Strategic Noise Map 2017 of Athens International Airport «Eleftherios Venizelos» (Traffic Data 2016)

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Summary

The Athens International Airport is one of the biggest infrastructure projects in Greece with a strong enterprising. In accordance with the European Directive 2002/49/EC and Joint Ministerial Decision 13586/724-28/3/06, in cooperation with the Ministry of Environment and Energy and the Civil Aviation Authority, AIA has produced the necessary study for Strategic Noise Map, including a review of the Aircraft Noise Action Plan. According to this, the study should be repeated every 5 years. This project concerns the Strategic Noise Map 2017 (traffic data 2016) and includes the solution of the appropriate acoustic model with the aim of creating the Strategic Noise Maps of the indicators L_{den} & L_{night} for the year 2016, based on the methodology ECAC.CEACDoc.29 "Report on Standard Method of Computing Noise Contours around Civil Airports". The 2017 SNM was developed using the CadnaA special airborne noise calculation software and based on the relevant Joint Ministerial Decision (JMD) 13586/724. The relevant analysis was based on the provisions of 2002/49/EC using analytic aircraft traffic tables per day/runway/procedure for the year 2016 (with the exception of helicopters, military and other special flights) categorized according to the relevant recommendation of the 6th of August 2003 Committee (2003/613/EC). The results of the comparative views of the SNMs 2007, 2012 and 2017 (2006, 2011 and 2016 data) are given in figures for the L_{den} & L_{night} limits of the Greek legislation. It is noted, that the increase of the movements combined with the implementation of the "Tango" SIC procedure contributes to the non-negative development of the effects of the air noise, resulting in the new isotonic curves of the highest statutory limits of the noise indicators: $L_{den} \leq 70$dB (A) and $L_{night} \leq 60$dB (A) continue to be limited within the boundaries of the airport.

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1. Introduction

"Athens International Airport S.A." (AIA) is responsible for the operation, management and development of the new Athens International Airport "Eleftherios Venizelos" at Spata. The airport started its operation immediately after the Hellinikon Airport closure in March 2001. Athens International Airport “Eleftherios Venizelos” is one of the most modern, functional and safest airports in the world with regard to technology and infrastructure, providing security, and an outstanding level of service. The Athens International Airport is the southern gateway of Europe to the world and one of the biggest infrastructure projects in Greece with a strong enterprising but also social character.

Table I. Airport Characteristics.

Operation since :	**2001**
Runways:	2, approximately 4Km each
Main Terminal Building:	4 levels, 14 passengers’ embarkation bridges, 150,000 sqm.
Satellite Terminal Building:	10 gates for passengers embarkation
Aircraft traffic (max capacity):	65 landings and take-offs per hour
Passenger Traffic 2011:	14.4 million passengers
Cargo Traffic 2011:	86,000 tones
Aircraft Traffic 2011:	173,000 movements
Passenger Traffic 2016:	20,0 million passengers
Cargo Traffic 2016:	88.500 tones
Aircraft Traffic 2016:	189.137 movements

The description of the natural and technical – operational characteristics and particularly the General Runway Data of AIA ‘Eleftherios Venizelos’, which is located 33 km northeast of Syntagma Square in the Centre of Athens, with the Code Name **ICAO: LGAV & IATA: ATH,** is given summarized below.

Table II. Airport’s Reference Point

Geographic latitude	375612.12 N
Geographic longitude	235640.20 E
Altitude	94 meters MSL

AIA has two runways. The first is Runway 03R/21L with length of 4000 meters and the second is Runway 03L/21R with length of 3800 meters.

This research project [1] concerns the Strategic Noise Map 2017 according to the European Directive 2002/49/ EC [2] and JMD 13586/724 [3] (using traffic data for 2016) and includes the Strategic Noise Maps for both noise indicators L_{den} & L_{night} for the year 2016, based on the methodology ECAC.CEACDoc.29 "Report on Standard Method of Computing Noise Contours around Civil Airports" [4]. The 2017 SNM was developed using the CadnaA special airborne noise calculation software that was used in the 2007 and 2012 (data 2006 and 2011) and based on the relevant JMD 13586/724 and Annex IV thereto. The maximum permissible limits for both noise indexes, L_{den} (24 h) and L_{night} (8 h), for airport environmental noise are defined as follows:

a. For the noise index L_{den} (24 h): 70 dB (A).
b. For the noise index L_{night} (8 h): 60 dB (A).

