

# Multiscale variability of soil aggregate stability: implications for rangeland hydrology and erosion

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# Why soil aggregate stability?

- Soil surface characteristics control capture and retention of water and nutrients
- Soil aggregate stability is related to soil erodibility & infiltration capacity, both of which are:
  - highly variable in space and time
  - difficult to measure

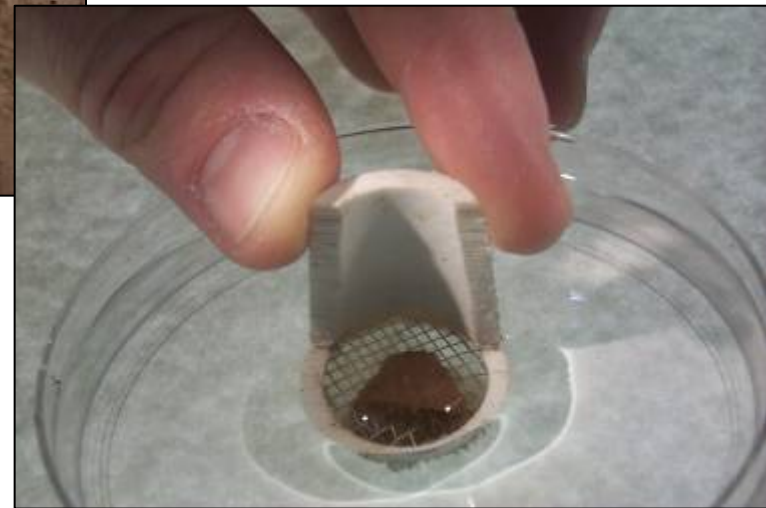
“... soil aggregate stability ... has been demonstrated to have a strong relationship with interrill erosion” (Blackburn & Pierson, 1994)

# Soil stability kit



- (2) Immerse in dI water.
- (3) Record slaking in 1<sup>st</sup> 5 min.
- (4) Wet sieve 5x.
- (5) Rate sample on a scale from 1 to 6.

- (1) Collect 6-8 mm-diameter sample from surface and 20-25mm depth (1 sample/sieve).





# Soil stability kit: interpretation

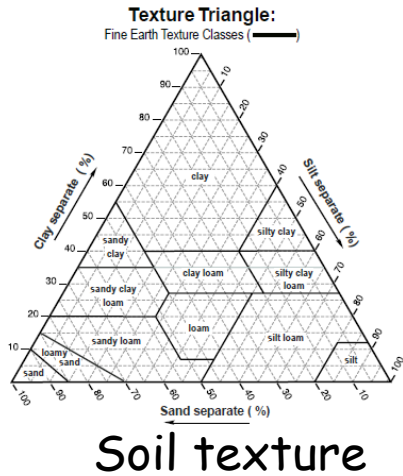
**Soil erosion:** high values indicate lower erodibility

**Water infiltration:** high values may be associated with higher infiltration rates.



Stability class	Criteria for assignment to stability class (for Standard Characterization) <sup>a</sup>
1	50 % of structural integrity lost within 5 seconds of insertion in water.
2	50 % of structural integrity lost 5 - 30 seconds.
3	50 % of structural integrity lost 30 - 300 seconds after insertion OR <10% of soil remains on sieve after 5 dipping cycles.
4	10 - 25% of soil remains after 5 dipping cycles.
5	25 - 75% of soil remains after 5 dipping cycles.
6	75 - 100% of soil remains after 5 dipping cycles.

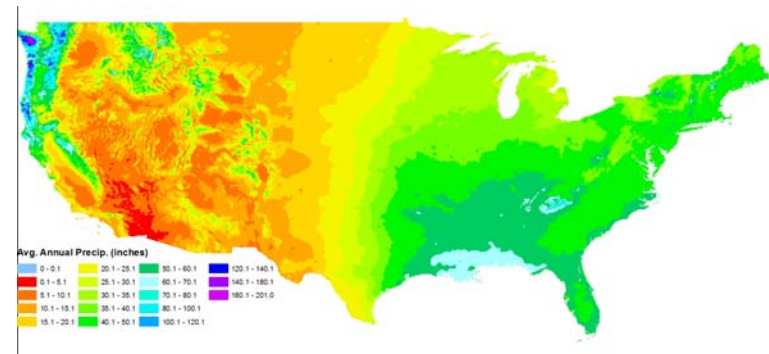
# Relatively static factors that affect aggregate stability



SOM (stable fraction, turnover time >15 yrs)

