MASCD meeting, Solomon Island, July 28, 2010

Adaptive Management of Winter Cover Crops using Remote Sensing and Data Sharing Strategies

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USDA Conservation Effects Assessment Project - Choptank River

Strategy

- Supporting Maryland Department of Agriculture winter cover crop cost share program
  - Improve effectiveness of cover crop cost-share programs
  - Quantification of environmental benefits (biomass production, cost per nitrogen uptake)
  - Identification and promotion of successful agronomic strategies

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Context

- Winter cover crops are a core management practice for reducing agricultural nutrient loss to Chesapeake Bay
- Program success must be increased to achieve water quality targets – current practices are not sufficient
- A need for adaptive management tools to inform farmers, planners, and Chesapeake Bay Program partners
- Collaborative research initiated by the Choptank River Conservation Effects Assessment Project

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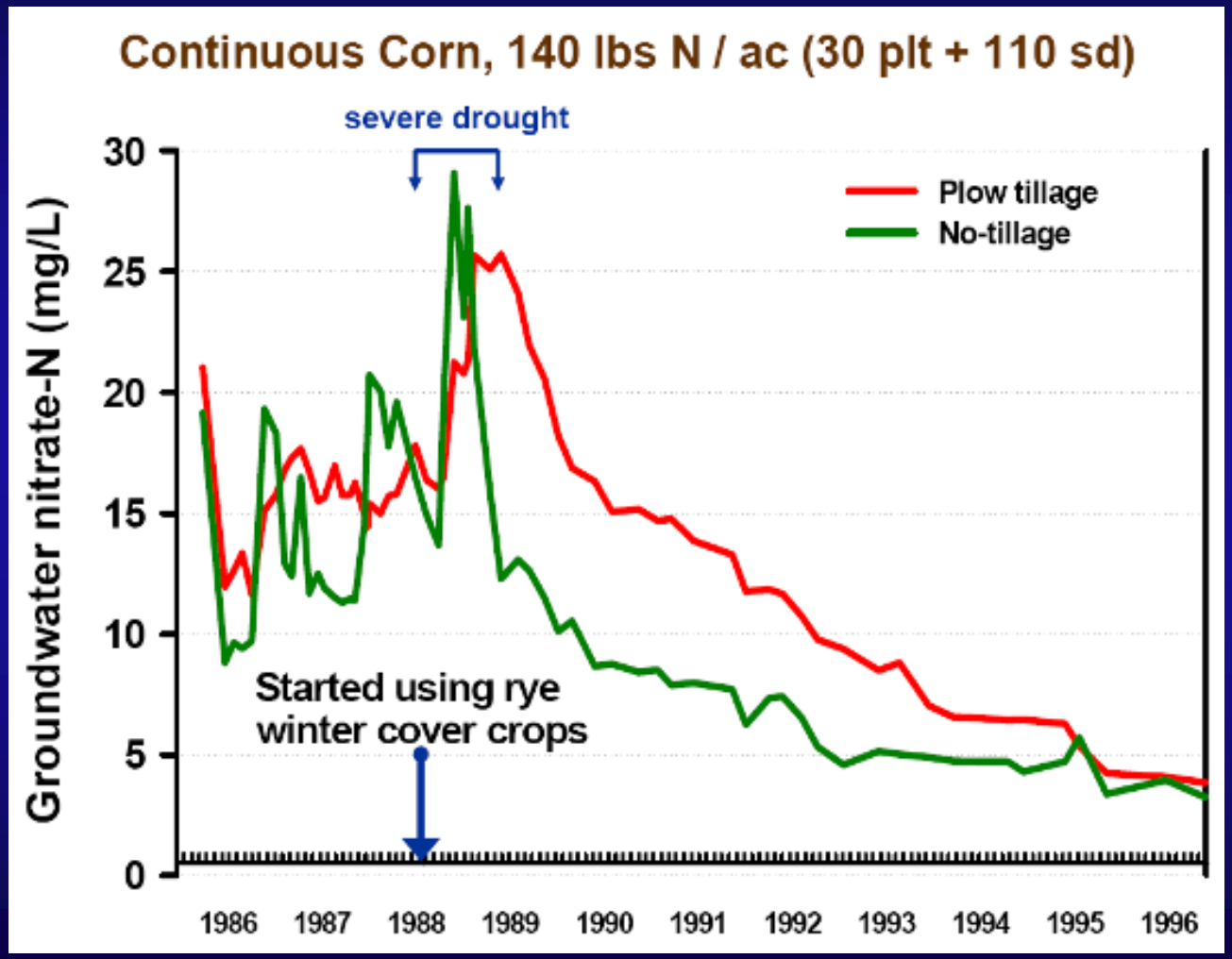
Winter cover crops can make a difference



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(data from Staver and Brinsfield - 1998)

Winter cover crops for water quality

Observations on the Eastern Shore

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- A very high biomass cover crop is certainly useful, but is also indicative of excess nutrients
- Nutrient management should be improved in those cases - work on amount and timing of application
- Use pyrolysis and digestion to transform manure into more useful products

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- **Even a good cover crop is not going to capture all nitrogen while it is becoming established**

- **If you want that, look to perennials and more complicated crop rotations**

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- A low biomass cover crop is a good environmental outcome *if* the cover crop itself is nitrogen limited due to excellent nutrient management by the farmer

- However, a robust cover crop is desired to promote soil health

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- Growing a productive grain crop is easier than growing an effective winter cover crop
- Identify costs and benefits associated with cover crops, educate farmers, and promote successful systems
- Reduce or eliminate fall fertilizer application to winter grains

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- Weather variability and regional growing conditions affect in cover crop establishment
- Identify cover cropping systems that work well in local environments, and promote them
- Plant early, plant often

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- **Some agronomic management strategies do not grow effective cover crops (late planting dates, seed broadcast without incorporation, wheat)**
- **Identify and promote successful systems**
- **Increase effectiveness through adaptive management**

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- **The good news is, there is room for improvement – a substantial portion of cover cropped fields do not perform as well as desired**

- **The bad news is, there are limits imposed by climate and by the leaky nature of row crop agriculture**

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What factors affect cover crop success?

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Planting date

Species choice

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Planting method

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Residual soil N

- Cover crops can be N limited (this is OK)

Climate

- Planting windows for cover crops are affected by regional temperatures, precipitation, and row crop harvest date

Enthusiasm and knowledge

- Timeliness is a farmer choice, and choices depend on accurate information about cover crop benefits

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Management issues

- Springtime soil moisture
- Springtime kill method
- Certified seed production
- Weeds and pests
- Seed availability
- Yield of subsequent row crops

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Reasons for successful cover crop performance

- Early planting date
- High performing species and varieties
- Good agronomy and seed-soil contact
- Abundant residual soil nitrogen
- Favorable climate conditions

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Target times and sites of nitrogen loss

- Cover crop after corn silage harvest – a low-hanging fruit in all Chesapeake Bay states
- Under-yielding corn fields - anywhere with a missed yield goal
- Well-drained agricultural soils (wetlands work)

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Nitrogen capture by winter cover crops can reduce nutrient loss to the Chesapeake Bay.

But, how much is captured?
And how do agronomic practices compare?

