

Contribution of Crop Modeling to Current Global Challenges

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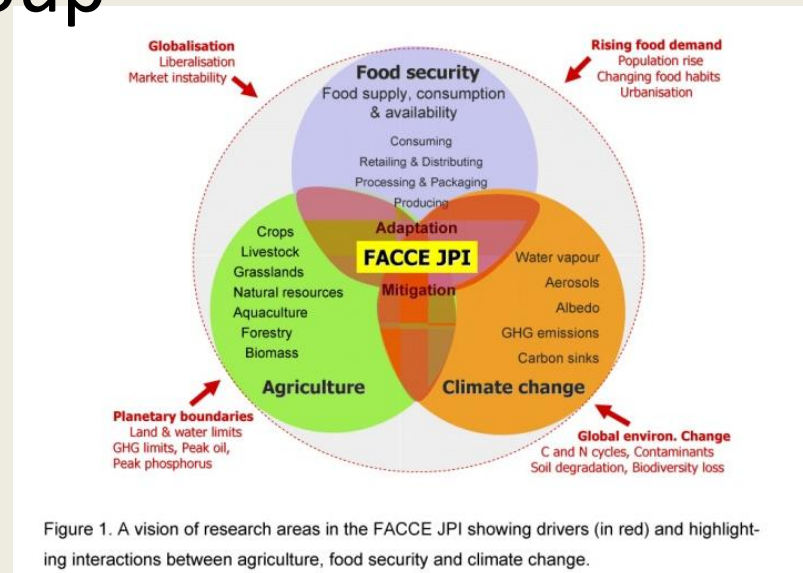
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John R Porter

European and Global Initiatives

- Crop Modeler
- IPCC (International Panel on Climate Change)
- AgMIP Steering Group
- MACSUR/CROPM



From: Porter, JR, JF Soussana, E Fereres, S Long, F Mohren, P Peltonen-Sainio, J von Braun. A European agronomic science plan for food security. (Manuscript In progress).²

John's First Introduction to Nadine

- John first met Nadine in the mid 1980s when she was a PhD student at INRA Avignon.
- She and John worked together on modeling leaf canopies, partly in connection with the AFRC model, the ground-breaking wheat model that John developed.
- They shared a PhD student
- Their kids were about the same age
- “She was a very bright person who had a lot of drive and energy as seen with her establishment of the STICS model”



My First Introduction to Nadine

- I met her in 1989 when I was working with Christian Gary in Avignon on tomato crop modeling
- Nadine worked with the SOYGRO model that Ken Boote and I developed at the University of Florida
- She was so enthusiastic and full of new ideas about how to improve crop models, leading her and others to develop the STICS model
- This model became widely used in France and widely known and respected globally



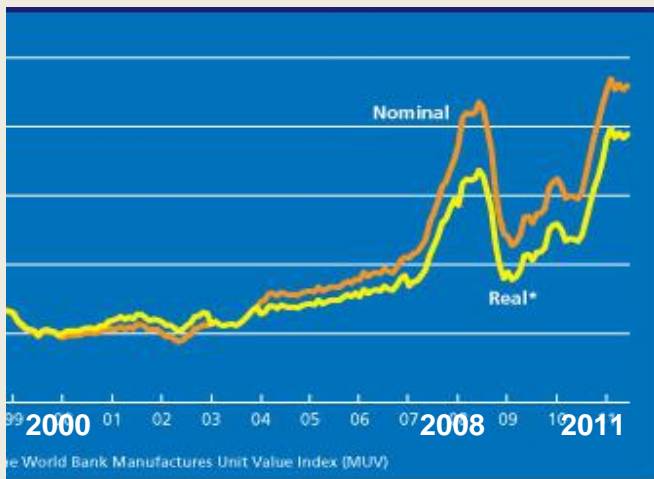
Jim's First Introduction to Nadine



Broad Societal Challenges:

Food Security, Energy Security, Sustainability

- Rising Demand for Grain (Now and Future Projections)
- Food and Energy Price Spikes
- Increased Water Scarcity
- Land Degradation
- Poverty
- Competition for Arable Land to Expand Production
- Weather Extremes – Drought, Heat Waves, Floods
- Climate Change, Current Trends and Projections

