



Bologna adaptation plan
for a resilient city
Bologna città resiliente

www.blueap.eu

BLUEAP

The Adaptation Plan of Bologna

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15 December 2016



COMUNE DI BOLOGNA



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LIFE11 ENV/IT/119
With the contribution
of the LIFE financial
instrument of the
European Community



Project: BLUE AP (LIFE11 ENV/IT/119)

Coordinator: Comune di Bologna

Partners: Kyoto Club, Ambiente Italia, ARPA Emilia Romagna

Project duration: 36 months (01/10/2012-30/09/2015)

Main objectives: In the context of European initiatives to improve awareness and actions regarding climate change, the BLUEAP project aims to support activities which will lead to the production and adoption of the climate change adaptation plan for Bologna.

About Bologna



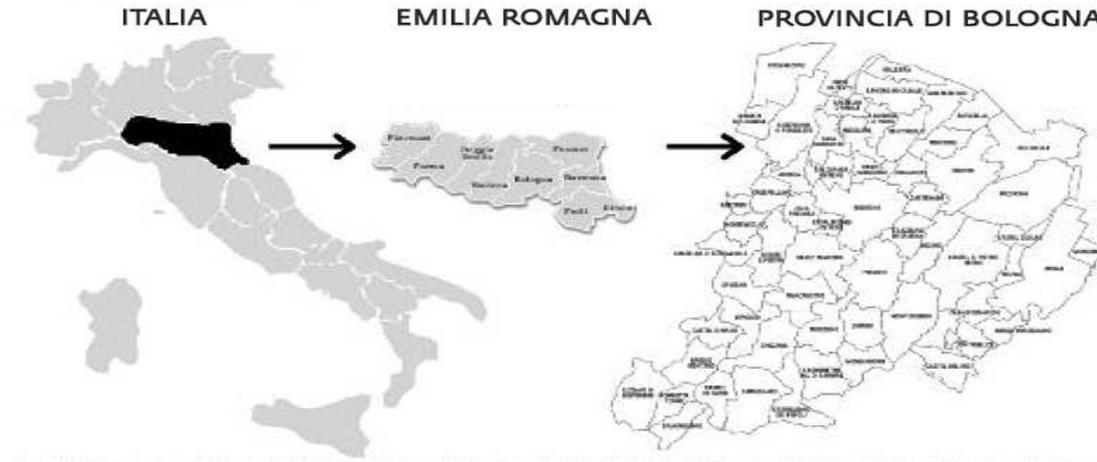
FROM NATIONAL
TO
LOCAL LEVEL

REGION
EMILIA ROMAGNA

PROVINCE
BOLOGNA

MUNICIPALITIES
60

PROVINCIA DI BOLOGNA IS COMPOSED BY 60 MUNICIPALITIES



- Population: *373.592 inhabitants*

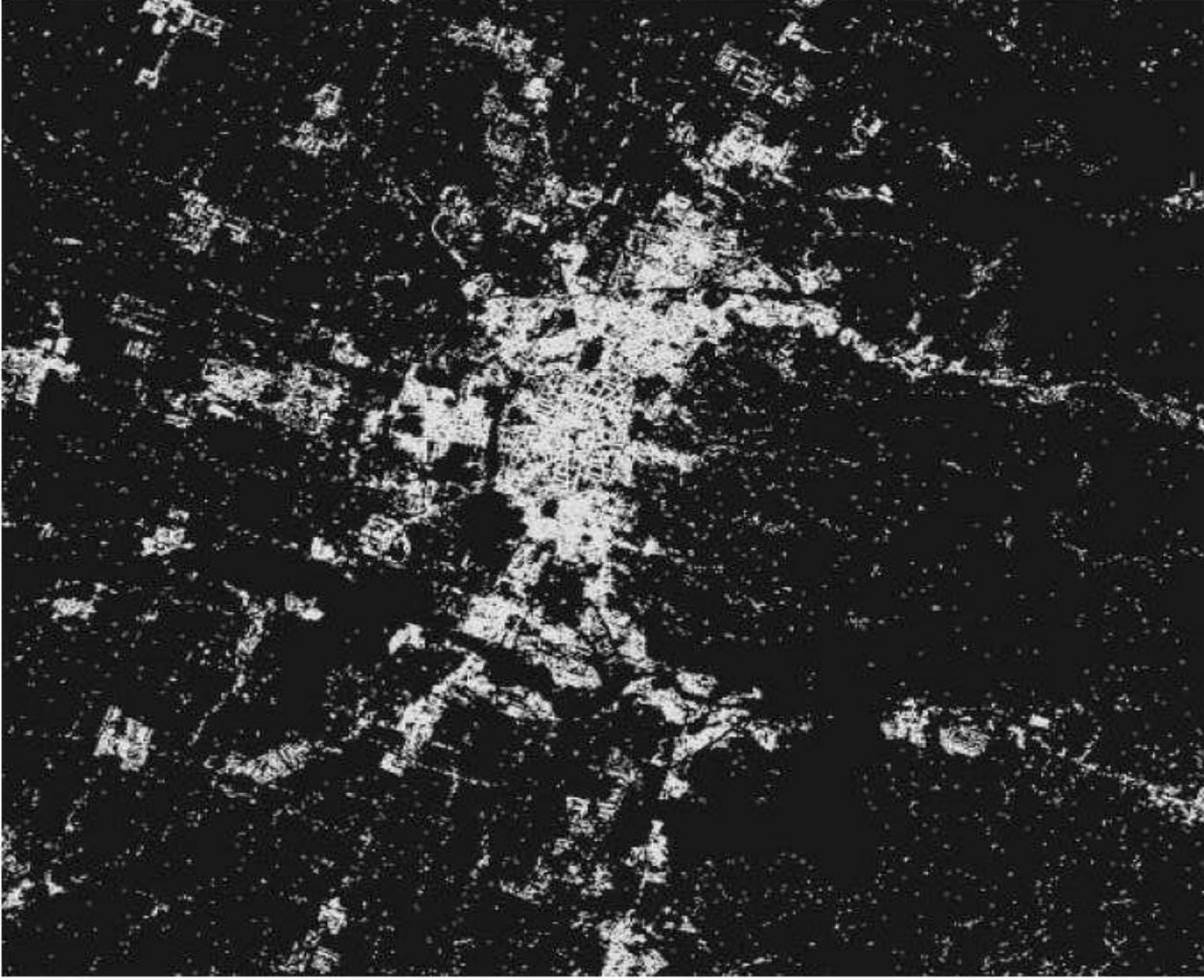
- Strong presence of **small and medium industry**

- Surface: *141 Km²*

- Historical **University**: almost 100.000 *students*

La citta' diffusa The sprawl

Inhabitants province bologna	984.342 (2009)
Common inhabitants Bologna	377.220 (2009)
Inhabitants in the conurbation bolognese	650.000 (2005)
Inhabitantes expected in 2015	1.000.000 (2005)
Extension of the province	3.700 km
Urbanized area	210 km
Daily trips to and from Bologna	400.000 (2005)
Average daily highway traffic crossing	45% (2005)
Average daily highway traffic exchange	55% (2005)





Bologna is in a particularly vulnerable location, and this is why man has always attended to its territory with special care.

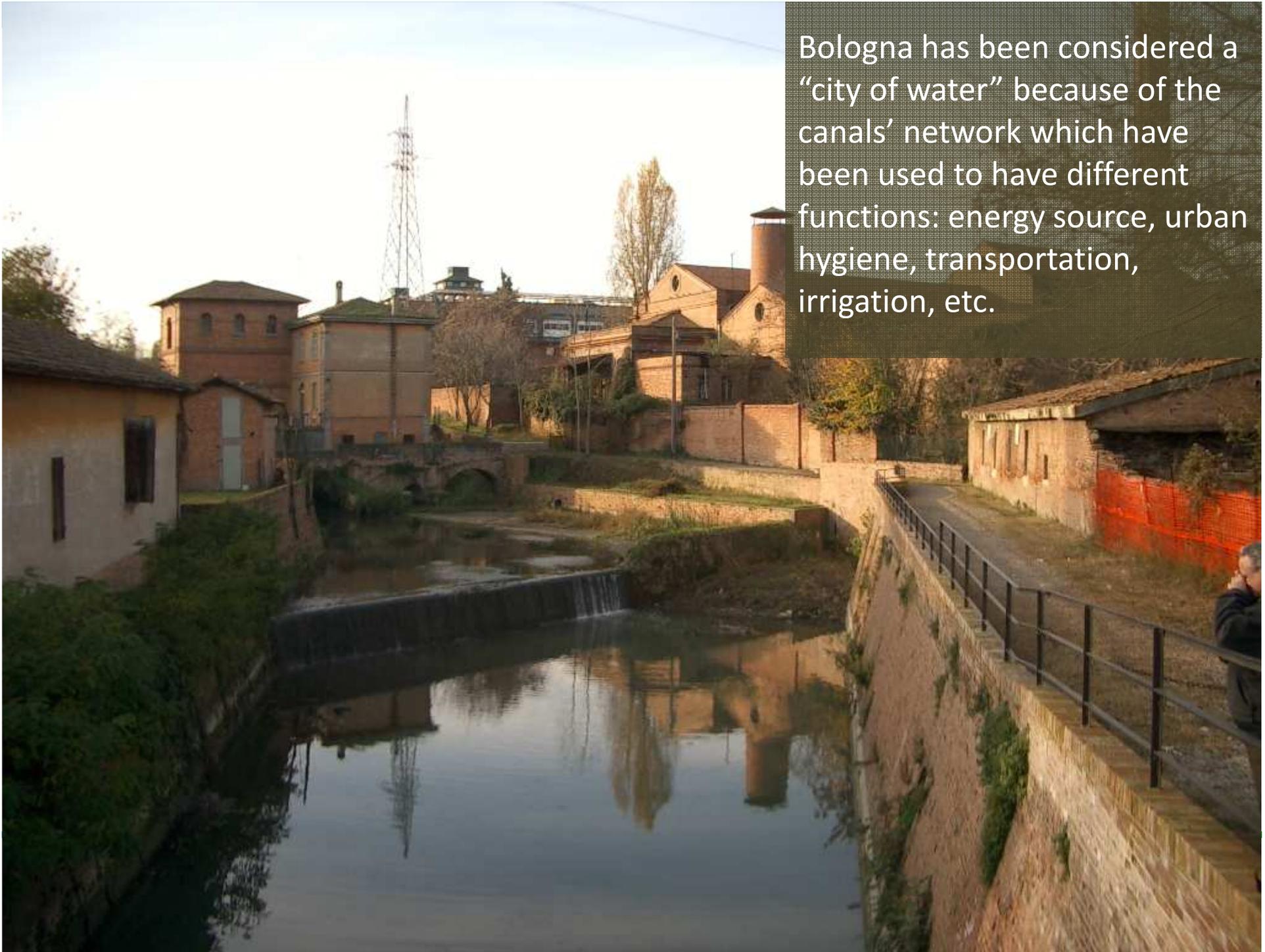
The territory has been organized and structured since Roman period: natural evolution has indeed been replaced by human management, through measures such as deforestation, reclamation of swamplands, flood-relief works, etc.

