



Department of Geography and Geology

Shrinking of the Aral Sea From 1988 to 2010

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Introduction:

The Aral Sea is located in central Asia split by the border of Kazakhstan to the north and Uzbekistan to the south. Fed by two rivers the Syr Darya in the north and the Amu Darya in the south, the lake was at one point the 4th largest lake in the world. The lake is said to have depleted by 90% since the major tributaries were diverted for irrigation purposes.

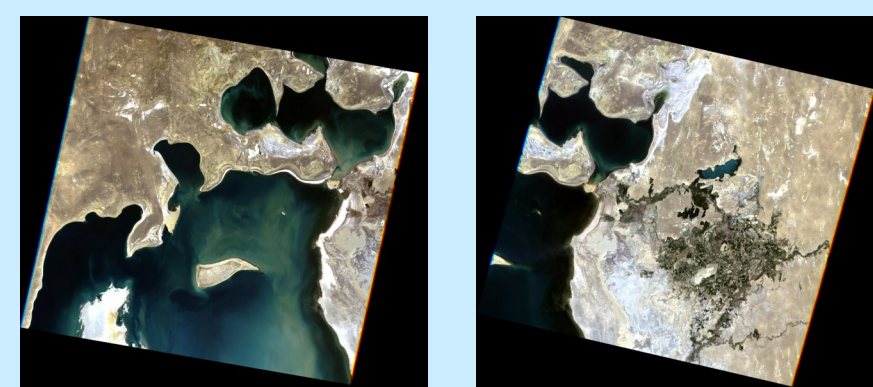


Starting in 1960 the demand for irrigation began increasing. The agricultural areas of the region demand large amounts of water, however, the irrigation canals or drainage collectors built to hold and move the water were usually built without liners. Lacking a proper liner much of the water is absorbed by the ground making the irrigation systems efficiency low.

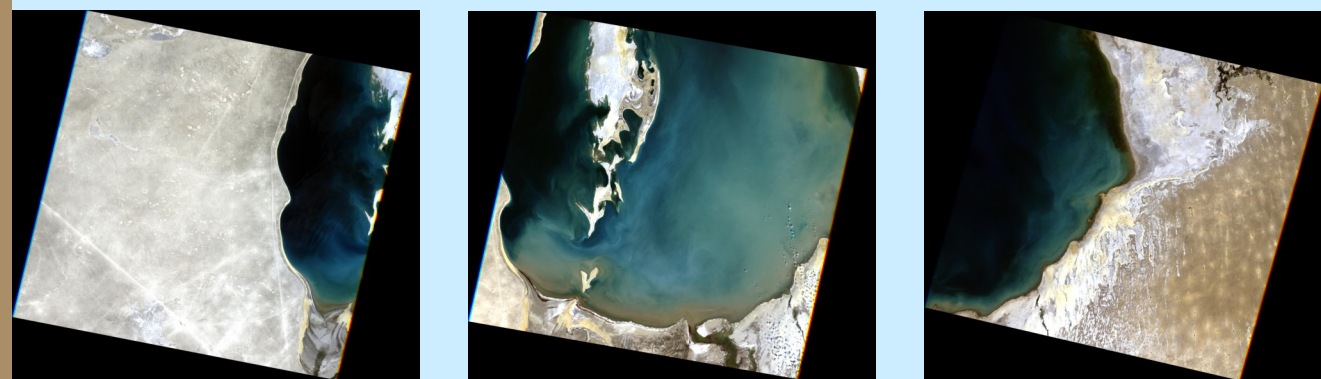
Diverting water from the Aral Seas major tributaries has caused the Lake to shrink significantly and increase in salinity. Using satellite imagery the change in surface cover can be shown and calculated using ENVI software.

