TransCom continuous experiments: Comparison of radon concentrations at inland stations

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- Evaluation
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- Mean concentrations vs PBL
- Standard Deviations vs PBL
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- Correlations vs altitude

Motivation/Objective

- Performance of radon simulation might help to interpret the CO2 fluxes inferred from inverse method.
- Achievement of models toward the observations.

  Mean, Amplitude, Correlations
- Which process is the key ?

  Boundary layer, Moist Convective transport, Long range transport
- Inter-relationship among performances in different areas

  Inland, mountain, coast, remote

What is radon ?

- Source = Radium-226
- Lifetime = 3.8 days (Half) to Po
- Experimental protocol
- Land and ocean 70-90N,70-90S 0
- Land & ocean 60-70N,60-70S 8.3e-23
- Land 60S-60N, 1.66e-20
- Ocean 60S-60N, 8.30e-23 (mol m-2 s-1)
- Hourly concentrations in 2002/2003

data

Heidelberg

University of Heidelberg

Ingeborg Levin

Schauinsland(SCH) and Freiburg (FRb)

Federal Office for Radiation Protection, Germany,

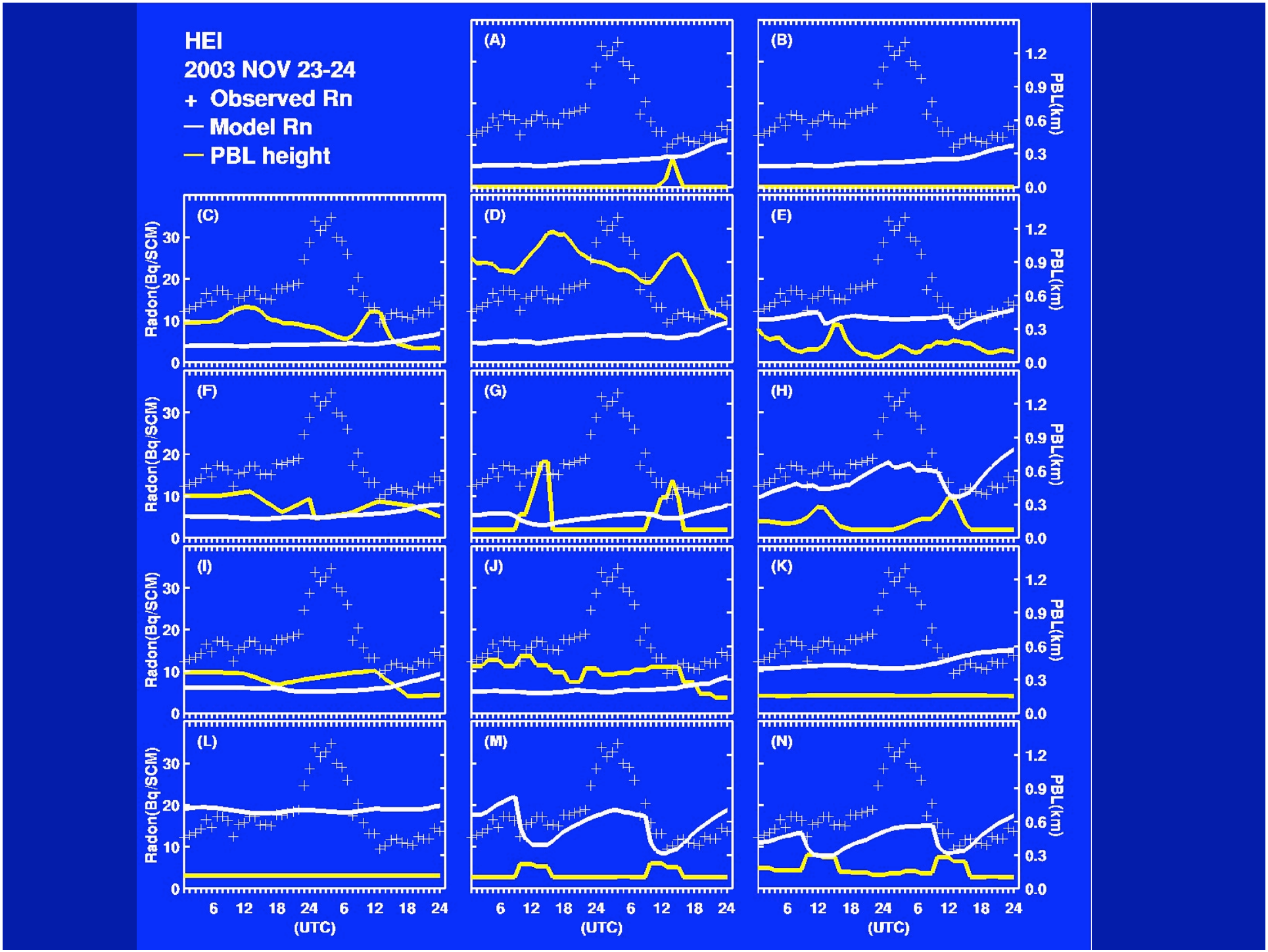
Hartmut Sartorius

14Models out of 28

- Radon.model.2002/3.
- Met.model.2002/3.(blh, p)
- X- all.model.xx
- Vertical profile of hourly data 2002 2003

Models

#.	On/Off	Meteor. data	Horizontal resolution	Vertical resolution	Transport scheme	Subgrid diffusion	Convective transport
A	On	NCEP	2.5x2.0	24ETA	Lin	LS	RAS
B	On	NCEP	(same as above)				
C	On	NCEP	-208km	18SIG	SLT	Louis	McGregor
D	On	NCEP	2.8x2.8	32SIG	LR	NL	AS
E	On	NCEP	1.1x1.1	32SIG	LR	NL	AS
F	Off	GEOS4	2.5x2.0	55ETA	LR	Kzz	Rasch
G	On	NCEP	-240km	54TER	Miura	MY	AS
H	Off	NCEP	1.0x1.0	47SIG	SLT	NL	none
I	Off	GEOS4	1.25x1.0	25ETA	LR	NL	ZM/Ha
J	Off	GEOS4	2.5x1.0	(same as above)			
K	Off	ECMWF	1.125x1.125	60ETA	SLT	NL	none
L	Off	NCEP	1.875x1.9	28SIG	SLT	NL	none
M	Off	ECMWF	3x2(1x1 Europe)	25ETA	RL	NL	Tiedtke
N	Off	ECMWF	3x2	(same as above)			


HEI
2003 NOV 23-24
+ Observed Rn
— Model Rn
— PBL height
(A)
(B)
(C)
(D)
(E)
(F)
(G)
(H)
(I)
(J)
(K)
(L)
(M)
(N)
Radon(Bq/SCM)
PBL(km)
0
10
20
30
0.0
0.3
0.6
0.9
1.2
6
12
18
24
(UTC)

