

**CDI SSF Category 3: Data and Information Assets**

**National Land Cover Database Visualization and Information Tool**

**Applicants/Principle Investigators(s):**

Collin Homer, USGS EROS, 47914 252<sup>nd</sup> St, Sioux Falls, SD 57198.

Ph (605) 594-2714 email [homer@usgs.gov](mailto:homer@usgs.gov)

Christopher Barnes, PhD, ARTS Contractor to USGS EROS, 47914 252<sup>nd</sup> St, Sioux Falls, SD 57198.

Ph (605) 594-6917 email [barnes@usgs.gov](mailto:barnes@usgs.gov)

**Abstract:**

The National Land Cover Database (NLCD) serves as the definitive Landsat-based, 30-meter resolution, land cover database for the Nation. NLCD supports a wide variety of Federal, State, local, and nongovernmental applications that seek to assess ecosystem status and health, understand the spatial patterns of biodiversity, predict effects of climate change, and develop land management policy. However, access to NLCD products for the USGS community and the public is a concern due to large file sizes, limited download options, and the expectation that users must download and analyze multiple land cover products in order to answer even basic land cover change questions. The proposed solution will develop an online land cover visualization tool that enables users to view and explore wall-to-wall, spatially explicit, national land cover changes and trends without the need for geographic information system software, download data, or advanced technical expertise. The visualization tool will facilitate and improve USGS data and information access to help users better visually analyze and explore NLCD land cover data. It will also allow users to query specific types of land cover changes between 2001 and 2006; additionally, users will have the ability to generate and export land change summary statistics, which will enhance communication and understanding of Earth's physical and biological systems. The shifting emphasis of the NLCD program from mapping to monitoring provides the opportunity for subsequent NLCD data products (i.e., NLCD 2011, 2016...) to be added to the tool which will result in continued innovative access to USGS land cover data.

**Total funding amount requested:** \$55,000

**Total in-kind funding:** \$35,000

**Datasets:**

USGS National Land Cover Database, land cover and imperviousness, 2001, conterminous U.S.

USGS National Land Cover Database, land cover and imperviousness, 2006, conterminous U.S.

**Geographic/geologic/ecosystem/habitat/taxonomic/other context:**

U.S. national, land cover change, ecosystem status and health,  
biodiversity, climate change

**Type of Product(s) Generated:**

Land cover and land change web site visualizing and analysis tool,

Land cover change statistical summary report.

