

Using Open Source and Low Cost software for aeronautical databases and charting



Corporación Centroamericana de Servicios de Navegación Aérea

It is a State compromise to comply with ICAO SARPs, some of them are:

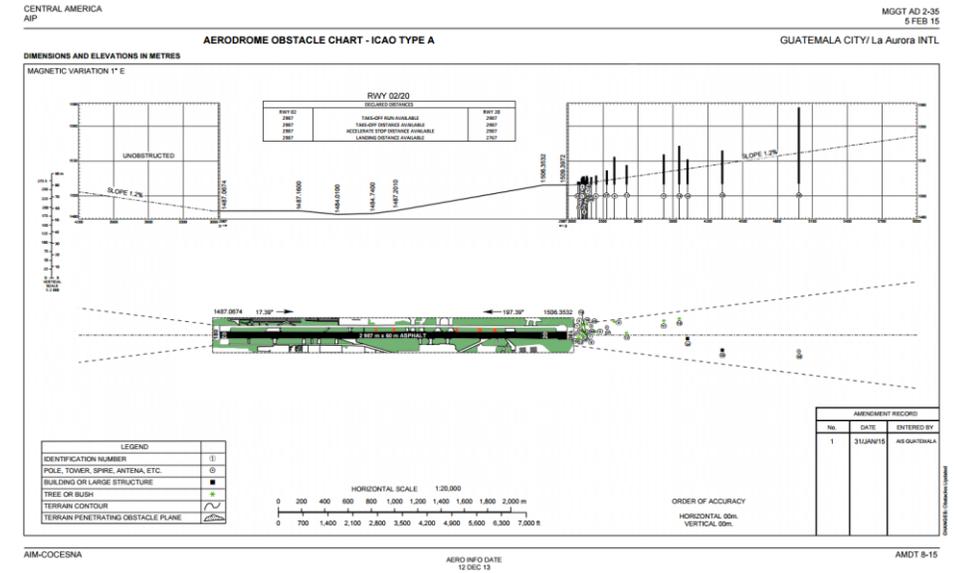
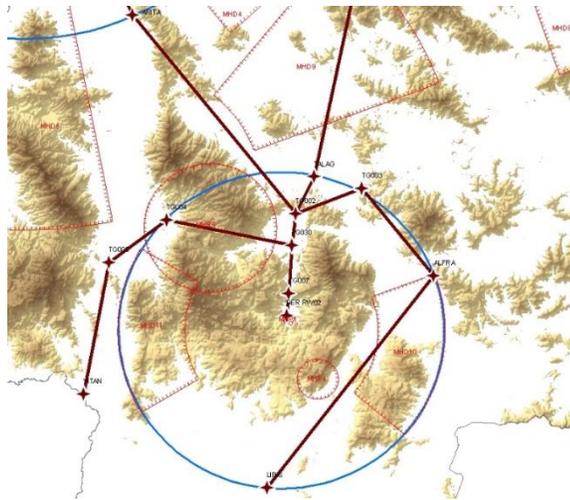
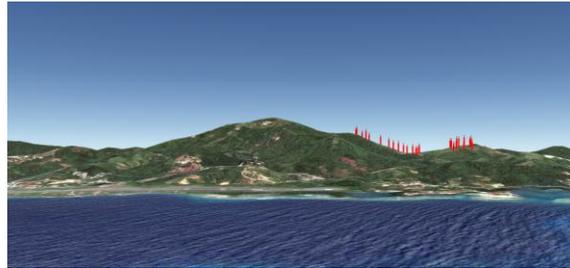
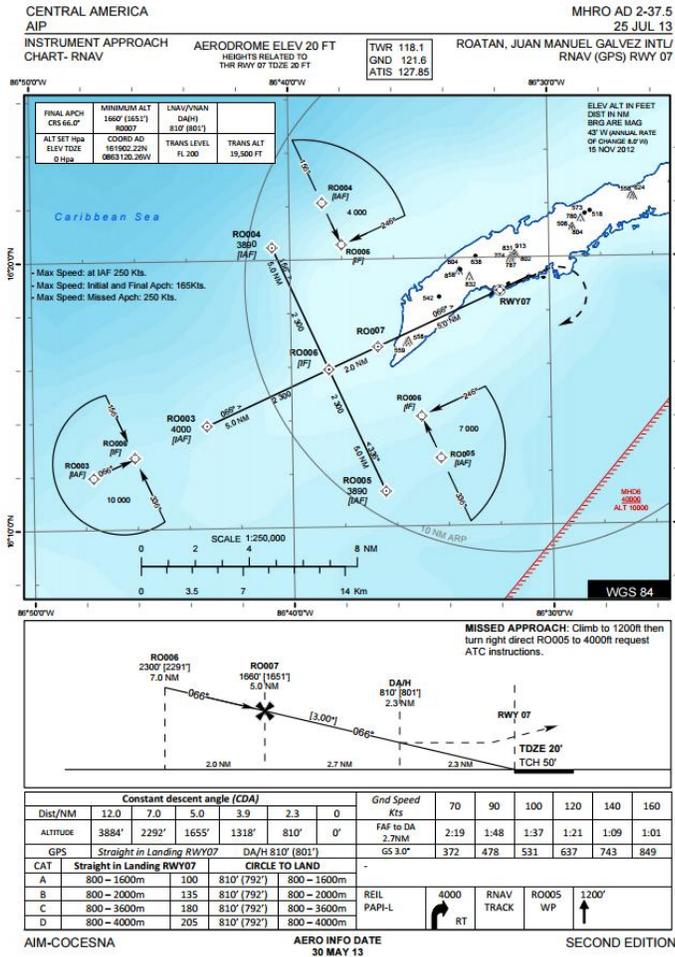
- Aeronautical Charts (ANNEX 4)
- Aerodromes (ANNEX 14)
- Aeronautical Information Services (ANNEX 15)

The industry as well as ICAO are demanding new requisites :

- Aeronautical databases (GIS)
- Electronic Terrain and Obstacle databases (eTOD)
- Airport Mapping Databases (AMDB)
- Electronic aeronautical charts
- Digital files of aeronautical data (Feature Datasets)

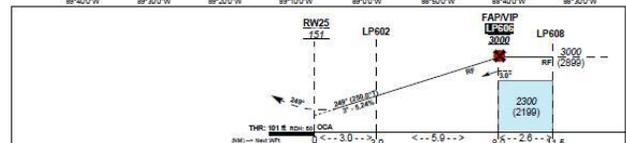
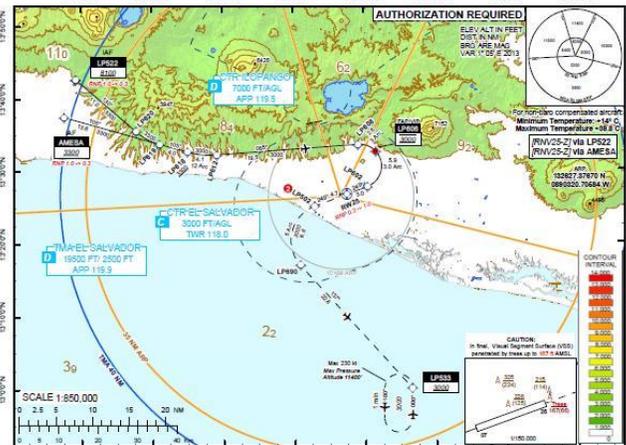
Introduction

In few words States are required to have and be able to produce



Introduction

CENTRAL AMERICA
AIP
MSL AD 2-39.33
18 SEP 14
INSTRUMENT APPROACH CHART
AERODROME ELEV 101 ft.
HEIGHTS RELATED TO THR RWY 25 ELEV 101 ft.
THR RWY 25 ELEV 101 ft.
ATIS 127.6
APP 119.9
TWR 118.0
EL SALVADOR / EL SALVADOR INTL
RNAV (RNP) Z RWY 25



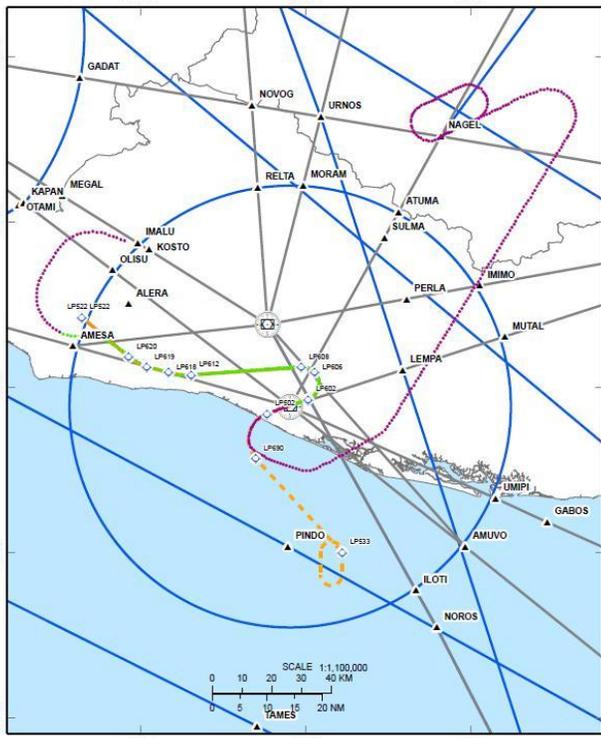
AD minima: Altitude and Height in feet. REF HGT: THR ELEV.