Model evaluations

1) Seasonal Mean Concentrations

2) Hourly Standard Deviations

3) Daily mean Standard deviations

4) Hourly correlations

5) Daily Mean correlations

Single bar=daily mean

Double bars=seasonal mean

Rader diagram=ratio from 14model average

$$\exp(-|\overline{\overline{M}} - \overline{\overline{O}}|)$$

$$\exp(-|Std(M) - Std(O)|)$$

$$\exp(-|Std(\overline{M}) - Std(\overline{O})|)$$

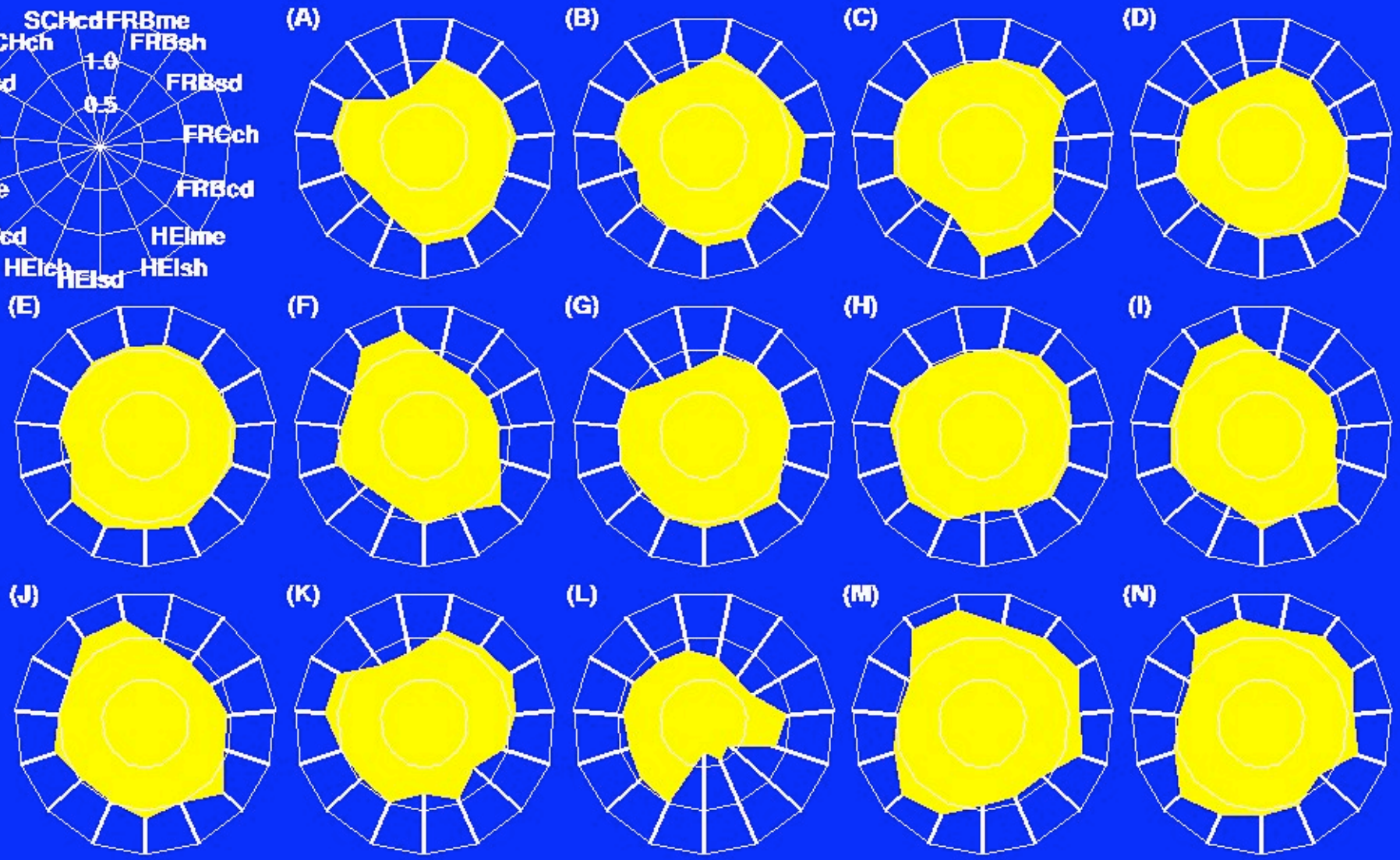
$$Cor(M \,\&\, O)$$

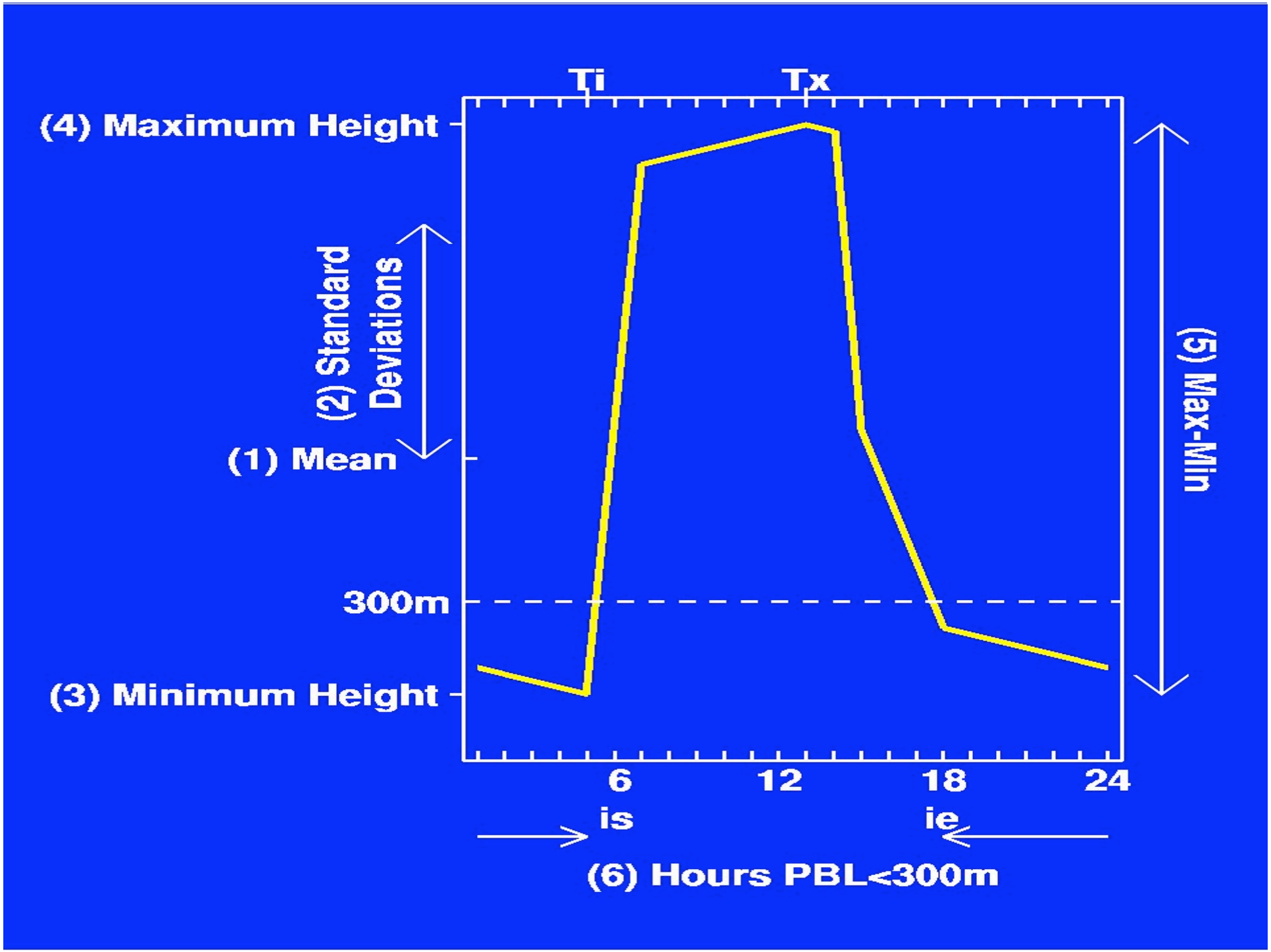
$$Cor(\overline{M} \,\&\, \overline{O})$$

