Adaptive N Management
Using *Adapt-N*
Incorporating the Weather Component

Bianca Moebius-Clune
Harold van Es, Jeff Melkonian, Laura Joseph

Cornell University
College of Agriculture and Life Sciences
Department of Crop and Soil Sciences

Outline for Today

- Adaptive Management
  - What is it?
  - Why is it important for nitrogen in corn?
  - Why use a model for this?
- Overview of the Adapt-N online tool available to the public for N-management in corn

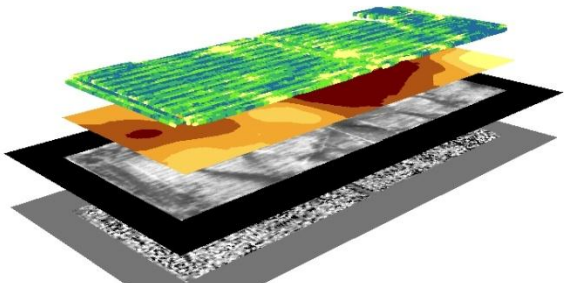
What is Adaptive Management?

"The process of refining a management strategy in response to evaluating its success"

- local conditions
- testing and measuring
- evaluation
- scientific principles
- experience

Why Adaptive Management?

- Site-specific characteristics (soils, farm, weather...)
- Management history (e.g., grain vs. livestock)
- Environmental Regulations
- Climate Change
- New tools provide a quantitative basis for adaptation.
  - Yield measurements (yield monitors)
  - Soil or tissue measurements
  - Models
  - Optical sensors…



Why
Adaptive Nitrogen Management?

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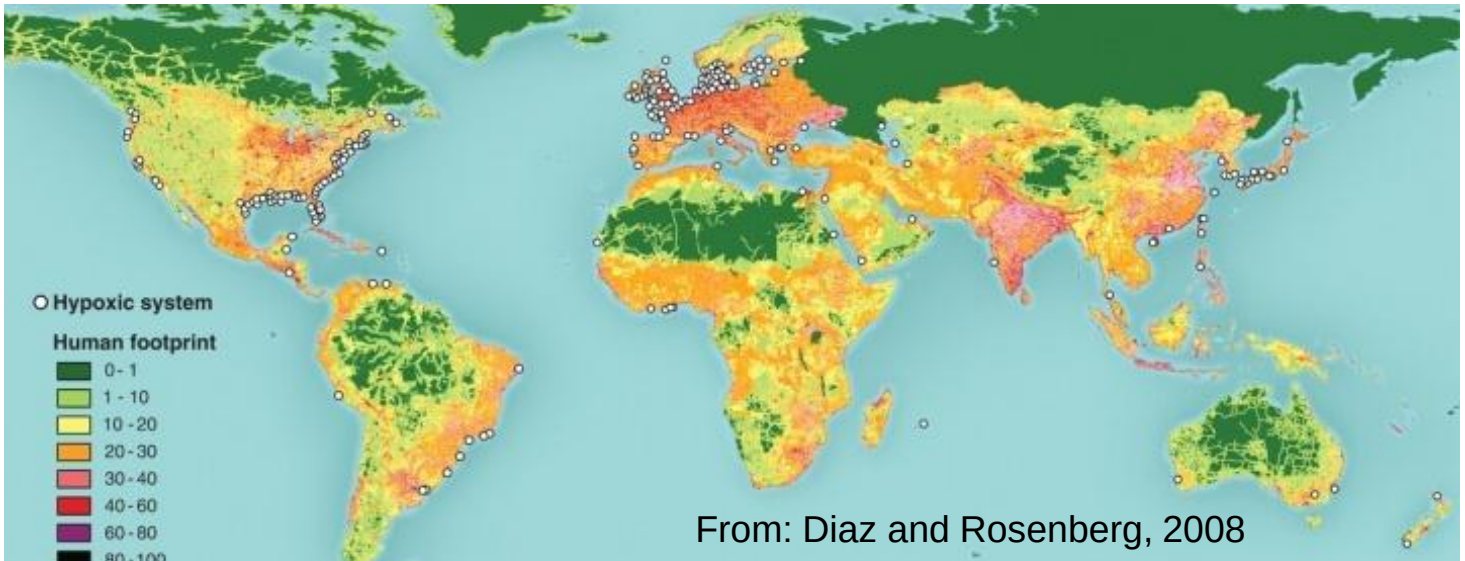
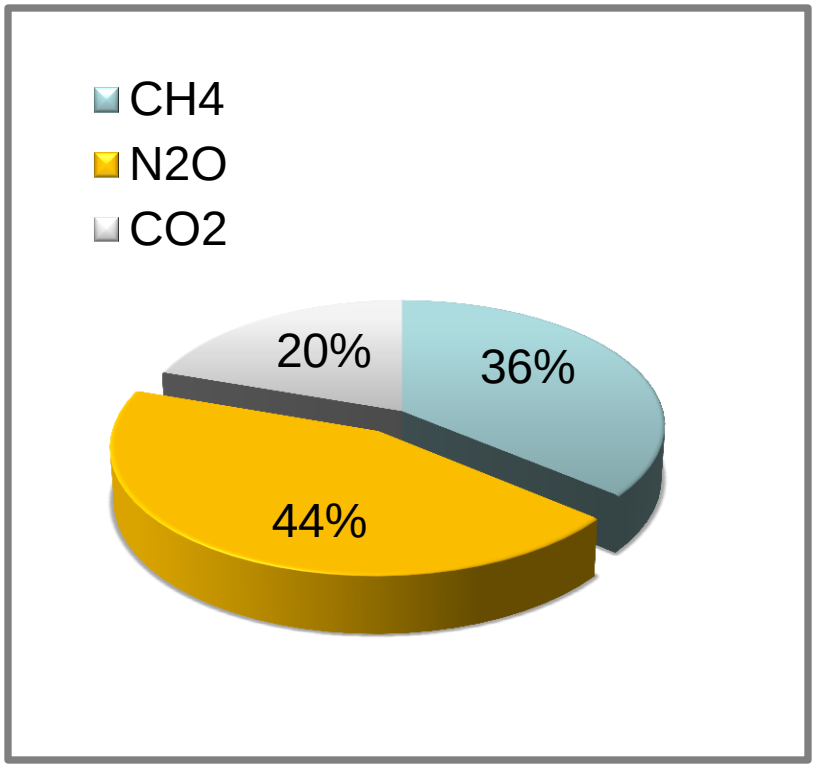
The Corn Nitrogen Problem

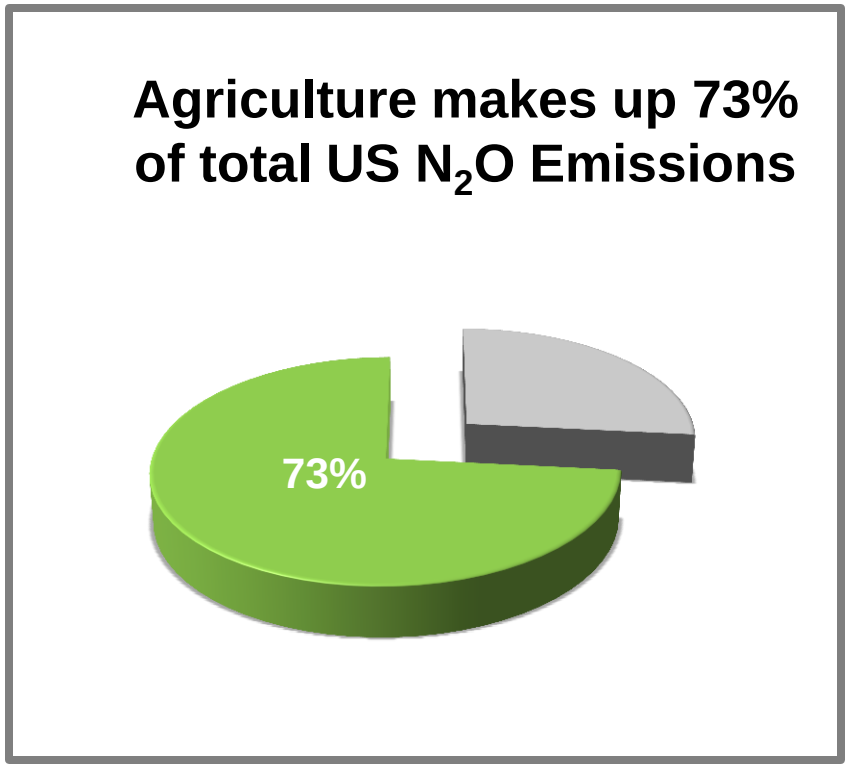
- ~ $5 billion/yr of N fertilizer applied to corn in U.S.
- Corn N use efficiency very low (30-50%)
- High groundwater nitrate levels
- Hypoxia/anoxia in estuaries not improving
- Greenhouse gases (N_2O and CO_2)
- High energy consumption (Haber-Bosch process, about 8,000 kcals per lb of urea)



