

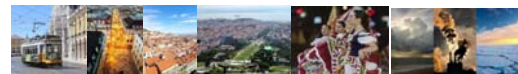
Cybersafety in Critical Water Infrastructure  
 NATO Advanced Research Workshop  
 Oslo, Norway, 8-11 October 2018  
 Session 1, 8<sup>th</sup> October, 14:40-15:00 h

**Risks, resilience and cascade effects on water urban services**

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**CONTENTS**

- Urban Water Cycle: Global Trends and Challenges
- The EU H 2020 RESCCUE Project. Resilience and Cascade Effects.
- Notes from the Lisbon Drainage Master Plan and Resilience Concerns
- Final Remarks

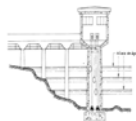
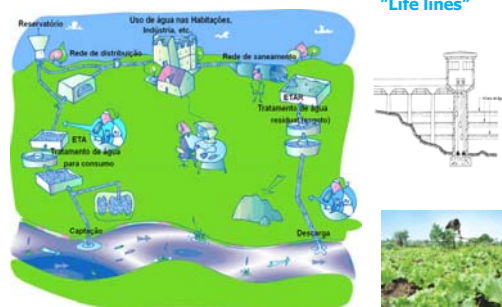


**URBAN WATER CYCLE. GLOBAL TRENDS AND CHALLENGES**



**Urban Water Cycle**

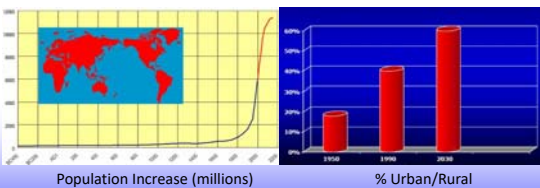
**Critical Infrastructures- "Life lines"**



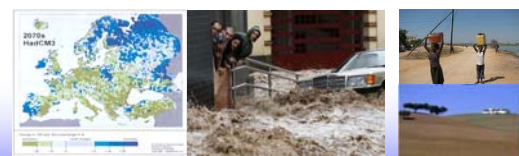
Circulation, Use, Reuse and Reintegration

**GLOBAL TRENDS AND CHALLENGES UNDERSTANDING THE WORLD**

- > DEMOGRAPHIC GROWTH, PRINCIPALLY IN DEVELOPING COUNTRIES ( AFRICA )
- > MIGRATION FROM RURAL TO URBAN ZONES (EXPONENTIAL EXPANSION OF UNFORMAL PERI-URBAN AREAS, without any formal water, energy or communication services)



- > INCREASING CONSUMPTION OF RESOURCES ; CONTAMINATION RISKS OF WATER SUPPLY SOURCES ;
- > AMBITIOUS LEGISLATION AND COMMITMENTS FOR OF THE WASH SECTOR (VISION, GOALS AND TARGETS) WITHOUT ENOUGH CARE WITH RESOURCES FOR ACHIEVING THE GOALS.
- > CHANGING ENVIRONMENT AND REQUIREMENTS (CLIMATE CHANGE, LAND USE CHANGES, NEW LEGISLATION,.....)
- > WATER SCARCITY, POVERTY AND LACK OF HOPE IN LARGE PARTS OF THE WORLD. MIGRATION, INCREASE OF RISKS AND A NEW DIGITAL WORLD



### SOME FIGURES

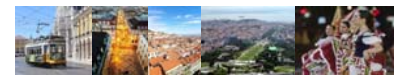
- Global water use has increased by a factor of 6 over the past 100 years and continues to grow at a rate of 1% due to population growth, economic development and changing consumption patterns.
- World population is expected to increase from 7.7 billions (2017) to between 9.4 and 10.2 billion by 2025, with 2/3 of the population living in cities at 2050. More than half of this increase is expected to occur in Africa (+1,7 billions), but also in Asia (+0.75 billions)
- Over the same period ( 2017-2050) GDP is expected to increase by a factor of 2.5. Global demand for agriculture and energy production are expected to increase, by 2015, 60% and 80% respectively ( UN Water Report 2018).



