From data to decision-making under conditions of uncertainty

August 26th to 28th, 2025

GRENOBLE ALPES MÉTROPOLE

RISK Summer School 2025

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The Graduated Anticipation Plan (GAP) : Decisions without regrets, in a context of uncertainties

The GAP, a tool develloped with the financial support of :

l'Europe s'engage sur le Massif Alpin — Union Européenne Fonds Européen de Développement Régional — Région Sud Provence Alpes Côte d'Azur — La Région Auvergne-Rhône-Alpes — République Française Agence Nationale de la Cohésion des Territoires

The GAP, a tool develloped with :

IMT Mines Alès École Mines-Télécom

Bertrand MARION Grenoble Alpes Métropole

UGA Université Grenoble Alpes — GS @UGA Université Grenoble Alpes — France 2030 — Grenoble INP UGA — Polytech Grenoble — Grenoble INP Ense3 UGA

Risk Institute Université Grenoble Alpes

DECODE Project

Decode stands for : DEvelop COmptences DEvoted to the management of uncertainty with creativity and drama tools

British Council

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Application Framework of GAP

Application Framework of GAP

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- The **Graduated Anticipation Plan (GAP)** is a doctrine and a planning and **crisis management tool** initially developed for the risk of hydraulic structure failure (dikes, etc.).

- However, **it can be applied to any type of hazard**, particularly those with rapid onset, such as the risk of torrential flooding or the overtopping of a structure.

- The GAP concept was developed with the École des Mines d'Alès and with financial support from the European Union (FEDER), the French State (FNADT), and the Auvergne-Rhône-Alpes Region.

IMT Mines Alès
École Mines-Télécom

l'Europe s'engage sur le Massif Alpin

UNION EUROPÉENNE
Fonds Européen de Développement Régional

RÉGION SUD PROVENCE ALPES CÔTE D'AZUR

La Région Auvergne-Rhône-Alpes

RÉPUBLIQUE FRANÇAISE
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FONDS NATIONAL D'AMENAGEMENT ET DE DEVELOPPEMENT DU TERRITOIRE
Massif des Alpes

A New Hazard Considered

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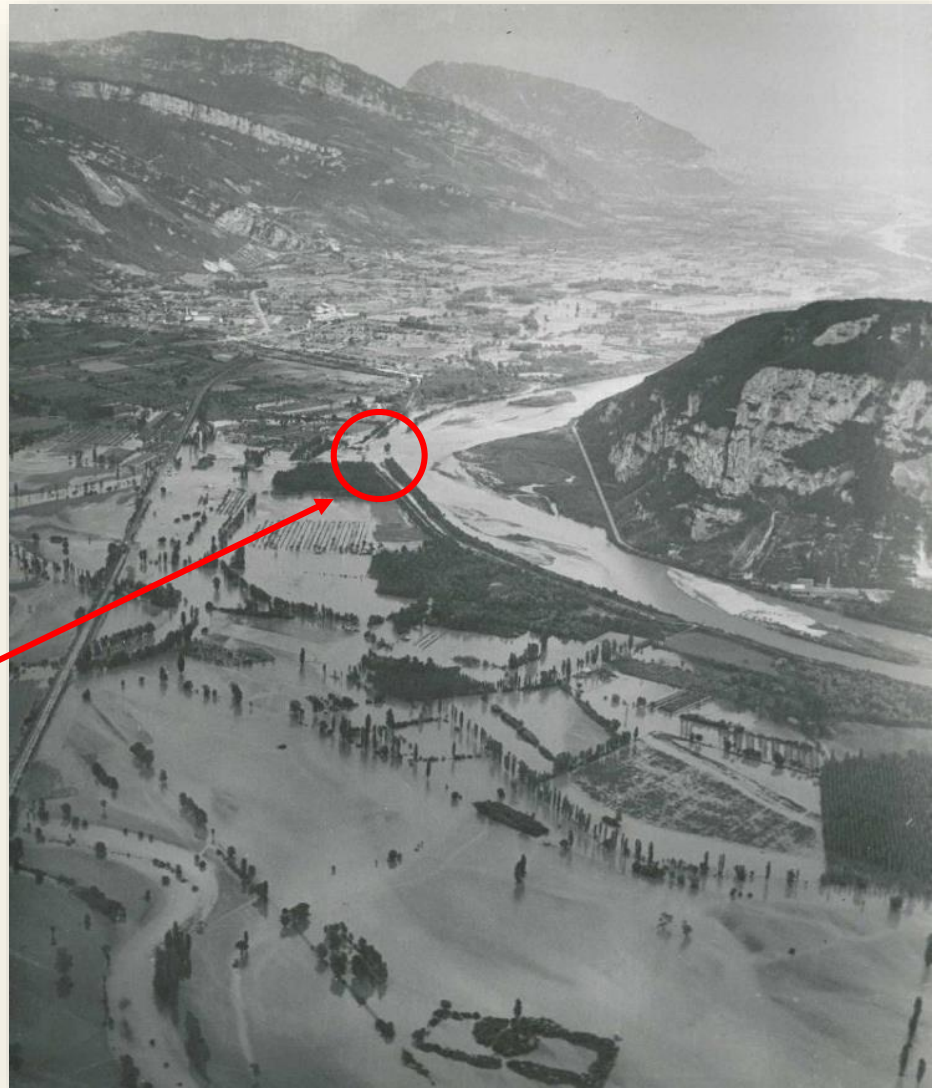
- A new hazard is now integrated into flood risk: **the hazard of dike failure**.
- The dike: **a protection that can also be a source of danger…**



