Pacific Institute for Climate Solutions

University of Victoria

THE UNIVERSITY OF BRITISH COLUMBIA

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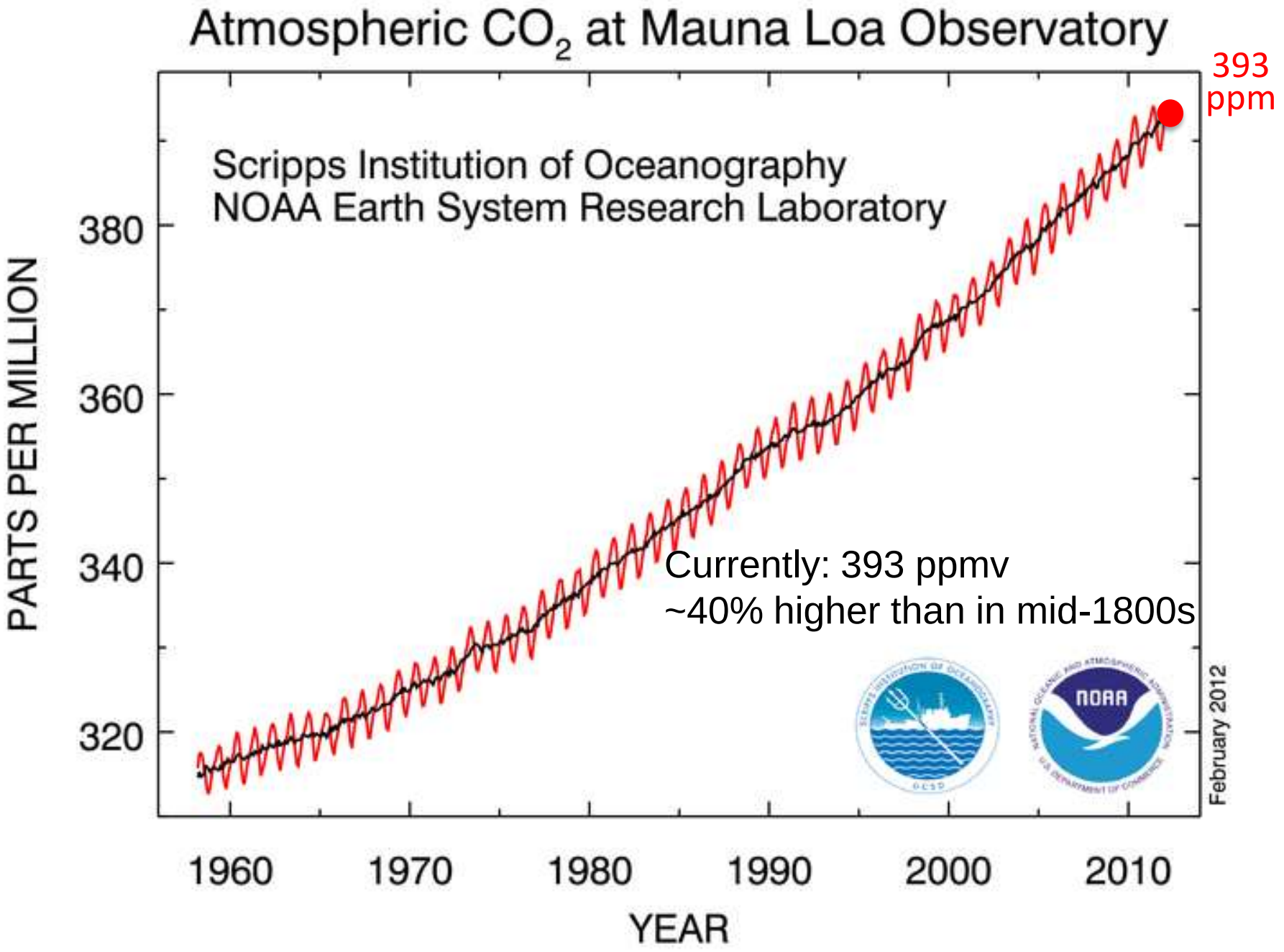
Global Warming and Water: Some Side-Effects

Tom Pedersen,
Executive Director, PICS
University of Victoria

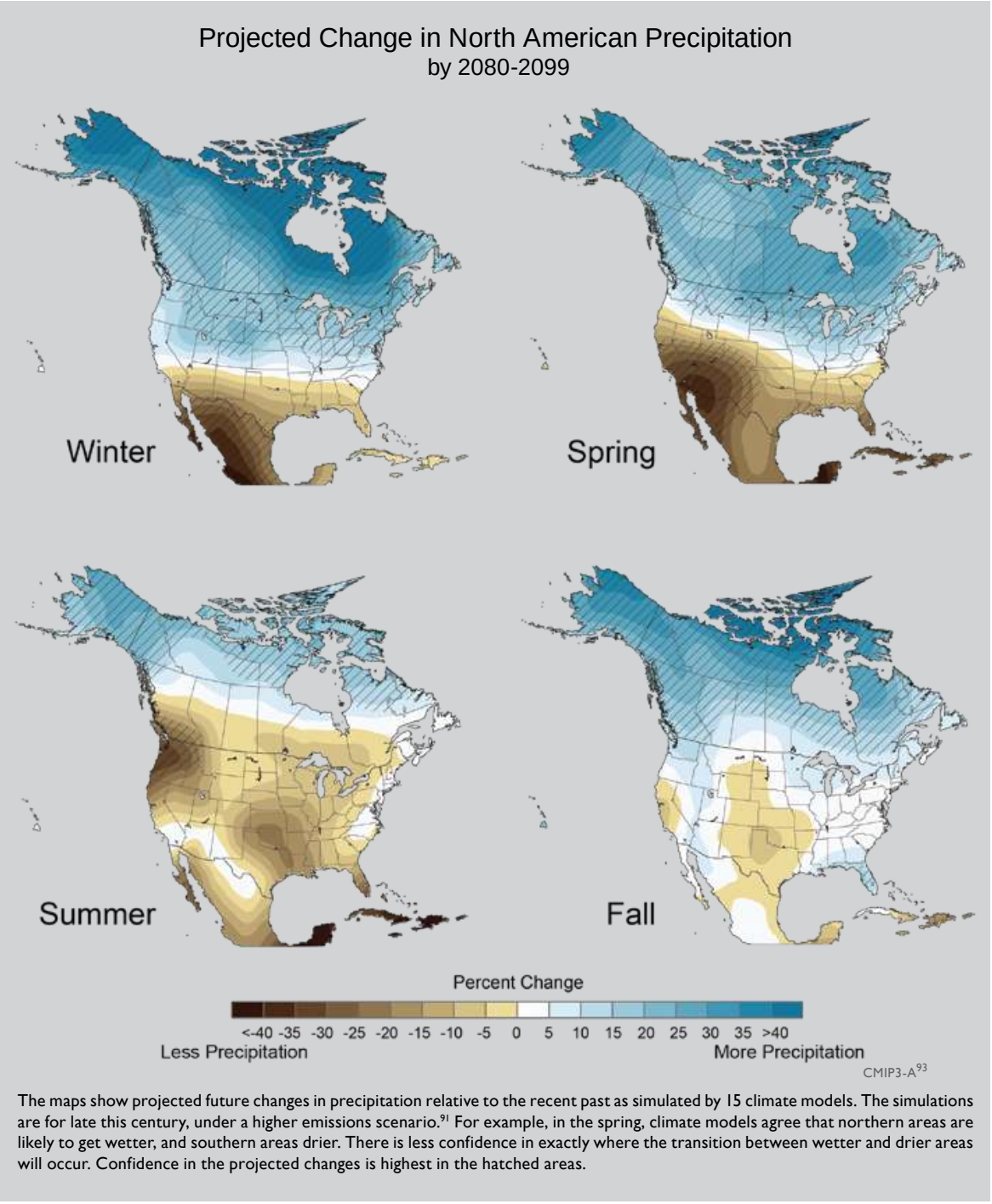
The "Keeling Curve"



