year)


Angstrom exponents, absorption, 1 um impactor
blue-green
blue-red
green-red
3.5
3
2.5
2
1.5
1
36
38
40
42
44
46
48
Angstrom exponents, absorption, 10 um impactor
blue-green
blue-red
green-red
4
3
2
1
36
38
40
42
44
46
48
time (day of year)

Progress so far…

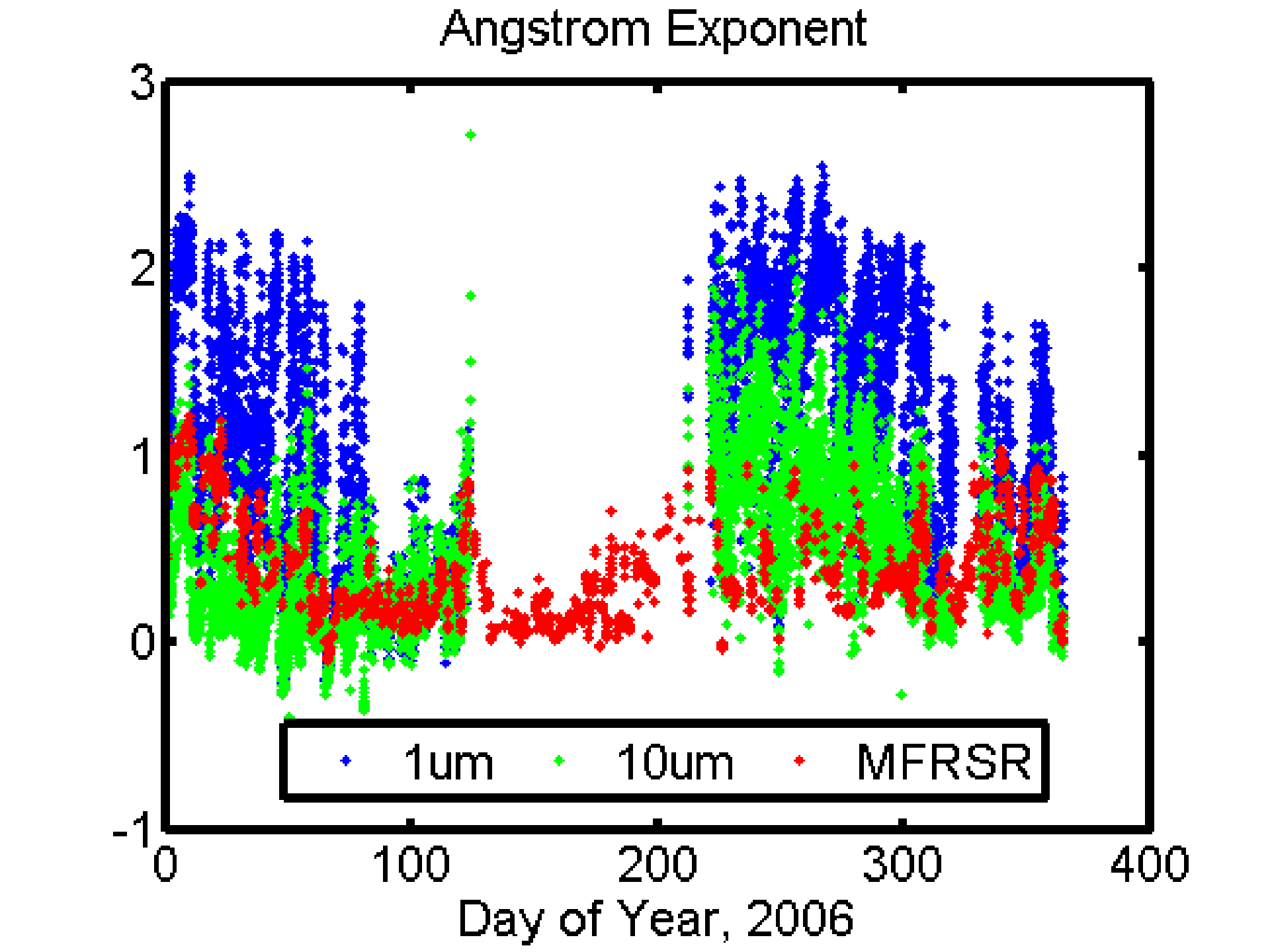
- Have obtained a fairly continuous time series of AOD at Niamey and Banizoumbou, though some serious questions remain.
- Have processed the entire year of surface aerosol properties, both bulk and intensive.
- Have developed a simple metric that shows some skill in identifying dust events.
- Additional information such as CCN fraction of CN as a function of SS% may help improve the skill in distinguishing smoke and dust.