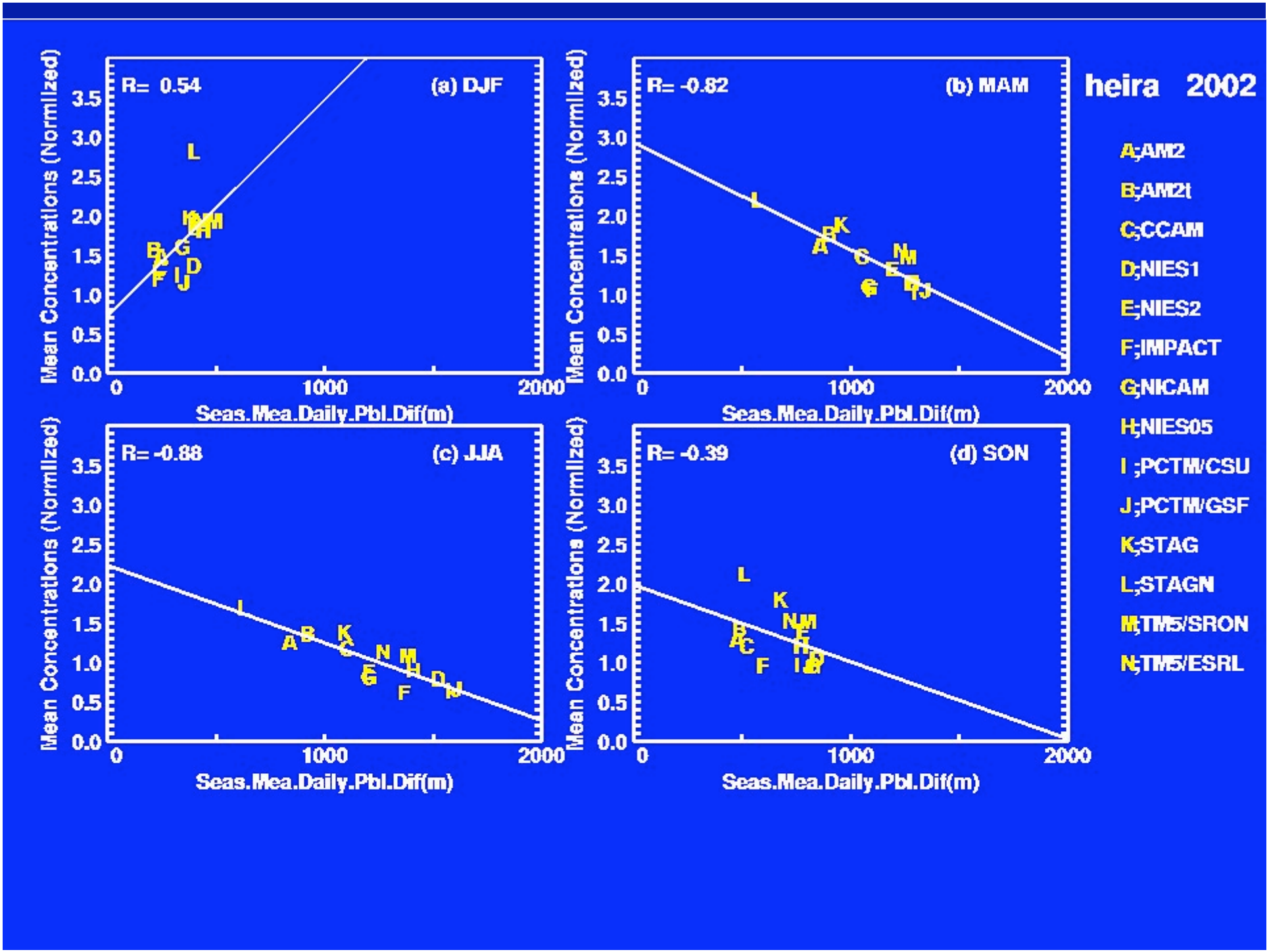
$$\overline{x}$$

$$\overline{\overline{x}}$$

Rader Diagram of Performance Relative to Model Mean




Ti
Tx
(4) Maximum Height
(2) Standard Deviations
(1) Mean
300m
(3) Minimum Height
(5) Max-Min
6
12
18
24
is
ie
(6) Hours PBL<300m


heira 2002
A;AM2
B;AM2t
C;CCAM
D;NIES1
E;NIES2
F;IMPACT
G;NICAM
H;NIES05
I ;PCTM/CSU
J;PCTM/GSF
K;STAG
L;STAGN
M;TM5/SRON
N;TM5/ESRL
R= 0.54
(a) DJF
R= -0.82
(b) MAM
R= -0.88
(c) JJA
R= -0.39
(d) SON
Mean Concentrations (Normlized)
Seas.Mea.Daily.Pbl.Dif(m)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
0
1000
2000

Seas.Mean.Cons vs Max-Min

		DJF	MAM	JJA	SON
FRB	2002	0.59	-0.62	-0.84	-0.40
	2003	0.43	-0.64	-0.85	-0.33
HEI	2002	0.54	-0.82	-0.88	-0.39
	2003	0.27	-0.72	-0.87	-0.36
SCH	2002	0.11	-0.66	-0.66	-0.51
	2003	-0.06	-0.39	-0.64	-0.25

