

# AgMIP and the role of model ensembles in modeling

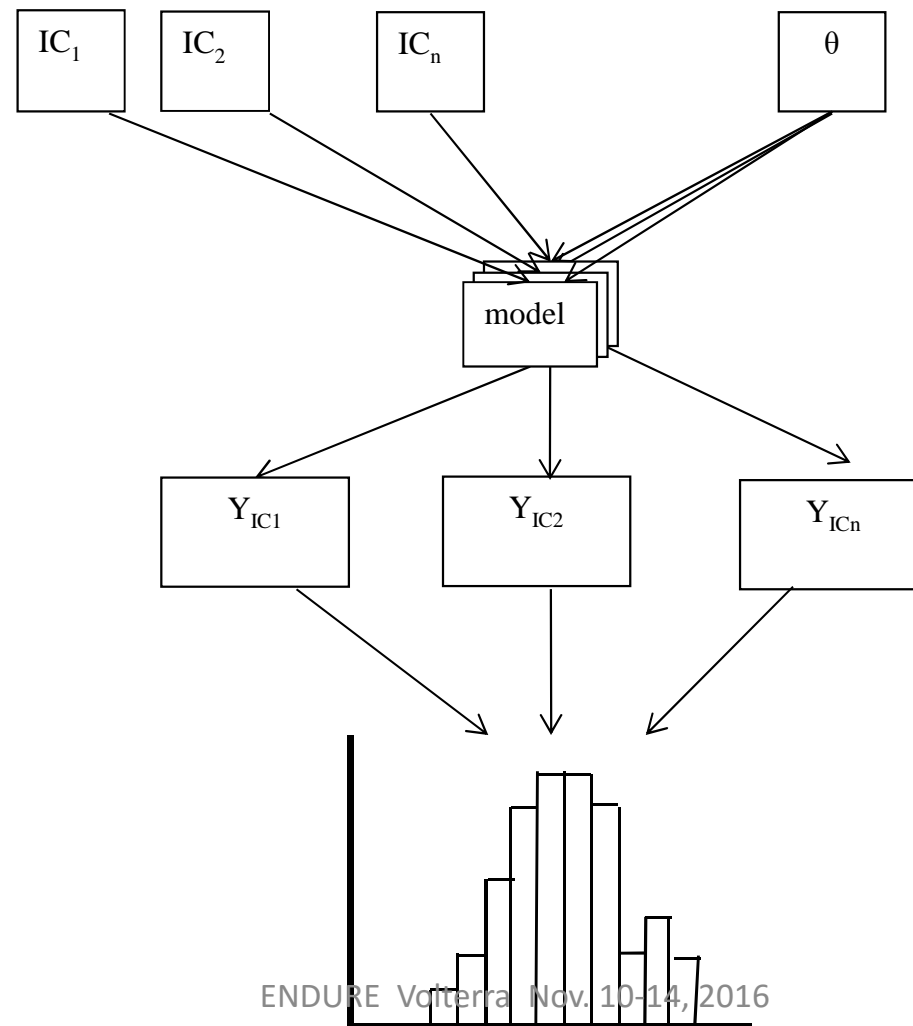
# What is a model ensemble?

- Several different models used to simulate for the same situation
  - Different models that represent uncertainty (we don't know true model)

