AgMIP The Agricultural Model Intercomparison and Improvement Project

The AgMIP Coordinated Global and Regional Assessments (CGRA) of Climate Change Impacts on Agriculture and Food Security




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Views expressed are those of the author, and don't necessarily represent those of NASA

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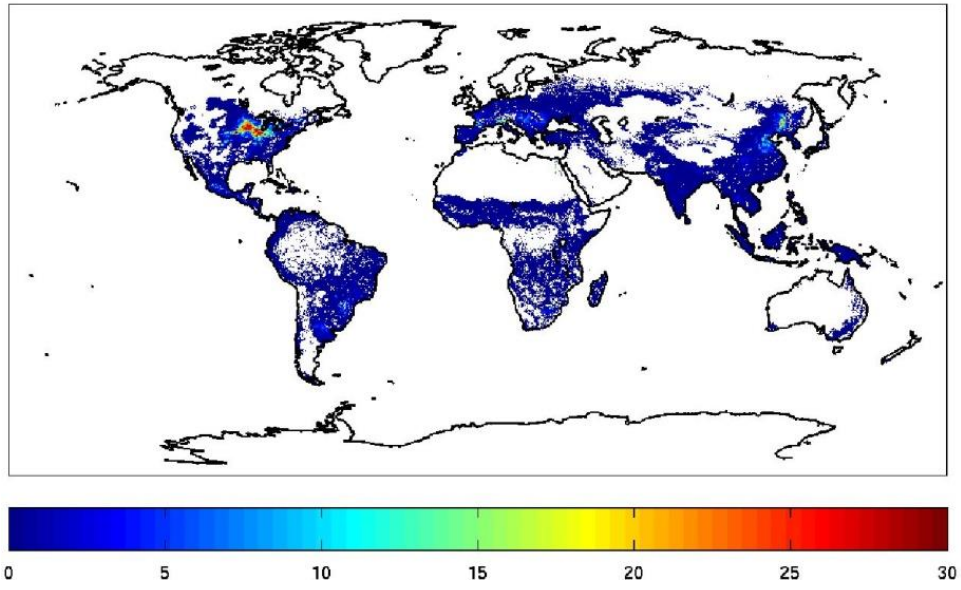
New York, N.Y.

CENTER FOR CLIMATE SYSTEMS RESEARCH
THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY

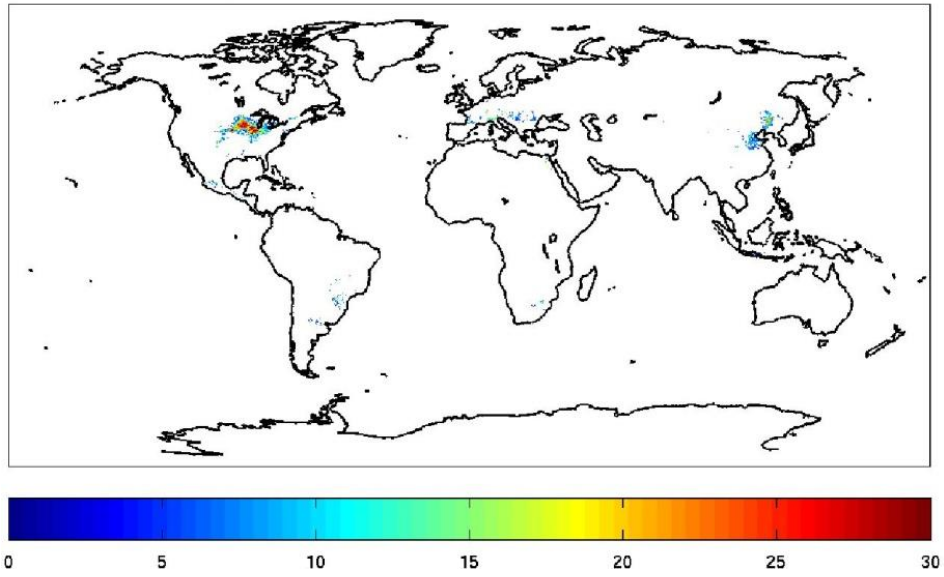
Global and Regional Resilience

All Maize Production (1000s of kg)



Data from Monfreda et al., 2002

Top Regions Accounting for 90% of World Maize Production



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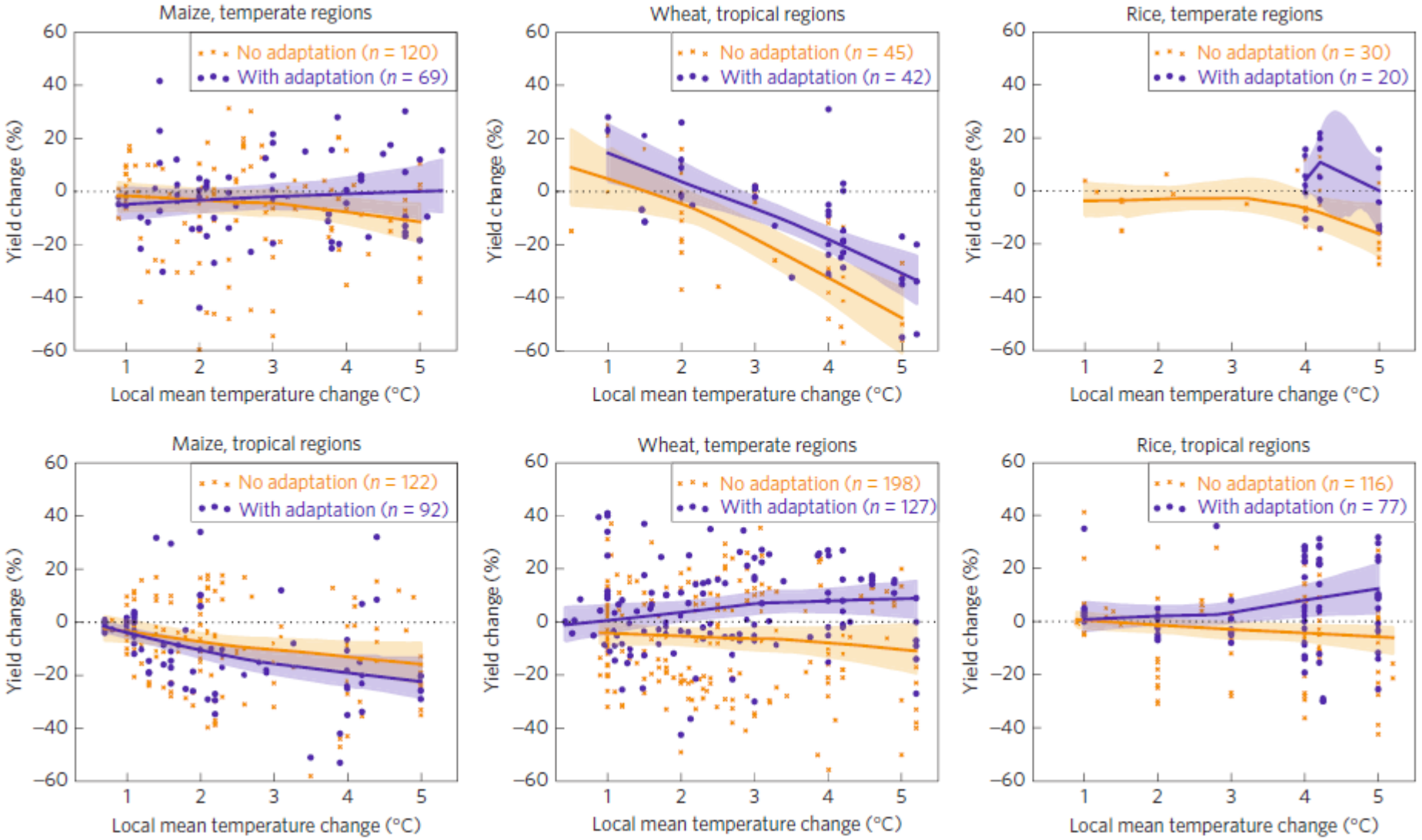
Crop Responses are Not Clear

