



Regional Climate Change Water Supply Planning Tools for Central Puget Sound

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Department of Civil and Environmental Engineering

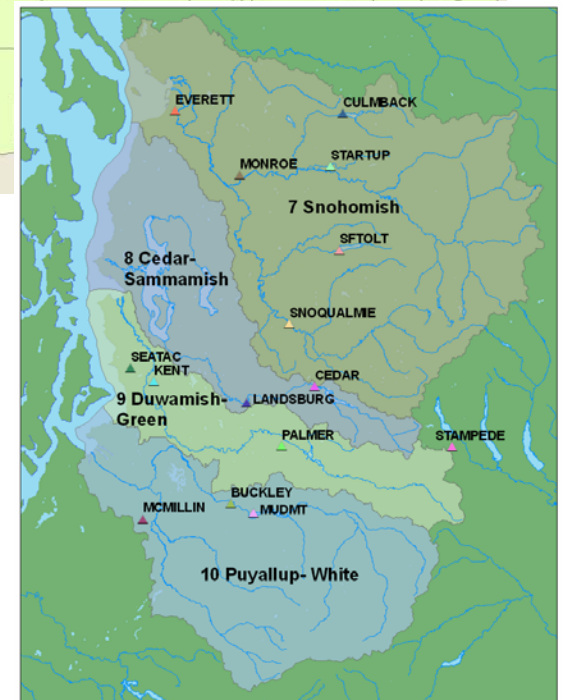
University of Washington

Seattle, WA 98105-2700

www.tag.washington.edu

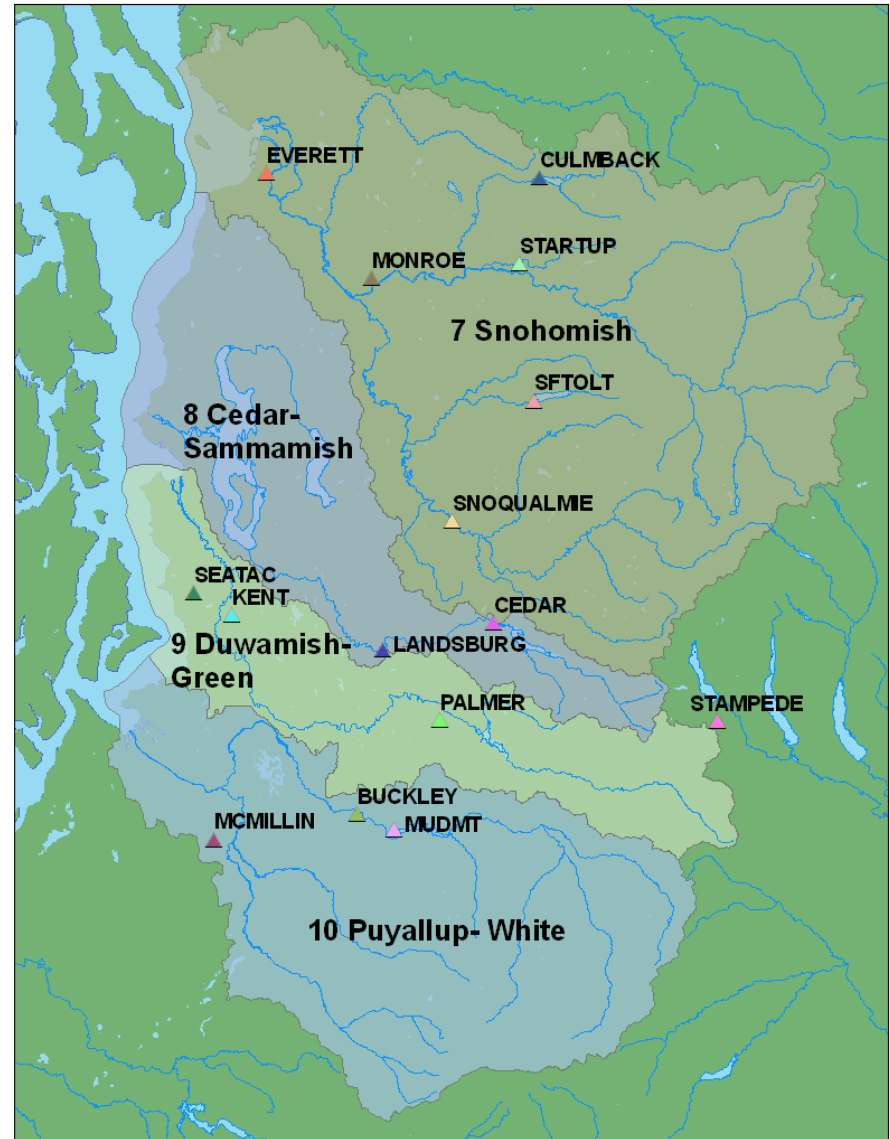
Regional Motivation

- Multiple agencies and organizations working together to develop data, information and pragmatic tools to assist in water resource and supply planning activities in the region.
- Regional Water Demand Forecast
- Water Supply Source Alternatives
 - **Climate Change**
 - Reclaimed Water
 - Source Exchange Strategies
 - Small Water Systems
 - Tributary Streamflows
- Research Goal: Provide climate impacted streamflows and meteorological data to Water Demand and Water Supply Committees



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Deliverables

- Meteorological Variables
 - Technical memorandum documenting the methods used, key assumptions, QA/QC efforts and results.
 - Database of climate variables for defined scenarios and future years for specific sites.
- Streamflow Data
 - Technical memorandum - for each portion of the WRIAs, documenting the methods used, key assumptions, model calibration and validation, QA/QC efforts and results.
 - For each of the climate change scenarios, database of projected streamflows into local reservoirs.
 - For each of the climate change scenarios, database of projected streamflows associated with environmental flows or other operational components.
- Other Support
 - Framework for estimating potential future climate change impacts on municipal water demand and supply.
 - Support to Municipal Water Demand Forecast and Water Supply Assessment Advisory Committees.
 - Cloud cover Study
 - Groundwater Study





IPCC web sites

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New Language Portals in all UN languages



User Guide to the IPCC Website

How do I find information about

"Climate Change 2007"

The IPCC 4th Assessment Report is coming out

A comprehensive and rigorous picture of the global present state of knowledge of climate change

Play



The Intergovernmental Panel on Climate Change (IPCC) has been established by WMO and UNEP to assess scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation. It is currently finalizing its Fourth Assessment Report "Climate Change 2007", also referred to as AR4. The reports by the three Working Groups provide a comprehensive and up-to-date assessment of the current state of knowledge on climate change. The Synthesis Report integrates the information around six topic areas. More

Other IPCC News

The future in our hands high-level event on climate change convened by the UN Secretary General on 24 September 07

> Speech by Mr. Rajendra Pachauri - Chairman of the Intergovernmental Panel on Climate Change (IPCC) New



> The IPCC Fourth Assessment Working Groups Reports: key findings - a presentation by the Chairman of the IPCC New

IPCC Fourth Assessment Report (AR4)

Working Group I Report "The Physical Science Basis"

- > FULL REPORT now available online
> SUMMARY FOR POLICYMAKERS
> Webcast of the Press Conference - Paris 2 Febr 2007



Working Group II Report "Impacts, Adaptation and Vulnerability"

- > FULL REPORT now available online New
> SUMMARY FOR POLICYMAKERS
> SPM figures and tables (high resolution)
> Webcast of the press conference Brussels, 6 April 2007
full video / audio only





Climate Science
in the Public Interest

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The **Climate Impacts Group (CIG)** is an interdisciplinary research group studying the impacts of natural climate variability and global climate change ("global warming") on the U.S. Pacific Northwest (PNW). Through research and interaction with regional stakeholders, the CIG works to increase the resilience of the Pacific Northwest to fluctuations in climate.

The CIG's research focuses on four key sectors of the PNW environment: water resources, aquatic ecosystems, forests, and coasts.

The CIG is unique in its focus on the intersection of climate science and public policy. We perform fundamental research on climate impacts and work with PNW planners and policy makers to apply this information to regional decision making processes. The CIG is part of the [Center for Science in the Earth System](#) at the University of Washington's [Joint Institute for the Study of the Atmosphere and Ocean \(JISAO\)](#).