These questions can be answered by combining conservation program enrollment records with satellite remote sensing and on-farm sampling

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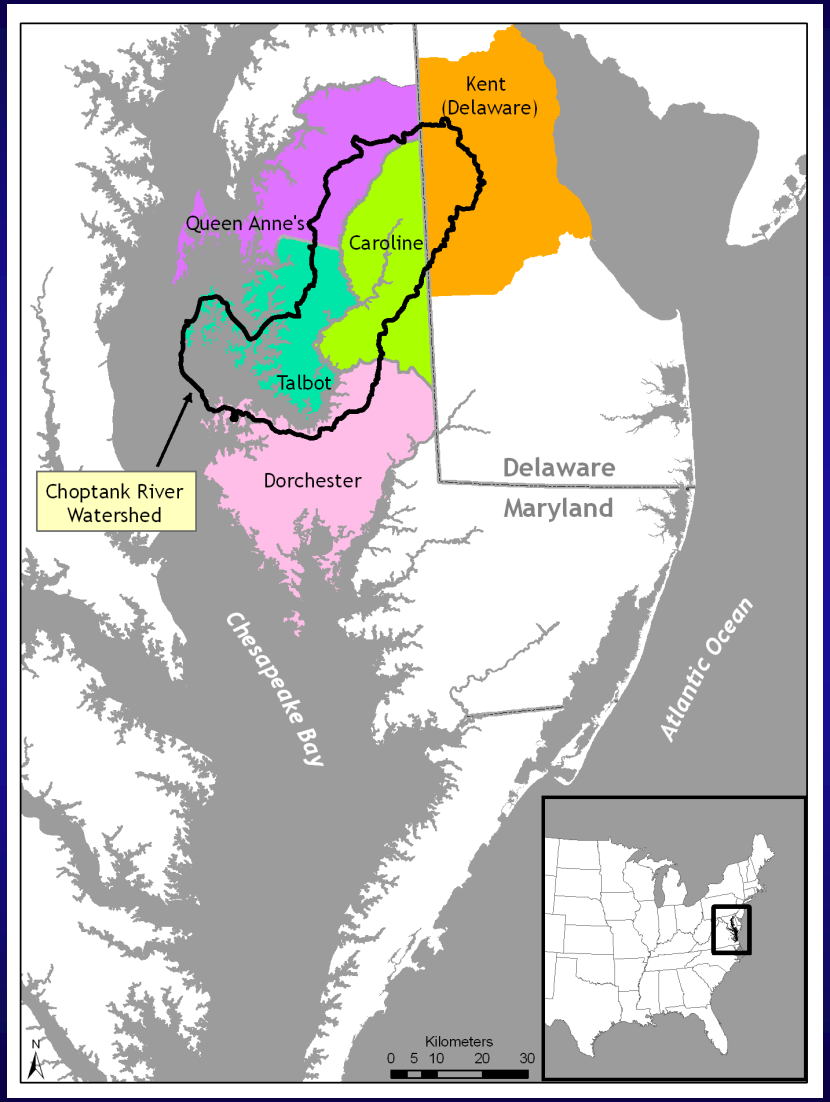
Choptank River Watershed



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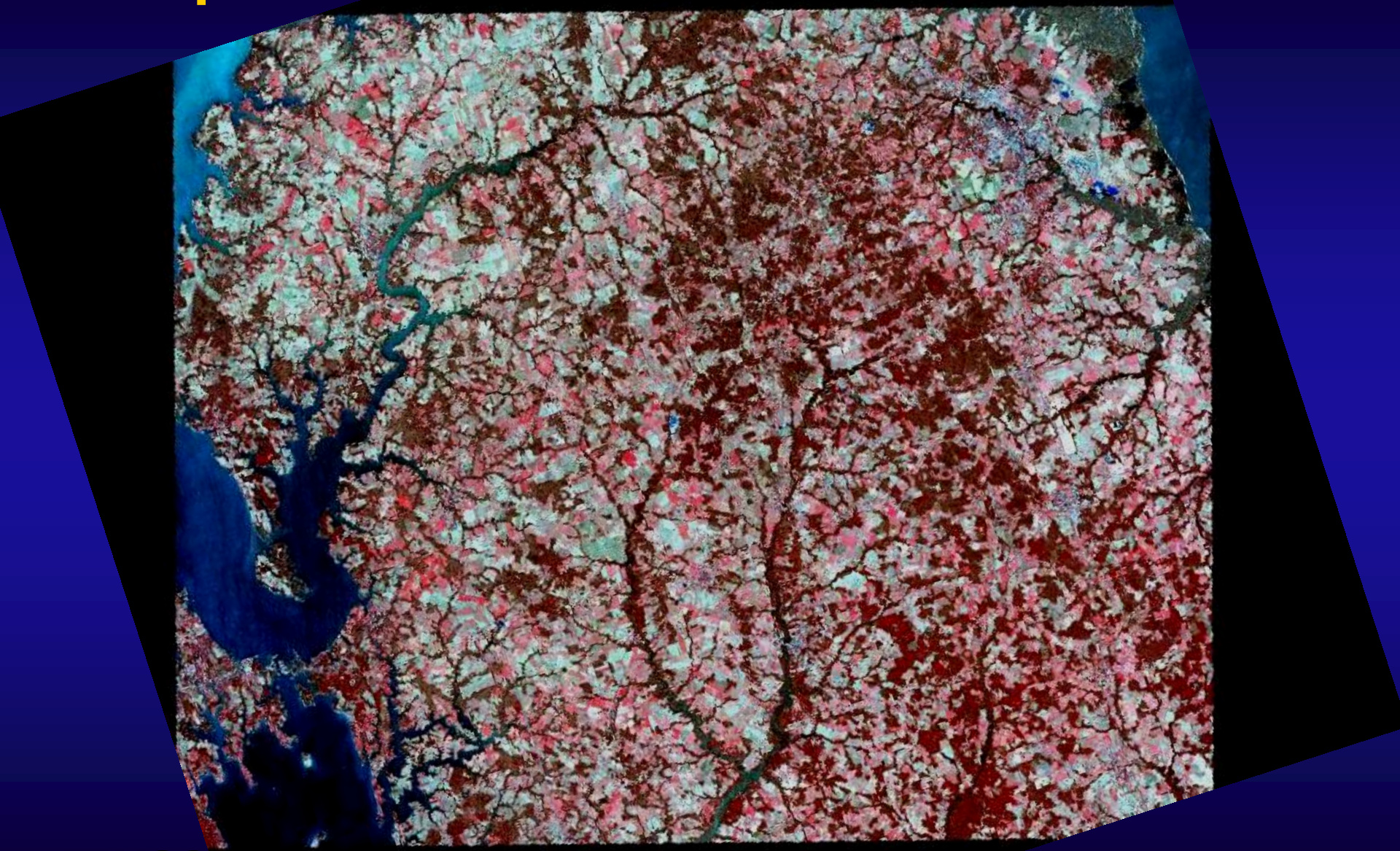
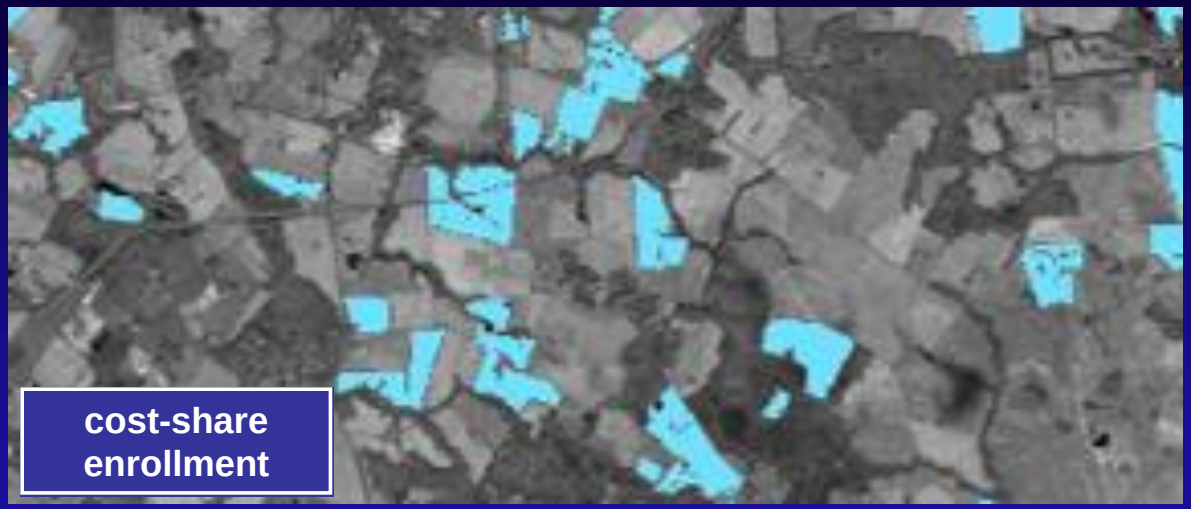
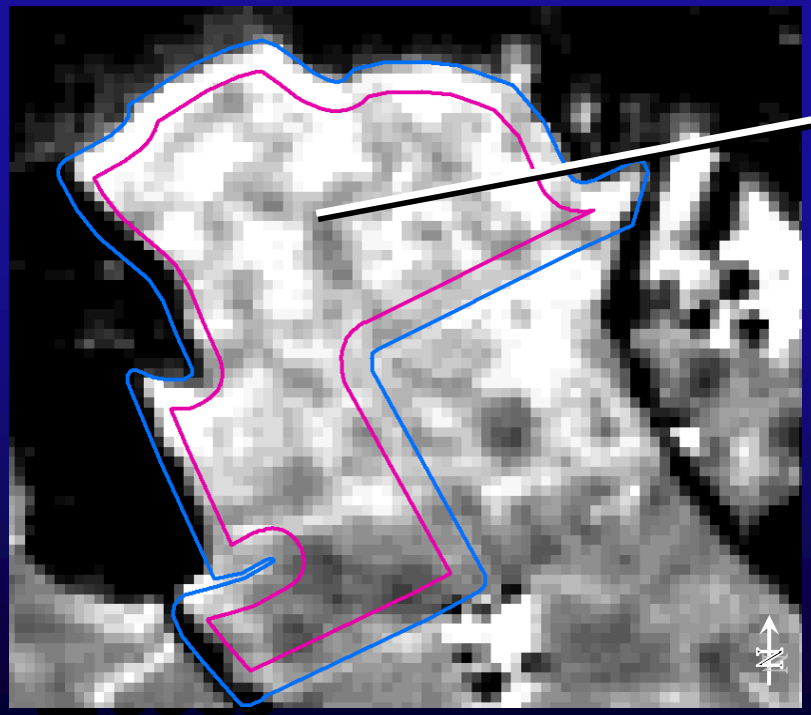
Choptank River focus area



