Scaling up

How do we scale up mechanisms of resilience from plot to field to regions?

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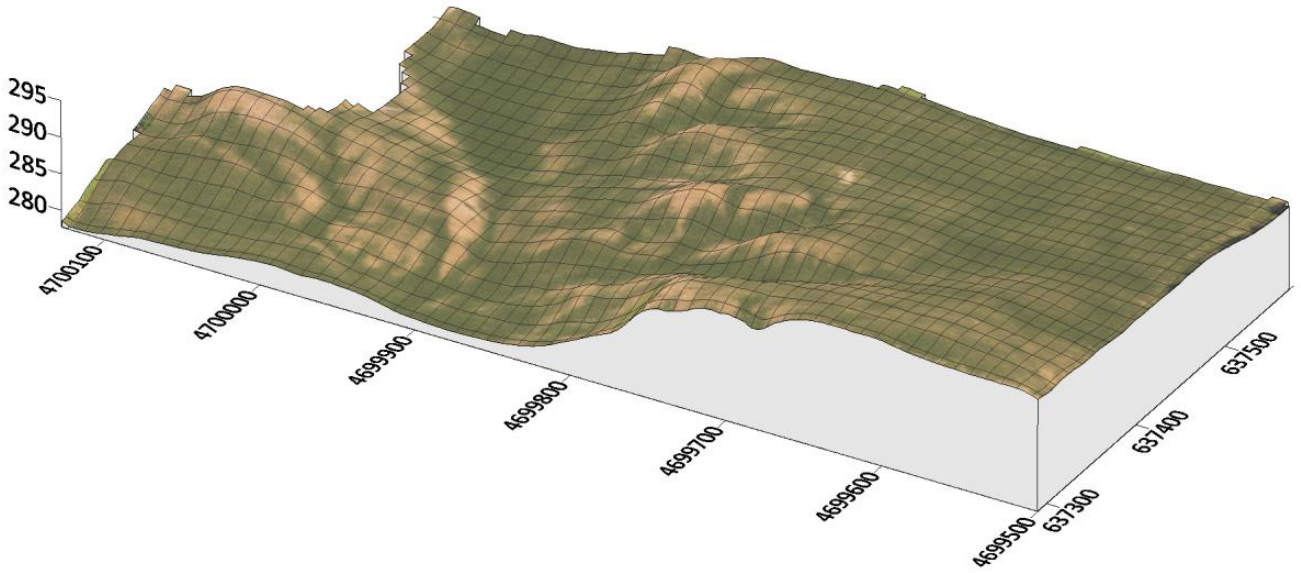
Kellogg Biological Station
Long-term Ecological Research

