BRINGING SCIENCES TOGETHER TO INFORM DECISION-MAKERS: THE CASE OF QUEBEC FLOODS

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Resilient Cities 2019,
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Consortium on Regional Climatology and Adaptation to Climate Change

OUR ORGANIZATION

- Non profit, based in Montreal, created by members in 2002
- Facilitates innovation through needs-based collaborative research, connected to decision-makers (policies, planning, operations)
- A critical mass of experts and practicioners developing and coordinating interdisciplinary, applied R&D that meets user needs
  - Budget: $7M to $10M + partner leverage
  - Employees: ≈50
  - # projects in progress ≈ 100
  - # network: 500+ partners
- Two majors programs:
  1. A Climate Science program dedicated to producing different climate scenarios and climate modelling at the regional scale
  2. A multi-disciplinary and multi-institutional Vulnerabilities, Impacts and Adaptation program

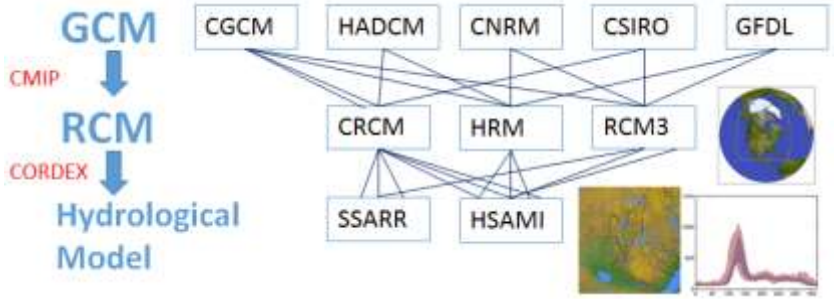
Regular members

Affiliated members

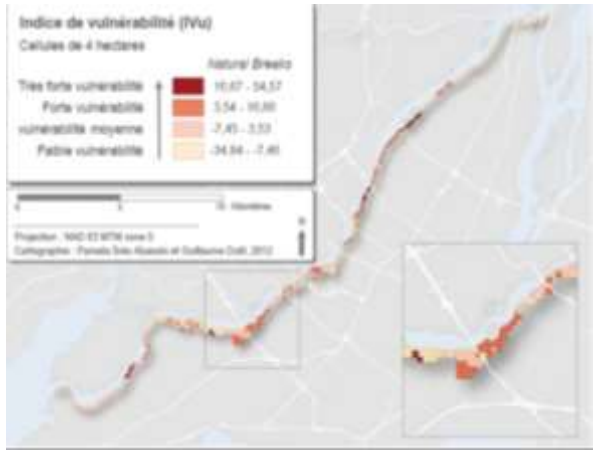
EXEMPLE OF OUR WORK

Climate science ⟷ **Decision making**

