



# ICAO SEMINAR ON GREEN AIRPORTS

## Measuring airports' vulnerability to assess their climate change resilience capacity

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STAC

# Context

- Climate change resilience national programme (PNACC) aims to prepare the country to climate change impacts
- Apply to several fields (health, tourism, urban planning, **transport**, energy and industry... )
- DGAC is responsible for the aviation component of the transport field
  - studying the impact of climate change to assess airports vulnerability on climate change effects.

# The VULCLIM project

**Goal: assessing the risk of climate change on airports in order to raise operators awareness on their resilience capacity**


- A three-step process
  - Identifying a list of climate change hazards and their consequences on airports
  - Developing a methodology to assess the risk associated with the previous climate change effects
  - Designing an automated tool for airports to identify their strenghts and weaknesses facing climate change

# Identifying climate change effects and impacts

- Climate change
  - (4+1) **climate variables** are expected to be affected by climate change


Temperatures  
Precipitations  
Sea level  
Wind

**IPCC**  
INTERGOVERNMENTAL  
PANEL ON  
CLIMATE CHANGE

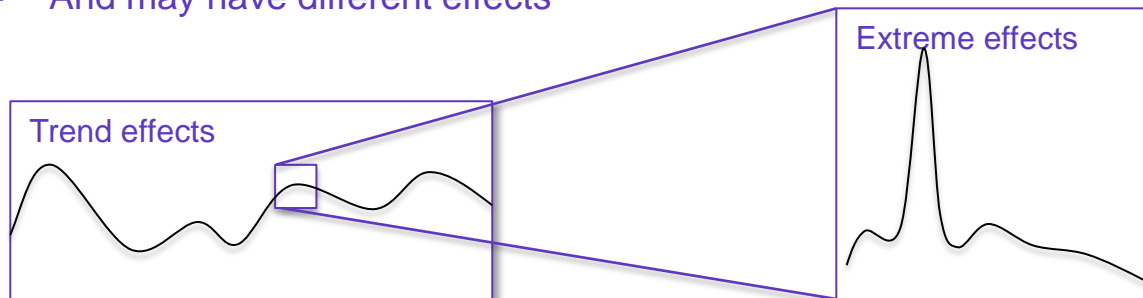


WMO UNEP

Biodiversity



- And may have different effects



# Identifying climate change effects and impacts

- List of possible climate change effects (associated with the 5 variables)
  - Change in the mean direction of winds
  - Higher strong winds
  - Decreasing number of rainy days
  - Increasing number of days with heavy rains
  - Sea-level rise
  - More frequent and intense sea-swells
  - Etc.

