Variability in community productivity: mediation by vegetation traits

Wayne Polley and Brian Wilsey

USDA/Agricultural Research Service
Grassland, Soil & Water Research Laboratory
Temple, TX

Department of Ecology, Evolution and Organismal Biology
Iowa State University
Ames, Iowa

Temporal variability in aboveground net primary productivity (ANPP)

$= CV^2 = (\sigma/\mu)^2$

Premise:

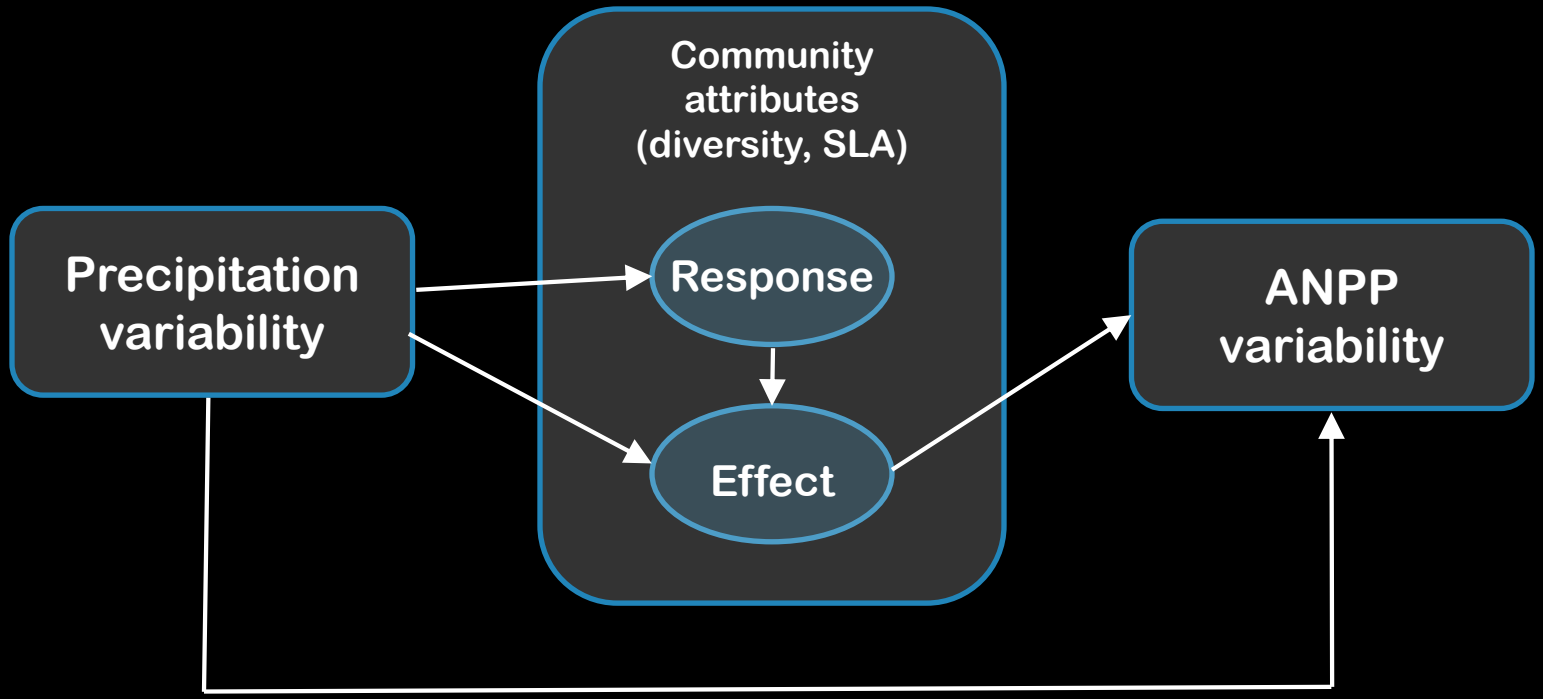
Temporal variability in plant productivity differs among communities because communities differ in functional attributes that mediate the response of productivity to environmental variation.

