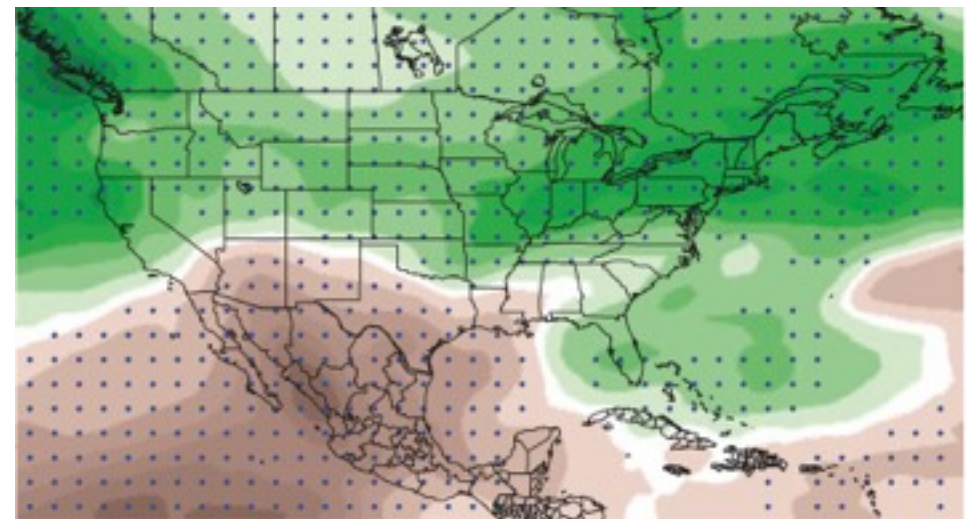
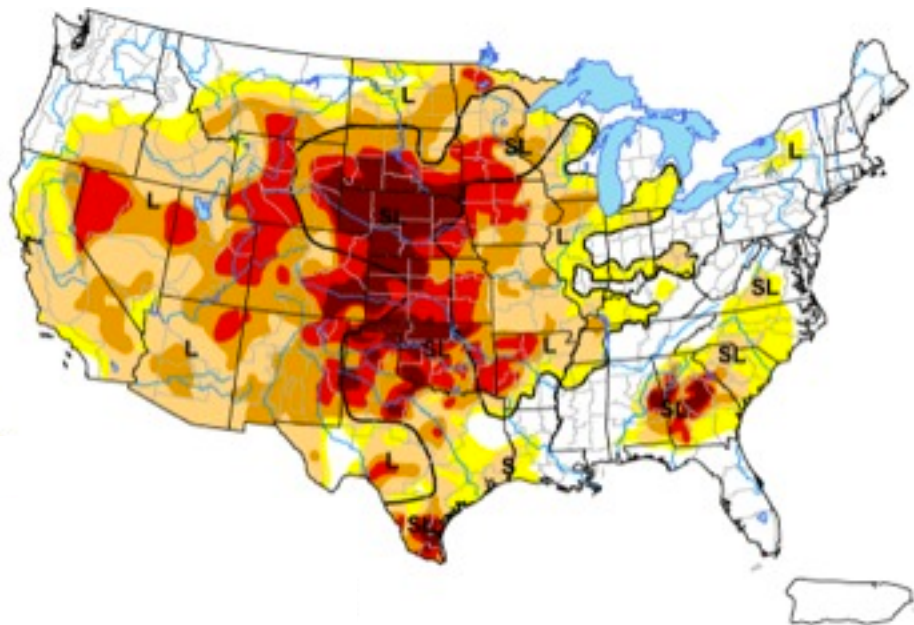
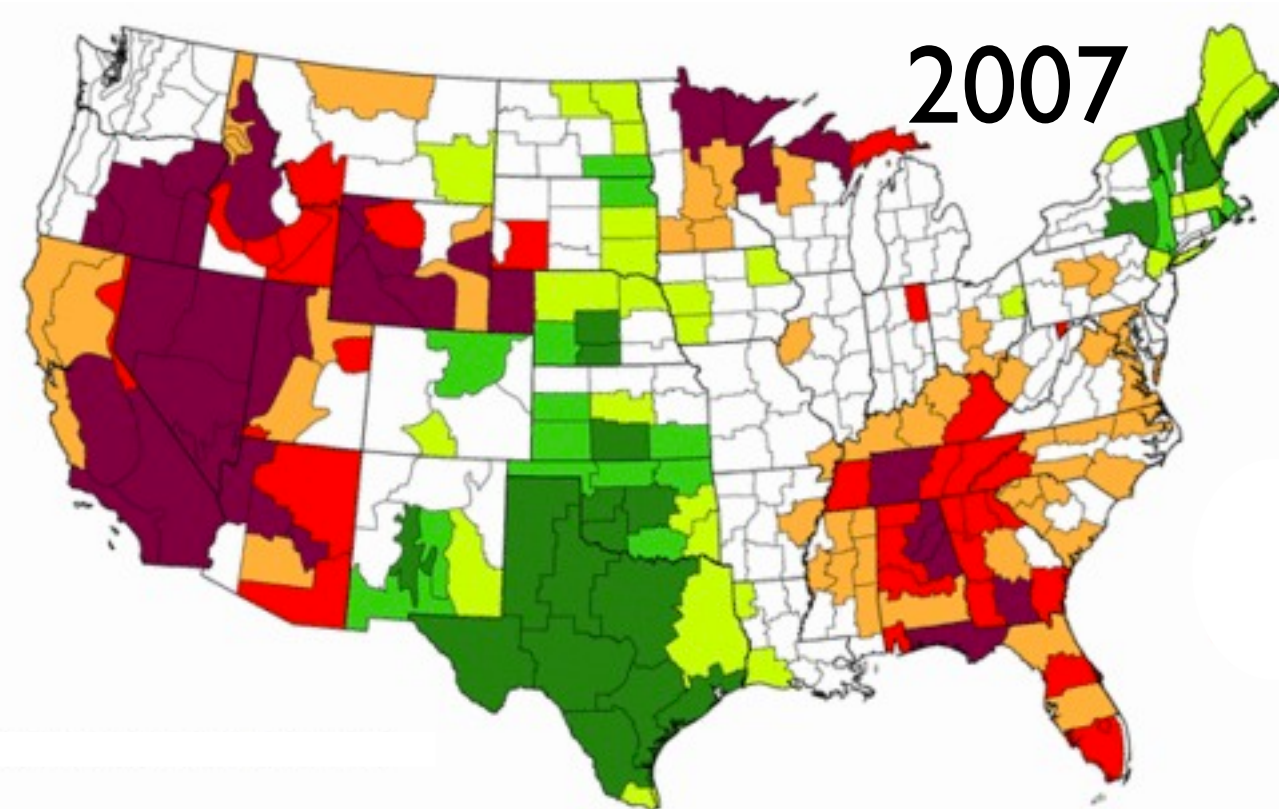
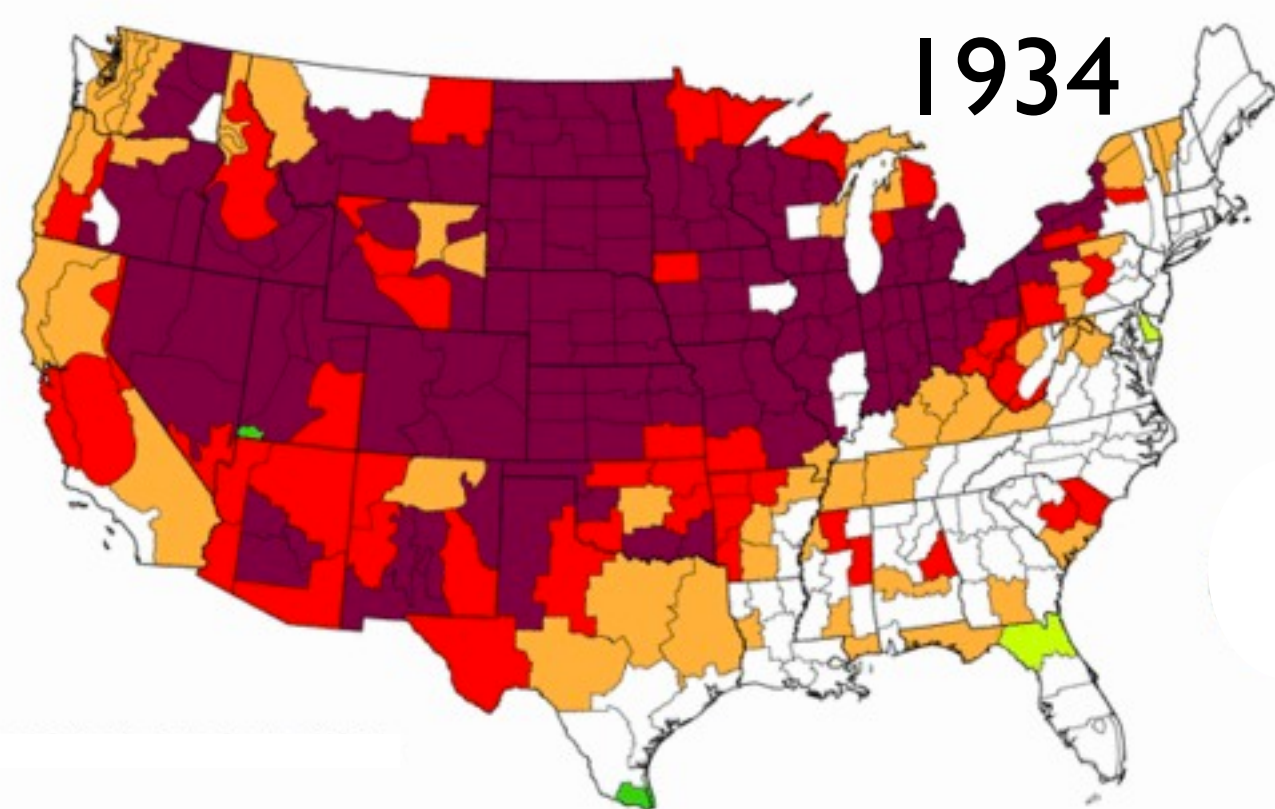