## EU H 2020 RESCCUE PROJECT . RESILIENCE AND CASCADE EFFECTS



- EU RESCCUE ( 2016-2020): RESilience to cope with Climate Change in Urban arEas** - a multisectorial approach focusing on water -
- 18 Partners, 8 millions Eur, 48 months, 3 research cities: Lisbon, Barcelona and Bristol



### EU RESCCUE ( 2016-2020)

- WP1-Climate change scenarios
- WP2-Sectorial models
- WP3-Risk assessment
- WP4-Resilience action plans
- WP5-Adaptation strategies
- WP6-Interdependencies and cascade effects

“Urban resilience is the capacity of individuals, communities, institutions, businesses, and systems within a city to **survive, adapt, and grow** no matter what kinds of chronic stresses and acute shocks they experience, and even **transform** when conditions require it.”



### Resilience - Challenges

**Flooding consequences**  
**Cascade Effects and Interdependencies of Services:** Communications, energy, mobility (train, metro, bus lines, ...), solid wastes, receiving waters, water supply,...

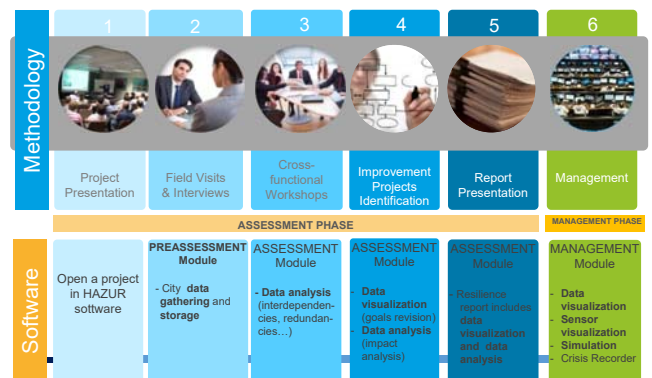
#### Assessing Resilience:



#### Resilience Management

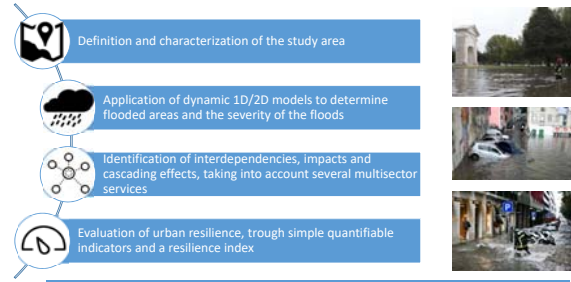
**Technological measures and non technological approaches and solutions** (resilience officer, resilience board, municipal data base, monitoring and simulation,....)

### HAZUR® = TOOL + METHODOLOGY

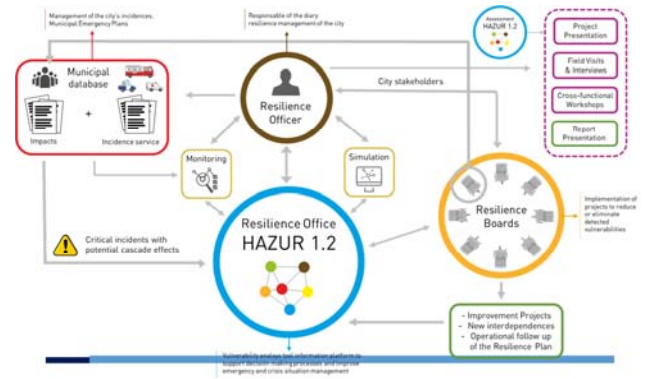


## 2. Methodology

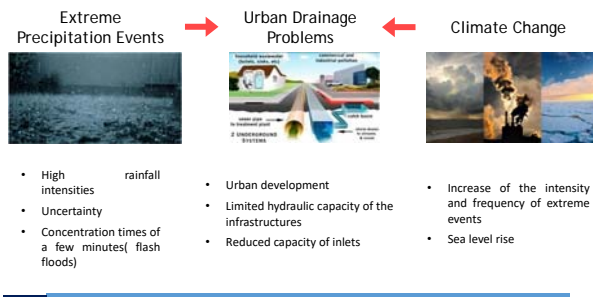
### URBAN RESILIENCE ON THE SCOPE OF URBAN FLOODS



