Incorporating Climate Change Impacts into Water Resources Planning

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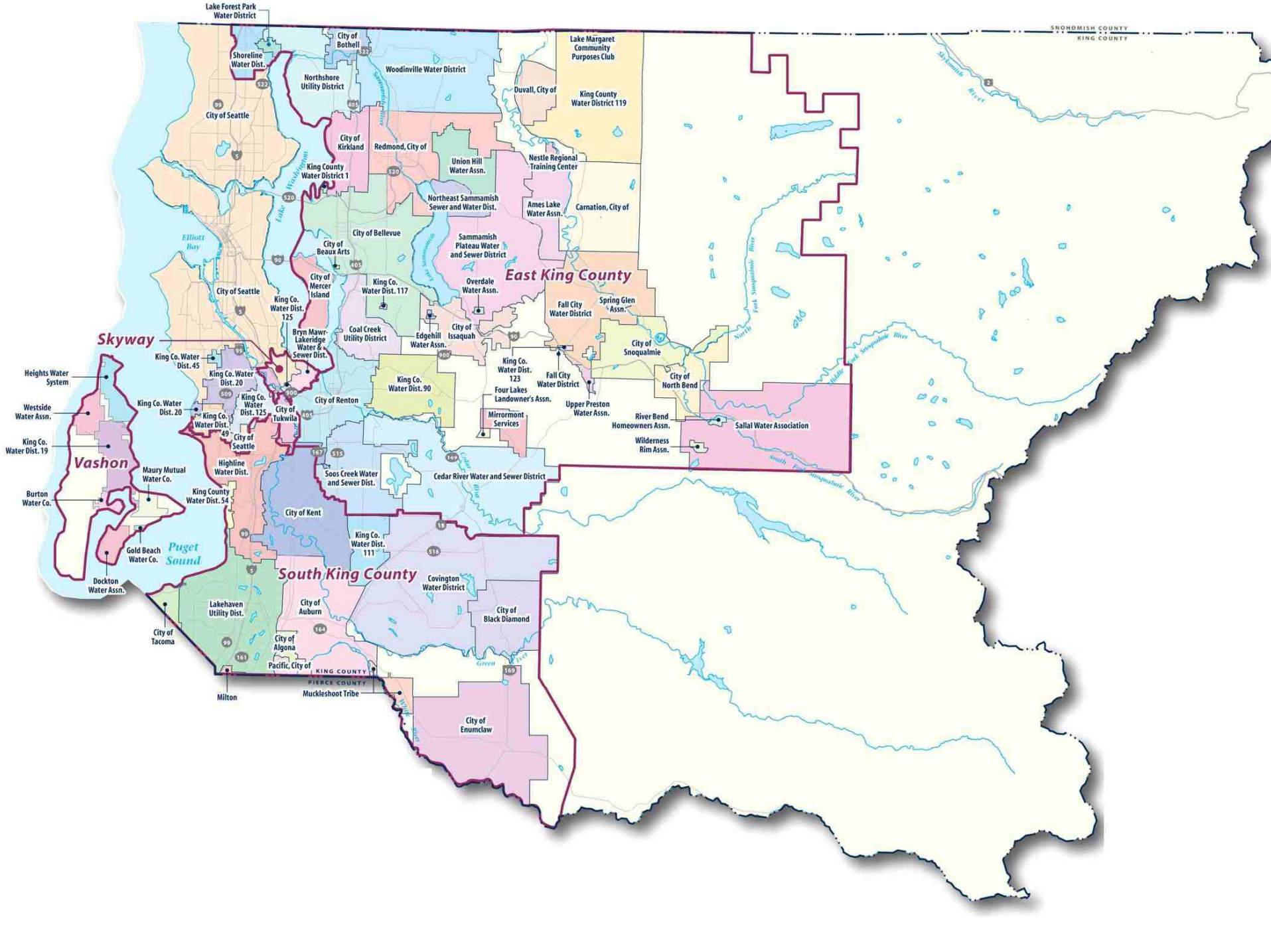
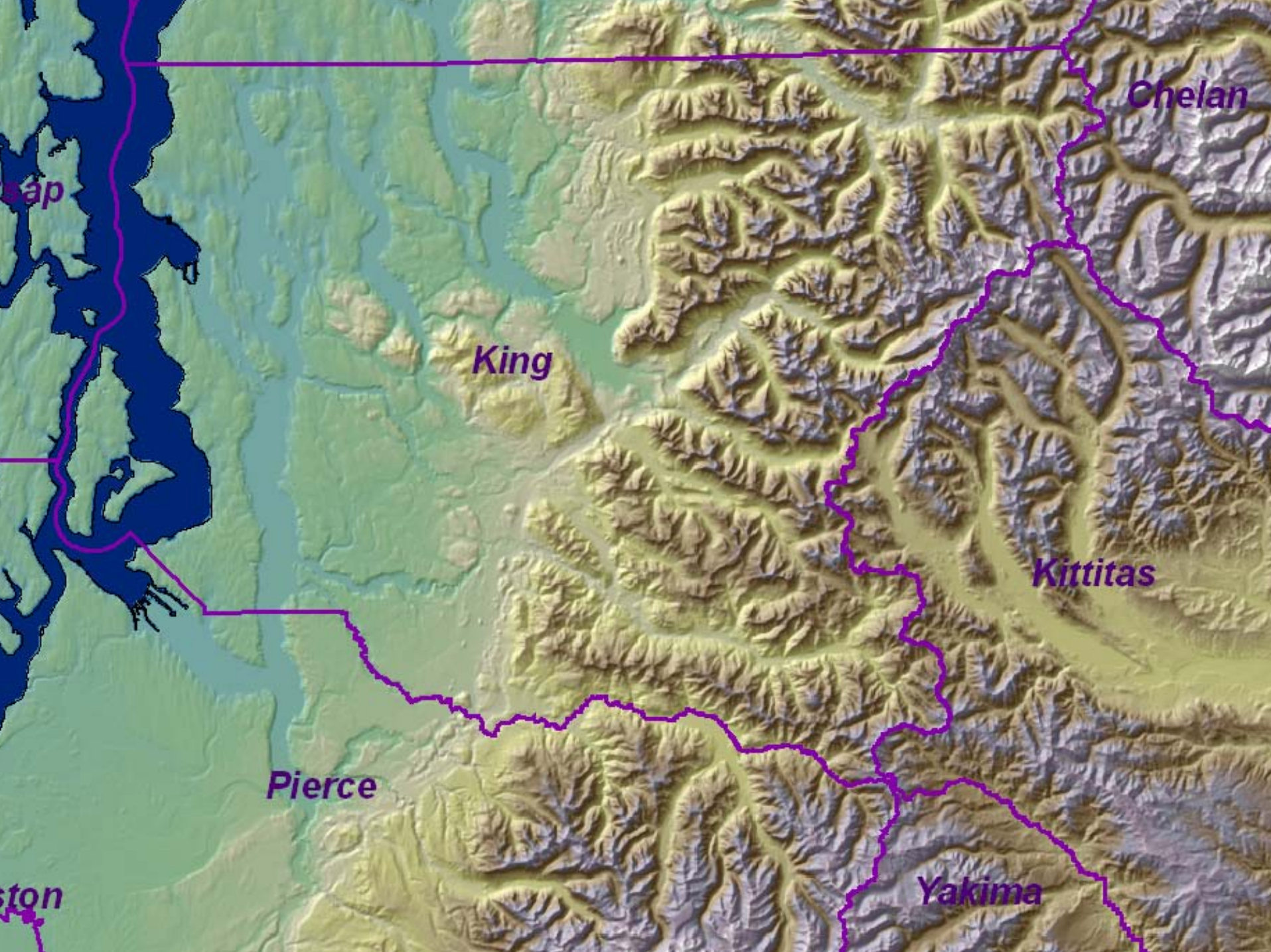
CLIMATE IMPACTS GROUP

UNIVERSITY OF WASHINGTON

Talk Overview

- Geographic Scope
- Purpose of the talk
- Global, Regional, and Local Evidence of Climate Change
- Evaluating the Impacts of Climate Change
- Seattle Climate Change Study
- Snohomish Basin Climate Change Study
- The “King County” Planning Process
- Incorporating Emerging Science into Policy

