DRI CCN spectrometers in ICE-T

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Two CCN spectrometers as in ICE-L, RICO, PASE, etc.

to cover the entire S range, need to extend range in both directions; high S (>1%) and low S (large nuclei; GN)

to check each other in overlap S range

to provide redundancy

one can monitor ambient while the other measures processed aerosol

- volatility
- size versus S_c
- CVI?
- interstitial?

ICE-T will be RICO2

RICO had great variability, factor of 4 in CCN and cloud droplet concentrations

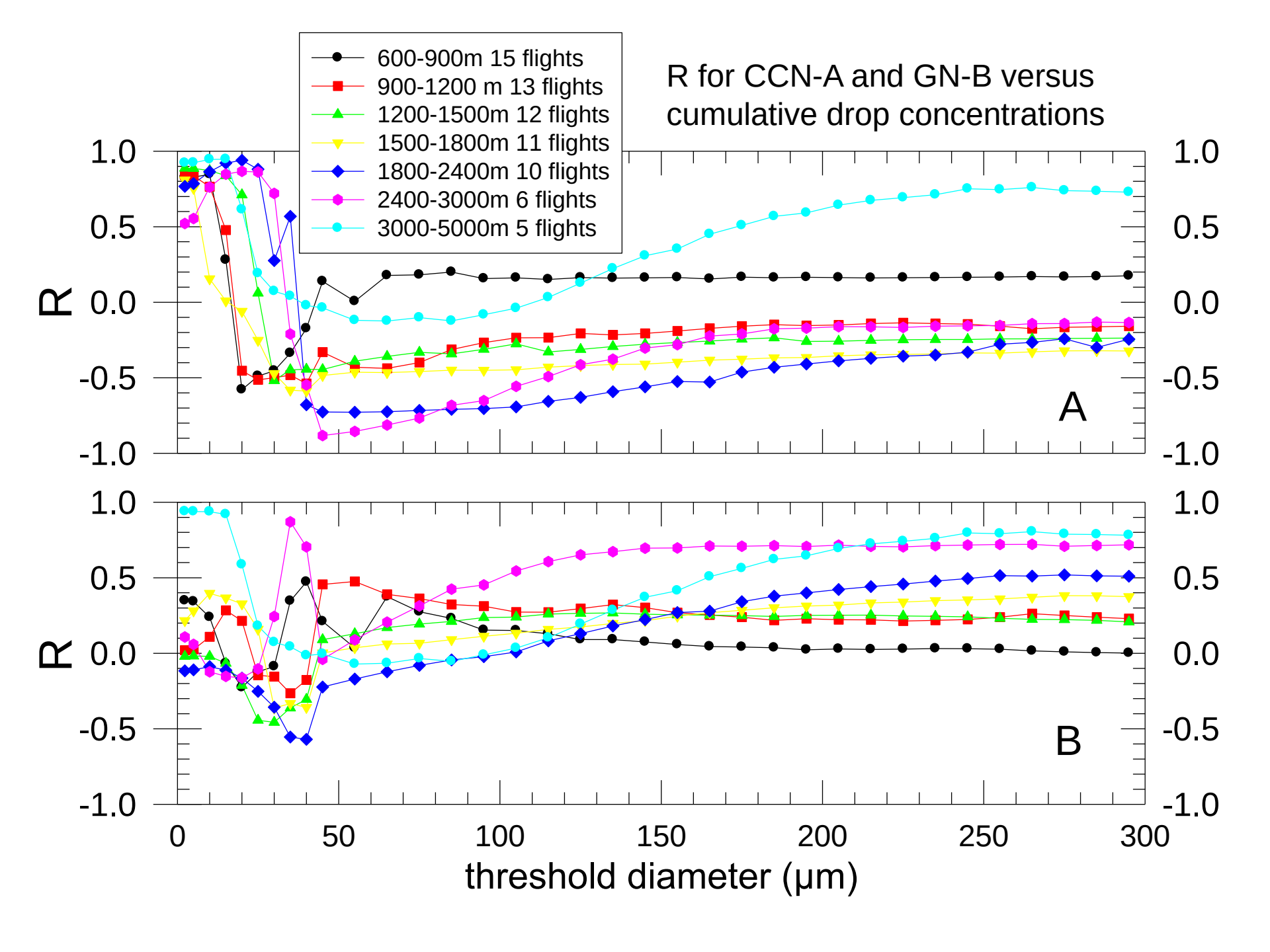
Drew my interest in Giant Nuclei (GN); paper published in GRL last week

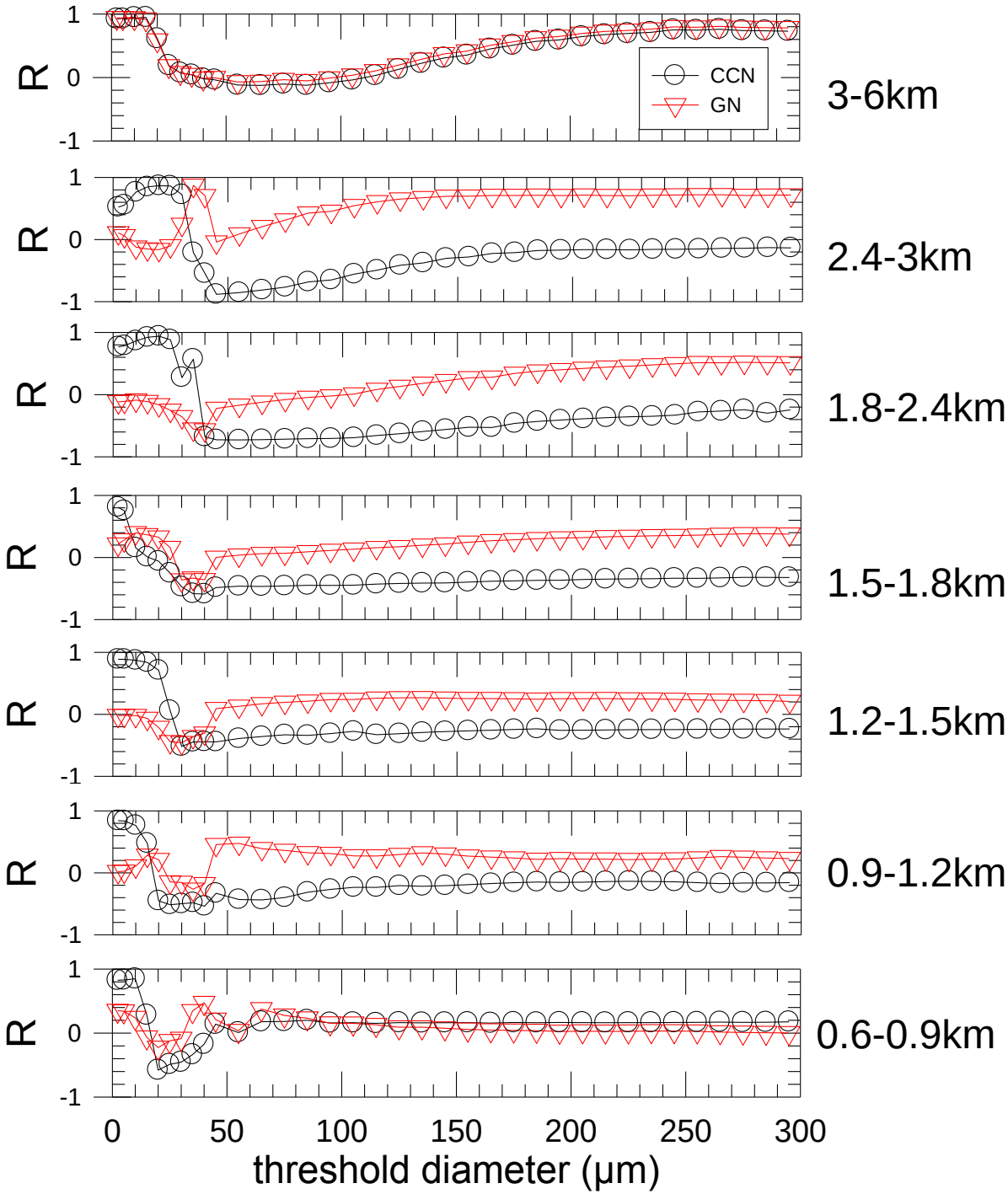
More higher altitude cloud measurements in ICE-T, limited in RICO—only 5 flights with cloud above 3 km

