



Eastern Lands and Resources Council & Western States Land Commissioners Association

Joint Spring Conference April 7, 2008

USGS Science on the Land
Mark Myers, Director, U.S. Geological Survey

U.S. Department of the Interior
U.S. Geological Survey

Humans become agents of environmental change

Ecological equilibrium disturbed

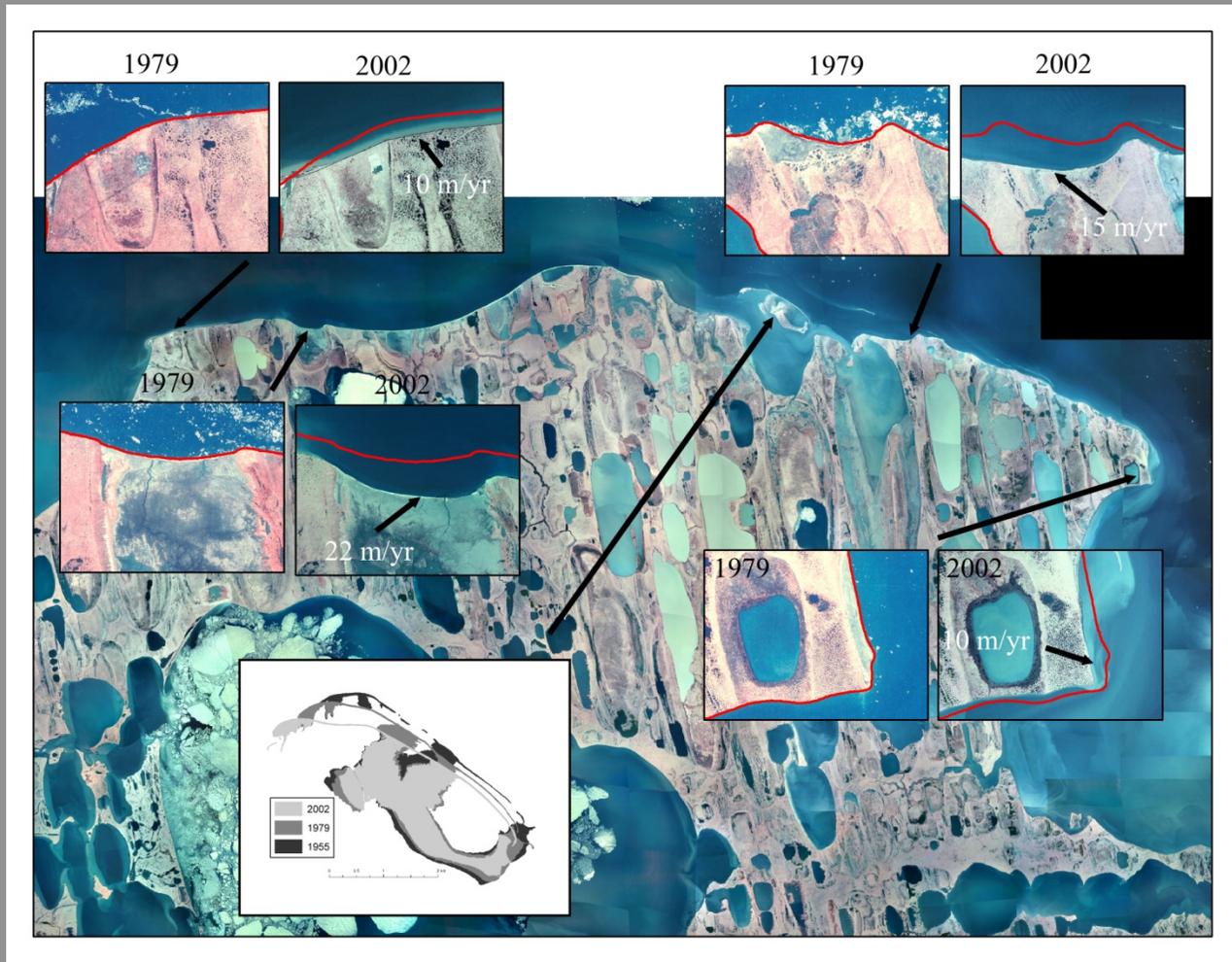
Human-induced changes on a global scale

Approaching thresholds of ecosystems

Threats to earth resources

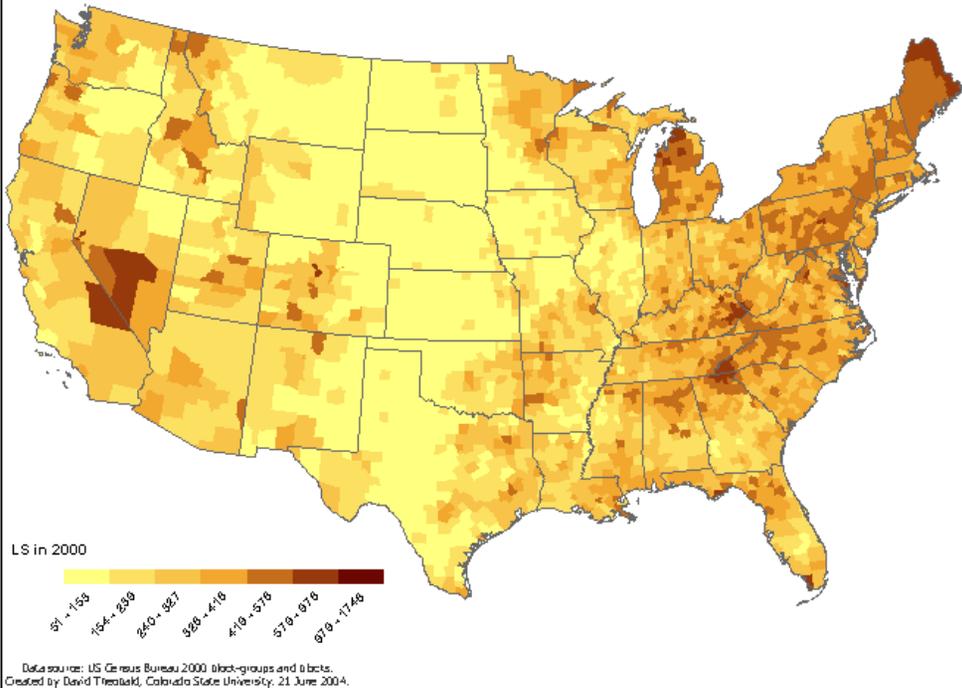


Coastal Erosion NPRA



Population growth and Land Use Change

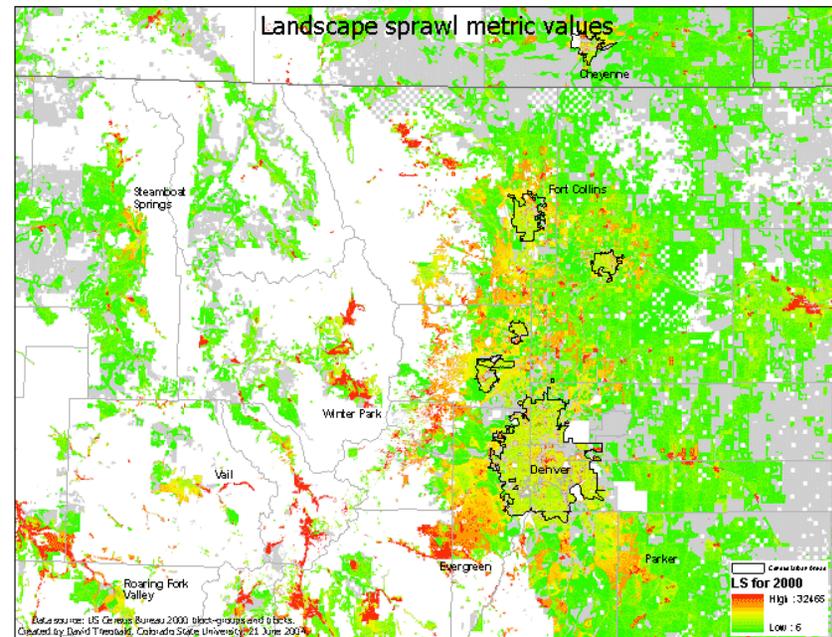
County-averaged landscape sprawl metric values