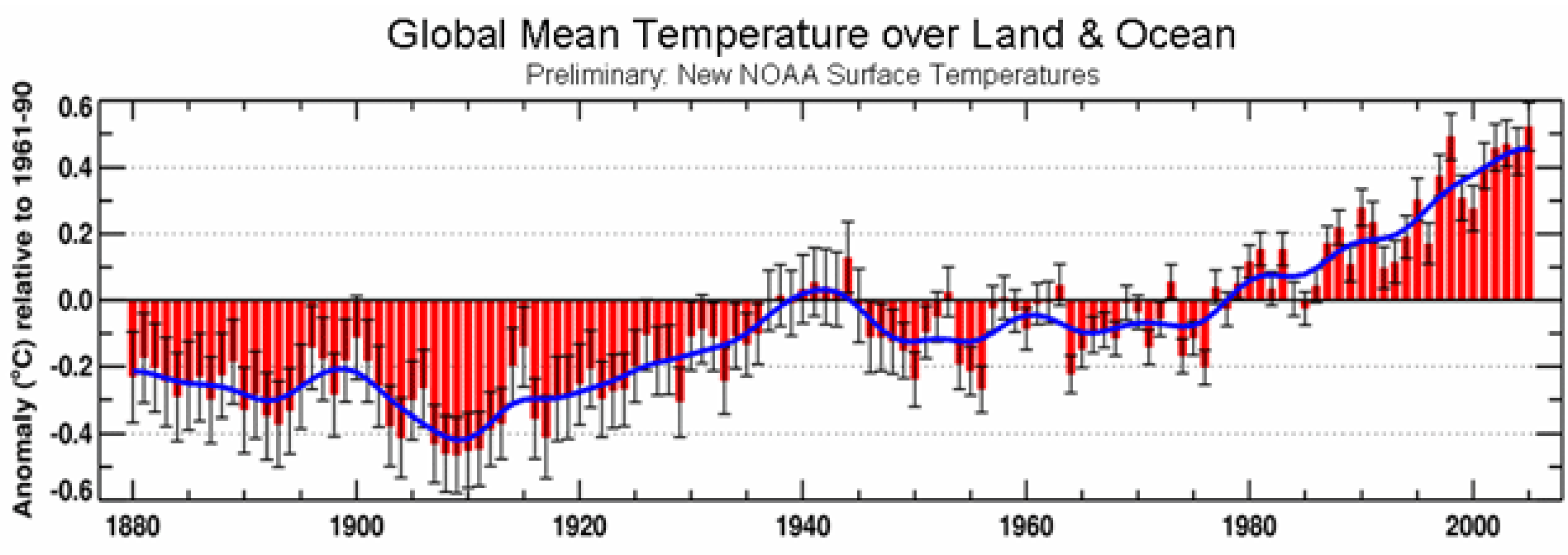

Lake Forest Park Water District
Shoreline Water Dist.
City of Bothell
Northshore Utility District
Woodinville Water District
Lake Margaret Community Purposes Club
Duvall, City of
King County Water District 119
SNOHOMISH COUNTY
KING COUNTY
Skykomish River
City of Seattle
City of Kirkland
Redmond, City of
Union Hill Water Assn.
Nestle Regional Training Center
King County Water District 1
Lake Washington
Northeast Sammamish Sewer and Water Dist.
Ames Lake Water Assn.
Carnation, City of
Elliott Bay
City of Bellevue
Sammamish River
Sammamish Plateau Water and Sewer District
City of Beaux Arts
East King County
City of Mercer Island
King Co. Water Dist. 117
Overdale Water Assn.
Fall City Water District
Spring Glen Assn.
North Fork Snoqualmie River
City of Seattle
King Co. Water Dist. 125
Coal Creek Utility District
Edgehill Water Assn.
City of Issaquah
Bryn Mawr-Lakeridge Water & Sewer Dist.
Skyway
King Co. Water Dist. 45
King Co. Water Dist. 90
King Co. Water Dist. 123
Four Lakes Landowner's Assn.
Fall City Water District
City of Snoqualmie
Middle Fork Snoqualmie River
Heights Water System
King Co. Water Dist. 20
King Co. Water Dist. 125
City of Renton
City of North Bend
Westside Water Assn.
King Co. Water Dist. 20
King Co. Water Dist. 49
City of Tukwila
Upper Preston Water Assn.
River Bend Homeowners Assn.
Sallal Water Association
King Co. Water Dist. 19
City of Seattle
Mirrormont Services
Wilderness Rim Assn.
Vashon
Highline Water Dist.
Soos Creek Water and Sewer Dist.
Cedar River Water and Sewer District
Maury Mutual Water Co.
Burton Water Co.
King County Water Dist. 54
City of Kent
South Fork Snoqualmie River
King Co. Water Dist. 111
Gold Beach Water Co.
Puget Sound
South King County
Covington Water District
Dockton Water Assn.
Lakehaven Utility Dist.
City of Auburn
City of Black Diamond
City of Tacoma
City of Algona
Green River
Pacific, City of
KING COUNTY
PIERCE COUNTY
Milton
Muckleshoot Tribe
City of Enumclaw
White River


Chelan
King
Kittitas
Pierce
Yakima

Purpose of Talk

- To indicate how climate impacts are included in evaluations of water supply and fish production
- To describe an ongoing, planning process in the region
- To illustrate the challenges of integrating planning and “engineering or science”
- Goal – To ensure climate change is considered in long-term planning

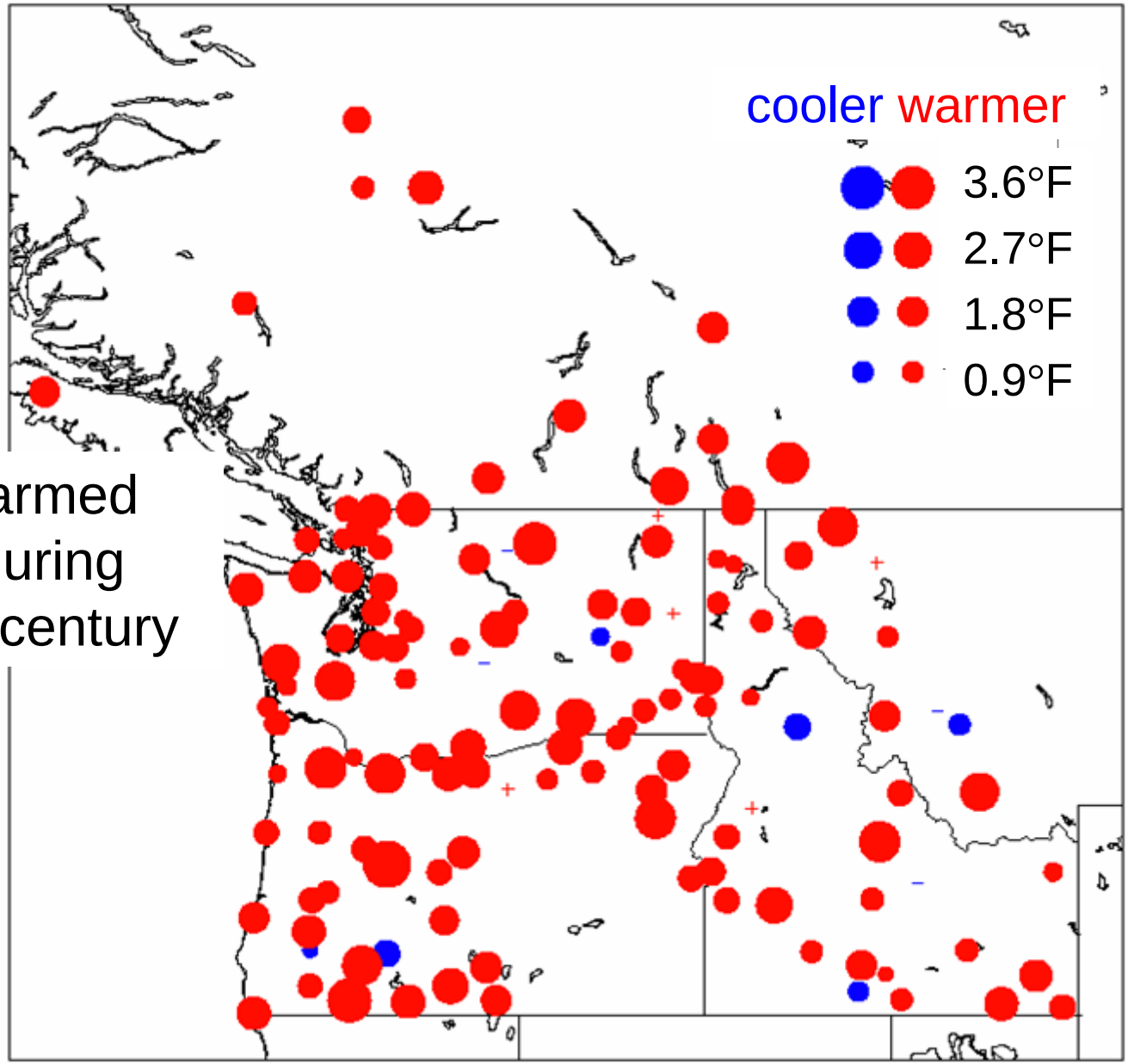
Evidence of Warming



In the past 16 years we have experienced the 13 warmest global temperatures on record.

