

# An Example of a Tier 3 Inventory Method: Soil Organic C Stock Changes

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University)

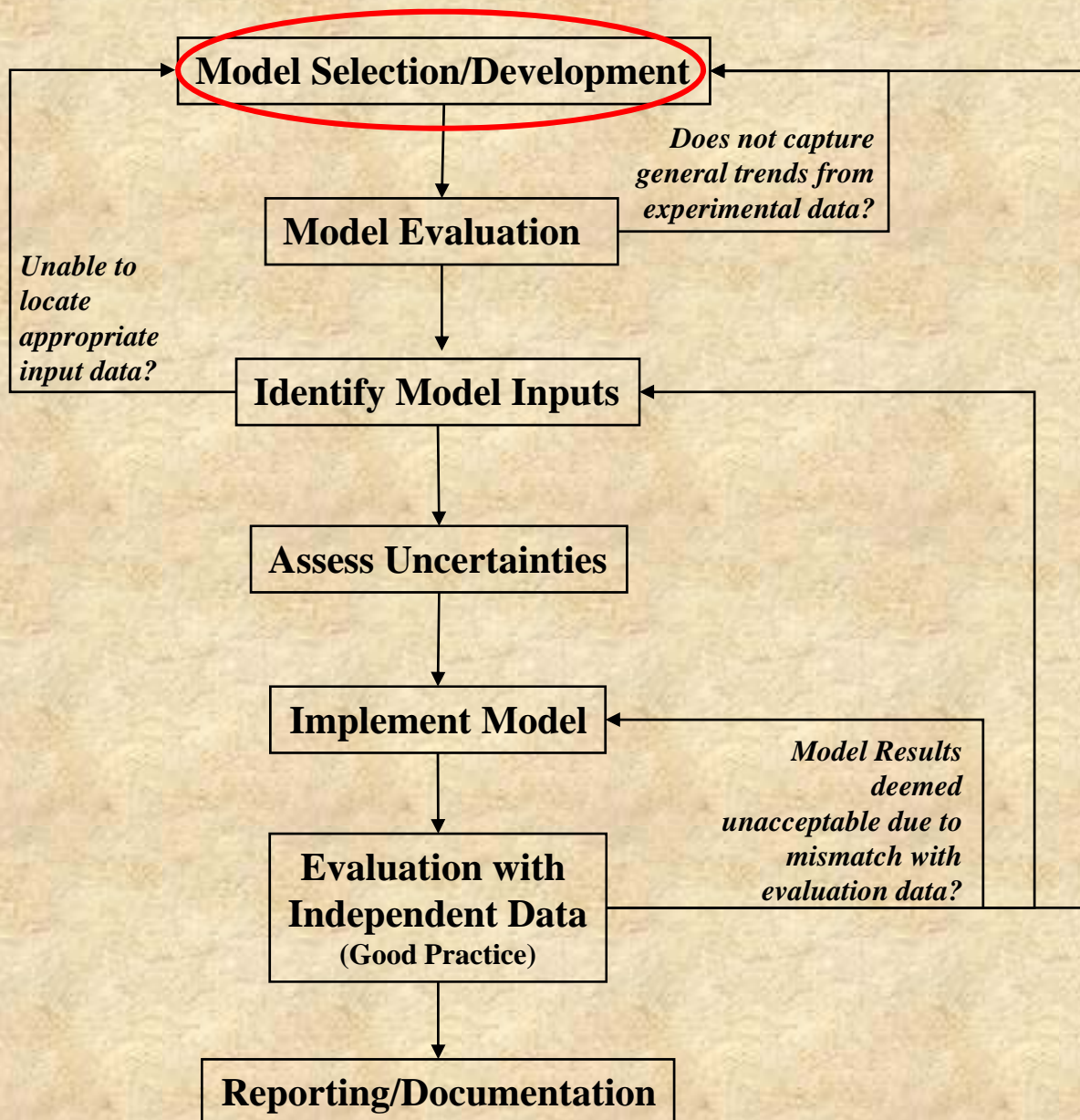


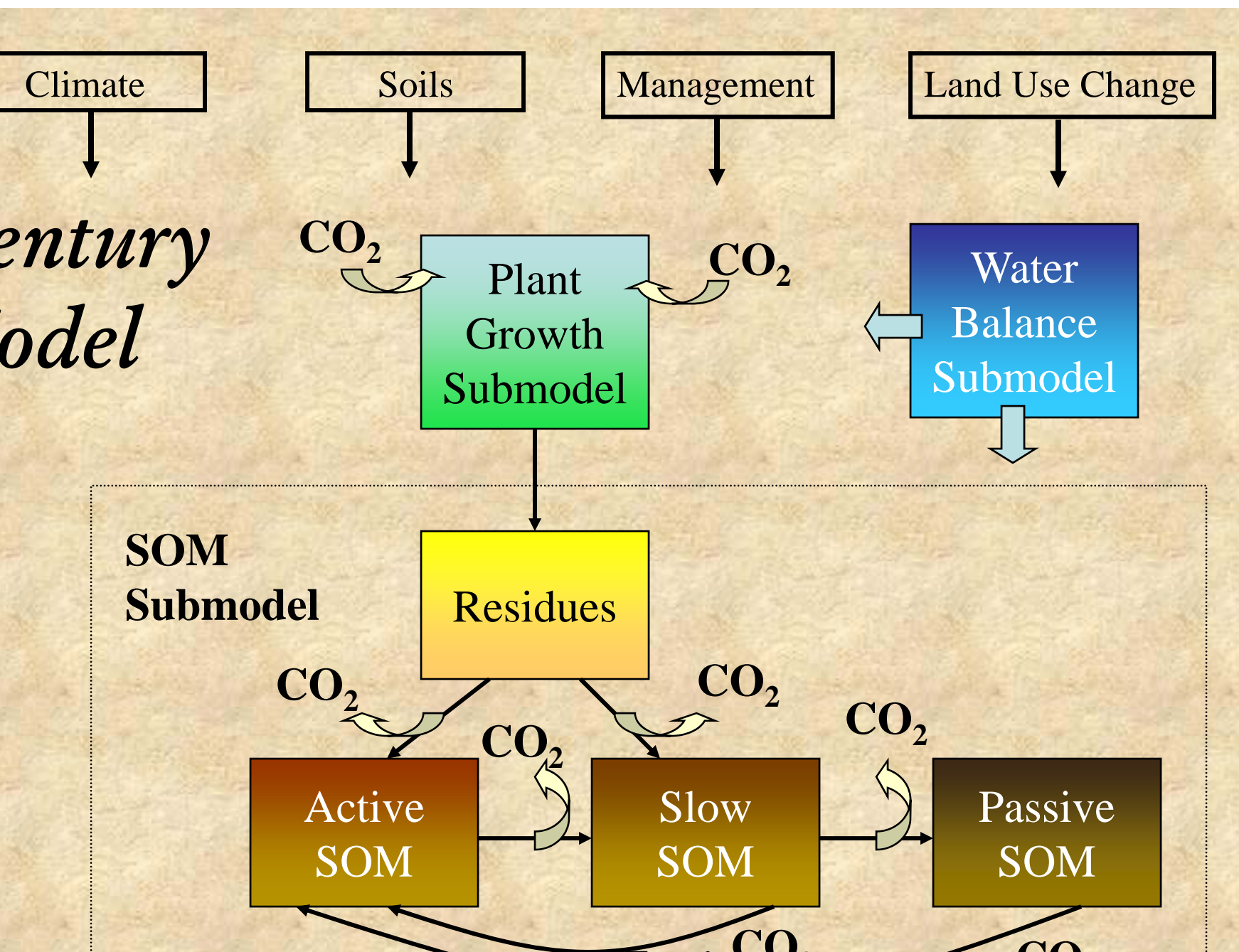
For more information:  
US EPA National CHC Inventory

