MID Region RVSM Airspace Safety Assessment Related to the Expected Traffic Growth During FWC 2022

Prepared by the Middle East Regional Monitoring Agency (MIDRMA)

SUMMARY

The aim of this study is to present to the FWC 2022 TF the expected hotspots/bottlenecks generated from the predicted RVSM traffic data for FIRs expected to be affected by the traffic growth during the FWC 2022 event.

1.Introduction:

1.1 With reference to the MIDANPIRG Conclusion 17/24 related to the MID Region RVSM Airspace safety assessment during the period of the FWC 2022 event (November – December 2022), the meeting noted that the subject has been followed up by the MIDRMA Board, the FWC 2022 TF and the ATM SG; and it was found that, the MIDRMA would be able to assess the technical risk, while the operational risk would need LHD reports, which could not be available beforehand. Therefore, it would not be possible to meet the mandate given by MIDANPIRG, through Conclusion 17/24, to identify the peak periods, hotspots, bottlenecks, etc.

1.2 MIDANPIRG was informed that, as a follow-up action and in order to find a way forward to meet the mandate given by MIDANPIRG, the ICAO MID Office organized coordination meetings with the FWC2022 TF Chairman, Qatar, the MIDRMA and the MIDRAS Developer. It was agreed that it is possible to use artificial intelligence and the available historical data related to LHD, forecasted traffic and the ATS Route Network Structure to provide probabilistic/predicted LHD reports, which will enable the MIDRMA to use the current version of the MIDRAS software to conduct the required safety assessment, as per MIDANPIRG Conclusion 17/24. MIDANPIRG/18 (Virtual, 15 – 22 Feb 2021) meeting reviewed the project proposal by the MIDRAS Developer (Cost # 25,600 USD). No consensus was reached to proceed with the proposal. Based on a proposal by the MIDRMA, the meeting agreed that the MID Region RVSM Airspace safety assessment related to the FWC 2022, be developed based on a worst case scenario (using all available historical LHD reports) for the assessment of the risk of collision due to operational errors. And agreed on MIDANPIRG Conclusion 18/30: MID Region RVSM Airspace Safety assessment related to the FWC 2022

That, the MIDRMA conduct a MID Region RVSM airspace safety assessment, to ensure that the overall risk is meeting the ICAO TLS; and identify the peak periods, hotspots, bottlenecks, etc., based on a worst case scenario, using the forecasted traffic during the FWC 2022 period and all historical LHD reports available within the MIDRMA database.

2.Discussion:

2.1 According to the proposal presented by MIDRMA to MIDANPIRG/18to conduct the assessment based in a worst case scenario, the MIDRMA requested from Qatar the forecasted traffic for landing/departing all the airports in Qatar, these data will be supplemented with the forecasted RVSM traffic for all the surrounding FIRs to Qatar including Bahrain FIR which is the most affected FIR by the event.

2.2 The MIDRMA accepted the final version of Qatar predicted traffic data on 14th March 2021 which is only 8 days to hand over the assessment to ICAO MID Office for presenting it during the FWC2022 TF/5, Virtual,23 - 24 Mar 2021. Although the time was not enough to finalize this assessment, the MIDRMA decided to proceed with the study by close coordination with the ICAO MID ATM Officer to avoid further delay.

2.3 **Forecasted TDS Received from Qatar**

a- The total predicted movements received from Qatar were **30,916**, distributed as **15,541** Departures from Qatar airports and **15,375** as Arrivals.

b- Out of the **15,541** departures from Qatar airports MIDRMA found **8,190** flights will be exiting Bahrain FIR below RVSM airspace and will not be included in the assessment for Bahrain FIR but will be used for further en-route analysis beyond Bahrain FIR, the remaining **7,351** flights were used for the analysis.

c- Out **15,375** arrivals for Qatar airports MIDRMA found **7,037** movements entering Bahrain FIR below the RVSM airspace and will not be used in the assessment for Bahrain but these movements will be used in the previous FIRs, the remaining **8,338** movements were used for the assessment.

d- The total movements to/from Qatar airports used for the assessment :

7351 + 8338 = **15,689** movements

e- MIDRMA had to correct some errors found in the received data such as wrong exit/entry flight levels and points.

2.4**Forecasted TDS Used for RVSM Airspace Safety Assessment**

a- MIDRMA decided to use the archived RVSM TDS which was received to develop SMR 2019 as the TDS for SMR 2020 was not reflecting the actual/normal traffic level for the MID Region because of the Corona Pandemic.

b- After a careful review of the traffic flow of FWC 2022, MIDRMA found that most FIRs that will be affected by this event are: Bahrain, Baghdad, Kuwait, Muscat, Jeddah, Tehran

and Emirates FIRs, while other FIRs may be affected but not as severe as those mentioned due to its proximity to Qatar.

c- MIDRMA developed a software to generate the forecasted TDS taking into consideration the following:

i. Annual traffic growth of 13%.
ii. Traffic growth for the event was calculated per day/hour/minute at each entry/exit points including departure/arrival aerodromes.
iii. Distribution of entry/exit flight levels.
iv. Distribution of entry/exit times with logic longitudinal spacing.

d- MIDRMA merged the forecasted TDS received from Qatar with the forecasted TDS developed for each FIR (after applying 39% traffic growth) based in the entry/exit points and linked all the TDS for the continuity of traffic flow in the neighboring FIRs.

2.5 Operational Error Reports – Large Height Deviations (LHDs)

a- In order to calculate the overall risk for RVSM airspace during the FWC 2022 event, the archived LHD reports received from the most affected FIRs mentioned in Para 2.4 for last three years were used to obtain the results for the worst case scenario.
Note: The level of reporting LHD in the MID region for SMR 2018 reporting period was very low.

b- Calculated technical and overall TLS for each FIR:

FIR	Technical Risk Values ICAO TLS 2.5×10^{-5}	Overall Risk Values ICAO TLS 5×10^{-5}	Remarks
Bahrain	$\mathbf{1.856\times10^{-16}}$	$\mathbf{2.916\times10^{-10}}$	Both Values Above ICAO TLS
Baghdad	$\mathbf{3.87\times10^{-12}}$	$\mathbf{1.949\times10^{-10}}$	Both Values Above ICAO TLS
Kuwait	$\mathbf{7.144\times10^{-17}}$	$\mathbf{4.672\times10^{-13}}$	Both Values Above ICAO TLS
Muscat	$\mathbf{5.617\times10^{-15}}$	$\mathbf{5.762\times10^{-10}}$	Both Values Above ICAO TLS
Jeddah	$\mathbf{2.6810\times10^{-14}}$	$\mathbf{1.067\times10^{-10}}$	Both Values Above ICAO TLS
Tehran	$\mathbf{8.358\times10^{-14}}$	$\mathbf{2.008\times10^{-10}}$	Both Values Above ICAO TLS
Emirates	$\mathbf{2.715\times10^{-14}}$	$\mathbf{3.13\times10^{-13}}$	Both Values Above ICAO TLS

c- The above results reflect ICAO's TLS for assessing RVSM safety based on forecasted traffic without knowing whether the traffic volumes will return back to normal or not as the MID region lost approximately 68% of RVSM traffic during the SMR 2020 reporting period compared to SMR 2019 due to the Corona pandemic.

d- The calculated results could be severely affected if more LHD reports are received for the next period which could increase the risk values. Therefore, the above mentioned results should be considered as hypothetical results without giving any guarantee in case these results deteriorate or even improve.

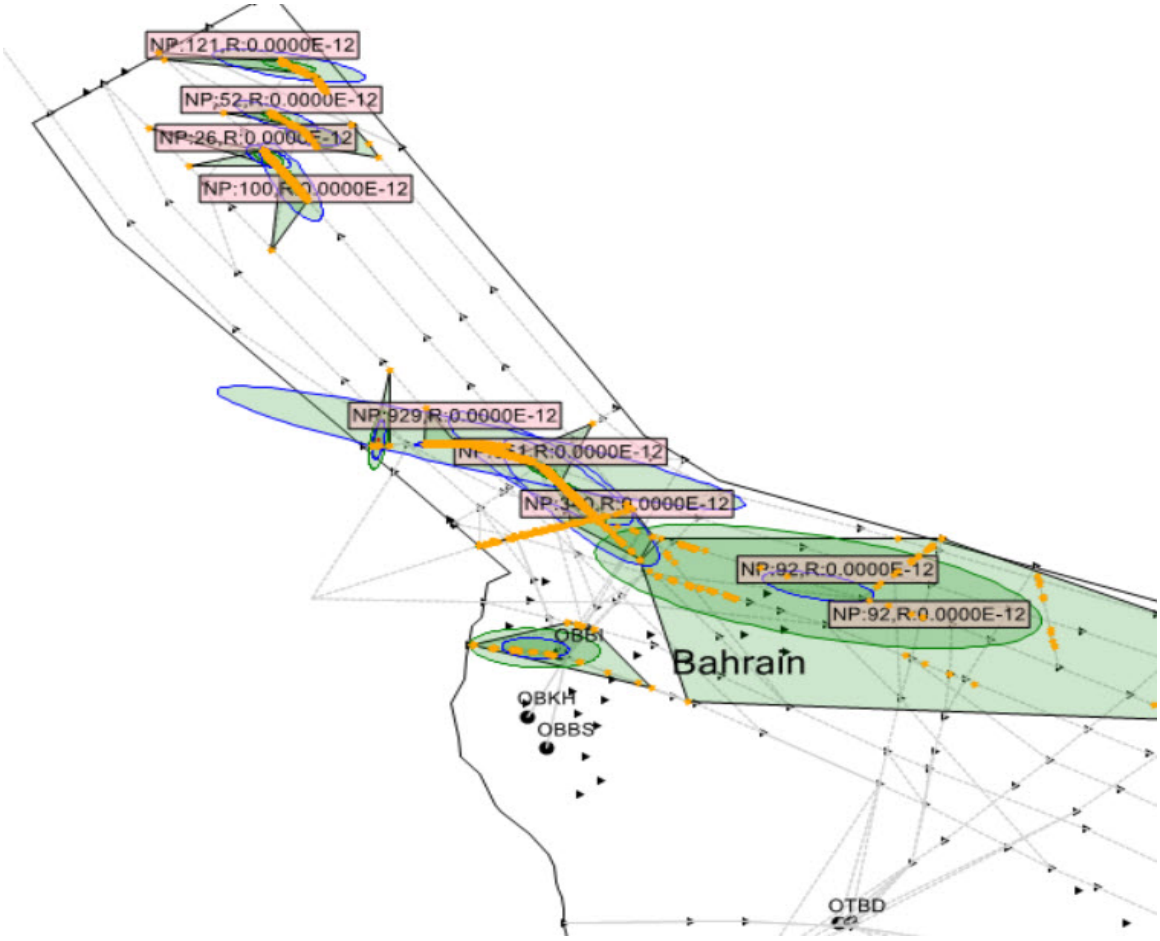
3. MIDRMA Observations for the ICAO MID RVSM Airspace ONLY.

3.1 Bahrain FIR

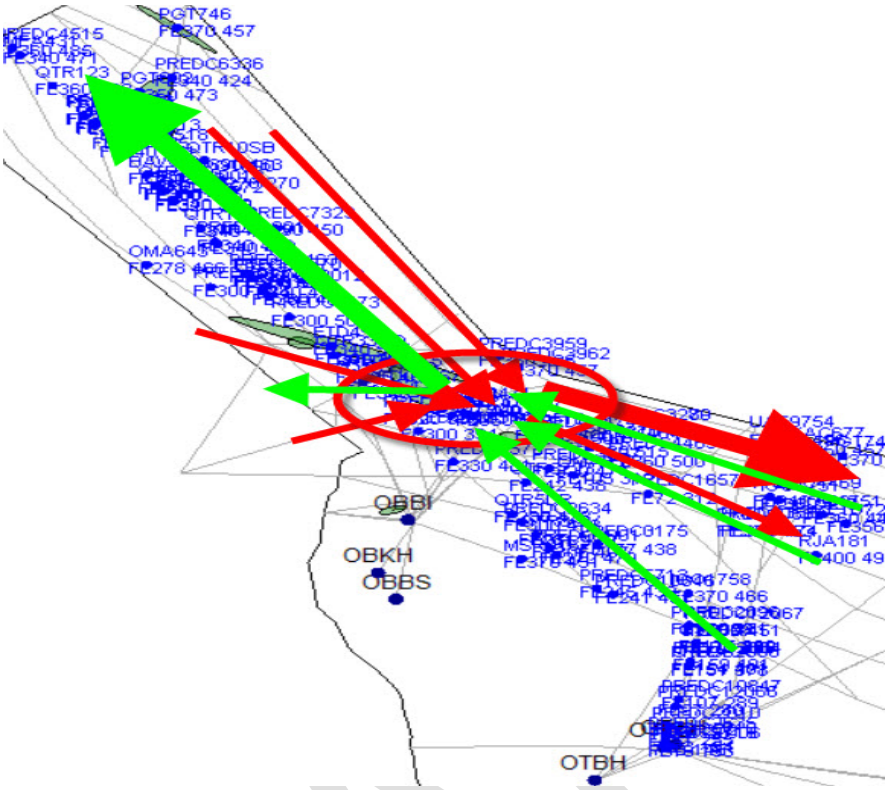
a. Bahrain FIR considered to be the most affected FIR in the Middle East region during the FWC 2022 event because large number of Qatar airports landers/departures will be either descending/climbing phase and will be mixed with departures/arrivals for adjacent aerodromes such as Bahrain and Dammam which will cause air traffic congestion below the RVSM airspace and might have serious impact to RVSM airspace as well.

b. The RVSM airspace to the north and north east of Bahrain VOR is the converging /diverging airspace of nearly all the overflying traffic within Bahrain FIR, this airspace formed one of the most complicated hotspots observed in this study (also detected during the annual MID RVSM SMRs) which caused the passing frequency to increase well above the normal figures for the annual SMRs.

