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Climate Change and Agricultural Trade: How effective is reform as an adaptation measure?

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ICTSD and IPC Climate Change and International Agricultural Trade Rules

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Preview of Results

- Climate change alters the comparative advantage of producers
- Agricultural trade flows change significantly under CC—with developing countries increasing their net import position for staples
- Unchecked climate change will result in a 20 percent increase in malnourished children by 2050
- Reduced agricultural protection changes impacts, but results differ under CC based on changes in domestic producer prices
- Trade results still considered preliminary

Outline

1. Climate Change Modeling Methodology
2. Impacts: Crop Production, Demand, and Trade
3. Climate Change Adaptation Costs
4. The Effects of Changes in Protection

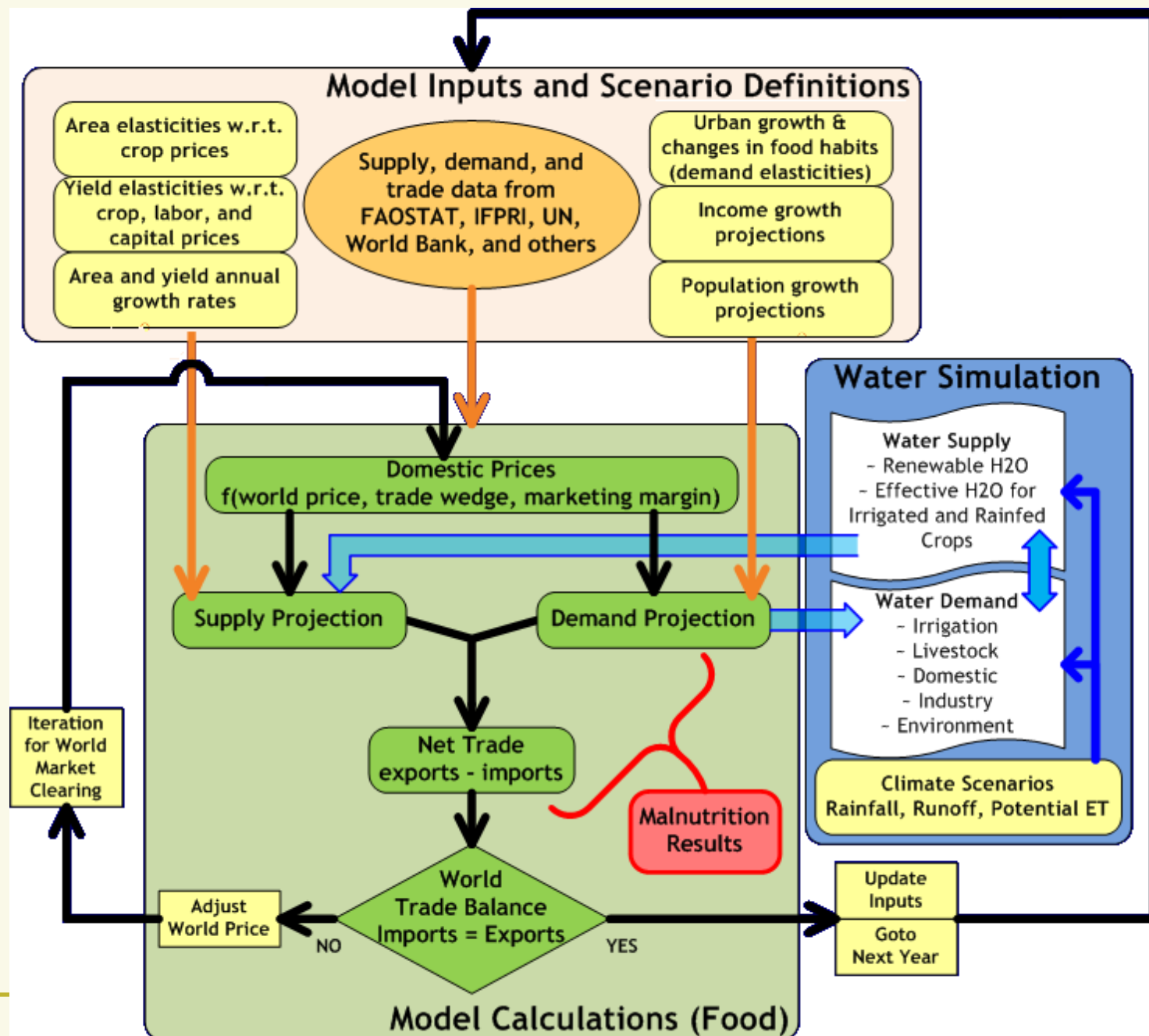
MODELING METHODOLOGY FOR CLIMATE CHANGE IMPACTS

Integrating Location-specific Biophysical and Socioeconomic Modeling is Critical

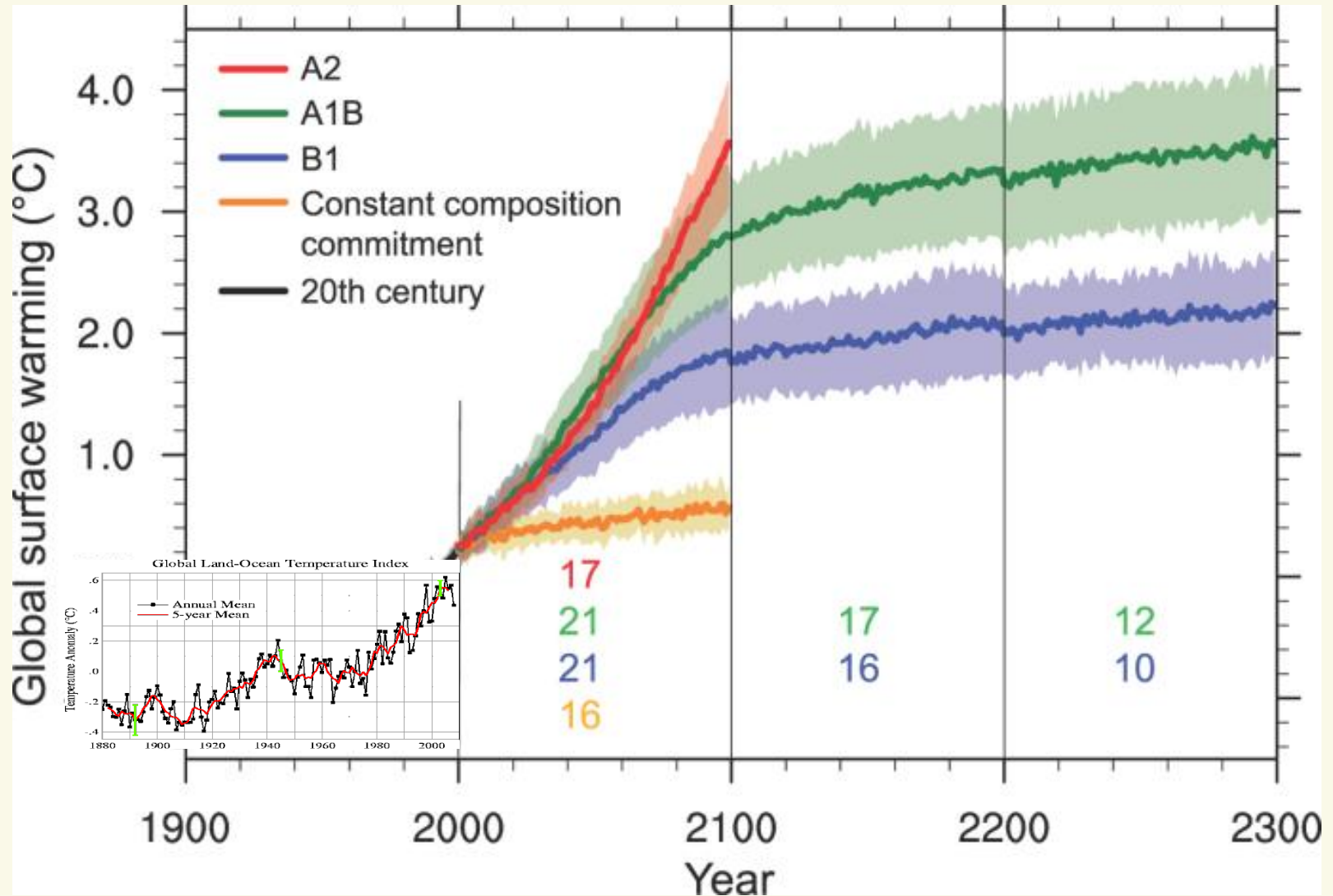
- Climate change will bring *location-specific* changes
 - in precipitation, temperature and variability
- Need to reconcile
 - limited resolution of macro-level economic models that operate through equilibrium-driven relationships *with*
 - detailed models of dynamic biophysical processes – crop models
- Provide more realistic modeling of climate change effects (biophysical and economic) on global/regional agriculture

Global Change Model Components

- GCM climate scenarios
 - NCAR (wetter) and CSIRO (drier) using SRES A2
- DSSAT crop model
 - Biophysical crop response to temp and precipitation
- ISPAM
 - Spatial distribution of crops based on crop calendars, soil characteristics, climate of 20 most important crops
- IMPACT2009
 - Global food supply demand trade model. Results to 2050 with water simulation module and associated global hydrology model



