WEATHER RESILIENCE

Shared, real-time data and easy-to-understand visuals to help aviation handle rough weather and turbulence.

SITA EBOOK

Contents

#1

Introduction

The need for greater resilience to weather has never been more critical. We're living - and flying - in an era of increasingly frequent and severe weather spurred on by climate change. Flooded airports, extreme heatwaves and increased clear-air turbulence are affecting all of us - from passengers to people who work in the cabin, the cockpit, control/area towers, or the dispatch office. Dealing with these challenges costs money, time, and harms reputations. To tackle this, aviation professionals need better tools to make decisions confidently.

The answer? A single, shared source of information for pilots, dispatchers, and air traffic controllers, combining easy-to-understand visuals with real-time data, ensuring passenger safety, smooth flights, and cost savings for airlines.

#2

The intensifying challenges of climate change

Climate change is happening. We're already feeling the effects with more frequent and extreme weather events making flying more difficult. Rising sea levels, more intense storms, extreme heat, changing wind and icing conditions. The list goes on. All these factors are affecting your operations, making the job of keeping you, your crew and your passengers safe and on time more difficult every day.

Here are only a few examples of the most recent disruptions caused by changing weather patterns:

December 2023

Denver International Airport (DEN) shut down due to a blizzard, causing over 400 flight delays[1]

December 2023

A heavy snowstorm forced the grounding of all flights out of Munich International Airport (MUC)[2]

April 2024

Dubai International Airport (DBX) had to cancel 1,244 flights due to extreme flooding[3]

June 2024

A severe hailstorm badly damaged an Austrian Airlines flight from Mallorca[4]

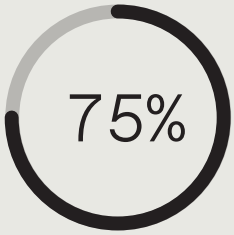
Extreme weather events like this account for 75% of air traffic delays, according to data from the US Federal Aviation Administration covering a five-year period ending May 2022.

In addition, severe clear-air turbulence alone has increased by more than 50% in some areas over the last 40 years due to climate change, accounting for around three-quarters of weather-related incidents, according to the USA's National Transportation Safety Board (NTSB).

US pilots already report around 70,000 encounters with turbulence every year. But both turbulence and intense weather events are only going to get worse.

These figures are from a comprehensive study into turbulence by the UK's University of Reading[1]:

Air traffic delays



US Federal Aviation Administration

US pilots report

70,000

Clear-air turbulence encounters every year

Clear-air turbulence

Increased over the last 40 years

"We find that severe clear-air turbulence has increased by 55% over the North Atlantic and 41% over the US since 1979. It does go up and down from one year to the next, but there's a clear long-term upward trend, consistent with the expected effects of climate change. We find similar increases on other busy flight routes over Europe, the Middle East and the south Atlantic.

These increases are projected to occur all around the world. Some regions, including North America, the north Atlantic and Europe, are set to experience several hundred per cent more turbulence in the coming decades. Every additional 1°C of global warming will increase the amount of turbulence further still."

It's not just Clear Air Turbulence that's getting worse, the Intergovernmental Panel on Climate Change warns:

> "With further warming, climate change risks will become increasingly complex and more difficult to manage. Multiple climatic and non-climatic risk drivers will interact, resulting in compounding overall risk and risks cascading across sectors and regions."

What does this all mean to airlines?

Let's have a look at a typical day in the Operations Control Centre (OCC) of a functional international carrier based in Europe.

#3

A typical day in the Operations Control Centre

Early morning turbulence

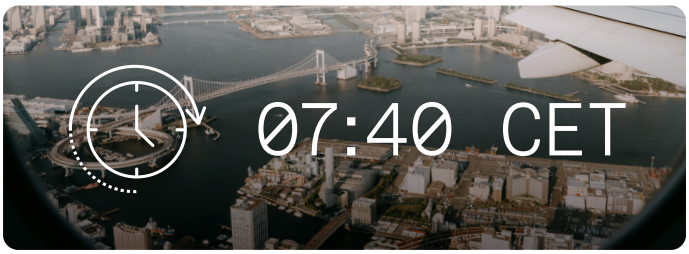
The OCC is buzzing as we prepare for the first wave of departures. Dispatchers are finalizing flight plans, crew assignments are being confirmed, and the first aircraft are ready for boarding. However, before we can get the first flight off the ground, we receive an urgent report from the flight deck of an overnight New York (JFK) to Paris (CDG) flight.

