Aviation Reimagined

2024 webinar series

Supporting European Aviation



Climate Proofing Aviation Now and for the Future

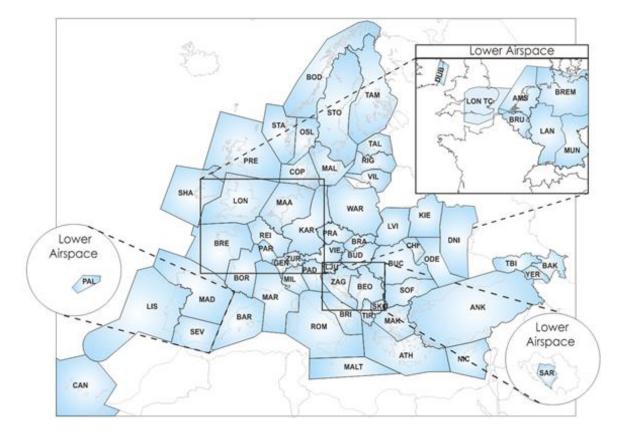
Rachel Burbidge, EUROCONTROL 17th October 2024





EUROCONTROL – who are we?

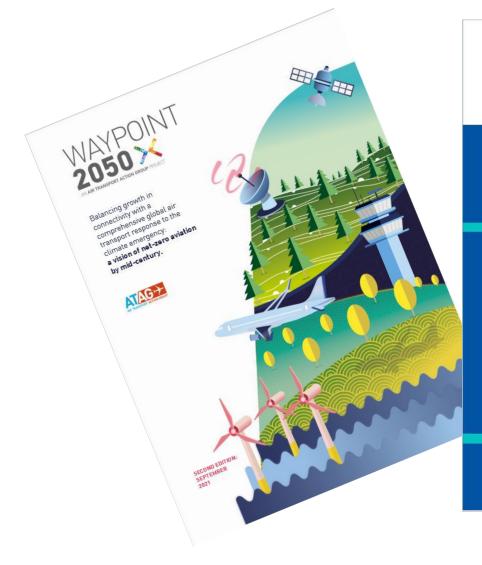




- 41 Member States, typically each with its own ANSP
- Approximately 64 Area Control Centres (ACC)
- Over 700 sectors when at full capacity
- Approx. 17,000 Air Traffic Controllers
- 14.2 million flight hours controlled

We know that decarbonisation is urgent...









Climate Change impacts for aviation are wide-ranging









Low visibility caused by sandstorm disrupts flight operations. (Pic: Dubai Airport twitter)





