



United States Department of Agriculture

Climate Change and the Agricultural Economy



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*The views expressed are the author's and
should not be attributed to ERS or USDA*

Photos courtesy of USDA/ARS



Sources of Uncertainty in Analysis

Climate Change



Crop Sector Impact

Climate Projections

- Emissions trajectory
- Climate models

Downscaling

Biophysical Crop Response

- Weather generators: translate climate to weather
 - Spatial and temporal correlation in weather
- Models that represent crop growth and soil processes
 - Characterization of crop response to CO₂, temperature, precipitation, interactions, etc.
- Variability across crop models

Aggregation

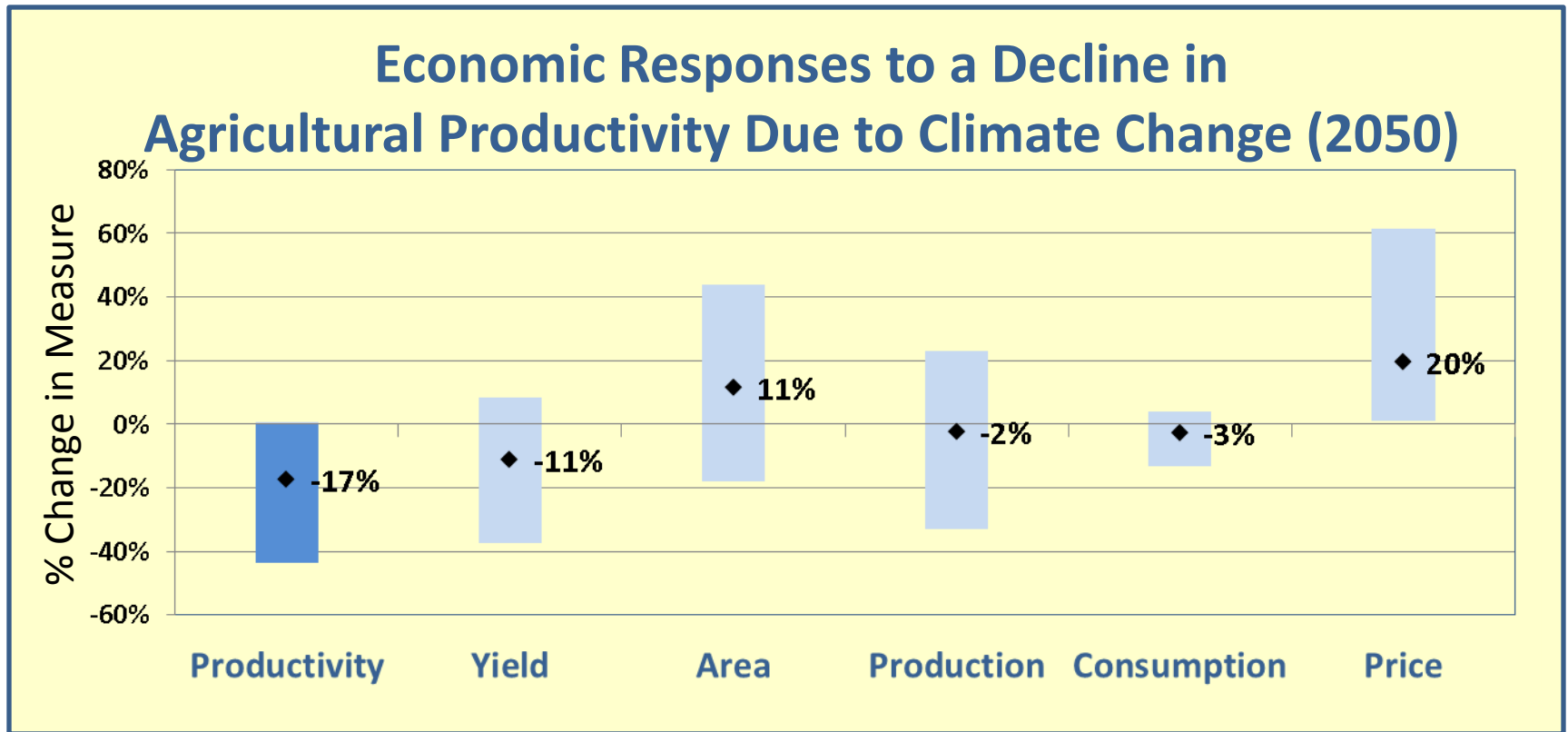
Economic Response/Adaptation

- Behavioral response
 - Farmer, consumer, trade
