

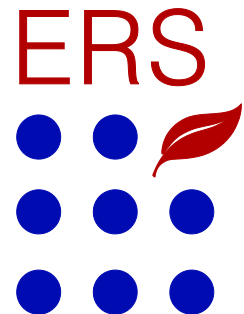
Crop Production in the Chesapeake Bay Watershed under a Changing Climate: Global Impacts, Local Consequences

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Building a Better Bay Model: A Workshop for Agricultural Partners
May 22-23, 2013



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What is the issue?

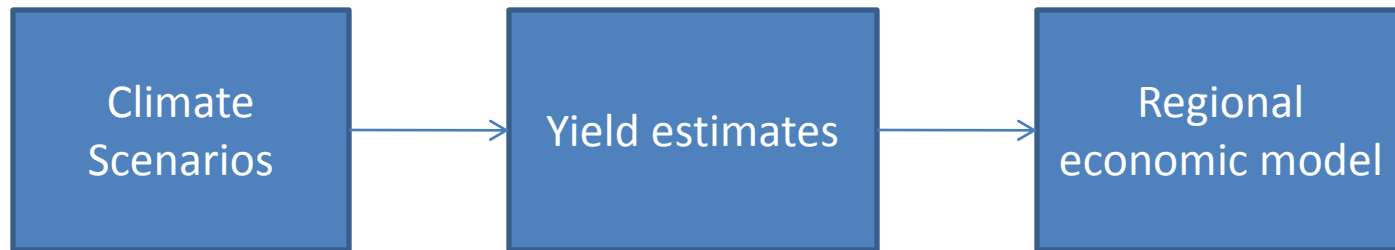
- Changing climate conditions will influence crop growth, availability of resources and agricultural markets
- The Chesapeake Bay region is small in the context of national agricultural output
- How might crop production in the region fare compared to the rest of the U.S. under climate change?



How might producers respond?

- Farmers have historically adjusted to changes in demand for crops, new technological developments, a changing policy environment, and pressure from development
- We do not attempt to project new technology, market trends or policies, nor assess their potential contribution to future U.S. agriculture
- Adaptation is restricted to shifts in prevailing crop distribution and production practices that affect land use, national markets, and environmental consequences

Modeling and Analysis Process



- No climate change Baseline
- 4 climate change scenarios

- Baseline yields computed using EPIC (biophysical crop growth simulation model)
- Sensitivity analysis cases

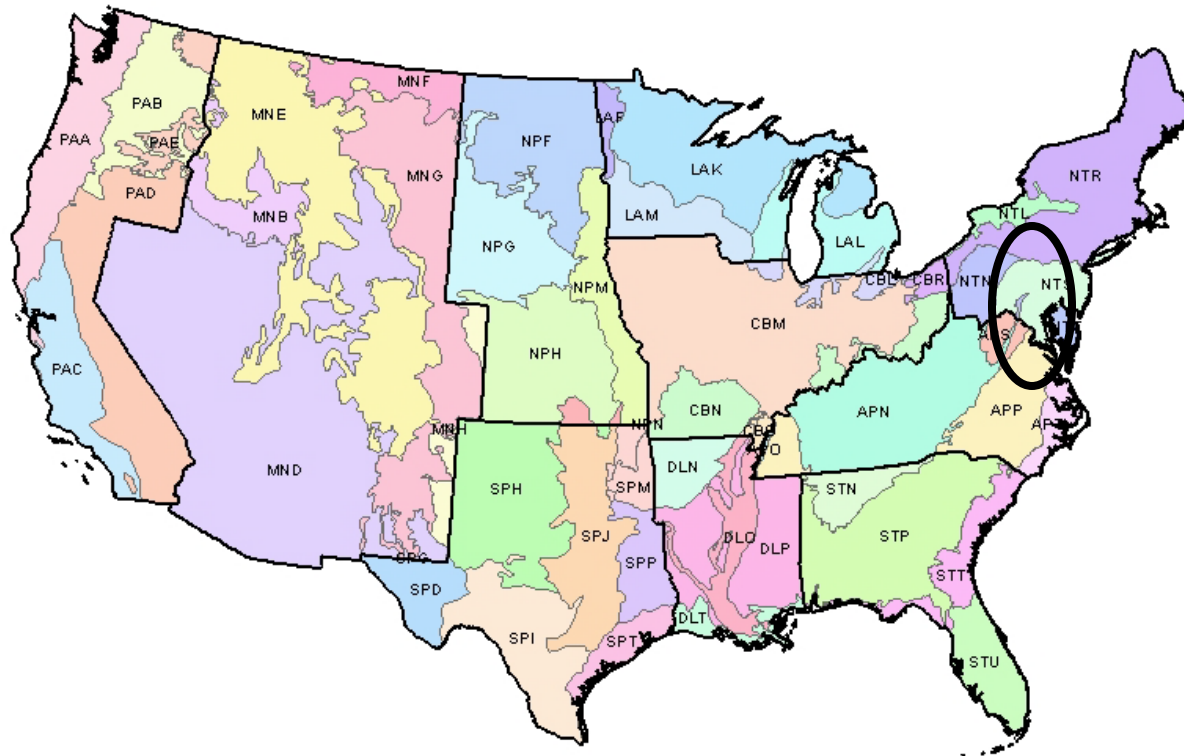
- REAP – Regional Environment and Agriculture Programming model
- USDA baseline partially extended to 2030



