Climate-soil interactions

Global change, local properties, and ecological sites

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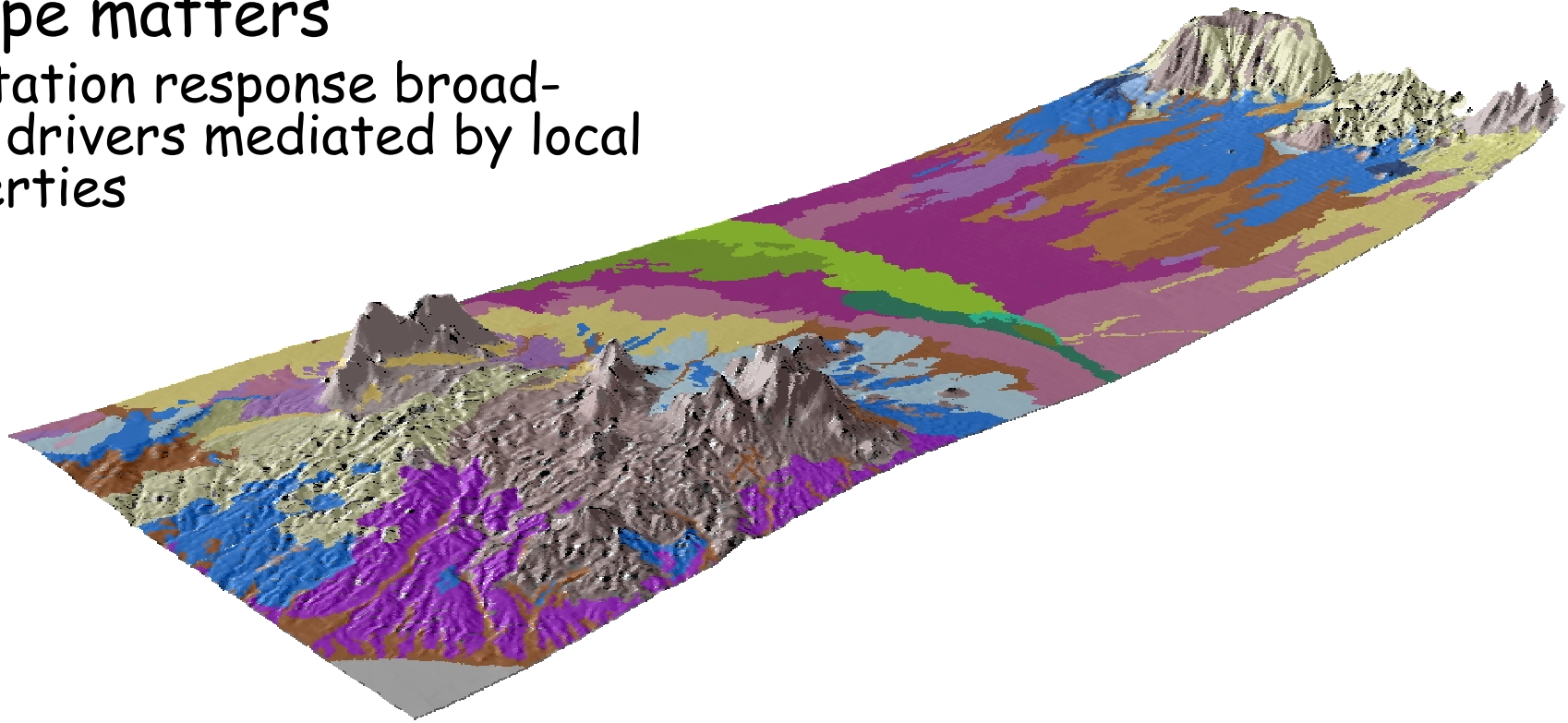
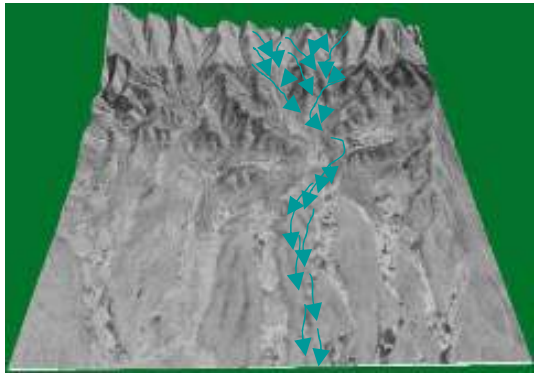
Landscape as a filter

- 2 things that are going to happen w/ GCC
  - Temp & rain changes
  - Increased variability/change in event sizes
- Where you are on the landscape matters
  - Vegetation response broad-scale drivers mediated by local properties

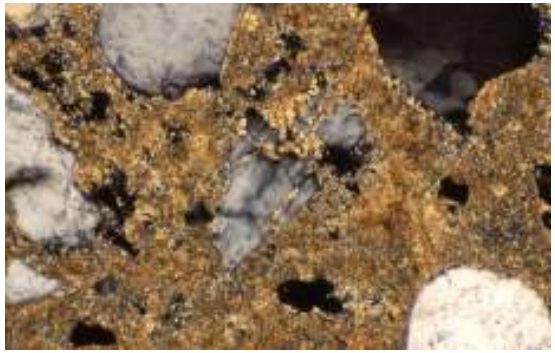


Landscape as a filter

Static properties (Ecological Site)



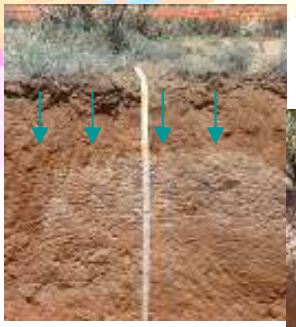
Landscape Position

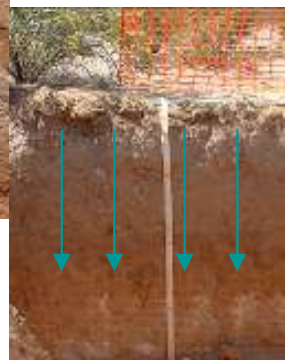


Mineralogy/Parent Material

Surface texture

Aspect





Soil Profile

Landscape as a filter

Dynamic properties (Ecological State)

Plant community composition

Bare ground & canopy cover

Soil organic matter

Production

Soil structure

Soil biota,
Biological soil crusts

Landscape as a filter

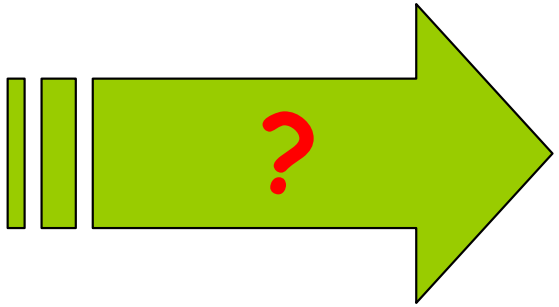
- This talk is focused on <u>static/ecological site properties</u>
  - Plant community composition/ecological state is also very important
- Example from a water limited system

