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1. General Scope

- States sent several traffic samples (August month of reference). All year reported LHD used.
- Only deviations in nominal routes or incorporating to nominal routes have been considered.
- Only crossing routes with four or more flights per month have been considered.
- Whenever time information in deviations is not known, five minutes has been considered.
- Pz obtained from Eurocontrol information: $Pz(1000)=6.04*10^{-13}$
- Traffic growth hypothesis from STATFOR information (February 2018): 4,5%

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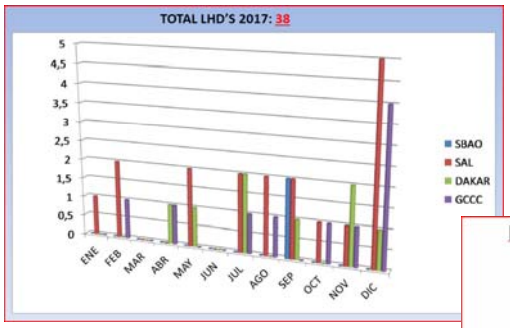
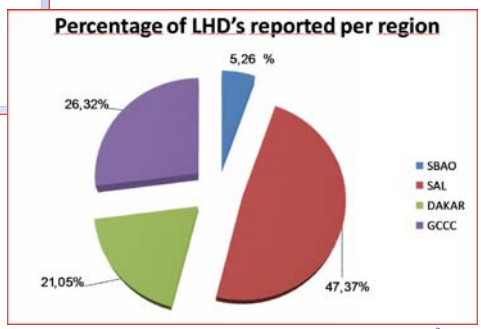
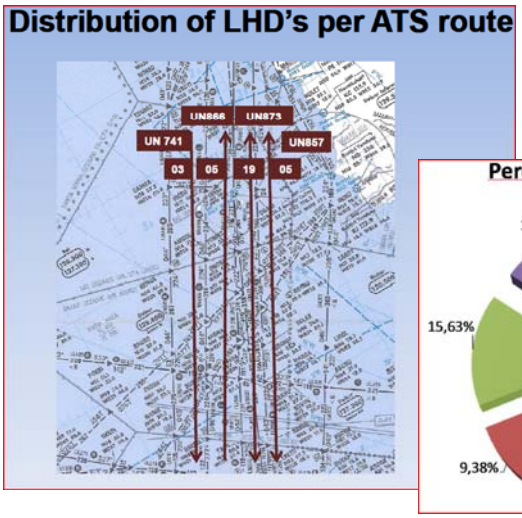
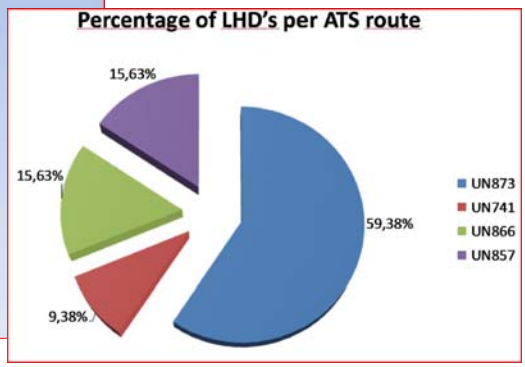
2. LHD 2017 Report (I)