# IPCC Method Tiers

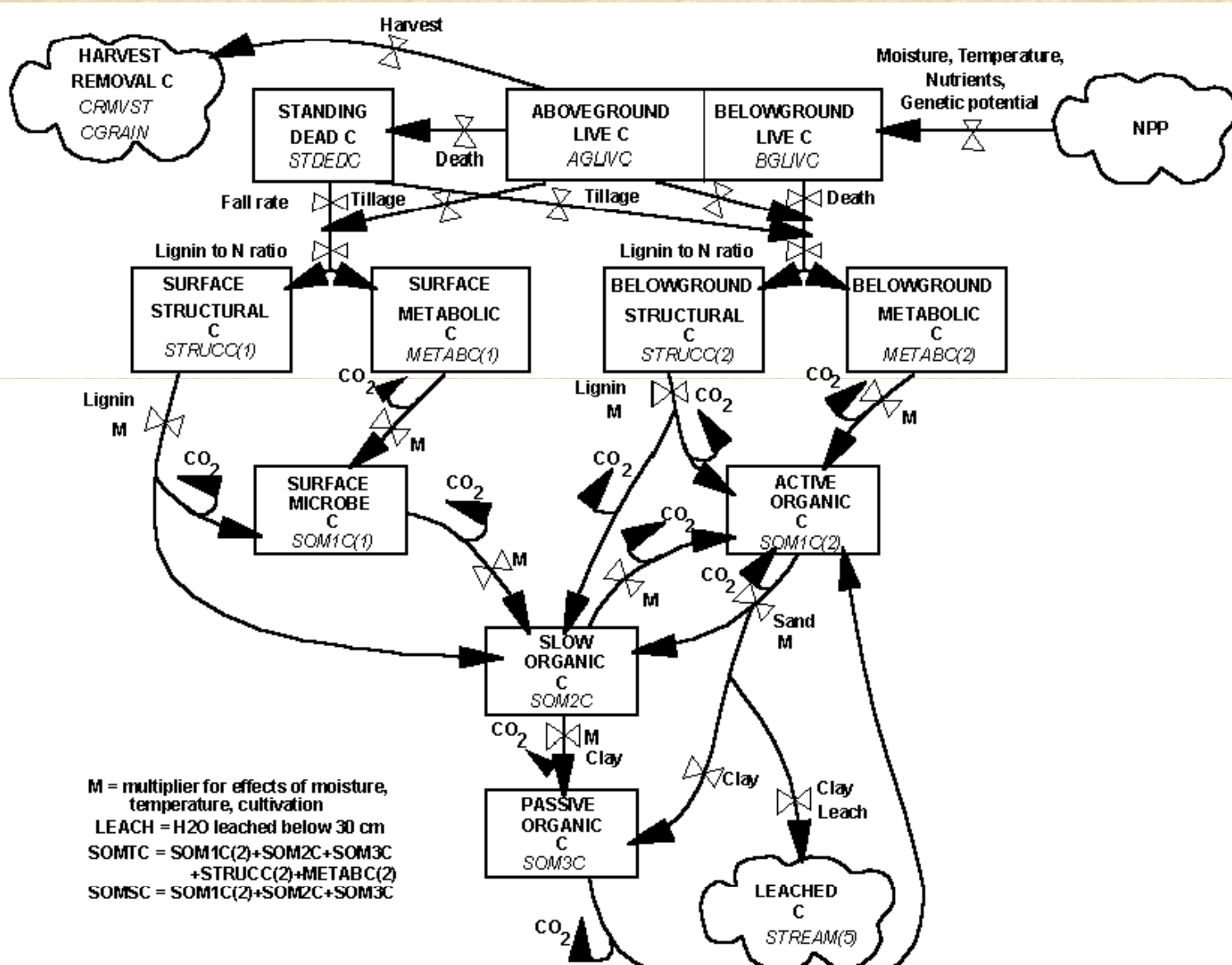
	Accuracy	Complexity
IPCC Tiers	Estimation method	Data Requirements
Tier 1	<i>Empirical</i>	<i>Low</i>
Tier 2	<i>Empirical</i>	<i>Medium to High</i>
Tier 3	<i>Model or Measurement-Based</i>	<i>High</i>

Part 3  
Guidance  
(Adapted from 2006  
Guidelines)

