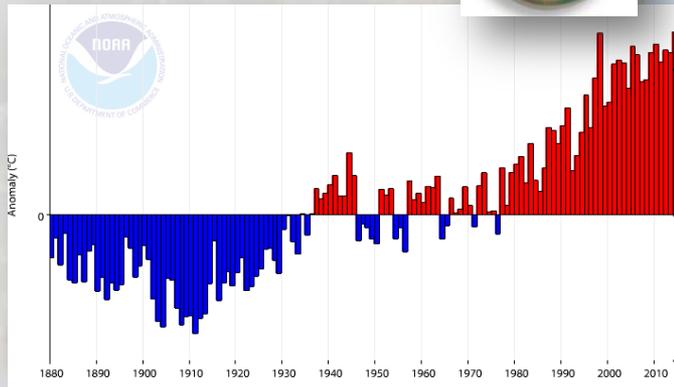
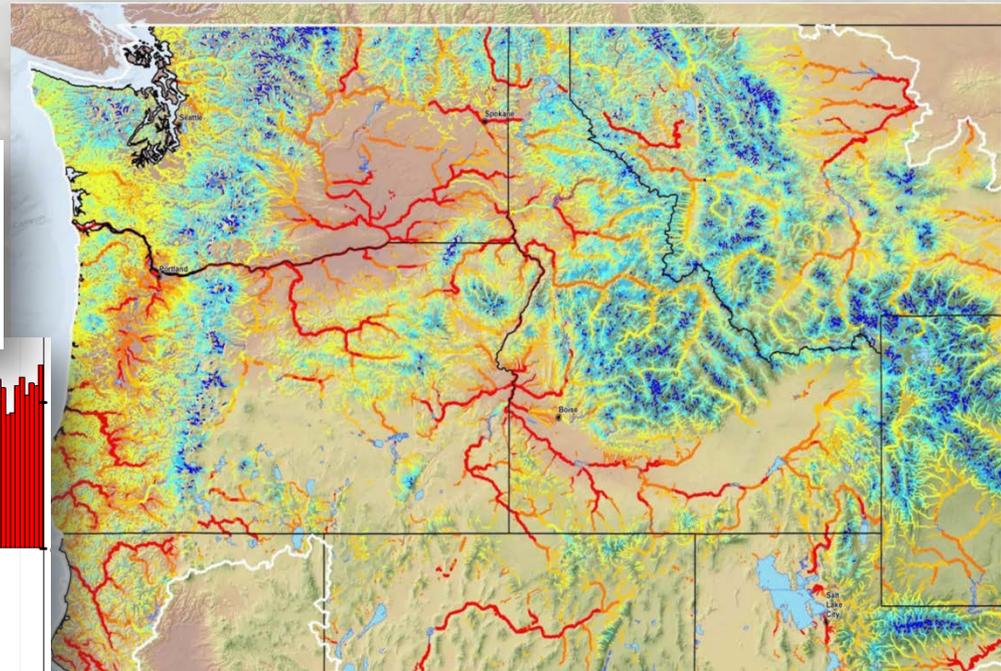
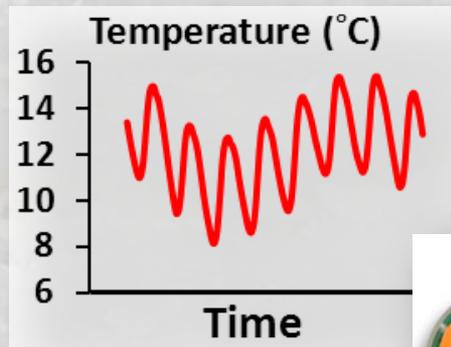
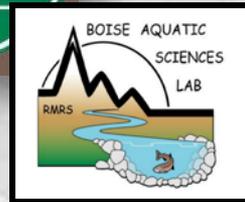


Stream & River Temperature Monitoring & Climate Assessments for the U.S.

Dan Isaak, US Forest Service
Rocky Mountain Research Station



Miniature Temperature Sensors & National Monitoring Efforts

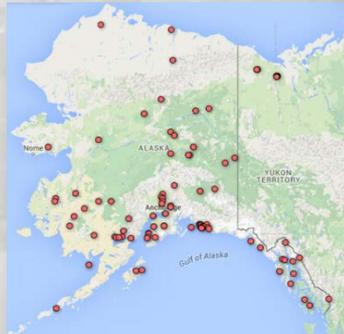
A)



B)



C)

