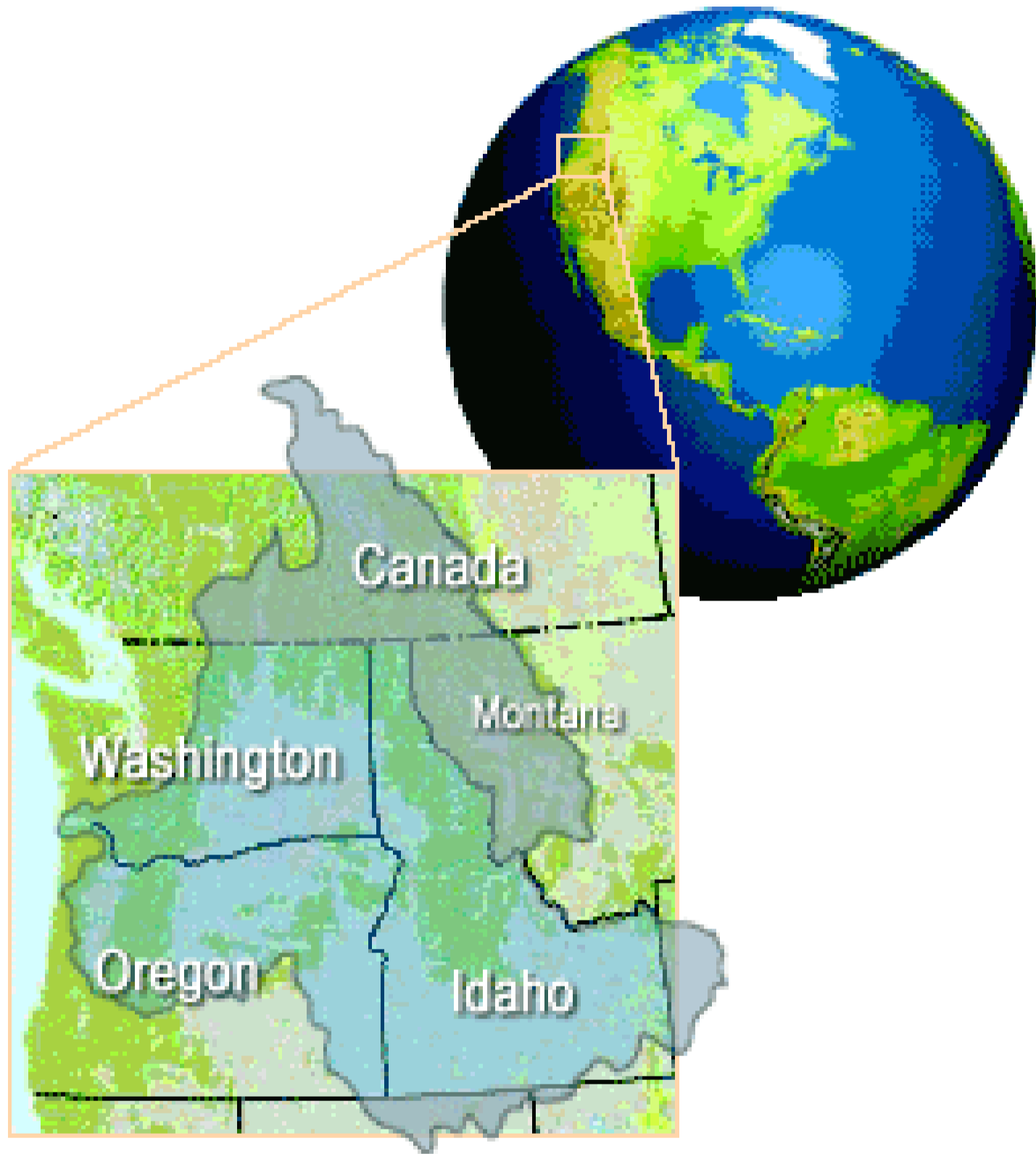


Science informing decisions: The Pacific Northwest Climate Impacts Group



Philip Mote
University of Washington



NOAA's RISA program

1995-98

Northwest, California,
Southwest, Florida,
Western Water
Assessment

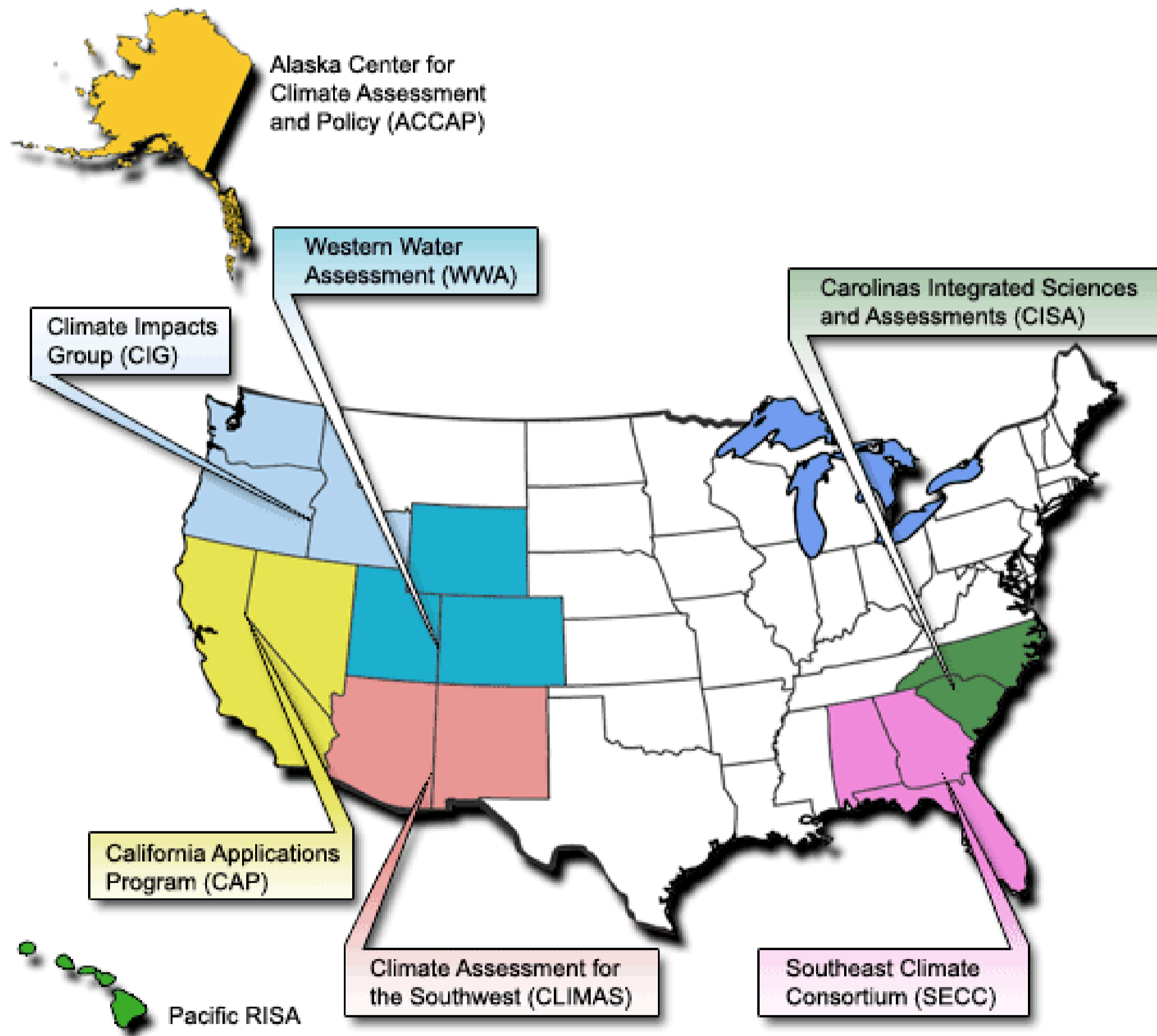
2002-2003

New England, Hawaii/
Pacific Islands, Carolinas

2006

Alaska

Currently Funded RISA Teams



NOAA's RISA program

1995-98

Northwest, California,
Southwest, Florida,
Western Water
Assessment

2002-2003