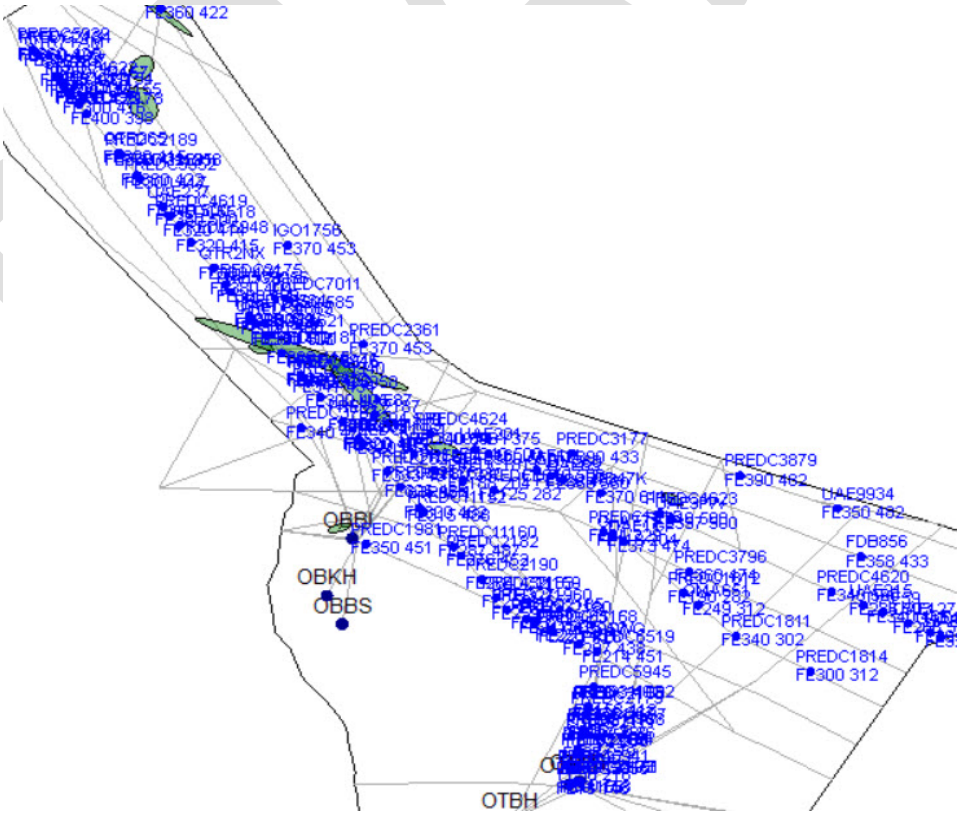
c. Map 1 below reflects the hotspots of Bahrain FIR which are marked by orange color along the traffic congestion.



Bahrain FIR Hotspots – Map 1



Bahrain FIR - Traffic Flow Simulation 1



Bahrain FIR - Traffic Flow Simulation 2

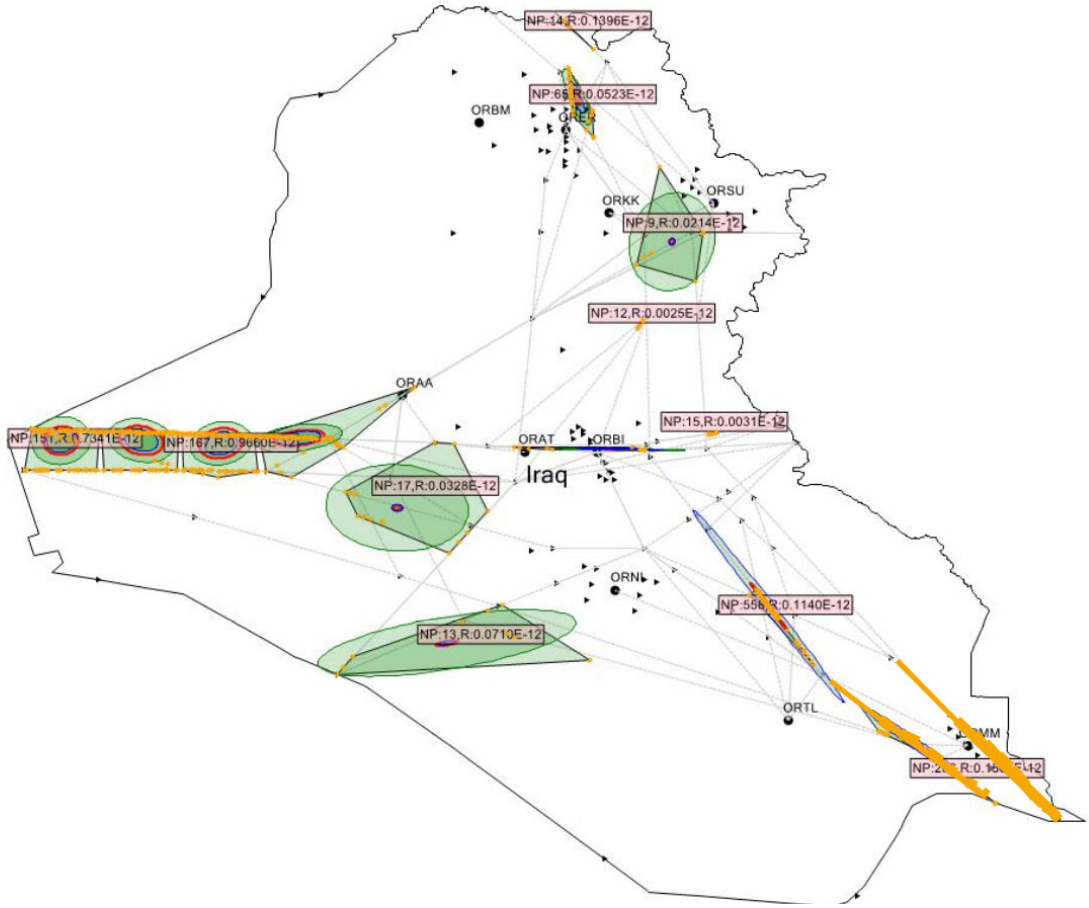
3.2 Baghdad FIR

a- The extreme majority of the traffic flow in Baghdad FIR are flowing North to South and vice versa with some considerable number of traffic crossing this flow from East to West and vice versa which is causing the Technical Risk Value to be lower than all the other FIRs in this study, this reduction is still well above the ICAO TLS and acceptable for RVSM operations.

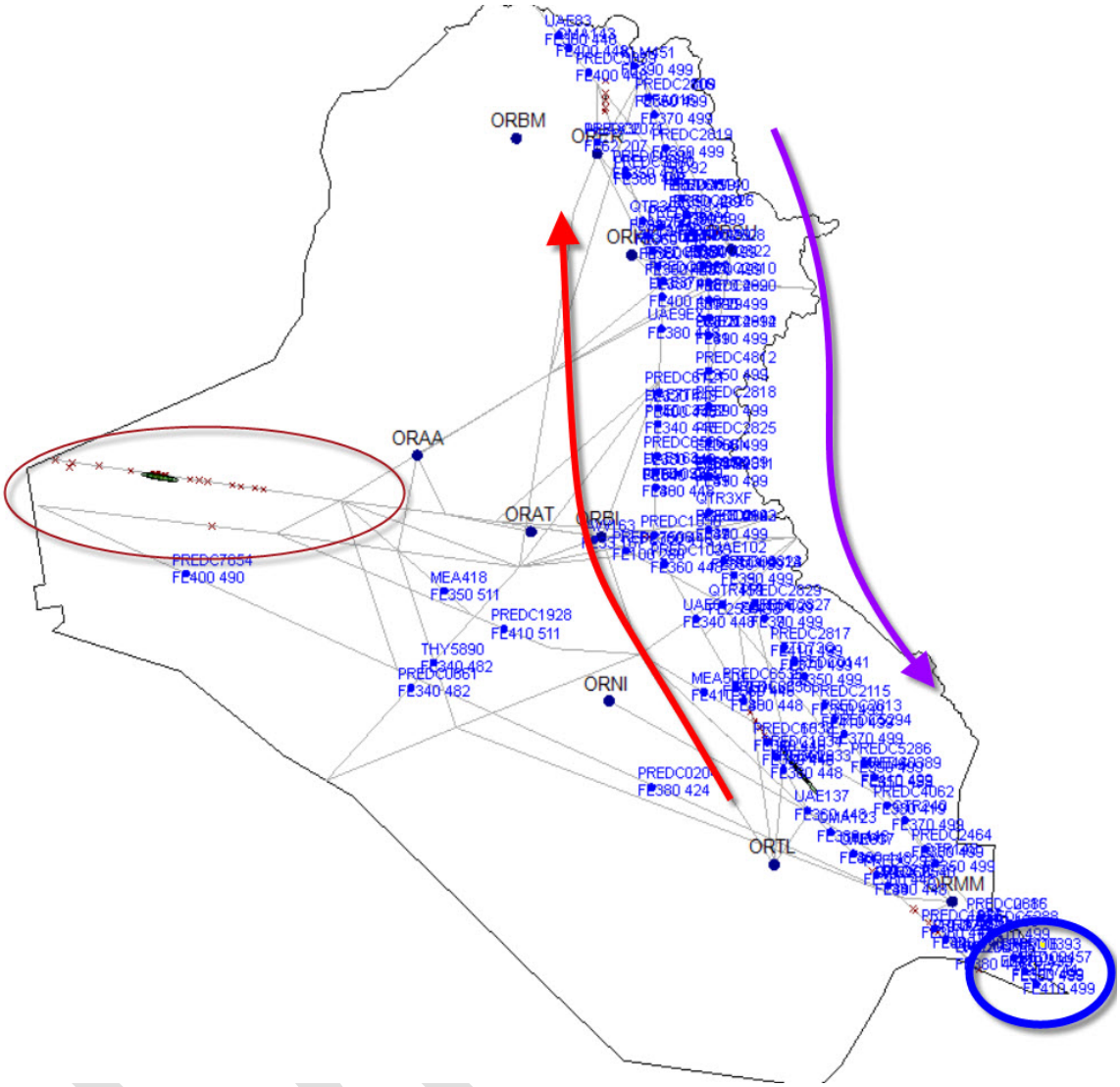
b- The passing frequency between RAPLU and MODIK increased very high and reached to a level that will require the ATM Authority in Iraq to review the flow in this airway.

c- MIDRMA suggests to split this airway into two different airways (east and west).

d- Baghdad FIR entry point TASMI at the southern FIR boundary with Kuwait is the most congested point in the Middle East RVSM airspace and so as SIDAD the exit point into Kuwait FIR, these two points cannot take any more of traffic growth and it is time for Iraq ATM to establish another points adjacent to SIDAD as an exit point and another one close to TASMI as an entry point to reduce the traffic congestion.



