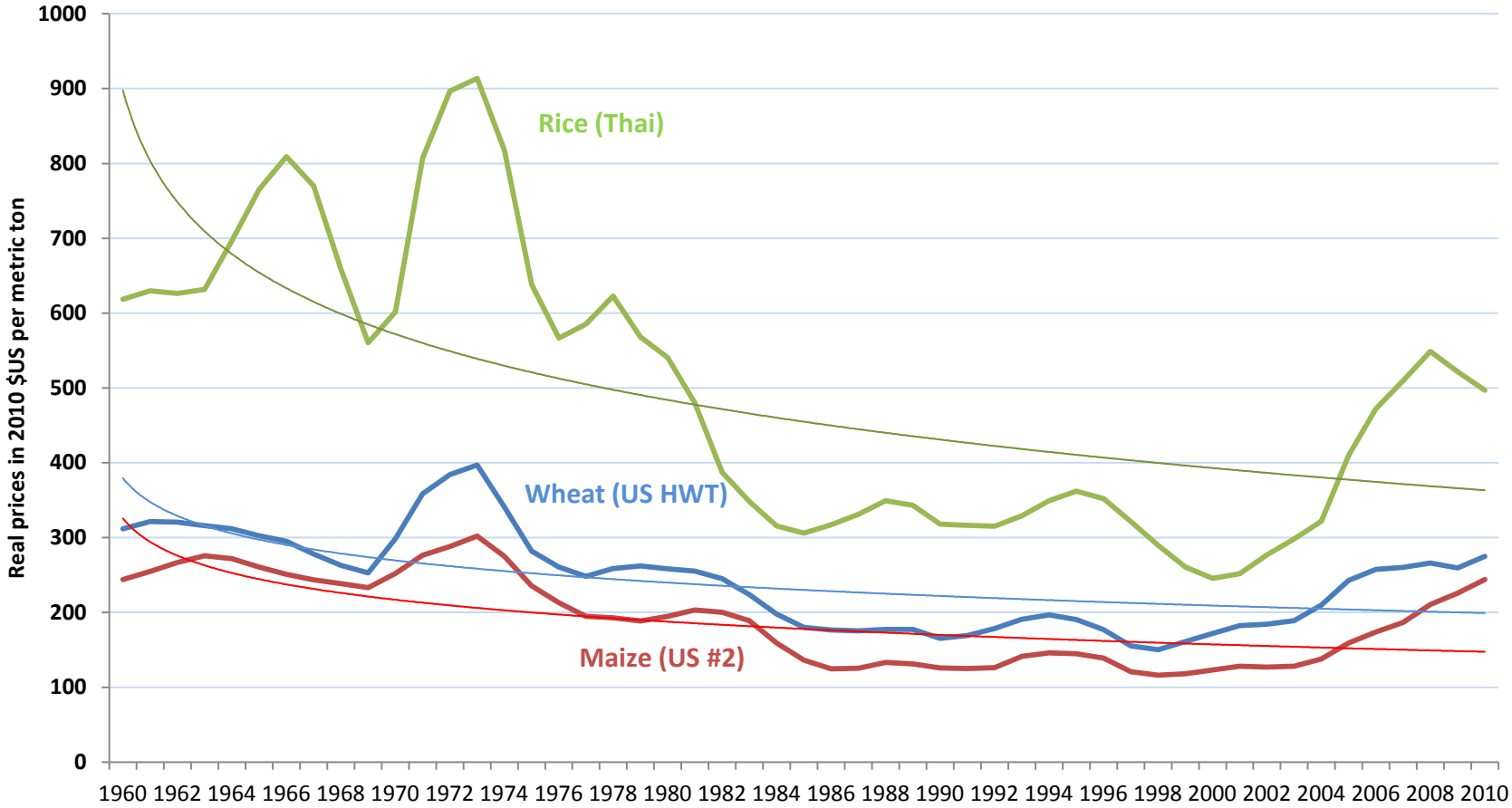
CLIMATE CHANGE:
AGRICULTURAL AND ECONOMIC IMPACTS

Intersessional Meeting of the Intergovernmental Group on Tea
Rome, 5-6 May 2014

Dominique van der Mensbrugghe
Agricultural Development Economics (ESA)
Food and Agriculture Organization of the United Nations