Spotlight (past Spotlight features)

→ JISAO climate change lecture series

Ron Sims, Konrad Steffen, and Jonathan Overpeck will participate in the inaugural JISAO climate change lecture series this winter at Seattle's Pacific Science Center (1.28.08)

→ The PNW Climate CIGnal Issue #12 is now posted

Read the latest issue of the CIG's on-line newsletter (1.28.08)

→ The PNW climate outlook has been updated

Find out what forecasters are saying about Pacific Northwest climate in the coming months (1.28.08)

→ New report on sea level rise

Interpreting projections of global sea level rise along with local factors like tectonic uplift for Washington's coastal waters ([press release](#)) (01.17.08)

→ Hard copies of the CIG's climate change adaptation guidebook now available



Pacific Northwest. The Climate Impacts Group focuses on the

Building Blocks



(Source:
<http://agexted.cas.psu.edu/FCS/mk/images/BuildingBlocks.jpg>)

- Conceived as Team Building and as an 'Ice-Breaker' → became extended, heated issue.
- Uncertainty: As with other science, our understanding will improve with time, uncertainties exist, but much is known
- Impacts organized into six areas:
 - Temperature
 - Precipitation
 - Snowpack and Glaciers
 - Streamflows
 - Sea Level Rise
 - Salmonid Habitat
- Areas of interest
 - Global trends
 - National trends
 - Pacific Northwest trends
 - Puget Sound Region
- Available at: <http://www.climate.tag.washington.edu>

Building Blocks



(Source:
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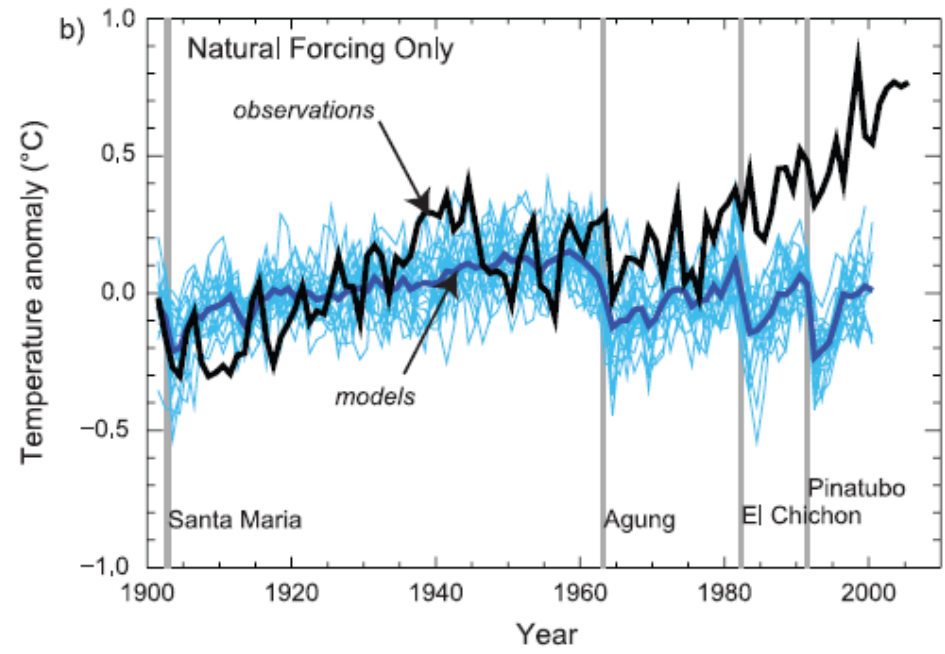
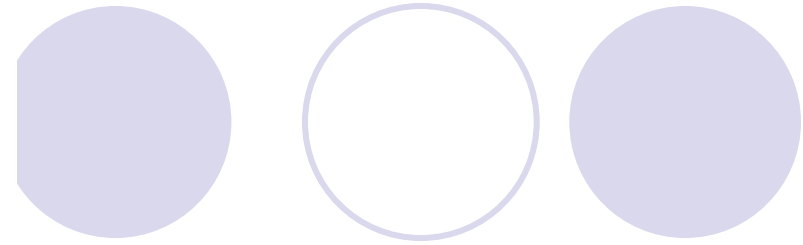
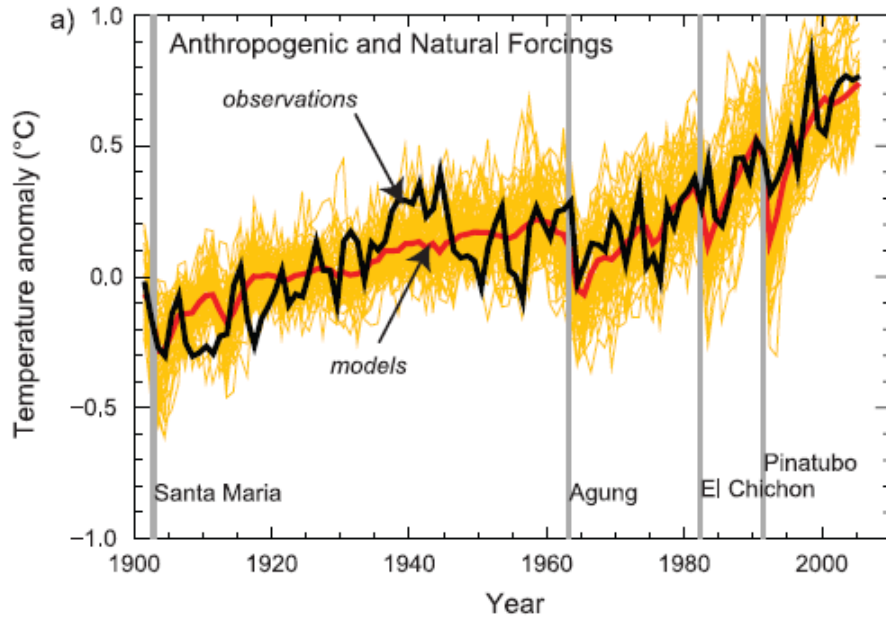
- Conceived as Team Building and as an 'Ice-Breaker'

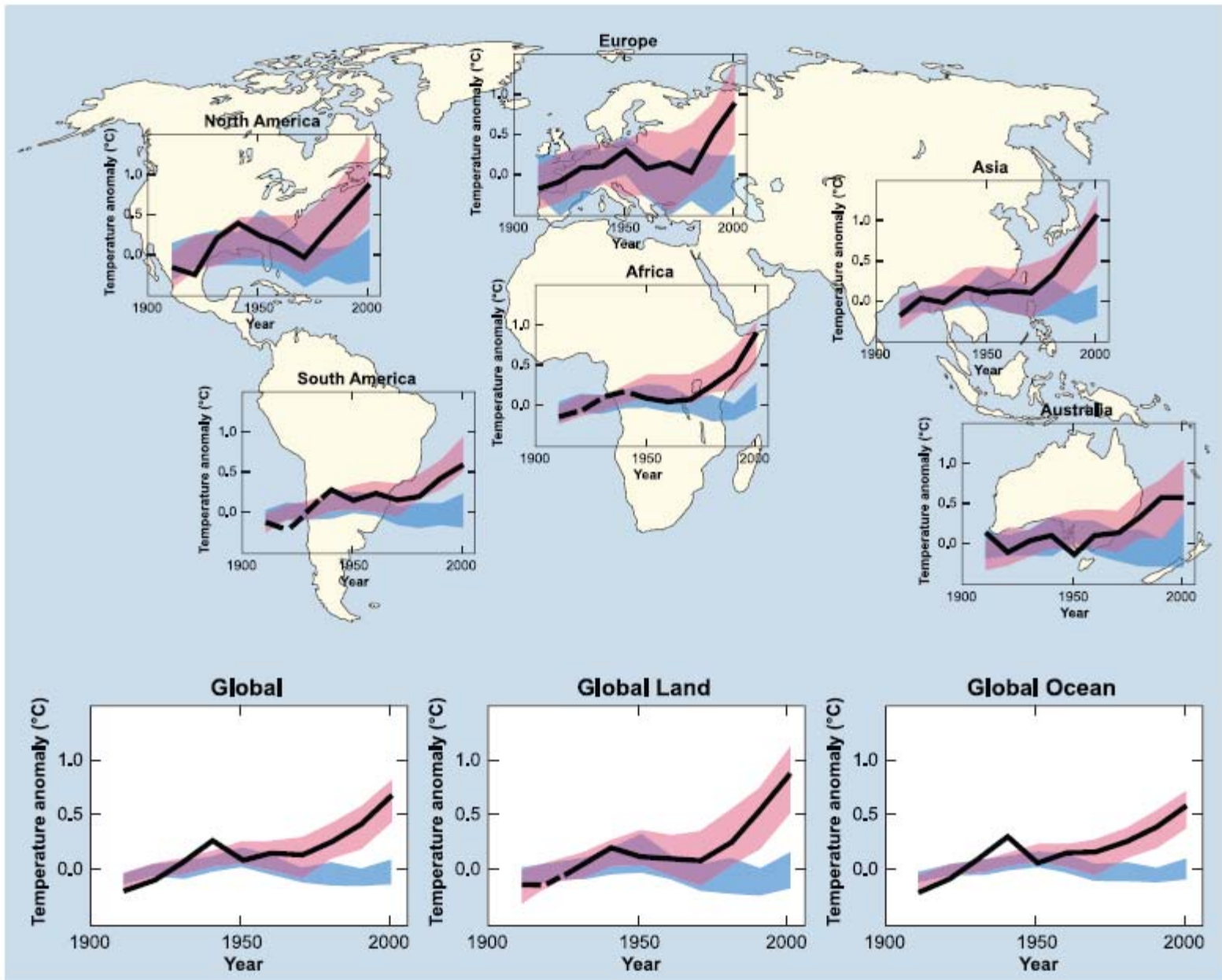
○ Puget Sound Region

- Available at: <http://www.climate.tag.washington.edu>

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GLOBAL MEAN SURFACE TEMPERATURE ANOMALIES





models using only natural forcings
 models using both natural and anthropogenic forcings