New England, Hawaii/
Pacific Islands, Carolinas

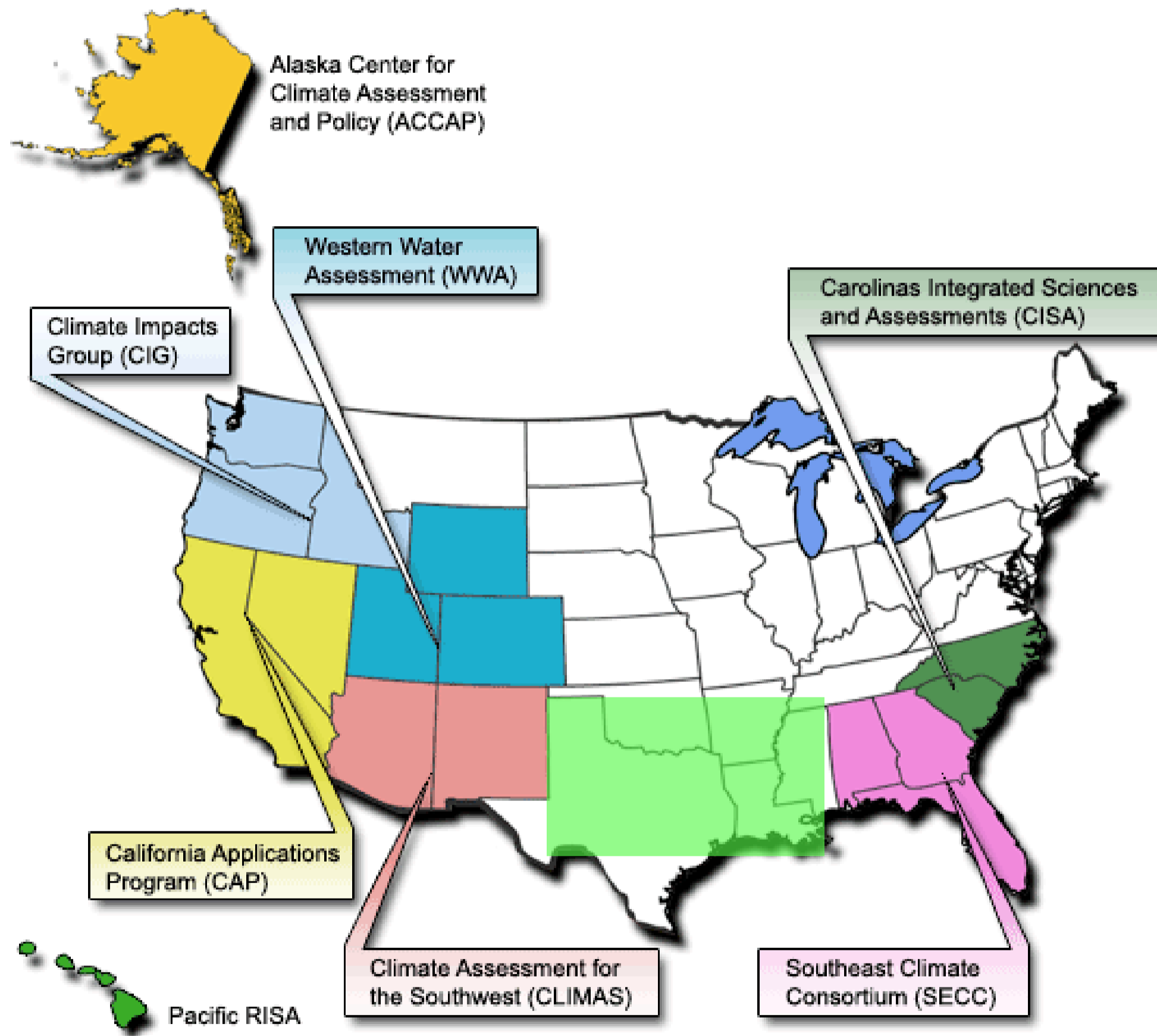
2006

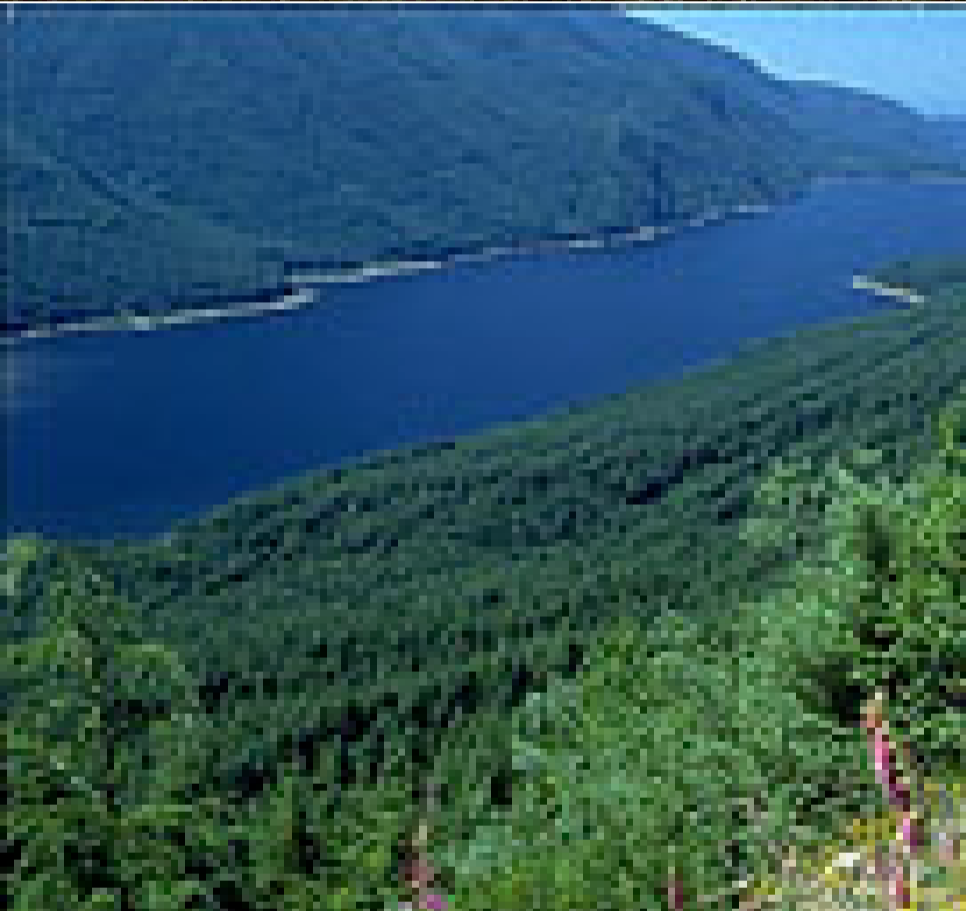
Alaska

2008

Southern Gt Plains

Currently Funded RISA Teams





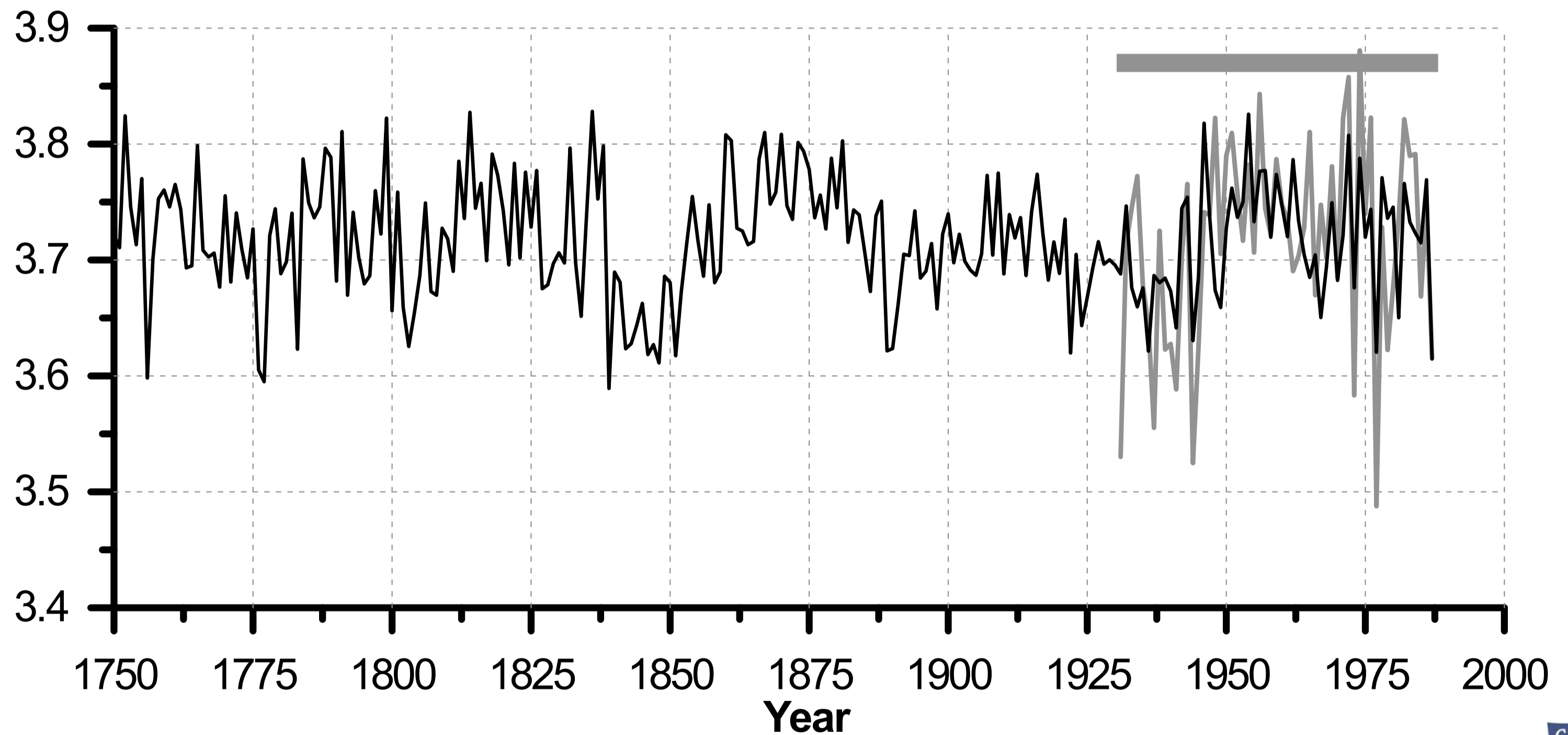
Research approach

- **retrospective**: establish past impacts of climate and societal responses
 - e.g., infrastructure built around seasonal cycle
- **interdisciplinary**: whole greater than the sum of parts
- **contextual**: climate one of many factors influencing natural resources

