Resilience of Water Systems as seen in IHP Activities

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"Resilience in Water Services"
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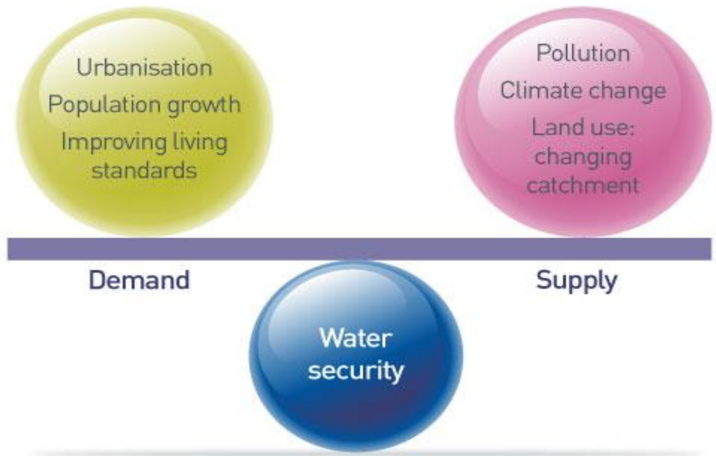
United Nations Educational, Scientific and Cultural Organization
International Hydrological Programme

Water and human settlements of the future

Theme 4

Water Security Definition

Capacity of a population to safeguard access to adequate quantities of water of 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 (floods, landslides, land subsidence and droughts)



Water Security: 21st Century key challenges

United Nations Educational, Scientific and Cultural Organization

International Hydrological Programme

85% of the human population live in arid and semi arid areas

6-8 million human beings are killed each year from water-related disasters and diseases.

750 million people lack access to safe water and 2.5 billion to adequate sanitation.

Water Security: 21st Century key challenges

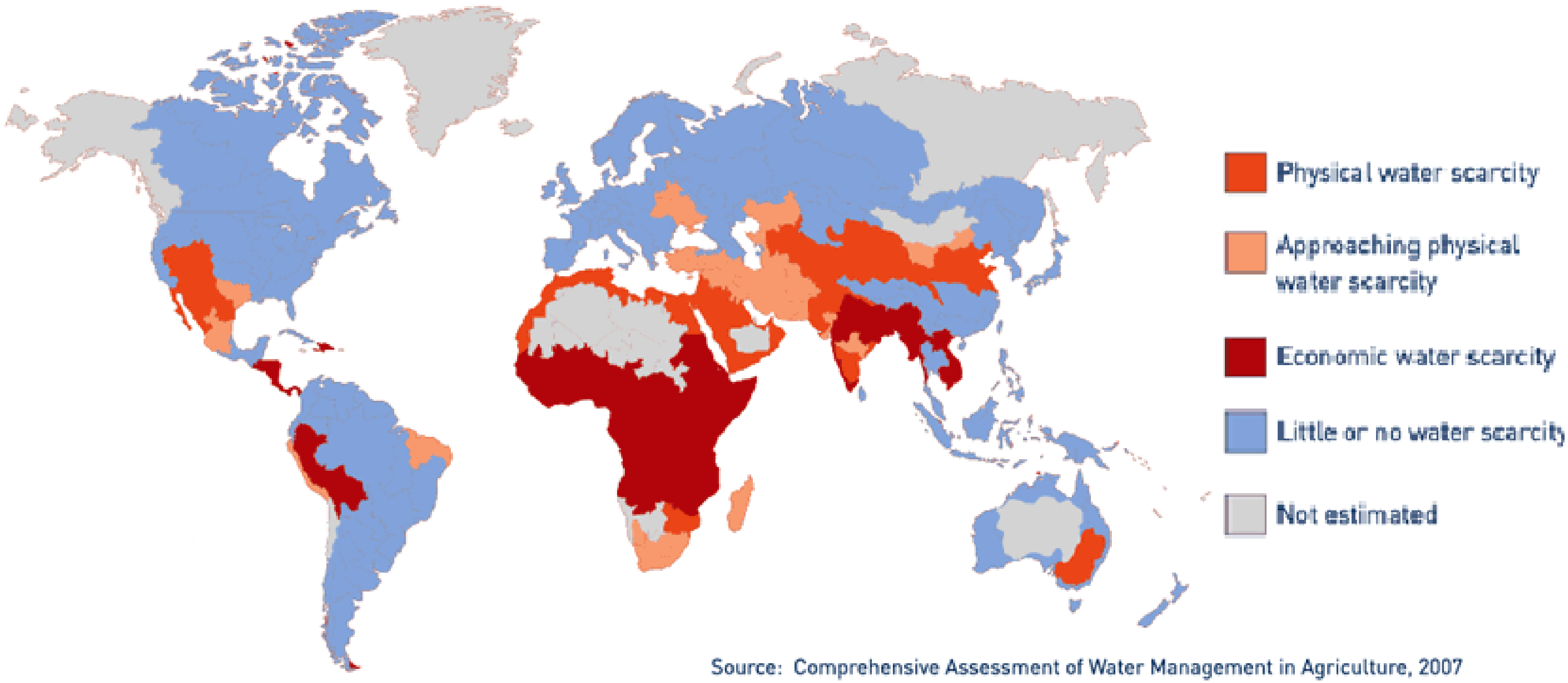
United Nations Educational, Scientific and Cultural Organization
International Hydrological Programme

Almost 85% of the world's total wastewater is discharged without adequate or any treatment.

In just thirty years, freshwater populations species declined by 50%

145 nations have transboundary river basins and there are 650 transboundary aquifers shared by 2-4 countries

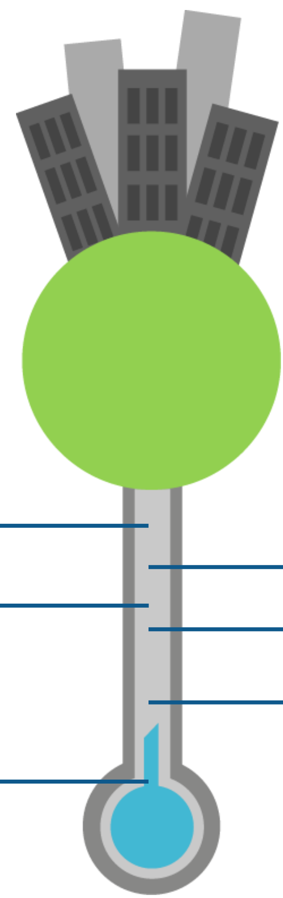
Water Scarcity & Water Security



Key Risks

Vulnerabilities and Risks: Water Uses – ex. Municipal Services

With more than half of the world population living in cities under conditions of climate change, water utilities are confronted with:



Less natural storage of water (ice melting and higher evapotranspiration)

Higher water availability variation and shift in timing of river flows

Higher water demand due to higher ambient and water temperatures

Higher competition for the resource

Higher pollution problems

Insufficient treatment capacity to deal with increased pollution problems

Resiliency & Risk

Resilience: The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.

