DEVELOPMENT OF TERRAIN AND OBSTACLE DATABASE OF AREAS IN VICINITY OF AERODROMES USING REMOTE SENSING

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ABSTRACT

According to ICAO Annex 15, the Contracting States are required to collect and make available the electronic terrain and obstacle database (eTOD) of its aerodromes regularly used in international civil aviation. Our goal was to introduce the methodology suitable for development of electronic terrain and obstacle database using satellite data and use this methodology to create a database of terrain and obstacles of the areas in vicinity of aerodromes.

During the course of this research, we will define the terrain model of the areas in vicinity of aerodromes from elevation data of SRTM radar. We will also define the natural and man-made obstacles of the same aerodromes from stereo data from GeoEye and World View 1 satellites. These terrain and obstacle data will be used to develop the electronic terrain and obstacle database.

As a result of this research, aeronautical charts used for landing and take-off flight operations will be available in electronic format which offers many advantages over the conventional charts such as providing the flight crew with most up-to-date terrain and obstacle information. The research will take place at Aeronautical Information Services Division of Civil Aviation Authority of Mongolia.

Based on our current results, we are confident that high resolution terrain model and natural and man-made obstacle data of areas in vicinity of the aerodromes can be collected using satellite data and these data can be successfully employed in development of electronic terrain and obstacle database.

KEYWORDS: eTOD, Aerodrome, obstacle, terrain

1. INTRODUCTION

Improved common situational awareness and applications such as Ground Proximity Warning Systems, advanced navigation displays, taxi situational awareness displays, Runway Incursion Prevention Systems, and Synthetic Vision Systems will enhance the safety and efficiency of aircraft operations in-flight, during approach/take-off, and while maneuvering on the aerodrome surface. These systems are information-dependent and must use accurate, reliable, and up-to-date terrain, obstacle and aerodrome mapping data.

Mongolia is a mountainous country especially in the North and South and the implementation of electronic terrain and obstacle data (eTOD) is of vital importance if safety is to be enhanced and confidence in flying to/in our country is ever increasing. Currently, Mongolia has made the Area 1 terrain data available for its entire territory and has collected the Area 2 terrain and obstacle data for 19 out of 24 aerodromes. We have taken the eTOD implementation seriously and in our opinion, voice spoken through our implementation experience at this meeting would be of vital importance.

Since their introduction in 2004, the eTOD requirements sparked discussion worldwide. The implementation, provision and on-going maintenance of terrain and obstacle data is a costly exercise and

needs careful consideration. In its Doc 9881, which is still disclaimed, ICAO has provided some guidance for determination of appropriate funding and cost recovery to allow States to determine the beneficiaries of the data, the owner of the data and the allocation of costs to recovery mechanisms. However, it is not clear on what level the airspace users should be involved in this process. Defining the user requirements of these data such as determining which obstacles are "a hazard to air navigation" rests with the data provider rather than with the users of the data who know best what data is necessary for their operations. Besides traveling public, the one from the ATM community that would appreciate the eTOD most are pilots. Many airlines are using data provided by companies like Jeppesen, Lufthansa and GAF-AG but their data and State data are not always consistent.

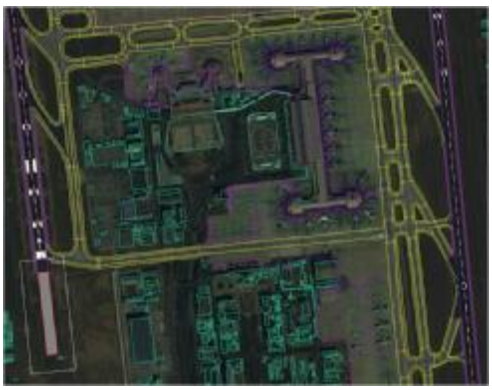
2. THE STUDY AREA

To satisfy identified user requirements for electronic terrain and obstacle data, while taking into account cost-effectiveness, acquisition methods and data availability, the data are to be provided according to four basic coverage areas. Area 1 is the entire territory of a State, Area 2 covers the established terminal control areas, Area 3 covers the aerodrome/heliport area and Area 4 is restricted for use only for those runways where precision approach Category II or III operations have been established.

