EUR/SAM CORRIDOR: "DOUBLE UNIDIRECTIONALITY" POST-IMPLEMENTATION COLLISION RISK ASSESSMENT

Table of contents

- Introduction
- Data availability and assumptions
- Lateral collision risk assessment
- Vertical collision risk assessment
  - Technical vertical risk
  - Operational risk
- Conclusions and recommendations

Introduction

Introduction

- This presentation shows the results for the “Double unidirectionality” post-implementation collision risk assessment in the EUR/SAM Corridor.
- The assessment includes the calculation of lateral and vertical collision risk.

Data availability and assumptions

Data available

- Flight progress data obtained from Palestra database for the Canaries UIR (10/07/2007-10/07/2008)
- Traffic samples from EUR_SAM corridor FIRs from 01/09/2007 to 30/06/08 regarding Information on all aircraft overflying the airspace and on aircraft overflying the airspace that do not overfly the Canaries.

Assumptions adopted

- Some traffic samples do not include all the flights and/or all the information for the required waypoints.
- Assumptions derived from the lack or incoherence of traffic data:
  - Data from 10/07/07 to 10/07/08 used for Canaries assessments.
  - Data from 01/11/07 to 31/01/08 and from 01/04/08 to 30/06/08 used for SAL, Dakar and Recife assessments.
  - Data had to be extrapolated.
  - Trajectories and information at required waypoints (i.e., time and FL) were assumed, considering the most logical routes and speeds.

Problems detected and assumptions

- Aircraft flying in opposite direction at the same flight level at the same time found on route UR-976 (SAL)

  ➢ During 2007-2008 there were not any collisions ⟶ the flight level of one of the aircraft of each pair was changed

- High percentage of proximate pairs detected at the same flight level on crossing routes (time difference at crossing point less than 10 minutes)

  ➢ No deviation reports received ⟶ All of them considered as proximate pairs at different flight levels.

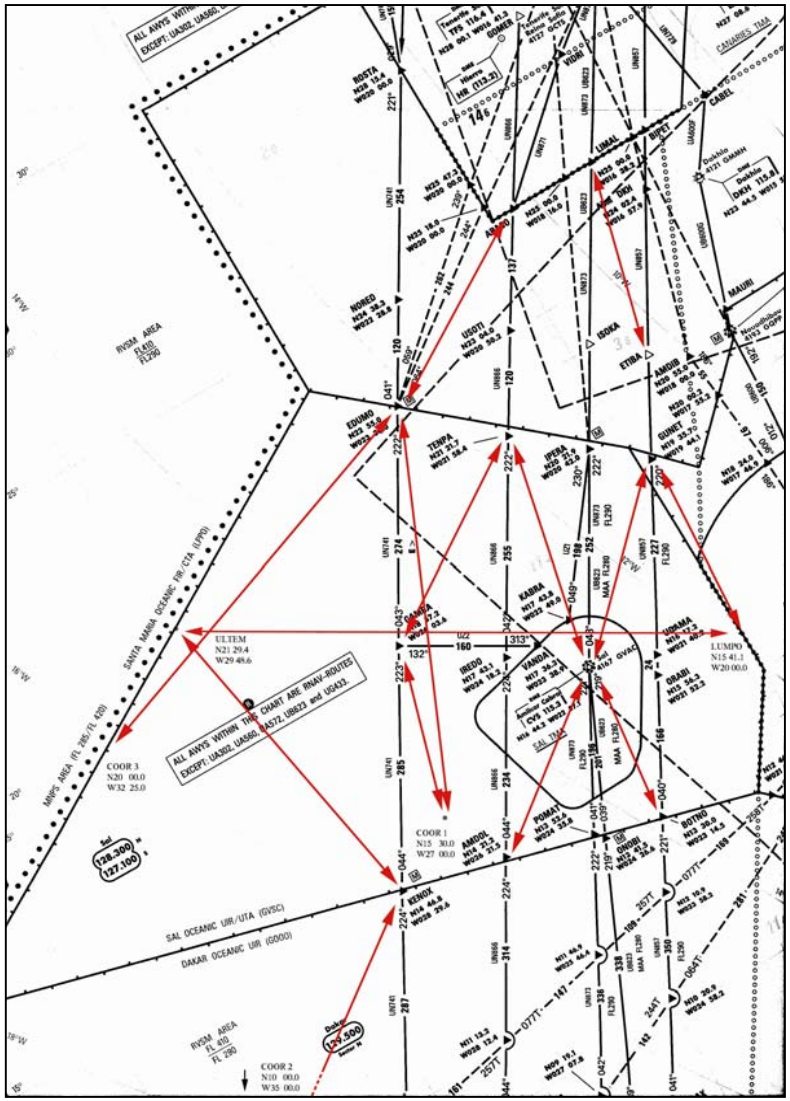
Crossing traffic in non published routes (I)

- Apart from the published crossing routes (UR-976/UA-602, UL-435 and UL-695/UL-375), several crossing trajectories have been identified.