Methodology:

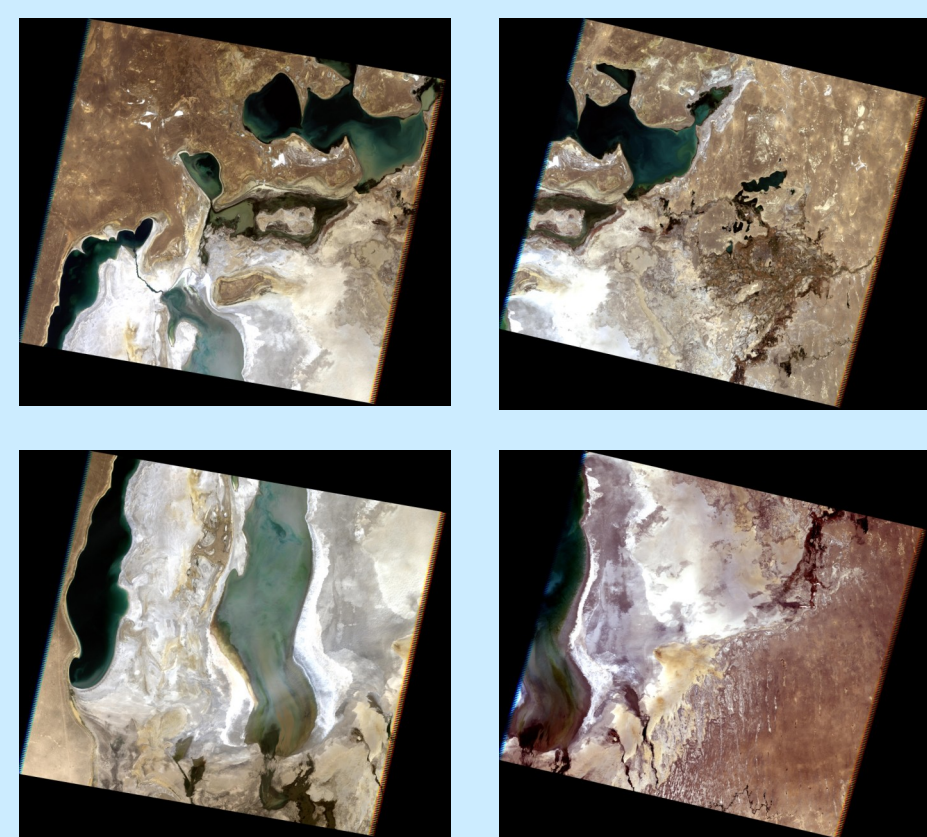
Landsat 4-5 Thematic Mapper images from Glovis were downloaded to start the project. Because the Aral Sea spans over such a large area multiple images from 1988 and 2010 were needed. To keep the study as accurate as possible the images were also collected from the same season.



