Caribbean/South American Regional Traffic Forecasts 2011-2031

Report of the Ninth Meeting
Of the CAR/SAM Traffic
Forecasting Group (CAR/SAM TFG)

Tegucigalpa. Honduras, 30 April-4 May 2012

International Civil Aviation Organization

NINTH MEETING OF THE CAR/SAM TRAFFIC FORECASTING GROUP

CAR/SAM TFG

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TABLE OF CONTENTS

1. INTRODUCTION

1.1 The main purpose of the Caribbean/South American (CAR/SAM) Region Traffic Forecasting Group (TFG) which was established in 1996, is to prepare forecasts for air passenger traffic and aircraft movements as well as peak period analysis, used to support the planning of air navigation services in the Region. Traffic forecasts and the analysis of peak-period planning parameters are important in anticipating where and when airspace and airport congestions may occur. It is then possible to plan for the required expansion of capacity. These forecasts also have an important role in planning the implementation of CNS/ATM systems. The primary users of the forecasts developed by the CAR/SAM TFG are expected to be Member States of ICAO, air navigation service providers in the region, and the ICAO planning and implementation regional group for CAR/SAM (GREPECAS).

1.2 The CAR/SAM TFG to date has held 9 meetings. During the last meeting, held in Tegucigalpa, Honduras from 30 April to 4 may 2012, the Group developed a new set of forecasts for the six major route groups to, from and within the Region, taking into account the recent developments. The forecasts cover passenger and aircraft movements traffic. Passenger traffic forecasts are based on assumptions made for economic growth and passenger yields. Aircraft movements traffic forecasts are based on assumptions for future trends in average load factors and average aircraft seating capacity. Projections of aircraft movements traffic for the top 25 city pairs in each of the major route groups were also developed. In addition, the analysis of FIR aircraft movements traffic data including peak-period planning parameters for the airspace controlled by COCESNA (CENAMER FIR) was carried out. In preparing the forecasts, the base year was 2011, and the forecasts were developed for the periods 2011-2016, 2016-2031and 2011-2031.

2. METHODOLOGY

2.1 Definition of Route Groups

2.1.1 Traffic to, from and within the CAR/SAM Region is classified, into the following six major route groups as defined in Appendix C:

1) South Atlantic
2) Mid-Atlantic
3) Intra-South America
4) Between South America and Central America/Caribbean
5) Intra-Central America/Caribbean
6) Between North America and South America and Central America/Caribbean

2.2 Air Passenger Forecast Methodology

2.2.1 In preparing passenger forecasts for the CAR/SAM region, the Group estimated a passenger model that uses Gross Domestic Product and yields to explain air passenger demand for scheduled service. Non-scheduled, or charter services are not included. No specific assumptions were made about various possible geo-political and economic events in the future beyond those implicit in the GDP assumptions (GDP assumptions are discussed in Section 2.3.2 and Yields Assumptions in Section 3.3.3).

2.2.3 The Group's model uses both time series and cross-sectional sets of data from 1993 to 2011 covering all of the above six routes. Scheduled air passenger statistics and yields were obtained from ICAO whereas GDP data was obtained from IHS Global Insight. With respect to the form of the model, a log linear regression model was estimated using Excel, and this was similar to the model developed at the previous 2010 meeting. In order to account for the disparities among the six routes, the model was calibrated with the following three dummy variables:

- South Atlantic and Mid Atlantic
- Intra-South America and Intra Central America/Caribbean
- Between South America and Central America/Caribbean AND between North America and South America/Central America/Caribbean

2.2.4 The model calibration resulted in the equation shown below, which was deemed to be the best fit of the historical data, hence it was used to forecast air passenger traffic. Total Regional air passenger forecasts for each route were then produced using the model results and forecasts of GDP and yields. To finalize the forecast, adjustments were applied accordingly based on differential growth rates of the routes.

LN (Passengers) = Constant + A*LN(GDP) + B*LN(Yield) + Dummy Variables

In this functional form, A and B are constant coefficients which represent elasticities.

The calibration produced the following results:

Ln (Passengers) = -13.22 + 1.93 ln(GDP) - 0.74 ln(Yield) - 2.33 (D_1) + 1.90 (D_2) - 0.36 (D_3)

(Adj. R2 = 0.95, tGDP = 26.12, tYield = -3.81, tD1 = -22.24, tD2 = 22.14, tD3 = -4.78)

2.3 **Aircraft Movement Forecast Methodology**

2.3.1 Forecasts of aircraft movements for each route group were derived from forecasts of air passengers and assumptions about future trends in load factors and average aircraft seating capacity. The link between these variables is expressed below:

$$\text{Number of Aircraft Movements} = \frac{\text{Number of Air Passengers}}{\text{(Passengers/Seats) * (Seats per Aircraft)}}$$

$$= \frac{\text{Number of Air Passengers}}{\text{(Load factors) * (Average Aircraft Seating Capacity)}}$$

2.3.2 The relationship between changes in the same variables can therefore be deduced to:

$$Y = X1 - X2 - X3$$

Where:

Y = Change in number of aircraft movements (%)
X1 = Change in number of air passengers (%)
X2 = Change in load factors (%)
X3 = Change in average aircraft seats (%)

2.3.3 Judgement was applied to assess expected trends in load factors. In addition an analysis of future trends in average aircraft seating capacity was discussed. It was assumed that historical trends of using aircraft with larger seating capacity and matching of aircraft size to demand levels will be continued by airlines over the forecast horizon.

2.3.4 Aircraft movement forecasts were then allocated to each of the respective city-pairs taking into account traffic service patterns, types of aircraft, demographics and other pertinent factors.

2.3.5 The historical trends in total seats available, average aircraft size, average load factor as well as aircraft movements were established for each of the route groups concerned based on data from Traffic by Flight Stage (TFS) compiled by ICAO.

2.3.6 For each of the major route groups concerned, a detailed city-pair traffic flow was developed using the 2011 Official Airline Guide (OAG) data as the basis. A relationship between the TFS data and the aircraft movement data from the OAG was established.

3. HISTORICAL TRENDS AND FORECAST ASSUMPTIONS

3.1 Global Trends

3.1.1 Global Economic trends

3.1.1.1 Between 2001 and 2011, the aggregate world economy measured in terms of Gross Domestic Product (GDP) grew at an average annual rate of 3.6 per cent in real terms. Growth rates varied across regions, from a low of 1.6 per cent for North America to as high as 6.2 per cent for Asia/Pacific. During the same period the world population increased at an average annual rate of 1.2 per cent. The resulting world GDP per capita was a healthy increase of 2.4 percent per year over the 10 year period.

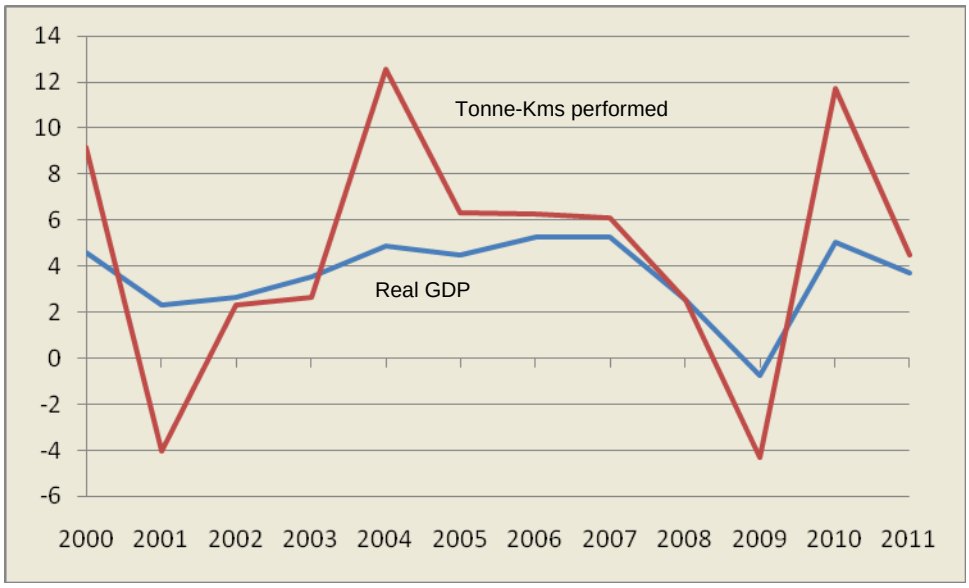
3.1.1.2 After a decline of about 1 per cent in 2009, the world economy began to recover. The real GDP grew 5.1 and 3.7 per cent in 2010 and 2011 respectively. In the short term the world economy is expected to grow 3.4 and 4.1 percent during the years 2012 and 2013. Over the long-term (2011 to 2031) the world economy is projected to grow at an average annual rate of 4.0 per cent in real terms, while world GDP per capita is projected to grow by 3.1 per cent.

3.1.2 Global Traffic trends

3.1.2.1 Between 2001 and 2011 total scheduled airline traffic, measured in terms of passenger-kilometres performed (PKPs), grew at an average annual rate of 5 per cent reaching some 4980 billion PKPs by 2011. As expected, the growth pattern of passenger traffic reflects that of economic growth and this linkage is illustrated in Figure 1 below. The early to mid 1990s were generally a period of robust growth for both GDP and air passenger traffic. Following that period, traffic growth slowed down considerably amid weak global economic conditions which were set-off by the Asian financial crisis in 1997 followed by the oil price increases of 1999 and further exacerbated by the events of September 11, 2001. It was only in 2004 that world traffic growth fully recovered registering a whopping 14.1 per cent growth, reflecting strong recovery by the airlines in Asia/Pacific (the region worst affected by the SARS outbreak), improved performance of some regional economies and the sustained expansion of the Middle East economy. Global traffic continued to grow remarkably between 2005 and 2007, supported by a strong performance of the world economy, registering growth rates of 8.0, 6.1 and 7.7 per cent respectively. In 2008 the global financial crisis and the ensued economic recession led to a significant slowdown in traffic growth resulting in a modest increase of about 3 percent. In 2009 the worst decline of 1.1 percent in air passenger traffic was experienced. In 2010 the world traffic bounces back and registered a growth of 8 per cent due mainly to the economic recovery. During 2011 the world traffic grew at 6.4 per cent as the economic recovery slowed down.

FIGURE 1

WORLD ANNUAL GROWTH IN GDP AND AIRLINE TRAFFIC
2000-2011



3.2 Trends and Prospects for The Latin American And Caribbean Region

3.2.1 Data sources

3.2.1.1 In order to study the relationship between traffic and socio-economic trends in the Latin American and Caribbean Region, data from several sources were collected on the economies of the countries in the area. GDP historical and forecast data originate from IHS *Global Insight*. Airline yield information was obtained from ICAO and adjusted by the CAR/SAM TFG based on the most recent information available from other sources.

3.2.2 Historical Traffic Trends of the Latin America and Caribbean Airlines

3.2.2.1 During the past decade (2001-2011), scheduled traffic of the Latin American and Caribbean region airlines, measured in terms of passenger–kilometers performed, grew at an average annual rate of about 5.4 per cent, compared to 5 per cent for global traffic, reaching some 226 billion passenger kilometres by 2011. Traffic growth was volatile over this period. After experiencing declining growth rates in 2001 (1 percent) and 2002 (3 percent), the region's traffic recovered in 2004 (9.6 percent) and continued to expand until 2007 supported by an improved economic environment. In 2008 the region's traffic maintained its momentum and grew by 8.1 percent, contrary to the world traffic which slowed down. In 2009 as the economic crisis took its toll on global traffic and as a consequence, the region's traffic also suffered a decline of 0.7 per cent. As the economic environment in the Region has been getting better progressively, the airline traffic has also continued to improve. In 2010 the Airlines of the region registered an impressive11 per cent growth while during 2011 the growth was about 7.5 per cent.