Eastern shore showing Maryland and Delaware
March 2006 SPOT-5 satellite image

Cover crop evaluation

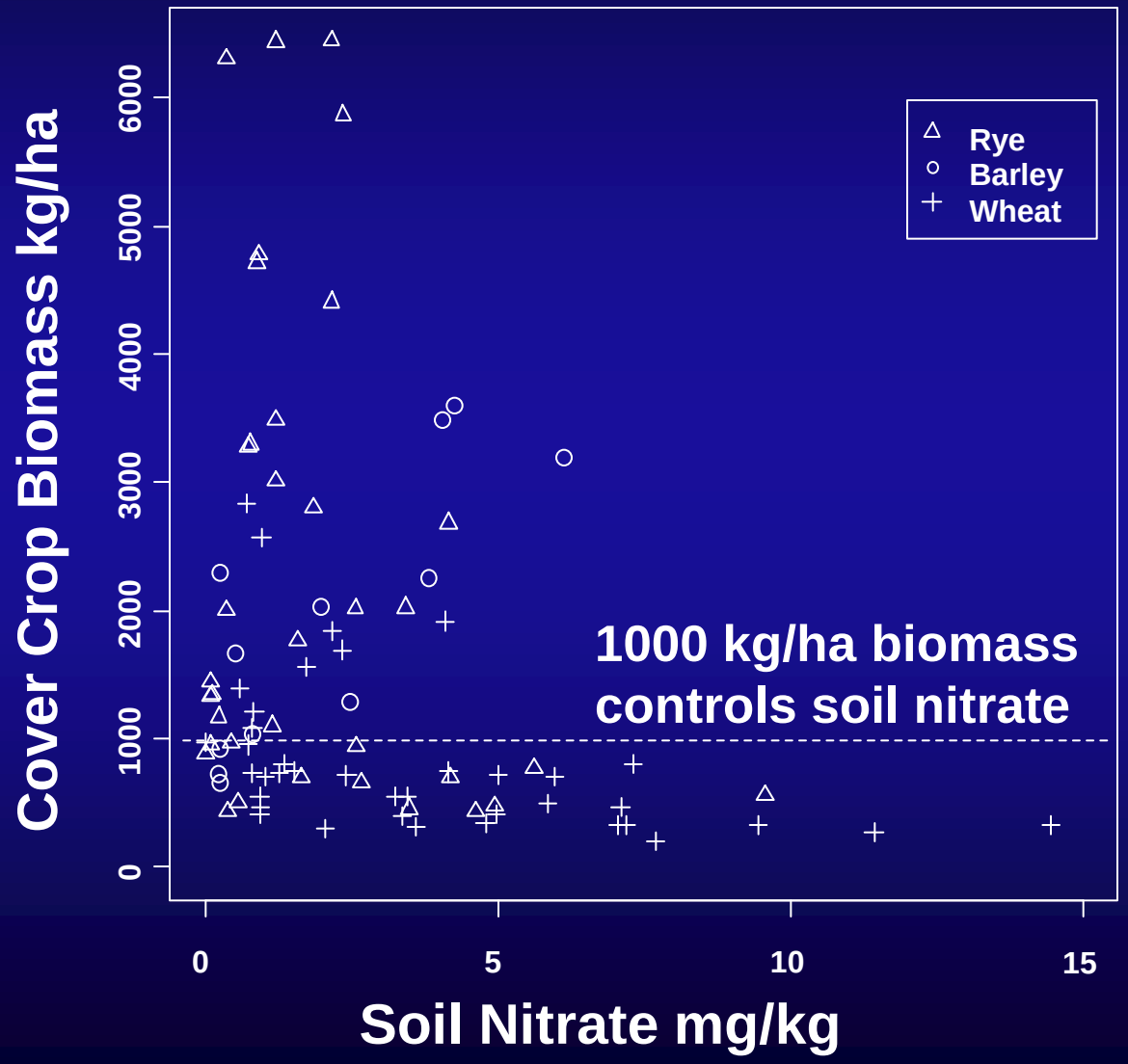




vegetation
measurements

Robust cover crop growth will reduce soil nitrogen

(Data from Hively et al., 2009)