If these were independent probability is 4×10^{-11}

Temperature trends (°F per century) since 1920

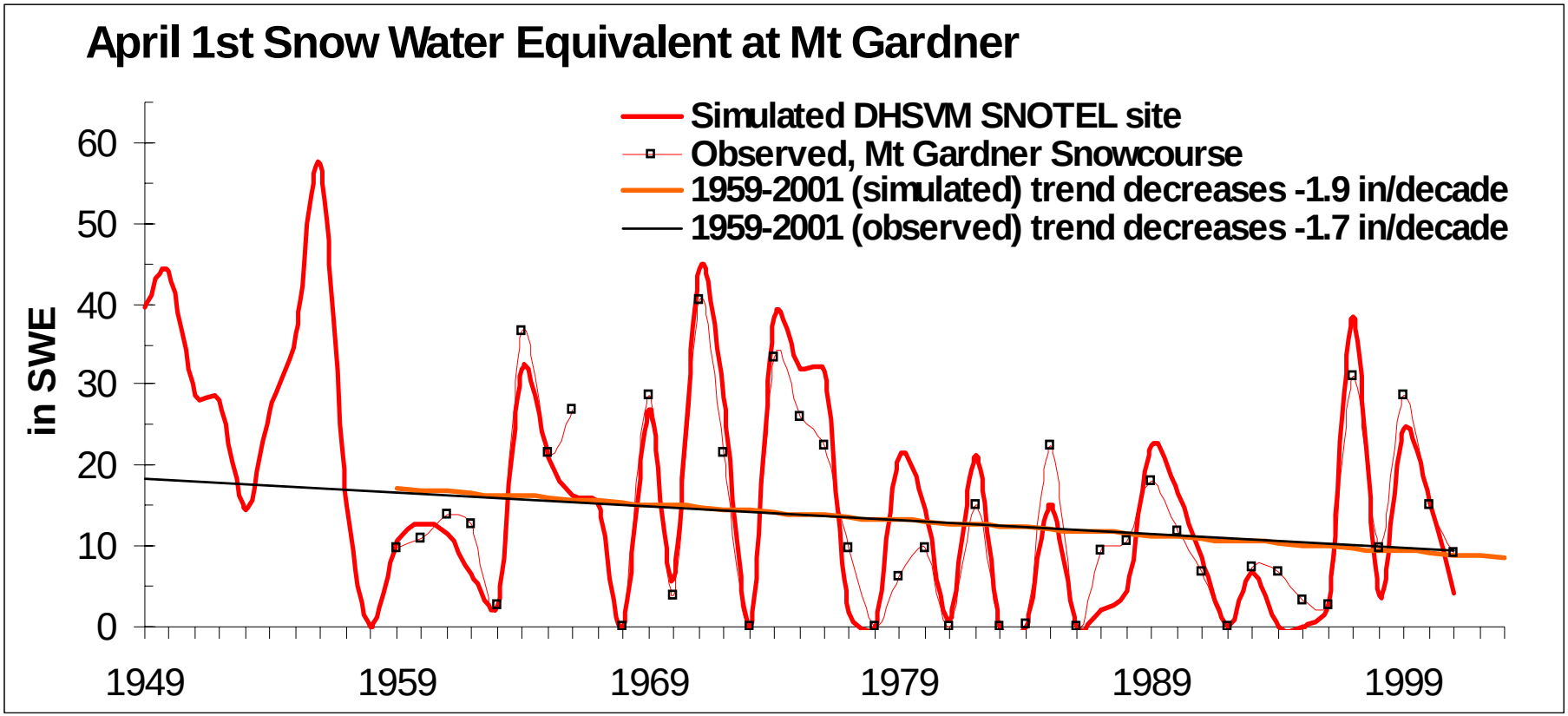


PNW warmed **+1.5 F** during the 20th century

These simple shifts imply

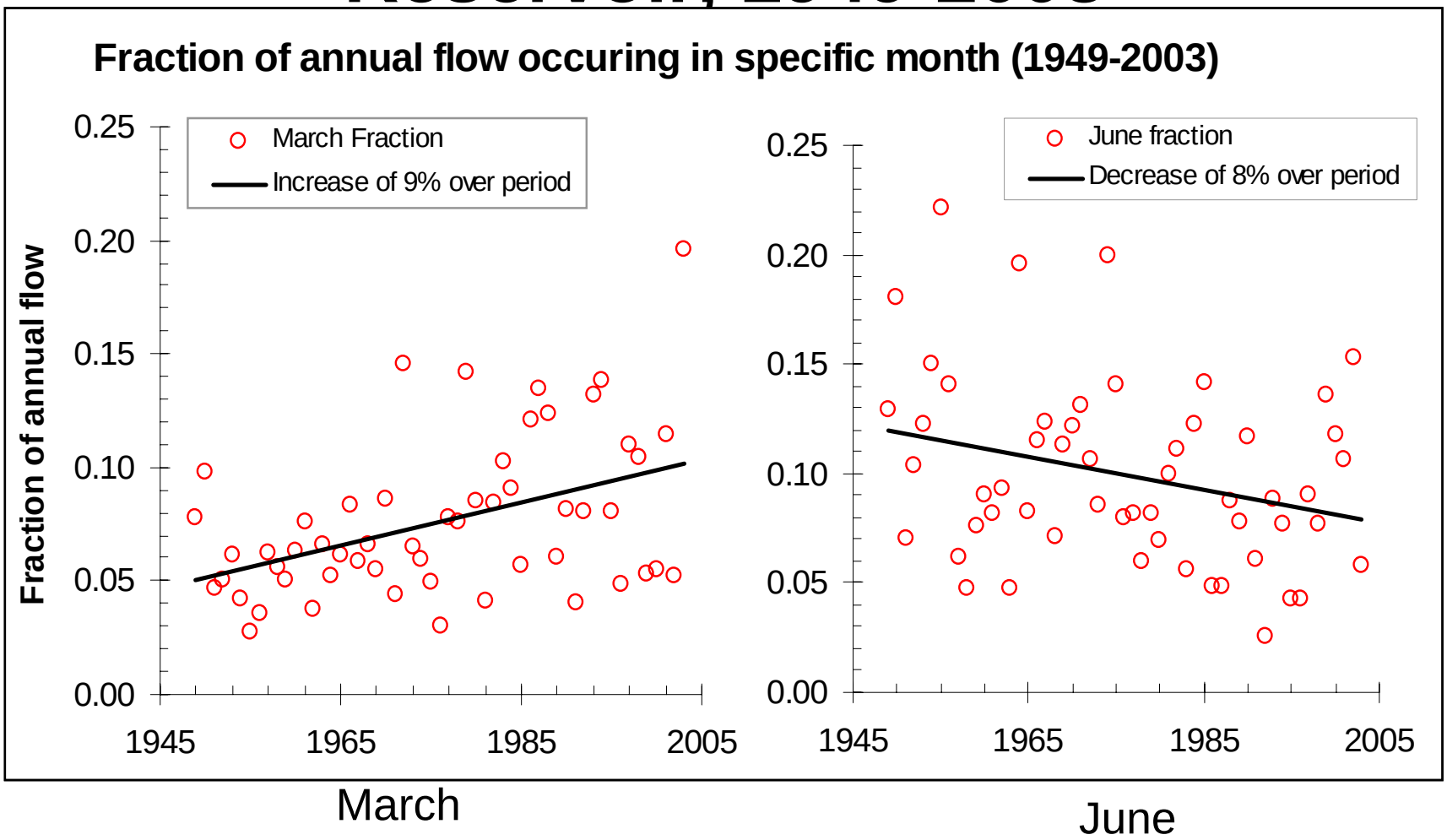
- Less snowpack to feed reservoirs in the spring
- Potential increases in outdoor water demands
- Lower streamflows in late summer
- An increase in the return period of low flow events

April 1 SWE at Mt. Gardner



Consistent declining trend between observed and simulated April 1 SWE for Mt. Gardner

Changes in Annual Spring Flow on the Cedar River above Chester Morse Reservoir, 1949-2003



Fractions of annual flow occurring in March and June on the Cedar River above Chester Morse reservoir. Station Elevation 1560 ft.