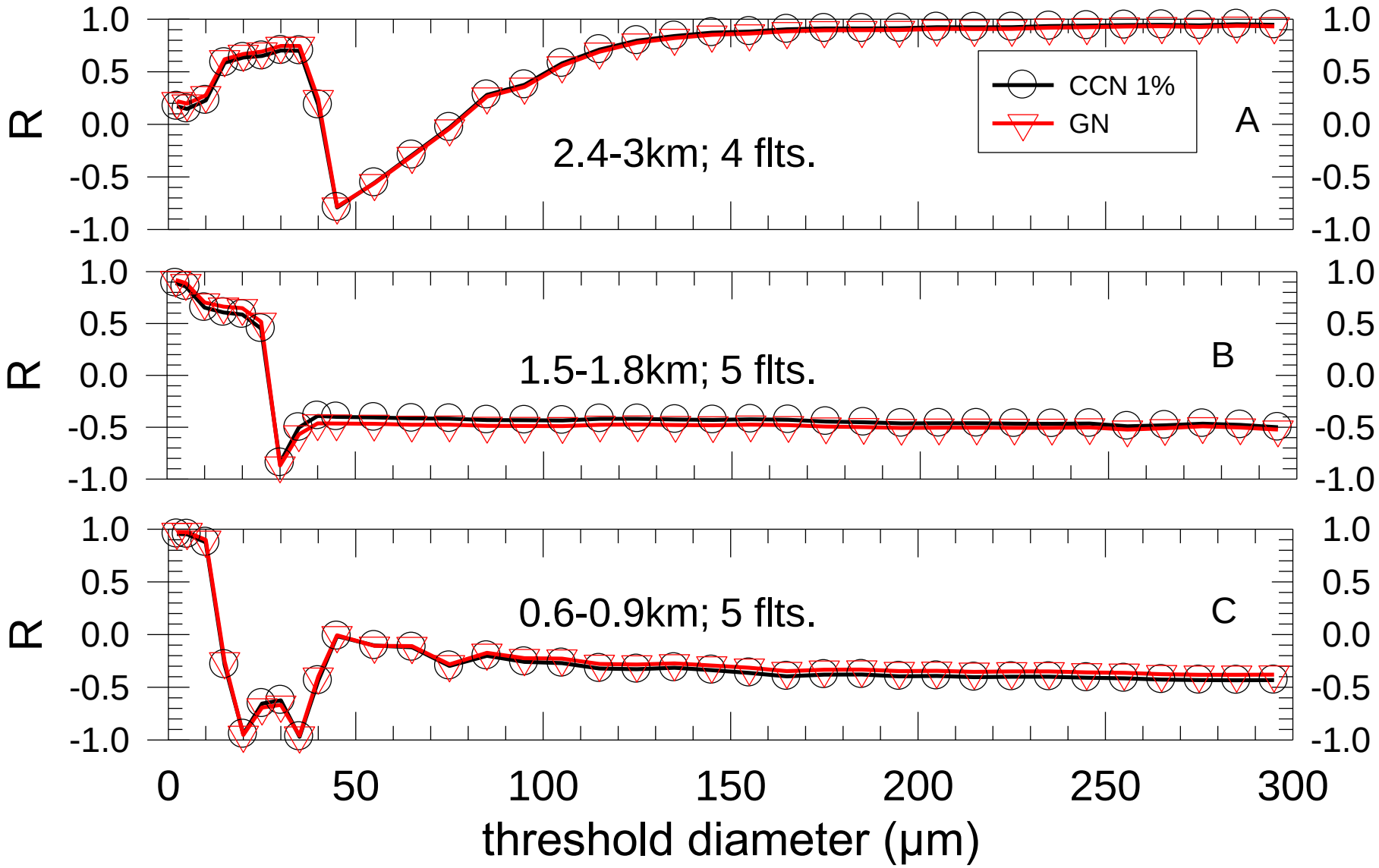
Sea salt (NaCl) as CCN??

CCN volatility, Twomey 1971, Hudson and Da 1996

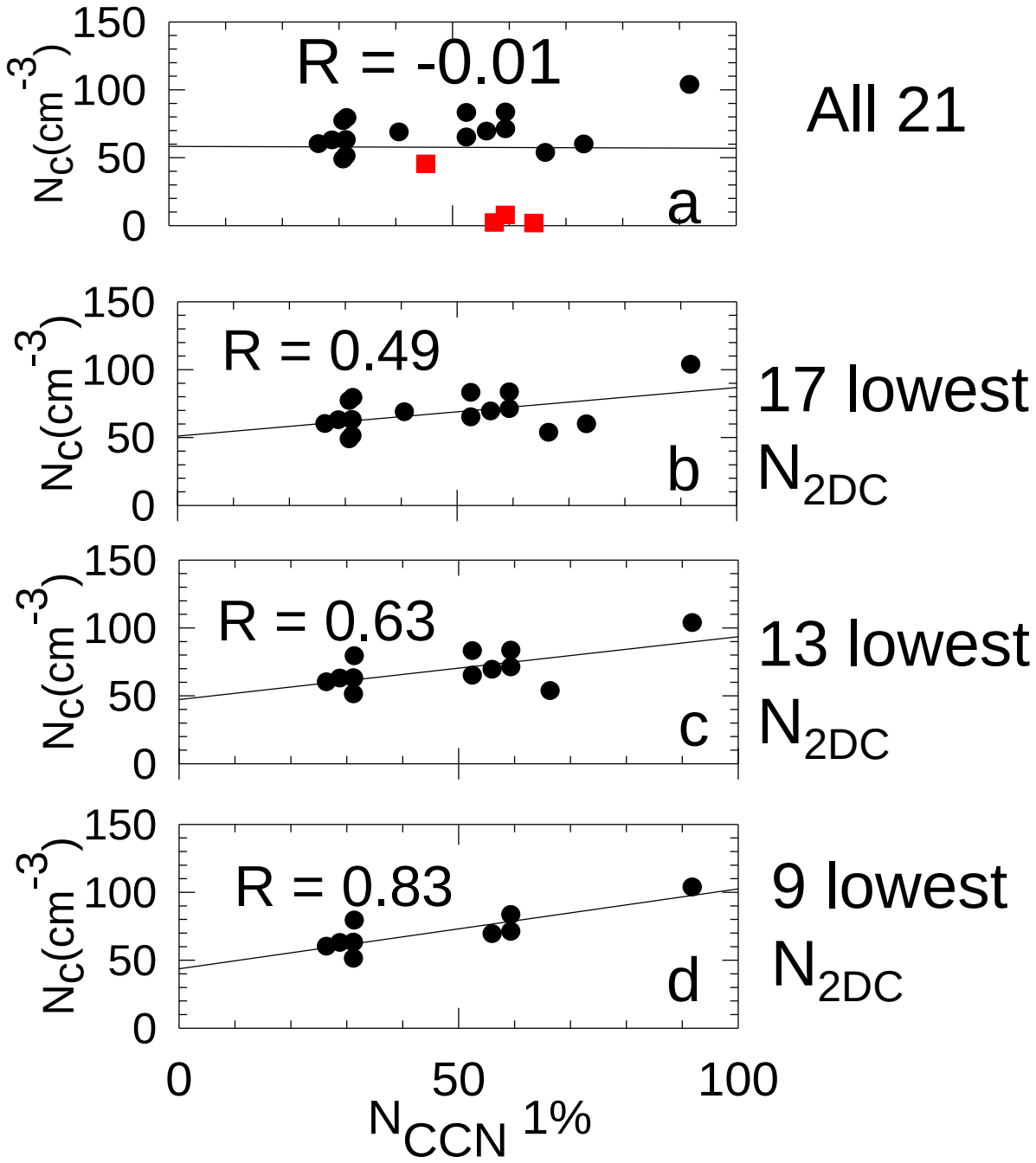
Cloud supersaturations higher than conventional wisdom, GRL paper published late last year—means that smaller particles make cloud droplets, especially in cleaner air

