BASE BOTTOM-UP CLIMATE ADAPTATION STRATEGIES TOWARDS A SUSTAINABLE EUROPE

Economic assessment of implemented flood control measures in Prague

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ECONADAPT workshop, NTK

9. February 2017

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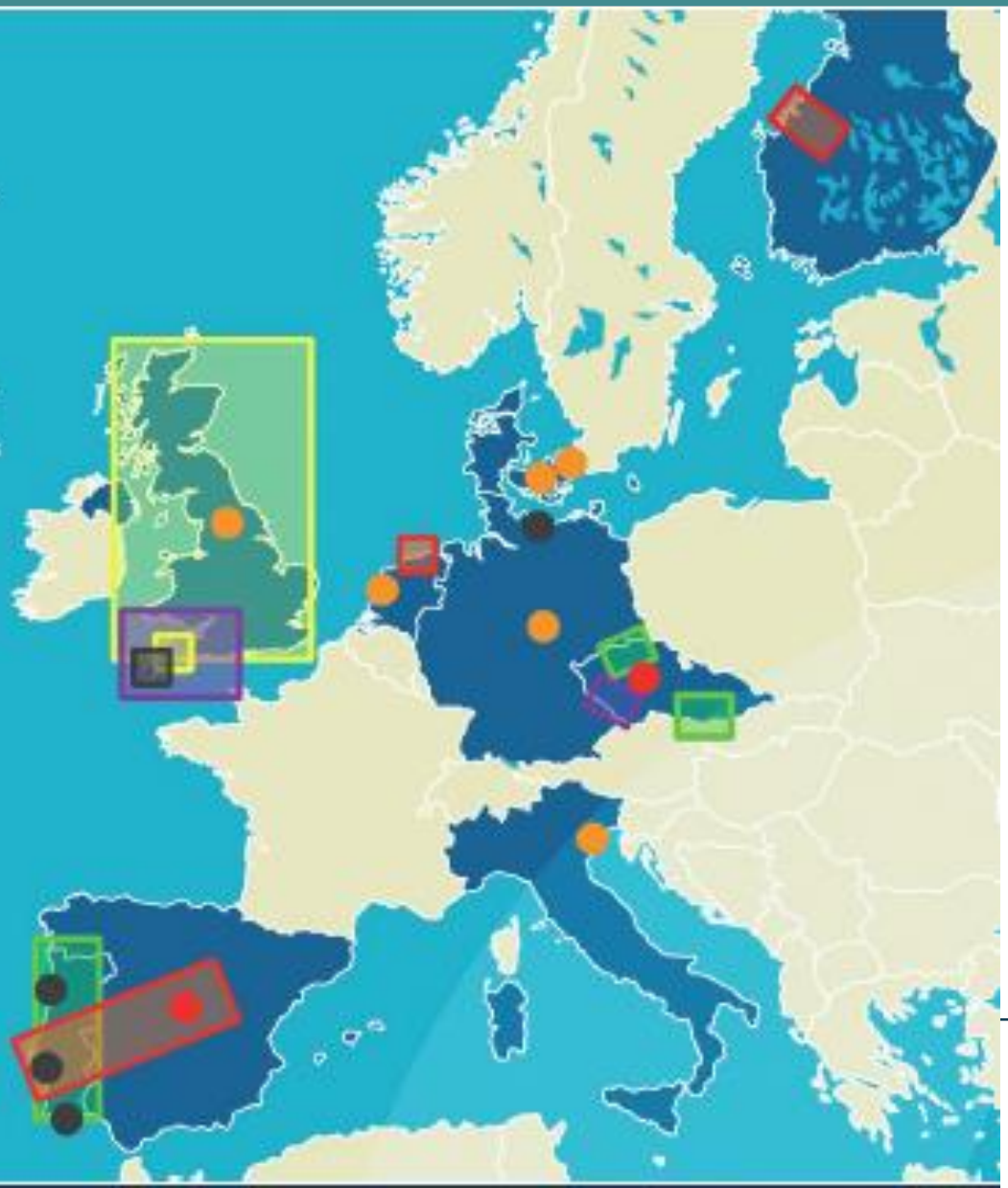
Case studies

To gather insights from the local level, the BASE project examines climate change adaptation case studies from across Europe. The case studies focus on key adaptation sectors such as water and ecosystem services, rural and urban areas, food production and coastal zones. Many case studies cover multiple sectors or policy levels, examining the interactions between sectors and across scales.