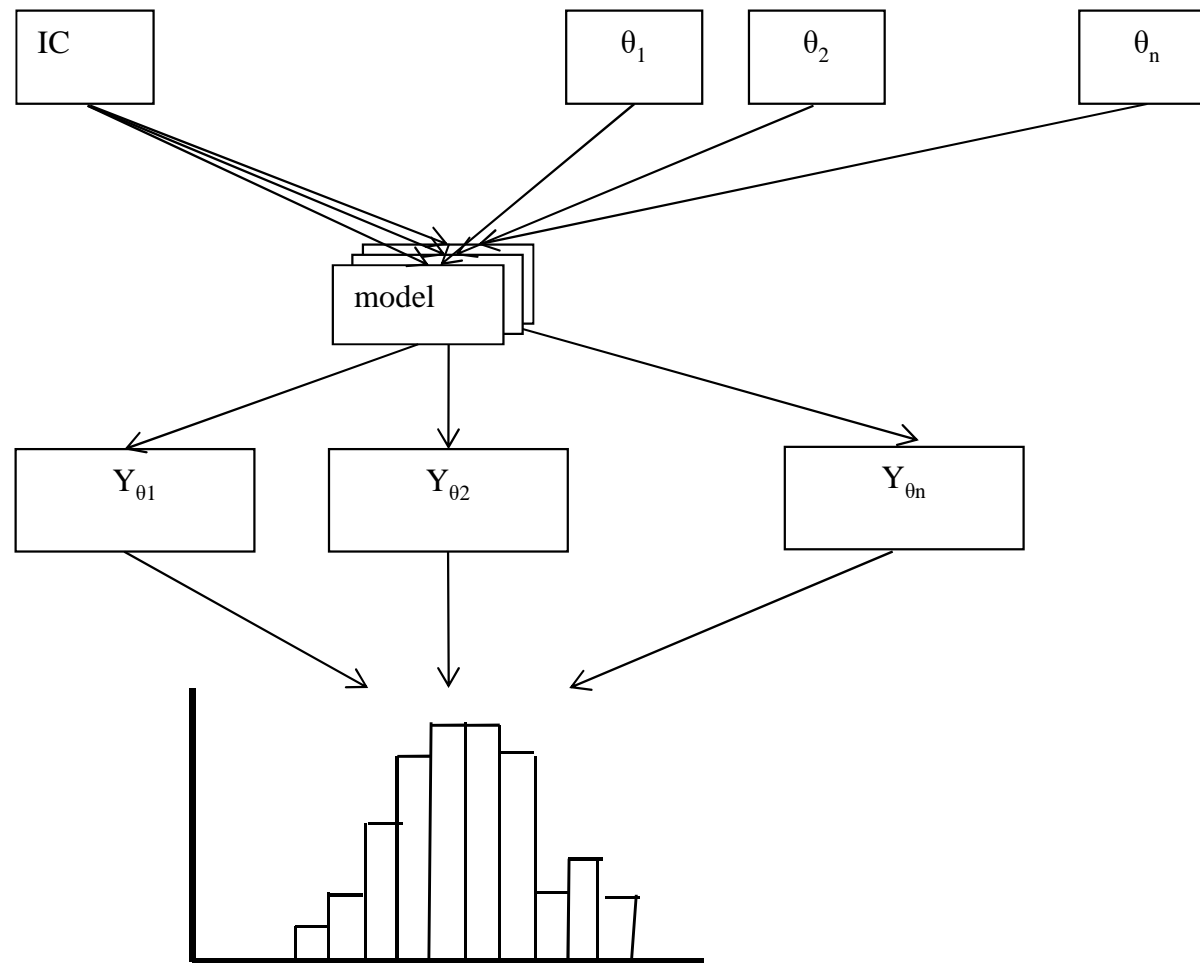
There are single model ensembles

Same model structure

Multiple estimates of uncertain inputs (e.g. initial conditions)