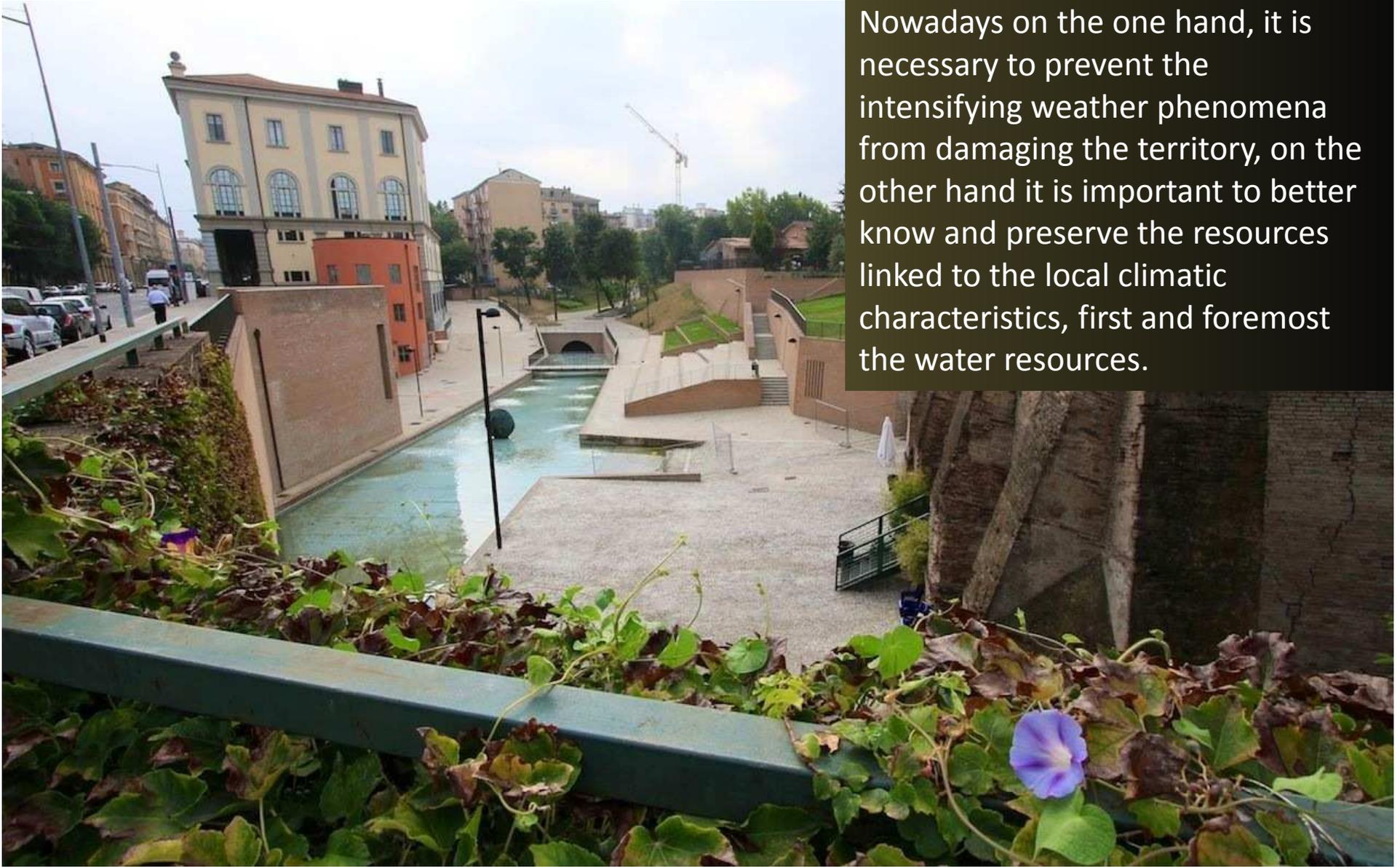


Climate has been - and still is - a precious resource for the city.

The Latin word “Bononia”, from which the name of the city derives, refers to a community which builds its own existence on food and farm production.

Bologna has been considered a “city of water” because of the canals’ network which have been used to have different functions: energy source, urban hygiene, transportation, irrigation, etc.





Nowadays on the one hand, it is necessary to prevent the intensifying weather phenomena from damaging the territory, on the other hand it is important to better know and preserve the resources linked to the local climatic characteristics, first and foremost the water resources.

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LOCAL CLIMATE PROFILE



STAKEHOLDERS INVOLVEMENT



LOCAL ADAPTATION PLAN



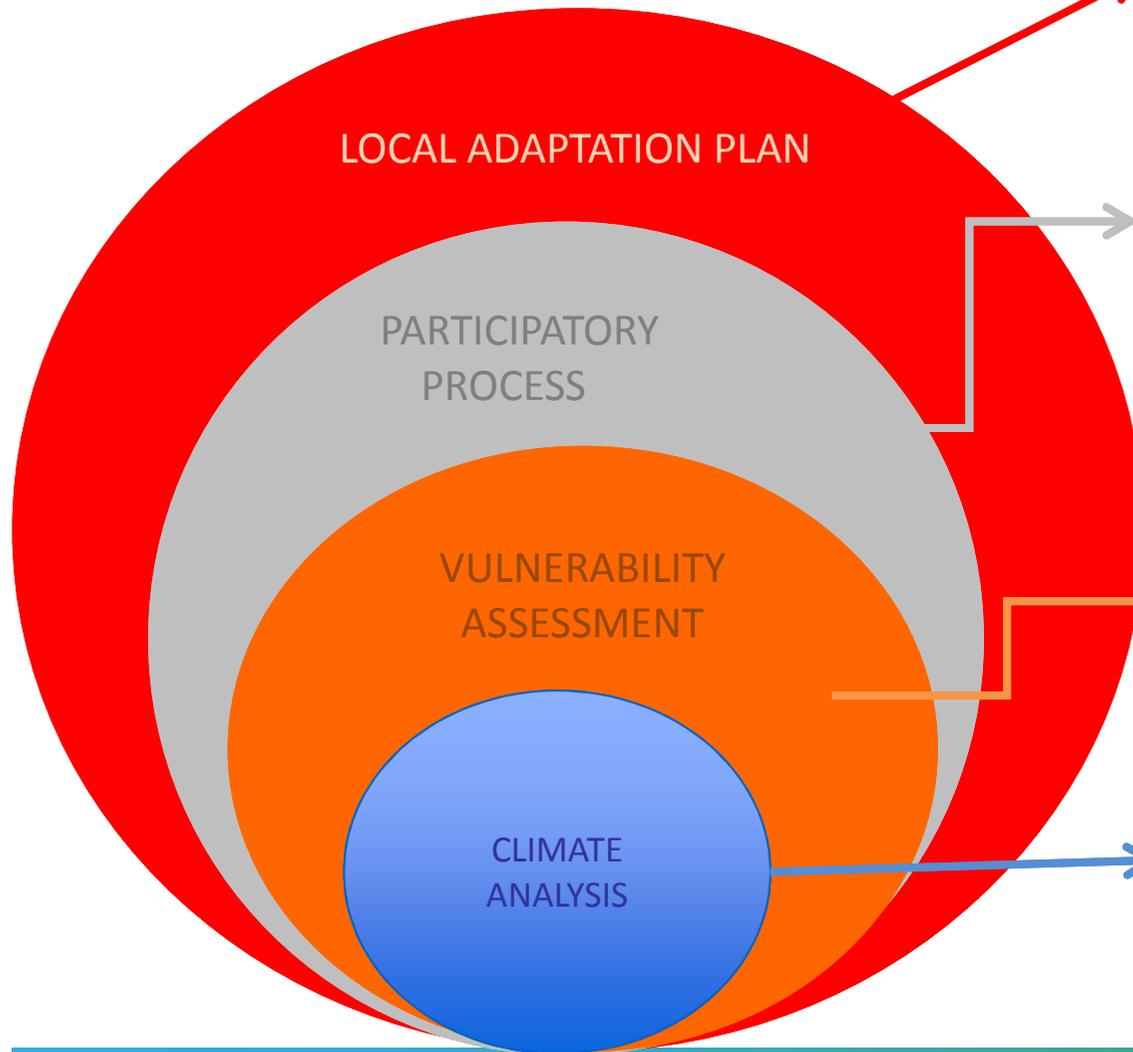
PILOT ACTIONS



MONITORING



PLAN DEVELOPMENT....