## Urban resilience with HAZUR



## URBAN DRAINAGE, FLOODS AND CLIMATE CHANGE



## NOTES FROM THE LISBON DRAINAGE MASTER PLAN AND RESILIENCE CONCERNS



### Drainage Alternative solutions (PGDL 2016-2030)

**Sol A (increasing sewers hydraulic capacity)**

**Sol B (Emphasis on Storage)**

**Sol C (Emphasis on Flow transfer-tunnels)**

- Main objective: flooding control
- Minimize social Impact at the construction phase.
- Emphasis on physical and non physical measures



### FLOODING CONTROL: TYPICAL MEASURES AND APPROACHES: Grey solutions, Nature Based Solutions ("NBS") or Hybrid Solutions

- Mitigation Measures (reduction of peak flows, based on infiltration, storage)
- Adaptation Measures (based on increasing sewers capacity, or flow transfer)
- ☐ Decentralized solutions ("source control")
- ☐ Centralized Solutions (storage, trunk sewers)
- Main Physical Measures (storage, tunnels, sewers), Complementary Measures (Minimizing head losses, installing tide valves, inlets performance,.....)
- Non Physical Measures (Knowledge and know how transfer, capacity building, awareness-raising, monitoring and warning,..)



PLANO GERAL DE DRENAGEM 2016-2030

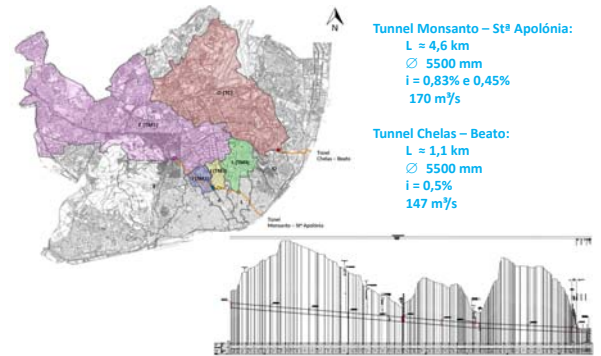
Recommended Solution ( Sol C)-Example Monsanto Sta Apolonia tunnel



Multipurpose Lisbon Tunnels



- Reduce flooding risk; pre-treating overflows (microscreening and settling tank)
- Storage
- Tunnel with technical gallery – e.g. water to reuse in different locals of Lisbon, telecommunications, energy lines....

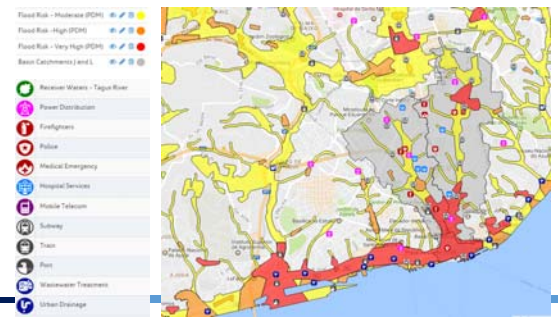


Resilience - Important Challenges related with flooding

- 1) Rainfall Intensity and Uncertainty
- 2) Rising Sea Level
- 3) Aging Infrastructure
- 4) Landslide



Resilience - Service Interdependencies at Downtown ( J , L) Catchments ( Hazur Lisbon print screen)





### 3. Lisbon Downtown Case Study

#### DEFINITION AND CHARACTERIZATION OF THE STUDY AREA

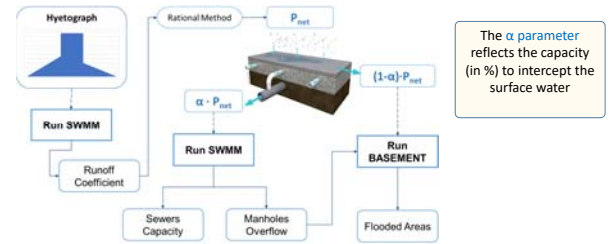
Sector	Service	Infrastructures
Water Sector	Water Distribution	District Metering Areas
	Urban Drainage	Wastewater Pumping Stations
Power Sector	Secondary Power Distribution	Power substation
	Subway	METRO Power Substation
Mobility Sector	Public Transport Hubs	Hubs
	Bus	Bus Routes
	Traffic Management	Traffic Control Room
Waste Sector	Unselective Municipal Waste Collection	Routes
Telecommunication Sector	Mobile Telecom	Analysed only as a service provider
Environmental Sector	Receiver Waters	Tagus River
	<b>10 Services</b>	<b>130 Infrastructures</b>