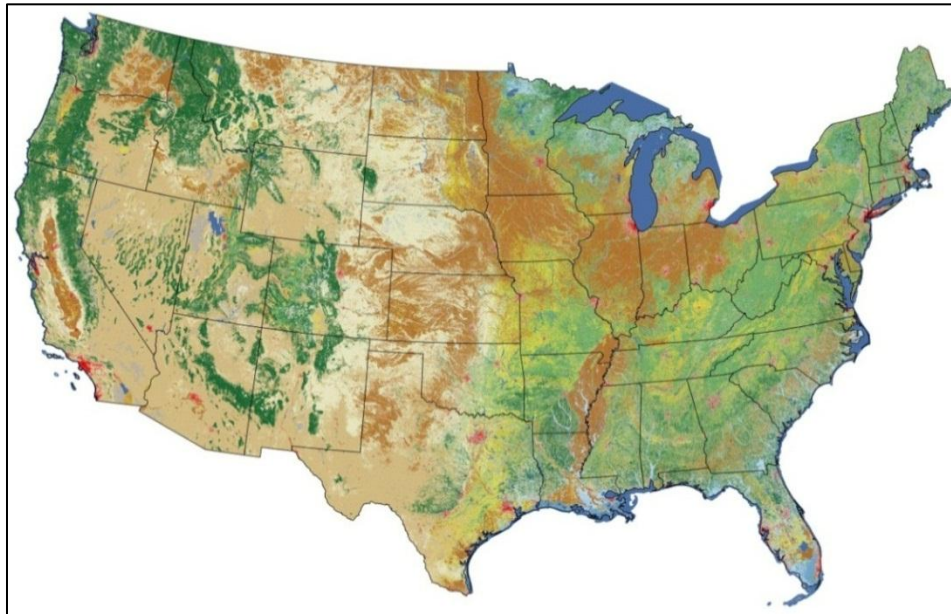
## Summary

### **Project title: National Land Cover Database Visualization and Information Tool**

**CDI SSF Category: Data and Information Assets**

### **Introduction and Background**

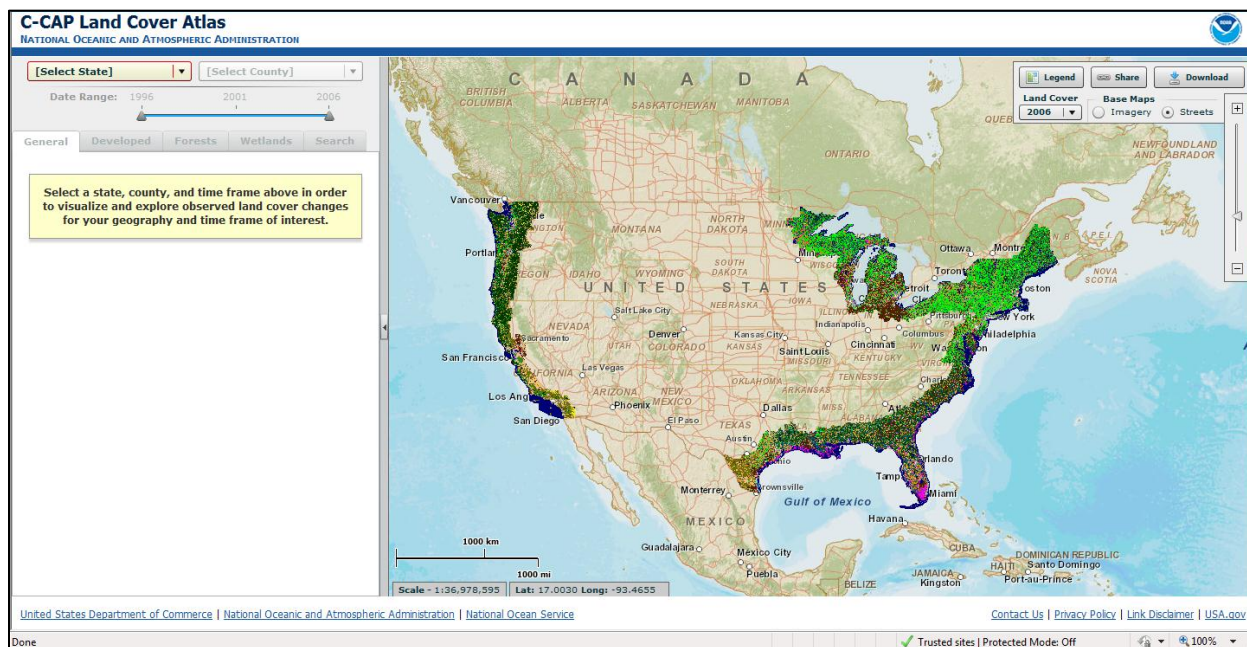
National Land Cover Database (NLCD) products provide spatial reference and descriptive data for characteristics of the land surface such as thematic class (for example, urban, agriculture, and forest), percent impervious surface, and percent tree canopy cover throughout the conterminous United States (Figure 1). These products are created by the Multi-Resolution Land Characteristics (MRLC) Consortium, a partnership of Federal agencies (Environmental Protection Agency, National Oceanic and Atmospheric Administration, U.S. Forest Service, U.S. DOI Bureau of Land Management, U.S. Department of Agriculture, National Parks Service, NASA, U.S. Fish and Wildlife Service and the Army Corps of Engineers) led by the USGS. The recent release of NLCD 2006 provides - for the first time - the capability to assess wall-to-wall, spatially explicit, national land cover changes and trends across the conterminous United States from 2001 to 2006. However, access to NLCD products is a concern due to their file sizes (e.g., compressed, NLCD 2006 land cover is about 1.0 Gb) and limited download options. Although all NLCD data products are available for download at no charge from the MRLC website (<http://www.mrlc.gov/>) users can only view and use the data if they have a geographic information system software license, at least 30 Gb of available disk space (to view NLCD 2001 and NLCD 2006 land cover), and some technical expertise. This proposed NLCD visualization tool will use the software architecture from NOAA's Coastal Change Analysis Program (C-CAP) Land Cover Atlas as the initial base to further improve USGS NLCD web capability to enable discovery, analysis, understanding, and visualization of land cover data across the lower 48 states. Using the NOAA software architecture will maximize the utility of this online tool and optimize the use of USGS resources.