REAP Model Overview

- Regional Environment and Agriculture Programming (REAP) model
 - U.S. production and use for major field crops, livestock and processed products
 - 50 agricultural production regions
 - Intersection of USDA Farm Production Regions and Land Resource Regions
 - Generally homogenous units that have similar production and cost conditions within each region
 - Data from ARMS, NRI, Ag Census, EPIC and ERS estimates
 - Integrates crop, livestock and agricultural products via supply/demand functions and livestock rations
 - Explicit relationship between production practice (rotation, tillage, fertilizer), crop yields and environmental measures

REAP regions



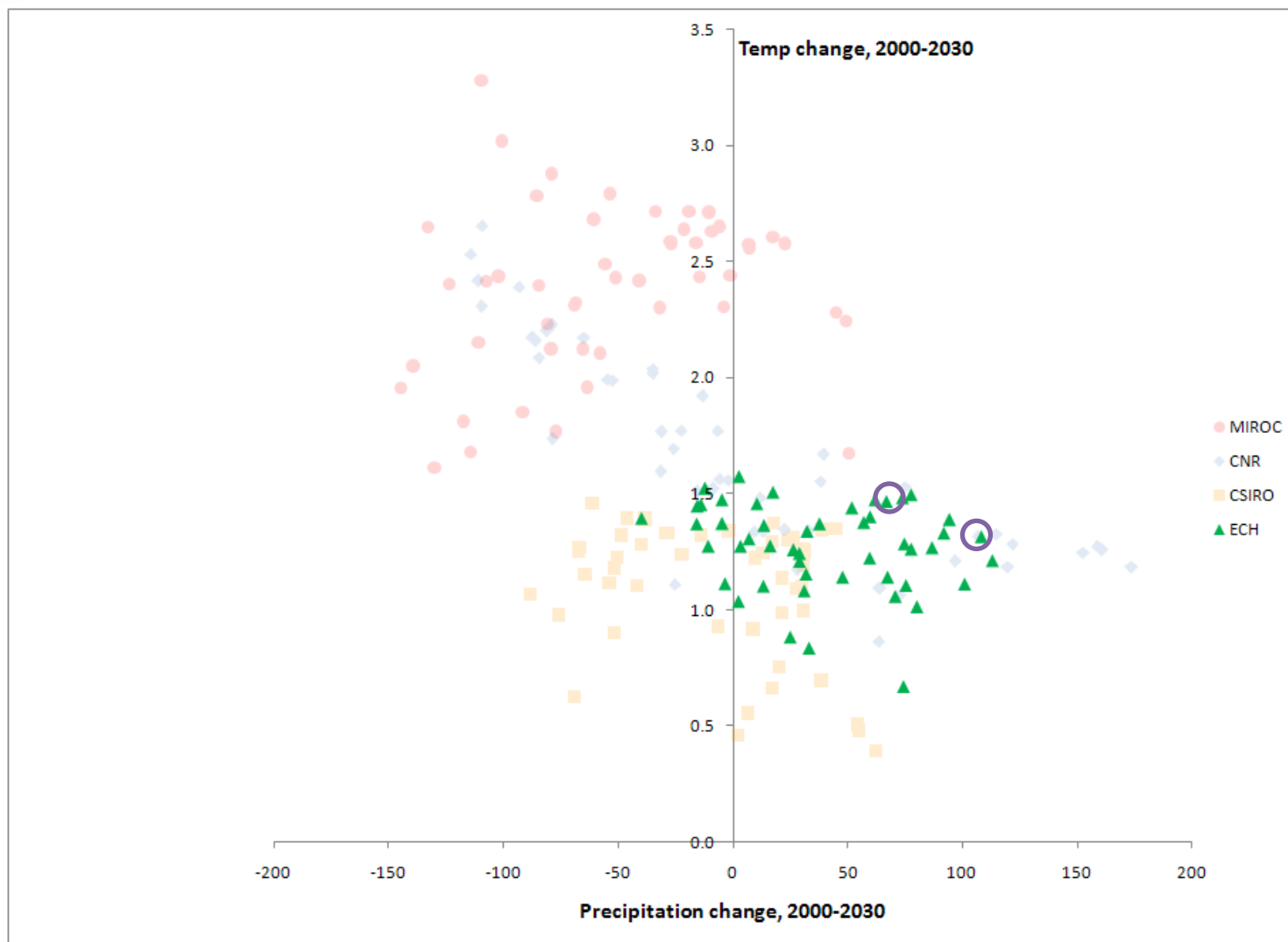


Climate change scenarios

Model Name	Label	Institution	Reference
CNRM-CM3	CNR	Météo-France/Centre National de Recherches Météorologiques, France	Déqué et al. (1994)
CSIRO-Mk3.0	CSIRO	Commonwealth Scientific and Industrial Research Organisation (CSIRO) Atmospheric Research, Australia	Gordon et al (2002)
ECHam5	ECH	Max Planck Institute for Meteorology, Germany	Roeckner et al (2003)
MIROC3.2	MIROC	Center for Climate System Research (University of Tokyo), National Institute for Environmental Studies, and Frontier Research Center for Global Change (JAMSTEC), Japan	K-1 Developers (2004)