2. Airport’s traffic data and aircraft flight paths.

The relevant analysis was based on the provisions of 2002/49/EC using analytic aircraft traffic tables per day/runway/procedure for the year 2016 (with the exception of helicopters, military and other special flights) categorized according to the relevant recommendation of the 6th of August 2003 Committee (2003/613/EC) and the aircraft database "AzB-99" «Neue zivile Flugzeugklassen für die Berechnung von Lärmschutzbereichen (Entwurf), Umweltbundesamt, Berlin 1999 [5].

SNM	P1	P 2.1	P 2.2	S 5.1	S 5.2	S 5.3	S 6.1	S 6.2	S 6.3	S 7	TOTAL YEAR
2007	4.805	39.134	399	25.662	97.100	3.953	10.667	176	2.395	303	**184.594**
(data 2006)	2.6%	21.2%	0.2%	13.9%	52.6%	2.1%	5.8%	0.1%	1.3%	0.2%	**100.0%**
2012	1.807	38.284	347	12.963	108.323	496	6.242	366	376	269	**169.473**
(data 2011)	1.1%	22.6%	0.2%	7.6%	63.9%	0.3%	3.7%	0.2%	0.2%	0.2%	**100.0%**
2017	1690	40426	32	9818	123193	94	7152	138	364	54	**182.961**
(data 2016)	0.92%	22,1%	0,02%	5,37%	67,33%	0,05%	3,91%	0,08%	0,20%	0,03%	**100,0%**

The best approach for numerical modelling is the use of the total year traffic volume for 2016 with distribution per runway for the 3 distinct time periods as per 2002/49/EC as well as representative flight paths both horizontally and vertically in an impact area of some 20Km^2 taking into account the dispersion as recorded by the airport's radar. In order to access the best corresponding flight paths per runway and landing/take-offs, the density charts from the AIA's Noise Monitoring System (NOMOS) were employed. By detailed evaluation of the recorded flight paths for 2016, a single flight path was chosen per runway/movement type for all four thresholds [6], [7].

For the longitudinal profiles, the relevant SNM 2017 assumption was implemented according to longitudinal profile for departures for all aircraft categories for ECAC 29 according to "AzB-99" and longitudinal profile for arrivals for all aircraft categories according to AIP GREECE - ILS 03L/21R and 03R/21L enforced throughout 2016.

3. Study Area: Land use – Population data (NSSG)

Taking into account the needs of the Study on Aircraft Noise within the immediate and greater area of AIA ‘Eleftherios Venizelos’, a three-dimensional model of the greater Mesogea area was formed with the use of a Geographical Information System with the minimum geographical unity at the level of blocks of residences.

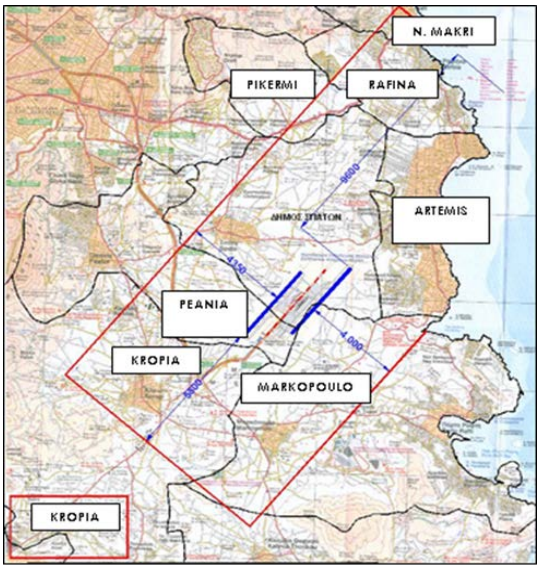

Figure 1. Study Area

The noise "sensitive" types of land use (schools, churches, health centres, etc.), were recorded and were depicted in inventory maps. More specifically, 146 updated locations of "sensitive" types of land use, grouped in six categories, were detected and inserted at the relevant geographic thematic level: Churches, Schools, Community centres, Health centres, Nursery schools, Camps [8], [9], [10].