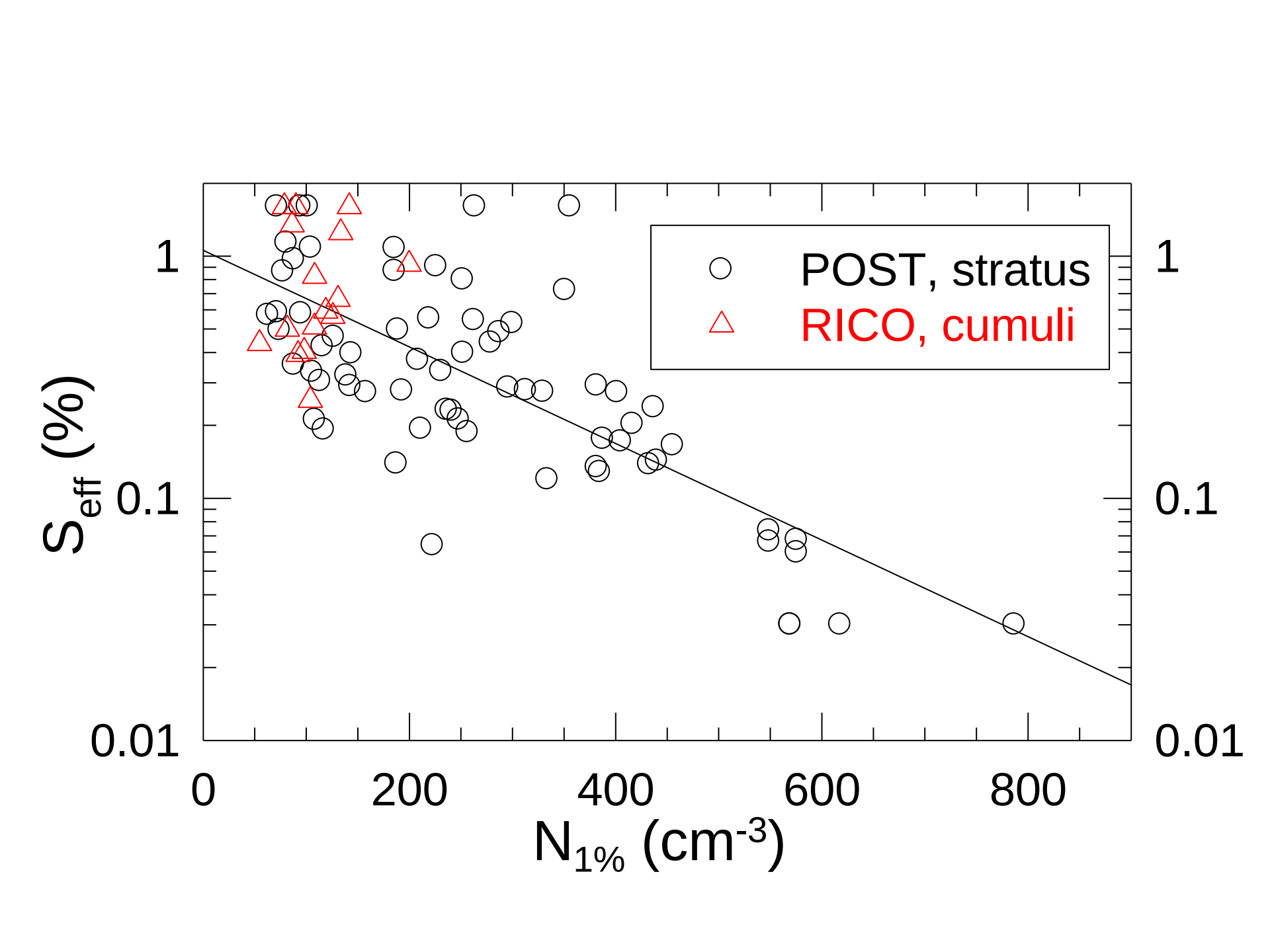

600-900m 15 flights
900-1200 m 13 flights
1200-1500m 12 flights
1500-1800m 11 flights
1800-2400m 10 flights
2400-3000m 6 flights
3000-5000m 5 flights
R for CCN-A and GN-B versus
cumulative drop concentrations
R
1.0
0.5
0.0
-0.5
-1.0
A
B
0
50
100
150
200
250
300
threshold diameter (μm)


R
1
0
-1
CCN
GN
3-6km
2.4-3km
1.8-2.4km
1.5-1.8km
1.2-1.5km
0.9-1.2km
0.6-0.9km
0
50
100
150
200
250
300
threshold diameter (μm)

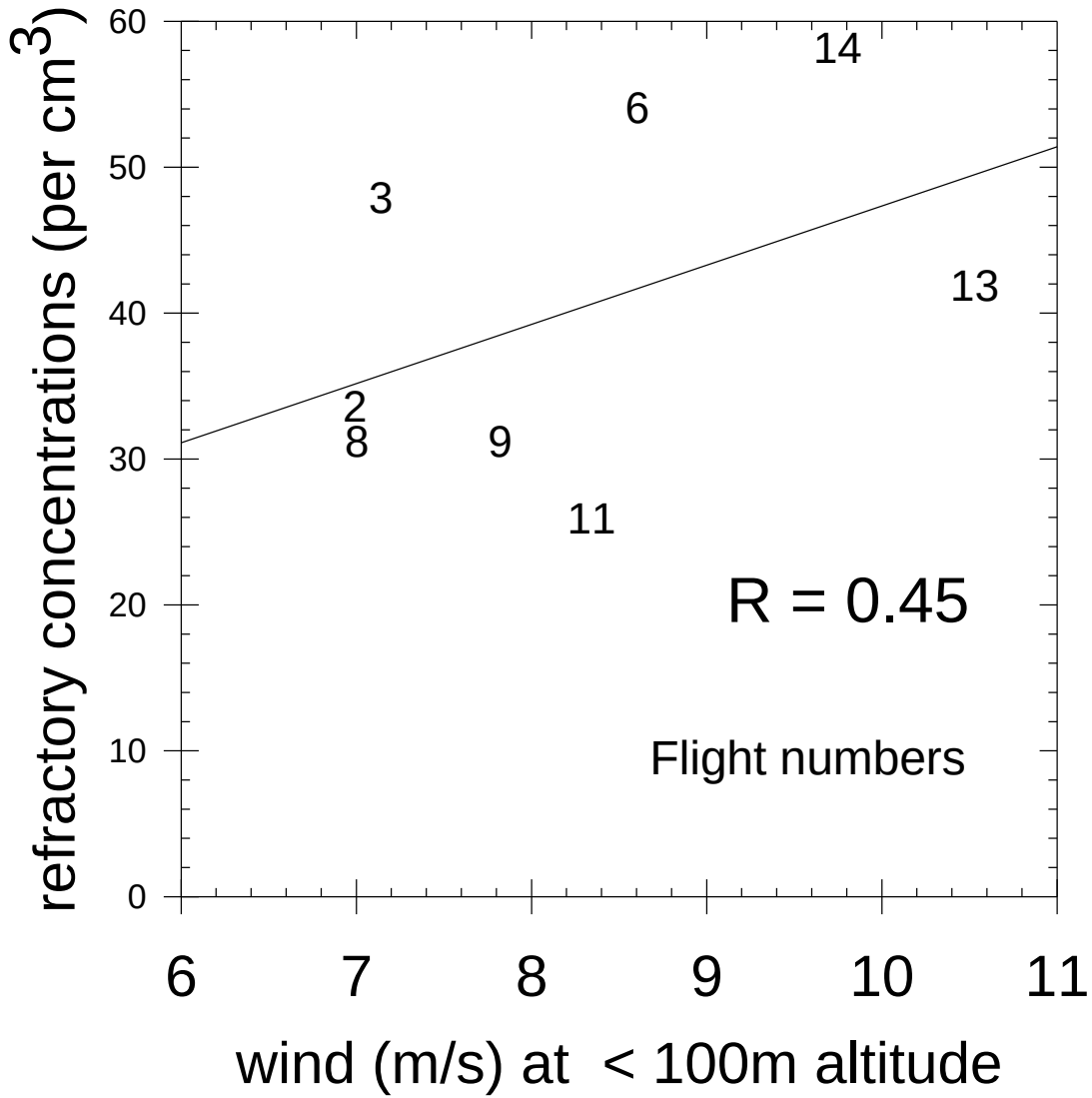


Only for flights in these altitude bands with high R for N_{GN}-$N_{1\%}$. For 2.4-3 km R for N_{GN}-N_d > all 6 flights, for 1.5-1.8 km R < all 11 flights, for 600-900m R < for all 15 flights.