4. ADAPTATION PLAN

- Policy
- Management
- Technology and Infrastructure
- Behaviours

3. PARTICIPATORY PROCESS

- Thematic Session
- Focus Group
- One-to-one Meeting
- BLUE AP 2.0
- Training and Educational Activities

2. VULNERABILITY ASSESSMENT

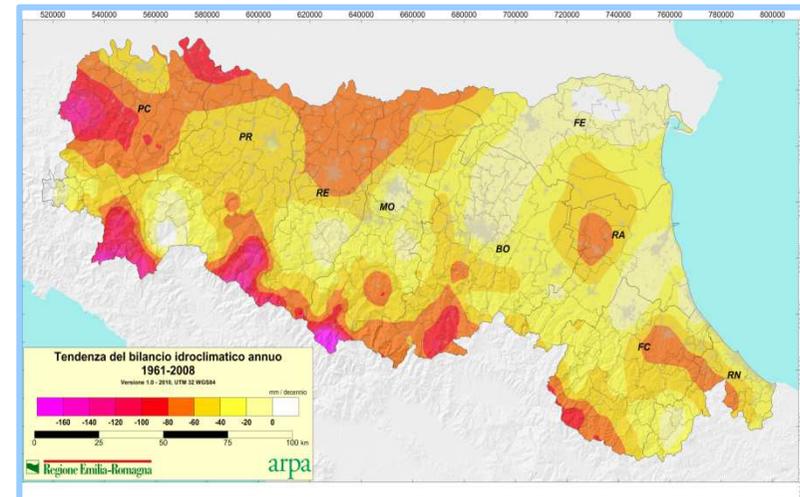
- Soil use
- Infrastructures
- Green and blue areas
- Heat waves impacts
- Drought impacts
- Flooding impacts

1. DATA COLLECTION AND SCENARIO ELABORATION

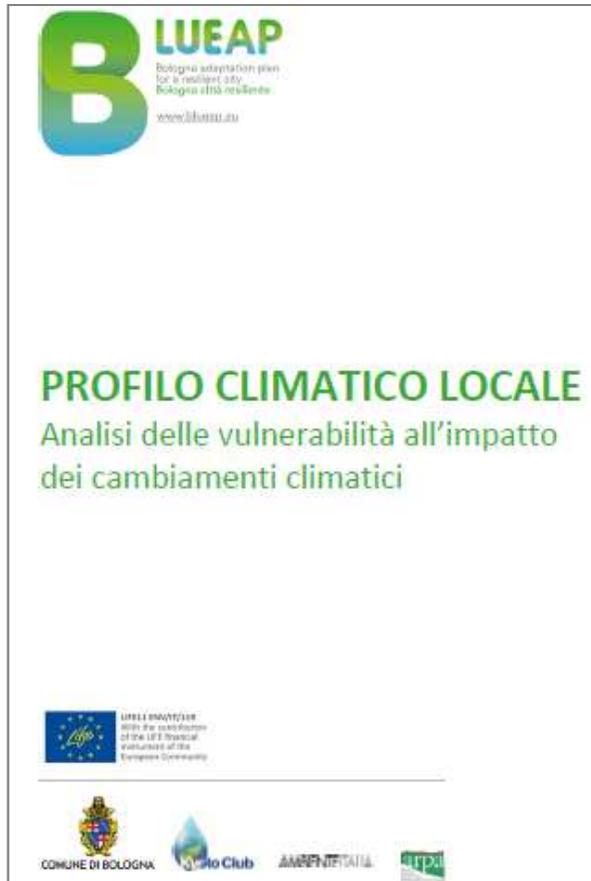
- Temperature
- Precipitation

LOCAL CLIMATE PROFILE

Production of a **comprehensive information system** (Local Climate Profile), oriented to support the participatory planning process and to select better and effective strategies, useful as baseline framework to monitor and to periodically improve the actions defined by the process.



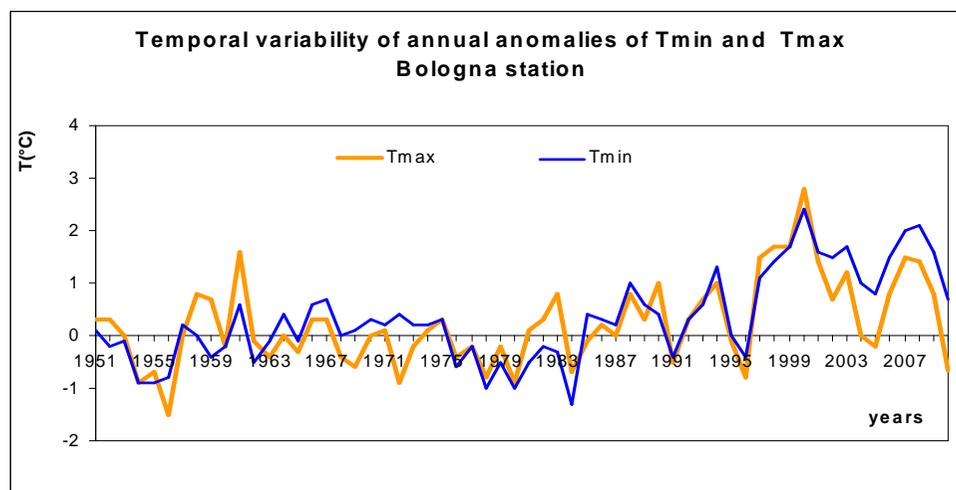
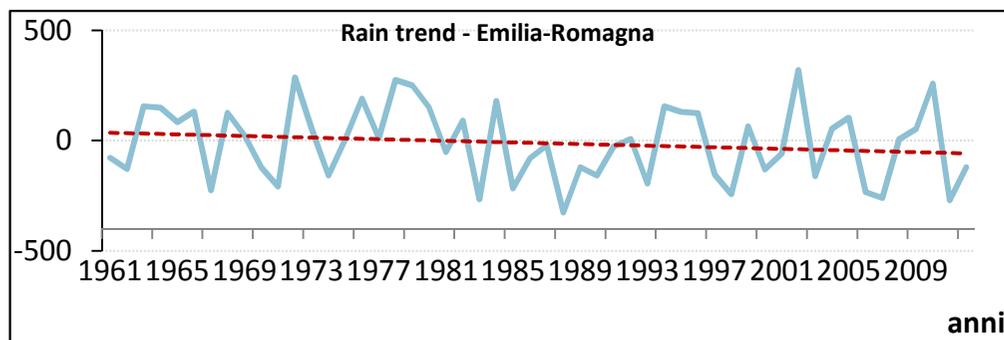
LOCAL CLIMATE PROFILE - CHAPTERS



1. **Climate analysis**
2. **Land use and infrastructures**
3. **Heat waves and heat islands**
4. **Water network and hydrogeological vulnerability**
5. **Water consumption and drought**
6. **Main resilience factors**

HISTORICAL CLIMATE TRENDS

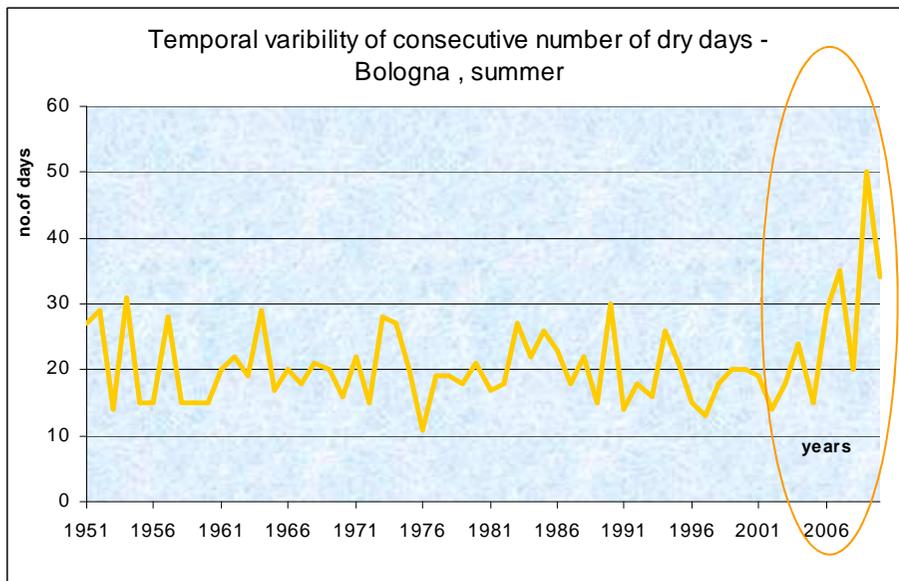
Some data, available only at regional level, were downscaled and **integrated with the local information systems.**



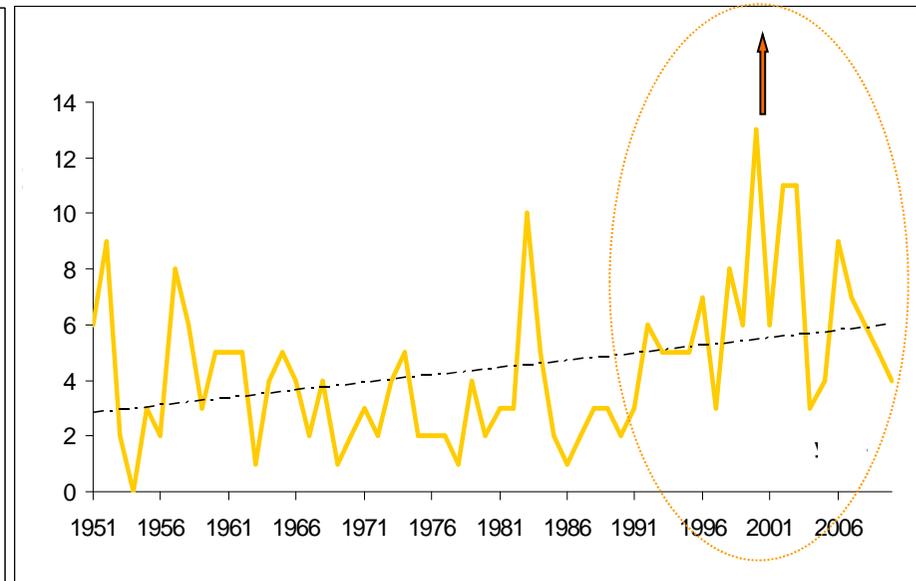
HISTORICAL CLIMATE TRENDS

- Decreasing trend in frost and ice days during winter, spring and autumn; the signal is more intense during winter;
- Increasing trend in seasonal heat waves; the signal is more intense during summer
- The signal of changes in mean and extreme temperature is more intense after 1990.