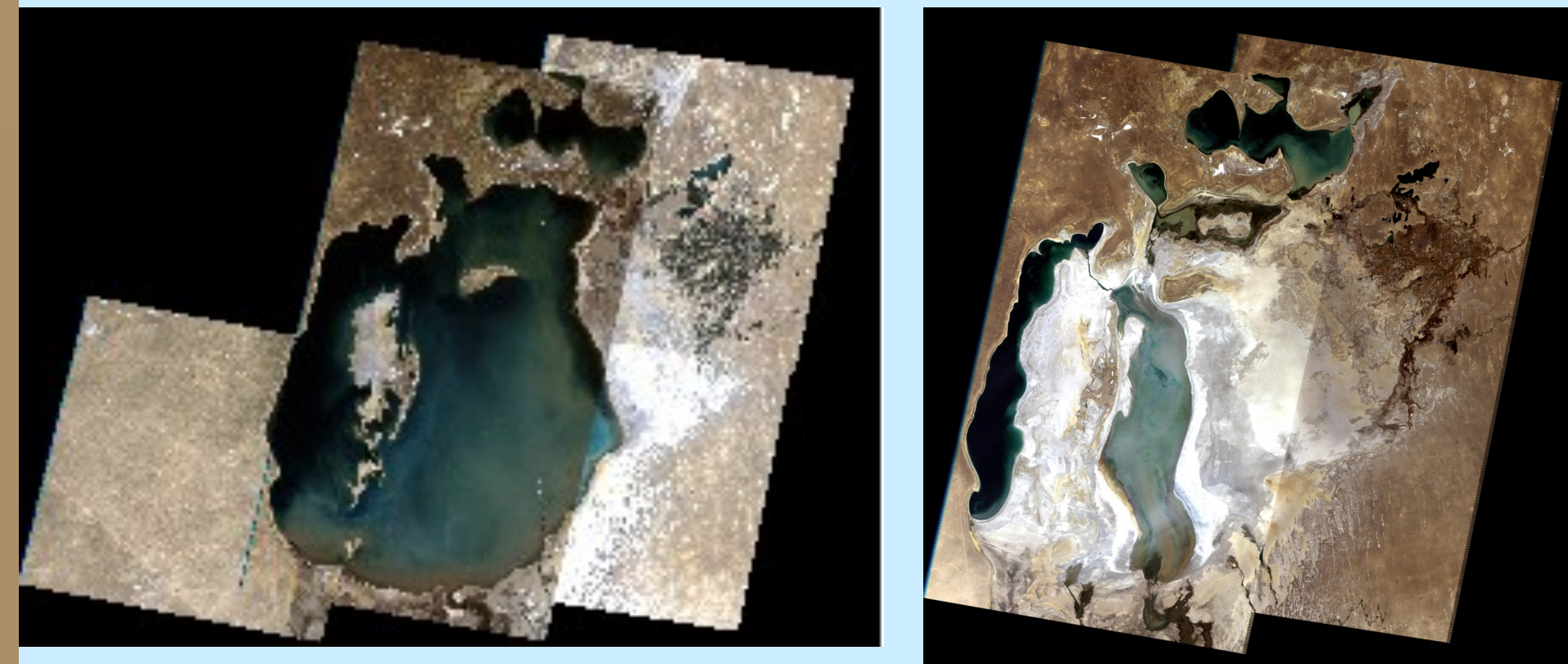
1988 Raw Images displayed in true color



2010 Raw Images Displayed in true color



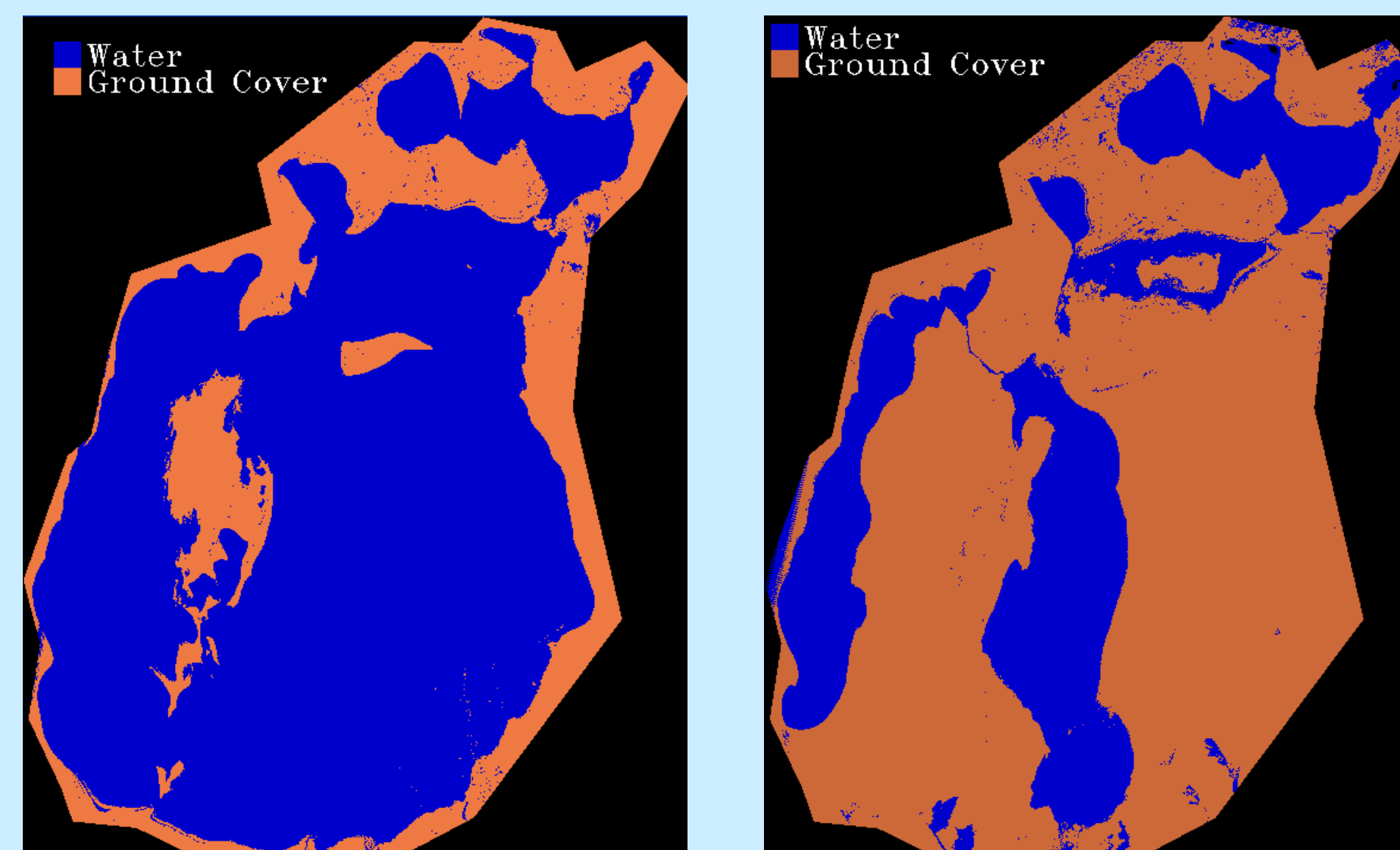
Using the ENVI software, the individual images that made up the study area were combined by completing a mosaic to create a single image for each year. Areas that were unimportant to this study seen in the image produced by the mosaic process were omitted after clipping the desired area with a ROI polygon overlain onto the images.



