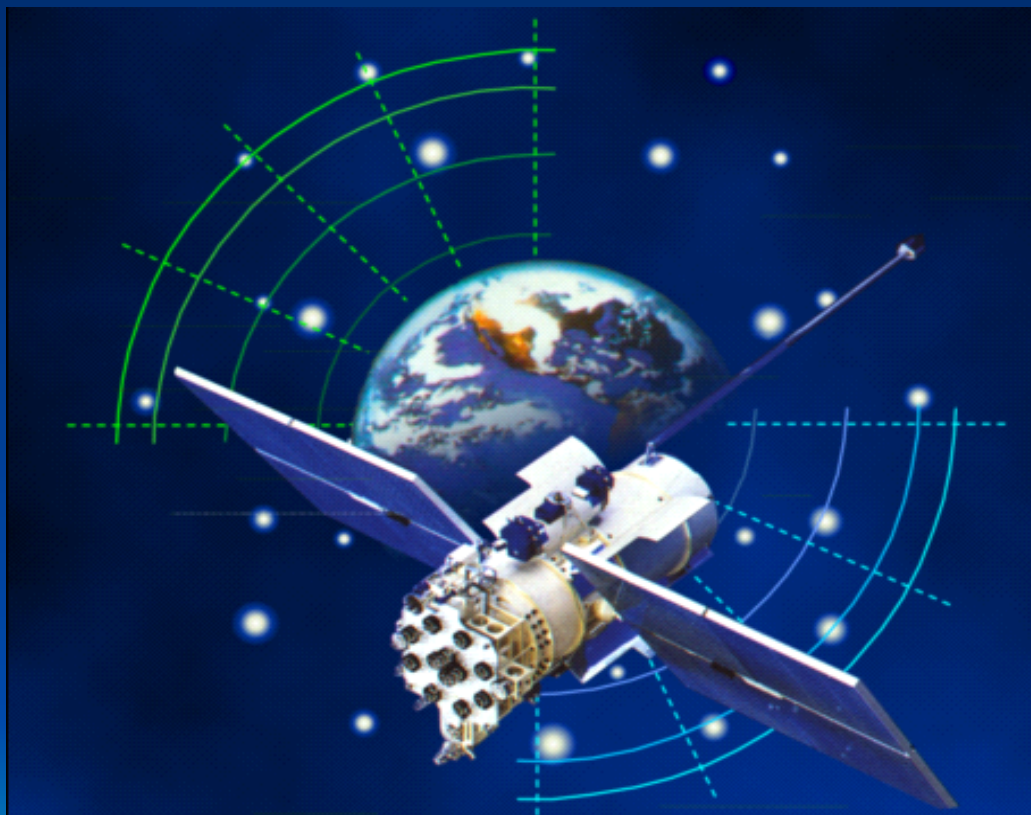




## USE AND APPLICATION OF GNSS IN AIR NAVIGATION IN ECUADOR



**United Nations / ICTP Workshop on the Use of Global Navigation Satellite Systems (GNSS) for Scientific Applications**

**1 – 5 December 2014 (ICTP, Trieste, Italy)**

**ATCO. BOLIVAR DAVALOS C. CHIEF OF PANS-OPS  
CIVIL AVIATION DIRECTION OF ECUADOR**



## BACKGROUND

- ✈ **1980 ICAO RECOGNIZES THE LIMITATIONS OF CURRENT AIR NAVIGATION SYSTEMS AND THE NEED TO IMPROVE THE NEEDS OF AVIATION IN THE XXI CENTURY**
- ✈ **1983 ICAO ESTABLISHES A SPECIAL COMMITTEE NAMED FANS (FUTURE AIR NAVIGATION SYSTEM) TO STUDY AND IDENTIFY NEW TECHNOLOGIES THAT WILL ALLOW A COORDINATED DEVELOPMENT OF AIR NAVIGATION SYSTEMS IN THE NEXT 25 YEARS.**



✈ **1991 WORLDWIDE APPROVAL OF THE CONCEPT  
CNS / ATM IN THE 10TH AIR NAVIGATION  
CONFERENCE OF ICAO (MONTREAL) WITH  
BACKUP OF INTERNACIONAL AIR  
TRANSPORTATION ASSOCIATION (IATA).**

**MAIN RECOMMENDATION: NEED FOR THE  
IMPLEMENTATION OF PROGRESSIVE WORLDWIDE  
NEW CONCEPT OF CNS / ATM SYSTEM BASED  
MAINLY IN SATELLITES.**



✈ **2003 ELEVENTH AIR NAVIGATION WORLD CONFERENCE (ANCONF / 11) GUIDELINES FOR THE TRANSITION OF SATELLITE BASED NAVIGATION SYSTEMS IN THE CAR / SAM REGIONS AND ADOPTED BY THE 12th MEETING OF GROUP OF PLANNING AND IMPLEMENTATION OF THE CAR / SAM (GREPECAS, IN ORDER TO INTRODUCE IN AN EVOLUTIONARY WAY GNSS CAPACITY IN ALL PHASES OF FLIGHT.**

✈ **2006 RNAV / GNSS / RNP PROCEDURES IN OLD QUITO INTERNATIONAL AIRPORT IATA / AA / DGAC**





2006

**RNAV / GNSS / RNP  
PROCEDURES IN OLD  
QUITO INTERNATIONAL  
AIRPORT**







## 2008 NATION BIGGEST AVIATION CHALLENGE: NEW INTERNATIONAL AIRPORT IN QUITO, ECUADOR





## SCENARIO...

- ✈ **IRREGULAR TOPOGRAPHY**
- ✈ **MOUNTAINOUS AREA**
- ✈ **WORK INFRASTRUCTURE (BUILDINGS, RWY, TWY)**
- ✈ **NAVAIDS INSTALLATION (VOR / DME, ILS, PAPI)**
- ✈ **SYSTEMS (CNS)**
- ✈ **SERVICES (AIS, COM, MET, ATC)**