3.2.3 Economic trends and prospects

3.2.3.1 Over the 2001-2011 period, the aggregate Latin American and Caribbean economies grew at an average annual rate of 3.7 per cent in real terms, whereas GDP per capita grew 2.4 per cent, at the same rate compared to world GDP per capita growth for the same period.

3.2.3.2 In the late nineties, the economy of the region experienced a slowdown and grew only by 0.4 per cent in 1999. This was partly due to the financial market setback, which led Brazil to introduce severe austerity measures. Other countries in the region, such as Peru, Ecuador, El Salvador, Honduras and Nicaragua, suffered from the adverse effects of repeated natural disasters which resulted in constricted output, especially due to devastation in the agricultural and industrial sectors, and consequently declining overall economic performance. While the Latin American and Caribbean Region enjoyed above average growth in the 1990s, due mainly to large capital inflows, the years 2000 and 2001 posted weak growth, affected by the 2001 slowdown and the 2002 recession. In 2003, recovery began to take its root causing GDP growth to strengthen. During 2004, with the world's economy enjoying an impressive growth of 4.9 per cent, the Latin American and Caribbean Region also registered robust growth of 5.9 per cent and that upswing was held up well until 2007. In 2008, economic growth in the region eased somewhat, showing an increase of 4.2 per cent as a result of moderating exports, softer commodity prices and severe financial conditions. In 2009 the economic conditions continued to deteriorate pushing the region into a recession with a decrease of 1.8 per cent. The year 2010 saw a robust economic recovery in the Region and accordingly the GDP grew at an impressive 5.9 per cent. The momentum has so far continued and during the year 2011 the economic growth has somewhat slowed down with a growth of 4.4 per cent, higher than the world average of 3.7 per cent in the same year.

3.2.3.3 **Table 1** below shows GDP growth rates for the major economies in the CAR/SAM region and those of other regions.

TABLE 1

GDP GROWTH RATES FOR THE REGION'S MAJOR ECONOMIES

Country/Region	GDP Growth Rate (per cent)							
	Estimate	Forecast						
						Average annual growth rate		
	2011	2012	2013	2014	2016	2011 to 2016	2016 to 2021	2011 to 2031
Countries								
Argentina	9.3	4.0	4.9	5.1	4.6	4.7	4.4	4.1
Brazil	2.9	3.5	5.2	5.8	5.0	4.8	4.5	4.5
Chile	6.3	3.8	3.8	3.3	3.4	3.6	3.6	3.7
Colombia	5.9	4.9	4.1	4.3	4.7	4.5	4.7	4.2
Mexico	1.5	1.9	3.1	2.4	1.9	2.3	1.8	1.7
Peru	4.0	3.0	4.2	4.7	4.0	4.0	3.7	3.5
Venezuela	4.0	3.6	4.3	4.0	3.2	3.6	3.0	2.9
Regions								
Latin America and Caribbean	4.4	3.7	4.1	4.7	4.3	4.2	4.1	3.9
North America	1.8	2.2	2.4	3.3	2.9	2.7	2.5	2.5
Europe	2.0	0.2	1.4	2.1	2.5	1.7	2.3	2.0
Asia-Pacific	5.8	6.0	6.4	6.7	6.3	6.4	5.8	5.0
Middle East	4.5	3.3	3.8	4.4	3.9	4.0	3.5	3.6
Africa	2.3	4.7	5.6	5.4	5.0	5.2	4.6	4.2
Total World	3.7	3.3	4.1	4.7	4.6	4.4	3.3	3.3

Note: Regional growth rates based on all the countries in the region.
Source: ICAO/ IHS Global Insight.

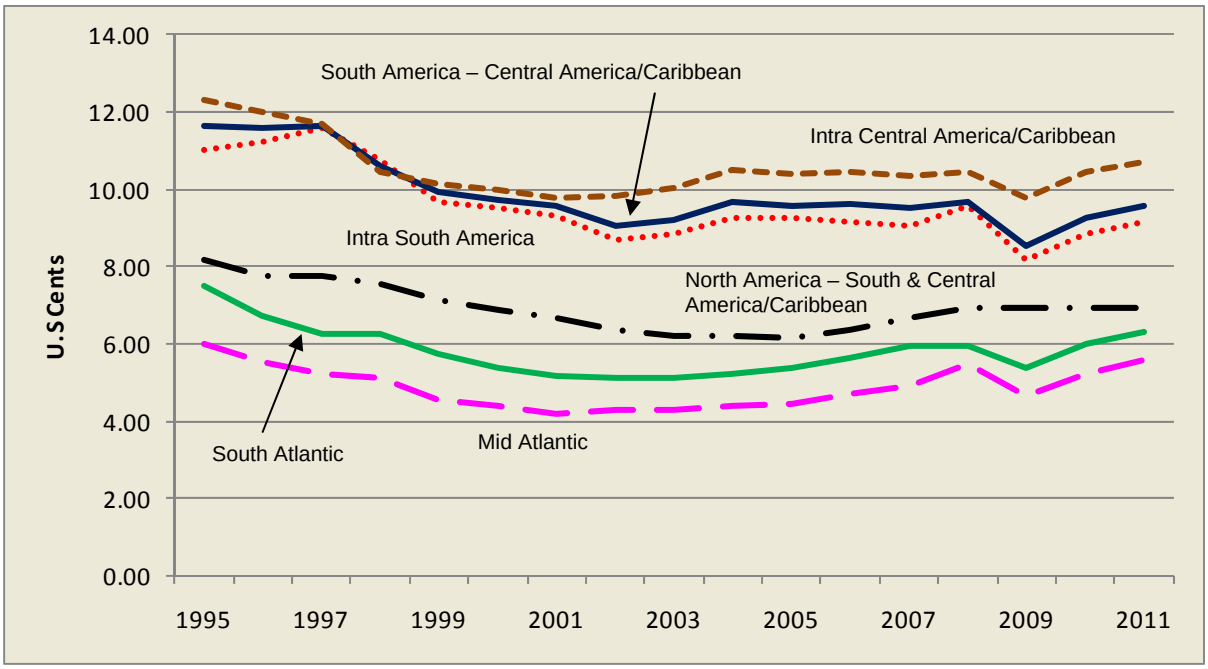
3.3 Yields trends and assumptions

3.3.1 The prospects for airline yields are closely related to cost developments and market conditions in the airline industry. Changes in fuel prices have significant effects on costs, hence on financial returns and airline yields. After soaring in 1999 and 2000, fuel prices declined moderately in 2001 and have risen continuously since then until July 2008 when they reached record breaking levels inflicting financial strain on the world airline industry. After August-2008, oil prices declined dramatically to reach levels below 50$/barrel by the end of 2008 and increased somewhat to average about 60 $/barrel in 2009. During 2010 the prices continued to escalate and reached about 80$/barrel on the average. The year 2011 saw the fuel prices still rising beyond the level of 2010 and achieving a level of about a 100 $/barrel. In the long run, oil prices are expected to remain somewhat on a higher level. During the next 30 year period it is expected that the prices could reach about 130 $/barrel. These various cost pressures will provide a benchmark for airline yields, with revenues needing to be sufficient to cover costs over the long term.

3.3.2 **Figure 2** depicts the developments in average yields over the past decade for the six major route groups considered in this report. Overall, it shows that average yields on routes between the CAR/SAM region and North America and between the CARSAM region and Europe are lower than those for routes within the CARSAM region. It also shows that the declining trend reversed in 2004, when yields in general started to increase. During the economic crisis of 2009 the yields declined considerably in order boost the traffic in the region. Since then, faced with increasing fuel costs, airlines managed to increase their fares in conjunction with other productivity improvements such as higher load factors and aircraft utilization.

FIGURE 2

DEVELOPMENTS IN AVERAGE PASSENGER YIELDS (1995-2011)



3.3.3 Yields assumptions are provided in **Table 2**. Yields are expected to increase in mature markets and in markets with limited competition and to decline moderately on growing markets with increasing competition.

TABLE 2

YIELDS CHANGE ASSUMPTIONS (PER CENT)

Route Groups	2011-2016 (%)	2016-2021 (%)	2021-2031 (%)
South Atlantic	0.2	1.0	0.0
Mid-Atlantic	1.8	1.5	0.0
Intra-South America	-0.7	-1.0	-0.5
Between South America and Central America/Caribbean	-0.5	-0.1	0.0
Intra-Central America/Caribbean	1.0	0.5	0.5
Between North America and South America and Central America/Caribbean	1.1	1.2	0.5

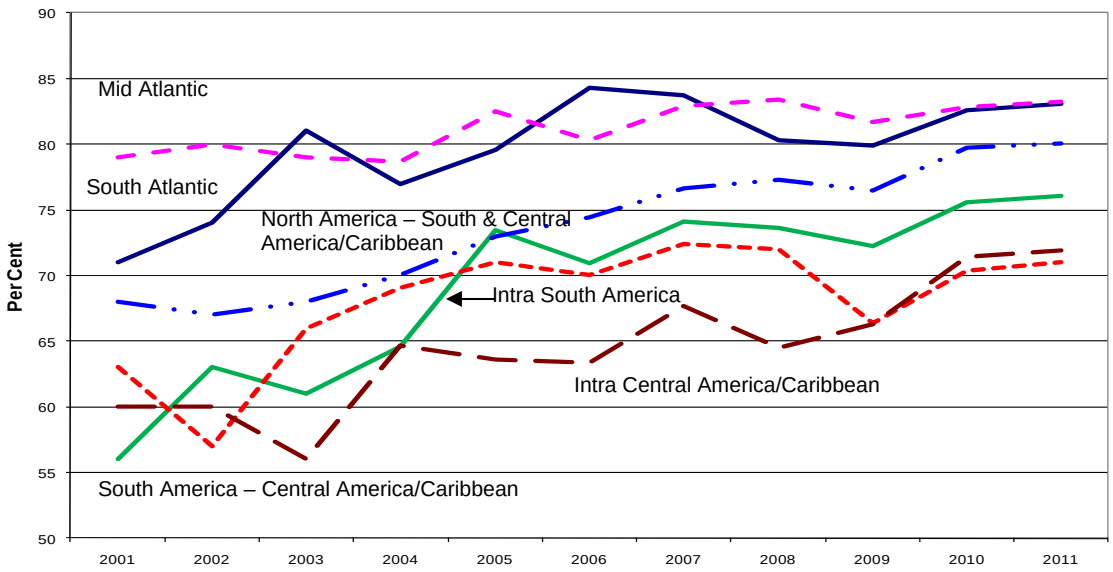
3.4 **Analysis of Load Factors and Capacity**

3.4.1 The projections for load factors and average aircraft seating capacity for the period up to 2031 have been developed using the approach described in the Methodology section.

3.4.2 **Figure 3** below depicts the historical load factors for the six CARSAM routes and shows that since the year 2000, airlines have been increasing load factors as part of their efficiency improvement strategies.

FIGURE 3

HISTORICAL LOAD FACTORS (2001-2011)



3.4.3 **Table 3** below shows the load factors and indicates that compared to 2001 levels, load factors are projected to be significantly higher in 2031 on all route groups with the exception of the South Atlantic and Mid-Atlantic where they are anticipated to increase only marginally.

