

Climate Change and Agriculture in North Carolina

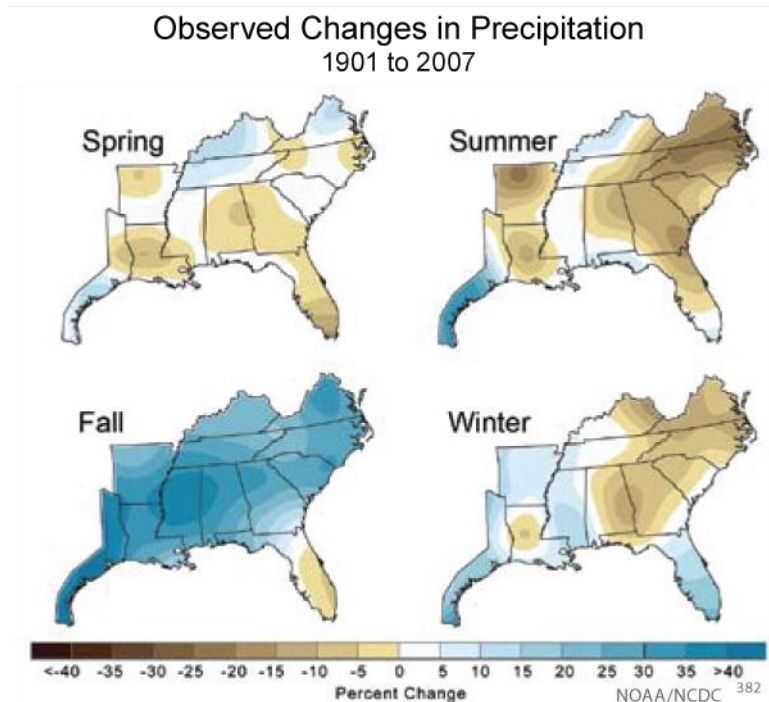
EXTENSION ANNUAL CONFERENCE
OCTOBER 30, 2019

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Dept. of Ag and Resource Economics
NC State University

Outline

- NC climate: past and future
- Climate change and NC crop yields
- Water adaptation in agriculture
- Effects on agricultural land values (if time)

Climate Change, Past and Present



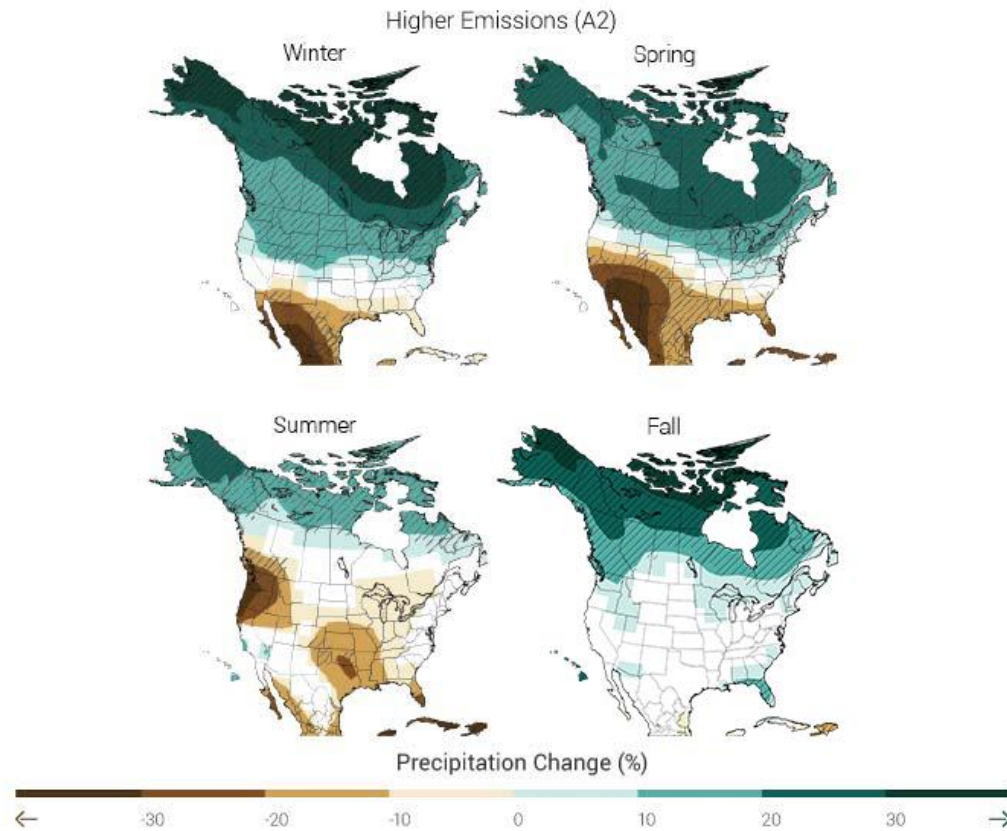
- Large climate shifts since 1900
- Precipitation in Southeast has increased by about 30%
- Parts of NC, however, have seen 30% decreases in summertime precipitation

Climate and Agriculture

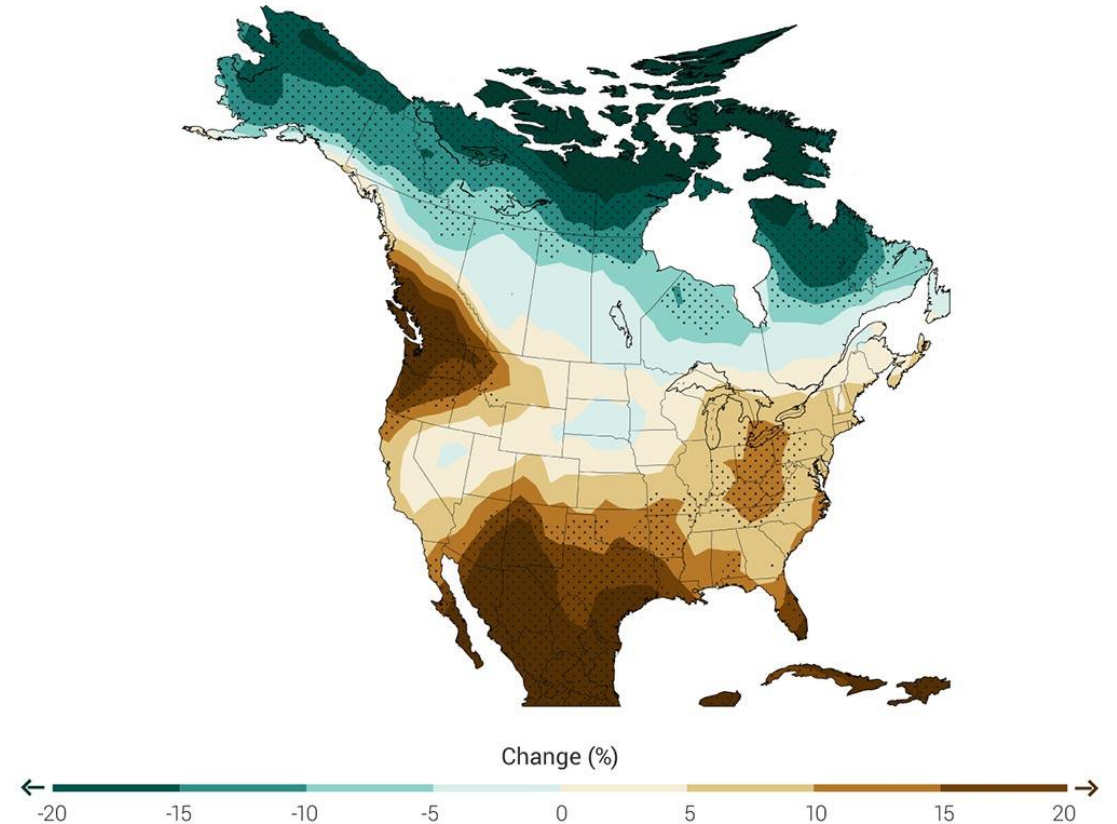
- Plant response to climate is affected by:
 - Carbon dioxide (CO₂)
 - Temperature
 - Solar radiation
 - Precipitation
- Timing of changes is important
 - Temperature during pollination stage