From: Diaz and Rosenberg, 2008

Agricultural GHG Emissions (2008)



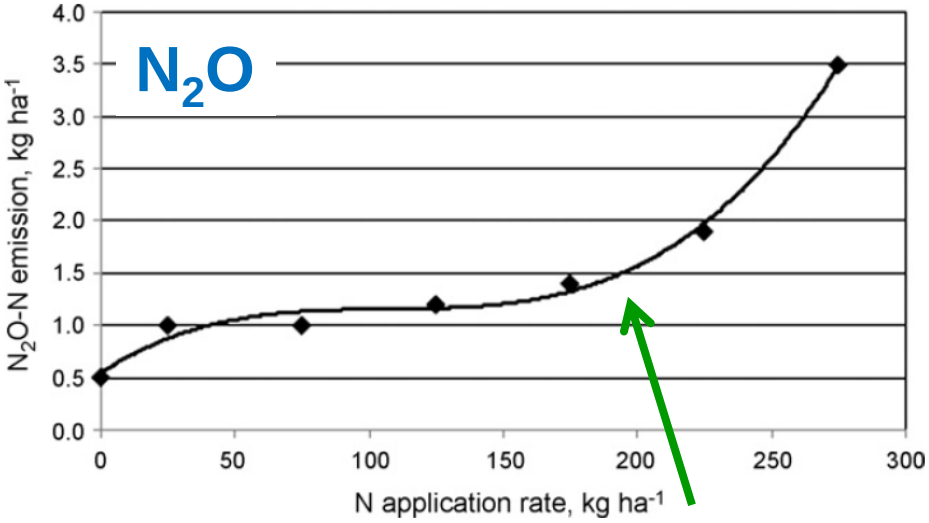


Source: EPA, 2010

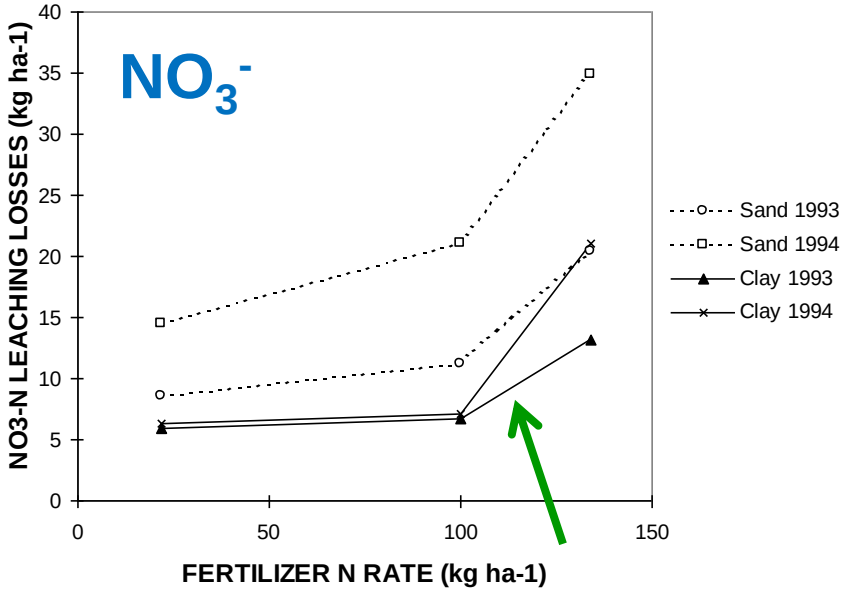
Agricultural <u>soil management</u>, in 2008, accounted for:

- **92% of Agricultural N_2O**
- **Greater global warming potential than all of U.S. Aviation!**
- **1.5 x greater global warming potential than Enteric Fermentation**

Win-Win Opportunities with more Precise Estimation of Corn N Fertilizer Needs



From: Snyder et al., 2009, based on data by Bouwman et al., 2002

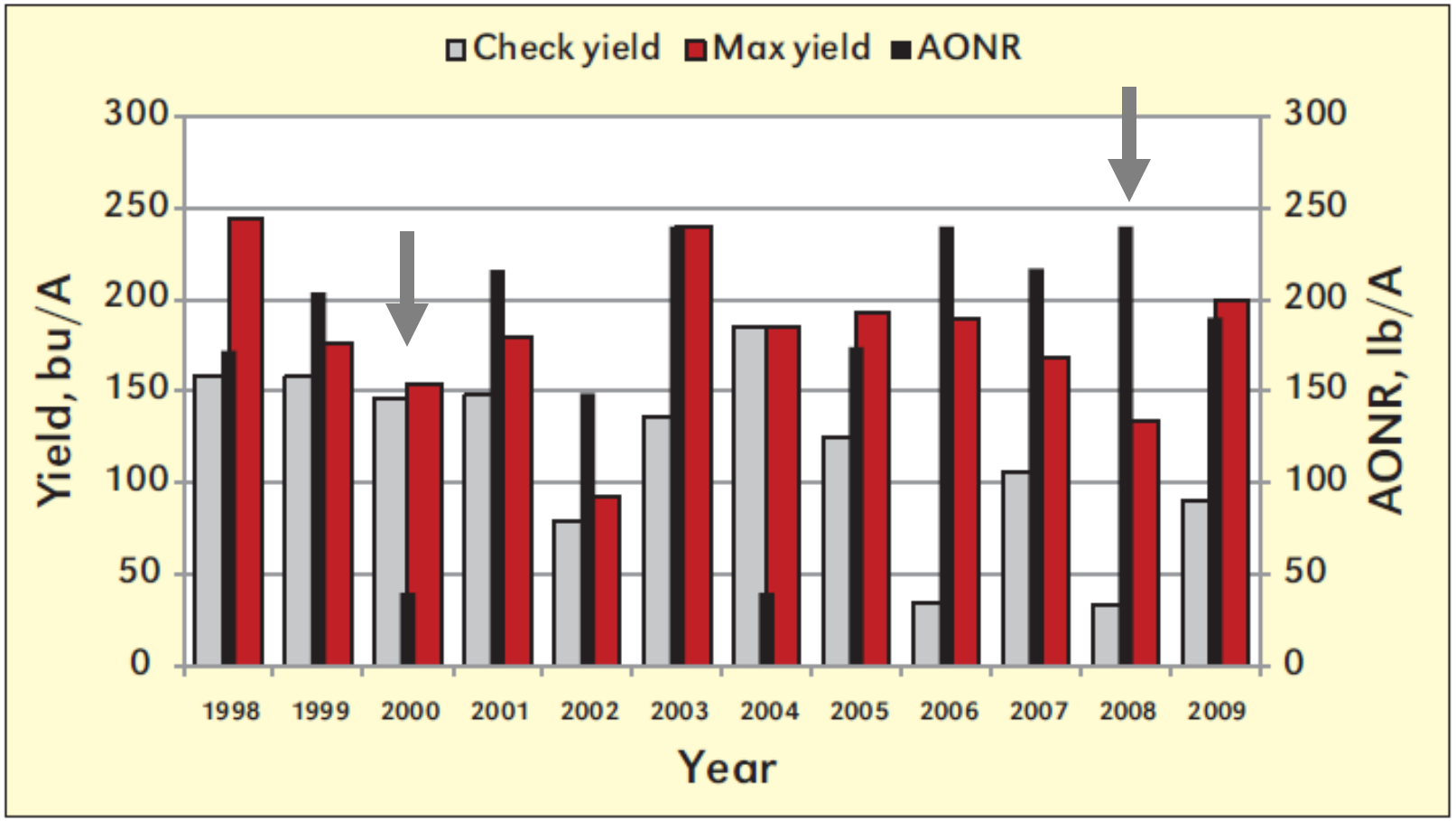


van Es et al., 2002

****Large losses occur once crop demand is satisfied****

Variability in Agronomic Optimum N Rates

Maximum and Check Yields, and Agronomic Optimum N Rate (corn after soybean, Ohio)



From: Mullen, LaBarge and Diedrick, 2010, Better Crops, Vol. 94 (3).

