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Agenda Item 8: CAR/SAM Air Navigation Implementation

IMPACT OF CLIMATE CHANGE ON THE PROVISION OF AIR TRAFFIC SERVICES IN THE MHCC FIR

(Presented by COCESNA)

EXECUTIVE SUMMARY

Climate change has become a factor that directly affects the provision of air traffic services at both the global and regional levels. ICAO and other international technical organizations have indicated that the increasing variability of meteorological conditions is impacting operational safety, capacity, and the efficiency of the air navigation system.

Within Central American airspace, and specifically in the MHCC FIR, these impacts are manifested not only through extreme meteorological events such as tropical storms and hurricanes, but also through recurrent adverse weather conditions. These conditions increase operational complexity, raising the workload of ATS personnel, and reduce the margins for anticipation in decision-making.

Meteorological variability associated with climate change complicates the timely definition of airspace sector configurations and sector opening times, requiring increasingly dynamic airspace management. In this context, COCESNA has formally identified adverse weather conditions as an operational safety risk, developing analyses and defining action plans aimed at mitigation, and conducts monthly monitoring to assess their effectiveness.

Regional operational experience demonstrates that dynamic airspace management, the integration of meteorological information, and regional coordination make it possible to sustain service continuity and operational safety in an increasingly variable climatic environment. In this regard, this note invites GREPECAS to consider climate change as a cross-cutting element in the regional planning of operational safety, capacity, and air navigation efficiency

Action:	GREPECAS is invited to take note of the information presented and to consider the impact of climate change as a cross-cutting element in work related to operational safety, capacity, and the efficiency of air navigation in the Region.

Strategic Objectives 2026-2050:	• Every flight is safe and secure • Aviation is environmentally sustainable • Aviation delivers seamless, accessible, and reliable mobility for all • No country left behind • The International Civil Aviation Convention and Other Treaties, Laws and Regulations Address All Challenges • The Economic Development of Air Transport Assures the Delivery of Economic Prosperity and Societal Well-Being for All
References:	• 2024 ICAO Climate Adaptation Synthesis Report. • Climate Change: Climate Risk Assessment, Adaptation and Resilience.

1. Introduction

1.1 The evolution of the climate and the increase in the frequency and intensity of adverse meteorological phenomena represent a growing challenge for the civil aviation system. ICAO has indicated that these impacts are already being experienced by the aviation sector and affect both infrastructure and operations, including directly air navigation service providers.

1.2 In this context, the assessment of risks associated with climate change and the strengthening of operational resilience become essential elements to ensure the continuity and safety of ATS services. This approach is particularly relevant for regions such as Central America, which are characterized by high exposure to meteorological phenomena and strong operational interdependence among adjacent airspaces.

1.3 The MHCC FIR, managed by COCESNA, concentrates continental and oceanic air traffic flows that traverse areas influenced by tropical convection, cyclonic systems, and significant variations in upper-level wind patterns. These characteristics increase the sensitivity of the ATS system to adverse weather and reinforce the need to adopt proactive management and adaptation approaches.

2. Climate Change in the provision of air traffic services

1.4 Climate change is creating an increasingly complex operational environment for the provision of air traffic services by increasing the frequency, intensity, and persistence of adverse meteorological conditions that directly affect traffic management. ICAO studies and the operational experience of air navigation service providers show that these impacts are not limited to occasional extreme events, but rather manifest recurrently through intense convection, extensive areas of significant weather, variations in upper-level wind patterns, and an increase in reports of turbulence at higher flight levels.

1.5 In the MHCC FIR, these conditions reduce the predictability of air traffic and affect the stability of traffic flows, generating frequent deviations, unplanned changes in routes and flight levels, as well as temporary traffic concentrations in certain areas of the airspace. As a result, operational complexity increases, the workload of ATS personnel rises, and the margin for anticipation in tactical decision-making is reduced, affecting both operational safety and system efficiency.