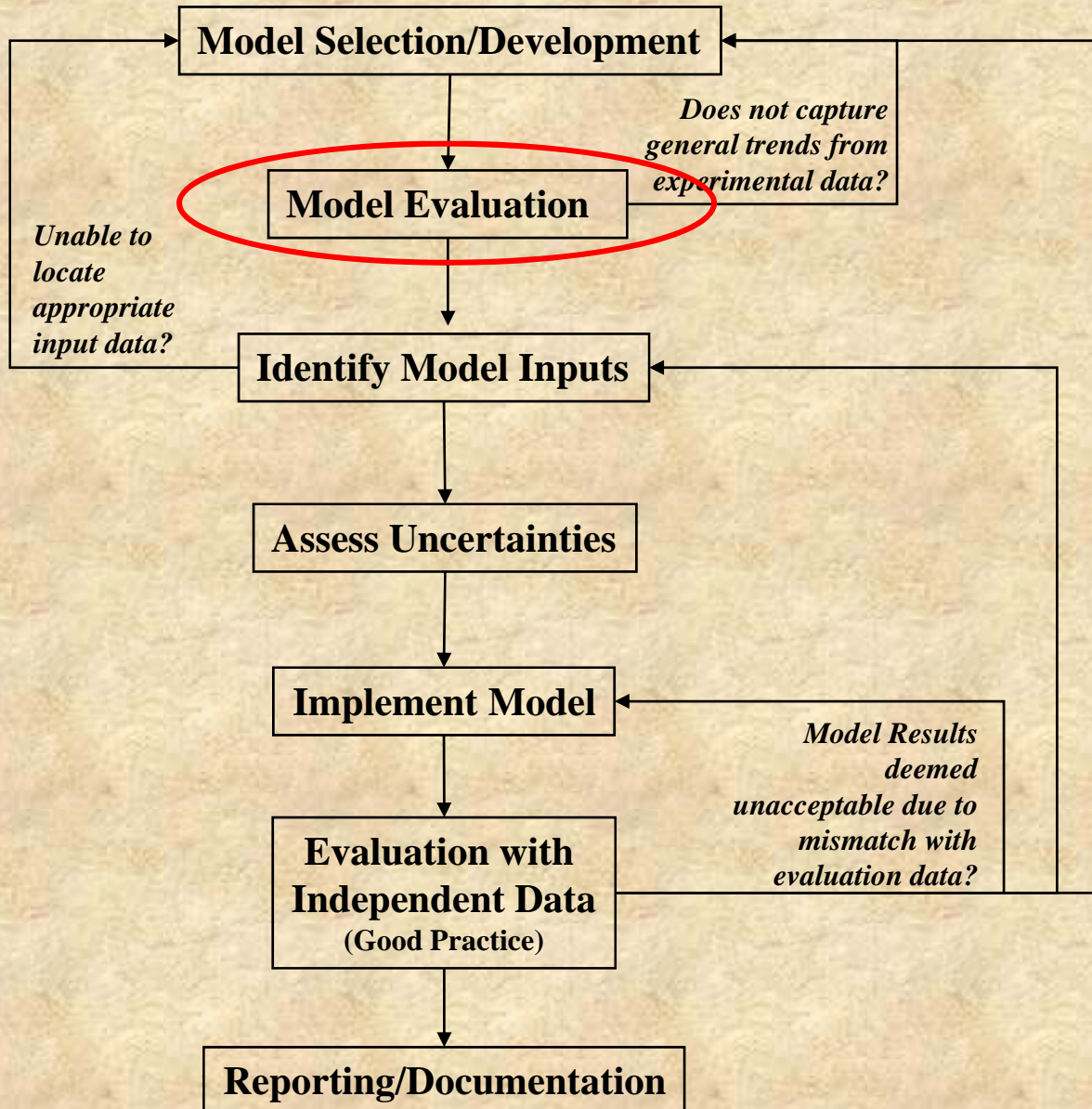




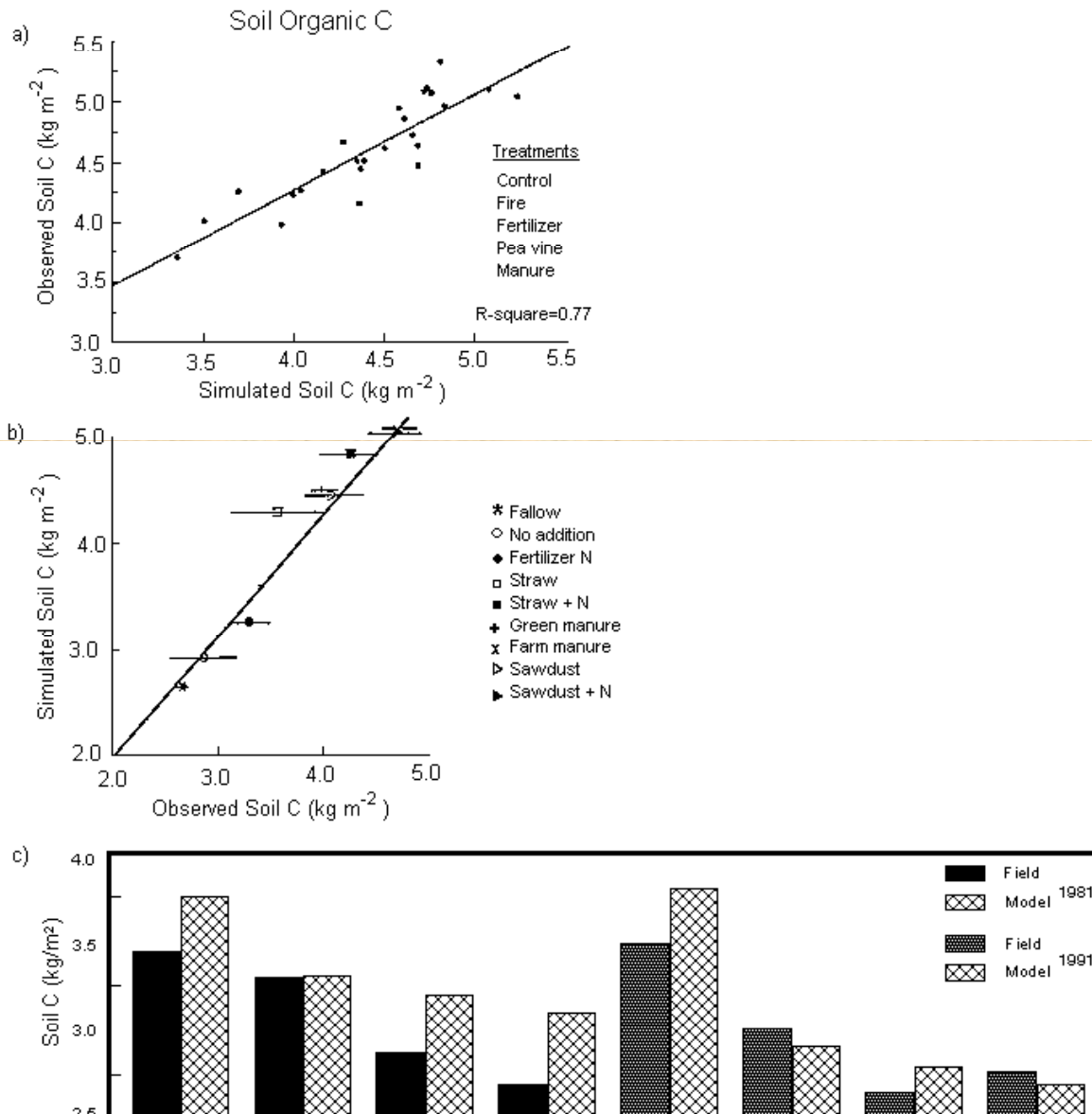
# Carbon Sub-Model



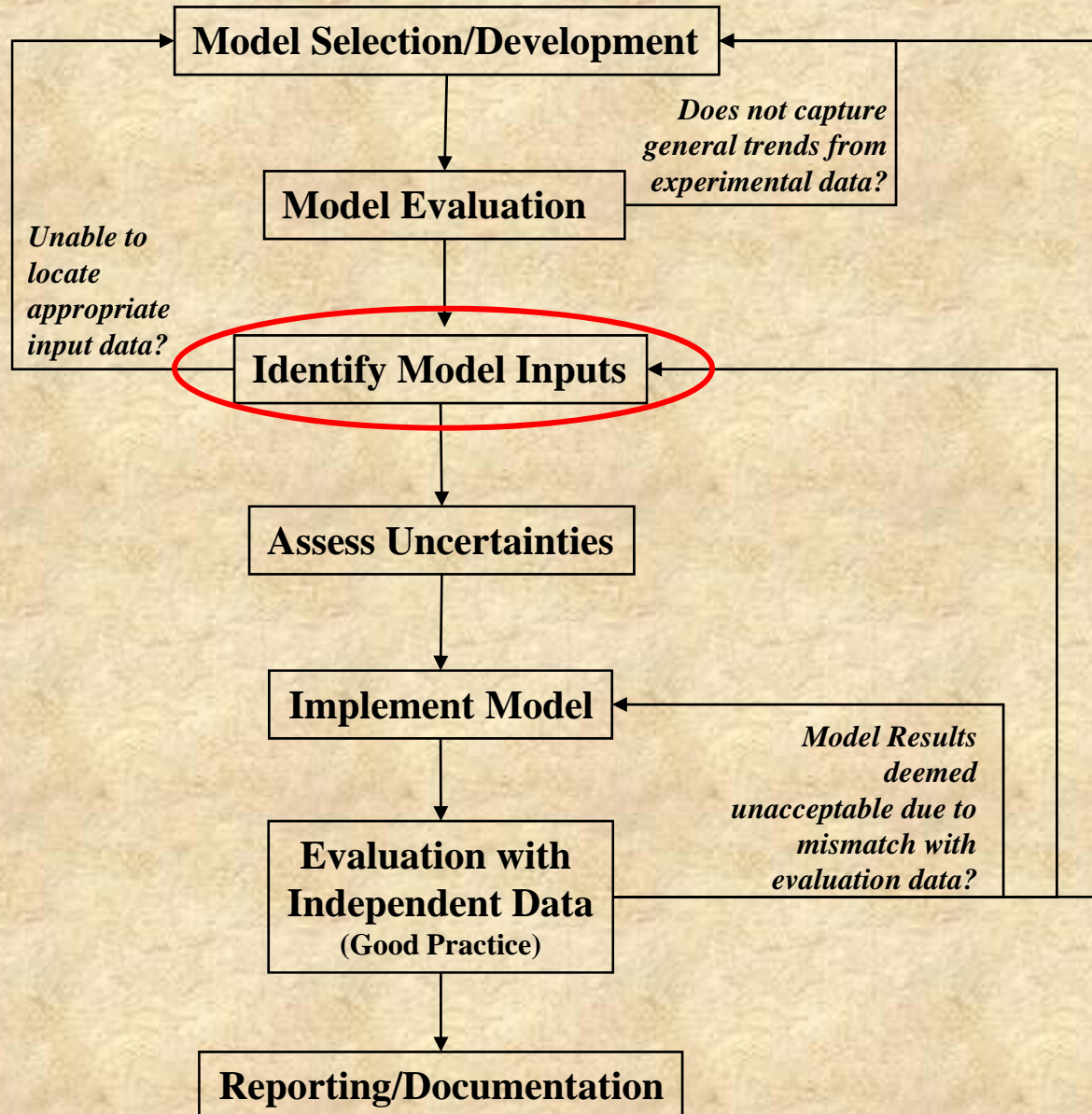
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# Century Model Evaluation

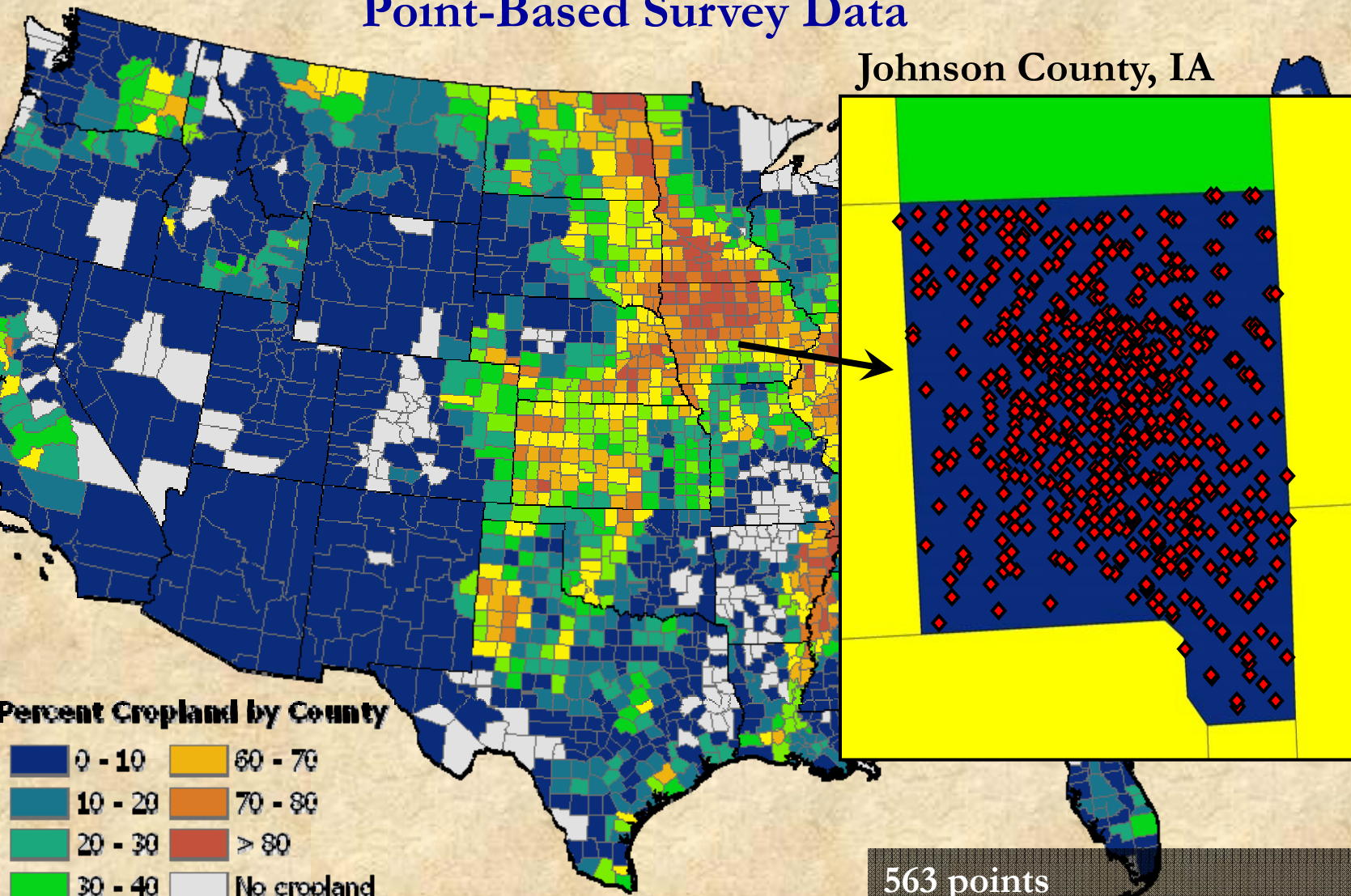


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# US National Resources Inventory (NRI):