CAT	M.A. Climb Gradient: 2.5% 152 FT/NM				MISSED APPROACH	
	RNP AR FINAL 0.3		M.A. RNP 1.0		MA RNP 0.3	MA RNP 1.0
A	374 (273)	389 (279)	348 (247)	356 (249)	400	1 600m
B	385 (284)	400 (291)	357 (256)	360 (259)	400	1 600m
C	414 (313)	430 (319)	385 (284)	370 (269)	400	1 600m
D	433 (332)	449 (339)	378 (275)	380 (275)	400	1 600m

AIM-COCESNA AERO INFO DATE 18 SEP 14 AIRAC SUP A18/14

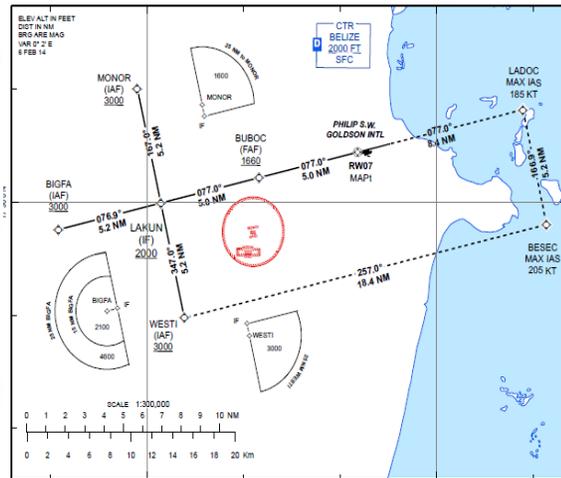


EL SALVADOR PBN APPROACHES RADAR PLOTS ANALYSIS
RNAV(RNP) Z RWY 25 via LP522 missed approach vector to NAGEL PBN SPECIFICATION RNP 0.3
08 AUG 14



AIM-COCESNA GIS ANALYSIS

INSTRUMENT APPROACH CHART
THR ELEV 15 ft
HEIGHTS RELATED TO THR ELEVATION TRANSITION ALTITUDE 19 000 ft
APP 121.0
TWR 118.0
GND 121.9
ATIS 132.75
BELIZE CITY
APPROACH CHART
PHILIP S. W. GOLDSON INTL
RNAV (RNP) RWY 07



RECOMMENDED PROFILE - (LNAV 5.2%, 320 FNM)

DIST THR	5	4	3	2
ALTITUDE	1860 (1845)	1340 (1325)	1030 (1015)	710 (695)

MISSED APPROACH:
LNAV RWY07
Climb on RWY heading
circling to LADOC.
Turn Right Circling to BESEC.
Turn Right Circling to WEST1.
+4000 ft and request
ATIS instructions.

For loss of RNAV capability
Climb on RWY heading to 1800 ft
and request ATIS instructions

OCA/H	A	B	C	D	Ground Speed	70	90	100	120	140	160
LNAV/VNAV	NA	NA	NA	NA	Rate of Descent	372	478	531	637	743	849
LNAV	420 (405)	420 (405)	420 (405)	420 (405)	FAF/MAP1 3.0° (5.2%)						
VM(C) OCA	400 (485)	610 (495)	610 (595)	710 (695)							

Note:
1. No Turn before MAP1. 2. Timing not authorized for defining the MAP1. 3. NM to/from THR RWY 07. 4. Visual Circling not allowed North of Runway

INSTRUMENT APPROACH CHART
THR ELEV 15 ft
HEIGHTS RELATED TO THR ELEVATION TRANSITION ALTITUDE 19 000 ft
APP 121.0
TWR 118.0
GND 121.9
ATIS 132.75
BELIZE CITY
APPROACH CHART
PHILIP S. W. GOLDSON INTL
RNAV (RNP) RWY 07

IAF MONOR

Designator	Path Description	Waypoint Identifier	Latitude	Longitude	Flyover	Course (M/T)	Turn Direction	Altitude (ft)	Distance (NM)	Speed Limit (kt)	Magnitude Variation	VM (ft)	Navigation Specification
RNAV (GNSS) RWY07	IF	MONOR	17.38021039N	088.0021919W	-	-	-	+3 000	-	-	-	070° E	-
RNAV (GNSS) RWY07	TF	LAKUN	17.29578146N	088.0211388W	-	0.167 (0.167)	L	+2 000	6.2	-	070° E	-	
RNAV (GNSS) RWY07	TF	BUBOC	17.1063284N	088.0411280W	-	0.277 (0.277)	-	+1 660	6.0	-	070° E	-	
RNAV (GNSS) RWY07	TF	RWD7	17.3212842N	088.1005248W	Y	0.277 (0.277)	-	-	6.0	-	070° E	-070°	
RNAV (GNSS) RWY07	TF	LADOC	17.34060398N	088.10311127W	-	0.277 (0.277)	R	+1 800	6.4	186	070° E	-	
RNAV (GNSS) RWY07	TF	BESEC	17.29027465N	088.0913717W	-	0.167 (0.167)	R	+2 140	6.2	206	070° E	-	
RNAV (GNSS) RWY07	TF	WEST1	17.2452892N	088.0042679W	-	0.287 (0.287)	-	+4 000	18.4	250	-	-	

IAF BIGFA

Designator	Path Description	Waypoint Identifier	Latitude	Longitude	Flyover	Course (M/T)	Turn Direction	Altitude (ft)	Distance (NM)	Speed Limit (kt)	Magnitude Variation	VM (ft)	Navigation Specification
RNAV (GNSS) RWY07	IF	BIGFA	17.28478974N	088.0352668W	-	-	-	+3 000	-	-	-	070° E	-
RNAV (GNSS) RWY07	TF	LAKUN	17.29578146N	088.0211388W	-	0.277 (0.277)	-	+2 000	6.2	-	070° E	-	
RNAV (GNSS) RWY07	TF	BUBOC	17.1063284N	088.0411280W	-	0.277 (0.277)	-	+1 660	6.0	-	070° E	-	
RNAV (GNSS) RWY07	TF	RWD7	17.3212842N	088.1005248W	Y	0.277 (0.277)	-	-	6.0	-	070° E	-070°	
RNAV (GNSS) RWY07	TF	LADOC	17.34060398N	088.10311127W	-	0.277 (0.277)	R	+1 800	6.4	186	070° E	-	
RNAV (GNSS) RWY07	TF	BESEC	17.29027465N	088.0913717W	-	0.167 (0.167)	R	+2 140	6.2	206	070° E	-	
RNAV (GNSS) RWY07	TF	WEST1	17.2452892N	088.0042679W	-	0.287 (0.287)	-	+4 000	18.4	250	-	-	

IAF WEST1

Designator	Path Description	Waypoint Identifier	Latitude	Longitude	Flyover	Course (M/T)	Turn Direction	Altitude (ft)	Distance (NM)	Speed Limit (kt)	Magnitude Variation	VM (ft)	Navigation Specification
RNAV (GNSS) RWY07	IF	WEST1	17.2452892N	088.0042679W	-	-	-	+3 000	-	-	-	070° E	-
RNAV (GNSS) RWY07	TF	LAKUN	17.29578146N	088.0211388W	-	0.347 (0.347)	R	+2 000	6.2	-	070° E	-	
RNAV (GNSS) RWY07	TF	BUBOC	17.1063284N	088.0411280W	-	0.277 (0.277)	-	+1 660	6.0	-	070° E	-	
RNAV (GNSS) RWY07	TF	RWD7	17.3212842N	088.1005248W	Y	0.277 (0.277)	-	-	6.0	-	070° E	-070°	
RNAV (GNSS) RWY07	TF	LADOC	17.34060398N	088.10311127W	-	0.277 (0.277)	R	+1 800	6.4	186	070° E	-	
RNAV (GNSS) RWY07	TF	BESEC	17.29027465N	088.0913717W	-	0.167 (0.167)	R	+2 140	6.2	206	070° E	-	
RNAV (GNSS) RWY07	TF	WEST1	17.2452892N	088.0042679W	-	0.287 (0.287)	-	+4 000	18.4	250	-	-	



However we have the following issues:

- Lack of staff
- Lack of trained staff
- Lack of aeronautical data (geodetic surveys, calculations, etc)
- Lack of software

Introduction

Each of the issues listed before are easily solved

You only need



Money is always one of the important topics

What do we do if we have money?

Do we hire more staff?
(We probably need more)

or

Do we buy software we need?



What do we do if we don't have money?

Introduction



Sometimes one of the biggest costs is Software, this is due to the costs per license and/or user.

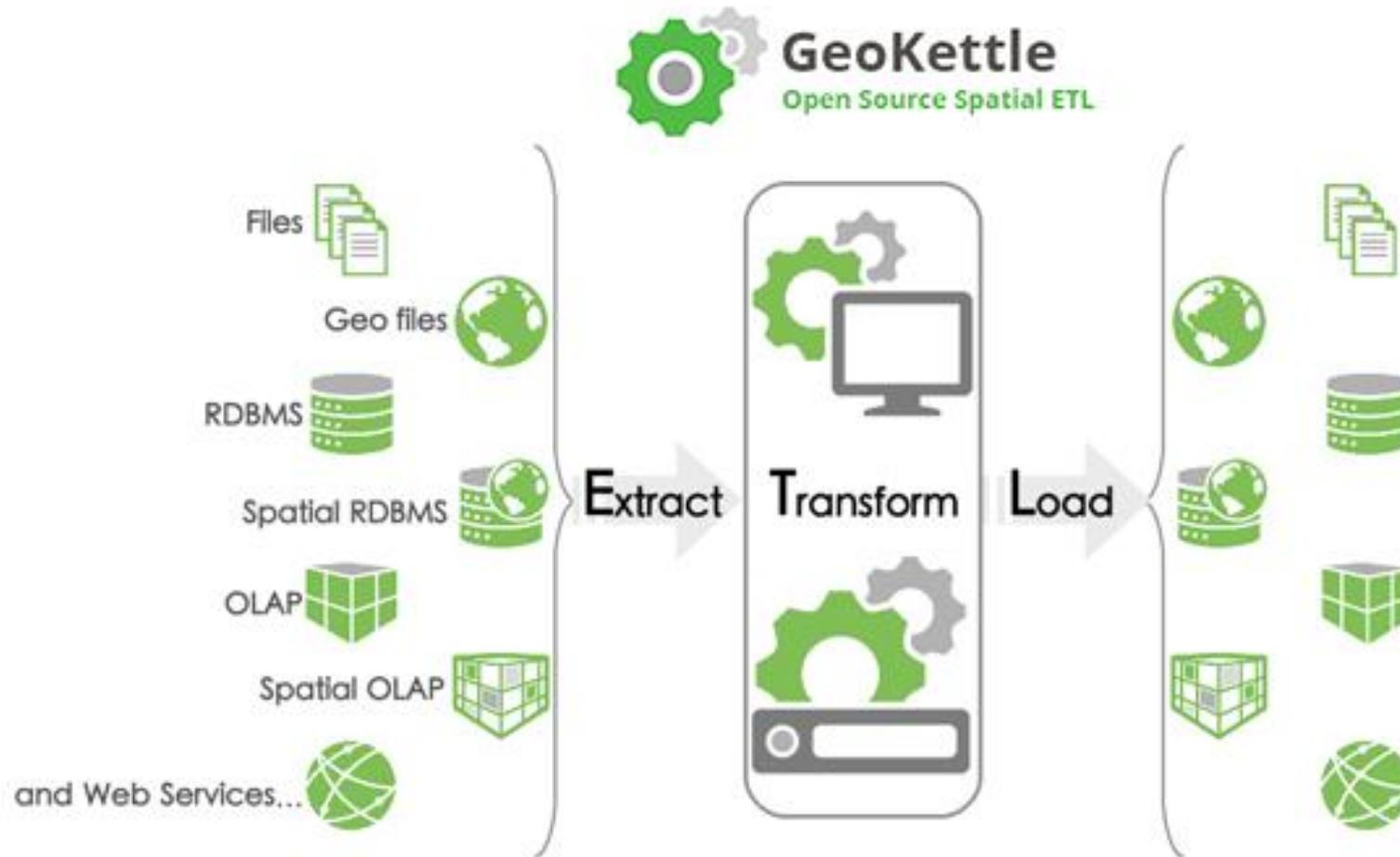
Exchange models AIXM, WXXM, etc. Will need specialized software, which has a cost (\$\$\$)