(Meta-analysis by Challinor et al., Nature Climate Change and IPCC WG2)



Difficult to make sense out of incredibly diverse studies

The Agricultural Model Intercomparison and Improvement Project (AgMIP)

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Worldwide Science Community

1st Global Oct 2010

2nd Global Oct 2011

4th Global Oct 2013

5th Global Feb 2015

Sub-Saharan Africa #3

South Asia #3

3rd Global Oct 2012

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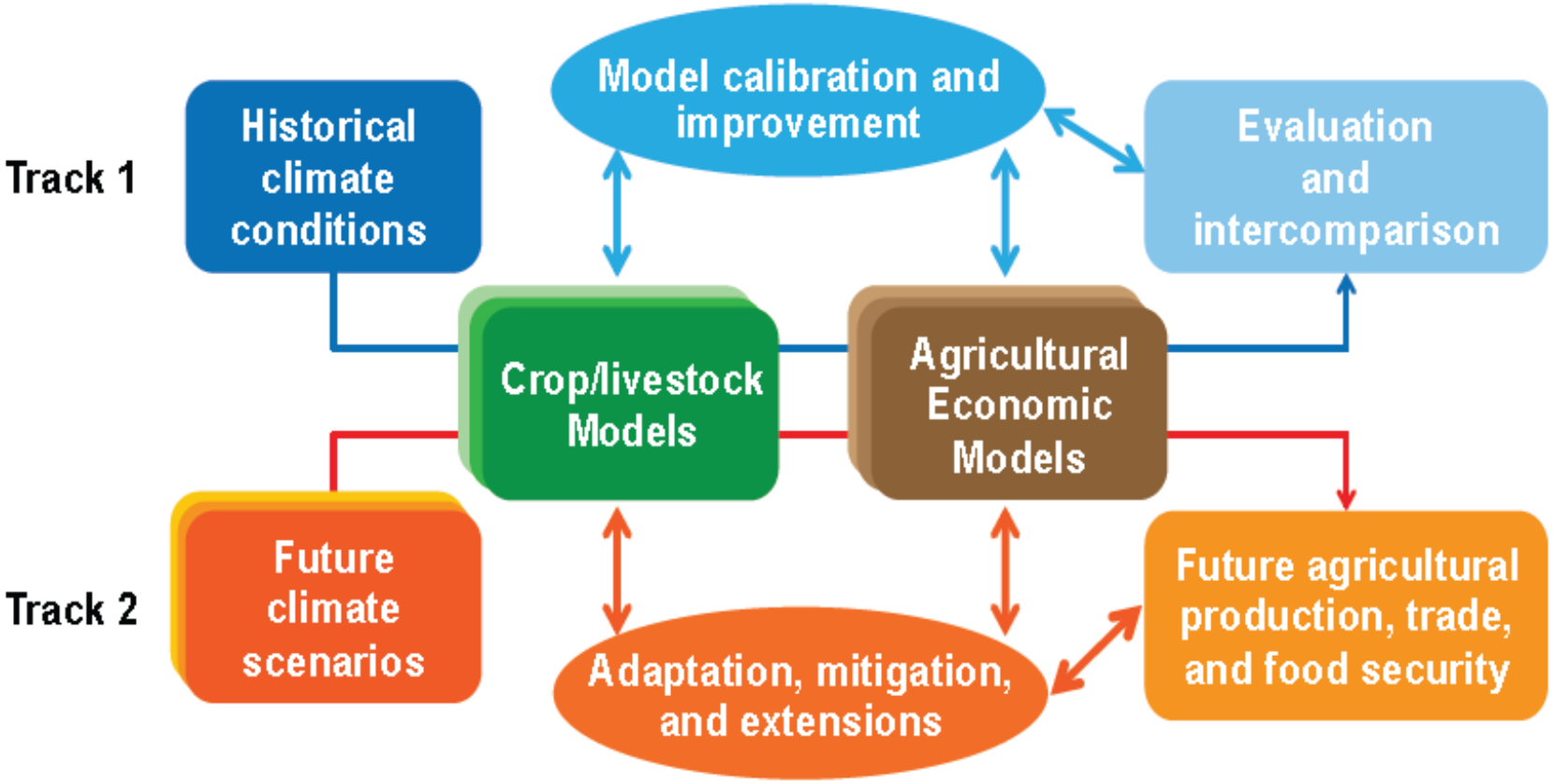
AgMIP Approach Enables *Testing* of Farm and Policy Strategies



