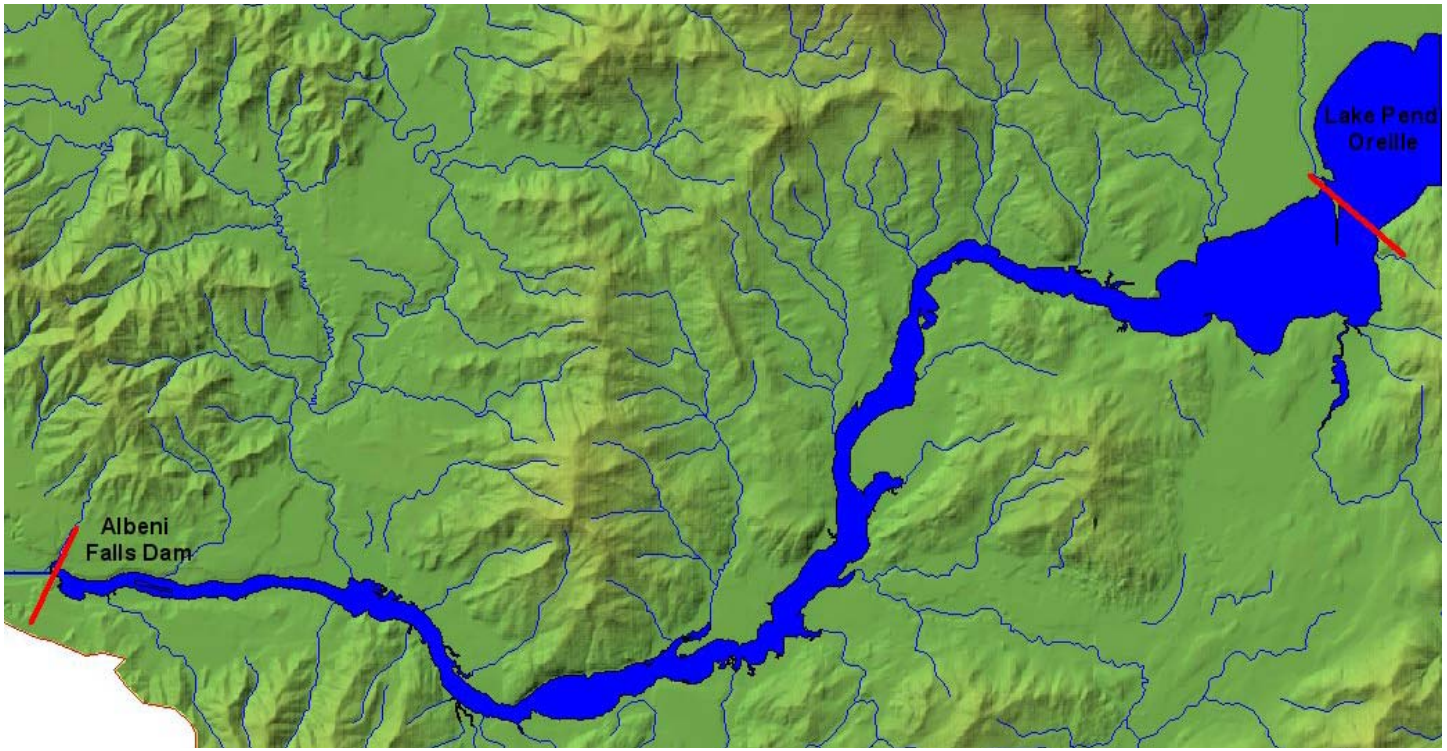
Pend Oreille River - Idaho Water Quality and Hydrodynamic Model

Portland State UNIVERSITY

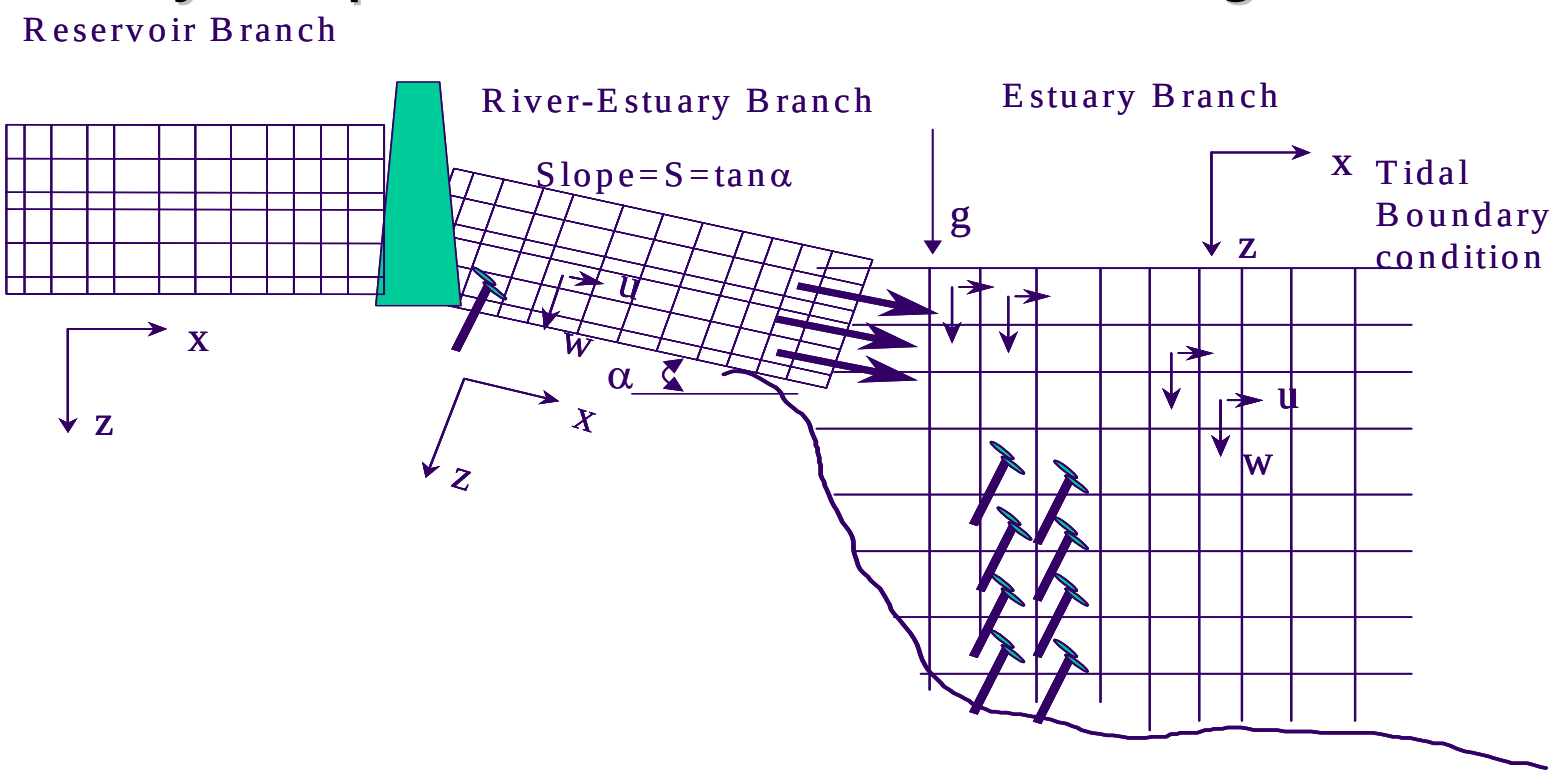
Water Quality Research Group

Idaho Department of Environmental Quality

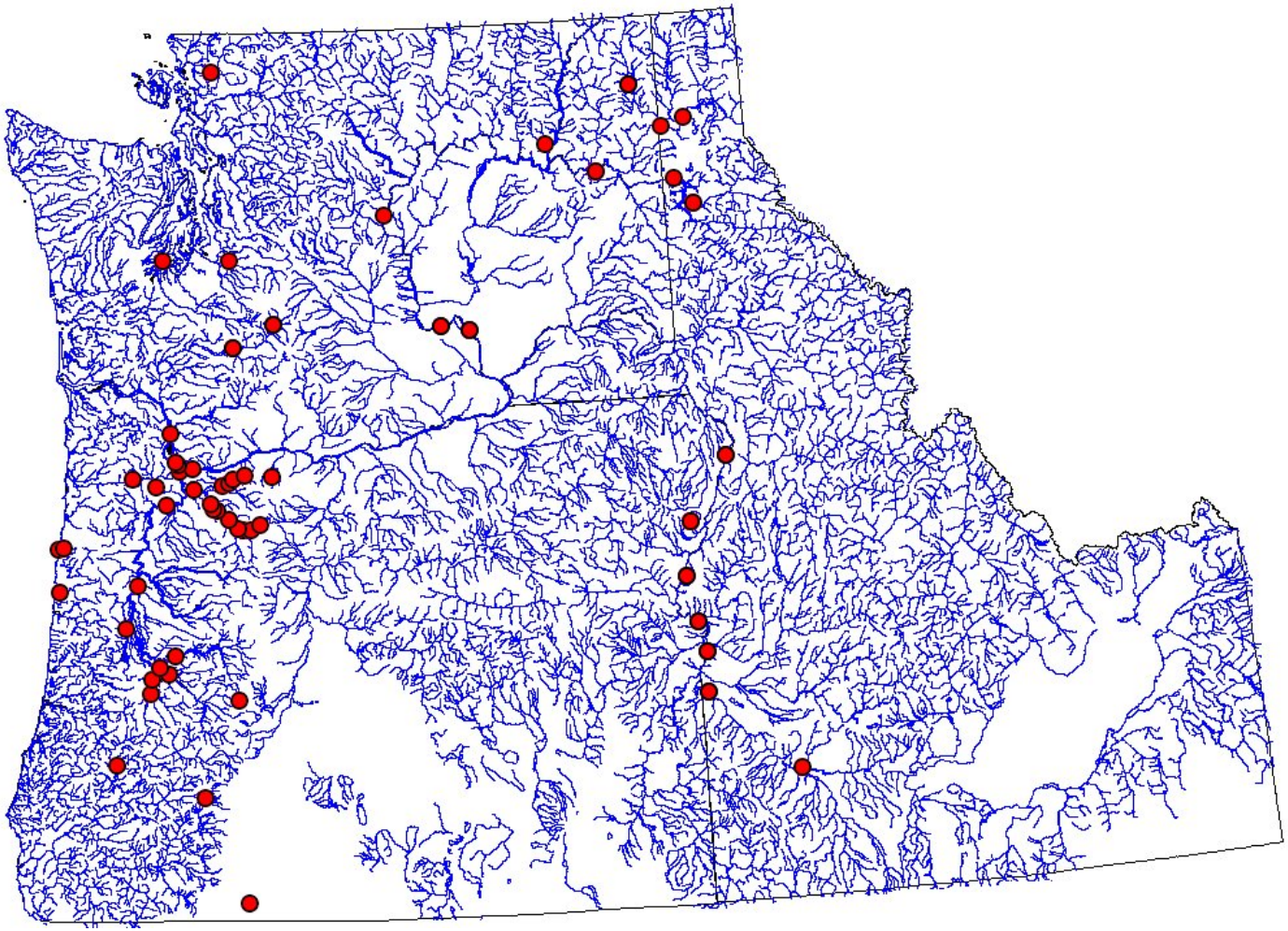


Model Choice: CE-QUAL-W2 River Basin Model Version 3

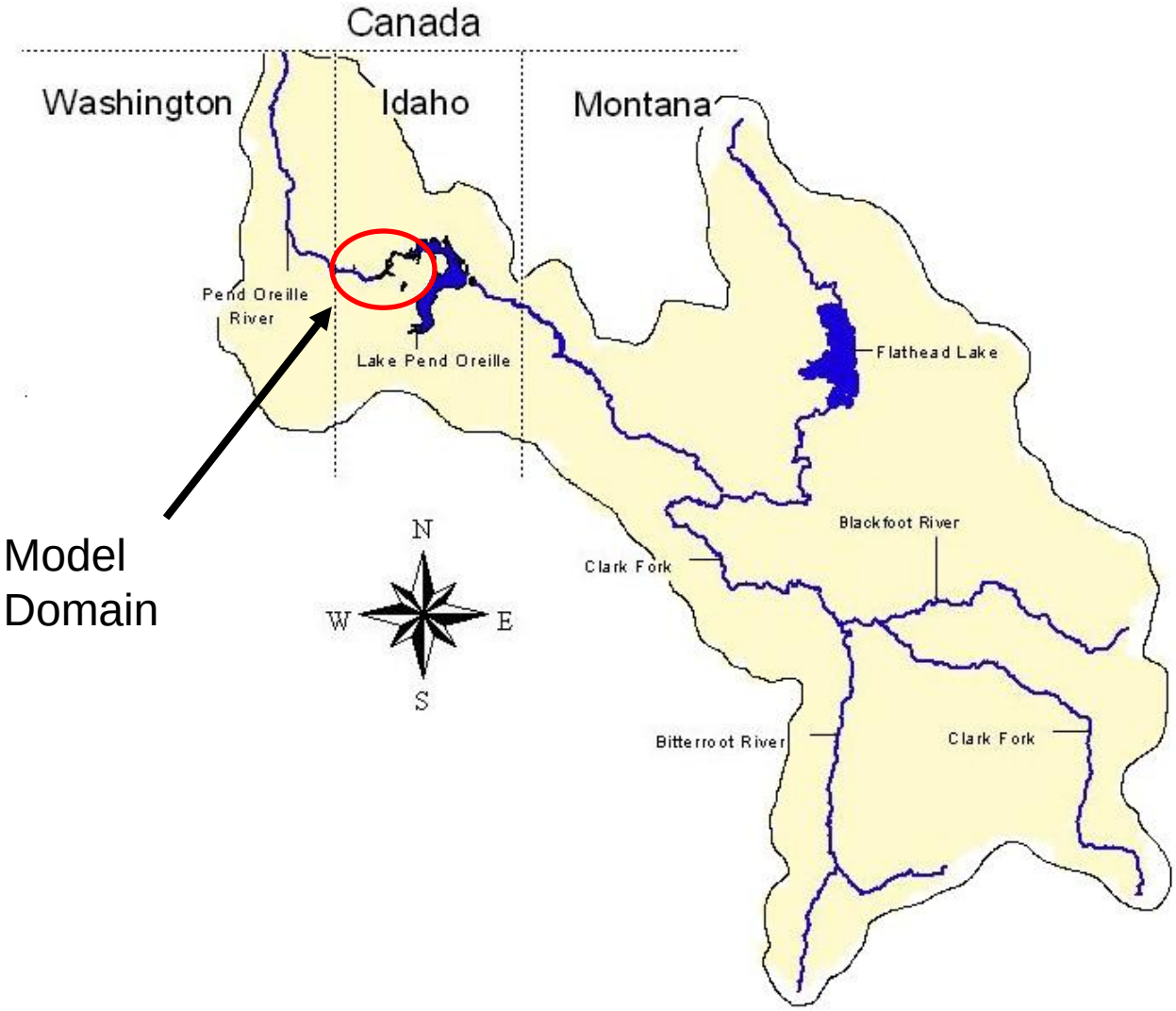
2-D (vertical-longitudinal), unsteady finite difference model for hydrodynamics and water quality for rivers, reservoirs, lakes, estuaries supported by the Waterways Experiment Station, Vicksburg, MS, USA



