AgMIP

The Agricultural
Model Intercomparison
and Improvement Project

UKaid from the British people

USDA

FOURTH ANNUAL GLOBAL WORKSHOP

OCTOBER 28 - 30, 2013
COLUMBIA UNIVERSITY
NEW YORK, NY

AgMIP gratefully acknowledges the UK Department for International Development's UKaid for major project funding, and the US Department of Agriculture for its founding and sustained support. AgMIP additionally thanks the CGIAR Research Program on Climate Change, Agriculture and Food Security and the United States Agency for International Development for ongoing project support.

AgMIP additionally acknowledges support from The International Life Sciences Institute/The Center for Integrated Modeling of Sustainable Agriculture & Nutrition Security, Monsanto, University of Florida, The National Oceanic and Atmospheric Administration, iPlant, and Columbia University/Earth Institute.

AgMIP extends a special thank-you to Columbia University and The Earth Institute for hosting AgMIP Coordination at its Center for Climate System Research, and for additional contributions in support of the Workshop, Reception and Poster Program.

AgMIP appreciates significant in-kind contributions from:

Agricultural Research Council, South Africa
Alliance for a Green Revolution in Africa, Burkina Faso
Chinese Academy of Agricultural Sciences
Columbia University, USA
Commonwealth Scientific and Industrial Research Organisation, Australia
Consultative Group on International Agricultural Research
Dartmouth College, USA
Department of Agriculture, Fisheries and Forestry, Australia
Democritus University of Thrace, Greece
Empresa Brasileira de Pesquisa Agropecuária, Brazil
Food and Agriculture Organization of the United Nations
Foundation for Environment, Climate, and Technology, Sri Lanka
Imperial College London, UK
Institut National de la Recherche Agronomique, France
Institute of Crop Science and Resource Conservation, Germany
International Center for Tropical Agriculture, Kenya
International Crops Research Institute for the Semi-Arid Tropics
International Fertilizer Development Center, USA
International Food Policy Research Institute, USA
International Livestock Research Institute, Kenya
International Maize and Wheat Improvement Center
International Potato Center, Peru
International Research Institute for Climate and Society, USA
International Rice Research Institute, the Philippines
International Water Management Institute
Macaulay Land Use Research Institute, UK
Massachusetts Institute of Technology, USA
MTT Agrifood Research, Finland
NASA-Goddard Institute for Space Studies, USA
National Center for Atmospheric Research, USA
National Engineering and Technology Center for Information Agriculture and Nanjing Agriculture University, China
National Institute for Agro-Environmental Sciences, Japan
National Institute for Environmental Studies, Japan
Oregon State University, USA
Organisation for Economic Co-operation and Development
Pacific Northwest National Laboratory, USA
Potsdam Institute for Climate Impact Research, Germany
Project Directorate for Farming Systems Research, India
South African Sugarcane Research Institute, South Africa
Tamil Nadu Agricultural University, India
United States Department of Agriculture
Universidad Politécnica de Madrid, Spain
University of Agriculture Faisalabad, Pakistan
University of Chicago, USA
University of Florida, USA
University of Ghana
University of Illinois at Urbana-Champaign, USA
Universidade de Passo Fundo, Brazil
University of Wisconsin-Madison, USA
University of Nebraska, USA
Wageningen University and Alterra Centre for Geo-Information, the Netherlands
Washington State University, USA
World Meteorological Organization, Switzerland

AgMIP especially appreciates the contributions of the 250 workshop participants, and the considerable contributions of the EI event staff, the student volunteers, and Columbia faculty house event coordinators.

AgMIP

4TH ANNUAL GLOBAL WORKSHOP
OCTOBER 28-30, 2013 | NEW YORK, NY

Table of Contents

AgMIP 4TH ANNUAL GLOBAL WORKSHOP

As the fine autumn weather continued in late October in New York City, the Agricultural Model Intercomparison and Improvement Project (AgMIP) convened its annual Global Workshop – the fourth such event since the US Department of Agriculture founded AgMIP in 2010. Members of the AgMIP community convened at Columbia University's Faculty House where Jeffery Sachs, Director of the Earth Institute, AgMIP Steering Group Co-Chairs Mannava Sivakumar and Martin Parry, and AgMIP Principal Investigators Cynthia Rosenzweig, James Jones, Jerry Hatfield, and John Antle kicked off the 3-day workshop.

The workshop brought together over 240 participants from 130 institutions representing the diversity of the AgMIP community. In addition to AgMIP core disciplines of climate, crop, and economic modeling and information technology, initiatives exploring water, soil and crop rotation, aggregation and scaling, pests and diseases, livestock and grasslands, uncertainty, ozone, and climate variability and extremes were also represented. The workshop focused on critical improvements for next-generation models, data, and decision support systems for agricultural assessments of climate change impact and adaptation, and for sustainable intensification of agriculture. Participants also advanced strategies for coordinated regional and global assessments of food security.

"You have convened at a crucial time." Jeffery Sachs said to the workshop participants, "Governments are going to need agricultural strategies and technological roadmaps. What new crop types, varieties, farm systems need to be put in place to resist climate change, create resilience, increase water efficiency, reduce heat stress, and so forth? I don't think these roadmaps exist right now."

A Speed Science session followed the introductions, in which 22 scientists shared key findings, recent accomplishments, and plans for the future. The presentations were divided into seven broad categories: Crop Model Intercomparisons and Improvement, Global Assessments, Regional Integrated Assessments, Cross-Cutting Themes, Key Interactions, New Approaches for Climate-Crop Assessment, and Data and Information Technology.

The first day was capped by an evening poster session and reception held at Columbia University's Low Library with support by The Earth Institute. G. Michael Purdy, Executive Vice-President for Research at Columbia, encouraged participants to mix and view the 65 posters displaying diverse topics such as Integrated Regional Assessments in Sub-Saharan Africa, South Asia, East Asia and Latin America, Economics, Climate, Pests and Diseases, Extreme Events, Water, Evapotranspiration,

Ozone, Soil and Crop Rotation, Adaptation, Data and IT, and crop specific topics such as wheat, rice, maize, soybean and potato.

“This is a great opportunity for exchange and learning in true interdisciplinary science to inform a very important problem –food security for a diverse and growing global population,” said G. Michael Purdy. “Columbia University is proud to host the coordinating office of AgMIP, and is very grateful to UKaid for its major support of this endeavor, to which USDA, CCAFs, USAID, and numerous collaborating partners contribute to enable the AgMIP community to deliver robust and policy-relevant research outputs.” PDFs of the posters and abstracts are available here for download.

In addition to breakouts focusing on model integration and scales, the second day of the workshop included a speed session highlighting complimentary global and regional programs CCAFS, MACSUR, USDA CAPs, Yield Gap Atlas, CIMSANS, FAO, and MODEXTREME.

At the completion of the third day breakout groups reconvened in plenary to present report backs from their sessions. PDFs of the reports as well as presentations from the workshop are available at http://www.agmip.org/feature-view/hats-off-to-the-4th-annual-agmip-global-workshop/.

Many of the groups made plans to meet again and collaborate on research and publications. Some groups like Pests and Diseases will be new to AgMIP while others will continue to build on work initiated previously. All will try to incorporate their findings into integrated assessments of food security on both the regional and global scale. It is these assessments, which combine information from crop, climate and economic models that will feed the next generation of decision support tools for policymakers in the coming decades.

Martin Parry, Co-Chair of the AgMIP Steering Committee remarked of the workshop, “What’s obvious about this project is it’s tapped into a huge latent demand… and that’s why it has picked up speed so quickly.” He continued, “90 -95% of the effort this week has been on improving the science. But you have also heard a call for messages, from donors and policymakers, and it can be complimentary. As one drives forward in model intercomparision and improvement, instead of a parallel path, have questions embedded in single pathway. How would the outcome from your model be altered with mitigation and adaptation?”

This is one of the questions AgMIP scientists will continue to pursue as the energy from this intensive workshop propels the teams forward into the coming year.

Attendees at AgMIP Global Workshop New York City.

Workshop Goals

1. Review AgMIP progress to date and set activities for coming year
2. Enable AgMIP groups to meet, report, interact, and plan
3. Develop plans to address critical improvements for next-generation models, data, and decision support systems needed for assessing climate change impacts and adaptation and for sustainable intensification
4. Advance strategy for coordinated regional and global assessments of food security

Synopsis

The 4th Annual AgMIP Global Workshop has been organized and structured to establish a shared understanding of progress to date, to enable advancement of initiatives underway, and to take on the challenge of creating a next generation of agricultural system models and decision support tools. The AgMIP Community must begin to address important and outstanding areas that are known to influence bio-physical and economic systems, and improve ways that critical investments in agriculture can be assessed in the context of a changing climate.

The Workshop begins with an overview of the current state of AgMIP. This includes a speed science session to highlight key areas of advancement – or challenges – or both – over the past year. This is intended to motivate interaction among Participants and existing AgMIP Work Groups throughout the rest of the Workshop, enabling Participants to associate with various AgMIP initiatives, and encouraging new collaborations over coffee breaks and in breakouts.

The afternoon features a work session to identify and prioritize key areas for model improvements. Motivating examples include climate extremes, crop/livestock interactions, pests/diseases/weeds, and ozone – but there are likely others also. The breakout structure for this work session is by Work Group (e.g., Global Economics, AgGRID, C3MP, etc.). AgMIP recognizes that each Work Group is planning for the coming year, and it is timely and appropriate for members to consider also next generation ideas and opportunities.

The day concludes with a reception hosted by the Columbia University Earth Institute in the Low Rotunda – a favorite academic building of cinematographers. The reception will feature posters from the AgMIP Sub-Saharan Africa and South Asia Research and Coordination teams, the AgMIP Work Groups, and the AgMIP Partners. A number of students, researchers and faculty interested in adaptation, land use, nutrition, policy, soils, and water – who might not otherwise be able to attend the workshop – will also join. The poster session allows for further detailing of results shown in brief during the day, and provides grounding for the creative thinking to come.

On Day 2 participants begin the process of developing plans to address critical improvements for next-generation models, data, and decision support systems, beginning with some perspectives from our collaborating Partners. Participants then breakout into a small number of aggregated Work Groups to consider how to collectively improve assessment of adaptation and sustainable intensification. After lunch, the Work Groups reconvene to address issues of scale. Following report-back of all groups, the participating Steering Committee Members are requested to join the AgMIP leaders in the Ivy Lounge for a discussion of the day, and to revisit priorities for Day 3.

The Day 3 morning plenary provides a glimpse of underway program planning at AgMIP, followed by a keynote address (speaker tbd) on future agricultural development. The session also poses some of the challenges of conducting integrated assessments across scales. Following Plenary, Participants breakout by the major regions in which integrated assessments are needed, as each region may have specific challenges and/or opportunities for planning and report-back. Participating Donors are invited to join the AgMIP PIs and Steering Committee Co-Chairs to share their perspectives during lunch. Lunchtime also finds the AgMIP workgroups self-organizing to organize their recommendations and highlights of work group plans for the final plenary session. The final plenary includes a presentation from the AgMIP leaders on what has been learned, and concludes with views from the AgMIP Steering Committee Co-Chairs. Following the conclusion of the Workshop, the available Steering Committee Members are requested to join the AgMIP Leaders in the Ivy Lounge to affirm plans for moving forward.

AGENDA

Day 1 – Monday, October 28th

7:30 am: Check-In, Registration, Coffee/Tea

Morning Plenary – Results from the AgMIP Research Community

8:30 am: Welcoming Remarks – Cynthia Rosenzweig, Moderator

8:35 am: Welcome from the Earth Institute – Jeffrey Sachs, Director, Columbia Earth Institute

8:50 am: Welcome, Introductions, Workshop Goals, and Goals for Day 1 – Jim Jones, Cynthia Rosenzweig, Jerry Hatfield, and John Antle

9:10 am: Climate change and global food security: a perspective on the AgMIP contribution to 20 years of study – Martin Parry

9:30 am: Global Framework for Climate Services: a Perspective on the AgMIP Contribution – Mannava Sivakumar

9:50 am: State of AgMIP – Cynthia Rosenzweig

10:15 am: Morning Break

10:45 am: AgMIP Work Group Introductions and Results:
Speed Science Session – Peter Craufurd, Moderator

10:50 am: Crop Model Intercomparisons and Improvement

Wheat Team – Senthold Asseng and Frank Ewert

Maize Team – Simona Bassu, Jean-Louis Durand, and Jon Lizaso

Rice Team – Tao Li and Toshi Hasegawa

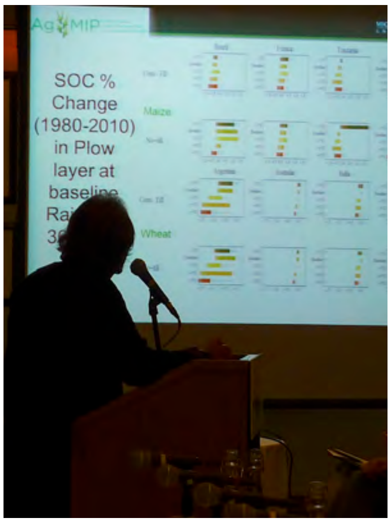
Sugarcane Team – Peter Thorburn, Abraham Singels, and Fabio Marin

Potato Team – Roberto Quiroz, Bruno Condori, and David Fleisher

Crop Model Improvement – Ken Boote and Matthijs Tollenaar

11:20 am: Global Assessments

Global Gridded Crop Model Intercomparisons – Joshua Elliott and Christoph Müller



Global Economic Model Intercomparisons – Jerry Nelson and Martin Von Lampe

11:35 am: Regional Integrated Assessments

Integrated Assessment Approach and Methods – John Antle

Sub-Saharan Africa Research – Job Kihara

South Asia – Dileepkumar Guntuku

11:55 am: Cross-Cutting Themes

Quantifying and Managing Uncertainty – Linda Mearns, Mike Rivington, and Daniel Wallach

Aggregation and Scaling Pilot – Frank Ewert and Lenny van Bussel

Representative Agricultural Pathways (RAPs) – John Antle and Roberto Valdivia

12:10 pm: Key Interactions

Soils and Crop Rotation Team – Bruno Basso

Water Resources – Jonathan Winter

12:20 pm: New Approaches for Climate-Crop Assessment

Near-Term Climate Change – Arthur Greene and Alex Ruane

Coordinated Climate-Crop Modeling Project – Alex Ruane and Sonali McDermid

AgGRID – Joshua Elliott, Cynthia Rosenzweig, and Jim Jones

12:35 pm: Data and Information Technology

Sentinel Sites – Ken Boote

Harmonizing AgMIP Site-based Data – Cheryl Porter and Chris Villalobos

Agricultural Data Journal – Sander Janssen

12:50 pm: Lunch

Afternoon Plenary: Opportunities for Model Improvement

2:00 pm: Key Processes to be integrated in Next-Generation Agricultural Models

Climate Variability and Extremes – Jerry Hatfield

Livestock and Pastures – Mario Herrero and Luis Tedeschi

Pests, Diseases, and Weeds – Karen Garrett

Ozone – Denise Mauzerall

3:00 pm: Discussion

3:20 pm: Charge to AgMIP Work Groups Breakout Session: Toward Next-Generation Model Improvements

- Summarize Work Group activities and discuss results
- Identify and prioritize key topics for model improvement and integration for impact and adaptation assessments – e.g., changes in climate extremes, crop/livestock systems, pest and disease pressures, ozone concentration; what others are important?
- Scope coming year of Work Group activities, including interactions with other groups

3:30 pm: Afternoon break

Afternoon Breakouts: Toward Next-Generation Model Improvements

4:00 pm: AgMIP Work Group Breakouts

A. Global Economics – Jerry Nelson and Dominique Van der Mensbrugghe

B. AgGRID – Joshua Elliott and Christoph Müller

C. Coordinated Climate-Crop Modeling Project (C3MP) – Alex Ruane and Sonali McDermid

D. Regional Integrated Assessments – John Antle and Roberto Valdivia

E. Crop Model Intercomparison and Improvement – Ken Boote and Peter Thorburn

F. Data, Decision Support Systems and IT – Cheryl Porter and Sander Janssen

G. Livestock and Grasslands – Mario Herrero and Jean-Francois Soussana

H. Pests/Diseases/Weeds/Ozone – Jim Jones and Karen Garrett

I. Water Resources – Jonathan Winter

J. Soils and Crop Rotation – Bruno Basso and Angela Kong

5:30 pm: Plenary Session – Report back from the breakout groups and discussion

6:30 pm: Adjourn Plenary Session

Earth Institute Reception, Low Rotunda, Columbia University

7:00 pm: Reception with AgMIP Poster Session (see also Appendix I)

- Sub-Saharan Africa and South Asia Regional Research & Coordination Team Posters
- Work Group Posters
- Partner Posters
- Others

Day 2 – Tuesday, October 29th

8:30 am: Day 2 Goals:

- Identify integration approaches for next-generation models, data, and decision support systems needed for assessing climate change impacts and adaptation and for sustainable intensification
- Lay the groundwork for coordinated regional and global assessments needed to improve

8:40 am: Opportunities for collaboration:

Speed Session on complimentary global and regional programs

CCAFS – Phillip Thornton

MACSUR – Martin Banse

USDA CAPs – Molly Jahn

Yield Gap Atlas – Lieven Claessens

CIMSANS – Dave Gustafson

FAO – Dominique van der Mensbrugghe

MODEXTREME – Ioannis Athanasiadis

Morning Breakouts – Opportunities for Model Integration

9:20 am: Charge to Integration Breakouts

- Identify approaches to address interactions across Work Groups for more comprehensive integrated biophysical and socioeconomic assessment
- Describe methods that will enable the next generation of agricultural model systems to improve assessment of adaptation and sustainable intensification

9:30 am: Model Integration Breakouts

A. Crops, Pests and Diseases, and Economics – Jim Jones, Karen Garrett, and Jerry Nelson

B. Carbon/Temperature/Water Responses, C3MP, and AgGRID – Jerry Hatfield, Ken Boote, Alex Ruane, and Joshua Elliott

C. Livestock and Pastures and Regional Integrated Assessments – Mario Herrero, Jean-Francois Soussana, and Roberto Valdivia

D. Aggregation / Scaling and Uncertainty – Frank Ewert, Linda Mearns, Daniel Wallach, and John Antle

10:30 am: Morning break

11:00 am: Model Integration Breakouts (continued)

12:45 pm: Lunch - Self-organized Work Groups

Afternoon Plenary

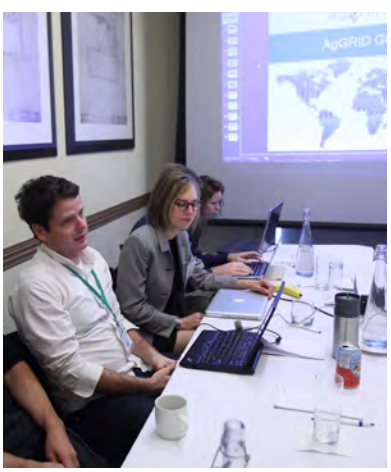
2:00 pm: Report back and discussion from morning breakouts

Toward Integration Across Scales

2:20 pm: Integrated Assessment across Scales – John Antle

2:45 pm: AgMIP Uncertainty Cascade – Linda Mearns

3:10 pm: Discussion



3:20 pm: Charge to Work Group: Planning and Addressing Scales

- Identify the major scaling issues in your Work Group and how they are being addressed
- Identify specific ways that your Work Group can contribute to consistent integrated assessment across scales
- Continue planning Work Group activities for the coming year

3:30 pm: Afternoon break

Afternoon Breakouts – Addressing Scales and Integration

3:45 pm: AgMIP Work Groups

A. Global Economics/RAPs – Jerry Nelson, John Antle, and Hermann Lotze-Campen

B. AgGRID – Joshua Elliott and Christoph Müller

C. Coordinated Climate-Crop Modeling Project (C3MP) – Alex Ruane and Sonali McDermid

D. Regional Integrated Assessments – Cynthia Rosenzweig, Patricia Masikati, and Geethalakshmi Vellingiri

E. Crop Model Intercomparison and Improvement – Peter Thorburn and Senthold Asseng

F. Data, Decision Support Systems and IT – Cheryl Porter, Sander Janssen, and Ioannis Athanasiadis

G. Livestock and Grasslands – Mario Herrero and Jean-Francois Soussana

H. Pests/Diseases/Weeds/Ozone – Jim Jones, Karen Garrett, Denise Mauzerall

I. Water Resources – Jonathan Winter

J. Soils and Crop Rotations – Bruno Basso and Angela Kong

5:30 pm: End-of-day plenary report back and discussion

6:15 pm: Adjourn

Steering Group check-in at Ivy Lounge

Day 3 – Wednesday, October 30th

Morning Plenary – Coordinating Regional to Global Integrated Assessments of Food Security

8:30 am: Day 3 Goal: Advance strategy for coordinated regional and global assessments with next-generation models, data, and decision support systems to address climate change and sustainability issues

8:40 am: The AgMIP Global Program – Cynthia Rosenzweig, Jim Jones, Jerry Hatfield, John Antle, Carolyn Mutter, Alex Ruane, and the AgMIP community

9:00 am: Evidence-based policymaking – Yvan Biot

9:30 am: Understanding future agricultural development: Adaptation and sustainable intensification – Stan Wood

Morning Breakouts – Linking Integrated Assessments Across Scales

10:00 am: Charge to Day 3 Breakouts on Integrated Assessment Across Scales

- How do global integrated assessment results compare with regional integrated assessment results?
- How can we design consistent and interactive regional and global assessments?
- Advance strategies for future assessments of food security and sustainable intensification

10:10 am: Mid-morning break

10:25 am: Breakouts by Region on Integrated Assessments

A. Africa – Patricia Masikati and Samuel Adiku

B. South Asia – Nataraja Subash and Ashfaq Chattha

C. Latin America and Caribbean – Eduardo Assad and Maria Travasso

D. East Asia and Australia – Fulu Tao and Peter Thorburn

E. Europe – Frank Ewert and Reimund Rötte

F. North America – Jerry Hatfield and Marca Weinberg

12:45 pm: Lunch

- Self Organized Work Groups
- Donor Forum Lunch

Afternoon Breakouts – Work Group Wrap-ups

2:00 pm: AgMIP Work Groups wrap-up sessions

A. Global Economics/RAPs – Jerry Nelson, John Antle, and Hermann Lotze-Campen

B. AgGRID – Joshua Elliott and Christoph Müller

C. Coordinated Climate-Crop Modeling Project (C3MP) – Alex Ruane and Sonali McDermid

D. Regional Integrated Assessments – Cynthia Rosenzweig, Patricia Masikati, and Geethalakshmi Vellingiri

E. Crop Model Intercomparison and Improvement – Peter Thorburn and Senthold Asseng

F. Data, Decision Support Systems and IT – Cheryl Porter, Sander Janssen, and Ioannis Athanasiadis

G. Livestock and Grasslands – Mario Herrero and J ean-Francois Soussana

H. Pests/Diseases/Weeds/Ozone – Jim Jones, Karen Garrett, Denise Mauzerall

I. Water Resources – Jonathan Winter

J. Soils and Crop Rotations – Bruno Basso and Angela Kong

3:00 pm: Report back from Regions and AgMIP Work Groups – Plans for coming year

3:30 pm: Afternoon break

Afternoon Plenary – The Way Forward

4:00 pm: What we've learned – AgMIP Next-Generation Models and Coordinated Integrated Assessments – Cynthia Rosenzweig, Jim Jones, John Antle, Jerry Hatfield, Alex Ruane, and Carolyn Mutter

4:30 pm: Feedback from Steering Group and Donor Forum – Martin Parry and Mannava Sivakumar

5:00 pm: Adjourn - Steering Group and Donor Forum check-in at Ivy Lounge

Report Backs from Break-out Groups

AgGRID Work Group Report

• Scientific Issues

Scaling, globally consistent understanding of climate impacts, harmonization and model intercomparison, informing land-use dynamics and food security.

• Group Activities and Protocols Underway

Phase one of the AgGRID GGCMI is underway since the end of May and involves an evaluation of the models against historical yield observations for the period 1948-2012 using both individual model default settings, and harmonized inputs in order to facilitate the comparison of process response. Primary aim is understanding how the models behave relative to each other, rather than making the best possible estimate of historical yields. Simulations have been submitted for 5 models, and the rest are due by 31st December 2013. Indeed we have added 2 new models during the 4th GW—the CLM-Ag model from MIT and the ISAM model from UIUC—and now count 20 model groups among our participants. Protocol design for phase II has also just begun and will be developed over the next 6 months. In essence the study will explore the response surface between CO2 concentration, temperature, water, and nitrogen availability (CTWN), with a set of protocols designed for consistency and comparability w/ CTW studies in C3MP.

• Near-term Model Improvements

Priority one is the adaptation of models to allow harmonization of management-specific processes in order to facilitate the comparison of fundamental processes (such as temperature, CO2 response). First priorities are sowing and harvest windows and fertilization. Soil harmonization is seen as important, but much too involved to tackle at this time. Priorities for improvement of model processes will be informed by the results of the harmonized simulations, but currently key areas are:

1. Nitrogen cycle in models that don't include it. (Stefan)
2. Heat stress at key stages (e.g. flowering). (Delphine)
3. Calibration and evaluation (Joshua, Nathalie, Benjamin)
4. Water balance (Benjamin, Johanna, …)
5. Crop rotations and intercropping (Christoph and Andy Challinor. Good data being compiled in South Asia. Component of the India project?)

• Next-Generation Components

Ozone, pests/pathogens/weeds, and nutrition have all been identified as important areas to be addressed in the future. Currently none of the AgGRID models are set up to deal with these processes. However, a much more pressing need is to address problems in the fundamental processes. In addition, those gridded models which are an upscaling of site models are not set up for adding new processes, instead relying on the site-based teams to develop these. That said, there are a number of large-scale gridded data products (especially for ozone) that could be exploited for use in gridded models if models can be updated to include this effect. However we will most likely have to take our cues from the field-scale modelers here.