NSF

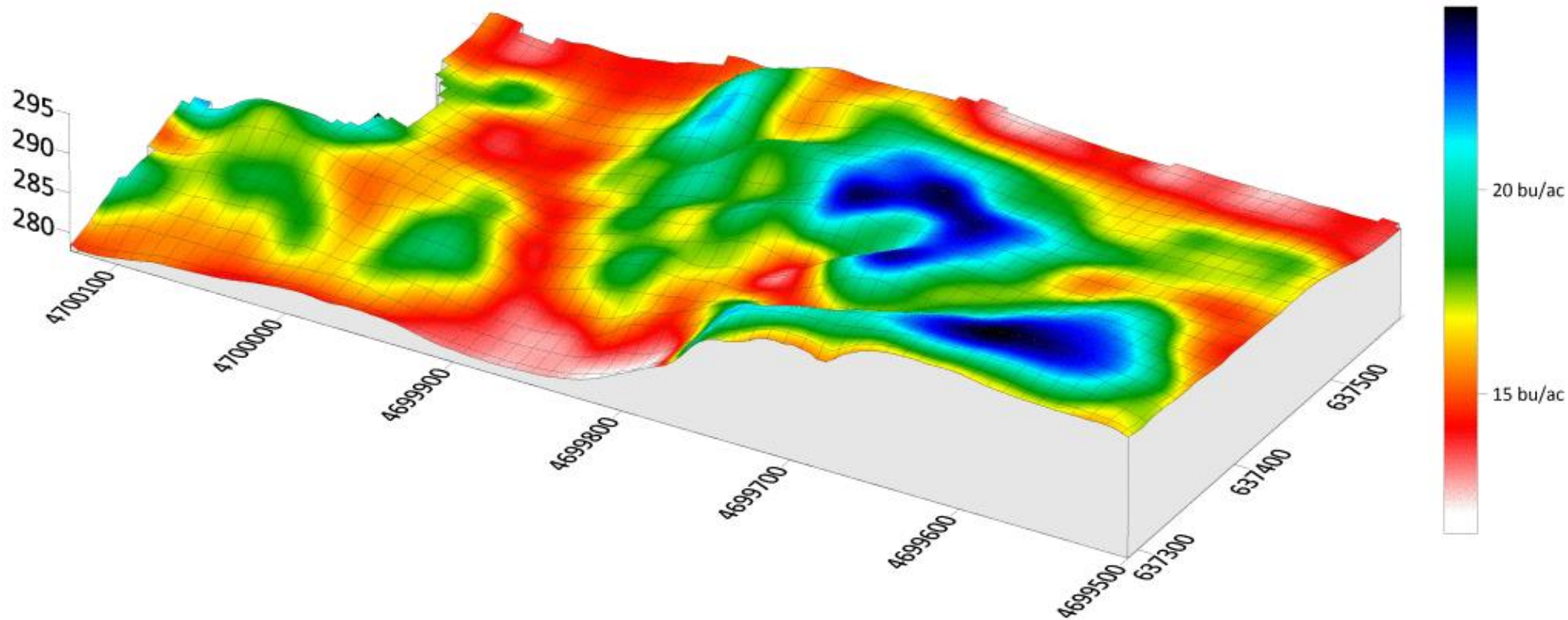
The Problem

- Spatial and temporal variability are the norm rather than the exception
- Managing variability requires an integrated geospatial systems approach
- Yield variation is not driven by just soil variability

