Investigation of SGP Atmospheric Moisture Budget for CLASIC – Recycling Study

Contributors

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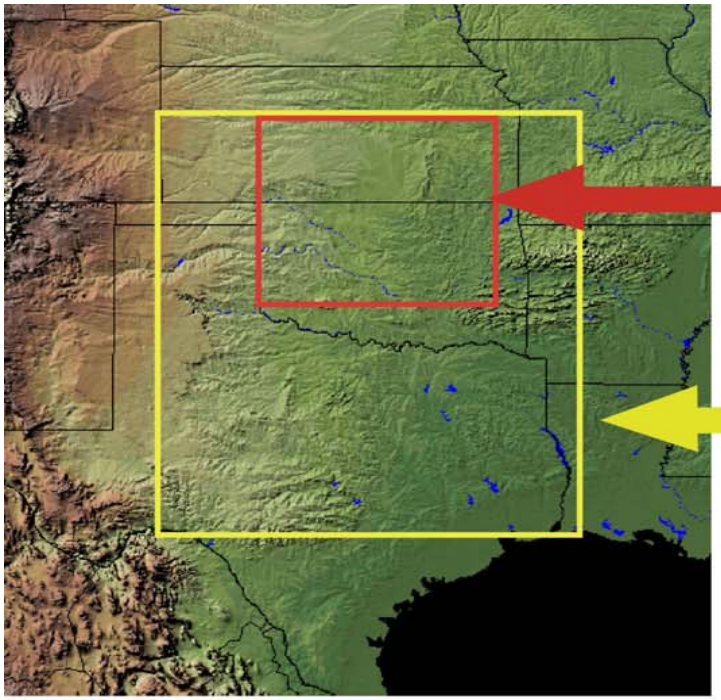
Background

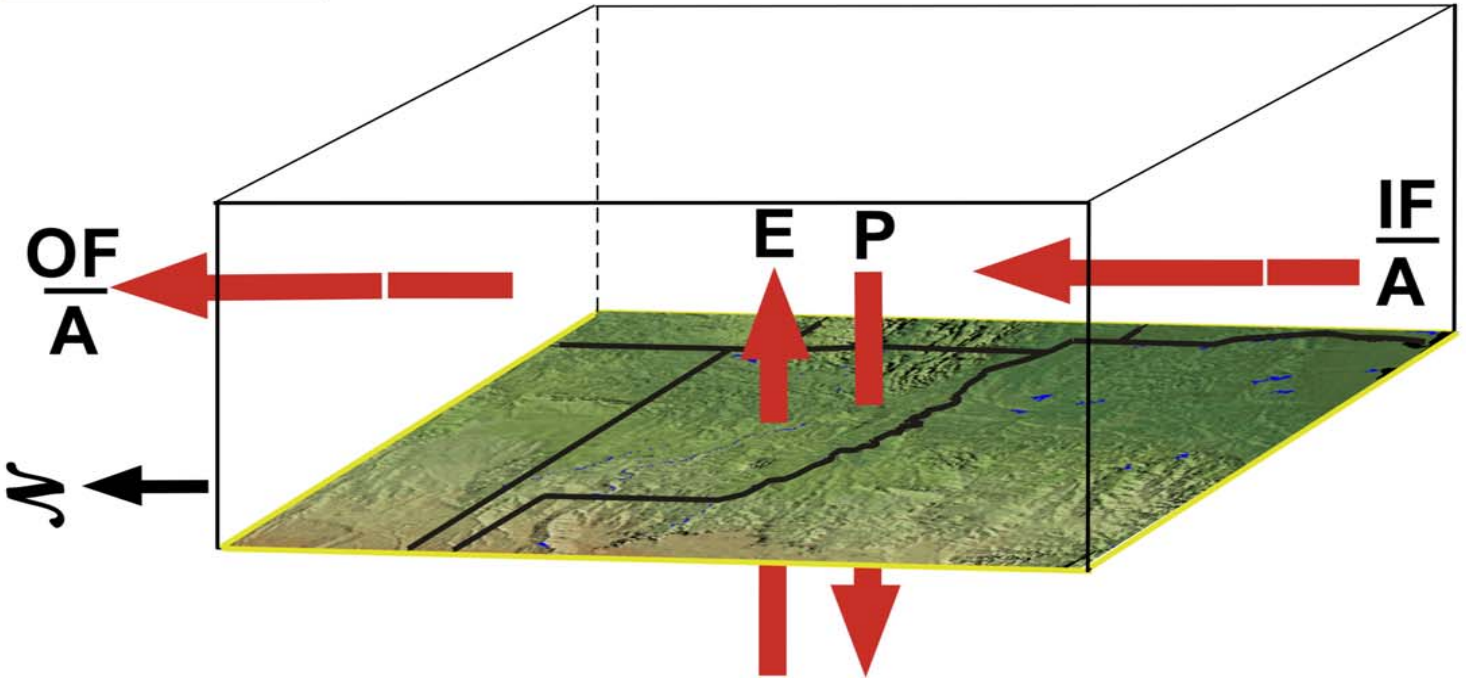
- Motivation: to provide larger-scale background for the interpretation of the results of CLASIC
- Moisture budgets and related variables are analyzed over a large area encompassing the CLASIC field study for May-June periods with contrasting precipitation regimes
- Emphasis will be given to the relative contribution to regional precipitation from local vs advective atmospheric water vapor.
- Follows the methods of a recently completed investigation of the moisture budget over the Midwestern Corn Belt (Zangvil et al. 2001, 2004)