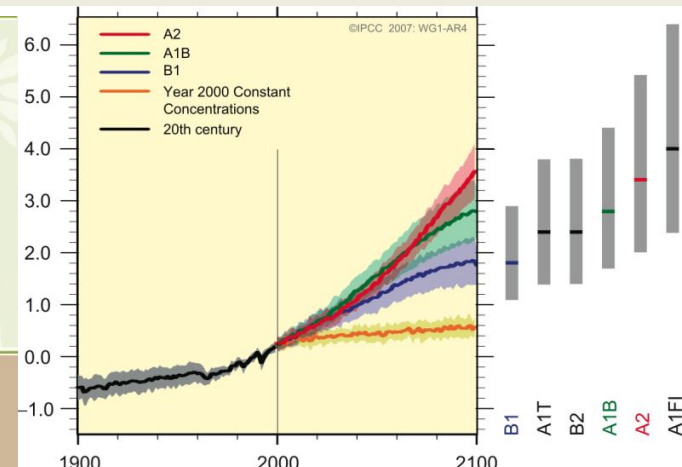


UNDERSTANDING VOLATILITY AND MANAGING RISKS

ARD Days 2011

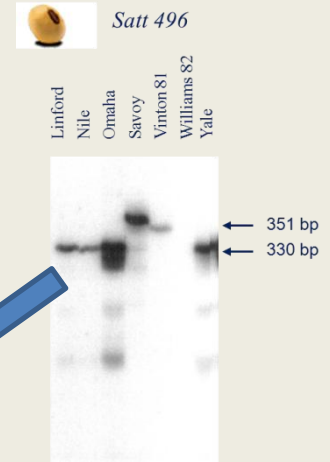
THE WORLD BANK

ARD
AGRICULTURE AND RURAL DEVELOPMENT

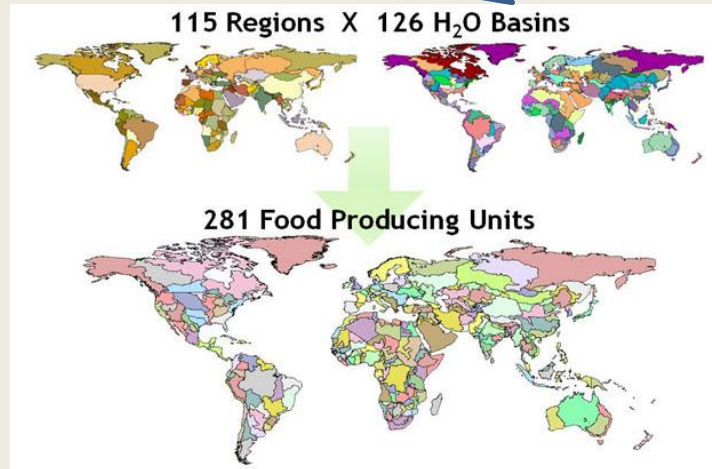


CROP Models: Applications Across Scales

- Microbial – molecular biology
- Field production
- Farming systems
- Watershed
- Region
- National
- Global



Crop Models



Microbial Scale: Using molecular markers to predict cultivar responses (Messina et al. 2006)