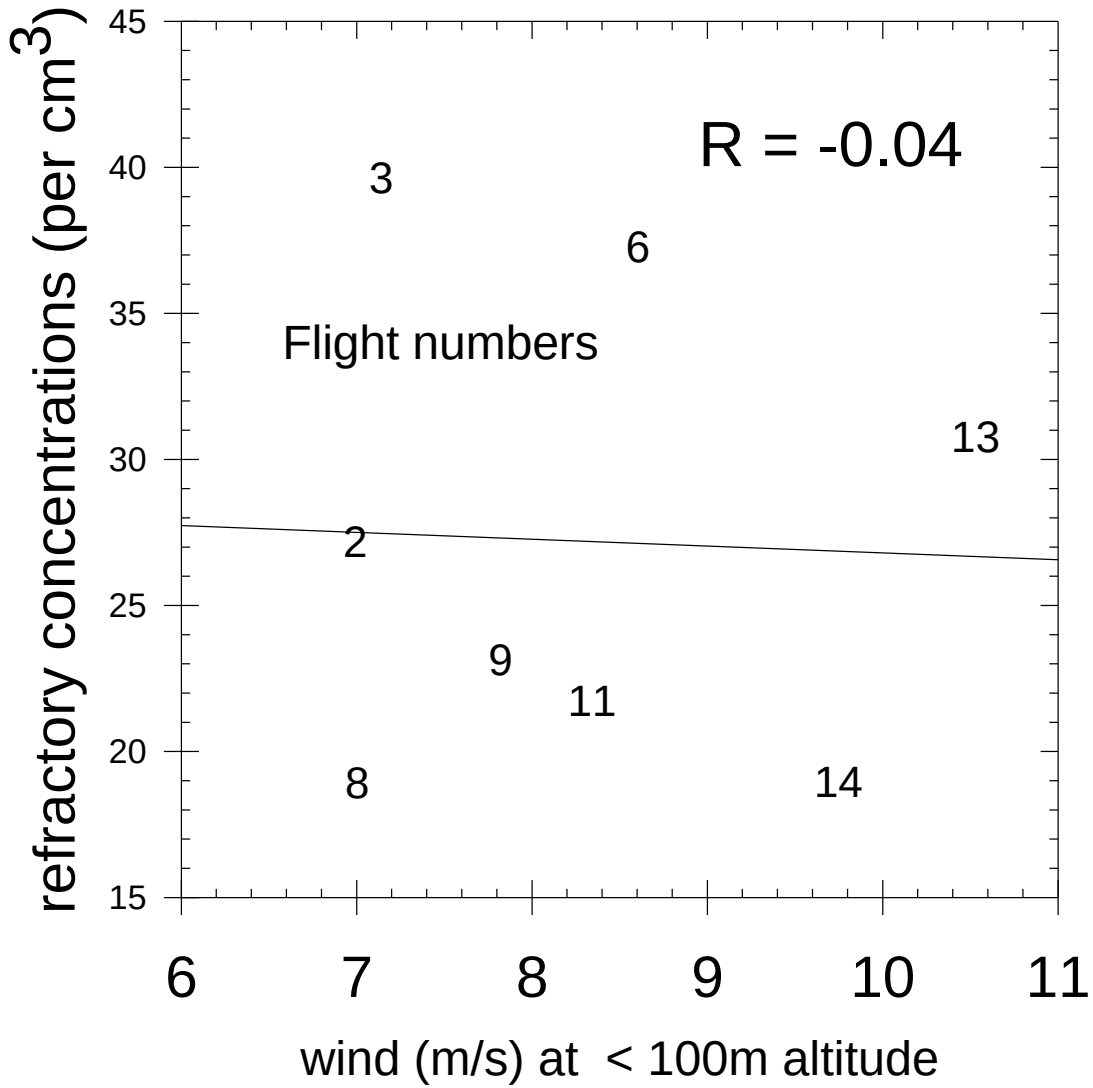

R = -0.01
a
All 21
R = 0.49
b
17 lowest
N2DC
R = 0.63
c
13 lowest
N2DC
R = 0.83
d
9 lowest
N2DC
Nc(cm-3)
150
100
50
0
0
50
100
NCCN 1%


POST, stratus
RICO, cumuli
1
0.1
0.01
S_{eff} (%)
0
200
400
600
800
$N_{1\%}$ (cm^{-3})

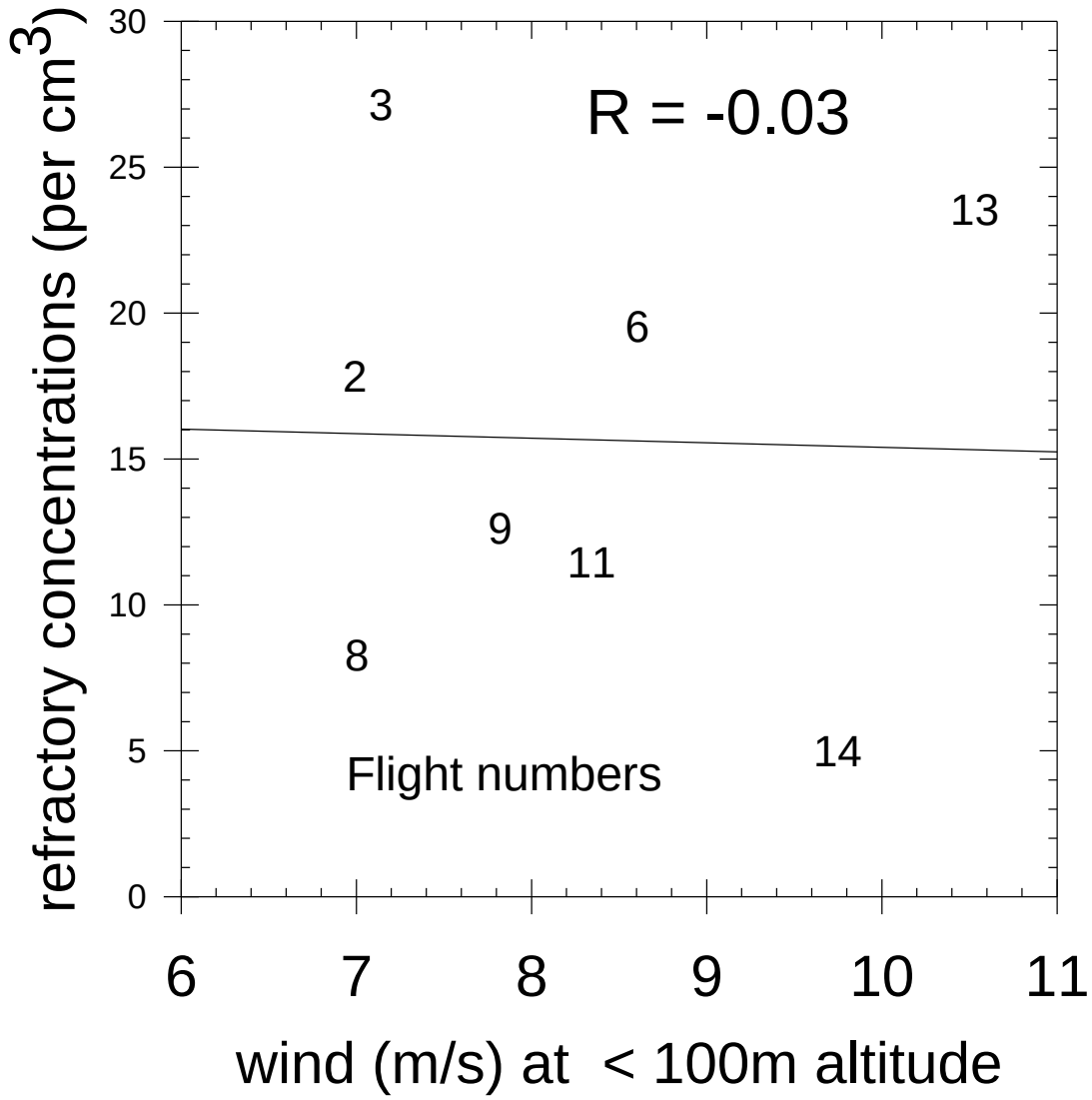
PASE volatility
refractory CCN 1% at 300C
versus wind velocity