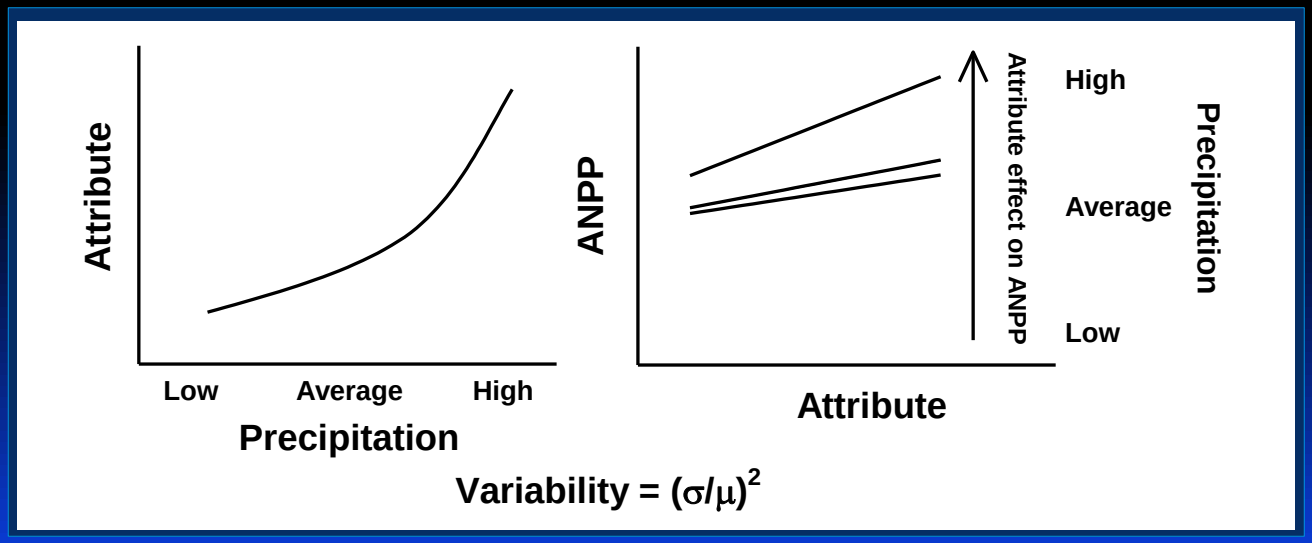
Community attributes/traits:

- Plant species diversity (1/Simpson's)
- Abundance-weighted values of community Specific Leaf Area (SLA)

Question:

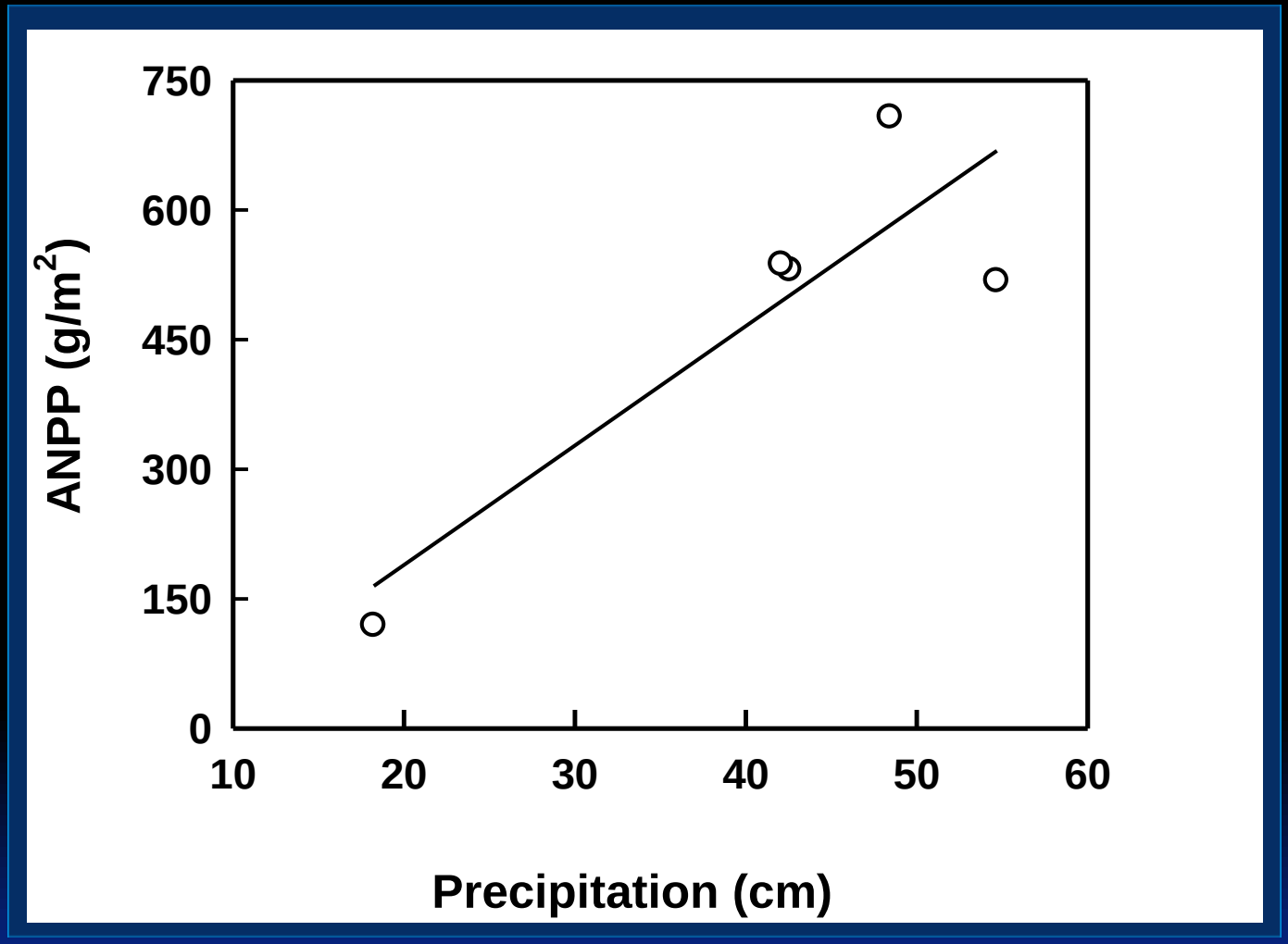
Is the relationship between attribute values and temporal variability in ANPP conserved?