- Sensitive to socio—economic projections
- Variability across economic models

Scope issues: extreme events, pests, livestock



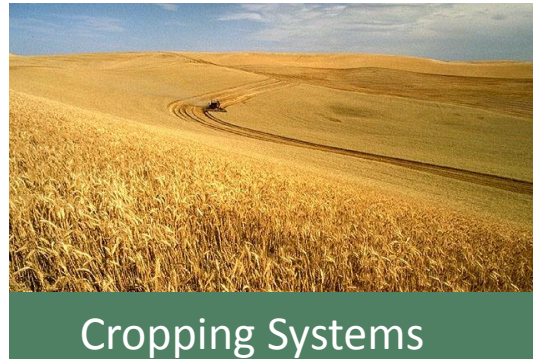
AgMIP: Global Economic Modeling



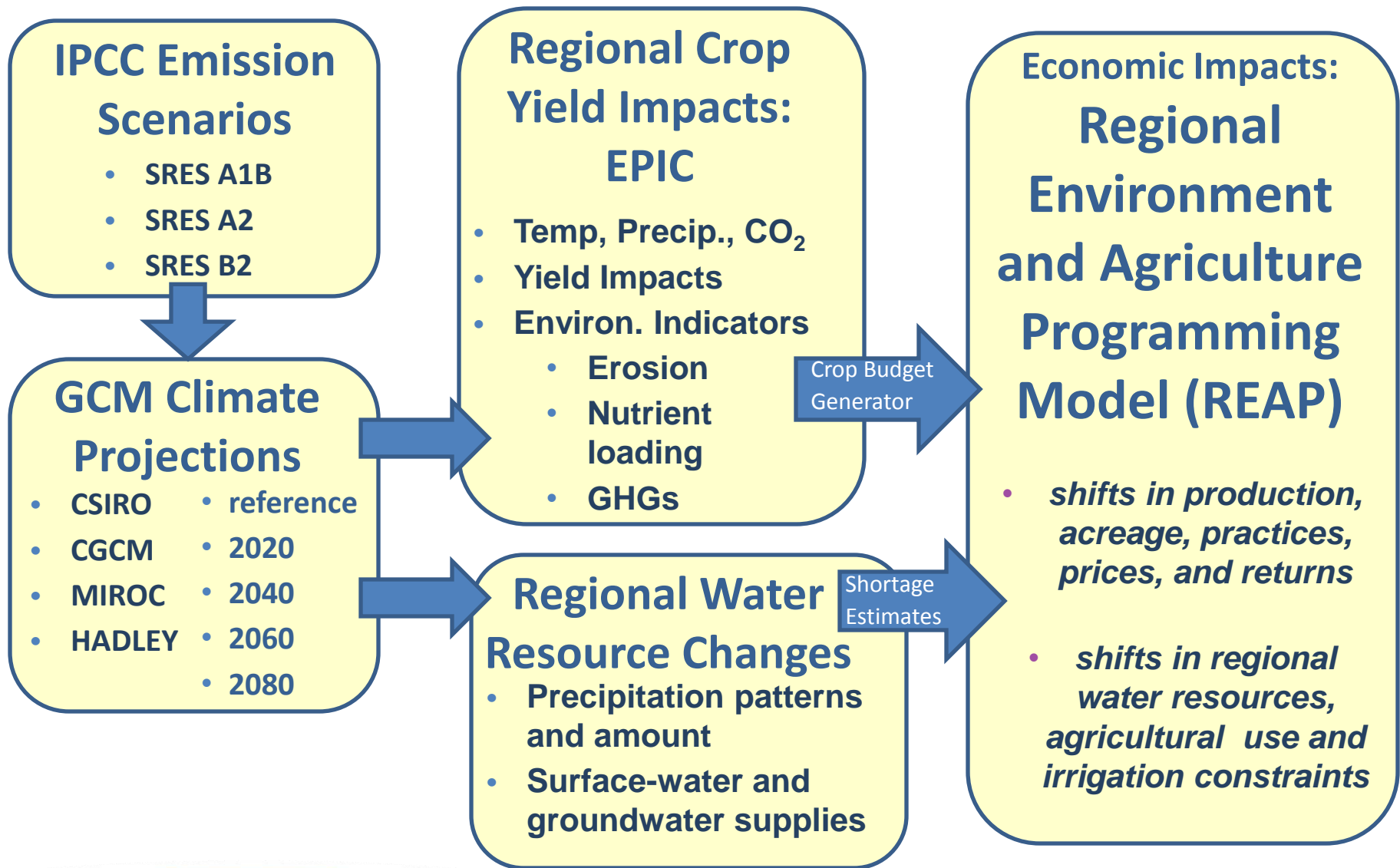
Source: Nelson et al. 2014. "Climate change effects on agriculture: Economic responses to biophysical shocks." *Proceedings of the National Academy of Sciences*, Vol. 111(9): 3274-3279.