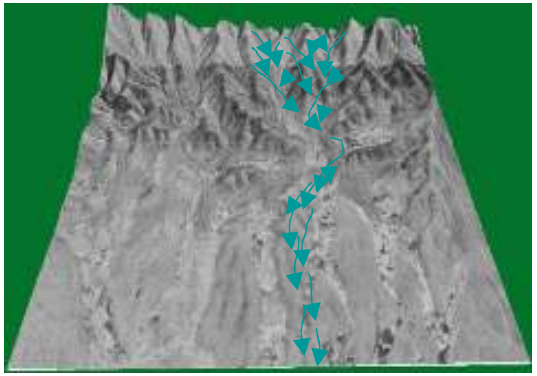
Water limited systems

- Changes in ecosystem function and community composition most proximally related to changes in water
- Example using Jornada LTER data to illustrate the importance of static factors for mediating response of plant community (NPP) to new climate regimes:
  - Long-term trends & relationship w/ site properties
  - Take advantage of a recent extreme event & relationship w/ site properties

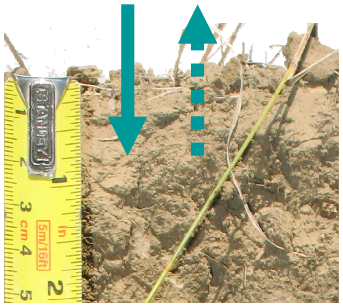
Water limited systems

& static properties that mediate NPP

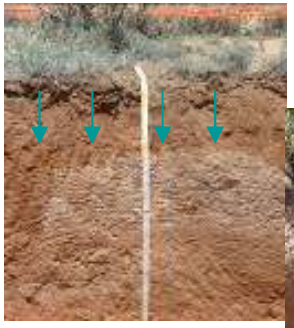


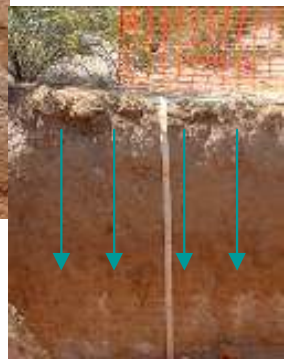


Landscape Position



Surface Soil Texture



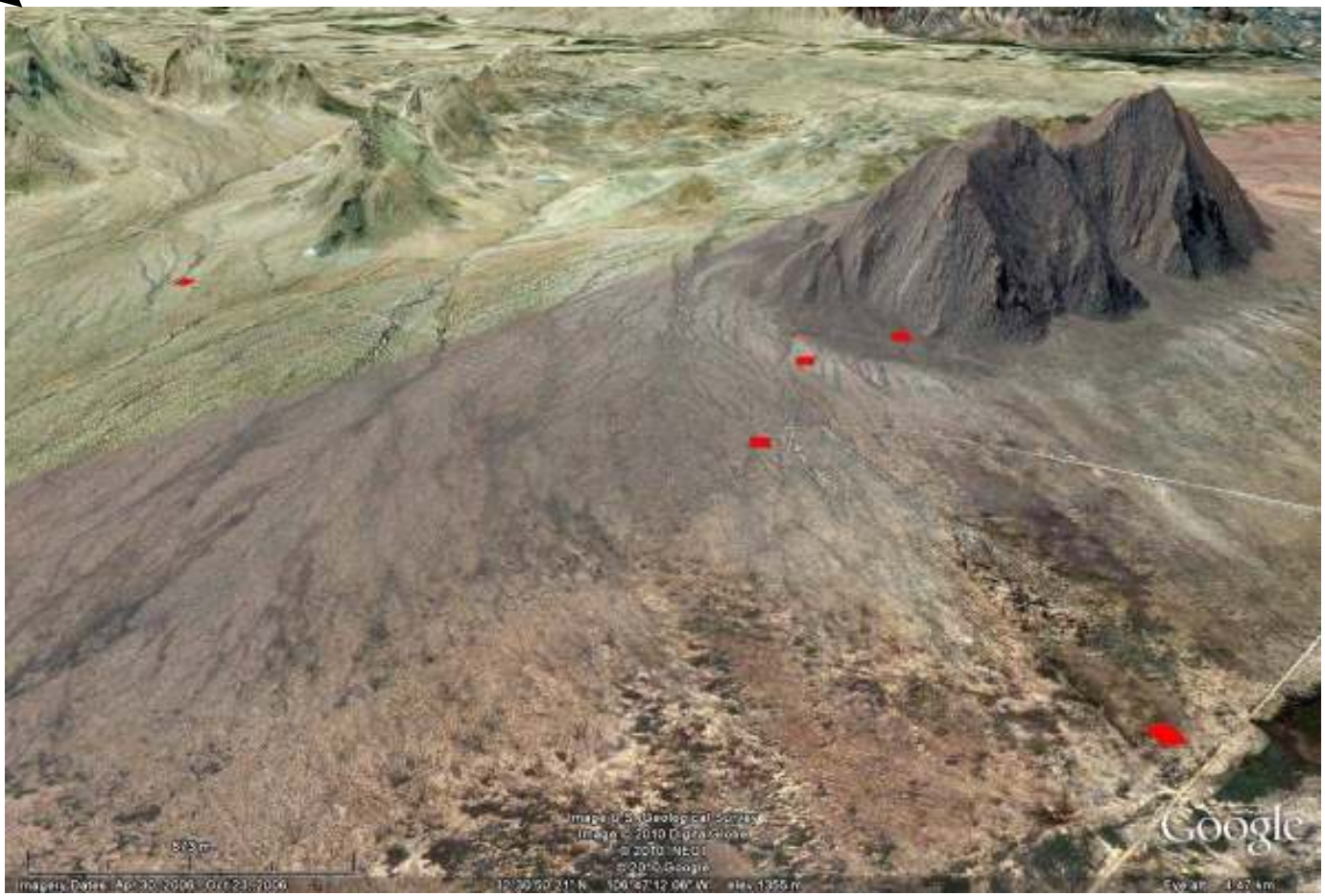


Soil Profile Water Holding Capacity

Long-term trends

NPP (1990-2008) at 5 sites along a bajada

Variety of landscape positions (some run-on & some run-off)



