When It Rains, It Pours

Global Warming and the Rising Frequency of Extreme Precipitation in the United States

Presented to the North Carolina Legislative Commission on Global Climate Change

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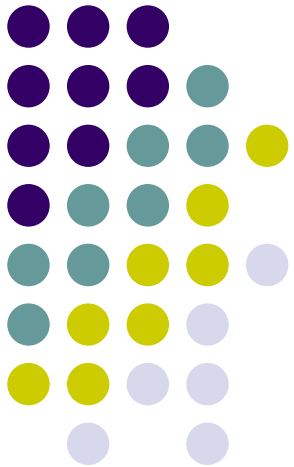

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How Will Global Warming Affect Precipitation Patterns?

- More Intense Precipitation
  - More downpours; and
  - Extended periods of dry weather
- Slight Increase in Total Precipitation
- But, Increased Drought

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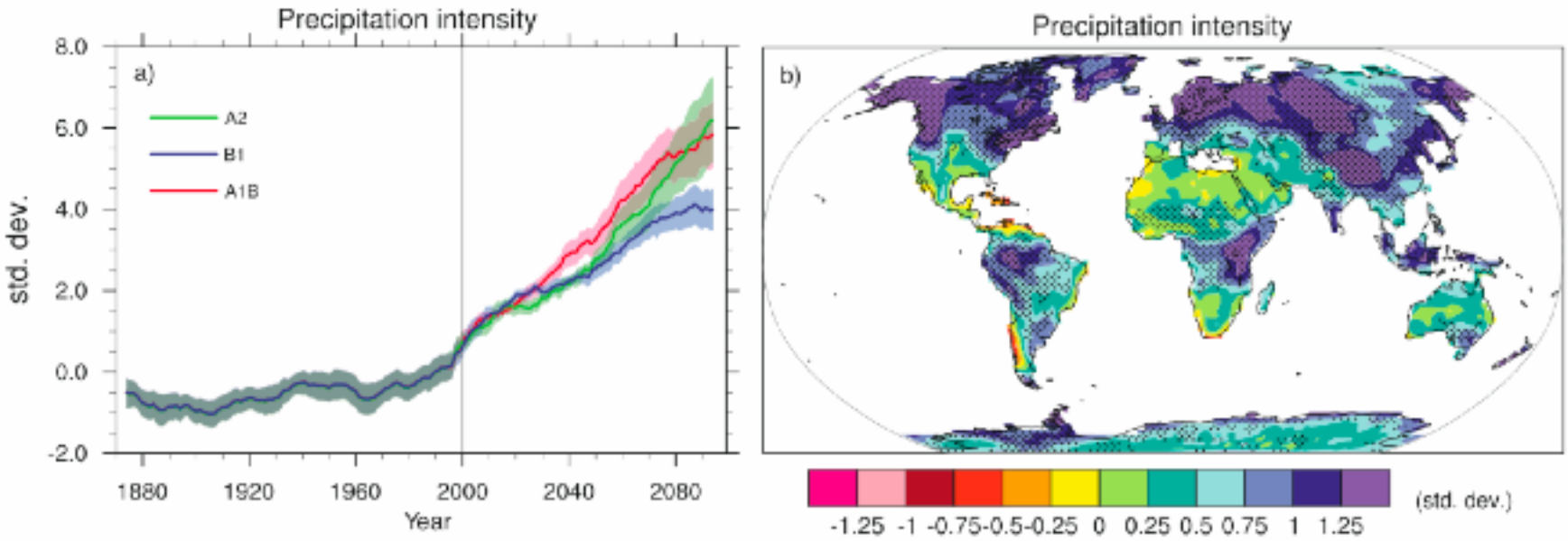
More Intense Precipitation

- When it rains, more rain is likely to fall.



Source: IPCC, "Global Climate Projections," *Climate Change 2007*.

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The Explanation:

- Warmer temperatures lead to greater evaporation.
- Warmer air can hold more water vapor.
  - These factors enable clouds to become richer with moisture.

