Agenda item 3: SAT Collision Risk Assessments (CRA)

a) ARMA, CARSAMMA and SATMA Activities

SATMA Collision Risk Assessment Activities in 2026

(Presented by SATMA)

SUMMARY	
The present paper summarizes the Collision Risk Assessment (CRA) activities conducted by SATMA during 2026, including updates related to the EUR/SAM Corridor safety monitoring programme and the extension of the CRA scope to include the entire Dakar Oceanic FIR.	
Strategic Objectives	• Safety

1. INTRODUCTION

1.1 Within the ICAO framework, Collision Risk Assessments (CRAs) are conducted to support the safe application of RVSM and RNP 10 operations in the EUR/SAM Corridor, covering the airspace under the responsibility of Spain/Canarias FIR, Cabo Verde/Sal Oceanic FIR and Senegal/Dakar Oceanic FIR.

1.2 Data from the Brazil/Atlantico FIR are not included in the scope of this paper, as this portion of the corridor is assessed separately by CARSAMMA.

1.3 During IMG/SOG07, SATMA was requested to extend the CRA scope to include the entire Dakar Oceanic FIR. Accordingly, this paper provides an updated overview of the CRA activities conducted during 2026 and includes an updated assessment of the 2025 Collision Risk Assessment previously presented to the Group, taking into account the additional airspace under the responsibility of Dakar Oceanic FIR, including the DIII sector.

1.4 The paper also presents the latest developments related to Large Height Deviation (LHD) reporting, occurrence monitoring activities and other initiatives supporting safety assessments within the EUR/SAM Corridor.

2. ACTIVITIES IN PROGRESS

2.1 The Large Height Deviation (LHD) reports received and the manner in which they have been considered in the assessment were presented to the current SAT SOG meeting.

2.2 In this context, a Navigation Error Investigation Form covering LHD, LLD and LLE occurrences has also been presented to support the forthcoming implementation of PBCS within the EUR/SAM Corridor.

2.3 The dualization of ATS route UN866 has been taken into consideration in the assessment.

2.4. The updated assessment incorporates the following changes:

- The revised scope, previously coordinated with ARMA and presented at IMG/SOG07, has been applied to the Collision Risk Assessment (CRA) and the associated analysis of Large Height Deviations (LHDs), as detailed below:

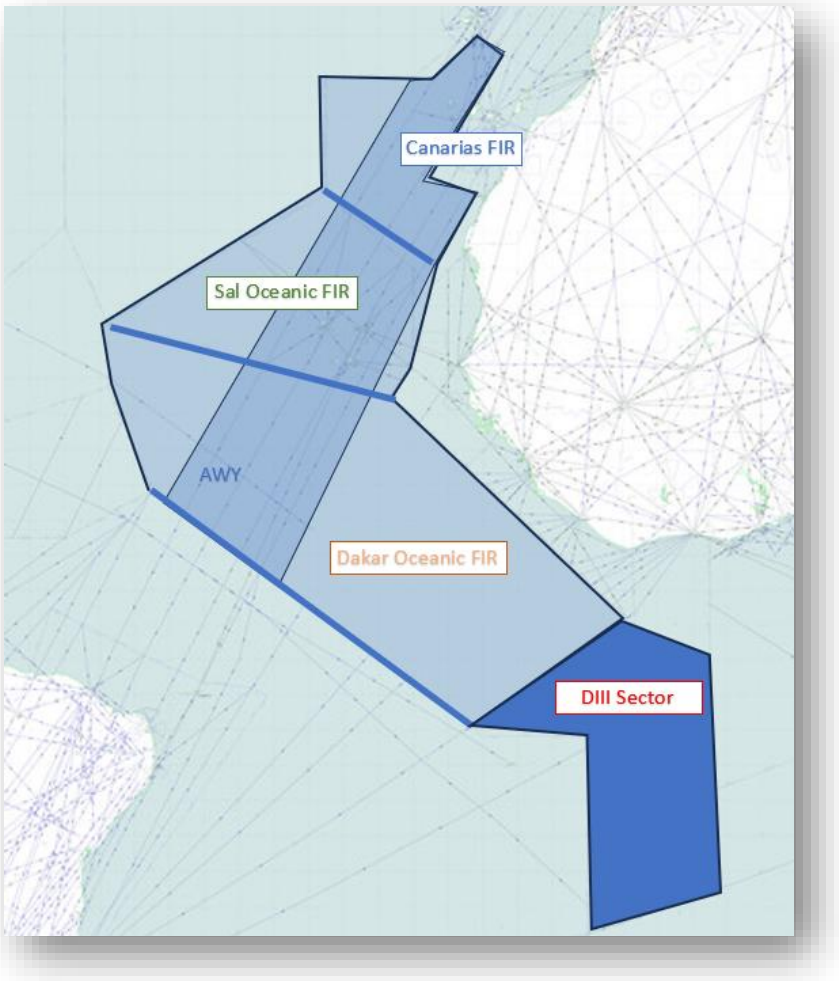


Figure 1. Scope of CRA -Review with DIII Sector

- Based on the revised scope, a comprehensive analysis was conducted for the EUR/SAM Corridor for the full year 2025. An extract of this analysis, focusing on the overall results, is presented below.