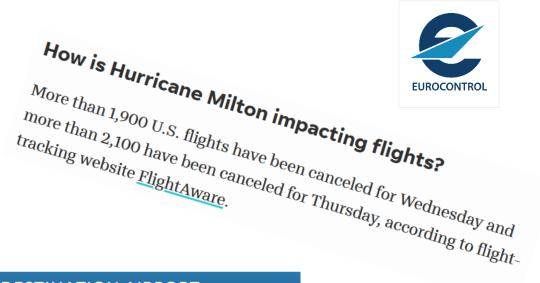
Hurricane Milton 10th October 2024

Total delays today: 9,187

Total delays within, into, or out of the United States today: 480

Total cancellations today: 2,687

Total cancellations within, into, or out of the United States today: 2,224

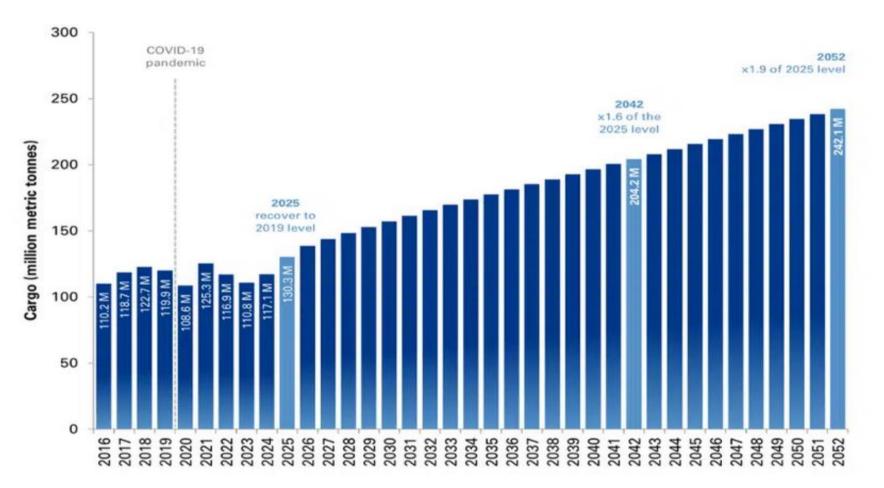


| BY ORIGIN AIRPORT | | | | | | BY DESTINATION AIRPORT | | | | | |
|-------------------|-----|---------|----|---|---|------------------------|-----|---------|-----|--|--|
| Cancelled | | Delayed | | AIRPORT | С | Cancelled | | Delayed | | AIRPORT | |
| # | % | # | % | AIRPORT | # | | % | # | % | AIRPORT | |
| 485 | 92% | 6 | 1% | Orlando Intl (<u>MCO</u>) | | 447 | 83% | 7 | 1% | Orlando Intl (MCO) | |
| 232 | 90% | 5 | 1% | Tampa Intl (<u>TPA</u>) | | 218 | 82% | 11 | 4% | Tampa Intl (<u>TPA</u>) | |
| 96 | 96% | 0 | 0% | Southwest Florida Intl (<u>RSW</u>) | | 92 | 92% | 0 | 0% | Southwest Florida Intl (<u>RSW</u>) | |
| 67 | 5% | 7 | 0% | Hartsfield-Jackson Intl (<u>ATL</u>) | | 91 | 15% | 19 | 3% | Miami Intl (<u>MIA</u>) | |
| 61 | 80% | 7 | 9% | Palm Beach Intl (<u>PBI</u>) | | 83 | 6% | 12 | 1% | Hartsfield-Jackson Intl (<u>ATL</u>) | |
| 55 | 9% | 26 | 4% | Miami Intl (MIA) | | 57 | 6% | 15 | 1% | Charlotte/Douglas Intl | |
| 50 | 5% | 13 | 1% | Charlotte/Douglas Intl (<u>CLT</u>) | | 50 | 56% | 9 | 10% | (<u>CLT</u>) Palm Beach Intl (<u>PBI</u>) | |
| 48 | 94% | 0 | 0% | Sarasota/Bradenton Intl (<u>SRQ</u>) | | 48 | 94% | 0 | 0% | Sarasota/Bradenton Intl (<u>SRQ</u>) | |

And traffic is growing...



Long-term global passenger traffic (2016–2052)



Source: ACI World Airport Traffic Forecasts (WATF) 2023–2052

Impacts of Storms



- Disruption to operations:
 - delays, re-routings, route extensions, trajectory management, HFE, increased fuel burn and emissions
 - potential en-route capacity loss and congestion
- Larger / more intense convective systems could affect multiple hub airports
- Damage to infrastructure
- Increase in lightning strikes: airport closures



EUROPE: Frequency of major storms forecast to drop by 2050, but intensity of storms that do affect flights will lead to more significant delay



-8% to -12%

Forecast drop in share of all flights likely to be delayed by a major storm (*if there was no change in the aviation system in* 2050)



20 to 22 minutes

Forecast average en-route ATFM delay due to weather per flight delayed by a major storm in 2050

