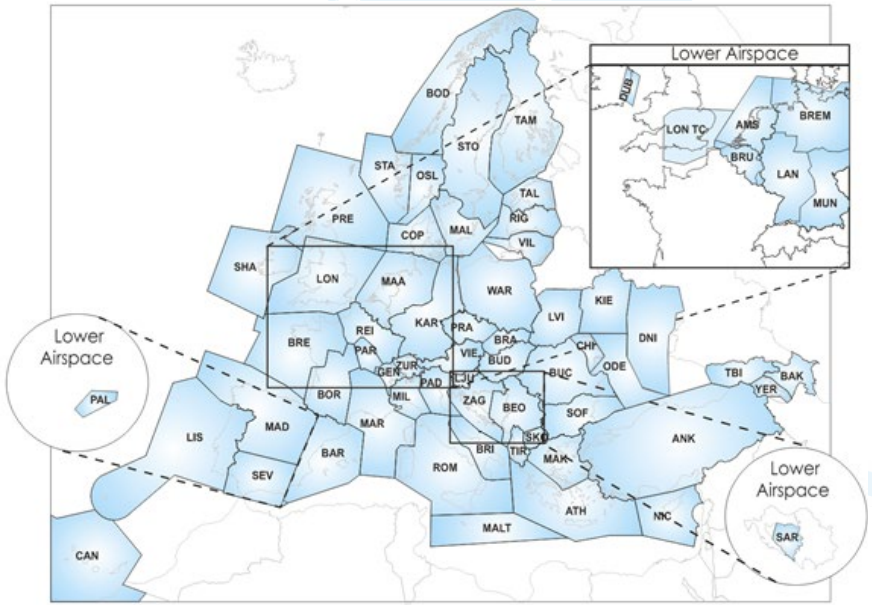


ADAPTING AVIATION TO A CHANGING CLIMATE - A GLOBAL AND REGIONAL PERSPECTIVE

Dr Rachel Burbidge,
EUROCONTROL



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



Adaptation must accompany decarbonisation

MITIGATION

Limit future warming
and reduce adaptation needs

SAFE
RELIABLE
EFFICIENT

ADAPTATION

Manage impacts already occurring
and prepare for future conditions

Parallel priorities, not competing agendas



Climate Change impacts for aviation are wide-ranging











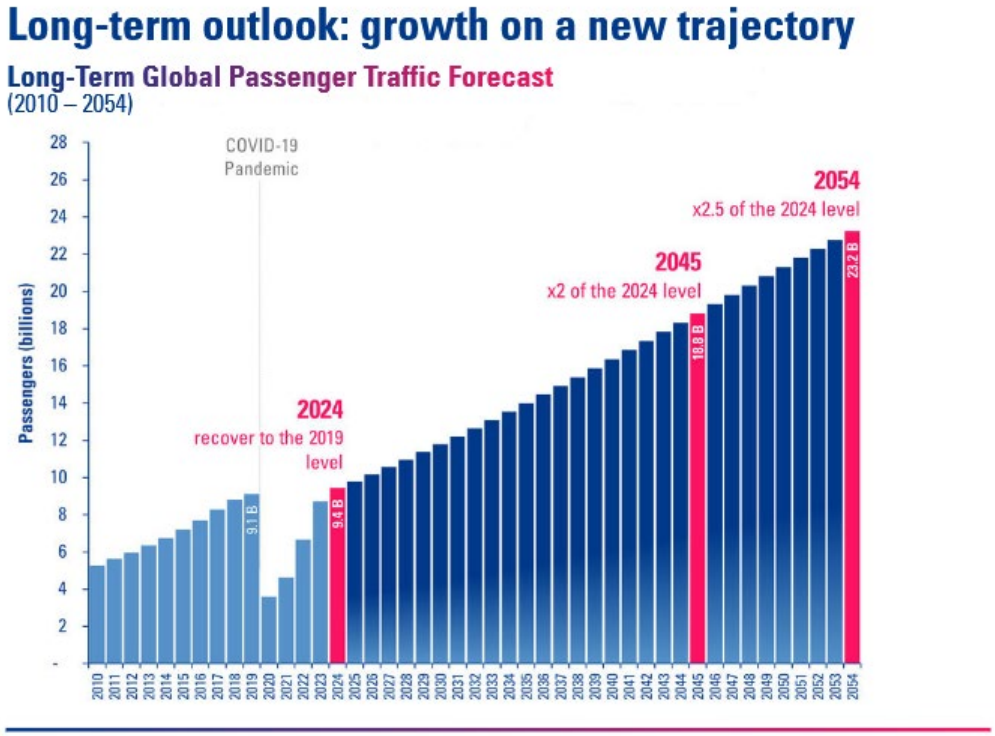






And traffic is growing…

Long-term global passenger traffic (2010-2054)



