Introduction to Ecological Intensification and the Global Maize Project of IPNI

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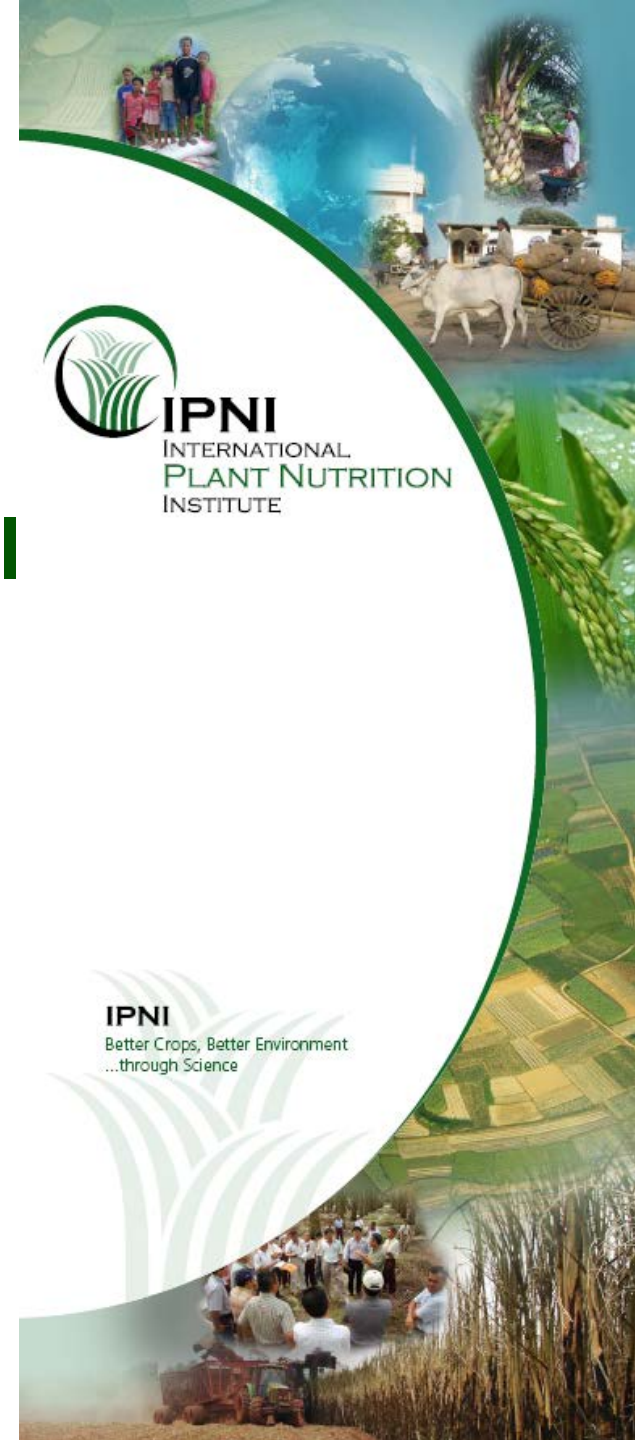

Ecological Intensification (EI) and Potential Yield

- Ecological Intensification
  - "...a production system that satisfies the anticipated increase in food demand while meeting acceptable standards for environmental quality." (Cassman, 1999)
- Potential Yield
  - "…the maximum yield that could be reached by a crop in given environments" (Evans and Fisher, 1999)

Cassman, K.G. 1999. Proc. Natl. Acad. Sci. 96:5952-5959; Evans and Fischer. 1999. Crop Sci. 39:1544

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Objectives of the Global Maize project

- Two Main Objectives of Global Maize:
  1. To use ecological intensification (EI) practices to improve yields over time at a faster rate than farmer practice while minimizing adverse environmental effects
  2. To test the ability of the *Hybrid Maize* simulation model to predict yield potential at individual maize locations
- This symposium will focus on progress at the various field sites in Latin America

A simple, globally consistent experimental design that compares ecological intensification (EI) to current farmer practice (FP)