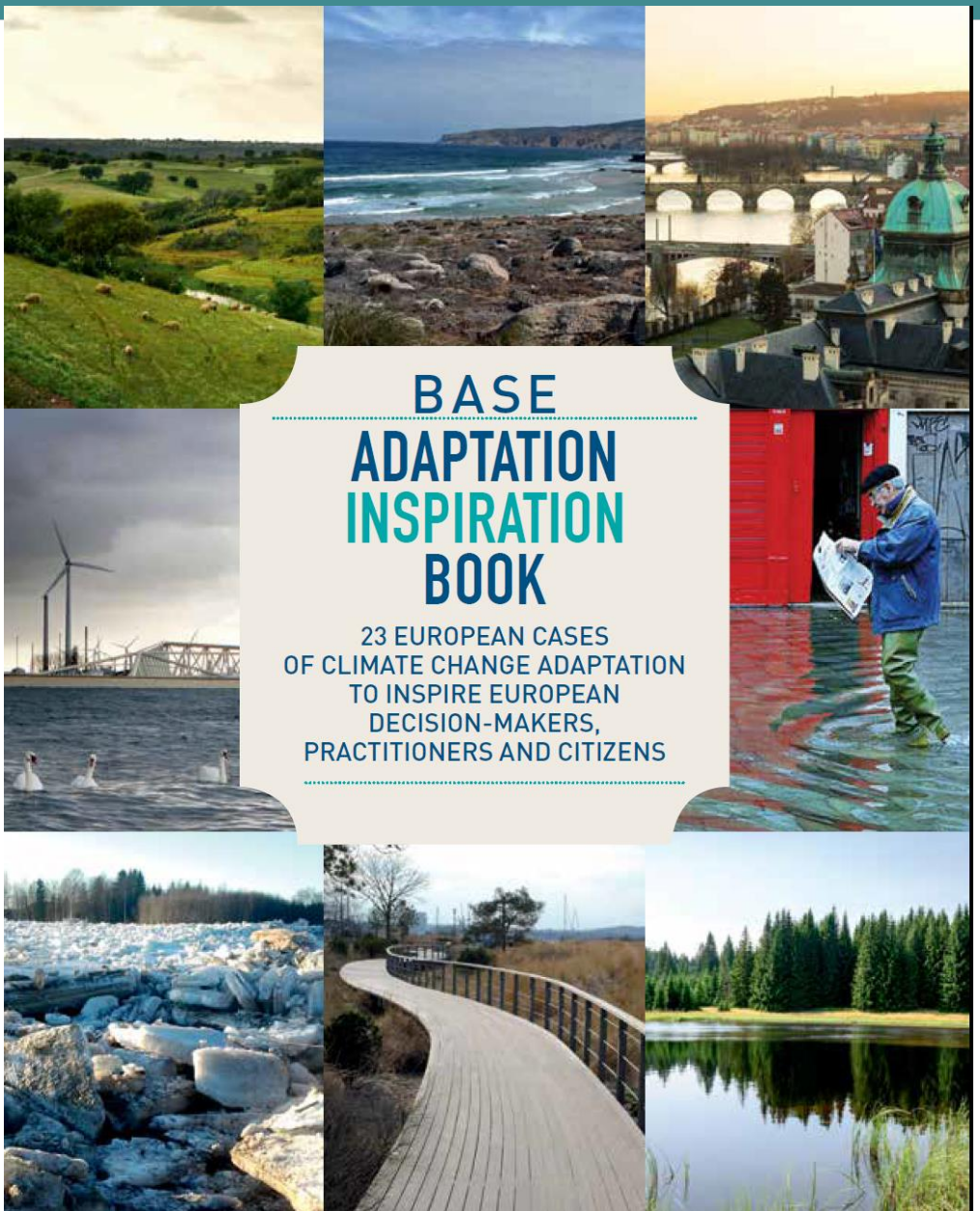
Case study sectors

- Coastal zones
- Agriculture & forestry
- Water resources
- Human settlements & infrastructure
- Biodiversity & ecosystems
- Health

