



**Regions4**

Sustainable Development



**REGIONSADAPT**

# 2018 Brief Report

## Multi-Level Governance in Climate Change Adaptation



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# Foreword



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Québec takes great pride in participating in RegionsAdapt and sharing the climate change adaptation actions it is undertaking with all the federated states involved in this initiative. RegionsAdapt brings together driving forces—governments that have chosen to adopt concrete measures because they are convinced that wise and early action is the best option.

In reading this report, you will have the opportunity to note that many of us are better equipping our societies to adapt to the major upheavals resulting from climate change. However, we still have much to learn when it comes to making our living environments more resilient to climate change, and there is an urgent need to share promising and structuring initiatives.

The time when the impacts of climate change might have seemed vague, distant and intangible is long past. The world is changing before our eyes at record speed. The 1.5 °C Special Report by the Intergovernmental Panel on Climate Change (IPCC) aptly demonstrates this point.

Adapting our communities and living environments to the impacts of climate change is no longer a choice: It is a necessity. Like many parts of the world, Québec's climate is changing, and our communities are clearly experiencing the repercussions of this phenomenon.

Our shorelines are rapidly eroding. Severe storm episodes are battering Québec's coastal regions, causing heavy damage to our infrastructure. Floods are more frequent. In spring 2017, major flooding forced thousands of citizens to evacuate their homes. Moreover, in the summer of 2018, temperatures in southern Québec reached an intensity unparalleled in over 150 years of observation. We now know that these painful and costly events are but harbingers of what awaits us in the coming decades.

Fortunately, Québec is taking action in a broad range of areas of intervention to find practical, innovative and modern solutions to meet the challenge of adaptation.

Creating in 2001, Ouranos, the Consortium on Regional Climatology and Adaptation to Climate Change, has contributed significantly to the advancement of knowledge on climate science and adaptation. Largely thanks to Ouranos, we have increasingly precise knowledge about future climate and we are now able to better estimate our vulnerabilities and the impacts of climate change on our living environments. We are therefore in a position to make informed decisions and assess the effectiveness of the adaptation measures to implement.

The Government Strategy for Climate Change Adaptation will guide the Québec government's actions in this regard between now and 2020. This strategy and the 2013-2020 Climate Change Action Plan provide for concrete actions, such as mitigating the impacts of coastal erosion, improving urban planning, reducing heat islands in cities, improving agricultural and forestry practices, monitoring biodiversity, and improving water management. As a result, Québec is becoming increasingly better prepared to adapt to the consequences of climate change that pose a major threat to our quality of life and to that of our children.

This year, Québec also launched the Climate Municipalities Program, which supports municipal organizations in implementing innovative pilot projects, including those focusing on adaptation. The program is also intended to strengthen social innovation through solutions based on collaboration among local stakeholders and to facilitate the emergence of practical and replicable solutions aimed at spawning a movement across Québec's regions.

An online interactive Atlas of the Vulnerability of the Québec Population to Climate Hazards allows Quebecers to gain an understanding of the Québec population's geographic vulnerability to heatwaves and floods. Investments will be used to update flood zone mapping in the context of climate change and to carry out studies regarding the effects of climate change on flooding risks and the safe operation of public and municipal dams.

Québec has thus achieved a number of significant outcomes in terms of adaptation. Sharing them with our partner colleagues in subnational governments and drawing lessons from their experiences is an extremely gratifying endeavour that stimulates innovation and sparks ambition.

The practices presented in this report are indeed inspiring, but they above all demonstrate that adapting to climate change contributes to the well-being of communities throughout the world.

Therefore, I encourage you to take inspiration from the wealth of experiences, progress and accomplishments of the federated states that are members of RegionsAdapt. I like to think that the initiatives described in this report will motivate thousands of cities, federated states, regions, and countries to implement them in their own territories as well. It's a win-win for us all!



Image 1. Forest blur background Credits: Shutterstock.com

# Members

Table 1. RegionsAdapt members who reported through CDP's platform in 2018

| Regional Government (Country)            | Head of Government                               | Land (km <sup>2</sup> ) | Population |
|--|--|-------------------------|------------|
| Ahafo (Ghana)                            | President Nana Addo Dankwa Akuffo Addo           | 80.008,95               | 484.210    |
| Alberta (Canada)                         | Premier Rachel Notley                            | 661.848                 | 3.702.578  |
| Australian Capital Territory (Australia) | Chief Minister Andrew Barr                       | 2.358                   | 350.000    |
| Auvergne Rhone Alpes (France)            | President Laurent Wauquiez                       | 70000                   | 7940000    |
| Azuay (Ecuador)                          | Prefect Paúl Carrasco Carpio                     | 8.310                   | 712.127    |
| Basque Country (Spain)                   | Governor Iñigo Urkullu                           | 7.235                   | 2.1690.38  |
| British Columbia (Canada)                | Premier Honourable John Horgan                   | 944.735                 | 4.465.924  |
| Brittany (France)                        | President Loïg Chesnais-Girard                   | 27.208                  | 3.195.000  |
| California (USA)                         | Governor Edmund G. Brown Jr.                     | 423.970                 | 37.335.000 |
| Catalunya (Spain)                        | President Joaquim Torra i Pla                    | 32.108                  | 7.512.381  |
| Ceará (Brazil)                           | Governor Camilo Santana                          | 148.886,3               | 8.452.381  |
| Cross River State (Nigeria)              | Governor Prof. Ben Ayade                         | 21.461,48               | 2.800.000  |
| Esmeraldas (Ecuador)                     | Prefect Lucia de Lourdes Sosa Robinzon           | 15.836,65               | 534.092    |
| Gossas (Senegal)                         | President Adama Diallo                           | 2.500                   | 140.000    |
| Guayas (Ecuador)                         | Prefect Jimmy Jairala Vallazza                   | 15.430                  | 3.778.720  |
| Imbabura (Ecuador)                       | Prefect Pablo Jurado Moreno                      | 4.800,76                | 413.657    |
| Jalisco (Mexico)                         | Governor Jorge Aristóteles Sandoval Díaz         | 80.137                  | 7.350.000  |
| KwaZulu-Natal (South Africa)             | Premier Mr. T. W. Mchunu                         | 94.361                  | 10.270.000 |
| La Reunión (France)                      | President Didier Robert                          | 2.512                   | 850.727    |
| Manabí (Ecuador)                         | Prefect Mariano Nicanor Zambrano Segovia         | 18.940                  | 1.369.780  |
| Minas Gerais (Brazil)                    | Governor Fernando Damata Pimentel                | 586.528                 | 20.134.742 |
| Misiones (Argentina)                     | Governor Hugo Mario Passalacqua                  | 29.801                  | 1.113.279  |
| Morona Santiago (Ecuador)                | Prefect Marcelino Chumpi                         | 24.059                  | 147.940    |
| Pastaza (Ecuador)                        | Prefect Antonio Kubes                            | 29.520                  | 83.933     |
| Prince Edward Island (Canada)            | Premier Wade MacLauchlan                         | 5.685,73                | 141.678    |
| Québec (Canada)                          | Premier François Legault                         | 1.667.712               | 7.929.365  |
| Río de Janeiro (Brazil)                  | Governor Luiz Fernando de Souza                  | 43.781,58               | 15.989.929 |
| Río Grande do Sul (Brazil)               | Governor José Ivo Sartori                        | 281.748                 | 10.914.795 |
| Rivera (Uruguay)                         | Departamental Intendant Marne Osorio Lima        | 9.370                   | 103.493    |
| Saint Louis (Senegal)                    | President of the Council Mamadou Moustapha Mbaye | 19.421                  | 279.427    |
| Santa Elena (Ecuador)                    | Prefect Patricio Cisneros Greanizo               | 3.690                   | 308.693    |
| São Paulo State (Brazil)                 | Governor Marcio França                           | 248.219,63              | 41.262.199 |
| South Australia (Australia)              | Premier Steven Marshall MP                       | 983.482                 | 1.650.000  |
| Sud Comoe (Ivory Coast)                  | President of the Council Eugène Aka Aouele       | 7.192                   | 591.021    |
| Tocantins (Brazil)                       | Governor Mauro Carlesse                          | 277.720,41              | 1.383.445  |
| Tucumán (Argentina)                      | Governor Juan Luis Manzur                        | 22.524                  | 1.448      |
| Wales (UK)                               | First Minister Carwyn Jones                      | 20.735                  | 3.000.000  |
| Zamora Chinchipe (Ecuador)               | Prefect Salvador Quishpe Lozano                  | 10.584                  | 95.194     |

# Introduction

The recently published IPCC Special Report “Global Warming of 1.5°C” reveals an alarming truth in terms of climate change: Global warming has almost reached 1°C compared to the average temperature in the pre-industrial era and is currently increasing by 0.2°C per decade due to past and ongoing emissions<sup>1</sup>. The **RegionsAdapt** members that reported this and the last years to CDPs states and regions reporting platform are already experiencing the impacts of this global warming, which is also confirmed by the IPCC report. The impacts of climate change pose extensive risks to human lives, infrastructure, socio-economic risks, as well as threats to ecosystems and natural resources, among others. As the report further points out, these risks are likely to intensify in the future, especially taking into consideration that current National Determined Contributions (NDCs) do not contain sufficient actions to limit global warming to well below 2°C. Given these facts, adaptation becomes an urgent necessity for all parts of the world. In order to develop and implement effective adaptation strategies, all levels of government need to be involved in the process. As the data disclosed by regional governments this year shows, more than half of

those regions are already involved in the adaptation planning of their national governments and almost all of the disclosing regional governments work closely with their local counterparts. Due to their key position between the national and local level, regional governments promote the coordination and vertical integration of policies, which is key to a coherent and efficient action oriented to lasting results. Regional governments are close to where adaptation actions are required and can incorporate the needs of their societies in adequate adaptation strategies at the regional level and where possible even at the country level.

Additionally, cooperation between regional governments can help them improve their adaptation actions and strategies and overcome obstacles and challenges. In this regard, Regions4 has started the **RegionsAdapt** initiative three years ago at COP 21 in Paris. At the beginning, regional governments that joined the initiative needed to fulfil three initial commitments within two years. The fulfilment of these first 2-years commitments has been assessed in the last **RegionsAdapt** report in

2017 and showed that the huge majority of the founding members of **RegionsAdapt** complied with these commitments. In this regard, the commitments have been expanded by two additional 2-year commitment phases, giving the **RegionsAdapt** members the chance to improve their adaptation strategies and extend the scope of their adaptation actions. Within the three years of the initiative it has become a platform for knowledge exchange, learning and joint projects in different areas related to adaptation.

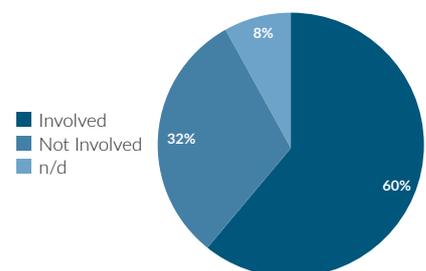
As part of the aforementioned commitments, **RegionsAdapt** members are requested to report their data on climate impacts and associated risks, as well as their adaptation efforts to CDP's states and regions platform. This report reflects the data disclosed by 38 regional governments that are members of the initiative. It demonstrates the awareness and huge potential of regional governments in adapting to a changing climate, their ability to integrate climate policies vertically and their ability to involve different sectors and stakeholders in adaptation planning.

## Multi-level governance in climate adaptation

The Paris Agreement not only recognizes the important role of subnational actors in climate action as the first climate agreement in history, it also lifts adaptation to a principle objective. Article 7 of the Paris Agreement establishes the global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, while its accompanying decision stresses the importance of multi-level governance in adaptation, stating that “Parties recognize that adaptation is a global challenge faced by all with local, subnational, national, regional and international dimensions, and that it is a key component of and makes a contribution to the long-term global response to climate change to protect people, livelihoods and ecosystems<sup>2</sup>” National governments are well aware of their responsibility with regards to the importance of

climate change adaptation and the advantages that a multi-level governance approach brings in this regard. According to the CAIT Climate Data Explorer<sup>3</sup> 145 (73.6%) of the submitted Nationally Determined Contributions (NDCs) included adaptation. In addition, the NDC Explorer<sup>4</sup> reveals that 136 NDCs mention supplementary adaptation plans and strategies, which means they are referring either to domestic adaptation plans and strategies, to UNFCCC-related plans and strategies, or to both. Furthermore, and in line with the provisions of the Paris Agreement, national governments are teaming up with other levels of governments. More than half of the 38 regional governments, that disclosed their data to CDP's states and regions platform, reported they are involved in the development and/or implementation of their national governments' adaptation plans.

Figure 1. Share of regional governments involved in national adaptation planning



<sup>1</sup> IPCC, 2018: Summary for Policymakers. In: Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [V. Masson-Delmotte, P. Zhai, H. O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J. B. R. Matthews, Y. Chen, X. Zhou, M. I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, T. Waterfield (eds.)]. In Press.