"I say the debate is over.
We know the science.
We see the threat.
And we know the time for action is now."

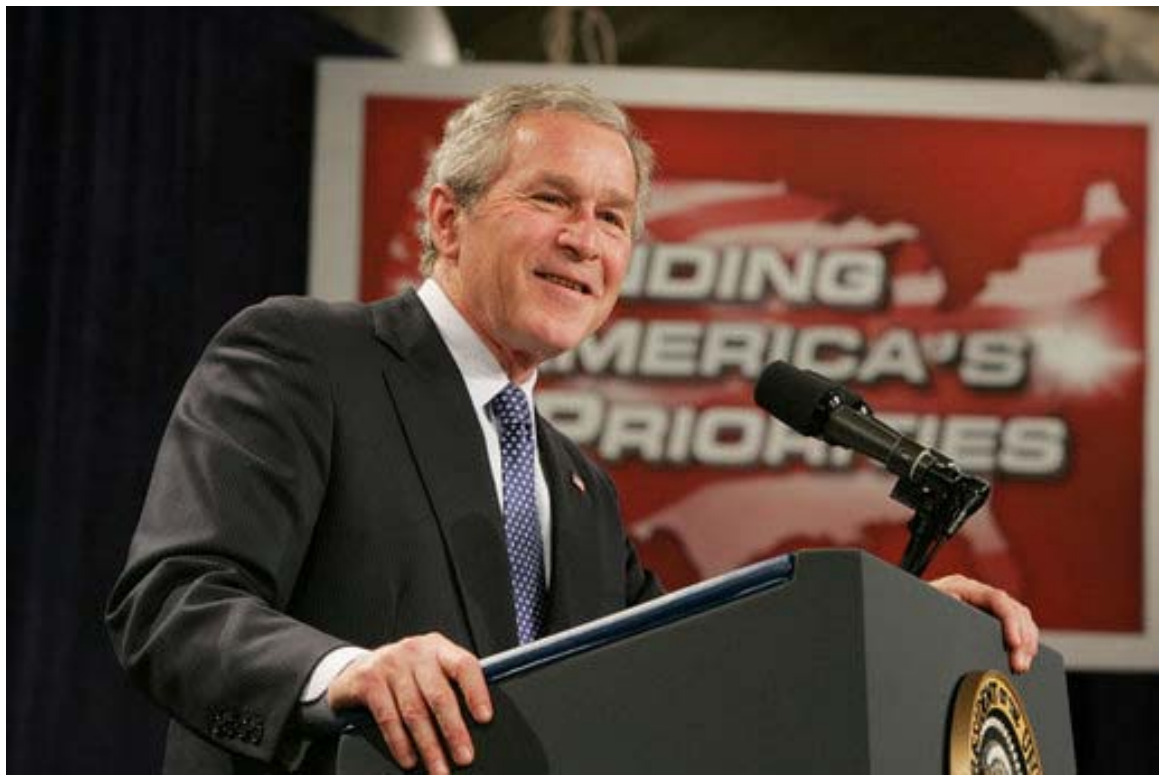
Governor Arnold Schwarzenegger, June 1, 2005

Federal Study Finds Accord on Warming

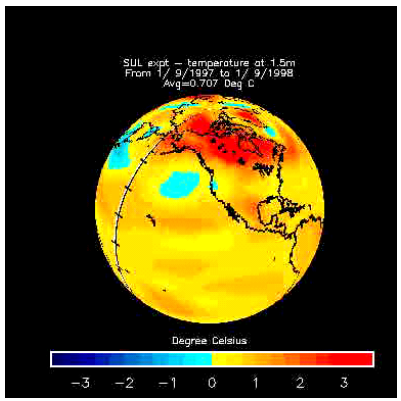
By ANDREW C. REVKIN

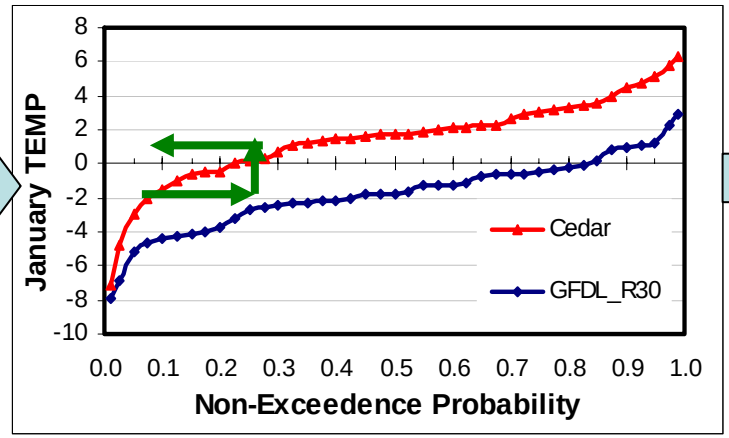
Published: May 3, 2006

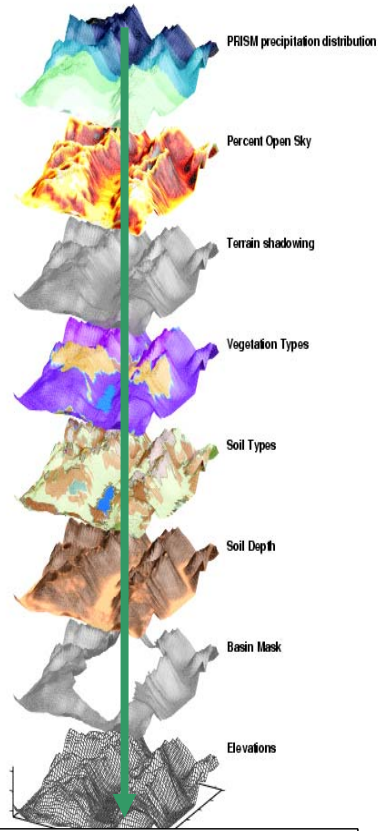
A scientific study commissioned by the Bush administration concluded yesterday that the lower atmosphere was indeed growing warmer and that there was "clear evidence of human influences on the climate system."

