Preparing airports for a changing climate

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As momentum in the aviation industry builds toward increased transparency and more ambitious climate targets, there is growing recognition that resilience is not just an environmental imperative, but a financial one. In an industry with high fixed costs and volatile profitability, having a keen understanding of the short- to long-term financial implications of climate risk is critical for informed decision-making and sustainable growth.

Climate-related disruptions that once seemed unlikely are now occurring with increasing frequency and severity. In truth, many of these events were always possible, but they were often not treated as plausible within traditional risk frameworks. Scientific literature and modelling have long pointed to such hazards, yet assumptions around recurrence and perceived improbability often kept them at the margins of planning. Risk is also not static, and climate change is amplifying the impact of many hazards and increasing the likelihood of disruption.

For the aviation sector, and airports in particular, this presents a growing operational challenge. From extreme heat and intense rainfall to stronger windstorms, these disruptions affect not only flight schedules but also the integrity of infrastructure, safety margins, and broader supply chains. The ripple effects extend far beyond terminals and runways to air traffic control, ground services, and global logistics networks, adding layers of complexity to resilience planning across aviation's physical and operational systems.

Understanding which climate risks are most relevant to each location, and how prepared you are to respond, is essential for strengthening airport resilience. But knowing where to invest and how to adapt requires a grounded understanding of today's risks, and a clear-eyed view of what may lie ahead.

Case study: When the desert floods

Extreme weather isn't just a challenge for storm-prone or tropical regions, it's increasingly disrupting places better known for heat and dryness. One of the most striking recent examples occurred in Dubai in 2024, where a rare and intense rainstorm overwhelmed infrastructure and disrupted operations. The UAE has minimal annual rainfall, typically around 78mm/year (for comparison, the UK's average rainfall is around 1,220mm/year), and rainstorms are rare in the region. When they do occur, they are often intense, and what's concerning is that records related to rainfall intensity that were broken in 2022 were broken again in 2024.

Dubai and the wider region lie within a hyper-arid zone, receiving very little rainfall and experiencing large year-to-year variability. Events like the April 2024 deluge are historically rare, with only short records of similar incidents available. This makes risk assessment inherently uncertain, particularly for events whose intensity and frequency are being amplified by climate change. The El Niño Southern Oscillation (ENSO), a naturally occurring climate phenomenon, has long influenced rainfall variability in the region. However, observational analyses suggest that the recent event was 10–40% more intense than it would have been during an El Niño year in a 1.2°C cooler climate.[1] In other words, human-induced warming made the event significantly more likely and more intense.

1 https://www.worldweatherattribution.org/heavy-precipitation-hitting-vulnerable-communities-in-the-uae-and-oman-becoming-an-increasing-threat-as-the-climate-warms/

A practical framework for navigating climate risk

Events like Dubai's floods serve as a warning that a narrow view of risk, based only on past data, may be insufficient in a changing climate. To better navigate these evolving challenges, applying risk management fundamentals—identifying today's vulnerabilities, quantifying their financial impact, and managing their exposure over time — can provide a practical framework.

This approach and set of challenge questions (Table 1) can support airport operators in integrating climate risk into decision-making across planning, finance, and operations:

TABLE 1: Challenging views of today's extreme risks.

Step	Action	Challenge Questions	Outcome
Identify	Identify, rank and prioritize current and future hazards to your assets	How well do you understand the physical characteristics of your assets and the local conditions that can significantly impact potential damage?	A strategic response to climate risks that protects financial performance, informs planning and disclosure.
Quantify	Assess the financial impact of physical risks and individual assets including your value chain	How are you currently assessing cost-benefit options for adaptation/ risk mitigation for physical climate and geophysical risks?	Prioritisation of investment and mitigation based on robust financial understanding.
Manage	Identify measures to avoid, reduce, transfer or retain risks from physical climate change	What are you doing to protect your organization's financial resilience to growing physical risks?	Targeted resilience-building aligned with broader strategic and operational goals.

Understanding and managing climate risk begins with a rigorous and credible assessment of today's landscape. Over the last year, flights have been grounded by searing heat[2], terminals flooded by unprecedented rainfall[3], and storms have caused damage and delays across increasingly congested skies[4]. While surprising to many, a review of historical records and climate data suggests that these events were always within the realm of possibility. This reinforces the importance of challenging assumptions and considering a wider range of scenarios when assessing risk across both near- and long-term horizons.

