International Civil Aviation Organization

Middle East Regional Monitoring Agency Board

Seventeenth Meeting (MIDRMA Board/17)
(Virtual, 18 – 19 January 2022)

Agenda Item 4: RVSM Monitoring and related Technical Issues

MID RVSM SMR 2021

(Presented by the MIDRMA)

SUMMARY

This working paper details the results of the MID RVSM Safety Monitoring Report 2021, which demonstrate according to the data used that the key safety objectives of the SMR in accordance with ICAO Doc 9574 were met in operational service.

Action by the meeting is at paragraph 3.

REFERENCES

- MIDANPIRG/18 Report
- MIDRMA Board/16 Report
- MID RVSM SMR 2019 and SMR 2021

1. INTRODUCTION

1.1 The MID RVSM Safety Monitoring Report (SMR) 2021 covers the reporting period from 1st January 2021 till 31st December 2022 for the ongoing process of providing periodic updates of information relevant to the continued safe use of the RVSM in the ICAO Middle East Airspaces.

1.2 The MID SMR 2021 Report reflects the airspace safety review of the MID RVSM airspace conducted based on a one-month traffic data sample (TDS) collected for July 2021. The MIDRMA encountered a lot of difficulties to process and analyze the TDS due corrupted and wrong data format submitted by some member States, which caused heavy work developing this Report. The MID SMR 2021 also includes the monthly Large Height Deviation (LHD) reports for the same reporting period submitted by MIDRMA member States through the LHD online reporting system.

2. DISCUSSION

2.1 The MID RVSM Safety Monitoring Report 2021 is at **Appendix A**.

3. ACTION BY the MEETING

3.1 The meeting is invited to:

a) review the results of the SMR 2021, at **Appendix A**, to be presented to MIDANPIRG/19 (14 – 17 February 2022) for endorsement;

b) urge States to continue reporting the LHDs categories A, B, C, D, H , J and K through the LHD on line reporting system;

c) urge Member States to investigate their related LHDs and reply back with their findings/corrective actions by using the reply feature in the LHD online reporting system;

d) address the RVSM Safety Protocol opened at Muscat/Mumbai FIR boundaries; and

e) discuss the increasing numbers of LHD reports submitted by Sana'a ACC and agree to open an RVSM Safety Protocol to resolve this critical safety issue.

MID RVSM SMR 2021

MID RVSM SAFETY MONITORING REPORT 2021 (SMR 2021)

Prepared by the Middle East Regional Monitoring Agency (MIDRMA)

SUMMARY

The aim of the MID RVSM Safety Monitoring Report 2021 is to provide airspace safety review of the MID RVSM airspace and to highlight by means of arguments and supporting evidence that the implementation of RVSM in the ICAO Middle East Region is acceptably safe.

1. INTRODUCTION:

1.1 Executive Summary

The MID RVSM Safety Monitoring Report is issued by the Middle East Regional Monitoring Agency (MIDRMA) for endorsement by the Middle East Air Navigation Planning and Implementation Regional Group (MIDANPIRG).

The report presents evidence that according to the data and methods used, all safety objectives set out in the MID RVSM Safety Policy in accordance with ICAO Doc 9574 (2nd Edition) continue to be met in operational services within the Middle East RVSM airspace with some reservation for Safety Objective 3 which is under continuous monitoring by MIDRMA.

To conclude on the current safety of RVSM operations, the three key safety objectives endorsed by MIDANPIRG have to be met:

Objective 1 The risk of collision in MID RVSM airspace due solely to technical height-keeping performance meets the ICAO target level of safety (TLS) of $2.5x10^{-9}$ fatal accidents per flight hour.

The value computed for technical height risk is estimated **3.509×10^{-12}** this meets RVSM Safety Objective 1.

Objective 2 The overall risk of collision due to all causes which includes the technical risk and all risk due to operational errors and in-flight contingencies in the MID RVSM airspace meets the ICAO overall TLS of **$5x10^{-9}$** fatal accidents per flight hour.

The value computed for the overall risk is estimated **4.073×10^{-10}** this meets RVSM Safety Objective 2.

Objective 3 Address any safety-related issues raised in the SMR by recommending improved procedures and practices; and propose safety level improvements to ensure that any identified serious or risk-bearing situations do not increase and, where possible, that they decrease. This should set the basis for a continuous assurance that the operation of RVSM will not adversely affect the risk of en-route mid-air collision over the years.

Middle East RVSM Airspace Estimated Annual Flying Hours = (**1,421,352**) Average Aircraft Speed = **444.35 kts**			
Risk Type	**Risk Estimation**	**ICAO TLS**	**Remarks**
Technical Risk	**3.509×10^{-12}**	**2.5×10^{-9}**	**Below ICAO TLS**
Overall Risk	**4.073×10^{-10}**	**5×10^{-9}**	**Below ICAO TLS**

Conclusions:

(i) The estimated risk of collision associated with aircraft height- keeping performance is **3.509×10^{-12}** and meets the ICAO TLS of **2.5×10^{-9}** fatal accidents per flight hour (RVSM Safety Objective1).

(ii) The estimated overall risk of collision due to all causes which includes the technical risk and all risk due to operational errors and in-flight contingencies is **4.073×10^{-10}** meets the ICAO overall TLS of **5×10^{-9}** fatal accidents per flight hour (RVSM Safety Objective 2)

(iii) Based on currently-available information (Except for Tripoli FIR), there is no evidence available to MIDRMA that the continued operations of RVSM adversely affects the overall vertical risk of collision other than the violation of Non-RVSM approved aircraft to the MID RVSM airspace which is under continuous monitoring and review by MIDRMA. (More details in 2.5)

1.2 **Considerations on the Safety Objectives for MID RVSM SMRs**

When considering the three safety objectives for RVSM, the following considerations should be borne in mind:

1. The assessment of risk against the TLS, both for technical and overall risk estimates, relies on height keeping performance data to assess the risk in the vertical plane and studies of traffic density to calculate the risk in the horizontal plane. There are numbers of assumptions that must be verified to satisfy the reliability of the risk assessment, the verification of these assumptions deals primarily with monitoring of aircraft performance issues.
2. The Aircraft performance is assessed by individual airframe and by monitoring group. A monitoring group consists of aircraft that are nominally of the same type with identical performance characteristics that are made technically RVSM compliant using a common compliance method. Monitoring group analysis is necessary to verify that the Minimum Aviation System Performance Standards (MASPS) for that group is valid. Aircraft that are made RVSM compliant on an individual basis are termed non-group.
3. RVSM Safety Objective 2, dealing with overall risk, takes into account the technical risk together with the risk from all other causes. In practice, this relates to the human influence and assessment of this parameter relies on adequate reporting of Large Height Deviation (LHD) Reports, and the correct interpretation of events for input to the CRM.
4. RVSM Safety Objective 3 requires the RMA to monitor long-term trends and to identify potential future safety issues, this compare the level of risk bearing incidents for the current reporting period. It also highlights if there are issues that should be carried forward as recommendations to be adopted for future reports.

2.0 Discussion

Scope:

The geographic scope of the MID RVSM Safety Monitoring Report covers the MID RVSM airspace, which comprises the following FIRs/UIRs:

Amman	Bahrain	Beirut	Baghdad	Cairo	Damascus	Emirates
Jeddah	Kuwait	Khartoum	Muscat	Sana'a	Tehran	Tripoli*

T-1: FIRs/UIRs of the Middle East RVSM Airspace

***Note: Tripoli FIR excluded from the RVSM safety analysis due to lack of data.**

The Data Sampling periods covered by SMR 2020 are as displayed in the below table

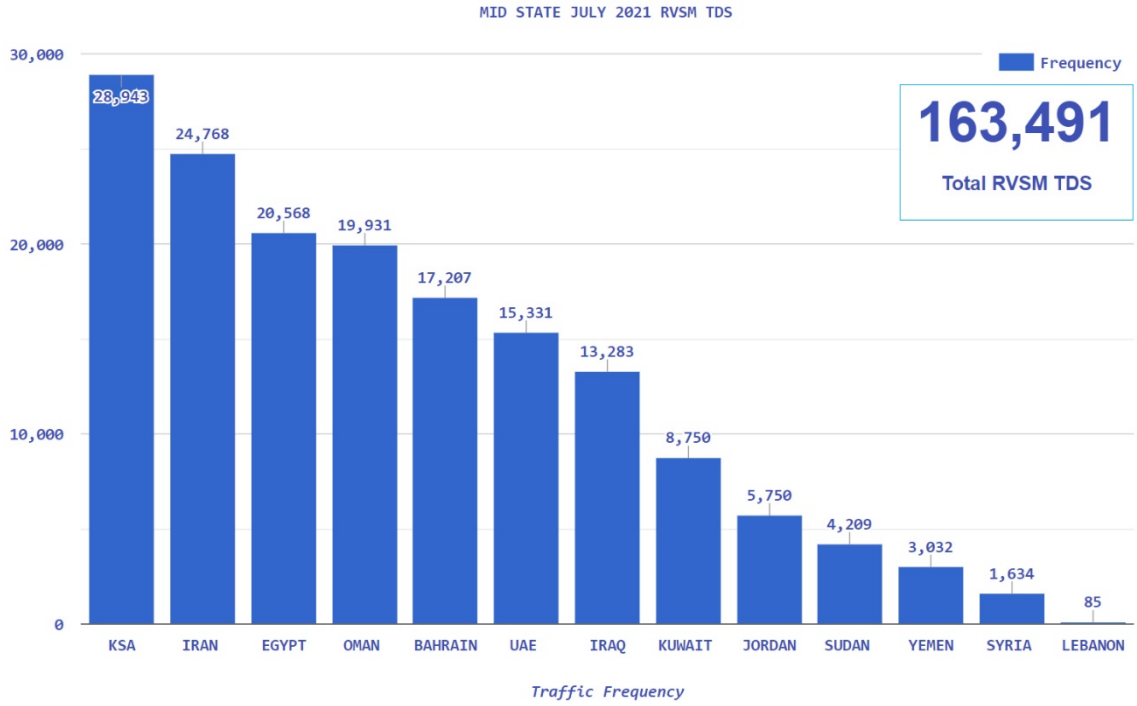
Report Elements	Time Period
Traffic Data Sample	01/07/2021 - 31/07/2021
Operational & Technical Errors	01/01/2021 - 31/12/2021