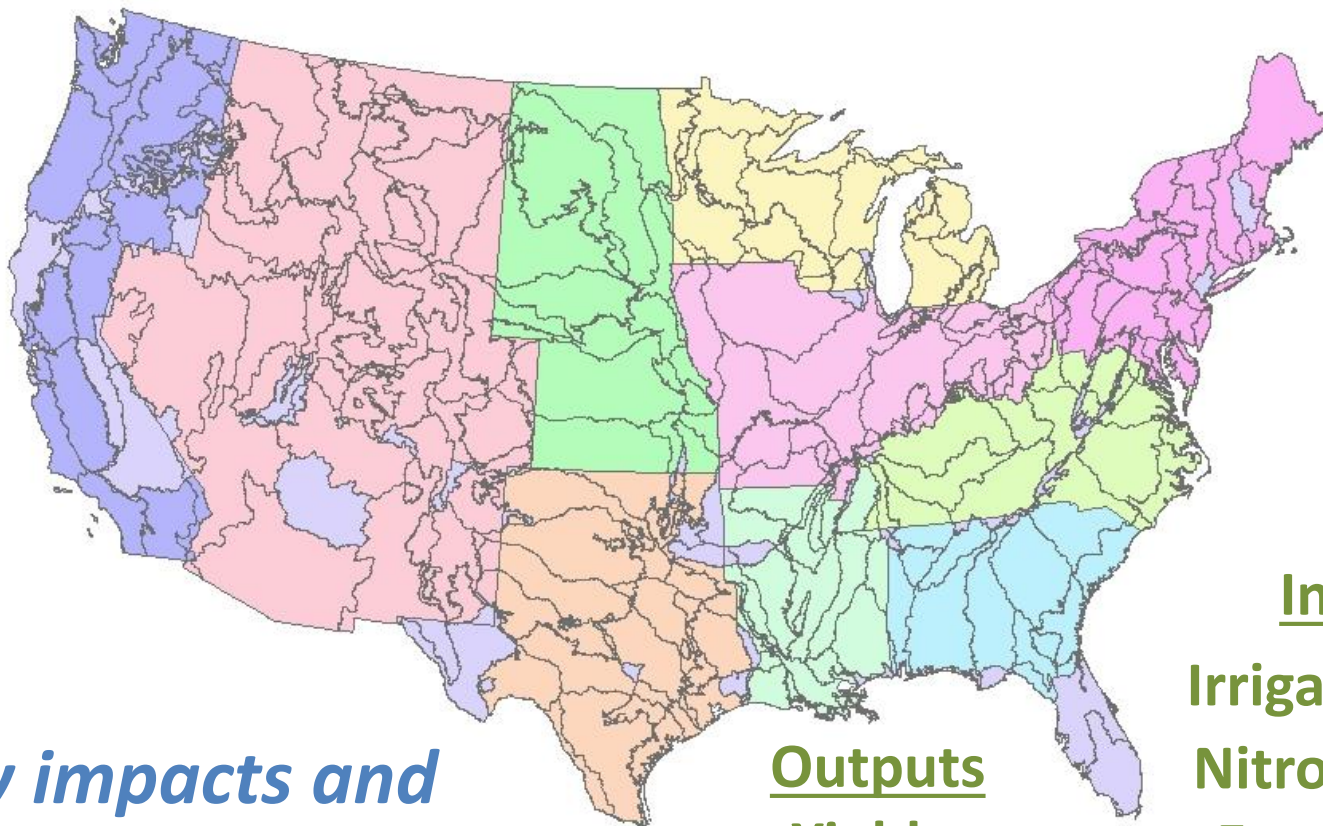
U.S.: Agriculture & Adaptation



Domestic Impacts Modeling System



~270 Production Regions



Identify impacts and potential resource constraints by region

Outputs

Yields

Erosion

Nitrogen and Phosphorus Loss

Soil Carbon Sequestration

Inputs

Irrigation use

Nitrogen use

Energy Use



U.S. Farm return impacts

(\$millions/year, SRES A1B Scenario, 2030)

Clim. Model →	ECH	CSIRO	CNR	MIROC
Corn Belt	-1114	-2165	-2112	-4053
Delta	904	167	-521	-146
Lake States	41	902	1001	-37
N. Plains	1256	1671	-914	255
S. Plains	418	322	7	681
US	3619	2165	-332	-1465

	ECH	CSIRO	CNR	MIROC
Corn	-742	-839	-33	-223
Wheat	-10	332	-265	-456
Soybeans	1361	-180	-2772	-3412
Cotton	1135	1081	1474	1266

Source: Malcolm et al, USDA/ERS, 2012



Photos courtesy of USDA/ARS, Scott Bauer

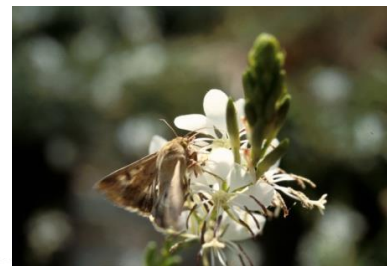


Additional impacts due to pest damage

Changes in returns to crop production
(\$millions/year, SRES A1B Scenario, 2030)

Climate Model —→	ECH	CSIRO	CNR	MIROC
US (no pests)	3619	2165	-332	-1465
US	1716	694	-2936	-4473

Source: Malcolm et al. 2012. “Agricultural Adaptation to a Changing Climate: Economic and Environmental Implications vary by U.S. Region.” ERR-136, USDA/ERS.



