

PROTECTION OF NATURAL CATCHMENT AREAS SUPPLYING WATER TO ISTANBUL AND MONITORING ILLEGAL CONSTRUCTION WITH PERIODICALLY COLLECTED IKONOS IMAGERY

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ABSTRACT:

Being one of the fastest growing cities in the world in terms of population, Istanbul suffers significantly from illegal construction which is very difficult even to monitor with field survey methods. There are seven main natural catchment areas supplying water to Istanbul. Each area is divided into different protection zones and construction is prohibited in most of these areas. Istanbul Water and Sewerage Administration, which has the authority to demolish the structures in the first two zones, monitors the illegal construction in the catchment areas with orthorectified IKONOS imagery collected in the periods of three months. The imagery of seven catchment areas are collected every three months and following the collection in each period, change detection analysis is performed to determine the newly constructed structures in the five different protection zones of each catchment area. To determine the harm potential of the structures, field work follows the change detection analysis. Attributes of the structures such as construction type (residential, commercial, industrial ect.), building number, floors obtained from the field work are recorded into a geodatabase. The application of such an effective method improves the capability of Istanbul Water and Sewerage Administration in terms of preventing illegal construction with saving considerable time and giving consistent results.

1. INTRODUCTION

Illegal construction is one of the very important problems for most of the growing cities in the world. It is not only difficult to prevent, but also difficult to detect and monitor. Istanbul, being one of the fastest growing metropolises in the world, significantly suffers from illegal construction. Today Istanbul has a population of 12 Million and this population is spread to two continents where there are a few very important catchment areas that supply water to the city. Considering the fact that this population will increase up to 18 million in the following decades current sources must be protected very carefully while searching for additional sources.

2. CATCHMENTS IN ISTANBUL

Istanbul has 7 main catchment areas that supply water to the city. 3 of them is on the Asian side and 4 of them is on the European side. These catchments has a total area of 2480 sqkm which constitutes nearly half of the province area. The catchment areas are divided into 5 zones considering the distances to the lakes. The first two zones are called the "absolute" and "short" zones which constitutes the areas closer than 1 km to the lakes. Although construction is strictly prohibited in those areas there are now more than 12.000 structures detected with high resolution satellite imagery. This number increases to 150.000 when you consider all the zones of these catchments where construction is harmful for the city.

Istanbul Water and Sewerage Administration (ISKI in Turkish) is responsible for protecting the catchment areas in Istanbul. It was founded in 1981 and its primary aim is to supply clean

water to its citizens. But it won't be right to say ISKI was successful to realize its aim. ISKI even did not have the correct information about the construction in the catchment areas when they decided to monitor illegal construction with high resolution satellite imagery.

Such a study first started in July 2003 when ISKI and INTA Spaceturk started working together to monitor the catchment areas with IKONOS imagery. Today IKONOS imagery is collected every three months for 8760 sqkm corresponding to the authority region of ISKI.

3. IKONOS IMAGE COLLECTION AND ORTHORECTIFICATION

Ikonos image is periodically collected in the Satellite Ground Station Located in Ankara. Inta Spaceturk has the authority to collect imagery within a communication zone which includes 50 countries in Europe, Asia and Africa. The imagery is produced in Geotiff format and delivered to Istanbul the day after the collection. Image processing applications take place in ISKI where INTA Spaceturk has a small office and 3 Operators. The primary step is the orthorectification the output of which is the 1m(RMSE) IKONOS Orthorectified Color imagery. The reference used for the orthorectification is the 1/5000 Ortorectified Aerial photos of General Command of Mapping and 1/5000 Digital Elevation Model.

4. CHANGE DETECTION ANALYSIS

Secondary step in the ISKI Office is the change detection analysis made by the operators comparing the newly collected imagery and the imagery of 3 months before. The analysis is made in all the zones of the 7 catchment areas. A geodatabase is created for the change detection data and updated every period.



Figure 1. IKONOS Imagery before Construction



Figure 1. IKONOS Imagery after Construction

5. FIELD SURVEY

Today there are 12000 structures in the absolute and short zones of the catchment areas and new structures are being detected every period. Although ISKI has the authority do demolish those structures it can not be done very easily. So if you have to do it one by one you have to be sure that you are demolishing the most harmful building first. Change detection analysis gives the results in terms of numbers corresponding to illegal construction. But in order to determine the harm potential of these newly constructed structures, field surveys take place following the change detection analysis. Attribute data such as Building type, number of floors ect. is collected in field surveys and the data is recorded in to the geodatabase.

6. REPORTS

Each period a detailed report is presented to the director of ISKI to help the director make the best decisions when preparing the demolishing plans.

7. CONCLUSION

The effectiveness of the method comes from the reliability of the data obtained from the satellite imagery. Before using this technology ISKI had to trust all its field workers who are responsible to report the illegal structures in the catchment areas. But the early results of this study showed that ISKI was unaware of the numbers which are clearly determined from the satellite imagery. Implementation of such and effective method to protect catcmets should be a model for all the cities that suffer from illegal construction.