Higher average and extreme temperatures





Sea-level rise & storm surge



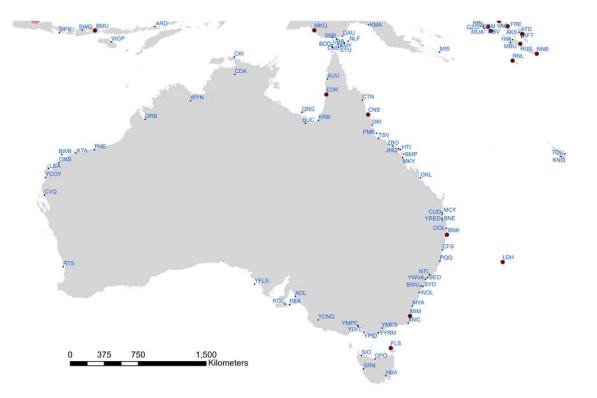


- Disruption to operations
 - Delay and disruption from runway inundation
 - Network disruption
- Permanent / temporary loss of airport capacity /infrastructure



Sea-level rise: global impact

- SLR of 0.62m (consistent with a warming scenario of 2°C by 2100): 100 airports below mean sea level, 364 airports in the coastal floodplain, over 900 routes at risk of disruption (Yesudian & Dawson, 2021).
- SLR of 1.8m: 572 airports in the coastal floodplain and over 3500 route disruptions (Yesudian & Dawson, 2021).
- Includes many hub-airports serving major cities and handle millions of passengers a year at risk.

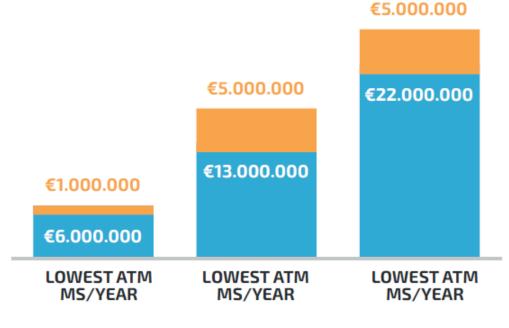


Source: Yesudian and Dawson (2021) Global Analysis of Sea Level Rise Risk to Airports, Figure SM.15 Regional map of Risk under the RCP8.5 scenario Operational impacts = costs



COST IMPACTS FOR MEDIUM AIRPORTS €100.000 €4.000.000 €150.000 €3.000.000 €50.000 €1.000.000 LOWEST ATM LOWEST ATM LOWEST ATM MS/YEAR MS/YEAR MS/YEAR

