ADDRESSING WATER SECURITY

Climate Impacts and Adaptation Responses in Africa, Asia, Latin America and the Caribbean
A big step towards sustainable water security in Africa, Asia, Latin America and the Caribbean

Achieving water security is a challenge, particularly in this twenty-first century characterized by tremendous changes that affect water resources. High water stress is experienced by over 2 billion people, while 4 billion suffer from severe water scarcity during at least one month of the year, according to the 2019 World Water Development Report. To guarantee long-term water security, it is necessary to identify appropriate and timely adaptation measures focusing on vulnerable regions.

In order to help communities most prone to risks related to climate vulnerability and change, UNESCO-IHP launched in 2014 the Water Security project, which served as a platform for data and knowledge sharing, and reached more than 850 stakeholders from 80 countries through capacity building and awareness raising activities. Facilitating the uptake and use of a new generation of methodologies for addressing decision-making under uncertainty, the project led to the development of a manual for the Climate Risk Informed Decision Analysis (CRIDA). In the long term, it laid the groundwork for future activities in strengthening sustainable and climate-resilient water management.

This report invites scientists, policy-makers, professionals and practitioners to learn about best practices and to identify key lessons for future efforts to ensure water security for vulnerable regions.

“Since wars begin in the minds of men and women it is in the minds of men and women that the defences of peace must be constructed”
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ACCOMPLISHMENT REPORT
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Preface

by Abou Amani, Secretary of UNESCO IHP

The great challenge for the water resources community is to identify appropriate and timely adaptation measures in a continuously changing environment. The Post 2015 Water Thematic Consultation Report highlighted the following most important Climate Change Related Risks threatening the hydrological cycle: urban heat waves, melting glaciers, longer droughts, drying reservoirs, and increased frequency of floods and droughts. All of these climate change impacts will affect fresh water availability, and in the longer perspective, endanger water security. The expected increase in climate variability will result in increased water variability. Developing countries are most vulnerable to risks related to water security. The main scientific gaps are: i) incomplete understanding of hydrological processes and its links with atmosphere/biosphere/human society; ii) lack of appropriate techniques for data integration and/or assimilation, iii) scaling and heterogeneity issues; iv) capabilities to predict hydrological processes and their interactions and feedbacks with socio-ecological systems; v) uncertainty estimation, communication, and its incorporation into adaptive resource management decision-making. In addition, there is a need for being more pro-active in timely transferring knowledge to policy and decision makers, to ensure that decisions take into account the best available knowledge.

In this context, and with the support from the Flanders Fund-in-Trust (FUST), UNESCO initiated the project “Addressing Water Security: Climate Impacts and Adaptation Responses in Africa, Asia, Latin America and the Caribbean”. The main goal of the project was to provide support in developing adaptation strategies for achieving water security in the context of climate change, with a particular focus on vulnerable regions such as mountainous, dry lands, arid and semi-arid regions of the world.

The project contributed to promoting and increasing the overall climate literacy as advocated by the Intergovernmental Panel on Climate Change in its Special Report on the Ocean and Cryosphere in a Changing Climate (IPCC, 2019). This was facilitated by a wide range of capacity building and outreach activities implemented at various levels, which allowed the strengthening of public awareness and understanding about climate change impacts on water availability and opportunities for adaptation.

Through its capacity building and outreach events, the project reached more than 850 stakeholders, of which over 30% women, from over 80 countries from Asia, Africa, Latin America and the Caribbean. They were able to benefit from a range of trainings and workshops covering topics such as remote sensing, water harvesting, and citizen science for sustainable water resources management, among others. Six publications in English and Spanish were produced in the framework of the project, aimed at raising awareness and providing methodologies for effective tackling of water security issues.

Facilitating the uptake and use of a new generation of methodologies for addressing decision-making under uncertainty was the cornerstone of the project, leading to the development of a manual for the Climate Risk Informed Decision Analysis (CRIDA; UNESCO and ICIWaRM, 2018) and initiating case studies. By pursuing locally embedded solutions to the specific threats to water insecurity due to climate and other global changes, the project substantially enhanced understanding and visibility of these so-called bottom-up approaches for climate resilience. Through the development of these methodologies, it has also contributed to the global agreements such as the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals.
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(SDGs), Paris Agreement on climate change and Sendai Framework on disaster risk reduction. In doing so, the project reinforced the role of water as the ultimate connector among the global commitments towards a sustainable future (WWDR, 2020; UN Water, 2019). Through establishing dialogues with local vulnerable communities in the formulation of strategies and policy guidelines for improved water resources management, it promoted inclusive, sustainable and integrated approach to water security.

Finally, the project provided important feedback for the development of the strategy for the 9th phase of the Intergovernmental Hydrological Programme (IHP-IX), covering the 2022-2029 period with an overarching aim of overcoming water security challenges globally.

I would like to sincerely thank the Government of Flanders for their kind funding support to the project. Likewise, I would like to thank all of the involved stakeholders who supported the project to achieve its objectives.

Abou Amani
Director of the Water Sciences Division
Secretary of the Intergovernmental Hydrological Programme (IHP), UNESCO

Preface

by Gert Verreet, Department of Economy, Science and Innovation of the Flemish Government

As a sponsor to the UNESCO IHP, the Flanders Government aims to contribute to facilitating international science-based cooperation. The project “Addressing Water Security: Climate Impacts and Adaptation Responses in Africa, Asia, Latin America and the Caribbean” (“Water Security”) was granted financial support by the Flanders – UNESCO Science Trust Fund (FUST) by the decision of the Government of Flanders in May 2014. This trust fund supports UNESCO projects in the application of scientific knowledge and stakeholder cooperation practices to deal with sustainable use of natural resources, such as water.

The Water Security project has eminently demonstrated that the fastest and most useful way to tackle the growing water security issues is to bundle and exchange experiences among stakeholders. The rapid development of climate change phenomena, changing land use and demography, all require that water security is addressed as a systemic issue, with sound knowledge as a common basis. We thank all the contributors to the project for its successful completion, and look forward to the IHP building further on its lessons.

Gert Verreet
Flemish Government
Department of Economy, Science and Innovation (EWI)
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Executive summary

A key challenge for the water resources community is to identify appropriate and timely adaptation measures in a continuously changing environment. In this context, the main scientific gaps remain in the incomplete understanding of hydrological processes and their links with human society; capabilities to predict hydrological processes and their interactions and feedbacks with socio-ecological systems; uncertainty estimation, communication, and incorporation into adaptive resource management decision-making. It is therefore of crucial importance to mobilize scientific knowledge, research and training activities for exploring solutions to improve water resources management, adaptation responses and resilience, particularly in the mountains, dry lands, arid and semi-arid regions of the world that remain the most vulnerable. In this context, the aim of the project was to develop adaptation strategies in order to contribute to achieve water security impacted by climate change, with special focus on the aforementioned vulnerable regions.

The project “Addressing Water Security: Climate Impacts and Adaptation Responses in Africa, Asia, Latin America and the Caribbean” was initiated by UNESCO in 2014 with the support from the Flanders Fund-in-Trust (FUST) for the support of UNESCO’s activities in the field of Science, and aimed at advancing water security through leveraging scientific knowledge.

This report aims to provide a concise overview of the project implementation and its main achievements. It is structured around the following three pillars: (1) Vulnerability assessment in vulnerable regions, (2) Awareness raising on potential water security risks, and (3) Implementation of a global forum on climate change adaptation strategies. Each of these three sections presents an overview of the implemented activities and achieved results.

Among the greatest accomplishments of the project is the development of the Climate Risk Informed Decision Analysis (CRIDA), which provides a collaborative process for risk-informed decision making (UNESCO and ICIWaRM, 2018). Moreover, a comprehensive 9-step methodology to construct a drought vulnerability atlas at the national level was developed and applied to Chile. With a view of empowering decision makers by generating scientifically sound climate information, the “Drought Atlas for Latin America and the Caribbean” and “Midsummer Drought Atlas for Central America and the Caribbean” were released, improving the understanding of the drought phenomenon in the region. Finally, the project contributed to strengthening drought monitoring and early warning capacities by establishing and maintaining the drought observatories.

Overall, more than 850 stakeholders from 80 countries have been involved in the project through its training workshops, outreach, communication and other activities. In total, 25 events were organized to capacitate and raise awareness on the issues of sustainable water management, water harvesting and remote sensing, among others. More than 50 partners across the world, representing UNESCO category II centres, chairs and experts from IHP networks, as well as academic and scientific institutions, were mobilized in the implementation of the project. Furthermore, the activities were also coordinated with the Global Network on Water and Development Information for Arid Lands (G-WADI). The outcome of the project provided scientific contribution to 8th phase of the Intergovernmental Hydrological Programme: Water Security: Responses to Local Regional and Global Challenges (IHP VIII- 2014-2021).
Introduction

The challenge of achieving water security

Water security is defined as “the capacity of a population to safeguard access to adequate quantities of water of an acceptable quality for sustaining human and ecosystem health on a watershed basis, and to ensure efficient protection of life and property against water-related hazards such as floods, landslides, land subsidence, and droughts” in the strategic document of UNESCO’s Intergovernmental Hydrological Programme (IHP-VIII- 2014-2021) (UNESCO, 2012).

Achieving water security is a huge challenge, particularly in this twenty-first century which is characterized by tremendous changes that affect water resources. Unprecedented population growth, a changing climate, rapid urbanization, expansion of infrastructure, migration, land use change, and pollution translate into changes in the fluxes, pathways and forms of water—from rapidly melting glaciers to the decline of groundwater due to overexploitation. Watersheds, aquifers and the associated ecosystems have undergone significant modifications which affect the quality and availability of water. Over 2 billion people live in countries experiencing high water stress (WWDR, 2019). This number is expected to further increase due to the expected increase in water demand and climate change (WWDR, 2019). Although women play an important role in water management and conservation, women and young girls are regularly discriminated against and experience inequality in access to safe drinking water in many parts of the world (Thompson et al., 2017; WWDR, 2019). The recently published United Nations World Water Development Report (WWDR, 2020) emphasizes that water is the ‘climate connector’ that allows for greater collaboration and coordination across the majority of targets for sustainable development (2030 Agenda and its SDGs), climate change (Paris Agreement) and disaster risk reduction (Sendai Framework).

