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WORKING PAPER

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ASSEMBLY — 36TH SESSION

TECHNICAL COMMISSION

Agenda Item 31: Continued evolution of a performance-based global air traffic management (ATM) system

TRANSITION PLAN FOR A MOVE FROM LOCAL GEODETIC COORDINATE DATABASES TO THE WGS-84 IN COUNTRIES WITH FEWER TECHNICAL AND ECONOMIC RESOURCES AVAILABLE FOR DIRECT GEODETIC SURVEYS

(Presented by Venezuela)

EXECUTIVE SUMMARY

This working paper presents a proposed transition plan for a move from local geodetic coordinate databases to the WGS-84. It reviews the methodology contained in Doc 9674 for the introduction of the WGS-84 using transformations from local reference frames to world geocentric systems, basing itself on the situation in Venezuela.

Action: The Assembly is:

- a) invited to note the Venezuelan experience as a reference for the implementation of each Contracting State's plans for the transition from local geodetic databases to the WGS-84 in accordance with the global ATM system;
- b) urged to propose to the Council of ICAO to review sections 4.2.1 and 4.2.2 of the *World Geodetic System — 1984 (WGS-84) Manual* in light of the Venezuelan experience; and
- c) the most developed countries are urged to provide economic assistance to countries with fewer technical and economic resources to carry out geodetic surveys, in accordance with an established plan for the reliable and safe transition of all ICAO Contracting States to the WGS-84.

<i>Strategic Objectives:</i>	This working paper relates to Strategic Objectives A and D
<i>Financial implications:</i>	N/A
<i>References:</i>	ICAO Doc 9674, <i>World Geodetic System — 1984 (WGS-84) Manual</i>

¹ Spanish version provided by Venezuela.

1. INTRODUCTION

1.1 Based on research carried out by the University of Zulia in Venezuela, the PATVEN98 transformation parameters were made official. These parameters were recommended by the Simón Bolívar Geographic Institute of Venezuela (IGVSB) in order to facilitate for users the transformation from the existing geodetic and cartographic reference frame to the WGS-84.

1.2 At the First International Geodesy Congress, held in Caracas in 2002, Petróleos de Venezuela (PDVSA) and the University of Zulia presented a technical report on the transformation of reference systems when geodetic and cartographic work is carried out with combined products on different datums (local and WGS-84). This report offered a solution to the mathematical problem of the appropriate adoption of transformation parameters, concluding that the most aptly similar mathematical model is the Molodensky-Badekas model. The technical report established that if commercial transformation software supporting this matrix is not available, a methodology can be established for the calculation of new transformation parameters based on three- or seven-parameter matrices, which are indicated in the ICAO *World Geodetic System – 1984 (WGS – 84) Manual* (Doc 9674).

1.3 In the work referred to above, the PT was calculated using the Bursa Wolf model, similar to the Helmert Formula (see ICAO Doc 9674, paragraph 4.2.2 and Appendix D). This was done for the purposes of evaluation and comparison with respect to the official parameters calculated using the Molodensky-Badekas PATVEN98 model.

1.4 In order to evaluate the quality of the transformation process when using different groups of parameters, PDVSA carried out various tests using a 16-point sample with coordinates in the La Canoa datum (mostly triangulation vertices) and SIRGAS-REGVEN (WGS-84) double-frequency GPS measurements.

1.5 These transformations led to the following conclusions regarding the situation in Venezuela:

- a) When using datum transformation software, the geodetic datum must not be assumed; it must be verified and introduced (this statement does not appear in the ICAO *World Geodetic System — 1984 [WGS-84] Manual*). If there is any doubt, geodetic experts must be contacted.
- b) It is recommended that work be carried out directly with the WGS-84 datum and that the use of transformations be avoided as much as possible. If, for economic or other reasons, this is not possible, alternatives which fulfil accuracy requirements must be found.

1.6 The results obtained through PDVSA's research and the datum change problem in ICAO Contracting States have demonstrated that the use of the transformation parameters recommended for Venezuela by the IGVSB together with the matrices specified in the ICAO *World Geodetic System — 1984 (WGS-84) Manual* (Doc 9674) produces incorrect results which do not meet the accuracy requirements indicated in Tables 2-1, 2-2 and 2-5 of Doc 9674.

1.7 The implementation of this proposal would ensure that Contracting States with fewer economic and technical resources have a geodetic database which is reliable and compatible with the global ATM system in accordance with ICAO requirements, since, while transformation-related costs are considerably reduced in comparison with the costs associated with direct geodetic surveys, there is no reduction in the accuracy required.

2. CONCLUSION

2.1 The use of transformation parameters must be in harmony with the mathematical model most suitable according to the geodetic reality of the Contracting State. As well, geodetic datum transformations must be carried out with the proper guidance of the Contracting State's geodetic research specialists, avoiding the undue use of commercial software. In view of this, the methodology indicated in ICAO Doc 9674, section 4.2.2, which establishes the possibility of three different approaches for transforming coordinates, is not completely reliable.

2.2 The Bolivarian Republic of Venezuela definitively and resolutely concludes that, as is established by the research carried out by PDVSA, the use of transformation parameters with unsuitable mathematical models and without the supervision of highly trained geodetic experts can produce undesired mathematical results which, if applied to aviation, can result in coordinate information which does not meet accuracy requirements.

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