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Agriculture and Climate Change

Impacts, Adaptation, Mitigation and Trade

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Senior Research Fellow

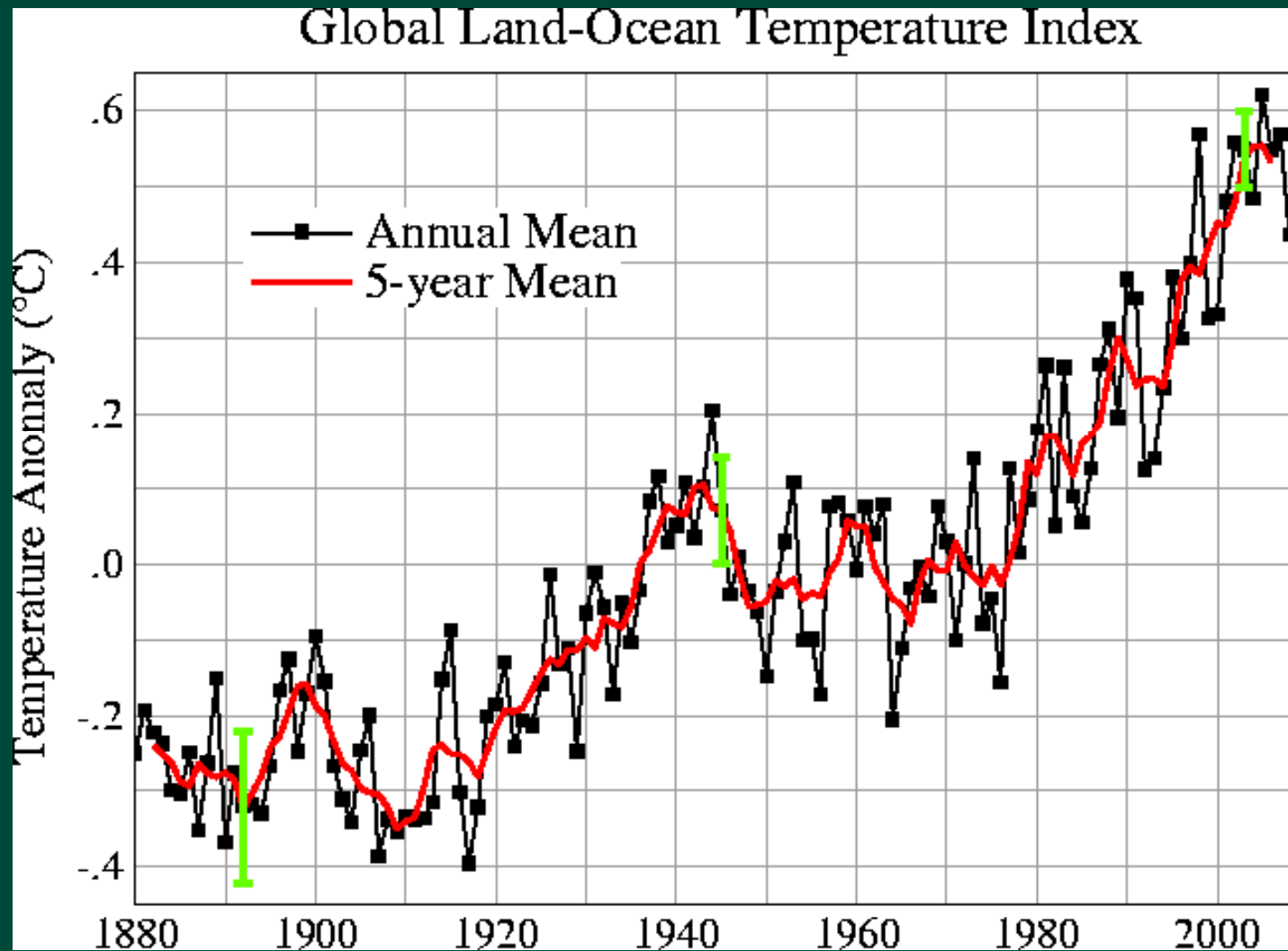
ICTSD/IPC Side Event on “Climate Change, Agriculture and Trade: Promoting
Policy Coherence” 6 April 2009

Presentation Overview

- Climate change will affect agriculture
 - Higher global temperatures, more precipitation, more variability and extreme events
 - Likely negative effects: Where and how much?
- Adaptation/resilience: Agriculture will need
 - New varieties, more infrastructure, changes in management practices and policies
 - International institutions that support resilience globally
- Mitigation: Agriculture can
 - Reduce emissions of greenhouse gasses
 - Act as a sink for other sectors
- Climate Change, Agriculture and Trade