4. Existing action plan for aircraft noise at AIA

The Noise Abatement Procedures have been established prior to the operation of the airport in cooperation with the Hellenic Civil Aviation Authority. The procedures have been published in the AIP Greece, Volume I and include measures concerning runway use including restrictions during the night, the aircraft engine testing and Auxiliary Power Unit (APU) usage. In particular, the Noise Abatement Procedures include:

Use of runways:

- Runway 21L is not to be used for landings during the night (11pm – 7am)
- Runway 03R is not to be used for departures during the night (11pm – 7am)
- Chapter 2 aircraft licensed to use the airport cannot use runway 03R for take-offs or runway 21L for landings on a 24-hr basis.
- In addition, the following marginally accepted Chapter 3 aircraft are not allowed to use runway 03R for take-offs or runway 21L for landings (implemented in April 2012) on a 24-hr basis.
- All military aircraft are not allowed to use runway 03R for departures or runway21L for landings on a 24-hr basis (implemented for 03R in April 2012 and 21L in December 2011). Military aircraft of civil aircraft type not included in the above table– are excluded from this restriction.
- Deviations of the above may be allowed for security reasons during extreme meteorological phenomena or when capacity and operational procedures are necessary.

Reverse thrust use: Use only under safety procedures in force

Thrust Reduction – Acceleration, runways 03L and 03R: Unless necessary for safety reasons, all turbo-prop and jet-powered aircraft shall not reduce take-off thrust until a minimum altitude of 1800 feet MSL has been reached and shall not accelerate above initial climb speed (V2+10) or change take-off flap and slat configuration until a minimum altitude of 3300 feet MSL has been reached.

Other procedures: Restriction of take-offs from runway 03R and restriction of landings on runway 21L are also enforced from 15:00 to 18:00 through temporary NOTAMs which are renewed upon expiration

Following collaboration with the Hellenic Civil Aviation Authority, representatives of airlines (pilots) and also the Municipality of Artemis, a new take-off procedure (SID) was assessed for the runway 03R The procedure concerns the straight line flight path after taking off from 03R and turning right at 12DME ("Tango"). The procedure is in addition to the existing SIDs still in use while the implementation of the 'Tango' procedure has started since 2013.

AIA's Noise Monitoring System: AIA "Eleftherios Venizelos" is the only airport in Greece that operates a permanent Noise Monitoring System (NOMOS). The monitoring of the noise intensity level in the broader area of the airport as well as the correlation of the noise levels with specific aircraft movements is achieved with ANOMS application. The monitoring system is composed of a network of ten (10) permanent Noise Monitoring Terminals (NMTs), a mobile station and a central unit with software for the collection, processing and storage of data and includes a connection with the Hellenic Civil Aviation Authority's radar to obtain data about aircraft flight paths, the Airport Operation Data Base (AODB) for data about the flight plan, as well as a connection with AIA's Air Quality Monitoring

Network for meteorological data. An automatic correlation of noise levels with particular aircraft movements based on the minimum distance of the aircraft flight path from each station is accomplished with ANOMS. The measurement data are used to evaluate the consequences of aircraft movements upon noise levels in the vicinity of the airport, the monitoring of the compliance with the Noise Abatement Procedures, the investigation of public complaints and planning in general. The system uses a large number of indicators for the description of the acoustic environment (Lden, Lnight, Lmax, Lday, Levening, etc.).

