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

Corporación Centroamericana de Servicios de Navegación Aérea

Introduction

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)

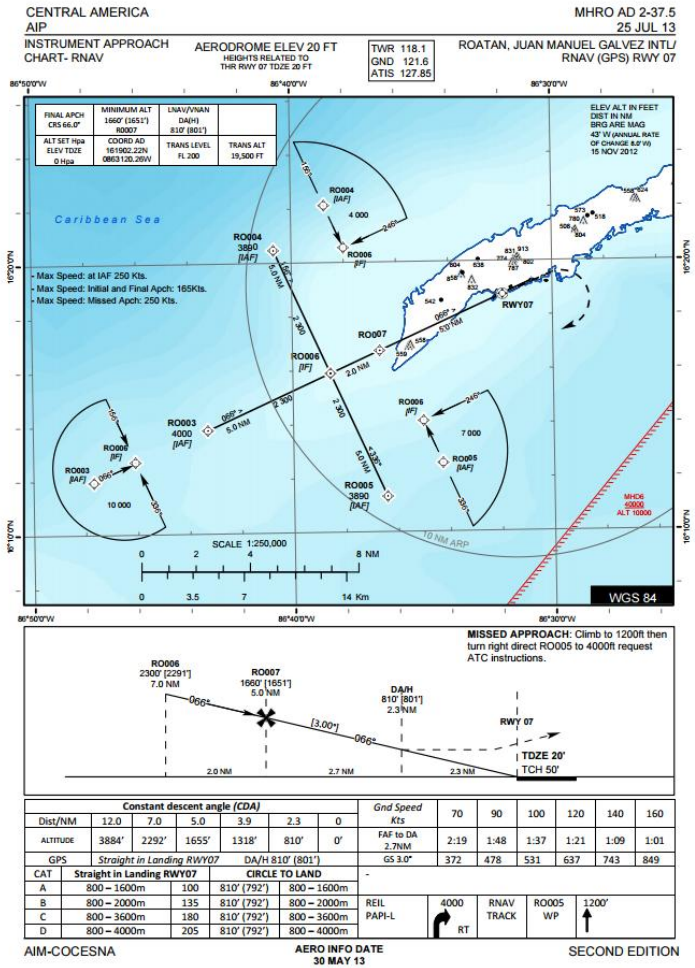
Introduction

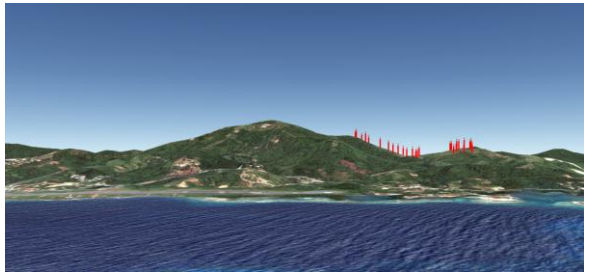
The industry as well as ICAO are demanding new requisites :

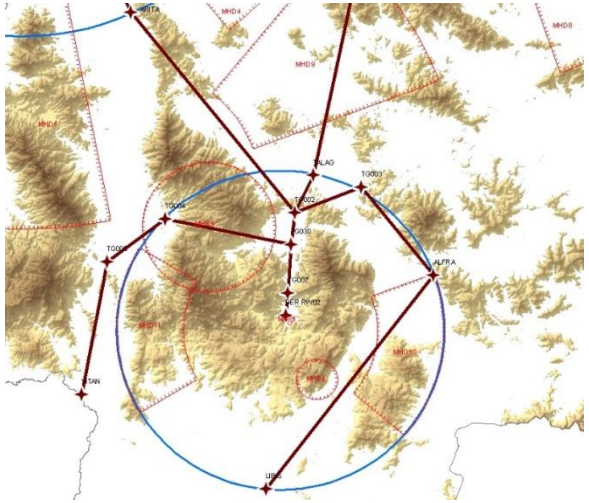
- Aeronautical databases (GIS)
- Electronic Terrain and Obstacle databases (eTOD)
- Airport Mapping Databases (AMDB)
- Electronic aeronautical charts
- Digital files of aeronautical data (Feature Datasets)

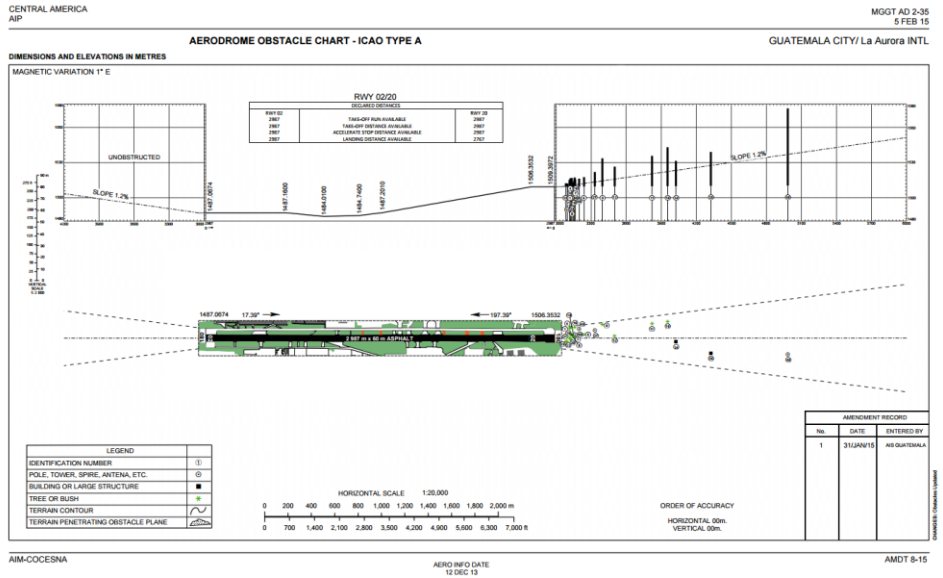
Introduction

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

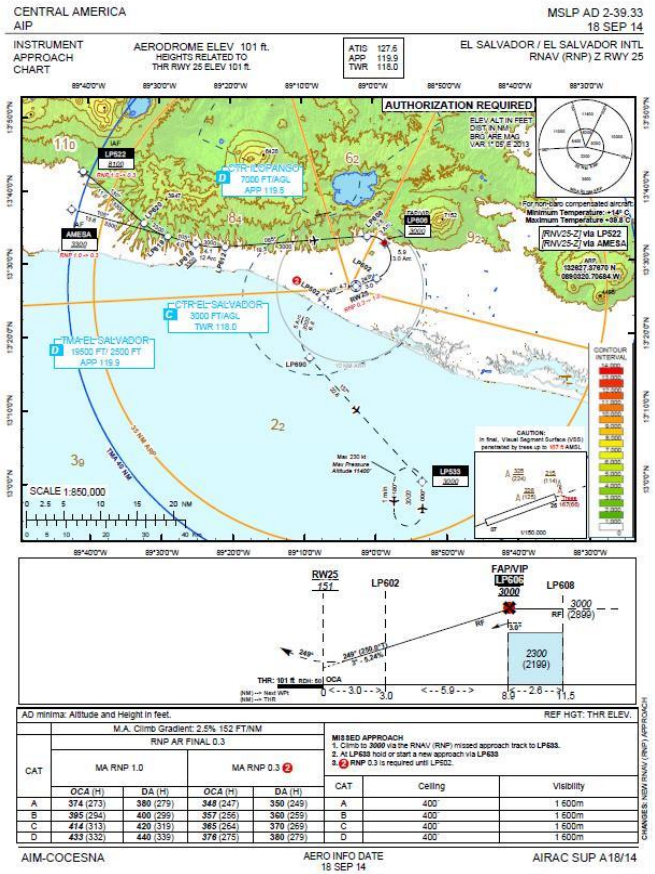


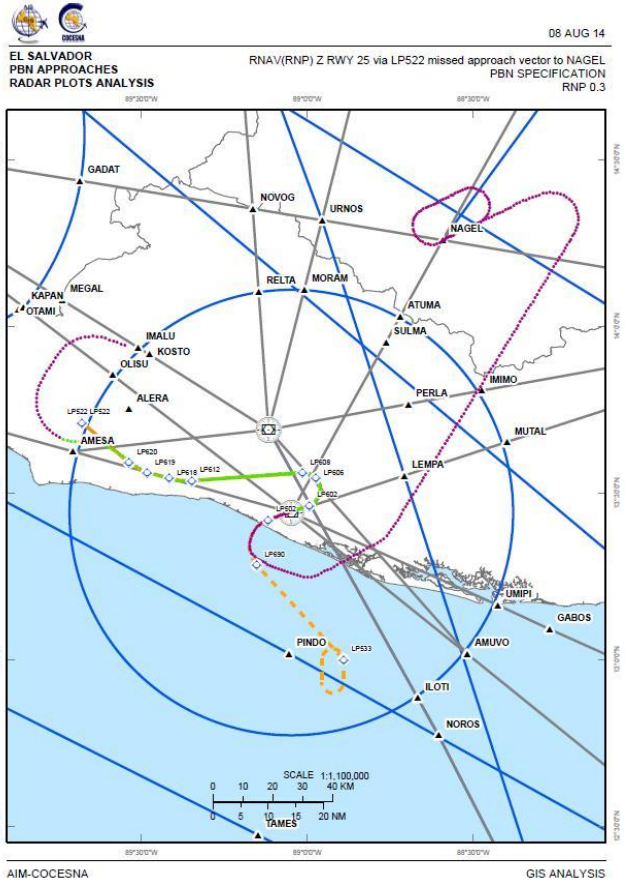


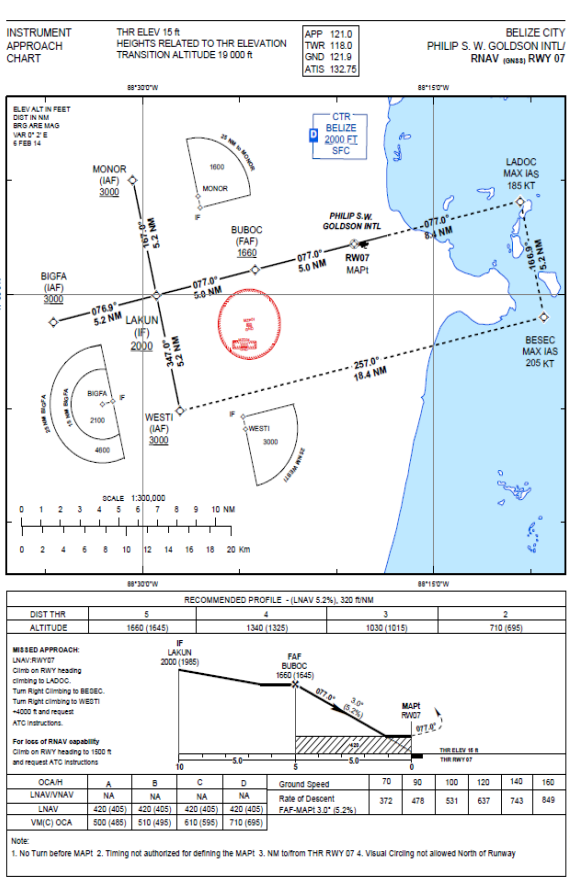


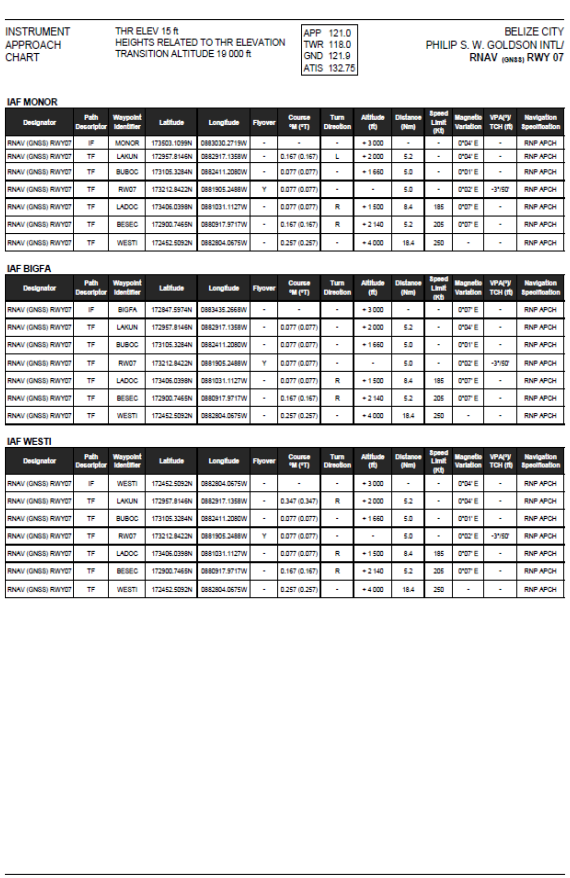


Introduction









Designator	Path Descriptor	Waypoint Identifier	Latitude	Longitude	Flyover	Course °M (°T)	Turn Direction	Altitude (ft)	Distance (Nm)	Speed Limit (kt)	Magnetic Variation	VPA/°V TCH (ft)	Navigation Specification
RNAV (GNSS) RWY07	IF	MONOR	173503.1099N	0883030.2719W	-	-	-	+ 3 000	-	-	0°04' E	-	RNP APCH
RNAV (GNSS) RWY07	TF	LAKUN	172957.8146N	0882917.1368W	-	0.167 (0.167)	L	+ 2 000	5.2	-	0°04' E	-	RNP APCH
RNAV (GNSS) RWY07	TF	BUBOC	173105.3284N	0882411.2080W	-	0.077 (0.077)	-	+ 1 660	5.0	-	0°01' E	-	RNP APCH
RNAV (GNSS) RWY07	TF	RW07	173212.8422N	0881905.2488W	Y	0.077 (0.077)	-	-	5.0	-	0°02' E	-3°/62	RNP APCH
RNAV (GNSS) RWY07	TF	LADOC	173406.0398N	0881031.1127W	-	0.077 (0.077)	R	+ 1 500	8.4	185	0°07' E	-	RNP APCH
RNAV (GNSS) RWY07	TF	BESEC	172900.7465N	0880917.9717W	-	0.167 (0.167)	R	+ 2 140	5.2	205	0°07' E	-	RNP APCH
RNAV (GNSS) RWY07	TF	WESTI	172452.5092N	0882804.0675W	-	0.257 (0.257)	-	+ 4 000	18.4	250	-	-	RNP APCH