Baghdad FIR Hotspots – Map 2



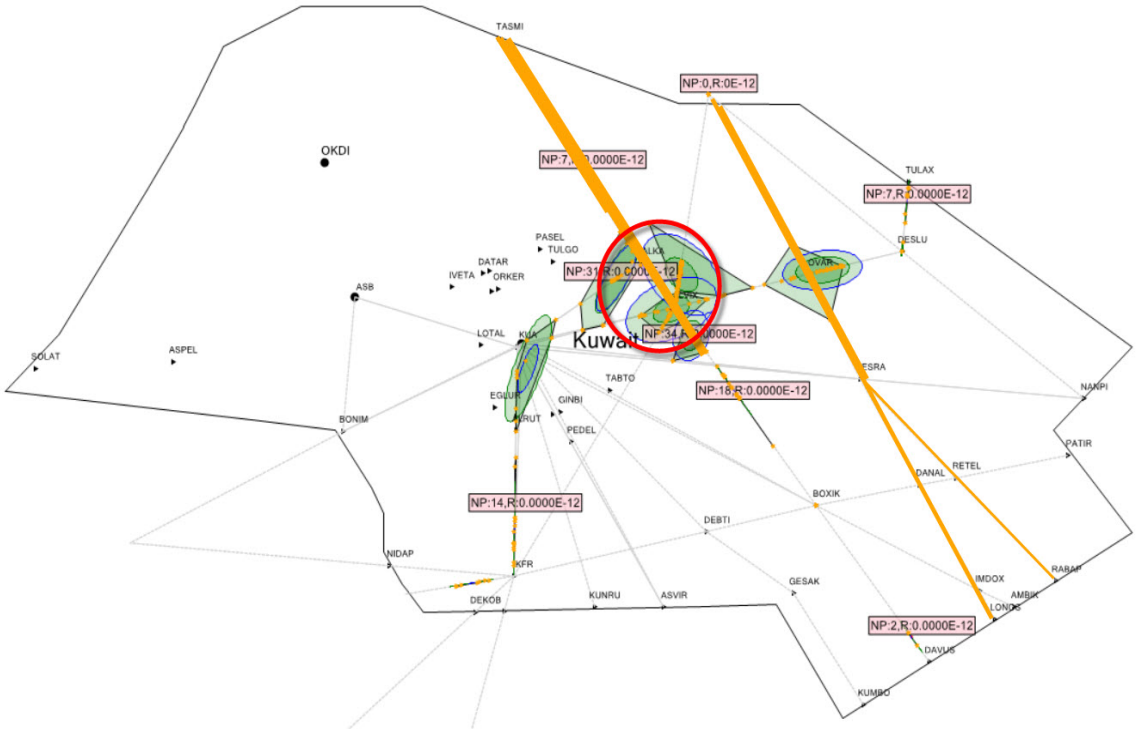
Baghdad FIR - Traffic Flow Simulation 1

3.3 Kuwait FIR

a- The traffic flow in Kuwait FIR mostly linked with Baghdad and Bahrain FIRs, and flows north and south bound with small number of traffic crossing east and west bound.

b- Traffic congestion was clearly demonstrated between TASMI and RALKA as a northbound flow and between SIDAD and SESRA as a southbound traffic flow supporting MIDRMA's proposal to establish two more points to reduce this traffic congestion.

c- The main hotspot observed in Kuwait FIR found between points ALVIX and RALKA were 63% of the crossing traffic occurred at this portion of the airspace, the passing frequency is not very high but it’s worth reviewing the airway structure to the east and north east of KUA and explore better flow options to reduce the congestion between these two points.



Kuwait FIR Hotspots – Map 3

3.4 Muscat FIR

a- Muscat FIR RVSM airspace remains at the forefront of the busiest FIRs in ICAO MID RVSM airspace in terms of its size and capacity with traffic flow nearly from every direction.

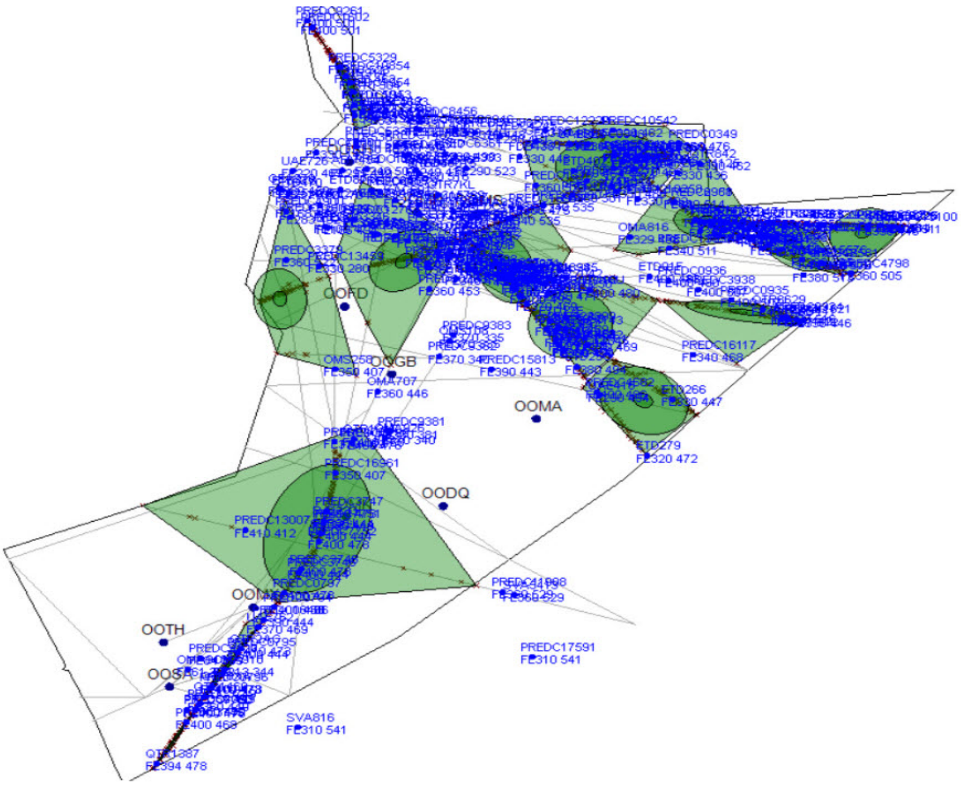
b- Muscat FIR Hotspots – Map 4 below explains itself, the traffic congestions/concentration to the west of points RASKI, PARAR, TOTOX, REXOD, ALAMA and KITAL.

c- One of the busiest hotspots detected is the triangle of OOMS, EMISO and EMURU which recorded 43% of the crossing traffic in Muscat FIR with high passing frequency and reflects the need to review the flow of RVSM traffic in this part of the FIR.

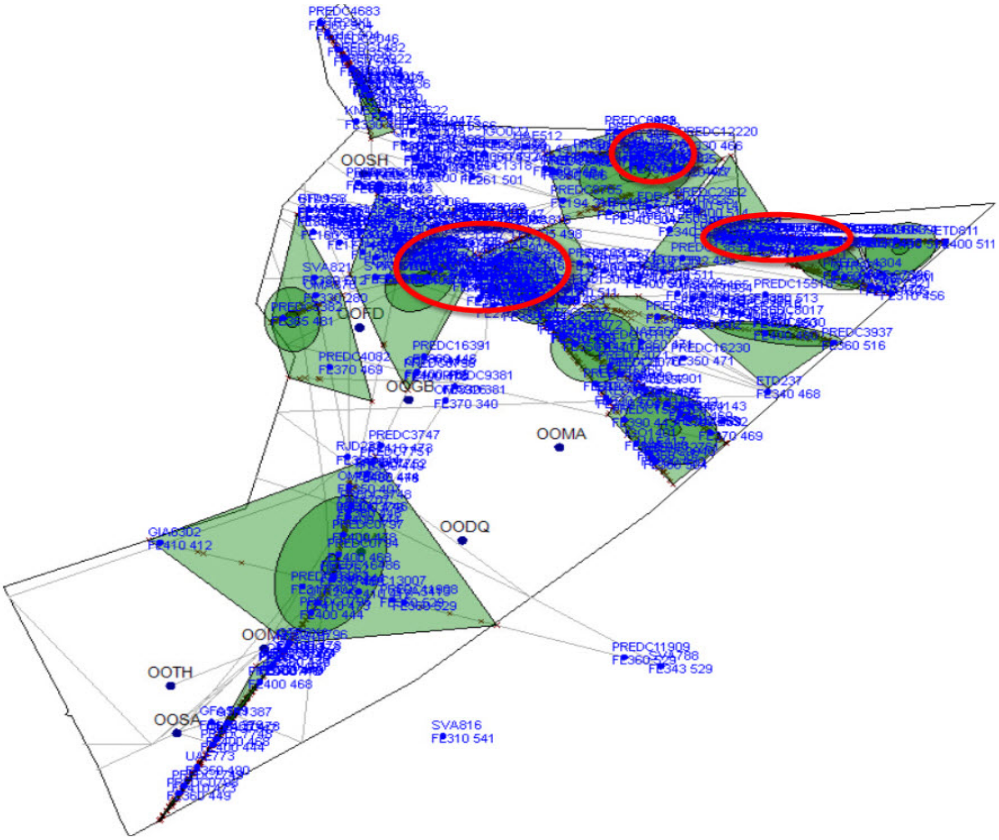
d- More hotspots to the west of RASKI and PARAR were detected and concentrated between SETSI and RAGMA, again with high passing frequency caused from the complexity of RVSM traffic flow.

e- Due to the complexity of the traffic flow within Muscat FIR, MIDRMA decided to make further analysis for each RVSM flight level (FL290 –FL410) and shall keep that in Appendix A of this study.

Muscat FIR Hotspots – Map 4



Muscat FIR Fast Simulation 1



Muscat FIR Fast Simulation 2

3.5Tehran FIR

a- The concentration of the traffic flow clearly detected to the North West of Tehran FIR and marked from N/W of OITZ all the way to Ankara FIR.

b- The RVSM airspace to the west of point ASVIB and RUKOT/NOVSU also recorded high passing frequency, due to the presence of a portion of the airways to the west of point ASVIB and GOKSO/GENEV (141 NM) treated as bidirectional airway. It is recommended to establish another point to the south of the ASVIB to remove this congestion.

c- Other hotspots observed in Tehran FIR (see Tehran FIR Hotspots Map 5 for more details) however, due to the large spacing of these hotspots in the wide airspace of Tehran FIR, their influence will be limited and not related to the traffic growth of the FWC 2022 event other than the ones in paragraph a. and b. above.

d- Further analysis to some RVSM flight levels in Tehran FIR in appendix A of this study.