To guarantee long-term water security, the water resources community continues its efforts to identify appropriate and timely adaptation measures in a continuously changing environment. Scientific gaps remain a challenge, the main ones being: i) incomplete understanding of hydrological processes and their interactions with atmosphere, biosphere and human society; ii) lack of appropriate techniques for data integration and assimilation, iii) scaling and heterogeneity issues; iv) capabilities to predict hydrological processes and their interactions and feedbacks with socio-ecological systems; and v) uncertainty estimation, communication, and incorporation into adaptive resource management decision-making. It is also crucial to facilitate knowledge transfer to policy and decision makers, thus ensuring that decisions are made based on the best available knowledge.

Within this framework, UNESCO’s Intergovernmental Hydrological Programme (IHP) organized an inception workshop on addressing water security on 9-10 February 2015, which launched a discussion on the development of a global knowledge forum on water security that would build on established networks, knowledge and experience. It was intended to develop partnership mechanisms and projects that would contribute to the assessment of vulnerability and map adaptation strategies in vulnerable regions. In doing so, dialogue and further research would be enhanced for climate change impacts in mountain regions, with emphasis on integrating all activities. Awareness of the impacts of climate change on water scarcity would increase through expert engagement and case studies.
Addressing water security

To address these water-security challenges, UNESCO initiated a project on “Addressing water security: climate impacts and adaptation responses in Africa, Asia, Latin America and the Caribbean” or, in short, the “Water Security” project, which was implemented from 2014 until 2020. It was a follow-up project of the two previous projects funded by the Flanders Fund-in-Trust (FUST), namely “Managing Water Resources in Arid and Semi-Arid Regions of Latin America and Caribbean” (MWAR-LAC) and “The impact of glacier retreat in the Andes: International Multidisciplinary Network for Adaptation Strategies”. The aim of the water security project activities was to develop adaptation strategies in order to contribute to achieving water security, impacted by global change. Particular focus was placed on vulnerable regions such as mountains, dry lands, and arid and semi-arid regions. The project was implemented within the 8th Phase of IHP (IHP-VIII) “Water security: responses to local, regional and global challenges” (2014-2021).

A wide range of activities was implemented in order to meet the three main goals of the project. The first goal was to assess the vulnerability of water resources to climate variability and climate change in vulnerable communities. Several publications, including “The Midsummer Drought Atlas for Central America and the Caribbean” (UNESCO and CAZALAC, 2018) and “The Latin American and Caribbean Drought Atlas” (UNESCO and CAZALAC, 2018), were developed to achieve this. Another important project outcome is the development of the Climate Risk Informed Decision Analysis (CRIDA; UNESCO and ICIWaRM, 2018). This methodology was developed to enable water managers and decision makers to assess the impact of climate uncertainty and change on their water resources and develop resilient and flexible adaptation pathways. The second goal of the project was to raise awareness and enhance capacities of vulnerable communities to assess, monitor and communicate on water security, water vulnerability and climate risk management. This was done by organising a series of workshops. The last goal of the project was to establish a global knowledge platform to gather all the data and knowledge generated by different projects in Asia, Africa, Latin America and the Caribbean. This was accomplished through the creation of an online “Knowledge Forum on Water Security and Climate Change”.

The project was initiated with an international workshop on “Climate change impacts on snow, glacier and water resources: multidisciplinary network for adaptation strategies”, organized from 6 - 7 November 2014 in Koblenz, Germany. The workshop emphasized the importance of scientific cooperation and collaboration among different sectors of the society, scientific institutions, research centres and governments. Various case studies, which considered geographic hotspots of particular concern such as melting glaciers in mountainous regions, were presented during the workshop. Finally, the meeting identified the key issues to be addressed in order to enhance resilience to global change, including improved understanding of vulnerabilities, opportunities for adaptation, and the development of science-based strategies and policies in major mountainous regions of Africa, Asia, Europe and Americas.

Inception workshop

Following the workshop on climate change impacts, the aforementioned inception workshop took place at UNESCO Headquarters from 9 - 10 February 2015, where the project’s framework and objectives were presented to potential partners. This two-day meeting helped to develop an action plan and advance mechanisms for better identification of potential collaborations among partners.

Participants expressed their commitment to improving communication and sharing of research results, with a view to bridge the gap between policy and science. Evidence-based decision making underpinned by scientific findings was recognized as a necessary pathway to increase resilience, along with building capacity in the vulnerable regions, particularly in developing countries. Adaptation needs were identified based on vulnerability assessment;
mapping and implementation of adaptation strategies; raising awareness of potential impacts through outreach activities; and integrating case studies. Stakeholders, including scientists and policy and decision-makers, would promote innovative solutions for sustainable water resources management, particularly for mountain catchments, dry regions and arid regions. Organizing a global knowledge forum was a shared priority for partners.

Inception workshop participants discussed:

- Developing a set of benchmarks on vulnerabilities and adaptive capacities in the context of climate change, particularly for the mountainous regions;
- Generating evidence-based knowledge for adaptation strategies to address water security;
- Raising awareness and enhancing capacities to assess, monitor and communicate the impacts of climate change on natural and socio-economic environments at local, national and regional levels, and human responses to these impacts;
- Developing strategies and policy guidelines considering vulnerabilities, opportunities and potentials for adaptation, strengthening the role of indigenous and local communities;
- Facilitating, strengthening and developing coordination with the on-going research activities in the different regions; and
- Generating and sharing information and knowledge about the environment in vulnerable regions, promoting a policy dialogue with local stakeholders, national governments and regional bodies, and strengthening human and institutional capital for leadership training on sustainable development of water resources impacted by climate change.

The water security project was received as an opportunity to directly address water security challenges by developing climate resilient tools and methodologies, and by facilitating science-policy dialogue, allowing and showcasing the work performed in other relevant projects, supporting networking, enhancing multi-stakeholders dialogue, and promoting further research on climate change impacts.

As an outcome of the meeting, a document summarizing its main findings was developed and made available here.

PHOTO 1
Participants during the inception meeting in Paris, France, 2015
Planning workshop

Following the inception meeting, a planning workshop was organised in Brussels, Belgium, on 25 February 2016 in the framework of the water security project. It was held jointly with the closure meeting of the MWAR-LAC project, in order to allow the project partners to discuss the current advances in water security management and climate change adaptation strategies in the different regions of the world. The discussions allowed for further identification of potential partnerships in light of the future activities foreseen as part of the water security project.

The implementation of the different components of the project led to a wide range of activities during the period 2014-2020. This accomplishment report presents an overview of these activities, which contributed to the implementation of IHP-VIII (2014-2021), helped to raise awareness on opportunities and challenges related to water cooperation, facilitated dialogue among stakeholders, and promoted innovative solutions for the achievement of sustainable water resources management, particularly in vulnerable regions such as mountains and arid and semi-arid zones across the globe.
Addressing Water Security
Climate Impacts and Adaptation Responses in Africa, Asia, Latin America and the Caribbean

Assessing vulnerability: Identification of current and future water resources availabilities in vulnerable regions

Water supply in mountainous and arid regions is often highly variable. With the changing climate, the water supply in these regions is becoming even more unpredictable, making the people living in these areas and relying on water for agricultural irrigation and domestic purposes even more vulnerable.

The goal of the water security project was to assess the vulnerability of these communities. Methodologies of evidence-based decision making under the context of climate change underpinned by scientific findings were developed. A bottom-up approach was found to be appropriate, as it is based on a shared vision between stakeholders and decision makers in defining sustainable, flexible solutions through robust climate stress tests to identify uncertainty of climate projection for water resources management. Climate Risk Informed Decision Analysis (CRIDA) was developed and applied to case studies in vulnerable areas. The CRIDA approach allows a manager to develop appropriate and effective climate change adaptation measures by taking future climate scenarios into account in water resources planning. In addition, efforts were made to assess the vulnerability to drought in vulnerable regions. Furthermore, publications such as “The Midsummer Drought Atlas for Central America and the Caribbean” and “The Latin American and Caribbean Drought Atlas” were developed. Lastly, awareness raising and tool development were carried out to enhance adaptation strategies and climate risk management of local and vulnerable communities.

Climate Risk Informed Decision Analysis (CRIDA)

Engineers and water managers have always incorporated uncertainty in water resources operations, design and planning by means of safety margins, redundancy, and in some cases risk-based planning. However, in recent years, disquiet has been growing that many existing methods to address uncertainty in planning and design may not be sufficient to cope with the consequences of climate change. In particular, many water managers are concerned that events like floods and droughts may increase in frequency and severity in the future under a novel climate, undermining the effectiveness of infrastructure design, having negative consequences for stakeholders such as citizens, industry and business.

Consequently, a new method termed Climate Risk Informed Decision Analysis (CRIDA) was developed in the framework of the project in order to provide a solution to better integrate uncertainties linked to climate variabilities in water management. CRIDA is a decision-centric approach for addressing water resources uncertainties during planning, design, and operations of water management infrastructure and aquatic systems. The approach begins with a thorough understanding of the water resources system, including the project objectives and important performance metrics as well as the vulnerability of the system to climatic and non-climatic stressors. This information is then used to guide the decision maker through the decision making process. This approach shifts the emphasis from what we do not know - such as climate uncertainties - to what we do know - the water management system. The CRIDA approach provides step-by-step guidance within the typical planning frameworks (Fig. 1). CRIDA helps to (1) Identify vulnerabilities to potential future scenarios; (2) generate plans that mitigate against those specific vulnerabilities in a way that doesn’t require us to predict the future; and (3) provide a collaborative framework for risk informed decision making under deep uncertainty.
Through continuous training and outreach, UNESCO is developing a global CRIDA community of practice. The project supported these efforts by publishing a CRIDA manual entitled “Climate Risk Informed Decision Analysis (CRIDA): Water Resources Planning & Design for an Uncertain Future” (UNESCO and ICIWaRM, 2018), which constitutes one of its major achievements. Moreover, it also established synergies with other projects, most notably CliMWaR (Enhancing Climate Services for Improved Water Resources Management in Vulnerable Regions to Climate Change: Case studies from Africa and Latin America and the Caribbean), which implements follow-up activities to elaborate the methodology, for example by organizing trainings for regional stakeholder groups in implementing CRIDA and other bottom-up approaches. Finally, the project initiated the development of a CRIDA case study for Chile by applying the three first steps of the methodology to the Limarí river basin. To finalize the analysis, steps four and five are to be demonstrated in collaboration with CliMWaR.