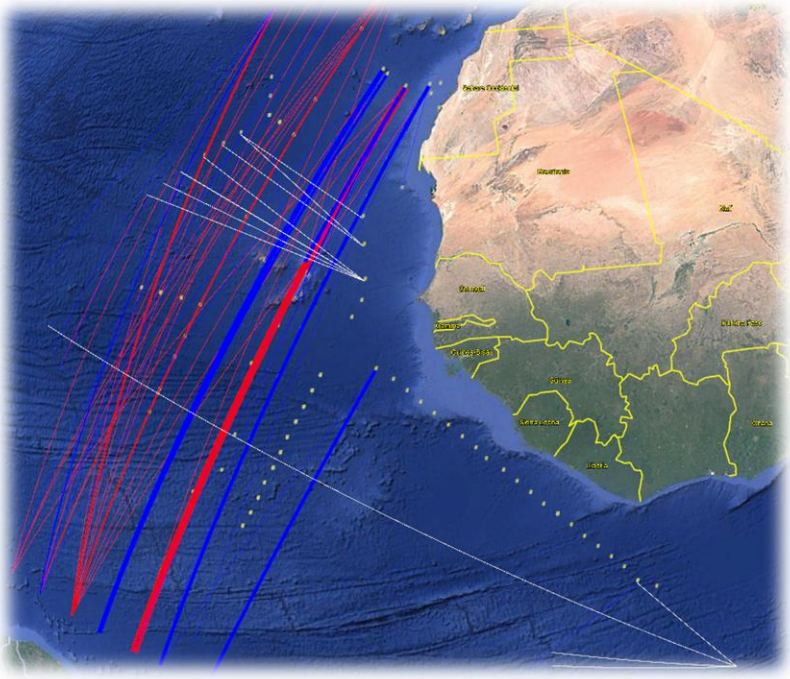


Figure 2. Main flows – Updated with DIII Sector

- SATMA has already provided to SAT States in previous SOG regarding data and usage of SLOP procedures to be included in the methodology of Collision Risk Assessment (EUR/SAM Corridor). For the purpose of the CRA, the SLOP distribution observed in Canarias FIR is assumed to be representative of operations throughout the remainder of the EUR/SAM Corridor. The next table shows the SLOP data for each analysed year. Although the distribution remains similar, the overall proportion of aircraft applying SLOP was higher in 2025.

	Centerline	1-Mile Right Offset	2-Mile Right Offset
2023	**60.6%**	**27.3%**	**12.1%**
2024	60.3%	27.9%	11.9%
2025	**53.8%**	**34.4%**	**11.8%**