Portland State CE-QUAL-W2 Model Applications in Pacific Northwest



Pend Oreille Model - Idaho

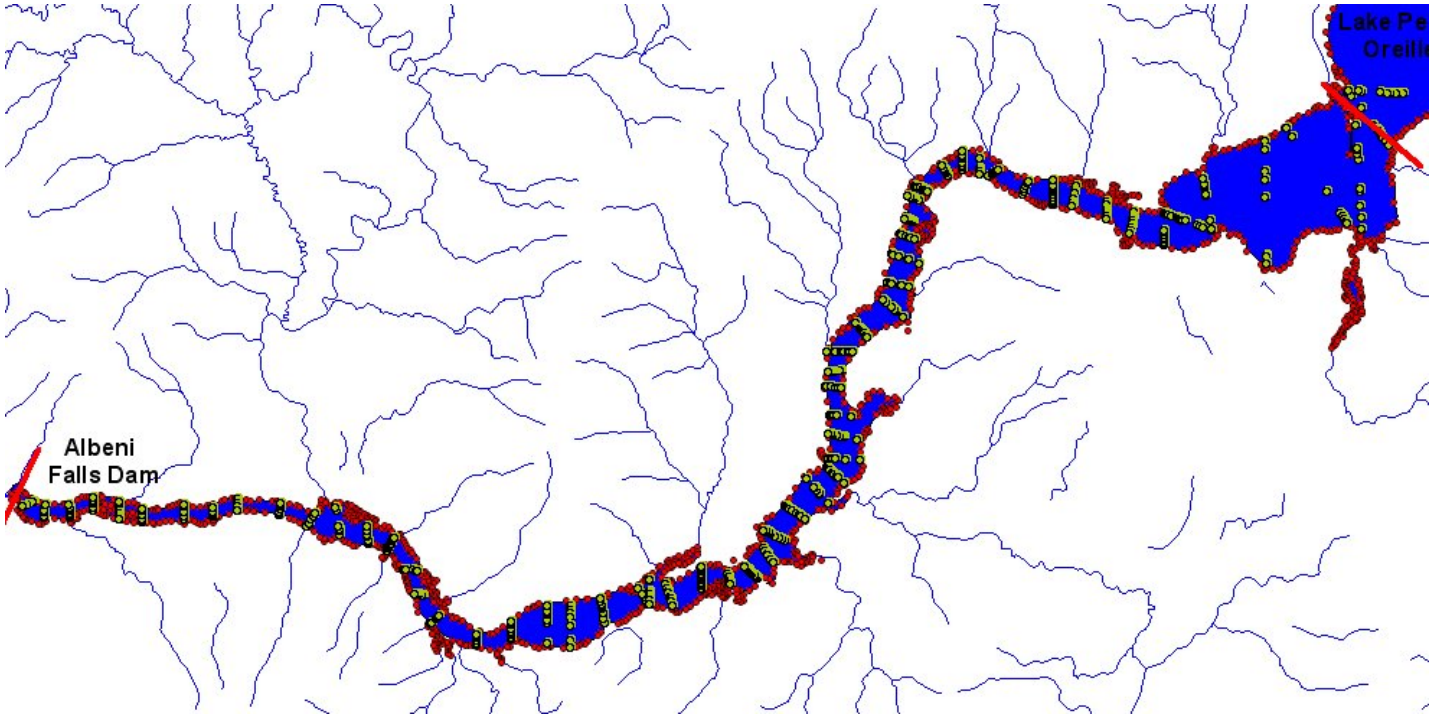


Pend Oreille model capabilities

- Temperature, velocity (U, W), Water surface elevation
- Conductivity
- CBOD
- labile and refractory dissolved organic matter groups
- Total inorganic carbon
- algae
- NH_4-N
- PO_4-P
- NO_3-N+NO_2-N
- Alkalinity
- pH and carbonate system
- Sediment Model (0 order, 1st order)

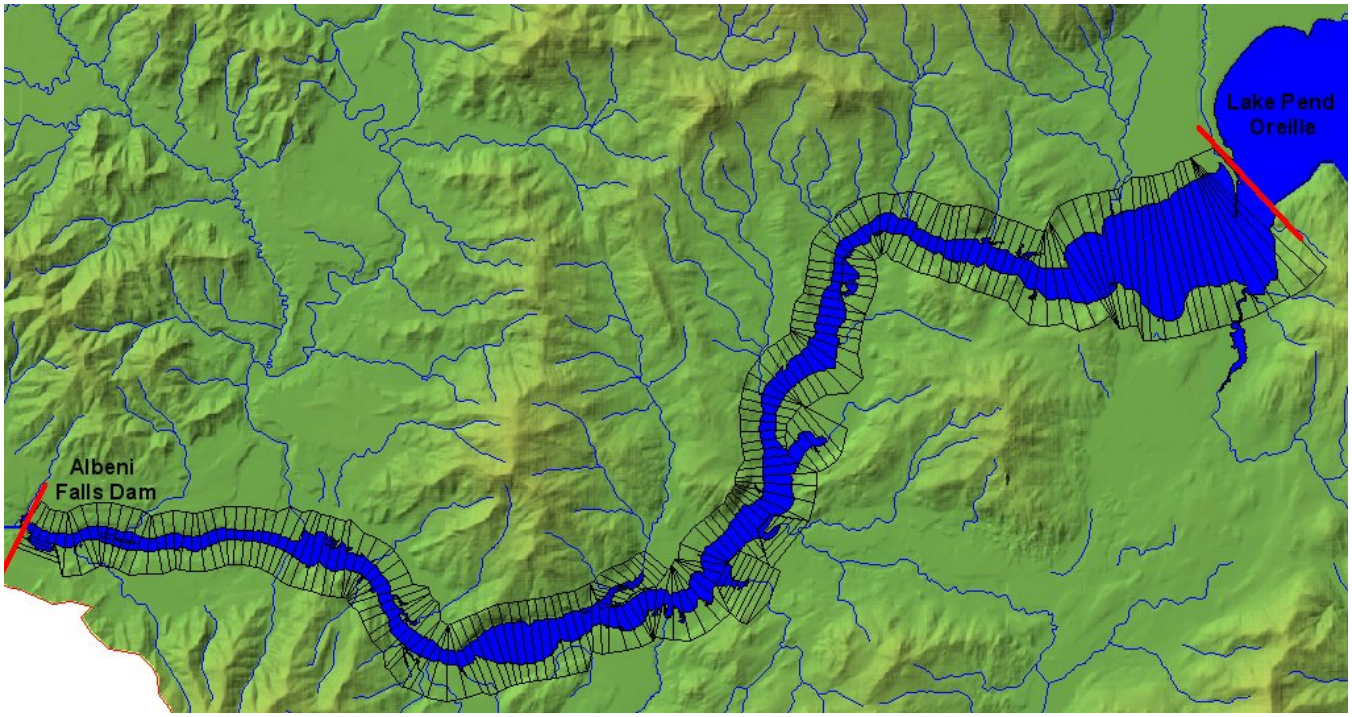
Model Bathymetry - Data

- USGS cross sections surveyed 1996 (Fields et al., 1996)
- Digital elevation model (DEM) Geographic Information System (GIS)



Model Bathymetry

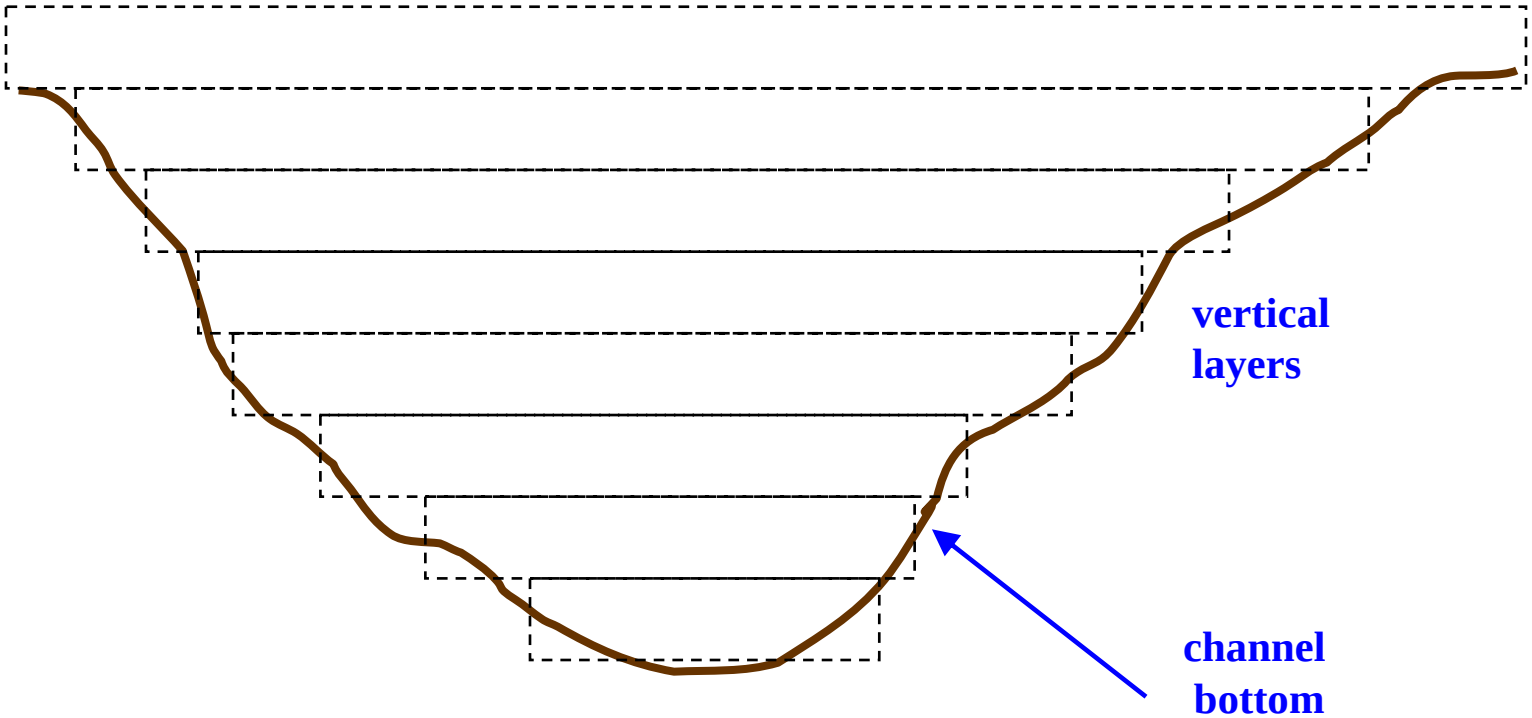
- 234 model segments
- Each 250 meters long