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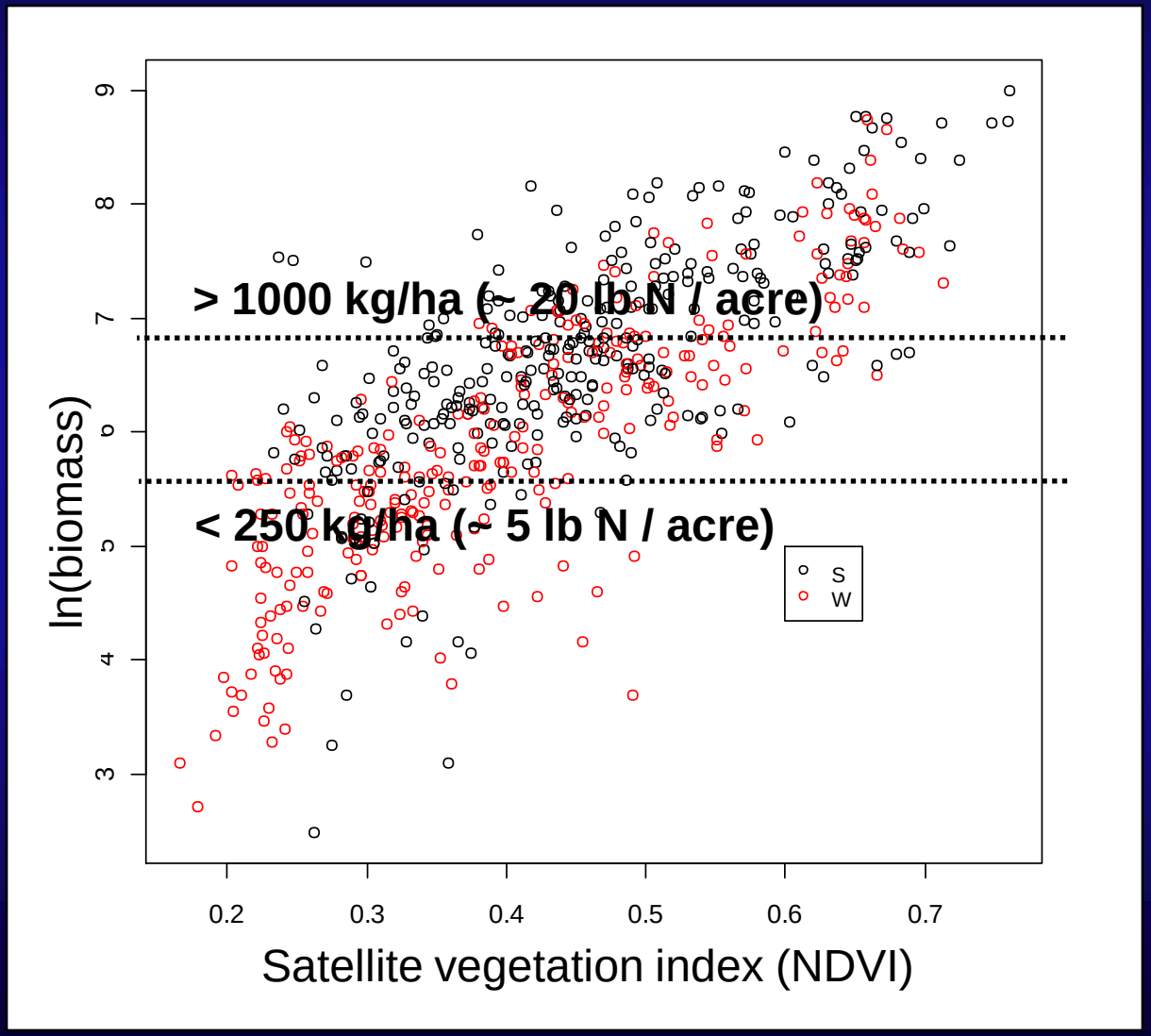
Using satellite NDVI to predict biomass

Implications for cover crop performance

- **Consistently good performance is needed to impact water quality**
- **How can we improve results?**



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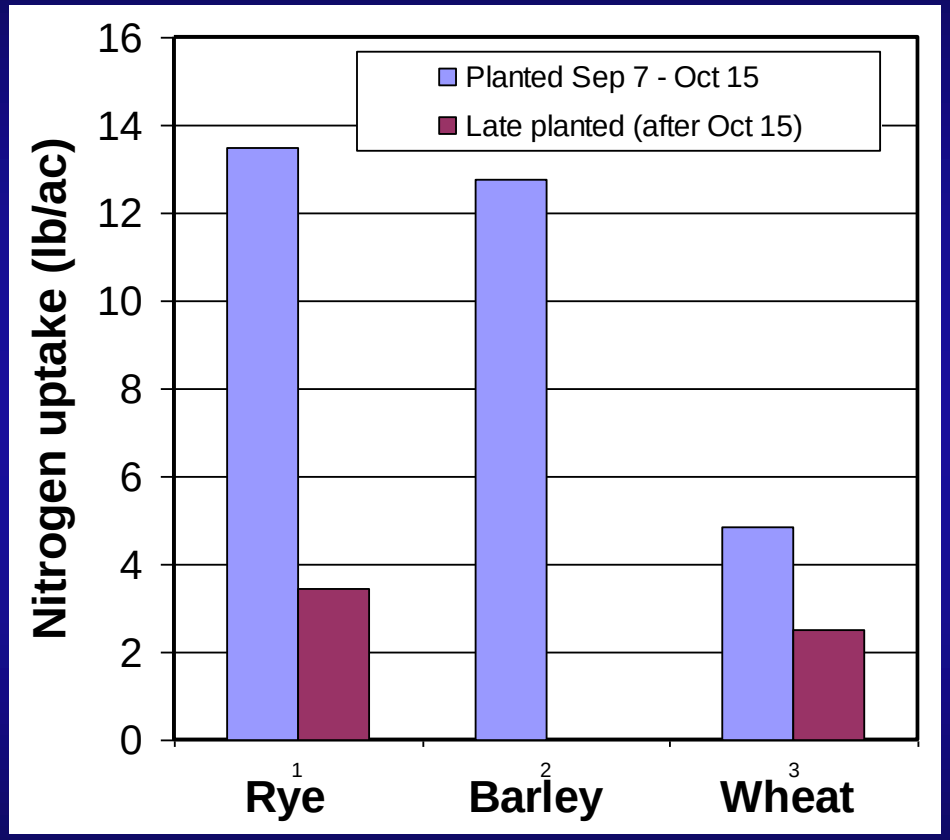
Summarize cover crop performance

(2005-6 data from Hively et al., 2009)



Planting date	Cost per lb of N uptake
Rye	
before Oct 15	$ 3.07
after Oct 15	$ 7.02
Barley	
before Oct 15	$ 3.46
after Oct 15	-
Wheat	
before Oct 15	$ 8.99
after Oct 15	$ 9.36