While you acquire the specialized software the question is

What can we do?

Even if you do buy specialized software you will surely require other software capable to transform from one format to another the data

Open Source Software and Low cost software



What is open source software?

Open Source Software refers to the freedom of the user to execute, copy, distribute, study, change and improve the software. As a more precise definition, it refers to the following four freedoms of the users of the software:

- **The freedom to use the software, for any purpose** (Freedom 0).
- The freedom to study how the program works and adapt it to your needs (freedom 1). Access to the source code is a pre-requisite for this condition
- **The freedom to distribute copies, with which you can help your neighbor** (freedom 2).
- The freedom to improve the program and make the improvements public for others, so the community may benefit (freedom 3). Access to the source code is a pre-requisite for this condition

(<http://hispalinux.es/>)

What is low cost software?

Low cost software, is simply software which acquisition and annual maintenance cost is accesible and doesn't represent a high investment.

www.qgis.org

An open source Geographic Information System



QGIS is able to read/write a great number of formats:

- ESRI Shapefile
 - DXF
- Mapinfo File
 - CSV
 - Postgis
 - MSSQL
 - Oracle
- GPX...etc

QGIS 2.8.2-Wien - lower_ATS_routes

Project Edit View Layer Settings Plugins Vector Raster Database Web Processing Help

Layers

- volcanoesofficial
- runway
- obstacle
- fixes_required
- AREA_CTA_NICARAGUA
- AREA_CTA_EL_SALVADOR
- nav aids
- route_lines
- holding_pattern
- MARITIME
- designated_points
 - ICAO
 - Coordinates
 - Procedures
- ama_1deg
- 1
- atc_surveillance_minima
- Rutas
 - rnav_routes
 - designated_points_belize
 - ICAO
 - Coordinates
 - Procedures
 - lower_ats_routes
 - upper_ats_routes
 - star_leg
- airspace
 - fir_area
 - zprd
 - tma
 - ctr
 - atz
- airport_heliport
- airport_heliport_national
- AMA
- OCH Landscape
- Google Physical
- OpenStreetMap
- Google Satellite

Processing Toolbox

Search...

Recently used algorithms

- r.aspect - Generates raster maps of aspect from a elevation rast...
- r.buffer - Creates a raster map layer showing buffer zones surro...
- r.slope - Generates raster maps of slope from a elevation raster ...
- Contour lines from grid
- Hillshade
- r.neighbors - Makes each cell category value a function of the ca...
- GDAL/OGR [45 geosalgorithms]
- GRASS commands [160 geosalgorithms]
- Models [0 geosalgorithms]
- Orfeo Toolbox (Image analysis) [83 geosalgorithms]
- QGIS geosalgorithms [103 geosalgorithms]
- SAGA (2.1.2) [235 geosalgorithms]
- Scripts [0 geosalgorithms]

Coordinate: -10154104,1665266 Scale: 1:2,500,000 Rotation: 0.0 Render EPSG:3857 (OTF)

QGIS is extensible, there are a great number of plugins that add functionality also

The screenshot shows the QGIS Python Plugins Repository website. The page title is "QGIS Python Plugins Repository" and it indicates that 507 records were found. A table lists various plugins with columns for Name, Author, Stars (votes), Stable version, and Experimental version.

Name	Author	Stars (votes)	Stable	Exp.
ARPAT plugin	Martin Dobias (Faunalia)	★★★★ (8)	0.3.3	—
Acca plugin	Bastrakov Sergey	★★★★ (14)	0.3	0.2
AccurAssess	Jaime Loya, Jean F Mas	★★★★ (8)	0.2	0.1
Accuracy Assessment	Jared Kibebe	★★★★★ (23)	0.4.2	0.4.1
Affine Transformations	Mauricio de Paulo and Erik Timmers	★★★★★ (29)	1.0.2	—
AniMove for QGIS	Francesco Boccacci, Victor Gonzalez, Alexander Bruy	★★★★ (29)	1.3.3	1.4.2
ArcGIS REST API Connector	geometalab	★★★★★ (13)	—	0.1.1
ArcheoCAD	Nariman Hatami - INRAP	★★★★★ (33)	0.1.3	—
Area Along Vector	Alexis Dupont-Roc	★★★★ (11)	1.1	0.1-beta
Arrows	Gregoire Piffaut	★★★★★ (4)	0.2.2	—
Astrogeology POW	Jay Laura	(0)	—	0.3
Atlas	Vincent Picavet	★★★★★ (34)	0.2.3	0.3
Attribute painter	Enrico Ferreguti	★★★★★ (10)	3.0	—
AutoPlot	Colley	★★★★ (4)	—	0.2
AutoTrace	Peter Wells for Lutra Consulting	★★★★★ (47)	1.0.6	1.0.2
Auxiliary Window	Luiz Motta	★★★★★ (4)	—	0.4

If you can code using python you can automate writing
 your own software

The screenshot shows the 'Conditional Format Rules' dialog in QGIS. On the left is an attribute table for 'Pipes' with 5538 features. The table has columns 'Primary_Me' and 'Unit_Of_M'. The 'Primary_Me' column is highlighted with a color gradient based on values. On the right, the 'Conditional Format Rules' panel is open, showing a condition '@value < 10' and several format buttons with different colors and text 'abc - 123'. Below the format buttons are 'Custom' options for background color, text, and font style (Comic Sans MS).

Primary_Me	Unit_Of_M
80.82	M
76.64	M
7.90	M
2.75	M
2.93	M
8.15	M
2.87	M
22.31	M
8.18	M

PRO TIP:

If you are going to work using GIS you need to learn to code, at least to the level to write small scripts which are small programs to automate tasks



