How far do decision-makers see? A spatiotemporal investigation of flood risk governance in a French Alps city

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Abstract

At the confluence of two rivers, the Grenoble Metropolitan area of France is a fabric of municipalities surrounded by Alpine massifs. Despite the absence of a major flood since 1859, flood risks persist, further amplified by climate uncertainties. We investigated how institutional structures manage these evolving risks. From previous research using Q-methodology, we found tensions related to spatial and jurisdictional aspects of flood risk management. To gain a deeper understanding of the temporal aspects not apparent from the Q-method study, we conducted a thematic analysis of seven interviews of study participants who hold managerial positions. Even though the interviewees were well aware of flood history and climate change, regulatory and policy mechanisms often impede the mobilisation of a long-term view into flood risk management strategies.

Keywords: flood risk governance; policy myopia; institutional inertia; thematic analysis; France

1 Introduction

Urban planning presents various "wicked" problems that are complex, multifaceted, and pervasive throughout socio-ecological systems (Rittel and Webber, 1973). Managing these problems is challenging as they involve multiple interrelated and co-evolving processes with no single best solution. Similarly, stormwater and flood risk management are wicked problems that operate within the context of evolving hydro-social systems, both constrained by and co-evolving with existing socio-cultural settings, land use patterns, governance structures, and infrastructures (Holling, 1973; Armitage *et al.*, 2009; Montanari *et al.*, 2013; Hommes, Hoogesteger and Boelens, 2022; Arik, 2024). Most water infrastructure and policies in developed areas are rooted in the concept of 'stationarity,' which uses the past hydrological regime to determine the envelope of variability for current and future water management decisions. In the face of increased uncertainties related to climate change, the assumption that hydro-climate systems exist in a fixed envelope of variability risks implementing inadequate infrastructure planning and water management strategies (Milly *et al.*, 2008; Sivapalan and Blöschl, 2015; Nair and Howlett, 2017). However, better capturing the uncertainty posed by evolving hydro-climate systems remains a major science and policy challenge. As a result, well-tested engineering methods based on stationarity remain prevalent in water infrastructure planning and management approaches (Brown, 2005; Harries and Penning-Rowsell, 2011; Milly *et al.*, 2015; Meng *et al.*, 2022; Robert, Quercy and Schleyer-Lindenmann, 2023).

To better meet the pace of evolving climate challenges, the concept of 'path dependency' helps conceptualise how the past shapes possible futures through current societal structures and systems (Haasnoot *et al.*, 2013, 2020; Bruley *et al.*, 2021). In other words, existing societal

structures can limit future pathways for adaptation to changing risks and climate uncertainties, even if there are known strategies to reduce risks. Some scholars explain the persistence of these societal structures in terms of reproduction, equating it to 'social inertia' by suggesting that institutions reproduce themselves over time, which causes self-reinforcing dynamic that resists directional changes even if the status quo is maladaptive (Mahoney, 2000; Barnett *et al.*, 2015). These pathways add a layer of complexity to managing flood risk as they can be hard to predict and can hinder the implementation of climate-adaptive flood risk management strategies even when they are known or have a contingency of supporters who work in flood risk management.

Therefore, the range of implementable climate change adaptation actions depends on the alignment of implementable strategies, scientific knowledge, governance processes, infrastructure lifecycles, and political and social will. Our study investigates whether the institutional structures match the spatial and time scales necessary to manage evolving flood risks. We focused on the Grenoble metropolitan area of France, where we interviewed 62 specialists who are members of an advisory committee in flood risk management. For this, we used Q-methodology paired with semi-structured interviews. The Q-method helped identify issues related to the jurisdictional mismatch in the scale of risk prevention and crisis management (Arik *et al.*, 2023). As jurisdictions are socially constructed, it makes sense that tensions related to spatial scaling would emerge from the study of perspectives. However, a temporal perspective of flood risk management did not emerge from the Q-method study. To go deeper into the temporal aspects, we conducted an exploratory analysis for this paper focusing on the interviews of seven study participants with managerial positions representing diverse perspectives, prompted by retrospective and prospective questions. We investigated how they learn from Grenoble's history of flooding and incorporate climate change knowledge into their decision-making.