spatial scales: kilometers to global

time scales: intraseasonal to millennial

Columbia River flow, reconstructed from tree rings

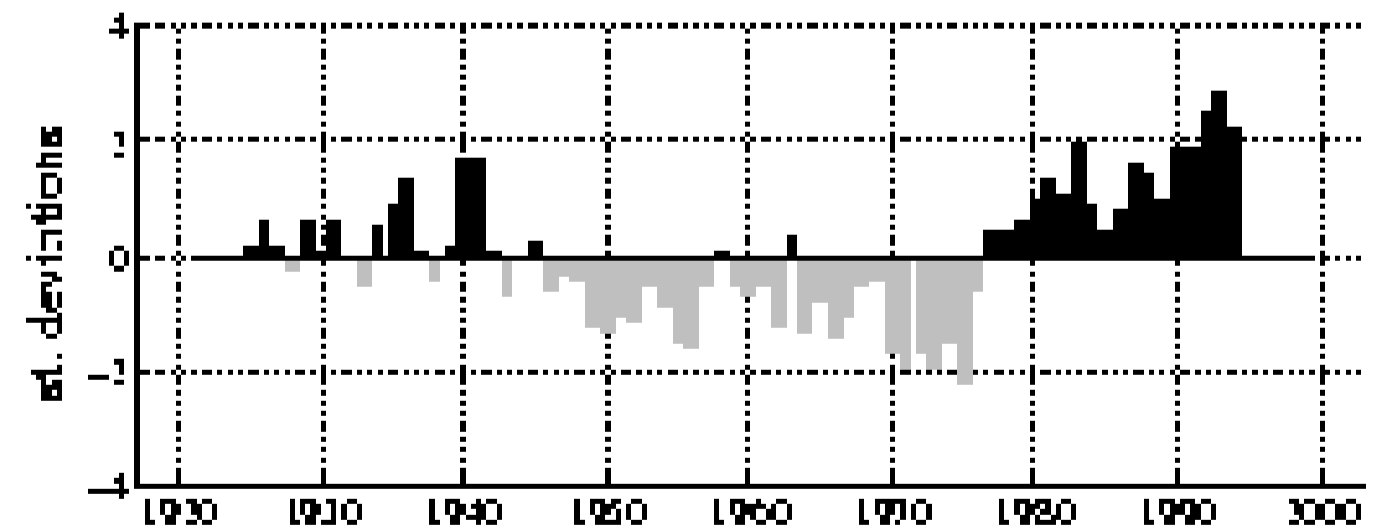
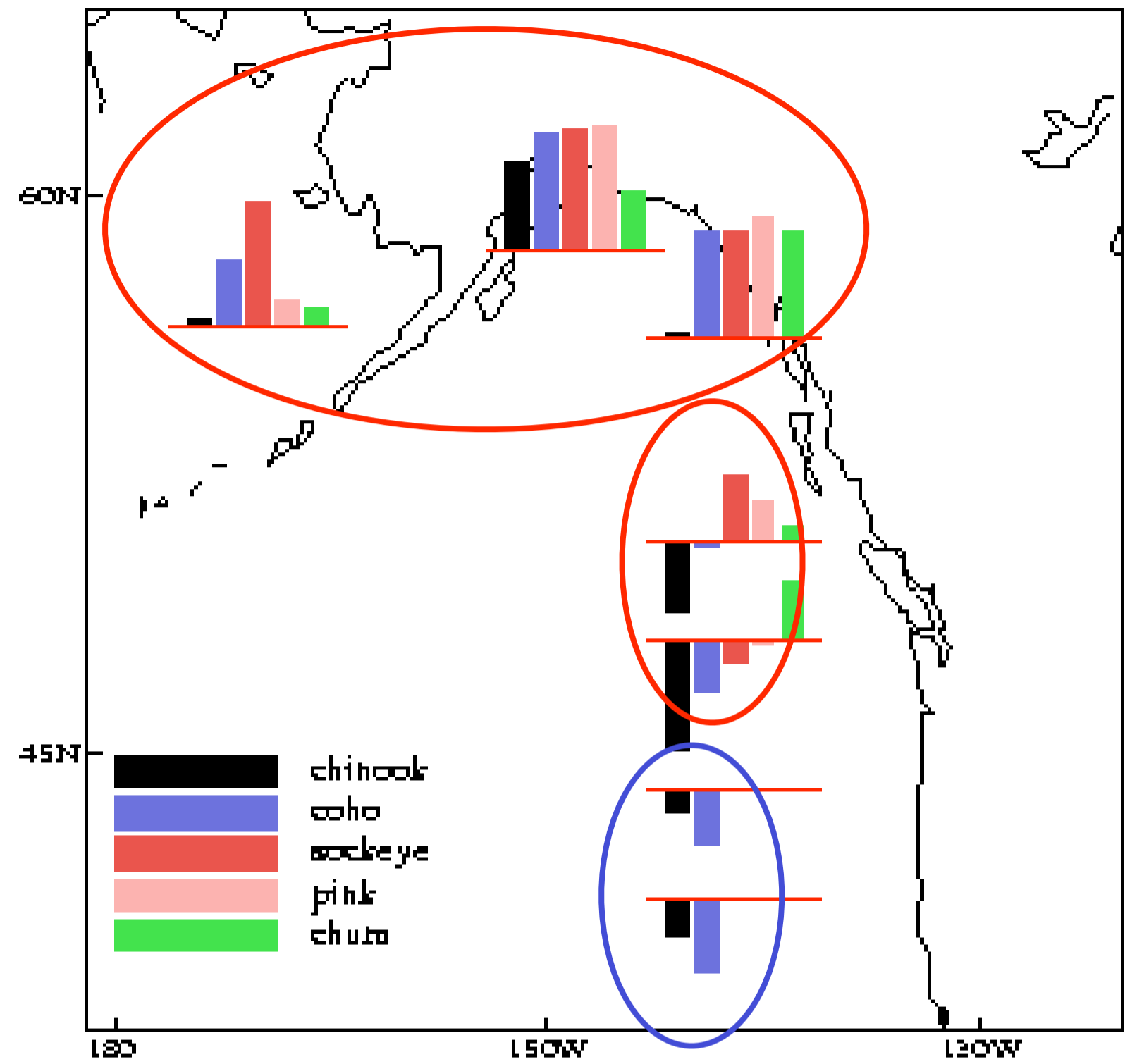
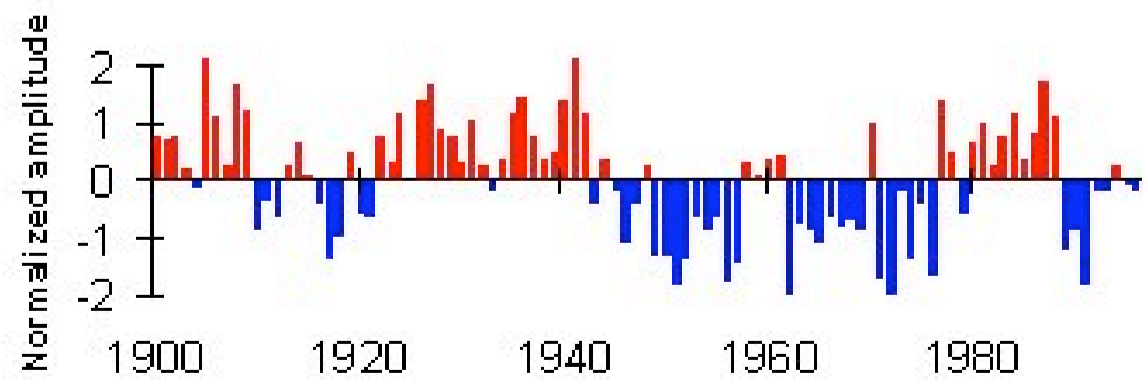
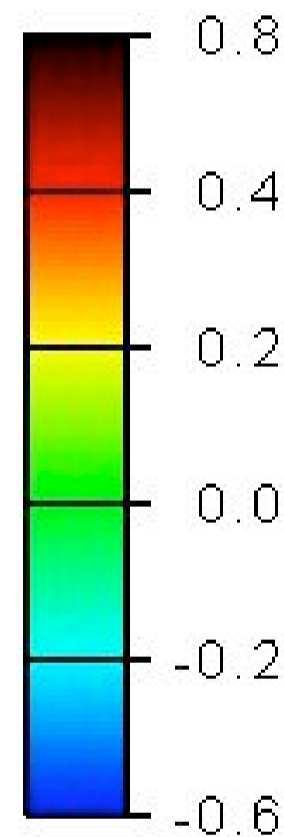
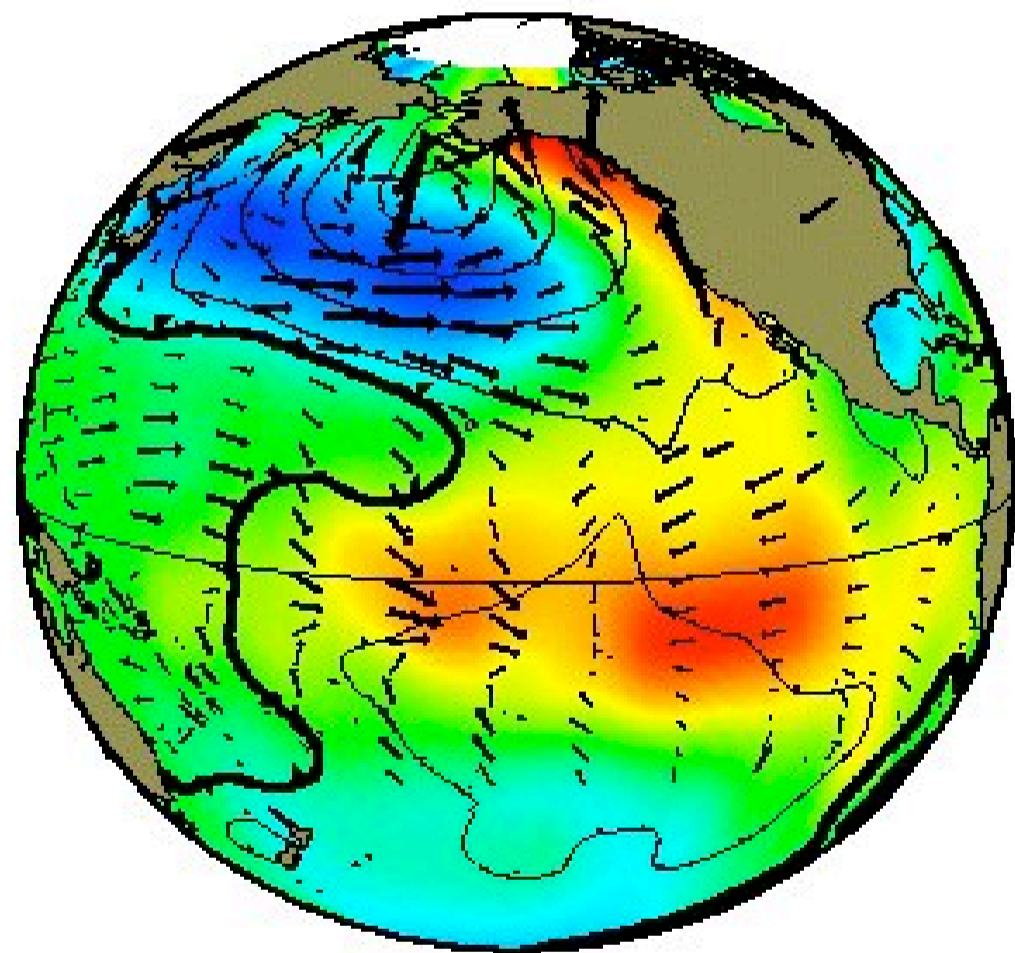


Gedalof et al., JAWRA, 2005



Alaska and PNW salmon production are out of phase (Hare et al 1999, Fisheries)

