# PHOTOGRAMMETRIC MEASUREMENT OF THE MEKE LAKE AND ITS ENVIRONMENT WITH KITE PHOTOGRAPHS TO MONITORING OF WATER LEVEL TO CLIMATE CHANGE

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**ABSTRACT:**

Over the last hundred years or so, the instrumental temperature record has shown a trend in climate of increased global mean temperature, i.e., global warming. Global warming and climate change have caused a decrease in lake waters, an increase in the sea level, and changes in streams and precipitation models and have started to show negative impacts on all aquatic organisms from plankton to mammals. Semi-arid and arid areas are particularly exposed to the impacts of climate change on freshwater. Unfortunately, due to global warming and the uncontrolled irrigation of farms, the "eye" of the lake has dried and rest of the lake is drying. This project has been started to get data about decreasing the water level and the physical changes in the Lake Meke. From September to March, the level of water has been determined. For this purpose, photogrammetric measurements have been done. Kite and remote-control camera has been used. With calibrated cameras and points on ground, the lake's surface has been evaluation photogrammetric software and got merged with present time map.

## 1. INTRODUCTION

The impacts that global warming has created and will probably create on aquatic ecosystem can be listed as increase in water temperature and drying of the lakes, regression of glaciers, increase in the sea level, degradation in coastal ecosystem, change in precipitation amounts and models, change in the frequency and density of extreme weather phenomena, change in streams, increase in the extinction of species and increase in the distribution areas of ailment vectors.

Lakes are particularly sensitive to changes in climatic parameters. Alterations in air temperature, precipitation, wind directly cause changes in evaporation, water balance, lake level, ice events, hydrochemical and hydrobiological regimes and entire lake ecosystems. Under some climatic conditions, lakes may disappear entirely (Poff et al. 2002).The impact of global warming on lakes comes out as the increase in water temperature and regression of lakes**.** The lakes that are under threat in Turkey due to global warming are Tuz Lake, Beysehir Lake, Eğirdir Lake, Ulubat Lake, Ereğli Reeds, Kulu Lake, Aksehir Lake, **Meke Lake**, Manyas Lake and Eber Lake. (Anonim, 2007)

In this study, the physical changes and decreasing the water level of Meke Lake has been researched using by photogrammetric methods.

## 2. SITE DESCRIPTION

MEKE LAKE make crater lake is; on the southwest of Acı lake, southeast of Karapınar, 8 km. from Karapınar and 2 km. from Karapınar-Ereğli highway. Meke Lake has a circular shape and there is an island in the middle of it which is called Meke. The dept of the lake never exceeds 12 m. The water of the lake comes out from the ground and its water is salty which contains magnesium and sodium sulfate. Meke salty area covers 0.5 $km^2$. The lake was formed in a circular shape collapse which had occurred in the first era. And after that, an eruption caused a chimney to rise in the lake. In geology, this rise is called as "Secondary Rise". After this formation volcanic Meke height is formed in the middle of the lake. Formations didn't end up with these and later on with various eruptions seven other formations were formed (they are called as little Meke) some adjacent to main cone and some as separate islands. These formations are called in geology as "parasite cones" In the middle of the Meke lake (main Meke) which is 981 m. from sea level there is a volcanic cone. This cone is 50 m. high from the water level and there is a salt water lake in it with 25 m. depth. For a while, this lake is utilized for its salt. The special volcanic mess that forms the island has an ability to absorb even the most heavy rain showers. That is the reason why Meke has preserved its shape for thousand years for the Global Warming.


Figure 1. Location of Meke Lake

Figure 2. Meke Lake

## 3. KITE MONITORING SYSTEM

Kites are among the first instruments used for aerial photography. It was very interesting for authors to observe that kite aerial photography (known as KAP) has a very big community of fans all round world. The primary use of KAP is the hobby but it is also being used for some other, mostly experimental imaging purposes, like archeological site aerial imaging. KAP is very cheap, has very lost initial cost, required no communication for flying have sufficient payload capacity, quite portable, can be designed to be relatively stable. Despite those advantages, kite has a big disadvantage. It needs appropriate wind to fly. Additionally, pilot cannot make kite stand where they want it. (Leloglu).