CLASIC Field Campaign

Study Area

"Tank Model"



Moisture Budget Equation

$$E - P \equiv \frac{1}{g}\frac{\partial}{\partial t}\int_S^T q\,dp + \frac{1}{g}\int_S^T \mathbf{V}\bullet\nabla q\,dp + \frac{1}{g}\int_S^T q\,\nabla\bullet\mathbf{V}\,dp$$

E-P | **dPW** | **HA** | **HD**

$$HA + HD = \frac{1}{g}\int_S^T \nabla\bullet qV\,dp = \frac{1}{Ag}\int_S^T \oint q V_n\,dl\,dp = \frac{OF}{A} - \frac{IF}{A}$$

Recycling Ratio

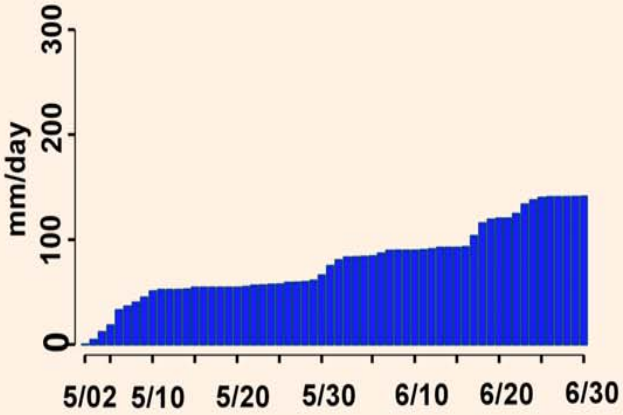
$$\frac{P_{(\text{Local Origin})}}{P_{(\text{Local + Advective})}} = \frac{P_E}{P} = \frac{E}{E + \frac{IF}{A}}$$

