Project Title: Lidar Point Cloud Analysis

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I. Introduction

   A. For this project we have been tasked with creating a map of land cover in a portion of the central Sierra Nevada Mountains near Big Pine, CA. We will classify the area using a Landsat 8 image of the region, which includes both the Sierras and a portion of the adjacent Owens valley. The image was acquired on June 8, 2014 and contains 10 spectral bands.

II. Motivation

   A. In this project, we are interested in using several classification methods to classify the water, agricultural, snow, ice, forest, bedrock, desert, and urban land cover types. By employing multiple classification methods we can determine which method is best for the region and the land cover types we are interested in.

III. Methods

   A. To classify the image we will employ the unsupervised IsoData method and the supervised Maximum Likelihood, Minimum Distance, and Decision Tree Classifier methods.

      1. IsoData Classification

         a) In this method, ENVI will select the number of classes and perform the classification without the aid of the user.

      2. Maximum Likelihood

         a) In this method, we will first create regions of interest based on each land cover type, each containing roughly 1000 pixels. Then the algorithm will create a classification result based on the probability of each pixel residing within each class.

      3. Minimum Distance

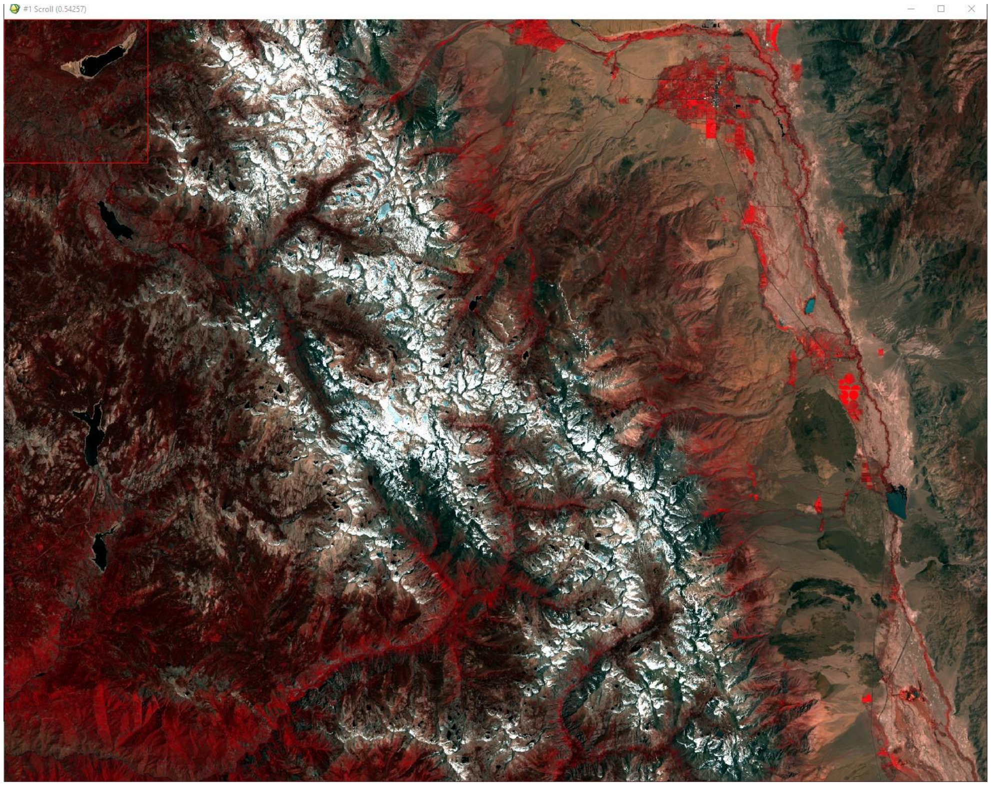
   a) In this method, we will use the same regions of interest, but the algorithm will assign values based on euclidean distance to the mean of each class.