Regional scale climate + hydro ensembles



FLOOD VULNERABILITY INDEX



Thomas et al. 2012

PARTICIPATORY APPROACHES

NEW FLOODPAIN MAPPING METHODS

Biron et al. 2013

COST BENEFITS ANALYSIS

Da silva et al. 2015

2017 FLOODING EVENT

291 municipalities impacted

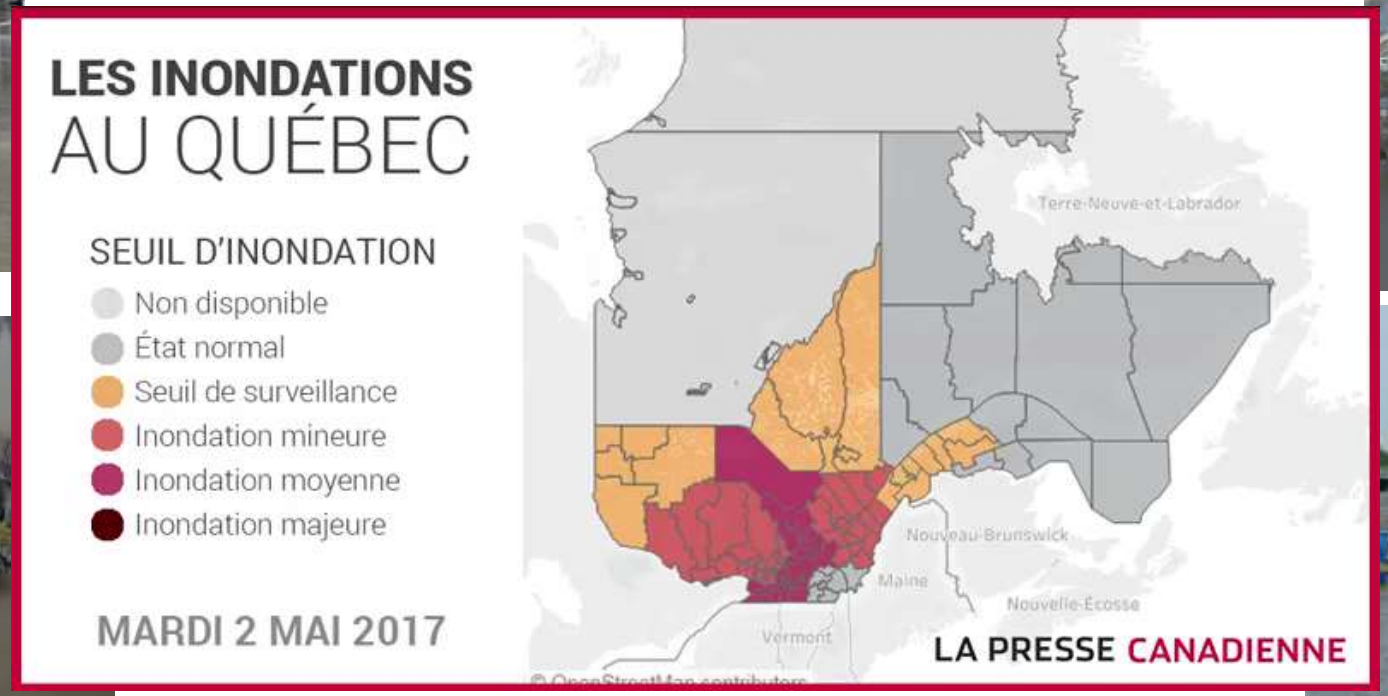
~ 2 600 soldiers were deployed

4 000 evacuees

0 direct fatalities

5 300 flooded homes

180 landslides reported

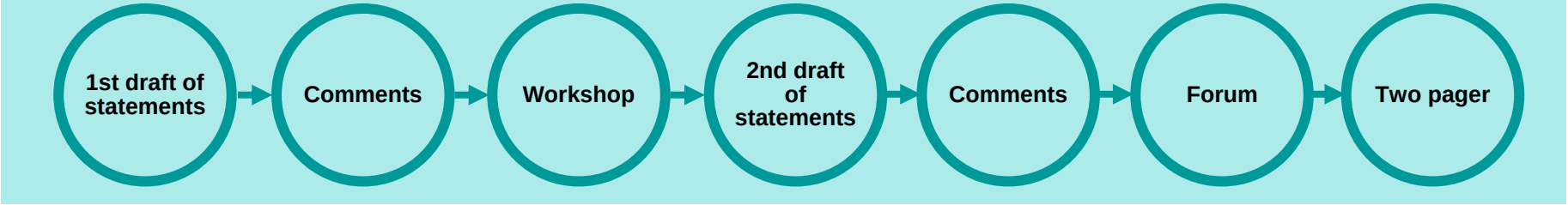


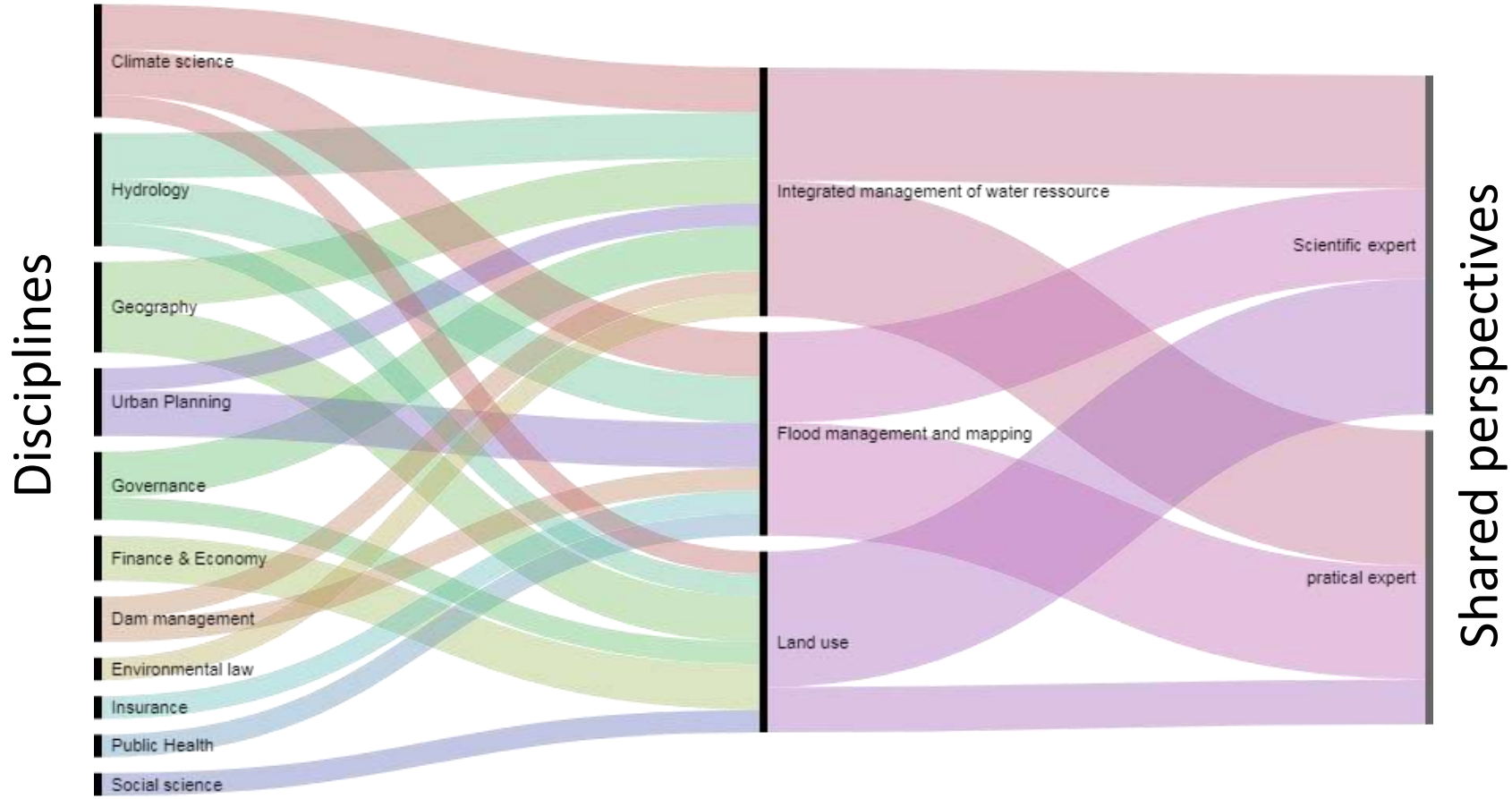
22 municipalites and **1** metropolitain area declared a state of emergency