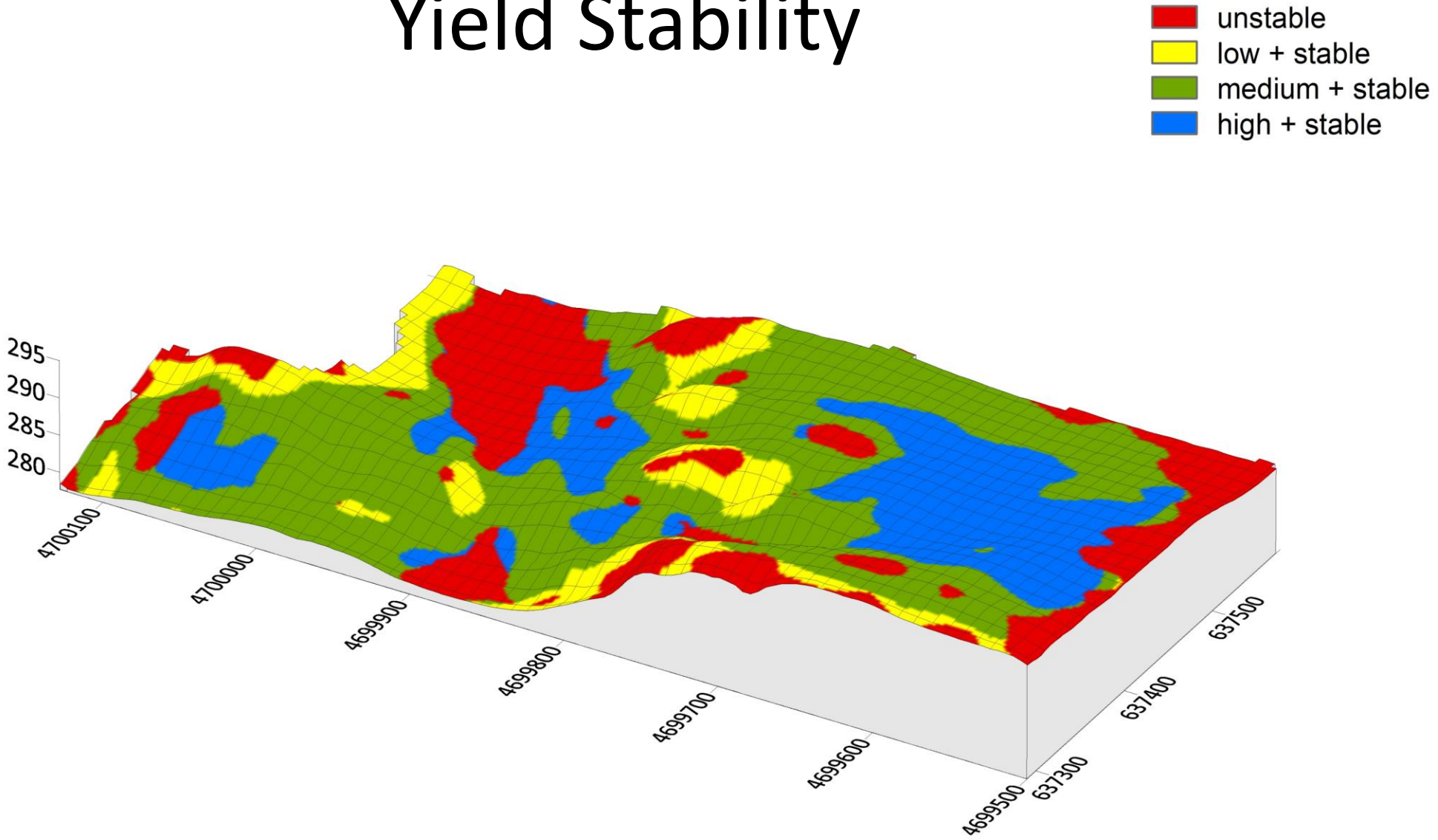


UAV visible image (1 inch spatial resolution) of a corn field (43 acres) at KBS

Yield monitor data

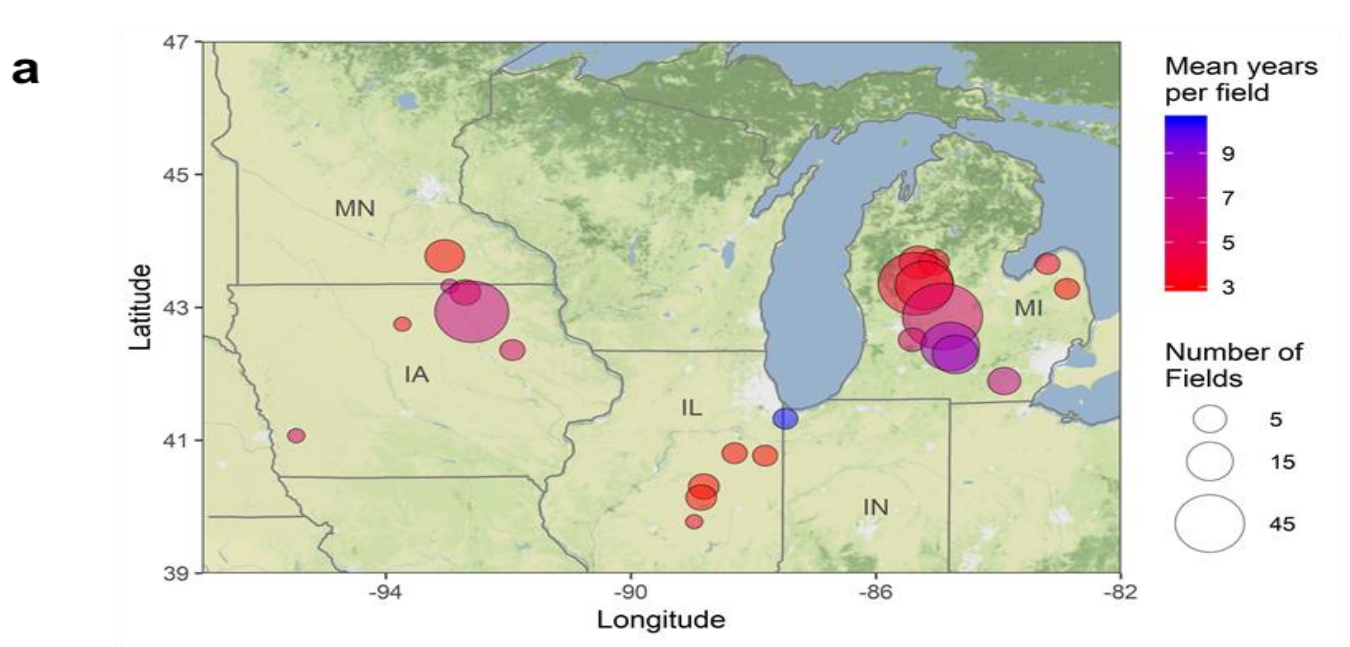


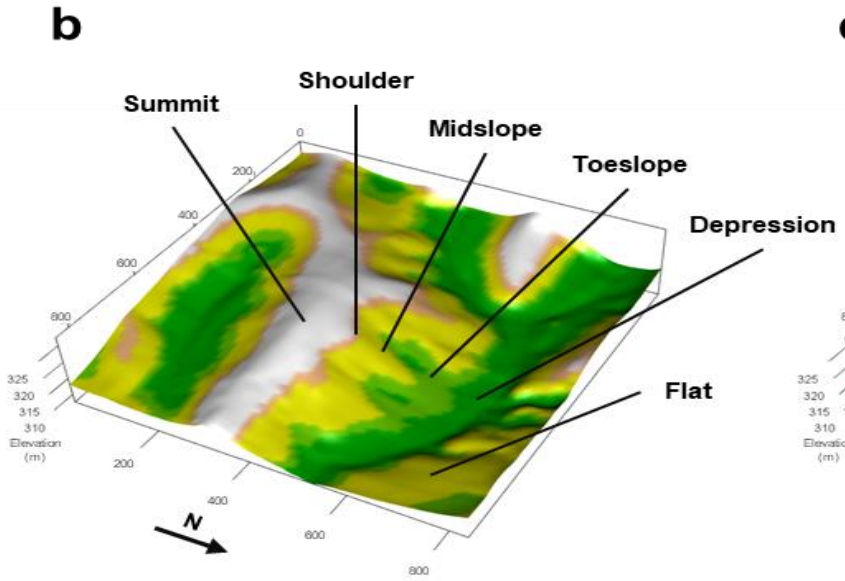
Yield Stability

