Subsidence Susceptibility Map for the Conterminous U.S.

CDI FY19 Statement of Interest

Lead PI Information

PI Name: Jeanne Jones
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PI Organization: USGS Western Geographic Science Center
PI Mission Area: Land Resources
PI City, State: Menlo Park, CA

Financial Information

Total Requested Funds: 40278
In-Kind Matching Funds: 12106

Project Information

Project Description: This project aims to create an authoritative nationwide subsidence susceptibility map based on established research enhanced with innovative processing techniques
List of Anticipated Deliverables: GIS raster heatmap, web service, methodology, documentation
SSF Element 1: Information
SSF Element 2: Web Services
SSF Element 3: Publishing / Sharing

Collaborators

	Name	City	State	Organization
Co-PI	Dan Doctor	Reston	VA	Eastern Geology and Paleoclimate Science Center
Collaborator	Jeff Falgout	Denver	CO	Core Science Systems
Collaborator	Natalya Rapstine	Denver	CO	Core Science Systems

Title: Subsidence Susceptibility Map for the Conterminous U.S.
USGS Lead PI: Jeanne Jones, Western Geographic Science Center

Project Narrative

This project aims to create an authoritative nationwide subsidence susceptibility map based on established research enhanced with innovative processing techniques. USGS researchers have developed algorithms to identify closed depressions related to subsidence at the surface. However, the computer processing required to create a nationwide product has been beyond reach of these subject matter experts. We will use the USGS Yeti supercomputer along with nationwide 10-meter DEMs, NHD, and karst geology layers to develop a raster density heatmap showing areas more likely to have karst depressions. Independent work in smaller study areas will be used to provide a confidence rating on the automated analytical processing.

This data is of significant interest to several USGS Mission areas through the identification of (1) potential **hazards** to DOI and U.S. infrastructure due to sinkholes causing foundational structure instability, (2) hydrologically significant areas with increased **water** detention storage for groundwater recharge, and (3) vernal pools in sensitive **ecosystems** that are a vital landscape resource in the life cycle of amphibians and their insect food sources. This project (1) contributes to the understanding of the Earth's physical and biological systems through the creation of a nationwide product based on USGS expertise, (2) uses existing USGS authoritative data to create a new information product, and (3) completes the science data life cycle by documenting, preserving, and sharing both the product and the methodology.

The subsidence susceptibility heatmap will be made available as a web service in the existing CDI Risk Map project and archived in ScienceBase along with the methodology used to create it. As part of the CDI Risk Map, the heatmap can be visualized along with the existing catalog of assets and other hazards, while the web service will be available for research use to anyone on the internal DOI network.

To create the heatmap, we will begin with ArcGIS toolboxes HydroCutter and Contour-tree developed by researchers for identifying closed depressions. Using 10-meter DEMs and vector lines for NHD streams and roads from the National Map, we first run the Cutter tool to allow streams to pass across roads and remove "digital dams" by creating a new, modified "burned" DEM with stream crossings burned across roads. Next, the Hydro tool defines artificial stream lines that conform to the DEM topography and produces a DEM that has filled each closed depression to its spill point. Then the Sinker tool finds the closed depressions in the "burned" DEM created by the Cutter tool. Finally, the Contour-tree tool is run to identify compound depressions. This process runs successfully on a county-level study area and processing parameters have been optimized for identifying closed depressions with a high degree of accuracy. **The challenge and thrust of this CDI proposal will be to scale this established process up to the conterminous U.S. and optimize the code for the high-performance computing environment.**

The principal investigator has led and successfully completed multiple software projects at the USGS including the 2018 CDI Risk Map project and has taken the USGS Yeti training class. Collaborator #1 (co-PI) is a research geologist specializing in karst studies and has developed and taught a class on identifying closed depressions in DEMs. Collaborators #2 and #3 are computer scientists with the Advanced Research Computing group and have extensive experience programming Yeti. We anticipate 1 month dedicated to code conversion, 1 month to generate results, and 1 month for quality assurance and hosting of the final product.

Estimated budget table

Budget Category	Federal Funding "Requested"	Matching Funds "Proposed"
1. PERSONNEL (SALARIES including benefits):		
Federal Personnel Total: Jeanne Jones (6 PP), Dan Doctor (2 PP) Jeff Falgout (1 PP), Natalya Rapstine (1 PP) - CSS	$30,600	$10,600*
Contract/Collaborator Personnel Total:	$0	$0
Total Salaries:	$30,600	$10,600
2. TRAVEL EXPENSES:		
Travel Total (Per Diem, Airfare, Mileage/Shuttle) **x** # of Trips: 1 trip to CDI workshop, 1 trip from Reston to Menlo	$1,200	$1,187
Other Expenses (e.g. Registration Fees):	$0	$0
Total Travel Expenses:	$1,200	$1,187
3. OTHER DIRECT COSTS: (itemize)		
Equipment (including software, hardware, purchases/rentals):	$0	$0
Publication Costs:	$0	$0
Office Supplies, Training, Other Expenses (specify):	$0	$0
Total Other Direct Costs:	$0	$0
Total Direct Costs:	$31,800	$11,787
Indirect Costs (% 26.916):	$8,478	$319**
GRAND TOTAL:	$40,278	$12,106

* Dan's salary will be funded by his science center, with no overhead

** This indirect cost is on the $1187 travel to be paid by WGSC