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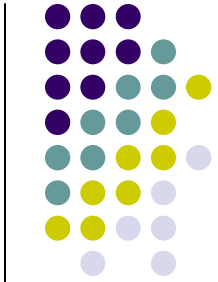
Changes in Overall Precipitation



- Overall, global warming is expected to slightly increase total annual rainfall across much of the United States.
- Summers will tend to be drier and winters, wetter.

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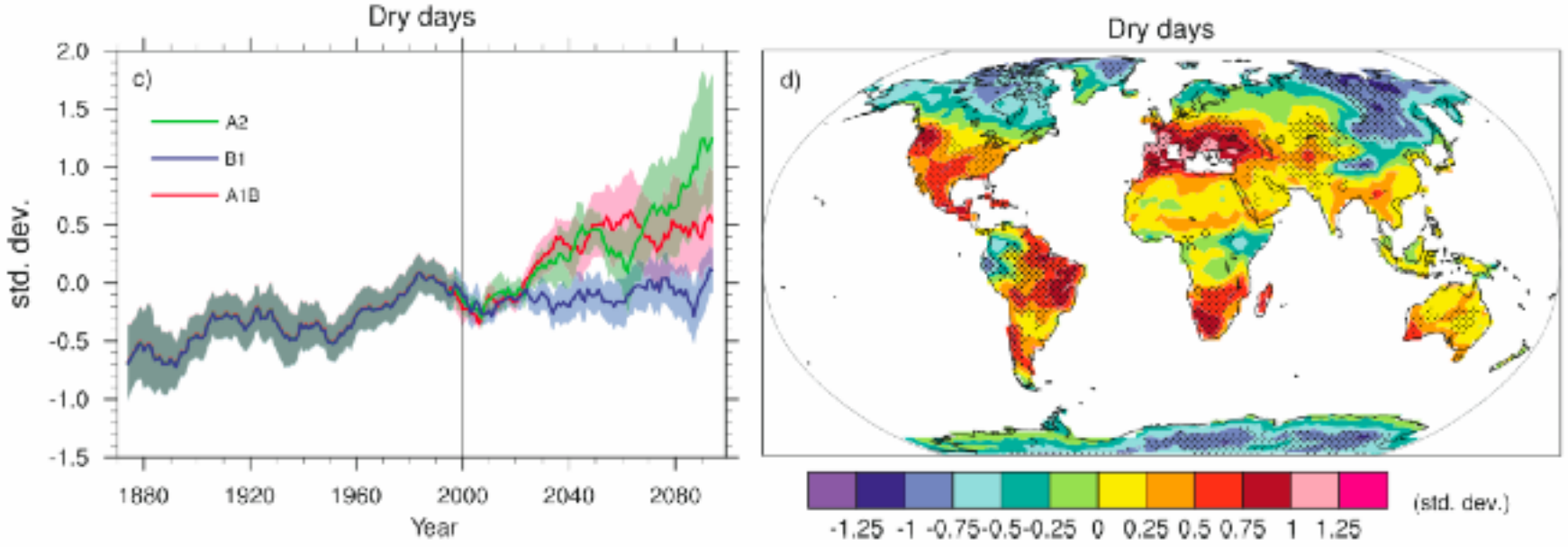
Increased Drought

- At the same time, global warming is expected to cause extended periods of dry weather.



Source: IPCC, "Global Climate Projections," *Climate Change 2007*.

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Methodology: In Brief

- We looked at daily precipitation records from more than 3,000 weather stations, identifying the largest storms.
- We then examined trends in the frequency of these storms over time, at each weather station.