**FIGURE 1**
CRIDA provides step-by-step guidance within the typical planning frameworks

**CRIDA Trainings**

**CRIDA Workshop for Southern Africa**

In coordination with the CliMWaR project, a workshop named “Climate Risk Informed Decision Analysis: A collaborative workshop to address an uncertain future” was organized on 27-31 May 2019 in Cape Town, South Africa. During this workshop, stakeholders in the Southern African region were trained on the use of CRIDA and potential case studies in the region were identified.

In the workshop, instructors presented a short overview of the CRIDA approach, highlighting the different aspects treated in the CRIDA manual. The Berg river basin was used to demonstrate the different steps of the CRIDA approach. In the first step, the plausibility and impact of climate variability and change on water security in the basin were identified. Afterwards, climate change adaptation pathways for the basin were assessed and the use of the pathway generator was demonstrated. During a discussion session, the development of a full-scale project proposal for the region was debated.
The Limarí river basin was chosen to illustrate how the CRIDA method can help water resources planners to navigate through an uncertain world toward imperfect but robust and socially acceptable solutions, in line with local needs. The Limarí river basin is extremely important for agriculture in the Norte Chico area of Chile. It supplies water for irrigation for more than 70,000 hectares of agricultural land. Climatic conditions vary across the vast watershed with an average annual precipitation of 150 millimetres, with 80% generally occurring in winter months.

A stakeholder consultation was held to identify the current vulnerabilities of water security in the Limarí river basin and to identify key performance indicators. The conversation highlighted primarily that the watershed is highly vulnerable to water scarcity, evident from the impacts of the 2009-2015 megadrought, which resulted in very low water levels in the La Paloma reservoir. This reservoir is the main water reservoir, supplying water for irrigation, and is, therefore, important for the livelihoods that rely on agriculture in this area. After discussions with local actors, three performance indicators were defined:

- A requirement of 7 million m$^3$/year for the City of Ovalle
- A threshold level of 10% of the capacity of the La Paloma Reservoir (330 million m$^3$)
- A threshold of an annual unmet irrigation demand of 2.5 million m$^3$ in the Grande area

After pre-processing the data to identify models that successfully reflected the current conditions, it was predicted that for every 1°C rise in temperature, precipitation would decrease by an average of 4% in the Limarí river basin. These models were then used as an input in the SIGMEN environment to produce a host of probabilistic time series for future climate scenarios, which were then applied to the WEAP (Water Evaluation and Planning) hydrological model. The output demonstrated likely future climate conditions with a temperature range from 8-24°C and an annual precipitation range of 100-240 mm. A reduction in annual precipitation to 120 mm would result in the Paloma reservoir level dropping below the critical threshold of 330 million m$^3$, thus highlighting the high vulnerability of the basin to water insecurity.

A sensitivity analysis was carried out to evaluate the risk of the impacts of climate change. From this analysis it was concluded that there is a significant risk of negative climate change impacts and a lower water security for the Limarí river basin.

A medium/high level of concern was assigned to the La Paloma reservoir based on a high risk and medium plausibility of the La Paloma reservoir falling below the critical threshold of 330 million m$^3$.

Since the Limarí river basin is fed by mountain river systems, synergies were developed with the project “The Impact of Glacier Retreat in the Andes: International Multidisciplinary Network for Adaptation Strategies”, which ended in December 2019. This contributed to developing the vulnerability assessment for the Limarí case study.
Drought vulnerability assessment

Vulnerability assessment of agricultural drought in Chile

The 2007 drought in Chile resulted in a cost of $30 million in mitigation, and had long-lasting effects on rural communities due to the failed harvest and severe water scarcity. As with many extreme meteorological events, the effects and associated mitigation costs were exacerbated due to a lack of preparation prior to this event. In response to this problem, the Ministry of Agriculture created the National Unit of Agricultural Emergencies (UNEA) and the Agroclimatic Risk Management organization. Later, in 2014, the Executive Committee of the Agroclimatic Observatory was set up in order to strengthen collaboration between government agencies and other organisations linked to the agroclimatic sector, with the aim of carrying out an effective monitoring and early warning system for droughts, a phenomenon that is increasingly affecting the region with serious impacts.

A preliminary vulnerability assessment of agricultural drought in Chile was conducted based on relevant drought vulnerability indicators that are currently available at national scale. The objective was to deliver a strategic framework for integrated drought risk management and to identify gaps in crucial information for vulnerability characterization. As a result, a comprehensive nine-step methodology to assess drought vulnerability was developed. In brief, the methodology outlines how to define the spatial scale, select indicators for the assessment, process and validate the collected data and finally evaluate the overall vulnerability of the study area. The results were implemented in the Agroclimatic Observatory of the Ministry of Agriculture, taking into account 16 different socio-economic and environmental indicators.

When the impact of droughts on rural communities is considered, a common problem is the lack of preparedness prior to this type of natural events, making any subsequent governmental action less cost effective. Therefore, there is certainly a need for a shift from crisis management to risk reduction and prevention. Understanding and assessing vulnerability is one of the key components of moving towards drought risk reduction and prevention strategies.

Using groundwater to assess drought vulnerability

Groundwater levels provide an important indicator of the current hydrological situation of a region and can be used to assess the onset of drought. In light of the paucity of monitoring and, therefore, sparse data on groundwater resources available in Chile, a workshop on groundwater monitoring was organized on 9-11 November 2015 with an aim to strengthen the capabilities of Chilean professionals in groundwater monitoring and early warning. It was developed in collaboration with experts from the University of Birmingham and Imperial College London within the framework of the Agroclimatic Observatory.
The objectives of the workshop included increasing the capacity to quantify drought risk and its related impacts on groundwater resources, identifying community vulnerabilities and contributing to improvement in the current drought policy. The meeting strengthened the monitoring and early warning capabilities of the Chilean government. In addition, representatives of public institutions were trained on integrated drought risk management and drought vulnerabilities were identified at the national level, which is essential for identifying areas in need of increased support.

The Midsummer Drought Atlas for Central America and the Caribbean

For Central America and the Caribbean, a significant effort was made to characterize the frequency of the so-called Midsummer Drought, known as the Canícula in the countries of the region, by developing the “Midsummer Drought Atlas for Central America and the Caribbean”.

The Midsummer Drought is a reduction of rainfall during the rainy season which typically occurs between July and August, but its characteristics are modulated by the independent or combined effect of climate drivers like El Niño-Southern Oscillation (ENSO), the North Atlantic Subtropical High (NASH) and the Madden-Julian Oscillation (MJO). The Midsummer Drought occurs in several locations of Central America and the Caribbean and is of paramount importance for water and food security. There was, therefore, a strong need to develop a regional Midsummer Drought atlas that would consolidate information on this phenomenon’s frequency, duration, and intensity. This type of publication allows for identification of this event’s characteristics, as well as specific areas with highest vulnerability. Providing such information to decision-makers across multiple sectors facilitates implementation of more effective and targeted policies.

The Midsummer Drought atlas was developed for Central America and the Caribbean by integrating several regional methodologies into a software package and using a homogenous data source (the CHIRPS remote sensing data set). The methodology for the development of the publication was discussed during a regional workshop held in Antigua, Guatemala, on 24-28 July 2017. In total, 23 participants from the region were present in this meeting, attending on behalf of national hydrometeorological agencies, ministries and academic institutions. As an outcome of the workshop, participants received training in the methodology of the Midsummer Drought atlas, provided suggestions regarding its potential improvements, and contributed to consolidating the regional Midsummer Drought atlas by using national precipitation data sets.

Afterwards, a one-week, hands-on training on Midsummer Drought characteristics and prediction was organised in Antigua, Guatemala, on 3-7 December 2018. The objectives of the workshop were to (i) strengthen the capacities of the national hydro-meteorological agencies in Central America and the Caribbean, (ii) increase the understanding of the physical mechanisms and characteristics of the Midsummer Drought and (iii) evaluate the potential for predicting the Midsummer Drought using a sub seasonal-to-seasonal modelling framework. The workshop was designed to have a strong practical component (approx. 70%) and “real-world exercises”. 

PHOTO 3
Participants during the workshop on the Midsummer Drought Atlas in Antigua, Guatemala. July 2017
Addressing water security: adaptation strategies and climate risk management

Climate change will affect water resources through its impact on the quantity, variability, timing, form and intensity of precipitation. This will have further profound impacts on water security worldwide, affecting the way in which these water resources should be managed. As a result, adaptation responses are urgently needed, but the deep uncertainty associated with climate change scenarios brings additional challenges to the medium and long-term planning strategy. The water security project enhanced climate risk management solutions and adaptation strategies through implementation of early warning systems in pilot regions, organisation of workshops on water-harvesting techniques, and training of local stakeholders on the use of remote sensing for assessing water security.

Early warning systems in pilot regions to support climate risk management

Online climate risk management systems were made available in three pilot basins of Chile, Peru and Central America, and local stakeholders were trained to use this new information for decision-making.

CASE STUDY – STRENGTHENING EARLY WARNING CAPACITIES IN CHILE AND PERU

In follow-up to the establishment of drought observatories in Chile (2013) and Peru (2014) during the MWAR-LAC project (2012-2016), a number of activities were implemented in these two observatories to further strengthen their monitoring and early warning capacities, and enhance their role as a tool for climate informed decision making. Moreover, a new flood and drought monitoring and forecasting system for Chile was developed with a high 0.05° (~5 km) resolution intended to provide advance warning of impending floods and droughts. This system is based on the Variable Infiltration Capacity and Hydrologiska Byråns Vattenbalansavdelning hydrological models, and provides daily, freely accessible historical data and forecast ensembles for several key hydrological variables, including soil moisture, evaporation, runoff, and streamflow. To obtain the best possible predictions across all climate zones in Chile, the meteorological forcing is derived by merging a wide range of station, satellite, and atmospheric model data.