Jornada Basin LTER

Long-term trends

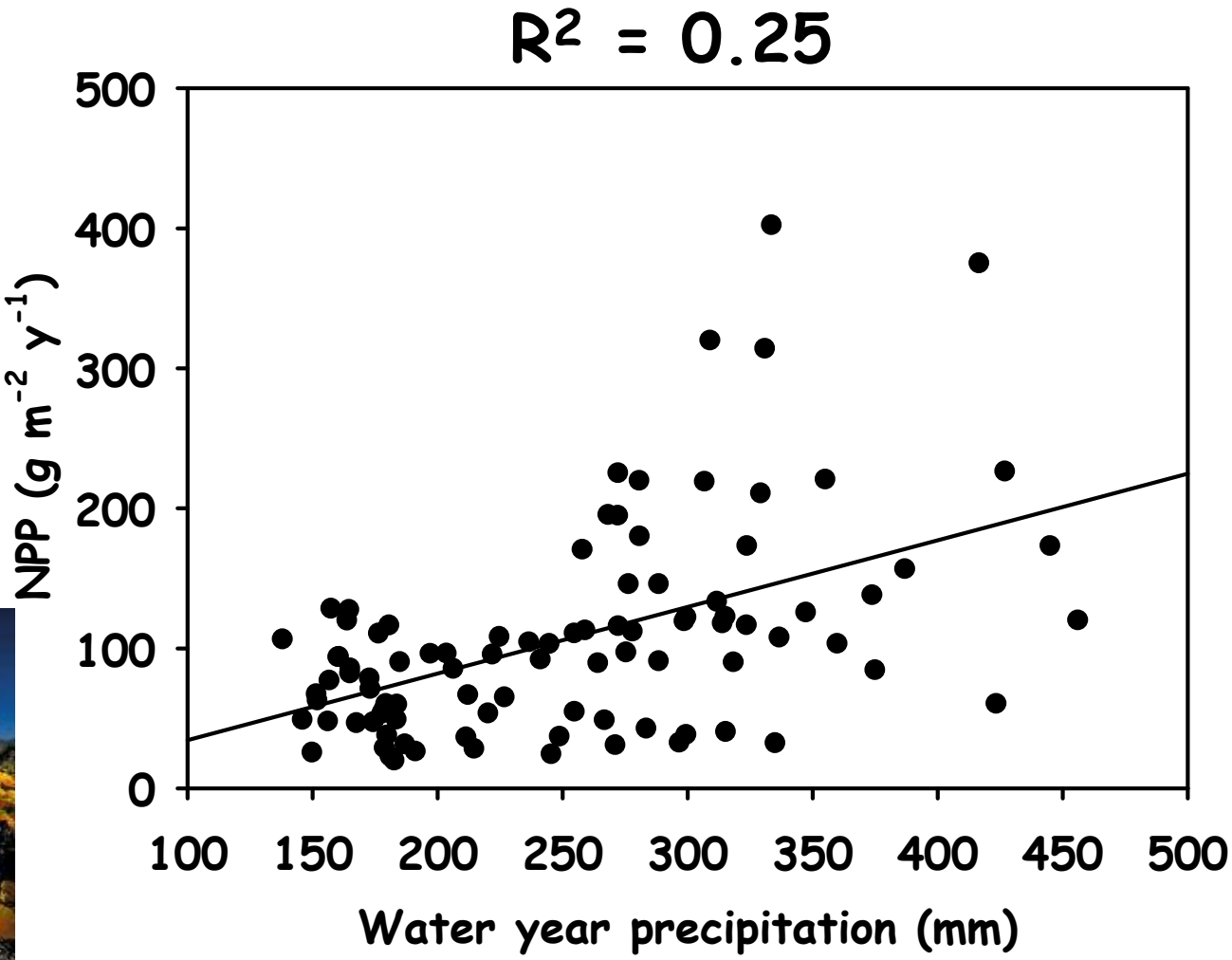
NPP (1990-2008) at 5 sites along a bajada

Variety of surface texture & soil profile properties

NRCS

Long-term trends

NPP (1990-2008) at 5 sites along a bajada



Long-term trends

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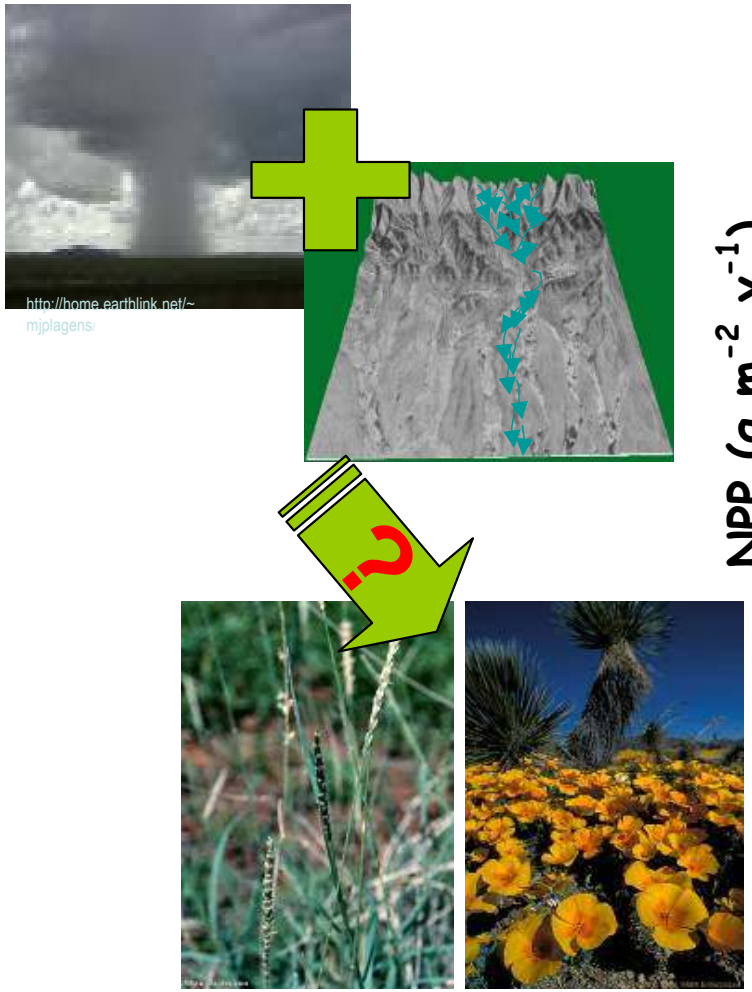
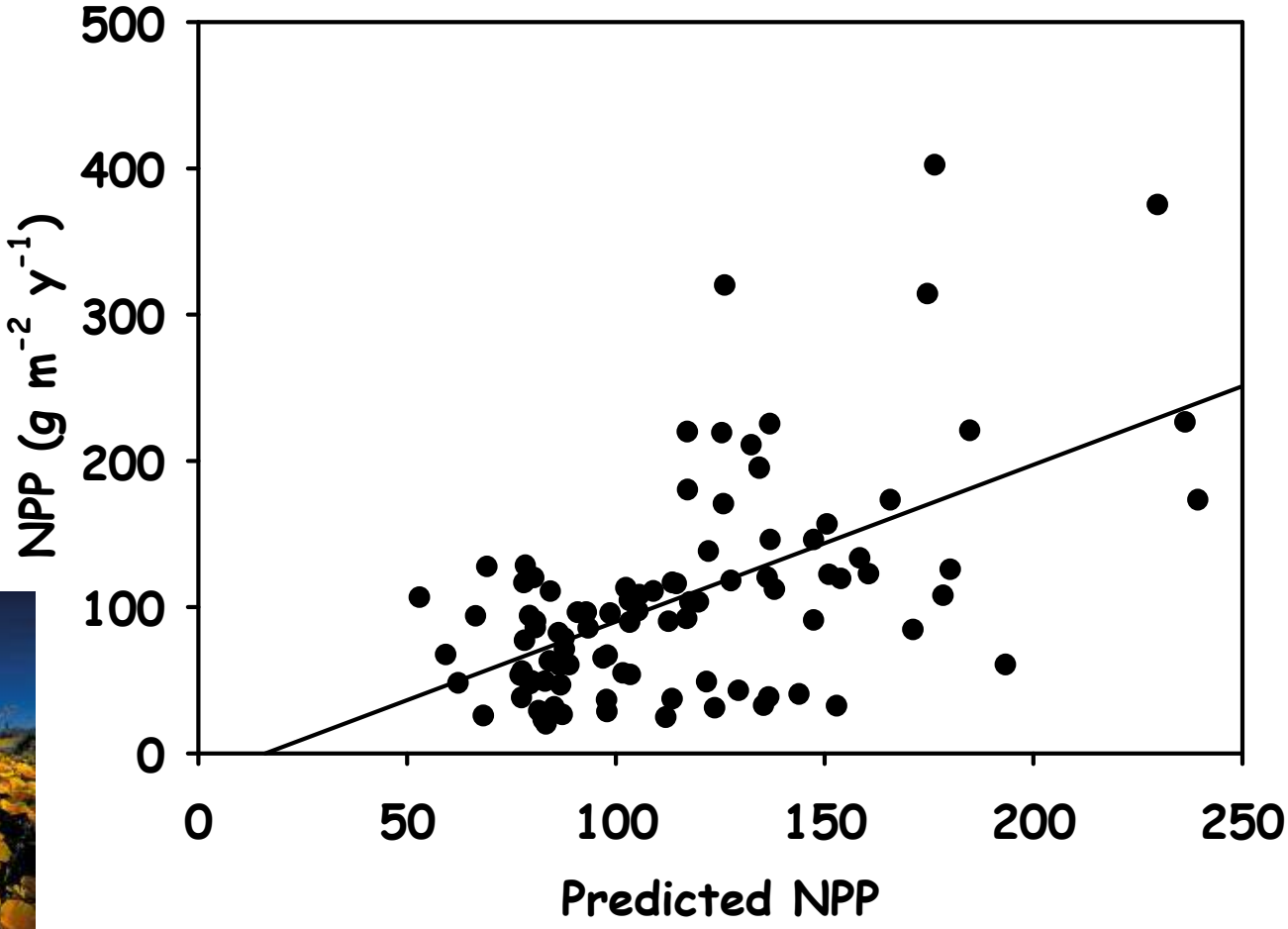