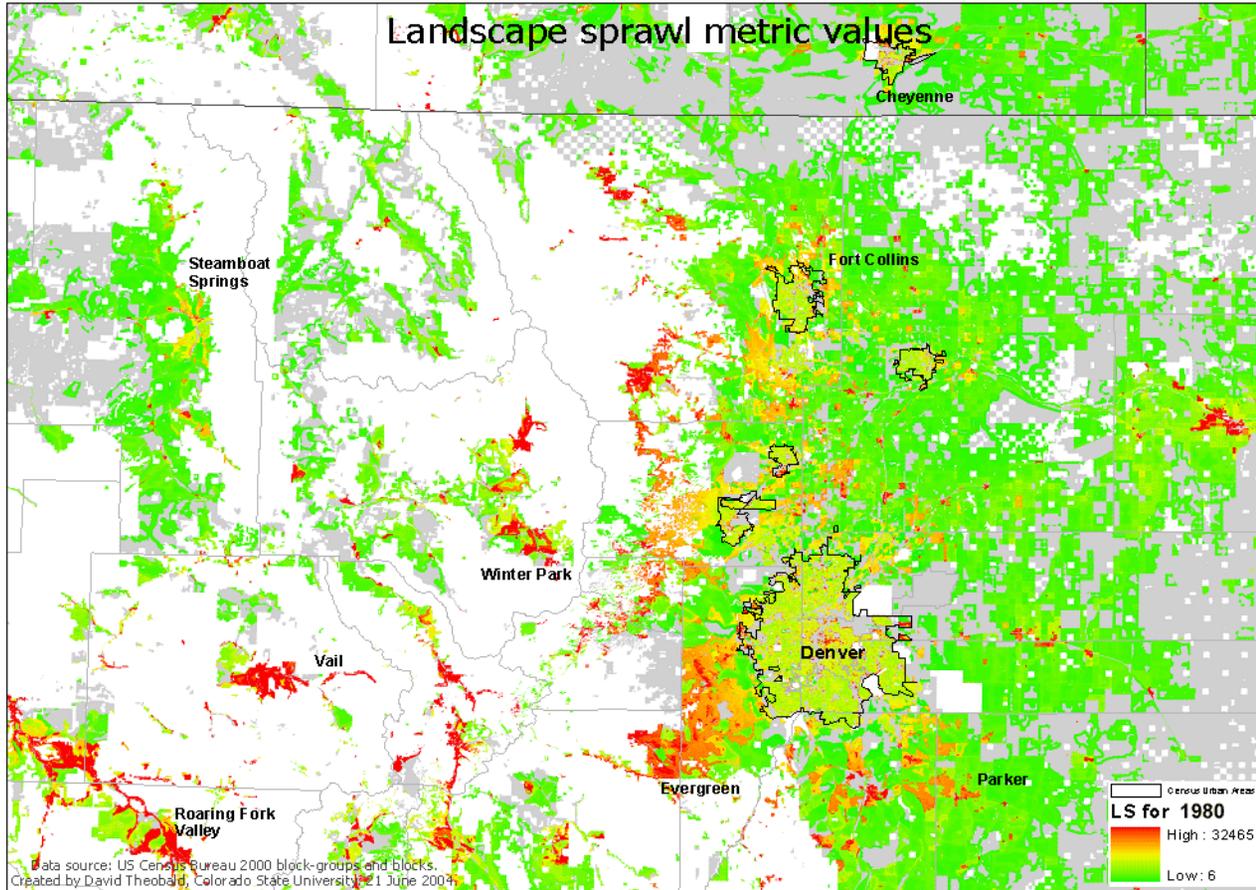
From Theobald (2005) Ecology and Society

<http://www.ecologyandsociety.org/vol10/iss1/art32/>

Landscape sprawl metric values



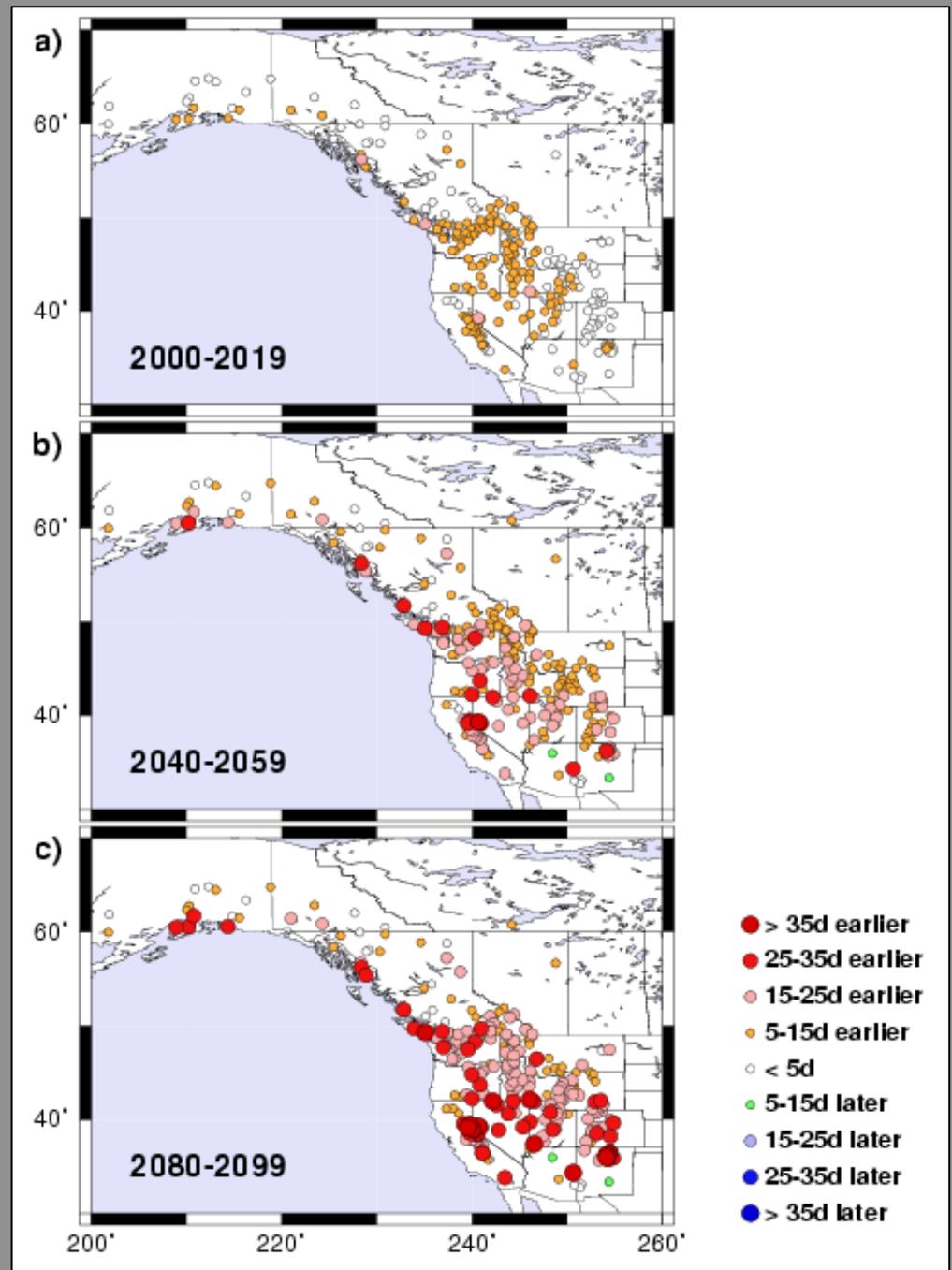
Landscape sprawl metric values



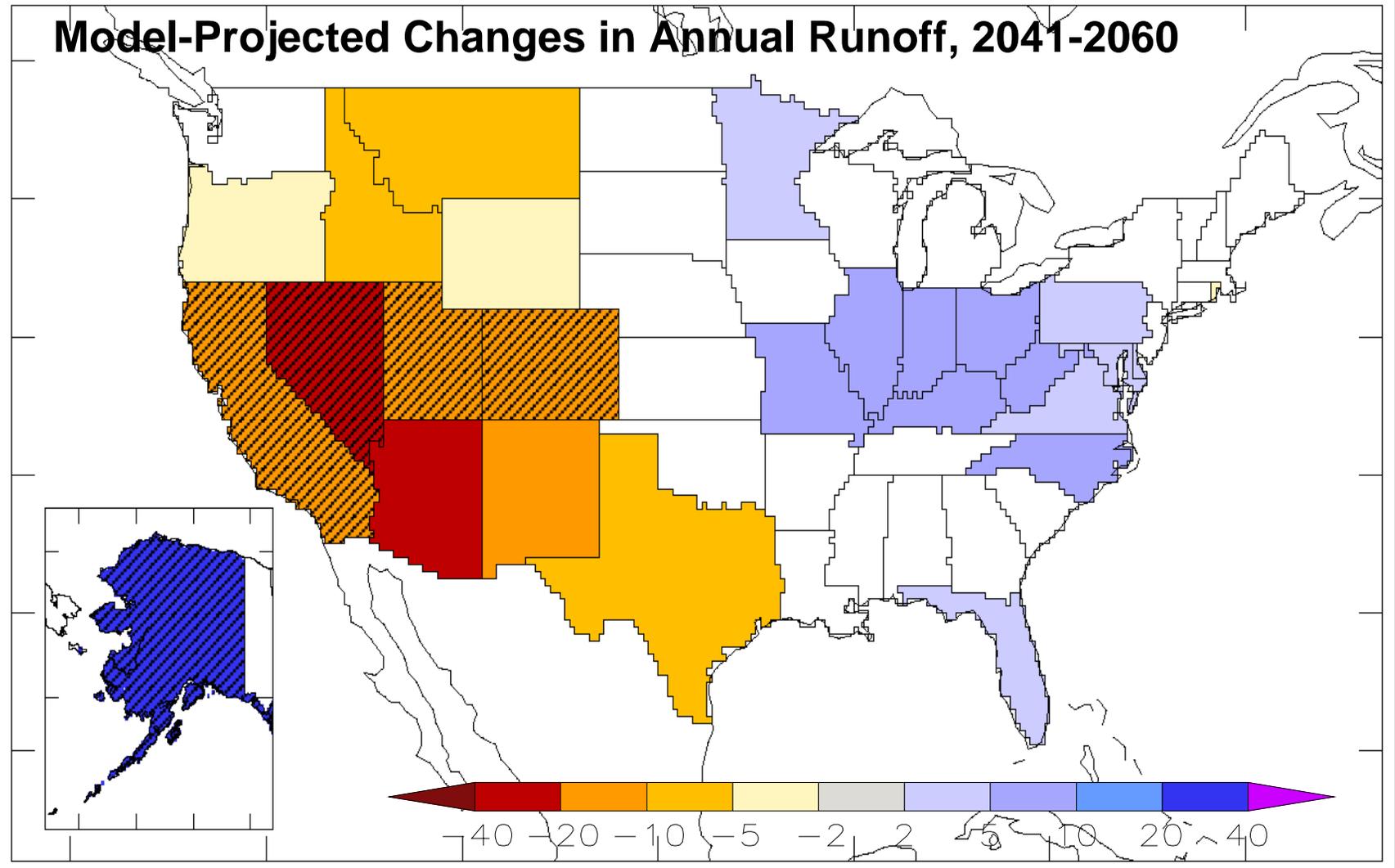
Projections for Center of Mass Timing B1 scenario (+2.5°C)