**Figure 1.** The National Land Cover Database (NLCD) land cover layer is one of several primary and supplementary layers in NLCD 2006. NLCD 2006 is the most recent 30-meter, seamless, wall-to-wall land cover database. This is the first opportunity that provides a national capability to view and assess land change across the lower 48 states between 2001 and 2006.

## Scope

The goal of the NLCD Visualization Tool is to facilitate unprecedented online access to wall-to-wall national land cover and land change data for USGS scientists and managers across all mission areas, as well as the public. This tool will provide the first ever, spatially explicit, nationally standardized database of land cover and land change information across all lower 48 states, delivering an immediate solution to an existing USGS data integration and access challenge. Currently, NOAA's C-CAP Land Cover Atlas viewer only provides nationally standardized land cover and land change information for *coastal* regions of the lower 48 states (Figure 2).



**Figure 2.** The color-shaded regions in NOAA's Land Cover Atlas viewer above represent the area where Coastal Change Analysis Program (C-CAP) land cover data are available. The proposed NLCD Visualization and Information Tool will provide the USGS community and the public access to a nationally standardized database of land cover and land change information across all lower 48 states.

Taking advantage of the USGS/NOAA MRLC partnership, NOAA staff will provide USGS EROS Center software engineers with the C-CAP Land Cover Atlas viewer software architecture to create a similar online data viewer to help deliver consistent user-friendly access to wall-to-wall NLCD data that will:

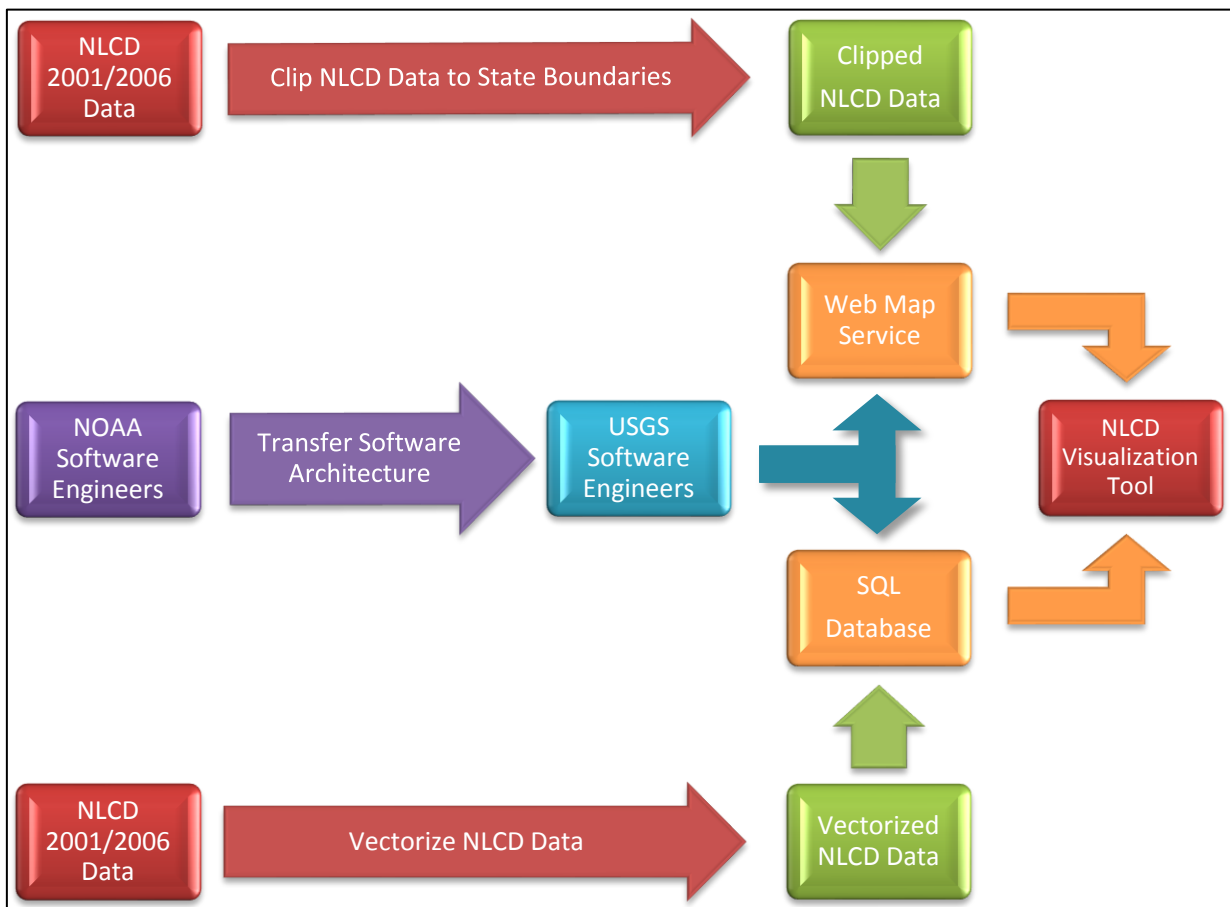
- **help** users of all abilities to visually analyze and explore NLCD land cover data
- **allow** users to query specific types of land cover changes between 2001 and 2006
- **generate** summary reports and data tables of land cover changes to enhance communication and advance understanding of land changes and trends

The first project milestone will be to advance online access to NLCD 2001 and NLCD 2006 land cover data and to provide land cover change and trend information without the need for geographic information system software, download data, or advanced technical expertise. Land cover data will be viewable at the continental or user-selected state scale. The tool will summarize general land change trends as well as provide users with the option to specify and explore specific land change classes of interest. Throughout the fiscal year, the project will be promoted via the USGS Land Cover Twitter (~700 followers to date) and USGS Facebook accounts. Completion of the tool will coincide with a USGS News Room press release.

The proposed tool is technical in scope and provides a solution that transfers land cover data from the *Scientific Data Life Cycle Processes* to the *Information and Knowledge: Understanding of Earth Systems* horizontal element in the Community for Data Integration Science Support Framework. Furthermore, this solution supports Goal Three of the **USGS Global Change Science Strategy: A Framework for Understanding and Responding to Climate and Land-Use Change** (Burkett *et al.*, 2011) which aims to “improve understanding of land-use and land-cover changes: rates, causes, and consequences”. Because land changes have local origins and regional and global consequences, this visualization tool will encourage interdisciplinary land change investigations that must focus on patterns, processes, and consequences of land cover change at multiple spatial and temporal scales across all USGS mission areas. The shifting emphasis of the NLCD program from mapping to monitoring ensures that subsequent NLCD data products (i.e., NLCD 2011, 2016...) can be added to the tool, providing an additional solution to future innovative applications such as access to and analysis of USGS data on mobile applications. Future updates could also include additional options for other user defined areas of interest such as National Park boundaries, wilderness areas, and watersheds.

### **Technical Approach**

Transfer of NOAA’s Land Cover Atlas viewer architecture to USGS contract software engineers is made possible through the well-established collaborative relationship USGS and NOAA share through the MRLC. NOAA has expressed full commitment to this proposed solution and is eager to help bring this land cover and land change visualization capability to the USGS community and public. NLCD Project servers located at the EROS Center will provide the hardware system requirements to support the viewer. Figure 3 briefly outlines the steps, tasks and procedures necessary to accomplish this projects objective.