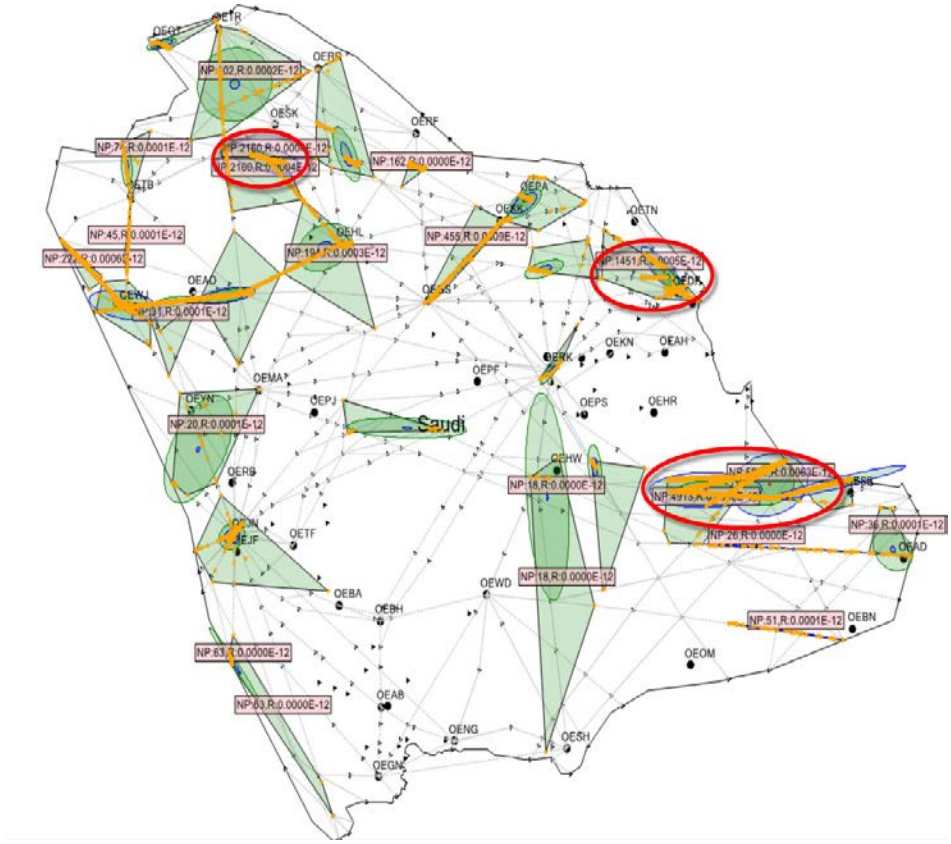
Tehran FIR Hotspots – Map 5

3.6 Jeddah FIR

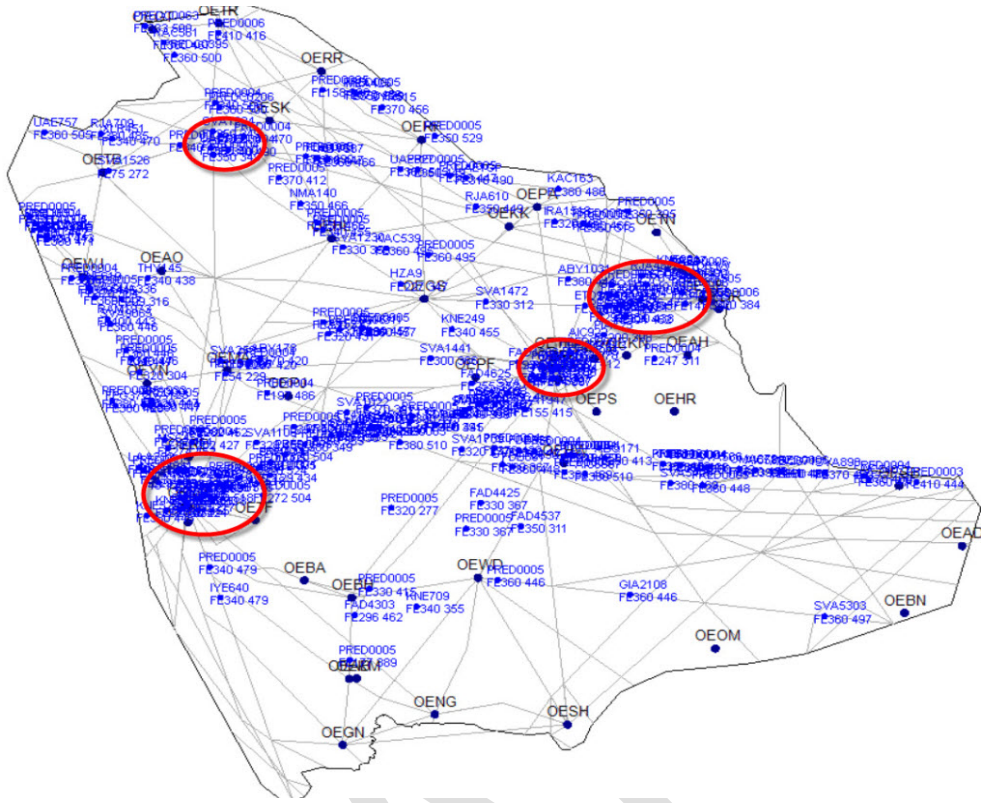
a- Four major hotspots have been discovered in the Jeddah FIR and the busiest is located in the Empty Quarter to the west of the UAE FIR (see Jeddah FIR hotspots - Map 6 for more details) but this is not related to FWC 2022 traffic growth such as the data was generated based on the level of traffic during the Hajj season, and it is useful to have an idea of the potential traffic congestion in the Empty Quarter if the traffic growth reaches close to 40% or more of the traffic for 2019.

b- The other hotspot which is definitely related to the traffic growth of the FWC 2022 is located to the N/W of Dammam and adjacent to Bahrain FIR, although the passing frequency is not high and it's within the normal average figures its necessary that both ATM Units review their needs to reduce this congestion because this hotspot is very close to the boundaries of their FIRs.

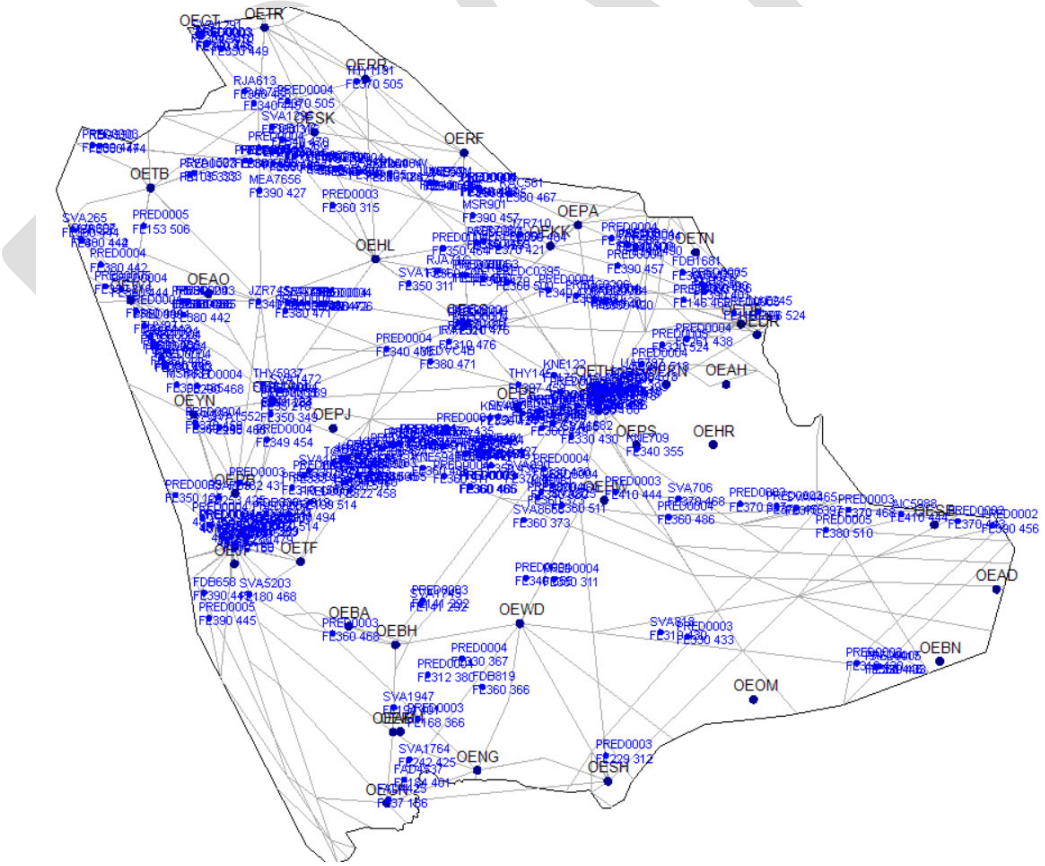
c- The other two hotspots detected to the south of OESK and between OEAD and point PASAM, the passing frequency slightly increased from the figures in SMR 2019.



Jeddah FIR Hotspots - Map 6



Jeddah FIR Fast Simulation 1



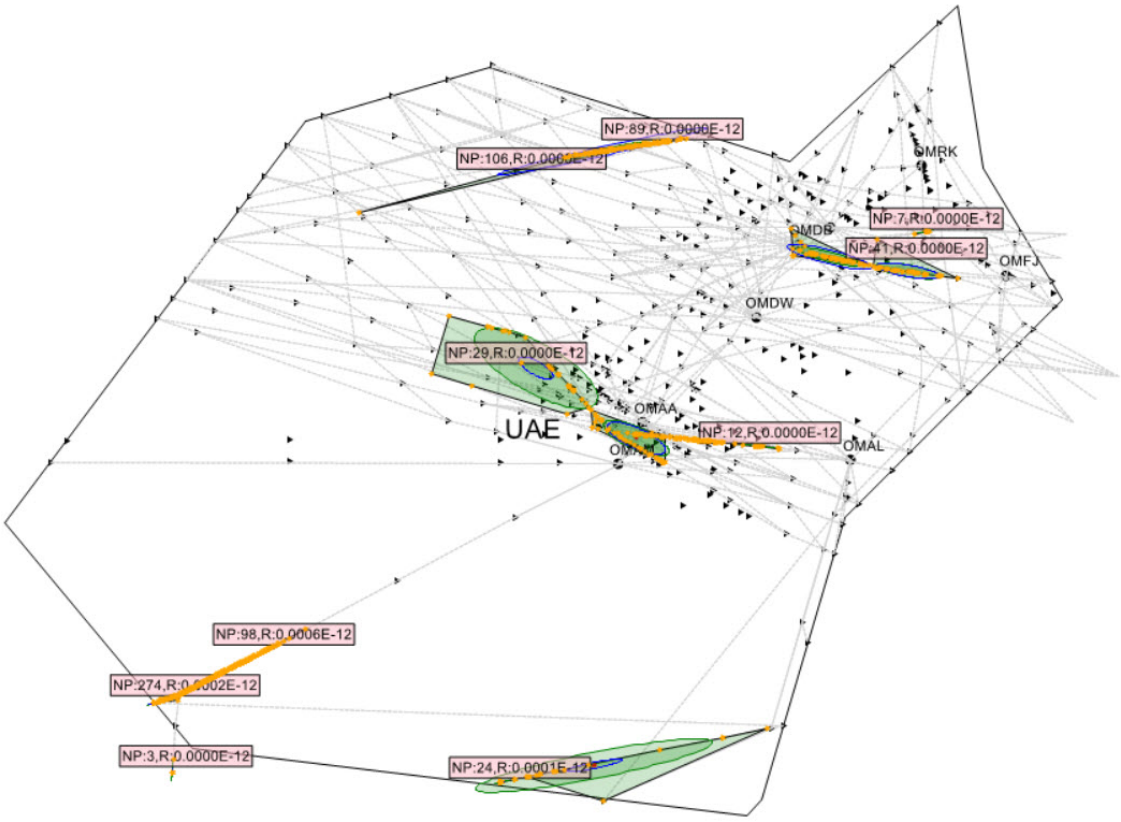
Jeddah FIR Fast Simulation 2

3.7 Emirates FIR

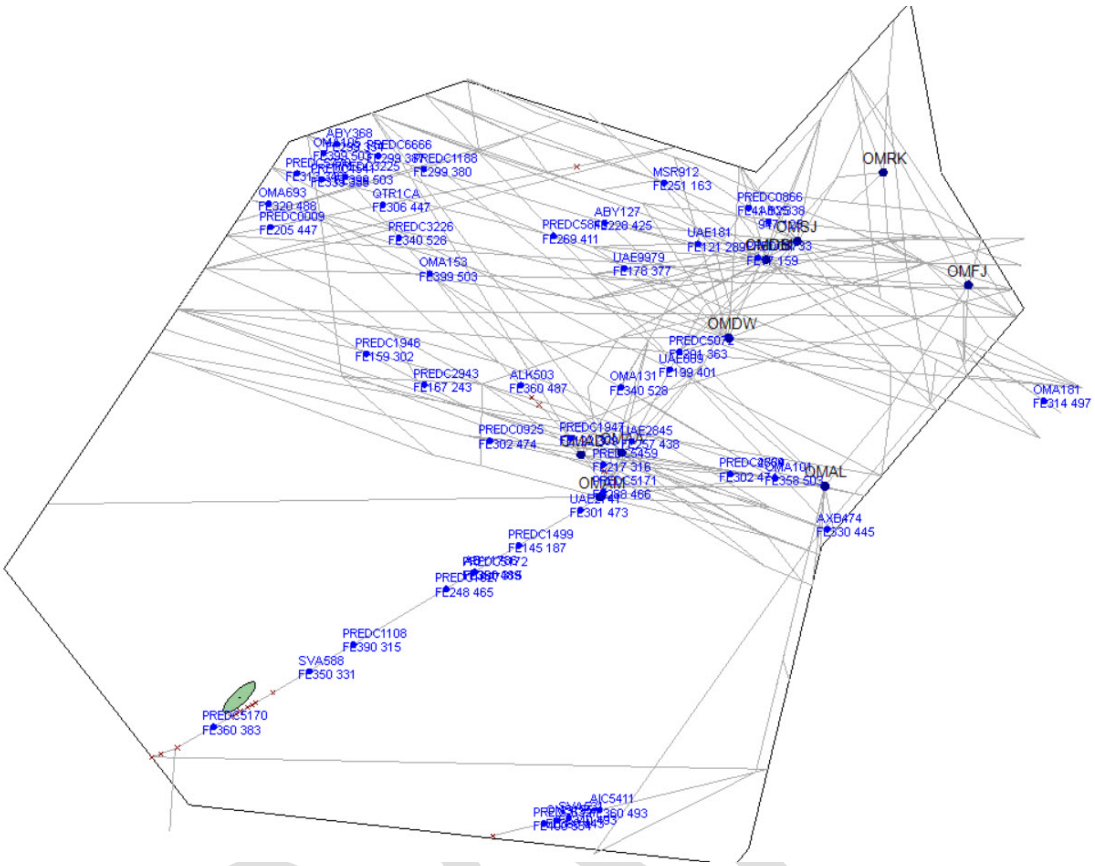
a- Emirates FIR is expected to be extremely busy during the FWC 2022 event below the RVSM airspace as it will receive all the traffic bound from/to Muscat, Tehran, Bahrain FIRs and due to the location of the Emirates FIR the majority of the RVSM traffic will be either in the descend/climb phase with more in level flight overflying the Emirates FIR.

b- The two hotspots detected to the N/W of OMAA recorded normal passing frequency and without risk as they were formed due to increased traffic.

c- The portion of AWY M318 between GOLGU and ESROM is bidirectional were RVSM traffic are either crossing at their flight levels or initiating descend from the RVSM airspace or going through the RVSM layer for their cruise levels.