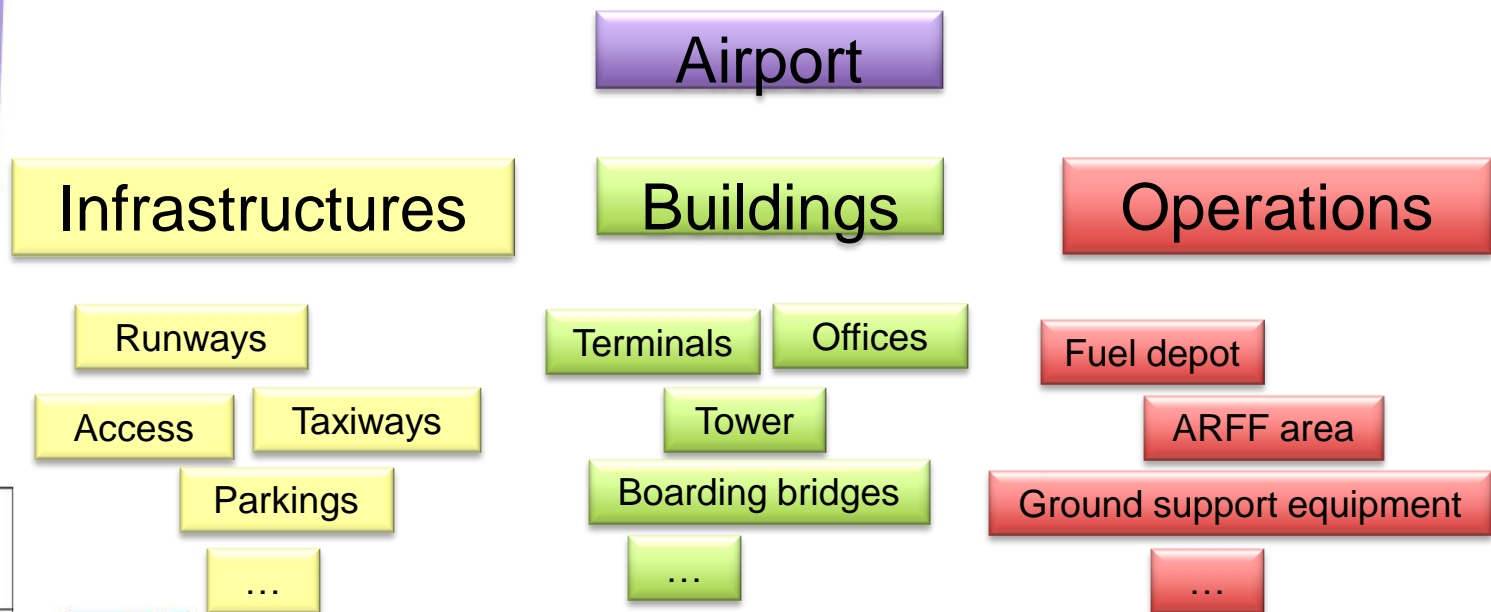
**IMPACTS on airport operations?**

- Nine climate change effects are included in the climate change scenario

Evolution	Wind	Biodiversity	Sea-level rise	Temperatures			Extreme events		
Effects	Direction change	Location, migration	1 metre rise	Heat wave	Drought	Sea swell or waves	Strong rains	Extreme winds	Snowfalls
Impacts	Binding Xwind	Wildlife hazard rise	Submersion	Fires, long take-offs	Clay expansion	Ponctual submersion	Floodings	Destruction	Contamination, destruction

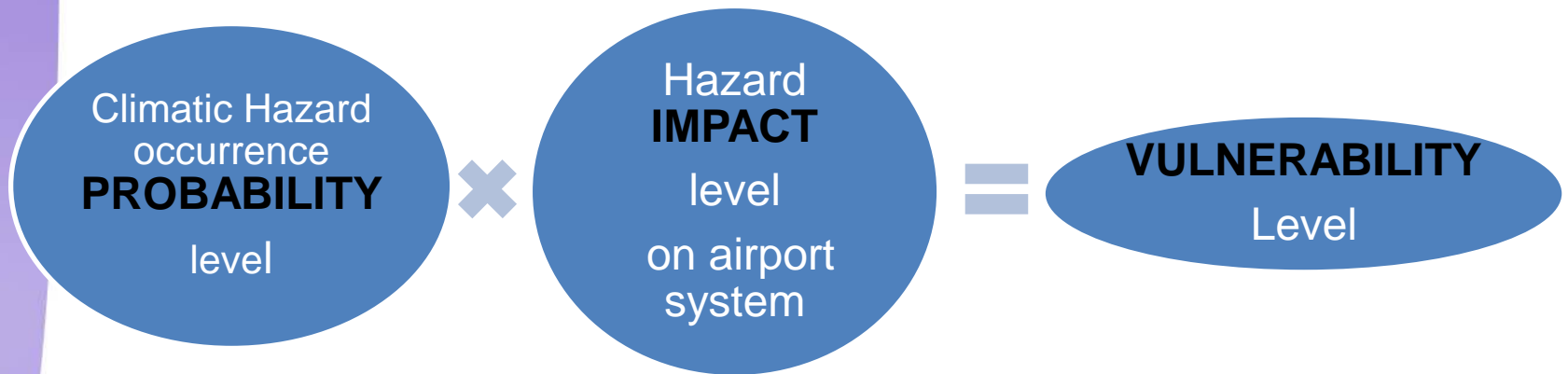
# Assessing airports' vulnerability on climate change effects

- Measuring the risk that every hazard has to airport based on **risk cartography**:
  - Complete knowledge of climate change characteristics → definition of effects ✓
  - Exhaustive portrait of the airport from the « transport » perspective → definition of airport system components ✗