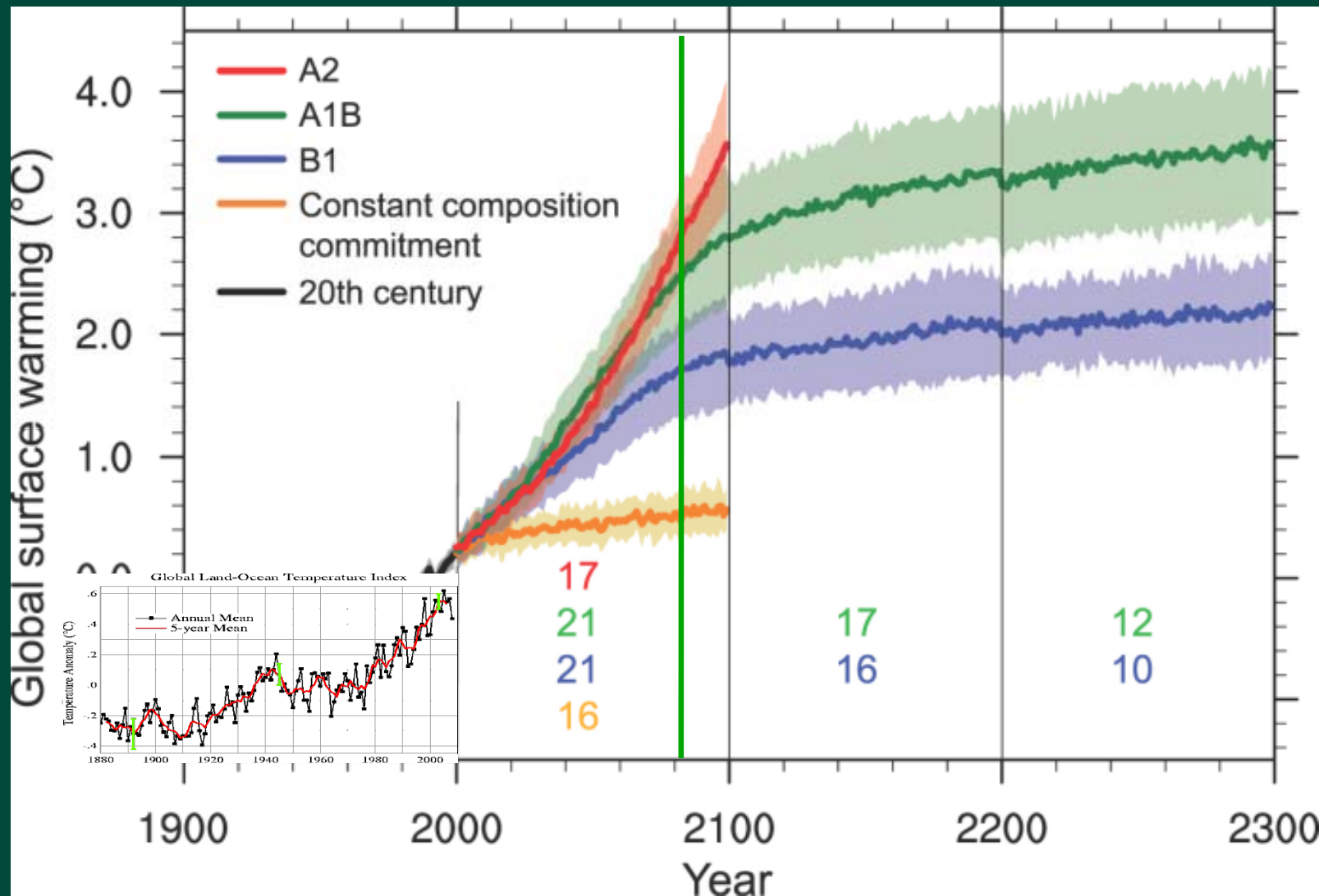
IMPACTS OF CLIMATE CHANGE ON AGRICULTURE

Rising average temperatures



Source: <http://data.giss.nasa.gov/gistemp/graphs/>

... could increase much more



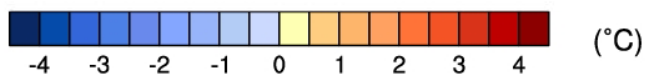
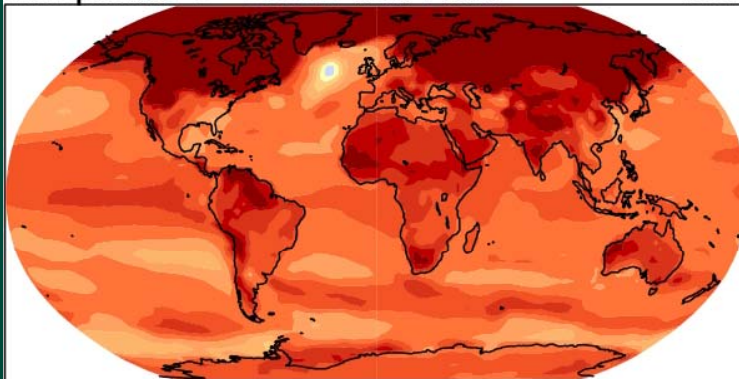
Source: Figure 10.4 in Meehl, et al. (2007)

Consequences:

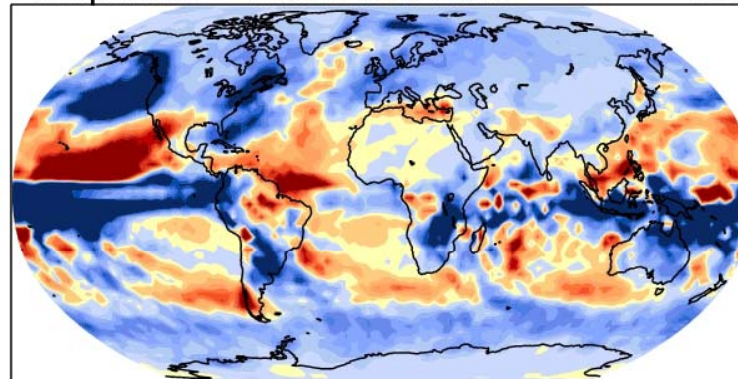
Higher temperatures and more but shifting precipitation...

Dec-
Feb

Temperature A1B: 2080-2099

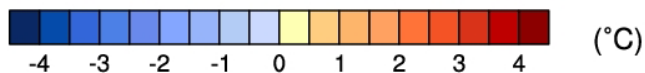
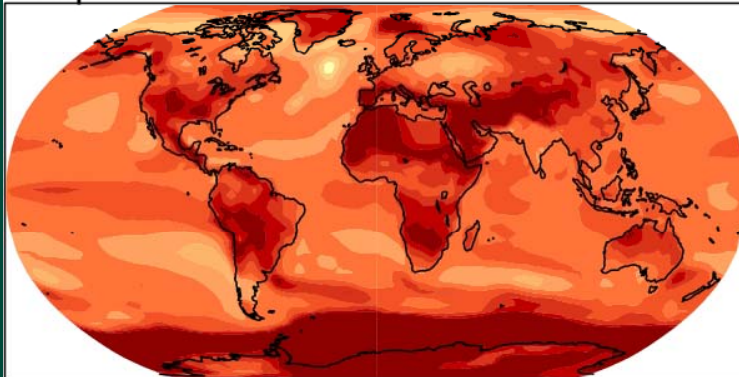