<sup>2</sup> UNFCCC (2015): Decision 1/CP.21 Adoption of the Paris Agreement

<sup>3</sup> WRI; Open Climate Network: CAIT Climate Data Explorer <https://cait.wri.org/indc/#/>

<sup>4</sup> Deutsches Institut für Entwicklungspolitik (DIE) (2008): NDC Explorer, <https://klimatlog.die-gdi.de/ndc/#NDCExplorer/worldMap?NDC??climatechangeadaptation??cat38>



Image 2. Adaptation to the conception of transport in Québec (Credit: Government of Québec)

The Canadian provinces **Alberta**, **British Columbia**, **Prince Edward Island** and **Québec** are working with the federal government through the Pan-Canadian Framework on Clean Growth and Climate Change. The framework was developed in 2016 together with the Canadian provinces and territories and in consultation with indigenous peoples. Key areas of the framework are to support projects that make infrastructure more resilient to a changing climate, and to help communities adapt to a changing climate. The **Prince Edward Island** even co-chaired the adaptation group that contributed to the framework. British Columbia also worked directly with the federal government, for example in the Canadian Council of Forest Ministers, that addresses issues of mutual interest including wildfire, pest management and climate change adaptation. In addition, the pan-Canadian Forestry Adaptation Working Group provides a forum for communication and continuous shared learning on adaptation. Along with federal and other provincial and territorial governments, **Alberta** is co-exploring implementation options of the Pan-Canadian Framework commitments, including translating scientific information and traditional knowledge into action, building climate resilience through infrastructure, protecting and improving human health and well-being, supporting particularly vulnerable regions, and reducing climate-related hazards and disaster risks. **Alberta** also works with the federal government to advance provincial and national adaptation goals, through participation on Canada's Climate Change Adaptation Platform. The Platform is a forum through which experts and decision-makers share resources and collaborate on adaptation

priorities. Furthermore, Alberta contributes to the national biannual reporting on adaptation to the UNFCCC. In Australia, a National Adaptation Working Group, involving national, state and local governments, including **South Australia**, exists to provide for information sharing and collaboration on select activities. The Spanish national government together with regional representatives including from the **Basque Country** and **Catalonia** also established a working group on climate change impacts and adaptation. The working group is an administrative collaboration body between the regions and the Ministry of Environment to define policies and actions of the National Adaptation Plan (NAP) through the exchange of experiences. A visible result of this network is a dedicated online platform<sup>5</sup>. **Cross River State** in Nigeria participates in meetings coordinated by the Federal Ministry of Environment together with other critical stakeholders from other regions to brainstorm on adaptation strategies the country wide level. In Mexico, the State of **Jalisco** has adopted adaptation measures that the federal government undertook through its NDC: Adaptation of the social sector to climate change, Ecosystem-based adaptation (EbA), and adaptation of strategic infrastructure and productive systems. These approaches have become common use and allow to set and communicate goals and priorities. An example of this are some of the goals included in the NDC: strengthening the adaptive capacity of at least 50% of the most vulnerable municipalities in the national territory, based on the social sector approach; establish early warning and risk management systems at all levels of government, and achieve a zero rate of

deforestation, contemplated under the EbA approach. In **Rio de Janeiro** studies are being promoted using the national guidelines to gain knowledge in order to create mechanisms that promotes corrective actions and new techniques. These guidelines and studies come from the Brazilian NDC, which is developed by the Brazilian Climate Change Forum, and the National Adaptation Plan, which is developed by the Ministry of Environment by means of the Monitoring and Adaptation Working Group. **Rio de Janeiro** is part of this working group as a representative along the Brazilian Association of State Environmental Entities (ABEMA in its acronym in Portuguese) in order to develop strategies and actions to minimize the impacts of the climate change. The Department of **Rivera** in Uruguay is one of the members to the National System of response to Climate Change, within which it works on the implementation of the Uruguayan NDC. Since May 2018 Rivera has also been involved in the implementation of the National Adaptation Plan to Climate Change.

Other regions are not involved in the development of the national strategies, but their national governments are supporting them in the development of their regional plans. In **KwaZulu-Natal**, for example, the national government has developed the country's provincial adaptation plan and the government of **Esmeraldas** has developed its Provincial Climate Change Plan with the advice of the Central Government in Ecuador. And still others, like **Minas Gerais** and **Tocantins** in Brazil and **Sud Comoé** in Ivory Coast, contribute through their actions to the objectives and accomplishments of the goals of the NDCs of their respective countries. **Ahafo** in Ghana is being consulted, in order to include their climate data in the NDC of the national governments. In the case of **Wales**, the national government developed its National Adaptation Plan primarily for England due to the nature of the political and legal jurisdiction in the UK. Nevertheless, it also covers reserved, excepted and non-devolved matters for other regions and the **Welsh** Government is working with the UK Government to share areas of common interest and to ensure a consistent approach in the shape and focus of all the programs.

The cooperation between regional and national governments in adaptation is only one part of the multi-level governance needed for effective climate change adaptation. This is because when it comes to adaptation, it is crucial to ensure that local realities are reflected in regional and in particular in national adaptation plans. Therefore, it is not only important that regional governments work together with their national counterparts on national adaptation plans and strategies, but it is likewise crucial that regional governments

<sup>5</sup> <http://www.adaptecca.es/>

involve local governments in adaptation planning. The regions who disclosed this year for the purpose of this report, are widely recognizing this importance: 34 out of 38 regions reported to work with local governments in the development and/ or implementation of their regional adaptation strategies. The missing 4 regions did not give any indication to whether they are involving their local governments in their adaptation efforts.

In **Tucumán**, Argentina, the government works with local governments and communities through specific projects: The Integrated Management Plan of the Marapa Graneros River Basin requires interaction with local communities throughout the area, and the Sugar Cane Eradication Program collaborates with local governments providing environmental education on the risks of fires. The government of **Santa Elena**, Ecuador, also targets local governments through the development of projects in agroecology, bio-business and forest management. The **South Australian** Government has worked with local governments to develop and support Regional Adaptation Plans. These plans address the climate risks and priorities in a number of regions<sup>6</sup> in **South Australia**. In **São Paulo**, there exist partnerships between State institutions, like the Institute of Technological Research, Geological Institute and State Secretariat for the Environment, and municipalities to develop and implement adaptation strategies, mainly in the coastal areas. **Rivera** integrates the National System of Response to Climate Change into local policy development and implementation through the Congress of Governors (Congreso de Intendentes in Spanish). Further, the government leads the Network of Municipalities of the North of Uruguay and collaborates with the Network of Green Municipalities of Argentina led by the Municipality of Rosario with visits, projects and reciprocal events. It also works with the Municipalities of Santa Cruz and Roboré in Bolivia, in order to exchange knowledge on protected areas, waste Management and adaptation to climate change. In **Rio de Janeiro**, Brazil, municipal Civil Defenses (Defesa Civil in Portuguese) are involved in the process of identifying vulnerable areas regarding the hydrological risk for planning the Flood Alert System Network. The 2013-2020 Climate Change Action Plan developed by the government of **Québec** comprise support for the integration of adaptation to climate change in municipal planning. Two types of actions will be implemented imminently. The first will offer technical support such as formations, guides and accompanying tools to the municipal sector. The second will offer financial support to municipal governments for the realization of risk and opportunity assessments, and to identify and integrate adaptation solutions into municipal planning and actions and actions. Moreover,

numerous programs finance adaptation projects for municipal actors in **Québec**. The government of **Prince Edward Island** works regularly with local governments to provide guidance on initiatives, tools to support decision making, and training and capacity building opportunities. In **Morona Santiago**, Ecuador, the regional government is working with local governments to develop methodologies for the execution of drainage channels in agricultural areas. In addition, they involve local governments in natural resources monitoring and for the development of environmental education programs. The government of **Misiones** in Argentina has put in place an early warning system at the provincial level to reduce disaster risks. Different local actors are trained to apply anticipated and effective measures or provide immediate and appropriate responses to climatic phenomena, to reduce or avoid the loss of lives and property damages. In **Minas Gerais**, a climate change vulnerability index was created, using local indicators that represent each component of vulnerability. The final results (for each city of the territory) were used to generate maps that classify each region according to its vulnerability, which helps to identify the cities where adaptation actions must be prioritized. In addition, the government hosts an online platform to support local governments in their transition to a low carbon economy. Local districts in **KwaZulu-Natal** have been supported by the regional government in developing their climate change plans, and the state of **Jalisco** works very closely with the Inter-municipal Environment Boards to support the development

of their Municipal and Regional Climate Change Programs, as well as the implementation of mitigation and adaptation projects alike. The government of **Imbabura**, Ecuador, envisioned that 40% of its local governments incorporate the topic of climate change in their development programs and projects until 2019. The provincial government works through the Participatory Budget Assemblies to encourage local and parochial governments to direct economic resources in the implementation of adaptation measures. As a result, five parochial governments are investing around 80,000US\$ in the project "Implementation of ecological kitchens as a rural energy efficiency strategy and mitigation to climate change", with the provincial government contributing with 20,000US\$ to complement the institutional effort. The government of **Guayas** in Ecuador is working together with its local governments on different fields. They are planning socialization and training workshops on climate change, evaluated vulnerabilities and threats, and discussed measures to address these vulnerabilities. In addition, they are supporting the development of a climate change plan and of projects for this purpose. The province is also working on the incorporation of climate change in the development plans and in territorial planning policies.

<sup>6</sup> in this context 'regions' refers to the level below the State level. South Australian government departments and agencies use a consistent set of boundaries to define 12 administrative regions in the state.

## CONGOPE – Supporting local adaptation and mitigation policies in Ecuador

In compliance with its commitments acquired by joining the RegionsAdapt initiative in 2016, the Consortium of Provincial Governments of Ecuador - CONGOPE, with funding from the European Union, carries out the Project "Support for the generation and implementation of local public policies of adaptation and mitigation to Climate Change".

Within this project, provincial climate change strategies are generated and – in some cases – updated. Based on the formulation and implementation of these instruments, the implementation of adaptation and mitigation measures to climate change will be encouraged, as well as the strengthening of capacities and dissemination of good practices.

The preparation of the Provincial Climate Change Strategies has required the diagnosis of the current situation of each province in the face of climate change. In the case of adaptation, climatic risk estimations were made, assuming and adjusting six sectors of adaptation of the National Climate Change Strategy as parameters that supported the determination of climatic threats, exposed elements and the conditions that make them more / less sensitive or better / worse adapted to climatic variability and extreme climatic events, at the provincial level.

Now, the first actions within the preparation phase of the Provincial Climate Change Strategies are being implemented. Its formulation is supported in the methodological guideline document of the CONGOPE, in order to promote an in-depth and critical analysis that combines the most relevant findings of the provincial diagnoses with the priorities and strengths of each territory.

The province of **Esmeraldas** strengthens local capacities in climate change issues in its different parishes<sup>7</sup> of the province, Cross River State holds regular meetings with local government chairmen to develop and plan adaptation strategies at the grassroots level and in **Ceará** the respective Secretariat is working with the city of Fortaleza in the elaboration of the Municipal Adaptation Plan. The adaptation objectives of **Catalonia** are established through Law 16/2017 on Climate Change. The responsibility to achieve the purposes of the law is shared by the regional government, local authorities, productive sectors, political, social and economic agents and citizens overall. In addition, the **Catalan** Office for Climate Change collaborates with local authorities and provides support to municipalities for climate adaptation and mitigation actions (e.g. Public grants and economic finance for developing local adaptation action plans or meetings with local stakeholders to develop actions financed by European Projects for local climate change adaptation). Furthermore, the Strategic Reference Framework for Adaptation foresees that local authorities participate through introducing their policies, actions and objectives relating to reducing vulnerability to the impacts of climate change. The government of **California** works closely to coordinate with and provide guidance to local governments. The Integrated Climate Adaptation and Resiliency Program<sup>8</sup> serves as the hub for most of these efforts and the Adaptation Planning Guide<sup>9</sup> is the basis for local adaptation planning and requirements. **British Columbia** worked in collaboration with local partners, including local governments and local agricultural organizations, to develop Regional Adaptation Strategies. In addition, the provincial government works with local governments in the implementation of adaptation strategies in many ways, including guidance documents and funding. Provincial legislation provides local

governments with the authority to implement measures that are adaptive in nature, for example, hazard and environmental protection in the Regional Growth Strategies, Official Community Plans and Bylaw approvals. Under the **British Columbia** Climate Action Charter, the provincial government works jointly with the Union of **British Columbia** Municipalities (UBCM) through the Green Communities Committee to support local government climate action, including increasing local government resilience. The government also supports local government efforts to increase resilience through supporting adaptation initiatives, providing guidance on sea dike design and coastal development to protect from sea level rise, and on integrating resilience considerations into decision making, through numerous publications. Further, it integrates resilience considerations into incentive programs, such as the Climate Action Revenue Incentive Program (CARIP), it provides direct and indirect development of tools and funds or works with national funding programs, to advance disaster mitigation measures across the province. In 2002, the **Basque Country** government created the "Udalsarea 21"<sup>10</sup>, a municipality working net towards sustainability, with the aim of developing and evaluating Local Action Plans. This platform allows to share experiences, work in interest groups, and develop actions and evaluation tools. Different administration levels work together with municipalities through this platform, for example deputations and government departments (water, energy, etc.). Thus, it is a useful platform for developing new adaptation tools, piloting and integrating in Sustainable Local Action Plans. In the province of **Azuay** in Ecuador, the government facilitates the application of regulations and climate change plans through sharing their strategies with municipalities, in **Auvergne-Rhône-Alpes**, the regional strategy aims to accompany territories

and local governments, and Ahafo in Ghana is carrying out planning processes with local level participation. The provincial government of **Alberta** is working with the cities of Edmonton and Calgary on incorporating climate change considerations into the City Charters. The regulation requires mitigation and adaptation plans to be developed by each city.

Additionally, **Alberta** has provided funding for adaptation planning in smaller municipalities, through the Municipal Climate Change Action Centre, and local authorities are prompted to consider the effects of climate change in their submissions for funding for relevant programs.

The cooperation and collaboration between different levels of governance is a crucial prerequisite in order for a country and its territories to adapt to climate change. Only passing mention will be made at this point of the fact that cooperation between different regional governments within a country and outside is another important vehicle for regional governments to a successful climate adaptation strategy. In **Saint Louis**, Senegal, the Territorial Approach to Climate Changes (TACC) Program unites regions within the country with similar problems to create territories that are emitting less greenhouse gases (GHGs) and that are more resilient to climate change. Internationally, the **RegionsAdapt** is one of such cooperation initiatives bringing together regional governments from around the globe to exchange knowledge and establish partnerships for effective climate adaptation.

<sup>7</sup> Parishes are local governments even smaller than municipalities

<sup>8</sup> <http://opr.ca.gov/planning/icarp/>

<sup>9</sup> <http://resources.ca.gov/climate/safeguarding/local-action/>

<sup>10</sup> <http://www.udalsarea21.net/>



Image 3. International Cooperation Agreement between CONGOPE and European Union - Ecuadorian Prefects with the EU Ambassador in Ecuador (Credit: CONGOPE)

# Impacts of climate change and associated adaptation actions

## Regions adapting to physical risks deriving from climate change

This year, in 2018, 38 regional governments disclosed their data on climate risks and adaptation actions through CDP'S platform. Almost all of them stated to face physical risks associated with the impacts of climate change. Only three regions could not affirm they face risks, mainly because a lack of information on climate change impacts and the missing assessment of risks. More than half of the disclosing governments have already undertaken a climate change risk or vulnerability assessment, and another 16% is currently in the process of undertaking the process (see Figure 2). Such assessment can help regional governments determine the risks from climate change impacts for their territories, thus guiding the necessary adaptation actions to be developed.

