Climate-Aquatics Blog #29: Part 3, Spatial statistical models for stream networks: Freeware tools for model implementation

Being given the right tools for free is the best…

Hi Everyone,
It's a new world today if you're a stream ecologist, manager, or researcher that's interested in understanding, accurately modeling, or managing stream ecosystems at spatial scales larger than a pool/riffle or an individual stream. As described previously, new types of spatial statistical models have been developed for stream networks (blog #27) that often provide fundamentally better inference (& new types of inference) from many commonly available datasets (blog #28). The GIS tools and R scripts for implementing these models have not previously been widely available, which has limited their broad application. Today, however, a new website was launched to provide these tools as freeware (http://www.fs.fed.us/rm/boise/AWAE/projects/SpatialStreamNetworks.shtml), thereby culminating almost a decade of research and development by Jay Ver Hoef and Erin Peterson.

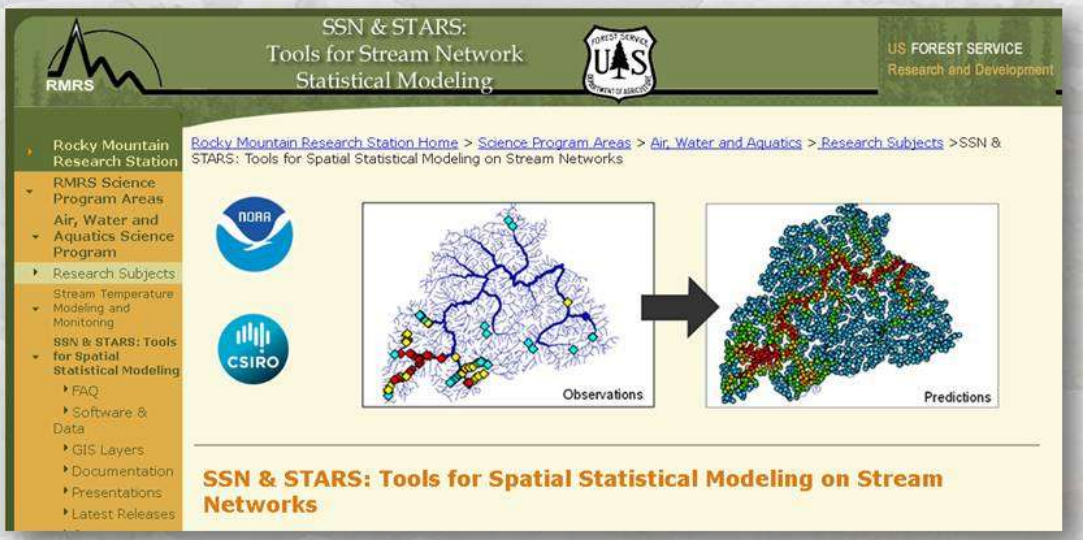
On the website, you'll find: 1) the STARS ArcGIS custom toolbox used to pre-process stream datasets and develop auxiliary information, 2) the SSN (SpatialStreamNetworks) package for the freeware R statistical program (downloadable here: http://www.r-project.org/), which is used to fit the spatial models, 3) example datasets, and 4) tutorials to help familiarize yourselves with the tools and their functionality. If you're planning to use the spatial models with datasets in the Northwest U.S., there's also a set of NHD+ hydrocoverages that have already been reconditioned to work consistently with the spatial models (downloadable here: http://www.fs.fed.us/rm/boise/AWAE/projects/SSN_STARS/GIS_reconditioned_NHDstreams.shtml). Use of these hydrocoverages should save you some time by eliminating a few of the pre-processing steps otherwise required in STARS.

Attached to this email is a vignette that steps through several well annotated examples in R. Even if you don't know how to operate in the R environment, it's possible to get the gist from the thorough descriptions and interpretation of the statistical outputs. The datasets used in the vignette are also embedded within the SSN package to facilitate working directly through them in R after loading the SSN package onto your computer. With a basic level of familiarity, implementing the models with your stream databases just requires doing the preprocessing steps described in the STARS tutorial, then crunching through the statistical analysis much as one would with any other analysis.