The project initiated a new phase in the development of the Chilean Agroclimatic Observatory, in which specific attention was given to bringing the drought monitoring and early warning capacities in line with the drought policy of the country. For this purpose, a combined drought index was developed and validated with observed drought impacts in the country. Further efforts were made to consolidate the available data. The missing cryospheric, hydrological and groundwater data from the Dirección General de Aguas (DGA) was added to the Climate Data Library. To improve alerting capabilities to affected communities, an sms/email-alerting system has been implemented, with support from Laboratório de Análise e Processamento de Imagens de Satélites, a partner from Brazil.

In Peru, a drought observatory was established and two capacity building activities were organized to transfer the technology and know-how to the local partners. During this process, the climatic and hydrological databases were consolidated, and a manual and tutorial for end users were elaborated. In collaboration with the national meteorological agency (SENAMHI), seasonal forecasts were added to the observatory on a monthly basis, significantly strengthening the early warning component of the Peruvian Drought Observatory.
Water harvesting – an effective adaptation strategy

In the last decade, climate change has influenced precipitation patterns in the arid and semi-arid zones of the world. These changes in rainfall patterns influence the availability of water for human consumption, riverine ecosystems, agriculture, hydropower plants and industry.

Techniques for harvesting rainwater have been used since the first human civilizations. However, the climate risks, combined with the increasing population and water consumption, require these techniques to be more sophisticated and efficient. Additionally, infrastructure for rainwater harvesting has to be installed in areas where there was never any need for them and where experience regarding their use and design is lacking.

To increase the resilience to insecure water availability, activities on water harvesting techniques were organised for local stakeholders in different pilot basins.

Rainwater harvesting techniques in Latin America and the Caribbean

In coordination with the regional partners in Latin America and the Caribbean, a seminar “Rainwater harvesting techniques – a tool to deal with water scarcity” was organized to identify the state-of-the-art water harvesting techniques in the region and to highlight lessons learnt during their implementation in different climatic zones. The seminar was organised on 9 and 10 March 2017 in Santiago, Chile, in the framework of the UNESCO Global Network on Water and Development Information for Arid Lands (G-WADI) programme.

The objective of this seminar was to exchange and gather knowledge of different water harvesting techniques and aquifer recharge experiences in the Latin-American and Caribbean region. A secondary objective was to create a cooperation network of the participating professionals around this topic, as part of the G-WADI regional and global community.

The thematic focus of the workshop was twofold and revolved around the issues of rainfall water harvesting and managed aquifer recharge. In the first part of the meeting, an overview of the UN programmes on water management was provided, followed by a presentation on regional experiences in water harvesting and aquifer recharge, delivered by the representatives of the Global Water Partnership (GWP) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). Case study presentations were given during the rest of the workshop, highlighting regional experiences, best practices and lessons learned with regard to the major approaches employed for water harvesting and aquifer recharge. These presentations are available, along with the meeting’s agenda, on the website of the Regional Water Centre for Arid and Semi-Arid Zones of Latin America and the Caribbean (CAZALAC), a UNESCO Category 2 Centre.

In the afternoon of the second day, a field visit was organized to an active aquifer recharge site, managed by water users of the Maipo Basin in which the capital of Santiago is also located. As this is one of the first examples of Managed Aquifer Recharge in Chile, it offered an excellent location for discussion among the participants of the workshop.

The seminar successfully brought together a large community of governmental and intergovernmental agencies, universities, research institutes, water chairs and centres, individual experts, practitioners and local actors, in order to exchange experiences on the very diverse solutions to address water scarcity through rainwater harvesting and aquifer recharge.

The broad set of experiences received from the region, coming from very diverse socio-economic backgrounds, and including both rural and urban applications, indicates the great potential for these techniques. Some examples also demonstrate the clear benefit for vulnerable highland communities to improve their...
economic situation, while strengthening the sustainability of their activities. As such, the apparent benefit of water harvesting techniques as a tool for lowering the vulnerability to climate variability and change has been demonstrated, making it clear that the promotion of these techniques to inform local stakeholders is an important objective.

**Rainwater harvesting techniques in Africa**

In the African region, a seminar “Rainwater harvesting techniques - towards effective adaptation strategies” was organised in Khartoum, Sudan, on 26-28 September 2018, in collaboration with the UNESCO Khartoum Office, Regional Centre on Capacity Development and Research in Water Harvesting (RCWH), Global Network on Water and Development Information for Arid Lands (G-WADI) Secretariat, Sudanese Ministry of Water Resources, Irrigation and Electricity (MoWR), and National Commission for Education, Science and Culture (NATCOM).

The objective of this seminar was to exchange knowledge and experiences, and to collect the available information on the different water harvesting techniques implemented in Africa and the Arab regions. Participants were invited to share their perspectives, issues and questions related to the topic, while at the same time establishing a regional cooperation network.

The specific seminar themes included:
- Experiences with rainwater harvesting techniques: problems, solutions and best practices;
- The role of rainwater harvesting in the Sustainable Development Goals;
- Socio-economic and environmental aspects of rainwater harvesting;
- Policies for rainwater harvesting: gaps and opportunities;
- Cultural aspects of water harvesting and aquifer recharge;
- Advanced tools for assessment and management of water harvesting (models, remote sensing, etc.); and
- Water harvesting as adaptation tools to climate change.
Remote sensing as a tool to assess water security

Accessible and high quality water data and information is at the core of good water management and governance. The increased accessibility to technology and the development of innovative tools for water resources monitoring, such as remote sensing, can exponentially improve how we can see and manage water globally. As part of the water security project, several activities on satellite remote sensing were organised to highlight how remote sensing can support water resources management.

In the Latin American and Caribbean region, two workshops were held in Foz de Iguazu, Brazil. The workshops on “Application of satellite remote sensing to support water resources management in Latin America and the Caribbean” and “Application of remote sensing to support the management of hydrographic watersheds in Latin America and the Caribbean” took place on 13-20 July 2016 and 29 November-6 December 2017, respectively. During these workshops, more than 140 participants from 20 countries were trained on the use of remote sensing applications for water resources management.

Specifically, the workshops contributed to:
- Capacity building of early-career professionals on the application of remote sensing applications for improved water resources management;
- Training on the available open source software options (R-scripts and Python) for remote sensing applications; and
- Dissemination of tools and methods using remote sensing data products in data-poor regions of Latin America and the Caribbean.

In the African region, the water security project contributed to an international training course “Remote sensing for water resources management in Africa”, organised on 12-19 January 2019 in Pietermaritzburg, South Africa, in the framework of the CliMWaR project and the Global Network on Water and Development Information for Arid Lands (G-WADI) programme. The aim of this seven-day workshop was to train water resources managers and officials from government agencies and institutes, policy makers, researchers, NGOs and the corporate sector in current remote sensing data sources and their application in water resources management. Thirty participants, of whom 13 were women, gathered during the meeting.

The workshop included lectures, group work exercises and field visits. The lectures and training were provided by facilitators from the University of Southampton, UK, Princeton University, USA, Flemish Institute for Technological Research (VITO), Belgium, and the University of the West of England, UK.

The training programme directly contributed to:
- Capacity building of early-career professionals in the application of remote sensing data products and information systems for improved water resources management;
- Training on the available open-source software options for analysis of remotely sensed data;
- Dissemination of data portals, tools, methods and information systems for using remote sensing data products in data-poor regions of sub-Saharan Africa; and
- Establishing a cross-regional network of water professionals with an interest in using remote sensing approaches for solving regional water resource management challenges.
Awareness raising programmes and outreach activities

A series of activities was carried out, aiming to raise awareness on water security, water vulnerability and climate risk management. Citizen science workshops were held in Latin America and Africa, engaging local communities and stakeholders in the use of simple scientific tools to monitor water resources, and, consequently, building capacity in these areas. Impacts of climate change were communicated to local stakeholders both at the policy and community levels in order to enhance the understanding of climate change impacts and identify responses in the context of water security.

Awareness building of local vulnerable communities on current and future climate risks

AFRICA: Workshop on climate change risk, vulnerability assessment and early warning for Africa

In collaboration with the AGRHYMET (AGRrometeorology, HYdrology, METeorology) Regional Centre, the Global Technical Secretariat for G-WADI, and the Joint Research Centre (JRC) of the European Commission, a technical workshop “Climate risk in Africa: vulnerability assessment, early warning and hydroclimatic expertise” was organized in Niamey, Niger, on 13-16 June 2017. Over 40 participants, mainly hydrologists and climate experts, from 17 African countries attended the workshop.

During this four-day workshop, multiple presentations were delivered by participants, facilitating a dialogue on the themes of climate risk and its successful management, and allowing for a discussion on the methods, tools and best practice examples of early warning systems and climate risk assessment in Africa.

The main objectives of the meeting included:
- Improving understanding of the risks associated with climate change;
- Discussing and learning from best practices applied in the region with regards to climate risk management;
- Building capacity of participants to apply climate risk assessment methods and tools; and
- Developing recommendations for improving water security in the African countries.

As an outcome of the meeting, gaps and needs within regional climate risk management were jointly identified by the participants. Key recommendations were also developed, including:
- Strengthen capacity of the African countries to update seasonal hydrometeorological forecasting at the national level;
- Communicate the importance of seasonal forecasts to policy advisors and decision makers;
- Improve capacity of managers working on hydrometeorological data management;
- Raise awareness on the importance of data collection and the need for its increased funding; and
- Support countries in the development of flood forecasting systems.

The objective was to identify the gaps and needs for climate risk management in African countries, as well as to present the available tools and methodologies, as provided through UNESCO-IHP and its flagship programmes, such as G-WADI.
During the four-day workshop, several sessions were organized. During the first session, case studies and lessons learnt on climate risk management in Africa were presented by the different participants. This allowed identification of the gaps and needs remaining in the different countries. The second session provided an overview of concrete solutions and the different tools developed over recent years to strengthen climate risk management for improved water security. A full day of hands-on training complemented the workshop.

