

# Improving Stream Temperature Predictions for River Water Decision Support Systems

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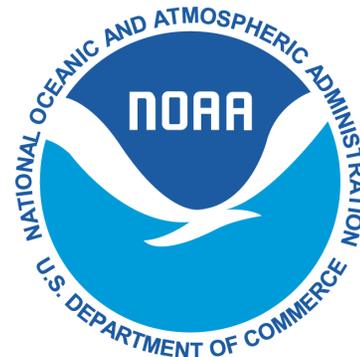
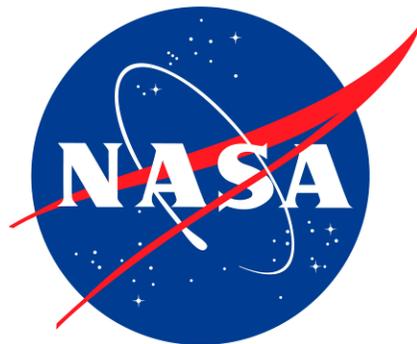
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# Background

Salmon populations in the California Central Valley are in significant decline

- *Listed under the Endangered Species Act*
- *Entire California fishery closed in 2008, 2009, partial closure in 2010*

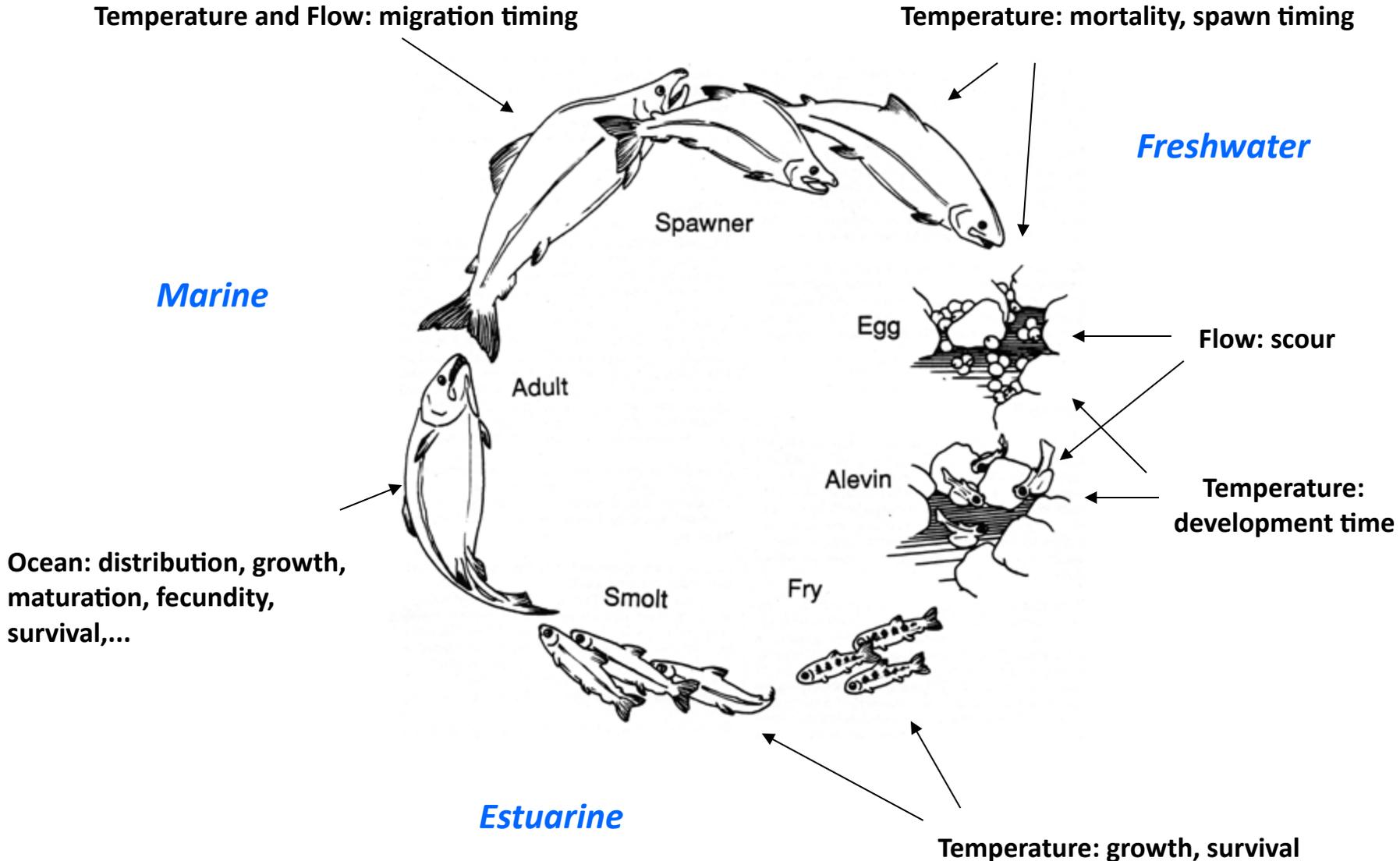
Many factors involved...

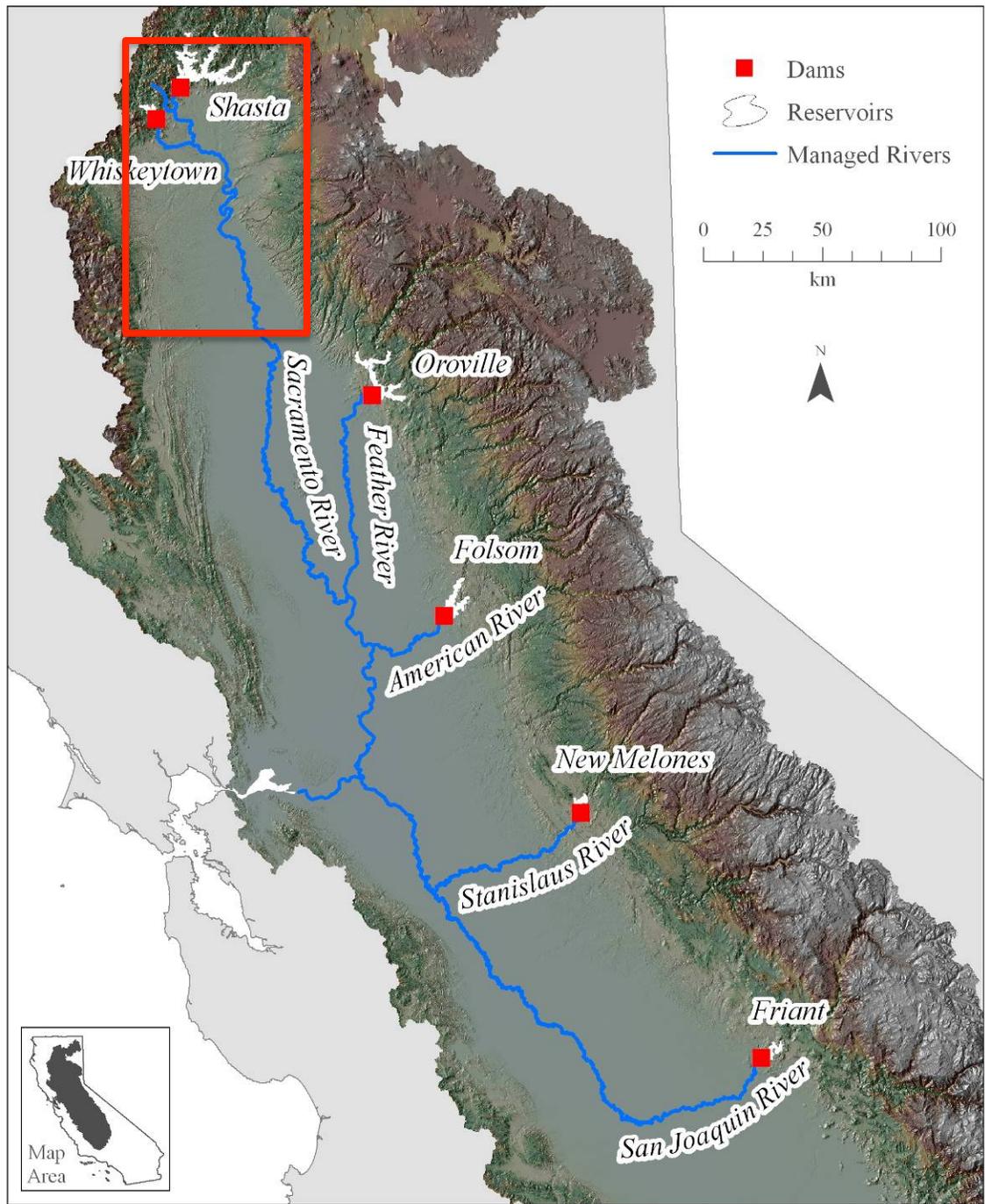
- *Loss of freshwater habitat*
- *Optimal water temperature and flow in remaining habitat*