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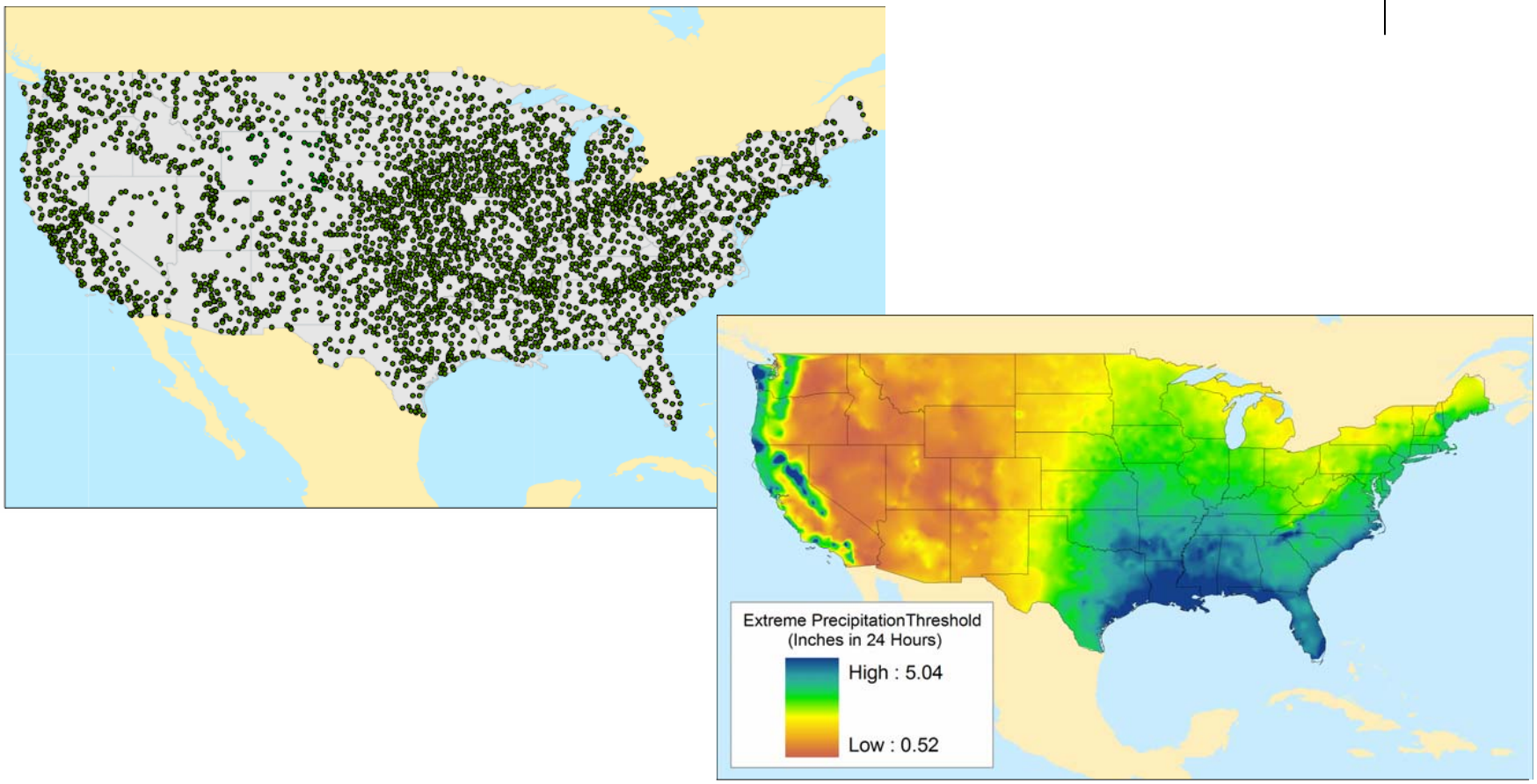
Methodology: In Brief



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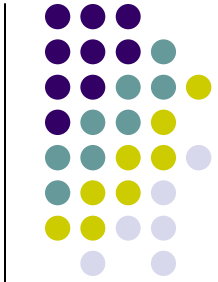
Extreme Precipitation Has Increased in Frequency



- Storms with extreme precipitation have increased in frequency by 24 percent across the continental U.S. since 1948.
- With 95 percent confidence from statistical analysis, the increase ranged between 22 to 26 percent.