Extensive real-time media coverage

~ 367 M$ estimated in direct government compensation

A COLLABORATIVE APPROACH





A TANGIBLE OUTCOME: 2 PAGES SYNTHESIS

OURANOS ADVISORY SHEET ON A TARGET TOPIC

FLOODING IN THE CONTEXT OF CLIMATE CHANGE

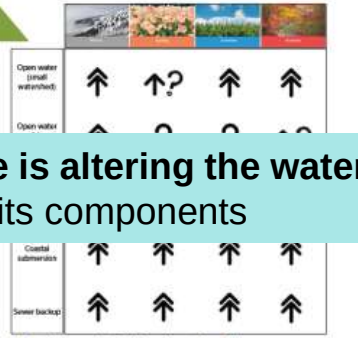
Flooding is a recurring phenomenon for the province and is the main hazard that causes **social, environmental and economic impacts whose costs and consequences are borne by the State and society. Québec has a history of extreme hydrological events** (Saguenay 1996, Châteauguay 1998, Rivière-au-Renard 2007, Richelieu 2011, province of Québec spring 2017) **which illustrates the vulnerability of the territory and of Québec society.** The average costs associated with flooding were in the order of $70 M/year (in 2012 dollars) for the period 1991-2013, but extreme events, such as the Saguenay in 1996 and the Richelieu in 2011, raised the bill to more than $189 M (in 2012 dollars) [13]. These events provided a better understanding of flood episodes and their consequences, from which lessons could be drawn for better risk management. However, in the context of climate change, territorial development and socio-economic transformation, the flood risks are likely to change. This requires a better understanding of flooding and its consequences and a renewal of risk prevention approaches to support a resilient society and territory.

Source: MEDD

Given that **disaster risk is a function of hazard, exposure and vulnerability** [10], any understanding of flood risk in the context of climate change must consider the evolution of all three factors in order to better prevent and manage risk.

UNDERSTANDING FLOOD HAZARD

Flooding is a highly variable phenomenon, with or without climate change, and hydrological extremes are a reality in Québec. The fact remains that climate change is altering the water cycle by disrupting several of its components [5, 17].



Main trends forecast for flood hazard in southern Québec

Source: Ouranos (Forum inondations 2017, MDDELCC). The symbol "?" indicates an uncertain trend. Several of these phenomena are complex and do not apply equally to all waterways. The Hydroclimatic Atlas of Québec provides information for 350 waterways.

To reduce the intensity and recurrence of the hazard, it is necessary to reduce greenhouse gas emissions. Adaptation will allow a reduction or management of residual impacts of inevitable changes or those who have already begun.

REDUCING VULNERABILITY AND EXPOSURE

flooding. This integration must take place between administrative levels and between the different actors involved in flood risk management. In addition, **flood management planning must begin at the watershed level in order to align the policy space with the physical processes at work.** [7, 8, 11].

The fact remains that **climate change is altering the water cycle** by disrupting several of its components

While flood preparedness is critical, such as the use of **warning systems**, which allow for better decision making, impact reduction and the coordination of actions…

Furthermore, citizen involvement is necessary because it provides a better local understanding of risk and promotes the identification and implementation of sustainable, acceptable solutions [1, 11, 12, 24]. Given the number and diversity of actors and levels involved, and **to ensure the proper integration of flood risk management**, there is a need for **a decisional framework that clearly defines the coordination between actors, uses and levels when it comes to prevention and intervention** [4, 11, 15]. In addition, a **plan for risk-sharing** (economic, health, social, environmental, etc.) **would provide a means of**

Flood risk mapping is a crucial means of illustrating risk, offering a tool for awareness-raising and land-use planning and support for decision-making and action…

to use. **It is important that these maps share a common language, in addition to providing consistent and comparable results, to avoid confusion and facilitate decision-making** [15, 18]. **Furthermore, risk mapping should be dynamic in order to take into account the evolution of risk over time, especially in the context of climate change** [4, 15, 18]. **Regulatory mechanisms must be put in place and respected to ensure the implementation**