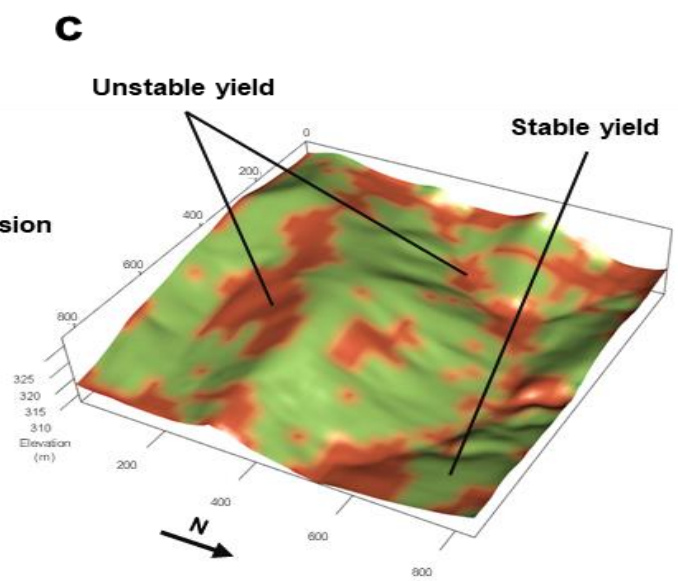


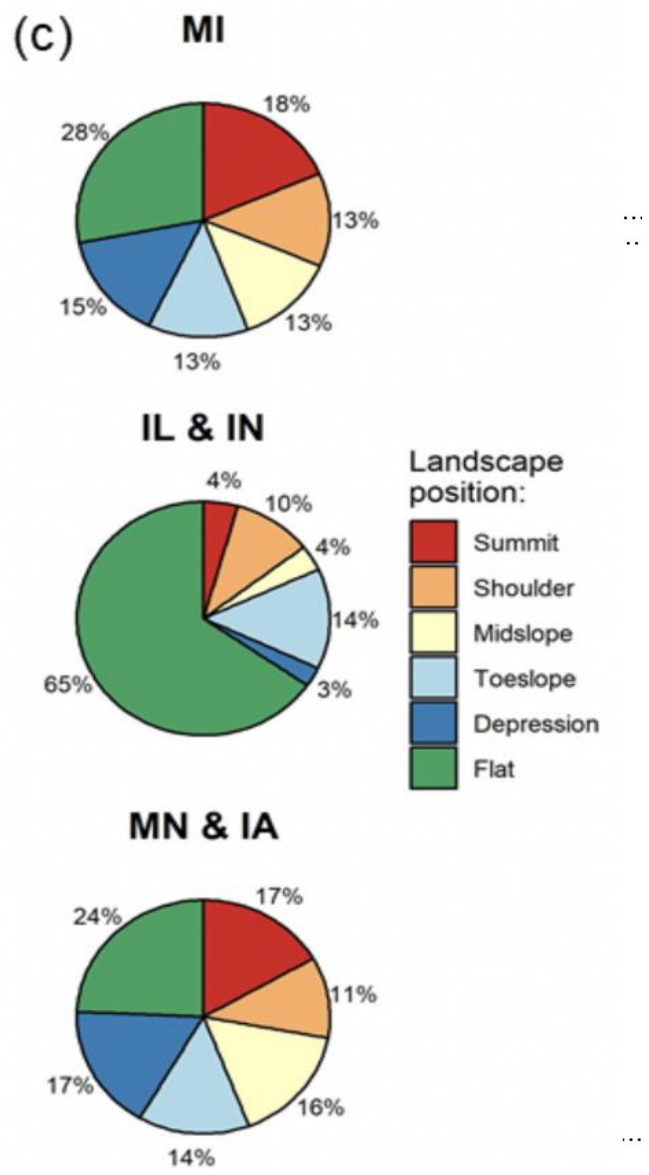
Basso et al., 2019 Scientific Reports

Dataset


a
47
45
43
41
39
Latitude
MN
IA
IL
IN
MI
-94
-90
-86
-82
Longitude
Mean years per field
9
7
5
3
Number of Fields
5
15
45