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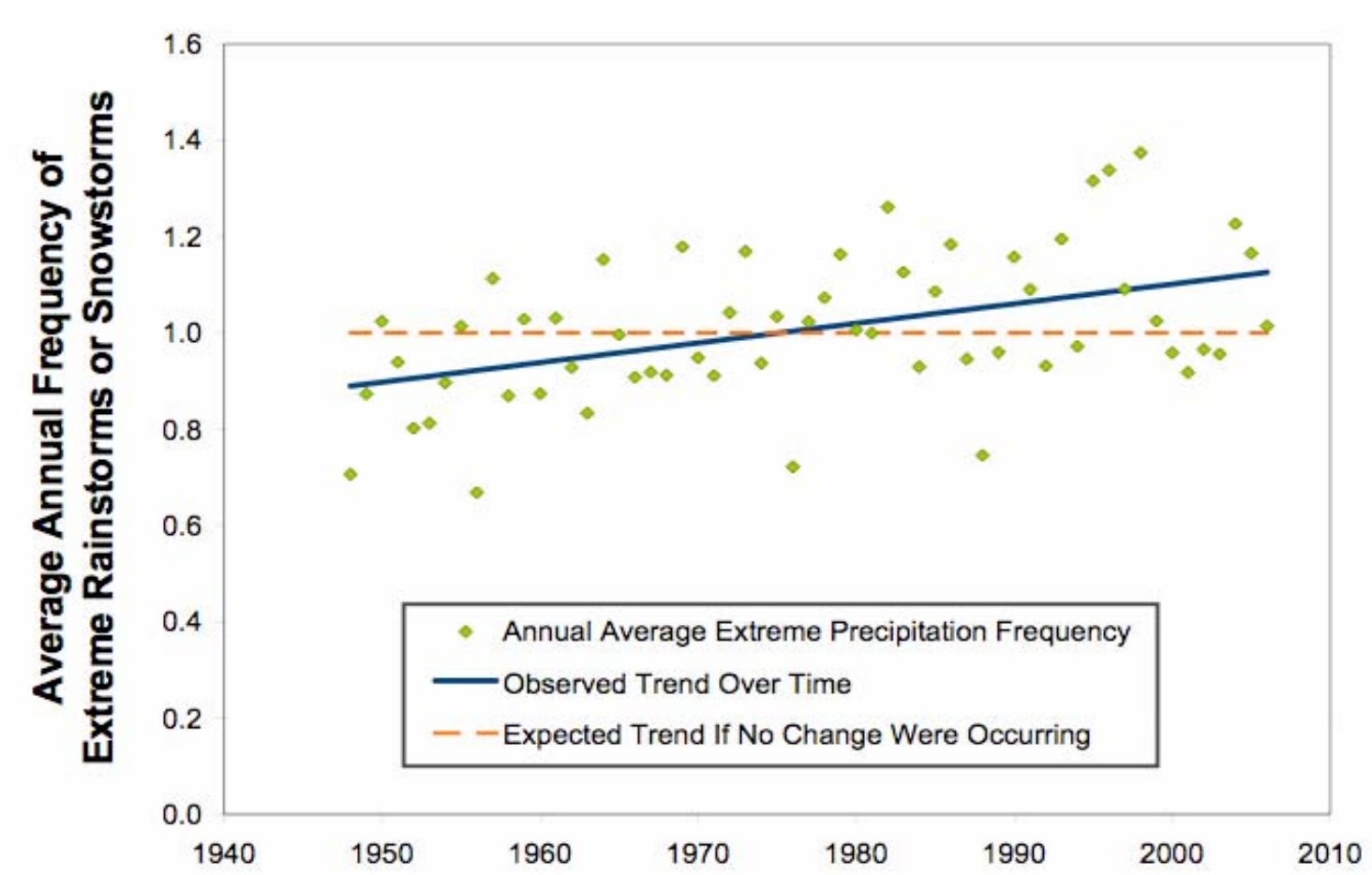

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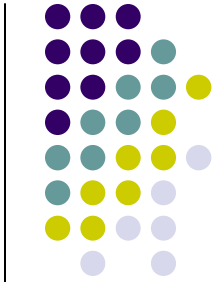

- In the South Atlantic, extreme precipitation increased in frequency by 15 percent (10 to 20 percent).
- In North Carolina, extreme storms became 16 percent more frequent (6 to 26 percent).