Rain + Topographic Wetness Index

$R^2 = 0.31$



Long-term trends

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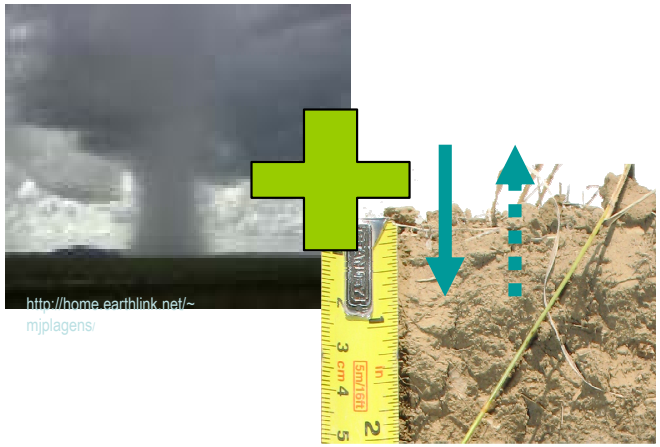
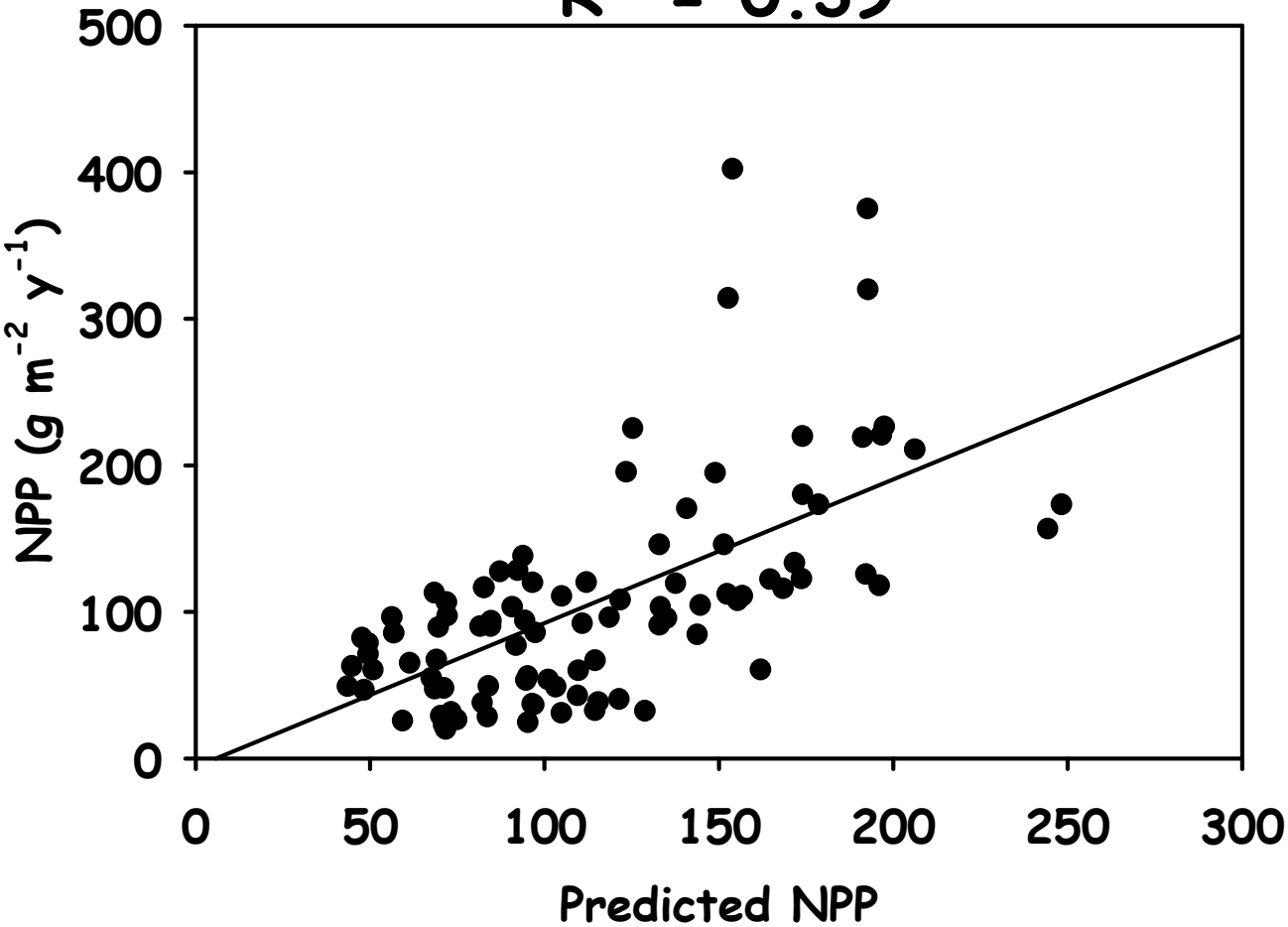