DNA Analysis

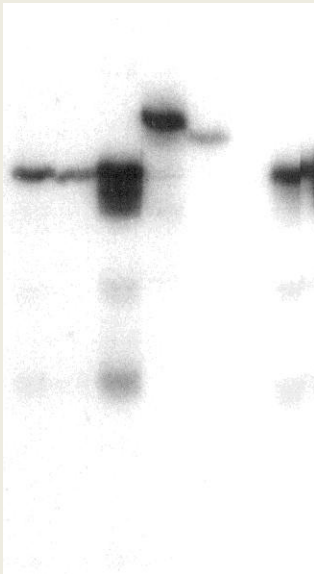


Predictions



Satt 496

Linford
Nile
Omaha
Savoy
Vinton 81
Williams 82
Yale

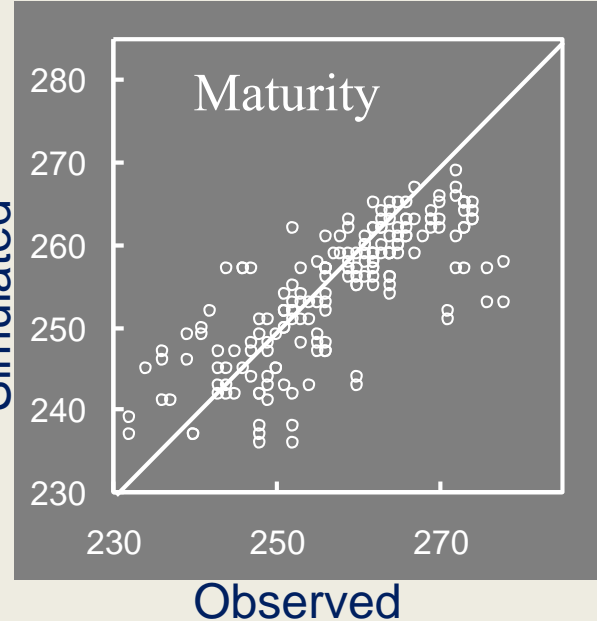


Planting dates
Row spacing
Irrigation

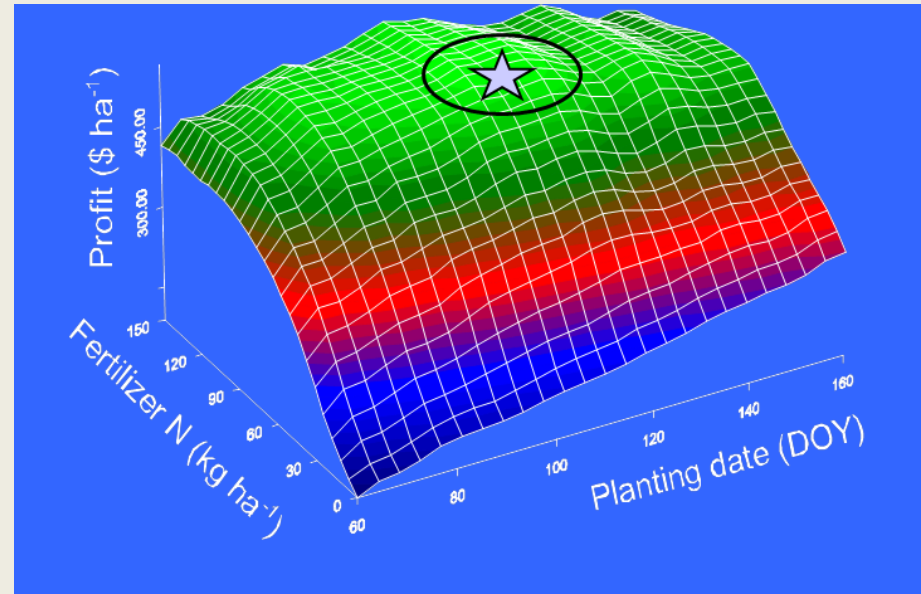
CROP
MODEL

Illinois, 7 Locations
5 years 1995-99

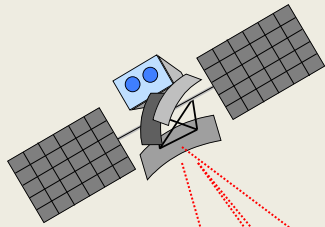
Simulated



Optimizing Field Management Practices

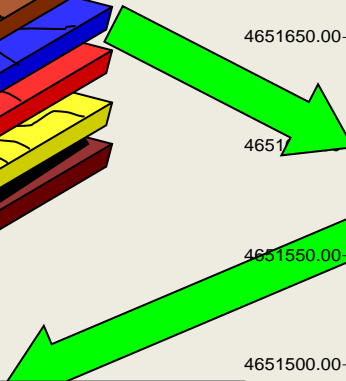
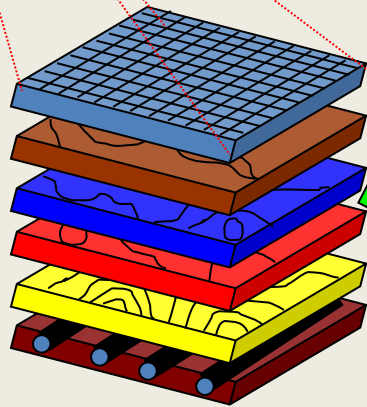