4. Decision Tree Classifier

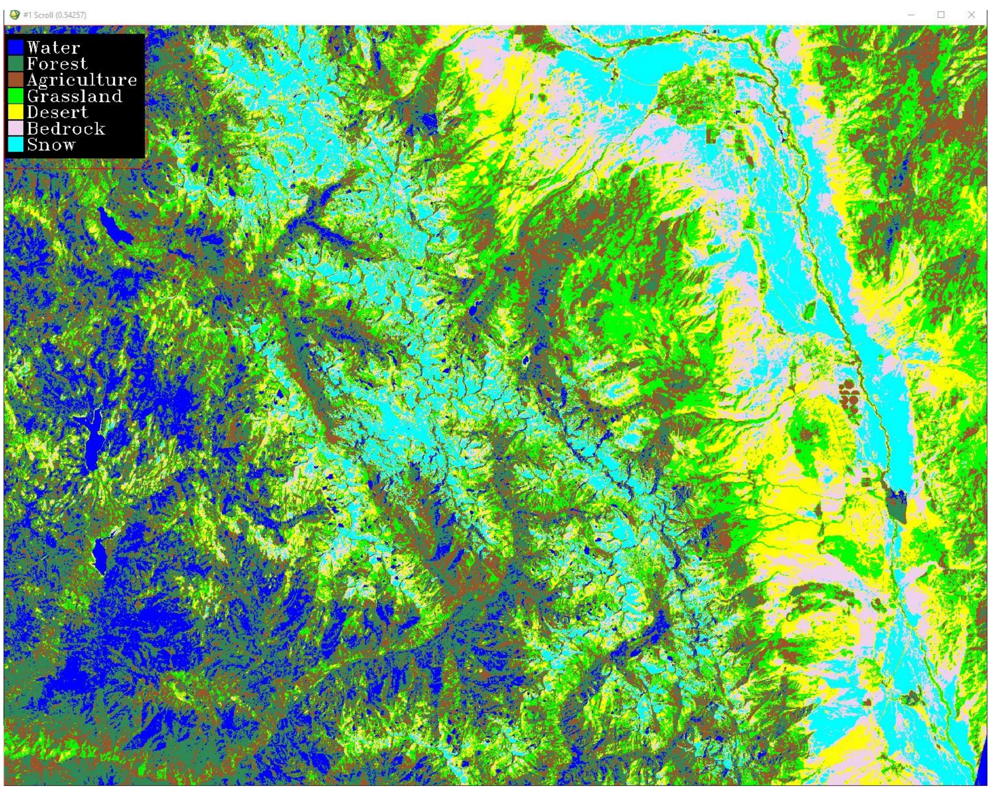
   a) In this method, we will use the same regions of interest. However, this time we will assign specific thresholds for the algorithm to make decisions on how to classify each pixel.