Rosenzweig et al., 2013 AgForMet

Current AgMIP Activities

Rosenzweig et al., 2015; Climate Change and Agroecosystems, Volume 3 Part 1

AgMIP is an international community of 800+ **climate scientists**, **agronomists**, **economists**, and **IT experts** working to improve assessments of **future food security**

Visit www.agmip.org for more information and to sign up for AgMIP listserv

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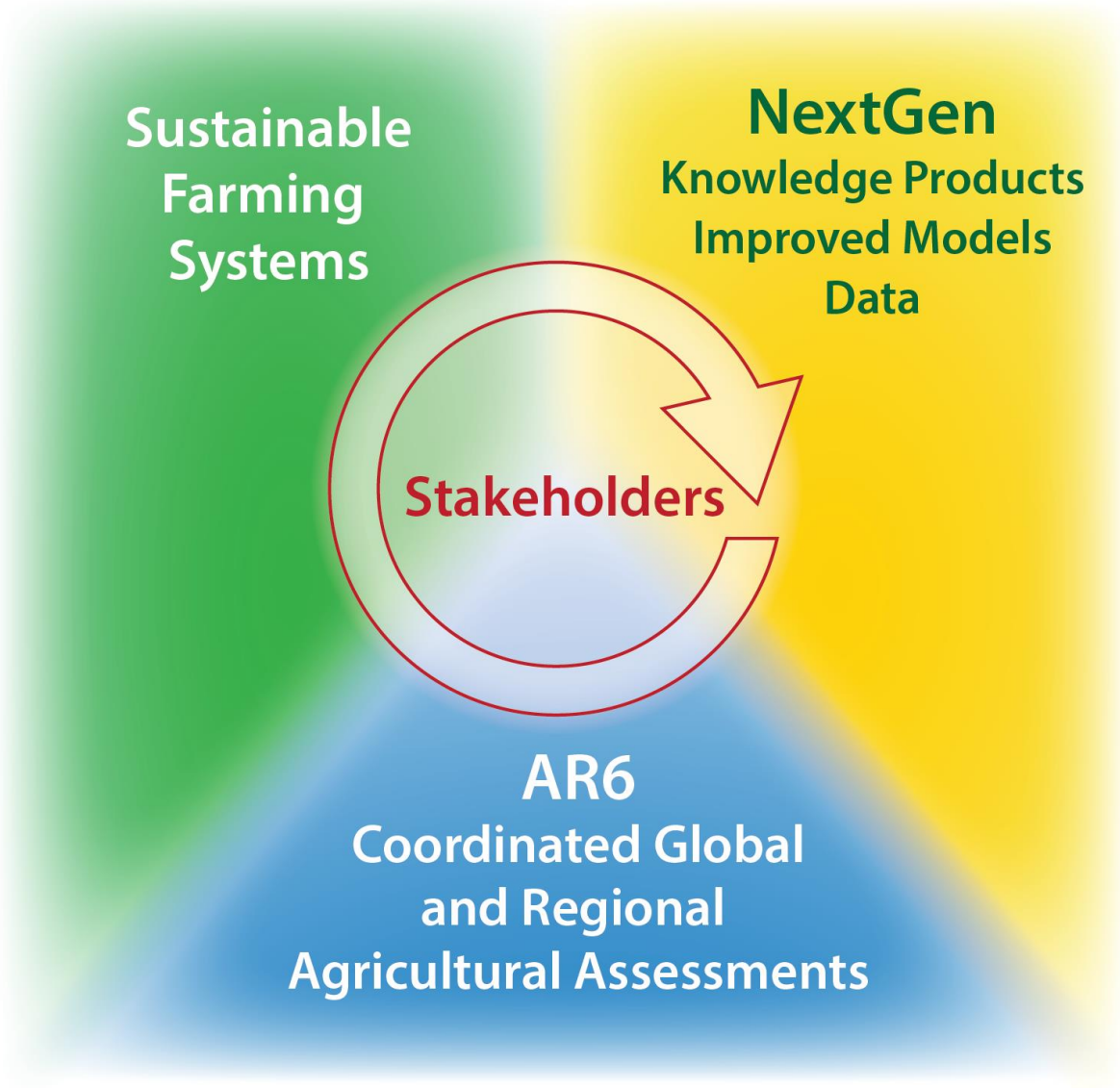
AgMIP Focus Areas




Constructing a Framework
for Global Assessment

Global assessments need climate, crop, and economic responses

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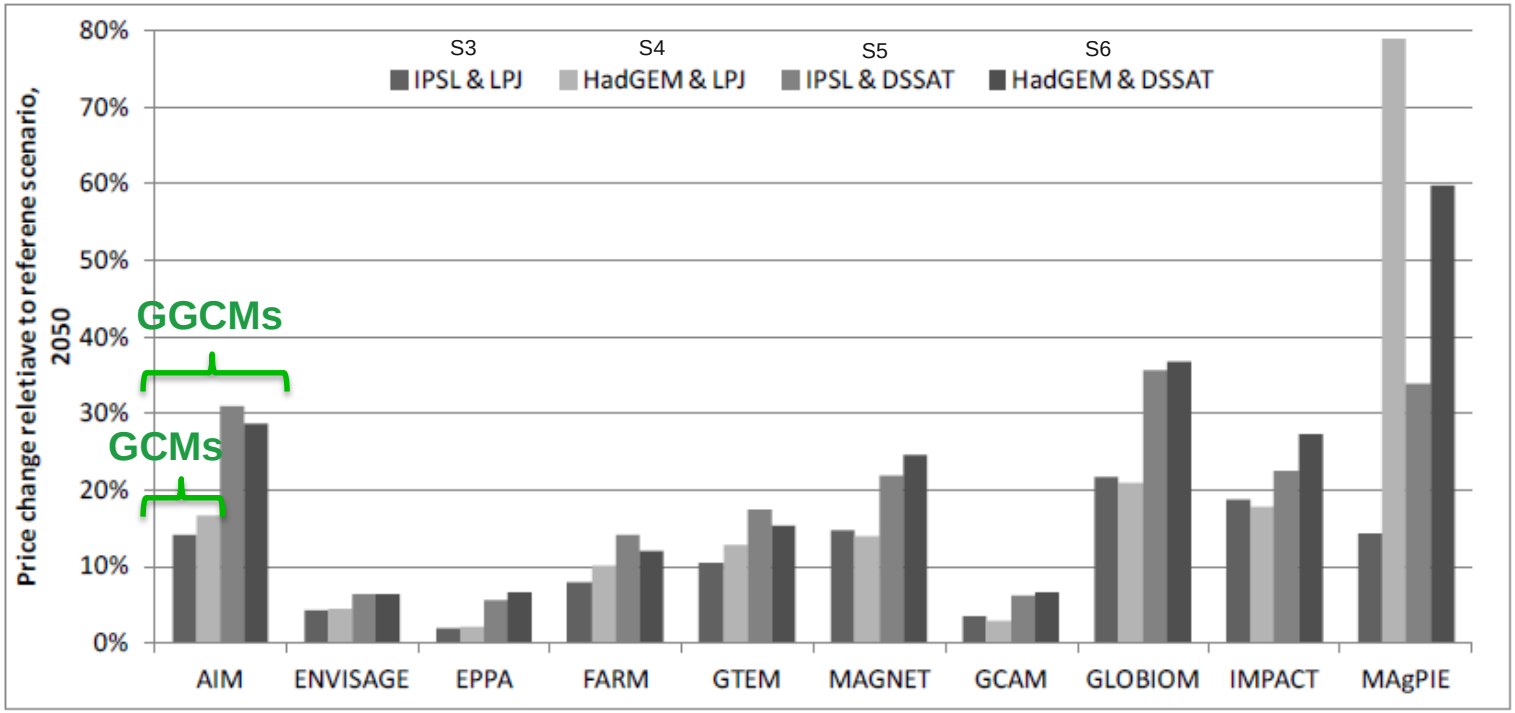
Effects of climate change on agricultural prices
(2050 RCP8.5 relative to results without climate change in 2050)