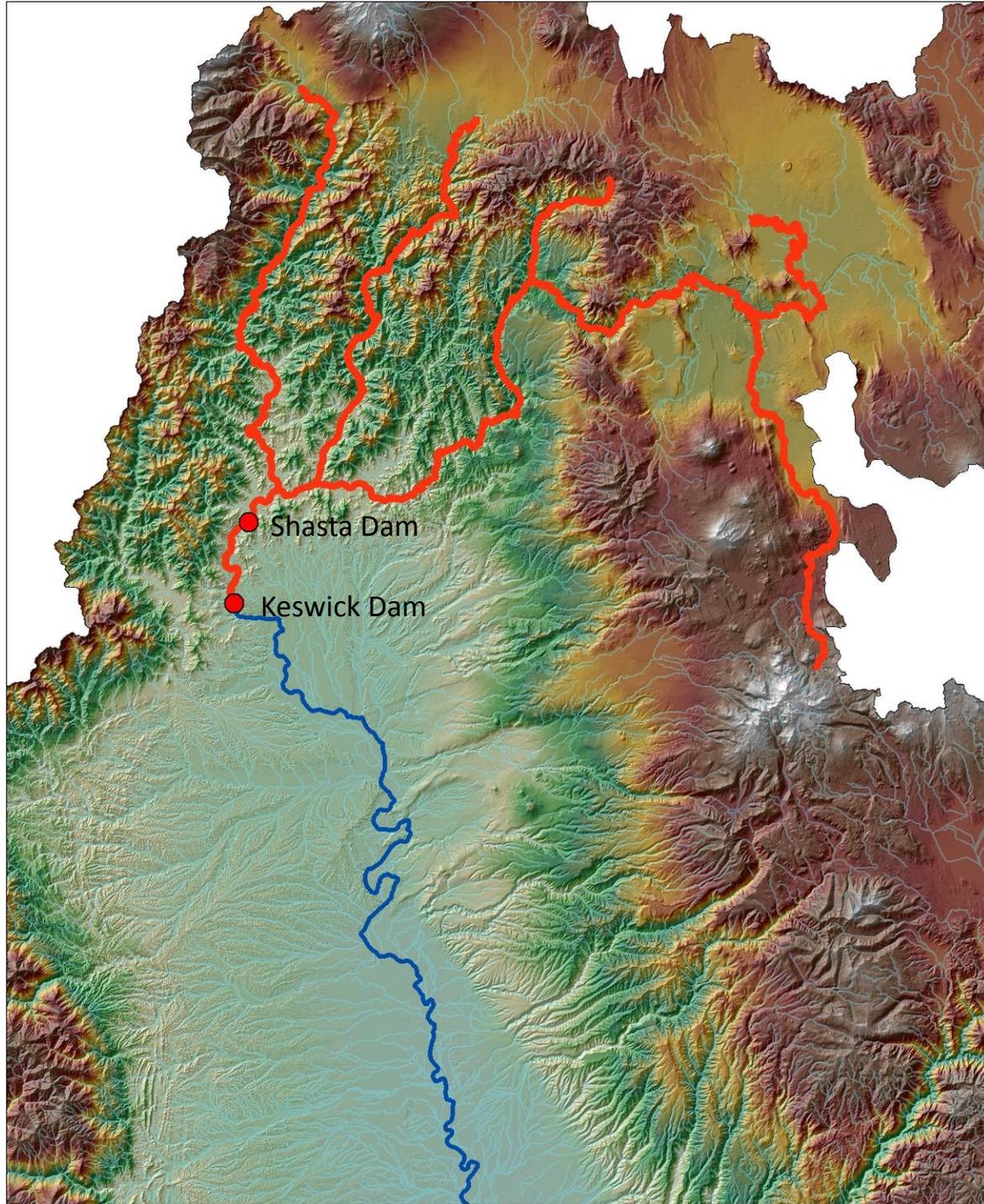
Our goal: improve existing Decision Support System (DSS) for water allocation

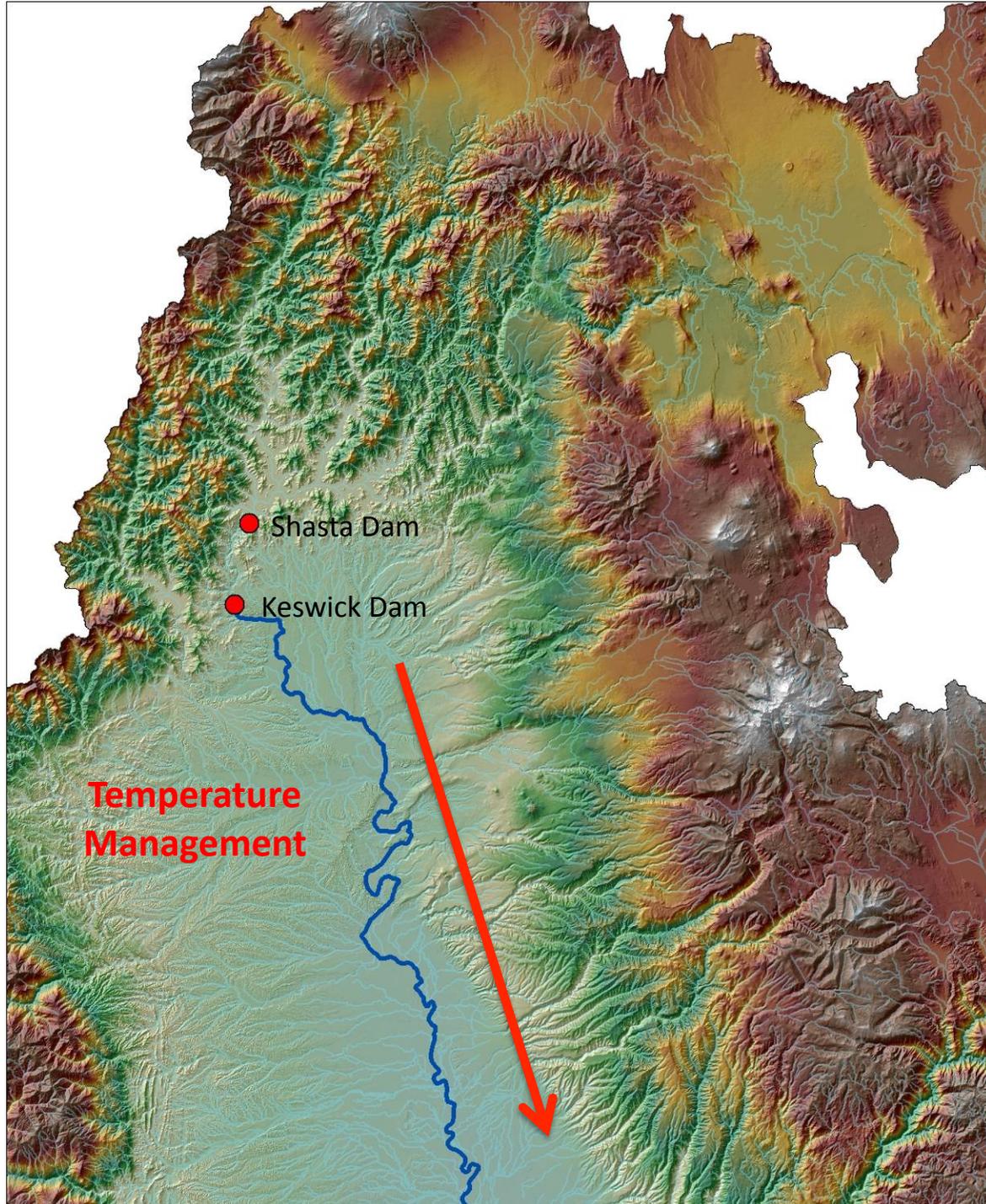
Make the model results readily available to the fisheries and water managers