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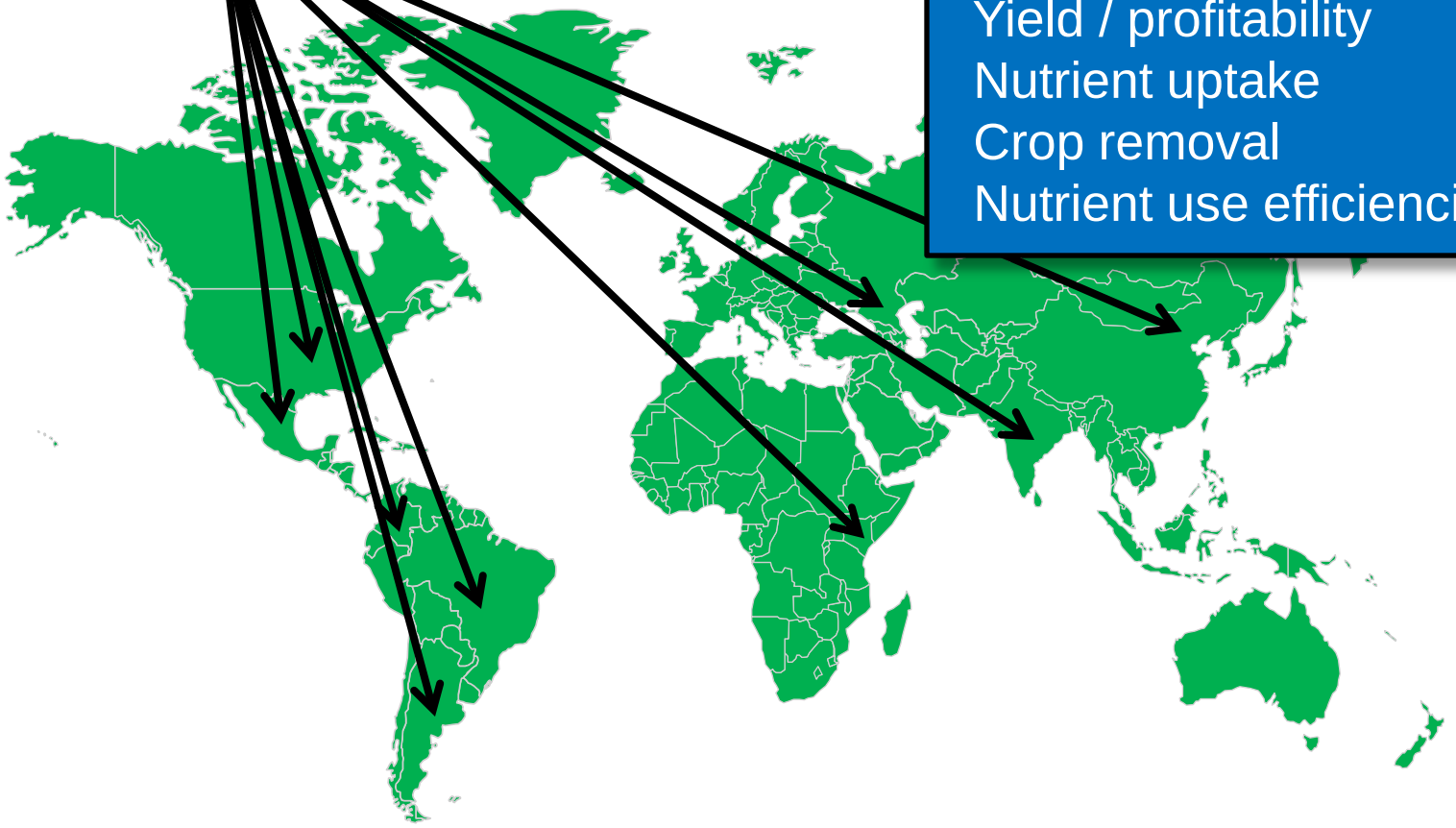
ANOVA

Factors:

- Location
- Replication
- Management practice
- Year

Dependent variables:

- Yield / profitability
- Nutrient uptake
- Crop removal
- Nutrient use efficiencies



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Basic Designs for Global Maize: A-Sites