observations

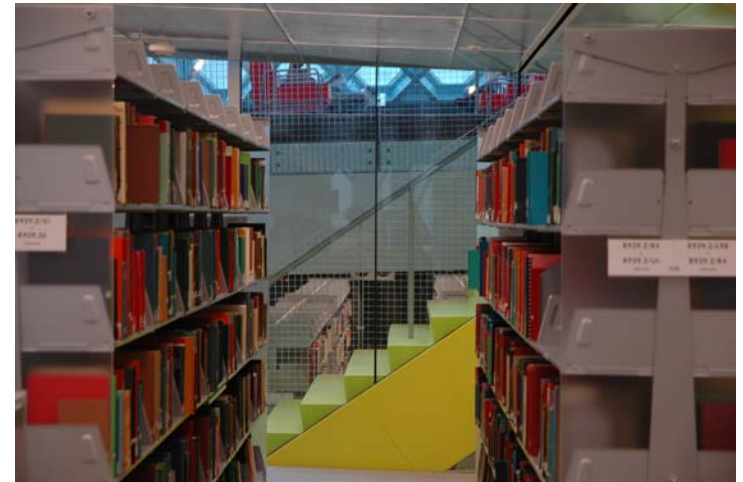
Building Blocks



- **Building Block 1 – The global average temperature has increased during the 20th century and is forecasted to increase in the 21st century.**
- **Building Block 13 –Climate change, as described in Building Blocks 1-12, is forecasted to contribute toward stream flow and temperature conditions that have been shown to negatively impact freshwater and estuarine habitat of most species of salmonids in the Puget Sound watersheds.**

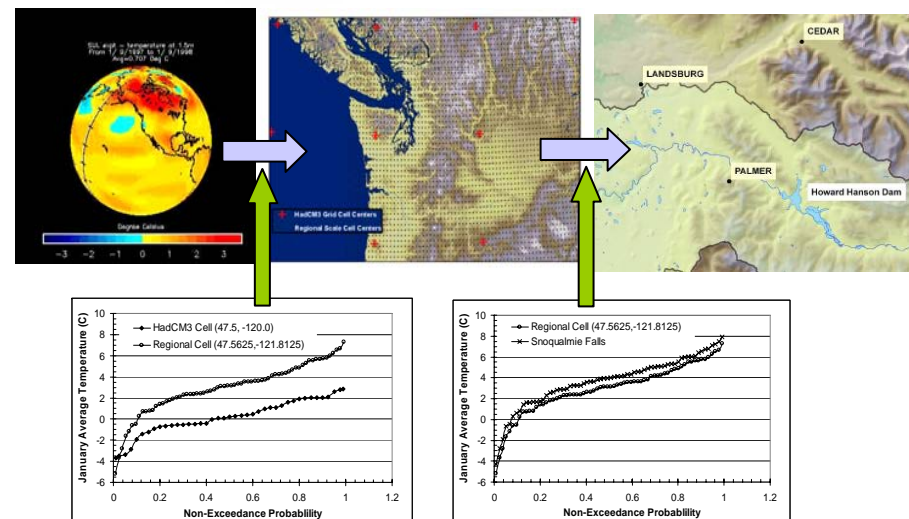
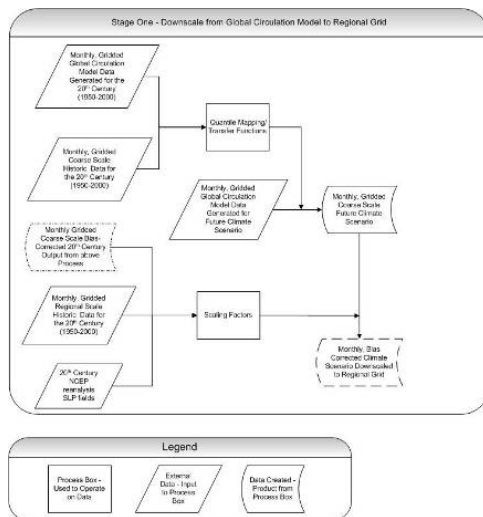
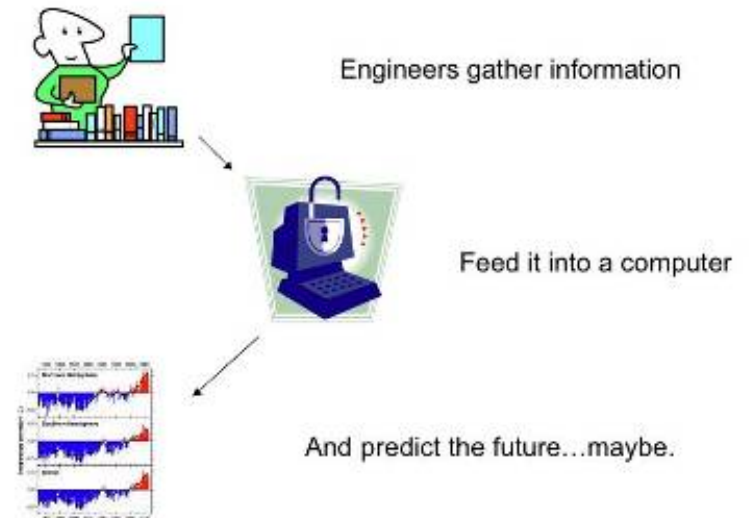
Tech Memo #1 - Literature Review

- Climate Change Primer
- Historical perspective of incorporating climate change into water resources planning
 - Discussion of GCMs, Downscaling Methods, and Hydrology Models
- Incorporating uncertainty

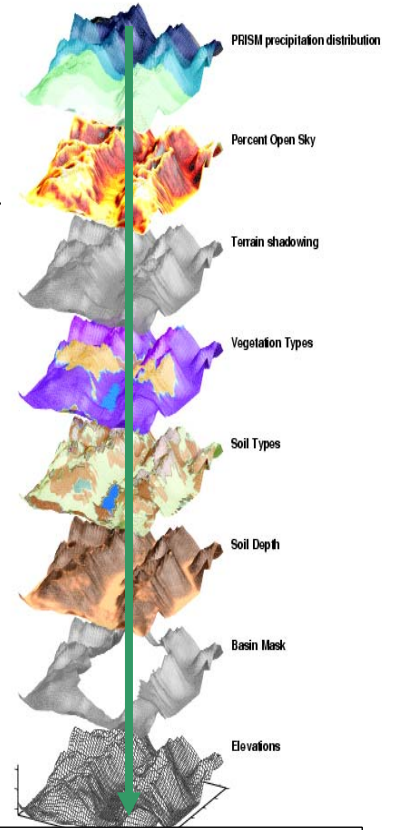
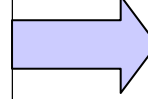
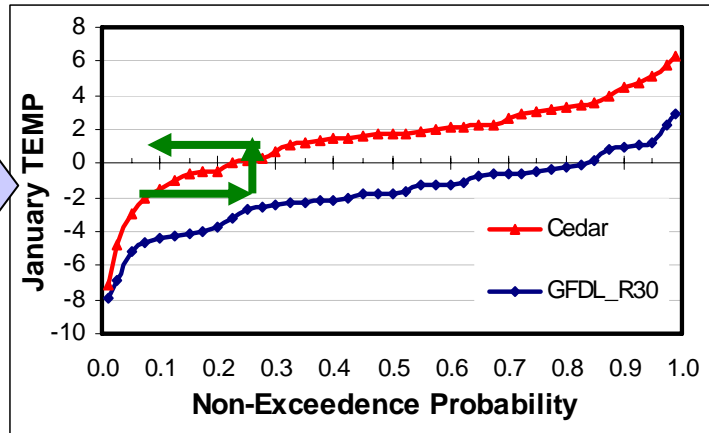
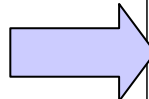
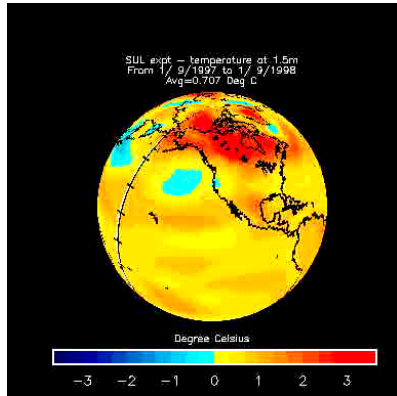


