**Agriculture, Climate Change and Climate Change Mitigation** 

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Mitigation

**Effects** 

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#### **Climate Change has in part a human cause**







Source http://ssca.usask.ca/2002conference/Bennett.htm

Source : U.S. National Assessment/.

## Climate Change is projected to go on

Virtually all climate models predict increasing emissions will cause a temperature increase



year



#### **Climate Change is projected to go on**

#### **Temperature Change**

How to read these maps: The color scale indicates changes in temperature in ...F over a 100 year period. For example, at 0...F there is no change; at +10...F there is a 10...F increase from the begining to the end of the century.

**Observed 20th Century** 



The change in the annual average temperature over the 20th century has a distinctive pattern. Most of the US has warmed, in some areas by as much as 48F. Only portions of the southeastern US have experienced cooling, and this was primarily due to the cool decades of the 1960s and 1970s. Temperatures since then have reached some of the highest levels of the century.



#### **Precipitation Change**



Significant increases in procipitation have occurred across much of the US in the 20th century. Some localized areas have experienced decreased precipitation. The Hadley and Canadian model scenarios for the 21st century project substantial increases in precipitation in California and Nevada, accelerating the observed 20th century trend (some other models do not simulate these increases). For the eastern two-thirds of the nation. the Hadley model projects continued increases in precipitation in most areas. In contrast, the Canadian model projects decreases in precipitation in these areas, except for the Great Lakes and Northern Plains, with decreases exceeding 20% in a region centered on the Oklahoma panhandle. Trends are calculated relative to the 1961-99 average.

#### **Canadian Model 21st Century**





#### Summer Soil Moisture Change (Relative to the 1961-90 Average)





Soil moisture has tended to increase in the central US with decreases in some localized areas. In the Northeast and in the western third of the country, there has been less change in soil moisture, despite the increase in precipitation, due to compensating temperature increases.

The Hadley and Canadian models project strong increases in soil moisture in the Southwest. For the rest of the nation, the Hadley model projects mostly increases while the Canadian model projects mostly decreases, with large decreases in the Central Plains. The contrasts between the two models result from the combination of greater precipitation in the Hadley model and higher air temperatures in the Canadian model.







### **Climate Change can be disruptive**





## **Agricultural Effects to Consider**

Temp	Rainfall	C02	SeaLevel	Extreme Events
Х	x	Х		x
Х	x	Х		x
X	x			x
Х	х	х		x
Х	x	Х		
X	x			x
X	x	х		x
Х	х			x
x	x			x
Х	x	Х		
	x		x	x
	x		x	x
х	x			
X	x			x
	Temp X X X X X X X X X X X X X X X X X X X	Temp Rainfall X X X X X X X X X X X X X X X X X X X	TempRainfallCO2XXX	Temp Rainfall CO2 SeaLevelXX

## Methodology – Climate Change Assessment

Climate Scenarios – GCMs

Crop Simulation – regional crop yields (dry and irrigated) regional irrigated crop water use

Hydrologic simulation – irrigation water supply,

Expert opinion – livestock performance,

Range and hay simulation and calculation -livestock pasture usage, animal unit month grazing supply

Other studies – international supply and demand

**Regression** –

pesticide usage

**Economics** –

**ASM sector model** 



# **Percentage Changes in Crop Yield**



	Can	Canadian		dley
	2030	2090	2030	2090
Cotton Dry	+10%	+104%	+34%	+79%
Cotton Irr	+45%	+113%	+34%	+79%
Corn Dry	+19%	+ 23%	+17%	+34%
Corn Irr	- 1%	- 2%	+ 0%	+ 7%
Soybean Dry	+16%	+ 21%	+26%	+60%
Soybean Irr	+16%	+ 27%	+17%	+34%
Wheat Dry	-16%	+104%	+21%	+55%
Wheat Irr	- 4%	- 6%	+ 5%	+13%
Tomato Irr	-10%	- 22%	- 4%	- 9%
Oranges Irr	+32%	+ 99%	+40%	+69%
Hay Dry	-10%	- 1%	+ 2%	+15%
Hay Irr	+ 3%	+ 2%	+23%	+24%

## **2030 Regional Effects – Cropped Acreage**

	Canadian	Hadley
Northeast	+ 3	+ 4
Lakestates	+63	+43
Cornbelt	+16	+14
Northplains	- 2	+18
Applachia	-24	-25
Southeast	-60	-15
Delta	- б	+25
South Plains	-24	- 7
Mountain	+30	+39
Pacific	+26	+47



### **Climate Change Effects In Texas Regions**

Gainers East Texas Central Blacklands Rolling Plains South Texas Losers High Plains Edwards Plateau Coastal Bend TransPecos





## **Some Findings - Climate Change Assessment**

Climate change will not cause a food production disaster. Climatic alteration less than current range of temperatures

Regions can experience large changes in productive capacity and significant economic hardship.

