Assessment of Lake Water Quality and Quantity Using Satellite Remote Sensing

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Introduction

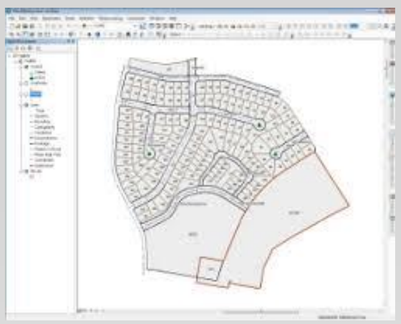
For many decades, scientists has been trying to monitor the water quality of lakes because it is responsible for sustaining local lives and ecosystems. Lakes are popular hosts of environmental problems as a result of urbanization and modernization of human societies.

Eutrophication is ne major problem.[1] it is the excessive algal growth in a body of water. It is often caused by the buildup of nutrients and minerals in lakes, and it is the leading source of impairment of water quality deterioration in lakes.[2] Some of the causes of algal bloom include sewage and agricultural discharges.[3] Algal blooms may in turn cause anoxic conditions, which is the depletion of oxygen in water. Cyanobacteria are a blue algae that produce cyanotoxins. They dominate eutrophic lakes and make the water toxic.[4]

In this study we explored eutrophication in 5 lakes across the world, each chosen for the significance of their impact on local livelihood.

Methods

- Satellite images were used in conjunction with Geographical Informations Systems (GIS) software to collect necessary data.
- Images without any cloud cover over the bodies of water were selected, because the functions that were used to determine the presence of chlorophyll and sedimentation relied upon the properties of reflectance of light.
- To properly use the images, they had to be combined together to form a complete image. We eliminated the empty data values that distort the pictures that would have prevented us from creating a combined image, which is known as a mosaic.
- The satellite images that were downloaded from the Landsat 1 Collection 1 Level-1 library. The selected images were then downloaded with the " LandsatLook Images with Geographic Reference" option in order to be able to have the images automatically oriented geographically upon downloading, taking advantage of the automatic georeferencing done by ArcMap.
- To combine the images while removing the empty data values, we used the "Raster" tool available as a part of the ArcToolbox group of features available on ArcMap. We used the Copy Raster function.