~15 to 35 days earlier
by late 21st century

Courtesy of Mike Dettinger



Model-Projected Changes in Annual Runoff, 2041-2060

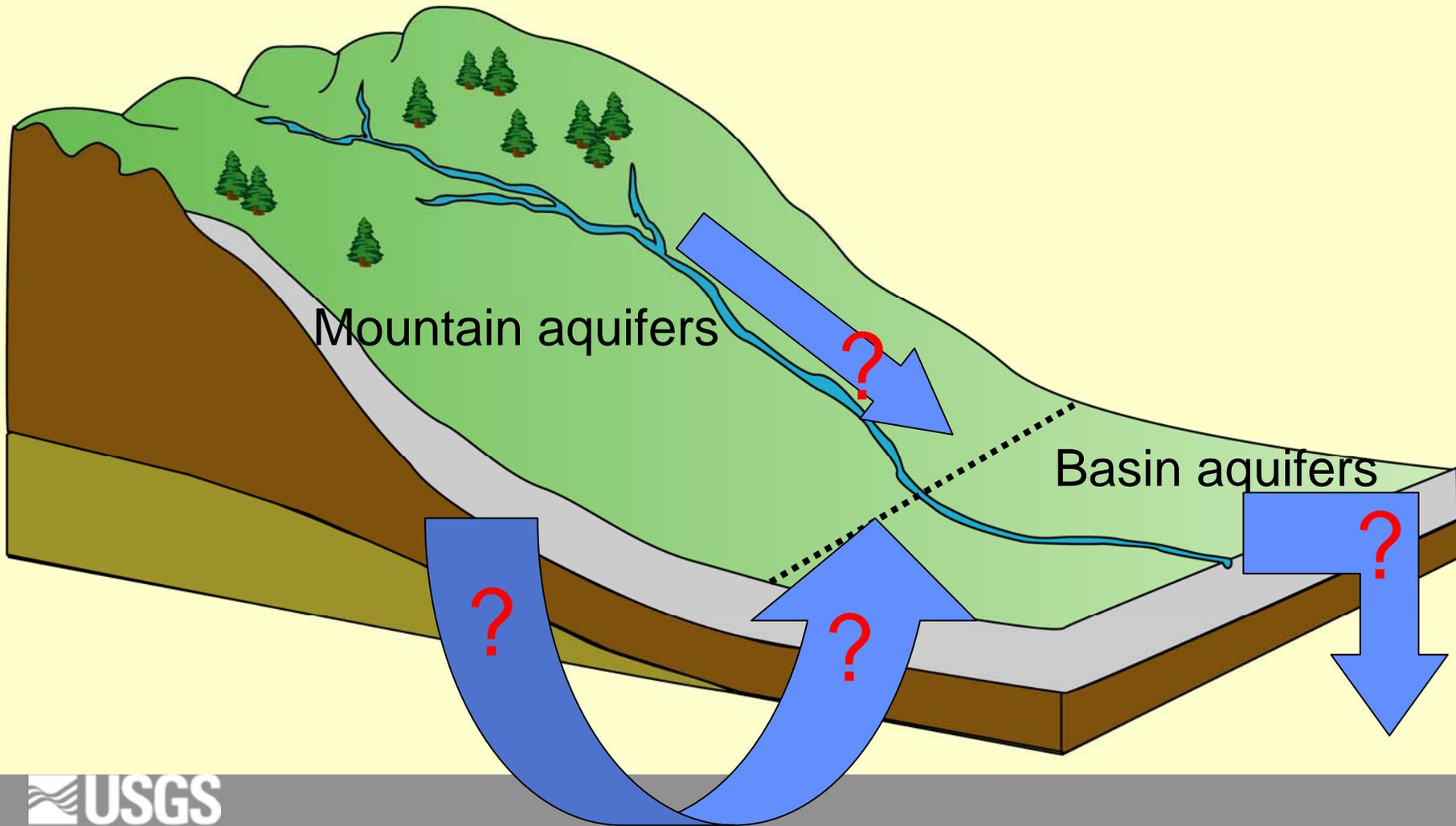


(After Milly, P.C.D., K.A. Dunne, A.V. Vecchia, Global pattern of trends in streamflow and water availability in a changing climate, *Nature*, 438, 347-350, 2005.)

With mountain recharge at risk,

Groundwater inputs to upland streams at risk...

Recharge to basin aquifers across mountain fronts may also change.

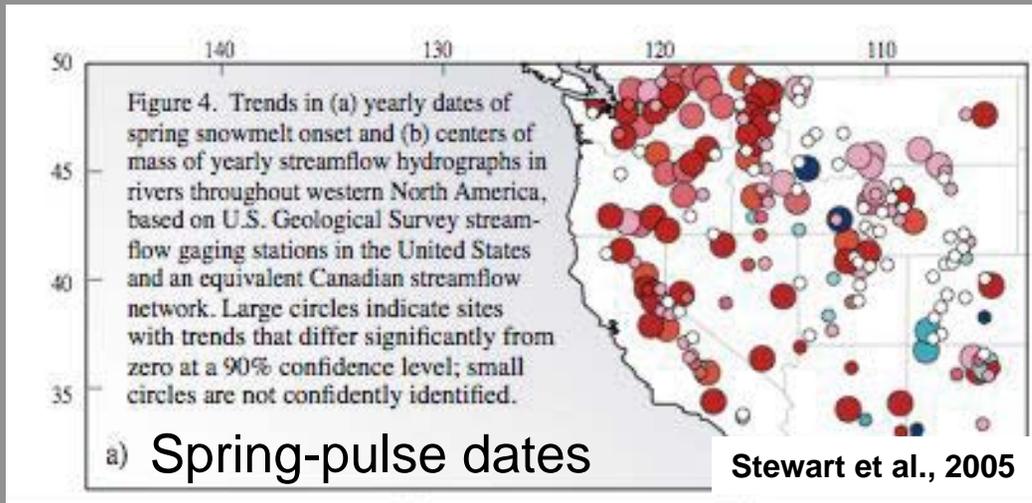
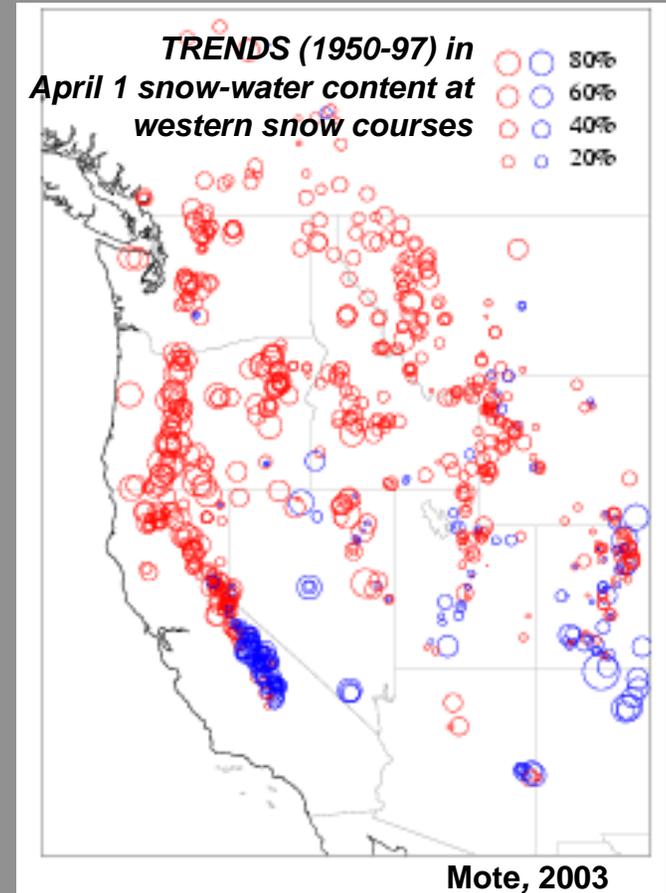
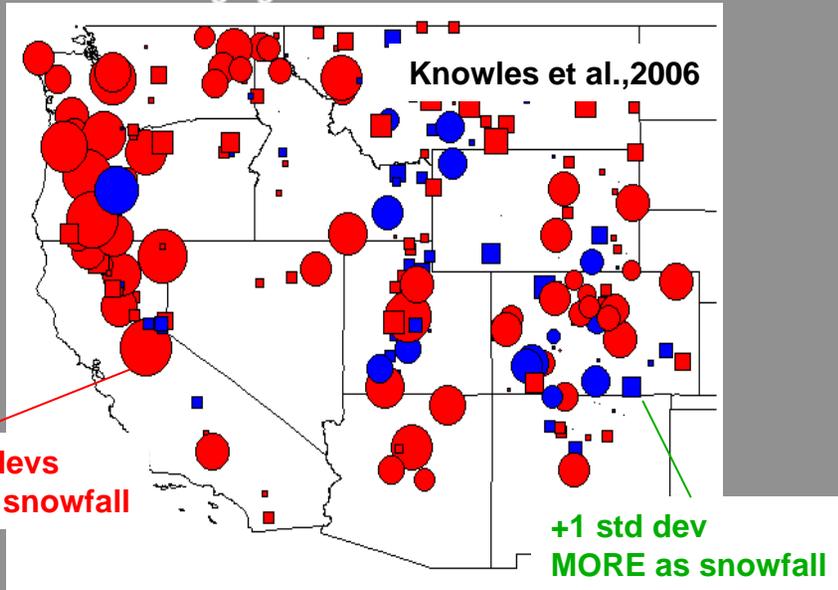


Warming already has driven significant hydroclimatic changes.