- City/Municipality
- Regional/National level



For more information, please visit:
www.base-adaptation.eu/case-studies



Souhrn 23 evropských případových studií na CCA

Agriculture & Forestry / Biodiversity & Ecosystems

Water resources & Health

Coastal zones / Human settlements & Infrastructure

http://base-adaptation.eu/publications

http://climate-adapt.eea.europa.eu/metadata/case-studies

BASE CCA case studies

- To present different approaches to cost-benefit analysis (CBA) of adaptation measures

- Prague case study
  - **Flood-control system**
  - Urban heat adaptation pathways

Extreme river flood event in 2002

In 2002, Prague experienced severe flooding (with a return period of 500-year) with total damage of **24 billion CZK**. This event was recognized as one of the most expensive weather-related disaster in the history of the city with heavy damages on infrastructure, housing and environment.

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Prague investment into flood control system (FCS)

- Since the 2002 event, the implementation of flood control measures by Prague municipality substantially speeded up.

- The flood control system constructed in Prague consists mostly of grey infrastructure, such as fixed and mobile barriers and safety valves in the canalisation network along the Vltava River.

- Before the construction of such protection system, the area threatened by floods in Prague was **57.5** square kilometres (in total **11.6%** of the city).

- Currently, **52.5 km²** of the previously threatened area is protected against flooding.

- The areas with limited flood protection consist of Sedlec and Troja areas and areas of Vltava and Berounka river confluence, which are not densely populated.

Prague flood-control CBA

- Retrospective case study
- Aims:
  - To apply a cost-benefit analysis of flood-control adaptation measures in Prague
- Climate-related hazards:
  - Severe flooding in 2002
  - Total damage of 24 billion CZK

Background

- Before 2002
  - Flood-control measures designed for 100-year flooding
- Response to an exceptional flood event in 2002:
  - Enhancement of flood-control measures capacity to 500-year flooding (30% increase)

Flood Control System

- Based on the 2002 flood experience, the flood control measures were improved and designed to protect city from 2002 flood (Q 2002 = 5 160 $m^3 s^{-1}$), which corresponds to a water level of 782 cm with safety reserve of 30 cm.
- The construction of the flood control system in Prague was realised throughout 8 phases, each one addressing a specific sector of the Vltava River. The total length of flood protection measures (fixed barriers, solid concrete walls and mobile barriers) after the completion of all stages is approximately 19.255 km, of which 6.925 km are mobile barriers.

"Grey" adaptation measures

- Fixed barriers (levees, dykes)
- Mobile barriers
- Closures and pumping systems in the canalisation

Prague: Cost-benefit analysis

- **Costs:**
  - One-off costs of constructing flood-related adaptation measures (144.4 Million EUR, 2013)
  - Costs of barrier installation in the case of flood events (0.65 Million EUR, 2013)
  - Annual storage and maintenance costs (0.89 Million EUR, 2013)

  Total costs reach 3.7 billion CZK (2013).