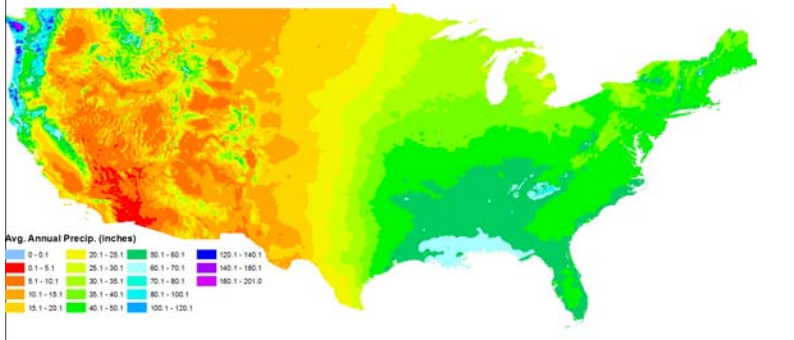


Mineralogy

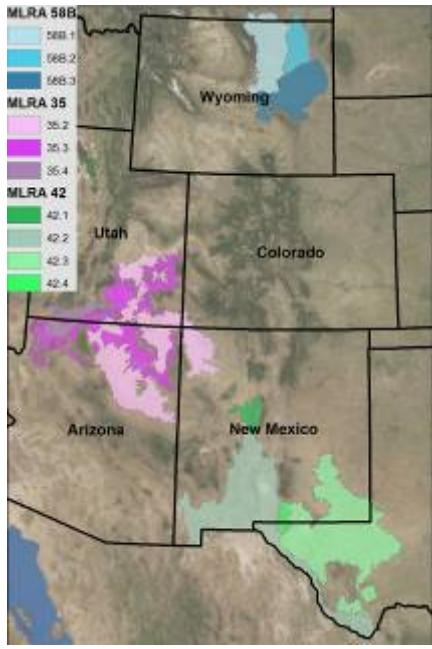


Regional climate

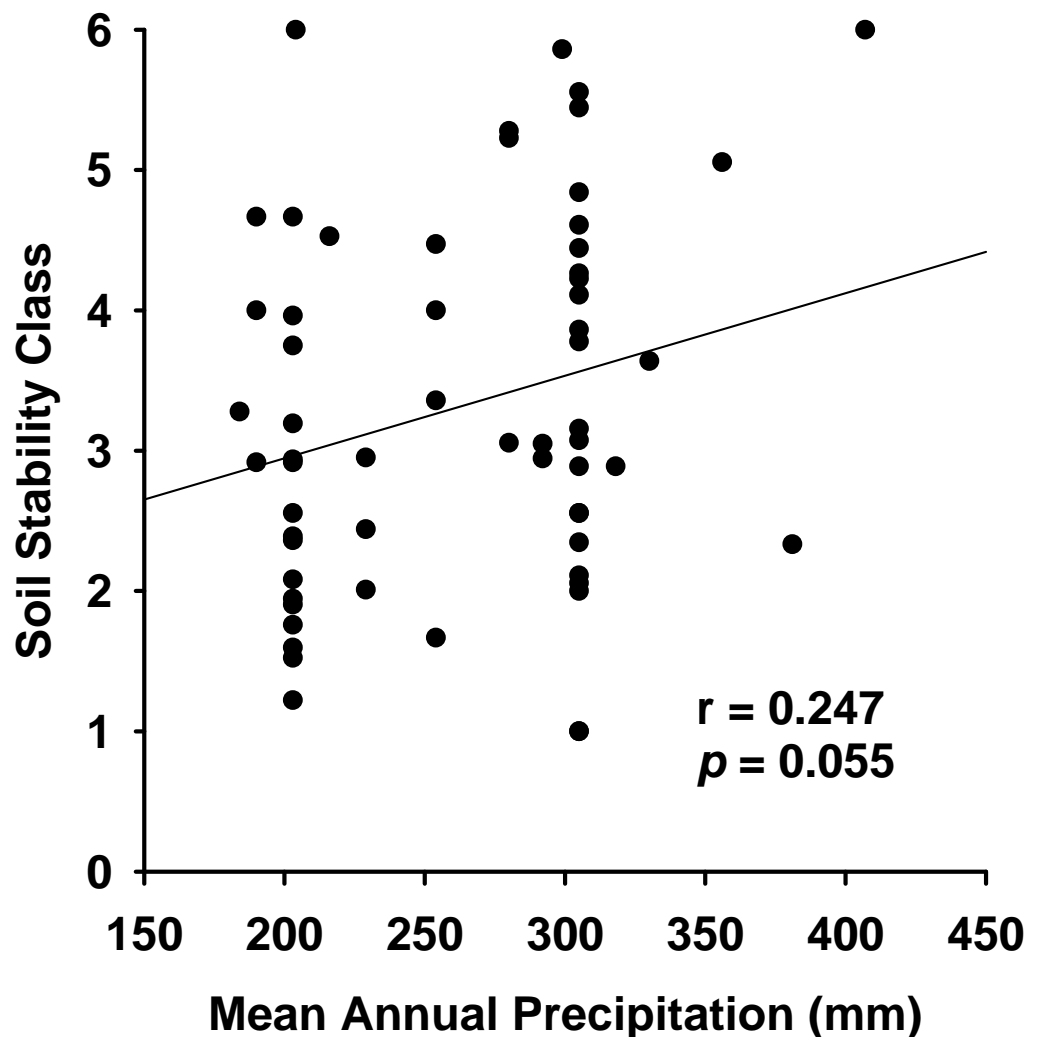
# Relatively static factors that affect aggregate stability