Minimum Design

Block 1	Block 1	Block 2	Block 2
EI	FP	FP	EI

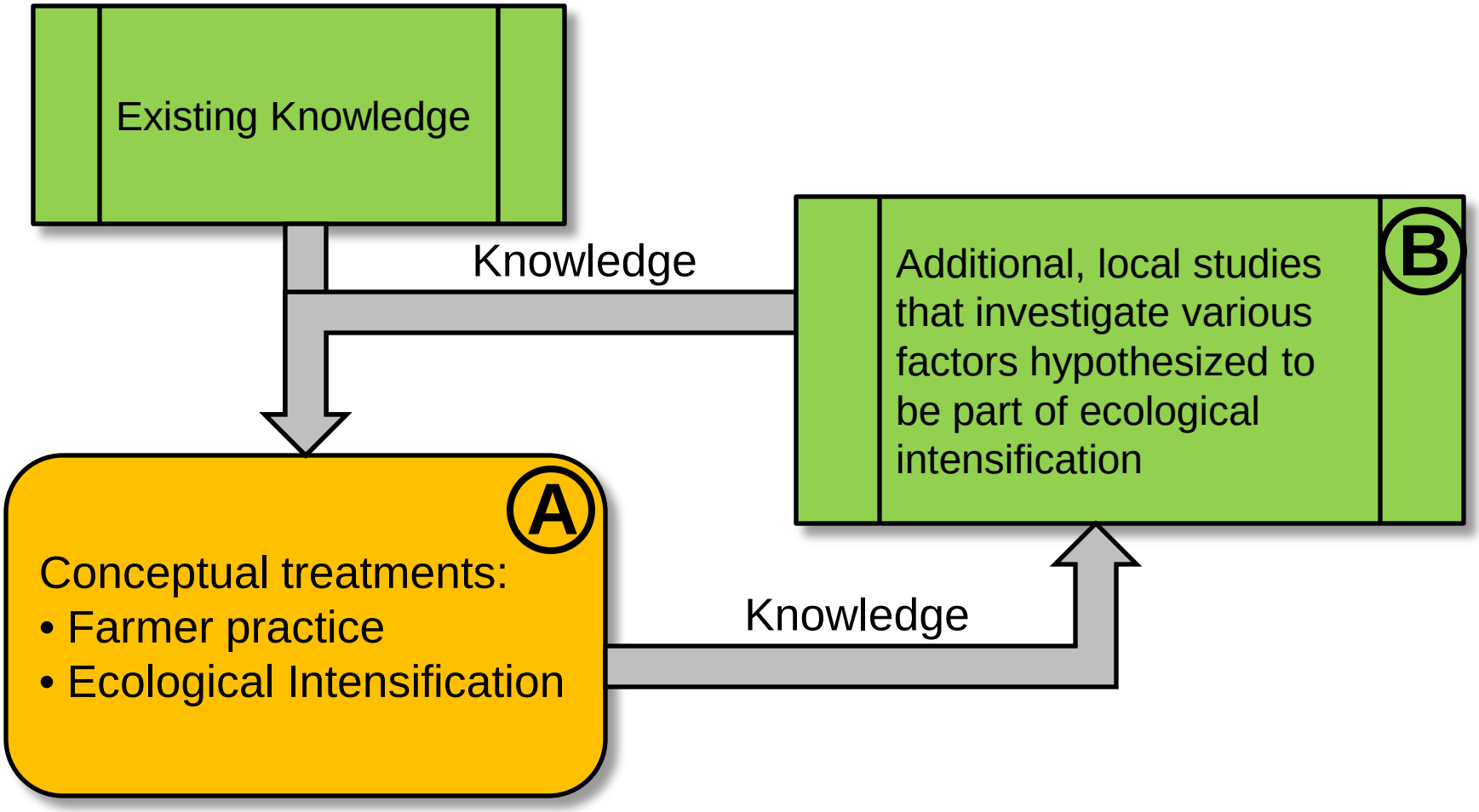
Block 3	Block 3	Block 4	Block 4
FP	EI	EI	FP

Minimum Design for N Use Efficiency

Block 1	Block 1	Block 1	Block 1	Block 2	Block 2	Block 2	Block 2
EI	EI	FP	FP	FP	FP	EI	EI
N	0	0	N	N	0	N	0

Block 3	Block 3	Block 3	Block 3	Block 4	Block 4	Block 4	Block 4
FP	FP	EI	EI	EI	EI	FP	FP
N	0	N	0	0	N	N	0