Designator	Path Descriptor	Waypoint Identifier	Latitude	Longitude	Flyover	Course °M (°T)	Turn Direction	Altitude (ft)	Distance (Nm)	Speed Limit (kt)	Magnetic Variation	VPA/°V TCH (ft)	Navigation Specification
RNAV (GNSS) RWY07	IF	BIGFA	172847.5974N	0883435.2668W	-	-	-	+ 3 000	-	-	0°07' E	-	RNP APCH
RNAV (GNSS) RWY07	TF	LAKUN	172957.8146N	0882917.1368W	-	0.077 (0.077)	-	+ 2 000	5.2	-	0°04' E	-	RNP APCH
RNAV (GNSS) RWY07	TF	BUBOC	173105.3284N	0882411.2080W	-	0.077 (0.077)	-	+ 1 660	5.0	-	0°01' E	-	RNP APCH
RNAV (GNSS) RWY07	TF	RW07	173212.8422N	0881905.2488W	Y	0.077 (0.077)	-	-	5.0	-	0°02' E	-3°/62	RNP APCH
RNAV (GNSS) RWY07	TF	LADOC	173406.0398N	0881031.1127W	-	0.077 (0.077)	R	+ 1 500	8.4	185	0°07' E	-	RNP APCH
RNAV (GNSS) RWY07	TF	BESEC	172900.7465N	0880917.9717W	-	0.167 (0.167)	R	+ 2 140	5.2	205	0°07' E	-	RNP APCH
RNAV (GNSS) RWY07	TF	WESTI	172452.5092N	0882804.0675W	-	0.257 (0.257)	-	+ 4 000	18.4	250	-	-	RNP APCH

Designator	Path Descriptor	Waypoint Identifier	Latitude	Longitude	Flyover	Course °M (°T)	Turn Direction	Altitude (ft)	Distance (Nm)	Speed Limit (kt)	Magnetic Variation	VPA/°V TCH (ft)	Navigation Specification
RNAV (GNSS) RWY07	IF	WESTI	172452.5092N	0882804.0675W	-	-	-	+ 3 000	-	-	0°04' E	-	RNP APCH
RNAV (GNSS) RWY07	TF	LAKUN	172957.8146N	0882917.1368W	-	0.347 (0.347)	R	+ 2 000	5.2	-	0°04' E	-	RNP APCH
RNAV (GNSS) RWY07	TF	BUBOC	173105.3284N	0882411.2080W	-	0.077 (0.077)	-	+ 1 660	5.0	-	0°01' E	-	RNP APCH
RNAV (GNSS) RWY07	TF	RW07	173212.8422N	0881905.2488W	Y	0.077 (0.077)	-	-	5.0	-	0°02' E	-3°/62	RNP APCH
RNAV (GNSS) RWY07	TF	LADOC	173406.0398N	0881031.1127W	-	0.077 (0.077)	R	+ 1 500	8.4	185	0°07' E	-	RNP APCH
RNAV (GNSS) RWY07	TF	BESEC	172900.7465N	0880917.9717W	-	0.167 (0.167)	R	+ 2 140	5.2	205	0°07' E	-	RNP APCH
RNAV (GNSS) RWY07	TF	WESTI	172452.5092N	0882804.0675W	-	0.257 (0.257)	-	+ 4 000	18.4	250	-	-	RNP APCH

COCESNA

Introduction

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

COCESNA

Introduction

Money is always one of the important topics

What do we do if we have money?

COCESNA

Introduction

Do we hire more staff?

(We probably need more)

or

Do we buy software we need?

Introduction

What do we do if we don’t have money?

COCESNA

Introduction

Open Source Software and Low cost software

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 ($$$)

Open Source Software and Low cost software

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

COCESNA

Open Source Software and Low cost software

Open Source 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 freedomes 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/)

COCESNA

Low Cost Software

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.