Area 1

Area 2

Area 3



Area 4

3. DATA AND METHODS

Every requirements of data resolution are different. Even though there are many way to collect an eTOD data, laser scan's chart installed in an aircraft, images pulled from satellite, and images pulled from an aircraft are being used widely. From these, the cheapest is the images pulled from satellite and the laser scan's chart is the most accurate.

In order to collect eTOD, DTM was used to display the terrain data and digital surface model , and it was pulled off from the satellite stereo. In addition surveying the place on the spot using ground survey data. During the collection of obstacle data, data files are created in accordance with ICAO requirements. Horizontal system is WGS-84 and vertical system is EGM-96.

Used data:

Terrain data SRTM 30 DTM

Obstacles Geoeye' stereo image

Used program: ArcGIS 10, Erdas Imagine, ENVI

	Area 1	Area 2	Area 3	Area 4
Post spacing	3 arc seconds (approx. 90 m)	1 arc second (approx. 30 m)	0.6 arc seconds (approx. 20 m)	0.3 arc seconds (approx. 9 m)
Vertical accuracy	30 m	3 m	0.5 m	1 m
Vertical resolution	1 m	0.1 m	0.01 m	0.1 m
Horizontal accuracy	50 m	5 m	0.5 m	2.5 m
Confidence level	90%	90%	90%	90%
Data classification Integrity level	Routine 1 × 10–3	Essential 1 × 10–5	Essential 1 × 10–5	Essential 1 × 10–5
Maintenance period	as required	as required	as required	as required

Obstacle data numerical requirements

	Area 1	Area 2	Area 3	Area 4
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Terrain data numerical requirements

4. RESULTS AND DISCUSSION

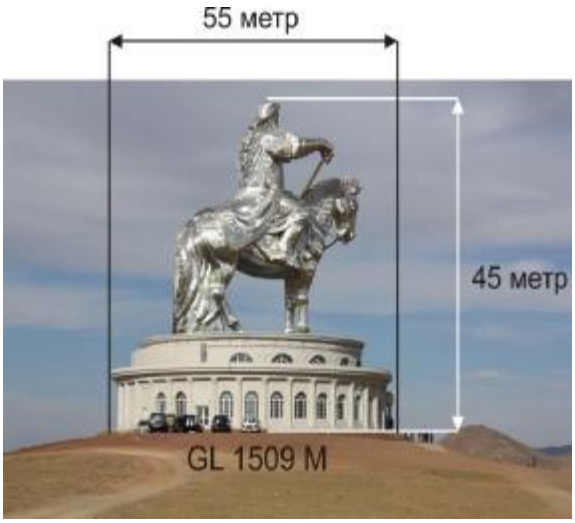
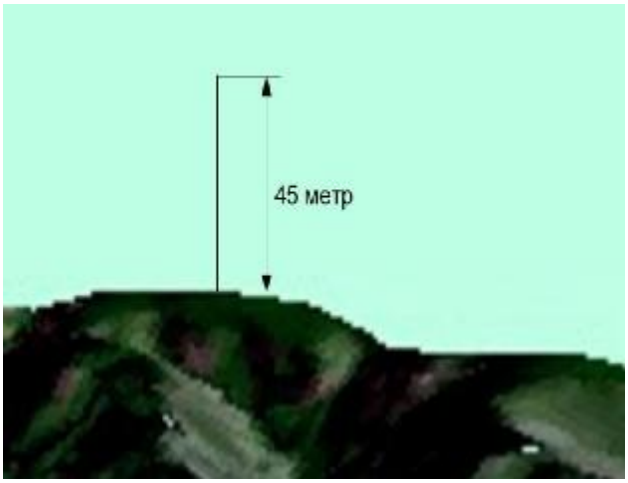