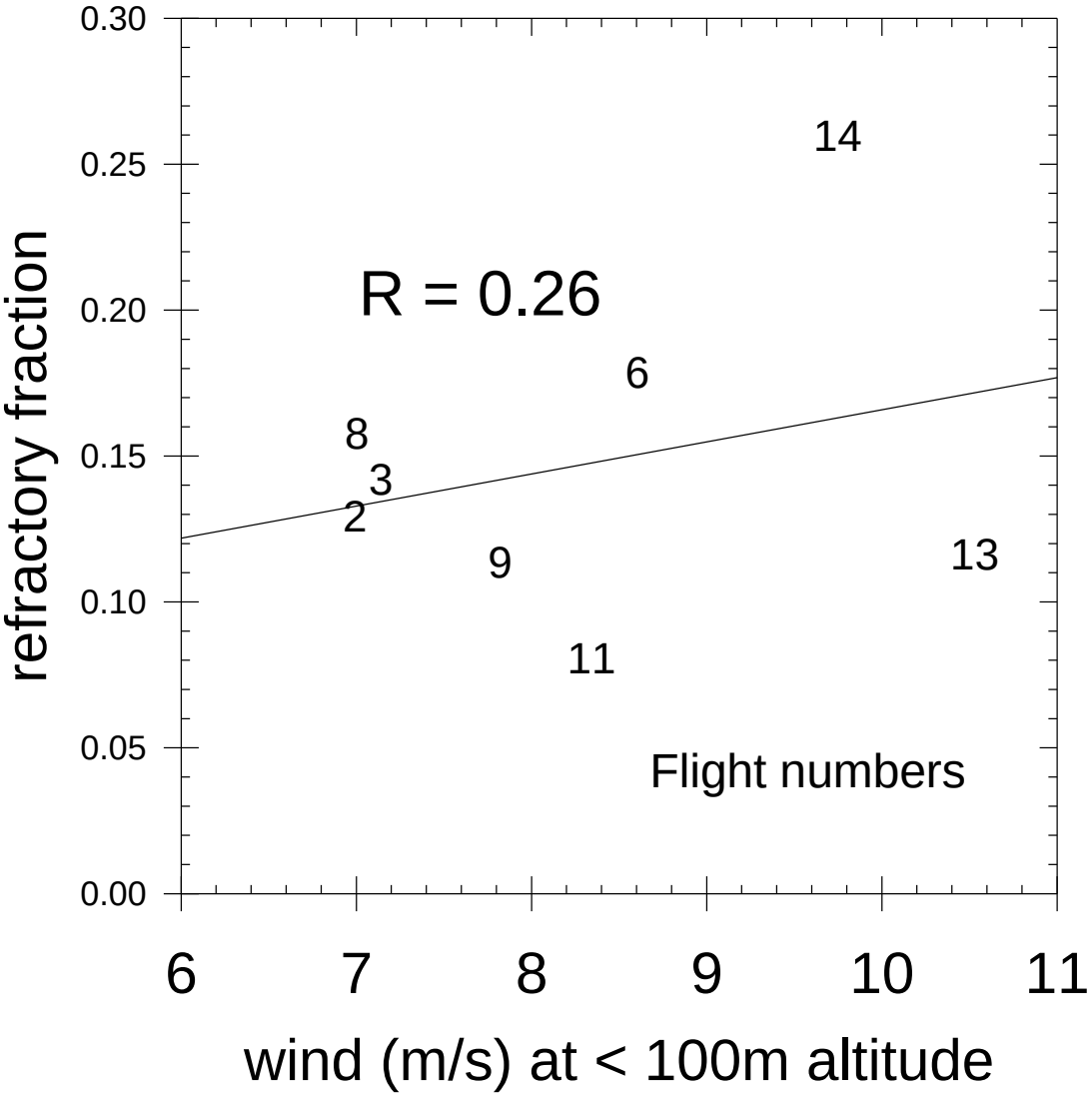
PASE volatility
refractory CCN 0.3% at 300C
versus wind velocity



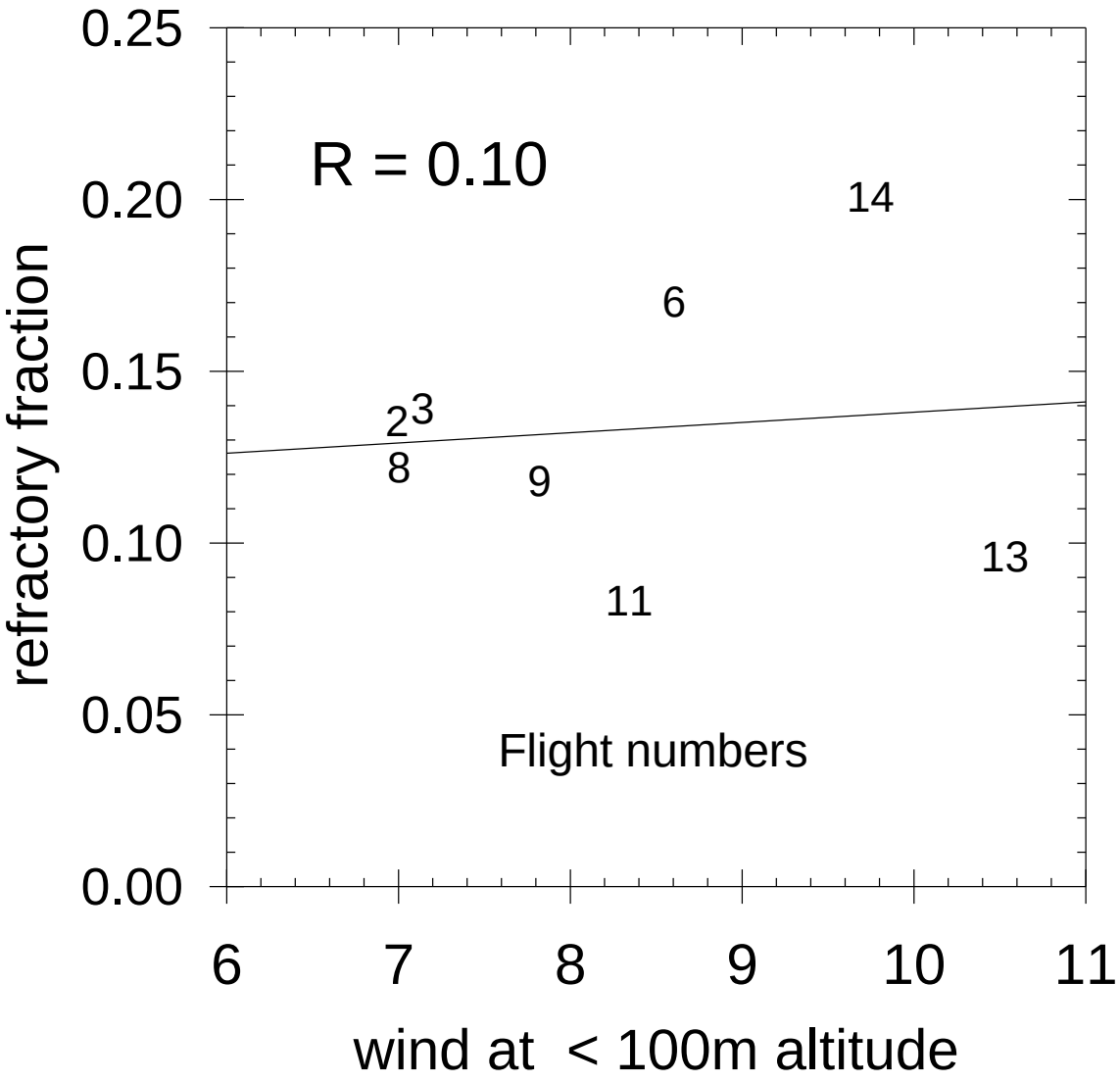
PASE volatility
refractory CCN 0.1% at 300C
versus wind velocity