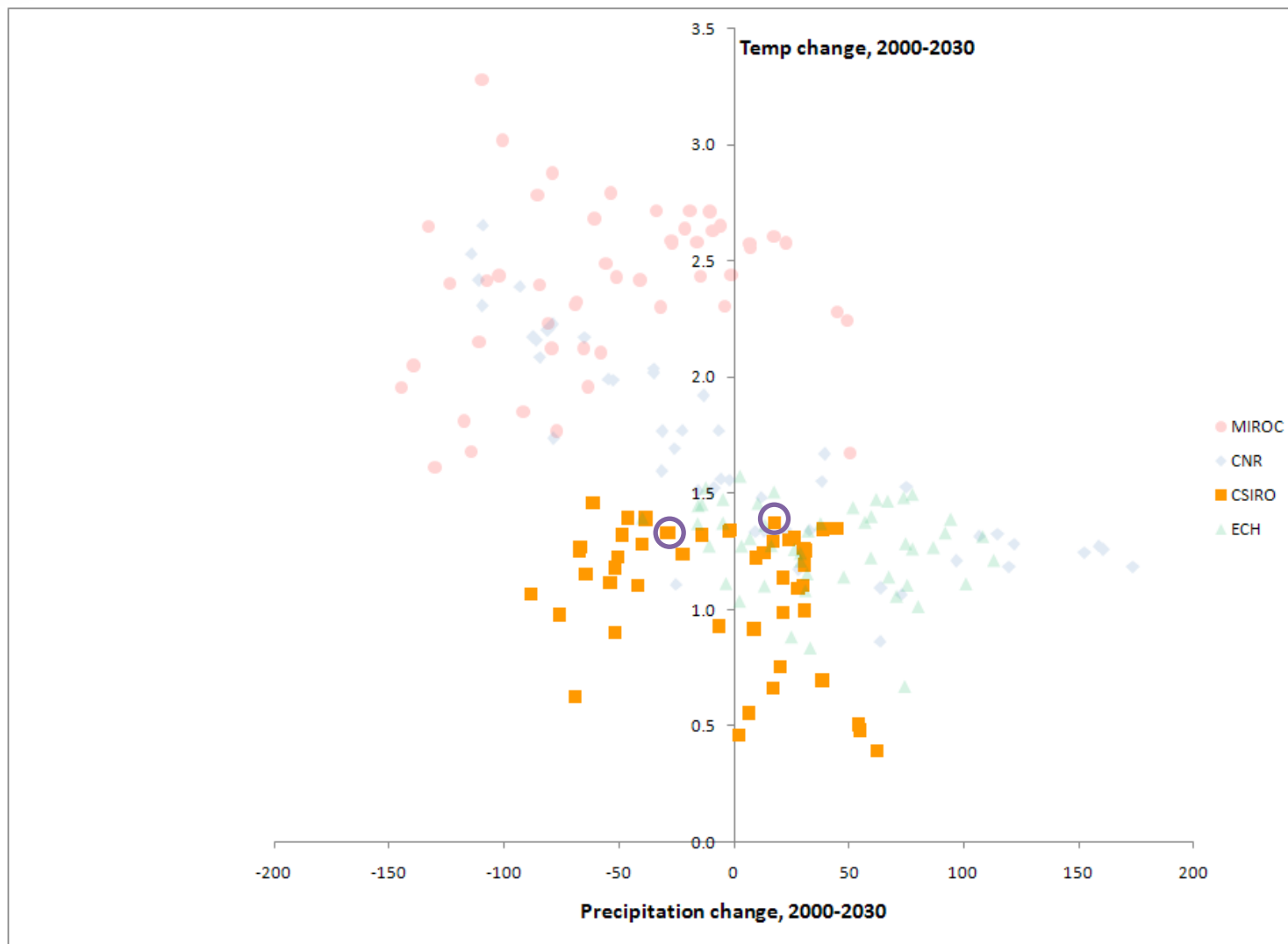
- These scenarios are not exhaustive of the range of potential climate change in the US
- Coarse data were downscaled with points representing non-agricultural land removed
- The scenarios have differing temperature and precipitation shift characteristics