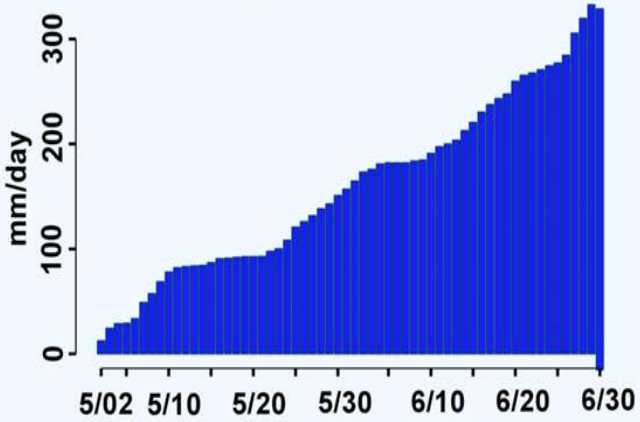
See Zangvil et al. 2004 for derivation

2006

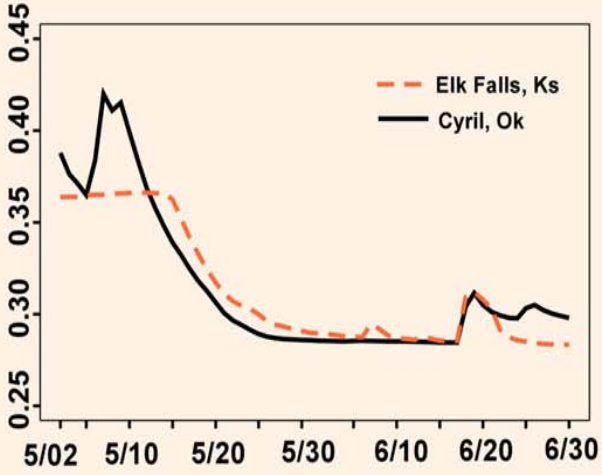
2007

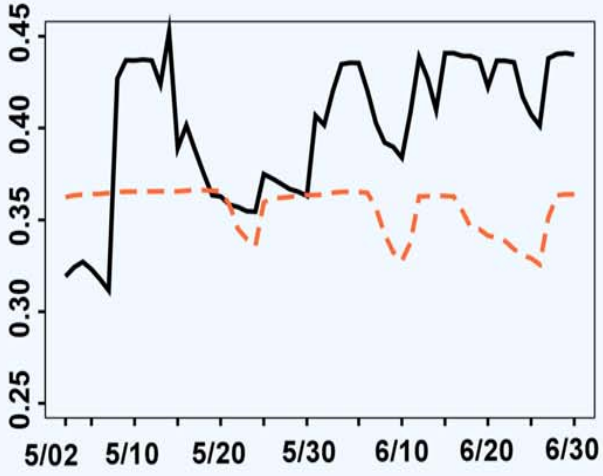
Cumulative Precipitation over Study Area