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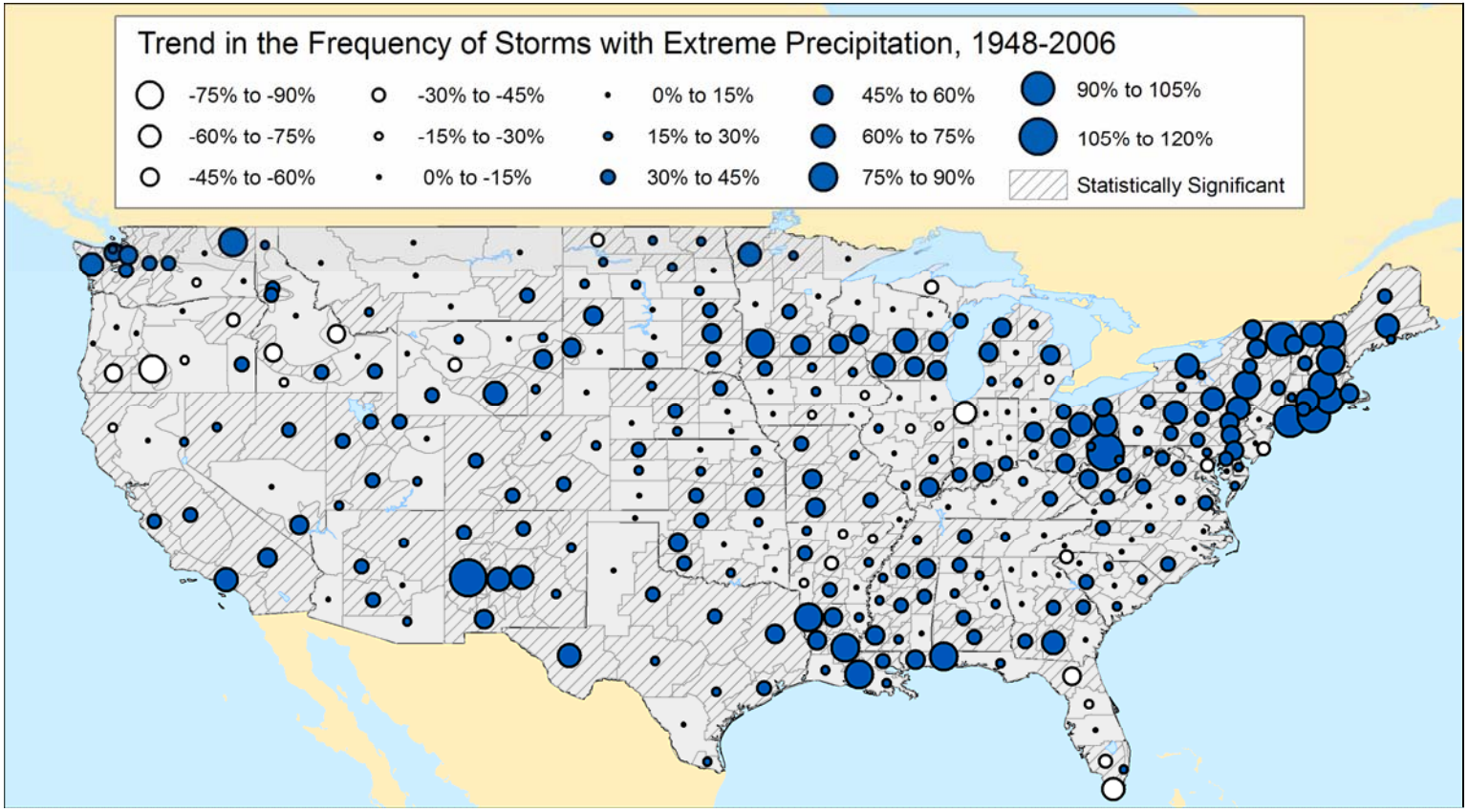
Extreme Precipitation Has Increased in Frequency