1.6 This context highlights that climate change constitutes a factor that directly influences the provision of ATS services by altering the historical assumptions upon which demand, capacity, and airspace management were planned. Consequently, air navigation service providers face the challenge of operating in a less predictable environment, in which meteorological variability becomes a permanent element of daily air traffic management.

3. Impact of Climate Change on Sector Management and Operational Safety Risk

3.1 Upper airspace management in the MHCC FIR is based on a flexible sector structure that allows sector configurations to be adapted to air traffic demand. However, the increasing meteorological variability associated with climate change has reduced the reliability of historical patterns used for sector planning, resulting in frequent changes in flight profiles and dynamic traffic redistributions. These conditions require continuous adjustments with reduced margins for anticipation and greater reliance on tactical management in near-real time.

3.2 In this more complex environment, the integration of meteorological information into ATS management becomes essential to enhance situational awareness and support operational decision-making. Nevertheless, the combination of sudden increases in workload, frequent sectorization adjustments, and time-pressured decisions continues to represent a risk to operational safety. In this context, COCESNA has formally identified adverse weather conditions as a risk within its safety management system and conducts specific analyses aimed at their mitigation, to preserve safety margins and the efficiency of the ATS system.

4. COCESNA's Operational Experience in Response to Meteorological Contingencies in the Region

4.1 The experience gained by COCESNA during real contingencies associated with hurricanes in the Caribbean provides an example of the challenges and opportunities that climate change poses for air traffic management. In June 2023, the temporary interruption of ATC service in the Kingston FIR generated significant deviations into CENAMER airspace. Subsequently, in July 2024, Hurricane Beryl again affected that FIR, once more increasing demand on the adjacent sectors of the MHCC FIR.

4.2 These experiences made it possible to identify lessons learned, which were analysed by COCESNA and led to the implementation of preventive measures aimed at strengthening response capacity for similar events. As part of this process, regional coordination agreements were established with Panama and Havana, organized flows were defined for diverted traffic, and adjustments to airspace configuration were assessed to optimize the distribution of operational workload.

4.3 The application of these lessons was tested during the contingency generated by Hurricane Melissa, when the Kingston airspace declared ATC ZERO conditions for several days. In response, COCESNA implemented a reconfiguration of Sector 3 through a North–South split, assigned additional personnel, and coordinated with adjacent service providers and users on the application of alternative routes and flows.

4.4 During this period, CENAMER airspace absorbed an approximate 30% increase in traffic compared to the FIR's normal flow, and more than a 200% increase in Sector 3, while maintaining operational safety and service continuity without the need to apply restrictive ATFM measures. This experience demonstrated the effectiveness of pre-tactical preparation, dynamic airspace management, and regional coordination as key elements of operational resilience in the face of extreme meteorological events.

5. Considerations from the Perspective of ICAO and Other Organizations

5.1 The approach adopted by COCESNA is consistent with ICAO guidance on risk assessment and adaptation to climate change to strengthen the operational resilience of air navigation service providers. The integration of risk analyses, action plans, periodic monitoring, dynamic airspace management, and meteorological information reflects a practical application of the principles of resilience and continuous improvement recommended at the international level.

6. Conclusions

6.1 Climate change constitutes a factor with a direct impact on the provision of air traffic services. Increased variability in meteorological conditions, the recurrence of adverse phenomena, and the rise in extreme events have reduced air traffic predictability and increased the complexity of operational management.

6.2 These effects translate into a higher workload for ATS personnel, a greater frequency of tactical adjustments, and reduced margins for anticipation in decision-making, affecting both operational safety and system efficiency. In this context, traditional management based on historical patterns is becoming increasingly less effective in responding to the demands of the current operational environment.

6.3 To mitigate the effects of climate change and strengthen the operational resilience of the ATS system, COCESNA, based on the early identification of risks, applies mitigation measures such as dynamic airspace management and the progressive integration of meteorological information to absorb significant increases in demand without resorting to restrictive ATFM measures.

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