A2 Scenario



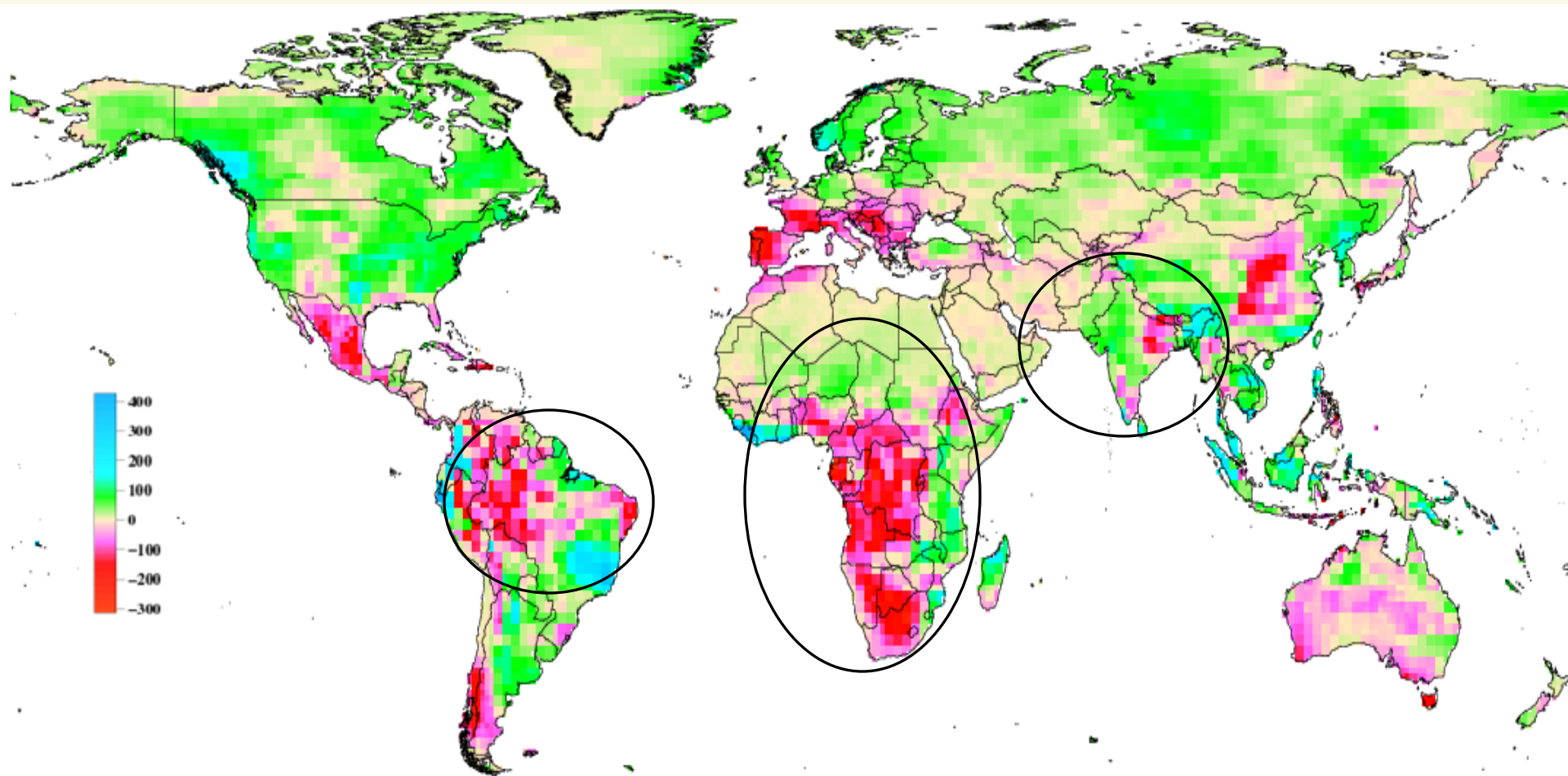
Source: Figure 10.4 in Meehl, et al. (2007)