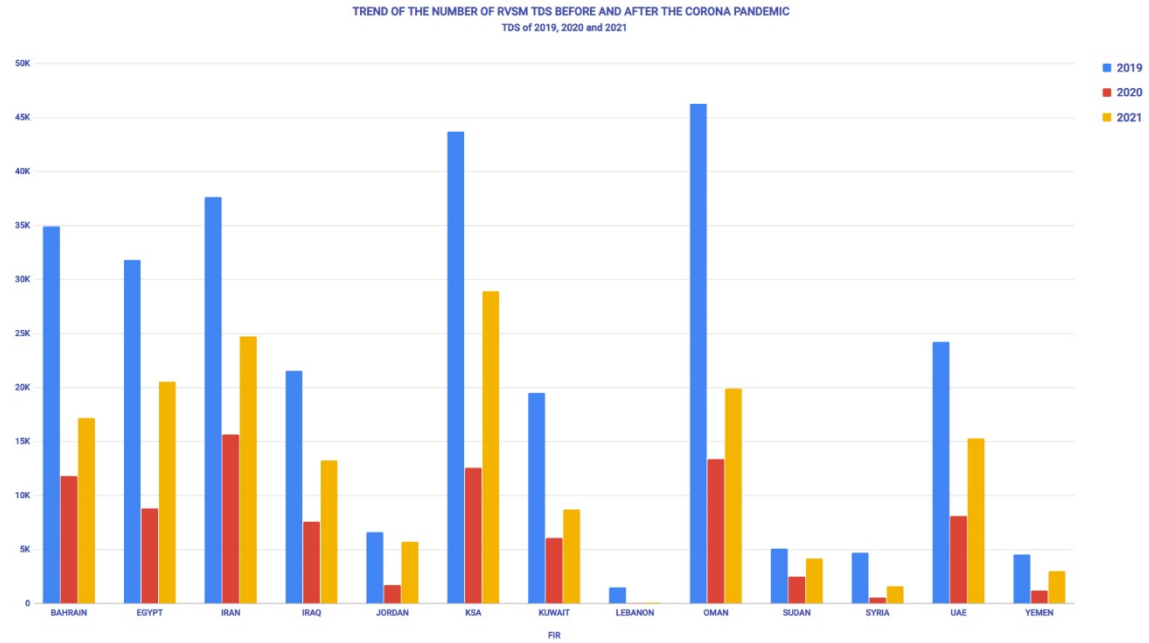
2.1 The descriptions of the traffic data collected from each MIDRMA Member State are depicted in table below:

MID States	No. of Flights	Received Dates	Status
Bahrain FIR	17207	12/08/2021	Accepted
Cairo FIR	20568	26/08/2021	Accepted
Amman FIR	5750	28/08/2021	Accepted
Muscat FIR	19931	17/08/2021	Accepted
Tehran FIR	24768	12/09/2021	Accepted
Khartoum FIR	4209	30/08/2021	Accepted
Emirates FIR	15331	22/08/2021	Accepted
Damascus FIR	1634	12/09/2021	Accepted
Sana'a FIR	3032	23/08/2021	Accepted
Baghdad FIR	13283	25/08/2021	Accepted
Kuwait FIR	8750	01/08/2021	Accepted
Jeddah FIR	28943	19/08/2021	Accepted
Beirut FIR	85	04/09/2021	Accepted
Tripoli FIR	-	-	No Data Submitted
Total	**163491**		

Table 1: Details of the MID States RVSM Traffic Data Sample (TDS) for July 2021.
Note: MIDRMA still faces number of errors/mistakes in the delivered TDS data from many States.

2.2 The description of the traffic data processed for each MIDRMA member state by the MID Risk Analysis Software (MIDRAS) is depicted in the graph below, a total of **163,491** flights were processed for the 13 FIRs, these flights were evaluated and processed very carefully to ensure accurate results according to the data submitted.

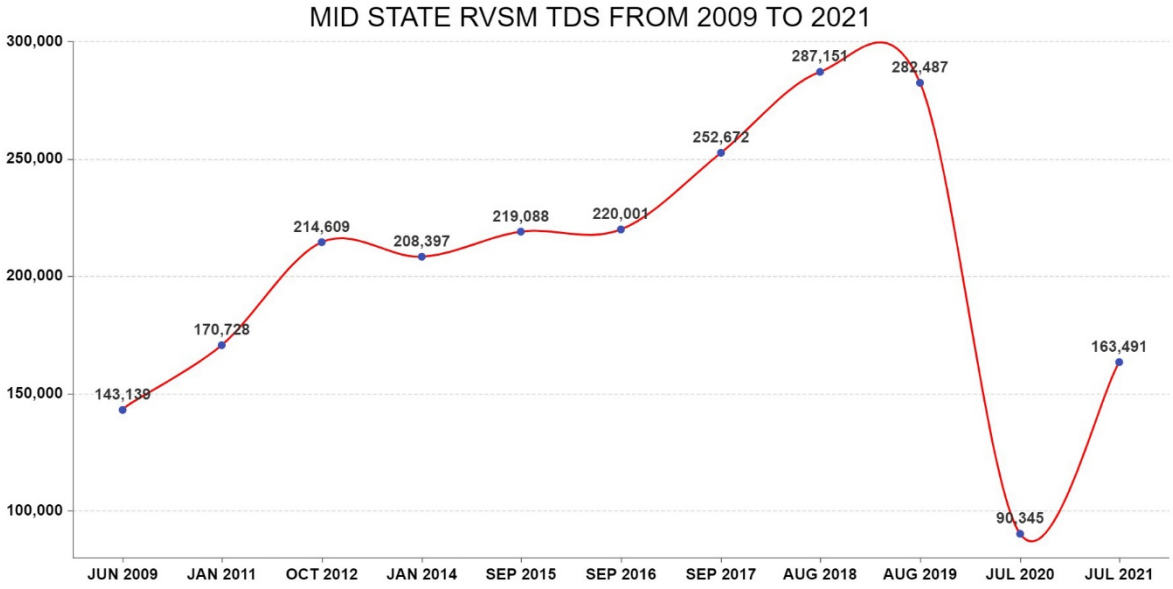




2.3 The COVID-19 pandemic has had a major impact on the airline industry across the world due to travel restrictions and reduced demand among travelers. The significant decrease in passenger demand is starting to improve compared to 2020 while this SMR TDS has reached 58% of what was recorded for TDS 2019 (before the pandemic).

#	MID FIRs	No of TDS July 2020	No of TDS July 2021	TDS Difference 2020 vs 2021	% of TDS Difference 2020 vs 2021
1	**Bahrain FIR**	11844	17207	5363	↑ **45.28 %**
2	**Cairo FIR**	8838	20568	11730	↑ **132.72 %**
3	**Amman FIR**	1752	5750	3998	↑ **228.2 %**
4	**Muscat FIR**	13404	19931	6527	↑ **48.69 %**
5	**Tehran FIR**	15689	24768	9079	↑ **57.87 %**
6	**Khartoum FIR**	2526	4209	1683	↑ **66.63 %**
7	**Emirates FIR**	8137	15331	7194	↑ **88.41 %**
8	**Damascus FIR**	582	1634	1052	↑ **180.76 %**
9	**Sana'a FIR**	1233	3032	1799	↑ **145.9 %**
10	**Jeddah FIR**	12605	28943	16338	↑ **129.62 %**
11	**Beirut FIR**	28	85	57	↑ **203.57 %**
12	**Baghdad FIR**	7602	13283	5681	↑ **74.73 %**
13	**Kuwait FIR**	6105	8750	2645	↑ **43.33 %**
14	**Tripoli FIR**	NO TDS	NO TDS	-	-
	Total	**90,345**	**163,491**	**73,146**	**↑ 80.96%**

Comparison Table of MIDRMA Member States TDS for Years 2020 and 2021



2.4 Compiling and correcting the traffic data and then analysing it require a lot of efforts and follow up with the focal points to ensure the highest quality results obtained are reliable to study the impact of RVSM implementation within the ICAO Middle East Region, the MIDRMA decided to arrange for an upgrade to the MIDRAS to overcome problems with the errors in the received TDS

from some member states, the upgrade will include other necessary features which will facilitate calculating all RVSM risk parameters and shall save a lot of time to avoid rejecting the TDS due to a lot of errors which usually delay the production of the SMR.

#	Reporting Points	FIRs	Frequency
1	**TASMI**	BAGHDAD / KUWAIT	4951
2	**RATVO**	BAGHDAD / ANKARA	4857
3	**SIDAD**	BAGHDAD / KUWAIT	4823
4	**DAVUS**	BAHRAIN / KUWAIT	4500
5	**NINVA**	BAGHDAD / ANKARA	4133
6	**ULINA**	CAIRO / AMMAN	4041
7	**KITOT**	CAIRO / JEDDAH	3634
8	**ULADA**	BAHRAIN / JEDDAH	3541
9	**LONOS**	BAHRAIN / KUWAIT	3156
10	**DEESA**	AMMAN / JEDDAH	3004
11	**RASKI**	MUSCAT / MUMBAI	2848
12	**GABKO**	TEHRAN / EMIRATES	2661
13	**ALPOB**	BAHRAIN / EMIRATES	2542
14	**RASDA**	CAIRO / NICOSIA	2477
15	**NUBAR**	CAIRO / KHARTOUM	2363
16	**TUMAK**	BAHRAIN / EMIRATES	2339
17	**DAROR**	BAHRAIN / JEDDAH	2305
18	**NARMI**	BAHRAIN / JEDDAH	2290
19	**PASAM**	CAIRO / JEDDAH	2249
20	**BONAM**	TEHRAN / ANAKRA	2221

TDS 2021 Top 20 Busiest FIR Entry / Exit Points in the ICAO MID RVSM Airspace

2.5 For the Seventh consecutive Safety Monitoring Reports, Tripoli FIR excluded temporary from the RVSM safety analysis due to lack of TDS and LHD reports, taking into consideration the MIDRMA never done any risk analysis for Tripoli FIR RVSM airspace since Libya joint the MIDRMA, this issue require the MIDRMA board and MIDANPIRG to decide what action should be taken if RVSM operations resume within the Tripoli FIR in the future

2.6 **The Collision Risk Model (CRM)**

2.6.4 The risk of collision to be modelled is that due to the loss of vertical separation between aircraft flying between FL290 and FL410 in a given portion of an airspace. One collision between two aircraft is counted as the occurrence of two accidents. The risk of collision depends both on the total number and types of aircraft flying in the system and the system characteristics.

