



Agenda Item 1: Implementation of the provision of electronic terrain and obstacle data (e-TOD)

Electronic terrain and obstacle data (e-TOD) in Area 2

(Presented by Ecuador)

SUMMARY	
This working paper presents the progress made by the AIS in the implementation and surveying of electronic terrain and obstacle data (e-TOD), particularly in Areas 2a, 2b, and 2c. The AIM experts of the Region must review and update the information provided.	
References	
- Annex 15 to the ICAO Convention - SAM/AIM multilateral meetings	
<i>ICAO strategic objectives</i>	<i>A - Safety E – Environmental protection</i>

1. Background

1.1 In accordance with Annex 15 to the Convention, electronic terrain and obstacle data for Area 2 should have been provided since 12 November 2015 at aerodromes regularly serving international civil aviation.

1.2 The various meetings on the transition of AIS to AIM have analysed different aspects of e-TOD. In this regard, it was felt convenient to present this working paper on this matter, as well as data collected by the AIS of Ecuador on the status of implementation.

1.3 eTOD is the digital representation of terrain and obstacles provided as datasets satisfying user requirements for a series of airborne and ground applications, such as EGPWS, TAWS, A-SMGCS, MSAW, procedure design, etc.

1.4 A terrain dataset is a digital representation of the elevation of the terrain at a number of discrete points. Major features of a terrain database include geometric distribution/position of discrete points, horizontal/vertical datum and specific units of measurement. In the context of eTOD, terrain is defined as "The surface of the Earth containing naturally occurring features such as mountains, hills, ridges, valleys, bodies of water, permanent ice and snow, and excluding obstacles."

2. Discussion

2.1 Electronic terrain and obstacle data (eTOD) is intended for use in several air navigation applications, such as:

- a) the ground proximity warning system with forward-looking terrain avoidance function and minimum safe altitude warning (MSAW) system;
- b) determination of contingency procedures for use in the event of an emergency during a missed approach or take-off;
- c) aircraft operating limitations analysis;
- d) instrument procedure design (including circling procedure);
- e) determination of en-route “drift-down” procedure and en-route emergency landing location;
- f) advanced surface movement guidance and control system (A-SMGCS); and
- g) aeronautical chart production and on-board databases.

2.2 Several ICAO meetings have recognised that this data may also be used in other systems, such as flight simulators, ATS control systems, and may assist in the height restriction or removal of obstacles that pose a hazard to air navigation.

2.3 The coverage areas of the electronic terrain and obstacle datasets for Area 2 include the following:

- **Area 2:** within the vicinity of an aerodrome, sub-divided as follows:
- **Area 2a:** a rectangular area around a runway that comprises the runway strip plus any clearway that exists;
- **Area 2b:** from the ends of Area 2a in the direction of departure, with a length of 10 km and a splay of 15% to each side;
- **Area 2c:** extending outside Area 2a and Area 2b at a distance of not more than 10 km to the boundary of Area 2a; and
- **Area 2d:** outside of Areas 2a, 2b and 2c up to a distance of 45 km from the aerodrome reference point, or an existing TMA boundary, whichever is nearest.

2.4 Taking into account the relevance of updating the status of implementation of electronic terrain and obstacle data (e-TOD) surveying in Area 2 and in order to comply with Annex 15, the AIS of Ecuador has developed a plan for the acquisition of electronic terrain data through external providers that have the technology and infrastructure to provide the required information in compliance with the established data quality standards, and are certified by the *Instituto Geográfico Militar*, which regulates and controls mapping in Ecuadorian territory.

2.5 Data will be acquired through satellite images, which will be processed by the company, delivering aerodrome chart databases and electronic terrain and obstacle databases as the end product. To this end, the following specific objectives have been considered:

- Capture stereoscopic images of the areas of interest with the Pleiades and Spot6/7 satellites.
- Generate elevation models, using the stereoscopic pairs obtained.
- Obtain maps of the airports and their surroundings, in accordance with the technical parameters required and needed.
- Generate AMDB and eTOD of the airports of interest

EJEMPLO DE UNA IMAGEN PLEÍADES



Figure 1. Example of a Pleiades image corresponding to Joya de los Sachas - 2014.