Climate change impacts are assessed according to their level of risk and their anticipated timescale (in years). The level of risk is described by estimating the potential impact from the anticipated effect of climate change, along with the likelihood of that effect occurring. On CDP's platform, four options are available using this metric: (i) Extremely serious; (ii) Serious; (iii) Less serious; and (iv) Other. Similarly, there are four options to describe the expected timescales:

- Current: the region is already experiencing the identified effect of climate change;
- Short-term: the region will experience the identified effect of climate change by 2025;
- Medium-term: the region will experience the identified effect of climate change between 2026 and 2050; and
- Long-term: the region will experience the identified effect of climate change after 2051.

Additionally, we included the expression "not defined" (n.d.) when governments did not make any specifications on the respective metric.

For this year's report, the disclosing governments reported 185 physical risks to their territories from climate change organized in 22 categories (For convenience we summarized some of these impacts in one category each, further along in this report). These categories were the following:

- Change in seasonality of rainfall
- Changes in humidity
- Coastal erosion
- Greater temperature variability
- Hotter summers
- Increased average annual rainfall
- Increased frequency of large storms
- Increased wind speeds
- More frequent droughts
- More frequent heat waves
- More frequent rainfall
- More hot days
- More intense droughts
- More intense heat waves
- More intense rainfall
- Reduced average annual rainfall
- Reduced average annual snowfall
- Salinization of water bodies
- Sea level rise
- Soil salinization
- Warmer water temperatures
- Other

This year, the most reported impact from climate change reported by 71% of the disclosing regional governments are extreme rainfall events, that said, more frequent and/or intense rainfall, followed by more frequent and/or intense heat waves (54%) and more frequent and/or intense droughts and more hot days (both 51%). The change of seasonality of rainfall, as well as sea level rise was reported by 37% of the disclosing regional governments. 31% of those governments stated that they face or will face risks resulting from greater temperature variability, and 26% classified the increased frequency of large storms as an impact causing risks for their territories. Hitter summer, coastal erosion and warmer water temperatures were also among the climate change impacts most reported this year.

For the 185 reported physical risks from climate change, only two had not been classified in term of anticipated timescale and impacts seriousness. Out

Figure 2. Climate change risk or vulnerability assessments undertaken

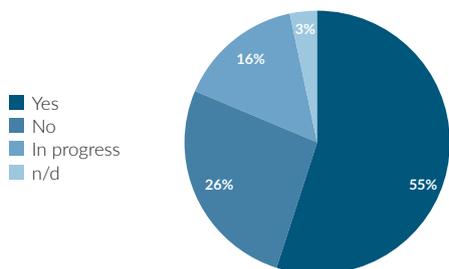
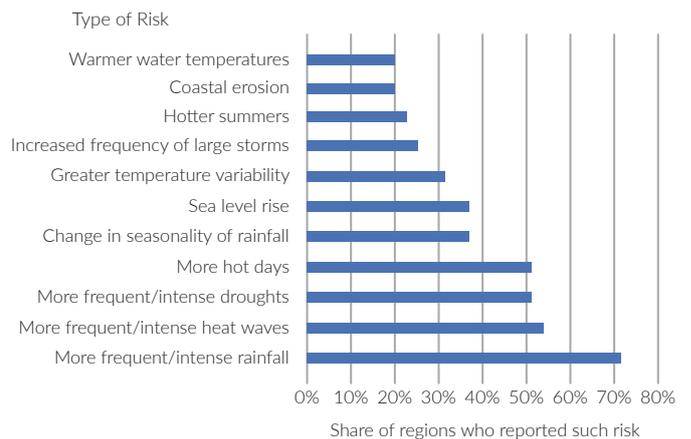


Figure 3. Climate change impacts most commonly reported by disclosing governments



of the rest, 69% have been classified as serious, 17% as extremely serious, and only 14% as less serious. Regarding the anticipated timescale of the reported risks, the majority (43%) are currently constituting a threat to the regions that reported. 16% will be experienced in the short-term, one-third in the medium term and 8% in the long-term.

The fact that so many impacts from climate change are already occurring or will occur in the short- to medium-term, makes adaptation a pressing issue for regional governments. As stated before, most of the had already assessed their vulnerability or are currently in the process of doing so. The next step after the vulnerability assessment is then the development of an adaptation strategy or plan. More than half of the disclosing regions do have such plan and another 10% are currently developing one. In addition, and as can be seen in figure 7, adaptation plans are being published or reviewed constantly.

However, almost one third of do not have an adaptation plan due to different reasons. In some regions, adaptation is covered under a main regional strategy, while for others, human and financial resources, as well as lack of data and expertise constitute constraints to the development of an adaptation strategy. Knowledge exchange, cooperation and partnerships as being promoted through *RegionsAdapt*, can support regional governments to overcome such obstacles, and help developing and implementing adaptation plans in the regions.

Figure 4. Seriousness of reported climate change impacts

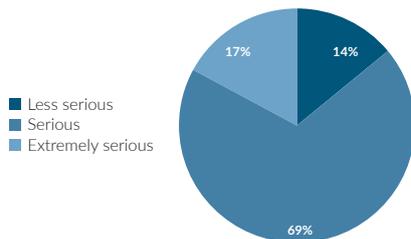


Figure 5. Anticipated timescale of reported climate change impacts

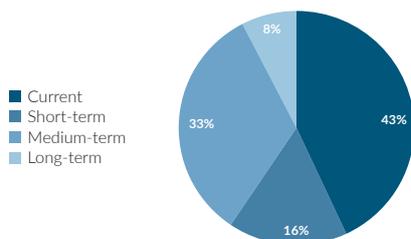


Figure 6. Existence of adaptation plans within the disclosing regions

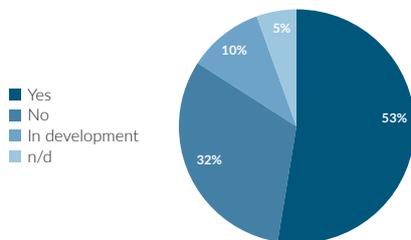
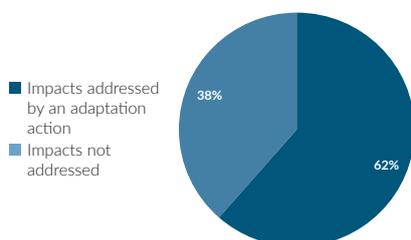


Figure 9. Coverage of adaptation actions



Nevertheless, the majority of the disclosing regions (even some of those that do not hold a regional adaptation plan) execute adaptation measure to adapt their societies and territories to a changing climate. In total, 165 different adaptation actions have been reported, confirming the determination of regional governments to act on climate change. The majority of the reported adaptation actions is currently in the implementation or operation phase, with others already completed or at an earlier stage (see Figure 8). While for some risks resulting from climate change several adaptation actions are being developed and implemented, for others there are currently no adaptation options foreseen (see Figure 9).

The disclosing governments could choose from a number of categories of adaptation actions within the reporting platform and the regions could further specify their actions within the respective categories. Figure 10 shows the most commonly reported adaptation categories of adaptation actions in 2018. However, a significant number of adaptation actions (41) do not fall under a category. This confirms that adaptation is a topic very specific to the respective territory and its conditions. However, during the work within the *RegionsAdapt* initiative, regional governments could identify a number of similar climate conditions that can be addressed through slightly different adaptation actions.

The next section of this report will explore the adaptation actions developed and implemented by regional governments in order to mitigate the impacts and risks deriving from climate change, thereby reducing vulnerabilities and increasing resilience within their territories.

Figure 7. Publication year of adaptation plans

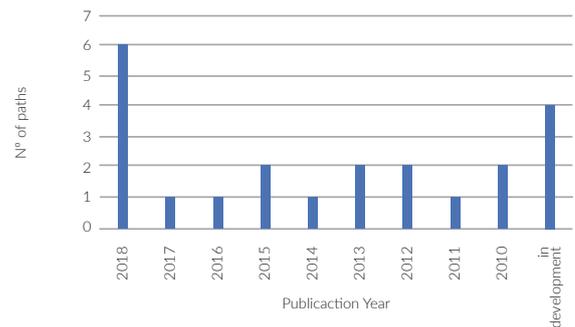


Figure 8. Status of adaptation actions

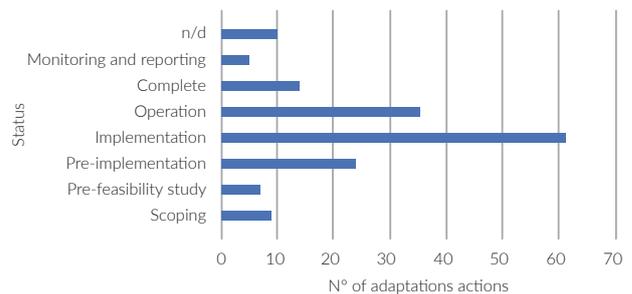
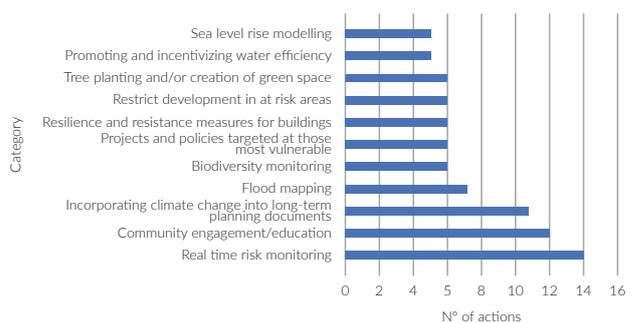


Figure 10. Types of adaptation actions undertaken the most



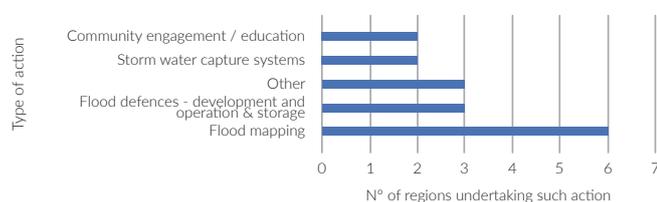
## More extreme rainfall events

More frequent and more intense rainfall events are the most common physical risks the disclosing regions face or will face in the short- to medium-term. Extreme rainfall events are highly related to flooding and represent hazards to human lives, as well as infrastructure and buildings. Human health systems also tend to collapse with emergency services being frequently requested. In addition, these risks also represent issues for agriculture and livestock through damages to crops, fruit trees and other plants, hence, the income sources for rural communities might be at risk. In addition, extreme rainfall events can lead to extreme runoff events, increasing the risk of soil erosion, damage to riparian environments, and damage to buildings and infrastructure.

A total of twenty-one of the disclosing regions reported they currently experience or will be experiencing more frequent or more intense rainfall. In four cases, even both. In most of the cases extreme rainfall events were considered as a serious impact from climate change.

In order to mitigate the risks from flooding caused by extreme rainfall events, regional governments are developing and implementing different mechanisms. Flood mapping is the action mostly mentioned by the disclosing governments. In **Wales** flood mapping was completed by Natural Resources Wales, a **Welsh** Government sponsored body whose purpose is to ensure that the natural resources of **Wales** are sustainably maintained. The mapping is publicly available at a website and improves preparedness for coastal and fluvial flooding risk. The flood risk mapping is in the process of being updated to reflect all existing flood risk assets in **Wales** and will allow for current climate change projections. The updated flood risk maps will be available by the end of 2018. The governments of **Australian Capital Territory**, **Azuay**, **Québec**, and the **Basque Country** also designed flood-mapping systems. In addition to flood mapping, flood defenses are an effective measure when it comes to extreme rainfall events. The government of **Alberta** is currently evaluating its Flood Mitigation and Protection Alternatives through flood vulnerability assessments, weather forecasting review projects, watershed management projects, regional hydrologic assessments, and flood mitigation studies. More concrete, the building of the Springbank Off-stream Storage Reservoir (SR1) is proposed. The proposed SR1 Project is aimed at the protection of human life, property, and regional ecosystems. The Project is located west of the City of Calgary approximately 15 km upstream of the Glenmore Reservoir in a relatively undeveloped farmland and ranchland area valley. This SR1 dam concept considers diverting extreme flood flow from the Elbow River into an off-stream storage reservoir where it would be temporarily contained and later released back into the Elbow River after the flood peak has passed. Project components include a diversion structure constructed across the Elbow

Figure 11. Most common adaptation actions to extreme rainfall events



River, and a diversion channel excavated through the adjacent uplands to transport flood water into an off-stream storage reservoir. The aim of the **Welsh** government is to build resilience to prepare for likely future impacts by reducing the vulnerability