Scenario regional weather changes



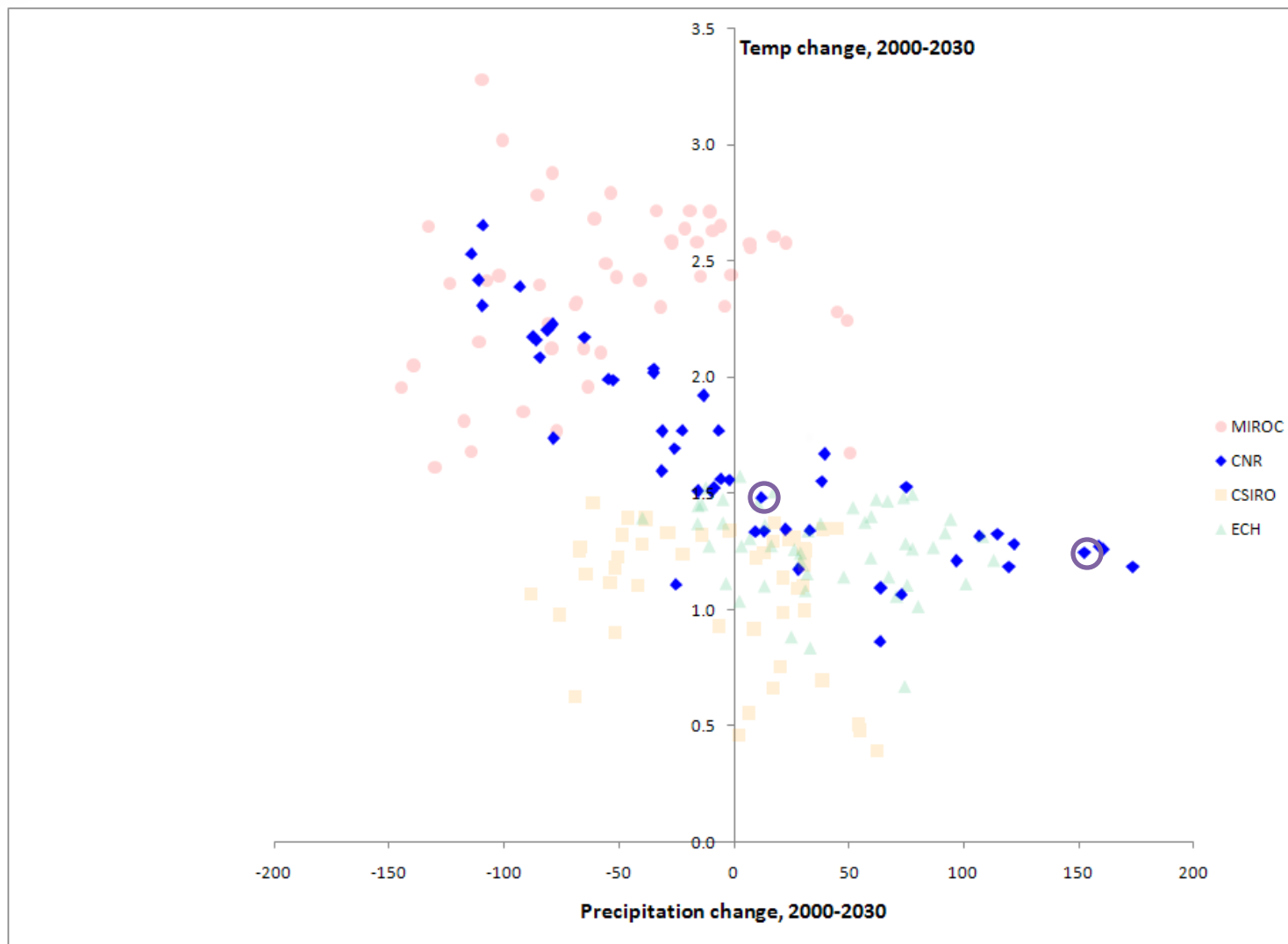
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Scenario regional weather changes



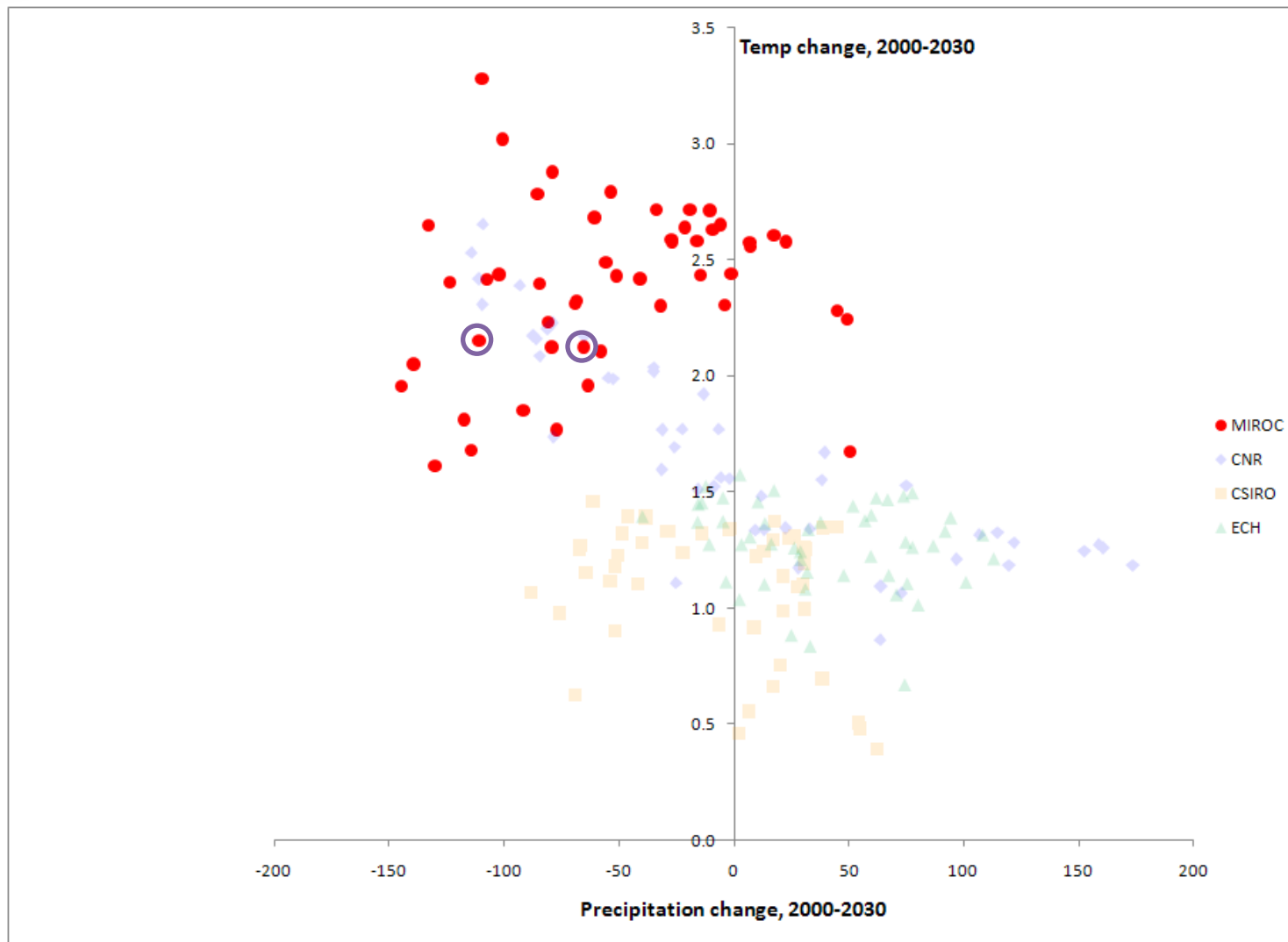
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National changes