Defining Ecological Intensification Locally is Iterative



Global Maize A-Sites

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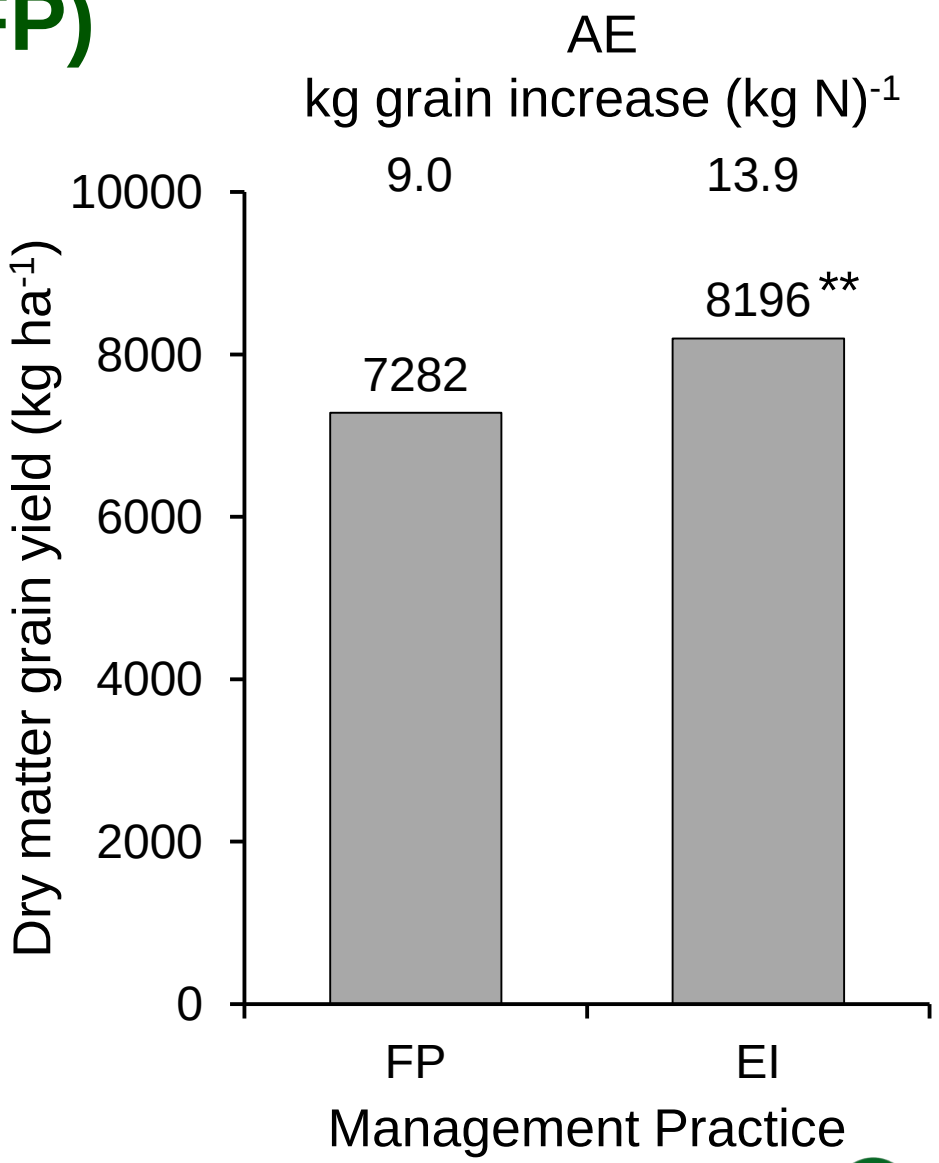
Analysis of Variance across Several Locations: First Maize Season

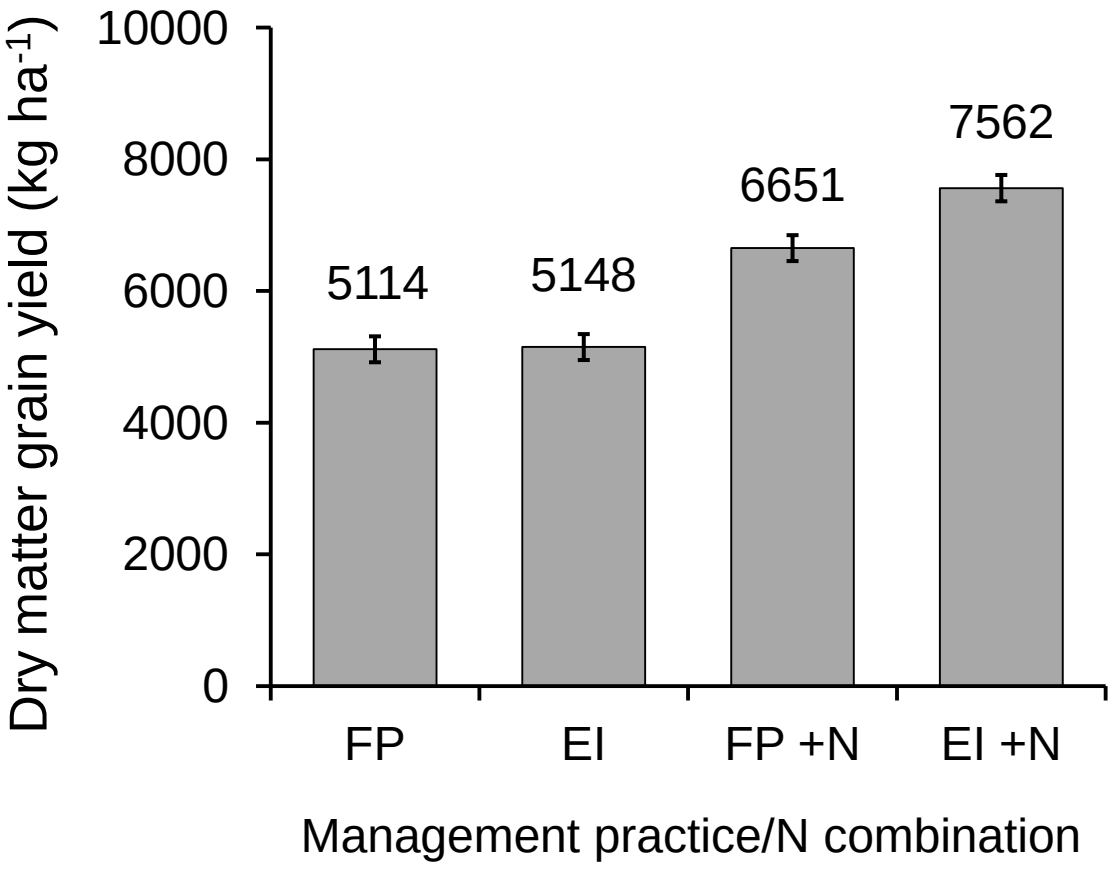
Comparing ecological intensification (EI) to farmer practice (FP)