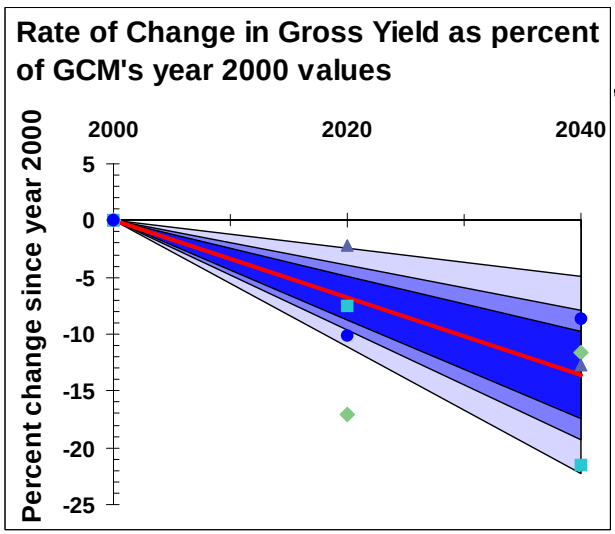


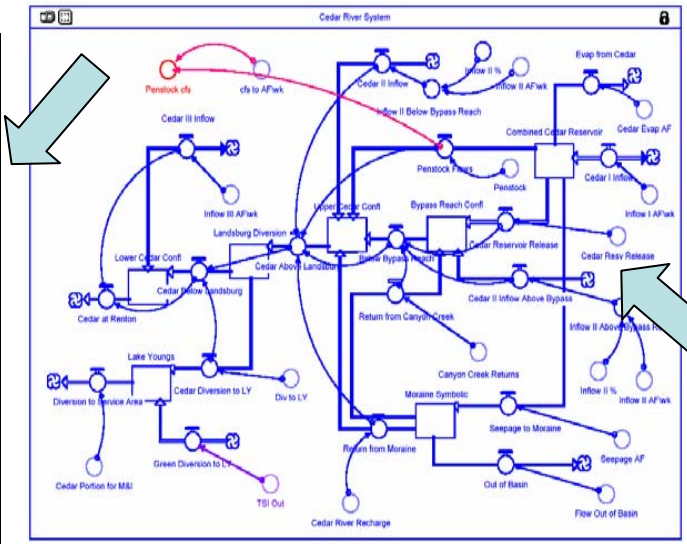
Impact Assessment Method

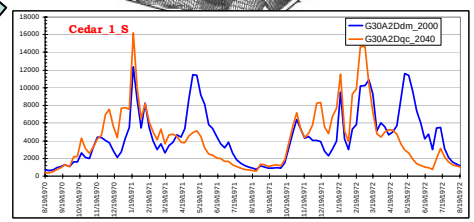




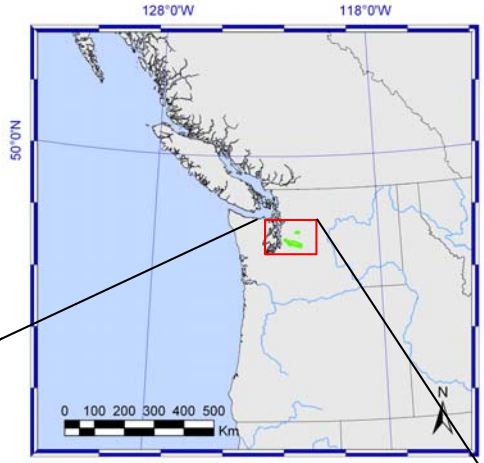


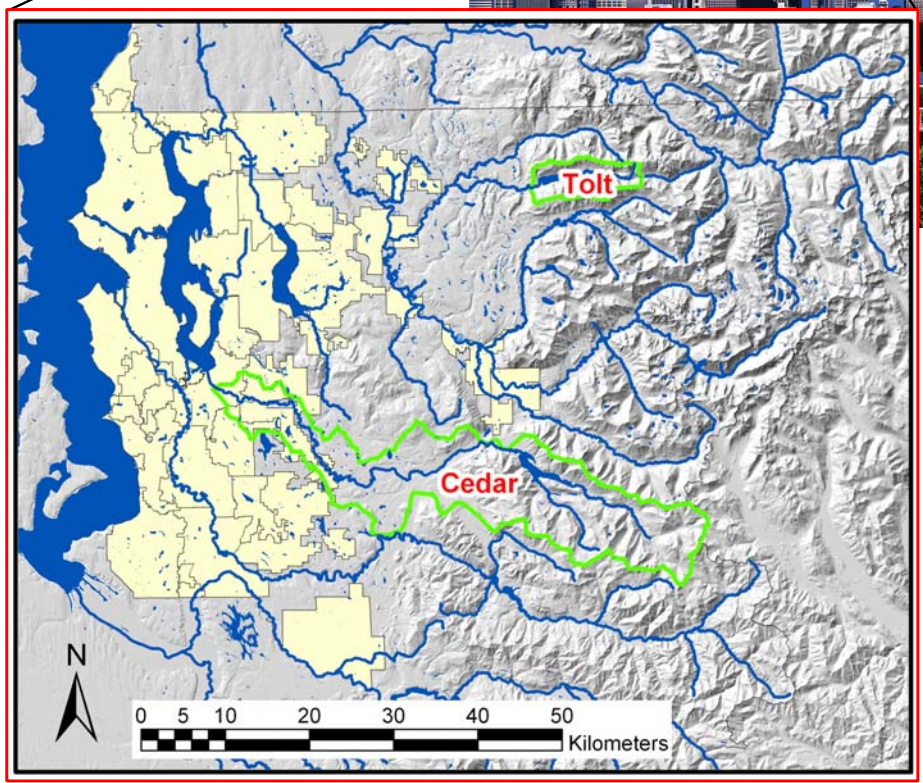






Impacts of Climate Change on Seattle's [illegible]pply





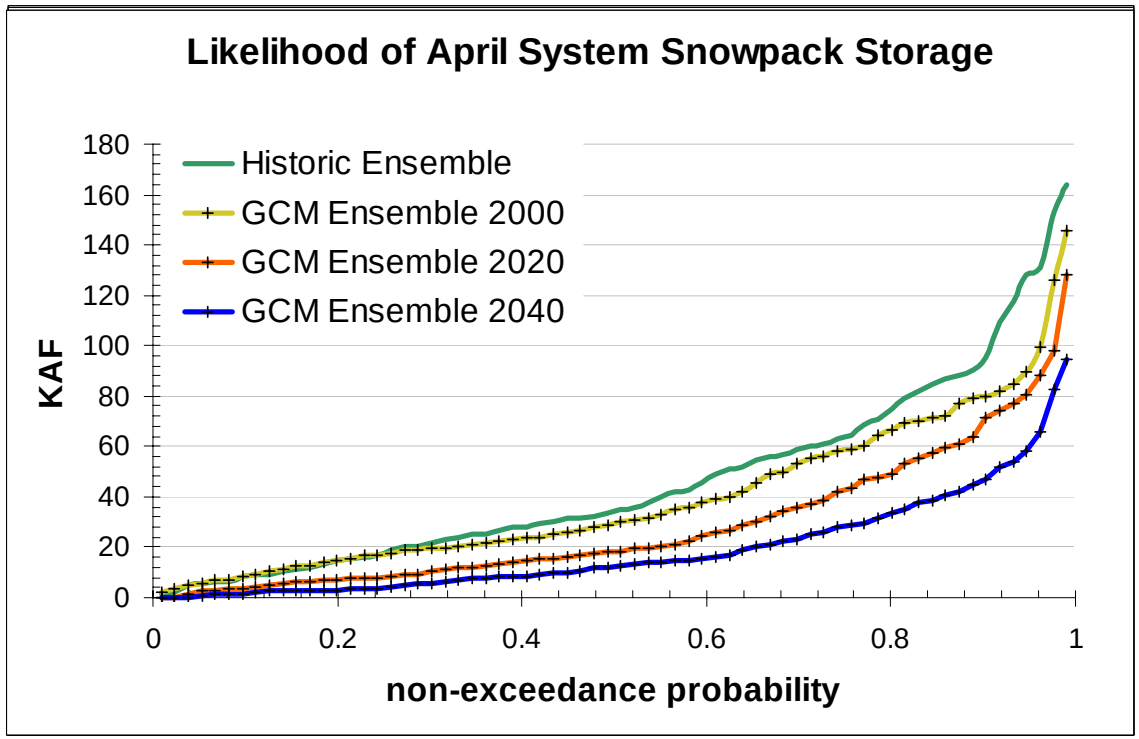
Seattle Water Supply

- Three sources
  - South Fork Tolt River (29%)
  - Cedar River (70%)
  - Highline well fields (1%)
- Reservoirs
  - Tolt Reservoir 56.2 KAF active storage
  - Chester Morse 48.5 KAF active storage
- Combined storage is approximately 68% of average annual demand
- Storage in snow is important !