**Figure 3.** Steps and methods required to implement the proposed project solution to create the National Land Cover Database Visualization Tool.

## **Project Experience**

Successful completion of this project is greatly dependent on the Project Lead's (**Christopher Barnes**) organization skills and experience and, communication with the CDI implementation team. Christopher's prior project management experience includes the release and present day-to-day operation of the USGS Land Cover Institute (<http://landcover.usgs.gov/>), redesign, release, and maintenance of the NLCD website (<http://www.mrlc.gov/>), and mapping coordinator for NLCD 2006, prior to competitively winning a multi-year NASA Earth System Science Fellowship in 2006 for his PhD research. **Collin Homer, Joyce Fry, Jon Dewitz** and **Richard Vandersnick** have an extensive legacy working on the NLCD project. Their combined experiences range from establishing a research strategy team, source data preparation, change analysis, impervious/canopy estimation, land cover characterization of change pixels, post-processing and final product release. To date, they are responsible for ten NLCD products, and are currently involved in the initial mapping phase of NLCD 2011. Their experience will be used to prepare NLCD 2001 and NLCD 2006 data for accurate display and analysis. **Nate Herold** and **Brian Hadley** are responsible for NOAA's C-CAP Land Cover Atlas viewer and will coordinate with **Wyatt Anderson's** Spatial Data Warehouse software engineers to help with the technical transfer of NOAA's software architecture to the EROS Center.

## **CDI Implementation Team**

### **Principal Investigator**

#### **Collin Homer**

USGS EROS  
47914 252<sup>nd</sup> St,  
Sioux Falls, SD 57198.  
Ph. (605) 594-2714  
[homer@usgs.gov](mailto:homer@usgs.gov)

### *Other Team Personnel*

#### **Joyce Fry**

USGS EROS  
47914 252<sup>nd</sup> St,  
Sioux Falls, SD 57198.  
Ph. (605) 594-2739  
[jfry@usgs.gov](mailto:jfry@usgs.gov)

#### **Jon Dewitz**

USGS EROS  
47914 252<sup>nd</sup> St,  
Sioux Falls, SD 57198.  
Ph. (605) 594-2715  
[dewitz@usgs.gov](mailto:dewitz@usgs.gov)

## **Collaborating Personnel**

### **Nate Herold**

NOAA Coastal Services Center  
2234 South Hobson Ave,  
Charleston, SC 29405  
Ph. (843) 740-1183  
[nate.herold@noaa.gov](mailto:nate.herold@noaa.gov)

### **Project Lead**

#### **Christopher Barnes, PhD**

ARTS Contractor to  
USGS EROS  
47914 252<sup>nd</sup> St,  
Sioux Falls, SD 57198.  
Ph. (605) 594-6917  
[barnes@usgs.gov](mailto:barnes@usgs.gov)

#### **Richard Vandersnick**

SGT Inc., Contractor to  
USGS EROS  
47914 252<sup>nd</sup> St,  
Sioux Falls, SD 57198.  
Ph. (605) 594-6518  
[vanders@usgs.gov](mailto:vanders@usgs.gov)

#### **Wyatt Anderson**

SGT Inc., Contractor to  
USGS EROS  
47914 252<sup>nd</sup> St,  
Sioux Falls, SD 57198.  
Ph. (605) 594-2516  
[vanders@usgs.gov](mailto:vanders@usgs.gov)

#### **Brian Hadley**

NOAA Coastal Services Center  
2234 South Hobson Ave,  
Charleston, SC 29405  
Ph. (843) 202-2629  
[brian.hadley@noaa.gov](mailto:brian.hadley@noaa.gov)

Permission has been requested, and confirmation received, from the EROS Center COR, Joy Hood ([jhood@usgs.gov](mailto:jhood@usgs.gov)) and the EROS Director, Frank Kelly ([fkelly@usgs.gov](mailto:fkelly@usgs.gov)) for USGS contracting staff participation in this CDI project implementation team.