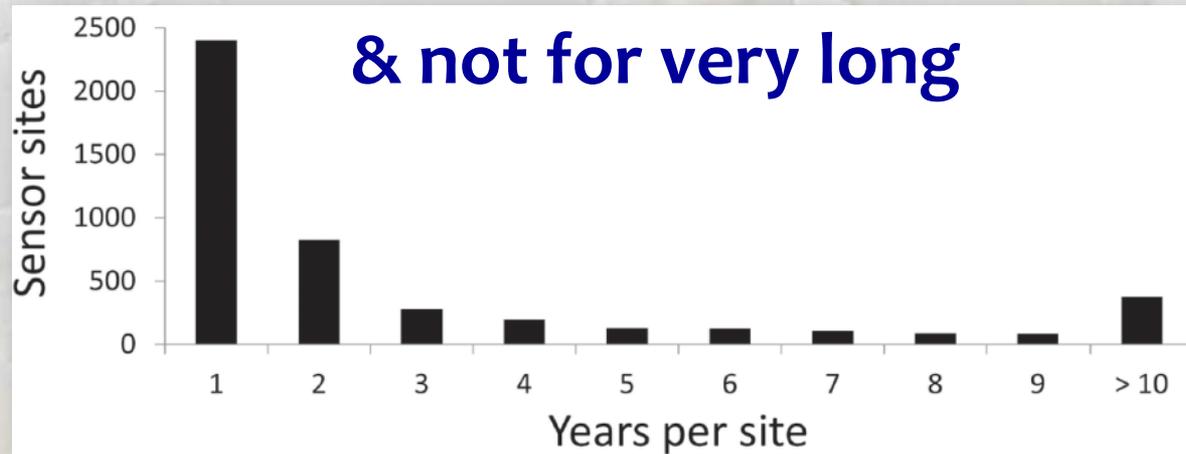
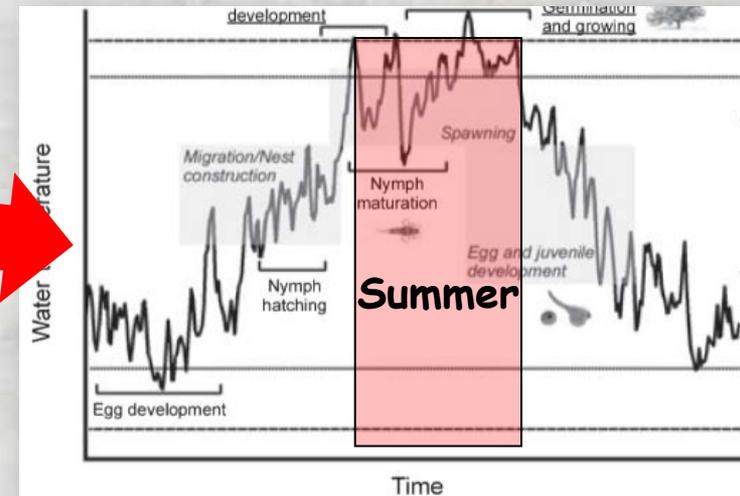


GAPS in existing Monitoring

Many Sites, but...