TABLE 3

ANALYSIS OF LOAD FACTORS (PER CENT)

Route Groups	Historical			Forecast		
	2001	2006	2011	2016	2021	2031
South Atlantic	71.0	84.3	83.1	83.1	83.6	84.0
Mid-Atlantic	79.0	80.3	83.2	83.2	83.7	84.1
Intra-South America	56.0	70.9	76.0	76.0	76.5	76.9
Between South America and Central America/Caribbean	63.0	70.0	71.0	71.0	71.6	72.2
Intra-Central America/Caribbean	60.0	63.4	71.9	71.9	72.4	72.9
Between North America and South America and Central America/Caribbean	68.0	74.4	80.0-	80.0	81.8	85.0

3.4.4 Average aircraft seats for each of the route groups for the period 2001-2011 and the projected average aircraft seats for the target years 2016, 2021 and 2031 are provided in **Table 4**. The average aircraft seats in 2031 are expected to vary from a low of 103 seats for the Intra Central America/Caribbean route group to a high of 289 seats for the Mid-Atlantic route group.

TABLE 4

ANALYSIS OF CAPACITY (AVERAGE AIRCRAFT SEATS)

Route Groups	Historical			Forecast		
	2001	2006	2011	2016	2021	2031
South Atlantic	278	277	272	277	277	277
Mid-Atlantic	301	300	299	289	289	289
Intra-South America	160	159	160	158	159	160
Between South America and Central America/Caribbean	163	159	161	143	144	145
Intra-Central America/Caribbean	91	93	94	102	102	103
Between North America and South America and Central America/Caribbean	175	174	170	159	160	160

4 FORECASTS OF PASSENGER TRAFFIC AND AIRCRAFT MOVEMENTS FOR MAJOR ROUTE GROUPS TO, FROM AND WITHIN THE LATIN AMERICAN AND CARIBBEAN REGION

4.1 South Atlantic

4.1.1 **Table 5a)** depicts the number of passengers for the South Atlantic route for selected periods from 2001 to 2011 and projections for traffic from 2011 to 2031. Passenger traffic grew at an average annual rate of 7.4 per cent, from some 4.3 million passengers in 2001 to about 8.9 million passengers in 2011.

4.1.2 For the period 2011-2031, passenger traffic is expected to grow at an average annual growth rate of 4.9 per cent, reaching approximately 23.4 million passengers in the year 2031.

TABLE 5a)

	Year	Passengers (Million)	Load Factor	Average Seats
Historical				
	2001	4.34	75.0	278
	2006	6.79	84.3	284
	2011	8.89	83.1	277
Forecast				
	2012	9.39	83.1	277
	2013	9.92	83.1	277
	2014	10.49	83.1	277
	2015	11.13	83.1	277
	2016	11.76	83.1	277
	2021	14.83	85.0	278
	2031	23.35	85.0	280
Average Annual Growth (Per cent)	2011-2016	5.7	0.0	0.0
	2016-2021	4.7	0.5	0.1
	2021-2031	4.6	0.0	0.1
	2011-2031	4.9	0.1	0.1

4.1.3 The aircraft movements for the period 2011-2031 are projected to grow at an average annual growth rate of 4.8 per cent, reaching over 97 000 movements in the year 2031, as illustrated in **Table 5b).**

TABLE 5b)

	Year	Aircraft Movements
Historic	2011*	38493*
Forecast	2012	40622
	2013	42940
	2014	45390
	2015	48155
	2016	50898
	2021	62573
	2031	97851
Average Annual Growth (Per cent)	2011-2016	5.7
	2016-2021	4.2
	2021-2031	4.6
	2011-2031	4.8

* OAG data

4.1.4 Aircraft movements forecast of the top 25 city pairs for the **South Atlantic** route group are illustrated in **Table 5c)**.

TABLE 5c)

Rank	City Pair	Total Aircraft Movements[1/] 2011[2/]	Total Aircraft Movements[1/] 2031	Average Annual Growth (Per cent) 2011-2031
1	Madrid - Buenos Aires	2881	4721	2.5
2	Sao Paulo(Intl) - Paris(CDG)	2556	5086	3.5
3	Sao Paulo(Intl) - Madrid	2315	8157	6.5
4	Rio De Janeiro - Paris(CDG)	2121	11249	8.7
5	Santiago - Madrid	1561	3420	4.0
6	Sao Paulo(Intl) - London(Heathrow)	1460	3521	4.5
7	Sao Paulo(Intl) - Frankfurt	1459	3322	4.2
8	Rio De Janeiro - Lisbon	1172	4288	6.7
9	Rome - Buenos Aires	1148	4698	7.3
10	Sao Paulo(Intl) - Lisbon	1146	2764	4.5
11	Sao Paulo(Intl) - Johannesburg	1054	4477	7.5
12	Sao Paulo(Intl) - Rome	795	4883	9.5
13	Rio De Janeiro - London(Heathrow)	763	2447	6.0
14	Paris(CDG) - Buenos Aires	730	1453	3.5
15	Sao Paulo(Intl) - Amsterdam	730	2130	5.5
16	Sao Paulo(Intl) - Doha	730	2341	6.0
17	Zurich - Sao Paulo(Intl)	730	2130	5.5
18	Sao Paulo(Intl) - Dubai	729	3097	7.5
19	Sao Paulo(Intl) - Milan	728	1449	3.5
20	Rio De Janeiro - Madrid	705	2057	5.5
21	Rio De Janeiro - Frankfurt	695	2028	5.5
22	Santiago - Paris(CDG)	684	2194	6.0
23	Recife - Lisbon Portugal	674	1788	5.0
24	Salvador - Lisbon	673	1786	5.0
25	Lisbon - Fortaleza	672	1783	5.0
	Total above routes	28911	87268.0	5.7
	All other routes	9582	10583	0.5
	TOTAL	38493	97851	4.8

1/ Both directions.
2/ OAG data.

4.2 **Mid-Atlantic**

4.2.1 **Table 6a)** depicts the number of passengers for the Mid Atlantic route for selected periods from 2001 to 2011 and projections for traffic up to 2031. Mid-Atlantic traffic grew from 6.2 million passengers in 2001 to slightly over 9 million passengers in 2011, which is an average annual growth rate of 3.9 per cent.

4.2.2 For the period 2011-2031, passenger traffic is forecast to grow at an average annual growth rate of 5.5 per cent, reaching approximately 26.8 million passengers in the year 2031.

TABLE 6a)

	Year	Passengers (Million)	Load Factor	Average Seats
Historical				
	2001	6.19	79.0	301
	2006	7.72	80.3	296
	2011	9.10	83.2	289
Forecast				
	2012	9.67	83.2	289
	2013	10.28	83.2	289
	2014	10.93	83.2	289
	2015	11.61	83.2	289
	2016	12.29	83.2	289
	2021	15.71	85.0	289
	2031	26.79	85.0	290
Average Annual Growth (Per cent)	2011-2016	6.2	0.0	0.0
	2016-2021	5.0	0.4	0.0
	2021-2031	5.5	0.0	0.0
	2011-2031	5.5	0.1	0.0

4.2.3 The number of aircraft movements for the period 2011-2031 are projected to increase at an average annual growth rate of 5.4 per cent, reaching about 174 000 movements in the year 2031, as illustrated in **Table 6b)**.

TABLE 6b)

	Year	Aircraft Movements
Historic	2011*	60491*
Forecast		
	2012	64286
	2013	68319
	2014	72606
	2015	77161
	2016	81699
	2021	102162
	2031	173802
Average Annual Growth (Per cent)	2011-2016	6.2
	2016-2021	4.6
	2021-2031	5.5
	2011-2031	5.4

* OAG data.

4.2.4 Aircraft movement forecasts of the top 25 city pairs for the **Mid-Atlantic** route group are illustrated in **Table 6c)**.

TABLE 6c)

Rank	City Pair	Total Aircraft Movements[1/] 2011[2/]	Total Aircraft Movements[1/] 2031	Average Annual Growth (Per cent) 2011-2031
1	Pointe A Pitre - Paris(Orly)	2920	5810	3.5
2	Paris(Orly) - Ft. De France	2731	5434	3.5
3	Madrid - Lima	2229	12492	9.0
4	Mexico City - Madrid	2223	6486	5.5
5	Madrid - Caracas	1991	7016	6.5
6	Madrid - Bogota	1915	3138	2.5
7	Paris(CDG) - Mexico City	1894	3104	2.5
8	London(Gatwick) - Barbados	1889	5012	5.0
9	Madrid - Havana	1561	2102	1.5
10	Santo Domingo - Madrid	1385	2269	2.5
11	Curacao - Amsterdam	1202	5602	8.0
12	Punta Cana - Madrid	1124	11853	12.5
13	Madrid - Guayaquil	1092	2050	3.2
14	Paris(Orly) - Cayenne	1044	4435	7.5
15	Paramaribo - Amsterdam	998	5593	9.0
16	St. Lucia - London(Gatwick)	948	9997	12.5
17	Madrid - Cancun	928	3942	7.5
18	London(Gatwick) - Antigua	880	1751	3.5
19	London(Gatwick) - Cancun	812	3785	8.0
20	Paris(CDG) - Havana	768	2558	6.2
21	Lima - Amsterdam	730	2130	5.5
22	San Jose - Madrid	730	2212	5.7
23	Frankfurt - Caracas	728	3092	7.5
24	Mexico City - Amsterdam	728	981	1.5
25	Mexico City - Frankfurt	724	975	1.5
	Total above routes	34174	113820	6.2
	All other routes	26317	59982	4.2
	TOTAL	60491	173802	5.4

1/ Both directions.
2/ OAG data

4.3 **Intra-South America**

4.3.1 **Table 7a)** depicts the total number of international passengers between countries in South America for selected periods between 2001 and 2011 and projections for traffic up to 2031. The passenger traffic within South America increased from some 6 million in 2001 to approximately 20 million passengers in 2011, which reflects an average annual growth rate of 13.6 per cent.

4.3.2 For the period 2011-2031, passenger traffic is forecast to grow at an average annual rate of 8 percent, reaching over 93 million passengers by the year 2031.

TABLE 7a)

	Year	Passengers (Million)	Load Factor	Average Seats
Historical				
	2001	5.59	55.9	160
	2006	10.81	70.9	166
	2011	19.99	76.0	158
Forecast				
	2012	21.93	76.0	158
	2013	24.06	76.0	158
	2014	26.39	76.0	158
	2015	28.74	76.0	158
	2016	31.17	76.0	158
	2021	45.11	78.2	162
	2031	93.31	80.0	170
Average Annual Growth (Per cent)	2011-2016	9.3	0.0	0.0
	2016-2021	7.7	0.6	0.5
	2021-2031	7.5	0.2	0.5
	2011-2031	8.0	0.3	0.4

4.3.3 The aircraft movement forecasts for the same period are projected to increase at an average annual growth rate of 7.4 per cent, reaching around 615 000 in the year 2031, as illustrated in **Table 7b)**.

TABLE 7b)

	Year	Aircraft Movements
Historic	2011*	147989*
Forecast		
	2012	162330
	2013	178060
	2014	195314
	2015	212701
	2016	230740
	2021	317827
	2031	614952
Average Annual Growth (Per cent)	2011-2016	9.3
	2016-2021	6.6
	2021-2031	6.8
	2011-2031	7.4

* OAG data.

4.3.4 Aircraft movement forecasts of the top 25 city pairs for the **Intra-South America** route group are illustrated in **Table 7c)**.