# ***GNSS SARPS SYSTEMS***

**Annex 2 - Rules of the Air**

**Annex 4 - Aeronautical Charts**

**Annex 6 - Operation of Aircraft**

**Annex 10 - Aeronautical  
Telecommunications**

**Annex 11 - Air Traffic Services**

**Annex 14 - Aerodromes**

**Annex 15 - Aeronautical Information  
Services**



# ***GNSS DOCS SYSTEMS***

**9849 GNSS MANUAL**

**9750 Global Air Navigation Plan for CNS/ATM**

**9674 WGS 84 MANUAL**

**8071 Manual on testing of radio navigation aids  
(VOLUMEN II)**

**4444 Procedures for Air Navigation Services —  
Air Traffic Management**

**8126 Aeronautical Information Services Manual**



# RNAV/GNSS SID's Procedures



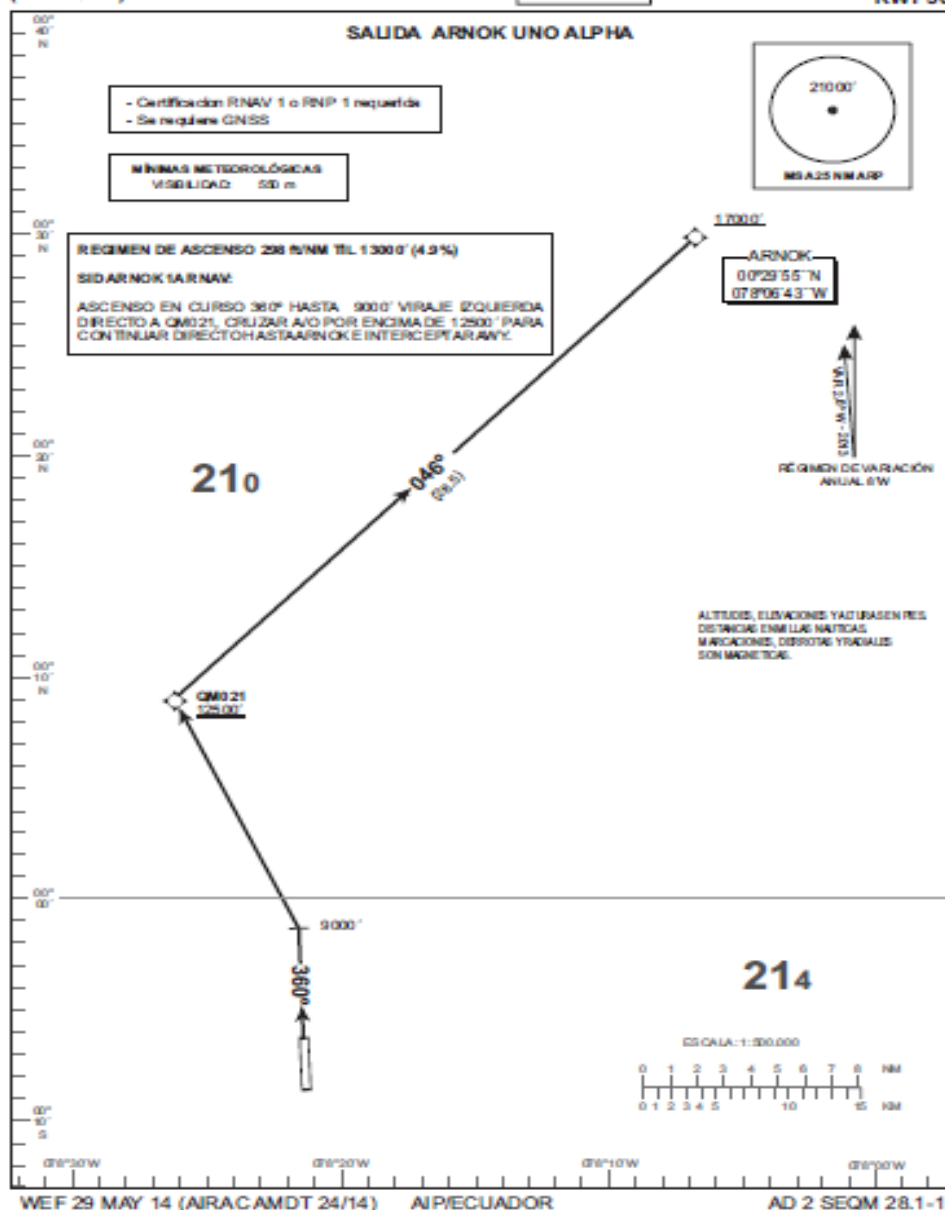
CARTA DE SALIDA NORMALIZADA  
VUELO POR INSTRUMENTOS - OACI  
(RNAV SID 1)

ALTITUD DE TRANSICIÓN  
18000'