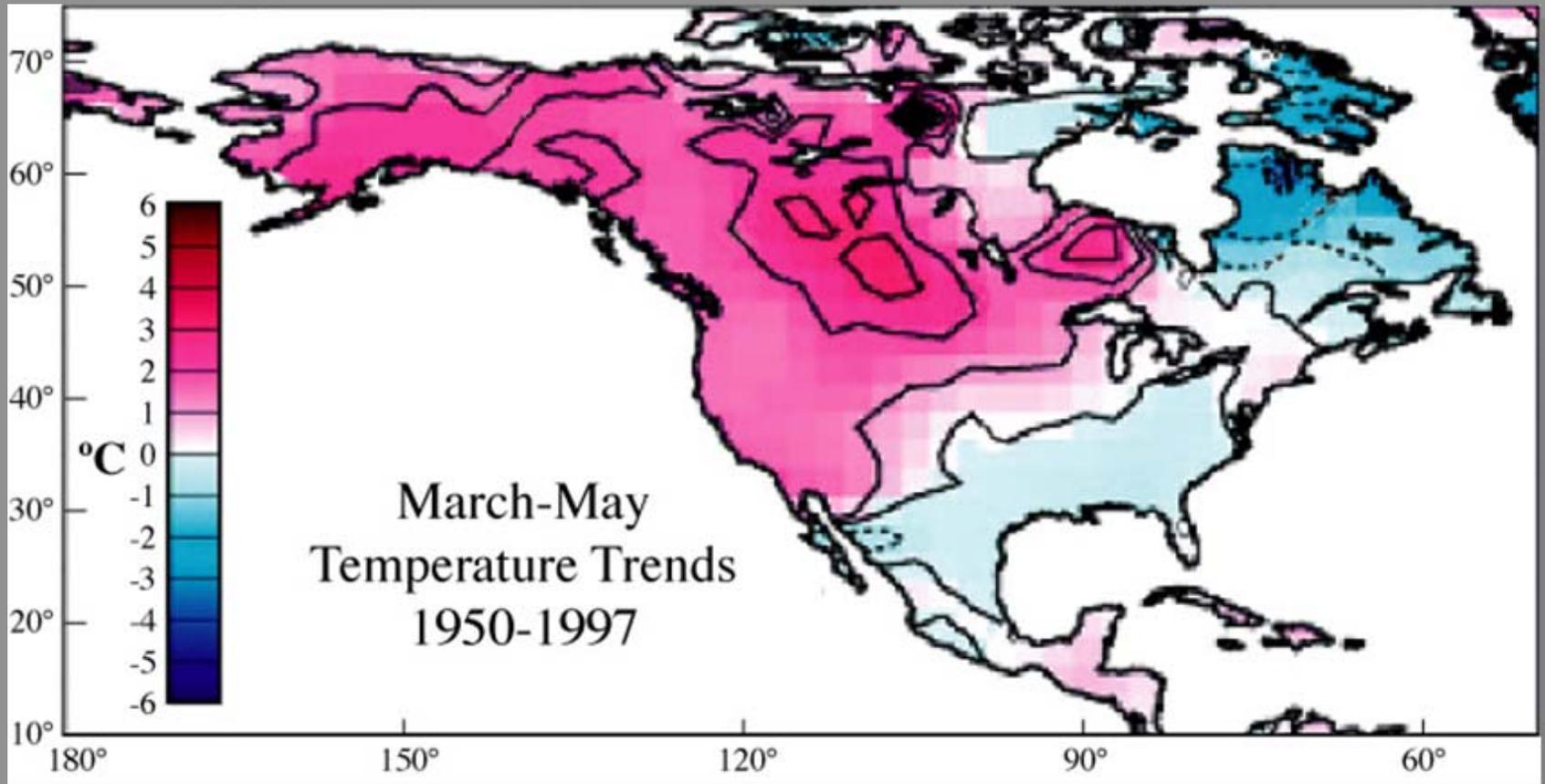
Less snow/more rain

Less spring snowpack



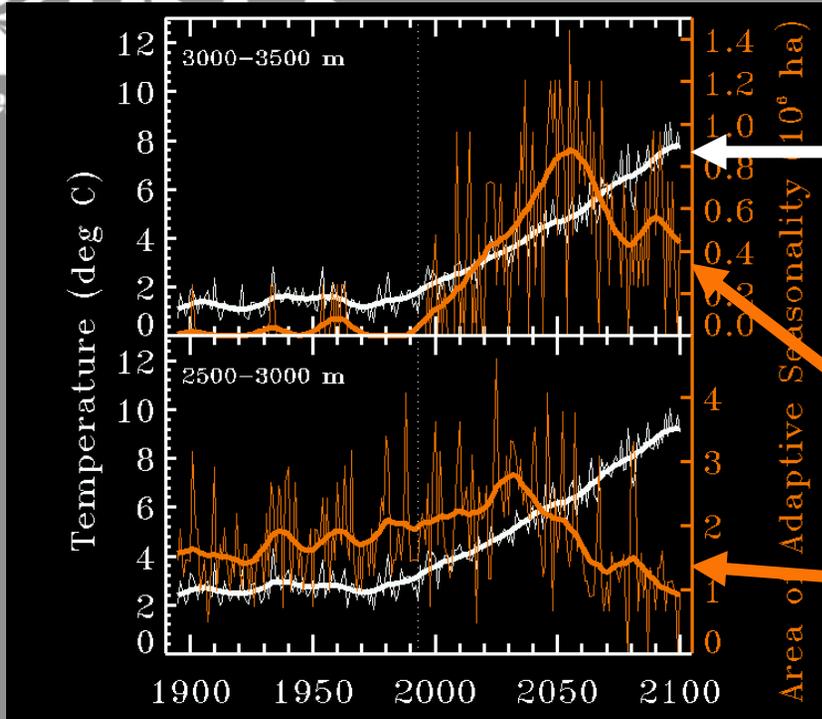
Earlier snowmelt runoff

During the past 50 years, long-term winter-spring warming trends have changed the West.



Cayan et al., 2001

Whitebark Pine Susceptibility to Mountain Pine Beetle Epidemics



High-elevations in western US predicted to be continuously warmer in future decades

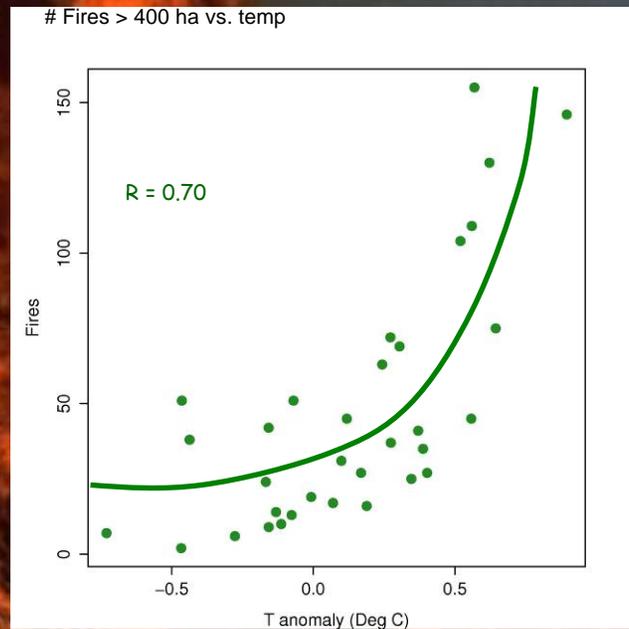
Area of climate suitability projected to increase at highest elevations
And decrease at lower elevations