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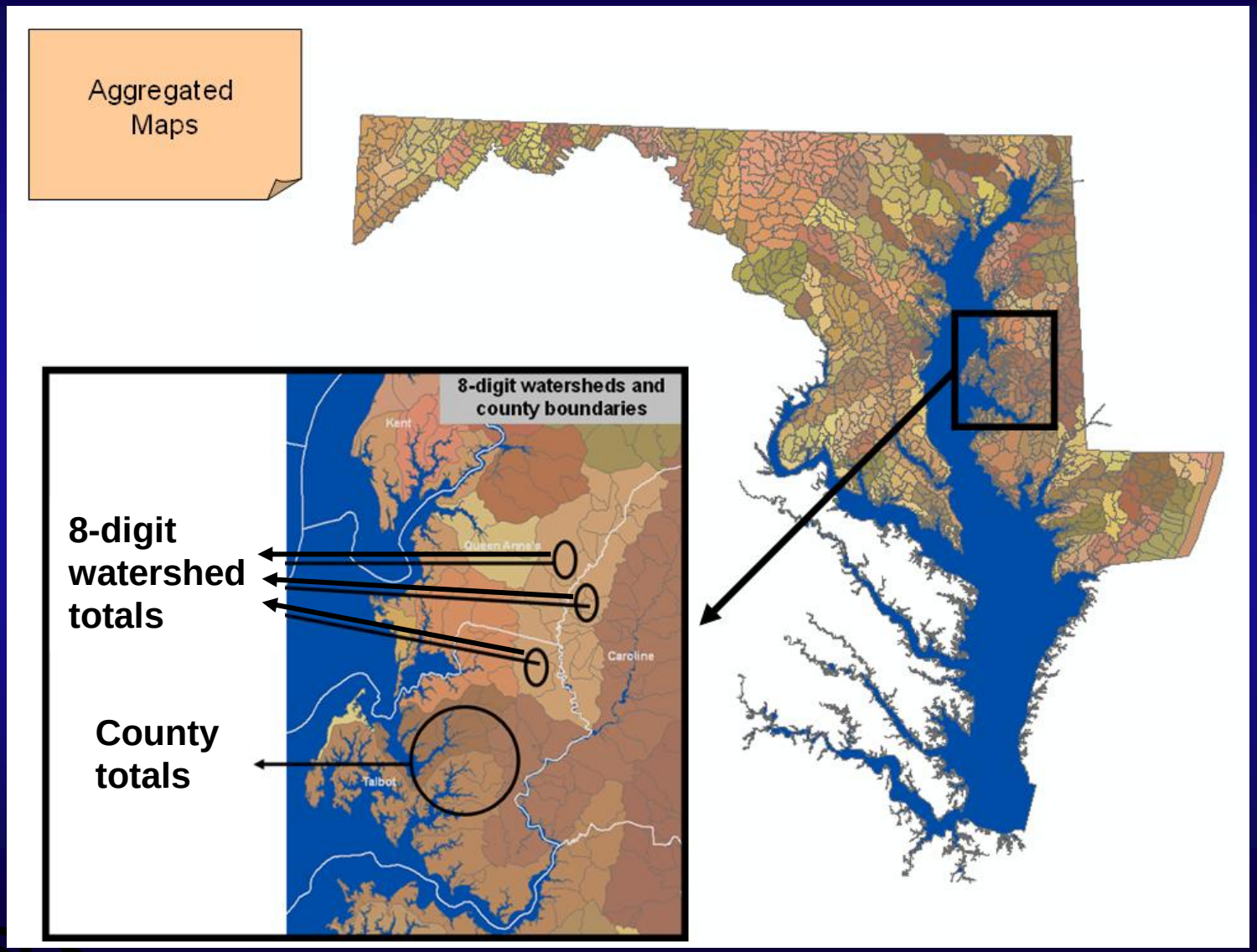
Data aggregation to share conservation information



Adaptive Management of Winter Cover Crops

Target low-productivity fields for site visits by SCD and TSP

Provide field-specific information to to farmers

Produce watershed-specific summary reports

Cover crop performance in the Tuckahoe Creek watershed, MD, 2005-2006.
(From Hively et al., 2009 JSWC)

Species	Planting Date	n[a]	December 22nd 2005 Biomass (kg ha^{-1})			N Uptake (kg ha^{-1})		
			min	average	max	min	average	max
WHEAT	Overall	84	23	409	1026	0	8	19
	Early[c]	34	84	523	1026	2	10	19
	Standard[d]	19	262	528	962	5	10	18
	Late[e]	31	23	212	410	0	4	8
RYE	Overall	27	44	1274	2858	1	24	54
	Early	9	506	1699	2772	10	32	53
	Standard	6	1073	2021	2858	20	38	54
	Late	12	44	582	2344	1	11	45
BARLEY	Overall	25	473	1119	2199	9	21	42
	Early	17	476	1163	2199	9	22	42
	Standard	8	473	1024	1585	9	19	30
	Late	0	na	na	na	na	na	na

Notes: 'n' refers to the number of fields included in analysis. Planting date categories, as defined by the Maryland Cover Crop Program, are as follows: Early - Sept. 7 to Sept. 30; Standard: Oct. 1 to Oct. 15; Late: Oct. 15 to Nov. 5. Average first frost date in the region is October 15th.

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Strategy

- Developing tools to transfer results and observations into an adaptive management framework
  - Tools for field management (information transferred to farmers and SCD in a privacy-protected context)
  - Tools for watershed management (information aggregated to protect farmer privacy, and transferred to State and Federal agencies and other Chesapeake Bay partners)

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Strategy

- Working directly with Soil Conservation Districts
- Protecting privacy of farm conservation data to meet Farm Bill (Section 1619) and state requirements

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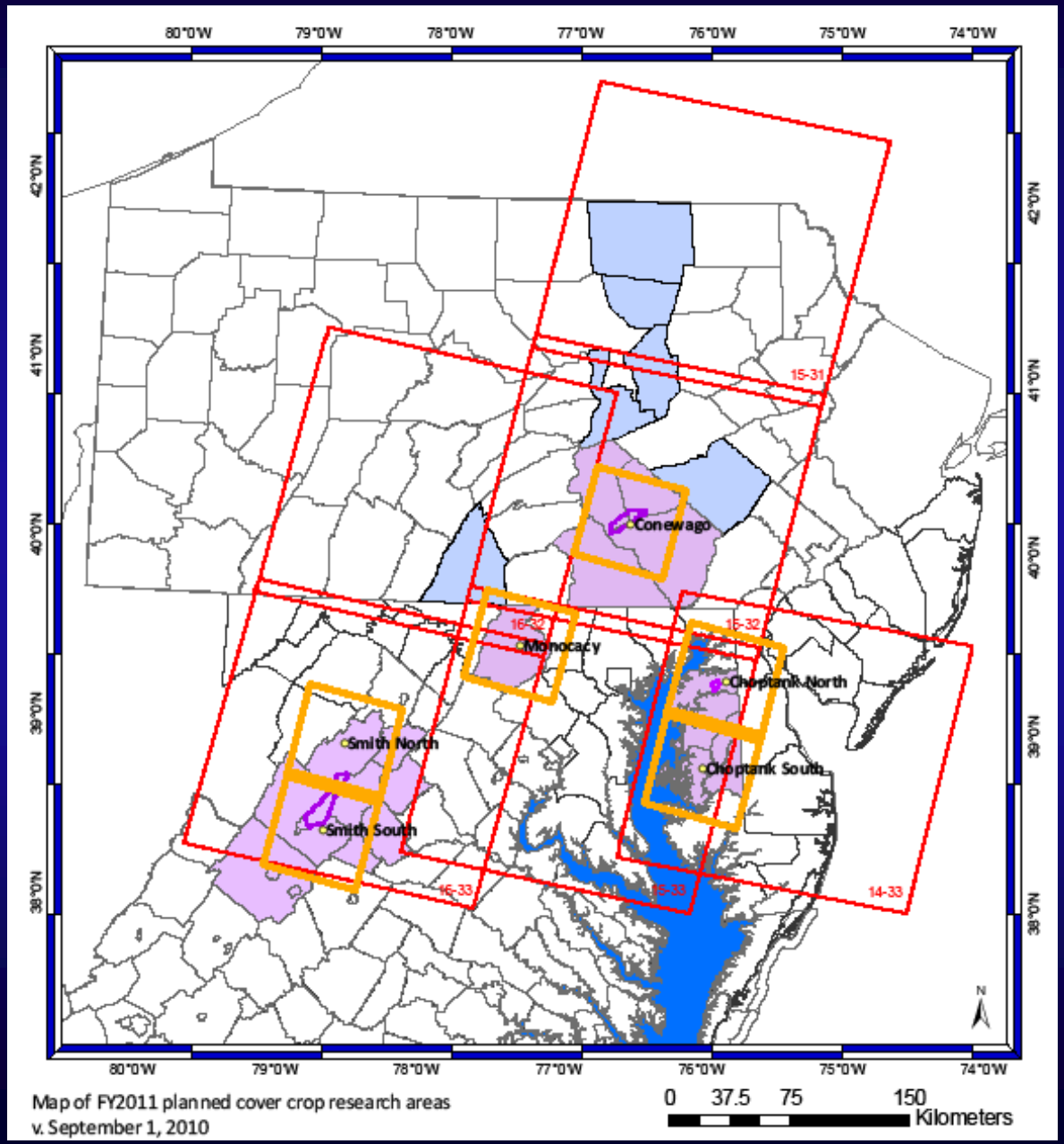
2011-2013 Focus Areas