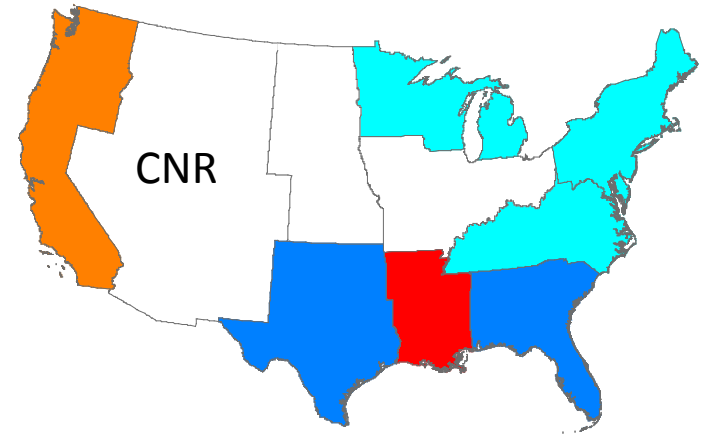
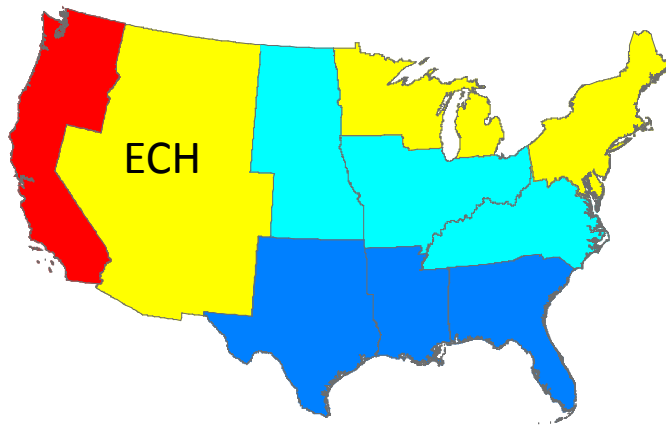
Acreage

Crop	ECH	CSIRO	CNR	MIROC	
<i>Percent change</i>					
Total		0.6	0.6	0.2	1.0
Corn		1.7	2.8	3.0	4.2
Wheat		-1.1	-0.2	1.0	0.8
Soybeans		1.4	1.0	-2.8	-1.8
Other		-0.1	-1.5	-0.2	0.5

Price

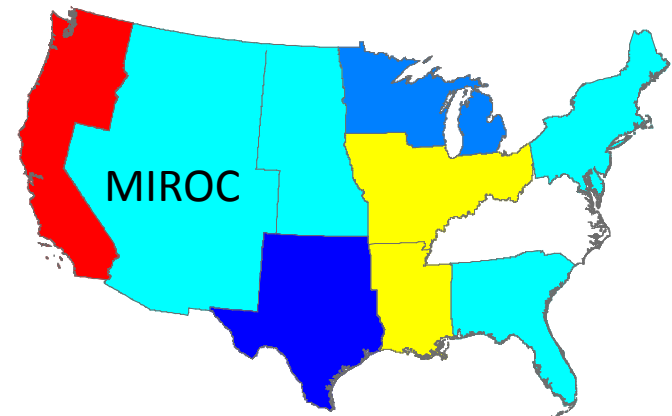
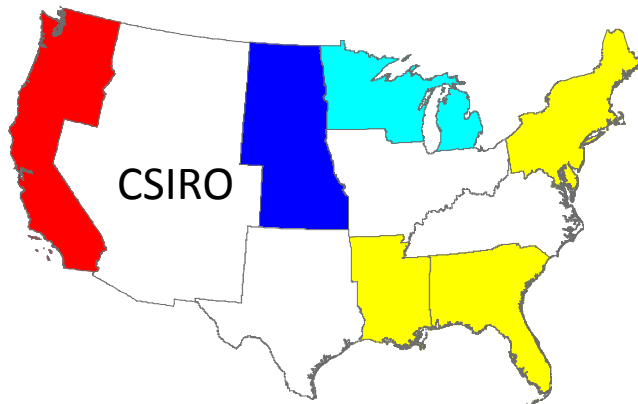
Crop	ECH	CSIRO	CNR	MIROC	
<i>Percent change</i>					
Corn		-2.2	-2.1	3.7	6.1
Wheat		-1.5	-5.9	-0.8	-1.0
Soybeans		-3.5	0.3	7.6	22.1