Many sources of variation in N availability

→ generalized recommendations less applicable for corn N needs

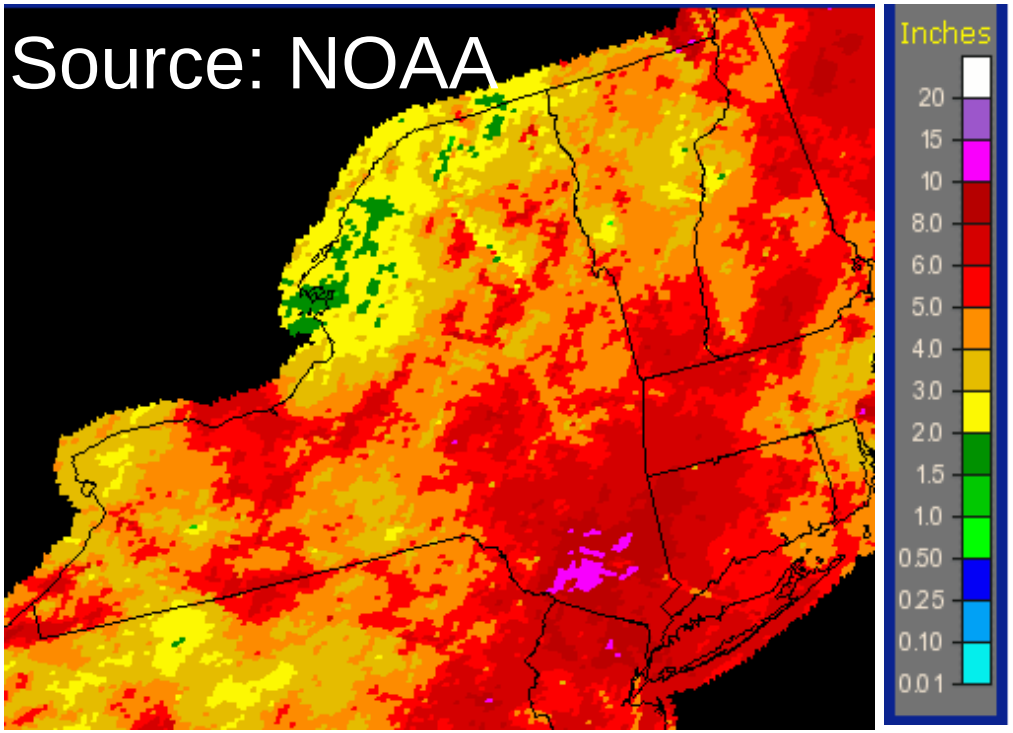
Sources of Variability:

- Organic amendments (manure, compost, etc.)
- Crop rotations
- Soil type differences
- Soil organic matter contents (management-induced soil change)
- **<u>Weather</u> (especially early season rains)**

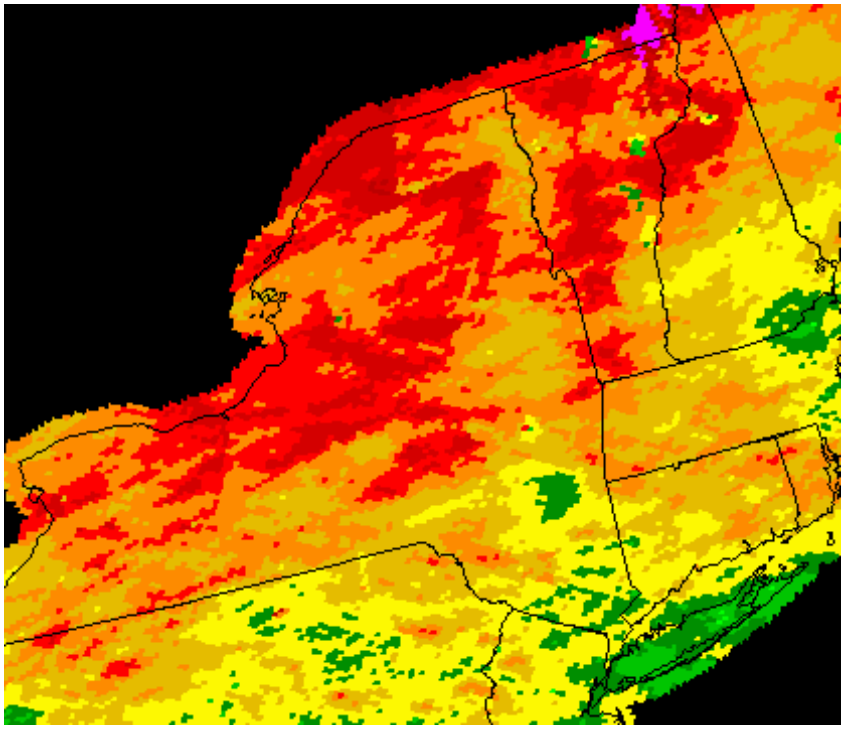
→ N needs CANNOT be predicted accurately at the beginning of the growing season