COST IMPACTS FOR LARGE AIRPORTS



% of average ATM in ECAC/day

Cancelled ATMs/day

Diverted ATMs/day

Estimated costs of a one-day closure for European Airports

Source: EUROCONTROL Climate Change Risks for European Aviation 2021

Changing wind patterns

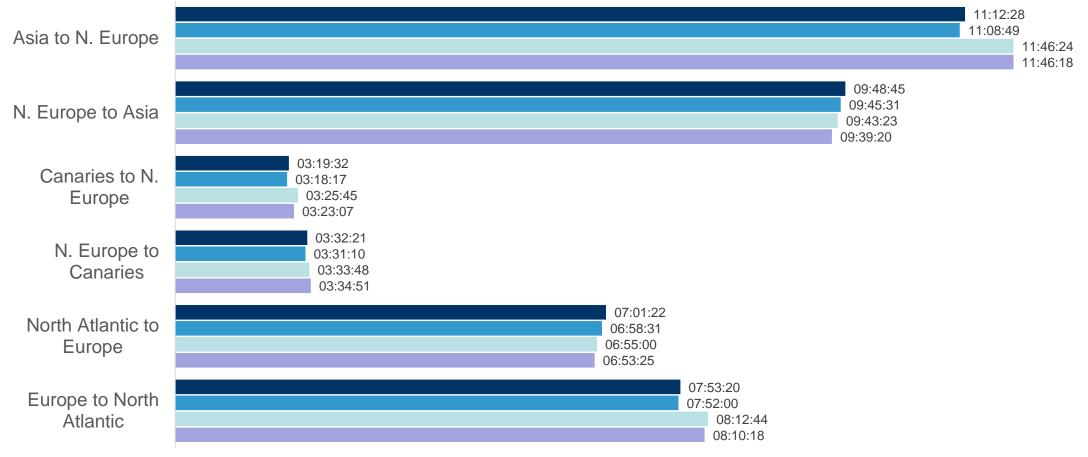




- Changes to trans-Atlantic flight times and routings: airport slot management
- Increase in crosswinds due to shifts in prevailing wind direction
- Changes in procedure due to crosswinds environmental impact?
- Reduction in capacity at airports with no crosswind runway
- Disruption to operations if winds are too strong to take-off or land for spec aircraft type
- More clear air turbulence: injuries and aircraft damage



Overall flight durations will be shorter for both eastbound and westbound transatlantic flights by 2050



Historical duration Summer Projected duration Summer Historical duration Winter Projected duration Winter

Average flight duration*

* Where apparent contradictions to the existing literature exist - this is due to more recent TP algorithm and climate models being used in present analysis, including multi-model.

Source: EUROCONTROL Climate Change Risks for European Aviation 2021

Turbulence

Singapore Airlines plane jolted up and down for five seconds - report

29 May 2024

Share < Save +

Thomas Mackintosh Katy Austin BBC News Transport Correspondent



Watch: How chaos onboard Singapore Airlines SQ321 unfolded

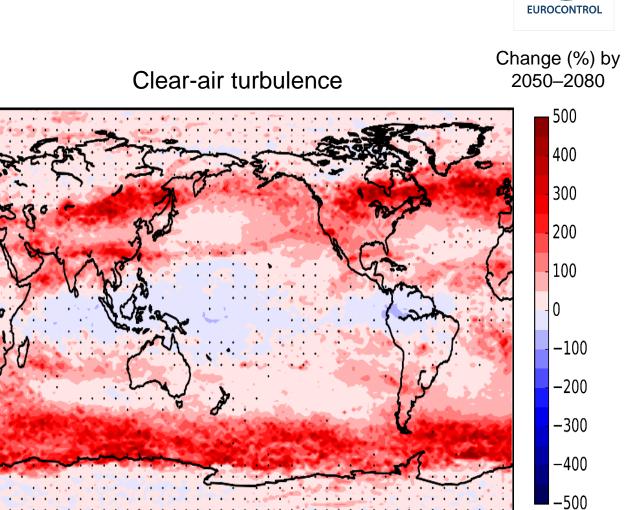
Turbulence on Doha-Dublin flight leaves 12 injured

27 May 2024

Matt Fox & Rebekah Wilson

Share < Save +





Source: Storer, Williams & Joshi (2017) Global Response of Clear Air Turbulence to Climate Change



Summer 2023: the start of a new normal?



Will 'prime fire season' force a change to our summer holidays forever?

According to a recent poll two thirds (67%) of UK holidaymakers said the extreme heat of 2022 has seen them change their travel plans this year.



Mallorca tourists run for their lives as terrifying storms send deckchairs flying

The holiday hotspot has been battered by a vicious storm that caused a cruise ship crash and has turned dream getaways into nightmares for many Brits caught in the chaos