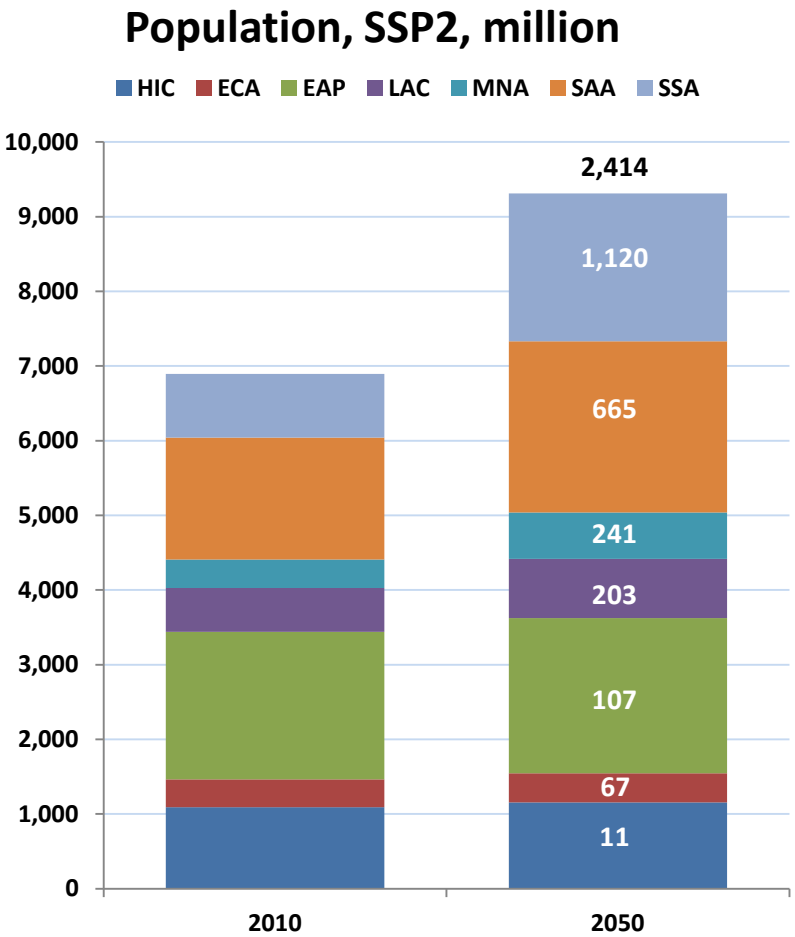
Long-term downward trend in real agricultural prices though-out the 20th century

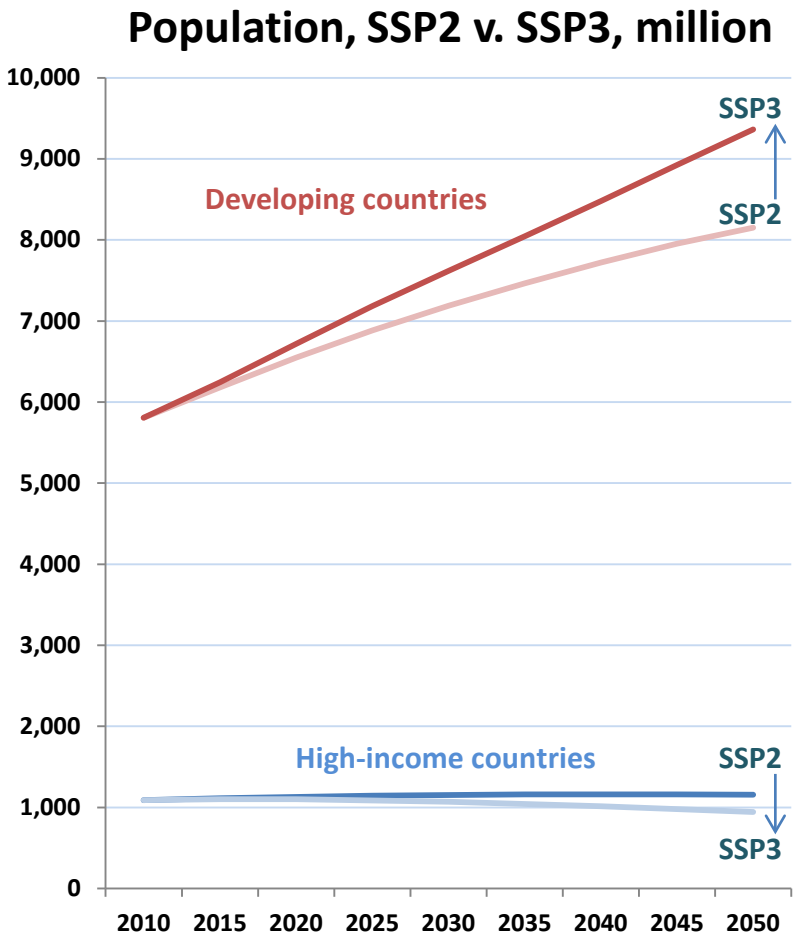


Source: World Bank pink sheet (http://go.worldbank.org/4ROCCIEQ50, accessed 7-Jan-2014) and own calculations

Note: 4-year leading moving average (last year available = 2013).