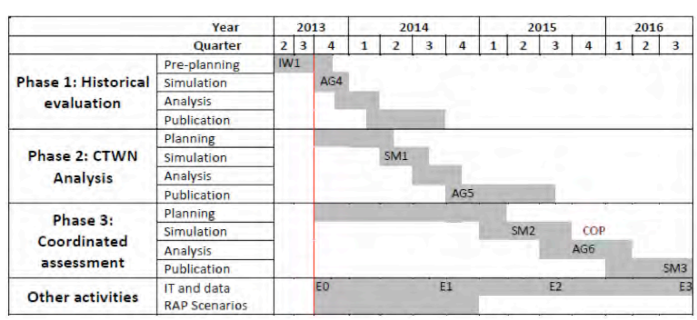
• Priorities for Integration across Disciplines

Land-use change and food security is key to address with global and regional economic teams (good AgMIP ATLAS project discussions and great interactions with regional teams and etc.).

• Contributions to Regional/Global Scale Interactions

Activities of the GGCMI are principally global scale, with regional/site scale evaluation where this is feasible/appropriate. India has been identified as a target area for a regional analysis due to the availability of high quality yield data for this region for wheat and sorghum.

• Timeline for Coming Year



• Funding Requirements

Substantial. Two proposals outstanding for GGCMI (DOE and FACCE/Belmont). Workshop proposal for Lorentz center.

• Brief lay-person-oriented description of work group activities

Global perspective with local information important for policy, economy, adaptation, and climate-smart development.

• Publications in press

Elliott, J., D. Deryng, C. Muller, K. Frieler, M. Konzmann, D. Gerten, M. Glotter*, M. Florke, Y. Wada, N. Best*, S. Eisner, C. Folberth, B. Fekete, I. Foster, S. Gosling, I. Haddeland, N. Khabarov, F. Ludwig, Y. Masaki, S. Olin, C. Rosenzweig, A. Ruane, Y. Satoh, E. Schmid, T. Stacke, Q. Tang, and D. Wisser (2013). Constraints and potentials of future irrigation water availability on global agricultural production under climate change. Proceedings of the National Academy of Sciences, in press.

Nelson, G., H. Ahammad, D. Deryng, J. Elliott, S. Fujimori, P. Havlik, E. Heyhoe, P. Kyle, M. von Lampe, H. Lotze-Campen, D. Mason-D'Croz, H. van Meijl, D. van der Mensbrugghe, C. Müller, R. Robertson, R. Sands, E. Schmid, C. Schmitz, A. Tabeau, H. Valin, and D. Willenbockel. (2013). Assessing uncertainty along the climate-crop-economy modeling chain., Proceedings of the National Academy of Sciences, in press.

Rosenzweig, C., J. Elliott, D. Deryng, A.C. Ruane, A. Arneth, K.J. Boote, C. Folberth, M. Glotter*, N. Khabarov, C. Müller, K. Neumann, F. Piontek, T. Pugh, E. Schmid, E. Stehfest, and J.W. Jones, (2013). Assessing agricultural risks of climate change in the 21st century in a global gridded crop model intercomparison. Proceedings of the National Academy of Sciences, in press.

Piontek, F., C. Müller, T. Pugh, D. Clark, D. Deryng, J. Elliott, F. Col_on-Gonz_alez, M. Florke, C. Folberth, W. Franssen, K. Frieler, A. Friend, S. Gosling, D. Hemming, N. Khabarov, H. Kim, M. Lomas, Y. Masaki, M. Mengel, A. Morse, K. Neumann, K. Nishina, S. Ostberg, R. Pavlick, A. Ruane, J. Schewe, E. Schmid, T. Stacke, Q. Tang, Z. Tessler, A. Tompkins, L. Warszawski, D. Wisser, and H. Schellnhuber, (2013). Leaving the world as we know it: Hotspots of global climate change impacts. Proceedings of the National Academy of Sciences, in press.

• Publications in review

Deryng, D., J. Elliott, A. Ruane, C. Folberth, C. Müller, T. Pugh, E. Schmid, K. Boote, D. Gerten, J. Jones, S. Olin, S. Schaphoff, H. Yang, and C. Rosenzweig, (2013). Global opportunities for producing more crops per drop under rising atmospheric CO2. Proceedings of the National Academy of Sciences, in review.

• Publications planned

We currently plan at least 6 submissions during the publication component of GGCMI Phase I (roughly Spring 2014).

1. Historical analysis of model and ensemble hindcasting skill;
2. Agro-climatic analysis of the relative import of different methods for developing climate forcing datasets (reanalysis models, bias-correction technique, and target datasets; from the priority 2.1 "Climate Track" simulations);
3. A summary of Phase 1 results for priority 2 crops (from the priority 2.2 "Crops Track" simulations).
4. A detailed assessment of all national- and continental-scale extreme climate events in the historical record, and the ability of models to reproduce the agricultural impacts of these events.
5. Sensitivity of simulated crop yields to the ET0 equation used within the crop model, which has been identified as a priority model process difference to evaluate and understand in Phase I. Preliminary results, obtained using pDSSAT run with both Penman-Monteith and Priestley-Taylor ET equations, show a difference in simulated yield up to 30% in some regions (most notably in rainfed systems in arid regions.
6. Variability from models, weather, over the historical period.

We will submit at least two of these publications to top tier general-interest science journals (e.g. Science, Nature, NCC, etc.) and expect other submissions to more technical high-level general science journals (such as PNAS, Nature Communications, etc.).

C3MP Work Group Report

Alex Ruane and Sonali McDermid

• Brief lay-person-oriented description of work group activities

The Coordinated-Climate Crop Modeling Project (C3MP) organizes crop modelers from around the world to investigate how agriculture will respond to climate changes. Experts at more than 1000 locally-calibrated sites from around the world have contributed results to enable detailed study of how changes in rainfall, temperatures, and carbon dioxide concentrations will affect agricultural systems in the coming decades.

• Scientific Issues

Understanding the response of different crops, models, and locations to changes in mean carbon dioxide concentration, temperature, and water (CTW). How can we assess the quality of this response and the minimum requirements for comparison of two simulation sets? What is the density (or number of sites with a common characteristic) required to perform more comprehensive analyses (e.g., of a broader region, crop, or crop model)? How consistent are the CTW responses?

• Group Activities and Protocols Underway

C3MP has an established and simple protocol. The overall project is relatively simple, however:

1) the execution of CTW sensitivity tests can be quite arduous for some models
2) the creation of C3MP tools facilitates project execution and results reporting
3) the organization of the project requires detailed planning
4) the distribution of project results must be carefully controlled.

• Near-term Model Improvements

The entire project improves with each further participant and simulation set that expands the C3MP network; therefore we are looking for more crops, crop models, and locations. We would be grateful for more assistance in the creation of IT tools to facilitate the generation of C3MP scenarios, which would facilitate and encourage additional participants. Dominique indicated that this could easily be done for STICS model users. As groups are successful for particular models we need to capture and tools or procedures they created in order to assist future participants with the same model.

• Next-Generation Components

Future C3MP initiatives would be improved by the inclusion of a closer look at climate variability metrics (e.g., a monsoon-oriented set of sensitivity tests for South Asia, SE Asia, and/or West Africa), devoted analysis of nitrogen interactions, and capacity for harmonized archives of C3MP results from gridded crop models. Submissions planned for grasslands and livestock production. Pests and diseases also respond to CTW changes, so sensitivity tests would be appropriate way of developing damage functions that could inform AgMIP simulations and analyses.

• Priorities for Integration across Disciplines

Already have strong climate and crop modeling participation. Would like to pursue connections to economics modeling, e.g., simple yield change factors for TOA or integrated assessment modeling.

• Contributions to Regional/Global Scale Interactions

C3MP has the potential to bridge scales as a dataset that spans a large area and a large number of crops, but where each site was individually calibrated. Results may thus be used to compare against GGCMI simulations from AgGRID, against model results and experimental data at crop model pilot sites, and against the directly simulated scenarios in AgMIP's Regional Integrated Assessments. As the density of C3MP results increases, there may eventually be the ability to aggregate up to national (and potentially higher) scales.

• Timeline for Coming Year

December 31st, 2013 = Next submission deadline

January – December, 2014 = Archives still open for submission; results only available to those who have contributed results

January 1st, 2015 = Outputs publically available

• Planned Publications

1) Working Title: C3MP Protocols and Archive

Authors: Sonali McDermid (sps2113@columbia.edu) and ALL C3MP Participants

2) Working Title: Global Climate Impacts
Authors: Alex Ruane (alexander.c.ruane@nasa.gov), and ALL C3MP Participants

3) Working Title: C3MP Projections for Argentina
Authors: Gabriel Rodriguez (garodri@gmail.com) and Guillermo Garcia

4) Working Title: C3MP Wheat
Authors: Senthold Asseng (sasseng@ufl.edu) and participants who submitted wheat data

5) Working Title: C3MP Rice
Authors: Participants who submitted rice data

6) Working Title: C3MP Maize
Authors: Participants who submitted maize data

7) Working Title: C3MP Sorghum
Authors: Flavio Justino, KPC Rao (?) and participants who submitted sorghum data

8) Working Title: Comparison of AgMERRA and local weather data for C3MP results
Authors: Alex Ruane (alexander.c.ruane@nasa.gov) and participants who submitted both datasets

9) Working Title: Comparison between DSSAT 4.5 and DSSAT 3.0
Authors: Richard Goldberg

10) Working Title: Patterns of global agro-climatic sensitivity
Authors: Sonali McDermid (sps2113@columbia.edu), Alex Ruane, and Nick Hudson

11) Working Title: Comparison of C3MP and GGCMI results
Authors: Alex Ruane (alexander.c.ruane@nasa.gov), Joshua Elliott, and Sonali McDermid

12) Working Title: Forms and fidelity of C3MP Emulators
Authors: tbd

13) Working Title: CTW responses for Bambara Groundnut
Authors: Asha Karunaratne

14) Working Title: Uncertainty in CTW Impacts Response across the C3MP Network (broad audience)
Authors: tbd and ALL C3MP Participants

15) Working Title: CORDEX and Global Model Impacts
Authors: tbd

16) Working Title: Differentiating climate impacts on worst years versus average years
Authors: tbd

Funding Requirements

C3MP is currently unfunded, but support for coordination and IT development would be beneficial

Crop Modeling Work Group Report

Peter Thorburn and Ken Boote

• Scientific Issues

Crop models have been developed to capture the effects of how crops respond to the environmental factors they experience during their growth. The concepts and algorithms in the models have largely been drawn for the responses measured in field experiments. Those experiments have been conducted in the past and so necessarily reflect the climate and atmospheric conditions of the past. As these conditions vary in the future through global climate change, there is well-founded concern that the model predictions may not be accurate for future climates. Thus, these models may not be providing accurate indications of crop growth and food supply in the future.

In addition to this uncertainty about the validity of mechanisms within crop models under future climatic conditions, the models differ in their structure, parameterization, etc. These differences reflect the uncertainty within the crop modeling community about the understanding of these processes and how they are best represented in models. So, this uncertainty is inherent in all predictions, but not revealed in simulations coming from a single model. Therefore, making predictions with an ensemble of models offers an improvement and way to reduce overall uncertainty.

• Group Activities and Protocols Underway

Crop model intercomparison and improvement groups currently established include

- Wheat
- Maize
- Maize model improvement group
- Rice
- Sugarcane
- Soils

These groups have commenced activities and have produced outputs ranging from preliminary intercomparison data (soils and maize improvement) to papers submitted or published (all other groups).

New groups that have been formed, but have yet to produce outputs are:

- Potato
- Sorghum
- Groundnut
- Cassava

There are also plans to establish new working groups to address important issue that have emerged from the AgMIP community over the past year. These groups will address:

- Canola/rape seed (contact: Enli Wang)
- Biofuel crops (contact: Gopal Kakani)
- Crop-water-use and ET team (contact: Jerry Hatfield)

• Near-term Model Improvements

It is important to note that improvements will be driven by comparison with data.

The wheat model improvement group is in the process of assessing the performance of 28 different models in simulating effects of high temperature, the factor determined to be the highest priority for improvement. This group has a methodology for modeling teams to test the improvements against data from the Hot Serial Cereal experiments. It is likely that improved wheat models will evolved during 2014, as the modelers modify code and parameterization to improve wheat model response to temperature. A sub-group will also test models from AgFACE data from Australia (O'Leary et al.).

The rice model improvement group is focusing on CO2 responses, using data from FACE experiments in Japan and China. There is also a planned activity in the near future looking at improving temperature responses by testing against elevated temperature response observations.

The maize crop intercomparison group is aiming to evaluate growth and ET at elevated CO2 against data from FACE experiments in Germany and USA. The maize model improvement group (MMIG) is developing a new model called AgMaize with improved phenology, leaf area expansion, leaf-canopy assimilation and partitioning.

The sugarcane improvement group has gathered data from a wide array of environments, and these data will allow a partial space-time analysis for water and temperature stress that will provide the basis for model improvement. Glasshouse experiments have recently been conducted on CO2 response, and the models will have their CO2 response functions updated accordingly.

• Next-Generation Components

The highest priority next generation components are to develop models better equipped to represent effects of extreme elevated temperature, water stress and CO2 concentration. Our modeling of these processes is, in reality, data constrained.

Representing other processes important in climate change impact, but not included in current models, is likely to be even more constrained by data. Detailed interactions between the crop modeling community and process scientists in these areas will be required to make progress. These other processes will include, but not be limited to, effects of ozone on crop growth, pests and diseases, soil drainage, crop submergence, water logging, salinity and grain quality. The magnitude of the effort to incorporate these processes into crop models accurately should not be underestimated. Having said that, some models do have capacity to represent some of these processes, to greater or lesser extent (e.g. APSIM and RZWQM modeling tile drainage, APSIM's link with Dymex to model pests in grains) that may provide examples for other modeling groups.

- **Priorities for Integration across Disciplines**

Good to explore links with the following global communities:

- Good potential links to Global Energy and Water Cycle Experiment (GEWEX :http://www.gewex.org/) for insights into ET.
- Remote sensing community for information on ET, canopy development, etc.

There are plans to establish a new working group to address the important issue of crop water use-ET (contact: Jerry Hatfield) because model intercomparisons show large variation in predicted ET and transpiration across models. The crop water-use-ET team will work across crops, across site-specific models, and across global modeling communities to test their models against available ET-crop-water-use data. The links to global communities (e.g., GEWEX, remote sensing and experimentalists) will be especially important to the Crop water use-ET group.

Another important issue to emerge during the Global Workshop was the need for stronger interactions between the crop modelers and the economists to discuss RAPS. The priority for these discussions is the representation of adaptation, such as changed management, genetic improvement and socio economic constraints. Integrated assessment activities need to place a higher priority on simulating adaptations.

- **Contributions to Regional/Global Scale Interactions**

Discussions of regional/global scale interactions identified a number of potentially useful interactions, such as:

- What does a grid represent?
- Sensitivity analyses of predictions for a grid that contains good point simulations, such as comparing relative sensitivity of the global model against point data (as in ET).
- How do we parameterize cultivars?

These ideas will only be better developed through detailed interactions between the members of the crop and gridded modeling communities.

- **Timeline for Coming Year**

Time lines are either given above or available through work plans for the individual improvement groups.

Plans for publications

- Wheat: Eight papers under consideration, ranging from recent submission (PNAS) to concept development.
- Maize: One paper submitted (GCB), and one (on ET) in the pipeline.
- Maize improvement; < 4 in the pipeline
- Rice: One submitted (PRS London) and two in process
- Sugarcane: One paper submitted (EM&S).
- Biofuels: Several papers are being published on the development of biofuel crop models.

- **Funding Requirements**

US$150,000/yr per Group to undertake meaningful work in a timely manner. So the ten Groups in existence imply an investment of US$1.5M/yr.

- **Brief lay-person-oriented description of work group activities**

Much of our knowledge of crop production and food security come from our past experience. As the climate changes in the future, this experience will become less relevant and there will be increasing uncertainty about the extent to which agriculture will be able to meet food demands for an expanding population.

This activity will improve simulation models of crop production so they are better tools for assessing future food supply. In addition, it will develop and demonstrate methods for more explicitly representing the uncertainty in these assessments, so that they provide a more robust and higher quality evidence base to inform policy discussions on future food security at local, regional and/or global scales.

Global Economic Modeling Work Group Report

- **Scientific Issues**
  - Model comparison – improve understanding of the sources of differences between the global economic model results
  - How to better link global and regional modeling
  - Communicate the results to users

- **Group Activities and Protocols Underway**
  - Compare model results to explicitly specified shocks to elicit arc demand and supply elasticities
  - Develop review paper on land use modeling approaches
  - Participate in regional/global model discussions in EU, US, and Canada, and others as opportunities arise
  - See RAPs discussion

- **Near-term Model Improvements**

  Shorten time steps

- **Next-Generation Components**

  Incorporate uncertainty. This is a 3 year effort.

- **Priorities for Integration across Disciplines**

  Better integration with global gridded crop models

- **Contributions to Regional/Global Scale Interactions**

  See above

- **Timeline for Coming Year**

  Complete shocks experiment and land use modeling review paper

- **Funding Requirements for one year**

  $500,000

- **Brief lay-person-oriented description of work group activities**

  Policy makers need simple metrics of model performance as well as straight forward explanations of key model results. The shock experiment will generate metrics that are familiar to agricultural policy makers. The land use review paper will expand on the Agricultural Economics paper on land use to a more in-depth assessment of model specific methods of quantify land use expansion potential.

Grasslands & Livestock Report

Lead: Jean-François Soussana, INRA, France.

- **Scientific Issues**

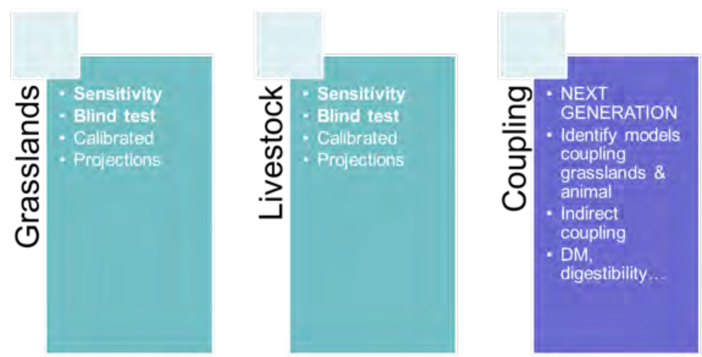


Figure 1. Organisation of the grasslands and livestock group

We have expanded the scope of activities by including livestock modeling activities (initially, cattle only). Hence, there are two pillars corresponding to grasslands and to livestock. In each pillar, we plan the following activities (model sensitivity climate, intercomparison with blind tests, model calibration and further intercomparison, site based model projections). While the two pillars can be seen as partly decoupled activities, some models simulate in a coupled way pastures and livestock. Moreover, indirect coupling could be developed (e.g. simulating herbage production and herbage digestion by ruminants) (Fig. 1).

- **Group Activities and Protocols Underway**

Grasslands

Sensitivity analysis, contributing to C3MP

Sensitivity will be first assessed with models that have been calibrated/evaluated at high quality sentinel sites and that meet the AgMIP requirements (see Annex 1 for groups agreeing to contribute). This will be organized as a grasslands contribution to C3MP (see workflow below). We agreed on three broad grassland categories: temperate, tropical, rangelands.

For each category, we have a subset of modeling groups. We will ask each group to report on their model and their site (model and site templates) and to provide 31 yrs weather data complying with C3MP standards. We will then use the C3MP procedures for generating the modified weather products that will allow to run the CO2*T*P hypercube for each site/model pair. The detailed outputs will be processed by the Grasslands activity and simpler production outputs will be reported to C3MP. The IT team will provide support (translators, raw data formats, data archives). We will ask groups to report on sites used for models calibration/evaluation and also on high quality datasets that can be used for sentinel sites.

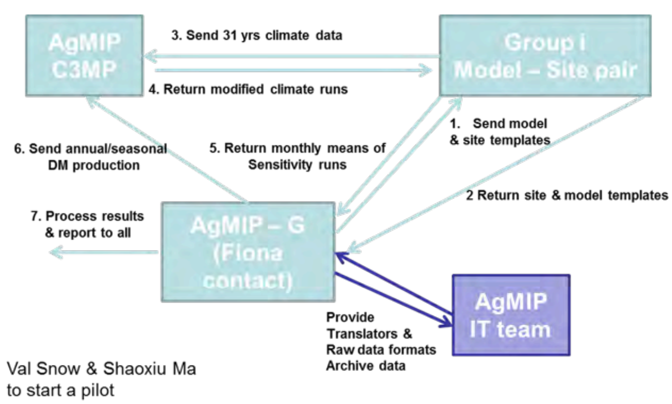


Figure 2. Provisional workflow for the grasslands sensitivity analysis

We agreed on data outputs and on the theoretical management assumed in each site for this sensitivity analysis:

Theoretical grassland management. Assume cuts every two weeks (on 1 and 15 of each month of each year). Cuts will be effective whenever the biomass is sufficient. The reason for applying such a cutting procedure is that large changes in climatic conditions resulting in herbage accumulation changes would require adaptations in grazing (e.g. stocking density) that are site specific and that will confound the sensitivity. Fertilization needs to be kept constant across the climate conditions and to be adapted to the nutrients exports resulting from cuts. Note that an alternative would be to have short grazing events every two weeks, but this seemed more difficult to standardize.

Output variables. NPP (GPP), harvested DM, mean above-ground DM, mean below-ground DM, mean LAI, mean harvested (N content, digestibility, NDF), total SOC stock (annual to 30 cm and to total soil depth), N2O (and total denitrification if possible), soil temperature in 0-30 cm, soil moisture in 0-30 and in total depth, real evapotranspiration. A preliminary step will be to populate a table with models times output variables. All output variables will be reported as monthly means.

Formats. We are exploring the format standards with the IT team. While there is a medium term need for standardization of vocabulary, development of further translators (etc…), we will base our initial effort on formats adapted from those used by the crop teams.

Publication plans. We anticipate a paper focused on the climate sensitivity of grassland models and a contribution to the broader C3MP paper. Depending on results, other papers could be prepared.

- **Grassland model intercomparison and benchmarking**

Based on their description and applicability, models (see Annex 1) will be allocated to one or several of the three grassland types (temperate, tropical, rangelands). In the sensitivity step, models performances were reported for a theoretical management at a site for which the model has been calibrated. We therefore have in each grassland category, a subset of models/site pairs.

Site selection. Following the general principles of the silver/gold/platinum classification, the best sites will be delineated in each grassland category. We expect to have at least three high quality sites on different continents in each category. The input data (climate, vegetation, herd, soil, management,…) will be reported for those sites to the coordinating team and their formats standardized. Moreover, key data for model benchmarking (see provisional list, Table 1) will also be send to the coordinating team and will be processed according to a standard template.

Blind test In each grassland category, each model will be run for each site based only on the input data send in the standard format to each site. Some site-specific parameter values may be adapted by model teams, based on their expertise. Details of this procedure will be discussed with the wheat and maize pilots to benefit from their experience. The blind test model outputs will be reported in the standard format (using monthly values?).

- **Model intercomparison and benchmarking workshop**

This workshop will take place on March 20-21, 2014 in Paris. It will be organized jointly with the C-N group of the Global Research Alliance (GRA) on agricultural greenhouse gases, to take advantage of the synergies between the two activities (within GRA, models are used for GHG emissions estimates and for tests of mitigation options). In this workshop, the first results of the blind test will be reported and discussed, the use of the mean of an ensemble of models will be evaluated and further steps will be planned. We anticipate to run a second intercomparison after calibration, plus a parameter permutation exercise (in order to test the role of changes in parameter values).

- **Near-term model improvements and next generation components**

In the near term, we will concentrate on the sensitivity and intercomparison/benchmarking steps. From the understanding gained, we plan for model improvements focusing on the following areas which were identified as sources of large uncertainties:

i) Response of vegetation and soil to climate (T, P, CO2) with focus on extreme events. This would be organized through a questionnaire to have modelers report on the functions used. Links with ecosystem manipulation experimental data will be organized to improve parametrisation.

ii) Herbage quality. Key variables (N content, digestibility, NDF…) will be evaluated and discussed and improvements considered.

iii) Plant functional types composition and dynamics. A review of the models will be organized and discussions initiated.

Based on these discussions, we will encourage modelers to run model improvements. This may, however, targeted funding. The next generation component that we foresee concerns the 'climate proofed pasture models, including grazing management and GHG balance' (CPPM..).

Contributions to Regional/Global Scale Interactions

We have three DGVMs

MODEL	CONTACT	COMMENT
ORCHIDEE	Viovy, Nicolas (FR)	C3/C4 grass, management
LPJml	Rolinski, Suzanne PIK	Temperate
Biome BGC	Montana U. (tbc)	

These have plant functional types, including C3 and C4 grasses and some (e.g. Orchidee new version) have grazing management. These models will be part of the intercomparison and will benefit from the activities in the group. Collaborations on grazing management, on diet quality etc… could be further developed. Other integrated models (e.g. GLOBIOM) have EPIC which is also part of the grassland intercomparison. Gridded applications of pasture models could help in proposing bias corrections in the main DGVMs and integrated models. In 2014, we anticipate to start the first discussions on this issue.

- **Timeline for Coming Year**

End 2013. Send model and site templates.
Collect weather data.

December 2014. Send the blind test input data.

January 2014. Process the hypercube.

Early 2014. Send the modified weather data to model groups. Deadline for model runs: end February 2014.

March 2014. Benchmarking and intercomparison workshop.

May-September 2014. Data analysis from blind test and from intercomparison.

- **Housekeeping**

A collaborative space and a server space will be organized for the activity.

- **Funding Requirements**

100,000 $ per year would be required.

We hope at least some support for travel of groups participating, especially from developing countries. Support from IT team and from C3MP will be critical for the success of the activities.