Climate Change Projections

Projected Precipitation Change by Season

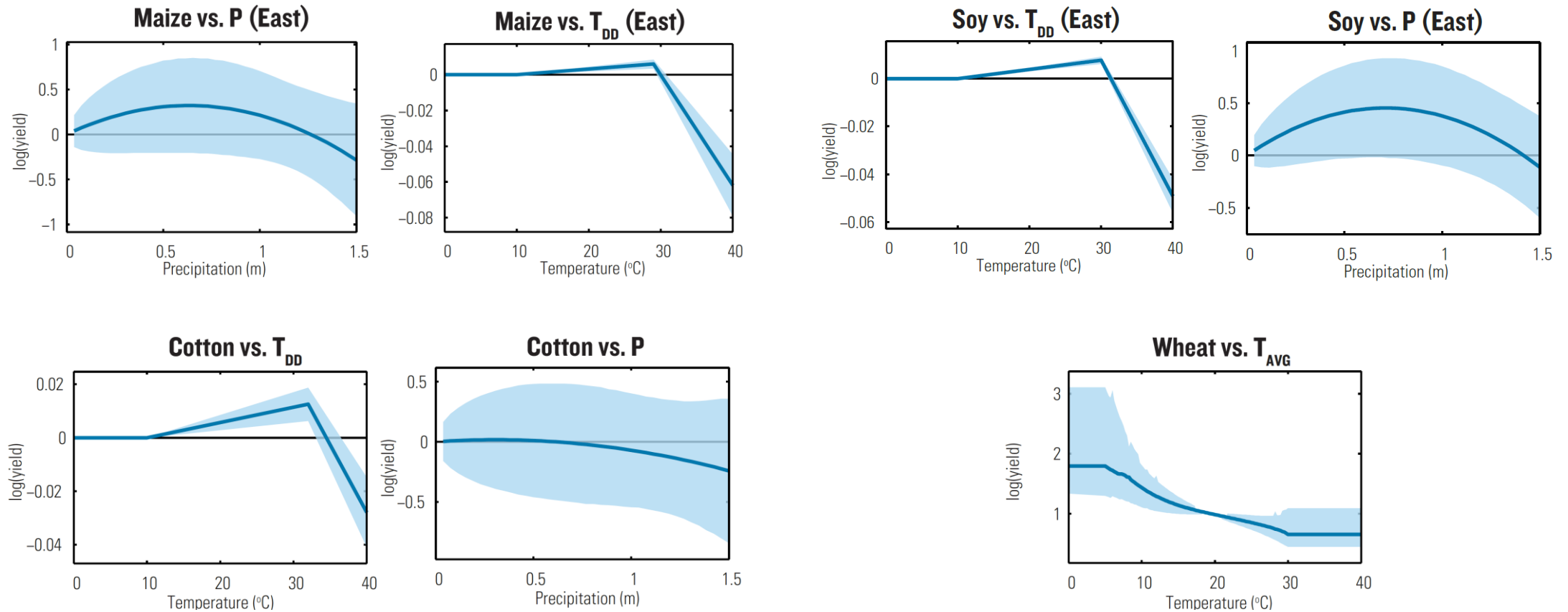


Change in Maximum Number of Consecutive Dry Days



Source: National Climate Assessment with data from NOAA NCDC / CICS-NC

Crops: Big-4 / Climate Relationship



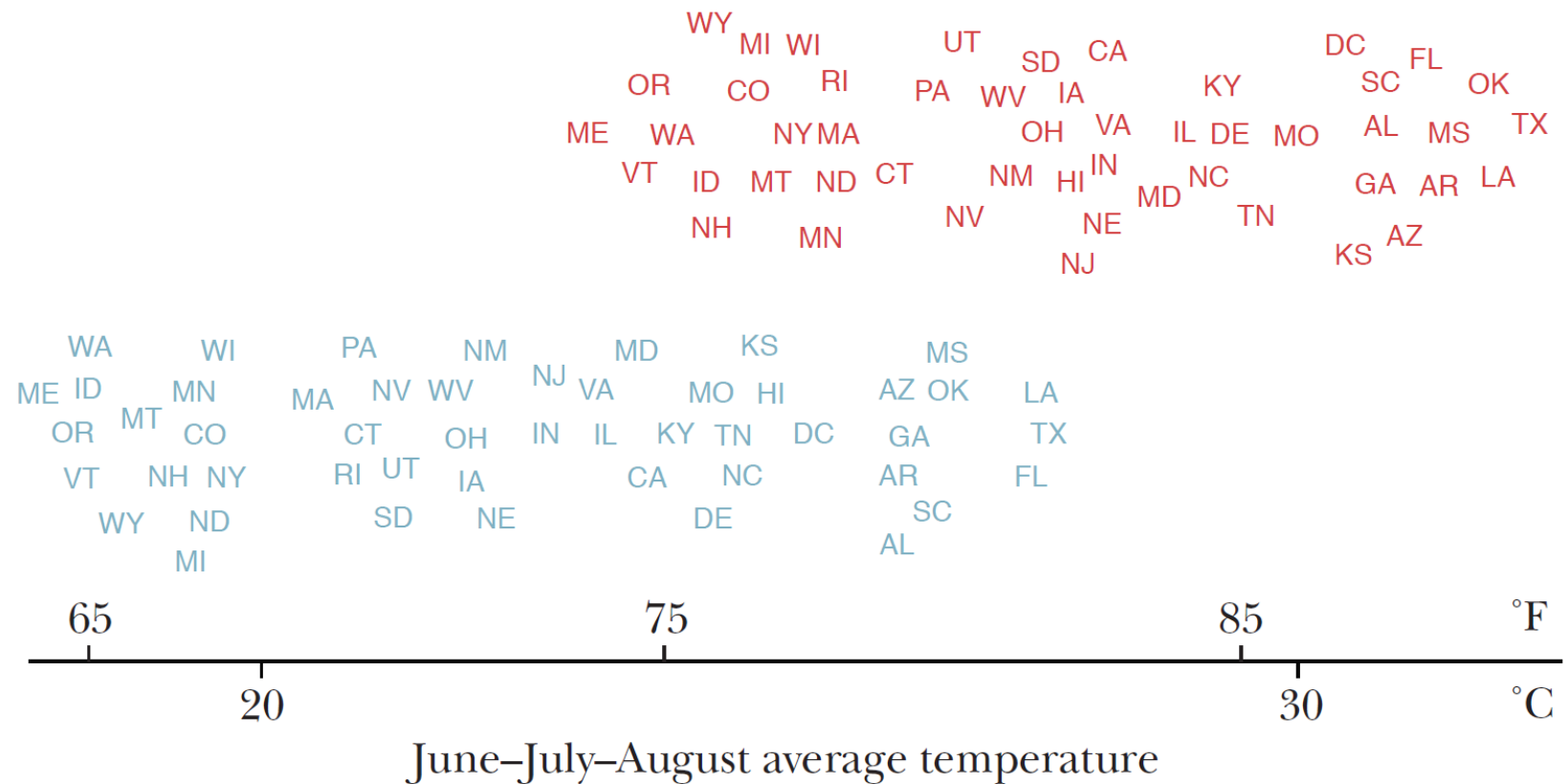
Source: Hsiang, S., Kopp, R., Jina, A., Rising, J., Delgado, M., Mohan, S., Rasmussen, D.J., Muir-Wood, R., Wilson, P., Oppenheimer, M. and Larsen, K., 2017 Estimating economic damage from climate change in the United States. *Science*, 356(6345), pp.1362-1369.