Pacific Decadal Oscillation



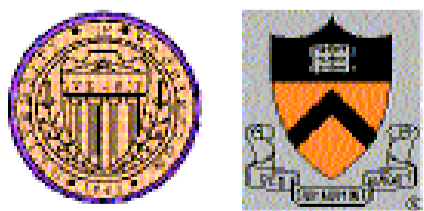
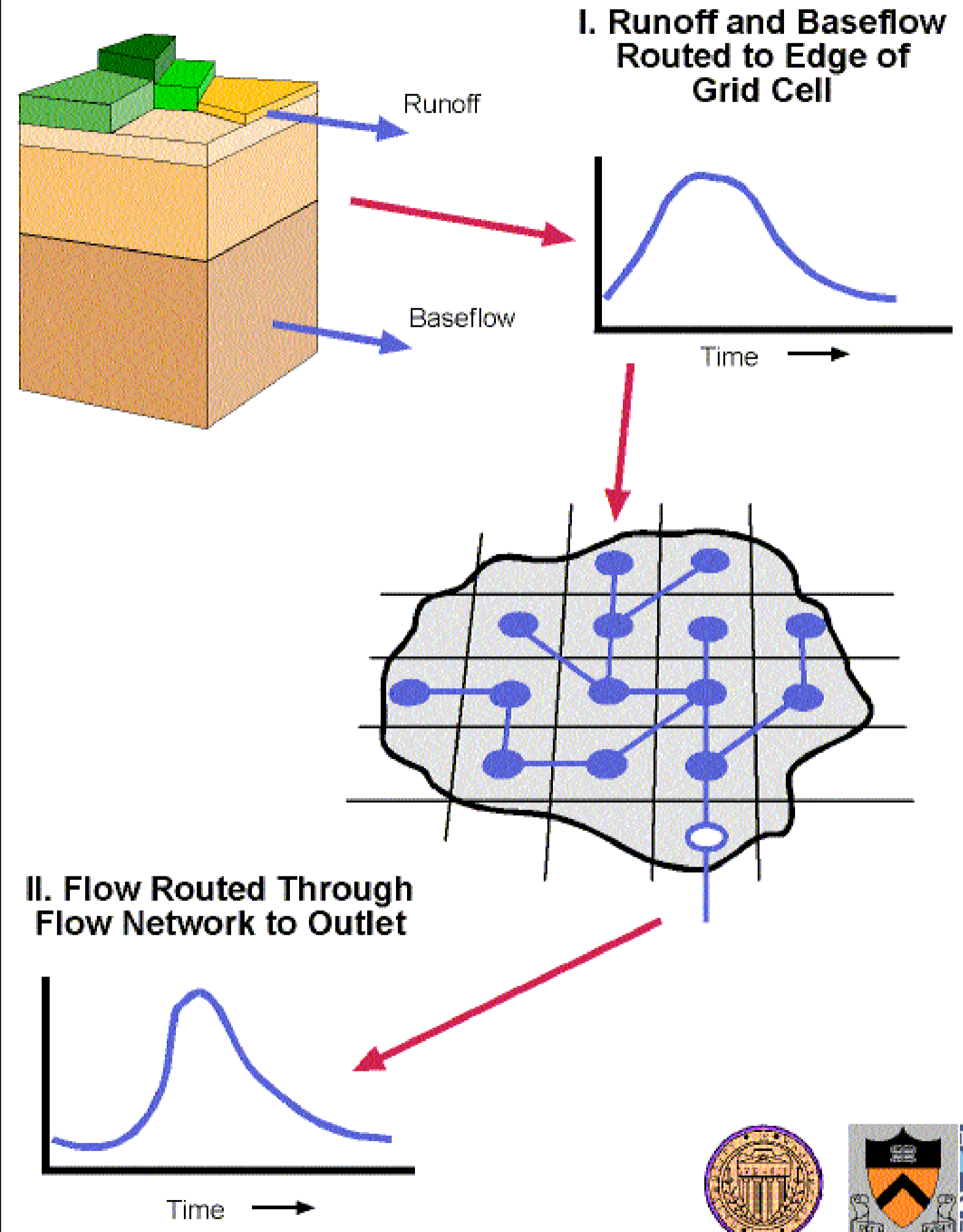
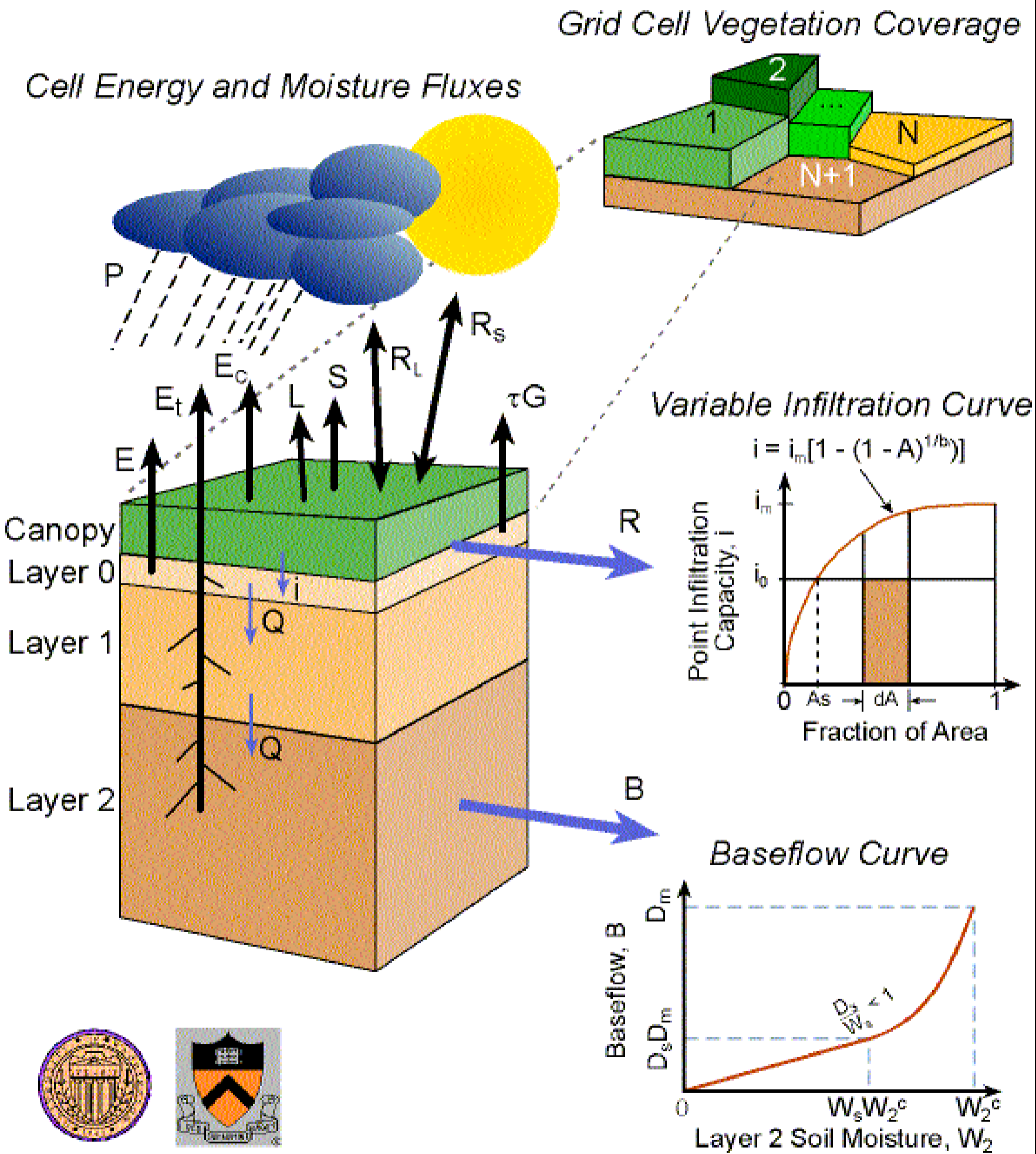
Decision-Support Tools: Climate Variability

Designed to help with management on seasonal to interannual time scales. Main products and services:

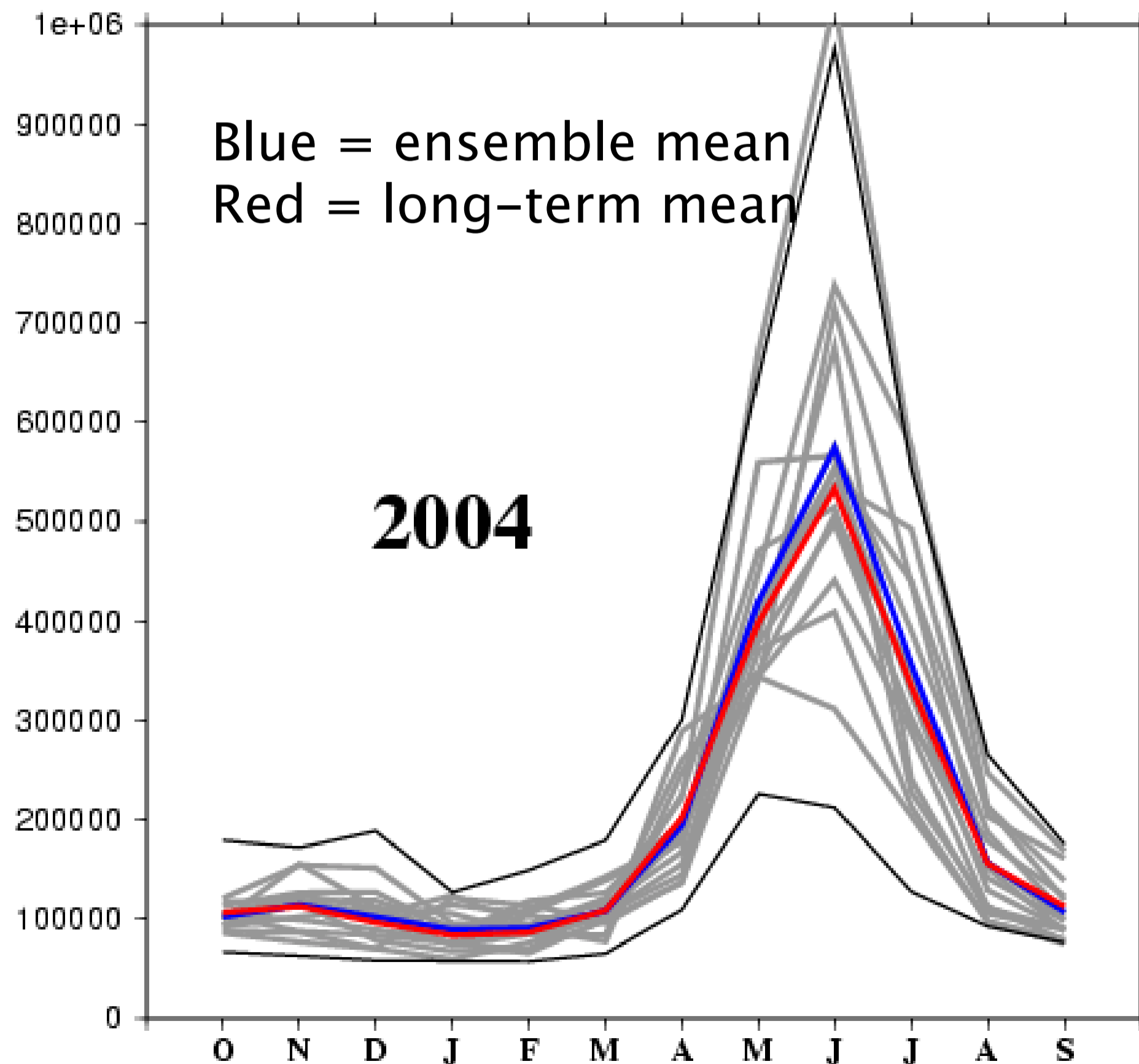
- Seasonal climate outlook
- Long-lead (1 year) climate-based streamflow forecasts
- Six-month lead time reservoir forecasts tools (under development)
- Oregon Coastal Coho salmon survival forecasts
- Extreme weather risk forecasting