# Salmon Life Cycle









● Shasta Dam

● Keswick Dam

**Temperature  
Management**

# Project goals

Better water temperature models

- *Temporal and spatial scales for salmon habitat management*
- *Forecasts*

Salmon growth models

- *Acute temperature levels*
- *Egg development time (emergence time)*
- *Juvenile growth*
- *Spawning adult timing and health*

Satellite data?

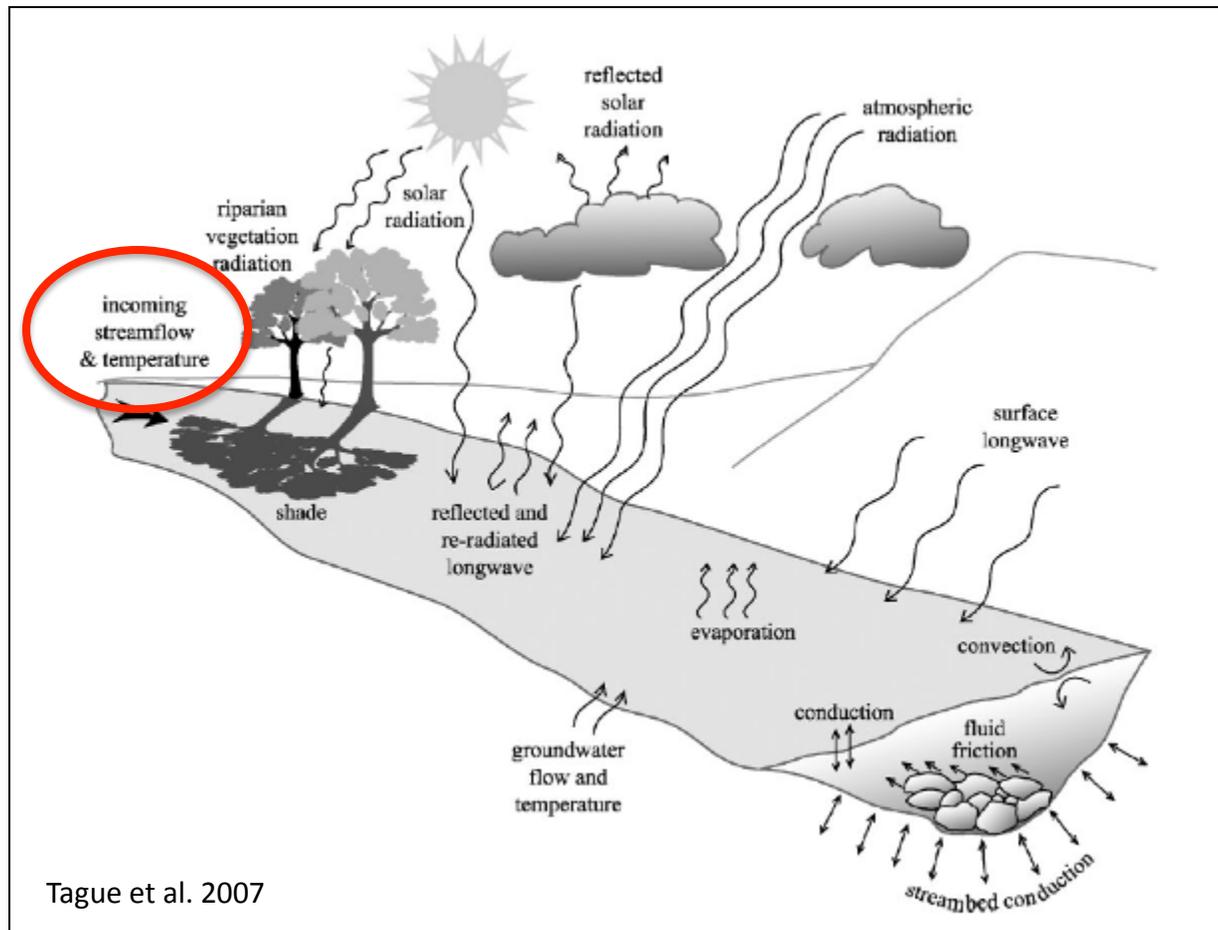
# Heat Budget

Based on both atmospheric inputs and water temperature

$$H_{net} = \left( H_{shortwave} + H_{longwave\_in} \right) - \left( H_{longwave\_out} + H_{evaporation} + H_{conduction} \right)$$