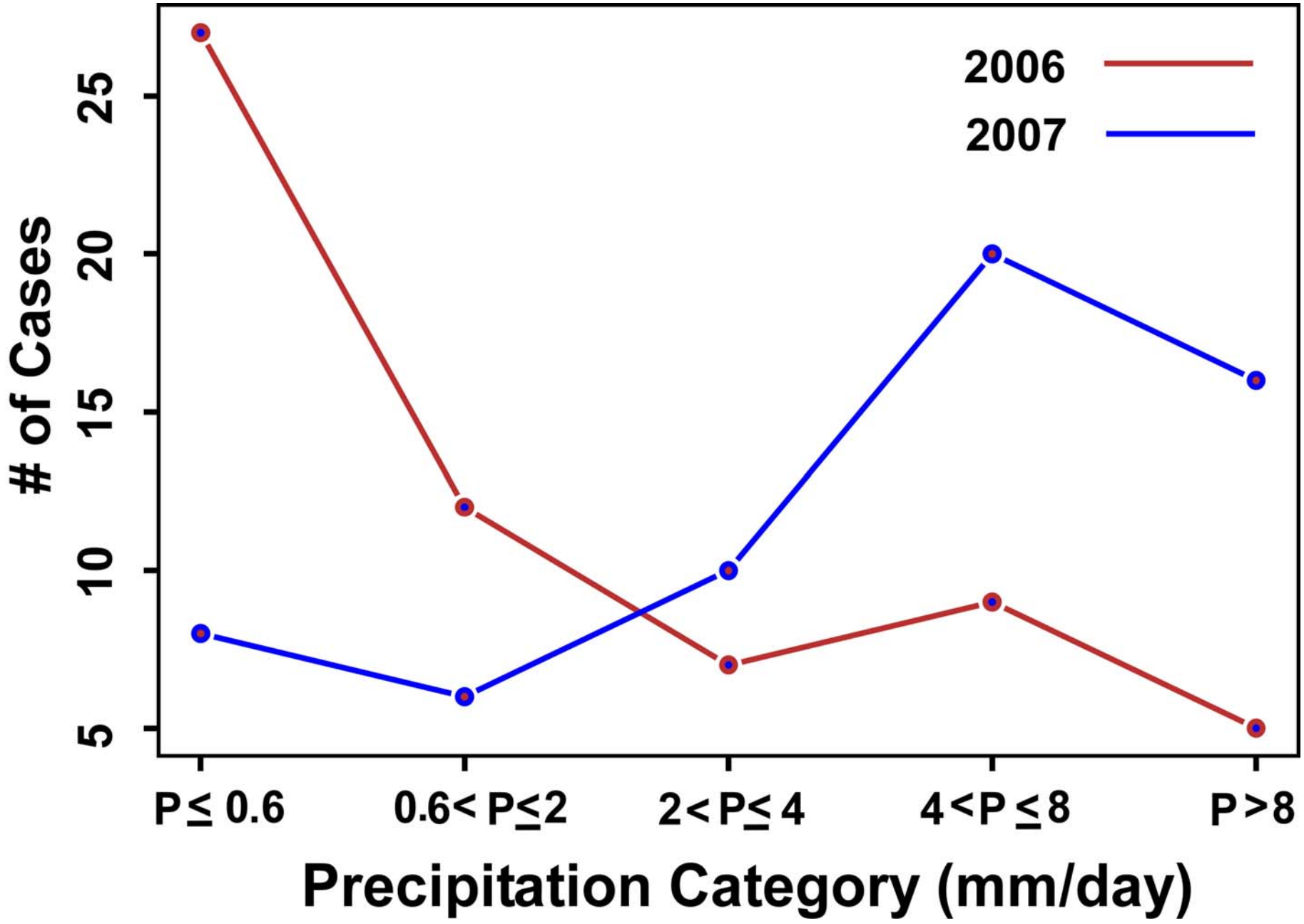


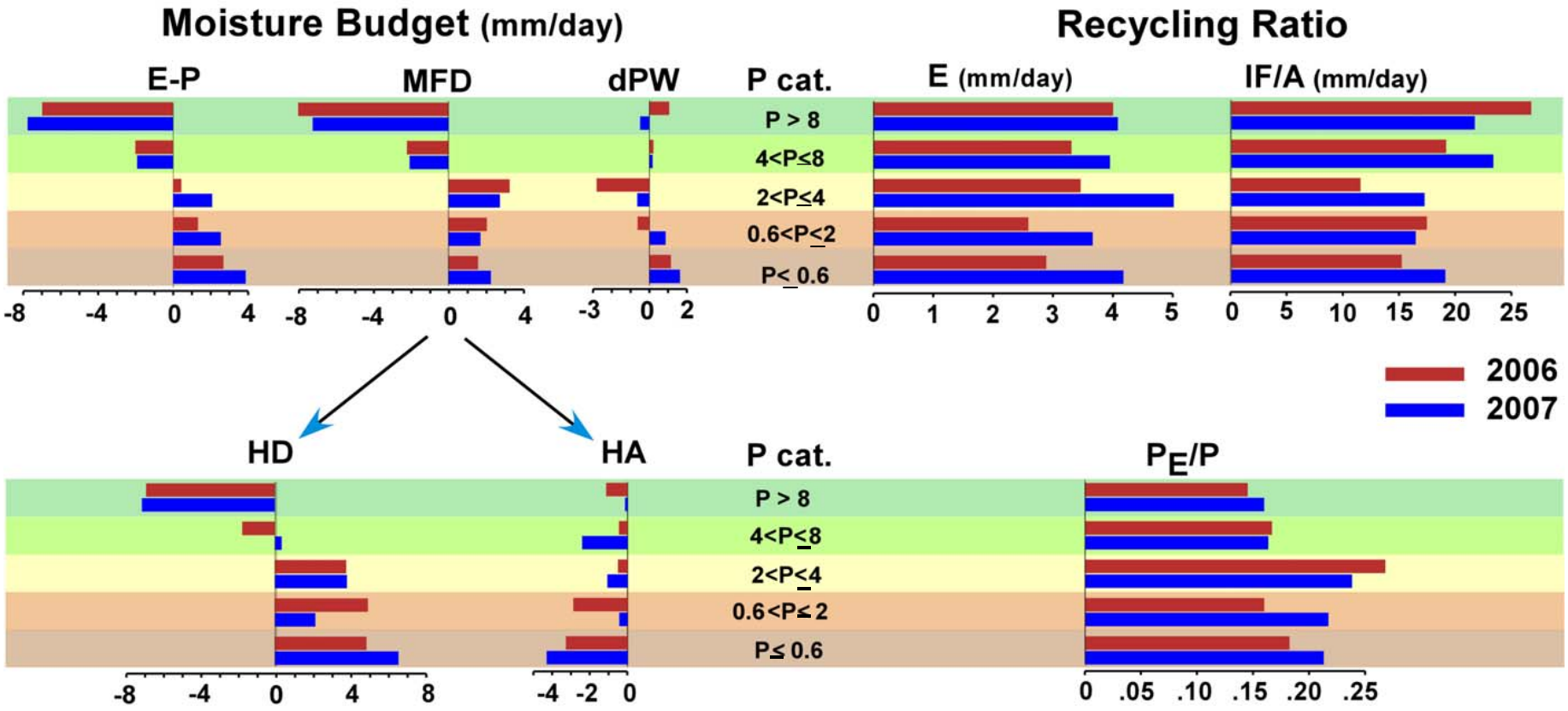


Volumetric Soil Moisture at 5cm from ARM SWATS






2006
2007
# of Cases
5
10
15
20
25
P ≤ 0.6
0.6< P ≤2
2< P ≤ 4
4 <P ≤ 8
P >8
Precipitation Category (mm/day)



> P is highly correlated with E-P, HD, and MFD

> Recycling ratio comparison: wet 2007 vs dry 2006

- P > 4 mm/day: P_E/P is ~ constant.
- P ≤ 2 mm/day: P_E/P is greater for the wet 2007
- 2 < P ≤ 4 mm/day: P_E/P is greater for dry 2006 due to reduced IF/A

Correlation Among Above Components for May - June 2006 and 2007

	E-P	E	P	MFD	HD	HA	dPW	IF/A	P_E/P
E-P	+1.00	+0.20	-0.91	+0.72	+0.76	-0.12	+0.13	-0.24	+0.35
E	+0.20	+1.00	+0.23	+0.08	-0.09	+0.19	+0.10	+0.15	+0.51
P	-0.91	+0.23	+1.00	-0.68	-0.80	+0.21	-0.09	+0.30	-0.13
MFD	+0.72	+0.08	-0.68	+1.00	+0.61	+0.36	-0.60	-0.40	+0.36
HD	+0.76	-0.09	-0.80	+0.61	+1.00	-0.52	+0.01	-0.38	+0.21
HA	-0.12	+0.19	+0.21	+0.36	-0.52	+1.00	-0.66	+0.02	+0.14
dPW	+0.13	+0.10	-0.09	-0.60	+0.01	-0.66	+1.00	+0.28	-0.11
IF/A	-0.24	+0.15	+0.30	-0.40	-0.38	+0.02	+0.28	+1.00	-0.62
P_E/P	+0.35	+0.51	-0.13	+0.36	+0.21	+0.14	-0.11	-0.62	+1.00