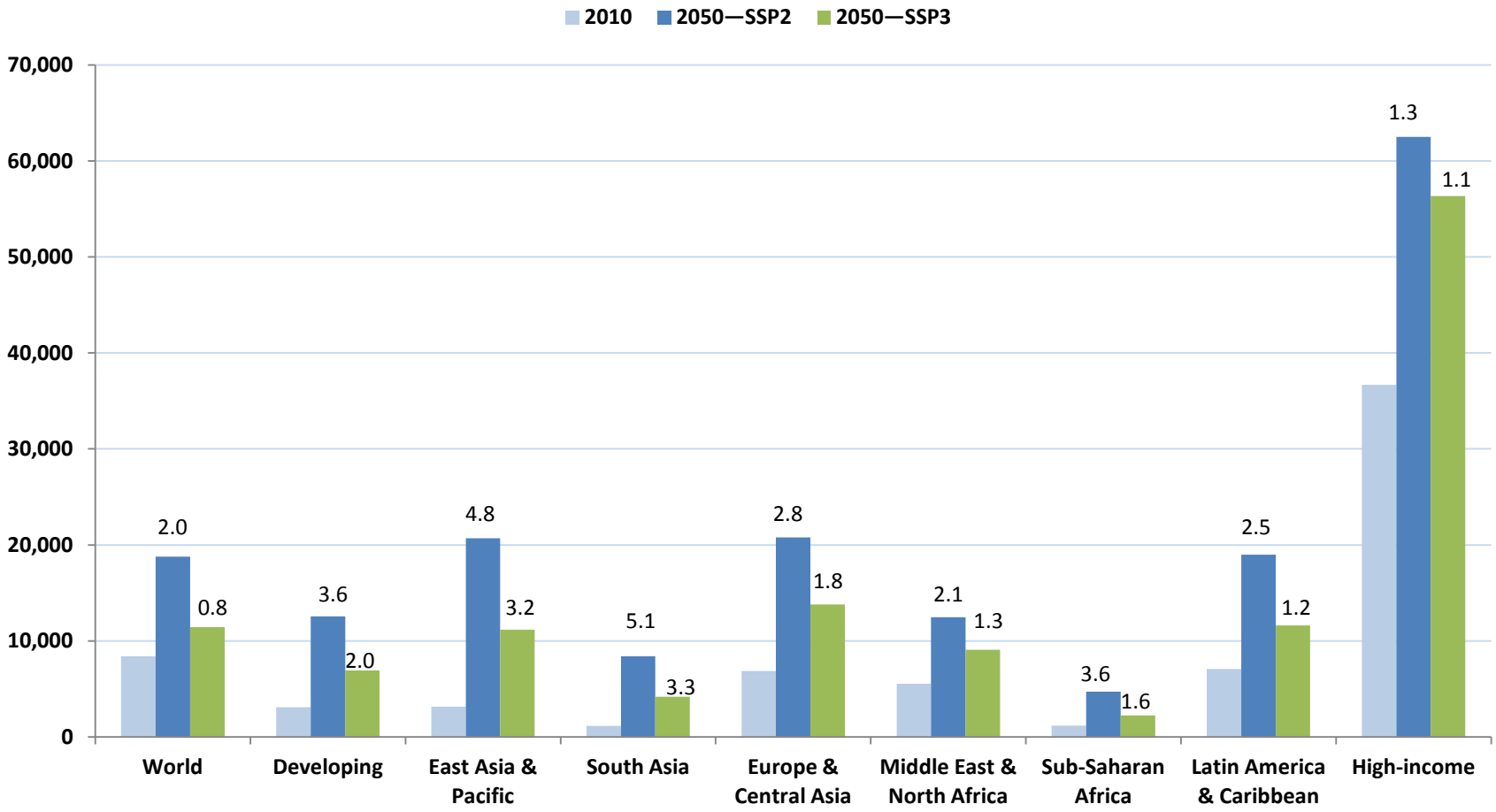
Slowing population growth, however…





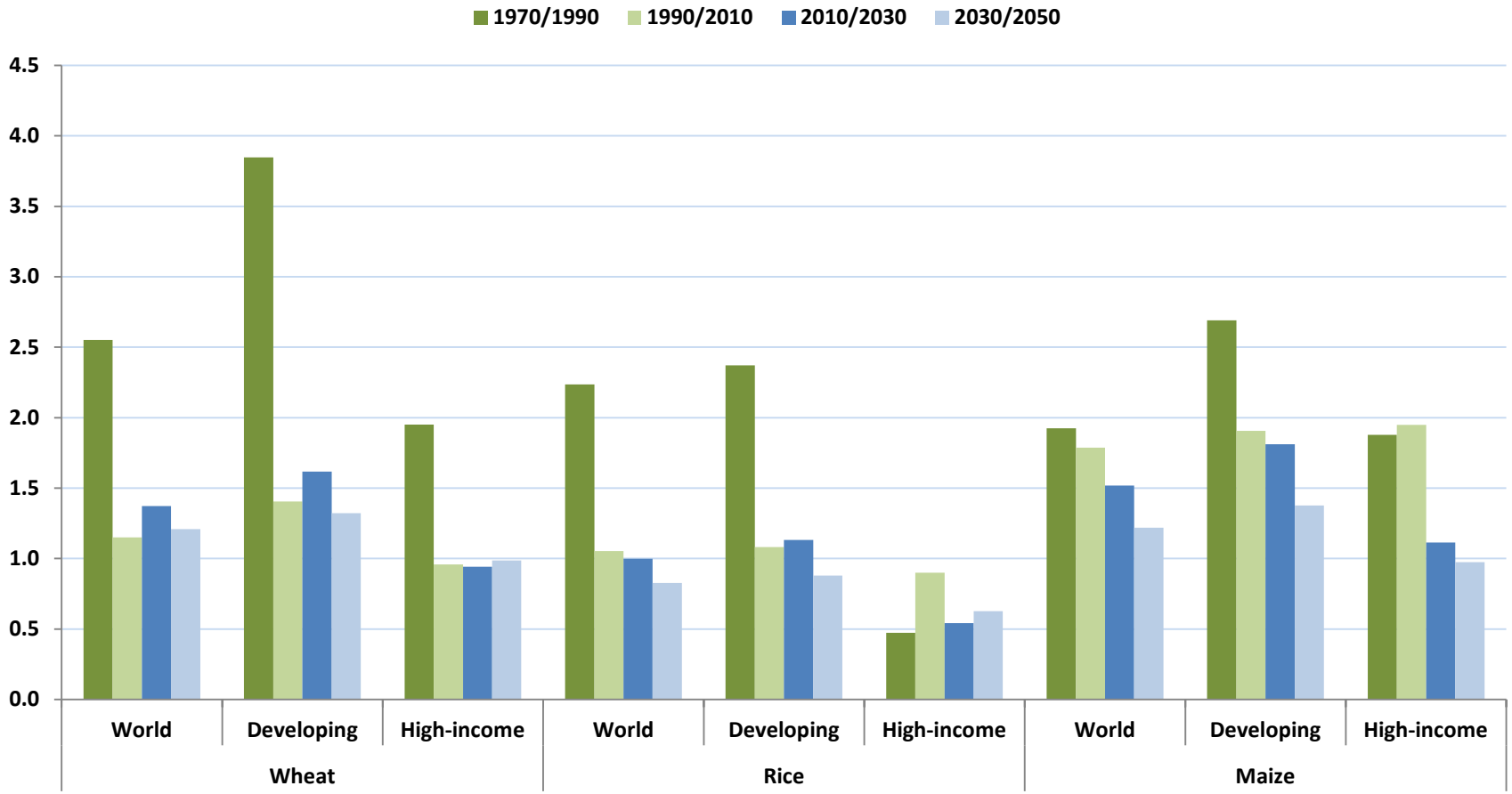
Note: 2010-2050 incremental change indicated in 2050 column. High-income (HIC), Europe & Central Asia (ECA), East Asia & Pacific (EAP), Latin America & Caribbean (LAC), Middle East & North Africa (MNA), South Asia (SAA), Sub-Saharan Africa (SSA).

GDP per capita under SSP2 and SSP3, $2007



Note: Growth rates, percent per annum, on top of columns.

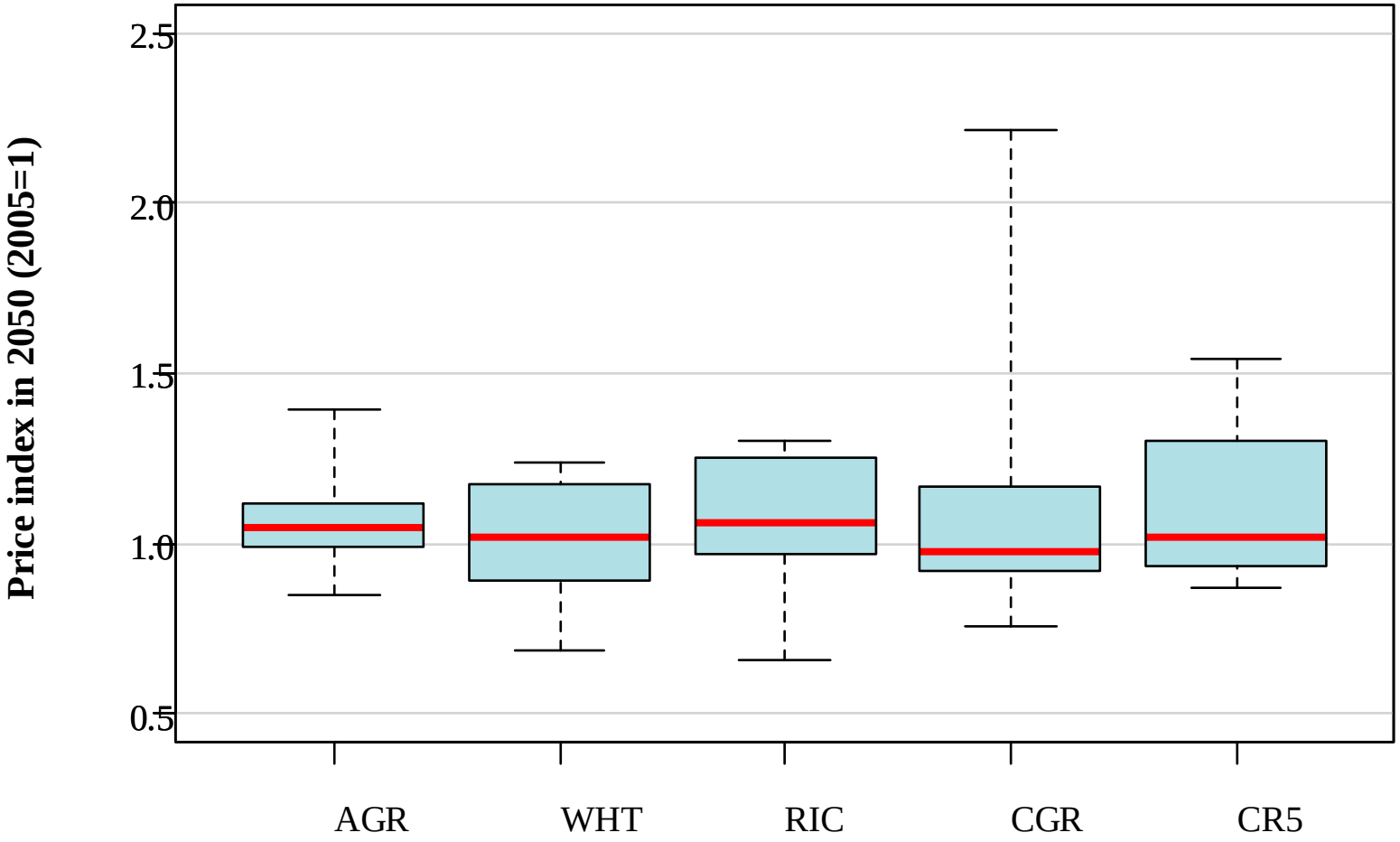
History vs. projected yield growth, percent per annum