2 Background and methodological notes

2.1 Setting the scene

This study was conducted in the Grenoble-Alps Metropolitan area (Grenoble-Alpes Métropole, GAM) of France, a region with a rich historical context in flood risk management. With a population just short of 450,000 (INSEE, 2022), this medium-sized metropolitan administrative entity governs an agglomeration of 49 individual municipalities. While each municipality has its own mayor and public officials, the agglomeration provides an inter-municipality governance structure to facilitate cohesion across planning efforts and public services. Notably, within the last ten years, all water-related responsibilities were transferred under the purview of GAM, and the municipalities no longer have the power to act, except for sanitation. GAM comprises a flat and densely developed valley, surrounded by less urbanised regions situated at the foothills of the surrounding mountains. Over a hundred steep torrents descend from these mountain massifs, flowing into two major rivers—the Isère and Drac Rivers, which converge in the City of Grenoble. The urbanisation of the valley was significantly influenced by the flooding regime of these merging rivers and surrounding torrents. A period of disastrous floods from 1600 to 1859 prompted major engineering efforts to curtail the flooding (Cœur, 2003). Consequently, since 1859, the valley has not experienced a major regional flood. However, the region experiences regular localised flooding, landslides, and torrential flows along the periphery, and the risk of catastrophic flooding remains a concern for the region (Creutin et al.,

2022). Alongside these flood events, the concentration of flood risk oversight and responsibility has evolved over centuries from hyper-decentralized to hyper-centralized and levels in between (Renou, Brochet and Creutin, 2020). Currently, GAM oversees most flood management and financing, but certain responsibilities are distributed across different levels of government, requiring cooperation. Table 1 provides an overview of key actors in flood risk governance in the region.

Table 1. Relevant flood risk management actors and their roles, represented on the committee for the management of aquatic environments and flood protection, CoMAPI.

Actors	**Flood Risk Governance Roles**
GAM (Grenoble Alps Metropolis)	GAM is the intercommunal government structure that governs 49 municipalities, including the City of Grenoble. Through the GEMAPI law enacted in 2018, GAM is responsible for aquatic environment management and flood prevention, particularly the smaller waterways not under the purview of SYMBHI. Through GEMAPI, GAM also collects a tax to fund these efforts and organises the CoMAPI, a committee of actors (as described in this table) who play an advisory role in aquatic environment management and flood prevention decisions.
SYMBHI (Joint Association of the Isère River Basin)	SYMBHI is the public body responsible for the planning and management of the South Isère River and Drac River basins, and it plays a key role in waterway management and flood risk prevention for the major rivers.
Regional agencies of the State	These include the water agency, the forestry agency, and the health department, among others. The health department has a prominent role in crisis management, especially for significant events.
Municipalities	Each of the 49 municipalities within GAM has an autonomous government, including a mayor and a town hall. The mayors are responsible for crisis management and coordination in the event of local flooding but do not carry direct responsibility for flood risk management.
Riparian landowners and riparian landowner unions (ASAs)	Riparian landowners are legally responsible for managing their streambanks. Historically, they transferred this role to riparian landowner unions, which collected fees and could access the stream reaches for management activities. Many of these unions have been eliminated in the region, but riparian landowners remain responsible for maintaining their streambanks.
Other stakeholders and associations	These include, for example, the electricity company (EDF) that manages hydroelectric dams in the basin and associations concerned with biodiversity or recreation.

2.2 Q-method and beyond

Studying wicked problems has multiple modes of entry and requires drawing wieldy boundaries around an inherently complex system (Holling, 2001; Hou, Li and Song, 2022). Because of the complex nature of wicked problems, mixed-methods approaches offer a means to look at multiple aspects of a problem (Mertens, 2015). Q-methodology (QM) is a mixed method increasingly used to study subjectivity related to complex issues (Dziopa and Ahern, 2011;

Zabala, Sandbrook and Mukherjee, 2018; Dieteren *et al.*, 2023). Using data reduction techniques, QM enables researchers to understand complex, multi-dimensional issues through a digestible set of perspectives. For this paper, we outline the findings of a QM study we conducted (Arik *et al.*, 2023) and how we take the study further through a thematic analysis of interviews.