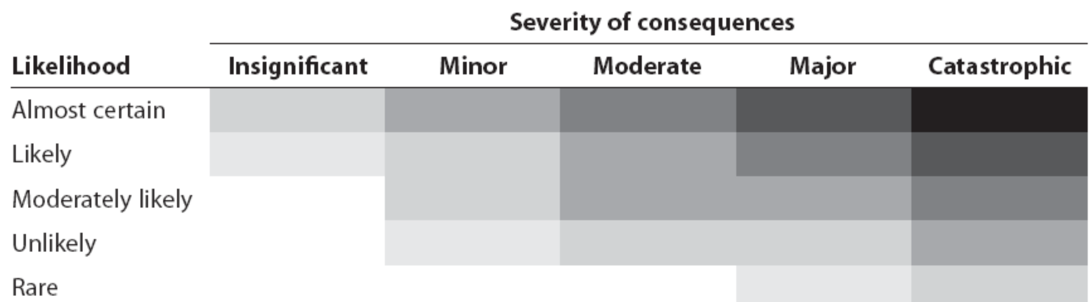


Table 4.3 Examples of definitions of likelihood and severity categories that can be used in risk scoring

Item	Definition
Likelihood categories	
Almost certain	Once per day
Likely	Once per week
Moderately likely	Once per month
Unlikely	Once per year
Rare	Once every 5 years
Severity categories	
Catastrophic	Potentially lethal to large population
Major	Potentially lethal to small population
Moderate	Potentially harmful to large population
Minor	Potentially harmful to small population
Insignificant	No impact or not detectable

WATER SUPPLY SECURITY

The likelihood of suffering large and persistent interruption of the water supply varies mainly according to:

- the geographical situation,
- the availability of the resource,
- the growing of the needs

PARADOXES

- The concern of the population with the water supply failure possibility is generally reversely proportioned to the level of service.
- Water infrastructure is generally very expensive, but most people consider that the acceptable cost for water supply should be very low.

Critical geographical conditions

- Low lands and flat zones (rivers deltas or coastal areas).- They are flood prone and experience tougher competition for water among municipal supply, navigation, agricultural and power generation users

- Mountain regions as elevated areas it is costly to raise water from lower basins to feed them. As result they depend on the water produced on their own basins (glaciers shrinking or lower precipitation)

- Arid and semiarid regions that already are under water stress conditions and therefore any additional factor increase critical conditions

RISK MANAGEMENT IN THE WATER SUPPLY: WHY?

- Pressure drops or interruption of water distribution may rapidly lead to sanitation problems and degradation of daily life; fire fighting is also a major issue.
- Ingestion, contact or breathing of polluted water may result in diseases and could cause death.

Whenever a drinking water supply service has suffered interruption of distribution, or insufficient pressure, or bad water quality water suppliers will be held responsible:

- for their lack of anticipation,
- for their lack of preparation,
- for their inappropriate or insufficient reaction

WHY RISK MANAGEMENT IN THE WATER SUPPLY: WHAT RISKS?

Water supply activity related risks:

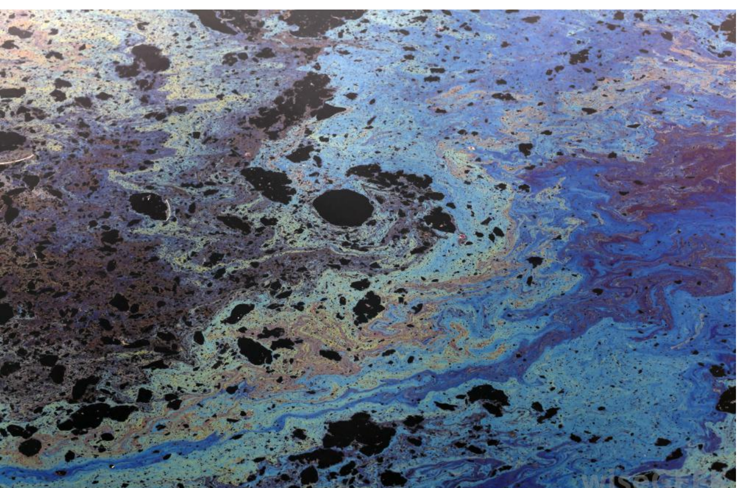
- pollutions, breaks, backflow….
  « part of the job »

Indirect risks as a result of interdependency:

- interruption of power supply, communications, …
- delivery failure of reagents,
- transportation strikes…

WHY RISK MANAGEMENT IN THE WATER SUPPLY: WHAT RISKS?

Natural Hazards depending on location and more or less predictable: potentially high level of damages.



Environmental Hazards: due to the proximity of potentially dangerous activities like chemical factories.

In a dangerous world, water supply is a potential target.

« An impossible situation is just a situation that has not occurred yet »

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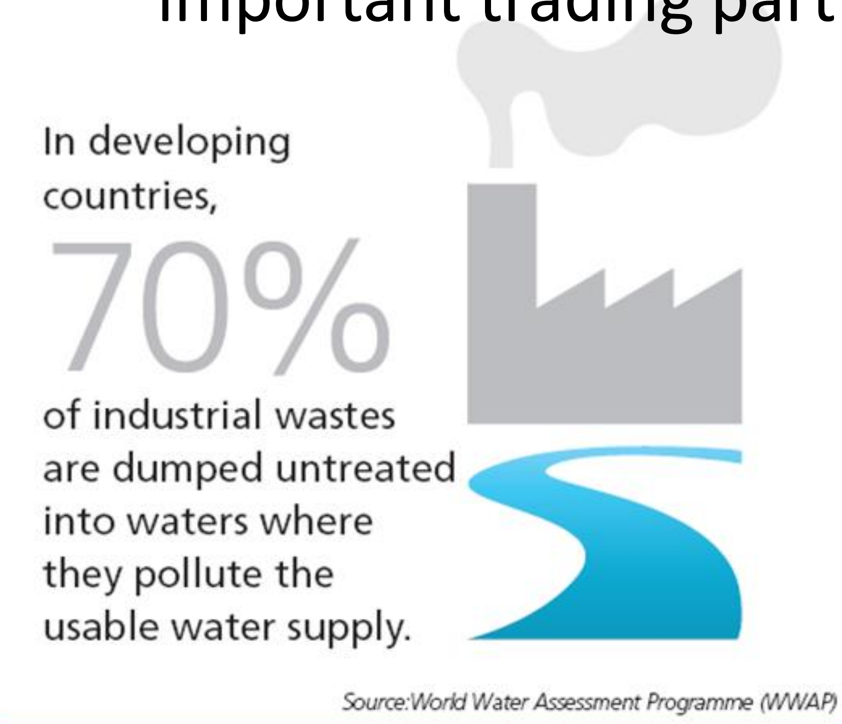
Key risks for the supply of water

- From now and through 2040 water shortages and **pollution** probably will harm the municipal supply of water but as well the economic performance of important trading partners

