Improving Site Specific Nitrogen Management Using Crop Modeling Tools

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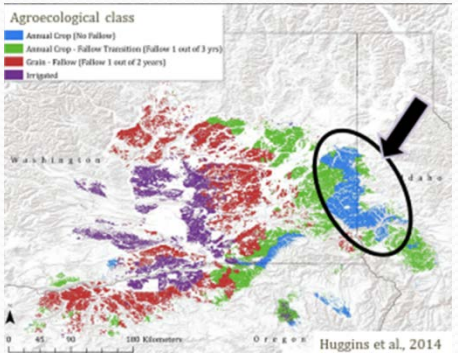
Justification For the Study

Enhance the sustainability of Inland Pacific Northwest cereal production systems…while contributing to climate change mitigation.

- Captures variable crop yield indirectly by the use of crop modeling tools
- High precipitation zone
- Framework for interdisciplinary research

Need of Precision Agriculture in the REACCH Region

- Steep topography
- History of erosion
  - Leading to shallow, less productive ridgetop soils
  - Roughly 10% of the Palouse region is eroded clay hilltops (USDA, 1978)
- Variable soil fertility
- Virtually all workable land is under cultivation (Cox, 2015)
  - Nitrogen loss by denitrification, surface volatilization and leaching
- New methodology

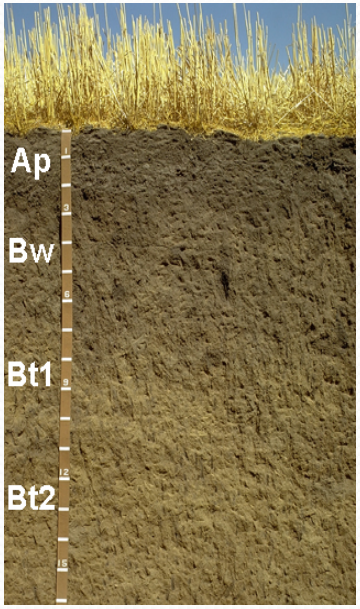


Variation in Soil Type in the REACCH Region

- Garfield
  - Shallow (20-30 cm)
  - Alfisol
    Resulted from weathering processes
  - Well drained silt-clay-loam
- Southwick
  - Moderately deep (70-90 cm)
  - Mollisol
    - Relatively fertile, higher organic matter
  - Moderately well drained silt loam
- Palouse
  - Deep (>150 cm)
  - Mollisol
  - Well Drained siltloam

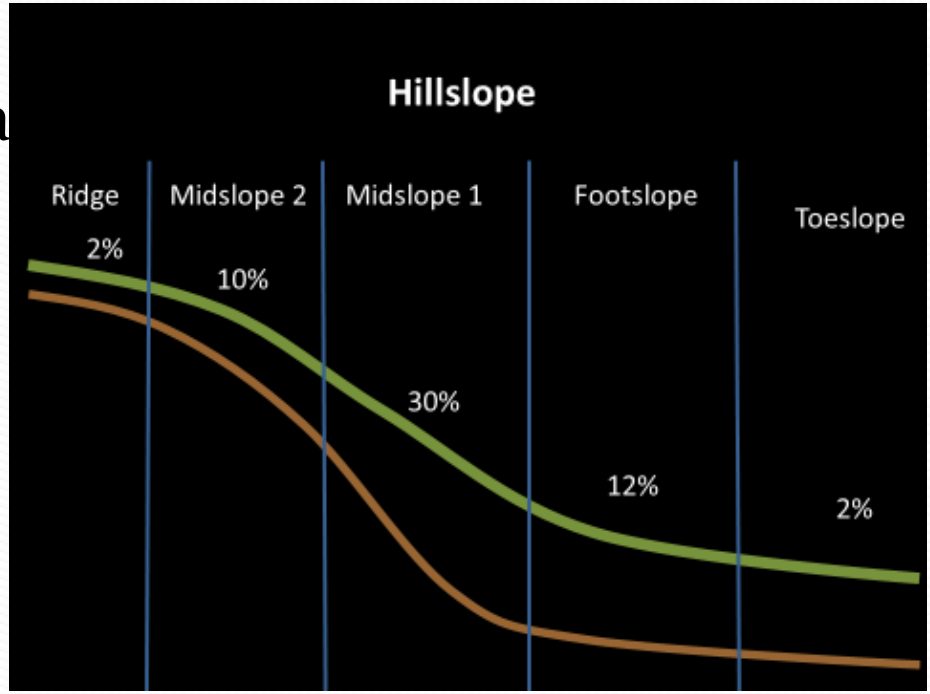
Southwick

Palouse



CropSyst-Microbasin

- A process-based cropping model
- Simulates 3D changes along a hillslope
- Spatial and temporal predictions
- Inputs adjusted by user
- Useful for capturing variability in crop yield
- Calibrated for the Palouse (Ward, 2015)