Source: Model results as of February 15, 2013

Note: All changes relative to the reference scenario for the same year.

AgMIP Global Economics Model Intercomparison

10 Global Economics Models, 2 GCMs, 2 crop models

Von Lampe et al., Agricu*ltural Economics, 2013*

Baseline from SSP2

AgMIP/ISI-MIP Global Gridded Crop Model (GGCM) Assessment

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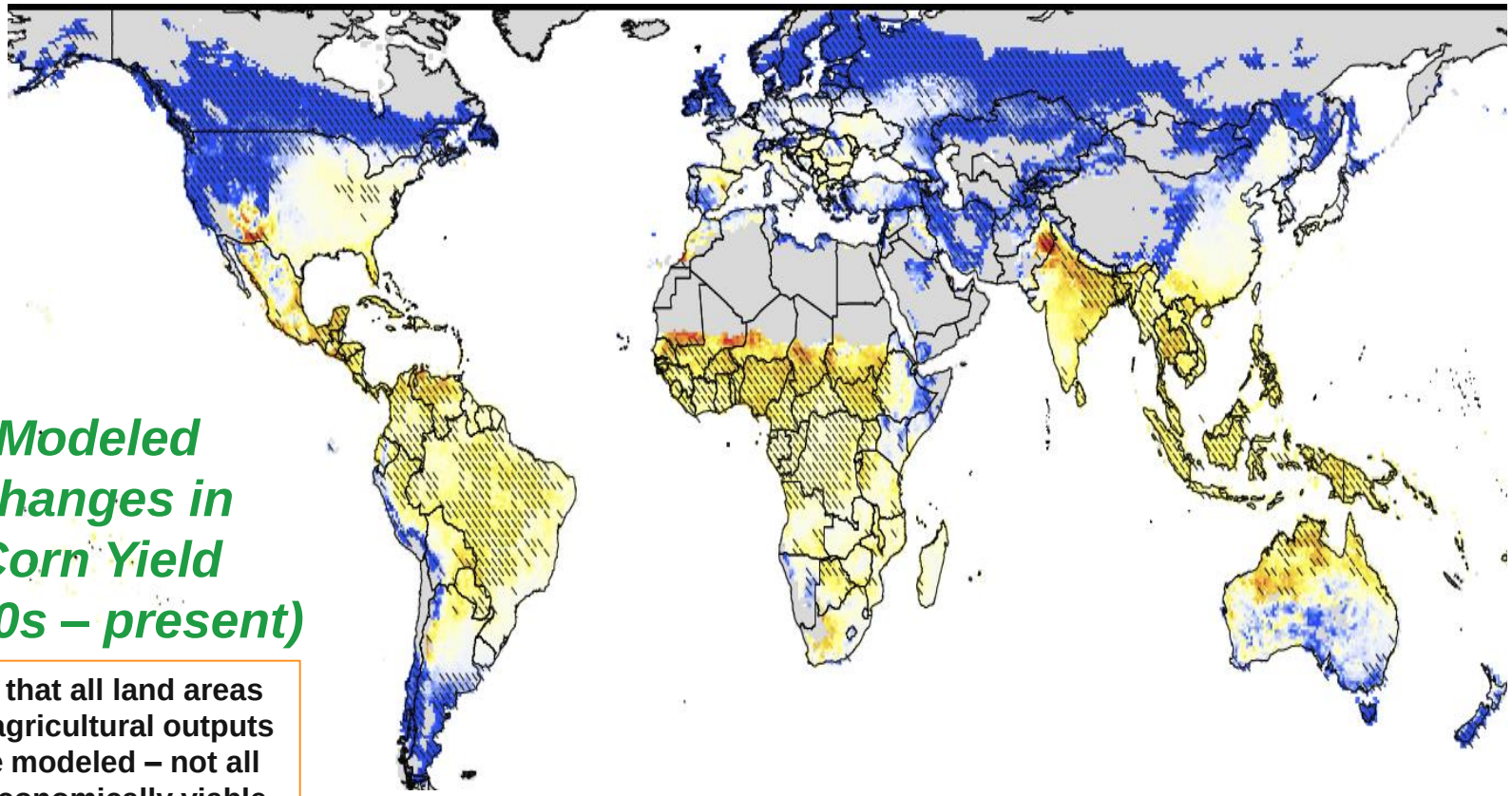


Modeled Changes in Corn Yield (2080s – present)

