Temperature Modeling

Available Models and Ability to Estimate Change

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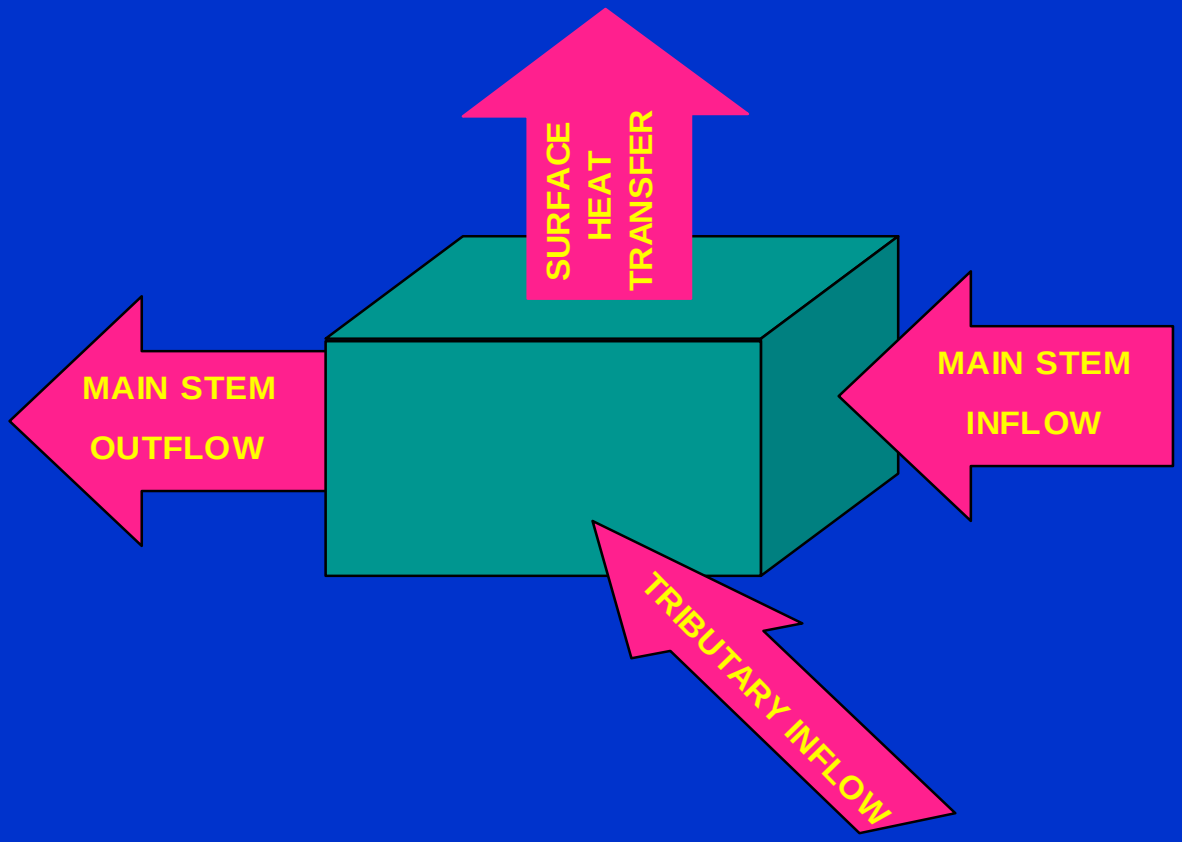
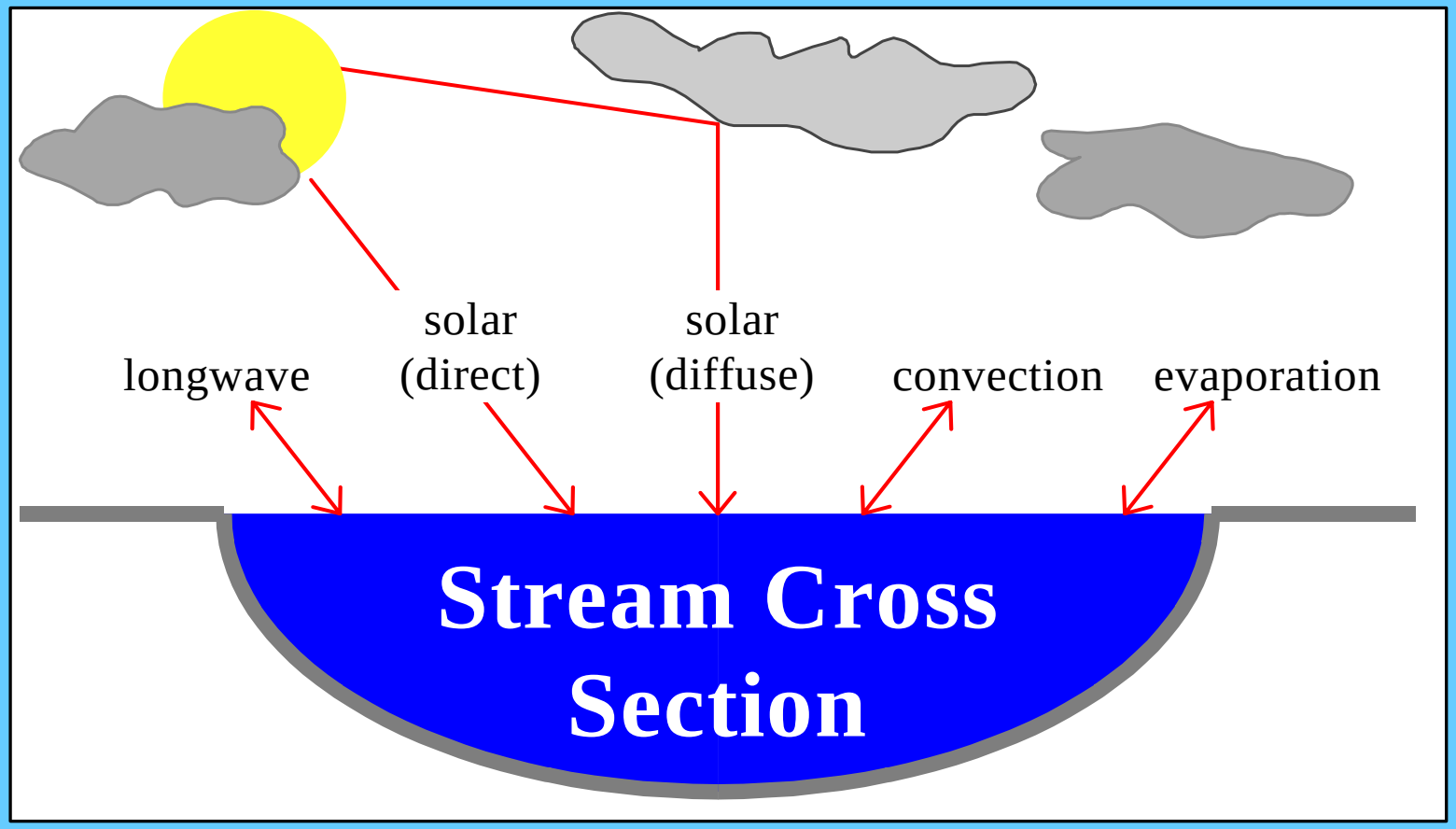
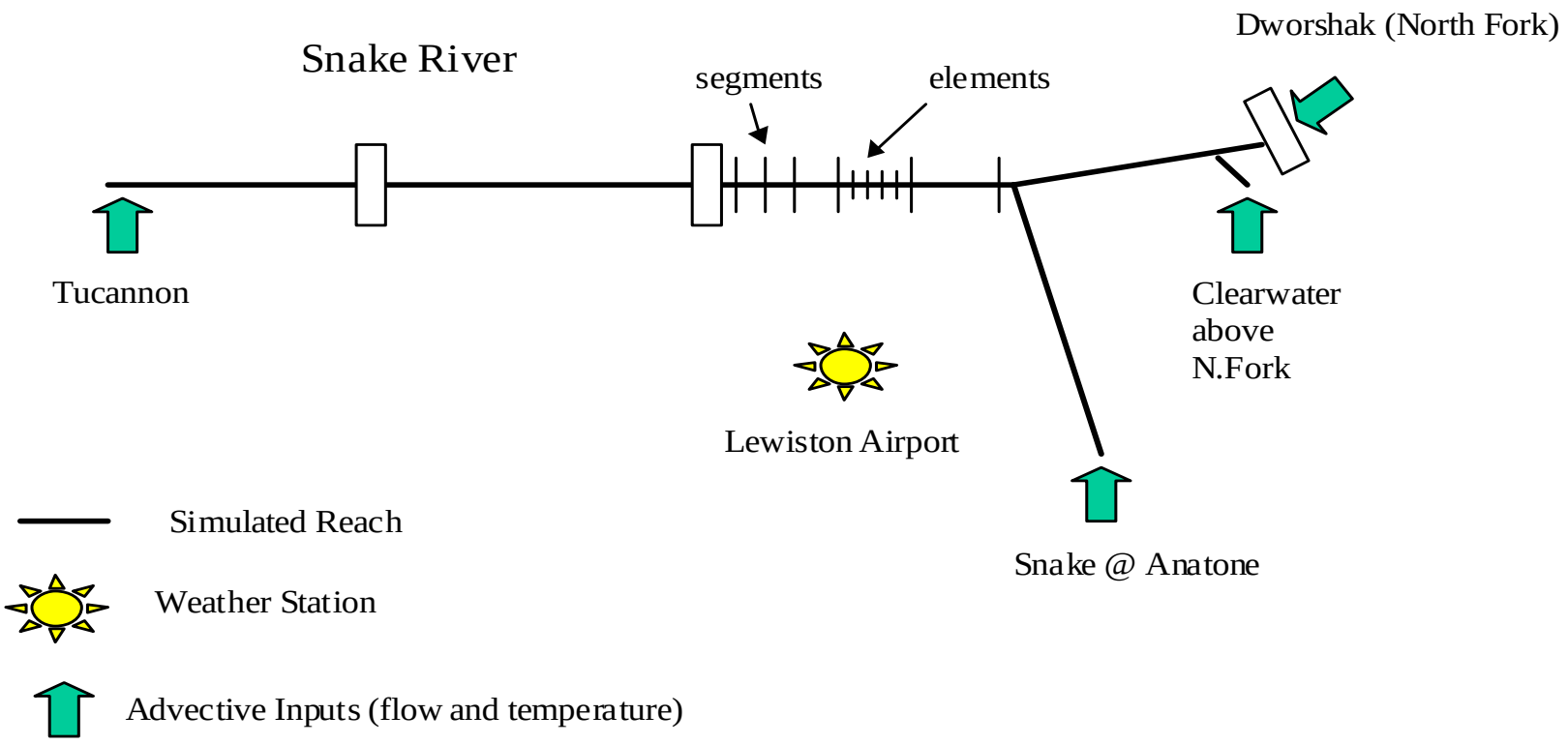
ONE-DIMENSIONAL ENERGY BUDGET MODEL