The pilot reports entering UK airspace and encountering severe turbulence that was not indicated on any weather radar. Despite contacting ATC for assistance, there isn't enough time to facilitate a diversion. The pilot has reported multiple injuries onboard and is requesting immediate medical assistance upon arrival at CDG.

Flooded airport crisis

As we manage the turbulence situation with the JFK-CDG flight, we face another challenge. Our flight to Venice (VCE), scheduled to land in an hour, is unable to do so due to severe flooding at the airport. The ground teams at VCE have notified us that the airport is diverting all incoming flights.

Our immediate task is to find an alternative airport. Verona (VRN) appears to be the best option, but our operations communications team is struggling to reach the ground team there. Time is critical, and we need to secure a landing slot and ensure all safety protocols are in place. Our teams are closely monitoring the situation, hoping for a prompt response from VRN.



Snowstorm delays

Just as we begin to believe that the worst of today's challenges are behind us, we're hit with another significant issue. A flight landing at Oslo (OSL) experiences a hard landing due to an extreme snowstorm. The aircraft sustains damage, necessitating immediate maintenance.

Our team is now scrambling to arrange an alternative aircraft and coordinate maintenance. However, communication with the maintenance team is proving difficult. The likelihood of this aircraft being grounded for an extended period is high, and we need to make quick decisions to minimize disruptions to our schedule.

We can all agree that sounds like a stressful morning! The pilots are thinking about a multitude of things: the safety of their passengers and crew, the physical and operational challenges of flying in unexpected turbulence, fuel, the limitations of the aircraft, constant situational awareness, communication with the ground. In OCC dispatchers and others are having to be reactive to the diverse problems of various pilots and crews in the air to coordinate everything safely: monitoring weather, communicating, ensuring safe landings and dealing with re-routing and delays. Everyone is operating under a tremendous amount of pressure and responsibility.

#4

The airline business consequences

Unexpected weather and turbulence mean higher operational costs.

If your aircraft can't fly, costs start to spiral: aircraft leasing, staff, parking fees, passenger re-routing and compensation. Grounding costs airlines around $150,000 per day per aircraft. If that happened just five times a month, that's $9 million a year!

Airlines already spend an estimated $150 - 500m a year in the USA alone on repairs and maintenance, flight delays and passenger injuries caused by turbulence. If turbulence increases by another 50%, those costs will rise to somewhere around $225m - 750m a year.

First and foremost, there is the human cost: the passengers and crew who have been injured and traumatised by the effects of turbulence and hard landings.

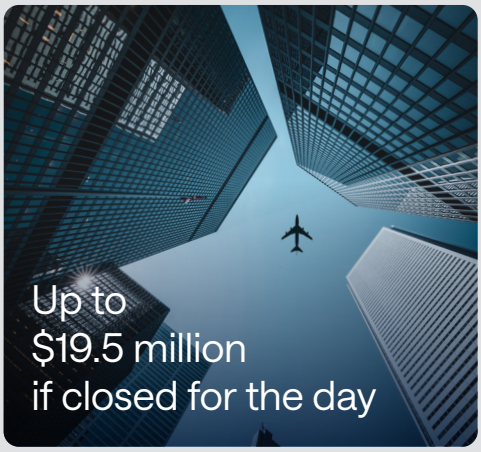
And there are more business costs to consider

Turbulence compensation

Assuming a median cost of compensation for the various injuries that CAT can cause — including to the head, neck and back — and that only a third of the passengers successfully claim, this could cost you more than $2 million for that single flight.