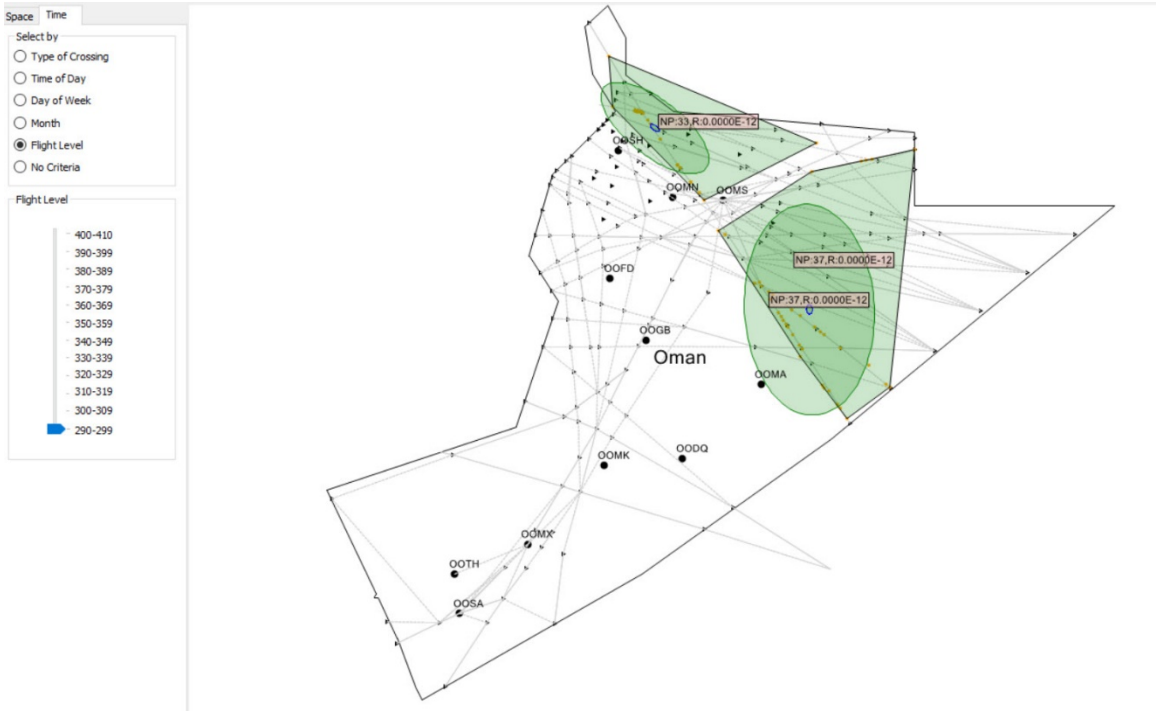
Emirates FIR Hotspots – Map 7

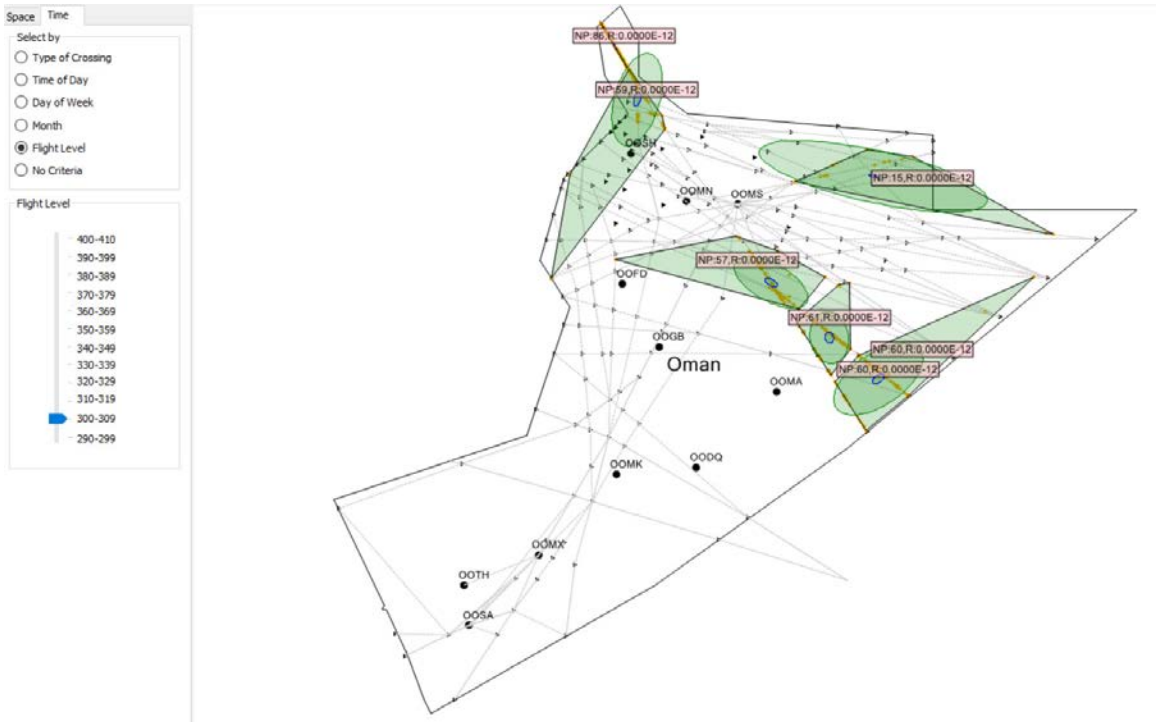


Emirates Fast Simulation 1

Appendix "A" – Analysis of RVSM Flight Levels

Muscat FIR



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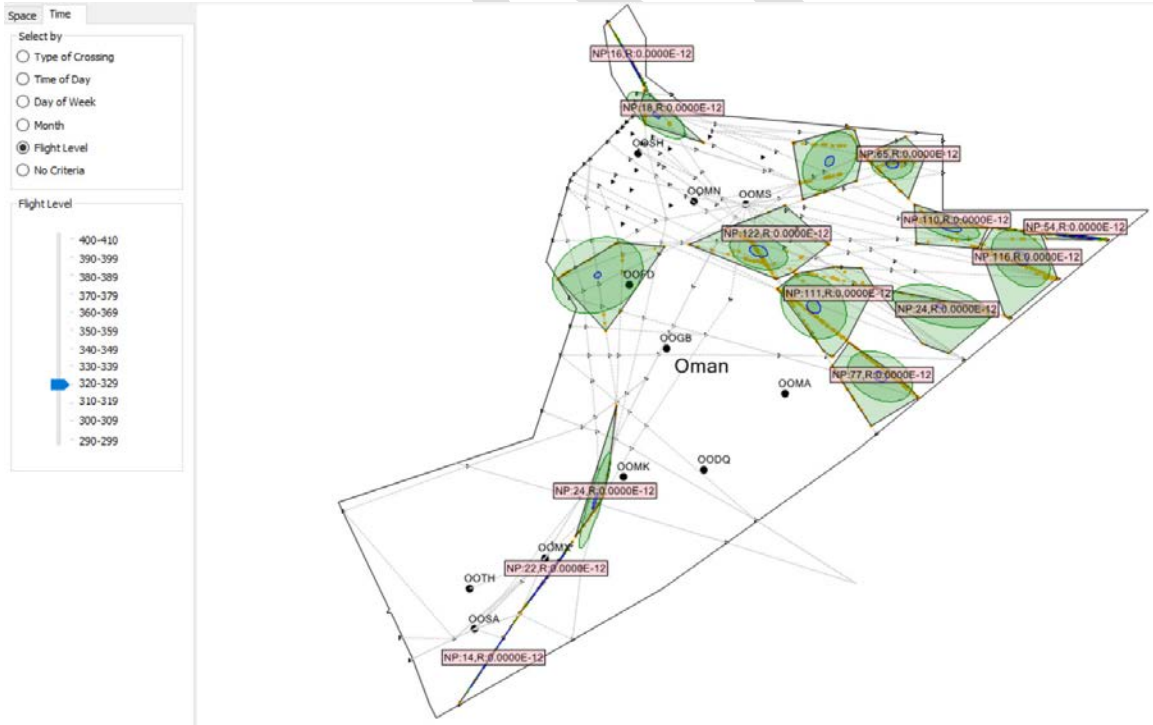
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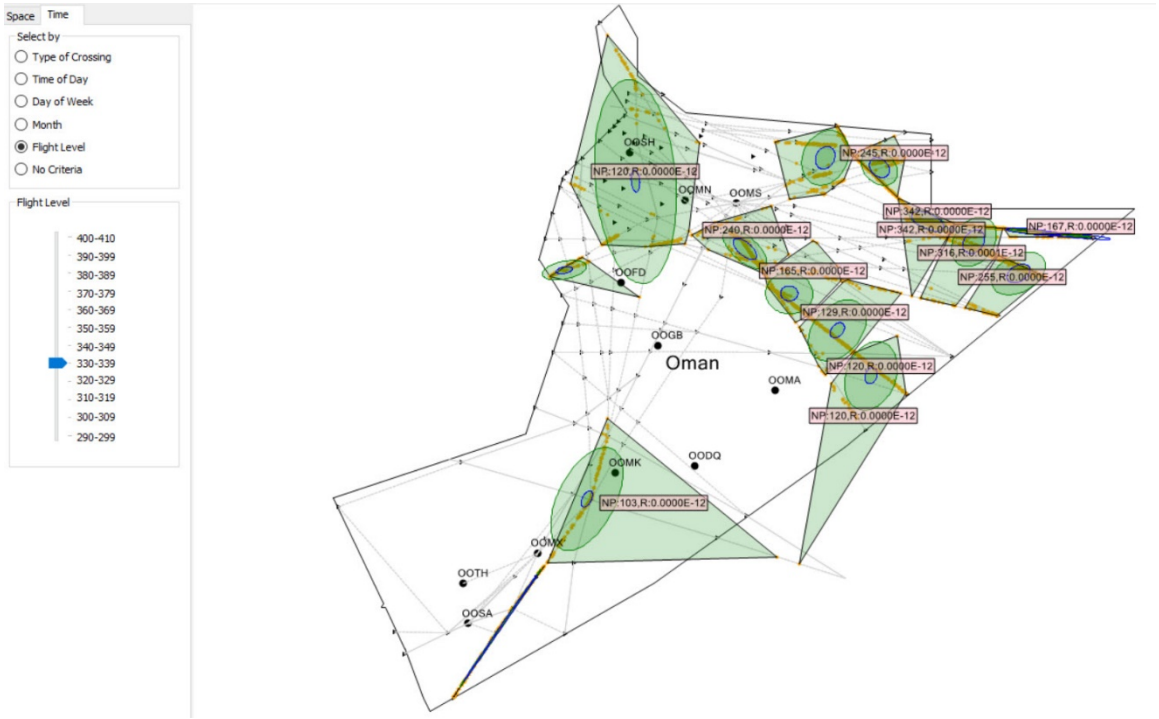
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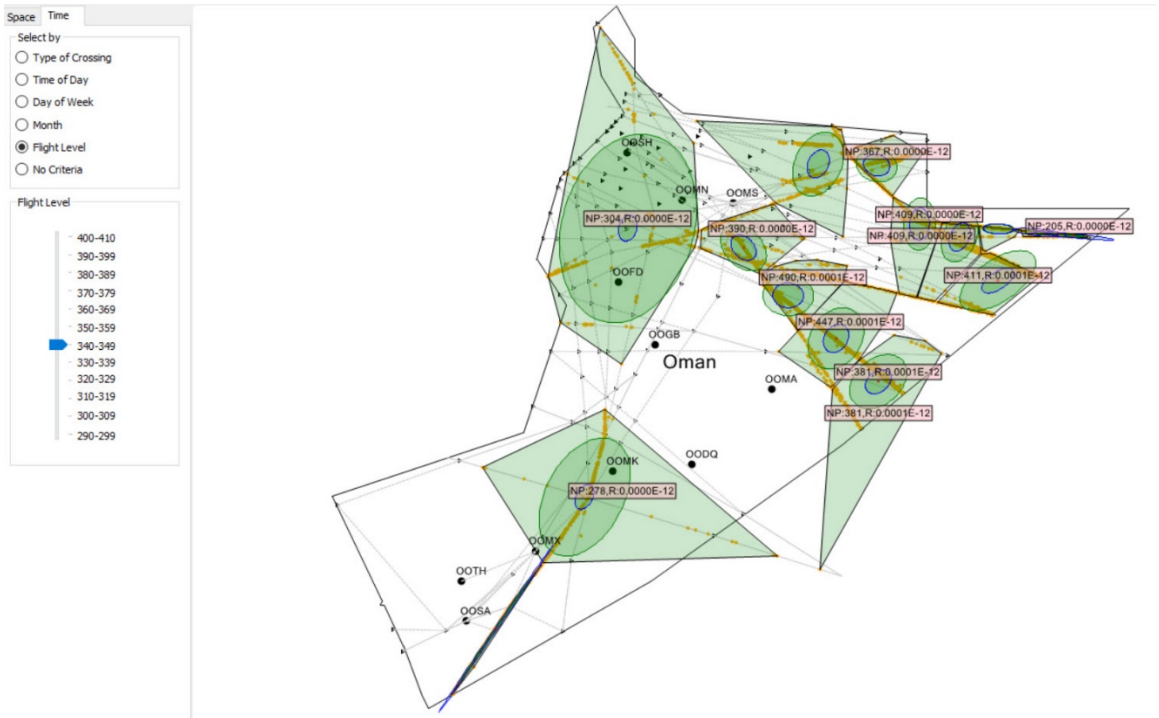
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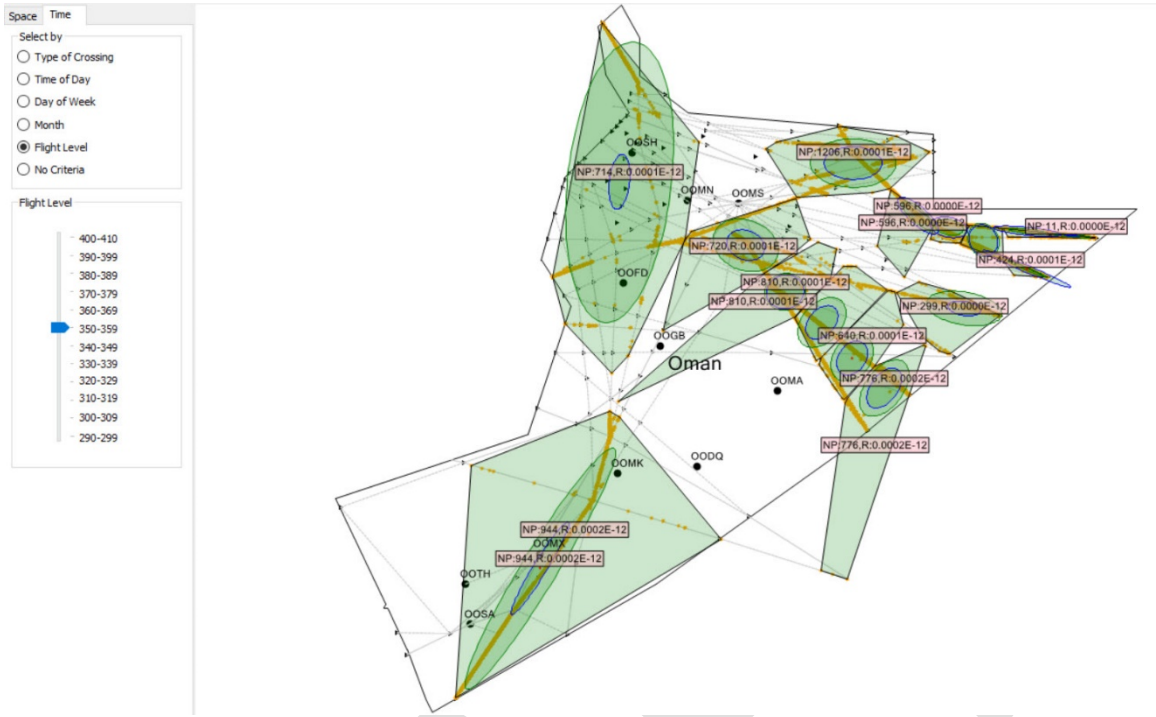
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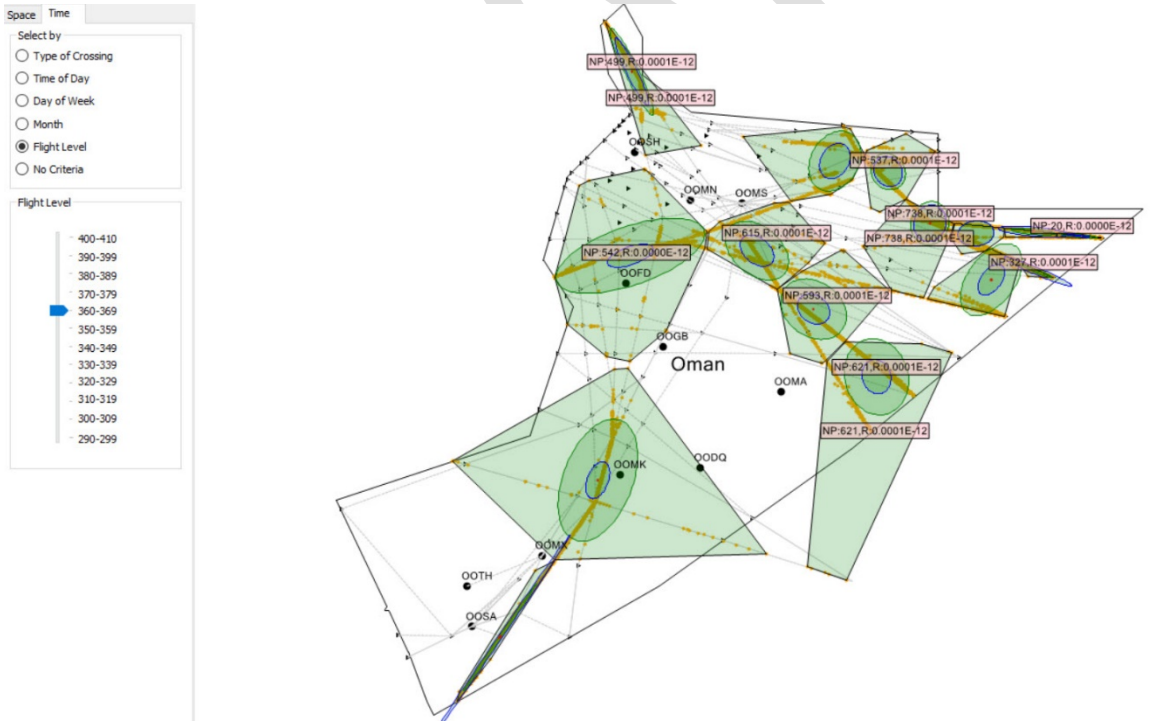
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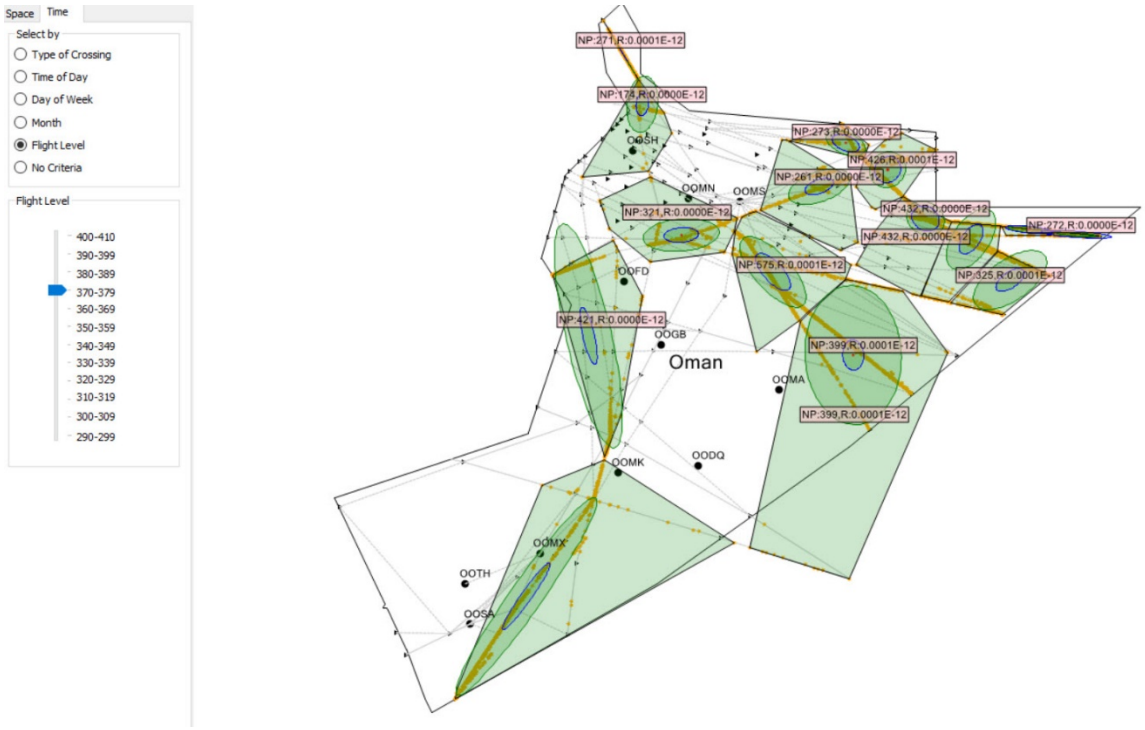
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Time
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Type of Crossing