• Brief lay-person-oriented description of work group activities

Pastures and livestock are critical aspects in both low-intensity and high-intensity agricultural systems and how such systems are likely to respond to climate change. These systems will also play an important role in the mitigation of GHG emissions. As regional and global impact assessments are undertaken it is important that we have confidence in the performance of the models that simulate pastures and animals and their integration into cropping systems. This workgroup will undertake activities to benchmark models simulating pasture and animal performance under a wide range of environments - from cool-temperate to tropical to rangeland conditions. The benchmarking exercise and the data used in the benchmarking will be used to improve the models and then we will use the ensemble of models applied to high-quality datasets to quantify the uncertainty of our predictions of pasture and animal performance under current and possible future conditions. The information will be used to inform or improve the models used in global gridded assessments and to inform assessments of the impact of climate change on individual farms and households.

Annex 1. Provisional list of models contributing to the intercomparison, benchmarking and sensitivity analysis. Data provision is still being explored.

MODEL	CONTACT	COMMENT	Available data
CENTURY, DAYCENT / SAVANNA	Conant Rich (USA)	Grasslands / Rangelands	YES
GPFARM-Range	Ahuja, Laj (USA)	Rangelands	
	Samuel Adiku (Ghana)	Savannah rangeland	
FASSET, FARMGHG	Olesen, Joergen E (DK)	Temperate grassland	
LINGRA, LPJ Grass	van Itersum, Martin (NL)	Temperate grassland	
STICS Grassland	Ruget, Francoise (FR)	Temperate grassland	
PROGRASS	Calanca, Pier Luigi (CH)	Temperate grassland	
PASIM, FARMSIM	Bellocchi, G; Soussana, J-F (FR)	Temperate (field/farm)	YES
TOA-MD	Antle, John (USA)	Temperate grassl/rangel.	
EPIC	Roggero, PP (IT)	Temperate/Tropical	YES
APSIM-GRAZPLAN/AgPasture	Moore, Andrew (AU), Val Snow (NZ)	Temperate/Tropical	YES
DAIRYMOD/ECOMOD	Cullen Brendon (AU/NZ)	Temperate/Tropical	
CROPGRO	Boote, Ken (USA)	Tropical	
APSIM - APSFARM	Masikati, Patricia (CGIAR)	Tropical	
GRASSIM	van Itersum, Martin (NL), Descheemaeker, Katrien (NL)	Tropical (semi-arid, savanna)	YES
Phygrow/APEX/EPIC	Jay Angerer (USA)	Tropical, Savannah, Temperate	
SAVANNA/QuD	Greg Kiker	Savannah (Kruger Park)	
G-Range, Ruminant	Herrero, Mario (CSIRO)	Tropical grassl./rangel.	

Aggregation / Scaling and Uncertainty Work Group Report

Antle, John; Ewert, Frank; Hoffmann, Holger; Mearns, Linda; Wallach, Daniel

• Scientific Issues

From the scaling point of view, the main issues involve the identification and quantification of influences of scaling methods (e.g. sampling and aggregation) on model performance and representativeness. The aim of the scaling activities in AgMIP is to identify and quantify strategies applicable for crop model upscaling. Methods are developed in order to extract characteristic model sensitivities and optimal sampling and aggregation strategies. The approaches include the evaluation of crop model uncertainty on the multi-model level at local and regional scale in order to deduct general conclusions for upscaling applicable across regions and models including model ensembles.

The three main scientific issues concerning uncertainty are how to characterize the uncertainty (e.g., do we know the source and understand it?), how to quantify the uncertainty for different responses at different scales, and how to apportion overall uncertainty to specific causes.

Further research topics addressed are:

Quantification of sources of uncertainty using comparisons with observed regional and subregional yield.

Uncertainty in impact assessment

Quantification / Estimation of the fraction of uncertainty in crop models which is ignored (effects of weeds, diseases, pests, ozone, other) , compared to the fraction which is known / considered.

Evaluation of crop model uncertainty based on ensembles (of crop models). (Profiting from the experience with climate models, e.g., use of model weighting).

Model calibration as a source of model uncertainty

Effect of internal climate model variability on impact assessment

Climate uncertainty vs. crop model uncertainty as function of time horizon, e.g. estimating the time of emergence (ToE) / significant horizon (see Hawkins & Sutton 2009, Hoffman & Rath 2013).

• Group Activities and Protocols Underway

A regional multi-model scaling study (1st regional scaling) with stratified sampling for different numbers of sampling points has been conducted in order to investigate optimum sampling strategies and the contribution of sampling to the simulation error / uncertainty. All groups contributed their single model runs to the ensemble of potential and water limited yield of winter wheat. First results are presented and ongoing evaluation and uncertainty analysis discussed. Next steps will increase the level of spatial heterogeneity by including soil information.

In order to set up / investigate effects in ensemble runs, the range of methodological approaches known from climatology (e.g. Hawkins & Sutton 2009) will be tested. Parameter and structural uncertainty of crop models will be separated by the example of phenology / phenological model compartments.

A draft white paper on uncertainty has been circulated, and will serve as the basis for further discussions concerning uncertainty. All AgMIP participants are encouraged to provide comments on the draft.

• Near-term Model Improvements

Optimum sampling / contribution of sampling to regional model performance will be included in future model simulations.

• Next-Generation Components

Optimal sampling strategies with regard to spatial variability, model characteristics and interaction of scale and model, possibly extended for model ensembles.

Comparison of methods of estimating uncertainty based on ensembles, and establishing improvements in methods.

Estimation of uncertainty in impact analysis.

• Priorities for Integration across Disciplines

The investigated issues are general and therefore applicable to most model types. Optimum scaling and sampling are prerequisites for simulations whereas analysis of uncertainty propagation is interdisciplinary per se.

Propagation of uncertainties in crop model outputs to economic models.

- **Contributions to Regional/Global Scale Interactions**

Scaling crop model simulations to a spatial aggregation level that is usable for economic models.

- **Timeline for Coming Year**

2014: Regional scaling exercise with increased complexity
2014: Case study separating parameter and structural crop model uncertainty
2014: Identification and set up of climatological uncertainty analysis methods which are potentially applicable to ensembles of climate-crop-socio-economic model chains (review).
2014: Study on application of lessons from climate modeling to ensemble-based uncertainty for crop models.

- **Funding Requirements**

PhD for extending scaling exercise to other region(s) in Africa and crop(s) (e.g. Nigeria, e.g. Millet) and for linking upscale model results with economic models.

Uncertainty postdoc to work on the full range of uncertainty research topics. Partial support for programmer if large data set manipulation is required.

- **Brief lay-person-oriented description of work group activities**

The first goal of this group is to develop methods for simulating yields at the level of a region, based on simulations for individual fields. Studies are being carried out to test and evaluate various methods. These studies involve multiple modeling groups.

The second goal is to characterize and quantify uncertainty in simulated responses. A draft white paper has been distributed, and will be the basis of discussions among a large community of researchers interested in this area. The white paper has a broad discussion of the sources of uncertainty and the way uncertainty is evaluated, the contribution of AgMIP to the methodology of evaluating uncertainty in crop models, ag-economic models, the details of current uncertainty analysis in AgMIP and finally proposals for future AgMIP research and for the organization of this theme in AgMIP.

- **Publications**

Two paper on the scaling exercise (phase 1, one in 2013, one in 2014).

Three + X papers on the scaling exercise (phase 2, 2014) are planned.

A draft white paper on uncertainty has been circulated, and will serve as the basis for further discussions concerning uncertainty.

One paper on the application of lessons from climate modeling to ensemble-based uncertainty for crop models (and possibly ag-economic models).

Soil and Crop Rotation Work Group Report

Bruno Basso and Angela Kong

- **Scientific Issues**

Typically climate change impacts on crop yields are simulated with an approach that re-initializes soil conditions to the same state each year. If simulations neglect to include year-to-year changes in soil conditions related to agronomic management (soil organic carbon, soil nitrogen, soil water content), adaptation and mitigation strategies designed to maintain stable yields under climate change cannot be properly evaluated, thus re-initialization of initial conditions as per status quo is not appropriate.

In a recent meta-analysis of CERES models applied to measured data on maize, wheat and rice, Basso and Liu (2014) found that CERES models have been extensively tested for yields or biomass (over 120 papers), but their validation for soil water balance (20 papers), carbon and nitrogen cycling in agricultural systems has been limited (only 8 papers). It is rather clear that crop models need to include soil parameters as proper initial conditions to produce realistic simulations of grain yield by capturing the legacy effects of soil carbon, nitrogen and water from the off-season on the next growing season. The Soil and Crop Rotation Work Group is comparing the results of sequential simulation (continuous runs without resetting initial conditions) of different models on soil variables (e.g., soil organic carbon and nitrogen, water balance, and later greenhouse gas emissions). In the context of climate change, if adaptation and mitigation strategies are to be identified, then changes in soil conditions over time need to be accounted for.

• **Group Activities and Protocols Underway**

Since mid-2013, the AgMIP Soil and Crop Rotation Work Group has been engaged with Phase I simulations of the wheat and maize pilot sites using continuous simulations. The objectives of Phase I are to: i) assess crop model uncertainties in simulating soil carbon, nitrogen and soil water balance dynamics in a maize - fallow and wheat - fallow crop rotation under different management strategies in a sequential mode for 30 continuous years (historical (1981-2010) and future climate projections (2011 -2040)) using different management strategies and crop rotation, and ii) to compare yields simulated using the prior method of constant reinitialized soil parameters used in the wheat and maize pilot studies accounting for legacy effects of soil water, carbon and nitrogen obtained by running the model in the sequential mode. Protocols and data sets to be used in Phase I simulations can be found at http://www.agmip.org/soils. The sites selected to be used in Phase I are identical to those used in the wheat pilot (Australia, Netherlands, Argentina and India) and maize pilot studies (USA, France, Brazil, and Tanzania).

In Phase II (see timeline below), the Soil and Crop Rotation Work Group will follow up Phase I with model tests at long-term sites (ideally at least 20 years) that have more detailed soil carbon, nitrogen and water data. Another objective of Phase II is to evaluate how the models cope with sites with low availability of input, e.g., sentinels copper sites like chrono-sequence sites in western Kenya.

• **Near-term Model Improvements:**

With Phase I model runs currently underway, there are few near-term model improvements proposed at this stage. Model improvements will depend on the performance of the initial pilot results. Expected limitations may deal with the way different models handle soil organic carbon and nitrogen mineralization rates. Improvements will be made to models if soil fertility impact on yield is not properly captured.

• **Next-Generation Components**

The next-generation models should incorporate salinity, excess soil water and drought and greenhouse gas emissions in order to properly identify adaptation and mitigation strategies when these issues are predominant. The Soil and Crop Rotation Work Group will also focus on developing better transferability of the models and reducing the sensitivity of models to limited inputs (e.g., sentinel copper sites).

• **Priorities for Integration across Disciplines**

Modeling of soils processes (soil fertility, available water, soil quality/degradation) must be included in every crop modeling exercise that aims at modeling long-term impact of management strategies and climate change on crop yield. The AgMIP Soil and Crop Rotation Work Group plans to be in close contact with the crop the Crop and Livestock teams, as well as the Regional Groups working on integrated assessment.

• **Contributions to Regional/Global Scale Interactions**

It is pertinent that crop modeling at the regional/global scale includes properly initialized soil conditions in order to accurately model yields as well as carbon, nitrogen and water fluxes. In order to scale up from the field level, a spatial component is necessary. FAO and UNESCO, along with the Digital Soil Mapping initiative will cover an important role on providing existing information on soil maps which can be used to scale up from field to Region.

• **Timeline for Coming Year**

The AgMIP Soil and Crop Rotation Work group is currently engaged in Phase I simulations (described above). The group will complete Phase I by the end of 2013 and synthesize the results into a publication in 2014. Phase II, which will include new sites and more data measurements, will begin in the Spring of 2014.

• **Funding Requirements**

a. Pursue funding for workshop and travel funds to Global Workshop
b. Funding for core person (programmer/post-doc) to support this initiative/work group in compiling and analyzing data from all the groups.

• **Brief lay-person-oriented description of work group activities**

Soils are the backbone of agro-ecosystem function and productivity. Therefore, it is pertinent to include soil components into simulations of management scenarios to identify best management practices under current and future climate. Crop models generally re-initialize soil conditions, which might suffice when looking at climate variability; however, this approach suffers from not taking into account legacy effects of soil carbon, nitrogen, and water content. The primary aim of the AgMIP Soil and Crop Rotation Work Group is to account for changes in soil conditions over time (e.g., soil carbon and nitrogen and water balance) in order to accurately model crop yields at sites covering a range of data richness as well as identify adaptation and mitigation strategies.

• Planned Publications

AgMIP Soil and Crop Rotation Work Group plans to publish the results of Phase I and II in highly ranked journals including as co-authors, AgMIP leaders, data providers and scientists participating in the initiative.

Water Work Group Report

• Participants

Jonathan (Dartmouth College), Francisco Meza (Catholic University of Chile), Tom Gerik (Texas A&M), Daniel Hillel (Columbia University), Arthur Gueneau (International Food Policy Research Institute), Arthur Greene (International Research Institute for Climate and Society), Forrest Melton (Cal State Monterey Bay, NASA Water Resources Program), Vijay Nazareth (University of Florida), Christine Lee (AAAS Fellow, NASA Water Resources Program), Greg Kiker (University of Florida), Rafa Muñoz-Carpena (University of Florida), Liqiang Sun (North Carolina State University), Stefan Niemeyer (European Commission Joint Research Centre)

• Scientific Issues

The three key scientific issues discussed were: efficiently linking available water for irrigation to agricultural assessments, the representation of evapotranspiration (ET) and other hydrological fluxes in crop models, and scaling hydrologic and crop model output to decision-relevant (river basin, regional, national, global) levels. In addition, the group also discussed a variety of topics, including: timing of limited irrigation, water infrastructure and management, water competition from other sectors, supply allocation, salinity and quality, groundwater and drainage, non-stationary supplies (snow, glaciers), how to interface with decision makers and stakeholders (e.g., AgMIP crop and economic modelers, regional water managers, agencies, ministries), the use of station and remote sensing data to constrain hydrologic and crop models (e.g., SMAP, SWOT reservoir height, Landsat 8 ET, GRACE groundwater), hydrometeorological extremes, linkages between water, agriculture and energy, policy, including boundaries and compacts.

• Group Activities and Protocols Underway

The only explicit AgMIP Water activity is continuing collaborations from the AgMIP-ERS Water Workshop, which was held in April 2013. However, there are multiple relevant projects being pursued by AgMIP-related investigators at various stage of integration with AgMIP efforts, including: WEAP-DSSAT Central Valley project (Winter), WEAP-CropSYST in Chile (Meza), SWAT across the US and world (Gerik), construction of drought scenarios (Greene), IFPRI IMPACT water model integration (Gueneau), Costa Rican QnD watershed management (Muñoz-Carpena and Kiker), ET estimation and irrigation management in the Central Valley (Melton), combining LISFLOOD, BIOMA, and CAPRI (JRC). The group felt that given the early stage of AgMIP Water, detailed, official, protocols were not necessary and it would be best to instead rely on open communication and collaboration to encourage informal protocols.

• Near-term Model Improvements

The discussion focused more on potential projects as opposed to model improvements. Potential priorities for AgMIP Water included: develop the best (comprehensive and efficient) way to integrate crop and hydrologic models, interface with ISI-MIP Water and GGCMI, map global crop water stress frequency indicators, participate in the development of RAPs, establish geographic regions of interest to build efforts. Other projects proposed were: assess uncertainty in water resources supplies of global models vs. catchment models, improve crop and hydrologic models by extracting information hydrologic models can provide to crop models and vice versa, create a platform for coupling hydrologic and crop models, further scenario approaches to water resources assessments, focus on places and times of urgency, assess the vulnerability of areas dependent on groundwater, evaluate non-renewable water supplies (groundwater, glaciers, etc.), explore what global agriculture (yields and prices) would look like without groundwater, advance projections of water use and distributions, provide water database for crop modelers in collaboration with the IT group.

- **Next-Generation Components**

The group identified the following longer term goals: modularize hydrologic and crop models to enable greater ensembles leveraging more model combinations, develop and implement a range of water use projections and distribution scenarios, explicitly integrate groundwater, develop close partnerships between AgMIP Water, ISI-MIP Water, and AgGRID, assess water excess impacts, evaluate salinity and other water quality issues.

- **Priorities for Integration across Disciplines**

The priorities for integration across disciplines discussed by the group included: economics - yields, energy, link water use and distributions to RAPs; crops - irrigation water supply, flooding, water logging, run-on, transpiration, deep percolation, recharge, water demand, runoff, water conservation practices, crop management, irrigation scheduling; pests and diseases - water-dependent pests, diseases, and processes; livestock - flooding, water demand, water quality; climate - temperature and precipitation forcings.

- **Contributions to Regional/Global Scale Interactions**

The key contribution of AgMIP Water to regional and global scale interactions is to provide consistent water constraints on agriculture. The group felt that it was too early to discuss this contribution in further detail.

- **Timeline for Coming Year**

The timeline agreed upon by the group was: Next AgMIP Water Workshop – Start immediately, target July/August 2014. Funding Possibilities: NASA E.2, NSF, NIFA, USDA International Programs, EPA, EU sources. Submit Manuscript – Start immediately, target Fall 2014. Review and proof-of-concept manuscript submitted as a group. Working title: "On the Need for Hydrological Linkages in Crop Modeling". Collaborations - Team members will continue to work and report progress on their respective "Sentinel Watersheds". Partnerships - Jonathan and other AgMIP Water participants attend ISI-MIP Water meetings.

- **Funding Requirements**

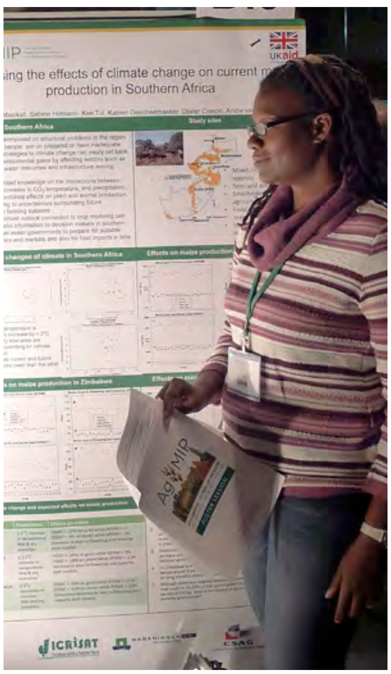
The group thought it was premature to brainstorm funding requirements, so instead discussed possible ways to fund near-term work. This included workshop money potentially from NASA E.2, NSF, NIFA, USDA International Programs, Cotton Growers, EPA, and EU sources. In the short term, projects will be supported by grants obtained by AgMIP-related scientists and leveraging existing AgMIP networks and efforts.

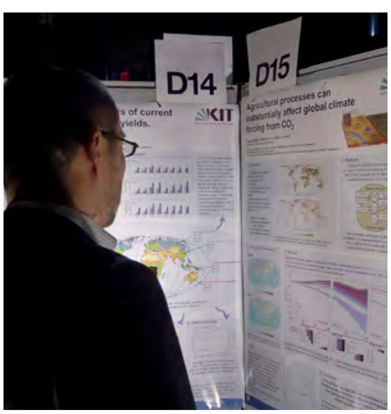
- **Brief lay-person-oriented description of work group activities**

Understanding evolving water resources, such as changing precipitation patterns, decreasing groundwater supplies, and growing water use, is a key component of determining climate impacts on agriculture. During the AgMIP Global Workshop a group of researchers convened over a series of breakouts to start the process of organizing an AgMIP research effort to improve the representation of water supply and demand in assessments of the agricultural sector. The breakouts started by brainstorming relevant methods, datasets, and currently existing projects. The conversation then transitioned to identifying ways to develop an AgMIP program on water and agriculture. By the end of the breakouts, the group decided to prioritize the following next steps: organize an AgMIP Water workshop, submit a review and proof-of-concept manuscript on water issues within agriculture, and pursue collaborations with related external programs.

- **Planned Publications**

Given the early stage of AgMIP Water, the group proposed a review and proof-of-concept manuscript: On the Need for Hydrological Linkages in Crop Modeling". The group noted that it would potentially be helpful for AgMIP to organize a special issue that could host a variety of these papers.





POSTERS

See Appendix A for Abstracts

Estimating Impact Assessment and Adaptation Strategies under Climate Change Scenarios for Crops at EU27 Scale, M. Donatelli et al.

Assessing Climatic Risk in Rice Productivity Using Integrated Climate, Crop and Economic Modeling Techniques, A. Ahmad et al.

Global Crop Yield Reductions due to Surface Ozone Exposure: Crop Production Losses and Economic Damage in 2000 and 2030 under Two Future Scenarios of Ozone Pollution, Shiri Avnery et al.

Improving Global Agricultural Production by Mitigating Ozone Damages to Crops via Methane Emission Controls and Ozone Resistant Cultivar Selection, Shiri Avnery et al.

Infrared Warming Affects Leaf Gas Exchange and Water Relations of Spring Wheat, G.W. Wall et al.

Economic Impacts of Climate change on farmers in Nioro du Rip, Senegal: An integrated assessment, Hathie, et al.

AgMIP Wheat, Senthold Asseng et al.

AgMIP Water: Integrating Water Scarcity into Future Agricultural Assessments, Jonathan M. Winter et al.

Biophysical and economic constraints on agricultural intensification in global diet scenarios, Thierry Brunelle et al.

Anthropogenic Climate Feedbacks via Changes in Crop Productivity, Andrew D. Jones and William D. Collins

The Influence of Shifting Planting Date on Cereal Grains Production under the Projected Climate Change, Dae-jun Kim et al.

Critical temperature and sensitivity for white immature rice kernels, Yuji Masutomi et al.

A library of software components for plant airborne diseases simulation, S. Bregaglio et al.

Adaptation of a generic fungal plant disease simulator to assess blast disease (Magnaporthe oryzae Cav.) impact on rice grown in temperate conditions,

S. Bregaglio et al.

Modeling insect pest distribution under climate change scenarios, A. Maiorano et al.

Modelling soil borne fungal pathogens of arable crops under climate change, L.M. Manici et al.

Representative Agricultural Pathways and Climate Impact Assessment for Pacific Northwest Agricultural Systems, John Antle et al.

Enhancing Capacities of the AgMIP South Asia Regional Teams through Capacity-Building Workshops and Knowledge-Sharing Platforms, Guntuku Dileepkumar et al.

An Integrated Assessment of Climate Change Impact on Crop Production in the Nioro du Rip Basin of Senegal I: Crop Modelling, D.S. MacCarthy et al.

ORACLE: Opportunities and risks of agrosystems & forests in response to climate, socio-economic and policy changes in France, Nathalie de Noblet-Ducoudré et al.

Impacts of projected climate change scenarios on the production and prices of staple and nutritionally important crops in the Southern Africa: project overview, Y. Beletse et al.

Integrated assessment of impacts of projected climate change on maize production in the Bethlehem District, Free State, South Africa, Y. Beletse et al.

Projecting spring wheat yield changes on the Canadian Prairies: Resolutions of a regional climate model, Budong Qian et al.

An integrated analysis on Austrian agriculture - climate change impacts and adaptation measures, Martin Schönhart et al.

Modeling crop yields and yield gaps in Russia, Ukraine and Kazakhstan under climate change, Friedrich Koch et al.

Agricultural impacts of climate variability and change in Eastern Africa, K.P.C. Rao et al.

Strengthening Simulation Approaches for Understanding, Protecting and Managing Climate Risks in Stress-prone Environments across the Central and Eastern Indo-Gangetic Basin, Nataraja Subash et al.

Assessing Climate Change Impact on Rice Based Farming Systems in Sri Lanka and Adaptation Strategies using DSSAT and APSIM Models, S.P. Nissanka et al.

Integrated Assessment of Climate Change Impacts on Principle Crops and Farm Household Income in Southern India, Paramasivam Ponnusamy

Integrated assessment of climate change and policy impacts on food security: a case study for protein crop supplies in Austria, Hermine Mitter et al.

Climate change adaptations for crop-livestock systems in semi-arid Zimbabwe, Sabine Homann-Kee Tui et al.

Assessing the effects of climate change on current smallholder-subsistence maize production in Southern Africa, Patricia Masikati et al.

TOA-MD: A New Approach to Assess Climate Change Impacts and Adaptation for Agricultural Households, John Antle et al.

TOA-MD: A Novel Simulation Approach to Multi-Dimensional Impact Assessment, John Antle et al.

Sentinel Site Data for Model Improvement and Application – Definitions and Characterization, K. J. Boote et al.

Need Across-Models-Across-Crops Testing of Evapotranspiration and Crop Water Use Against Data, K. J. Boote et al.

Progress on the Maize Pilot Study, J.I. Lizaso et al.

AgMIP Rice Team Activities, Tao Li et al.

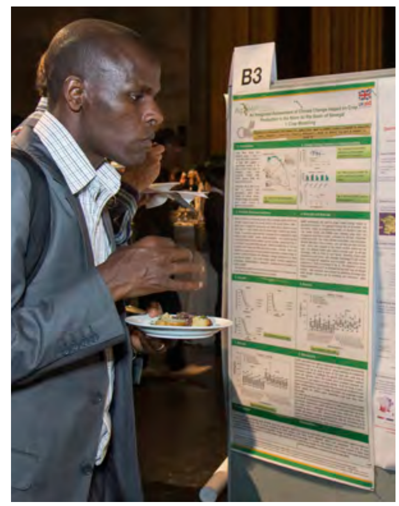
AgMIP Potato Pilot: A summary of progress made, Bruno Condori et al.