Variable Infiltration Capacity - n Layer (VIC-nL) Macroscale Hydrologic Model

River Network Routing Scheme for VIC-nL

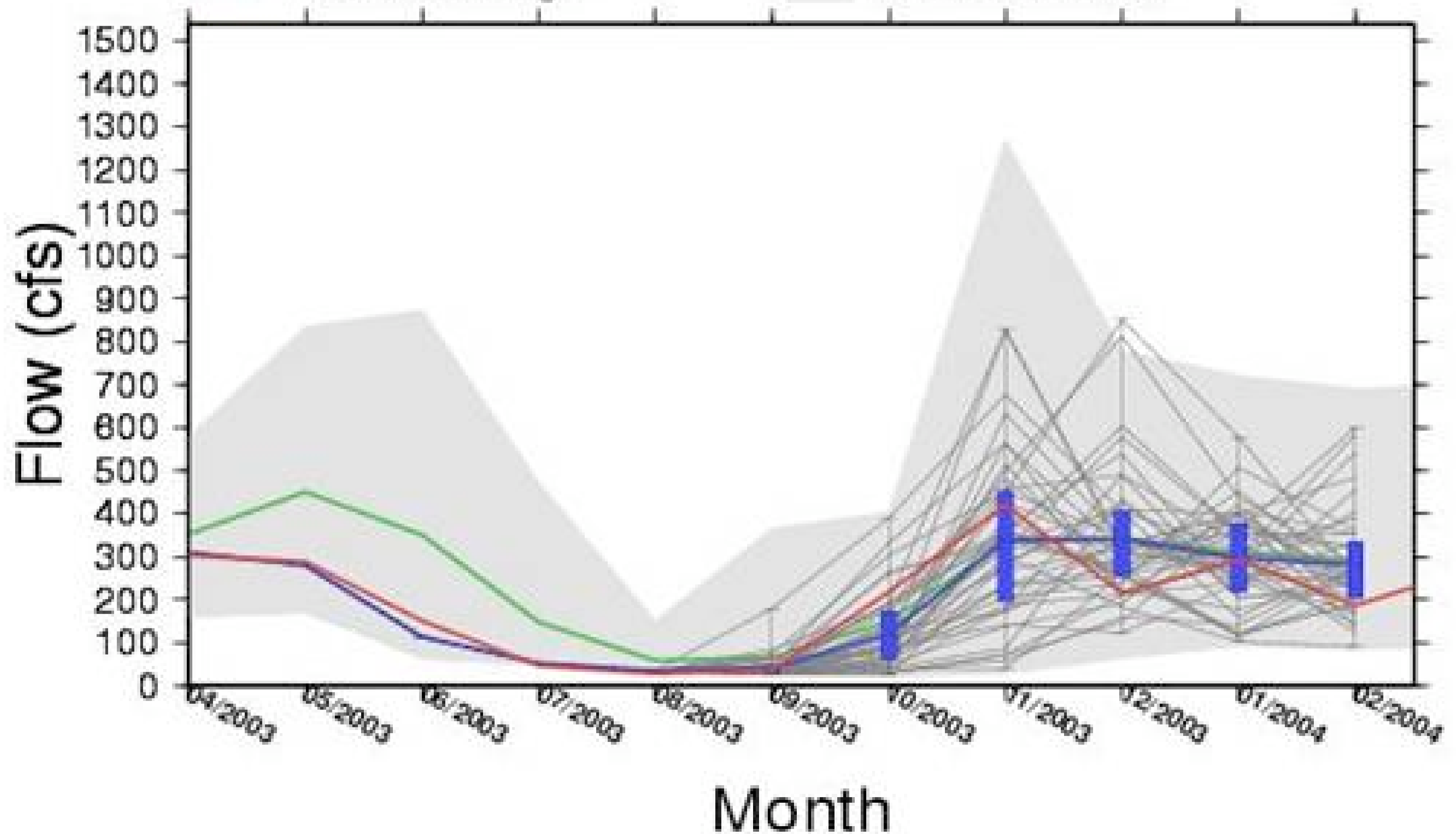


One-year ensemble streamflow forecasts of Columbia River flow based on initial soil conditions and ENSO forecasts



Ensemble forecast of municipal water supply

- ESP traces - ENSO Neutral conditions
- Ensemble Average
- Observed 12115000
- Historic Average
- Historic Max/Min





Oregon Coastal Coho Marine Survival Forecasts

Coastal Ocean Conditions

Sea surface temperatures

Sea level

Nearshore winds



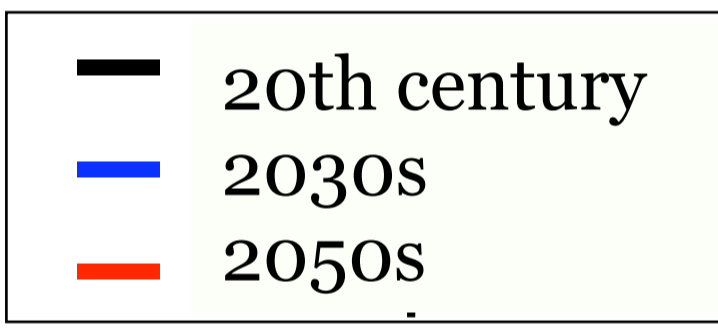
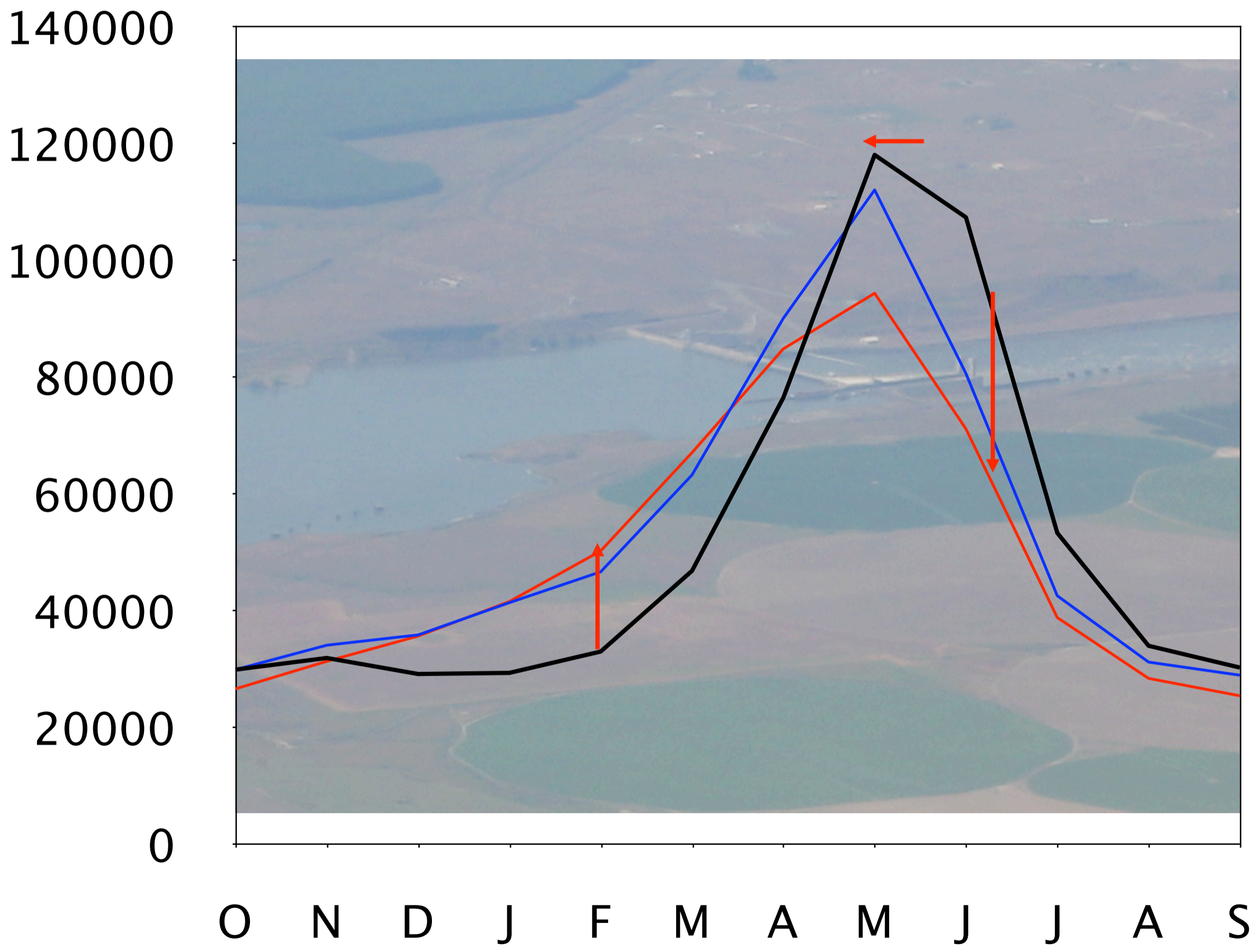
Forecasted Jan-March 2005 SST	Forecasted Return Rate for March 2005
9.33 (1 stand. dev. below mean)	2% (+/- 1%)
10.15 (mean value)	1% (+/- 1%)
10.98 (1 stand. dev. above mean)	<1%