Table 2. Regions affected by more extreme rainfall events

| Region   | Anticipated timescale      | Impact seriousness                     |
|--|----------------------------|--|
| Alberta<br>* More intense rainfall                                     | Medium term                | Serious                                |
| Australian Capital Territory<br>* More intense rainfall                | Current                    | Serious                                |
| Azuay<br>* More intense rainfall                                       | Short term                 | Less serious                           |
| Basque Country<br>* More intense rainfall                              | Medium term                | Serious                                |
| British Columbia<br>* More intense rainfall                            | Current                    | Serious                                |
| Brittany<br>* More intense rainfall                                    | Medium term                | Serious                                |
| Catalonia<br>* More intense rainfall                                   | Short term                 | Serious                                |
| Esmeraldas<br>* More intense rainfall                                  | Medium term                | Serious                                |
| Guayas<br>* More intense rainfall                                      | Short term                 | Serious                                |
| Imbabura<br>* More frequent rainfall<br>* More intense rainfall        | Current<br>Current         | Serious<br>Serious                     |
| Jalisco<br>* More frequent rainfall                                    | Current                    | Serious                                |
| KwaZulu-Natal<br>* More frequent rainfall                              | Short term                 | Serious                                |
| Minas Gerais<br>* More intense rainfall                                | Medium term                | Extremely serious                      |
| Morona Santiago<br>* More frequent rainfall<br>* More intense rainfall | Medium term<br>Medium term | Serious<br>Serious                     |
| Prince Edward Island<br>* More intense rainfall                        | Current                    | Serious                                |
| Québec<br>* More frequent rainfall<br>* More intense rainfall          | Current<br>Current         | Serious<br>Extremely serious           |
| Río de Janeiro<br>* More intense rainfall                              | Current                    | Serious                                |
| South Australia<br>* More intense rainfall                             | Medium term                | Serious                                |
| Sud-Comoé<br>* More intense rainfall                                   | Current                    | Serious                                |
| Tucumán<br>* More intense rainfall                                     | Current                    | Serious                                |
| Wales<br>* More frequent rainfall<br>* More intense rainfall           | Current<br>Current         | Extremely serious<br>Extremely serious |

of **Wales'** transport network, especially to flooding. This will help to reduce the risk of economic impacts associated with such events and help to keep people safer. **Welsh** Government's National Strategy for Flood and Coastal Erosion Risk Management sets 4 objectives: i) Reduce the consequences for individuals, communities, businesses and the environment from flooding and coastal erosion, ii) raising awareness of and engaging people in the response to flood and coastal erosion risk, iii) providing an effective and sustained response to flood and coastal erosion events, and iv) prioritising investment in the most at risk communities. In addition to flood mapping and flood defenses, other adaptation actions are being developed and implemented by regional governments in order to mitigate the risks resulting from extreme rainfall events. In **British Columbia**, intense rainfall may increase the chance of landslides and debris torrents or exceed the capacity of drainage and sewage systems. Therefore, climate change is incorporated into long-term planning documents based on engineering design processes and improved weather forecasting and warning dissemination will enhance preparedness ahead of major storms. A similar action is being implemented by the government of **Québec**, developing new material and land use planning documents incorporating a strategy and activities on soil retention. The overall forecast for **Catalonia** is an increase in the likelihood of extreme convective precipitation events and for this, water capture systems are being implemented. At the same time, the city of Badalona is part of a project that will focus on the study of the

climate change shock in urban drainage (sewerage network) and discharges into the sea. As part of the project, the changes in temperatures and rainfall patterns on a medium- to long-term horizon will be evaluated locally. In view of the different climate scenarios, the associated risks of flooding and loss of sea water quality will be assessed. The project will propose mitigation and adaptation measures or new infrastructures and improvements in the management to solve the impacts. As rainfall events affect agriculture and forestry in regions such as **Esmeraldas**, **Morona Santiago**, **Sud Comoé** and **Minas Gerais**, their governments link their adaptation actions to national policies on climate change, environmental education programs and formulate proposals for international cooperation calls. **KwaZulu-Natal** is improving its infrastructure by increasing the number of reservoirs and wells for water storage and **Prince Edward Island** is implementing pilot green infrastructure projects for storm water management and shoreline protection. The State of **Río de Janeiro** annually strengthens its flood alert system while **South Australia** counts on an emergency management system that frameworks prevention, preparedness, response and recovery for flooding events. **Tucumán** in Argentina is prioritizing regulations and control in areas where risks are higher. Inhabitants are not allowed to develop infrastructure projects in those at-risk areas. In addition, **Tucumán** is currently re-categorizing areas that are currently under Category II (medium conservation value) to Category III (high conservation value - no deforestation allowed).



Image 4. Before and after the beach replenishment to protect Percé coast in Québec (Credit: Ville de Percé)

## Heat extremes: Heat waves, more hot days and hotter summers

More frequent and more intense heat waves are the second most common reported physical risk. twenty-five of the disclosing regions are experiencing or will experience at least one impact related to heat extremes in their territories. In this same context of heat extremes, more hot days and hotter summers are experienced in several regions as a risk resulting from climate change. Heat waves are associated with health problems due to the deterioration of air quality- These health impacts include heat stress (to people and crops), heat strokes and increased respiratory illness. The latter being a big concern especially for vulnerable populations, like children and older people. Heat waves may also increase the intensity of wildfire events, lead to loss of agricultural assets, reduce productivity and livestock health, and influence water supply availability. In the same sense, more hot days and hotter summers bring serious consequences for territories. These include risks to wildlife species, which are not able to adapt to changing temperatures, increased aridity risk to soils, risks to agriculture and wildlife from water scarcity, risks to business

from reduced employee productivity due to infrastructure disruption and higher temperatures in working environments, as well as melting of polar ice that could lead to an increase in sea level and floods.

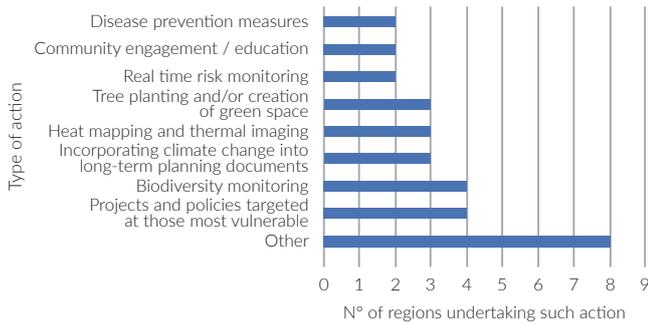
In **Ahafo** the forestry sector is the most affected by heat waves. In order to tackle this effect, all Districts and Municipal assemblies are tasked to plant trees along rivers and protecting river basins. In addition, associations are partnering with other institutions and the government to plant trees and green cities. The **Australian Capital Territory**, through its Climate Change Adaptation Strategy, identified heat refuges and review opportunities for the government and other publicly accessible buildings to be used as heat refuges, and publish information on potential heat refuges around the **Australian Capital Territory** to enable at-risk individuals to seek out areas where they can go to for relief during extended periods of hot weather. In addition, the government of the **Australian Capital Territory** reviews workplace health and safety policies

**Table 3. Regions affected by warmer conditions**

| Region                       | Anticipated timescale | Impact seriousness |
|------------------------------|-----------------------|--------------------|
| Ahafo                        |                       |                    |
| * More intense heat waves    | Current               | Serious            |
| Alberta                      |                       |                    |
| * More frequent heat waves   | Current               | Serious            |
| * More intense heat waves    | Long term             | Extremely serious  |
| * More hot days              | Current               | Serious            |
| * Hotter summers             | Current               | Serious            |
| Australian Capital Territory |                       |                    |
| * More frequent heat waves   | Current               | Serious            |
| Auvergne Rhône Alpes         |                       |                    |
| * More hot days              | Current               | Serious            |
| * Hotter summers             | Current               | Serious            |
| Azuay                        |                       |                    |
| * More hot days              | Current               | Less serious       |
| Basque Country               |                       |                    |
| * More frequent heat waves   | Medium term           | Serious            |
| British Columbia             |                       |                    |
| * More frequent heat waves   | Medium term           | Serious            |
| * More intense heat waves    | Medium term           | Serious            |
| * More hot days              | Medium term           | Less serious       |
| * Hotter summers             | Short term            | Serious            |
| Brittany                     |                       |                    |
| * More frequent heat waves   | Long term             | Serious            |
| California                   |                       |                    |
| * More hot days              | Medium term           | Serious            |
| * Hotter summers             | Current               | Serious            |
| Catalonia                    |                       |                    |
| * More intense heat waves    | Short term            | Serious            |
| * More hot days              | Current               | Serious            |
| Ceará                        |                       |                    |
| * More hot days              | Current               | Serious            |
| Cross River State            |                       |                    |
| * More hot days              | Medium term           | Serious            |
| Guayas                       |                       |                    |
| * More intense heat waves    | Short term            | Serious            |

| Region                     | Anticipated timescale | Impact seriousness |
|----------------------------|-----------------------|--------------------|
| Imbabura                   |                       |                    |
| * More frequent heat waves | Current               | Serious            |
| * More intense heat waves  | Current               | n/d                |
| * More hot days            | Short term            | Serious            |
| * Hotter summers           | Short term            | Serious            |
| Jalisco                    |                       |                    |
| * More hot days            | Medium term           | Serious            |
| KwaZulu-Natal              |                       |                    |
| * More hot days            | Short term            | Serious            |
| Manabí                     |                       |                    |
| * More hot days            | Short term            | Serious            |
| Minas Gerais               |                       |                    |
| * More hot days            | Medium term           | Serious            |
| Morona Santiago            |                       |                    |
| * More frequent heat waves | Medium term           | Serious            |
| Prince Edward Island       |                       |                    |
| * More hot days            | Medium term           | Serious            |
| * Hotter summers           | Short term            | Serious            |
| Québec                     |                       |                    |
| * More frequent heat waves | Medium term           | Serious            |
| * More intense heat waves  | Medium term           | Serious            |
| * More hot days            | Current               | Less serious       |
| * Hotter summers           | Current               | Less serious       |
| Rivera                     |                       |                    |
| * Hotter summers           | Medium term           | Serious            |
| South Australia            |                       |                    |
| More frequent heat waves   | Short term            | Extremely serious  |
| More intense heat waves    | Short term            | Extremely serious  |
| Tucumán                    |                       |                    |
| * More hot days            | Short                 | Serious            |
| Wales                      |                       |                    |
| * More frequent heat waves | Medium term           | Less serious       |
| * More intense heat waves  | Medium term           | Less serious       |
| * More hot days            | Medium term           | Less serious       |
| * More hot summers         | Medium term           | Less serious       |

Figure 12. Most common adaptation actions to heat extremes



and guidelines to ensure that potential climate impacts on workers are identified and addressed. In the **Basque Country**, some demonstration projects about heat modeling have been developed for the purpose of regeneration of urban areas. In addition, the relation between heat waves, air quality and morbidity/mortality is currently under research in order to include these events in emergencies prevention system. The government of **Québec** is mapping urban heat islands and cool zones and support municipalities in realizing projects to reduce existing heat islands. These include tree planting, construction of shaded areas, use of reflective material and preservation of existing cool zones. In addition, the government is testing a telephone alert system for vulnerable groups. Heat mapping and thermal imaging is also one of **California's** adaptation actions implemented to address risks associated with more hot days and hotter summers. An interactive map shows urban heat islands color coded according to their intensity in **California** as measured through the Urban Heat Island Index. The Urban Heat Island Index is calculated as a temperature differential over time between an urban census tract and nearby upwind rural reference points at a height of two meters above ground level, where people experience heat. In **South Australia**, various adaptation measures are occurring across local and state Government and by regional stakeholders or research institutions. **South Australia** Health is undertaking community education and engagement around managing personal heat health impacts. Businesses and organizations are changing requirements for working in extreme heat conditions. Heat and green infrastructure mapping are being undertaken to understand and prioritize treatments including the role of green infrastructure, which is a widespread practice also applied in **California**. In addition, research continues on the potential impacts of increased temperatures and extreme heat on the community and the use of early warning systems for emergency events is being promoted at all times. In **Cross River State**, **Prince Edward Island** and **Québec**, feasibility studies are being

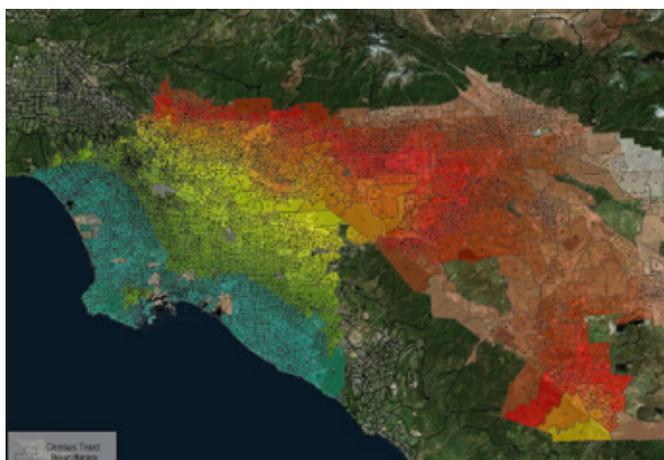


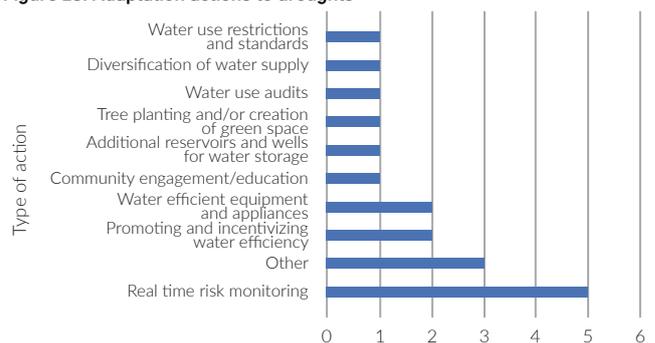
Image 5. Urban heat island map. Sample of Southern California (Credit: State of California)

undertaken to generate cost effective adaptation measures in order to protect biodiversity. **Québec** in particular assesses vulnerabilities, monitors key species indicator of ecosystems health, and monitors invasive species. Additionally, the government of **Québec** created a multidisciplinary observatory for evaluating, monitoring and prevention of zoonotic diseases such as Lyme disease. The observatory is a networking and collaboration structure between partner organizations, bringing together the disciplines of human and animal health as well as environmental sciences. As a unique space for knowledge sharing and consultation between public and scientific policy makers, the Observatory aims to see the future of zoonoses in **Québec**, to support risk management and better adapt to climate change. In **Cross River State** and **Tucumán** forestation programs are executed. The Forestation Program in Tucumán aims to plant 1,500,000 trees in three years. In the same sense of projects, **Imbabura** aims to protect its vulnerable populations by executing the project "Implementation of ecological kitchens as a strategy for rural energy efficiency and mitigation of climate change". The government of **Minas Gerais** offers territorial training about climate change and disaster risk reduction, besides providing key information about this issue through an online platform. The Climate Change Strategy for **Wales** sets out UK and **Welsh** targets and actions. Climate change is a key commitment in the current Programme for Government - 'Taking Wales Forward'. In this dynamic of planning, **Catalonia** published a study that was carried out during July 2017, and which analyzes the risks and opportunities of the agricultural sector of the north zone of Pyrenees and Aran region. The study indicates that the agricultural sector needs to change the productive focus towards human feeding and extensive pasture to adapt to climate change. If there is no action, between the years 2030 and 2050 there will be a reduction estimated income to the sector of 8.9%, but if adaptation measures are applied the economic gains can increase more than 200%. Additionally, the **Catalan Law 16/2017**, of 1 August, on Climate Change includes a provision to protect vulnerable population from energy and water poverty.