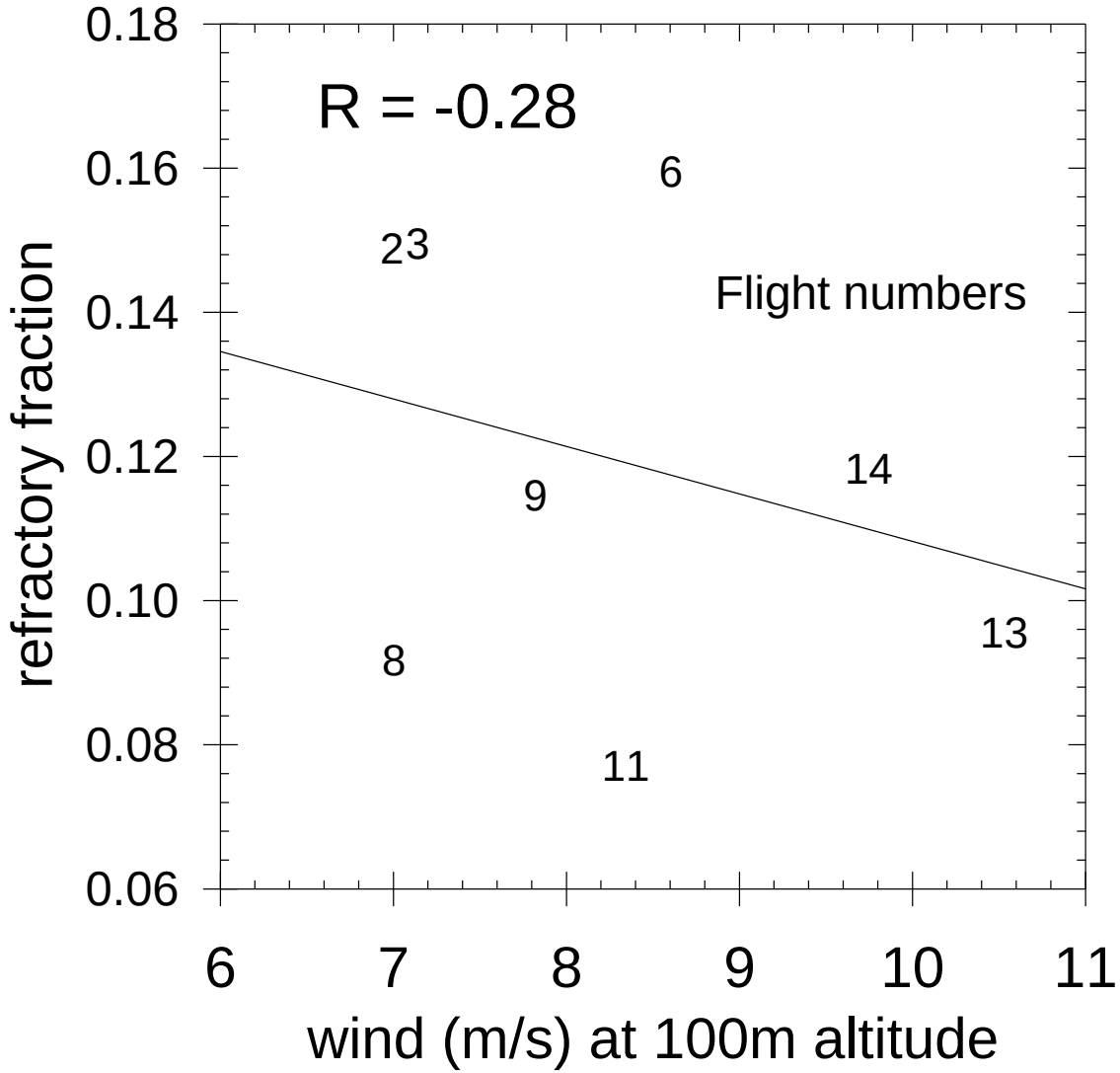
PASE volatility
refractory CCN 1% at 300C
versus wind velocity



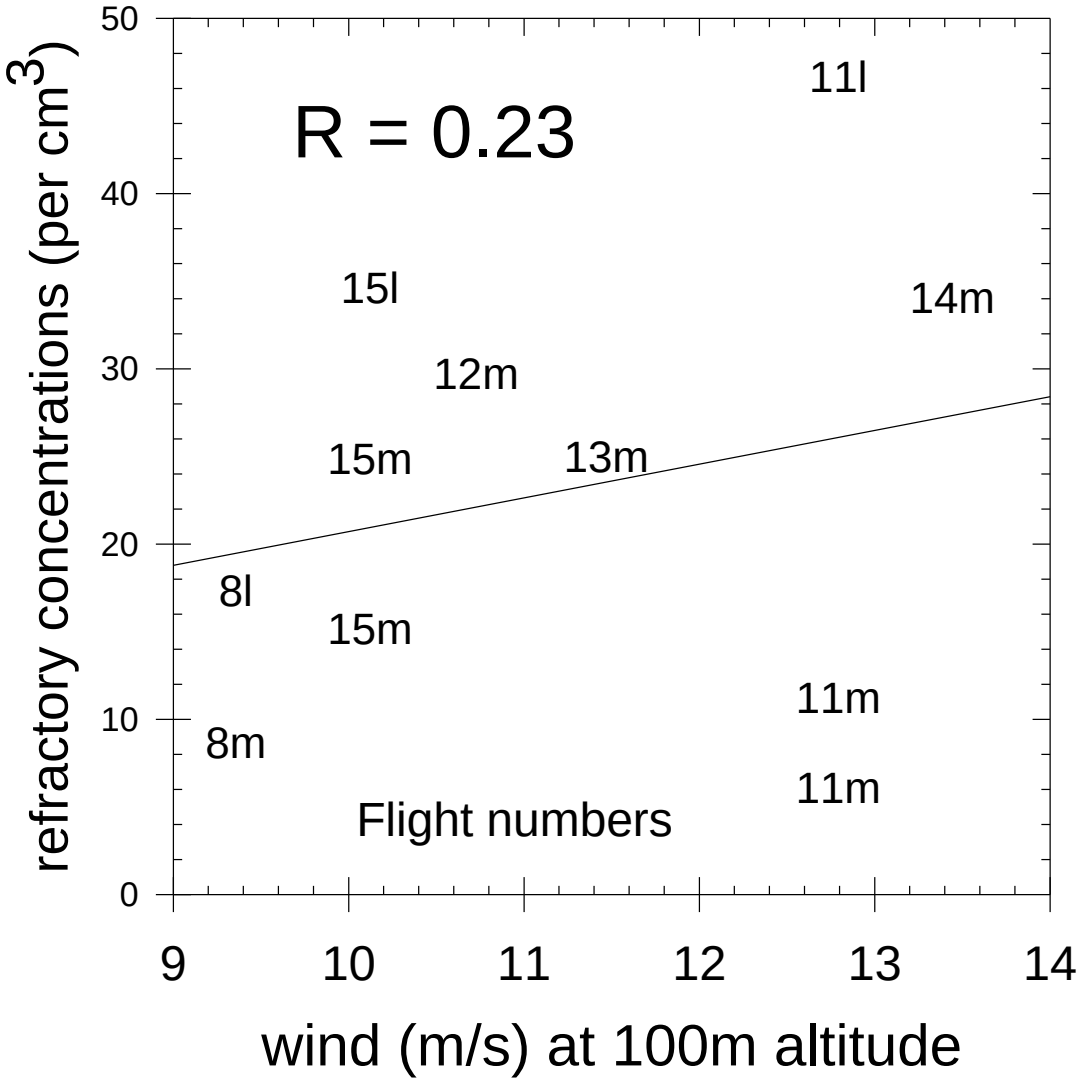
PASE volatility
refractory CCN 0.3% at 300C
versus wind velocity