COCESNA

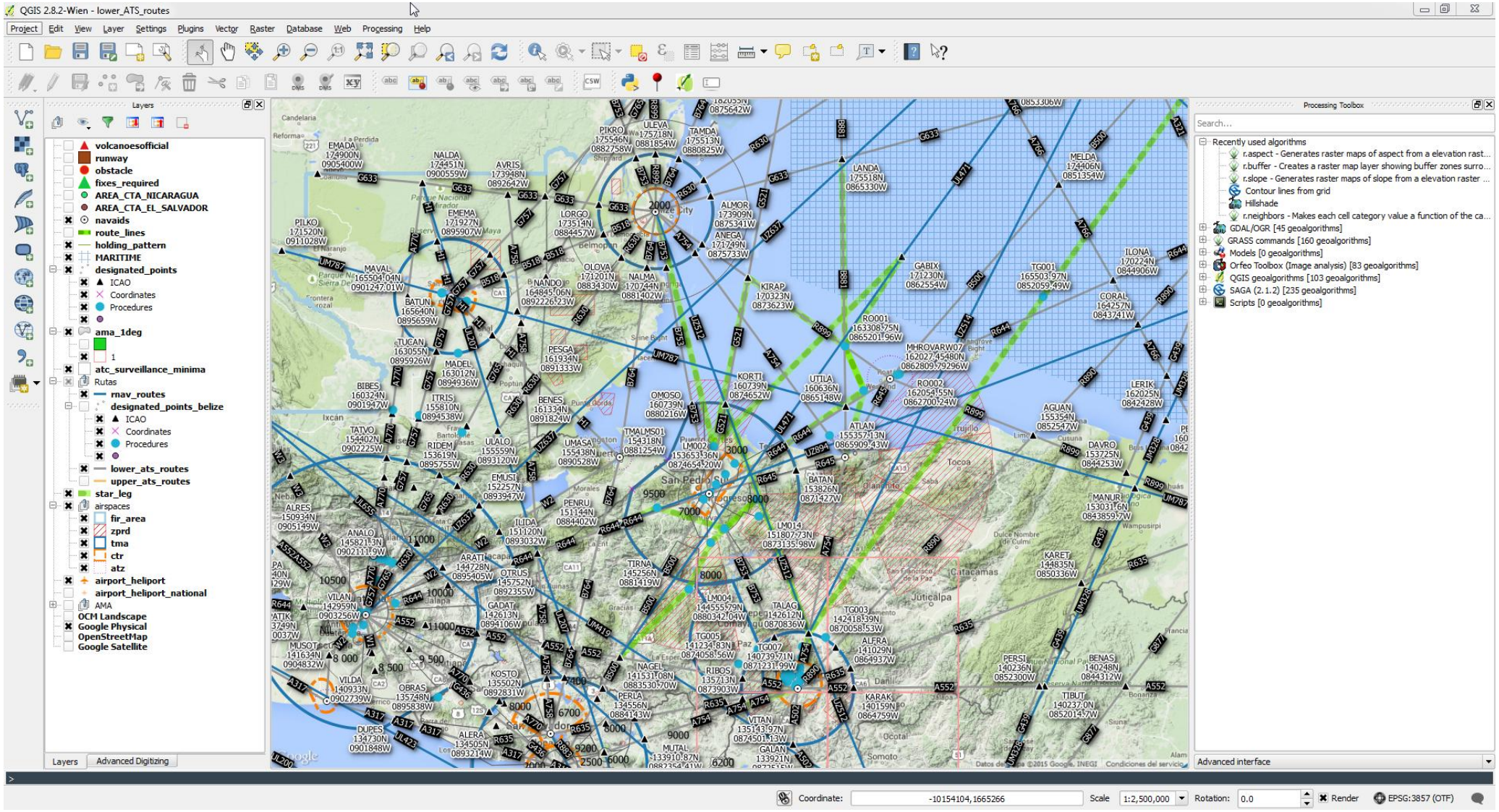
www.qgis.org

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

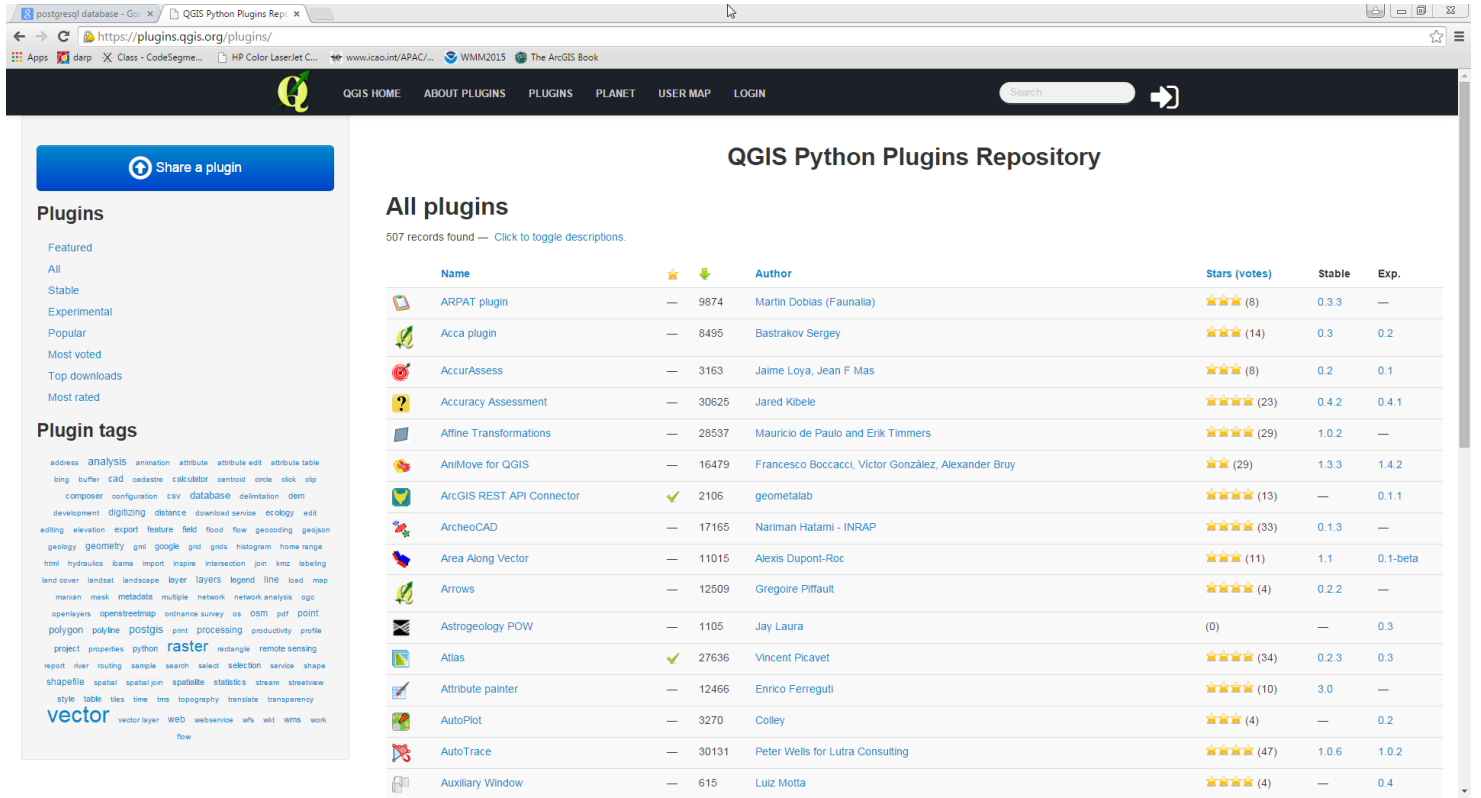
QGIS



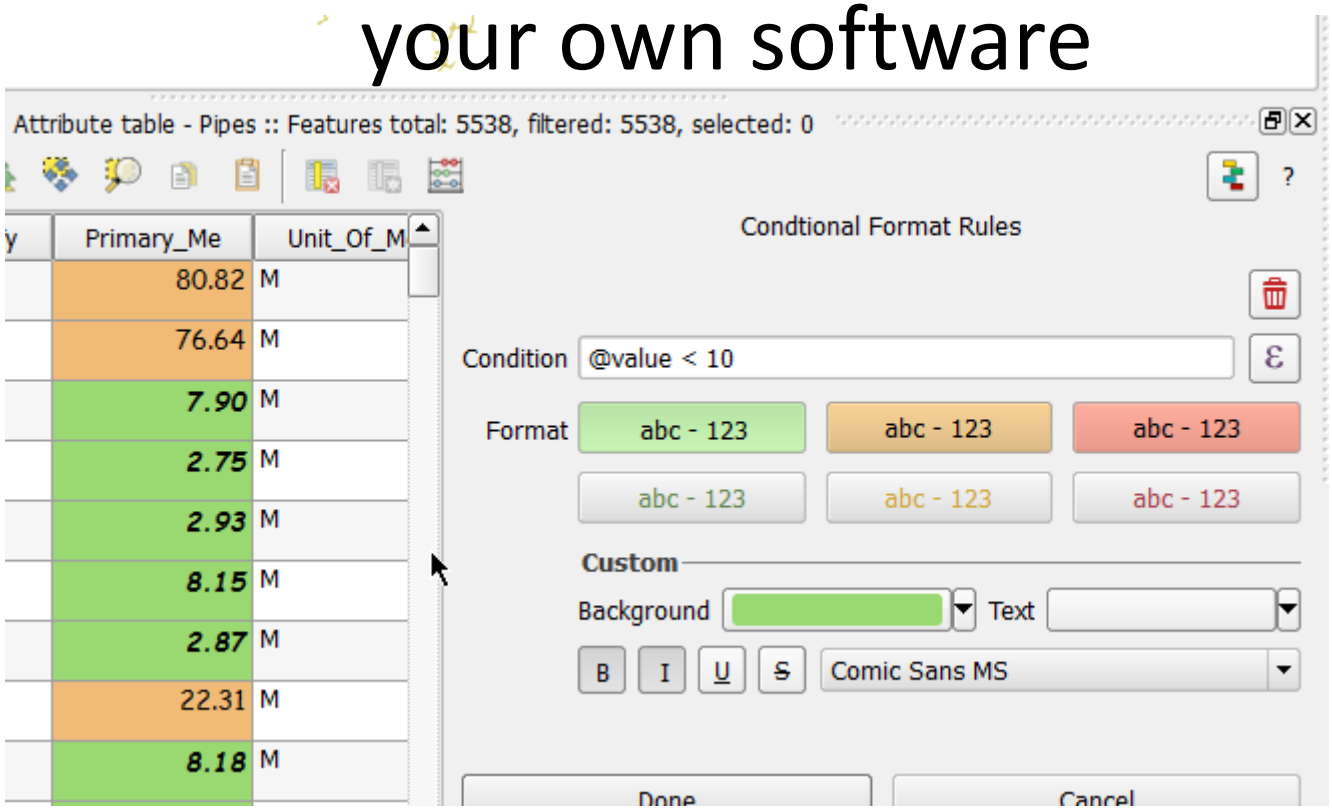
COCESNA

QGIS

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



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



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

Postgresql+Postgis

www.postgresql.org.es/

www.postgis.refractions.net/

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

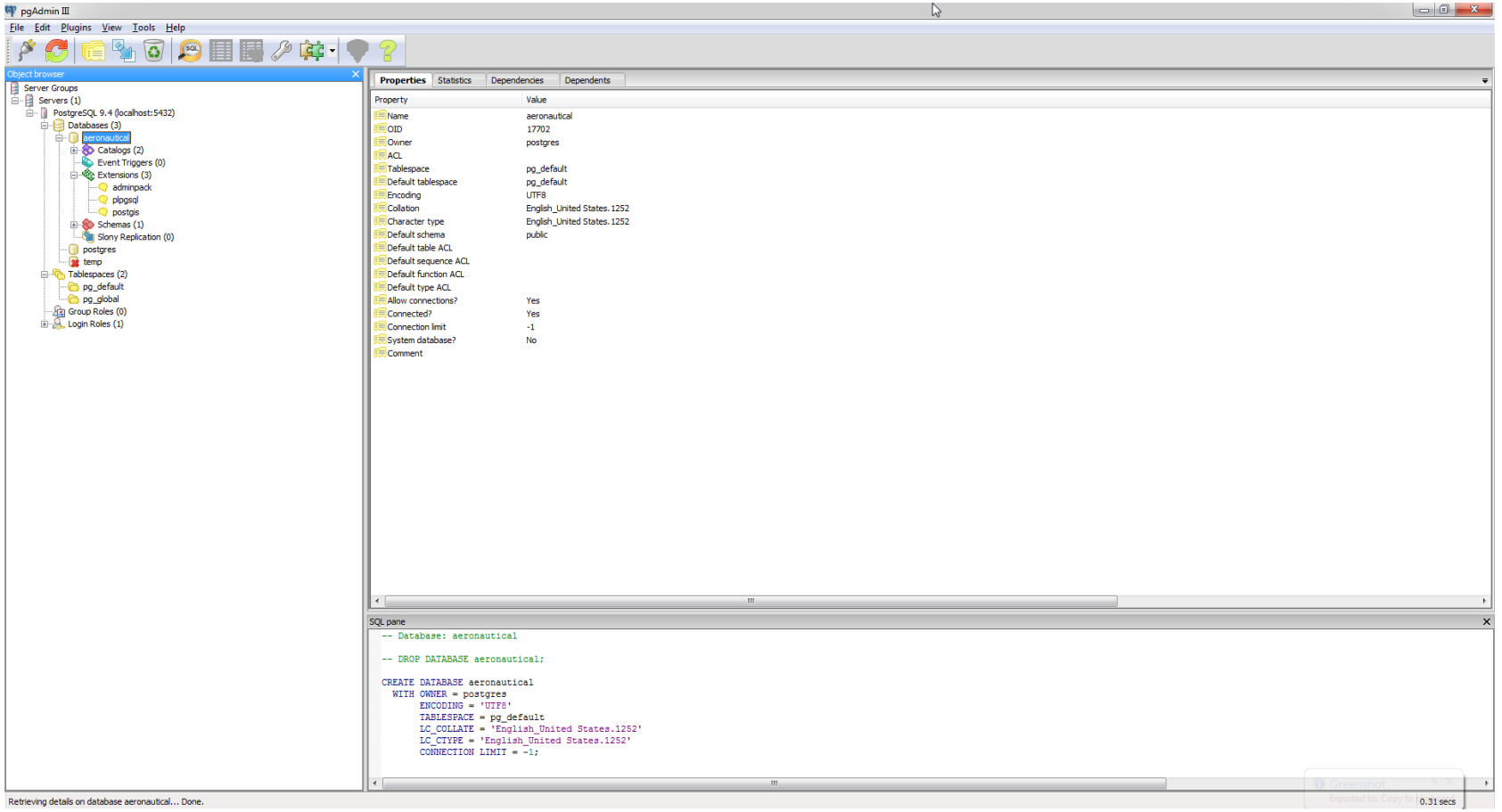
PostGIS: Is an extension to the PostgreSQL relational database. It permits the use of GIS(Geographic information systems). PostGIS includes support for GiST indexes based on R-tree and basic functions for the analysis of GIS objects.

COCESNA

Postgresql+Postgis

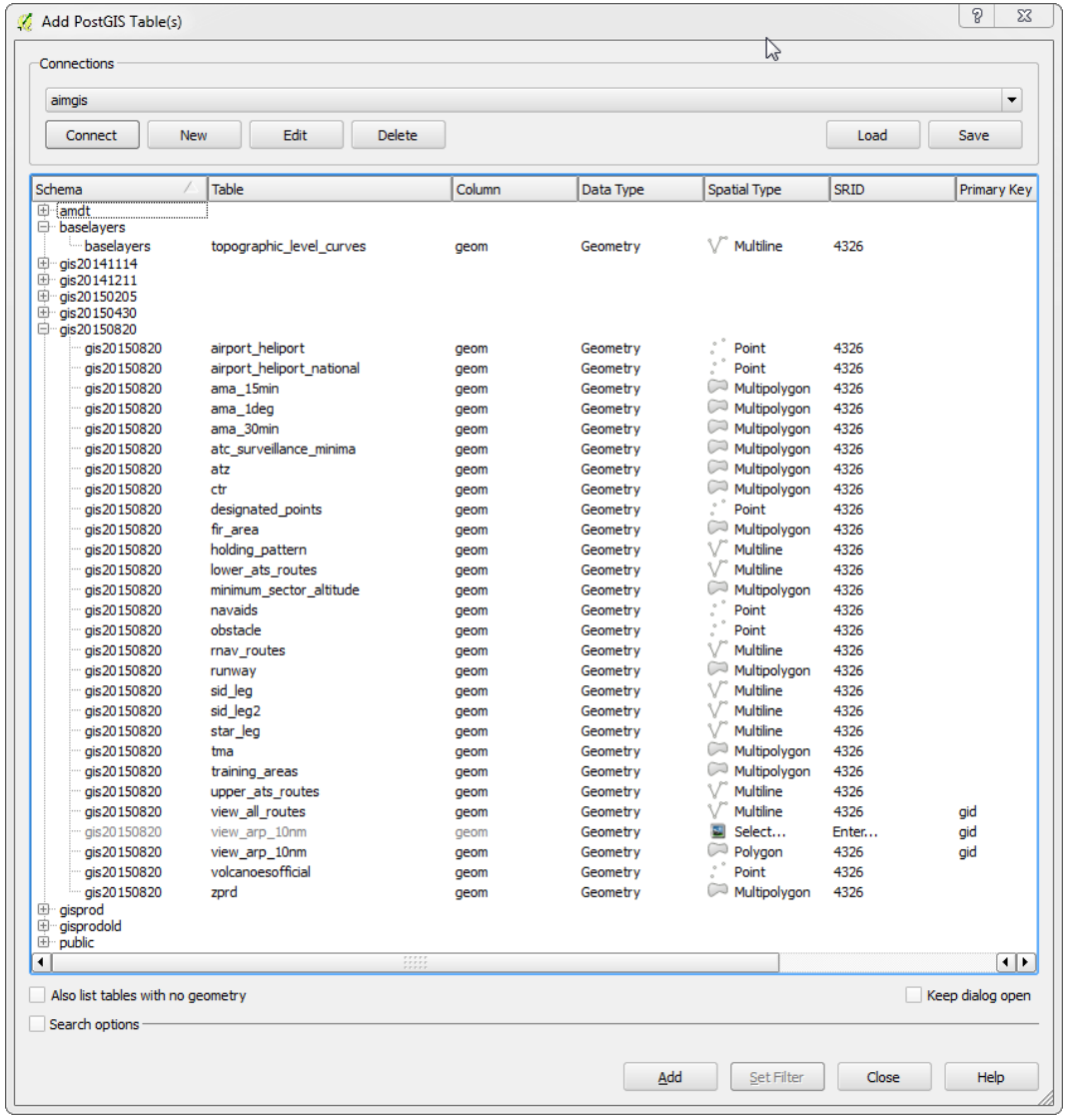
www.postgresql.org.es/

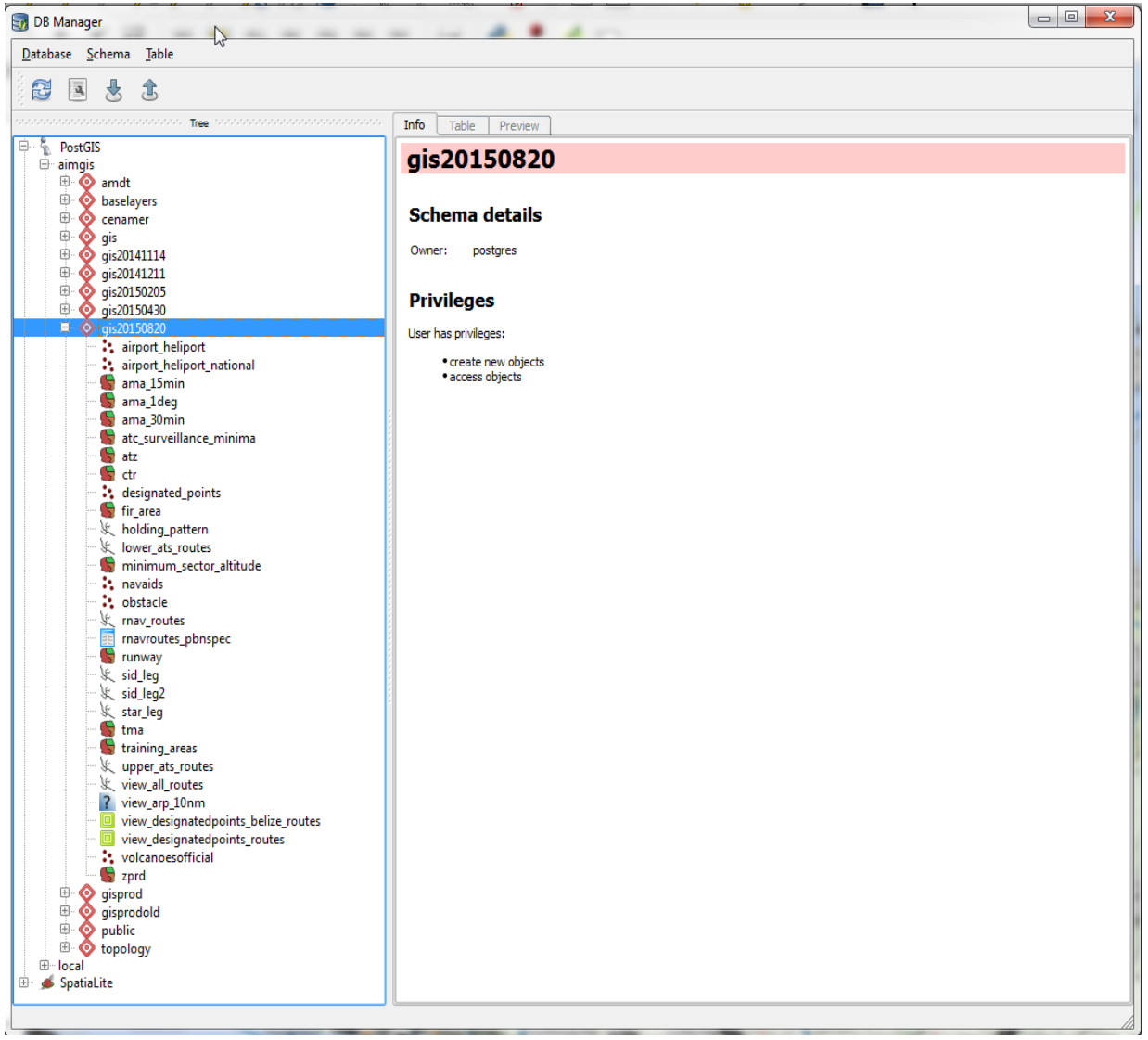
www.postgis.refractions.net/



COCESNA

Postgresql+Postgis





COCESNA

Postgresql+Postgis+QGIS (Fixes at 25 NM VOR/DME TNT)