DJF Precipitation A1B: 2080-2099

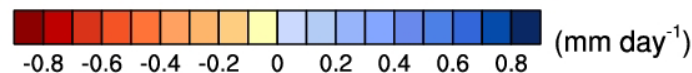
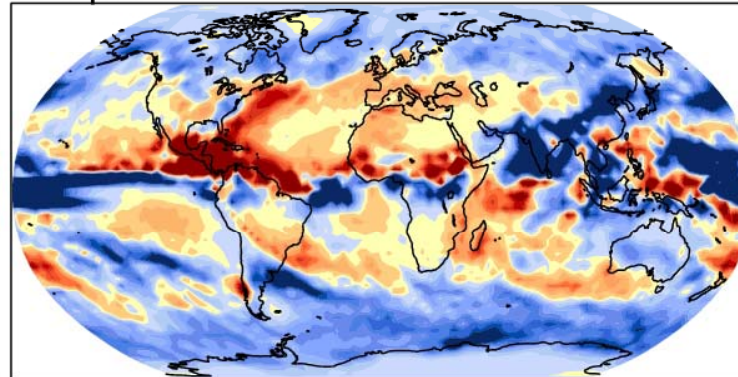


Jun-
Aug

Temperature A1B: 2080-2099



JJA Precipitation A1B: 2080-2099

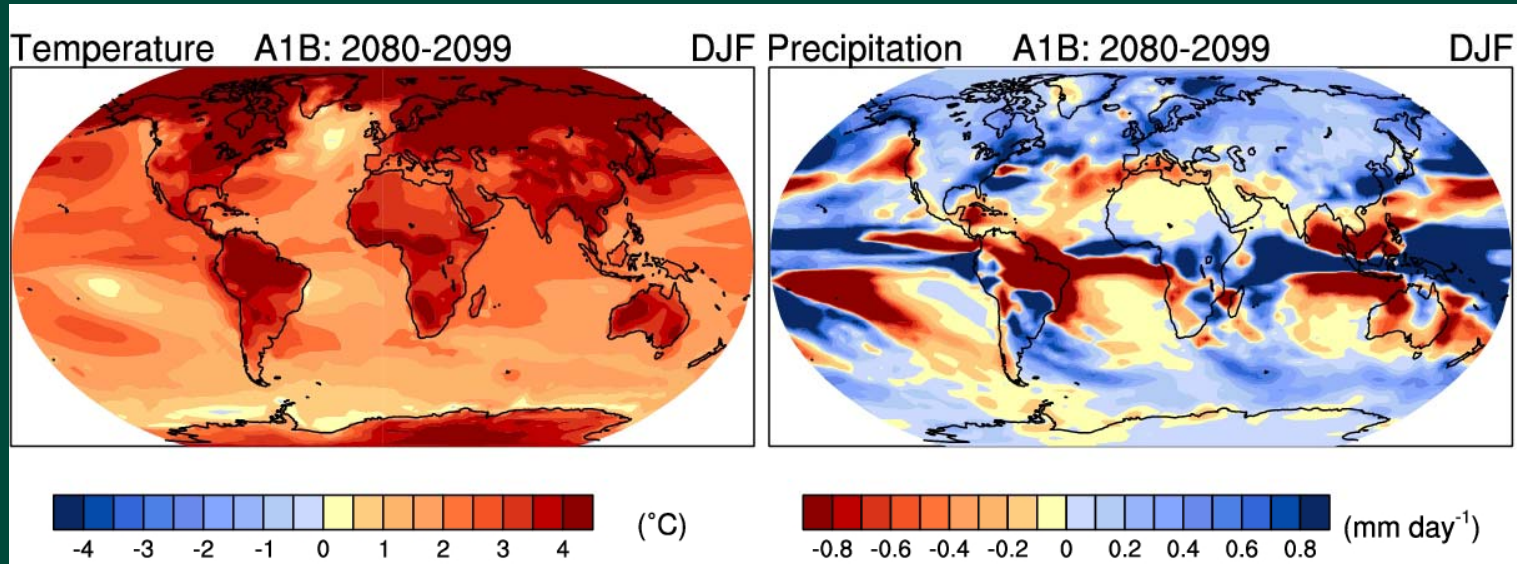


GCM3.1 (T63), SRES A1B Scenario

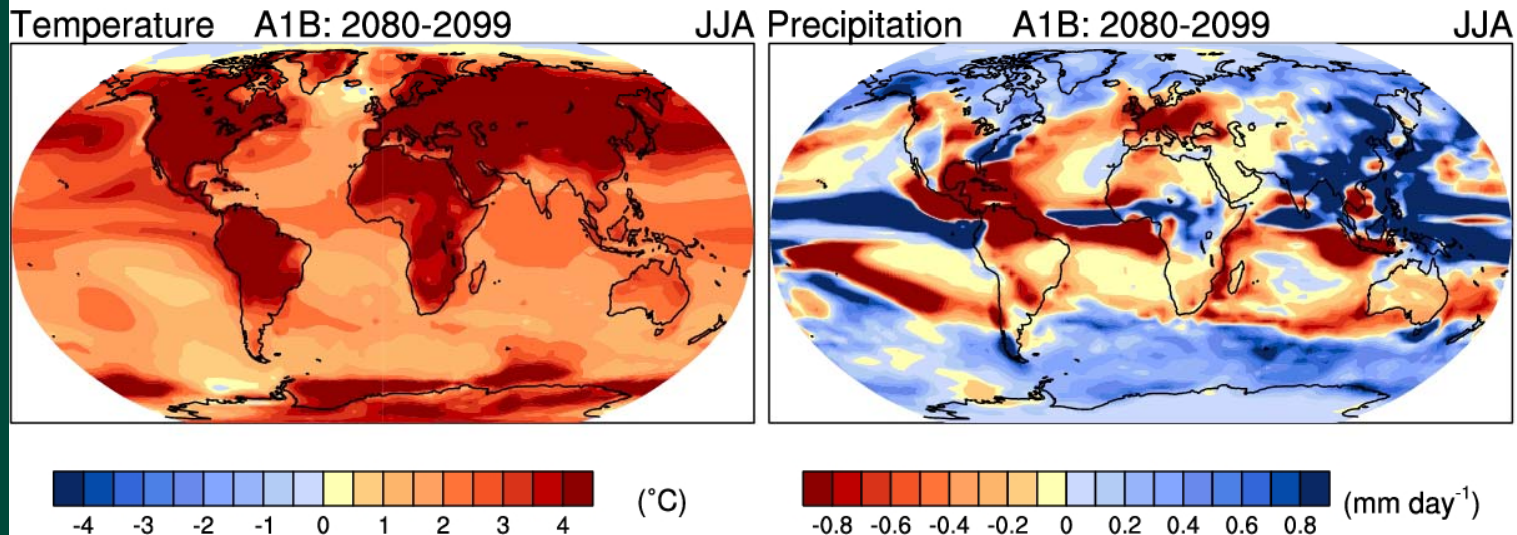
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... but uncertainty about where and how much