# Assessing airports' vulnerability on climate change effects

The Risk assessment methodology

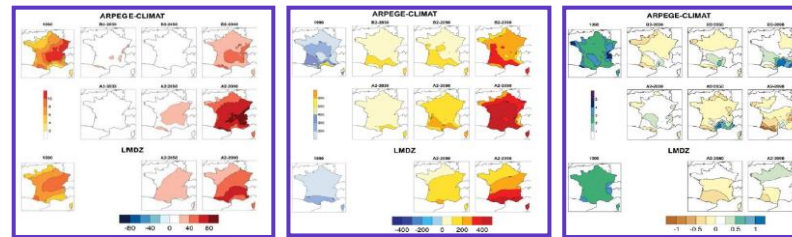


# Assessing airports' vulnerability on climate change effects

- Probability of climate change occurrence based on :

- For all effects, compare:

- Climate forecast...



- ... or airport experience

- Ex: number of wildlife accidents is constant, slightly increasing, strongly increasing

- ... to standard criteria

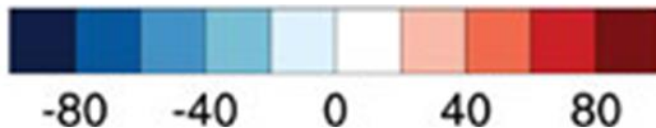
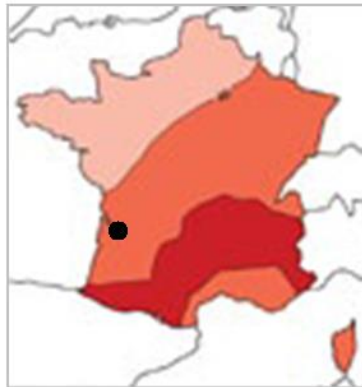
- Pick the mark of the standard criteria matched by airport forecast or experience

A mark from 1 to 3 is associated with all nine climate effects.



# Assessing airports' vulnerability on climate change effects

- Example of assessment of probability of climate change occurrence:
  - Heat-waves:
    - Climate forecast



Airport is located in:

- Light red area, probability of occurrence =1
- Medium red area, **probability of occurrence =2**
- Dark red area, probability of occurrence =3

# Assessing airports' vulnerability on climate change effects

- Impact of climate change hazards on airport components:
  - Consider the operational consequences that climate change hazards pose to airport components
    - E.g.: extreme precipitations on airport access
  - Compare with some identified standard situations
    - Normal : impact = 1
    - Acceptable degraded conditions : impact = 2
    - Restrictive degraded conditions : impact = 3
    - Unacceptable degraded conditions : impact = 4
  - Pick the mark of the standard situation which matches the considered operational consequences

A mark from 1 to 4 is associated with all pairs of airport component / climate change effects.

# Assessing airports' vulnerability on climate change effects

- Exemple of impact assessment : extreme precipitations on runways



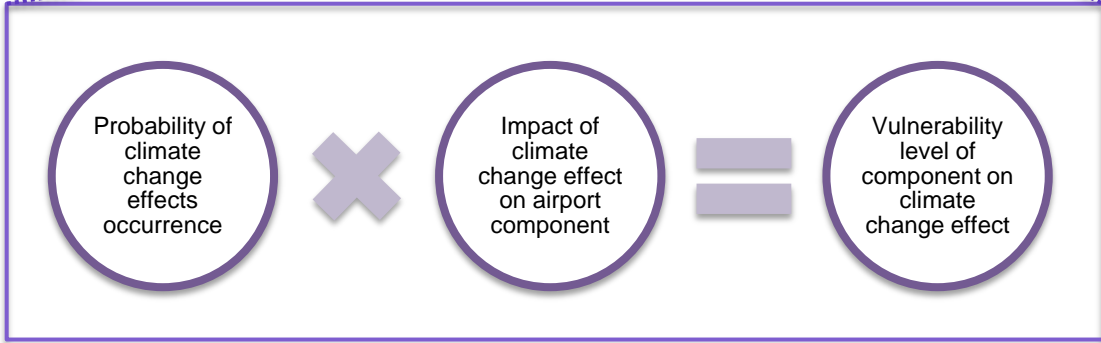
- All runways are operational : impact = 1
- At least one runway is operational : impact = 2
- **All runways are briefly out of order : impact = 3**
- All runways are out of order on the long term : impact = 4