1948: Dike failure of the Isère at Bec de l'Echaillon (Moirans, near Grenoble).

Dikes as a Risk

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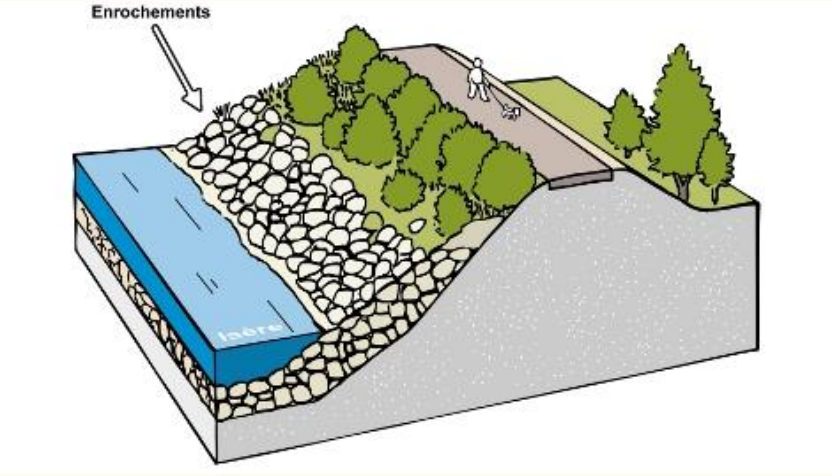
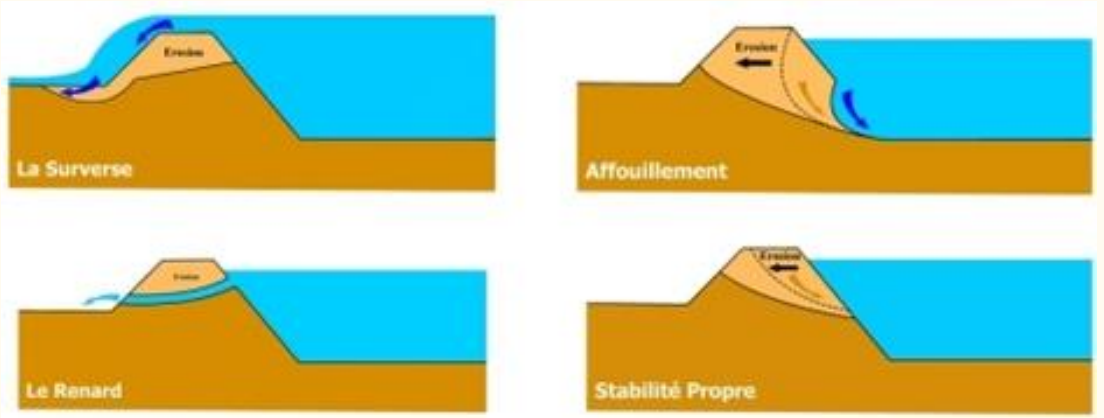
- Dikes are a protection, but they are not infallible.
- They help **mitigate flood risk** but also introduce an **additional hazard in case of failure or overtopping**.
- **The higher the discharge** in the main channel, **the greater the probability of failure.**
- However, **failure cannot be ruled out from the moment the dike is under load**.
- **Once the protection level is reached, overtopping occurs**.