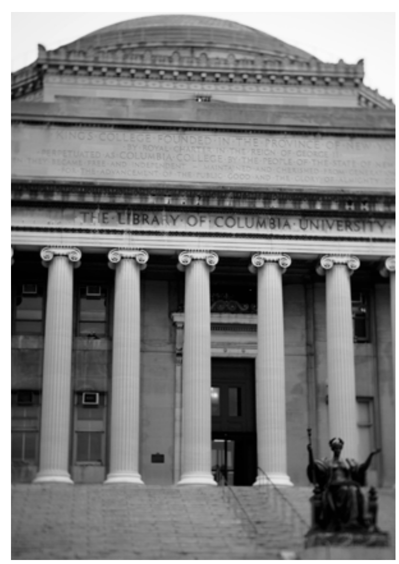
Soil suitability for sustainable intensification in smallholder systems in Sub-Saharan Africa, L. Claessens, et al.

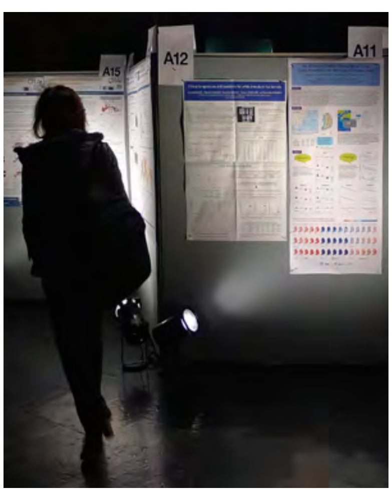
Software frameworks for crop model development and multi-purpose application, A. Topaj et al.

CropBASE: an integrative decision support platform for underutilised crops across research value chains, Asha S. Karunaratne et al.

Modeling the impact of global warming on the sorghum sowing window in distinct climates in Brazil, Flavio Justino et al.







Reimplementation and reuse of the Canegro model: from sugarcane to giant reed, T. Stella et al.

Multi-model simulations for rice yield forecasts in Jiangsu (China), V. Pagani et al.

Simulation of climate change impacts on rice yield and pre-harvest quality in Latin America, G. Cappelli et al.

The Impacts of Climate Change on Rice Farming Systems in North-Western Sri Lanka, L. Zubair et al.

Representative Agricultural Pathways and Scenarios: A Trans-Disciplinary Approach to Agricultural Model Inter-comparison, Improvement and Climate Impact Assessment, John Antle et al.

Development and application of a weather data client for preparation of weather input files to a crop model, Chung-Kuen Lee et al.

Using EPIC for simulating global wheat production: model set-up and future projections, Juraj Balkovi et al.

The Coordinated Climate-Crop Modeling Project (C3MP): Overview and Protocol Evaluation, Sonali McDermid et al.

Climate Impact Estimates on C3MP's Worldwide Network of Crop Modeling Sites, Alex Ruane et al.

The Global Gridded Crop Model Intercomparison (GGCMI), Joshua Elliot et al.

The 2012 AgMIP/ISI-MIP Fast-Track Assessment, Joshua Elliot et al.

Evaluating the utility of dynamical downscaling in large-scale yield assessments, Michael Glotter et al.

Climate scenarios for driving AgMIP models, Arthur Greene

The Extraction of Double-Cropping Areas in North Korea using Fourier Transform

Analysis of Time-series MODIS Imagery, Su-Young Cha et al.

Modelling Efforts and Integrated Regional Studies in FACCE MACSUR, Martin Köchy

Enhancing Model Reuse via Component-Centered Modeling Frameworks: the Vision and Example Realizations, Marcello Donatelli et al.

MODEXTREME - MODelling vegetation response to EXTREMe Events, Gianni Bellocchi et al.

Big Data for Big Solutions: Eddy Flux, Mesonet and C Sequestration, Vijaya Gopal Kakani et al.

A biome-based analysis of current and future global crop yields, T.A.M. Pugh et al.

Agricultural processes can substantially affect global climate forcing from CO2, T.A.M. Pugh et al.

Simulating Adaptive Managagement Using Impact Models in a Risk Framework, Nina K. Pirttioja et al.

Global Crop Yield Reductions due to Surface Ozone Exposure: Crop Production Losses and Economic Damage in 2000 and 2030 under Two Future Scenarios of O3 Pollution, Shiri Avnery et al.

Improving Global Agricultural Production by Mitigating Ozone Damages to Crops via Methane Emission Controls and Ozone Resistant Cultivar Selection, Shiri Avnery et al.

Harmonizing AgMIP Site-Based Data, Porter et al.

PARTICIPANTS

LAST NAME	FIRST NAME	ORGANIZATION
Adamu	James	Nigerian Meteorological Agency
Adiku	Samuel	University of Ghana
Aggarwal	Pramod	CGIAR, Indian Agricultural Research Institute
Ahmad	Ashfaq	University of Agriculture Faisalabad
Ahmad	Shakeel	Bahauddin Zakariya University Multan-Pakistan
Alderman	Phillip	CIMMYT
Amikuzuno	Joseph	University for Development Studies
Andresen	Jeffrey	Michigan State University
Antle	John	Oregon State University
Ashfaq	Muhammad	University of Agriculture, Faisalabad-Pakistan
Assad	Eduardo	EMBRAPA
Asseng	Senthold	University of Florida
Athanasiadis	Ioannis	Democritus University of Thrace
Baethgen	Walter	IRI/Columbia University
Baigorria	Guillermo	University of Nebraska-Lincoln
Balser	Teri	University of Florida
Banse	Martin	Thuenen-Institute
Bantilan	Cynthia	ICRISAT
Barreda	Carolina	International Potato Center
Basso	Bruno	Michigan State University
Bationo	Andre	AGRA
Beletse	Yacob	Agricultural Research Council
Bellocchi	Gianni	French National Institute for Agricultural Research (INRA)
Bernardi	Michele	FAO
Bertuzzi	Patrick	INRA - US Agroclim - Avignon
Best	Neil	University of Chicago
Blanc	Elodie	MIT
Boote	Kenneth	University of Florida
Bortolon	Elisandra	EMBRAPA- Natl Lab of Fisheries, Aquaculture and Agricultural Systems
Bortolon	Leandro	EMBRAPA - Natl Lab of Fisheries, Aquaculture and Agricultural Systems
Cammarano	Davide	University of Florida
Cane	Mark	Columbia University, IRI
Cha	SuYoung	Seoul National University
Chryssanthacopoulos	James	Columbia University
Chung	Uran	CIMMYT
Ciaian	Pavel	European Commission, Joint Research Center
Claessens	Lieven	ICRISAT
Cole	Jefferson	U.S. EPA
Condori	Bruno	International Potato Center
Confalonieri	Roberto	University of Milan
Costello	Christine	University of Missouri
Cox	Carolyn	University of Florida
Craufurd	Peter	CIMMYT
Danda	Raji Reddy	Acharya N.G.Ranga Agricultural University
Darai	Rajendra	Nepal Agricultural Research Council(NARC)
De Groot	Hugo	Alterra, Wageningen UR
de Noblet	Nathalie	CNRS / LSCE
Debats	Stephanie	Princeton University

LAST NAME	FIRST NAME	ORGANIZATION
Denisov	Vitalij	Klaipeda University
Deryng	Delphine	University of East Anglia
Dickson	Caleb	Oregon State University
Donatelli	Marcello	CRA
Downie	Katie	International Livestock Research Institute
Dumas	Patrice	CIRAD/CIRED
Durand	Jean-Louis	INRA
Durigon	Angelica	Center for Nuclear Energy in Agriculture - University of São Paulo
Echereobia	Christopher Ogbuji	Federal University of Technology Owerri, Nigeria
Edgerton	Mike	Monsanto Company
Elliott	Joshua	University of Chicago
Ewert	Frank	University of Bonn
Fiona	Ehrhardt	INRA-CODIR-DSENV
Fleisher	David	USDA
Frank	Stefan	IIASA
Furlow	John	USDA
Gangwar	Babooji	PDFSR
Garrett	Karen	Kansas State University
Gayler	Sebastian	WESS - Water & Earth System Science Competence Cluster
Gerik	Thomas	Texas A&M AgriLife Research
Giacomo	De Sanctis	INRA - US Agroclim - Avignon
Gilbert	Xavier	Imperial College London
Glotter	Michael	University of Chicago
Gopinath	Munisamy	Oregon State University
Grace	Peter	Queensland University of Technology
Greene	Arthur	IRI/Columbia University
Gueneau	Arthur	IFPRI
Guntuku	Dileepkumar	ICRISAT
Gustafson	Dave	ILSI Research Foundation - CIMSANS
Hansen	James	International Research Institute for Climate and Society
Hatfield	Jerry	USDA-ARS-NLAE
Hendley	Paul	Phasera Ltd
Herrero	Mario	CSIRO
Hickman	Jonathan	Columbia University
Hillel	Daniel	Columbia University
Hoffmann	Holger	Institute of Crop Science and Resource Conservation (INRES), University of Bonn
Hohenstein	William	USDA Climate Change Program Office
Holzworth	Dean	CSIRO
Hoogenboom	Gerrit	Washington State University
Howden	Mark	CSIRO
Hudson	Nick	Columbia
Hussain	Jamshad	University of Agriculture, Faisalabad-Pakistan
Ines	Amor VM	IRI/Columbia University
Islam	Shahnila	International Food Policy Research Institute (IFPRI)
Iyob	Biniam	USAID-Bureau for Food Security
Jahn	Molly	University of Wisconsin-Madison
Jain	Atul	University of Illinois
Jalandoni	Alessandra	University of the Philippines (Open University)
Janssen	Sander	Alterra
Jones	Andrew	Lawrence Berkeley Laboratory

LAST NAME	FIRST NAME	ORGANIZATION
Jones	James W	University of Florida
Jorgenson	Jason	University of Reading
Justino	Flavio	Universidade Federal de Viçosa
Kadiyala	Dakshina Murthy	ANGR Agricultural University
Kakani	Vijaya Gopal	Oklahoma State University
Kandaswamy	Mahendran	Tamil Nadu Agricultural University
Karunaratne	Asha	Sabaragamuwa University of Sri Lanka
Kersebaum	Kurt Christian	Leibniz Centre for Agricultural Landscape Research
Kihara	Job	CIAT
Kiker	Gregory	University of Florida
Kilavi	Mary	Kenya Meteorological Service
Kim	Dae-jun	Kyung Hee University
Kim	Kwang Soo	Seoul National University
Kinfe	Yosef Welderufael	Ethiopian Agricultural Transformation Agency (ATA)
King	Anthony	Oak Ridge National Laboratory
Koch	Friedrich	Leibniz Institute of Agricultural Development in Central and Eastern Europe (IAMO)
Kong	Angela	NASA-GISS/Columbia University
Küchy	Martin	Thünen Institute of Market Analysis
Kuhlgatz	Christian	Thünen Institute of Market Analysis
Kyle	Page	Pacific Northwest National Laboratory
Laborde	David	IFPRI
Lee	Christine	NASA
Levy	Marc	Columbia
Li	Tao	International Rice Research Institute
Lifson	Shari	Columbia University
Liu	Bing	Nanjing Agricultural University
Liu	Leilei	Nanjing Agricultural University
Liu	Xing	Purdue University
Lotze-Campen	Hermann	Potsdam Institute for Climate Impact Research (PIK)
MacCarthy	Dilys	University of Ghana
MacGregor	Bob	Agriculture and Agri-Food Canada
Magrin	Graciela Odilia	INTA
Mamo	Girma	EIAR
Manici	Luisa Maria	CRA - Research Centre for Industrial Crops
Marin	Fabio	University of Sao Paulo
Masikati	Patricia	CGIAR
Mason-D'Croz	Daniel	International Food Policy Research Institute (IFPRI)
Masutomi	Yuji	Center for Environmental Science in Saitama
Mauzerall	Denise	Princeton University
McDermid	Sonali	Columbia University
Mearns	Linda	National Center for Atmospheric Research
Melton	Forrest	NASA
Mencos Contreras	Erik Alejandro	Columbia University
Meza	Francisco	Centro de Cambio Global Pontificia Universidad Catolica de Chile
Mitter	Hermine Christiane	University of Natural Resources and Life Sciences Vienna, Austria
Monier	Erwan	MIT
Moscuzza	Alessandro	UKAID-DFID
Mu	Jianhong	Oregon State University
Müller	Christoph	Potsdam Institute for Climate Impact Research
Muñoz-Carpena	Rafael	University of Florida
Musumba	Mark	Columbia University

LAST NAME	FIRST NAME	ORGANIZATION
Mutter	Carolyn	Columbia University
Nazareth	Vijay	University of Florida
Nedumaran	Swamikannu	ICRISAT
Negm	Lamyaa	NCSU
Nelson	Gerald	University of Illinois at Urbana-Champaign
Nendel	Claas	Leibniz Centre for Agricultural Landscape Research (ZALF)
Ngugi	Moffatt	USAID
Niemeyer	Stefan	European Commission, Joint Research Centre
Nissanka	Sarath	University of Peradeniya
OLeary	Garry	Department of Environment and Primary Industries
Olesen	Jørgen E.	Aarhus University
Olin	Stefan	Lund University
Parry	Martin	Imperial College
Pinto	Hilton	State University of Campinas - Unicamp
Ponnusamy	Paramasivam	TNAU
Porter	Cheryl	University of Florida
Prescott	Ryan	Agriculture and Agri-Food Canada
Pugh	Thomas	Karlsruhe Institute of Technology / IMK-IFU
Qian	Budong	Agriculture and Agri-Food Canada
Ramarohetra	Johanna	IRD
Rao	KPC	ICRISAT-Nairobi
Ren	Xiaolin	National Center for Atmospheric Research
Reynolds	Matthew	CIMMYT
Ripoche-Wachter	Dominique	INRA - US Agroclim - Avignon France
Rising	James	Columbia
Rivera	Vilma	The Earth Institute
Robinson	Sherman	International Food Policy Research Institute (IFPRI)
Rodriguez	Gabriel	Instituto Nacional de Tecnologia Agropecuaria - INTA
Rooyen	Andre	ICRISAT
Rosegrant	Mark	IFPRI
Rosenzweig	Cynthia	NASA-GISS/Columbia University
Rötter	Reimund	MTT Agrifood Research Finland
Ruane	Alex	NASA GISS
Sachs	Jeffrey	Columbia University
Sands	Ron	USDA-Economic Research Service
Schneider	Kate	Bill & Melinda Gates Foundation
Schoenhart	Martin	University of Natural Resources and Life Sciences
Seifert	Christopher	Stanford University
Semenov	Mikhail	Rothamsted Research
Shelia	Vakhtang	Washington State University
Sinabell	Franz	Austrian Institute of Economic Research
Singh	Balwinder	CIMMYT
Sivakumar	Mannava V.K.	WMO
Skalsky	Rastislav	International Institute for Applied Systems Analysis
Snow	Val	AgResearch
Soussana	Jean-Francois	INRA, France
Springer	Nathaniel	Agriculture Sustainability Institute, UC Davis
Springmann	Marco	University of Oldenburg
Stockle	Claudio	Washington State University
Subash	Nataraja	PDFSR

LAST NAME	FIRST NAME	ORGANIZATION
Sullivan	Clare	Columbia University
Sultan	Benjamin	IRD-LOCEAN
Sun	Liqiang	North Carolina State University
Tao	Fulu	MTT
Tedeschi	Luis	Texas A&M University
Tenywa	Moses	Makerere University Agricultural Research Institute, Kabanyolo (MUARIK)
Thibodeau	Andrew	Columbia University
Thorburn	Peter	CSIRO
Thornton	Philip	ILRI, CCAFS
Tiscornia	Guadalupe	INIA Uruguay
Tollenaar	Matthijs	Monsanto Co.
Tommaso	Stella	University of Milan
Topaj	Alex	Agrophysical Research institute
Travasso	María Isabel	INTA
Valdivia	Roberto	Oregon State University
van der Mensbrugghe	Dominique	FAO
Van Doren	Saratha	Monsanto Co
van Ittersum	Martin	Wageningen University
van Meijl	Hans	LEI, Wageningen UR
Vanuytrecht	Eline	KU Leuven
Vellingiri	Geethalakshmi	Tamil Nadu Agricultural University
Villalobos	Christopher	University of Floirda
von Lampe	Martin	Organisation for Economic Co-operation and Development OECD
Waha	Katharina	Potsdam Institute for Climate Impact Research
Wajid	Syed Aftab	University of Agriculture, Faisalabad-Pakistan
Wall	Gerard W	USDA-ARS
Wallach	Daniel	INRA
Wang	Enli	CSIRO Land and Water
Wei	Xiong	IIASA
Weinberg	Marca	USDA-ERS
Whitbread	Anthony	University of Goettingen, Germany
Wiebe	Keith	IFPRI
Wieruszeski	Sophie	CNRS - LSCE
Willenbockel	Dirk	Institute of Development Studies at the University of Sussex
Wilson	Lloyd	Texas A&M AgriLife Research - Beaumont/Eagle Lake
Winchester	Niven	MIT
Winter	Jonathan	Dartmouth College
Wood	Stan	Bill and Melinda Gates Foundation
Wouk	Byron	Columbia
Xia	Lili	Rutgers University
Yan	Nana	Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences
Yao	Xia	Nanjing Agricultural University
Youssef	Mohamed	NCSU
Zeng	Hongwei	The Institute of Remote Sensing and Digital Earth (RADI), Chinese Academy of Sciences (CAS)
Zhang	Meng	University of Florida
Zhang	xin	Princeton University
Zhu	Yan	Nanjing Agricultural University
Zubair	Lareef	Foundation for Environment, Climate, and Technology, Sri Lanka

VOLUNTEERS

Toyah Barigye
Onella Cooray
Dannie Dinh
Vivianne Reynoso
Bo Yeon Jang
Ece Ersoz
Salama Shelton
Daniel Nothaft
Shifali Gupta
Chenyan Lu
Monica Pasqulino
Molly Schneider
Molly Slotznick
Harneet Kaur
Yun Lu
Colin Gannon
Lea Cohen

ACKNOWLEDGEMENTS

AgMIP would like to thank the Earth Institute/Columbia University for hosting the Global Workshop and providing meeting support, especially Vilma Gallagher and her team for assisting with meeting logistics. We would also like to thank the team at the Columbia Faculty House for their dedication and attention to detail.

AgMIP would also like to thank all those that contributed time and effort to making this workshop a success.

LINKS TO ONLINE MATERIAL

Agenda:
http://www.agmip.org/wp-content/uploads/2013/12/4th-AgMIP-GW-Agenda-final1.pdf

Participant List:
http://www.agmip.org/wp-content/uploads/2013/12/Participant-Listing-10.24.pdf

Presentations:
http://www.agmip.org/4th-annual-global-workshop-presentations/

Work Group Reports:
http://www.agmip.org/4th-annual-global-workshop-work-group-reports/

PDFs of Posters:
http://www.agmip.org/4th-annual-global-workshop-posters/

Poster Abstracts:
http://www.agmip.org/wp-content/uploads/2013/12/4th-Annual-GW-Poster-Program-Final1.pdf

Appendix A: Poster Titles and Abstracts

Assessing Climatic Risk in Rice Productivity Using Integrated Climate, Crop and Economic Modeling Techniques

A. Ahmad et al.
Poster position: A2

A. Ahmad, M. Ashfaq, A. Wajid, G. Rasul, T. Khaliq, S. Ahmad, W. Naseem, J. Hussain, M.H. Rahman, U. Saeed, S.A.A. Naqvi and G. Hoogenboom

Rice-wheat cropping zone of Pakistan is facing accelerated incidence rate of extreme weather events. AgMIP-Pakistan is working to quantify the climate change effects on rice crop currently at farm levels using climate, crop and economic models. Five rice producing districts were surveyed and data of 155 farmers were collected for crop and economic models. DSSAT and APSIM were used for crop simulations under present and future climate scenarios. The yield simulations of crop models were obtained separately for baseline (1981-2010) and five future scenarios using 5 GCMs with RCPs 8.5 between 2040 and 2069. The predicted mean data of GCMs showed about 2°C temperature and 0.13% increase in rainfall till mid-century (2040-2069). The performance of DSSAT was relatively better than APSIM with RMSE (425.46, 440.48 kg ha^{-1}), d-stat (0.784, 0.786) and R^2 (0.52, 0.44), respectively. Models showed a decreasing trend in yield by 30, 20, 13, 7 and 6% (mean 15.2%) in DSSAT and 19, 14, 16, 15 and 18% (mean 17.2%) in APSIM, using five GCMs GFDL, MPI-ESM, CCSM4, MICROS and Had-GEM, respectively. The overall results of TOA-MD model without adaptation showed about 26 and 25 percent gainers for DSSAT and APSIM models, respectively. The results of analysis with adaptation showed that the numbers of adopters would be 64 and 42 percent in APSIM and DSSAT, respectively. Mean net returns per farm were calculated as $2511 and $3728 for without and with-adaptation scenarios for overall APSIM model. Similarly, the mean net returns per farm were calculated as $2505 and $2671 for without and with-adaptation scenarios in case of DSSAT model.

Representative Agricultural Pathways and Climate Impact Assessment for Pacific Northwest Agricultural Systems

John Antle et al.
Poster position: B1

John Antle[1], Elina Mu[2], Hongliang Zhang[3], Susan Capalbo[4], Sanford Eigenbrode[5], Chad Kruger[6], Claudio Stockle[7], J.D. Wolfhorst[8]
[1] Professor of Agricultural and Resource Economics, Oregon State University
[2] Post-doctoral researcher, Agricultural and Resource Economics, Oregon State University
[3] Graduate research assistant, Oregon State University
[4] Professor and Department Head, Agricultural and Resource Economics, Oregon State University
[5] Professor of Entomology and REACCH Project Director, University of Idaho
[6] Director, Center for Sustaining Agriculture and Natural Resources, Washington State University
[7] Professor and Chair, Department of Biological Systems Engineering, Washington State University
[8] Professor, Social Sciences Research Unit, University of Idaho

Representative Agricultural Pathways (RAPs) are projections of plausible future biophysical and socio-economic conditions used to carry out climate impact assessments for agriculture. The development of RAPs is motivated by the fact that the various global and regional models used for agricultural climate change impact assessment have been implemented with individualized scenarios using various data and model structures, often without transparent documentation or public availability. These practices have hampered attempts at model inter-comparison, improvement, and synthesis of model results across. This poster aims to (1) present RAPs developed for the principal wheat-producing region of the Pacific Northwest, and to (2) combine these RAPs with downscaled climate data, crop model simulations and economic model simulations to assess climate change impacts on winter wheat production and farm income. This research was carried out as part of a project funded by the USDA known as the

Regional Approaches to Climate Change in the Pacific Northwest (REACCH).

To develop RAPS for the REACCH region, project scientists and other experts with knowledge of the region's agricultural systems are working together through a step-wise process designed to record and document the information used to create RAPS. The REACCH team developed 3 RAPS to represent the future agricultural pathways and scenarios, labeled Business-as-Usual, Dysfunctional World and Aggressive Climate Policy. In each RAP, key variables are identified, narratives are constructed, and quantitative values are assigned. These RAPS are then used by the modeling team to simulate climate change impacts and how technological innovations will help farmers adapt to changing environmental and economic conditions.

TOA-MD: A New Approach to Assess Climate Change Impacts and Adaptation for Agricultural Households

John Antle et al.

Poster position: C1

John M. Antle[1], Roberto O. Valdivia[1*]
[1] Department of Agricultural and Resource Economics, Oregon State University
[*] Corresponding:
Roberto.Valdivia@oregonstate.edu

Despite the growing attention paid to the potential for climate change to affect climate variability and extremes, most models being used to assess climate change impacts on agricultural producers are based on averaged or aggregated data over relatively large populations. The only sense in which such studies can assess vulnerability – defined as the risk of a negative impact – is in terms of average impacts on groups of farm households stratified by some criterion such as a spatial unit, typically a political unit or an agro-ecozone. In this presentation we present a new economic simulation approach that combines available historical data, statistical models, down-scaled climate data, experimental data and process-based production models, to approximate future distributions of production and associated economic outcomes such as farm net returns. We also show how this model can be used to parameterize an economic impact assessment model, the Tradeoff Analysis Model for Multi-Dimensional Impact Assessment (TOA-MD; Antle 2011; Antle and Valdivia 2011). TOA-MD provides the capability to go beyond the analysis of averaged or aggregated data, by representing the distributions of economic, environmental and social outcomes in heterogeneous populations of farm households. When used for climate impact assessment, the TOA-MD model can be used to show how the distributions of outcomes are affected by climate and by adaptations farmers may undertake in response to climate change.

TOA-MD: A Novel Simulation Approach to Multi-Dimensional Impact Assessment

John Antle et al.

Poster position: C2

John M. Antle[1], Roberto O. Valdivia[1*]
[1] Department of Agricultural and Resource Economics, Oregon State University
[*] Corresponding:
Roberto.Valdivia@oregonstate.edu

This poster presents a novel approach to impact assessment of agricultural systems which has been implemented as the TOA-MD simulation model. The TOA-MD Model is a unique simulation tool for multi-dimensional impact assessment that uses a statistical description of a heterogeneous farm population to simulate the adoption and impacts of a new technology, a change in environmental conditions, and ecosystem services supply. TOA-MD is a parsimonious approach to impact assessment that is particularly well-suited to ex ante assessment. Unlike conventional ex post statistical or econometric methods that require large, detailed cross-sectional or panel data sets, TOA-MD is designed for ex ante assessment and can be implemented with various types of data, including survey, experimental, and modeled data, together with technological and socio-economic scenarios derived from experts and stakeholders. The poster provides an overview of the approach and the TOA-MD model software, and illustrates the use of the model with results from an application of the model to assess impacts of the adoption of Integrated Agriculture-Aquaculture in Malawi.