Number of consecutive days with no rain



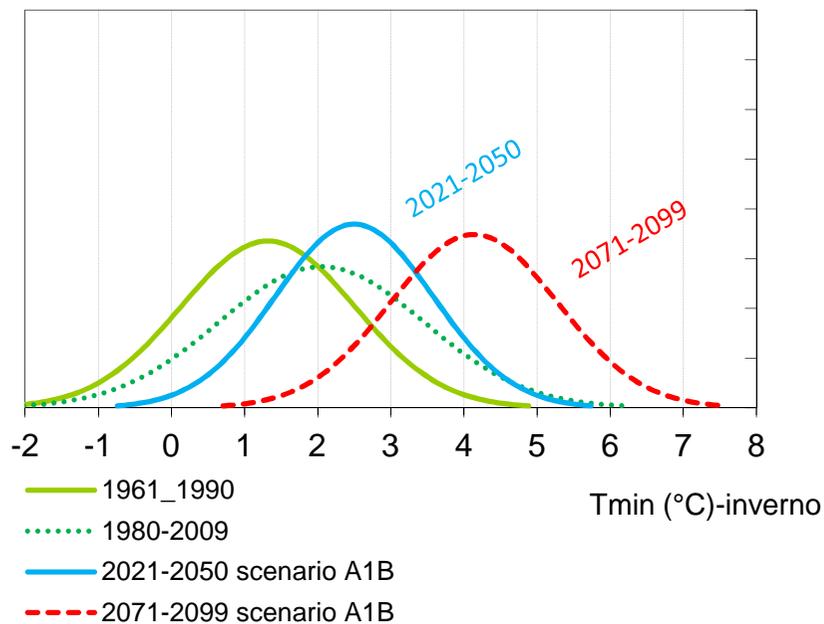
Heat waves in Summer



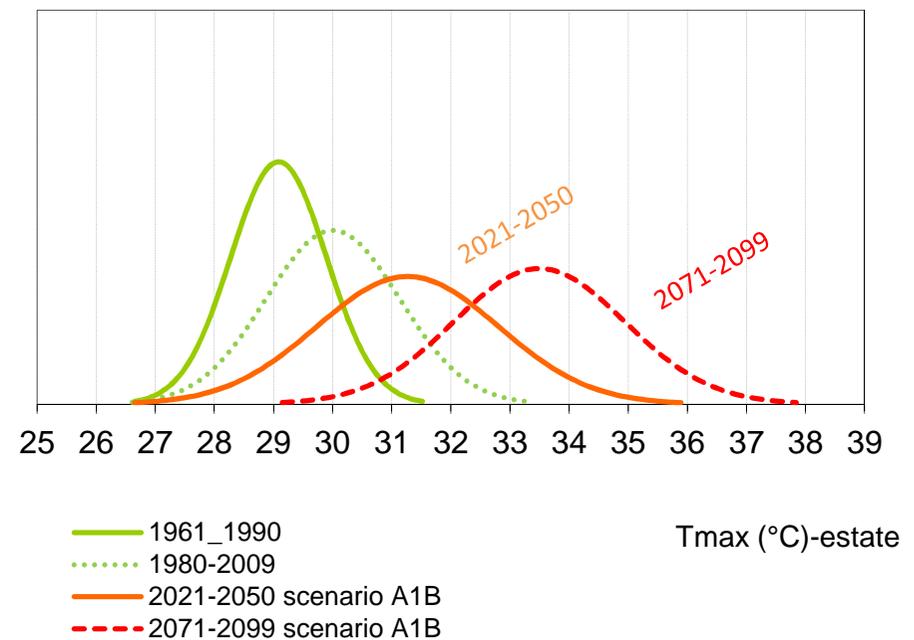
FUTURE CLIMATE SCENARIOS

Downscaling statistical techniques for global climate models to identify future climate projections for the city of Bologna. (2020-2050)

Scenari climatici a Bologna - Temperatura minima inverno (dicembre-febbraio)



Scenari climatici a Bologna - Temperatura massima estate (giugno-agosto)



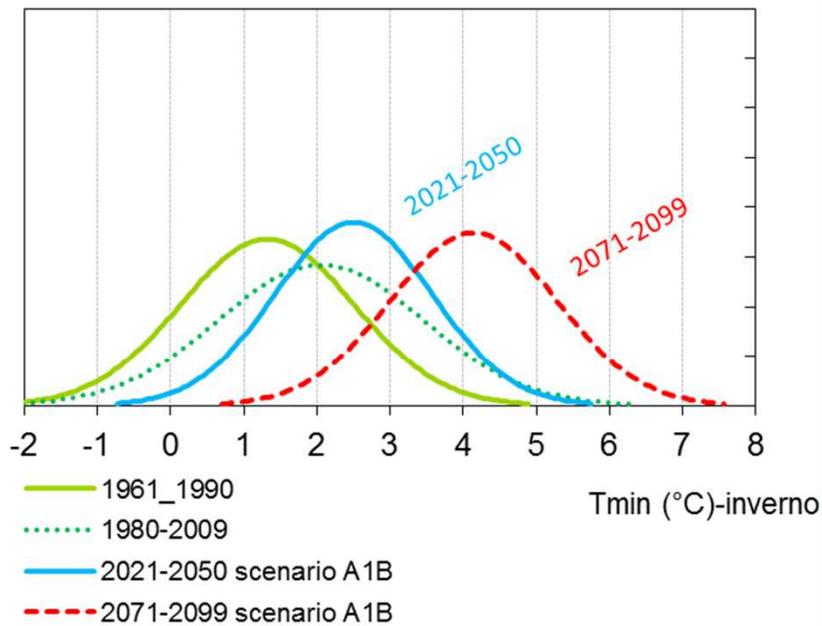
FUTURE CLIMATE SCENARIOS

- A possible increase in the minimum and maximum temperature, around 2°C over the period 2021-2050 with respect to 1961-1990;
- The increase of temperature is more pronounced to the end of the century, and especially during summer, when the anomalies could reach 5.5°C respect to present climate;
- A possible increase in the heat wave duration, more intense during summer and to the end of century;
- A reduction of the amount of precipitation during all seasons, more intense to the end of century and especially during summer season (reduction around 30%).

FUTURE CLIMATE SCENARIOS

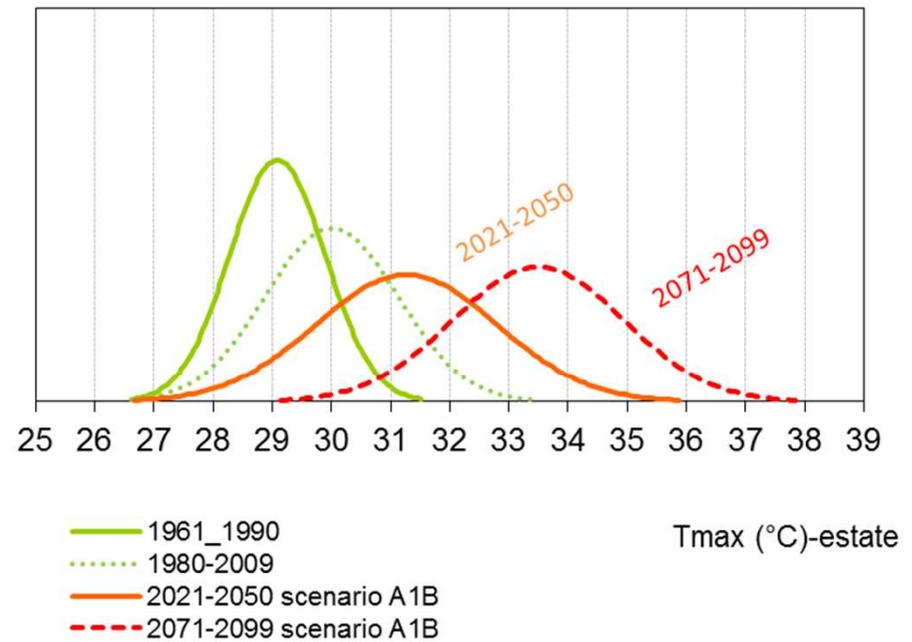
WINTER

Scenari climatici a Bologna - Temperatura minima inverno (dicembre-febbraio)



SUMMER

Scenari climatici a Bologna - Temperatura massima estate (giugno-agosto)



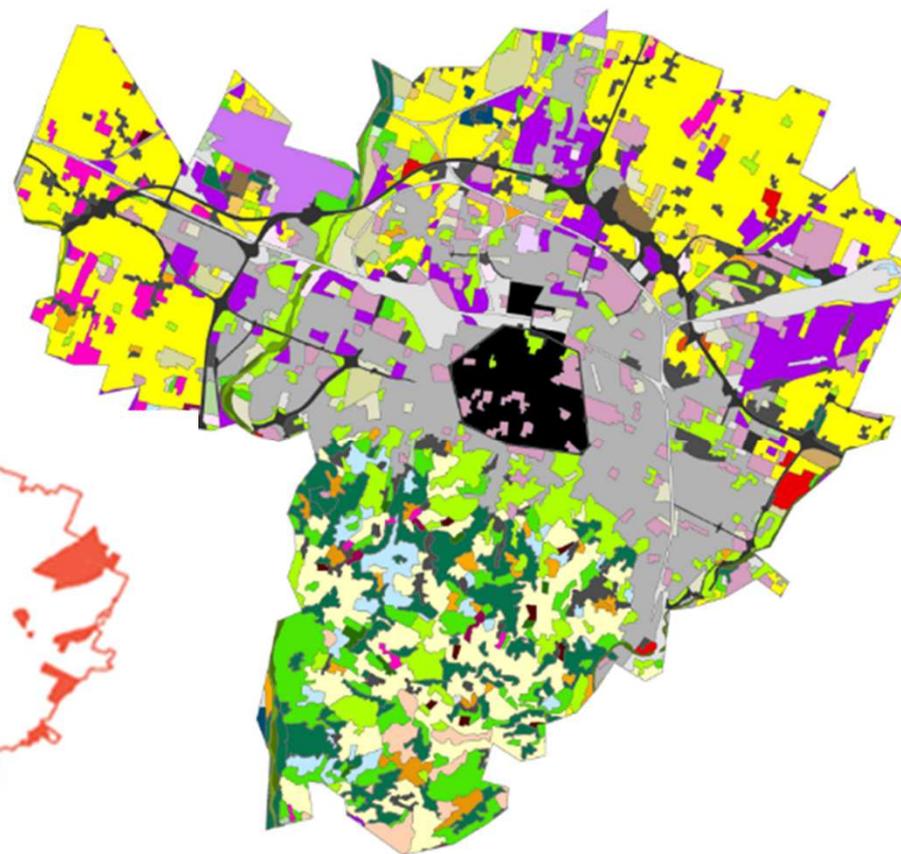
SOIL USE

- Urbanized surface raised from 23% (1971) to 34% (2003)
- Established urbanized surface and transformation/renovation areas account for 47% of the total surface.