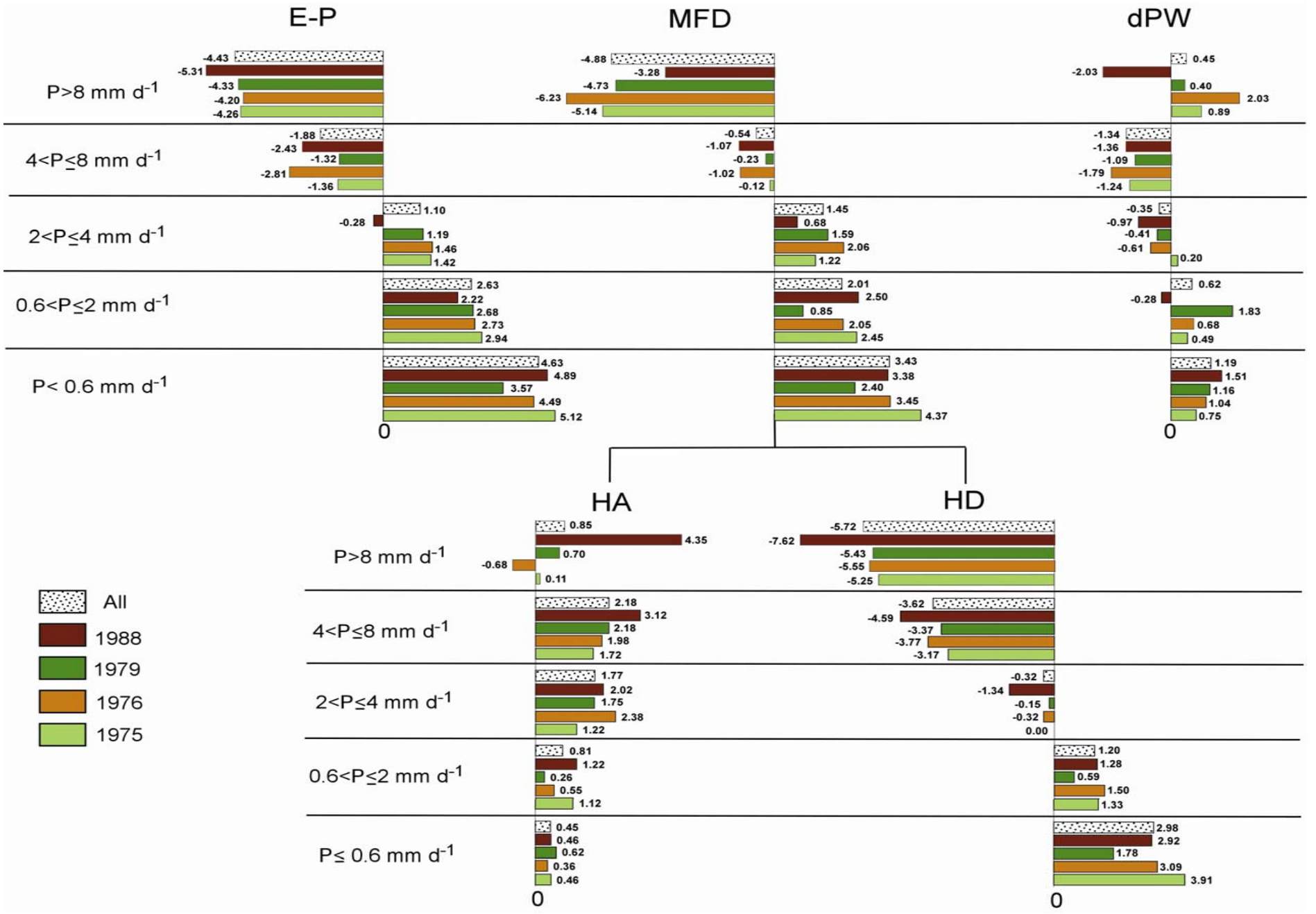
> P is highly correlated with HD (-0.80) and MFD (-0.68)