Regional climate

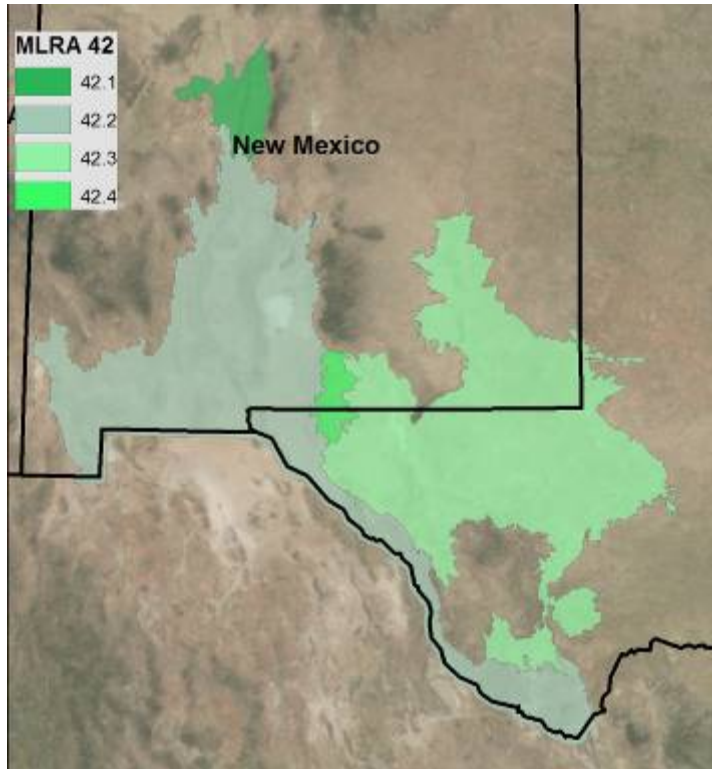


NRCS NRI Data from 2003-06

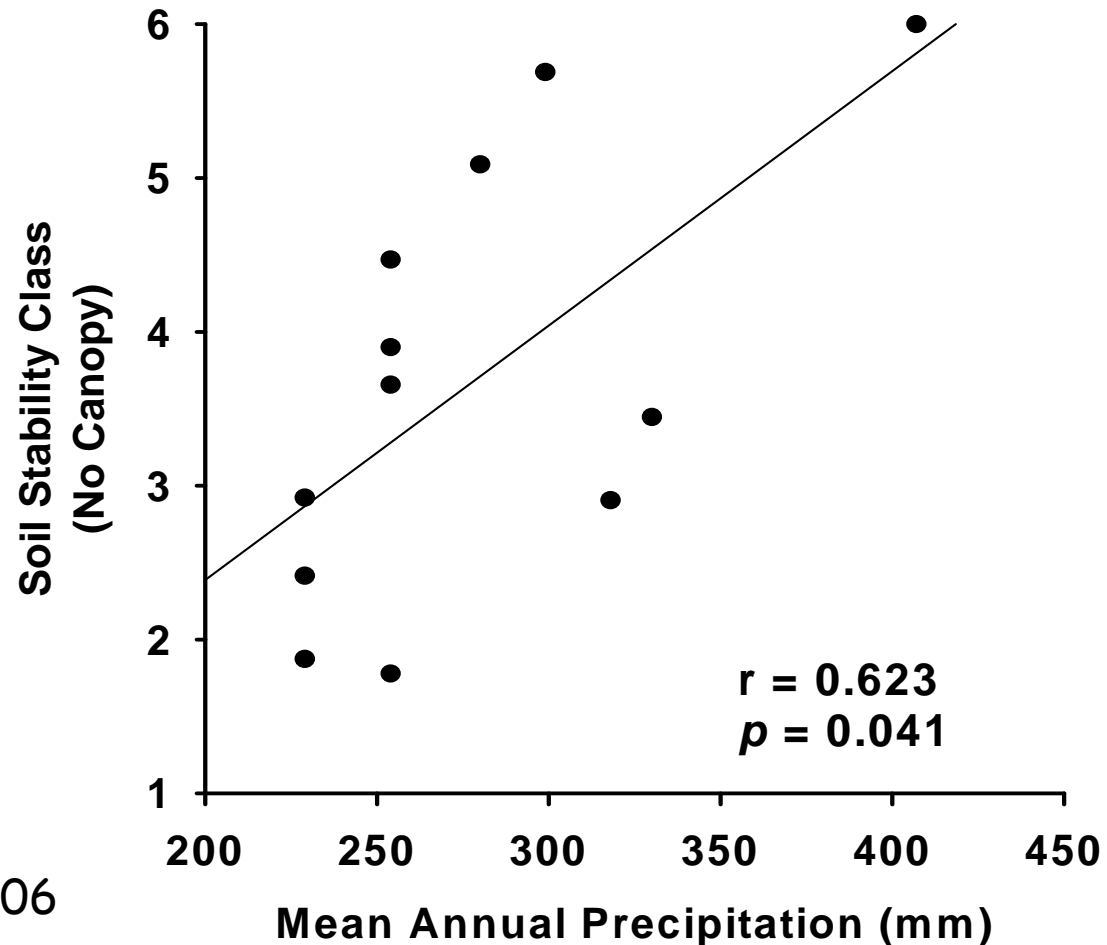