Furthermore, **risk mapping should be dynamic** in order to take into account the evolution of risk over time, especially in the **context of climate change..**

they often have the effect of amplifying flood risk [4, 13, 19]. Education is therefore needed regarding the roles and limits of protective structures (e.g. dams) to avoid creating a false sense of security. Conversely, the implementation of resilient measures that generate co-benefits for other issues helps reduce risk and avoid the need for major investment in an uncertain context, especially in already developed areas [18]. These measures include **the protection, conservation and restoration of wetlands, which contribute considerably to flood resilience** by temporarily storing flood waters and by regulating water flow [2, 9]. To foster resilient land use and avoid construction in flood-risk zones, a review of municipal funding mechanisms is desirable. An **ecofiscal approach offers an interesting alternative to current municipal tax laws for diversifying municipal revenue while encouraging adequate consideration of risk in land use planning** [6]. **In addition, the consideration of flood risk in land use policy and adaptive management mechanisms in the use of traditional land-use planning tools** (urban plan, zoning by-laws, etc.) **allows for the implementation of adaptation measures and their continual adjustment in response to new knowledge**. In all cases, legal mechanisms must support the measures implemented to better manage flood risk.

CONCLUSION AND RECOMMANDATIONS

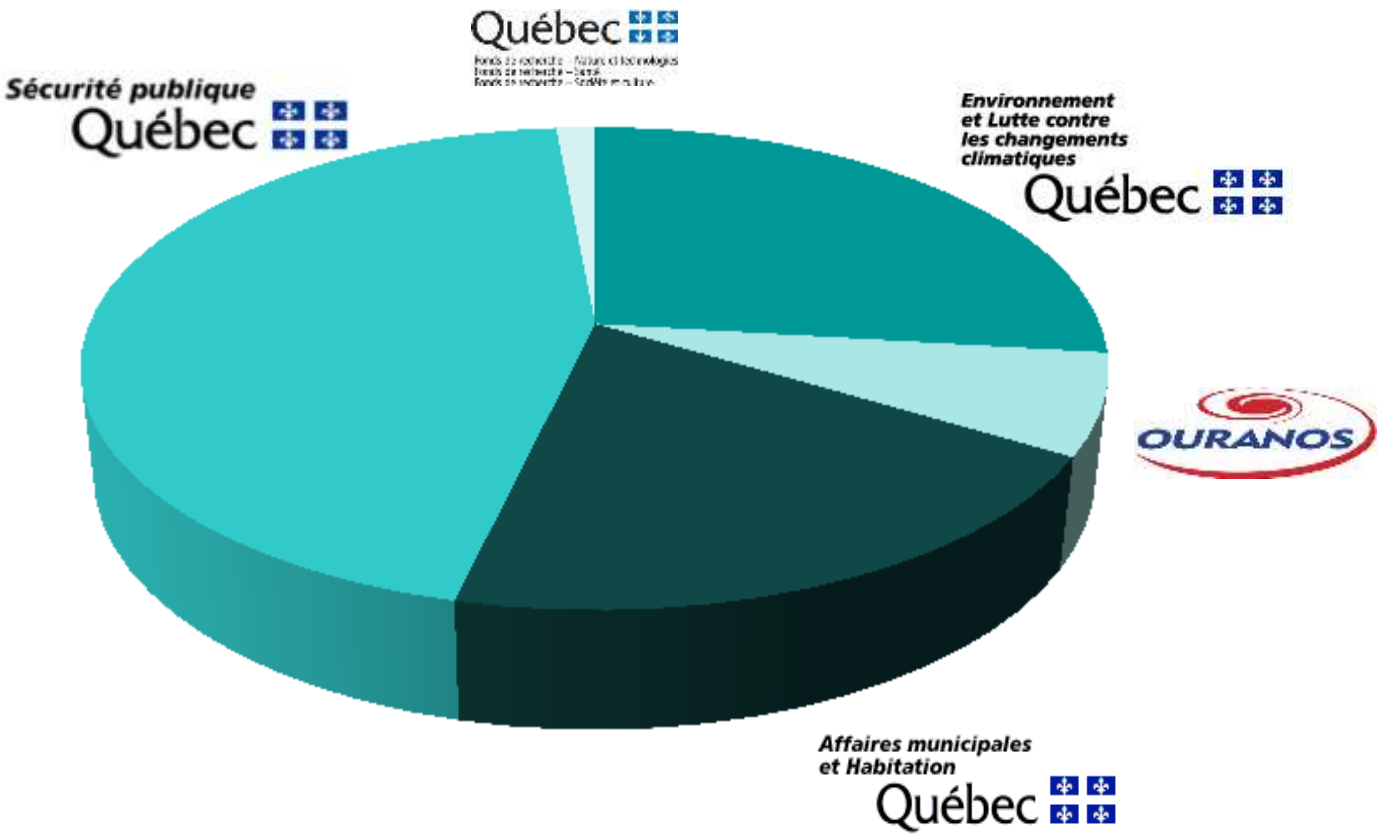
Building resistance to climate change calls for proactive adaptation. Nevertheless, the current **post-event** context **is an opportunity to take measures to reduce risk and strengthen adaptive capacity using the "Build Back Better" principle** [18, 22]. The introduction of quantified vulnerability reduction targets would help maintain this post-event momentum as well as allowing for the alignment of long-term objectives with short-term decisions. In addition, reducing vulnerability to flooding and enhancing adaptive capacity requires information sharing and mutual learning between science and practice. To that end, **the state of knowledge provides a basis for better risk assessment and will support future solution proposals and decision-making**. Given the current state of risk, it is possible to act now on the basis of this knowledge, as well as by drawing on the examples of a number of other countries affected by similar issues that have begun to develop