2.6.2 The CRM provides an estimate of the number of accidents within an airspace system that might occur per aircraft flight hour due to aircraft collisions resulting from the loss of vertical separation in an RVSM environment analysis, is expressed in terms of quantifiable parameters. In the vertical dimension the CRM can be broken down in order to separately model a single route on which aircraft are flying in the same or opposite directions at adjacent flight levels, pairs of crossing routes

and combinations of individual and intersecting routes, this model is applied equivalently to vertical, lateral and longitudinal separation.

2.6.3 Three parameters used within the CRM:

a. The Vertical Overlap Probability, denoted as Pz(1 000).

b. The Lateral Overlap Probability, denoted as Py(0).

c. The aircraft Passing Frequency are the most important quantities in determining the vertical collision risk. Of these, the vertical overlap probability is also an important parameter to calculate.

2.7 Technical Height Keeping Performance Risk Assessment

RVSM Safety Objective 1

The risk of collision in MID RVSM airspace due solely to technical height-keeping performance meets the ICAO target level of safety (TLS) of **2.5×10^{-9}** fatal accidents per flight hour.

Direct evidence of compliance with TLS for Technical Height-Keeping Error

The result shows the risk of collision due to technical height-keeping performance is estimated to be **3.509×10^{-12}** fatal accidents per flight hour, which is less than the ICAO TLS **2.5×10^{-9}**.

MID RVSM SMRs Technical Risk Values				
Year 2006	**Year 2008**	**Year 2010**	**Year 2011**	**Year 2012/13**
2.17×10^{-14}	**1.93×10^{-13}**	**3.96×10^{-15}**	**5.08×10^{-14}**	**6.37×10^{-12}**
Year 2014	**Year 2015**	**Year 2016**	**Year 2017**	**Year 2018**
3.18×10^{-12}	**3.056×10^{-10}**	**6.347×10^{-11}**	**4.966×10^{-11}**	**1.562×10^{-11}**
Year 2019	**Year 2020**	**Year 2021**		
2.012×10^{-13}	**9.185×10^{-13}**	**3.509×10^{-12}**		

According to the technical risk values as shown in the above table the TLS values still, meet the ICAO TLS.

2.7.1 Supporting evidence of compliance with TLS for technical height-keeping performance

To demonstrate that the result is reliable, it is necessary to demonstrate that the following assumptions are true:

a. The estimated value of the frequency of horizontal overlap, used in the computations of vertical-collision risk, is valid;

b. Pz(1000) – the probability of vertical overlap due to technical height-keeping performance, between aircraft flying 1000 ft. separation in MID RVSM airspace is estimated **5.207×10^{-10}** valid and is less than the ICAO requirement of **1.7×10^{-8}**.

c. The monitoring target for the MID RVSM height-monitoring programme is an on-going process.

d. The input data used by the CRM is valid.

e. An adequate process is in place to investigate and correct problems in aircraft technical height-keeping performance.

2.7.2 Calculating the Probability of Lateral Overlap (P_y (0))

The probability of lateral overlap $P_y(0)$ is the probability of two aircraft being in lateral overlap which are nominally flying on (adjacent flight levels of) the same route. The calculation of the Py (0) for the SMR 2021 has the following to consider:

a. The MIDRMA continued to calculate the probability of lateral overlap $\boldsymbol{P_y(0)}$ for all the MID RVSM airspace as per the ICAO methodology developed for this purpose and derived by the MID Risk Analysis Software (MIDRAS).

b. The MIDRMA calculated the probability of lateral overlap $\boldsymbol{P_y(0)}$ for each MIDRMA Member State and found all the results are valid :

1- Bahrain FIR:
Passing Frequency (n_equiv): 6.43304E-003
Probability of Lateral Overlap (Py(0)): 0.16441.

2- Cairo FIR:
Passing Frequency (n_equiv): 2.38668E-001
Probability of Lateral Overlap (Py(0)): 0.15226.

3- Baghdad FIR
Passing Frequency (n_equiv): 2.95343E-002
Probability of Lateral Overlap (Py(0)): 0.1658.

4- Tehran FIR
Passing Frequency (n_equiv): 4.18680E-002
Probability of Lateral Overlap (Py(0)): 0.14065.

5- Amman FIR
Passing Frequency (n_equiv): 4.13924E-002
Probability of Lateral Overlap (Py(0)): 0.13698

6- Kuwait FIR
Passing Frequency (n_equiv): 3.87258E-003
Probability of Lateral Overlap (Py(0)): 0.1716

7- Beirut FIR
Passing Frequency (n_equiv): Not enough traffic to measure
Probability of Lateral Overlap (Py(0)): 0.097463

8- Muscat FIR
Passing Frequency (n_equiv): 1.93820E-001

Probability of Lateral Overlap (Py(0)): 0.16611

9- Jeddah FIR
Passing Frequency (n_equiv): 2.13603E-002
Probability of Lateral Overlap (Py(0)): 0.14626

10- Khartoum FIR
Passing Frequency (n_equiv): 5.63241E-002
Probability of Lateral Overlap (Py(0)): 0.17548

11- Damascus FIR
Passing Frequency (n_equiv): 2.82413E-001
Probability of Lateral Overlap (Py(0)): 0.12441

12- Emirates FIR
Passing Frequency (n_equiv): 3.61452E-003
Probability of Lateral Overlap (Py(0)): 0.16116

13- Sana'a FIR
Passing Frequency (n_equiv): 2.39246E-001
Probability of Lateral Overlap (Py(0)): 0.17121

c. Overall, the results are considered to be valid.

2.7.3 Pz(1000) Compliance

The Pz(1000) is the probability that two aircraft at adjacent RVSM flight levels will lose vertical separation due to technical height keeping errors. The value of the probability of vertical overlap Pz(1000), based on the actual observed ASE and typical AAD data is estimated to be of **5.207×10^{-10}**

This value meets the Global System Performance Specification that the probability that two aircraft will lose procedural vertical separation of 1000ft should be no greater than **1.7×10^{-8}**.

The MIDRMA continues to issue the minimum monitoring requirements (MMRs) through the automated MMR software which is programmed to address the MIDRMA member states with their updated requirements according to the latest RVSM approvals received, the MMR table valid for December 2021 is available in **Appendix B**.

Note: All member states are required to check and comply with their MMR through the MIDRMA website (www.midrma.com).

2.7.1 **Conclusions on Technical Vertical Collision Risk:**

a. The current computed vertical-collision risk due to technical height-keeping performance meets the ICAO TLS.

b. The probability of vertical-overlap estimate, Pz(1000), satisfies the global system performance specification.

c. Most monitoring groups are complying with ICAO TVE component requirements (also known as technical height-keeping group requirements).

2.7.2 **Recommendations for Safety Objective 1:**

a. The MIDRMA shall continue to review the content and structure of its aircraft monitoring groups (on going task).

b. The MIDRMA will continue to keep the methods of calculating the technical CRM parameters and the risk due to technical height keeping errors under review and explore more options to enhance the MID Risk Analysis Software (MIDRAS),

Note: new project has started to include more features in the MIDRAS (will be presented to the MIDRMA Board meeting for approval.

c. The MIDRMA shall carry out continuous height monitoring survey and investigation concerning aircraft flying within the MID RVSM airspace by collecting the TDS from member states offered to submit their RVSM TDS on a monthly basis.

d. More MIDRMA Member states other than Bahrain, Iraq and UAE are encouraged to send their monthly RVSM traffic data to explore more possible violations to the MID RVSM airspace.

2.8 Assessment of overall risk due to all causes against the TLS of 5 x 10^{-9} fatal accidents per flight hour

RVSM Safety Objective 2

The overall risk of collision due to all causes which includes the technical risk and all risk due to operational errors and in-flight contingencies in the MID RVSM airspace meets the ICAO overall TLS of **5 x 10^{-9}** fatal accidents per flight hour.

The value computed for the overall risk is estimated **4.073 x 10^{-10}** this meets RVSM Safety Objective 2.

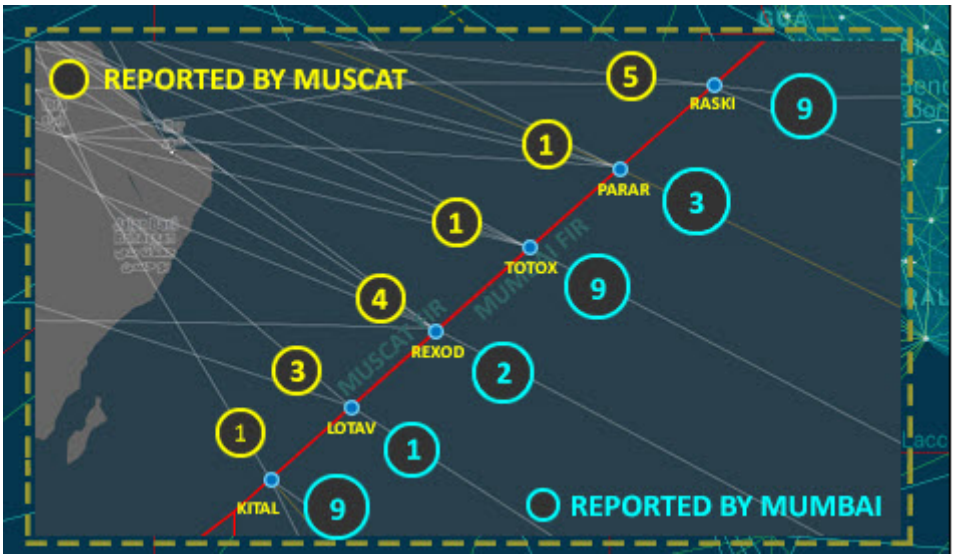
Overall Risk Values				
Year 2006	**Year 2008**	**Year 2010**	**Year 2011**	**Year 2012/13**
Not calculated	**4.19x10^{-13}**	**6.92x10^{-12}**	**1.04x10^{-11}**	**3.63x10-11**
Year 2014	**Year 2015**	**Year 2016**	**Year 2017**	**Year 2018**
4.91x10^{-11}	**7.351x10^{-10}**	**5.691x10^{-10}**	**4.518 x10^{-11}**	**9.845 x10^{-11}**
Year 2019	**Year 2020**	**Year 2021**		
8.345 x10^{-10}	**5.206 x10^{-10}**	**4.73 10^{-10}**		

2.8.1 The vertical risk estimation due to atypical errors has been demonstrated to be the major contributor in the overall vertical-risk estimation for the MID RVSM airspace, In the previous SMRs the processed data were severely influenced by either NIL reporting of Large Height Deviations (LHDs) and very few reports of categories A, B, C, D, J and K as without enough data (especially from FIRs with high volume of traffic) will not reflect confidence with the final results.