SQL window - aimgis [PostGIS]

SQL query:

Store | Delete

```
SELECT s.gid, s.designator,s.geom,s.geo_lat,s.geo_long,s.point_type
  FROM gis20150820.designated_points s
    LEFT JOIN navaids n ON ST_DWithin(s.geom, n.geom, 46400,true)
  WHERE n.designator ='TNT'
  ORDER BY designator
```

Execute (F5) 28 rows, 0.0 seconds | Clear

Result:

	gid	designator	geom	geo_lat	geo_long	point_type
1	156	ALFRA	0101000020E61...	141029N	0864937W	ICAO
2	196	ANGEL	0101000020E61...	142003N	0865615W	ICAO
3	216	GALAN	0101000020E61...	133921N	0872515W	ICAO
4	103	KARAK	0101000020E61...	140159N	0864759W	ICAO
5	151	KARID	0101000020E61...	135354N	0873812W	ICAO
6	96	LEPAX	0101000020E61...	140606N	0873906W	ICAO
7	218	LIBIS	0101000020E61...	133648N	0871600W	ICAO

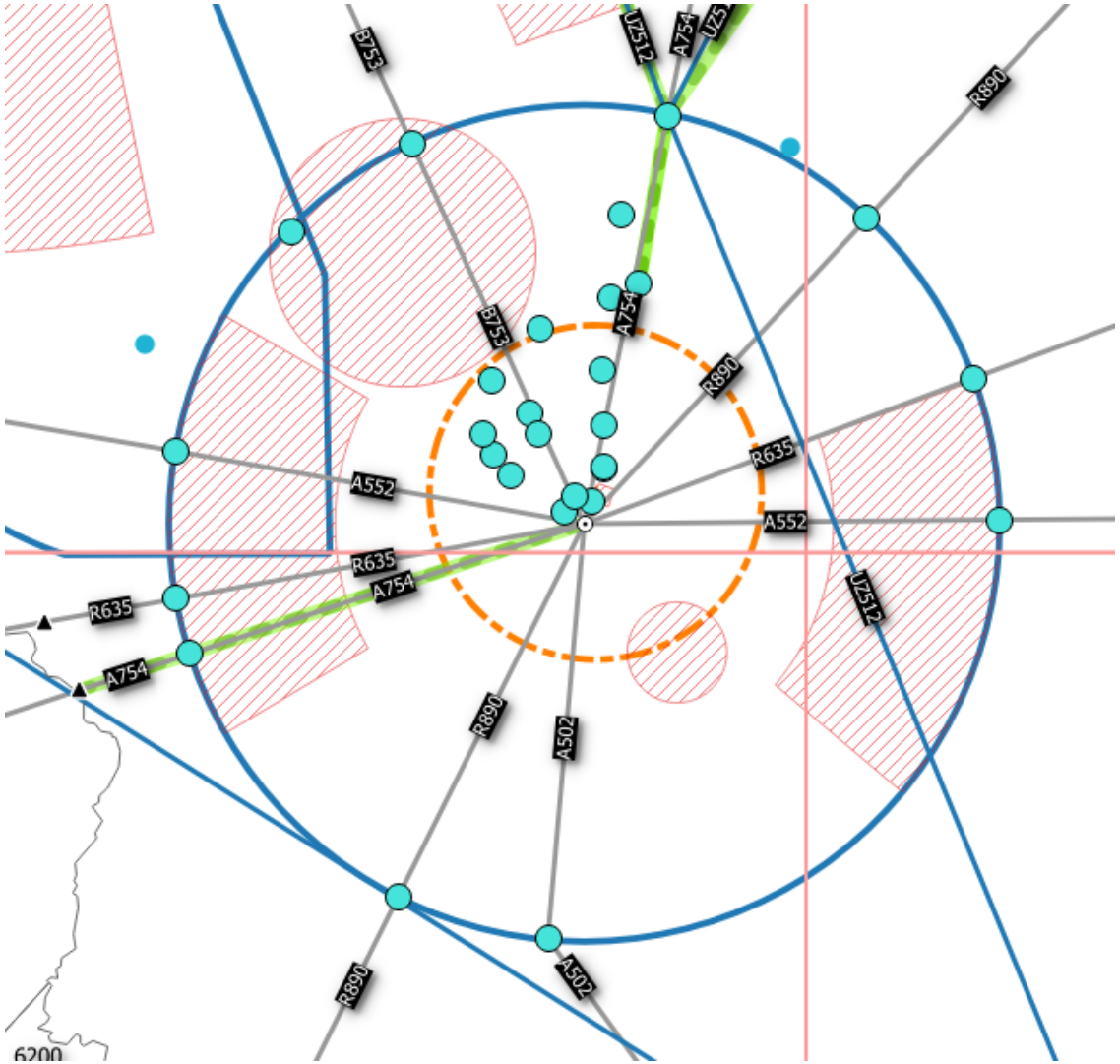
Load as new layer

Column with unique integer values: gid | Geometry column: geom | Retrieve columns

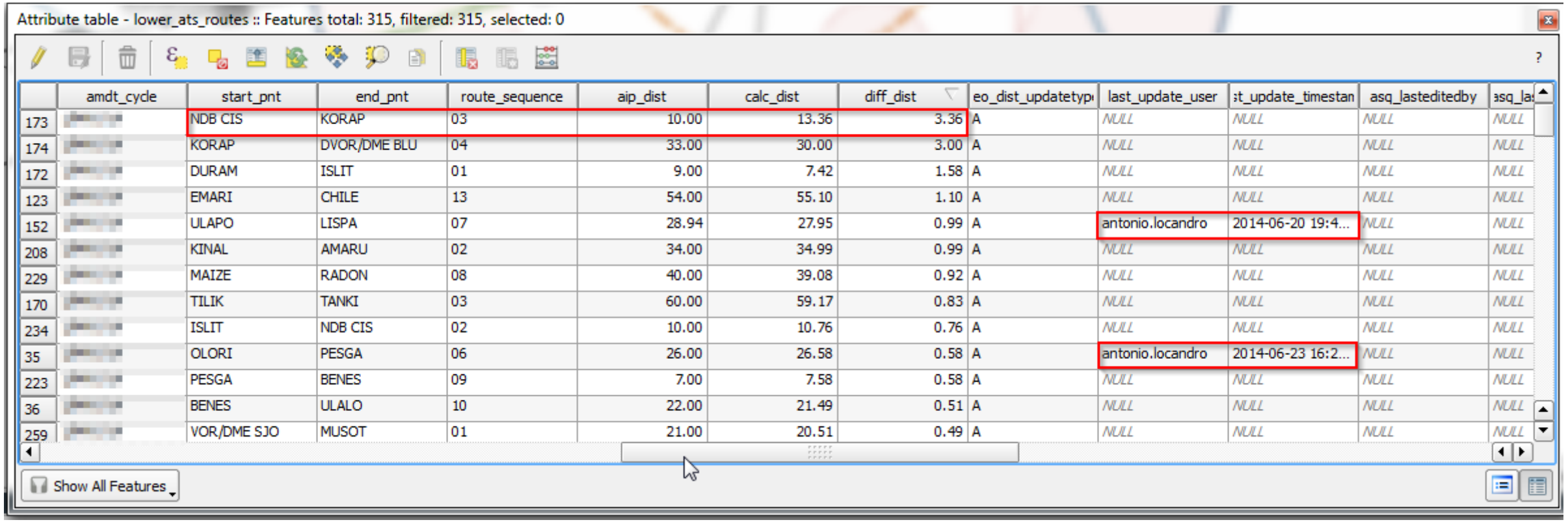
Layer name (prefix): tnt_25nm_query | Load now!

Avoid selecting by feature id

Close



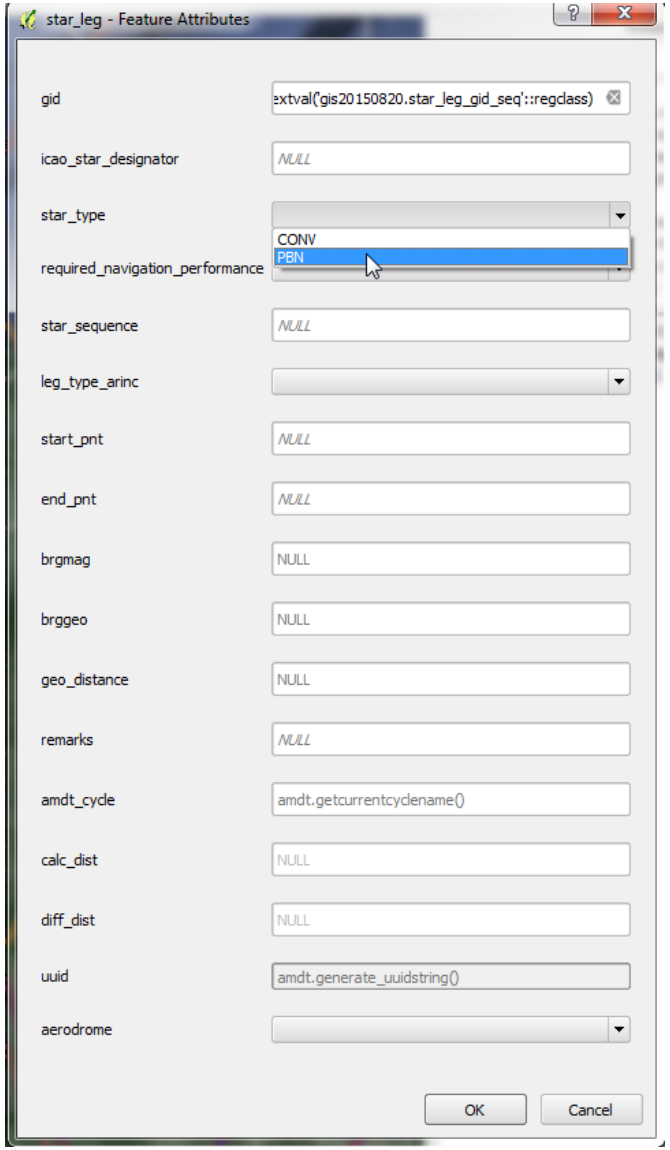
Postgresql+Postgis+QGIS (Automatic review and trazability)