TABLE 7c)

Rank	City Pair	Total Aircraft Movements[1/] 2011[2/]	Total Aircraft Movements[1/] 2031	Average Annual Growth(Per cent) 2011-2031
1	Sao Paulo(Intl) -Buenos Aires(Pistarini)	7929	12993	2.5
2	Montevideo - Buenos Aires(Newbery)	7906	22209	5.3
3	Santiago - Buenos Aires(Pistarini)	7787	12760	2.5
4	Sao Paulo(Intl) - Buenos Aires(Newbery)	7312	23451	6.0
5	Quito -Bogota	6430	21414	6.2
6	Santiago-Lima	6426	27297	7.5
7	Punta Del Este-Buenos Aires(Newbery)	4670	21767	8.0
8	Lima -Buenos Aires(Pistarini)	4646	23751	8.5
9	Sao Paulo(Intl) - Santiago	4556	10988	4.5
10	Santiago-Buenos Aires(Newbery)	4327	15247	6.5
11	Sao Paulo(Intl) - Montevideo	4274	21849	8.5
12	Caracas -Bogota	4115	6743	2.5
13	Lima -Bogota	4112	23045	9.0
14	Santiago-Montevideo	3339	20507	9.5
15	Rio De Janeiro-Buenos Aires(Pistarini)	3318	8804	5.0
16	Sao Paulo(Intl) -Bogota	3041	15546	8.5
17	Quito -Lima	2993	11582	7.0
18	Rio De Janeiro(Intl) -Buenos Aires(Newbery)	2902	10226	6.5
19	Sao Paulo(Intl) -Lima	2857	18199	9.7
20	Santiago-Mendoza	2596	11027	7.5
21	Porto Alegre -Montevideo	2076	8819	7.5
22	Guayaquil -Bogota	1870	9213	8.3
23	Lima -Guayaquil	1823	7054	7.0
24	Lima -Caracas	1731	2836	2.5
25	Montevideo -Buenos Aires(Pistarini)	1642	2440	2.0
	Total above routes	104678	369764	6.5
	All other routes	43311	245188	9.1
	TOTAL	147989	614952	7.4

1/ Both directions.
2/ OAG data.

4.4 **Between South America and Central America/Caribbean**

4.4.1 **Table 8a)** depicts air passenger traffic between South America and Central America/Caribbean for selected periods between 2001 and 2011 and projections for traffic up to 2031. The passenger traffic increased from about 2.6 million in 2001 to almost 5.5 million in 2011, which reflects an average annual growth rate of 7.8 per cent.

4.4.2 For the period 2011 to2031, passenger traffic is forecast to increase at an average annual growth rate of 8.9 per cent, reaching over 30 million passengers in 2031.

TABLE 8a)

	Year	Passengers (Million)	Load Factor	Average Seats
Historical				
	2001	2.58	63.3	163
	2006	4.59	70.0	155
	2011	5.45	71.0	150
Forecast				
	2012	5.90	71.0	149
	2013	6.45	71.0	147
	2014	7.05	71.0	146
	2015	7.71	71.0	144
	2016	8.42	71.0	143
	2021	12.58	74.1	148
	2031	30.17	80.0	160
Average Annual Growth (Per cent)	2011-2016	9.1	0.0	-1.0
	2016-2021	8.4	0.9	0.7
	2021-2031	9.1	0.8	0.8
	2011-2031	8.9	0.6	0.3

4.4.3 The number of aircraft movements for the period same period are projected to increase at an average annual growth rate of 8 per cent, reaching just over 357 000 movements in the year 2031, as illustrated in **Table 8b)**.

TABLE 8b)

	Year	Aircraft Movements
Historic	2011*	76698*
Forecast		
	2012	83810
	2013	92427
	2014	101929
	2015	112408
	2016	123965
	2021	172225
	2031	357432
Average Annual Growth (per cent)	2011-2016	10.1
	2016-2021	6.8
	2021-2031	7.6
	2011-2031	8.0

* OAG data.

4.4.4 Aircraft movement forecasts of the top 25 city pairs for the route group **between South America and Central America/Caribbean** are provided in **Table 8c)**.

TABLE 8c)

Rank	City Pair	Total Aircraft Movements[1/] 2011[2/]	Total Aircraft Movements[1/] 2031	Average Annual Growth (Per cent) 2011-2031
1	Panama City - Bogota	5918	36346	9.5
2	Mexico City - Bogota	3727	25073	10.0
3	Pt. of Spain - Georgetown	3285	8075	4.6
4	Panama City - Medellin	3156	21232	10.0
5	Panama City - Lima	2954	18142	9.5
6	Panama City - Caracas	2916	15753	8.8
7	Panama City - Cali	2198	13499	9.5
8	Las Piedras - Aruba	2190	6152	5.3
9	Sao Paulo(Intl) - Panama City	2188	12262	9.0
10	Mexico City - Lima	2186	13426	9.5
11	Santiago - Panama City	1979	8099	7.3
12	Curacao - Caracas	1826	5328	5.5
13	Panama City - Buenos Aires(Pistarini)	1770	3804	3.9
14	Georgetown - Barbados	1663	2725	2.5
15	Quito - Panama City	1460	3454	4.4
16	Panama City - Guayaquil	1458	2958	3.6
17	Valencia - Curacao	1424	3778	5.0
18	Ft. De France - Cayenne	1398	2291	2.5
19	San Jose - Bogota	1386	5363	7.0
20	San Jose - Lima	1320	3183	4.5
21	Mexico City - Buenos Aires(Pistarini)	1263	4887	7.0
22	Panama City - Barranquilla	1216	5668	8.0
23	Panama City - Cartagena	1188	3466	5.5
24	Santiago - Mexico City	1170	2113	3.0
25	Pt. of Spain - Caracas	1136	2901	4.8
	Total above routes	52375	229982	7.7
	All other routes	24323	127450	8.6
	TOTAL	76698	357432	8.0

1/ Both directions.
2/ OAG data.

4.5 Intra-Central America/Caribbean

4.5.1 **Table 9a)** depicts the number of air passengers within the Central America/Caribbean for selected periods between 2001 and 2011 and projections for traffic up to 2031. The passenger traffic increased from about 3.4 million in 2001 to 4.7 million in 2011, which reflects an average annual growth rate of 3.3 per cent.

4.5.2 For the period 2011-2031, passenger traffic is forecast to grow at an average annual rate of 7.8 per cent, reaching 21 million by 2031.

TABLE 9a)

	Year	Passengers (Million)	Load Factor	Average Seats
Historical				
	2001	3.37	60.4	91
	2006	3.51	63.4	95
	2011	4.65	71.9	101
Forecast				
	2012	5.10	71.9	101
	2013	5.59	71.9	101
	2014	6.13	71.9	101
	2015	6.67	71.9	101
	2016	7.17	71.9	102
	2021	10.24	74.3	103
	2031	21.00	79.0	105
Average Annual Growth (Per cent)	2011-2016	9.0	0.0	0.2
	2016-2021	7.4	0.7	0.3
	2021-2031	7.4	0.6	0.2
	2011-2031	7.8	0.5	0.2

4.5.3 The aircraft movements for the period 2011-2031 are projected to increase at an average annual growth rate of 7.2 per cent, bringing total movements to 1.1 million by 2031, as illustrated in **Table 9b)**.

Table 9b)

	Year	Aircraft Movements
Historic	2011	266438*
Forecast		
	2012	292257
	2013	320577
	2014	351642
	2015	382159
	2016	410716
	2021	561586
	2031	1072075
Average Annual Growth (Per cent)	2011-2016	8.8
	2016-2021	6.5
	2021-2031	6.7
	2011-2031	7.2

* OAG data.

4.5.4 Aircraft movement forecasts of the top 25 city-pairs for the **Intra Central America/Caribbean** route group are illustrated in **Table 9c)**.

TABLE 9c)

Rank	City Pair	Total Aircraft Movements[1/] 2011[2/]	Total Aircraft Movements[1/] 2031	Average Annual Growth (Per cent) 2011-2031
1	St. Maarten - St. Barthelemy	23097	81386	6.5
2	St. Thomas - San Juan	12261	30723	4.7
3	Pointe A Pitre - Ft. De France	11564	30683	5.0
4	Tortola - San Juan	11024	26587	4.5
5	Curacao - Aruba	10231	57339	9.0
6	St. Croix - San Juan	7935	19137	4.5
7	Curacao - Bonaire	7447	34710	8.0
8	San Jose - Panama City	5716	19398	6.3
9	Santo Domingo - San Juan	4846	10618	4.0
10	Santo Domingo - Panama City	3693	27204	10.5
11	Montserrat - Antigua	3664	7291	3.5
12	San Jose - Guatemala City	3582	21999	9.5
13	Pt. of Spain - Barbados	3548	6408	3.0
14	Panama City - Havana	3516	21594	9.5
15	Pt. of Spain - Grenada	3493	6309	3.0
16	St. Maarten - St. Eustatius	3400	6765	3.5
17	Virgin Gorda - San Juan	3285	11575	6.5
18	St. Lucia - Barbados	3240	5309	2.5
19	Panama City - Guatemala City	2939	19065	9.8
20	St. Maarten - Saba Bonaire	2865	5175	3.0
21	Tortola - St. Maarten	2849	4668	2.5
22	Mexico City - Guatemala City	2713	4900	3.0
23	St. Vincent - Barbados	2685	4849	3.0
24	San Salvador - Guatemala City	2679	7817	5.5
25	Grenada - Barbados	2560	4624	3.0
	Total above routes	144832	476132	6.1
	All other routes	121606	595944	8.3
	TOTAL	266438	1072075	7.2

1/ Both directions.
2/ OAG data.

4.6 **Between North America and South America and Central America/Caribbean**

4.6.1 **Table 10a)** shows the number of air passengers between North America and CARSAM for periods between 2001 and 2011 and projections for traffic up to 2031. Passenger traffic increased from 43.3 million in 2001 to over 65 million passengers in 2011, which reflects an average annual growth rate of 4.2 per cent.

4.6.2 For the period 2011-2031, passenger traffic is expected to increase at an average annual growth rate of 5.1 per cent, bringing total traffic to slightly over 175 million passengers by 2031.

TABLE 10a)

	Year	Passengers (Million)	Load Factor	Average Seats
Historical				
	2001	43.33	67.0	175
	2006	53.88	74.4	164
	2011	65.38	80.0	163
Forecast				
	2012	69.48	80.0	162
	2013	73.96	80.0	161
	2014	78.96	80.0	161
	2015	83.76	80.0	160
	2016	88.03	80.0	159
	2021	108.93	81.8	162
	2031	175.26	85.0	170
Average Annual Growth (Per cent)				
	2011-2016	6.1	0.0	-0.5
	2016-2021	4.4	0.4	0.4
	2021-2031	4.9	0.4	0.5
	2011-2031	5.1	0.3	0.2

4.6.3 The corresponding number of trips for the same period are projected to be around 1.5 million, which represents a growth rate of 4.5 percent per year as illustrated in **Table 10b)**.

TABLE 10b)

	Year	Aircraft Movements
Historic	2011*	595734*
Forecast		
	2012	636071
	2013	680281
	2014	729623
	2015	777670
	2016	821199
	2021	975687
	2031	1446777
Average Annual Growth (Per cent)		
	2011-2016	6.6
	2016-2021	3.5
	2021-2031	4.0
	2011-2031	4.5

* OAG data

4.6.4 Aircraft movement forecasts of the top 25 city pairs for the route group **Between North America and CARSAM** are illustrated in **Table 10c)**.