# Results and perspective

Airport system components

Enjeux	Aléas	Evénements extrêmes								
		Evolution du régime des vents	Evolution biodiversité	Evolution du niveau de la mer	Evolution des températures		Cyclones/Tempête/évolution pluviométrie, hausse en intensité, diminution en fréquence Chutes de neige (intensités mais tendance à diminution)			
		Changement de direction des vents dominants	Evolution horizons d'obstacles	Submersion marine	Vague de chaleur	Sécheresses	Fortes houles	Pluie abondante	Vents orages	Chutes de neige
Infrastructures	Accès			3	3	1	3	B	2	1
	Parking			3		1	3	B		
	Piste, système de pistes	3 ou +	4	6	3	1	6	3	2	1
	Taxiway		4	3	3	1	6	3	2	1
Bâtiment	Aire de trafic			3	3	1	3	3	2	1
	Aérogares (terminaux passager et Fret)			3	3	1	3	3	2	
	Infrastructure de liaison entre les terminaux			3	3	1	3	3	2	1
	Bureaux et autres bâtiments			3	3	1	3	3	2	
Exploitation	Passerelles			3	3		3	3	2	1
	Tour de contrôle			3	3	1	3	3	2	1
	Zones de dépôt de carburant			3	3		3	3	2	1
	Opérations de dégivrage									3
	Zone réservée pompiers SSL			3	3		3	3	2	2
	Tracteur engins d'assistance			3	3		3	3	2	1
	Capacité de l'aérodrome	2 ou +	2	3	3		6	B	2	2
	Equipement liés à la navigation aérienne			6			6	B	2	1
Facteur humain (personnel de l'aérodrome)				3			B	2	2	

Effects



# Results and perspective

- Today: a **method** giving a matrix which highlights the strenghts and weaknesses of the airport regarding the expected climate change effects
  - Identify major effects
  - Identify airports' components to be strenghtened in order to increase climate change resilience
- Tomorrow: providing airports operators with an **automated tool** to make the vulnerability evaluation easy
  - For airports operators
  - Based on 2 limesurvey open source questionnaires
  - Built the airport risks matrix
  - The tool is made with the participation of airports

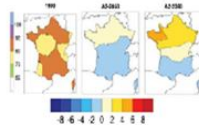
[[Quelle est la situation de l'aérodrome face à l'évolution des vents extrêmes ? \*]]

Veuillez sélectionner une réponse multi-voies

Veuillez choisir plusieurs des réponses qui conviennent :

- L'en 1950, l'aérodrome se situait en zone jaune et il se trouve en zone beige ou bleue en 2100 (1)
- En 1950, l'aérodrome se situait en zone jaune et il se trouve en zone orange ou rouge en 2100 (2)
- L'en 1950, l'aérodrome se situait en zone orange et il se trouve en zone beige ou bleue en 2100 (3)
- En 1950, l'aérodrome se situait en zone orange et il se trouve en zone orange ou jaune en 2100 (4)

Pour répondre, repérez le position de l'aérodrome sur les cartes suivantes (le nombre de jours de vents extrêmes en 1950 et en 2100 et indiquez par un cercle de couleur la zone à laquelle il appartient).



[[Quel est l'impact de vents extrêmes sur les passerelles de l'aérodrome ? \*]]