## Point-Based Survey Data



Johnson County, IA

563 points

Note: points not spatially

## **Other Key Input Data**

**Tillage Practices, Conservation Technology  
Information Center**

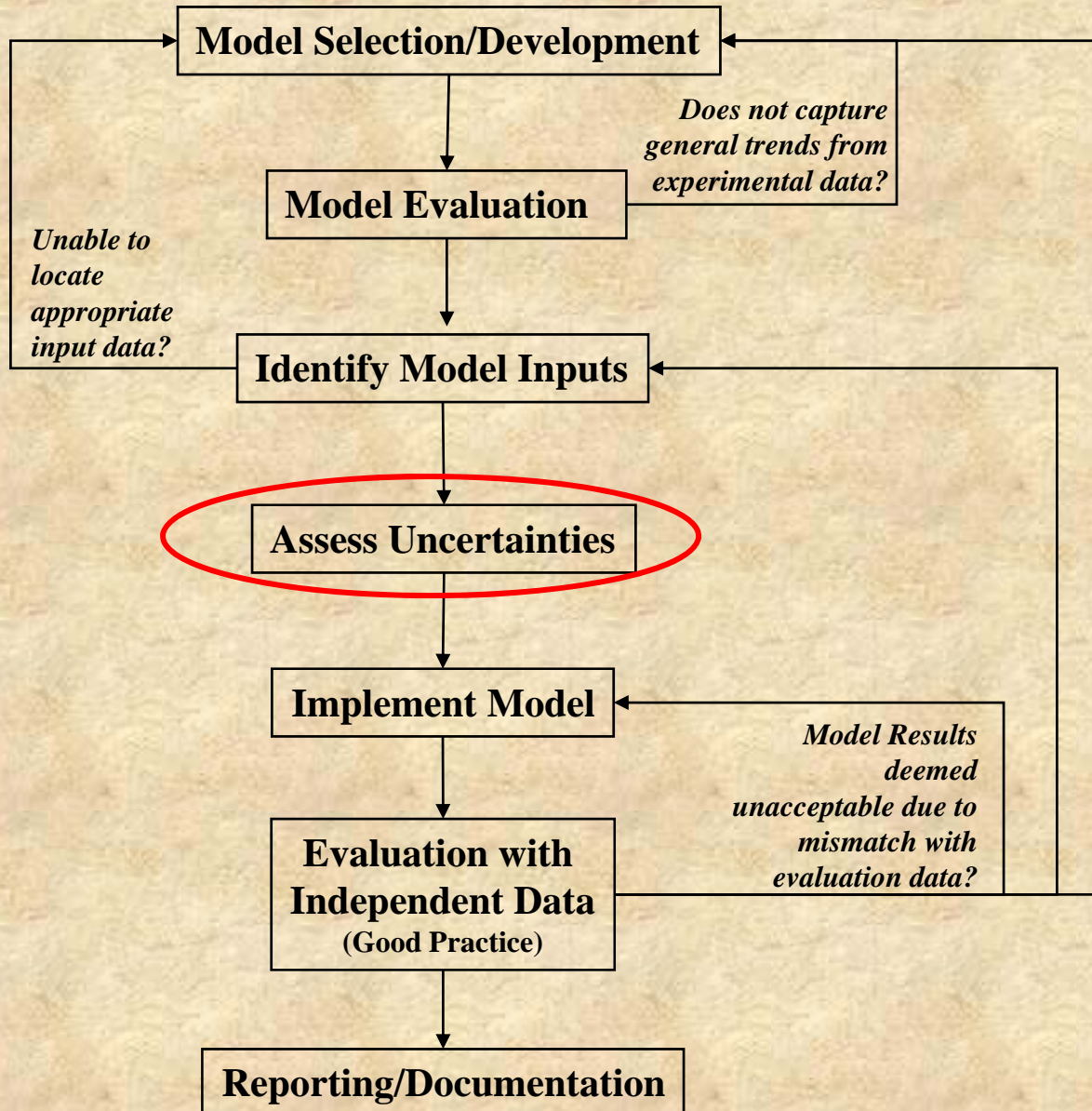
**Mineral Fertilizer Rates, USDA-ERS**

**Manure amendment application rates by crop  
type (USDA-NRCS)**

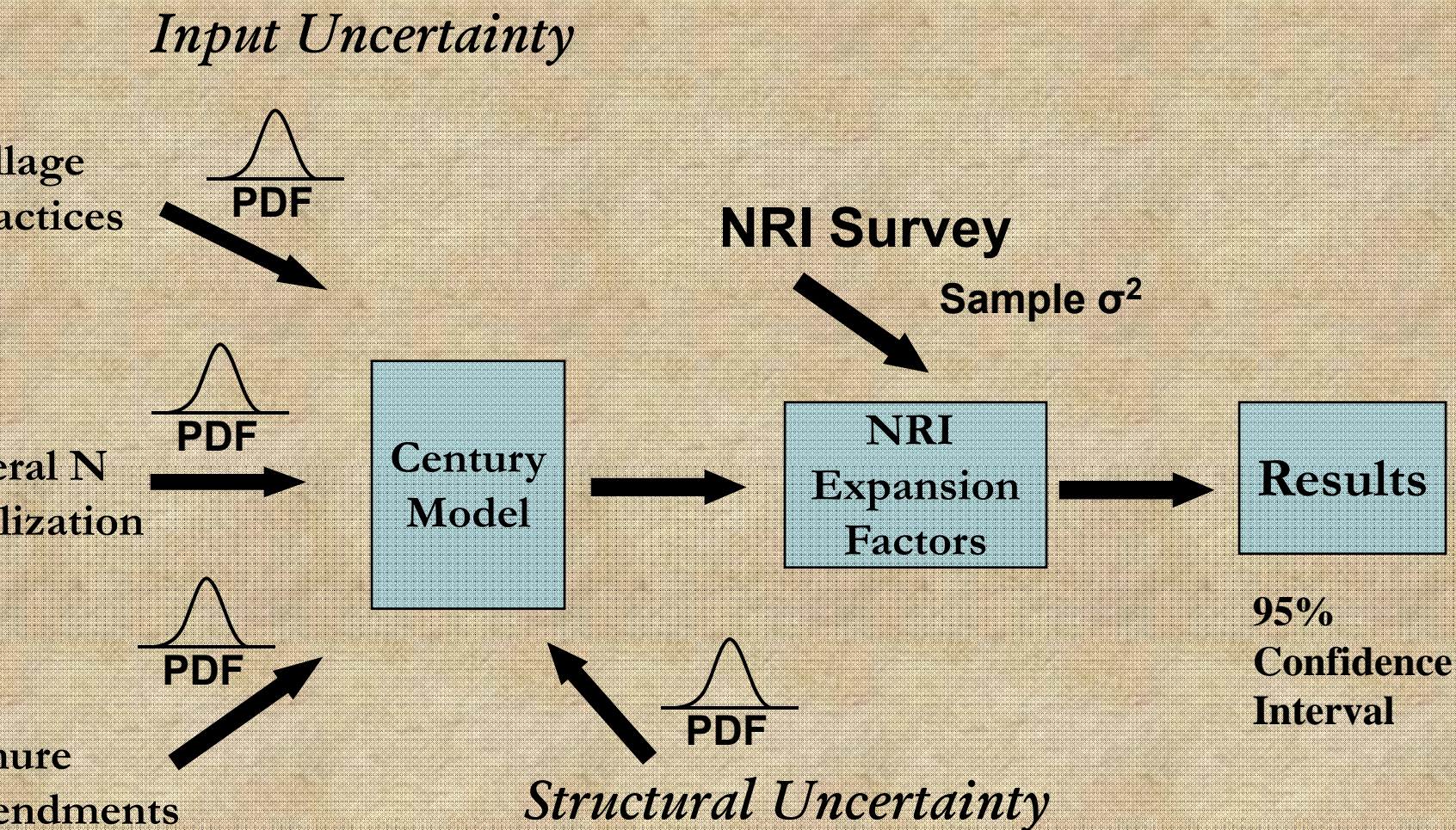
**Manure available for amendment (US-EPA)**