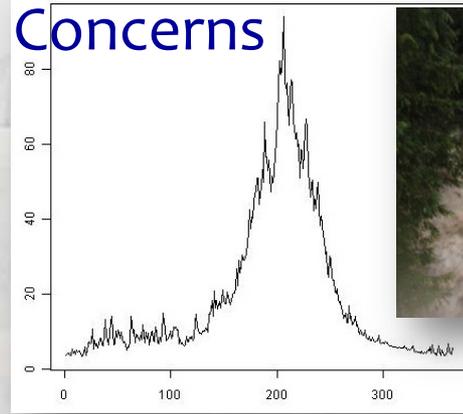
usually summer data



& not for very long

More Longterm, Annual Monitoring Needed

Annual Flooding



Underwater epoxy cement



\$130 = 5 years of data

Data retrieved from underwater



Sensors glued to large boulders & bridges

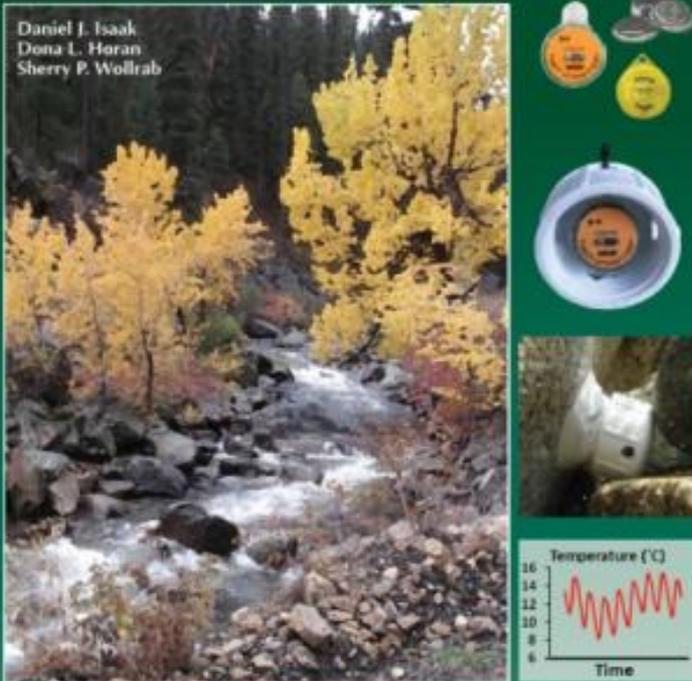


Isaak et al. 2013. USFS Report;
Isaak & Horan 2011. *NAJFM* 31:134-137

Standard Protocols & Miniature Sensors Make Data Collection Easy & Inexpensive

A Simple Protocol Using Underwater Epoxy to Install Annual Temperature Monitoring Sites in Rivers and Streams

Daniel J. Isaak
Dona L. Horan
Sherry P. Wollrab



The cover features a central photograph of a river with vibrant yellow trees on the banks. To the right, there are images of various sensors: a yellow and orange sensor, a white sensor in a blue container, and a white sensor mounted on a rock. Below these is a line graph showing temperature fluctuations over time.

Temperature (°C)

Time

United States Department of Agriculture / Forest Service
Rocky Mountain Research Station
General Technical Report R082-GTR-814
September 2014