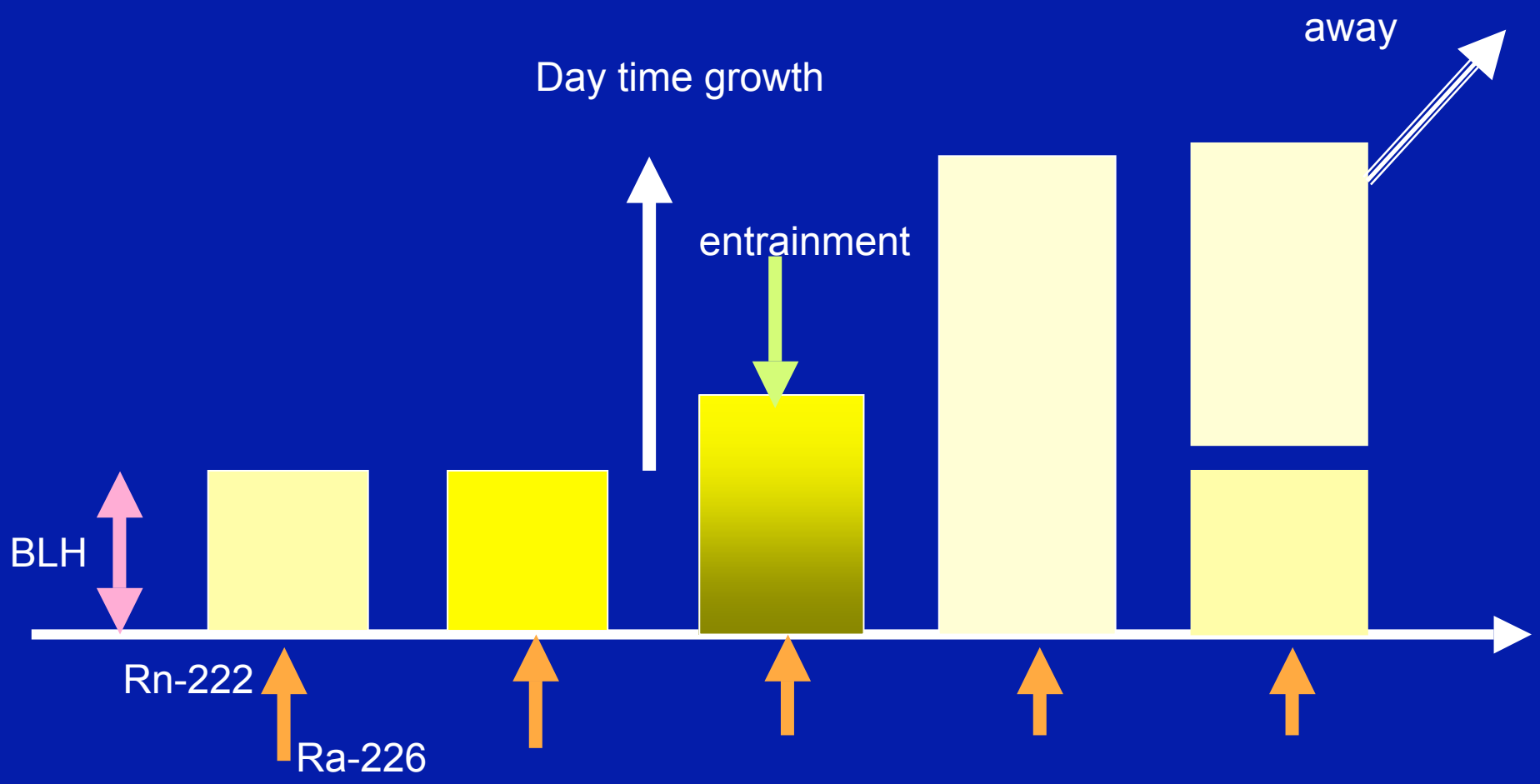
STD vs Max-Min

		DJF	MAM	JJA	SON
FRB	2002	0.60	-0.54	-0.79	-0.36
	2003	0.44	-0.52	-0.79	-0.25
HEI	2002	0.60	-0.73	-0.76	-0.24
	2003	0.34	-0.53	-0.74	-0.15
SCH	2002	0.34	-0.79	-0.74	-0.48
	2003	0.30	-0.58	-0.63	-0.28

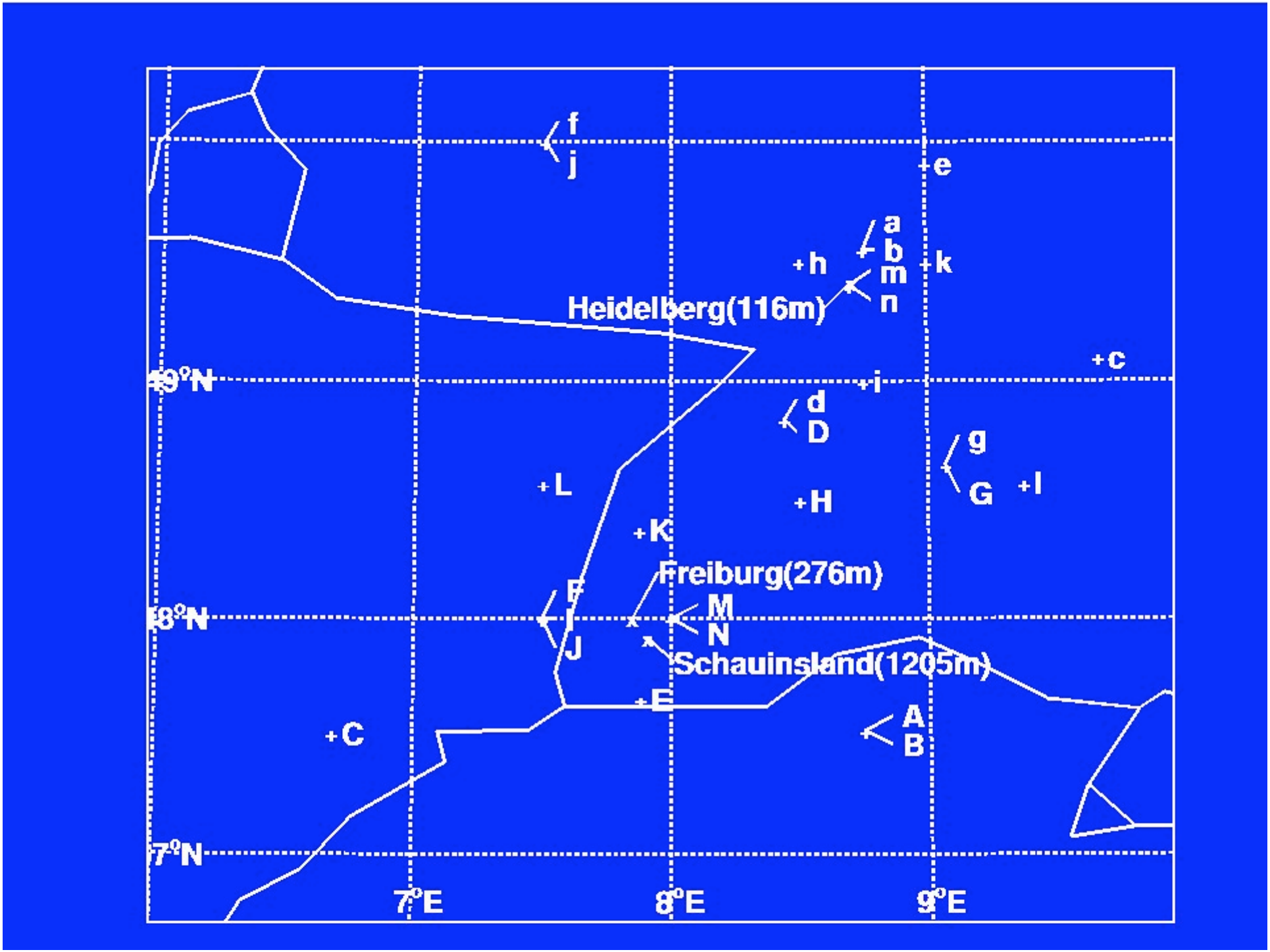
Mean/Variance and PBL(Max-Min)