# Relatively static factors that affect aggregate stability

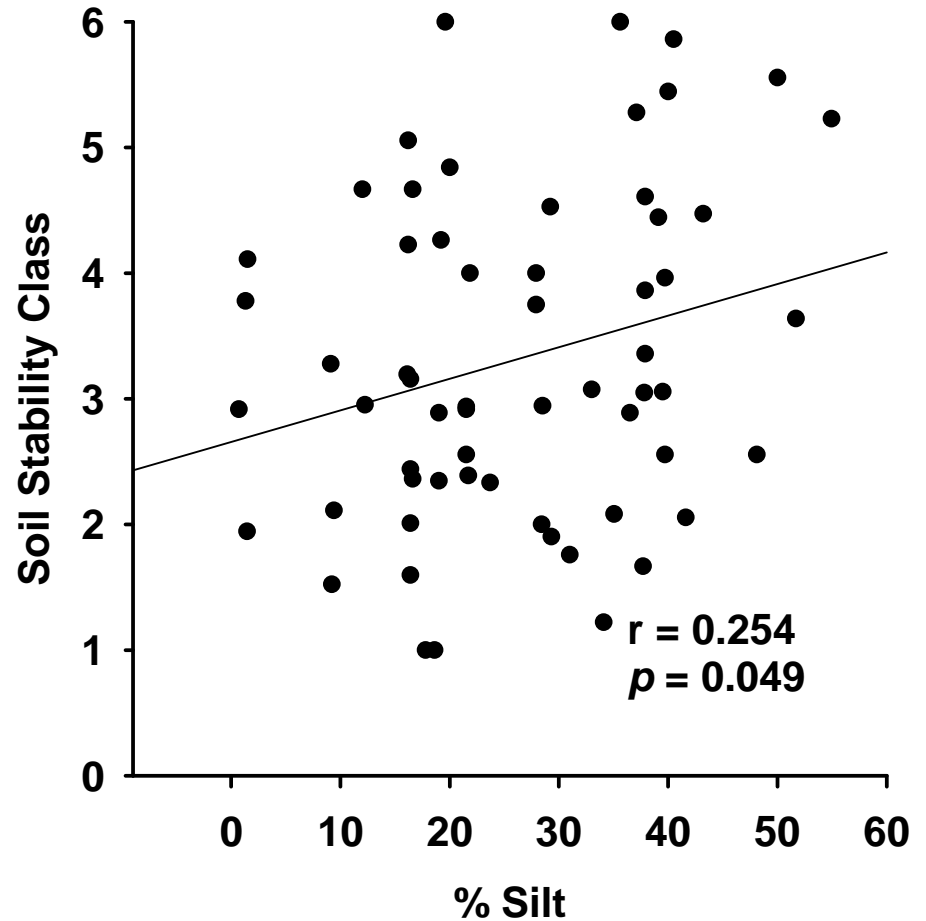
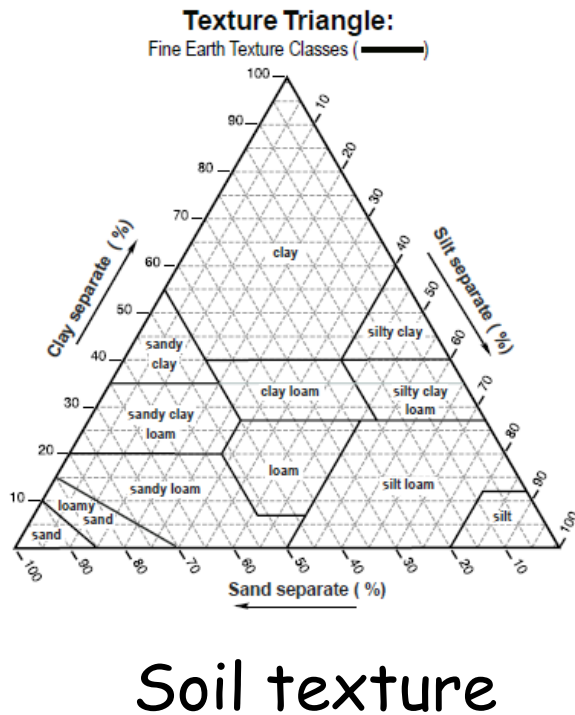
## Regional climate