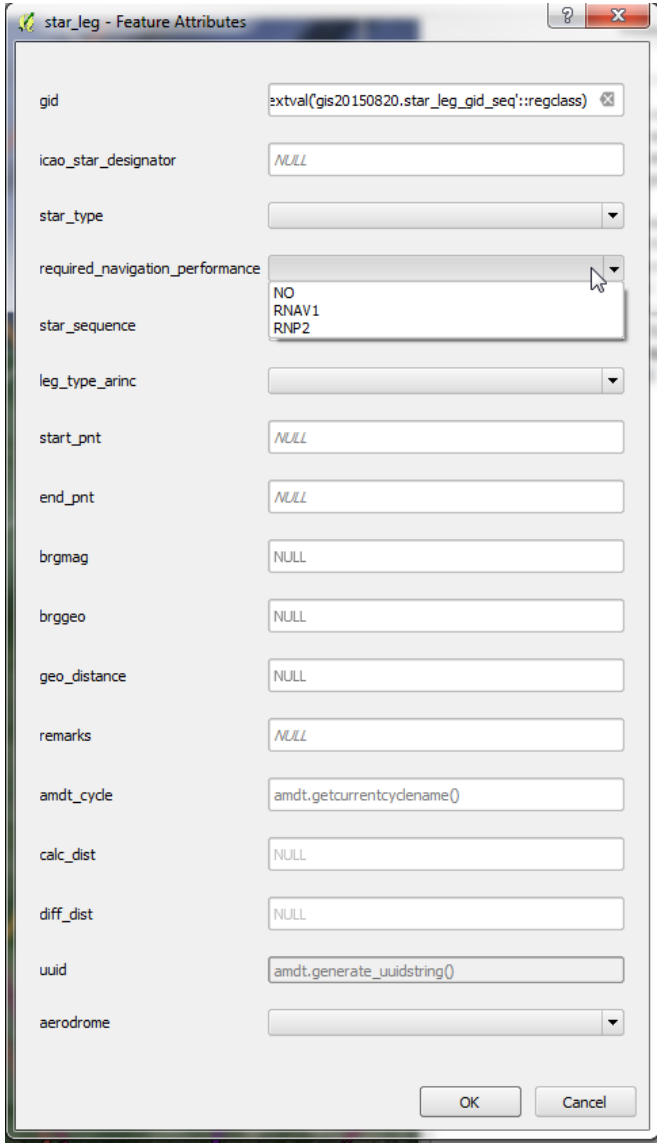


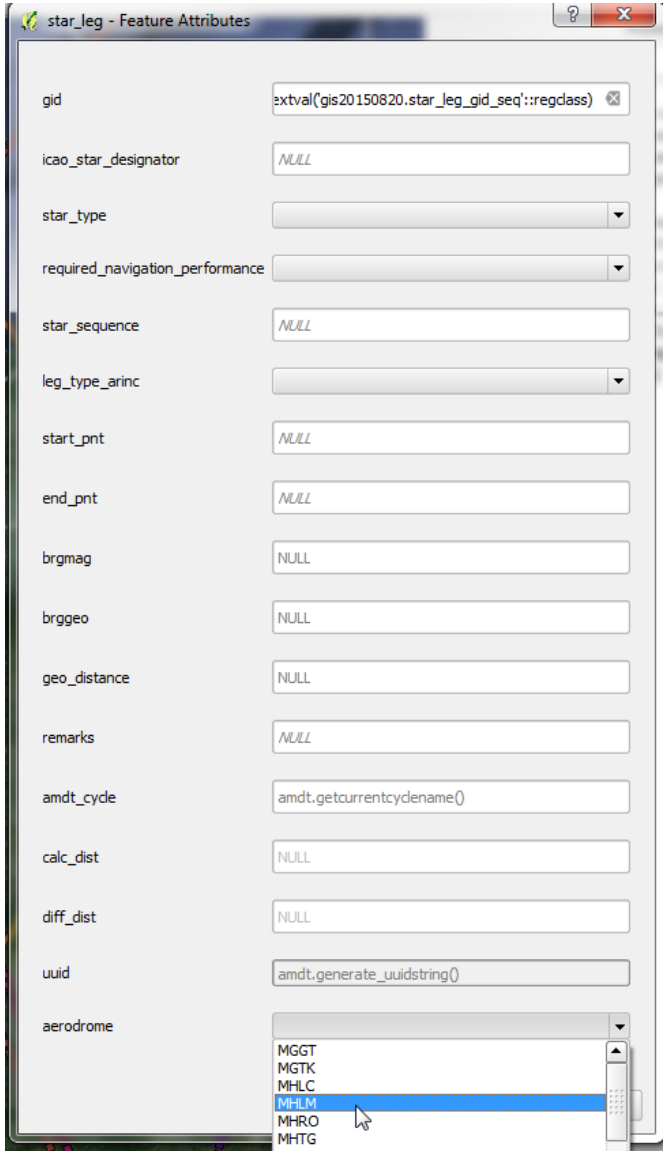
	amdt_cycle	start_pnt	end_pnt	route_sequence	aip_dist	calc_dist	diff_dist	eo_dist_updatetyp	last_update_user	st_update_timestan	asq_lasteditedby	asq_la
173		NDB CIS	KORAP	03	10.00	13.36	3.36	A	NULL	NULL	NULL	NULL
174		KORAP	DVOR/DME BLU	04	33.00	30.00	3.00	A	NULL	NULL	NULL	NULL
172		DURAM	ISLIT	01	9.00	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

COCESNA

Postgresql+Postgis+QGIS (Input forms and validations)

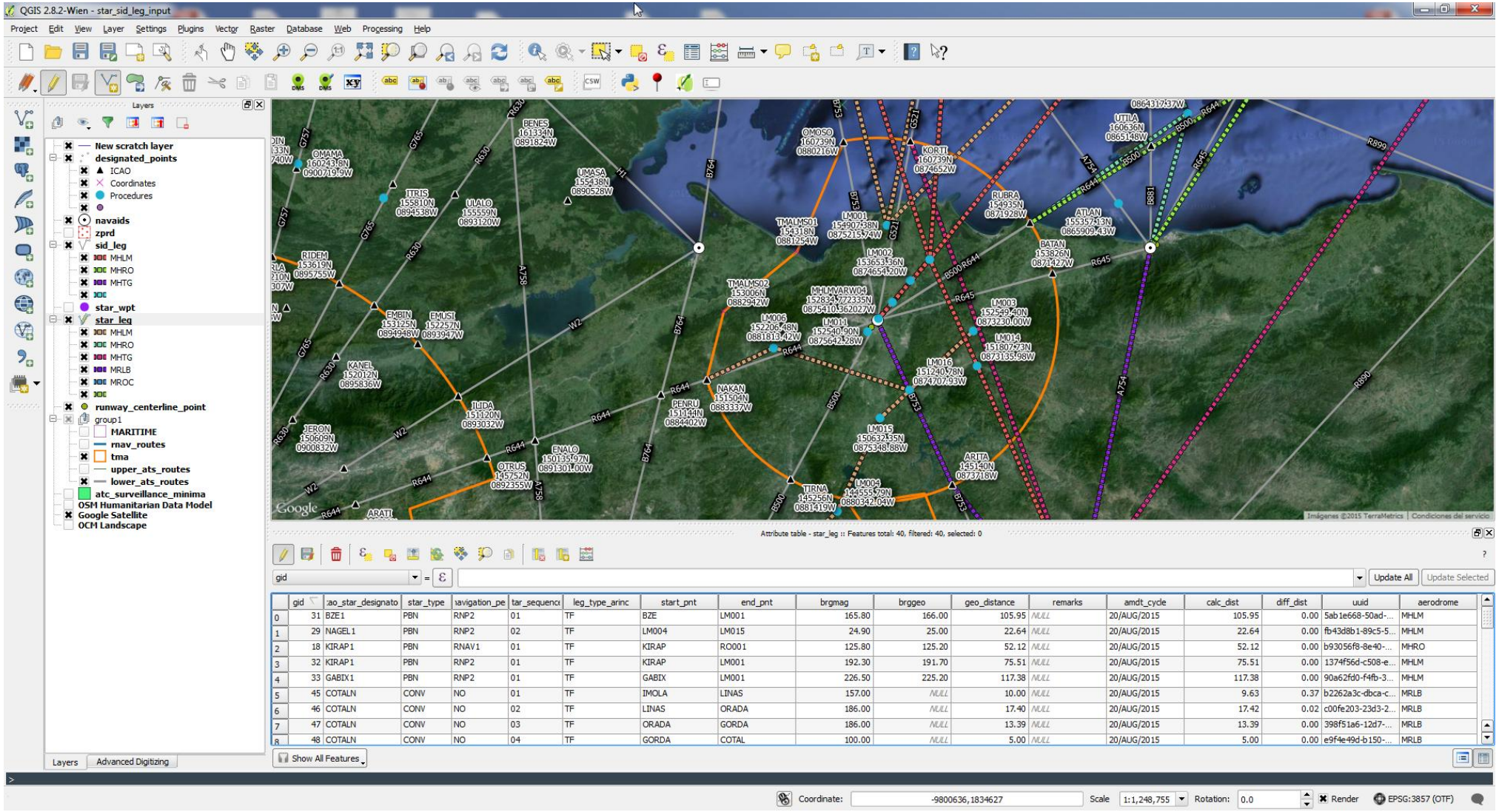






COCESNA

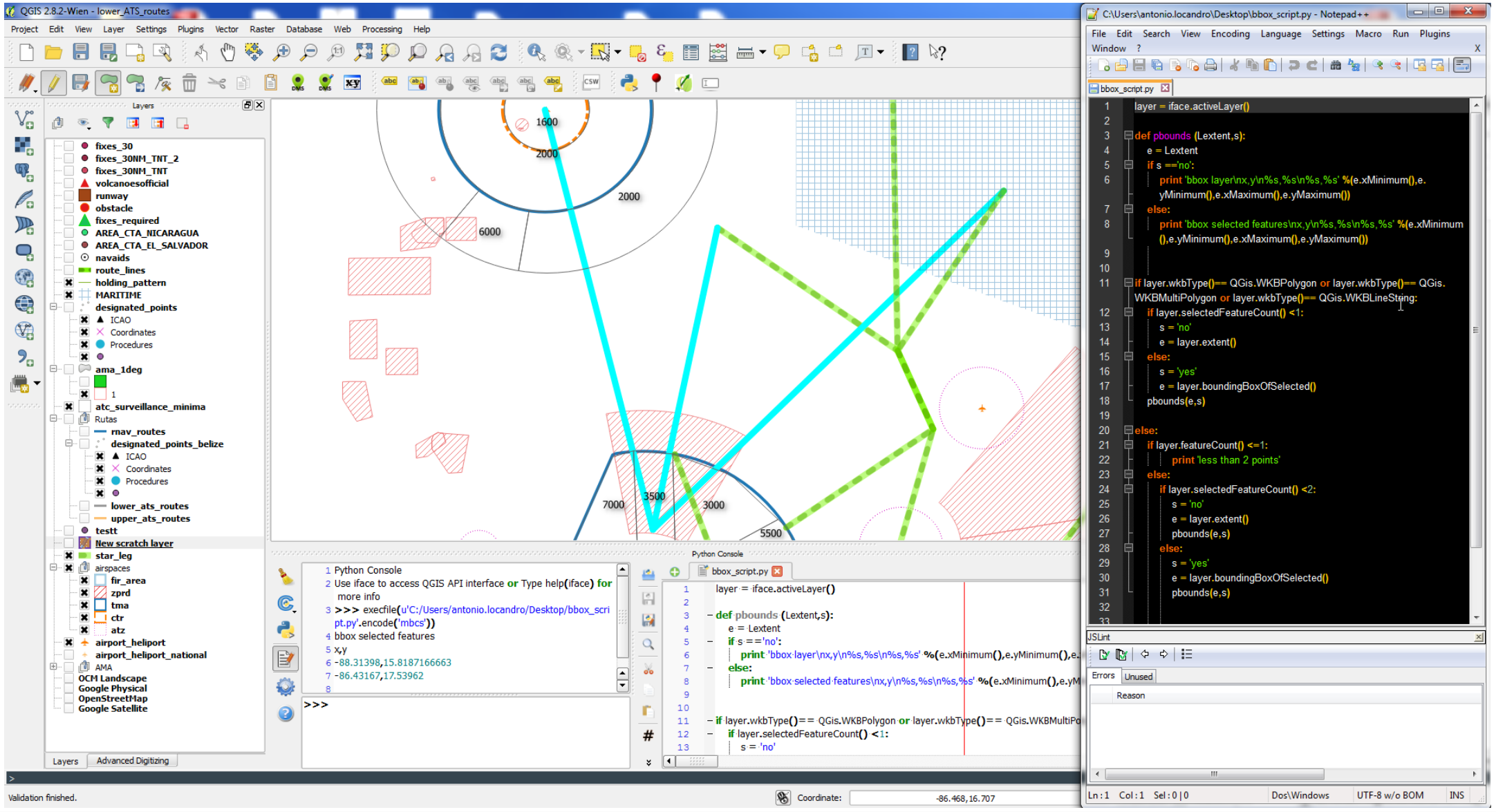
Postgresql+Postgis+QGIS (Input forms and validations)



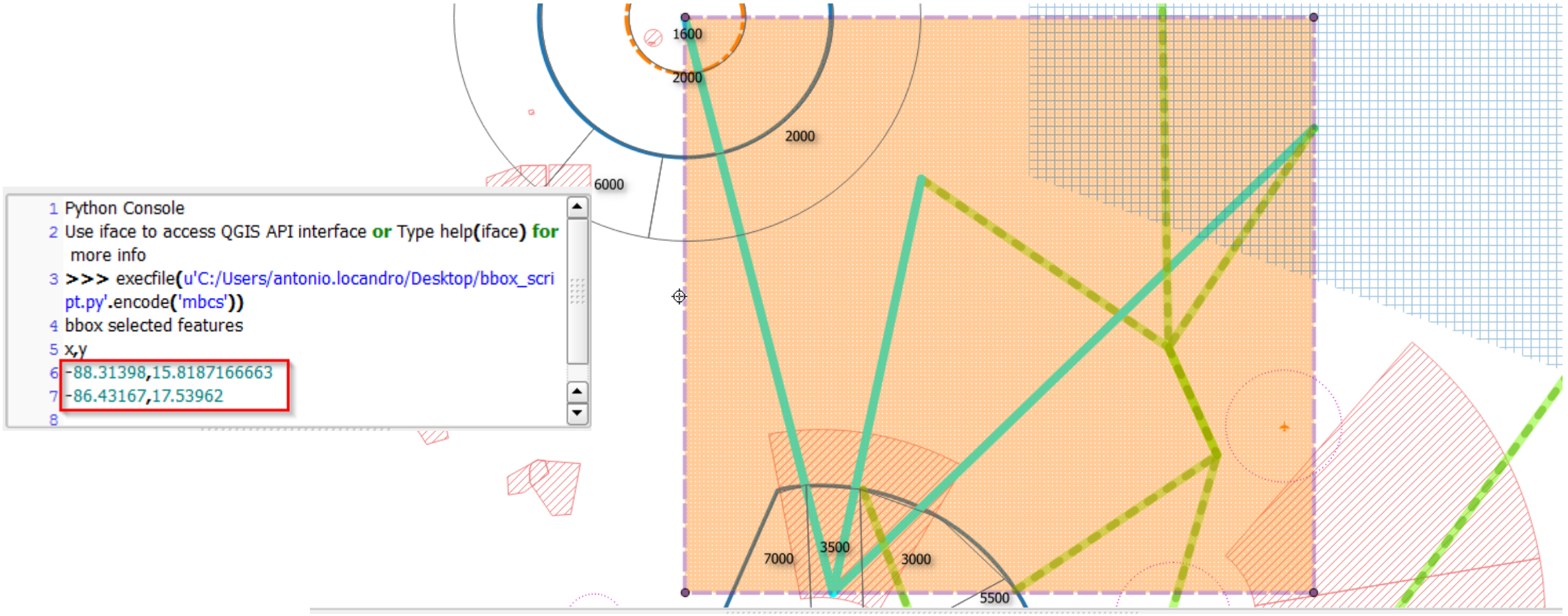
	gid	ao_star_designato	star_type	avigation_pe	tar_sequenc	leg_type_arinc	start_pnt	end_pnt	brgmag	brggeo	geo_distance	remarks	amdt_cycle	calc_dist	diff_dist	uuid	aerodrome
0	31	BZE1	PBN	RNP2	01	TF	BZE	LM001	165.80	166.00	105.95	NULL	20/AUG/2015	105.95	0.00	5ab1e668-50ad-...	MHLM
1	29	NAGEL1	PBN	RNP2	02	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