2.8.2 The MIDRMA continues to monitor the LHD reports at the eastern FIR boundary of Muscat FIR filed by Mumbai, the MIDRMA indicated in SMR 2017 the level of LHD reports filed by Muscat and Mumbai ATCUs related to each other at their transfer of control points reached to a dangerous level and started to effect the ICAO TLS of RVSM implementation in the MID and APAC regions, therefore the MIDRMA requested from MIDRMA Board/15 meeting (Muscat – Oman 29 – 31 January 2018) to open a Safety Protocol for the purpose of resolving this issue as soon as possible.

2.8.3 Although, the traffic level reduced at the common FIR boundary points for Muscat and Mumbai, the MIDRMA can't see much improvement for SMR 2021 as the safety concern still exist and more works required from both ATCUs to close this safety protocol such as the implementation of OLDI/AIDC which is still ambiguous at this stage and required follow up from MIDANPIRG.

Note: A Safety Protocol is a critical safety issue effecting the implementation of RVSM operations which require the concerned authority an immediate action to rectify/resolve the problem in a certain period of time under the supervision of MIDRMA and ICAO MID Office.

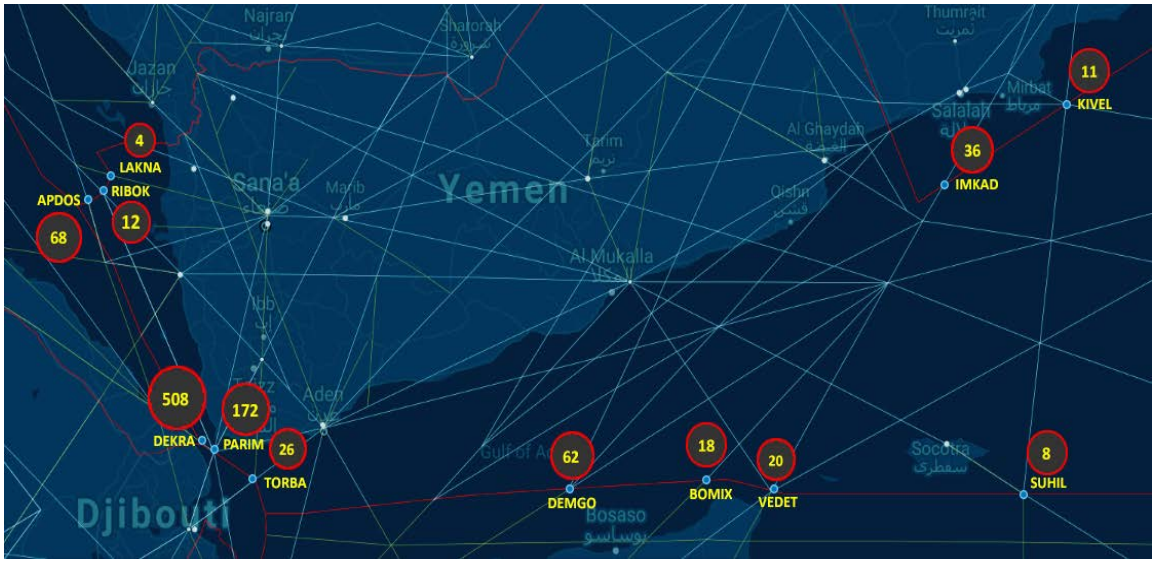


2.8.4 The Safety Protocol is under continuous review by MIDRMA and MAAR and the LHD reports filed by all concerned ATC Units are investigated and evaluated through the MIDRMA online LHD system and further update will be addressed to the next MIDRMA Board meeting.

2.8.5 The problem of the increased number of LHD reports submitted by Sana'a ACC related to some its neighboring ATCUs began to appear more than three years ago and did not improve even with the decrease in the number of air traffic in 2020 and 2021 due to the outbreak of the Corona pandemic, the MIDRMA is addressing this issue to the MIDRMA Board/17 to take all necessary measures to resolve this problem.

2.8.6 Through the evaluation review for the LHD reports valid for SMRs 2017, 2018, 2019 and 2020 the MIDRMA noticed very few Member States are investigating the reported LHDs related to their FIRs and reply with their outcomes/corrective actions. The meeting may wish to note that the Online LHD System has the feature to allow all Member States to forward their reports directly to the concerned focal points responsible to receive the LHD reports and allow them to reply with their outcomes in the same report which will be archived for future analysis.

2.8.7 The MIDRMA pointed out during the last Board meeting the issue of lack of response to the received LHD reports using the feature of direct response to the reporting unit to ensure that all responses are archived and referenced when needed. Unfortunately, the extreme majority of the Member States are not using this feature and don't bother to investigate and reply to the received LHD reports.



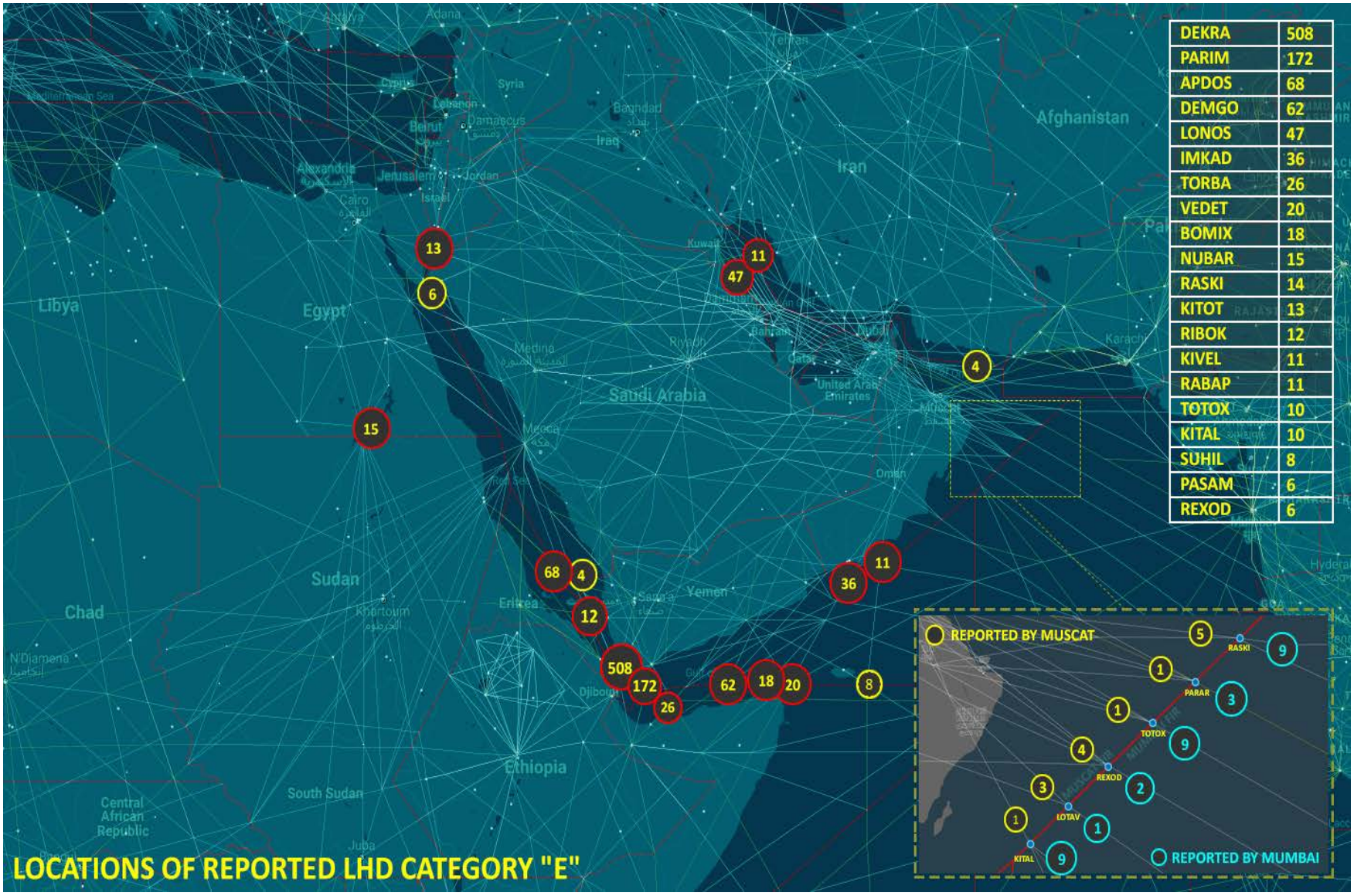
2.8.8 The Table below presents a summary of operational risk associated with Large Height Deviation (LHD) reports by LHD categories, these reports used to calculate the overall vertical collision risk for the MID RVSM airspace.

LHD Cat. Code	Large Height Deviation (LHD) Category	No. of LHDs	LHD Duration (Sec.)
A	Flight crew fails to climb or descend the aircraft as cleared	**6**	**95**
B	Flight crew climbing or descending without ATC clearance	-	-
C	Incorrect operation or interpretation of airborne equipment	-	-
D	ATC system loop error	-	-
E	ATC transfer of control coordination errors due to human factors	**42**	**990**
F	ATC transfer of control coordination errors due to technical issues	**1**	**15**
G	Aircraft contingency leading to sudden inability to maintain level	-	-
H	Airborne equip. failure and unintentional or undetected FL change	**2**	**25**
I	Turbulence or other weather related cause		
J	TCAS resolution advisory and flight crew correctly responds	**1**	**5**
K	TCAS resolution advisory and flight crew incorrectly responds	-	-
L	An aircraft being provided with RVSM separation is not RVSM approved	**1**	**20**
M	Other	-	-
	Total	**53**	**1150**

Summary of Operational Risk associated with Large Height Deviation Reports

MID RVSM SMR 2021

2.8.9 The picture below reflects the locations of the top 20 reported LHDs category E in the ICAO Middle East Region.


DEKRA 508
PARIM 172
APDOS 68
DEMGO 62
LONOS 47
IMKAD 36
TORBA 26
VEDET 20
BOMIX 18
NUBAR 15
RASKI 14
KITOT 13
RIBOK 12
KIVEL 11
RABAP 11
TOTOX 10
KITAL 10
SUHIL 8
PASAM 6
REXOD 6
REPORTED BY MUSCAT
REPORTED BY MUMBAI
RASKI
PARAR
TOTOX
REXOD
LOTAV
KITAL
LOCATIONS OF REPORTED LHD CATEGORY "E"

MID RVSM SMR 2021

2.8.10 **Effects of Future Traffic Growth**

For the second year, the Coronavirus outbreak and the relevant precautionary measures to limit its spreading are having clear impacts on human mobility at global scale. This provoked a reduction of domestic and international volumes of air passenger traffic worldwide, such effects are currently being observed in the Middle East region. This has clear implications for the aviation industry as well as indirect consequences to several sectors (e.g. tourism) and the economy at large as well as the society.