- Only those with more than 50 aircraft per annum have been analysed.

Crossing traffic in non published routes (II)

- Analysed non published routes:
  - CVS-GUNET
  - LIMAL-ETIBA
  - EDUMO-APASO
  - ULTEM-KENOX
  - GUNET-LUMPO
  - GAMBA-TENPA
  - CVS-AMDOL
  - BOTNO-CVS
  - TENPA-CVS
  - COOR1-GAMBA
  - COOR1-EDUMO
  - COOR2-KENOX
  - COOR3-EDUMO
  - ULTEM-LUMPO



Assumptions about the direct routes (RANDOM)

- Traffic on the direct routes ROSTA-NADIR and NADIR-ABALO (RANDOM) has not been considered in the risk assessments.

- It is assumed that risk due to these routes will not dramatically change the results obtained because… Traffic on these two routes only represent 2.5% of the total traffic

- Traffic on the route ROSTA-NADIR is southbound traffic and mainly even levels are used

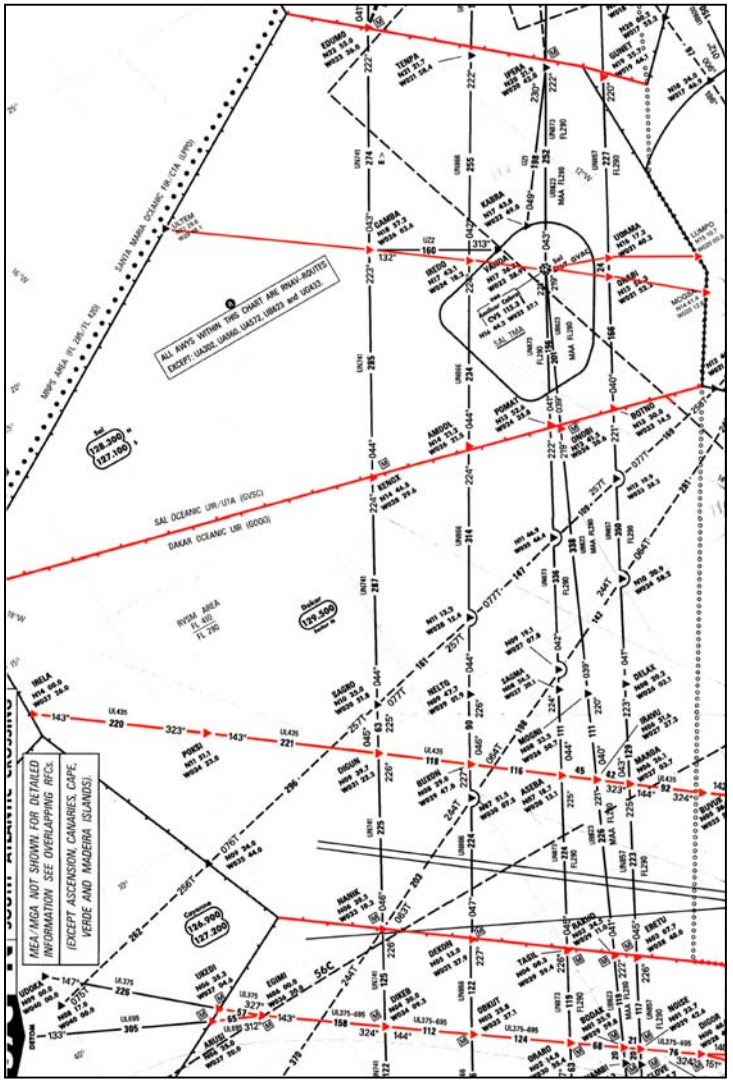
- Traffic on the route NADIR-ABALO is northbound traffic and only odd levels are used

Traffic assumption

- Traffic growth hypothesis: 8% per annum

Risk evaluated in 6 locations

- **CANARIES** = FIR/UIR limit
- **SAL1** = UR976-UA602
- **SAL2** = SAL OCEANIC UIR / DAKAR OCEANIC UIR
- **DAKAR1** = UL435
- **DAKAR2** = DAKAR OCEANIC UIR/ ATLANTIC FIR
- **RECIFE** = UL375-695



Lateral collision risk assessment

- Lateral collision risk: It models the lateral collision risk due to the loss of separation between aircraft on adjacent parallel tracks, flying at the same flight level.