TABLE 10c)

Rank	City Pair	Total Aircraft Movements[1/] 2011[2/]	Total Aircraft Movements[1/] 2031	Average Annual Growth (Per cent) 2011-2031
1	Mexico City - Houston	8070	19463	4.5
2	San Juan - New York(JFK)	7755	15431	3.5
3	Nassau - Miami	7589	13707	3.0
4	Mexico City - Los Angeles	6886	11732	2.7
5	San Juan - Orlando	6829	19925	5.5
6	Monterrey - Houston	6148	12233	3.5
7	Miami - Mexico City	6064	10952	3.0
8	Los Angeles - Guadalajara	5935	9725	2.5
9	San Juan - Miami	5539	9076	2.5
10	Nassau - Ft. Lauderdale	5264	7822	2.0
11	Santiago - New York(JFK)	5264	17204	6.1
12	Santo Domingo - New York(JFK)	5083	49032	12.0
13	Miami - Caracas	5080	10108	3.5
14	San Juan - Atlanta	5040	17759	6.5
15	San Juan - Ft. Lauderdale	4737	16692	6.5
16	Panama City - Miami	4663	11246	4.5
17	Cancun - Atlanta	4580	20192	7.7
18	Miami - Cancun	4238	6944	2.5
19	Houston - Cancun	4159	9113	4.0
20	Ft. Lauderdale - Freeport	4100	6718	2.5
21	Houston - Guadalajara	4036	11776	5.5
22	Mexico City - Chicago	3826	6269	2.5
23	Sao Paulo - Miami	3777	6822	3.0
24	Pt. Au Prince - Miami	3712	8952	4.5
25	Mexico City - Dallas/Ft. Worth	3706	6073	2.5
	Total above routes	132080	334967	4.8
	All other routes	463654	1111810	4.5
	TOTAL	595734	1446777	4.5

1/ Both directions.
2/ OAG data.

4.7 Summary of Major Route Group Forecasts

4.7.1 Passenger Forecasts

4.7.1.1 **Table 11** is a summary of the passenger traffic forecasts for the six route groups to, from and within the CAR/SAM Region for the period 2011 to 2016 and target years 2021 and 2031.

TABLE 11

PASSENGER TRAFFIC FORECASTS, IN MILLIONS, 2011-2031

								Average Annual Growth (%)			
Majour Route Groups	2011	2012	2013	2014	2016	2021	2031	2011-2016	2016-2021	2021-2031	2011-2031
South Atlantic	8.89	9.39	9.92	10.49	11.76	14.83	23.35	5.7	4.7	4.6	4.9
Mid Atlantic	9.10	9.67	10.28	10.93	12.29	15.71	26.79	6.2	5.0	5.5	5.5
Intra-South America	19.99	21.93	24.06	26.39	31.17	45.11	93.31	9.3	7.7	7.5	8.0
Between South America and Central America/ Caribbean	5.45	5.90	6.45	7.05	8.42	12.58	30.17	9.1	8.4	9.1	8.9
Intra-Central America/Caribbean	4.65	5.10	5.59	6.13	7.17	10.24	21.00	9.0	7.4	7.4	7.8
Between North America and South America /Central America/Caribbean	65.38	69.48	73.96	78.96	88.03	108.93	175.26	6.1	4.4	4.9	5.1
TOTAL	113.47	121.48	130.27	139.94	158.85	207.39	369.88	7.0	5.5	6.0	6.1

4.7.1.2 The economy has recovered from the declines registered in 2009, nevertheless, the growth is projected to be somewhat slower, therefore the air passenger traffic forecasts, on the routes associated with North America and Europe are somewhat lower. The rest of the route groups in the Region are projected to grow faster due mainly to better economic performance expected in the future.

4.7.1.3 Overall passenger traffic to, from and within the region is projected to grow at an average annual rate of 6.1 per cent. It is anticipated that the average annual growth rates for the route groups will fall between 4.9 percent (South Atlantic) and 8.9 per cent (Between South America and Central America / Caribbean).

4.7.2 **Aircraft movements forecast**

4.7.2.1 **Table 12** depicts the aircraft movements for the major route groups to, from and within the CAR/SAM Region for the period 2010 to 2014, and the target years 2019 and 2030.

TABLE 12

AIRCRAFT MOVEMENTS FORECAST,IN THOUSANDS, 2011-2031

Majour Route Groups	2011	2012	2013	2014	2016	2021	2031	Average Annual Growth (%)			
								2011-2016	2016-2021	2021-2031	2011-2031
South Atlantic	38.49	40.62	42.94	45.39	50.90	62.57	97.85	5.7	4.2	4.6	4.8
Mid Atlantic	60.49	64.29	68.32	72.61	81.70	102.16	173.80	6.2	4.6	5.5	5.4
Intra-South America	147.99	162.33	178.06	195.31	230.74	317.83	614.95	9.3	6.6	6.8	7.4
Between South America and Central America/ Caribbean	76.70	83.81	92.43	101.93	123.96	172.22	357.43	10.1	6.8	7.6	8.0
Intra-Central America/Caribbean	266.44	292.26	320.58	351.64	410.72	561.59	1072.08	9.0	6.5	6.7	7.2
Between North America and South America/Central America/Caribbean	595.73	636.07	680.28	729.62	821.20	975.69	1446.78	6.6	3.5	4.0	4.5
TOTAL	1185.84	1279.38	1382.60	1496.50	1719.22	2192.06	3762.89	7.7	5.0	5.6	5.9

* OAG data

4.7.2.2 The overall number of movements is forecast to increase from about 1.2 million in 2011 to slightly over 3.7 million in 2031, which reflects an average annual growth rate of 5.9 per cent. The average growth rates for the route groups will range from 4.5 per cent (between North America and CARSAM route) to 8 per cent (Between South America and Central America/Caribbean).

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APPENDIX A

PEAK-PERIOD ANALYSIS FOR CENTRAL AMERICAN FIR

The Group also carried out a detailed analysis of the FIR traffic data for the year 2011, provided by COCESNA. In order to define the peak-period parameters, due to a considerably large dataset pertaining to the FIR, certain amount of queries were performed using Microsoft Access to in order to generate the various output results highlighting different peaks. The results of the analyses are presented below in this appendix in the forms of graphs and tables.

The FIR traffic data provided by COCESNA includes the following fields :

Name	Type	Size (field)
Date_Flight	Date/Time	8
Time_entry	Date/Time	8
Flight_Number	Text	10
Registration	Text	15
Type	Text	10
Distance	Integer long	4
Time_Exit	Date/Time	8
Point_entry	Text	5
Point_exit	Text	5
Origin	Text	5
Destination	Text	5
Flight_level	Integer long	4

The following output results were extracted, categorized by COCESNA control centre:

1. Monthly traffic

2. Daily traffic analysis
    - 2.1. Daily profile of traffic
    - 2.2. Maximum, minimum and average daily traffic
    - 2.3. Daily traffic ranking
    - 2.4. Daily traffic probability distribution

3. Hourly traffic analysis
    - 3.1. Hourly Traffic (whole year)
    - 3.2. Traffic profile by specified hour
    - 3.3. Maximum, minimum and average hourly traffic
    - 3.4. Traffic peaking by specified hour

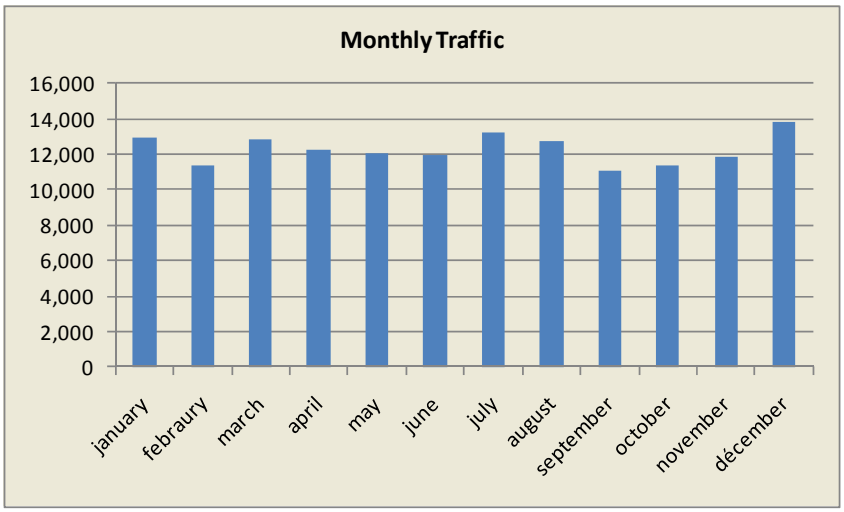
4. Annual traffic analysis
    - 4.1. Aircraft movements by aircraft type
    - 4.2. Aircraft movements by flight level
    - 4.3. Aircraft movements by entry point
    - 4.4. Aircraft movements by exit point
    - 4.5. Aircraft movements by pair of entry point - exit point
    - 4.6. Aircraft movements by origin and destination
    - 4.7 Detailed analysis of aircraft movement traffic (through data field combinations)

5. Traffic density analysis
    - 5.1. Time interval density
    - 5.2. Point in time density

1. Monthly traffic

The following table illustrates the monthly traffic for the Central American FIR for the year 2011:

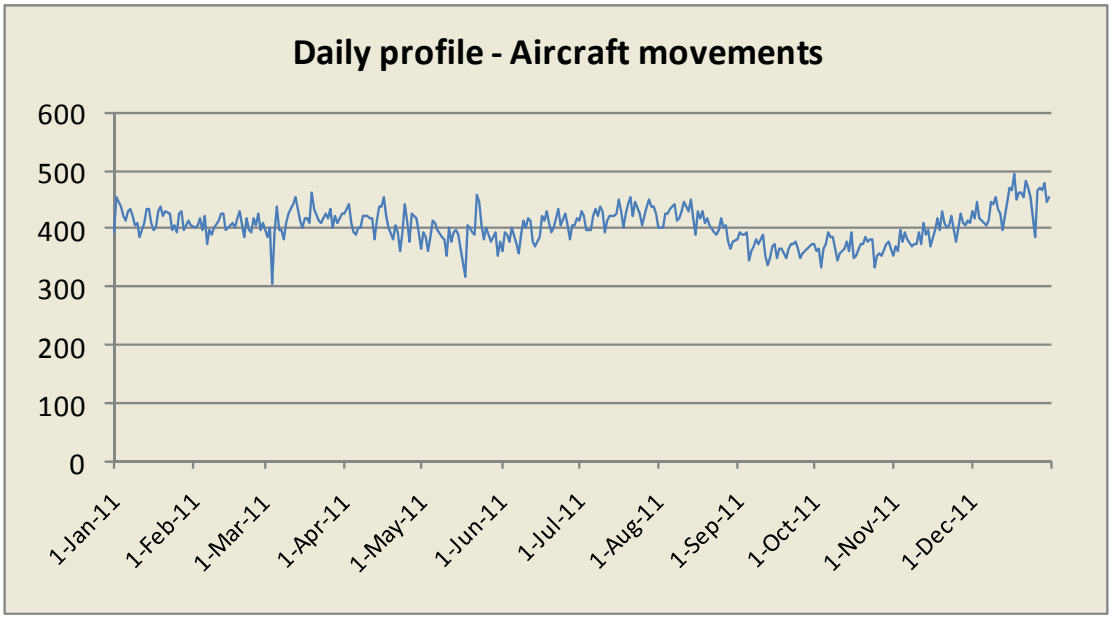
Central American FIR 2011	
Month	**Movements**
January	12,904
February	11,387
March	12,822
April	12,264
May	12,073
June	11,990
July	13,187
August	12,771
September	11,031
October	11,370
November	11,850
December	13,786