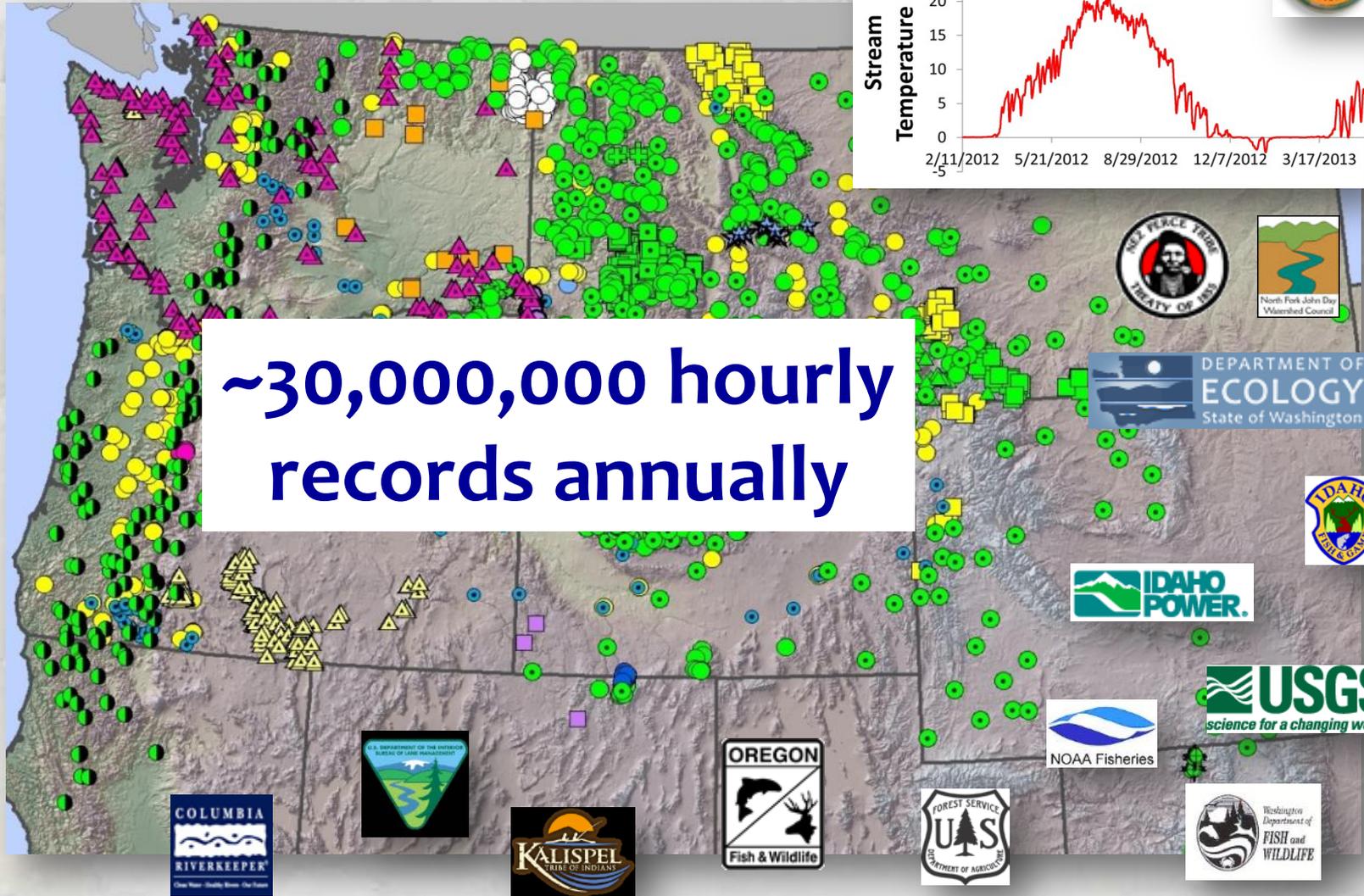
USDA

Best Practices for Continuous Monitoring of Temperature and Flow in Wadeable Streams

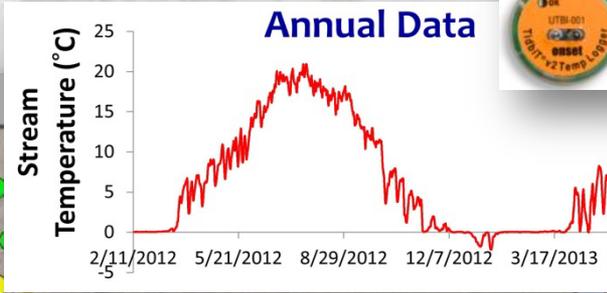


Annual Temperature Monitoring Sites

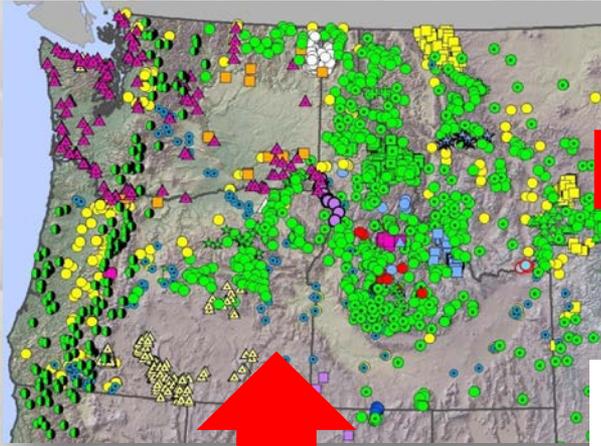
>4,000 sites in Pacific Northwest



~30,000,000 hourly records annually

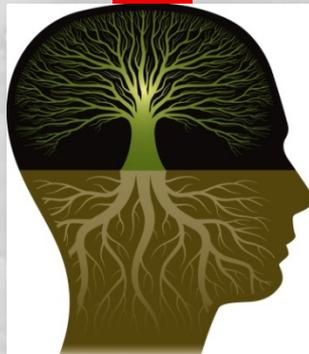
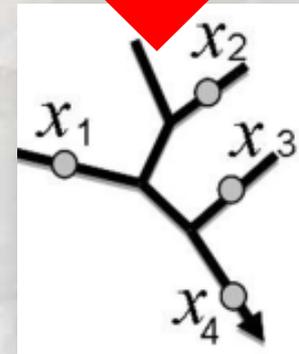


