



ASSEMBLY — 42ND SESSION

TECHNICAL COMMISSION

Agenda Item 24: Aviation Safety and Air Navigation Priority Initiatives

FORWARD-LOOKING MEASURES TO ADDRESS THE CHALLENGES OF SPACE DEBRIS IN RELATION WITH HIGHER AIRSPACE OPERATIONS (HAO)

(Presented by the United Arab Emirates)

EXECUTIVE SUMMARY

The increasing activity in higher airspace operations (HAO), including the re-entry of space debris and natural celestial bodies, poses growing challenges to civil aviation, national security, and public safety. The UAE has been active in tracking re-entering objects and contributing to planetary defence. These efforts have revealed a critical need for global frameworks and coordinated response strategies to mitigate risks to aviation and the public. This paper calls upon ICAO to further develop guidance on integrating Space Situational Awareness (SSA) into air navigation systems, support Member States in establishing early warning capabilities, and initiate a structured roadmap to address airspace safety in the context of HAO.

In recognizing the growing international engagement on space matters, including the existing Memorandum of Understanding (MoU) between ICAO and United Nations Office for Outer Space Affairs (UNOOSA), this paper encourages ICAO to build upon current cooperation and explore expanded coordination mechanisms and practical deliverables in support of global aviation safety.

It also highlights the need to consider the legal, institutional, and technical dimensions of space debris re-entry, including State responsibilities, notification obligations, and temporary airspace management procedures.

Action: The Assembly is invited to:

- urge ICAO to accelerate work on frameworks that incorporate SSA into air navigation systems, including the development of standardized protocols for data use, notification, and short-term airspace coordination.
- invite ICAO to build upon its existing MoU with the UNOOSA by identifying concrete deliverables, such as joint guidance material, data-sharing frameworks, and coordinated response models for re-entry scenarios affecting civil aviation.
- emphasize the importance of integrating space operations with existing air traffic management systems and recognizing the unique performance characteristics of new entrants, including trajectory unpredictability, re-entry uncertainty, and rapid notification requirements.
- invite Member States to share their experiences and best practices related to space debris re-entry events and associated airspace coordination in similar forums or international meetings, in support of the development of future guidance material, operational concepts, and broader awareness

Strategic Goals:	This working paper relates to <i>Every Flight is Safe and Secure</i>
Financial implications:	No financial implications are expected from this paper.

<i>References:</i>	<i>Annex 11 – Air Traffic Services</i> <i>Doc 10209, Report of the Fourteenth Air Navigation Conference (Recommendations 2.2/1 and 2.5/1)</i> <i>Doc 10162, Manual on Monitoring Implementation of Regional and National Aviation Safety Plans</i> <i>Doc 10160, Report of the High-level Conference on COVID-19</i> <i>Doc 10084, Risk Assessment Manual for Civil Aircraft Operations Over or Near Conflict Zones</i> <i>Doc 10100, Manual on Space Weather Information in Support of International Air Navigation</i> <i>Doc 9971, Manual on Collaborative Air Traffic Flow Management</i> <i>Doc 9854, Global Air Traffic Management Operational Concept</i>
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1. INTRODUCTION

1.1 Higher airspace operations (HAO) are evolving rapidly as new technologies emerge and the number of objects in orbit continues to grow. As of May 2025, approximately 11 700 active satellites orbit Earth, most located in low-Earth orbit (LEO). Including inactive satellites and those in “graveyard” orbits, the total could be around 14 900. The number of satellites has surged, especially since the 2010s, due to the rise of private space operators. Experts predict satellite numbers could reach up to 100 000 before stabilizing. However, this rapid growth poses significant risks such as increased space debris as one of the major ones amongst others.

1.2 The United Arab Emirates has been actively engaged in monitoring these developments. Through national and private sector facilities, the United Arab Emirates has contributed to early warning, public education, and scientific investigation of space debris re-entries and meteor events. These national capabilities have uncovered gaps in the global aviation systems’ preparedness to respond to such events.

2. DISCUSSION

2.1 The concern over airspace safety during space debris re-entry is not hypothetical. In a notable example, the United Arab Emirates provided assistance to authorities in determining the optimal window for airspace closure during the re-entry of object WT1190F in 2015¹. The closure of a specific portion of airspace over the Indian Ocean, south of Sri Lanka, was implemented for a short duration to ensure safety during the anticipated window of re-entry. While no adverse impact occurred, the event highlighted the importance of having predictive tools and procedural coordination in place.