Image 1



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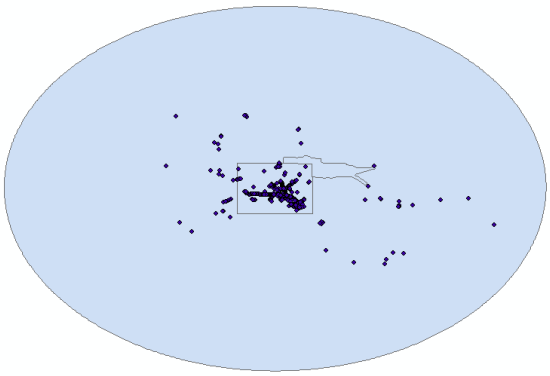
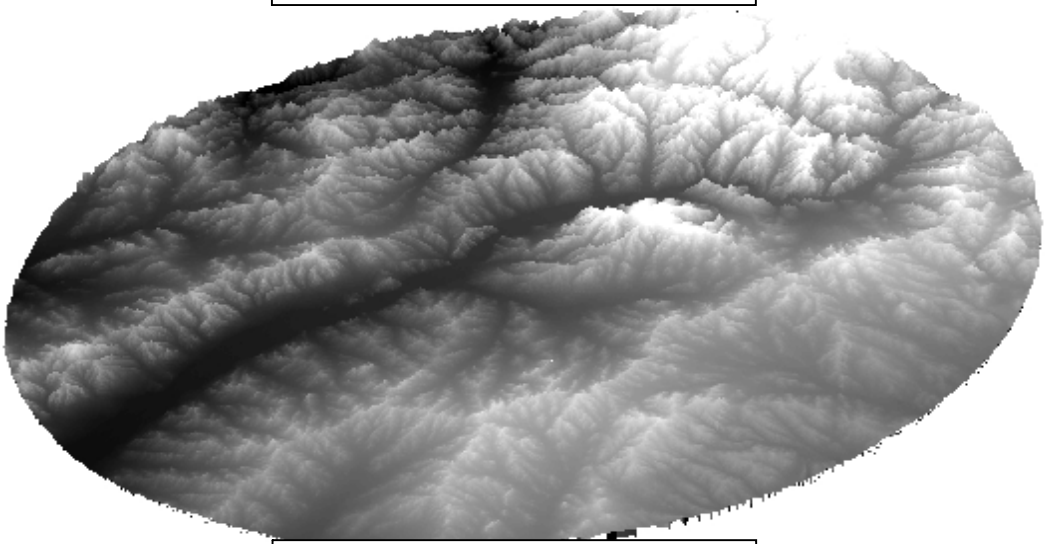


Image 3

Image 4

Image 5



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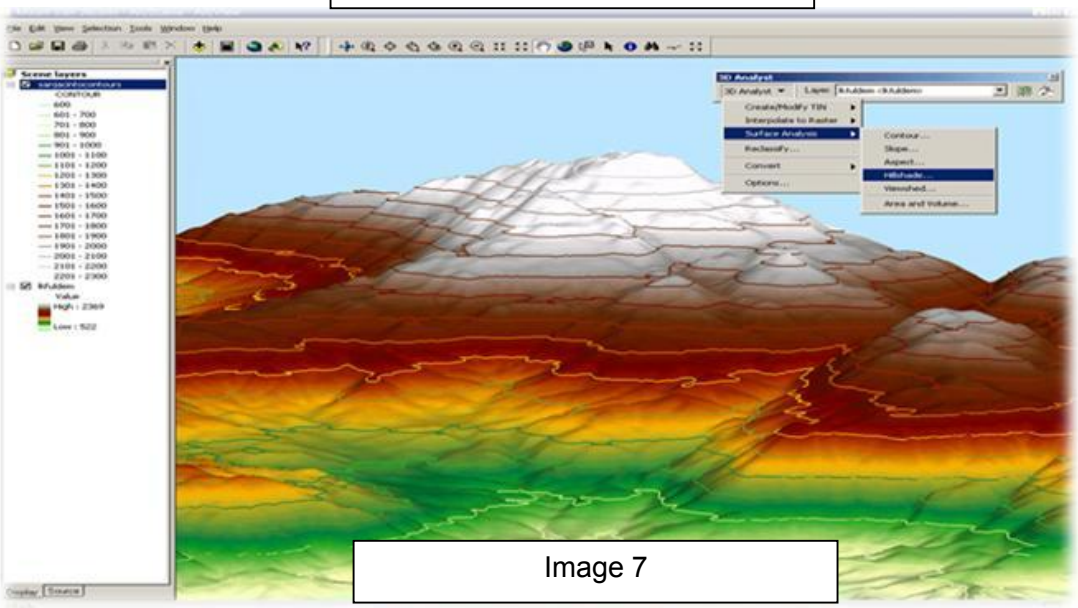