Juan Lopez



Photos courtesy of USDA/ARS



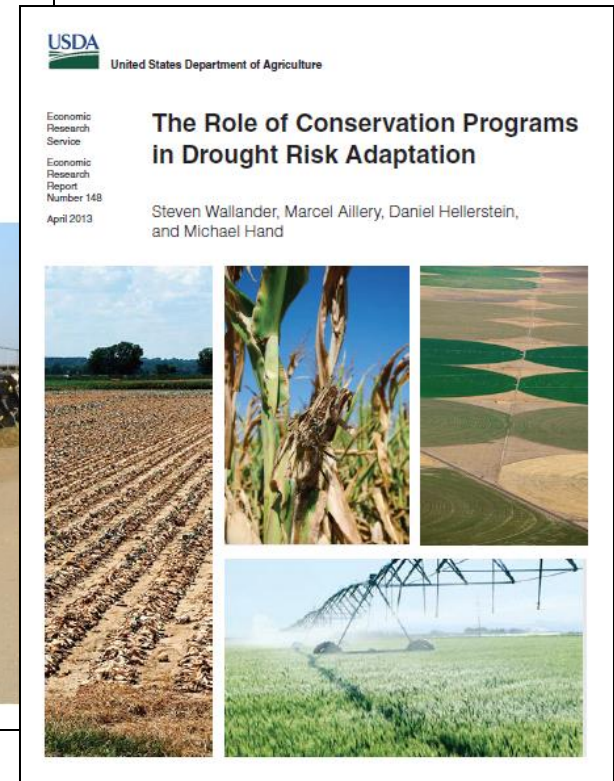
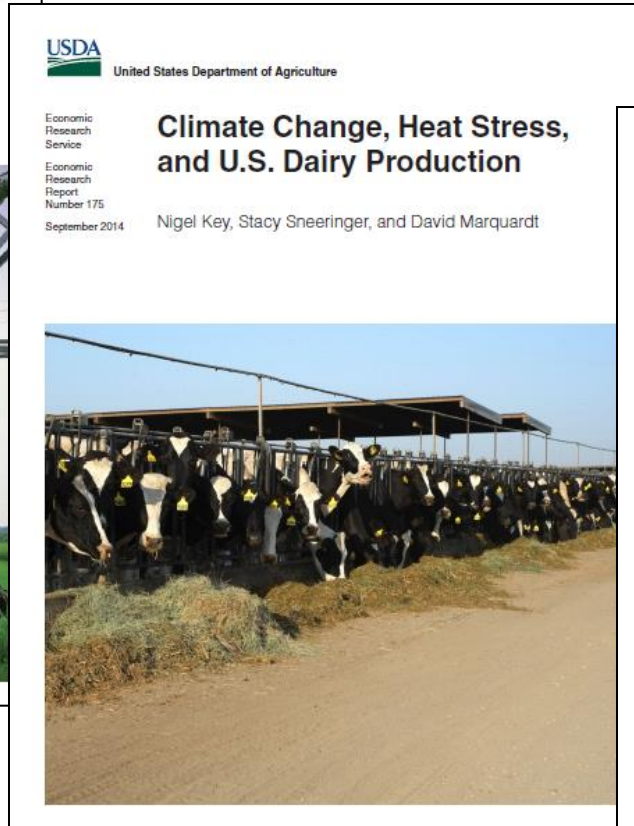
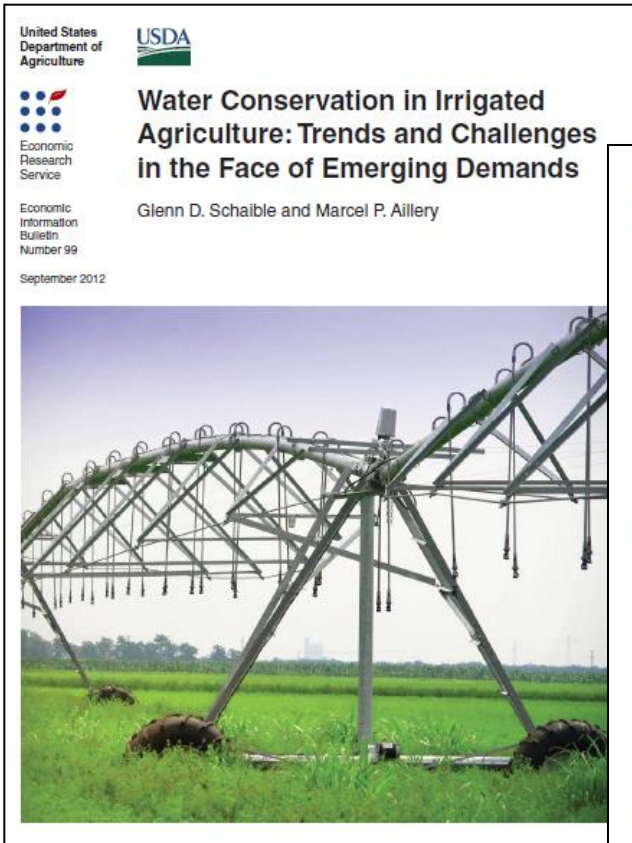
Future Research Plans and Priorities