Representative Agricultural Pathways and Scenarios: A Trans-Disciplinary Approach to Agricultural Model Inter-comparison, Improvement and Climate Impact Assessment

John Antle et al.
Poster position: C16

John Antle[1], Roberto Valdivia[1*], Lieven Claessens[2], Gerald Nelson[3], Cynthia Rosenzweig[4], Alex Ruane[4], and Joost Vervoort[5]
[1] Oregon State University
[2] International Crops Research Institute for the Semi-Arid Tropics, ICRISAT
[3] International Food Policy Research Institute, IFPRI
[4] NASA Goddard Institute for Space Studies
[5] University of Oxford/CCAFS
[*] Corresponding: Roberto.Valdivia@oregonstate.edu

This poster presents concepts and methods for the development of global and regional Representative Agricultural Pathways and Scenarios that can be used for agricultural model inter-comparison, improvement and impact assessment. These pathways and scenarios are based on the integrated assessment framework developed by the Agricultural Model Inter-comparison and Improvement Project. This framework shows that both bio-physical and socio-economic drivers are essential components of agricultural pathways and logically precede the definition of adaptation and mitigation scenarios that embody associated capabilities and challenges. Based on this approach, we describe a trans-disciplinary process to design pathways and then to translate pathways into scenarios for both bio-physical and economic models that are components of agricultural integrated assessments of climate impact, adaptation and mitigation. To implement this trans-disciplinary approach, we propose a step-wise process similar to the "story and simulation" (SAS) approach to scenario design that brings together expertise from the relevant disciplines to design pathways, and then use these pathways to design consistent scenarios (i.e., model-specific parameters) for crop and livestock simulation models and economic impact assessment models. We present an example of modeling impacts of climate change using the RAPs concept.

Improving Global Agricultural Production by Mitigating Ozone Damages to Crops via Methane Emission Controls and Ozone Resistant Cultivar Selection

Shiri Avnery et al.
Poster position: A4

Shiri Avnery, Denise L. Mauzerall, Arlene M. Fiore

No abstract provided.

Global Crop Yield Reductions due to Surface Ozone Exposure: Crop Production Losses and Economic Damage in 2000 and 2030 under Two Future Scenarios of Ozone Pollution

Shiri Avnery et al.
Poster position: A3

Shiri Avnery, Denise L. Mauzerall, Junfeng Liu, and Larry W. Horowitz

No abstract provided.

Using EPIC for simulating global wheat production: model set-up and future projections

Juraj Balkovič et al.
Poster position: D2

Juraj Balkovič[1], Marijn van der Velde[1], Rastislav Skalský[1], Wei Xiong[1], Nikolay Khabarov[1], Alexey Smirnov[1], Michael Obersteiner[1]
[1] International Institute for Applied Systems Analysis (IIASA), Ecosystem Services and Management Program, Schlossplatz 1, A-2361 Laxenburg, Austria

With a current production of ~700 Mt, wheat is the third largest crop globally, and an essential source of calories in human diets. Sustainable intensification of wheat systems to satisfy rising food demands and the impacts of future climate on wheat yields are widely discussed aspects of securing and sustaining future world wheat production. In this study we present a global EPIC implementation to quantify global wheat production under new generation of climate change scenario. The global modelling system was constructed at 5 arc-min grid by combining the EPIC, v. 0810 model and GIS layers on soils, relief, administrative units, 0.5 arc-deg weather grid, wheat growing periods and fertilizers consumption around 2000 (Mueller et al. 2012). The Princeton weather data were used for the baseline time period (1990 - 2000) and bias-corrected HadGEM2-ES GCM simulations for RCP2.6, 4.5, 6.0 and 8.5 concentration scenarios for the future projections (2041 – 2060, 2081 – 2100). The EPIC model performed satisfactorily in the prediction of average historical wheat yields and production. EPIC simulations with four climate change projections revealed spatially heterogeneous impacts on actually achieved and potential wheat yields across regions and RCP scenarios. From the global perspective and averaged for all RCPs, global wheat production on currently cultivated cropland would likely decrease respectively by 7 and 12% in the 2050s and 2090s because of worsening climatic conditions. There are many differences among regions pointing to spatially differing effects of the climatic drivers on wheat growth.

Impacts of projected climate change scenarios on the production and prices of staple and nutritionally important crops in the Southern Africa: project overview

Y. Beletse et al.
Poster position: B5

Y. Beletse[1], W.Durand[2], O.Crespo[3], C.Nhemachena[6], W.Tesfuhuney[5], M Jones[4], M.Teweldemedhin[7], M.Gamedze[5], P. Gwimbi, T. Mpusaing, PM Bonolo[7], J Siyanda[6] and D Cammarano[8]
[1] Agricultural Research Council-Roodeplaat, KuwaMahlanga road, Pretoria 0001, South Africa
[2] Agricultural Research Council-Small Grain Institute, Potchefstroom, South Africa
[3] Climate System Analysis Group, Environmental and Geographical Science Department, University of Cape Town, 7701 Rondebosch, South Africa
[4] South African Sugarcane Research Institute, 170 Flanders Drive. Mount Edgecombe. KwaZulu-Natal
[5] University of the Free State, PO Box 339 (int 60) Bloemfontein 9300 South Africa
[6] Human Sciences Research Council, Pretorius street, 134 Pretoria, South Africa
[7] Polytechnic of Namibia, Storch Street
[8] Agricultural & Biological Engineering Department, University of Florida, Gainesville, FL 32611, USA

SAAMIIP is a regional AgMIP project with members from South Africa, Lesotho, Swaziland, Botswana and Namibia. The objective of the project is to assess, using climate, crop and economic models, the impacts of projected climate change on agricultural production and socio economics factors in southern Africa. Two crop models (DSSAT and APSIM) were calibrated against detailed field data collected at 'sentinel sites' in each of the countries. Climate dataset for baseline (historical, 1980-2010) and future (2040-2070) was then used by the two crop models to generate a yield change between baseline and future. This information, along with socio economic data and farming communities cropping regions are used as input in the TOA-MD economic model to assess climate change

adaptation strategies and their physical and social impacts on farming communities.

The data were gathered from five countries in collaboration with 10 institutions in Southern Africa. The frequent training and the workshops helped the team to clarify the methodologies for using the inputs and for making assumptions for running the climate, crop, and economic models. In addition, the team achieved a better understanding of Regional Agricultural Pathways (RAPs), and the process of developing RAPs for using them in the economic model. Southern Africa is predicted to be affected by increase in temperature and variable rainfall. Without sufficient adaptation measures, the region will likely to suffer negative impacts on several crops that are important in securing food in the region.

Integrated assessment of impacts of projected climate change on maize production in the Bethlehem District, Free State, South Africa

Y. Beletse et al.
Poster position: B6

Y. Beletse[1], W.Durand[2], C.Nhemachena[6], O.Crespo[3], W.Tesfuhuney[5], M Jones[4], M.Teweldemedhin[7], M.Gamedze[5], PM Bonolo[7], and J Siyanda[6]
[1] Agricultural Research Council-Roodeplaat, KuwaMahlanga road, Pretoria 0001, South Africa
[2] Agricultural Research Council-Small Grain Institute, Potchefstroom, South Africa
[3] Climate System Analysis Group, Environmental and Geographical Science Department, University of Cape Town, 7701 Rondebosch, South Africa
[4] South African Sugarcane Research Institute, 170 Flanders Drive. Mount Edgecombe. KwaZulu-Natal
[5] University of the Free State, PO Box 339 (int 60) Bloemfontein 9300 South Africa
[6] Human Sciences Research Council, Pretorius street, 134 Pretoria, South Africa
[7] Polytechnic of Namibia, Storch Street

The impacts of projected climate change on maize production were assessed for 400 maize fields in the Bethlehem District, in the Free State Province, South Africa using climate, crop and economic models. Data used as input by crop and economic models were field crop boundaries, satellite imagery classification, yield surveys, land type classification. Two crop models (DSSAT and APSIM) were calibrated for the local condition using observed climate, soil and agronomic data in the region. Past (1980-2010) and future (5 GCMs for the time period 2040-2070, with RCP8.5 and CO_2 of 571ppm) maize production was simulated and the yield change between future and baseline was determined. The simulated yield changes were used as input into the Trade of Analysis for multi-dimensional impact assessment model (TOA-MD) to characterize the economic impact of climate change. Projections of future changes in climate for South Africa showed an increase in temperature and variability in rainfall, increasing the risk of crop failure and food insecurity in the region. Overall, DSSAT and APSIM simulated a decrease of maize production using projected changes in climate in the region, which will have major implication to food security. The TOA-MD projections showed that about 74% of the farmers in the district would benefit from climate change.

MODEXTREME - MODelling vegetation response to EXTREMe Events

Gianni Bellocchi et al.
Poster position: D12

Gianni Bellocchi[1], Francisco Villalobos[2], Marcello Donatelli[3], Ole B. Christensen[4], Pasquale Steduto[5], Roberto Confalonieri[6], Ioannis N. Athanasiadis[7], Irina Carpusca[8], Claudio Stöckle[9]
[1] Institut National de la Recherche Agronomique (INRA), Clermont-Ferrand, France
[2] Universidad de Córdoba (UCO), Córdoba, Spain
[3] CRA-CIN, Consiglio per la Ricerca e la sperimentazione in Agricoltura, Bologna, Italy
[4] Danmarks Meteorologiske Institut, Copenhagen, Denmark

[5] Food and Agriculture Organization of the United Nations (FAO), Rome, Italy
[6] Università degli Studi di Milano, Milan, Italy
[7] Democritus University of Thrace, Xanthi, Greece
[8] INRA-Transfert, Paris, France
[9] Washington State University, Pullman, United States of America

Extreme weather events are combinations of environmental drivers occurring with a low frequency and negatively impacting on agricultural productions. The project EU-FP7 MODEXTREME (coordination: INRA; grant: 2,000,000 €; start: November 1st, 2013; duration: three years) has the overarching goal to improve the capability of biophysical crop and grassland models by integrating climatic variability and extreme events (mainly high/low temperatures; water deficit/excess). The project includes 18 worldwide partners (seven universities, eight research institutions, one international organization, one software enterprise and one service management society). Generically reusable software units implementing libraries of process models will be created to extend existing modelling capabilities to extreme weather impacts. Estimates from existing and new modelling solutions will be both compared on a variety of datasets and evaluated with respect to medium-term trajectories of future climate. This will be achieved via the multi-model platform for plant growth and development simulations BioMA (The Biophysical Model Application) and will support short- and medium-term forecasts in Europe via the Monitoring Agricultural ResourceS (MARS) workflow of European Commission Joint Research Centre. Project results will also contribute to improve food security monitoring and early warning systems outside Europe (Argentina, Brazil, China, South Africa, United States) via transfer of knowledge to local stakeholders.

Sentinel Site Data for Model Improvement and Application – Definitions and Characterization

K. J. Boote et al.
Poster position: C3

K. J. Boote[1], C. H. Porter[2], J. W. Jones[2], P. J. Thorburn[3], and G. Hoogenboom[4]
[1] Agronomy Dept., University of Florida, Gainesville, FL 32611
[2] Agric and Biol. Engr. Dept., University of Florida, Gainesville, FL 32611
[3] CSIRO, Brisbane, Australia
[2] Washington State University, Prosser, WA

Quality experimental data are a necessary pre-requisite for use by crop modelers in order to calibrate, evaluate, and improve models for ability to respond to climatic change factors of carbon dioxide, temperature, precipitation and the interaction with management and genetic factors. Here we describe criteria for characterizing the quality, quantity, reliability/accuracy, and value of measured crop, soil, weather, and management data for modeling purposes. AgMIP is establishing a data base for storage of crop, soils, and weather data to be used for running and testing of models. The data sets are categorized as platinum, gold, silver, or copper based on quality. Platinum indicates highest quality observed data for model evaluation, and improvement, with a full complement of variables including in-season and end-of-season crop growth and yield measurements, with observed site-specific data on soil, weather, and management conditions for model inputs. The second-tier 'gold sentinel' sites have sufficient information for model calibration and evaluation, but lack the breadth of variables or intensity of data available, and weather or soil data may not be measured on-site. The third-tier 'silver sentinel sites' is characteristic of yield trials that plant breeders manage, where end-of-season yield is measured, along with management inputs of planting date, irrigation, and fertilization. However, in-season measurements and phenology are lacking, and weather and soil data are not site-specific. Copper sentinel sites have fair quality data such as site-specific farm survey yields or variety trial yields, but local

weather and soil information are not available and some management data are approximated.

Need Across-Models-Across-Crops Testing of Evapotranspiration and Crop Water Use Against Data

K. J. Boote et al.
Poster position: C4

K. J. Boote[1], Co-Coordinator, AgMIP Crop Modeling, assisted by AgMIP-Maize, AgMIP-Wheat, and Global Gridded Modelers
[1] Dept of Agronomy, University of Florida, Gainesville, FL 32611

All crop models, whether site-specific or global-gridded and regardless of crop, simulate daily crop transpiration and soil evaporation during the crop life cycle, resulting in seasonal crop water use. Modelers use several methods for predicting daily potential evapotranspiration (ET), including FAO-56, Penman-Monteith, Priestley-Taylor, Hargreaves, full energy balance, and transpiration water efficiency. They use extinction equations to partition energy to soil evaporation or transpiration, depending on leaf area index. Most models simulate soil water balance and soil-root water supply for transpiration, and limit transpiration if water uptake is insufficient, and thereafter reduce dry matter production. Intercomparisons of multiple crop and global gridded models in AgMIP show surprisingly large differences in simulated ET and crop water use for the same climatic conditions. Unfortunately, model intercomparison alone is not enough to know which models are correct. There is an urgent need to test these models against field-observed data on ET and seasonal crop water use. Because water resources are so important for production, it is crucial that we establish a new effort across all crops and across models, with the goal of testing and improving the models for predicting ET and crop water use. Two types of data include: 1) season-long water use computed from soil-water balance where runoff and deep percolation are known or zero, 2) instantaneous transpiration-soil evaporation measured by lysimeters, Bowen ratio, and eddy flux systems. Special emphasis should be placed on using available FACE data to test simulated reduction in transpiration with rising CO_2.

A library of software components for plant airborne diseases simulation

S. Bregaglio et al.
Poster position: A13

S. Bregaglio[1], M. Donatelli[2], R. Confalonieri[1]
[1] Dep. of Agricultural and Environmental Sciences - Production, Landscape, Agroenergy, University of Milan, Milan, Italy
[2] CRA-CIN, Consiglio per la Ricerca e sperimentazione in Agricoltura, Bologna, Italy

The importance of including the impacts of plant diseases in crop production simulation studies is widely recognized, although an explicit coupling of disease forecasting models with crop growth models is still not operational. The increasing adoption of component-oriented programming in agro-ecological modelling could lead to fill this gap, thanks to the handling of the high complexity of the simulated biophysical processes. This work presents four independent software components aimed at simulating a generic polycyclic fungal epidemic, which can be extended with alternate approaches and reused under diverse modelling platforms. These components provide options for simulating the initial conditions of an epidemic, the progress of the disease over time driven by meteorological variables, the yield losses due to the pathogen impact and the agro management practices to reduce disease development. This platform was parameterized for wheat brown rust and rice blast disease and coupled to two crop simulators (WOFOST and WARM). These modelling solutions were evaluated via a spatially distributed sensitivity analysis exercise to gain an in-depth knowledge about model functioning and to obtain information about possible reduction or simplifications. The results indicated that the modelling solutions were sensitive to diverse parameters according to the pathogen simulated and coherent about the small relevance of parameters belonging to same processes in the two pathosystem tested. The framework presented here represents one step to move beyond both statistical models and a misuse of process based model via calibration which leads only to data fitting, instead of forecasting models.

Adaptation of a generic fungal plant disease simulator to assess blast disease (Magnaporthe oryzae Cav.) impact on rice grown in temperate conditions

S. Bregaglio et al.
Poster position: A14

S. Bregaglio[1], P. Titone[2], G. Cappelli[1], L. Paleari[1], L. Tamborini[2], M. Donatelli[3], R. Confalonieri[1]
[1] Dep. of Agricultural and Environmental Sciences - Production, Landscape, Agroenergy, University of Milan, Milan, Italy
[2] CRA-SCS, Consiglio per la Ricerca e sperimentazione in Agricoltura, Lodi, Italy
[3] CRA-CIN, Consiglio per la Ricerca e sperimentazione in Agricoltura, Bologna, Italy

The blast disease (Magnaporthe oryzae) is the primary constraint of rice production worldwide and it is present in more than 85 countries, causing severe epidemics especially in paddy rice grown in temperate regions. Yield losses are around 10-30% of the total world production. Since years researchers started developing models to forecast the evolution of blast epidemics and to support farmers in the scheduling of fungicide sprays. Most of the available models were evaluated in Asian rice growing areas and only in few cases they were coupled with rice simulators to consider blast impact on leaf area and biomass accumulation, to obtain the quantification of yield losses. This work presents the adaptation of a generic platform for the simulation of blast epidemics and its coupling with a rice crop model. The modelling solution was run in Italian rice cultivated areas (first European producer) by considering multiple years and cultivars. The number of disease assessments was 274, organized in a scale ranging from 0 to 5. Results showed good performances both in calibration and evaluation datasets (R^2=0.813 and 0.783, respectively), clearly indicating its suitability in responding to the heterogeneity of the agro-meteorological conditions explored. When converted to ordinal values, the simulated blast impacts matched visual assessments in 50.3% of cases, and in 37.6% they missed reference values by one rank. Given the massive datasets used for its evaluation, this modelling solution will be applied in climate change scenarios to assess the potential future impact of blast disease on European rice productions.

Biophysical and economic constraints on agricultural intensification in global diet scenarios

Thierry Brunelle et al.
Poster position: A9

Thierry Brunelle, François Souty, Patrice Dumas and Bruno Dorin

Globalization drives a process of diet convergence, and in so doing increases the uncertainy about future patterns of food consumption. To address this issue we map the range of possible future diet changes and explore their impact on agriculture using the Nexus Land Use model. Four scenarios built on distinct assumption on the diet convergence process depict very contrasting visions on agricultural systems in 2050. The study focuses on agricultural intensification, taking into account economic and biophysical constraints. A non-linear response of fertilizer on cropland and a potential yield limit allows to represent decreasing returns of fertilizer application at high yields. Land-use change is driven by a trade-off between the extensive system with grazing ruminants, established on the lands with lowest fertility, and the intensive system with mixed livestock and cropland. To assess the accuracy of model results, the model ability to reproduce past observations is evaluated through a backcasting exercise.

Simulation of climate change impacts on rice yield and pre-harvest quality in Latin America

G. Cappelli et al.
Poster position: C14

G. Cappelli[1], S. Bregaglio[1], M. Donatelli[2], R. Confalonieri[1]
[1] Dep. of Agricultural and Environmental Sciences - Production, Landscape, Agroenergy, University of Milan, Milan, Italy
[2] CRA-CIN, Consiglio per la Ricerca e sperimentazione in Agricoltura, Bologna, Italy
[3] University of East Anglia

Despite the large availability of models simulating crop growth and development, few operational approaches have been developed to assess pre-harvest quality of agricultural productions. This represents a clear gap of knowledge researchers are trying to fill, in light of the evidences of a climate change-driven decline in nutritional properties of important food crops, with direct implications on the economic value of productions and on food security issues. This contribution presents an assessment of pre-harvest rice quality under different climate change scenarios in Latin America. Simulations were performed using the BioMA platform, in which the WARM rice model was linked to modelling approaches simulating grain amylose and protein contents, and the occurrence of chalkiness and fissured grains. Simulations were performed at 25×25 km spatial resolution for all the Latin American rice districts and results were aggregated at national level. Despite some differences due to emission scenarios and general circulation models, simulations revealed an overall maintenance of current production levels, whereas a general decay of quality variables is expected, especially in countries where severe climatic anomalies are foreseen (Brazil and Mexico). The negative impact on quality will be more relevant for Japonica cultivars compared to Indica ones, coherently with the different thermal requirements for starch synthesis for the two ecotypes. Our projections also indicate that climate change will lead to positive effects in countries where rice will explore conditions of better adaptation, like in Chile. This analysis demonstrated the usefulness of approaches to simulate quality variables and their potential for defining effective adaptation strategies to alleviate the expected decline in rice quality.

The Extraction of Double-Cropping Areas in North Korea using Fourier Transform Analysis of Time-series MODIS Imagery

Su-Young Cha et al.
Poster position: D9

Su-Young Cha[1], Chong-Hwa Park[2], Yeo-Chang Youn[3]
[1] Research Institute for Agriculture and Life Sciences, Seoul National University
[2] Graduate School of Environmental Studies, Seoul National University
[3] Department of Forest Sciences, Seoul National University

Human-induced forest alterations in North Korea have been expanded by the severe food crisis. Many forests have been converted into cropping area. It is important to know such deforested area in North Korea, which is not easy to access by direct field survey. Here we developed a method to get the deforested area. The double cropping area, where the NDVI (Normalized Difference Vegetation Index) has double maxima in a year is the evidence of the human farming. Such double cropping area has been detected through the Fourier analysis of the time-series MODIS (Moderate Resolution Imaging Spectroradiometer) data from 2000 to 2009. The intensity of the second harmonics, i.e., the bimodal NDVI component is directly related to the double cropping areas. Crop information of South Korea was used to access the accuracy of the result. We did not find the double cropping area only in the western field area but also on the mountainous area. The Daehongdangun region known as a large collective farm in North Korea showed strong second harmonics. The methodology used in this study is useful for detecting the deforested area that is used for the double cropping in North Korea.

AgMIP Potato Pilot: A summary of progress made

Bruno Condori et al.
Poster position: C7

Bruno Condori, Carolina Barreda, David Fleischer and Roberto Quiroz

The potato crop (Solanum sp.) has a substantial social and economic importance for many developing and developed countries. This crop is dispersed around the world, growing in very high contrasting environments: from 0 to 4000 meters above sea level, latitudes from 65° to -40°, and photoperiods ranging from 12 to 15 hours. The potato cropping systems are quite variable spanning from rain-fed low input conditions to high-tech precision agriculture. A striking difference with other crops of global importance is the variation in the cultivated ploidy (2x=24, 3x=36, 4x=48 and 5x=60), conferring the crop a wide adaptation range and thus adding complexity to the assessment of the response to climate variability and change. The AgMIP potato is a new pilot of the international effort that links the climate, crop, and economic modeling communities with cutting-edge information technology to produce improved crop and economic models and the next generation of climate impact projections for the agricultural sector. So far, 28 researchers and 10 potato modeling groups have agreed to become part of this initiative. Furthermore, five sentinel sites have been selected in Bolivia, Peru, Burundi, Denmark and USA. A preliminary analysis of the yield statistics around sentinel sites - 10 to 100 tons of fresh tubers per hectare – summarizes the challenges that the trans-disciplinary team will face.

ORACLE: Opportunities and Risks of Agrosystems & forests in response to CLimate, socio-economic and policy changEs in France

Nathalie de Noblet-Ducoudré et al.
Poster position: B4

Nathalie de Noblet-Ducoudré, Iñaki Garcia de Cortazar Atauri, Julie Caubel, Anne-Isabelle Graux, Sophie Wieruszeski, Dominique Carrer, Jean-Christophe Calvet, Nabil Laania

ORACLE aims at providing spatially-gridded assessments of potential future changes in a) the functioning of agro-ecosystems, b) land uses in France at rather high resolution (8 x 8 km2). These assessments involve the production of tools and data to study the relationships between climate change and possible changes in land use, together with the impacts of changing policies. We will focus our analysis and modeling on the main components of the non-urban land use, namely crops, grasslands and forests. We will study their production as well as their environmental functionalities (GHG emission, hydrology, soil carbon storage) and develop a small set of relevant indicators. Climate-induced changes in those indicators will be analyzed and, wherever possible, their upper and lower limits will be defined. This will allow us to assess, per grid-cell, risks of dis-functioning of specific systems, potential disappearance of present-day land-uses, and potentialities of appearance of new ones. We will also try to combine the indicators with water availability to identify potential future hot-spots in France and Europe, i.e., grid-cells or regions that may experience drastic land-use changes.

Insights on land-use change will be obtained following two parallel methodologies. First, we will use the climatically-induced variations of the above-mentioned indicators to explore reshaping of farming systems, optimizing opportunities and minimizing constraints, without accounting for changes in socio-economic drivers. The propositions will rely on a) meta-analysis of published data on agronomic performances and environmental impacts of cultivation systems, and b) expert knowledge.

In the second methodology, we will jointly evaluate the impacts of changes in climatic and socio-economic drivers on anthropogenic land-uses. We will rank those impacts and identify areas where the impacts of climate change on land-uses may overrule those resulting from socio-economic changes. We will also attempt to estimate land-use change between agriculture and forest when both climatic and economic drivers change.

Results will be obtained i) at two spatial scales, namely France and hydrological basin (Seine and Leyre basins), ii) for two time horizons (2020-2050 and 2070-2100) in reference to the 1970-2000 period. Both prospective uncertainty (socio-economic scenarios, crop or forest management) and epistemic uncertainty (due to imperfect knowledge within models) will be analyzed at various levels through multi-model and multi-scenario approaches and appropriate statistical analysis. Results of the uncertainty analysis will be used as an input for modeling anticipative adaptation decisions in the economic models.
In terms of methodology, the main idea of the project is to rely on well-known models (global vegetation models, agronomic and forest models, economic models) and on published experimental data, and profit from existing methods (climate downscaling, meta-analysis, indicator reckoning…) and databases developed within the framework of previous projects on climate change impacts, in an integrated and coordinated way.

ORACLE is a true multi-disciplinary project that brings together climatologists, crop and forest scientists, economists, hydrologists and statisticians who have an experience in climate change issues at various scales.