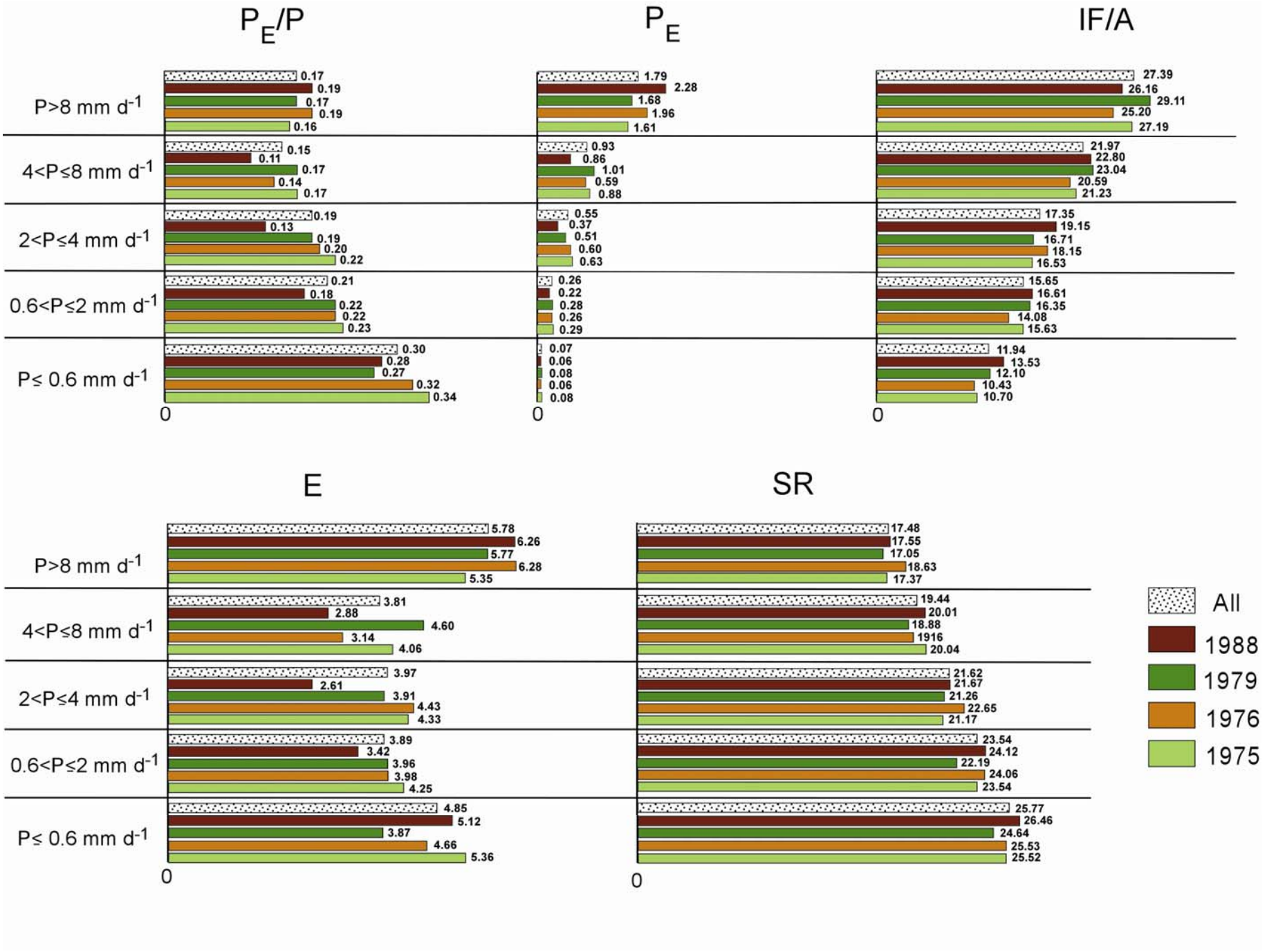
> The surplus of E over P is positively correlated with HD (+0.76)