AVERAGE ANNUAL PRECIPITATION CHANGES BY GCM

Watch Sub-Saharan Africa, the Amazon, and South Asia

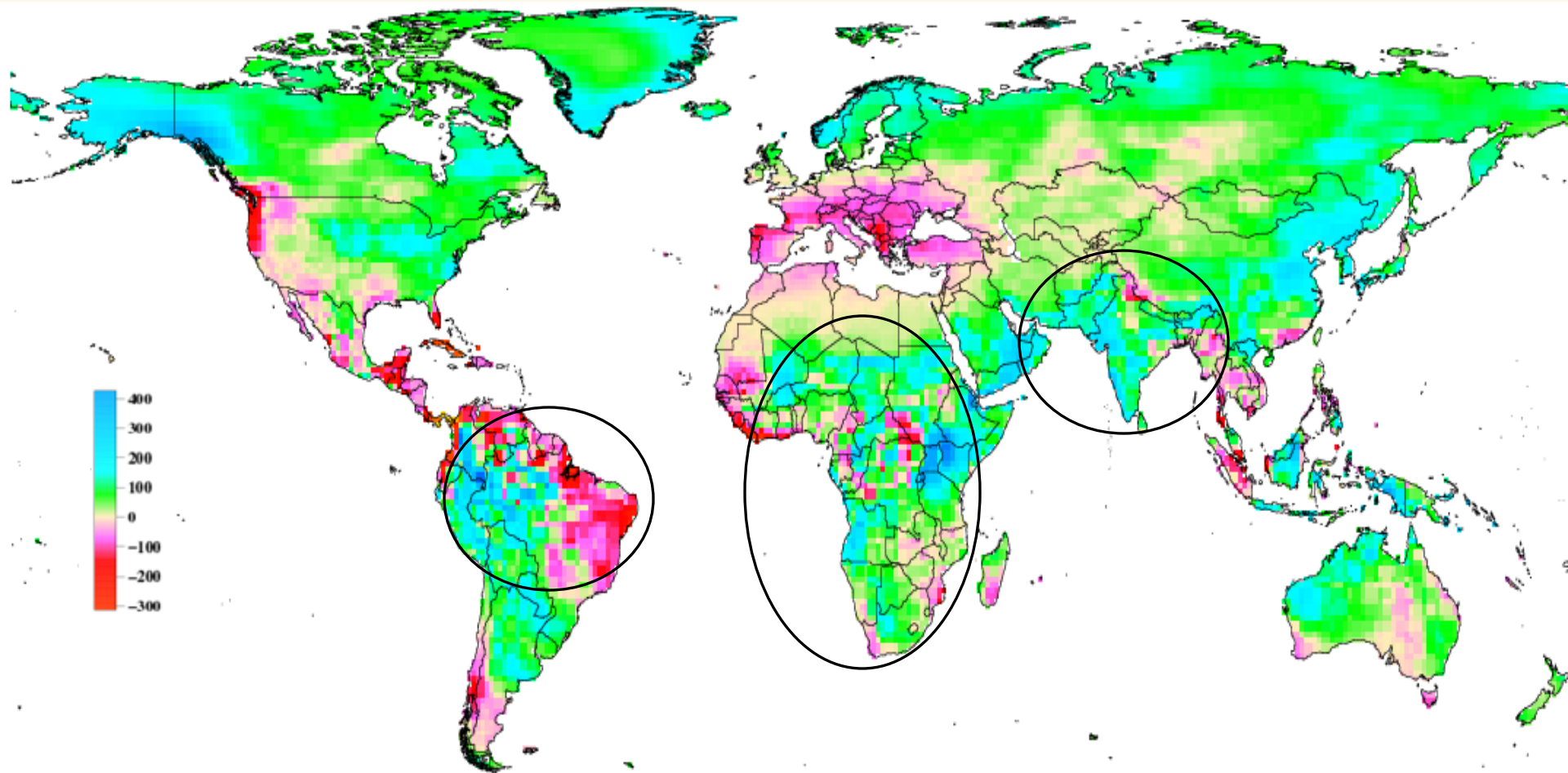
Change in Precipitation, 2000-2050

CSIRO, A2, AR4



Change in Precipitation, 2000-2050

NCAR, A2, AR4



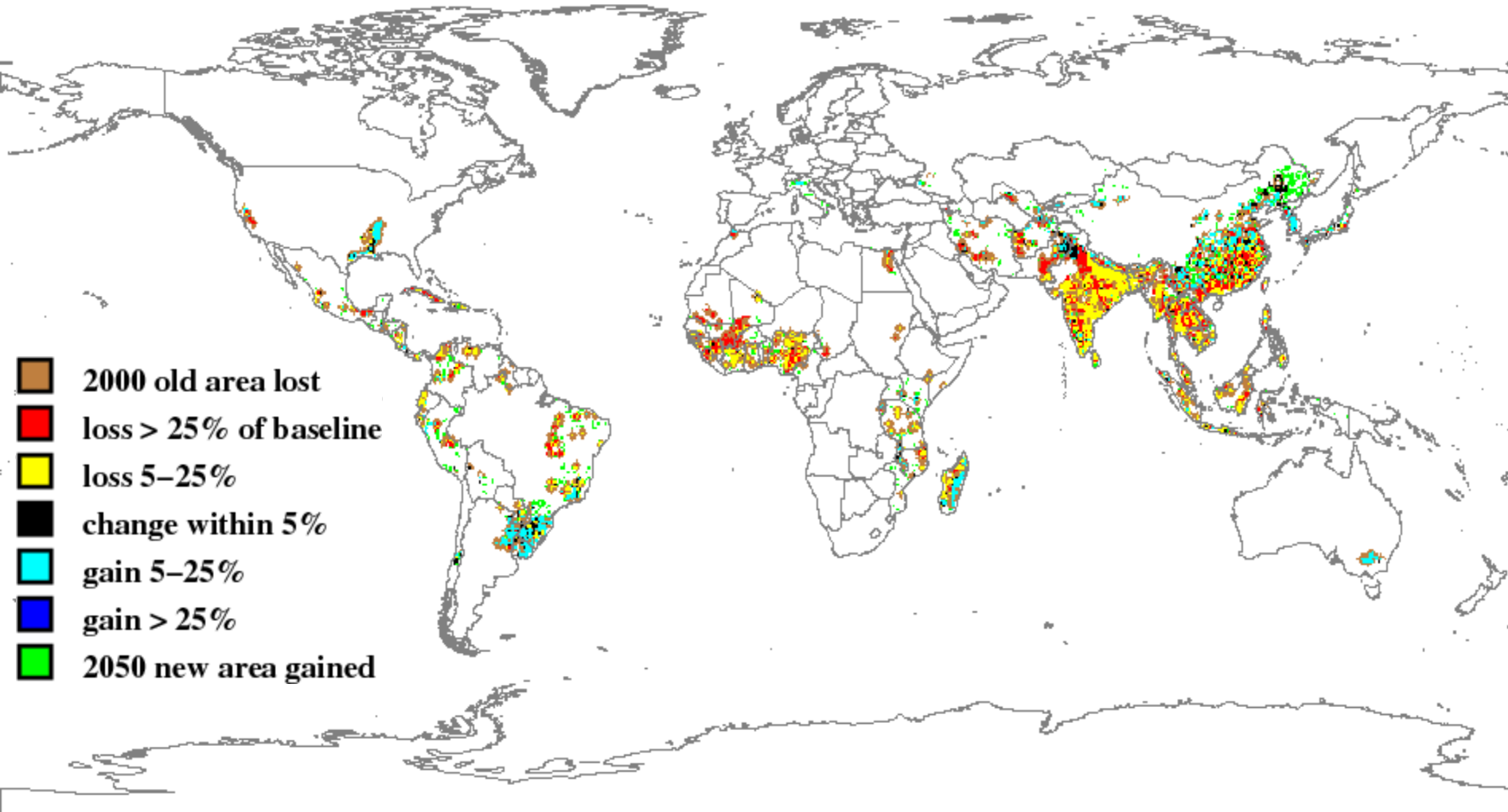


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BIOPHYSICAL PRODUCTION RESULTS

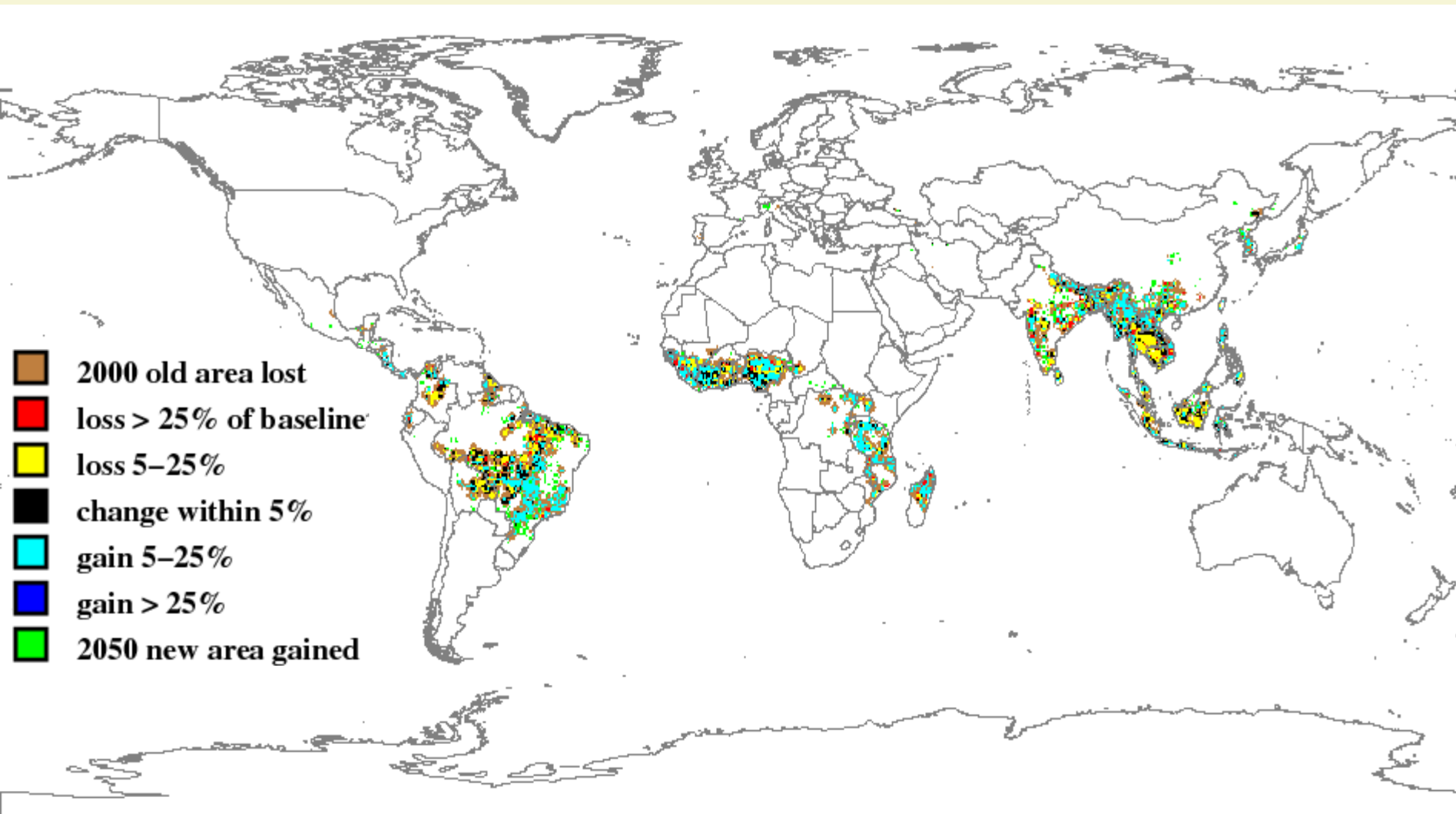
Climate-change-only effects on yield and area