COCESNA

Postgresql+Postgis+QGIS+Python (Bounds)

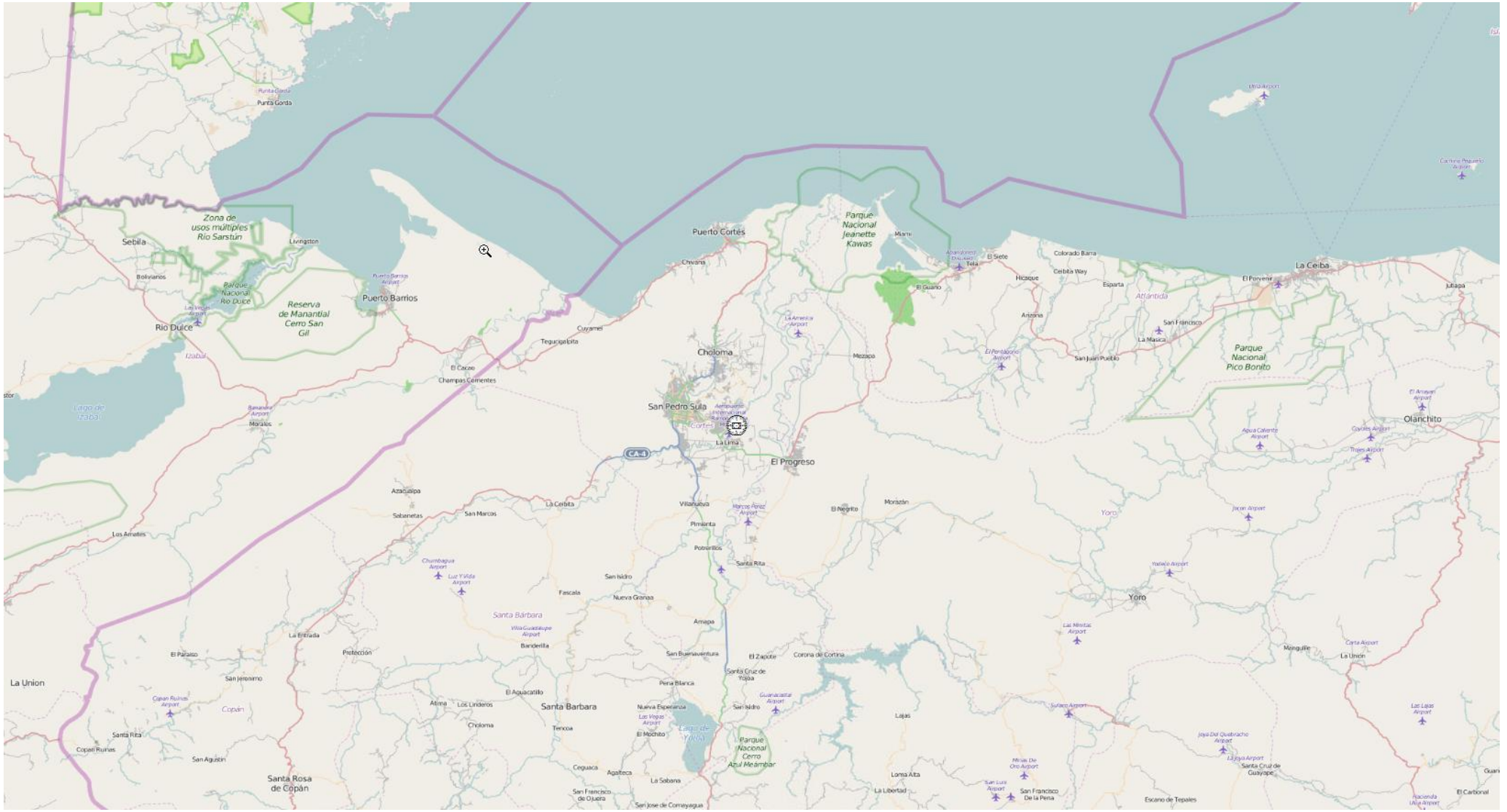


Postgresql+Postgis+QGIS+Python (Bounds)

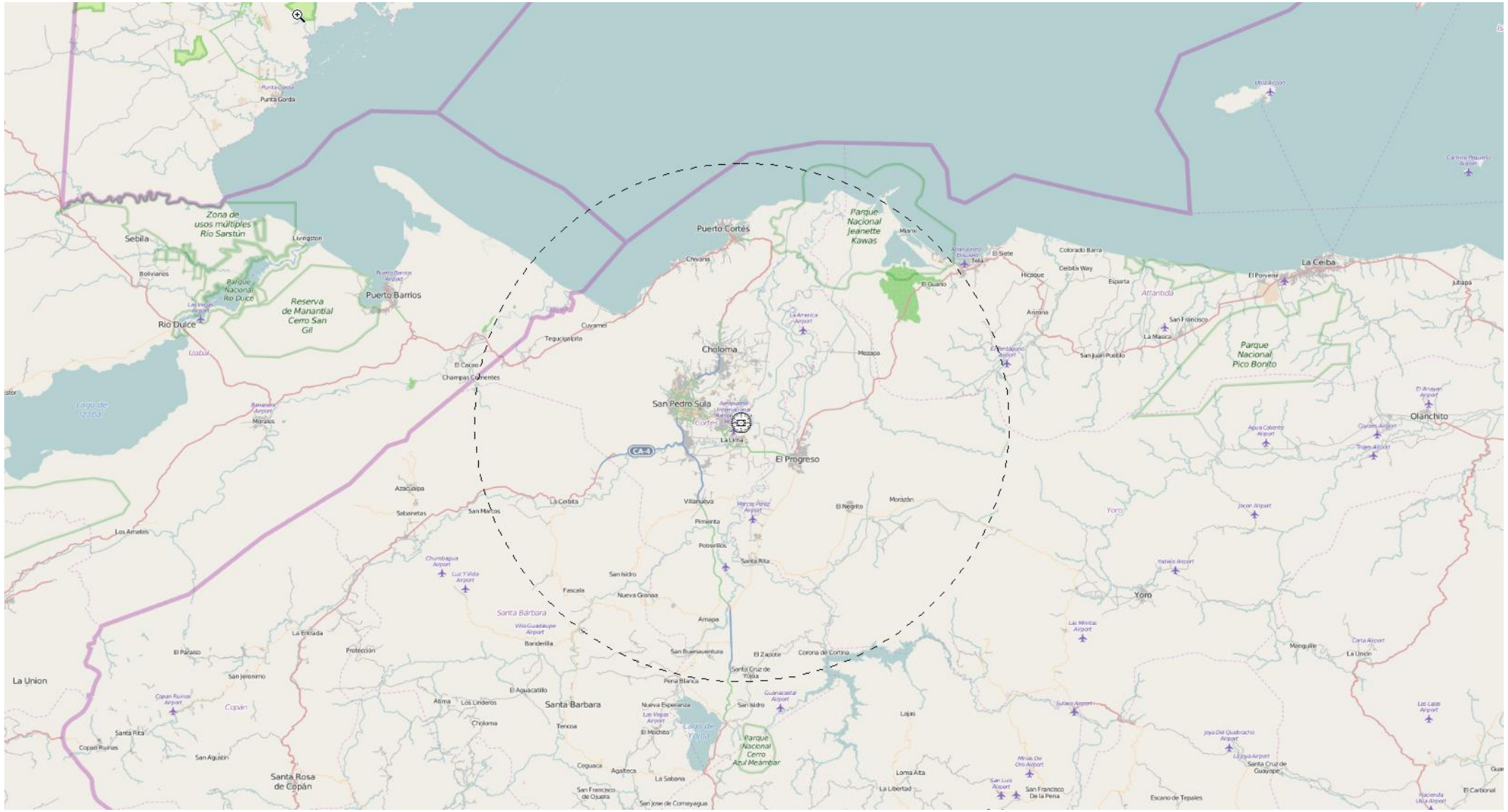


COCESNA

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

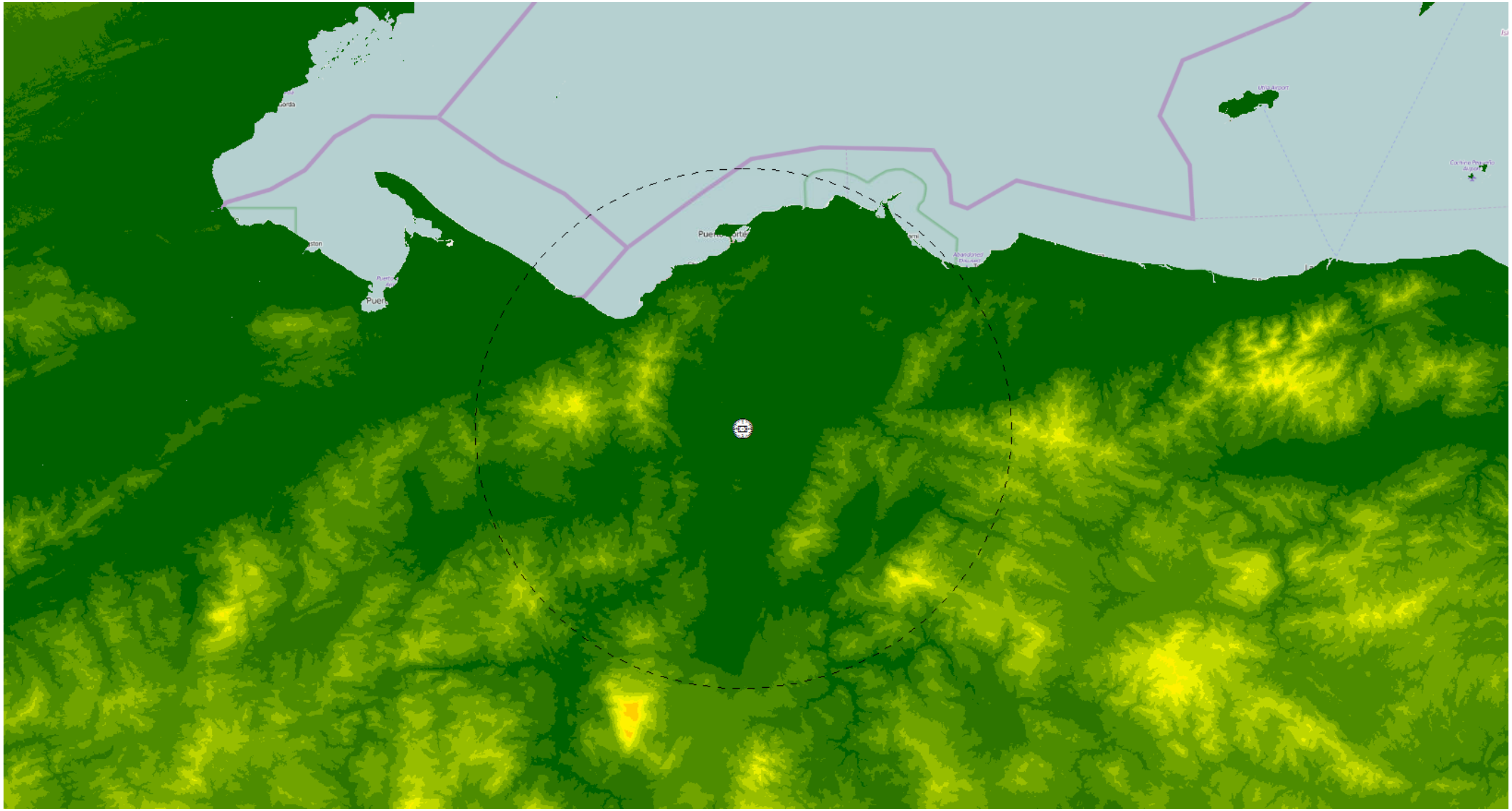


Postgresql+Postgis+QGIS+Python (MSA Maximum Elevation)