**ASIA: Workshop on understanding the impact of climate change on water resources**

A regional workshop was held in Langkawi, Malaysia, on 10-11 July 2017, to improve understanding of the impacts of climate change on water resources and water-related disasters. In this context, the workshop was oriented towards upscaling local Integrated Water Resources Management (IWRM) approaches for strengthening water security and regional cooperation.

The workshop brought together 34 participants from twelve Asian, Pacific and African countries, including UNESCO Category 2 Centres and Institutes in the Natural Sciences, a UNESCO Chair in Water Resources, authorities from Langat UNESCO Hydrology for the Environment, Life and Policy (HELP) River Basin, local partners of UNESCO-IHP Malaysia, as well as policy makers, water experts, academics and others. It was jointly organized by UNESCO-IHP and the UNESCO Jakarta Regional Science Bureau for Asia and the Pacific as part of the projects “Addressing Water Security: Climate Impacts and Adaptation Responses in Africa, Asia, Latin America and the Caribbean” and “Upscaling water security to meet local, regional, and global challenges”, and co-sponsored by the Malaysia-UNESCO Cooperation Programme (MUCP), the Malaysia Funds-in-Trust, and the Flanders Fund-in-Trust (FUST).

The workshop was divided in two main sections. In the first one, a technical session was held to share and improve knowledge on how climate change impacts water resources and water-related disasters, as well as on how the HELP initiative and ecohydrology can be used as practical tools for delivering IWRM for tackling those issues. During the presentations, a variety of case studies was introduced, highlighting lessons learned from some of UNESCO-IHP’s flagship initiatives, including the International Flood Initiative (IFI), the International Drought Initiative (IDI), and Asian G-WADI (Global Network on Water and Development Information for Arid Lands), which aimed towards improving understanding of flood and drought early warning systems and glacial lake outburst floods (GLOFs) in Asia. The second section focused on facilitating a policy dialogue with a view to raising awareness on how to best translate the scientific knowledge into action to contribute to a sustainable future.

As an outcome of the workshop, participants were introduced to best practices in the area of climate risk management, drawing on the case studies presented. Awareness was also raised on climate risk assessment for water resources, water-related disasters, as well as tools and methods for enhancing water security in the region. Finally, the workshop came up with a set of recommendations for policy advisers and decision makers, such as implementing climate responsive water management at multiple levels, empowering communities through education and awareness raising on climate risk management, promoting energy efficient and cost-effective technologies for water supply and waste water management, and proper collection and dissemination of water-resources data and information.
LATIN AMERICA AND THE CARIBBEAN: Towards sustainable water management

UNESCO-IHP, in coordination with CAZALAC and the project “Water security and climate change adaptation in Peruvian glacier-fed river basins” (RAHU), organized the seminar “Towards sustainable water management in Latin America and the Caribbean: exchange of experiences of methods to conserve, increase availability and improve the efficiency of water use” on 5-6 August 2019 in Lima, Peru. 26 (including 6 women) regional water researchers, technicians and professionals gathered to discuss the state of water management in Latin America and the Caribbean, as well as the potential of emerging technologies to increase regional water-use efficiency, and water management and sustainability, under both current and future pressures.

The main objectives of this seminar were to exchange and gather knowledge on the techniques for sustainable water management available in the region, and to contribute to the formulation of supporting policies. Three main themes explored during this meeting included:

- Methods to increase water availability (e.g. water and fog harvesting, runoff collection);
- Methods to improve water use efficiency in agriculture (e.g. drip irrigation, deficit irrigation, aquaponics farming system); and
- Water conservation techniques (e.g. water recycling, wastewater treatment, green infrastructure).

Some of the questions that guided the discussions around the aforementioned themes were:

- What are the trends in research and technology of efficient water use in the region?
- What progress has been made in developing or recovering techniques that support sustainable water use in the region?
- What are the strengths and weaknesses of the presented techniques and overall water management in the region?

As an outcome of the meeting, a comprehensive inventory of the regional sustainable water management techniques is currently in development in the form of a technical report. It will be made available on the project website. The publication presents a compilation of experiences from Brazil, Chile, Colombia, Costa Rica, Mexico, Peru and Venezuela, demonstrating the analysis and specific applications of various techniques.

Engagement through citizen science

Latin America: Workshop on citizen science and agro-climatic risk management

This workshop was co-organized by the Chilean Government, the British Council, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), and Chile’s National Institute for Vocational Education (El Instituto de Capacitación Profesional de Chile, INACAP) on 14 March, 2017 in Santiago, Chile. During the workshop, the history of citizen science (including typologies, management tools, pros and cons) and its comparison to conventional science was presented. In addition, citizen science tools for water quality management and agro-climatic risk management were discussed.

Following the workshop, a field visit was organized on 15 March 2017 to the Cachapoal watershed. The aim of the field visit was to learn about projects in the region and to apply different citizen science techniques to measure water quality.
Finally, on 16 March 2017, a half-day seminar on citizen science and agro-climatic risk management was organized. Following the presentations of three exemplary case studies on the application of citizen science, a panel discussion was held.

**LATIN AMERICA: Citizen science for water and drought management**

The second workshop on citizen science for water and drought management was held in Santiago, Chile on 24-28 September 2018. The objective of this seminar was to exchange and gather knowledge of different approaches for incorporating citizen science for data collection, data analysis, as well as decision and policy making in the Latin American and Caribbean region. Participants were asked to share their experiences with the topic. This workshop was part of the project “A Citizen Science Approach to Drought Risk Management in Peru and Chile”, supported by the Newton-Picarte Fund through the British Council as a delivery partner, carried out by Chile’s Ministry of Agriculture, through its Section of Emergencies and Management of Agricultural Risks, and within the framework of the UNESCO G-WADI programme. A cooperation network of the participating professionals was created as part of the G-WADI LAC programme.

**AFRICA: Leveraging science in water and climate information services to achieve the Sustainable Development Goals**

A workshop was held on “Leveraging science in water and climate information services to achieve the sustainable development goals” in Addis Ababa, Ethiopia, on 11 May 2017, involving a total of 23 participants. The workshop provided key messages on how to promote citizen science as an integral element to achieve the Sustainable Development Goals (SDGs), and how it can be used to monitor the progress on the SDGs by incorporating local observations, participation and transparency in state-led assessments.

The following topics were discussed: protecting the poor in vulnerable situations, strengthening resilience and adaptive capacity to water-related hazards, strengthening regional and international cooperation, and enhancing knowledge sharing.

The workshop was developed in partnership with the Natural Environment Research Council (NERC), the Economic and Social Research Council (ESRC) and the Ecosystem Services for Poverty Alleviation (ESPA) Programme, as part of the project “Adaptive governance of mountain ecosystem services for poverty alleviation enabled by environmental virtual observatories” (Mountain EVO).
Development of a global knowledge forum on water security and climate change

Achieving and maintaining water security is increasingly challenging under current climatic variability and projected climate change, especially in vulnerable areas such as mountainous and arid regions. Therefore, there is a need to identify pathways to integrate the science-based understanding of climate impacts on water security into mitigation and adaptation policies.

As a response, the Knowledge Forum on Water Security and Climate Change, organized by UNESCO-IHP in Paris, France, on 18-20 October 2017, had been designed to strengthen this process through keynote presentations to highlight scientific frontiers, opportunities and gaps in research and scientific uncertainties. It brought together researchers, practitioners, policy and decision makers, partners and collaborators working in the water sector to share knowledge, best practices and ideas for a sustainable water resources management under the impacts of global change. The participants engaged in the crucial discussion of water security in contribution to the Sustainable Development Goals (SDGs) and sustainable future more broadly.

The Knowledge Forum addressed water security under climate change by:

i) Identifying the gaps remaining in the science-policy dialogue on water security and water diplomacy;

ii) Highlighting the role of international networks and citizen science for multi-stakeholder communication;

iii) Identifying climate impacts and showcasing innovative solutions and adaptation strategies to address water security challenges; and

iv) Engaging in a dialogue on scientific challenges to achieve the water-related SDGs and the Paris Agreement, involving visions from young researchers and professionals.

As an outcome of the meeting, scientific frontiers, opportunities, gaps in research and scientific uncertainties were identified. Furthermore, knowledge and best practices were shared to help address the most pressing water challenges under global change, highlighting the contribution from young researchers and professionals. Communication among multiple stakeholders was also strengthened using a participatory approach and by identifying priorities, capacities and funding needs. Finally, the meeting served as an opportunity to strengthen synergies and collaboration among IHP and partners, as well as to provide guidance for further action on water security, following the recommendations made during the sessions.
Outreach activities

Exhibition “Climate change impacts on mountain regions of the world”, COP20, Lima, Peru, December 2014

On the occasion of the United Nations Framework Convention on Climate Change’s 20th Conference of the Parties (COP20), the exhibition “Climate change impacts on mountain regions of the world” was organized by UNESCO-IHP and the Man and the Biosphere Programme (MAB) of UNESCO in Lima, Peru, in December 2014. The exhibition showcased satellite images of different mountain regions worldwide, many of which are designated UNESCO Biosphere Reserves and World Heritage sites. It also highlighted the implications of climate change for mountain ecosystems, water resources and livelihoods.

- Event details
- Catalogue
- Exhibition Panels

Session on the water security project and high level panel during the 7th World Water Forum, South Korea, April 2015

During the 7th World Water Forum in South Korea, a session “Data and products to address flood and drought challenges: case studies from the UNESCO G-WADI Programme” was organized on 14 April 2015 to highlight the data and products developed in the framework of the project.

In addition, a high level panel on “Water security and sustainable development: co-operation among disciplines and stakeholders” was organized by UNESCO-IHP in South Korea on 16 April 2015. It emphasized the importance of cooperation among disciplines and incorporation of scientific findings into social, economic and political processes to address water security challenges and accelerate progress to achieve the SDGs.
Exhibition “Mountains: Early warning systems for climate change”, COP21, Paris, France, November – December 2015

In collaboration with UNESCO’s Man and the Biosphere Programme (MAB), and with the support of the Permanent Delegation of the French Republic to UNESCO and the Flanders Fund-in-Trust (FUST), UNESCO-IHP organized the exhibition “Mountains: early warning systems for climate change” to raise awareness on the impacts of climate change in mountains and potential adaptation approaches, as well as to disseminate scientific data to policy and decision makers, diplomats and the general public during the 21st United Nations Climate Change Conference (COP21), held in Paris, France, from 30 November to 11 December 2015.