b
Summit
Shoulder
Midslope
Toeslope
Depression
Flat
N

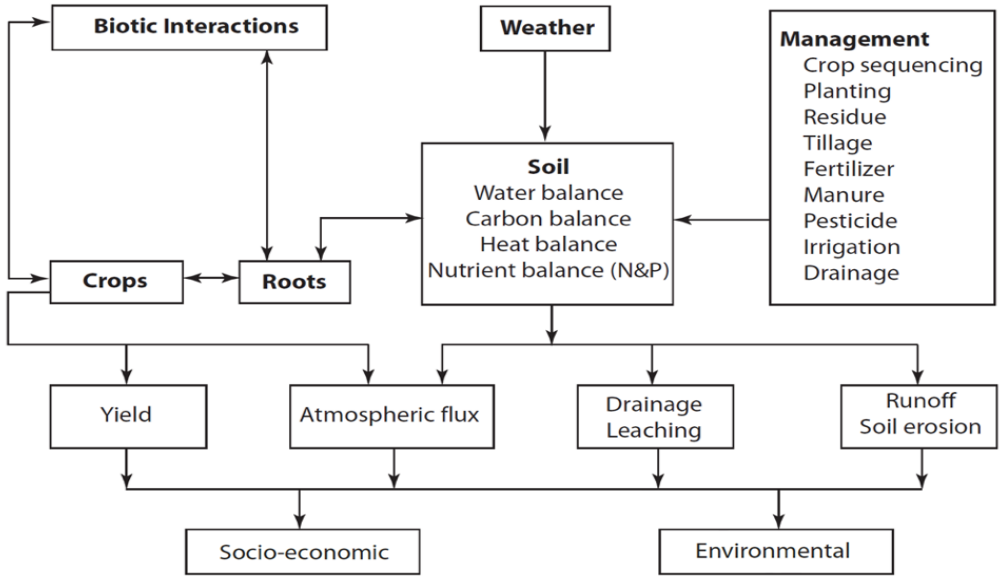

c
Unstable yield
Stable yield
N

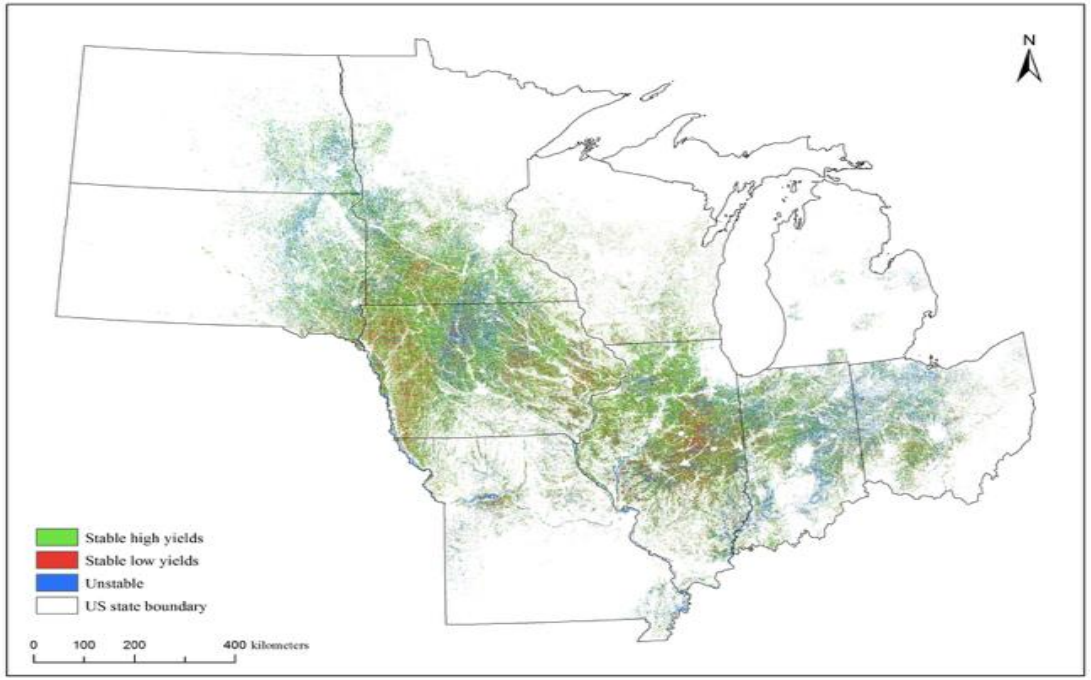

(c)
MI
18%
13%
13%
13%
15%
28%
IL & IN
4%
10%
4%
14%
3%
65%
Landscape position:
Summit
Shoulder
Midslope
Toeslope
Depression
Flat
MN & IA
17%
11%
16%
14%
17%
24%

New Questions: Scaling up

Can we predict spatial and temporal patterns of yield from field to landscape to region to increase resilience of yield?

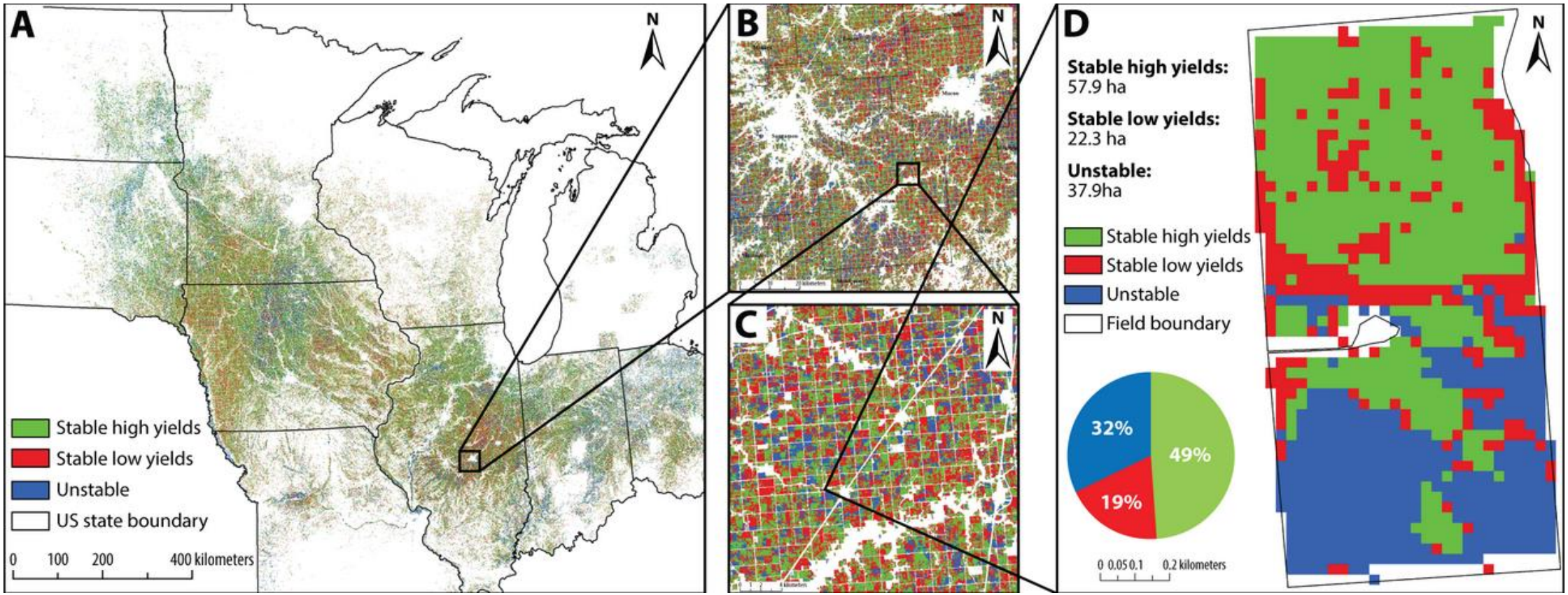
Hypothesis: the interaction between soil (SOC and water), weather and landscape position affects yield resilience at field and regional scale