- Field Experiments
 - Measurements
 - Parameterize, & evaluate model
- Computer Experiments
 - Max Profit, Min N Leaching
{Planting date, Variety,
N Fertilizer, Irrigation, Density}

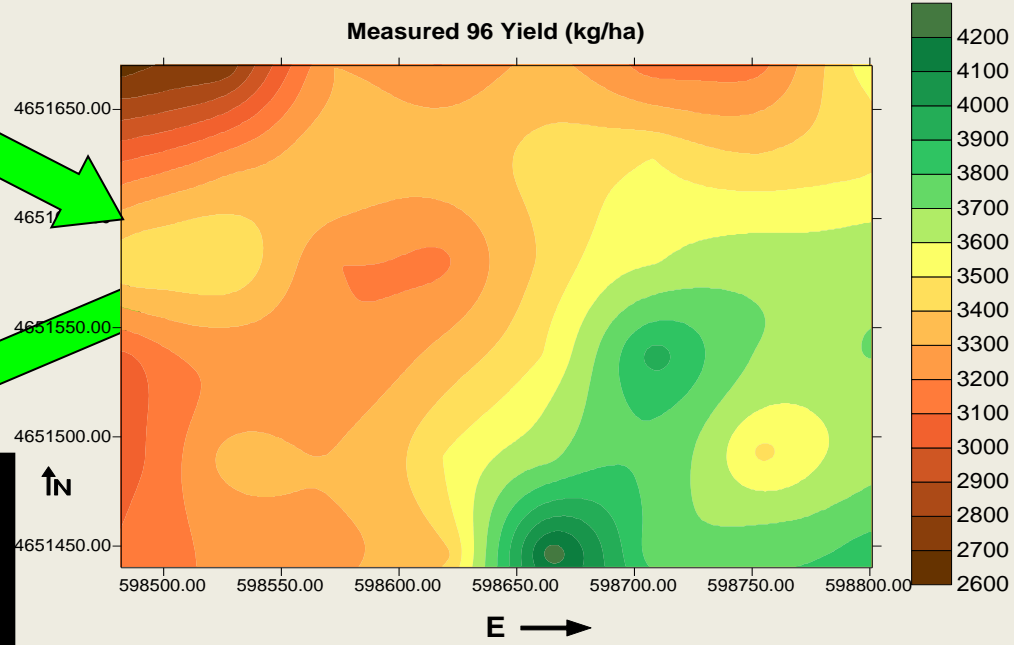


Crop Models & Precision Farming

- Yield
- Soil type
- Images
- Pests
- Elevation
- Drainage
- Fertility



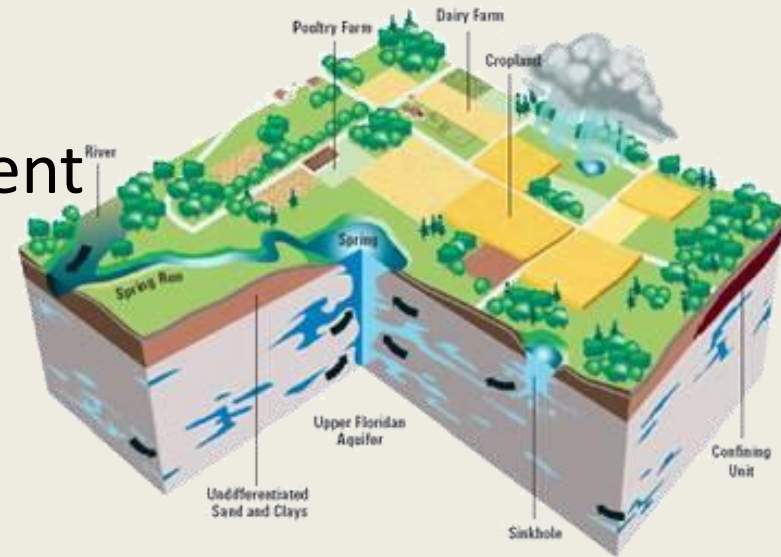
- Causes of Yield Variability
- Develop Prescriptions
- Risk Assessment
- Economics



W.D. Batchelor A. Irmak , et al.