NRCS NRI Data from 2003-06



# Relatively static factors that affect aggregate stability

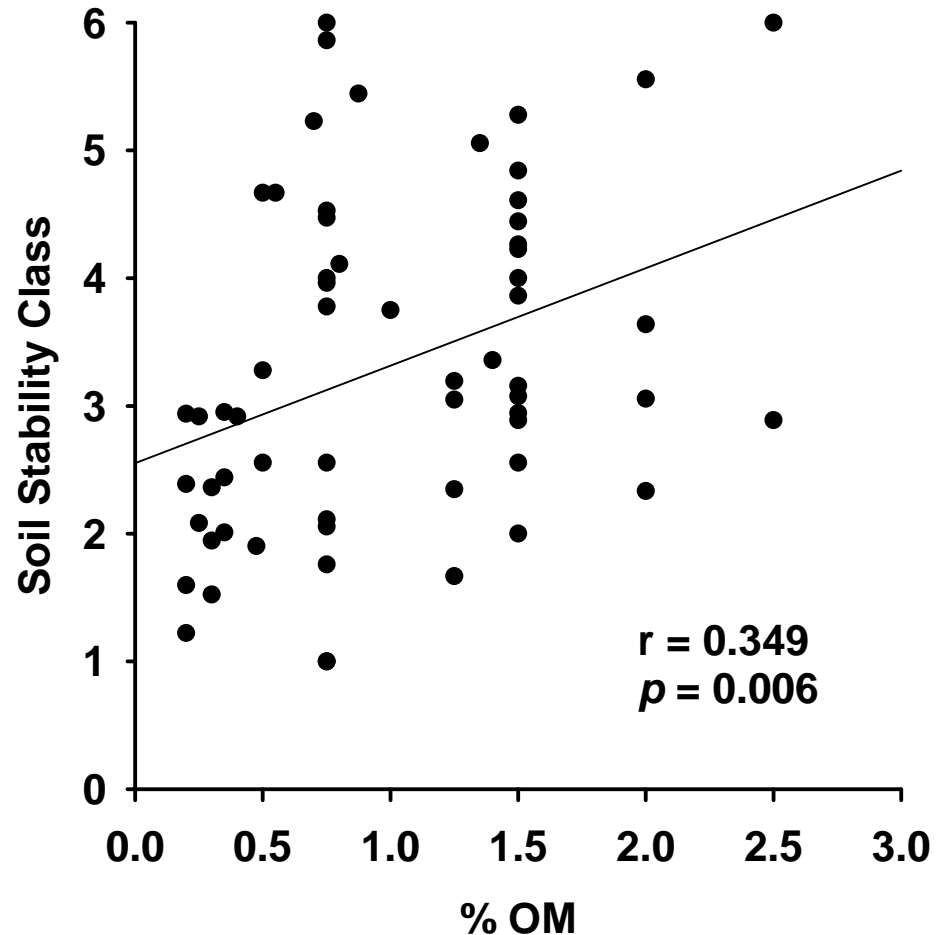




# Relatively static factors that affect aggregate stability



SOM (stable fraction, turnover time >15 yrs)



# Dynamic factors that affect aggregate stability



Plant biomass/  
production



Plant community  
composition

Bare  
ground &  
canopy  
cover



SOM (active  
fraction, 1-2 yr  
turnover)