- During a flood, dikes are subjected to various loading and erosion phenomena, which can be **rapid, unpredictable, and difficult to control**

→ risk of failure



Differents types of dike failure

Specific Hazard Zones

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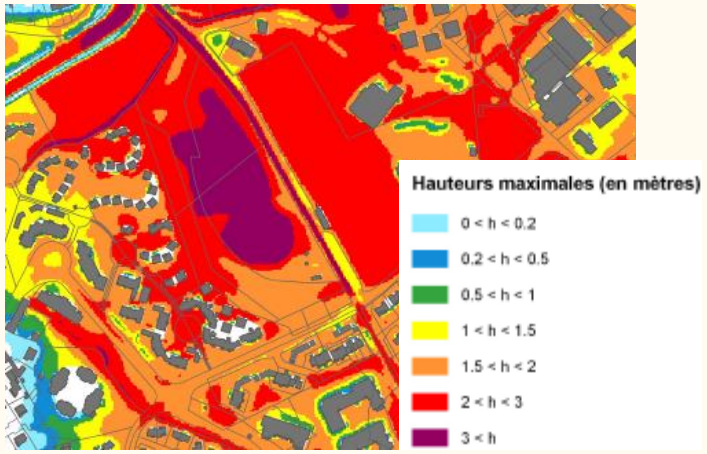
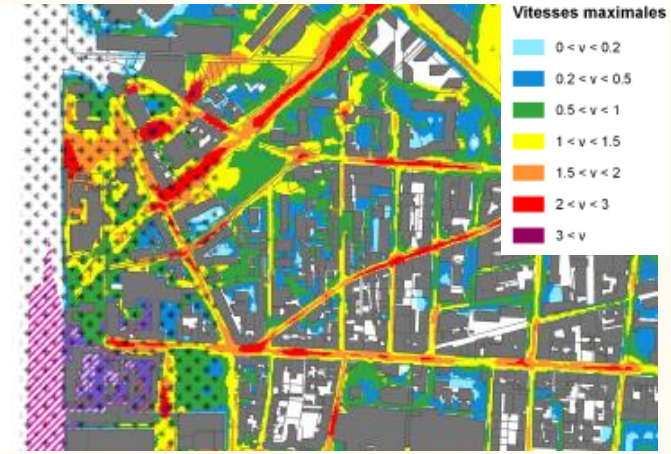
- Failure or overtopping creates specific danger zones, notably:
  - **Low points** (depressions) where water levels can be significant and remain for long periods.
  - **Areas of potential scour and increased velocities** (precaution zones).
  - **Preferential flow paths** (streets, spaces between buildings, etc.).



Low points (depressions)



Preferential flow paths (between buildings)

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Reminder of the specificities of a flood due to dike rupture

Reminder of Specificities of Dike-Breach Flooding

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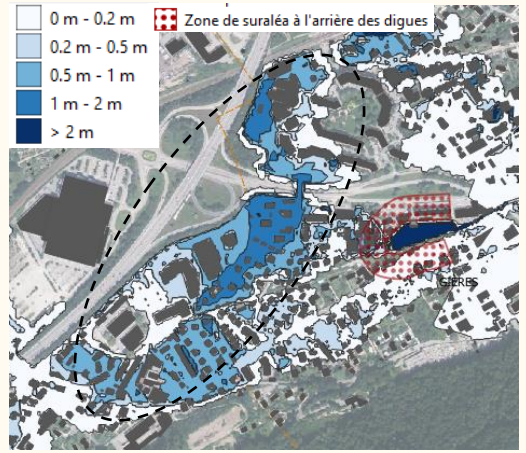
- Floods with **rapid onset**: a **complex situation in crisis** management:
  - **Difficulty predicting the flood** (a dike failure is possible for a small flood as soon as the loading is sufficient, just like it may not occur at the reference flood ; difficulty in predicting precipitation (storms in particular) and its impact on small watersheds)
  - **Rapid** (or even immediate) **water arrival after dike breach or torrential flood**
  - **Difficult interventions**.
  - **Very complex evacuations** once water is present (particularly in the event of a dike-breach or torrential phenomenon (short delays, unforeseen circumstances, panic, etc.)