Enhancing Capacities of the AgMIP South Asia Regional Teams through Capacity-Building Workshops and Knowledge-Sharing Platforms

Guntuku Dileepkumar et al.
Poster position: B2

Guntuku Dileepkumar, Dakshina Murthy Kadiyala, S. Nedumaran, Piara Singh, Raji Reddy, P Paramasivam, V Geethalakshmi, B Gangwar, N Subash, Ashfaq Ahmad, Lareef Zubair, S.P. Nissanka, V Sumanthkumar, Cynthia Rosenzweig, Jim Jones, John Antle, Carolyn Mutter

Agricultural systems are sensitive to extreme climatic events such as droughts, floods, delayed onset of monsoon, intermittent dry spells, heat and cold waves. The impact of these events is felt by regional agricultural systems differently based upon their climate, environment and socio economic conditions. Although there are many initiatives in progress to address the impacts of climate change all over the world but there are very few focusing on analysing impacts of climate variability and change through a transdisciplinary effort that consistently linking state-of-the-art climate scenarios to crop and economic models. The Agricultural Model Intercomparison and Improvement Project (AgMIP) is such initiative at global level linking climate, crop, and economic modeling communities with cutting-edge information technology to produce improved crop, and economic models and the next generation of climate impact projections for the agricultural sector.

The AgMIP South Asia Coordination Research Team (SA-CRT) ensures enhancing capacities of South Asia AgMIP Regional Research Teams in coordination with AgMIP Global team. The main goals of AgMIP South Asia CRT team are (1) enhance capacities of the multi-disciplinary research teams throughout the region and prepare them for integrated assessments of climate change impacts and adaptations (2) helps in designing workshops to publish the results of the integrated assessments that each research team has put together during the project. In addition, the SA-CRT also aims to develop knowledge-sharing platforms so as to facilitate learning exchanges among and across the various AgMIP regional teams of South Asia and also ensure the national systems and various stakeholders utilizing the benefits of AgMIP research results.

In this paper the authors present the innovative capacity building and knowledge sharing platforms designed during the project period and their implications to meet the goals and objectives of AgMIP.

Enhancing Model Reuse via Component-Centered Modeling Frameworks: the Vision and Example Realizations

Marcello Donatelli et al.
Poster position: D11

Marcello Donatelli[1], Iacopo Cerrani[2], Davide Fanchini[2], Davide Fumagalli[2], Andrea Emilio Rizzoli[3]
[1] CRA-CIN, Consiglio per la Ricerca e Sperimentazione in Agricoltura, Bologna, Italy
[2] JRC IES, European Commission, Ispra (VA), Italy
[3] Dalle Molle Institute for Artificial Intelligence, Manno, Switzerland

Model frameworks have represented a substantial step forward with respect to monolithic implementations of biophysical models. However, the diffusion of such frameworks, as model development environment, beyond the groups developing them has been very modest. The reusability of models has also proved to be modest. The reason for the latter was attributed also to the lack of standardization toward few frameworks. Emphasis has been placed on the framework and even new implementations of models have been made targeting a specific framework, likely assuming that the reusability of the model unit would have been directly proportional to the quality of the framework. In any case, the goal of several projects has been to make available the framework. Developers in the operational arena, but even in research, have reacted by developing their own framework. Still, the problem of model reuse has been largely unsolved; estimating that increasing the flexibility for reuse would have added a costly overhead, in terms of both complexity and possibly as lack of efficiency in the operational use. The focus on frameworks has made software architects overlooking on the requirements of reusability per se of model units. The component oriented programming paradigm allows targeting intrinsic reusability of discrete model units, and makes room for enabling advances functionalities in simulation systems. This paper firstly present the abstract architecture of a component oriented framework articulated in independent layers: Model, Composition, and Configuration. The Application layer may link to any of these, to develop from simple console applications to sophisticated MVC applications. Proofs of concept are presented for each layer, including the BioMA framework of the European Commission used for agriculture and climate change studies.

Estimating Impact Assessment and Adaptation Strategies under Climate Change Scenarios for Crops at EU27 Scale

M. Donatelli et al.
Poster position: A1

M. Donatelli[1], A.K. Srivastava[2], G. Duveiller[2], S. Niemeyer[2]
[1] CRA-CIN, Consiglio per la Ricerca e Sperimentazione in Agricoltura, Bologna, Italy
[2] JRC IES, European Commission, Ispra (VA), Italy

Policy makers at European and national level demand for estimates of potential vulnerability of agricultural production. Estimates are requested specific to province level, and articulated for crops. The base of such estimates is the biophysical representation of crop responses both under conditions of no adaptation, and exploring the level of adaptation which could be acted on autonomously by farmers. However, producing such estimates poses significant challenges due to the usability of climate inputs to simulation models, to reliability and completeness of data, to the level of abstraction to be chosen, and to

technological aspects. This study provides an impact assessment of climate change scenarios on agriculture over EU27 focused on the time horizons of 2020 and 2030 with respect to a baseline centered on the year 2000. Potential and water-limited yields are simulated for 3 priority crops (wheat, rapeseed and sunflower) over a 25 by 25 km grid using the CropSyst model implemented within the BioMA modelling platform of the European Commission. Input weather data are generated with a stochastic weather generator parameterized over RCM-GCM downscaled simulation from the ENSEMBLES project, which have been statistically bias-corrected. Two realizations of the A1B emission scenario within ENSEMBLES are used, based on the HadCM3 and ECHAM5 GCMs, which respectively represent the "warmer" and "colder" extremes in the envelope of the ensemble with regard to the air temperature trends, and different with respect to rainfall patterns. Alleviating the consequences of unfavorable weather patterns is explored by simulating technical operations which can be acted on by farmers, highlighting the limits of autonomous adaptation, hence estimating potential vulnerability hotspots. Data are presented focusing on the difference between the baseline chosen and the 2020 and 2030 time horizons. Both data (accessible via web services) and the simulation platform are available for non-commercial use.

The Global Gridded Crop Model Intercomparison (GGCMI)

Joshua Elliot et al.
Poster position: D5

Joshua Elliott[1], Christoph Muller[2], and Delphine Deryng[3]
[1] University of Chicago, Argonne National Lab, and Columbia University
[2] Potsdam Institute for Climate Impact Research
[3] University of East Anglia

Initial results from the 2012 AgMIP/ISI-MIP Fast-Track assessment indicate the potential of global gridded crop model simulations and the need to further improve understanding of mechanisms, assumptions, and uncertainties of model design and execution; these are best addressed in a coordinated model intercomparison project at continental and global scale. In Spring 2013, we developed a new set of protocols for the GGCMI, which will run for 3 years and include 3 overlapping phases of increasing duration: 1) Historical simulation and model evaluation, 2) Analysis of model sensitivity to CTWN (carbon, temperature, water, and nitrogen), and 3) Coordinated regional and global climate assessment.

In this poster we summarize the protocols for the three phase project and present preliminary results from Phase 1 of the GGCMI: Historical simulation and model evaluation. In this stage, models are being run using various observation and reanalysis-based historical weather products so that they can be evaluated over the historical period globally and in various key interest regions. The project currently includes ~18 modeling groups from 11 countries, along with several other major data partners, and simulations are being performed over the Summer and Fall of 2013.

The 2012 AgMIP/ISI-MIP Fast-Track Assessment

Joshua Elliot et al.
Poster position: D6

Joshua Elliott[1], Christoph Muller[2], Delphine Deryng[3], Jerry Nelson[4], Franziska Piontek[5], and Cynthia Rosenzweig[6]
[1] University of Chicago, Argonne National Lab, and Columbia University
[2] Potsdam Institute for Climate Impact Research
[3] University of East Anglia
[4] University of Illinois at Urbana-Champaign
[5] Potsdam Institute for Climate Impact Research
[6] NASA GISS

In 2012 AgMIP led a Global Gridded Crop Model (GGCM) Intercomparison Fast-Track project in coordination with the PIK-led Inter-Sectoral Impacts Model Intercomparison Project (ISI-MIP). This fast-track included 7 GGCMs and updated the state of knowledge on climate change vulnerabilities and impacts using modern global high-resolution models driven by climate model output from CMIP5. This fast-track culminated with the January 31st submission of 6 papers to a PNAS special issue, of which 5 are accepted or are in revision (3 accepted in time to meet deadlines for inclusion in IPCC AR5). In this poster we summarize each of these papers along with key findings from the 2012 Fast-Track assessment.

Evaluating the utility of dynamical downscaling in large-scale yield assessments

Michael Glotter et al.
Poster position: D7

Michael Glotter, Joshua Elliott, Alex Ruane, and Elisabeth Moyer

Because agricultural yield is highly sensitive to climate variability, yield projections require high spatial and temporal resolution weather products. Recently, multiple projects have combined GCM output with regional climate model (RCM) simulations to produce fine-scale (dynamically downscaled) climate projections to drive climate impact models. We investigate here whether these computationally intensive practices improve or affect large-scale crop yield estimates under future climate change. We drive a parallelized version of the DSSAT crop model for the continental United States with climate products from the NARCCAP regional climate model comparison project, using different GCMs both with and without dynamical downscaling. We find that once applying a relatively simple (but necessary) bias correction, there is little significant difference between crop yields whether driven by simply interpolated GCM output or by dynamically downscaled climate. Our results suggest that computationally intensive downscaling practices likely lend little additional value in agricultural impact applications. Yield projections under climate change may instead benefit most from improved observational climate data, especially in the developing world where data is scarce and modelers are often forced to rely on reanalyses (models nudged by observed atmospheric data). Reanalysis model output has significant flaws, however, and initial results suggest that observed precipitation is necessary for accurate agricultural yield estimates. Improving precipitation measurements in the developing world may be a critical part of estimating future food supply under climate change.

Climate scenarios for driving AgMIP models

Arthur Greene
Poster position: D8

Arthur Greene[1]
[1] International Research Institute for Climate and Society, Earth Institute at Columbia University, Palisades, New York, USA

We present a method for the generation of stochastic simulations on "near-term climate change" (i.e., decadal) time horizons, designed for driving models participating in AgMIP. In the absence of skillful decadal forecasts (particularly over land regions), such simulations provide a useful means of characterizing climate uncertainty and modeling its propagation through agricultural and ultimately, economic systems. The method involves the combining of information from various sources, including global climate models, local observational records and current research results. The climate models provide large-scale and long range information on climatic trends, while local observational records are employed for the characterization of higher-order variability. Both parametric and nonparametric techniques are employed in the merging of information. Example simulations are provided for selected regions, and issues that arise in simulation generation are described.

Climate change adaptations for crop-livestock systems in semi-arid Zimbabwe

Sabine Homann-Kee Tui et al.
Poster position: B15

Sabine Homann-Kee Tui[1], Patricia Masikate[1], Katrien Descheemaker[3], Lieven Claessens[2], Olivier Crespo[4], Andre van Rooyen[1], Roberto Valdivia[5]
[1] International Crops Research Institute for the Semi-Arid Tropics (ICRISAT, www.icrisat.org), PO Box 776, Bulawayo, Zimbabwe, and [2] PO Box 39063, Nairobi, Kenya
[3] Wageningen University, Plant Production Systems Group, Wageningen, The Netherlands
[4] University of Cape Town, Climate Systems Analysis Group (CSAG), Cape Town, South Africa
[5] Oregon State University, Corvallis, Oregon

We present preliminary results of the Crop-Livestock Intensification Project (CLIP), answering AgMIP's three core questions: Potential impact of climate change (CC) on future agricultural systems and economic impacts of CC adaptation strategies. We focus on smallholder crop-livestock systems in semi-arid Zimbabwe. Maize is the predominant crop, with low yields (average 650kg/ha). Livestock productivity is also low; dry season feed shortages are major bottleneck. Two adaptation strategies were compared: 1. Crop intensification through fertilizer applications (0, 18 and 52 N kg/ha), 2. Systems shift towards livestock by introducing maize-mucuna rotation.

Climate simulations between current (1980-2010) and mid-century climate scenarios (2040-2070), for 5 selected GCMs project increasing temperatures (+2 - +3.3°C), but future rainfall is uncertain. Crop simulations (APSIM) suggest that maize yields can decrease by more than 20%, fertilizer and mucuna can offset these effects. Livestock simulations (LIVSIM) suggest marginal CC effects on livestock; fertilizer and maize-mucuna rotation can increase livestock productivity. The effects of GCMs on crops and livestock production are not consistent.

The TOA-MD economic ex-ante impact assessment, using household survey data and combined with RAPs developed through stakeholder consultation, indicates small CC effects on entire farms and heterogeneous farm populations in semi-arid Zimbabwe. Maize-mucuna rotation was identified as the more CC resilient adaptation strategy, providing higher farm net returns against less risk, compared to fertilizer applications. Economic benefits on the poor will however be minimal. More drastic systems shifts towards diversified and better integrated farming systems are required to sustain food security and move farms above poverty thresholds.

Anthropogenic Climate Feedbacks via Changes in Crop Productivity

Andrew D. Jones and William D. Collins
Poster position: A10

Andrew D. Jones[1], William D. Collins[1]
[1] Lawrence Berkeley National Laboratory

Climate change has the potential to impact agricultural productivity through multiple mechanisms. To the extent possible, farmers will respond to these changes by altering management practices and shifting the geographic distribution of various crops. Meanwhile, climate mitigation measures are placing unprecedented demands on agricultural systems for the provision of bioenergy. Such changes in land use and landcover are known to impact climate at both regional and global scales through changes in carbon storage and through direct physical consequences of landcover change. Yet, the current generation of 21st century climate projections (the CMIP5 RCP scenarios) do not account for dynamic land-use feedbacks. To address this gap, we are developing a new coupled model framework, the Integrated Earth System Model (iESM), which links the human decision making elements of an integrated assessment model with the physical and ecosystem components of a state-of-the-art global climate and earth system model.

Key to capturing agricultural land-use responses to climate change within this framework is the development of a new crop model for the Community Land Model (CLM) capable of representing bioenergy crops. Preliminary results demonstrate the ability of this model to reproduce seasonal leaf area index dynamics for C4 perennial biofuel crops grown in North America. We have also conducted a sensitivity analysis to identify which parameters of the model yield meaningful changes in the simulation of climatically relevant variables such as surface energy and water fluxes, and soil carbon storage.

Modeling the impact of global warming on the sorghum sowing window in distinct climates in Brazil

Flavio Justino et al.
Poster position: C11

Flavio Justino[1], Marine Cirino Grossi[1], Camilo de Lelis Teixeira Andrade[2], Eduardo Alvarez Santos[1], Rafael Avila Rodrigues[1], and Luiz C. Costa[1]
[1] Departamento de Engenharia Agricola, Universidade Federal de Viçosa, PH Rolfs 36570 000, Viçosa, MG, Brazil
[2] Empresa Brasileira de Pesquisa Agropecuária, Centro Nacional de Pesquisa de Milho e Sorgo., Rod. MG 424, Km 45, Zona Rural, 35701970 - Sete Lagoas, MG, Brazil

F. Justino[1], M. Grossi[1], C. Lelis[2], E. Santos[1], R. Rodrigues[1] and L. Costa[1]

This poster presents recent result published by the European Journal of Agronomy.
http://www.sciencedirect.com/science/article/pii/S1161030113000919

This study aims to calibrate, and validate the CSM-CERES-Sorghum model and to investigate the vulnerability of sorghum yield for current (1982-1999) and future (2047-2064) epochs, by applying weather observations and climate outputs based on ECHAM, CCCma and GFDL models. Field experiments have been conducted in the experimental area of Janaúba and Sete Lagoas located in Minas Gerais State, Brazil. It has been found that the CSM-CERES-Sorghum model reasonably simulates crop phenology, crop biomass production, leaf area and yield components that are crucial to ensure the model reliability to reproduce in situ conditions. Comparison between the CSM-CERES-Sorghum results driven by the climate models and baseline observations shows that the ECHAM better reproduces the current observations. However, inaccurate results are found by utilizing the GFDL climate primarily due to lower precipitation values. This is found for both cities. Turning to future conditions, the simulations indicated that in Janaúba the average yields for current and future climate conditions were not statistically different, but in Sete Lagoas, there was a statistically significant increase in the sorghum productivity in the latter scenario. Moreover, it has been found that the simulations using the 52 sowing dates indicated that climate change modifies the grain yield projecting a delay in the most favorable planting date. According to the results the seeding of sorghum will very likely be held later in both cities.

Big Data for Big Solutions: Eddy Flux, Mesonet and C Sequestration

Vijaya Gopal Kakani et al.
Poster position: D13

Vijaya Gopal Kakani[1], Kundan Dhakal[1], Pradeep Wagle[1]
[1] Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, OK

Bioenergy holds potential to positively contribute to economic and environmental well-being at farm and global scale. Quantification of C sequestration by bioenergy cropping ecosystem can be of great importance as measured ecosystem level CO_2 fluxes can be extrapolated to estimate the regional carbon balance and simulate future atmospheric CO_2 concentrations. Eddy flux systems provide continuous data on crop CO_2 and H_2O response to its environment. Weather networks such as Mesonet (www.mesonet.org) in Oklahoma provide high quality environmental data across the state. A combination of eddy flux and Mesonet data streams can provide estimates of regional C sequestration. The objectives of the study were to

(1) characterize the effects of key environmental factors on daytime NEE and to explore the underlying mechanisms, (2) identify potential switchgrass production areas across the State of Oklahoma, (3) conduct seasonal (April to August) spatial modeling of net ecosystem exchange (NEE) of C across potential switchgrass production area. Study window was limited to the active growing season. Potential switchgrass production areas in Oklahoma were identified from the USDA-NASS Cropland Data Layer (CDL). Mesonet data was checked thoroughly and processed to calculate 30-minute average values. Temperature response curves were developed for NEEsat, apparent quantum efficiency (AQE), day and night respiration based on eddy-covariance measurements at Chickasha, OK in 2011. The 30 min NEE values were generated as a function of NEEsat, PPFD and AQE for entire Oklahoma. The results of this study are useful for the modeling community to develop, improve, and validate the models for global climate change studies.

CropBASE: an integrative decision support platform for underutilised crops across research value chains

Asha S. Karunaratne et al.
Poster position: C10

Asha S. Karunaratne[1,2], Sayed Azam-Ali[1], Sue Walker[1]
[1] Crops For the Future Research Centre (CFFRC), c/o University of Nottingham, Malaysia Campus, Semenyih, Selangor, Malaysia
[2] Faculty of Agricultural Sciences, Sabaragamuwa University, Belihuloya, Sri Lanka

CFFRC is the world's first centre for research on underutilised crops for food and non-food uses. From its headquarters near Kuala Lumpur, Malaysia, CFFRC is building a global stakeholder alliance of education, public, private and civil society partners for research on underutilised crops. CFFRC activities focus around five research 'themes' that provide a `Research Value Chain' of facilities and expertise on underutilised crops spanning plant genomics to applied social sciences.

CFFRC also has six research 'programmes' of which CropBASE provides an underpinning knowledge system and web-based platform for decision support and knowledge sharing on underutilised crops and their end uses. CropBASE will provide a quantitative basis to compare underutilised crop productivity and resource use efficiency with those of major crops and cropping systems under current and future climate scenarios. To provide such comparisons, CropBASE is developing interactive tools that integrate novel data on underutilised crops with geo-referenced information in existing and new databases.

The main analysis engine of CropBASE involves crop-climate modelling that introduce specific underutilised crops into recognised crop models (APSIM, AquaCrop, DSSAT) and link available climate databases within a geospatial information system framework. This poster presents a preliminary use-case scenario of bambara groundnut (an underutilised African legume) genotypes under baseline and future climate scenarios. By using contrasting African locations, interrogation methods are demonstrated that can identify genetically distinct material from matched climatic conditions to predict optimal selections of parental germplasm for breeding material suited to different locations and future climates.

Keywords: underutilised crops, productivity, crop models, climate change

The Influence of Shifting Planting Date on Cereal Grains Production under the Projected Climate Change

Dae-jun Kim et al.
Poster position: A11

Dae-jun Kim[1], Jae-hwan Roh[2], Jung-gon Kim[3], Jin I. Yun[1]
[1] Department of Ecological Engineering, Kyung Hee University, Yongin 446-701, Korea
[2] Rice Research Division, National Institute of Crop Science, Iksan 570-080, Korea
[3] Korean Wheat & Barley Industry Development Institute, Suwon 441-857, Korea

Yield reduction in major cereal grains seems unavoidable with the existing cropping systems under the projected climate change in Korea. Crop models were used to predict the effects of planting date shift on grain yields of rice, winter barley and soybeans at 64 agroclimatic zones in Korea. The shift of planting date by 7, 14, and 21 days before and after the recommended planting dates were incorporated in DSSAT experiment files to simulate growth, development and grain yields of major cereal crops. These included 3 rice cultivars representing early-, medium- and late- maturity groups, 1 winter barley and 1 soybean cultivars. Partial mitigation in yield reduction was found with earlier planting in the early maturing rice cultivar and with delayed planting in the late maturing rice cultivar under the RCP8.5 projected climate change in Korea. Additional yield increase in winter barley was expected by earlier planting treatments. Soybean showed a positive effect on grain yield with earlier planting. However, the rate was much lower than the case with winter barley and delayed planting caused yield reduction.

Modeling crop yields and yield gaps in Russia, Ukraine and Kazakhstan under climate change

Friedrich Koch et al.
Poster position: B9

Friedrich Koch[1,2]*, Florian Schierhorn[1]*, Alexander Prishchepov[1], Daniel Müller[1,3]
[1] Leibniz Institute of Agricultural Development in Central and Eastern Europe (IAMO) Theodor-Lieser-Str. 2, 06120 Halle (Saale), Germany
[2] Helmholtz Centre for Environmental Research (UFZ), Permoserstraße 15, 04318 Leipzig/Germany
[3] Department of Geography, Humboldt-Universität zu Berlin Unter den Linden 6, 10099 Berlin, Germany
* Corresponding author (koch@iamo.de)

Global demand for agricultural products is projected to increase considerably. To satisfy the growing demand at low environmental costs is a key challenge for humanity. Russia, Ukraine, Kazakhstan can potentially contribute substantial additional production to global agricultural markets with their ample land reserves, fertile soils and high crop yield gaps. However, no comprehensive assessment of yield gaps in the region has been conducted to date. Of particular interest herein is the southern black soil (Chernozem) belt that possesses the highest production potentials in the region but is marred with frequently occurring droughts that are projected to increase further in terms of frequency and severity. The climatic conditions are in part also responsible for the prevailing low-input land management practices and low crop yields. We applied the process model SWAT to assess yield gaps throughout the region. SWAT includes plant growth and hydrology modules that are essential for large-scale physiological modeling in regions with volatile precipitation conditions because they allow to assessing climate, plant, soil and nutrient dynamics and simulating water management strategies. Our SWAT results for European Russia indicate yield gaps of 46-68% for spring and winter wheat, suggesting that land-use intensification, irrigation and re-cultivation of abandoned lands can potentially contribute to substantial production increases. We will further present how we will assess the impact of climate

change on crop yields at different spatial scales and which options exist to reduce yield gaps and to better adapt agricultural management practices.

Modelling Efforts and Integrated Regional Studies in FACCE MACSUR

Martin Köchy
Poster position: D10

Martin Köchy[1]
[1] Thünen Institute of Market Analysis, Bundesallee 50, 38116 Braunschweig, Germany

MACSUR is a knowledge hub (first phase 2012-2015) that gathers the excellence of research in livestock, crop, farm and trade modelling in Europe. It will illustrate for political decision makers how climate variability will affect regional farming systems and food production in the near and far future (till 2050). Furthermore, it will assess the associated risks and opportunities for European food security.

MACSUR develops multi-faceted approaches for integrated assessments in diverse regions like Europe. Aspects of heterogeneity include environment, structure, policy, climate, soils. An ensemble of crop and livestock models is benchmarked, inter-compared and coupled to both climatic and economic models in collaboration with AgMIP. In addition, MACSUR assesses options for crop rotations, mitigation measures, adaptation measures across scales, and considers national and farm economics.

Scaling, uncertainty analyses, and probabilistic assessment of impacts using calibrated models complement AgMIP activities.

In MACSUR regional pilot studies we assess crop production, livestock management, and farm economics in an integrated way, developing RAPs for Europe and involving stakeholders. First results compatible with AgMIP global scenarios will be presented at project meeting in April 2014.

Development and application of a weather data client for preparation of weather input files to a crop model

Chung-Kuen Lee et al.
Poster position: D1

Chung-Kuen Lee[1], Junhwan Kim[1], Kwang Soo Kim[2]
[1] National Institute of Crop Science, RDA, Suwon 441-857, Korea
[2] Department of Plant Science, Seoul National University, Seoul 151-742, Korea

Crop yield prediction has been made using a crop growth model that relies on four categories of input data including soil, crop, management, and weather. Most crop models are a single column model, which requires individual weather inputs for each site of interest. The objectives of this study were to develop a weather data service client that generates weather input files for a crop growth model and to examine its application to yield prediction at a national scale. The weather data service client was designed and implemented to download daily weather data from the web-based weather data service portal operated by Korean Meteorological Administration (KMA) and to generate weather input files for the ORYZA 2000 model. In total, 4950 input files were generated to predict rice yield in 2011 and 2012 using the weather data service client. To generate nearly 5000 weather input files, it would take more than a month for a skilled person to download weather data from the KMA database and to reorganize those data to the input data format for the ORYZA 2000 model manually. Using the weather data service clients, several hours were enough to generate all of the input files without error associated with manual preparation as well as with minimum effort and labor.