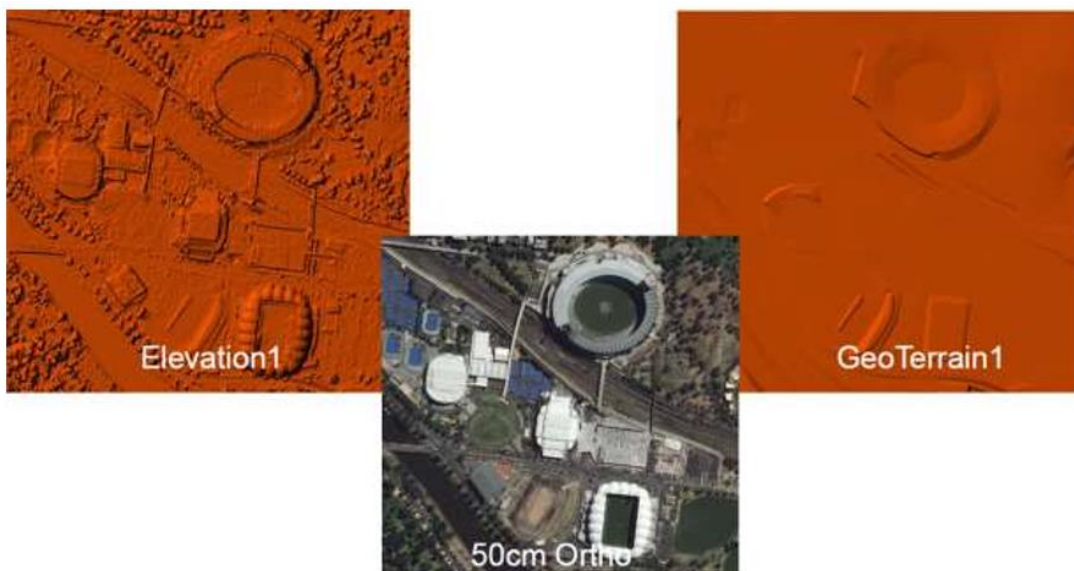


Figure 2. Left: DSM (digital surface model) Elevation1. Right: DTM (digital terrain model). Centre: Pleiades satellite image