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Developing remote sensing tools for adaptive conservation management

- Providing confidential reports for farmers, farm consultants, and Soil Conservation Districts
- On-line data aggregation tools to report watershed conservation and best management practice implementation data in a useful, but anonymous format
- Mapping winter groundcover biomass thresholds
- Mapping voluntary cover crop acres
- Mapping silage crop acres with and without cover crops
- Linking to nutrient management and climate data

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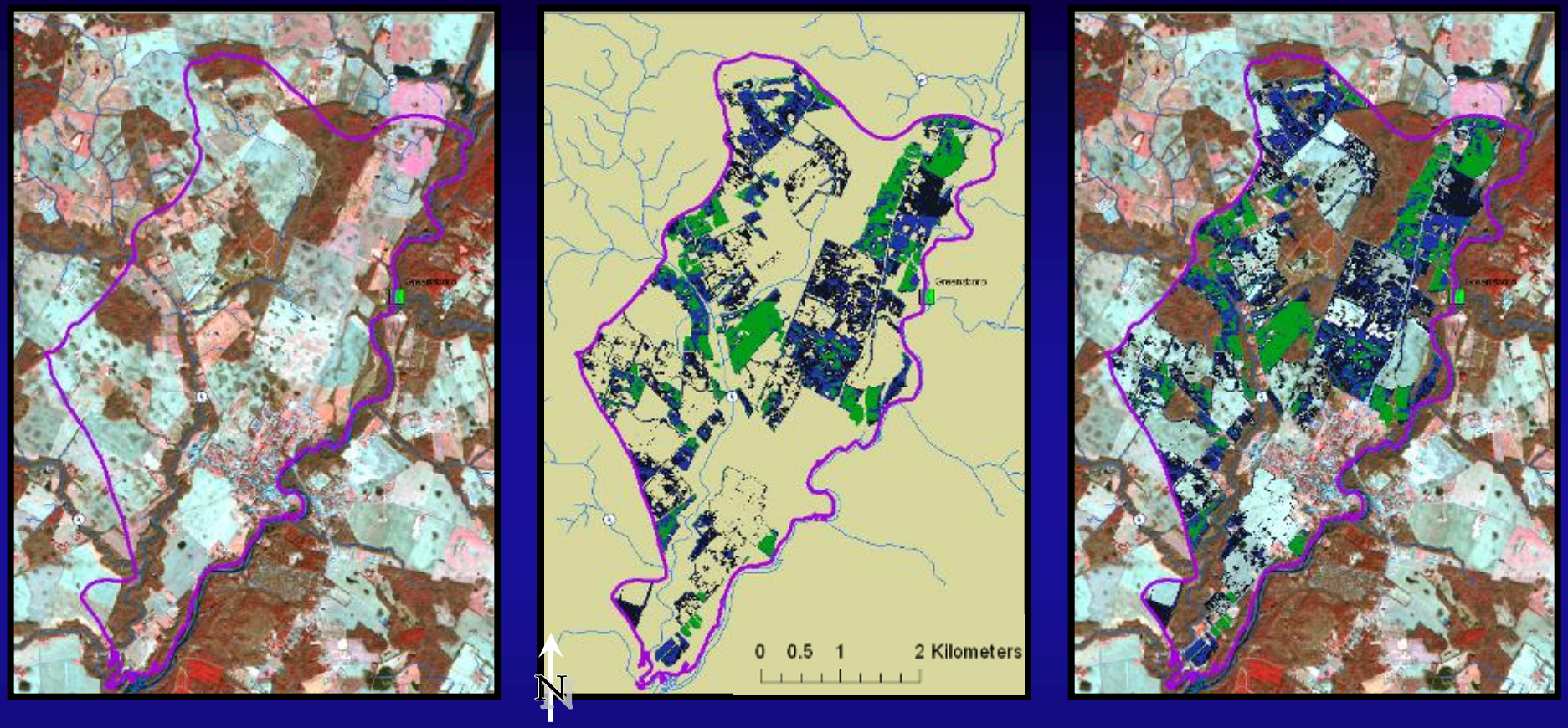
Winter groundcover biomass thresholds



- Identification of winter groundcover in an Upper Choptank watershed. Jan 24, 2010 SPOT imagery
- Vegetation index (NDVI) thresholds were used to identify fields with high, medium, low, and minimal biomass