### **Commitment to Effort**

The NLCD Visualization Tool will be made available to the USGS community and the public on the NLCD website with further access provided via the USGS Land Cover Institute, USGS Climate and Land Use, and the USGS EROS Center websites. Long term sustainability of the tool beyond the award period is particularly promising. NLCD 2011 is currently in the initial mapping stage with an anticipated public release in December 2013. NLCD products will likely remain on a 5-year product cycle (initial planning for NLCD 2016 is already underway), meaning that subsequent NLCD products can be added to the tool, providing unprecedented wall-to-wall, spatially explicit, national assessment of land cover change back to 2001 (Homer *et al.*, 2012). Furthermore, potential exists to make the tool available on mobile devices, giving users the ability to compare multiple geographical locations while in the field (funding for mobile capability is not included in this CDI proposal).

### **Budget**

<b>Budget Category</b>	<b>Federal Funding 'Requested'</b>	<b>Matching Funds 'Proposed'</b>
<b>1. Salaries</b>		
<b>Personnel</b>		
Collin Homer (Project PI)		\$6,000
Joyce Fry (Geographer)		\$5,500
Jon Dewitz (IT Manager)		\$9,500
<b>Contract Personnel</b>		
Christopher Barnes (Project Lead)	\$5,000	\$7,000
Richard Vandersnick (MRLC Database Coordinator)	\$5,000	\$4,000
Wyatt Anderson (Senior Programmer Analyst)	\$3,000	\$3,000
Software Engineer Salary	\$40,000	
<b>Collaborating Personnel</b>		
Nate Herold (NOAA)		
Brian Hadley (NOAA Software Engineer)		
Total Salaries:	\$53,000	\$35,000
<b>2. Field Expenses</b>		
USGS CDI Annual Meeting Travel Estimate		
Airfare for 1 person	\$1,300	
Lodging for 1 room for 3 days	\$400	
Per Diem for 1 person for 3 days	\$200	
Public Transportation	\$100	
Total Field Expenses:	\$2,000	
<b>GRAND TOTAL:</b>	<b>\$55,000</b>	<b>\$35,000</b>

**Table 1.** Budget for this proposed Community for Data Integration project.

## Timeline

Task/Objective	March 31 <sup>st</sup> , 2013	April 2013	May 2013	June/July 2013	August 31 <sup>st</sup> , 2013	1 <sup>st</sup> week Sept 2013	15 <sup>th</sup> Dec 2013
<b>Funding Awarded</b>	✓						
CDI implementation team ‘kick-off’ meeting		✓					
NOAA transfers technical software architecture to EROS		✓	✓				
Clip by State NLCD 2001 and NLCD 2006 land cover products		✓					
Vectorize NLCD 2001 and NLCD 2006 land cover products		✓	✓				
Create progress/status presentation for CDI Annual Meeting			✓				
CDI implementation team meeting and social media update			✓				
<b>TNM/CDI Annual Meeting</b>			✓				
Design NLCD Visualization Tool web page on NLCD web site			✓				
Design layout template for land cover statistics output report			✓				
CDI implementation team meeting and social media update				✓			
Draft press release for datablast				✓			
<b>CDI Epose (Datablast)</b>				✓			
Complete visualization tool architecture (June)				✓			
Complete NLCD Visualization Tool NLCD web page (June)				✓			
NLCD Visualization Tool available for beta test (July)				✓			
Identify and fix bugs/problems/concerns from beta test (July)				✓			
Complete beta test and resolve any other technical issues					✓		
CDI implementation team meeting and social media update					✓		
<b>Deadline: Final Deliverable</b>							
NLCD Visualization Tool available to USGS personnel and the public. USGS News Room press release and social media announcement					✓		
EROS CDI implementation team meeting debrief					✓		
<b>Progress Report Due</b>						✓	
<b>Deadline: CDI Annual Report</b>							✓

**Table 2.** FY13 Community for Data Integration proposed task and objective timeline.

## References

Burkett, V.R. and others, 2011, Public review draft—USGS global change science strategy: A framework for understanding and responding to climate and land-use change: U.S. Geological Survey Open-File Report 2010–1033, 32 p., at <http://pubs.usgs.gov/of/2011/1033/>.