Data



Functional

Databases



Management Decisions

Analysis & Information

Databases Require Database Teams



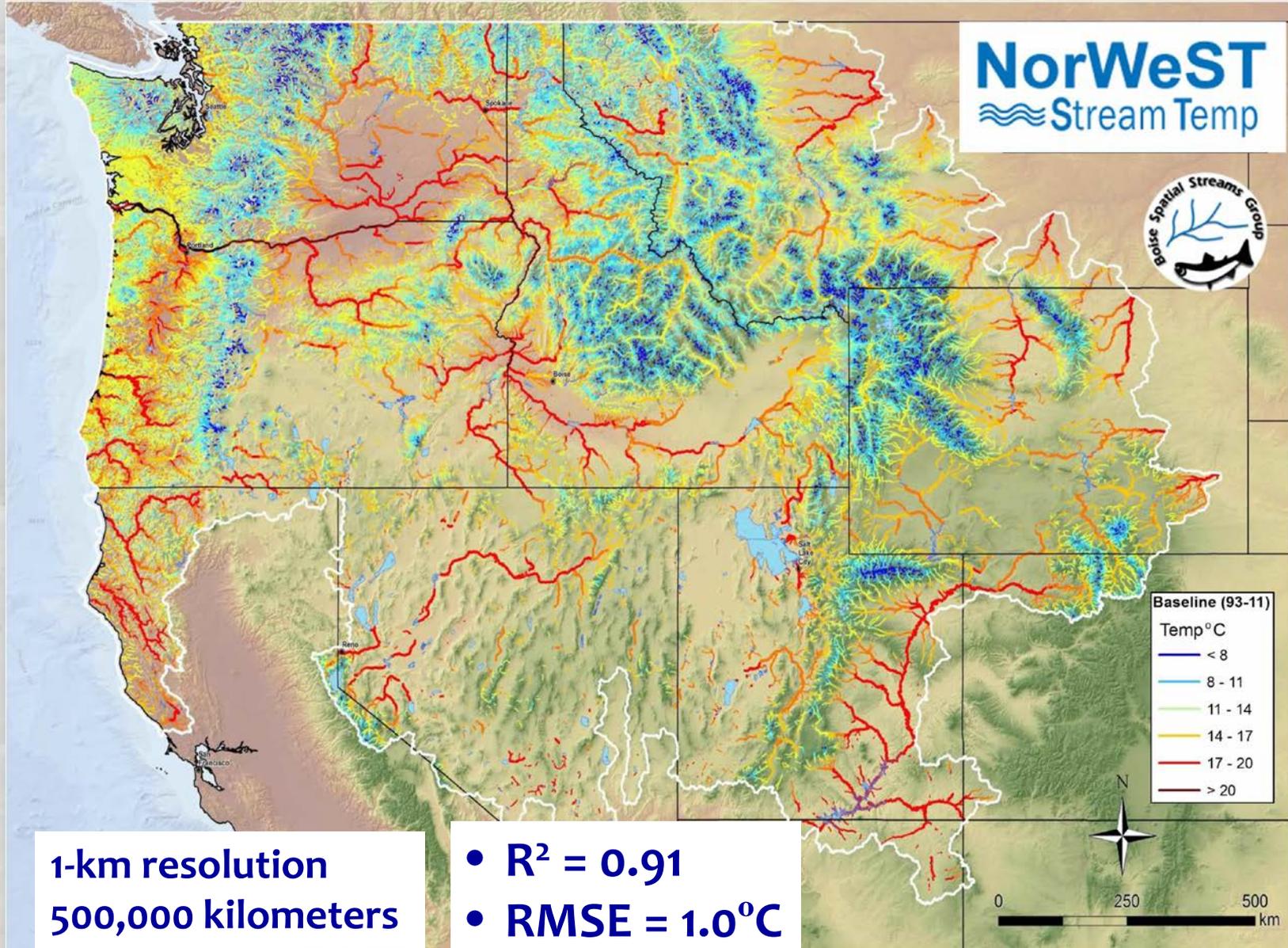
NorWeST
Stream Temp

Forging Disparate Data Into a Functional Database

Funded by:

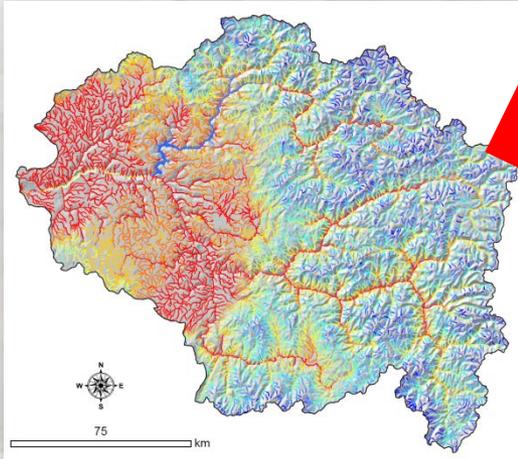


High-Resolution Stream Scenarios

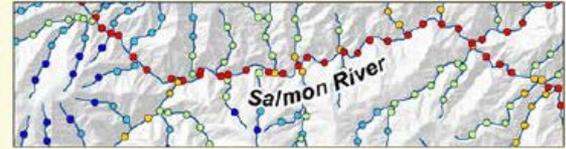


Website: Distributes Information in Useful Digital Formats (ArcGIS & .pdfs & Excel)