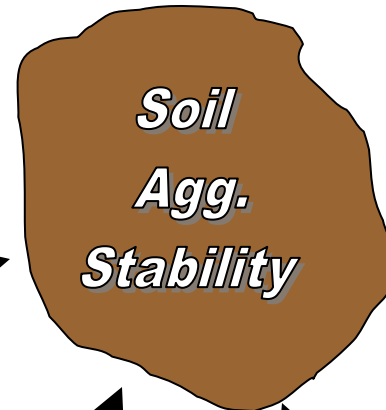
Soil biota,  
Biological soil crusts



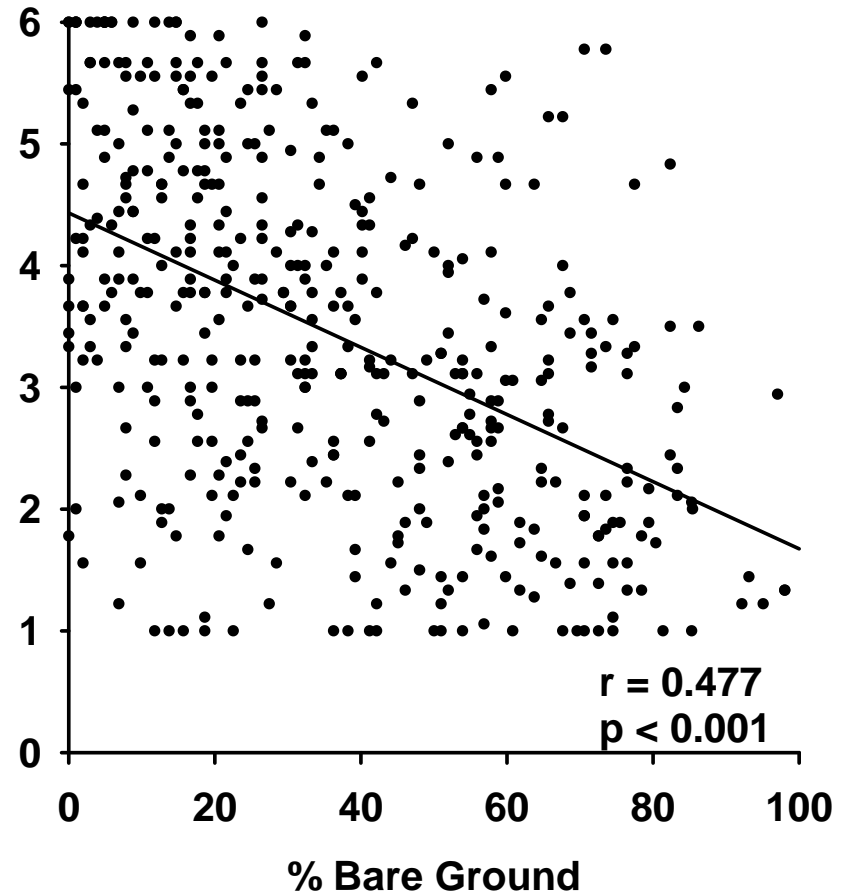
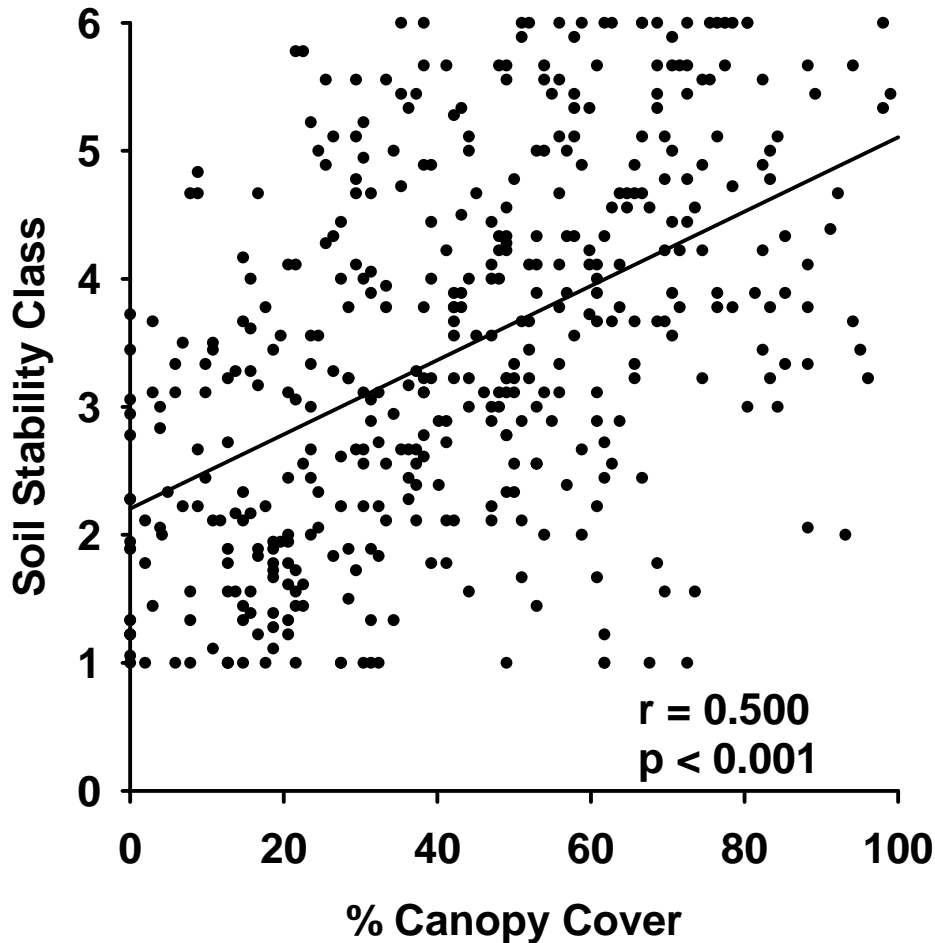
Disturbance