2.2.1 Q-method insights reveal local-level gaps in hazard management

The Q-method uses an "inverse factor analysis" to study the associations between peoples' viewpoints rather than grouping people according to their characteristics (Stephenson, 1936, 1977). This is carried out by asking several participants ("P-set") to individually react and rank a set of stimuli ("Q-sample") relative to one another according to a semi-normal grid ("Q-sort"). Generally, the Q-sample is a set of non-provable statements pertinent to a particular subject. Principle component analysis or data reduction techniques are then used to identify similar perspectives from the Q-sorts. Several studies have mobilised QM to identify differing perspectives on flood risk governance or stormwater management (Cousins, 2017a, 2017b; Rittelmeyer, 2020; Arik, 2022; Tafel *et al.*, 2022). As a part of this study, we used QM to uncover tensions within the governance of flood risk in GAM; the full description of this part of the study is published in Arik et al. (2023). Briefly, the study included 32 statements, of which we asked participants to sort according to a semi-normal grid ranging from -5 (strongly disagree) to +5 (strongly agree). In total, we had 62 participants and collected 55 sorted sets of statements from members of CoMAPI or similarly affiliated flood risk management specialists.

Our study revealed three different perspectives (see Figure 1). The first group we identified as "Hydro-experts" tended to have a global 'point-of-view' and a specialised background in flood management. In this case, the expression 'point-of-view' can be understood verbatim as it refers to a characteristic that structures the overall perspective and flood risk management in GAM generally. The second and third groups represented participants connected to flood risk management at a local jurisdictional scale, dubbed the "Hydro-generalists" and "Hydro-operators." The Hydro-generalists were typically elected officials of periphery municipalities responsible for crisis management. They were concerned that blame would fall on the mayor for any unattended management of flooding hazards, even if stream management is not their responsibility. The Hydro-operators were local technicians who worked on everyday management issues, particularly current or formally associated professionals of an ASA, which are being phased out within the institutional space. Both of these latter groups observed a similar management gap of smaller streams under the jurisdiction of GAM caused by the administrative complexification of access to private land in cases where private landowners are not maintaining streambanks on their property.

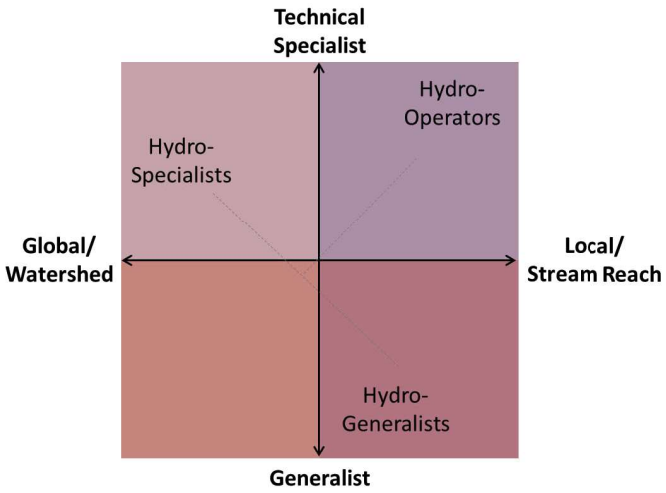

Figure 1. Orthogonal characteristics of the three perspectives identified through the Q-method. The hydro-specialist perspective of flood risk management is that of a technical specialist with a global or watershed view, the hydro-operator perspective is also that of a technical specialist but with a more stream-level view, and the hydro-generalist perspective is a generalist with an on-the-ground point-of-view.