Time of Day
Day of Week
Month
Flight Level
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OOMS
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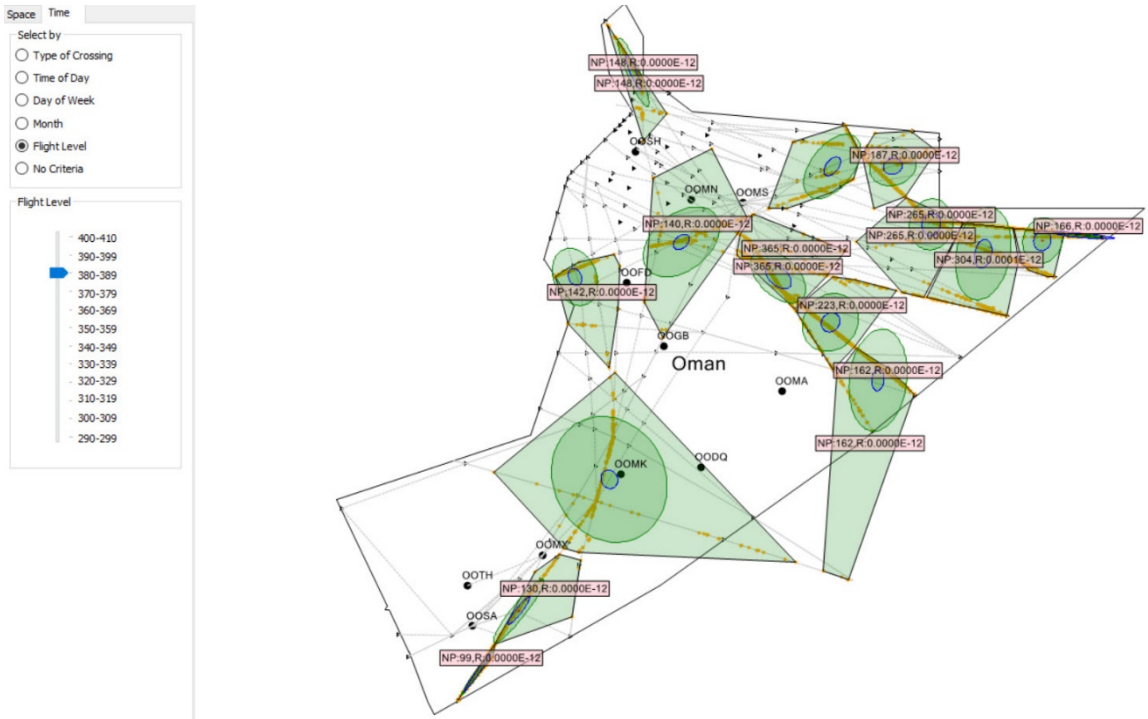
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NP:130,R:0.0000E-12
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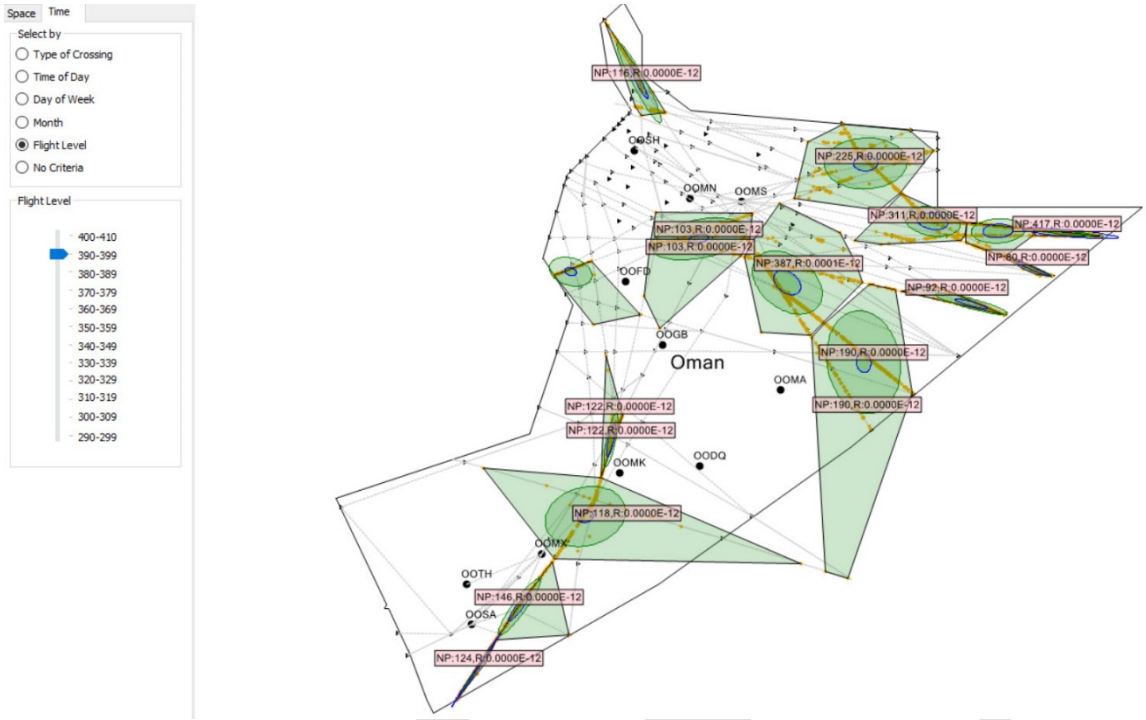
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Time of Day
Day of Week
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Flight Level
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OOMA
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NP:122,R:0.0000E-12
OOMK
OODQ
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OOSA
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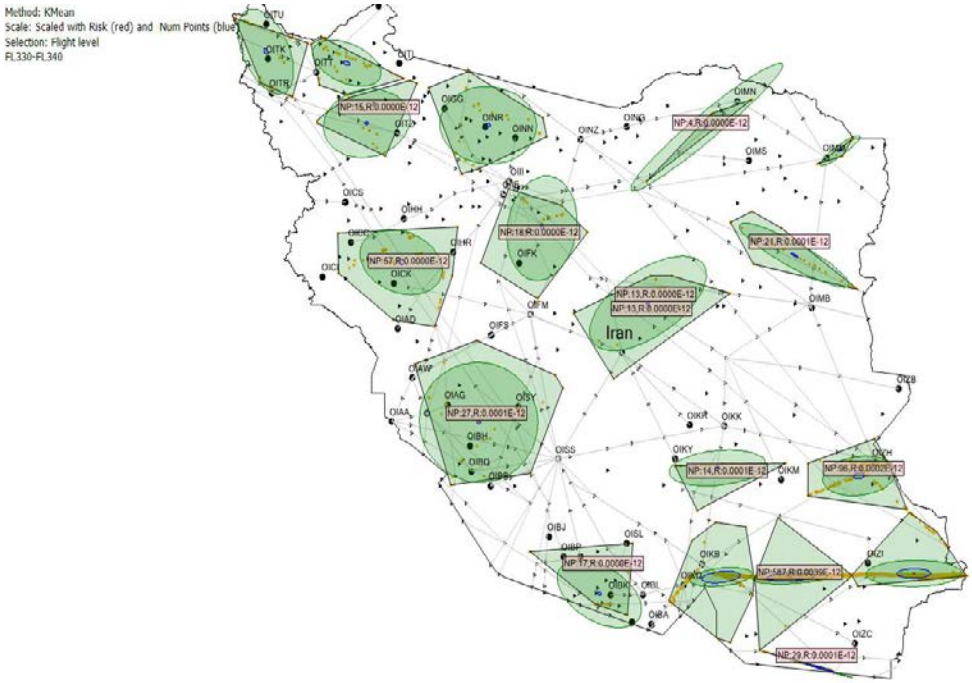
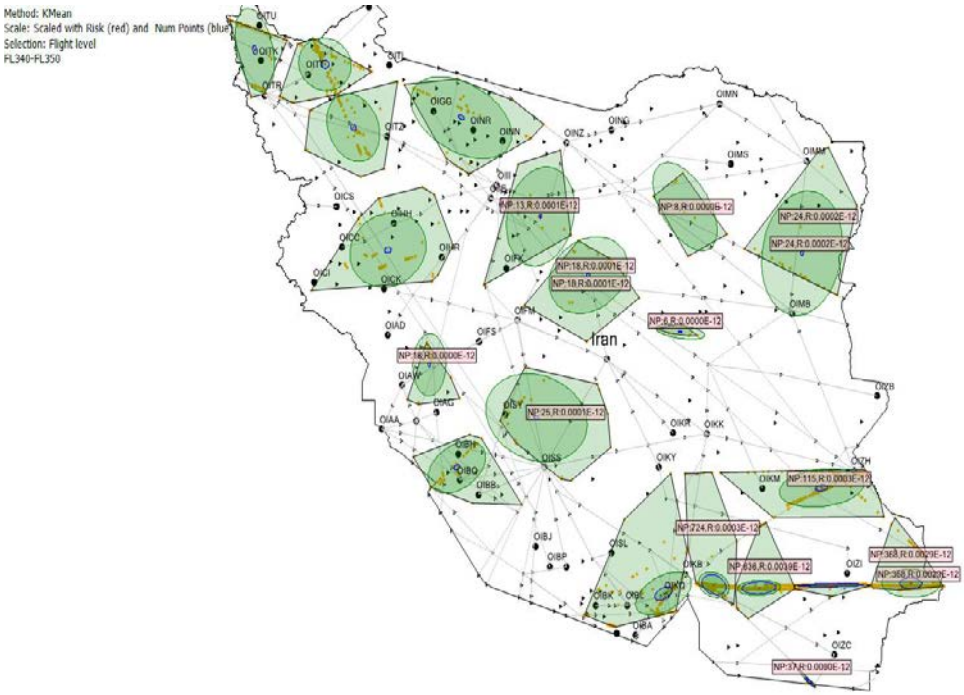
Tehran FIR