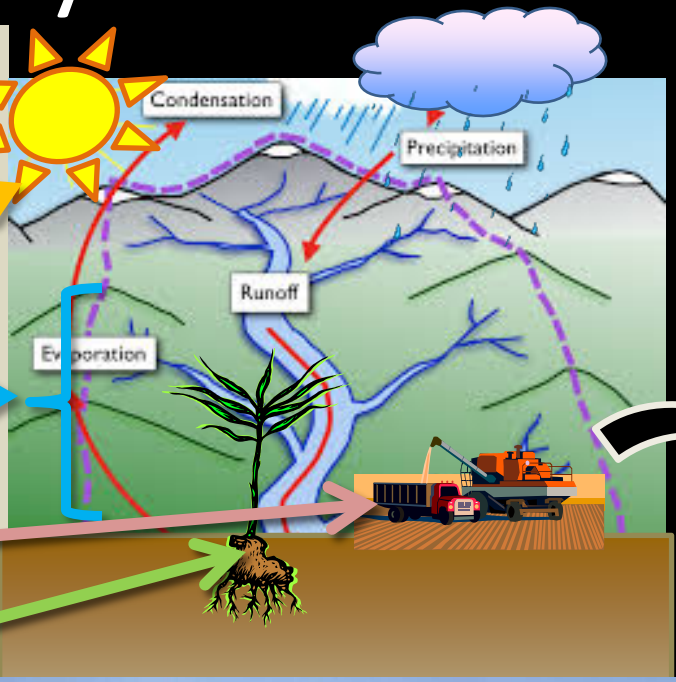
(Stöckle et al., 2014) (Ward, 2015)

3D CropSyst-Microbasin Model

INPUTS

(Each 30x30m pixel in basin can have unique input parameters)

- Weather
- Microbasin (watershed) characteristics
- Farm Management Practices
- Crop Characteristics
- Soil Characteristics



DETAILED!

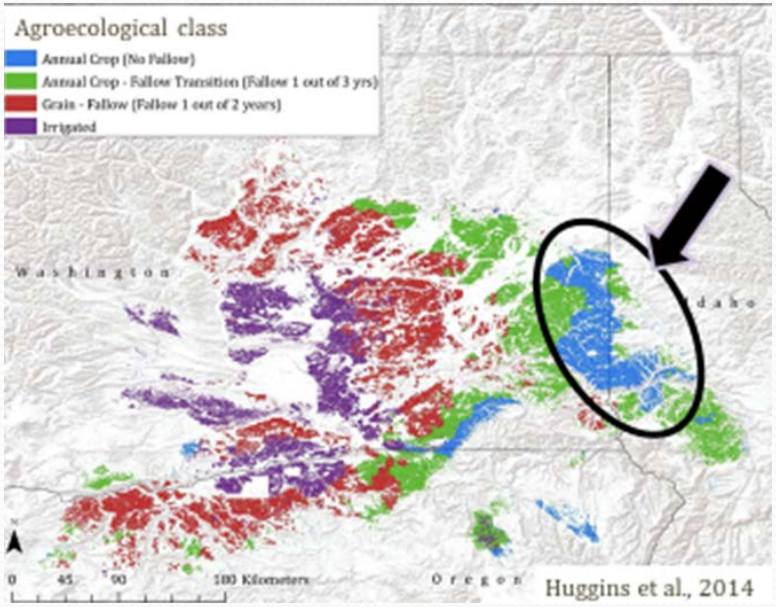
Stöckle et al., 2014

Objectives of Study

- Use CropSyst-Microbasin to determine major factors affecting crop yield variability
  - Soil type
  - Topographic position
  - Time (Climate change)
- Generate ideas for communicating this science into a useable form for growers