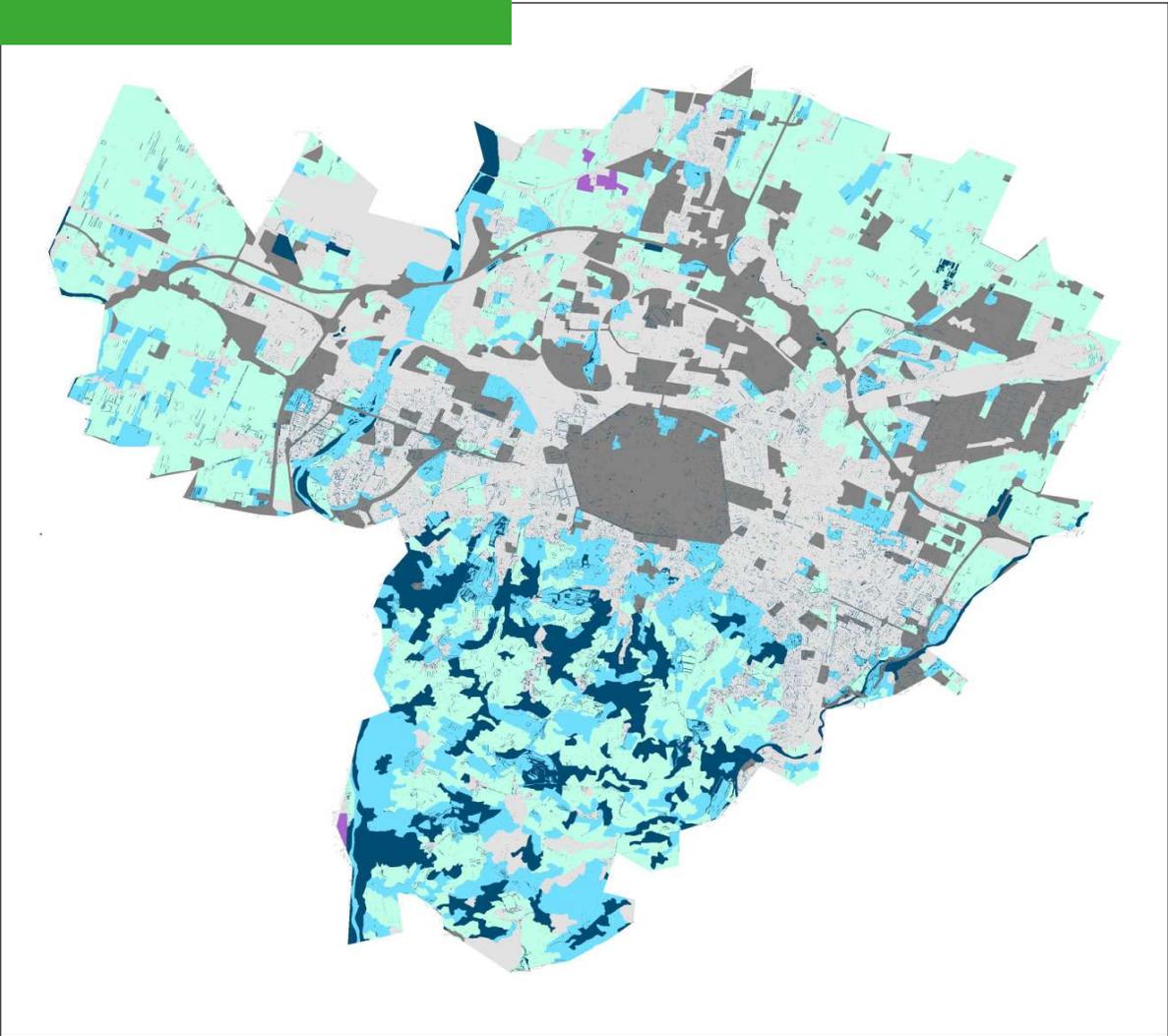
New developments



Existing soil use categories



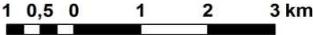
SOIL PERMEABILITY



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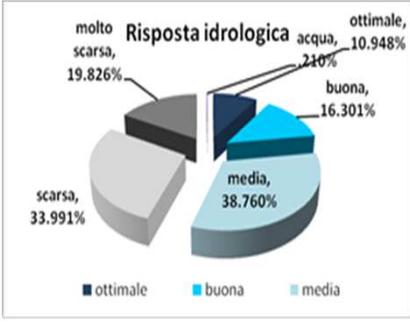
Risposta idrologica

Scala 1: 60.000



Legenda

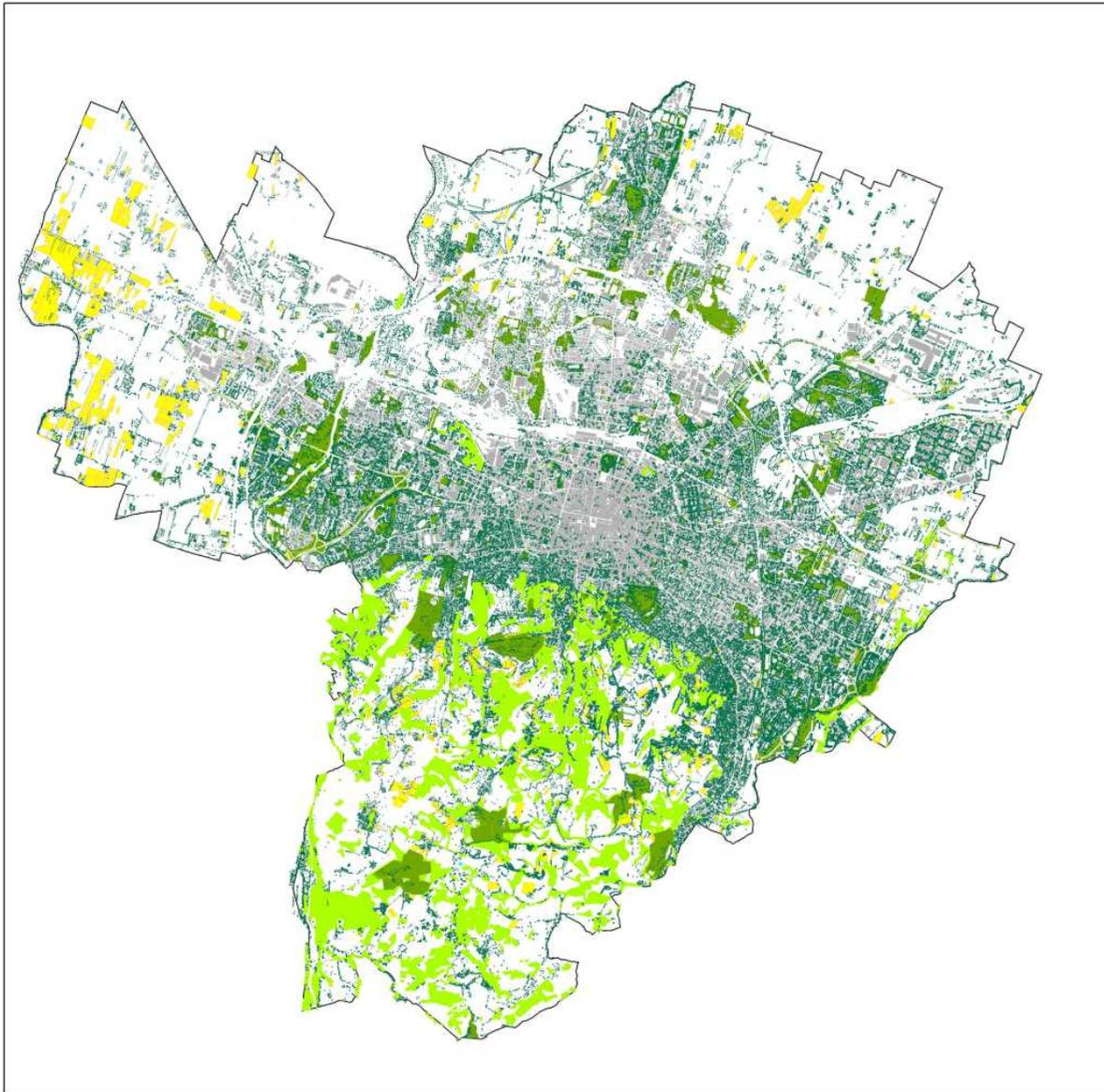
- Risposta idrologica**
- ottimale
 - buona
 - media
 - scarsa
 - molto scarsa
 - acqua



GREEN INFRASTRUCTURES

- Green urban areas cover 1.100 Ha (600 Ha parks and gardens), about 9% of the total surface.
- The per capita availability of parks and gardens and other similar green areas is about 20 m²/inhabitant.
- In the city there are 100.000 trees in parks and 18.000 trees along roads.
- The total availability of «green areas» (including wooded areas) is about 60 m²/inhabitant, but it is not “equally” distributed.