Hicke et al., JGR-Biogeosciences, 2006

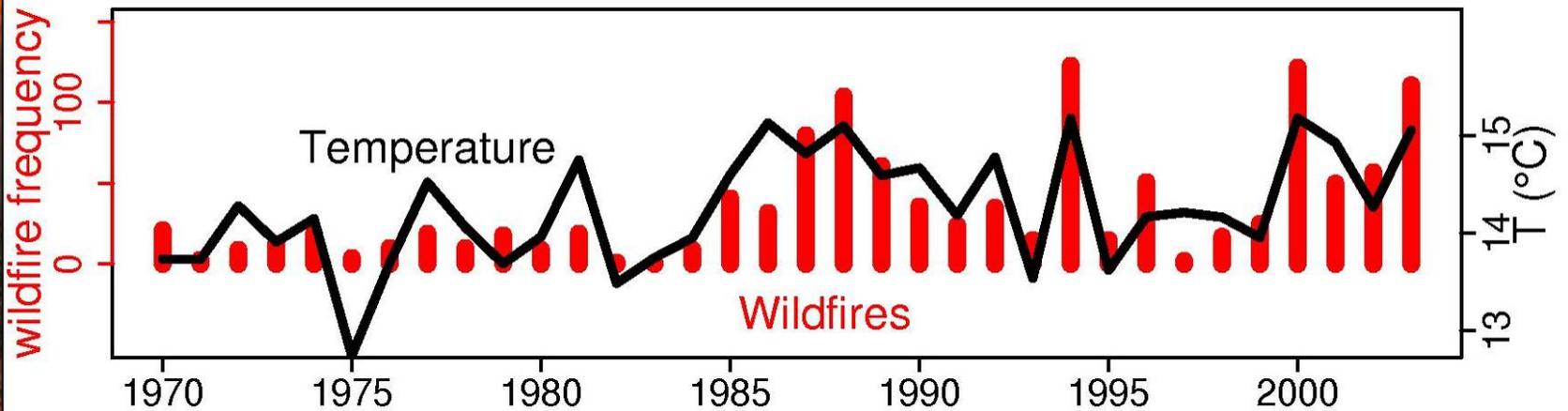


Changes in Wildfire and the Timing of Spring in Western US Forests,

A.L. Westerling, H.G. Hidalgo, D.R. Cayan, T.W. Swetnam.
Science (2006)

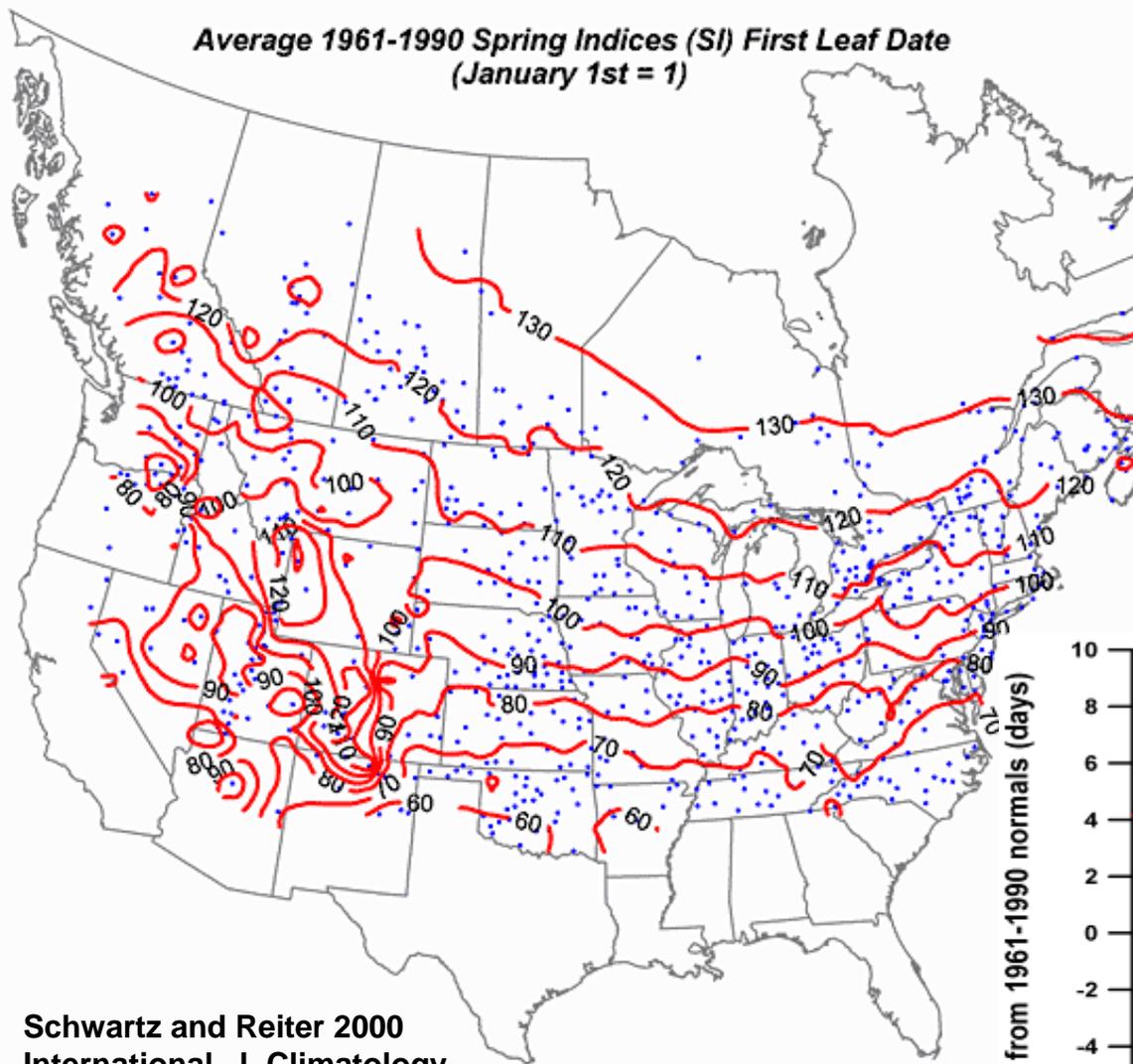


Western US Forest Wildfires and Spring–Summer Temperature

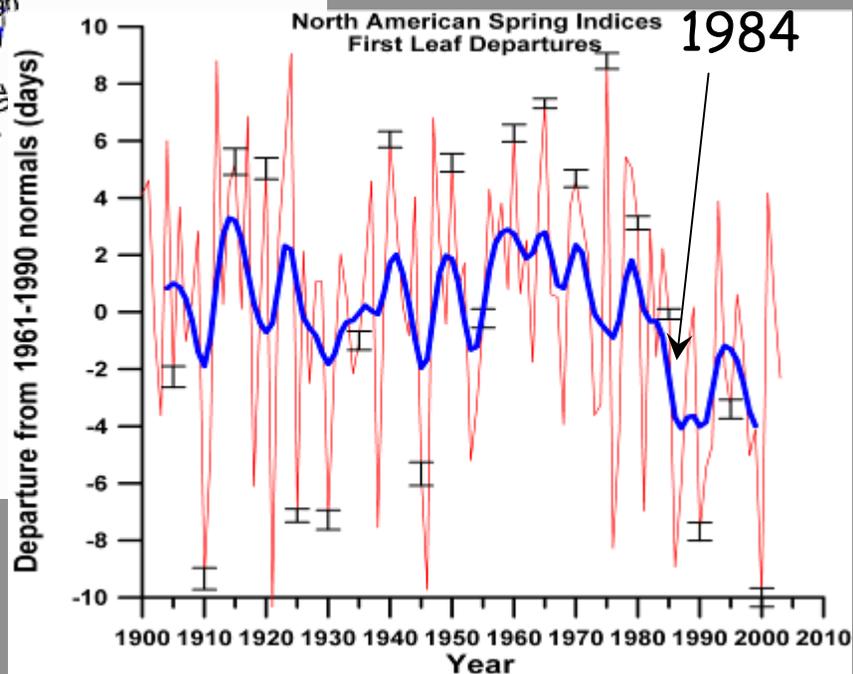


Spring index based on first leaf date for lilacs

Average 1961-1990 Spring Indices (SI) First Leaf Date
(January 1st = 1)



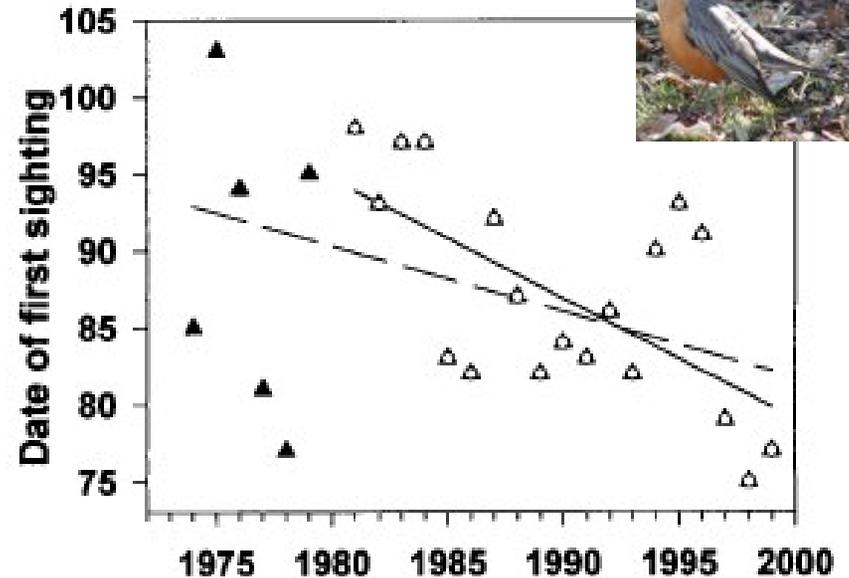
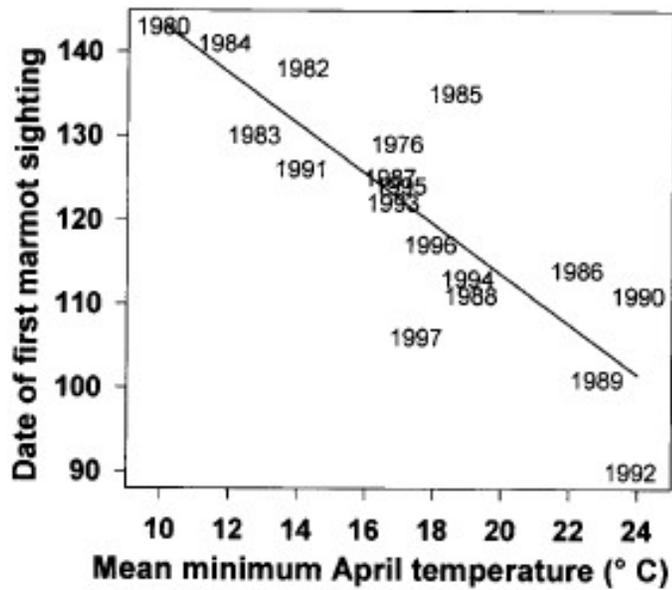
Schwartz and Reiter 2000
International. J. Climatology