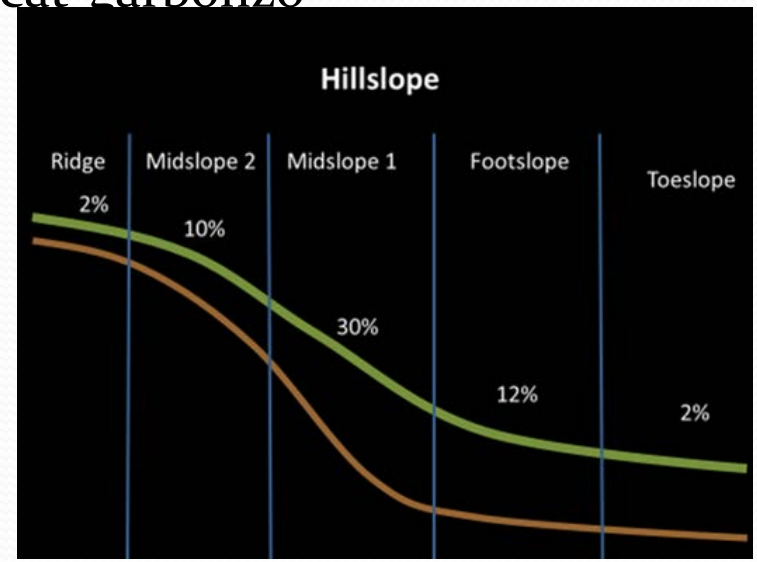
Methods and CropSyst-Microbasin

- Three soil types: shallow, moderate, deep
- Apply down scaled climate data by the CNRM-CM5 climate model for 89 year period (Abatzoglou, 2013)
  - Location: Leland, Idaho
    - High precipitation zone