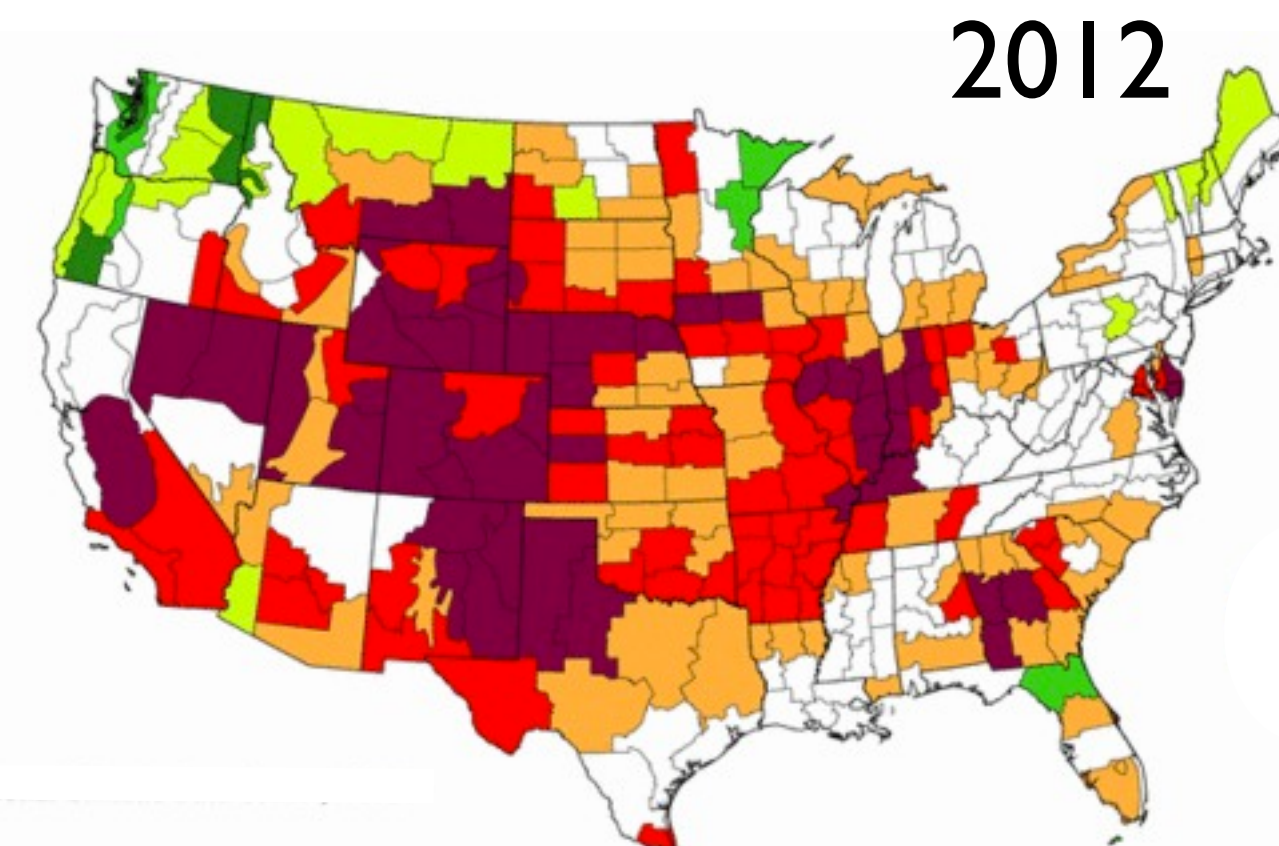
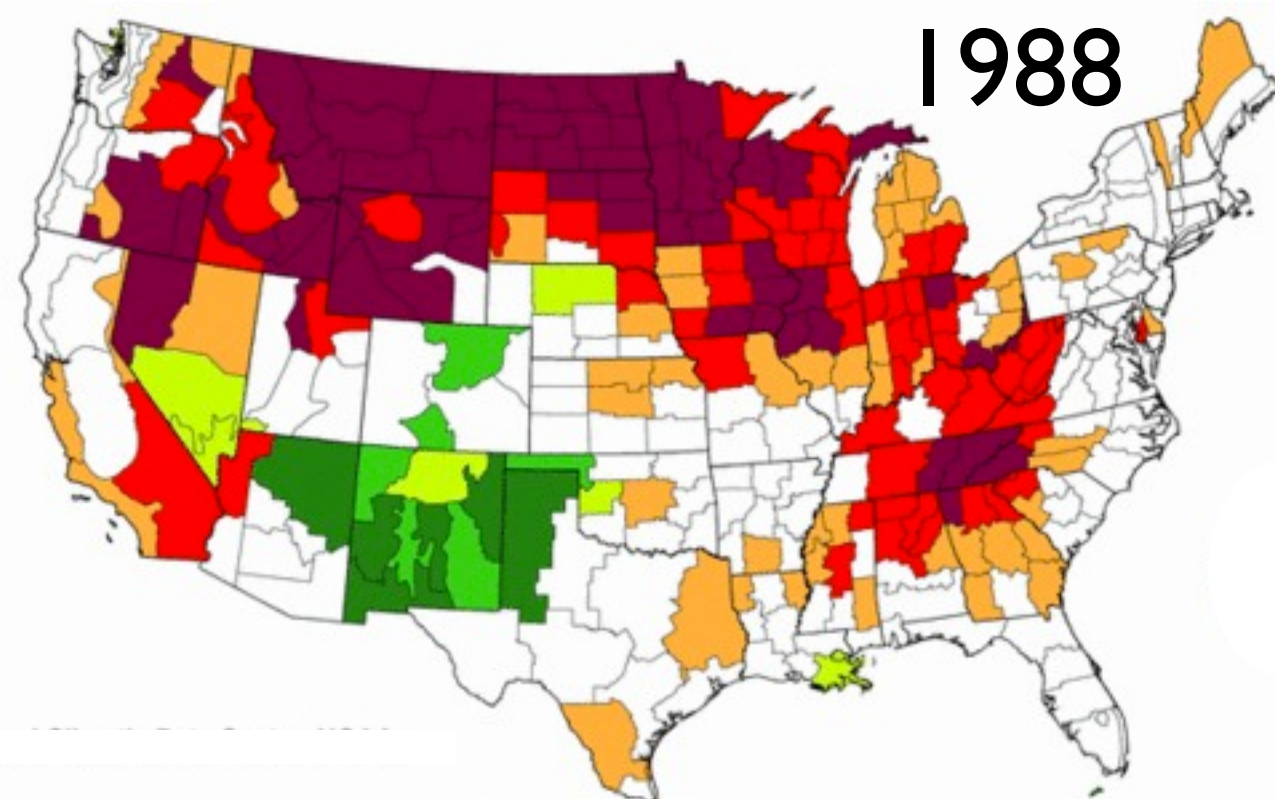
Was 2012 a Taste of Growing Seasons to Come?

Bill Bland
UWEx Soil and Water
Conservation Specialist
UW-Madison, Department of Soil
Science