Farm scale analysis of dairy farm management in North Florida

- Couple crop model & farm economic model
- Multiple objectives (economic and water quality)
- Climate variability risk assessment
- Profit, environmental goals

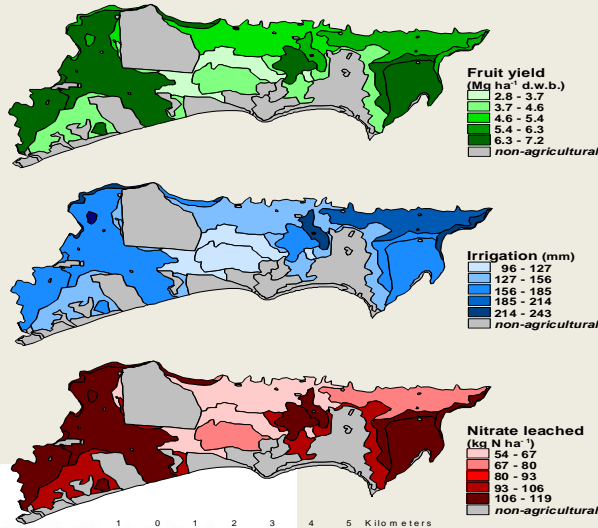


- Cabrera et al. 2005. Agr Ecosystems & Environment.

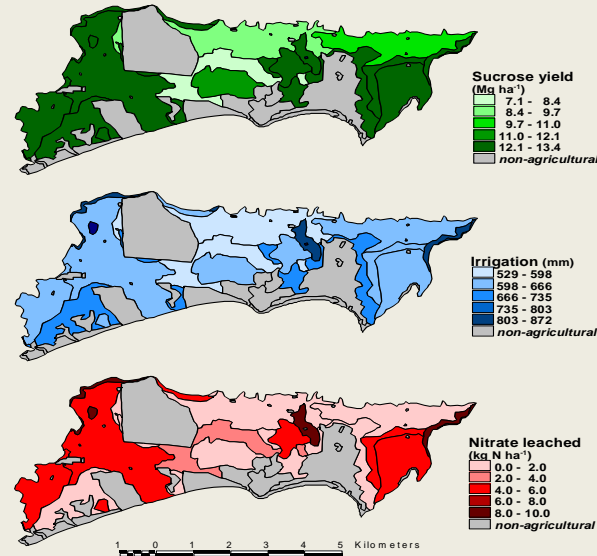
Assessment of Different Agricultural Uses of Land: Yield, Irrigation Requirements, N Leaching of Tomato vs. Sugarcane



Simulated tomato yields, irrigation requirements and nitrate leached



Simulated sugarcane yields, irrigation requirements and nitrate leached



Assessing Climate Change Impacts in France using Crop Models (STICS +)