June Precipitation Variability in NY

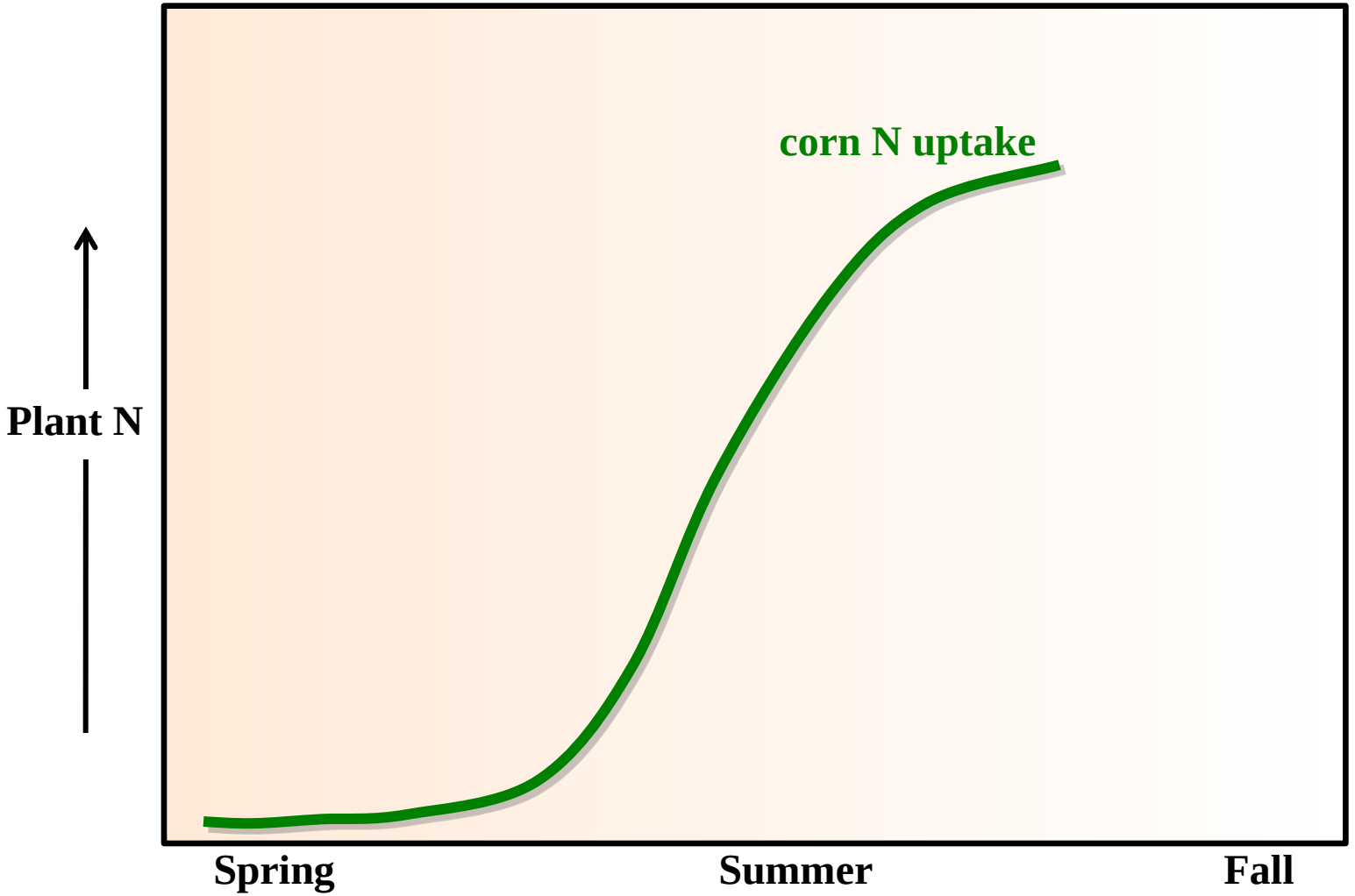
2009



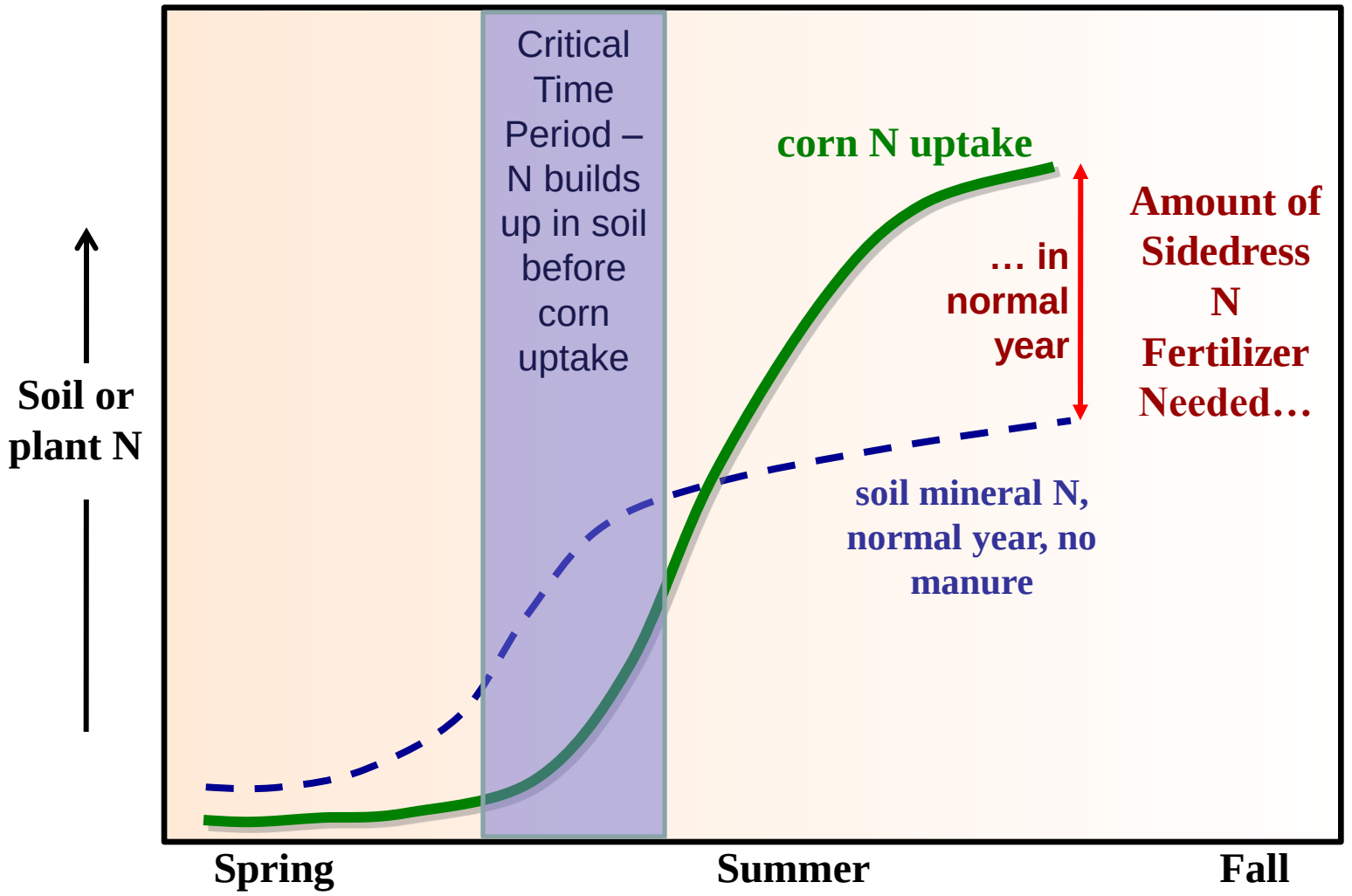
2010



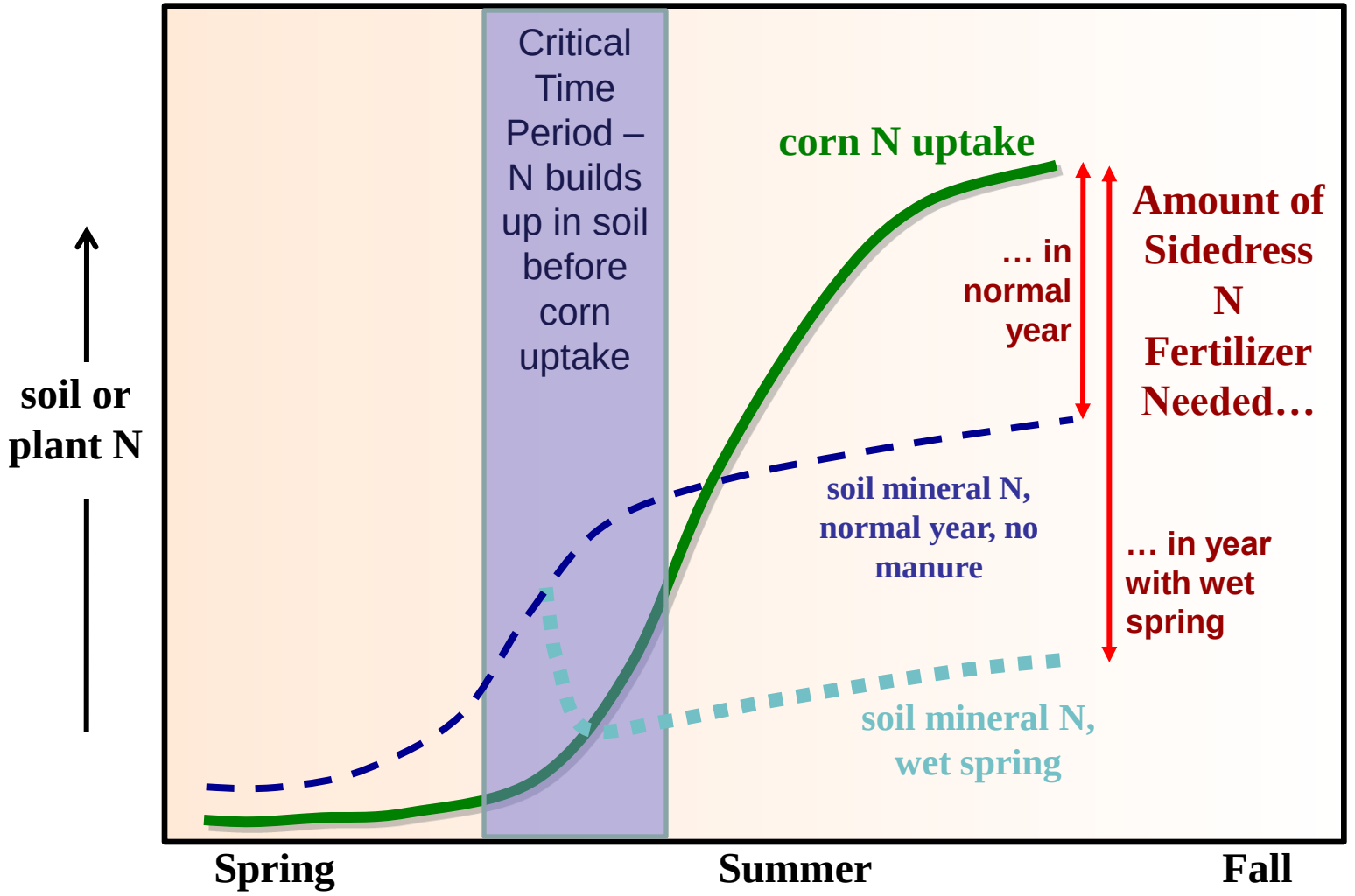
Crop N uptake patterns ……



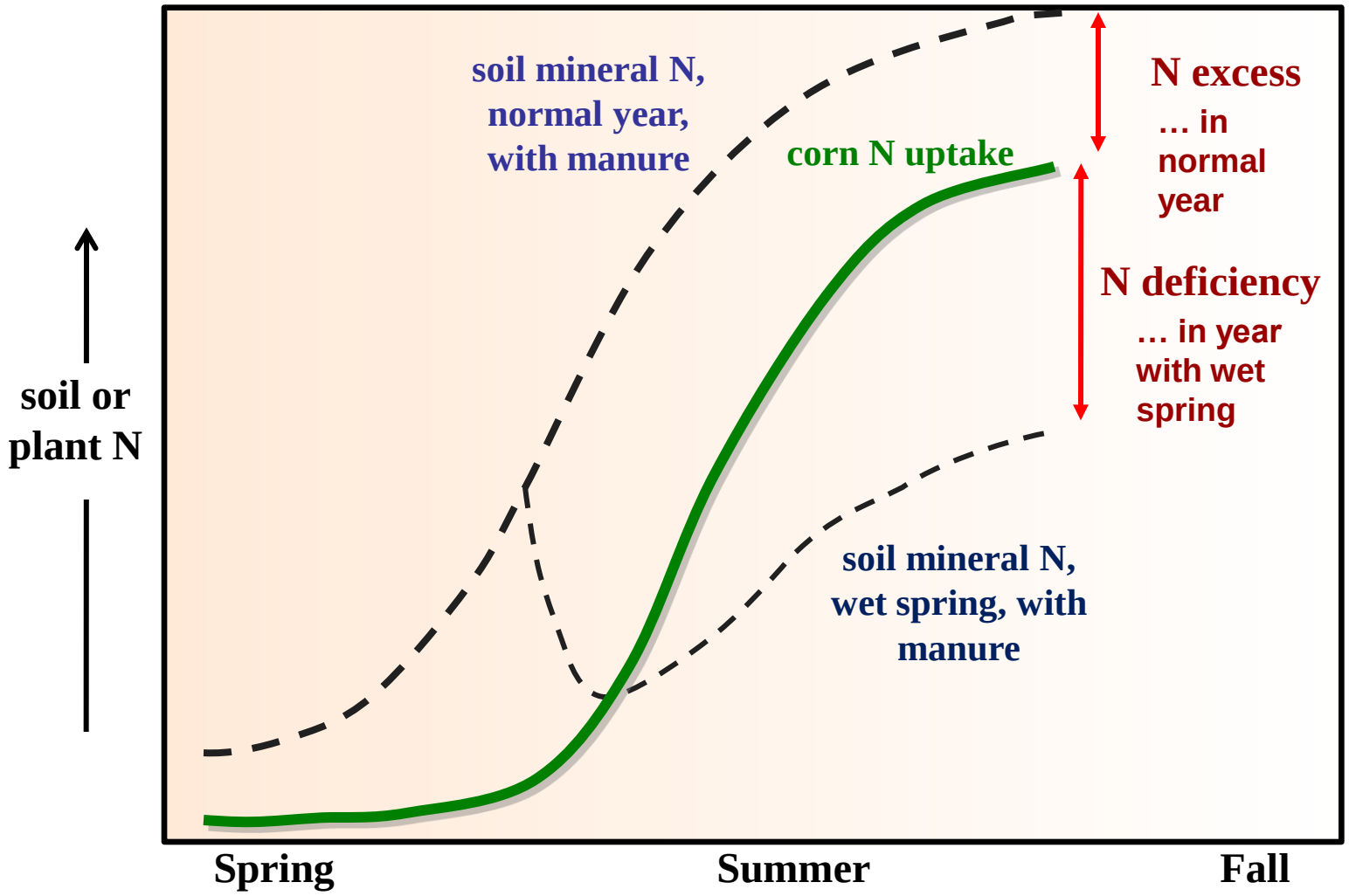
SOM mineralization occurs ahead of corn N uptake……



Need for supplemental N fertilizer depends on early season weather …

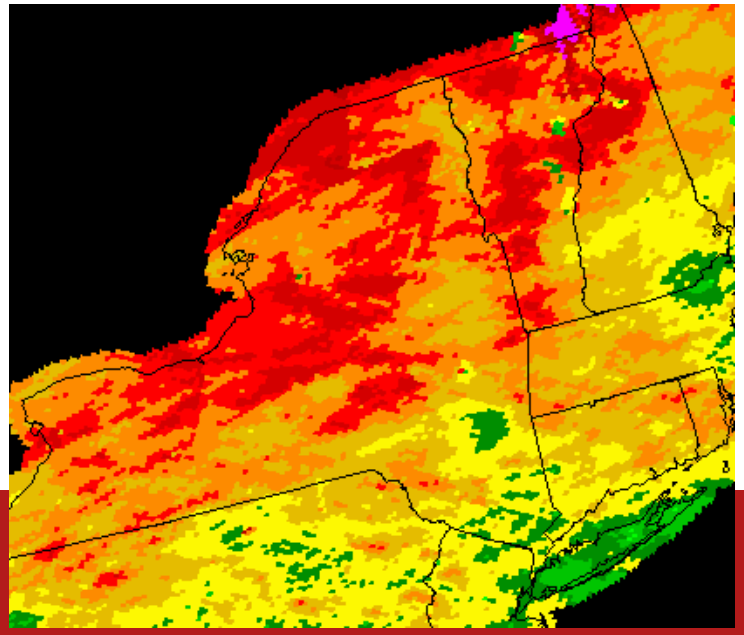


Manure Scenario: Soil N mineralizes from SOM and Manure



That is why N needs CANNOT be predicted accurately at the beginning of the growing season!