TWR: 116.1  
APP: 119.7  
GND: 121.2

ATIS  
116.9

QUITO/Miscal Surco  
ARNOK 1A RNAV  
RWY 36



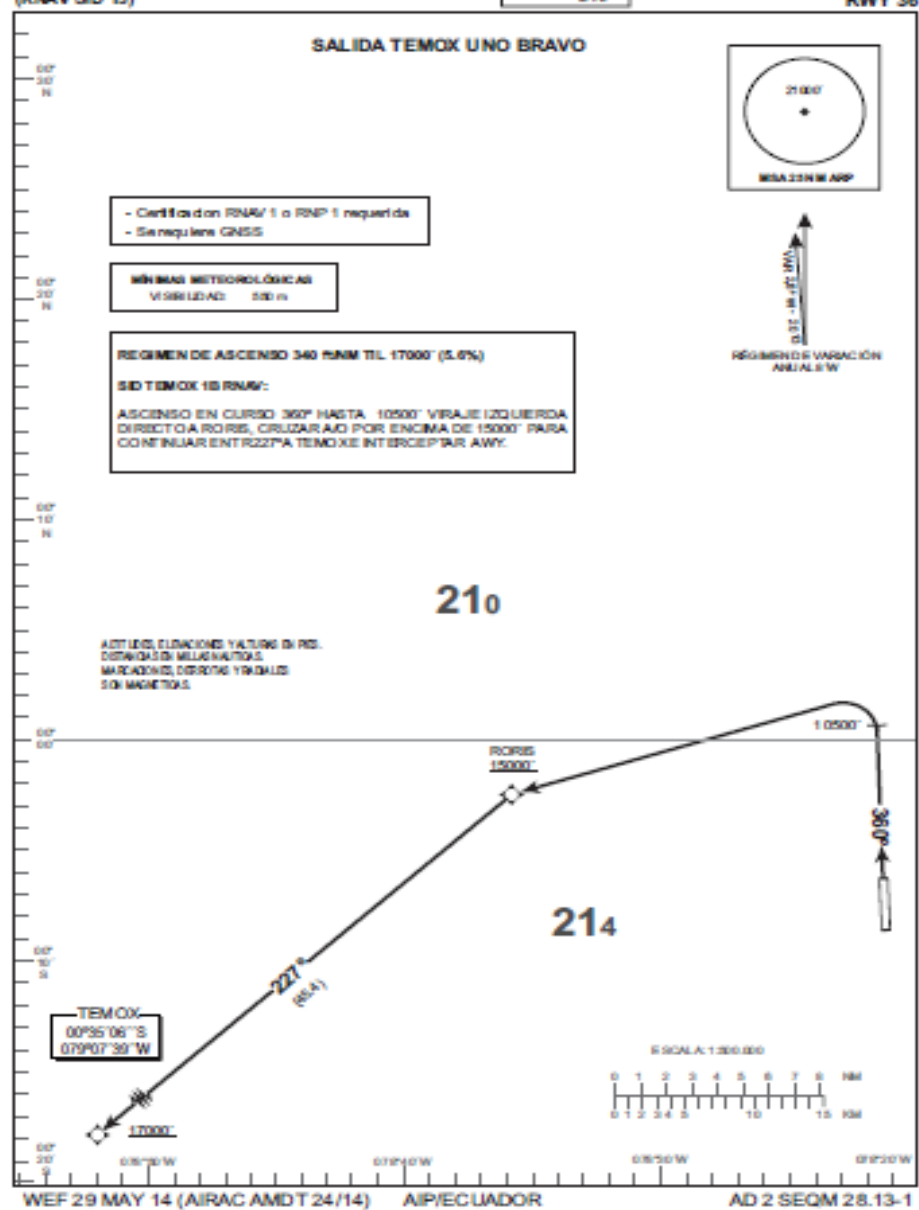
CARTA DE SALIDA NORMALIZADA  
VUELO POR INSTRUMENTOS - OACI  
(RNAV SID 13)

ALTITUD DE TRANSICIÓN  
18000'

TWR: 116.1  
APP: 119.7  
GND: 121.2

ATIS  
116.9

QUITO/Miscal Surco  
TEMOK 1B RNAV  
RWY 36





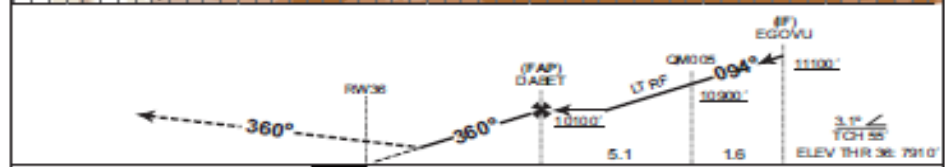
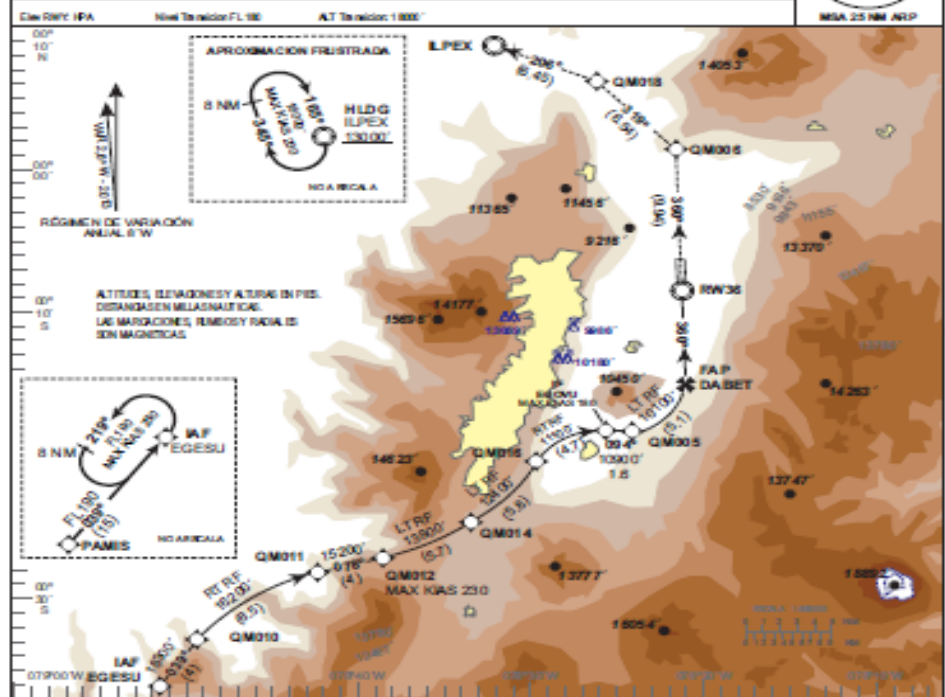