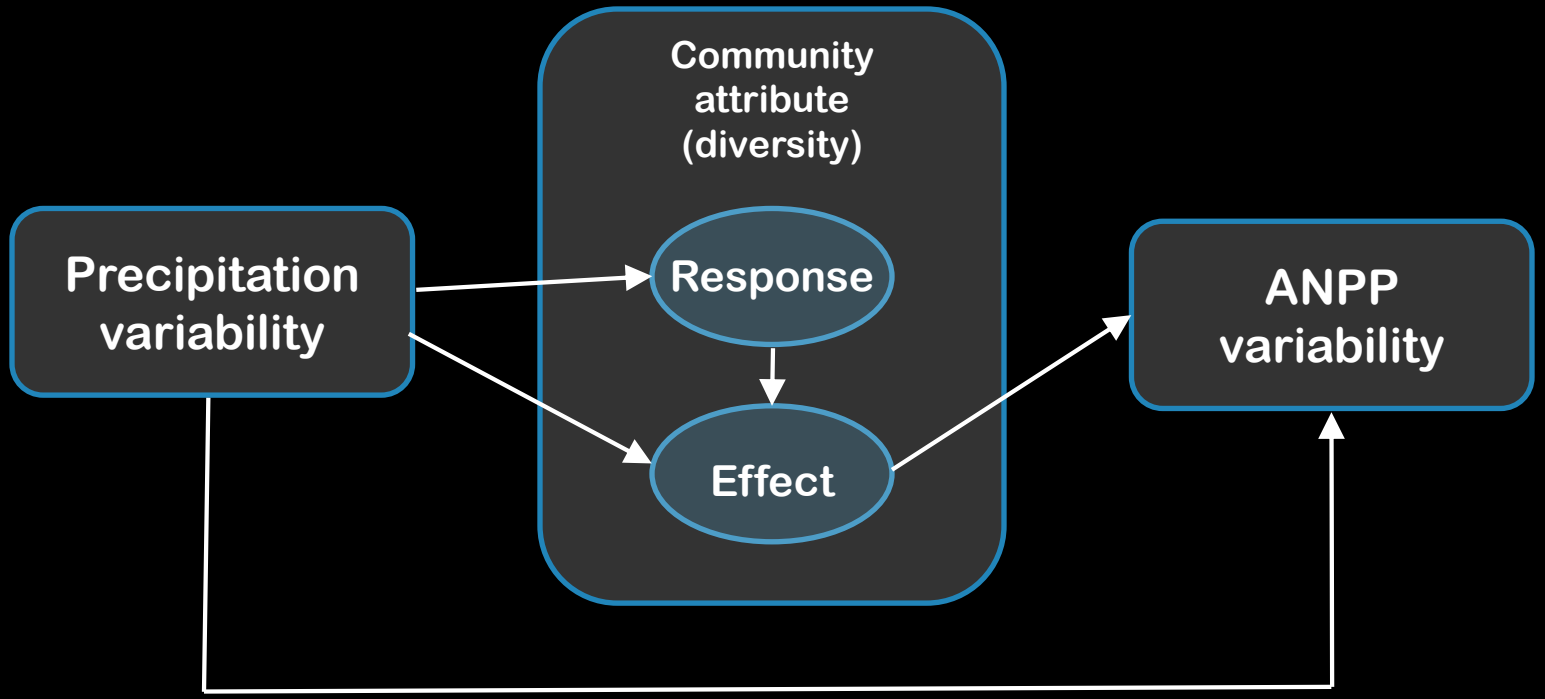

Community attributes (diversity, SLA)
Precipitation variability
Response
Effect
ANPP variability

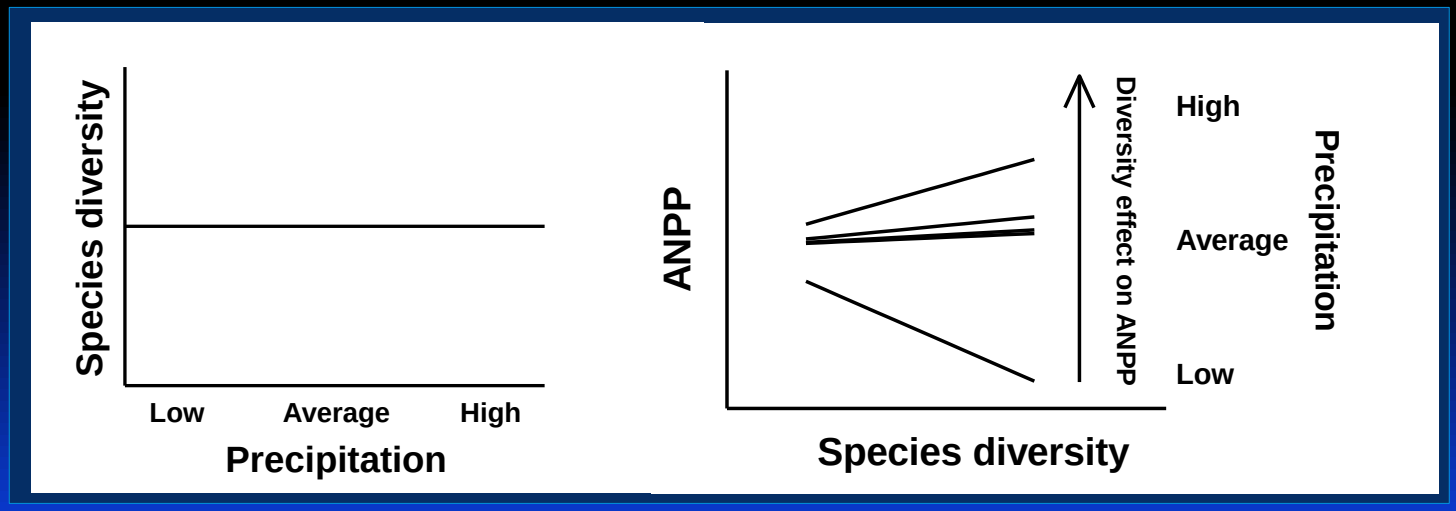

Attribute
Low
Average
High
Precipitation
ANPP
Attribute effect on ANPP
High
Average
Low
Precipitation
Attribute
Variability = $(\sigma/\mu)^2$

