



SOURDINE II

D4-1-5b

Noise results Naples Capodichino

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Summary

This deliverable provides principal results of noise assessment performed on Naples Capodichino airport. It includes complete information on the whole assessment process, detailed description of the methods, scenarios and main conclusions. The simulations have been performed according to the experimental plan of the SII Validation Methodology running the following scenarios:

- Baseline scenarios: Starting from the current scenario (2002), a future scenario at 2015 for the Naples Capodichino airport has been set up. The traffic sample recorded in 2002 in Naples-Capodichino has been increased according to local air traffic forecasts to reach the 2015 target, the fleet mix has been updated consistently with available data on renewal of airlines' fleet. Further elaborations on the fleet mix at 2015 have been done on the basis on substituting criteria detailed in the Chapter 3. Enhanced approach procedure for arrivals and ICAO A for departures have been used as reference procedures for the baseline scenarios [SII_D3_1_2]
- Sourdine II scenarios: Keeping the same air traffic and fleet mix defined in the baseline scenario, the SII scenarios have been set up replacing, scenario by scenario, the reference procedure with a single SII procedure, for all four SII arrival scenarios and two departure scenarios.

Two additional scenarios, called both calibration scenarios (Filter 1 and Filter 2), were run in the Capodichino case, due to the nature of Naples fleet mix. In the substitution table (Chapter 3) set up by the SII consortium, there weren't any aircraft ready to substitute turboprops or small jets, but, their number (about 30% of the whole fleet mix), in the Naples case, was not negligible. SICTA was in charge to quantify the percentage error done leaving out turboprops and small jets. As results of these two runs, the error of not including turboprops was about 3-4% in the noise contour calculation and about 9-16% for not including small jets was. For more details on methods and results on the calibration scenarios see Annex A.

It has been decided to exclude small jets from the analysis, because the target of the SII project was not to give the absolute value for the noise contours using the SII NAPs, but to make an estimation of the benefits in the noise reduction making use of the SII NAPs instead of the standard A/D procedures.

Making a summary of the SII NAPs noise assessment results, it can be concluded that, for the approach procedures, NAAP III is the best one in reducing the noise contour around Naples airport, this is mainly because an aircraft flying NAAP III is always at a higher altitude than an aircraft flying a reference procedure. This result shows the fundamental role played from altitude of a noise source (aircraft) with respect to the other parameters contributing to a balanced approach to the noise reduction.

Concerning the departure procedures it has been seen that the efficiency in the noise reduction for a NADP depends on the geographic area you want to pay attention to. In the Naples case, most of populated areas are located in the airport vicinity, south-west, so the Close-in procedure could be a good solution in the noise reduction for people leaving around the airport.

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1 Introduction

1.1 Purpose

The objective pursued through this validation exercise is to assess the environmental impact of the SII NAPs on Naples Capodichino airport.

As seen in the D5.3, the SII NAPs have been, one by one, already assessed on for noise and the most noise beneficial of those proposed (see deliverable D3-1.2) have been filtered and assessed for capacity [SII_D4_1-5a]. The noise impact of applying the SII NAPs on airport scale is described in this document.

1.2 Background

The “Environment” is one of the validation objectives considered within the SII project, together with safety, capacity and economic aspects. Keeping the safety as first objective, the SII project focuses on environmental aspects, proposing new arrival and departure procedures on long term (beyond 2015), aiming at reducing the impact of noise (emissions). The noise assessment performed required less assumptions compared to the capacity assessment, but long time was spent for setting up a new INM version and for preparing updated input files for the INM database.

The effects of implementing the SII NAPs on Naples airport have been assessed through the new INM7.0, using part of SIMMOD input/output too.

As established from the Validation methodology [SII_D2_1], in the Naples airport case, capacity and noise assessment have been done separately, but it's clear that, to have a consistency of the exercises, the two validation activities made use of the same input data on traffic, airport/airspace configuration, SIDs/STARs.

1.3 Glossary

A/D	Arrivals and Departures
AENA	Aeropuertos Españoles y Navegacion Aerea
ATC	Air Traffic Control
FAA	Federal Aviation Administration
FTS	Fast Time Simulation
ICAO	International Civil Aviation Organisation

ILS	Instrument Landing System
INECO	Ingeniería y Economía del Transporte
NAAP	Noise Abatement Arrival Procedure
NADP	Noise Abatement Departure Procedure
NAP	Noise Abatement Procedure
NPD	Noise-Power-Distance
MTOW	Maximum Take Off Weight
RTS	Real Time Simulations
RWY	Runway
SICTA	Sistemi Innovativi per il Controllo del Traffico Aereo
SID	Standard Instrumental Departure
SII	SOURDINE II
SOURDINE	Study of Optimisation procedURes for Decreasing the Impact of NoisE around airports
STAR	Standard insTrument ARrival
THR	Threshold
TMA	Terminal Manoeuvring Area

1.4 Reference documents

[EC_2002/49]	OJ L189/13 of 18/07/2002, Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise
[SII_D2_1]	SOURDINE II “D2.1 Validation Methodology Report”, April 2004
[SII_D2_1_App]	SOURDINE II “D2.1 Validation Methodology Report, Appendixes”, April 2004
[SII_D3_1_2]	SOURDINE II “Update of definition of new noise abatement procedures”, June 2005
[SII_D4_1-5a]	SOURDINE II “Capacity results Capodichino”, August 2005
[SII_D5_3]	SOURDINE II “Single Event Noise Calculations”, February 2003

2 Description of the analysis

The experimental design of the study was based on the Validation Methodology agreed in the SII project [SII_D2_1]. With respect to the initial plan, it was necessary to add two more validation exercises, because they were necessary for the setting up and the development of the Baseline and the SII scenarios.

Performances/acoustic data on new NAPs were available [SII_D5_3] for a small number (some Airbus/Boeing) of aircraft, not covering the whole fleet mix foreseen at 2015 in the four SII airports, so the SII Consortium agreed on set up a substitution table for replacing those aircraft for which acoustic/performance data were not available (see Chapter 3). The agreed substitution table did not include turboprops and small jets, because none of Airbus/Boeing aircraft was thought suitable in substituting them.

The limited number of substituting aircraft was problem in the Naples case because the foreseen fleet is mostly composed of small/medium aircraft, in fact turboprops and small jets are about 30% of the whole fleet. So it was agreed to leave out from the Baseline and the SII scenarios the turboprops and the small jets, assessing, in this last case, the error made in the noise contour calculation, by two succeeding runs (with INM6.1). These two scenarios have been called Calibration Filter 1 and Calibration Filter 2 and details on them can be read in the Annex A.

2.1 Naples Capodichino airport

The study is focused only on Naples Capodichino Airport, part of Rome TMA. For more details on Naples airspace look at Appendix II of the SII deliverable D2-1 “Validation Methodology, Appendixes”.

Naples Capodichino it is a city airport, completely surrounded by populated areas and only 7 Km far from downtown. Densely populated areas surround the airport not only in the South-West of airport (Naples centre is located along extended centre line of runway 06) but also in the north part of airport. The following picture shows the urbanization status around Naples Capodichino.