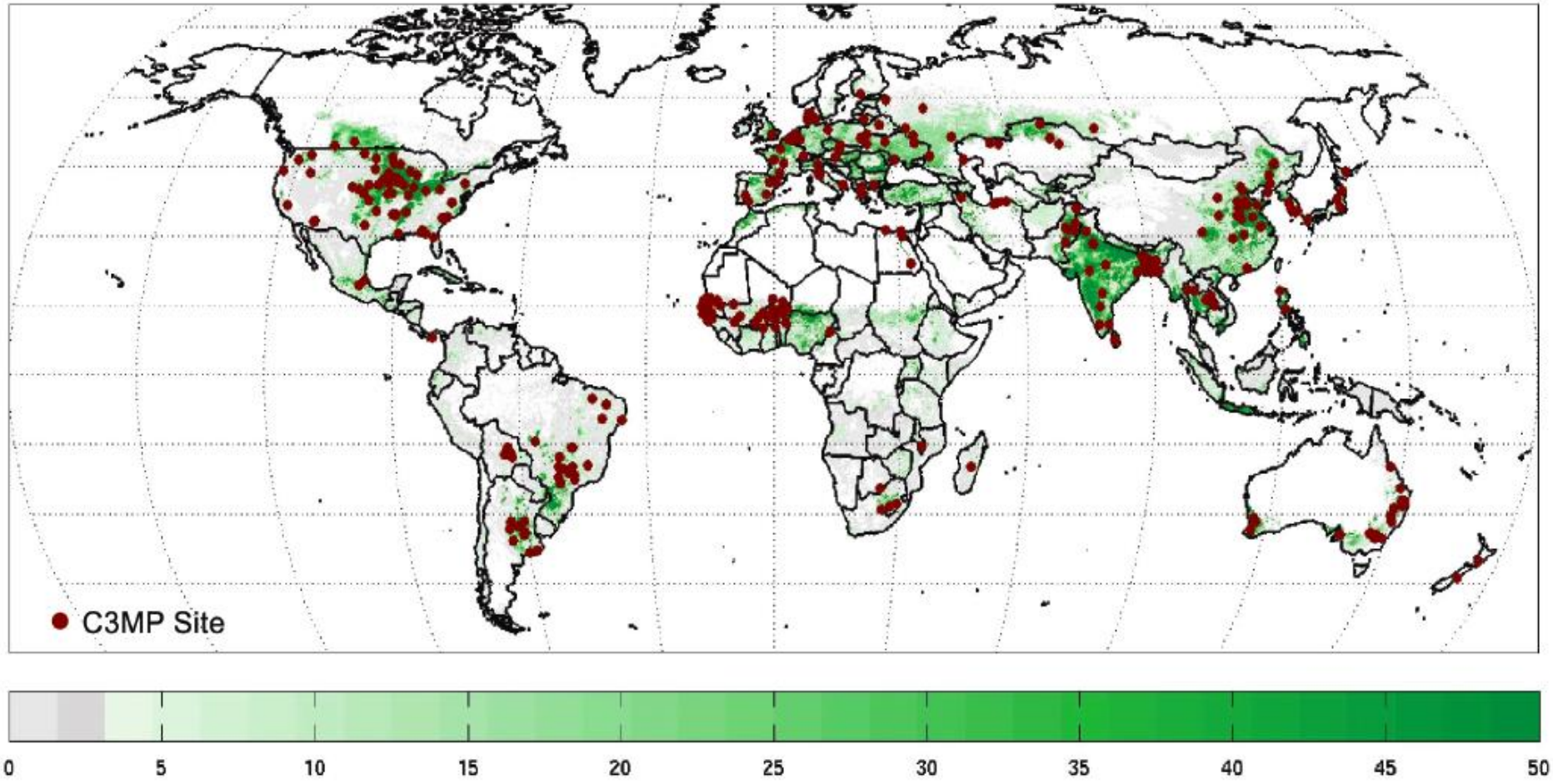
Note that all land areas with agricultural outputs were modeled – not all are economically viable

Rosenzweig et al., 2013

5 GCMs, 7 GGCMs; hatched = 70% agreement in sign of change

Sites included in AgMIP's Coordinated Climate-Crop Modeling Project

All C3MP Submitted Sites and Major Croplands (Percentage Area)



C3MP submitted site (1137 sites as of August, 2015)

Green = fractional crop land area data from Monfreda et al. (2008)

From McDermid et al., 2015

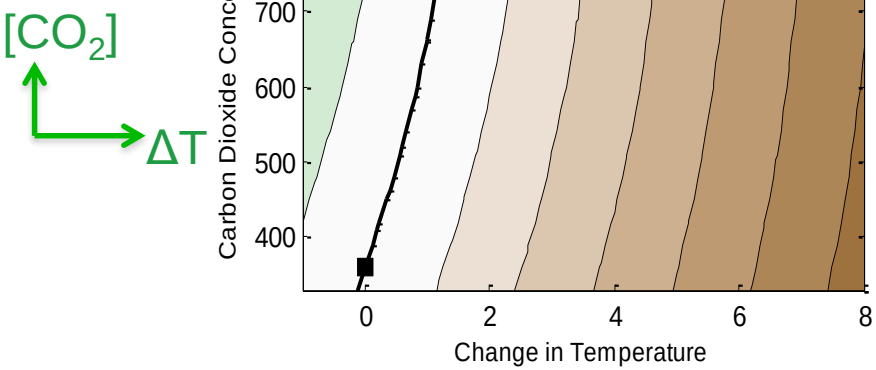
The AgMIP Coordinated Climate-Crop Modeling Project (C3MP): Methods and Protocols