While QM does not determine the percentages of a sample population that ascribe to a particular viewpoint, we found it striking in our analysis that a great majority of participants correlated with the Hydro-expert perspective. Our findings, therefore, revealed a large unity among the flood risk management actors of the region. However, we also noted differences in ideas between the Hydro-experts and the latter two groups, which represents friction along the 'fringe' of the body of CoMAPI actors. This raises a question of the right balance between the scale of governance and the orchestration of roles and responsibilities within an integrated flood risk management architecture under GAM. The separation of these groups reflects real or perceived insufficiency of measures in the institutional arrangement to address management issues affecting local municipalities. Efficiencies might be found at the jurisdictional scale of GAM in terms of watershed management, harmonisation in planning, and strategic investments in projects and infrastructure. However, these efficiencies need not come at the cost of incorporating issues that arise in a local context and likely require better institutional mechanisms to connect management scales from the bottom up.

2.2.2 Going deeper through interviews

While the QM study revealed friction related to the jurisdictional mismatch in the scale of roles and responsibilities between actors in charge of flood risk management and crisis management, it revealed little about the temporal aspect. To explore this further, we conducted a thematic analysis of semi-structured interviews. For this qualitative analysis, we first identified participants with current or former decision-making or policy-influencing roles in flood risk management at the scale of GAM or the greater watershed (ca. 20, based on their titles and our knowledge of their roles). Since many participants fit this profile, we used the principal

component correlations to select a more manageable sample of seven participants representing a range of views, including five representing the Hydro-experts (out of 44) and one each from the Hydro-operators and Hydro-generalists (out of 3, respectively). Specifically, we visualised the correlation values of the first six principal components (PCs) using Chernoff faces (Chernoff, 1973; Wolf, 2019), which captured 82% of the explained variance. From the facial plots, we selected a sample of participants aimed to capture a wide range of views based on their 'facial characteristics.' We explain the Chernoff faces and our selection more in Appendix A.

During the interviews, we asked a range of questions relating to the QM study statements, the participant's experience with floods and risk management, the impacts of climate change, and the evolution and needs in risk management. For this paper, we were particularly interested in the following questions asked of interviewees:

- What are your sources of information about climate change and its impacts? Do you take climate change into account in your flood management-related work? In what way(s)?
- Have your views of flood management evolved [during your career]? Do you think flood management practices, in general, have evolved [particularly in what you have witnessed during your career]?
- What do you believe is necessary to bring all the different actors within GAM to the table to work together on flood risk management? Or do you see obstacles in what already exists?

Note that the interviews were conducted in French, and relevant material was translated for this paper. The interviewees for the thematic analysis included a director associated with GAM, a president of a biodiversity association, a city resiliency leader, a mayor and a vice mayor of different municipalities, an environmental service lead for a State agency, and a former president of an ASA. All of the interviewees were well-experienced and represented a diversity of backgrounds.

3 (A)synchronicity in the temporal outlook on flood risk management

While the Q-method allowed us to identify misalignment in the jurisdictional scaling of flood risk management and crisis management, the interviews gave us insight into the misalignment of temporal aspects of management. Several aspects of temporality were revealed through the interviews, with most interviewees thinking multi-decades into the past and future to describe how that affects their daily functions or the set of flood risk management problems to tackle.

3.1 Policy myopia: A problem too abstract

Not surprisingly, climate change was well-accepted as a critical problem in flood risk management. However, no one admitted climate change was well-mobilised in flood risk management. However, some pointed to efforts, especially personal, toward learning and integrating climate change knowledge in their work. For example, this interviewee talks about the inability to take into account potential climate change impacts because of current regulations:

> [Climate change is] on the radar, and every time we work, we say "yes!" But we don't know [how to include it in our work] because the regulations don't necessarily include it...In concrete terms, the sizing of projects is based on [the flood risk prevention plan]. So even if we're worried […the project] may be undersized […], in reality, we give authorisation based on regulations that don't necessarily take [climate change] into account. – *city resilience program leader*

Similarly, another interviewee references a comparable lack of regulation and guidelines, and adds what they are doing personally to understand the subject better:

> [About the basin's master plan for water development and management] there are about ten pages of broad principles, but there's nothing else: No instructions from any ministry on the subject. No technical notes. No regulatory reflection. So, professionally speaking, apart from a few technical days organised by the Rivière Rhône-Alpes Auvergne Association or things like that, there's nothing. Then, from a personal point of view, I seek information myself. I'm thinking about taking on a trainee or a part-time employee to set up a method to suggest modelling [based on IPCC projections] without necessarily imposing it on project managers. – *state agency head of environmental services*

Nair and Howlett (2017) aptly refer to the concept of 'policy myopia,' where long-term uncertainty is not adequately incorporated because short-term certainty is better known and understood. This myopia may contribute to or reinforce the institutional and cultural inertia that upholds the status quo, even when flood risk managers see the importance of taking a longer-term view.

Reflecting on the past was, in some ways, easier for interviewees because of lived and learned experiences. One interviewee suggested that experiencing or seeing major climate change-related flood disasters has served to increase awareness and can change perceptions strategies needed for better flood risk management:

> Our colleagues in planning today are much more aware than they were 10 years ago […] At one point, the departments, or rather the various players, were somewhat in denial about the risk. I also think well-known tragic events may have changed their perception, like [Cyclone] Xynthia and what happened in Germany last year [2021]. – *metropolitan director of environment and public services*

The same interviewee also pointed out that an ironic barrier to improved flood risk management in GAM is the lack of recent disastrous flood events. Similar to the concept of the 'dike paradox' (Vinet, 2008; Haer *et al.*, 2020)—an expression capturing the irony of flood protection infrastructure encouraging development in flood-prone areas—the interviewee suggests a lack of historical memory of flooding leads to a sense of security, creating an absence of risk culture:

> You might find it strange, but I think the biggest obstacle we have, locally, is that the last [major] flood was in 1859, which is not on the scale of human memory. When there are recurrent floods, the knowledge of the risk is maintained, and no one questions the

> wisdom of taking any measures...people don't realise that rivers can be devastating here. – *metropolitan director of environment and public services*

These ideas suggest that even with technical knowledge of climate change impacts or historic flooding, a long-term view can become too abstract without proper support structures or mechanisms to incorporate this knowledge. In other words, technical and scientific knowledge of long-term flood risks will likely be underutilised when it exists within social, political, and institutional structures that favour the certainty of a short-term view. Some interviewees alluded to elected officials either helping or hindering climate change adaptation, however, there was a sense that the lack of ability to mobilise adaptation strategies was beyond their control.

3.2 Systems Inertia: A (frustratingly) slow evolution toward (hopefully) better

The interviewees' outlook often reflected expressed or muted emotions when recognising their professional role within a larger system beyond their control. On one hand, they found it frustrating when they perceived inaction or slow change. On the other hand, most could also identify positive outcomes that gave them a certain level of hope, which seemingly motivates their continued work:

> It's complicated [and slow]. But we're getting there. Well, [more like] we're going. When you see the people who work on floods in local authorities, syndicates, etc., there are many young, super-trained, super-savvy people […] Among the technical-administrative intermediaries, I find that the overall level is super good with really committed people who believe in [climate resilience] and think transversally, horizontally. However, action takes time because [there is] a heritage, an inertia. But, yes, it's changing in the right direction. – *city resilience program leader*

In this sense, as with the concept of path dependency, a long, sometimes invisible, history can have a huge impact on the current possible trajectories. Like the law of physics, Mahoney (2000) describes social inertia as processes that are set into motion towards a particular outcome that stay in motion and continue to track that outcome. Many processes embedded within social-infrastructural systems add to inertia, thus creating a perception of slow and incremental change and tension in the aspects of time incongruency. On the one hand, there is a stagnant viscosity to the reality, while on the other, there is an accelerating desire for change.