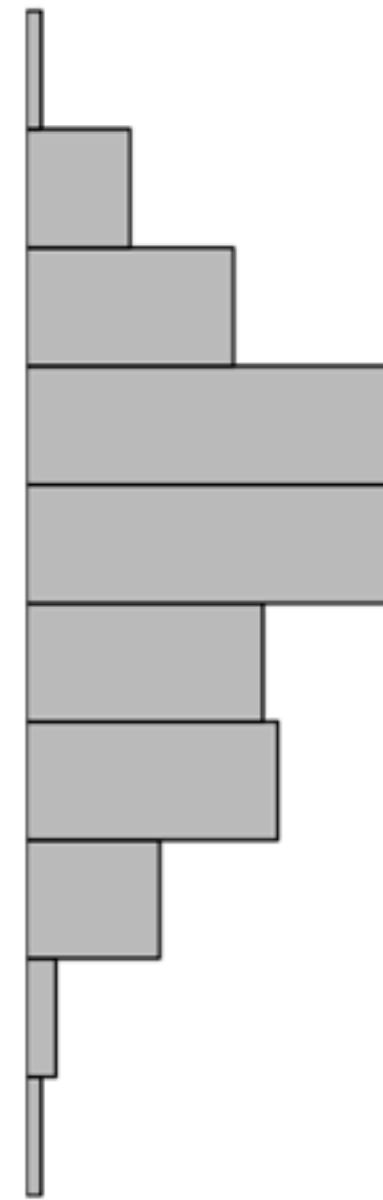
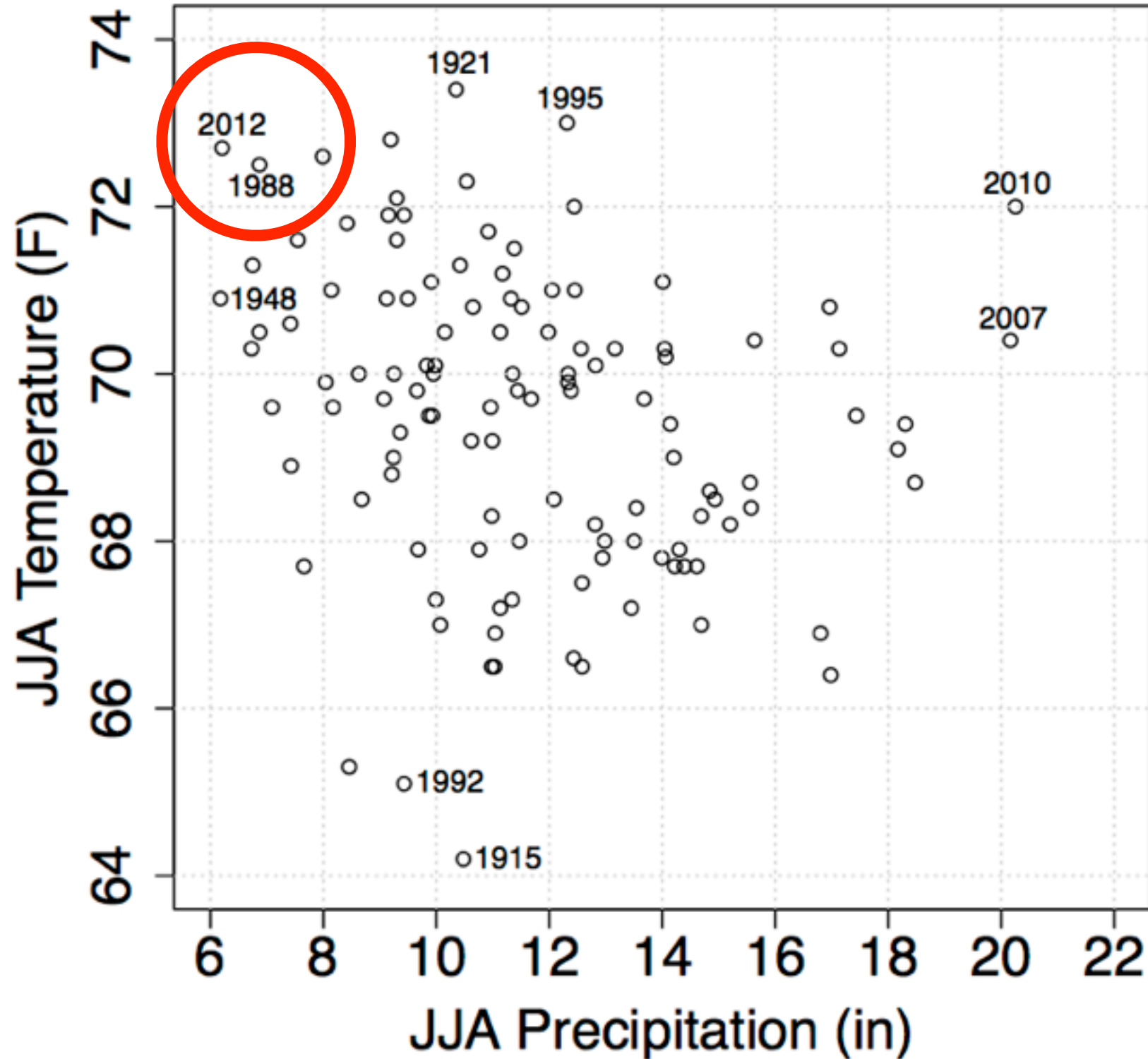




Palmer Drought Severity Index - July

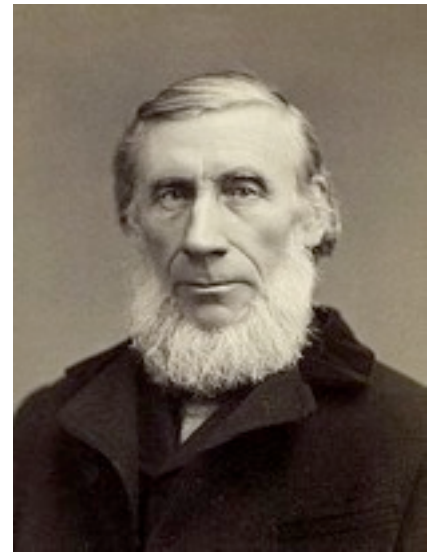


Wisconsin CD8 (southcentral) 1895-2012



Drought Futures

- once thought of cycles
- now: what about **global warming**?
- well underway, long understood



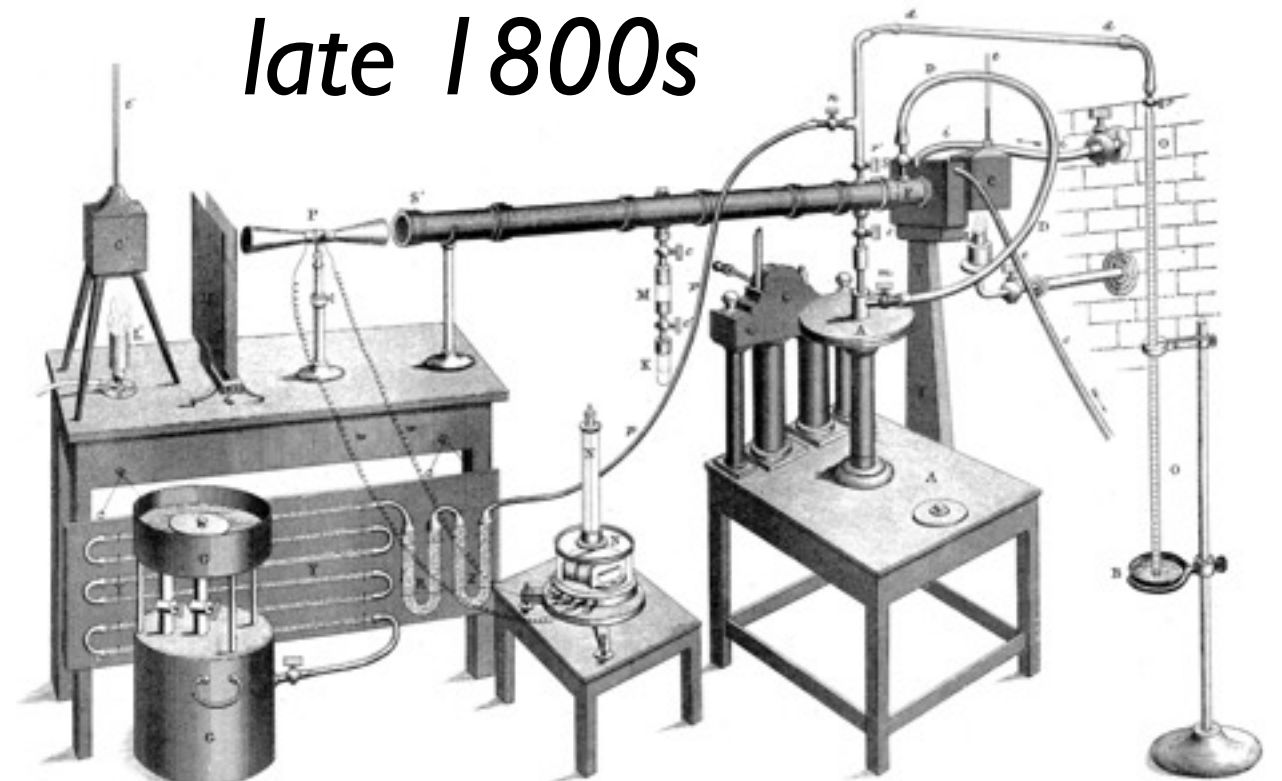
John Tyndall

Phil. Trans. 1861, 1862, 1863, 1864, 1865, 1866, 1867, 1868, 1869, 1870, 1871, 1872, 1873, 1874, 1875, 1876, 1877, 1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1907, 1908, 1909, 1910, 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920, 1921, 1922, 1923, 1924, 1925, 1926, 1927, 1928, 1929, 1930, 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1938, 1939, 1940, 1941, 1942, 1943, 1944, 1945, 1946, 1947, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1956, 1957, 1958, 1959, 1960, 1961, 1962, 1963, 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025