Using satellite images, aerial and ground level photography and descriptive texts, the exhibition explained the diverse climate change impacts on mountain ecosystems, glaciers, water resources and ecosystem services. Case studies were used to illustrate both impacts and adaptation solutions, coming mainly from UNESCO sites: Biosphere Reserves and World Heritage sites.

The exhibition was part of the celebrations of the 70th anniversary of UNESCO and the 50th anniversary of UNESCO’s water programmes. In this context, the launch took place on 2 November 2015 at UNESCO Headquarters during the 38th session of the General Conference of UNESCO, addressed by Ms. Irina Bokova, Director-General of UNESCO; H.E. Mr Filip D’havé, General Representative of the Government of Flanders to UNESCO; and H.E. Mr Philippe Lalliot, Ambassador, Permanent Delegate of the French Republic to UNESCO.

The panels were first displayed at UNESCO Headquarters and later moved to Cité internationale universitaire de Paris (Ciup), which enabled a wide public, from students to member states representatives, to see the exhibition. The visibility was enhanced by making a virtual exhibition available online, and by publishing a catalogue of the panels. A teaser presenting the exhibition and the motivation behind it was also developed in collaboration with GRID-Arendal.

👩‍💻 Video teaser “Mountains: early warning systems for climate change”
Data, tools and methodologies to address water resources challenges, COP21, Paris, France, December 2015

An entire day was dedicated to the theme of water and climate change at the Paris Climate Conference COP21 on 2 December 2015, as UNESCO presented the tools, methodologies and applications that were developed in coordination with several category 2 centres to address flood and drought challenges in Asia, Africa and Latin America. In addition, in the forefront of COP21, the World Glacier Monitoring Service (WGMS) and UNESCO jointly launched a Glacier App for mobile devices, which provides scientific information on worldwide glacier changes. The application features a map interface which provides the user with access to glacier-related data, including historical trends and recent developments in size and elevation of worldwide glaciers, as well as changes in their length and volume.

Launch of Publications, COP24, Katowice, Poland, December 2018

During COP24, the key publication of the project, “Climate Risk Informed Decision Analysis (CRIDA): Collaborative Water Resources Planning for an Uncertain Future”, as well as the “The Andean Glacier and Water Atlas: the impact of glacier retreat on water resources” (outcome of the project “The Impact of Glacier Retreat in the Andes: International Multidisciplinary Network for Adaptation Strategies”) were launched in Katowice, Poland. The CRIDA publication was presented during a dedicated event “Decision-making under uncertainty for water resources management: CRIDA approach with IHP case studies” on 6 December 2018, co-led by UNESCO-IHP and the Alliance for Global Water Adaptation (AGWA). The event was convened in the form of a lecture given as part of the Climate Classroom session organized at COP24. The lecture highlighted CRIDA case studies and other citizen science approaches which advocate moving away from the ‘one size fits all’ approach, and to pursue locally embedded solutions to the specific threats to water insecurity due to climate and other global changes. Another CRIDA launch event was held on 12 December 2018 during the American Geophysical Union (AGU) fall meeting that took place from 10-14 December 2018 in Washington, D.C., USA.

PHOTO 15
Lecture during the climate classroom session at COP24, Poland, 2018
Key publications

**A Stress Test for Climate Change Impacts on Water Security: Case Study From the Limarí Watershed In Chile**  
*(Published In 2020)*

The publication provides an example application of a climate stress test for a pilot watershed of Limarí, Chile to identify water insecurity hazards under climate change projections. Using a Climate Risk Informed Decision Analysis or CRIDA approach, a stakeholder analysis was performed to identify performance indicators and the critical thresholds beyond which significant economic impacts occur.

[https://unesdoc.unesco.org/ark:/48223/pf0000373781?posInSet=1&queryId=bbd9712b-43d7-4b7d-814b-a7ab04179c04](https://unesdoc.unesco.org/ark:/48223/pf0000373781?posInSet=1&queryId=bbd9712b-43d7-4b7d-814b-a7ab04179c04)

**The Midsummer Drought Atlas for Central America and the Caribbean**  
*(Published in 2018)*

The publication, available in Spanish, provides an overview of the Midsummer Drought (Canícula), its causes, impacts and frequency. UNESCO-IHP and its Category 2 Centre, CAZALAC, engaged with the member states to identify the characteristics of the Midsummer Drought in the region by identifying the frequency of the most damaging events, as well as assessing its spatial extent and inter-annual variability. Through a literature review, current knowledge of its origin and drivers are explored. An English translation of the publication is currently underway.

[https://unesdoc.unesco.org/ark:/48223/pf0000266144?posInSet=1&queryId=d55e1267-5cd7-40ad-855c-7c9fbeb632d3](https://unesdoc.unesco.org/ark:/48223/pf0000266144?posInSet=1&queryId=d55e1267-5cd7-40ad-855c-7c9fbeb632d3)

**The Latin American and Caribbean Drought Atlas**  
*(Published in 2018)*

In 2018, UNESCO and CAZALAC released the Drought Atlas for Latin America and the Caribbean in Spanish (Atlas de Sequías de América Latina y el Caribe). The publication contains 12 continental maps showing the minimum expected precipitation for return periods from 2 to 100 years. The Atlas is thus designed to help planners and managers to evaluate the frequency of a severe meteorological drought (such as one characterized by an annual precipitation of less than or equal to 40% of a normal year). Drought return periods for Chile and Peru, expressed as either a 20%, 40%, 60% or 80% deficit compared to mean precipitation amounts, are presented in graphs and maps. The publication is available in Spanish.

[https://unesdoc.unesco.org/ark:/48223/pf0000265894](https://unesdoc.unesco.org/ark:/48223/pf0000265894)
**Climate Risk Informed Decision Analysis (CRIDA): collaborative water resources planning for an uncertain future**  
*(Published in 2018)*

The publication introduces the CRIDA approach and elaborates on the different steps that this bottom-up methodology entails. The CRIDA methodology has been developed for water resources decision makers and stakeholders and aims to include the uncertainties about future conditions in the planning and decision making process in order to improve resilience. This publication was co-published by UNESCO and ICWARM.

https://unesdoc.unesco.org/ark:/48223/pf0000265895 (English)  
https://unesdoc.unesco.org/ark:/48223/pf0000375241 (Spanish)

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**The Andean glacier and water atlas: the impact of glacier retreat on water resources**  
*(Published in 2018)*

The water security project built upon the efforts of the project “The impact of glacier retreat in the Andes: International Multidisciplinary Network for Adaptation Strategies”, and as such, contributed to the promotion of the Andean Glacier and Water Atlas, which focuses on the status of water resources in the Andes, published jointly by UNESCO and GRID-Arendal. The Atlas illustrates the significant reduction in glacier mass happening throughout the region, and provides specific recommendations on addressing the issues of water vulnerability and security. It is available both in English and Spanish.

https://unesdoc.unesco.org/ark:/48223/pf0000265810

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**Key outcomes of the inception workshop: addressing water security – climate impacts and adaptation responses in Africa, Americas and Asia**  
*(Published in 2016)*

This publication was developed to summarize the main outcomes of the inception meeting “Addressing Water Security: Climate Impacts and Adaptation Responses in Africa, Americas and Asia”, which took place on 9-10 February 2015 at UNESCO Headquarters in Paris, France. The inception meeting was organized with potential partners aiming at launching a discussion on the establishment of a Global Knowledge Forum on water security by building on already established networks, know-how and experiences.

https://unesdoc.unesco.org/ark:/48223/pf0000243994
Websites and phone applications

Knowledge Forum on Water Security and Climate Change

Water security cannot be reached without the development of adequate human and institutional capacities, both inside and outside of the water sector. Therefore, a “Knowledge Forum on Water Security and Climate Change” website was established, serving as a repository of data and knowledge generated in various projects. The website increased the visibility of the water security project and contributed to outreach and dissemination by highlighting its main activities and outcomes. It is available in English.

http://en.unesco.org/water-climate-knowledge-forum

Glacier App

In the build-up to COP21 in Paris, France, in December 2015, UNESCO and the World Glacier Monitoring Service (WGMS) jointly launched a Glacier App for mobile devices. The tool provides access to real-time glacier information around the world.

https://wgms.ch/
The project in numbers
Detailed overview of activities and partners

1. **International workshop “Climate change impacts on snow, glacier and water resources: multidisciplinary network for adaptation strategies”**

   **Location:** Koblenz, Germany
   **Date:** 6-7 November 2014
   **Countries:** Austria, Canada, Chile, China, France, Germany, Nepal, Netherlands, Switzerland, USA
   **Co-organization:** UNESCO, International Centre for Water Resources and Global Change (ICWRGC)

   **Description:** The workshop emphasized the importance of cooperation between scientists, governments and different sectors of the society, and identified recommendations to enhance the interface between science and policy to develop sustainable adaptation strategies. The workshop presented case studies, which considered geographic hotspots of particular concern such as melting glaciers. Finally, the workshop identified key issues to be addressed to enhance resilience to global change, particularly climate change, through improved understanding of vulnerabilities, opportunities and potentials for adaptation, and the development of strategies and policies based on scientific/evidence-based knowledge in major mountain regions of Africa, Asia, Europe, and Americas.