# RNAV/GNSS APP Procedures



CARTA DE APROXIMACION POR INSTRUMENTOS - QACI (RNAV IAC 1) COORDAP: 00°07'27"S 078°21'16"W QUITO / Mariscal Sucre RNAV (RNP) Z RWY 36 ELEV AP: 7910'

ATIS	QUITO APROXIMACION (APP)	QUITO TORRE (TWR)	QUITO SUPERFICIE (END)	
118.9	119.7 121.2	118.1	121.9	21000'
RNAV	CURSO APOCHI FINAL 360°	DA (H) Referencia a table de milímetros	ELEV THR RWY36 7910'	

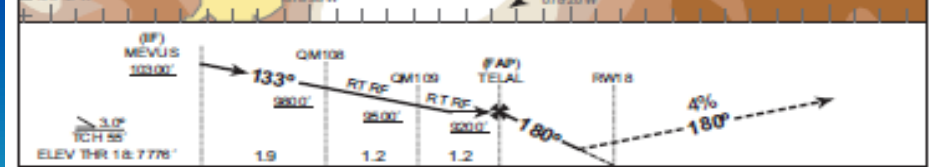
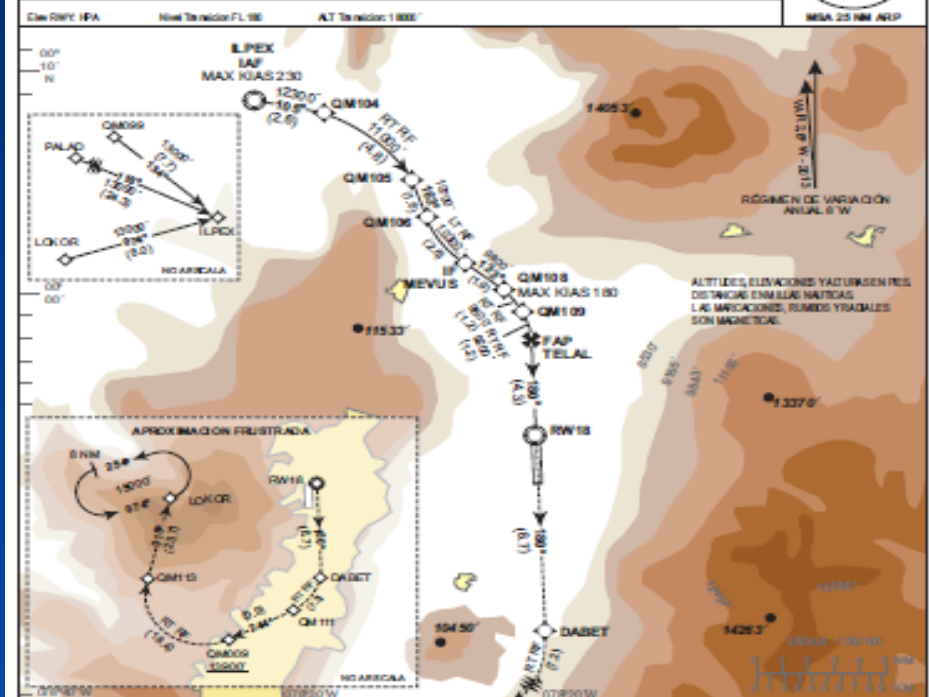


APROXIMACION FRUSTRADA: Ascenso en dirección 360° hasta QM 006, continuar de acuerdo a trayectoria RNP hasta IAF EGSU, solo por encima de 13000' en HLDG ascender a 16000' o superior de acuerdo a instrucciones ATIS.		SE REQUIERE AUTORIZACION ESPECIAL PARA TRIPULACION Y ACFT	
APCHD Inicia RWY 36		1.- Capacidad RF Requerida	
CATEGORIA	ACFT	2.- Para Sistema Bero RNAV no compensado	
RNP 0.15 DA (H)	6280' (370')	Procedimiento no autorizado bajo OPC o sobre 30°C	
RNP 0.30 DA (H)	8450' (540')	3.- Segmentos Inicial e Intermedio RNP 0.3, Feeder RNP2	
		4.- Aproximación Frustrada RNP1	
		A. Frustrada	
		G. Aproximación	
		200 RNM	
		267 334 408 468 535 602	

WEF 29 MAY 14 (AIRAC AMDT 24/14) AIP/EQUADOR AD 2 SEQM 36.1-1

CARTA DE APROXIMACION POR INSTRUMENTOS - QACI (RNAV IAC 4) COORDAP: 00°07'27"S 078°21'16"W QUITO / Mariscal Sucre RNAV (RNP) RWY 18 ELEV AP: 7910'

ATIS	QUITO APROXIMACION (APP)	QUITO TORRE (TWR)	QUITO SUPERFICIE (END)	
118.9	119.7 121.2	118.1	121.9	21000'
RNAV	CURSO APOCHI FINAL 180°	DA (H) Referencia a table de milímetros	ELEV THR RWY18 7776'	