- Sites had the data needed to determine both:
  - dry matter (DM) grain yield
  - agronomic efficiency (AE)
- 5 sites
  - Brazil (1)
  - China (2)
  - Colombia (1)
  - United States (1)



Examining the highly significant interaction of management practice and nitrogen

- Sites met criteria for experimental design and contained N rates at the split-plot level
- 6 Sites
  - Brazil (1)
  - China (2)
  - Colombia (1)
  - India (1)
  - United States (1)



Note: error bars are ± 1 std. dev.

Preliminary Findings

- Ecological Intensification (EI) practices significantly increase maize grain yield in the first growing season compared to current farmer practice (FP)
  - Applying known management improvements produced significant yield increases in the first maize season
  - Average yield improvement across all sites was 914 kg grain dry matter ha^{-1}
  - Increased yield was associated with a greater agronomic efficiency of nitrogen (N)
- The N rates selected in each location for the EI treatment produced a greater yield response than the N rates selected for current farmer practice

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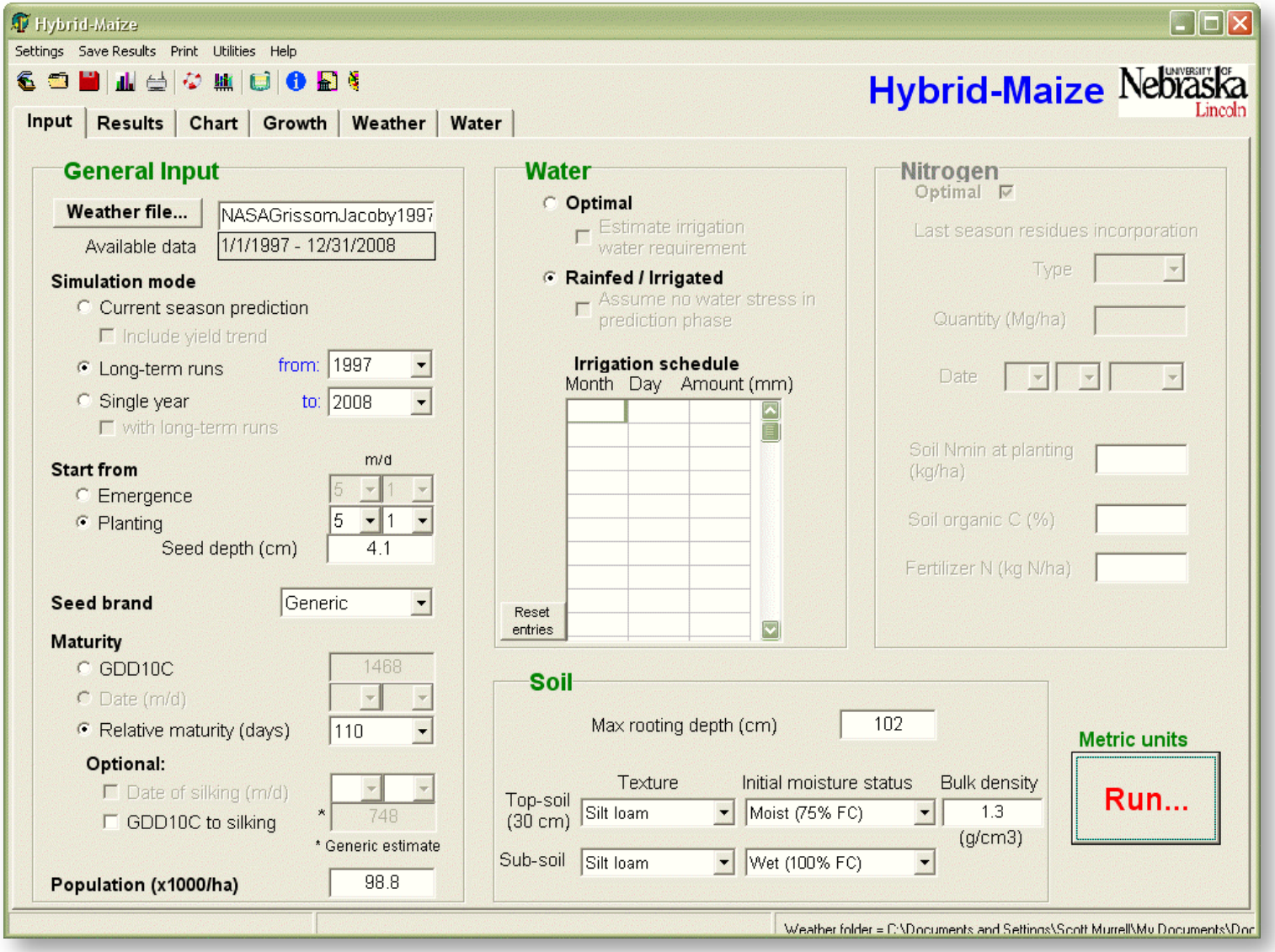
Estimating potential yield