V. Completed Project Data

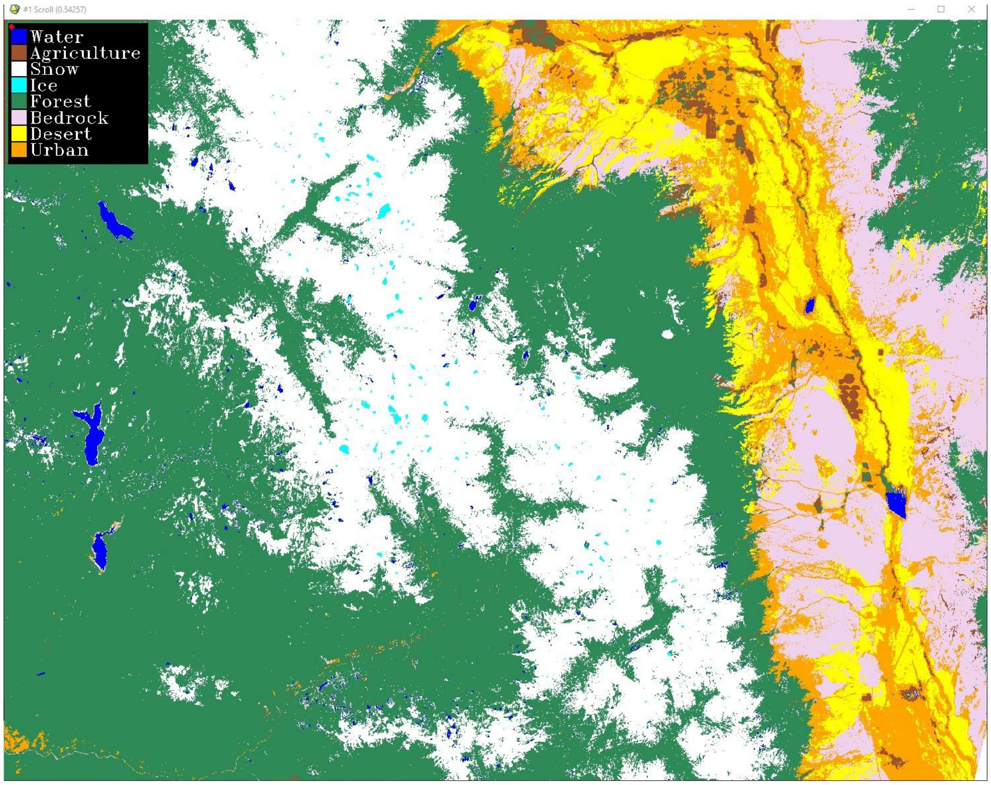
NDVI



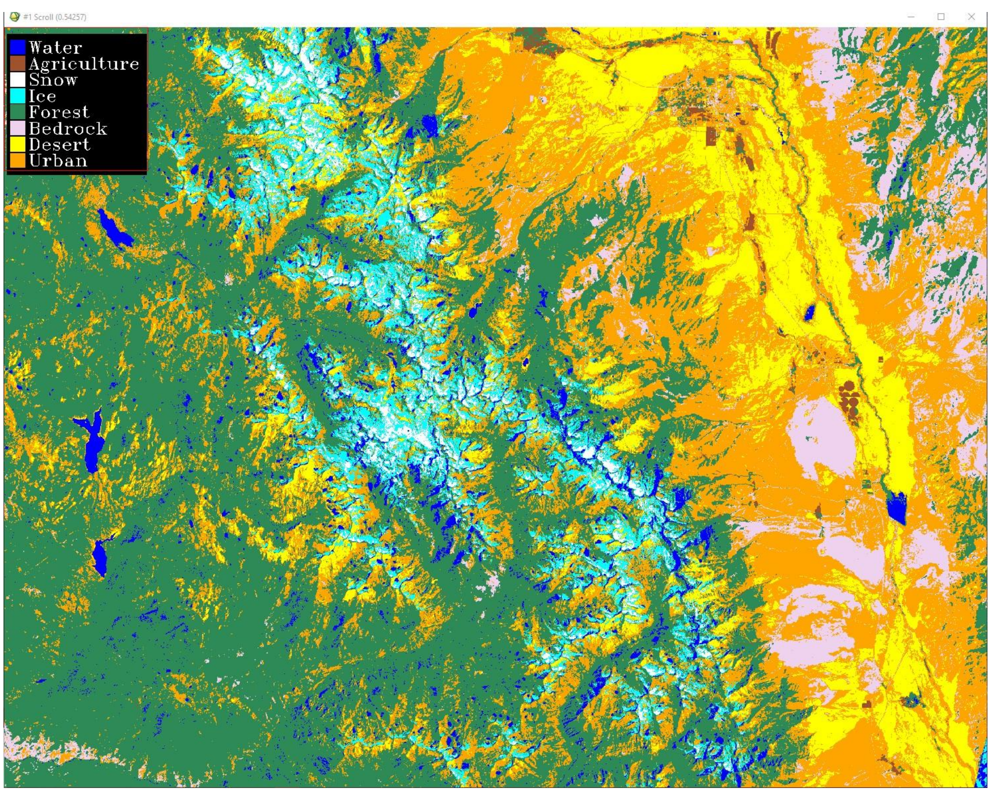
IsoData



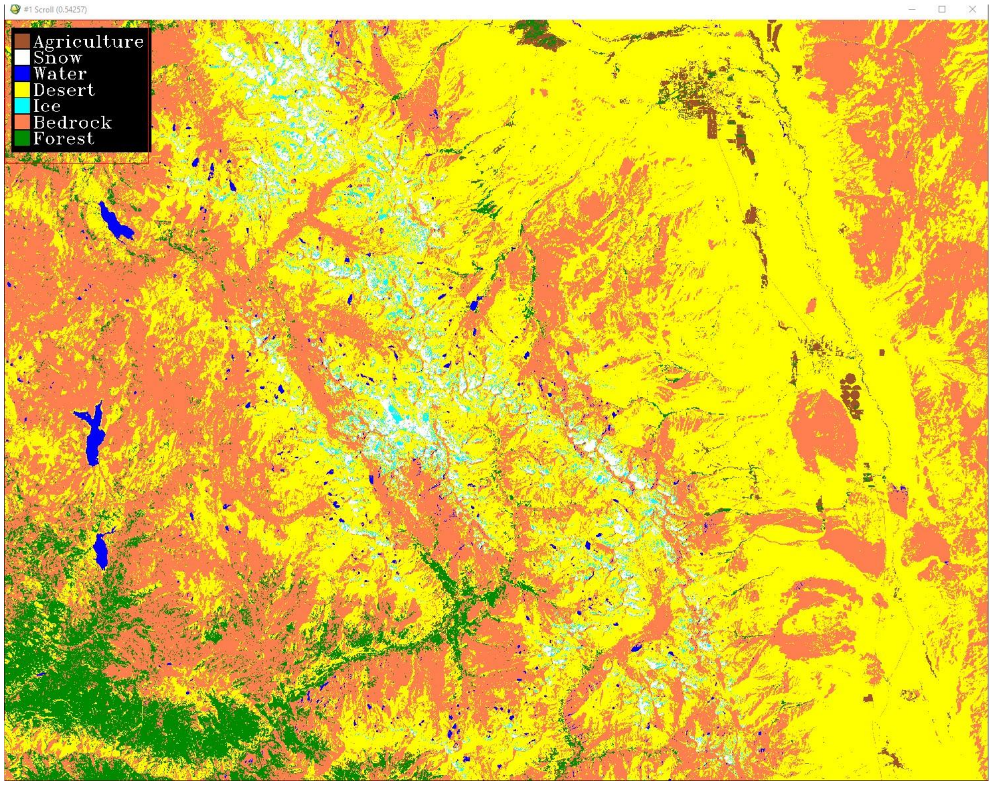
Maximum Likelihood



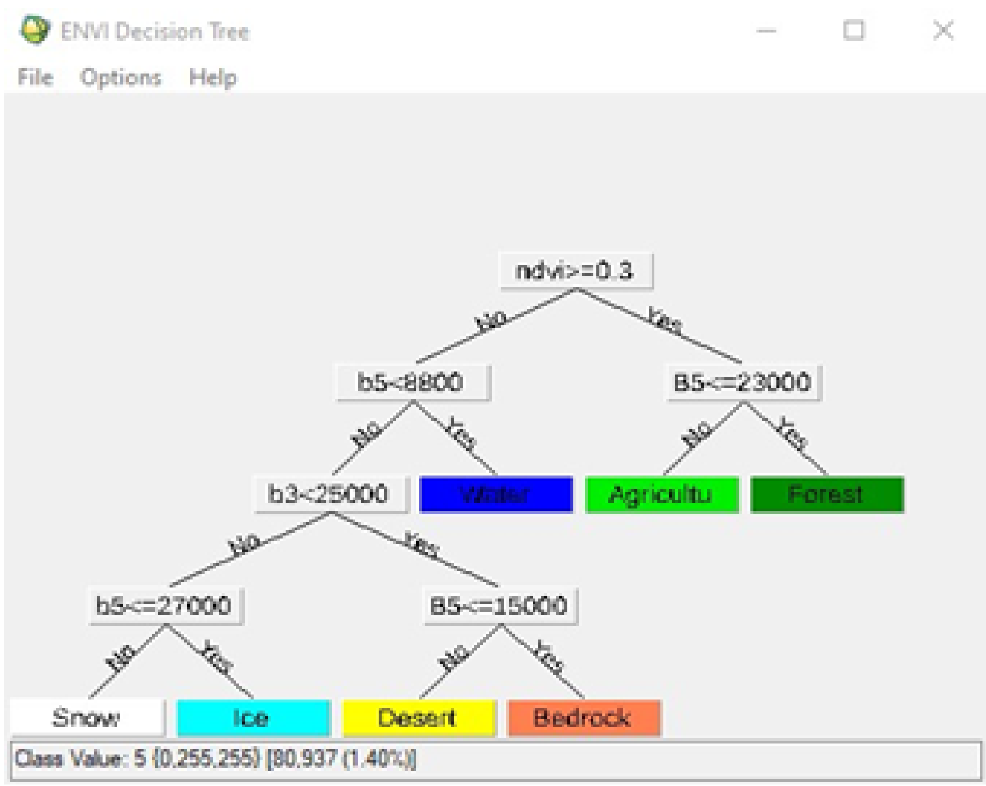
Minimum Distance



Decision Tree Classification



Decision Tree



VI. Conclusion

The ISODATA classification method provides a quick and easy way to classify image data. This method is better at finding pixels that match each other because the classification is done by the computer. With this method, the user knows that each class is as identical as possible because there is no room for human error. This method is good if the image contains well-defined land cover types with well-defined borders. It is also helpful in determining the general number of classes within an image if not much is known about the study area. The **downsides** of this classification method are that it can break similar regions into too many classes. The user needs to be careful of how many classes the algorithm is asked to make otherwise superfluous classes can be produced. This method may also characterize two different land cover types as the