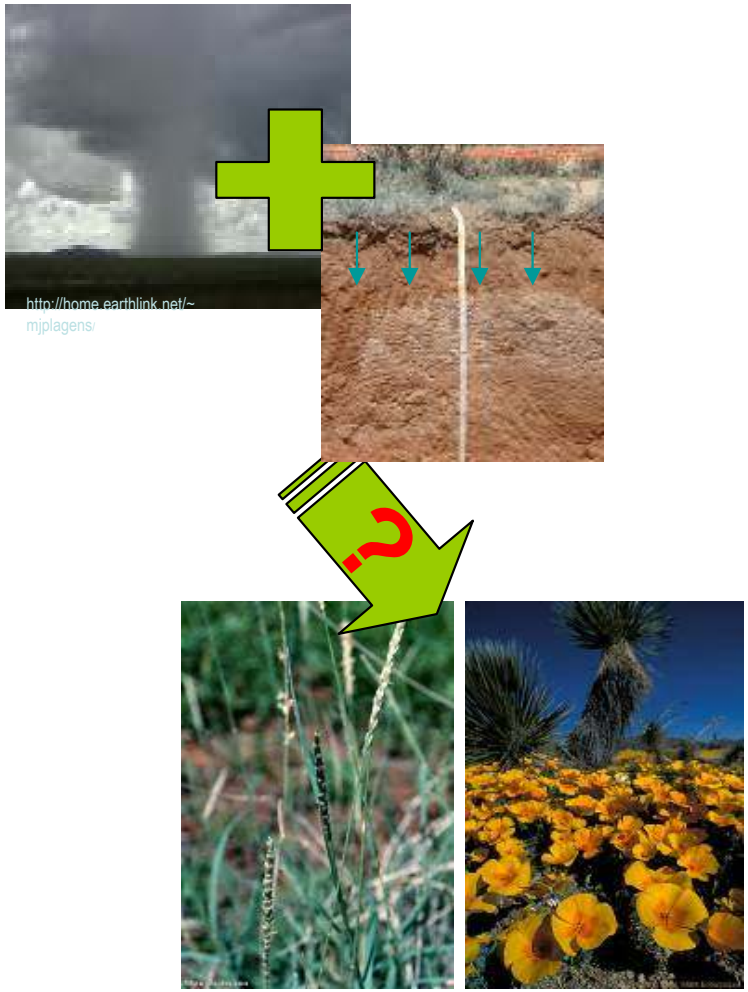
Rain + Saturated hydraulic connectivity (top 10cm)