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Image 8

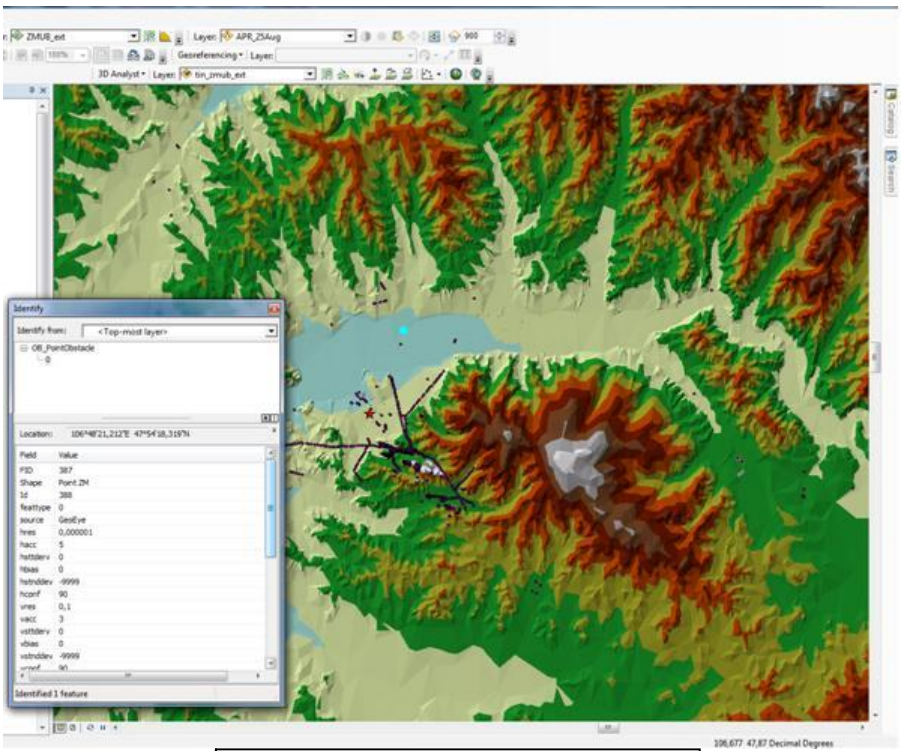

Image 9

CONCLUSIONS

The use satellite data for eTOD, saves time and money. Also terrain, obstacle and aerodrome chart data play an important part in helping the pilot's decision making process through the delivery of eTOD data. With the existence of this data, pilots' capability to observe the surrounding in any weather condition greatly increases. The data not only acts to separate aircraft from another aircraft, but provide safety around the terrain and obstacle and eliminate any occurrences where the pilot's operation is affected due to limitation of visibility.

This eTOD process has already been effective at our 7 international aerodromes and it is still in process of 12 domestic aerodromes.

With the development of Advanced technology, the use of remote sensing and GIS provide safety to the flight operations. So more attention need to be present in order to achieve data quality and resolution. Collection of eTOD method should be more in detail.

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