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Verde per tipologia

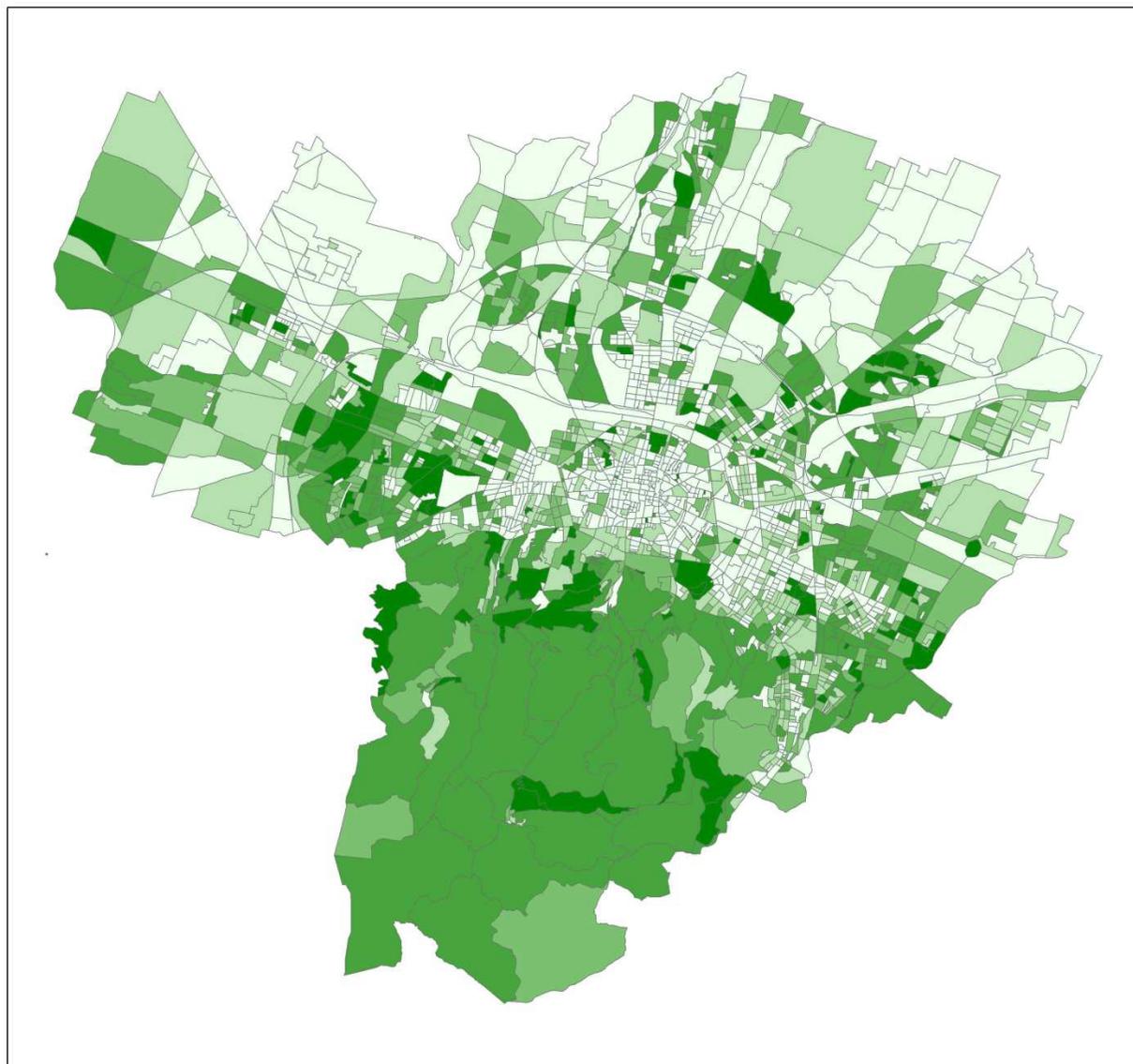
Scala 1: 60.000

1 0,5 0 1 2 3 km

Legenda

- filari, siepi e alberi
- verde urbano
- verde agricolo alberato
- aree vegetate non coltivate (boschi)
- edifici
- confine

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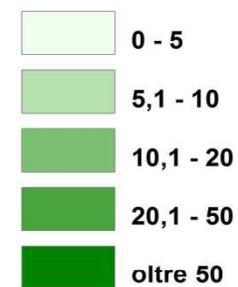
**Verde
per sezione censuaria (%)
Anno 2011**

Scala 1: 60.000

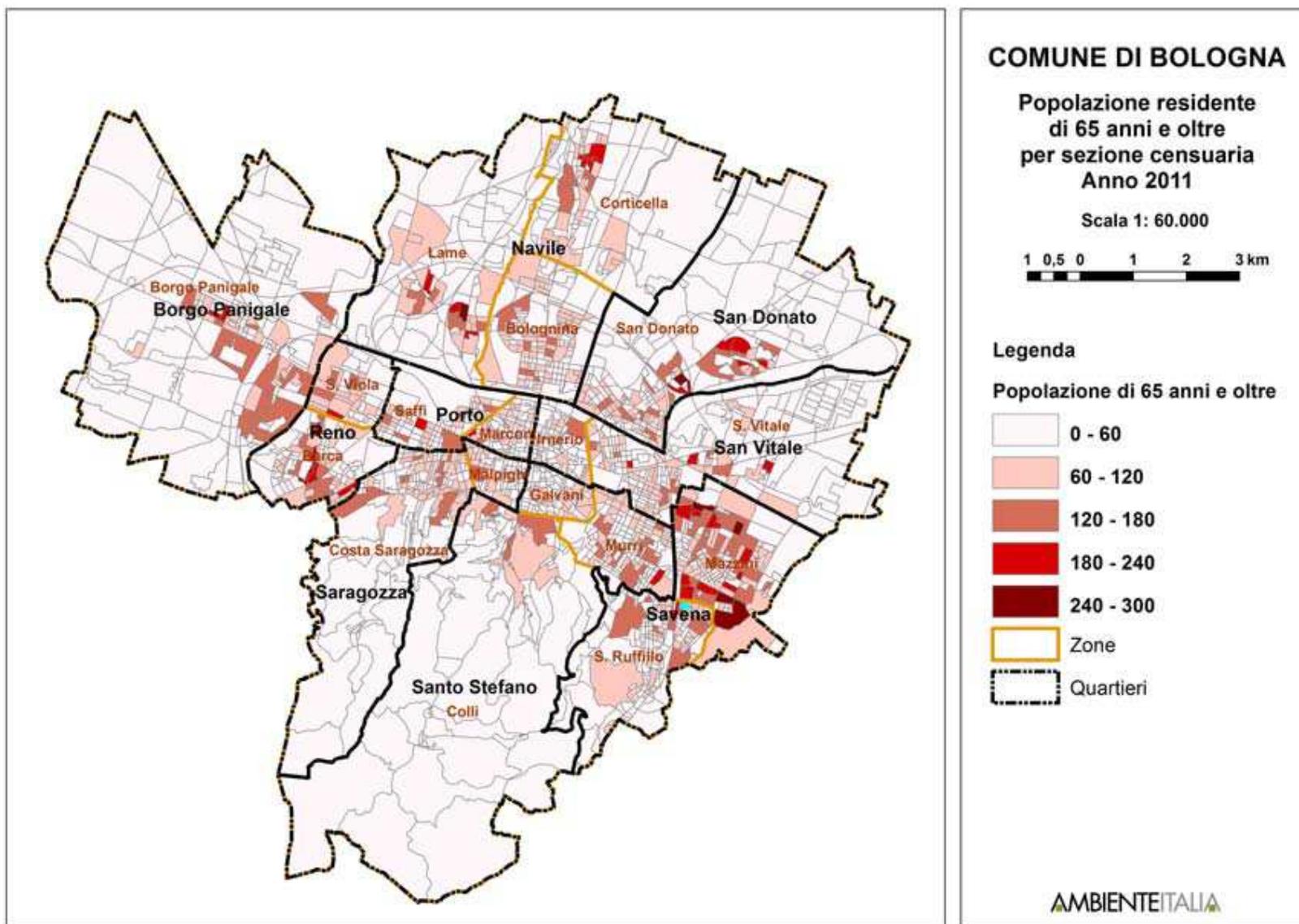
1 0,5 0 1 2 3 km

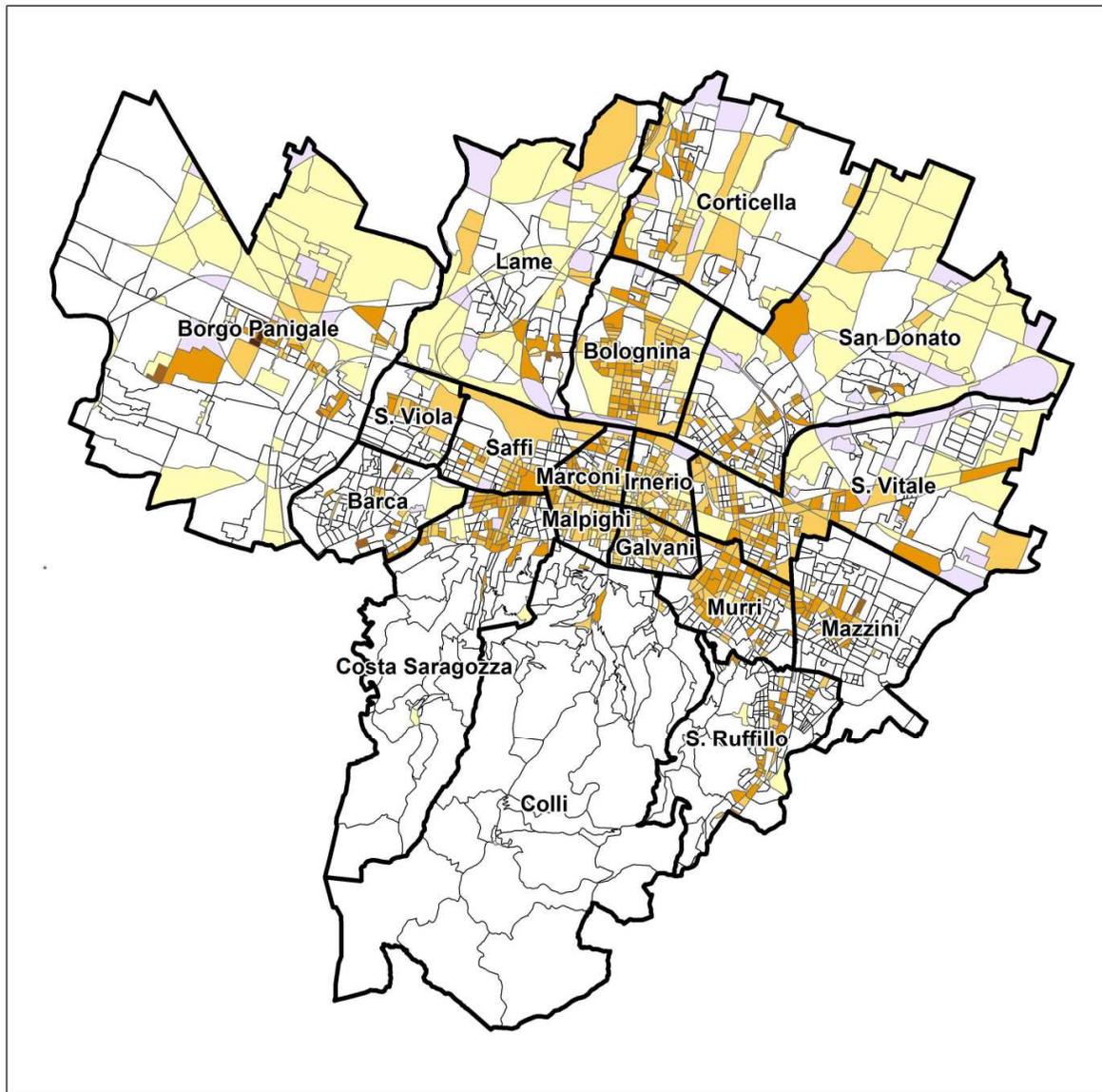
Legenda

Verde totale per sezione (%)