*We can expect a **wetter north** and a **drier south**…on average*

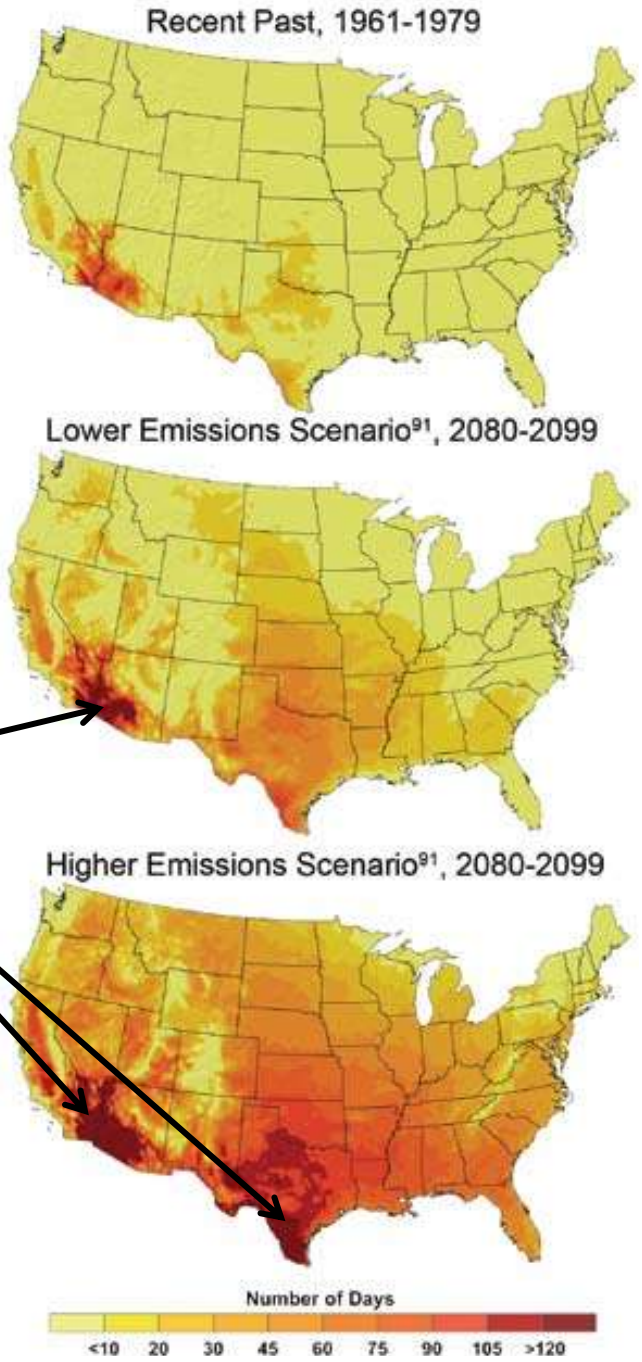
Projections for the change in precipitation **by 2080-2099**, relative to now

Source: 'Global Climate Change Impacts in the United States', US Global Change Research Program Report, 2009



The maps show projected future changes in precipitation relative to the recent past as simulated by 15 climate models. The simulations are for late this century, under a higher emissions scenario.[91] For example, in the spring, climate models agree that northern areas are likely to get wetter, and southern areas drier. There is less confidence in exactly where the transition between wetter and drier areas will occur. Confidence in the projected changes is highest in the hatched areas.

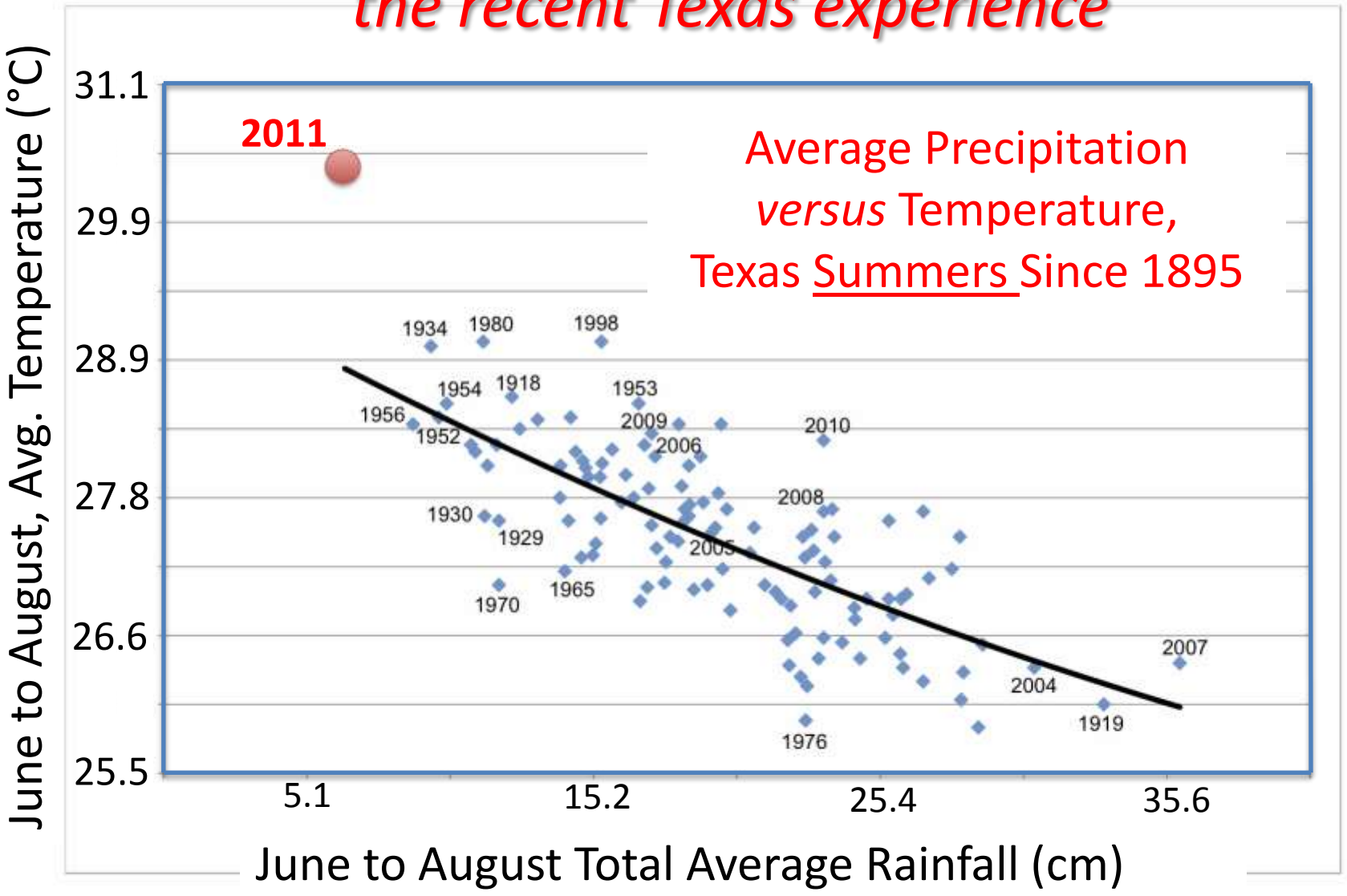
The drier areas will get hotter: *Projected number of days per year by the* ***<u>end of this century</u>*** *with daytime highs <u>above</u> 37.7 °C (100 °F)*