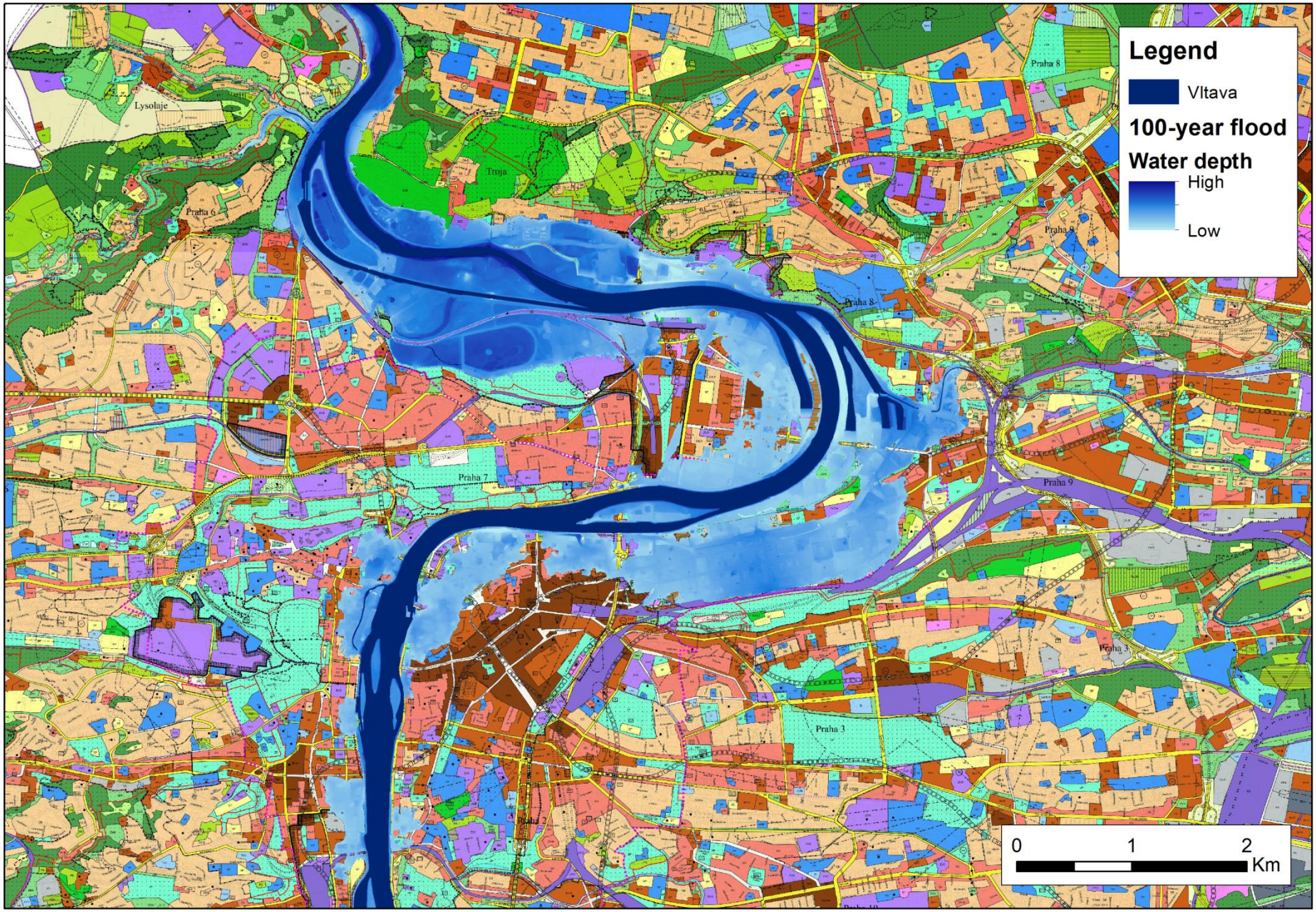
- Sensitivity/uncertainty analysis:
  - Discount rates (5%, 3%, 1%)

- **Time horizon: 80 years**

We quantified benefits as a **net present value (NPV)** over a time horizon of 80 years.

- Benefits
  - Avoided damage costs (Million EUR):
    - Residential buildings, ranging between 332 (Q20) and 1,971 (Q500);
    - Infrastructure and industrial buildings, ranging between 124 (Q20) and 613 (Q500);
    - Equipment, ranging between 42 (Q20) and 254 (Q500);
    - Citizen´s evacuation, cleaning and other costs, ranging between 42 (Q20) and 74 (Q500);
    - Environmental and cultural assets, ranging between 38 (Q20) and 57 (Q500).
- Use of damage factors: $D = p * A * H * V$,

(*p* denotes the percentage of covered surface within the urban fabric for a particular land use, *A* is the area (m^2) of land use, *H* is the water depth damage factor and *V* is the average price per m^2 for an apartment)


Legend
Vltava
100-year flood
Water depth
High
Low
Lysolaje
Troja
Praha 6
Praha 7
Praha 8
Praha 9
Praha 3
0
1
2
Km

Results

The total costs of damage from flooding in Prague without a flood control system, and total benefits with FCS.