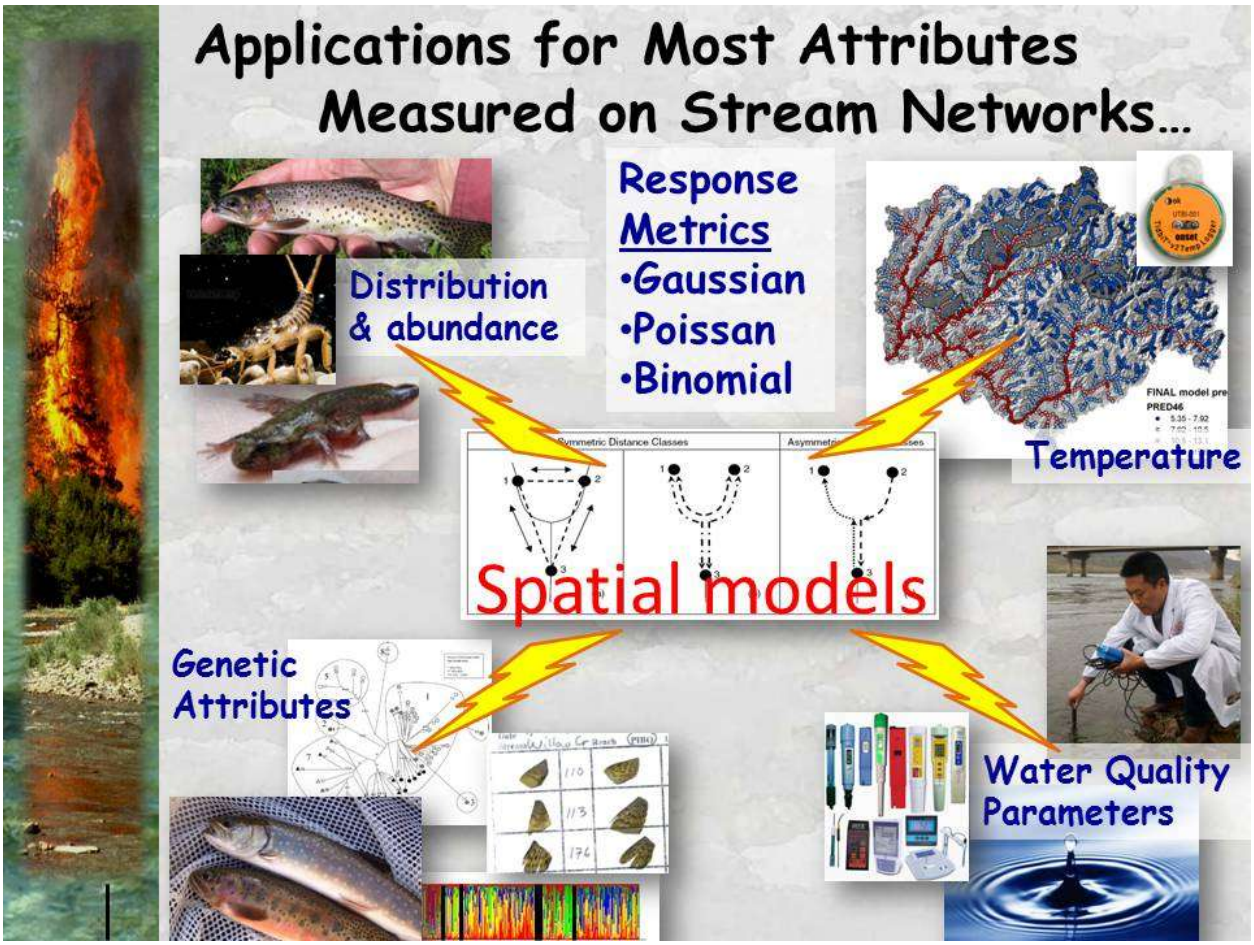
Not much more to say than that, but have at it & let's learn lots of new stuff about streams & their critters so we keep as many of them around this century as possible.