3.2.1 Technical limitations to adaptation: Do what can be done, where it can be done

Several case studies explore the concept of inertia as an impediment to climate adaptation action. One common finding is the persistence of traditional engineered approaches in institutional cultures and development regimes of territories (Harries and Penning-Rowsell, 2011; Meng *et al.*, 2022; Robert, Quercy and Schleyer-Lindenmann, 2023). In GAM, there was a similar sentiment expressed by some interviewees that the urban fabric cannot easily accommodate changes:

> The problem we're facing isn't that we don't know what needs to be done; it's that we're intervening in a city that's already built up, and the main problem is that the rivers have been corseted; they don't have enough space. Now we have to make do, or more that it's

> complicated to give them more room to roam. The Isère Amont [upstream restoration project] is typically about giving space back to the river. Although the structures are very man-made, they still reflect the idea that you have to let the water spread out so that it doesn't cause as much damage downstream. – *metropolitan director of environment and public services*

Another technical obstacle that slows progress relates to the sheer magnitude of expenditures needed for even minor adjustments to water or wastewater infrastructure networks. These infrastructure assets have a value on the order of magnitude of multi-billion euros and have been built over centuries. Therefore, as one interviewee explains, spending €10 million a year on water or wastewater infrastructure improvements touches only about 1% of the infrastructure. Thus, climate resiliency actions—as interpreted by several interviewees—need to include efforts to 'live with flooding' or reduce its destructive capability when there is an event. For example, ensuring that ground-level floors are floodable in exposed areas. Additionally, elevating less 'fixed' infrastructure, such as telecom equipment and cables, can help reduce vulnerability.

Many interviewees referred to the problem of surface artificialisation adding to the flood risk. There was a widespread agreement that "pouring concrete" needs to stop, and the cities need to de-artificialise or re-permeabilise developed areas. Several interviewees connected the idea to concepts of being "more ecological" or "green." Specifically, one interviewee had a tightly integrated view of managing climate and biodiversity. In urban areas, creating greater opportunities for biodiversity while improving climate resilience:

> We're working with our partners to integrate biodiversity; to create a city where nature is part of the design, such as de-impermeabilising (sic) and buildings with native plant garden programs to make them better adapted to climate change. – *local chapter president of a national environmental protection association*

As this same interviewee pointed out, climate change impacts also create technical limitations in managing mountain spaces for either flood risk management or biodiversity. For example, climate change impacts in the mountains, including changing snow altitude, changes in snowfall timing, increased fire impacts, and higher temperatures, are already putting certain species at risk and impacting flood risk. However, no further mitigation can be done at some point, whether it is species loss or hydrological changes.

3.2.2 Institutional stagnation: Bureaucratic delay and knowledge loss

Across the board, interviewees expressed a general 'slowness' in implementing flood risk management projects or strategies, with one interviewee alluding to a tanker needing to turn. Often, scales referenced in terms of waiting to 'get something done' are on the order of decades. This institutional slowness was rightfully a source of frustration for the interviewees. While it is undeniable that institutions are incorporating climate resilient flood risk management practices at a slower rate than managers would like to see and the rapid pace of climate change. However, what is unclear from the interview discussion is how much of the slowness is a tactic to either kill a project or avoid public or political scrutiny. Some interviewees directly pointed to a "political blockage" to implementing projects or better strategies:

> Something that might work on the technical side can be completely swept away because the two elected representatives are tense. We [on the technical side] don't feel it too much because we're dealing with a subject that's quite well agreed upon […] In a lot of departments, sometimes they've worked for six months setting up a project and then at the last minute, it's scratched. When it comes to collaboration […] the political issues must be ironed out. – *city resilience program leader*

In another example, an interviewee recounted a sediment removal project with the State and indicated being dismissed when they suggested that the amount of sediment removed was insufficient for getting ahead of a problem:

> It's annoying because we don't go any further than the existing problem. In other words, we're not going to solve the problem. We're going to wait and see. – *former president of an ASA*

Regarding collaboration on flood risk management, CoMAPI is supposed to serve that role for GAM, with GAM as the coordinator. However, several interviewees expressed dissatisfaction with the role that CoMAPI plays, suggesting that its role is somewhat ineffective in consulting, knowledge mobilisation, and collaboration. For example, this interviewee specifically talks about the CoMAPI meetings:

> I get the impression that the meetings are much more focused on sharing information than consulting actors. What is lacking and what, in my opinion, is difficult to implement are real consultation committees between the various parties responsible, i.e., the municipalities, GAM, and the State. – *former president of an ASA*