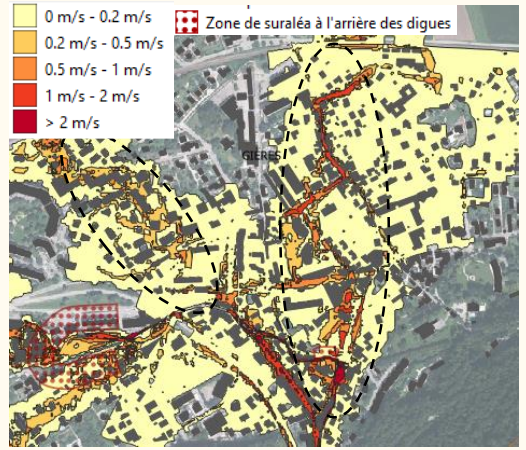
Anticipation Need

- **Anticipation is necessary** (evacuation impossible once the breach has occurred – **feedback** from the Drac crisis exercise).
- Without anticipation: evacuation in reflex mode (vertical evacuation) but not suitable for all situations.
- **Risk culture**.
- **Culture of uncertainty** (misunderstanding if not followed by event…)
- **A new safeguard scheme: “Manage the risk upstream to avoid having to manage the crisis.”**

Horizontal evacuation by boat



Low points (depressions)



Preferential flow paths

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What's a GAP ?

GAP Logic

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- **Main objectives:**

  - Structure an **anticipated crisis response** by **grading actions according to identified levels of criticality.**

  →**Anticipate in the face of uncertainty**

  - **Target decisions and actions before first overflows** or breaches on dikes.

  →**Act, before the high thresholds of vigilance**

- **Objectives** within the framework of the **Inter-Municipal Safeguard Plan**:

  - Propose a new form of response that **supports existing planning**.

  - Provide a doctrine for **efficient and acceptable risk management**.

  - Decline and allow the **appropriation of the doctrine** by each actor in the crisis.

Key GAP Axes

- Define **impact zones and timeframes** for the arrival of water: (for exemple) 30 min, 1 h, 2 h, 7 h 45.
- Propose **measures for 'least regret'** of the type:
  - **Closure for sensitive issues** (schools...)
  - Implementation of **remote work**
  - **Closure of certain public establishments**
  - **Cancellation of events**
  - ...**A goal: to minimize issues on the site (hazard x issue = risk)**
- **Plan the security of the population**, targeted and in gradual stages
  - Occasional horizontal sheltering (prioritizing vulnerable people)
  - Vertical sheltering
- Identify the road and cycle routes impacted as soon as possible to take the most appropriate measures
- **Shared actions between municipalities and territorial actors**

→ The **acceptability** of the measures must be accompanied by specific and targeted **NON-CRISIS information campaigns**.

Niveau de surveillance	NIVEAU d'anticipation	Principales actions
Activation PCS		
VIGILANCE RENFORCEE	A4	Zone 30min : Aucune action **Zone 1h : Fermeture des enjeux** Zone 2h : Aucune action Zone 7h45 : Aucune action
VIGILANCE RENFORCEE	A3	**Zone 30min : Mise à l'abri des riverains et Evacuation des plain-pied** Zone 1h : Aucune action **Zone 2h : Information des riverains. Fermeture des enjeux** Zone 7h45 : Aucune action
PRE-ALERTE	A2	Zone 30min : Aucune action **Zone 1h : Mise à l'abri des Riverains. Evacuation des plain-pied** Zone 2h : Aucune action **Zone 7h45 : Informer les riverains d'une éventuelle mise à l'abri, fermeture des enjeux**
ALERTE	A1	Zone 30min : Aucune action Zone 1h : Aucune action **Zone 2h : Mise à l'abri des riverains. Evacuation plain-pied** Zone 7h45 : **Toute la zone inondable : information des riverains et fermeture des enjeux**
Mode Reflex	A0	

Main actions of the Gières GAP by anticipation threshold

Action Types in GAP

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- Actions in three types:

  - **MONITOR**: hydrology (Vigicrues (national tool) or metrpolitan hydrometric station), servere weather, field observations.