Source ACI World Airport Traffic Forecasts 2025-2054



Aviation faces a changing multi-hazard environment

INTENSE STORMS

Convective disruption
Lightning and heavy rain

01

EXTREME HEAT

Aircraft performance
Pavements and equipment

02

FLOODING

Runway inundation
Drainage and access

03

CHANGING WINDS

Routing and crosswinds
Capacity implications

04

TURBULENCE

In-flight safety
Operational constraints

05

The challenge is not one hazard in isolation, but interacting risks across a connected system.



Climate hazards become aviation-system risks through exposure and vulnerability

CLIMATE HAZARD
Changing intensity, frequency or duration

→

EXPOSURE
Assets, operations, people and access

→

VULNERABILITY
Sensitivity and capacity to cope

→

DIRECT IMPACT
Physical or operational effect

→

SYSTEM CONSEQUENCE
Safety, capacity, cost and connectivity

Example: intense rainfall → inadequate drainage capacity → runway restriction → diversions and network delay

Risk reduction is possible at every stage.



Impacts of Storms

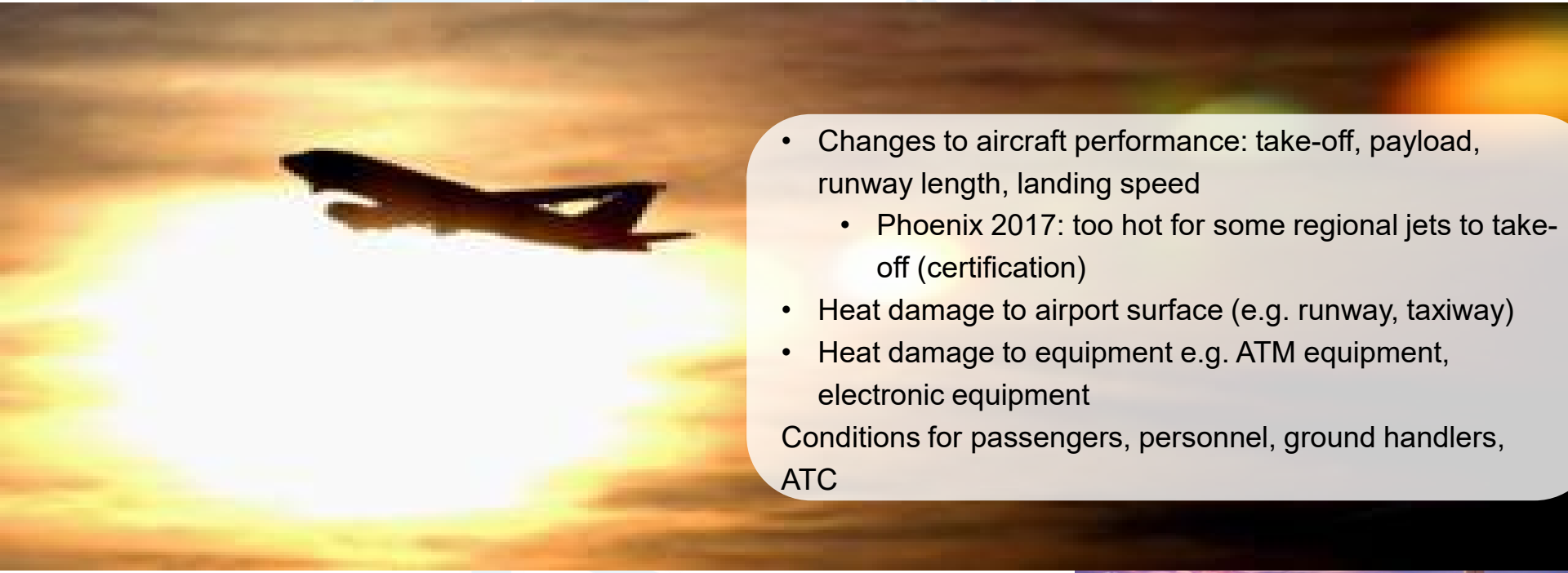


- Disruption to operations:
  - delays, re-routings, route extensions, trajectory management, HFE, increased fuel burn and emissions
  - potential en-route capacity loss and congestion
- Larger / more intense convective systems could affect multiple hub airports
- Damage to infrastructure
- Increase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

