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NRS 533 Project

Lake Mead Is Shrinking

Introduction –

Lake Mead is located in the states of Nevada and Arizona. It is the largest reservoir in the United States of America. Water inflow into the lake occurs due to snowmelt from the Colorado, Wyoming and Utah Rocky Mountains. It is a very valuable resource of water as it supplies water to 36 million people in the seven states on the western half of the United States. The water is mainly used for agricultural purposes, hydropower generation from Hoover dam and water utilities by many cities. There has been a drastic decline in the water levels of the lake for more than fourteen years. Using remote sensing technology, a few observations have been made about the causes and results of shrinking of Lake Mead.

Objective –

Lake Mead is a very important resource of water for Arizona, California, Colorado, New Mexico, Nevada, Wyoming and Utah. It can hold 28 million acre-feet of water at its full capacity. It also generates hydropower at Hoover dam to satiate the power demands of Arizona, Nevada and California.

The water levels of Lake Mead have been declining every year drastically. This is strongly impacting the environment around it. As Lake Mead is one of the most important resources of water in the USA, remote sensing technology is employed to understand possible causes related to water loss.

Data and Methods –

Remote sensing data is downloaded from USGS Earth Explorer website (http://earthexplorer.usgs.gov/). Datasets of *Landsat 4-5* from March 1991 and *Landsat 8* from November 2013 with less than 10% cloud cover are selected and downloaded.

Using ERDAS Imagine 9.3 *layer stack* function, an 8-band composite containing band 2, 3, 4, and 5 TIFF files from each dataset is created. This combines and overlays the information recorded by each band on top of one another. The information captured reveals clearly the areas of changes and water loss in the lake. Different combinations of bands reveal different changes that have happened in and around Lake

The data is then classified using *Supervised* and *Unsupervised* classification methods. *Supervised* classification method was performed using the *Minimum distance rule* algorithm to minimize the misclassification of pixels. Training signature interpreted for both classification methods contained 20 clusters or classes, which were reduced to water, soil, urban, snow and vegetation using the *merge* function. It was observed that there was some prominent misclassification of pixels due to shadows of mountains and clouds. They were classified as water.

Discussion –

After performing classification methods on the datasets, the various changes that happened in the last 22 (1991-2013) years were determined. The causes for these changes were researched. Some were visible from the imagery and some had to be researched into. The two extreme changes noted were large areas of water loss and expansion of the city of Las Vegas. The areas that were submerged under water in 1991 are seen revealed and converted either into vegetation or dry land in 2013. These areas can guide in estimating the intensity of water loss. In addition to the former, Las Vegas has almost tripled in its size and population in the last 22 years. As the city becomes larger so does the amount of water required to fulfill its needs. This also sets the base for high agricultural and power demands. The effect can be clearly seen in Figure 1. below where areas shaded in blue depict regions that have lost water over the past two decades. A major cause appears to be the dramatic expansion of the city of Las Vegas (Figure 2.)

March 1991 **November 2013**

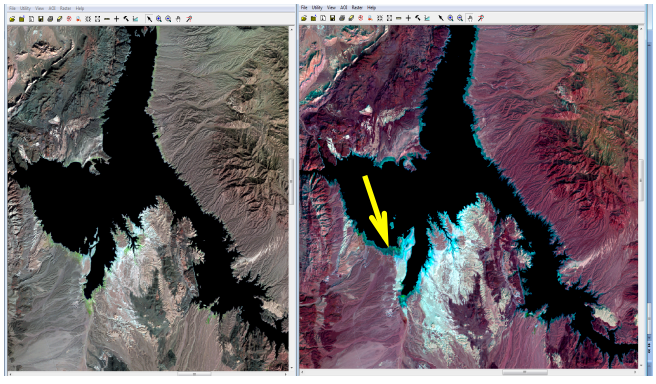

Figure 1. November 2013 picture shows the areas of water loss in blue color.