2.6 Specific products of the aerodrome obstacle database

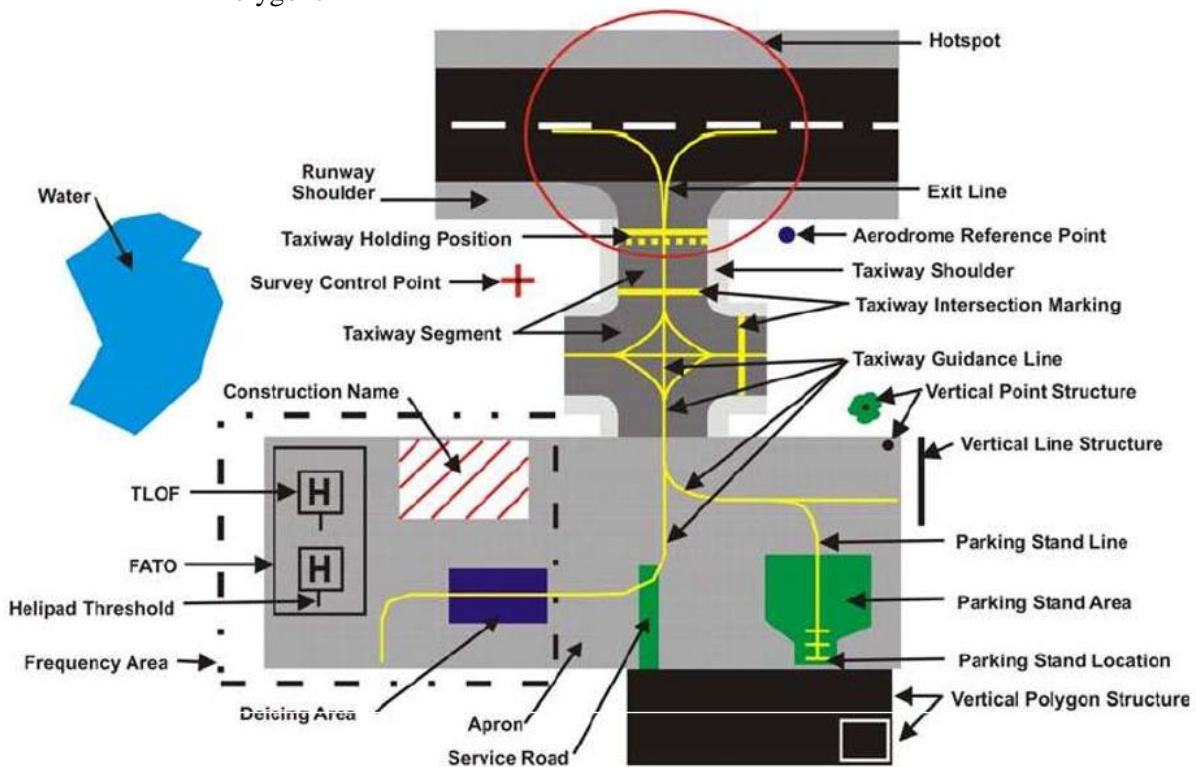
2.6.1 AMDB – Airport Mapping DataBase

- Geospatial vector database representing all airport-related layers
- EUROCAE standards - ED-99 accuracy level: Intermediate category (5m)
- Coverage: Airport boundaries
- Input data: Pleiades stereo images, AIP (Aeronautical Information Package) documentation, and ground control points.
- Output: GIS DataBase (ESRI SHP format)