INTERNATIONAL COUNCIL OF THE AERONAUTICAL SCIENCES
ICAS2026
SYDNEY | AUSTRALIA
13-17 SEPT 2026
icas2026.com


INTERNATIONAL COUNCIL OF
THE AERONAUTICAL SCIENCES
ICAS2026
SYDNEY | AUSTRALIA
13-17 SEPT 2026
icas2026.com

Higher average and extreme temperatures

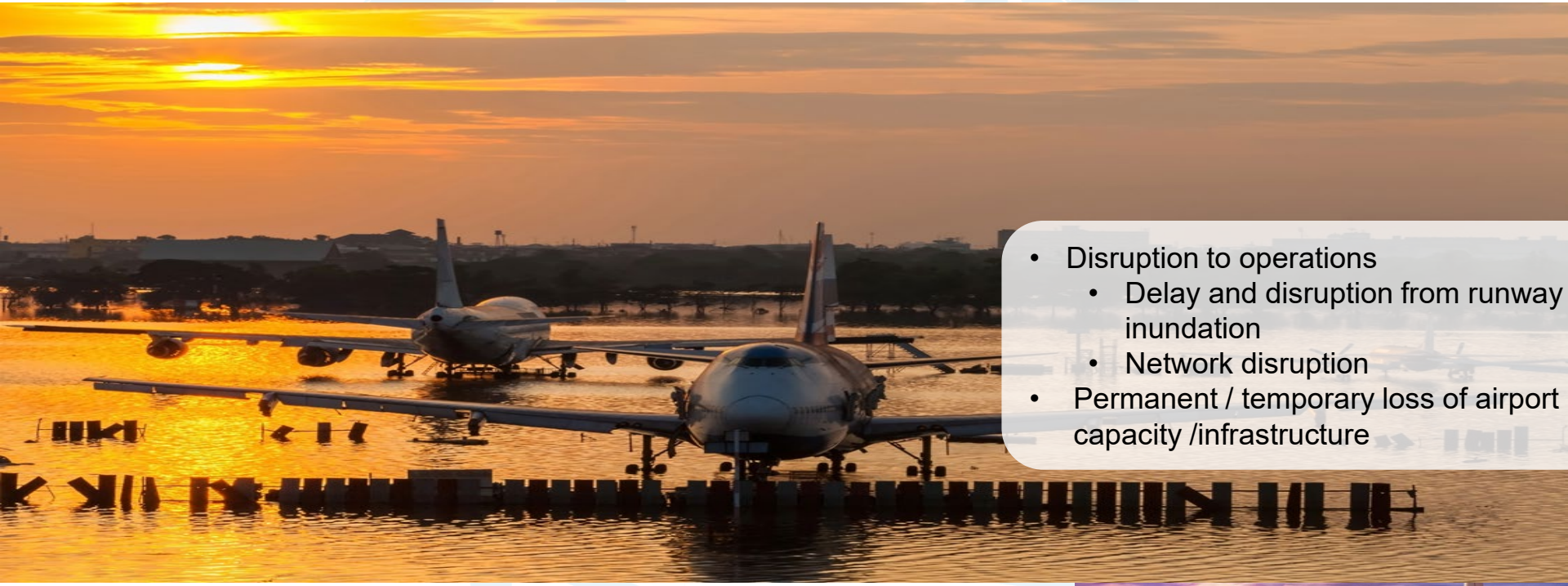


- Changes to aircraft performance: take-off, payload, runway length, landing speed
  - Phoenix 2017: too hot for some regional jets to take-off (certification)
- Heat damage to airport surface (e.g. runway, taxiway)
- Heat damage to equipment e.g. ATM equipment, electronic equipment