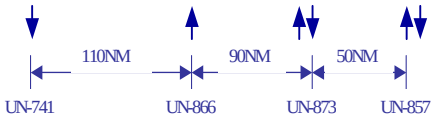
- Safety objective: Target Level of Safety (TLS): $5*10^{-9}$

Locations	Lateral Collision Risk 2008	Lateral Collision Risk 2018
Canaries	$2.1289*10^{-9}$	$4.5961*10^{-9}$
SAL 1	$2.0055*10^{-9}$	$4.3296*10^{-9}$
SAL 2	$2.4510*10^{-9}$	$5.2915*10^{-9}$
Dakar 1	$1.9075*10^{-9}$	$4.1182*10^{-9}$
Dakar 2	$1.6749*10^{-9}$	$3.6160*10^{-9}$
ATL - Recife	$1.7024*10^{-9}$	$3.6752*10^{-9}$

Vertical collision risk assessment

- Total vertical collision risk is composed of the technical vertical risk and the operational risk.
  - Technical vertical risk models the risk due to the loss of vertical separation between aircraft on adjacent flight levels due to normal or typical height deviations.
  - Operational risk models the risk due to large height deviations.
- Safety objectives:
  - Technical vertical risk: TLS = $2.5*10^{-9}$
  - Total vertical risk: TLS = $5*10^{-9}$

Technical vertical risk



TLS=$2.5*10^{-9}$

Locations	Technical Vertical Collision Risk 2008	Technical Vertical Collision Risk 2018
Canaries	$0.2725*10^{-9}$	$0.5883*10^{-9}$
SAL 1	$0.1337*10^{-9}$	$0.2887*10^{-9}$
SAL 2	$0.1488*10^{-9}$	$0.3212*10^{-9}$
Dakar 1	$0.1822*10^{-9}$	$0.3935*10^{-9}$
Dakar 2	$0.1776*10^{-9}$	$0.3835*10^{-9}$
ATL - Recife	$0.1633*10^{-9}$	$0.3527*10^{-9}$

Operational risk assessment (I)

- All large height deviations are due to a coordination error between ATC units.
  - No notification of the transfer
  - Transfer at unexpected flight level
- Only data from Recife includes all the required information (duration and magnitude of the deviation)

Operational risk assessment in Atlantic-Recife UIR

- There were no reports due to large height deviations not involving whole numbers of flight levels → no collision risk due to this type of deviations.

- All reported large height deviations were due to coordination errors between ATC units → no collision risk due to aircraft climbing or descending through a flight level.

Only risk due to aircraft levelling off at a wrong level

Operational risk assessment in Atlantic-Recife UIR (II)

- Operational collision risk obtained for Atlantic-Recife UIR is

$$N_{az}^{wl} = 1.0535 \text{x} 10^{-6}$$

- Its contribution to the whole Corridor is:

$$N_{az}^{wl} = 2.252 \text{x} 10^{-7}$$

Operational risk assessment in Atlantic-Recife UIR (IV)

- So

$$N_{opp}^{RECIFE} >> TLS$$

- As the TLS is already exceeded, operational risk contributions from Dakar and SAL have not been calculated.
  - Some hypothesis regarding time at the incorrect flight level would have been necessary for these calculations

Conclusions and recommendation

Conclusions

- Values of lateral and technical vertical collision risk are similar in all UIRs and below the TLS.
- The operational vertical risk in the Corridor already exceeds the TLS just with the contribution of the large height deviations reported by Atlantic-Recife

$$N_{operational} > TLS$$

So…

Conclusions (II)

- Regarding the total vertical risk:
  - All deviations are due to coordination errors between ATC units, and not related to RVSM operations.
  - Despite these large values for total vertical risk, the deviation reports indicated that there was not any traffic in conflict.
  - If these coordination errors were not taken into account, the operational risk would be zero and the total vertical risk would comply with the TLS.
  - Total vertical risk could not be calculated for the previous routes configuration. Nevertheless, it is believed that the high risk obtained is not related to “double unidirectionality” implementation.