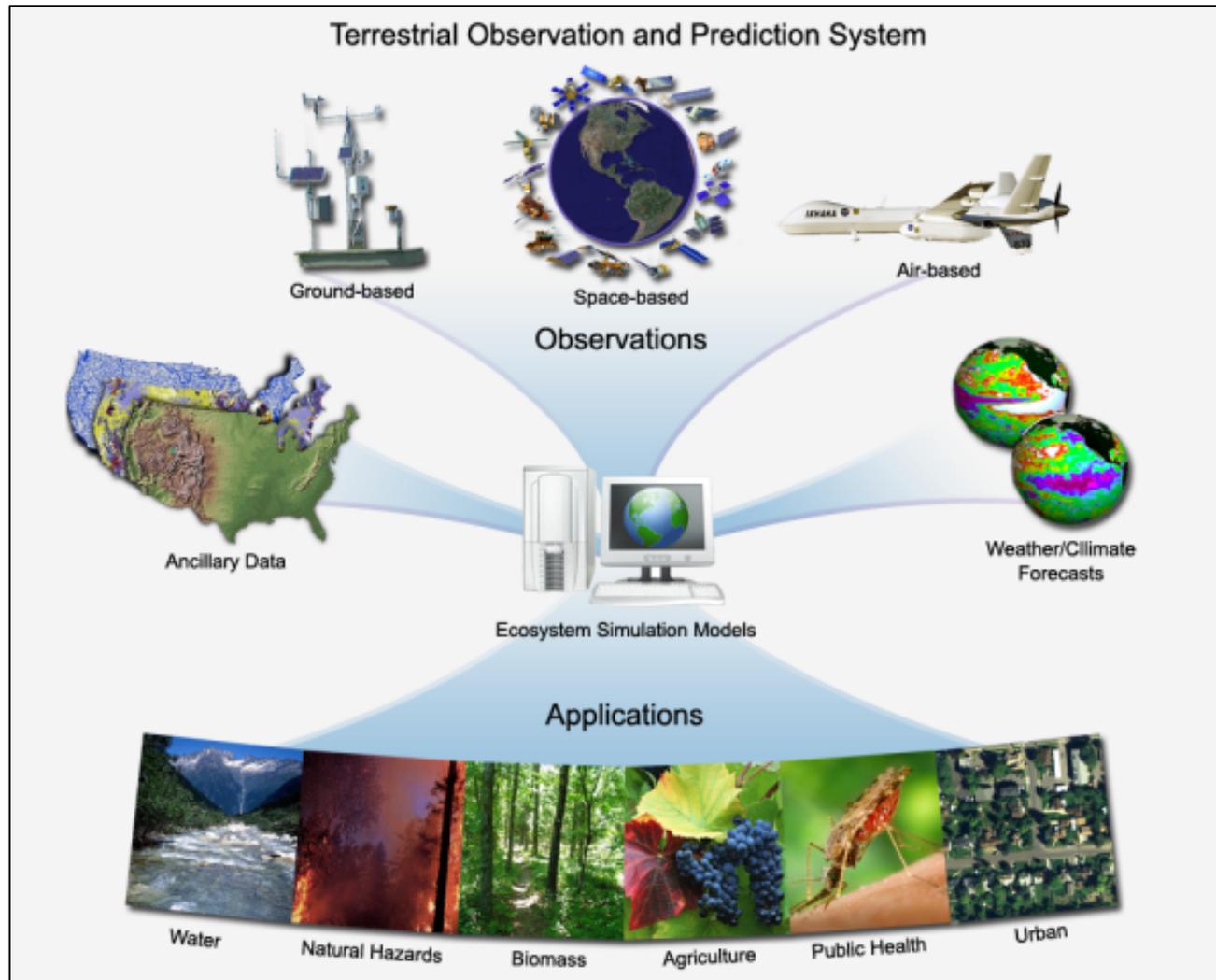
←----->                      ←----->

atmospheric terms                      water temperature terms

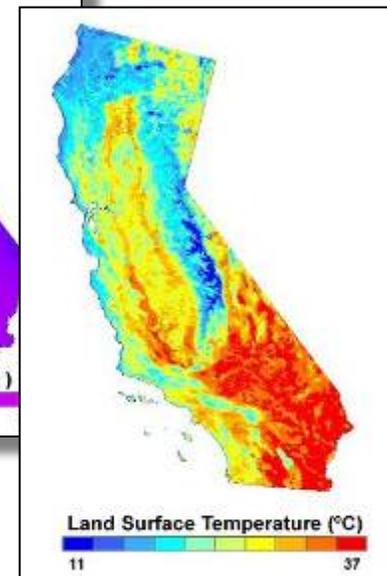
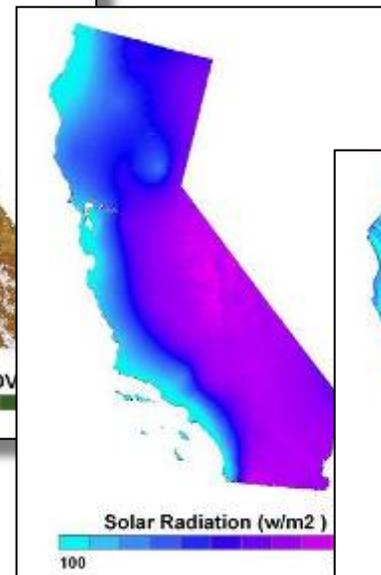
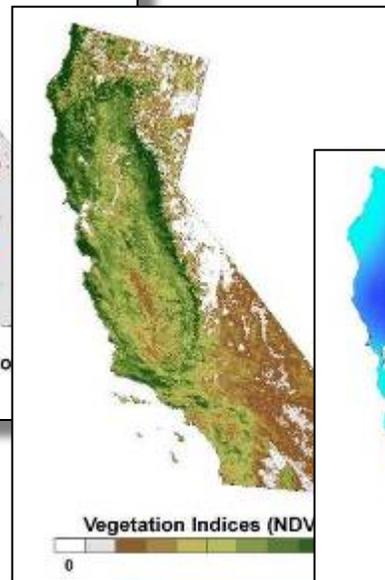
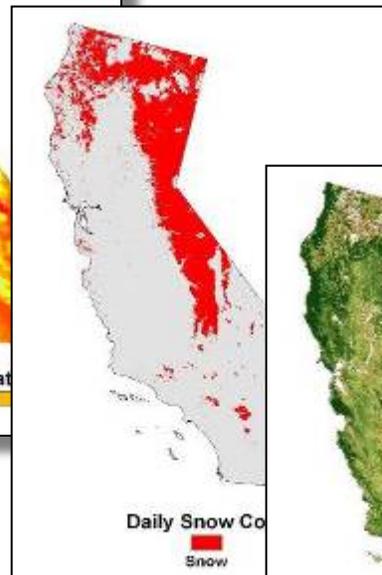
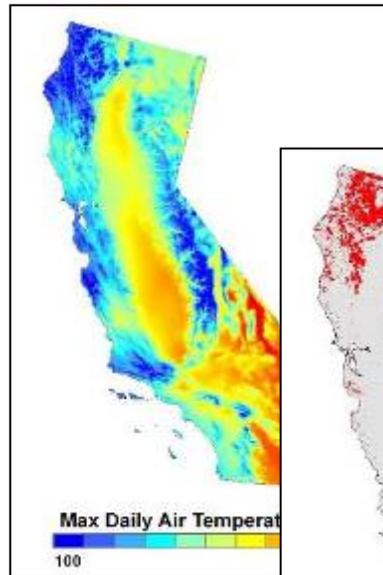