APROXIMACION FRUSTRADA: Ascenso en dirección 180° hasta DABET, continuar de acuerdo a trayectoria RNP hasta LOHRR para ingresar en HLDG a 15000' o superior de acuerdo a instrucciones ATIS.		SE REQUIERE AUTORIZACION ESPECIAL PARA TRIPULACION Y ACFT	
APCHD Inicia RWY 18		1.- Capacidad RF Requerida	
CATEGORIA	ACFT	2.- Para Sistema Bero RNAV no compensado	
RNP 0.30 DA (H)	8190' (414')	Procedimiento no autorizado bajo OPC o sobre 30°C	
		3.- Segmentos Inicial e Intermedio RNP 0.3, Feeder RNP1	
		4.- Aproximación Frustrada RNP1	
		5.- G. Ascenso MA 4% TI 11 000', luego 3.3%	
		A. Frustrada	
		G. Aproximación	
		243 RNM	
		324 405 486 567 648 729	

WEF 29 MAY 14 (AIRAC AMDT 24/14) AIP/EQUADOR AD 2 SEQM 36.4-1





# RNAV/GNSS APP Procedures

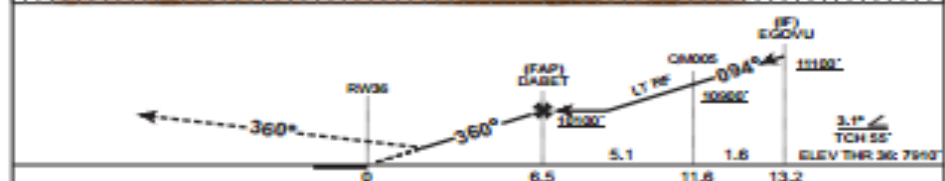


CARTA DE APROXIMACION  
POR INSTRUMENTOS - GAD  
(RNAV IAC 2)

COORDAP: 00°0'21"S 079°21'16"W  
ELEVAP: 7910'

QUITO / Mariscal Sucre  
RNAV (RNP) Y RWY 36

ATE	QUITO APROXIMACION (APP)	QUITO TORRE (TWR)	QUITO SUPERFICIE (END)	
118.9	119.7 121.2	118.1	121.9	21000'
RNAV	CURSO APOH FINAL 360°	DA (P) Referirse a tabla de mínimos	ELEV THR RWY 36 7910'	



<b>APROXIMACION FRUSTRADA:</b> Ascenso en demora 360° hasta OM 006, continuar de acuerdo a trayectoria RNP hasta ILPEX alo por encima de 13000' en HLDG ascender a 15000' o superior de acuerdo a instrucciones ATC.										<b>SE REQUIERE AUTORIZACION ESPECIAL PARA TRIPULACION Y ACFT</b> 1.- Capacidad RF Requerida 2.- Para Sistemas Bare VNAV/ no compensados Procedimiento no autorizado bajo OPC o sobre 30PC 3.- Segmentos Inicial e Intermedio RNP 0.3, Feeder RNP2 4.- Aproximacion Frustrada RNP1									
APCH Directa RWY 36				ALS				Sin ALS											
CATEGORIA		ACFT		A	B	C	D	A	B	C	D								
RNP 0.15 DA (H)		8280'(370')		N.A.				1000m				N.A.		1700m					
RNP 0.30 DA (H)		8450'(540')		N.A.				1700m				N.A.		2400m					

A. Frustrada 200 RNM	80	100	120	140	160	180
	202°	234°	401°	468°	535°	603°

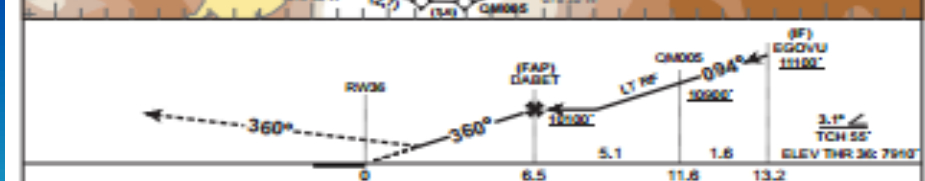
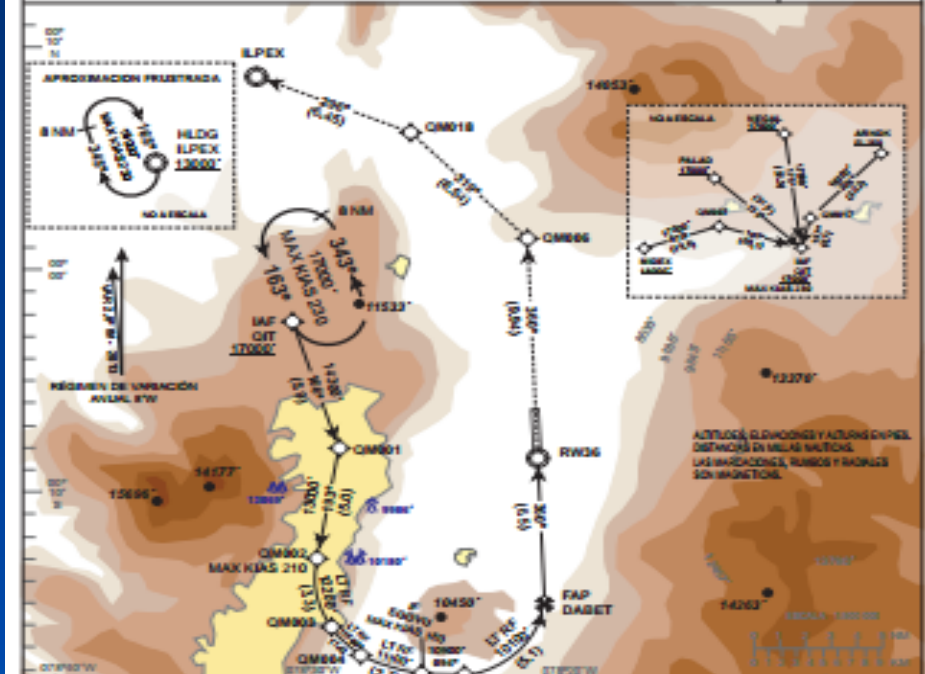
WEF 29 MAY 14 (AIRAC AMDT 24/14) AIPECUADOR AD 2 SEQM 36.2-1