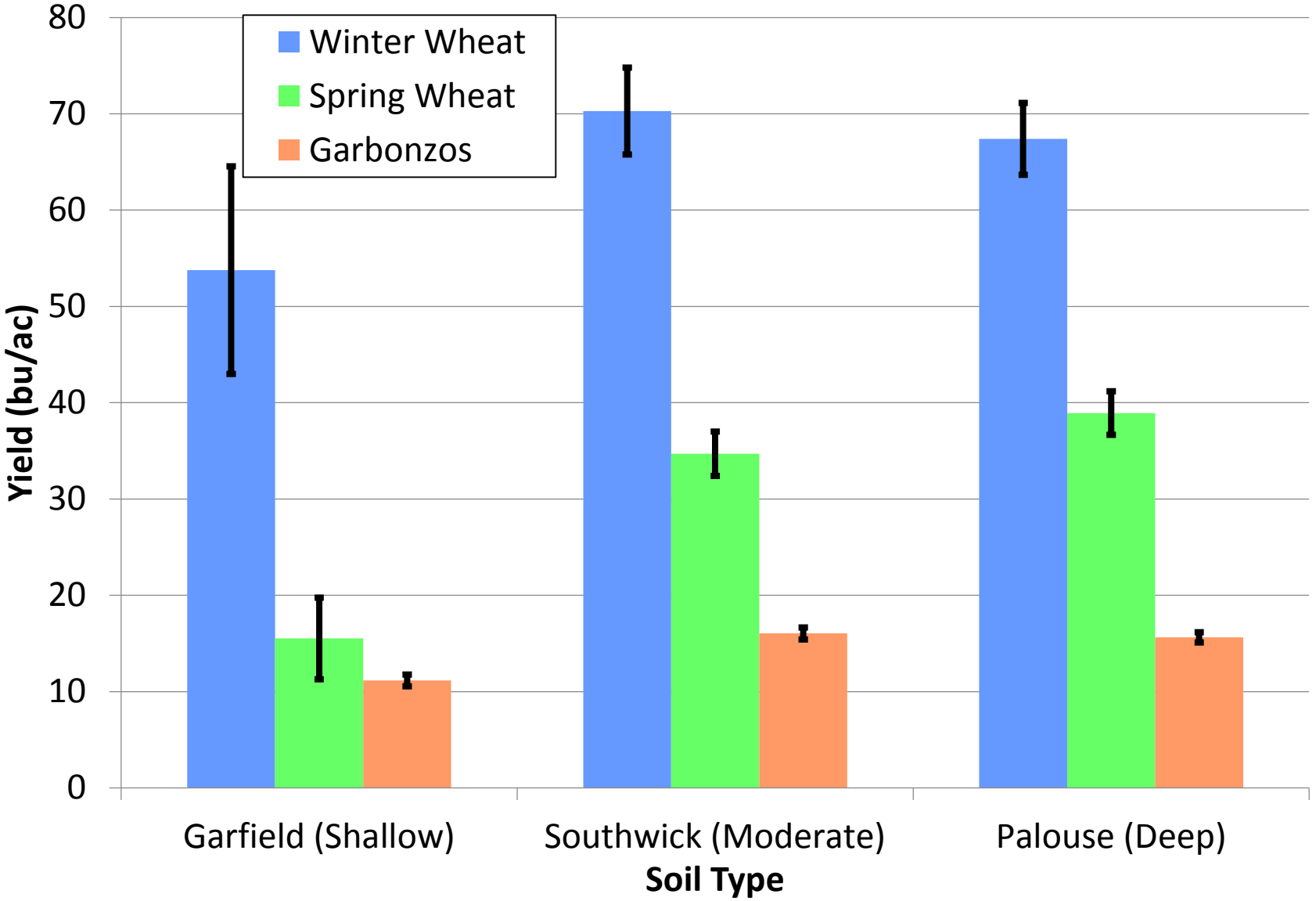


Methods and CropSyst-Microbasin

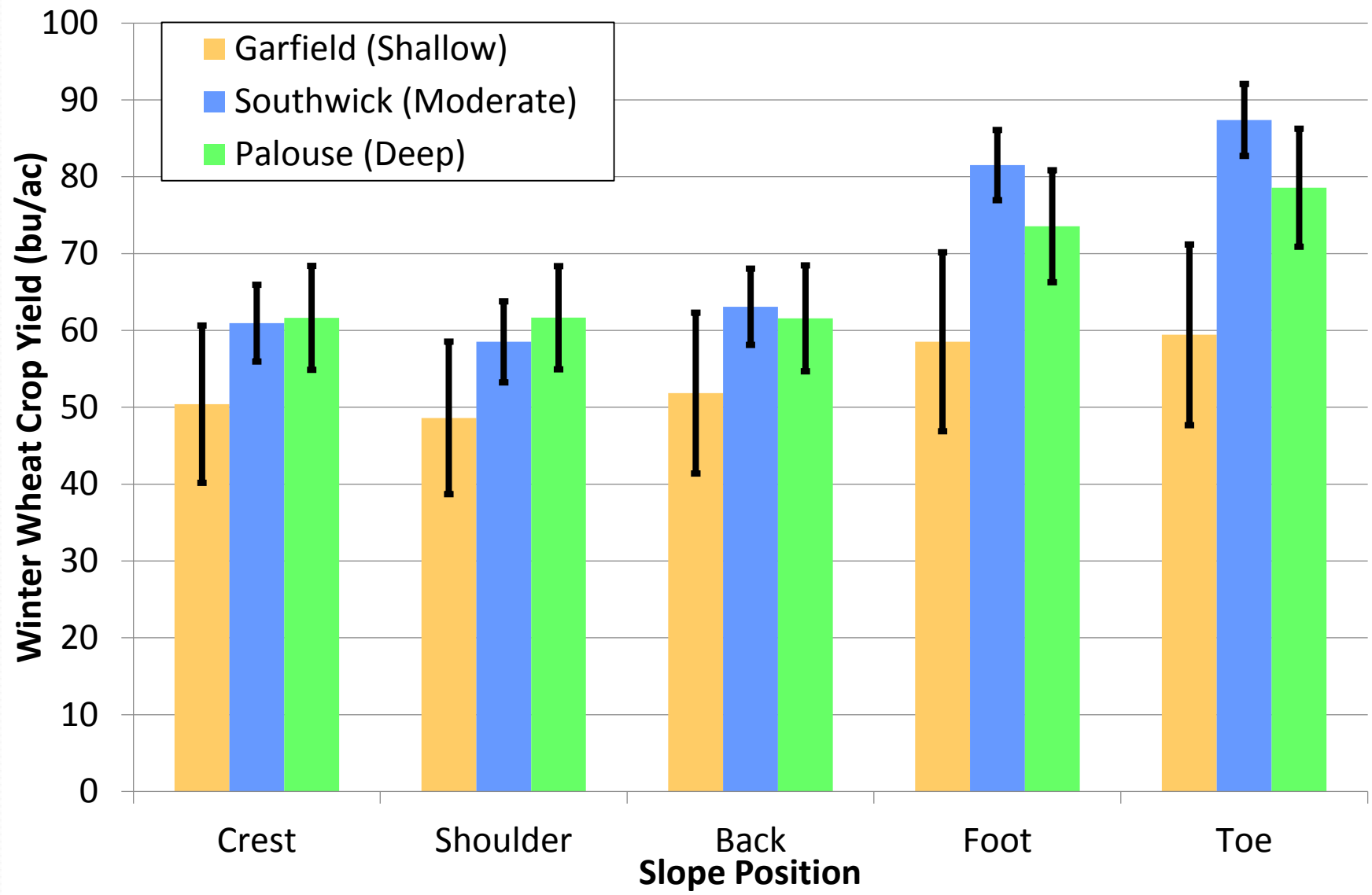
- Three soil types: shallow, moderate, deep
- Single location (Leland, Idaho)
- Use 89 year down-scaled climate dataset
  - CNRM-CM5 (Abatzoglou, 2013)
- Three year crop rotation (Ward, 2015)
  - Soft white winter wheat-spring wheat-garbonzo
- Single hillslope
  - Uniform soil types
  - Variable soil types