Climate induced percentage change in yield in 2050: Irrigated Rice



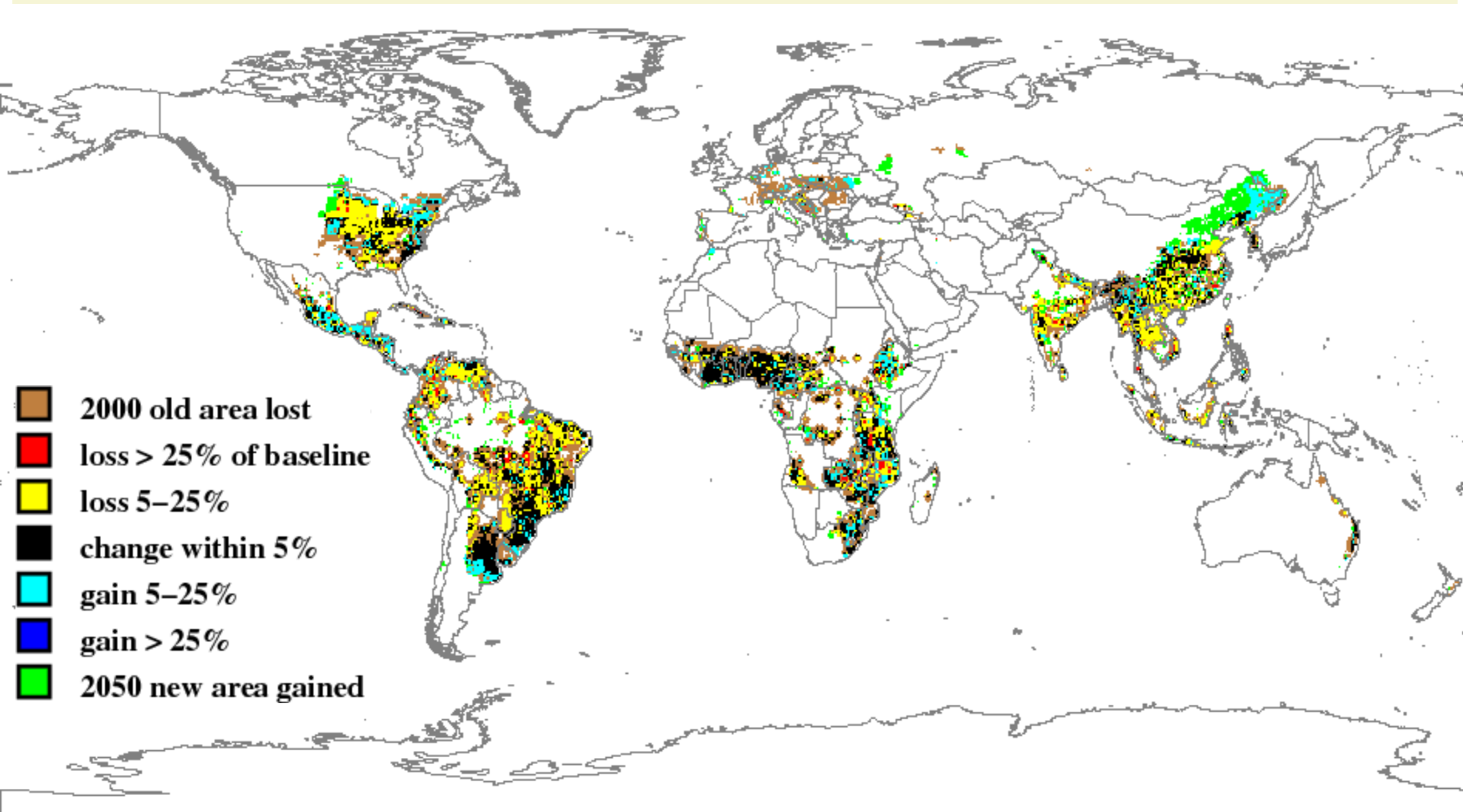
NCAR A2

Climate induced percentage change in yield in 2050: Rainfed Rice



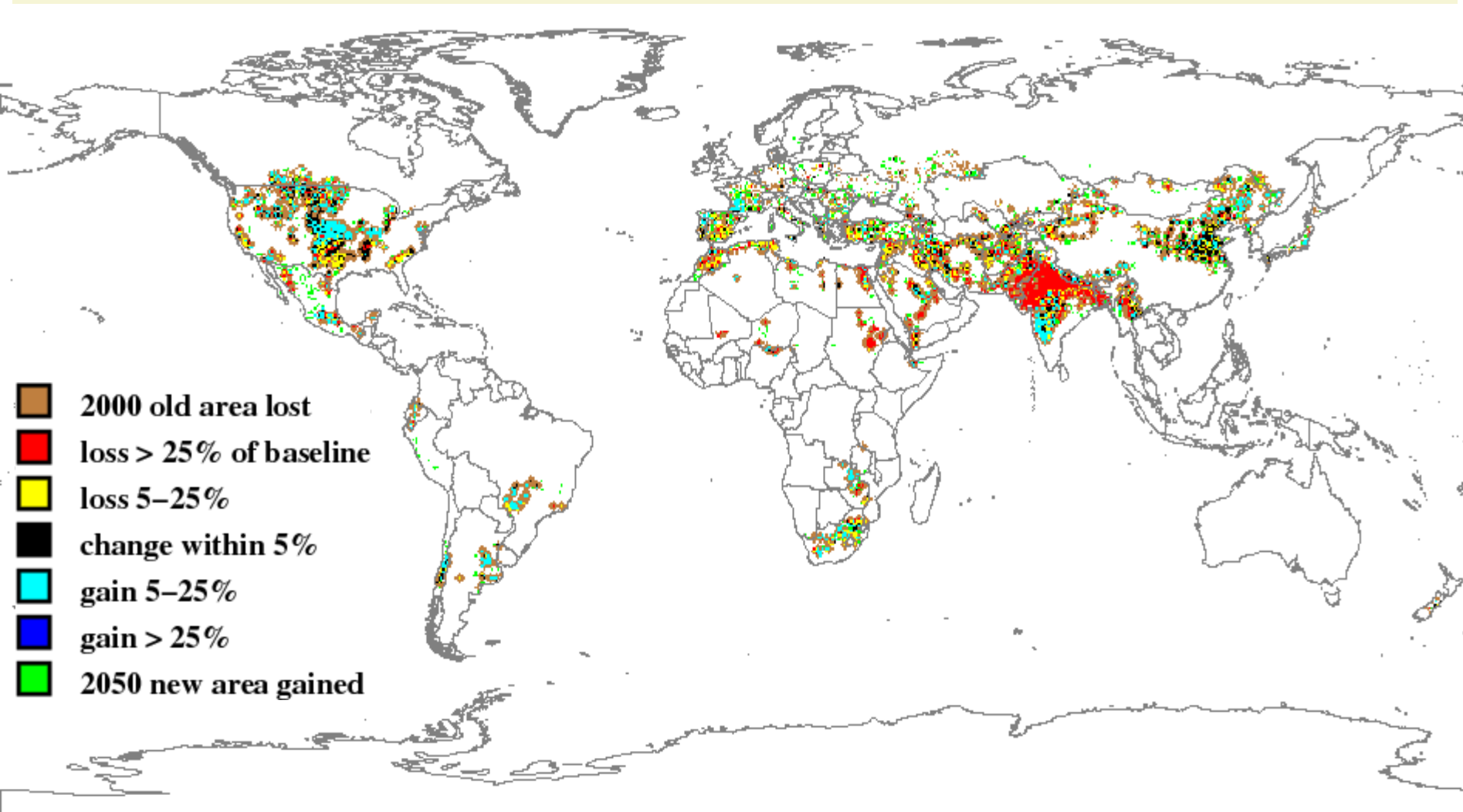
NCAR A2

Climate induced percentage change in yield in 2050: Rainfed Maize



NCAR A2

Climate induced percentage change in yield in 2050: Irrigated Wheat



NCAR A2



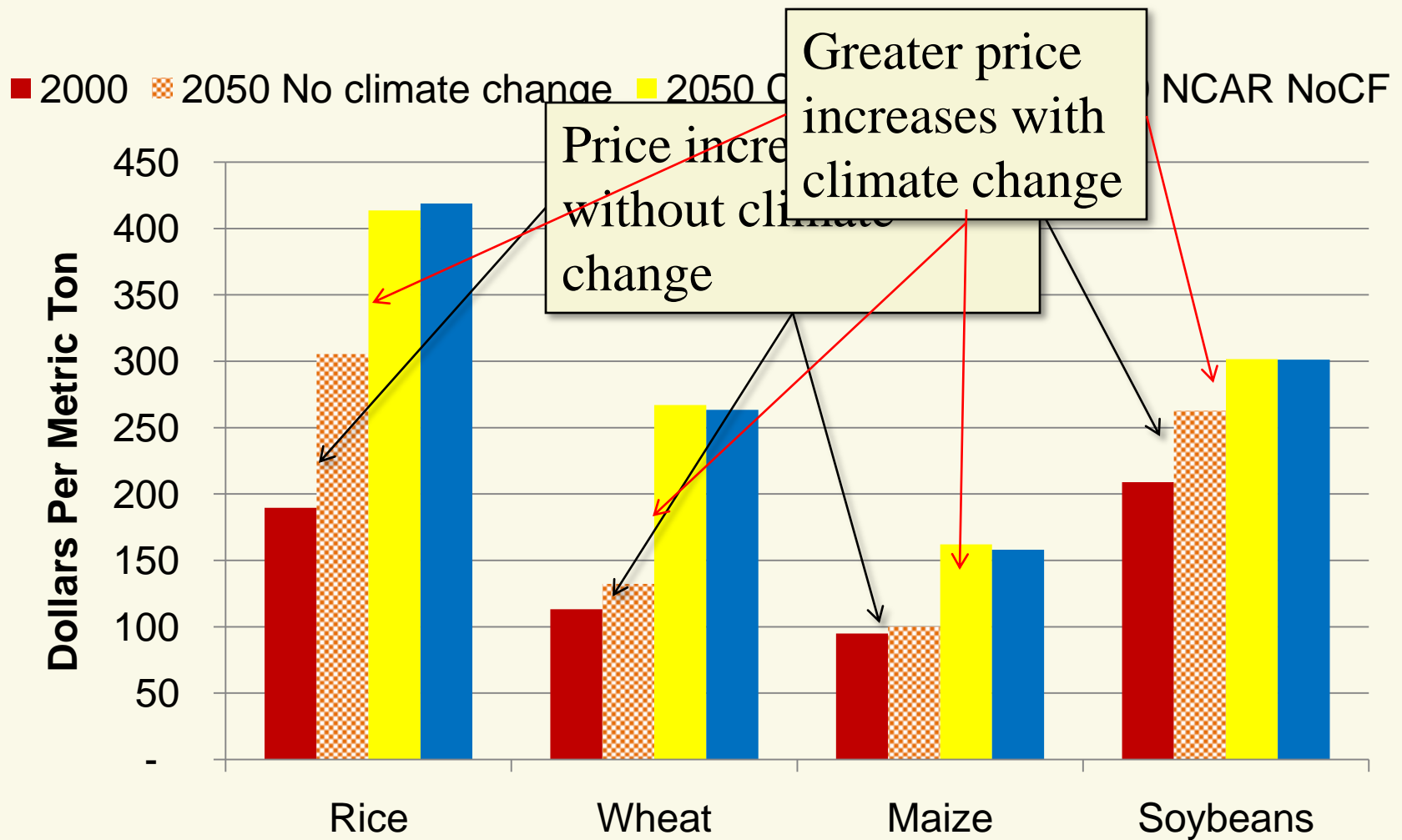
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FOOD SUPPLY AND DEMAND RESULTS