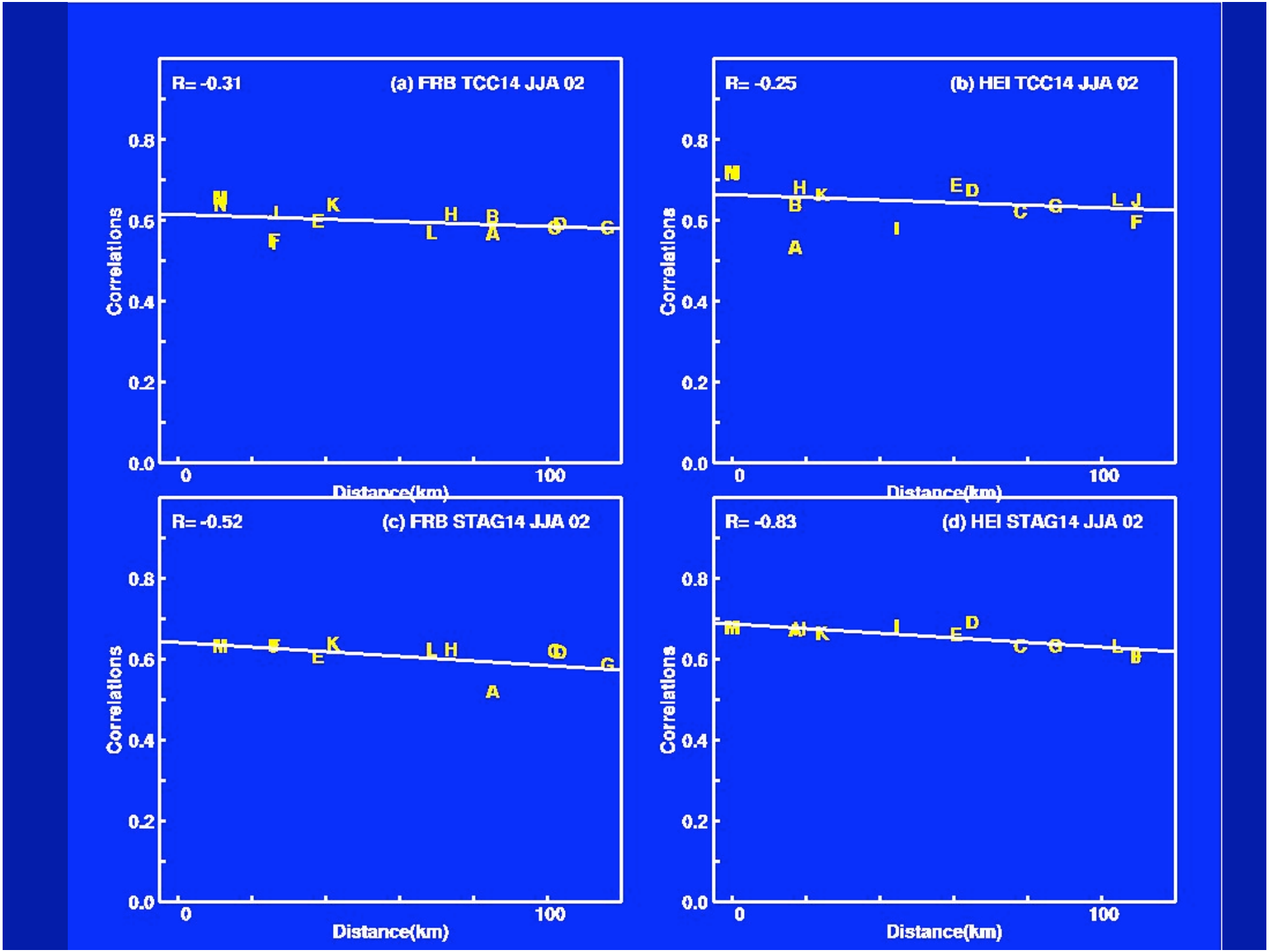
- DJF
  PBL Max-Min increase
  → Mean cons up, Variance up
- MAM and JJA
  PBL Max-Min increase
  → Mean cons down, variance down
- SON
  PBL has no relation with cons