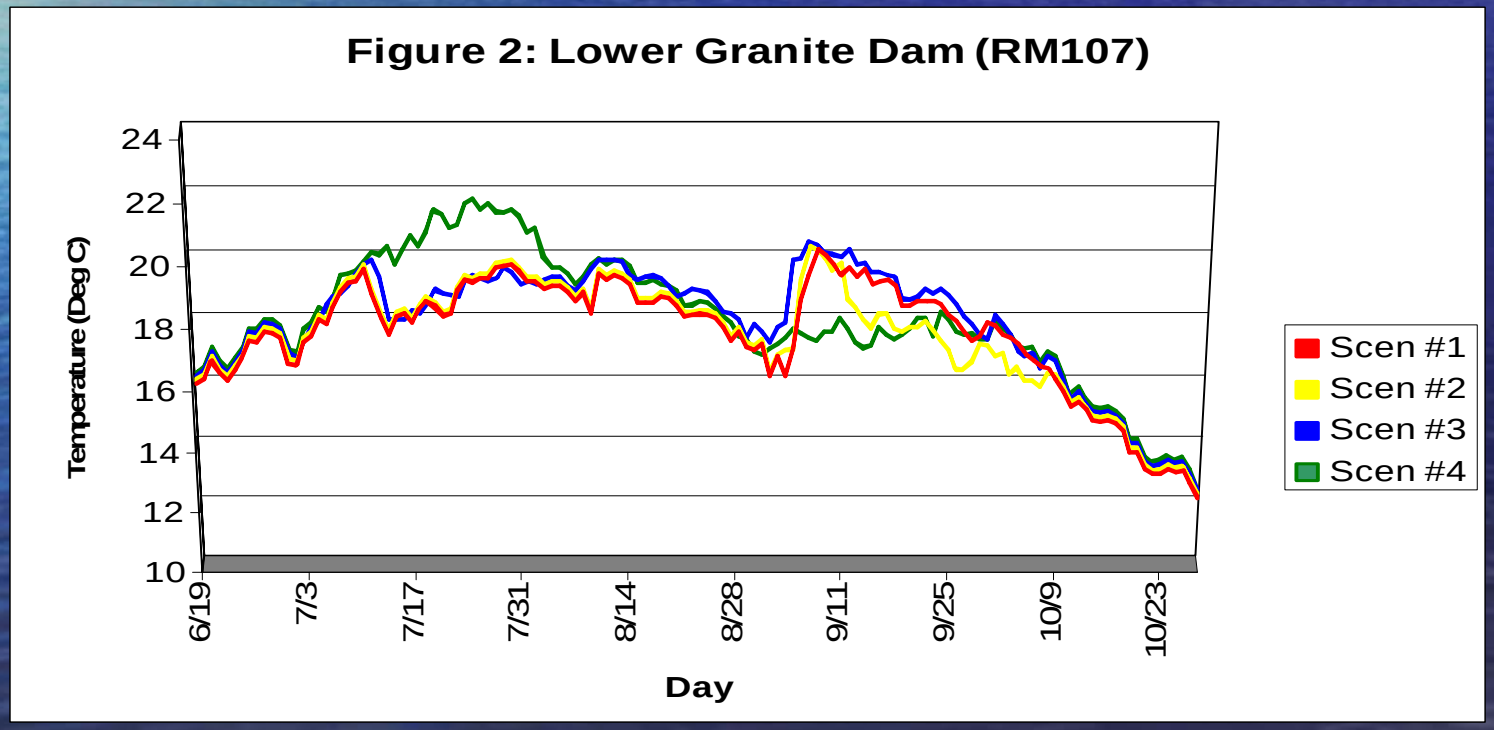

solar
(direct)
solar
(diffuse)
longwave
convection
evaporation
Stream Cross
Section

Boundaries and Topology