Total acreage change with adaptation

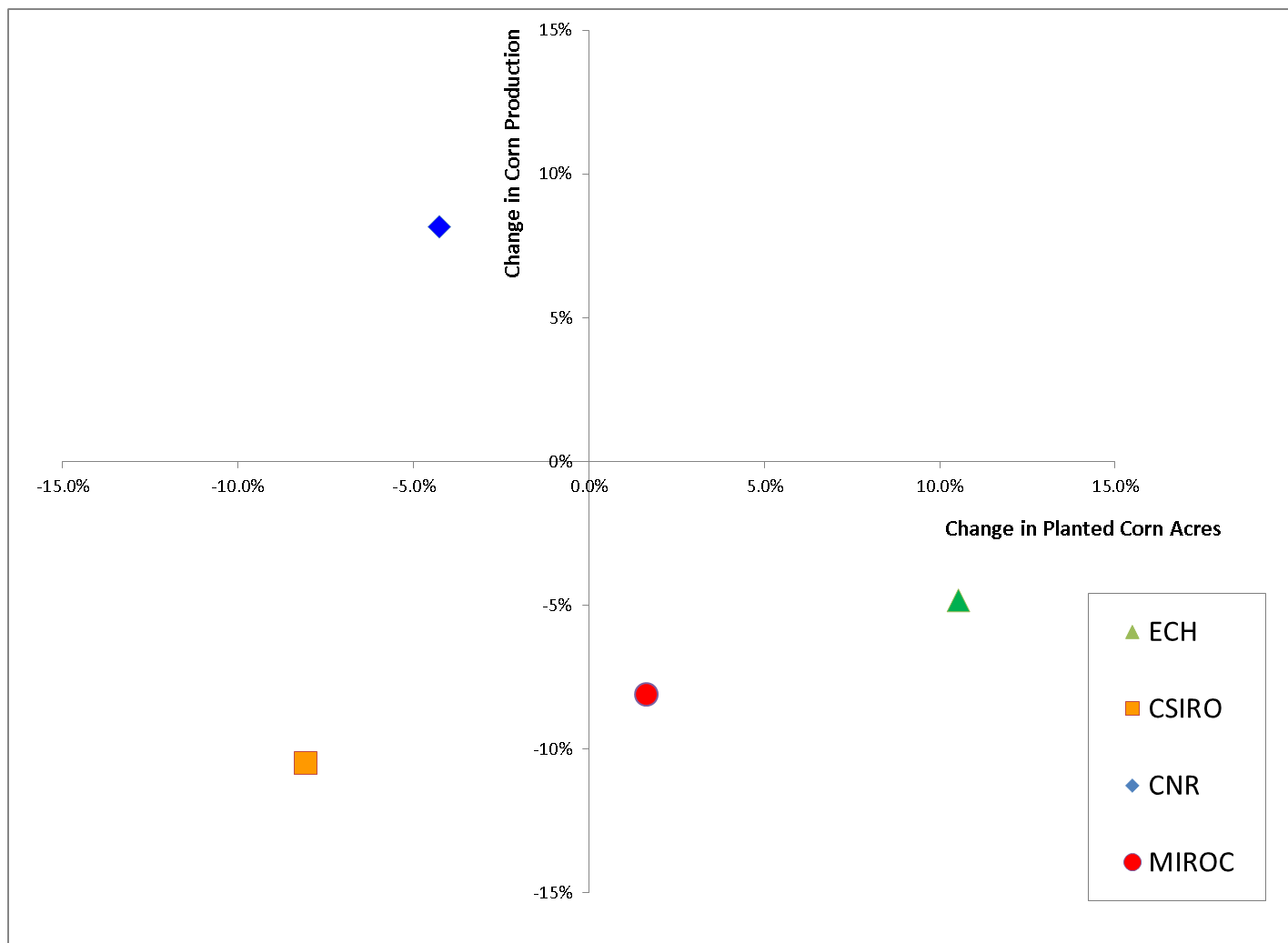


Blues: Adaptation leads to increased acreage

Reds (& yellows & orange): Adaptation leads to reduced acreage