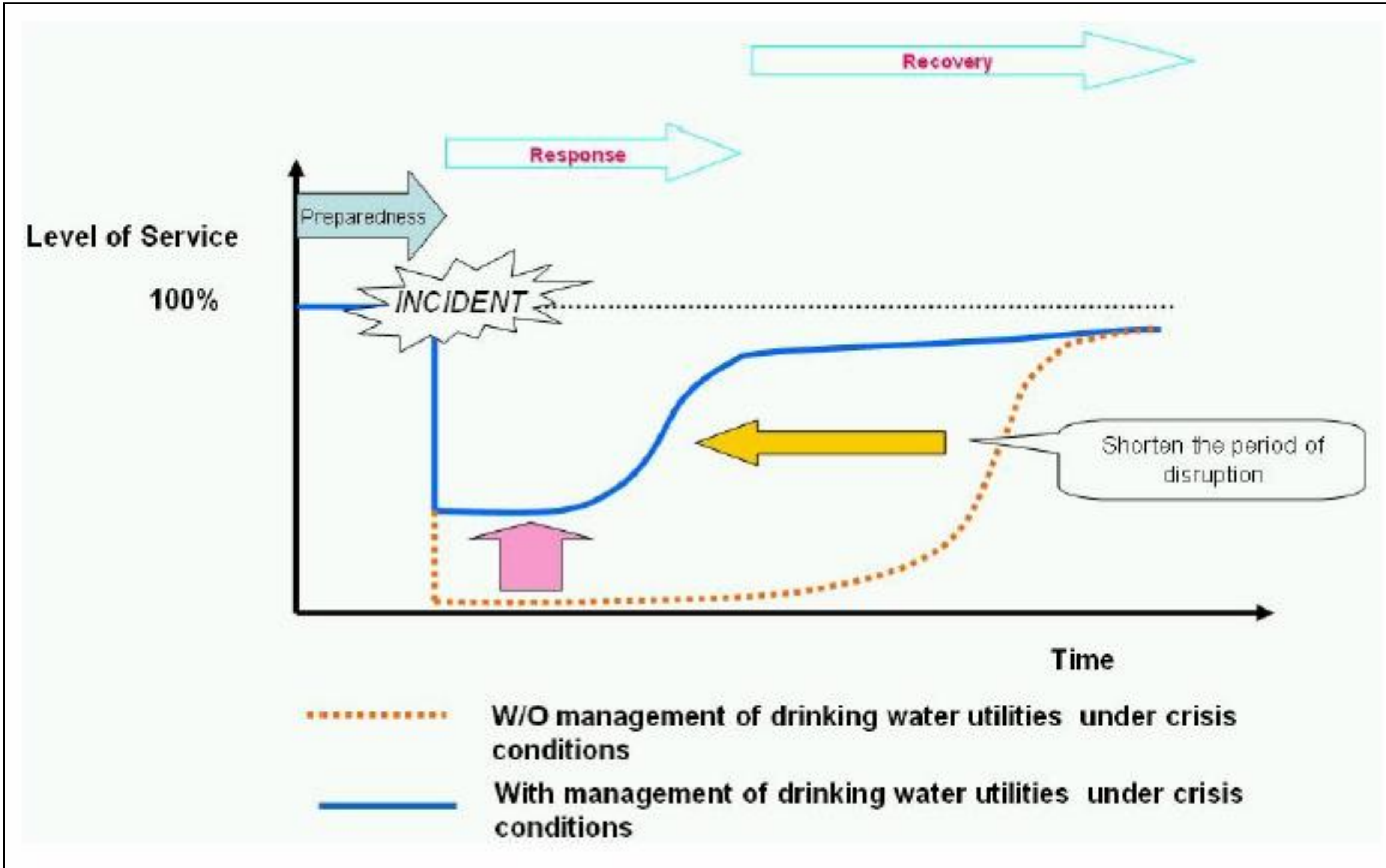


Drivers for resilience

- An event: realization of existing risks when a disaster happens and raises general awareness
- Legislation: new legislation imposing compliance with stricter standards, rules and regulations
- Political pressure: strong political will from the decision-makers’ side, or a strong pressure from the NGO’s side
- Others: depending on local cultural, environmental, economical, political or societal context.

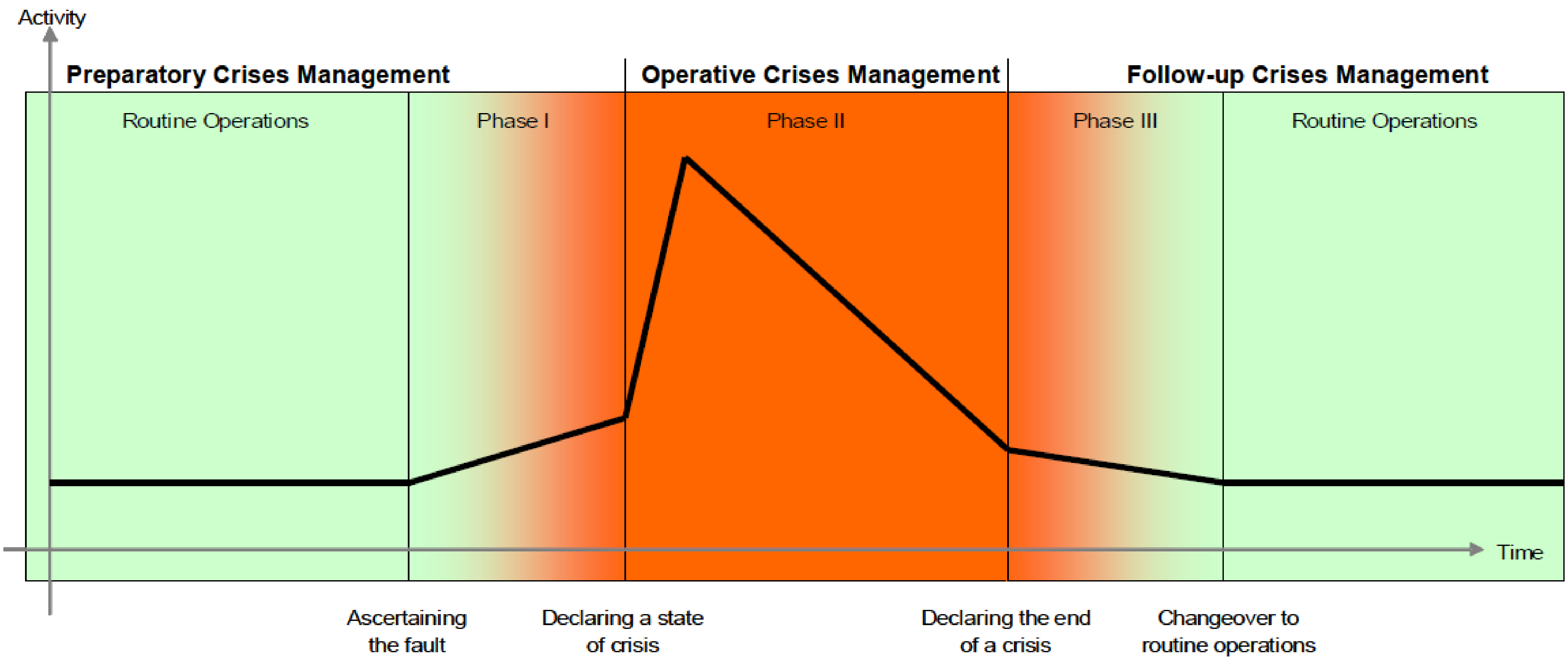
Steps to be taken

- Assess the risks
- Define priorities specific to water resiliency with objectives, targets, and indicators
- Take measures:
  - passive measures: affecting the infrastructure and the way it is operated
  - active measures: procedures and the capacity of the people to apply them
- Plans for crisis situations need to be put in place.



Recovery
Response
Preparedness
Level of Service
100%
INCIDENT
Shorten the period of disruption
Time
W/O management of drinking water utilities under crisis conditions
With management of drinking water utilities under crisis conditions

Resources Deployed in Mitigation



Infrastructure adaptation

- Infrastructure for supplying more drinking water complying to stricter regulation, in particular with regards to water quality including emerging pollutants; for collecting and treating wastewater and reducing direct discharges into the environment; for safely managing stormwater, and for developing reuse. In other words, quantity and quality: bigger and longer pipes, larger and better treatment and storage facilities.
- Infrastructure with more built-in intelligence capable of collecting and treating much more information than before (smart water systems, early warning systems, smart metering…).
- Better environmental-friendly infrastructure that at the same time reduce carbon footprint, and provide better living conditions to the neighborhood and other advantages as well. These include among others nature based solutions and green infrastructures.

Infrastructure adaptation

- More efficient and more resilient infrastructure considered globally with other service providers like energy, telecommunications, transports, wastes… Robust, redundant, repairable, and replaceable infrastructure has to be considered thoughtfully by urban planners and operators in order to keep or to improve the level of water services availability even during disturbed situations.
- Adaptation of existing water infrastructure has a high cost and high investment needs. Therefore, long-term planning and constant effort are required.

EXAMPLE OF IHP ACTIVITY TO PROMOTE WATER RESILIENCY IN WATER SYSTEMS

SMART WATER MANAGEMENT SYSTEMS

United Nations
Educational, Scientific and
Cultural Organization

International
Hydrological
Programme

Smart Management Systems for Urban Water Distribution

Smart Grids are a very efficient technology known and used in the energy industry

What are the challenges and priority needs for which Smart Grids are useful in the water industry?

Question asked to W-Smart Utilities

- ➔ Water losses reduction in the distribution pipe network by active leakage detection and repair.
- ➔ Pipe burst prevention and reduction of their social costs by efficient renewal of the conduits. Decision support system for crisis management.
- ➔ Prevention of water quality defaults identified by sampling analysis and customer's complaints.