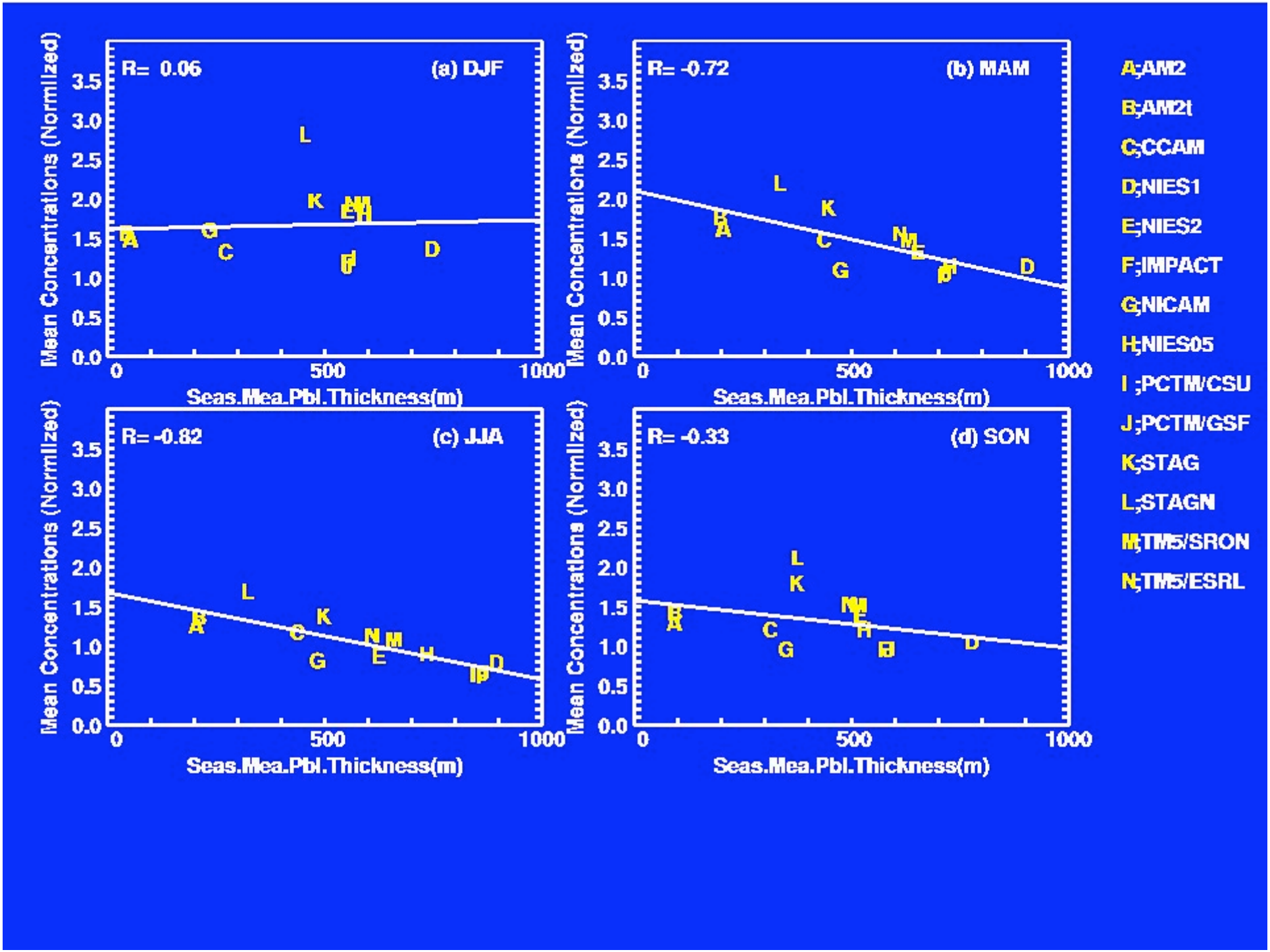
Go with the wind model

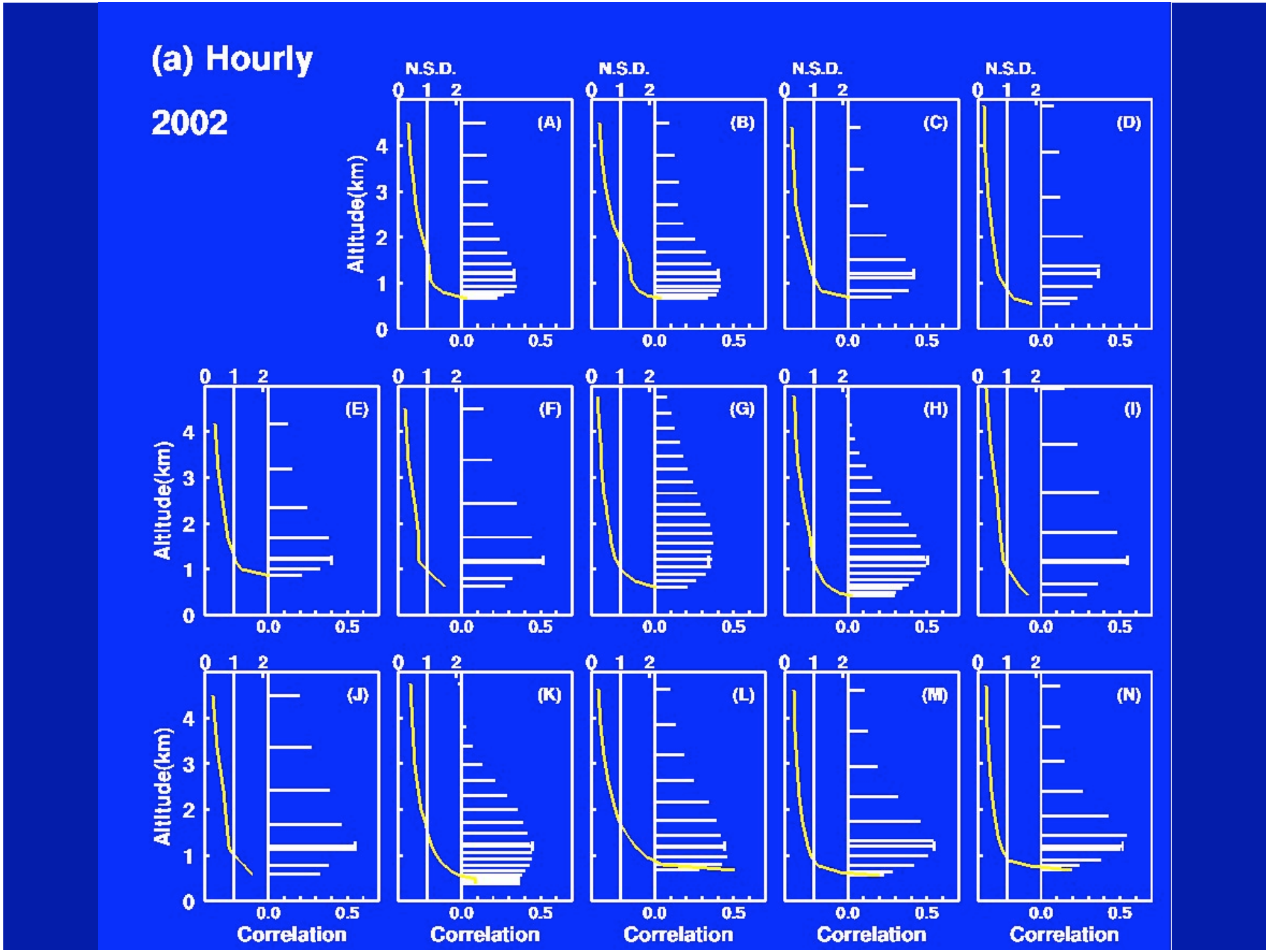


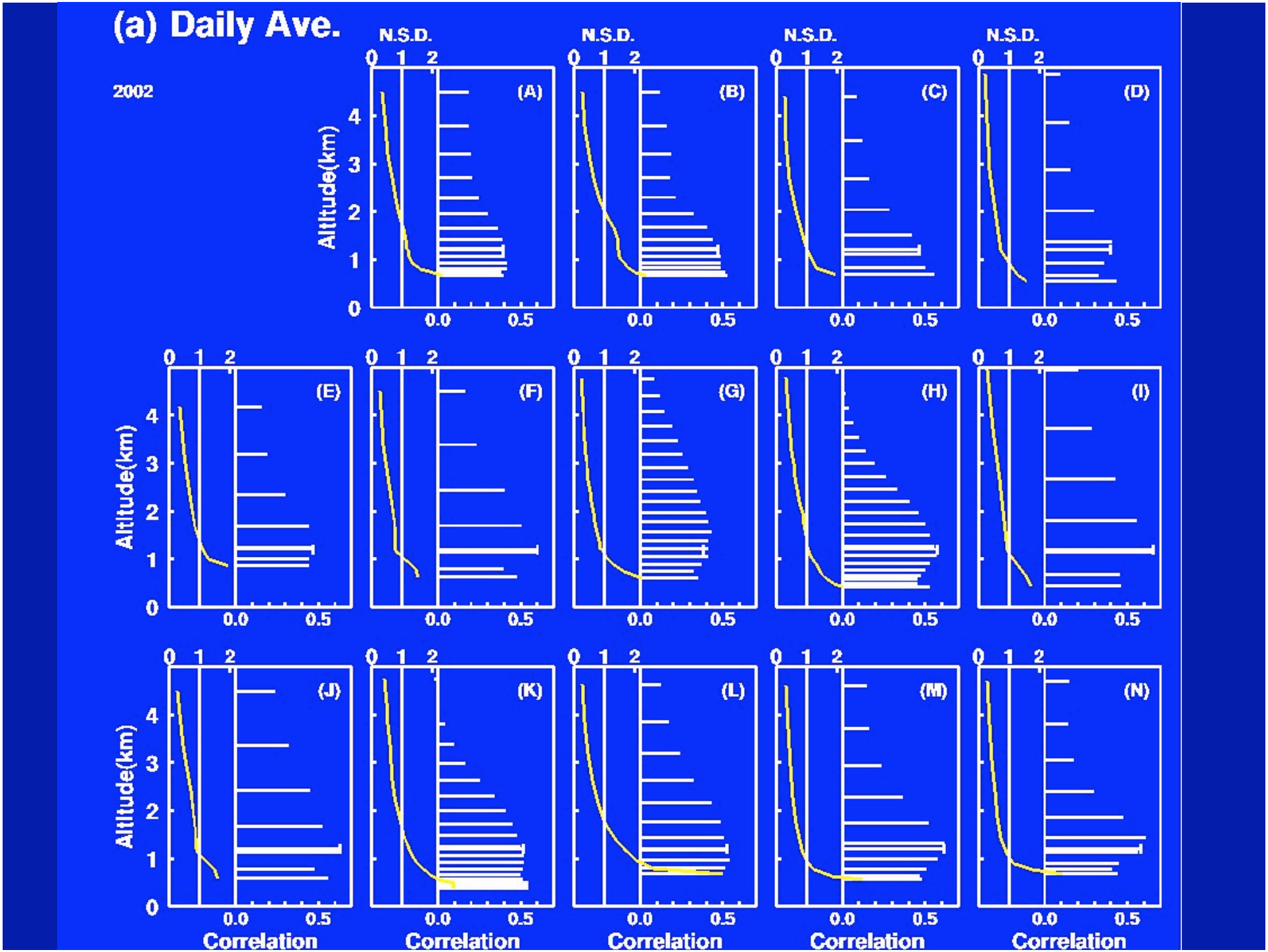
(a)
(b)
(c)
(d)
PBL Height
Mass in PBL
Concentrations
Max-Min
1 2 3 4
Days


f
j
e
a
b
m
n
h
k
Heidelberg(116m)
c
9°N
i
d
D
g
G
l
L
H
K
Freiburg(276m)
F
M
8°N
N
J
Schauinsland(1205m)
E
A
B
C
7°N
7°E
8°E
9°E


R= -0.31
(a) FRB TCC14 JJA 02
R= -0.25
(b) HEI TCC14 JJA 02
R= -0.52
(c) FRB STAG14 JJA 02
R= -0.83
(d) HEI STAG14 JJA 02
Correlations
Distance(km)
0.0
0.2
0.4
0.6
0.8
0
100