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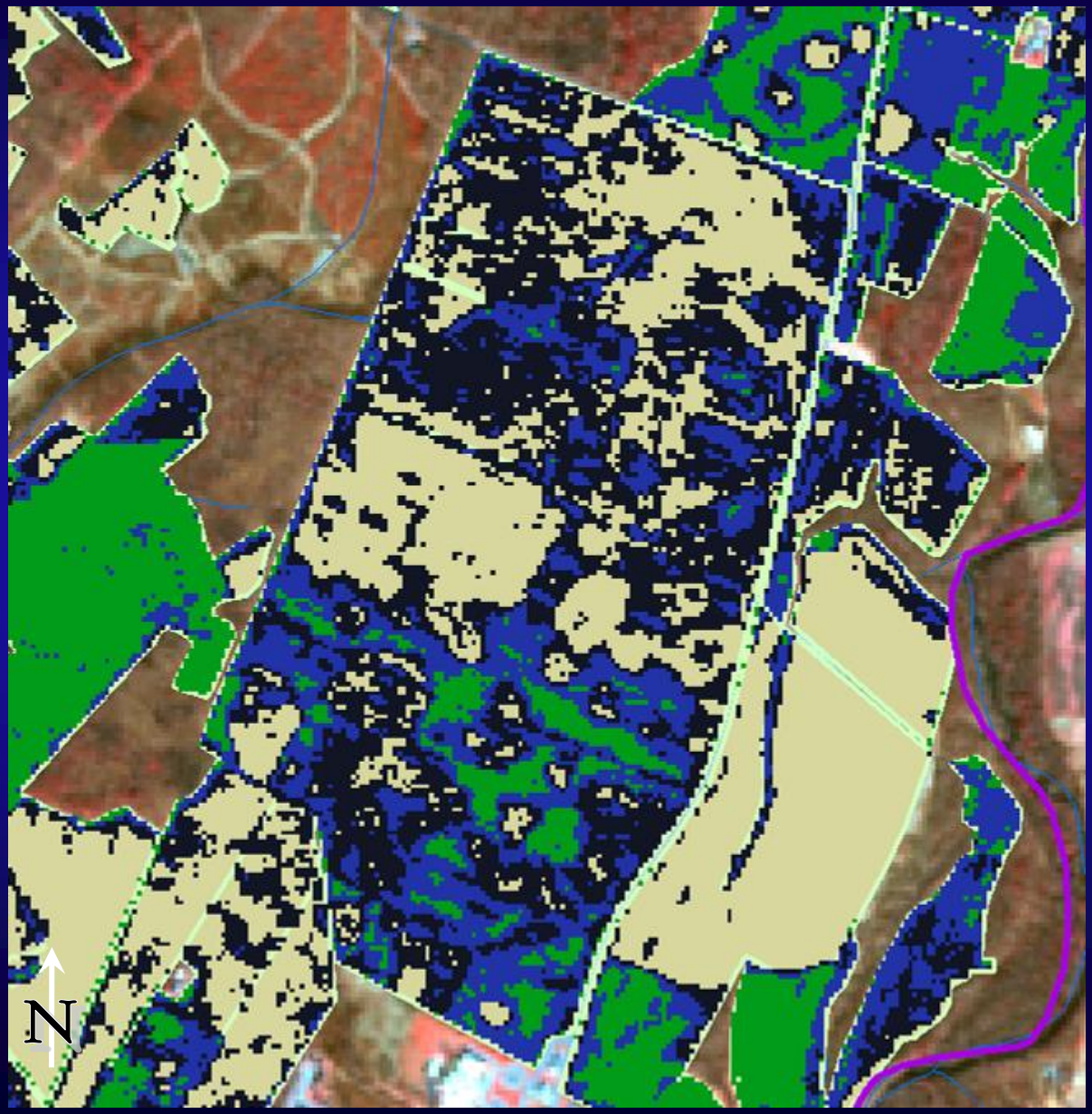
Winter groundcover biomass thresholds

High
Medium
Low
Minimal



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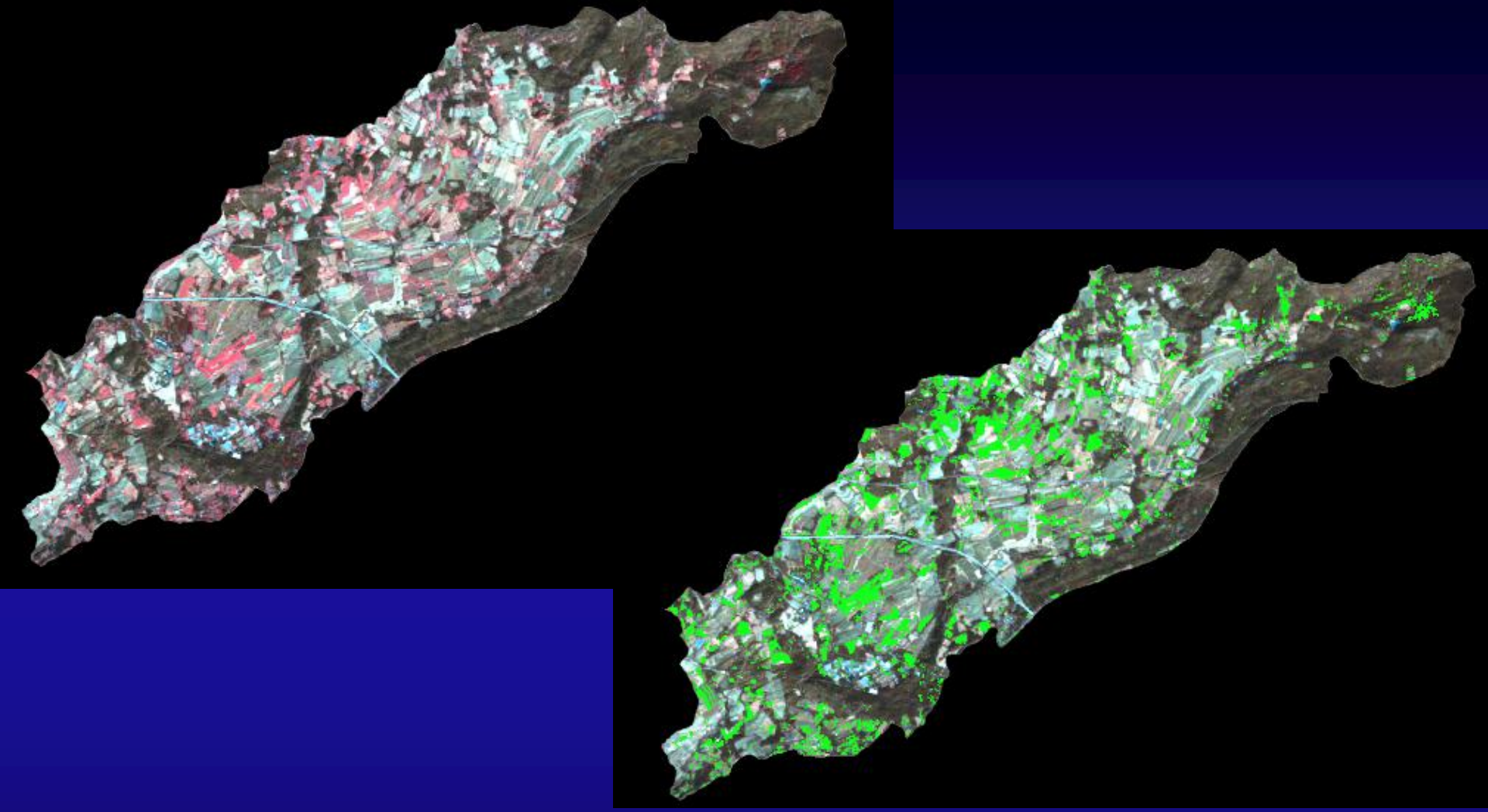

Jan 22rd 2010 Landsat 5 imagery of the Conewago watershed, PA (upper left), with identification of winter groundcover (lower right) based on vegetation index (NDVI> 0.3) threshold value