**Municipal sewage amendment to agricultural  
soils (US-EPA)**

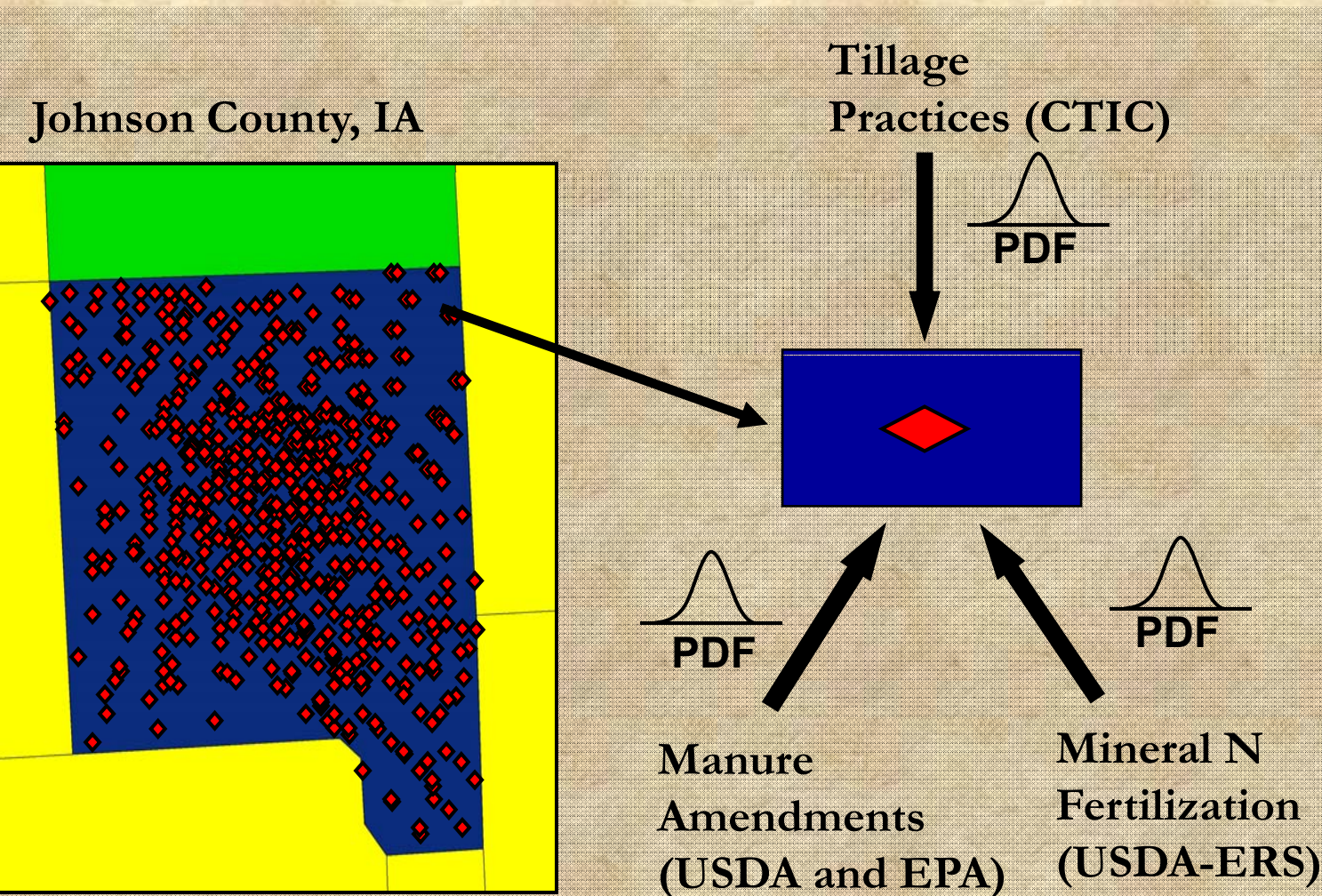
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# Uncertainty Framework



# Model Input Uncertainty

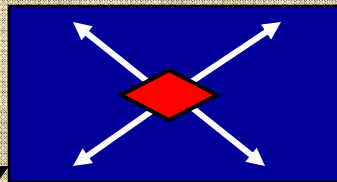
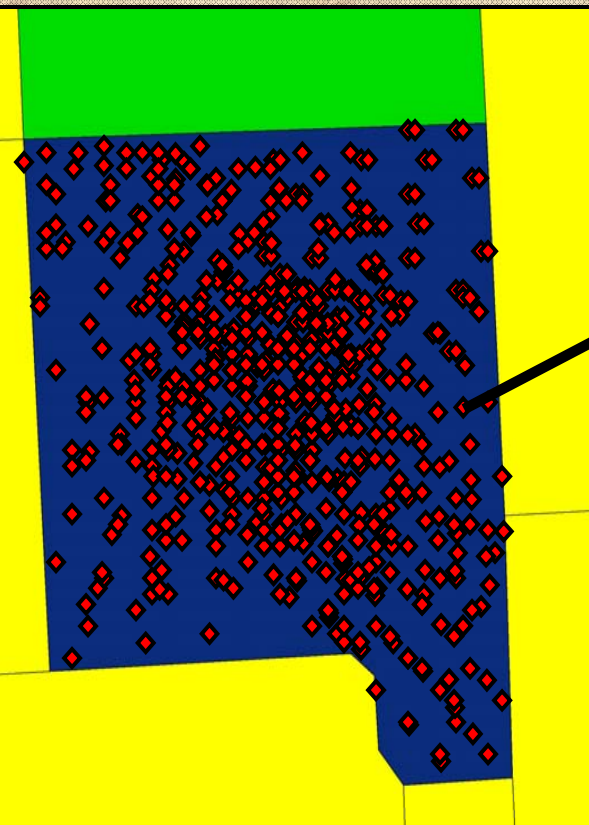


Monte Carlo Analysis

# Uncertainty in NRI Survey

NRI Survey is a Two Stage Sample

Johnson County, IA



NRI Weights

NRI survey sample  $\sigma^2$

# Model Structural Uncertainty

Model algorithms (i.e., equations),  
parameterization and measurement error

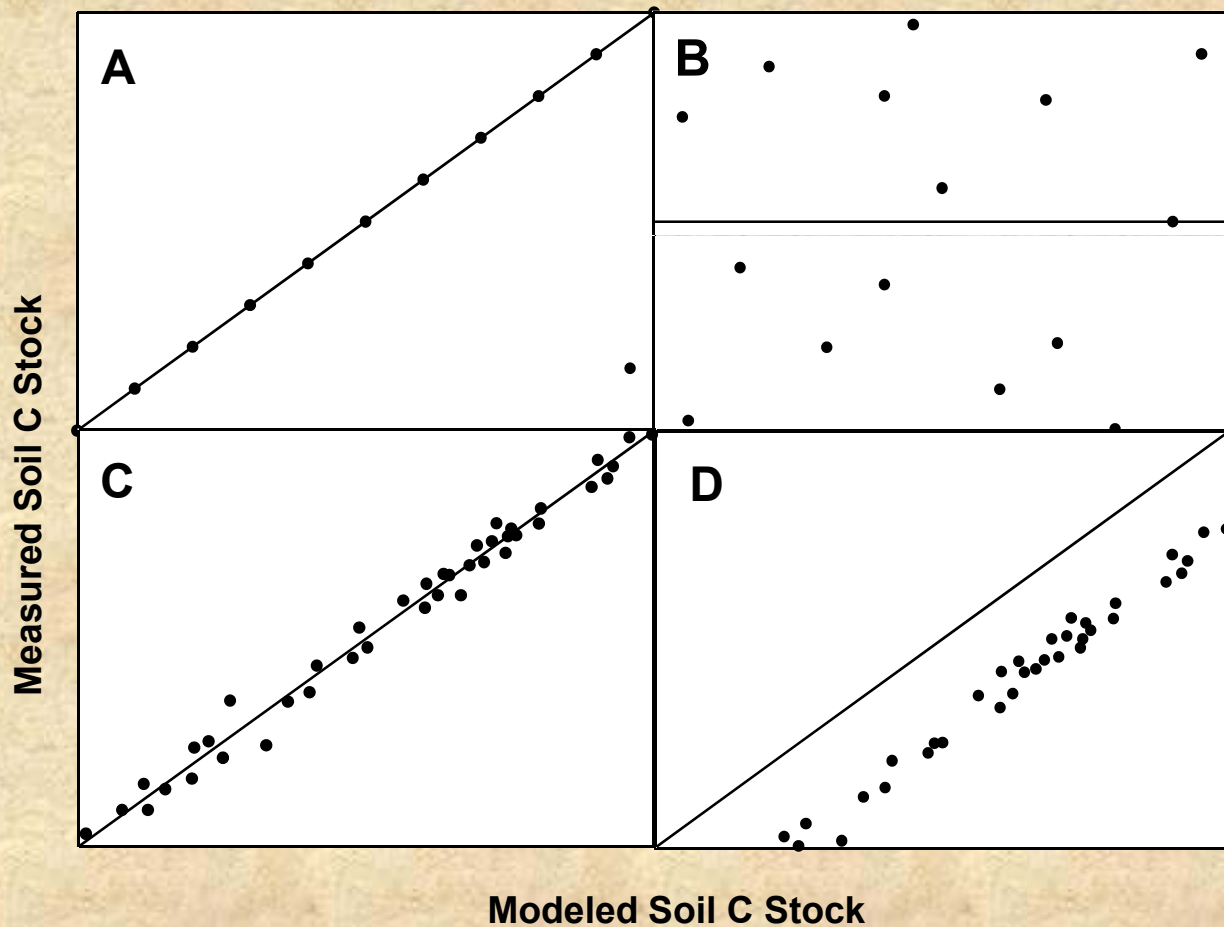
## Empirically-Based Approach

- Simulate management impacts on SOC storage for experimental sites
  - ca. 50 sites with over 800 management treatment observations
- Linear mixed effect models