Chapter 2 aircraft: The ban of Chapter 2 aircraft is in effect since the end of 2002. The withdrawal of these aircraft, which represented approximately 12% of the overall movements in AIA prior to the ban, has played an important role in reducing noise levels according to the results of AIA's Noise Monitoring System

Public Complaint Management System: AIA has created a special "We Listen" telephone line which concerned citizens can call for information and to register their complaints. The telephone line operates on a 24-hour basis. The public may also submit noise-related complaints via a special page on the AIA's website (www.aia.gr)

Reporting: Reports based on the results of the implementation of the Action Plan are submitted to the relevant authorities (e.g. Ministry of the

Environment, Hellenic Civil Aviation Authority) on a monthly and a six-monthly basis. At the same time, information about noise and measurement results is given to the local community through the annual publication of AIA's Environmental Services Department entitled Care for the Environment

Flight paths: From 2013, the 'Tango' procedure was implemented as a preferred departure from the 03R corridor (were most inhabitants complaints may occurred) , as per the figure 2 hereafter:

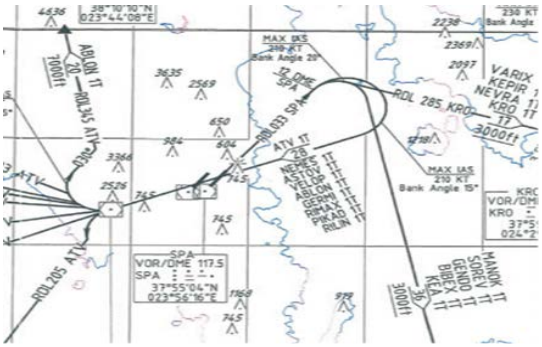

Figure 2. Tango

The distribution of movements on representative flight paths inserted in the model, for each threshold, take in to account the actual path of each aircraft movement in a range as defined in the model boundaries Airport - based on their actual dispersion, using the relevant flight paths data from the AIA's Noise Monitoring System (NOMOS), for each runway, threshold, and aircraft traffic type for the year 2016. In this way, the most representative horizontal and longitudianl profile was implemented based on actual recorded flight paths for all 2016 movements foe all three distinct time periods, eand all four runway thresholds in a linear form since no significant turnings were recorded (fig.3).

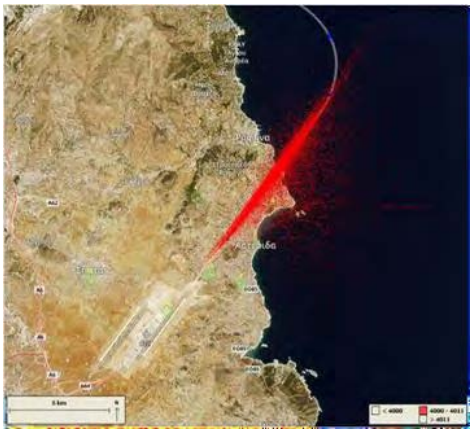

Figure 3. Total take-off for 2016 from 03R

Regarding the actual longitudinal profiles of all movements (especially for RW 03R) for the year 2016 compared with the suggested profiles per aircraft category as per the AzB database, it wast established that the actual climbing is far more increased compared to all AzB relevant paths ensuring that the model take in to account the whorst case scenario regarding the proximity to ground level. In figure 4 a comparison of actual recorded longitudinal flight paths vs AzB theoretical flight path for the most common aircraft category 5.1 vs Tango procedure is shown for all 2016 take offs at RW03R

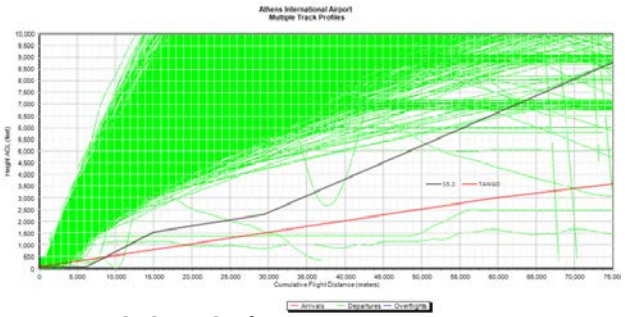

Figure 4. Flight paths from 03R

Investigate an alternative scenario for "Intersection Take-Offs" at 03R: As part of the further analysis of take-offs from the Eastern runway, it was considered appropriate to investigate the Intersection Take-off scenario as a possible additional measure in the AIA Action Plan which is expected to have a positive impact on the noise and acoustic burden of land- taxi procedures by deflecting a portion of the medium range flights from the intersection holding point "D4" relative to the 03R threshold to the BCR end of the 03R. This scenario based on the deflection of the takeoffs of class P 2.1 - S 5.1 - S 5.2 aircrafts on the intersection holding point "D4" (A / C type ATR - De Havilland Dash - Avro and A320 - B737 by approximately 40% of departures from 03R).