After clipping process



An unsupervised K-means classification was conducted on the clipped images. Five classes were identified in each image. The classes that characterized ground cover were combined into a single class and the classes that characterized water were combined into a single class as well.



Having combined the classes from the two images into identical classes, a change detection was calculated. The change detection shows how much area of the surface cover was converted from water to general ground cover such as dirt or sand between 1988 to 2010, a 22 year span of time. The numbers below represent km².

	Water	Ground Cover	Row Total	Class Total
Water	15,350.67	637.01	15,987.68	16,162.86
Ground Cover	26,551.27	12,588.64	39,139.91	40,303.34
Row Total	41,962.06	14,334.52		
Class Total	26,611.39	1,745.87		
Image Difference	-25,799.2	25,968.82		

Results:

The change detection revealed a 61% decrease over a 22 year span from 1988 to 2010, a loss in water area equal to 25,799.2 km². Literature values from "The Aral Sea Disaster" listed below show that the area from 1989 to 2006 had a 56% decrease between those years. The 22 year span that was looked at during this study showed a 61% decrease and the 17 year span researched in the study in "The Aral Sea Disaster," which fell in between the span I researched, had a 56% decrease. These numbers verify that the Aral sea is rapidly shrinking.

Literature Values from "The Aral Sea Disaster:

	Area (km ²)	% Change
1989	39,734	—
2006	17,382	-56%

Conclusions:

Ever since 1960 the Aral Sea has been rapidly shrinking. Building canals and water holding areas for irrigation has depleted one of the worlds largest lakes by over 61%. The loss of water has caused the destruction of majority of the native flora and fauna species, a change in the climate of the surrounding area, and a rise in salinity of the lakes remaining water. Predicting the future for the lake is difficult to do because there are multiple factors impacting the water body. According to the results of this study, if conditions stay the same as they are and have been since the tributaries to the Aral Sea were diverted for irrigation then the water body will be entirely depleted within 15 years.



References:

- Glazovsky, Nikita. *Regions at Risk: Comparisons of Threatened Environments*. New York: United Nations University Press, 1995. Pgs 92-139
Micklin, Philip. "The Aral Sea Disaster." *Annu. Rev. Earth Planet. Sci.* 2007. 35:47-72.

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