Observed Changes in Wildlife at Gothic, CO



Marmots
emerging 38 days
earlier than in
1977



Robins arriving 14 days earlier

Inouye et al., PNAS 2000

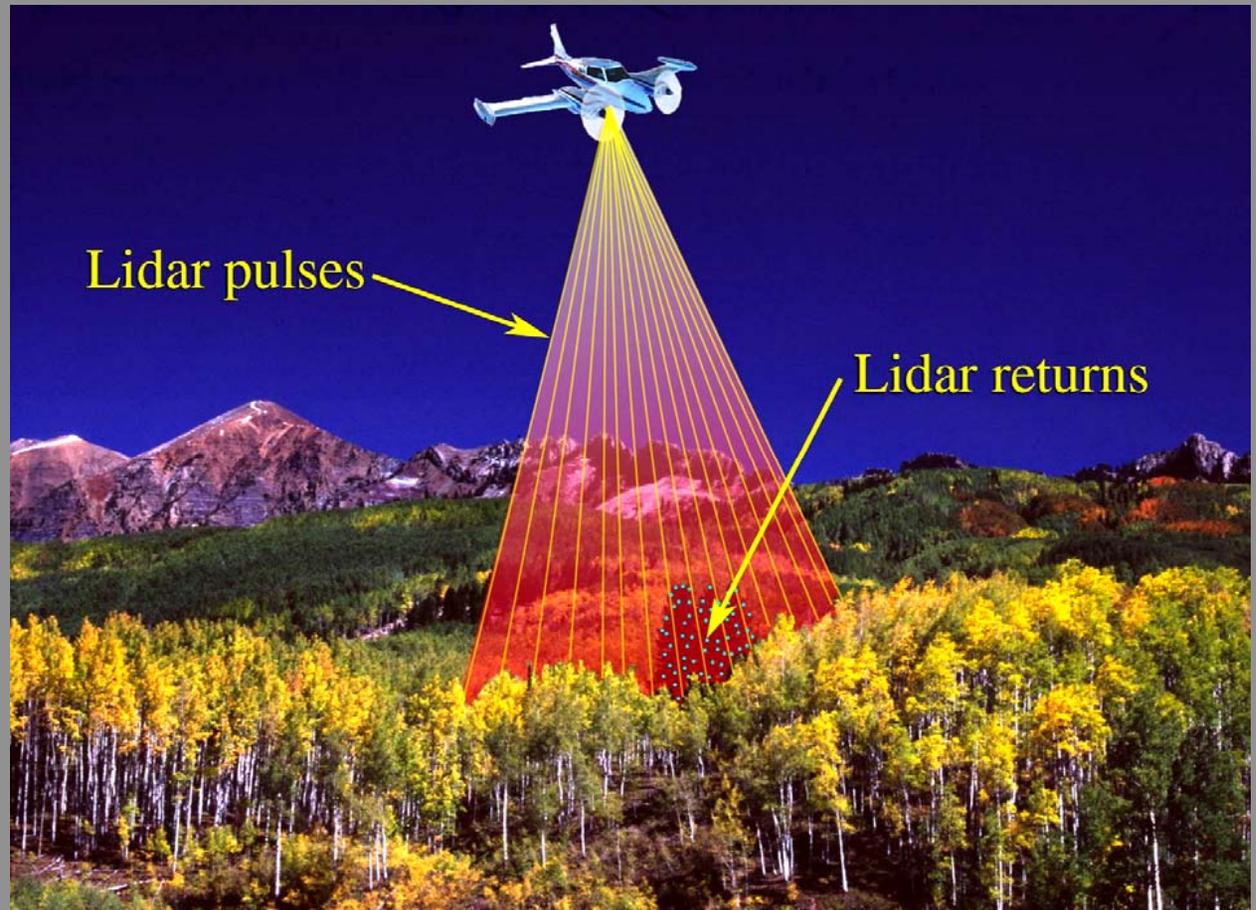
Ecosystem Services

- Goods and services of value to humans that come from natural systems
- Not fully valued in economic discussions, societal decisions
- Markets insufficient to convey benefits of ecosystems



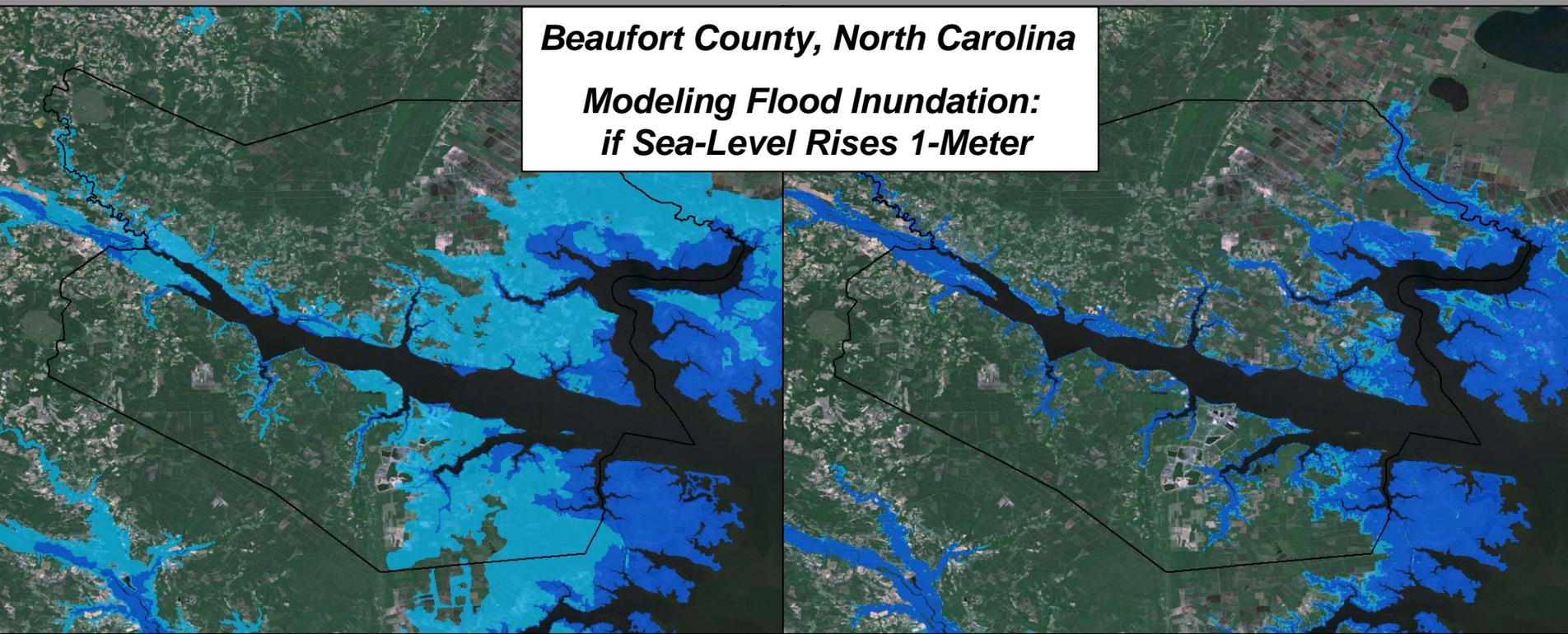
Lidar

- Acronym: Light Detection and Ranging
- Remote sensing technology
- Laser pulses determine the position and other characteristics of imaged features



Beaufort County, North Carolina

**Modeling Flood Inundation:
if Sea-Level Rises 1-Meter**



Calculated using 30-m DEM

Calculated using 3-m lidar data

Darker blue tint: Inundated land if sea level rose ≤ 1 -meter

Lighter blue tint: Area of uncertain inundation if sea level rose ≤ 1 -meter

The Human Effect

- **Humans have already transformed 40-50% of the ice-free land surface on earth.**
- **Humans now use 54% of the available fresh water on the globe.**
- **Humans are now an order of magnitude more important at moving sediment than the sum of all other natural processes operating on the surface of the planet.**

Increased demands - globally and locally

Energy

Minerals

Water

Agriculture

Recreation

Preserved natural habitat



Water Quality and Availability

Water a limited resource, global issue

Diminished by climate change,
population growth,
agricultural use

Transboundary issues



Science – a bridge to rational solutions



Evangelical Leaders Join Global Warming Initiative - New York Times
 February 8, 2006
 By LAURIE GOODSTEIN
 Despite opposition from some of their colleagues, 86 evangelical Christian leaders have decided to back a major initiative to fight global warming, saying "millions of people could die in this century"

SATURDAY, FEBRUARY 11, 2006
Lots of talk, no solution to America's oil addiction
 The challenge and the rebuttal have some similarities. Last week's speeches, part of a series of events to mark the anniversary of the 9/11 attacks, were a continuation of the debate over the future of the oil industry.