March 1991 **November 2013**

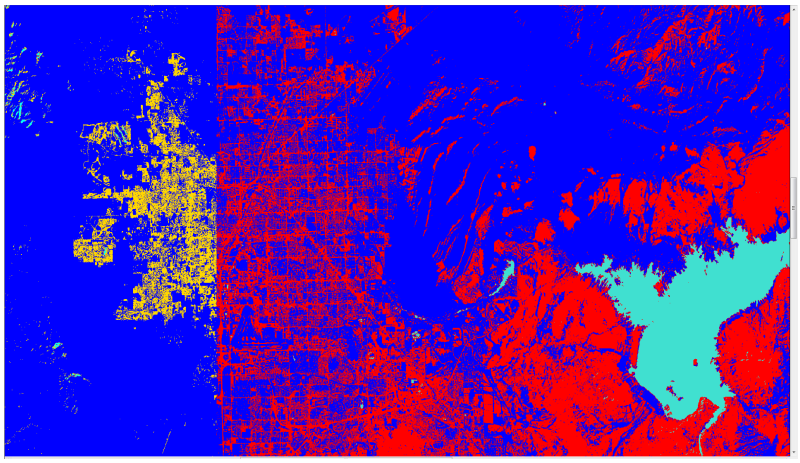

Figure 2. Through supervised classification expansion of Las Vegas is shown

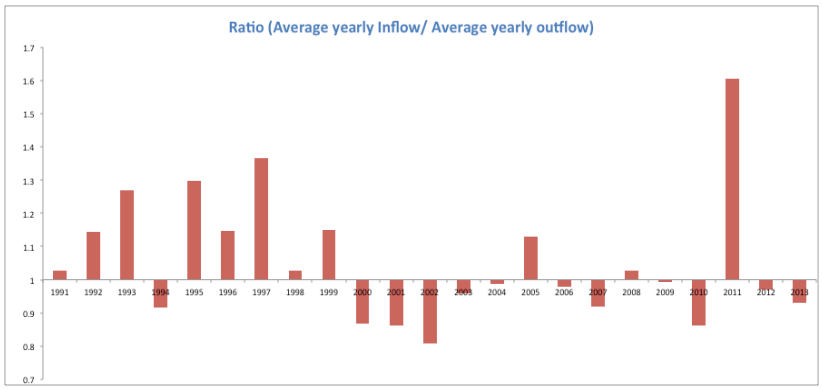

Figure 3. Ratio of average yearly inflow over average yearly outflow

From an analysis of the yearly Lake Mead inflow/outflow water ratios (Figure 3.) it can been seen that the overall trend over the past 14 years has been towards more water being lost from the lake (with 2005, 2008 and 2011 being exceptions). The trend in the 10 years prior was much the opposite (with exception of 1994 all years during this period experienced higher inflow vs. outflow). 2011 is an outlier in the dataset most likely due to high rainfall and snowfall on the Rocky Mountains in that particular year.

Additionally, the scarcity of water can be explained in part due to extreme drought conditions, which have persisted in the whole area for the past 14 years. The below average levels of rainfall and snowfall has reduced the amount of inflow into Lake Mead. Although the average yearly inflow is below normal, the average yearly outflow has not gone down with respect to inflow. This imbalance in the inflow-outflow ratio has made the condition of the lake poorer.

The current water level of Lake Mead is 1,175 feet, which is only 100 feet away from the critical limit of 1,075 feet. If the lake continues to lose water at this pace soon some drastic measures will have to be adopted in order to control the outflow from the lake.

Conclusions –

Lake Mead's water level is decreasing rapidly every year. Analysis of the causes and results of Lake Mead's current condition is performed using remote sensing technology. It is concluded that there are many factors influencing the great loss of water in Lake Mead. A major factor is the persistent drought affecting the inflow of water into the lake. The inflow of water into the lake has been impacted due to below average levels of rainfall and snowfall for the last 14 years. The second cause is increased water and power demands due to the expansion of the city of Las Vegas, which has tripled in its size and population in last 22 years. There is more outflow of water than the inflow, which is causing the water levels to drop even further. The scarcity of water will result in impacting the wildlife and endangered species in that area, affecting generation of hydropower from Hoover dam, increasing the loss in agricultural production, disturbing water services in the cities etc.

References –

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