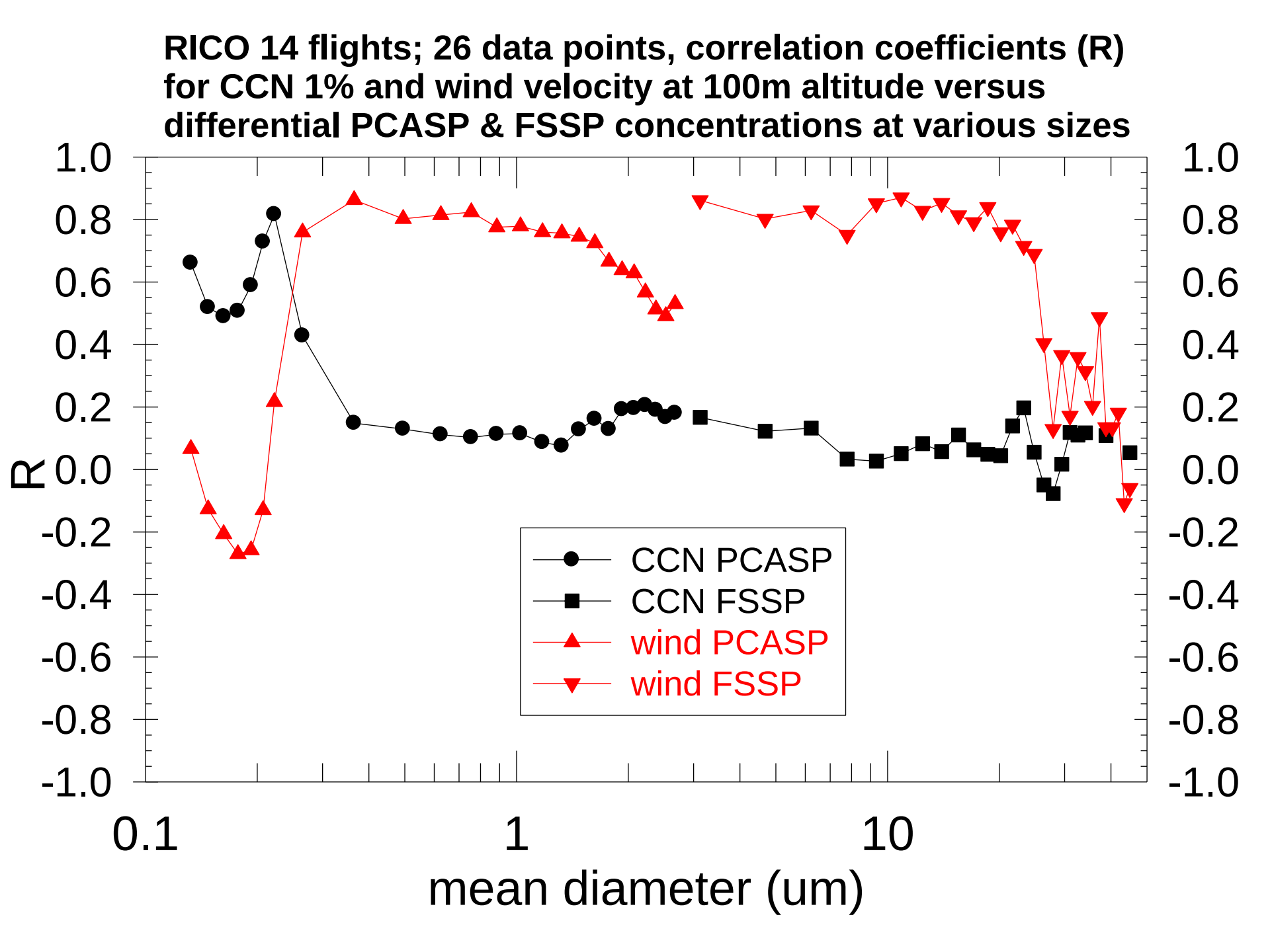


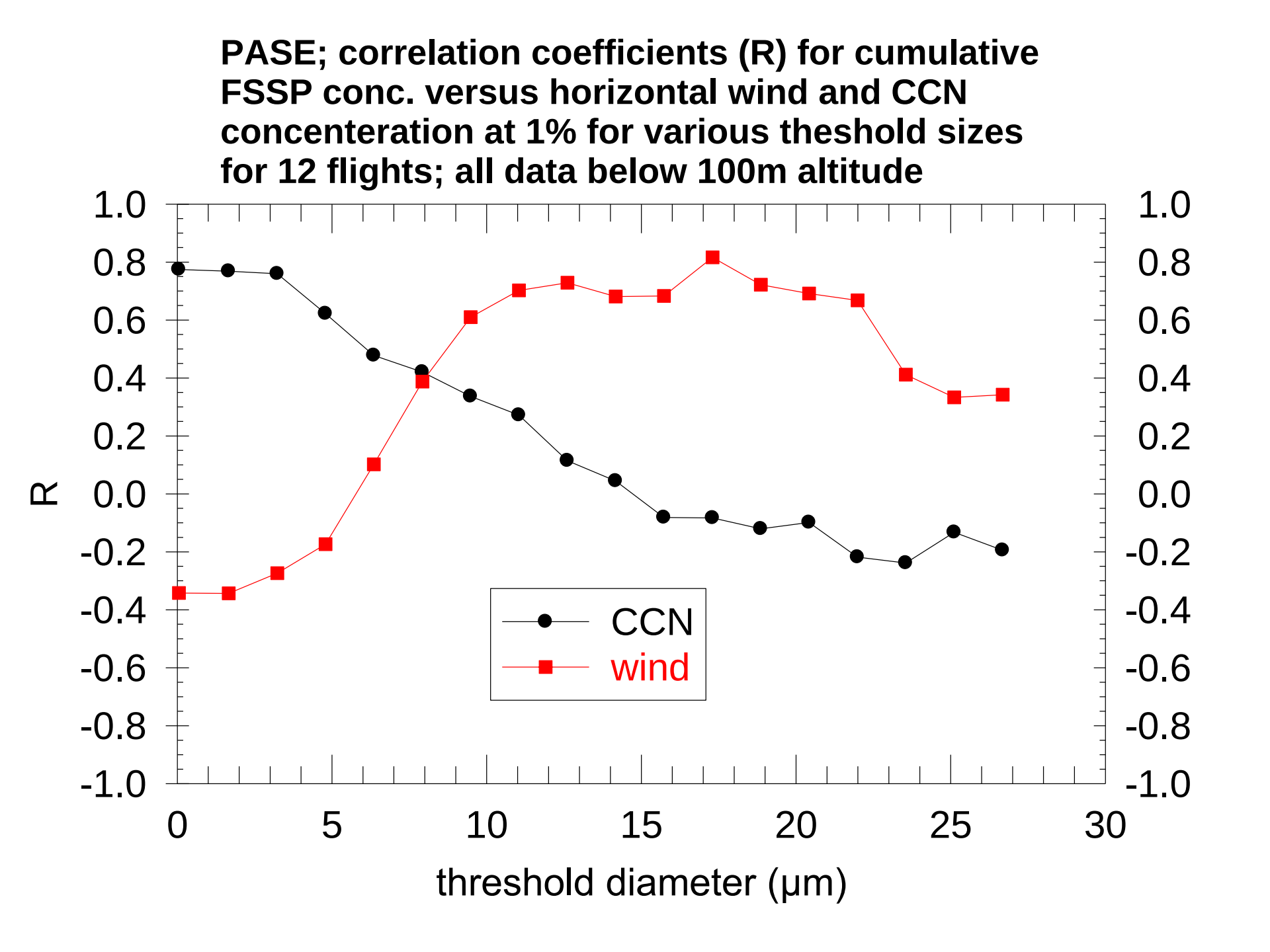
RICO volatility
refractory fraction of total CCN
at 300C versus wind velocity