late 1800s

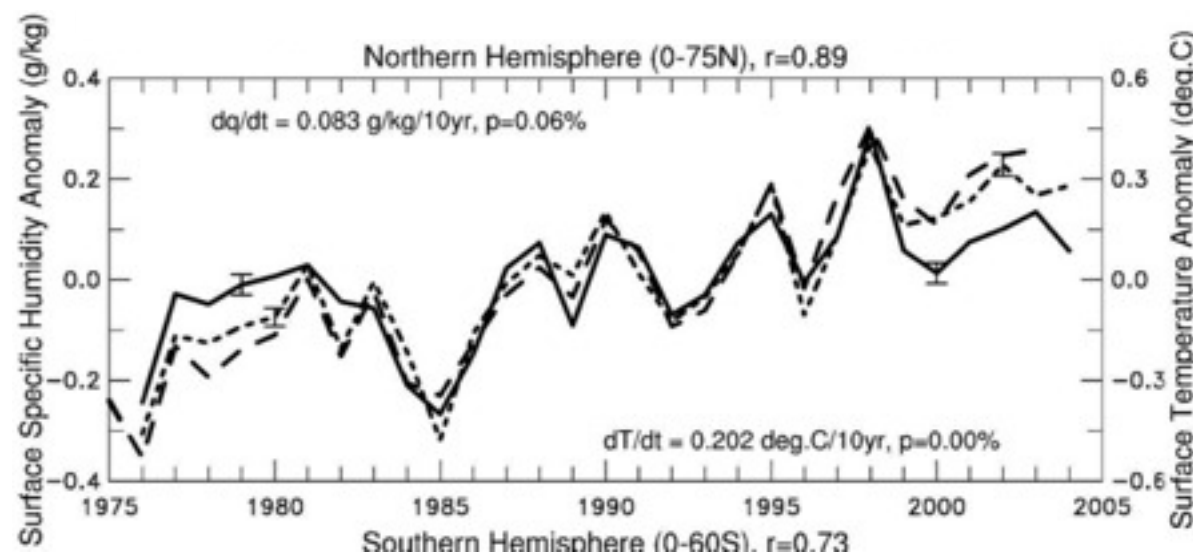
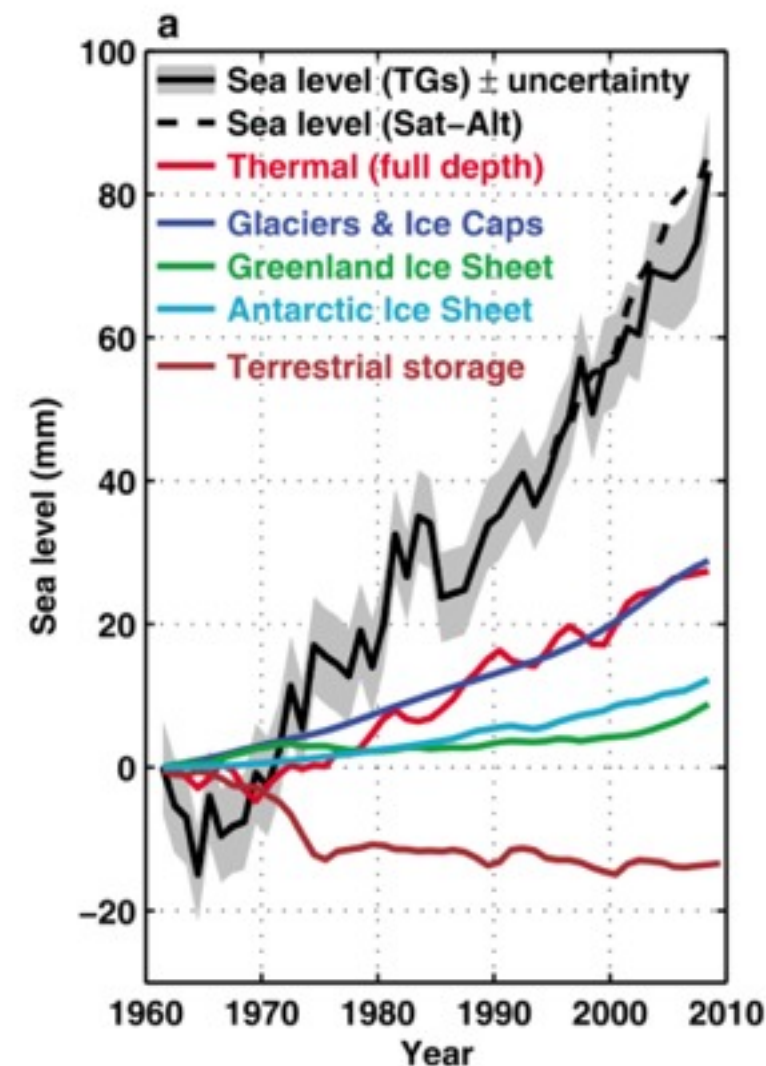
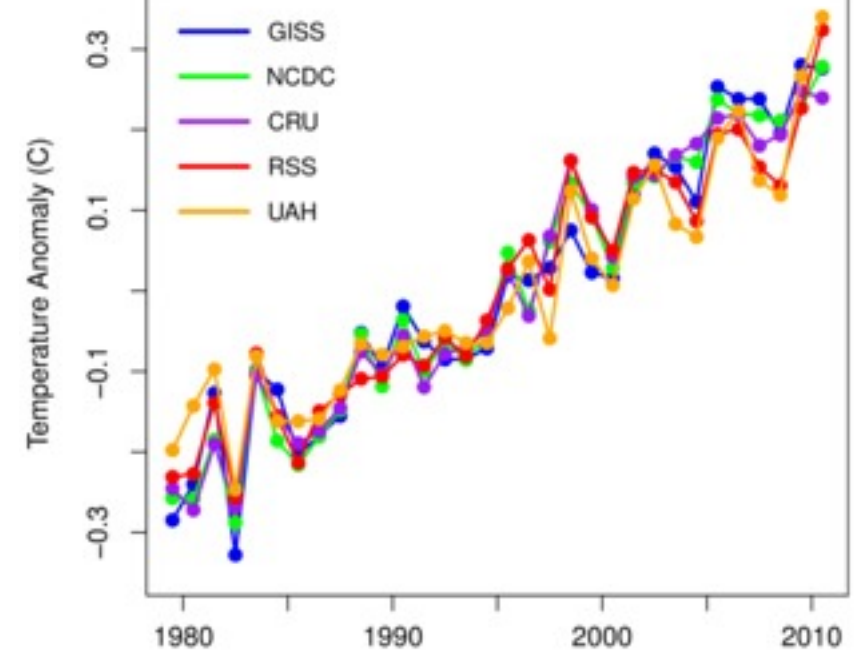


Svante Arrhenius



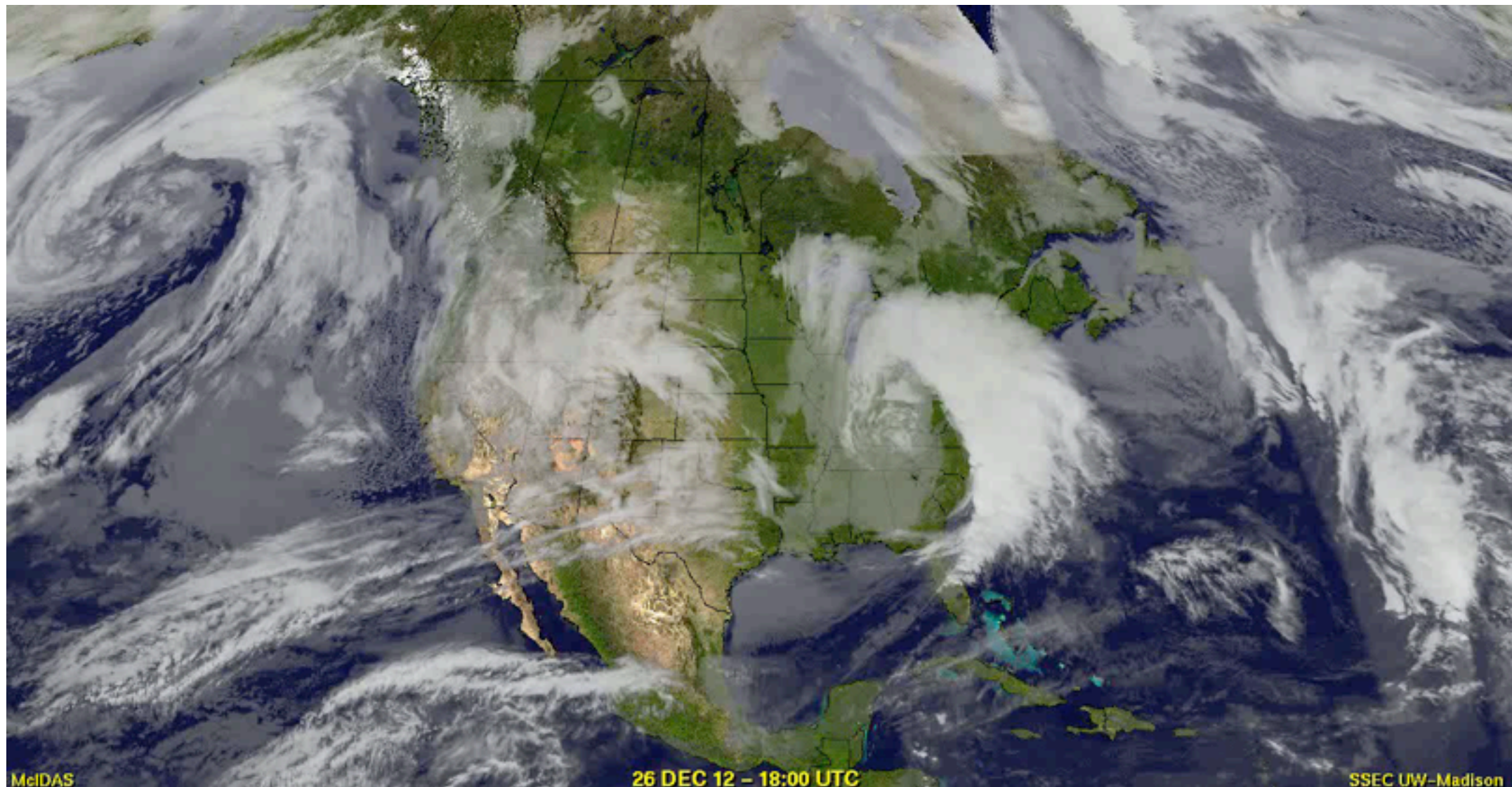
Global Warming: Many Faces

- temperature - ocean, atmosphere
- melting mountain glaciers, ice caps
- loss of sea ice area and thickness
- sea level increase
- increased water vapor in atmosphere