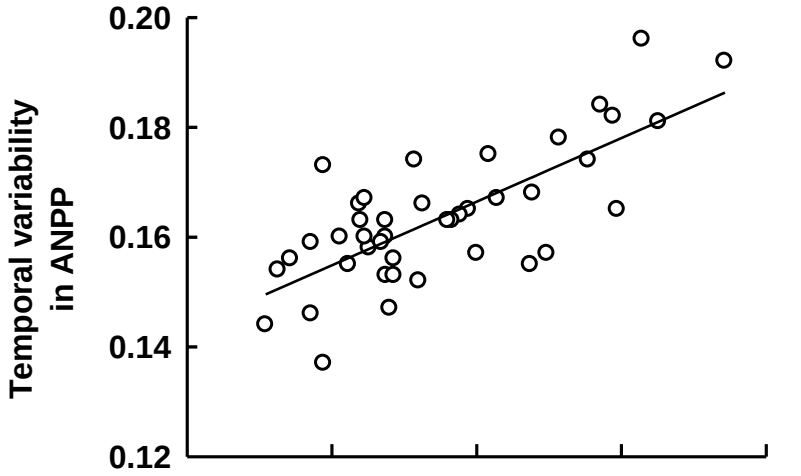
Methods

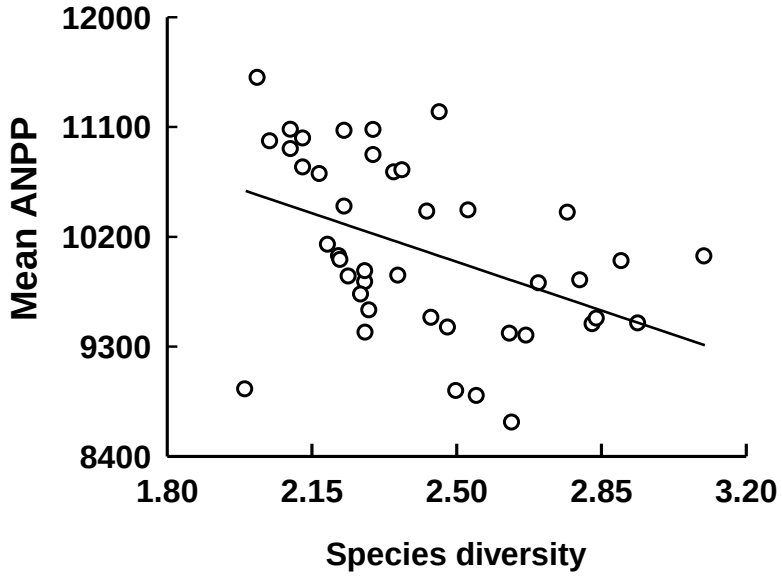
- Created 42 aggregate communities - combine data from 21 randomly-selected mixtures (1 m x 1 m)
- Weighted SLA = $\sum_{i=1}^{n}(SLAi\ x\ pi)$
- Species diversity = 1/ $\sum_{i=1}^{n} pi2$
- Temporal variability in ANPP = $CV^2 = (\sigma/\mu)^2$