Dec-
Feb



Jun-
Aug



Hadley Model, SRES A1B Scenario

Climate Change Effects on Agriculture

What did we think in the *mid-1990s*?

▪ No problems

- Agricultural effects of climate change would be manageable
- Negative yield effects in temperate regions buffered by trade
- CO₂ fertilization important
- Increased trade flows needed

Climate Change Effects on Agriculture

What did we think in the *early 2000s*?

▪ Potential problems but manageable

- Production in DCs benefit; declines in LDCs
- Regional differences grow stronger over time
- Substantial increases in risk of hunger in poorer nations
- CO₂ fertilization important
- Increased trade flows needed

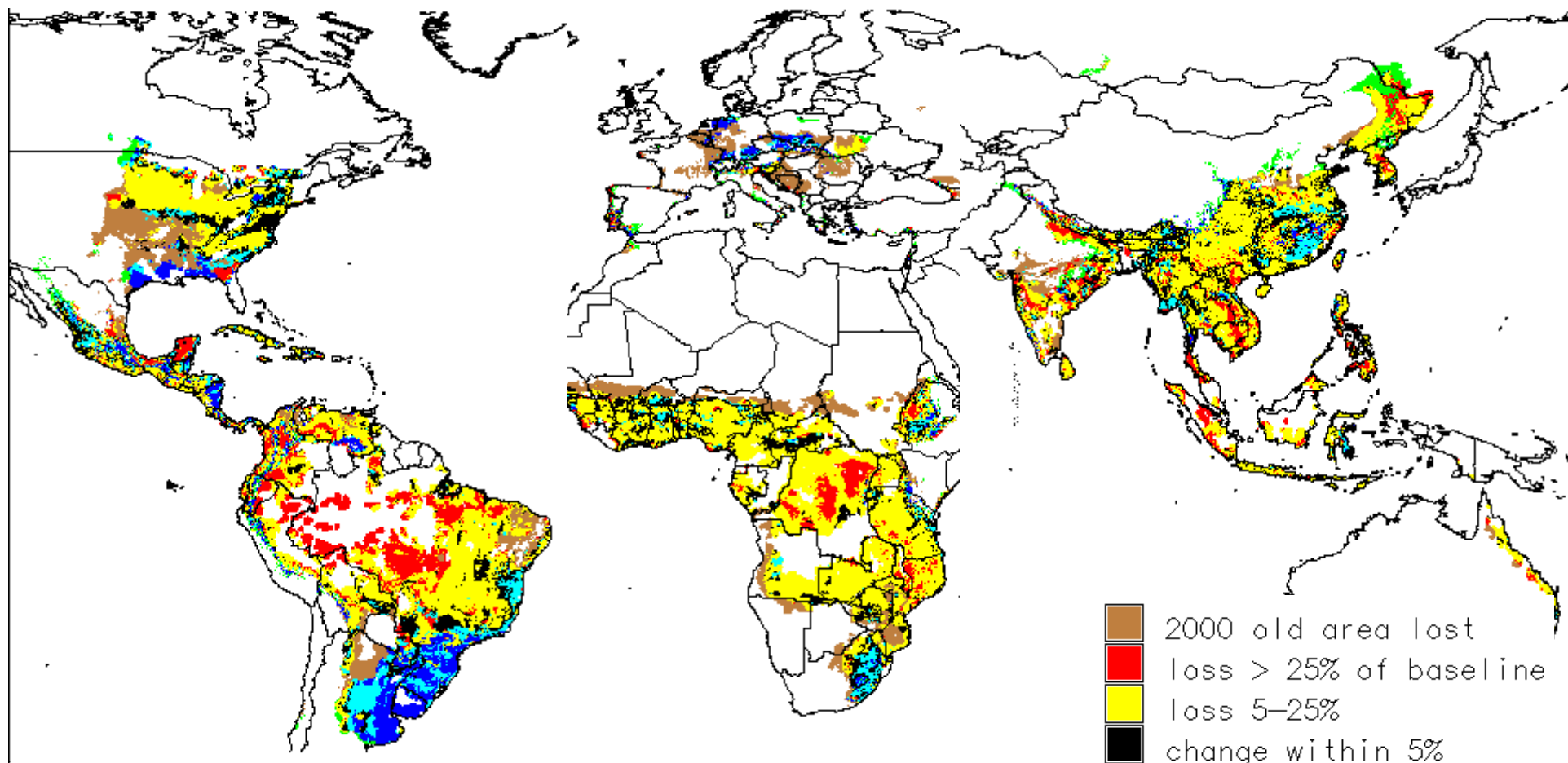
Climate Change Effects on Agriculture

What did we think in the *mid-2000s*?