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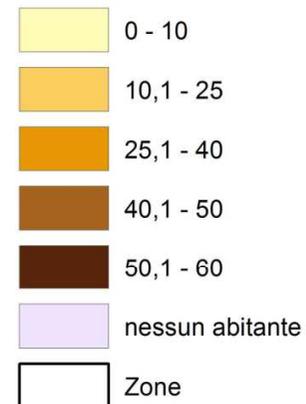
Popolazione di 65 anni e oltre
per sezione censuaria
con verde < 5%
Anno 2011

Scala 1: 60.000



Legenda

Popolazione 65 anni e oltre (%)



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WATER CONSUMPTION

Potable water network withdrawals:
43 Million m³

Potable water consumption invoiced: 32 Mm³

Domestic consumptions: 22 Mm³

Commercial and industrial consumptions
(potable water): 7 Mm³

Agricultural withdrawals (no potable water):
4 Mm³ (EVALUATION)

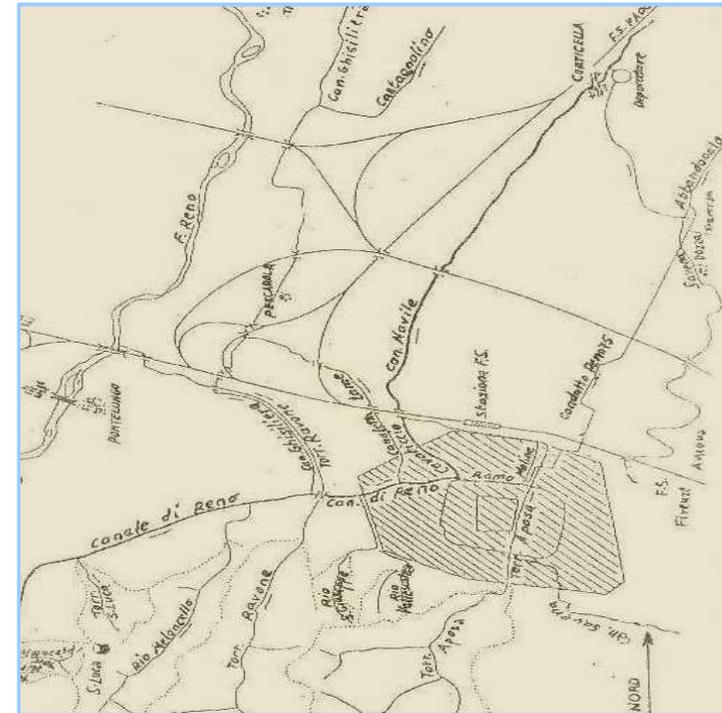
Industrial withdrawals (no potable water):
2.5 Mm³ (EVALUATION)



WATER CHANNELS AND WATER SUPPLY IN THE CITY

The city is crossed by a river (Reno) and two creeks (Savena and Lavino), as well as by many seasonal hill creeks.

In the centuries the city developed a relevant artificial channel system, due to the important role of the city as manufacturing centre.



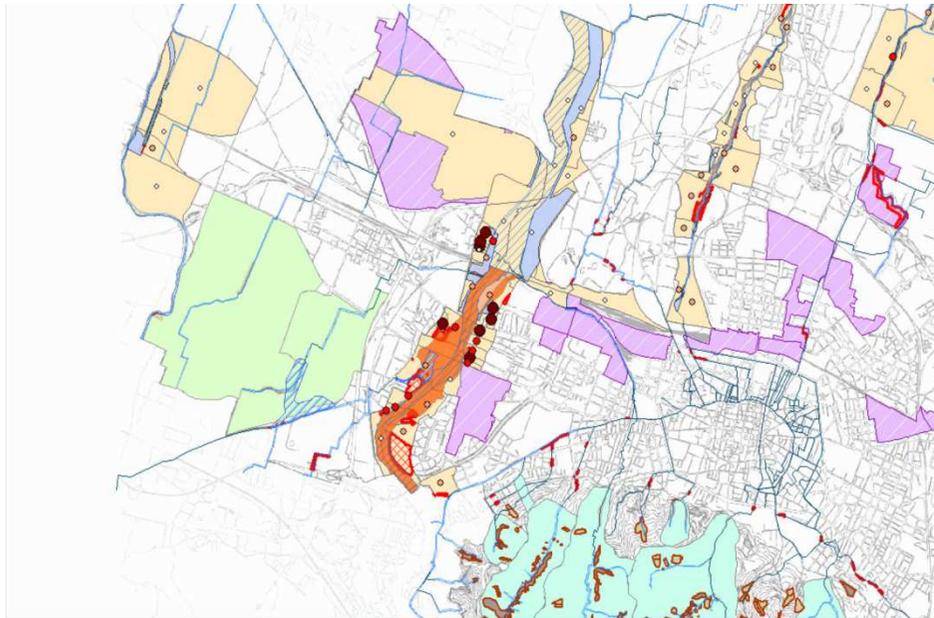
The water supply network of the metropolitan area is composed by 24 natural creeks and 24 channels.

Most all the natural and artificial riverbeds crossing the city have been buried and partially used as sewers.