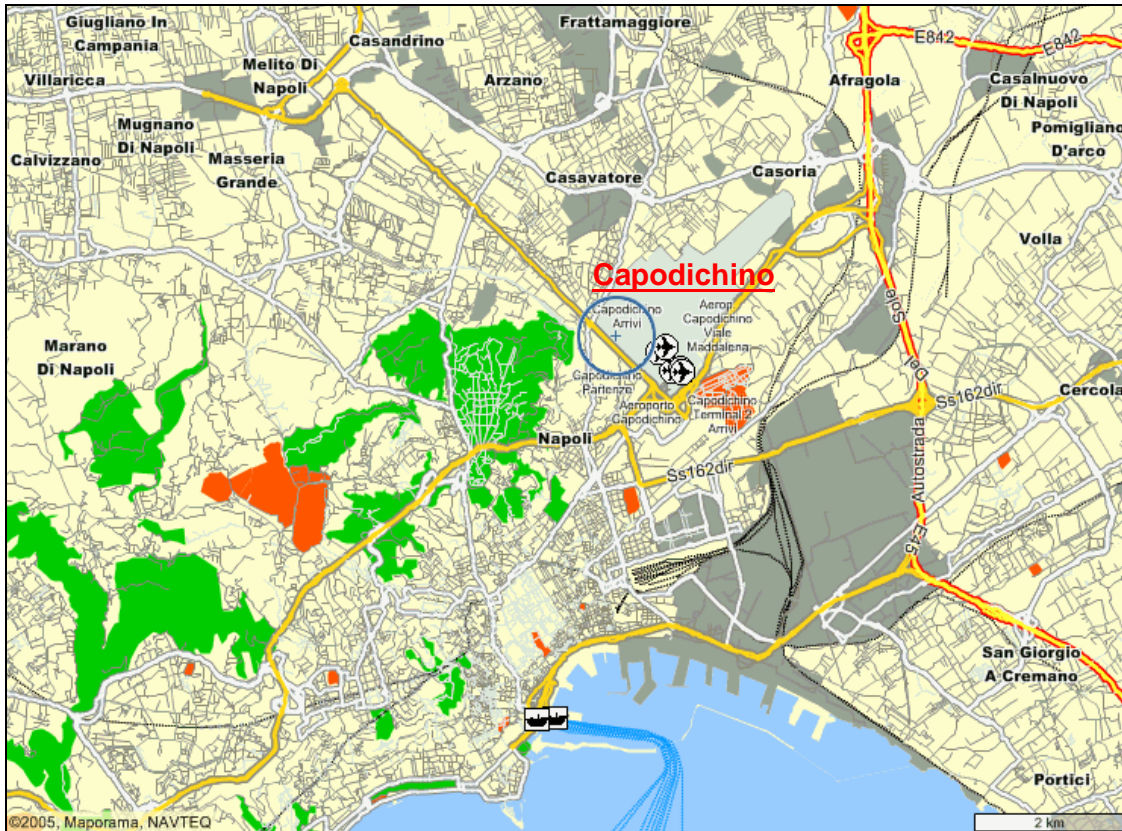


Figure 1: Naples-Capodichino urbanisation status

Naples Capodichino airport is a military airport open to civil air traffic, meaning the traffic varies from flying school and regional brigade air forces (e.g. Police, Fire Brigade, Carabinieri, Guardia di Finanza, Medical Rescue, etc.) to small/general aviation and helicopters. This mix of traffic brings out a particular ATC complexity which aims to manage increasing commercial movements with small different aircraft.

One runway “24-06” is available at Naples Capodichino airport for take offs and landings. Taking into account that the runway 24 is the only one equipped with ILS, that natural and artificial obstacles are located on southwester of RWY 06 and that the predominant wind direction is SSW, it's clear the reason why most aircraft land on RWY 24.

Aircraft with big MTOW prefer taking off from RWY 06, because they can take advantage of the runway slope.

Northbound aircraft, taking off from RWY 06, can use the SID TEANO 5B, avoiding the fly-over of the city and allowing time and fuel saving, but, on the other hand an aircraft flying

that SID has to pass through a military area, that it's feasible only upon authorisation by military airport of Grazzanise.

Other particular characteristic of Naples-Capodichino airport is its demand. Naples airport must deal with a seasonal demand, where peaks are located from spring to autumn, the tourist season.

Several remarkable geographical obstacles are located in the airport surrounding. The most limiting obstacles are located 5500m and 6700m from airport centre, which do not satisfy standard obstacle clearances, causing special designs of certain manoeuvres.

From the above lines it's clear that the situation of Naples Capodichino airport is highly complex. Changes in the ATC procedures for the decrease of noise impact around the airport are not always achievable for the reason above written. Therefore the implementation of the SII NAPs in the future (beyond 2015) could represent a solution for the decreasing of noise nuisance around airports.

For a complete description of Naples airport and its related airspace configuration, refer to the SII deliverable "D2-1 Validation Methodology, Appendixes"[SII_D2_1_App], Appendix II.

2.2 Noise Modelling Method

The tool selected for the noise assessment is INM (distributed from the FAA) as established from the SII Validation Methodology. Two versions of the tool have been used, INM6.1 and INM7.0S, the first one doesn't have any use restriction, the second one was a prototype version (developed from FAA/Volpe) and its use was restricted only to SII partners.

In the new INM7.0S version, acoustic/performances/vertical profile data related to new NAPs for some Boeing/Airbus aircraft have been stored in its database.

INM is an analytical tool able to calculate the changes in the noise impact resulting from variation in airport/runways configuration, fleet mix, routes, etc. Change an arrival or a departure procedure means to change all the input data (performances/acoustic) associated to the new procedure in the INM database. So, the INM tool, doesn't have any natural constraints, it only needs detailed performances/acoustic/vertical profile data per aircraft and per procedure.

The simulation process has been executed through the following phases:

- Collection of required input data for setting up the scenarios on Naples Capodichino airport;
- Scenarios run;
- Analysis of results and comparison of SII scenarios results with Baseline scenarios.

2.3 Procedures Modelled

Eight scenarios were run, three for departures and five for arrivals, as shown in the next lines:

- Departures
 - Baseline
 - Close-in
 - Distant

- Arrivals
 - Baseline
 - NAAP II
 - NAAP III
 - NAAP IV
 - NAAP V

With respect to the Baseline scenarios (departures and arrivals) the SII scenarios are different only in the use of performances/acoustic/vertical profile data related to the single NAP, the rest of input parameters remain unchanged.

3 Input Data and Modelling Assumptions

The noise assessment results represent the core of the SII project, that's the reason why a considerable effort was spent on the release of a new INM7 version (INM7.0S prototype) and in updating the performance/acoustic data related the new NAPs stored in its database.

Details on the methodology, results and comparisons between the two INM versions and the two set of performances/acoustic can be found in the deliverables D5.2 and D5.4.

Five scenarios for approaches and three scenarios for departures have been analysed. It is important to see that approaches and departures have been analyzed separately, too see the effects of implementing a new NAAP or a new NADP on noise point of view.

3.1 Original Fleet Mix

The selection of the aircraft types can have a large effect on the estimation of predicted noise levels. Different aircraft produce different noise footprints even if there are under the same conditions (procedure, meteo, etc). It is therefore very important, for the accuracy of the validation exercise, to have a fleet mix as close as possible to the actual fleet flying on an airport at a selected timeframe.

the development of the SII project required to work on the fleet mix foreseen to fly from/to Naples Capodichino airport, excluding turboprops and small jets. The following table lists the whole fleet mix foreseen in Naples at 2015, to give a complete picture, but only the aircraft written in black have been considered for the SII noise assessment:

Aircraft Type
A320
CL601
DO328
A319
737800
737300
ATR72
EMB145

Table 1: Naples fleet mix foreseen at 2015

3.2 Performed Substitution

As mentioned, performances and acoustic data associated to the new SII NAPS were available for a limited group of aircraft. The performance/acoustic data available for the noise assessment were more than those available for the capacity assessment, in fact Boeing data were added to the Airbus data already available in the capacity assessment, but any case it was necessary to set up an a substitution list for those aircraft of Naples, Madrid, Amsterdam and Paris fleet mix for which there weren't update data.

Details on the methods and criteria used for organising this table can be read in the D4-1-b top level document.