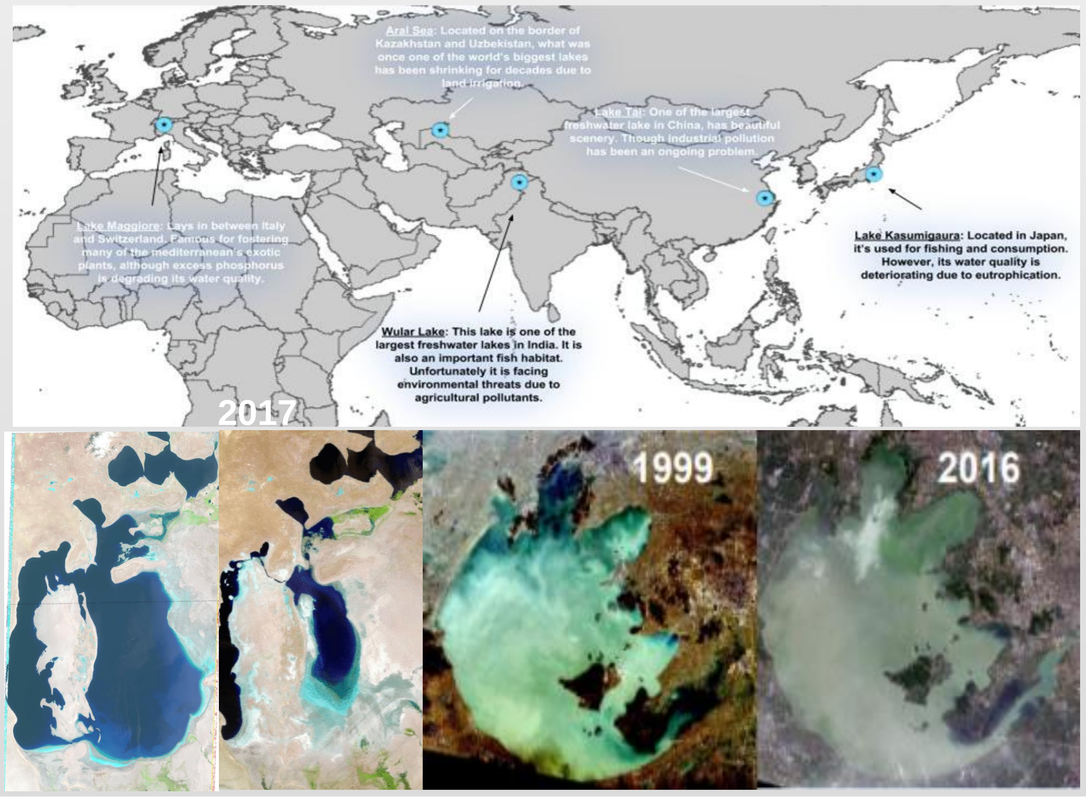


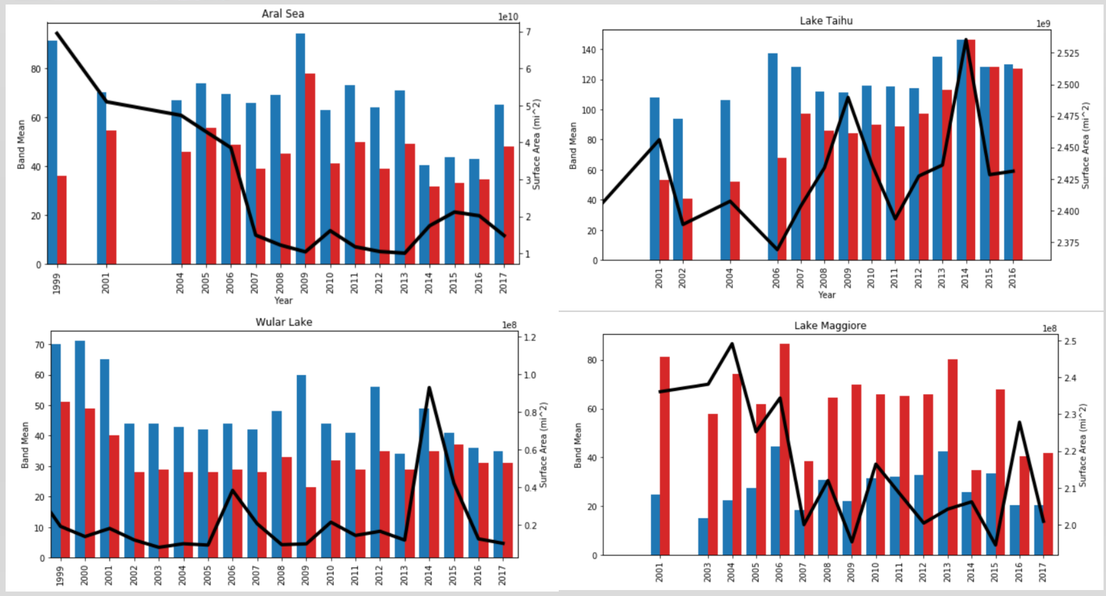
ArcGIS® ESRI

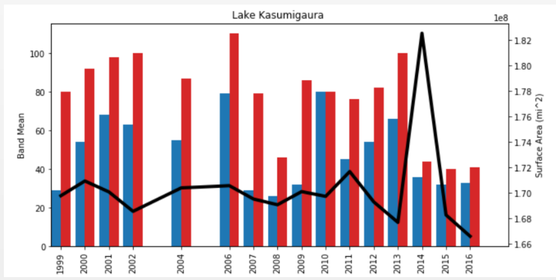
Methods Continued...

- After creating the mosaic image, we used the "Edit Features" tool to edit the shape file creating geometric profiles referred to as features. The freeform tool was used to adhere to the curvature of all the lakes, eliminating the possibility distortion of data by the analysis of areas not covered by water.
- In cases of bodies of water as massive as the Aral Sea, multiple features were used to yield an accurate cover. Following the clipping of the shapefiles to the mosaic images, we were able to receive the appropriate results.

Results







Discussion

We studied 5 lakes over the period of 15 years to observe its differences overtime. We were able to observe the following patterns:

- In some of these lakes, like the Aral Sea, Lake Taihu, and Wular Lake, the blue band values were higher than red values.
  - This is a result of more blue band reflected, and TSS mostly absorbs light in blue wavelength.
  - This signifies that there were higher concentrations of chlorophyll versus TSS.
- In other lakes, like Lake Maggiore and Lake Kasumigaura, the red band values were higher than blue band.
  - This is a result of more red band reflected, and chlorophyll mostly absorbs light in red wavelength.
  - This signifies a higher concentration of TSS over chlorophyll.
- In general the surface area decreases but in some cases the values fluctuate.

References

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