1-Dimensional Temperature Models

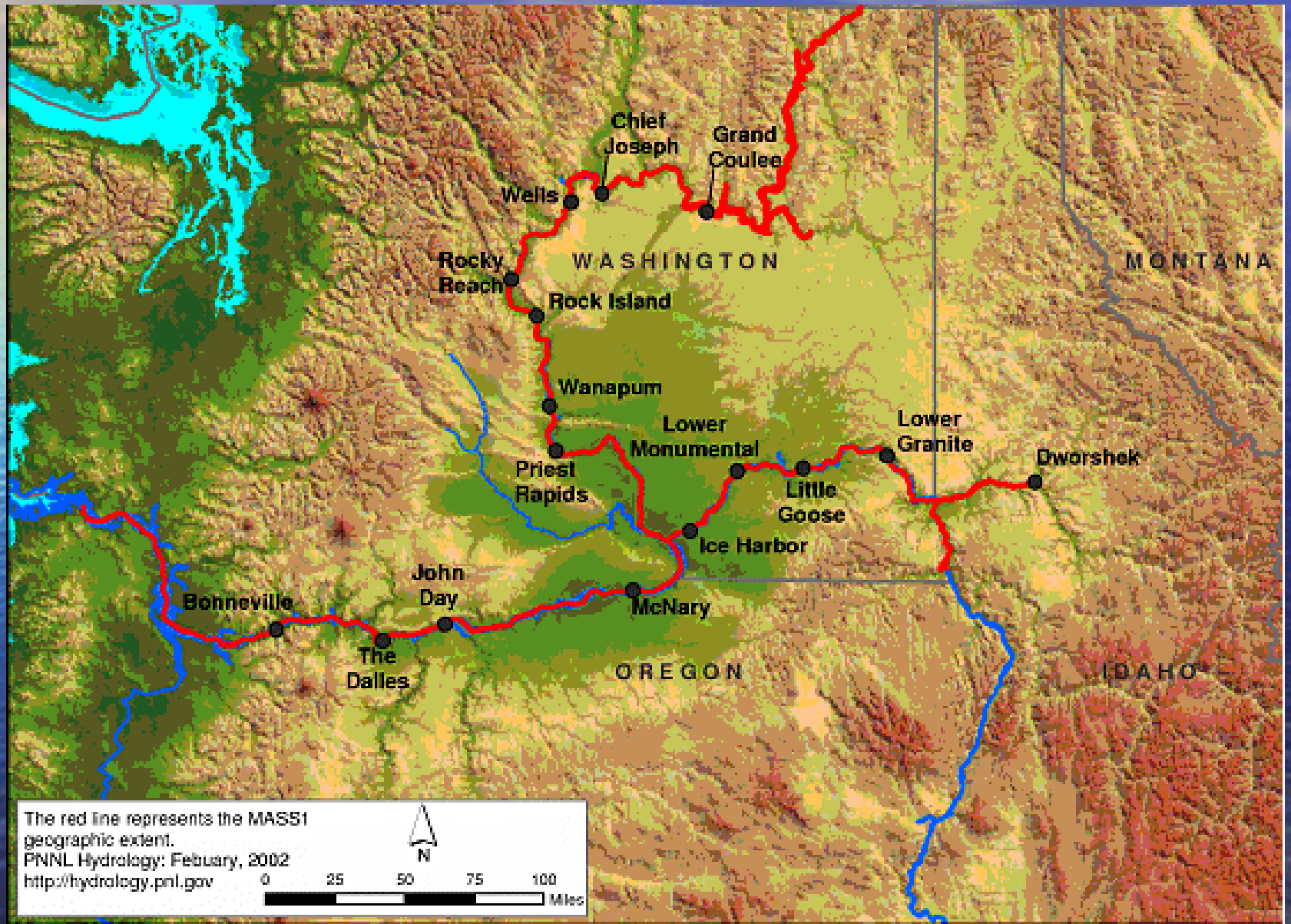
- 1-D Models provide cross-sectional average temperature estimates