An issue that seemed to be circulating among several interviewees with more local roles, and similar to what we found in the QM study, was the idea that GAM is not organising well with the municipalities to incorporate on-the-ground realities into their flood risk management responses:

> For me, GAM needs to step up and better involve the municipalities. Because [municipalities are] the first point of contact locally. Also, everything passes through a municipality, local knowledge and so on. – *mayor of a municipality*

Another interviewee elaborates on the history of this relating to the transfer of responsibilities from the ASAs to GAM, resulting in a loss of information and confusion about roles and responsibilities:

> Flood protection disappeared when the responsibility was transferred to [GAM…] For a long time, people thought [GAM] would [maintain the streams and torrents]. Whereas that is not the case […] As a result, the owners no longer know where they stand when there's a problem or who they should call. There's a loss of communication, a loss of information. Yes, a very significant loss of information because I sincerely believe that homeowners no longer know who's looking after what. – *former president of an ASA*

While CoMAPI offers an important structure for collaboration, there seem to be aspects that could be improved to address these issues raised. However, the question is, at what cost? This interviewee aptly describes the reality that effective collaboration requires time, and time is costly:

> When [collaboration] works, you can't see it, but it takes up a huge amount of time. Organisations don't think about coordination time. For me, it's more of a global thing: If we want people to work together, we need to make it something we can quantify and pay for. – *city resilience program leader*

On the one hand, the frustration over the slow pace of implementing projects and acting toward climate-resilient strategies was palpable among the interviewees. There was an across-the-board agreement that better collaboration is needed (partly prompted by an interview question), especially to have more holistic management of flood risk and to mobilise on-the-ground knowledge. However, the time outlays of such solutions are rarely considered. In other words, effective collaboration also requires a significant investment of time (Renou *et al.*, 2024), and although it might lead to better management outcomes and is needed to address certain issues, spending more time on collaboration would be unlikely to assuage the perceptions and criticisms about slow implementation.

3.2.3 The movement of ideas: Optimism in turnover

While thinking about present-day obstacles might have prompted a sense of frustration for the interviewees, asking them to reflect on the changes they have seen during their careers tended to expose an optimism in the ability to actually enact some of the changes that they would like to see toward climate resilience and better connecting flood risk management to environmental management.

> From what I've seen, there's been a generational shift. With the 'resilience label'—which you can criticise—I saw a shift from those who said, "We'll be able to prevent it" to those who said, "In fact, it's going to happen." And that, for me, really changed the perspective and the way we acted. – *city resilience program leader*

However, from the experiences recounted, there seem to be many layers of interconnected processes, some of which have changed and others which have not. The above quote refers many to ideational shifts, which they then describe as "percolating slowly" into how flood risk management is handled even though the generational shift was "noticeable." This was similar to another interviewee:

> We have a rich history in the Isère, but a lot has changed in 10 years. However, my perception of the issues and my technical perception have changed relatively little. In other words, I'm convinced we must include as much [environmental management] as possible in our policies. – *state agency head of environmental services*

Even those who are impressed by the changes (generally, the younger interviewees) admit that much of the technical knowledge has remained the same for the last 20-30 years. The

descriptions indicate the significant role that political and social values play in flood risk management, even when it is viewed as a technocratic exercise.

However, not all changes within the evolution of flood risk management were viewed as positive. For example, one interviewee talks about some of the changes and events they've witnessed during their career as clearly climate change-related. At the same time, at other times, they have been unconvinced about whether an event was linked to climate change or lack of maintenance. They give a specific example of when they were younger, there were road maintenance workers; now, they do not exist, and they see that the drainage backs up quickly leading to flooding. These issues relate to the previous section, the loss of information, and the lack of a mechanism to mobilise on-the-ground issues to the level of GAM. While the evolution that most interviewees referenced relates to institutionalising widely accepted concepts, such as holistic and integrated management, it is important to realise that this change in the institutional structure has also led to the loss of other institutional structures that served a critical function.