  - **DECIDE**: **take low-regret measures.**

  - **ANTICIPATE**: project into crisis evolution, identify the major decisions to be made...

–> Synthèse des risques jusqu'au samedi 2 décembre 2023 à 20h lég.

Risques météo surveillés	Plaine	Chartreuse	Belledonne	Vercors
Cumul neige	Faible	Modéré	Modéré	Modéré
Fortes pluies	Modéré	Modéré	Modéré	Modéré
Vent fort	R.A.S.	R.A.S.	R.A.S.	R.A.S.
Pluie en surfusion	R.A.S.	R.A.S.	R.A.S.	R.A.S.
Pluie sur sol gelé	R.A.S.	R.A.S.	R.A.S.	R.A.S.
Gelée blanche	R.A.S.	R.A.S.	R.A.S.	R.A.S.
Congélation d'eau préexistante	R.A.S.	R.A.S.	R.A.S.	R.A.S.
Brouillard dense et/ou givrant	R.A.S.	Modéré	Modéré	Modéré
Orages	R.A.S.	R.A.S.	R.A.S.	R.A.S.
Congères	R.A.S.	R.A.S.	R.A.S.	R.A.S.
Fonte nivale - Echelle départementale	Fort	idem Plaine - Échelle départementale N.C.	idem Plaine - Échelle départementale N.C.	idem Plaine - Échelle départementale N.C.

Severe Weather

Supervisor of flood monitoring of Grenoble-Alpes Métropole

Time vs Certainty Balance

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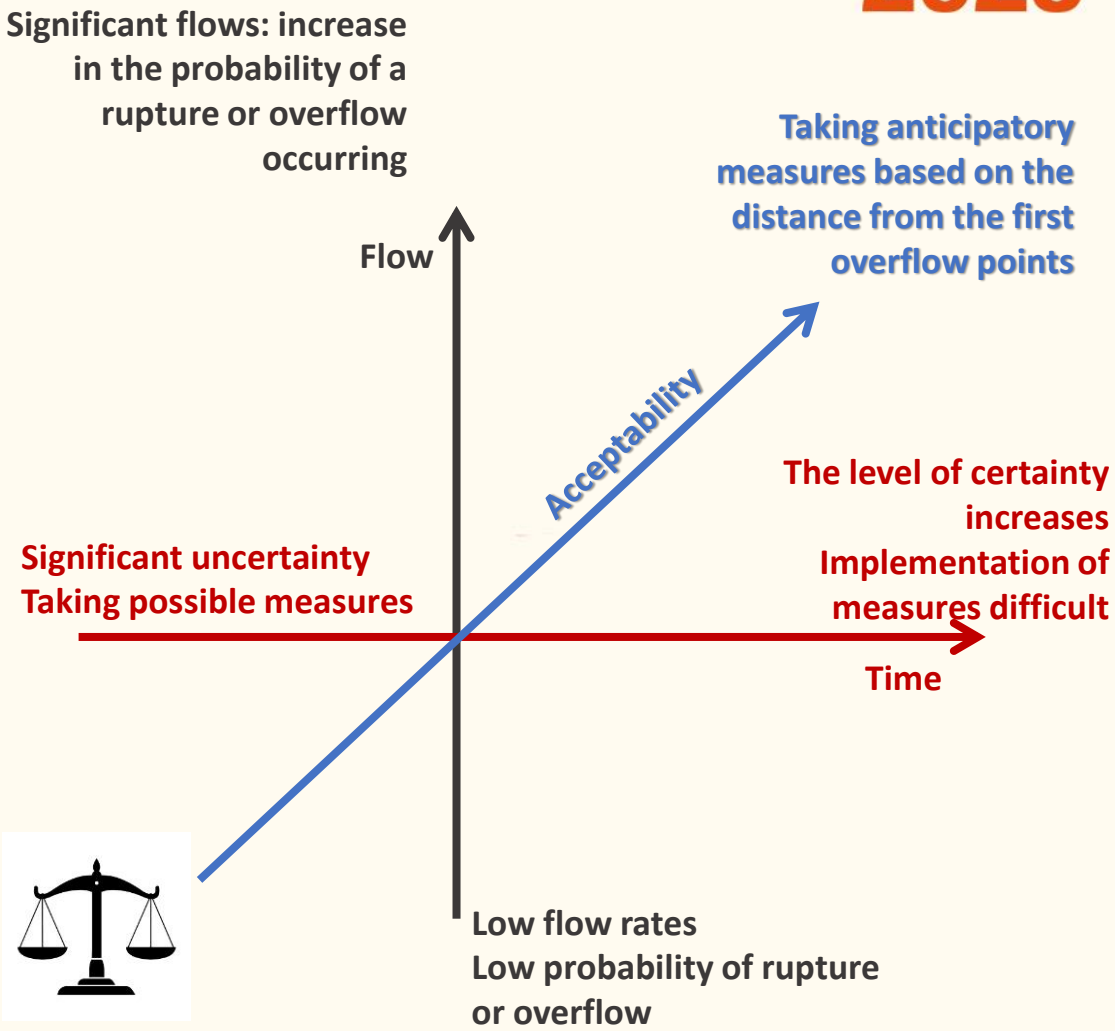
- **More time passes → more certainty, less reaction time.**
- The objective of the GAP is to retain **anticipation thresholds** that allow for measures to be taken with **least regrets based on their acceptability**.
- **Balance between uncertainty, acceptability, necessity, and capacity to act.**