>120 days/year above 37.7 °C

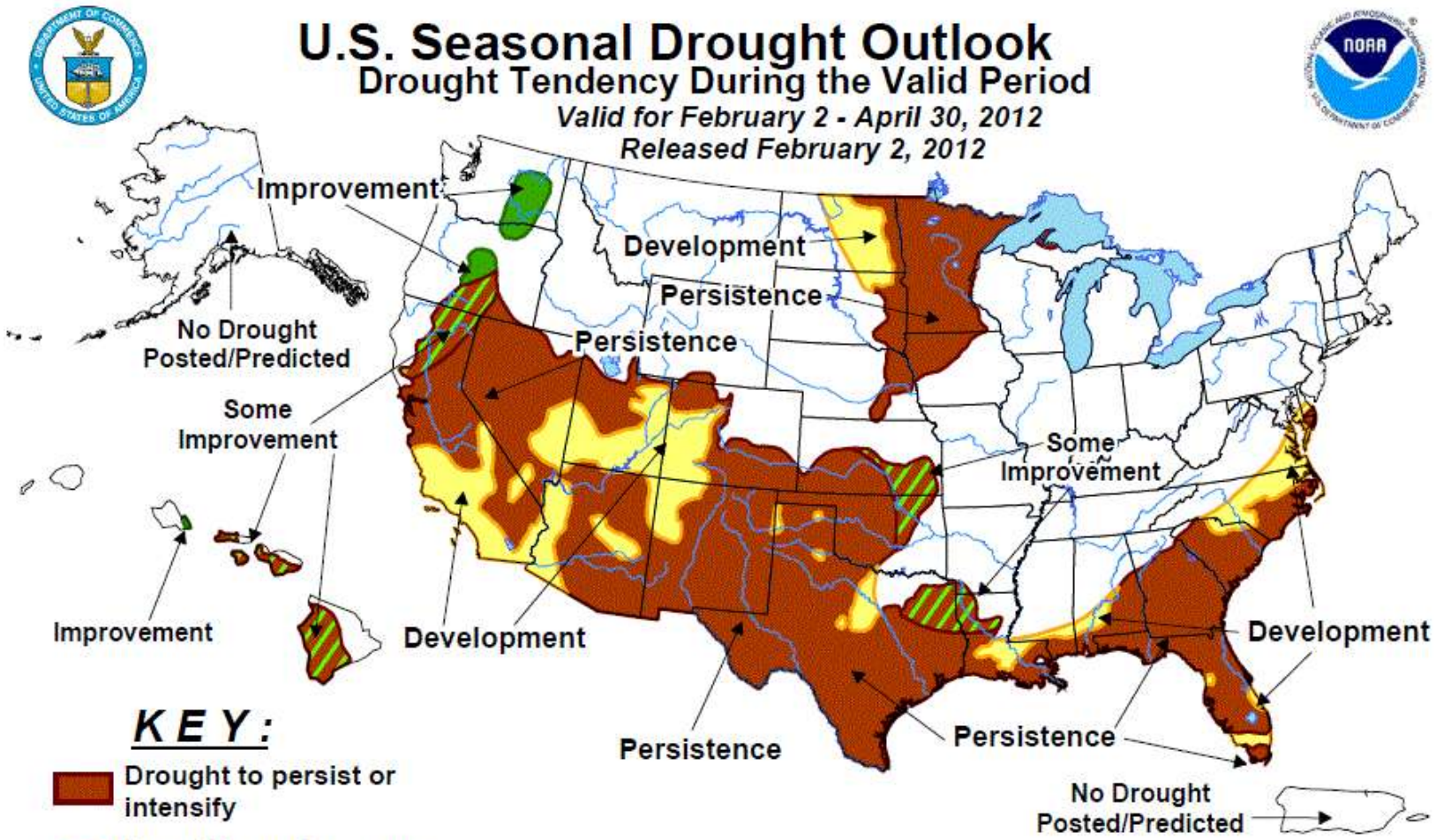
Source: 'Global Climate Change Impacts in the United States', US Global Change Research Program Report, 2009

An example of drier and hotter: the recent Texas experience



Based on original chart prepared by Dr. John Nielsen-Gammon, Texas State Climatologist;
Units converted from Farenheit and inches

U.S. Drought Forecast to April 30, 2012



Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Short-term events -- such as individual storms -- cannot be accurately forecast more than a few days in advance. Use caution for applications -- such as crops -- that can be affected by such events. "Ongoing" drought areas are approximated from the Drought Monitor (D1 to D4 intensity). For weekly drought updates, see the latest U.S. Drought Monitor. NOTE: the green improvement areas imply at least a 1-category improvement in the Drought Monitor intensity levels, but do not necessarily imply drought elimination.

From: "2012 Water for Texas", Texas Water Development Board, January 2012, p. 174

Quick Facts

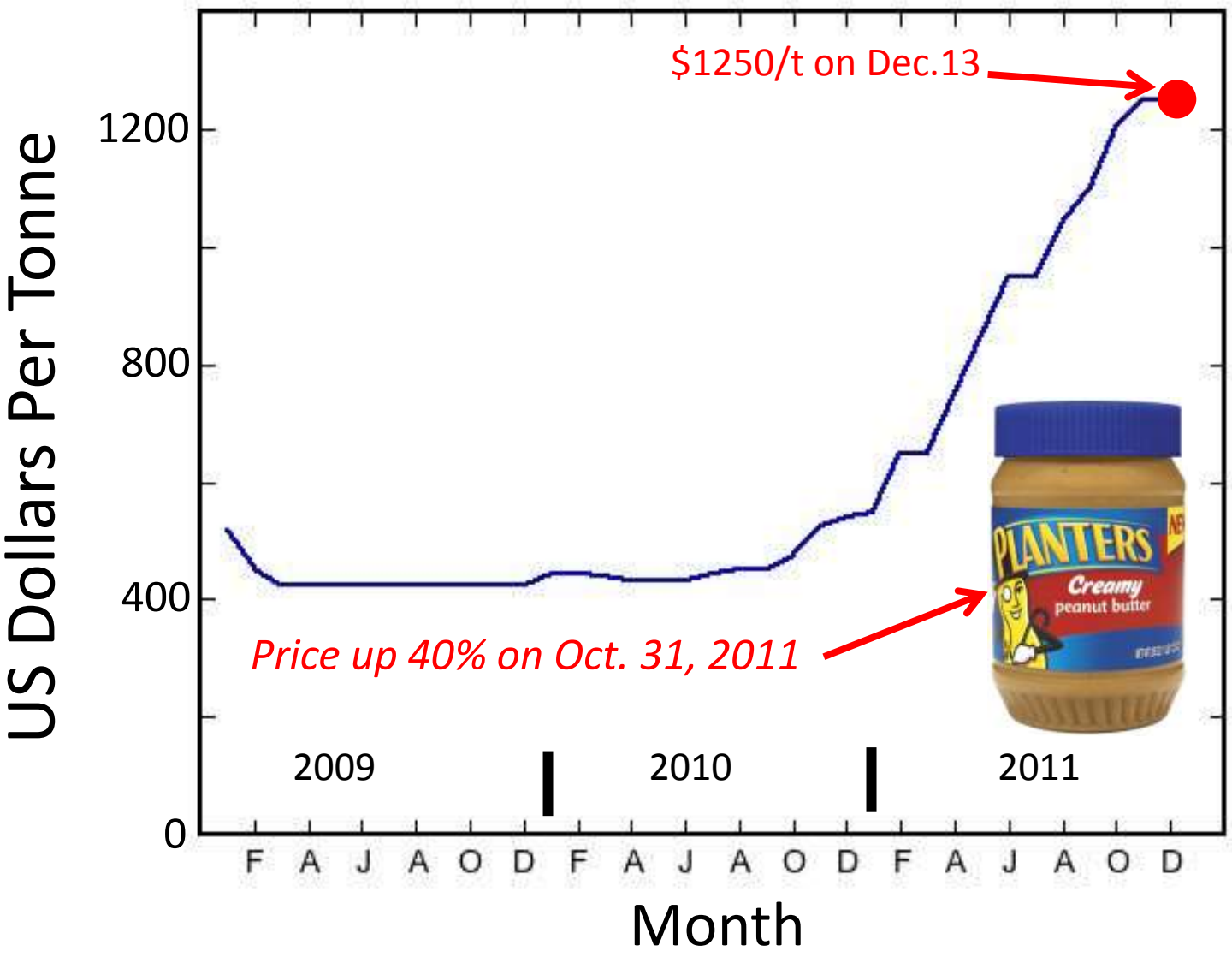
In the event of severe drought conditions, with the current drought conditions showing a representative example, the state faces an immediate need for additional water supplies of 3.6 million acre-feet per year.