The table in the next page shows the results of the substitution criteria agreed from the SII consortium and used for the noise assessment on the four SII airports:

MTOW Class [1000kg]	Aircraft	MTOW [1000kg]	SL Max EPNdb	Noise Assessment Substitution	
				substitution	optional
15 ≤ MTOW < 40	CRJ-100/200	21.5	86	none	
	EMB145	22-24	84.6	none	
	ATR42	16	80.7	none	
	Dornier 328	16	83.8	none	
	Embraer RJ145	22	84.2 – 84.6	none	
40 ≤ MTOW < 60	Fokker70/100	45.18	91.7	B737-300	A319-111
60 ≤ MTOW < 100	B737-300	62.8	90.4	B737-300	
	A319-111	64-75.5	92	A319-111	
	B737-400	62.9-68.1	93.2	B737-300	
	B737-700	60-70	94.7	B737-800	
	MD-88	72.5	97.2	A321-232	
60 ≤ MTOW < 100	MD-87	63.5	97.1	A321-232	
	MD 81(S80)	63.5	97.3	A321-232	
	MD82	67	96.3	A321-232	
	A320-211	73.5-77	94.4	A320-211	
	A320-214	73.5-77	94.4	A320-214	
	A320-232	73.5-77	94.4	A320-232	
	B737-800	78-79	93.1	B737-800	
	B737-900	78-79	94.3	B737-800	
	A321-211	83-93.5	94.3	A321-211	
A321-232	83-93.5	95.6	A321-232		
100 ≤ MTOW < 160	B757-200	98.8-115.6	94.2-94.4	B757-200	
	B757-300	123.6	94.5	B757-200	
160 ≤ MTOW < 230	B767-300	184.8-186.8	97	A330-301	B777-200
230 ≤ MTOW < 300	A330-301	230-233	97.2	A330-301	
	A340-313	271-275	95.8	A340-313	
	MD11	275	96.1- 96.5	B777-200	
	B777-200	253-305.97	96.1	B777-200	
300 ≤ MTOW < 400	747-400	363-396.6	103.8	A340-313	

MTOW Class [1000kg]	Aircraft	MTOW [1000kg]	SL Max EPNdb	Noise Assessment Substitution	
				substitution	optional
	A340-600	368-380	98	A340-313	

Figure 2: Substitution table, aircraft with the whole set of acoustic/performance data replacing the rest of the fleet mix planned in 2015

3.3 Resulting Fleet mix

The traffic sample used for the noise assessment comes from the Baseline scenario set up in the capacity assessment. As made in the capacity assessment case, due to the restricted number of aircraft with update performance/acoustic data, a smaller number of aircraft has been used for representing the Capodichino fleet mix in the noise assessment (Chapter 3) substitution criteria listed in the Annex A, the original fleet mix was reduced to four aircraft type: A319, A320, B737300 and B737800.

The following table there are details on the traffic sample. The table includes also aircraft not used in the simulation (grey in the table).

In details the first column lists the aircraft type, the second the movements number per aircraft model and last three columns detail how the aircraft movements are distributed per time periods, in line with the hourly classes established from the “END Directive” [EC_2002/49].

Aircraft Type	Movements Number (24H)	% during		
		Day	Evening	Night
		07.00-19.00	19.00-23.00	23.00-07.00
A320	72	61%	24%	15%
CL601	43	72%	18%	9%
DO328	37	82%	7%	11%
A319	36	65%	16%	20%
737800	30	71%	17%	12%
737300	30	71%	17%	12%
ATR72	28	72%	16%	12%
EMB145	25	67%	22%	10%

Table 2: Movements distribution per aircraft model and per time period

As seen in the capacity assessment, Naples airport has only one runway 06-24. Departures and arrivals from both RWY ends are allowed, even if RWY 24 is used preferentially for arrivals because it is ILS equipped. In this study the A/D operations were distributed per runway as following:

	Arrivals	Departures
RWY 24	100%	76%
RWY 06		24%

Table 3: A/D distribution per RWY

3.4 Runways-Route/Track Dispersion

To guarantee the consistency among different validation exercises, airspace configuration used for the capacity assessment has been here kept to perform the noise assessment. The SIDs and STARs tracks are the same as those used for the Baseline and for the SII scenarios in the capacity assessment. For more details on the SIDs/STARs see Annex B of D4-1-5a.

In the assumptions list it has been clearly specified that the two-dimensional data (tracks on horizontal plan) of initial climb/final approach procedures, SIDs and STARs do not change for the Baseline and the SII scenarios. The two-dimensional tracks, coupled with the vertical/performance profile stored in the INM database let to model the three-dimensional aircraft flight profile.

The following figure is a simplistic picture of the initial climb/final approach procedures, SIDs and STARs system as they are drawn in the INM7.0S model. For more detailed information on them see the deliverable D4-1-5b.

Meteorological conditions:

Meteorological conditions are very important to determine actual sound propagation and the needed information are following described:

- Air Temperature (°C or °F, according to the system being used, metric or English respectively);
- Humidity (%);
- Pressure (mm-Hg or in-Hg);
- Wind velocity (Km/hr or kts);
- Average wind direction.

In the SII project case, as recommended from the INM7.0S user manual, default INM meteorological conditions have been used.

3.6 Other information

Hypothesis/ Assumptions

Assumptions and hypotheses have been required for developing the SII project. Some of them are common to all the scenarios and others are related to a single scenario. In the following lines, the common assumptions to all the scenarios have been listed, while those specific on a single scenario have been detailed in the scenario description.

The common assumptions to all the scenarios are:

- Airport and airspace configuration scenario in 2015 is unchanged with respect to the situation in 2002;
- Air traffic has been increased for the Baseline and the SII scenarios on the basis of Eurocontrol/local air traffic forecast;
- Two-dimensional data (tracks on horizontal plan) of initial climb/final approach procedures, SIDs and STARs have been used for running the Baseline and the SII scenarios.

Metrics selection

To be in line with latest European Recommendations and Directives [EC_2002/49] it was established to use L_{den} , L_{night} [SII_D2_1] as metrics quantifying the noise contours for the Baseline and the SII scenarios and for making comparisons among them.



In the SII Validation Methodology it has been to use 55 dB and 90dB such as lowest and highest thresholds, with a increase of 5dB.

4 Noise results

Noise results are presented in a relative way: SII procedures are evaluated against the Baseline Procedures. Results are provided for Lden and Lnight. By this way is very simple to see the change in the noise contour flying the SII NAAPs with respect to the reference procedure

Noise levels are given from 55 dB for Lden and for Lnight, and incremented by 5dB. The highest noise level threshold to be accounted for in the results is determined by airport (and metric) specificities, and is determined by the surface of the corresponding contour - there is no point in presenting contour area variations (in percent) for very small areas – but in any case, the highest threshold levels do not exceed 75 dB for Lden, and 70 dB for Lnight.

4.1 Noise contours

The following diagrams show noise contours for SII procedures, overlaid on those resulting from Baseline.

4.1.1 Arrivals, Lden

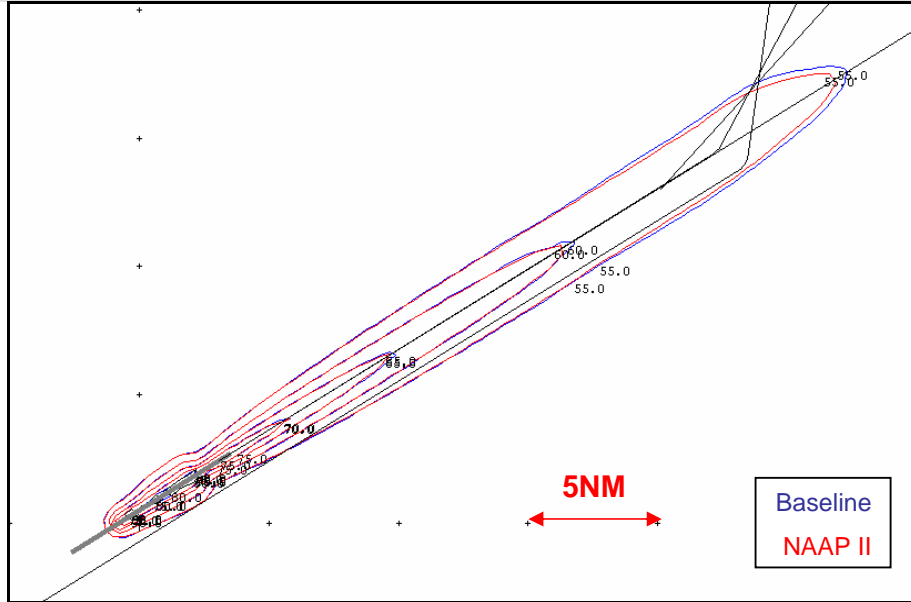


Figure 4: Approaches - Baseline vs. NAAP II, noise contours comparison (L_{den})