CARTA DE APROXIMACION  
POR INSTRUMENTOS - GAD  
(RNAV IAC 3)

COORDAP: 00°0'21"S 079°21'16"W  
ELEVAP: 7910'

QUITO / Mariscal Sucre  
RNAV (RNP) X RWY 36

ATE	QUITO APROXIMACION (APP)	QUITO TORRE (TWR)	QUITO SUPERFICIE (END)	
118.9	119.7 121.2	118.1	121.9	21000'
RNAV	CURSO APOH FINAL 360°	DA (P) Referirse a tabla de mínimos	ELEV THR RWY 36 7910'	



<b>APROXIMACION FRUSTRADA:</b> Ascenso en demora 360° hasta OM 006, continuar de acuerdo a trayectoria RNP hasta ILPEX alo por encima de 13000' en HLDG ascender a 15000' o superior de acuerdo a instrucciones ATC.										<b>SE REQUIERE AUTORIZACION ESPECIAL PARA TRIPULACION Y ACFT</b> 1.- Capacidad RF Requerida 2.- Para Sistemas Bare VNAV/ no compensados Procedimiento no autorizado bajo OPC o sobre 30PC 3.- Segmentos Inicial e Intermedio RNP 0.3, Feeder RNP2 4.- Aproximacion Frustrada RNP1									
APCH Directa RWY 36				ALS				Sin ALS											
CATEGORIA		ACFT		A	B	C	D	A	B	C	D								
RNP 0.15 DA (H)		8280(370')		N.A.				1000m				N.A.		1700m					
RNP 0.30 DA (H)		8450(540')		N.A.				1700m				N.A.		2400m					

WEF 29 MAY 14 (AIRAC AMDT 24/14) AIPECUADOR AD 2 SEQM 36.3-1



**The goal is to have in the near future, procedures GNSS RNAV / RNP RNAV / RNP / AR  
with a maximum degree of precision, and.....**







**without using ground equipment**





## NOWADAYS QUITO'S AIRPORT HAS:

- 13 SIDs

RNAV/GNSS

- 4 APPCH

RNAV/GNSS







**THE FIRST  
AIRCRAFT  
LANDED  
IN NEW QUITO  
INTERNATIONAL  
AIRPORT  
TEST FLIGHT**





- THE MOST IMPORTANT AIRLINES IN THE WORLD OPERATE IN NEW QUITO'S INTL AIRPORT.