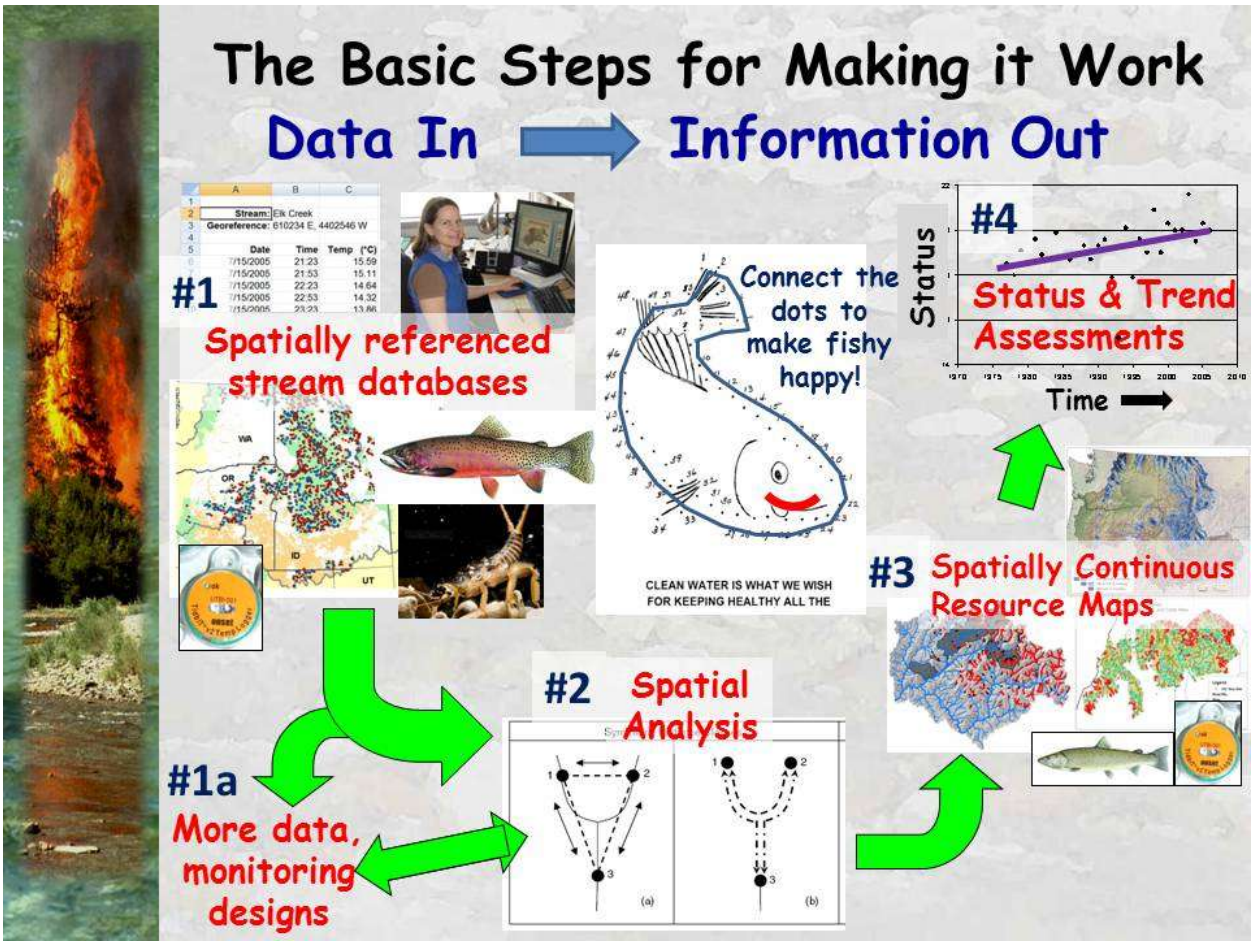
Until next time, best regards,
Dan

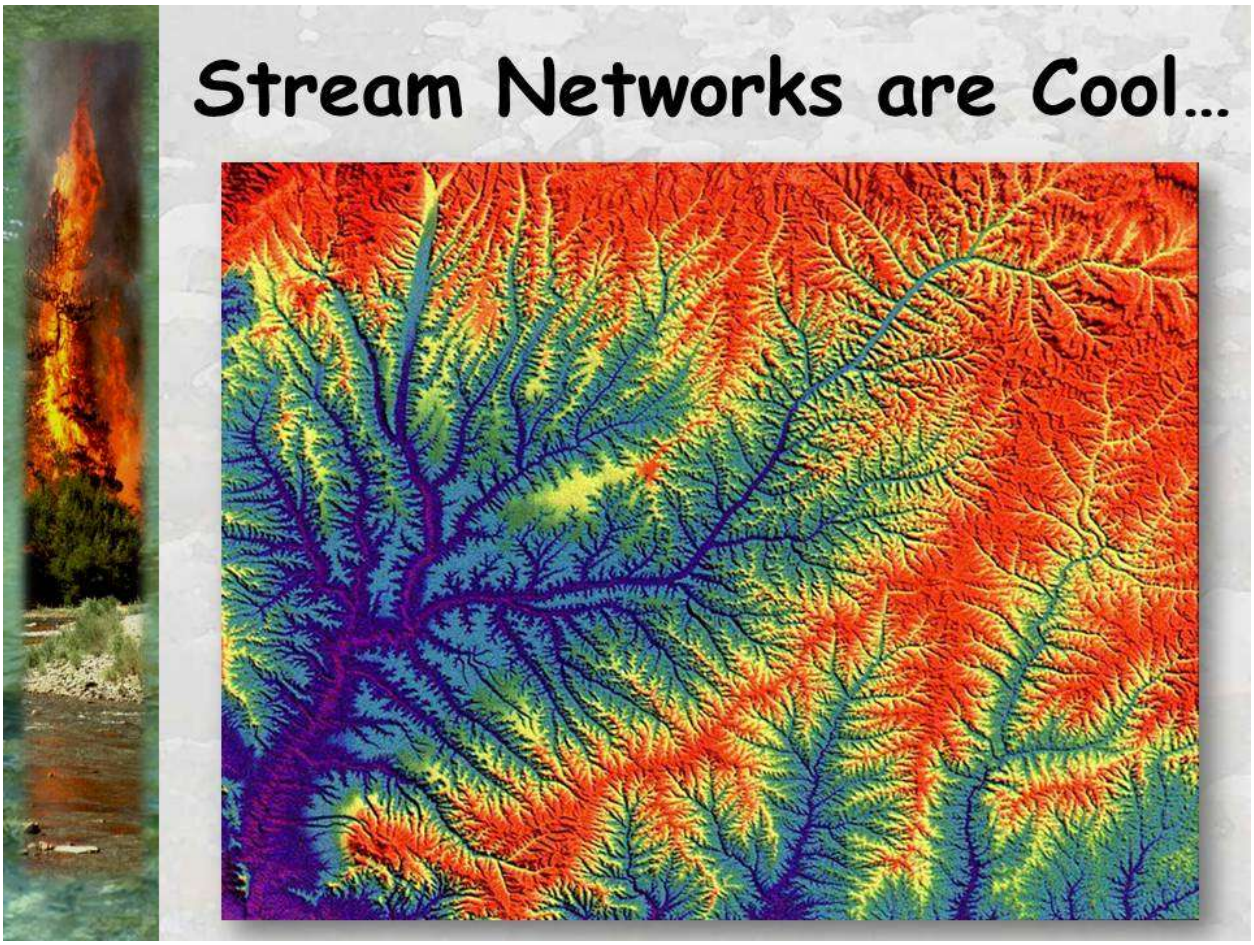
Website & Tools for Implementing Spatial Statistical Stream Models



Just Google "SSN & STARS" or go to this website address: http://www.fs.fed.us/rm/boise/AWAE/projects/SpatialStreamNetworks.shtml


Applications for Most Attributes Measured on Stream Networks…
Response Metrics
•Gaussian
•Poissan
•Binomial
Distribution & abundance
Temperature
Spatial models
Genetic Attributes
Water Quality Parameters


The Basic Steps for Making it Work
Data In
Information Out
#1
Spatially referenced stream databases
Stream: Elk Creek
Georeference: 610234 E, 4402546 W
Date Time Temp (°C)
7/15/2005 21:23 15.59
7/15/2005 21:53 15.11
7/15/2005 22:23 14.64
7/15/2005 22:53 14.32
WA
OR
ID
UT
Connect the dots to make fishy happy!
CLEAN WATER IS WHAT WE WISH FOR KEEPING HEALTHY ALL THE
#1a
More data, monitoring designs
#2
Spatial Analysis
(a)
(b)
#3
Spatially Continuous Resource Maps
#4
Status & Trend Assessments
Status
Time