by
N. Brisson and F.
Levrault

site-basis (13)
7 cropping systems plus forests
5 climate models
2-3 crop models



Nadine Brisson and Frédéric Levrault

THE GREEN BOOK

OF THE

CLIMATE
FOR

PROJECT

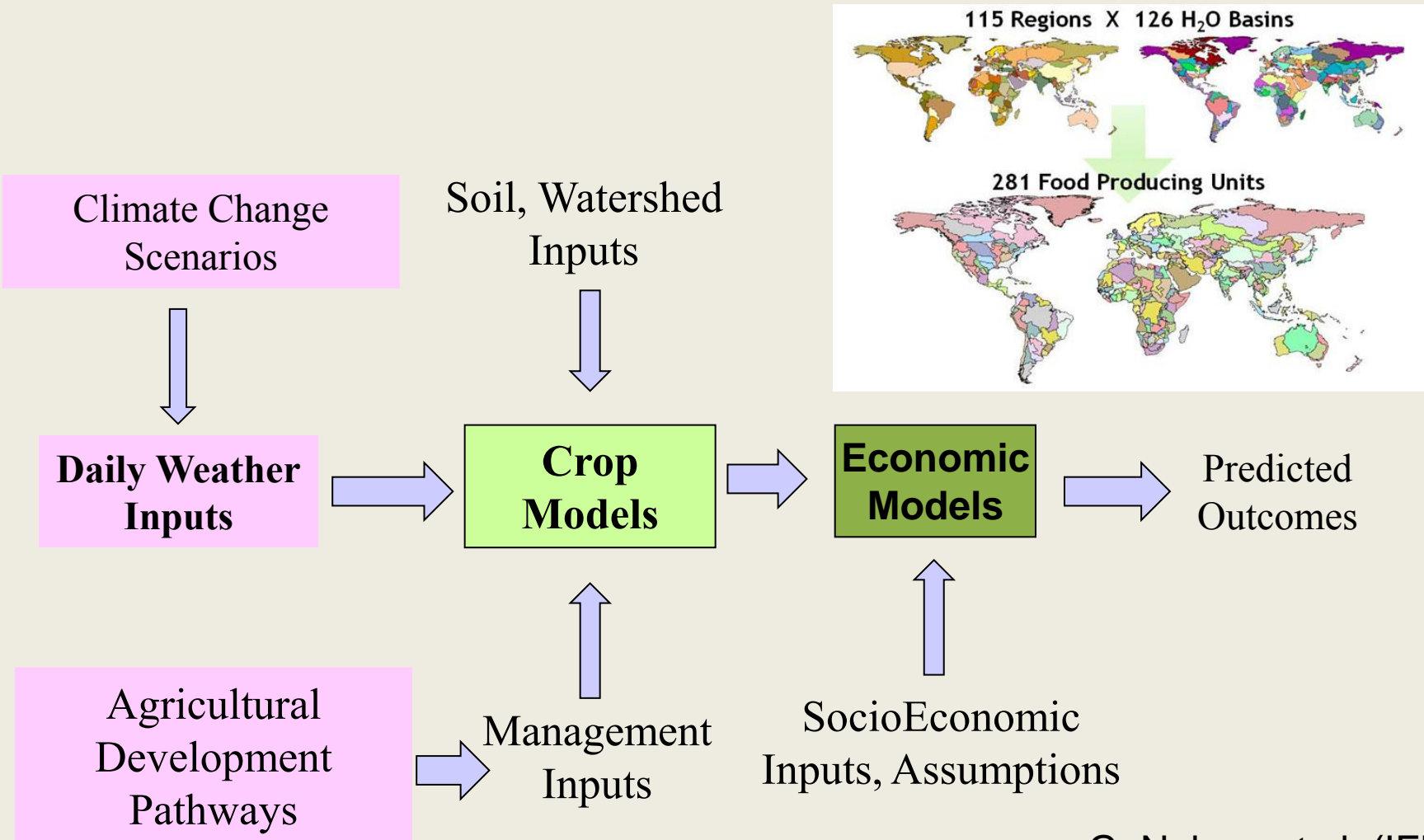
*Climate change, agriculture and forests in France:
simulations of the impacts on the main species*

2007-2010

ANR  NRA



Climate Change: Agricultural Impacts and Adaptation at Global Scale



AgMIP – Agricultural Model Intercomparison and Improvement Project

Cynthia Rosenzweig, James W. Jones, and Jerry Hatfield
NASA Goddard Institute for Space Studies, New York
University of Florida, Gainesville
USDA-ARS, Ames

Significantly advance scientific capabilities for addressing
complex Ag & food security issues, global and regional



AgMIP Global Workshop

October 10-12, 2012

Rome, Italy (FAO)