- Need to sidedress…
- How much?



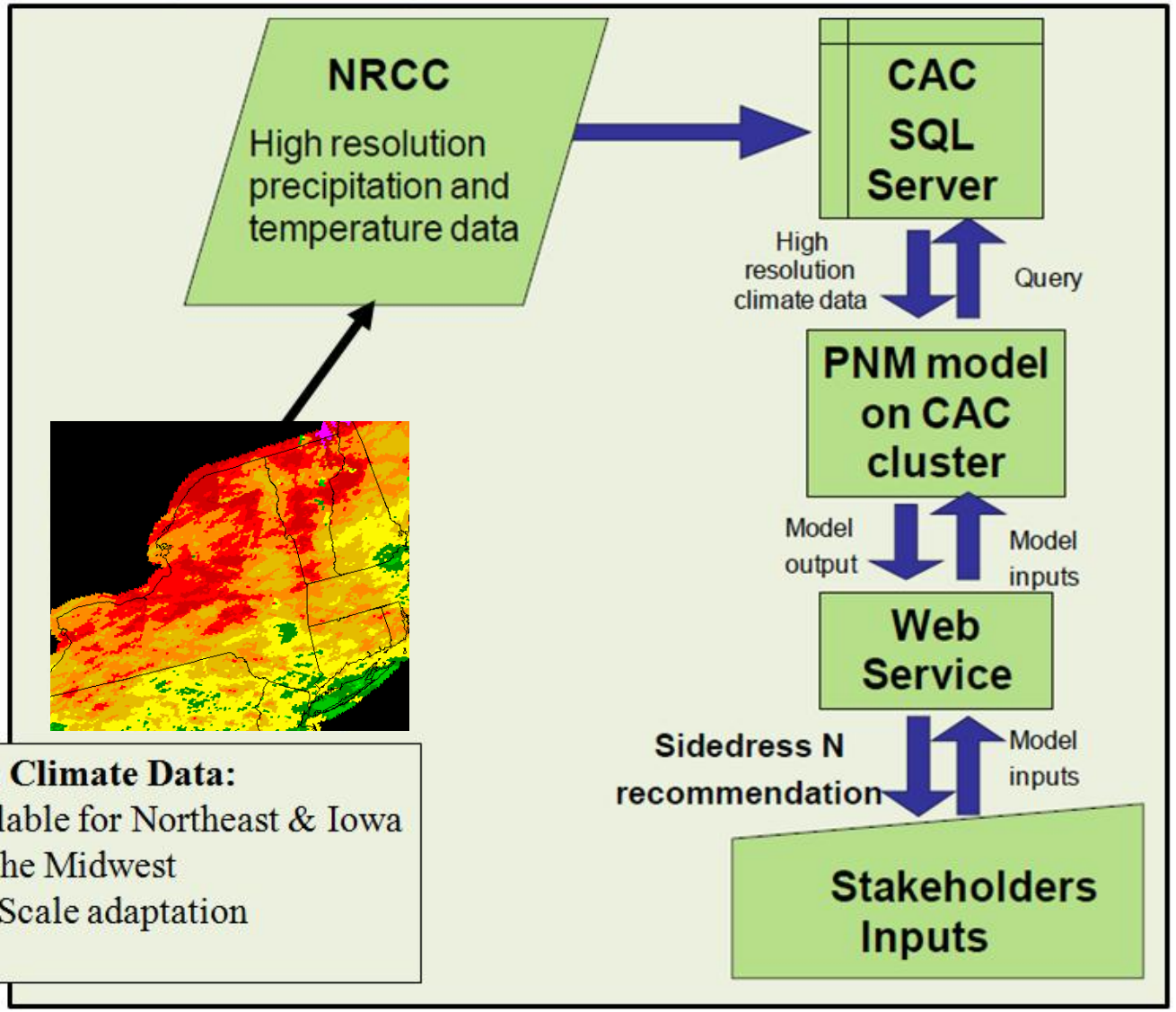
Adapt-N *web-based N management decision tool*

http://adapt-n.cals.cornell.edu/

1) **User-friendly web interface** available for on-farm application since 2008 for NE USA
2) **Model incorporates weather** effects & complex dynamics at individual field-scale
3) **N sidedress recommendation** and other info
4) **Currently no cost!**

High Resolution Climate Data:

- Currently available for Northeast & Iowa
- Expanding to the Midwest
- Enables Field-Scale adaptation