Approaches

Yield stability

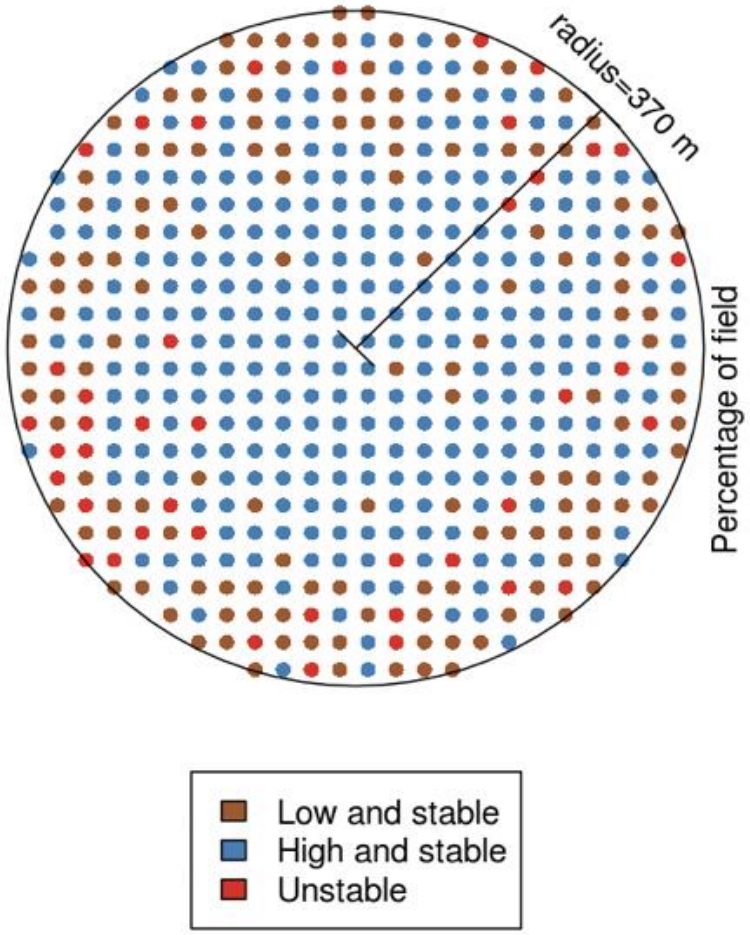


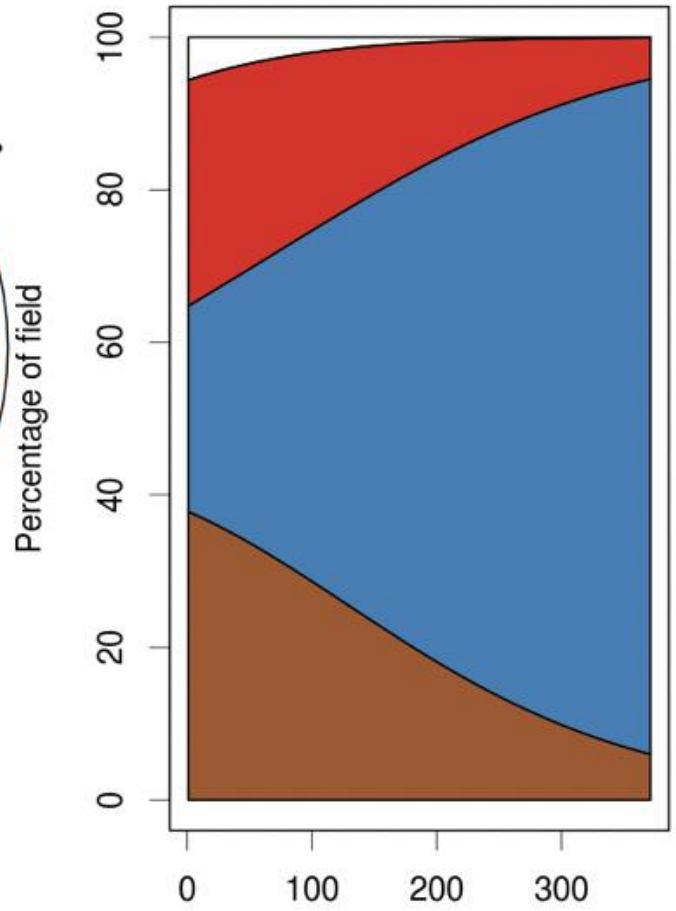
Across 70 M acres of corn fields in US Midwest, on average