Tague et al. 2007

# NASA Ames Ecological Forecasting Lab

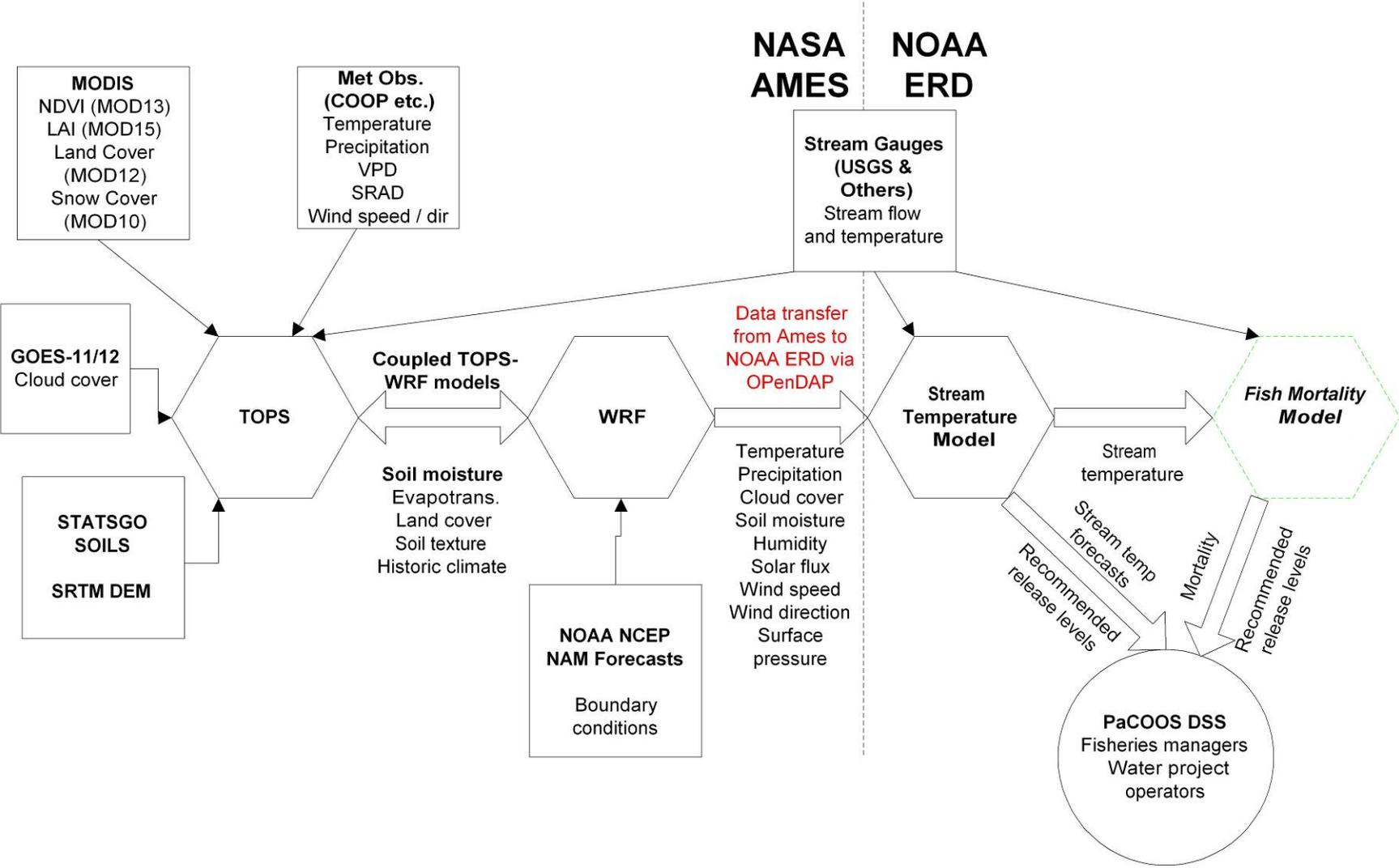


Integrate WRF model into  
Terrestrial Observation and  
Prediction System (TOPS)

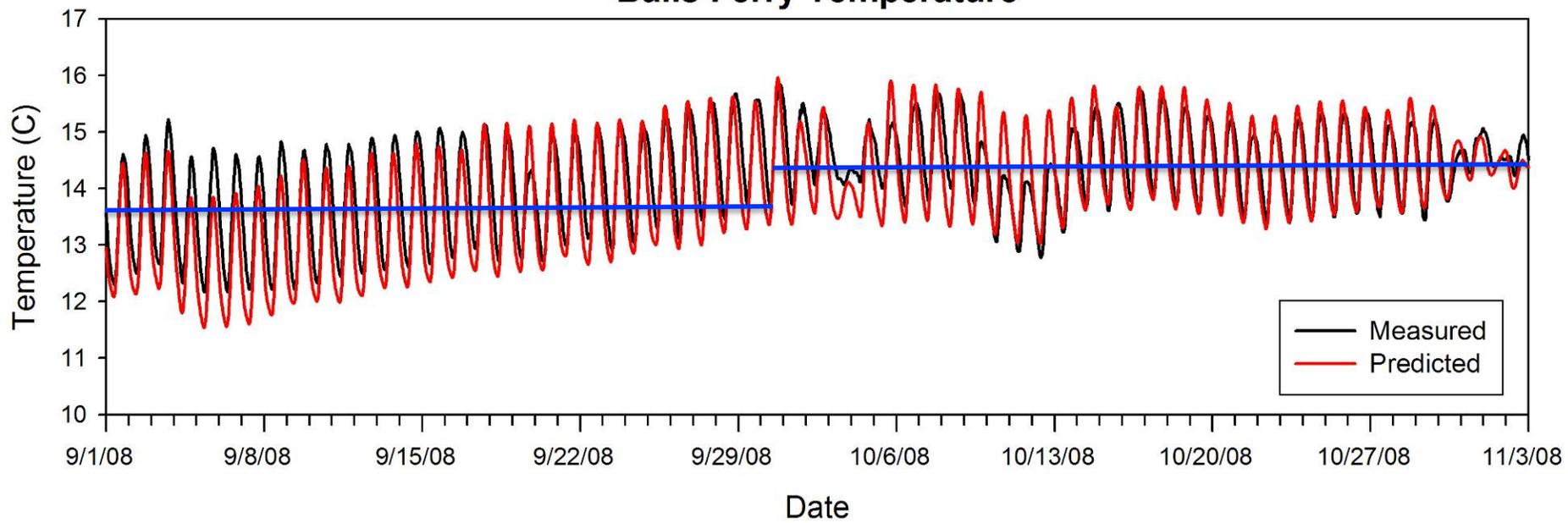


Coupled TOPS-WRF system to generate  
hindcasts and forecasts of weather  
conditions every 15 minutes at a spatial  
resolution of 1km<sup>2</sup>