CE-QUAL-W2 Version 3

River Basin Reservoir Model 2-D longitudinal-vertical

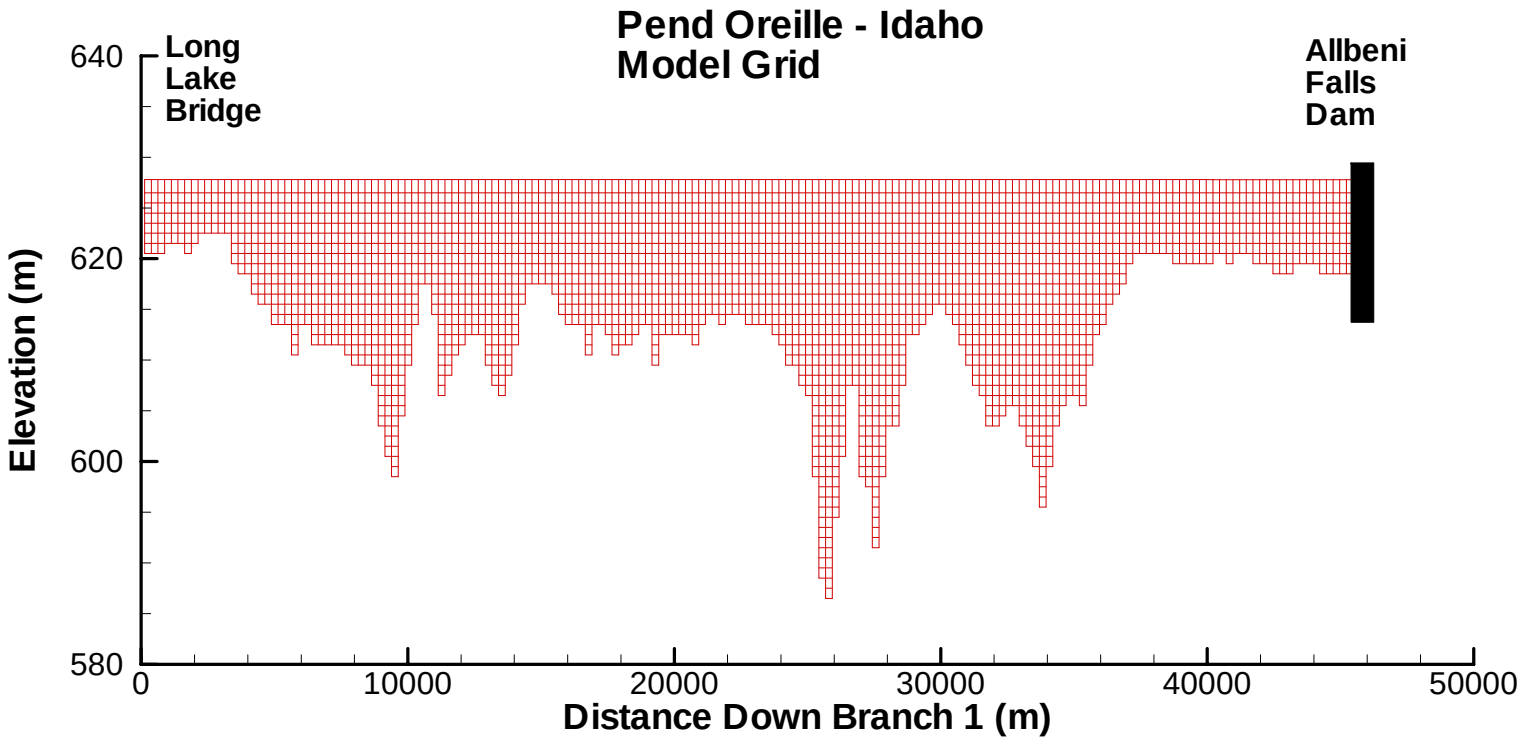
Model segment i



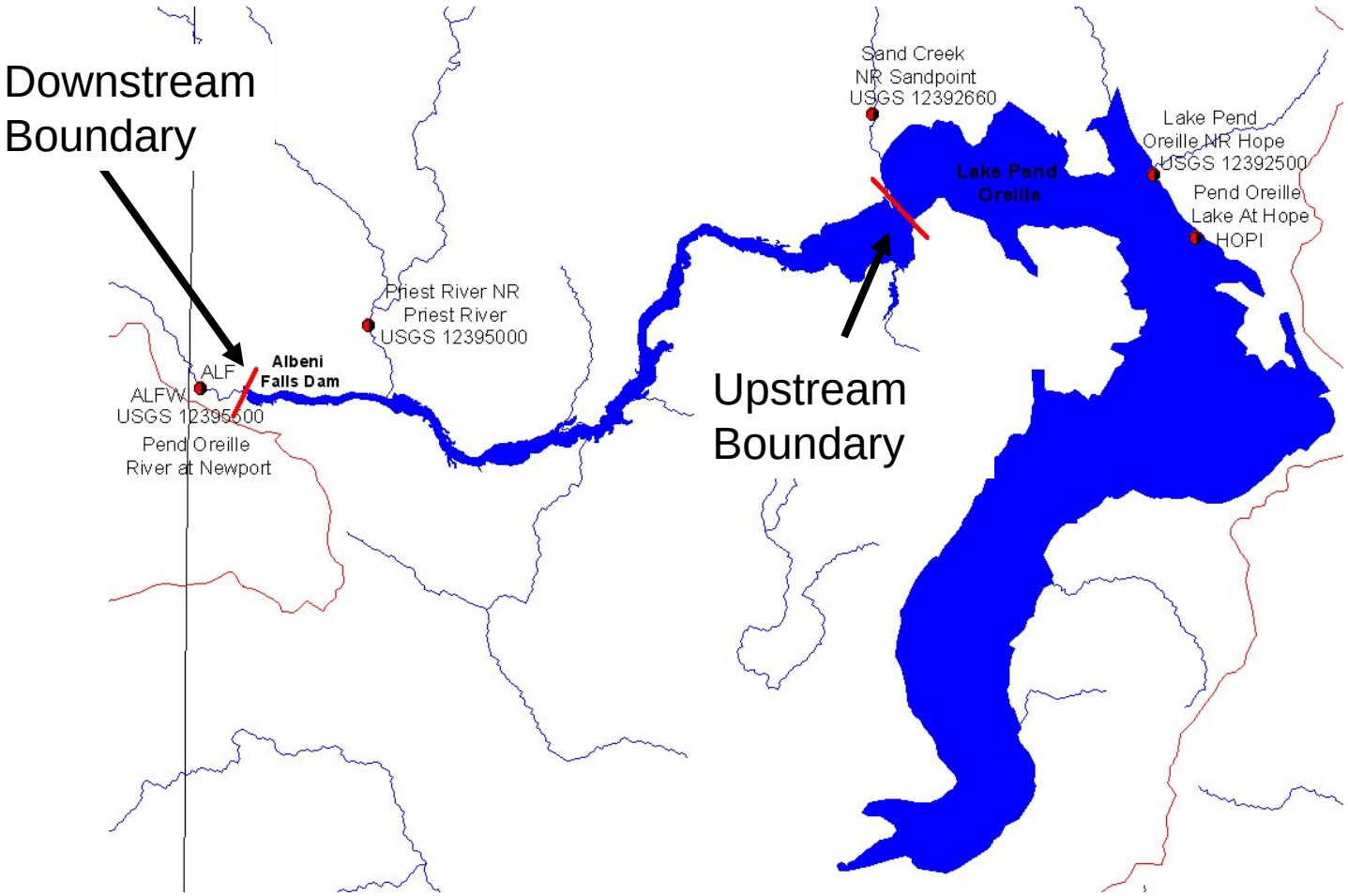
Model Bathymetry

1 meter thick layers

92 layers



Model Boundaries

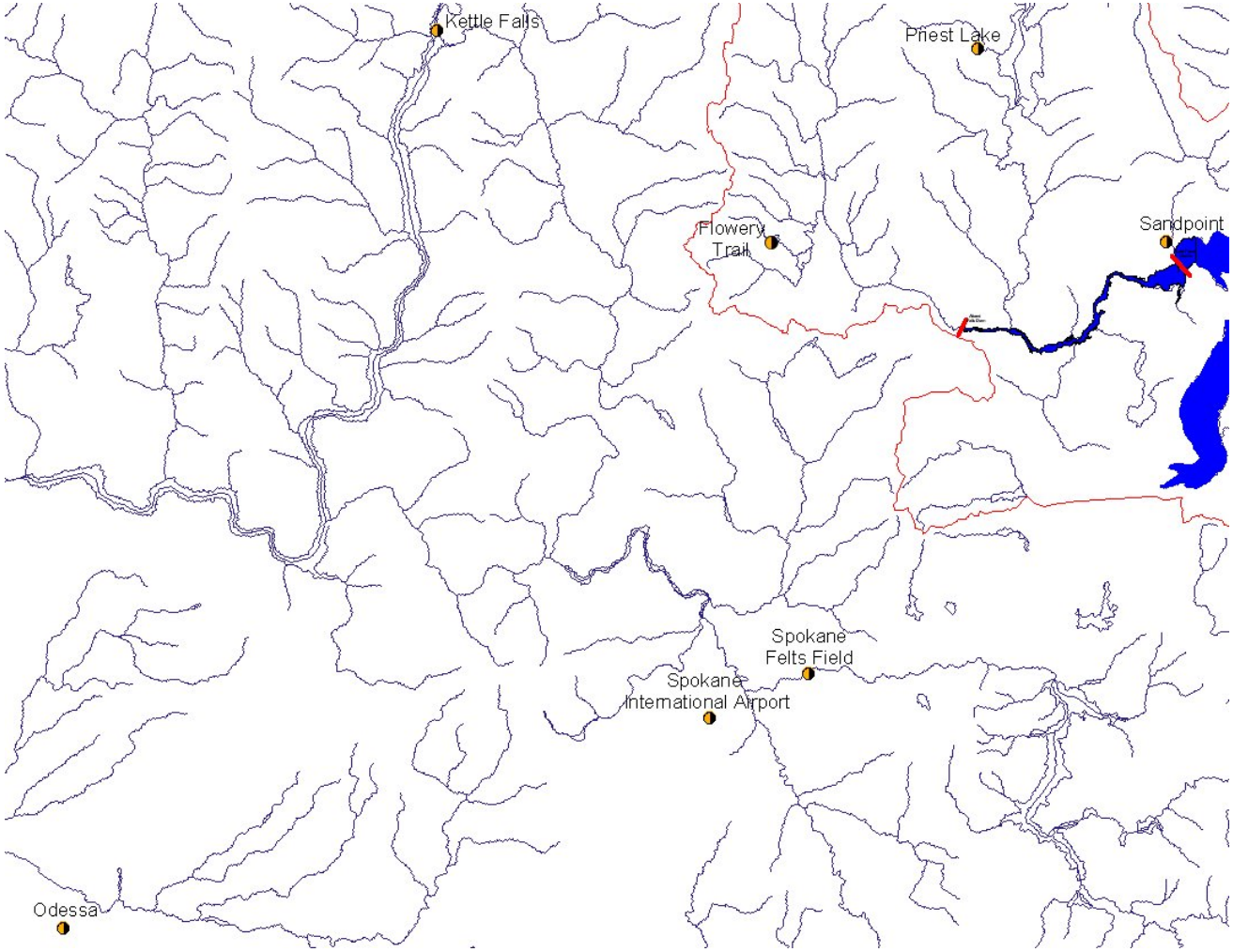


Meteorological Inputs Used by Model

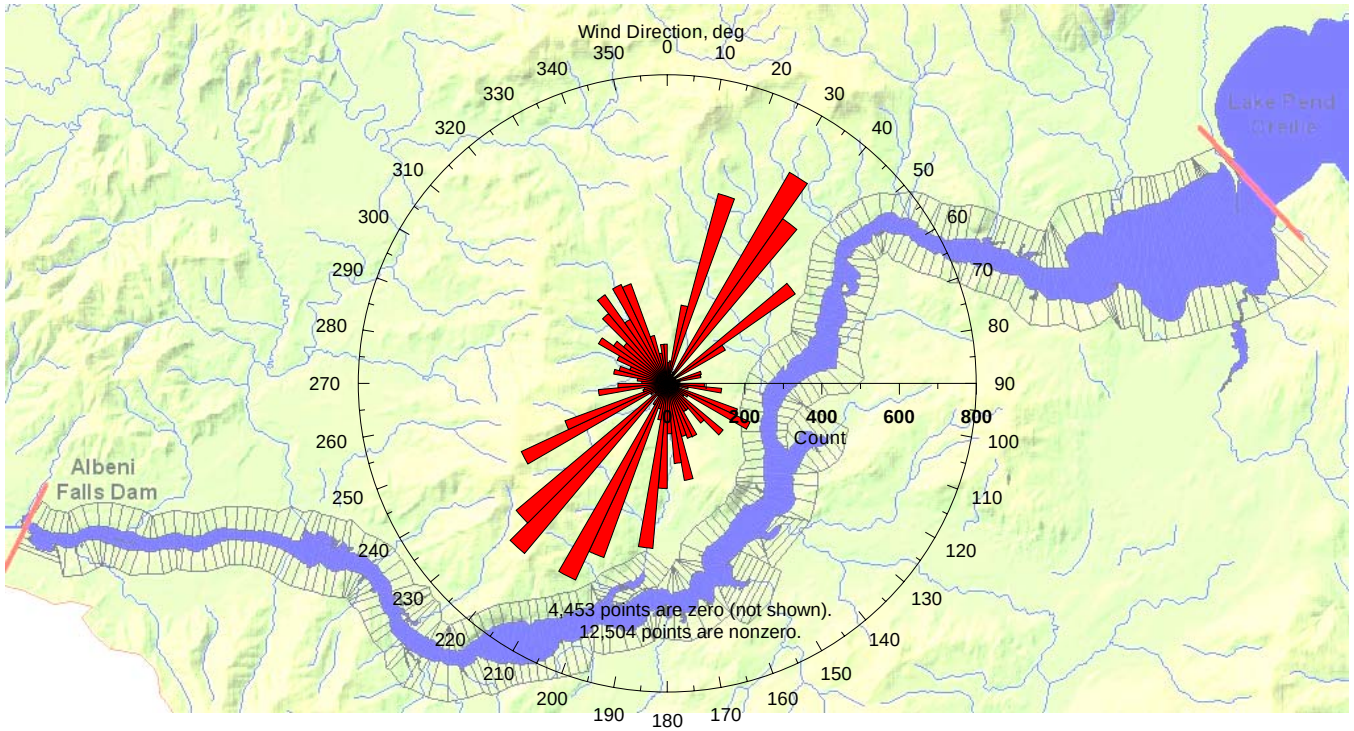
- Air Temperature
- Dew Point Temperature
- Wind Direction
- Wind Speed
- Cloud Cover
- Short Wave Solar Radiation
- Precipitation

Topographical shading also Simulated

Meteorological Site Locations



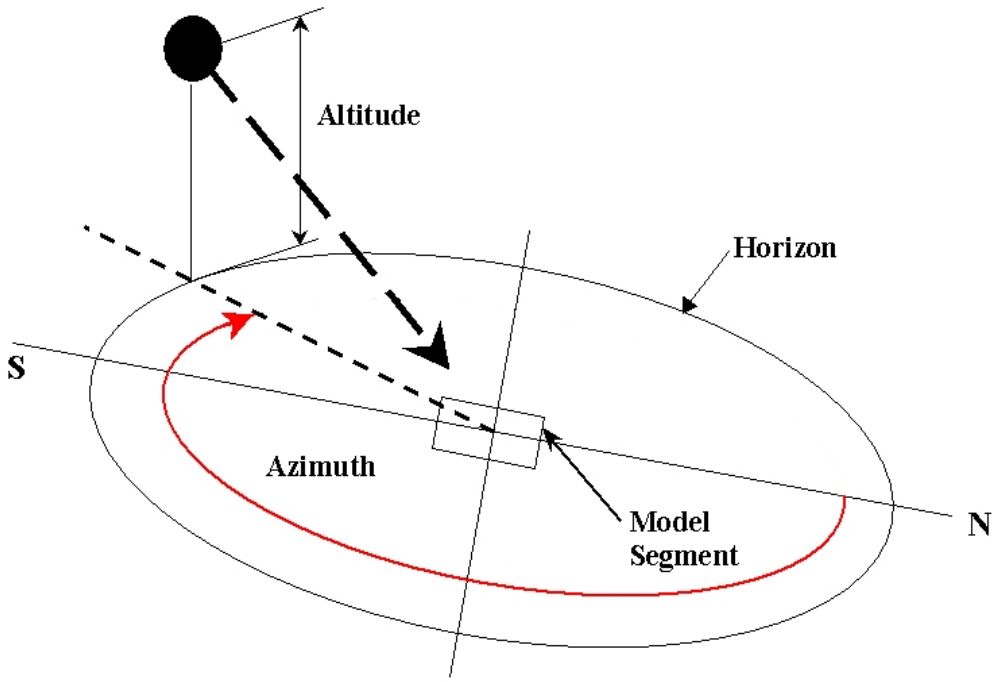
Wind direction measured at Sandpoint, ID



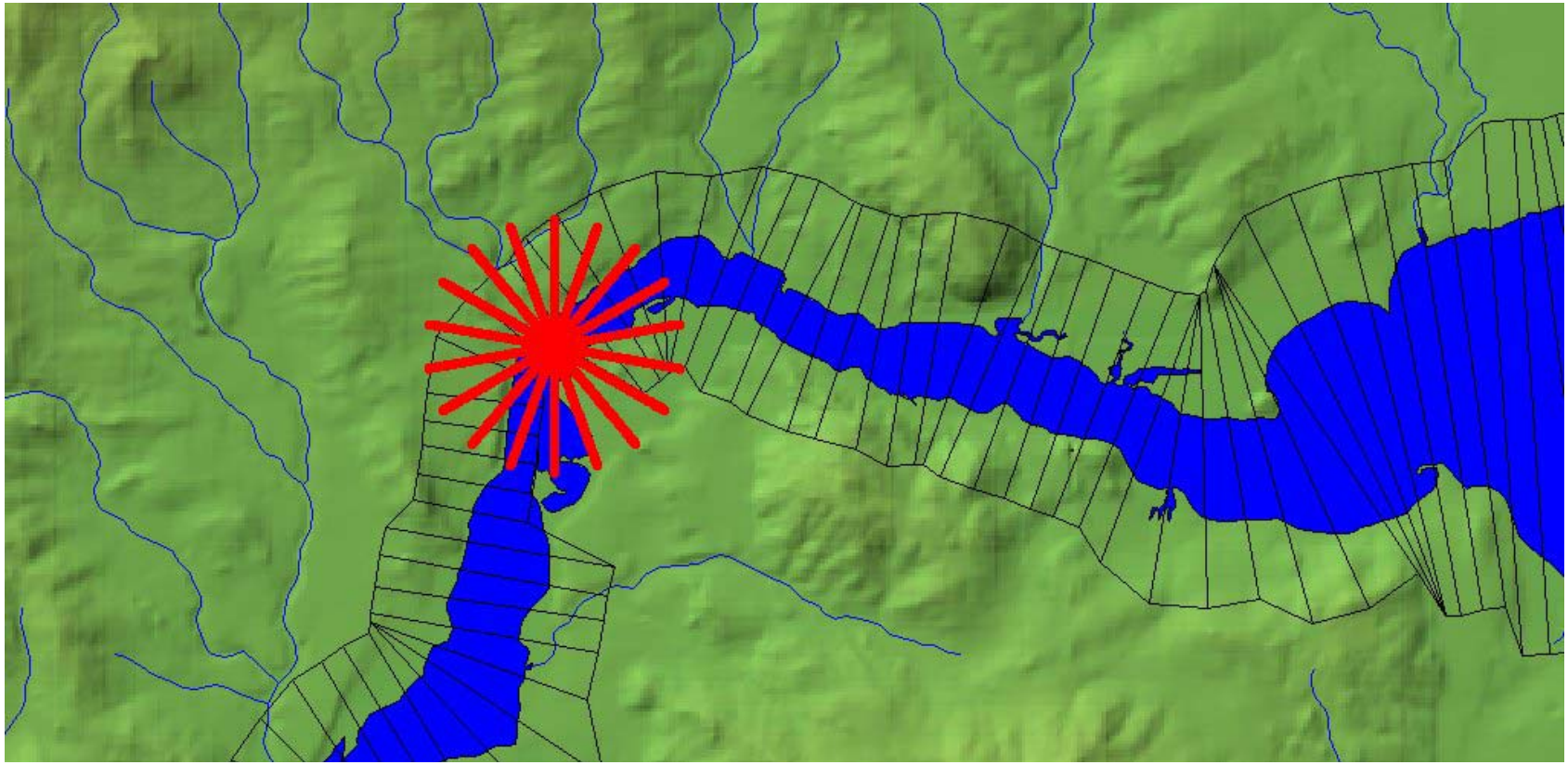
Dynamic Shading Algorithm

Equations:

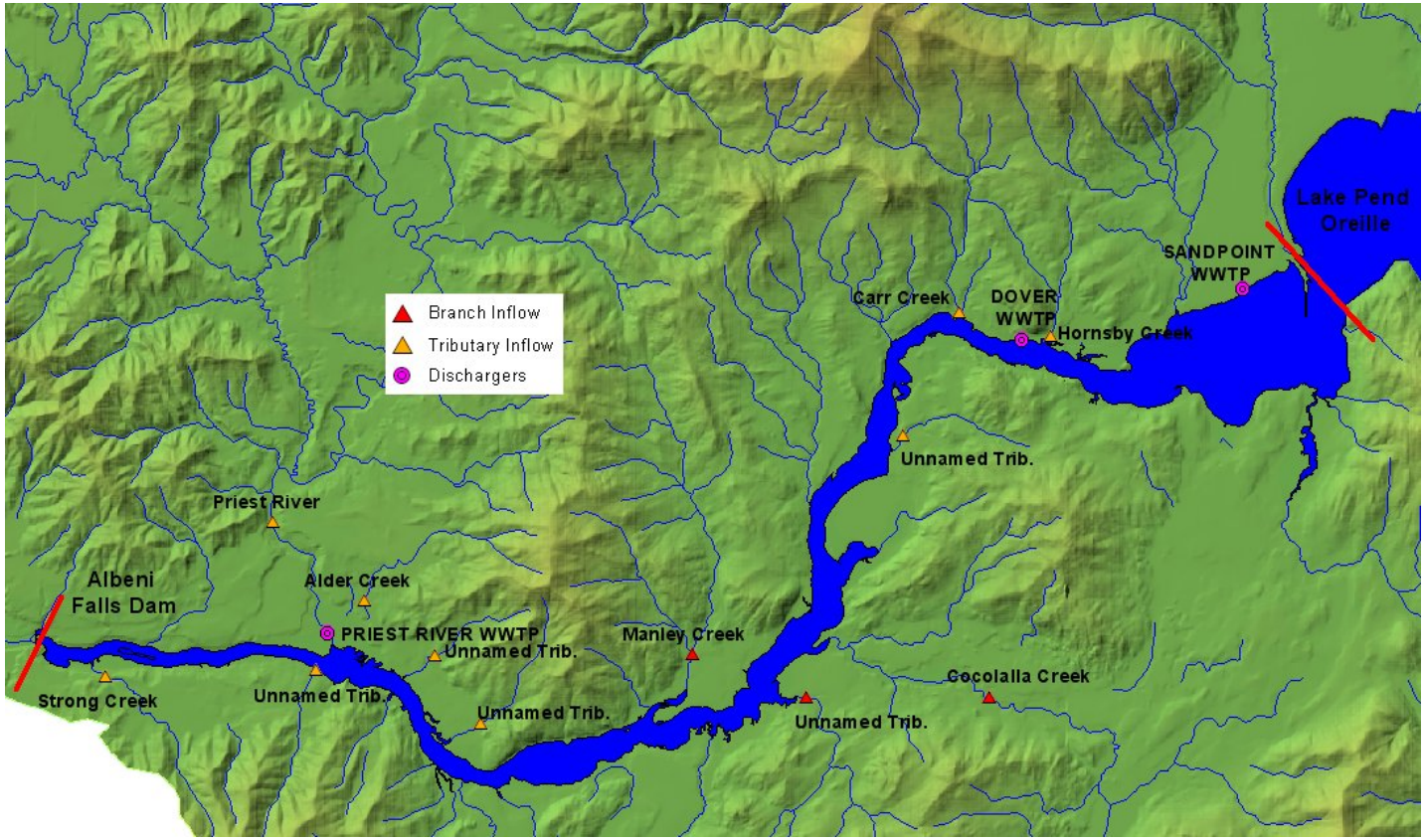
- Solar declination
- Equation of time
- Local Hour Ang
- Azimuth