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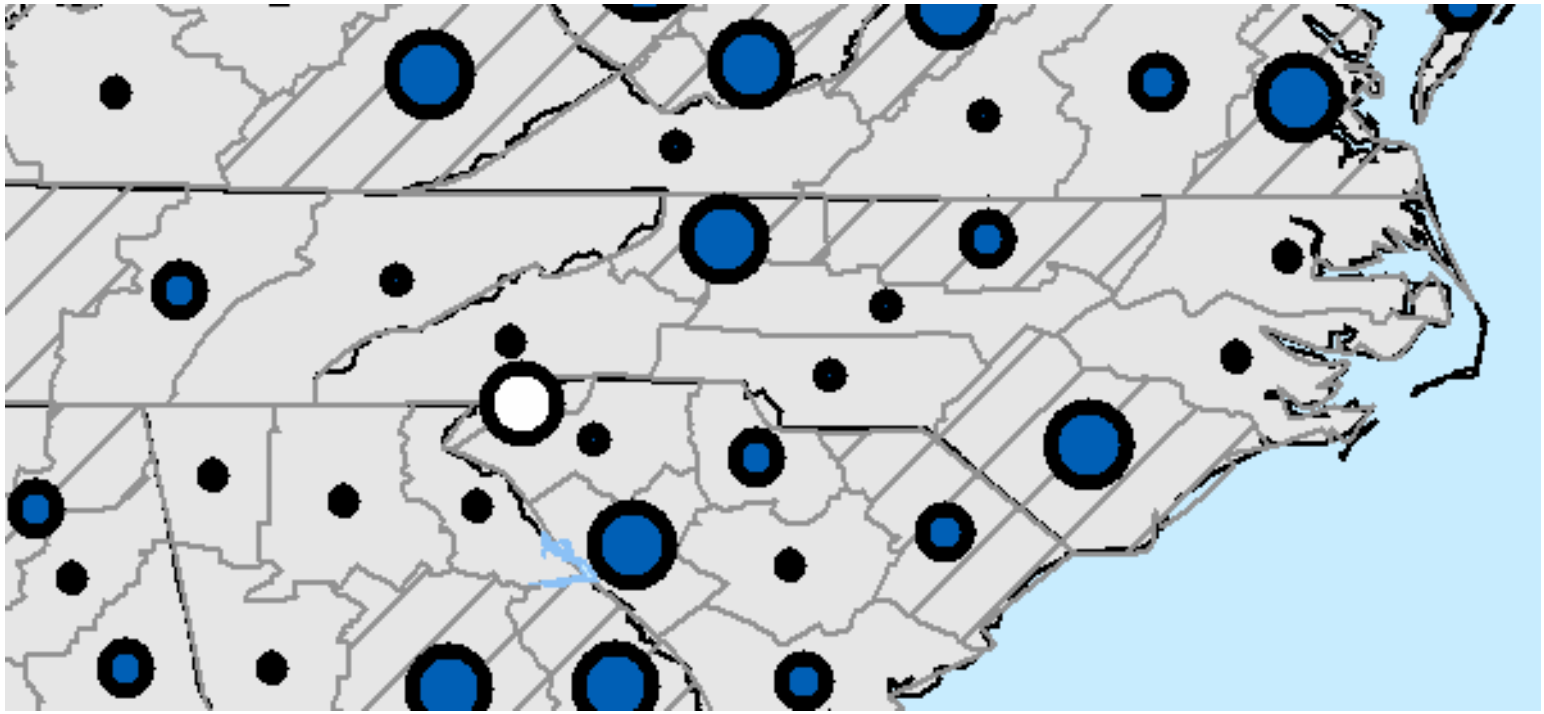

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These Results Agree with Previous Research

- Other researchers have also documented this trend, observing in recent decades:
  - warmer weather,
  - higher atmospheric water content,
  - increased formation of storm clouds,
  - increased thunderstorm activity, and
  - trends toward increasingly frequent extreme precipitation in locations across the world, from subtropical Brazil to Siberia.

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Links Between Observed Trends and Global Warming

- Scientists have documented human fingerprints in:
  - Increasing levels of carbon dioxide in the air;
  - Increasing global average temperature;
  - Changing temperature extremes;
  - Widespread melting of snow and ice;
  - Rising global sea level;
  - Altered wind patterns;
  - Increasing moisture content of the atmosphere over the oceans;
  - Increasing annual precipitation totals in temperate regions of the Northern Hemisphere
- Evidence is growing that increasingly intense precipitation is also linked to global warming.