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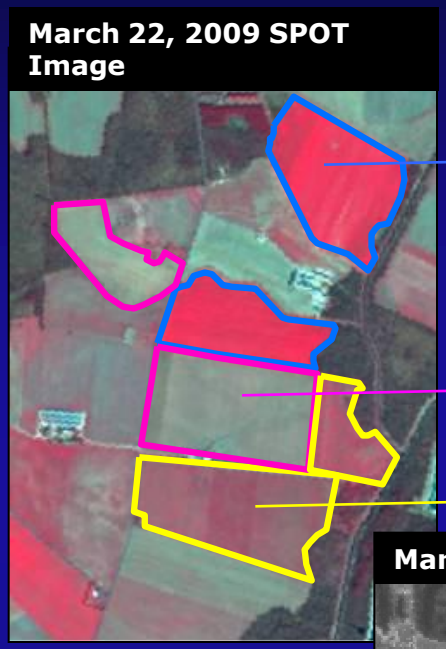
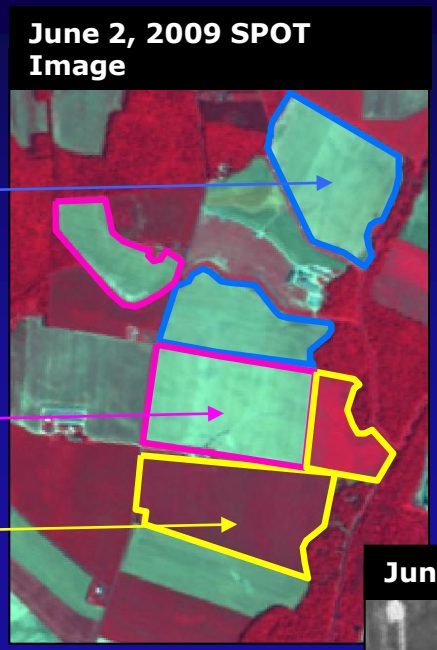
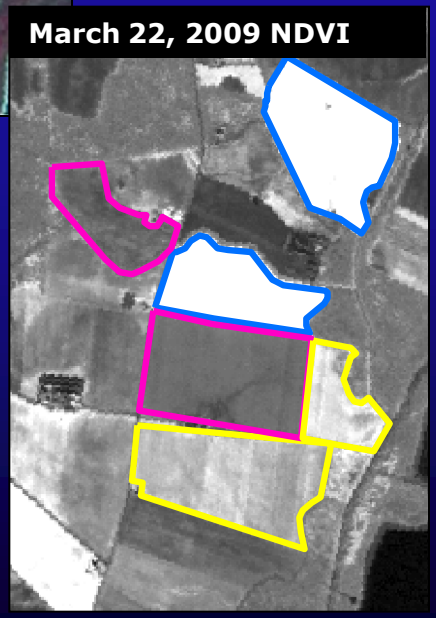
D. Hively – Choptank CEAP

Mapping voluntary cover crop acres





Fallow
Winter Cover Crop
Small Grain Commodity Crop



NDVI
High
Low

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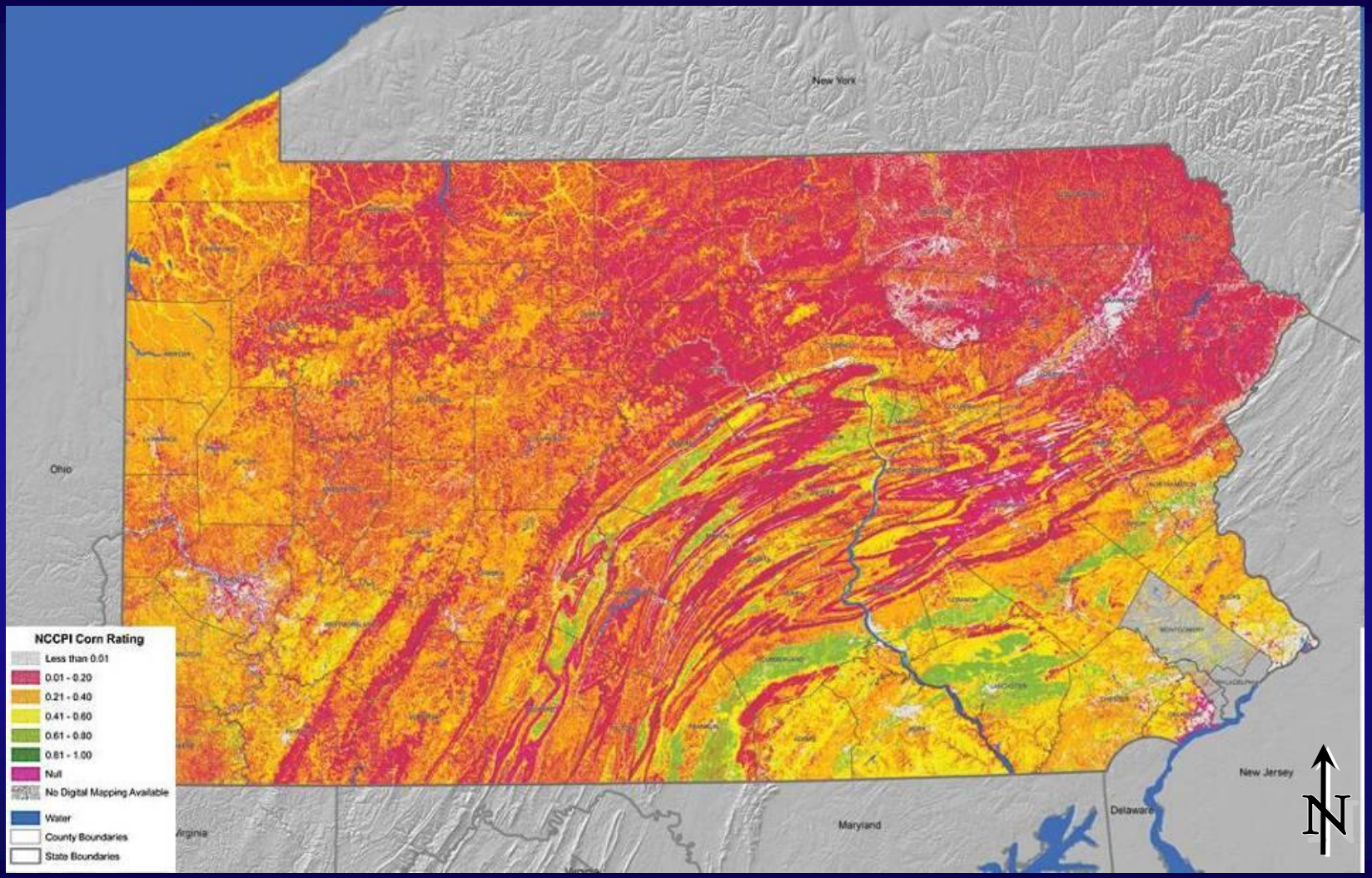
Corn productivity rating



http://www.esri.com/mapmuseum/mapbook_gallery/volume24/agriculture3.html

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There is a lot of activity on cover crops

- It appears to me:
  - ✓ Silage acres can successfully implement cover crops
  - ✓ Cover crops work with no till to build soil structure
  - ✓ Cover crops work well with manure management
  - ✓ Target areas with missed yield goals
  - ✓ Tie in with nutrient and soil management
  - ✓ Focus on local seed sources, practical solutions
  - ✓ Maximize fall growth through early planting
  - ✓ Strategize to avoid springtime management problems
  - ✓ Expect year-to-year variability in success

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Chesapeake Bay Program
A Watershed Partnership

Thank you! ~ Questions?

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For further details see Hively et al., 2009 - open access articles available online in Sept-Oct 2009 Journal of Soil and Water Conservation
http://www.jswconline.org/content/64/5/ 154A.full.pdf+html
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