Total cost	Q20	Q50	Q100	Q500
CZK (million) 2013	10 650.17	13 666.94	16 309.05	25 106.78
EUR (million) 2013	409.57	525.89	627.58	966.12

	Q20	Q50	Q100	Q500
Total Benefits (Mil. EUR 2013)	170.67	662.71	1464.1	2003.44

Results

- There is no national guideline for climate change adaptation measures in the Czech Republic. The discount rate applied would be 3% with a sensitivity test of 1 and 5%.
- How to deal with data uncertainty? Data uncertainty is quite high and therefore average or “as close as possible” data will were used for the analysis. Such items where the uncertainty is too high (e.g. impact on businesses, i.e. „second-order effects“) are not be included in the analysis.

Discount rate	1%	3%	5%
NPV [in mil. EUR]	1 872	918	599

Results

- Return on investments:
  - At least one 50-year or higher flooding event
  - At least one 20-year combined with one additional flooding event
- Learning process: adaptive reaction to the 2002 flooding event
  - Enhancement of flood-control measures
  - Flood-prove test in 2013 (100-year level)
  - Potential increase in flooding intensity induced by climate change

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UrbanAdapt project

„Development of **urban adaptation** strategies using **ecosystem-based approaches to adaptation“**

Project duration:

January 2015 – December 2016

8 project partners (CZ, IS)

website: urbanadapt.cz

supported by a grant from Iceland, Liechtenstein and Norway

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Prague Climate Change Adaptation Strategy

- Initiated within the project **UrbanAdapt**
- Development of urban adaptation strategies using ecosystem-based approaches to adaptation

Analytical part (*Prague Institute for Planning and Development, CzechGlobe*)

Climate Change Adaptation Strategy (*Prague city and IPR*)