Method: KMean
Scale: Scaled with Risk (red) and Num Points (blue)
Selection: Flight level
FL330-FL340
Iran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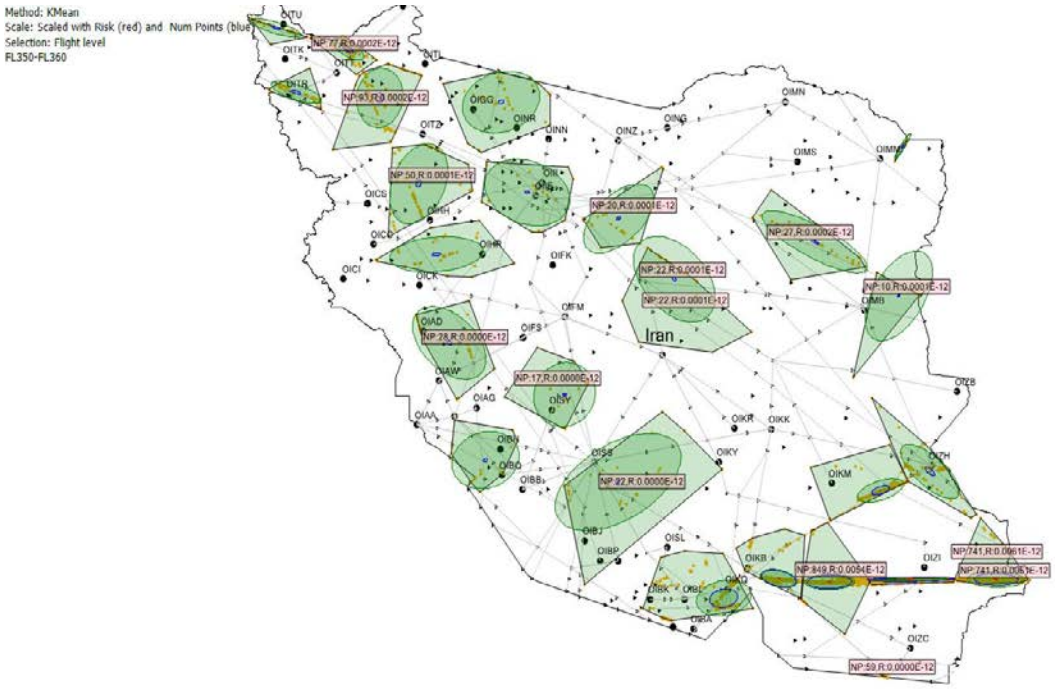
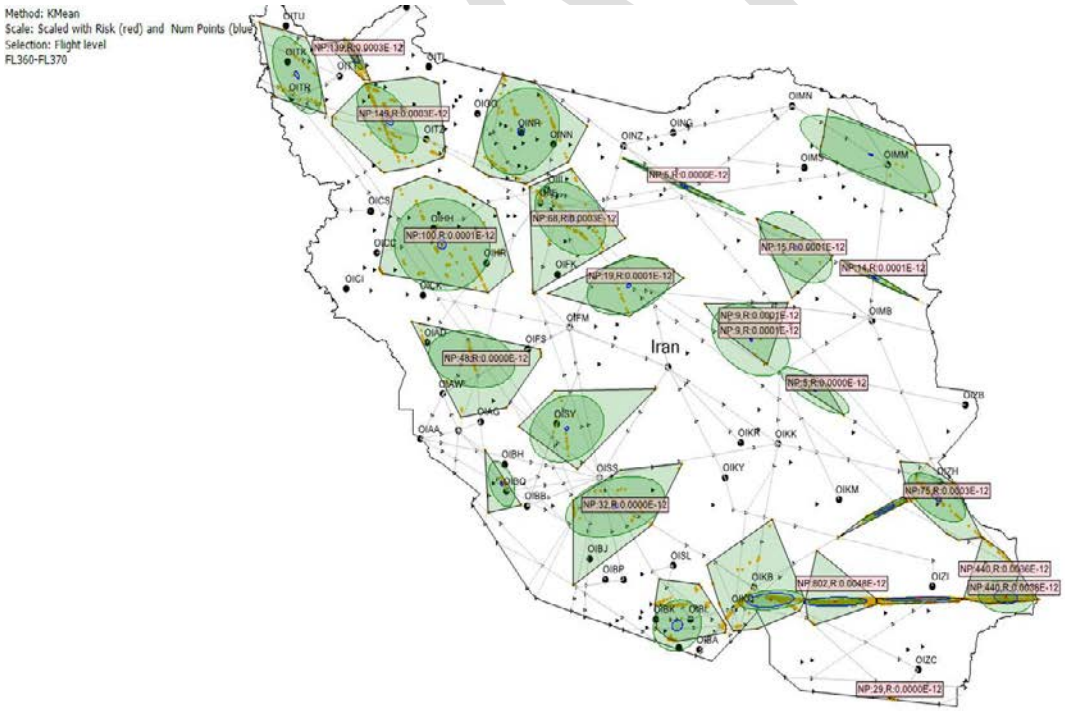
Scale: Scaled with Risk (red) and Num Points (blue)
Selection: Flight level
FL340-FL350
Iran