Sonali P. McDermid[1,2], Alexander C. Ruane[2], Cynthia Rosenzweig[2], Nicholas I. Hudson[3], Monica D. Morales[3], Prabodha Agalawatte[55], Shakeel Ahmad[60], L. R. Ahuja[4], Istiqlal Amien[54], Saseendran S. Anapalli[4], Jakarat Anothai[5], Senthold Asseng[6], Jody Biggs[63], Federico Bert[8], Patrick Bertuzzi[9], Virender S. Bhatia[10], Marco Bindi[11], Ian Broad[12], Davide Cammarano[13], Ramiro Carretero[8], Ashfaq Ahmad Chattha[50], Uran Chung[14], Stephanie Debats[56], Paola Deligios[64], Giacomo De Sanctis[15], Thanda Dhliwayo[14], Benjamin Dumont[7], Lyndon Estes[56], Frank Ewert[16], Roberto Ferrise[11], Thomas Gaiser[16], Guillermo Garcia[8], Sika Gbegbelegbe[17], Vellingiri Geethalakshmi[18], Edward Gerardeaux[19], Richard Goldberg[3], Brian Grant[20], Edgardo Guevara[21], Jonathan Hickman[22], Holger Hoffmann[18], Huanping Huang[23], Jamshad Hussain[50], Flavio Barbosa Justino[24], Asha S. Karunaratne[25], Ann-Kristin Koehler[26], Patrice K. Kouakou[61], Soora Naresh Kumar[27], Arunachalam Lakshmanan[18], Mark Lieffering[57], Xiaomao Lin[28], Qunying Luo[29], Graciela Magrin[21], Marco Mancini[11], Fabio Ricardo Marin[52], Anna Dalla Marta[11], Yuji Masutomi[30], Theodoros Mavromatis[31], Greg McLean[32], Santiago Meira[21], Monoranjan Mohanty[33], Marco Moriondo[11], Wajid Nasim[60], Lamyaa Negm[34], Francesca Orlando[11], Simone Orlandini[11], Isik Ozturk[35], Helena Maria Soares Pinto[52], Guillermo Podesta[53], Zhiming Qi[36], Johanna Ramarohetra[37], Muhammad Habib ur Rahman[50], Helene Raynal[38], Gabriel Rodriguez[21], Reimund Rötter[58], Vaishali Sharda[6], Lu Shuo[39], Ward Smith[20], Val Snow[59], Afshin Soltani[40], K. Srinivas[41], Benjamin Sultan[66], Dillip Kumar Swain[42], Fulu Tao[43], Kindie Tesfaye[44], Maria I. Travasso[21], Giacomo Trombi[11], Alex Topaj[65], Eline Vanuytrecht[51], Federico E. Viscarra[45], Syed Aftab Wajid[50], Enli Wang[46], Hong Wang[47], Jing Wang[39], Erandika Wijekoon[55], Lee Byun-Woo[48], Yang Xiaoguang[39], Ban Ho Young[48], Jin I. Yun[49], Zhigan Zhao[39], and Lareef Zubair[55]

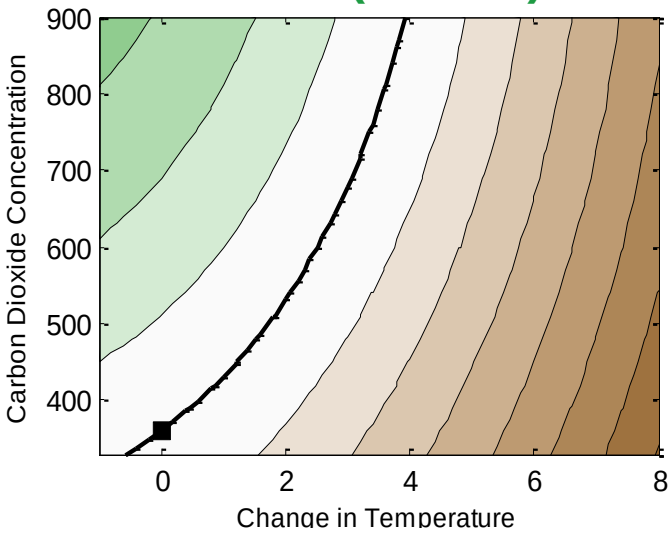
Crop responses vary by species

(C3MP – Ruane et al., 2013; Mavromatis et al., Forthcoming)

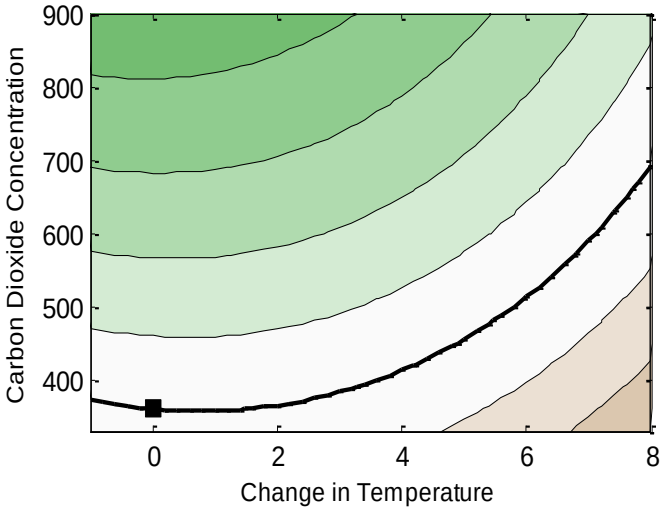
Maize (135 sets)



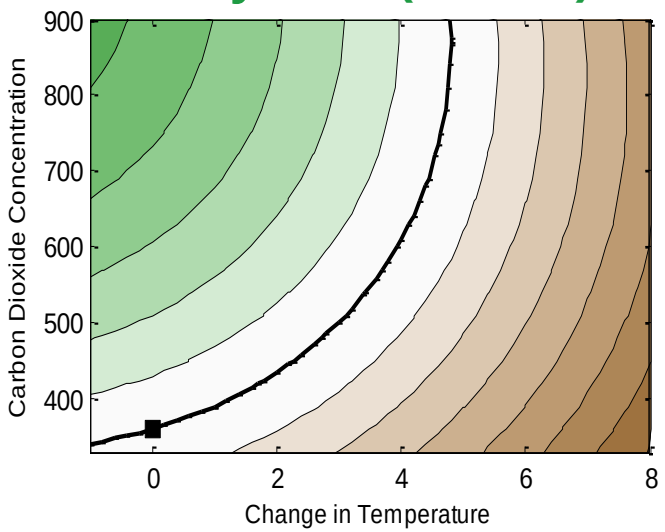
Rice (48 sets)



Winter Wheat (75 sets)



Soybean (92 sets)



Note: Rain-fed results shown for all species

Preliminary results from C3MP; article forthcoming

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Launch of the CGRA

Aspen Global Change Institute –
September, 2015

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Major Assessment Questions

***Core Question*: How can we manage risks of and develop resilience to extreme weather, climate change, and other disruptions for agricultural production and food security, now and in the future ?**