# NEW QUITO'S INTL. AIRPORT





# USE OF GNSS IN ROUTE







# NATURAL WORLD HERITAGE SITE





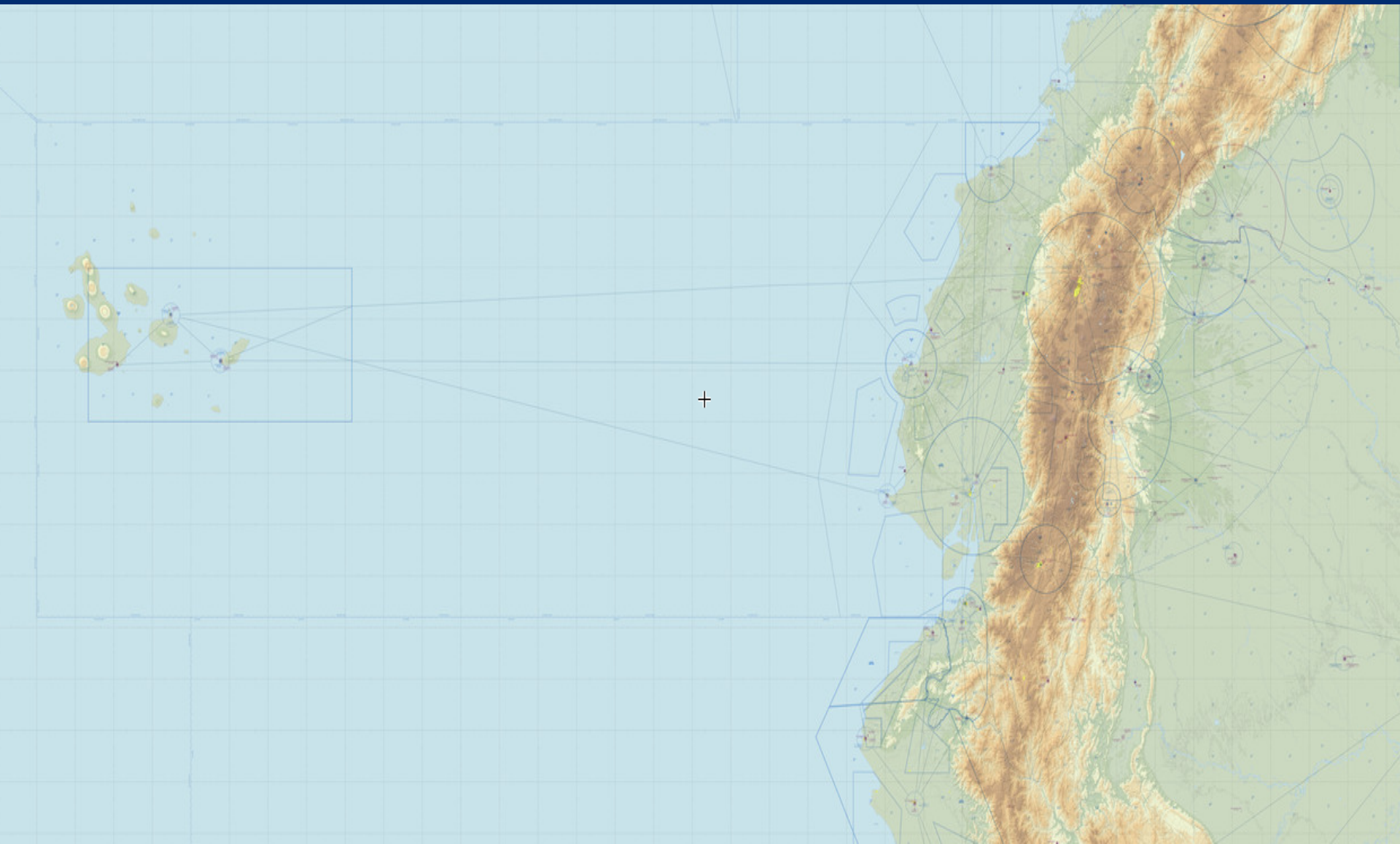


# GALAPAGOS





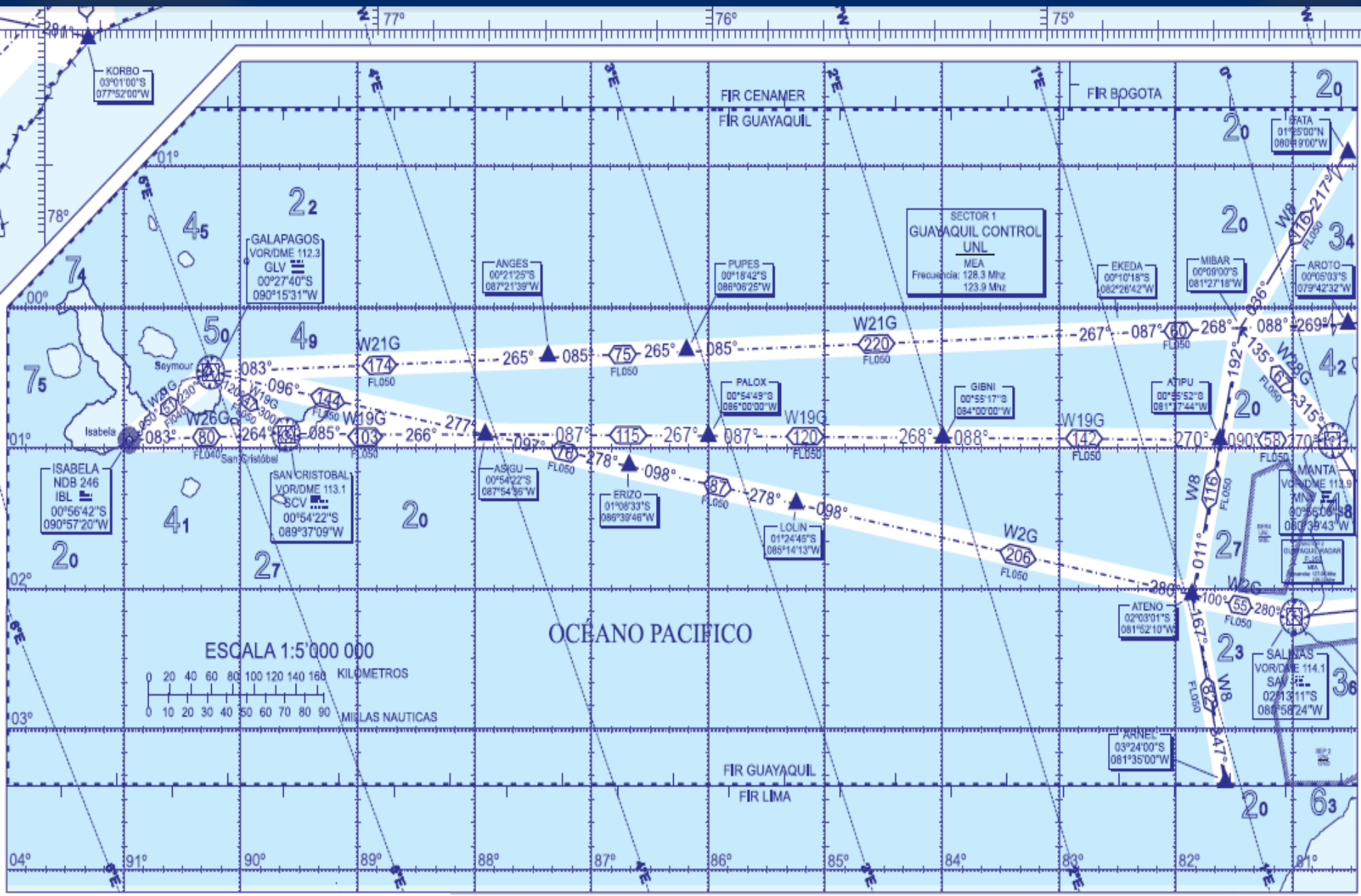
# MAP 600 NM







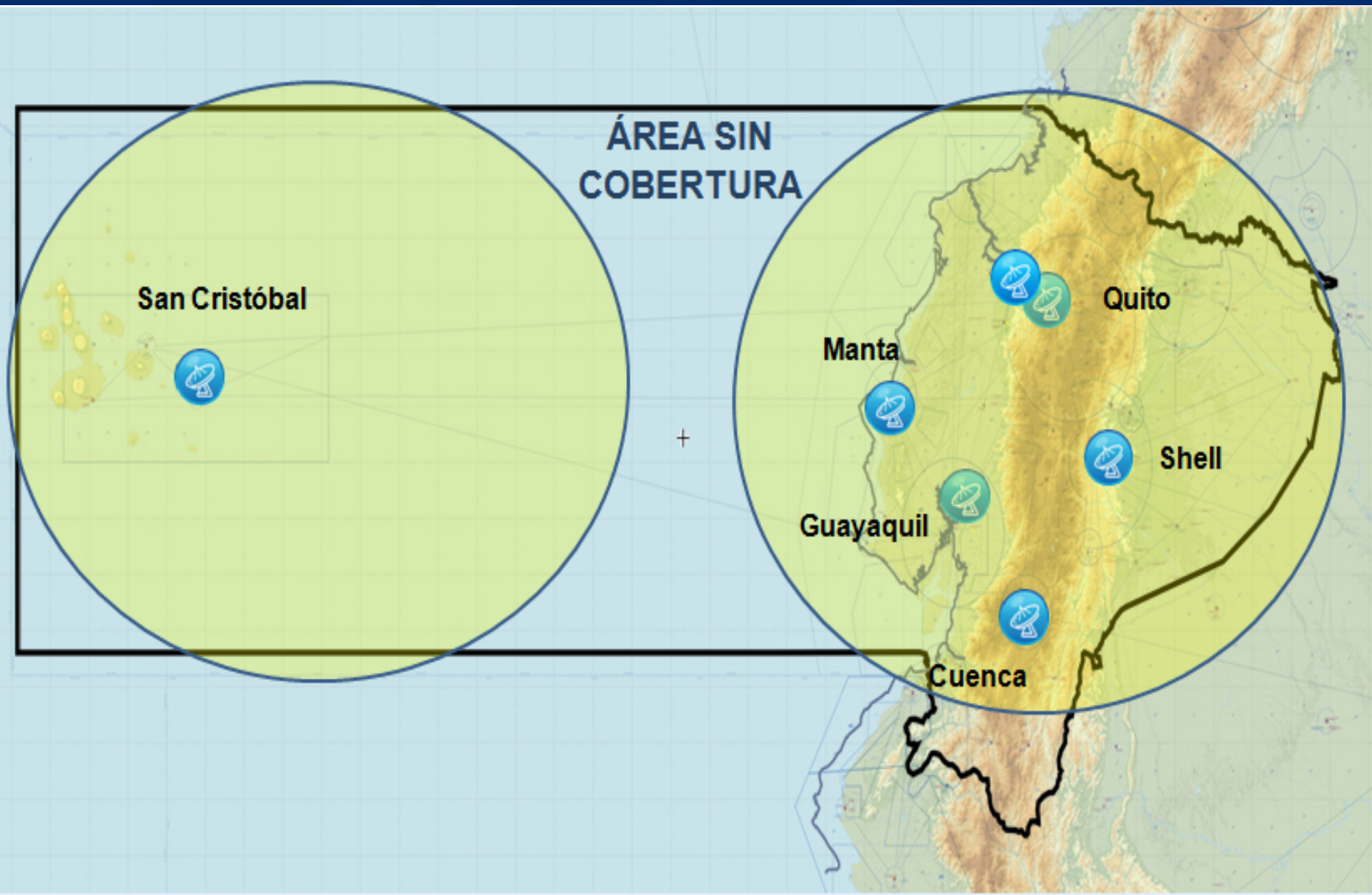
# CONVENTIONAL ROUTES







# RADAR COVERAGE





UT-100

UT-101

UT-102



# ADVANTAGES

- ✈ Increased safety
- ✈ Flight time reduction
- ✈ Operational costs reduction
- ✈ Best operational itineraries
- ✈ Standardization of procedures for pilots / ATC
- ✈ Instrument procedures without using ground equipment
- ✈ Airspace capacity



# BENEFICIARIES

- ✈ **Operators / Airlines**
- ✈ **Airports**
- ✈ **Civil Aviation Authorities**
- ✈ **Users / passengers**



# CONCLUSIONS

- ✈ **GNSS IS THE MOST DEVELOPED MEANS FOR AIR NAVIGATION.**