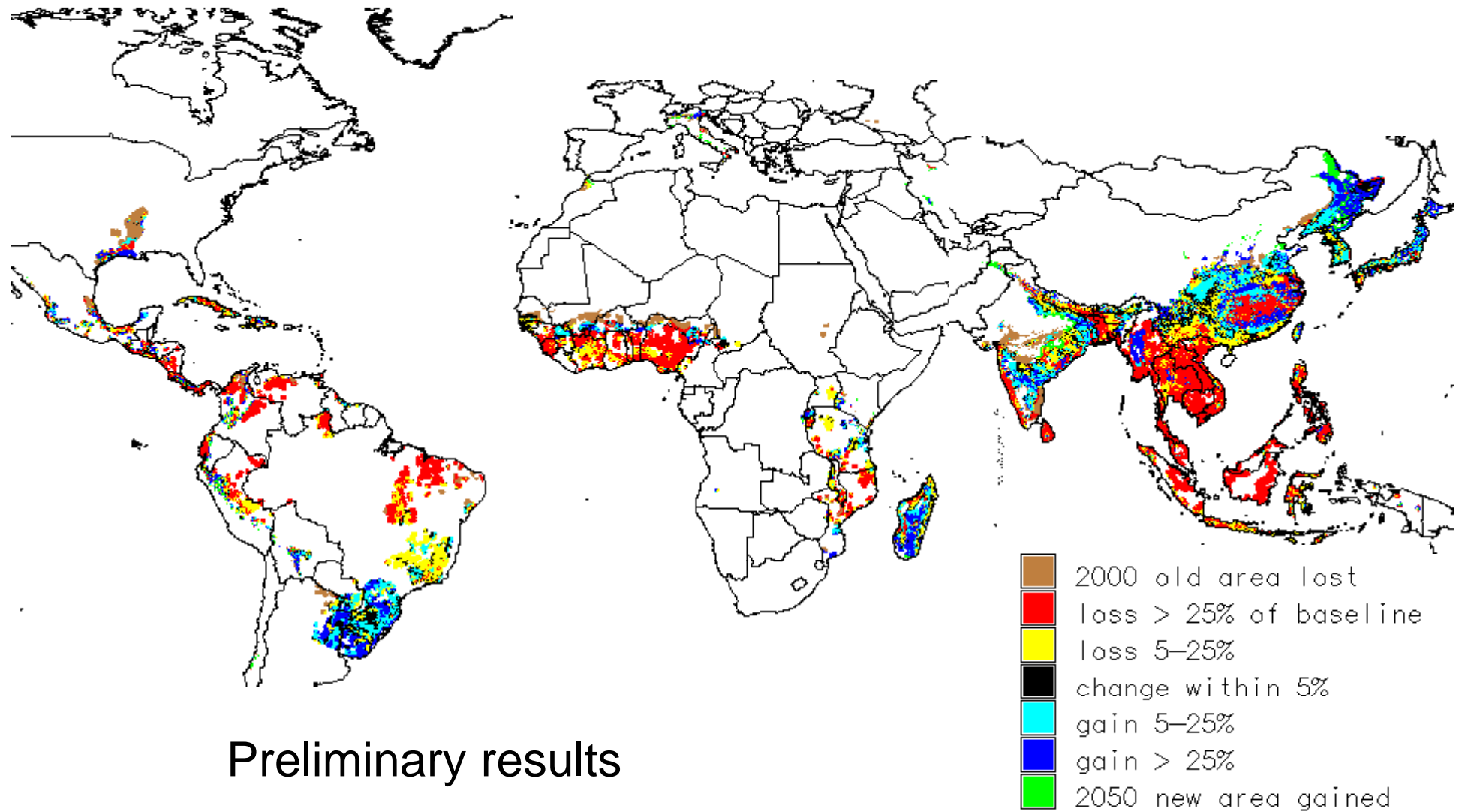
- Potential for problems is larger
 - Yields would likely increase somewhat in all regions
 - Smaller gains in the temperate regions than previous models
 - Small yield gains in the tropics
 - CO₂ fertilization important
 - Increased trade flows needed

What about the CO₂ fertilization effect?

- **Needed in all models to offset some of productivity losses from climate change, but...**
- **Recent reports on field experiments on CO₂ fertilization are negative**
 - Higher levels of atmospheric CO₂ increase susceptibility
 - Soybeans to the Japanese beetle
 - Maize to the western corn rootworm