If Texas does not implement new water supply projects or management strategies, then homes, businesses, and agricultural enterprises throughout the state are projected to need 8.3 million acre-feet of additional water supply by 2060.

Planning groups were unable to find economically feasible strategies to meet over 2 million acre-feet of annual needs, with the vast majority of the unmet needs in irrigation.

Annual economic losses from not meeting water supply needs could result in a reduction in income of approximately $11.9 billion annually if current drought conditions approach the drought of record, and as much as $115.7 billion annually by 2060, with over a million lost jobs.

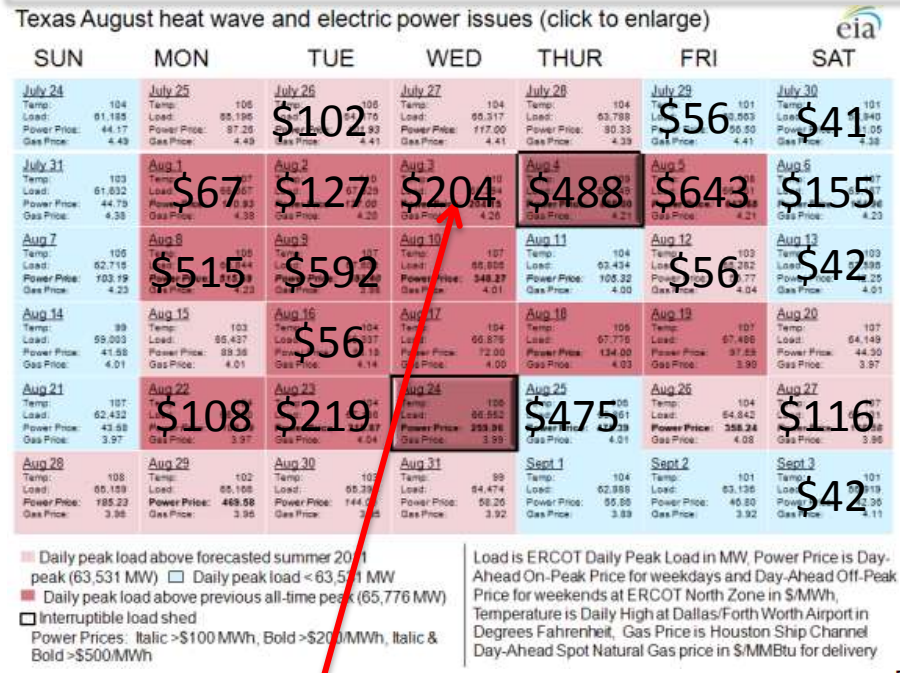
Runner Peanut Prices, USA, 2009-2011

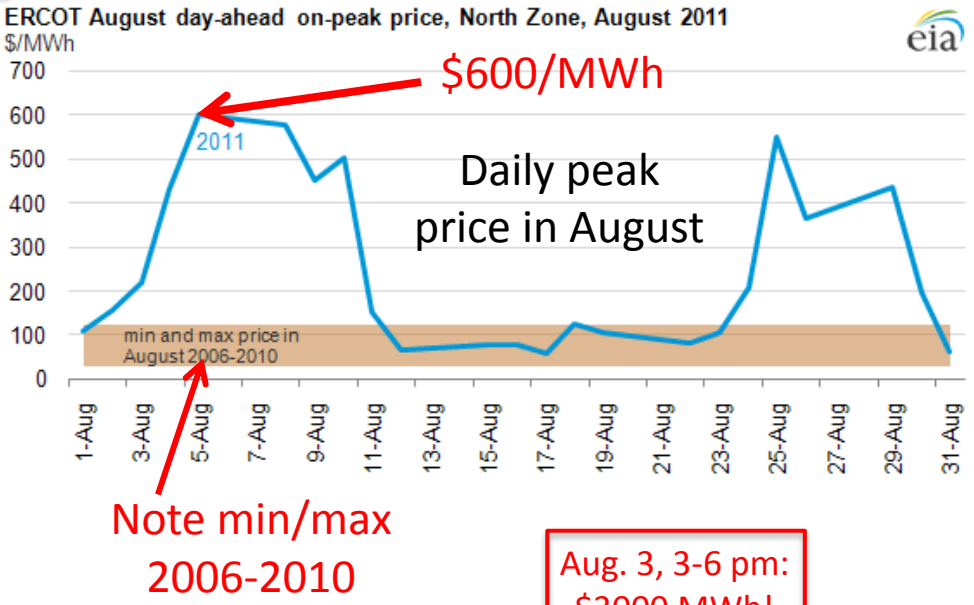


Data: Farm Service Agency, USDA

July 24 to September 3, 2011 Calendar: Record electricity demand days in dark rose. Numbers in black are the day-ahead **off-peak** price.

Energy Reliability Council of Texas August day-ahead **on-peak** price, Dallas-Fort Worth region, August 2011

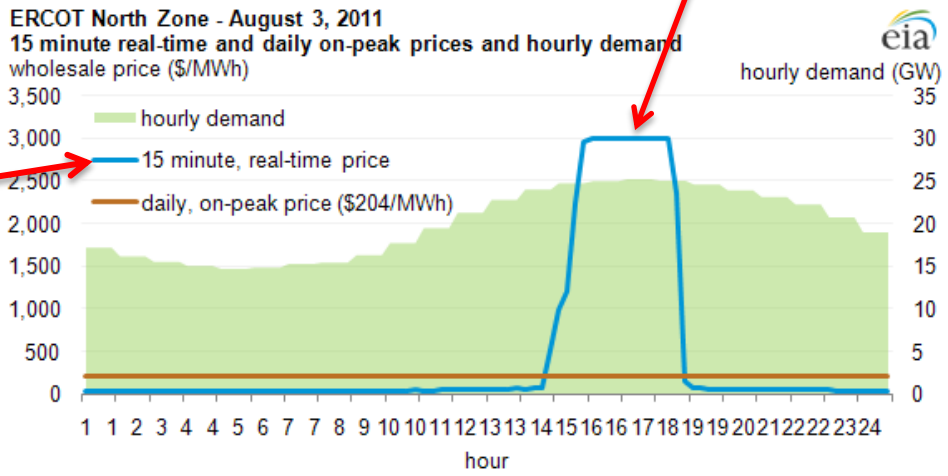




Note min/max 2006-2010

Aug. 3, 2011: Dallas-Fort Worth Airport, 110° F (43° C)

Aug. 3, 3-6 pm: $3000 MWh!