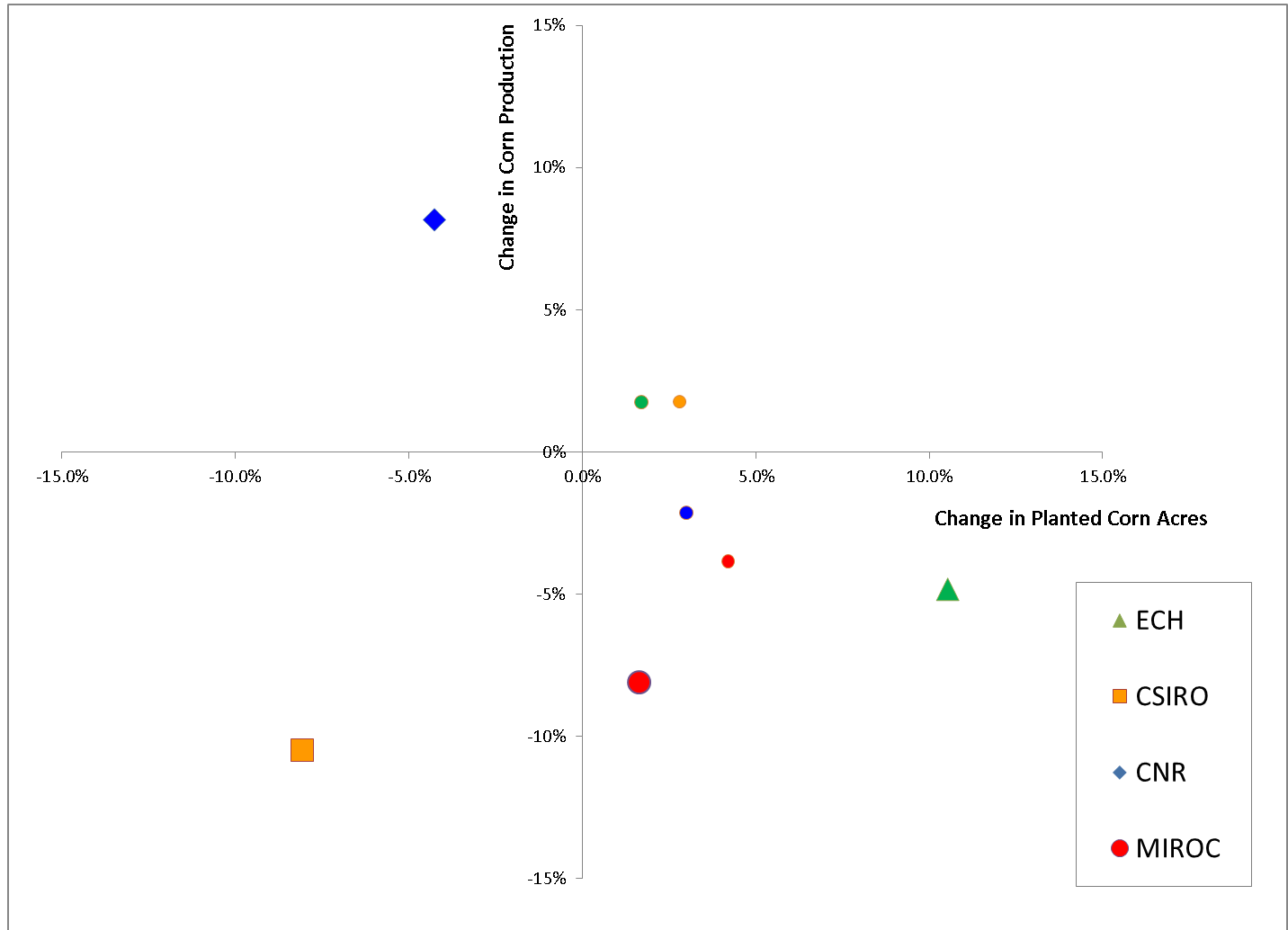


Changes in Chesapeake Region Corn



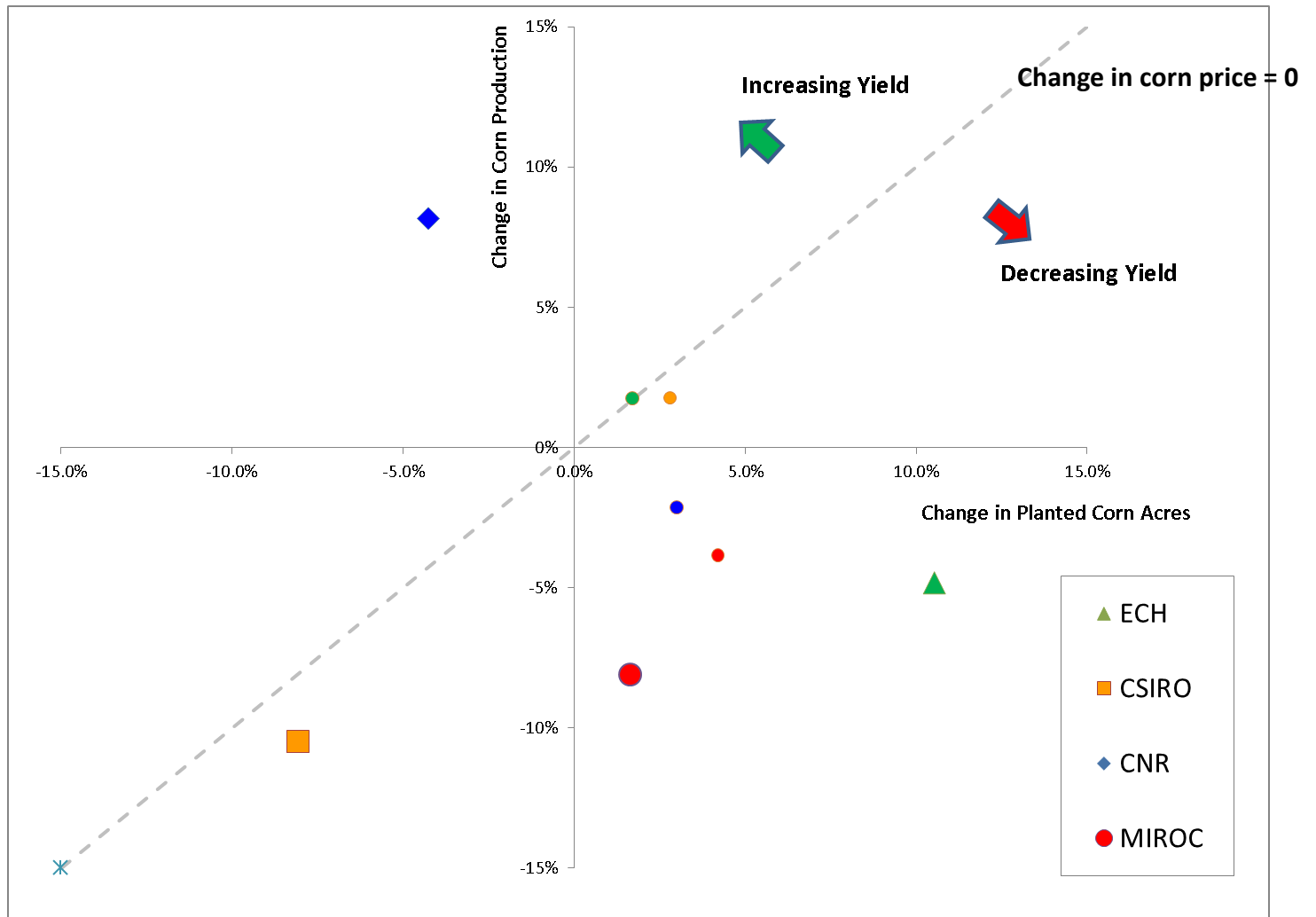
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Compared to National Changes