Preliminary results



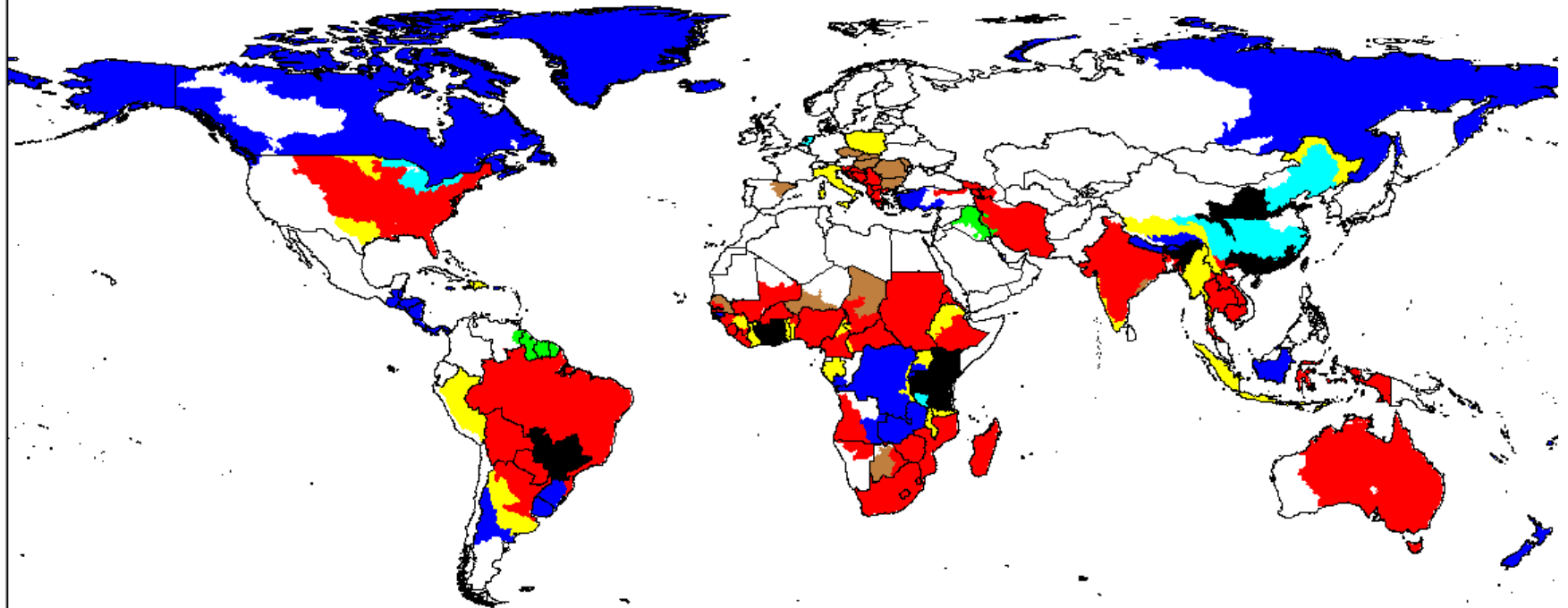
Preliminary results

Maize, IMPACT model FPU Level

lost
baseline

5%

gained

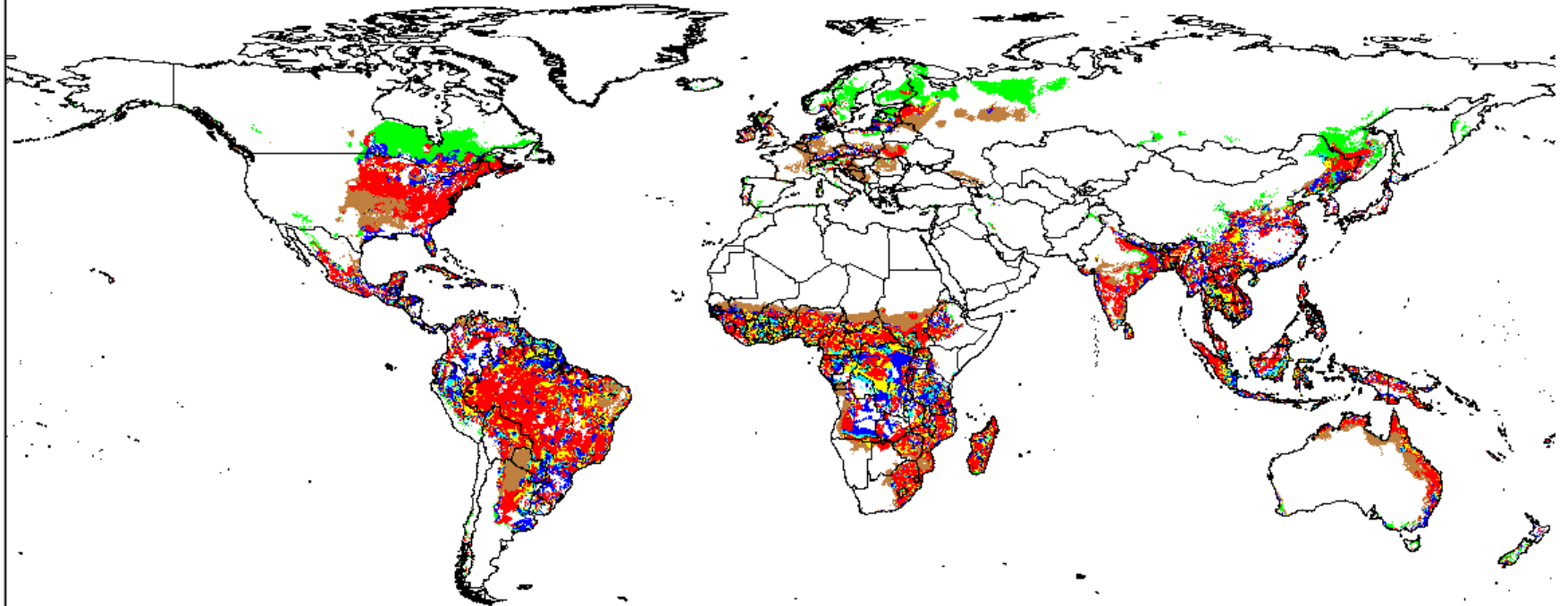


Maize Variety 990001

lost
baseline

5%

gained

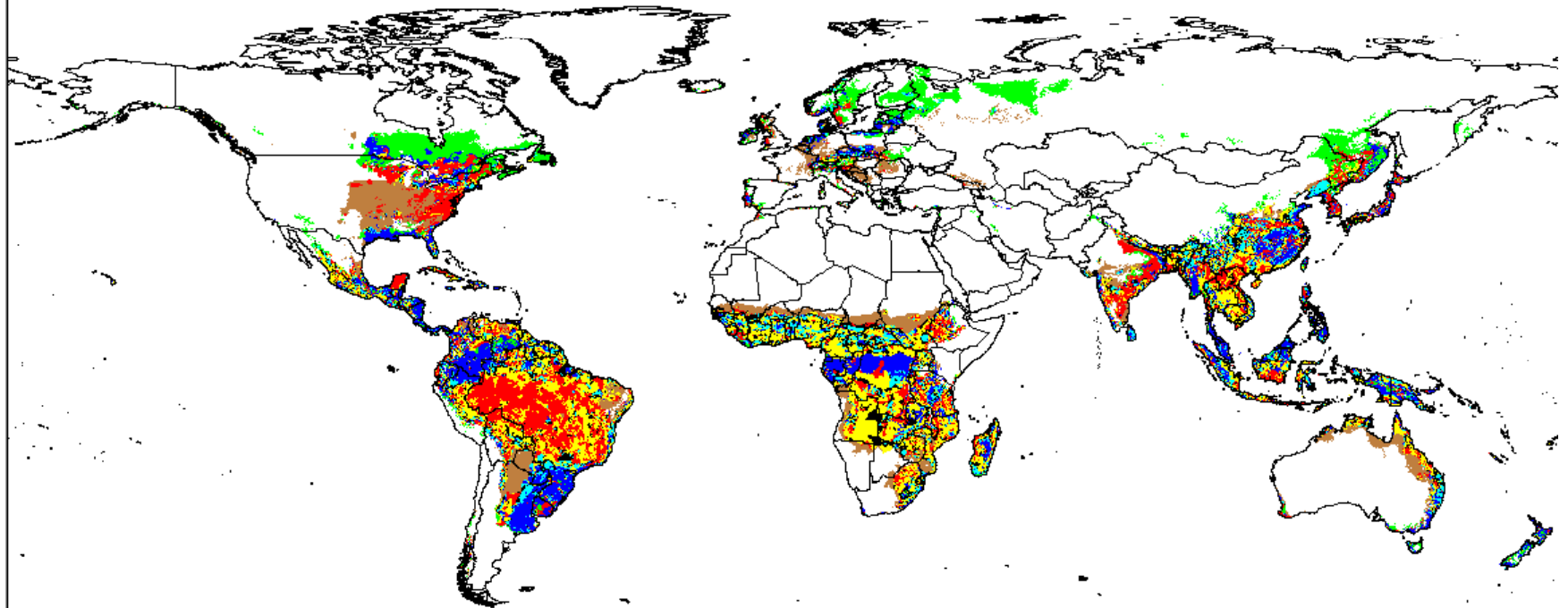


Maize Variety IB0041

lost
baseline

5%

gained

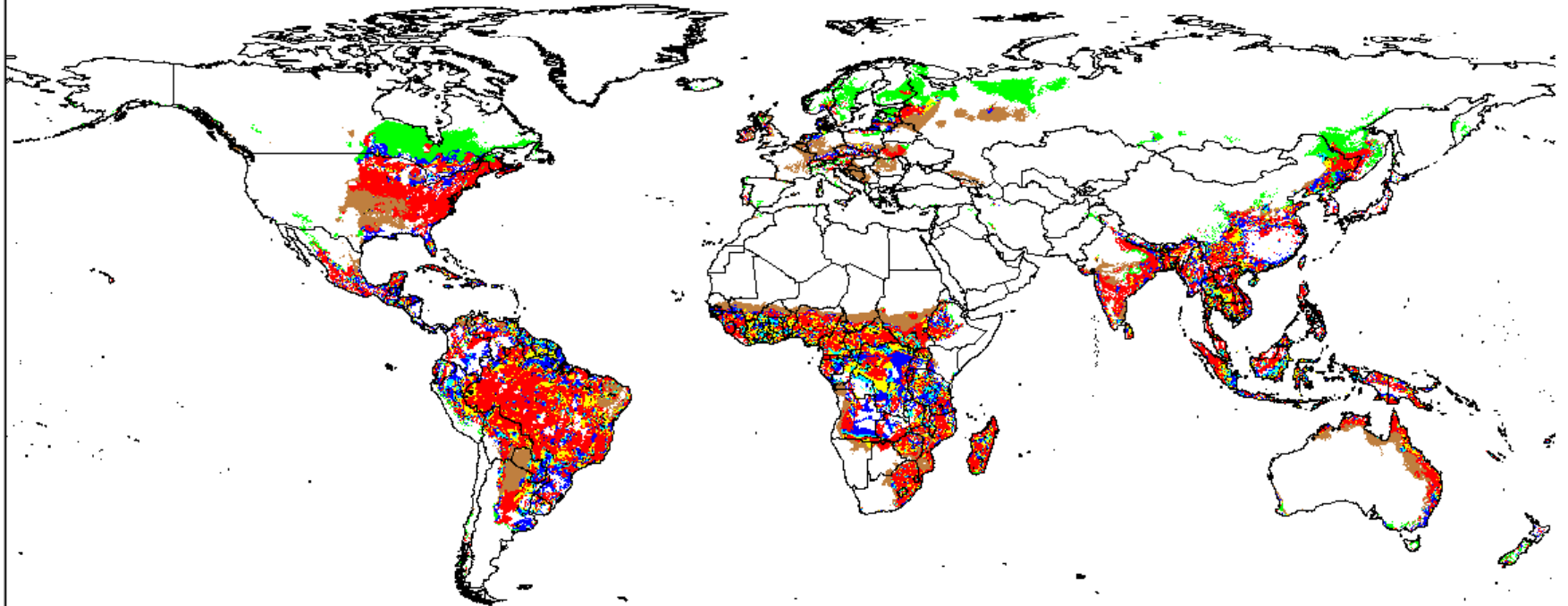


Maize Variety 990001

lost
baseline

5%

gained

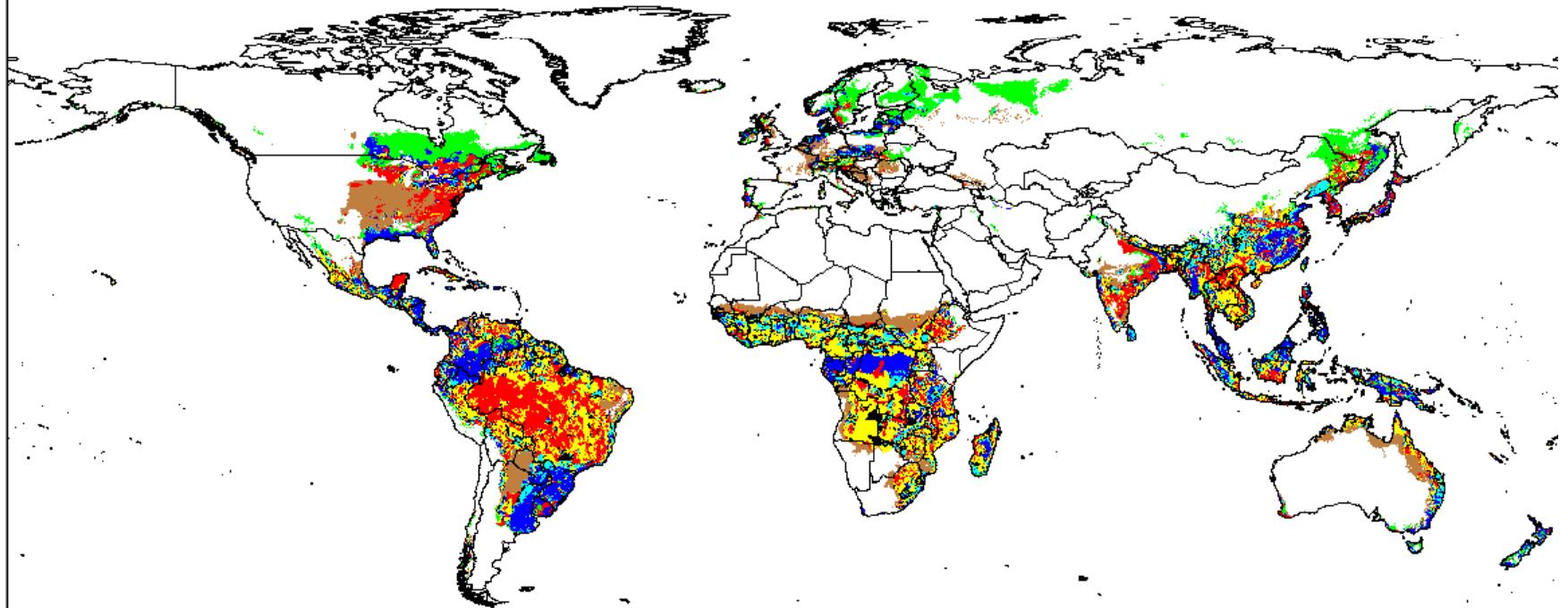


Maize Variety IB0041

lost
baseline

5%

gained



Suggested Negotiating Outcome for Agriculture

- Make funds available for research to improve our understanding of the interactions between climate change and agriculture
 - Higher spatial resolution and
 - more relevant outputs from climate models
 - better integration of agriculture into integrated assessment models
 - Better biophysical and socioeconomic modeling of climate change-agriculture interactions

AGRICULTURE AND CLIMATE CHANGE ADAPTATION

Adaptation in agriculture is **essential**

- **Good development policy** is important first step
 - Higher incomes from productive agricultural resources, used sustainably, provide resilience in the face of climate change
- **Location, location, location**
 - Climate change effects vary across the landscape
 - What's needed?
 - Location-specific analysis
 - Location-specific programs and policy measures
- **International institutions that support resilience globally are critical**