## Droughts more frequent and intense

Last year, droughts were the climate change impact most often mentioned by the regional governments that disclosed their data through CDP's platform, whereas this year, droughts constitute the third most widespread physical impact in the disclosing regions, with thirteen of them indicating risks associated with either more intense, or more frequent droughts, or both. Water scarcity - reoccurring water deficits (droughts) have implications for the regions' economies and environments. Climate projections for the water cycle indicate even more reduced reliability of evenly spread rain throughout the year and with decreasing reliability of rainfall, plant life will become stressed with flow-on effects for natural ecosystems and urban landscapes.

Figure 13. Adaptation actions to droughts



**Table 4. Regions affected by more frequent and/or intense droughts**

| Region                       | Anticipated timescale | Impact seriousness |
|------------------------------|-----------------------|--------------------|
| Alberta                      |                       |                    |
| * More frequent droughts     | Medium term           | Serious            |
| * More intense droughts      | Long term             | Serious            |
| Australian Capital Territory |                       |                    |
| * More frequent droughts     | Medium term           | Less serious       |
| British Columbia             |                       |                    |
| * More frequent droughts     | Medium term           | Serious            |
| California                   |                       |                    |
| * More frequent droughts     | Current               | Extremely serious  |
| * More intense droughts      | Current               | Extremely serious  |
| Catalonia                    |                       |                    |
| * More intense droughts      | Short term            | Extremely serious  |
| Guayas                       |                       |                    |
| * More intense droughts      | Medium term           | Serious            |
| Imbabura                     |                       |                    |
| * More frequent droughts     | Short term            | Serious            |
| * More intense droughts      |                       |                    |
| Esmeraldas                   |                       |                    |
| * More intense rainfall      | Medium term           | Serious            |
| Guayas                       |                       |                    |
| * More intense rainfall      | Short term            | Serious            |
| Imbabura                     |                       |                    |
| * More frequent droughts     | Current               | Serious            |
| * More intense droughts      | Current               | Serious            |
| Québec                       |                       |                    |
| * More intense droughts      | Medium term           | Less serious       |
| Río de Janeiro               |                       |                    |
| * More frequent droughts     | Current               | Serious            |
| Rivera                       |                       |                    |
| * More intense droughts      | Long term             | Serious            |
| São Paulo                    |                       |                    |
| * More frequent droughts     | Current               | Extremely serious  |
| South Australia              |                       |                    |
| * More frequent droughts     | Medium term           | Extremely serious  |
| * More intense droughts      | Medium term           | Extremely serious  |
| Wales                        |                       |                    |
| * More frequent droughts     | Medium term           | Serious            |
| * More intense droughts      | Medium term           | Serious            |

The government of **Alberta** through its Provincial Drought and Excess Moisture Advisory Group monitors the whole territory and provides in-timing government responses. The **Australian Capital Territory** engages its population in caring for land and water by improving knowledge and understanding of land managers about climate impacts and adaptation actions. **British Columbia** carries out climate change assessments for key economic sectors identifying climate-related risks and actions that can help these sectors prepare for droughts.

The State of **California** and the State of **Río de Janeiro** both promote and support the acquisition of water efficient equipment and appliances and **California** is currently investing in water storage with the greatest public benefit under future climate conditions. With a similar climate condition, **Catalonia's** forest management helps to make more robust forests in scenarios of climate change. The Life Medacc project, led by the **Catalan**

Office for Climate Change, has designed and executed forest management actions aimed at reducing vulnerability of the main types of forests of three water basins (Segre, Ter and Muga). Pilot tests carried out have confirmed the suitability of the measures to reduce vulnerability of certain tree types. In addition, the **Catalan** Water Agency together with the Forest Property Center of **Catalonia** and the **Catalan** Office for Climate Change has been carrying actions to monitor production and improvement of the drainage or generation of blue water and therefore, reduce the vulnerability of the hydric system. In the province of **Guayas** in Ecuador, albarradas<sup>11</sup> and reforestation plans are being implemented. So far, there have been 1100 plants reforested in the Pedro Carbo canton and an albarrada, in the parish of Valle la Virgen. In this same infrastructure context, the State of **São Paulo** increases the resilience of its water supply system through the implementation of inter basin transfers. The governments of Québec and **South Australia** are carrying out research projects on integrating the impact of climate change in analyzing the cumulative impact of water collection while also promoting and incentivizing water efficiency. In this same dynamic, water resources management plans in Wales are in place and currently cover up to the year 2040. These are adequate to adapt to 2050 medium scenario projections of climate change. The Water Act 2014 Act 'resilience duty' requires water companies to plan for drought in their business plans.

<sup>11</sup> Albarradas are artificial lentic wetlands.



Image 6. Forestry pilot projects in the Muga basin are parte of the Life Medacc project, led by the Catalan Office for Climate Change (Credit: Government of Catalonia)

## Change in seasonality of rainfall

Change in seasonality of rainfall implies multiple kinds of risks to thirteen if the disclosing regions, with most of them associating a serious level of impact with the changing seasonality of rainfall. One of the sectors highly affected is the agricultural sector. The sector will need to deal with the potential increased impacts on farm operations of extreme weather events such as droughts, as well as pest infestations and increased crop vulnerability from year-to-year. Overall, water availability is likely to become even more of a challenge for farmers under the changing climate and available rivers are drying up quickly offseason.

The **Ahafo** Development Association and the government of **Tucumán** engage communities and impart training on the changing nature of rainfall and how to behave before these changes, in terms of responsible consumption, approaches, technology innovation and how to manage the risk associated. The **Basque Country** is taking into consideration water availability reduction in hydrologic planning cycles and the renovation of water supply infrastructures while taxes are being reviewed by the pertinent authorities. In **KwaZulu-Natal** the municipal system and disaster management acts require that disaster management practitioners identify areas of risk. This involves monitoring where and what investments can be made and assessing developments under planning. This same adaptation action is also applied by **Sud Comoé**, in Ivory Coast. In addition, **Sud Comoé** created an agricultural training center in a climate change resilience strategy to build a new generation of modern

farmers that takes climate into account. **Québec**, by consolidating its water monitoring network, produced an hydroclimatic atlas that evaluates the impact of climate change on river flood and low-flow periods. Even so, **Québec** continues to carry out research projects and gaining knowledge on vulnerabilities of hydroelectricity production and reservoirs management adaptation to these new climate conditions. **Tucumán** also reviews the parameters related with flood and drought in hydroelectric dams and taking this into account, a modification on the contract with the hydroelectric power generation company has been recently made.

Figure 14. Adaptation actions to change in seasonality of rainfall

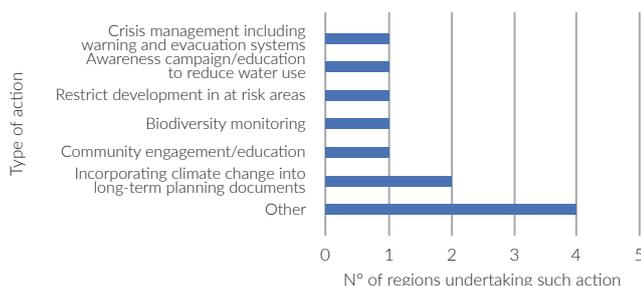


Table 5. Regions affected by change in seasonality of rainfall

| Region           | Anticipated timescale | Impact seriousness |
|------------------|-----------------------|--------------------|
| Ahafo            | Current               | Serious            |
| Alberta          | Current               | Serious            |
| Basque Country   | Short term            | Serious            |
| British Columbia | n/d                   | Less serious       |
| Catalonia        | Current               | Serious            |
| Imbabura         | Current               | Serious            |
| KwaZulu-Natal    | Long term             | Extremely serious  |
| Morona Santiago  | Medium term           | Serious            |
| Québec           | Current               | Less serious       |
| South Australia  | Medium term           | Extremely serious  |
| Sud-Comoé        | Current               | Serious            |
| Tucumán          | Current               | Serious            |
| Wales            | Short term            | Serious            |

## Sea level rise

According to the recently published IPCC Special Report on Global Warming of 1.5°C, “sea level rise will continue beyond 2100 even if global warming is limited to 1.5°C in the 21st century [...]”<sup>12</sup> and it is estimated that the global mean sea level rise will be around 0.26 to 0.77m by 2100 if global warming is limited to 1.5°C and will be even higher for global warming of 2°C<sup>13</sup>. More than one third of the **RegionsAdapt** members, that reported their data, are or will be facing physical risks due to sea level rise in their territories. To most of them it constitutes either a serious or extremely serious impact from climate change. A significant number of citizens live near the coast and are therefore directly affected by sea level rise. Risks arising from sea level rise are flooding and coastal erosion, which can be worsened by more frequent storms and extreme rainfall events; increased vulnerability of coastal farming communities, which face salt water intrusion entering

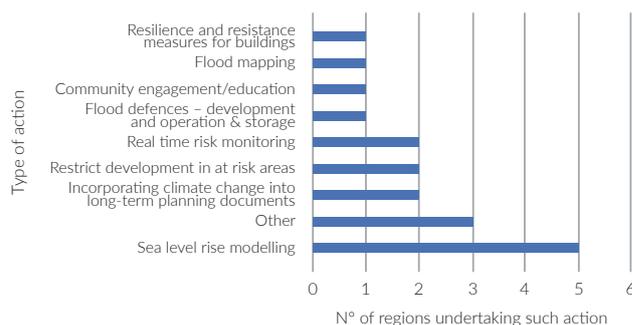
irrigation systems and accumulating in soils; threats to infrastructure, like highways, roads, bridge supports, railway and other kinds of infrastructure at or near sea level. In addition, sea level rise will result in loss of beaches and coastal ecosystems, as well as the change of some freshwater marshes into estuarine or marine tidal marshes due to seawater intrusion.

Table 6. Regions affected by sea level rise

| Region               | Anticipated timescale | Impact seriousness |
|----------------------|-----------------------|--------------------|
| Basque Country       | Short-term            | Serious            |
| British Columbia     | Long-term             | Serious            |
| Brittany             | Short-term            | Extremely serious  |
| California           | Short-term            | Serious            |
| Catalonia            | Current               | Less serious       |
| Jalisco              | Medium-term           | Serious            |
| KwaZulu-Natal        | Short-term            | Extremely serious  |
| Prince Edward Island | Current               | Serious            |
| Québec               | Current               | Serious            |
| São Paulo            | Current               | Less serious       |
| South Australia      | Current               | Extremely serious  |
| Sud Comoé            | Current               | Serious            |
| Wales                | Long-term             | Extremely serious  |

Regional governments are implementing a number of adaptation action to address the threat of sea level rise. The most common one is sea level rise modelling. In **Québec**, the government is modelling sea level rise and studies its impact on coastal submersion and erosion. The **Basque Country** recently started a multiannual, and multilevel project with the aim to evaluate the impact, exposition, and risks in the whole **Basque** coast to mean sea level rise, sea waves and precipitation conjunction. In **California**, the Coastal Commission and other agencies are developing plans to help communities manage planned retreat from rising sea levels. In addition, a new State-funded modeling will come online in 2018 and 2019 for the entire coast within the State. The government of **KwaZulu-Natal** is currently assessing the relative coastal vulnerability in its territory in order to identify areas of high risk, infrastructure at risk and communities that would be most adversely affected by sea level rise.

Figure 15. Adaptation actions to sea level rise



<sup>12</sup> IPCC, Op.cit.

<sup>13</sup> Ibid.

Another way of adapting to the rising sea level is to restrict development in at-risk areas, like the government of **KwaZulu-Natal** is doing through the establishment of a coastal set-back line has been defined, which prohibits or restricts the building, erection, alteration or extension of structures that are wholly or partly seaward of the set-back line. Through the environmental assessment of municipal urban plans, the **Catalan** Office for Climate Change introduces criteria to adapt to climate change to avoid the development of urban areas in flood risk areas from sea level rise to coastal municipalities. Further, planning urban developments should take into account the risks of the impacts of climate change and finance adaptation measures. In addition, the **Catalan** Office for Climate Change and Coastal Management Service is carrying out the preliminary work and governance to develop an integral coastal plan that contains an assessment of the impacts of climate change on the beaches of **Catalonia**. Through this work, it is envisioned to identify measures that help avoiding risks and to regulate the uses of the area in accordance with the future scenarios of sea level rise. In **Prince Edward Island**, resilience and resistance measures for building include the development of guidance for new construction in order to minimize flood exposure.

Restricting development in at-risk areas and guidance for new constructions is one way of addressing the issue of climate change, protecting existing infrastructure to sea level rise is another. The government of **British Columbia** uses flood defenses, as well as new engineering and planning guidance on sea dike design and coastal development to mitigate the

impacts from sea level rise in the province. Flood mapping and risk monitoring can support both, support protecting existing infrastructure and guiding the development of new infrastructure. In **Prince Edward Island**, province-wide flood risk maps are in development, and the tide gauge monitoring network in the province is being expanded. In **Sud-Comoé**, the government uses real-time risk monitoring for the implementation of a Coastal Environmental Information Management System to strengthen the capacity of key stakeholders.

The incorporation of climate change into long-term planning documents is another important instrument, not only in climate change adaptation, which **British Columbia** and the **Basque Country** are applying. The **Basque Country** includes climate change in the "Basque Guidelines for Spatial Planning", with a special emphasis on green infrastructure, urban regeneration and limiting artificialization. The guidelines elaborate on the municipal vulnerability and risk index and include the

climate change adaptation and vulnerability index in one Master Plan as a demonstration project. The **South Australian** government uses development plans to manage development in at-risk areas. Plans have been developed across the state to identify key areas of vulnerability and adaptation actions. Detailed adaptation strategies have been identified for some coastal areas. Structural and infrastructure protections have been developed for some areas and monitoring and mapping activities are being undertaken to better understand risks.