In this study, kite and remote-control camera has been used. Taking photos using kite has been purposed to obtain photos of study region. Firstly, kite size has been determined for better seen from to photos of control points. The kite size is 150*150 cm in hexagon geometry. To mounted camera on kite, many test flight has been actualized until suitable weather condition right. Many photographs were taken when the kite gets at appropriate height. Best fit images were selected for photogrammetric process.

Figure 3. Kite

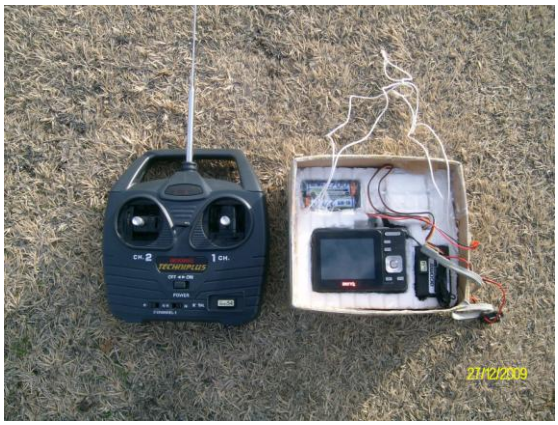

Figure 4. Camera and remote-control

## 4. DATA COLLECTION FOR MEKE LAKE PROJECT

In Lake Meke, it's impossible to make a geodetic measurement on the water-covered surface. Because, on the way of the lake, there's rarely well ground but, generally 3-5m mud and swampy ground, so, it's not possible to take measure of the water surface. For this purpose, a photogrammetric measurement has been done. Before all the research, to produce topographical map, the nearest land surveying triangulation network has been founded and 8 traverse station points established. To calculate the coordinates and elevation point, GPS session has been done as a 2 hour interval. Total station has been used to measure all area at intervals 25-30m. At last the present time map has been done. From September to March, the level of water has been determined.

Kite and remote-control camera has been used for photogrammetric measurement. Many tries have been done to

get the enough height, wind and weather conditions for kite unit.

Once, because of the strong wind, the kite's construction has been damaged. The arrangements have been made to make the kite fly again, but this time some balance problems have been seen. The arrangements for the kite's tail have been made to fix this problem. While these tries, the camera platform fell down many times and to fix the platform, a lot of time has spent. After these experiences, the kite and the camera platform became suitable for the experiments. Sometimes, there wasn't any wind so the experiments have been delayed. To get the mathematical evaluation from kite, 50 pieces of 50*50cm control points has been provided and measurements have been finished.

Figure 5. Control points

The water level of Meke Lake has been researched using by photogrammetric methods. Evaluation of water surface has been done PhotoModeler software. PhotoModeler is windows based photogrammetry software developed by Eos System Inc. Photomodeller software package is well-known as being low cost 3D measurement tool for close range photogrammetry applications. PhotoModeler is a powerful 3D software product that calculates measurements and constructs 3D models from photographs simply and easily.

Photogrammetric orientations parameters and adjustments have been calculated with PhotoModeler software and 3D coordinates of 50 points on the surface of the object have been measured for the modeling its geometric surface. With calibrated cameras and points on ground, the lake's surface has been evaluated photogrammetrically and got merged with present time map.

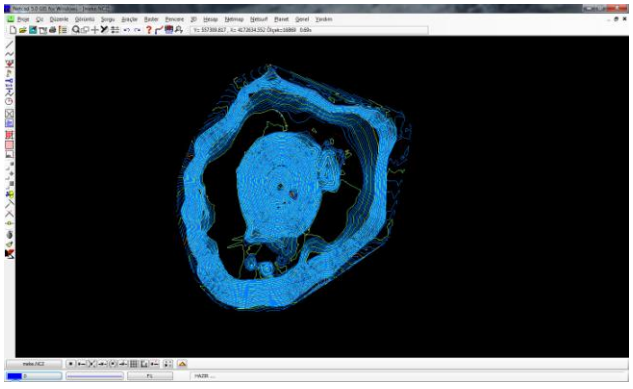

Figure 5.The present timemap of Meke Lake

The average monthly temperature variation and sunshine duration is shown below charts as the daily meteorological data.