IPR PRAHA | STRATEGICKÉ PLÁNOVÁNÍ | ÚZEMNÍ PLÁNOVÁNÍ | VEŘEJNÝ PROSTOR | SOUTĚŽE | MAPY A DATA | PARTICIPACE

IPR › Strategické plánování › Dílčí strategie › Adaptační strategie

Strategie adaptace hl. m. Prahy na klimatickou změnu

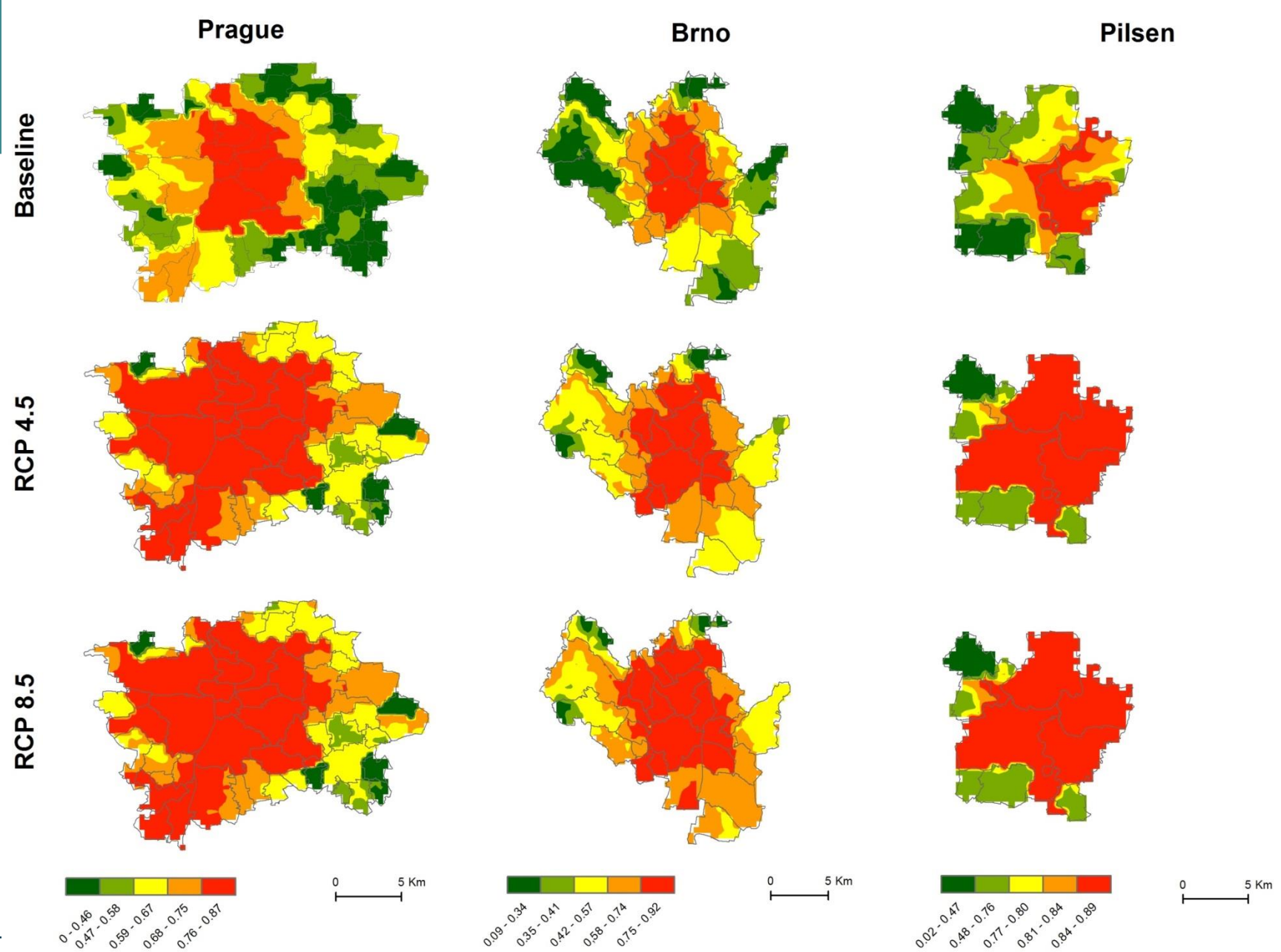
Magistrát spolu s IPR Praha zveřejnil návrh Strategie adaptace hl. m. Prahy na klimatickou změnu. Ta se zaměřila především na udržitelné hospodaření s vodou, „zazeleňování" ulic nebo vytváření ekologicky šetrných staveb.

Proč adaptační strategie?

Klimatická změna vyvolává v posledních období častější extrémy počasí. Přívalové deště způsobují bleskové záplavy ve městech, častější sucha a vlny veder zase ohrožují zdraví lidí, poškozují vodní zdroje a infrastrukturu.

Jaká je naše vize?

Zvýšení dlouhodobé odolnosti a snížení zranitelnosti hlavního města Prahy vůči dopadům změny klimatu postupnou realizací vhodných adaptačních opatření (s přednostním využitím ekosystémově založených opatření v kombinaci s šedými –



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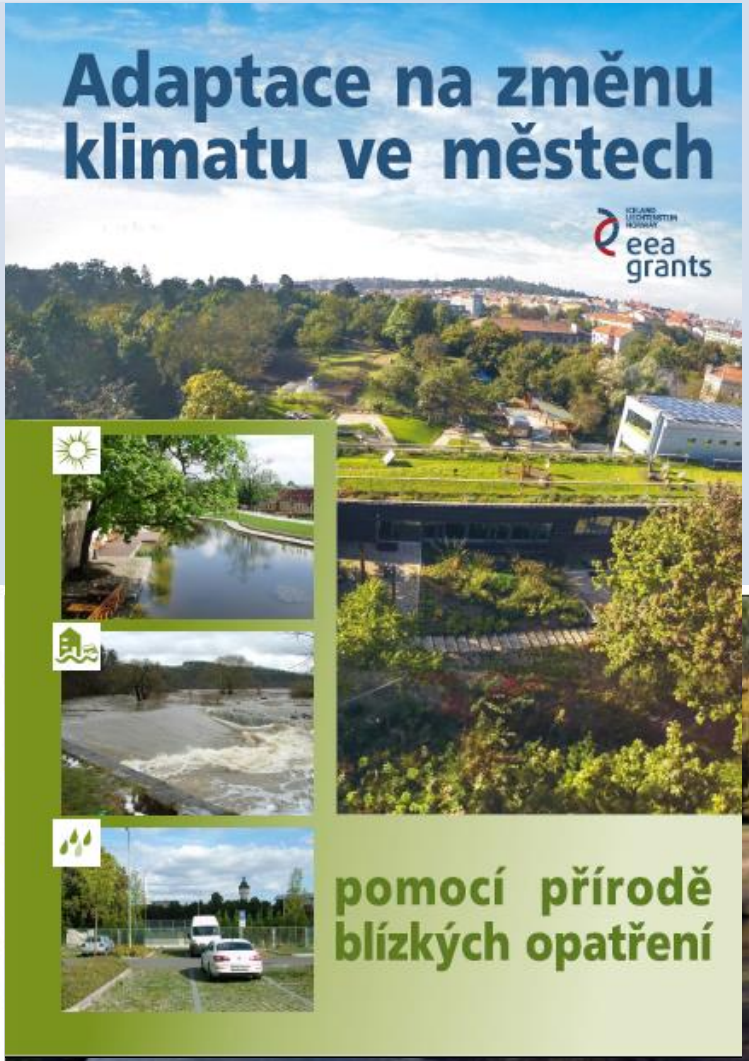
Krkoška Lorencová et al. submitted