Principles for Early Warning Systems

Early detection of incidents for proper response, accurate mitigation, and quick return to normal operation of drinking water systems

Water Quantity Incident

Water Quality Incident

Real time Monitoring

- Flow meters
- Customer meters

- Chlorine Sensors
- Others (many....)

3 steps

1. Cleaning of Raw Data,
2. Detection of Anomalies,
3. Raising of Alarms

Historical Database

Feasibility Assessment for Developing EWS

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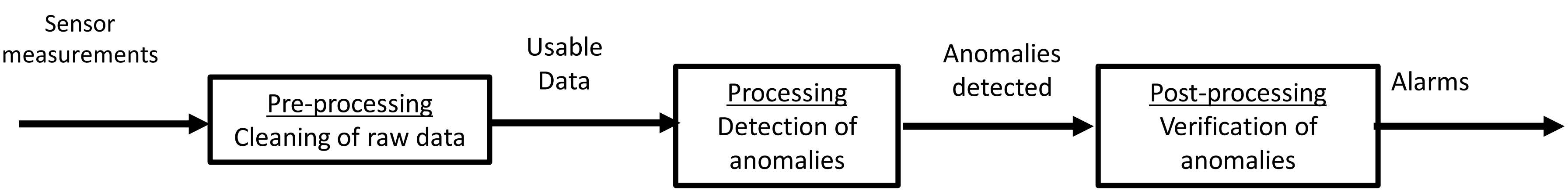
Leakages

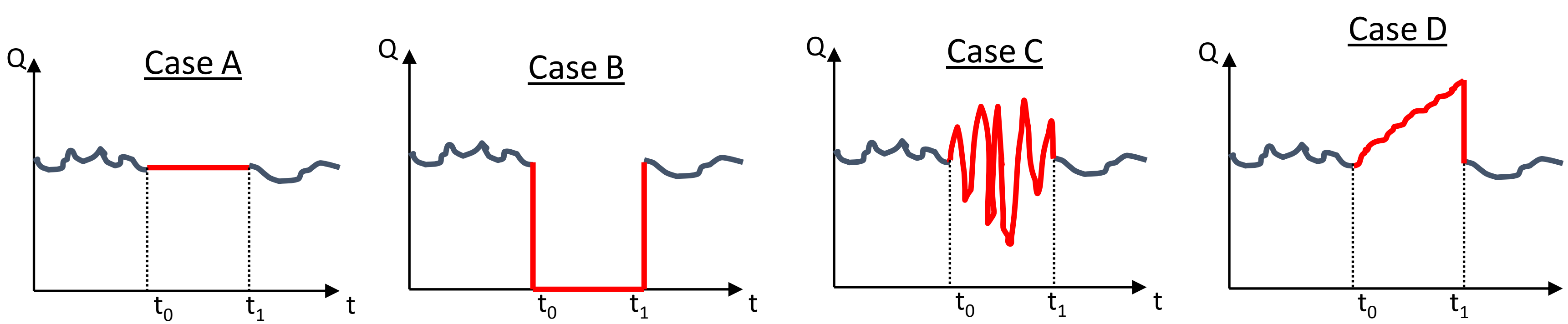
- Excellent availability of historical data (>20 years for many)
- 99 % of detected anomalies confirmed (real leakages, sensors defaults…)
- Algorithms using predictions of consumption, DMA-AMR comparison, and MNF (Minimum Night Flows) analysis.
- New methods for early detection of anomalies in water consumption time series.

Water Quality Events

- Limited availability of historical data (recent water quality sensors implementation in the water distribution network).
- Too few real drinking water bio contamination events; need for integration of all potential input.
- Focus on the signature of specific contaminations measured on multi water quality parameters.
- Look at contamination pattern signature on parameters, and its transformation as water flows and is measured downstream in the distribution network.

3 Steps Process for EWS using AI

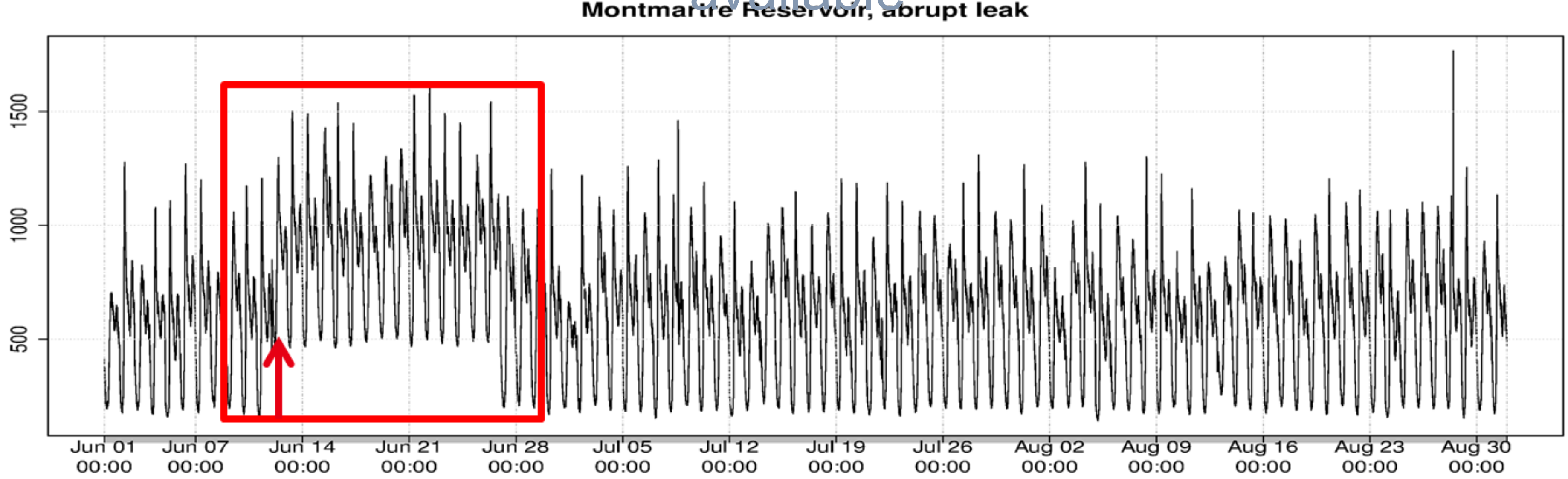


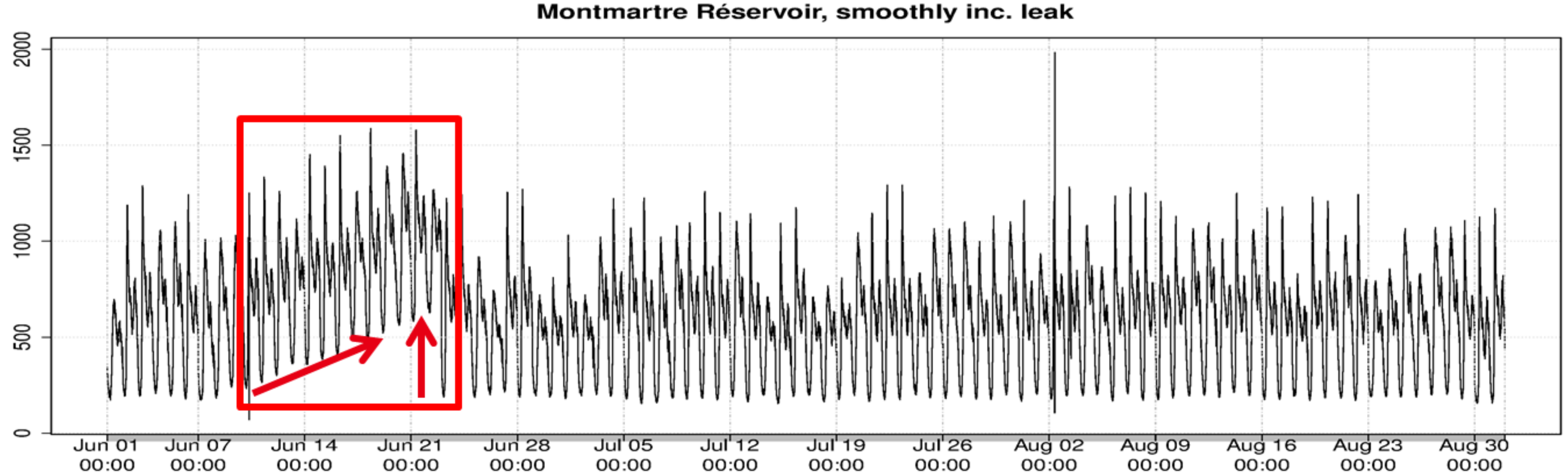


- t_1 is the intervention date when the sensor has been repaired.
- t_0 is the presumed date of apparition of the default.