JavaScript

Postgresql+Postgis

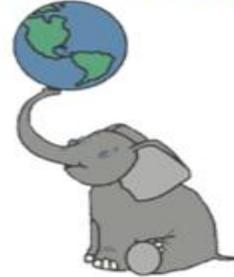
www.postgresql.org.es/

www.postgis.refractory.net/

PostgreSQL



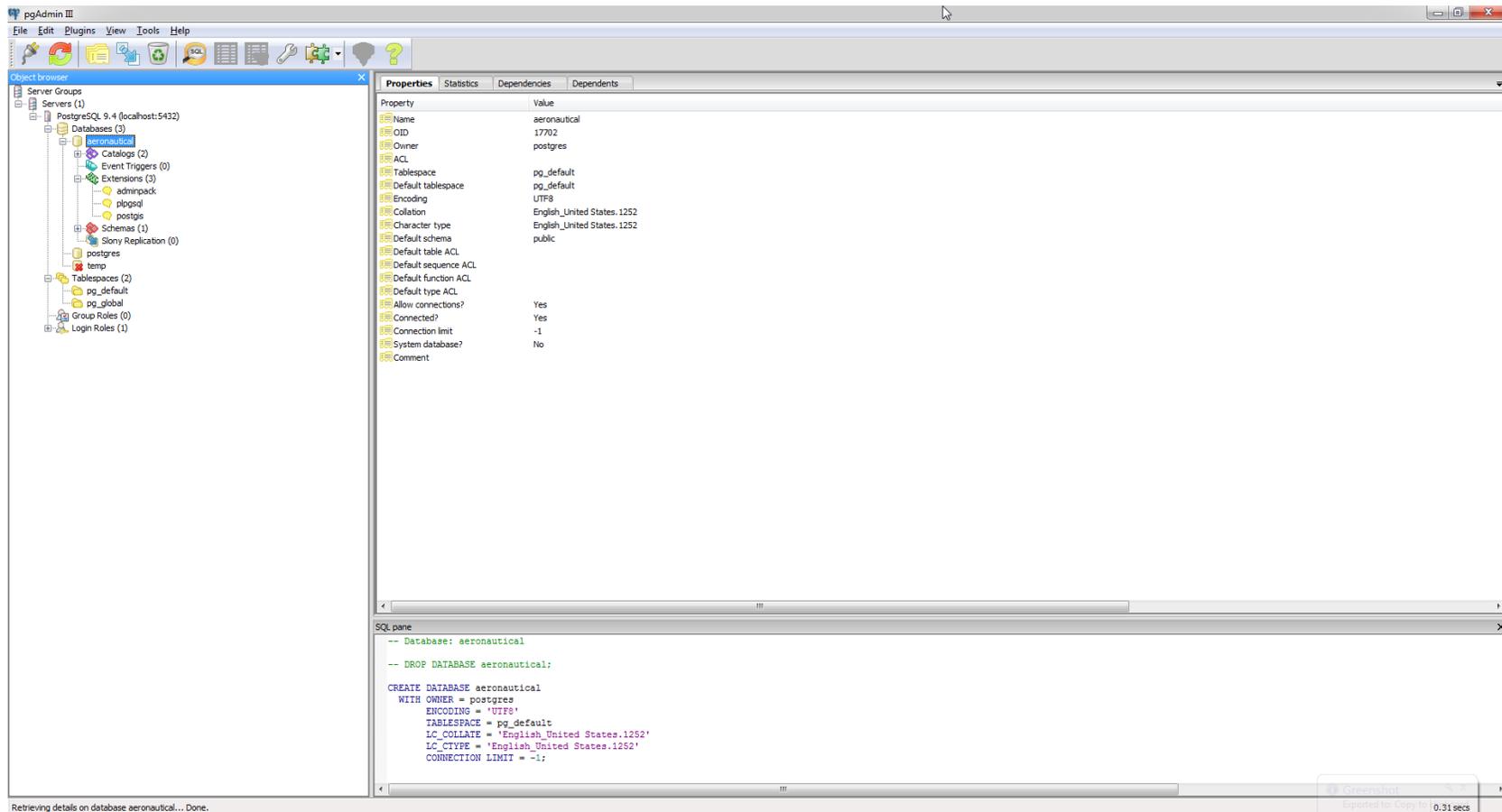
PostGIS



PostgreSQL is object oriented relational database management system distributed under a BSD license and its source code is freely available.

PostGIS: Is an extension to the PostgreSQL relational database. It permits the use of GIS(Geographic information systems). PostGIS includes support for GiST indexes based on R-tree and basic functions for the analysis of GIS objects.

www.postgresql.org.es/
www.postgis.refractorions.net/



The screenshot shows the pgAdmin III interface. On the left, the Object browser displays a tree view of the PostgreSQL server structure, including Servers, Databases, Catalogs, Extensions, Schemas, and Tablespace. The 'aeronautical' database is selected. The main window displays the Properties tab for the 'aeronautical' database, showing various configuration parameters and their values.

Property	Value
Name	aeronautical
OID	17702
Owner	postgres
ACL	
Tablespace	pg_default
Default tablespace	pg_default
Encoding	UTF8
Collation	English_United States.1252
Character type	English_United States.1252
Default schema	public
Default table ACL	
Default sequence ACL	
Default function ACL	
Default type ACL	
Allow connections?	Yes
Connected?	Yes
Connection limit	-1
System database?	No
Comment	

The SQL pane at the bottom shows the following SQL commands:

```
-- Database: aeronautical
-- DROP DATABASE aeronautical;
CREATE DATABASE aeronautical
WITH OWNER = postgres
ENCODING = 'UTF8'
TABLESPACE = 'pg_default'
LC_COLLATE = 'English_United States.1252'
LC_CTYPE = 'English_United States.1252'
CONNECTION LIMIT = -1;
```

Retrieving details on database aeronautical... Done.

Exported to Copy to 0.31secs

Postgresql+Postgis

The 'Add PostGIS Table(s)' dialog box shows a list of tables in the 'gis20150820' schema. The table 'topographic_level_curves' is selected. The dialog includes options to 'Also list tables with no geometry' and 'Search options'.

Schema	Table	Column	Data Type	Spatial Type	SRID	Primary Key
gis20150820	airport_heliport	geom	Geometry	Point	4326	
gis20150820	airport_heliport_national	geom	Geometry	Point	4326	
gis20150820	ama_15min	geom	Geometry	Multipolygon	4326	
gis20150820	ama_1deg	geom	Geometry	Multipolygon	4326	
gis20150820	ama_30min	geom	Geometry	Multipolygon	4326	
gis20150820	atc_surveillance_minima	geom	Geometry	Multipolygon	4326	
gis20150820	atz	geom	Geometry	Multipolygon	4326	
gis20150820	ctr	geom	Geometry	Multipolygon	4326	
gis20150820	designated_points	geom	Geometry	Point	4326	
gis20150820	fir_area	geom	Geometry	Multipolygon	4326	
gis20150820	holding_pattern	geom	Geometry	Multiline	4326	
gis20150820	lower_atc_routes	geom	Geometry	Multiline	4326	
gis20150820	minimum_sector_altitude	geom	Geometry	Multipolygon	4326	
gis20150820	navaids	geom	Geometry	Point	4326	
gis20150820	obstacle	geom	Geometry	Point	4326	
gis20150820	rnav_routes	geom	Geometry	Multiline	4326	
gis20150820	runway	geom	Geometry	Multipolygon	4326	
gis20150820	sid_leg	geom	Geometry	Multiline	4326	
gis20150820	sid_leg2	geom	Geometry	Multiline	4326	
gis20150820	star_leg	geom	Geometry	Multiline	4326	
gis20150820	tma	geom	Geometry	Multipolygon	4326	
gis20150820	training_areas	geom	Geometry	Multipolygon	4326	
gis20150820	upper_atc_routes	geom	Geometry	Multiline	4326	
gis20150820	view_all_routes	geom	Geometry	Multiline	4326	gid
gis20150820	view_arp_10nm	geom	Geometry	Select...	Enter...	gid
gis20150820	view_arp_10nm	geom	Geometry	Polygon	4326	gid
gis20150820	volcanoesofficial	geom	Geometry	Point	4326	
gis20150820	zprd	geom	Geometry	Multipolygon	4326	

The 'DB Manager' window shows the 'gis20150820' schema details. The schema owner is 'postgres'. The user has privileges to 'create new objects' and 'access objects'.

gis20150820

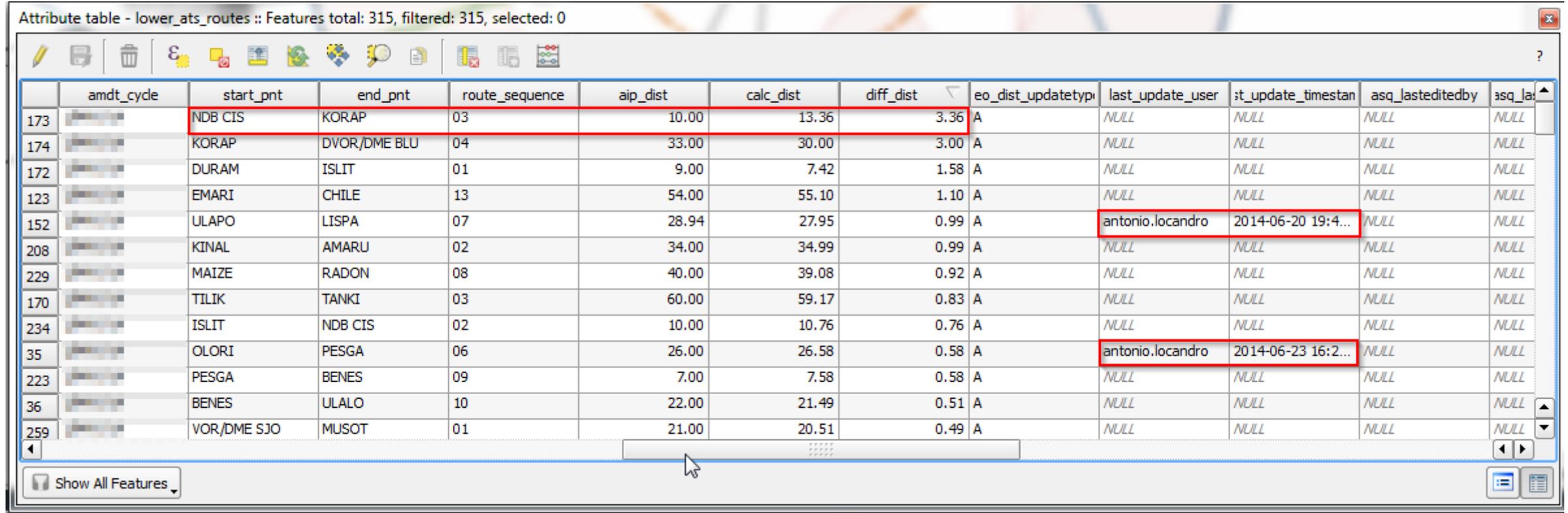
Schema details
Owner: postgres

Privileges
User has privileges:
• create new objects
• access objects



Postgresql+Postgis+QGIS (Automatic review and trazability)

Attribute table - lower_ats_routes :: Features total: 315, filtered: 315, selected: 0



	amdt_cycle	start_pnt	end_pnt	route_sequence	aip_dist	calc_dist	diff_dist	eo_dist_updatetyp	last_update_user	st_update_timestan	asq_lasteditedby	asq_la
173		NDB CIS	KORAP	03	10.00	13.36	3.36	A	NULL	NULL	NULL	NULL
174		KORAP	DVOR/DME BLU	04	33.00	30.00	3.00	A	NULL	NULL	NULL	NULL
172		DURAM	ISLIT	01	9.00	7.42	1.58	A	NULL	NULL	NULL	NULL
123		EMARI	CHILE	13	54.00	55.10	1.10	A	NULL	NULL	NULL	NULL
152		ULAPO	LISPA	07	28.94	27.95	0.99	A	antonio.locandro	2014-06-20 19:4...	NULL	NULL
208		KINAL	AMARU	02	34.00	34.99	0.99	A	NULL	NULL	NULL	NULL
229		MAIZE	RADON	08	40.00	39.08	0.92	A	NULL	NULL	NULL	NULL
170		TILIK	TANKI	03	60.00	59.17	0.83	A	NULL	NULL	NULL	NULL
234		ISLIT	NDB CIS	02	10.00	10.76	0.76	A	NULL	NULL	NULL	NULL
35		OLORI	PESGA	06	26.00	26.58	0.58	A	antonio.locandro	2014-06-23 16:2...	NULL	NULL
223		PESGA	BENES	09	7.00	7.58	0.58	A	NULL	NULL	NULL	NULL
36		BENES	ULALO	10	22.00	21.49	0.51	A	NULL	NULL	NULL	NULL
259		VOR/DME SJO	MUSOT	01	21.00	20.51	0.49	A	NULL	NULL	NULL	NULL