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Effect on Returns (corn production only)

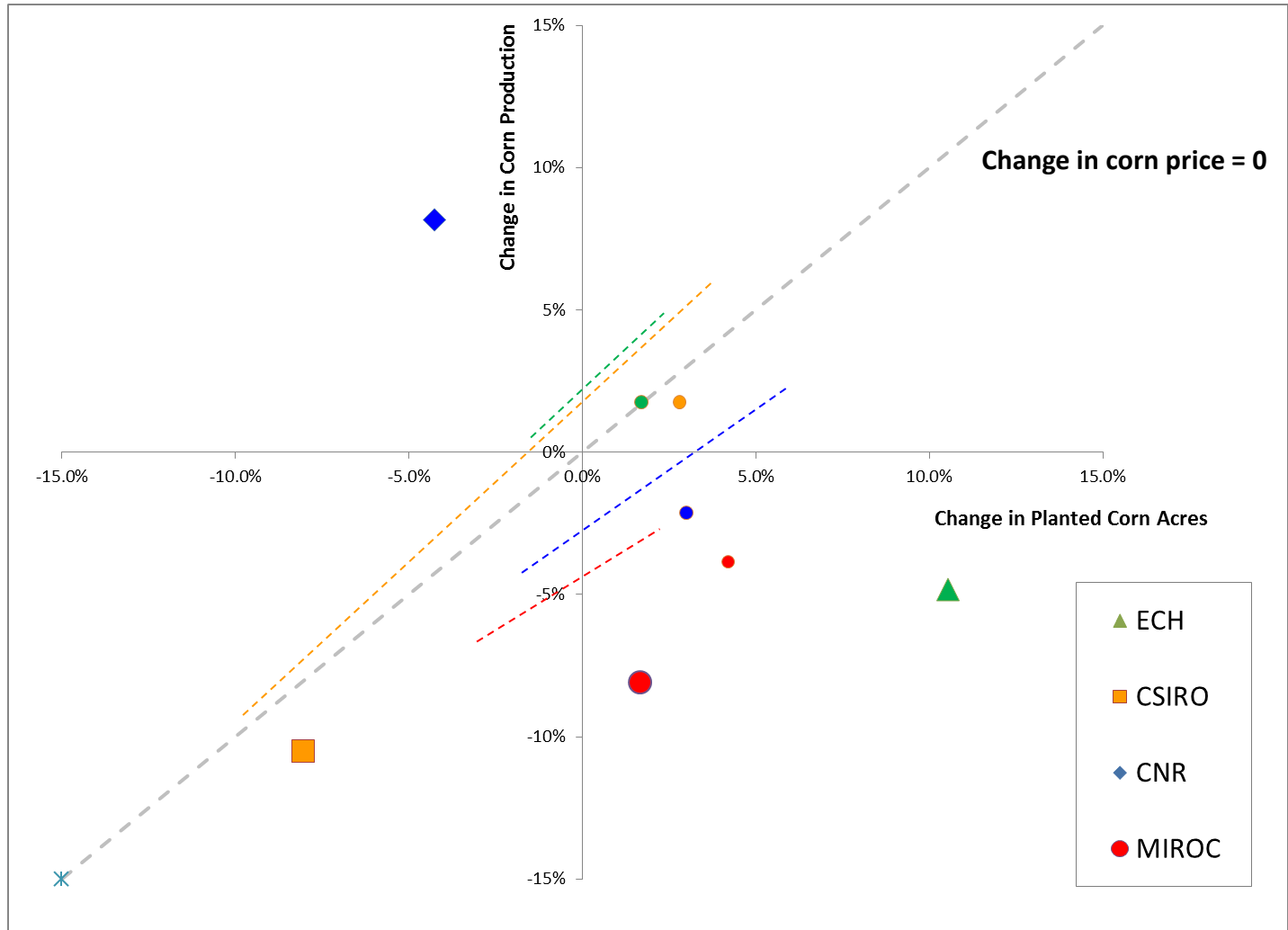


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Regional vs. National Returns

Change in corn price

ECH	1.8%
CSIRO	1.8%
CNR	-2.1%
MIROC	-3.8%



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Environmental Consequences

Nitrogen
deposited
to water

	ECH	CSIRO	CNR	MIROC
	<i>Percent change</i>			
Chesapeake Bay Region	-0.6	-4.4	5.2	-8.4
US	1.4	1.5	2.1	5.0

Soil erosion

	ECH	CSIRO	CNR	MIROC
	<i>Percent change</i>			
Chesapeake Bay Region	-3.8	-9.0	1.4	-17.3
US	0.3	2.2	4.3	7.7



Conclusions

- Adaptation does not uniformly benefit producers, but consumers generally benefit
 - Impacts on producers vary by region and on the extent of climate change
 - Changes to crop mix influence environmental outcomes, in addition to changes in planted acreage
- In general, climate change impacts in the region are relatively greater than national impacts, but neither consistently worse or better.
- Negative consequences of climate change may be alleviated by factors not considered in the model
 - Alternative land uses
 - New crops and/or varieties
 - Site-tailored management practices