Hybrid-Maize plant growth simulation software



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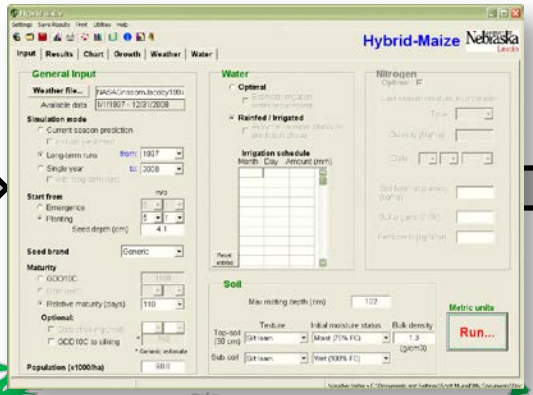
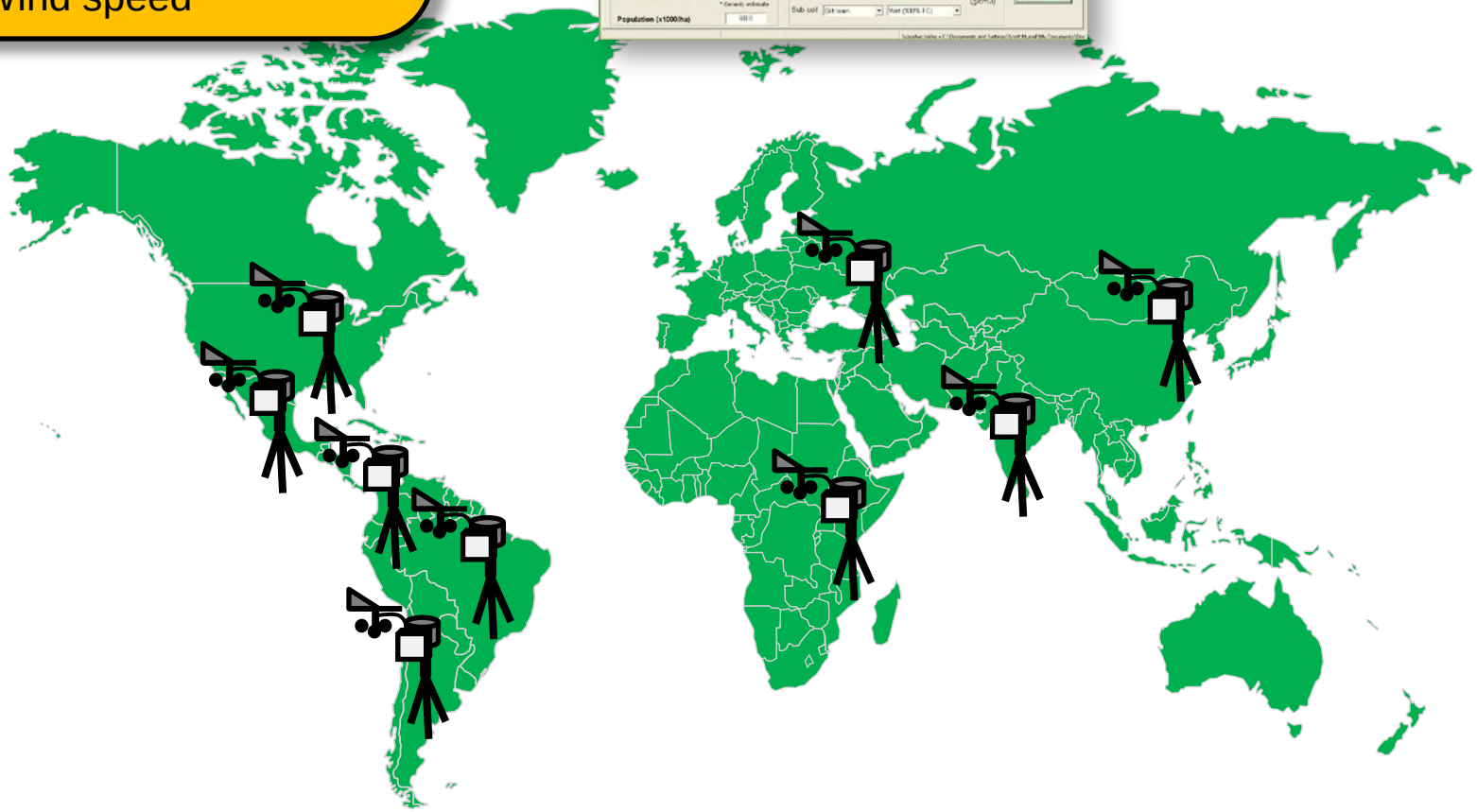
Hybrid Maize model