Show All Features

Postgresql+Postgis+QGIS (Input forms and validations)

star_leg - Feature Attributes

gid: extval(gis20150820.star_leg_gid_seq::regclass)

icao_star_designator: NULL

star_type: [dropdown]

required_navigation_performance: CONV
PBN

star_sequence: NULL

leg_type_arinc: [dropdown]

start_pnt: NULL

end_pnt: NULL

brgmag: NULL

brggeo: NULL

geo_distance: NULL

remarks: NULL

amdt_cycle: amdt.getcurrentcydename()

calc_dist: NULL

diff_dist: NULL

uuid: amdt.generate_uuidstring()

aerodrome: [dropdown]

OK Cancel

star_leg - Feature Attributes

gid: extval(gis20150820.star_leg_gid_seq::regclass)

icao_star_designator: NULL

star_type: [dropdown]

required_navigation_performance: [dropdown]
NO
RNAV1
RNP2

star_sequence: NULL

leg_type_arinc: [dropdown]

start_pnt: NULL

end_pnt: NULL

brgmag: NULL

brggeo: NULL

geo_distance: NULL

remarks: NULL

amdt_cycle: amdt.getcurrentcydename()

calc_dist: NULL

diff_dist: NULL

uuid: amdt.generate_uuidstring()

aerodrome: [dropdown]

OK Cancel

star_leg - Feature Attributes

gid: extval(gis20150820.star_leg_gid_seq::regclass)

icao_star_designator: NULL

star_type: [dropdown]

required_navigation_performance: [dropdown]

star_sequence: NULL

leg_type_arinc: [dropdown]

start_pnt: NULL

end_pnt: NULL

brgmag: NULL

brggeo: NULL

geo_distance: NULL

remarks: NULL

amdt_cycle: amdt.getcurrentcydename()

calc_dist: NULL

diff_dist: NULL

uuid: amdt.generate_uuidstring()

aerodrome: [dropdown]
MGGT
MGTK
MFLC
MFLM
MHRO
MHTG

OK Cancel

Postgresql+Postgis+QGIS (Input forms and validations)

The screenshot displays the QGIS 2.8.2-Wien interface with a map of flight routes. The map shows various airports and connecting routes, with labels for airports like BZE, LM001, and GORDA. The interface includes a toolbar, a layer list on the left, and a data table at the bottom.

Layers:

- New scratch layer
- designated_points
 - ICAO
 - Coordinates
 - Procedures
- navaids
- zprd
- sid_leg
 - MHLM
 - MHRO
 - MHTG
- star_wpt
- star_leg
 - MHLM
 - MHRO
 - MHTG
 - MRLB
 - MROC
- runway_centerline_point
 - group1
 - MARITIME
 - nav_routes
 - tma
 - upper_ats_routes
 - lower_ats_routes
 - atc_surveillance_minima
 - OSM Humanitarian Data Model
 - Google Satellite
 - OCM Landscape

Attribute table - star_leg: Features total: 40, filtered: 40, selected: 0

gid	ao_star_designato	star_type	navigation_pe	tar_sequenci	leg_type_arinc	start_pnt	end_pnt	brgmag	brggeo	geo_distance	remarks	amdt_cycle	calc_dist	diff_dist	uid	aerodrome
0	31 BZE1	PBN	RNP2	01	TF	BZE	LM001	165.80	166.00	105.95	NULL	20/AUG/2015	105.95	0.00	5ab1e668-50ad-...	MHLM
1	29 NAGEL1	PBN	RNP2	02	TF	LM004	LM015	24.90	25.00	22.64	NULL	20/AUG/2015	22.64	0.00	fb43d8b1-89c5-5...	MHLM
2	18 KIRAP1	PBN	RNAV1	01	TF	KIRAP	RO001	125.80	125.20	52.12	NULL	20/AUG/2015	52.12	0.00	b93056f8-8e40-...	MHRO
3	32 KIRAP1	PBN	RNP2	01	TF	KIRAP	LM001	192.30	191.70	75.51	NULL	20/AUG/2015	75.51	0.00	1374f56d-c508-e...	MHLM
4	33 GABIX1	PBN	RNP2	01	TF	GABIX	LM001	226.50	225.20	117.38	NULL	20/AUG/2015	117.38	0.00	90a62fd0-f4fb-3...	MHLM
5	45 COTALN	CONV	NO	01	TF	IMOLA	LINAS	157.00	NULL	10.00	NULL	20/AUG/2015	9.63	0.37	b2262a3c-dbca-c...	MRLB
6	46 COTALN	CONV	NO	02	TF	LINAS	ORADA	186.00	NULL	17.40	NULL	20/AUG/2015	17.42	0.02	c00fe203-23d3-2...	MRLB
7	47 COTALN	CONV	NO	03	TF	ORADA	GORDA	186.00	NULL	13.39	NULL	20/AUG/2015	13.39	0.00	398f51a6-12d7-...	MRLB
8	48 COTALN	CONV	NO	04	TF	GORDA	COTAL	100.00	NULL	5.00	NULL	20/AUG/2015	5.00	0.00	e9f4e49d-b150-...	MRLB

Coordinate: -9800636,1834627 **Scale:** 1:1,248,755 **Rotation:** 0.0 **Render:** **EPSG:3857 (OTF)**

Postgresql+Postgis+QGIS+Python (Bounds)

The image displays a QGIS 2.8.2-Wien interface with a map showing various layers and a Python console window. The map features several layers, including 'fixes_30', 'fixes_30NM_TNT_2', 'volcanoesofficial', 'runway', 'obstacle', 'fixes_required', 'AREA_CTA_NICARAGUA', 'AREA_CTA_EL_SALVADOR', 'navaids', 'route_lines', 'holding_pattern', 'MARITIME', 'designated_points', 'ICAO', 'Coordinates', 'Procedures', 'ama_1deg', 'atc_surveillance_minima', 'Rutas', 'mav_routes', 'designated_points_belize', 'ICAO', 'Coordinates', 'Procedures', 'lower_ats_routes', 'upper_ats_routes', 'testt', 'New scratch layer', 'star_leg', 'airspace', 'fir_area', 'zprd', 'tma', 'ctr', 'atz', 'airport_heliport', 'airport_heliport_national', 'AMA', 'OCM Landscape', 'Google Physical', 'OpenStreetMap', and 'Google Satellite'. The map shows a cyan line representing a route, with several circular and polygonal features overlaid. The Python console window displays the following code:

```
1 layer = iface.activeLayer()
2
3 def pbounds (Lextent,s):
4     e = Lextent
5     if s == 'no':
6         print 'bbox layer\nx,y\n%s,%s\n%s,%s' %(e.xMinimum(),e.
7             yMinimum(),e.xMaximum(),e.yMaximum())
8     else:
9         print 'bbox selected features\nx,y\n%s,%s\n%s,%s' %(e.xMinimum
10             (),e.yMinimum(),e.xMaximum(),e.yMaximum())
11
12 if layer.wkbType() == Qgis.WKBPolygon or layer.wkbType() == Qgis.
13     WKBMultiPolygon or layer.wkbType() == Qgis.WKBLineString:
14     if layer.selectedFeatureCount() < 1:
15         s = 'no'
16         e = layer.extent()
17     else:
18         s = 'yes'
19         e = layer.boundingBoxOfSelected()
20         pbounds(e,s)
21
22 else:
23     if layer.featureCount() <= 1:
24         print 'less than 2 points'
25     else:
26         if layer.selectedFeatureCount() < 2:
27             s = 'no'
28             e = layer.extent()
29             pbounds(e,s)
30         else:
31             s = 'yes'
32             e = layer.boundingBoxOfSelected()
33             pbounds(e,s)
```

The Python console also shows the execution of the script, displaying the bounding box coordinates for the selected features:

```
1 Python Console
2 Use iface to access QGIS API interface or Type help(iface) for
3 more info
4 >>> execfile(u'C:/Users/antonio.locandro/Desktop/bbox_scri
5 pt.py'.encode('mbcs'))
6 bbox selected features
7 X,y
8 -88.31398,15.8187166663
9 -86.43167,17.53962
10
11 #
12
13 >>>
```

