COAL - Coal and Open-pit surface mining impacts on American Lands

Introduction and Context

Mountain-top Mining (MTM) is a method of open surface mining with the primary aim of exploring and exploiting coal seams present within the land and solid earth (LSE) on mountaintops. Amongst other surface mining activities, MTM is known to be an extremely destructive mining procedure predominantly limited to the spatial boundaries of the Southern Appalachians (Eastern Kentucky, West Virginia and very small sections of Virginia and Tennessee). MTM is known to have caused irreparable damage to mountain landscapes and significant immediate and longer-term damage to key streams and watersheds. Larger afield, the rest of the U.S.A has some extensive surface mining in various places for exploitation of resources such as gravel/sand, various metals, other minerals and even radioactive materials, etc. Several studies have provided important scientific understanding related to the local, regional and state-level impacts of such environmentally destructive practices, however a similar understanding on the national and continental levels are very much lacking.

Project Motivation & Statement

This project will deliver **COAL** - ***C****oal and* ***O****pen-pit surface mining impacts on* ***A****merican* ***L****ands* - a suite of algorithms to identify, classify, characterize, and quantify (by reporting a number of key metrics) the direct and indirect impacts of MTM and related destructive surface mining activities across the continental U.S (and further afield).

Project Objectives

(i) Work with the NASA JPL team to utilize imagery from satellites such as Landsat 5, 7 and 8 to build a suite of imagery processing algorithms that identify mining activity across the U.S. dating from ~1980 to present. Examples of such activity are located within the central Appalachian regions of the eastern United States where the U.S. Environmental Protection Agency (EPA) estimated 2,200 square miles (5,700 km^2) of Appalachian forests were cleared for MTM sites by the year 2012, with over 500 mountaintops being destroyed due to MTM activity;

(ii) Eventually, enable improved accuracy of correlations between proximity of MTM activities to streams, rivers, estuaries, etc. through use of hydrology, dam and reservoir datasets such as the Global Reservoir and Dam Database (GRaND) and other water system datasets. EPA impact statements have found that streams in valley filling from MTM-affected watersheds contain higher levels of minerals in the water and decreased aquatic biodiversity. Mine-affected streams also have high selenium concentrations, which can bioaccumulate and

produce toxic effects (e.g., reproductive failure, physical deformity, mortality), and affect reservoirs below such streams; and

(iii) Provide a baseline suite of reporting metrics which will appropriately rank and document the changes within LSE areas and hydrological waterways as observed over time; finally (iv) extend **COAL** as a set of reusable components which can be used in cloud-based platforms such as Mapbox's Landsat-live or NASA Ames Stereo pipeline, amongst others.

Knowledge Required

It is essential that Engineering team have a rooted interest in image processing and analysis technologies as well as an understanding (or aptitude to learn about) scientific data formats such as netCDF and HDF5-EOS. Students must be reasonably fluent in Python and C/C++ programming languages.

Candidates should be VERY prepared to work with Open Source communities (primarily at the Python communities and possibly communities within the Apache Software Foundation) to find solutions and develop open source solutions based upon their own willing and initiative. All code will be permissively licensed under the Apache License v2.0.

Website

N/A

Project Deliverables

1. Based on the development one or more appealing usage scenarios; develop and deliver a working architecture and systems engineering document that defines the scope of the COAL software suite.
2. Provide a schedule of works that defines milestones and timelines for achieving 1 above.
3. Deliver on subtasks which address parallel development of
    - A suite of imagery processing algorithms that identify, classify, characterize, and quantify mining activity across the U.S. dating from ~1980 to present.
    - Tests for such algorithms
    - An interactive, self sustaining Website which will be updated with imagery exposing and highlighting the destructive nature of the mining activities detailed earlier within this document.

Additional Comments

2016-2017 will be our 3rd Capstone project engagement with OSU. Our 2014-2015 project iPReS; The Internationalization Product Retrieval Service was a success. Details of iPReS can be found here - http://lewismc.github.io/iPReS/, and our 2015-2016 efforts ARIA-P are documented at http://aria-p.github.io. We

very much look forward to engaging with the current Capstone initiative and look forward to meeting our students.