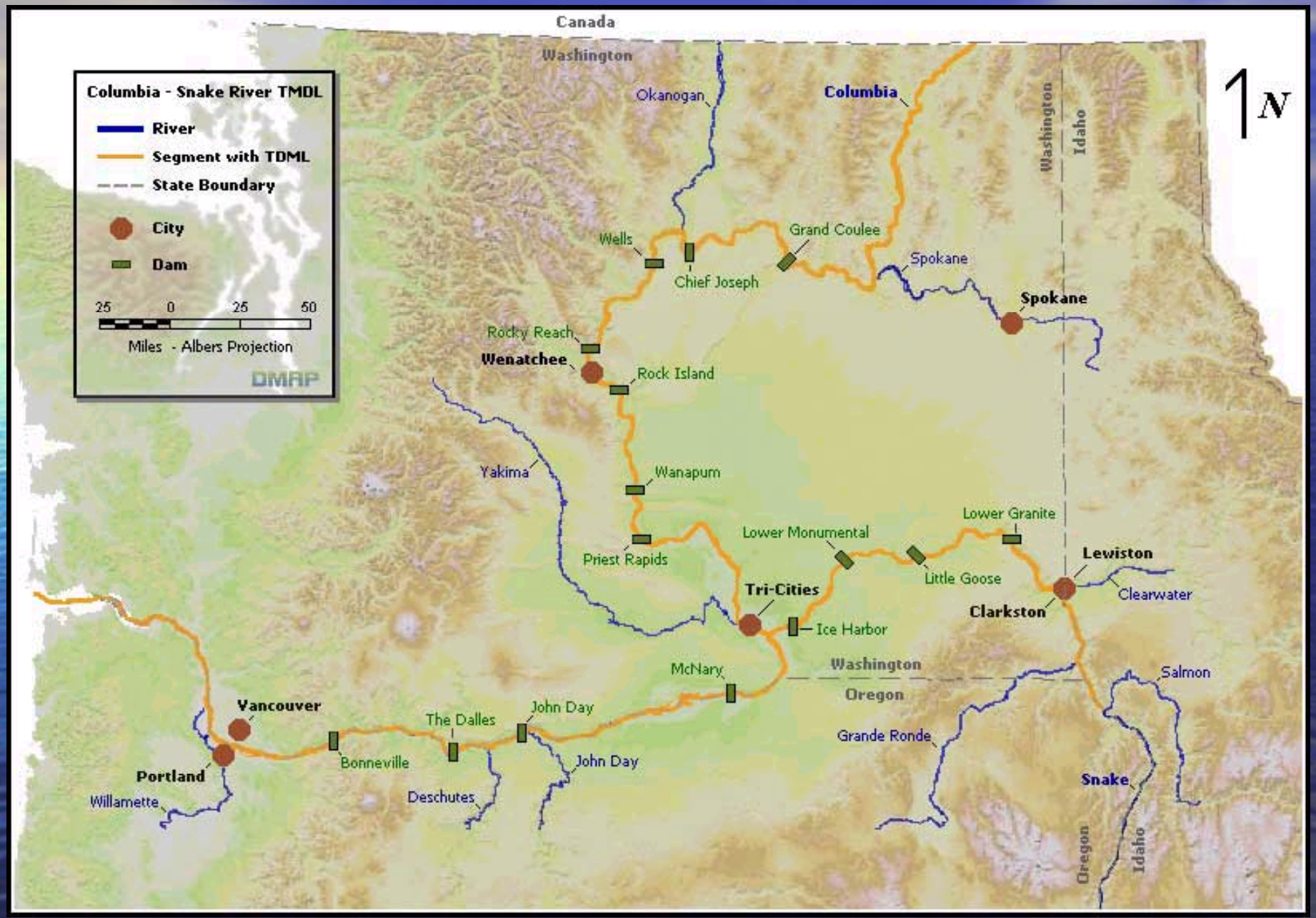
1-Dimensional Temperature Models

- Models used for the Columbia R. studies
  - MASS1 (Battelle)
  - RBM10 (EPA)