The MIDRMA continuously monitoring the traffic growth from the RVSM traffic data received on a monthly basis from Bahrain, Iraq and UAE and found the traffic growth compared with July 2020 has increased by 25% - 30% . These range from a quick and complete recovery to less optimistic scenarios of a slower or even incomplete recovery, and will depend on the duration and severity of the lockdown and the spread of this virus in the MIDRMA member states.

The effect of future traffic growth on the vertical collision risk can be evaluated on the assumption of a linear relationship between traffic growth and frequency of horizontal overlap, which will directly affect the two components of the risk: the risk due to technical height-keeping performance and due to atypical operational errors.

With the current uncertainty over traffic growth this issue will be revisited when the Middle East economic conditions return to more normal growth.

2.8.11 **Conclusions on the overall vertical risk:**

a. The overall risk of collision due to all causes which includes the technical risk and all risk due to operational errors and in-flight contingencies in the MID RVSM airspace, estimated from the operational and technical vertical risks calculated with LHD reports from most of the member states, the computed result for this SMR is considered to be representative for the MID RVSM airspace.

b. The effect of future traffic growth on the vertical collision risk can be evaluated on the assumption of a linear relationship between traffic growth and frequency of horizontal overlap, which will directly affect the two components of the risk: the risk due to technical height-keeping performance and due to atypical operational errors. It is very clear the MID region is suffering sever reduction in the traffic growth which is keeping the estimation of overall risk in safe side.

2.8.12 **Recommendations Applicable to Safety Objective 2:**

a. The MIDRMA shall continue to encourage States to provide Large Height Deviation Reports (LHD) of all categories and not only related to handover issues.

b. Due to the failure of replying related LHD reports by some member states, the MIDRMA will upgrade the LHD online reporting system to alert states who failed to respond with the need to investigate and report their outcomes in the system itself as soon as possible.

c. The MIDRMA, in coordination with concerned States, assure that incidents and violations which have direct impact on the implementation of RVSM within the MID Region are reported in continuous basis through the MIDRMA LHD online reporting system in due time for operational safety assessment analysis.

2.9 **ASSESSMENT OF SAFETY-RELATED ISSUES RAISED IN THIS REPORT**

RVSM Safety Objective 3

Address any safety-related issues raised in the SMR by recommending improved procedures and practices; and propose safety level improvements to ensure that any identified serious or risk-bearing

situations do not increase and, where possible, that they decrease. This should set the basis for a continuous assurance that the operation of RVSM will not adversely affect the risk of en-route mid-air collision over the years.

a. The MIDRMA improved its monitoring capabilities by conducting trial ADSB Height Keeping Performance for some RVSM approved aircraft registered by MIDRMA member states.

b. The MIDRMA started to build its database for the RVSM approved aircraft registered by MIDRMA member states which are capable of ADSB out to conduct height monitoring using AHMS (ADSB Height Monitoring System)

c. The MIDRMA started to address Performance-Based Communication and Surveillance (PBCS) approvals request from member states issuing PBCS approvals and forward reports received from other regions related none compliant of PBCS requirements.

d. The MIDRMA will address the Hot Spots of each MID FIR generated by the (MIDRAS) Software (for information only).

e. Current risk-bearing situations have been identified by using the MIDRAS and the MID Visualization and Simulation of Air Traffic and action will be taken to ensure resolving all violations to RVSM airspace by non-approved aircraft.

f. The MIDRMA continued to carry out scrutiny checks for aircraft filling W in their flight plans for all aircraft flying within the ICAO Middle East RVSM airspace and address all violating aircraft to the concerned authorities.

g. The MIDRMA arranged for an upgrade project to enhance the MIDRAS which will improve and facilitate the calculation of all RVSM risk parameters.

-It is concluded that this Safety Objective is currently met.

Appendix A

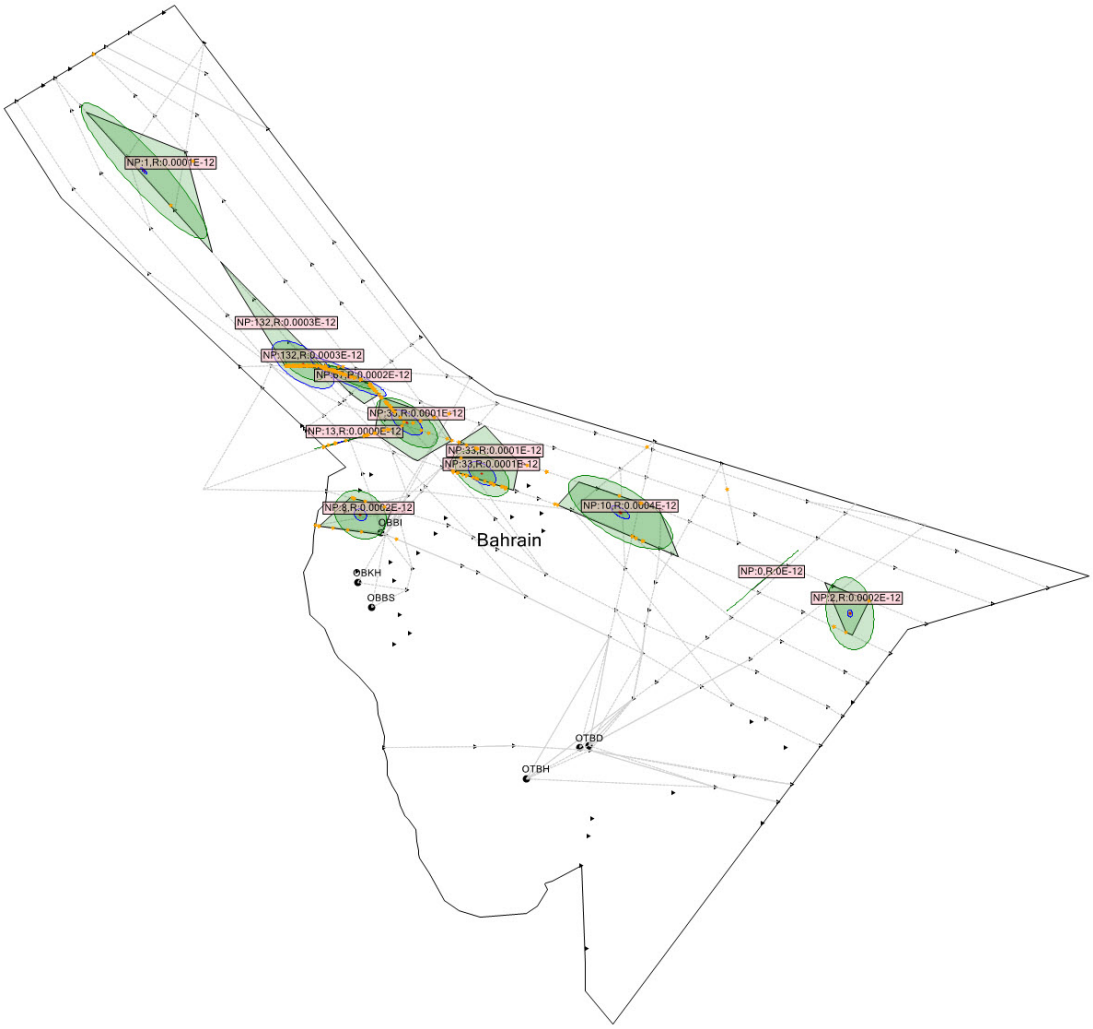
MID STATES RVSM AIRCRAFT MINIMUM MONITORING REQUIREMENTS

Valid as of 31st December 2021

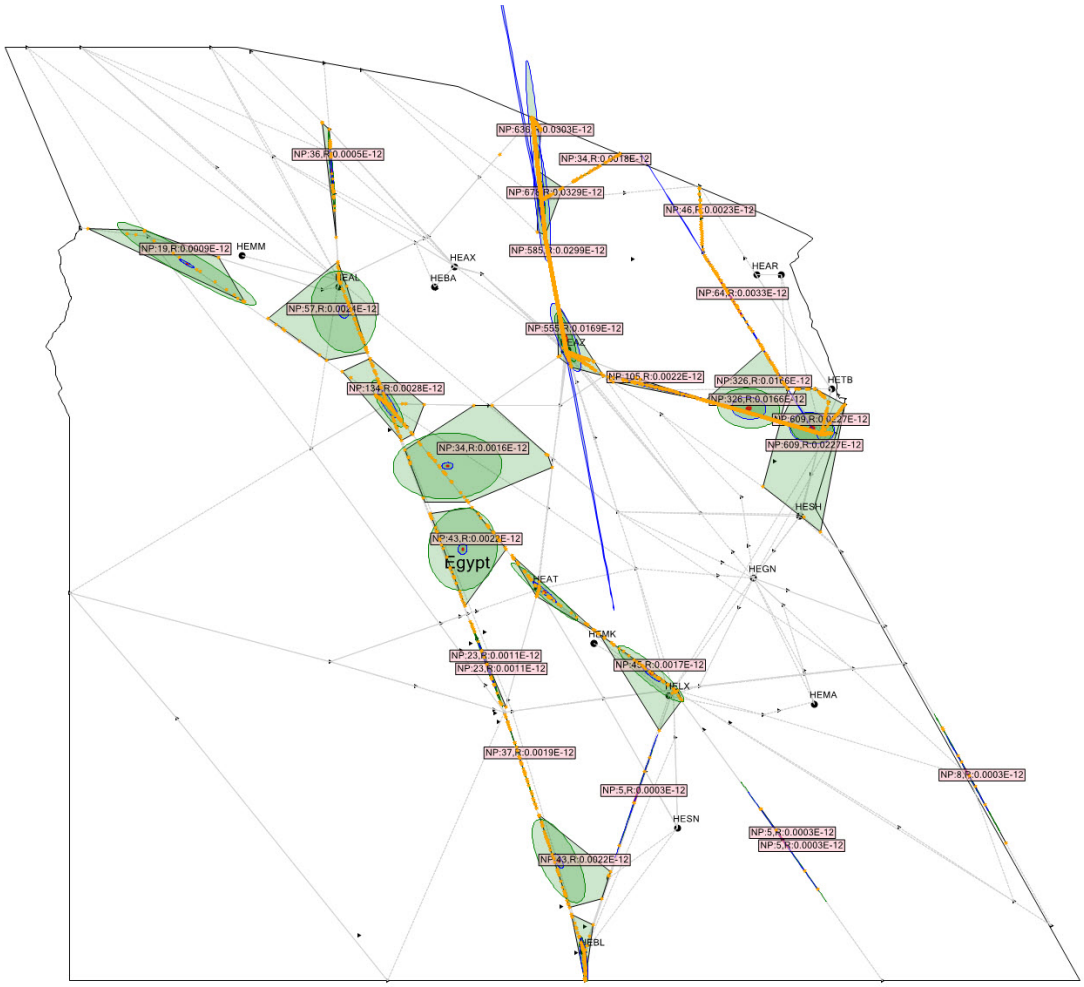
MID STATES	RVSM APPROVED A/C	HAVE RESULTS OR COVERED	NOT COVERED	NOT COVERED IN %	A/C MMR
Bahrain	60	60	0	0%	**0**
Egypt	156	113	43	28%	**27**
Iran	249	138	111	45%	**36**
Iraq	43	43	0	0%	**0**
Jordan	44	40	4	9%	**4**
KSA	259	257	2	0.8%	**2**
Kuwait	70	64	6	9%	**5**
Lebanon	32	32	0	0%	**0**
Libya	31	9	22	71%	**15**
Oman	72	63	9	13%	**3**
Qatar	276	276	0	0%	**0**
Sudan	10	10	0	0%	**0**
Syria	15	0	15	100%	**9**
UAE	584	529	55	9%	**24**
Yemen	5	0	5	100%	**5**
TOTAL	**1906**	**1635**	**271**	**14.22%**	**130**