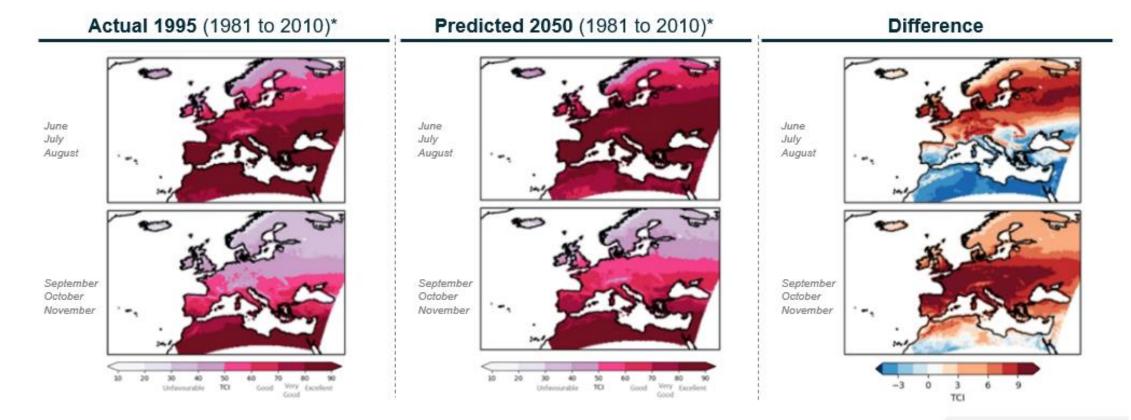
Extreme heat in Europe is becoming the new normal — prompting tourists toward cooler destinations

More tourists are thought to be prioritizing milder temperatures or even off-season travel to avoid spending their time away in oppressive heat.





EUROPE: Longer periods of 'good' to 'ideal' climate for general, low level tourist activity



Source: EUROCONTROL Climate Change Risks for European Aviation 2021

BUT... more extremes, intense summer storms, wildfires...?



We have to adapt to reduce future damage, disruption and costs...







European Aviation Climate Change Adaptation Working Group







A role for research: key areas for action to address knowledge, awareness and implementation gaps

- Broaden geographical coverage, particularly to address the current lack of studies addressing climate risks and responses in Central and South America, Africa and the Middle East;
- Extend knowledge of physical impacts;
- Address known-unknowns such as the risks associated with unprecedented or compound extreme events;
- Extend knowledge of adaptation including cost-benefit analysis and consideration of integrated mitigation and adaptation;
- Identify and apply relevant research from other disciplines;
- Sector bodies to support and facilitate collaboration between researchers and practitioners to codevelop accessible user-oriented climate adaptation services.

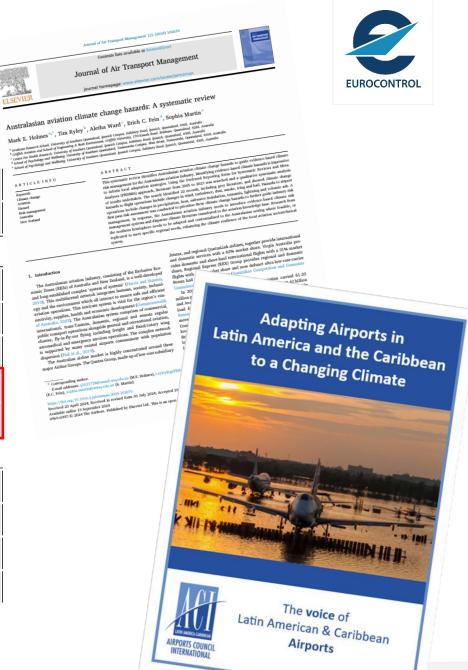
Broaden Geographical Coverage

| Region | Impacts | Adaptation | | | | | |
|--------------------------------------|---------|------------|--|--|--|--|--|
| ICAO regions | | | | | | | |
| N America, C America, & Caribbean | 46 | 38 | | | | | |
| Asia Pacific | 26 | 18 | | | | | |
| Europe & N Atlantic | 26 | 17 | | | | | |
| W & C Africa | 1 | 1 | | | | | |
| E & S Africa, Middle East, S America | 0 | 0 | | | | | |
| Other | | | | | | | |
| Global | 13 | 11 | | | | | |
| Transatlantic | 7 | 3 | | | | | |
| Non-specific | 12 | 10 | | | | | |

131

98

Source: Burbidge et al (2023) A systematic review of adaption to climate change impacts in the aviation sector