Tech Memo #2 – Downscaling Methodology

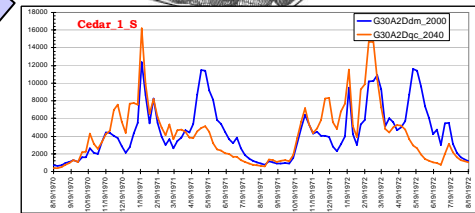
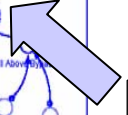
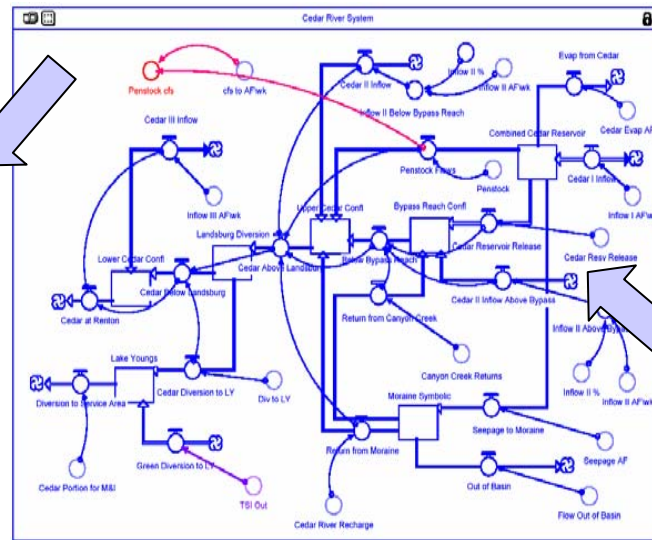
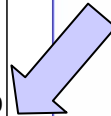
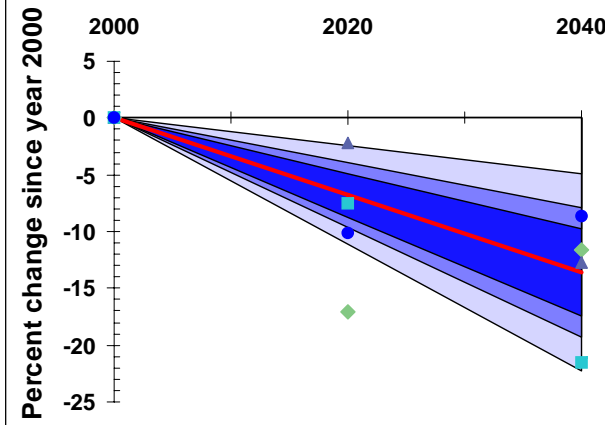
- Details downscaling method in two different formats:
 - An in-depth discussion of the method and a case-study provided as a journal paper
 - An overview discussion of the method accompanied by a process diagram



Impact Assessment Methodology

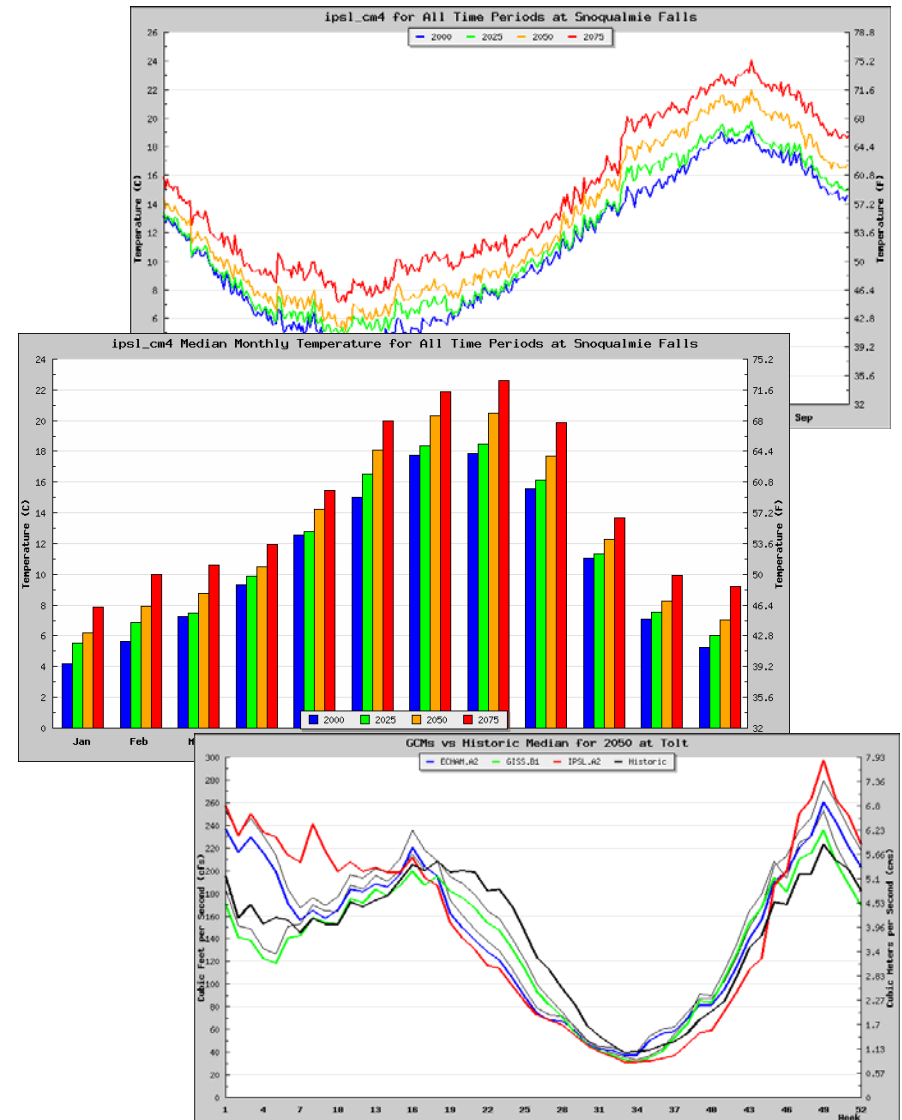


Rate of Change in Gross Yield as percent of GCM's year 2000 values



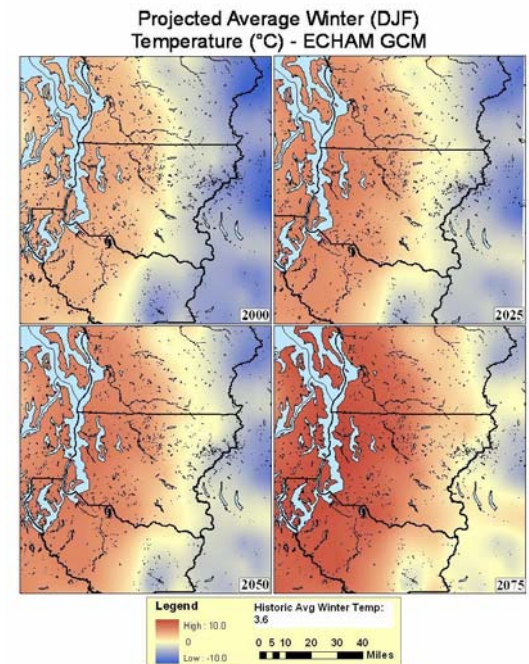
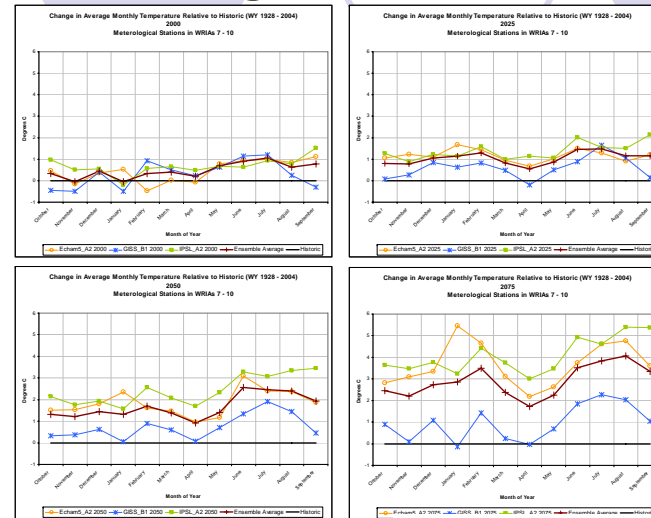
Tech Memo #3 – Website and Database Functionality