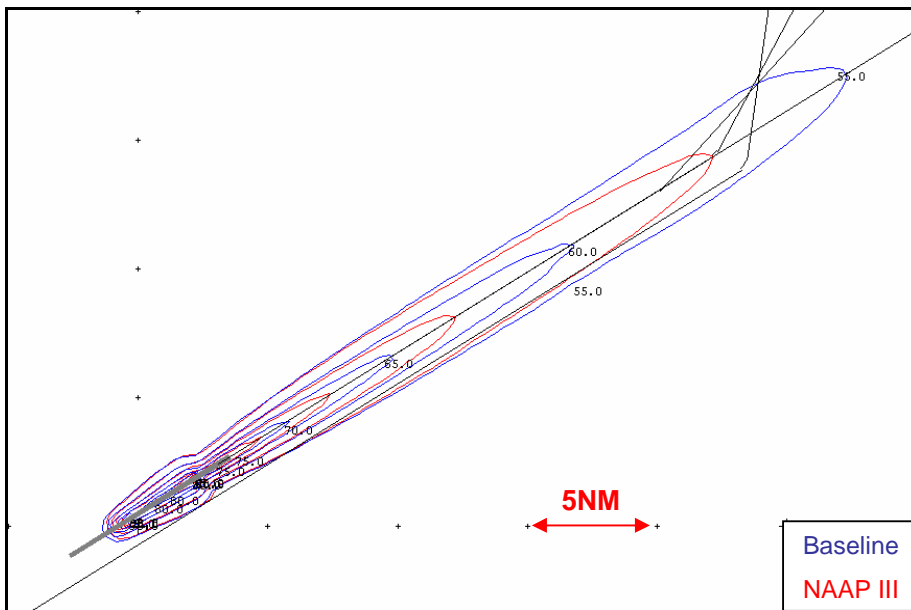


Figure 5: Approaches - Baseline vs. NAAP III, noise contours comparison (L_{den})

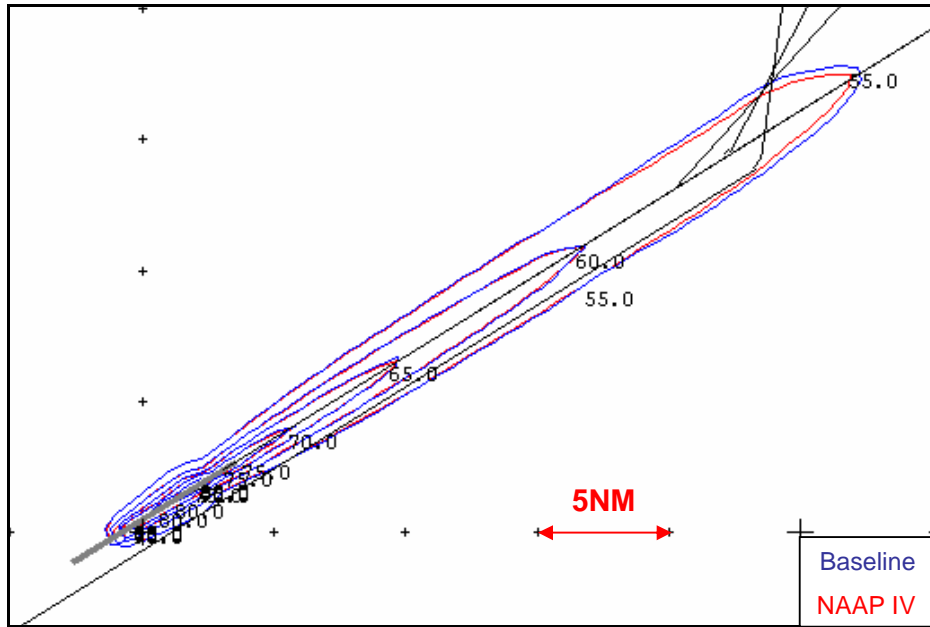


Figure 6: Approaches - Baseline vs. NAAP IV, noise contours comparison (L_{den})

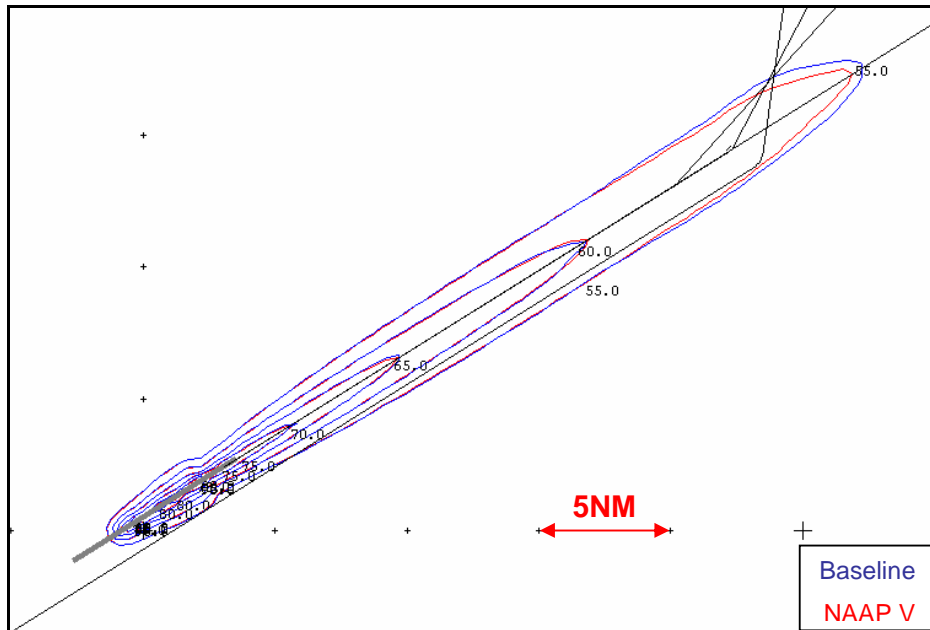


Figure 7: Approaches - Baseline vs. NAAP V, noise contours comparison (L_{den})

4.1.2 Arrivals, L_{night}

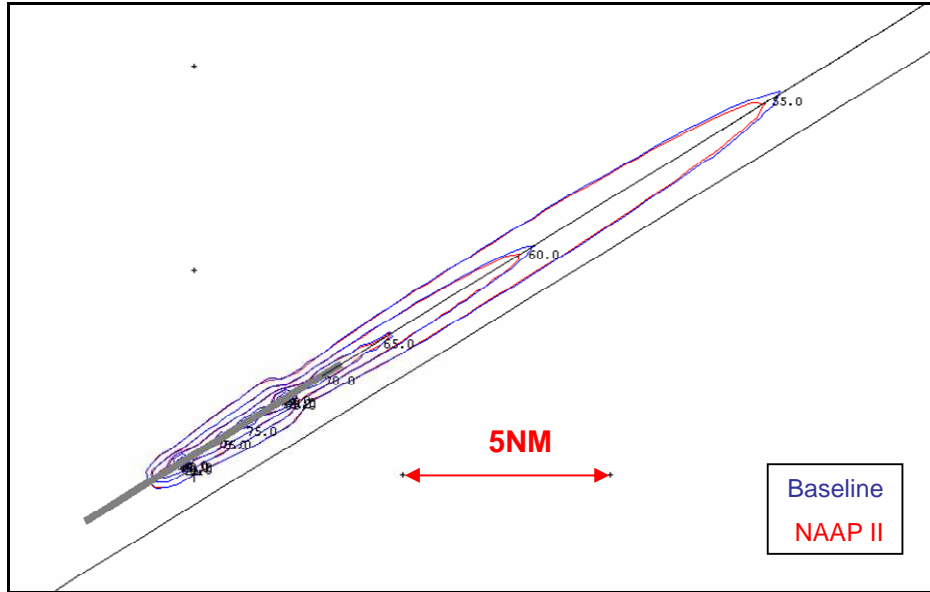


Figure 8: Approaches - Baseline vs. NAAP II, noise contours comparison (L_{night})