In addition to these measures and policies, it is crucial to bring the citizens on board. The ISACC TorDelta project in **Catalonia** involves society in adaptation to climate change in the Tordera Delta. The objective of the project is to create a space for debate with experts and administrations in the area of integrated Delta management that takes into account the effects of storms on the beaches of the region, constant loss of sand, delta dynamics, as well as raise actions for the future strategic plan of the area.

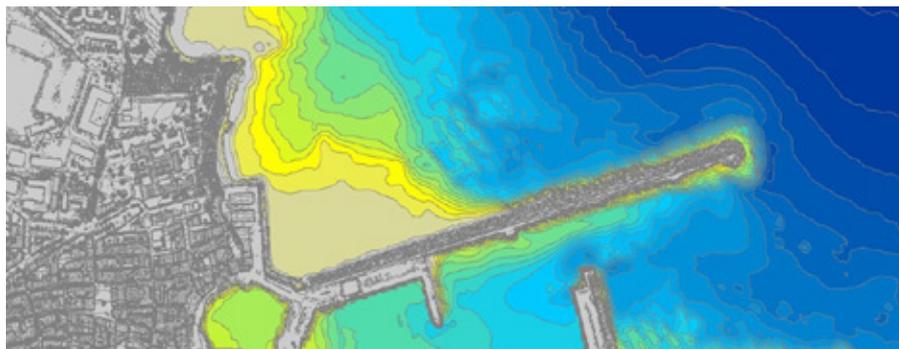


Image 7. Sea level evaluation in Basque Country (Credit: Department of the Environment, Territorial Planning and Housing - Basque Government)

## Greater temperature variability

Eleven of the **RegionsAdapt** members, that reported their data, mentioned greater temperature variability as an impact in their territory resulting from climate change. For the majority of them it is already a problem, with a varying seriousness depending on the region. Temperature variability introduces uncertainty over the timing of planting, harvesting, and livestock grazing. It also decreases weather predictability, e.g. by shifting precipitation patterns, and may impact the ability of agricultural stakeholders to take adaptive measures to mitigate negative impacts to crops and livestock. It can also lead to the reduction of soil moisture, which can cause the loss of habitat, more carbon to be released into the atmosphere, erosion water quality issues and more flooding. Furthermore, changes in temperature can impact rainfall and snowmelt conditions which may lead to freshet flooding. These flooding events may result in restricted access to transportation infrastructure (e.g. highways, resource and community access roads); loss of agricultural production, quality, and assets; and

may negatively impact source water quality and the capabilities of treatment systems.

Out of the eleven regions that reported to be affected by greater temperature variability, only six developed adaptation measures to address the impact. In **Ahafo**, all districts and municipal assemblies are tasked to plant trees along rivers and protect river basins. Associations are also partnering with other institutions and government to plant trees and green cities. While the province of **Azuay** is scoping the possibility of economic diversification measures, the province of **British Columbia** is incorporating climate change into long-term planning documents. For example, the agricultural sector developed a provincial risk & opportunity assessment in 2012, consisting of six regional reports and a provincial report summarizing how changes to the climate may impact agricultural production in key regions of **British Columbia**. Moreover, over 2013 – 2018 the Province has invested over \$5.7 million through Growing Forward 2 (now known as Canadian

Agricultural Partnership), a federal-provincial initiative to develop and implement Regional Adaptation Strategies in six key agricultural regions of the province, and to pilot and demonstrate farm adaptation practices on **British Columbia's** farms and ranches. This work is continuing for 2018-2023 under the new Canadian Agricultural Partnership. Given that greater temperature variability in **Québec** is increasing the number of freeze-thaw cycles, which leads to increased damage to roads, supporting structures and retaining walls, the government is carrying out research on infrastructure (including transportation and buildings) adaptation to these freeze-thaw cycles. In Wales, the pre-implementation phase of a soil retention strategy is currently ongoing. The "Welsh Government Agricultural Land Capability, Suitability & Climate Programme" (CSC) runs from 2018 until 2020 with a total project value of £550,000. The objective of the program is to refine the predictive agricultural land classification map (land capability) and to produce a crop suitability model. Furthermore, the program should develop the UKCP 09 and 18 data sets to model how capability and suitability may change under different scenarios, as well as providing rainfall and temperature information; refine the national soil map; and provide a better understanding between soil and climate relationship. The CSC in **Wales** will provide better evidence to policy teams for land use planning, adaptation measures, habitat, flooding, agriculture and forestry. Proposals for Future Land Management Policy (including business model adaptation) were being devised with internal and external stakeholders in order to publish high level proposals in July 2018.

Figure 16. Adaptation actions to greater temperature variability

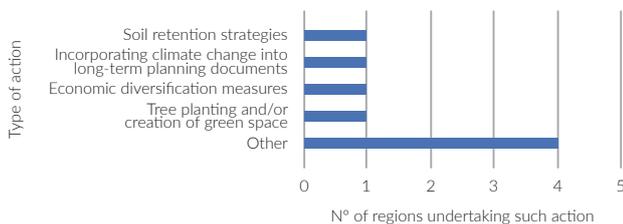


Table 7. Regions affected by greater temperature variability

| Region           | Anticipated timescale | Impact seriousness |
|------------------|-----------------------|--------------------|
| Ahafo            | Current               | Serious            |
| Alberta          | Long-term             | Serious            |
| Azuay            | Short-term            | Less serious       |
| British Columbia | Medium-term           | Less serious       |
| California       | Medium-term           | Extremely serious  |
| Guayas           | Current               | Serious            |
| Imbabura         | Current               | Serious            |
| Québec           | Current               | Less serious       |
| São Paulo        | Current               | Less serious       |
| Wales            | Current               | Serious            |
| Zamora Chinchipe | Current               | Serious            |



Image 8. The Government of Azuay supports farmers with small plants (Credit: AGROAZUAY - Gobierno Provincial del Azuay)

## Increased frequency of large storms

The increase in frequency of large storms can result in a number of risks faced by regions worldwide. More than one quarter of the regions that reported this year are or will be either seriously or extremely seriously affected by the increased frequency of large storms. Flooding and storm surges are risks mentioned often with associated impacts to agriculture, infrastructure and buildings, sewers, electricity and transformation stations and transport networks. Moreover, risks to energy, transport and digital infrastructure from high winds and lightning, as well as risks to building fabric from moisture, wind and driving rain may result from large storms.

The government of **British Columbia** is anticipating the risks resulting from large storms through flood defences, improved weather forecasting and warning dissemination to enhance preparedness, and requiring and providing engineering design processes and procedures for promoting climate resilient infrastructure, such as highways, bridges and culverts affected from increased flows. **Rivera** is using stormwater capture systems to mitigate the risks resulting from large storms, and

**Misiones** is evaluating alternatives, costs and efficiency of local early warning mechanisms for vulnerable cities, as well as training and executing evacuation drills to safe places before the flood emergency. In **Québec**, crisis management including warning and evacuation systems are part of the risk prevention and public security policies, and the government is operating projects in natural disaster risk prevention, including increasing resilience of infrastructure and building of structures to protect against coastal erosion.

This section showed the most pressing physical risks resulting from climate change and how regional governments aim to adapt to them. Nevertheless, there are various other climate change impacts, as well as adaptation actions that could not be displayed in this report, that show the commitment of regional governments to climate action. In addition, climate change poses other risks to regions worldwide, such as water supply risks and risks connected to the socio-economic conditions of a region. These topics will be addressed in the following sections of the report.

**Table 8. Regions affected by an increased frequency of large storms**

| Region               | Anticipated timescale | Impact seriousness |
|----------------------|-----------------------|--------------------|
| Alberta              | Medium-term           | Serious            |
| British Columbia     | Short-term            | Serious            |
| California           | Medium-term           | Extremely serious  |
| Imbabura             | Short-term            | Serious            |
| Misiones             | Current               | Serious            |
| Prince Edward Island | Medium-term           | Serious            |
| Québec               | Current               | Extremely serious  |
| Rivera               | Long-term             | Serious            |
| Wales                | Current               | Serious            |

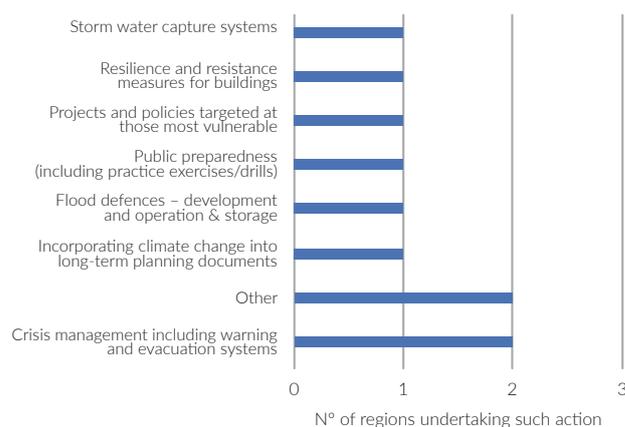
**Figure 17. Adaptation actions to increased frequency of large storms**


Image 9. Large storms are felt in Quebecian territories (Credit: Ville de Percé)

## Water supply risks and adaptation actions at a regional level

Water is the primary medium through which the effects of climate change are being felt<sup>14</sup>. According to the most recent World Water Development Report 2018<sup>15</sup>, the global demand for water has been increasing at a rate of about 1% per year as consequence of population growth, consumption patterns, and other factors, and it is predicted that it will continue to grow over the next two decades due to the impact of new industries and domestic demand. However, the most important use for water is and will continue to be agriculture.

At the same time and taking into account data from the aforementioned report, the global water cycle is intensifying due to climate change and “at present, an estimated 3.6 billion people (nearly half the global population) live in areas that are potentially water-scarce at least one month per year, and this population could increase to some 4.8–5.7 billion by 2050”.

The most recent World Water Forum that took place in March 2018 in Brasilia, Brazil, called for dialogue between different actors in order to propose innovative solutions, and the mobilization of public and private actions in order to promote better water resource quality and sustainability. In this framework, the “Brasilia Local and Regional Governments Call for Action on Water and Sanitation” was launched where local and regional authorities strongly encourage all stakeholders to apply five recommendations. These recommendations aim to strengthen the implementation of water-related policies, programs and initiatives and enclosed in these, projects and goals

that ultimately contribute to the fulfillment of the Sustainable Development Goals and the New Urban Agenda.

In this sense, the **RegionsAdapt** initiative reiterates that climate change impacts are dramatically felt at the territorial level, and that data collection and monitoring are especially needed at the subnational level. This is underlined by the data provided by regional governments with regards to water supply risks.

A number of 35 regions reported on this section of CDP’s platform. In most of the regions water supply risks resulting from climate change are experienced, while other could not confirm it as a risk, mainly due to a lack of assessments in this field. The majority of the 71 risks to water supply, that were reported, are considered as serious or extremely serious, with the most common type of risk reported being the increased risk of water stress or scarcity, followed by fourteen reports on declining water quality and the same number for flooding (Figure 19).

<sup>14</sup> UN Water, 2018. UN Water. [Online] Available at: <http://www.unwater.org/water-facts/climate-change/>

<sup>15</sup> United Nations World Water Assessment Programme, 2018. The United Nations World Water Development Report 2018: Nature-Based Solutions for Water, Paris: UNESCO.

Figure 18. Water supply risks

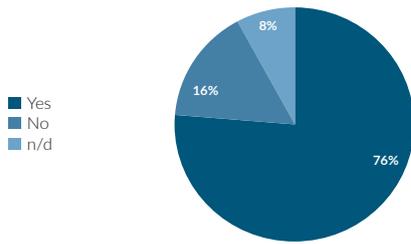
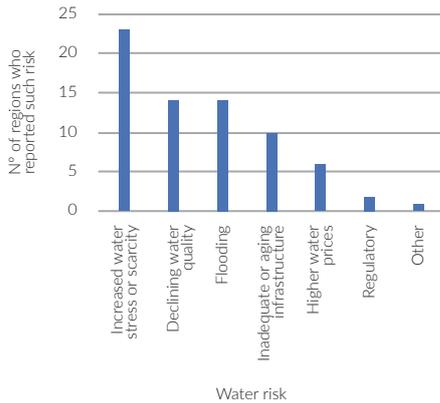


Figure 19. Most common water supply risks



## Increased water stress or scarcity

Water stress or scarcity can mean scarcity in availability due to physical shortage, or scarcity in access due to the failure of institutions to ensure a regular supply or because of inadequate infrastructure<sup>16</sup>. Water stress and scarcity is a significant problem around the world, also confirmed by the FAO publication “Coping with water scarcity. Challenge of the twenty-first century”<sup>17</sup>. Around 1.2 billion people, or almost one-fifth of the world’s population, live in areas of scarcity and another 1.6 billion people face economic water shortage. This reality is shared by 23 of the 35 regional governments that reported to this section, whereas 75% of them consider this risk as serious and 21% even considered it as extremely serious.

The most common adaptation practice to face water stress or scarcity is diversifying water supply. For example, in the Australian Capital Territory in extended dry periods, when storage levels are low, water can be pumped from two pump stations located on the upper Murrumbidgee River. For even more protracted dry periods, when the river’s natural flows are low, extra water can be sourced through water trading and through the arranged releases from Snowy Hydro Limited’s Tantangara Reservoir as part of a portfolio of water rights already acquired.