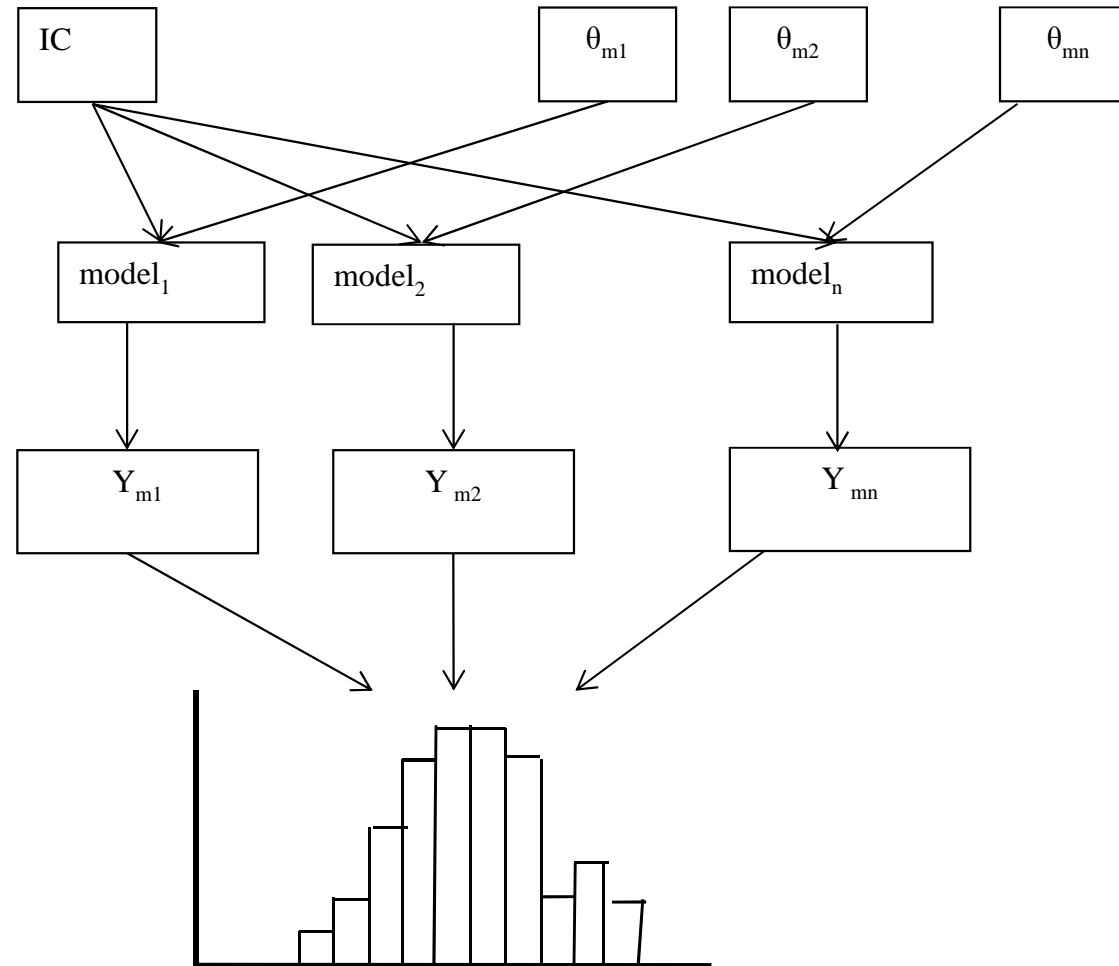


There are single model ensembles  
Same model structure  
Multiple estimates of parameters