MASS1 Domain



RBM10 Domain

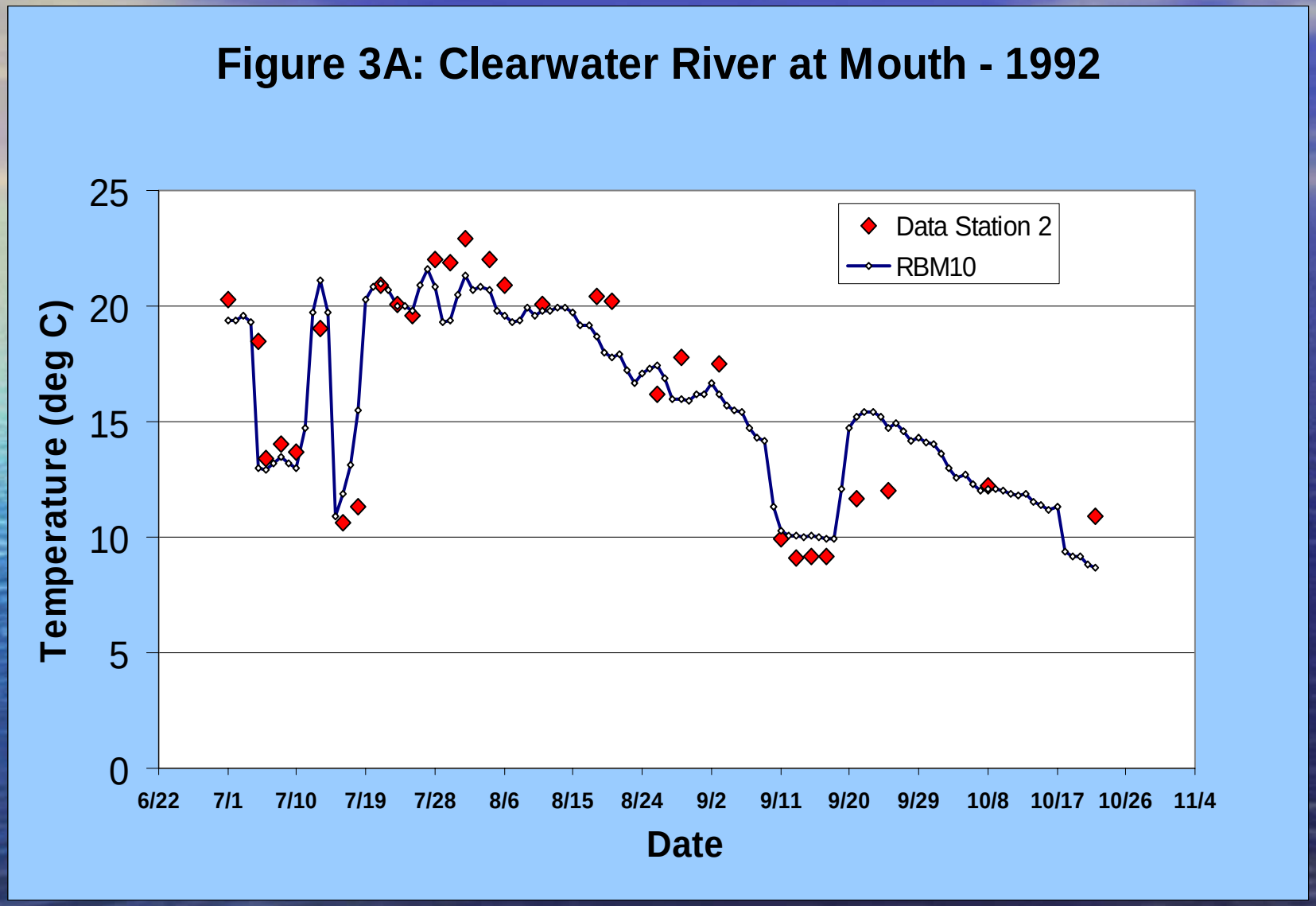


How to estimate incremental impacts

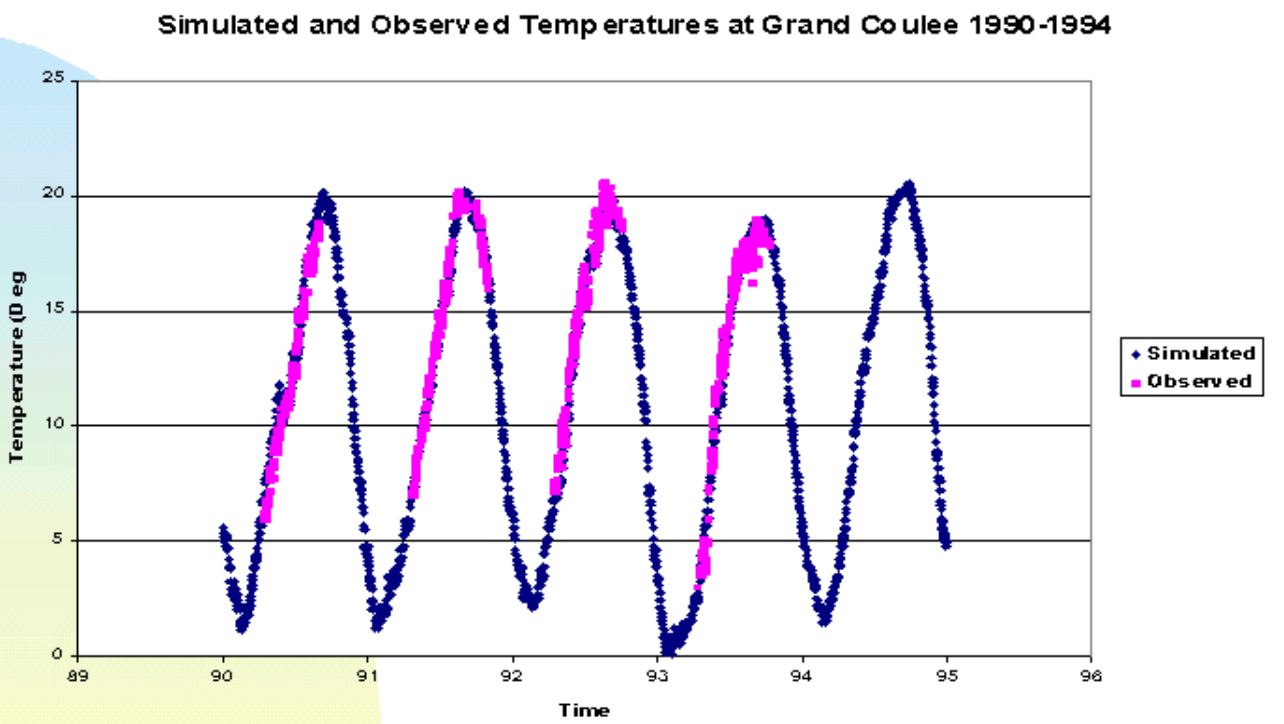
- Model is run on existing conditions of selected year(s)
  - Outputs compared to measurements
  - Achieve model acceptance

- Change one boundary condition – inflows
  - All other model parameters and weather unchanged
  - Compare model outputs of current and projected conditions
  - Compute statistics of interest (e.g., avg mean difference, min/max difference, etc.)