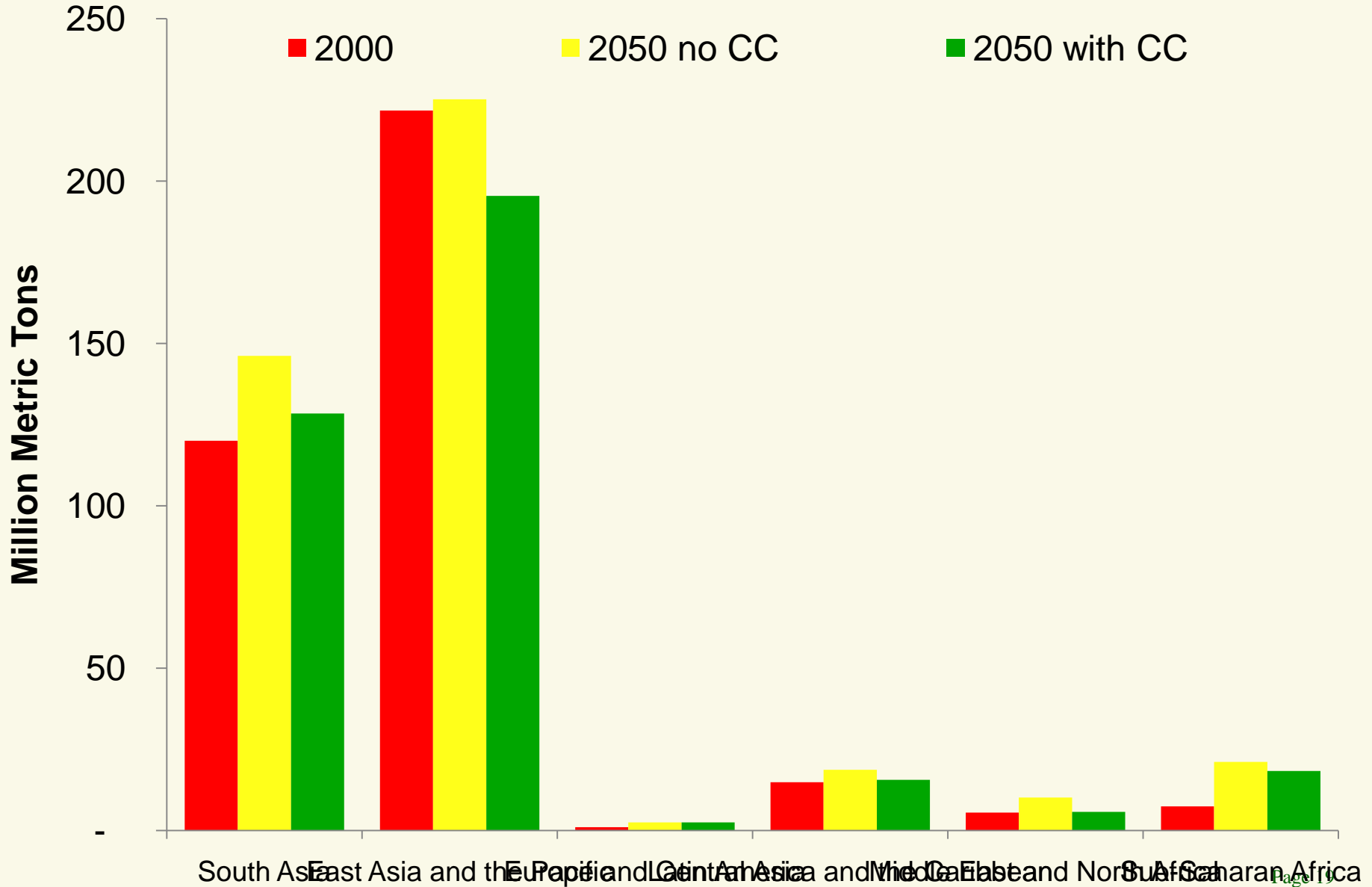
IMPACT2009

Biophysical effects from crop and hydrology models
and
economic effects from global PE model