Soil Type Effects

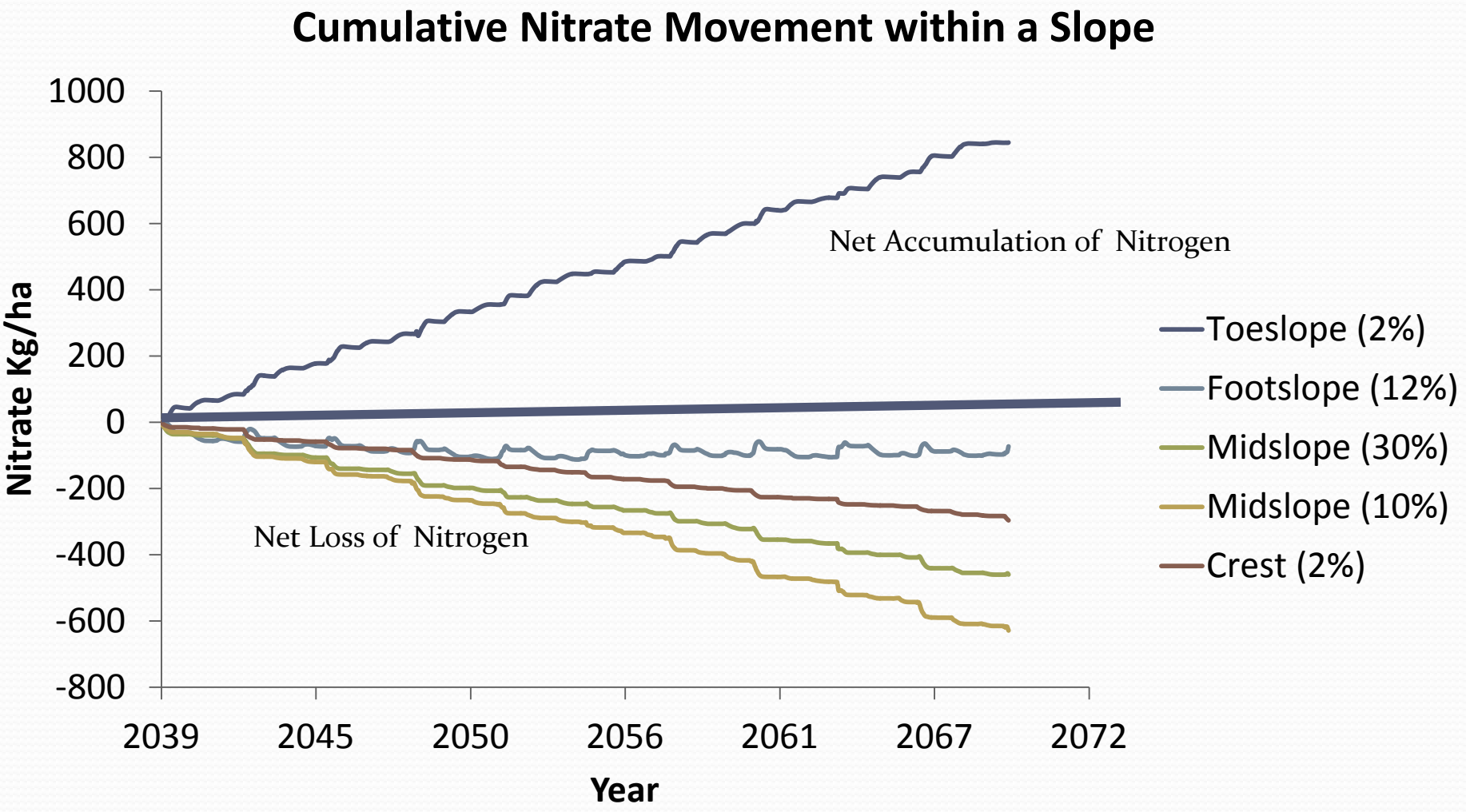


Effects of Topographic Position

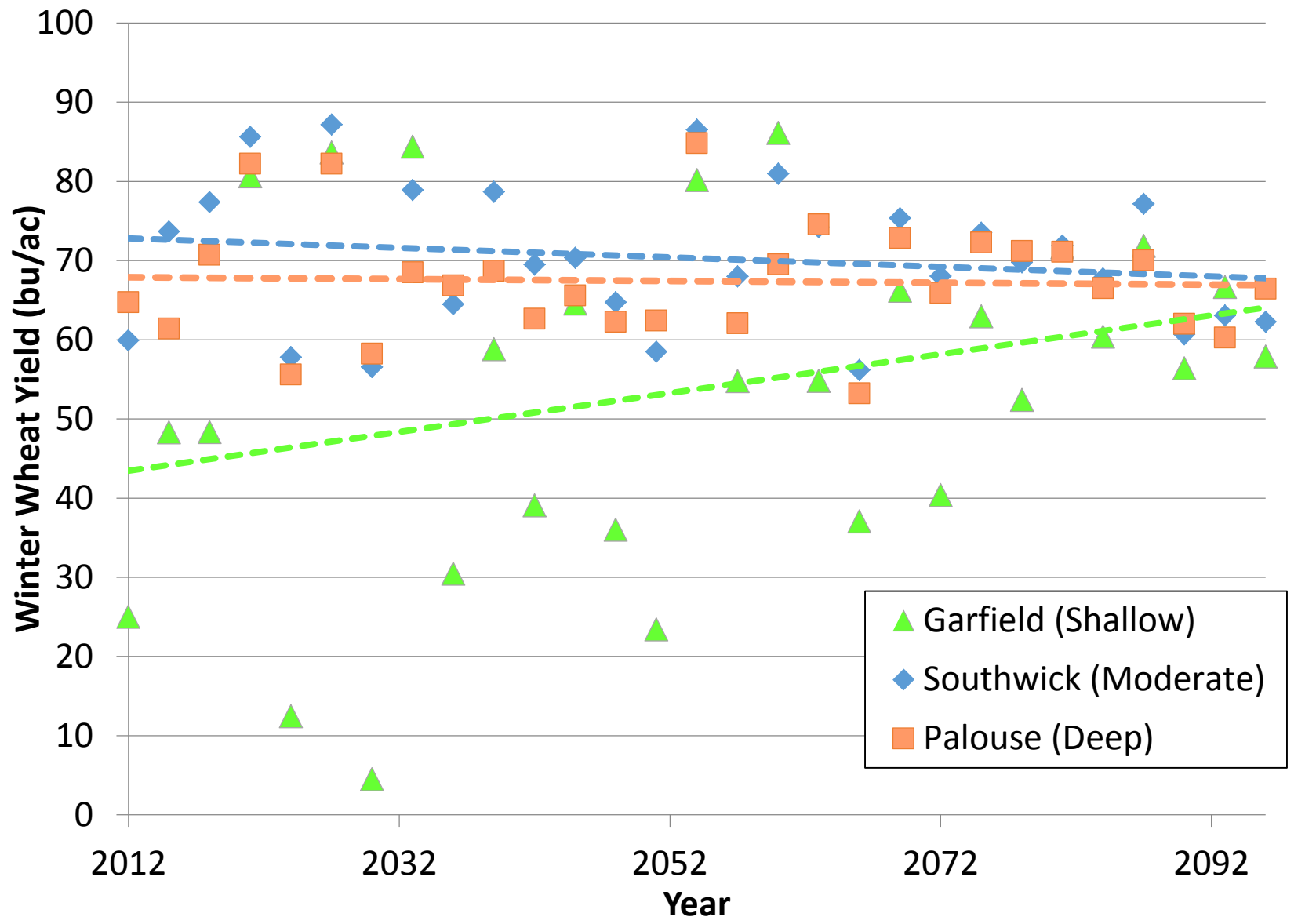