US Temperature Change Projections

A: States (USA)

2080–2099
high emission
(RCP 8.5) scenario

1981–2010
(Historical)

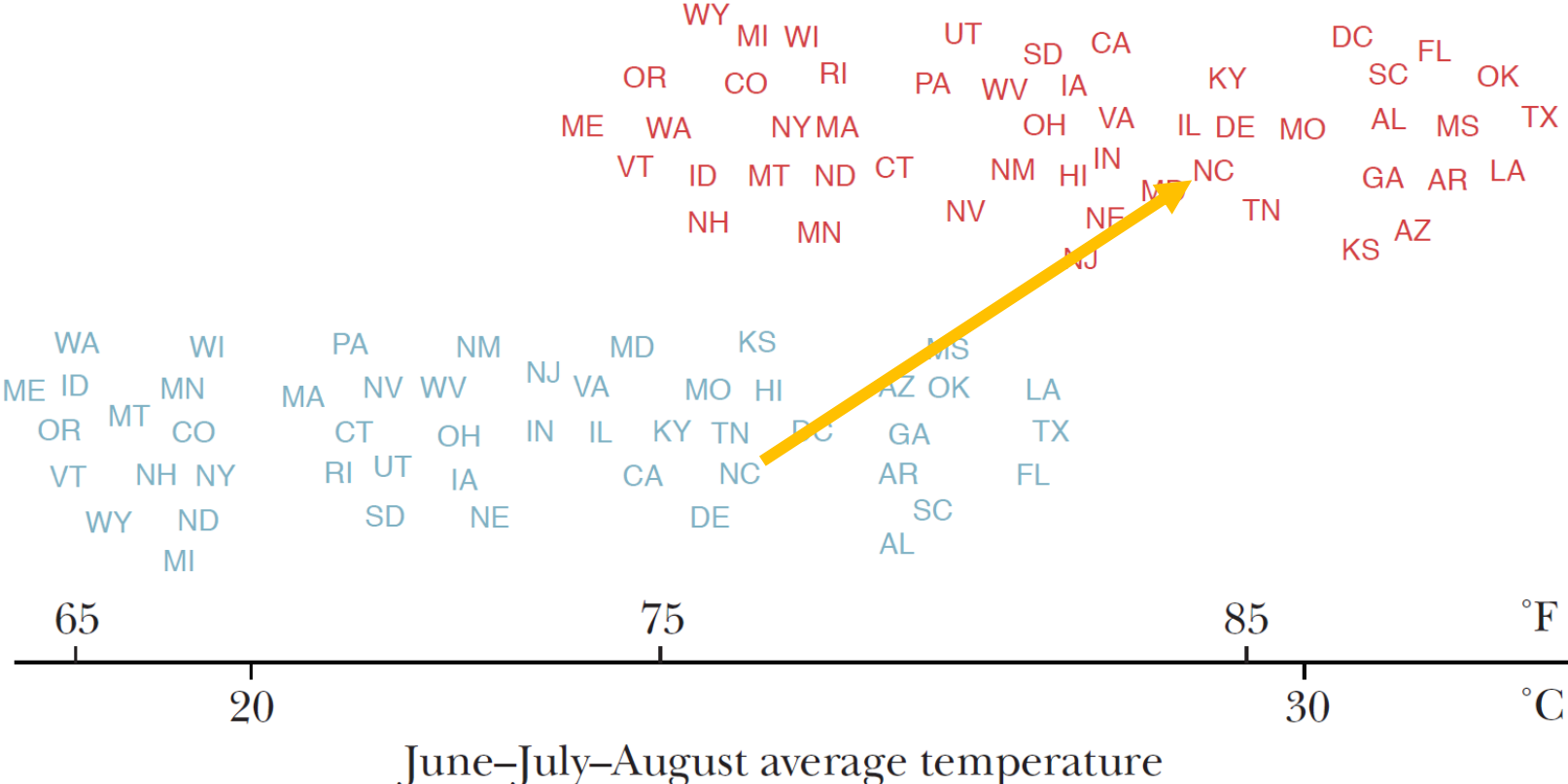


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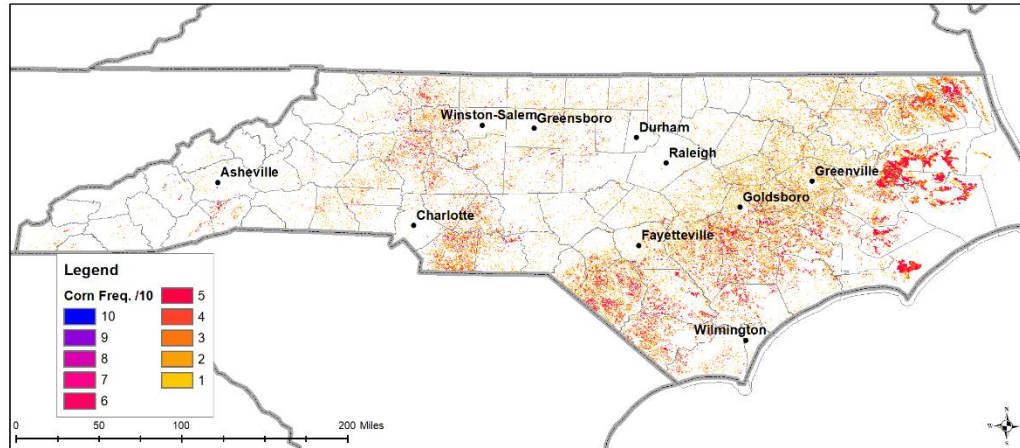
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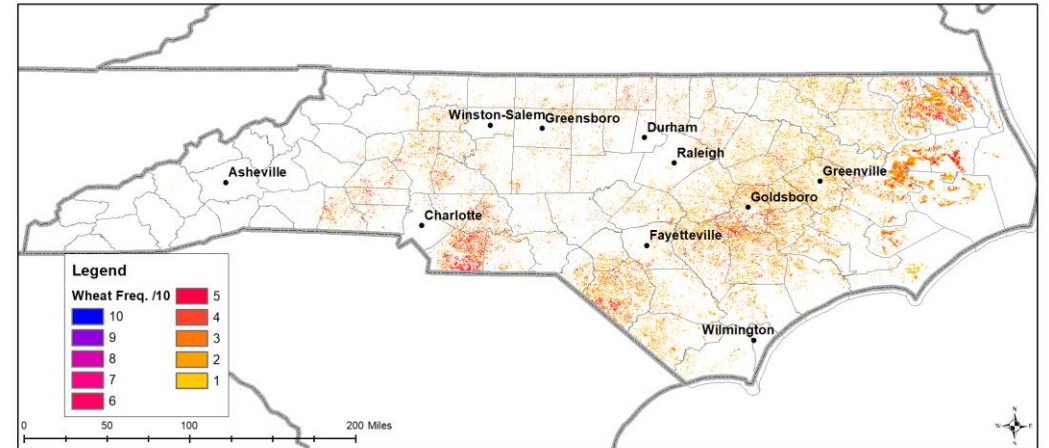
Source: Hsiang, S. and Kopp, R.E., 2018. An Economist's Guide to Climate Change Science. *Journal of Economic Perspectives*, 32(4), pp.3-32.