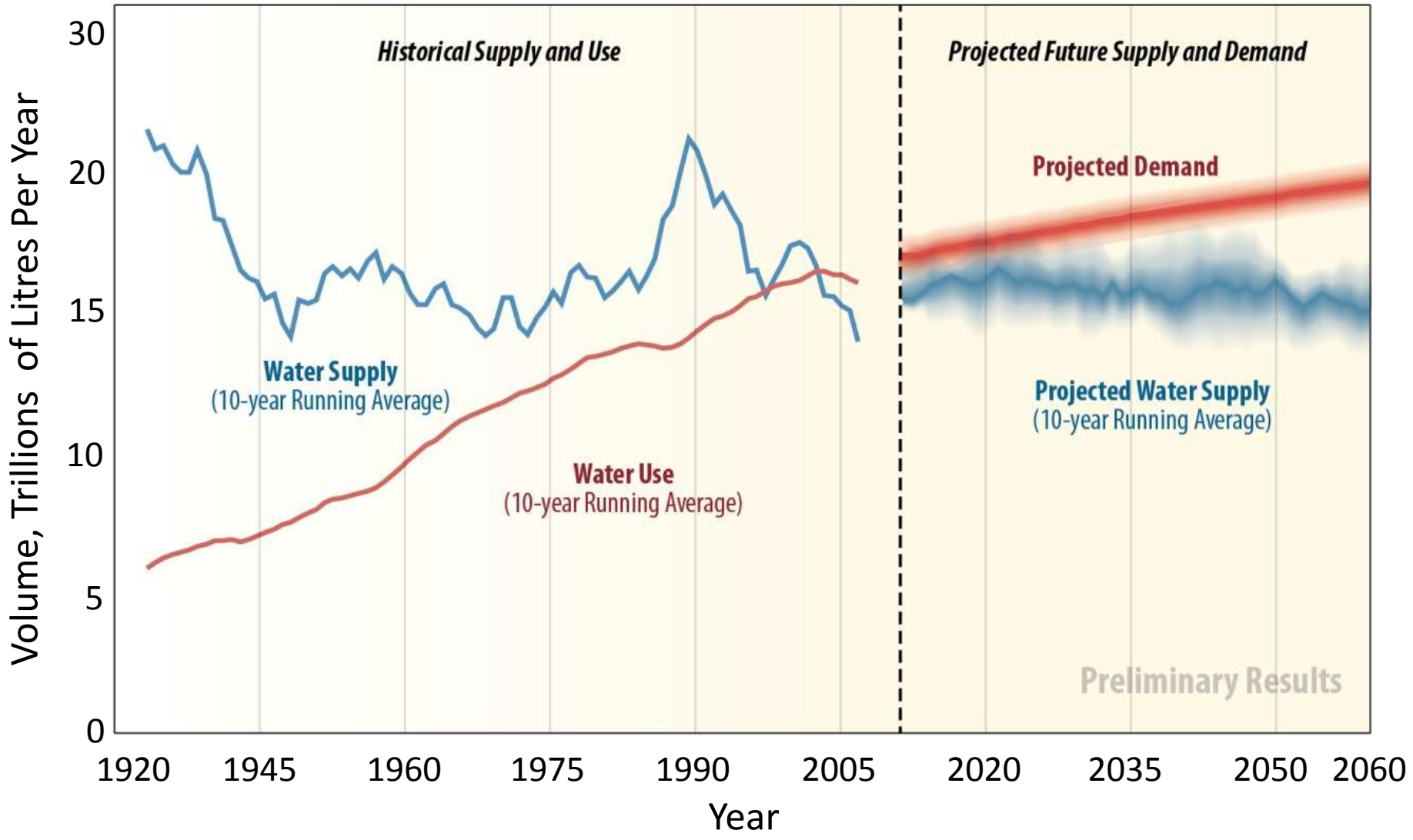


http://205.254.135.24/todayinenergy/detail.cfm?id=3010

Colorado River Watershed (shaded)

M.J. Cohen, Municipal Deliveries of Colorado River Basin Water, Pacific Institute,2011

Projected Future Colorado River Basin Water Supply and Demand



US Bureau of Reclamation, Status Webinar, December 6, 2011

Implications for the future:

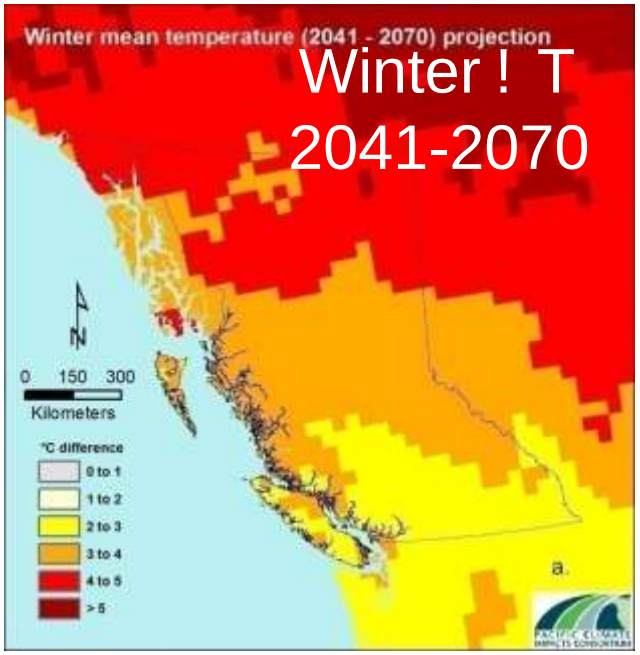
- Colorado River supplies 100% of the irrigation water for the Imperial Valley, southern California, the source of much of the fruits and vegetables consumed in North America in winter.

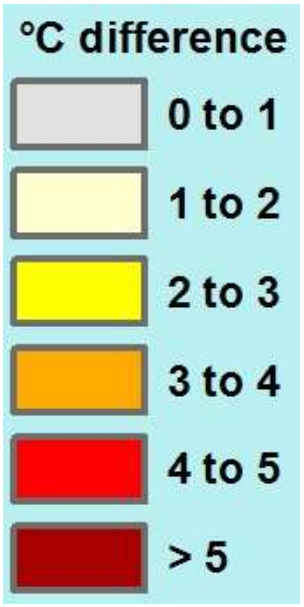
- Growing tension between urban/residential and agricultural users of diminishing water.

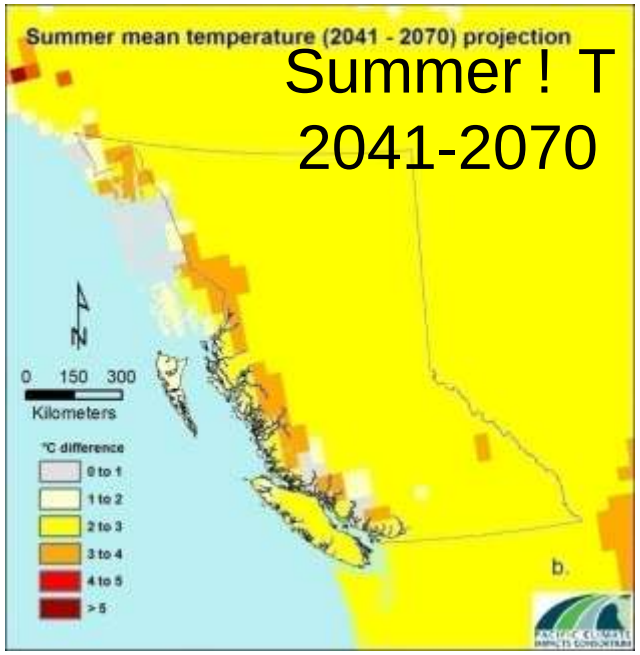
- Growing tension among bordering states.

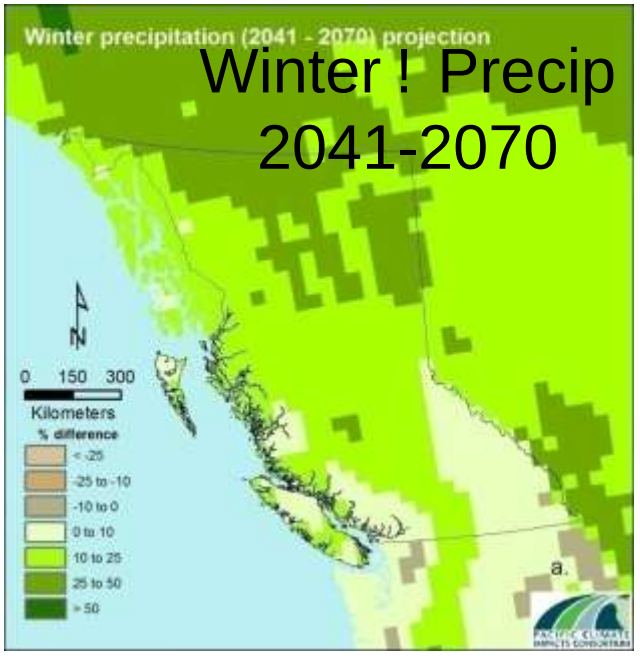
- The Hoover Dam on the Colorado River (Lake Mead) generates 2 GW of electricity (1/6 of BC's total capacity) when the reservoir is at full volume…it hasn't been near full for the last 13 years, and electricity production is down ~30%.