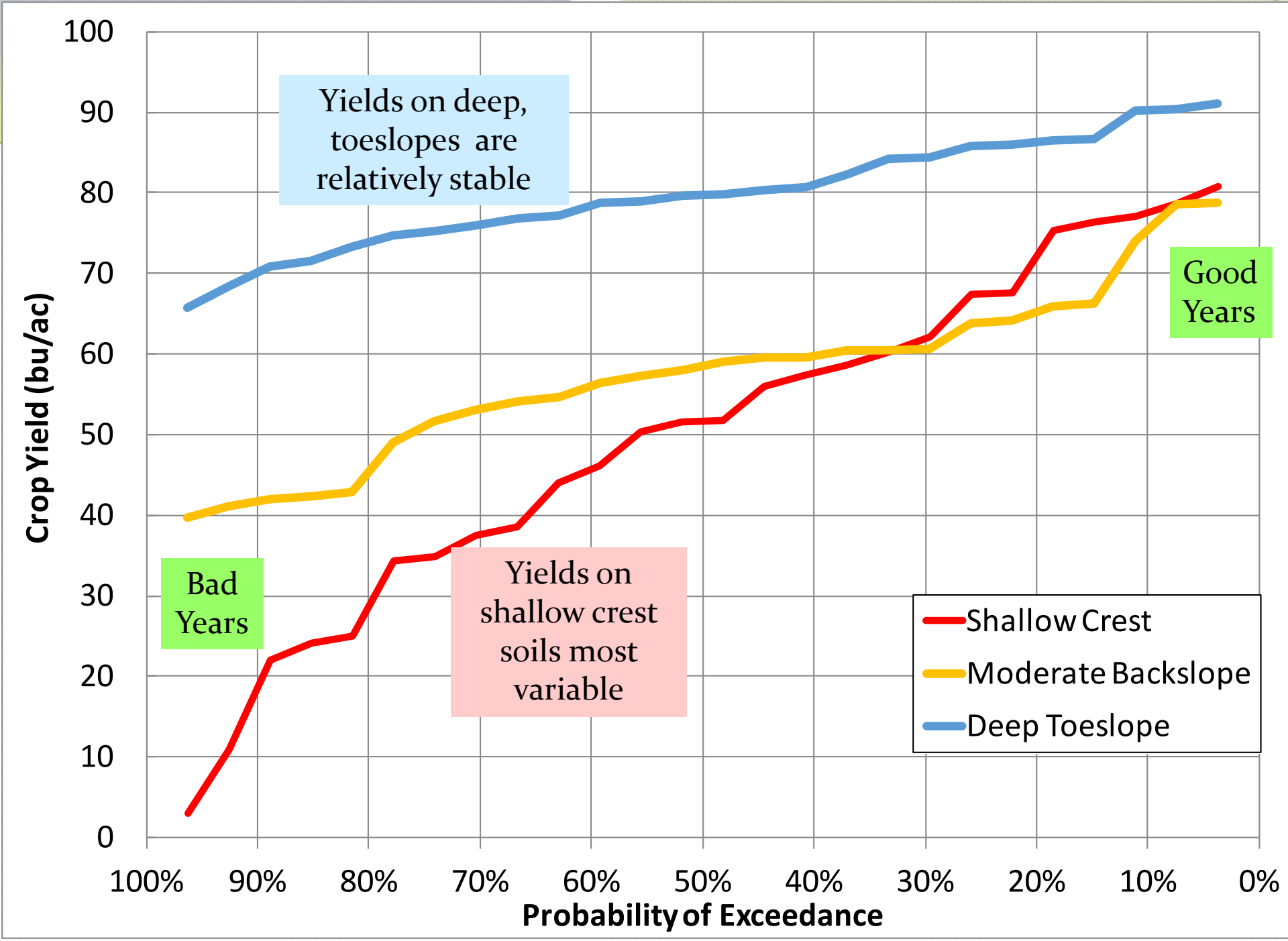
Evidence of Lateral Redistribution

- Downslope accumulation of Nitrogen (water)