4 Conclusion

In this paper, we investigated the spatiotemporal aspects of flood risk governance to understand the alignment (or misalignment) of spatial and time scales needed to continue to manage evolving flood risks. Our study took place in the Grenoble metropolitan area of France, where we explored how flood risk managers considered spatial and temporal scales in their work missions. The investigation was conducted in two parts. The first uncovered scaling issues using the Q-method, which helped identify tensions related to scaling management actions and jurisdictional boundaries. Overall, this highlighted the need for better knowledge mobilisation between actors at the local and watershed level, and better distribution of roles between risk management and crisis management. A deeper exploration via seven interviews of policy influencers of diverse backgrounds highlighted some of the ways in which temporality comes into play (or not) in flood risk management. Our analysis suggests a misalignment between policy actions and long-term objectives. This misalignment is exacerbated by myopic policy decisions, which favour short-term certainty even if technical solutions are known. The study also highlighted the persistent issue of systems inertia, where technical limitations, slow institutional responses, and ideational stagnation often impede progress towards more climate-resilient flood risk management. Despite these challenges, the interviewees were generally hopeful for the future as they recounted changes seen during their careers with shifts in thinking and adopting new approaches.

Drawing lessons from the findings, there is a subtle recognition of the importance of investing in the less tangible aspects of flood risk management such as relationships and knowledge mobilisation, instead of solely focusing on material or institutional structures. Often, seeking an alignment of spatial aspects in flood risk management can dominate the dialogue when the alignment of temporal aspects is also critical, even though aspects of time add more uncertainty to already challenging management issues. This raises the crucial question of how 'time' can be integrated as a more common factor in the collective retrospective and prospective views of flood risk management as an approach to better adapting to wicked problems.

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Appendix A

As a visual aid for selecting the seven participants for this study, we used a plot of Chernoff faces. Figure A1 shows the facial outputs according to the first six PCs and the seven selected participants. Chernoff's faces are a method to visualise multivariate data in a form that is more relatable for the human mind than graphical plots and can be used as an aid in discrimination analysis, for example. Chernoff faces use the PC correlation values to modify facial characteristics. For example, we associated PC1 with head shape, meaning Q-sorts with the highest PC1 correlation values show larger, blockier faces. Meanwhile, low correlation values show smaller, rounder faces. Using Chernoff faces to visualise the Q-sort data provided us with a more objective way to select interviews for this exploratory study rather than selecting based on our prior interactions or connections to the participants. For example, of the participants that

fit the profile, we tried to ensure that there was a range of nose sizes to capture the range of views comprising PC5.

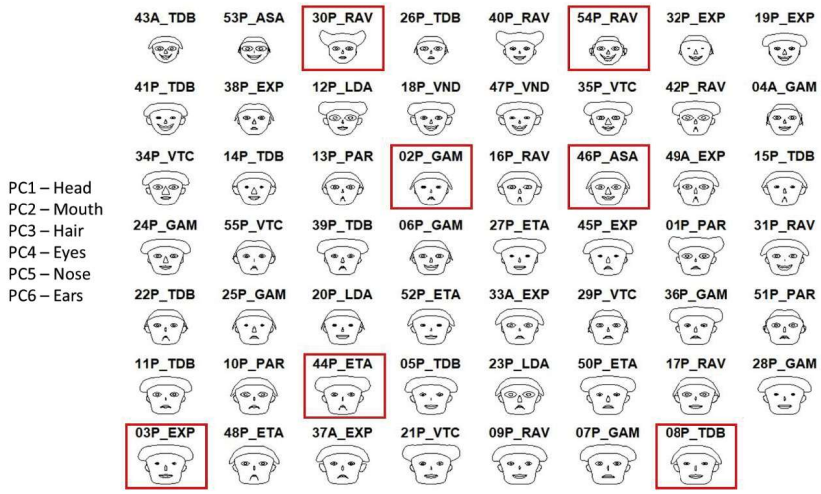

Figure A1. Mapping of Chernoff faces based on the correlation values to the first six principle components. For this paper, faces highlighted are participants selected to investigate the temporal aspect of flood risk management.