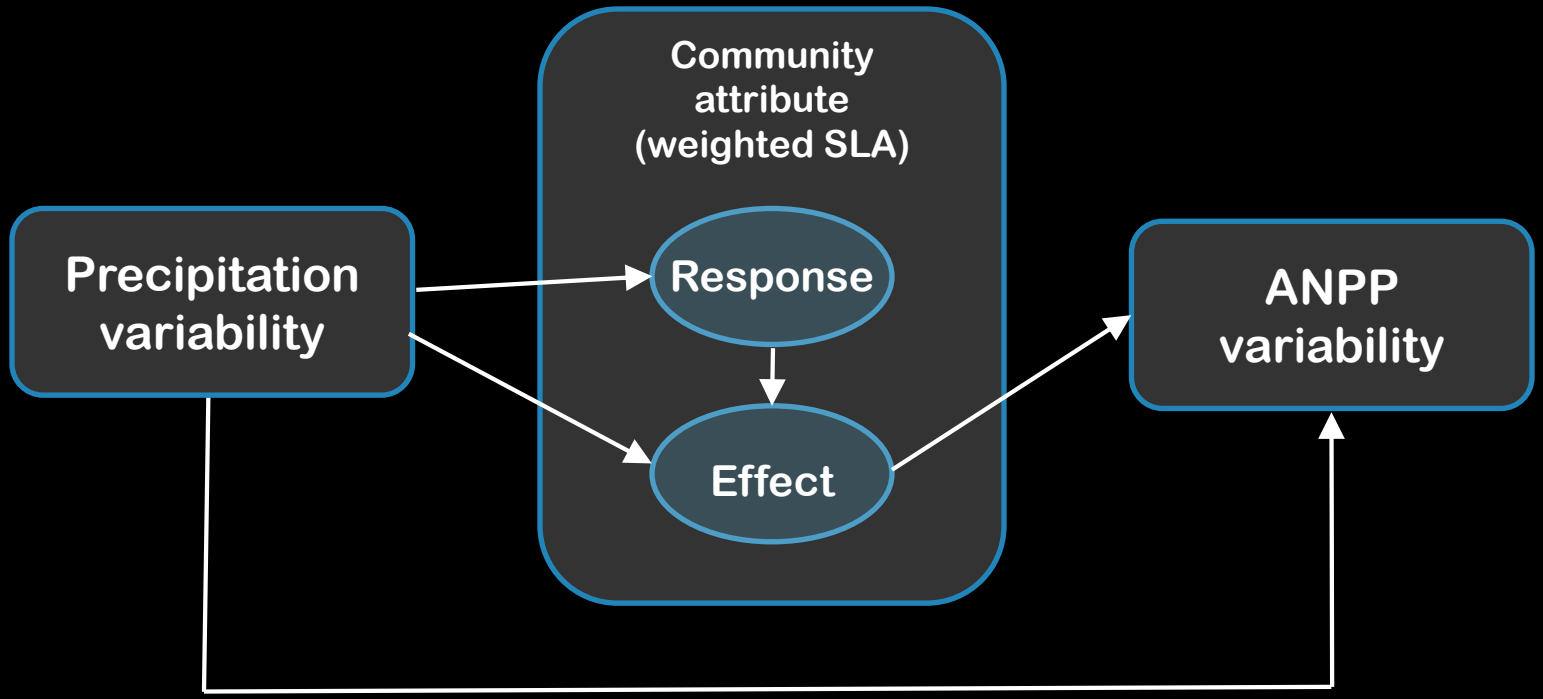

750
600
450
300
150
0
ANPP (g/m2)
10
20
30
40
50
60
Precipitation (cm)

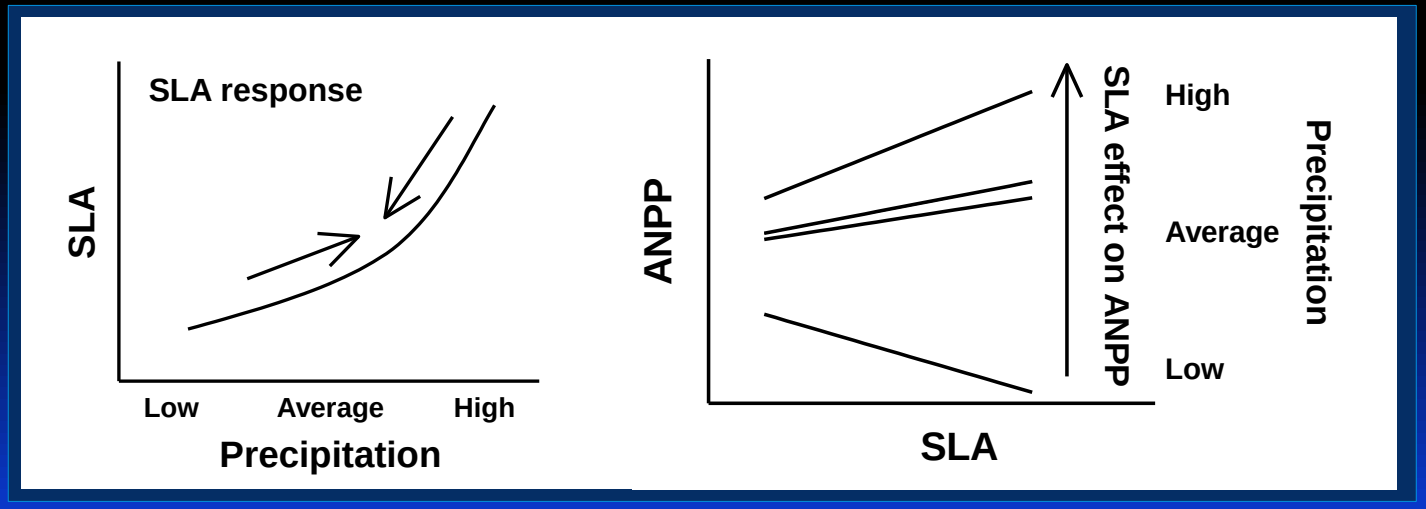

Community attribute (diversity)
Precipitation variability
Response
Effect
ANPP variability