Method: KMean
Scale: Scaled with Risk (red) and Num Points (blue)
Selection: Flight level
FL350-FL360
Iran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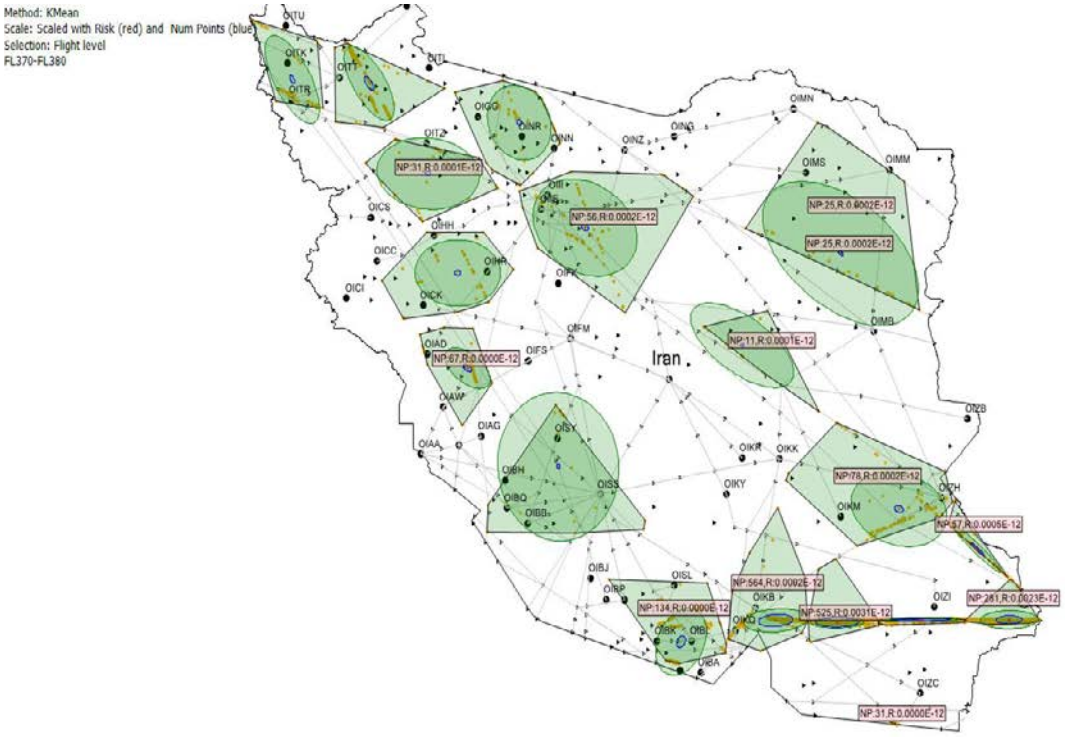
Scale: Scaled with Risk (red) and Num Points (blue)
Selection: Flight level
FL360-FL370
Iran


Method: KMean
Scale: Scaled with Risk (red) and Num Points (blue)
Selection: Flight level
FL370-FL380
Iran
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NP:25,R:0.0002E-12
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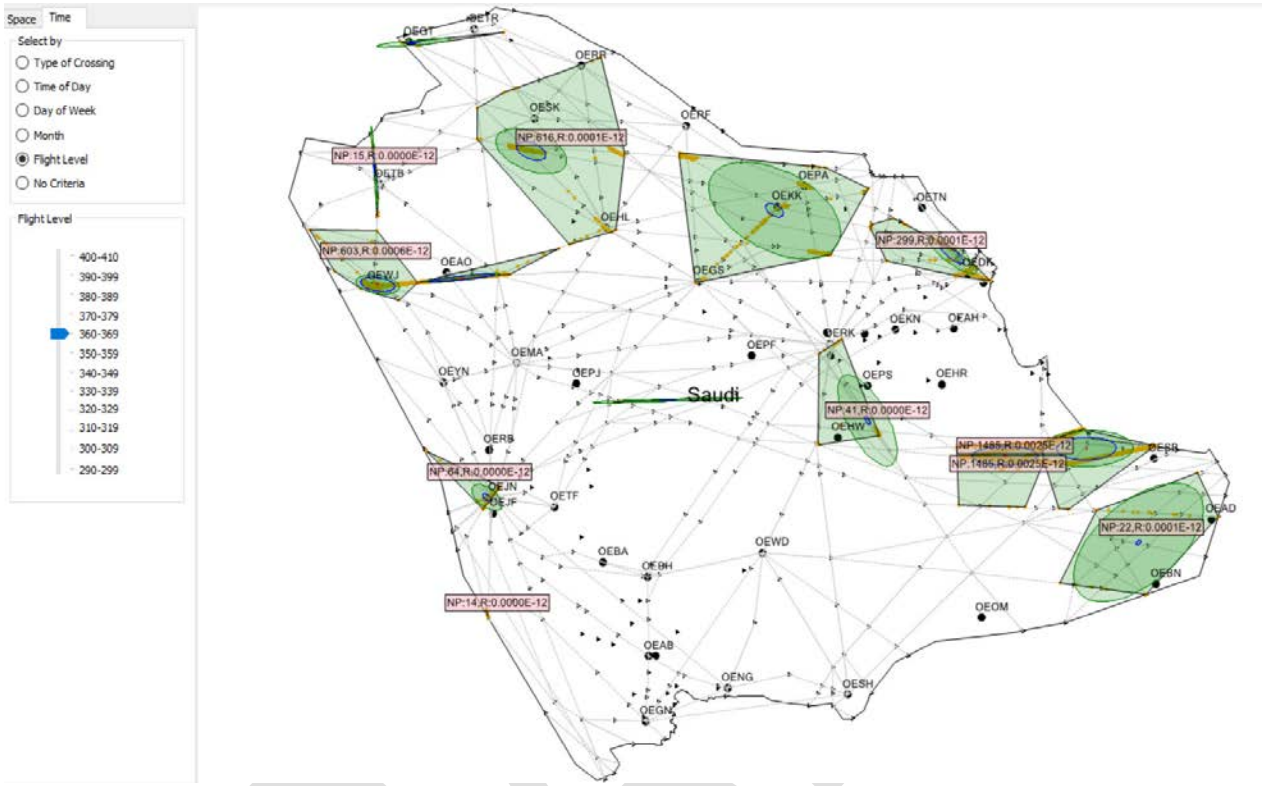
NP:11,R:0.0001E-12
NP:67,R:0.0000E-12
NP:78,R:0.0002E-12
NP:57,R:0.0005E-12
NP:564,R:0.0092E-12
NP:134,R:0.0000E-12
NP:525,R:0.0031E-12
NP:261,R:0.0023E-12
NP:31,R:0.0000E-12

Jeddah FIR


Space
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290-299
OEGT
OETR
OERR
OESK
OERF
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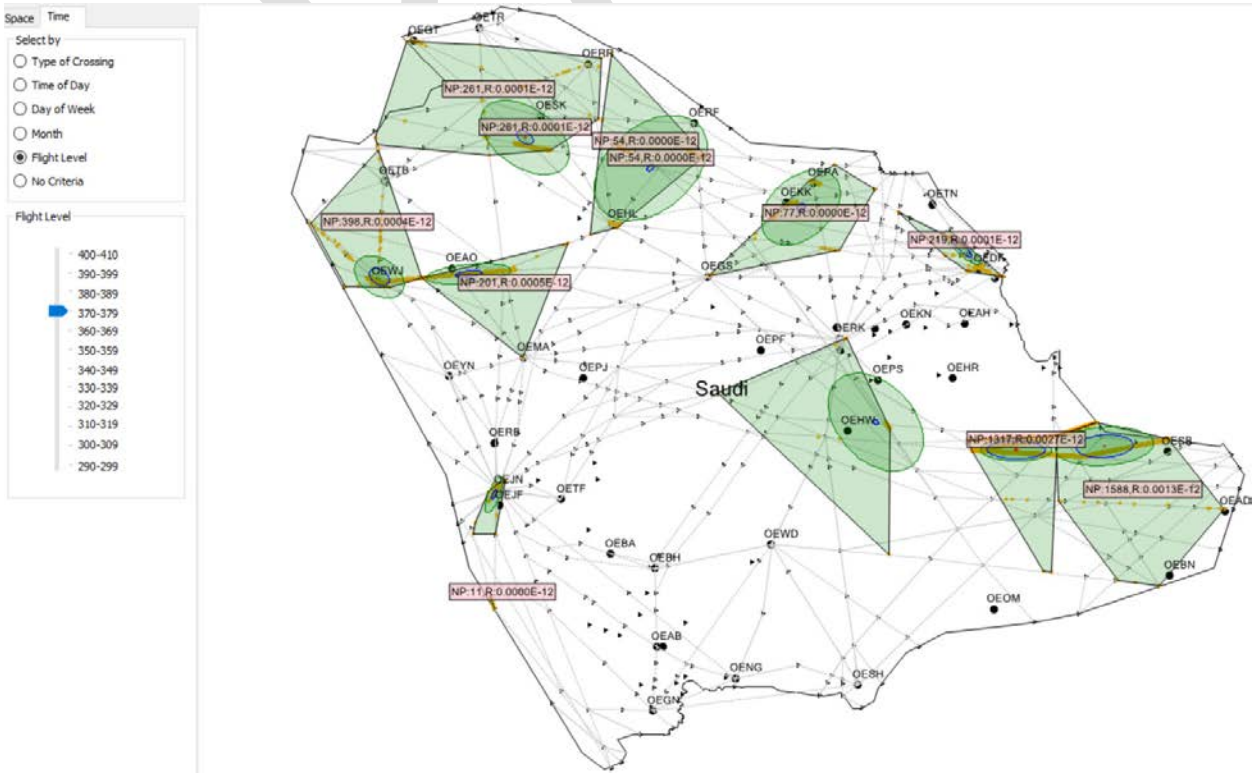
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Time of Day
Day of Week
Month
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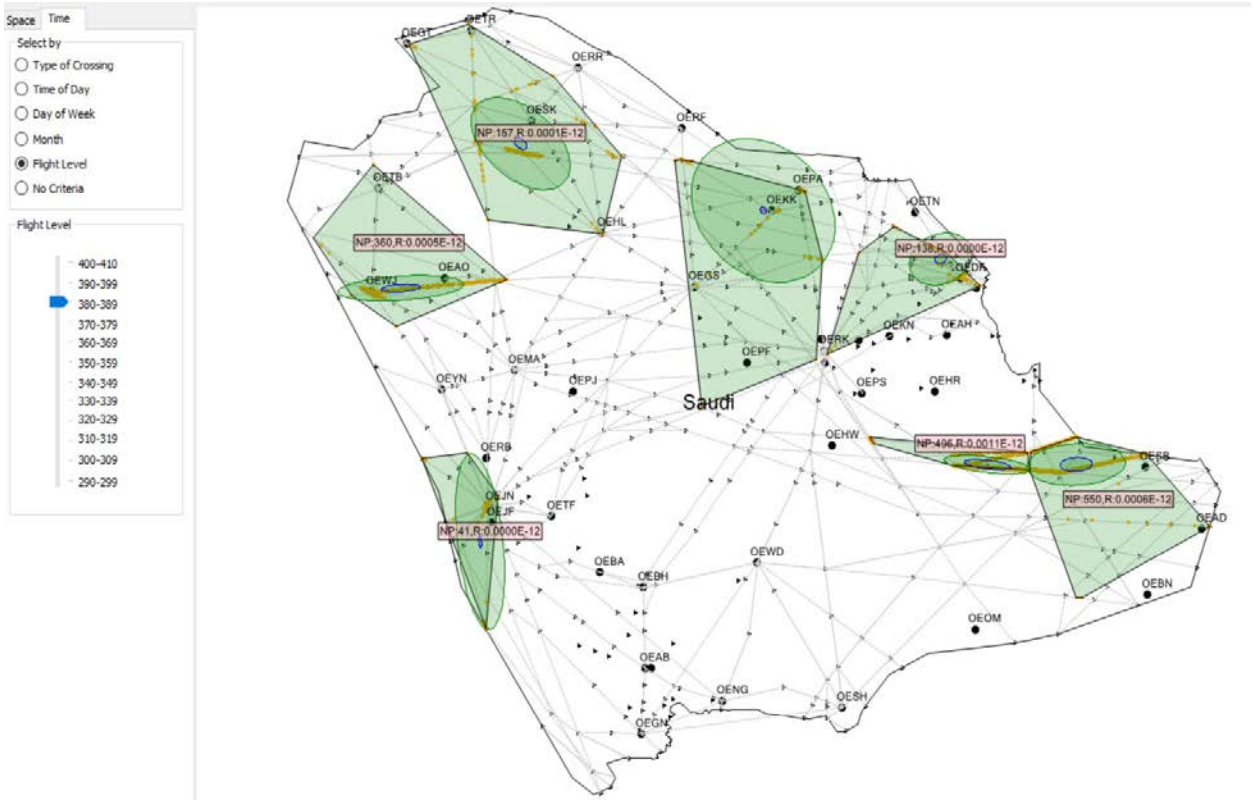
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Select by
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Day of Week
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