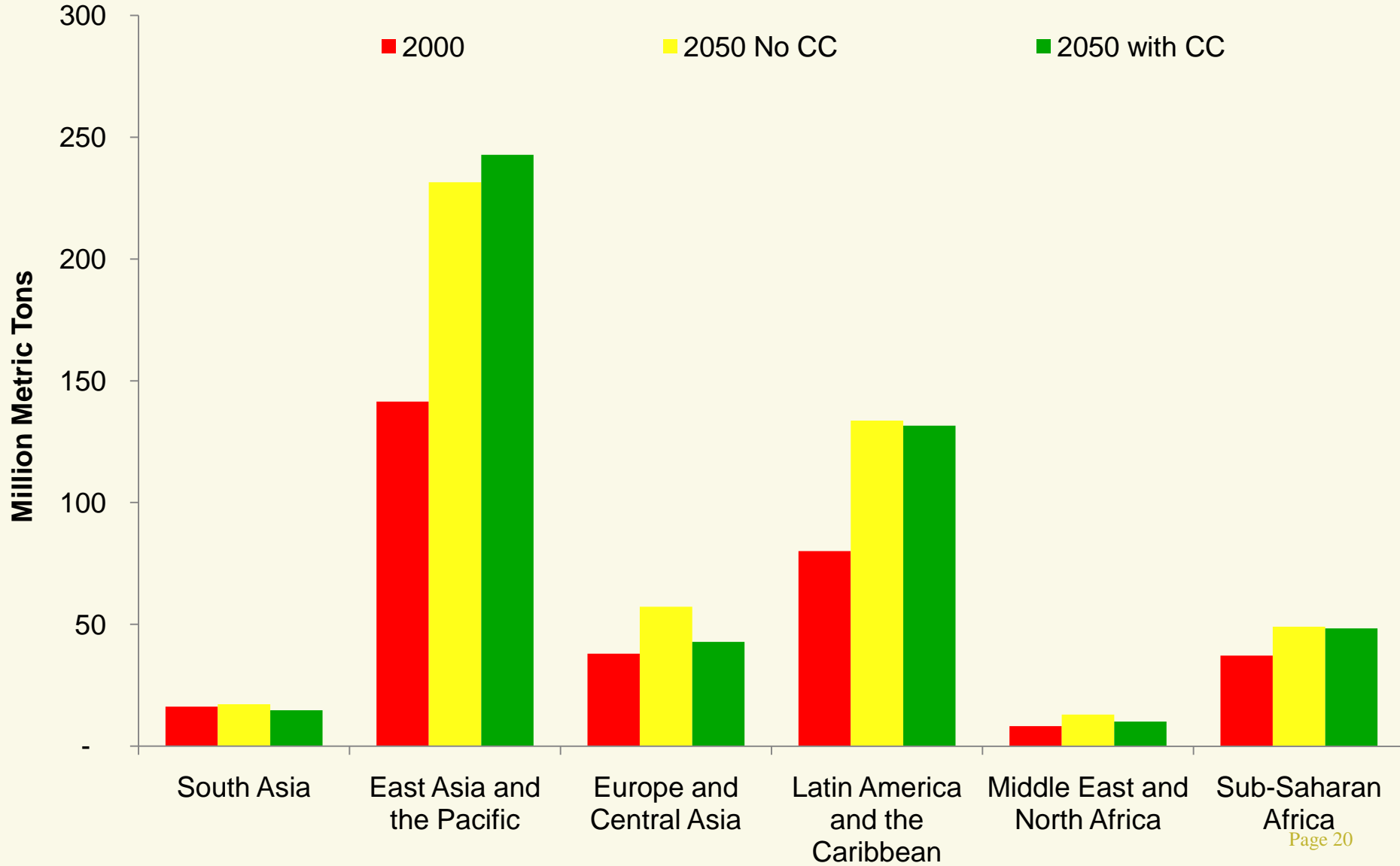
Impact on International Food Prices



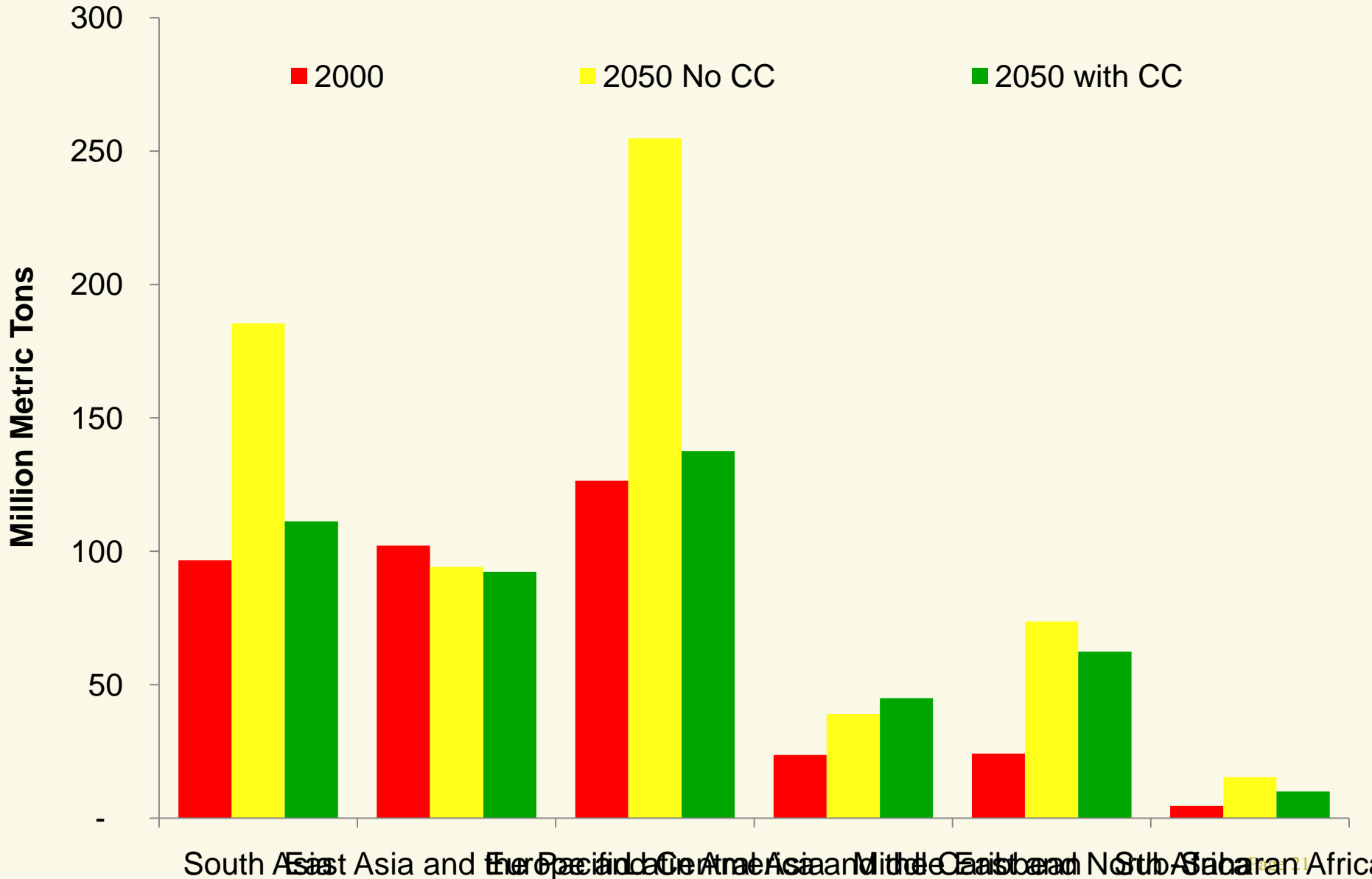
Climate Change Plus Economic Impacts on Rice Production (NCAR)



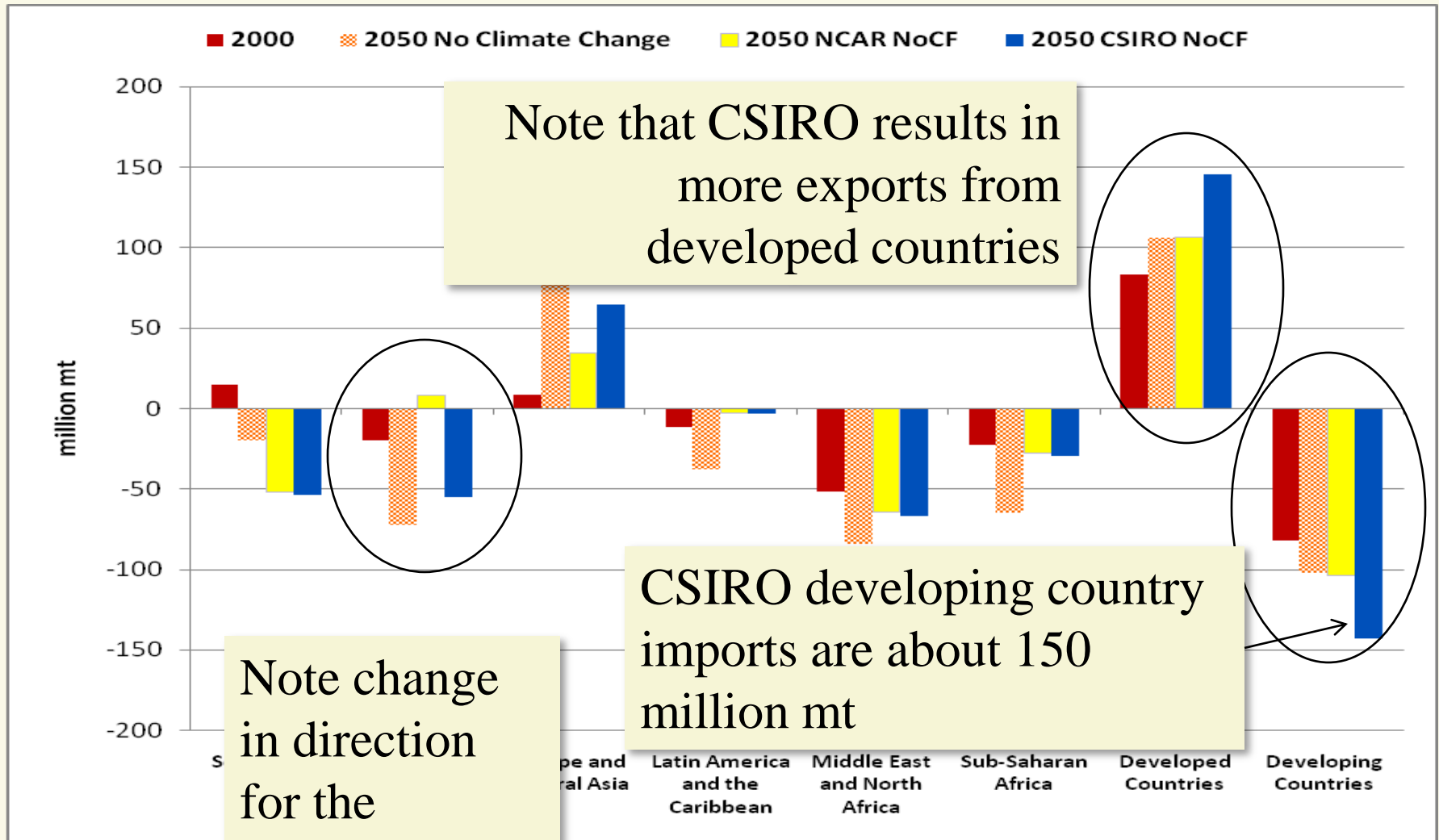
Impacts on Maize Production (NCAR)



Impacts on Wheat Production (NCAR)