1) GIS shapefiles of stream temperature scenarios

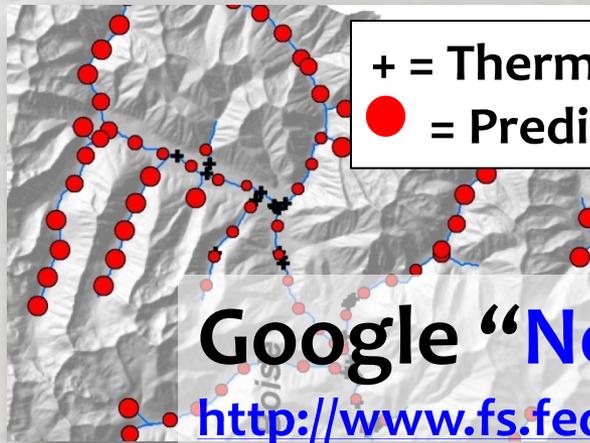


NorWeST
Stream Temp



Regional Database and Modeled Stream Temperatures

2) GIS shapefiles of stream temperature model prediction precision



+ = Thermograph
● = Prediction SE

3) Temperature data summaries



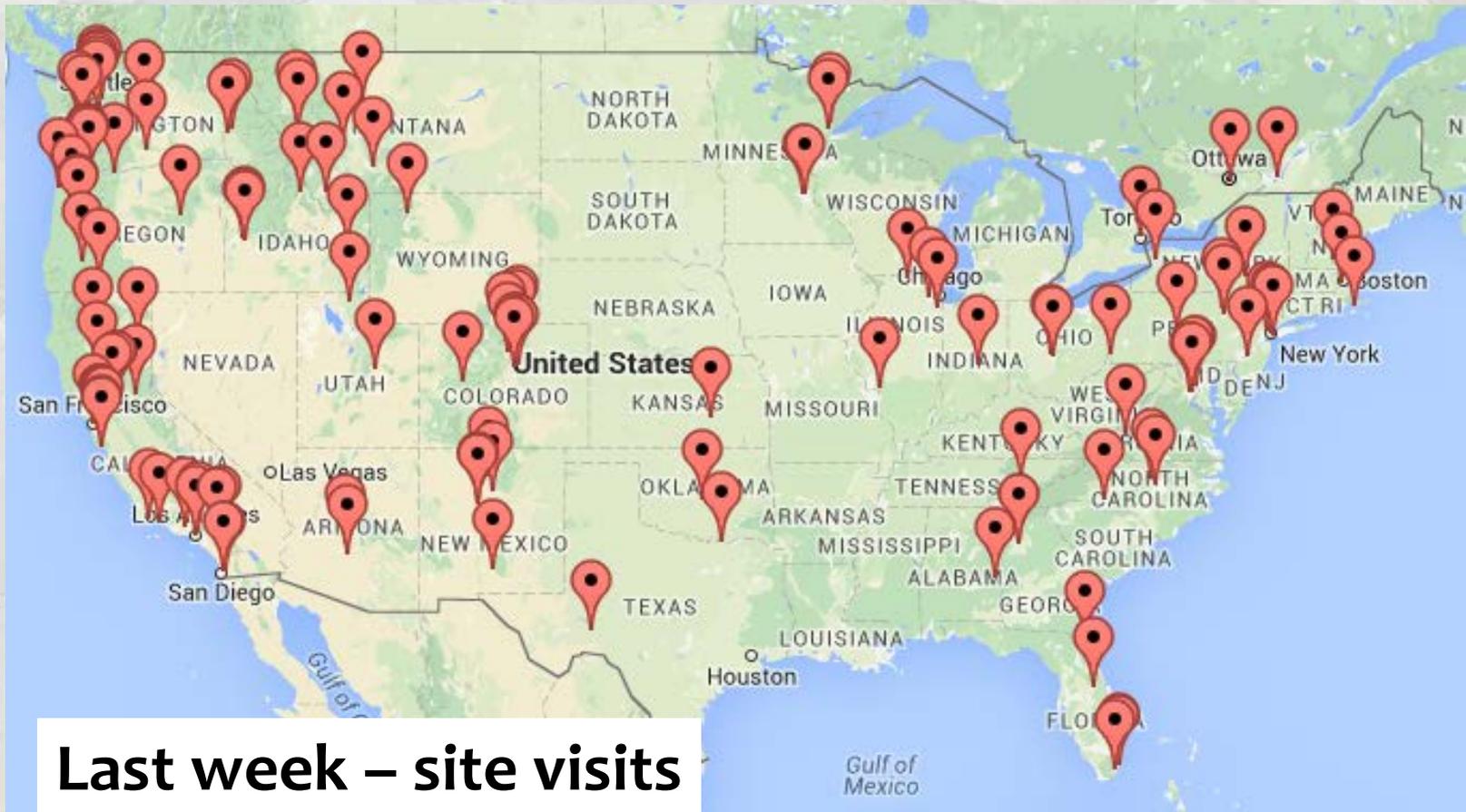
Google **NorWeST** or go here...