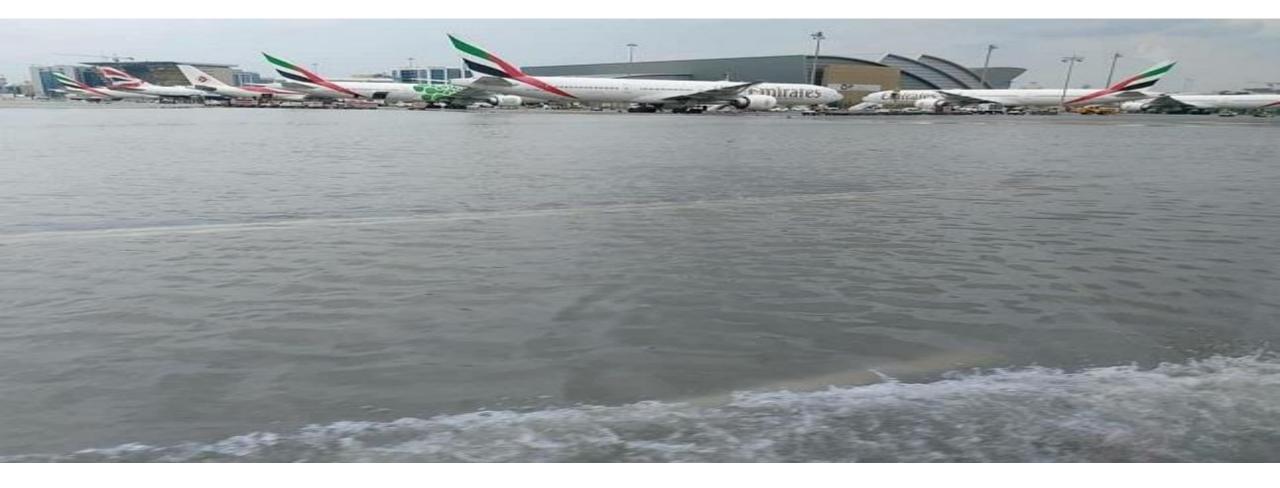


ENVIRONMENT

Total

We need to adapt: but how much and how fast?





What is the role of policy?

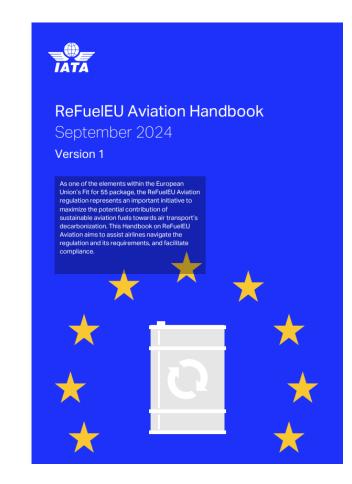


Biden-Harris Administration Announces Nearly \$300 Million in Awards for Sustainable Aviation Fuels and Technologies as part of Investing in America Agenda

Friday, August 16, 2024

WASHINGTON — The Federal Aviation Administration (FAA) is announcing \$291 million from the Inflation Reduction Act for projects that will help achieve the goal of net-zero greenhouse gas emissions from aviation by 2050 as part of President Biden's Investing in America Agenda.





Effective in driving decarbonisation?

Time for a mandate?



12

Strategic aviation operators Source: ACI-LAC: Adapting Airports in Latin America and the Caribbean to a Changing Climate Yes, we have an adaptation strategy or plan **Climate adaption reporting third round: Heathrow Airport** We are currently developing 1 August 2023 Research and analysis an adaptation strategy or plan Climate adaption reporting third round: Glasgow Airport We intend to develop an 1 August 2023 Research and analysis adaptation strategy or plan We do not have an adaptation strategy or plan **Climate adaption reporting third round: Birmingham Airport** but we have implemented ad-hoc measures 8 February 2022 Policy paper We do not currently intend to develop **Climate adaption reporting third round: Cardiff Airport** an adaptation strategy or plan 8 February 2022 Research and analysis I don't know if we intend to develop an adaptation strategy or plan Climate adaption reporting third round: Edinburgh Airport 14 February 2022 Research and analysis Other **Climate adaption reporting third round: Gatwick Airport** 0 4 8 14 February 2022 Research and analysis Adapting to Climate Change: Ensuring Progress in Key Sectors Number of respondents Climate adaption reporting third round: Luton Airport 2009 Strategy for exercising the Adaptation Reporting Pov and list of priority reporting authorities 14 February 2022 Research and analysis 5-15 million ppa 25-40 million ppa <2 million ppa</p> 2-5 million ppa 15-25 million ppa Climate adaption reporting third round: Manchester Airp Midlands, London Stansted and Manchester Airports) 28 January 2022 Research and analysis Climate adaption reporting third round: NATS (Air Traffic 24 February 2022 Research and analysis