Some examples of sensors' failures

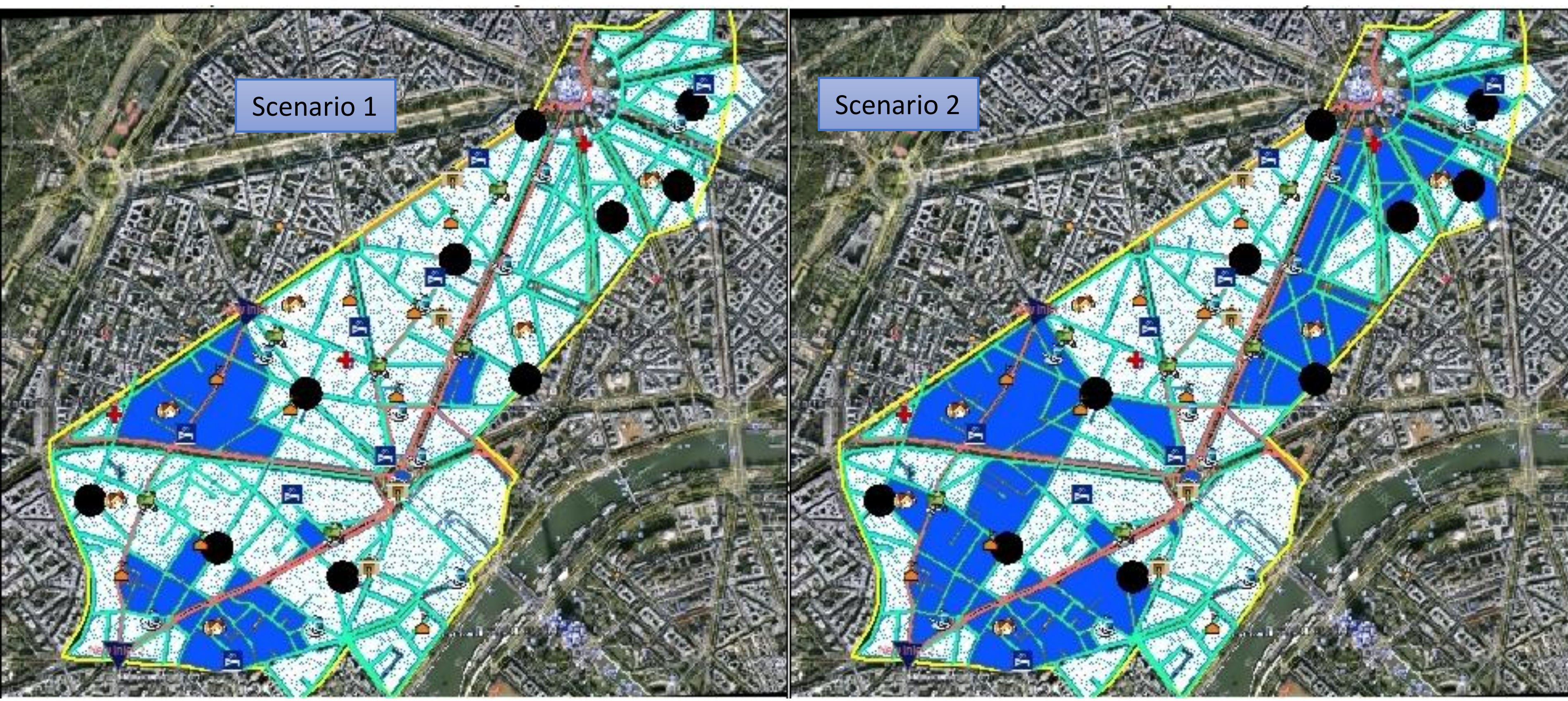
Early warning systems using latest tools available



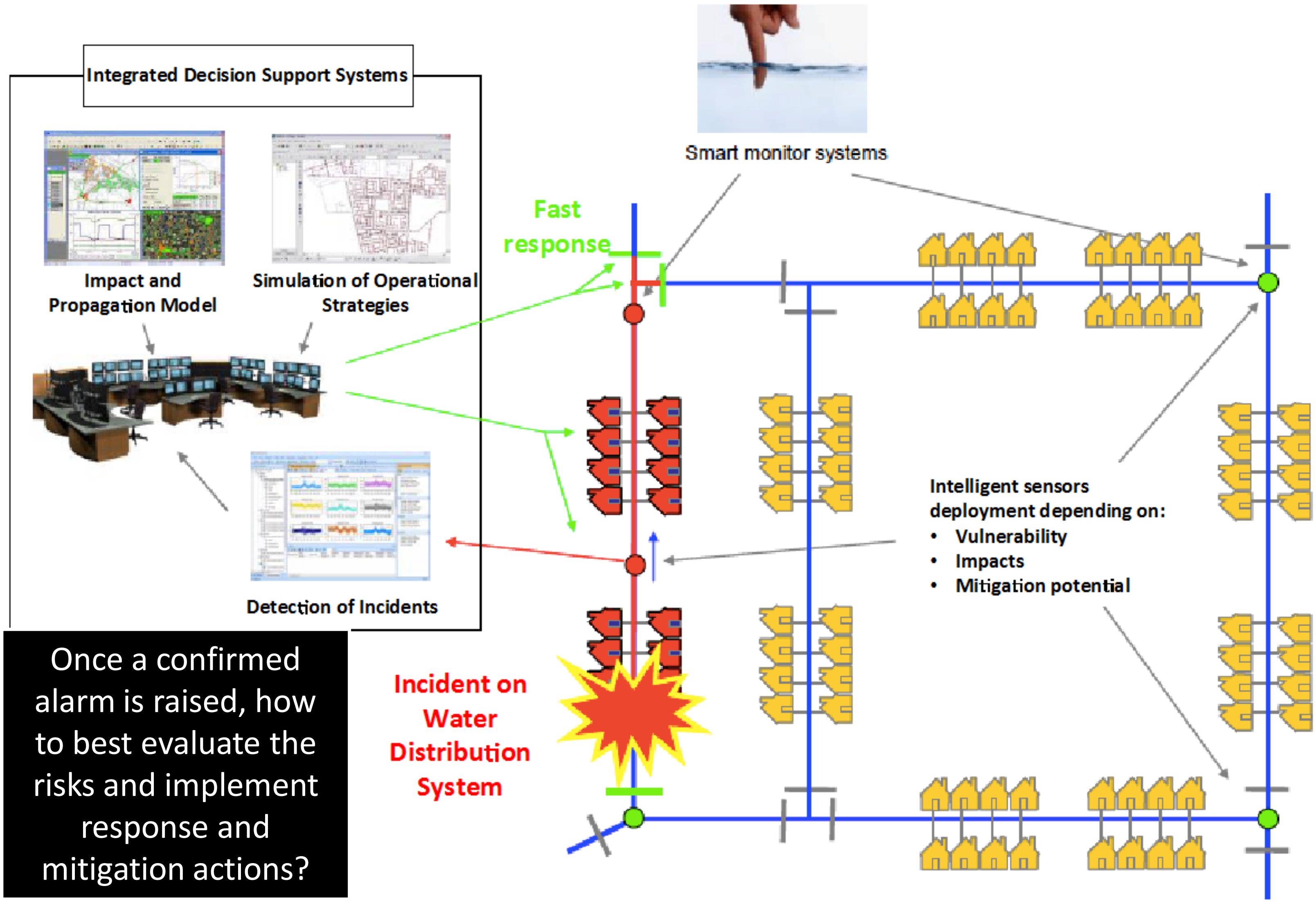


Decision support systems (DSS) to enhance Mitigation and Response during incidents

Matrixes for risk assessment are combined with Hydraulic Models to predict and compare the results of different operational strategies for response to crisis situations (here the dispersion and flush of polluted water in the pipe distribution system).