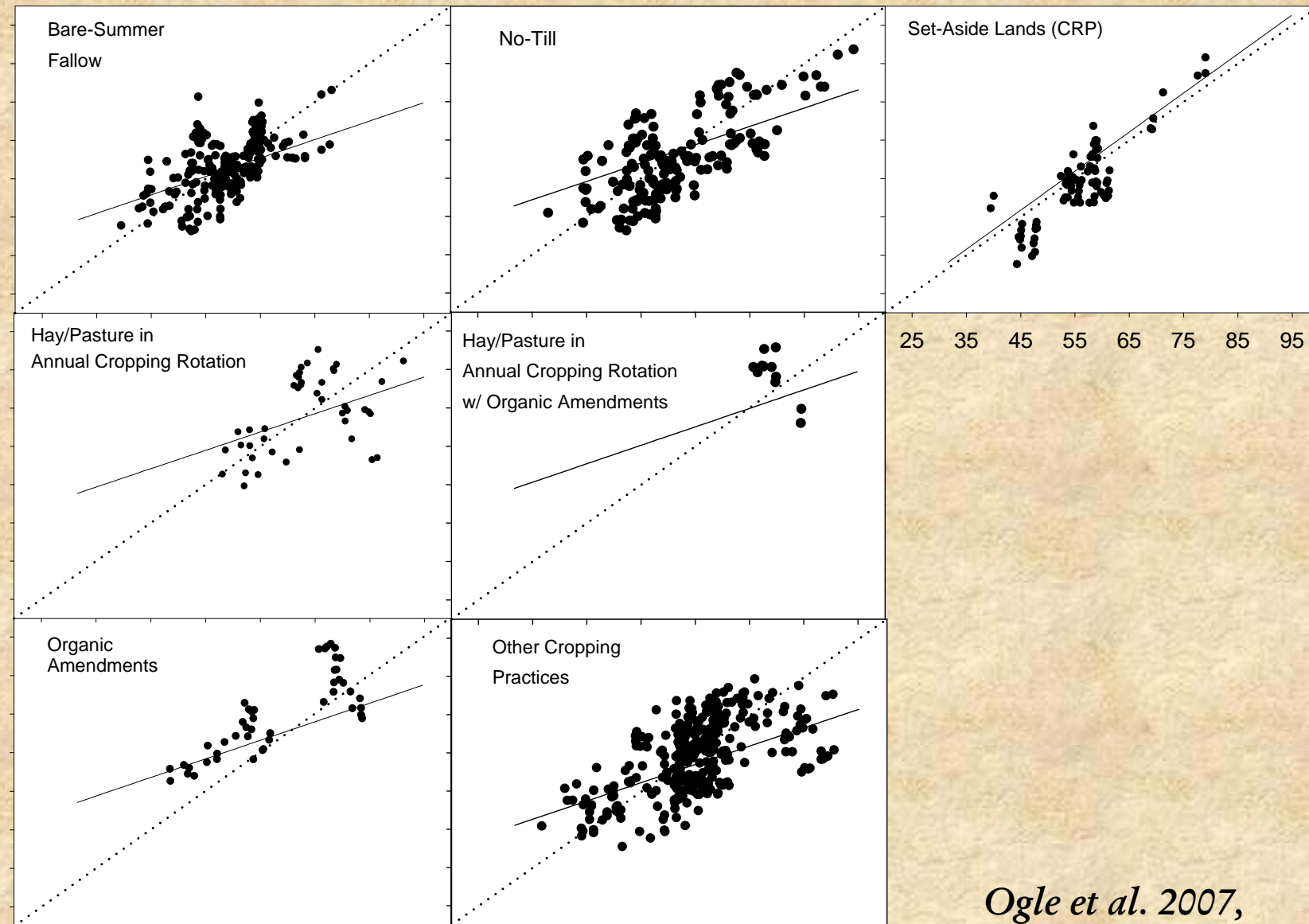
$$SOC = \beta_0 + \beta_1 X_1 + \dots + \beta_p X_p + \gamma_{mlra} + \gamma_{site} + \gamma_{year*site} + \varepsilon$$

Adjust for biases and apply a measure of  
precision associated with model predictions