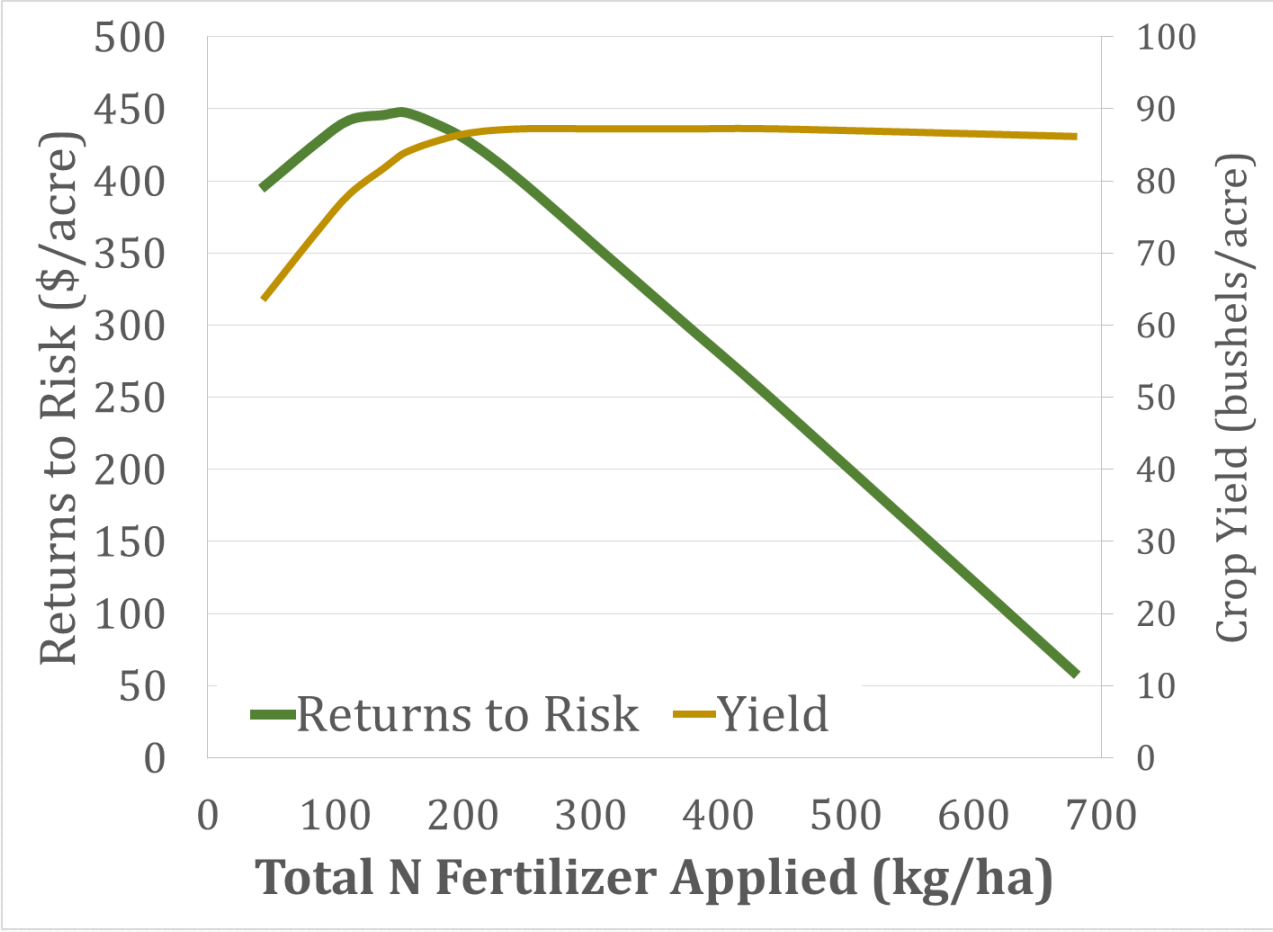
Changes in Time




Yields on deep, toeslopes are relatively stable
Good Years
Bad Years
Yields on shallow crest soils most variable
Shallow Crest
Moderate Backslope
Deep Toeslope
Crop Yield (bu/ac)
100
90
80
70
60
50
40
30
20
10
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Probability of Exceedance

The Bottom Line

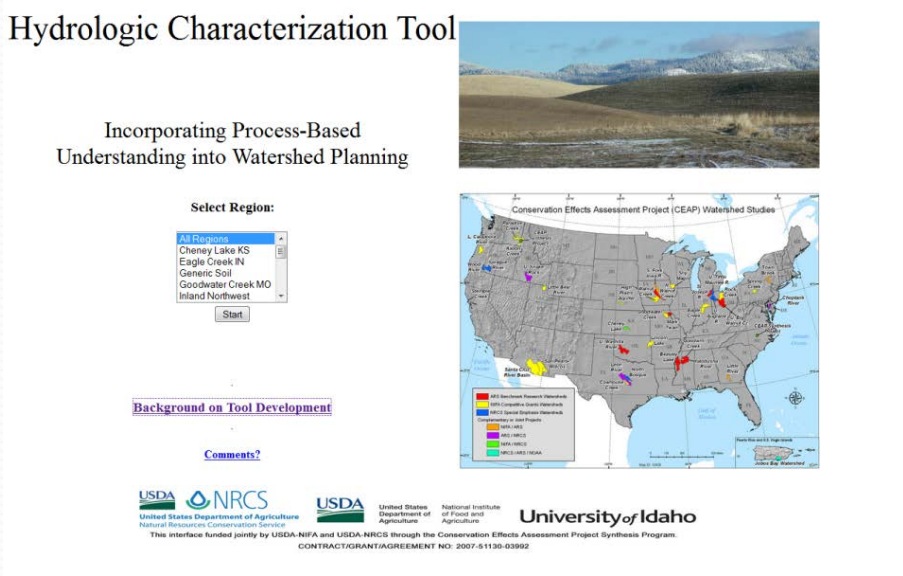
- Residual Nitrogen
- Cropping rotation
- Increase Revenue
- Reduce Nitrogen leaching



Ward, 2015

Example Approach:
Hydrologic Characterization Tool

- Web interface
- Simple, easy to use
- Drop down menu
- No need to learn a process-based model



The Crop Coordinator

Why not grow, in the know.

Step 1. Enter Location

State

County

Go!

Step 2. Enter Landscape Information

DROP DOWN

- Southwick-Palouse
- Palouse Soil
- Latah Soil
- Garfield Soil
- Palouse Soil

DROP DOWN

- Hard Red Winter Wheat
- Soft White Winter Wheat
- Corn
- Canola

Special Thanks

Erin Brooks

Nicole Ward

REACCH Interns

Questions?