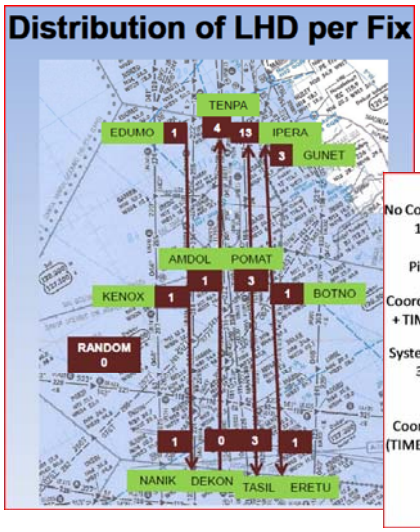


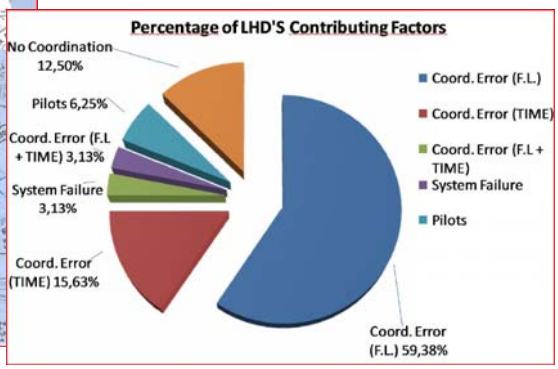
2. LHD 2017 Report (II)





2. LHD 2017 Report (III)





3. Considered hypothesis

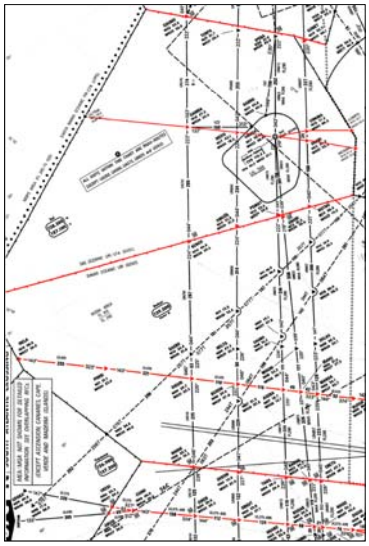
- Traffic information was not complete and did not include information about all the waypoints.
→ data has been extrapolated.

- In the extrapolation aircraft have been detected in the opposite directions in the same flight level at the same time.
  - As there are no corresponding deviations, errors have been assumed in the data and they have been corrected.

- Many proximate events in the same level within less than ten minutes have been detected.
  - No corresponding deviations detected → they have been taken as proximate events at different flight levels.

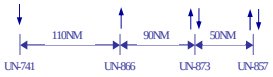
2017 CRM results. Evaluation points

- Canaries: FIR/UIR limit
- SAL1: UR-976/UA-602
- SAL2: UIR SAL Oceanic/UIR Dakar Oceanic
- Dakar1: UL-435
- Dakar2: UIR Dakar Oceanic/Atlantic FIR
- Recife: UL-375/UL-695

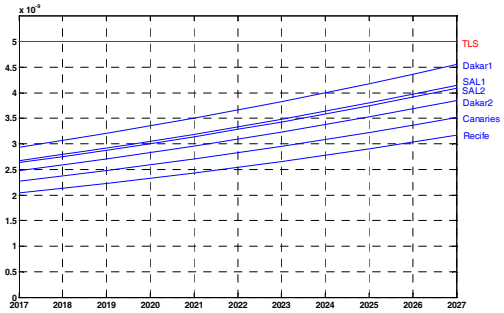


2017 CRM results. Lateral risk

- It models the lateral collision risk due to the separation loss between paralel routes at the same flight level.
- TLS=$5*10^{-9}$



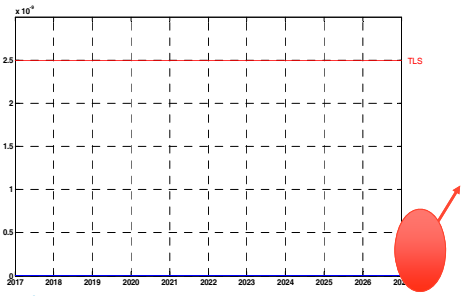
FIR	Lateral Collision Risk 2017	Lateral Collision Risk 2027
Canaries	$2.2664*10^{-9}$	$3.5197*10^{-9}$
SAL1	$2.6724*10^{-9}$	$4.1501*10^{-9}$
SAL2	$2.6340*10^{-9}$	$4.0905*10^{-9}$
Dakar1	$2.9374*10^{-9}$	$4.5617*10^{-9}$
Dakar2	$2.4797*10^{-9}$	$3.8509*10^{-9}$
Recife	$2.0403*10^{-9}$	$3.1686*10^{-9}$