- Methodology unique in recognizing the impact of winter conditions on coho marine survival.
- Provides a pathway for incorporating 1 year lead time climate forecasts into seasonal harvest, allocation, and hatchery decisions
- **Benefit: Forecasts available 6 to 8 months in advance of traditional forecast methods (jacks, plankton)**



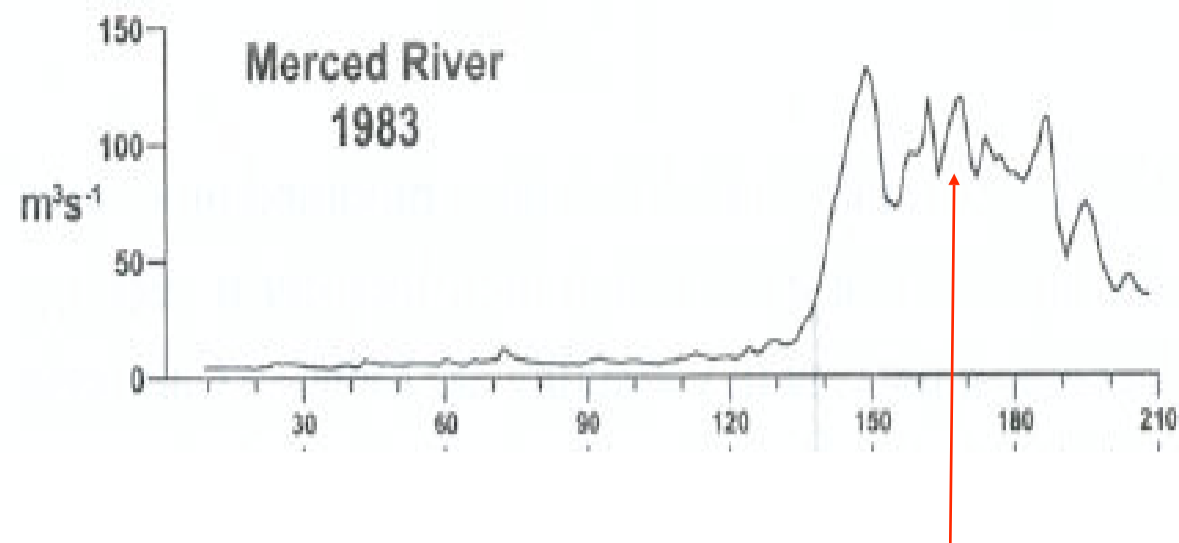
“I’d chalk it up to just another crazy backyard hobby, except that he’s the world’s leading authority on global warming.”

Flow of the Snake River at Ice Harbor Dam

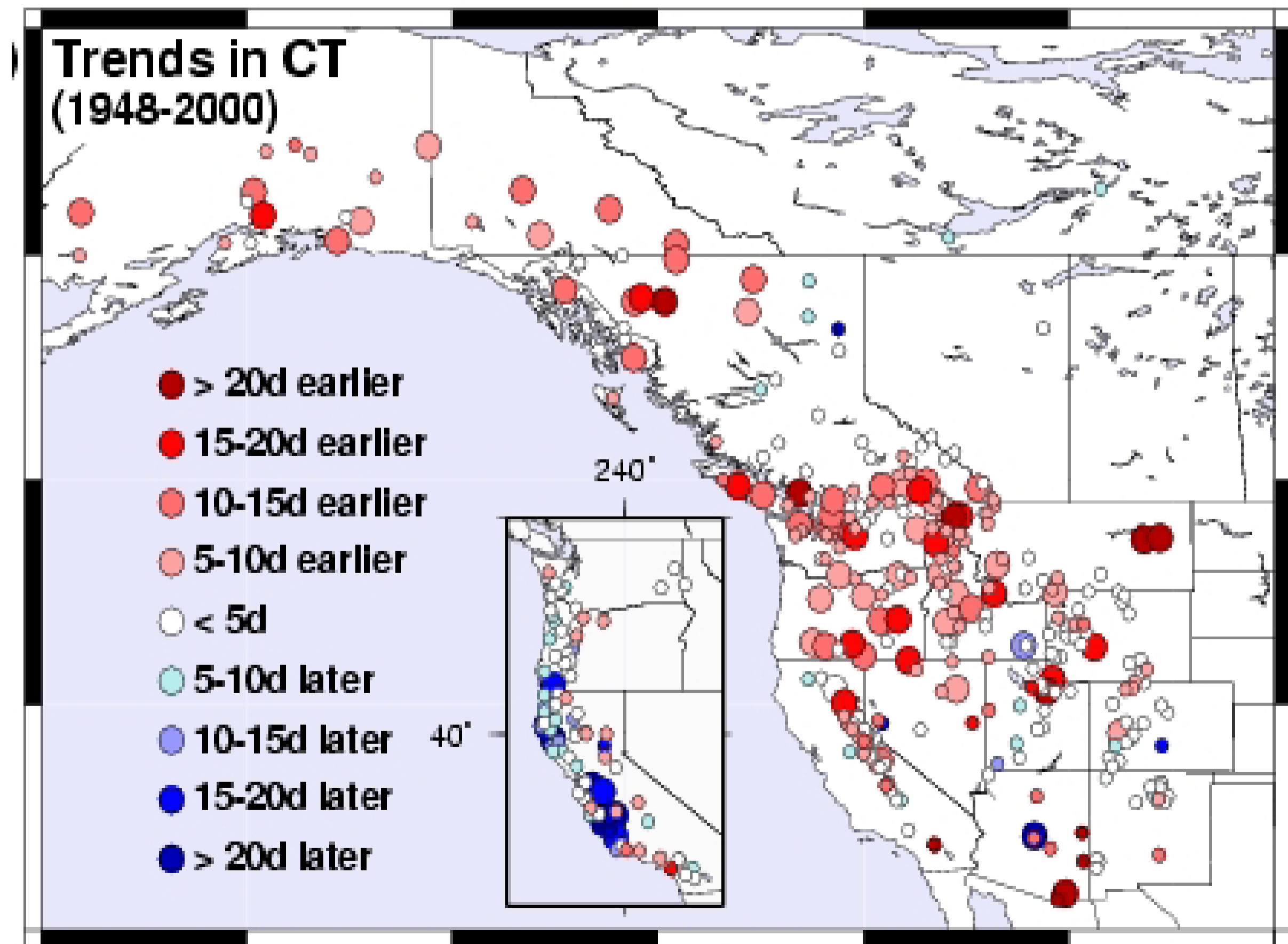


Three changes in a warming climate





Changes in centroid of flow



Stewart et al., J Climate 2005

Steps to adaptation

- Awareness
- Analysis
- Action

Awareness

Northwest Hydropower Association

Insurance Commissioner, State of WA

Puget Sound Clean Air Agency

Washington Public Utility District Association

Energy Northwest, Inc.

Cascade Natural Gas, Inc.

Lake Roosevelt Forum

Portland General Electric

King County Council, WA

Puget Sound Energy, Inc.

Pacificorp, Inc.