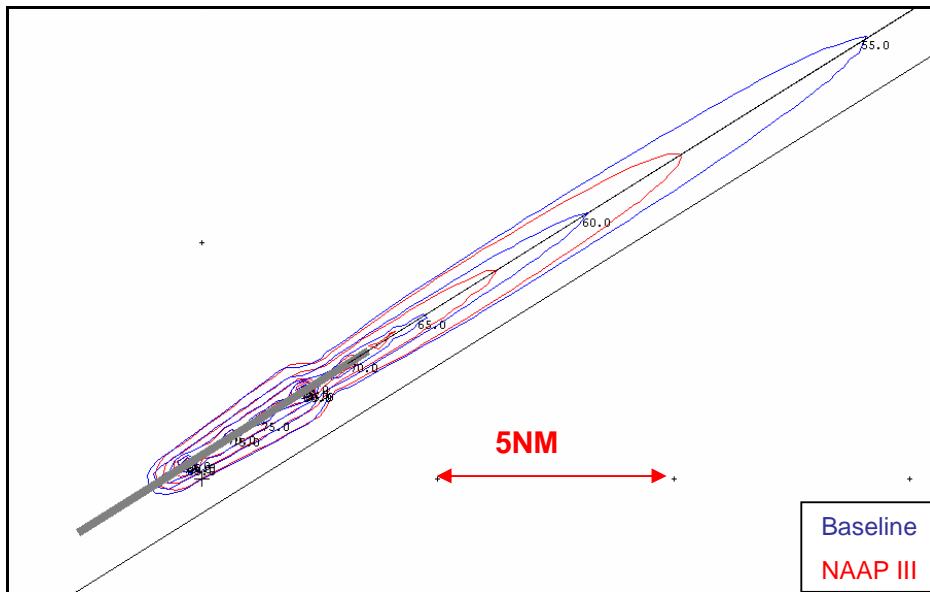


Figure 9: Approaches - Baseline vs. NAAP III, noise contours comparison (L_{night})

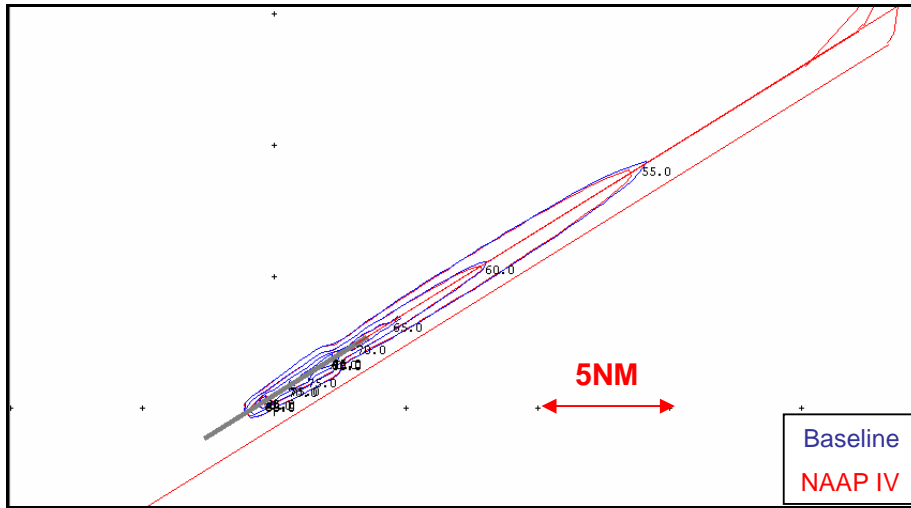


Figure 10: Approaches - Baseline vs. NAAP IV, noise contours comparison (L_{night})

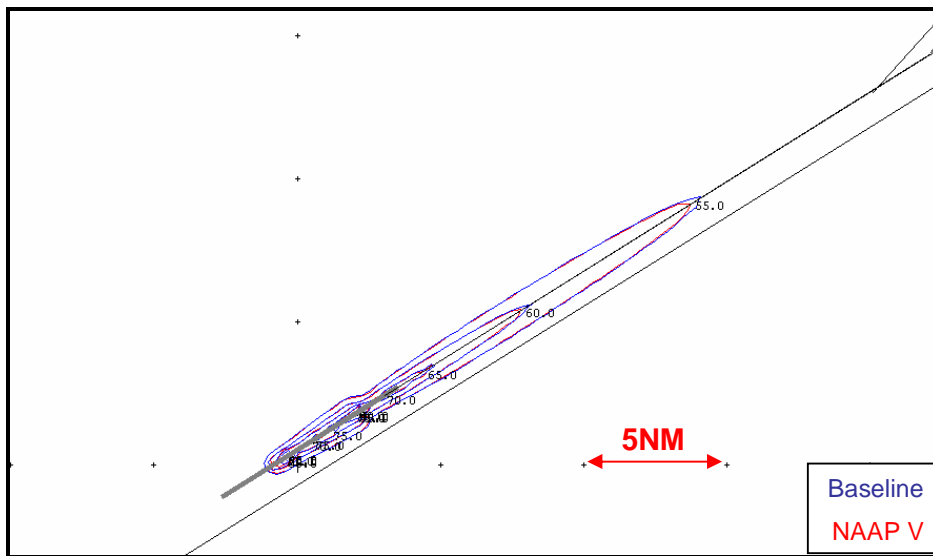


Figure 11: Approaches - Baseline vs. NAAP V, noise contours comparison (L_{night})

4.1.3 Departures, Lden

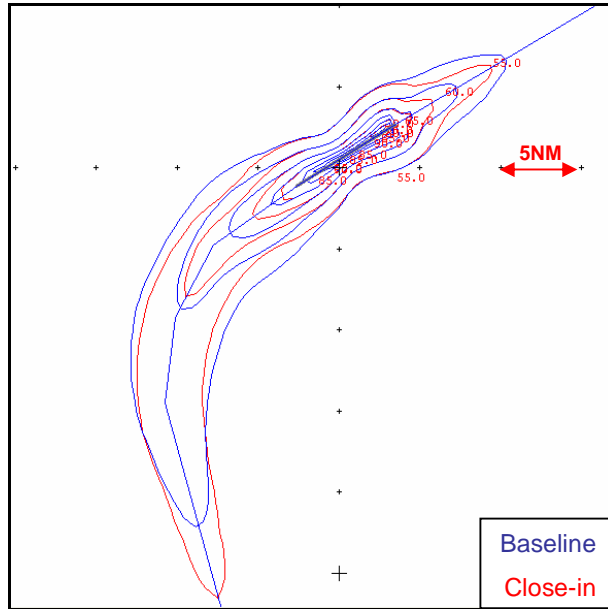


Figure 12: Departures - Baseline vs. Close-in, noise contours comparison (L_{den})

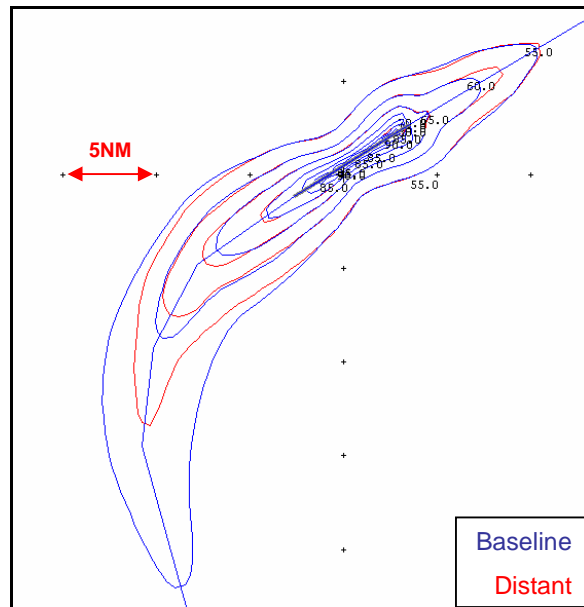


Figure 13: Departures - Baseline vs. Distant, noise contours comparison (L_{den})