# Structural Uncertainty: Theoretical Relationships

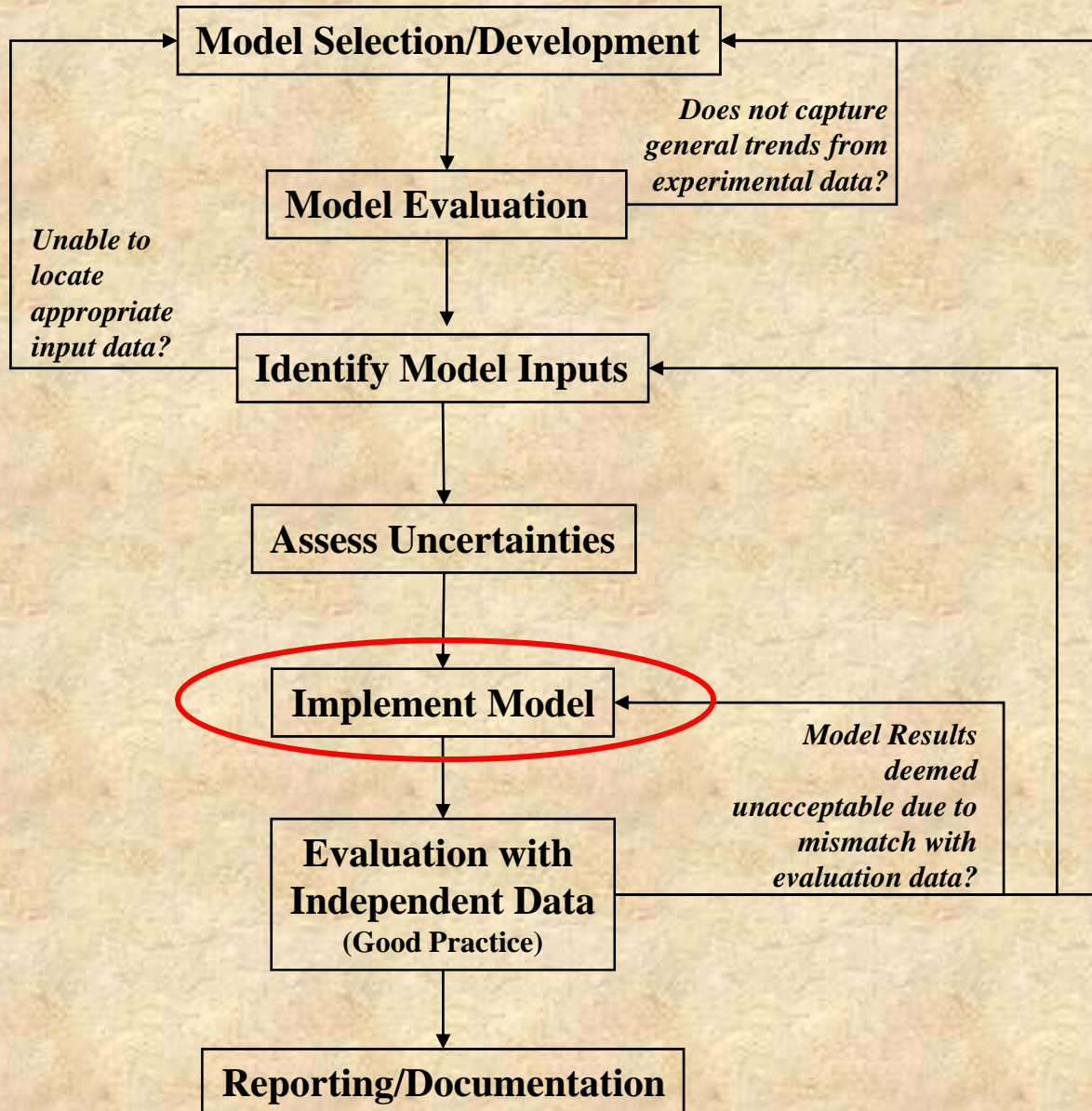


# Century Structural Uncertainty

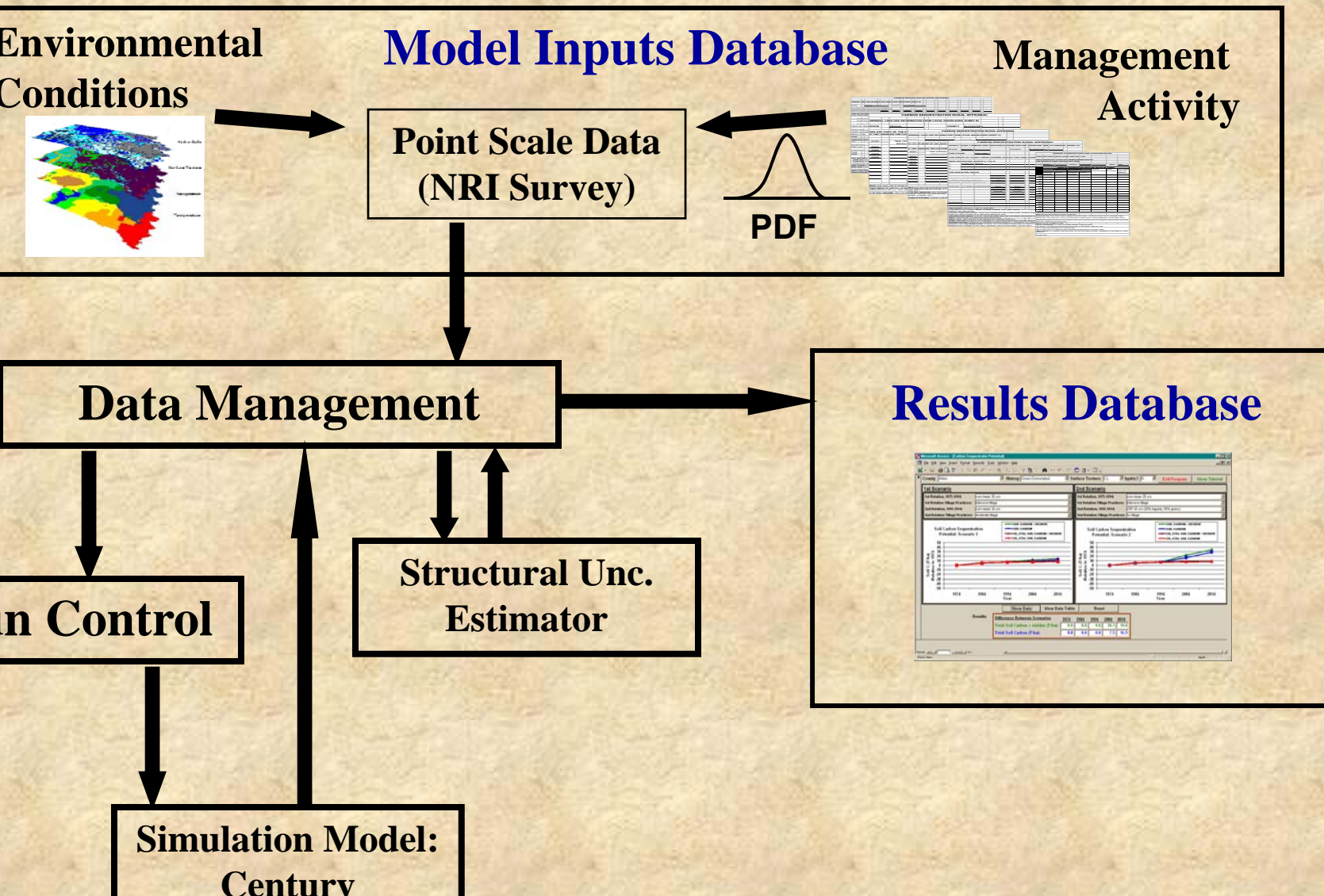


Ogle et al. 2007,

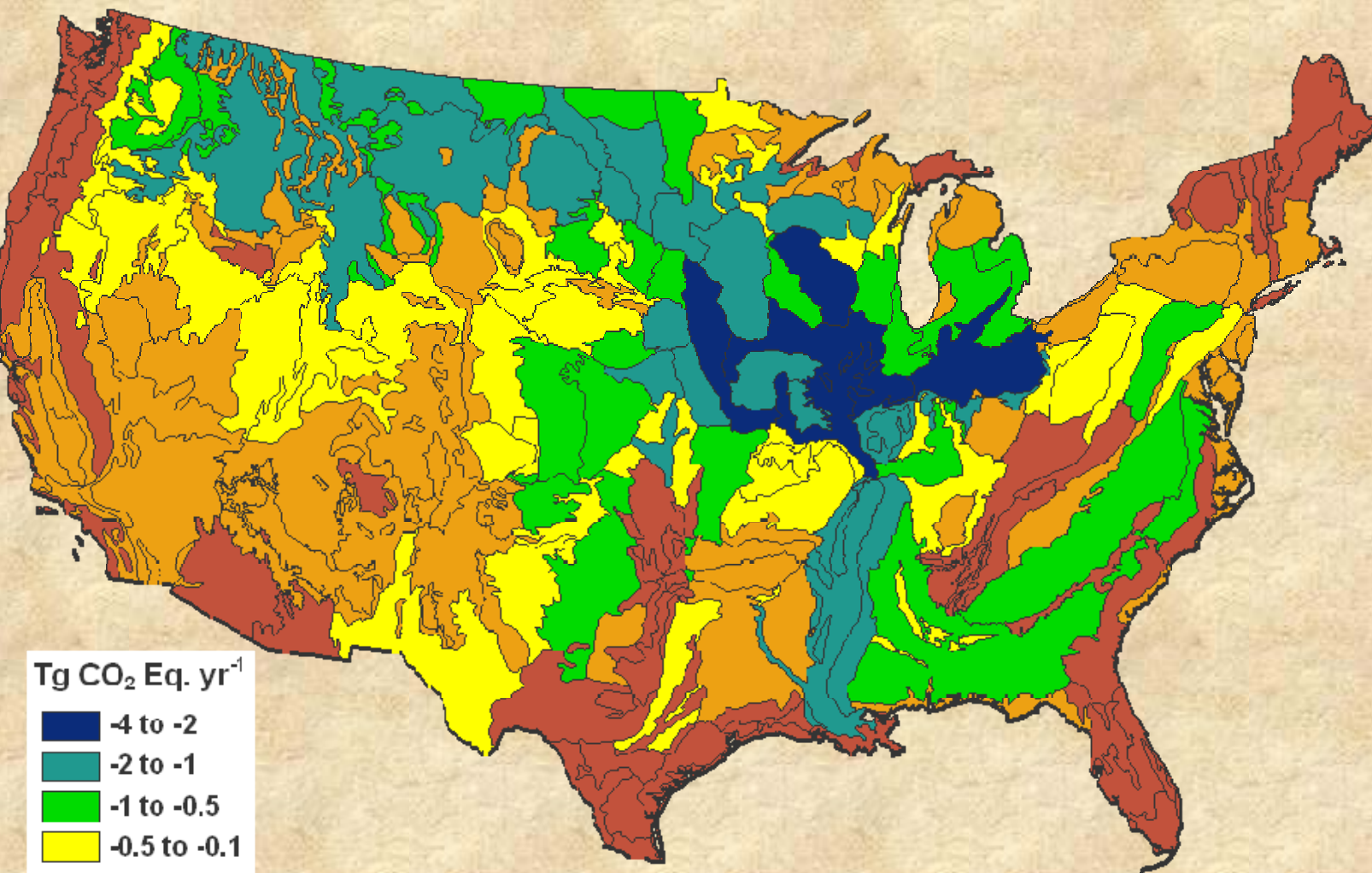
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# Implementation Framework