#### APPLICATION OF DYNAMIC 1D/2D MODELS

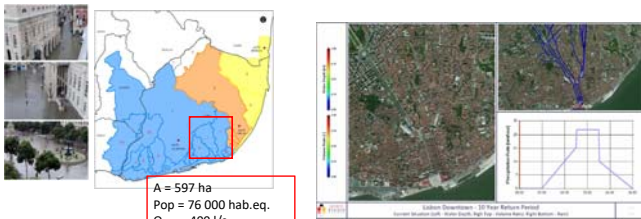
##### Combined Model SWMM+BASEMENT

Coupling of SWMM (US EPA) and BASEMENT (ETH Zurich)



#### RESCUE

Integration in a Software Tool – HAZUR\* ✓ City case: Downtown Catchments (J and L)- Critical zones (e.g flooding)

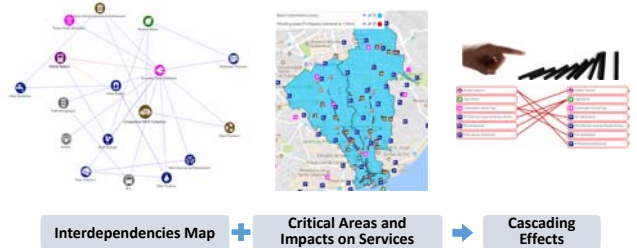


A = 597 ha  
Pop = 76 000 hab.eq.  
Q<sub>def</sub> = 400 l/s  
Q<sub>cr</sub> (T=10) = 50 m<sup>3</sup>/s

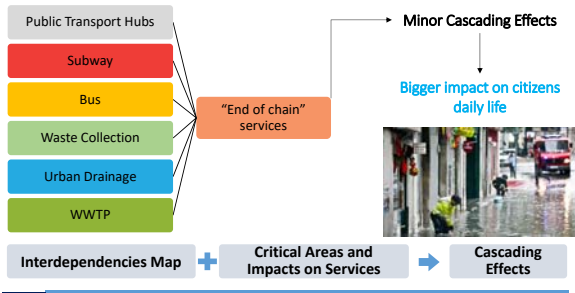
Modeling results 2D (1D-2D) – T=10 years  
Role of communication

#### IDENTIFICATION OF INTERDEPENDENCIES, IMPACTS AND CASCADING EFFECTS

(Electricity, gas, communication, transport, water lines...)



#### IDENTIFICATION OF INTERDEPENDENCIES, IMPACTS AND CASCADING EFFECTS



#### Strategies and Measures to increase resilience

Technological and non-technological solutions

Measure	Level	Resilience of network	Level	Resilience of network	Level	Resilience of network	Level	Resilience of network	Level	Resilience of network
Mha.1	0.5	+10	0.5	+10	0.5	+10	0.5	+10	0.5	+10
Mha.2	0.5	+10	0.5	+10	0.5	+10	0.5	+10	0.5	+10
Mha.3	0.5	+10	0.5	+10	0.5	+10	0.5	+10	0.5	+10
Mha.4	0.5	+10	0.5	+10	0.5	+10	0.5	+10	0.5	+10

140 measures identified – BINGO and PEARL projects  
Reduce recovery time. Cost-benefit

## FINAL REMARKS



## FINAL REMARKS

- ❖ World is changing rapidly and water sector is largely affected by these changes
- ❖ Challenges ( extreme events: flooding and droughts events) will not decrease – will increase, in a more demanding society ( in terms of environmental and social requirements).
- ❖ “Society of cities” with peri-urban areas largely populated with very low income people
- ❖ Infrastructures should be at service of the services: In the road to more resilience cities, infrastructures are crucial but much more is needed to have sustainable approaches (co-knowledge and co-innovation, sensibilization, education, warning, and communication)
- ❖ A sustainable city is a resilience city- a resilience city should be cybersafe



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**THANK YOU**

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