5. Presentation of the results from the aircraft noise simulation model: 2017 SNM.

In the relevant annex which follows, the presentation of the 2017 Strategic Noise Map (SNM) based on ECAC.CEACDoc.29 is given for the noise indicators L_{den} & L_{night} having a digital satellite image as a background layer in accordance with the results of the special aircraft noise computation software CadnaA. It must be

noted that according to the relevant JMD 13586/724, its IV annex and European Directive 2002/49/EC, the 55 and 65 dB noise contours must be included in one or more of the maps where information for the geographic location of villages, settlements, cities, and towns within these contours is presented. The surface data exposed to the different noise buffer zones of the L_{den} index of the study area must be categorized – according to the aforementioned institutional framework – in noise buffer zones higher than 55, 65 and 75 dB respectively and at a height of four meters above the ground

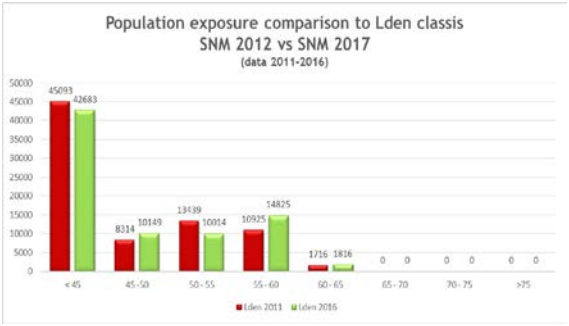

Figure 6.: Graphical comparison of exposure population of the study area within buffer zones of noise indicator L_{den} – SNM 2012 vs SNM 2017

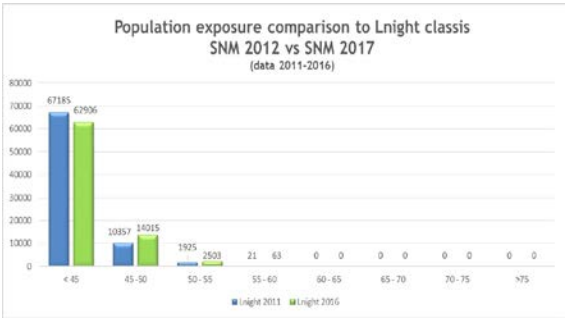

Figure 7.: Graphical comparison of exposure population of the study area within buffer zones of noise indicator L_{night} – SNM 2012 vs SNM 2017

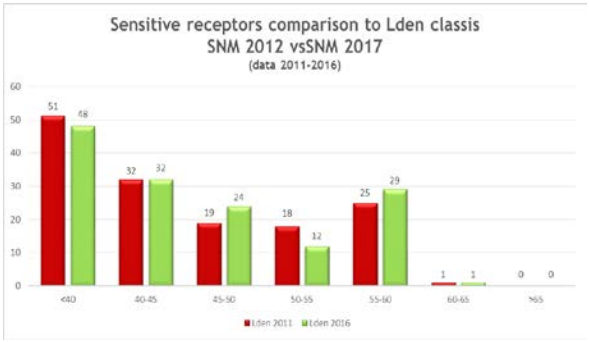

Figure 8.: Graphical comparison of exposure of noise sensitive receptors for indicators Lden – SNM 2012 vs SNM 2017