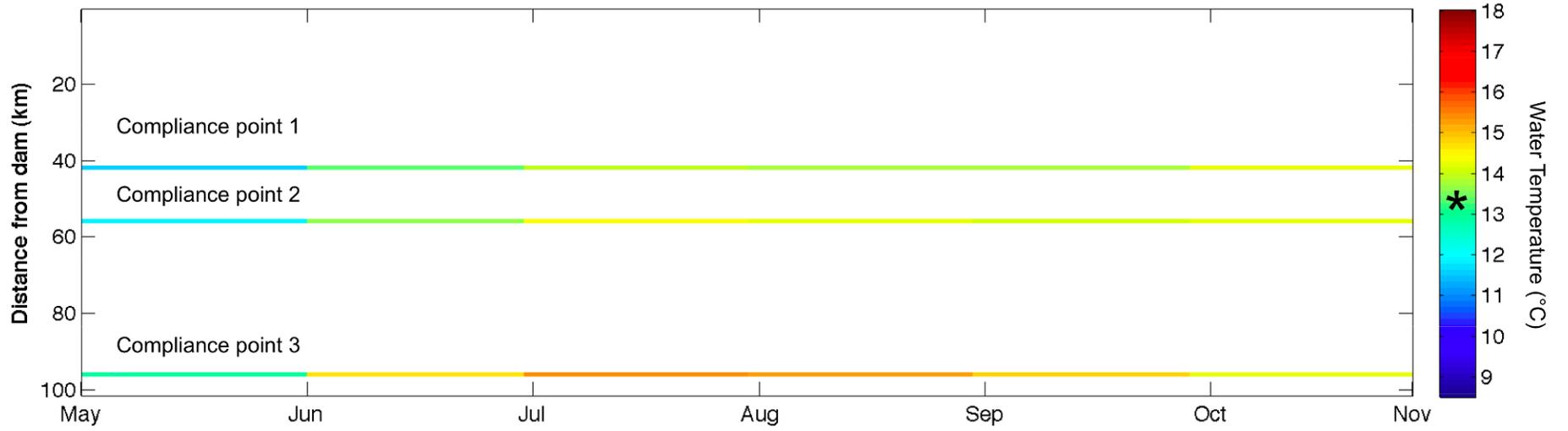
# System Architecture



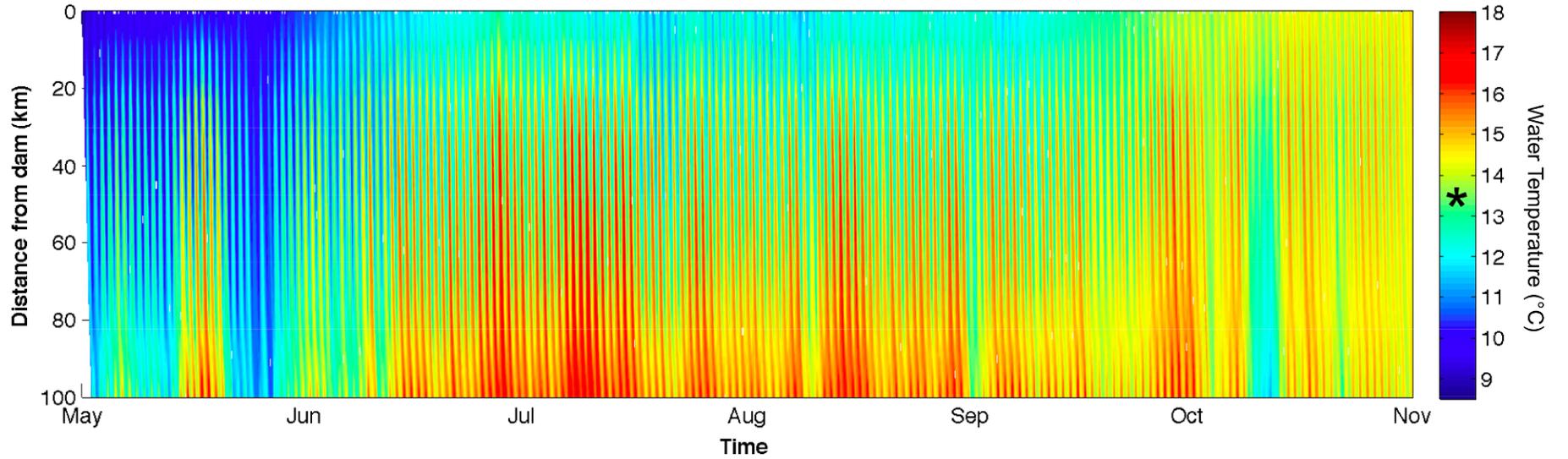
### Balls Ferry Temperature



River Temperatures in Space and Time: current DSS



River Temperatures in Space and Time: improved DSS



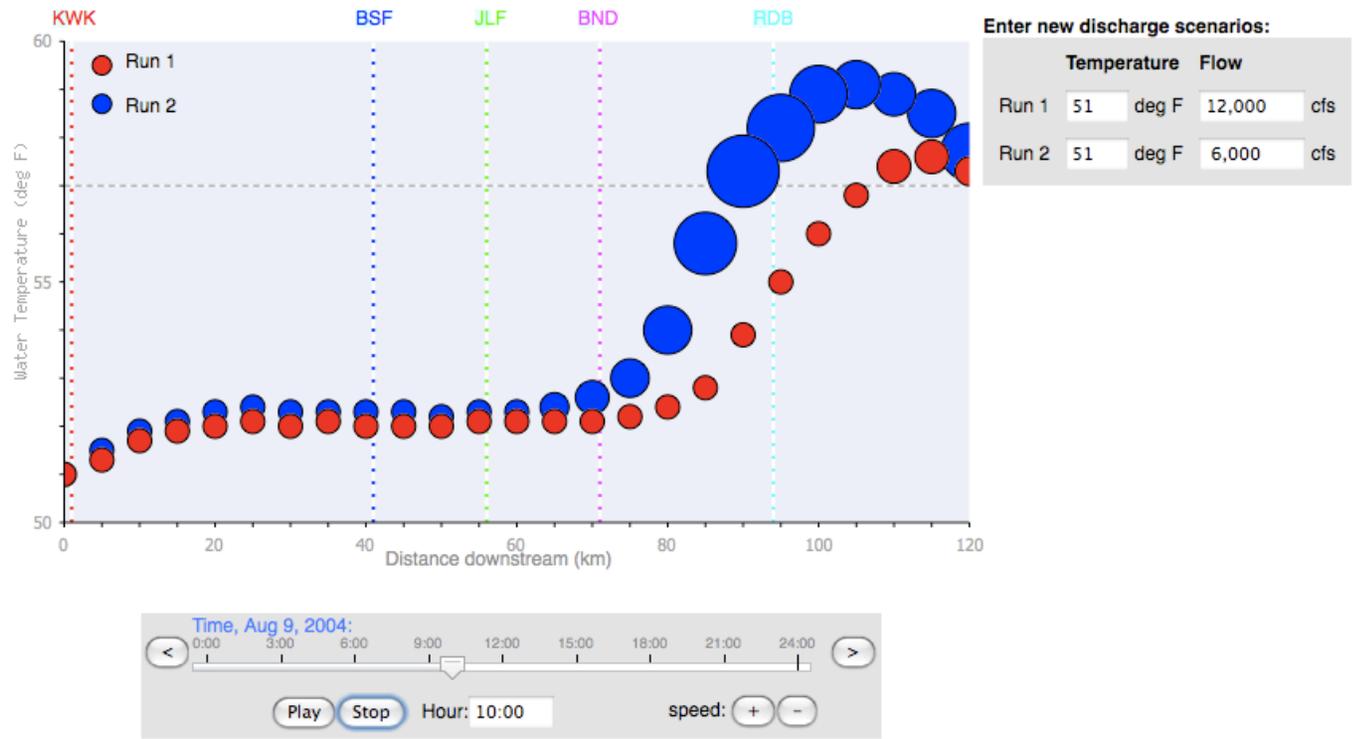