   **16 participants** attended the meeting.

2. **Inception workshop “Addressing water security. Climate impacts and adaptation responses in Africa, Americas and Asia”**

   **Location:** Paris, France
   **Date:** 9-10 February 2015
   **Countries:** Austria, Belgium, Canada, China, France, Germany, Greece, Italy, Kazakhstan, Norway, Mexico, Peru, Switzerland, UK, Uruguay, USA
   **Organization:** UNESCO
   **Participation:** Global Energy and Water Exchanges (GEWEX), International Network for Alpine Research Catchment Hydrology (INARCH), World Glacier Monitoring Service (WGMS)

   **Description:** High-level hydrologists, water resources experts, policymakers, members of the IHP network, UN institutions and other stakeholders from around the world were selected and invited to attend this meeting based on their expertise on water security issues. The specific objectives of the meeting were to develop a partnership mechanism and projects to contribute to the vulnerability assessment and to map existing implementation of adaptation strategies in vulnerable regions. Furthermore, the goal was to raise awareness on potential impacts of climate change on water resources by benefiting from the experience of invited experts and different case studies on effective adaptation strategies. During this event, the framework and objectives of the project were presented to potential partners with a view to identify mechanisms and ideas for collaboration, as well as to develop a dedicated action plan.

   **40 participants** attended the meeting.
3 Workshop “Drought management in the Andean region”

**Location:** Cartagena, Colombia  
**Date:** 30 June-3 July 2015  
**Countries:** Argentina, Bolivia, Chile, Costa Rica, Honduras, Peru  
**Organization:** UNESCO

**Description:** During this workshop, water managers from pilot watersheds in different pilot countries were trained in the application of near-term climate scenarios to assess water resource vulnerabilities, which led to the development of national projections on a range of different water resource challenges.

4 International workshop “Development of near-term climate scenarios (2020–2035) for vulnerable watersheds to climate variability at the inter-annual, decadal and climate change time scales”

**Location:** Cartagena, Colombia  
**Date:** 18-21 August 2015  
**Countries:** Argentina, Bolivia, Chile, Colombia, Costa Rica, Honduras and Peru  
**Co-organization:** UNESCO, Regional Water Centre for Arid and Semi-Arid Zones of Latin America and the Caribbean (CAZALAC), International Research Institute for Climate and Society (IRI), Latin American Network of Knowledge Centres in the Water Sector (RALCEA), Spanish Agency for International Development Cooperation (AECID)

**Final meeting report:**  

**Description:** During this workshop, a step by step manual was established on the methodology to develop near-term climate scenarios using a practical case study of the Huasco basin in Chile. The participants were trained to generate medium-term climate scenarios, taking the historical information of each country into account, and allowing the identification of projected trends for their pilot basins. The SimGen model was used for this exercise and the first results of each country were discussed. The demand for this tool was confirmed for each present country, e.g. long term planning of water supply for irrigation or hydroelectric power applications, identification of threats to water security, incorporation of this methodology in university course material and identification of water availability at government level for the purpose of irrigation projects. Water managers from seven pilot countries were supported to use the case study as a course example and deliver similar outcomes for their pilot watersheds.

**17 participants** attended the meeting.
5 Workshop on groundwater monitoring and early warning

**Location:** Santiago, Chile  
**Date:** 9-11 November 2015  
**Co-organization:** UNESCO, Government of Chile, Regional Water Centre for Arid and Semi-Arid Zones of Latin America and the Caribbean (CAZALAC), Imperial College London, University of Birmingham  
**Description:** This workshop was organized with an objective to strengthen the capacities of Chilean professionals in groundwater monitoring and early warning with respect to groundwater drought hazards.  
**20 participants** attended the meeting.

6 Training workshop “Advances in water resources management in arid and semi-arid areas: a G-WADI approach”

**Location:** Khartoum, Sudan  
**Date:** 17-18 February 2016  
**Countries:** China, Egypt, Ethiopia, France, Germany, India, Japan, Niger, Nigeria, Senegal, Serbia, Sudan, UK, USA  
**Co-organization:** UNESCO, Global Network on Water and Development Information for Arid Lands (G-WADI), Water Research Centre of the Faculty of Engineering of the University of Khartoum, Regional Centre on Capacity Development and Research in Water Harvesting (RCWH), Sudanese Ministry of Water Resources, Irrigation and Electricity (MoWR), Sudanese National Commission for UNESCO  
**Description:** This training workshop was organized within the framework of the graduate college annual conference of the University of Khartoum. It consisted of four technical sessions addressed by thirteen experts from distinguished institutions worldwide. The trainees were drawn from various categories such as decision makers from the Ministry of Water Resources Irrigation and Electricity, academics and researchers from the Sudanese universities and research centres.  
**60 participants** attended the meeting.
Planning workshop of the water security project

**Location:** Brussels, Belgium

**Date:** 25 February 2016

**Countries:** Belgium, Bolivia, Chile, Ecuador, Germany, Norway, Peru, UK, USA

**Organization:** UNESCO

**Description:** The goal of this meeting was to present the achievements of the MWAR-LAC project on identifying drought vulnerability, capacity building on adaptive water management, monitoring and early warning of climate risks, and stakeholder outreach for strengthening resilience. The project activities were highlighted which helped securing impact by applying scientific work to support decision making at multiple levels, and by increasing partnerships within the scientific community across the states from the region, allowing embedding solutions in a science-policy framework. The workshop consisted of five thematic sessions: i) introduction and project overview, ii) climate change risk and vulnerability assessment in mountainous regions, iii) implementation of climate risk management, iv) adaptive water and soil conservation measures, and v) capacity building, outreach activities and the Global Knowledge Forum.

Training “Application of satellite remote sensing to support water resources management in Latin America and the Caribbean”

**Location:** Foz de Iguazú, Brazil

**Date:** 13-20 July 2016

**Countries:** Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, France, Germany, Guatemala, Honduras, Mexico, Panama, Paraguay, Peru, Uruguay, USA, Venezuela

**Description:** The objective of this training was to train professionals, water resources managers and representatives of governmental agencies and institutes on the current advances in remote sensing for water resources management, through a hands-on training using transferable examples from around the globe. 55 participants (19 women) attended the meeting.

**Co-organization:** UNESCO, International Water Security Network (IWSN), International Centre on Hydroinformatics (CIH), National Aeronautics and Space Administration (NASA), Laboratório de Análise e Processamento de Imagens de Satélites (LAPIS), Flemish Institute for Technological Research (VITO), Center of Excellence for Water Security in the Arid Americas (AQUASEC), International Center for Integrated Water Resources Management (ICIWaRM), European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)
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9 Seminar “Rainwater harvesting techniques: a tool to deal with water scarcity”

**Location:** Santiago, Chile  
**Date:** 9-10 March 2017  
**Countries:** Argentina, Aruba, Brazil, Chile, Colombia, Cuba, Ecuador, Honduras, Mexico, Nicaragua, Peru, Uruguay, USA  
**Co-organization:** UNESCO, Global Network on Water and Development Information for Arid Lands (G-WADI), Regional Water Centre for Arid and Semi-Arid Zones of Latin America and the Caribbean (CAZALAC)

**Description:** This regional workshop helped to identify the current status of water harvesting techniques and aquifer recharge in the Latin American and Caribbean region. Twenty-three case studies from twelve different countries of the region were presented, as well as some experiences from Australia and the United States.  
**122 participants (38 women)** attended the meeting.

10 Workshop “Citizen science and agro-climatic risk management”

**Location:** Santiago, Chile  
**Date:** 14-16 March 2017  
**Co-organization:** UNESCO, Government of Chile, British Council, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Instituto de Capacitación Profesional de Chile (INACAP)

**Description:** During this workshop, citizen science methodology and tools for water quality management and agro-climatic risk management were discussed.

11 Workshop “Leveraging science in water and climate information services to achieve the sustainable development goals”

**Location:** Addis Ababa, Ethiopia  
**Date:** 11 May 2017  
**Countries:** Ecuador, Ethiopia, France, Germany, Kyrgyzstan, Nepal, Netherlands, United Kingdom, USA  
**Co-organization:** UNESCO, Consortium of the Project “Adaptive governance of mountain ecosystem services for poverty alleviation enabled by environmental virtual observatories” (Mountain EVO) by the UK Ecosystem Services for Poverty Alleviation (ESPA) Programme

**Description:** During this workshop, the use of citizen science was introduced and promoted as a tool to achieve and monitor the progress of SDGs.  
**23 participants (5 women)** attended the meeting.
12 **Technical regional workshop “Climate change risk in Africa: vulnerability assessment, early-warning and hydro-climatic expert assessment”**

**Location:** Niamey, Niger  
**Date:** 13-16 June 2017  
**Countries:** Botswana, Burkina Faso, Chad, France, Gambia, Ghana, Guinea, Italy, Ivory Coast, Kenya, Nigeria, Senegal, Sudan, USA  
**Co-organization:** UNESCO, AGRHYMET Regional Center, Global Network on Water and Development Information for Arid Lands (G-WADI), International Center for Integrated Water Resources Management (ICIWaRM), Joint Research Centre (JRC) of the European Commission  

**Description:** The main objective of the workshop was to enhance the understanding of climate change risk in Africa following the state of the art knowledge, to share experiences on climate risk management, to reinforce the capacities of the participants on several climate risk evaluation methods, and to formulate recommendations to improve water security in the African region.  

**40 participants (3 women)** attended the meeting.

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13 **Workshop “Building resilience to climate change risk and vulnerability to meet water security challenges”**

**Location:** Langkawi, Malaysia  
**Date:** 10-11 July 2017  
**Countries:** Australia, Indonesia, Iran, Japan, Malaysia, Namibia, Nepal, Nigeria, Pakistan, China, Philippines, Sudan  
**Co-organization:** UNESCO’s Intergovernmental Hydrological Programme (IHP), UNESCO Jakarta Regional Science Bureau for Asia and the Pacific, Malaysia-UNESCO Cooperation Programme (MUCP), Malaysia Funds-In-Trust (MFIT), River Engineering and Urban Drainage Research Centre (REDAC)  

**Description:** The objective of the workshop was to improve understanding on the impact of climate change on water resources and water-related disasters. During the workshop, best practices on climate risk management were introduced through lessons learned from case studies.  