Source: 1970/2010 FAOSTAT (accessed 22-Jul-2013), IFPRI's IPRs and own calculations

Note: Slight differences in regional aggregations between history and projections. Maize yield projections equivalent to coarse grain definition in GTAP.

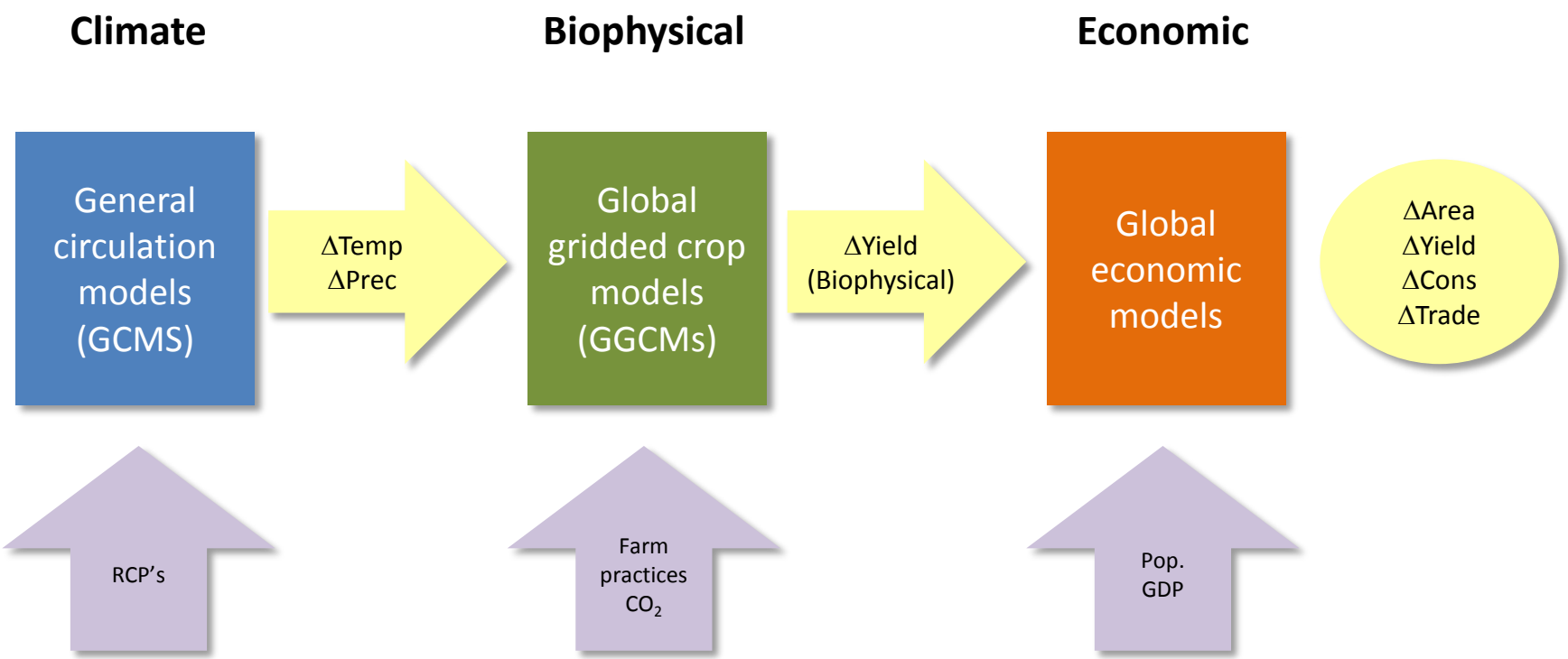
Variation of world prices across commodities in 2050



Note: All agriculture (AGR), wheat (WHT), rice (RIC), coarse grains (CGR), index for wheat, rice, coarse grains, oil seeds and sugar (CR5).