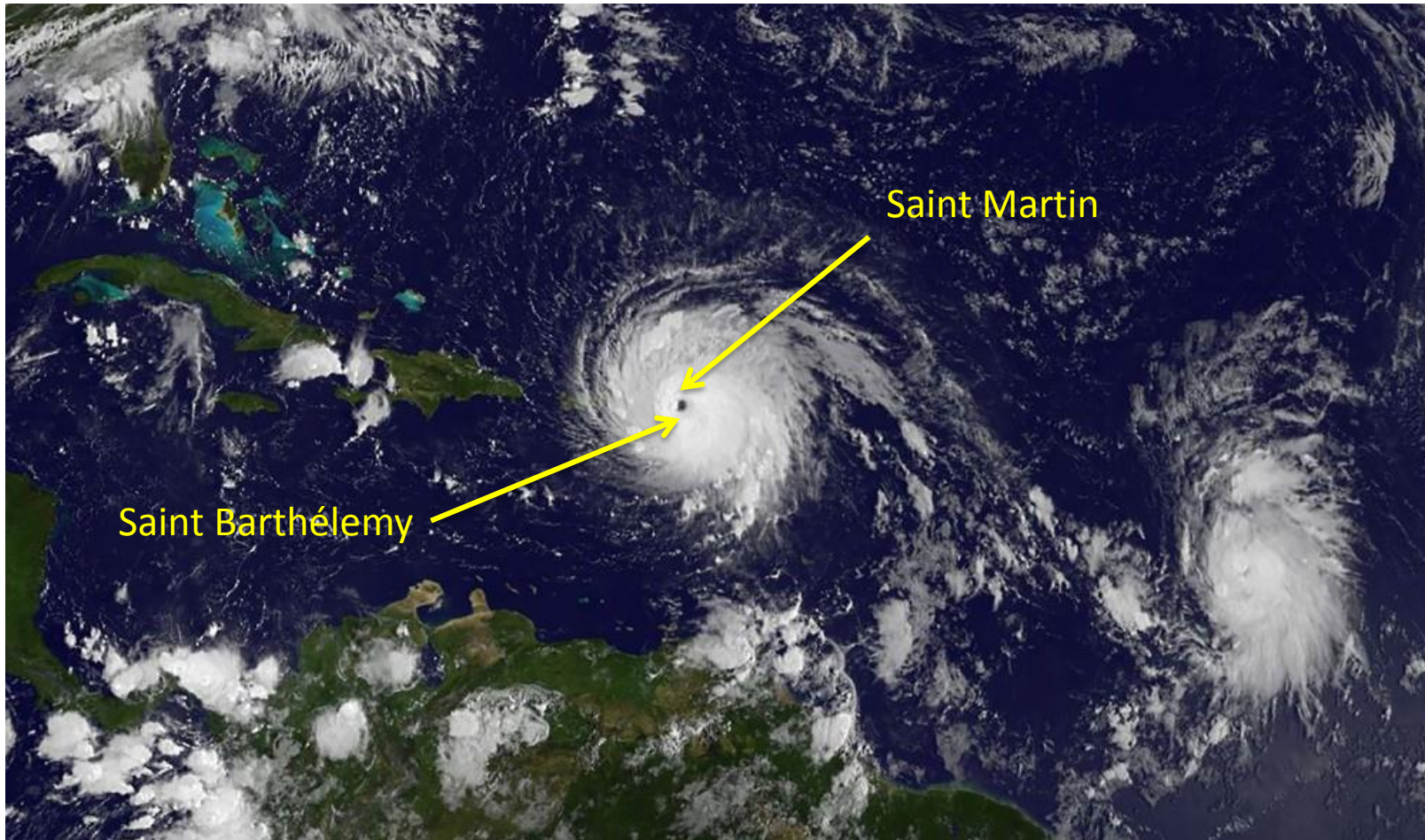
Veuillez sélectionner une réponse multi-voies

Veuillez choisir plusieurs des réponses qui conviennent :

- Toutes les passerelles sont affectées et nécessitent aux vents extrêmes (1)
- Une partie des passerelles est affectée et nécessite des vents extrêmes (2)
- La majorité des passerelles est multivaleuse ou non affectée aux vents extrêmes (3)
- Toutes les passerelles sont multivaleuses par vents extrêmes (4)
- Toutes les passerelles sont multivaleuses aux vents extrêmes (4)

Pour afficher un vent extrême, indiquez le vent (1 à 6) et le nombre de jours de vents extrêmes au cours des 30 derniers jours.

# Feedback after hurricane Irma in St-Barthelemy and St-Martin islands



# Feedback after hurricane Irma in St-Barthelemy and St-Martin islands

-> Before IRMA → be prepared to limit damage

-> After IRMA → trying to re-open airports ASAP.

- An expert team arrived just after IRMA and just before Jose
- List of damage
- Are runways available for military rescue airplane ?
- Cost of recovery of the airports (emergency and short term costs)

# Feedback after hurricane Irma in St-Barthelemy and St-Martin islands

Many Damage  
Safety issues  
airport protections  
animals, FODs



MINISTÈRE  
DE LA TRANSITION  
ÉCOLOGIQUE  
ET SOLIDAIRE



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# Feedback after hurricane Irma in St-Barthelemy and St-Martin islands

## Infrastructures and equipments



**Thank you for your attention.**



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