Predictability

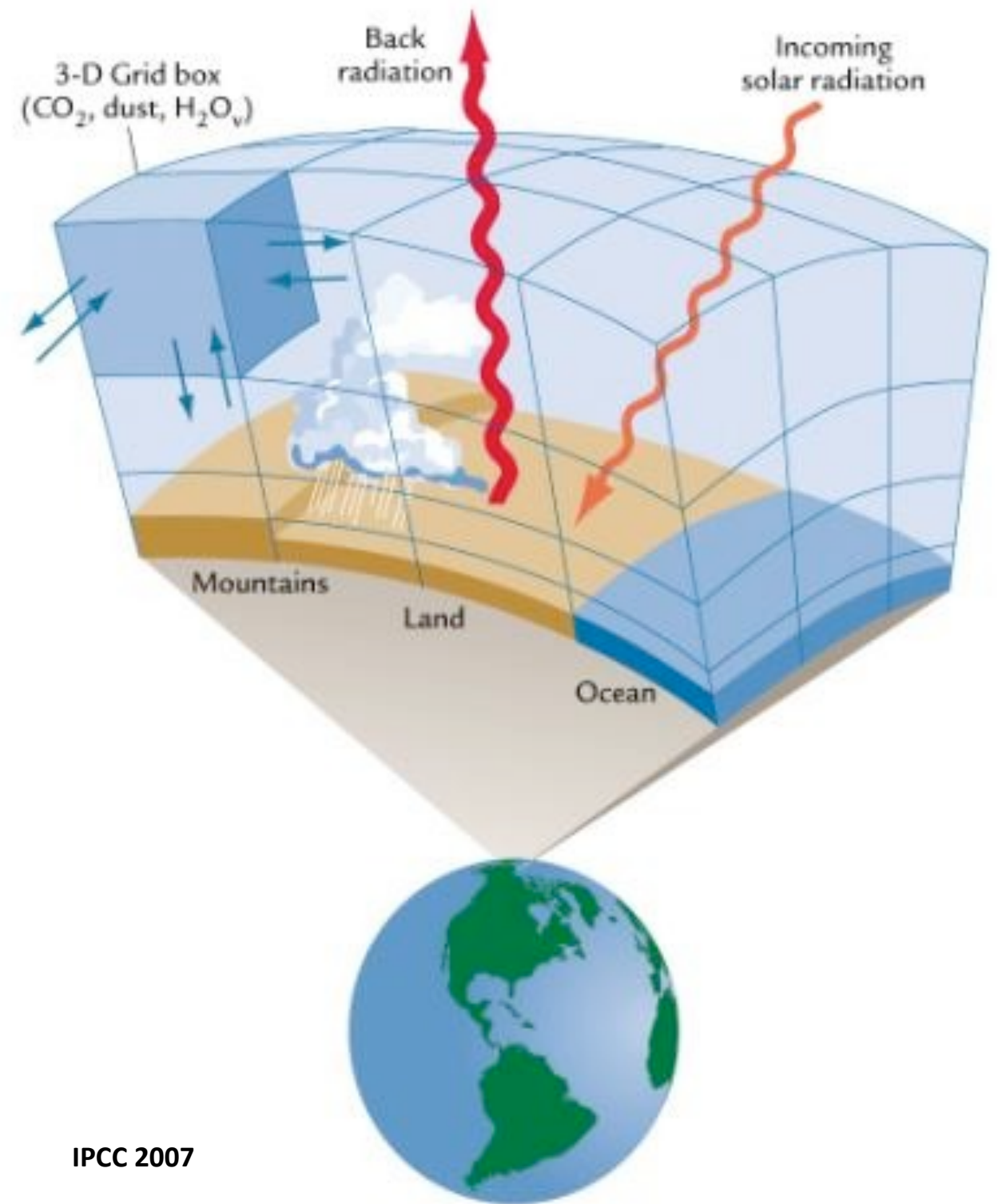
- some features of AGW more predictable than others
- precipitation changes are especially difficult



Climate Models

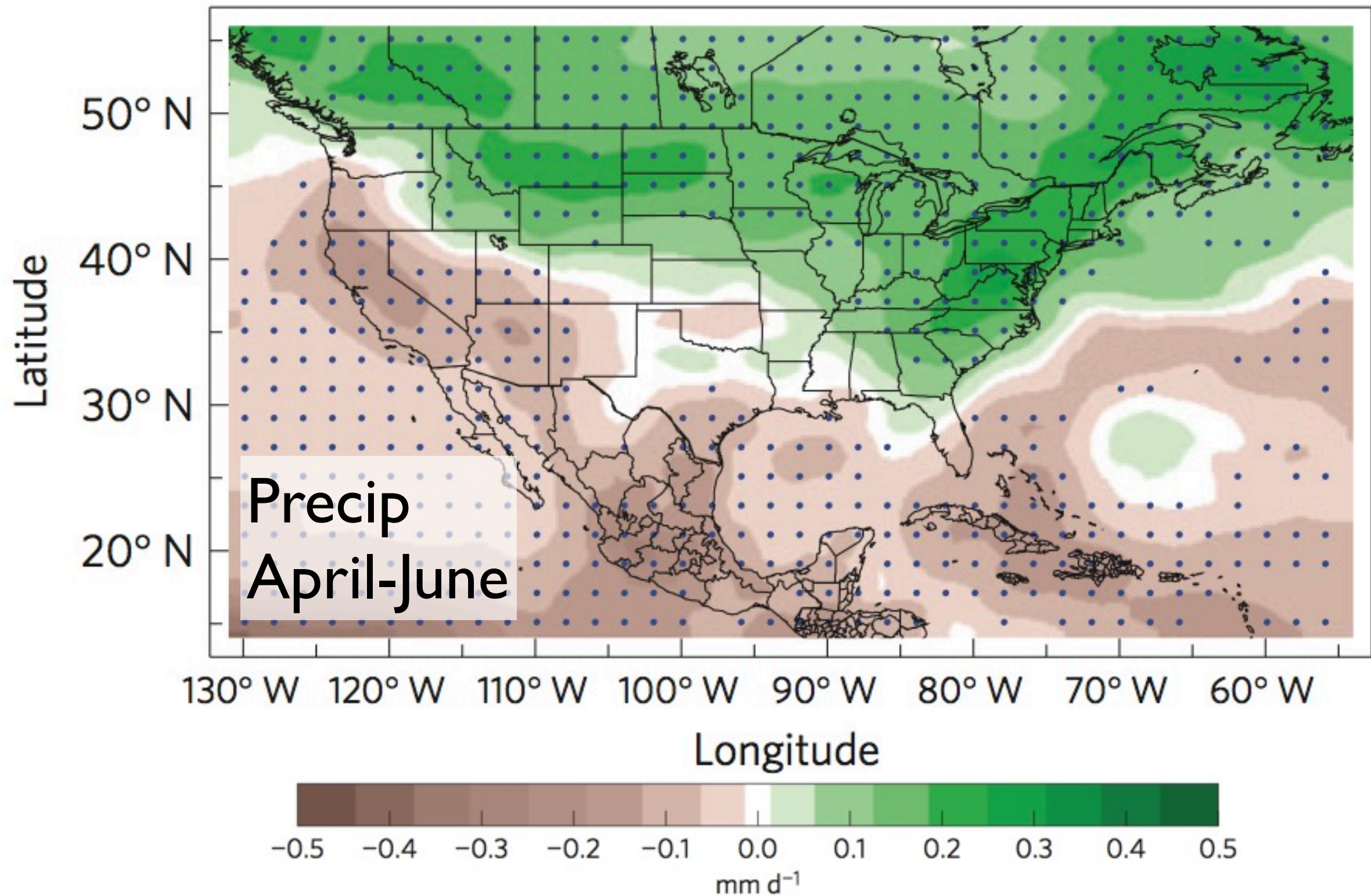
Huge computer models include:

- Atmosphere
- Clouds
- Oceans
- Topography
- Rainfall
- Radiant heat



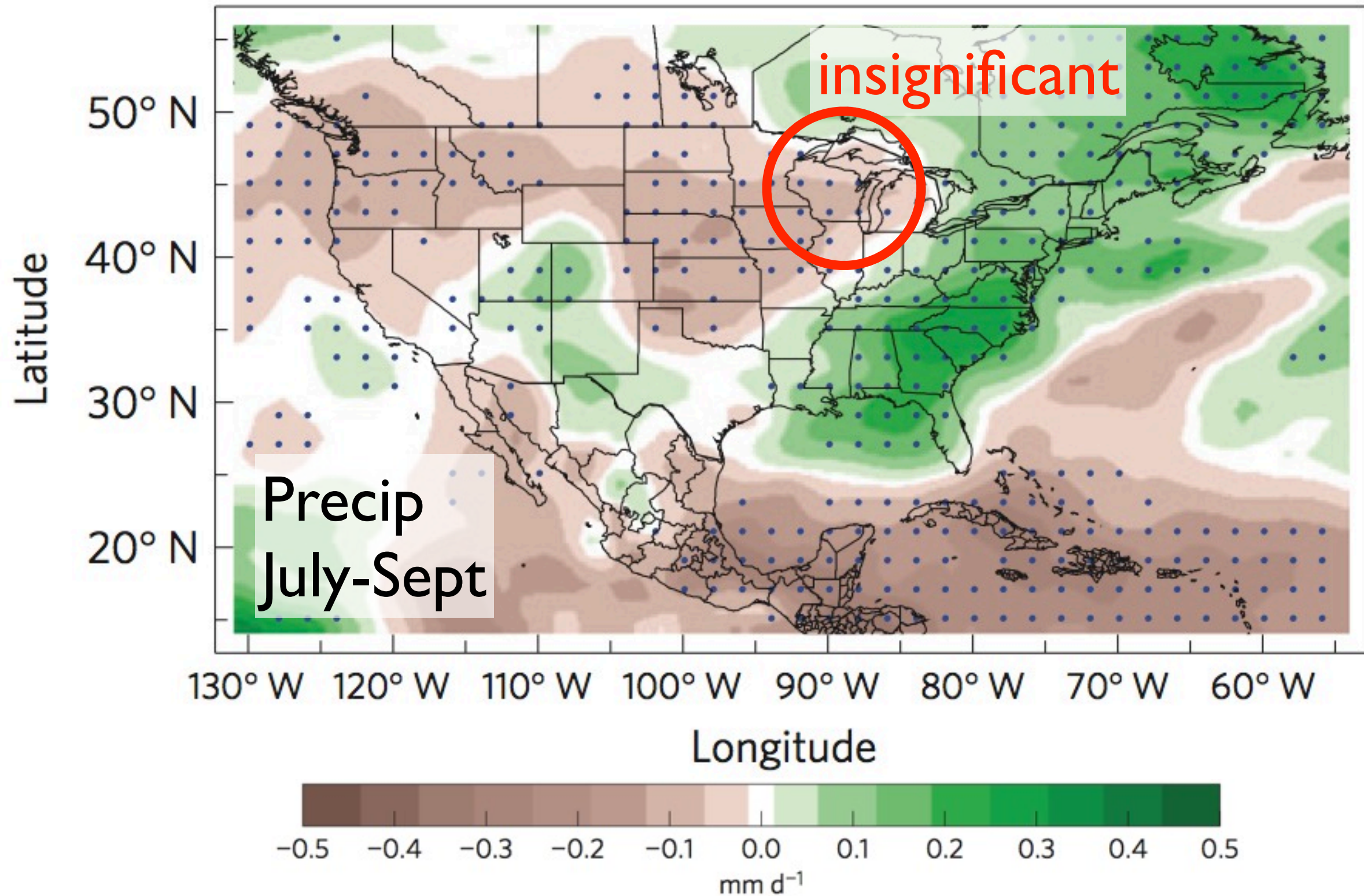
IPCC 2007

Predictions of 2030ish, compared to 1951-2000



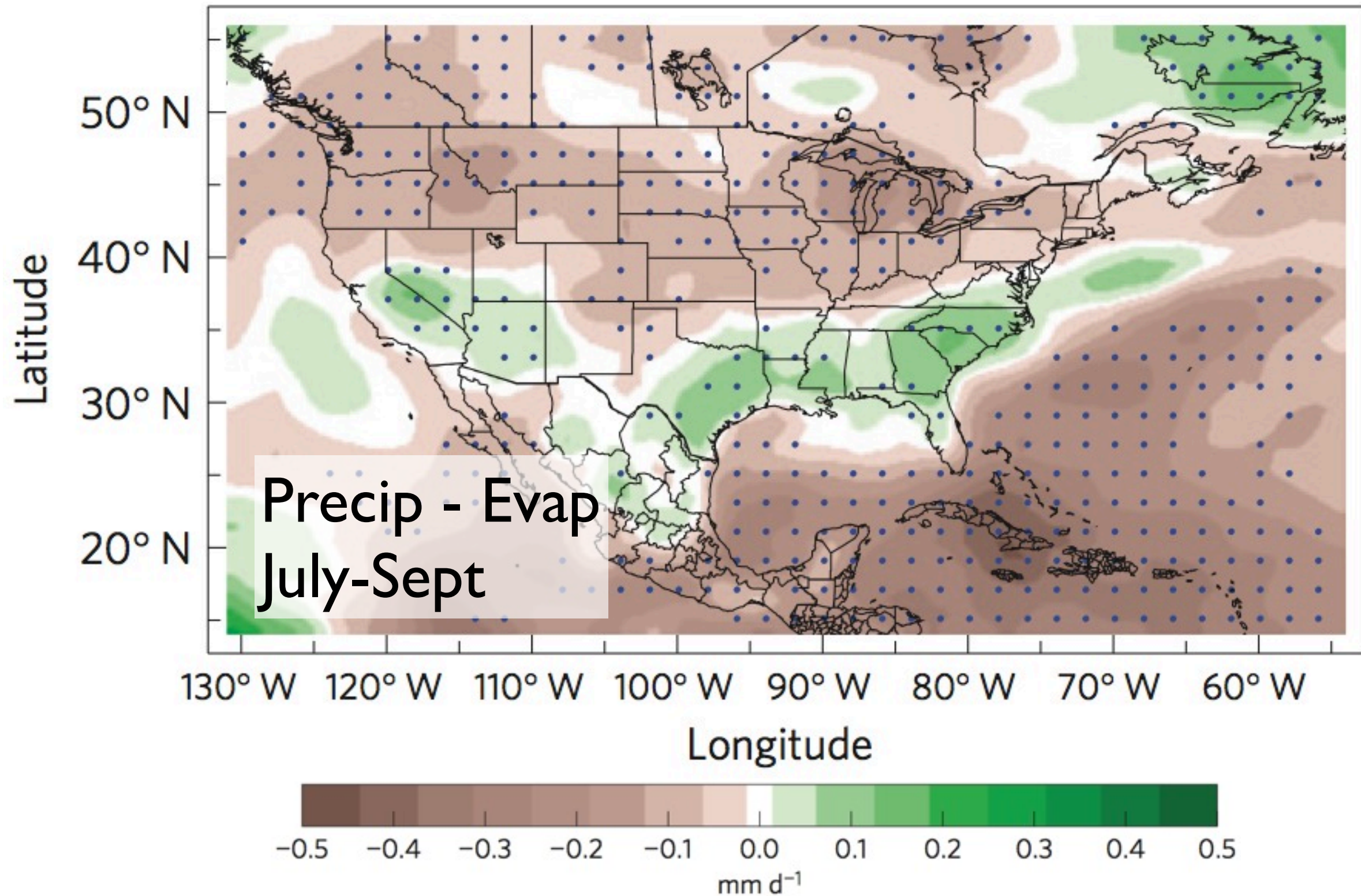
Seager, R., Ting, M., Li, C., Naik, N., Ben Cook, Nakamura, J., & Liu, H. (2012). Projections of declining surface-water availability for the southwestern United States. *Nature Climate Change*, 3(1), 1–5. doi:10.1038/nclimate1787

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Water Balance Futures

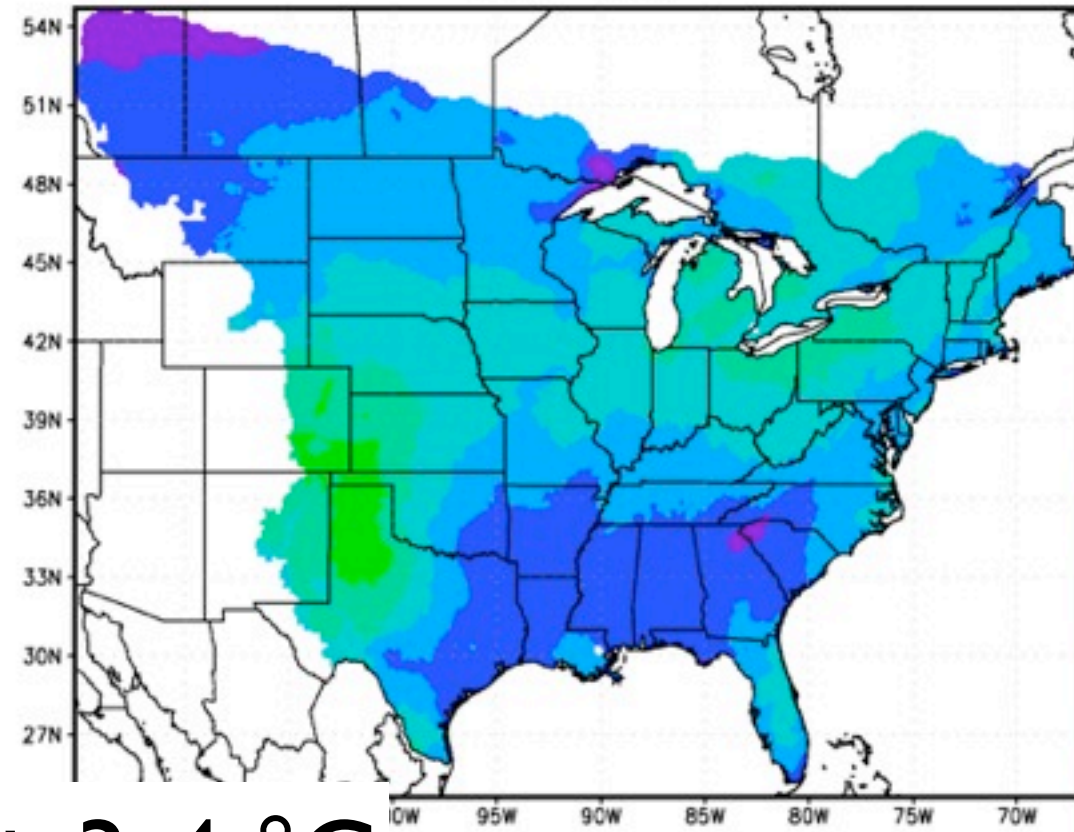
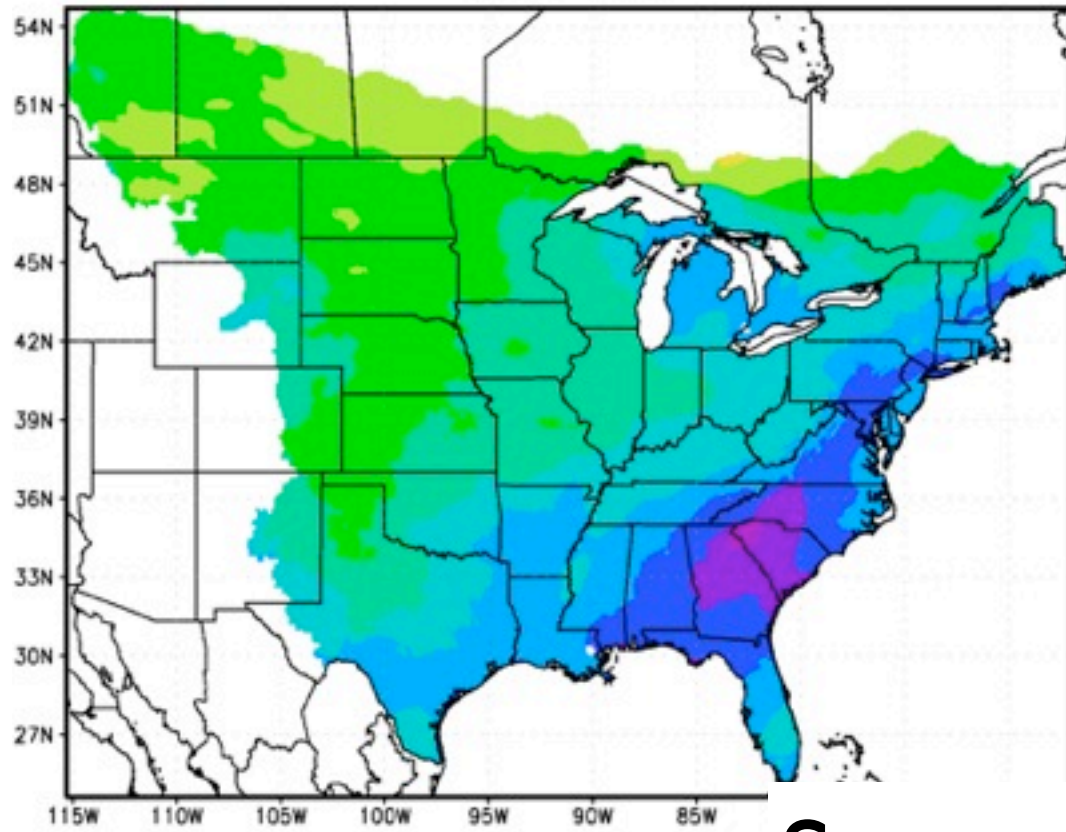
- Wisconsin on the good side of “rich get richer” possibility for annual precip
- Evaporation will increase with warming
- Higher temperatures bigger worry