Nové revitalizační koryto Rokytky – lávka.

EEA Report | No 12/2016

Urban adaptation to climate change in Europe 2016

Transforming cities in a changing climate

ISSN 1977-8449

Spotlight on selected areas of action: is action effective to meet future climate challenges?

Box 5.9 Research supporting Czech cities to prepare for climate risks

'Czech cities are currently not very advanced in their adaptation to climate change for several reasons. Climate change adaptation was so far not so high on the political agenda; cities to some extent lack awareness, knowledge, and governance structures. In this situation, the Global Change Research Institute (CzechGlobe) together with partners from the cities, NGOs and universities created the UrbanAdapt project focusing on the development of urban adaptation strategies using ecosystem-based approaches to adaptation. Within this project we aim at initiating the process of development urban adaptation strategies in Prague, Brno and Pilsen.' David Vačkář, project coordinator, Global Change Research Institute.

Population: 1 259 079 (Prague)/ 377 440 (Brno)/ 169 033 (Pilsen)
Biogeographical region: Central and eastern Europe

The Global Change Research Institute provides Prague, Brno and Pilsen with access to scientific knowledge and information from international experiences. It helps translate them into information needed for the local context, especially for suitable ecosystem-based adaptation measures and actions. Within the project the consortium organised two rounds of stakeholder workshops in each of the three cities in 2015. Participants came from city administrations, regional authorities, the ministry of the environment, the private sector, NGOs and research institutions. They discussed the current problems of the city related to climate change impacts and jointly defined a strategic vision and future goals for 2030 that the city could follow. Some of the problems in the three cities are quite similar, such as urban heat island effects (especially in the city centres), the lack, or low quality of green areas and insufficient rainwater retention. Other problems were specific to each city. For instance, in Pilsen, scarcity of