4.1.4 Departures, L_{night}

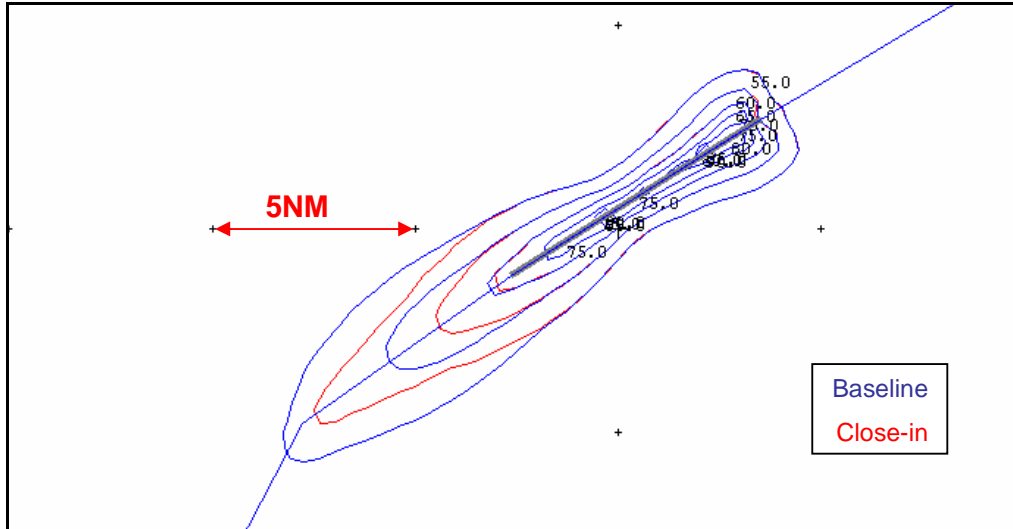


Figure 14: Departures - Baseline vs. Close-in, noise contours comparison (L_{night})

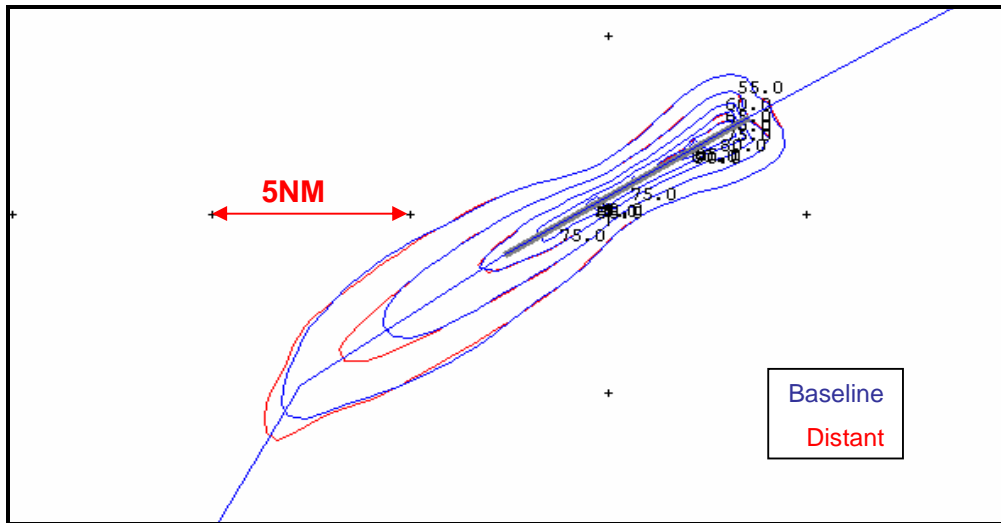


Figure 15: Departures - Baseline vs. Distant, noise contours comparison (L_{night})

4.2 Contour area tables

Additional information on the environmental effects of the new procedures comes from the sizes of the areas within selected noise levels. The following tables show the sizes of the areas (km²) within a specified noise values (L_{den}, L_{night}, L_{AMAX}) and the percentage difference between the Baseline and the SII NAPs. In the second table the percentage variation of the area within a noise level for a SII NAP with the respect to the Baseline scenario are shown.

4.2.1 Arrivals, Lden values

PROC. NR.	Lden	AREA IN SQ. KM							
		55	60	65	70	75	80	85	90
Baseline		10,872	3,581	1,229	0,439	0,128	0,026	0,010	0,002
NAAP2		10,159	3,450	1,174	0,422	0,118	0,027	0,010	0,002
NAAP3		7,359	2,383	0,865	0,341	0,114	0,028	0,010	0,002
NAAP4		10,048	3,457	1,164	0,420	0,118	0,027	0,010	0,002
NAAP5		10,108	3,532	1,186	0,424	0,118	0,027	0,010	0,002

Table 4: NAAP, Noise contour size above selected noise levels (L_{den})

PROC. NR.	Lden	Percentage variation of SII NAAPs footprint areas vs. Baseline footprint area							
		55	60	65	70	75	80	85	90
Baseline									
NAAP2		-6,6%	-3,7%	-4,5%	-3,9%	-7,8%	3,8%	-	-
NAAP3		-32,3%	-33,5%	-29,6%	-22,3%	-10,9%	7,7%	-	-
NAAP4		-7,6%	-3,5%	-5,3%	-4,3%	-7,8%	3,8%	-	-
NAAP5		-7,0%	-1,4%	-3,5%	-3,4%	-7,8%	3,8%	-	-

Table 5: NAAP, Percentage variation of noise contour size above selected noise levels (L_{den})

4.2.2 Arrivals, Lnight values

PROC. NR.	Lnight	AREA IN SQ. KM							
		55	60	65	70	75	80	85	90
Baseline		2,460	0,849	0,303	0,084	0,019	0,006	0,000	
NAAP2		2,339	0,807	0,290	0,082	0,019	0,006	0,000	
NAAP3		1,637	0,623	0,233	0,079	0,021	0,007	0,001	
NAAP4		2,312	0,804	0,289	0,082	0,019	0,006	0,000	
NAAP5		2,362	0,813	0,290	0,081	0,019	0,006	0,000	

Table 6: NAAP, Noise contour size above selected noise levels (L_{night})

Percentage variation noise contour areas, SII NAAPs vs. Baseline									
	Lnight	55	60	65	70	75	80	85	90
PROC. NR.									
Baseline									
NAAP2		-4,9%	-4,9%	-4,3%	-2,4%	0,0%	0,0%	-	-
NAAP3		-33,5%	-26,6%	-23,1%	-6,0%	10,5%	16,7%	-	-
NAAP4		-6,0%	-5,3%	-4,6%	-2,4%	0,0%	0,0%	-	-
NAAP5		-4,0%	-4,2%	-4,3%	-3,6%	0,0%	0,0%	-	-

Table 7: NAAPs, Percentage variation of noise contour size above selected noise levels (L_{night})

4.2.3 Departures, Lden values

AREA IN SQ. KM									
	Lden	55	60	65	70	75	80	85	90
PROC. NR.									
Baseline		24,374	8,772	3,542	1,440	0,641	0,307	0,060	0,015
Close-in		21,636	6,745	2,818	1,355	0,640	0,308	0,060	0,015
Distant		16,739	8,438	3,772	1,488	0,641	0,308	0,061	0,015

Table 8: NADPs, Noise contour size above selected noise levels (L_{den})

	Lden	55	60	65	70	75	80	85	90
PROC. NR.									
Baseline									
Close-in		-11,2%	-23,1%	-20,4%	-5,9%	-0,2%	0,3%	-	-
Distant		-31,3%	-3,8%	6,5%	3,3%	0,0%	0,3%	-	-

Table 9: NADPs, Percentage variation of noise contour size above selected noise levels (L_{den})

4.2.4 Departures, Lnight values

AREA IN SQ. KM									
	Lnight	55	60	65	70	75	80	85	90
PROC. NR.									
Baseline		5,197	2,303	0,932	0,428	0,142	0,025	0,007	0,001
Close-in		4,080	1,928	0,921	0,428	0,142	0,025	0,007	0,001
Distant		5,332	2,521	0,939	0,427	0,142	0,025	0,007	0,001

Table 10: NADPs, Noise contour size above selected noise levels (L_{night})

Percentage variation noise contour areas, SII NADPs vs. Baseline									
	Lnight	55	60	65	70	75	80	85	90
PROC. NR.									
Baseline									
Close-in		-11,2%	-23,1%	-20,4%	-5,9%	-0,2%	0,3%	-	-
Distant		-31,3%	-3,8%	6,5%	3,3%	0,0%	0,3%	-	-

Table 11: NADPs, Percentage variation of noise contour size above selected noise levels (L_{night})