Towards Integrated DSS



Once a confirmed alarm is raised, how to best evaluate the risks and implement response and mitigation actions?

Conclusions

- An increase number of research programs and deployment of demonstration tools are devoted to Smart Water Management Systems.
- The objective of SWM is commonly to improve efficiency at water utilities both at the resource level and at the distribution level, to develop early warning systems, and to provide decision support system for incident response.
- Greater concern appears on the potential of SMS for managing customer's and consumer's relation
- Better management of water resources under stressed conditions however requires acceptance by the community of water recycling and reuse: modification of the short water cycle are, except for rare exceptions, still limited by legislation and culture.

THE MEGACITIES ALLIANCE OF FOR WATER AND CLIMATE

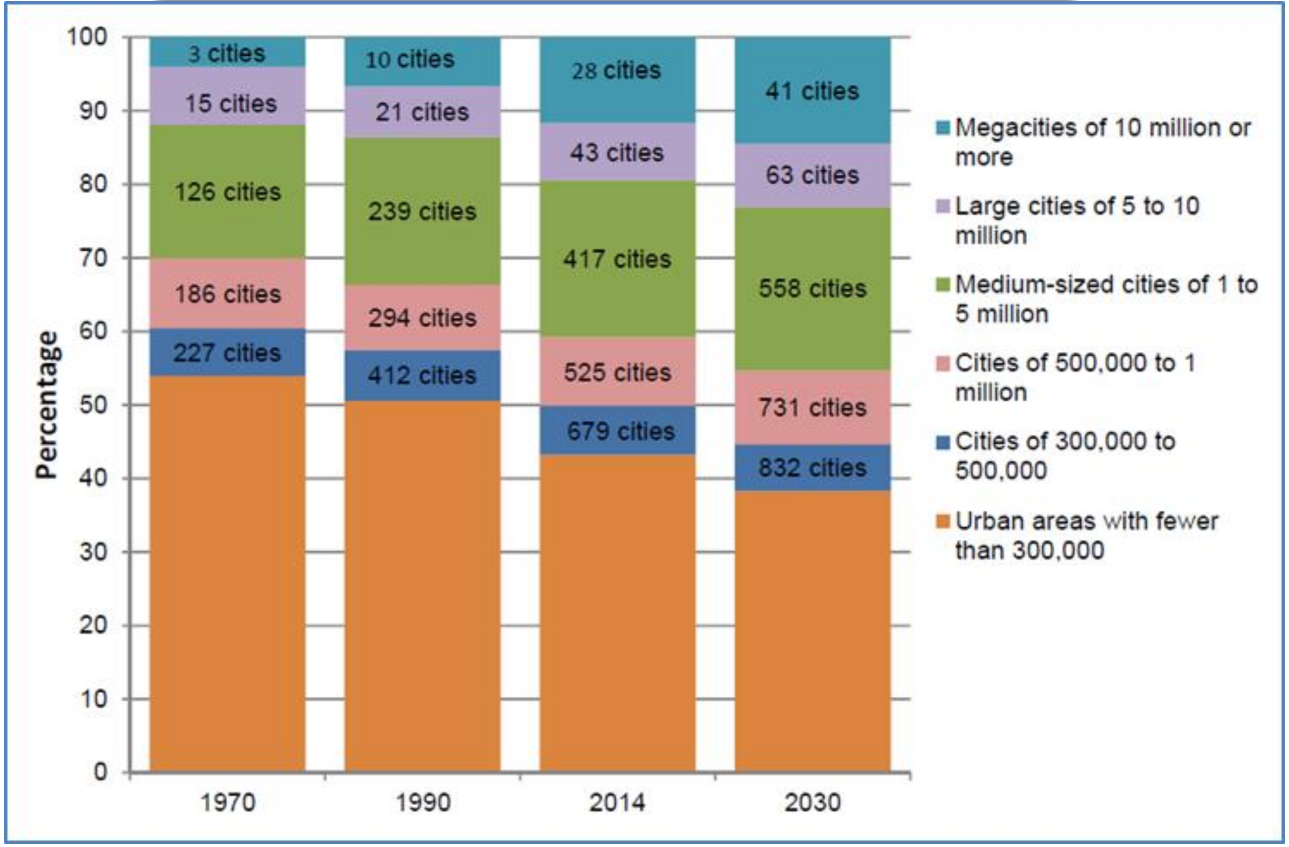
What are Megacities?

According to the UN definition, Megacities are cities with more than 10 million inhabitants. New York became the first megacity in the world in 1950, followed by Tokyo in 1960.

New megacities created between 2014 and 2030 will all be located in the least developed countries and regions.

The number of megacities increases

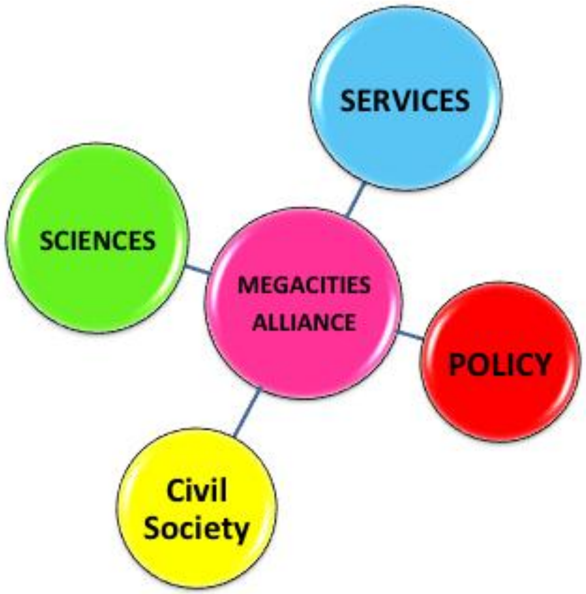
- 3 megacities in 1970
- 10 megacities in 1990
- 28 megacities in 2014
- 41 megacities in 2030



Source : World Urbanisation Prospects UN - 2014

Megacities because of their size...

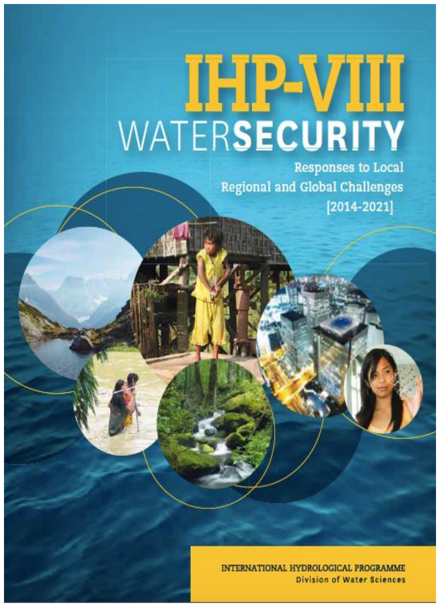
- Have a major impact on regional and/or national resources including water.
- Contribute to significant economic activity.
- Are responsible for massive environmental pollutions.
- Seldom have simple governance models.
- Concentrate many stakeholders: Decision makers, Utilities, Research Centers, NGOs.
- Maximize Social Inequities.
- And will bear the most adverse impacts of Climate Change.