- ***Question #1:*** **What are the capabilities of and limits to adaptation to extreme weather and climate change, now and in the future?**
  - **Key Topics: Technology trends vs specific adaptation strategies; Management; Genetics**
- ***Question #2:*** **What are the effects of agricultural mitigation policies, now and in the future?**
  - **Key Topics: Effects on land use and prices; Biofuels; Soil carbon**
- ***Question #3:*** **How does extreme weather and climate change affect food security/nutrition, now and in the future?**
  - **Key Topics: Availability; Access; Utilization/diet; Stability**
- ***Question #4:*** **How do policies affect agricultural production and food security, now and in the future?**
  - **Key Topics: Trade; Governance; Property rights; Institutions; Water; Land;**

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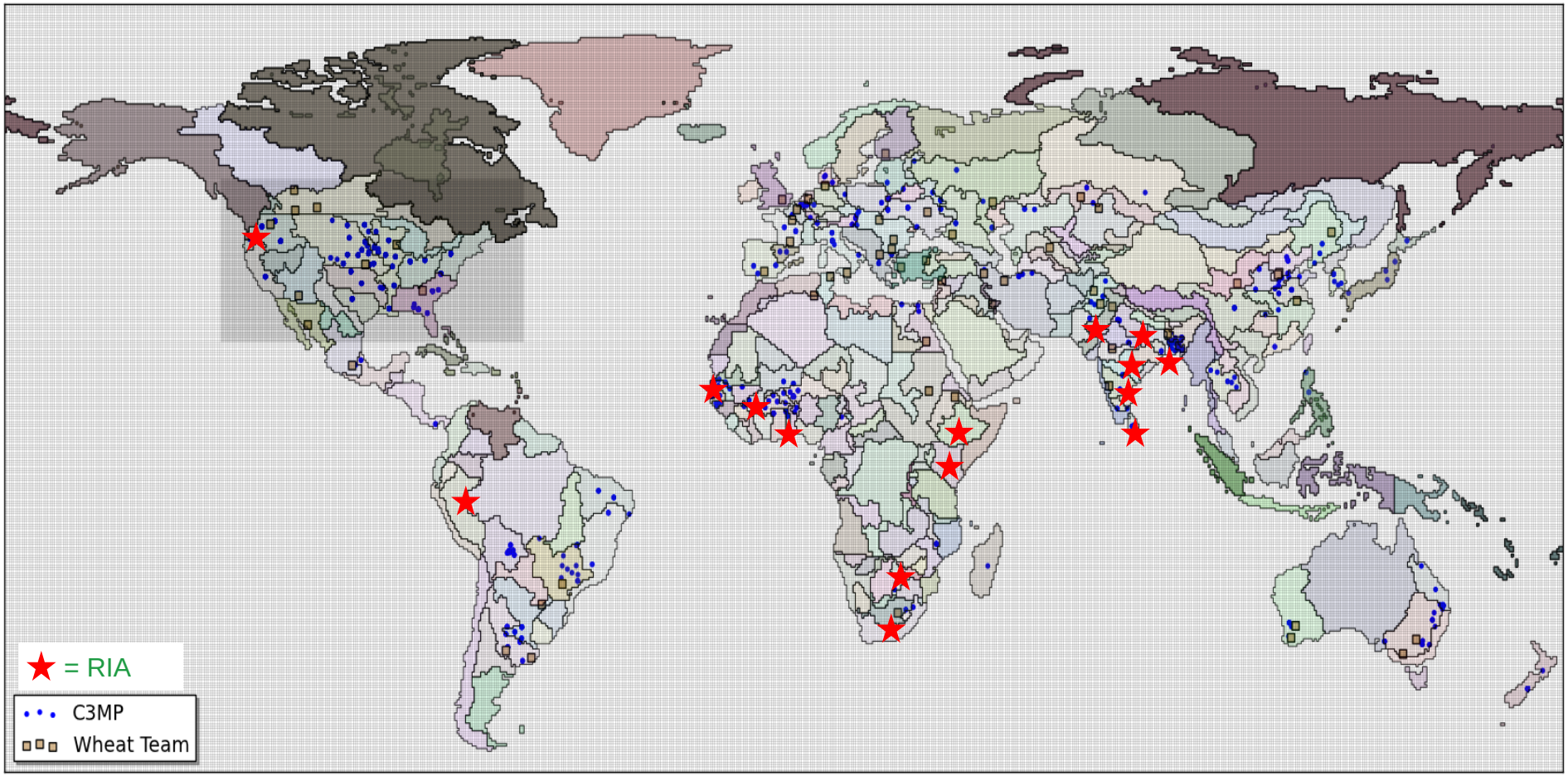
Overlapping Assessments



Grids = Global and regional crop models; Polygons = Food-producing units

TOA-MD has 100+ users around the world

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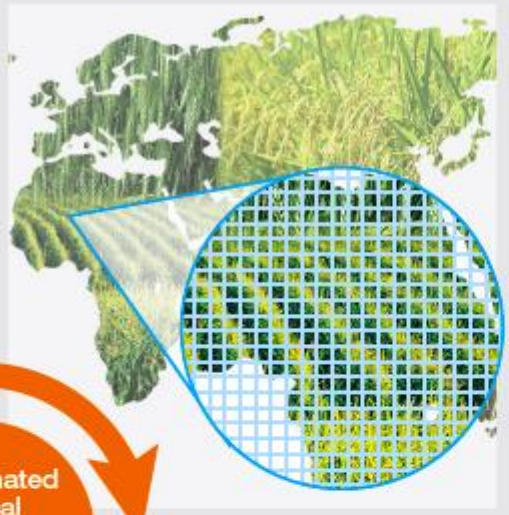
Building Blocks to allow telescopic scales, feedbacks, and details

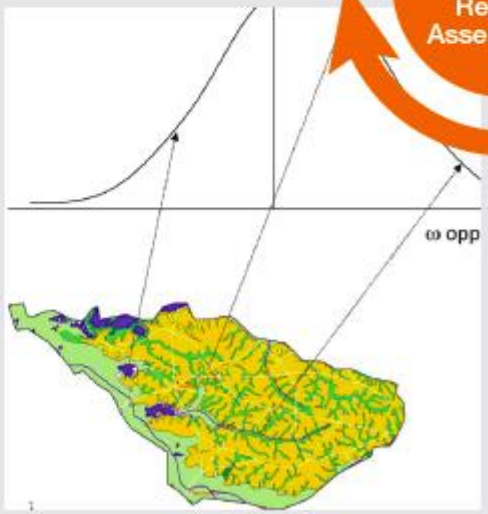
Regional research on farming systems using biophysical and socioeconomic models