10-year Crop Frequencies

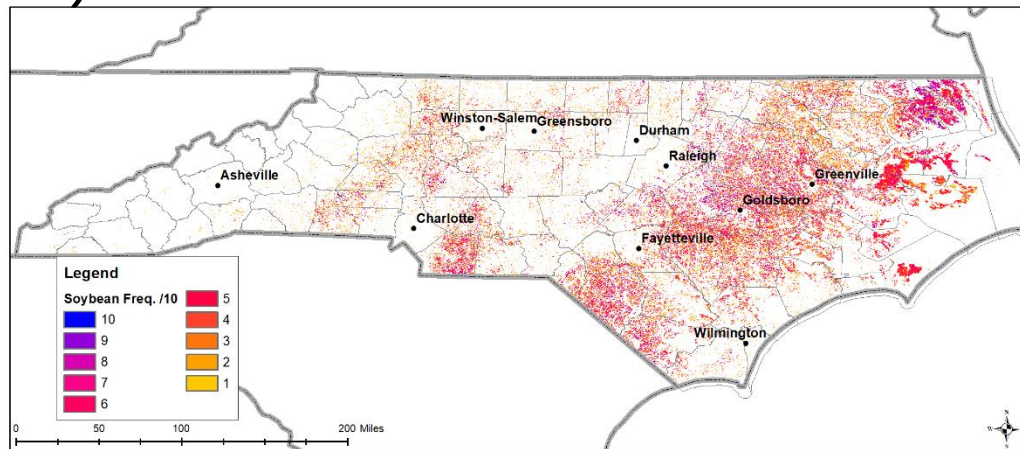
Corn



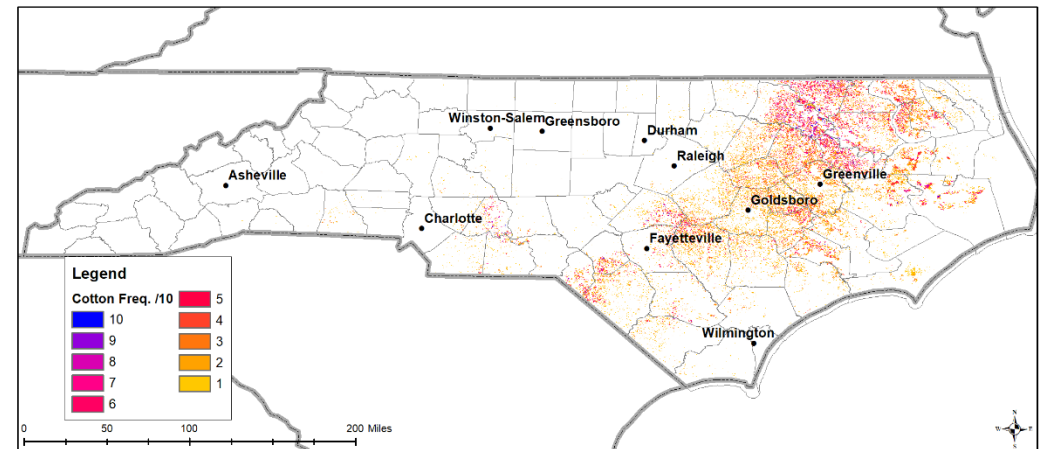
Wheat



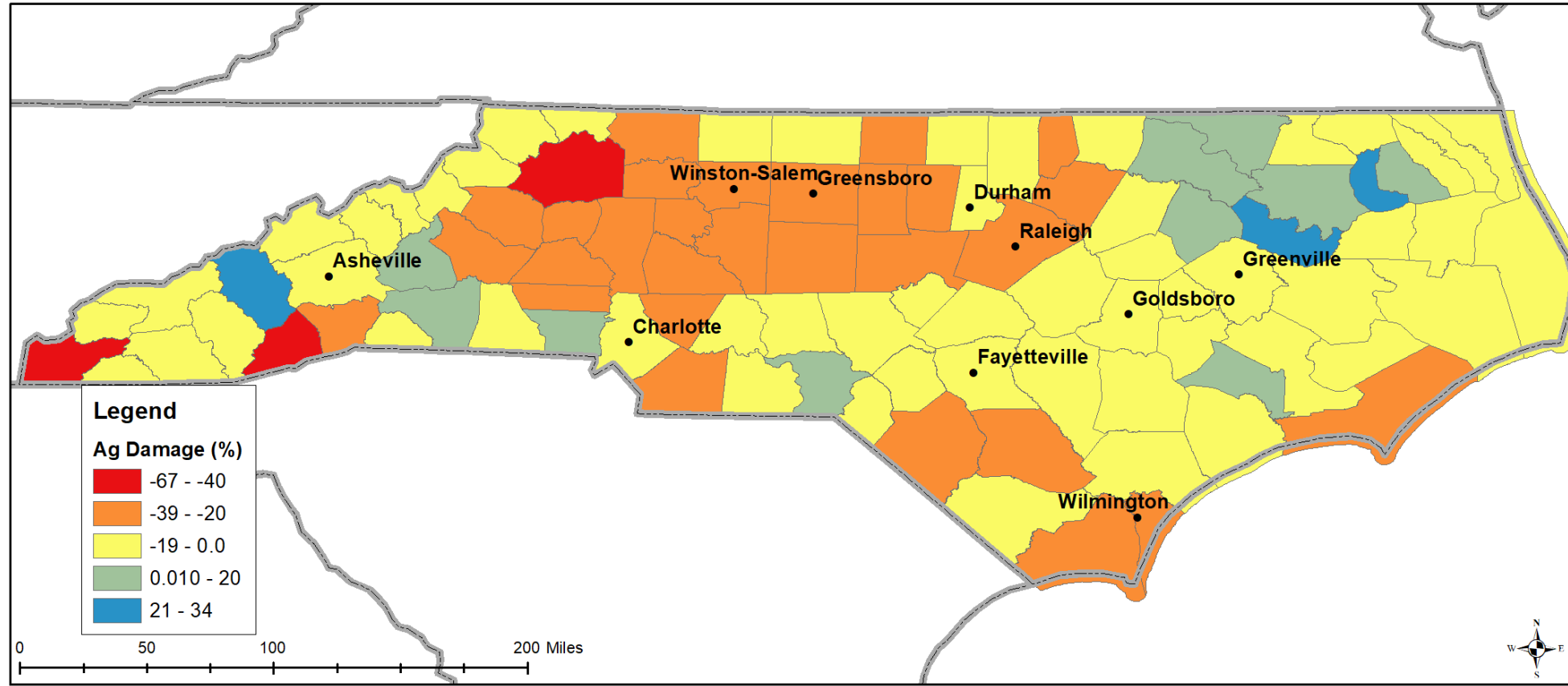
Soybeans



Cotton

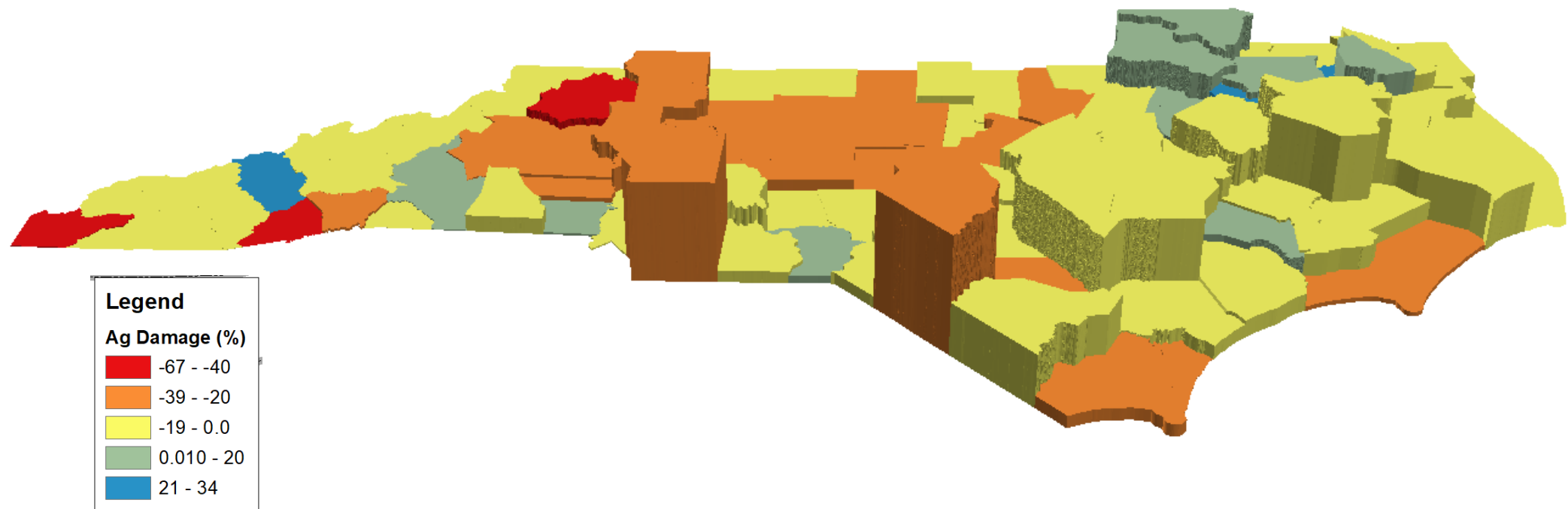


Big-4 Crop Yield Projections (2080-2099)



Data source: Hsiang et al (2017)

Damage Projections with Current Sales (Big 4)



Caveats

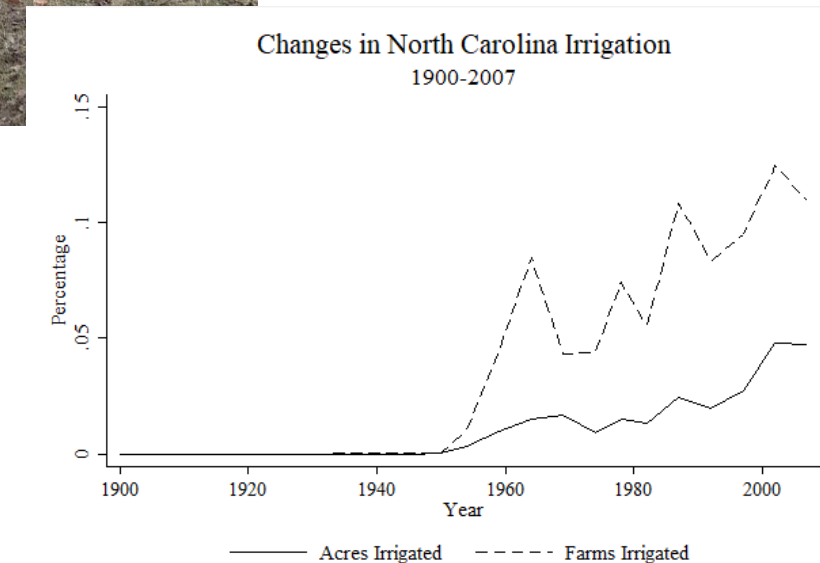
- Only Big-4 Crops
 - What about livestock?
 - What about specialty crops?
 - Sweet potatoes
 - Tree crops
 - Peanuts
- Assumes similar crop choice mix going forward
 - Change crops
 - Water management
 - Irrigation when dry, drainage when wet
 - High-precipitation events

Uncertainty: Extreme Events



Uncertainty: Water Adaptation

- Drainage
 - Current: 40 percent of the cropland requires drainage improvements
- Irrigation
 - Current about 5% of acreage and 10% of farms are irrigated