Adaptation needs

- Increased expenditures in agricultural science and technology
- Increased investments in water storage and management
- More development of rural Infrastructure, physical and institutional
- Policy improvements to internalize externalities associated with environmental services

Agriculture adaption: Suggested negotiating outcomes

- Include funding modalities for agriculture
 - Recognize the connection between pro-poor development policies for sustainable growth and climate-change adaption
 - Recognize and support synergies between adaptation and mitigation
- Provide funds for
 - Technology, infrastructure and institutional innovations
 - Global data collection
 - improves understanding of the spatial context of agriculture
- Support international institutions that foster resilience

AGRICULTURE AND CLIMATE CHANGE MITIGATION

Agriculture's GHG emissions are large, but shares differ by region

Region	Total GHG emissions (Mt CO ₂ e)	Share from agriculture	Share from land-use change and forestry
Europe	7,600	9.1	0.4
North America	7,208	7.1	-4.7
South America	3,979	23.6	51.6
Sub-Saharan Africa	543	12.7	60.4
Asia	14,754	14.4	26.8
Developing countries*	22,186	15.7	35.6
World	40,809	14	18.7

Source: WRI CAIT, 2009
* - Non Annex 1 countries

Agricultural mitigation: Cost-effective options

- Change crop mixes
 - plants that are perennial and/or with deep root systems
- Use cultivation systems that leave residues
 - reduce tillage, especially deep tillage
- Shift land use from annual crops to
 - Perennial crops
 - Pasture
 - Agroforestry
- KEY Issue – MRV - Measurable, Reportable, and Verifiable

Agricultural mitigation: Suggested negotiating outcomes

- Establish a chapter for agriculture-related mitigation (and adaptation) investments as part of any global mitigation funding mechanism
- Include agriculture and land-use change from the outset of any Post-Kyoto agreement but allow for long-term means-tested adjustment opportunities
- Fund development and implementation of low-cost monitoring systems
- Allow innovative payment mechanisms and support for novel institutions for agricultural mitigation

Climate Change, Agriculture and Trade

- Climate change will alter comparative advantage
 - Current trade flows will change
 - Direction and magnitude of changes are uncertain
 - LDC agricultural export growth has been in high value ecological niche products with uncertain futures
 - Exploiting seasonal differences (vegetables from south to north in north's winter)
 - Unique climate/soil niches – coffee, tropical fruits

- Trade measures that restrict flows make adjustments more difficult

Concluding remarks

- Our children will pay the price of climate change
- We must start adaptation now if we are to feed the world sustainably and reduce poverty
- Agriculture can play an important role in mitigating GHG emissions
- Including agriculture in a Copenhagen agreement is essential