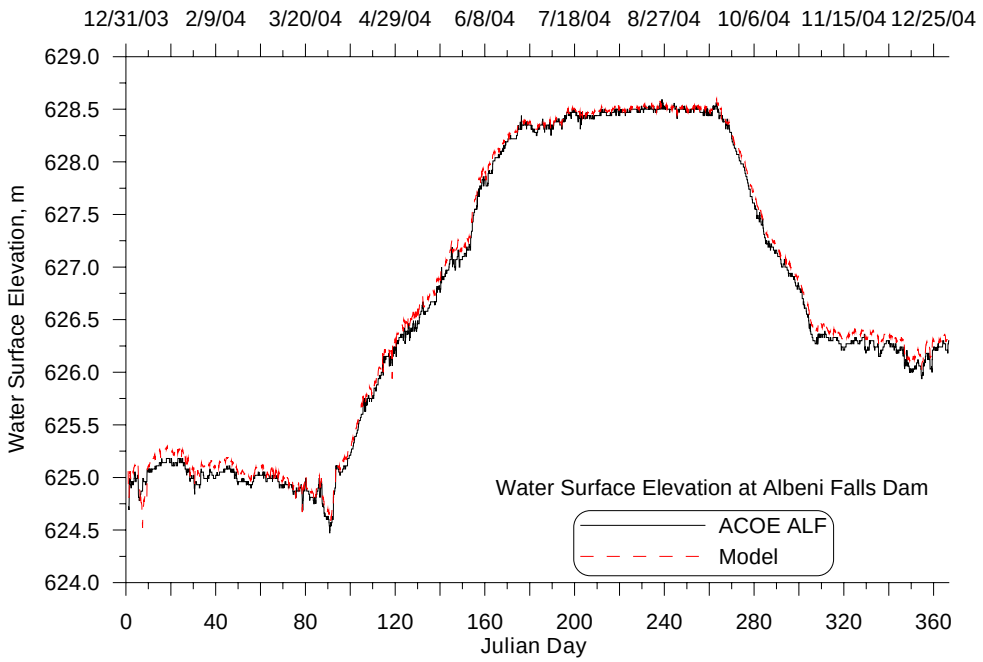
Dynamic Shading Algorithm

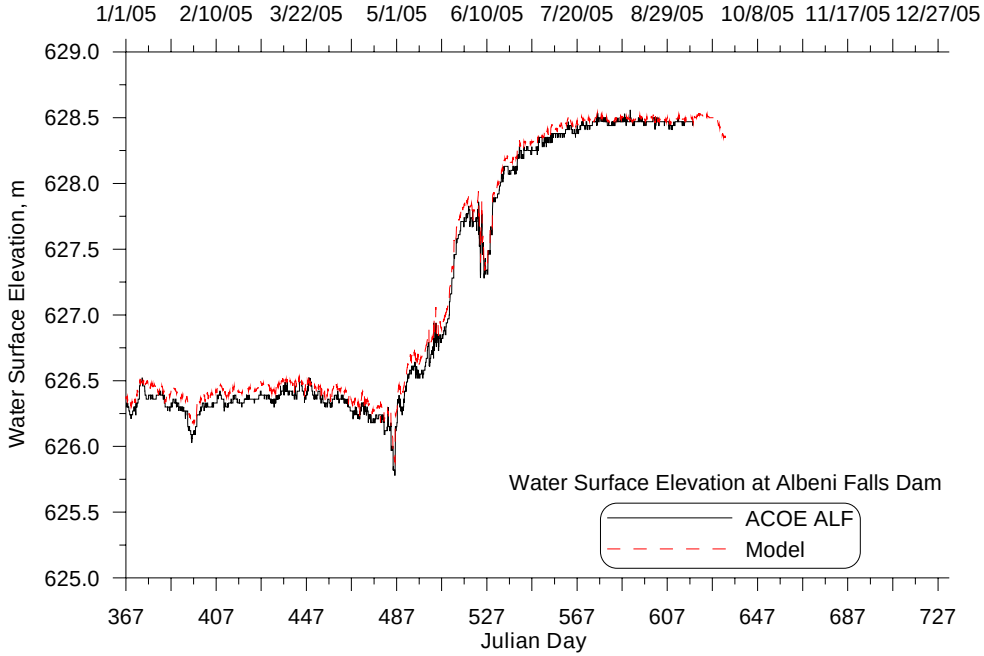


Tributaries

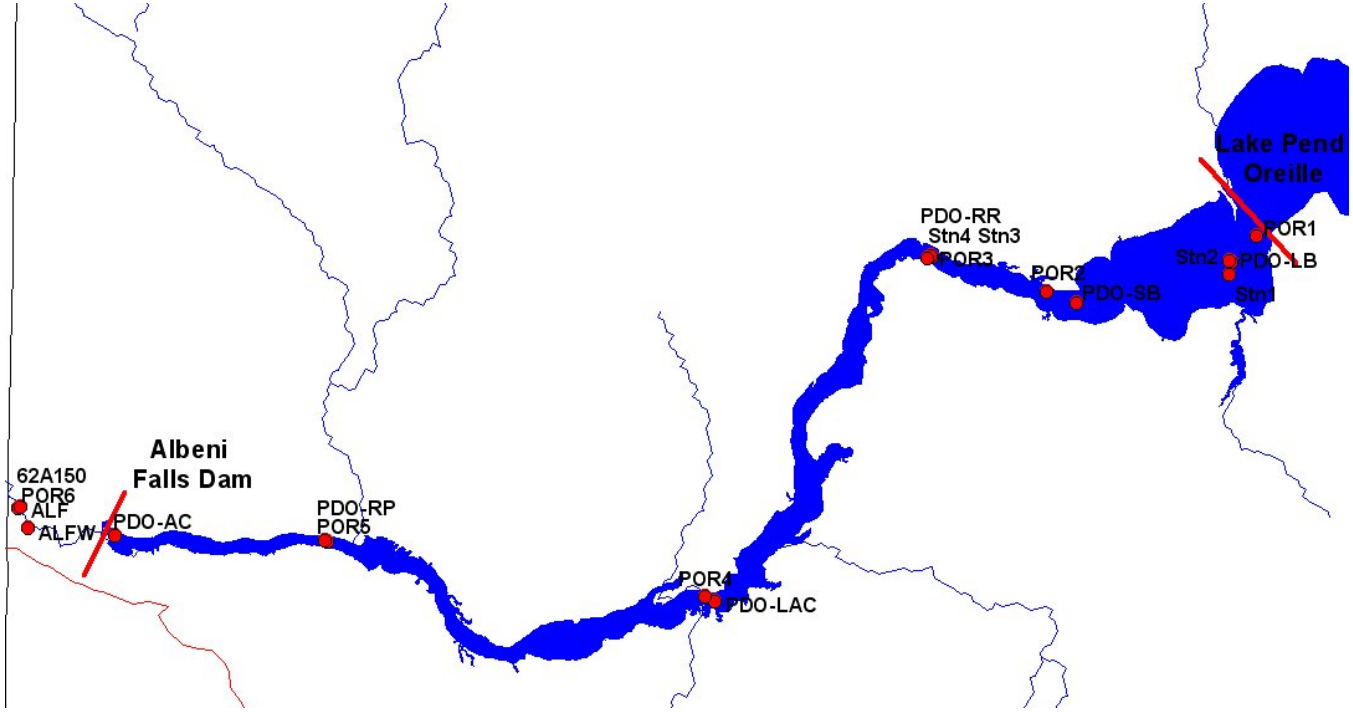


Water Level Calibration

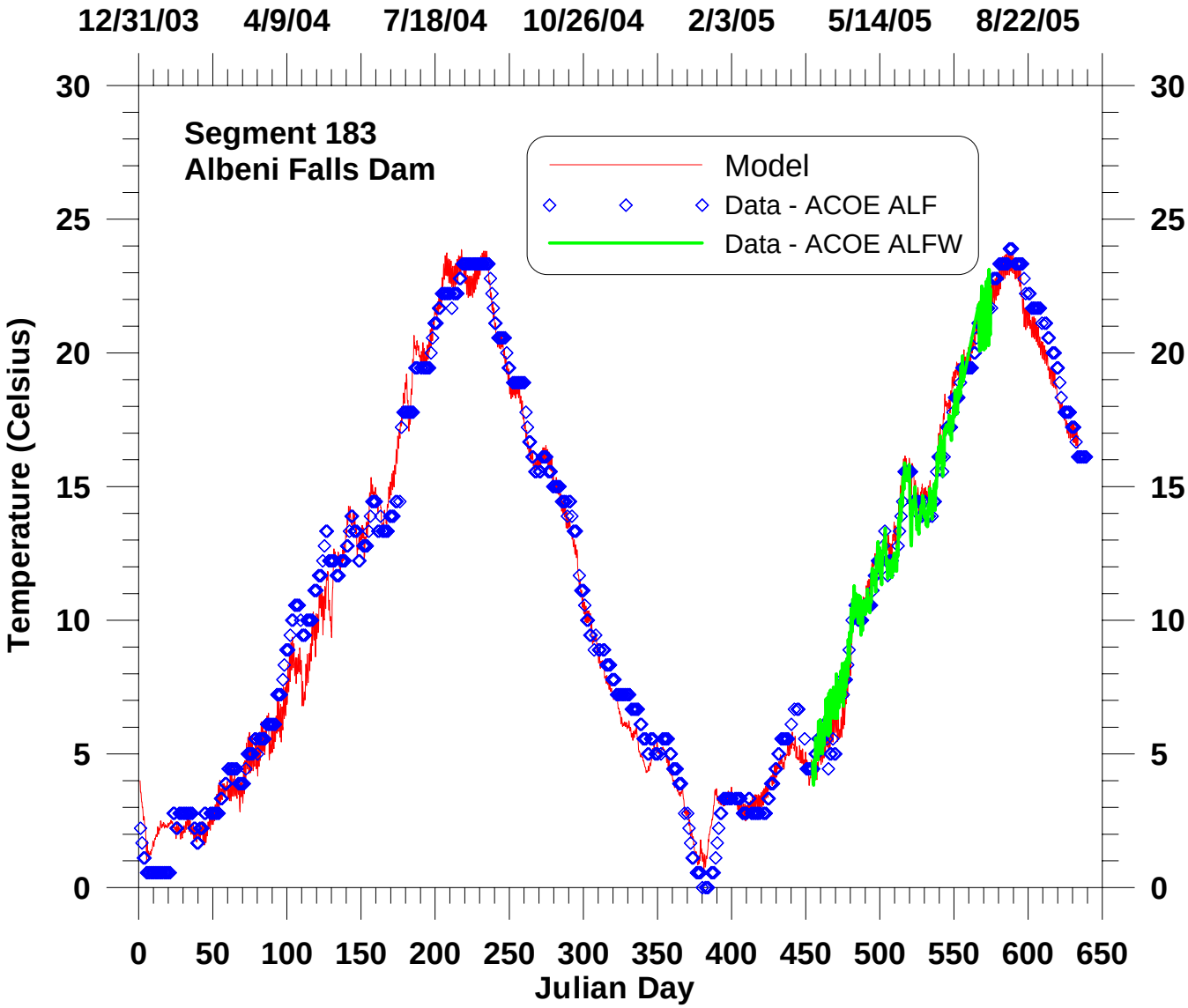




Temperature and Water Quality Calibration



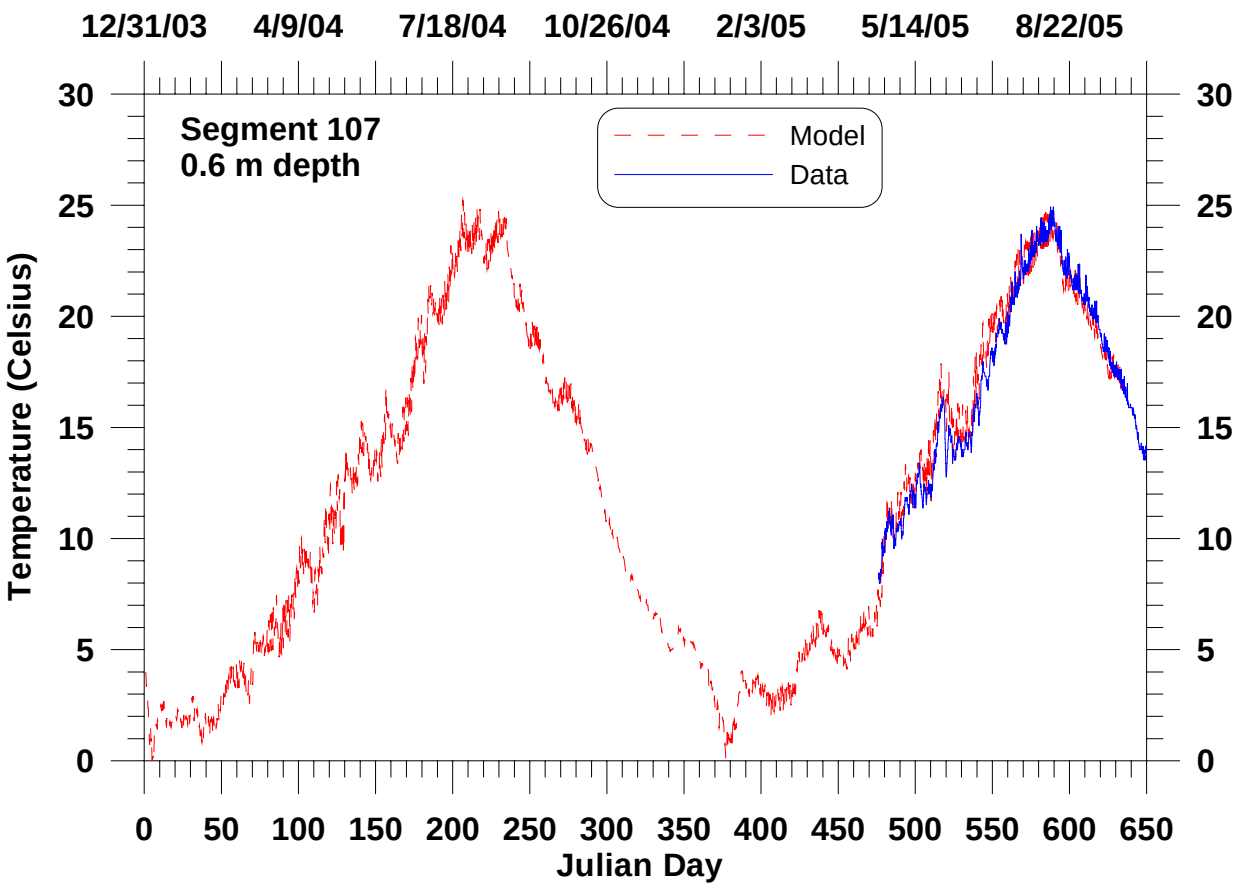
Temperature Calibration
Continuous Data



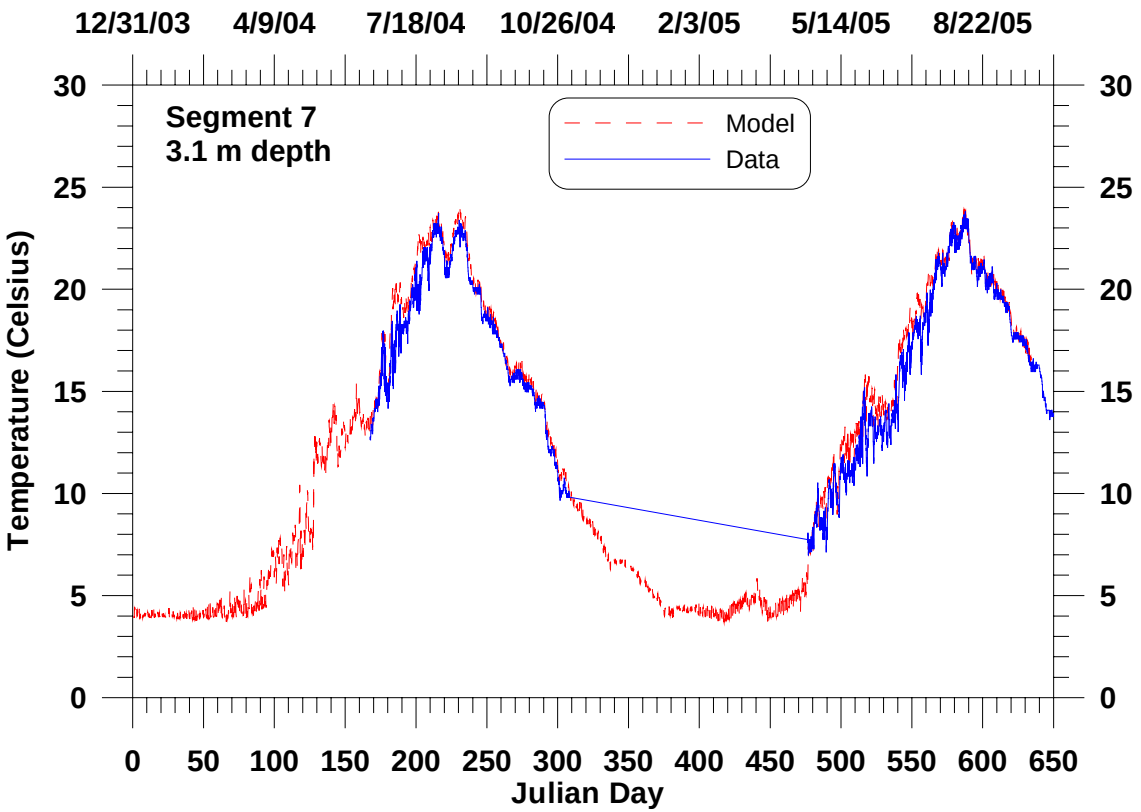
26 sites

Absolute Mean Error = 0.51

Temperature Calibration



Temperature Calibration

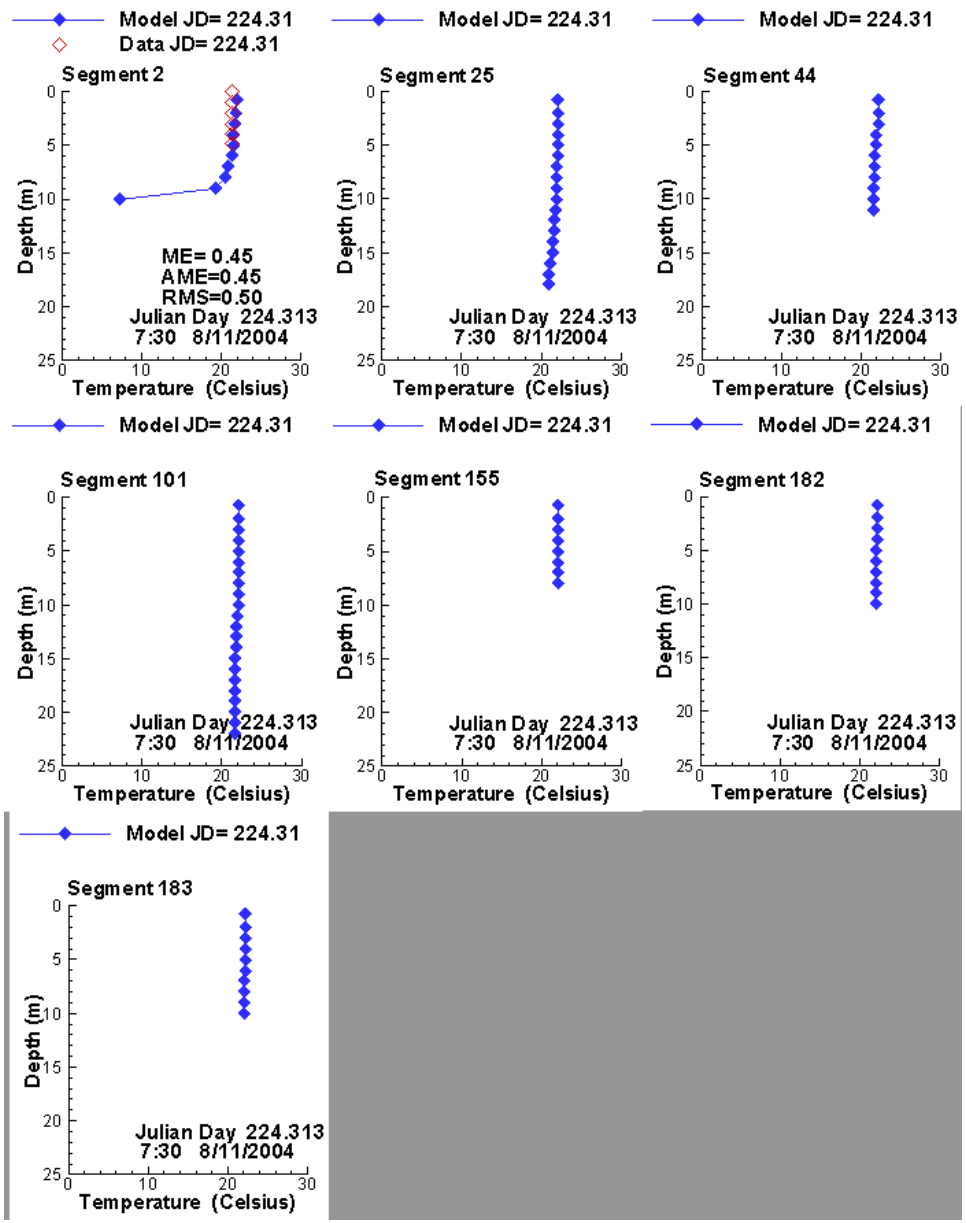