Diversion costs

A flooded airport could cost up to $19.5 million if closed for the day. While a diverted flight could cost between $12,000 and $100,000.[5]



Hard landing, maintenance and grounding

A grounded aircraft will cost the airline in the region of $150,000 per day per aircraft grounding, while overhauling the main landing gear could cost up to $950,000. [6]

Annual cost to airlines of flight disruptions

$60 billion annually [7]

Even if there are no injuries and no claims, there's the possible reputational damage and customer experience to consider. Airline pilot Thomas Amdal explains the dilemma perfectly: "Even with less severe weather, I always imagine my wife, who is afraid of flying, sitting in the back of my plane in 16C. Flying through suboptimal weather then seems not a good idea and not the experience I want for her or any of my passengers. I prefer to descend 2,000 feet and get a smooth ride so that everyone can enjoy their hot coffee or tea." Historically, this has been the kind of choice facing pilots: descend for your passengers' safety and comfort while burning more fuel, or brave more difficult conditions.

Customer experience can make or break an airline's reputation. If pilots are being caught out by unforeseen severe weather conditions, people will remember that bumpy flight or that rough landing and tell their friends and family. Many will also tell a wider audience about their negative experience on review sites and social media.

And then there's the environmental cost to consider. Bad weather forced airlines to fly one million extra kilometres in 2019, burning more than 6,000 tons of extra fuel, producing 19,000 tons of CO2. That adds more unnecessary pressure to decarbonisation targets on top of all the financial costs.

photo: @modermuna Twitter

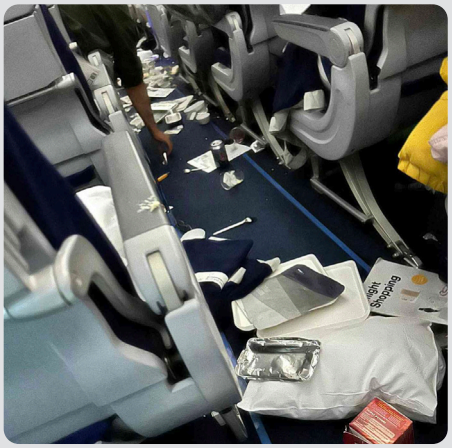


photo: Viralpress/Reuters

photo: Viralpress/Reuters

#5

How real-time, shared awareness can help

One of the biggest problems for pilots, ATC, dispatchers — all of us — is that we're not all on the same page. In fact, pages may be the problem: paper (weather charts specifically) and old radar systems are no longer the best medium for weather awareness.

But the reality is that the "old way" is already not working. The flight plan trajectory that airlines say they'll fly and that they actually fly are two different things. Static flight planning and weather charts are never going to give you the real-time information you need to carry out your job safely and cost-efficiently.

"We built processes around the old way of doing things. We made assumptions hours before the flight about exactly what was going to happen. We did a flight plan calculation, shared it with the ATC authorities, it was filed and then that was it, it was set in stone."

Ian Gray
Senior Product Manager, SITA

Real-time information

Flight planning weather charts

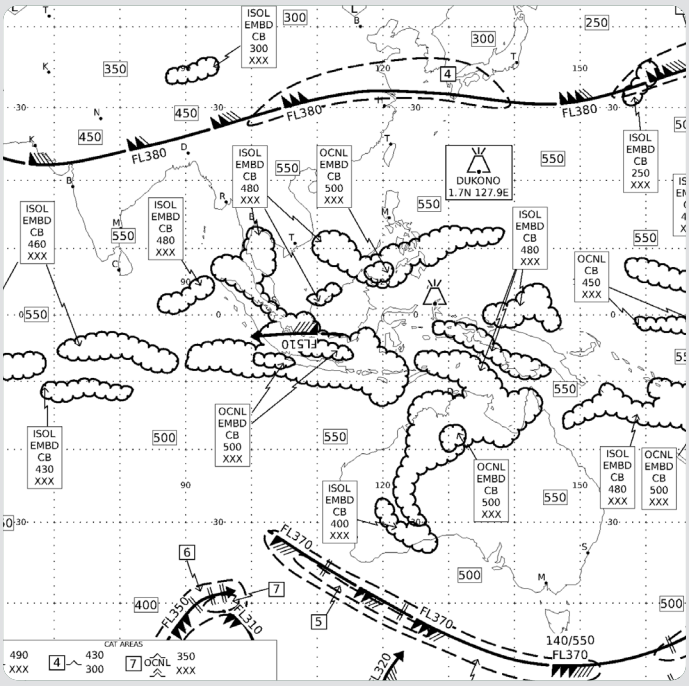
Our industry is not currently set up for easy collaboration between different job roles. When a storm, a flooded airport or wildfire means the printed plan is no longer of any use, pilots, dispatchers and ATC are not speaking the same language.