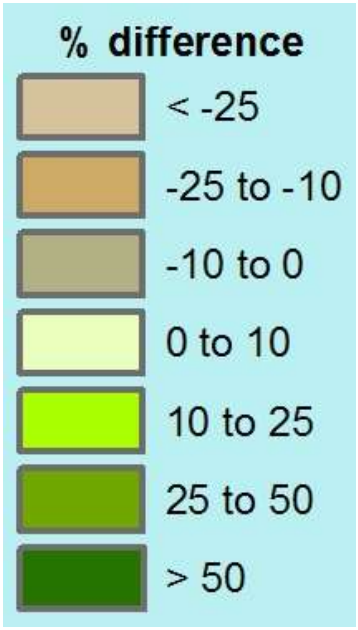
PCIC Results

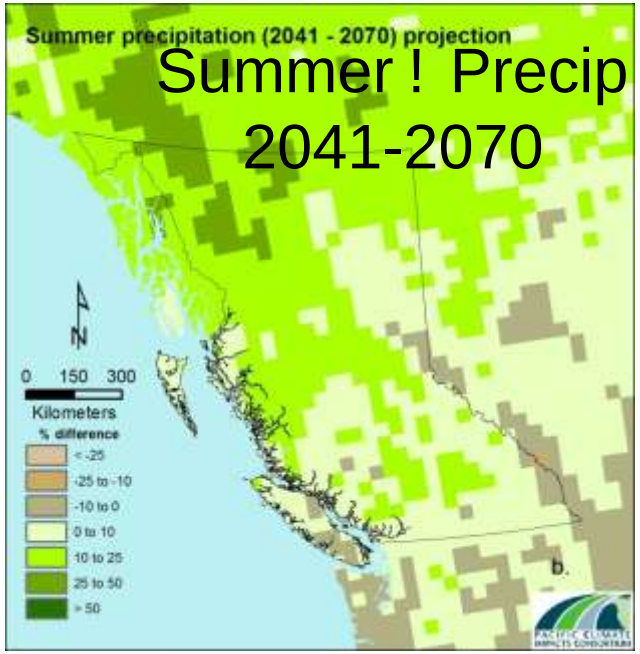






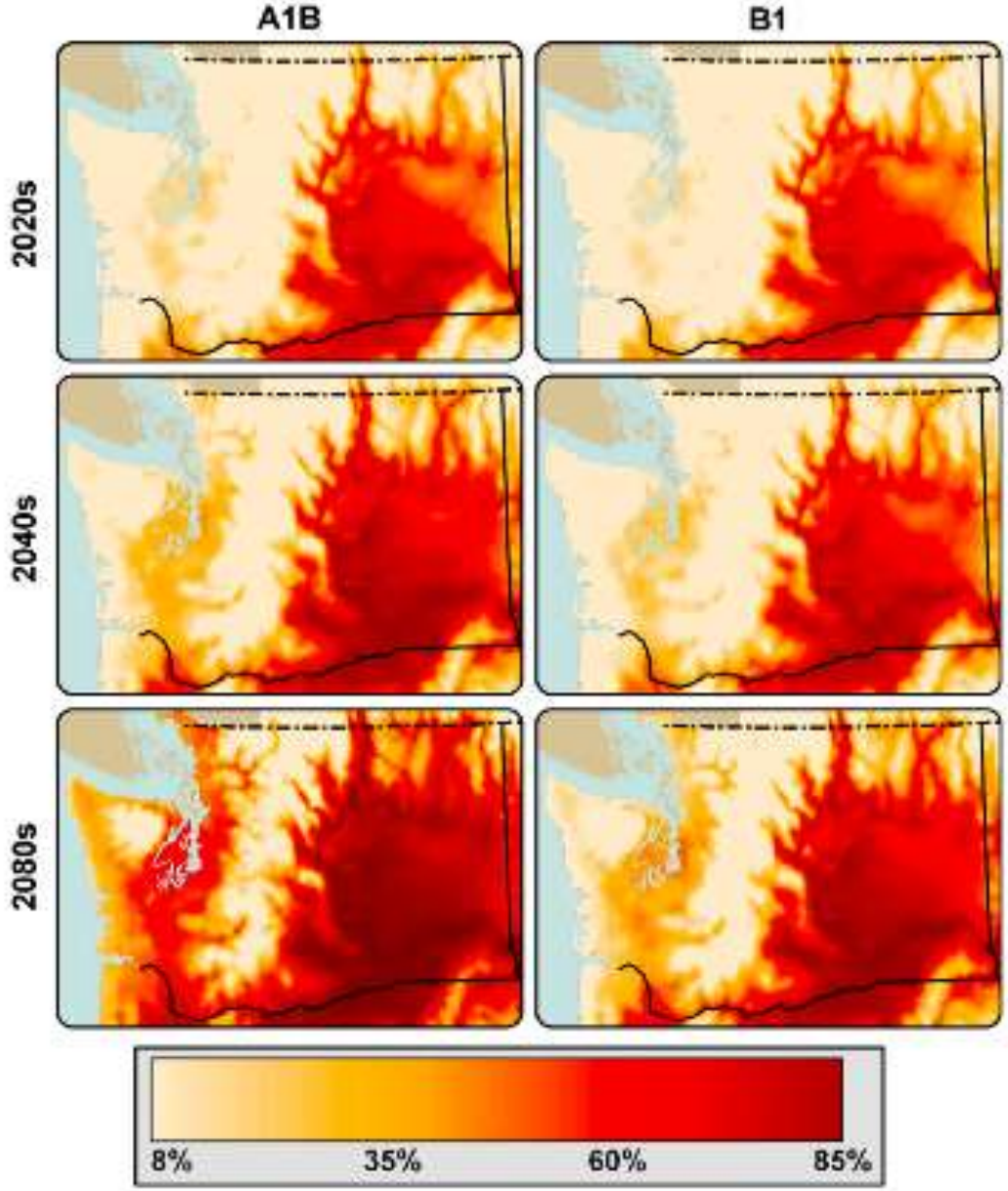






Courtesy Trevor Murdock

Projected Air Conditioning Market Penetration, Washington State



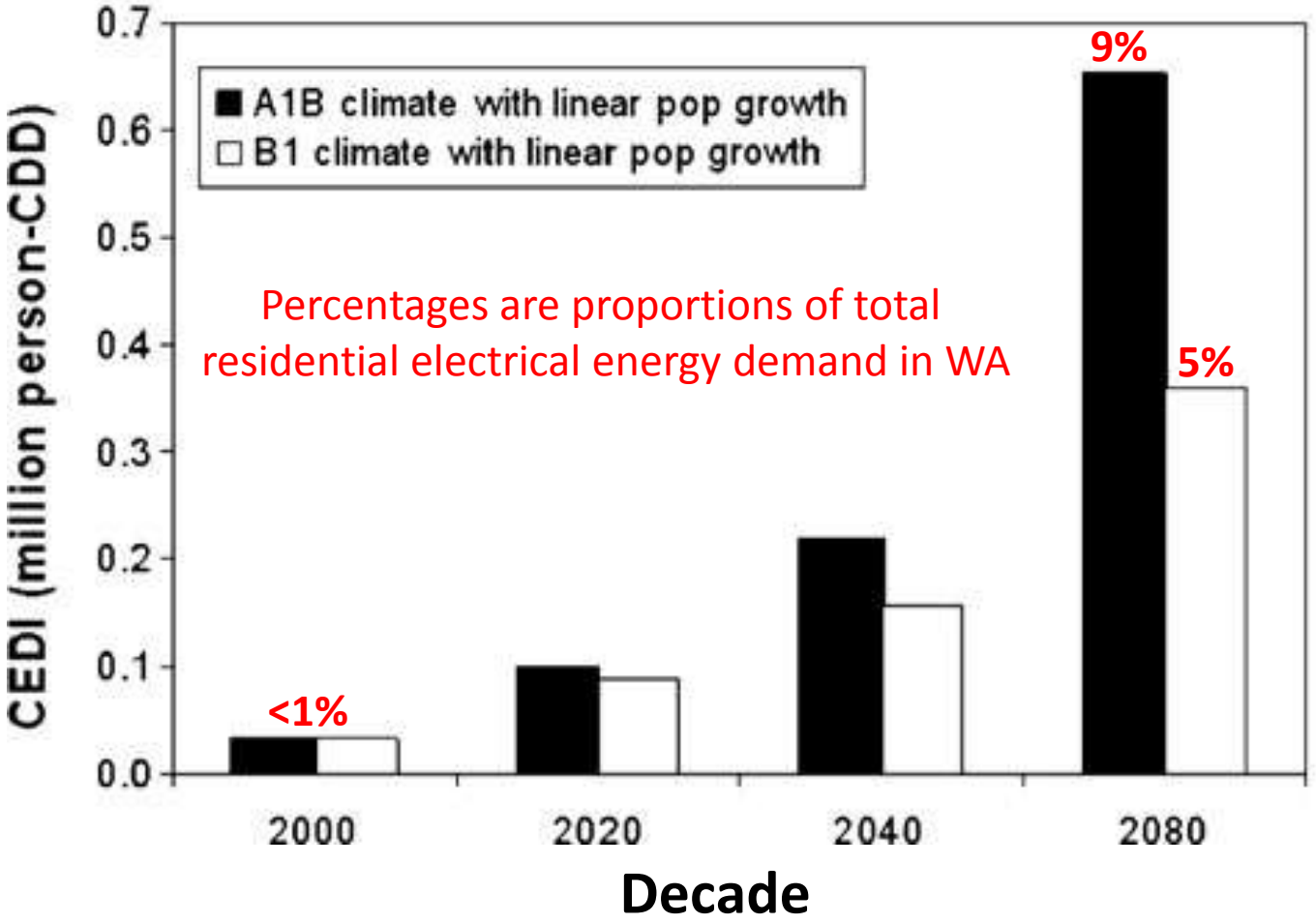
2020s

2040s

2080s

Alan Hamlet et al., 2010, Climatic Change

Cooling Energy Demand Index, Washington State



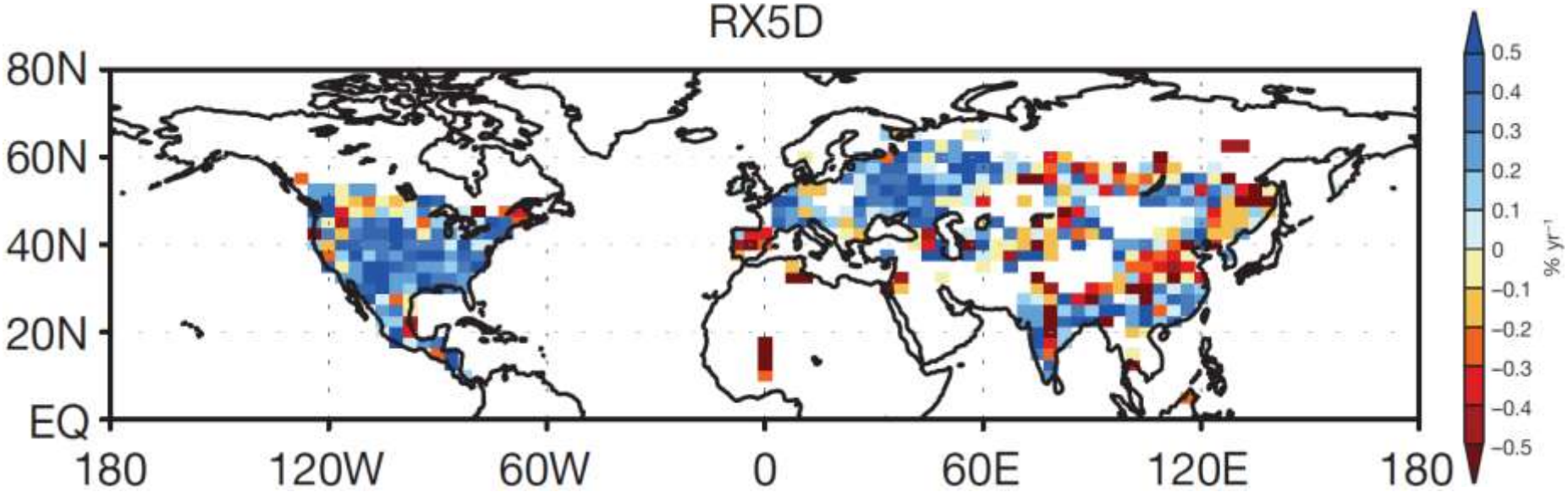
"By the 2080s hydropower production [in the Columbia River Basin] is projected to…***decrease*** by about 17.1–20.8% in summer…"