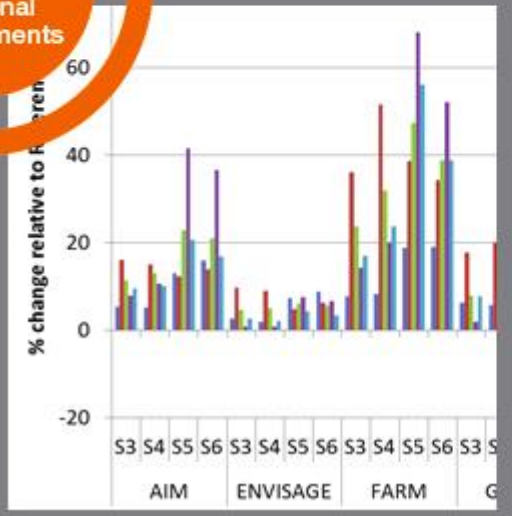


High-resolution gridded crop modeling for gap-filling and aggregation in each region

Coordinated Global and Regional Assessments

Production systems and regional economics to respond to price changes





Global economics with analysis of world and regional prices

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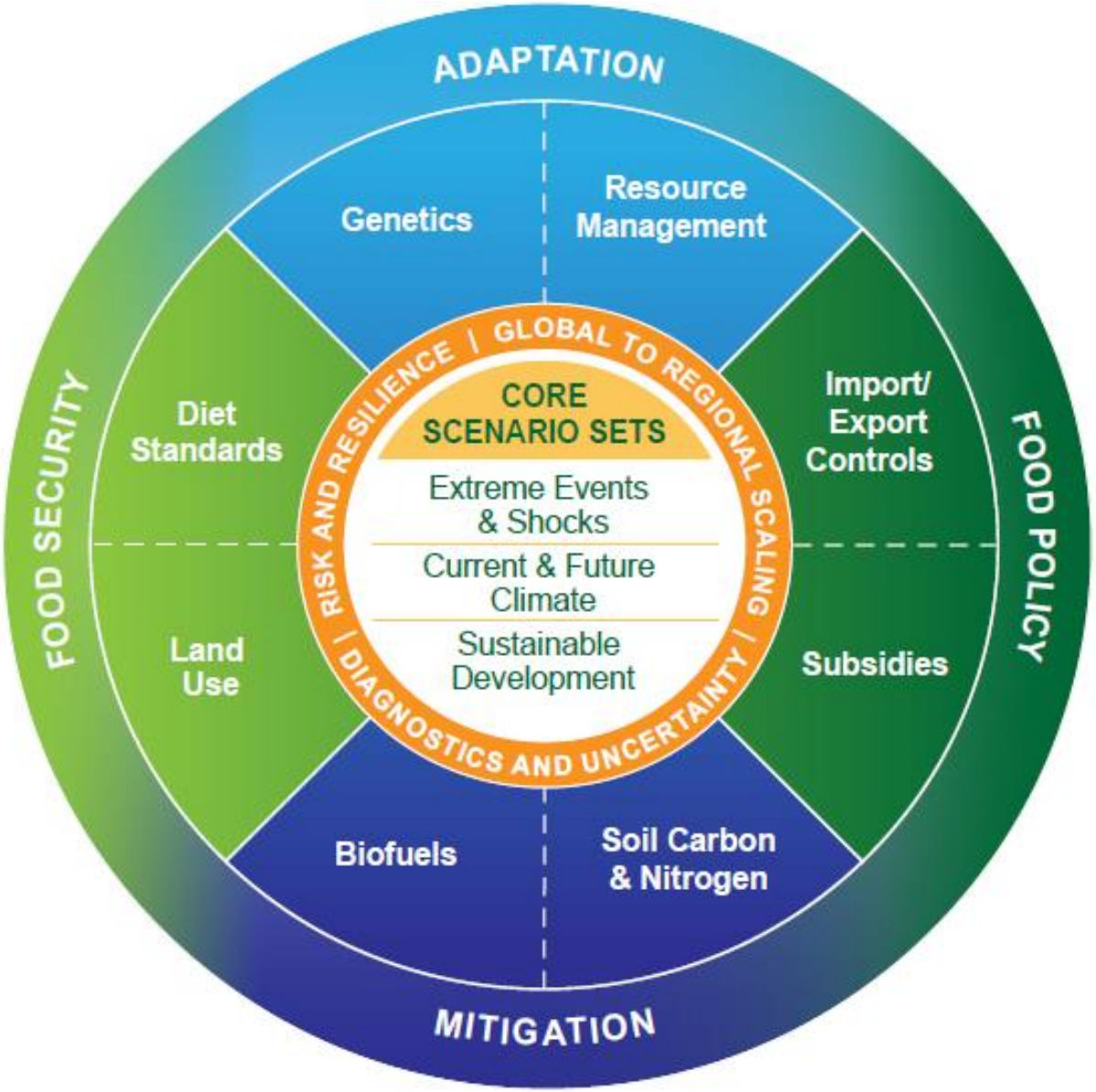
CGRA Scenario Sets – Core Risk and Resilience Framing



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Major New Developments in Agricultural Modeling Assessments

- **Disciplinary linkages**: Linked biophysical and economic models
- **Scale linkages**: Consistency from local to global scales
- **Resolution of human outcomes**: Connections to nutrition and health
- **Continuum of time scales**:
  current variability and extremes
  near- and long-term outlooks
- **Scenarios** of adaptation, mitigation, food policy, and food security

Concluding Thoughts

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Concluding Thoughts

- **AgMIP Projects and Partners use cutting-edge model, data, and IT approaches to understand resilience, sustainability, and productivity of farming systems and agricultural economies in support of stakeholder decisions from regional to global scales.**

- **The AgMIP community has grown in the last 5+ years, and participants are eager to demonstrate the use of models for the testing of sustainable solutions and informed decision making**

- **AgMIP tools could play a role in identifying and prioritizing food security solutions in diverse communities.**

- **AgMIP's Coordinated Global and Regional Assessments of Climate Impacts on Agriculture and Food Security will provide cutting-edge assessments – Join us!!**

Thanks!

More info: www.agmip.org

Contact me: alexander.c.ruane@nasa.gov