The creation of a research network bringing together experts from academia and practice would facilitate the sharing of knowledge, allow research to build on existing knowledge, and foster the alignment of research with the needs of the community.

This summary sheet is based on collective work by the Ouranos network of experts and on the references listed here:
https://www.ouranos.ca/publication-scientifique/Inondations-references.pdf

2017 – ACTIONS TAKEN BY QUEBEC GOVERNMENT

Additionnal Adaptation Investments



RIISQ

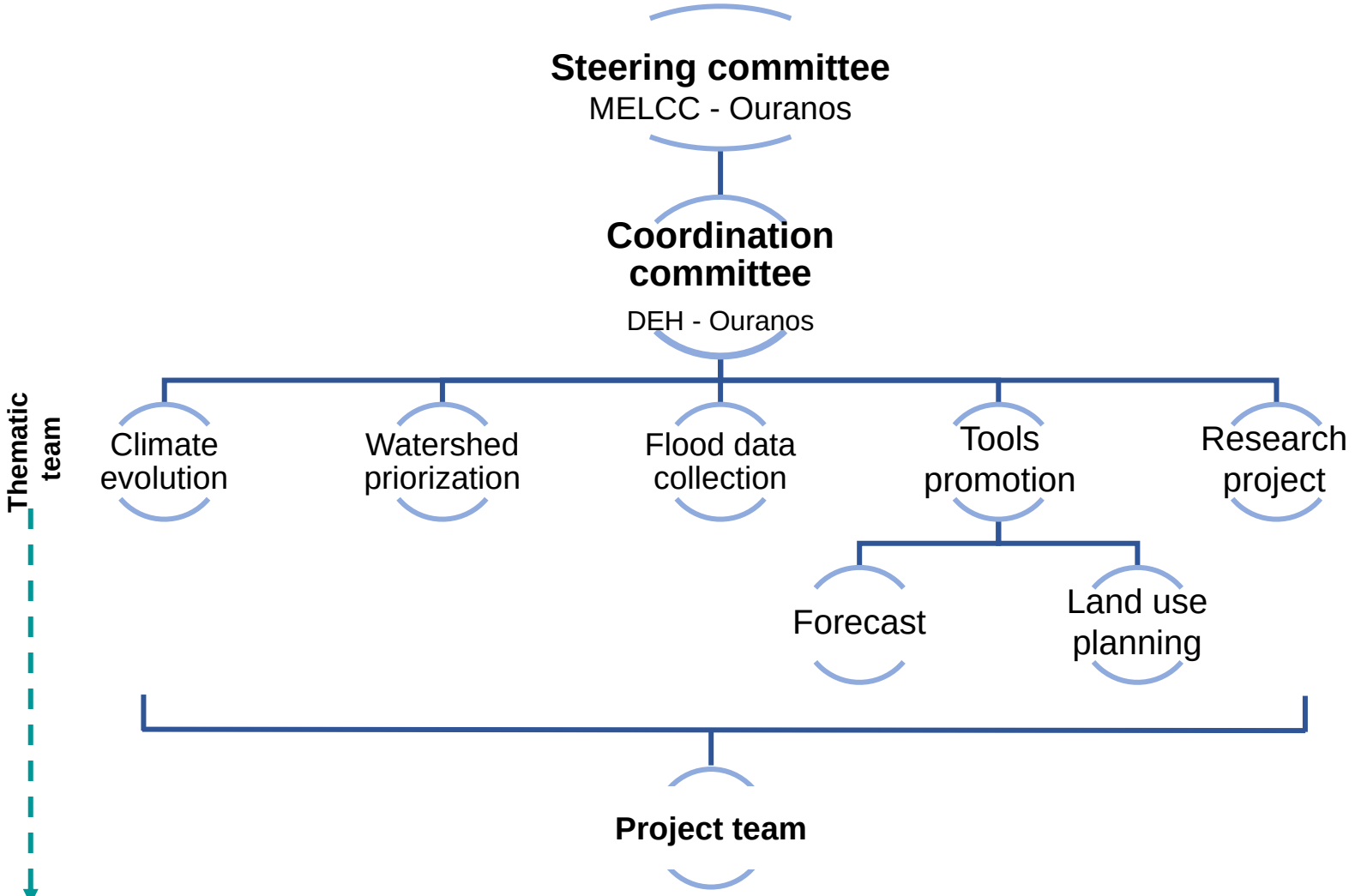
Réseau Inondations
InterSectoriel du Québec