Impacts of Climate Change

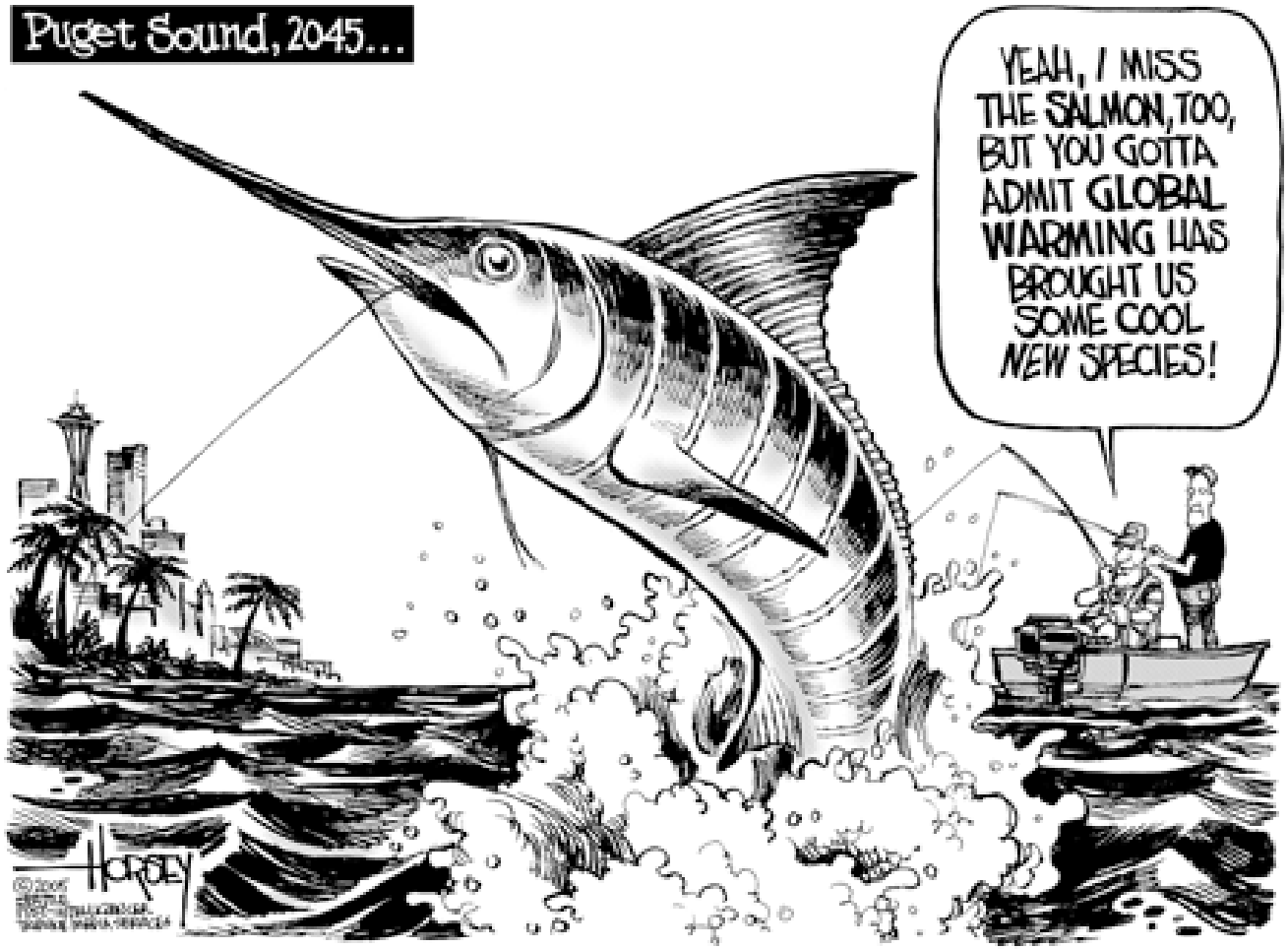
Snowpack

- Average annual maximum seen to decrease by as much as 50% by 2040
- Timing of peak shifts earlier in year.
- Extreme events will become more common.



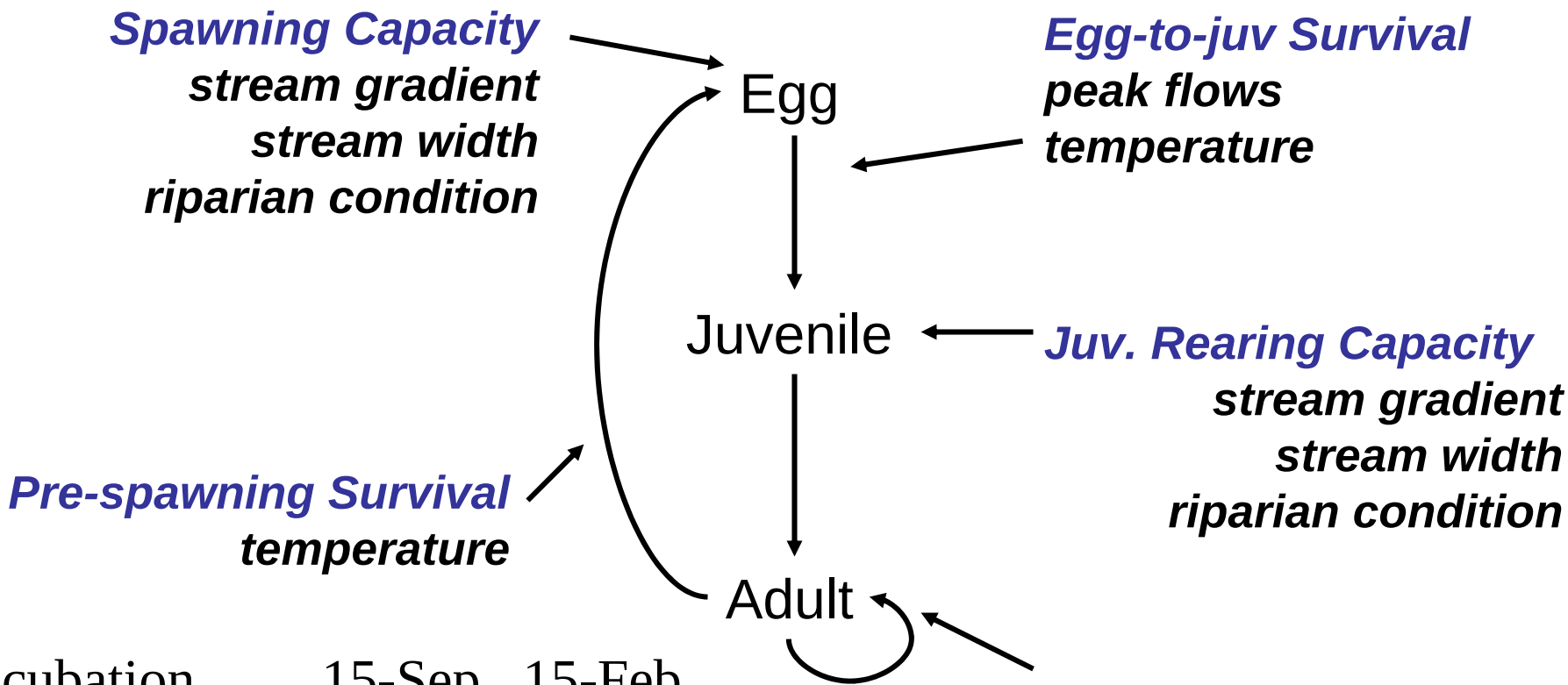
Climate Impacts on Chinnook Populations in the Snohomish Basin

- Study performed with NOAA
- Goal – to determine potential climate impacts on Chinook in Snohomish River Basin
- Two climate change models, years 2000, 2025, 2050
- Various land use options
- Look at factors impacting fish