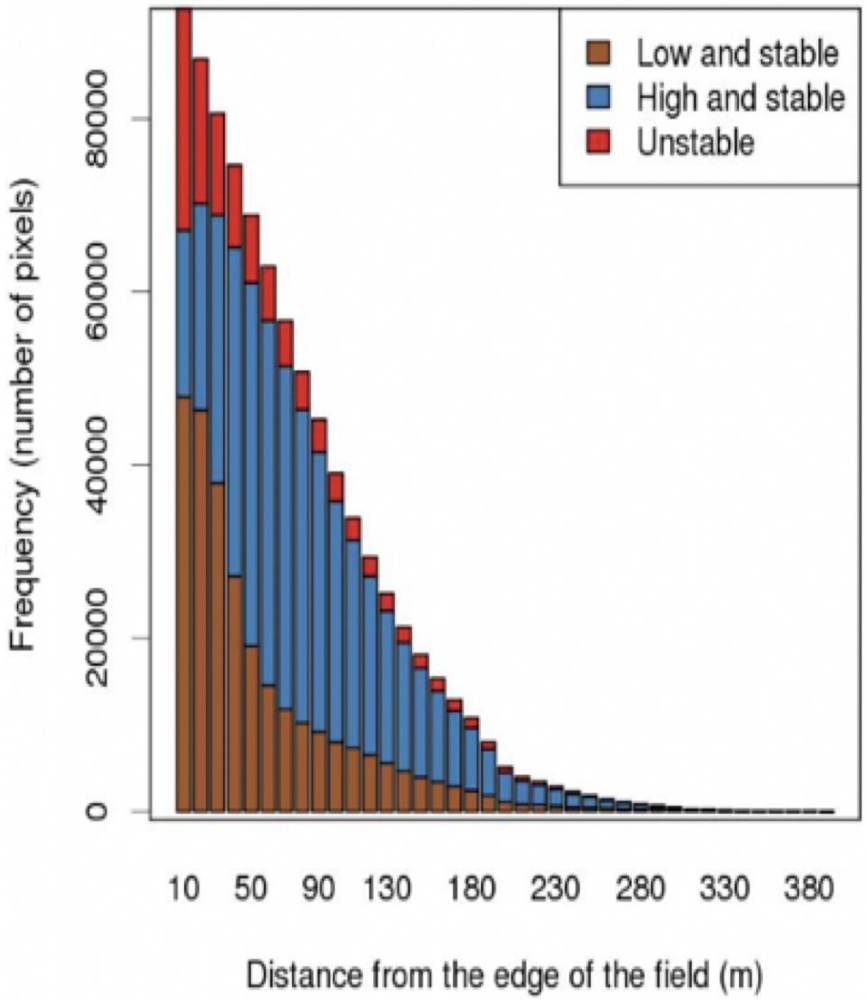
- 48% of the area of fields have stable high yields
- 25% have stable low yields
- 27% are unstable

