

# **pRasterBlaster: High-Performance Small-Scale Raster Map Projection Transformation Using the Extreme Science and Engineering Discovery Environment**

Michael P. Finn

U.S. Geological Survey (USGS), Center of Excellence for Geospatial Information Science (CEGIS)

Yan Liu

University of Illinois at Urbana-Champaign (UIUC), CyberInfrastructure and Geospatial Information (CIGI) Laboratory

David P. Mattli

USGS, CEGIS

Qingfeng (Gene) Guan

University of Nebraska -- Lincoln, School of Natural Resources

Kristina H. Yamamoto

USGS, CEGIS

Eric Shook

UIUC, CIGI Laboratory

Babak Behzad

UIUC, Department of Computer Science

## **ABSTRACT**

Enhancements in distributed geographic information systems, propelled to a large extent by the development of distributed processing, has evolved as an increasing area of exploration driven by geospatial problems in several fields that are increasingly computationally intensive (Zaslavsky and others, 2000). Research in the use of computing in the wider scientific community, termed cyberinfrastructure (CI) research (Atkins and others, 2003), is highly relevant to the research undertaken in cartography and geographic information communities and, thus, the importance of bridging CI and geographic information science to help the research of both domains (Wang and Liu, 2009).

A framework, portal, or gateway that provides this bridge allows a geographic information scientist to oblige legacy processes that are used in conventional computational tools, such as stand-alone programs like MapImage, or *mapIMG*, in an high-performance computing environment, such as the U. S. National Science Foundation's Extreme Science and Engineering Discovery Environment (Wang and others, 2009; Wang and Liu, 2009; Finn and others, 2011). This paper reports on the merging of geospatial data, interoperability, grid computing, and cyberinfrastructure domains for the purpose of rigorous map projection of raster datasets using pRasterBlaster, a parallel map reprojection program built on the basis of *mapIMG*, a computationally intensive program design for rigorous small-scale map projections. pRasterBlaster is designed to scale to thousands of processing cores by decomposing the spatial domain of a raster dataset. Re-projecting large raster datasets ranging to several gigabytes requires consideration of data handling. pRasterBlaster is being developed using the object-oriented general cartographic transformation program C++ library, the parallel raster processing programming library, and GISolve/ SimpleGrid (Williams and others, 2006; Guan and others, 2009; Wang and others, 2009).

KEYWORDS: map projection, raster datasets, high-performance computing, grid computing, geospatial data

#### DISCLAIMER

Any use of trade, product, or firm names in this paper is for descriptive purposes only and does not imply endorsement by the U.S. Government.

#### ACKNOWLEDGEMENTS

This work used the Extreme Science and Engineering Discovery Environment (XSEDE), which is supported by National Science Foundation grant number OCI-1053575.

#### REFERENCES

- Atkins, D. E., K. K. Droegemeier, et al. (2003). *Revolutionizing Science and Engineering Through Cyberinfrastructure: Report of the National Science Foundation Blue-Ribbon Advisory Panel on Cyberinfrastructure*. Arlington, VA, National Science Foundation.
- Finn, Michael P., Daniel R. Steinwand, Jason R. Trent, E. Lynn Usery, Robert A. Buehler and David Mattli (2011). An Implementation of MapImage, a Program for Creating Map Projections of Small Scale Geospatial Raster Data. Paper submitted to the journal *Cartographic Perspectives*.
- Guan, Qingfeng, Michael P. Finn, E. Lynn Usery, and David M. Mattli (2009). Rapid Raster Projection Transformation and Web Service Using High-Performance Computing Technology. Abstract presented at the *Association of American Geographers Annual Meeting*, Las Vegas, NV.
- Wang, Shaowen and Yan Liu (2009) TeraGrid GIScience Gateway: Bridging cyberinfrastructure and GIScience. *International Journal of Geographical Information Science*, Volume 23, Number 5, May, pages 631-656.
- Wang, Shaowen, Yan Liu, Nancy Wilkins-Diehr, and Stuart Martin (2009) SimpleGrid toolkit: Enabling geosciences gateways to cyberinfrastructure. *Computers and Geosciences*, Volume 35, Number 12, December, pages 2283-2294.
- Williams, Michael S., Michael P. Finn, and Robert A. Buehler (2006). An Open Source, Object-Oriented General Cartographic Transformation Program (GCTP). Abstract presented at the *International Society for Photogrammetry and Remote Sensing Commission IV Symposium on Geospatial Databases for Sustainable Development*, Goa, India.
- Zaslavsky, Ilya, Richard Marciano, Amarnath Gupta, and Chaitanya Baru (2000) XML-Based Spatial Data Mediation Infrastructure for Global Interoperability. *Proceedings 4th Global Spatial Data Infrastructure Conference*, Cape Town.