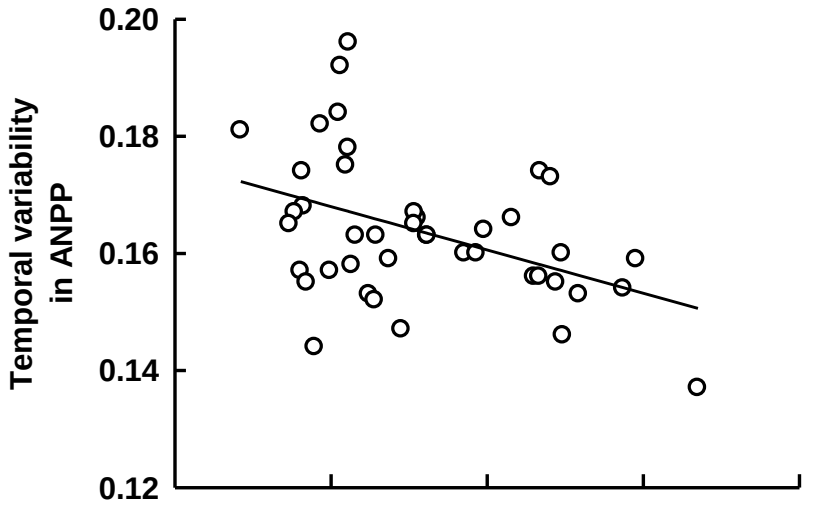

Species diversity
Low
Average
High
Precipitation
ANPP
Diversity effect on ANPP
High
Average
Low
Precipitation
Species diversity

