Long-term Ecological Research in Row-crop Agriculture

# Soils as Stabilizing Factors

Phil Robertson, Bruno Basso, Steve Hamilton

Phil Robertson Dept. of Plant, Soil, and Microbial Sciences and W.K. Kellogg Biological Station Michigan State University

robert30@msu.edu





# II. New conceptual model



What key mechanisms contribute to the long-term stability of important ecosystem services provided by complex agricultural landscapes?



U.S. Drought Disaster Map

2012

2012 No-till Drought Response

Source: Robertson et al., 2014 BioScience

### LTER Soybean Yield Stability 1988-2016 (MCSE)



- Permanent no-till substantially less variable (lower CV)
- Reduced input and Biologically based more variable
- Reflected in NT soybean yields (~8% higher)
- Buffered by SOM? Aggregation? Microbiome?

#### N<sub>2</sub>O Flux Stability (resistance to drought)



- Permanent no-till more resistant / stable
- Conventional least resistant (high droughtyear fluxes)
- Other systems also ~more resistant

#### Experimental approaches to test stability



Rain-out shelters can change rainfall patterns

# Nitrate loss in response to longer rainfall intervals



#### Spatial component to temporal yield stability

Maize yield stability at sub-field scales over the Midwest 2010-2015



Stable Unstable

# Questions going forward

What key mechanisms contribute to the long-term stability of important ecosystem services provided by complex agricultural landscapes?

To what extent can soil resources (plant-soil-microbe interactions) be managed to improve ecosystem services stability?

- What is the relationship between soil resources and the stability of important ecosystem services?
- What are the underlying causes of stability / instability?
- Are they manageable and if so, what trade-offs are entailed?

Irrigation, for example, illustrates trade-offs:

- Buffers against drought
- Enhances crop nitrogen use efficiency
- Should reduce nitrate loss?
- May increase N<sub>2</sub>O loss? Soil carbon loss?
- May reduce biodiversity elsewhere in landscape?