Annual, inter annual  
climate variability

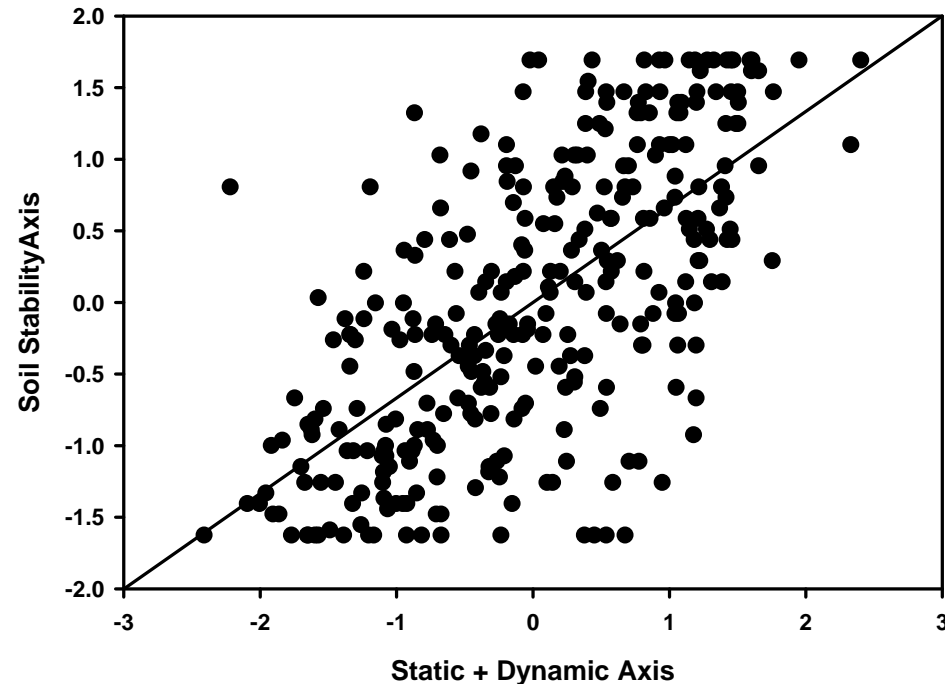


# Dynamic factors that affect aggregate stability



# How do we look at in context of hydrology and erosion?

- Auto correlated with many other plot attributes at larger scales
- Falsely conclude not important for predicting site hydrology and erosion characteristics

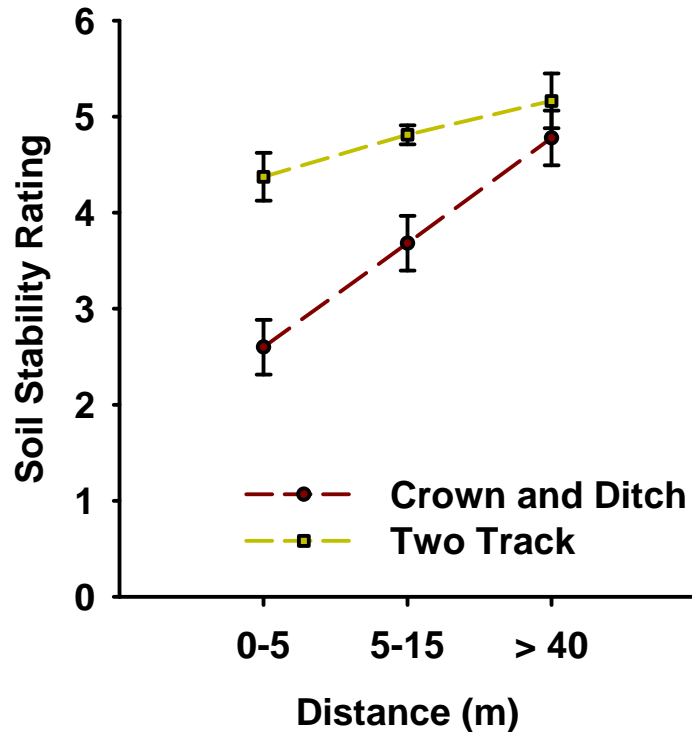


Canonical  
Corr =  
0.650  
 $p < 0.001$



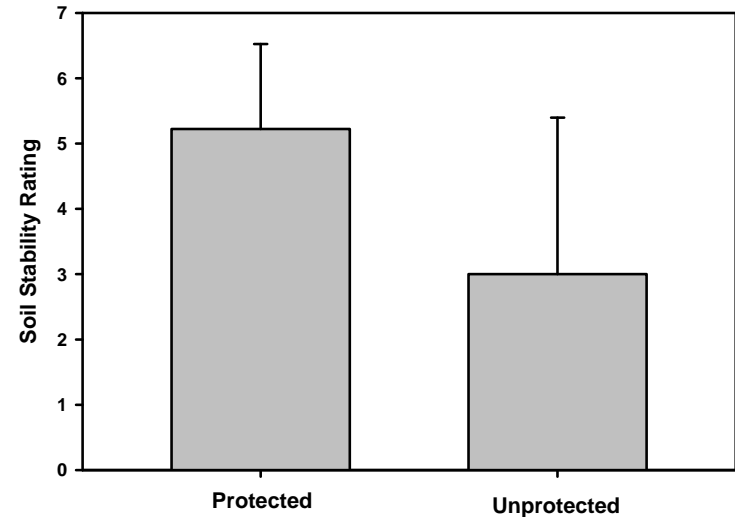
# How do we look at in context of hydrology and erosion?

