Fresh water is a vital resource for human life – not just for drinking, but also for agriculture, washing and many other activities. Water is among the key natural resources that is going to suffer from the impact of climate change. Some of the main questions that the water sector is forced to answer are how to improve the efficiency of water treatment and supply facilities; how to face different extreme weather conditions, such as drought or flooding scenarios; and how to increase the ratio of reused water. Analysing the effect of climate change in the water cycle is also required to start developing tools that will assist decision making.

The first Valencia E-Zine introduced the bio-physical characteristics of the Valencia region in Spain, as well as the main challenges for the water management and supply to the city of Valencia under climate change.

In October 2019, experts from all over the world reunited in Valencia to exchange knowledge in the context of the international workshop “Challenges and solutions for urban water supply in a changing climate and world”. The workshop gathered more than 80 participants and speakers from both a science and business background.

This E-Zine describes the main findings and lessons learned from this workshop by the Universitat Politècnica de València (UPV), the Climate Service Center Germany (GERICS) and Global Omnium.

Representatives from UPV, GERICS and Global Omnium during the workshop inauguration.
CITIES WATER SUPPLY AT RISK

The impact of climate and global change.

Urban water suppliers all over the world must adapt to the increasing weather variability and frequency of extreme events. The interaction between experts from the water utility companies, researchers and the authorities responsible of urban water supply, is key to ensure the adequate adaptation to the new climate scenario. The INNOVA international workshop aimed to promote the interaction between all these parts and gathered more than 80 participants from a scientific and business background. The international examples described technical innovations, experiences learned from extreme weather events and projects that are focused on improving the water security for cities. The workshop included a technical visit to the Global Omnium water treatment plant of “La Presa” and presentations from experts of the water utility companies operating in some of the main cities in Spain. More information and all presentations from the workshop can be found here.

PREDICTING THE EFFECT OF CLIMATE CHANGE ON WATER

Anticipating future trends is a key part for planning.

Knowing how climate change is going to affect us, is an essential element to design mitigation and adaptation strategies. Climate change impact on the continued supply of quality potable water is diverse and different depending on the geographic context and region of the world.

Having tools to predict future extreme meteorological events, such as flash floods in the Caribbean islands and in the State of Pennsylvania (USA), are essential to detect critical points in each hydrological system and to prioritize investments (Mr. Segre and Dr. Mejia, respectively). Such tools make it easier to understand trends in extreme events, and also assist with arguments for building or improving infrastructures such as reservoirs, the drainage capacity of watercourses or building contentions tanks to withstand flash floods. The use of such tools also allow water managers to test the existing capacity of the hydrological system to provide water during events such as droughts. Local researchers from the Valencia INNOVA hub have already showed how climate change will produce a severe reduction of the available water resources in the Jucar River basin (Spain) while increasing the regularity of extreme events such as flash floods and droughts.

Climate change is not only going to affect the amount of water available, but it also will have an impact on the water quality. Projects like WATExR (Mr. Mercado) predict the impact that climate extreme events will have on the raw water quality and aid the development of tools to support mid-term decision making in lakes, reservoirs and fisheries. The systems used to distribute drinking water will also be affected by climate change (as explained by Dr. Douterello, from United Kingdom). Her research focuses on studying the growth of microorganism in the water distribution pipes. The primary concern is the rise of microorganism growth rates in water supply systems caused by higher average temperatures. Changes in the abundance and the taxonomic composition of microorganisms can affect drinking water quality.

Pipe in Northwest England (Douterelo et al., 2014)
ROLE OF INNOVATION IN THE CLIMATE CHANGE ADAPTATION

Designing new solutions to tackle future challenges.

Innovation has a key role into the capability of humanity to answer new challenges. Examples of such innovation include the use of optical fiber to detect leaks in pressurized water networks, and the development of audio devices to estimate the domestic water use for each individual household in a big city. The use of optical fiber for leakage detection is an ongoing research presented by Ponz and Duran, from Global Omnium, to improve the efficiency of the Valencia water network.

Global Omnium has already been able to reduce leakage loses in the network by 18% thanks to the development of district metered areas (DMA) and the installation of flow meters and pressure gauges in strategic joints of the network. The data received is integrated into a Big Data & IoT Platform, achieving a centralized management and using advanced algorithms to detect leaks, frauds and meter alterations in real time and for each sector.

Additional innovations related to leak detection involves audio-detecting devices to collect, characterize and assign different frequencies and sound spectrums to domestic water uses, as presented by Dr. Cobacho, from UPV. This technology would allow to easily characterize water consumption with no interaction with the customers.

The same UPV team is developing algorithms to predict the service life of pipes based on easy to obtain data and historical records. Often, innovation is born from the use of well-known materials in unexpected ways. In this line, Dr. Martín (UPV), explained the key role that dewatered sludge -usually considered the unwanted leftover of water purification processes- can have to improve the efficiency of artificial wetlands.

Dewatered sludge in the Valencia water treatment plant.

The use of audio-detecting devices to characterize domestic water use is already being tested.
LEARNING FROM EXPERIENCE
How can the companies involved in water treatment, distribution and supply help shape the future?