- Climate change implications for water resources and irrigation shortages
- The environmental implications of changing patterns of production in response to climate change
- The potential for drought tolerant crop cultivars as an adaptation tool
 - Exploring baseline productivity growth assumptions and their implications for climate impact estimation
- The implications of climate change for annual variability of biophysical, economic, and environmental impacts
 - Extreme events: modeling change in incidence and impact
 - Adaptive decision-making in response to changes in production risk
- Improved treatment of pests and livestock

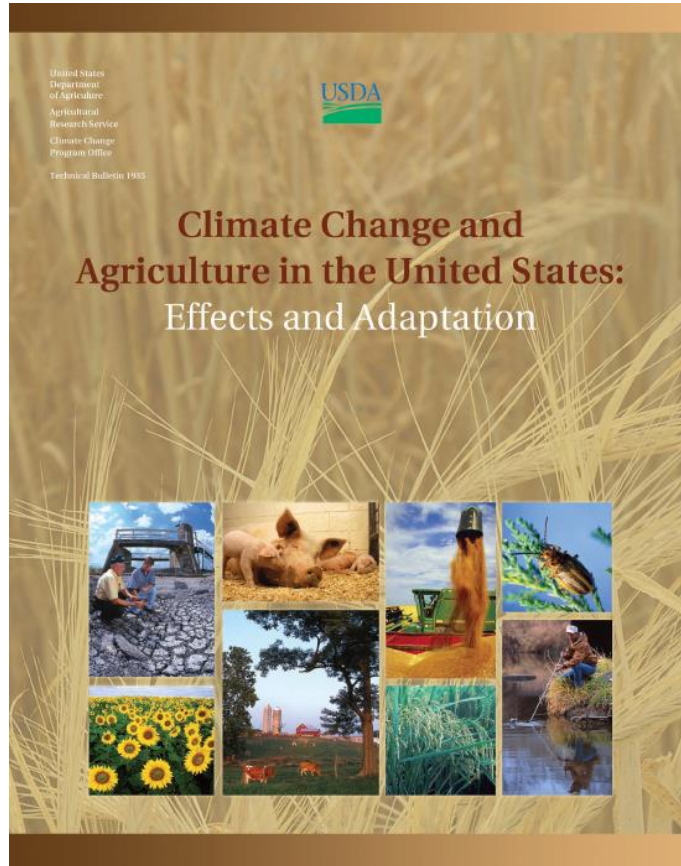


Other Climate-Related ERS Research

<http://www.ers.usda.gov>



USDA Research and Response to Climate Change



- Coordinated by the USDA Climate Change Program Office
 - Implications of climate change for agriculture, forests, grazing lands, and rural communities
- Objective, analytical assessments of the effects of climate change and proposed response strategies.
 - USDA technical report: Global Climate Change, Food Security, and the U.S. Food System (in progress)
- Liaison with other Federal agencies



U.S. Global Change Research Program



<http://www.globalchange.gov>



<http://nca2014.globalchange.gov>

Kenney, M.A, Janetos, A.C, et. al, National Climate Indicators System Report, National Climate Assessment and Development Advisory Committee, 2014.

The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment (in progress)