Table 1.- SLOP distributions - NO changes Last Report

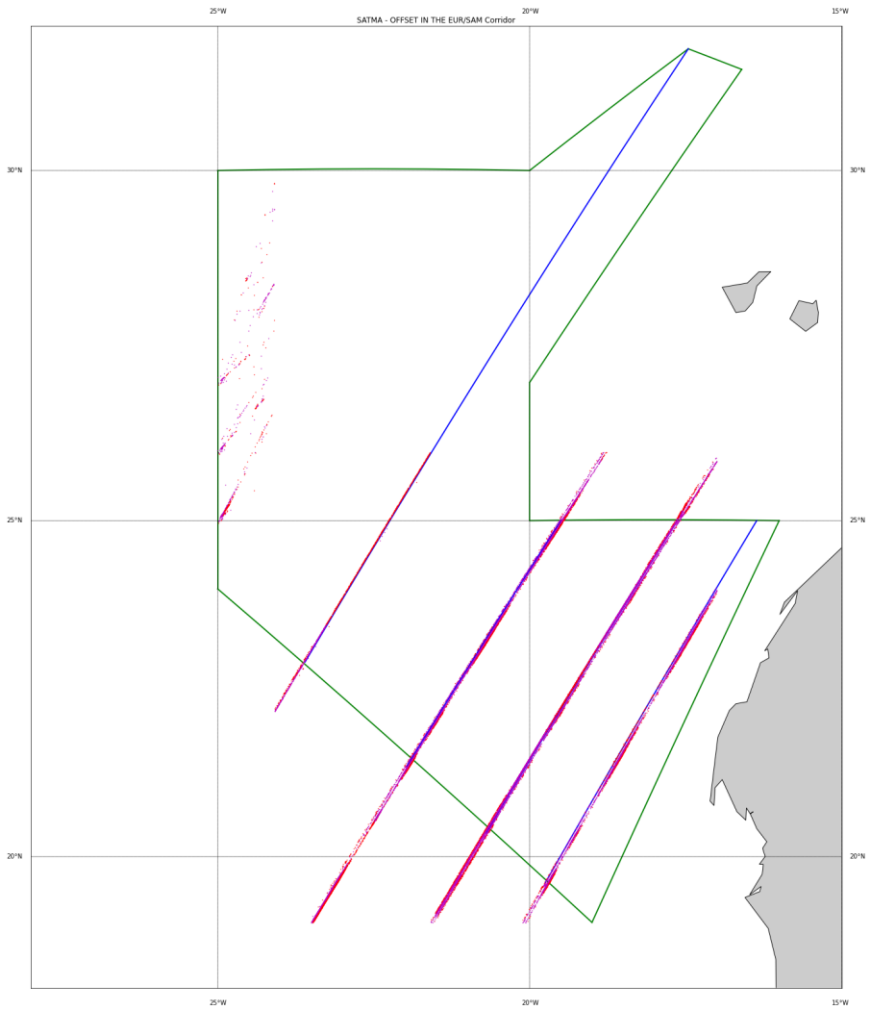


Figure 1. Strategic Lateral Offset Procedure (SLOP) Assumed for the CRA – No Changes

- The CRA methodology has been updated in accordance with:

  - The **total vertical risk** is defined as the sum of the technical risk and the operational risks. It is assumed that the same type of collision risk model is applicable to the different risk components. N means **Number** of fatal accidents per flight hour due to loss of planned vertical (az) separation.

$$N_{az}^{total} = N_{az}^{tech} + N_{az}^{wl} + N_{az}^{cl/d}$$

  - For example, the vertical collision risk associated with an incorrect flight level assignment is given by:

$$N_{aZ}^{wl} = P_y(0) \cdot \frac{\lambda_x}{S_x} \cdot \left\{ P_z^{wl}(S_z)_{same} E_{z_{same}} \cdot \left[\frac{|\Delta\bar{v}|}{2 \cdot \lambda_x} + \frac{|\dot{\bar{y}}|}{2 \cdot \lambda_y} + \frac{|\dot{\bar{z}}|}{2 \cdot \lambda_z} \right] + P_z^{wl}(S_z)_{opp} E_{z_{opp}} \cdot \left[\frac{2 \cdot |\bar{v}|}{2 \cdot \lambda_x} + \frac{|\dot{\bar{y}}|}{2 \cdot \lambda_y} + \frac{|\dot{\bar{z}}|}{2 \cdot \lambda_z} \right] \right\}$$
$$+ \frac{P_Z(0) \times t^{wl}}{T} \cdot \sum_{1}^{n} P_h(\theta_i) \cdot E_z(\theta_i) \cdot \left\{ \frac{v_{rel}(\theta_i)}{\frac{\pi\lambda_h}{2}} + \frac{|\dot{\bar{z}}|}{2 \cdot \lambda_z} \right\}$$

- The final term, which applies to all technical risk components, is evaluated at airway crossing points and does not take into account crossings executed tactically.

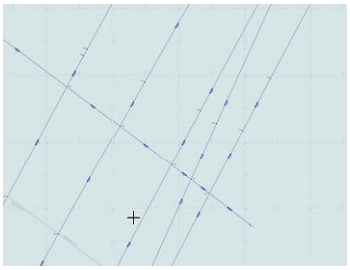


Figure 2. Considered crossings in the CRA

- The total lateral risk comprises the technical risk and the operational risks. However, in the absence of PBCS implementation, lateral risk is assumed to be limited to the technical component only. **Nevertheless, the methodology has been prepared to incorporate operational risk arising from LLD and LLE occurrences once PBCS monitoring data become available (following the planned PBCS implementation at the end of November 2026).**

$$N_{ay}^{total} = N_{ay}^{tech} + N_{ay}^{TC} + N_{ay}^{IT}$$

- SATMA has completed a preliminary calculation of the Altimetry System Error (ASE) using ADS-B data collected during 2026 for traffic operating within the EUR/SAM Corridor. This activity is being conducted in coordination with the Federal Aviation Administration (FAA) within the framework of the SAT RMA Harmonization/Standardization Project Team. This activity remains ongoing.