Conditions for passengers, personnel, ground handlers, ATC

INTERNATIONAL COUNCIL OF THE AERONAUTICAL SCIENCES
ICAS2026
SYDNEY | AUSTRALIA
13-17 SEPT 2026
icas2026.com

Sea-level rise & storm surge

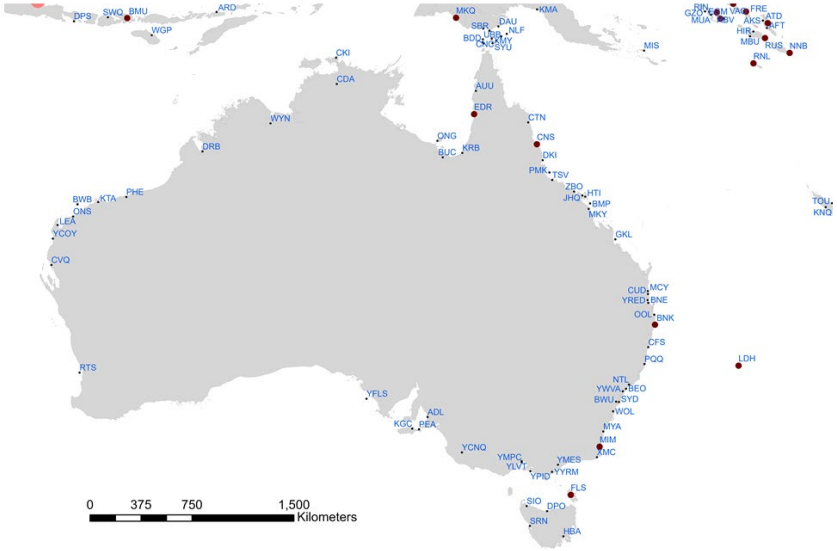


- Disruption to operations
  - Delay and disruption from runway inundation
  - Network disruption
- Permanent / temporary loss of airport capacity /infrastructure



Sea-level rise: global impact

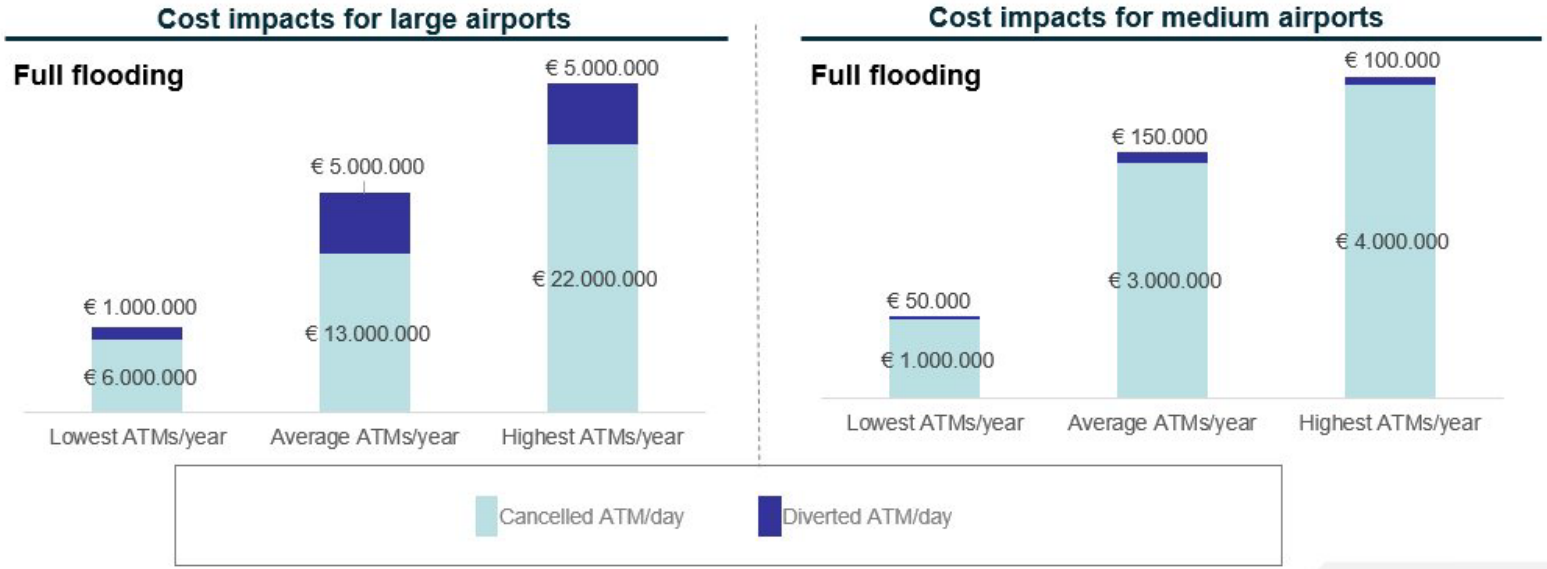
- SLR of 0.62m (consistent with a warming scenario of 2°C by 2100): 100 airports below mean sea level, 364 airports in the coastal floodplain, over 900 routes at risk of disruption (Yesudian & Dawson, 2021).
- SLR of 1.8m: 572 airports in the coastal floodplain and over 3500 route disruptions (Yesudian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