Homer, C.H., Fry, J.A., and Barnes C.A., 2012, The National Land Cover Database, U.S. Geological Survey Fact Sheet 2012-3020, 4 p., at <http://pubs.usgs.gov/fs/2012/3020/>.



**United States Department of the Interior**

U.S. GEOLOGICAL SURVEY  
National Center for Earth Resources Observation and Science  
Sioux Falls, South Dakota 57198

In Reply Refer To:  
DO 11-1 SAB 11-2

November 5, 2012

Jennifer Carlino  
U.S. Geological Survey Core Science Systems  
Denver Federal Center  
Denver, Colorado 80225

Dear Ms. Carlino:

The U.S. Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center is pleased to support the proposal "National Land Cover Database Visualization Tool" by Collin Homer and Christopher Barnes. The proposal is being submitted in response to the Request for Proposals: Community for Data Integration.

The proposal involves facilitating new, unprecedented access to the National Land Cover Database for the public, USGS scientists and land cover users. It will further the USGS EROS science vision of providing operational terrestrial land cover monitoring data, while also helping to advance USGS data integration and access goals. Given that both are key elements of the USGS mission, I wholeheartedly support this endeavor.

Collin Homer, the USGS team lead for Land Characterization, and, Christopher Barnes an employee of Arctic Slope Regional Corporation Research and Technology Solutions, contractor to USGS EROS, will serve as the principal investigators of the proposed project. Both have extensive experience in project management and working with National Land Cover Database products. Dr. Barnes will serve as the point of contact for this proposal, and can be reached by telephone at (605) 594-6917.

Sincerely,

Dr. Frank P. Kelly  
Director, USGS EROS  
USGS Space Policy Advisor





U.S. DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
Coastal Services Center  
2234 South Hobson Avenue  
Charleston, South Carolina 29405-2413

November 5, 2012

Dear Community for Data Integration Review Panel,

I am writing this letter in support of your selection of the proposed online land cover visualization tool for development. This proposal is being submitted by Chris Barnes to your internal Community for Data Integration Request for Proposals (RFP) announcement.

The proposed work focuses on developing an online viewer that will enable users to extract summary information and explore wall-to-wall, spatially explicit land cover changes and trends produced through the National Land Cover Database (NLCD) mapping efforts. The tool will accomplish these aims without the need for geographic information system software or advanced technical expertise, thereby greatly increasing the access and use of these data sets to those who are not as technically capable of performing such geospatial analysis themselves.

The proposed tool will leverage an existing NOAA tool, the C-CAP Land Cover Atlas. The Coastal Change Analysis Program (C-CAP) land cover and change mapping data set contributes to the NLCD efforts, providing much of the mapping effort in the coastal areas of the U.S. NOAA is a contributing member of the Multi-Resolution Land Characteristics (MRLC) consortium, which is the interagency body responsible (in conjunction with the U.S. Geological Survey) for production of the NLCD. The extension of this tool will not only provide an excellent resource to managers nationwide but will also strengthen NOAA's existing tool by expanding its coverage to complete coastal states and nationwide.

I hope that you will fully consider this project for selection and implementation. If NOAA is awarded, our agency's technical resources would be made available to the principal investigator during development. Agency personnel would provide copies of our existing code, answer questions, and aid in the tools scoping. Please feel free to contact me with any further requests related to NOAA's support of this project.

Sincerely,

Nathaniel Herold (Nate.Herold@noaa.gov)  
Coastal Change Analysis Program Manager  
NOAA Coastal Services Center  
2234 South Hobson Ave.  
Charleston, SC 29405-2413



NOAA Coastal Services Center  
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

[www.csc.noaa.gov](http://www.csc.noaa.gov)

National Ocean Service • National Marine Fisheries Service • National Weather Service  
Office of Oceanic and Atmospheric Research • National Environmental Satellite, Data, and Information Service