Alan Hamlet et al., 2010, Climatic Change

Summary

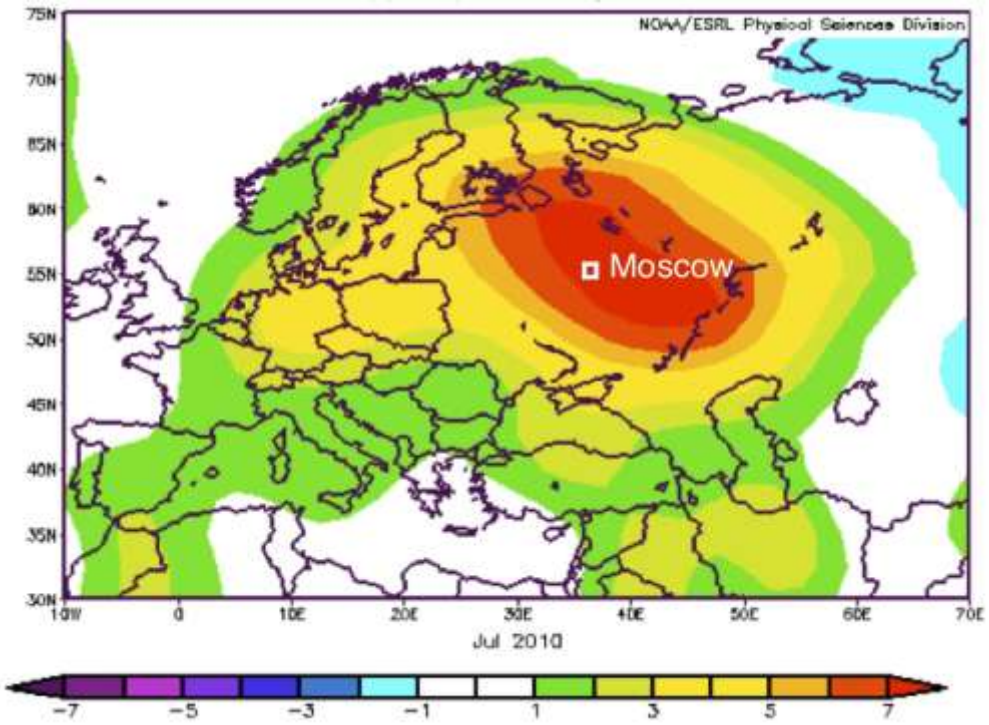
- the northern half of Canada will likely be wetter on average in future decades.
- southwestern Canada will likely see drier, warmer summers in future decades.
- farther south, increased warming and drying will affect electricity demand (impacting BC hydropower trade) and have negative impacts on food production (thus, higher food costs in Canada)