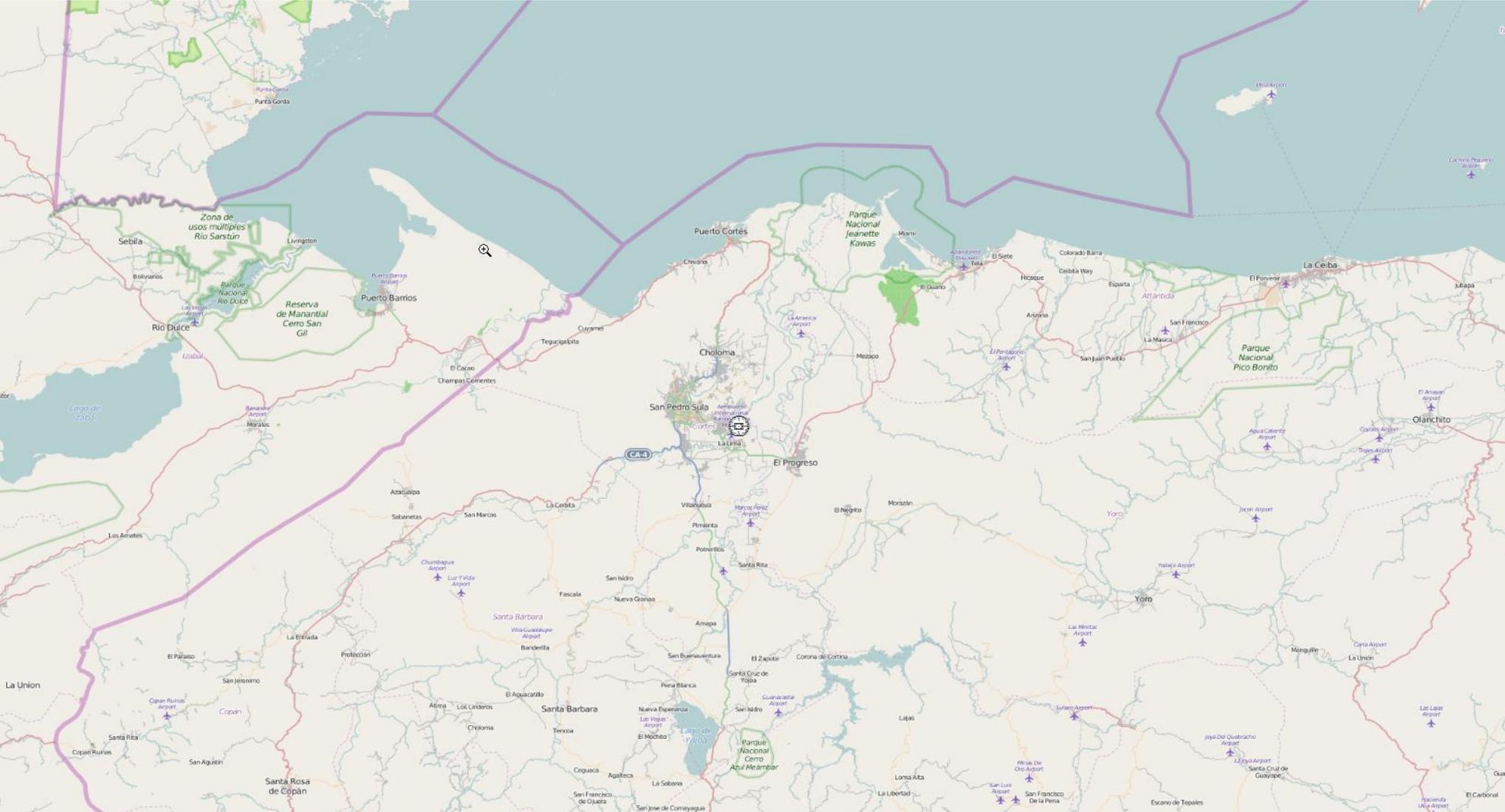
The status bar at the bottom of the QGIS window shows the coordinate: -86.468, 16.707.



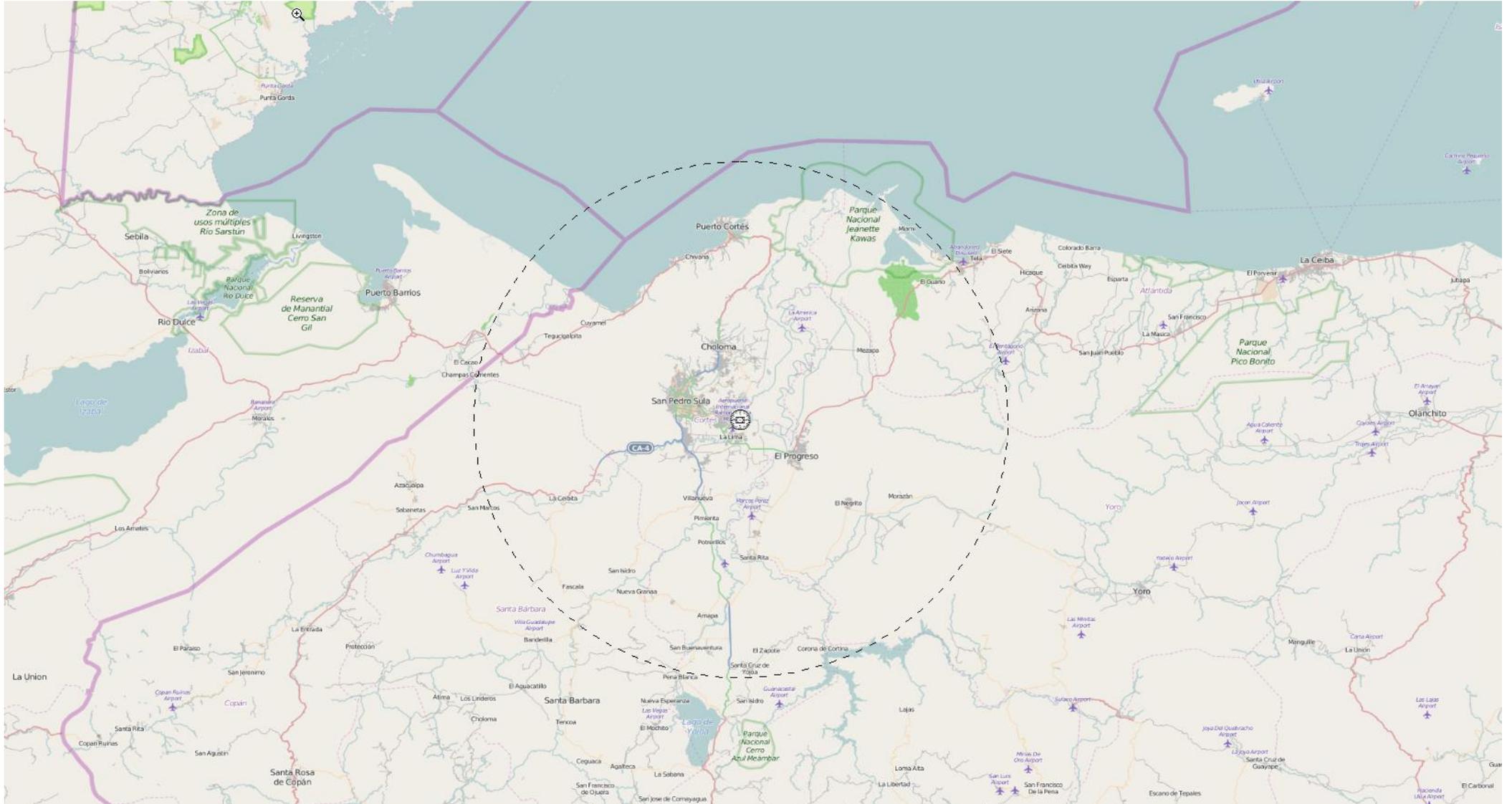
Postgresql+Postgis+QGIS+Python (Bounds)

```
1 Python Console
2 Use iface to access QGIS API interface or Type help(iface) for
  more info
3 >>> execfile(u'C:/Users/antonio.locandro/Desktop/bbox_scri
  pt.py'.encode('mbcs'))
4 bbox selected features
5 x,y
6 -88.31398,15.8187166663
7 -86.43167,17.53962
8
```

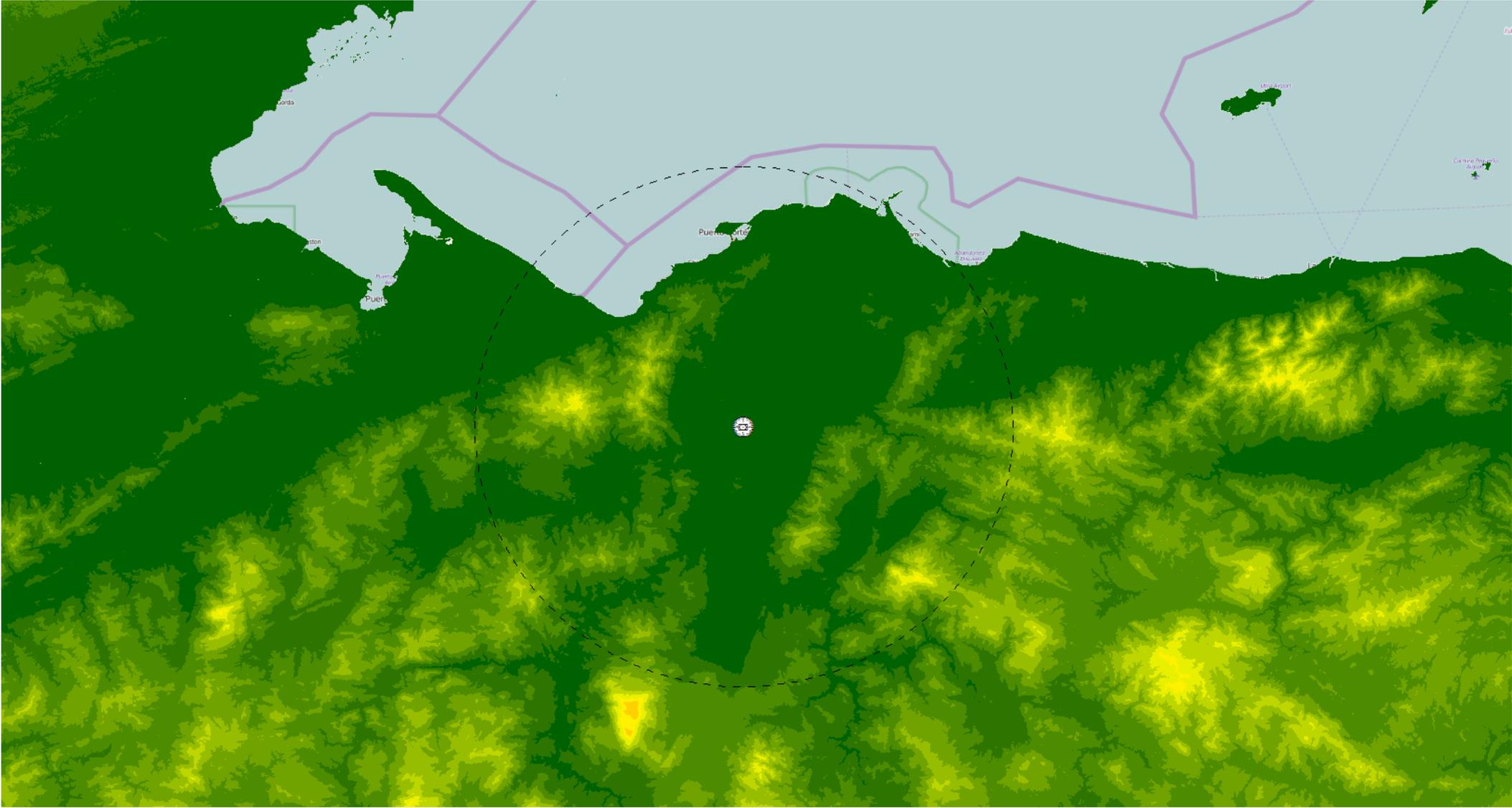
Postgresql+Postgis+QGIS+Python (MSA Maximum Elevation)