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Implications of More Intense Precipitation

- Flooding
  - Runoff Pollution and Sewage Overflows
  - Spread of Disease
  - Agricultural Damage
- Increased Drought

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Flooding

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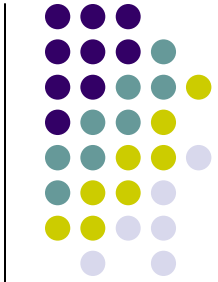
Runoff, Sewage Overflows, Disease



- Risk of water pollution;
- Design criteria for runoff control may need to be changed;
- Increased risk of sewage discharge and spread of waterborne disease.

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Agricultural Damage

After a storm in July 2006, the Lucas Farm lost about 300 acres of corn and green beans. Source: PA Department of Agriculture.

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Drought

- Brought on by extended periods of dry weather;
- Aggravated by increased evaporation

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Conclusions

- Global warming is already changing weather patterns in visible ways.
- Climate models predict that the trend toward increasingly frequent downpours will intensify in the future.
- At the same time, the number of dry days will also increase, making drought more likely.
- However, the severity of the trend depends upon our emissions of the pollution that drives global warming.

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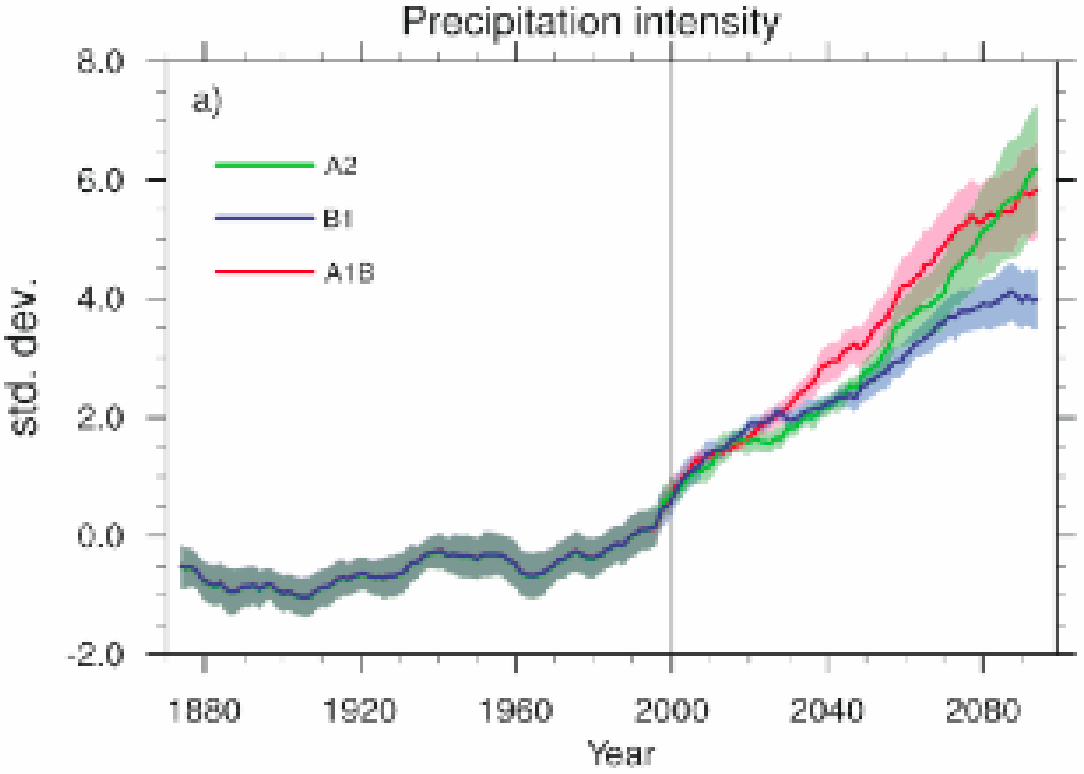
The Severity of the Trend Depends on Our Actions



Source: IPCC, "Global Climate Projections," *Climate Change 2007*.

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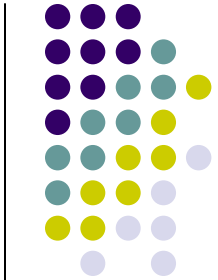
Policy Recommendations



- Establish mandatory limits on global warming pollution;
- Auction 100 percent of emission allowances under any cap-and-trade program;
- Adopt policies to improve energy efficiency and increase the use of clean, renewable energy.

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Thank You!

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