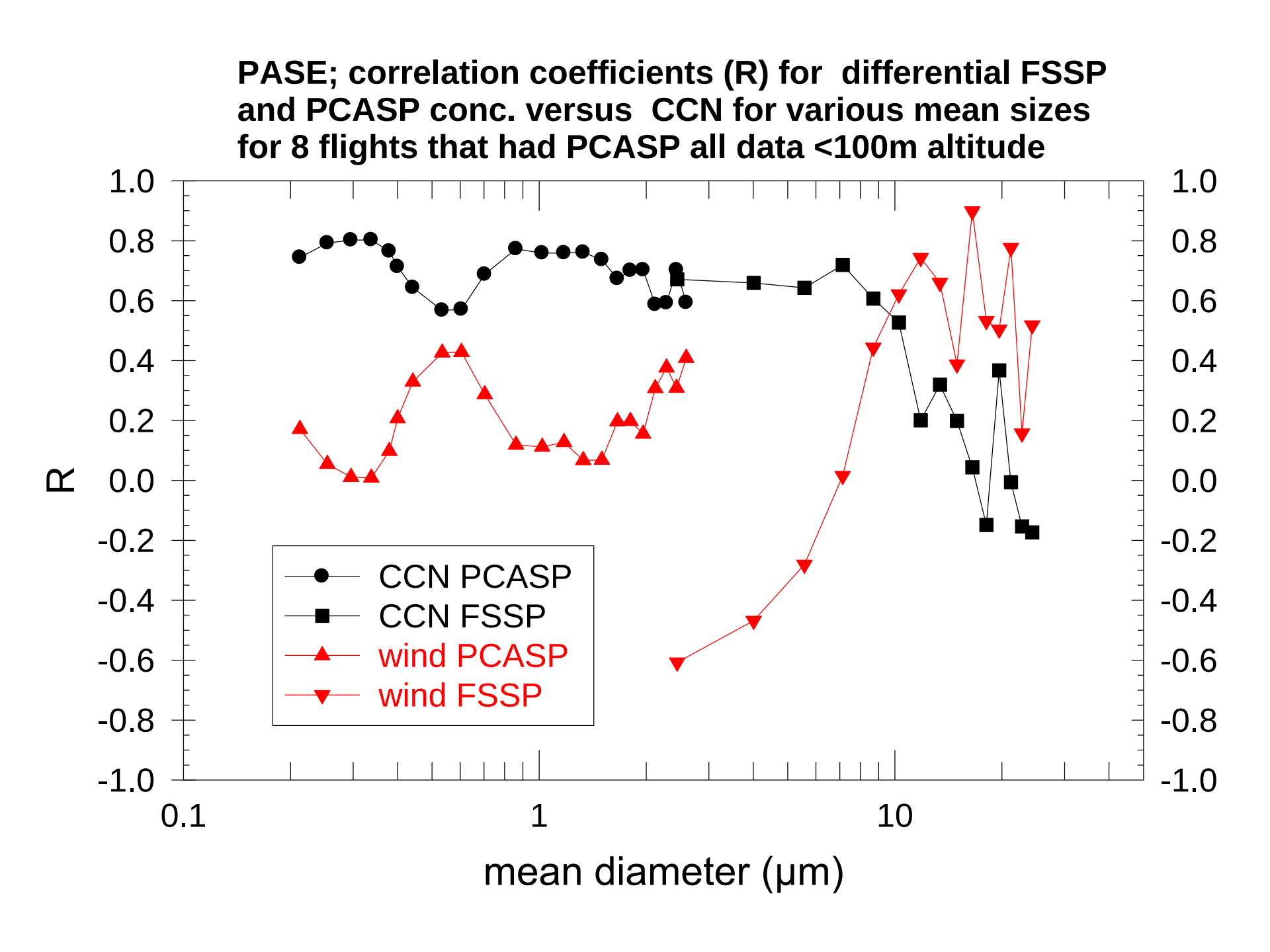


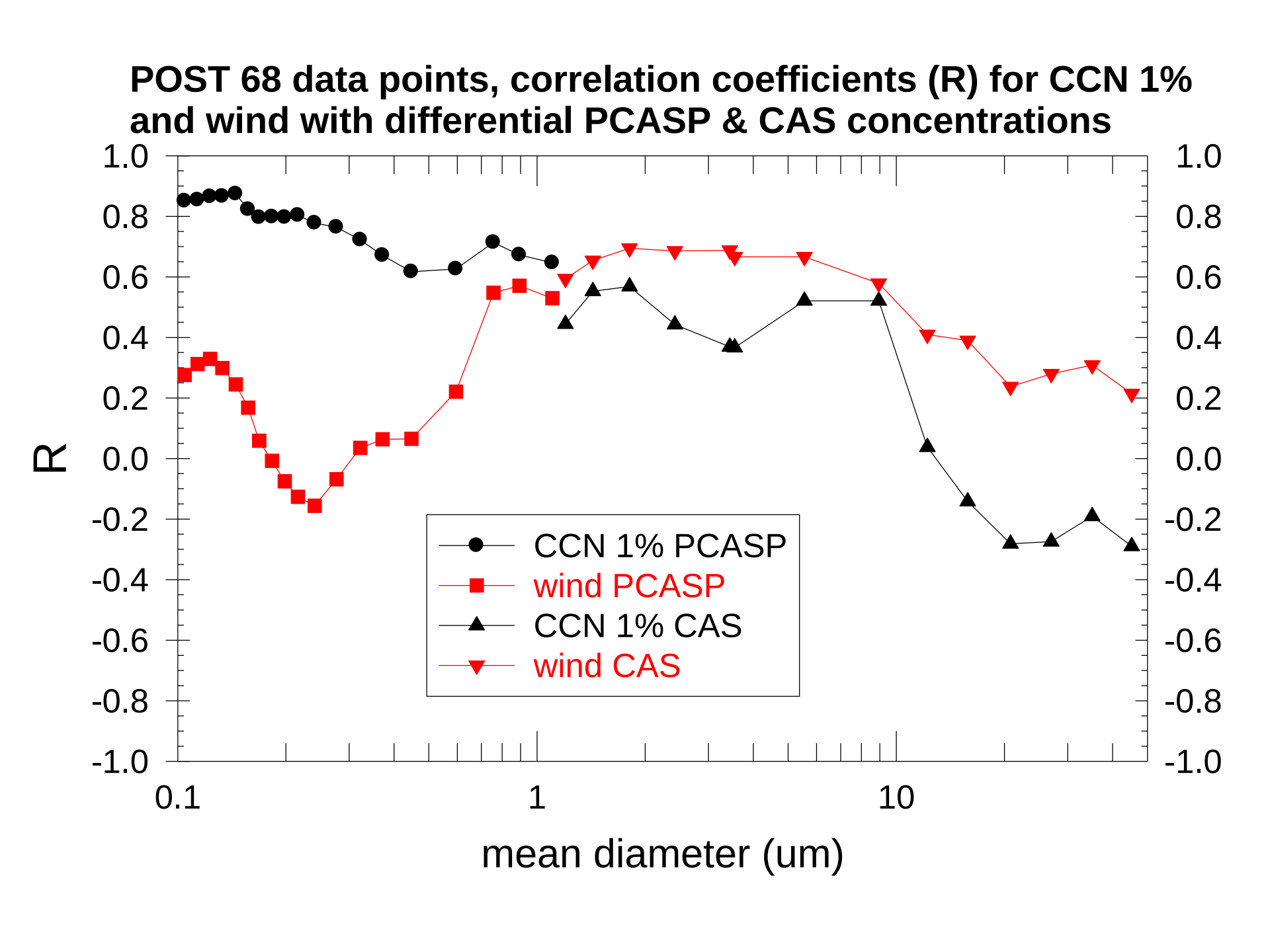
RICO volatility
refractory total CCN concentration
at 300C versus wind velocity




RICO 14 flights; 26 data points, correlation coefficients (R)
for CCN 1% and wind velocity at 100m altitude versus
differential PCASP & FSSP concentrations at various sizes
R
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0.1
1
10
mean diameter (um)
CCN PCASP
CCN FSSP
wind PCASP
wind FSSP


PASE; correlation coefficients (R) for cumulative FSSP conc. versus horizontal wind and CCN concenteration at 1% for various theshold sizes for 12 flights; all data below 100m altitude
R
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0
5
10
15
20
25
30
threshold diameter (μm)
CCN
wind


PASE; correlation coefficients (R) for differential FSSP and PCASP conc. versus CCN for various mean sizes for 8 flights that had PCASP all data <100m altitude
R
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0.1
1
10
mean diameter (μm)
CCN PCASP
CCN FSSP
wind PCASP
wind FSSP


POST 68 data points, correlation coefficients (R) for CCN 1% and wind with differential PCASP & CAS concentrations
R
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0.1
1
10
mean diameter (um)
CCN 1% PCASP
wind PCASP
CCN 1% CAS
wind CAS

0.3 micrometers diameter ~0.02% NaCl;
0.025% Ammonium sulfate
Large Nuclei; Giant Nuclei (GN)
related to CCN; to GN,
wind sea surface origin