Impacts on Cereal Trade Flows

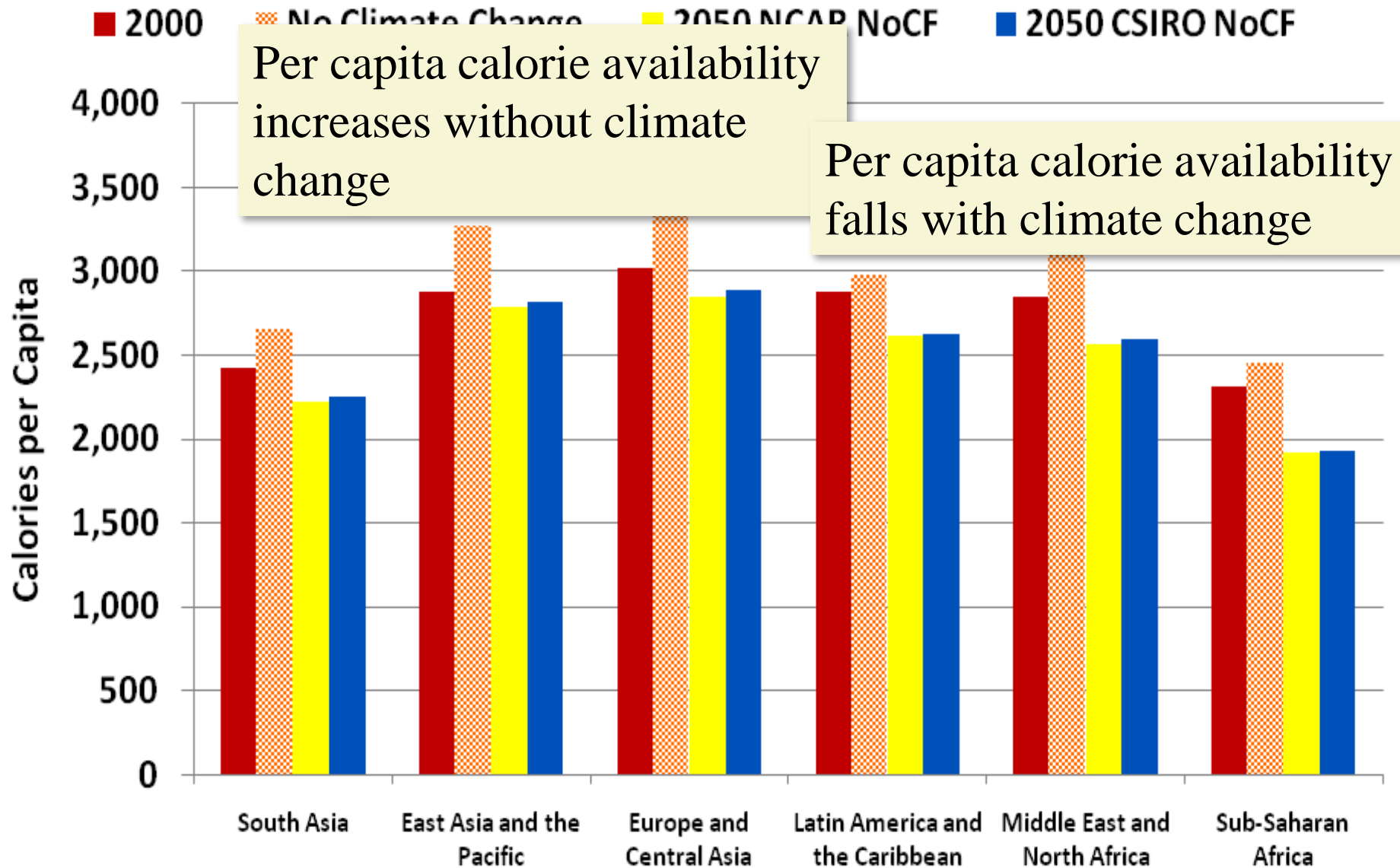


Note change in direction for the different scenarios

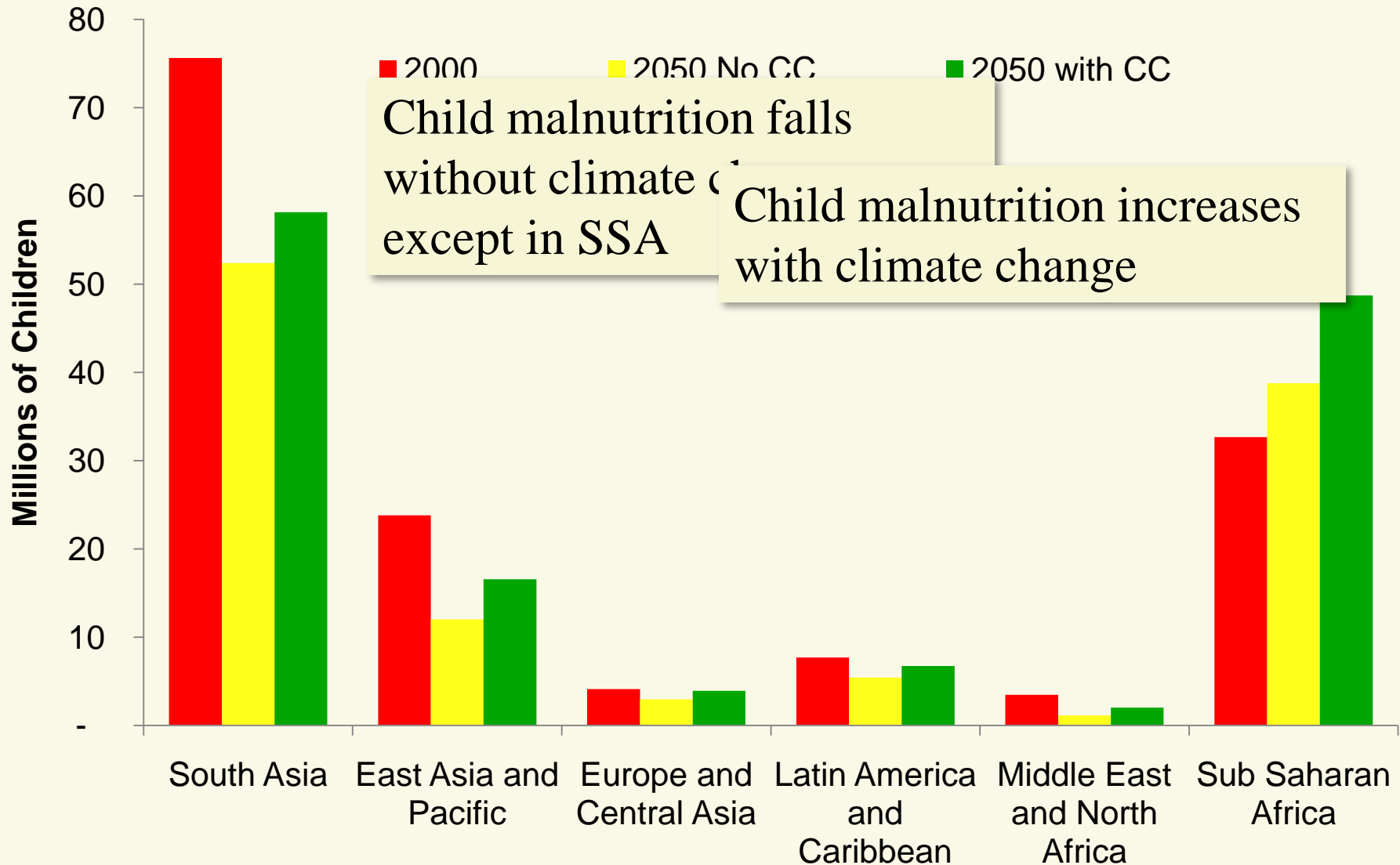
CSIRO developing country imports are about 150 million mt

Note that CSIRO results in more exports from developed countries

Impact on Per Capita Calorie Availability



Impact on Childhood Malnutrition





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CLIMATE CHANGE ADAPTATION COSTS

Our Definition of Agricultural Adaptation

- Agricultural investments that reduce child malnutrition with climate change to the level with no climate change

- What types of investments considered?
 - Public agricultural research
 - Irrigation expansion and efficiency improvements
 - Rural roads

Adaptation Costs are Large!

- Required additional annual expenditure
 - Wetter NCAR scenario = US\$7.1 billion
 - Drier CSIRO scenario = US\$7.3 billion
- Regional level
 - Sub-Saharan Africa - 40% of the total, mainly for rural roads
 - South Asia - US\$1.5 billion, agricultural research and irrigation efficiency
 - Latin America and Caribbean - US\$1.2 billion per year, agricultural research
 - East Asia and the Pacific - US\$1 billion per year, agricultural research and irrigation efficiency

Developed Country Adaptation Expenditures Help

- With additional investments in the developed countries, spillover effects to the developing world reduce the need for adaptation investments slightly (and the other way around)
- NCAR scenario, developing country adaptation costs
 - Developing countries investments only -> US\$7.1 billion
 - With additional developed country productivity investments -> US\$6.8 billion



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THE ROLE OF TRADE

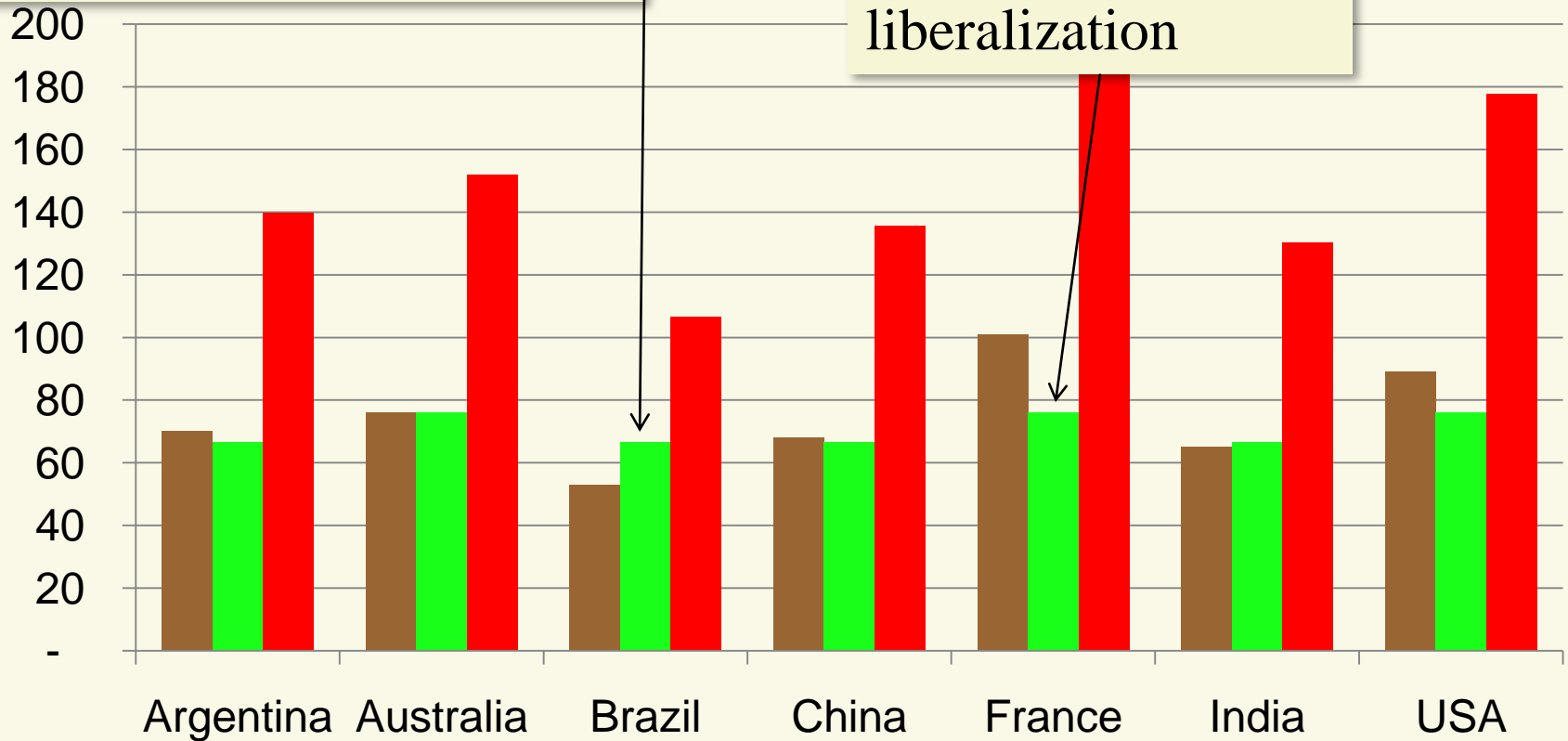
Trade liberalization as a policy to reduce adverse climate change impacts?