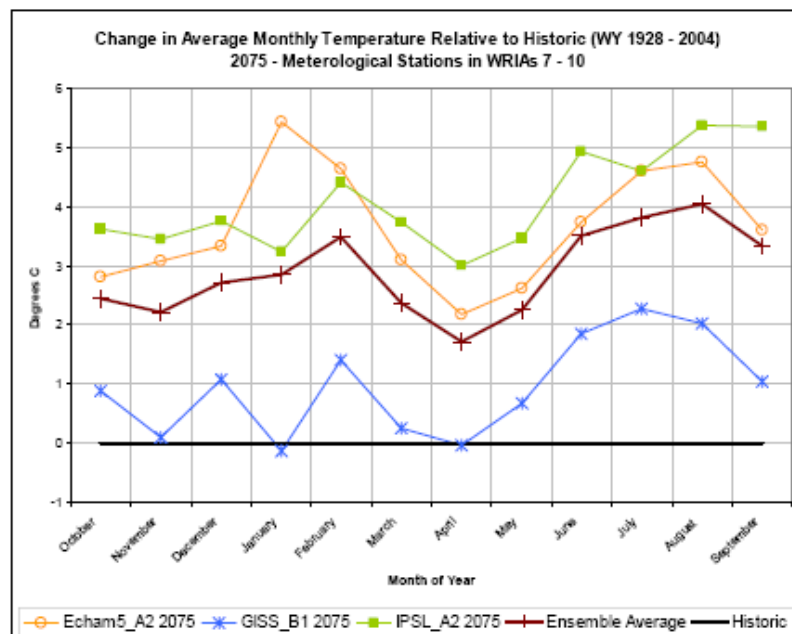
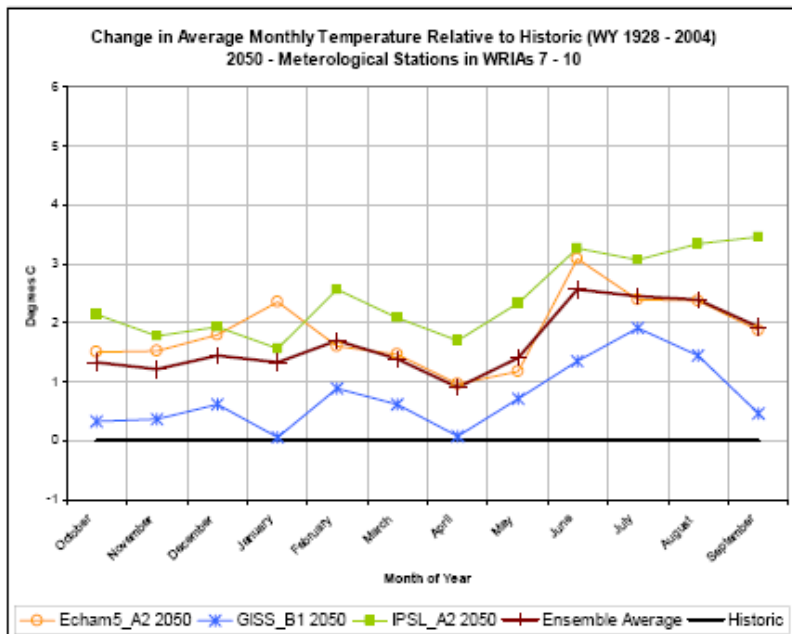
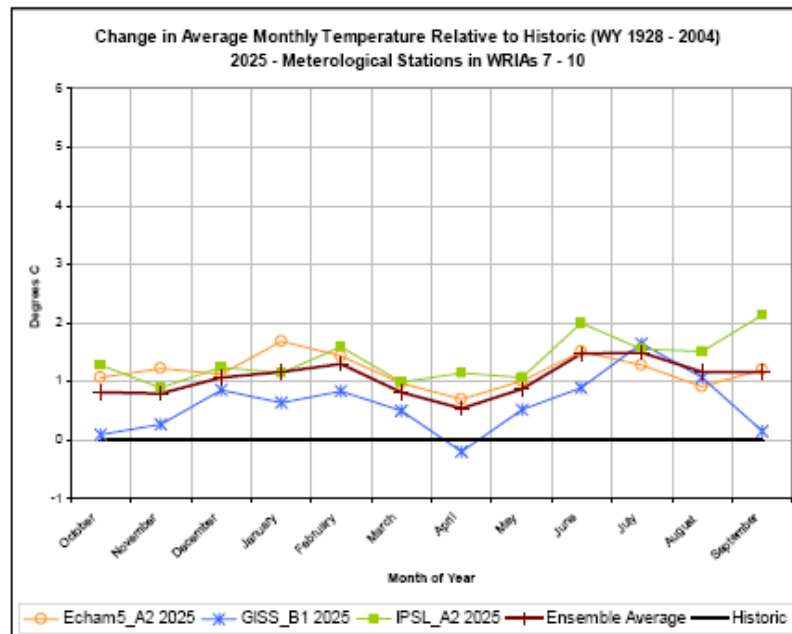
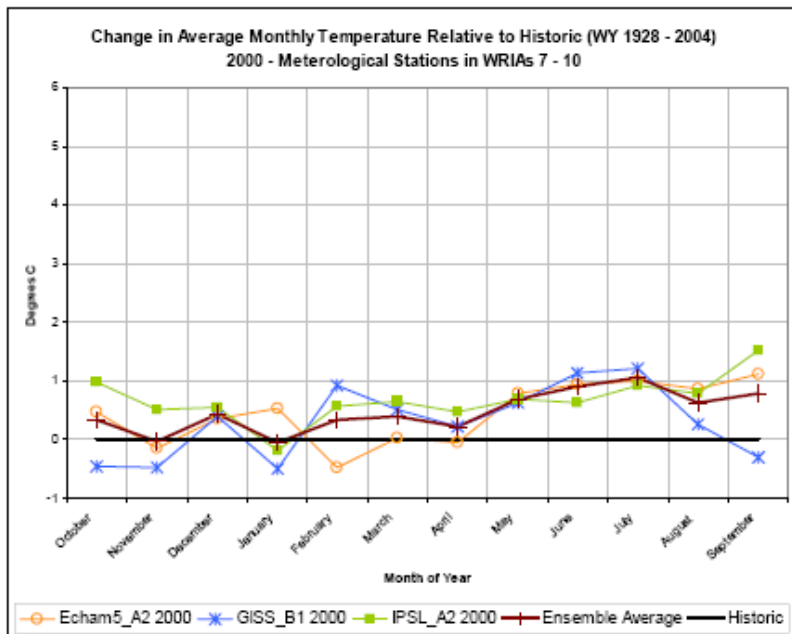
- Details construction and functionality of web-based database for climate variables
- Website contains historic and climate impacted precipitation and temperature data for 15 meteorological stations within planning area
- Simulated historic and climate impacted streamflows are accessible via plotting function



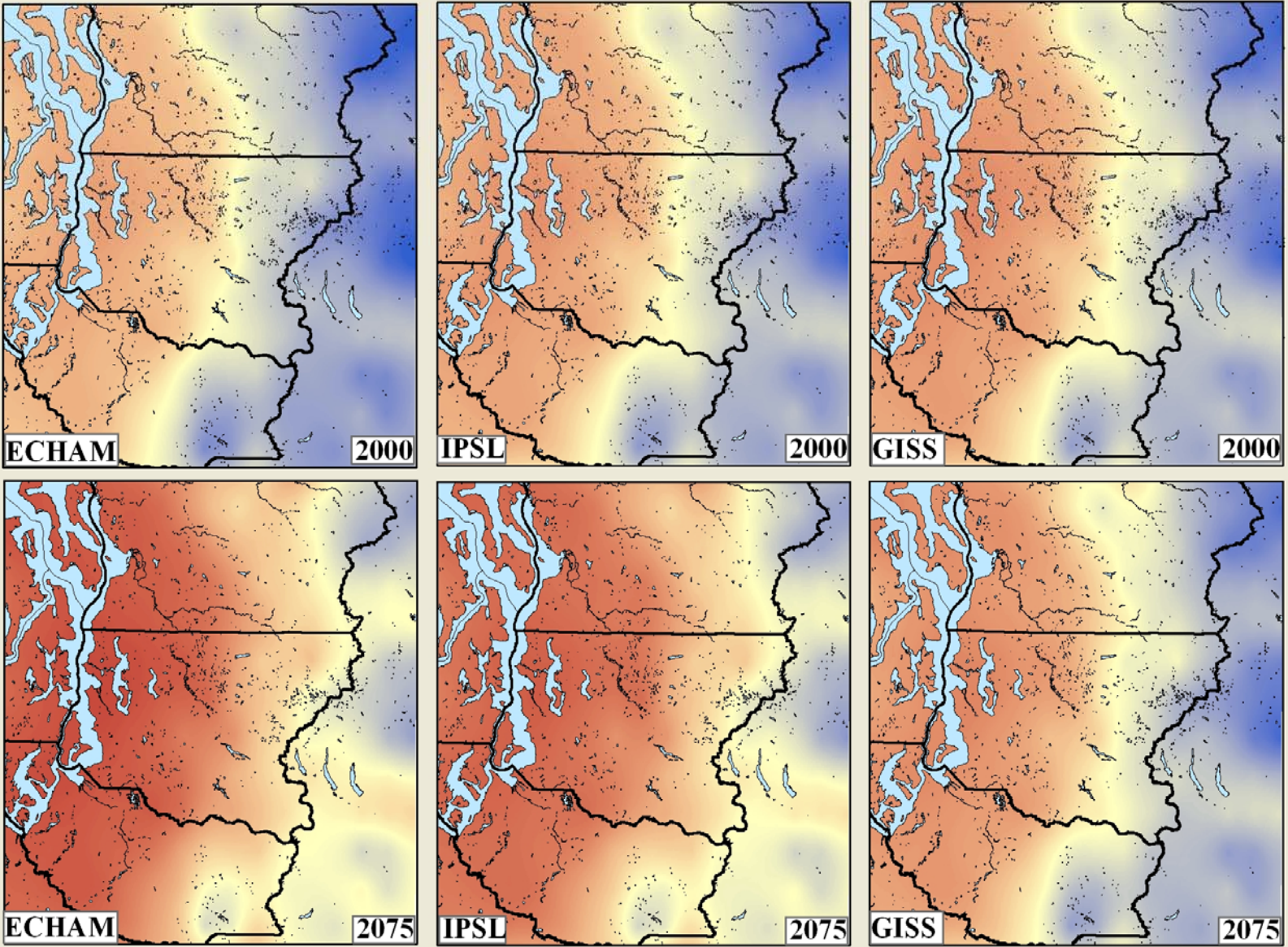
Tech Memo #4 – Meteorological Variables

- Evaluation of impacted climate data
 - Contains a quality control discussion of data and computer code used in generation of the data
 - Provides an assessment of future projections and likely impacts to temperature and precipitation for our region

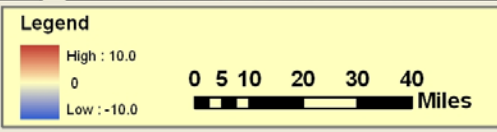




Projected Changes in Average Monthly Temperature Relative to Historic (1928-2004) Climate for Western Washington

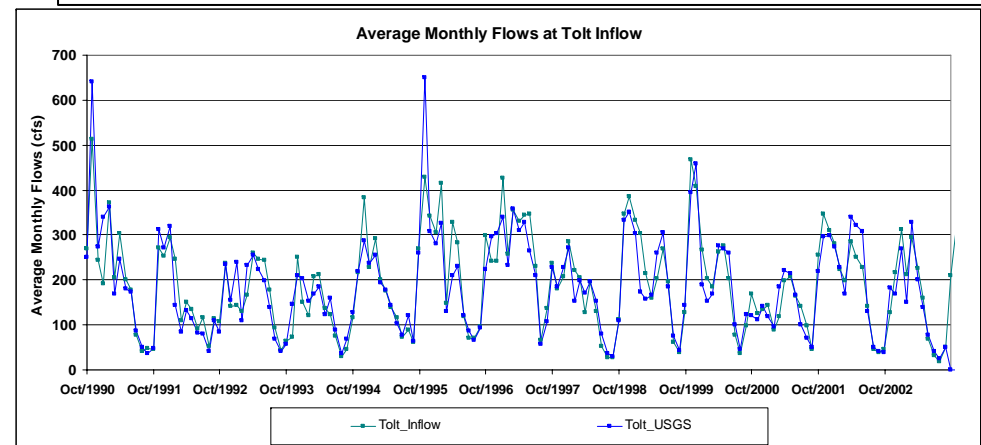
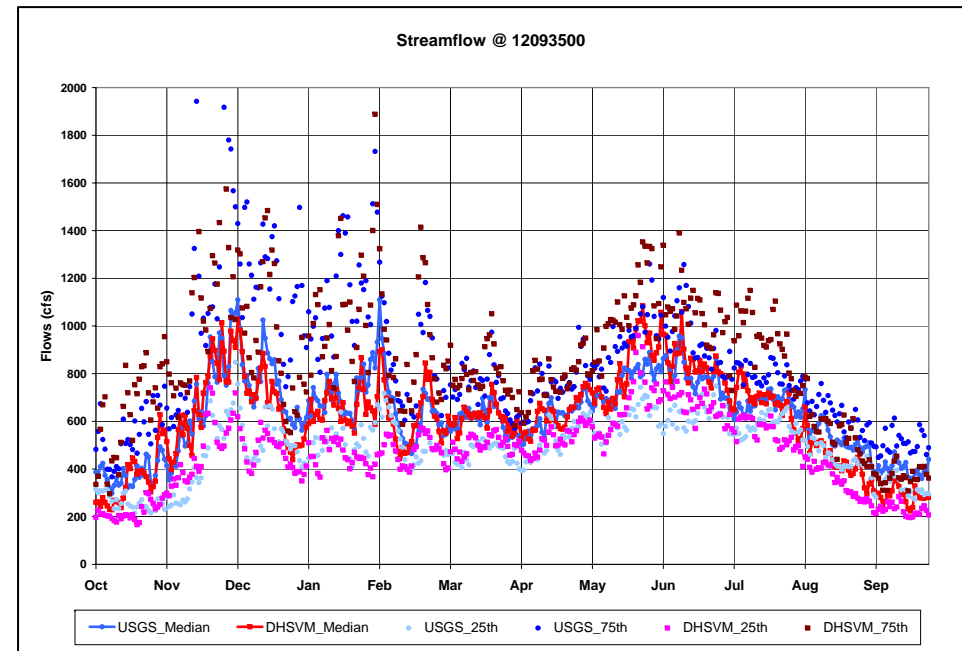
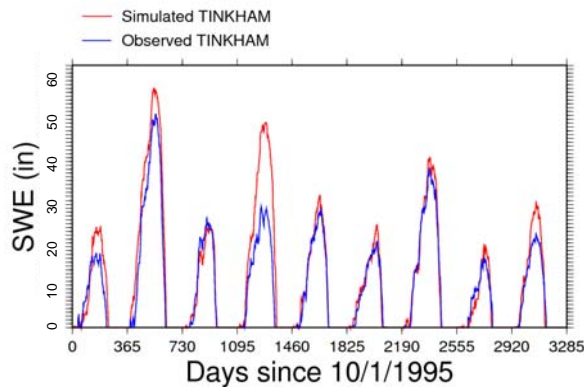


Simulated 2000 vs 2075 Average Winter (DJF) Temperature



Tech Memo #5 – Streamflow Generation

- Evaluation of climate impacted streamflows
 - Contains a detailed discussion on model development, calibration, and comparison to historic observed records
 - Provides an assessment of future impacts to streamflow for the Tri-County Region



