



United States Department of Agriculture

# Global Economics and Food Demand

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Next-Generation Food Shock Modeling  
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The Findings and Conclusions in This Preliminary Presentation Have Not Been Formally Disseminated by the U.S. Department of Agriculture and Should Not Be Construed to Represent Any Agency Determination or Policy. This research was supported by the intramural research program of the U.S. Department of Agriculture, Economic Research Service.

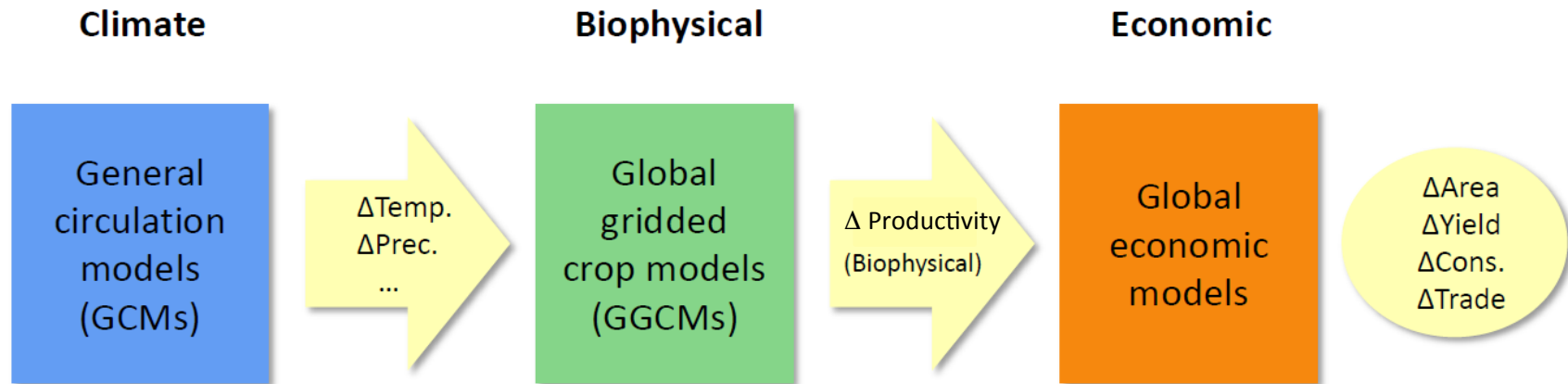


# Outline

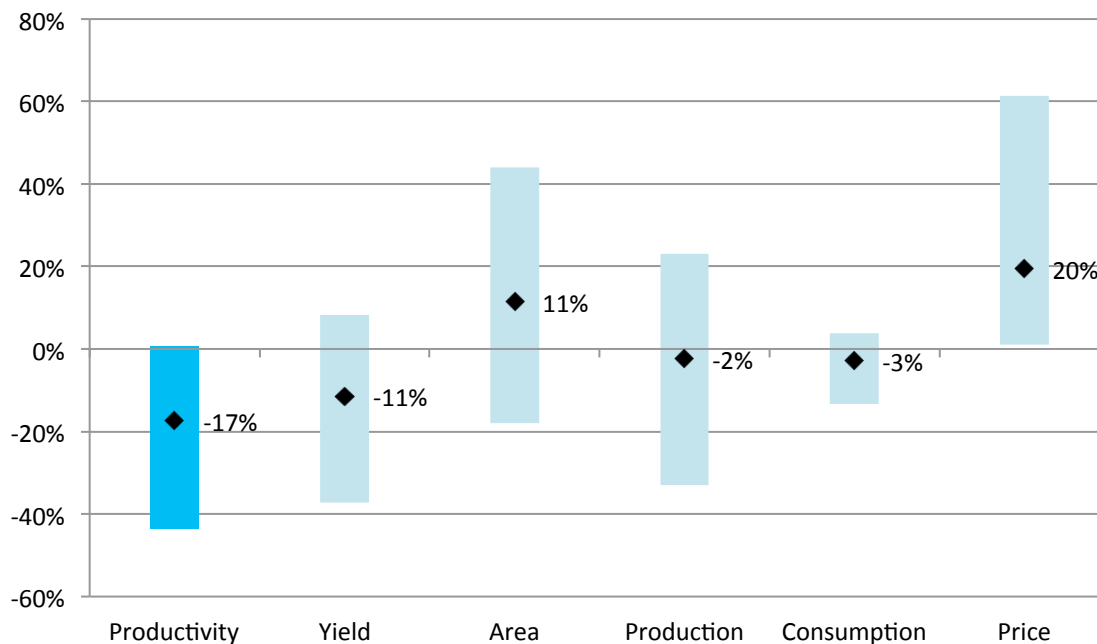
- Agricultural Model Intercomparison and Improvement Project (AgMIP) modeling chain
- Productivity shock in 2050 due to climate change
- Economic responses and tradeoffs
- Future demand for food
- Modeling challenges



# The climate modeling chain: From biophysical to socioeconomic



# Economic Responses to a Decline in Agricultural Productivity Due to Climate Change in 2050



Change in **Productivity** is the exogenous shock. All other changes are endogenous responses relative to baseline. The black diamond is the average (mean) percent change with climate change compared to no climate change in year 2050; the height of a column is the range across climate models, crop models, and economic models. Results are a world average across major field crops: wheat, rice, coarse grains, and oil seeds.

Source: Nelson et al. (2014) *Proceedings of the National Academy of Sciences*, Vol. 111(9): 3274-3279.