Basso et al., 2019 Scientific Reports

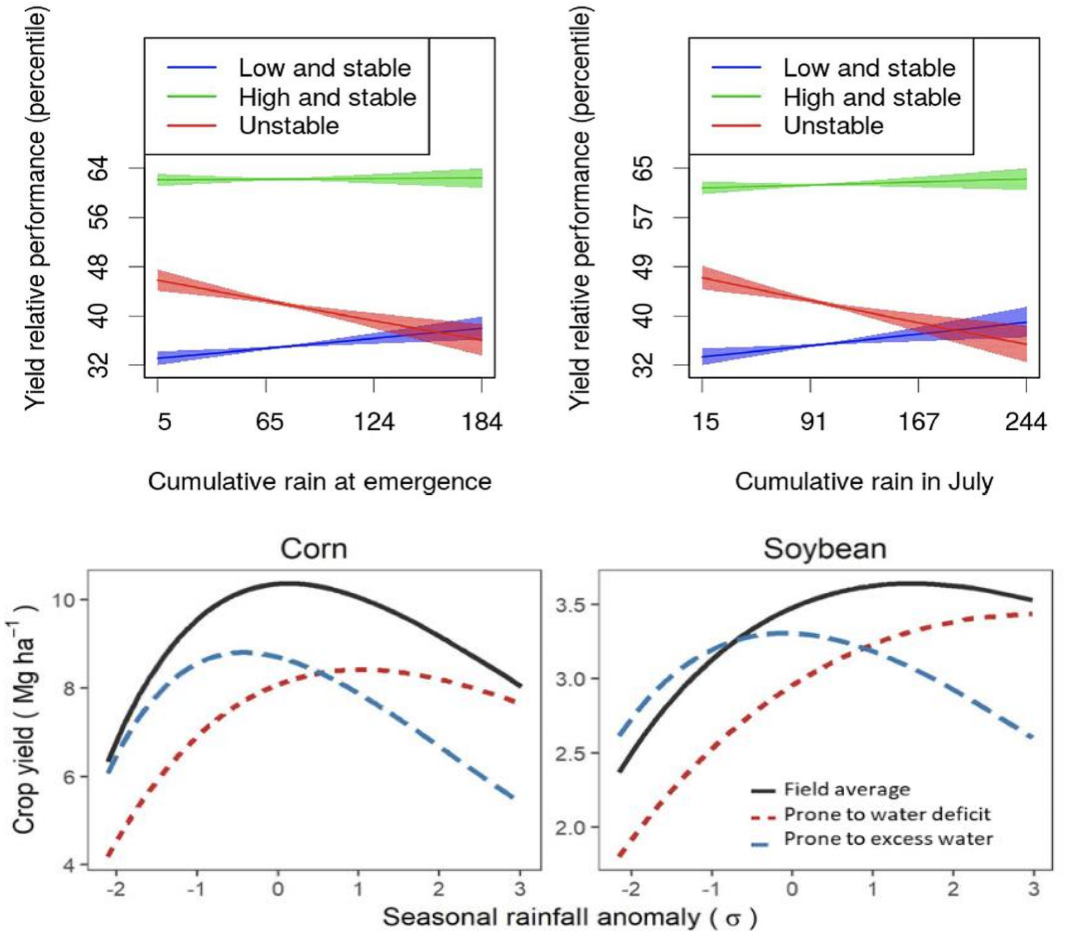
Spatial patterns of stability zones

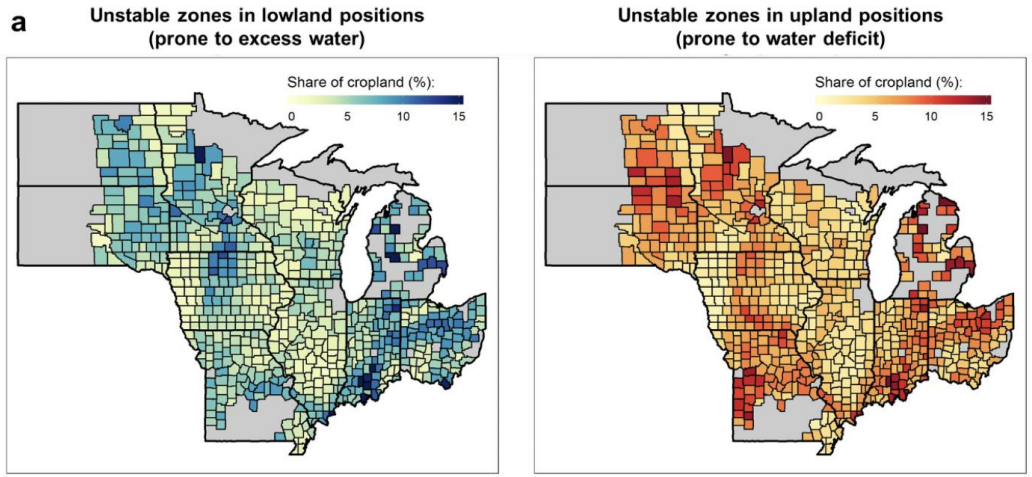






Spatial patterns of stability zones





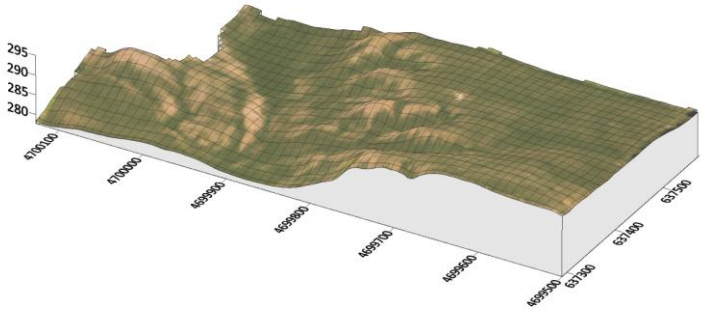
Cropland prone to water stress can lag as much as 23-33% below the field average during drought years and 26-33% during deluge years.

Maestrini and Basso, 2018, Martinez-Feria and Basso, submitted

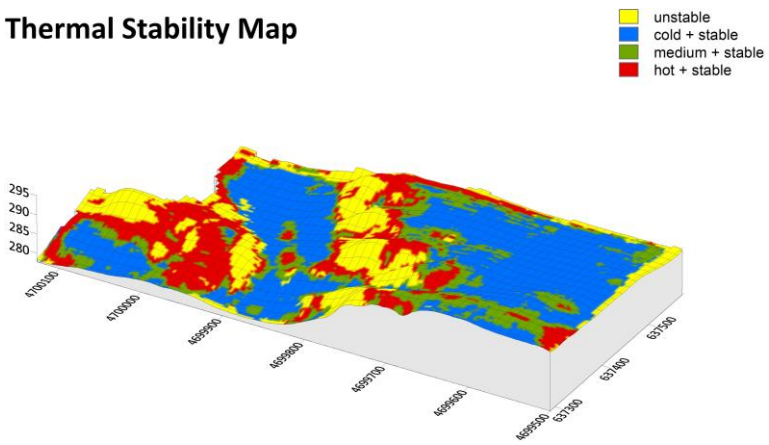
Collaboration opportunities

- Link stability maps analysis with Iowa STRIPS project and Iowa Water Center, and other LTARs sites
- Leveraging geospatial results with socio-economic and biodiversity groups
- Share results with other groups interested in using thermal imagery as proxy for scaling resources impacts on yield resilience (SOC, microbiome, biodiversity)

Soil-topography-climate interaction



Thermal Stability Map



Yield Stability