- ✈ **ICAO HAS DEVELOPED STANDARDS AND RECOMMENDED PRACTICES (SARPS) FOR GNSS AND OTHER TECHNICAL DOCUMENTS FOR IMPLEMENTATION.**
- ✈ **THE EVOLUTION OF GPS, GALILEO, GLONASS, ETC. WILL CONTRIBUTE TO THE IMPLEMENTATION OF GNSS IN ALL PHASES OF FLIGHT WORLDWIDE.**



...

✈️ **ECUADOR HAS NOW PROCEDURES RNAV GNSS / RNP/GNSS RELATIVELY EQUAL TO MOST IMPORTANT AIRPORTS IN THE WORLD**

✈️ **HAS REGULATIONS REGARDING GNSS FOR ITS USAGE**

✈️ **ITS IMPLEMENTATION (GNSS) WILL CONTRIBUTE TO ELIMINATE THE GAPS, IMPROVE SAFETY AND DEVELOPMENT OF AIR NAVIGATION IN CAR / SAM**

✈️ **IT IS NECCESSARY TO CONTINUE WITH THE EFFORTS, COORDINATION AND INTERNATIONAL COOPERATION TO ACHIEVE THE FULL IMPLEMENTATION OF GNSS IN THE CARIBBEAN AND SOUTH REGION (CAR / SAM).**





# ECUADOR HAS LIFTED OFF WITH GNSS ON BOARD!!



**THANK YOU**

**[bolivar.davalos@aviacioncivil.gob.ec](mailto:bolivar.davalos@aviacioncivil.gob.ec)**