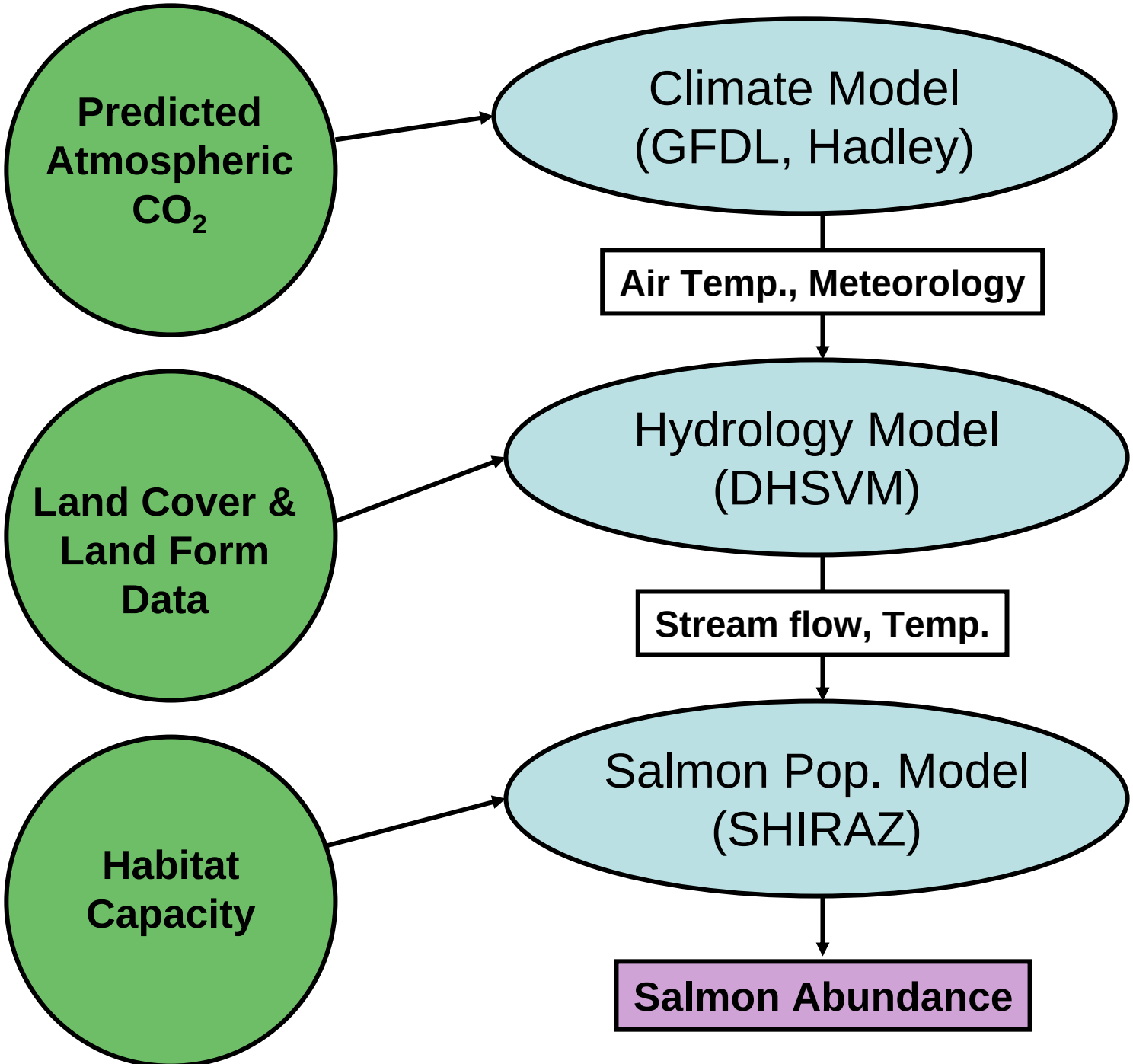


From the Seattle Post-Intelligencer, October 20, 2005

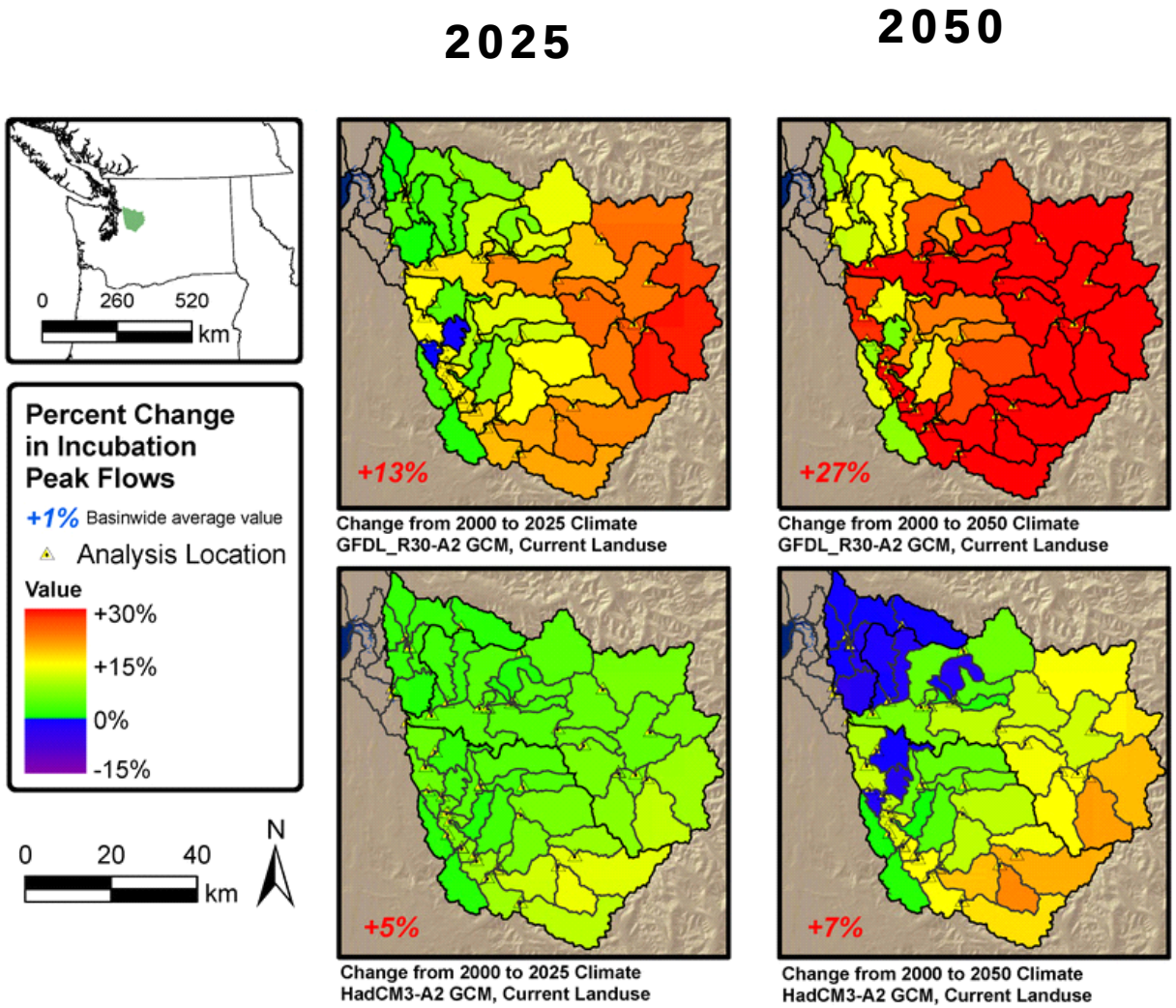
Habitat Effects in SHIRAZ



Incubation	15-Sep	15-Feb
Smolt migrat.	15-Mar	15-Jun
Pre-spawning	15-Jul	15-Oct
Spawning	15-Sep	15-Nov


Predicted Atmospheric CO_2
Climate Model (GFDL, Hadley)
Air Temp., Meteorology
Land Cover & Land Form Data
Hydrology Model (DHSVM)
Stream flow, Temp.
Habitat Capacity
Salmon Pop. Model (SHIRAZ)
Salmon Abundance