Temperature Calibration

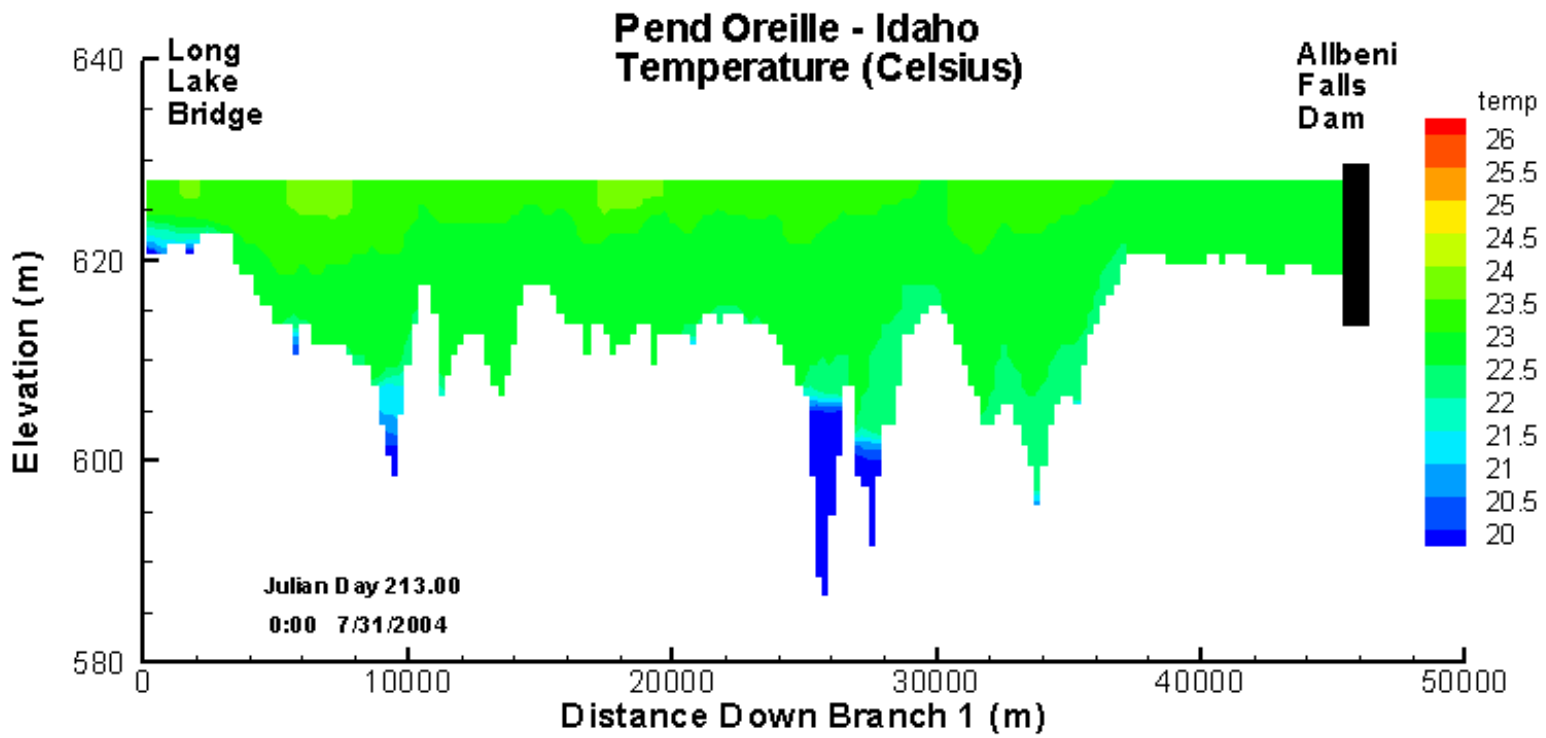
Vertical Profiles

7 Sites Total

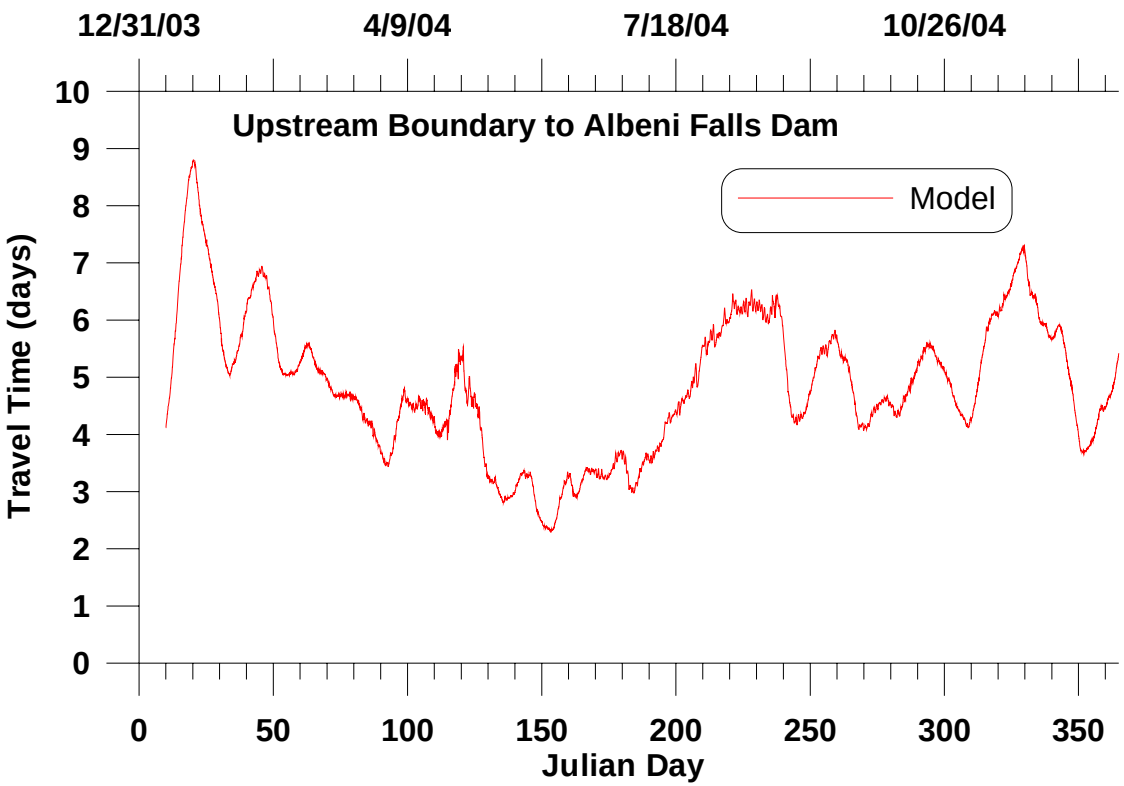
Mean Absolute Error = 0.38 degrees C



Temperature Animation



Travel Time


12/31/03
4/9/04
7/18/04
10/26/04
Upstream Boundary to Albeni Falls Dam
Model
Travel Time (days)
0
1
2
3
4
5
6
7
8
9
10
0
50
100
150
200
250
300
350
Julian Day

Summary

- Pend Oreille Hydrodynamic and Water Quality Model has been developed and is well calibrated relative to other water quality models