Income reacts in opposite ways for consumers and producers. Less produced consumers' pay more, producers make more.

Producers can adapt crop mixes and practices



Effects are sensitive to CO2 fertilization effect.

Pests problems and yield variability may be exacerbated.

#### **Extreme Events**

Some suggest climatic change would make El Nino and La Nina increase in frequency and be stronger. From 1 year in 4 to 1 in 3

Agriculture loses - \$323 - \$414 mill under freq shift under freq and strength \$905 - \$1,008 million

Variability goes down

Losses as big as effects of climate change on the mean



# **Edwards Aquifer Region**



Water is the issue -- Less recharge, greater demand

Slightly neg welfare result in region but strong neg on the agricultural sector.

Ag water use declines while nonag water use increases. Springflow decreases. Maintaining ecology becomes more expensive.

## Do we have to passively allow climate change

#### Maybe not GHG emission control



Thompson and Turk: Earth Science and the Environment, 2/e Figure 18.16





Saunders College Publishing

## Why Might We Mitigate?

- **Greenhouse gas forcing is causing climate change**
- International agreements under UNFCCC Kyoto Protocol
- International pressures for emission reduction
- Domestic policies at national or state level
- Industry planning under uncertainty
- Need for cheap emission offsets
- Congruence of programs with other agriculturally related societal desires such as farm income support and water quality protection
- Development of another market for farm products



### Where does Ag and Forestry Come in?



http://www.cotf.edu/ete/modules/climate/GCcarbon1.html



## **Role of Agriculture & Forestry in GHG Mitigation**

- Four agricultural and forestry roles w.r.t. GHG emission reductions
  - Emission reducers
  - A carbon or GHG sequestering sink
  - Offsetting net GHG emissions
  - Operating in a mitigating world

- The first place they will look is in the energy sector where 80% of the emissions come from.
- □ They will only come to the ag and forest sector if it is cheaper or otherwise attractive.



## Ag and Forest GHG Mitigation Strategies

Strategy	<b>Basic Nature</b>	CO2	CH4	N2O
Crop Mix Alteration	Emis, Seq	X		X
Crop Fertilization Alteration	Emis, Seq	X		X
Crop Input Alteration	Emission	X		X
Crop Tillage Alteration	Emission	X		X
Grassland Conversion	Sequestration	X		
Irrigated /Dry land Mix	Emission	X		X
<b>Biofuel Production</b>	Offset	X	X	X
Paper Recycling	Offset	X	X	( )
Afforestation	Sequestration	X		
Existing timberland	Sequestration	X		
Deforestation	Emission	X		≥ <b>0-0</b>
Enteric fermentation	Emission		X	
Livestock Herd Size	Emission		X	X
Livestock System Change	Emission		X	X
Manure Management	Emission		X	X
Rice Acreage	Emission	X	X	X





But US & US Agriculture is Vulnerable And We will be squeezed

#### **Basic Resources**

Intergovernmental Panel on Climate Change. <u>IPCC Third Assessment Report - Climate Change 2001:</u> <u>Impacts, Adaptation and Vulnerability</u>, <u>http://www.ipcc.ch/</u>.

Intergovernmental Panel on Climate Change. <u>IPCC Third Assessment Report - Climate Change 2001:</u> <u>Mitigation</u>, <u>http://www.ipcc.ch/</u>.

Intergovernmental Panel on Climate Change. <u>IPCC Third Assessment Report - The Scientific Basis</u>, <u>http://www.ipcc.ch/</u>.

Intergovernmental Panel on Climate Change. <u>IPCC Third Assessment Report – Synthesis Report</u>, <u>http://www.ipcc.ch/</u>.

National Assessment Synthesis Team, US Global Change Research Program , Climate Change Impacts on the United States: *The Potential Consequences of Climate Variability and Change Overview*: 2000 http://www.usgcrp.gov/usgcrp/Library/nationalassessment/overview.htm

National Assessment Synthesis Team, US Global Change Research Program , Climate Change Impacts on the United States:*The Potential Consequences of Climate Variability and Change* Foundation: 2000 <u>http://www.usgcrp.gov/usgcrp/Library/nationalassessment/foundation.htm</u>

http://agecon.tamu.edu/faculty/mccarl/papers.htm