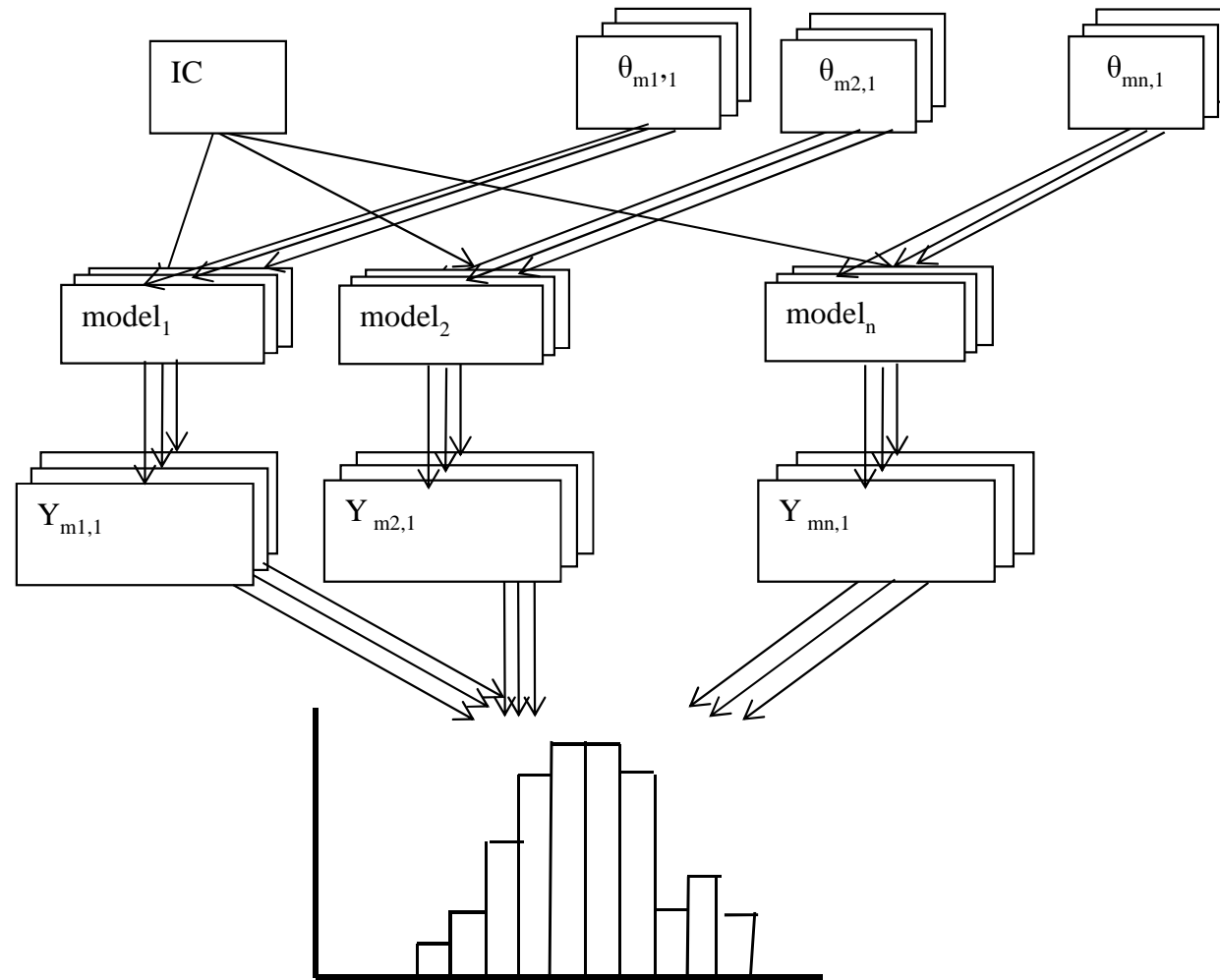
# There are multi-model ensembles

## Different model structures



# There are super-ensembles

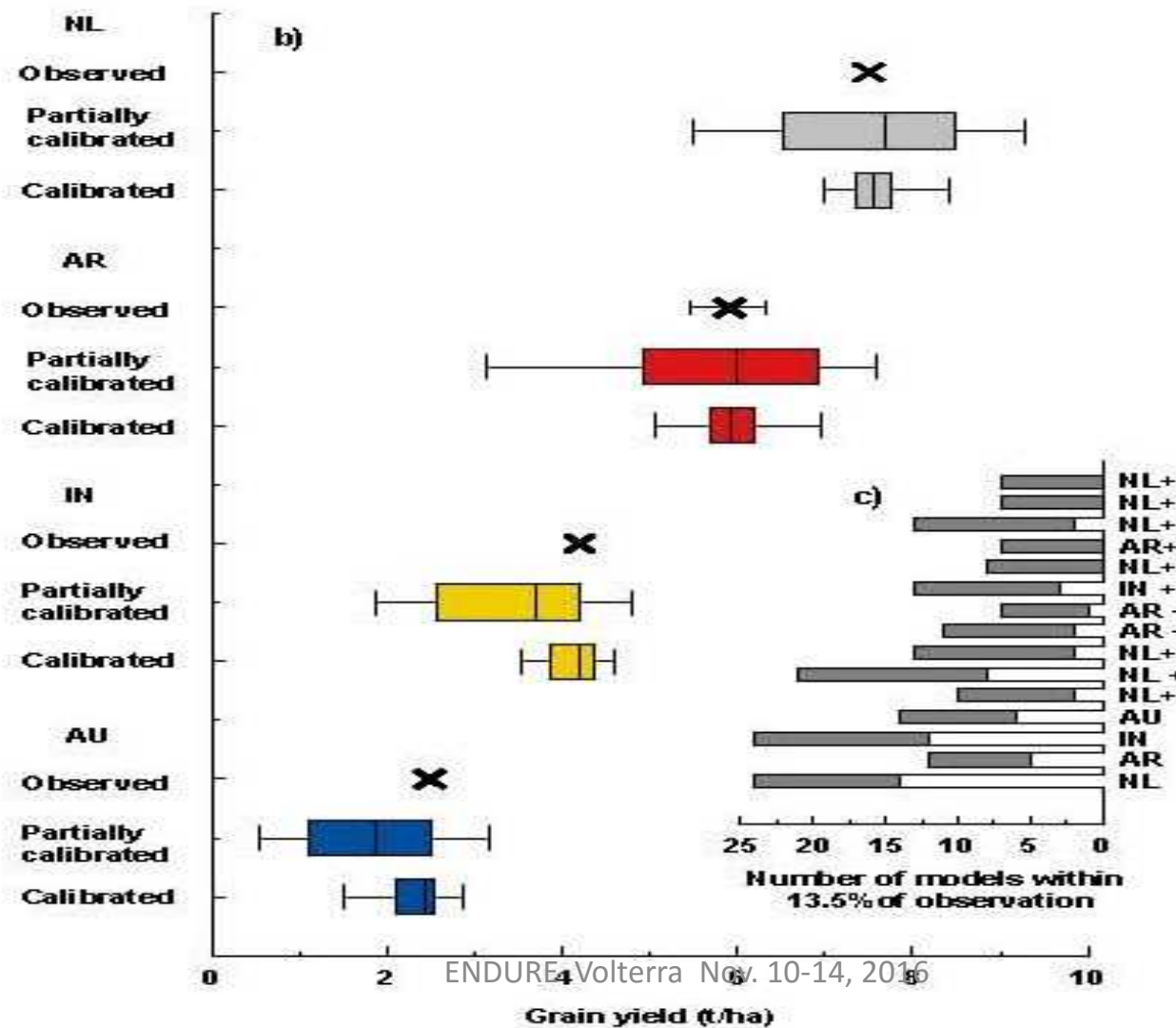
## Combine more than one type of ensemble