- Protection in IMPACT defined as PSE and CSE
- Two experiments
 - Double protection – multiply PSE and CSE by 2
 - Eliminate protection – set PSE and CSE to 0

2000 Maize Prices, Protection Experiments

Compare Brazil liberalization

To France liberalization



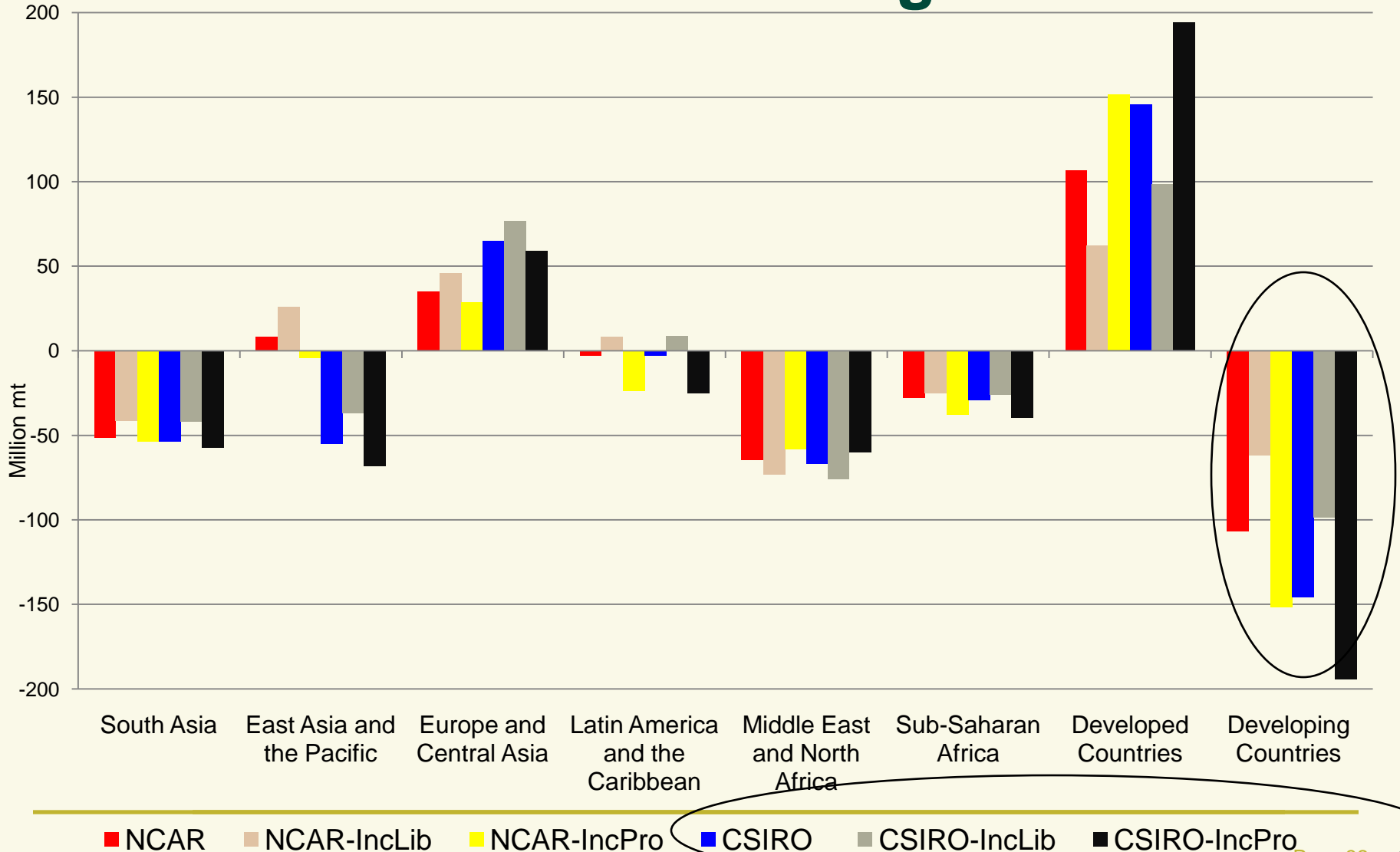
■ PS (US\$)

■ PS (US\$) complete liberalization

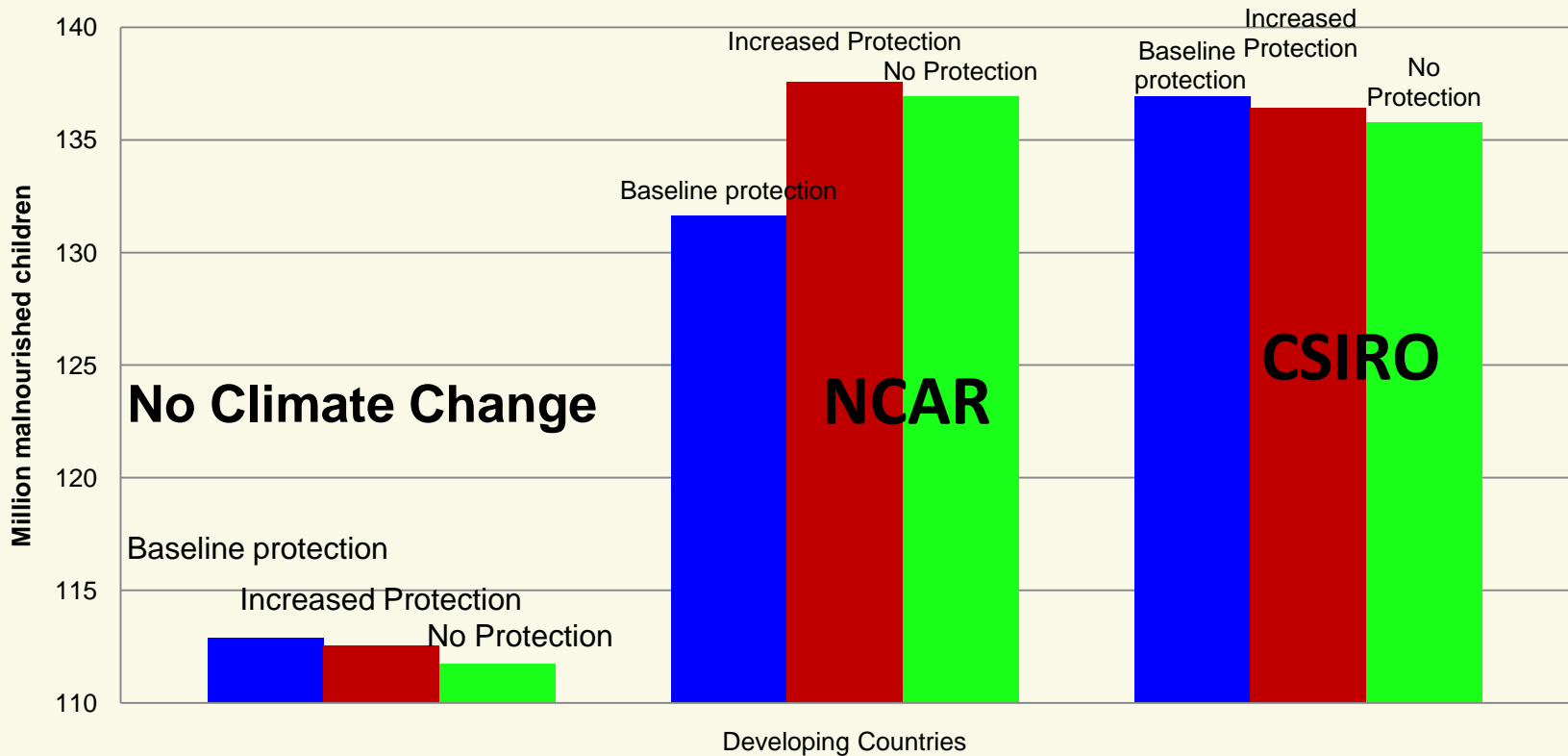
■ PS (US\$) double protection

Double protection has greater effect than elimination

Results from the Experiments: 2050 Cereal Trade Flow Changes



Results from the Experiments: 2050 Child Malnutrition Changes



Reduced protection outcomes better than increased protection outcomes; changes are small relative to adaptation needs

Conclusions

- Climate change will have negative impacts on agricultural production and food security in developing countries
- Agriculture is critical for
 - Employment
 - Economic development and
 - Food security
- Argues for significant expenditures to reduce the adverse impacts of climate change
- Reduced agricultural protection (border and domestic) can contribute to reduce adverse impacts—depending on scenario--but does not come close to offsetting climate change effects

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Thank you