defra

Thank you for your attention

Supporting European **Aviation**



rachel.burbidge@eurocontrol.int

Find more information here:



adimpter.

Climate Change Risks for European Aviation

INCOMPANYABLE ADDRESS ADDRESS



Climate



ELSEVIER Journal of Air Transport Management

Contents lists available at ScienceDirect

Australasian aviation climate change hazards: A systematic review

Mark E. Holmes", Tim Ryley b, Aletha Ward c, Erich C. Feind, Sophia Martin

ABSTRACT

⁴Oruburz Roserth School, Litverziy of Sonthern Quendind, Janekh Canpua, Stillotzy Band, Janekh, Qaenzind, et Sitt, Atarufia Colffield. Antimistan and School of Engineering & Bait Thermismus, Cariffiel University, TDF Kanadi Janek, Moolens, Quenciale, Stat. Control Frield Research, University of Santern Quencial, Quench Caraya, Schooly Dad, Quanci, Quencial, CSE, Anardia School of Physicing and Relificate Quencial Quenci Caraya, Schooly Dad, Quenci, Quencial, CSE, Anardia School of Physicing and Relificate Quencial Quenci Caraya, Schooly Dad, Quenci, Quenci, Quenci, Alexandra, CSE, Anardia Carabia Cara, School Physicing, Quenci, Quenci Caraya, Schooly Dad, Quenci, Quenci, Quenci, Alexandra, CSE, Anardia

ARTICLE INFO Keyseordi: Climate change Aviation Hazard Risk managemen Australia

This systematic review identifies Australasian aviation climate change hazards to guide evidence-based climate This systematic versive identifies A naturabatin a relation climate change bazards to galace evidence based climates in management for the A controlation a relation barry. Harding or observe based climates the inperative and the analysis of the controlation area of the systematic systematic and the systematic Analyses (PSIMA) approach, Bernetter free, 2006 to 2020 no sevel-the and a synthesize may be areas in subrafactor. The search leadedling 2 percent, Including perp Forenza, et al. More Climate change bazards to flight operations include changes in while, involving a star of the systematic analysis in particular systematic systematic systematic systematic systematic systematics and percent systematic systematic systematics and percent systematics and percent systematics and particular systematics. In response, the Annettansian relation in barries protecting a clickon barrole place instructs the instruction of climates barrol and analgement systema and disparse climate interainer transformed for the analos in barroly place indication barrole place instructions and the instruction of climates and a climate in the instruction of the systematic instruction of the instruction instruction of the instruction of the instruction of the instruction instruction instruction of the instruction instruction of the instruction of the instruction of the instruction instruction of the instruction instruction of the instruction of the instruction instruction of the instruction instruction instruction instruction of the instruction the northern hemisphere needs to be adapted and contextualised to the Australasian setting where feasible, or replicated to meet specific regional needs, enhancing the climate resilience of the local aviation sociotechnical votem.

