

# Science

## BRIEFING

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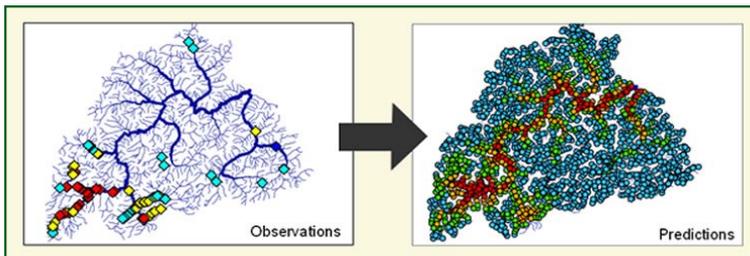
## SPATIAL STATISTICAL MODELING TOOLS FOR STREAMS

### BACKGROUND

Stream network structure, connectivity, and flow direction strongly affect spatial patterns in stream attributes. Most statistical analyses ignore network structure and may provide biased results for stream data.

### RESEARCH

**Research Activity:** Researchers at RMRS, NOAA, and CSIRO Australia have developed a new class of statistical model for stream networks that is applicable to most types of stream data. Spatial statistical models for streams provide a new set of analytical tools that can be used to improve predictions of physical, chemical, and biological characteristics on stream networks. These models are unique because they account for patterns of spatial autocorrelation.



*Spatial statistical stream network models can use data from a relatively small number of sites (left) to make unbiased predictions across larger river networks (right).*

**Benefits to Resource Managers:** Stream network models can be used with any type of data collected on streams, including distribution, abundance, and genetic attributes of aquatic organisms, stream temperature and water quality parameters, or channel habitat characteristics. This approach allows new information to be developed at low cost by aggregating existing databases, resource agencies can more easily share data, and many new types of sampling design are possible.

### MORE INFORMATION

Freeware GIS tools, statistical software, tutorials, and example datasets for running the network models are available through the SSN & STARS website ([www.fs.fed.us/rm/boise/AWAE/projects/SpatialStreamNetworks.shtml](http://www.fs.fed.us/rm/boise/AWAE/projects/SpatialStreamNetworks.shtml)). For more information, please contact **Dan Isaak**, USFS Research Fishery Biologist, [disaak@fs.fed.us](mailto:disaak@fs.fed.us) or (208)373-4385.

### KEY FINDINGS

- Statistical stream models accurately represent spatial patterns on stream networks by incorporating statistical programs that account for the direction of flow and changes at tributary junctions.
- Spatial Stream Network (SSN) & Spatial Tools for the Analysis of River Systems (STARS) are powerful tools for spatial statistical modeling of stream networks
- STARS is an ArcGIS toolset used in conjunction with the Functional Linkage of Waterbasins and Streams (FLoWS) toolbox. STARS is capable of generating and formatting the data needed to fit spatial statistical models to streams data in Program R. The eight tools STARS provides are designed to analyze, reformat, and export the spatial data as a Spatial Stream Network (SSN) object.
- An SSN object contains all of the spatial, topological, and attribute information needed to fit a spatial statistical model to stream data. The SSN object can be directly imported to R statistical software using the SSN package. The SSN package for Program R provides a powerful set of functions for spatial statistical modeling of stream networks and can be used to fit spatial models to stream network data.