“Cities are where the battle for sustainable development must be won. The new Sustainable Development Goals -- especially Goal 6 on universal access to water and sanitation services -- will only be achieved with the involvement of the world’s largest cities.”

Mrs. Irina Bokova,
Director-General of UNESCO

Water Challenges and Solutions in Big Cities



As part of the eight phase (2014-2021) of UNESCO's International Hydrological Programme on Water Security, an initiative was started for COP21 in Paris, December 2015 on "Water Megacities and Global Change"

Climate Change is expected to particularly and severely affect water services in urban centers

Risk Assessment for the Water situation and Challenges of:

BEIJING BUENOS AIRES
CHICAGO HO CHI MINH CITY
ISTANBUL KINSHASA LAGOS
LONDON LOS ANGELES MANILA
MEXICO MUMBAI NEW YORK
PARIS SEOUL TOKYO

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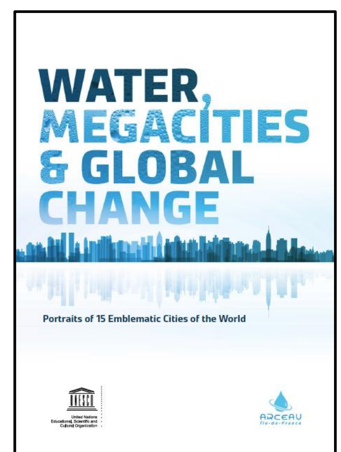


Megacities Alliance for Water and Climate

The Megacities Alliance was launched in Paris during COP21 on December 2015

The Megacities Alliance for Water and Climate is an initiative from UNESCO-IHP, SIAAP, ARCEAU-IdF and ICLEI

"Megacities in India with peripheral growth on their outskirts have reason to worry about implications of Climate Change since these can cause unpredictable high tides, floods and tsunamis. Mumbai will be happy to join the 'Megacities Alliance for Water and Climate' since it will be useful to exchange experience and expertise of various Megacities."

Mrs. Snehal S. Ambekar,
Former Mayor of Mumbai

Objectives of the Alliance

“If you want to go fast, then go alone
but if you want to go far, go together”
proverb

“Access to safe water and sanitation constitutes a major challenge for large global capitals. The development of an international exchange platform between large metropolises represents a genuine step forward, possibly improving the living conditions of billions of men and women.” **Mrs. Anne Hidalgo,**

Mayor of Paris

**A platform for cooperation involving :
operators, researchers, decision makers and civil society**

Collect and disseminate information at a worldwide scale on strategies and operational plans developed by local authorities and their water operators, as well as results achieved by their implementation.

Facilitate experience sharing between the academic community and water operators in improving adaptation through best practices assessments.

Identify means and mechanisms for funding the adaptation of Megacities to the impacts of climate change on urban water.

MEGACITIES ALLIANCE FOR WATER AND CLIMATE

United Nations Educational, Scientific and Cultural Organization

International Hydrological Programme

A <u>Regional approach</u> is engaged since Megacities from a given region often share environmental, cultural, legal, climate, and institutional similarities.

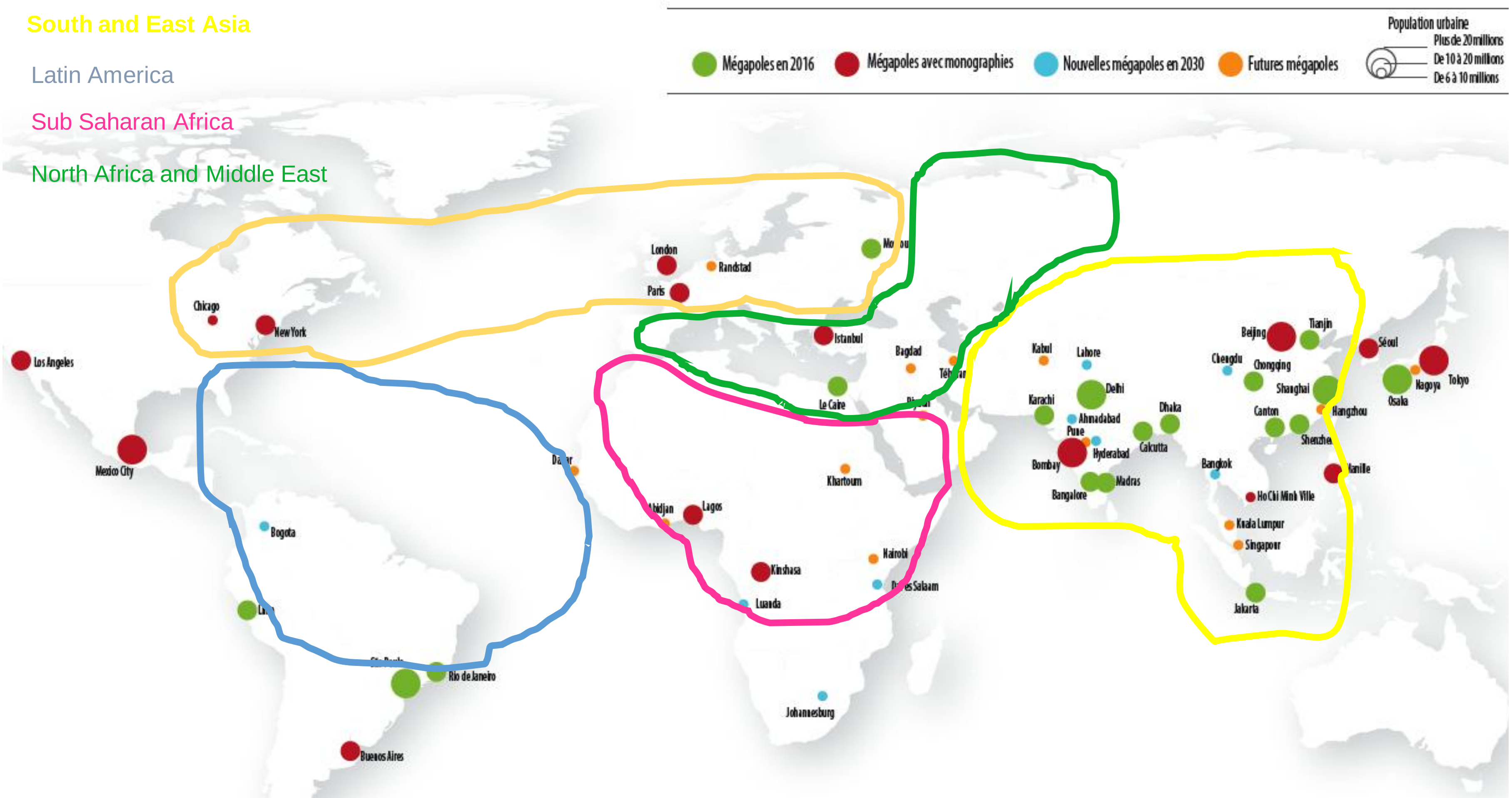
Europe and North-America

South and East Asia

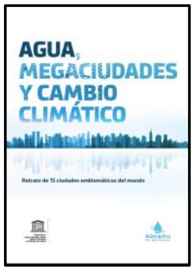
Latin America

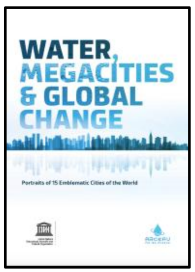
Sub Saharan Africa

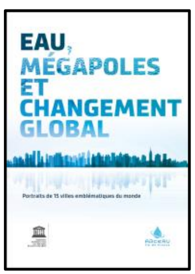
North Africa and Middle East



State of the Art in 16 Megacities







Drinking Water | IWRM | Energy Production
Drought | Sea Level Rise | Metering | Tariff
Research | NGOs | Public Participation | Reuse
Water Scarcity | Rainwater | Governance
Floods | Demand Management | Services
Water Quality | Natural Disasters | Financing
Heat Island Effect | Infrastructures | Climate
Crisis Management | Recreational | Economy
Customer Management | New Technologies
Network Efficiency | Wastewater | Legislation
Groundwater | Water Security | Demography