4.3 Bar-charts

4.3.1 Arrivals

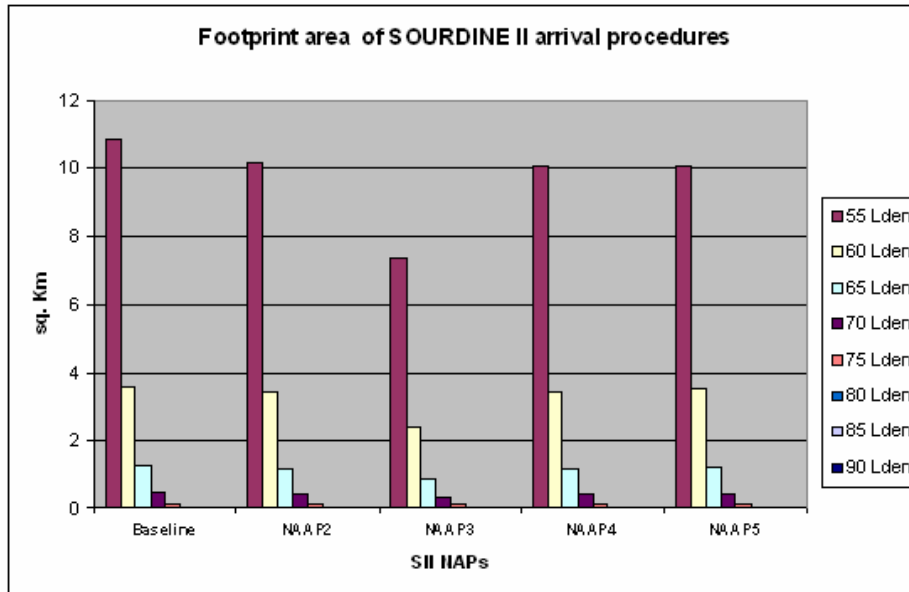


Figure 16: NAAP, Bar chart - Noise contour size above selected noise levels (L_{den})

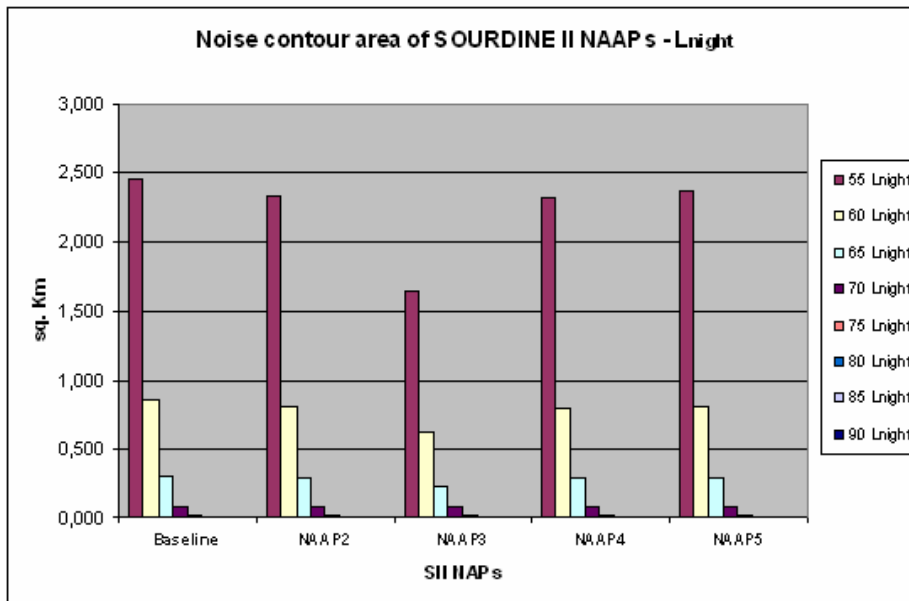


Figure 17: NAAPs, Bar chart - Noise contour size above selected noise levels (L_{night})

4.3.2 Departures

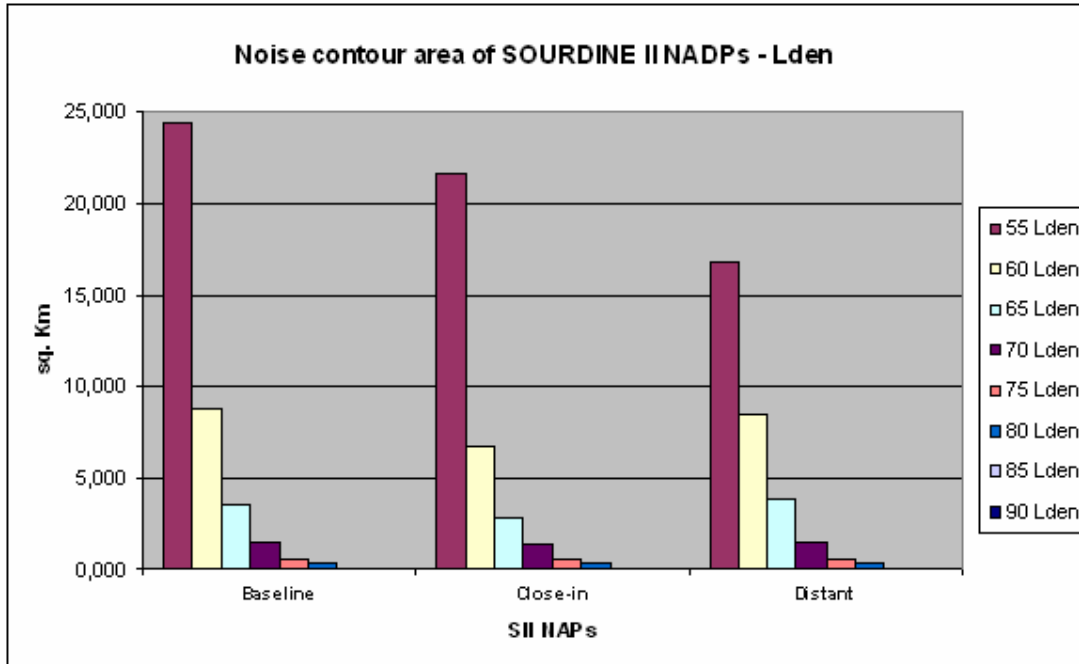


Figure 18: NADPs, Bar chart - Noise contour size above selected noise levels (L_{den})

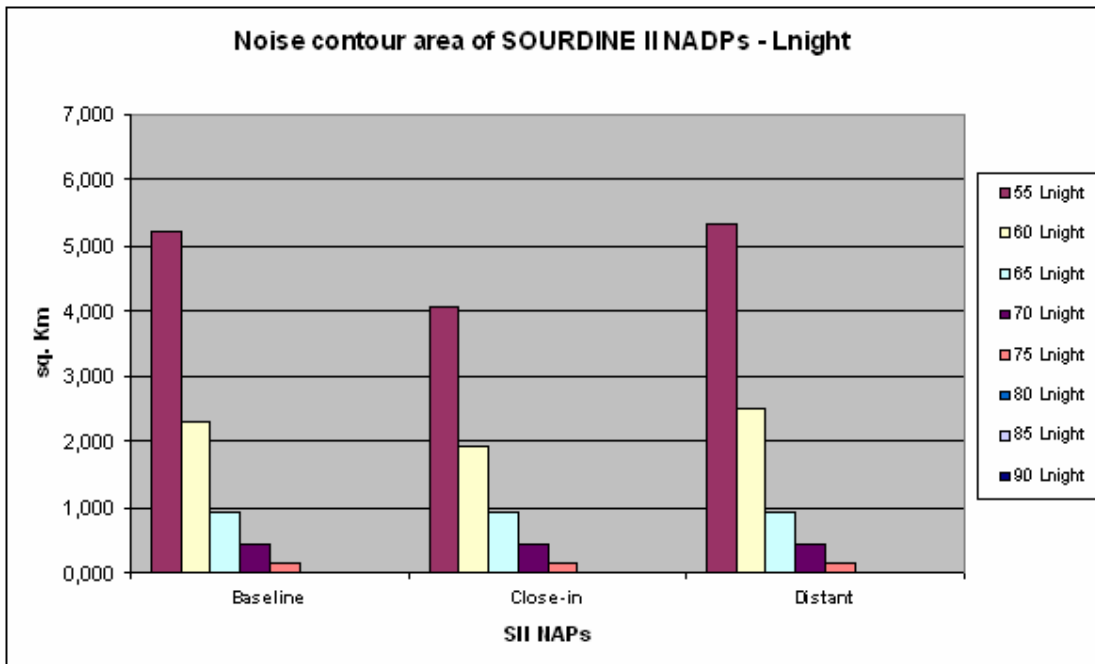


Figure 19: NADPs, Bar chart - Noise contour size above selected noise levels (L_{night})

5 Analysis of noise results

5.1 Arrivals

5.1.1 Procedure II (Figure 4)

Noise contours for the NAAP II and the Baseline differ slightly for 55dB and 60dB. Moving to the higher noise levels the noise contours practically coincide. This result is confirmed in the table resuming the quantitative results, Table 5, where the percentage variations in the noise contour areas above selected noise levels fluctuate from 3% to 7%.