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

Image: Thales

SYDNEY | AUSTRALIA
13-17 SEPT 2026
icas2026.com


INTERNATIONAL COUNCIL OF
THE AERONAUTICAL SCIENCES
ICAS2026
SYDNEY | AUSTRALIA
13-17 SEPT 2026
icas2026.com

Turbulence

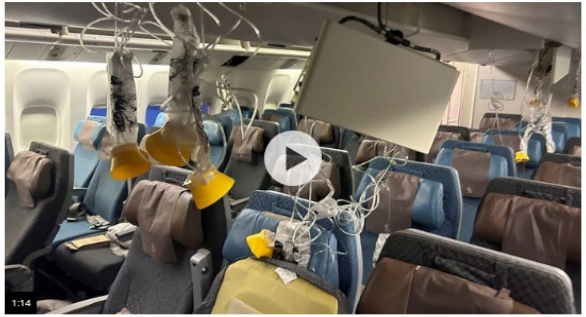
Singapore Airlines plane jolted up and down for five seconds - report

29 May 2024

Share Save

Thomas Mackintosh
BBC News

Katy Austin
Transport Correspondent



Watch: How chaos onboard Singapore Airlines SQ321 unfolded

Turbulence on Doha-Dublin flight leaves 12 injured

27 May 2024

Share Save

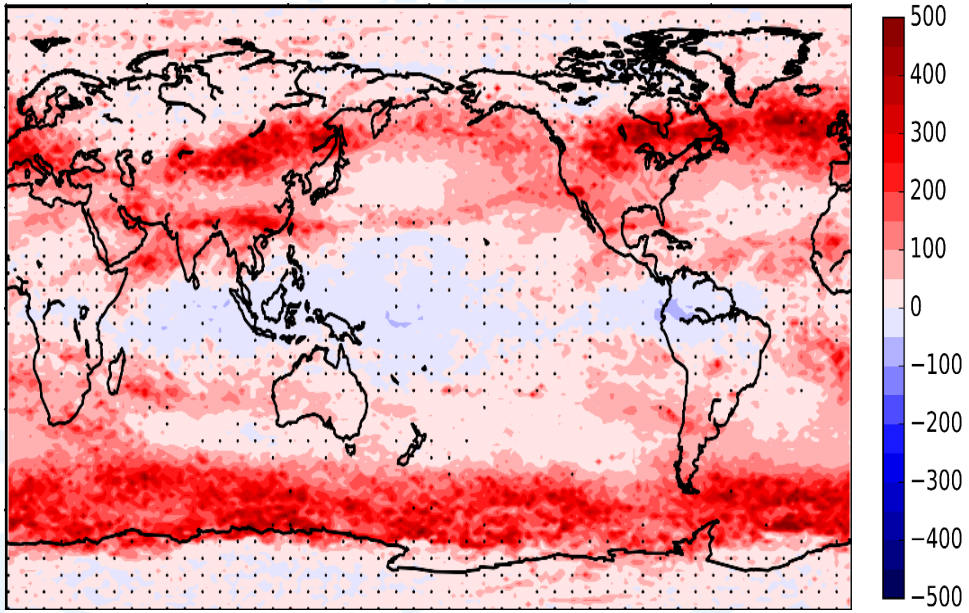
Matt Fox & Rebekah Wilson
BBC News NI



The plane was met by emergency services at Dublin Airport on Sunday

Clear-air turbulence

Change (%) by 2050–2080



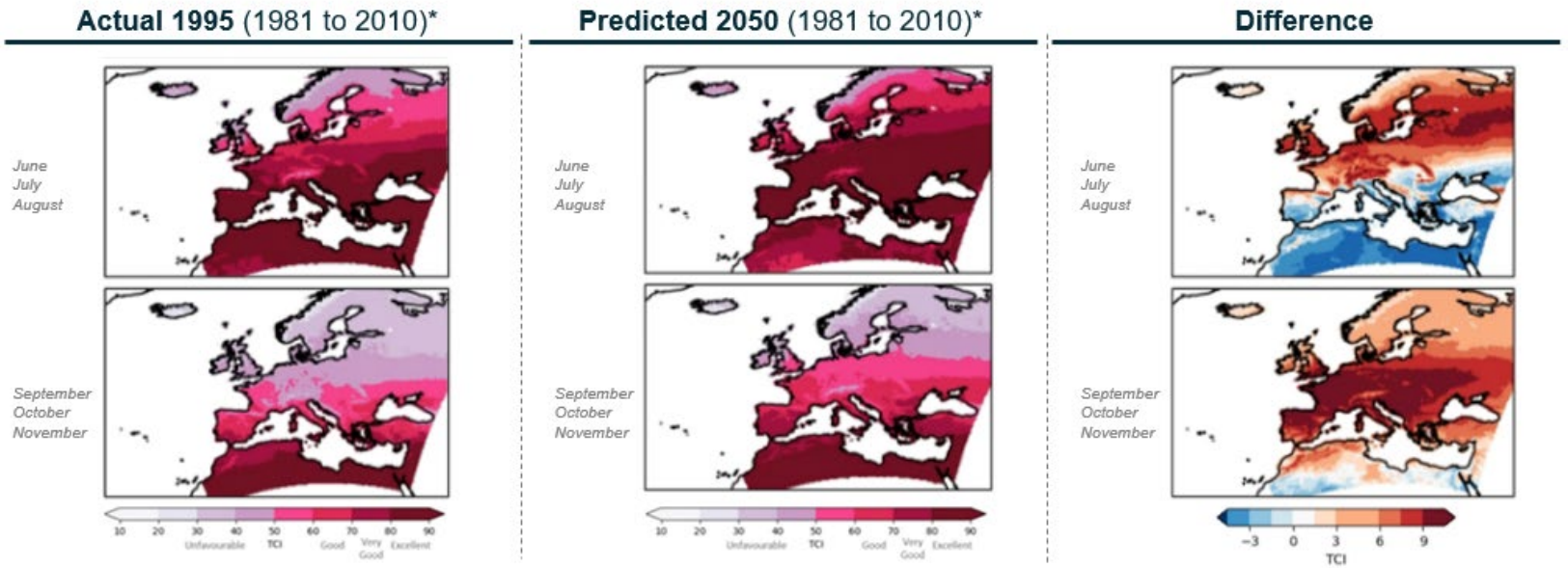
Source: Storer, Williams & Joshi (2017) Global Response of Clear Air Turbulence to Climate Change



Summer 2023: the start of a new normal?



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…?