185 Attendees

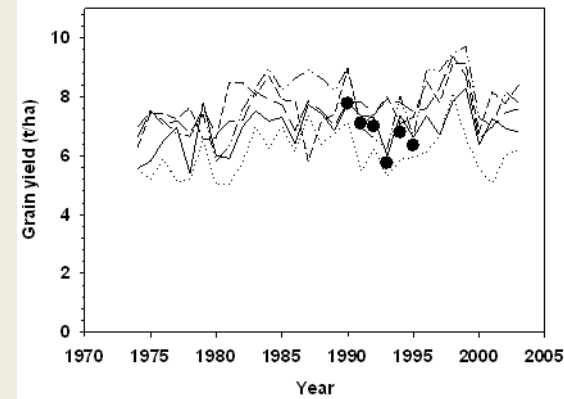
26 On-Going Activities



Current AgMIP Activities

Crop Model Pilots

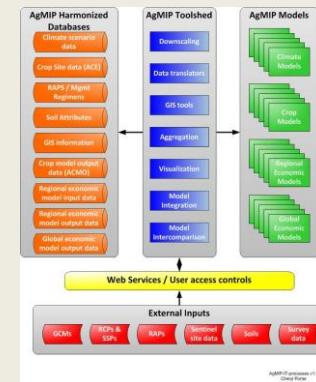
(Intercomparisons, Sensitivities)



- **Wheat Pilot (led by S. Asseng and F. Ewert)**
 - 27 wheat models , Phase I completed with papers in progress
- **Maize (led by N. Brisson*, Simona Bassu, Jean-Louis Durand)**
 - 14 models (?), nearly complete
- **Rice (led by B. Bouman, Tao Li, others)**
 - 13-14 rice models, nearly complete
- **Sugarcane (led by P. Thorburn, F. Marin, A. Singels)**
- **Sorghum, Potato, Soybean, Peanut are just starting**
- **Leaders – KPC Rao, R. Quiroz, K. Boote, P.Singh, respectively**

Current AgMIP Activities

Crop Model Improvement



- **Maize model improvement**
 - **Leaders – M.Tollenaar, S. Kumudini, K. Boote, J. Jones**
- **Model Improvement – work with experimentalists who have data on CO2, temperature, nitrogen, water responses**
 - **Leaders – J. Hatfield, K. Boote, ... First workshop held in Ames, Iowa - US, Sep 2012**
- **AgMIP Crop Experiment (ACE) database and interfaces for multiple crop models (DSSAT, APSIM, STICS completed)**
 - **Led by C. Porter, S. Janssen, C. Villalobos**
- **AgMIP Crop Model Output(ACMO) database for input to economic models and analysis/visualization**
 - **Led by C. Porter, S. Janssen, C. Villalobos**

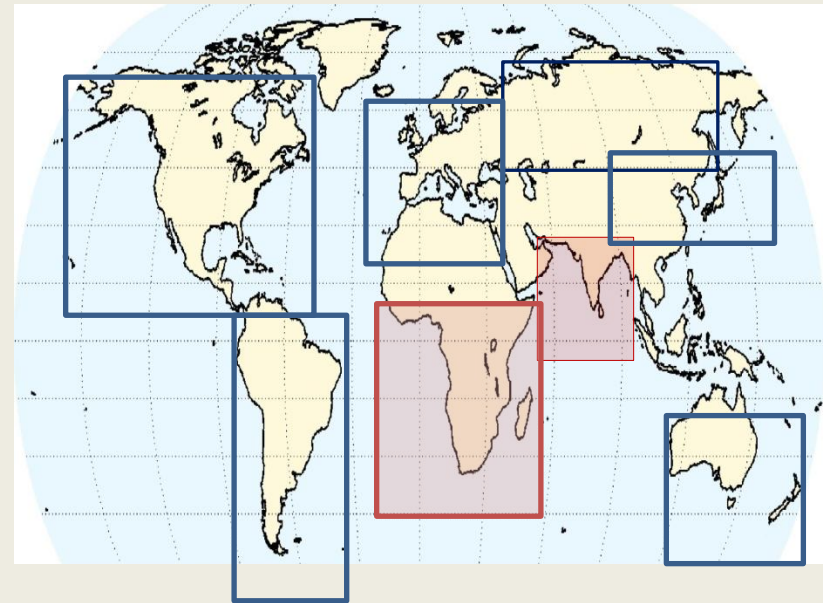
Current AgMIP Activities

- **Global Economic Model Intercomparisons, Fast Track Multi-Model Assessment using CMIP5 Climate Model results**
 - **Led by G. Nelson, 10 global agricultural economic models**
- **Global Gridded Crop Model Simulations, providing input for global economic models**
 - **Led by Joshua Elliott and Delphine Deryng**
- **Representative Agricultural Pathway development methods**
 - **Led by J. Antle, J. Nelson**
- **Livestock Model Intercomparisons**
 - **Led by Mario Herrero**