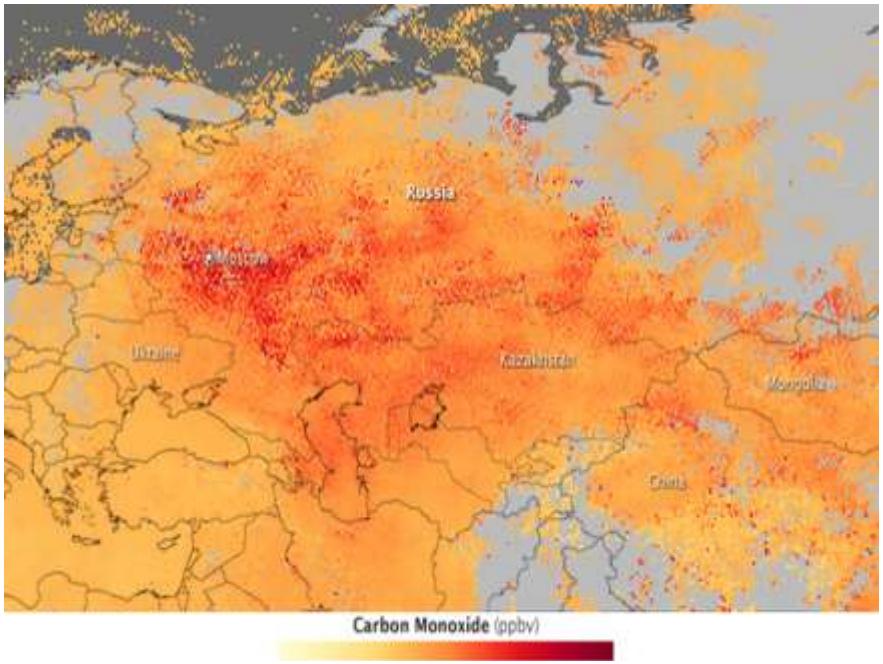
Trends in Extreme Precipitation Indices, 5-day events, Northern Hemisphere, 1951-1999



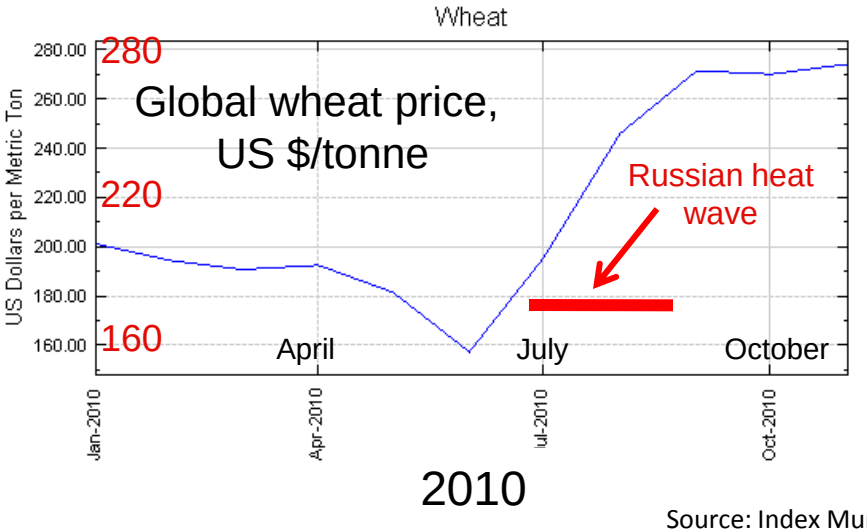
From: Min, Zhang, Zwiers and Hegerl, Nature, February 17, 2011, "Human contribution to more-intense precipitation extremes"

Russian heat wave, July-August, 2010





- 10,935 “excess” deaths (a 60% increase) in Moscow in July and August, 2010, attributed to heat, smog or smoke.
- ~25% of Russian grain crop lost (economic loss roughly $7-15 billion)

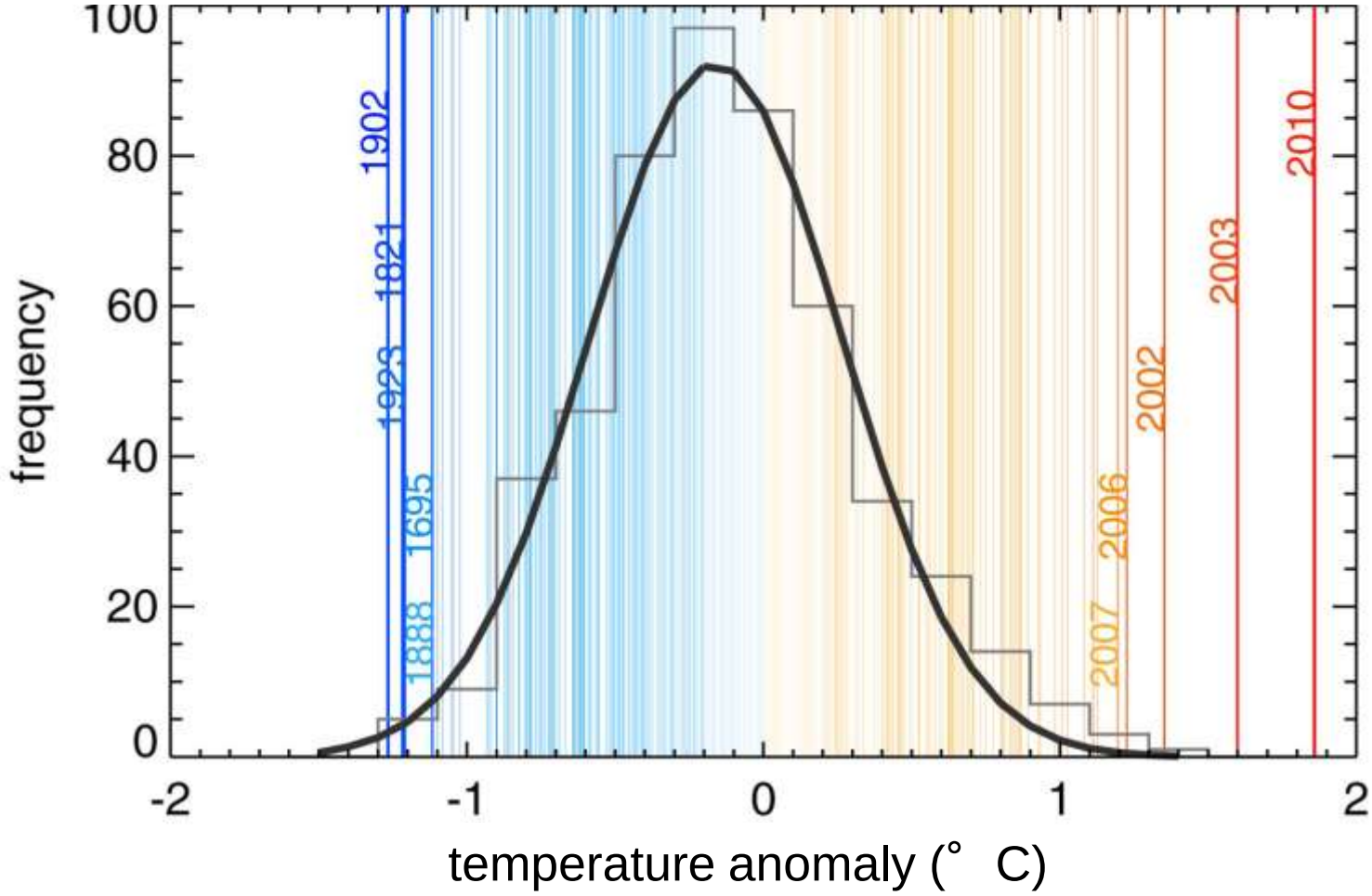


Source: AFP, Moscow

Source: Index Mundi

*We can also expect **more-extreme warm events**…*

European Summer Land Temperature Anomalies, 1500-2010 C.E.



Grey bars represent 1500-2002

Barriopedro et al., Science, 17 March, 2011