$R^2 = 0.39$



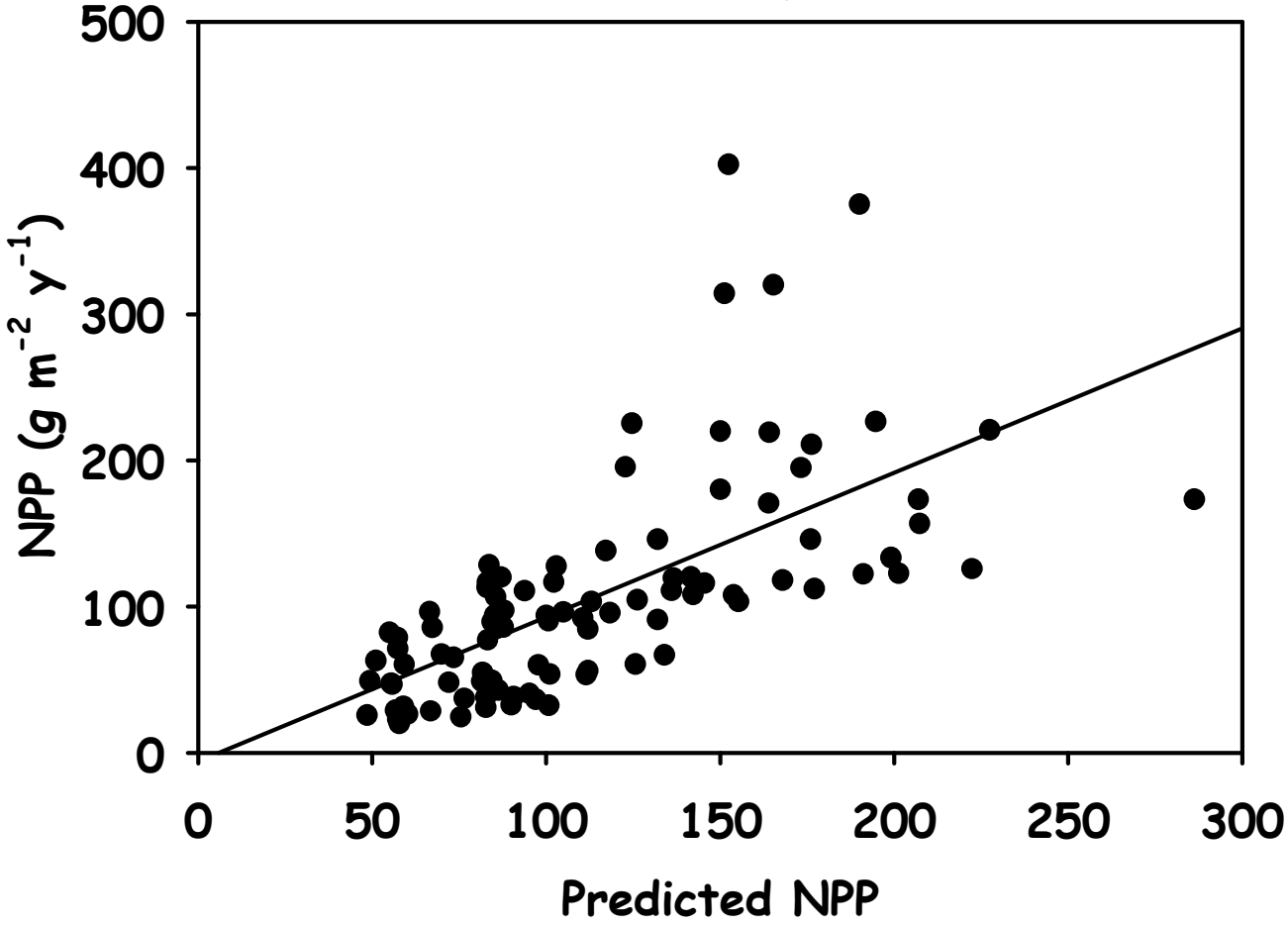
Long-term trends

NPP (1990-2008) at 5 sites along a bajada



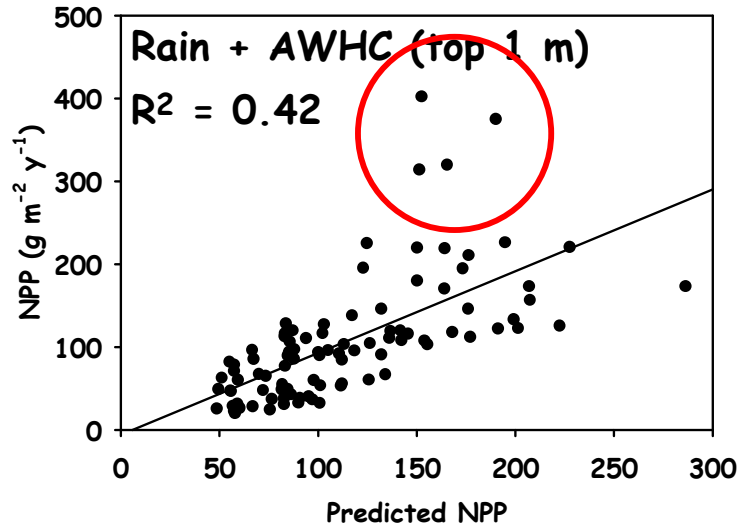
Rain + Available water holding capacity (top 1 m)

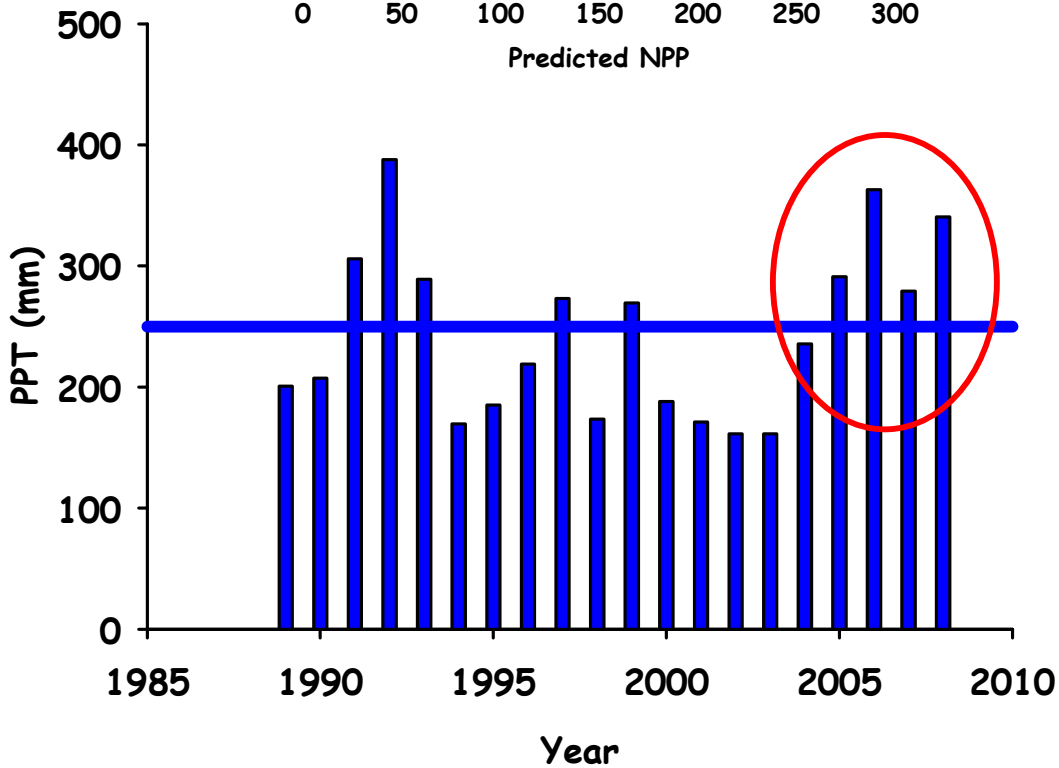
$R^2 = 0.42$



What about extreme events?

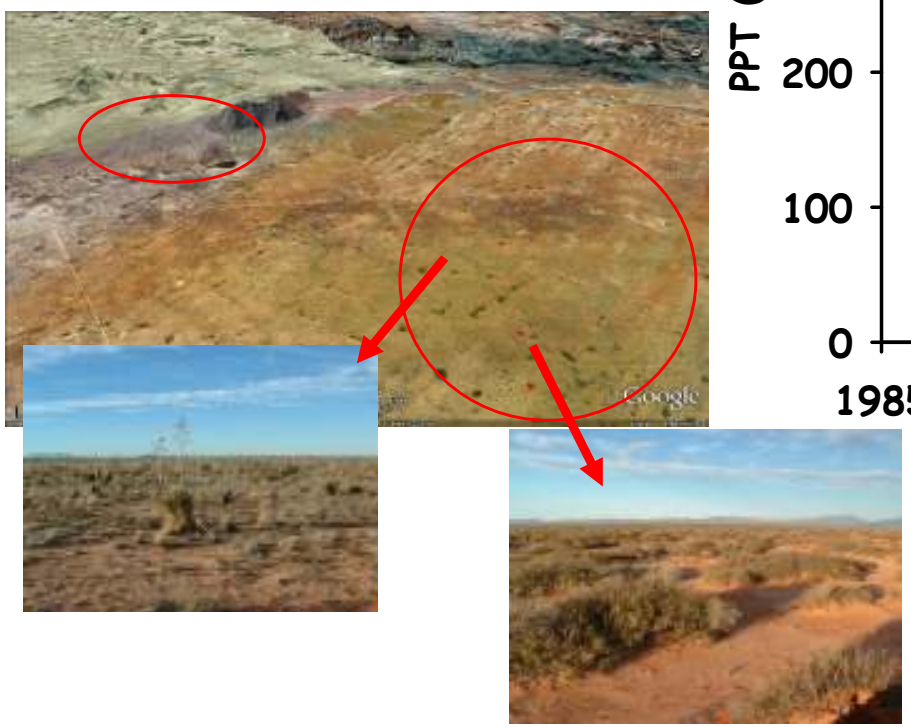
- Static properties mediate general NPP - PPT trends
- What about "extreme events" expected to become more common with GCC?
- Since 2005, we have had a sequence of really wet & just slightly wet years