Source: AgMIP global economic runs, February 2013 and own calculations.

The climate modeling chain: from biophysical to socioeconomic

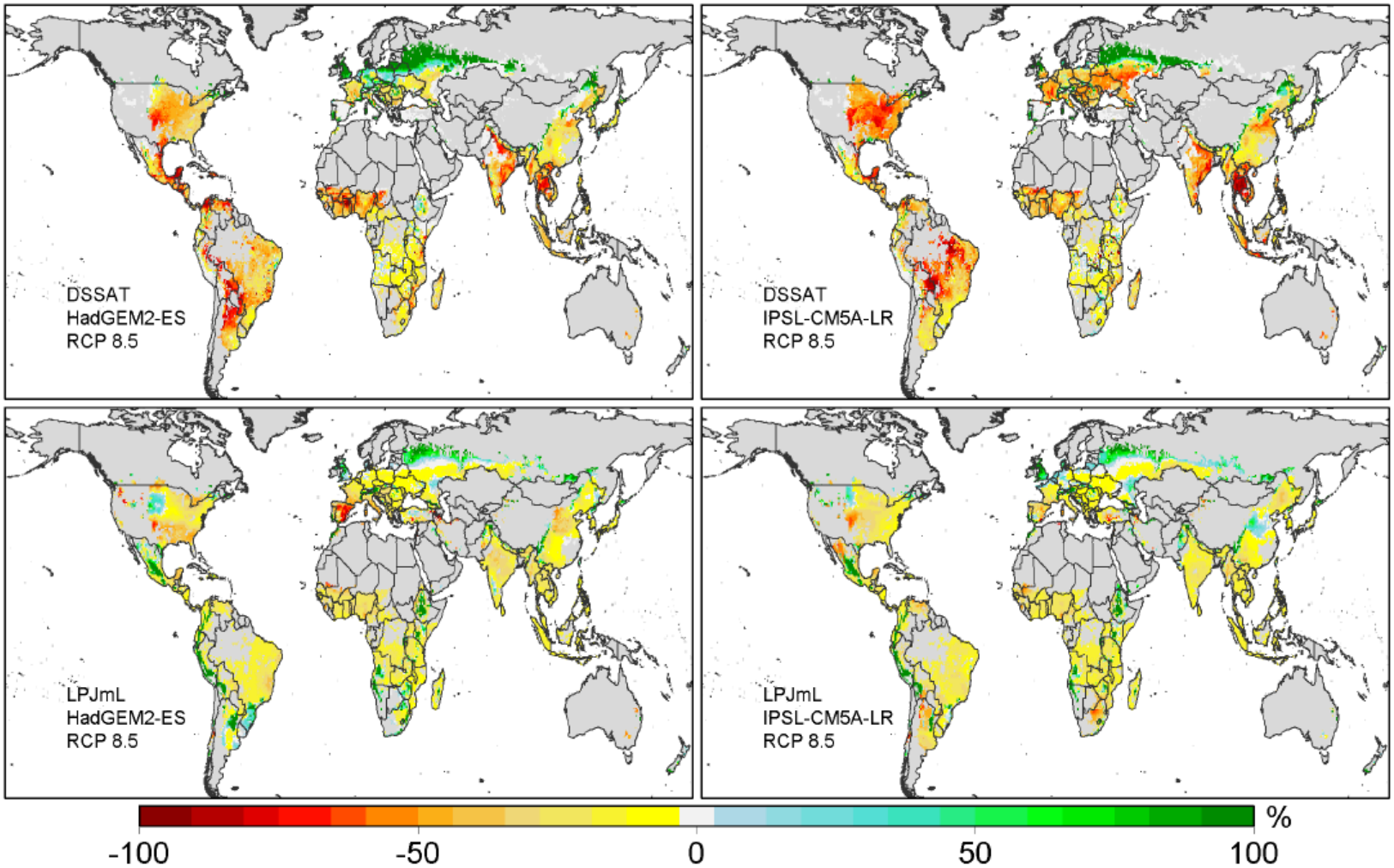


Source: Nelson et al., PNAS (2013).

An extreme climate scenario?