Pend Oreille River Box Canyon Temperature Model

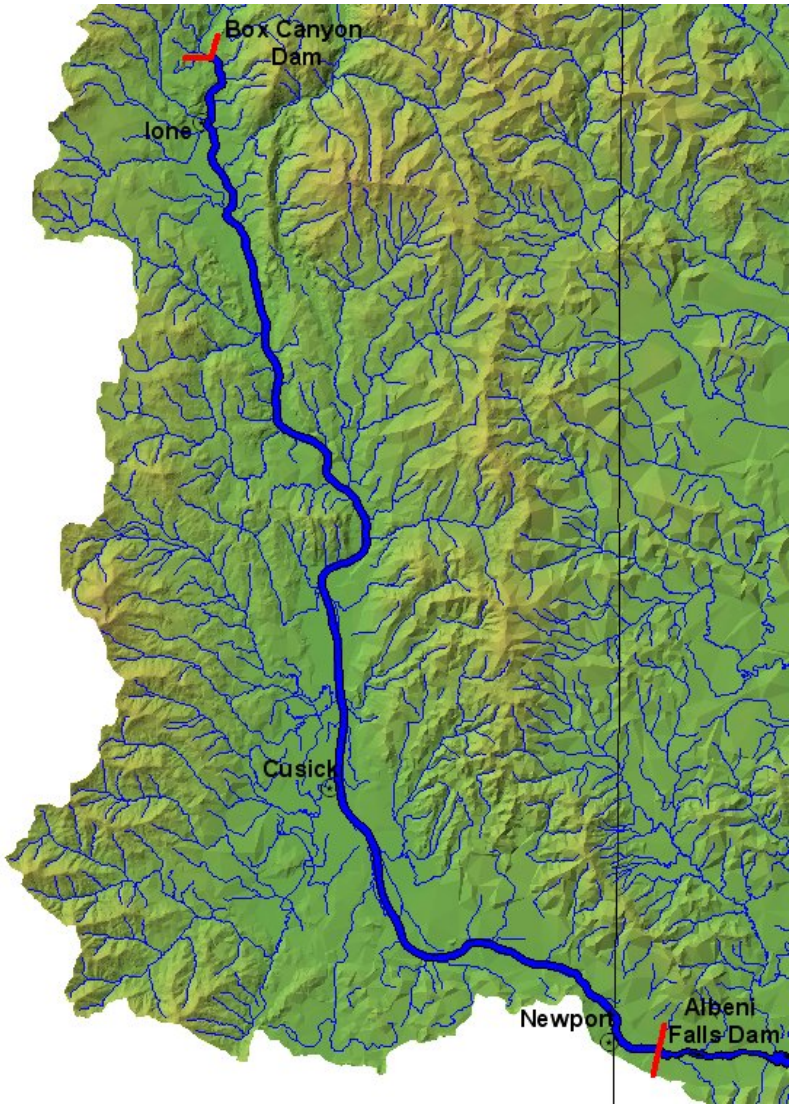
Portland State UNIVERSITY

Water Quality Research Group

Washington Department of Ecology

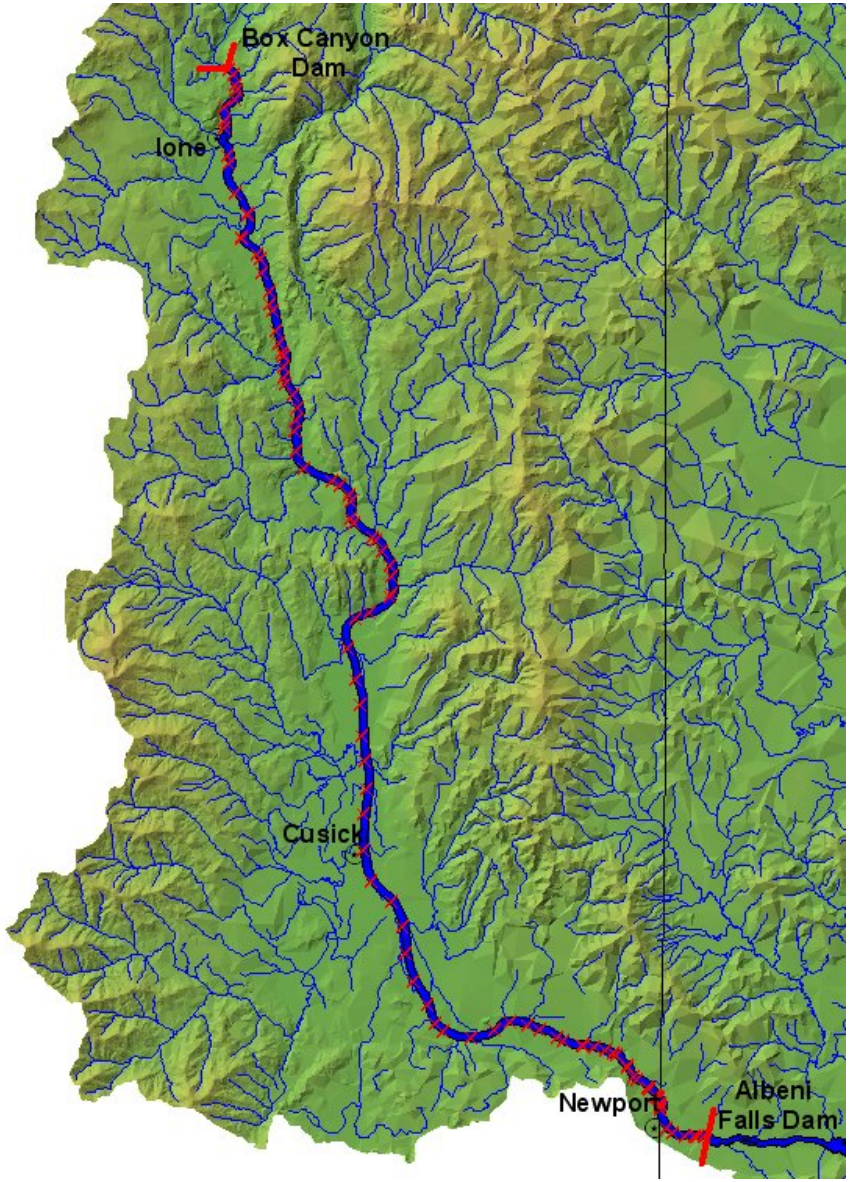
Pend Oreille Box Canyon Model

Simulation Periods
- 1997
- 1998
- 2004



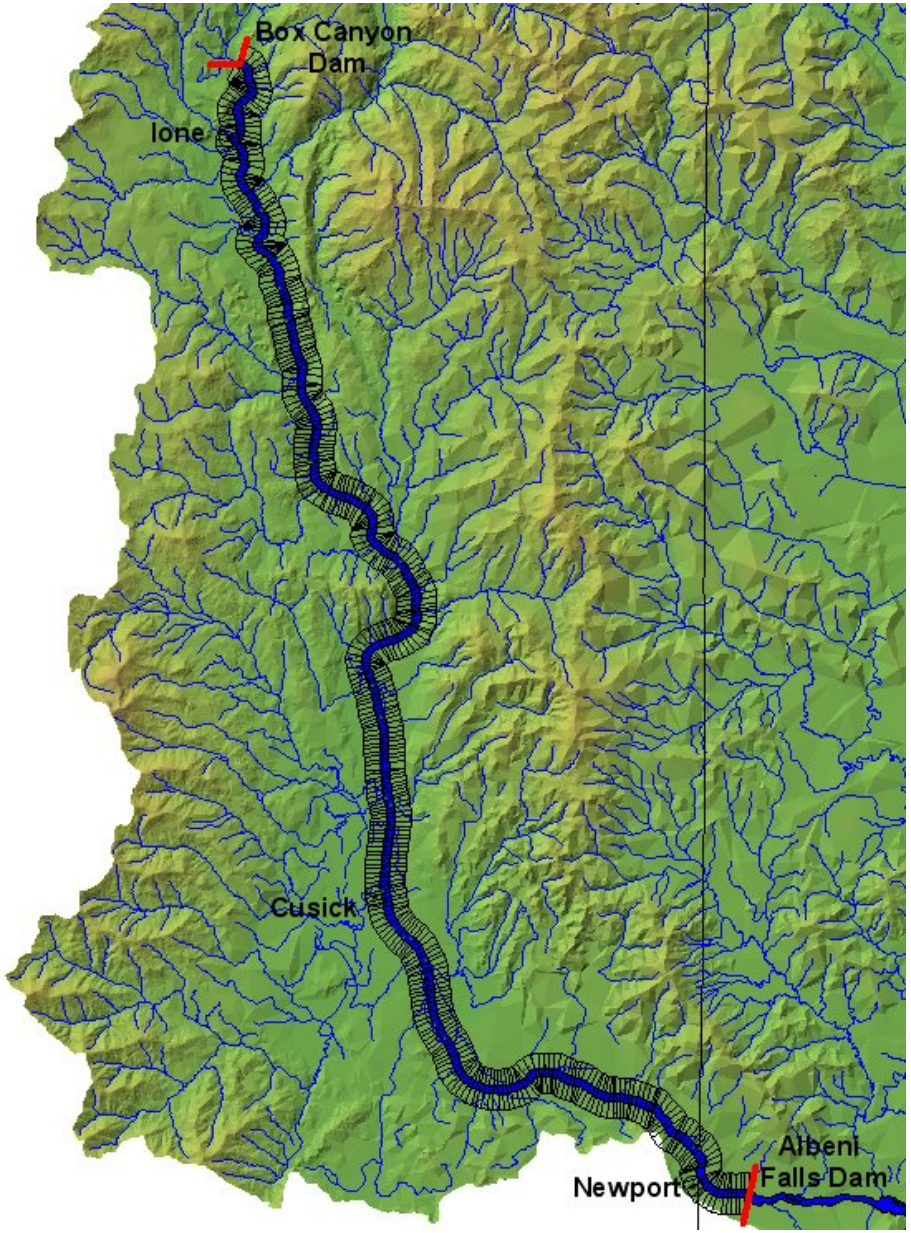
Model Bathymetry - Data

•Cross sections from Foster Wheeler Consulting, 1997 and 1998
•Digital elevation model (DEM) Geographic Information System (GIS)



Model Bathymetry

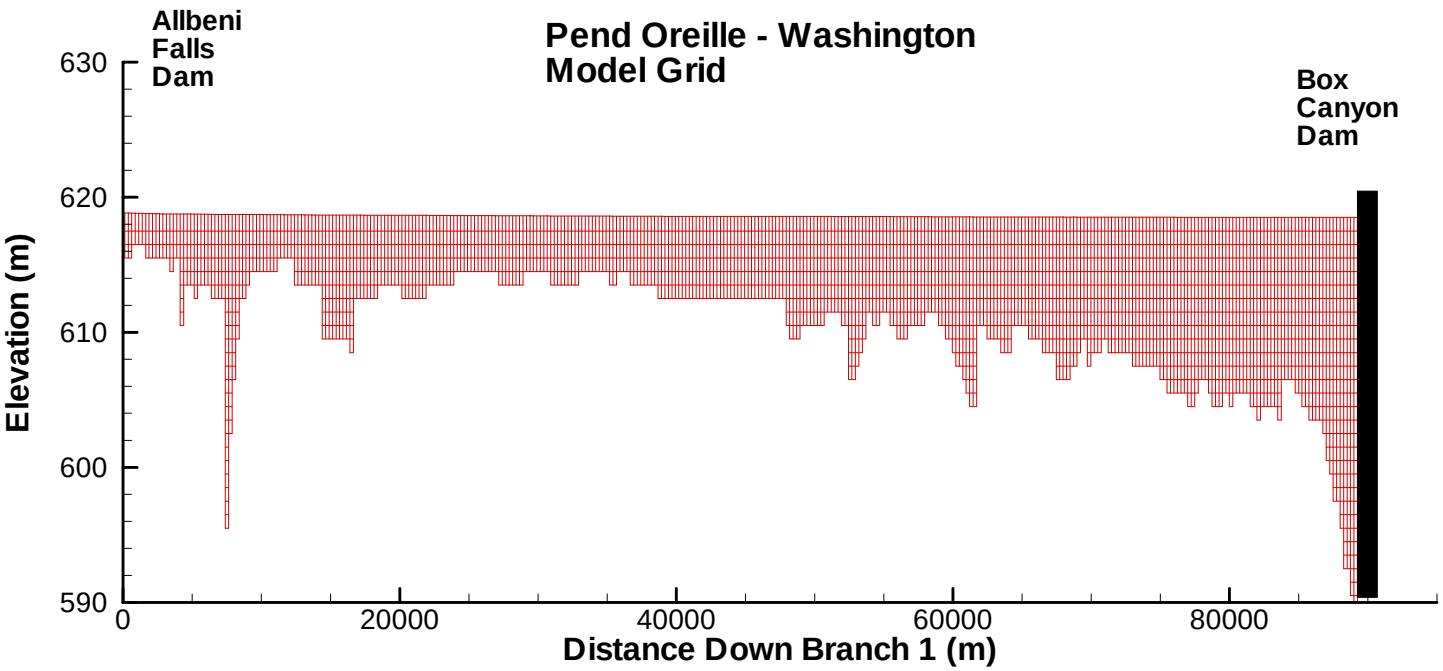
- 359 model segments
- Each 250 meters long