2. Daily traffic analysis

2.1. Daily profile of traffic

An illustration of the daily profile of traffic by control centre for a one-year period is shown in order to help identify any seasonality pattern in the annual traffic. The figure below shows the daily profile for Central American FIR:



2.2. Maximum, minimum and average daily traffic

In addition to the daily frequencies, the maximum, the minimum and the average daily traffic as well as the standard deviation were produced for the CENAMER FIR and is shown below:

Maximum daily traffic:	496
Minimum daily traffic:	305
Average daily traffic:	404
Standard Deviation:	30

2.3. Daily traffic ranking

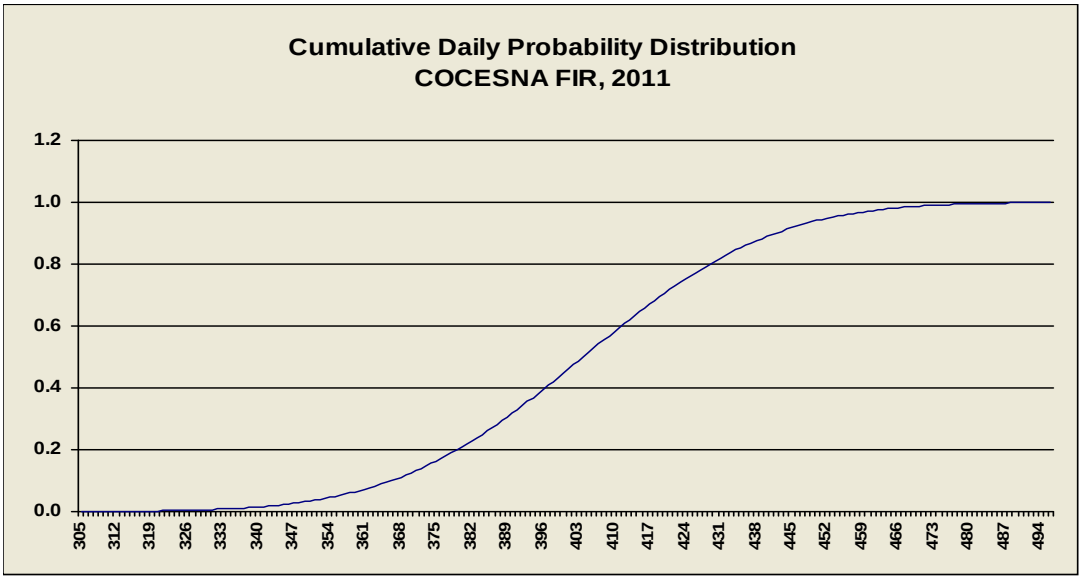
The daily traffic sorted by number of flights is shown in the table below. Among the other outputs, the daily traffic can be ranked by number of flights. This helps identify the busiest day and the least busy day for the whole year period (365 days). For illustration purposes, the busiest 20 days of Central American FIR are displayed in the table below:

Central American FIR		
2011		
Rank	**Date**	**Movements**
1	26-Feb-10	258
2	24-Dec-10	258
3	23-Dec-10	241
4	17-Dec-10	239
5	21-Dec-10	237
6	19-Feb-10	236
7	20-Nov-10	235
8	5-Mar-10	235
9	12-Dec-10	235
10	12-Mar-10	235
11	5-Nov-10	235
12	12-Nov-10	234
13	16-Dec-10	234
14	19-Dec-10	233
15	18-Dec-10	232
16	12-Feb-10	231
17	23-Apr-10	231
18	28-Nov-10	230
19	3-Dec-10	230
20	19-Mar-10	228

Note: The output result includes all 365 days.

2.4. Daily traffic probability distribution

The data was also used to build a normal probability distribution for the daily traffic. Such a distribution may be very useful for planning purposes, since it provides for any given daily traffic level, the probability that the actual traffic will exceed a given level. With respect to COCESNA FIR, 2011 data shows that if the capacity is set to 430 flights per day, there would be under-capacity 20 per cent of the time.



Similarly, if one decides to accept a probability of under-capacity of 10 per cent, then the planning parameter should be around 440 flights per day.

The following table illustrates as a sample, further the probability distribution and provides additional guidance in the capacity determination process:

Central American FIR	
2011	
Maximum Traffic per day	**Probability**
305	0.04
306	0.05
307	0.05
308	0.06
309	0.07
310	0.07
311	0.08
312	0.09
313	0.10
314	0.12
315	0.13
316	0.15
317	0.16
318	0.18
319	0.20
320	0.22
321	0.25
322	0.28
323	0.31
496	1.00

3. Hourly traffic analysis

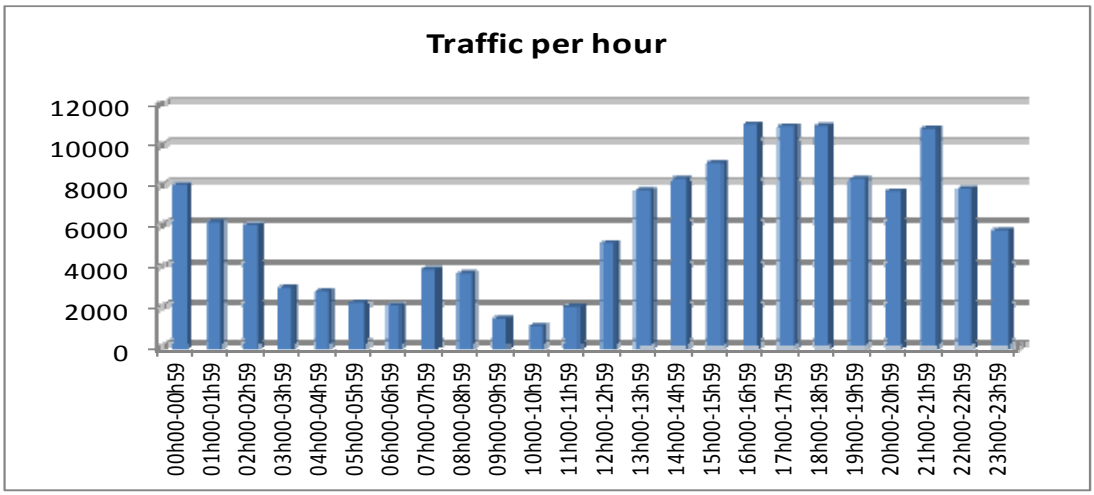
3.1. Hourly Traffic (whole year)

Traffic per hour over the whole year is calculated and sorted by amount of traffic which occurs on hourly basis. This helps to determine the hourly peaks and also is useful for planning the flight schedules. (the maximum size of the sorted list is 24*365= 8760 rows). The following table shows the top 20 hours in terms of traffic for the whole year:

Central American FIR			
2011			
Rank	Date	Hour	Movements
1	30-Dec-11	17	49
2	23-Dec-11	21	48
3	19-Dec-11	21	48
4	17-Dec-11	17	48
5	11-Mar-11	17	46
6	6-Jul-11	18	45
7	27-Nov-11	17	45
8	29-Dec-11	17	44
9	28-Dec-11	21	44
10	26-Nov-11	17	44
11	26-Dec-11	21	43
12	28-Dec-11	17	43
13	7-Aug-11	18	43
14	5-Feb-11	21	43
15	8-Dec-11	17	42
16	18-Dec-11	17	42
17	2-Jan-11	17	42
18	17-Mar-11	16	42
19	20-Dec-11	17	42
20	31-Dec-11	21	42

3.2. Traffic profile by specified hour

The hourly traffic profiles focuses on the period of time when the traffic flow is maximum on yearly basis. The graph below shows the number of flights by hour for 2011. It should be noted that most of the traffic occurs between 1600 and 1900 hours and between 2100 and 2200 hours. In terms of flight handling, more than 10,000 flights were managed for every hour specified in the hourly profile. The hour where there were most flights was between 1600 and 1700h with 10 953 flights: Hourly profiles are very useful for the staffing and management of the controlled airspace.



The same chart can be plotted for any hour of the day and by aircraft type.

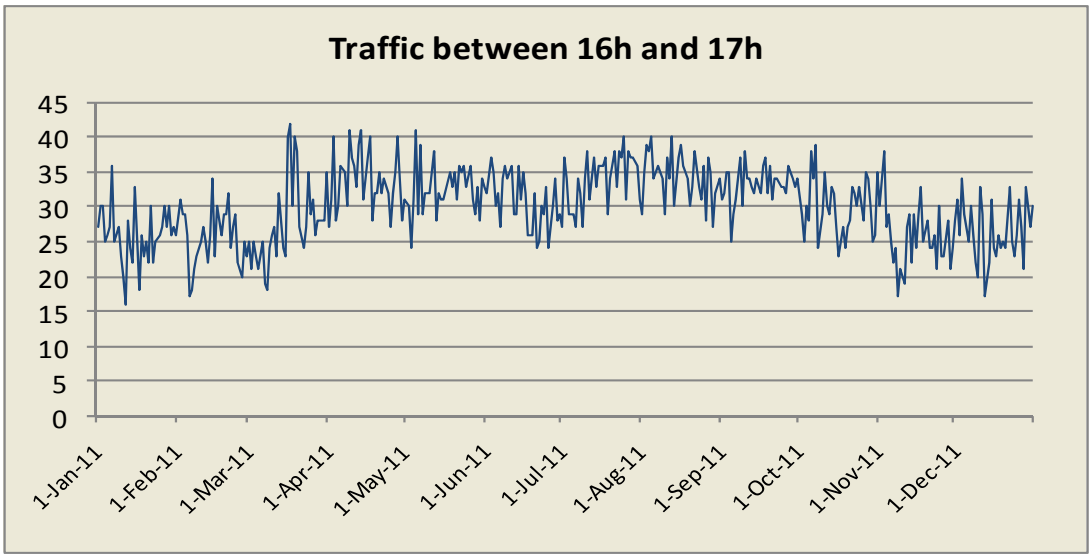
3.3. Maximum, minimum and average for a specified hour

Beyond, the graphical display, the minimum , maximum and the average traffic between 16h00 and17h00 for the Central American FIR, as well as the standard deviation, are shown below:

Maximum daily traffic:	42
Minimum daily traffic:	16
Average daily traffic:	30
Standard Deviation:	5

3.4. Traffic peaking by specified hour

The graph below indicates that the traffic pattern between 1600 and 1700 hours on yearly basis. It shows that the traffic is more dense between these hours. The following table below the graph provides more insight into traffic peaking during this slot throughout the year at 16h00 (by providing the list of the top 20 traffic days at 16h00):