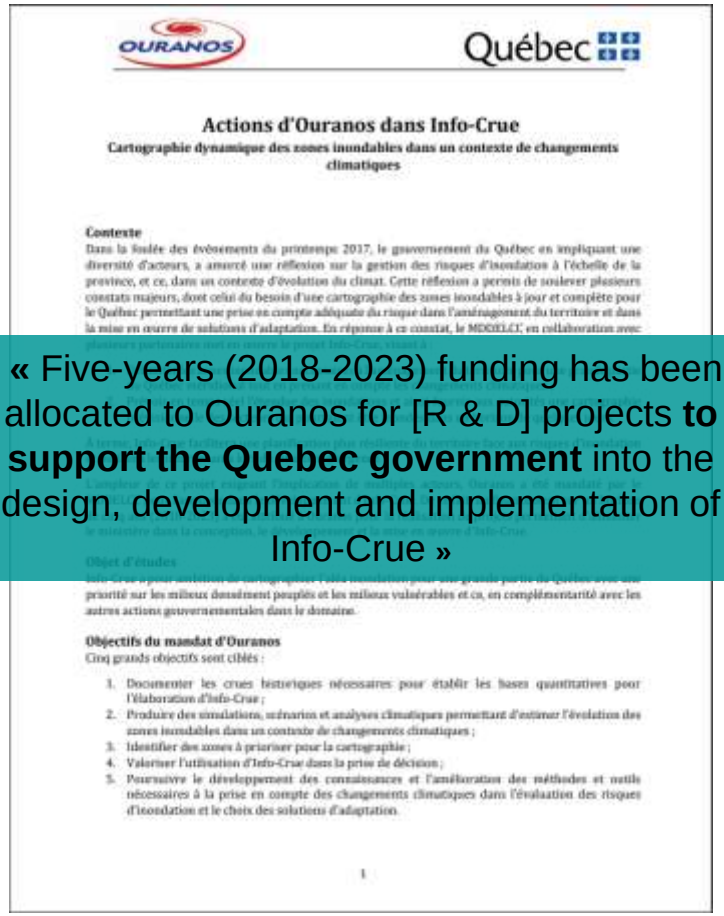
Infocrue

More than 100K$ invested

And several other initiatives

INFO-CRUE – OURANOS SUPPORT





OURANOS Québec

Actions d'Ouranos dans Info-Crue

Cartographie dynamique des zones inondables dans un contexte de changements climatiques

Contexte

Dans la foulée des événements du printemps 2017, le gouvernement du Québec en impliquant une diversité d'acteurs, a amorcé une réflexion sur la gestion des risques d'inondation à l'échelle de la province, et ce, dans un contexte d'évolution du climat. Cette réflexion a permis de soulever plusieurs constats majeurs, dont celui du besoin d'une cartographie des zones inondables à jour et complète pour le Québec permettant une prise en compte adéquate du risque dans l'aménagement du territoire et dans la mise en œuvre de solutions d'adaptation. En réponse à ce constat, le MDDELCC, en collaboration avec

Objectifs du mandat d'Ouranos

Cinq grands objectifs sont ciblés :

1. Documenter les crues historiques nécessaires pour établir les bases quantitatives pour l'élaboration d'Info-Crue ;
2. Produire des simulations, scénarios et analyses climatiques permettant d'estimer l'évolution des zones inondables dans un contexte de changements climatiques ;
3. Identifier des zones à prioriser pour la cartographie ;
4. Valoriser l'utilisation d'Info-Crue dans la prise de décision ;
5. Poursuivre le développement des connaissances et l'amélioration des méthodes et outils nécessaires à la prise en compte des changements climatiques dans l'évaluation des risques d'inondation et le choix des solutions d'adaptation.

1

« Five-years (2018-2023) funding has been allocated to Ouranos for [R & D] projects **to support the Quebec government** into the design, development and implementation of Info-Crue »

Environnement et Lutte contre les changements climatiques Québec · Sécurité publique Québec · Santé et Services sociaux Québec · Affaires municipales et Habitation Québec · Transports Québec · Forêts, Faune et Parcs Québec · Agriculture, Pêcheries et Alimentation Québec · Institut national de santé publique Québec · ROBVQ · Rio Tinto Alcan · Hydro Québec

SUCCESSES AND CHALLENGES

Successes

- Unusual open dialogue on flood risk managment
- Better collaboration between ministries
- Better collaboration between research disciplines
- Funding/Responsability for updated flood risk mapping
- Funding/Responsability for flood risk managment actions
- Funding for multidisciplinary flood risk research
- Improving state of knowledge and communication on flood risk managment
- Credible possibility to sustain those successes in next 3-5 years

Ongoing Challenges

- Maintening a global portrait of all the initiatives
- Maintaining the collaboration between experts, and with users
- Ensuring knowledge development focussed on the needs of communities and policies
- Coordination of various actions to ensure complementarity
- Use lessons learned to act pro-activaly for other risks/impacts instead of reactive adaptation
- Finding/Keeping a role for a boundary organization through all of those initiatives (perceptions of actors…)
- Changing traditional methods of flood governance, land-use planning, and « science – adaptation » connection
- Dealing with uncertainties
- « Detection/attribution » of the added value of Ouranos

2019…

Radio-Canada, 2019

Journal de Montréal, 2019

www.ouranos.ca

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