Current AgMIP Activities

Ten Regional Integrated Assessment Projects (funded by UK-DFID)

- **Sub Saharan Africa**
 - 5 projects led by KPC Rao; S. Adiku and S. Traore; P. Masicati; Y. Beetse; and J. Kihara
- **South Asia**
 - 5 projects led by A. Ahmad; S. P. Nissanka and L. Zubair; P. Paramasivam and V. Geethalakshmi; Y. B. Gangwar, and D. Guntuku



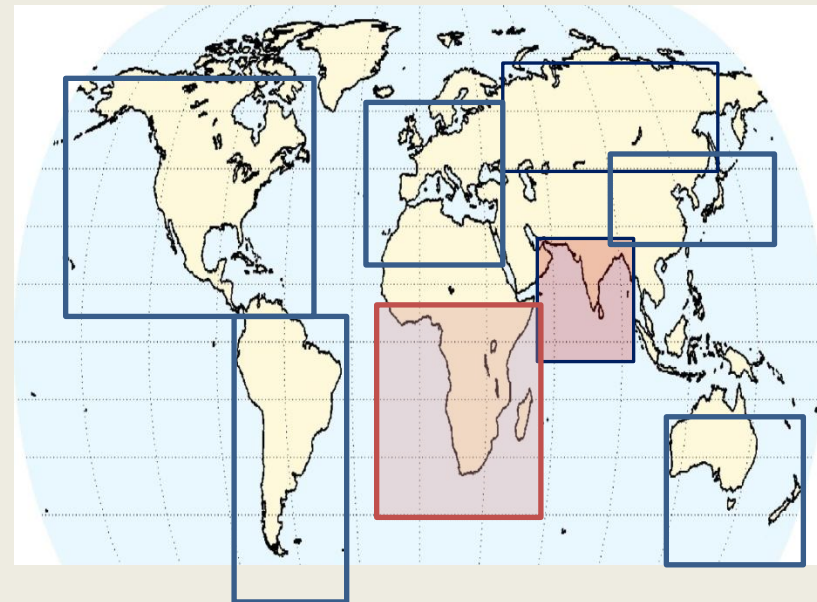
New AgMIP Activities

Regional Integrated Assessments

- **MACSUR (JPI initiative in Europe – partner activity)**
 - Led by M. Banse and R. Tiffin (<http://www.macsur.eu/>)



- **North American AgMIP initiative (North American Workshop in September)**
 - Led by J. Hatfield, others
- **Tentative plans for**
 - East Asia
 - South America



NEW AgMIP Initiatives

Announced Last Week

- **Global Climate Change Crop Modeling Pilot (C3MP)**
 - Led by S. McDermit and A. Ruane
 - Contributed Crop Modeling Results at Sentinel Sites
- **Scaling Pilot Project**
 - Led by F. Ewert, others
- **Uncertainty Pilot Project**
 - Led by D. Wallach and M. Rivington



NEW AgMIP Initiatives

Announced Last Week

- **AgMIP Data Licensing/Sharing Policy**
 - Led by **I. Athanasiadis and S. Janssen**
- **Evolving AgMIP from a Project to a Global Program**
 - Led by **C. Rosenzweig, J. Jones, J. Hatfield**
- **AgMIP public-private partnership (ILSI)**
 - Led by **D. Gustafson, G. Nelson and J. Jones**



ILSI

Research
Foundation

Future Needs

- Increased emphasis on developing/improving reliable crop models
- Improve model capabilities for addressing GxExM interactions
- Develop methodologies & applications for important issues
- New emphasis on experiments for improving, evaluating crop models and on minimum data collection
- Databases: Increase access, usability of agronomic data and increase awareness of the value of data
- Continue to build global community of science (AgMIP)
- **Critical need for increased education efforts to develop the next generation of crop modelers!**