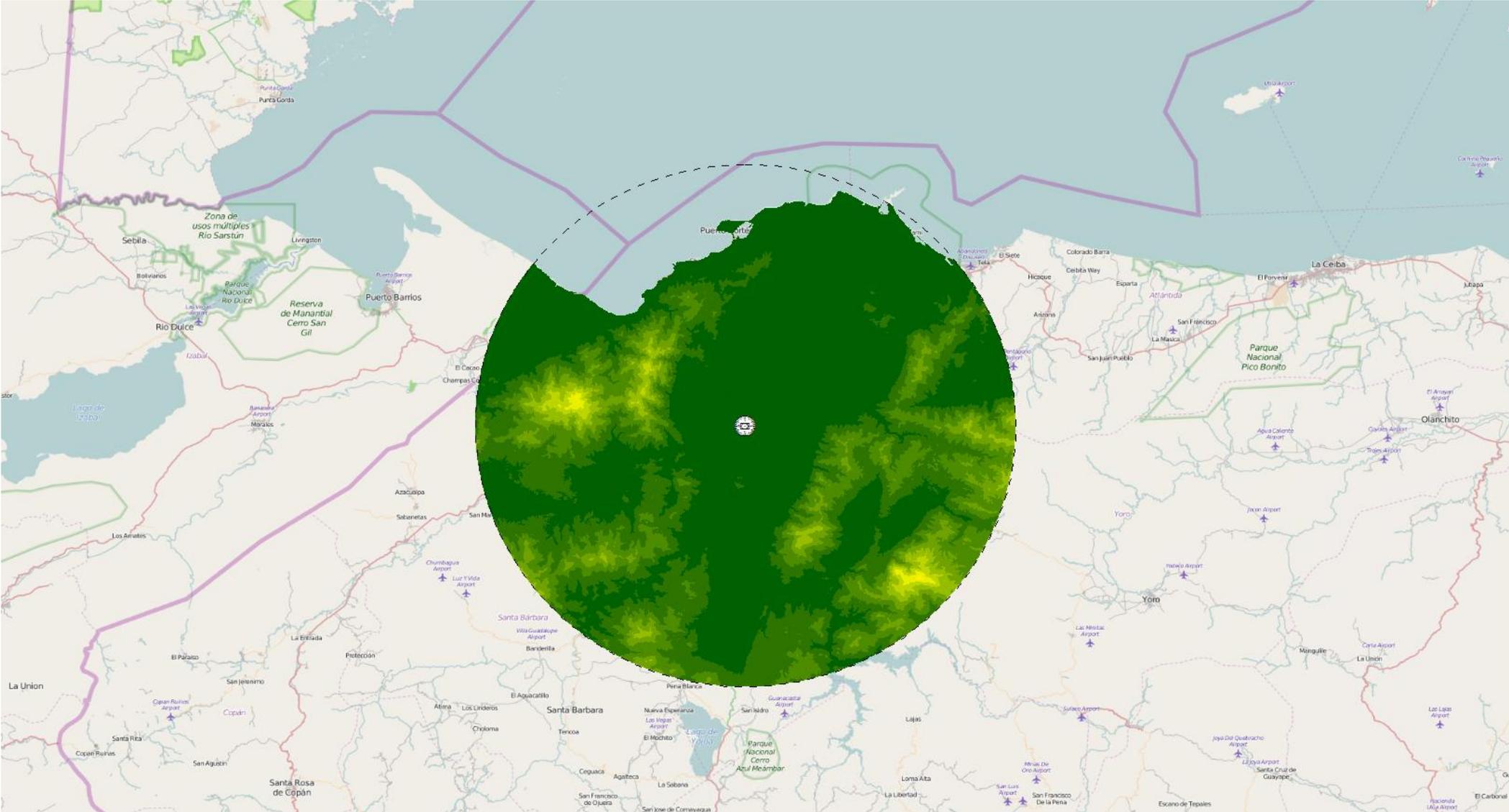
Postgresql+Postgis+QGIS+Python (MSA Maximum Elevation)



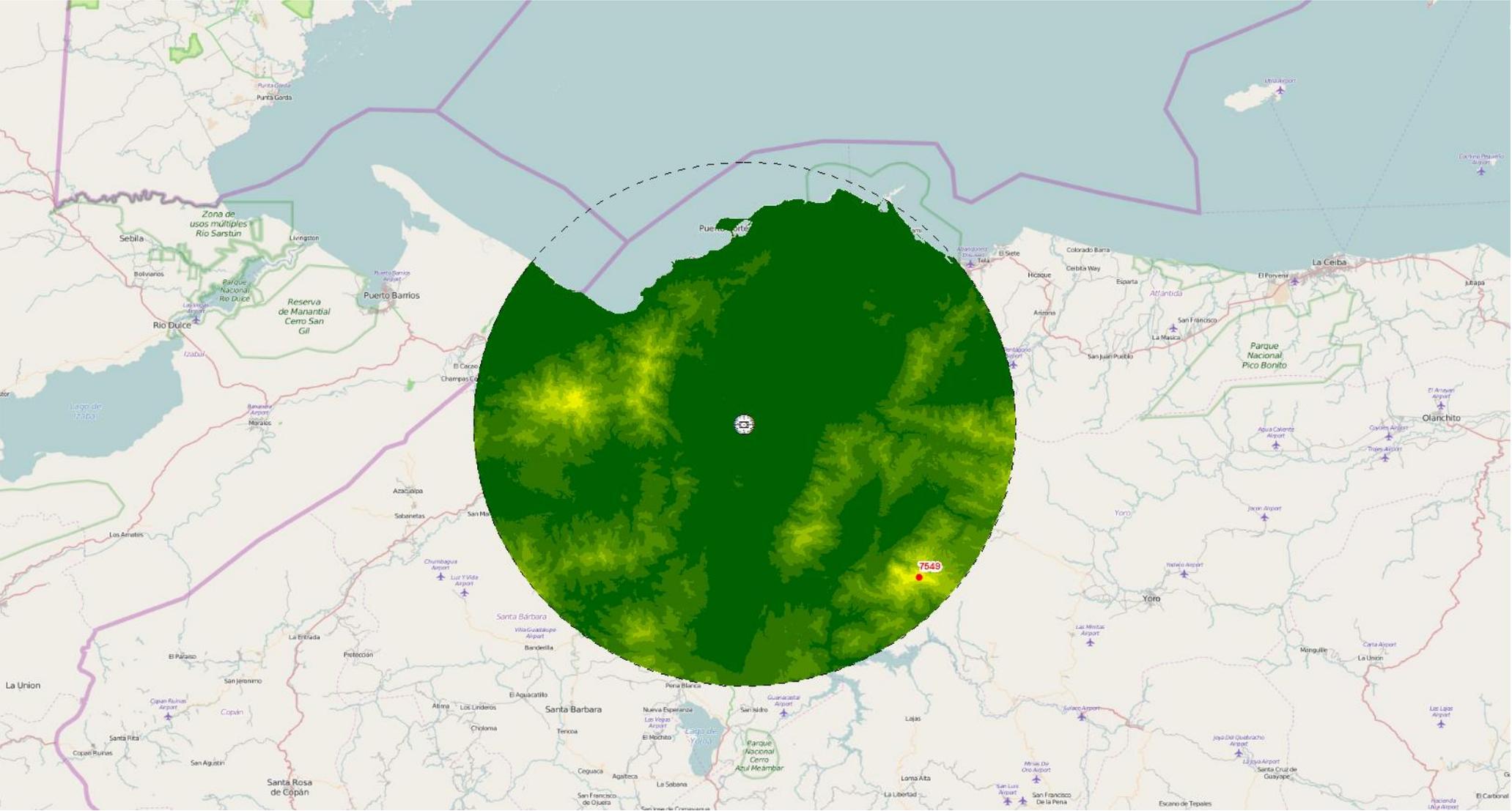
Postgresql+Postgis+QGIS+Python (MSA Maximum Elevation)



Postgresql+Postgis+QGIS+Python (MSA Maximum Elevation)



Postgresql+Postgis+QGIS+Python (MSA Maximum Elevation)



Fulcrumapp – Collect Data



fulcrum

fulcrumapp.com

It is also necessary to collect data, for that we can now use tablets and smartphones to fill input forms that include validations.

Fulcrum even though is not open source software has a reasonable price and a lot of functions.

But what about the precision of Tablet and Celphone GPS, it's not adequate!

That depends:

1. The purpose
2. The required precision
3. The GPS you are using

Fulcrumapp – Collect data



Precision ~ 1 m raw
Precision .10 m – 0.50 m con post
processing

Fulcrumapp - Recolectar datos

Table I-1-3 Minimum Survey Accuracy and Integrity Requirements

	Horizont Accuracy	Vertical Accuracy	Integrity Classification
Aerodrome Control Network	1.0 m (*)	1.0 m (*)	1×10^{-8}
Aerodrome Facilities	0.5 m (#)	0.25 m (#)	1×10^{-8}
Obstacles and Off Aerodrome Facilities	3.0 m (#)	0.3 m (#)	1×10^{-5}

(*) Accuracy with respect to the appropriate geodetic reference frame

(#) Accuracy relative to the aerodrome control network

The more detailed list of accuracies and integrity is provided at the Part II of this document.

The logo for Fulcrum consists of the word "fulcrum" in a bold, lowercase, sans-serif font. A red triangle is positioned above the letter 'u', pointing upwards.