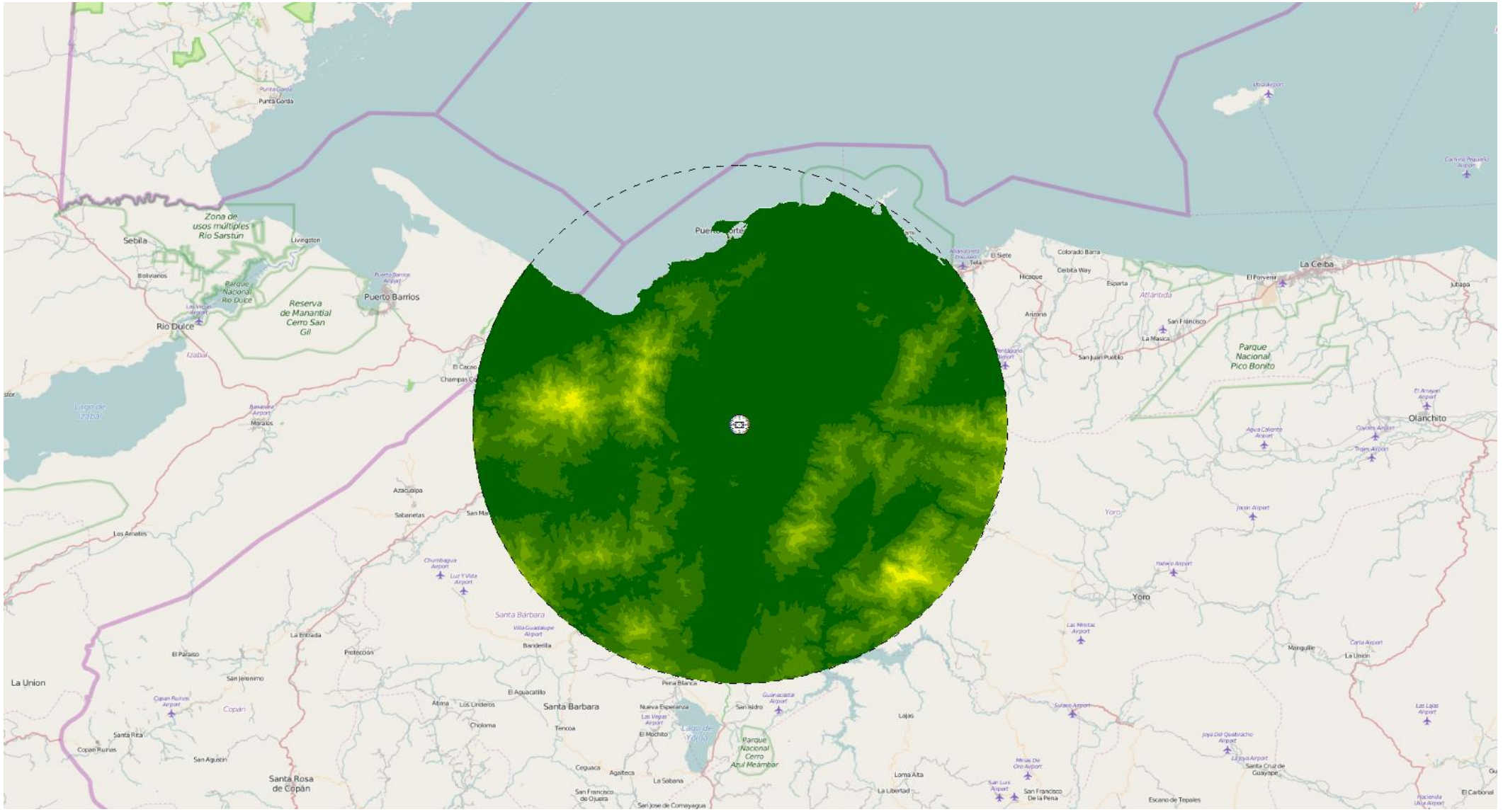
COCESNA

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



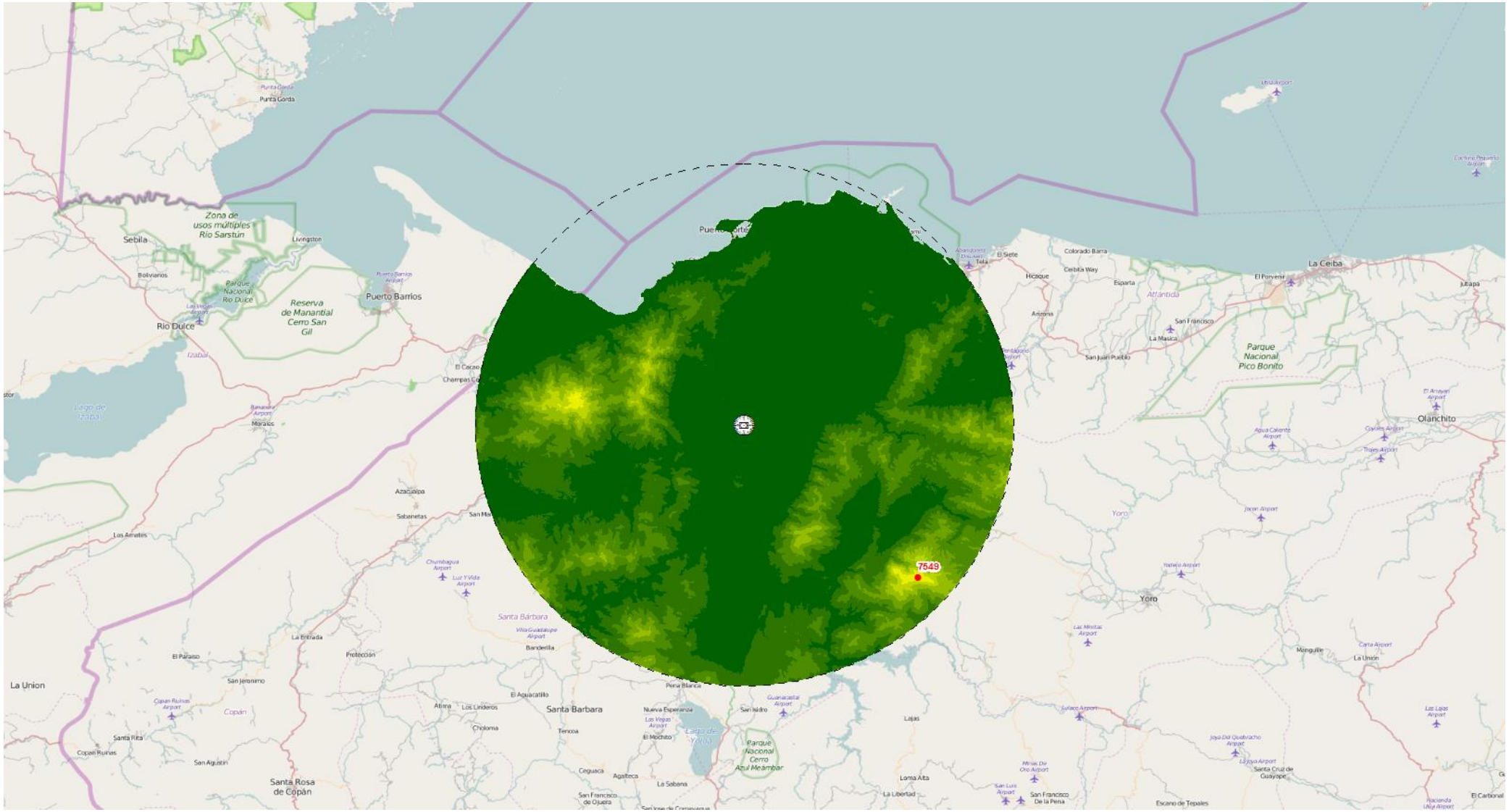
COCESNA

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



COCESNA

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



COCESNA

Fulcrumapp – Collect Data

fulcrumapp.com

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

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

COCESNA

Fulcrumapp – Collect Data

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

COCESNA

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}

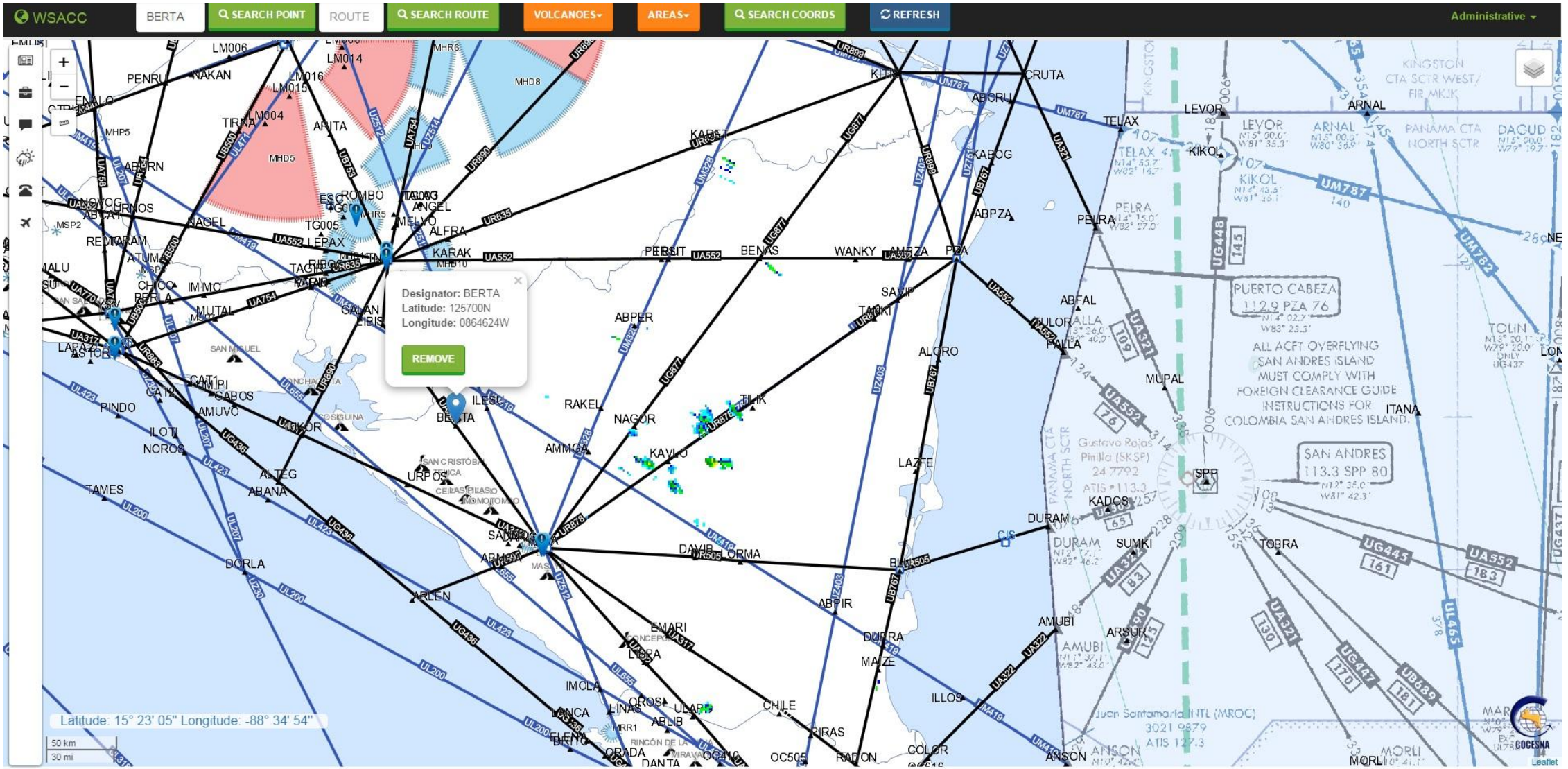
(*) Accuracy with respect to the appropriate geodetic reference frame
(#) Accuracy relative to the aerodrome control network
The more detailed list of accuracies and integrity is provided at the Part II of this document.