An impact at one airport can have a knock-on effect across the network



LOCAL

Infrastructure damage and reduced capacity

NETWORK

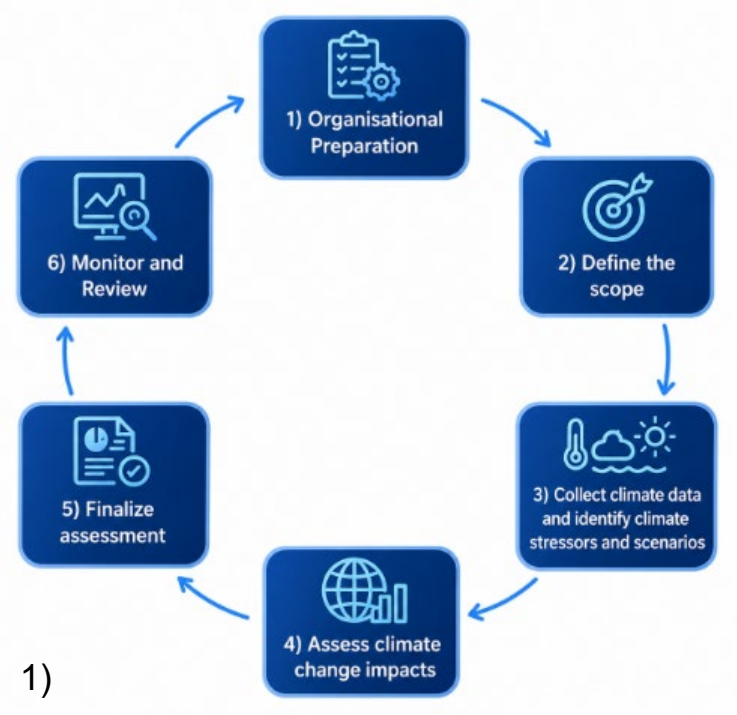
Delay, diversion and congestion

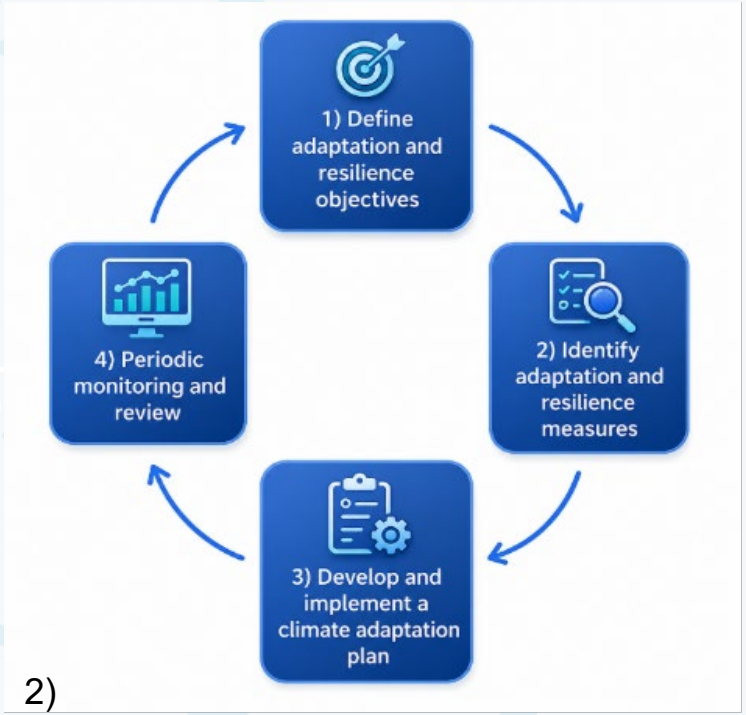
SOCIETAL

Connectivity, supply chains and regional economies

The resilience of an individual organisation depends partly on the resilience of the wider system.

Adaptation is an iterative risk-management process





Key steps in 1) climate change risk assessment and 2) climate adaptation planning and implementation

Source: ICAO (2022) Key Steps for Aviation Organisation Climate Change Risk Assessment and Adaptation Planning



A resilient response requires a range of adaptation actions

PHYSICAL & ENGINEERING

Heat- and flood-tolerant assets
Drainage and cooling
Power and equipment protection

OPERATIONAL & PROCEDURAL

MET forecasting to inform decision-making
Extreme-weather procedures, including for personnel
Flexible operational responses

RESILIENCE

INFORMATION & TECHNOLOGY

Climate projections
Impact-based climate risk assessments
Collaboration across the sector

INSTITUTIONAL & FINANCIAL

Governance and accountability
Investment frameworks and risk transfer mechanisms
Update design standards

(Non-exhaustive examples of potential adaptation actions)



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





Three messages to take away

01 **Climate impacts are already an aviation-system issue**

Adaptation is a safety, operational, people and business-continuity priority.

02 **Resilience requires integrated action**

Address infrastructure, operations, people, governance and finance.

03 **No organisation can manage network risk alone**

Connect local action with regional coordination and international collaboration.



Thank you for your attention

rachel.burbidge@eurocontrol.int

Find more information here:

