

Comparison of Simulated Runoff in the Yakima River Basin, Washington for Present and Global Climate-Change Conditions

- Watershed and River Management Program (WaRSMP)
- Description of Yakima River Basin and Yakima Storage Project
- MMS and Yakima River Basin models
- Global Climate-Change assumptions
- Comparison of Watershed simulations—present versus GCC scenarios

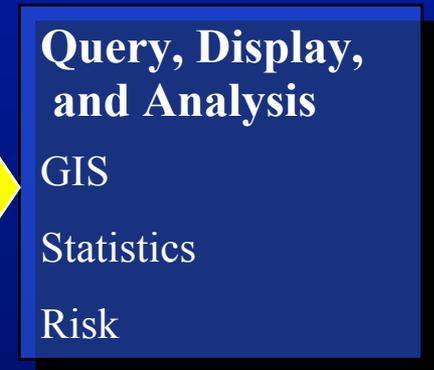
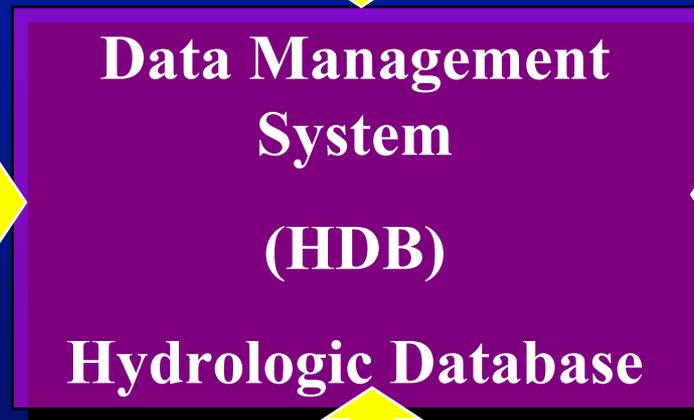
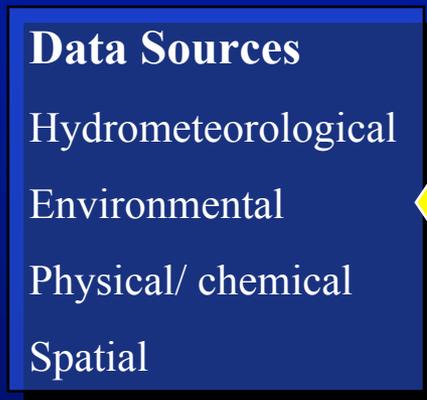
Mark Mastin

Warren Sharp

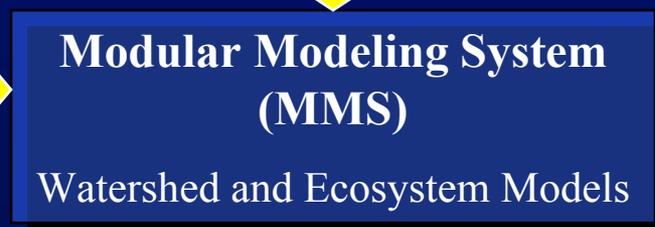
Watershed and River System Management Program (WARSMMP)

- Cooperative USGS / Bureau of Reclamation program
- Purpose is research, development, and implementation of a Decision Support System to achieve equitable balance among water resource issues.

Database-centered Decision Support System



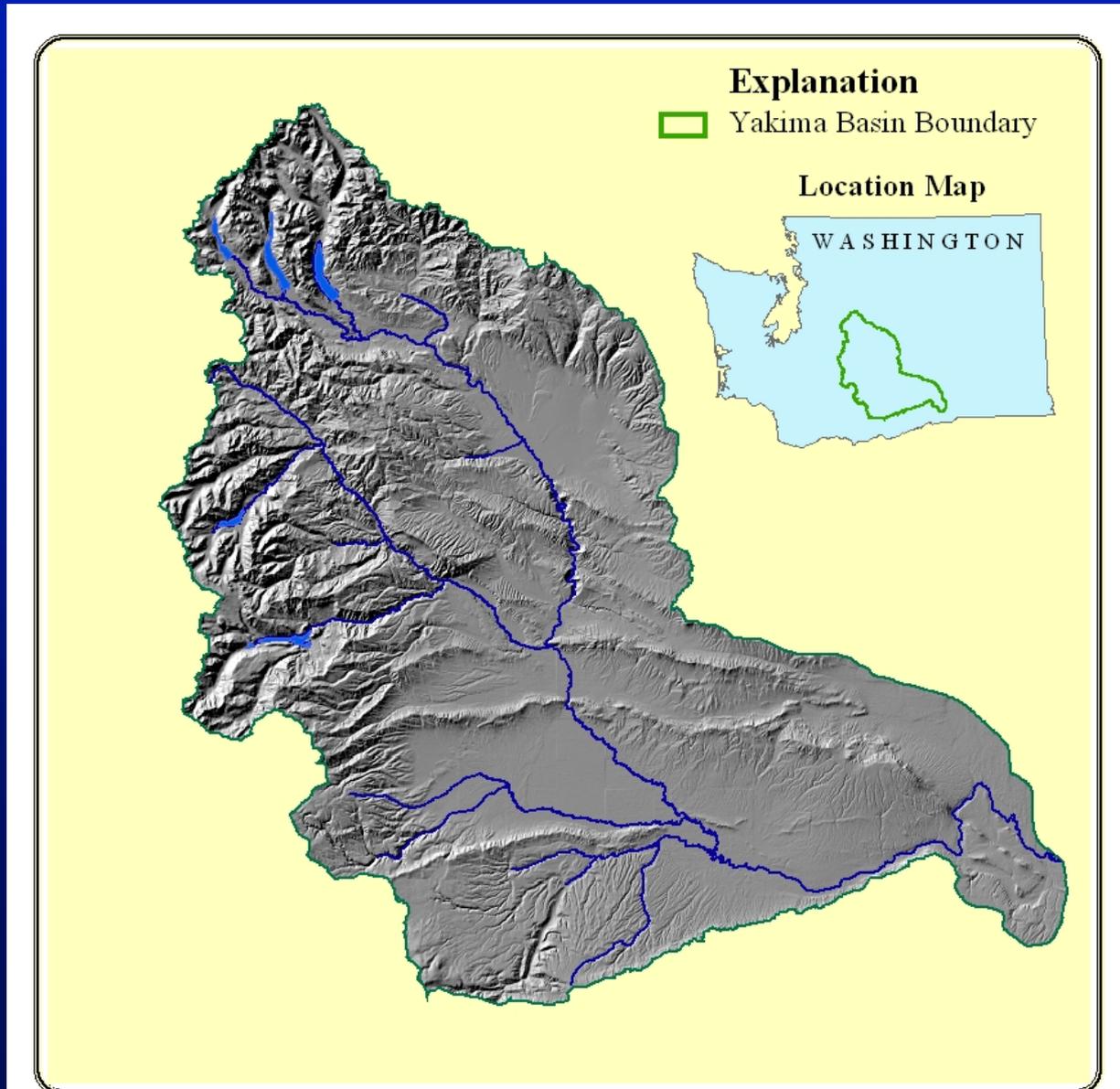
GIS Weasel



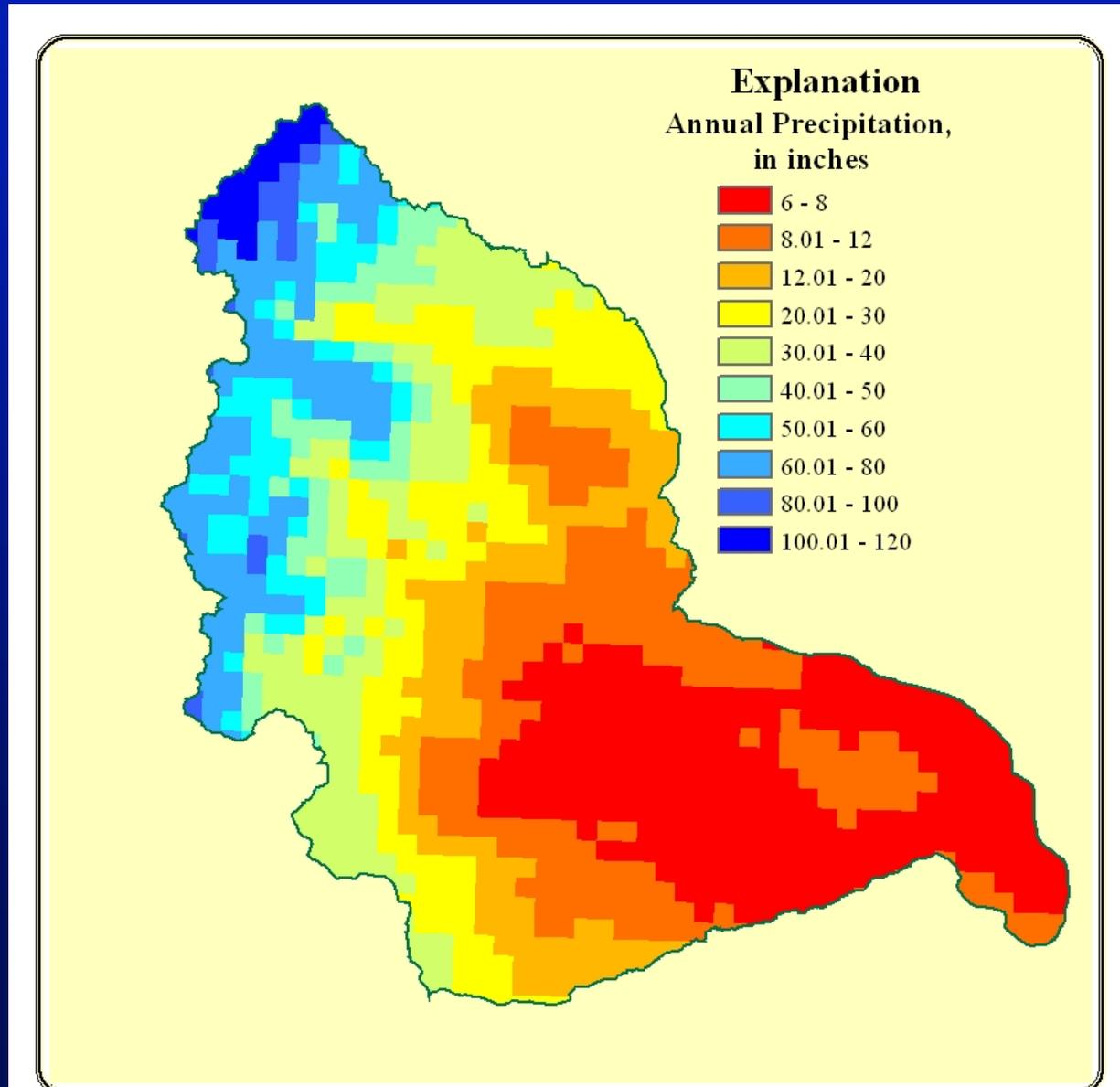
WaRSMP Basin Studies



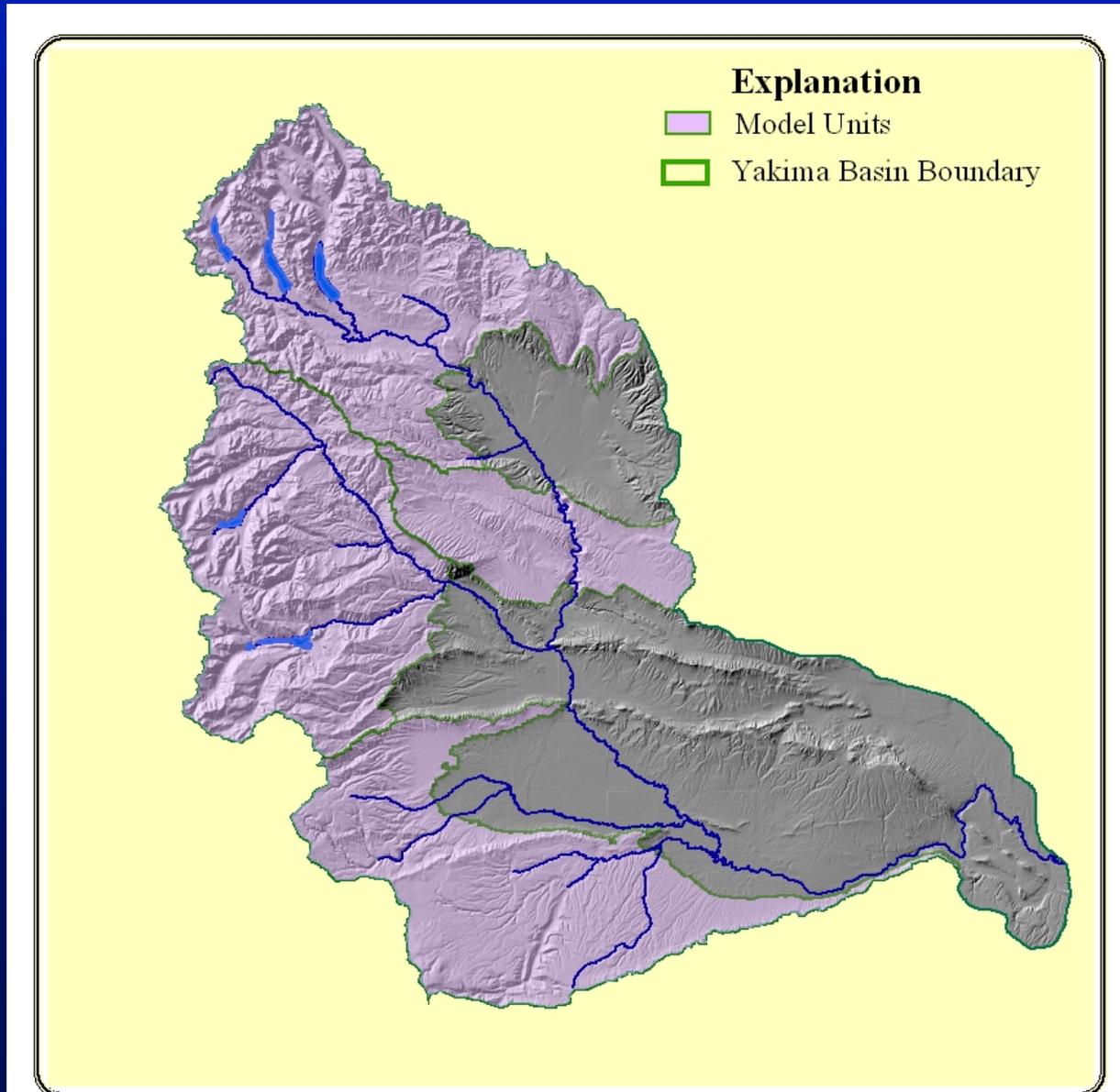
Yakima River Basin--topography and precipitation



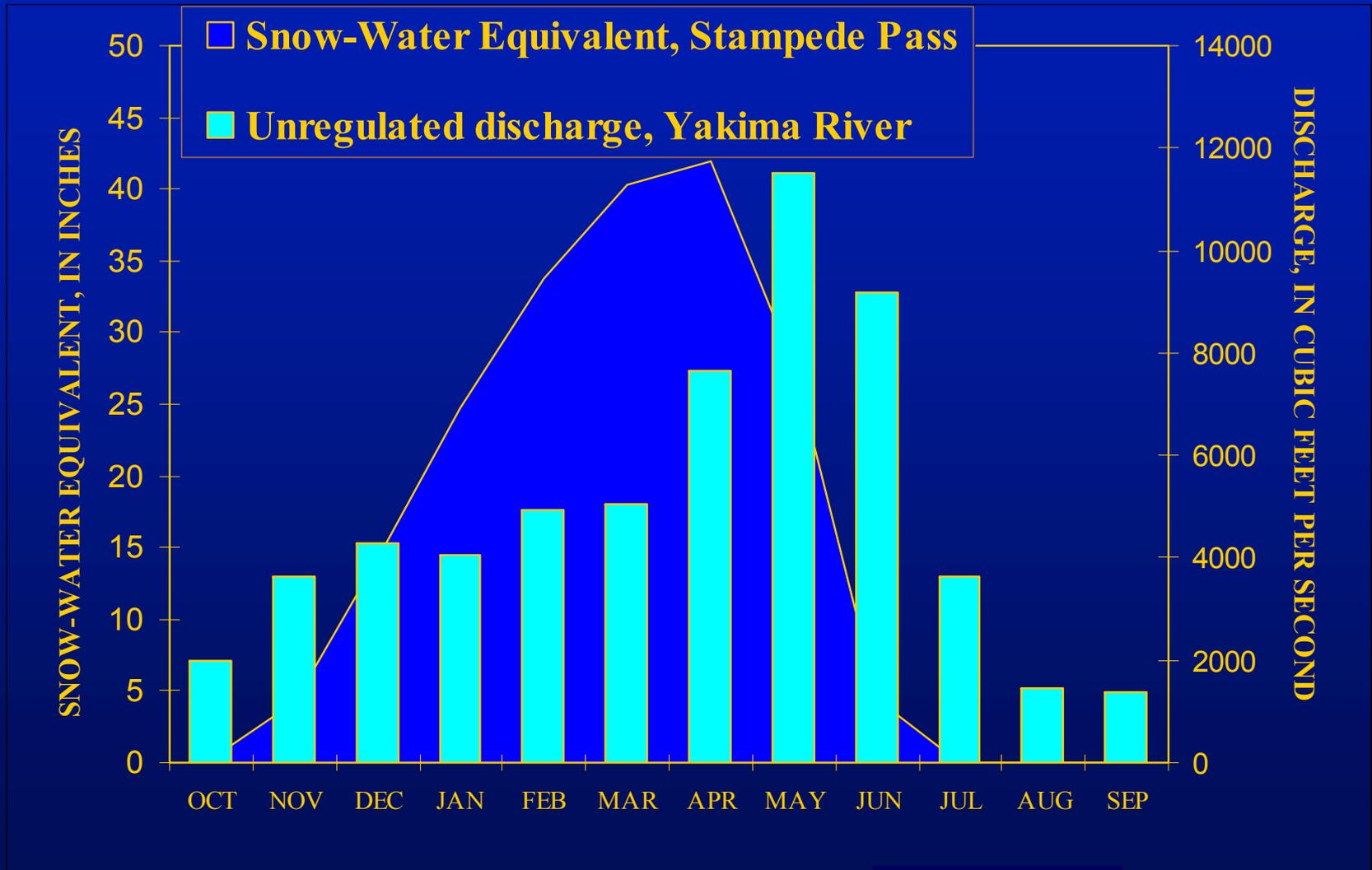
Yakima River Basin--topography and precipitation



Yakima River Basin--topography and precipitation



Snow Pack and Runoff Characteristics



Yakima River Basin Numbers

Water Balance

Ave. Precip. (27 inches)	= 8.7 million ac-ft	12,000 cfs
Unregulated runoff	= 4.0 million ac-ft	5,600 cfs
Regulated runoff	= 2.6 million ac-ft	3,600 cfs
Water Demand	= 2.5 million ac-ft	65% unregulated runoff
Storage	= 1.06 million ac-ft	26% unregulated runoff

Miscellaneous

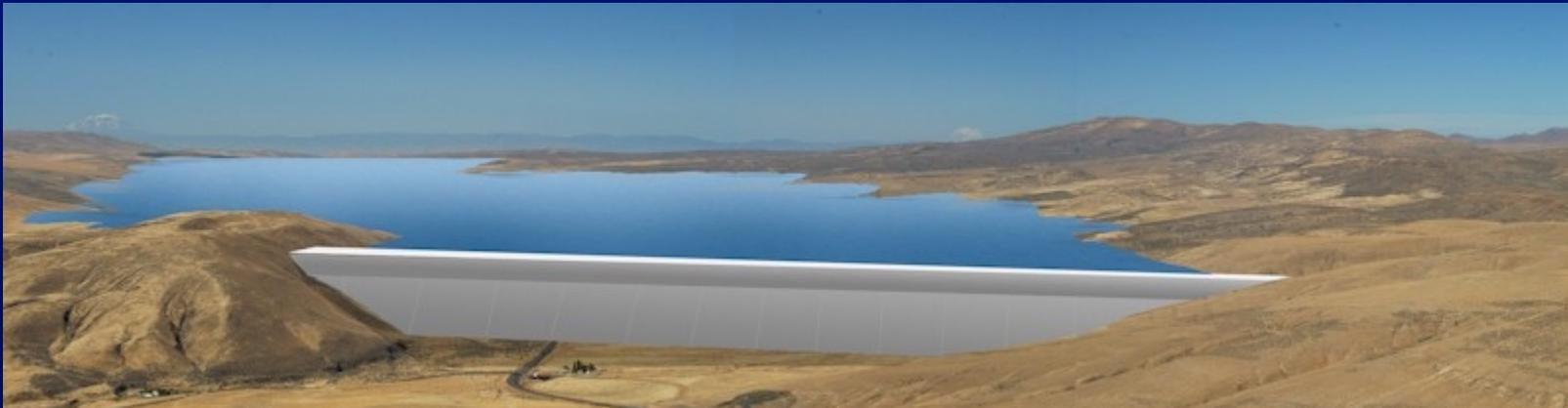
- Drainage Area = 6,200 sq. miles, ranging from 400 to 8,000 ft.
- Rainfall varies from 90 inches in the Cascades to 6 inches in the lower basin
- About 45% of water diverted for irrigation becomes return flow
- During low-flow season about 75% of the volume is return flow

Yakima Storage Study

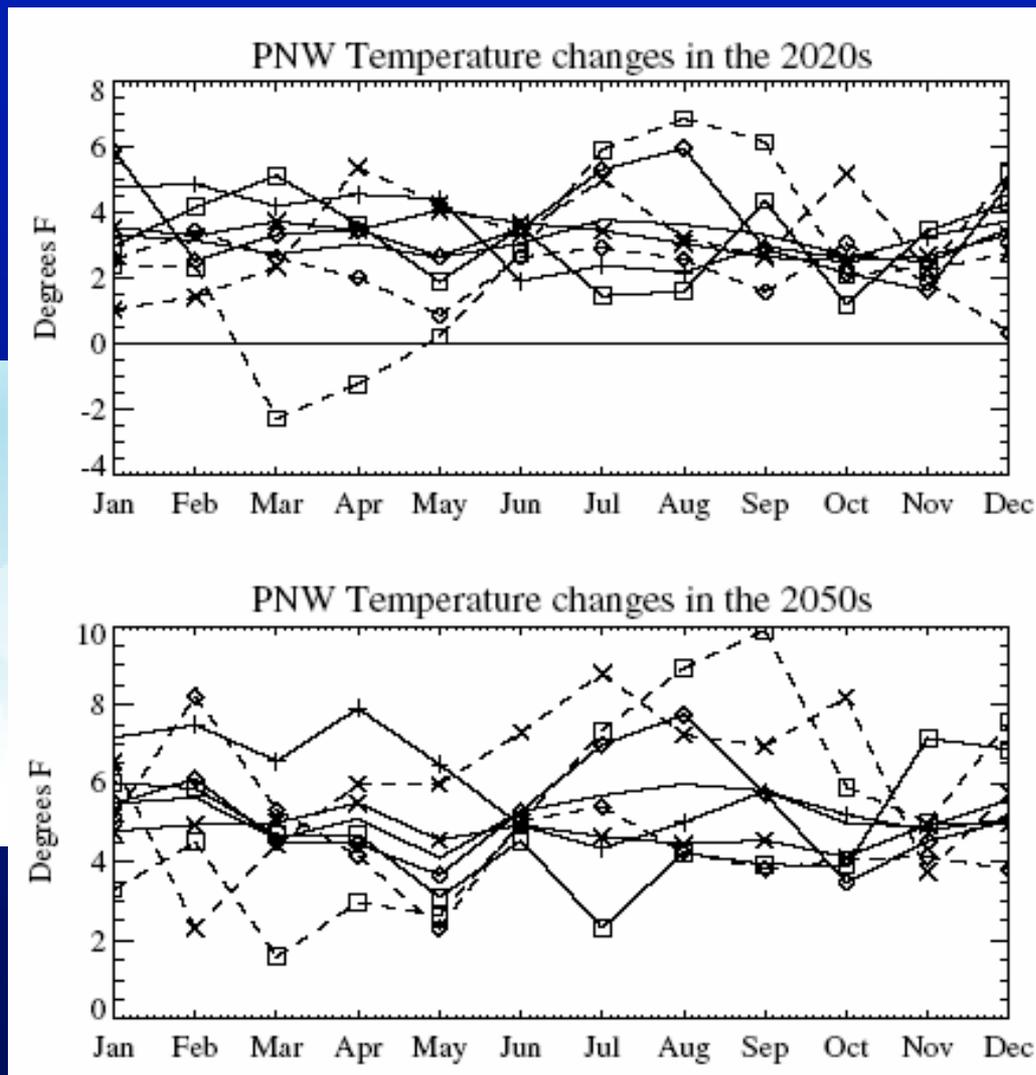
Evaluate four storage projects in terms of how will they improve fisheries



- Bumping Lake enlargement
- Wymer Dam
- Keechelus to Kachess pipeline
- Black Rock Reservoir—\$3.5-4.0 Billion, 1.3 million acre feet



Global Climate Change-- Pacific Northwest



By 2020
+3.1°F
(+1.72°C)

By 2050
+5.3°F
(+2.9°C)



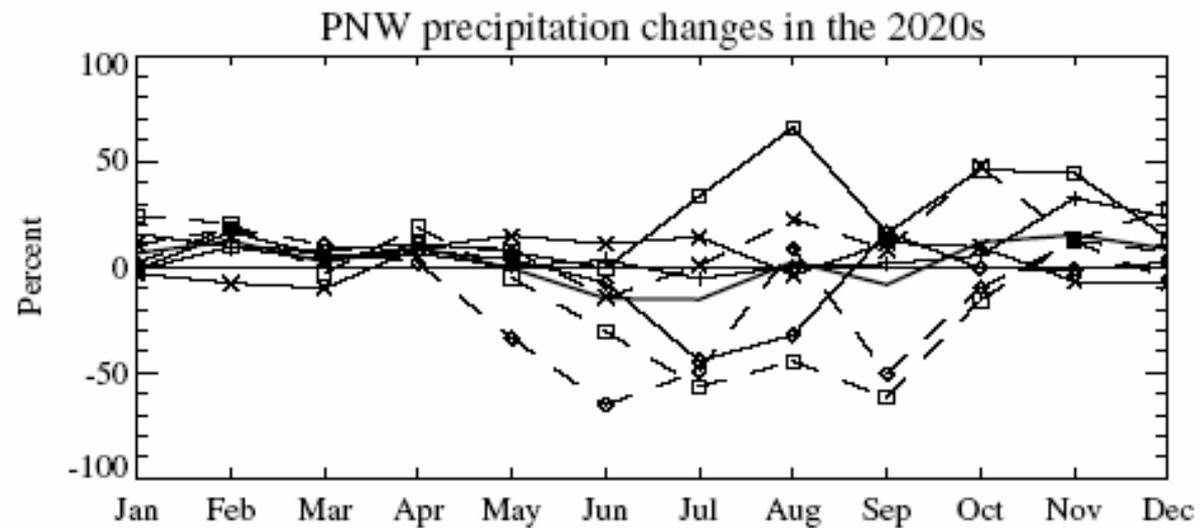
(Climate Impact Group, Mote and others, 1999, Impacts of Climate Variability and Change, Pacific Northwest)



Global Climate Change-- Pacific Northwest

“Projections of temperature changes, both globally and regionally, are made with higher confidence than precipitation changes.”

(Climate Impact Group, Mote and others, 1999, Impacts of Climate Variability and Change, Pacific Northwest)



Global Climate Change-- Pacific Northwest

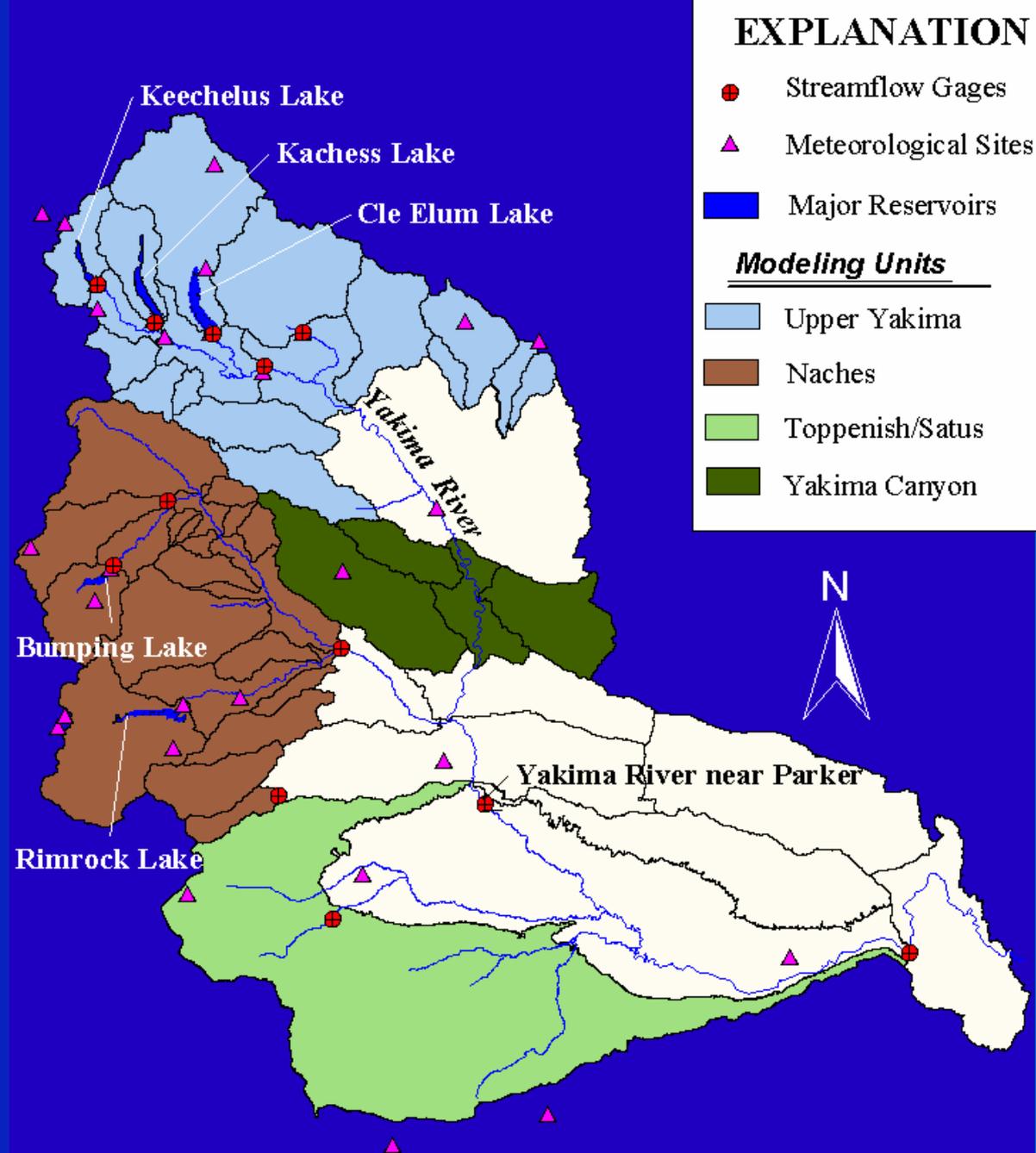
For this study:

- **Global Climate Change (GCC) Scenario**
+3.6°F (+2.0°C) increase in air temperature
throughout the year
- **Present Unregulated Flow (PUF) scenario**
represented by the average simulated runoff for
1950-2005 water years
- **Precipitation was not change for the GCC scenario**

Modeling Units

About 95 percent of the runoff at Yakima River near Parker is generated from the four modeling units:

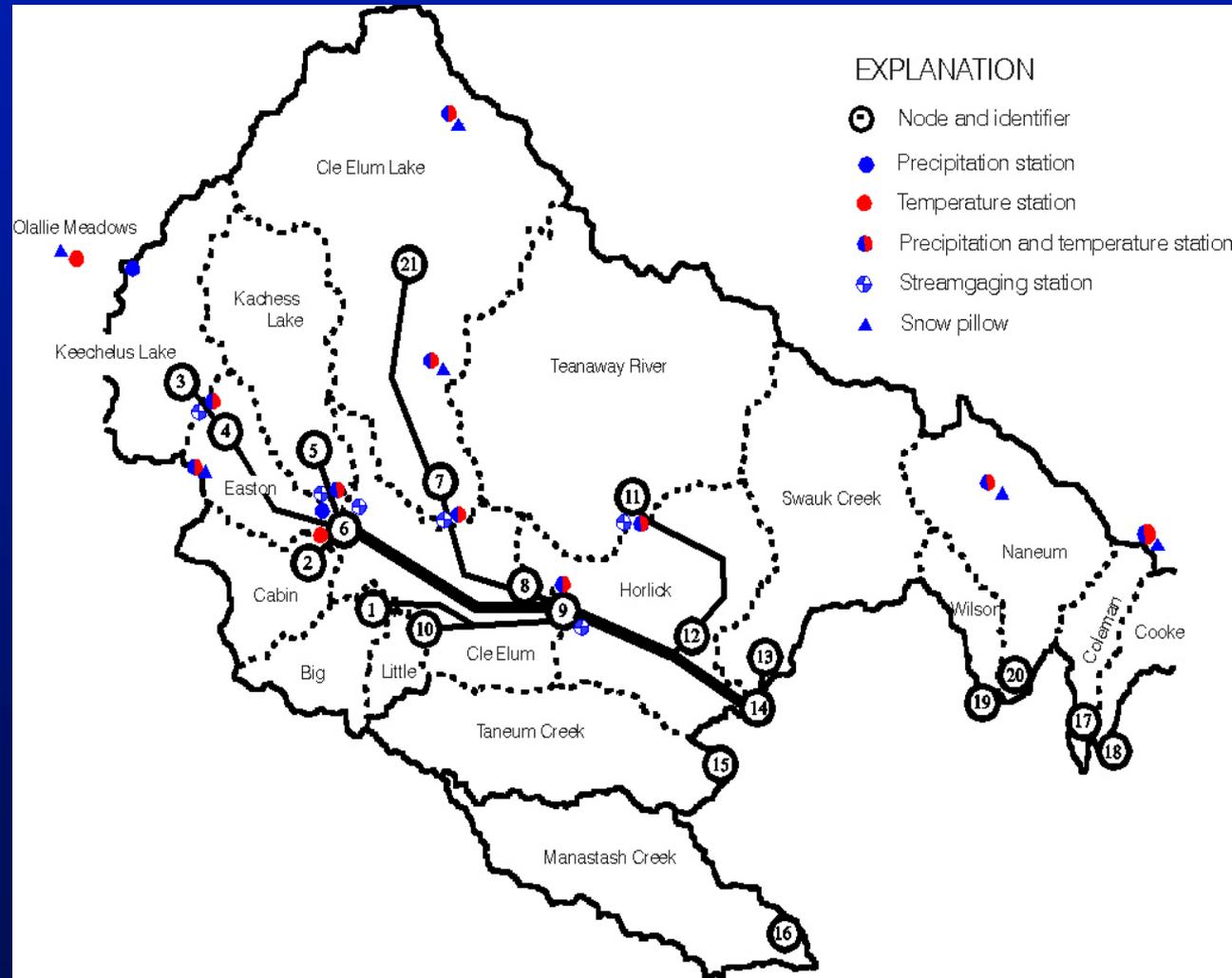
- Upper Yakima
- Naches
- Toppenish/Satus
- Yakima Canyon



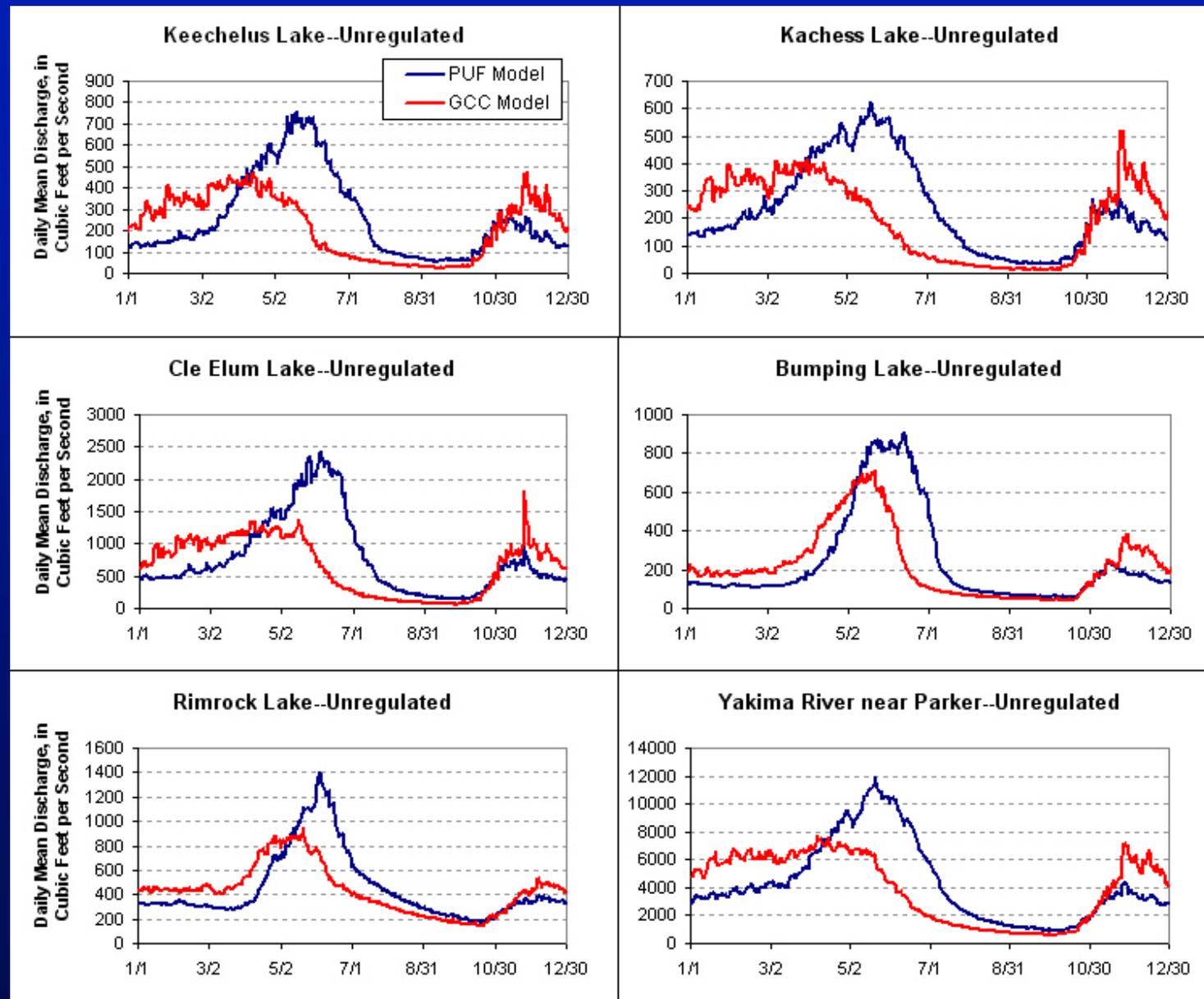
Upper Yakima Modeling Unit

Upper Yakima Modeling Unit

- 404 MRUs
- 17 subbasins
- 21 nodes
- 14 precipitation inputs
- 13 temperature inputs
- over 54,000 parameters



GCC scenario versus PUF scenario

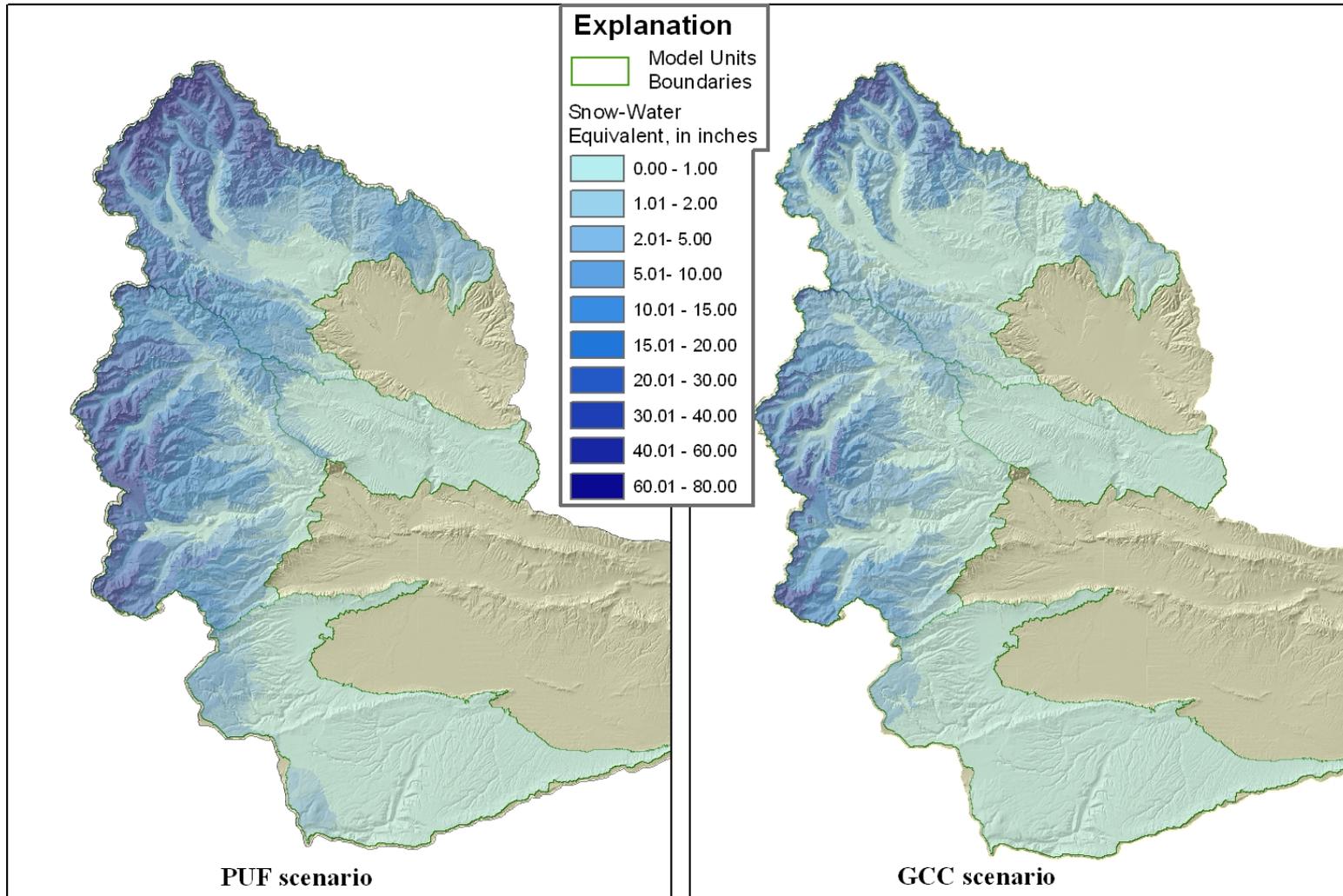


Simulation Results

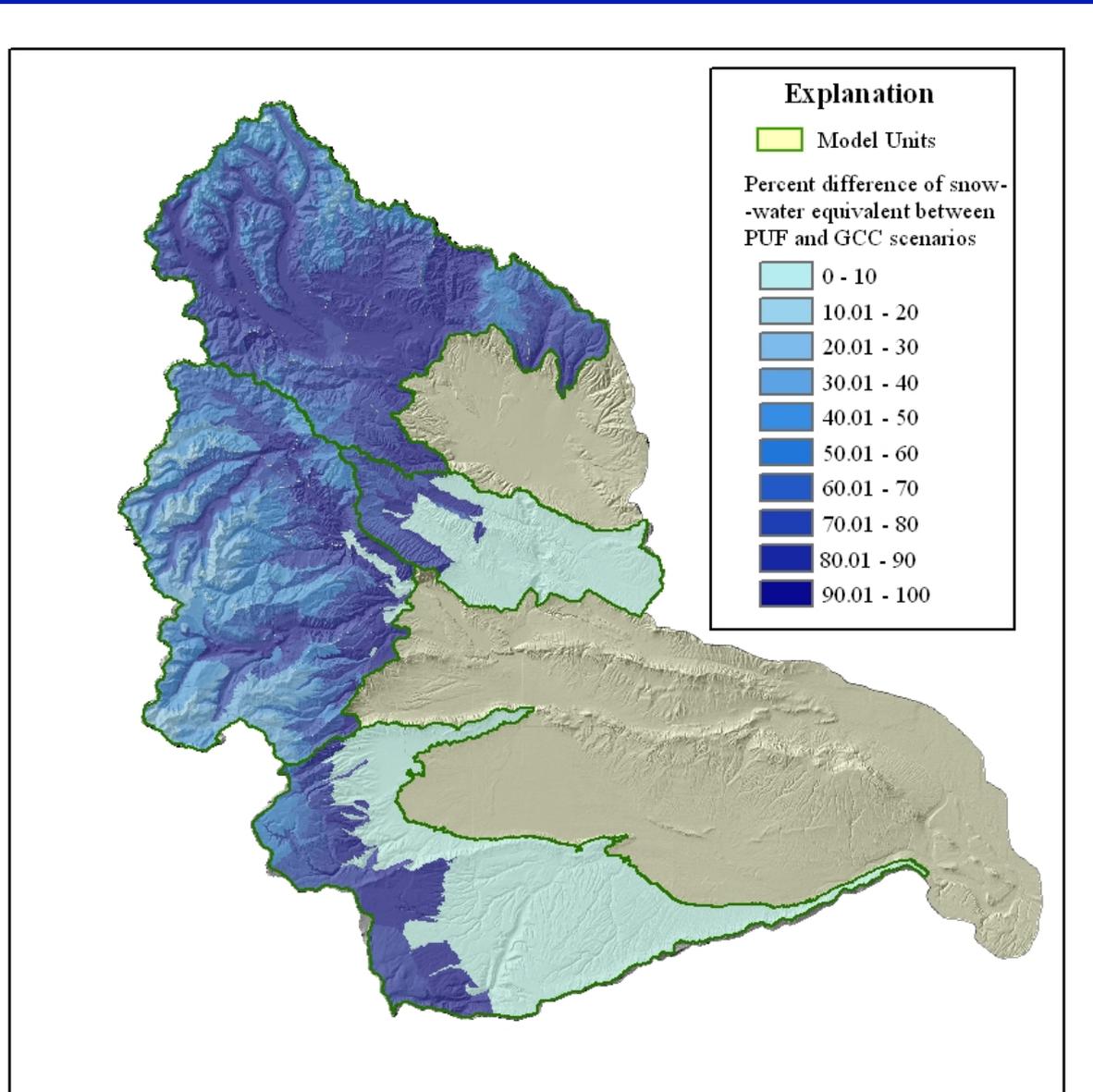
April thru August Runoff

Station or Reservoir	PUF		GCC			
	Exceedence Percentiles		Exceedence Percentiles			
	50%	90%	50%		90%	
	K ac-ft	K ac-ft	K ac-ft	% diff	K ac-ft	% diff
Cle Elum	364.7	148.2	185.3	-49.2	90.2	-39.2
Rimrock	204.0	104.2	164.0	-19.6	87.9	-15.6
Yakima R. nr Parker	1,891.8	922.6	1,118.5	-40.9	578.9	-37.2

GCC scenario versus PUF scenario

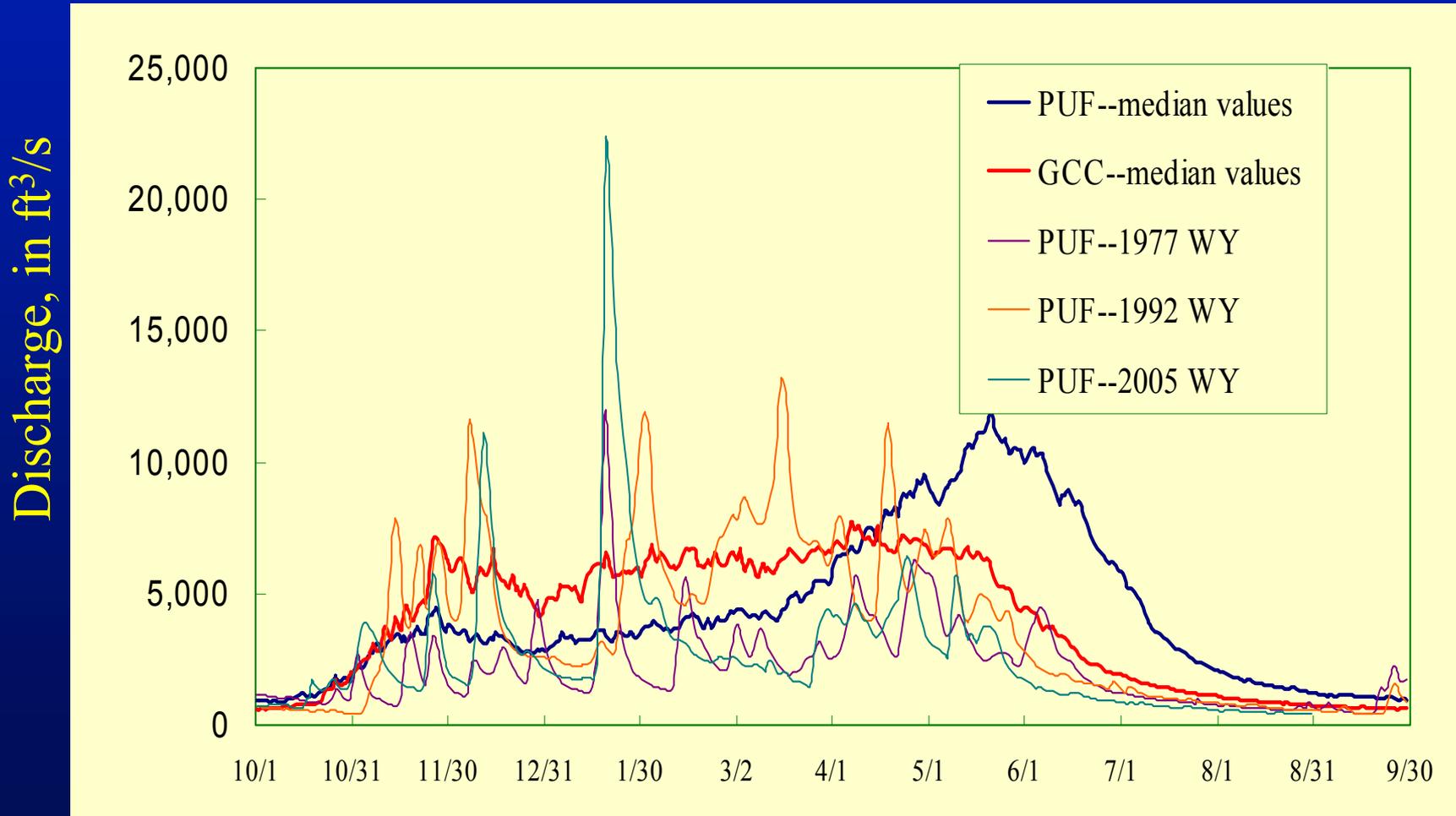


GCC scenario versus PUF scenario



GCC scenario versus PUF scenario

Yakima River near Parker



Simulation Results

Model Simulations Yakima R. nr. Parker	Runoff, ac-ft (Apr.1-August 31)
PUF--median daily	1,891,800
GCC--median daily	1,118,500
PUF--WY 1977	707,100
PUF--WY 1992	917,200
PUF--WY 2005	605,500

Simulation Results

Model Simulations Yakima R. nr. Parker	Runoff, ac-ft (Apr.1-August 31)
PUF--90% exceedence	922,600
GCC--90% exceedence	579,000
PUF--WY 1977	707,100
PUF--WY 1992	917,200
PUF--WY 2005	605,500

Conclusions

Compared to PUF scenarios, GCC scenarios have:

- Seasonal patterns of higher flows in late autumn and winter, peaks earlier in the water year, and low spring and summer runoff
- Spring snowpack less with biggest percent differences in the lower elevations
- Total median , April-August runoff about 770,000 ac-ft less at Parker
- Median total volumes of runoff probably manageable
- However, at least 10% of the water years can be expected to generate less runoff than the lowest observed runoff (1950-2005) and will likely provide significant challenges to water managers.

More Information

<http://wwwbrr.cr.usgs.gov/warsmp>

<http://wwwbrr.cr.usgs.gov/mms>

<http://wwwbrr.cr.usgs.gov/weasel>