Adapt-N Interface: User Inputs

Soil, Tillage

- User ID / Field ID
- Latitude / Longitude
- Soil textural group
- Approximate field slope
- Drainage
- Soil organic matter content
- Rooting depth
- Tillage information

Running the Adapt-N model using a smart phone

Fertilizer, Crop

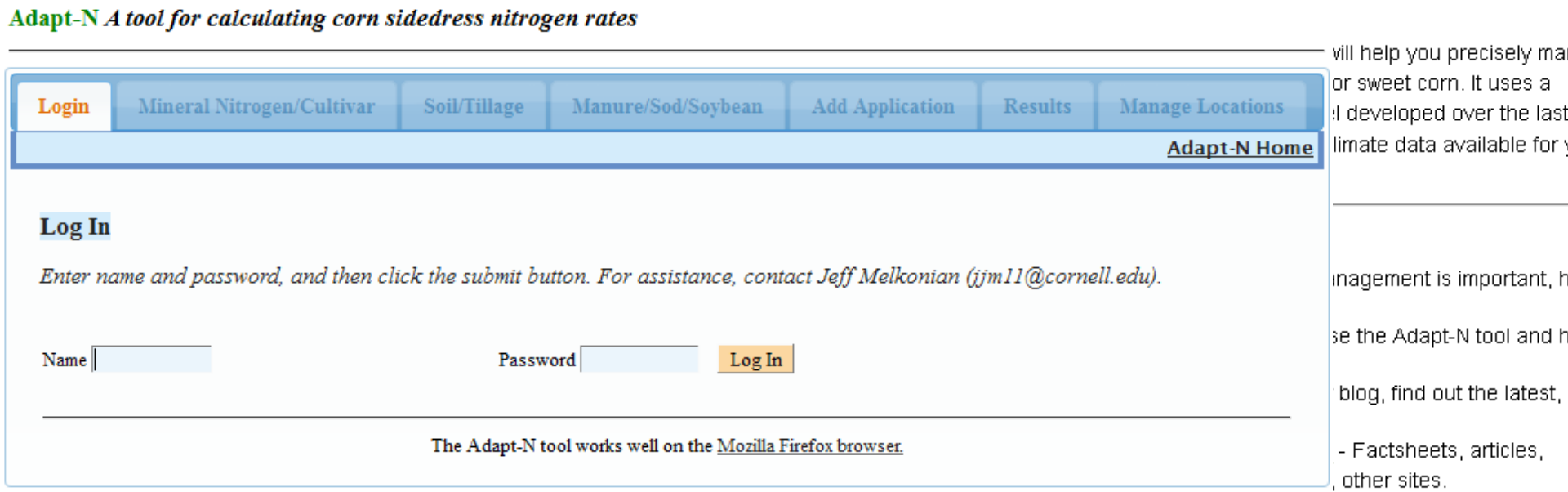
- Starter fertilizer
  - type/rate/depth/application date
- Additional fertilizer
- Cultivar maturity class
- Planting date
- Expected harvest population
- Expected Yield

Organic Inputs

- Manure applications:
  Two previous years/current year
- Previous sod crop
- 1st year corn after soybean?

Logging into Adapt-N

1. E-mail Jeff Melkonian (jjm11@cornell.edu) for a username and password



Entering Management Info for a Location

Tabbed interface. For example: Soil/Tillage Tab

Adapt-N *A tool for calculating corn sidedress nitrogen rates*

Login | Mineral Nitrogen/Cultivar | Soil/Tillage | Manure/Sod/Soybean | Add Application | Results | Manage Locations

Season End Date

Adapt-N Information

Soil Information

Please select a soil texture class (New York) or soil series (Iowa) that best describes the soil in the field.

Nicollet

Please select the estimated rooting depth. > 38 inches

Please select the approximate slope (%) of the field. less than 3%

Was there a soil test? There was a soil test in 2010

If you know the sample depth, please enter it in inches.
Otherwise, please enter 6 inches. *(inches)* 6

soil organic matter: *(%)* 2

Tillage System Information

Please select the tillage system for this field. no tillage (no till, zone till, strip till, ridge till)

When you've entered all your information, please click the submit button Submit

Adapt-N Results Page

Example 1. Need for sidedress N

Adapt-N *A tool for calculating corn sidedress nitrogen rates*

Login | Mineral Nitrogen/Cultivar | Soil/Tillage | Manure/Sod/Soybean | Add Application | Results

Season End Date

N recommendation based on daily weather data until day prior to simulation

Sidedress Nitrogen Recommendation: 65 lbs N/Acre

This recommendation is based on an "Expected Yield" entry that is assumed to be the economically optimum yield for your field. As such, it is relatively insensitive to profit within a range of +/- 15 lbs per acre around the recommended rate at current fertilizer and grain prices.

1. Calculation of Sidedress N Rate

   Sidedress N rate estimated by AdaptN = $CropN_{Harvest}$ - $CropN_{Current}$ - $SoilN_{Current}$ - $SoilN_{postsidedress}$ - $SoybeanN_{Credit}$

$CropN_{Harvest}$	154 *(lbs N/acre)*
$CropN_{Current}$	62 *(lbs N/acre)*
$SoilN_{Current}$	17 *(lbs N/acre)*
$SoilN_{postsidedress}$	-18 *(lbs N/acre)*
$SoybeanN_{Credit}$	30 *(lbs N/acre)*

Root Zone Crop Available Water

Note that these estimates are for non-irrigated corn production.

Current root zone crop available water:	*7 inches*
Crop available water at field capacity	*7 inches*

- Full Report and Graphs (pdf file)
- Sidedress N Definitions

Adapt-N Results Page

Example 2. Excess N in the system

Adapt-N *A tool for calculating corn sidedress nitrogen rates*

Login | Mineral Nitrogen/Cultivar | Soil/Tillage | Manure/Sod/Soybean | Add Application | Results | Manage Locations

Season End Date | Adapt-N Home

Sidedress Nitrogen Recommendation: No sidedress N recommended at this time

This recommendation is based on an "Expected Yield" entry that is assumed to be the economically optimum yield for your field. As such, it is relatively insensitive to profit within a range of +/- 15 lbs per acre around the recommended rate at current fertilizer and grain prices.

1. Calculation of Sidedress N Rate

   Sidedress N rate estimated by AdaptN = $CropN_{Harvest}$ - $CropN_{Current}$ - $SoilN_{Current}$ - $SoilN_{postsidedress}$ - $SoybeanN_{Credit}$

$CropN_{Harvest}$	154 *(lbs N/acre)*
$CropN_{Current}$	150 *(lbs N/acre)*
$SoilN_{Current}$	23 *(lbs N/acre)*
$SoilN_{postsidedress}$	-18 *(lbs N/acre)*
$SoybeanN_{Credit}$	30 *(lbs N/acre)*

2. Excess N

   Adapt-N has estimated that the seasonal N supplied (all sources) will exceed total crop N demand ($CropN_{Harvest}$) by at least 10 *lbs N/acre.*

   Estimated Excess N: 30 *lbs N/acres*

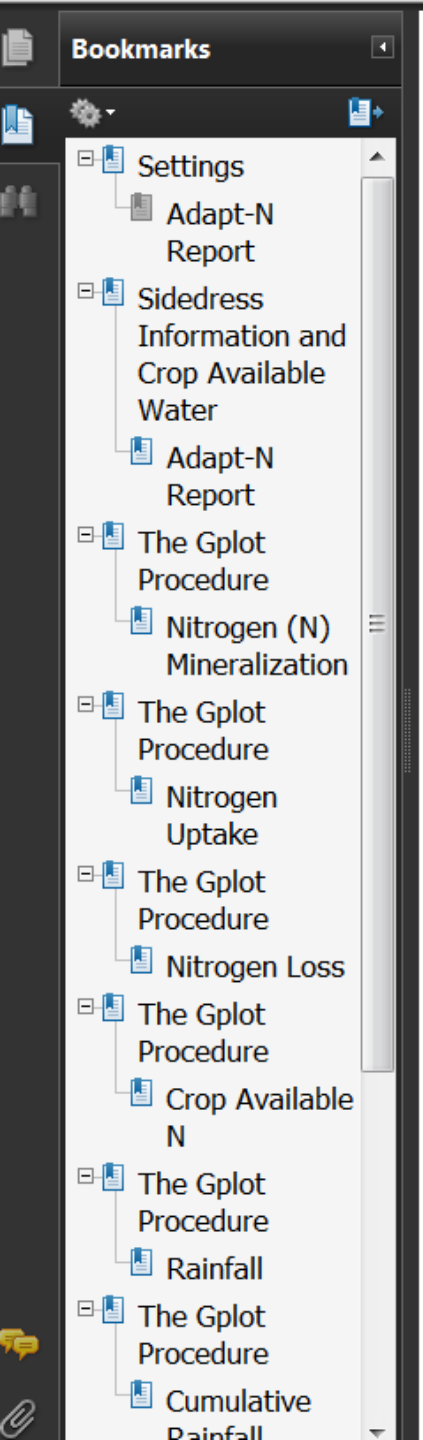
Root Zone Crop Available Water

Note that these estimates are for non-irrigated corn production.