Appendix B

MIDRMA Member States Hot Spots Generated from July 2021 TDS (For information ONLY)



Bahrain FIR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HEAX
HEBA
HEAL
NP:57,R:0.0024E-12
NP:34,R:0.0016E-12
NP:43,R:0.0022E-12
Egypt
HEAT
NP:23,R:0.0011E-12
NP:23,R:0.0011E-12
NP:37,R:0.0019E-12
NP:43,R:0.0022E-12
HEBL
NP:34,R:0.0018E-12
NR:46,R:0.0023E-12
HEAR
NP:64,R:0.0033E-12
NP:105,R:0.0022E-12
NP:326,R:0.0166E-12
NP:326,R:0.0166E-12
HETB
NP:609,R:0.0227E-12
NP:609,R:0.0227E-12
HESH
HEGN
HEMK
NP:45,R:0.0017E-12
HELX
HEMA
NP:8,R:0.0003E-12
NP:5,R:0.0003E-12
HESN
NP:5,R:0.0003E-12
NP:5,R:0.0003E-12

Cairo FIR


NP:28,R:6.4966E-12
NP:28,R:6.4966E-12
ORBM
NP:16,R:2.3710E-12
ORSU
ORKK
NP:6,R:0.7945E-12
NP:6,R:0.7945E-12
ORBD
ORAA
NP:135,R:20.4429E-12
NP:135,R:20.4429E-12
NP:91,R:13.6846E-12
ORAT
ORBI
Iraq
NP:3,R:0.3196E-12
NP:3,R:0.3196E-12
NP:2,R:0.5184E-12
ORNI
NP:0,R:0E-12
ORTL
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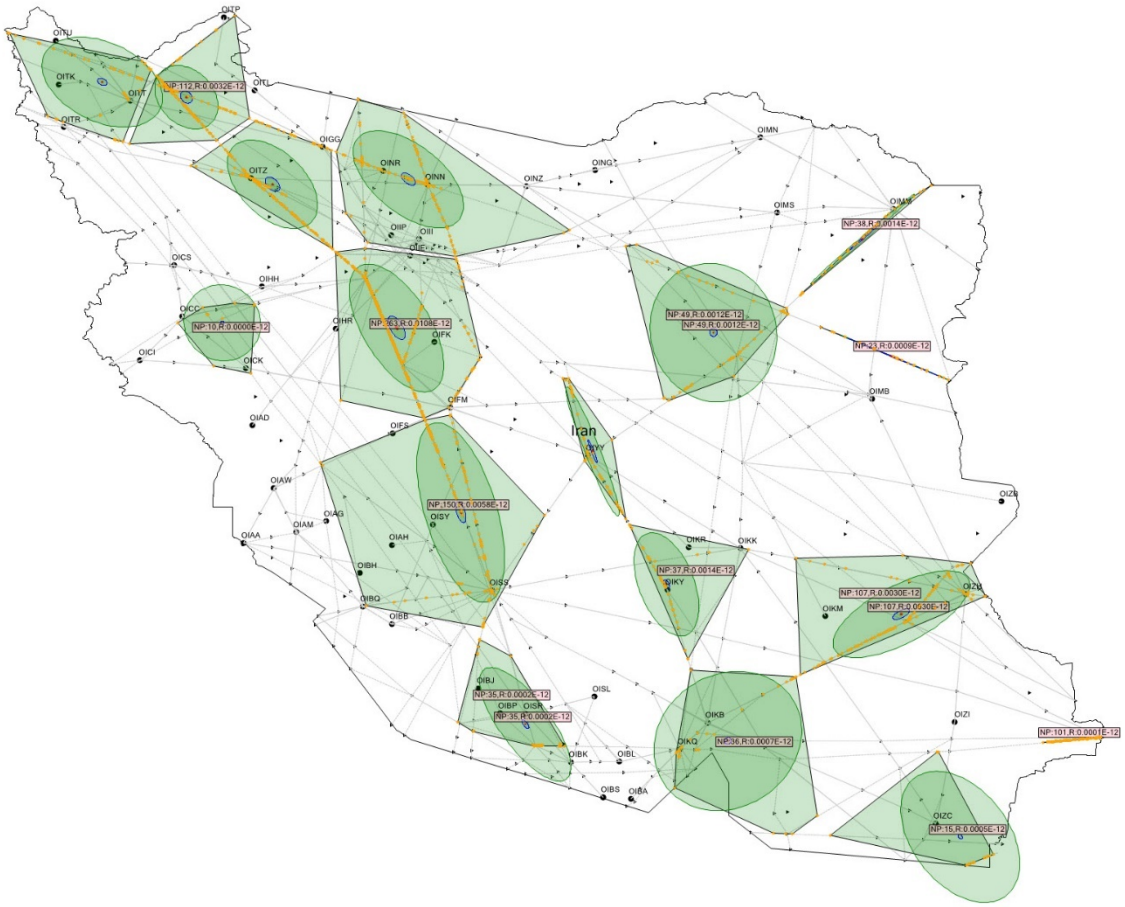
NP:7,R:1.5609E-12
ORMM
NP:0,R:0E-12

BAGHDAD FIR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OITU
OITK
OITT
OITR
OITL
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OIGG
OITZ
OINR
OINN
OINZ
OING
OIMN
OIMS
OIMM
NP:38,R:0.0014E-12
OIIP
OIII
OIIE
OICS
OIHH
OICC
NP:10,R:0.0000E-12
OIHR
NP:63,R:0.0108E-12
OIFK
NP:49,R:0.0012E-12
NP:49,R:0.0012E-12
NP:23,R:0.0009E-12
OICI
OICK
OIMB
OIFM
OIAD
OIFS
Iran
OIYY
OIAW
OIZB
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OIAG
OISY
OIAM
OIAA
OIAH
OIKR
OIKK
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OIKY
OISS
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OIKM
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OIBQ
OIBB
OIBJ
NP:35,R:0.0002E-12
OISL
OIBP
OISR
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OIKB
OIZI
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OIKQ
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OIBK
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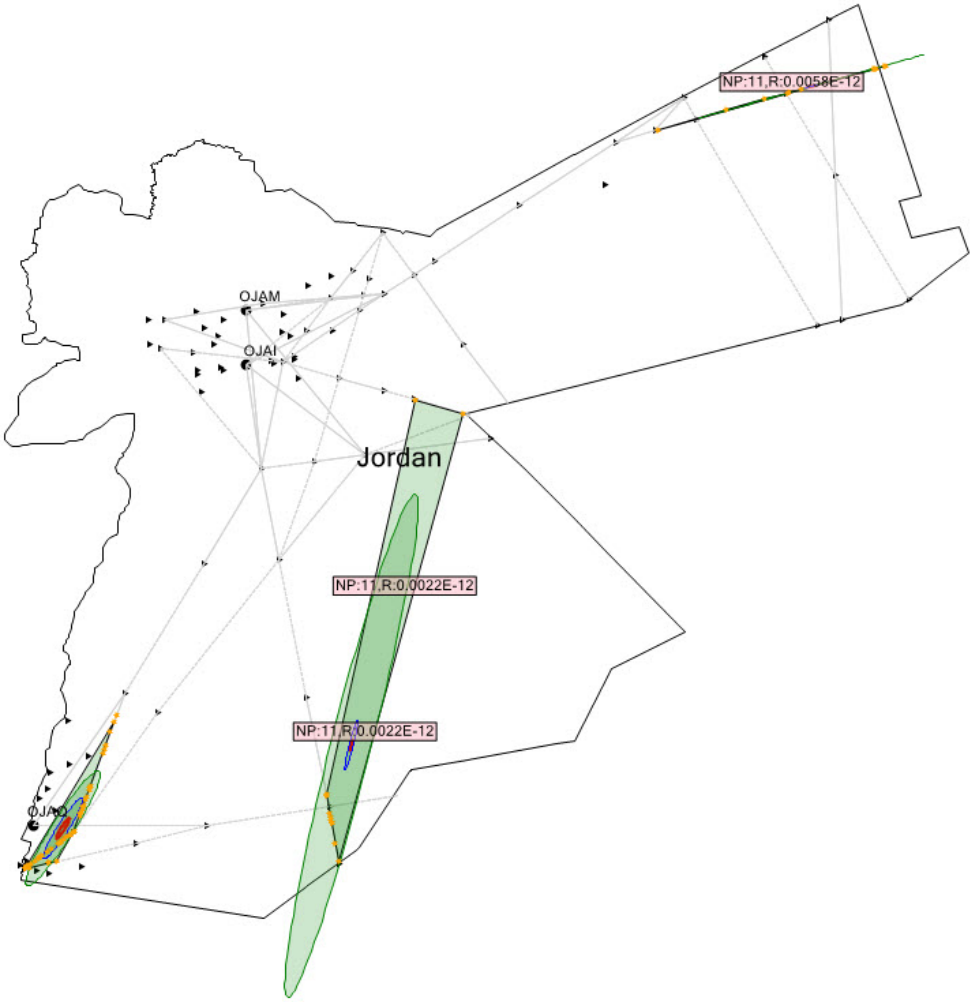
OIBS
OIBA
OIZC
NP:15,R:0.0005E-12