Model Bathymetry

1 meter thick layers

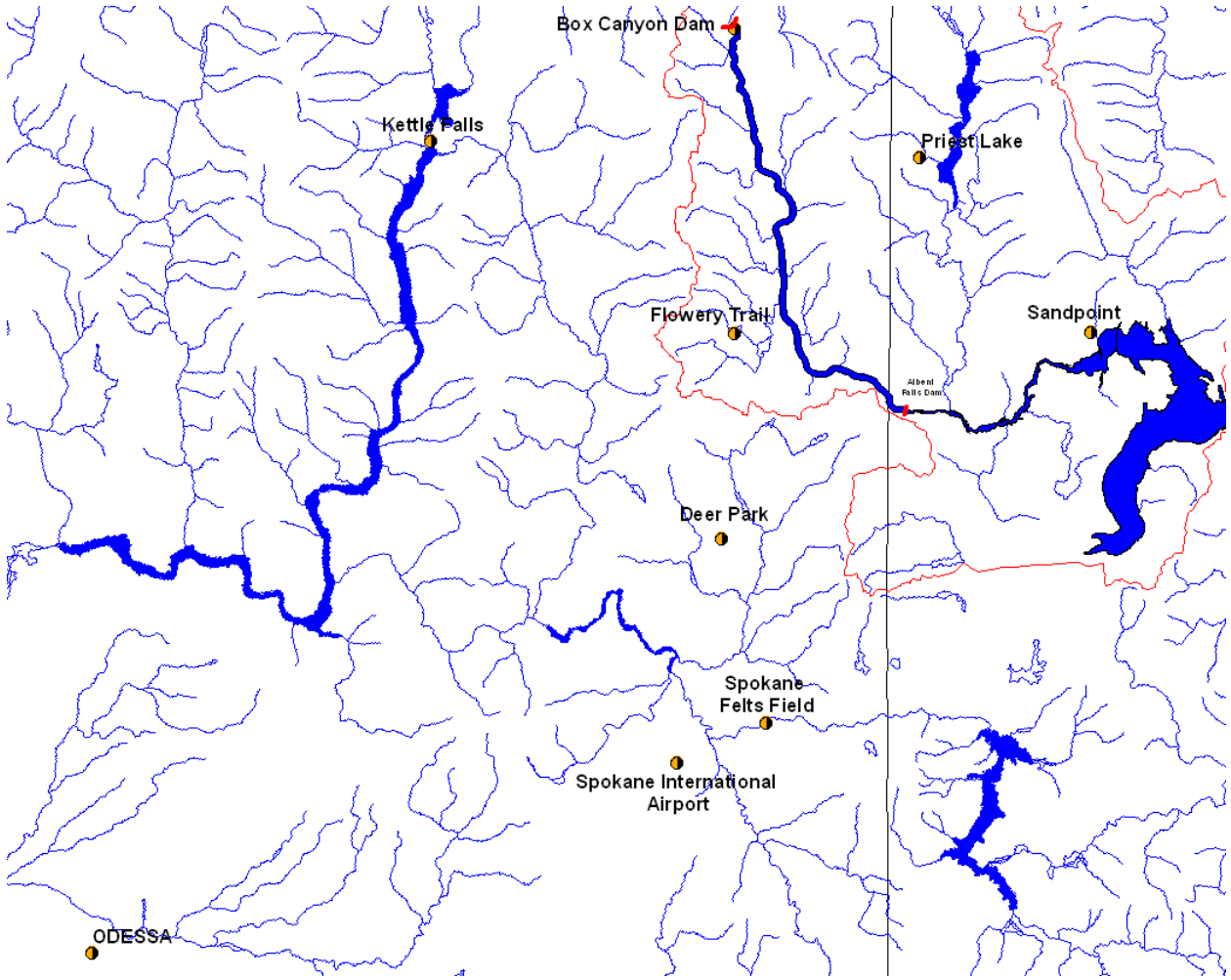
102 layers



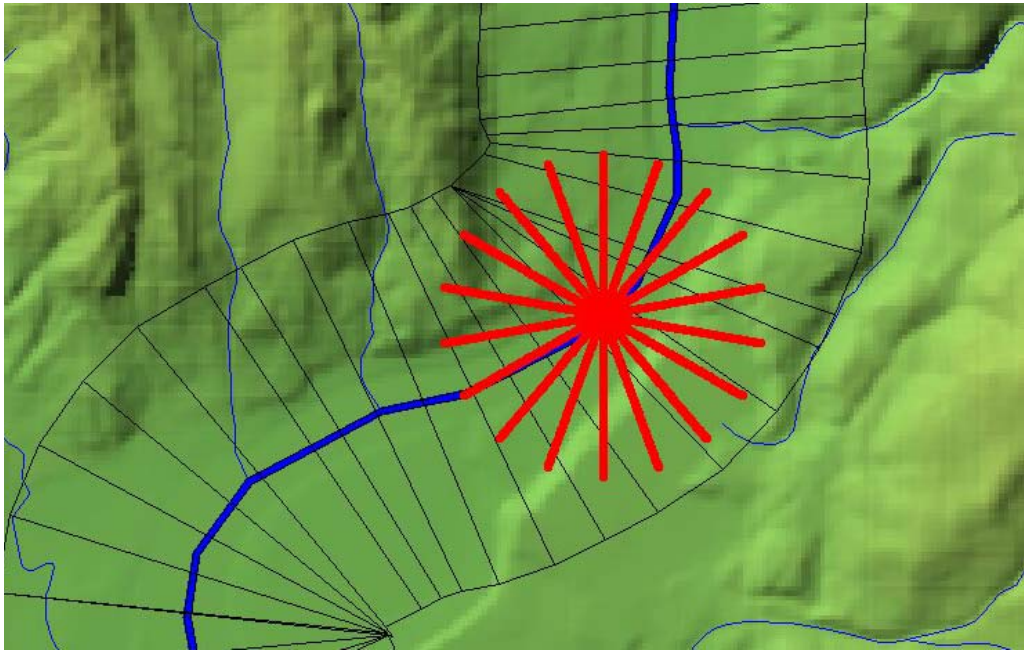
Meteorological Site Locations

Deer Park 2004

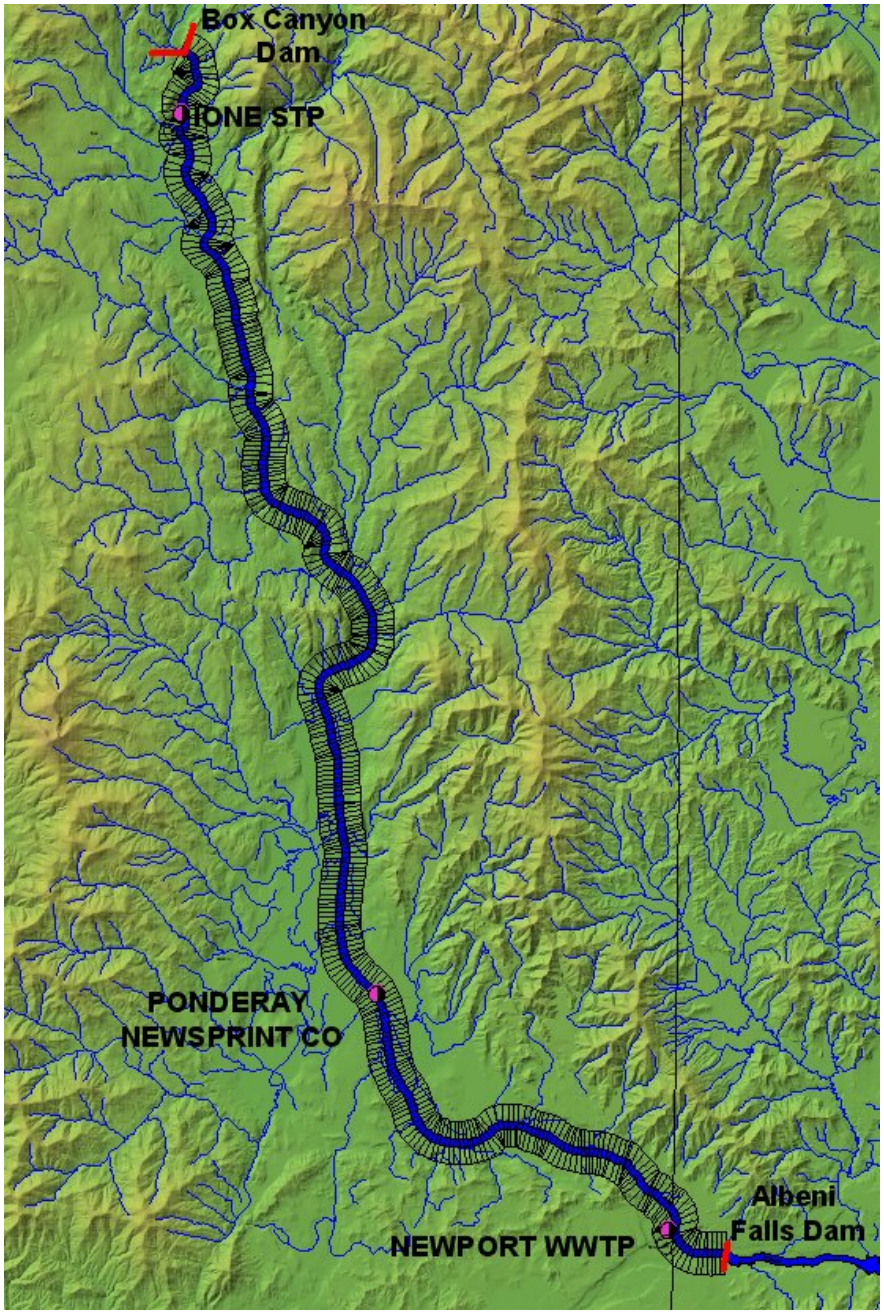
Flowery Trail
1997, 1998



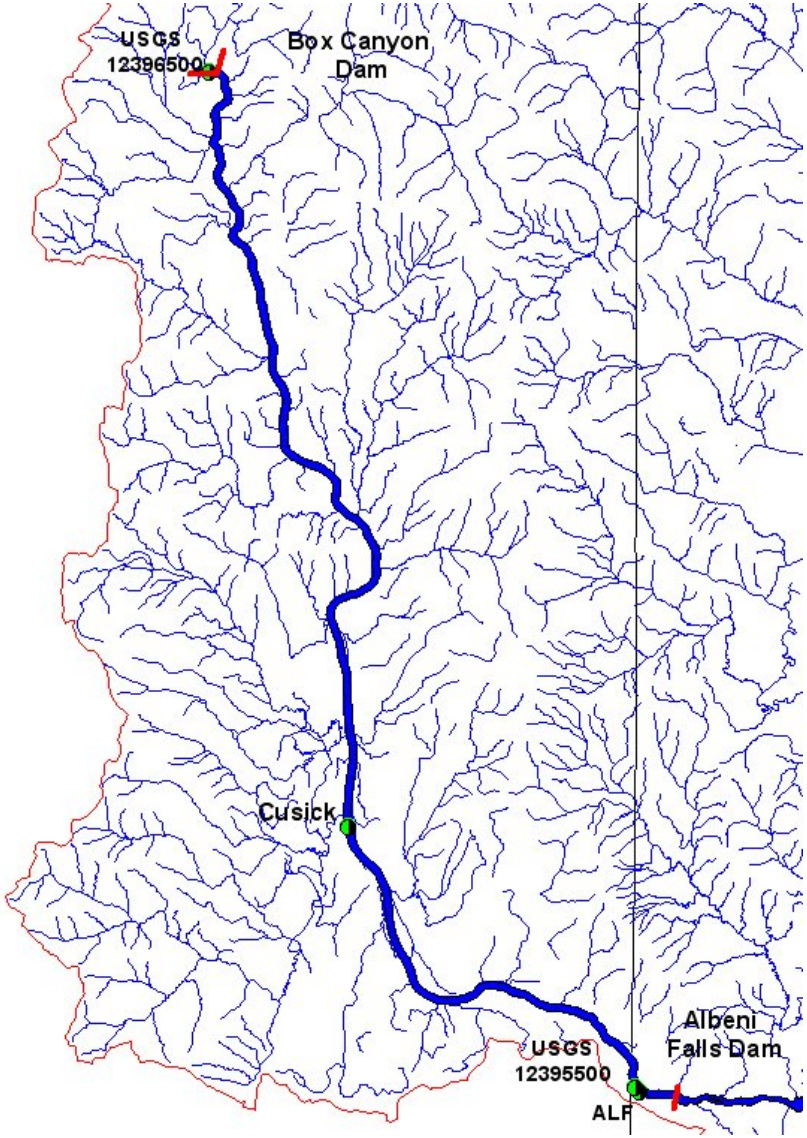
Dynamic Shading Algorithm

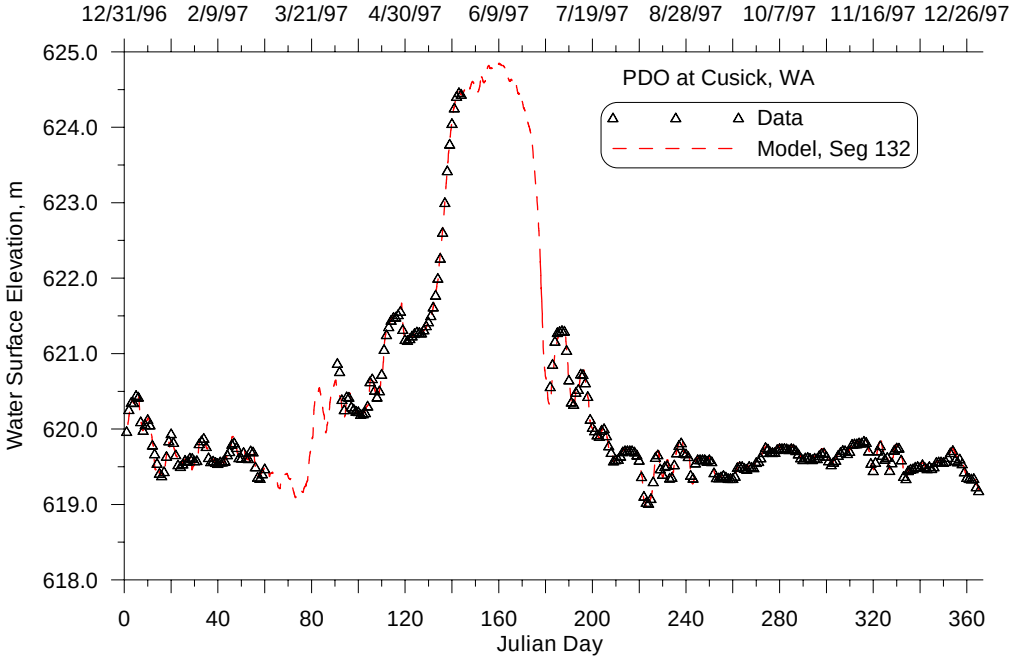


Tributaries



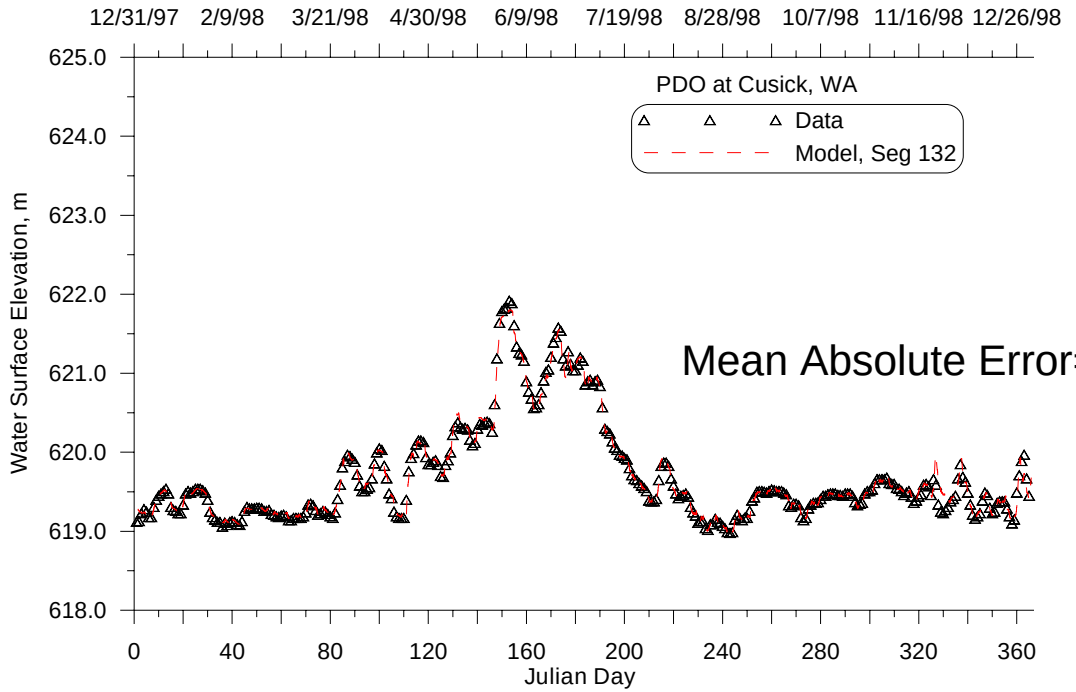
Water Level Calibration



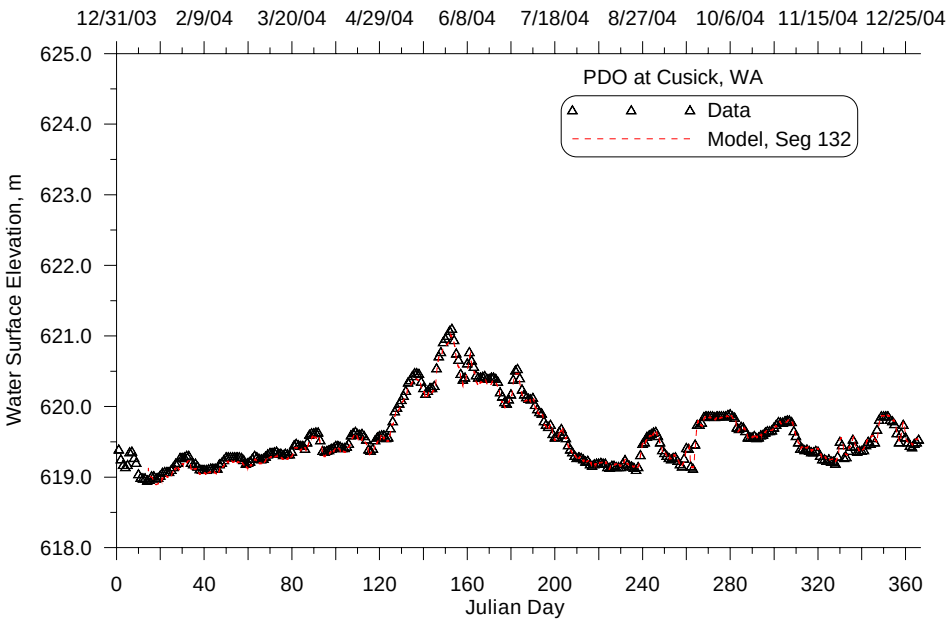


Mean Absolute Error=0.026 m

Water Level Calibration

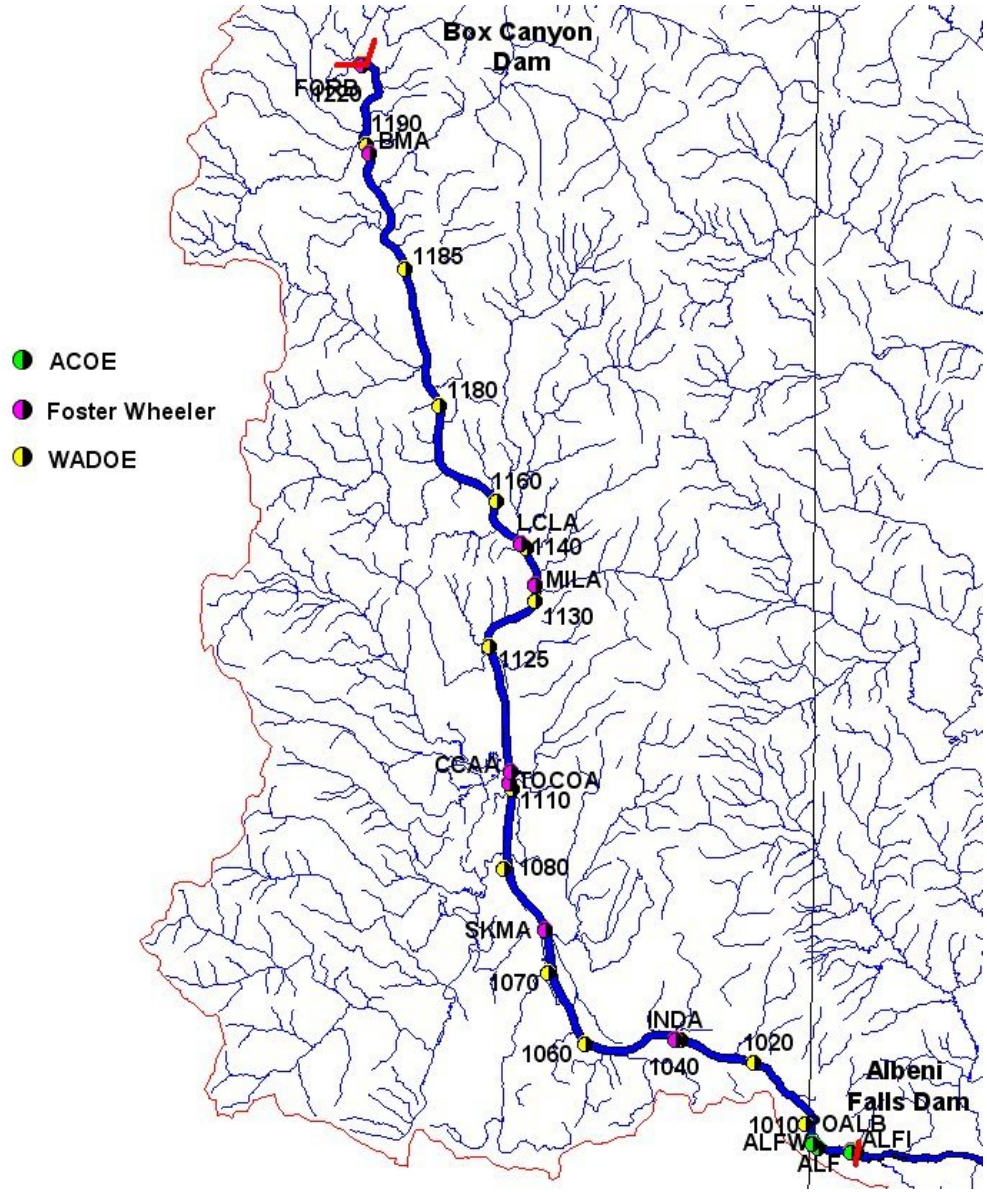


Mean Absolute Error=0.030 m

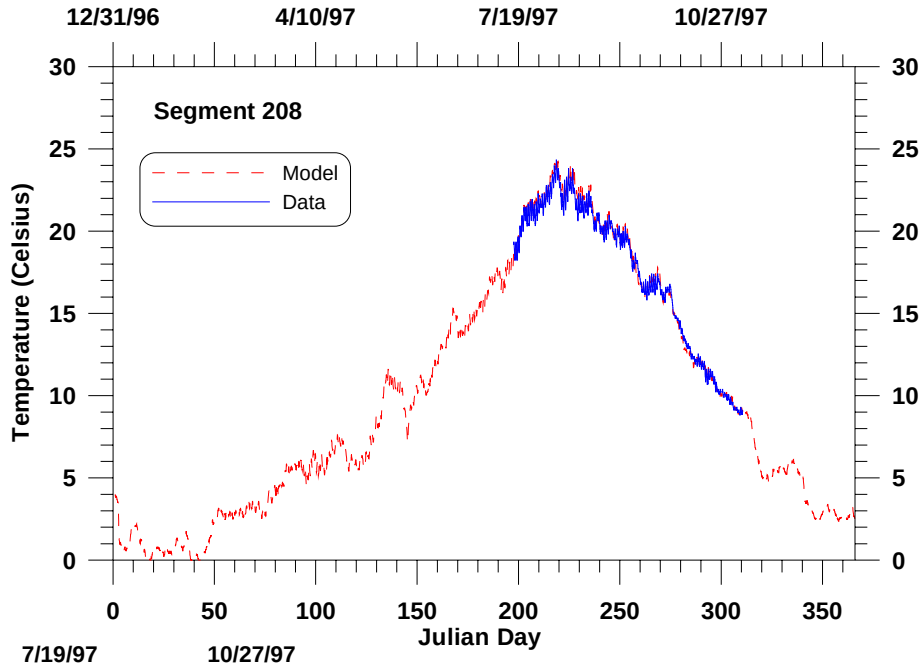


Mean Absolute Error=0.048 m

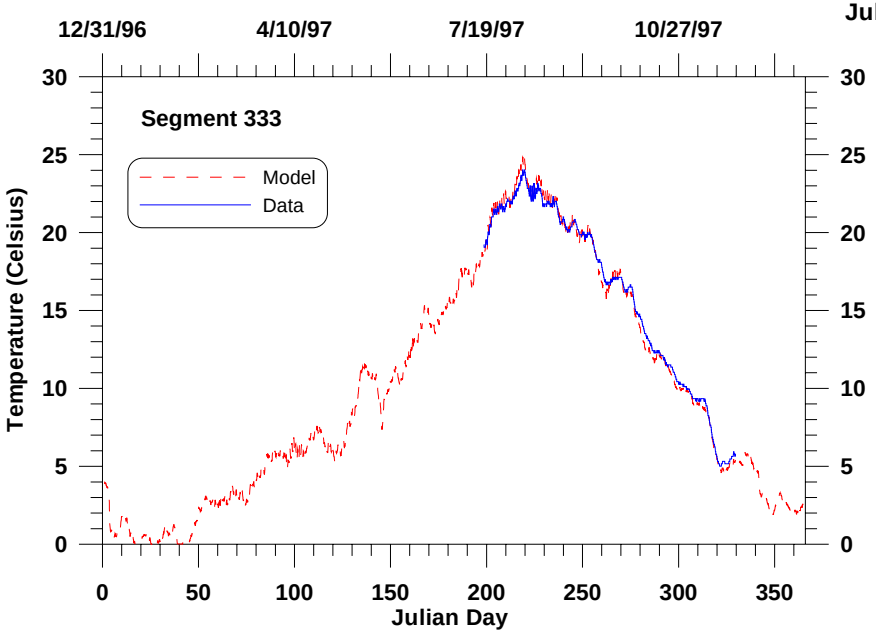
Temperature Calibration Sites



Temperature Calibration 1997