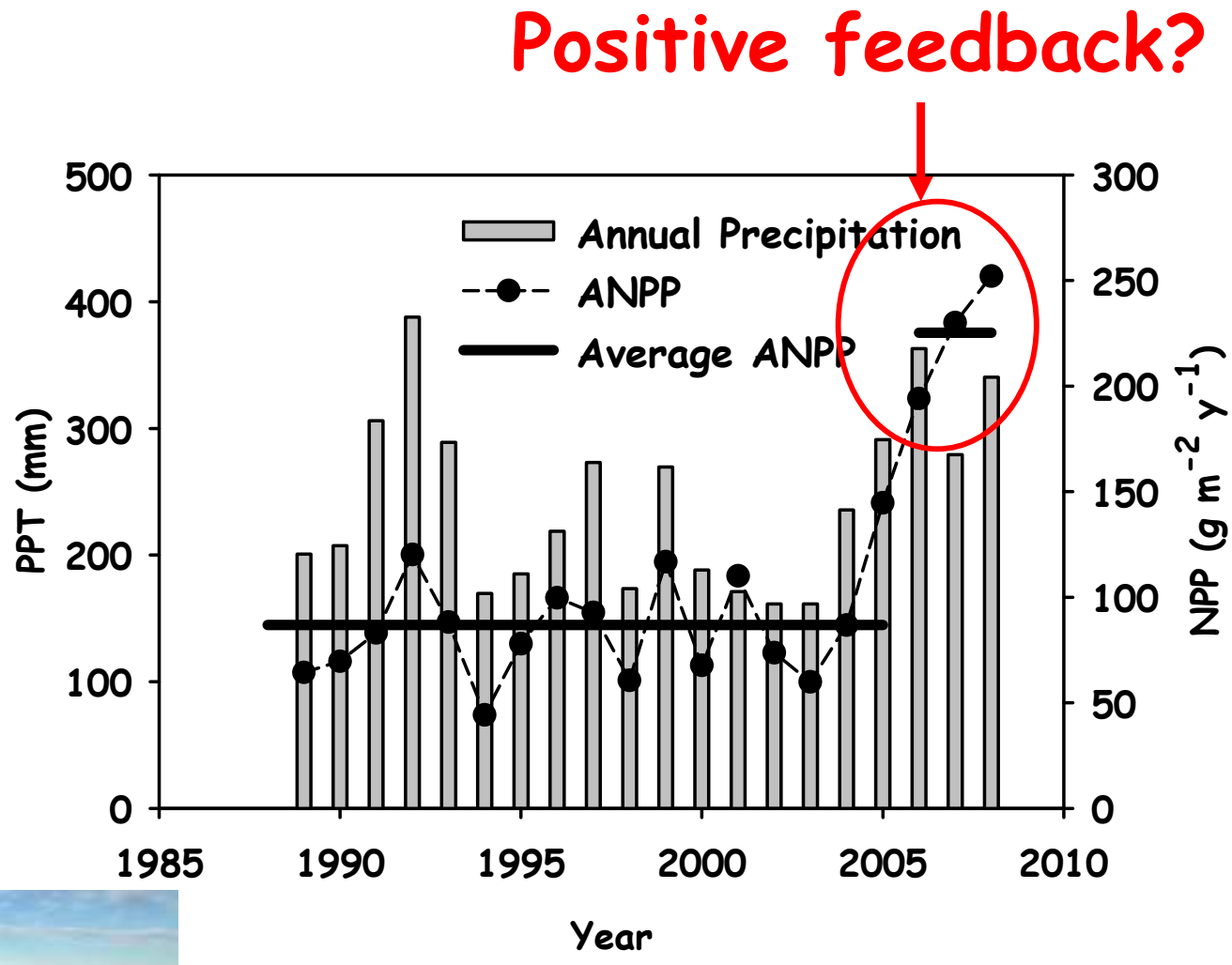




What about extreme events?

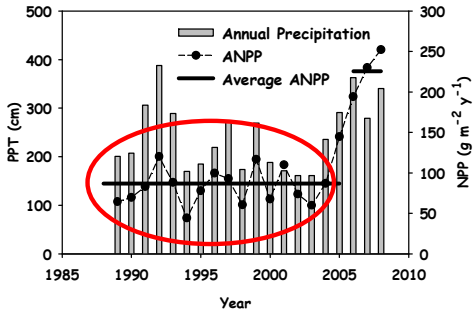
- Expand our view
- Include 4 additional sandy sites