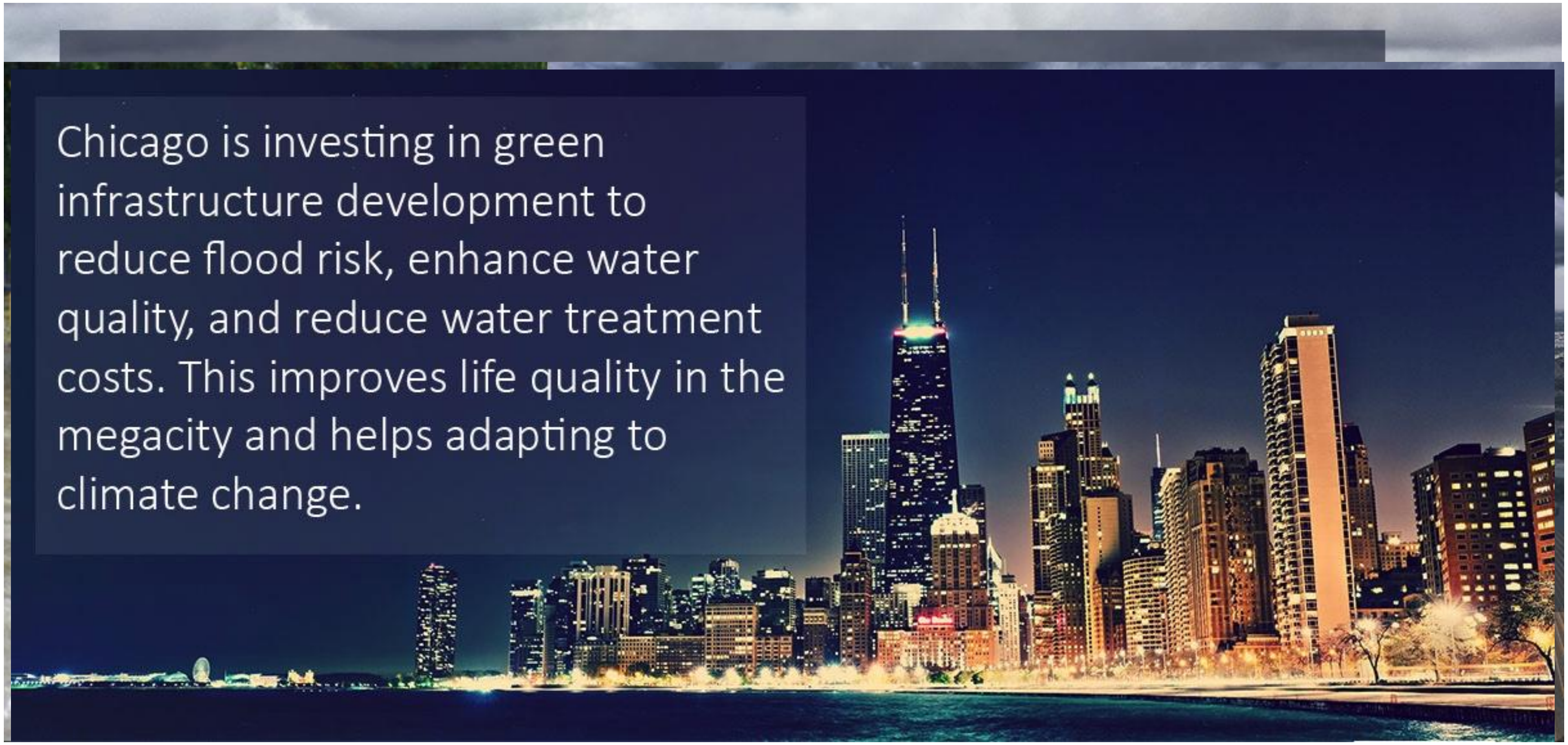
.....

Major Impacts of Climate Change on Water identified in Megacities

Not mentioning an effect does not mean that there is no effect, but that the consequences of this effect are estimated under control.

Megacity	Urban Flood	Sea Level Rise	Water Scarcity	Other impacts of Climate Change
Beijing	x		x	
Buenos Aires	x			Water table rise
Chicago	x			invasive aquatic species
Ho Chi Minh City	x	x		
Istanbul			x	
Kinshasa	x			soils erosion by rainfalls
Lagos	x	x		
London	x			
Los Angeles			x	
Manila	x		x	
Mexico City			x	
Mumbai	x	x		
New York	x	x		Storm surge
Paris			x	Low flow and surface water pollution
Seoul			x	
Tokyo			x	infrastructure destruction by natural disasters

Enhancing Urban Water Resilience by raising awareness and sharing case studies, experiences, best practices and innovative solutions for engaging the adaptation to new risks



Conclusion and Next Steps

- A water and climate database for megacities of today and tomorrow is under construction. It will focus on using existing definitions and units developed by IWA.
- At governmental level, UNESCO-IHP will setup a working group involving experts nominated by member states: their work will be to define and promote interactions between UN organizations and the Megacities' Alliance for Water and Climate, to explore financing, and to help recruit Megacities for joining the network.
- Participation in international events, and organization of regional workshops for promoting the Alliance and initiating concrete common actions.
- Preparation of the next EAUMEGA conference in Paris, in early 2019, for the official validation by Megacities of the ToR of the Alliance.

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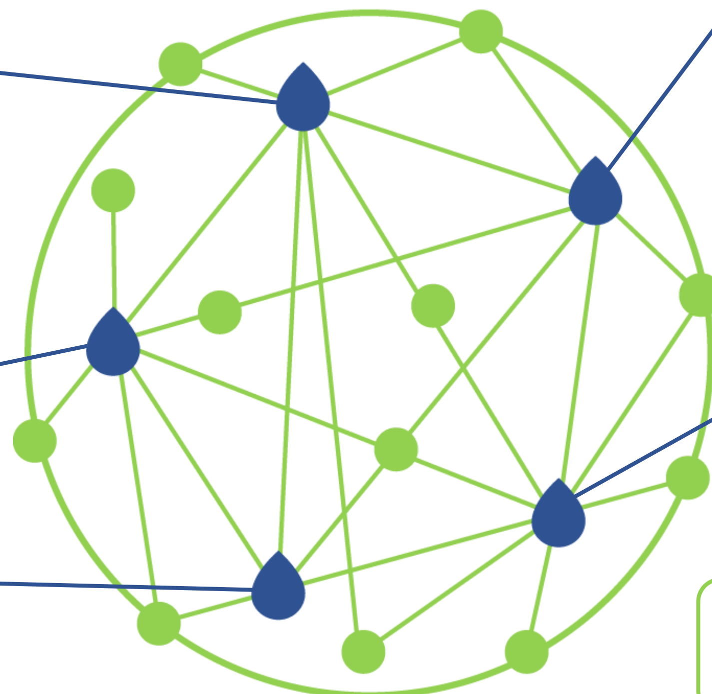
The UNESCO Water Family

Since the inception of IHD, UNESCO has been developing a network of networks, often called the UNESCO Water Family, composed of different kinds of water institutions that have been joining forces with UNESCO in order to support the implementation of its water programmes and the Organization's strategic goals. Today, as IHP is working on its eighth phase (IHP-VIII), the UNESCO Water Family operates globally as a network which includes:



UNESCO staff located at the Paris headquarters of the IHP Secretariat and the Regional Hydrologists located in the UNESCO field offices

IHP National Committees representing the Programme in **169** Member States

35 water-related Category 2 Centres under the auspices of UNESCO

The World Water Assessment Programme (WWAP), with its secretariat hosted and led by UNESCO in Italy and which produces the periodic World Water Development Report

42 UNESCO Water Chairs and UNITWIN networks

Together, they represent more than **1500** water experts worldwide

WATER

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International Hydrological Programme

Thank U

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