

Science You Can Use *Tool*

Raster Tools: Leveraging spatial analysis and AI towards a fire-resilient future, in minutes

To effectively manage fire, land and fire managers need detailed, current local information – for example, the amount of burnable material present, fuel moisture levels, winds, temperatures, and terrain changes across time and space. Managers also need these data to decide where, when, and how to treat a landscape while balancing costs and benefits, projected wildfire risk, and potential impacts.

Much of this information is collected by satellites, but processing this geodata into usable information and formats like maps, graphics, and reports is expensive and time-consuming. It's usually impossible without huge data farms and information processing centers.

That is, until now. John Hogland, a Research Forester at the Rocky Mountain Research Station, collaborated with the University of Montana Department of Computer Science to build [Raster Tools](#). Raster Tools is a Python package that can unlock the potential of large data sets and artificial intelligence (AI) to

RMRS Raster Utility Toolbar

The toolbar interface displays several functional panels:

- Code Editor:** Contains Python code for raster processing, including comments and function calls like `rf.computeNew(rf.minValues)[0]`.
- Summary Related Tools:** Features a 'Process' button and a 'Summary Statistics' section.
- Download Image:** Includes a 'Download' button and a 'Download to Store Image Title' field.
- Download Data:** Includes a 'Download' button and a 'Download to Store Image Title' field.
- Batch Process:** Includes a 'Run' button and a 'Batch Process' section.
- Summary Panel by Region:** Includes a 'Summary Panel by Region' section.

Raster Tools are grounded in the latest optimized processing techniques that leverage mathematical, statistical, and machine learning concepts to address questions like: What's the condition of a forest? How many trees are there per acre? What types of trees? What is the risk of wildfire? What was the fire severity level? These images show how multiple inputs feed into Raster Tools to yield future condition outputs, such as basal area as shown here (Hogland's Spatial Solutions 2025).

bolster wildfire mitigation and other land management efforts.

“Raster Tools integrates machine learning, artificial intelligence, and spatial learning, so that we can quickly analyze and use data to inform decision making,” said Hogland. “It’s free, open source,

and uses significantly less memory, space, and processing time than other related applications.”

Raster Tools can translate thought into real life applications in minutes. In terms of scope, Hogland compares it to an encyclopedia.

An article allows an author to promote one idea. A book allows a writer to share many ideas. Raster Tools is a multi-volume encyclopedia of numerous lines of code and mathematical functions that empowers an analyst to model outcomes and create new tools for natural resource planning and management.

This encyclopedia is not only vast; it's flexible. That means the classes and functions within the coding library allow for a wide range of functionality, including building new functionality. Imagine spatial modeling tools that can be easily updated based on information from the data used and questions asked by an analyst. Raster Tools is accessed through an intuitive application programming interface (API). While it can be integrated with other coding libraries to create a graphical user interface, it's not a point-and-click dropdown tool. Script builders use it to analyze data quickly and efficiently. It works on any processing platform (Windows, Mac, and Unix) to answer complex ecological and forestry-related questions and to build out the information users need to make complex decisions.

Hogland and colleagues have used Raster Tools to create various [products with tutorials](#). For example, they created a delivered cost analysis tool that quantifies timber values based on harvest and transportation distances to a mill. They also built [a tool to understand current forest conditions](#) and the most effective way to restore fire resiliency across multiple forests. Another tool, [Sample Design](#), aids researchers and practitioners alike in designing well-spread and balanced field samples.

Jason Barker, a Fire Analyst with the Forest Service Enterprise Program, has used the [delivered cost analysis tool](#) to map and analyze wildfire risk to landscapes and communities, coordinate response resources, and reduce burnable fuel. According to Barker, "Raster

Tools provides fire analysts with an agile tool to keep land managers updated on current risks to highly valuable resources and assets."

Management Considerations

- [Raster Tools](#) is a free python library that uses far less processing time, power, and computer storage space than other geospatial APIs and can run locally on laptops or in the cloud.
- Land managers can work with GIS specialists who have coding and scripting experience to use Raster Tools. The [QGIS plugin](#) can easily be added to a GIS analyst's toolbar.
- Raster Tools can be used to model detailed fuels treatments to a high specificity (unlike other modeling tools) and show the cost implications of specific wildfire mitigation treatments in exact locations.
- Raster Tools can be used to build other tools for a wide range of natural resources questions and applications.

Lead Scientist

[John Hogland](#), a Research Forester at the Rocky Mountain Research Station, is interested in quantitative methods within geographic information systems and in understanding the relationships between landscape patterns and forested ecosystems processes.

Annabelle Moore is the author of this Science You Can Use Tool. She is an endlessly curious freelance science writer intrigued by the connections between people and nature.

Further Reading

Hogland, J.; Anderson, N. 2017. [Function modeling improves the efficiency of spatial modeling using big data from remote sensing](#). Big Data and Cognitive Computing. 1(3): 1–14.

Hogland, J.; Dunn, C.J.; Johnston, J.D. 2021. [21st century planning techniques for creating fire-resilient forests in the American West](#). Forests. 12: 1084.

Access the [Raster Tools project page](#) and/or the [repository](#) for source code, code testing, documentation and more.



Rocky Mountain Research Station is part of Forest Service Research and Development.

While anchored in the geography of the West, our research is global in scale.

Our science improves lives and landscapes.