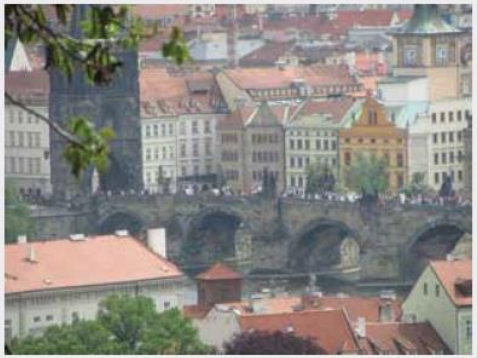
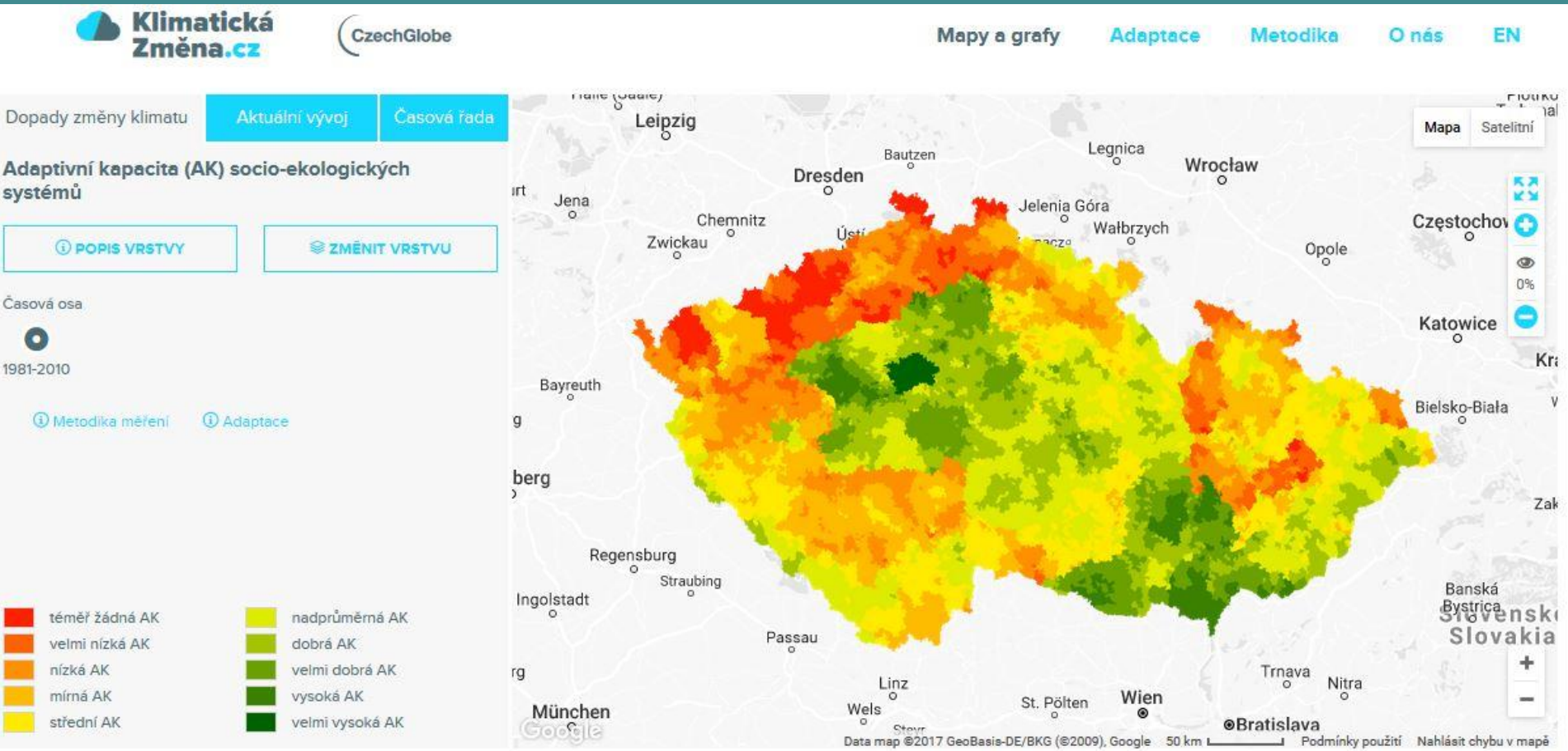


Photo: © Pia Schmidt



CzechAdapt -Systém pro výměnu informací o dopadech změny klimatu, zranitelnosti a adaptačních opatřeních na území ČR“. Za přispění grantů z Islandu, Lichtenštejnska a Norska. (www.klimatickazmena.cz)

Conclusions

- In the case of Prague, implementation of grey infrastructure including flood barriers was essential in order to effectively protect the city centre.
- Based on the performed cost-benefits analysis, the FCS proved to be a very effective investment.
- However, there are still possibilities to adopt green and blue measures on small streams (e.g. Rokytka or Botič).
- Prague Climate Change Adaptation Strategy is focusing also on other climate related risks (heat waves / urban heat island, sustainable water systems / rainwater management)

Thank you for your attention!

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www.base-adaptation.eu

www.urbanadapt.cz

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