- RCP 8.5 was selected
  - Currently on path consistent with 8.5 w/m^2
  - Excludes potentially positive effects of increasing CO_2 concentration
  - And crop models assume constant management practices (e.g. sowing dates)
- Is this the worst case? Crop models ignore:
  - Tropospheric ozone (spatially differentiated)
  - Pests, weeds and diseases
  - Extreme events

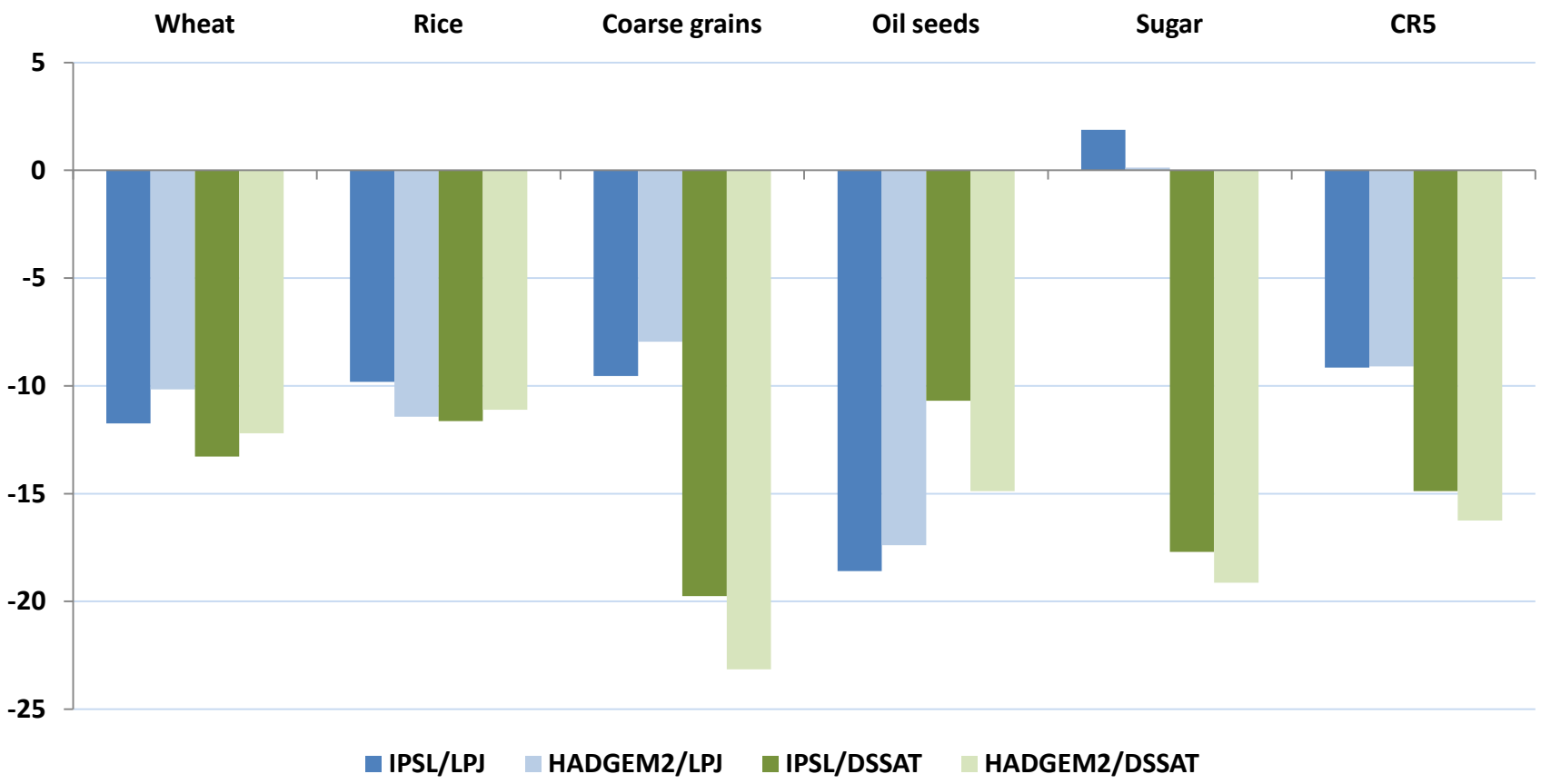
Four potential yield outcomes for maize in 2045 under RCP 8.5†



Source: Müller and Robertson (2014).