"ATC and dispatch are very reactive. They rely on pilots to ask for changes to a flight due to bad weather. That's how things are done traditionally. But behaving reactively is not efficient, and that inefficiency doesn't just affect one flight, it has a domino effect on the entire network. But with our tools, ATC and dispatch can have the same visibility into the weather. This means they can behave proactively, re-routing planes around storms earlier or planning flights to avoid clear-air turbulence. We can positively impact all stages of situational awareness for every stakeholder. It's optimizing on a network level."

Shivam Chandra
Pilot and Business Development Manager at SITA

Traditional flight plan

Aside from the fact it goes out of date quickly, a big limitation of a traditional flight plan is that vertical data is not visually represented.



Data visualization is also a big benefit of the latest systems. Combined with the real-time information element, it allows for intuitive decision-making. Pictured: SITA's eWAS application in use.

Tools already exist to give pilots weather visibility, namely weather radar on board the aircraft. Radar is a useful tool that detects precipitation and other weather conditions, providing pilots with real-time weather information during flights.

But radar has drawbacks and limitations: it can only see moisture, which limits its ability higher up in thunderstorm clouds. And it can't see ice or hail. Another limitation of radar systems is their resolution: often radar cannot distinguish between different types of precipitation or cannot accurately measure the intensity of a storm.

Radar is accurate up to a range of around 200 nautical miles, after which it becomes unreliable. It's also sensitive to inference, for example from other radar systems or even certain types of terrain. Radar also cannot see storms beyond storms. And it can sometimes display blind spots in intense weather, in a phenomenon called beam attenuation.

Ultimately, radar only gives a partial picture of the weather. And it leaves out other important stakeholders like dispatchers and ATC.

The industry needs real-time weather awareness for pilots, dispatchers, and ATC with a single, shared source of truth. A network of networks where all aviation job roles can have information tailored for their function but derived from the same source. Then you and all your colleagues across aviation can work together to solve the different challenges with confidence. A shared, intuitive visualization tool boosts your situational awareness, helping pilots, air traffic controllers and dispatchers figure out efficient and proactive evasive measures, from avoiding lightning strikes or icing to mitigating the effects of turbulence or volcanic ash.

As a pilot, you can combine weather forecasts with real-time data about conditions both horizontally (across your flight path) and vertically (altitude changes) letting you plan your flight to a level simply not possible with a static plan made on paper two hours pre-flight. Real-time, granular information empowers you to make decisions that improve safety, customer satisfaction and efficiency for everyone.

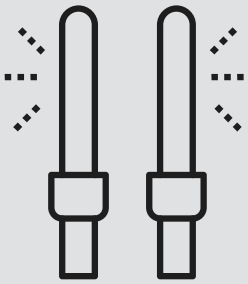
The real-time, shared-information solution also lets pilots see weather patterns in their path before they meet them, allowing far more time to coordinate with ATC and dispatchers about potential changes to their flight patterns. This is much better than having to react to changes when they see them with only a few minutes' notice.

Dispatchers and ATC will be able to collaborate with pilots more easily and efficiently by accessing the same real-time information, resulting in coordinated evasive actions while minimizing confusion.

Ground crews will have visibility into problems ahead of time due to being able to access the same information, again giving them more time to efficiently plan for secondary consequences like helping injured passengers, arranging alternate aircraft and crew changes.

Solving problems in collaboration, one decision at a time. That's the key to managing the effects of weather and turbulence.

Ground crews



The industry needs real-time weather awareness

#6

What's next

The weather challenge facing aviation is massive, but inaction is not an option. We must equip industry professionals with the tools and real-time information necessary to confidently navigate increasingly severe conditions. While the transformation required is significant, it can be achieved through incremental steps. Let's think big about the long-term vision of a more resilient and collaborative aviation ecosystem. Let's start small by implementing shared weather visualization platforms and fostering cross-functional coordination.

By embracing change today, we can ensure a future where passenger safety, operational efficiency, and environmental sustainability coexist harmoniously, even in the face of climate change's intensifying impacts.

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