Daily weather data:
- Solar radiation
- Minimum temperature
- Maximum temperature
- Precipitation
- Relative humidity
- Wind speed



Yield potential
for each location



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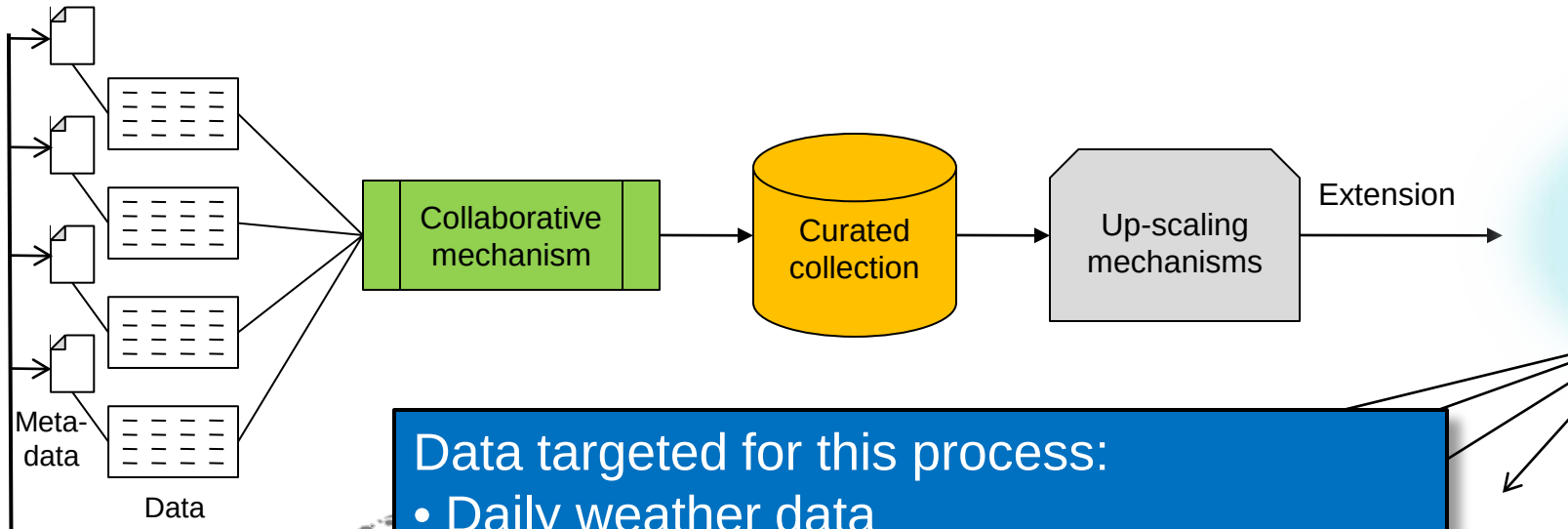
Spatial/temporal scale:

Discreet → Continuous → Discreet

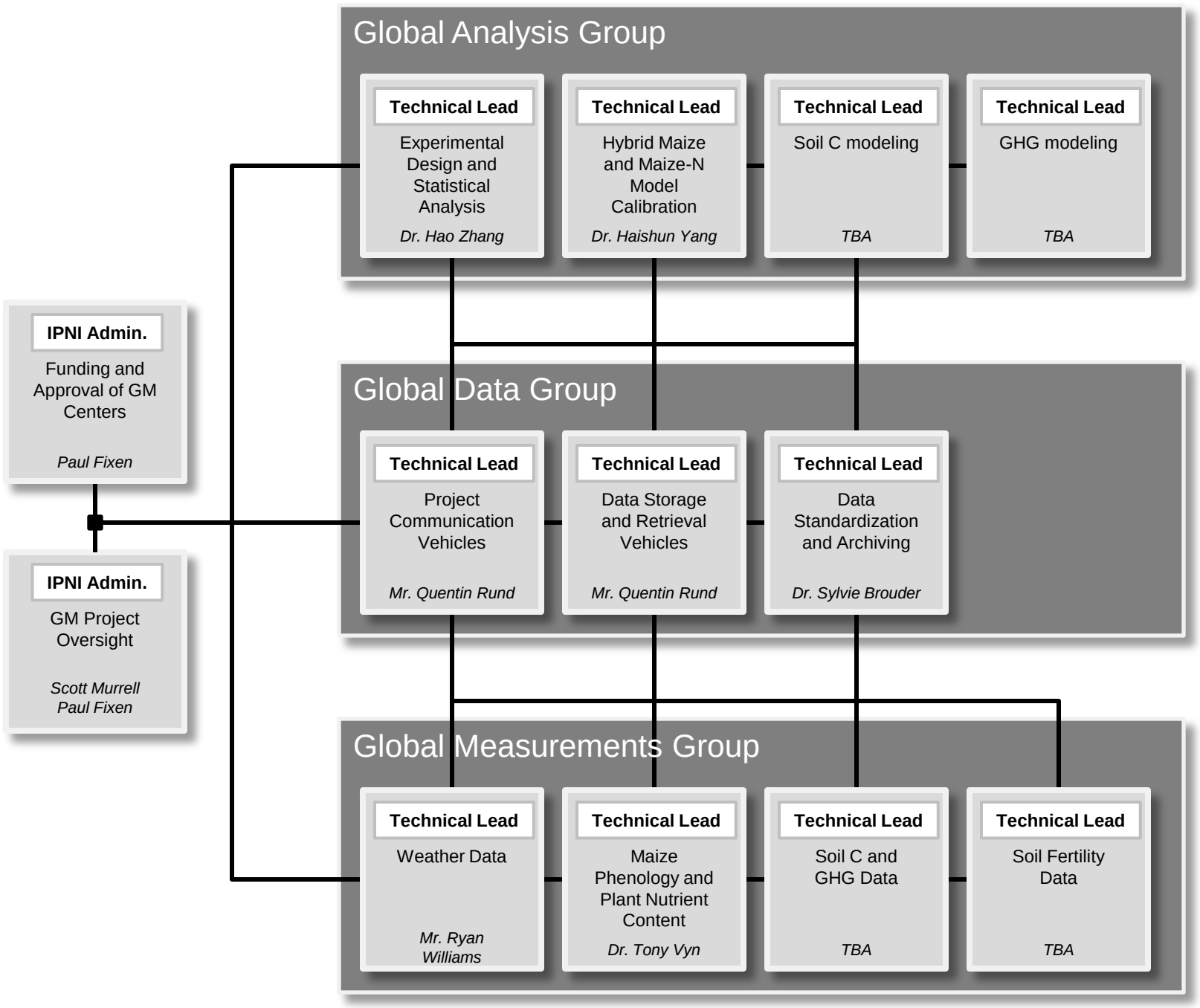


Data targeted for this process:

- Daily weather data
- Omission plot studies
- EI vs. FP studies going into global ANOVA

Up-scaling mechanisms:

- Hybrid Maize growth simulation model
- QUEFTS
- Delta-yield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Summary

- Approaches to using data from the Global Maize project:
  - ANOVA across years and locations
  - Input into Hybrid Maize to define local yield potential
  - Repository of yield gaps around the world (with metadata)
- Approaches for treatments
  - For global ANOVA, management treatments are defined locally
  - Ancillary studies that further define EI are local
- Challenges
  - Adopting common protocols and ensuring data quality
  - Adopting a common experimental design for global ANOVA

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