Figure 20. Adaptation actions to increased water stress or scarcity

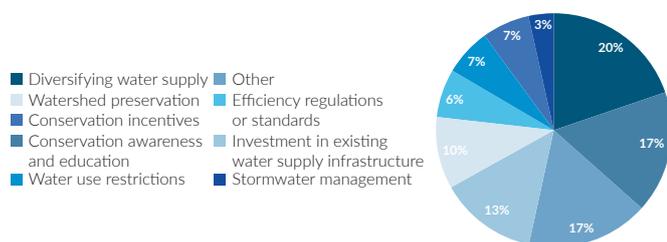


Table 9. Regions facing increased water stress or scarcity

| Region                       | Anticipated timescale | Level of risk     |
|------------------------------|-----------------------|-------------------|
| Alberta                      | Long-term             | Serious           |
| Australian Capital Territory | Long-term             | Serious           |
| Auvergne Rhône Alpes         | Current               | Serious           |
| Azuay                        | Medium-term           | Less serious      |
| Basque Country               | Long-term             | Serious           |
| British Columbia             | Short-term            | Serious           |
| Brittany                     | Medium-term           | Serious           |
| California                   | Current               | Extremely serious |
| Catalonia                    | Current               | Extremely serious |
| Ceará                        | Current               | Extremely serious |
| Guayas                       | Short-term            | Extremely serious |
| Imbabura                     | Current               | Serious           |
| Jalisco                      | Short-term            | Serious           |
| KwaZulu-Natal                | Medium-term           | Serious           |
| Manabí                       | Long-term             | Serious           |
| Misiones                     | Short-term            | Serious           |
| Prince Edward Island         | Medium-term           | Serious           |
| Río de Janeiro               | Current               | Extremely serious |
| São Paulo                    | Current               | Serious           |
| South Australia              | Medium-term           | Serious           |
| Sud Comoé                    | Long-term             | Serious           |
| Tocantins                    | Current               | Serious           |
| Zamora Chinchipe             | Medium-term           | Serious           |

Catalonia has predicted that water availability will decrease in their region due to climate change bringing results such as a reduced river discharge, subterranean recharge and modification of the chemical processes in it. For this, increasing flexibility of allocation of water systems, power generation and infrastructure (network interconnection to ensure security of supply) strengthening the security of supply through other local sources (water reuse, wells recovery, construction of rainwater tanks) and connecting to regional water networks are effective adaptation practices carried out by the Catalan region.

Regions in Latin America also invest in water supply infrastructure in their territories. **Ceará**, **Misiones** and the **State of São Paulo** in addition to the construction of dams, plan and install artesian wells and cisterns to supply and store water in rural areas for different uses such as fish farming, industrial processes and aquifer recharge. Another widespread practice for facing water stress or scarcity is the introduction of conservation awareness and education. With these, **Alberta’s** seven major water-using sectors have improved their water conservation, efficiency and productivity (CEP) by 30% since 2005.

<sup>16</sup> UN Water, 2018. UN Water. [Online] Available at: <http://www.unwater.org/water-facts/climate-change/> [Accessed 28 October 2018].

<sup>17</sup> FAO, 2007. Coping with water scarcity. Challenge of the twenty-first century, Rome: FAO.



Image 10. Allocation of desalination plant in Barcelona strengthening the security of supply on the Catalan region (Credit: Generalitat de Catalunya)

The **Basque Country** and **Guayas** use social media posts for awareness campaigns and **California** promotes "conservation as a way of life" as a well-known phrase to raise awareness on this issue.

In addition, **Prince Edward Island** through the assessment of climate change impacts on water resources helps policy makers to determine the potential impacts on water resources and how to properly allocate access to this resource. This is included in an Action Plan that also intends to promote and enhance water conservation efforts.

As can be drawn from figure 20, other types of adaptation practices are common to face increased water stress or scarcity. For instance, **Azuay** has implemented a program on planting native vegetation. **British Columbia**, through the provincial Water Sustainability Act, includes regulatory tools that can be applied during times of water

scarcity to protect essential flows for aquatic ecosystems and to protect fish populations at risk during a hydrological drought. The Water Sustainability Act also gives the highest priority to essential household needs – defined as 250l per household per day.

The investment in existing water supply infrastructure is another kind of strategy applied by **RegionsAdapt** members such as the case of the province of **Manabí**, which is preparing studies for drilling, deep wells and albarradas in the whole province establishing the largest number of them in the southern area because there the levels of rainfall are especially low.

In addition, the **State of São Paulo** has very strong knowledge in watershed preservation as a measure for climate adaptation. The government is implementing the program "Nascentes" that consists on planting seedlings. The government has also

implemented the Socio-environmental Recovery Program of the Serra do Mar and Atlantic Forest Mosaics through which 17,290 ha of rich vegetation were incorporated surpassing the 350,000 ha of the largest park in the state of São Paulo. The biochemical indicators of water quality of the Cubatão River also surpassed the goals benefiting more than 957,000 people from Baixada Santista (coastal zone) and big part of the Atlantic Forest was recovered through the planting of native species.

**South Australia** has taken this risk into consideration for some years and applies water restrictions in its territory since 2002. Among their water conservation measures that remain in force are not watering gardens by sprinkler during designated hours; no hosing down of external paved areas; washing of car or boat by hose with a trigger nozzle; dust suppression on building sites by hand-held hose or tanker only.

In regard to water regulations, the government of **Guayas** regulates water discharges that come from private companies and plans to apply a Water Footprint Assessment.

Last yet important, **Sud Comoé** partners with the national government to take into account the demographic evolution of the region for the exploitation of the aquifers of **Sud Comoé** in favor of the city of Abidjan, thus strengthening the production of drinking water.

## Declining water quality

Climate change is one important factor that is known to affect ecosystems. According to researchers, the main impact of climate change on water quality is attributed to changing air temperature and hydrology. As a result, water temperature is directly affected by global warming. Variations in water temperature alter physic-chemical equilibriums (e.g., nitrification, mineralization of organic matter, etc.) in rivers and hence change transport and concentration of contaminants<sup>18</sup>. The decline in water quality represents a serious risk to 64,3% of the regions and an extremely serious one to another 28,6%. Nevertheless, regional governments are working on effective solutions to minimize this risk.

34% of the adaptation practices reported, address the risk of declining water quality and are focused on efficiency regulations or standards. In this regard, **Ahafo** works with the Environmental Protection Agency and water related ministries in Ghana to enforce regulations and standards in corporate activities that impact water. The **State of Jalisco** supports the collaboration between the National Water Commission and the State Water Commission so through the State Action Plan for Climate Change (PEACC for its acronym in Spanish),

<sup>18</sup> Hosseini, N., Johnston, J. & Lindenschmidt, K.-E., 2017. Impacts of Climate Change on the Water Quality of a Regulated Prairie River. MDI, 10 March, pp. 1-15.

Table 10. Regions affected by declining water quality

| Region               | Anticipated timescale | Level of risk     |
|----------------------|-----------------------|-------------------|
| Ahafo                | Current               | Serious           |
| Alberta              | Long term             | Serious           |
| Auvergne Rhône Alpes | Current               | Less Serious      |
| Azuay                | Current               | Serious           |
| Brittany             | Long term             | Serious           |
| Catalonia            | Current               | Serious           |
| Ceará                | Short term            | Extremely serious |
| Cross River State    | Current               | Serious           |
| Guayas               | Short term            | Extremely serious |
| Imbabura             | Short term            | Serious           |
| Jalisco              | Current               | Serious           |
| KwaZulu-Natal        | Long term             | Serious           |
| Morona Santiago      | Medium term           | Extremely serious |
| Pastaza              | Short term            | Extremely serious |

“to reuse treated water from the Jalisco treatment plants for the use in agriculture, industry, recreation and irrigation of green areas, by offering it to users at lower prices compared to first-use water and to cogenerate electricity from biogas. Furthermore, **KwaZulu-Natal** through its Blue Drop process supports municipalities that are renewing their operational baselines and reprioritizing their plans with the primary objective of raising the current performance status in terms of municipal drinking water quality management.

As part of their watershed preservation approaches, **Auvergne Rhône Alpes** and **Catalonia** review on a constant basis their quality objectives established in their watershed management plans to adjust them to new environmental contexts, if applicable.

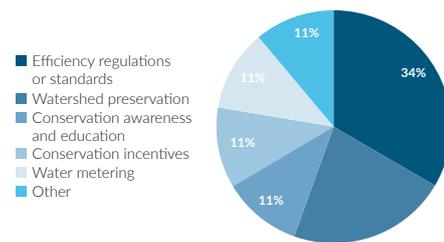
In the framework of conservation awareness and education for water quality, **Cross River State** sets regular campaigns on good hygiene practices, hand washing and proper waste disposal at regional level.

**Morona Santiago** and **Pastaza**, both regions from the Ecuadorian Amazon, face the risk of declining water quality due to factors

such as contamination by the mining and oil industry and the construction of electric dams. In this sense, to conserve its water sources clean, **Morona Santiago** seeks political support to keep underground, for 50 years, any mining project in its province. **Pastaza**, on its behalf, develops a holistic plan of resources conservation and management legally declaring its territory as a protected area.

Last, **La Reunión**, is currently funding an important project for their people, a drinking water plant.

Figure 21. Adaptation actions to declining water quality



## Flooding

Flooding is just as common and reported as the previous risk. Climate change is projected to increase the frequency and intensity of storms in many parts of the world and these storms can lead to extreme flooding and other impacts that can overstrain people, organizations and governments. In addition, floods may come from different sources. For instance, heavy rainfall or meltwater, when the infiltration capacity of the soil is exceeded and when discharges overpass the capacity of watercourses and exit from usual riverbeds<sup>19</sup>.

For this particular risk, **Alberta** counts with its Community Resilience Program which is a multi-year grant program supporting the development of long-term resilience to flood and drought events, while also supporting integrated planning and healthy functioning watersheds. In this same context, **Auvergne Rhône Alpes** includes in its planning watershed conservation and nature-based projects.

Another adaptation practice found in several regions is storm water management (natural or man-made infrastructure). For instance, the **Basque Country** identifies areas that nowadays are in risk of river flooding and condition them mainly through the elimination of barriers, the restoration of natural river beds and the creation of floodplains. **Misiones** and **Morona Santiago** project river basin systematization to apply in different communities and municipalities within their territory.

Furthermore, **Tucumán**, by being located between the Chaco Plain to the east and the cords mountainous Preandinos to the west, dominates the mountains and intermountain basins. Its entire mountainous system is very unstable due to strong and prolonged slopes and an aggressive subtropical climate with summer concentration of intense rainfall. However, the Government of Tucumán has devised an integral water management plan of the Marapa Graneros River Basin that

includes a photogrammetric flight at a convenient scale to identify the in-time situation of the sub-basin, in particular emphasizing hydrogeomorphology of channels, paleo-riverbeds and new erosions detected. In addition, it performs updated hydrological studies for different recurrences of rains in the current condition and with different proposals for future works.

Table 11. Regions affected by flooding

| Region               | Anticipated timescale | Level of risk     |
|----------------------|-----------------------|-------------------|
| Alberta              | Medium term           | Serious           |
| Auvergne Rhône Alpes | Current               | Serious           |
| Basque Country       | Medium term           | Less serious      |
| Brittany             | Short term            | Extremely serious |
| Catalonia            | Medium term           | Serious           |
| Esmeraldas           | Short term            | Extremely serious |
| Guayas               | Short term            | Extremely serious |
| Imbabura             | Medium term           | Serious           |
| Jalisco              | Current               | Serious           |
| KwaZulu-Natal        | Medium term           | Serious           |
| Misiones             | Medium term           | Serious           |
| Pastaza              | Current               | Extremely serious |
| São Paulo            | Current               | Serious           |
| Tucumán              | Current               | Extremely serious |

<sup>19</sup> EU Environment, 2007. European Commission. [Online]

Available at: <https://climate-adapt.eea.europa.eu/metadata/adaptation-options/adaptation-of-flood-management-plans>



Image 11. Flooding identification in Basque Country (Credit: Department of the Environment, Territorial Planning and Housing - Basque Government)

## Socio-economic vulnerability from climate change and related adaptation options

Climate change, in addition to causing physical risks to humans and nature, also has socio-economic impacts, representing a unique challenge for the world economy on a long-term basis. Therefore, substantial progress has been made in evaluating the direct and indirect socio-economic consequences of climate change, with vulnerable environments as the most exposed to these consequences.

Out of the 38 *RegionsAdapt* members reporting to CDP's platform, 32 confirmed they are facing socio-economic risks as result of climate change (Figure 22). In total, 97 socio-economic risks have been identified, allocated into 16 categories. The most prominent ones are the risk to already vulnerable populations, health risks and increased incidence and prevalence of diseases (Figure 23).

In addition, the majority of socio-economic risks are already being felt, representing a 45% of the 97 reported socio-economic risks, followed by most one-quarter of socio-economic risk expected in medium-term (Figure 24).

Figure 22. Regions that face or will face social risks due to climate change

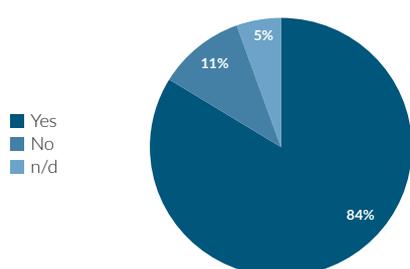


Figure 23. Most common socio-economic risks

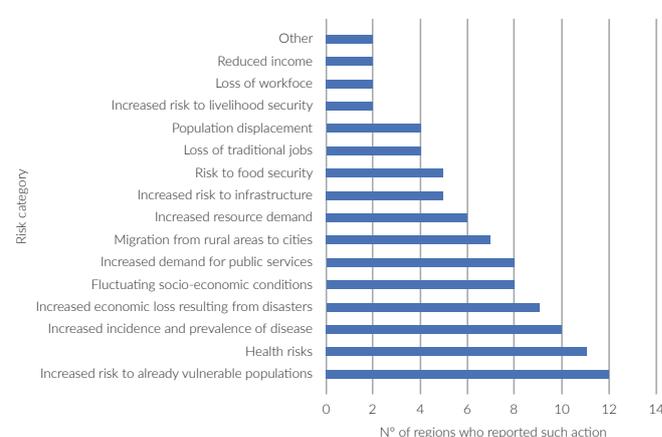
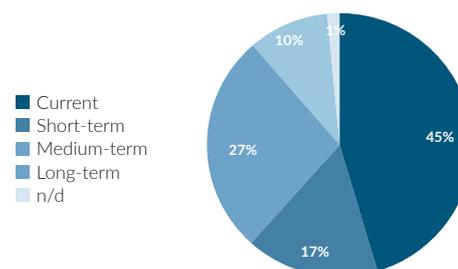


Figure 24. Anticipated timescale of socio-economic risks resulting from climate change



### Increased risk to already vulnerable populations

According to the data derived from this year's disclosure process, the most common socio-economic risk for regional governments is the increased risk to already vulnerable populations. Nearly one-third of the reporting regions are facing this risk. According to the WHO, vulnerable populations are those composed by children, pregnant women, elderly people, malnourished people, and people who are ill or immunocompromised<sup>20</sup>. These groups are at high risk, since they have severely constrained adaptive capacity and may be disproportionately affected by any additional stressors like poverty and its common consequences (malnutrition, homelessness, poor housing and destitution).