> Storage (dPW) is negatively correlated with HD (-0.66)

This study will be expanded with

- Extended seasons and more years
- Different timescales (e.g. diurnal, monthly and seasonal)
- Inclusion of related environmental data (crop, downward solar radiation, soil moisture)
- Comparison of E measurements: model, measured, residual


E-P
MFD
dPW
P>8 mm d-1
4<P≤8 mm d-1
2<P≤4 mm d-1
0.6<P≤2 mm d-1
P< 0.6 mm d-1
-4.43
-5.31
-4.33
-4.20
-4.26
-4.88
-3.28
-4.73
-6.23
-5.14
0.45
-2.03
0.40
2.03
0.89
-1.88
-2.43
-1.32
-2.81
-1.36
-0.54
-1.07
-0.23
-1.02
-0.12
-1.34
-1.36
-1.09
-1.79
-1.24
1.10
-0.28
1.19
1.46
1.42
1.45
0.68
1.59
2.06
1.22
-0.35
-0.97
-0.41
-0.61
0.20
2.63
2.22
2.68
2.73
2.94
2.01
2.50
0.85
2.05
2.45
0.62
-0.28
1.83
0.68
0.49
4.63
4.89
3.57
4.49
5.12
3.43
3.38
2.40
3.45
4.37
1.19
1.51
1.16
1.04
0.75
0
0
HA
HD
P>8 mm d-1
4<P≤8 mm d-1
2<P≤4 mm d-1
0.6<P≤2 mm d-1
P≤ 0.6 mm d-1
0.85
4.35
0.70
-0.68
0.11
-5.72
-7.62
-5.43
-5.55
-5.25
2.18
3.12
2.18
1.98
1.72
-3.62
-4.59
-3.37
-3.77
-3.17
1.77
2.02
1.75
2.38
1.22
-0.32
-1.34
-0.15
-0.32
0.00
0.81
1.22
0.26
0.55
1.12
1.20
1.28
0.59
1.50
1.33
0.45
0.46
0.62
0.36
0.46
2.98
2.92
1.78
3.09
3.91
0
0
All
1988
1979
1976
1975


P_E/P
P_E
IF/A
P>8 mm d-1
4<P≤8 mm d-1
2<P≤4 mm d-1
0.6<P≤2 mm d-1
P≤ 0.6 mm d-1
0.17 0.19 0.17 0.19 0.16
0.15 0.11 0.17 0.14 0.17
0.19 0.13 0.19 0.20 0.22
0.21 0.18 0.22 0.22 0.23
0.30 0.28 0.27 0.32 0.34
1.79 2.28 1.68 1.96 1.61
0.93 0.86 1.01 0.59 0.88
0.55 0.37 0.51 0.60 0.63
0.26 0.22 0.28 0.26 0.29
0.07 0.06 0.08 0.06 0.08
27.39 26.16 29.11 25.20 27.19
21.97 22.80 23.04 20.59 21.23
17.35 19.15 16.71 18.15 16.53
15.65 16.61 16.35 14.08 15.63
11.94 13.53 12.10 10.43 10.70
0
E
SR
5.78 6.26 5.77 6.28 5.35
3.81 2.88 4.60 3.14 4.06
3.97 2.61 3.91 4.43 4.33
3.89 3.42 3.96 3.98 4.25
4.85 5.12 3.87 4.66 5.36
17.48 17.55 17.05 18.63 17.37
19.44 20.01 18.88 1916 20.04
21.62 21.67 21.26 22.65 21.17
23.54 24.12 22.19 24.06 23.54
25.77 26.46 24.64 25.53 25.52
All
1988
1979
1976
1975