Current root zone crop available water:	5 *inches*
Crop available water at field capacity	7 *inches*

- Full Report and Graphs (pdf file)
- Sidedress N Definitions

Click on link to download a full report, including graphs. This pdf can be saved electronically or printed.



Adapt-N Results

Sample Full Report (for Example 1.)

Adapt-N Report

Settings	
Current Date	04/08/2011
Simulation End Date	10/31/2010
Field Name	Iowatest
Group Name	Ungrouped
Latitude	43.06236
Longitude	-94.042625
Soil/Field Input	
Soil Type	Iowa Soil Series: nicollet
Rooting Depth	> 38 inches
Field Slope	less than 3%
Soil Management	no tillage (no till, zone till, strip till, r
Preplant Soil Test	test in 2010
Sample Depth	6 inches
Soil Organic Matter	2%
Crop Information	
Planting Date	04/20/2010
Planting Density	32,500 plants/acre
Maturity Class	101_d_crm
GDD to maturity	2573
Expected Yield	160 bu/acre
Nitrogen Inputs: Sod	sod not applied
Nitrogen Inputs: Manure	manure not applied
Mineral Fertilizer: starter	
starter	solution N (UAN), 30 lbs N/acre
Date	04/20/2010
Depth of Incorporation	2-4 inches
Mineral Fertilizer: additional	additional not applied

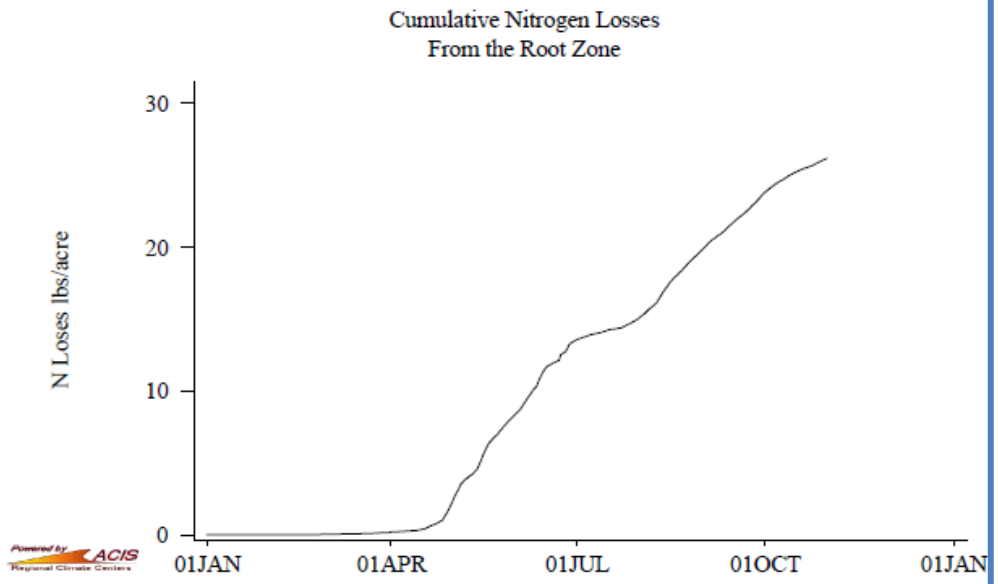
Sidedress N and Crop Available Water	
Sidedress N recommendation	65 lbs N/Acre
CropN (Harvest)	154 lbs N/acre
CropN (Current)	62 lbs N/acre
SoilN (Current)	17 lbs N/acre
SoilN (postsidedress)	-18 lbs N/acre
SoybeanN (Credit)	30 lbs N/acre
Crop Available Water	
Water in Root Zone	7 inches
Water at Field Capacity	7 inches

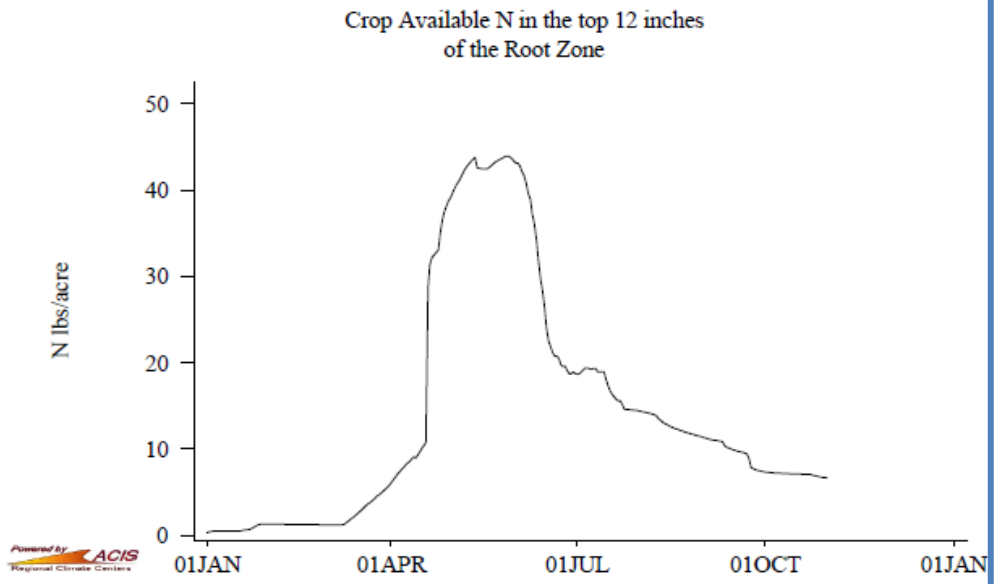
All user inputs are listed for easy record keeping

Results from Results page on interface are provided in pdf

Graphs are provided in following pages.

Adapt-N Report





Adapt-N Graphs

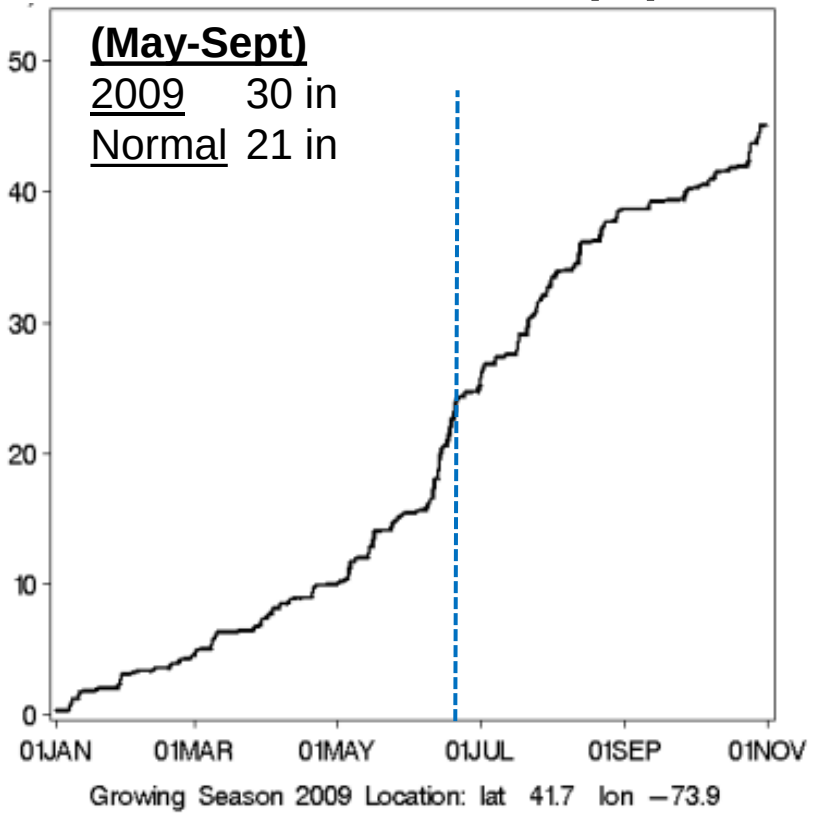
- Cumulative N Mineralization
- Cumulative N uptake by Crop
- N Losses from Root Zone
- Crop Available N at 0-12”
- Season Daily Rainfall
- Cumulative Rainfall
- Post Planting Days
- Growing Degree Days
- Leaf Number
- Season Average Temperature