1. Introduction

The Australasian aviation industry, consisting of the Exclusive Eco nomic Zones (EEZs) of Australia and New Zealand, is a well-developed and long-established complex 'system of systems' (Harris and Stanton, 2010). This multifaceted network integrates humans, society, technology and the environment which all interact to ensure safe and efficient aviation operations. This intricate system is vital for the region's con-nectivity, supplies, health and economic development (Commonwealth 5, 2023). The Australasian system comprises of commercial, international, trans-Tasman, domestic, regional and remote regular public transport operations alongside general and recreational aviation, charter, fly-in-fly-out flying including freight and fixed/rotary wing aeromedical and emergency services operations. The complex network is supported by many coastal airports consummate with population dispersion (Fisk et al., 2019). The Australian airline market is highly concentrated around three major Airline Groups. The Qantas Group, made up of low-cost subsidiary

Corresponding autho E-mail addresses: a107 an (M.E. Holmes). (E.C. Fein), sophi a edu au (S. Martin

Received 23 April 2024; Received in revised form 30 July 2024; Accepted 23 August 2024 Available online [3] september 2024 0696-6697/12 2024 The Authors, Published by Ekevier Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/

devicerifith of an (T. Ryley), alethan

and domestic services with a 62% market share. Virgin Australia pro-vides domestic and short-haul international flights with a 31% market share, Regional Express (REX) Group provides regional and domestic flights with a 5% market share and now defunct ultra-low-cost-carrie Bonza had a 2% market share (Australian Competition and Consume

million passengers, Revenue Passenger Klometres reached 08.42 billion and Available Seat Klometres were 85.01 billion with an industry-wide load factor at 80.5% (The Bureau of Infrastructure and Tra Research Economics [BITRE], 2024b). The top ten airports for passenge movements were Sydney, Melbourne, Brisbane, Perth, Adelaide, Gol Coast, Cairns, Canberra, Hobart and Sunshine Coast - eight of which are located on or near the coast. The top ten routes (Melbourne – Sydney, Brisbane – Sydney, Brisbane – Melbourne, Gold Coast – Sydney, Ade-laide – Melbourne, Gold Coast – Melbourne, Melbourne – Perth, Adelaide - Sydney, Perth - Sydney) were isolated to the south east of the

etstar, and regional OantasLink airlines, together provide internationa

In 2023, Australian domestic commercial aviation carried 61.32

integrated mitigation and adaptation; (v) to identify and apply other relevant research; and (vi) for sector bodies to support and facilitate collaboration between researchers and practitioners to co-develop accessible user-oriented climate adaptation services.

JOINT UNDERTAKING

TRANSPORT REVIEWS

ABSTRACT

https://doi.org/10.1080/01441647.2023.2220917

the aviation sector

^bEUROCONTROL, Brussels, Belgium

ARTICLE HISTORY Received 1 August 2022

Routledge

Taylor & Francis Gr

OPEN ACCESS Check for updates

Accepted 22 May 2023 climate will have operational, infrastructure and economic impacts for aviation. Given the criticality of aviation for global KEYWORDS connectivity and mobility, it is vital that the sector understands Aviation: climate change: and adequately adapts to these risks. This article presents a climate adaptation: climate systematic review of the growing but somewhat dispersed resilience; airport academic literature on climate change impacts and adaptation in the aviation sector. Information was synthesised from 131 studies (published between January 2000 and November 2022) on eleven climate change effects and the associated impacts and potential adaptation measures. Six areas for action to address knowledge,

A systematic review of adaption to climate change impacts in

Rachel Burbidge ^(a,b), Christopher Paling ^(b) and Rachel M. Dunk ^(b) ^aDepartment of Natural Sciences, Manchester Metropolitan University, Manchester, United Kingdom

The incremental changes and greater extremes of a changing

awareness and implementation gaps were identified: (i) to

broaden geographical coverage, particularly to address the

current lack of studies addressing climate risks and responses in

Central and South America, Africa and the Middle East; (ii) to

extend knowledge of physical impacts; (iii) to address known-

unknowns such as the risks associated with unprecedented or

compound extreme events; (iv) to extend knowledge of

adaptation including cost-benefit analysis and consideration of