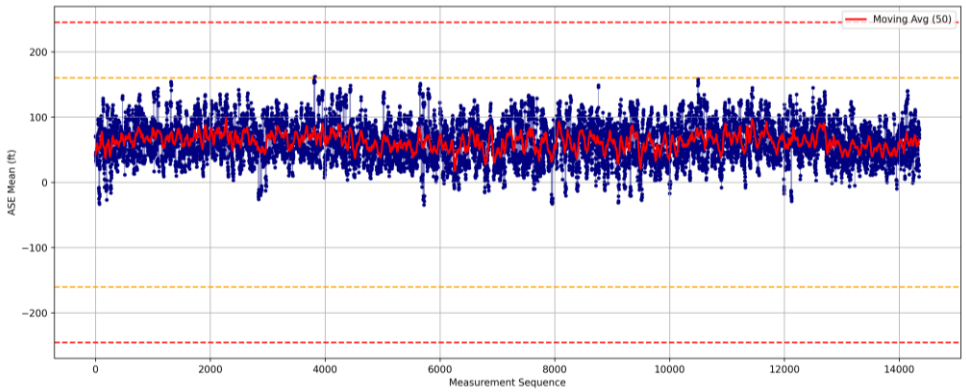


Figure 3. Example ASE Analysis by MMR Group- SATMA - 2026

- In the absence of complete ASE data representative of 2025 operations, SATMA proposes, for the purpose of the current Collision Risk Assessment (CRA), to assume that the ASE values obtained from the 2026 dataset are representative of 2025 traffic. Consequently, the CRA results presented in this paper should be considered provisional.
- Once the corresponding surveillance data from Eurocontrol become available, SATMA will validate the preliminary results against the additional dataset. Should any significant discrepancy be identified affecting the CRA assumptions or results, the matter will be reported to the Group and, if appropriate, discussed within the SAT RMA Harmonization/Standardization Project Team and/or the RMACG.
- The parameters shown below have been updated based on the information currently available. Nevertheless, the CRA results for 2025 should be considered provisional pending validation against the additional surveillance dataset expected from Eurocontrol.

2025 - UPDATED			
EUR/SAM Corridor*	Vertical Collision Risk Estimation (Naz)		
	TOTAL	Tech	Ope
Naz (SLOP)	1.35E-10	3.60E-13	1.35E-10
Naz (Not SLOP)	3.09E-10	1.24E-12	3.07E-10
Target Level of Safety (TLS)	5.00E-09	2.50E-09	5.00E-09

* See scope of this analysis

Table 2.- N_{az} for 2025 - UPDATED

2025 - UPDATED			
EUR/SAM Corridor*	Lateral Collision Risk Estimation (Nay)		
	TOTAL	Tech	Ope
Nay (SLOP)	2.13E-10	2.13E-10	
Nay (Not SLOP)	2.25E-10	2.25E-10	
Target Level of Safety (TLS)	5.00E-09	2.50E-09	5.00E-09

* See scope of this analysis

Table 3.- N_{ay} for 2025 - UPDATED

- As a follow-up to SAT/SOG-07, the forthcoming SATMA Working Paper on Collision Risk Assessment will incorporate a defined set of Safety Key Performance Indicators (KPIs), as outlined below.

sKPI	Description	2025	2024
SAT.SKI.01	Number of accidents	0	0
SAT.SPKI.02a	Number of LHD events divided by number of flight hours flown in the COVERED SAT AREA	9.60E-05	8.91E-05
SAT.SPKI.02b	Overall time of LHDs at unprotected flight level divided by total duration of flights in minutes	8.23E-04	1.01E-03
SAT.SPKI.03a	Number of Lateral deviations divided by number of flight hours flown in the COVERED SAT AREA	0	0
SAT.SPKI.03b	Overall time of lateral deviations on an unprotected profile divided by total duration of flights in minutes	0	0
SAT.SKPI.04	Number of losses of separation events divided by number of flight hours flown in the COVERED SAT AREA	0	0
SAT.SKPI.05a	Number of coordination errors divided by number of flight hours flown in the COVERED	6.40E-05	7.86E-05
SAT.SKPI.05b	Overall time of coordination errors spent at unprotected profile divided by total duration of flights in minutes	4.94E-02	5.66E-02
SAT.SKPI.06a	Collision Risk Estimate (CRE) in the vertical dimension	1.35E-10	1.57E-09
SAT.SKPI.06B	Collision Risk Estimate (CRE) in the lateral dimension	2.25E-10	4.19E-10

* See scope of this analysis

Table 4.- sKPI EUR/SAM Corridor - UPDATED

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information presented in this paper;

b) review the updated CRA activities conducted by SATMA, including the extension of the assessment scope to the entire Dakar Oceanic FIR;

c) note the progress achieved regarding ASE analysis, PBCS monitoring preparations and safety performance monitoring activities; and

d) provide comments and guidance, as deemed appropriate.

END