Retrospective Evaluation with Adapt-N
SE New York 2009

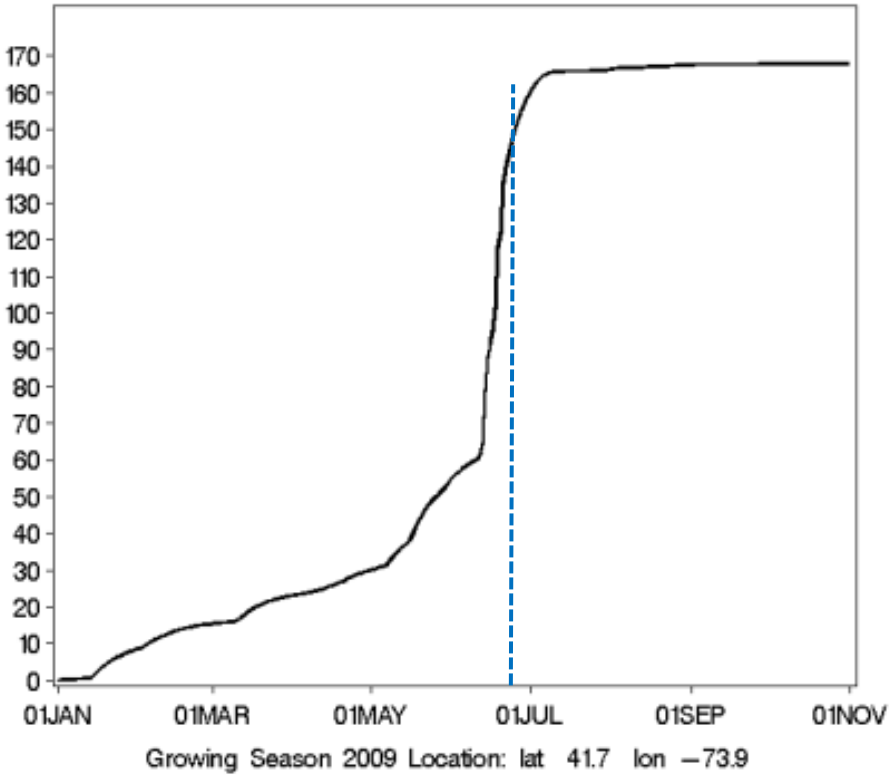
- Rotate from sod 10/20/07
- 10,000 gal/ac manure on 4/18/09
- Starter N as MAP on 5/1/09

----(blue line = time of sidedress)

Cumulative Rainfall (in)



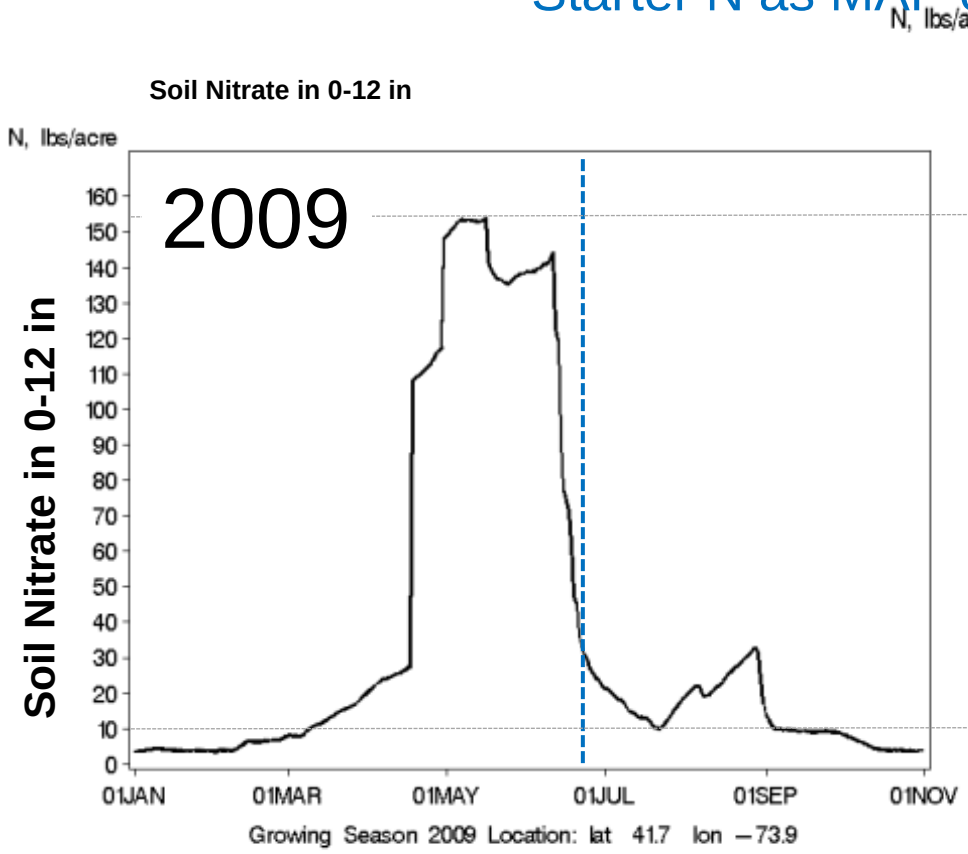
Cumulative N Losses (lb/acre)

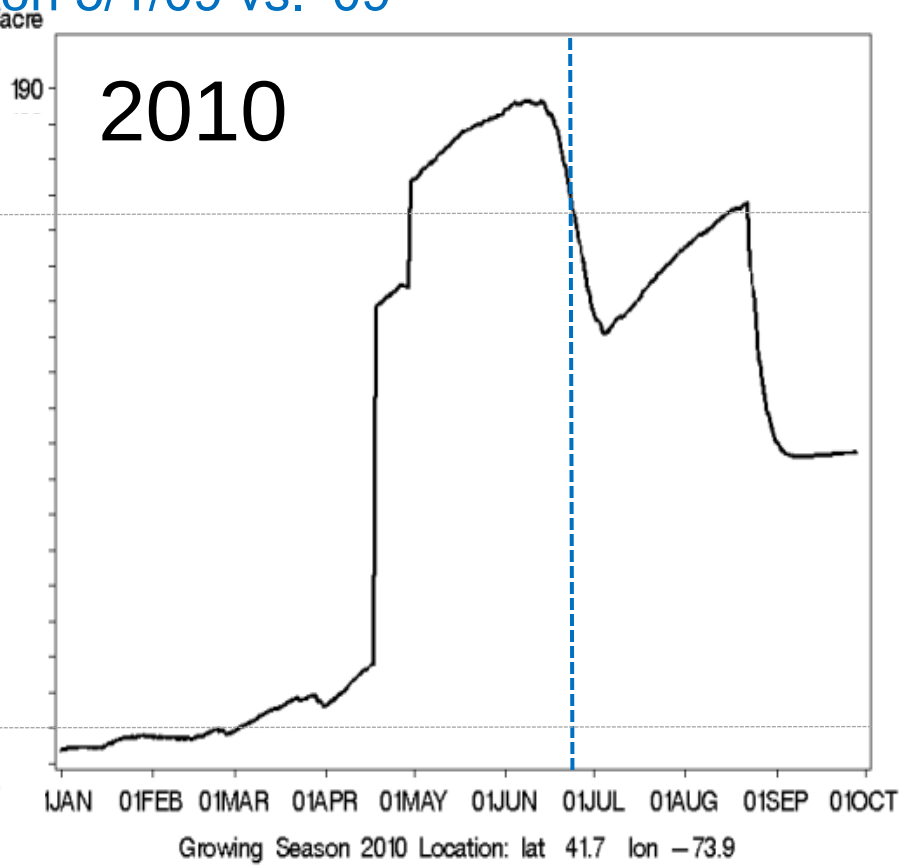


Retrospective Evaluation with Adapt-N
SE New York 2009

2009 (wet) vs. 2010 (average) with same practices

- Rotate from sod 10/20/07 vs. ‘08
- 10,000 gal/ac manure on 4/18/09 vs. ‘10
- Starter N as MAP on 5/1/09 vs. ‘09





Adapt-N Applications

Adapt-N can be used for a wide range of N management practices for corn:

- Split applications: Sidedress N rate recommendation
- Applications at planting: When are additional in-season N applications necessary?
- Manured fields – Interpretation of a low PSNT: Is additional N necessary, and how much?
- Retrospective evaluation of yields and yield response to N … and What if…?.
- Learning tool

Conclusion

- N needs can't be generalized
- N needs can't be predicted at the beginning of the growing season, because of localized variability
- Adaptive management is based on local data and scientific/practical knowledge
- Adapt-N provides N recommendations and is also a Learning Tool

Questions as you try it out?

Email Bianca Moebius-Clune bnm5@cornell.edu

Thank You!
Questions?

NY farm viability INSTITUTE

Cornell University
College of Agriculture and Life Sciences
Department of Crop and Soil Sciences

NRCS Natural Resources Conservation Service