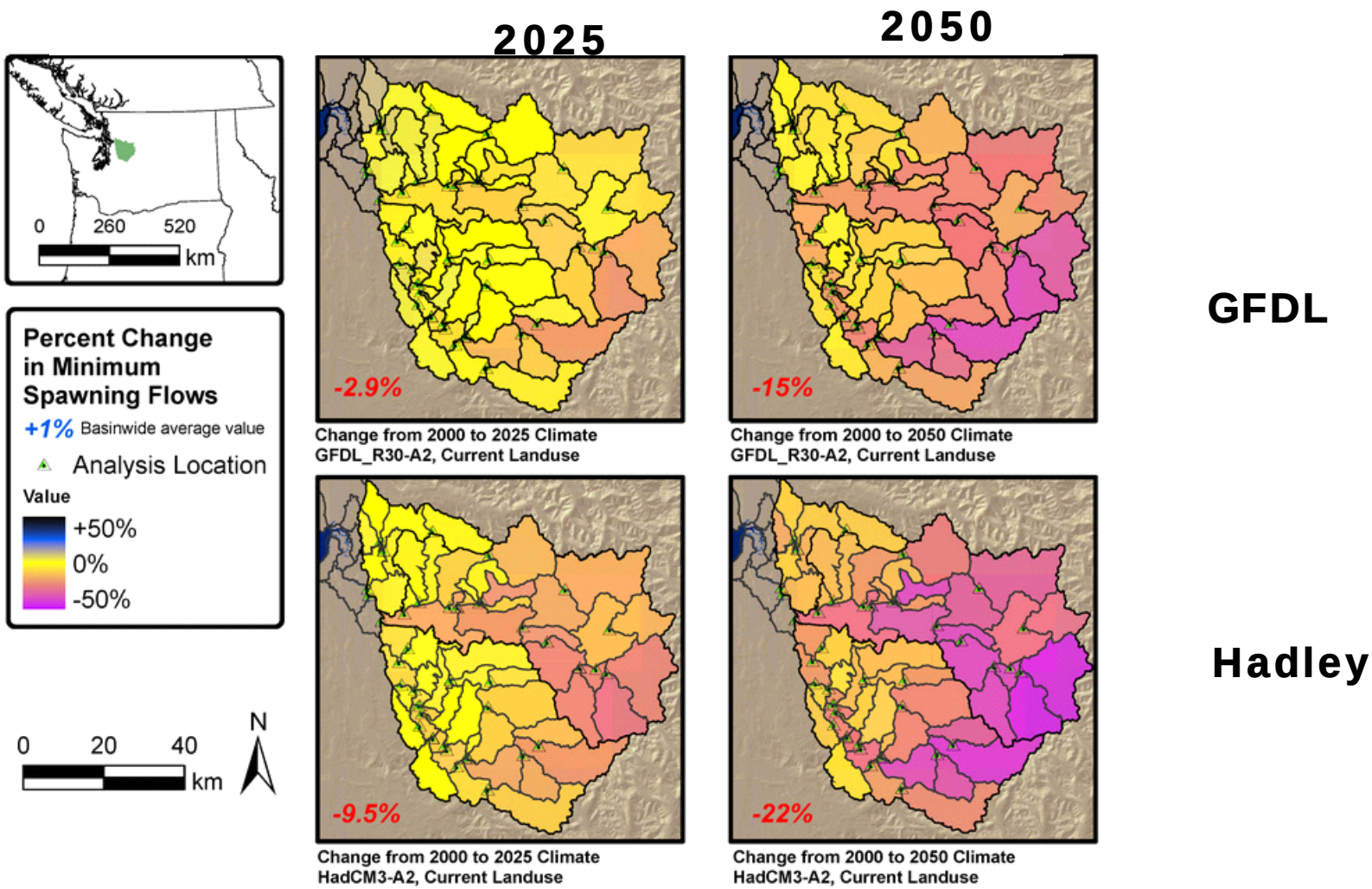
Climate Impacts: Peak Flow



Incubation peak flow-maximum instantaneous flow between Sept. 15th and Feb. 15th

Increases in average peak incubation flows 7-27%

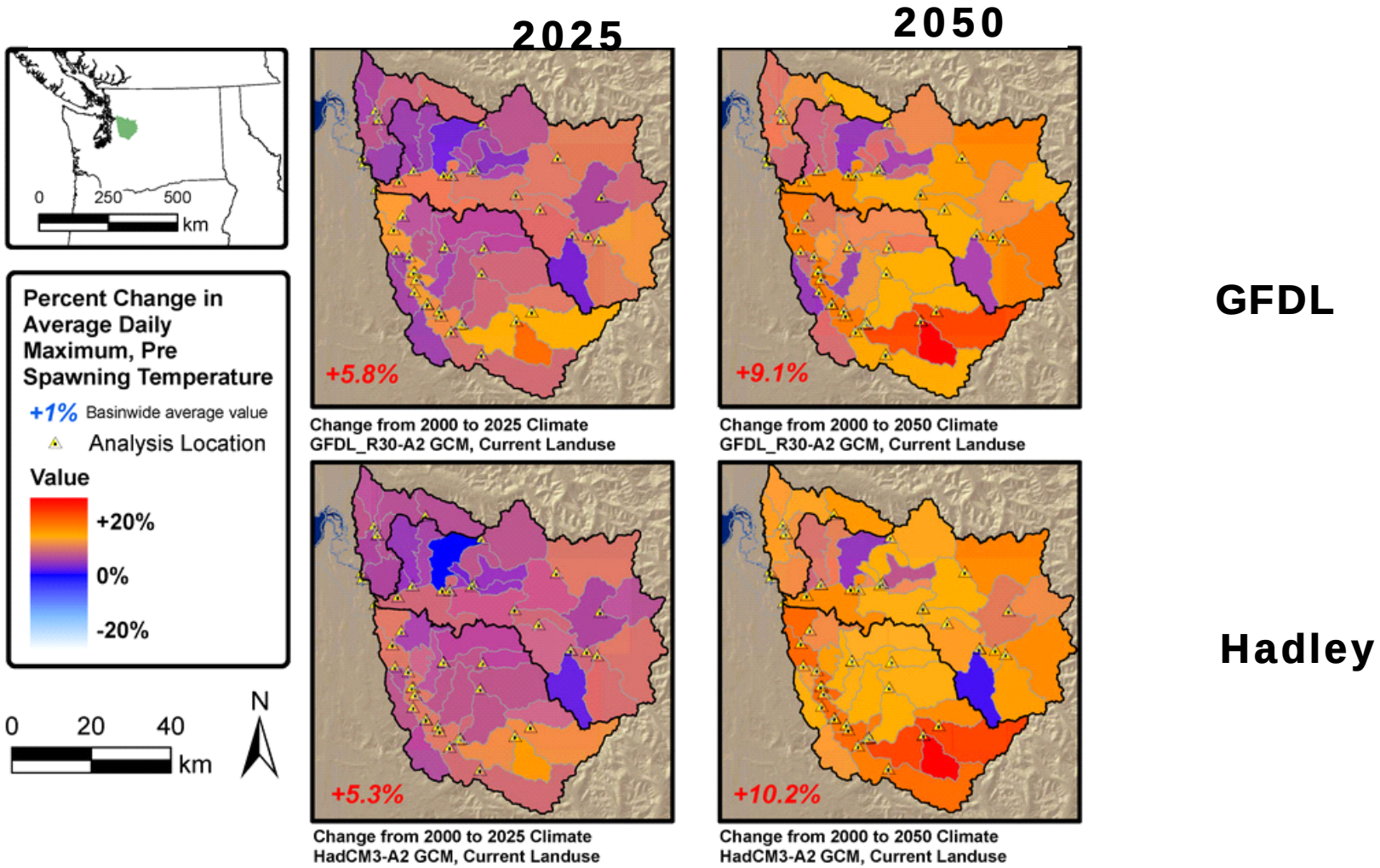
Climate Impacts: Low Flow



Minimum spawning flow- lowest instantaneous flow between Sept. 15th and Nov. 15th

Average reductions in minimum spawning flows 15-22%

Climate Impacts: Water Temperature



Pre-spawning temperature- mean of daily maximum temperatures for July 15th – Oct. 15th

Increases in average pre-spawning temperature ~ 10%




How does one get this into use?

- Wait for people to come to you?

- Integrate it into a planning process.

What is the “Planning Process?”

- The determination of the goals and objectives of an enterprise and the selection, through a systematic consideration of alternatives, of the policies, programs and procedures for achieving them.

Regional Planning Process

- A regional water supply planning process will develop substantive technical information regarding current and emerging water resource management issues in and around King County

- Other Planning processes
  - River basin planning
  - Water supply planning
  - Shared Strategy

Participants

- **Muckleshoot Indian Tribe,**
- **Departments of Ecology, Health, and Fish and Wildlife,**
- **Seattle,**
- **Auburn,**
- **King County Council,**
- **Tacoma Public Utilities,**
- **Cedar River Water and Sewer District, Lakehaven Utility District,**
- **Woodinville Water and Sewer District,**
- **Seattle-King County Public Health,**
- **Shared Strategy for Puget Sound,**
- **Washington Environmental Council,**
- **King County Department of Natural Resources and Parks, and**
- **Cascade Water Alliance.**

Goals of the Process

- To produce information/recommendations in seven areas:
  - water demand forecasts,
  - water supply assessments,
  - climate change impacts,
  - reclaimed water,
  - tributary stream flows,
  - source exchange strategies, and
  - small water systems.

Funding

- King County,
- City of Seattle,
- Cascade Water Alliance,
- Washington Department of Ecology, and
- Forum

Obstacles to Using Climate Change Information

- ~~Climate Change is not real~~
- It is an emerging science
- There is uncertainty in life
- There is no established paradigm
- Including climate change could result in the wrong answer What about not including it?

Incorporating Emerging Science into Policy and Risk Management

- Use the best science available
- Distinguish between the likely and unlikely
- Attempt to identify technical issues, value issues, and policy issues and get appropriate input

We must acknowledge

- Risks of climate change are real
- Decision making involves uncertainty
- Planning requires establishing a “status quo”
- Regret resistant solutions exist
- We do not want to look back and explain why evidence was ignored