AgMIP Rice Team Activities

Tao Li et al.
Poster position: C6

Tao Li[1,‡], Toshihiro Hasegawa[2*,‡], Xinyou Yin[3*,‡], Yan Zhu[4,‡], Kenneth Boote[5,‡], Myriam Adam[6], Simone Bregaglio[7], Samuel Buis[8], Roberto Confalonieri[7], Tamon Fumoto[2], Donald Gaydon[9], Manuel Marcaida III[1], Hiroshi Nakagawa[10], Philippe Oriol[6], Alex C. Ruane[11], Françoise Ruget[8,12], Balwinder Singh[1], Upendra Singh[13], Liang Tang[4], Fulu Tao[14], Paul Wilkens[13], Yubin Yang[15], Hiroe Yoshida[10], Zhao Zhang[16], Bas Bouman[1,†]

[1] International Rice Research Institute, Los Baños, Philippines
[2] National Institute for Agro-Environmental Sciences, Japan
[3] Centre for Crop Systems Analysis, Wageningen University, the Netherlands
[4] National Engineering and Technology Center for Information Agriculture, Nanjing Agricultural University, China
[5] University of Florida, USA
[6] CIRAD, UMR AGAP, France
[7] University of Milan, Italy
[8] INRA, UMR1114 EMMAH, F-84914 Avignon, France
[9] CSIRO Ecosystem Sciences, Australia
[10] National Agriculture and Food Research Organization, Japan
[11] NASA Goddard Institute for Space Studies, New York, USA
[12] UAPV, UMR1114 EMMAH, F-84914 Avignon, France
[13] International Fertilizer Development Institute, Florence, Alabama, USA
[14] Chinese Academy of Sciences, Institute of Geographical Sciences and Natural Resources Research, China
[15] Texas A&M University, USA
[16] State Key Laboratory of Earth Surface Processes and Resource Ecology, Beijing Normal University, Beijing 100875, China
[*] Corresponding: thase@affrc.go.jp; Xinyou.Yin@wur.nl [†] The leader of AgMIP Rice Team [‡] Members of leading group of AgMIP Rice Team. All other authors made equivalent contributions and are in alphabetical order by surnames.

AgMIP Rice Team was initiated under the umbrella of AgMIP at the kick of workshop at Bejing in 2011. It has thirteen crop modeling groups from Australia, China, France, Italy, Japan, Netherlands, CGIAR-IRRI and USA. The first annual meeting was held in December 2012 in International Rice Research Institute to share the achievements of the first-year implementation and to plan the activities for the next step. The second annual meeting will be held in Japan on 2 to 5 December 2013.

Over the last year, the team mainly focuses on the improvement of models for predicting rice response to CO_2 fertilization. We evaluated 12 rice crop models against multi-year FACE (Free-Air CO_2 Enrichment) experiments at two sites. Model simulation was implemented in two steps: 'blind' simulation, and simulation after model improvement or calibration. Groups in the team used own approaches to improve their model responses. The average responses and average predictions of all models on total above-ground biomass and grain yield were comparable or slightly improved before and after the model modifications. The differences between FACE measurements and predicting average of all models were less than 10% of measurements for both phases of simulation. However, some models might have uncertainty up to 20% of measurements. This exercise proved that current rice models are good enough for evaluating the effects of CO_2 elevation on rice growth and yield if ensemble model approach is used for the evaluation.

Progress on the Maize Pilot Study

J.I. Lizaso et al.
Poster position: C5

J.I. Lizaso[1], J.L. Duran[2], K.J. Boote[3], S. Bassu[4], N. Brisson[#4], J.W. Jones[5], C. Rosenzweig[6], A. Ruane[6], M. Adam[7], C. Baron[8], B. Basso[9], C. Biernath[10], H. Boogaard[11], S. Conijn[12], M. Corbeels[13], D. Deryng[14], G. De Sanctis[15], S. Gayler[16], P. Grassini[17], J. Hatfield[18], S. Hoek[11], C. Izaurralde[19], R. Jongschaap[12], A. Kemanian[20], C. Kersebaum[21], N.S. Kumar[22], D. Makowski[4], C. Müller[23], C. Nendel[21], E. Priesack[10], M.V. Pravia[20], S-H. Kim[24], F. Sau[1], I. Shcherbak[9], F. Tao[25], E. Teixeira[26], D. Timlin[27], K. Waha[23], T. Tollenaar[28], S. Kumudini[28]

[1] Dep. Producción Vegetal, Fitotecnia, Technical University of Madrid, 28040 Madrid, Spain.
[2] Unité d'Agronomie, INRA-AgroParisTech, BP 01, 78850 Thiverval-Grignon, France.
[3] Dep. of Agronomy, P.O. Box 110500, Univ. of Florida, Gainesville, FL 32611.
[4] Unité de Recherche Pluridisciplinaire sur la Prairie et les Plantes Fourragères, INRA, BP 80006, 86600 Lusignan, France.
[5] Dep. of Agric. & Biol. Engr., P.O. Box 110570, Univ. of Florida, Gainesville, FL 32611.
[6] NASA Goddard Institute for Space Studies, Climate Impacts Group, 2880 Broadway, New York, NY 10025.
[7] CIRAD, UMR AGAP/PAM, Av. Agropolis, Montpellier, France.
[8] CIRAD, UMR TETIS, 500 rue J-F. Breton, Montpellier, F-34093.
[9] Dep. of Geological Sciences, Michigan State University, USA and Dept. Crop Systems, Forestry and Environ. Sciences, University of Basilicata, Italy.
[10] Helmholtz Zentrum München, Institut für Bodenökologie, Ingolstädter Landstraße 1, D-85764 Neuherberg.
[11] Centre for Geo-Information, Alterra, P.O. Box 47, 6700AA Wageningen, The Netherlands.
[12] WUR-Plant Research International, Wageningen University and Research Centre, P.O. Box 16, 6700AA Wageningen, the Netherlands.
[13] CIRAD-Annual Cropping Systems, C/O Embrapa-Cerrados Km 18, BR 020 - Rodovia Brasília/Fortaleza, CP 08223, CEP 73310-970, Planaltina, DF Brazil.
[14] Tyndall Centre for Climate Change research and School of Environmental Sciences, University of East Anglia, Norwich, NR4 7TJ, UK.
[15] Unité AGROCLIM, INRA, Domaine st Paul Site Agroparc, 84914 Avignon cedex 9, France.
[16] Water & Earth System Science (WESS) Competence Cluster, c/o University of Tübingen, 72074 Tübingen.
[17] Dep. of Agronomy and Horticulture, University of Nebraska-Lincoln, 178 Keim Hall-East Campus, Lincoln, NE 68503-0915.
[18] USDA-ARS National Soil Tilth Laboratory for Agriculture and the Environment, 2110 University Boulevard, Ames, IA 50011.
[19] Pacific Northwest National Laboratory and University of Maryland, 5825 University Research Court, Suite 3500 College Park, MD 20740.
[20] Department of Plant Science, The Pennsylvania State University, 247 Agricultural Sciences and Industries Building, University Park, PA 16802.
[21] Inst. of Landscape Systems Analysis, ZALF, Leibniz-Centre for Agricultural Landscape Research, Eberswalder Str. 84, D-15374 Muencheberg, Germany.
[22] Centre for Environment Science and Climate Resilient Agriculture, Indian Agricultural Research Institute, New Delhi, 110012, India.
[23] Potsdam Institute for Climate Impact Research, Telegraphenberg A 31, P.O. Box 60 12 03, D-14412 Potsdam.
[24] School of Environmental and Forest Sciences, University of Washington, Seattle, WA, USA 98195-4115.
[25] Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, 100101, China.
[26] Sustainable Production, The New Zealand Institute for Plant & Food Research Limited, Lincoln, Canterbury, New Zealand.
[27] USDA/ARS, Crop Systems and Global Change Laboratory, 10300 Baltimore avenue, BLDG 001 BARC-WEST, Beltsville, MD, 20705-2350.
[28] Monsanto Company
[#] N. Brisson passed away during the study in 2011.

Within the AgMIP Track 1 approach, we report the progress obtained by the Maize Pilot Team. Twenty three maize simulation models were included in the first study. Four sentinel sites, representing important zones of maize production, provided one-year site specific

measurements for model simulations: Lusignan, France (43.3° N), Ames, Iowa, USA (42°N), Rio Verde, Brazil (17.5° S), and Morogoro, Tanzania (6.5° S). For each site, 30-year of historical daily weather data were provided. Baseline weather was modified by changing maximum and minimum temperatures and [CO_2] levels. Simulations of baseline and modified weather in single factor series and in several combinations were obtained. Modelers were supplied sequentially with two levels of input information, low (only soil, phenology, and management), and high (initial conditions and time series of soil and crop measurements). In spite of simulated yield variability, the model ensemble accurately captured actual yields even with low information. Ensembles of 8-10 models would reduce substantially yield variability. Temperature increase had much larger and consistent response than CO_2 elevation in simulated yields. Higher temperatures also shortened life cycle of current cultivars, with small variability. Raising CO_2 levels resulted in higher yields and reduced crop transpiration, with largest variability at the highest simulated [CO_2]. The maize team has also been developing an improved maize model under the leadership of M. Tollenaar, from Monsanto. The new public maize model, AgMaize, will incorporate the best available algorithms simulating crop phenology, leaf area, photosynthesis, respiration, C partitioning, and N dynamics, and will have a modular structure adaptable to several modeling systems.

An Integrated Assessment of Climate Change Impact on Crop Production in the Nioro du Rip Basin of Senegal I: Crop Modelling

D.S. MacCarthy et al.
Poster position: B3

D.S. MacCarthy[1], M. Diancoumba[1], B.S. Freduah[1], S.G.K. Adiku[1], A. Agali[2], I. Hathie[3], J. Lizaso[4], D. Fatondji[5], M. Adams[6], L. Tigana[7], E. Koomson[1], P.C.S. Traore[5], S. Traore[2], J. Amikuzuno[8], J.B. Naab[9], D.Z. Diarra[10], B. Sarr[2], O. N'diaye[11], M. Sanon[7]
[1] University of Ghana
[2] AGHRYMET, Niger: Centre National d'Agro-Hydro-Météorologie du Niger
[3] IPAR, Senegal:Initiative Prospective Agricole et Rurale
[4] Technical University of Madrid, Spain
[5] ICRISAT Mali : International Crops Research Institute for the Semi-Arid Tropics
[6] CIRAD : Centre de Coopération Internationale en Recherche Agronomique pour le Développement
[7] INERA, B. Faso : Institut de l'Environnement et de Recherches Agricoles
[8] UDS, Ghana : University of development studies
[9] SARI, Ghana: Savanna Agricultural Research Institute
[10] METEO Mali
[11] ACACIM, Senegal :Agence Nationale de l'Aviation Civile et de la Météorologie

The economy of West Africa is highly dependent on agriculture which contributes between 40 to 60 % to gross domestic product and is home to about 300 million people. Crop production is largely dependent on natural weather which is increasingly becoming erratic. Projected climate change shows an increasing temperature trend and possibly a decline in rainfall, posing a major threat to agriculture productivity in the sub-region. This study aimed at assessing the future productivity of the major crops in Nioro, using two crop models and projected future climate data from five General Circulation Models (GCMs). DSSAT and APSIM models were calibrated with experimental data and validated with data collected from 220 farms in a socio-economic survey. With the aid of the QUADUI, which is an innovative desktop utility, the effect of climate change with and without adaptation on the yields of millet, maize and peanut were simulated for 220 farms using multi-year baseline (1980-2009) and mid-century future (2040-2069) climate projections of five GCMs namely: E (CCSM4), I (GFDL-ESM2M), K (Had GEM2-ES), O (MIROC5) and R (MPI-ESM-MR).The yields of millet were negatively impacted by climate change using both crop models (i.e. 22 to 46% and 7 to 22% for DSSAT and APSIM, respectively). Similarly, simulated yields of peanut were lower with all GCM projected climates compared with baseline simulated yields. For maize, the responses of the GCMs were varied with GCMs R and K giving the lowest simulated yields. Introducing adaptation strategies however reduced the negative impact of climate change on simulated yields. This study indicates that the projected future climate will adversely affect crop production in Nioro. The negative effects can, however, be minimized with the use of improved crop ideotypes.

Modeling insect pest distribution under climate change scenarios

A. Maiorano et al.
Poster position: A15

A. Maiorano[1], I. Cerrani[2], D. Fumagalli[2], M. Donatelli[3]
[1] DISAFA, Università di Torino, Torino, Italy
[2] JRC IES, European Commission, Ispra (VA), Italy
[3] CRA-CIN, Consiglio per la Ricerca e Sperimentazione in Agricoltura, Bologna, Italy

This work describes potential impacts of climate change on a maize insect pest and a novel approach for predicting its distribution based on known physiological responses to specific weather factors. The model is based primarily on developmental responses, as these determine climates under which an insect can achieve a stable, adaptive seasonality. Cold tolerance during wintering was also modeled through an original approach based on the concept of lethal dose exposure. We simulated the potential winter survival, distribution, and phenological development of the corn borer Sesamia nonagrioides at three time horizons (2000, 2030, 2050), using the A1B IPCC scenario. Two modeling solutions for the simulation of winter survival were compared: the first using air temperature only as weather input (AirMS); the second taking into account the fraction of larvae overwintering in the soil, therefore considering also soil temperature (SoilAirMS). The survival model was linked to a phenological model. The SoilAirMS approach showed the best agreement, compared to the AirMS approach. Nevertheless the AirMS approach allowed identifying areas where the agronomic practices suggested for controlling S. nonagrioides should be considered ineffective. The projections to 2030 and 2050 suggested an overall slight increase of more suitable conditions for the S. nonagrioides in almost all the areas where it develops under the baseline. In these areas S. nonagrioides could become a new insect pest with a potential strong impact on maize. Differently from other works based on too simplistic approaches, results suggested that a warmer climate does not necessarily increases insect pest risks.

Modelling soil borne fungal pathogens of arable crops under climate change

L.M. Manici et al.
Poster position: A16

L.M. Manici[1], S. Bregaglio[2], D. Fumagalli[3], M. Donatelli[1]
[1] Dep. of Agricultural and Environmental Sciences - Production, Landscape, Agroenergy, University of Milan, Milan, Italy
[2] CRA-CIN, Consiglio per la Ricerca e sperimentazione in Agricoltura, Bologna, Italy
[3] JRC IES, European Commission, Ispra (VA), Italy

Soil-borne fungal plant pathogens, agents of crown and root rot, are seldom considered in studies on climate change and agriculture due both to the complexity of the soil system and to incomplete knowledge of their response to environmental drivers. A controlled chamber set of experiments was carried out to quantify the response of six soil-borne fungi to temperature,

and a species-generic model to simulate their response was developed. The model was linked to a soil temperature model inclusive of components able to simulate soil water content also as resulting from crop water uptake. Pathogen relative growth was simulated over Europe using the IPCC A1B emission scenario derived from the Hadley-CM3 global climate model. Climate scenarios of soil temperature in 2020 and 2030 were compared to the baseline centred on the year 2000. The general trend of the response of soil-borne pathogens shows increasing growth in the coldest areas of Europe; however, a larger rate of increase is shown from 2020 to 2030 compared to 2000 to 2020. Projections of pathogens of winter cereals indicate a marked increase of growth rate in the soils of Northern European and Baltic states. Fungal pathogens of spring sowing crops show unchanged conditions for their growth in soils of the Mediterranean countries, whereas an increase of suitable conditions was estimated for the areals of Central Europe which represent the coldest limit areas where the host crops are currently grown. Differences across fungal species are shown, indicating that crop-specific analyses should be run.

Assessing the effects of climate change on current smallholder-subsistence maize production in Southern Africa

Patricia Masikati et al.
Poster position: B16

Patricia Masikati[1], Sabine Homann-Kee Tui[1], Katrien Descheemaeker[2], Olivier Crespo[3], Andre van Rooyen[1]
[1] International Crops Research Institute for the Semi-Arid Tropics (ICRISAT, www.icrisat.org), PO Box 776, Bulawayo, Zimbabwe
[2] Wageningen University, Plant Production Systems Group, Wageningen, The Netherlands
[3] University of Cape Town, Climate Systems Analysis Group (CSAG), Cape Town, South Africa

Smallholder farming systems constitute the majority of farmers in Southern African and major cereal production has been declining and if not stagnated in the last 2 decades while on the other hand demographics are on the increase leaving most people food insecure and malnourished. The precarious food shortage in the region is due to a combination of factors that include unfavorable climatic conditions, poor and depleted soils; environmental degradation; failed sectorial and micro-economic policies among others. Climate superimposed on the multitude of structural problems in the different countries in southern Africa where people are un prepared or have inadequate adaptation strategies climate change can easily set back possible developmental gains by affecting sectors such as agriculture, water resources and infrastructure among others. We have limited knowledge on the interactions between increase CO2 temperatures and precipitation variations and their combined effects on plant and animal development hence adding to uncertainties surrounding future crop and livestock production in mixed farming systems of southern Africa. We used two crop models (APSIM and DSSAT) to assess the impact of climate change on maize production in southern Africa. Results showed possible reduction of maize grain and stover yields and also that days to physiological maturity will be substantially reduced. Simulated effects were at varying levels across the countries due to biophysical and socio-economic issues. Country climate outlook (connected to crop modeling) is necessary in southern Africa where most countries are net importers of food. This would assist governments to prepare for suitable crop varieties and markets and also to prepare for food imports in time.

Critical temperature and sensitivity for white immature rice kernels

Yuji Masutomi et al.
Poster position: A12

Yuji Masutomi[1], Makoto Arakawa[2], Toyotaka Minoda[2], Tetsushi Yonekura[1], Tomohide Shimada[1]
[1] Center for Environmental Science in Saitama, 914 Kamitanadare, Kazo, Saitama 347-0115, Japan
[2] Institute for Paddy Rice Research, Agriculture and Forestry Research Center, 1372 Kubojima, Kumagaya, Saitama 360-0831, Japan

The incidence of white immature rice kernels (WIRKs) due to high temperatures during a ripening period has been recently a problem in the rice production of Japan. What is worse, future global warming will increase the incidence of WIRKs. The objective of the study is to quantify the critical temperature at which WIRKs begin to emerge (T_{cr}), and the sensitivity of the incidence to temperatures during a ripening period (S_t). This information would be helpful for estimating the incidence of WIRKs under current and future global warming conditions. In this study, we focus on a variety of rice "Sai-no-kagayaki," which is a rice variety bred in Saitama prefecture of Japan. In 2010, extreme high temperatures in summer caused the high incidence of WIRKs for the variety.

To quantify T_{cr} and S_t, we first propose a simple statistical model that includes T_{cr} and S_t as parameters. Then T_{cr} and S_t for each WIRK type are statistically quantified by experimental fields data. The results showed that T_{cr}s for milky-white and white-core kernels (MAC) and basal-white kernels (BSL) were about 25 degree, while T_{cr} for back- and belly-white kernels (BAB) was about 27 degree. Thus we found that MAC and BSL begin to emerge at a lower temperature than BAB. S_ts for BAB and BSL were about 10 %/degree, while S_t for MLK was about 2.5%/degree. Thus we found that BAB and BSL have a higher sensitivity to temperatures than MLK. These results suggest that we should pay the most attention to BSL, which has a low critical temperature and a high sensitivity to temperatures.

The Coordinated Climate-Crop Modeling Project (C3MP): Overview and Protocol Evaluation

Sonali McDermid et al.
Poster position: D3

Sonali McDermid[1], Alex Ruane[1], Nicholas Hudson[2], Cynthia Rosenzweig[1,2], and more than 60 C3MP Participants
[1] NASA Goddard Institute for Space Studies, New York, NY, USA
[2] Columbia Center for Climate Systems Research, New York, NY, USA

This poster will present an overview of the Coordinated Climate-Crop Modeling Project (C3MP), and an initial evaluation of C3MP protocols and results. C3MP is an on-going initiative that has already mobilized over 150 crop modelers from over 40 countries in a coordinated climate impacts assessment via the Agricultural Model Intercomparison and Improvement Project (AgMIP). Crop modelers are invited to run a set of common climate sensitivity experiments at sites where their models are already calibrated, and then submit their results to enable coordinated analyses for high-impact publications and data products. Of particular interest is the sensitivity of regional agricultural production to changes in carbon dioxide concentrations, temperature and precipitation (CTW), which in many cases is more robust across crop models and locations than are the absolute yields. By coordinating an investigation into these fundamental sensitivities, C3MP enables an investigation of projected climate impacts across a range of global climate models, regional downscaling approaches, and crop model configurations. Initial results submitted to C3MP have been compiled and the C3MP protocols and methodology has been evaluated. The C3MP emulation of yield responses to CTW changes has proved a close fit to simulated crop yields in most contributed locations. We show that the C3MP emulators display a plausible range of crop responses to changes in CTW, and we demonstrate the utility of these response surfaces when evaluating the impact of climate change conditions. As more crop modelers conduct these experiments, coverage will

increase in crops, models, farming systems, and locations to enable additional analyses of uncertainty in the agricultural impacts of climate change. By analyzing CTW sensitivities with today's climate as the origin, C3MP results will also facilitate the identification of key vulnerabilities and urgent interventions.

Integrated assessment of climate change and policy impacts on food security: a case study for protein crop supplies in Austria

Hermine Mitter et al.
Poster position: B14

Hermine Mitter[1], Franz Sinabell[2], Erwin Schmid[1]
[1] University of Natural Resources and Life Sciences Vienna, Institute for Sustainable Economic Development; Doctoral School of Sustainable Development
[2] Austrian Institute of Economic Research; franz.sinabell@wifo.ac.at

We present a methodology of how to use existing crop models with widely available economic data sets and established statistics in order to measure the impacts of climate change and policy adjustments on agricultural production systems and food security. Our case study is on a country in Europe but the method is transferable to other regions, policy scenarios and projections of climate change.

Approximately 75% of feed protein for livestock production in the EU is imported. During the last decade, European protein crop production has even diminished which raises concerns about supplies of protein in Europe. The recent reform of the Common Agricultural Policy (CAP) increases the competitiveness of protein crop production as farmers will be allowed to use cropland for producing legumes that would otherwise have to be set aside. We analyze two questions: (i) what is the likely impact of this policy change on supplies and land use, and (ii) how will climate change affect the competitiveness of protein crop production relative to other crops? We use Austria as case study, because it represents several European countries well-suited for protein crop production (the Danube basin).

We apply an integrated modeling framework to assess climate change impacts on level and variability of Austrian crop yields in combination with a policy reform, to analyze changes in national supply balances, land use, and to quantify economic and environmental effects of more intensive crop production. The bio-physical process model EPIC (Environmental Policy Integrated Climate) is applied to simulate, spatially explicit, annual crop yields and environmental outcomes for a historical period (1975-2005) and three climate change scenarios until 2040. Marginal opportunity costs of expanding protein crop production are estimated by the economic bottom-up land use optimization model for Austria BiomAT. The implications for crop supplies are quantified by using agricultural supply balances in a comparative static analysis.

Our results show that expected climate change and the policy reform are likely to raise domestic outputs of protein crops and the use of nitrogen fertilizer will decline.

Assessing Climate Change Impact on Rice Based Farming Systems in Sri Lanka and Adaptation Strategies using DSSAT and APSIM Models

S.P. Nissanka et al.
Poster position: B12

S.P. Nissanka[1], A.S. Karunaratne[2], W.M.W. Weerakoon[3], R. Herath[3], P. Delpitiya[3], B.V.R. Punyawardena[3], L. Zubair[4] and J. Gunaratna[5]
[1] University of Peradeniya
[2] University of Sabaragamuwa
[3] Department of Agriculture
[4] Foundation for Environment, Climate and Technology of Sri Lanka
[5] University of Rajarata

In line with AgMIP's attempts to develop adaptation to climate change for agricultural sector globally and regionally, the AgMIP-Sri

Lanka project investigated the climate change impacts on rice based farming systems and adaptation strategies, led by the Stakeholder Institutes of Department of Agriculture and Agricultural Universities.

Commonly cultivated rice varieties (Bg300, Bg358, Bg357) of a major rice growing region (Kurunegala) selected for the study, where rice production and other socio-economic information of farm families are available, were calibrated for both DSSAT and APSIM models using experimental data obtained from the Rice Research and Development Institute. Rice yield was simulated for 104 farmer fields for two growing seasons (major and minor) for the base years (2012-2013), historical period (1980-2010), and mid-century (2040-2069) for five GCMs (CCSM4, GFDL-ESM2M, HadGEM2-ES, MIROC5, MPI-ESM-MR) of RCP-8.5 scenario. TOA-MD analysis was carried out using RAP strategies.

The base year RMSE for both seasons range around 1200-1300 kg/ha for observed (major-season 4289kg/ha; minor-season 3883kg/ha) vs simulated using DSSAT (major-season 4888kg/ha; minor-season 4410kg/ha). Compared to historical period, a significant yield reduction of 14%, 12%, 22%, 12%, 17% for the major-season and 31%, 30%, 42%, 28%, 35% minor-season, for the above five GCMs, was observed respectively. Among the adaptation strategies explored (adjusting planting window and short-duration variety), use of short-duration variety (Bg300) recovered yield losses significantly, especially in the minor-season where rainfall is relatively less and warmer. Similar trends were observed for APSIM model outputs as well. TOA-MD analyses revealed that the percentage losers are 68-70 and poverty level increase from 17% to 30% due to climate change.

Key words: Rice production, climate change impacts, food security, adaptation

Multi-model simulations for rice yield forecasts in Jiangsu (China)

V. Pagani et al.
Poster position: C13

V. Pagani[1], C. Francone[1], Z. Wang[2], S. Bregaglio[1], M. Donatelli[3], D. Fumagalli[4], F. Ramos[4], S. Niemeyer[4], Q. Dong[5], R. Confalonieri[1]
[1] Dep. of Agricultural and Environmental Sciences - Production, Landscape, Agroenergy, University of Milan, Milan, Italy
[2] Jiangsu Academy of Agricultural Sciences, People's Republic of China, Nanjing, Jiangsu, China
[3] CRA-CIN, Consiglio per la Ricerca e Sperimentazione in Agricoltura, Bologna, Italy
[4] JRC IES, European Commission, Ispra (VA), Italy
[5] Flemish Institute for Technological Research (VITO), Mol, Belgium

The Bio-physical Model Applications platform (BioMA) provides the opportunity to run multi-model simulations of crop growth and development against a common spatial database. Different crop models are characterized by their specific approaches to reproduce key physiological processes, thus producing varying crop responses to different environmental and climatic conditions. Within the EU-FP7 project E-AGRI on technology transfer of crop monitoring systems to developing economies the three crop models WARM, CropSyst and WOFOST were used to simulate rice growth in the Jiangsu province, China, in a warm (2006) and a cold (1999) season, using ECMWF weather data at 25 × 25 km resolution. The models performed similarly at field level with parameter sets calibrated on data of nine sites and two seasons. However, differing results of the crop growth simulations were obtained at the province level. While CropSyst-simulated biomass was driven mostly by air temperature gradients in the province, biomass simulated with WARM was dominated by radiation, with a more realistic response – especially in the warmest season – when air temperatures were higher than the optimum for the crop. WOFOST responded most strongly to high air temperatures, because unlike WARM it explicitly simulates the air temperature effect on respiration through a net-photosynthesis

approach. Facilitated through the BioMA platform the multi-model approach allowed for detecting and assessing the crop models' different peculiarities especially under anomalous and extreme weather conditions.