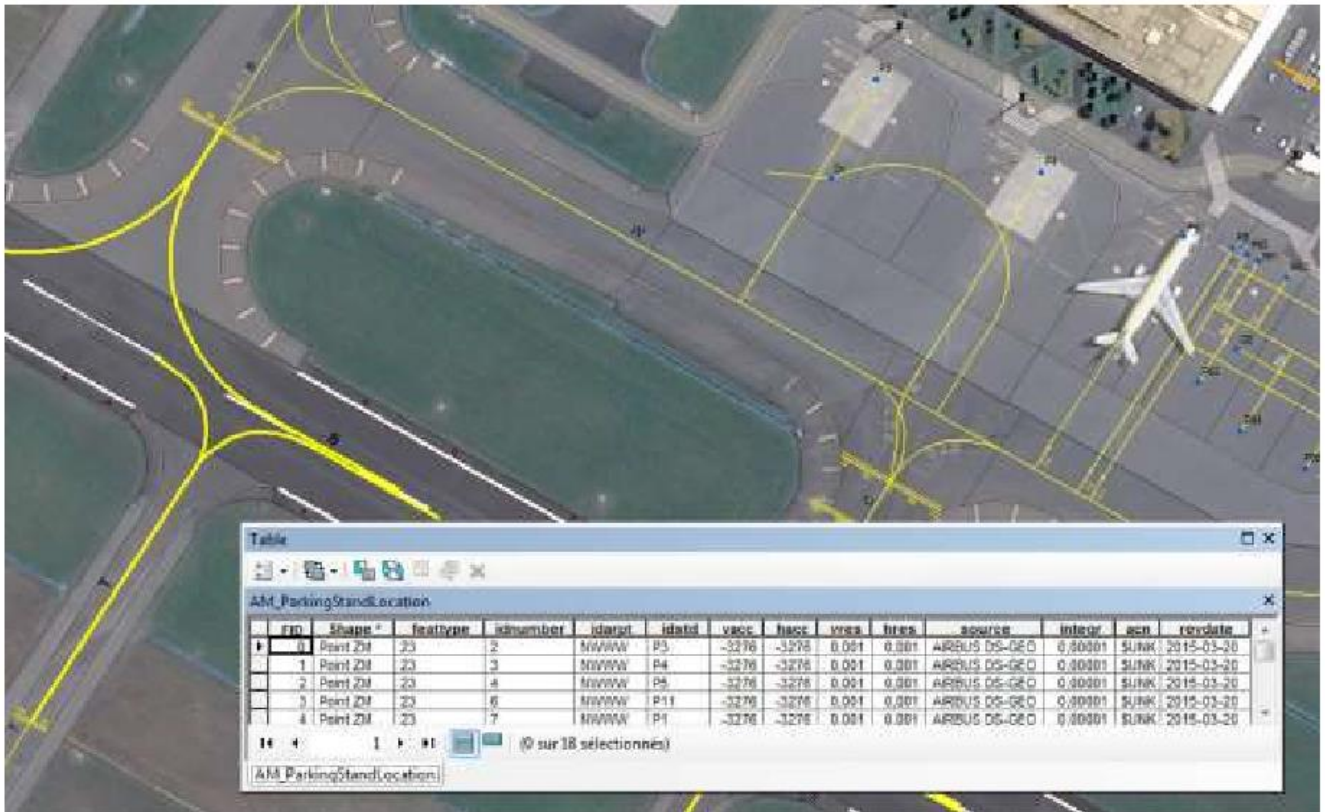
2.6.2 AMDB product specifications are governed by several standards, including documents EUROCAE ED-99 and ED-119. The data model and the catalogue of airport layers to be obtained will be standardised. Layers will be listed by class (RWY, TWY, parking, etc.). Database coding will contain information on standard layers (attributes, type of data and units, value domain, etc.).

2.6.3 The generation and production of AMDBs are based on photogrammetric processes (using satellite images). Database vector entities will be:

- Points
- Polylines
- Polygons



Example of airport layers



Example of AMDB data survey

2.7 Electronic terrain and obstacle database (eTOD)

- Specifications in accordance with ICAO Annex 15
- The eTOD package contains a terrain layer (terrain, digital surface model – DSM) and a database of obstacles (obstacles) around the airports that could have an impact on landing or take-off.
- Coverage:
 - Terrain layer: 45 km around the airport
 - Obstacles: divided into 4 areas (2a, 2b, 2c, 2d) depending on minimum height and intersection with obstacle collection surfaces.
- Input data: Spot6/7 and Pleiades stereo pairs, and control points

2.8 e-TOD implementation

2.8.1 e-TOD implementation, the SAMIG/13 meeting analysed many important factors to be taken into account when planning source data acquisition. These platforms include satellite, airborne, and ground systems, as well as ancillary sources, such as the State AIP and the Internet. Before acquiring source data, the organisation must analyse cost effectiveness, acquisition methods, accuracy requirements, as well as source data integrity and availability. An important factor is that source data collection methods for Areas 3 and 4 could be technically used for Areas 1 or 2, but their cost is generally prohibitive.

2.8.2 Regarding implementation costs, the States must assess the funding sources for implementation in Area 2, as well as data providers, which shall be certified by the State mapping regulatory agency.

2.9 **e-TOD training**

2.9.1 ICAO, through the Secretariat, should organise e-TOD training courses or workshops for the States, to be conducted by e-TOD surveying companies.

3. Suggested action

3.1 The Meeting is invited to:

- a) identify those States that have developed an action plan for e-TOD implementation in Area 2;
- b) identify groups of States that could receive e-TOD training.