# Web site

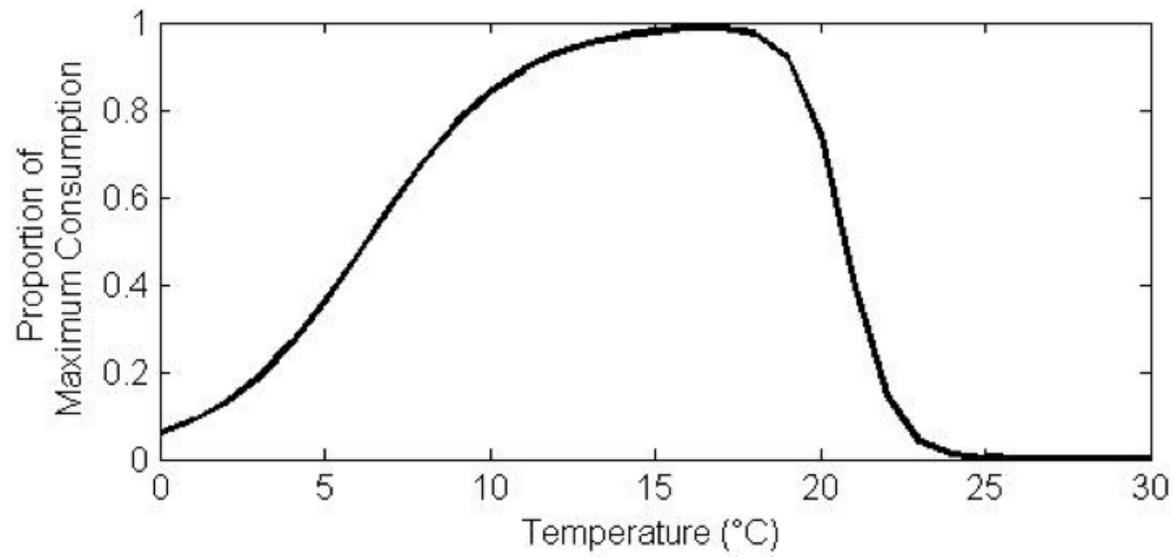
## CVP Stream Temperature DSS Test

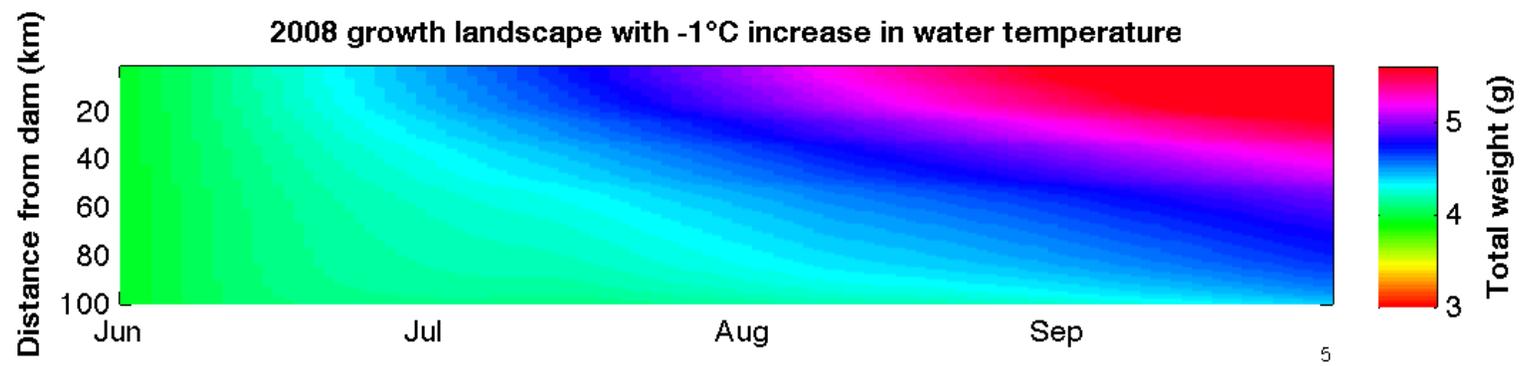
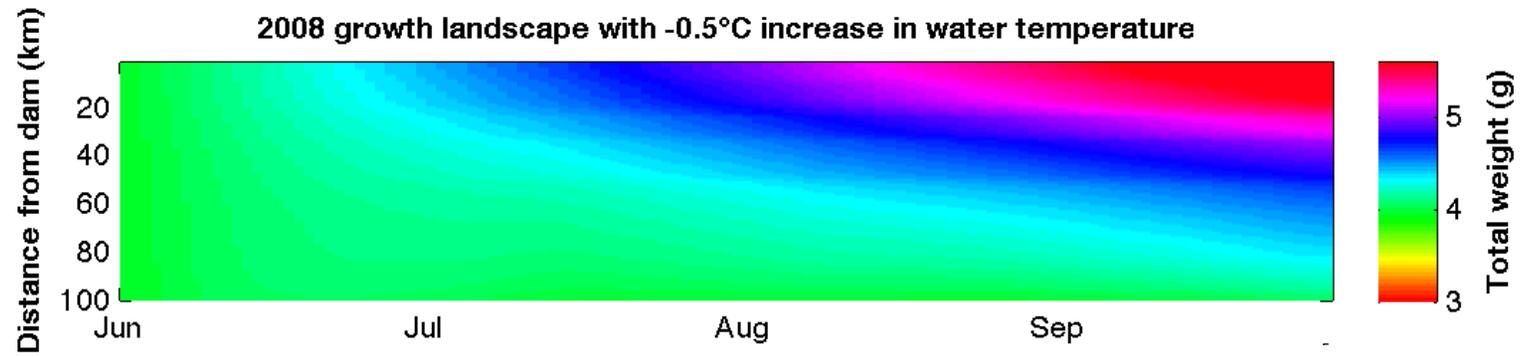
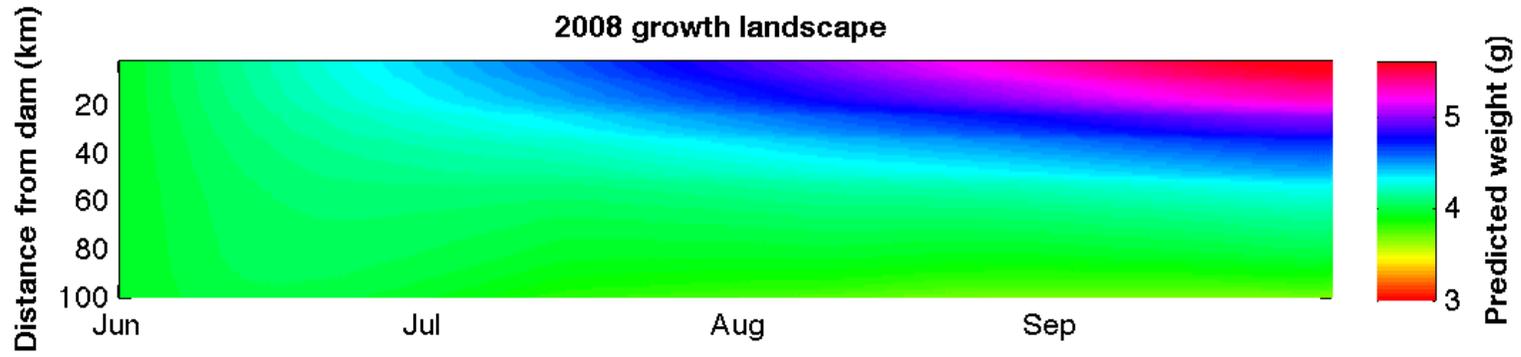
Home Management Scenarios Forecasts Project Information Links