Airport Runway Surface Inspection

COCESNA Internal Application - WSACC

WSACC

POINT SEARCH POINT ROUTE SEARCH ROUTE VOLCANOES+ AREAS+ SEARCH COORDS REFRESH Administrative

News

ACUERDO CON MID ACC RESPECTO COORDINACIONES, EL ACC QUE TRANSIERE DEBE LLAMAR AL ACC QUE ACEPTA Y DECIR, -DISTINTIVO DE LLAMADA, -PUNTO DE COORDINACION, -HORA, -NIVEL DE VUELO, -CODIGO

SSR MZBZ SER SUSPENDE PROVIDING APP CTL SER BY PROC APP ONLY HASTA 30 SEP 2015

La Habana no aceptará los códigos que terminen en 00. En este caso el sistema asignará sus propios códigos.

El sistema por DEFAULT NO acepta los codigos 5500;4444;2222;1200.

PARA LLAMAR A BOGOTA ACC DIRECTO CON EL PLANNER

Latitude: 18° 28' 47" Longitude: -86° 32' 14"

100 km
50 mi

COCESNA
Leaflet

COCESNA Internal Application - WSACC

The screenshot displays the WSACC application interface. At the top, there are navigation tabs: POINT, SEARCH POINT, ROUTE, SEARCH ROUTE, VOLCANOES, AREAS, SEARCH COORDS, and REFRESH. On the left, a 'News' sidebar contains three text-based news items. The main area shows a map of Central America with a 'View feature' popup window. The popup has tabs for 'Areas', 'Fixed points', 'Upper routes', 'Airports', 'Nav aids', and 'Notams'. The 'Airports' tab is selected, showing details for airport MHTG (Toncontin, Honduras). The popup also displays METAR information and a 'Raw Text' field. A 'CLOSE' button is at the bottom of the popup. The map background shows flight routes and airport locations. At the bottom left of the map, coordinates are given as Latitude: 14° 01' 10" Longitude: -88° 46' 46".

WSACC POINT SEARCH POINT ROUTE SEARCH ROUTE VOLCANOES AREAS SEARCH COORDS REFRESH Administrative

News

Numeros de TWR CA2 BZE:120, AUR:210, SAL:320, OCO:610, LIB:630, MGA:510, LMS:481, ROA:490, LCE:460, PZA:502, CENAMER:401-402-403

MGXX VOLCÁN FUEGO ACT SFC- 14,500 FT. agosto 24- hasta agosto 25 de 2135 a 2359

FLUJOS DE SALIDA Y LLEGADA A LA AURORA YA FUERON PUBLICADOS, PONERLOS EN PRACTICA A PARTIR DEL 12 DE AGO 2015

ACUERDO CON MID ACC RESPECTO COORDINACIONES, EL ACC QUE TRANSIERE DEBE LLAMAR AL ACC QUE ACEPTA Y DECIR, -DISTINTIVO DE LLAMADA, -PUNTO DE COORDINACION, -HORA, -NIVEL DE VUELO, -CODIGO

View feature

Areas Fixed points Upper routes **Airports** Nav aids Notams

Airports Feature Info

Id	8
Code	MHTG
Name	TONCONTIN
Country	HONDURAS

METAR Information

Conditions at	MHTG observed 2015-08-24 20:00:00.0
Temperature	
Dewpoint	
Pressure (altimeter)	30.00 inches Hg (101.0 mb)
Winds	
Visibility	99.99 km
Clouds	No clouds below 12,000 ft (3,700 m)

Raw Text
METAR MHTG 242000Z 09006KT 9999 SCT032 32/14 Q1016 A3000 NOSIG

CLOSE

Latitude: 14° 01' 10" Longitude: -88° 46' 46"

100 km
50 mi

COCESNA Leaflet

COCESNA Internal Application – SAR Tracking System

Dashboard
RCC/SPOC/SAR/TRACKING

MENSAJERIA

REPORTES

BITÁCORA

CONTACTOS

SEGURIDAD

Mensaje Sar :: 29929

General Bitacora Status Report (SIT-166)

Information SAR Message

MSG REF

No.	29929	Ref.	35335
-----	-------	------	-------

DETECTION FREQUENCY

Frecuencia	406.0368	MHZ
------------	----------	-----

USER CLASS

Tipo	ELT	Descripcion	SERIAL	ID	3397		
		Resolved Lat	1456.6N	Long	08920.4W	Prob	
		Doppler A Lat	2641.0N	Long	14320.8W	Prob	50
		Doppler B Lat	1428.4N	Long	08923.9W	Prob	50
		Encoder Lat	NIL	Long	NIL	Prob	

POSITIONS

	Resolved Lat	1456.6N	Long	08920.4W	Prob	
	Doppler A Lat	2641.0N	Long	14320.8W	Prob	50
	Doppler B Lat	1428.4N	Long	08923.9W	Prob	50
	Encoder Lat	NIL	Long	NIL	Prob	

DETECTED AT

Fecha Recibido	22/08/15 13:16	Detectado	22 AUG 15	Hora	1312
Sar Satellite	SARSAT	No	10		

COUNTRY OF BEACON REGISTRATION

Country ID	332	Country	GUATEMALA
------------	-----	---------	-----------

EMERGENCY CODE

Emergency Code	NONE
----------------	------

HEX ID

BEACON ID	A98C40351400315
-----------	-----------------

OTHER ENCODED INFORMATION

Manufacture	CSTA#197	Model	UNKNOWN
-------------	----------	-------	---------

OPERATIONAL INFORMATION

Email	
Aftn	

COCESNA Internal Application – SAR Tracking System



 sar\local\admin
 admin
 Dashboard 

MENSAJERIA 

REPORTES 

BITÁCORA 

CONTACTOS 

SEGURIDAD 

No.	Fecha Recibido	Detectado	Hora	Sar Satellite	No	Country ID	Country	Tipo	ID		
29934	23/08/15 21:52	23 AUG 15	1455	SARSAT	11	307	ARUBA	ELT	P4-MDH	✓	✓
29934	23/08/15 15:11	23 AUG 15	1455	SARSAT	11	307	ARUBA	ELT	P4-MDH	✓	⚠
29932	23/08/15 10:16	23 AUG 15	1012	SARSAT	07	765	SURINAM	ELT	P2-HWC	✓	⚠
29930	22/08/15 13:17	22 AUG 15	1312	SARSAT	10	332	GUATEMALA	ELT	3397	✓	✓
29929	22/08/15 13:16	22 AUG 15	1312	SARSAT	10	332	GUATEMALA	ELT	3397	✓	✓
29928	22/08/15 12:18	22 AUG 15	1216	SARSAT	07	332	GUATEMALA	ELT	3397	✓	✓
29927	22/08/15 11:31	22 AUG 15	1132	SARSAT	10	332	GUATEMALA	ELT	3397	✓	✓
29926	22/08/15 10:42	22 AUG 15	1037	SARSAT	07	332	GUATEMALA	ELT	3397	✓	✓
29925	22/08/15 09:55	22 AUG 15	0951	SARSAT	10	332	GUATEMALA	ELT	3397	✓	✓
29924	22/08/15 09:16	22 AUG 15	0913	SARSAT	12	332	GUATEMALA	ELT	3397	✓	✓
29923	22/08/15 07:37	22 AUG 15	0732	SARSAT	12	332	GUATEMALA	ELT	3397	✓	✓
29921	22/08/15 04:40	22 AUG 15	0425	SARSAT	11	332	GUATEMALA	ELT	3397	✓	✓
29920	22/08/15 03:48	22 AUG 15	0339	SARSAT	13	332	GUATEMALA	ELT	3397	✓	✓
29919	22/08/15 02:55	22 AUG 15	0245	SARSAT	11	332	GUATEMALA	ELT	3397	✓	✓
29918	22/08/15 00:52	22 AUG 15	0036	SARSAT	10	332	GUATEMALA	ELT	3397	✓	✓

<< < > >>

COCESNA Internal Application – SAR Tracking System





RCC/SPOC/SAR/TRACKING

Logout: sar\local\admin
Logout: admin
Dashboard

MENSAJERIA

REPORTES

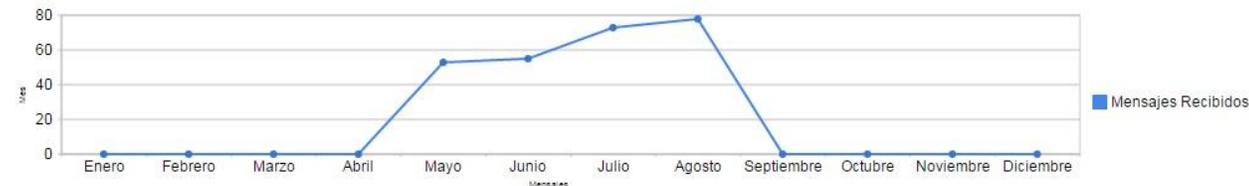
BITÁCORA

CONTACTOS

SEGURIDAD

Dashboard

Mensajes recibidos por mes

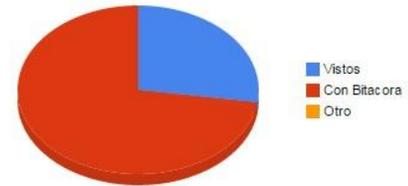


Mes	Mensajes
Enero	0
Febrero	0
Marzo	0
Abril	0
Mayo	50
Junio	55
Julio	70
Agosto	75
Septiembre	0
Octubre	0
Noviembre	0
Diciembre	0

Ultimos Mensajes Recibidos

No.	Fecha Recibido	Detectado	Hora	Country	Tipo	
Sun Aug 23 2015 10:16:00 GMT-0600 (Hora estándar, América Central)						
29932	23/08/15 10:16	23 AUG 15	1012	SURINAM	ELT	✓ ⚠
Sun Aug 23 2015 15:11:00 GMT-0600 (Hora estándar, América Central)						
29934	23/08/15 15:11	23 AUG 15	1455	ARUBA	ELT	✓ ⚠
Sun Aug 23 2015 21:52:00 GMT-0600 (Hora estándar, América Central)						
29934	23/08/15 21:52	23 AUG 15	1455	ARUBA	ELT	✓ ✓

Total Mensajes



Total de Mensajes: 259



Thank you for your time



Corporación Centroamericana de Servicios de Navegación Aérea