Ranking of daily movements between 1600 and 1700h

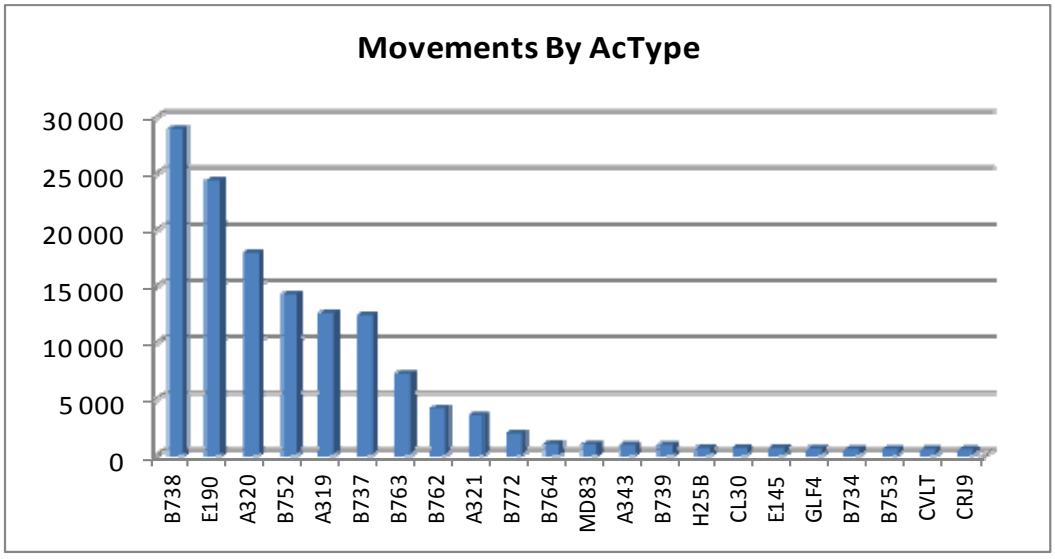
Central American FIR		
16h00 traffic 2011		
Rank	Date	Movements
1	17-Mar-11	42
2	5-May-11	41
3	9-Apr-11	41
4	14-Apr-11	41
5	25-Jul-11	40
6	16-Mar-11	40
7	19-Mar-11	40
8	5-Aug-11	40
9	13-Aug-11	40
10	3-Apr-11	40
11	28-Apr-11	40
12	17-Apr-11	40
13	3-Aug-11	39
14	7-May-11	39
15	8-Oct-11	39
16	16-Aug-11	39
17	13-Apr-11	39
18	20-Mar-11	38
19	11-Jul-11	38
20	21-Jul-11	38

Note: The full list has all 365 days.

4. Annual traffic analysis

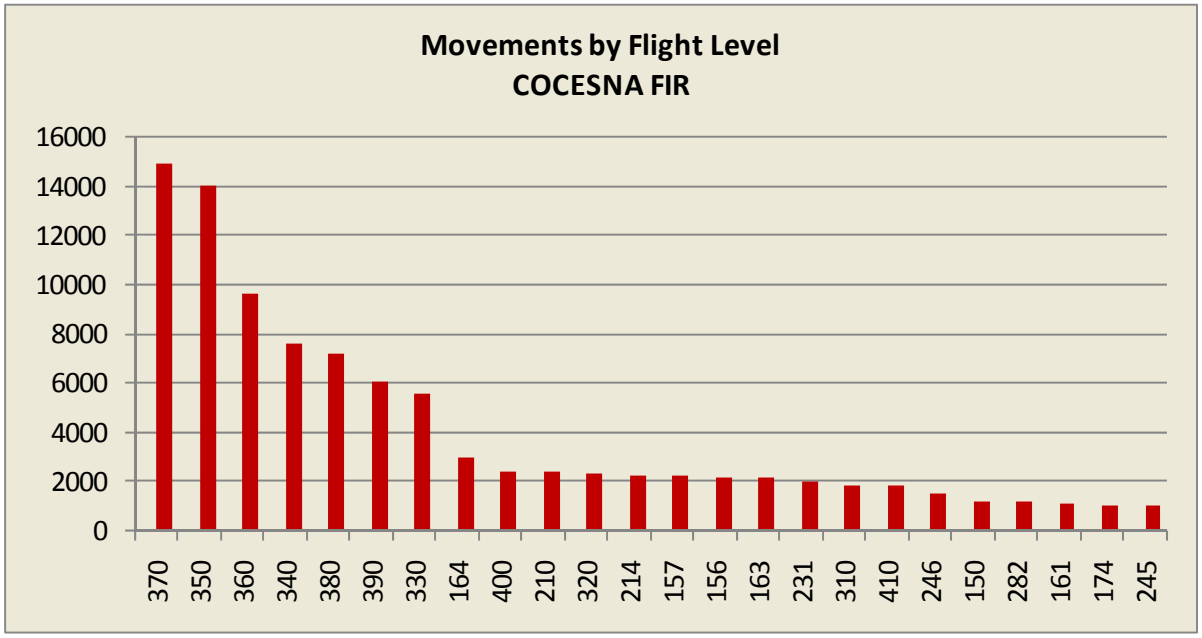
4.1. Aircraft movements by aircraft type

Using the COCESNA FIR traffic data, the following chart illustrates the aircraft movements traffic by aircraft type for the year 2011.The aircraft using the airspace with the highest number of flights was B737-800 with 28.895flights, followed by E190 with 24.345, and thereafter, B-757and A319 in between 12000 to 15.000 flights.



4.2. Aircraft movements by flight level

Using the same set of data, aircraft movements by flight level are illustrated in the figure below:



4.3. Aircraft movements by entry point

FIR traffic can be aggregated by entry point and sorted by traffic volume (aircraft movements). The table below shows the top 20 entry points for Central American FIR in 2011.

Central American FIR		
2011		
Rank	Entry Point	Movements
1	SELEK	8,038
2	ISEBA	6,696
3	PENSO	6,670
4	RADON	5,826
5	CACHI	4,770
6	PABEL	4,602
7	BUFEO	4,323
8	SIGMA	4,070
9	ERBOR	3,858
10	PINOS	3,582
11	RAB	3,529
12	CTM	3,429
13	CANAS	3,279
14	TAP	3,190
15	ARENA	3,145
16	GABOS	3,014
17	NALDA	2,235
18	AVRIS	2,215
19	NAGEL	2,186
20	ASOKU	2,164

4.4. Aircraft movements by exit point

FIR traffic can also be aggregated by exit point and sorted by traffic volume (aircraft movements). The table below shows the top 20 exit points for the Central American FIR in 2011.

Central American FIR		
2011		
Rank	Exit Point	Movements
1	PENSO	6,790
2	ISEBA	6,511
3	TAP	6,140
4	SELEK	6,059
5	OTAMI	4,535
6	URNOS	4,327
7	SIGMA	4,276
8	BUFEO	4,228
9	TABOG	4,056
10	CACHI	3,781
11	PABEL	3,466
12	ANAPO	3,121
13	ASOKU	3,066
14	FIORA	3,027
15	PIRAS	2,878
16	CTM	2,858
17	AMIDA	2,454
18	KALPA	2,289
19	PESTO	2,274
20	MOGSA	604

4.5. Aircraft movements by pair of entry point - exit point

The COCESNA FIR traffic has been aggregated by pair of entry and exit points and sorted by traffic volume (aircraft movements). It determines the spent by a flight in the controlled air space and is useful in terms of route planning and congestion management.Traffic carried on the 20 routes below represents more than quarter of the total traffic (29 per cent). In these routes, it is noted that the flights spent more than an hour on the average between the following entry and exit points:

- RADON and SELEK
- SELEK and PIRAS, FIORA, RAKEL
- ISEBA and TAP
- PABEL and URNOS
- PINOS and BUFEO

The table below shows the top 20 pair of entry and exit points, for the Central American FIR in 2011.

Central American FIR			
2011			
Rank	Entry-Exit	Movements	Flight time in airspace
1	CACHI-ISEBA	4,565	0:08:03
2	ISEBA-CACHI	3,575	0:08:49
3	RADON-SELEK	3,084	1:14:27
4	SELEK-PIRAS	2,293	1:13:37
5	RADON-PESTO	2,067	0:55:58
6	SELEK-FIORA	2,067	1:19:07
7	CTM-TILOT	1,959	0:28:45
8	SELEK-RAKEL	1,898	1:01:43
9	ABFAL-SIGMA	1,819	0:54:57
10	ISEBA-TAP	1,787	1:23:43
11	RAKEL-SELEK	1,746	1:00:26
12	NALDA-COBAN	1,742	0:17:10
13	PABEL-URNOS	1,725	1:00:58
14	ERBOR-KALPA	1,668	0:08:20
15	RAB-CTM	1,649	0:32:44
16	RAB-NALDA	1,589	0:22:12
17	CANAS-OTAMI	1,491	0:52:14
18	SIGMA-ABFAL	1,479	0:54:42
19	RELTA-AVRIS	1,453	0:28:41
20	PINOS-BUFEO	1,448	1:11:47

4.6. Aircraft movements by origin and destination

The FIR traffic can also be aggregated by pair of origin and destination airports and sorted by traffic volume (aircraft movements). The table below shows the top 10 pairs of origin-destinations, for the Central American FIR in 2011.

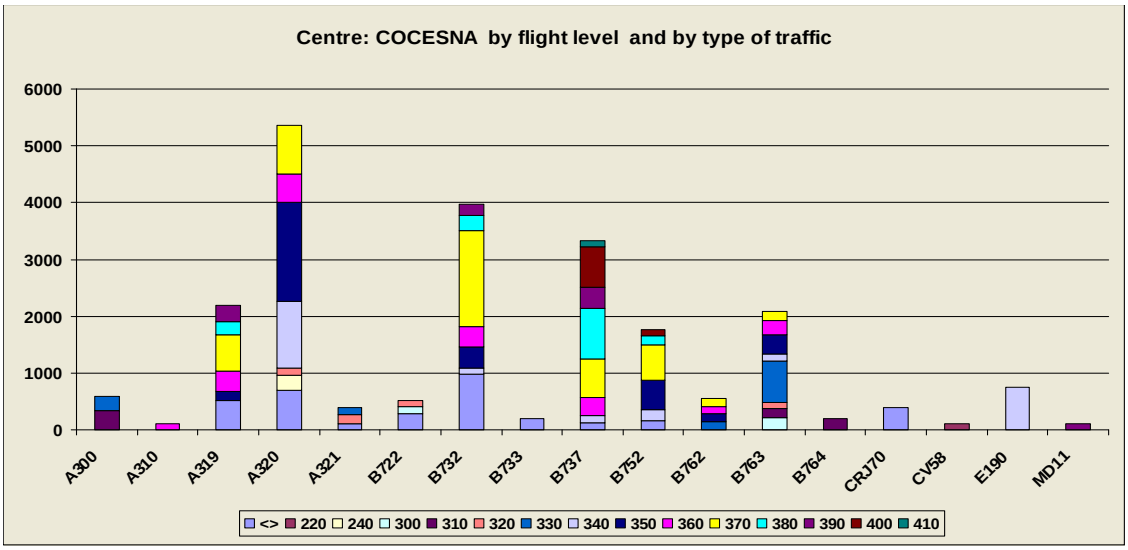
Central American FIR		
2011		
Rank	Origin-Destination	Movements
1	MROC-MPTO	3235
2	MPTO-MROC	3192
3	MROC-KMIA	2736
4	KMIA-MROC	2464
5	KMIA-MGGT	2266
6	MGGT-KMIA	2102
7	SKBO-MMMX	2084
8	MMMXSKBO	1928
9	MHLM-KMIA	1887
10	MPTO-MGGT	1824

4.7. Detailed analysis of aircraft movement traffic (through data field combinations)

An extended analysis of FIR data was performed in order to produce tables and charts combining relevant data fields such as aircraft type, flight level, pair of entry and exit points, pair of origin and destination and type of traffic (inbound, outbound, over flights, within the FIR).

This type of analyses is helpful in determining the number of aircraft movements by aircraft type and by flight level to give an indication about the proportion of aircraft not flying at their optimum flight levels. It also provides knowledge of the different aircraft types using different flight levels in a given FIR for better control and management of flight levels.

The figure below illustrates the traffic by aircraft type and by flight level for the COCESNA FIR



All combinations of the data fields above can be used to produce similar charts and/or tables.