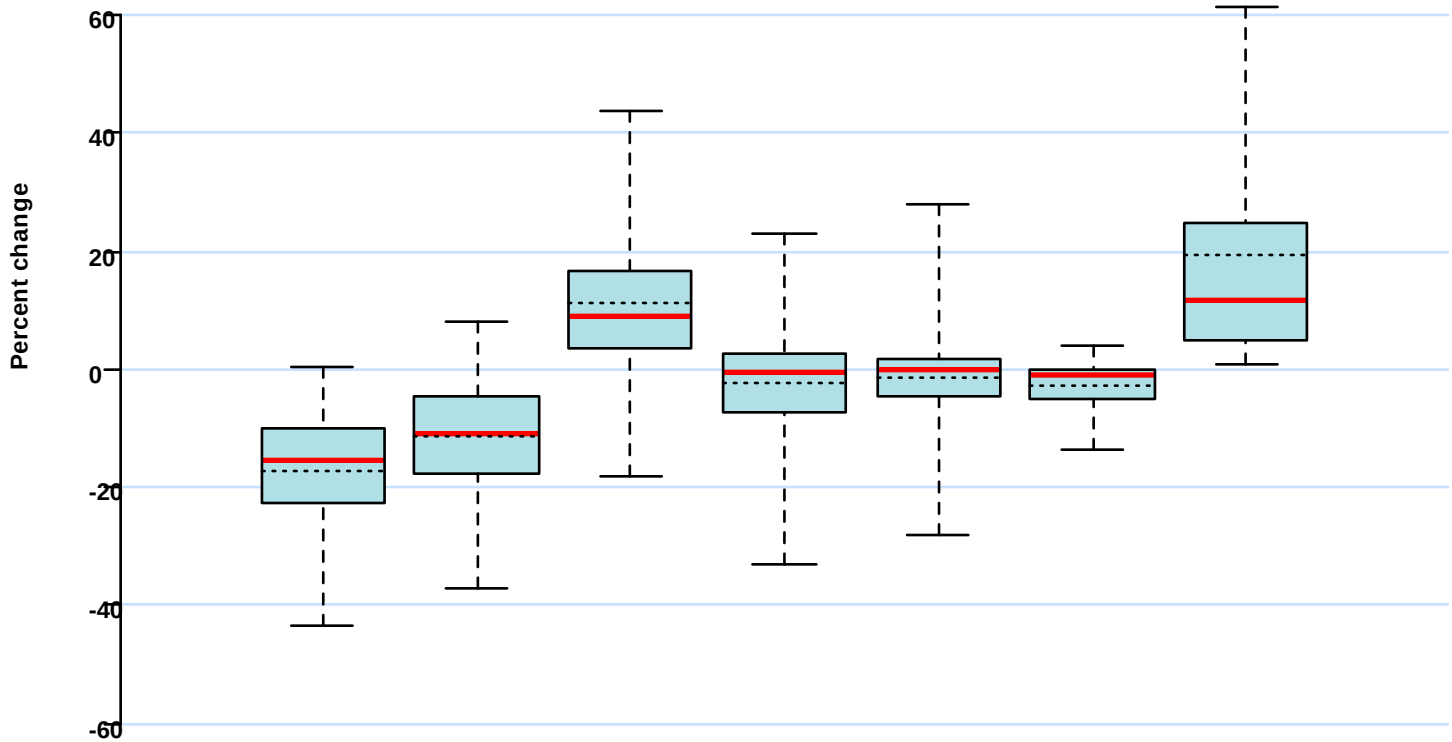
† Excludes CO_2 effects.

Simulated impacts for the four climate scenarios: global average for major crops in 2050 wrt reference



Source: Shocks from IFPRI as interpreted for use in the ENVISAGE model, Nelson, van der Mensbrugghe et al. (2014).

Climate induced changes to yields, land use, production, trade, consumption and prices in 2050



	YEXO	YTOT	AREA	PROD	TRSH	CONS	PRICE
n	2891	2891	2891	2891	2891	2891	2891
Mean	-0.17	-0.11	0.11	-0.02	-0.01	-0.03	0.2
SD	(0.131)	(0.166)	(0.249)	(0.25)	(0.264)	(0.063)	(0.242)

Source: Nelson et al., PNAS (2013).

Take away messages

- Long-term price trends depend on population and income growth and evolution of yields.
- Climate impacts will negatively affect prices, with many of the increases ranging from 5-25%.
- Analysis is complicated by significant uncertainty—climate, impacts of climate changes and future economic structure.

Further reading

Special issue of Agricultural Economics (2014):
http://onlinelibrary.wiley.com/doi/10.1111/agec.2014.45.issue-1/issuetoc

- **von Lampe, Willenbockel et al.**, "Why do global long-term scenarios for agriculture differ? An overview of the AgMIP Global Economic Model Intercomparison"
- **Robinson, van Meijl, Willenbockel et al.**, "Comparing supply-side specifications in models of global agriculture and the food system"
- **Valin, Sands, van der Mensbrugghe et al.**, "The future of food demand: understanding differences in global economic models"
- **Schmitz, van Meijl et al.**, "Land-use change trajectories up to 2050: insights from a global agro-economic model comparison"
- **Müller and Robertson**, "Projecting future crop productivity for global economic modeling"
- **Nelson, van der Mensbrugghe et al.**, "Agriculture and climate change in global scenarios: why don't the models agree"
- **Lotze-Campen, von Lampe, Kyle et al.**, "Impacts of increased bioenergy demand on global food markets: an AgMIP economic model intercomparison"

Proceedings of the National Academy of Sciences (PNAS) (2013):
http://www.pnas.org/content/early/2013/12/12/1222465110.full.pdf+html

- **Nelson et al.**, "Climate change effects on agriculture: Economic responses to biophysical shocks"