same type because they share similar characteristics. The fact that this method is unsupervised and based solely on spectral data means that human input through manual visual interpretation cannot help the processes, even if the land cover type of a certain pixel is known.

The minimum distance classification method is very useful when information is known about the study area because it is a supervised classification method. This method is particularly useful when well-defined classes are used because the user knows a lot of information about the land-cover types present in the study area. This method takes more processing power than the ISODATA method but not by much. There is, however, much necessary prep time required to produce good classifications in the form of sampling the base image and learning what land cover types are likely to be present.

The maximum likelihood classification method is also useful when information about the study area is known. The difference between this method and the minimum distance method are that 1) this method requires more processing power and 2) when well-defined samples are used (no overlap between land cover types in a single sample) the algorithm has less to work with when choosing a class for a specific pixel. In other words, if all samples for a “water” class are taken of clear water from a lake, the algorithm will only output clear water as that class, possibly ignoring water with sediment or rivers and streams. This method relies more on either the number of classes or that samples cover all variations in a single class.

This classification method is useful when precision is key and time is of no issue. This method allows the user to create very specific classifications that can be based on more than just spectral data numbers such as NDVI indices and slope. The difficulty with this method is finding a set of rules that can classify one land type but not affect the classification of others. Other difficulties include determining at what DN two land types differ, what DN ranges certain land types share and deciding what land types to classify first. Overall this method seems to be the most useful, however requires knowledge of the general differences in spectral reflectance between land types and a fair amount of statistical analysis and trial and error.