Case study: Airport risk index

WTW's Airport Risk Index (ARI)[5] was created as a comprehensive and data-driven framework to challenge assumptions and help operators stress-test a much broader set of severe-but-plausible risks.

Developed in partnership with the University of Cambridge Centre for Risk Studies, ARI captures the extreme disruption potential of 19 major threats across 110 airports worldwide.

WTW has been working with airports to use the insights in ARI to challenge their risk registers. The methodology is based on scenario analysis that assesses the likely scale of disruption airports may face from a range of severe but plausible threats. For each hazard, several levels of severity are modelled to reflect the range of potential operational impacts.

These scenarios help airports understand how often a disruptive event might occur and what it could mean for continuity of service, including temporary closure or loss of critical operations. This encourages a more expansive, evidence-based view of risk exposure.

2 In June 2024, a severe heatwave across the Midwest and Northeast United States led to exceeding 100°F in many areas, causing significant flight delays and cancellations.
3 In March 2025, Valley International Airport in Harlingen, Texas, was forced to close due to severe flooding caused by a rare and intense storm. The storm brought up to 21 inches of rain, leading to significant flooding that inundated the airport's runways and facilities.
4 In June 2024, an Austrian Airlines Airbus A320 encountered a sudden hailstorm during its approach to Vienna International Airport. The aircraft sustained significant damage, including a shattered nose cone and cracked cockpit windows, due to the hailstones.
5 https://www.wtwco.com/en-gb/insights/2022/11/building-resilience-with-wtws-airport-risk-index

Bridging today's risk to tomorrow's reality

While tools like ARI provide a structured, present-day lens for understanding risk exposure, the changing climate introduces deeper layers of uncertainty. Capturing the full picture requires forward-looking tools that can account for shifting baselines and emerging climate dynamics.

Risk management best practice for airport operations begins with identifying the full range of current and future physical risk hazards. This means drawing on historical records, present-day observations, and forward-looking climate hazard datasets. These hazards include acute events such as extreme rainfall and tropical cyclones, as well as chronic risks like water scarcity and sea level rise.

Once these hazards are identified, their potential impact can be quantified. This can be done using a combination of risk engineering, catastrophe modelling, and climate data. For example, higher daily temperatures are already triggering take-off weight restrictions for aircraft. As these temperatures rise further or occur more frequently, these operational constraints are likely to intensify. Impacts to runways, terminals, and equipment may require additional capital expenditure, while disruption to value chains or ground handling may reduce capacity and productivity, placing pressure on operating margins.

Linking physical hazard information to operational and financial impact is where risk management and business strategy value becomes clearer. Assessing the possible future range of hazards, and how this affects operations and business decisions has become more relevant as the climate baseline continues to shift.

From here, management strategies can be designed. Building on existing risk appetite and tolerance, climate risks can be treated as amplifiers of existing exposures. Ultimately, the financial exposure to these risks will depend on the operational structure and business model of the airport. Some airports may prioritise risk reduction over risk transfer, whilst others may prefer to build additional contingency into operations and embed the financial impact with passengers, cargo, airlines, and the wider value chain.

To effectively assess and act on these evolving risks, airport operators need tools that integrate climate science, business exposure, and time-based foresight. This is where WTW's Climate Quantified platform plays a critical role.

Case study: Climate Quantified

This forward-looking platform supports deeper investigation into questions such as: How will extreme rainfall events shift under a 2°C or 4°C world? Which airport assets are most exposed to future sea-level rise? What does the increasing frequency of heatwaves mean for future take-off performance or cooling system demands? By combining climate models with engineering thresholds and operational data, Climate Quantified allows users to visualise and quantify climate-related losses across time horizons.

Outputs from Climate Quantified are directly aligned to decision-making — whether it's planning capital investments, evaluating long-term insurance strategies, meeting regulatory requirements, or engaging with stakeholders on climate disclosures. For an industry like aviation that must balance long-term infrastructure investments with short-term performance demands, this level of foresight is essential.

Building climate resilience, one layer at a time

As the climate continues to evolve, so too must the way airports assess and prepare for risk. A clearer understanding of present-day vulnerabilities, combined with credible insights into how those vulnerabilities may shift in the future, offers a valuable foundation for long-term planning and resilience. This dual perspective enables aviation stakeholders to consider climate risk in both operational and strategic contexts, supporting a more robust approach to adaptation over time.