COCESNA

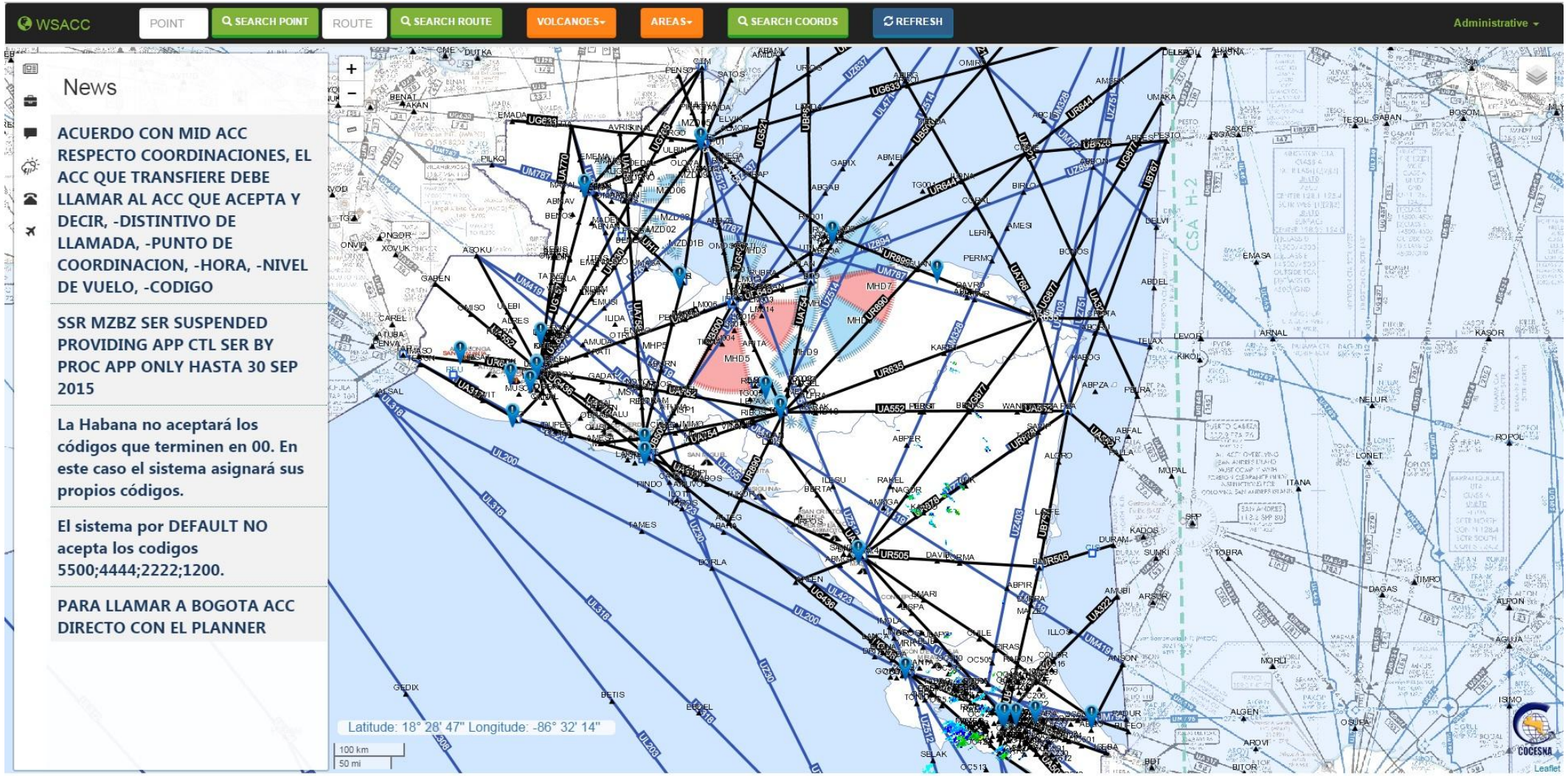
Fulcrumapp - Recolectar datos

COCESNA

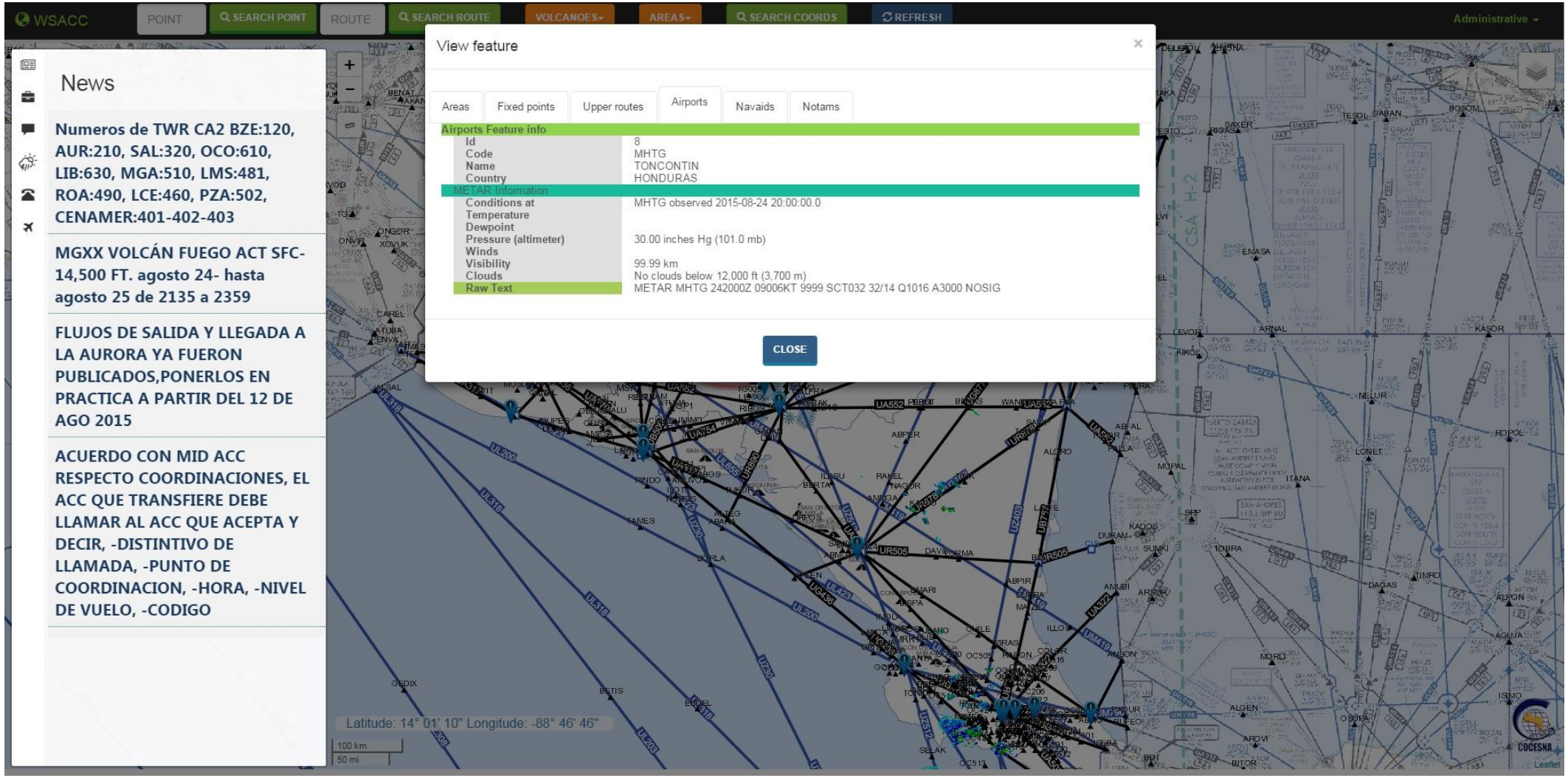
COCESNA Internal Application - WSACC



COCESNA Internal Application - WSACC

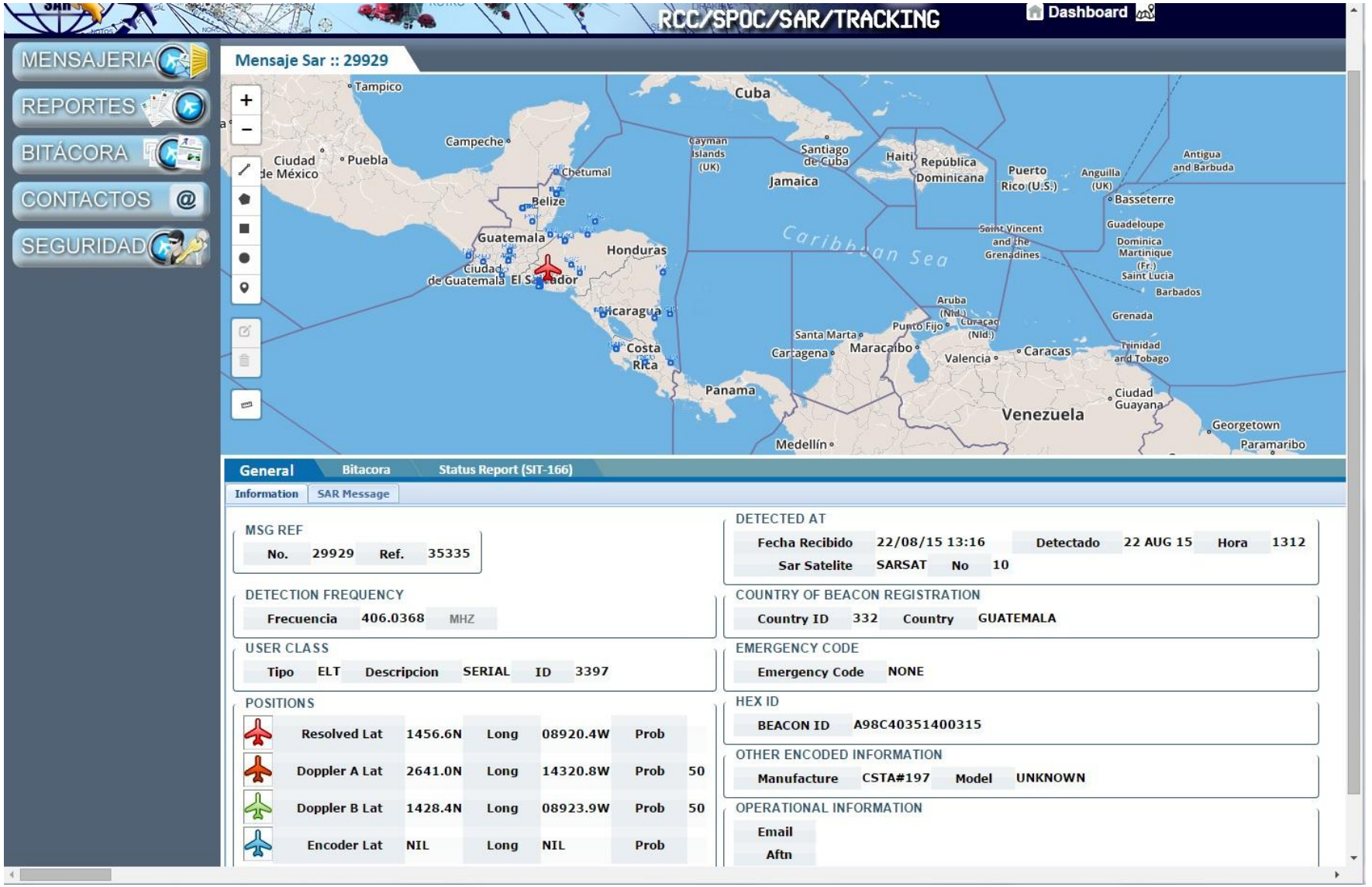


COCESNA Internal Application - WSACC



COCESNA

COCESNA Internal Application – SAR Tracking System

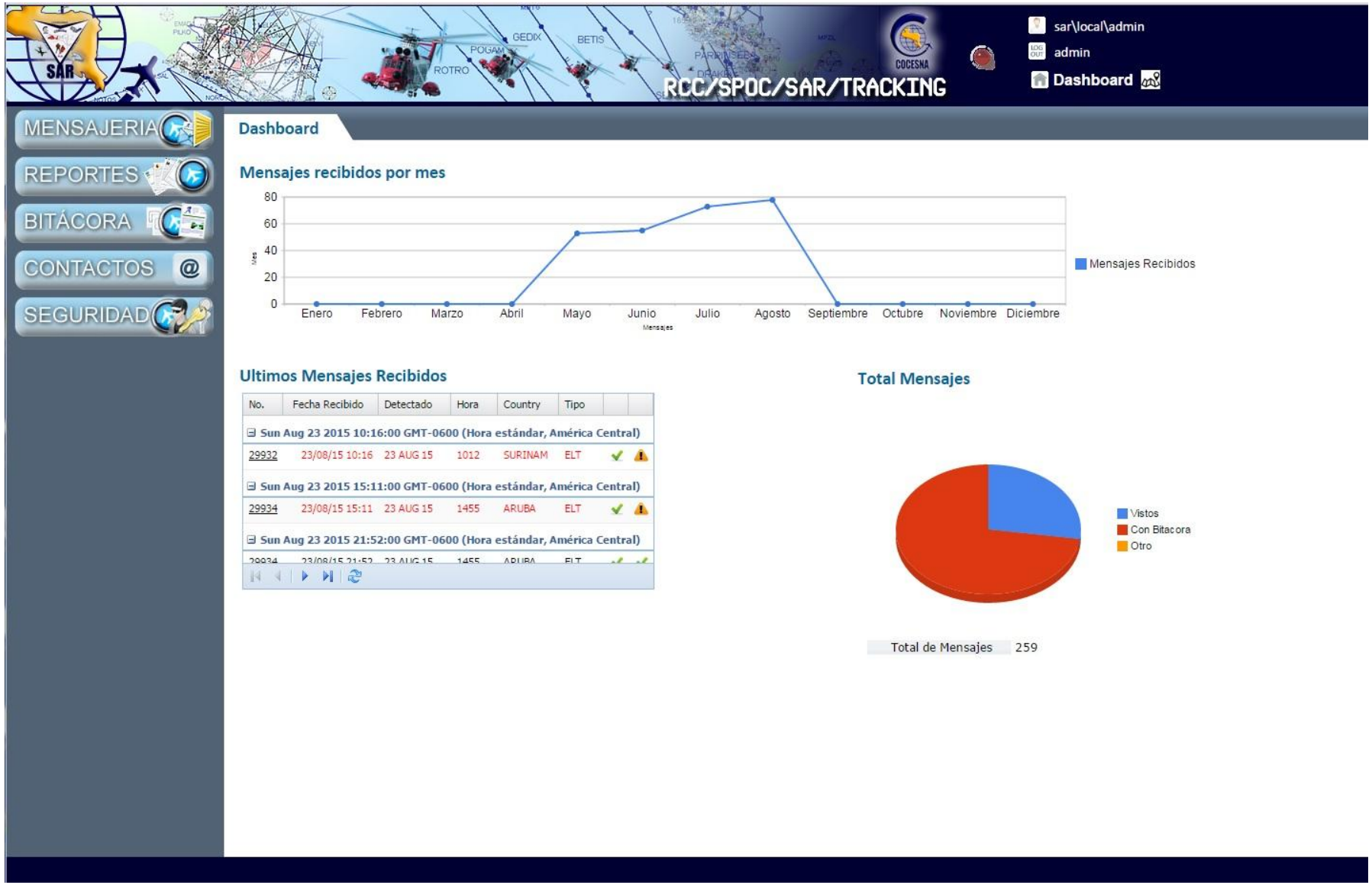


COCESNA Internal Application – SAR Tracking System

No.	Fecha Recibido	Detectado	Hora	Sar Satelite	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	PZ-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

COCESNA Internal Application – SAR Tracking System



Thank you for your time

COCESNA

Corporación Centroamericana de Servicios de Navegación Aérea