CDI FY17 Request for Proposals

Evaluation and testing of standardized forest vegetation metrics derived from lidar data

Submission Title: Evaluation and testing of standardized forest vegetation metrics derived from lidar data

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Science Support Framework Element 1: Data

Science Support Framework Element 2: Information

Science Support Framework Element 3: Communities of Practice

In-Kind Match: $19,000.00

List of anticipated deliverables from the project: The research team for this project will combine, evaluate, and extend processing scripts developed for computing 3D forest canopy structural metrics from LiDAR data and will produce, evaluate, and recommend the most appropriate geospatial output products and methodologies for a standardized set of vegetation canopy metrics. These scripts (written in the open-source Python language as wrappers to licensed LASTools and ArcGIS software) and geospatial data outputs, once finalized, will be made available to national mapping programs, other researchers, and the public. Ultimately, the recommendations and workflows resulting from this project could provide the basis for backend processing from repositories of lidar point cloud datasets that could be served to the public through a web interface for on-demand computation of vegetation canopy geospatial outputs.

Lead Cost Center: Leetown Science Center

Notes, Comments:

Project Description: The goal of this project will be to produce, evaluate, compare, and recommend a standardized set of lidar-based forest vegetation canopy geospatial datasets that could be incorporated into national mapping, wildfire management, and vegetation inventory programs (e.g. "Data and Information Assets").

Total Budget: $49,638.00

<u>Proposal Title</u>: Evaluation and testing of standardized forest vegetation metrics derived from lidar data: informing geospatial data products for 3DEP, LANDFIRE, and the National Park Service Vegetation Inventory programs.

<u>Scope:</u>

The USGS 3D Elevation Program has as its goal acquisition of complete nationwide coverage of lidar data (ifsar in Alaska) by 2023 for use in multiple applications. Lidar base specifications produced by the USGS provide much needed and widely implemented guidance to insure that lidar collections are at sufficient quality to produce high resolution "bare earth" elevation models. However much less guidance is currently available for producing standardized vegetation derivatives from lidar data. As a result, there is a (growing) wealth of under-utilized lidar point cloud data nationwide that could be exploited for mapping and monitoring vegetation community structure over extensive regions in ways that would otherwise require costly field work.

Lidar data has the potential to provide a rich set of metrics useful for quantifying the 3-dimensional nature of forest structure. Canopy structure information has many applications, such as vegetation community mapping, fire fuels modeling, wildlife habitat assessment, and biomass and carbon stock measurement. However the lack of standardized geospatial data products depicting aspects of 3D forest structure is a major information gap in managing wildlife habitat and assessing biodiversity in forests. DOI managers of National Parks and National Wildlife Refuges in particular could benefit greatly from this information to augment vegetation inventories, T&E species assessments, climate change monitoring, and fire management activities. **The goal of this project will be to produce, evaluate, compare, and recommend a standardized set of lidar-based forest vegetation canopy geospatial datasets that could be incorporated into national mapping, wildfire management, and vegetation inventory programs (e.g. "Data and Information Assets").**

<u>Technical Approach:</u>

Forest vegetation metrics can be readily derived from lidar data, including tree height and volume, canopy cover and density, height structure, and canopy gaps using several commercially available and open source software. In addition, recent research into representing lidar-based vegetation returns as volumetric pixels (or "voxels") holds promise for mapping additional components of vegetation structure. However, implementation of a suite of metrics over large regional collections requires scripting available functions for multiple lidar tiles, and computation of additional metrics not available in existing software. Although metrics may be generated by available software, very little guidance is available for evaluating the usefulness, consistency, and reliability of these data, as well as the appropriate resolution of output raster geospatial products. The research team for this project will combine, evaluate, and extend processing scripts developed for other efforts and will produce, evaluate, and recommend the most appropriate output products and methodologies. As a test of product applicability, we will work with National Park Service staff to evaluate DOI user needs for management application of lidar-based vegetation canopy geospatial products. NPS units with available recent, high quality lidar data and expressed needs (initially Shenandoah National Park, VA, and Grand Canyon, AZ) will be used as testbeds for this approach.

<u>Project experience and Collaboration:</u>

Through various previous projects including the DOI Hurricane Sandy supplemental, 3DEP, the Lidar Science effort of the Land Remote Sensing Project, pilot efforts for CSAS&L, and other efforts, the project team has written and implemented numerous lidar geoprocessing scripts to generate vegetation

canopy metrics from large volumes of lidar data (e.g. a "Community of Practice"). The project team includes:

John Young: USGS Leetown Science Center, Ecosystems Mission Area (Lead)
Jeff Danielson, Dean Gesch, Karl Heidemann, Kurtis Nelson, Birgit Peterson: USGS EROS
Jason Stoker, Cindy Thatcher: USGS National Geospatial Program, 3D Elevation Program
Monica Palaseanu-Lovejoy: USGS Eastern Geographic Science Center
Nicholas Kruskamp, Bill Slocumb: North Carolina State University, Center for Geospatial Analytics
Dan Hurlbert, National Park Service, Shenandoah National Park

Sustainability:

Processing scripts for generation of a standardized suite of forest canopy metrics as geospatial outputs are currently in their 3rd generation of development by project team participants. These scripts (written in the open-source Python language as wrappers to licensed LASTools and ArcGIS software) and geospatial data outputs, once finalized, will be made available to national mapping programs, other researchers, and the public. Ultimately, the recommendations and workflows resulting from this project could provide the basis for backend processing from repositories of lidar point cloud datasets that could be served to the public through a web interface for on-demand computation of vegetation canopy geospatial outputs.

Budget Justification:

Requested budget items are for travel, computer hardware and software, and salary for project participants. See below for breakdown.

Timeline: *1 month from project award*: Assemble team, gather data, revise processing scripts, *3 months from project award:* complete processing on all data tiles, evaluate outputs, compare data, *6 months from project award:* complete evaluation, summarize results, make recommendations, publish data and scripts

Estimated Budget:

Budget Category	Federal Funding "Requested"	Matching Funds "Proposed"
1. PERSONNEL (SALARIES including benefits):		
Federal Personnel Total:	$32,000	$16,000
Contract/Collaborator Personnel Total: NCSU	$5,000	$0
Total Salaries:	$37,000	$16,000
2. TRAVEL EXPENSES:		
Travel Total (Per Diem, Airfare, Mileage/Shuttle) **x** # of Trips:	$2000	$0
Other Expenses (e.g. Registration Fees):	$0	$0
Total Travel Expenses:	$2000	$0
3. OTHER DIRECT COSTS: (itemize)		
Equipment (including software, hardware, purchases/rentals): software licenses, hard drives	$1,000	$13,000
Publication Costs:	$0	$0
Office Supplies, Training, Other Expenses (specify):	$0	$0
Total Other Direct Costs:	$1,000	$0
Total Direct Costs:	$40,000	$0
Indirect Costs (%): 24.095 Leetown Science Center	$9,638	$0
GRAND TOTAL:	$49,638	$19,000