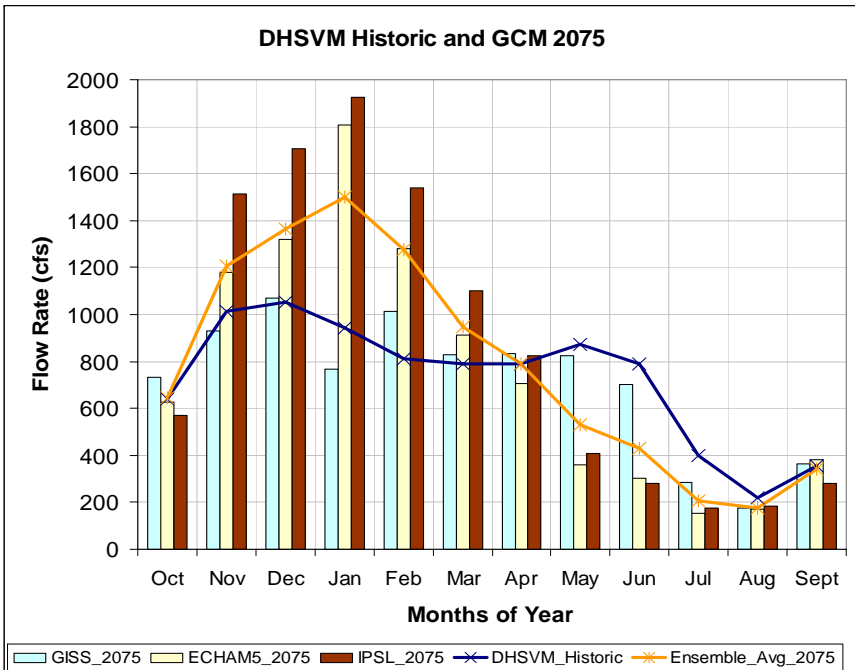
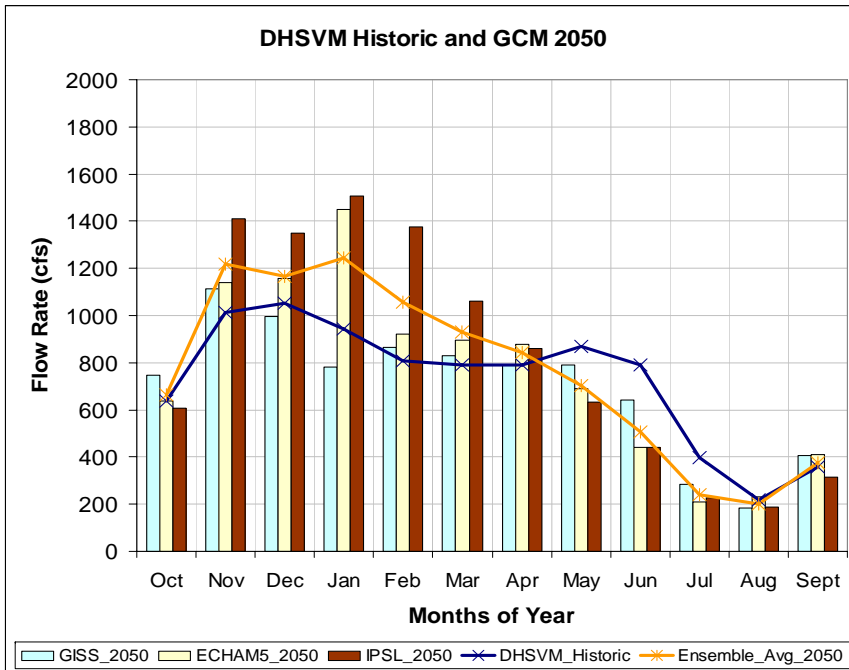
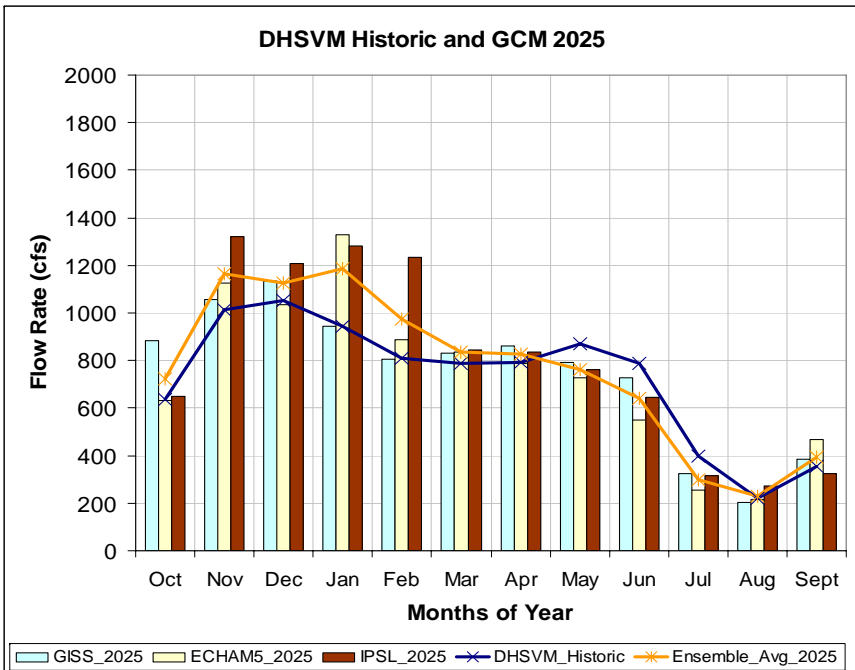
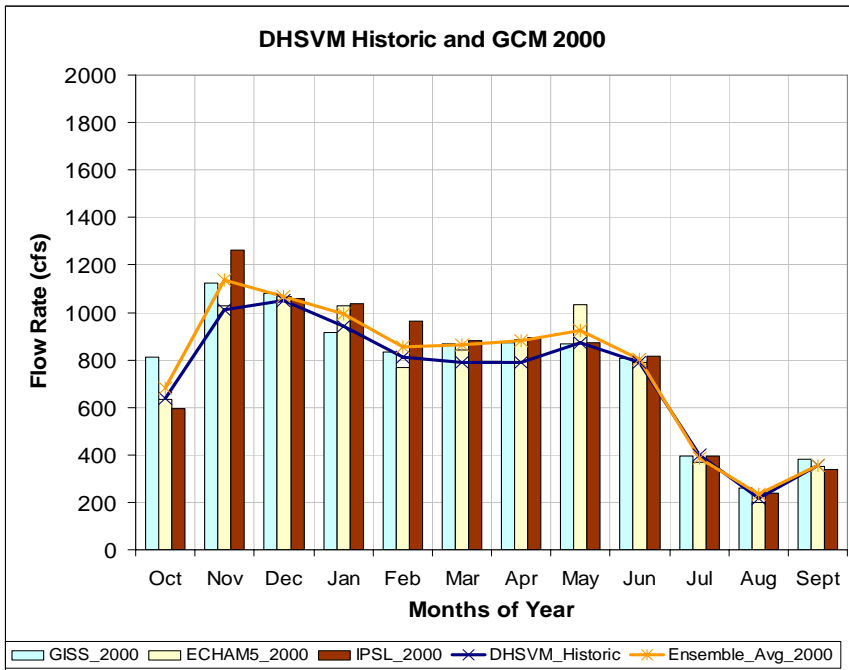
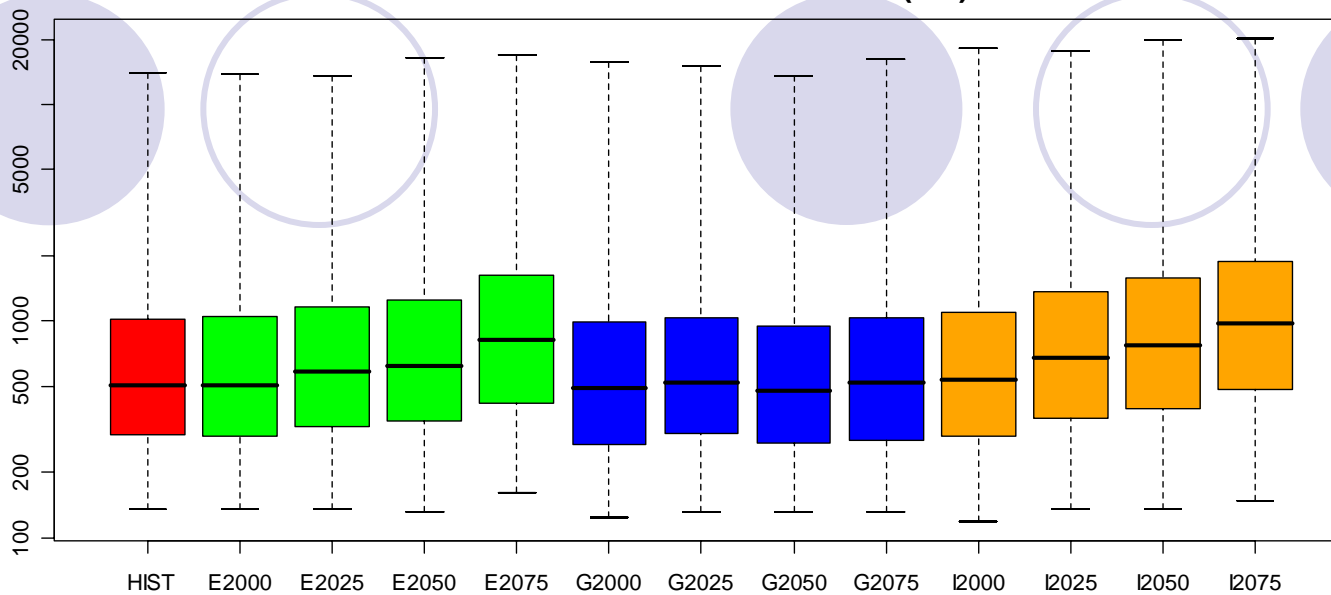
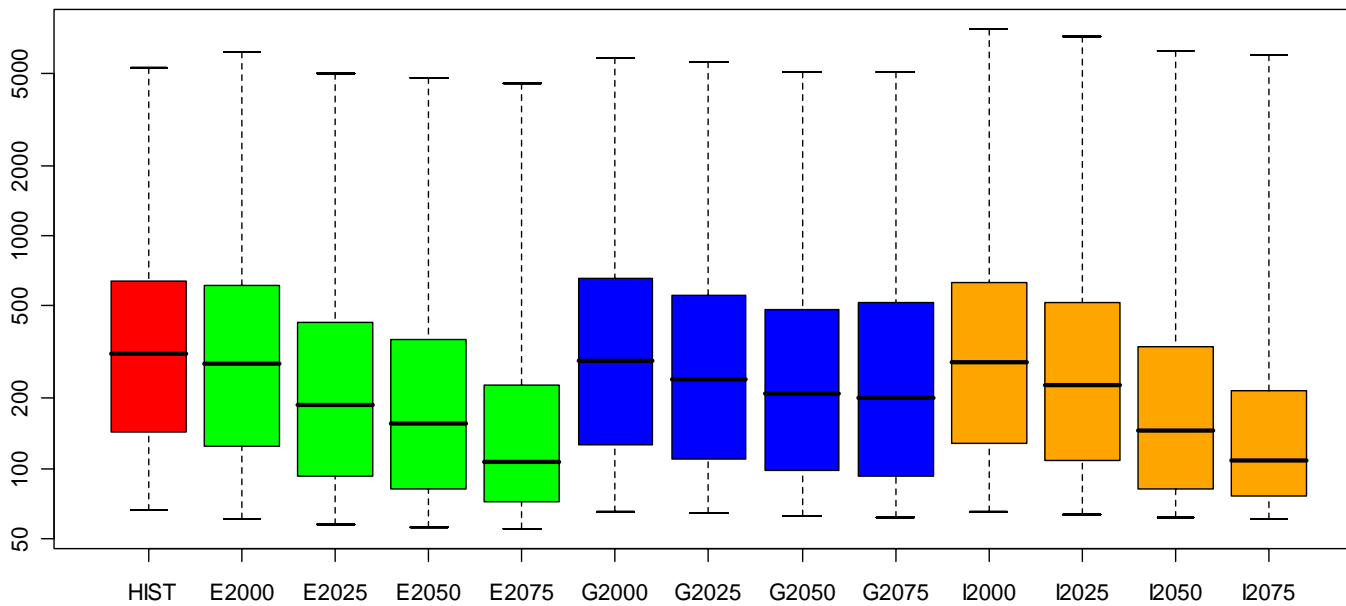


Figure 7: Hydrograph of Sultan Reservoir Inflows for the 2000, 2025, 2050, and 2075 periods.