Mediterranean regions have a climate characterized by warm temperatures and low precipitation. In this region, the drier seasons are often followed by flash floods in autumn and winter. Future climate scenarios predict extreme droughts and floods in the Mediterranean region to be more frequent and intense. Mediterranean cities such as València, Alicante and Barcelona are already adapting to the climate scenarios of the future. Representatives from the water utilities companies of these three cities participated in the international workshop.

The main goal of València’s water utility company is to guarantee the water quality and to improve the efficiency of the water supply network (Dr. Pedro). For this reason, they have installed a new water treatment using active carbon to remove taste and odor produced by microorganism in raw water. Model simulations project a rise in microorganism growth and concentration due to the increasing temperatures in the near future, hence the importance of researching techniques to remove them. The improvement of the water distribution network efficiency relates to the need of identifying critical points to reduce leakages.

Alicante city is located south of Valencia, in a dry area where water scarcity is perennial and flash floods occur in the rainy season periodically. For this reason, the city has built underground tanks to store excess rain water during the rainy season. The purpose of this storage facility is to reduce the flooding of the city and to retain water for later use. The rain water is pumped from the storage facility to the wastewater plant. Afterwards, clean rain water can be used to clean streets, irrigate farms, gardens and parks reducing the pressure on natural sources. In addition to the underground water deposit, Alicante has also developed nature-based surface water storage infrastructure, such as the La Marjal park. Normally, the multi-functional park serves as a recreation area for the people, but in the rainy season the park has the capacity to store as much water as 18 Olympic pools. The park, landscaped with native Mediterranean plants, has been rapidly populated by many species of birds, both resident and migratory. Water captured during heavy rainfalls is diverted to a treatment plant and is used for cleaning public areas.

In the case of Barcelona, the water authorities are trying to go one step further and by testing the use of reclaimed water. Reused wastewater is the process of converting wastewater into water that can be used for other purposes. Mr. Salguero, responsible of the office for the water cycle in the Barcelona Metropolitan Area, explained how they are re-introducing treated wastewater to the Llobregat and Ter Rivers. Both rivers have high purification potential and the reused water benefits the environmental state of the rivers while providing additional clean resources downstream. Reclaimed water also has direct uses such as agricultural and industrial use, public areas cleaning and the irrigation of public parks.
MANAGING CLIMATE EXTREMES
International examples of cities and regions facing extreme events such as drought and floods.

Extreme events can compromise the capacity of authorities to guarantee water supply to their inhabitants. Droughts and floods have forced many governments and local authorities to develop strategies quickly to mitigate their effects. During the Valencia workshop, three experts from South Africa, Taiwan and the United States of America presented the main lessons learned from their experiences.

Dr. Winter from the University of Cape Town (South Africa) explained the challenges and lessons learned from a drought that put the city of Cape Town 90 days away from running out of drinking water in 2018. Multiple causes were identified for the crisis, including the rapid urbanization and population growth of the city since the 90s, lack of adequate spatial planning and surface water been the source of the vast majority of the available resources. To cope with a drought that is currently ongoing, the water authorities of the region have developed an ambitious plan to diversify water supplies, increase the groundwater use and invest in desalination. The reuse of wastewater or reducing losses in the distribution network are other measures that the city is exploring.

Dr. Cheh-Shyh, national merit award by the National Water Agency of Taiwan in 2018, explained how the city of Kaohsiung is developing a project to use excess water from annual typhoons to recharge aquifers. This project will allow saving water and using it during droughts. The water stored in this way has better quality than surface water. Moreover, refilling aquifers helps reducing ground subsidence events that were frequent in the region. To help address both problems, authorities have built large infiltration lagoons.

Similar measures were applied in California (USA), as explained by Dr. Escriva from the Public Policy Institute of California. Escriva gave an overview of the different droughts that have taken place in California during the last 60 years. These events had a great impact on the social awareness to drought and motivated the definition of new strategies for managing water demand and saving water. The diversity of water sources (superficial, groundwater, reusability, desalination, etc.) was identified as the key to guarantee the supply in future. Resembling the conclusions reached in South Africa, but with decades of anticipation, California now has a varied portfolio of alternative sources of water to guarantee the supply in extreme drought conditions.

The artificial groundwater recharge project of Kaohsiung.

Dr. Escriva explained the lessons learned in California.
Climate services are an **essential tool** for the adaptation of public services and business to climate and global change. There are significant **opportunities** for developing climate services in the **water sector**, dedicated to key activities such as water supply. The water sector is going to experience challenges due to the increasing frequency of extreme events, such as droughts and floods. The expected **impact** is greater in the **Mediterranean region**, where climate extremes are already more frequent. The adaptation of water supply systems to the future climate scenarios requires a **multi-disciplinary approach** due to the spread factor of the climate impacts. Diversifying the water sources, paying attention to the issue of **water quality** under different climate conditions and introducing innovation for the **reuse** of water, dealing with flash floods in cities and increasing the efficiency of the distribution networks, are some of the key points identified during the workshop for the **adaptation** of the sector into the future.