Recommendations

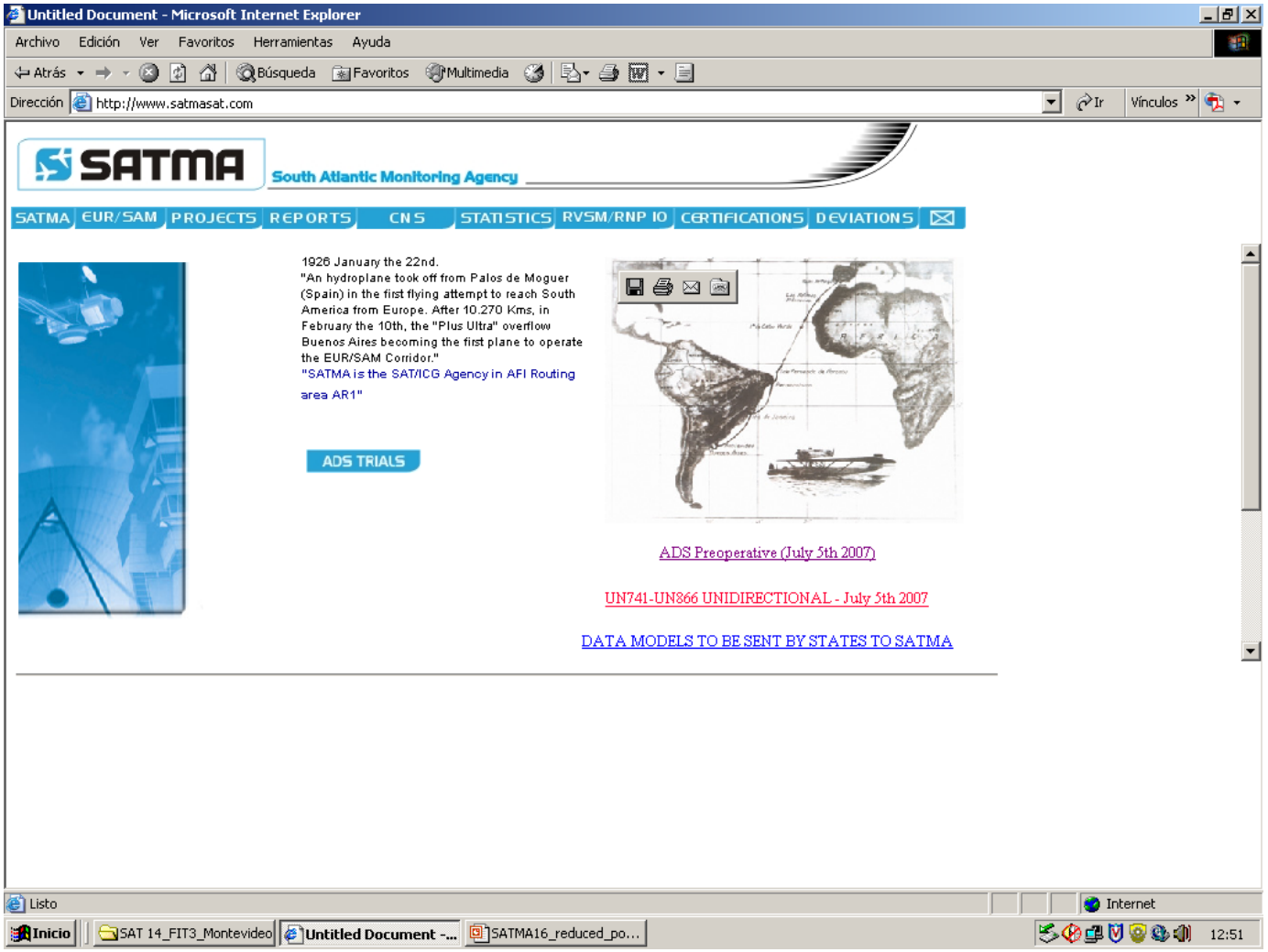
- As the problem relating large height deviations is clearly identified, coordination errors between ATC units, it is recommended that adequate corrective measures be applied as soon as possible.

- The results obtained depend on the validity of the assumptions made. Therefore, these assumptions should be verified.

Recommendations (II)

- As the accuracy of the assessments greatly depends on the availability and accuracy of the data provided, it is recommended that, for next assessments, data from all FIR/UIRs be made available, including as much information as possible in the traffic samples and in the large height deviation reports.

www.satmasat.com



Final Study an Presentation to be posted

Action by THE MEETING

The SAT14/TF1 Meeting is invited to approve the results of DOUBLE UNIDIRECTIONALITY post-implementation safety assessment presented by SATMA with results applying a collision risk model to available data :

a) **Lateral and Vertical technical collision risk are below TLS in all UIRs**

b) Following other RMAs criteria (Operational coordination errors may not imply a RVSM Deviation so they have not been taken into account), the total vertical risk comply with the TLS.

c) In order to subsane detected operational coordination errors, proper corrective actions should be implemented


SATMA