<http://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.shtml>

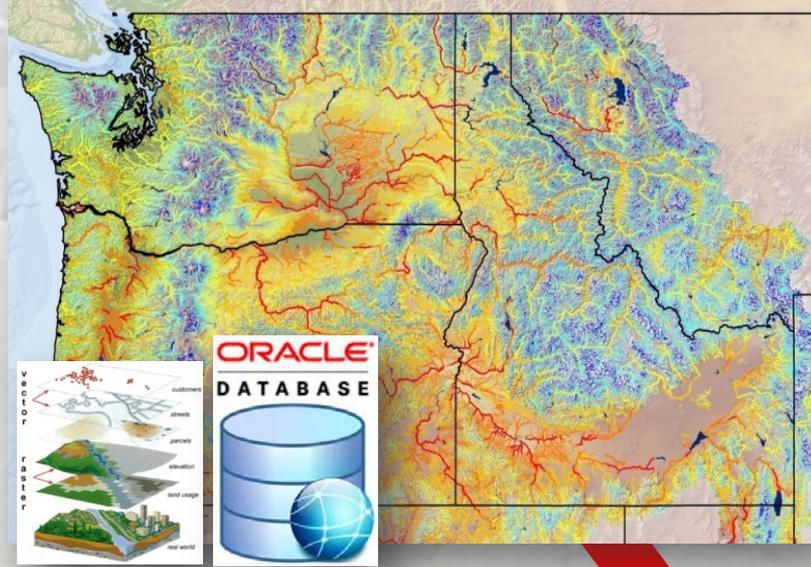
NorWeST User Community...

Website launched 3 Years Ago

- 12,000 visits/year
- 1,146 downloads last 6 months



Temperature Applications

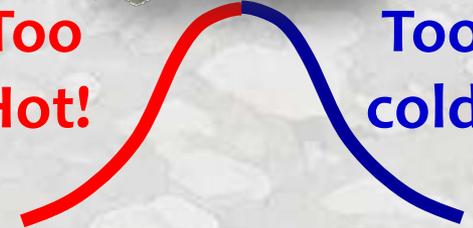


Regulatory temperature standards

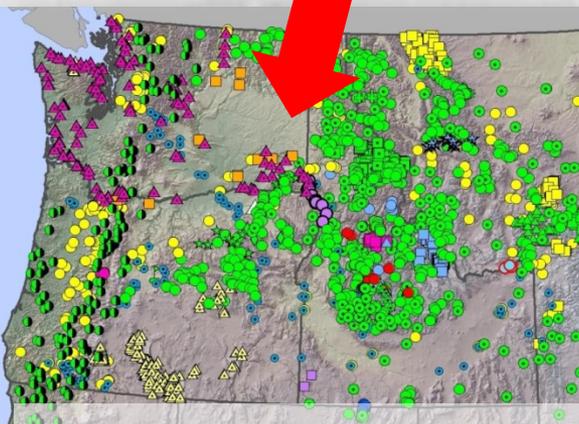


Too Hot!

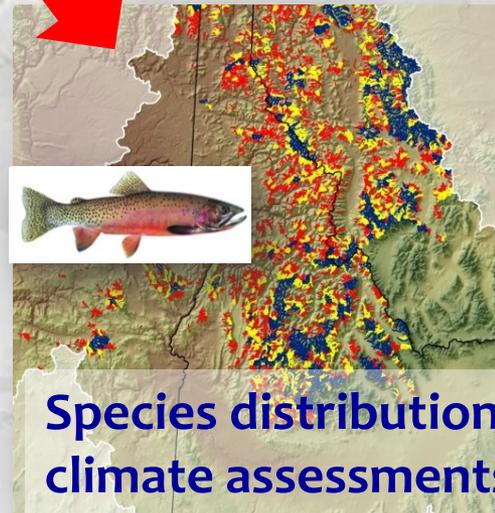
Too cold!