EXTREME EVENTS AND HYDROGEOLOGICAL RISK

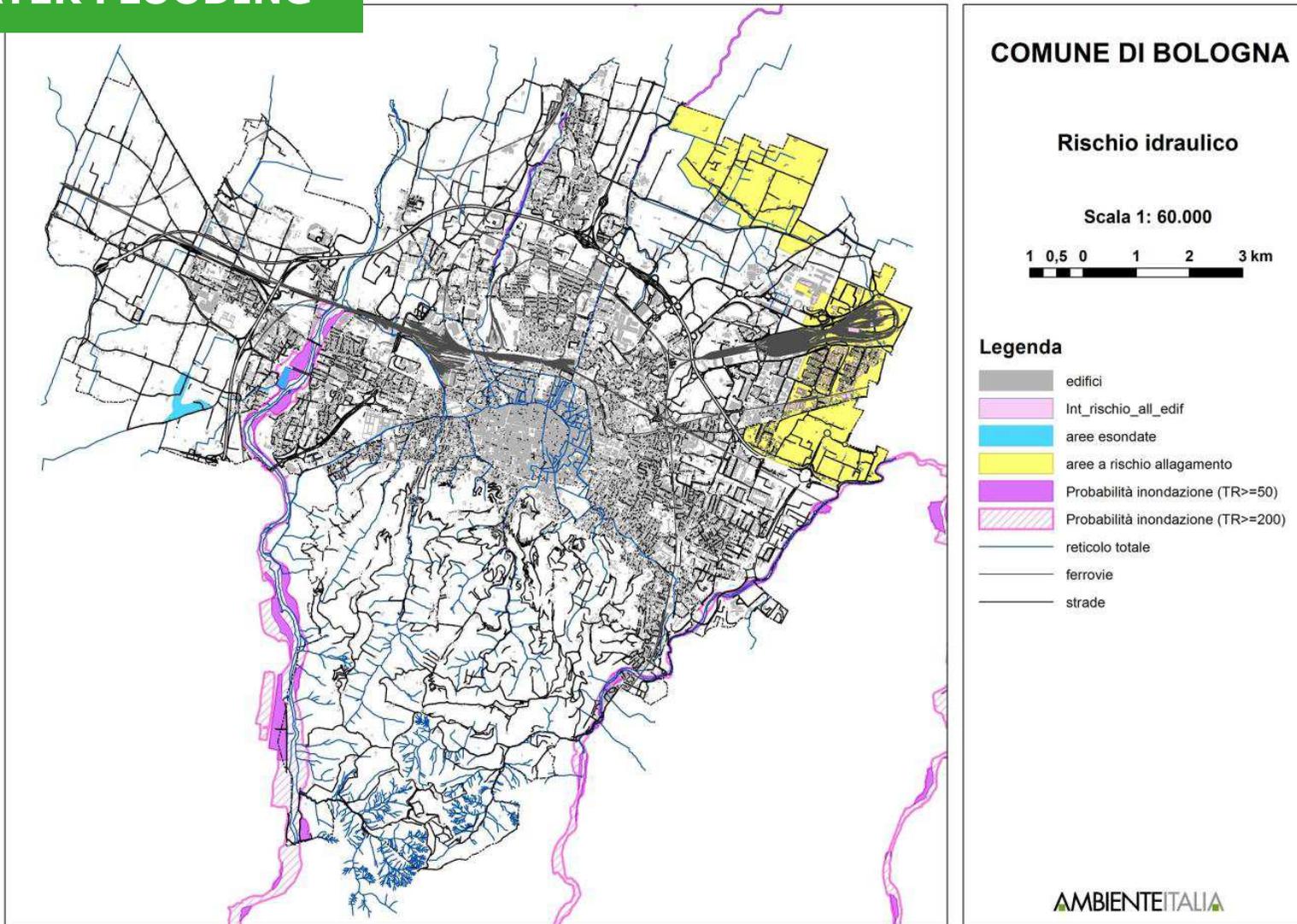


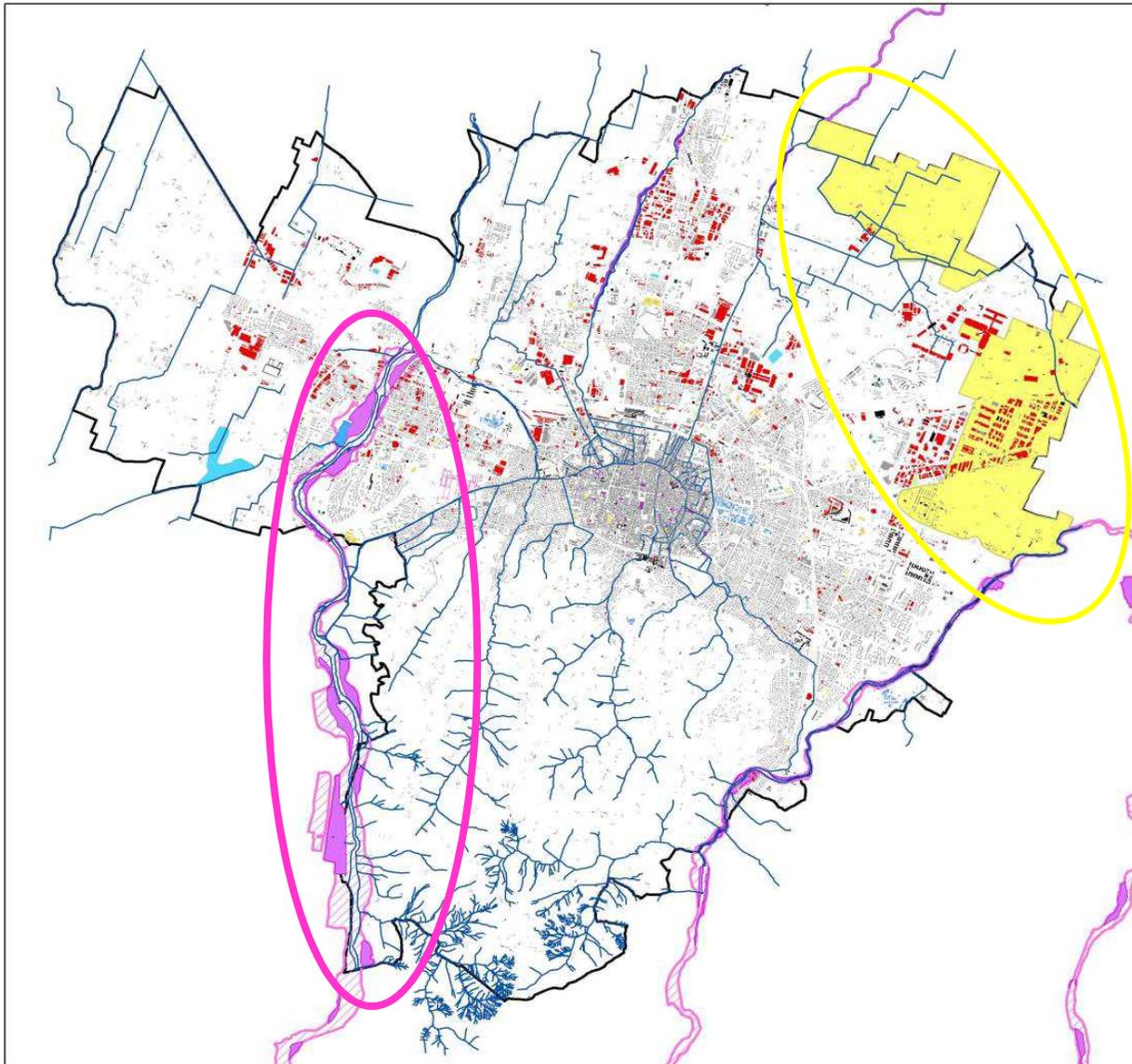
A dedicated geodatabase has been created to organize spatial information and to support the definition of actions for the adaptation plan.



The geodatabase organizes Local Climate Profile data and complete the cognitive framework.

WATER FLOODING





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Rischio idraulico e edifici per tipologia

Scala 1: 60.000



Legenda

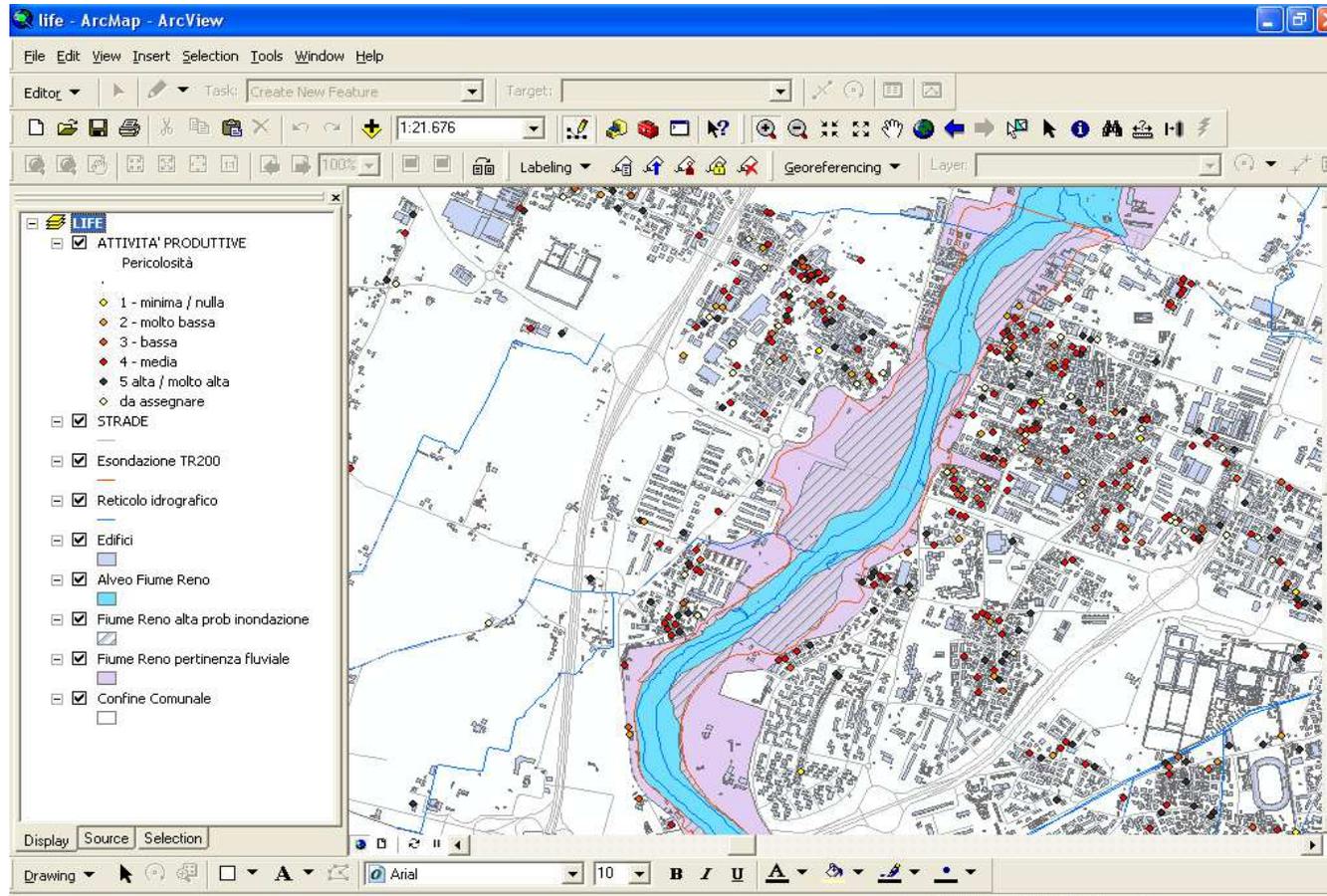
- aree esondate
- aree a rischio allagamento
- Probabilità inondazione (TR>=50)
- Probabilità inondazione (TR>=200)
- reticolo totale

edifici per tipologia

- Albergo
- Baracca
- Cabina ENEL
- Campanile
- Carcere
- Casello Autostradale
- Chiesa
- Chiosco alimentari
- Chiosco fiori
- Chiosco gelati
- Chiosco giornali
- Cimitero
- Edificio ad uso agricolo
- Edificio diroccato
- Edificio generico
- Edificio scolastico
- Edificio sportivo
- Mura storiche
- Ospedale
- Parcheggio multiplano
- Portico
- Prefabbricato
- Serra
- Silos
- Stabilimento industriale
- Stazione di rifornimento
- Tettoia
- Torre storica

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VULNERABILITY MAPS



The flood return periods are dramatically decreasing and the amount of water flowing per unit of time during extreme rainfall events are increasing.

Some case studies have already been carried out (Ravone stream), and the analysis model can be applied to other streams crossing the town.

Vulnerabilities



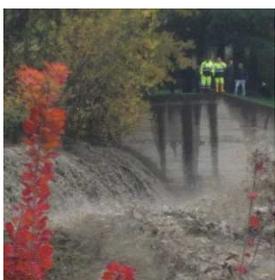
HEAT WAVES

Exposure: HIGH
Sensitivity: HIGH (population, tourism, air quality)



WATER SCARCITY

Exposure: MEDIUM/HIGH
Sensitivity: HIGH (population, mobility, economy)



EXTREME EVENTS

Exposure: MEDIUM/HIGH
Sensitivity: HIGH (population, hydrology)

CHALLENGES.....

- Downscaling of climate information at the urban level is difficult
- Administrative borders and the geographical “coverage” of some adaptation analysis and policies related to water (catchment river basin) and green infrastructures (wood belts) do not overlap
- Industrial and agricultural withdrawals and consumption have to be better monitored
- Social and environmental data crossing (evaluating vulnerability) need further refinement
- Need of further information in order to shift from vulnerability to risk analysis

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COMUNE DI BOLOGNA

Comune italiano di circa 380.000 abitanti, è capoluogo dell'omonima provincia e della regione Emilia-Romagna e costituisce un nodo strategico della rete stradale e ferroviaria nazionale.
comune.bologna.it



Organizzazione non profit costituita da imprese, enti locali e associazioni impegnati nel raggiungimento degli obiettivi di riduzione delle emissioni di gas serra assunti con il Protocollo di Kyoto.
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arpa.emr.it



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