# Why use model ensembles?

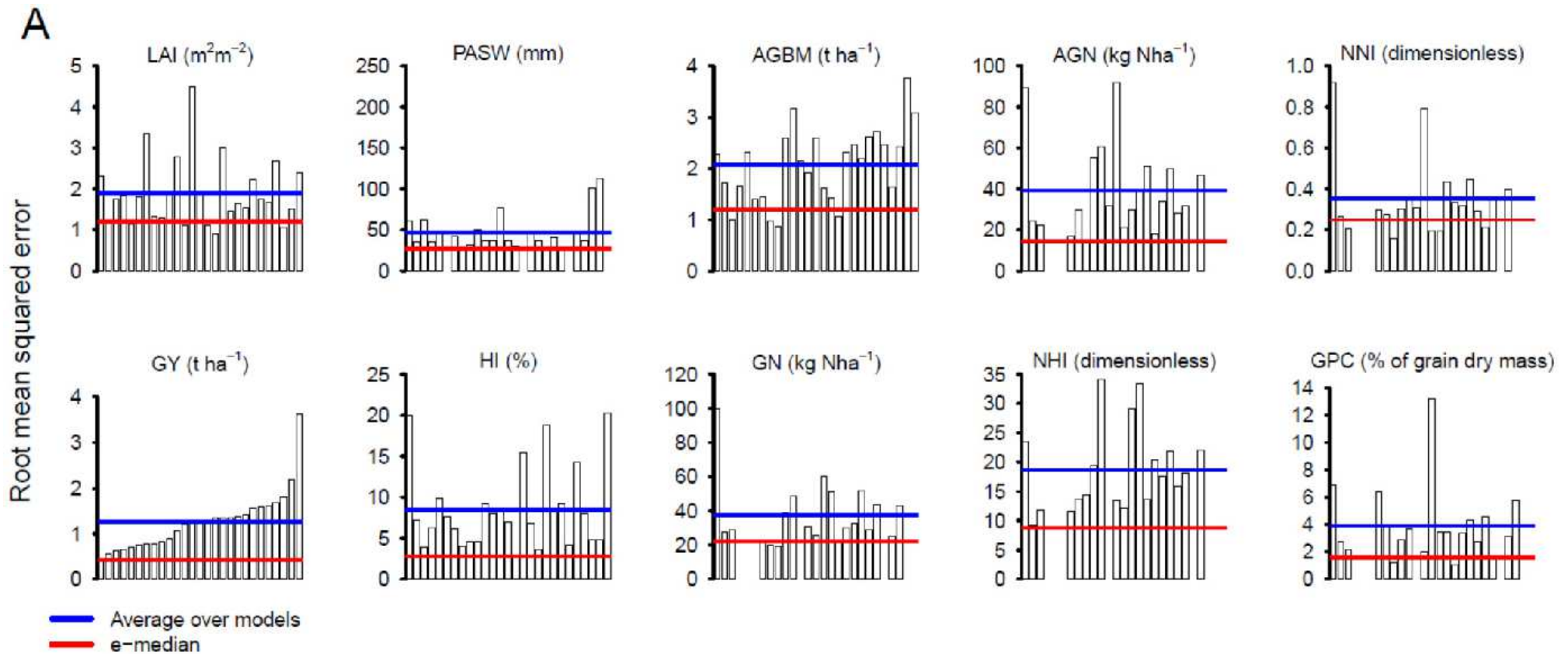
- Uncertainty
  - Usually, there is uncertainty as to model equations, parameter values, inputs
  - An ensemble samples from the uncertainty, translates it into output uncertainty
  - That gives new insights into uncertainty
- Better predictions
  - An average over the ensemble is often a better predictor than a single simulation
- Model improvement
  - Multi-model ensembles improve collaboration