Test of Model Capability to predict effects of boundary conditions on downstream temperatures



Test of Model Capability to Predict Temperatures below Reservoirs



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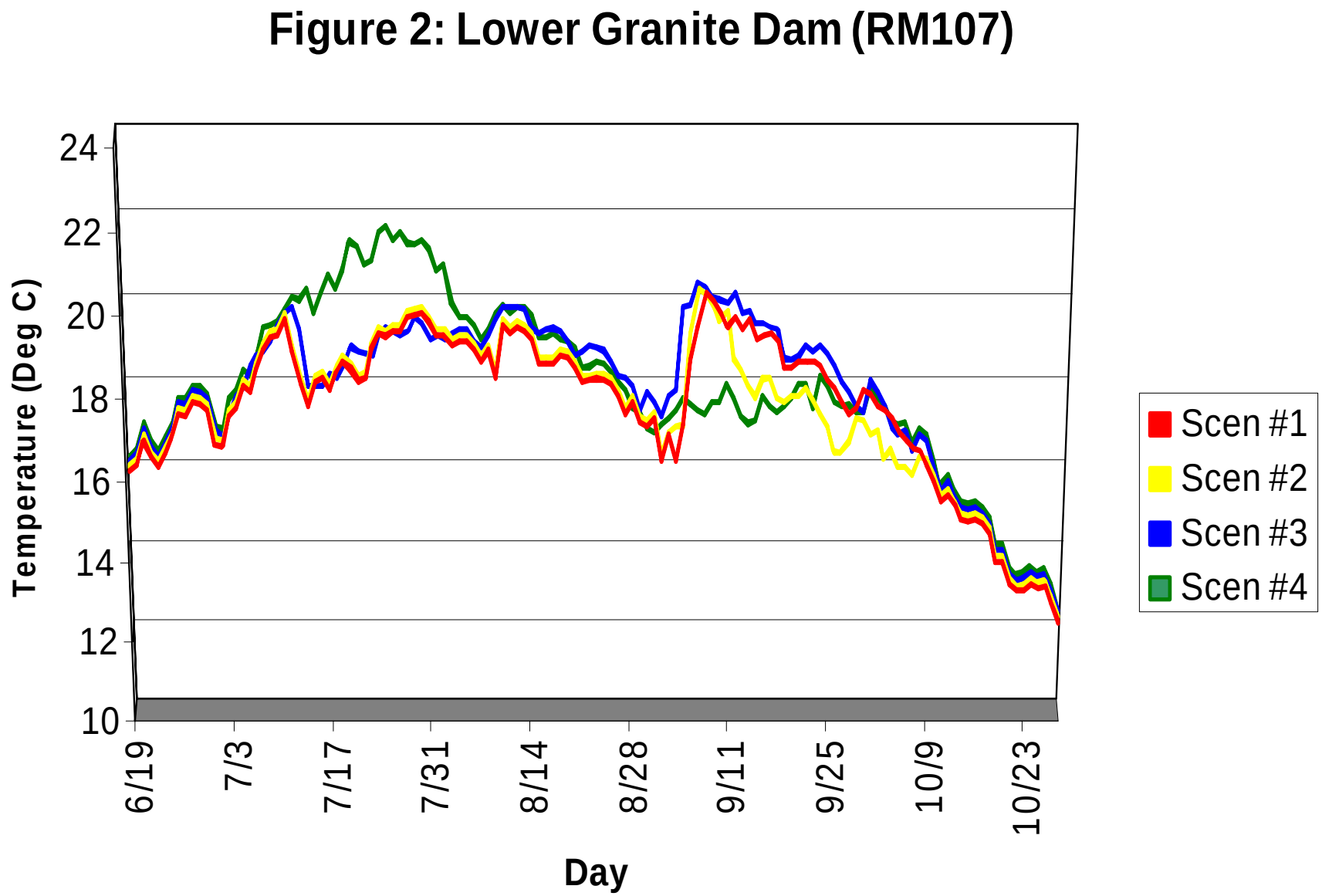
Error Estimates for Existing Columbia River Models

- **RBM10 (EPA, 2002)**
  Mean Difference = 0.04 Deg C
  Standard Deviation = 1.3 Deg C

- **MASS1 (Battelle, 2001)**
  RMS Error = 0.59 - 1.52 Deg C

Example of "What If" Scenarios Based on Changes to Boundary Flows Approximately 75 Miles Upstream



Will an action affect river temperature?

Building an answer to the question

Effort

Extend RBM10 or MASS1 upstream to incorporate entire system, test it, and examine effects

Screening level estimate

Use RBM10 or MASS1 to examine changes in WA domain

Ask a handful of experts-

What is likelihood that action will result in significant change?

Biologists define a significant temperature change