2.2 Space debris observations are being conducted by both governmental observatories and individual private ones. While their orbital and re-entry calculations are often precise, there have been multiple instances where variations in predictions resulted in considerable margins of error. These deviations can create significant uncertainty in determining potential risk zones, thereby imposing threats to civil aviation operations, especially in regions under heavy traffic.

2.3 Despite the growing operational capabilities in tracking and predicting re-entry trajectories, global aviation systems currently lack harmonized procedures for advance warning, risk assessment, and temporary airspace management in response to high-uncertainty re-entry events. The absence of clear protocols for inter-agency coordination and airspace user communication during such short-notice scenarios remains a critical gap.

2.4 Other global events further demonstrate the implications. In May 2025, the Soviet-era Kosmos 482 spacecraft re-entered Earth's atmosphere after decades in orbit and was confirmed to have impacted the Indian Ocean¹. In another incident in 2007, space debris was reported to have passed within five nautical miles of a commercial aircraft over the Pacific Ocean². These incidents demonstrate the potential hazards to aviation and the necessity for improved monitoring and coordination.

2.5 The modelling of potential re-entry zones reveals the scale of impact airspace restrictions may require. For instance, a corridor illustrated during previous planning exercises covered an approximate span of 200 nautical miles in length and 40 nautical miles in width, representing a notional risk zone around a projected debris path. This underscores the need for ICAO to lead in standardizing guidance and coordination practices among States especially if the re-entry window is over multiple small flight information regions (FIRs).

2.6 While this paper focuses specifically on the implications of space debris, this topic serves as a high-impact, time-sensitive entry point into the broader policy discussion surrounding HAO. Space debris re-entries are among the few HAO phenomena that create direct, immediate risks to civil aviation making them an ideal starting point for ICAO to exercise its leadership in developing safety frameworks, cross-border coordination protocols, and notification procedures.

2.7 The United Arab Emirates aligns with previous calls from States during the Fourteenth Air Navigation Conference (AN-Conf/14) emphasizing the importance of integrating space operations with existing air traffic management systems and recognizing the unique performance characteristics of new entrants. The United Arab Emirates offers its operational experiences as a case study for forward-looking cooperation. National programs have demonstrated that predictive accuracy and response depend heavily on data-sharing and regional coordination. Yet currently, there is no standardized mechanism for notifying States of potentially hazardous re-entries or for coordinating short-term airspace closures with aviation stakeholders.

2.8 Furthermore, important legal and regulatory considerations remain largely unaddressed. Issues related to sovereign airspace, jurisdiction, liability for damages, and institutional responsibility in space debris scenarios require further examination. ICAO's involvement in shaping guidance material in coordination with legal and space policy institutions would ensure a comprehensive and internationally accepted framework.

2.9 To safeguard aviation and build resilience in the face of expanding HAO activity, ICAO should take a leadership role in consolidating existing efforts, establishing guidance, and providing a roadmap for Member States to develop relevant capabilities.

3. CONCLUSION

3.1 The transition to a more active and risk-prone higher airspace environment requires ICAO to adopt a strategic posture. This paper advocates for space debris re-entry as a priority subdomain for ICAO action, given its direct operational implications for civil aviation safety, predictability, and coordination.

¹ <https://www.livescience.com/space/space-exploration/soviet-spacecraft-kosmos-482-crashes-back-to-earth-disappearing-into-indian-ocean-after-53-years-in-orbit>

² <https://en.mercopress.com/2007/03/28/lan-chile-airbus-has-near-miss-from-russian-space-junk>

3.2 The United Arab Emirates urges ICAO to provide clear guidance for States to manage the implications of space debris re-entry and celestial impactors on civil aviation, including the safe use of airspace, inter-agency coordination, and public communication.

3.3 Future ICAO initiatives in this area should also incorporate legal, institutional, and cross-sectoral dimensions, ensuring that airspace management is informed by comprehensive risk assessments, transparent responsibilities, and efficient international cooperation mechanisms.

3.4 The United Arab Emirates stands ready to collaborate with Member States and international partners in shaping a coherent and safe global framework for HAO, beginning with enhanced responses to space debris re-entry risks.

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