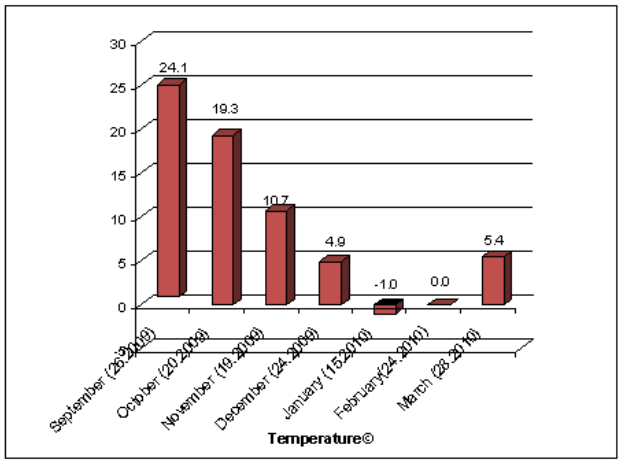


Figure 6. Monthly temperature variation of Meke Lake

Meke lake environment from the daily meteorological data obtained by the average monthly sunshine duration is to show.

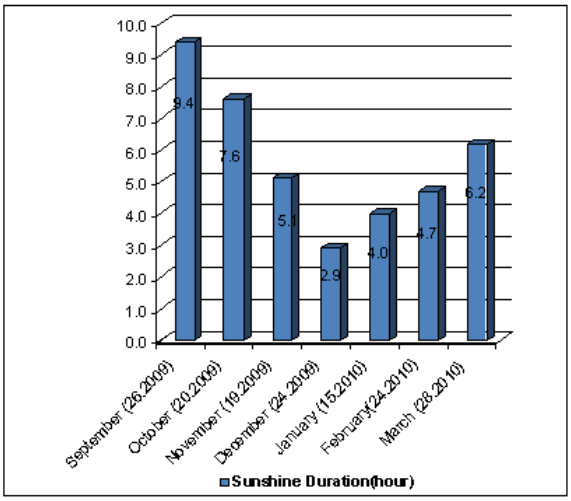


Figure 7. Monthly sunshine duration of Meke Lake

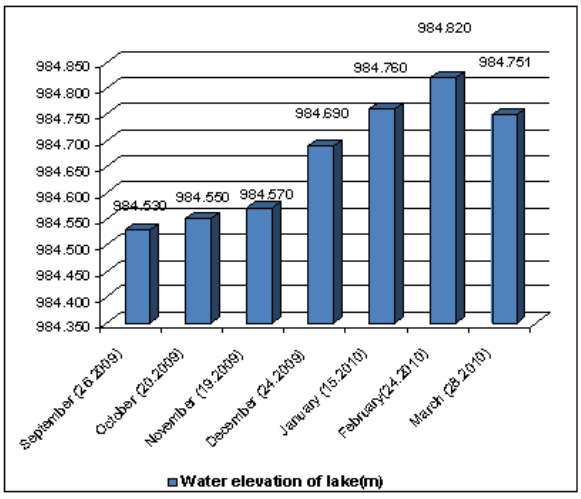


Figure 8. Monthly water elevation of Meke Lake by classic measurement method

## 5. CONCLUSION

In this study, decreasing water level of Meke Lake has been determined using kite aerial photographs and normal digital cameras for photogrammetric purposes. The kite as a platform has advantages and disadvantages. A kite is cheap, easy to operate and it requires no maintenance. On the other hand, a kite is not very stable platform. Sometimes the weather condition is not suitable to fly a kite. To fly a kite, the weather should be windy. Despite disadvantages this method is appropriate for evaluation of unreachable object. The physical condition around Lake Meke is not convenient to take measure of water surface. Because, on the way of the lake, there are 3-5 m. mud and swamps. Therefore these conditions, taking photos has been purposed using kite and remote-control camera system. According the photogrammteric measurement results, from September to March variation of water level has been determined. Although there are many disadvantages this method can be applied for the measurement object that is unreachable.

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