Site MILA

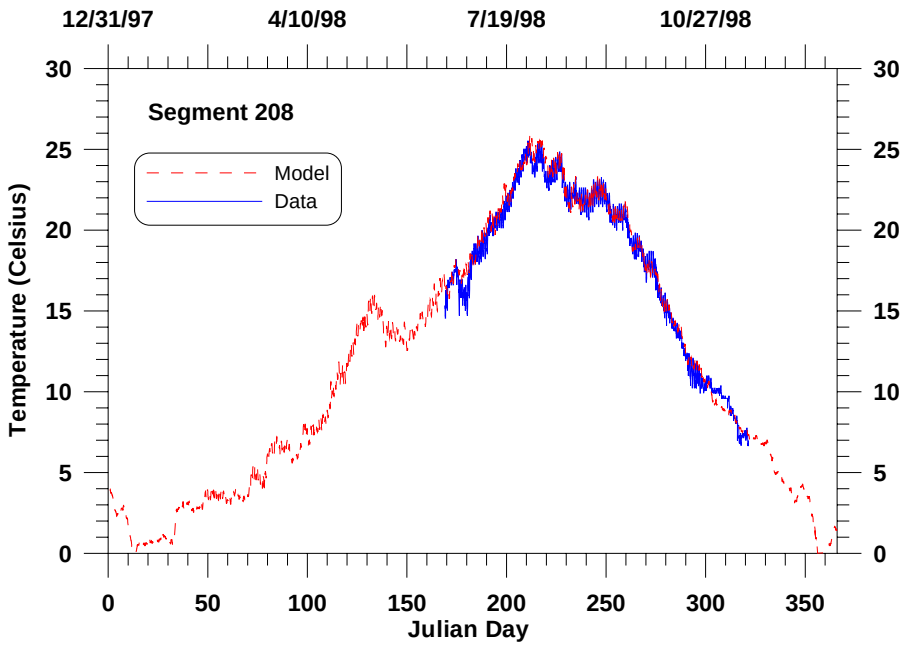


Site BMA

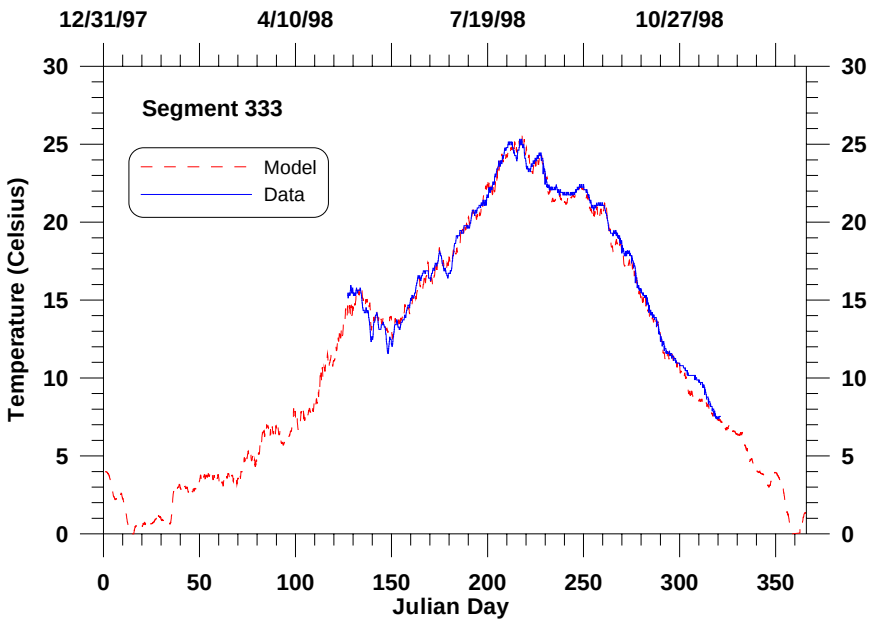
8 Sites Total

Mean Absolute Error = 0.25 degrees C

Temperature Calibration 1998



Site MILA

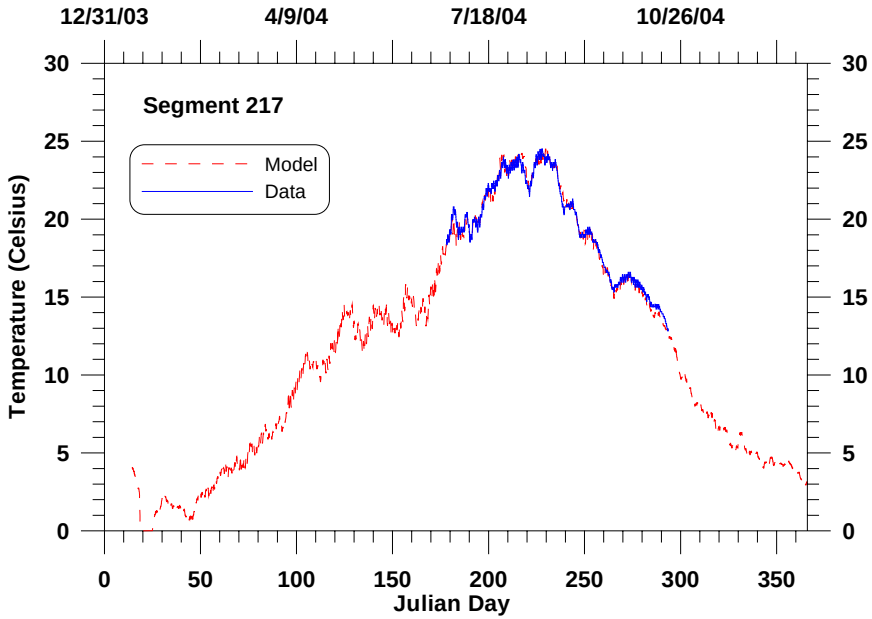


6 Sites Total

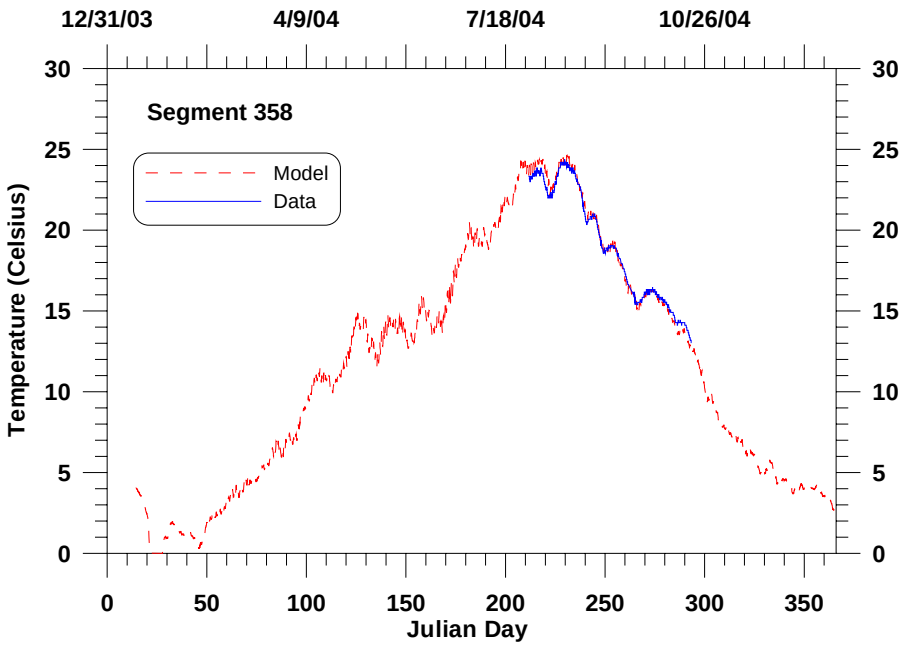
Site BMA

Mean Absolute Error = 0.46 degrees C

Temperature Calibration 2004



Site 1140



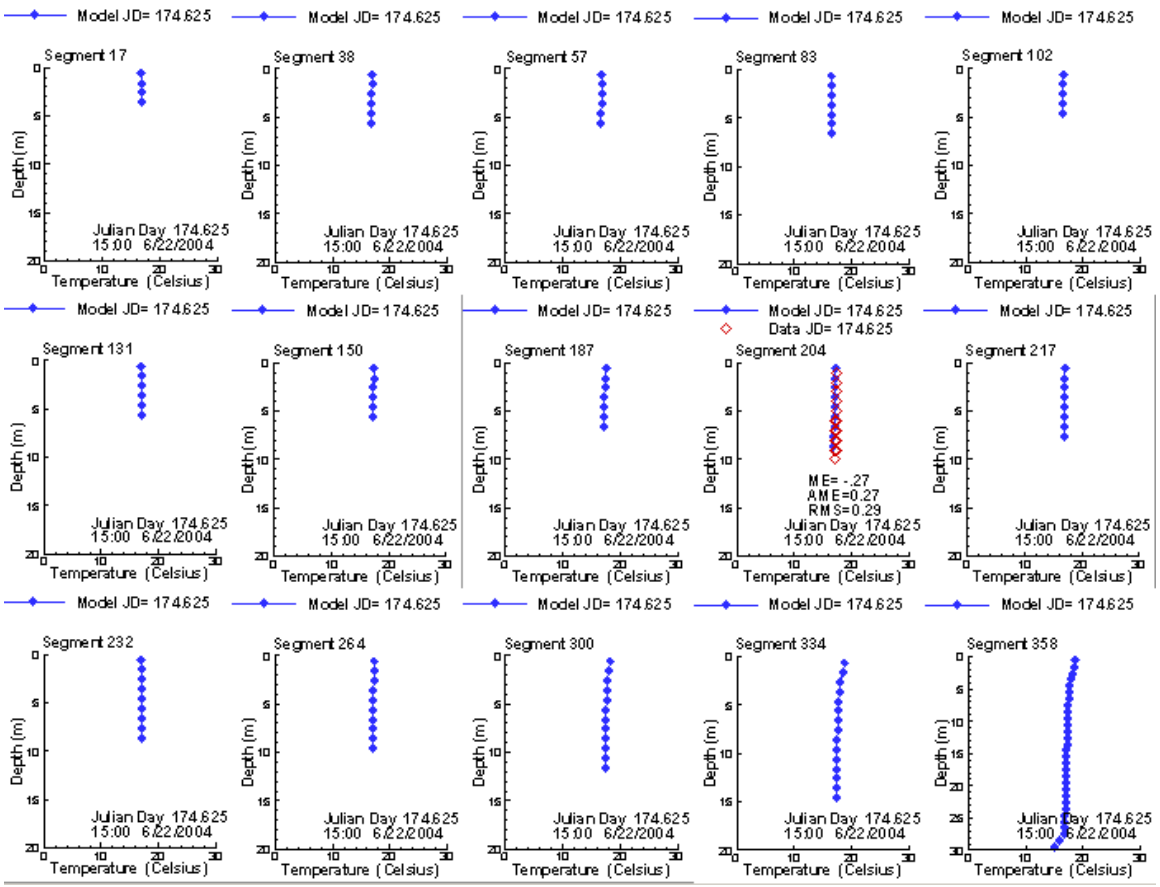
Site 1220

12 Sites Total

Mean Absolute Error = 0.27 degrees C

Temperature Calibration 2004

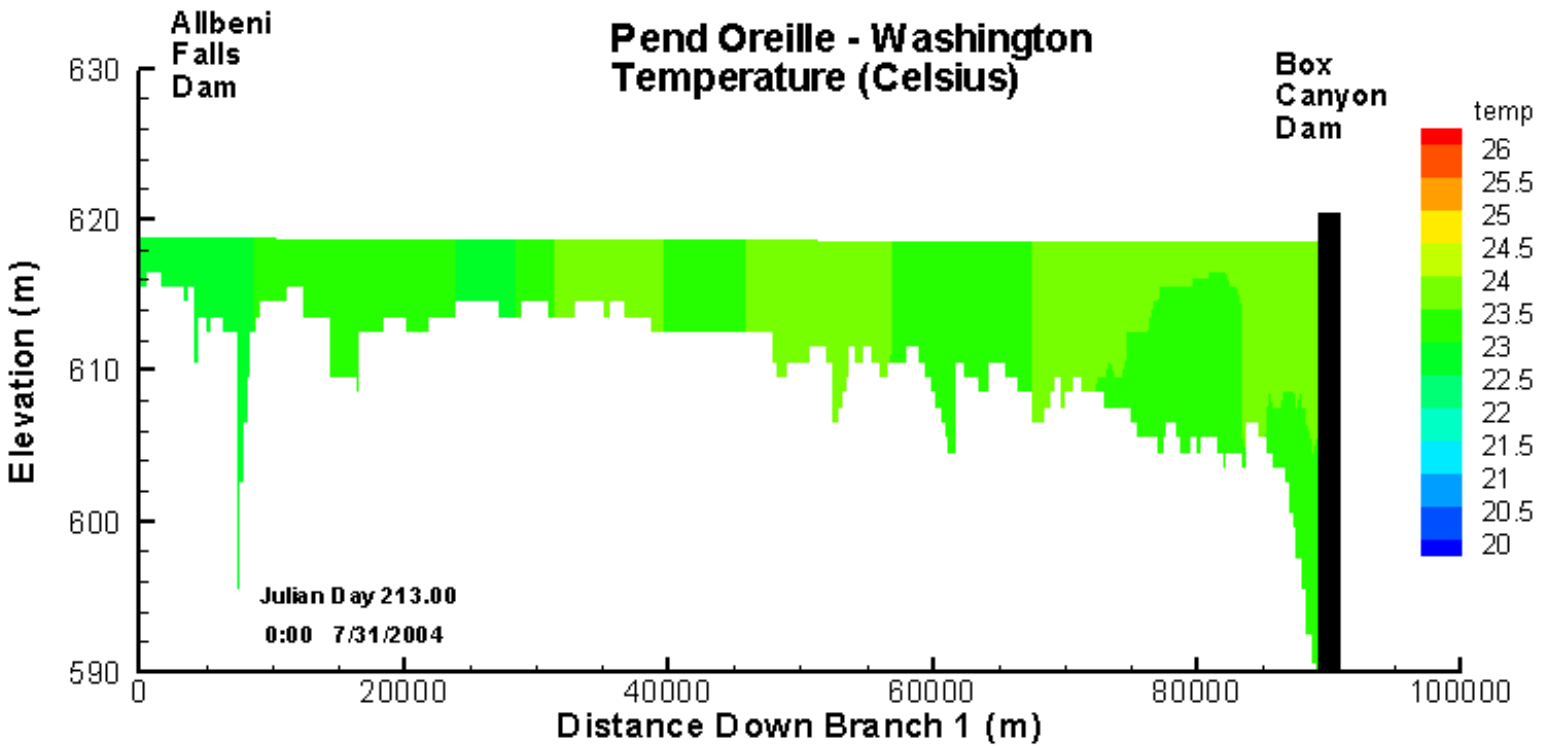
Vertical Profiles



13 Sites Total

Mean Absolute Error = 0.24 degrees C

Temperature Animation



Summary

- Pend Oreille Box Canyon Model has been developed and is well calibrated relative to other temperature models