In regard to this risk, **Catalonia**, recognizes that hotter climate may pose significant risks to vulnerable populations that cannot afford to take measures for keeping their homes at an adequate temperature. The government establishes a series of measures and recommendations to prevent the impact of heat waves through the Catalan Action Plan to Prevent the Effects of Heat Waves on Health (POCS). In addition, the region supports the City Council of Barcelona on promoting subsidies and public finance for the construction of green roofs of buildings and urban planning

<sup>20</sup> World Health Organization, 2018. World Health Organization - Environmental health in emergencies. Available at: [https://www.who.int/environmental\\_health\\_emergencies/vulnerable\\_groups/en/](https://www.who.int/environmental_health_emergencies/vulnerable_groups/en/)

with more green spaces. The government of **Wales** also experiences an increased risk to vulnerable populations in its territory, related to health risks from declined air quality, from overheating in homes and from flooding for those living in flood prone areas. To address these risks, adaptation considerations are underway to ensure homes are resilient to the effects of climate change. This includes an upcoming review of building regulations and a guidance to ensure any new plans for residential buildings to consider the risk of flood prior to approval.



Image 12. Historic Environment Sector Adaptation Plan in Wales (Credit: The Royal Commission)

**Table 12. Regions affected by an increased risk to already vulnerable populations**

| Region                       | Anticipated timescale | Impact seriousness |
|------------------------------|-----------------------|--------------------|
| Australian Capital Territory | Medium term           | n/d                |
| British Columbia             | Current               | Serious            |
| California                   | Current               | Extremely serious  |
| Catalonia                    | Short term            | Serious            |
| Ceará                        | Current               | Extremely serious  |
| Guayas                       | Short term            | Extremely serious  |
| Morona Santiago              | Long term             | Serious            |
| Pastaza                      | Current               | Extremely serious  |
| Québec                       | Current               | Serious            |
| Río de Janeiro               | Current               | Serious            |
| South Australia              | Medium term           | Variable           |
| Wales                        | Current               | Serious            |

## Health risks and an increased incidence and prevalence of diseases

Global warming may bring some very specific benefits to certain regions, such as fewer winter deaths and increased food production contributing to increased food security. However, according to the reporting regions, health effects are mostly serious and extremely serious and therefore, tremendously negative. Climate change affects social and environmental determinants of health, such as clean air, safe drinking water, sufficient food and secure shelter. Consequently, the increased incidence and prevalence of diseases is closely related to health risks. Therefore, and taking into account that the adaptation actions for both of these risks go hand in hand, they are addressed together in this report.

**Jalisco** in partnership with the College of Interdisciplinary Studies in Environmental Health applied a health diagnosis in their territory and the results were alarming: Six municipalities have been affected by an increase of respiratory, infectious and urinary tract diseases in periods when heat waves occurred. As a result, the State of **Jalisco** through its Special Program of Action on Climate Change, strengthened the capacities of the

**Table 13. Regions affected by health risks from climate change impacts**

| Region               | Anticipated timescale | Impact seriousness |
|----------------------|-----------------------|--------------------|
| Azuay                | Short term            | Extremely serious  |
| Guayas               | Short term            | Extremely serious  |
| Jalisco              | Current               | Serious            |
| Misiones             | Medium term           | Serious            |
| Pastaza              | Medium term           | Serious            |
| Prince Edward Island | Medium term           | Serious            |
| Québec               | Current               | Serious            |
| São Paulo            | Current               | Serious            |
| Tocantins            | Current               | Less serious       |
| Tucumán              | Short term            | Serious            |
| Wales                | Current               | Serious            |

personnel operating the program of epidemiological emergencies and disasters; addressed and controlled diseases caused by vectors and zoonoses; detected and notified climate impacts to the Surveillance System of Health Damage by Extreme Temperature; and designed and implemented a sanitary regulation protocol for shelters. In this same dynamic of partnerships, the government of **Québec** provides direct health assistance to its population carrying out an ongoing health research with the collaboration of many ministries and organizations. They assess the impacts of green spaces on social inequalities and mental health in a climate change context and improve the way to satisfying psychosocial needs of individuals and communities impacted by climate change risks in rural areas. **Wales**, through the Public Health Wales Communicable Disease Surveillance Centre (CDSC) monitors the incidence of disease vectors and pathogens, and **Tocantins** works on integrated fire management activities to protect people, properties and grazing areas of unwanted burning. The program consists of data collection (research), prevention, training, suppression and rehabilitation. In addition, actions of health brigades contribute significantly to the fight and control of forest

**Table 14. Regions affected by increased incidence and prevalence of diseases**

| Region                       | Anticipated timescale | Impact seriousness |
|------------------------------|-----------------------|--------------------|
| Australian Capital Territory | Medium term           | n/d                |
| Azuay                        | Long term             | Serious            |
| British Columbia             | Long term             | n/d                |
| California                   | Current               | Serious            |
| Guayas                       | Short term            | Extremely serious  |
| Morona Santiago              | Long term             | Serious            |
| Québec                       | Current               | Serious            |
| Río de Janeiro               | Current               | Serious            |
| South Australia              | Medium                | Variable           |
| Wales                        | Short term            | Serious            |

fires. **Misiones, Tucumán and São Paulo** are also taking actions against health impacts resulting from climate change by permanent monitoring and dissemination campaigns on preventive measures to avoid dengue and other vector-borne diseases and the importance of vaccination. All these actions are significant; however, there are still other regions that, due to

different challenges and constraints have to deal with difficulties in addressing this climate risk. This is the case of **Morona Santiago**, who are seeking to decentralize the health system in Ecuador in order to enable vulnerable groups to obtain a better quality of health care, thus avoiding major epidemics that would affect all citizens in the region.

## Increased economic loss resulting from disasters

Societies have long been influenced by natural hazards, but as populations continue to grow in areas at risk, losses will continue to increase causing severe negative impacts not only to human life, but also in terms of economic impacts. According to the report on “Economic and Financial Impacts of Natural Disasters”<sup>21</sup>, vulnerability to natural disasters is determined by a complex, dynamic set of influences, such as economic structure, stage of development and prevailing economic and policy conditions. The disclosing regions consider the economic impact of disasters as a serious risk and they apply different adaptation actions to understand and assess the economic consequences of natural hazards.

**Table 15. Regions affected by increased economic loss resulting from disasters**

| Region                       | Anticipated timescale | Level of risk     |
|------------------------------|-----------------------|-------------------|
| Australian Capital Territory | Medium term           | n/d               |
| Azuay                        | Long term             | Serious           |
| British Columbia             | Long term             | n/d               |
| California                   | Current               | Serious           |
| Guayas                       | Short term            | Extremely serious |
| Morona Santiago              | Long term             | Serious           |
| Québec                       | Current               | Serious           |
| Río de Janeiro               | Current               | Serious           |
| South Australia              | Medium                | Variable          |
| Wales                        | Short term            | Serious           |

Climate change scenarios indicate increasing frequency and intensity of disaster events for **Alberta** and **Cross River State**, especially affecting them through floods. Therefore, flood defenses and aggressive tree planting across the state are being undertaken respectively in these regions. The hurricane Patricia in 2015 caused great impact in **Jalisco**, especially in municipalities and the coast, causing severe damages. Around 8.280ha of crops especially of plantain, papaya and corn were affected by the hurricane. In response to this, multiple partners have supported the government of **Jalisco**, so that 80,000 trees of tropical plant species could be planted. **KwaZulu-Natal, Minas Gerais, Río Grande do Sul and Zamora Chinchipe** are addressing the issue of economic losses from disasters through the conduction of impact assessments in their most vulnerable areas in order to predict, monitor and alert on risks and to choose adequate insurance types that can be applied.



Image 13. In Zamora Chinchipe a tank is built with community labor and the support of the Provincial Government (Credit: Gobierno Provincial de Zamora Chinchipe)

## Increased demand for public services (including health) and resources

Regional governments are seizing their closeness to people and territories by including adaptation actions fit for their realities. They acknowledge the future of natural resources such as food, water, energy and minerals within their territories. These resources are important in several crosscutting sectors and its availability is highly contested, mostly because natural resource supply and demand are hard to predict, and all levels of governments require them to sustain standards of living and their economies<sup>22</sup>. Health and emergency services are still the most common public services that populations require. The governments of the **Australian Capital Territory, the Basque Country, British Columbia, California** and **Québec** all agree that a higher demand for health-related amenities is expected due to the increased prevalence

<sup>21</sup> Benson, C. & Clay, E., 2003. Economic and Financial Impacts of Natural Disasters: an Assessment of their Effects and Options for Mitigation, London: Overseas Development Institute.

<sup>22</sup> World Economic Forum, 2014. The future availability of natural resources. A new paradigm for global resource availability, Geneva: World Economic Forum.

**Table 16. Regions facing increased demand for public services (including health)**

| Region                       | Anticipated timescale | Level of risk     |
|------------------------------|-----------------------|-------------------|
| Australian Capital Territory | Medium term           | -                 |
| Azuay                        | Medium term           | Serious           |
| Basque country               | Medium Term           | Serious           |
| British Columbia             | Medium Term           | Serious           |
| California                   | Current               | Serious           |
| Guayas                       | Current               | Extremely serious |
| Québec                       | Short term            | Serious           |
| South Australia              | Medium term           | Variable          |
| Wales                        | Short term            | Serious           |

and incidence of diseases related to climate change (e.g. heat waves, extreme weather-related events). **South Australia** states that socio-economic disruption and health impacts, as the products of climate change, may also lead to greater work and school absenteeism causing lower education status, disability and limited mobility and dependence on others. Therefore, through its Adaptation Plan, this region applies climate change strategies related to emergency management and education that empower people to take action through making relevant information and decision-making tools easily accessible. The government of Wales puts its efforts on promoting further research around this risk in the development of its new Climate Change Adaptation Delivery Plan, due to be published this year.

As for other kinds of resources demand, **Azuay, Guayas, Jalisco, Morona Santiago, Prince Edward Island** and **Santa Elena** all agree that the adoption of good agricultural practices and the need of water for crops are priorities in their territories and recommend the application and the encouragement of holistic agricultural projects for the adaptation to climate change.

**Table 17. Regions facing increased resource demand**

| Region               | Anticipated timescale | Level of risk     |
|----------------------|-----------------------|-------------------|
| Azuay                | Current               | Extremely serious |
| Guayas               | Medium term           | Extremely serious |
| Jalisco              | Current               | Extremely serious |
| Morona Santiago      | Long term             | Serious           |
| Prince Edward Island | Current               | Serious           |
| Santa Elena          | Current               | Less serious      |

## Regional governments continue to strive for successful climate adaptation

The IPCC Special Report on “Global Warming of 1.5°C” was the latest wake-up call to political leaders worldwide. The emission gap needs to be closed urgently and actions undertaken to limit global warming to well below 2°C as requested by the Paris Agreement. Nevertheless, the most ambitious mitigation efforts cannot prevent the need of adaptation. This report has shown that climate change already threatens regions worldwide and will continue to do so in the future. Responding to these threats is crucial in order to reduce vulnerabilities and increase resilience of societies and ecosystems. It has been shown that regional governments are taking their responsibility seriously in making the necessary arrangements to mitigate risks from climate change through the development and implementation of adaptation strategies and actions. Climate change is being incorporated into more and more regional planning documents, a desirable development, since climate change impacts all areas and sectors. Of the 185 reported physical risks from climate change almost two-thirds are being addressed by regional adaptation actions. This is also possible because regional governments assess the vulnerabilities of their territories and develop adaptation plans accordingly. In addition, multi-level governance in climate change adaptation helps to address the impacts of climate change. As the report has shown, almost all disclosing regional governments work closely with their local counterparts and more than half of them are somehow involved in the development and implementation of national adaptation

strategies. That climate actions are most effective when national governments support local and regional governments in their efforts was also confirmed by the IPCC Special Report.

However, apart from all the excellent examples of regional climate adaptation and multi-level governance documented in this report, there are still some obstacles to overcome. In line with the ten recommendations shared in the last two **RegionsAdapt** reports, carrying out vulnerability assessments is a crucial step in addressing climate risks. Nonetheless, there are still some regions that lack sufficient data with regards to climate change impacts and therefore they face difficulties in developing adequate adaptation strategies and measures. Other challenges for regional governments are the lack of training and education and the lack of financial resources. The **RegionsAdapt** initiative supports its members to overcome those challenges through facilitating cooperating among regional governments, partnerships and knowledge exchange. In addition, **Regions4** as the Secretariat to the **RegionsAdapt**, advocates actively for vertical integration and multi-level governance in the global and climate change agenda, emphasising the crucial role of regional governments in climate policy. This crucial role has been made visible also in this report by showcasing how ambitious transitions by regional governments can reduce vulnerabilities. In this regard, the **RegionsAdapt** keeps working with regional governments helping them continue their successful adaptation efforts.



Image 14. Ebro river in Catalonia. The most vulnerable area in Catalonia to sea level rises and subsidence (Credit: Generalitat de Catalunya)

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## About Regions4

Regions4 (formerly known as the nrg4SD) is a global network that solely represents regional governments (states, regions and provinces) before UN processes, European Union initiatives and global discussions in the fields of climate change, biodiversity and sustainable development. Regions4 was established in 2002 at the World Summit in Johannesburg and currently represents 42 members from 20 countries in 4 continents. Through advocacy, cooperation and capacity building, Regions4 empowers regional governments to accelerate global action. For more information, visit: [www.regions4.org](http://www.regions4.org)

## About CDP



CDP is an international non-profit that drives companies and governments to reduce their greenhouse gas emissions, safeguard water resources and protect forests. Voted number one climate research provider by investors and working with institutional investors with assets of US\$87 trillion, we leverage investor and buyer power to motivate companies to disclose and manage their environmental impacts. Over 7,000 companies with over 50% of global market capitalization disclosed environmental data through CDP in 2018. This is in addition to the over 750 cities, states and regions who disclosed, making CDP's platform one of the richest sources of information globally on how companies and governments are driving environmental change. CDP, formerly Carbon Disclosure Project, is a founding member of the We Mean Business Coalition.



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