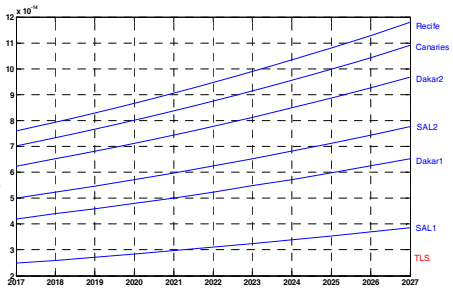


2017 CRM results. Vertical technical risk

- Vertical risk: technical vertical risk + operational risk
  - Vertical technical risk models the risk due to vertical separation loss between aircraft at adjacent flight levels due to normal deviations
  - Operational risk models risk due to large height deviations (LHDs)
- TLS
  - Vertical technical risk: TLS=$2.5*10^{-9}$
  - Total vertical risk: TLS=$5*10^{-9}$

FIR	Technical Collision Risk 2017	Technical Collision Risk 2027
Canaries	$7.0235*10^{-14}$	$1.0907*10^{-13}$
SAL1	$2.4904*10^{-14}$	$3.8674*10^{-14}$
SAL2	$5.0082*10^{-14}$	$7.7776*10^{-14}$
Dakar1	$4.2027*10^{-14}$	$6.5267*10^{-14}$
Dakar2	$6.2399*10^{-14}$	$9.6903*10^{-14}$
Recife	$7.5962*10^{-14}$	$1.1797*10^{-13}$





2017 CRM results. Vertical operational risk

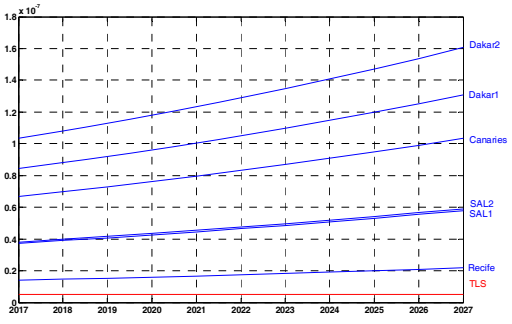
- Operational risk includes:
  - Risk due to aircraft climbing or descending a flight level
  - Risk due to an aircraft at a wrong flight level
  - Large height deviations not involving whole numbers of flight levels

- Depends on the reported LHD by the States
- All LHDs are due to coordination errors between ATC units:
  - No transfer notified
  - Transfer at an unexpected flight level.
- No reported LHD implying aircraft that crossed an UIR without coordination
- Have been reported a LHD in Dakar implying climbing at a RVSM flight level involving whole numbers of flight levels.

FIR	Same direction time at incorrect level, $t_{inl,same}$ (h)	Opposite direction time at incorrect level, $t_{inl,opp}$ (h)	Same direction number of crossed levels (N_{same})	Opposite direction number of crossed levels (N_{opp})
Canaries	1.13	0	0	0
SAL	0.25	0	0	0
Dakar	0.83	0	1	2
Recife	0.17	0	0	0

CRM 2017 results. Total vertical risk

FIR	Overall vertical Collision Risk 2017	Overall vertical Collision Risk 2027
Canaries	$6.6713*10^{-8}$	$1.0360*10^{-7}$
SAL1	$3.7315*10^{-8}$	$5.7949*10^{-8}$
SAL2	$3.8062*10^{-8}$	$5.9109*10^{-8}$
Dakar1	$8.4238*10^{-8}$	$1.3082*10^{-7}$
Dakar2	$1.0343*10^{-7}$	$1.6062*10^{-7}$
Recife	$1.4048*10^{-8}$	$2.1815*10^{-8}$



Conclusions and recommendations

- Lateral risk and vertical technical risk have values below TLS.
- Vertical operational risk is above TLS, as it includes LHDs contribution.
- Main LHDs source is identified: coordination error between ATC units. Correction measures should be applied.
- Accuracy and reliability if the studies depend on the availability and accuracy of data: more accurate information should be made available, both for traffic measures and LHDs.

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Thank you

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