Welcome to the Climate-Aquatics Blog. For those new to the blog, previous posts with embedded graphics can be seen by clicking on the hyperlinks at the bottom or by navigating to the blog archive webpage on our Forest Service site at: (http://www.fs.fed.us/rm/boise/AWAE/projects/stream_temp/stream_temperature_climate_aquatics_blog.html). To discuss these topics with other interested parties, a Google discussion group has also been established and instructions for joining the group are also on the webpage. The intent of the Climate-Aquatics Blog and associated discussion group is to provide a means for the 4,320 (& growing) field biologists, hydrologists, anglers, students, managers, and researchers currently on this mailing list across North America, Europe, and Asia to more broadly and rapidly discuss topical issues associated with aquatic ecosystems and climate change.

Messages periodically posted to the blog will highlight new peer-reviewed research and science tools that may be useful in addressing this global phenomenon. Admittedly, many of the ideas for postings have their roots in studies I and my colleagues have been a part of in the Rocky Mountain region, but attempts will be made to present topics & tools in ways that highlight their broader, global relevance. Moreover, I acknowledge that the studies, tools, and techniques highlighted in these missives are by no means the only, or perhaps even the best, science products in existence on particular topics, so the hope is that this discussion group engages others doing, or interested in, similar work and that healthy debates & information exchanges will occur to facilitate the rapid

dissemination of knowledge among those most concerned about climate change and its effects on aquatic ecosystems.

If you know of others interested in climate change and aquatic ecosystems, please forward this message and their names can be added to the mailing list for notification regarding additional science products on this topic. If you do not want to be contacted regarding future such notifications, please reply to that effect and you will be removed from this mailing list.

Previous Posts

Climate-Aquatics Overviews

Blog #1: Climate-aquatics workshop science presentations available online
Blog #2: A new climate-aquatics synthesis report

Climate-Aquatics Thermal Module

Blog #3: Underwater epoxy technique for full-year stream temperature monitoring
Blog #4: A GoogleMap tool for interagency coordination of regional stream temperature monitoring
Blog #5: Massive air & stream sensor networks for ecologically relevant climate downscaling
Blog #6: Thoughts on monitoring air temperatures in complex, forested terrain
Blog #7: Downscaling of climate change effects on river network temperatures using inter-agency temperature databases with new spatial statistical stream network models
Blog #8: Thoughts on monitoring designs for temperature sensor networks across river and stream basins
Blog #9: Assessing climate sensitivity of aquatic habitats by direct measurement of stream & air temperatures
Blog #10: Long-term monitoring shows climate change effects on river & stream temperatures
Blog #11: Long-term monitoring shows climate change effects on lake temperatures
Blog #12: Climate trends & climate cycles & weather weirdness
Blog #13: Tools for visualizing local historical climate trends
Blog #14: Leveraging short-term stream temperature records to describe long-term trends
Blog #15: Wildfire & riparian vegetation change as the wildcards in climate warming of streams
Blog #23: New studies describe historic & future rates of warming in Northwest US streams
Blog #24: NoRRTN: An inexpensive regional river temperature monitoring network
Blog #25: NorWeST: A massive regional stream temperature database
Blog #26: Mapping Thermal Heterogeneity & Climate in Riverine Environments

Climate-Aquatics Hydrology Module

Blog #16: Shrinking snowpacks across the western US associated with climate change
Blog #17: Advances in stream flow runoff and changing flood risks across the western US
Blog #18: Climate change & observed trends toward lower summer flows in the northwest US
Blog #19: Groundwater mediation of stream flow responses to climate change
Blog #20: GIS tools for mapping flow responses of western U.S. streams to climate change
Blog #21: More discharge data to address more hydroclimate questions
Blog #22: Climate change effects on sediment delivery to stream channels

Climate-Aquatics Cool Stuff Module

Blog #27: Part 1, Spatial Statistical Models for Stream Networks: Context & Conceptual Foundations
Blog #28: Part 2, Spatial Statistical Models for Stream Networks: Applications and Inference

Future topics…
Climate-Aquatics Biology Module
Climate-Aquatics Management Module