Getting the Water Off

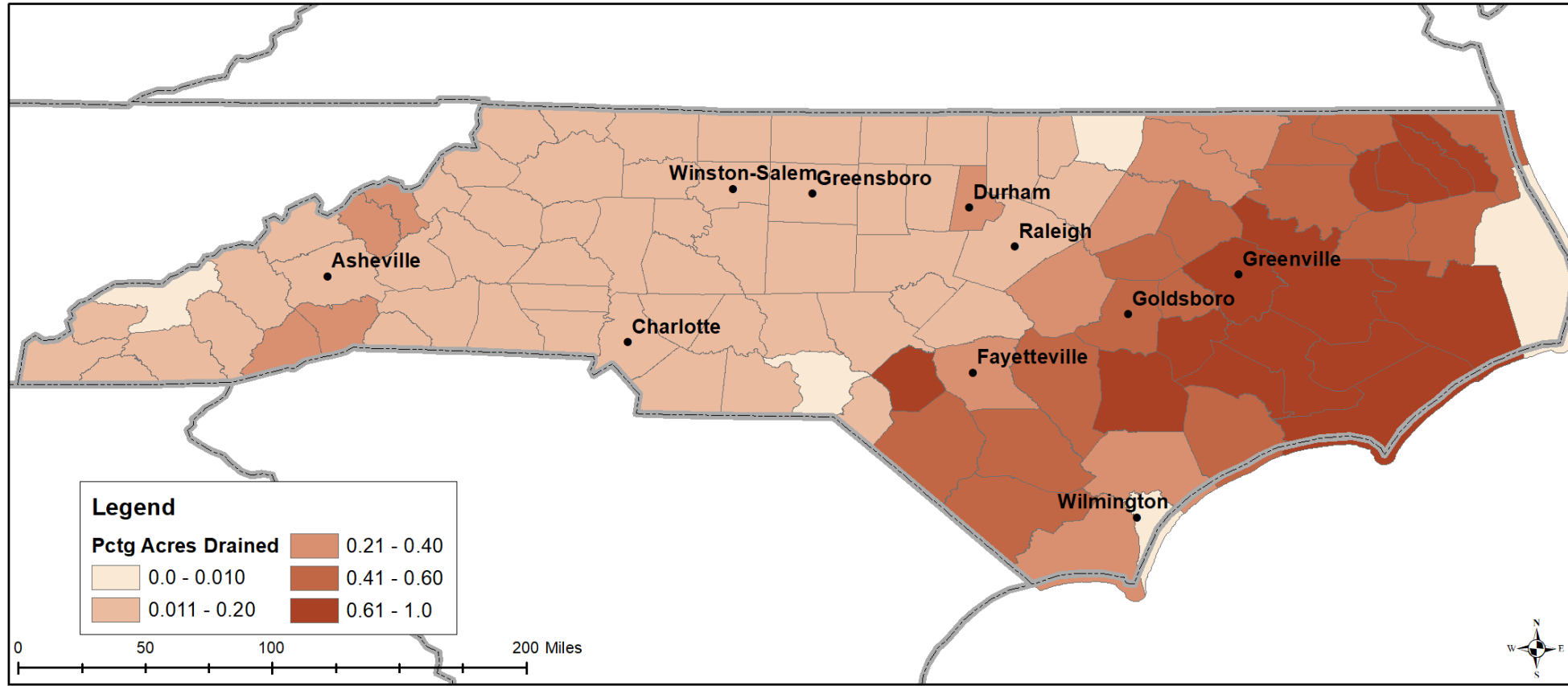
Drain Tiles



Drainage Ditches



Percentage of Crop Acres Drained



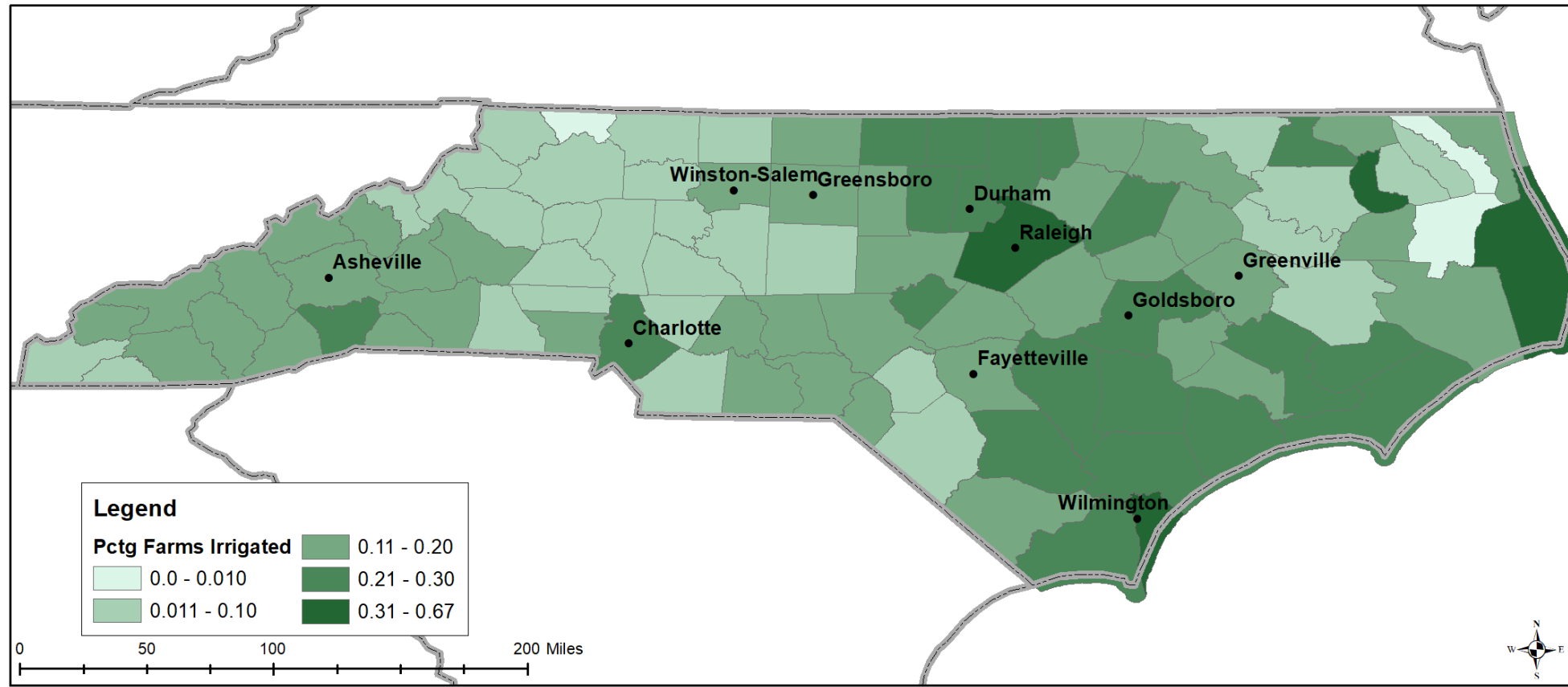
Data source: USDA Ag Census Quick Stats

Drainage Issues

- Farm drainage also drains nutrients
 - Nitrogen and phosphorous
- Drainage takes lands out of wetland habitat
 - 53% reduction from 1780 to 1992
- Smart systems
 - Avoid draining right before a drought
 - Apply fewer nutrients
 - Absorb nutrient runoff



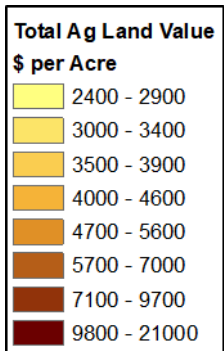
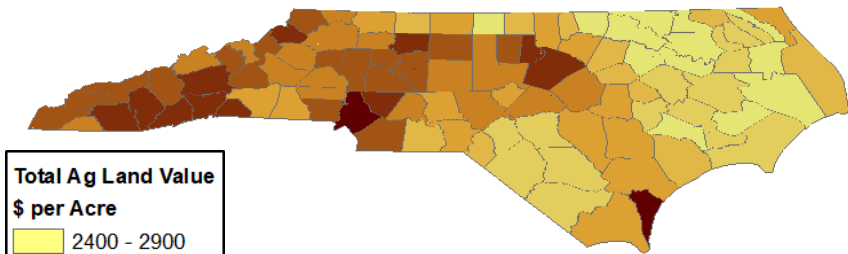
Percentage of Farms with Irrigation



Data source: USDA Ag Census Quick Stats

Climate and Land Values

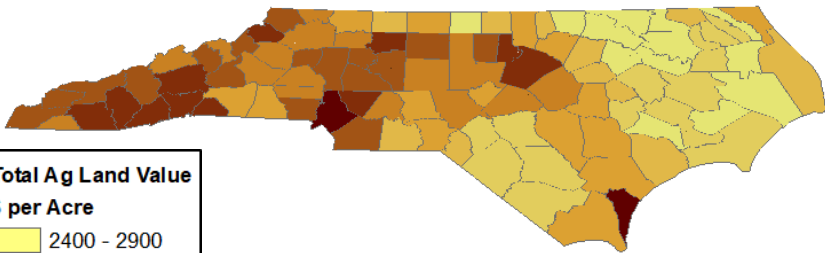
Land Value



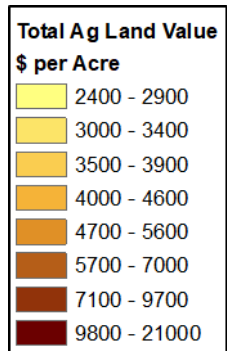
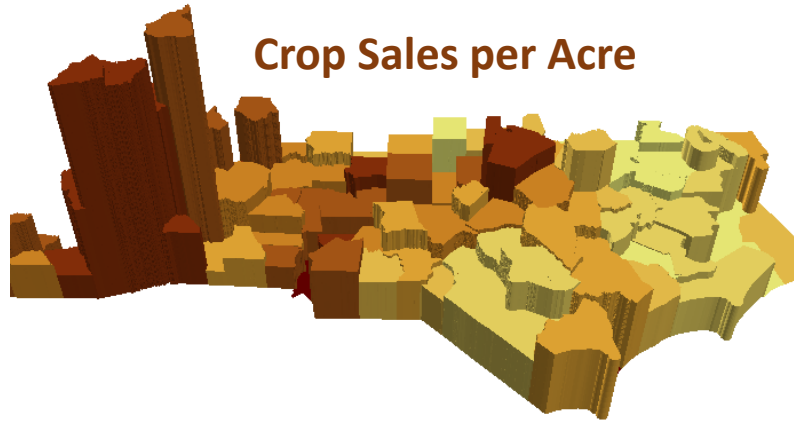
Data source: Authors drawing with USDA Ag Census Quick Stats

