Mapping Lake Evaporation Using Satellite Imagery

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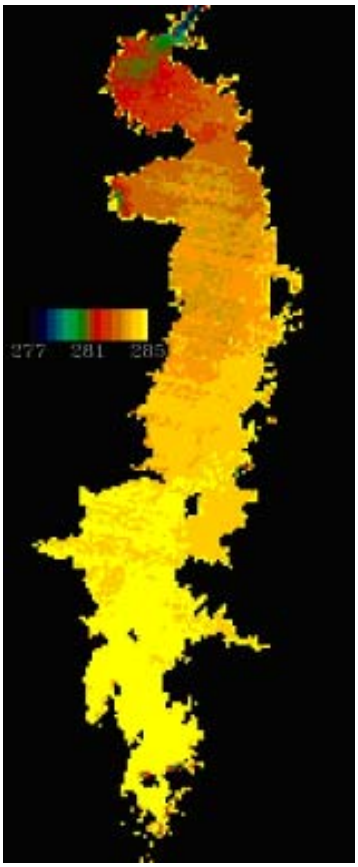
PURPOSE OF STUDY

Evaporation is a function of temperature, wind, and humidity, all of which are interdependent. Wind changes the humidity and if the humidity is low, the evaporation rate is higher. At the same time, air temperature influences humidity and surface temperature. These factors all contribute to evaporation with temperature likely being the dominant factor influencing evaporation. The purpose of this study is to determine if that is the case. Two methods are being utilized for determining evaporation over Elephant Butte lake using satellite imagery: a bulk-aerodynamic method and a linear regression. Both methods use remote sensing for locating evaporation over a body of water by finding the skin temperature of water. Thus far, analysis was completed for the date of December 22, 2001. This date was ideal because satellite imagery, New Mexico State University tower sensors, and pan evaporation data were available.

STATUS OF STUDY

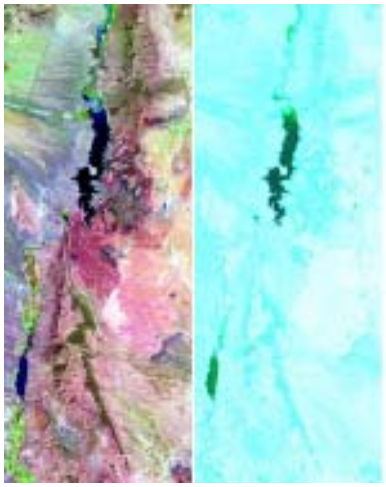
The researchers are using ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) images. ASTER is an imaging instrument contained on Terra, a satellite launched in December 1999 as part of NASA's Earth Observing System. ASTER can obtain detailed maps of land surface temperature, emissivity, reflectance, and elevation. To obtain surface temperatures of Elephant Butte lake, surface temperature photos were taken. The temperature difference between the ASTER image and the measured temperature from the temperature tower was 1.7º Celsius, a significant difference. When computations were performed, the bulk-aerodynamic evaporation calculated was much higher for the ASTER image than the measured counterpart. However, the bulk-aerodynamic evaporation result was calculated for just one point during the day and not numerous points. The assumption was that if the tower surface water temperature was close to the ASTER image temperature, then the ASTER image temperatures could be integrated across the entire lake, creating a thorough and accurate evaporation prediction. This would be a tremendous leap in making more accurate evaporation predictions and would greatly help determine the yearly water budget for Elephant Butte.



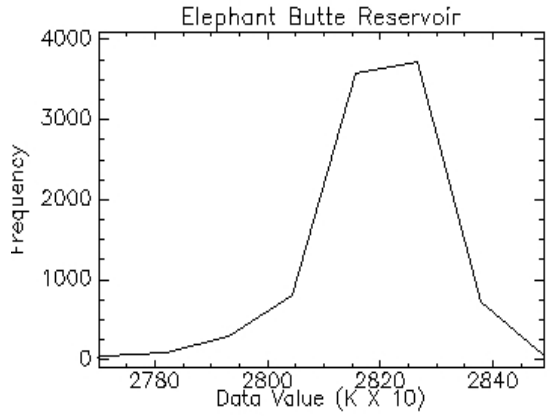
Elephant Butte Lake temperature difference in Kelvin x 10 on December 22, 2001.

Many assumptions are made in these calculations. The wind temperature is assumed to be constant throughout the lake, which, in reality, it is not. Also, the exact time for both the satellite image and the measured data must be identical in order to allow for comparison of evaporation values. Also, the measured bulk-aerodynamic method used many measured points at different times of the day, where the ASTER image was determined from a single point in time. If we could obtain many ASTER images from a single day, we would be able to calculate a more accurate evaporation result. Also, future research should include data from multiple time periods to accurately calculate evaporation.

Data for four more dates will be obtained and studied. Working with his adviser, the student will discuss the results and determine the next steps for future research. Ultimately, this research will lead to better management of our water supply.



Satellite Images of Elephant Butte



Histogram of temperature pixels