Yellowstone to Yukon Conservation Initiative

Congressman Jay Inslee, D-WA

Idaho Dept of Water Resources

Congressman Norm Dicks, D-WA

Oregon Water Resources

Congressman Dave Reichert, R-WA

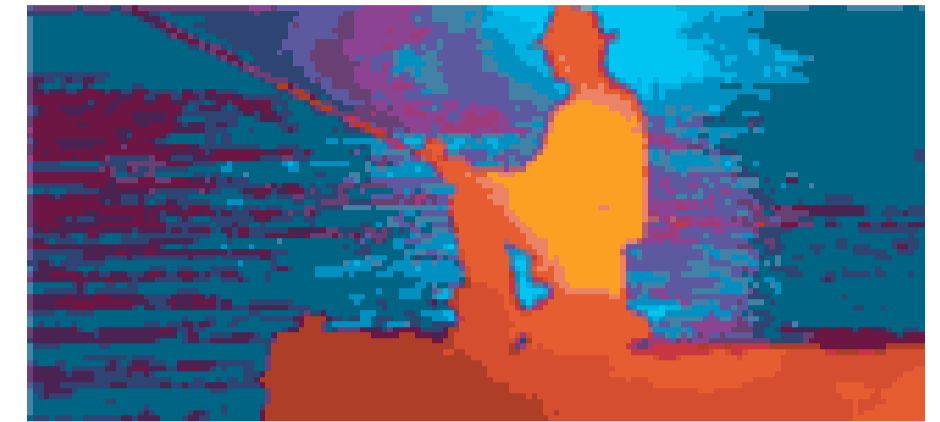
Board



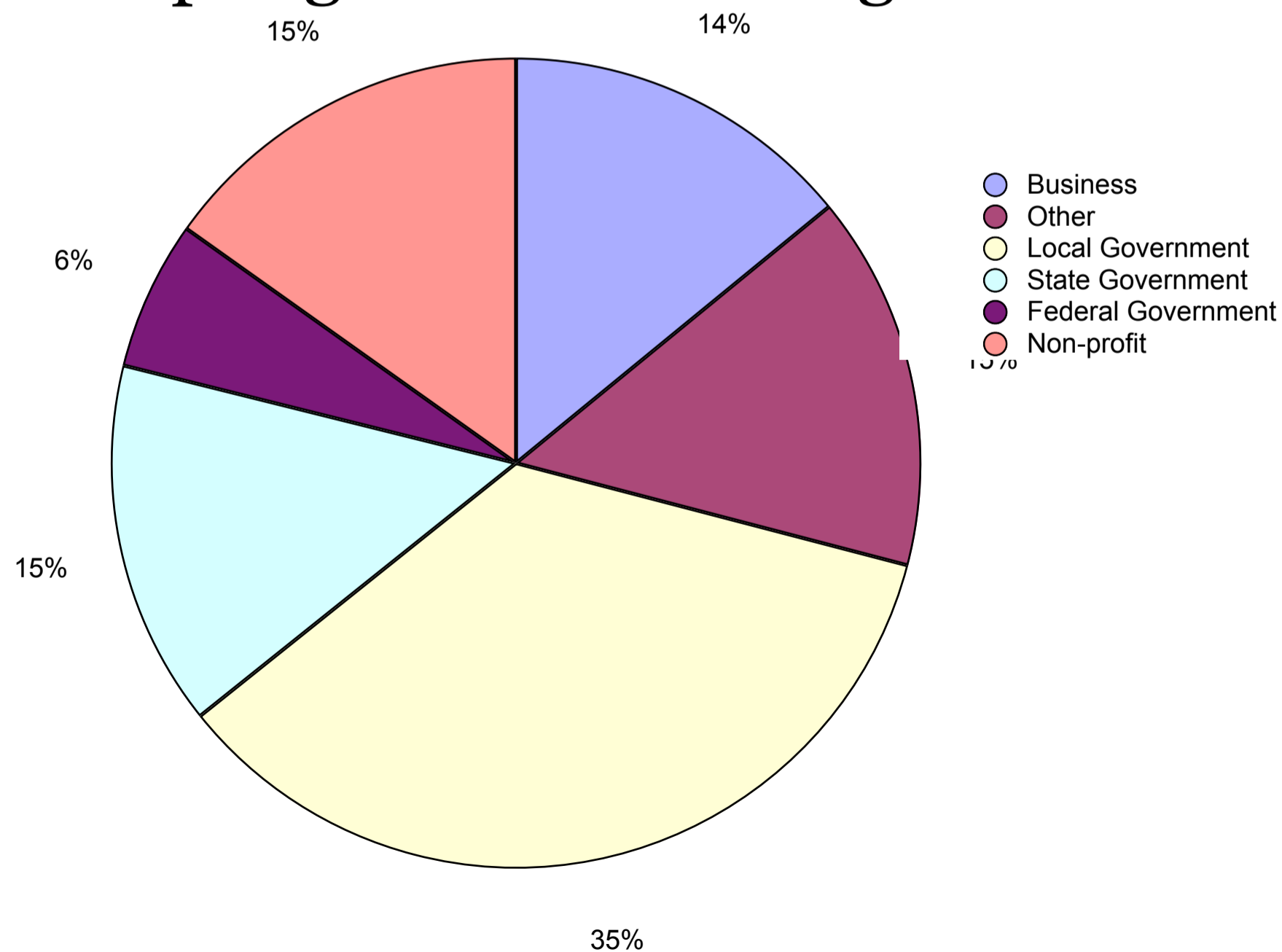
The Future Ain't What It Used To Be

Planning for Climate Disruption

Thursday, October 27, 2005, 7:00 a.m. - 5:00 p.m.
Qwest Field Conference Center, Seattle, WA



600+ attendees familiarize themselves with climate impacts and begin strategizing methods of preparing for/adapting to climate changes



Breakout Topics:

- agriculture
- coastal areas
- fish/shellfish
- flooding/stormwater/wastewater
- forestry
- hydropower
- municipal water supply

Analysis

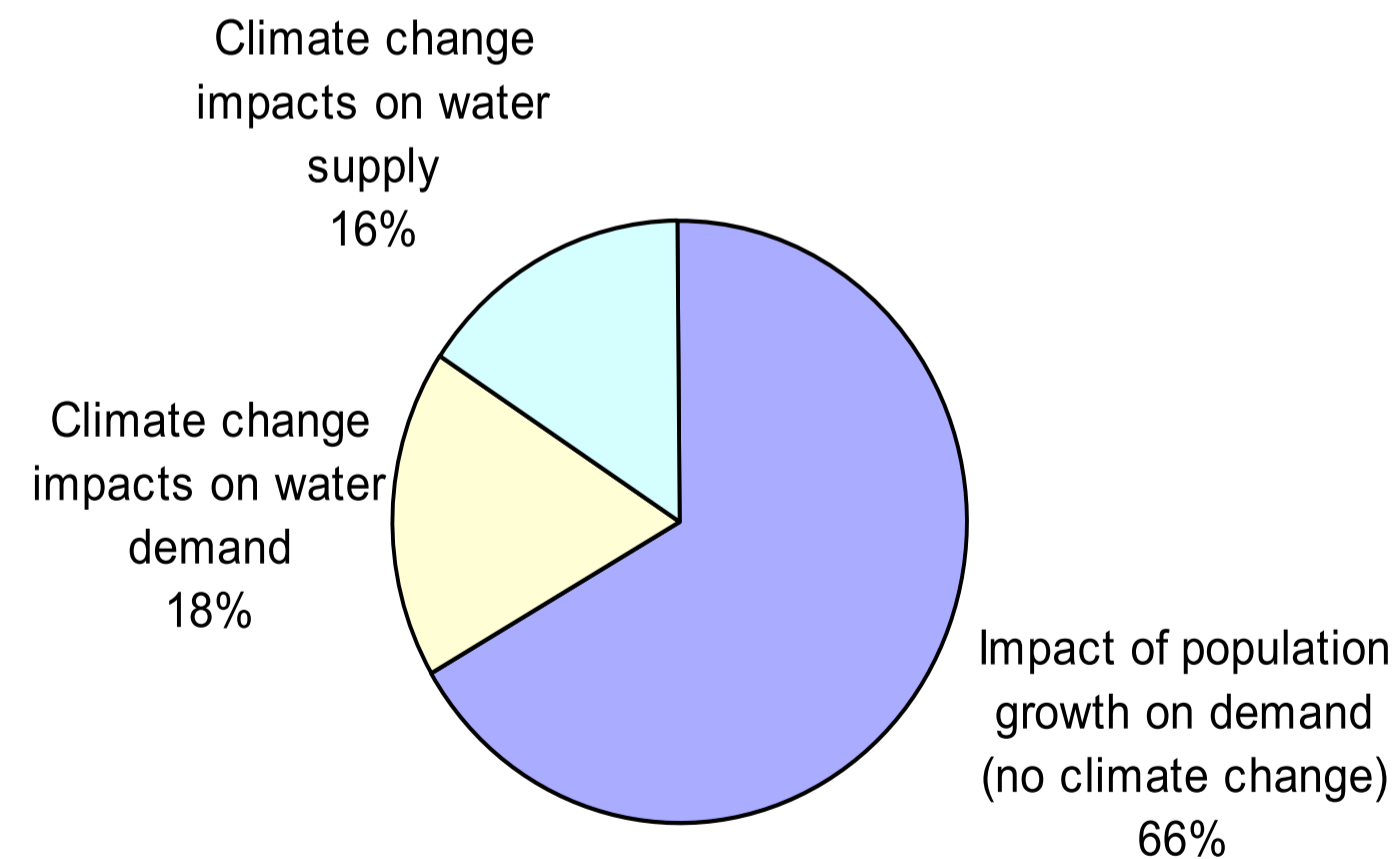
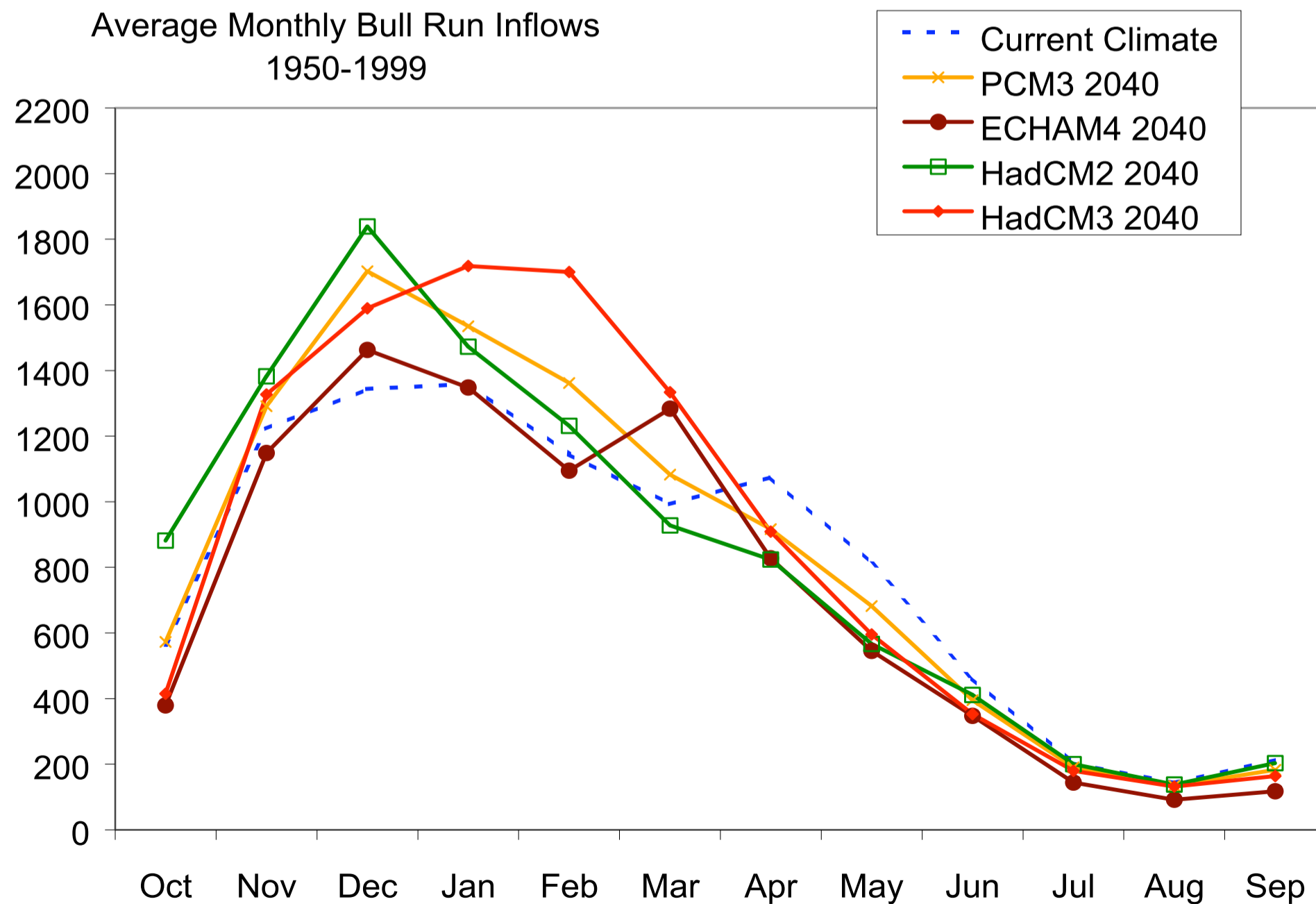
- NW Power and Conservation Council
- Portland Water Bureau
- Seattle Public Utilities
- NW Fisheries Science Center
- Corps of Engineers - Kootenai River sturgeon
- Columbia Basin Trust
- Idaho Dept of Water Resources
- Safeco insurance - wildfire risk

CIG in consulting role

- City of Portland (2002)
- Tualatin River Basin (2004)
- Seattle Public Utilities (2004)



Average Monthly Bull Run Inflows
1950-1999



Palmer, R.N. and M. Hahn, 2002. The Impacts of Climate Change on Portland's Water Supply: An Investigation of Potential Hydrologic Management Implications on the Bull Run System.



