United States Department of the Interior

U. S. GEOLOGICAL SURVEY
Box 25046, MS 980
Denver Federal Center
Denver, Colorado 80225-0046
Geosciences and Environmental Change Science Center

Project: Geologic map unit thickness estimator (GMUTE)

CSM CSCI370 SU25
USGS 1

Organization Background

The U.S. Geological Survey provides science for a changing world, which reflects and responds to society's continuously evolving needs. As the science arm of the Department of the Interior and one of the world's leading scientific institutions, the USGS brings an array of earth, water, biological, and mapping data and expertise to bear in support of decision-making on environmental, resource, and public safety issues.

Project Description

Geologic maps are fundamental to advancing our Nation's economic prosperity and security, with applications ranging from finding economic deposits of critical minerals such as lithium to identifying faults that could host earthquakes. Although geologic maps are among the most data-rich products in the geosciences, most are vastly underutilized as quantitative analytical tools. Through the National Cooperative Geologic Mapping Program, the USGS seeks to accelerate detailed geologic mapping of the United States and expand the maps' utility, quality, and interoperability.

For this project, students will develop a software toolbox that can estimate true thicknesses of sedimentary and volcanic units based on geologic map relationships. The students will also develop a system to display visualizations of the results in an existing web based USGS digital geologic map explorer page. The toolbox will calculate geologic unit thicknesses using vector-based geologic map data and raster-based digital elevation models (DEMs). The toolbox will report best estimates as well as the uncertainty and variability of unit thicknesses estimated across an area. As a dependency, the toolbox will require adaptation of existing code to calculate the orientations of planar surfaces (such as sedimentary bedding) based on polylines of geologic contacts and DEM data. The completed toolbox will be integrated with existing workflows to automate estimation of geologic unit statistics across large map areas.

Desired Skillset

- *Required:* Proficiency with Python, R, or another relevant language.
- *Desired:* Basic knowledge of geology, reading geologic maps, and trigonometry.
- *Desired:* Familiarity with geographic information systems (GIS) software such as ESRI ArcGIS Pro or QGIS.

- *Desired:* Experience creating web-based data visualizations.
- *Optional:* Experience using geospatial packages such as ArcPy, GDAL, or the R package terra.
- *Optional:* Proficiency with PostgreSQL.

Student Benefit

- Opportunity to develop highly valued and versatile skills with:
    - Geographic information systems (GIS),
    - Digital cartography including geospatial data processing, and
    - Geology and geologic mapping.
- Opportunity to work with government professionals on a topic of key importance to national security and economic advancement.

Team Size

The preferred team size is 2–5 students.

Work Location

The preferred work location is remote. Meetings will be via Microsoft Teams.

Intellectual Property

Any Intellectual Property (IP) developed during the Project will be owned by the either USGS, Colorado School of Mines, and (or) its students as determined by U.S. law. Notwithstanding, for all IP and derivative data created during the Project, USGS will receive a Government Use license, allowing the Government to reproduce, publish, modify, or otherwise use the IP. Government use may include providing the IP and derivative data to the public via USGS websites or public software repositories.

Non-Disclosure Agreement

An NDA is not required.

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