Climate and Land Values

Land Value



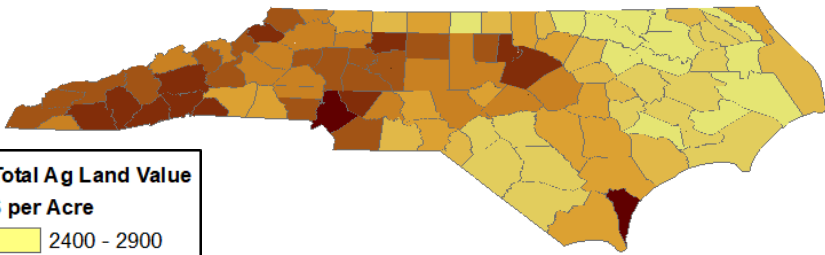
Crop Sales per Acre



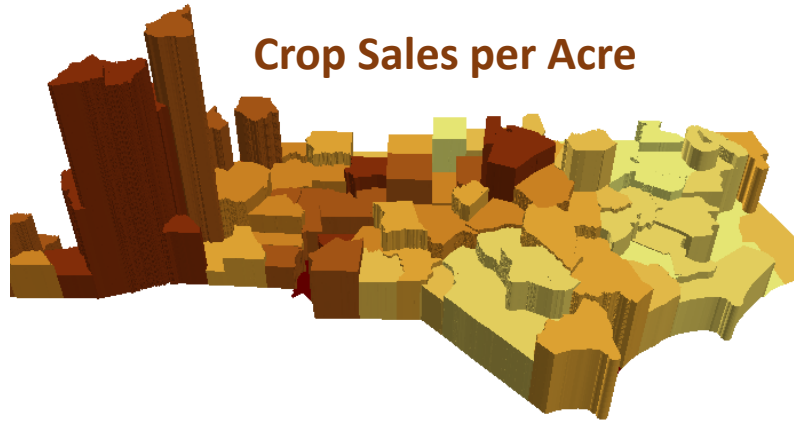
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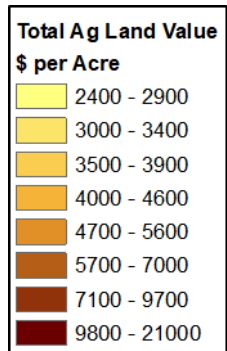
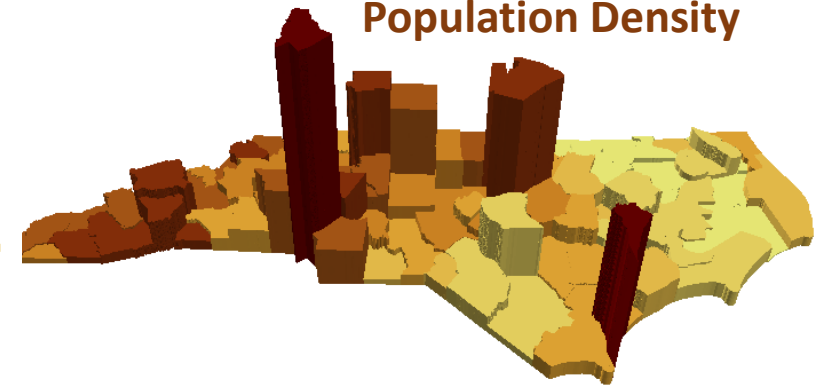
Land Value



Crop Sales per Acre



Population Density



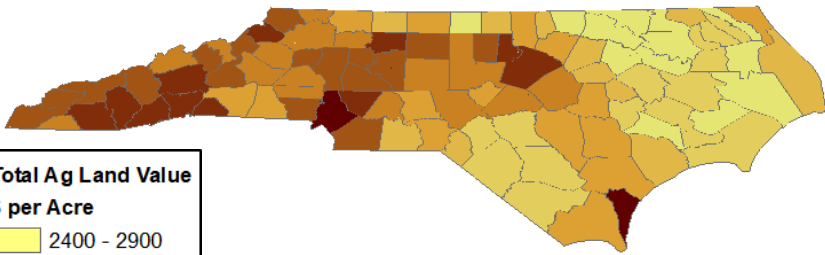
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Climate and Land Values

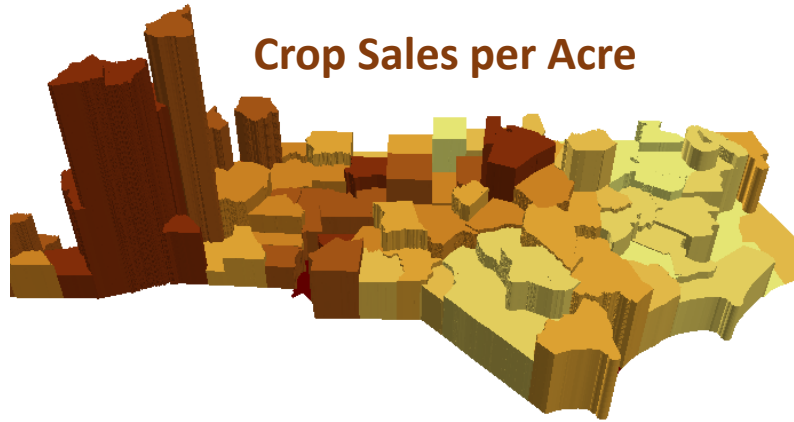
Value =



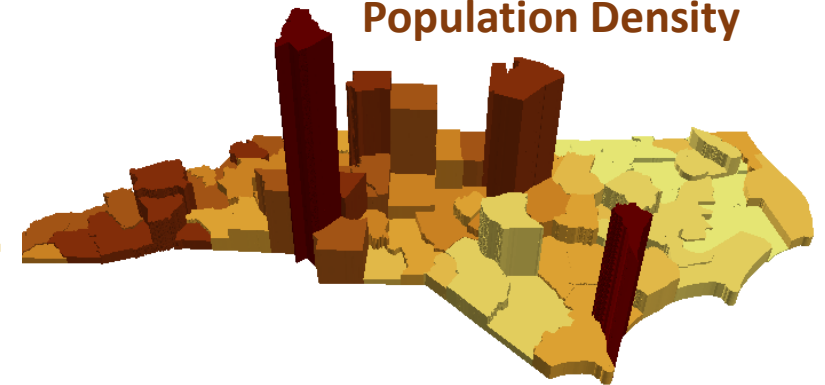
Land Value



Crop Sales per Acre



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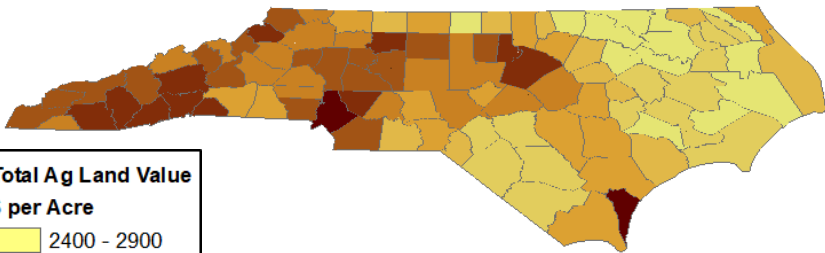
Total Ag Land Value \$ per Acre	
2400 - 2900	Lightest Yellow
3000 - 3400	Light Yellow
3500 - 3900	Yellow-Orange
4000 - 4600	Orange
4700 - 5600	Dark Orange
5700 - 7000	Brown-Orange
7100 - 9700	Dark Brown
9800 - 21000	Darkest Brown