Energy and Cost

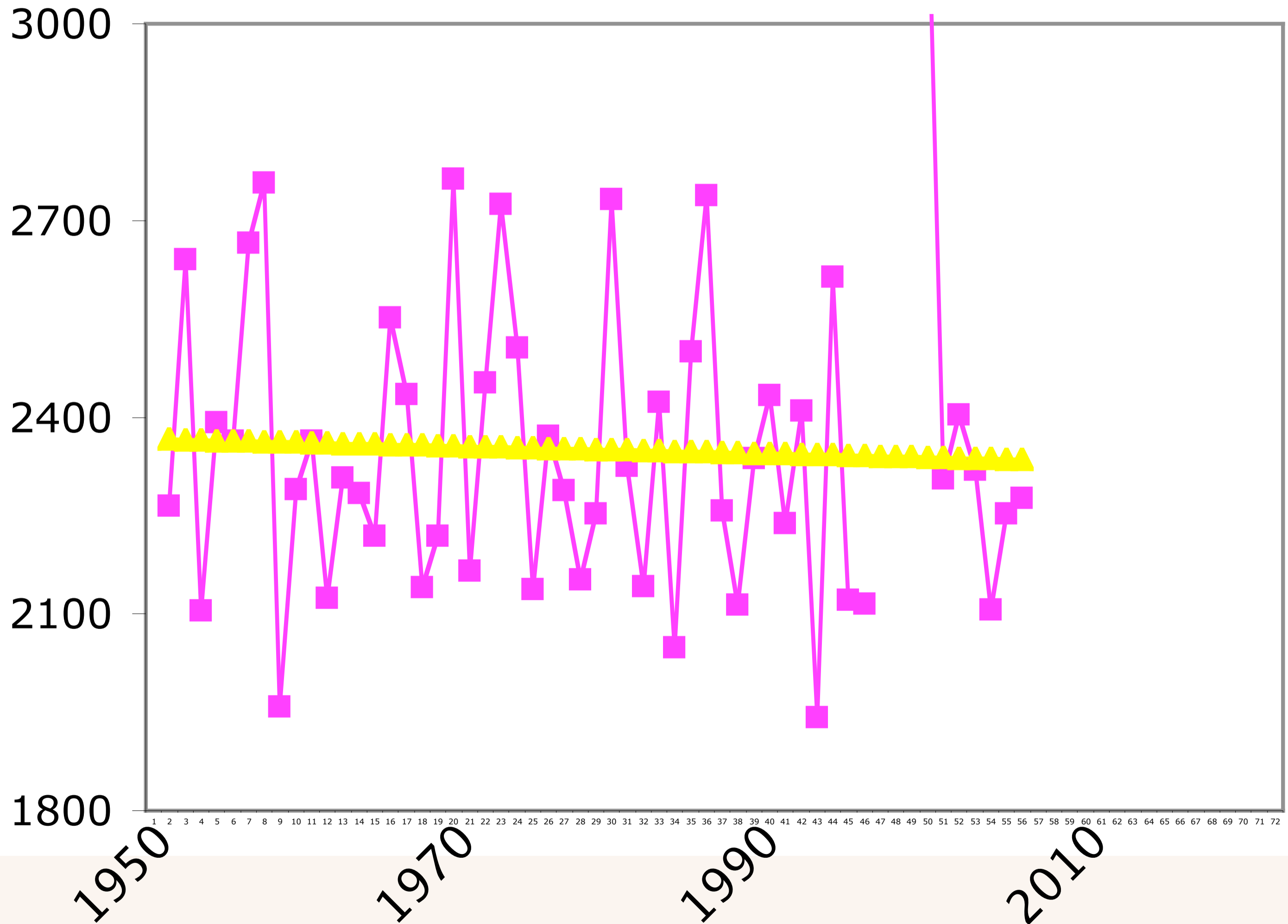
Scenario	Annual Energy (aMW)	Annual Benefit (Millions)
Warm/Wet	300	\$170
Mixed	-500	- \$160
Warm/Dry	-2000	- \$730



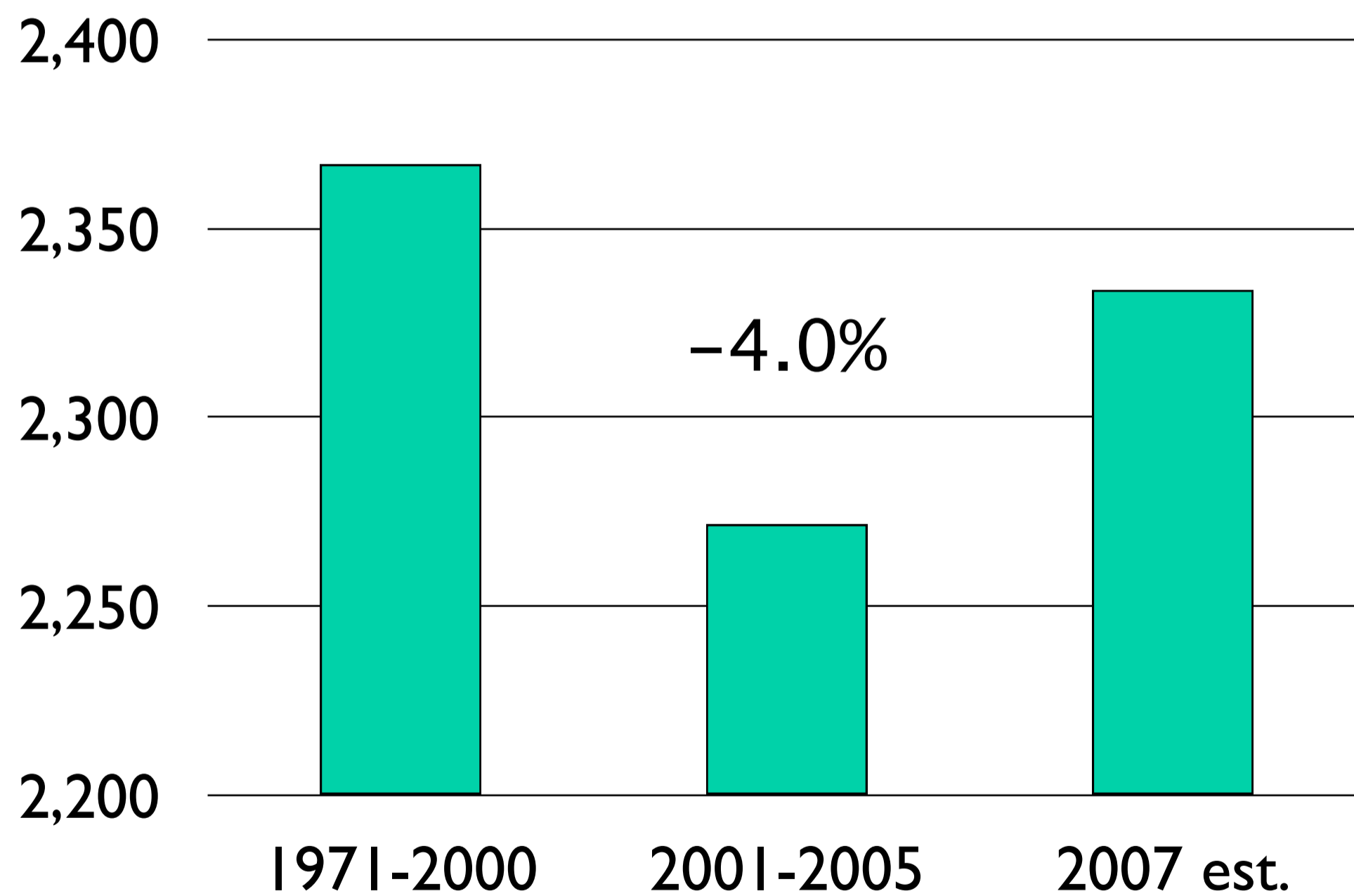
Action

- Rate case involving Cascade Natural Gas
- Washington state assessment

Bellingham DJF heating degree days



Predicting HDD for Bellingham



C. Washington Climate Change Challenge shall address the following elements and process steps:

- i) Consider the full range of policies and strategies for the state of Washington to adopt or undertake to ensure the economic and emission reductions goals are achieved, including policy options that can maximize the efficiency of emission reductions including market-based systems, allowance trading, and incentives;
- ii) Determine specific steps the state of Washington should take to prepare for the impact of global warming, including impacts to public health, agriculture, the coast line, forestry, and infrastructure;
- iii) Assess what further steps the state of Washington should take to be prepared for the impact of global warming to water supply and management;
- iv) Initiate active involvement by the state of Washington in the development of regional and national climate policies and coordination with British Columbia;
- v) Recommend how the state of Washington, as an entity, can reduce its generation of greenhouse gas emissions;
- vi) Work with the state of Washington's local governments to maximize coordination and effectiveness of local and state climate initiatives; and
- vii) Inform the general public of the process, solicit comments and involvement and develop recommendations for future public education and outreach.

State Climate Impacts Assessment –Sector Objectives

- Climate Scenarios
- Hydrology and Water Resources
- Agriculture *-New*
- Salmon
- Forests
- Coasts
- Human Health *-New*
- Infrastructure *-New*
- Adaptation

Conclusions - lessons learned

- solid science underpinnings - hydrol. response to warming, obs changes and PDO, paleoclimate, retrospective
- tightly knit team, strong leadership
- outreach: persistence, diversity. first push, then pull