Nation
New Mexico gets taste of dry future
 Some say this year's warm, parched weather is a start of climate change projected for next century



Copper prices set another record
 By Dale Funk, Contributing Editor
 Apr 1, 2006 12:00 PM
 While most wire and cable industry veterans and commodity analysts expected 2006 to be a year of moderation for copper prices, when copper jumped 9.45 cents to nearly \$2.36 a pound on March 17 on the New York Mercantile Exchange, it set another record.



A British experts report on climate change warns that failure to curb global warming could trigger worldwide economic devastation, with poor countries hit first and hardest. Prime Minister Tony Blair called for urgent international action.



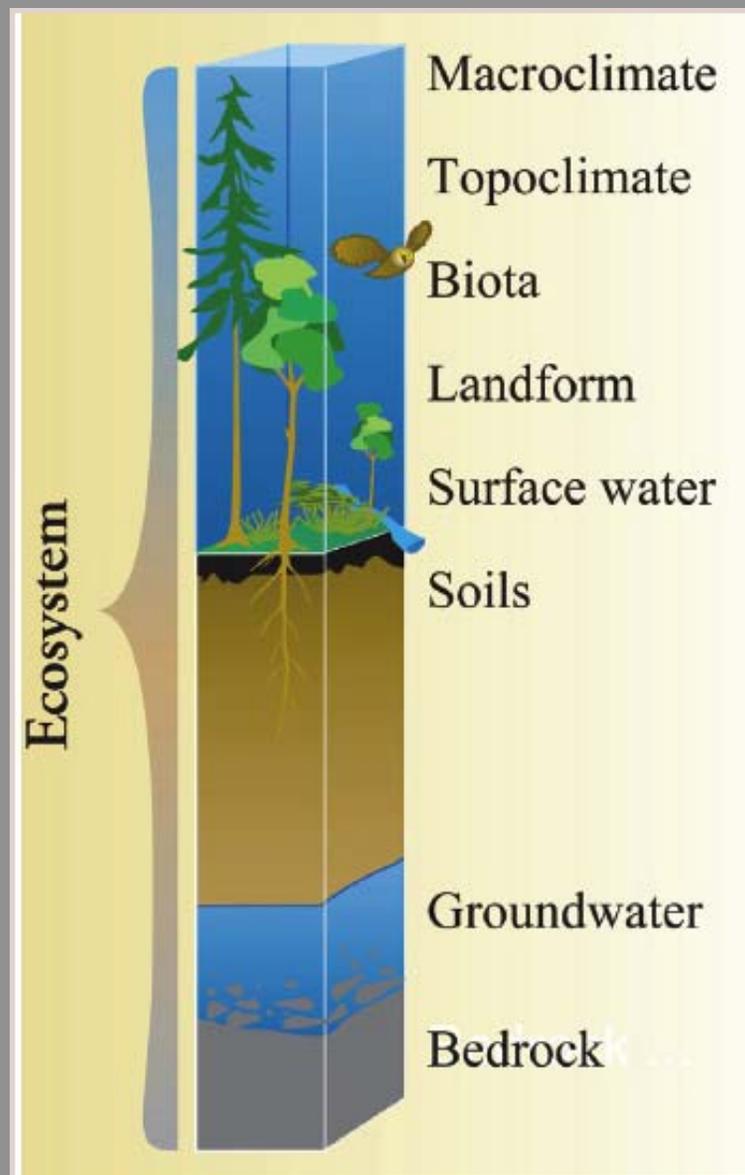
Understanding Earth Systems

All earth resources interrelated.

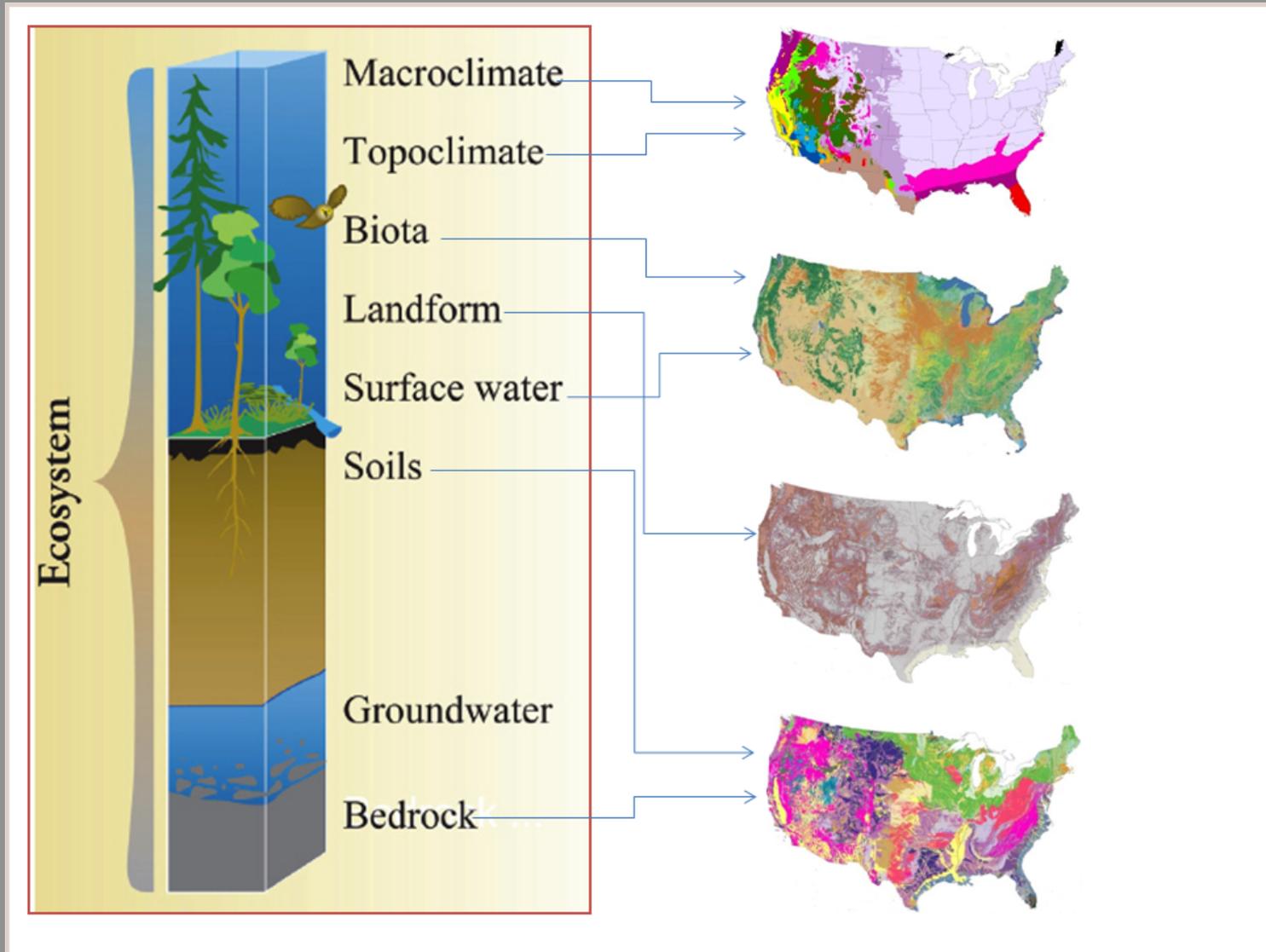
Climate change, population growth accelerate difficulties, complexity