Data source: Authors drawing with USDA Ag Census Quick Stats

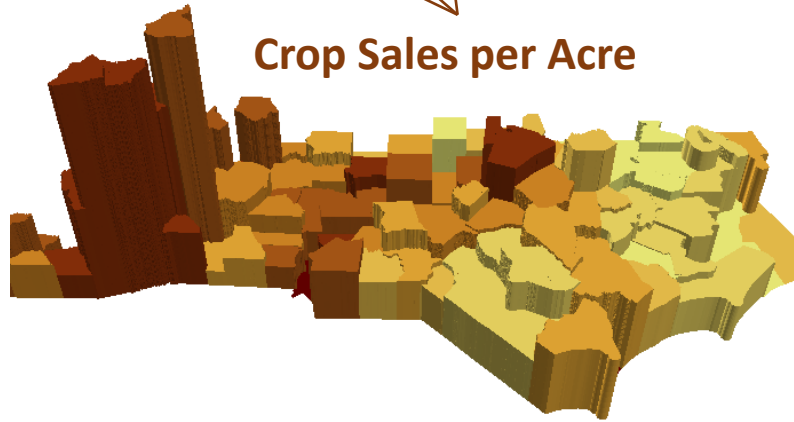
Climate and Land Values

$$Value = \frac{Rent_1}{1+r} + \frac{Rent_2}{(1+r)^2} + \frac{Rent_3}{(1+r)^3} + \dots$$

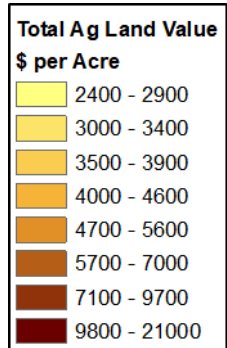
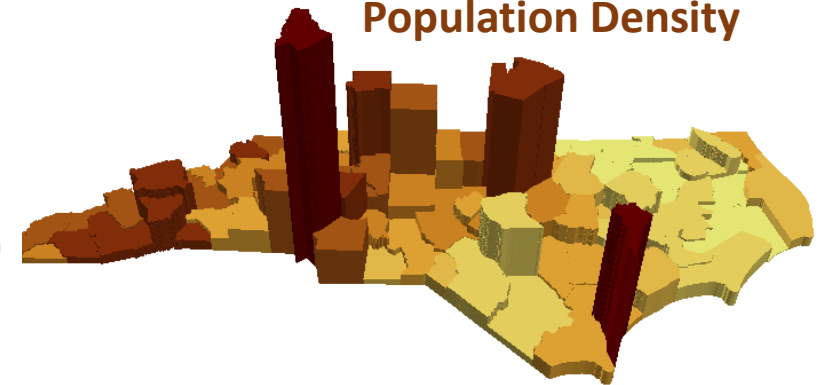
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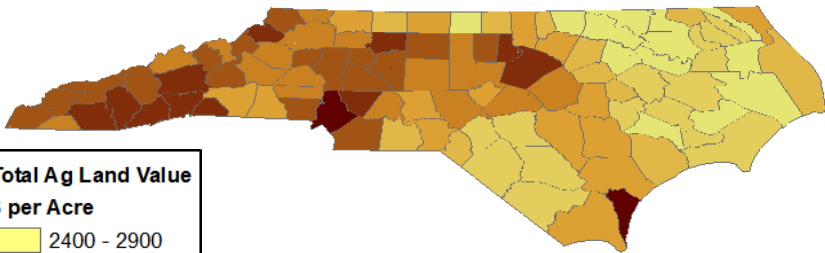


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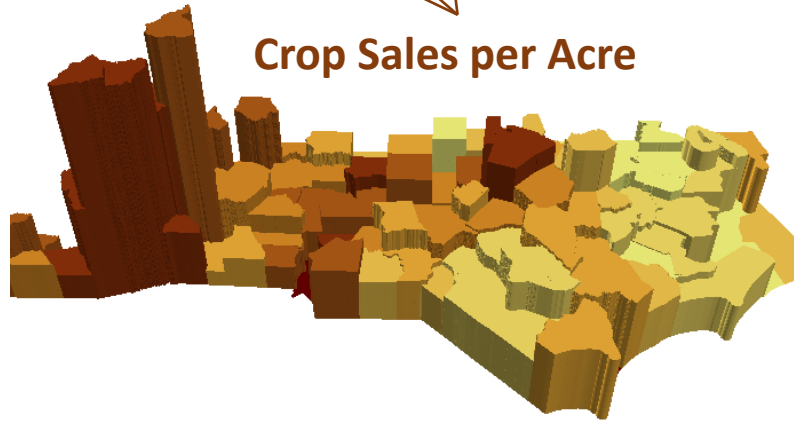
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$$Value = \frac{Rent_1}{1+r} + \frac{Rent_2}{(1+r)^2} + \frac{Rent_3}{(1+r)^3} + \dots + \frac{Sale_n}{(1+r)^n}$$

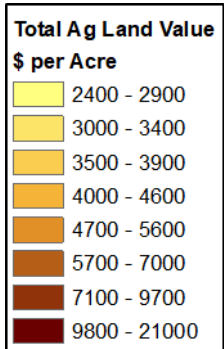
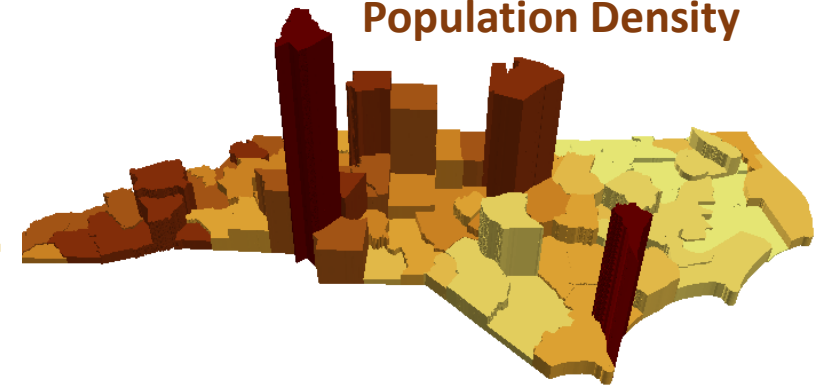
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Research Areas

- Water in Agriculture
 - Irrigation + Drainage
- Water Quality
 - Nutrient Trading
 - Coastal
- Climate Change
 - Adaptation + Resilience
- Water Conservation



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13 Photos and videos

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Eric Edwards @NCWaterEcon · Jan 31
Should I Stay or Should I Go: Coal Ash in North Carolina
"North Carolinians must determine the extent to which coal ash in its present locations can be tolerated and its damage mitigated – or how much money should be spent on removal."
[@SAnneSuther cal5.ncsu.edu/wp-content/upl...](https://www.ncsu.edu/wp-content/uploads/2018/01/Should-I-Stay-or-Should-I-Go-Coal-Ash-in-North-Carolina.pdf)