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GAP tested

GAP Tested During Exercises

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Grenoble Alpes Métropole organizes or participates in many **exercises**:

- **2 inter-municipal exercises tested GAP**:
  - Drac 2022 (Grenoble & Seyssinet-Pariset)
  - Sonnant 2023 (Gières & Saint-Martin-d'Hères)

→The **first exercise validated the GAP doctrine** and the associated least regrets measures

→The second exercise also aimed to **test the effectiveness of GAPs for torrential risk** (overflows and overflow of work)



Main Lessons from Exercises

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- About anticipation:
  - **Progressive GAP adapted to event certainty**
  - **Solves** many **problems before crisis**
  - **Allows decisions in non-catastrophic context**
  - **Free time for urgent actions** during crisis
  - **Multiple zones: good for actions, less for communication**
  - Need exact **vulnerability knowledge**
  - Need **specific tools**: vulnerability mapping (ACDC (Grenoble Alpes Métropole tool)), torrent instrumentation
  - **Anticipation cell** is valuable in the crisis unit
  - **Risk & uncertainty culture** needed
  - **GAP applicable to all rapid-onset floods**: dike failures (Drac) or torrential (Sonnant)

Main Lessons from Exercises

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About the inter-actor relationship:

- Need for **multi-municipal/metropolitan coordination and coherence**
- Essential **coordination between upstream and downstream** municipalities (transmission of information)
- Grenoble Alpes Métropole strong on its skills but **what role in coordinating responses to the crisis**
- **Anticipation necessary** to make during the crisis an **interactor management**
- **Good acceptance of the measures** to the extent possible by local services and elected officials
- Same for the **economic world** (case of the Drac)
- Need for **support from the State** in particular for certain decisions (example: closure/disturbances on highway axes)

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Conclusion and prospects

Conclusion

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In summary:

- The taking of **measures with fewer regrets in anticipation via the GAP tool appears to be a step forward for all the actors** present at the exercises.
- The **acceptability of the measures seems acquired**
- However, such action requires **good technical competence** among the actors, consistency at the territorial level, and a **culture of risk and uncertainty** among the population.
- The use of the **GAP for rapid kinetics** such as torrential floods **is particularly suitable** (in addition to the risk of structural failures)
- A logic of anticipation that could be reused during the **latest flood of Isère on November 2023**

Prospects

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Continuation of the support for the Risks Mission of the Metropolis for the **appropriation and transcription of the GAP in the Safeguard Plan of municipalities**

Creation of the metropolitan **Inter-Municipal Safeguard Plan** (one of the firsts in France) to maintain metropolitan skills and support municipalities in the deployment of their GAP by local solidarity

A **forest fire-specific GAP** logic is deployed in the PICS from 2023

Test and implement GAP in new contexts like flashfloods

Thank you for your attention

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