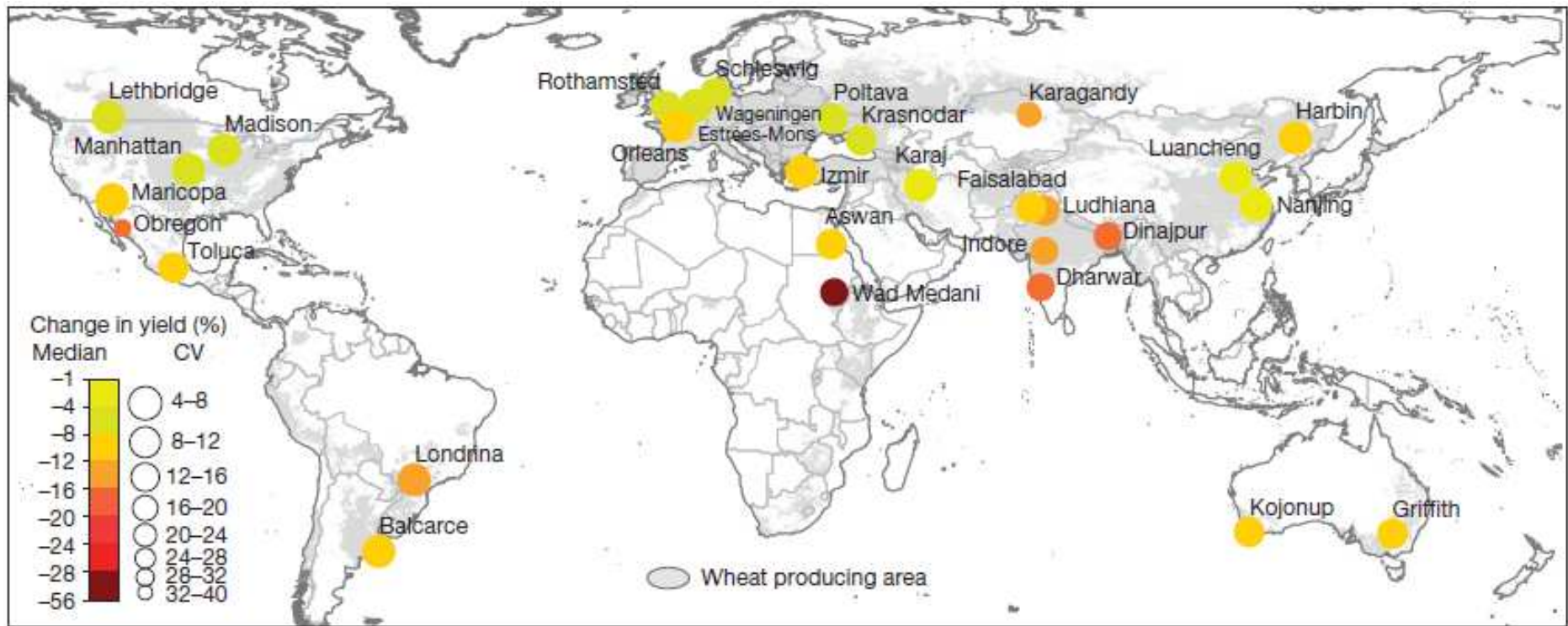
- Multi-model ensemble: 27 wheat models
  - There are many wheat models
  - There is large variability in results
  - The median of models is a good predictor





The median of simulated values is always quite good.  
 On average over all outputs, it is better than best individual model





- Effect of +2°C on world wheat production
- Median of 30 wheat models

- There are many multi crop model studies published and underway
- More recently, multi pest model simulations have begun
- This will be important in future modeling
  - Multi-models in applications
  - Methodology of using multi-model ensembles

# And AgMIP?

# AgMIP The Agricultural Modeling Intercomparison and Improvement Project



RESEARCH PROGRAM ON  
Climate Change,  
Agriculture and  
Food Security



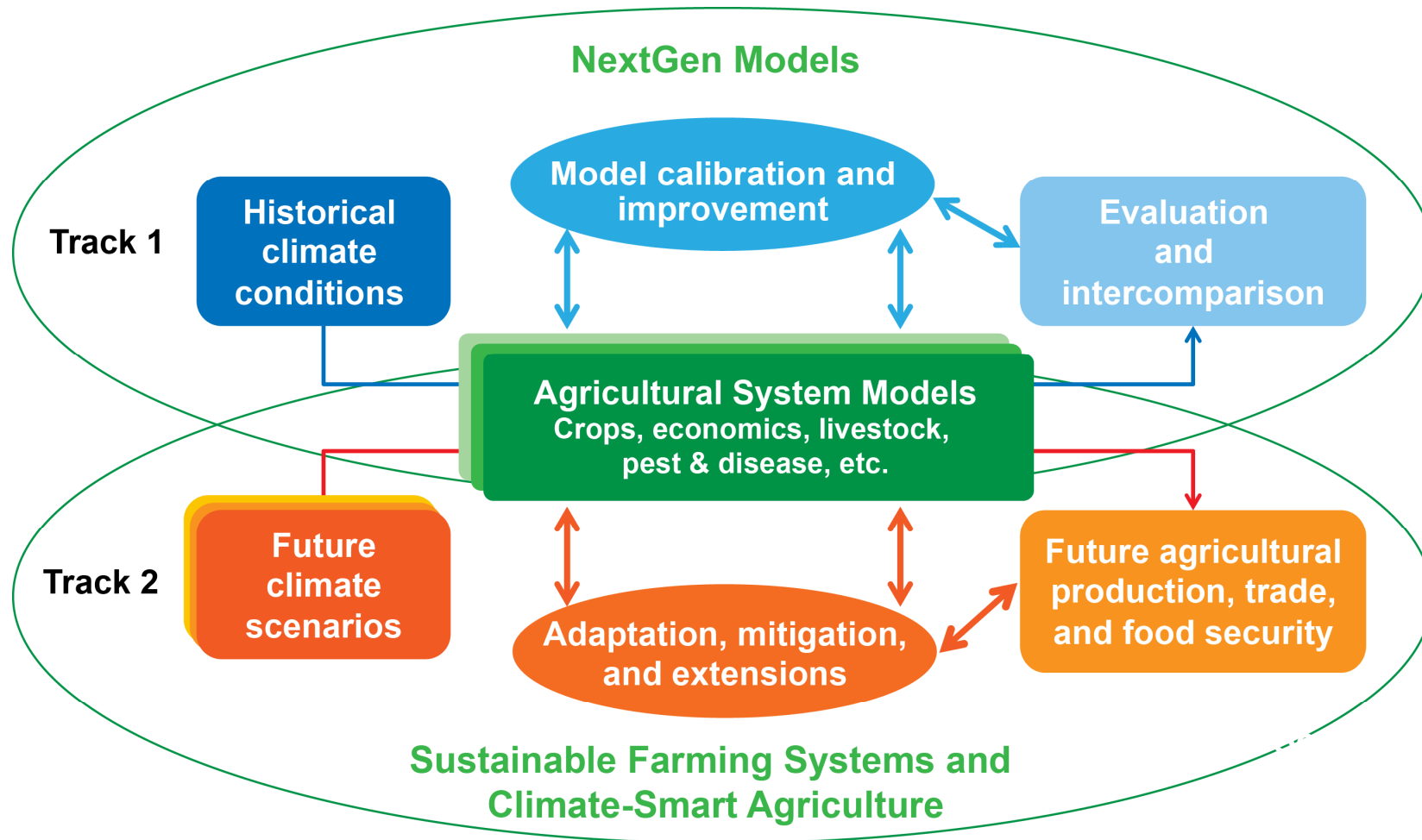
- First int'l program on crop model intercomparison
  - Began in 2011
  - Similar to CMIP (climate model intercomparison project, started 1995)

Provide effective science-based **agricultural** decision-making **models** and assessments of **climate variability and change** and sustainable farming systems to achieve local-to-global food security