USGS science strategy based on systems approach

Ecosystem Structure



Ecosystem Mapping



Ecosystem Analysis



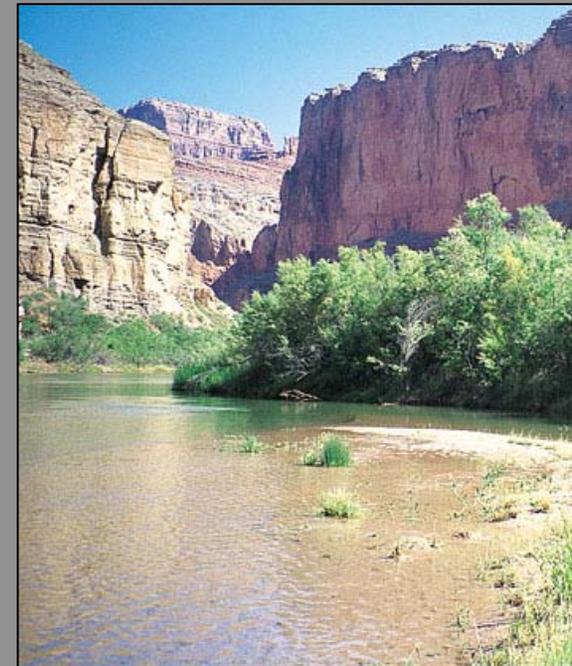
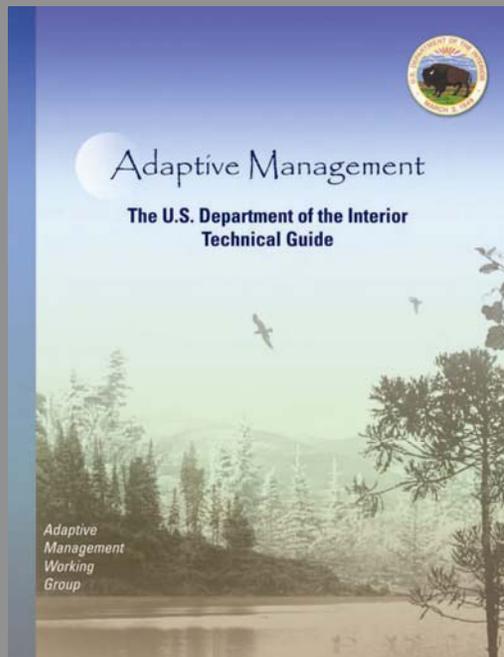
21st Century Science Delivery

- Traditional publications
- Models
- National, long-term databases
 - . Integrated information
 - . Some in near real-time
- Decision support tools
- Science conducted in partnership



Adaptive Management Defined

- Learning through management, then adjusting management based on what is learned
- The focus of adaptive management
 - reducing uncertainty about the influence of management actions, and
 - improving management as a result of improved understanding



The Healthy Lands Initiative Vision



“We developed the Healthy Lands Initiative to

- Improve the health and productivity of public lands in key areas of today’s fast-changing West,*
- Protect the quality of life Westerners have come to expect,*
- Ensure the economic well-being and energy security of all Americans.”*

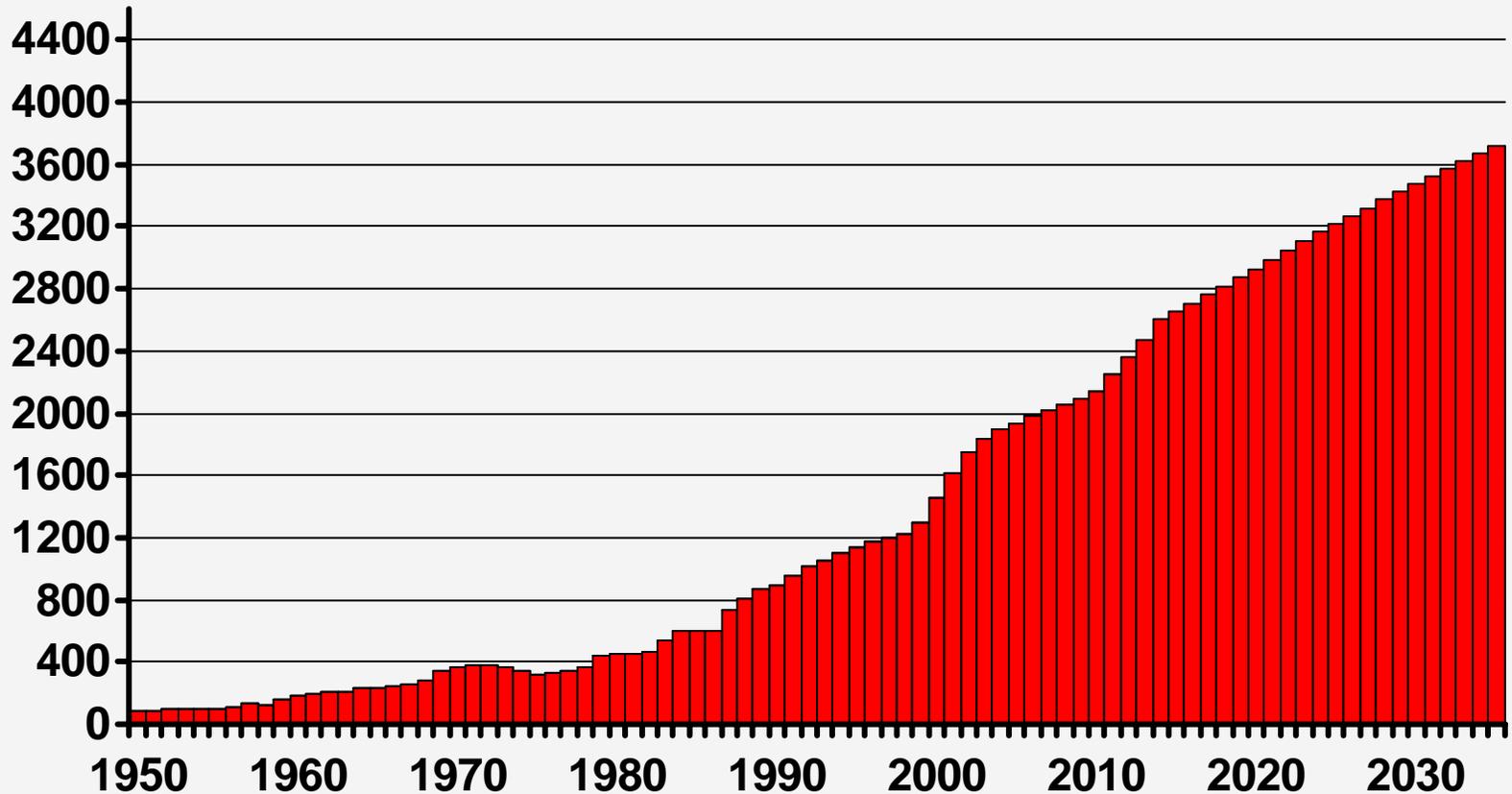
Wyoming Gas Production

1950-2003; PROJECTIONS TO 2035

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Finding balance: wildlife and energy resources



Wyoming Basins Ecoregional Assessment

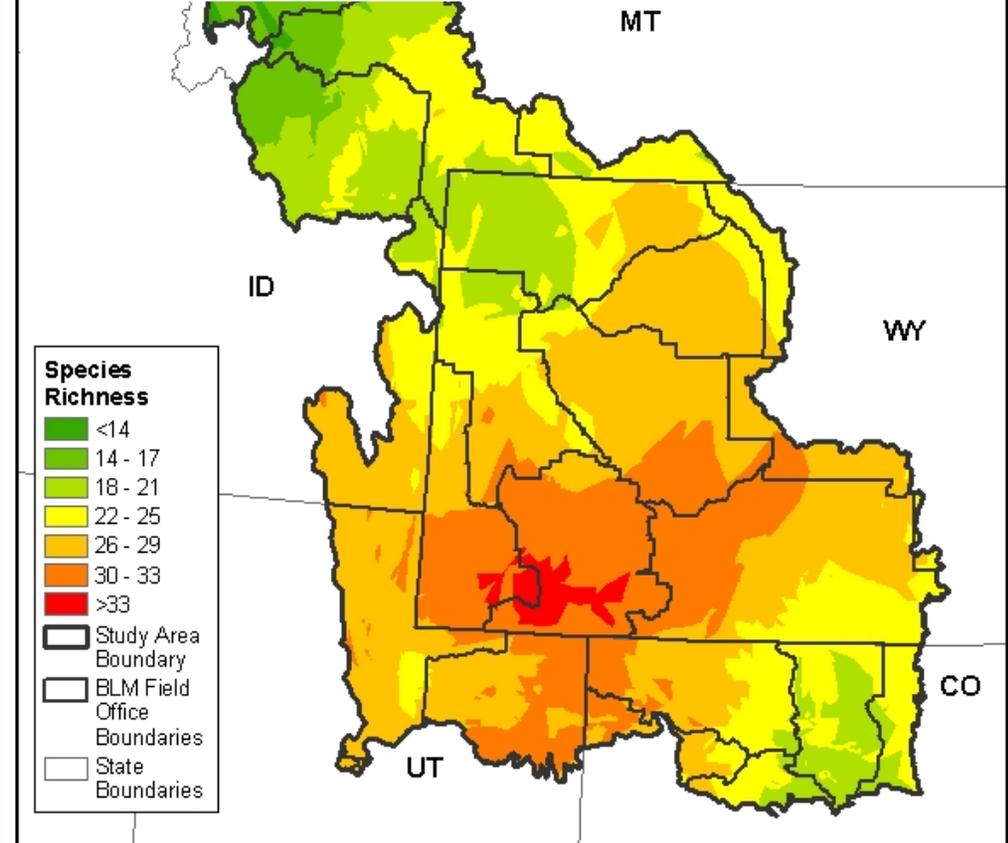
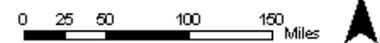
Goal: to summarize data and inform land-use planning across large landscapes

Steps:

- 1) **Identify Issues:** synthesize and analyze data at regional scales
- 2) **Collect and Inventory Data:** Assess species' distributions, predictive modeling, species richness, cumulative impacts
- 3) **Analyze the management situation:** Identify priority species and habitats, summarize threats, identify management and conservation priorities



C. L. Aldridge



Managing our lands for the future

Systems approach helps reveal nature of earth systems

Climate change, population growth present critical challenges at all scales of land management

We need

- **all available data and technical means**
- **the best management techniques**
- **an integrated science perspective to make wise decisions for the land.**