TEHRAN FIR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OJAI
Jordan
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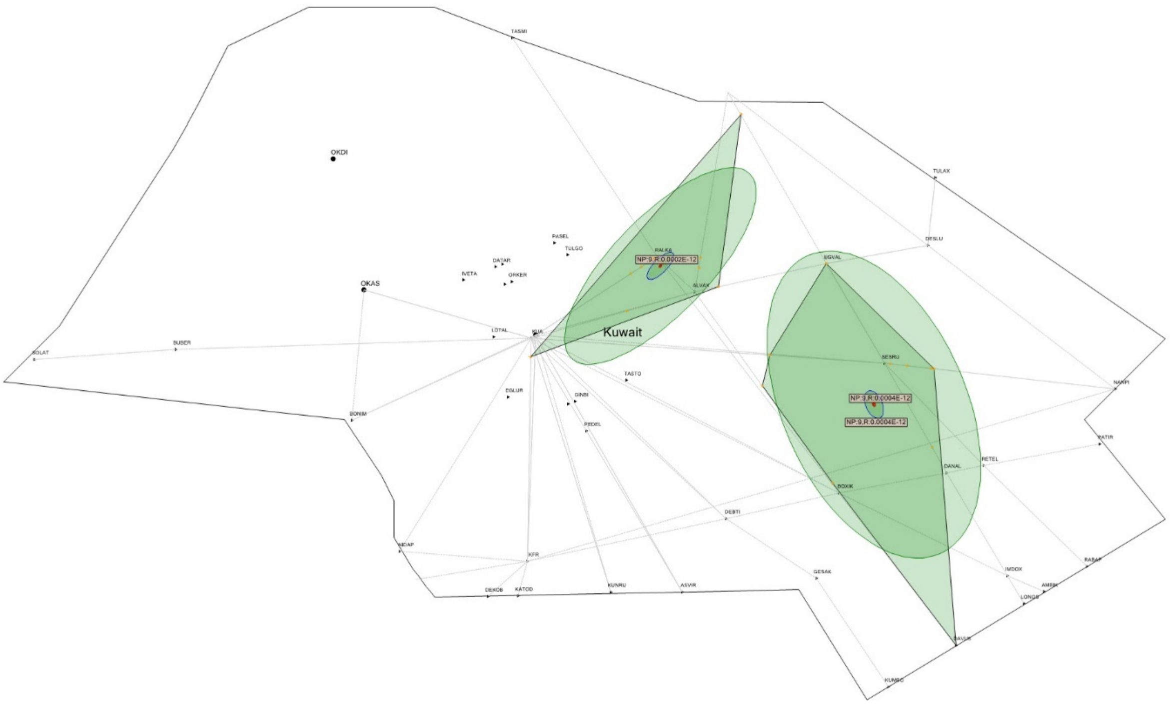
NP:11,R:0.0022E-12
OJAC

AMMAN FIR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OKDI
OKAS
PASEL
TULGO
DATAR
IVETA
ORKER
RALKA
NP:9,R:0.0002E-12
ALVAX
LOTAL
KUA
Kuwait
SOLAT
BUSER
TASTO
EGLUR
GINBI
BONIM
PEDEL
DEBTI
NIDAP
KFR
DEKOB
KATOD
KUNRU
ASVIR
TULAX
DESLU
EGVAL
SESRU
NAXPI
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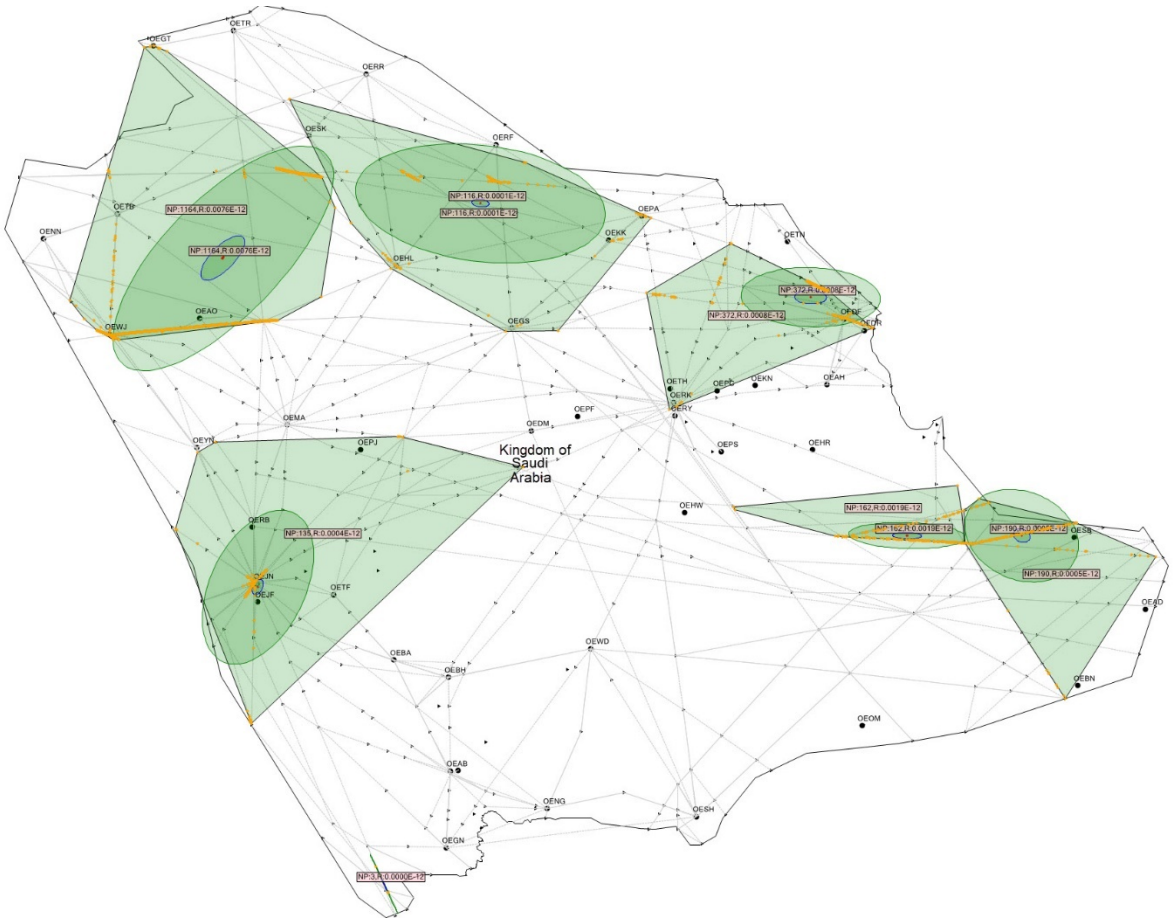
PATIR
RETEL
DANAL
BOXIK
GESAK
IMDOX
RABAP
LONOS
KUMBO

KUWAIT FIR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NP:116,R:0.0001E-12
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OENN
OEKK
OETN
OEHL
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NP:372,R:0.0008E-12
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OEWJ
OEGS
OEDR
OETH
OEPD
OEKN
OEAH
OERK
OERY
OEMA
OEPF
OEDM
OEYN
OEPJ
Kingdom of
Saudi
Arabia
OEPS
OEHR
OEHW
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OESS
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OERB
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OEJN
OEJF
OETF
OEAD
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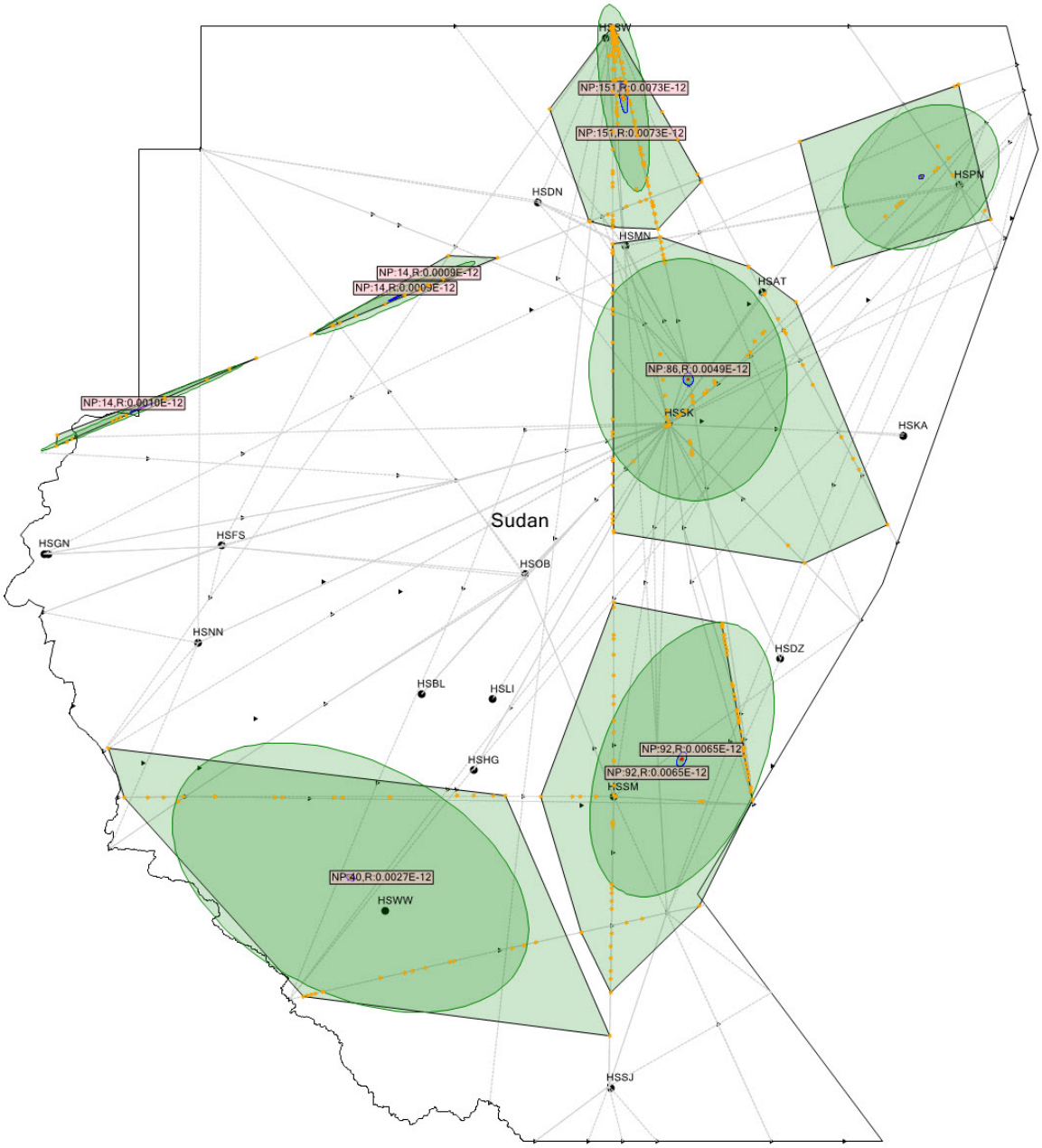
OEWD
OEBH
OEBN
OEOM
OEAB
OENG
OESH
OEGN
NP:3,R:0.0000E-12