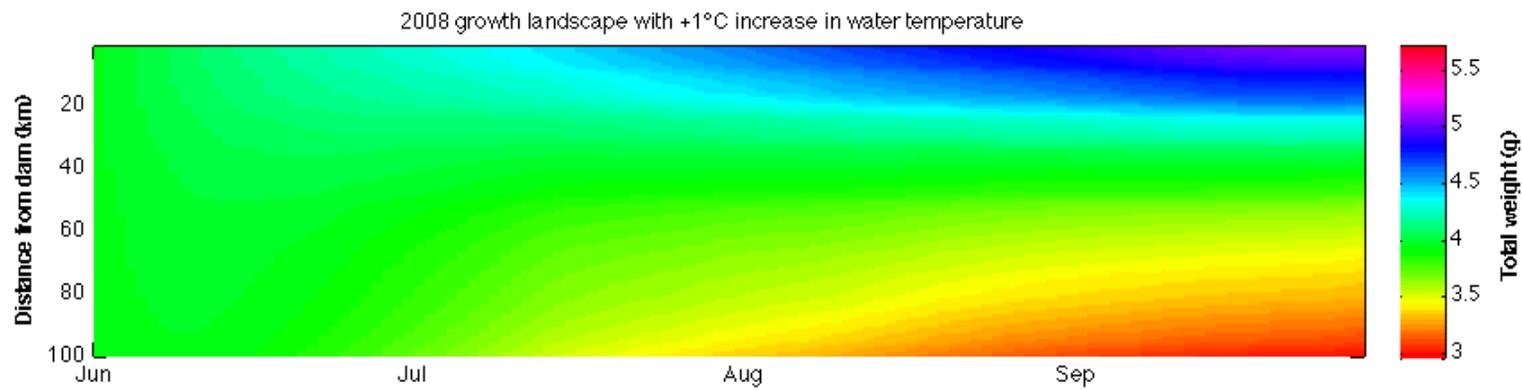
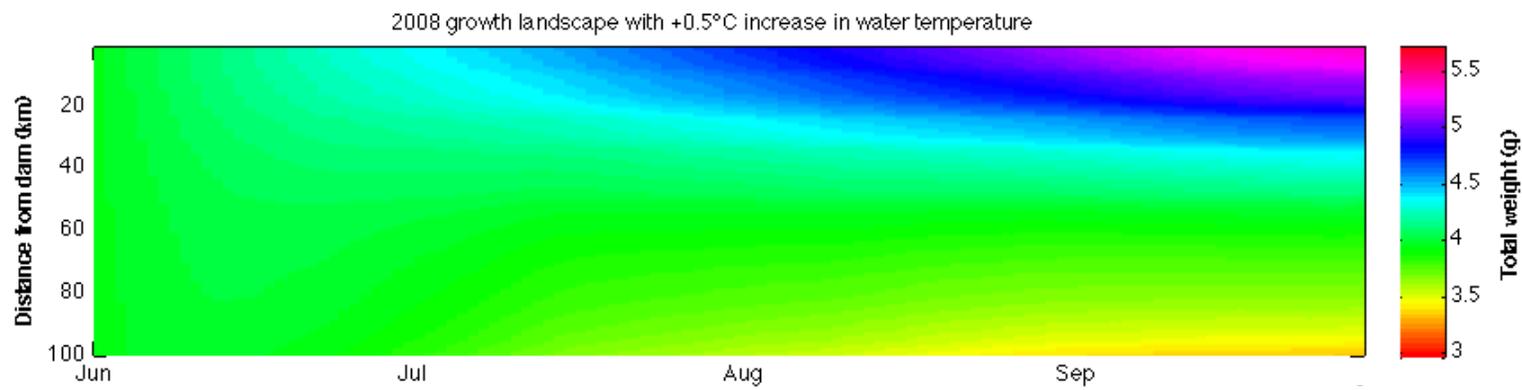
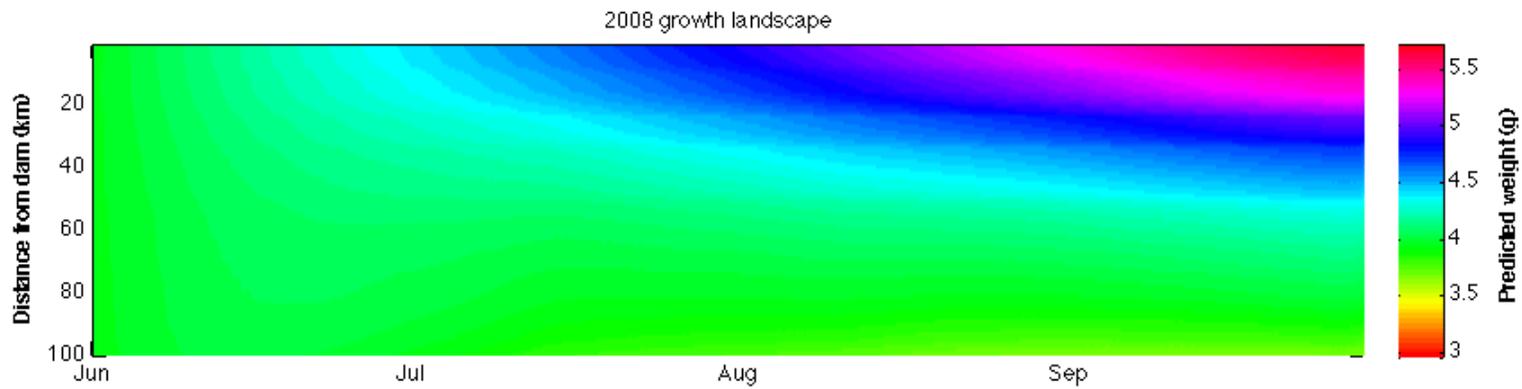
**Please note:** This site is a prototype of a user-interface for a stream temperature model and is for demonstration purposes only.



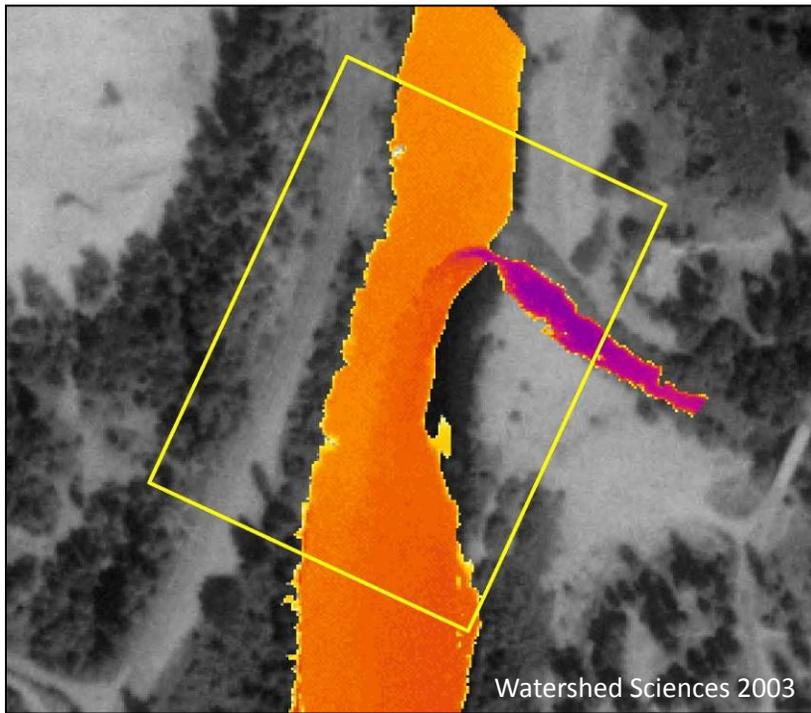
# Fish Bioenergetics



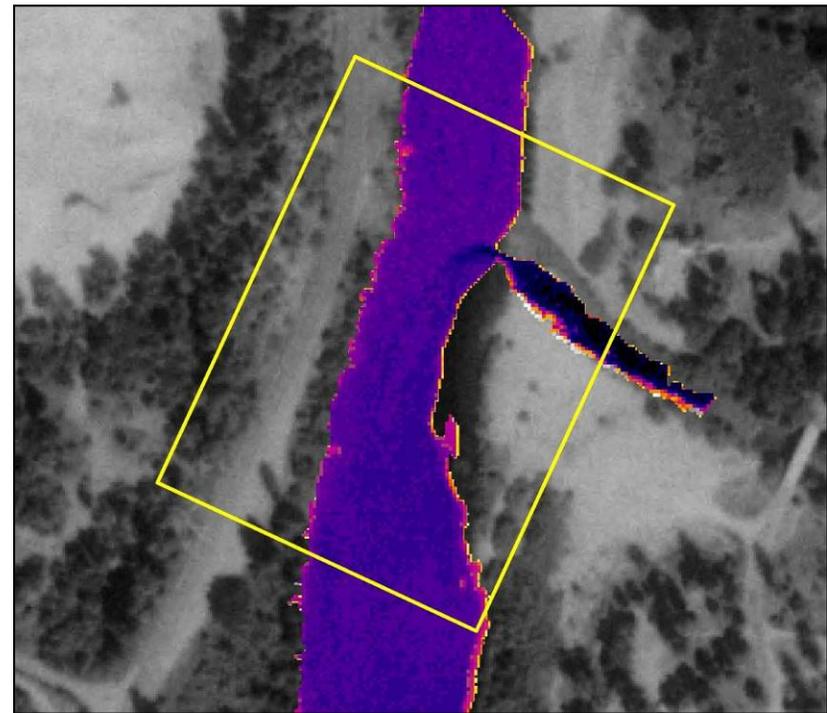




## Temporal dynamics of thermal refugia



July 2007



August 2007

# Summary

Management of remaining cold water spawning habitat for ESA listed salmon

Stream temperature and fish mortality models

- *NASA satellite data and NASA data models*
- *Provides high spatiotemporal stream temperature estimates*
- *Forecasting*
- *Estimates of fish growth and mortality across river landscape*

Mechanistic model: examine a wide range of scenarios including climate change

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