Integrated Assessment of Climate Change Impacts on Principle Crops and Farm Household Income in Southern India

Paramasivam Ponnusamy
Poster position: B13

Paramasivam Ponnusamy, Geethalakshmi Vellingiri, Lakshmanan Arunachalam,Sonali Mcdermid, Raji Reddy Danda, Dakshina Murthy, Mahendran Kandaswamy and Sunandini Prema

This study aims to assess the impact of climate change on agricultural production in southern India and its implications for farm household income and food security. Farm households in Tamil Nadu, Andhra Pradesh, and other Provinces excluding south-western Kerala of the Deccan Plateau are located in the rain-shadow of the Western Ghats. With meagre annual rainfall averaging 500 to 900 mm, the region is experiencing steadily decreasing soil fertility, growing dependence on groundwater for irrigation, falling ground water tables, and increasing fallow lands - characteristics that may be impacted by changes in long term climate trends. Agriculture sustains over half of the region's population. The study is carried out in Tamil Nadu (TN) and Andhra Pradesh (AP) States of South India. Household production systems in the region are characterized based on sources of irrigation in the region. Irrigated rice based cropping system in TN and both rain fed and irrigated maize based cropping systems in TN and AP are taken up for integrated impact assessment.

Crop models DSSAT and APSIM with climate parameter inputs from select RCP based (RCP 4.5 and 8.5) scenario downscales and management inputs from farm surveys are used to simulate base and climate impacted future yields with/without adaptations. Simulated yields are used for economic analysis to assess impacts on household incomes, employment and poverty. Following Shared Socio-economic Pathways (SSPs) under varying developmental assumptions, we attempt to develop Representative Agricultural Pathways (RAPs) to assess future trends and values for regional level management inputs through a participatory discussion process. Some of these RAPs based management variables are used in crop models along with future climate parameters to simulate future yields. Future farm characterizations derived from RAPs are combined with crop model simulated yields in economic tradeoff analysis using a Multi-Dimensional (TOA-MD) model for overall household impact assessment. The integrated analyses are replicated for a set of adaptation options to assess their efficacy in moderating climate change impacts on the rice and maize crops based production systems and households of the study region.

A biome-based analysis of current and future global crop yields

T.A.M. Pugh et al.
Poster position: D14

T.A.M. Pugh[1], S. Olin[2], A. Arneth[1]
[1] Karlsruhe Institute of Technology, Institute of Meteorology and Climate Research (IMK-IFU), 82467 Garmisch-Partenkirchen, Germany
[2] Department of Physical Geography and Ecosystem Science, Lund University, Sölvegatan 12, S-22362 Lund, Sweden

Natural terrestrial vegetation occurs as part of functioning ecosystems whose composition and behaviour is dictated by the prevailing climatic conditions and other environmental factors, such as nutrient availability. Globally ecosystems can be broadly categorised into types, or biomes, according to the prevailing conditions and the dominant vegetation types therein. Throughout history humans have modified their surrounding environment, clearing natural ecosystems to provide raw materials and/or make space for other land uses, predominant among which is agriculture. These actions in themselves create new ecosystems which, excepting anthropogenic actions such as fertilisation and irrigation, will function under largely the same environmental boundary conditions as the ecosystems they replace. These boundary conditions thus define the potential for how efficiently a new land-use can provide the service it was created for, such as food production. Using global observations of actual and potential yield we consider the yields of the major global staple crops wheat, maize and rice as a function of the natural biome in which they are grown. We compare the observed yields with those generated by a process-based global crop model, LPJ-GUESS. We then extend these biome-based yields into the future and consider how management processes such as irrigation and cultivar adaptation may influence the results. Finally we contrast the yield for each biome area with the carbon storage potential of the natural vegetation within that biome under present and future conditions and consider synergies and trade-offs between these two important ecosystem services.

Agricultural processes can substantially affect global climate forcing from CO_2

T.A.M. Pugh et al.
Poster position: D15

T.A.M. Pugh[1], S. Olin[2], A. Arneth[1]
[1] Karlsruhe Institute of Technology, Institute of Meteorology and Climate Research (IMK-IFU), 82467 Garmisch-Partenkirchen, Germany
[2] Department of Physical Geography and Ecosystem Science, Lund University, Sölvegatan 12, S-22362 Lund, Sweden

Anthropogenic land-use and land-cover change has substantially altered fluxes of carbon between the terrestrial biosphere and the atmosphere, exerting a strong influence on global climate. Yet only relatively recently have anthropogenic land-use and -cover change been explicitly and widely represented in global terrestrial biosphere and Earth-System Models (ESMs). Typically such models represent all crops and pasture land (~35% of global land area in 2000) as grasslands. However, crops and pasture typically differ from natural ecosystems in terms of plant species, productivity, phenology, management, the annual growth cycle, and harvest; fundamentally affecting the amount of carbon stored by the terrestrial biosphere. We show that incorporating agriculture-specific processes in a global terrestrial biosphere model (LPJ-GUESS) can dramatically increase the carbon emissions resulting from land-use change by as much as 80% over period 1850-2005. Using climate forcing from an ensemble of ESMs we calculate the difference in terrestrial carbon accumulation over the period 1850-2100 under both moderate and extreme future climate pathways. We find that agriculture-driven differences in terrestrial carbon accumulation can result in a change in sign of the influence of the terrestrial carbon cycle on global climate from a net cooling to a net warming and influence global radiative forcing by as much as 0.5 W m^{-2}.

Projecting spring wheat yield changes on the Canadian Prairies: Resolutions of a regional climate model

Budong Qian et al.
Poster position: B7

Budong Qian[1], Ted Huffman[1], Hong Wang[2], Yong He[2], Jiangui Liu[1], Reinder De Jong[1]
[1] Eastern Cereal and Oilseed Research Centre, Agriculture and Agri-Food Canada, Ottawa, Ontario
[2] Semiarid Prairie Agricultural Research Centre, Agriculture and Agri-Food Canada, Swift Current, Saskatchewan

In addition to the uncertainty associated with crop models, climate scenarios are still a major source of uncertainty in projecting crop yield changes under climate change. Regional climate models (RCMs) are used as a tool for dynamic downscaling of climate scenarios from global climate models (GCMs) to regional scales for climate change impact studies. It is known that running an RCM is more expensive and time consuming at a higher resolution than at a lower resolution. Therefore, it is interesting to investigate how resolutions of an RCM might result in differences in the projected crop yield changes. We employed the CERES-Wheat model in DSSAT to simulate yield changes of

spring wheat at 13 locations across the Canadian Prairies, with climate scenarios from a Canadian Regional Climate Model (CanRCM4) driven by a Canadian Earth System Model (CanESM2) with forcing scenarios RCP4.5 and RCP8.5 at 25km and 50km resolutions. Bias correction and a stochastic weather generator referred to as AAFC-WG were used to develop future climate scenarios as input to the crop model. The results showed that when changes were averaged across the locations, whether 25km or 50km resolution CanRCM4 data were used, the projected yield changes were fairly consistent, with approximately a 20% increase under RCP4.5 and close to a 30% increase under RCP8.5, especially if AAFC-WG was used to develop climate scenarios. Spatial distributions of the projected yield changes were also similar for the two resolutions of CanRCM4.

Agricultural impacts of climate variability and change in Eastern Africa

K.P.C. Rao et al.
Poster position: B10

K.P.C. Rao[1], G. Sridhar[1], Mary Kilavi[2], Richard Mulwa[3], Siza Tumbo[4], Moses Tenywa[5], Araya Alemie Berhe[6] and Benson Wafula[7]
[1] International Crops Research Institute for the Semi-Arid Tropics, Addis Ababa, Ethiopia
[2] Kenya Meteorological Department, Nairobi, Kenya
[3] University of Nairobi, Nairobi, Kenya
[4] Sokoine University of Agriculture, Morogoro, Tanzania
[5] Mekerere Univeristy, Kampala, Uganda
[6] Mekelle University, Mekelle, Ethiopia
[7] Kenya Agricultural Research Institute, Embu, Kenya

Climate change impacts on smallholder agriculture was assessed in four Eastern African countries - Kenya, Ethiopia, Tanzania and Uganda – using the protocols and tools developed by Agricultural Model Inter-comparison and Improvement Project (AgMIP). In each country, a study area of the size of a district (about 150-200,000 ha) representing at least three major agro-ecological zones of the country and having about 50,000 households was selected. Household surveys were conducted to obtain the required input data for crop and economic models. In Kenya, the assessment covered five different agro-ecologies in Embu County. Projected future climate change scenarios for mid (2041-2070) and end (2071-2100) century were downscaled to four weather stations. Coarse outputs of 20 CMIP 5 General Circulation Models (GCMs) for Representative Concentration Pathways (RCP) 4.5 and 8.5 were downscaled by delta method to generate location specific future climate projections. Experimental data from maize grown under different nitrogen regimes for both long and short rain seasons were used to parameterize and evaluate crop simulation models DSSAT and APSIM. Maize yields of main food crop Maize under observed and future climates were simulated with APSIM and DSSAT crop models that were calibrated to simulate the locally relevant varieties and management practices. The diversity in the management employed by the farmers in the target region was captured by setting up runs for each of the 441 farmers involved in the survey. Analysis of bias-corrected and spatially downscaled scenarios indicated substantial changes in the climatic conditions at all locations. All GCMs predicted higher increase in minimum temperature compared to maximum temperature and most GCMs projected rainfall amounts are increasing from 10 to 150% in the region. Couple of GCMs projected reduction in rainfall amounts by 20%. Both APSIM and DSSAT predicted an increase in Maize yields in four out of the five agro-ecologies with projected climatic conditions mainly due to an increase in rainfall and projected temperature changes were within the crop optimum range. Within the agro-ecology, household-level impacts differed with management. High input systems (>35 kg of N/ha) were found to be more adversely affected compared to low input systems. The analysis helped in identifying a sub-set of management practices that enable smallholder to adapt and take advantage of the projected changes in climate.

Climate Impact Estimates on C3MP's Worldwide Network of Crop Modeling Sites

Alex Ruane et al.
Poster position: D4

Alex Ruane[1], Sonali McDermid[1], Nicholas Hudson[2], Cynthia Rosenzweig[1,2], and more than 60 C3MP Participants
[1] NASA Goddard Institute for Space Studies, New York, NY, USA
[2] Columbia Center for Climate Systems Research, New York, NY, USA

We present preliminary projections of climate impacts from a network of 904 crop modeling sites contributed to the AgMIP Coordinated Climate-Crop Modeling Project (C3MP). At each site sensitivity tests were run according to a common protocol, which enables the fitting of crop model emulators across a range of carbon dioxide, temperature, and water (CTW) changes. When driven by global climate model projections, these emulators estimate probabilistic climate impacts across all sites for a range of scenarios and time periods. Preliminary results suggest consistently declining yields for irrigated and rainfed maize, with results comparable to (but slightly more pessimistic than) projections from an ensemble of global gridded maize models. Soybean and rice yield changes are relatively small; however wheat yields are projected to increase as some models demonstrate a beneficial reaction to initial temperature increases. Differences between C3MP results and comparisons with results from other AgMIP initiatives merit further study, so we invite you to join us at this workshop and to participate in C3MP in the months ahead.

An integrated analysis on Austrian agriculture - climate change impacts and adaptation measures

Martin Schönhart et al.
Poster position: B8

Martin Schönhart, Hermine Mitter, Erwin Schmid, Georg Heinrich, Andreas Gobiet

An integrated modelling framework (IMF) has been developed and applied to analyse climate change impacts and cost-effective adaptation measures in Austrian agriculture. Climate change is depicted by four contrasting regional climate model (RCM) simulations until 2050 and supplemented with three adaptation and policy scenarios. The IMF couples the bio-physical process model EPIC and the bottom-up economic land use model PASMA at NUTS-3 level considering agri-environmental indicators. Impacts from four RCM simulations show increasing crop productivity on national average. Changes in average gross margins at national level range from 0% to +5% between the baseline and three scenarios until 2040. The impacts are more pronounced at regional scale and range between -5% and +7% among Austrian NUTS-3 regions between the baseline and the three scenarios until 2040. Adaptation measures such as winter cover crops, reduced tillage and irrigation are cost-effective in reducing yield losses, increasing revenues, or in improving environmental states under climate change. Future research should account for extreme weather events in order to analyse whether average productivity gains at the aggregated level suffice to cover costs from expected higher climate variability.

Reimplementation and reuse of the Canegro model: from sugarcane to giant reed

T. Stella et al.
Poster position: C12

T. Stella[1], C. Francone[1], S.S. Yamaç[1], E. Ceotto[2], R. Confalonieri[1]
[1] Dep. of Agricultural and Environmental Sciences - Production, Landscape, Agroenergy, University of Milan, Milan, Italy
[2] CRA-CIN, Consiglio per la Ricerca e sperimentazione in Agricoltura, Bologna, Italy

The software design of simulation models often prevents their reuse and extension, forcing third-parties interested in modifying an available model to rewrite it from the beginning. This removes resources for model improvement, for the development of new models, and for the extension of their application domains, leading to the proliferation of software implementing models sharing large part of the algorithms. Component-oriented paradigm allows to overcome these limitations, favouring model extension and improvement, better maintenance, and massive code reuse. This study presents the application of these principles to the reimplementation of the sugarcane model Canegro, which led to the definition of an extensible, framework-independent component following the BioMA architecture. The innovation consists in the granularity and transparency of the implementation, as well as in architectural features that encourage the model analysis and extension. Each biophysical process (e.g., photosynthesis) is formalized through independent basic units (e.g., for light interception, energy conversion into assimilates, respirations), which can be easily substituted by alternative approaches. The advantages of this re-implementation lie (i) in the possibility of diffuse contributions to model development due to the independence from specific framework, and (ii) in the ease of reuse and modification of the model algorithms made possible by the fine granularity. The latter is here demonstrated through the extension of the component for giant reed (Arundo donax L.) simulation, a promising energy crop which shares several morphological and physiological features with sugarcane.

Strengthening Simulation Approaches for Understanding, Protecting and Managing Climate Risks in Stress-prone Environments across the Central and Eastern Indo-Gangetic Basin

Nataraja Subash et al.
Poster position: B11

Nataraja Subash, Harbir Singh, Babooji Gangwar, Guillermo Baigorria, Anup Das, Rajendra Dorai, Abeed Hossain Chawdhury, Andrew McDonald, Balwinder Singh and Sandeep Sharma

Climate change impacts are increasingly visible in Indo-Gangetic Basin of South Asia with greater variability of the monsoon. Direct and indirect impacts on agricultural production and thereby the food security and livelihoods of many small and marginal farmers, particularly in the more stress-prone regions of the central and eastern Indo-Gangetic Basin consist of India, Bangladesh and Nepal. Linking climate, crop and economic modeling will provide an insight into the integrated assessment of impacts of projected climate change on agricultural productivity of the region. The preliminary results of one site, Meerut (29^0 4′ N, 77^0 46′ E, 237 m ASL), of the Upper Gangetic region of the IGP, India based on AgMIP methodology is explained in this poster. To capture the yield variability, 76 farms were surveyed in 2009-10 to capture the variability. Sugarcane-wheat and rice-wheat are the most predominant cropping system followed in this region. The important observed variability of farms are viz., wide variability in dates of sowing - 17th October to 3rd January, Date of Harvest – 10th April - 17th May, Five cultivars – PBW223, PBW243,WL502, PBW343, UP232, No. of irrigations – 3,4 & 5, variability in N, P and K applications. In this preliminary analysis, we have calibrated the DSSAT and APSIM model for wheat crop. All GCMs predicted higher monthly mean maximum and minimum temperatures during the mid-century period 2040-2069 under RCP8.5 compared to baseline (1980-2010). All the five targeted GCMs (CCSM4, GFDL-ESM2M, HadGEM2-ES, MIROC5, MPI-ESM-MR) predicted more or less same nature of projections. DSSAT simulated higher yields under projected climate

change scenarios compared to APSIM. This may be due to difference in sensitivity of DSSAT and APSIM with changes in CO_2 and temperature. The mean and variability scenarios are not different compared to mean only scenarios. TOA-MD results predict higher percentage of gainers (58-61%) with DSSAT as compared to APSIM (44-50%) under five climate scenarios. Overall, Climate change situation, APSIM predicts losses (1-12%) but DSSAT shows gains (15-21%) in mean net farm returns.

Software frameworks for crop model development and multi-purpose application

A. Topaj et al.
Poster position: C9

A. Topaj[1], S. Medvedev[1], V. Yakushev[1], A. Komarov[2], V. Shanin[2], V.Denisov[3]
[1] Agrophysical Research Institute, Grazhdansky pr., 14, 195220, Saint-Petersburg, Russia
[2] Institute of Physicochemical and Biological Problems in Soil Sciences, Institutskaya str., 2, 142290, Pushchino, Russia
[3] Klaipeda University, Herkaus Manto str., 84, LT-92294, Klaipeda, Lithuania

Nowadays, there is an obvious need for multi-purpose applications of crop models and, therefore, the model as a software product should satisfy requirements of various groups of stakeholders. The requirements formulated should serve as a blueprint for the design and implementation of the crop modeling software. Main focus of the contribution is made on collaborative model development including model decomposition issues and implementation of generic frameworks for multi-variant model use. Three main objectives are defined by the authors for such kind of systems:

- Multivariate simulation – run-time environment allowing the multiple running of the model with different input data in a batch mode.
- Unified shell – generic user interface that allows running various models inside of a single application via standard forms and use cases.
- Structural adaptation – ability to assembly the current implementation of simulation algorithm from the set of alternative pre-designed modules without recompilation of whole model.

The contribution presents a coherent view on mentioned problems based on results that have been elaborated in several research institutions of Eastern Europe. It contains short historical review, current state and prospective ideas for improvement of modeling infrastructure suitable to perform multi-factor computer experiments with crop or forest simulation models. In particular, authors present the original products APEX (Automation of Poly-variant EXperiments) and DLES (Discrete Lattice Ecosystem Simulator) and briefly compare them with analogous products and technologies (DSSAT, GUICS, CAPSIS, OpenMI).

Infrared Warming Affects Leaf Gas Exchange and Water Relations of Spring Wheat

G.W. Wall et al.
Poster position: A5

G.W. Wall[1], B.A. Kimball[1], J.W. White[1], and M.J. Ottman[2]
[1] USDA-ARS, Maricopa, Arizona
[2] University of Arizona, Tucson
Atmospheric CO_2 concentration is rising, which is predicted to induce global warming. Our objective was to characterize and quantify the ecophysiological response of spring wheat (Triticum aestivum L. cv. Yecora Rojo) and its microclimate to any potential concomitant rise in ambient temperatures associated with global change. A Temperature Free-Air Controlled Enhancement (T-FACE) apparatus with infrared heaters was employed to warm the canopy temperature of spring wheat by 1.5 and 3.0 °C during the diurnal and nocturnal periods, respectively. The experimental design was a completely randomized Latin square (3x3) consisting of three ecosystem warming treatments (control, heated, reference) in three replicates

over three planting dates (Mar., Sept., Dec.) during 2007 and 2008. Gas exchange properties and water relations of leaves as well as soil CO_2 efflux were measured. Compared with either the control or reference plots, in the heated plots, the uppermost sunlit leaf and those lower in the canopy had warmer leaf temperatures, higher net assimilation rates, and a decrease in internal water status - but they had comparable stomatal conductance and relative water content. The soil CO_2 efflux was greater in heated compared with reference plots. These results are useful for development and validation of temperature response functions in crop growth models that are being used to perform impact assessment on the sustainability of cereal grain crop production in a future high-CO_2 world.

AgMIP Water: Integrating Water Scarcity into Future Agricultural Assessments

Jonathan M. Winter et al.
Poster position: A8

Jonathan M. Winter[1], Alexander C. Ruane[2], Cynthia Rosenzweig[2]
[1] Dartmouth College
[2] NASA Goddard Institute for Space Studies

Agricultural productivity is strongly dependent on the availability of water, necessitating accurate projections of water resources, the allocation of water resources across competing sectors, and the effects of insufficient water resources on crops to assess the impacts of climate change on agricultural productivity.

This poster will detail AgMIP efforts at the interface of water and agriculture, including a pilot project that deploys a coupled hydrologic, water resources, and crop model over the Central Valley of California to explore the implications of future climate on irrigated agriculture; the recently held AgMIP - USDA Economic Research Service Water Workshop, which brought together over 35 leading scientists in climate, hydrology, water resources management, agronomy, and economics to develop strategies for improving the representation of water supply and demand in agricultural assessments; research in development; and opportunities to become involved in AgMIP Water.

New Drought Indices and Assessment in Drought Monitoring

Nana Yan and Bingfang Wu
Poster position: A7

Nana Yan[1], Bingfang Wu[1]
[1] Key Laboratory of Digital Earth Science, Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing, China

Due to spatial coverage, data availability and cost efficiency, this paper focused on studying the potential to apply the satellite product to monitor drought. First is Standard Precipitation Index (SPI), which is widely used around the world for research and operational applications on meteorological and agricultural drought monitoring and early warning. SPI was designed to be calculated for any location that has a long-term precipitation record. Therefore, the accuracy of monthly precipitation data of TRMM (the Tropical Rainfall Measurement Mission) 3B43, was firstly investigated through comparison with rainfall data of forty ground stations in Hai Basin from 1998 to 2010.A single parameterized correction equation was presented to calibrate the TRMM rainfall data to formulate the series rainfall dataset of 30 year from 1981 to 2010. It was found that 3-month SPI was the best to depict the meteorological drought, which agreed well with the statistical drought information from 2000 to 2004. Second is Temperature-modified Anomaly NDVI Index (TANDVI) was improved based on the fact that NDVI was more affected by the accumulated temperature than precipitation in spring in the south plain of Hai Basin. The results indicated that the change of crop phenology would be an important factor which can bring the error on assessing the drought.

Irrigation and Rain Fed Croplands Separated Methodology Based on Remote Sensing

Hongwei Zeng et al.
Poster position: A6

Hongwei Zeng[1, 2], Bingfang Wu[1, 2, *], Nana Yan[1, 2]
[1] Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, 100101, China
[2] Key Laboratory of Digital Earth Science, Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, 100101, China
[*] Corresponding: wubf@irsa.ac.cn

Irrigation croplands are the main water consumption of agricultural water resources, especially in arid and semi-arid basins. Due to lack of stabilized water supply, the yield of rain fed croplands tends to show large fluctuation than irrigation croplands in different year, such as wet season and drought period. Normalized Difference Vegetation Index (NDVI) and NPP could monitor effectively crop condition and estimate crop yield during crop growing season. Based on this hypothesis on yield fluctuation in different year, this work constructed NDVI and NPP time series of wet season and drought period, presented a threshold method to separate irrigated and rain fed croplands. Shijin irrigation district located at Plain of ZIYA River (PZYR) of Hai basin, winter wheat, maize, and cottons are the main crop types in this region. Due to rainfall deficit, during the winter wheat growing season (April to June); irrigation water supply is necessary for increasing crop yield. In order to estimate water supply stabilization and promote water resources management, this work used threshold of NDVI and NPP to illustrate the whole process on separating irrigation and rain fed croplands.

Key words: NDVI; NPP; Irrigation; Rain fed

The Impacts of Climate Change on Rice Farming Systems in North-Western Sri Lanka

L. Zubair et al.
Poster position: C15

L. Zubair, S.P. Nissanka, P. Agalawatte, S.C. Chandrasekera, C.M. Navaratne, J. Gunaratna, D.I. Herath, R.M. Herath, A. Karunaratne, B.R.V. Punyawardhene, W.M.W. Weerakoon, K.D.N. Weerasinghe, P. Wickramagamage, E. Wijekoon, Z. Yahiya

As a contribution to the AgMIP project, the impacts of climate on farming systems in the Kurunegala District in Sri Lanka were analyzed based on farmer surveys undertaken for the 2011 and 2012 seasons. Meteorological observations for 1980-2010 were subjected to quality checks and gap filling. These data were used to generate future climate scenarios for the farms using the 20 GCM's in the CMIP5 archive under the RCP8.5 scenario with further analysis restricted to 5 GCM's that are more skillful in the region. Calibration of DSSAT and APSIM crop modeling were undertaken with experimental observations in selected years in the two cultivation seasons. After further tuning, these crop models were used to simulate cultivation in the 2011 and 2012 seasons, the historical and mid-21st century periods. The climate projections shows a rise in maximum and minimum temperature for the future period by1.5 to 2.5 °C and a rise in rainfall by 1-3 mm/day for both seasons except for a drop in a couple of models. The DSSAT crop model simulations showed a drop in yield that ranged from 1.7% to 17% for the main season with a wider range of declines in the minor season. At two sites, the losses led to a slight increase in the fraction of farmers who were adversely affected while in other sites the analysis showed larger fractions were adversely affected. In the latter sites, the use of short-duration variety mitigated yield losses significantly. Work to refine methodologies and understand uncertainties is in progress.

Key words: Sri Lanka, Rice, CMIP5, DSSAT, APSIM, TOA-MD

AgMIP's mission is to improve substantially the characterization of world food security as affected by climate variability and change, and to enhance adaptation capacity in both developing and developed countries.

AgMIP coordination is located at the Columbia University Earth Institute Center for Climate Systems Research, 2880 Broadway, New York, NY 10025 USA
phone +1.212.678.5563 |
email info@agmip.org