Near Arusha, Tanzania

# Two-track approach



**Track 1:** Develop/Test NextGen Agricultural Systems Models

**Track 2:** Conduct Multi-Model Assessments for Sustainable Farming

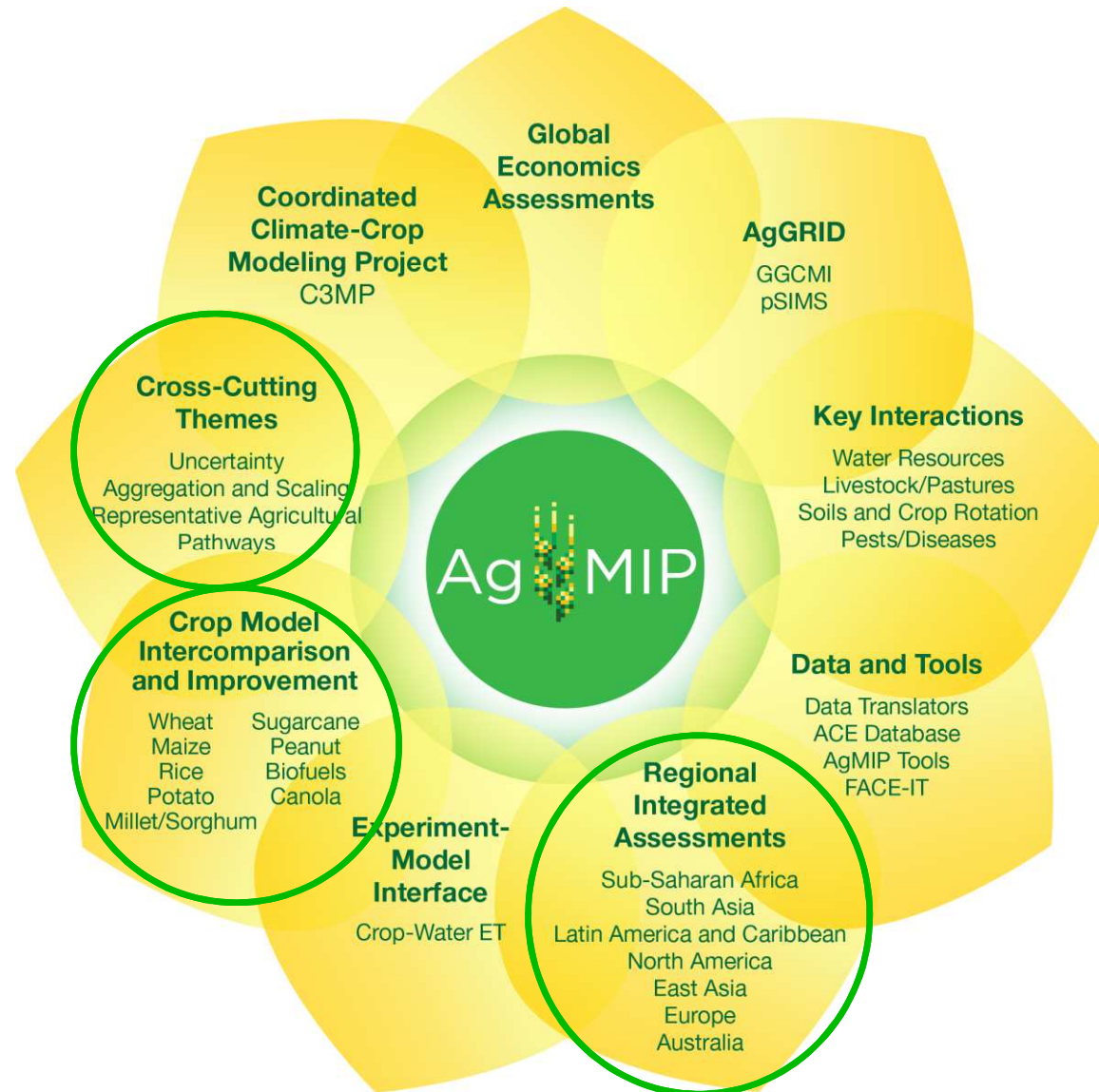
Systems and Climate-Smart Agriculture

ENR 100 Vol 10 No 11 Nov. 10-14, 2016

Rosenzweig et al., 2013 AgForMet



# AgMIP activities



# Specificity of AgMIP

- Organization
  - Voluntary
    - Not centrally funded
  - Open to all (modelers and others)
    - Participate or propose new initiatives
    - 200+ participants at last global workshop

- Cross disciplinary
  - Crop modeling
    - The heart of AgMIP
  - Climate modeling
    - Expertise on climate scenarios
  - Economic modeling
    - For impact assessment in terms of livelihood
    - Raps (representative agricultural pathways)
    - Comparison of economic models
  - Pest and disease modeling
  - Computer science
    - Input translators
    - Data bases (for data, for results)
  - Result: state of the art for all aspects

- Multiple scales
  - Field scale (impact of CC on growth and production)
  - Regional scale (impact of CC on livelihoods)
  - National and global scale (impact of CC on food security)

- Emphasis on data
  - Temperature gradient data
    - To test models for extreme temperatures
  - FACE data
    - To test models for augmented CO<sub>2</sub>
  - New data journal
    - To permit publication of data

# AgMIP received 2015 ASA Presidential Award

- For the AgMIP PIs
  - Cynthia Rosenzweig, Jim Jones, John Antle, Jerry Hatfield
- For major, long lasting impact.
- Specifically
  - AgMIP has dramatically increased the coordination, transparency, and scientific rigor of agronomic modeling to address the pressing challenges of global change.

# The END