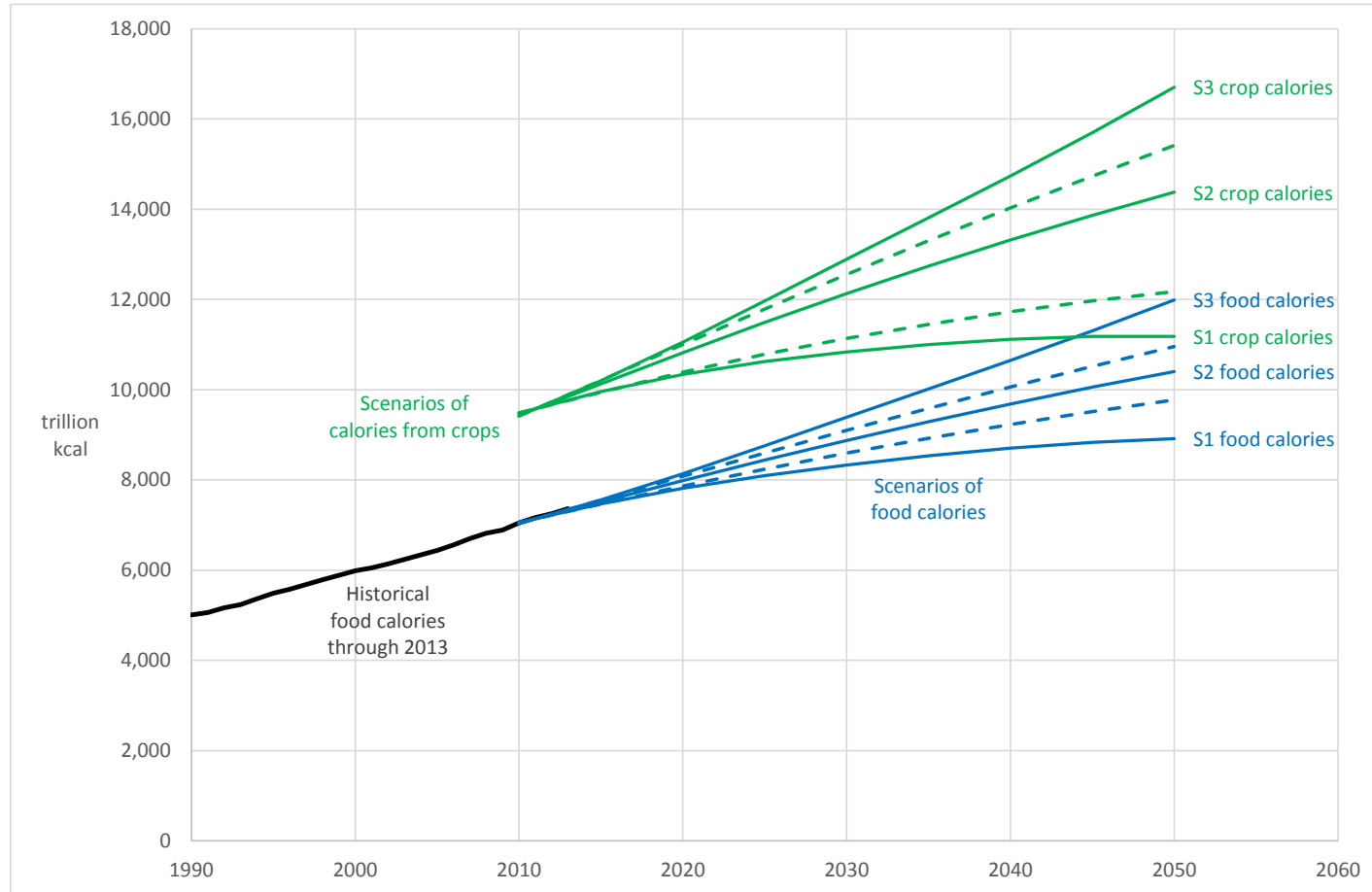


# Future demand for food

- World demand for food calories
  - Food and Agriculture Organization (FAO) of the United Nations provides historical data to 2013
  - Food available for consumption (includes waste at home and in restaurants)
  - Calories as unit of aggregation
  - Model-based projections to 2050
  - Shared Socioeconomic Pathways (SSPs) provide a range of scenarios, including variation in global diets, population, and per-capita income
  - Global demand for food calories increases in all scenarios from 2010 to 2050
- World demand for calories from crops
  - Model-based projections from 2010 to 2050
  - Demand for crop calories increases by 52 percent from 2010 to 2050 in “middle of the road” scenario, or about 1.1 percent per year



# World demand for food calories and crop calories



Note: The dashed lines show the variation due only to changes in diets, from scenario “S2 low livestock” to scenario “S2 high livestock.” The change in food calories due to dietary preference, the difference between the dashed blue lines, is much smaller than the difference between the dashed green lines (crop calories). This magnifying effect is due to the quantity of feed calories required per calorie of animal product.



# Modeling Challenges

- Relevance to U.S. Government science programs
  - U.S. Global Change Research Program: Interagency Group on Integrative Modeling
  - USDA Research Program Themes (3 of 5)
    - Sustainable Agricultural Intensification
    - Agricultural Climate Adaptation
    - Food and Nutrition Translation
- Modeling extreme events (e.g., floods and drought)
- Hydrology as a limitation to cropland expansion
  - Monthly time step
  - Watersheds as geographical unit
- Improve realism for agricultural productivity growth
- Bioenergy and land competition
  - Scale of bioenergy combined with CO<sub>2</sub> capture and storage (BECCS) as a negative-emissions technology
  - IPCC 1.5 C report includes scenarios with large areas of land dedicated to energy crops
  - Tradeoffs among bioenergy from forests, energy crops, and carbon stored in forests

