GE 440 Site Proposal and LandTrendr Support Plan

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Note: Milestones are in parenthesis at the end of each action item

1. **My Understanding of the LandTrendr and Time Sync Projects**

“LandTrendr” is a set of automated algorithms for detecting interesting features from a times series of data points originating in Landsat images. LandTrendr is an acronym for “**Lan**dsat based **D**etection of **Tren**ds in **D**isturbance and **R**ecovery.” These algorithms have the ability to distinguish between actual disturbances in the time series caused by unusual events like a landside or bug infestation from seasonal changes in vegetation or from noise caused by atmospheric disturbances.

The LandTrendr process transforms a spectral trajectory scatterplot of indices like NBR versus time, into a series of time segments whose vertices represent important inflection points in the pixel history of a landscape. Each vertex is either a disturbance or the beginning of a recovery for the vegetation represented by the pixels. For example one time segment in the time series might represent a bug infestation and the adjacent segment in the series might represent the regrowth in forest vegetation. Dr. Kennedy calls this process “temporal segmentation” to distinguish the process from segmentation that breaks a single image into a set of spatial features. After analysis, information about the vertices: the index value, the point in time, and source image, are stored in a database of vertex maps.

Accuracy of the LandTrendr algorithms is assessed by another project called “Time Sync.” Time Sync is conceptually similar to the LandTrendr project, but uses human experts instead of computer algorithms to separate genuine inflection points in Landsat time series data from noise. The human expert is aided by tools like a display of “chips,” small historical images of the area immediately around the pixel being studied, Z-plots and automatic linking to Google Earth imagery for the same spot in the landscape. The expert also uses other databases like the NLCD to do the time series classification. This is a time consuming, but necessary process, used to validate automated LandTrendr results.

Once the time series for each of the pixels in a set of historical images has been classified into a series of time segments and stored, adjacent pixels showing a simultaneous onset of a disturbance can be group into a “patch.” Patches are really polygons resulting from spacial segmentation of the change map based on time segmentation results. At this point, we know that, most likely, the same disturbance happened to the landscape at the same point of time over the area of the patch. However, we don’t know the nature of the disturbance. A human expert must now characterize the type of the land cover before the disturbance, the nature of the disturbance, and evolution of the land cover after the disturbance. The human expert uses a piece of software, the LandTrendr change attribution interface, to add a description of what happened to the patches of land, to the vertex map associated with the patches. The vertex map plus the attribution labels (descriptions) are the basis for the disturbance patch maps (change maps). The results from this attribution process are then used as training data for an algorithm that attempts to generalize the results to larger datasets covering greater periods of time.

LandTrendr is a machine learning application that uses unsupervised classification to detect land-based change recorded in Landsat images, confirms the existence of change using human experts in a partner project called “Time Sync,” uses experts to characterize the nature of change and then uses these results to further refine the temporal segmentation process, the spatial segmentation process and production of change maps in its goal to produce yearly change maps of landscapes more efficiently than can be accomplished by human analysis alone.

1. **My Site Proposal and Goals for This Course**
   1. Select a site that has already been classified by the Time Sync project and cloud masked by Zhe Zhu using Fmask. (March 7)
   2. Study and apply the same processes used by the Time Sync project and by Zhe Zhu to see if I arrive at the same classifications of land cover and change through time. (March 31)
   3. Study and manually apply LandTrendr processes to the site. (Apr 15)
   4. Finally, automatically apply the LandTrendr automated process to the same site for the same period in time and compare the results. (Apr 20)
2. **My Planned Contributions to the LandTrendr Project**
   1. Install the LandTrendr attribution interface website on an Amazon AWS VM instance. (March 31)
   2. Create plans to publish and provide client support for the LandTrendr algorithms. This action item may include creating a version control repository, bug database, installation package and wiki. Knowledge I gain in the class project should aid this endeavor. (July 30)
   3. Investigate not only putting the LandTrendr attribution interface in the “cloud,” but also the computation of vertex maps and maps of change.
3. **General Principals to Follow**
   1. This is a public project with a goal of encouraging worldwide participation and citizen-science.
   2. All elements of the project should be portable and not tied to any particular organization.
   3. We should document well, all software, processes and procedures so that they can be easily replicated by anybody at any time.