These results can be explained because the altitude profiles of NAAP II and Baseline coincide for a distance less than 9NM from the THR, NAAP II vertical profile is higher than the Baseline between 9 and 18 NM from the THR, and above 18 NM NAAP II vertical profile is lower than the Baseline, but thrust profile is lower too.

5.1.2 Procedure III (Figure 5)

An aircraft using NAAP III is mostly higher than an aircraft flying the Baseline, that's the main reason why the NAAP III noise contour is clearly smaller than for the Baseline. This result is confirmed in the table resuming the quantitative results, Table 5, where the percentage variations in the noise contour areas within selected noise levels are considerable, fluctuating from 8% to 33%.

In the level flight segment you should have the biggest difference in the noise contour, but this fact is not verified why the increased difference in the altitude profile is balanced from a reduced thrust profile for the Baseline procedure.

5.1.3 Procedure IV (Figure 6)

Noise contours for the NAAP IV and the Baseline differ slightly for 55dB noise levels. Moving to the higher noise levels the noise contours practically coincide. These results can be explained because the altitude profiles of NAAP IV and Baseline coincide for a distance less than 6NM from the THR, above this distance NAAP IV altitude profile is always higher than the Baseline and the corresponding thrust profile is higher too.

5.1.4 Procedure V (Figure 7):

The noise contours for the NAAP V and the Baseline differ slightly for 55dB noise levels. Looking at the higher noise levels the noise contours practically coincide. This result is confirmed in the table resuming the quantitative results (Table 5), where the percentage variations in the noise contour areas above selected noise levels fluctuate from 2% to 7%. These results can be explained because the altitude profiles of NAAP V and Baseline coincide for a distance less than 9NM from the THR, above this distance NAAP IV altitude profile is always higher than the Baseline one and the corresponding thrust profile is higher too.

5.2 Departures

The differences in the two Sourdine II departure procedures are very nicely illustrated by the variations in width and length of the contours they produce compared with the baseline.

5.2.1 Close-in

Looking at figure 12, it can be deduced that using a runway on both directions it is possible to obtain surprising results. The Close-in procedure is, conceptually speaking, very efficient in reducing the noise close to the airport but not very efficient in reducing the noise nuisance far from the airport. This theory has been confirmed from the SII results, in fact, looking at the figure 12, on the left side (most take offs), noise levels being equal, the Close-in noise contour is inside the Baseline one in the airport surroundings and the opposite situation is verified far from the airport. On the right side, where a smaller number of aircraft takes off the Close-in noise contour is always inside the Baseline one.

5.2.2 Distant

The Distant procedure is, conceptually speaking, very efficient in reducing the noise nuisance far from the airport, but not as good in reducing the noise in the airport surroundings. This theory has been confirmed from the SII results, in fact, looking at the figure 13 on the left side (most take offs), noise levels being equal, the Distant noise contour is inside the Baseline far from the airport (above 12NM from break release) while, in the airport surroundings the opposite situation is verified. On the right side, where a smaller number of aircraft takes off, the Distant noise contour overlaps the Baseline one, except for the 60dB value, where the Distant noise contour larger than the Baseline one.

6 Conclusions on noise assessment

6.1 Conclusions on the NAAPs noise assessment

Making a summary of the SII NAPs noise assessment results, it can be concluded that NAAP III is the best one in reducing the noise contour around Naples airport, this mainly because an aircraft flying NAAP III is always higher than an aircraft flying a reference procedure, above on the final approach segment (4° instead of 3° glideslope). This result shows the fundamental role played from altitude of a noise source (aircraft) with respect to the other parameters contributing to a balanced approach to the noise reduction.

The other SII NAAPs let to reduce the noise contour within a selected noise levels, but they are not such efficient as the NAAP III. In a hypothetic list of the best NAAPs, after NAAP III NAAP IV, NAAP II and NAAP V should follow in the list, but choice one instead of one other is very airport dependant.

6.2 Conclusions on the NADPs noise assessment

For analysing the results on the SII departure procedures noise assessment, considerations on the urbanisation status of Naples airport are required rather than on the procedures performances. The efficiency in the noise reduction for a NADP depends on the geographic area you want to pay attention to. In the Naples case, most of populated areas are located in the airport vicinity, south-west, so the Close-in procedure could be a good solution in the noise reduction for people leaving around the airport. The Distant NADP doesn't give any benefits in the Naples case, because the advantages of using those procedures mostly cover the see area. An additional general conclusion has to be done on the Close- in and Distant Procedures application: when the NADPs are flown from a small number of aircraft the benefits in using the NADPs are lost, in fact airport surroundings and areas far from the airport coincide.



Appendixes

Annex A – Calibration scenarios: Filter 1 and Filter 2

The calibration scenario run in the noise assessment is not the same as the capacity assessment, where it was used for calibrating the model, for building a scenario as close as possible to the daily airport behaviour. In the noise assessment case, two more scenarios were added to the original planned ones, not for the tuning of model parameters, but for quantifying the error done not including the turboprops and small jets in the noise assessment.

Calibration – Filter 1

In this scenario the weight of turboprops on the noise contour assessment was quantified. The experimental conditions used for the development of the validation exercise are:

- Platform used : INM6.1
- Meteorological conditions: INM default
- Airport/airspace/route planned at 2015
- Metric used for the noise contour calculation: L_{den}
- Traffic sample foreseen at 2015 (see par. 5.3.3 [SII_D4_1_5a]) excluding turboprops (~20 % of the Naples fleet mix)

Results obtained running this scenario are summarized in the following table:

Noise level (L_{den})	Turboprop	No Turboprop	Percentage Variation
55	11,28	10,99	2,7%
60	4,78	4,61	3,6%
65	1,93	1,88	2,4%
70	0,47	0,46	2,2%
75	0,15	0,15	2,8%
80	0,02	0,01	7,1%

Table 12: Calibration scenario – Filter 1: Comparison of noise contour size with and without turboprops

Looking at last column, where there are reported the percentage variations, it's clear that the variations per noise level are very small, about 2-3%, except above 80dB, where the change is about 7%, but 80dB contour is within airport borders, so it can be disregarded as result. Accordingly to the above results, turboprops were excluded from the analysis.

Calibration – Filter 2

In this scenario the weight of turboprops on the noise contour assessment was quantified.

The experimental conditions used for the development of the validation exercise are:

- Platform used : INM6.1
- Meteorological conditions: INM default
- Airport/airspace/route planned at 2015
- Metric used for the noise contour calculation: L_{den}
- Traffic sample selected in the Calibration scenario – Filter1, excluding small jets (~10% of the fleet mix) from the noise contour calculation.

Noise level (L_{den})	Small jet	No small jets	Percentage Variation
55	14,37	12,63	13,8%
60	5,83	5,03	16,0%
65	1,88	1,62	15,8%
70	0,59	0,53	11,1%
75	0,13	0,12	9,0%
80	0,04	0,03	19,4%

Table 13: Calibration scenario – Filter 2: Comparison of noise contour size with and without small jets

Even if the error done in leaving out the small jets varies from 9 to 16%, it has been decided to exclude them from the analysis, because the target of the SII project was not to give the right noise contour using the SII NAPs, but to make an estimation of the benefits in the noise reduction making use of the SII NAPs instead of the standard A/D procedures.