Tmax in 2090, relative to 1960-2000

change in tmax (°C), A1B 2081–2100

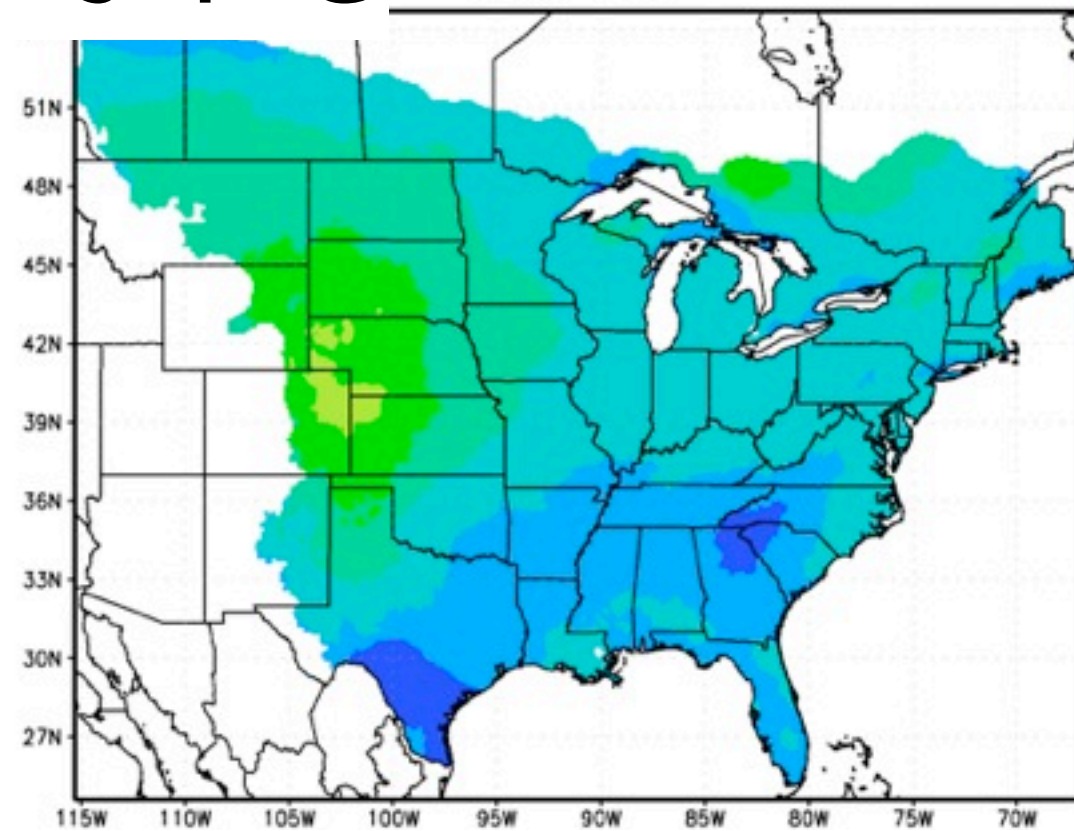
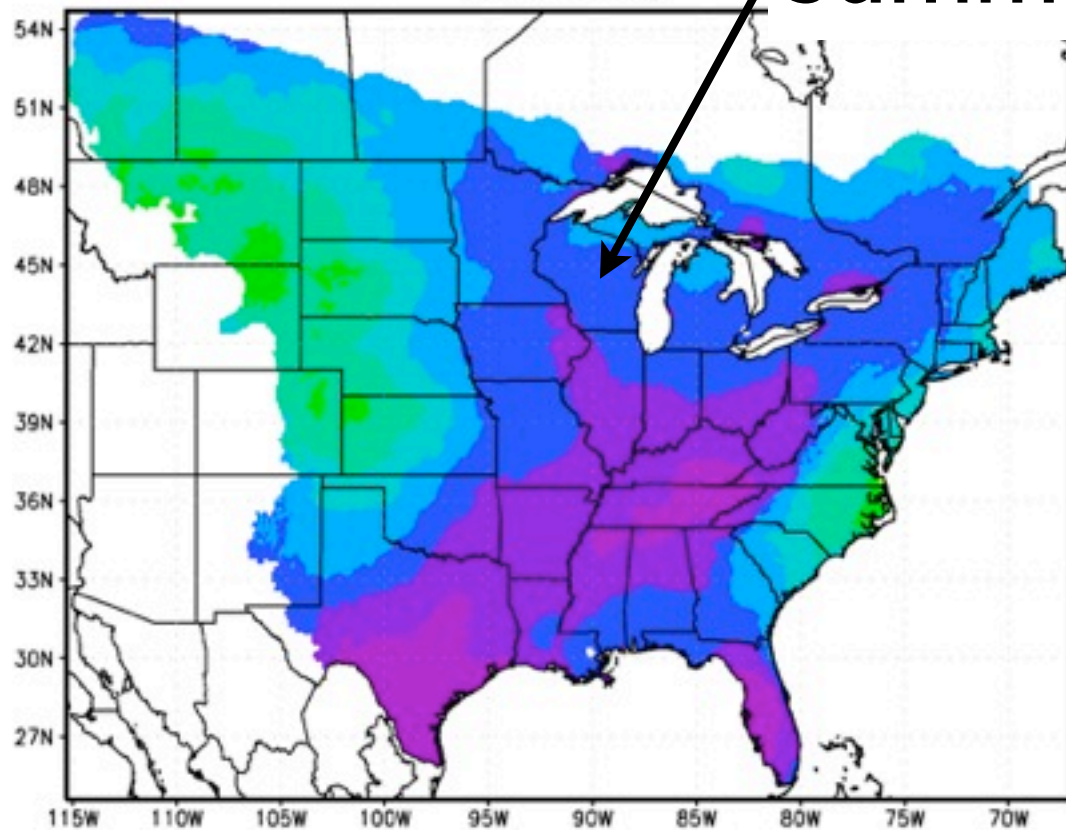
Dec–Feb