Sultan River DJF Flows at Q1 (cfs)



Sultan River JJA Flows at Q1 (cfs)



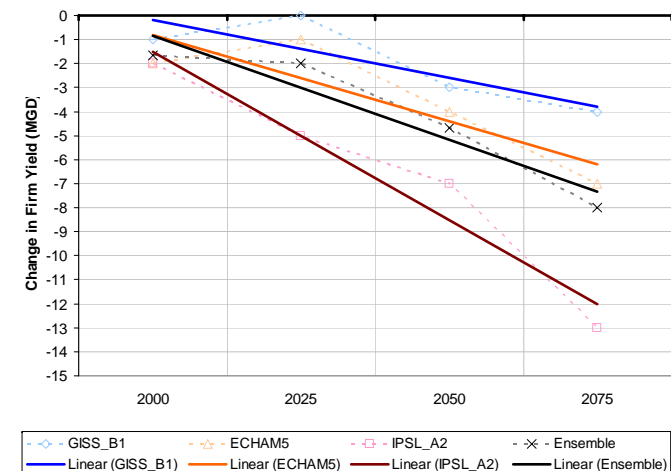
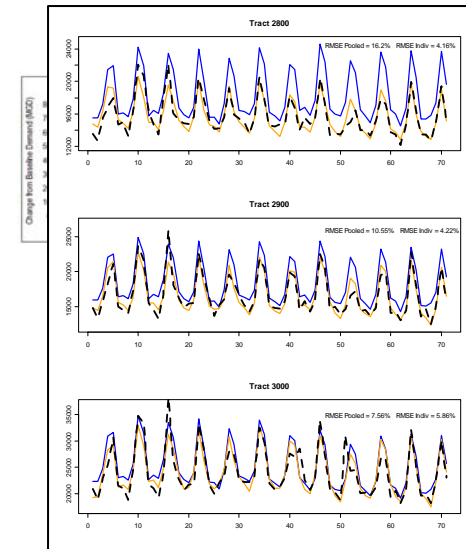
Tech Memo #6 and Executive Summary

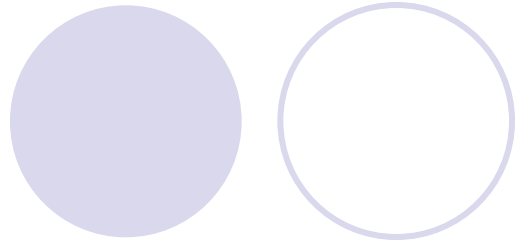
- Final Summarizing Documents
- Integrate documents produced by CCTC
- Make suggestions for incorporating available data and uncertainty into water resources planning



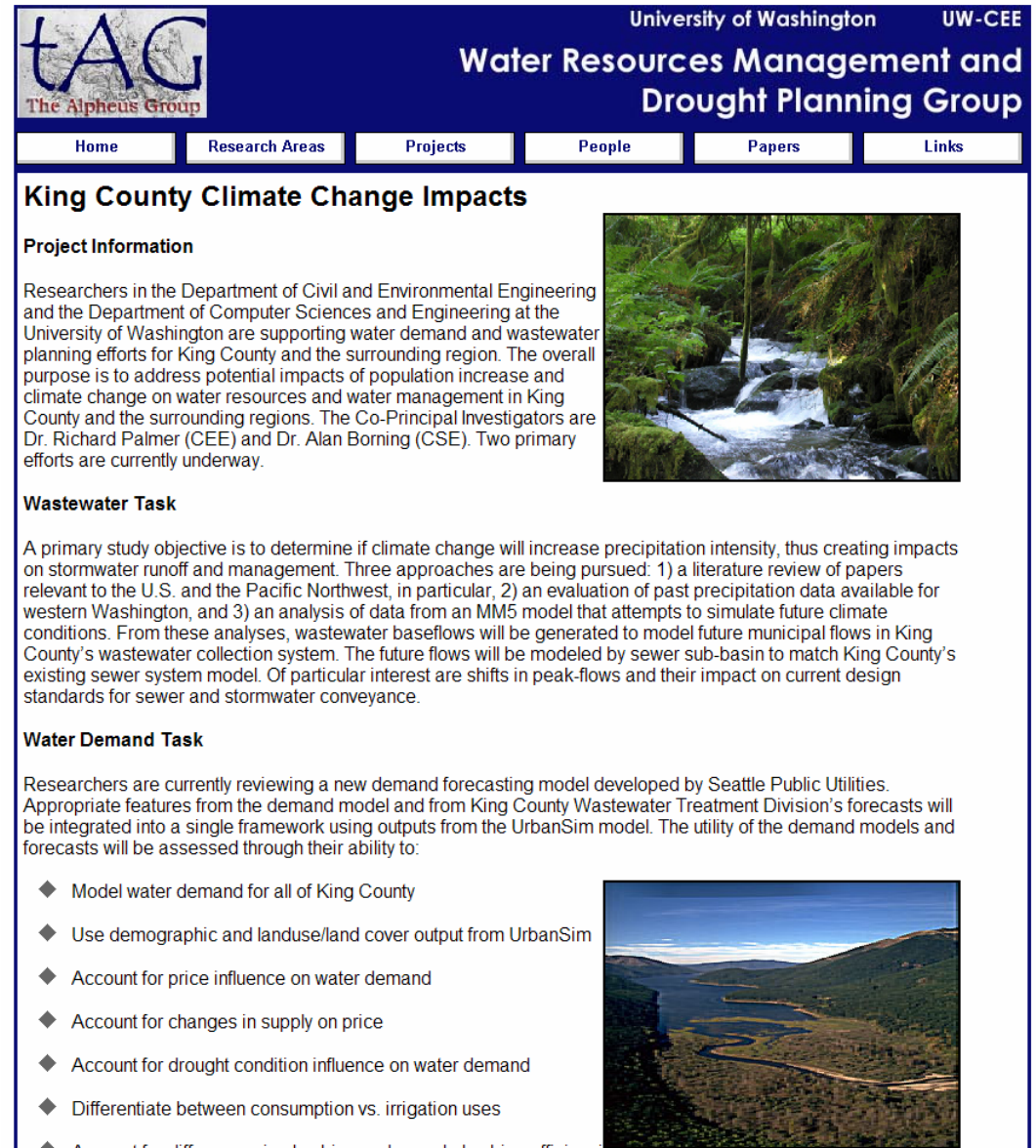

Use of Data By Stakeholders and in Other Research

- Water Supply Systems Modeling and Impacts
 - Each utility is evaluating system yield with climate impacted data
- Water Demand Modeling
 - Regional water supply will use temperature and rainfall elasticities
- Wastewater Management
 - Evaluate base waste water demand with regional demand model
- Potential Impacts of Climate Change on Flood Related Issues
 - Evaluate impacts of climate change on extreme rainfall events and associated runoff






- Over 20 half-day meetings/ workshops to establish study objectives and approach
- Significant participation from over 15 regional agencies and stakeholders
- Consensus achieved
- Results incorporated into evaluation of supply and demand alternatives in regional process



The screenshot shows the website for TAG (The Alpheus Group) at the University of Washington, UW-CEE. The page title is "Water Resources Management and Drought Planning Group". The navigation menu includes Home, Research Areas, Projects, People, Papers, and Links. The main content area is titled "King County Climate Change Impacts".

Project Information

Researchers in the Department of Civil and Environmental Engineering and the Department of Computer Sciences and Engineering at the University of Washington are supporting water demand and wastewater planning efforts for King County and the surrounding region. The overall purpose is to address potential impacts of population increase and climate change on water resources and water management in King County and the surrounding regions. The Co-Principal Investigators are Dr. Richard Palmer (CEE) and Dr. Alan Borning (CSE). Two primary efforts are currently underway.




Wastewater Task

A primary study objective is to determine if climate change will increase precipitation intensity, thus creating impacts on stormwater runoff and management. Three approaches are being pursued: 1) a literature review of papers relevant to the U.S. and the Pacific Northwest, in particular, 2) an evaluation of past precipitation data available for western Washington, and 3) an analysis of data from an MM5 model that attempts to simulate future climate conditions. From these analyses, wastewater baseflows will be generated to model future municipal flows in King County's wastewater collection system. The future flows will be modeled by sewer sub-basin to match King County's existing sewer system model. Of particular interest are shifts in peak-flows and their impact on current design standards for sewer and stormwater conveyance.

Water Demand Task

Researchers are currently reviewing a new demand forecasting model developed by Seattle Public Utilities. Appropriate features from the demand model and from King County Wastewater Treatment Division's forecasts will be integrated into a single framework using outputs from the UrbanSim model. The utility of the demand models and forecasts will be assessed through their ability to:

- ◆ Model water demand for all of King County
- ◆ Use demographic and landuse/land cover output from UrbanSim
- ◆ Account for price influence on water demand
- ◆ Account for changes in supply on price
- ◆ Account for drought condition influence on water demand
- ◆ Differentiate between consumption vs. irrigation uses
- ◆ Account for differences in plumbing codes and plumbing efficiency



<http://www.tag.washington.edu/projects/kingcounty.html>



Thank you!

CCTC Work:

www.climate.tag.washington.edu

TAG Work:

www.tag.washington.edu