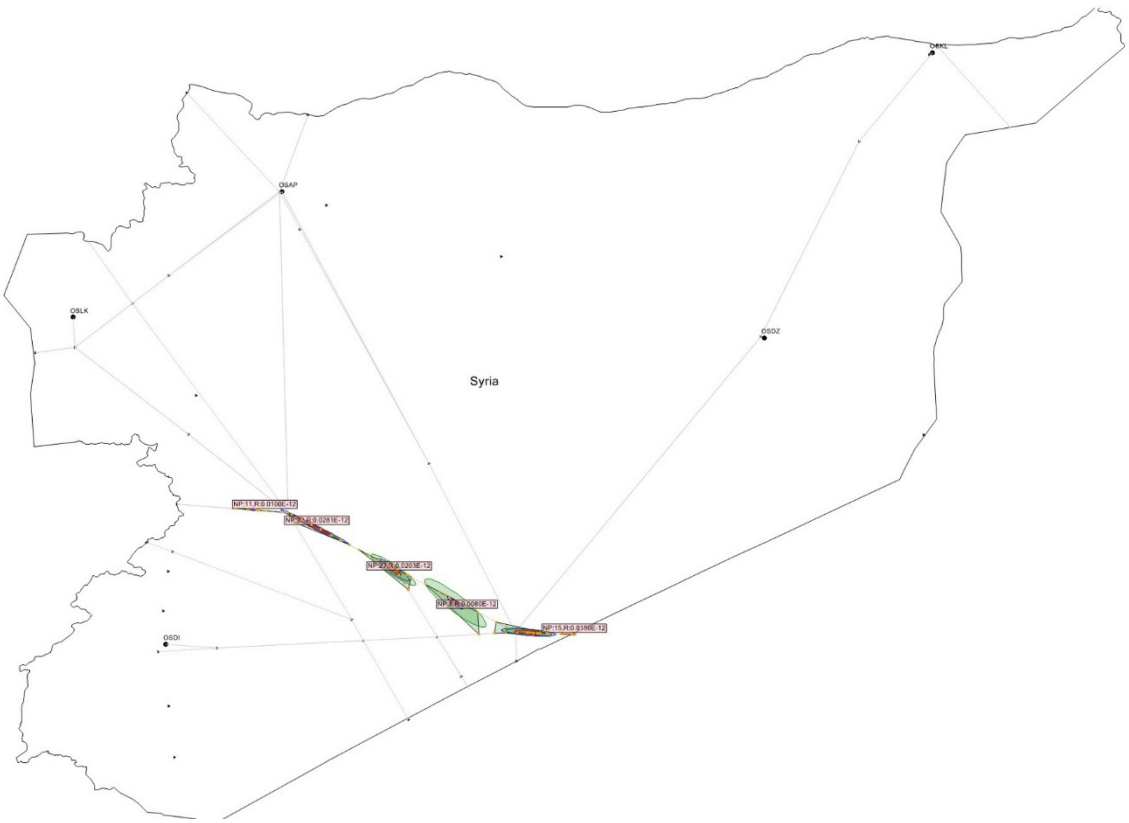
JEDDAH FIR


OOBH
OOMN
OOMS
NP:196,R:0.0001E-12
NP:196,R:0.0001E-12
NP:572,R:0.0005E-12
NP:8,R:0.0000E-12
NP:218,R:0.0003E-12
NP:211,R:0.0004E-12
NP:171,R:0.0005E-12
NP:110,R:0.0001E-12
OOFD
NP:140,R:0.0005E-12
NP:140,R:0.0005E-12
OOGB
Oman
OOMA
NP:63,R:0.0001E-12
OOMK
OODQ
OOMX
OOTH
OOSA
NP:195,R:0.0005E-12
NP:195,R:0.0005E-12

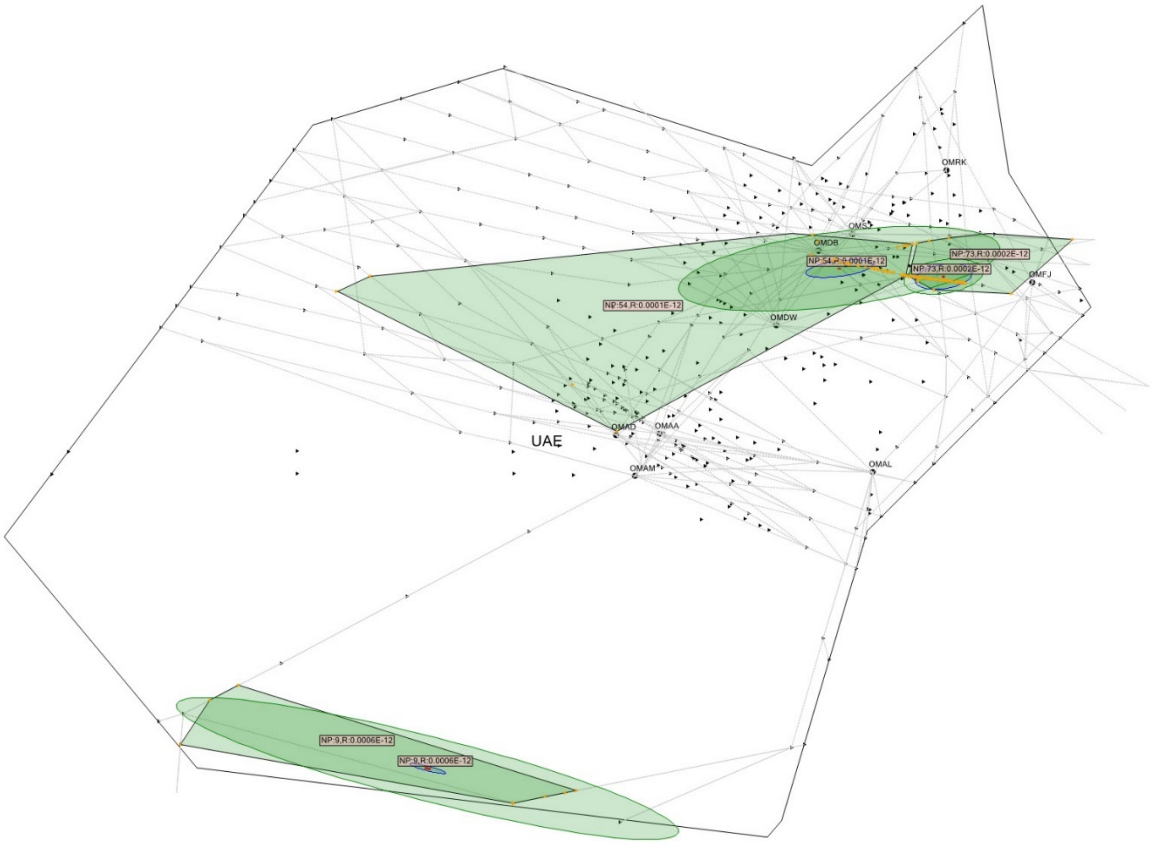
MUSCAT FIR



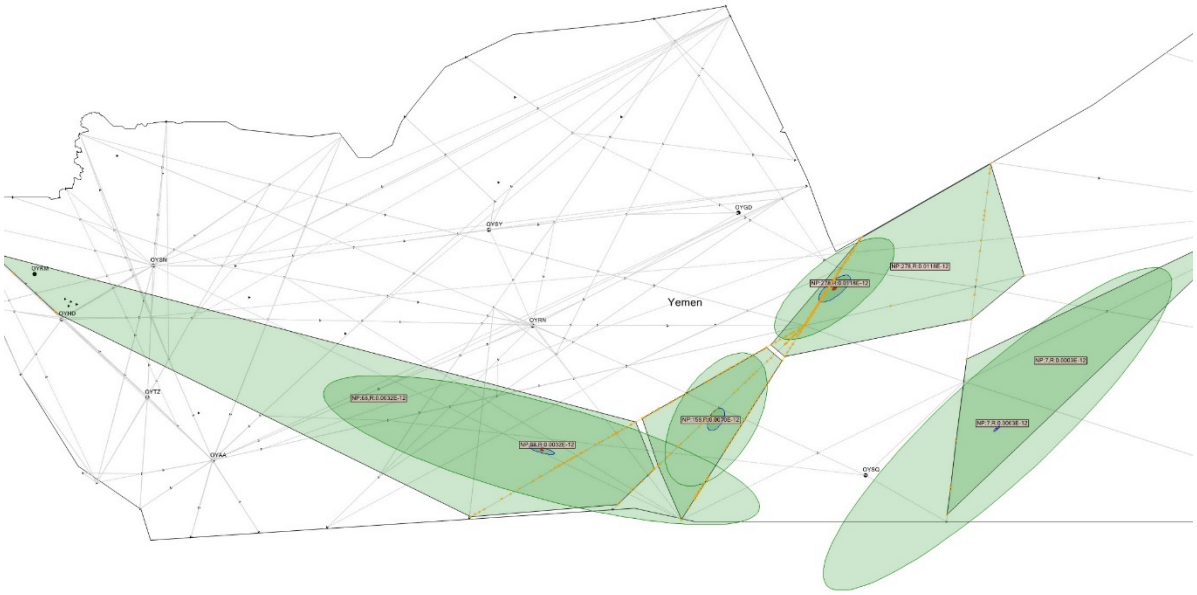
KHARTOUM FIR



DAMASCUS FIR



EMIRATES FIR



SANA'A FIR

- END -