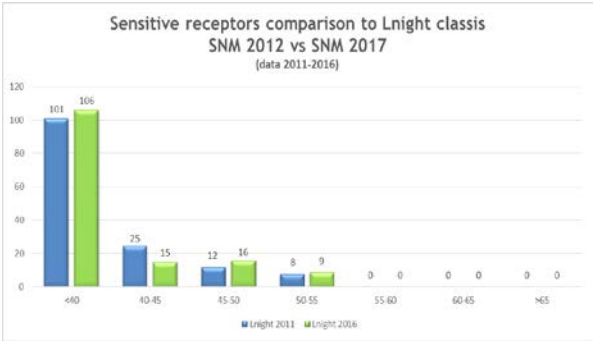

Figure 9.: Graphical comparison of exposure of noise sensitive receptors for indicators Lnight - SNM 2012 vs SNM 2017

6. Conclusions

It is noted that the increase of the movements is approximately at the level of the movements of 2006, combined with the implementation of the "Tango" procedure, it contributes to the non-negative development of the effects of the air noise, resulting in the new isotonic curves of the highest statutory limits of the noise indicators : L_{den} ≤70dB (A) and L_{night} ≤60dB (A) continue to be limited within the boundaries of the airport without impact on built-up residential areas or other sensitive receivers.

This situation continues to be reflected in the take-off scenario of part of the aircraft from Intersection holding point "D4" - with respect to the threshold of 03R towards the BA edge of 03R.

Based on the results of the SNM 2017 and their comparison with those of the SNMs 2007 and 2012, the noise limits defined in Joint Ministerial Decision 211773 / 27-4-2012 show that no limit values are exceeded and therefore the updated Action Plan for noise with the integration of the “Tango” procedure is considered to be effective and does not require revision.

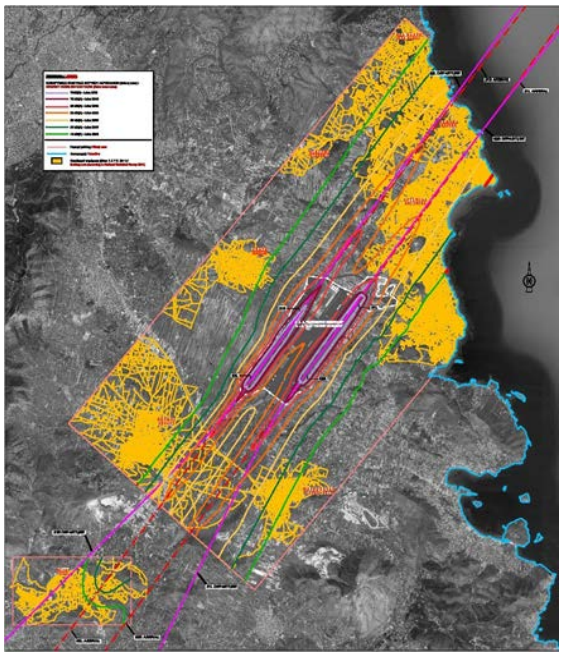

Figure 7. SNM 2017 - Enviromental noise indexe L_{den}

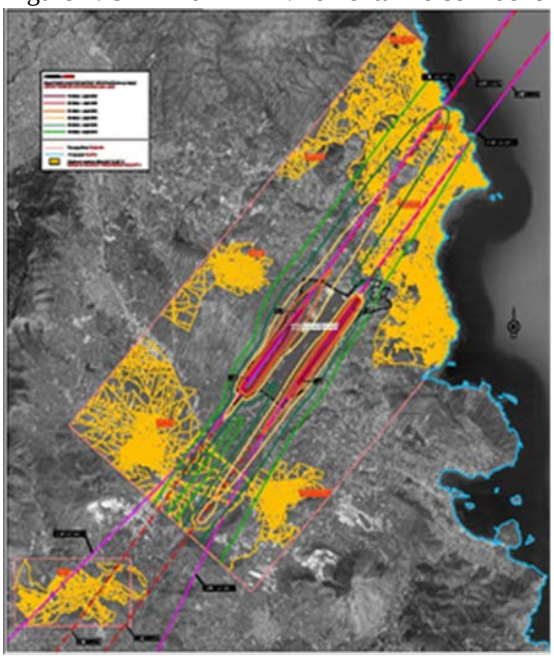

Figure 8. SNM 2017 - Enviromental noise indexe L_{night}

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