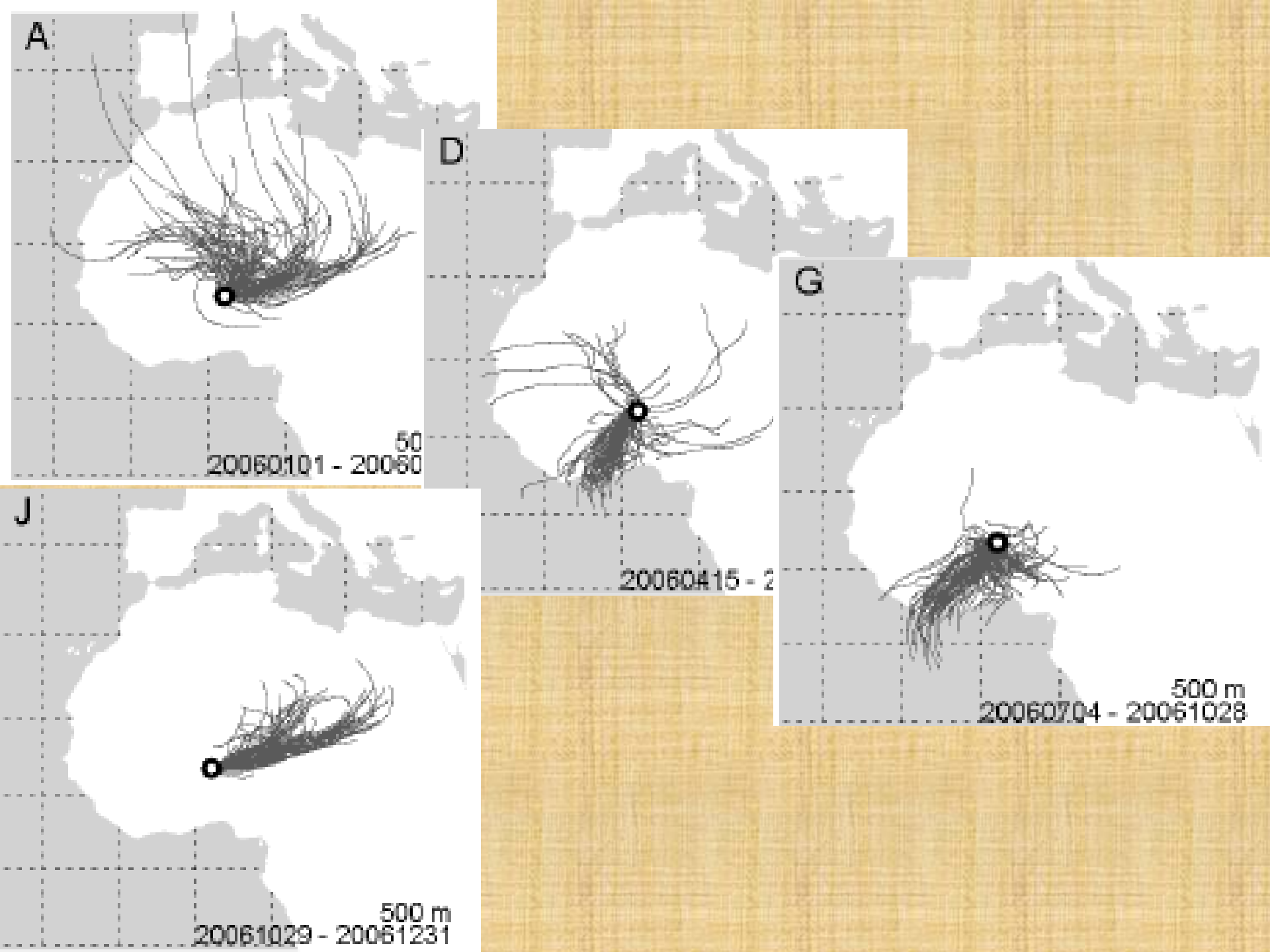

Fraction of particles that form CCN Niamey
CCN / CN
0
0.2
0.4
0.6
0.8
1
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
% supersaturation

Elevated layers…

Will need a different line of attack. Possibly look for departures in agreement between surface and column quantities such as AOS angstrom and corresponding MFRSR.

Or a more direct method such as identification in the lidar profile combined with backtrajectory to determine source.


Angstrom Exponent
3
2
1
0
-1
0
100
200
300
400
Day of Year, 2006
1um
10um
MFRSR


A
50
20060101 - 20060
D
20060415 - 2
G
500 m
20060704 - 20061028
J
500 m
20061029 - 20061231