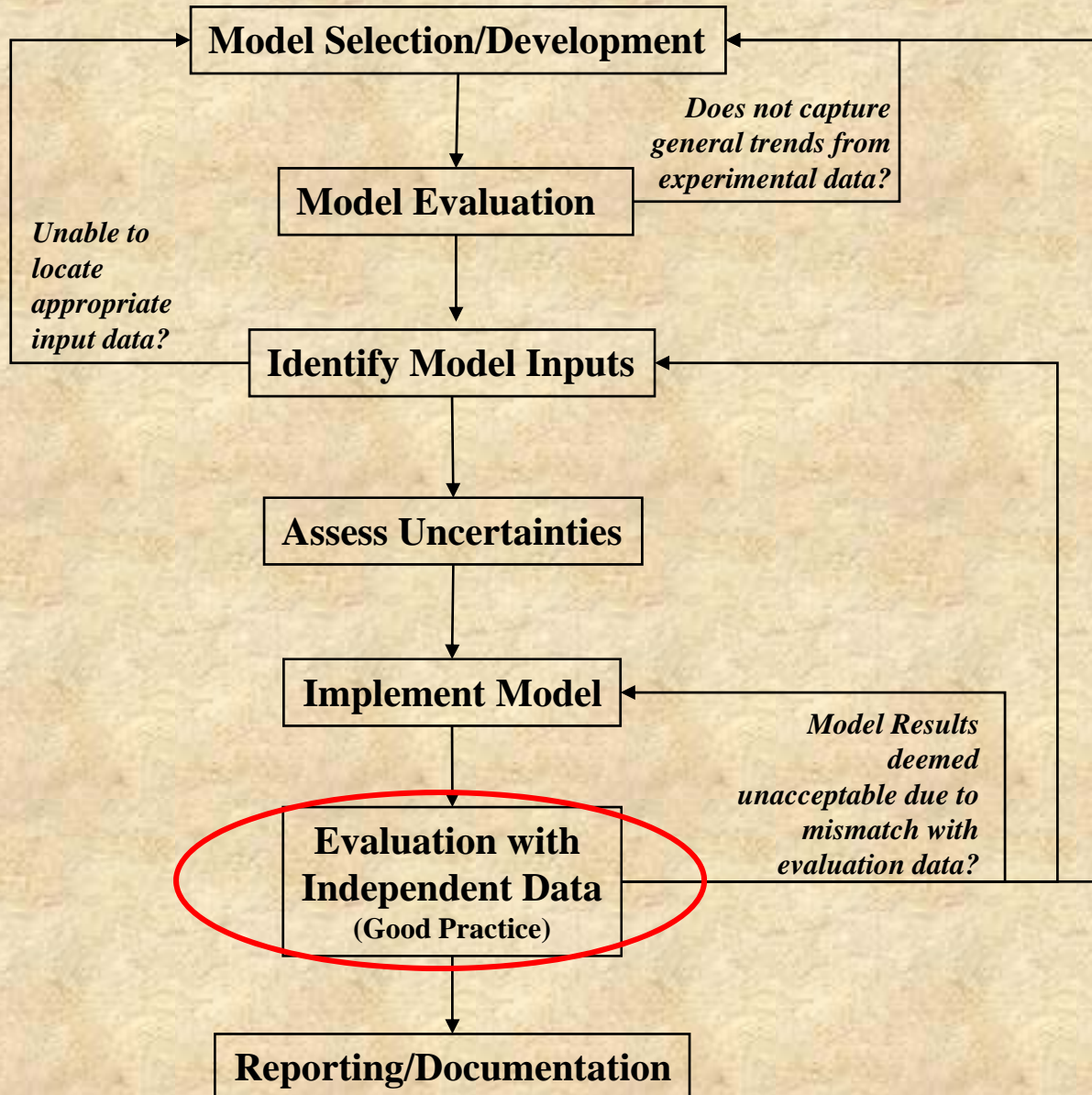


# Totals for US Croplands (i.e., Major Crops)



2006:  $-64.0 \pm 16\%$  Tg CO<sub>2</sub> eq. yr<sup>-1</sup>

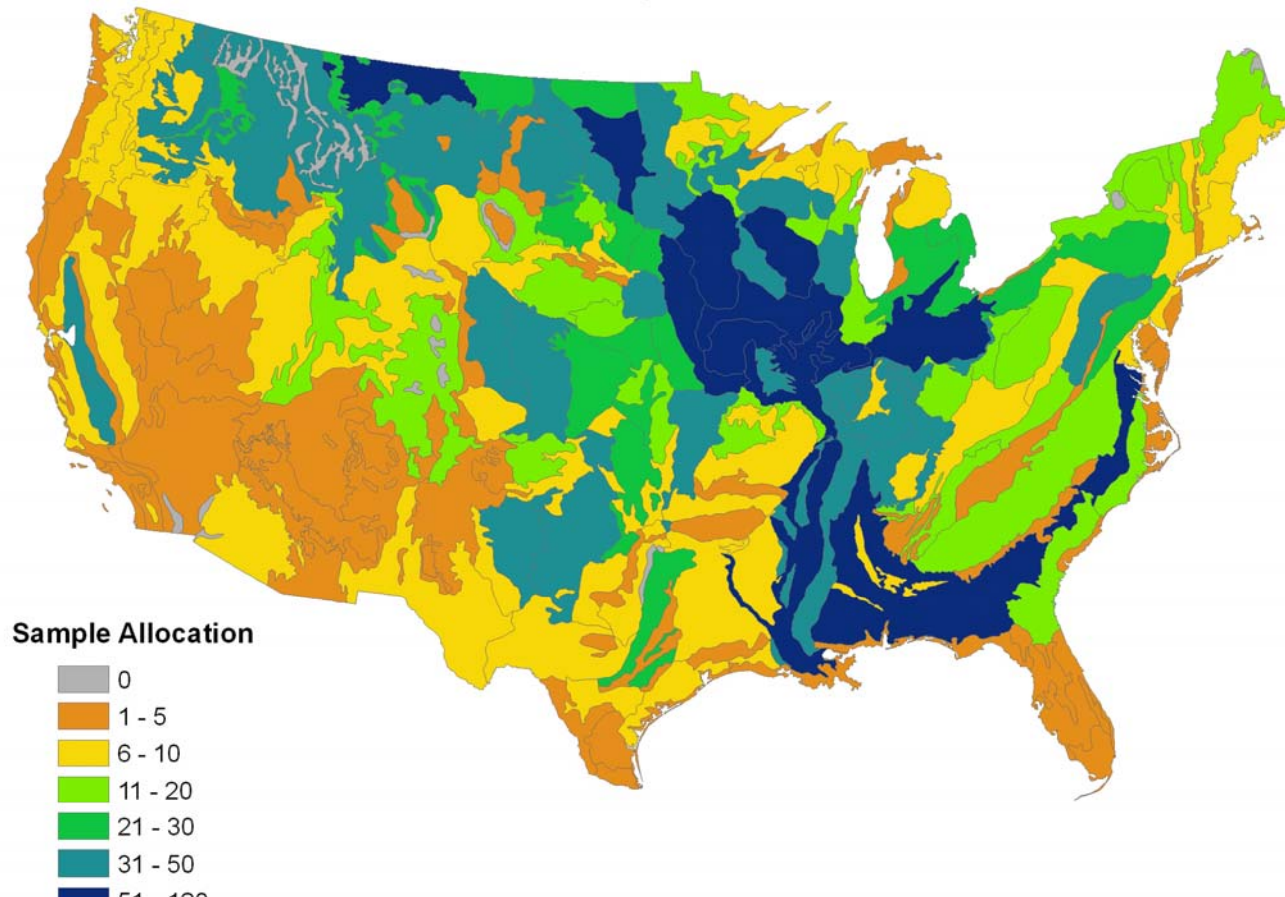
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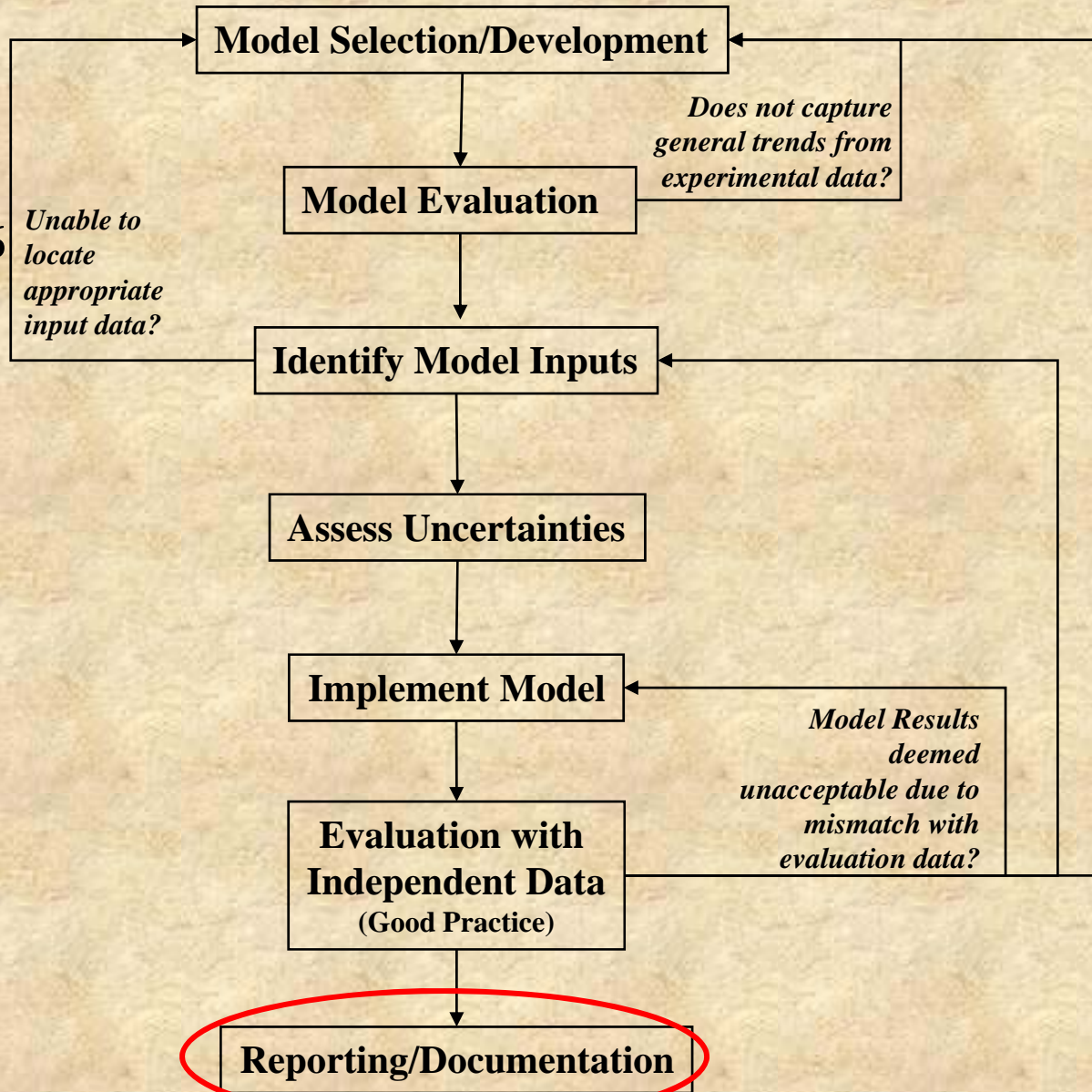
# Long-Term Monitoring Network (Proposed)

Neyman Allocation w/ Minimum 3 Samples Per Stratum

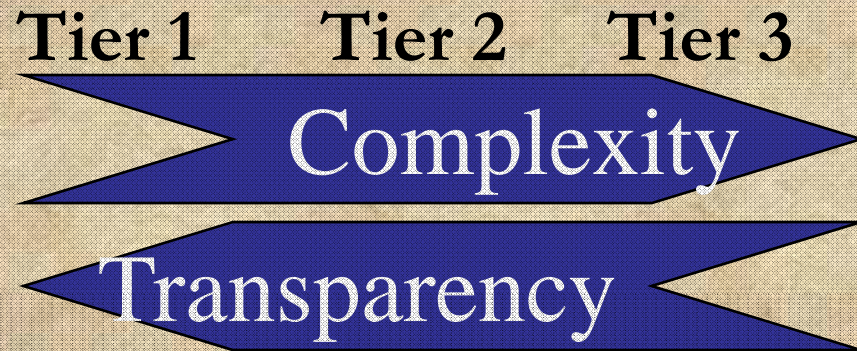
**Cropland**



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# Consideration for Reporting Tier 3 Inventory



Tier 3 more complex and can provide more accurate estimates of GHG emissions!

However, National Inventory Report (NIR) must provide transparent explanation of inventory methods, which is a challenge for Tier 3!

# Thanks for your attention!