- Disturbance & Patchiness



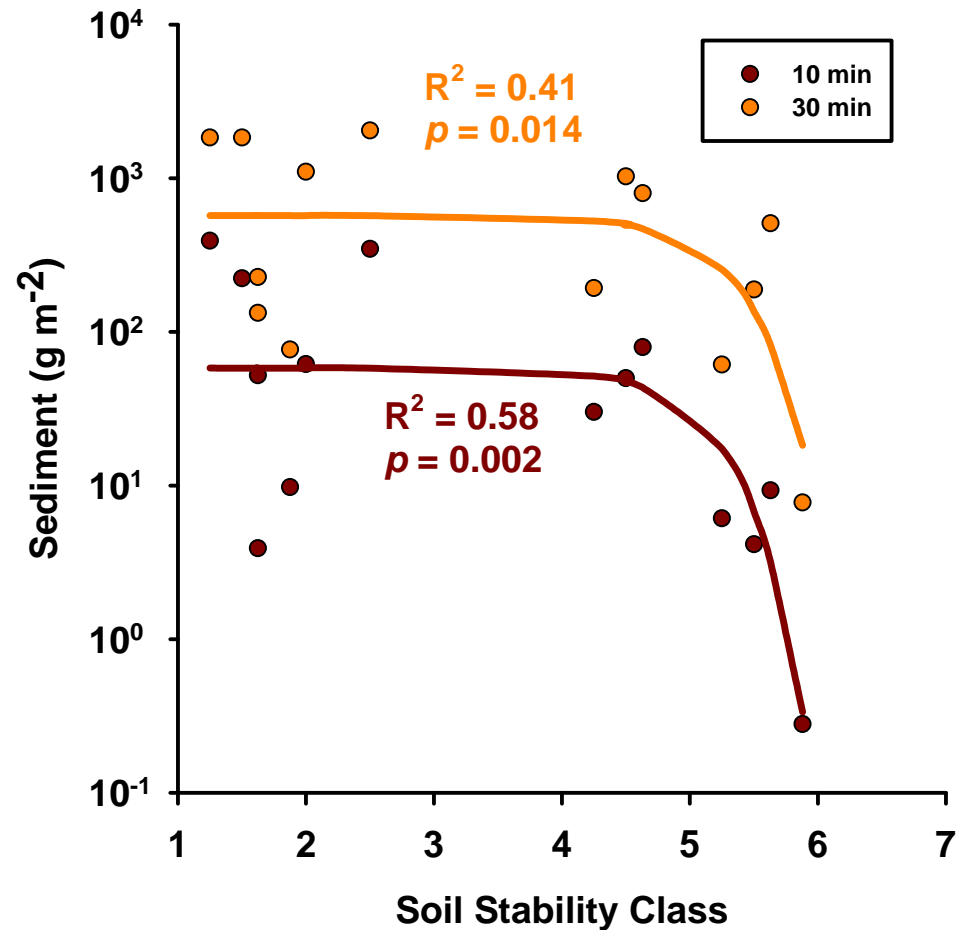
# How do we look at in context of hydrology and erosion?

- Protected vs. Unprotected
  - Protected not important for raindrop impact
  - Protected often not important for overland flow
- Site average not always reflective of importance



# How do we look at in context of hydrology and erosion?

- Non-linear response



# How do we look at in context of hydrology and erosion?

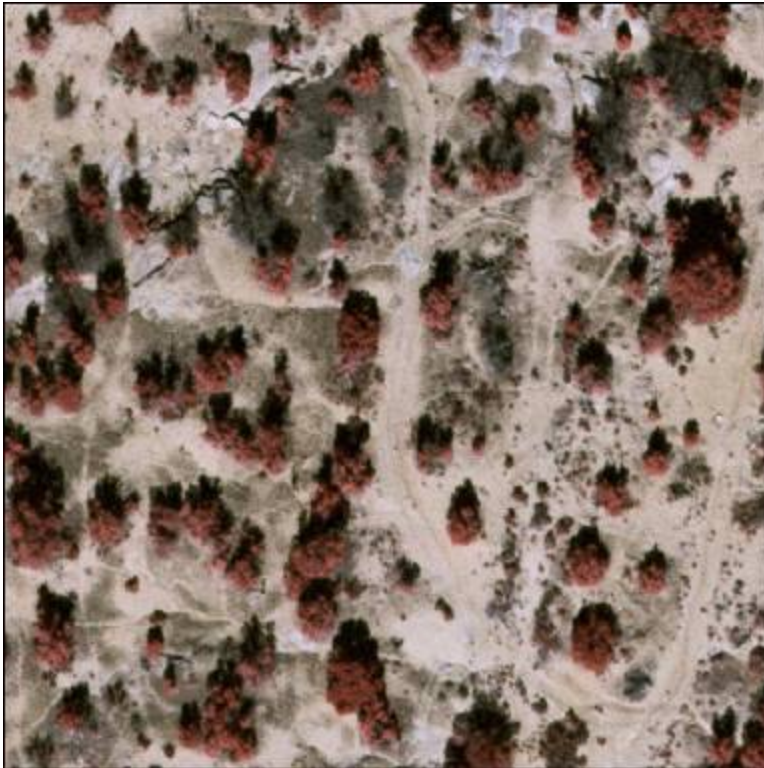
- Ideal for heterogeneous systems?
- Incorporate spatial distribution of:
  - Soil stability measures
  - Vegetation measures
  - Other soil & site properties
- With:
  - Multiscale runoff and erosion measures





# How do we look at in context of hydrology and erosion?

- And.....incorporate field data in spatially explicit analysis



0 5 10 20 30 40 Meters

Questions?