Mar–May



Jun–Aug

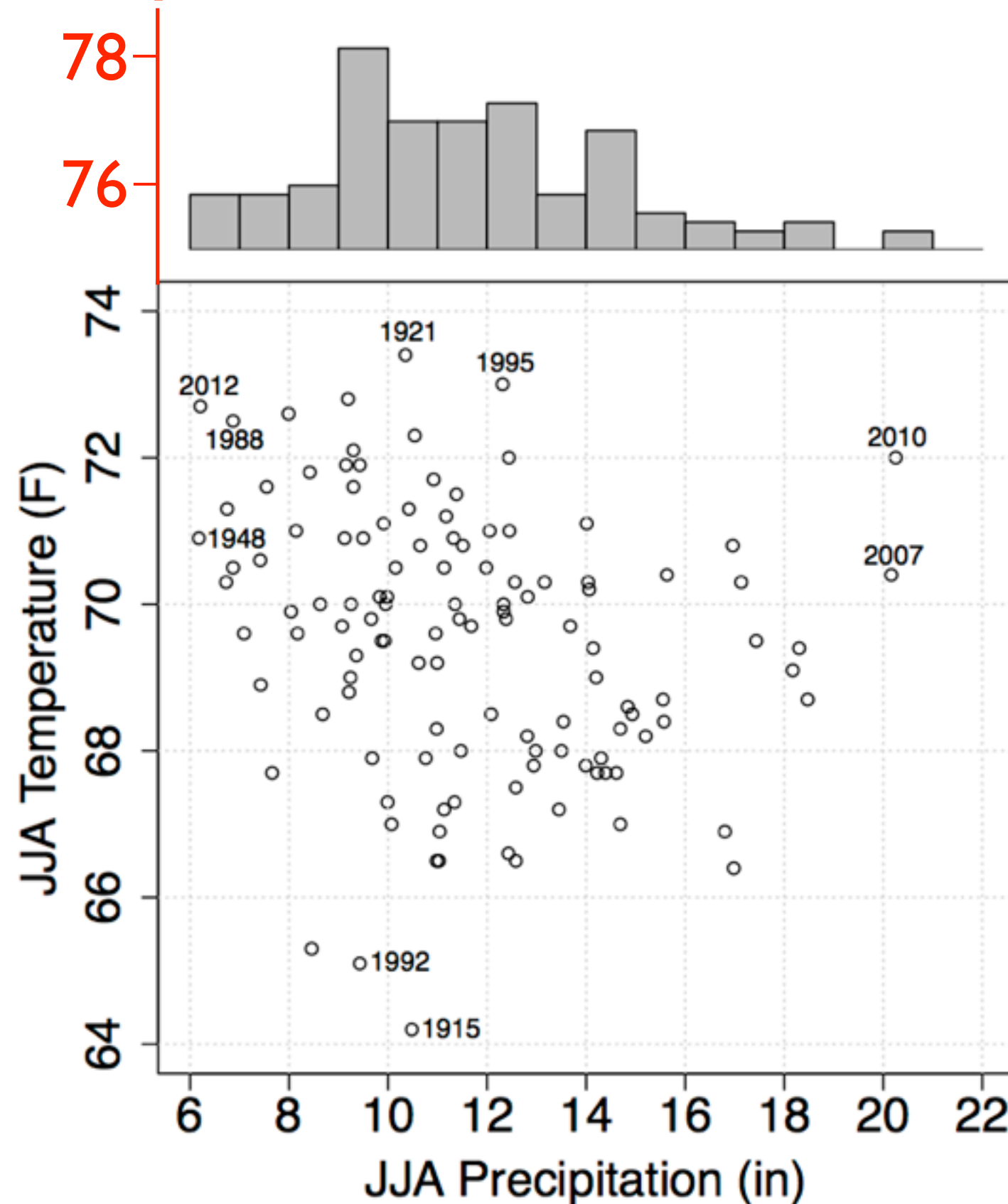
Sep–Nov



Summer + 3-4 °C

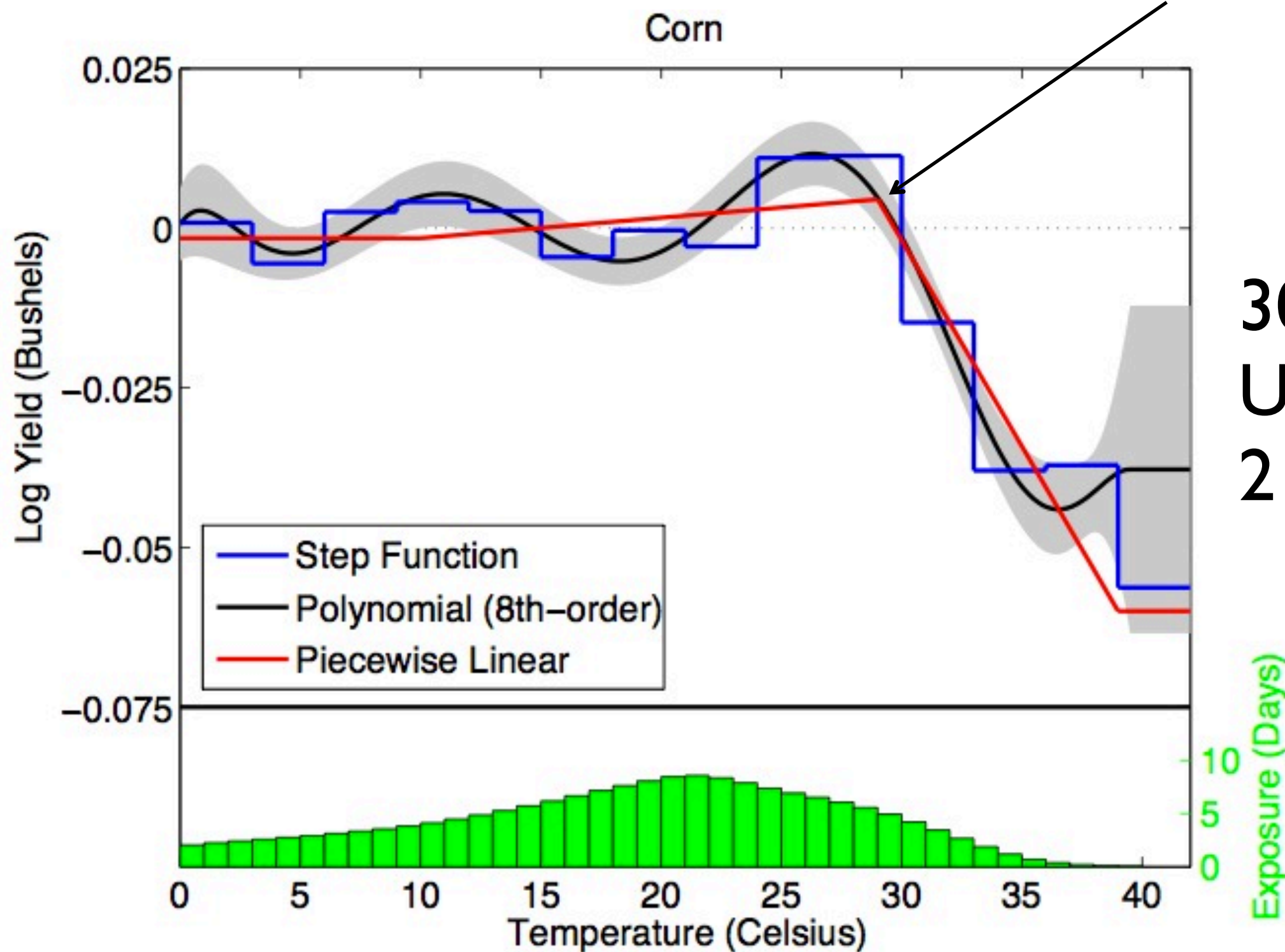
average summers much hotter
than any we've known

2100



Wisconsin
CD8 (southcentral)
1895-2012

Above $\sim 29^{\circ}\text{C}$ (84°F) corn yield drops dramatically



30-82% drop in
US yield, by
2100 possible

Schlenker, W., & Roberts, M. J. (2009). Nonlinear temperature effects indicate severe damages to U.S. crop yields under climate change. *Proceedings of the National Academy of Sciences*, 106(37), 15594–15598. doi:10.1073/pnas.0906865106

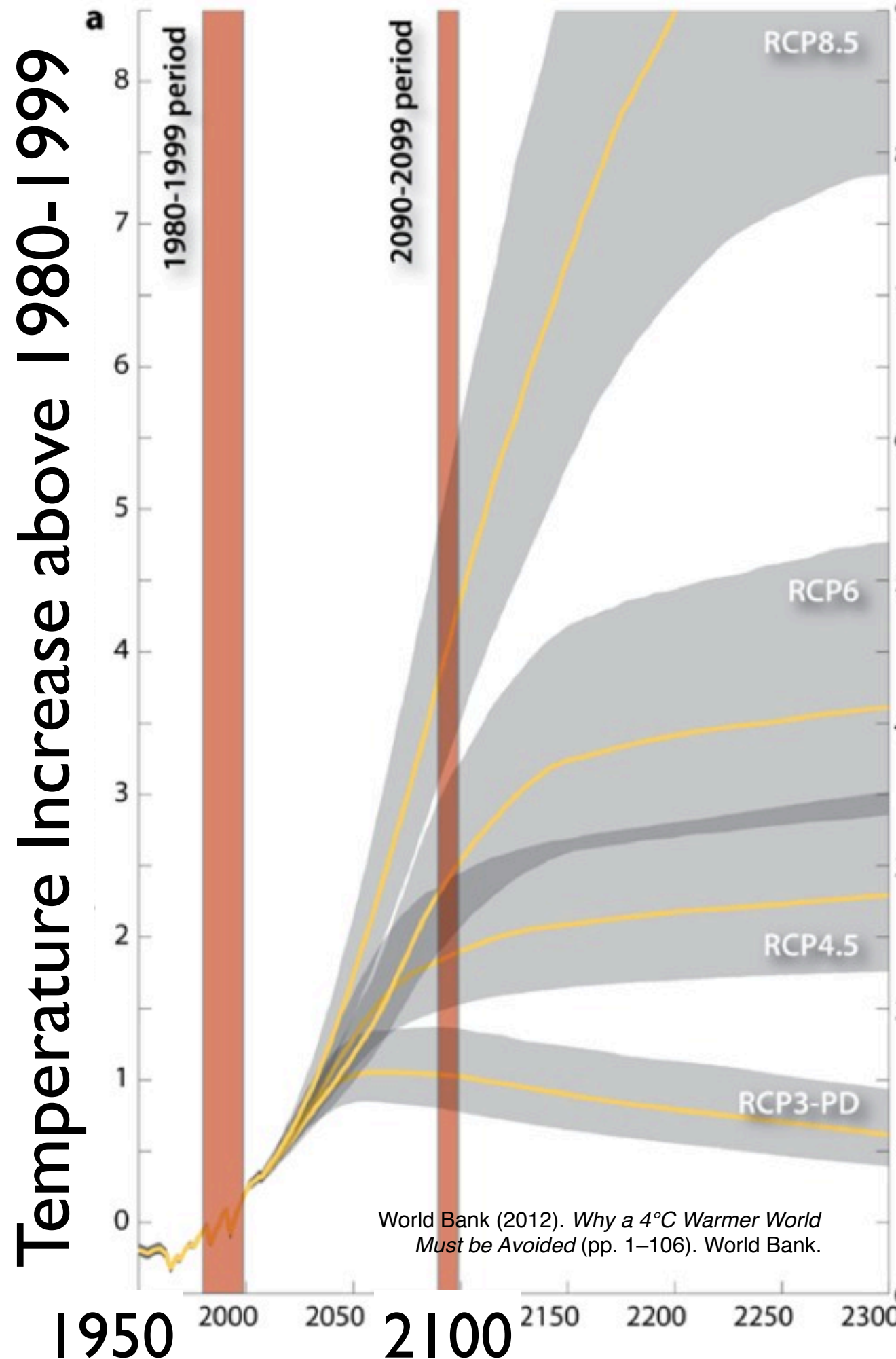
In Wisconsin...

- Warming and rain increases 1976-2006 *explained*
 - 40% of corn yield increase,
 - 35% of soybean
- BUT, for each 1°C (1.8°F) warming will *decrease*
 - corn (13%) and soybean (16%),
 - partially offset by precip increases in some counties

Summary

- No indication that drought will increase
- Temperatures sure to increase
- Crops and animals increasingly impacted by temperature extremes
- Wisconsin agriculture can & will adapt in coming decades, BUT...

We are just getting
started...
already committed to a
much warmer future.





The great significance of
global warming lies.....



elsewhere and
beyond our lifetimes.

<http://erdo.ca/programs/crisis/view/id/217>
[http://blogs.nature.com/news/2009/10/
us_moves_to_protect_polar_bear.html](http://blogs.nature.com/news/2009/10/us_moves_to_protect_polar_bear.html)
[http://kretscham-obercunnersdorf.de/infant-
pictures](http://kretscham-obercunnersdorf.de/infant-pictures)