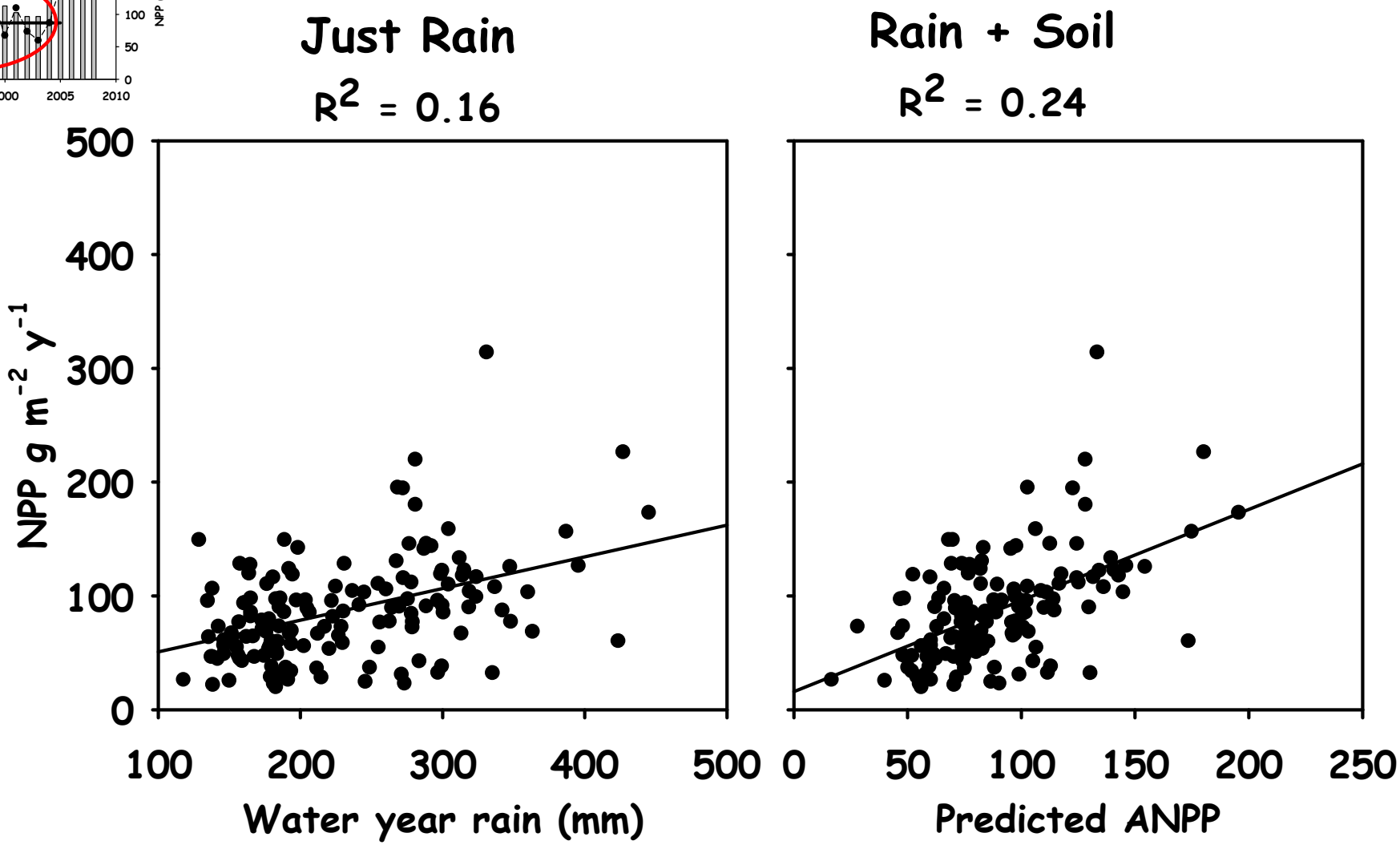




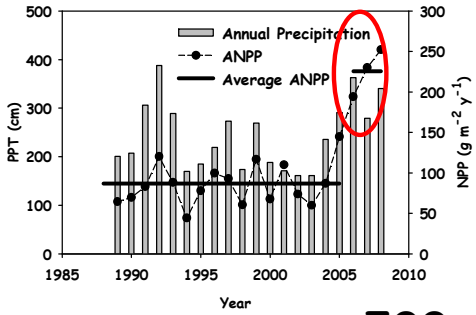
What about extreme events?

"Normal" years (1990 - 2005)





What about extreme events?



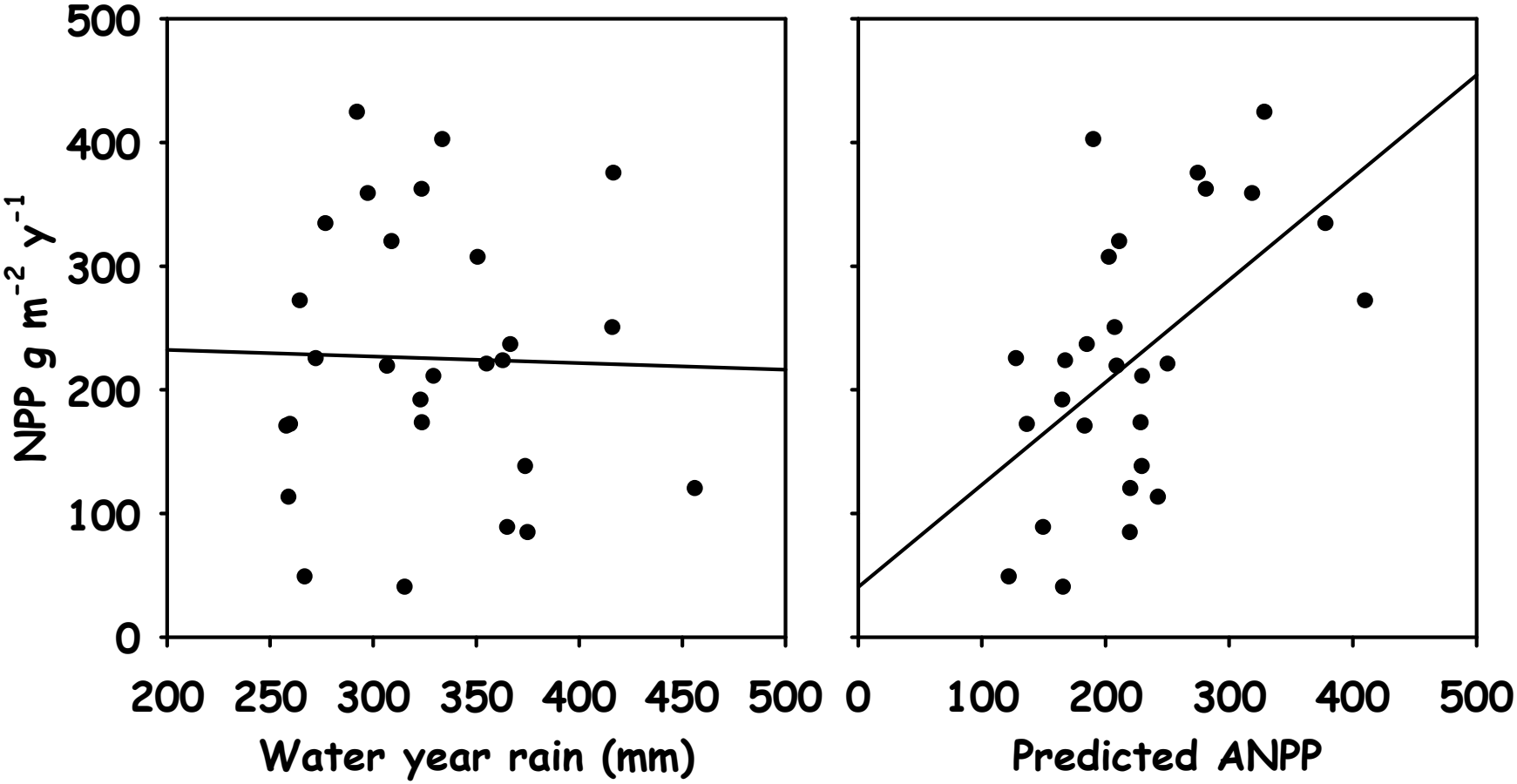
Really wet years (2006-2008)

Just Rain

$R^2 = 0.02$

Rain + Soil properties

$R^2 = 0.65$



How do we use this information?

- Variability of response to climate driven by landscape heterogeneity for both
  - general trends &
  - extreme events
- If going to compare and contrast point based data (GCC and/or long-term studies) in regional analysis, we need the soil & landscape context

How do we use this information?

- Dig a hole! Look around!
- Detailed soil & terrain data would be great
- What about using ecological sites?
  - All properties also used to differentiate ecological sites
  - Ecological sites already used as management units
  - Useful unit for synthesizing responses
  - Could be refined to account for GCC

Summary

- Need to account for local-scale properties
- Ecological sites already do this to some extent
  - Useful for communicating landscape context to others
- Dynamic properties/ecological state at beginning of extreme events effects outcome

Questions?