**34 participants (14 women)** attended the meeting.
14 Regional workshop “Development of the Midsummer Drought Atlas for Central America and the Caribbean”

**Location:** Antigua, Guatemala  
**Date:** 24-28 July 2017  
**Countries:** Belize, Chile, Costa Rica, Cuba, Dominican Republic, El Salvador, France, Guatemala, Honduras, Panama, Mexico, Nicaragua

**Co-organization:** UNESCO, Global Network on Water and Development Information for Arid Lands (G-WADI), Spanish Agency for International Development Cooperation (AECID), Banco Interamericano de Desarrollo (BID), Latin American Network of Knowledge Centres in the Water Sector (RALCEA)

**Description:** During this workshop, the methodology for the development of the Midsummer Drought Atlas for Central America and the Caribbean was discussed. The objective was to strengthen the capacities of the national hydro-meteorological agencies in the region to identify the frequency, duration and intensity of the Midsummer Drought, through the development of a regional Midsummer Drought Atlas based on available national precipitation data sets.  

23 participants (8 women) attended the meeting.

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15 Launch event of the Chilean Agroclimatic Observatory

**Location:** Santiago, Chile  
**Date:** 28-29 August 2017  
**Co-organization:** UNESCO, Chilean Ministry of Agriculture, NASA DEVELOP National Program, British Council, Adaptation Fund

**Description:** During this meeting, the Chilean Agroclimatic Observatory was officially launched as a tool to migrate from disaster management towards climate risk management, in line with the Sendai framework for Disaster Risk Reduction.
16 Knowledge Forum on water security and climate change: innovative solutions for sustainable water resources management.

**Location:** Paris  
**Date:** 18-20 October 2017  
**Countries:** Belgium, Bolivia, Canada, Chile, China, France, Germany, Indonesia, Italy, Japan, Kazakhstan, Kenya, Netherlands, Niger, Norway, Paraguay, Poland, Senegal, Serbia, South Korea, Sudan, Sweden, Switzerland, Turkey, UK, Uruguay, USA, Zimbabwe  
**Co-organization:** UNESCO  
**Description:** During this meeting, scientific frontiers, opportunities, research gaps and scientific uncertainties were identified, and knowledge and best practices were shared to address the most pressing water challenges under global change, highlighting the contribution from young researchers and professionals.  
**80 participants (24 women)** attended the meeting.

17 Workshop “Application of remote sensing to support the management of hydrographic watersheds in Latin America and the Caribbean”

**Location:** Foz de Iguazú, Brazil  
**Date:** 29 November-6 December 2017  
**Countries:** Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Guatemala, Honduras, Mexico, Panama, Paraguay, Peru, Uruguay and Venezuela  
**Organization:** UNESCO  
**45 participants (15 women)** attended the meeting.  
**Description:** This 10-day training course was designed as a follow-up activity to the previous workshop held in 2016, and aimed at advancing conceptual and practical training in remote sensing applications for water resources management. Capacities of water professionals and researchers were strengthened on the use of different remote sensing data to study the characteristics of water basins to support policy and decision-making.
18 International seminar on water harvesting techniques

**Location:** Khartoum, Sudan  
**Date:** 26-28 September 2018  
**Countries:** Egypt, Ethiopia, India, Kenya, Pakistan, Rwanda, South Africa, Serbia, Sudan, Tanzania, Tunisia, USA  
**Co-organization:** UNESCO’s Intergovernmental Hydrological Programme (IHP), UNESCO Khartoum Office, Regional Centre on Capacity Development and Research in Water Harvesting (RCWH), Global Network on Water and Development Information for Arid Lands (G-WADI), Sudanese Ministry of Water Resources, Irrigation and Electricity (MoWR) and Sudanese National Commission for Education, Science and Culture (NATCOM)  
**Description:** The objective of this seminar was to exchange and gather knowledge on the use, implementation and design of different water harvesting techniques in Africa and the Arab regions. Participants were asked to share their experiences on this topic and the difficulties encountered. In addition to expanding the network of water harvesting experts, the activity also contributed to global cooperation and knowledge transfer and exchange.  
62 participants (12 women) attended the meeting.

19 International seminar “Citizen science for water and drought management”

**Location:** Santiago, Chile  
**Date:** 24-25 September 2018  
**Countries:** Ten Latin American and Caribbean countries  
**Co-organization:** UNESCO, Chilean Ministry of Agriculture, British Council, Newton-Picarte Fund, Global Network on Water and Development Information for Arid Lands (G-WADI)  
**Description:** The objective of this seminar was to exchange and gather knowledge of different approaches for incorporating citizen science in data collection, data analysis, as well as decision and policy making in the Latin American and Caribbean region.  
25 participants attended the meeting.
Central American and Caribbean workshop on sub seasonal-to-seasonal predictability of the Midsummer Drought

**Location:** Antigua, Guatemala

**Date:** 3-7 December 2018

**Countries:** Bahamas, Barbados, Belize, Chile, Colombia, Costa Rica, Cuba, El Salvador, Granada, Guatemala, Guyana, Honduras, México, Nicaragua, Peru, Saint Vincent and the Grenadines, USA, and Venezuela.

**Co-organization:** UNESCO, International Research Institute for Climate and Society (IRI), International Centre for Theoretical Physics (ICTP), International Center for Tropical Agriculture (CIAT) on behalf of the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) for Latin America, Spanish Agency for International Development Cooperation (AECID)

**Description:** The objective of the workshop was to strengthen the capacities of the participants, particularly the representatives of national hydro-meteorological agencies from Central America and the Caribbean, with regard to their understanding of Midsummer Drought characteristics. The Midsummer Drought, or Canícula, present in several locations of Central America and the Caribbean basin, is of paramount importance for water and food security, and information on its occurrence, onset and demise is required by decision-makers in multiple sectors. During this workshop, the participants were trained on adequate tools to monitor and analyse the Canícula’s characteristics and to assess its subseasonal-to-seasonal (S2S) predictability.

45 participants attended the meeting.

Capacity building on the drought atlas for pilot African countries

**Location:** Paris, France

**Date:** 22-26 October 2018

**Co-organization:** UNESCO, Regional Water Centre for Arid and Semi-Arid Zones of Latin America and the Caribbean (CAZALAC), AGRHYMET Regional Center, International Center for Integrated Water Resources Management (ICIWaRM)

**Description:** The training contributed to improve climate risk management in pilot areas, with a specific focus to develop a concept of the African Drought Atlas, through capacity building of key African representatives from regional centres.

17 participants attended the workshop.
22 International training course “Remote sensing for water resources management in Africa”

**Location:** Pietermaritzburg, South Africa  
**Date:** 12-19 January 2019  
**Countries:** Angola, Botswana, Eswatini, Ethiopia, Lesotho, Malawi, Malawi, Mauritius, Namibia, Tanzania, South Africa, Zambia and Zimbabwe

**Co-organization:** UNESCO, University of the West of England (UWE Bristol) - Centre for Water, Communities and Resilience and the International Water Security Network, University of KwaZulu-Natal, South Africa, and the Institute of Natural Resources, Pietermaritzburg

**Description:** The aim of the meeting was to train water professionals, water resource managers and representatives of government agencies and other organisations in current remote sensing data sources and their application in water resources management, which is of direct relevance to their respective countries and regions.  
**30 participants (13 women)** attended the workshop.

23 Launch event of “The Latin American and Caribbean Drought Atlas”

**Location:** Santiago, Chile  
**Date:** 28 January 2019  
**Countries:** Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Honduras, Mexico, Paraguay, Peru and Venezuela

**Co-organization:** UNESCO, Chilean Ministry of Agriculture, International Center for Integrated Water Resources Management (ICIWaRM)

**Description:** The event launched the Drought Atlas for Latin America and the Caribbean in Spanish (Atlas de Sequías de America Latina y el Caribe), which raises awareness on exposure to drought throughout the Latin American and Caribbean region.  
**20 participants** attended the meeting.
A collaborative workshop to address an uncertain future

**Location:** Cape Town, South Africa

**Date:** 27-31 May 2019

**Countries:** Botswana, Eswatini, Lesotho, Mozambique, Namibia, South Africa, Zambia, Zimbabwe.

**Co-organization:** UNESCO, USAID’s Resilient Waters Program, International Center for Integrated Water Resources Management (ICIWaRM), Deltares, Stellenbosch University Water Institute (SUWI), and the NEPAD Water Centres of Excellence

**Description:** The objective of the workshop was to train stakeholders in the Southern African region on the use of the different steps of the Climate Risk Informed Decision Analysis (CRIDA), and to lay the groundwork for the development of a full project proposal to generate a CRIDA case study in the region to contribute to the CliMWaR project.

47 participants (18 women) attended the workshop.

Seminar “Towards sustainable water management in Latin America and the Caribbean: Exchange of experiences of methods to conserve water, increase water availability and improve water use efficiency”

**Location:** Lima, Peru

**Date:** 5-6 August 2019

**Countries:** Bolivia, Chile, Colombia, Costa Rica, Honduras, Jamaica, Mexico, Peru, Venezuela

**Co-organization:** UNESCO, Global Network on Water and Development Information for Arid Lands (G-WADI), Regional Water Centre for Arid and Semi-Arid Zones of Latin America and the Caribbean (CAZALAC) and the project “Water security and climate change adaptation in Peruvian glacier-fed river basins” (RAHU)

The aim of the seminar was to consolidate and collect available knowledge and to give a platform for sharing best practices towards sustainable water management in the Latin American and Caribbean region.

26 participants (6 women) attended the meeting.
References


ADDRESSING WATER SECURITY

Climate Impacts and Adaptation Responses in Africa, Asia, Latin America and the Caribbean

ACCOMPLISHMENT REPORT

The Accomplishment Report provides an overview of the main achievements of the project "Addressing Water Security: Climate Impacts and Adaptation Responses in Africa, Asia, Latin America and the Caribbean", implemented from 2014 to 2020 by UNESCO’s Intergovernmental Hydrological Programme (IHP) with the support from the Flanders Fund-in-Trust (FUST) for the support of UNESCO’s activities in the field of Science.

Main outcomes of the project include the development of the Climate Risk Informed Decision Analysis (CRIDA) – a bottom-up methodology for assessing the impact of climate uncertainty and change on water resources and developing resilient and flexible adaptation pathways. Publications such as "The Midsummer Drought Atlas for Central America and the Caribbean" and "The Latin American and Caribbean Drought Atlas" were also launched to provide drought-related information and help facilitate an effective implementation of strategies and policies to tackle these events and other water scarcity problems.