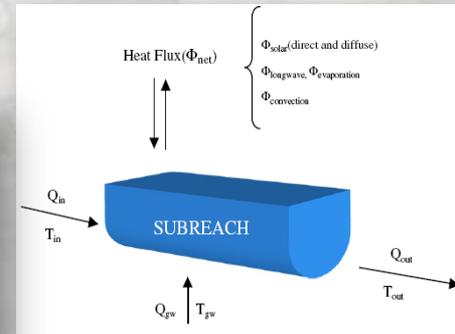
Data access accelerates temperature research



Coordinated Interagency monitoring

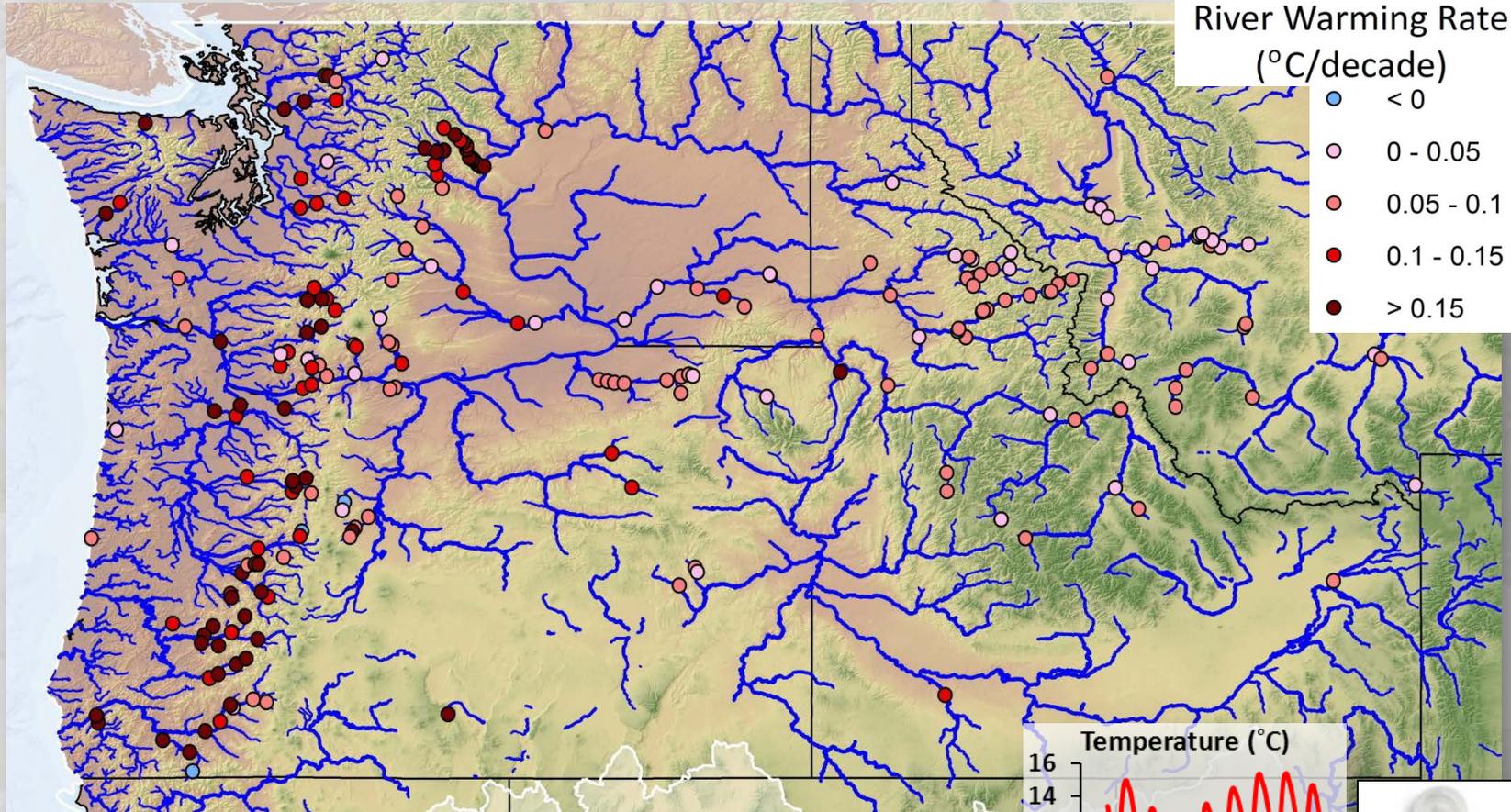


Species distribution models & climate assessments



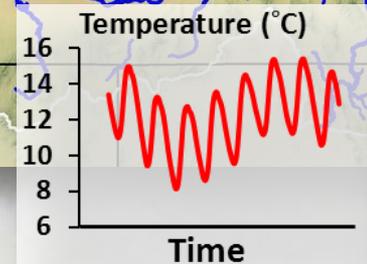
Historical River Temp Trends (1968-2011)

245 sites with >10 year monitoring records



+0.11 $^{\circ}\text{C}/\text{decade}$

98.5% sites are warming



Isaak et al. In Prep.

& Future Climate Projections...