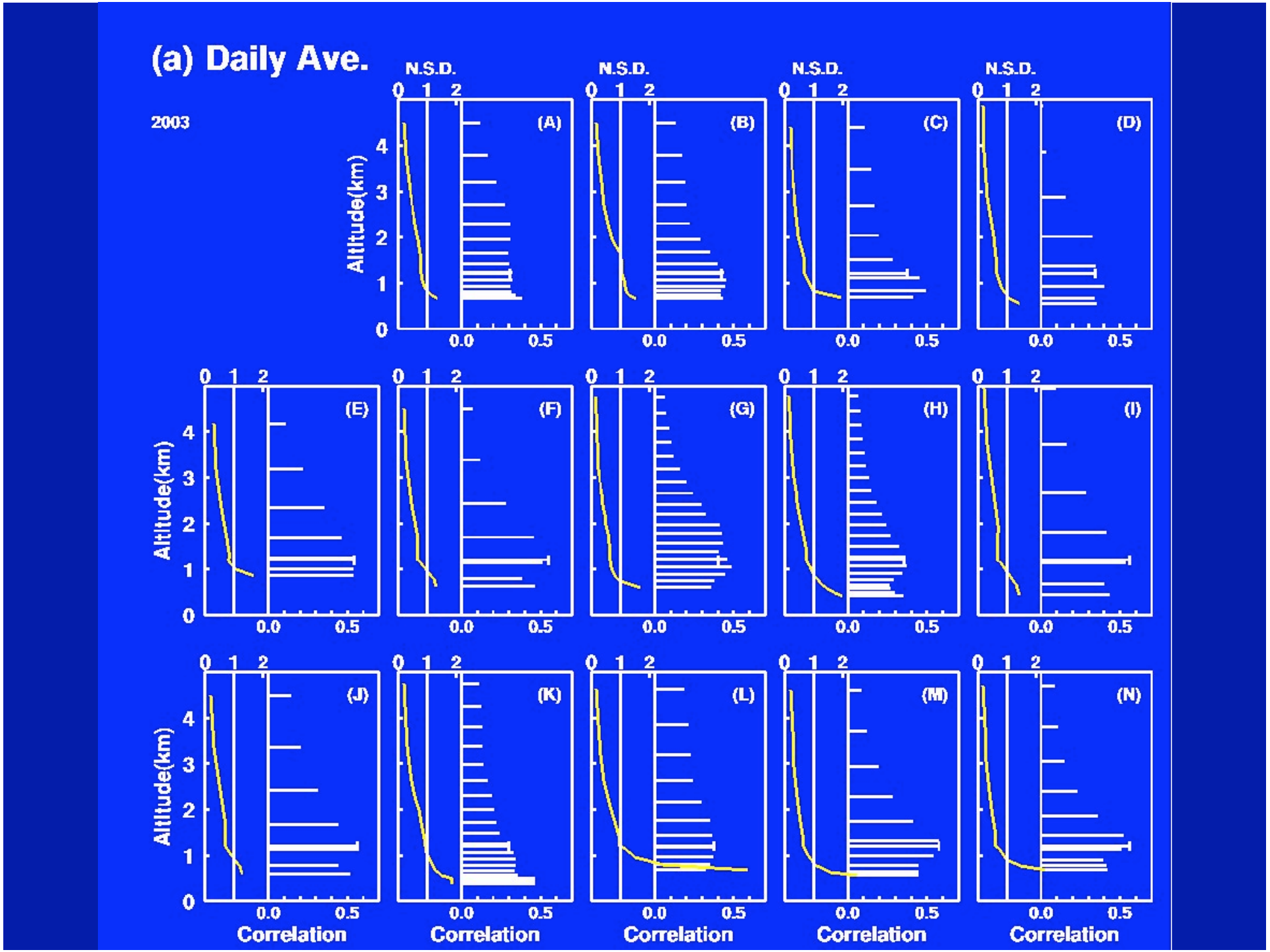

R= 0.06
(a) DJF
R= -0.72
(b) MAM
R= -0.82
(c) JJA
R= -0.33
(d) SON
Mean Concentrations (Normlized)
Seas.Mea.Pbl.Thickness(m)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
0
500
1000
A;AM2
B;AM2t
C;CCAM
D;NIES1
E;NIES2
F;IMPACT
G;NICAM
H;NIES05
I ;PCTM/CSU
J;PCTM/GSF
K;STAG
L;STAGN
M;TM5/SRON
N;TM5/ESRL


(a) Hourly
2002
N.S.D.
Altitude(km)
Correlation
(A)
(B)
(C)
(D)
(E)
(F)
(G)
(H)
(I)
(J)
(K)
(L)
(M)
(N)


(a) Daily Ave.
2002
N.S.D.
Altitude(km)
Correlation
(A)
(B)
(C)
(D)
(E)
(F)
(G)
(H)
(I)
(J)
(K)
(L)
(M)
(N)

conclusions

- At inland stations, performances of models are different among mean, standard deviations, and correlations.
- Seasonal mean concentrations and standard deviations are function of PBL variance except autumn.
- Correlations between model and observations are function of distance between sampling point in the model and actual location of the observational sites both for hourly and daily mean concentration.


(a) Daily Ave.
2003
N.S.D.
Altitude(km)
Correlation
(A)
(B)
(C)
(D)
(E)
(F)
(G)
(H)
(I)
(J)
(K)
(L)
(M)
(N)

Correlations-Hourly FRB/HEI 02/03 4SEASONS /Cor(K)

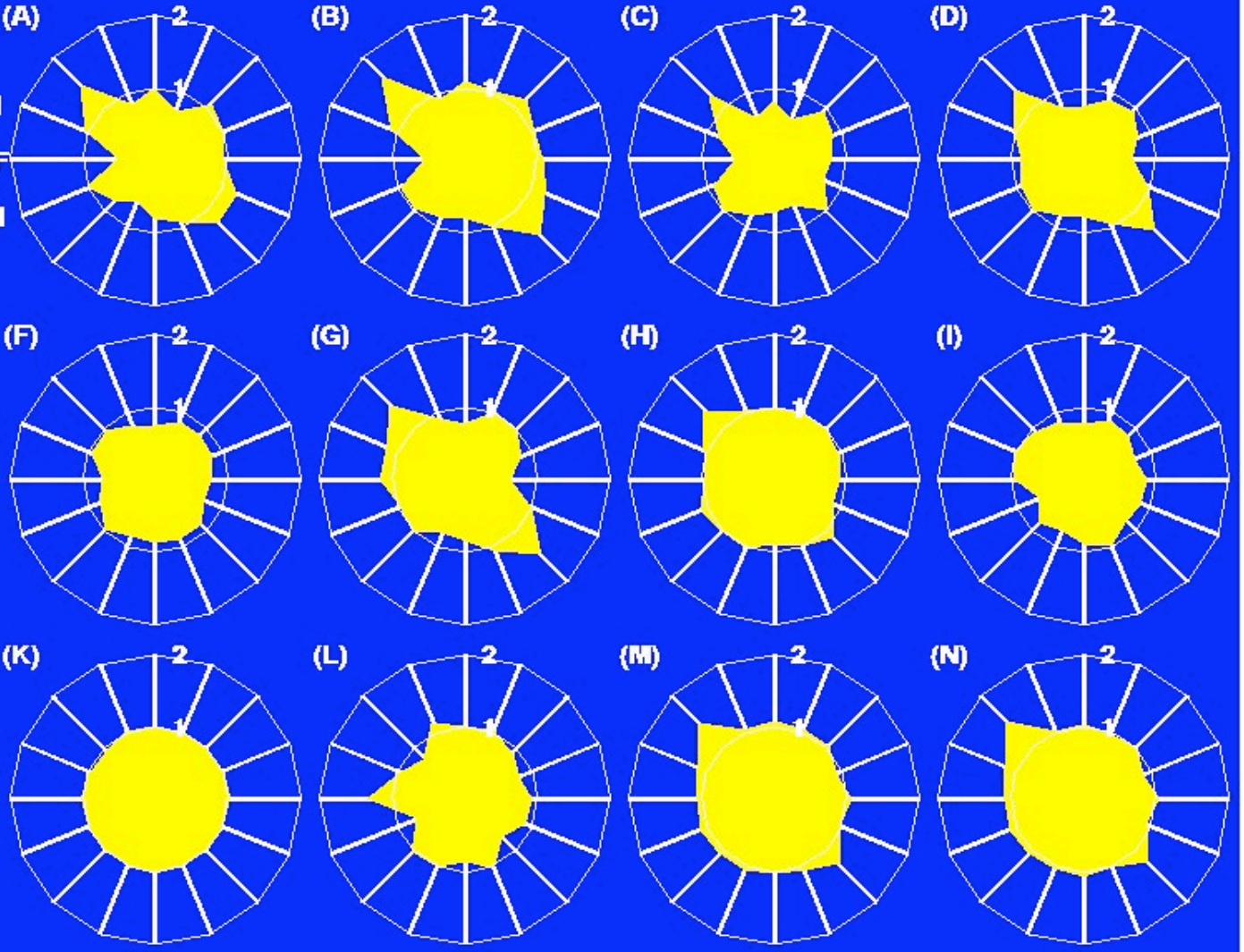


Table 4. Mean correlations averaged over a season

	DFJ	MAM	JJA	SON
FRB 02	0.68±0.10	0.55±0.12	0.60±0.03	0.59±0.05
FRB 03	0.56±0.13	0.54±0.05	0.57±0.08	0.58±0.09
HEI 02	0.59±0.07	0.54±0.08	0.65±0.05	0.58±0.08
HEI 03	0.52±0.14	0.57±0.06	0.54±0.11	0.58±0.09
SCH 02	0.61±0.14	0.34±0.12	0.38±0.07	0.51±0.11
SCH 03	0.26±0.13	0.49±0.11	0.24±0.13	0.45±0.08