5. Traffic density analysis

It is possible to perform a traffic density analysis either for a time interval or for a specific point in time.

5.1. Time interval density

The following table lists all the flights for the annual peak hour which occurs on the 30st of January 2011 between 16h00 and 17h00 .
This list includes all flights that have either entered or exited the Central American FIR during that hour or remained in the FIR for the whole hour. For this reason, the number of flights (76) is higher than the peak-hour traffic (49), which includes only the flights that have entered the FIR during the same hour.

Date	Type of Aircraft	Entry Point	Time of Entry	Exit Point	Time of Exit	Origin	Destination
30/12/11	E190	IMOLA	16:11	TABOG	16:19	MNMG	MROC
30/12/11	A319	ALERA	16:04	TAP	16:29	MSLP	MMMX
30/12/11	E190	ARENA	16:10	BERTA	16:38	MROC	MHTG
30/12/11	GLF5	DANUL	16:19	MAMBI	16:44	KDAL	MWCR
30/12/11	B738	RELTA	16:02	AVRIS	16:31	MSLP	KDFW
30/12/11	B762	SATOS	16:08	URNOS	16:40	KMIA	MSLP
30/12/11	B738	SATOS	16:45	BZE	16:51	KMIA	MZBZ
30/12/11	CRJ2	ROA	16:02	ULISA	16:43	MHLC	MWCR
30/12/11	E190	CACHI	16:32	ISEBA	16:40	MROC	MPTO
30/12/11	E190	TALAG	16:07	PABEL	17:13	MHTG	KMIA
30/12/11	B733	ROA	16:28	ULISA	17:09	MHLC	MWCR
30/12/11	A319	PARRI	16:35	PAPIN	17:02	MROC	SEQU
30/12/11	A319	RAB	16:29	CTM	17:01	MGGT	KMIA
30/12/11	E190	CACHI	17:00	ISEBA	17:08	MROC	SVMI
30/12/11	B738	PISIS	16:28	ROA	17:09	CYUL	MHLC
30/12/11	A319	CACHI	16:51	ISEBA	16:59	MROC	SKBO
30/12/11	B752	GABOS	17:15	TABOG	17:47	MSLP	MROC
30/12/11	B738	NALDA	16:58	COBAN	17:14	KIAH	MGGT
30/12/11	E190	ISEBA	17:10	CACHI	17:18	MPTO	MROC
30/12/11	B737	PENSO	17:17	BZE	17:24	KIAH	MZBZ
30/12/11	GLF4	MAMBI	17:05	DANUL	17:30	MWCR	KADS
30/12/11	B752	PATIK	17:15	TAP	17:26	MGGT	MMMX
30/12/11	B738	SELEK	16:58	RAKEL	17:58	KMIA	MNMG
30/12/11	B737	TELAX	16:02	PILKO	17:11	SVMI	MMMX
30/12/11	B738	CTM	17:05	TILOT	17:32	KMIA	MGGT
30/12/11	E190	ANSON	16:50	LIBIS	17:36	MPTO	MHTG
30/12/11	A319	RUBRA	16:55	PABEL	17:43	MHLM	KMIA
30/12/11	CVLT	CTM	17:17	NANDO	17:42	KMIA	MGGT
30/12/11	B738	PENSO	17:23	BERTA	18:09	KIAH	MNMG
30/12/11	A320	PARRI	16:39	LIXAS	17:43	MROC	SPIM
30/12/11	B737	ISEBA	16:07	TAP	17:29	SKBO	MMMX
30/12/11	A320	ISEBA	16:13	TAP	17:35	SKBO	MMMX
30/12/11	B752	MAMBI	17:16	DANUL	17:40	MKJS	CYYC
30/12/11	B738	AMIDA	17:28	KORTI	17:48	KATL	MHLM
30/12/11	LJ55	SATOS	17:16	AUR	17:55	KFXE	MGGT
30/12/11	E190	BUFEO	17:46	EMARI	18:11	MPTO	MNMG
30/12/11	A320	CANAS	16:55	OTAMI	17:46	MROC	MGGT
30/12/11	B752	MAMBI	17:21	DANUL	17:45	SBBV	MMUN
30/12/11	B737	PENSO	17:15	TALAG	17:50	KIAH	MHTG
30/12/11	B738	SELEK	16:34	IMOLA	17:51	KMIA	MRLB
30/12/11	B738	SELEK	17:20	RAKEL	18:21	KATL	MNMG
30/12/11	B738	RADON	16:51	SELEK	18:10	MROC	KJFK
30/12/11	C750	DANUL	17:37	MAMBI	18:01	KSAT	MWCR
30/12/11	E190	CACHI	17:47	ISEBA	17:55	MROC	MPTO
30/12/11	E190	BUFEO	17:04	ANAPO	17:55	MPTO	MSLP
30/12/11	B738	SIGMA	17:08	ABFAL	18:03	KIAH	MPTO

	Type of Aircraft	Entry Point	Time of Entry	Exit Point	Time of Exit	Origin	Destination
30/12/11	B739	PENSO	17:00	IMOLA	18:02	KIAH	MRLB
30/12/11	B738	ABFAL	17:15	SIGMA	18:10	MPTO	MMUN
30/12/11	GLF4	MAMBI	17:40	DANUL	18:05	TNCM	MMSD
30/12/11	E190	EMARI	17:44	BUFEO	18:12	MNMG	MPTO
30/12/11	B733	TAP	17:54	DUNEL	18:14	KHOU	MSLP
30/12/11	A320	SATOS	17:42	URNOS	18:14	MMUN	MSLP
30/12/11	B738	SIGMA	17:23	FALLA	18:21	MMUN	MPTO
30/12/11	B752	ARENA	17:34	ROMBO	18:14	MROC	MHLM
30/12/11	B738	AVRIS	17:45	URNOS	18:11	KIAH	MSLP
30/12/11	A320	RADON	17:07	SELEK	18:23	MROC	MUHA
30/12/11	B738	PENSO	17:58	OMOSO	18:17	KIAH	MHLM
30/12/11	A320	SELEK	16:58	PIRAS	18:11	KMCO	MROC
30/12/11	E190	PINOS	17:13	BUFEO	18:25	MGGT	MPTO
30/12/11	LJ35	ROA	17:36	PISIS	18:22	MHRO	KFXE
30/12/11	A320	SELEK	17:03	FIORA	18:22	KFLL	MROC
30/12/11	B752	ARENA	17:10	PENSO	18:24	MROC	KDFW
30/12/11	E190	BUFEO	17:20	OTAMI	18:30	MPTO	MGGT
30/12/11	B738	PENSO	17:17	ULAPO	18:22	KIAH	MROC
30/12/11	B737	SELEK	17:14	IMOLA	18:33	KEWR	MRLB
30/12/11	B752	SELEK	17:16	IMOLA	18:34	KATL	MRLB
30/12/11	B738	ISEBA	17:13	TAP	18:38	MPTO	MMMX
30/12/11	A321	PABEL	17:40	URNOS	18:40	KJFK	MSLP
30/12/11	B752	PESTO	17:39	PIRAS	18:36	KATL	MROC
30/12/11	C750	IMOLA	17:43	PENSO	18:46	MRLB	KHOU
30/12/11	H25B	PILKO	17:28	FALLA	18:48	MMPB	SKCG
30/12/11	A320	PABEL	17:56	URNOS	18:57	KIAD	MSLP
30/12/11	B752	SELEK	17:47	PIRAS	18:58	KMIA	MROC
30/12/11	A321	CANAS	17:57	ANAPO	18:28	MROC	MSLP
30/12/11	A320	LIXAS	17:40	ANAPO	19:16	SEGU	MSLP
30/12/11	A332	EGODI	17:53	ASOKU	19:16	SBGR	MMMX

5.2. Point in time density

It is also possible to determine the FIR traffic at a any point in time. For example, the following table lists the flights present in the Central American FIR on 17 March 2011 at 16:00.

Date	Type of Aircraft	Entry Point	Time of Entry	Exit Point	Time of Exit	Origin	Destination
17/03/11	B752	GABOS	16:08	URPOS	16:19	MSLP	MNMG
17/03/11	B737	OTAMI	16:22	OTAMI	16:22	MPTO	MGGT
17/03/11	LJ35	MAMBI	16:02	DANUL	16:29	TJSJ	MMCZ
17/03/11	B738	ALSAL	16:42	ALSAL	16:42	MPTO	MMMX
17/03/11	B752	BUFEO	16:30	CLARA	16:39	MPTO	MROC
17/03/11	MD83	ERBOR	16:19	DUNEL	16:40	KHRL	MSLP
17/03/11	B738	PENSO	16:26	OMOSO	16:46	KIAH	MHLM
17/03/11	B752	NALDA	16:31	COBAN	16:50	KATL	MGGT
17/03/11	E190	CACHI	16:30	ISEBA	16:38	MROC	MPTO
17/03/11	B753	ABPZA	16:07	SIGMA	16:57	MPTO	KIAH
17/03/11	B738	PENSO	16:11	BERTA	16:59	KIAH	MNMG
17/03/11	B738	AVRIS	16:31	URNOS	16:58	KIAH	MSLP
17/03/11	A320	TILOT	16:31	CTM	16:57	MGGT	KMIA
17/03/11	E190	CACHI	16:45	ISEBA	16:53	MROC	SKRG

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APPENDIX B

. **Definition of the route groups and geographical areas used in the development of the forecasts by the CAR/SAM TFG**

Route Groups

1. South Atlantic

Includes routes between, on the one hand, gateway points in the following South American States: Argentina, Brazil, Chile, Falkland Islands (Malvinas), Paraguay and Uruguay and, on the other hand, the geographical areas of Europe, Middle East and Africa.

2. Mid Atlantic

Includes routes between, on the one hand, gateway points in the geographical areas of Central America and the Caribbean and/or in the following South American States: Bolivia, Colombia (including the San Andres Islands), Ecuador, French Guiana, Guyana, Peru, Suriname and Venezuela and, on the other hand, the geographical areas of Europe, Middle East and Africa.

3. Intra-South America

4. Between South America and Central America/Caribbean

5. Intra-Central America/Caribbean

6. Between North America and South America and Central America/Caribbean

Geographical Areas

- North America

Bermuda, Canada, St. Pierre et Miquelon, United States including Alaska and Hawaii, but excluding Puerto Rico and the Virgin Islands.

- Central America / Caribbean

Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, British Virgin Islands, Cayman Islands, Costa Rica, Cuba, Dominica, Dominican Republic, El Salvador, Grenada, Guadeloupe, Guatemala, Haiti, Honduras, Jamaica, Martinique, Mexico, Montserrat, Netherlands Antilles, Nicaragua, Panama, Puerto Rico, Saint Kitts and Nevis1, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands and Virgin Islands of the United States.

- South America

Argentina, Bolivia, Brazil, Chile, Colombia (including San Andres Islands), Ecuador, Falkland Islands (Malvinas), French Guiana, Guyana, Paraguay, Peru, Suriname, Uruguay and Venezuela.

- Middle East

Bahrain, Iran (Islamic Republic of), Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, United Arab Emirates and Yemen.

- Europe

Geographical Europe and Azores, Canary Islands, Cyprus, Greenland, Iceland, Madeira, Malta, Russian Federation and Turkey.

- Africa

The continent of Africa (including Algeria, Egypt, Libya, Morocco, Sudan and Tunisia) and offshore islands, but excluding Azores, Canary Islands, Madeira and Malta.

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APPENDIX C

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