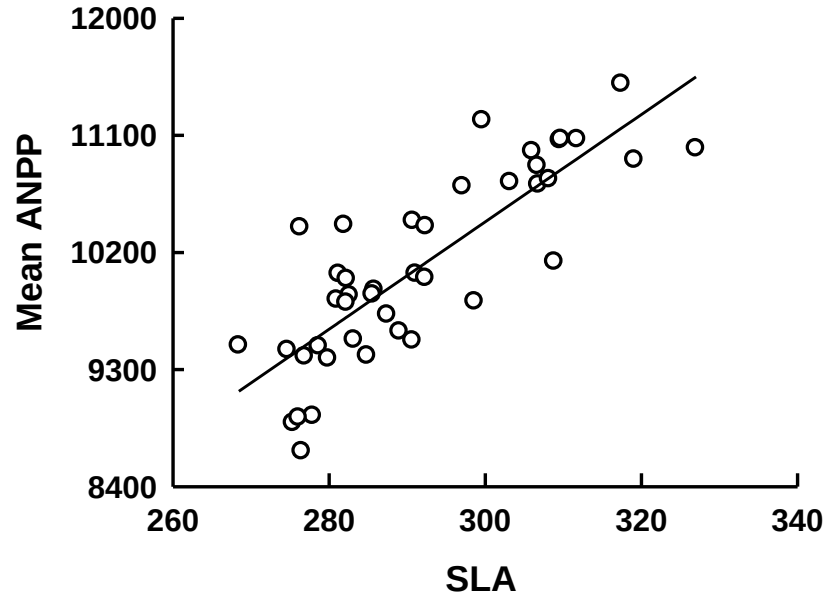

Temporal variability in ANPP
0.20
0.18
0.16
0.14
0.12

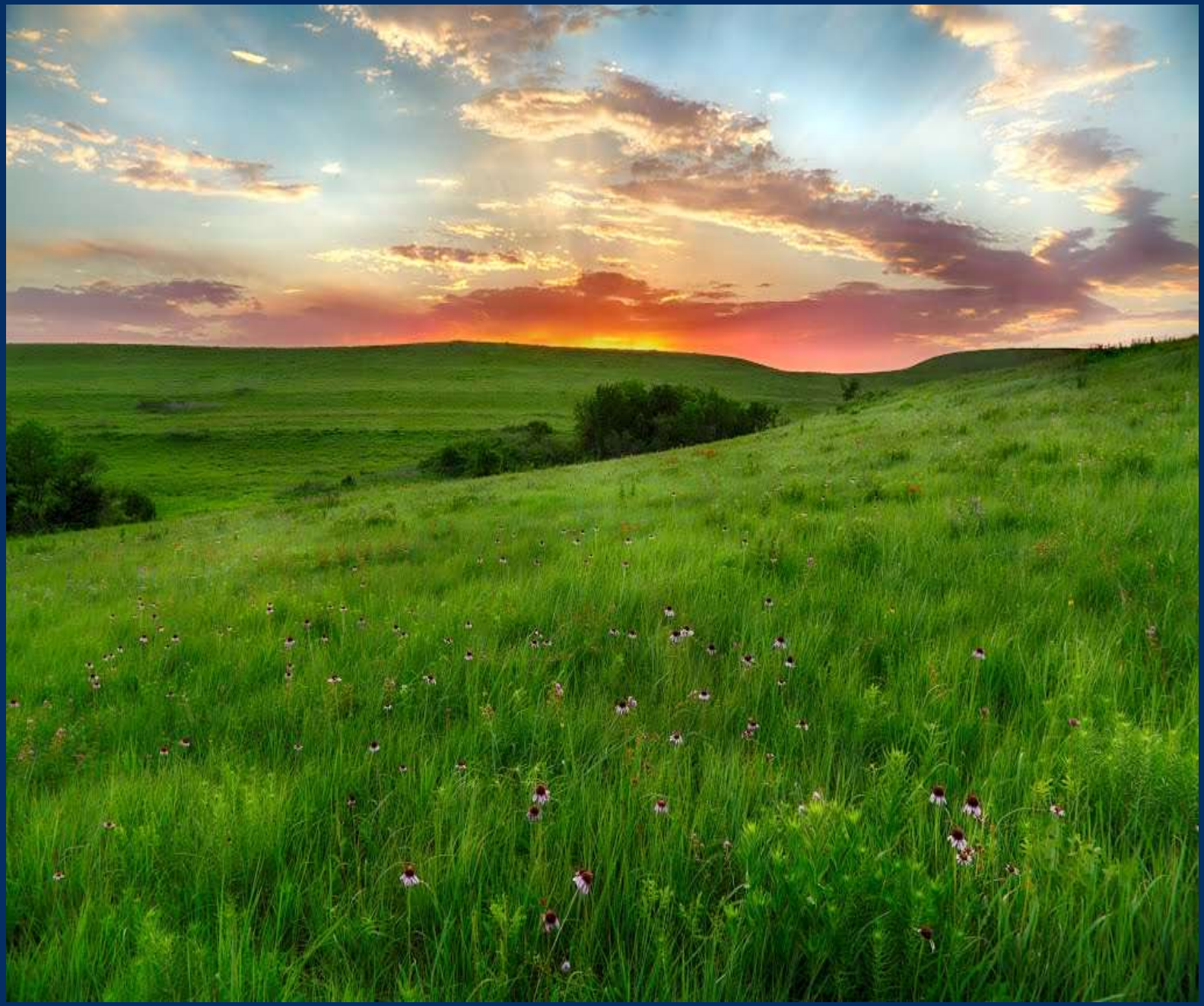

Mean ANPP
12000
11100
10200
9300
8400
1.80
2.15
2.50
2.85
3.20
Species diversity


Community attribute (weighted SLA)
Precipitation variability
Response
Effect
ANPP variability


SLA response
SLA
Low
Average
High
Precipitation
ANPP
SLA effect on ANPP
High
Average
Low
Precipitation
SLA


Temporal variability in ANPP
0.20
0.18
0.16
0.14
0.12


Mean ANPP
12000
11100
10200
9300
8400
260
280
300
320
340
SLA

Conclusions

- Communities that differed in diversity and weighted SLA differed in ANPP variability.
- The sign of the relationship between diversity and temporal variability in ANPP was not ‘conserved’.