Potentials of remote sensing and spatial analysis for urban disaster risk assessment

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AFRICA-ARAB PLATFORM ON DISASTER RISK REDUCTION | Tunis, Tunisia | 9-13 October 2018

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Current trends

- Urban Growth
  - Extension of Urban Areas
  - Increasing pressure on infrastructures
- Climate Change
  - Flash Floods
  - Erosion
  - Drought

→ increased Risk towards Natural Hazards

→ Sustainable Urban Planning

→ need for disaster risk assessment

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Project – Monastir, Tunisia

« Urban Disaster Resilience through Risk Asssessment and Urban Planning » (UD-RASP)

ECHO/SUB/2016/740186/PREV19

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Humanitarian Aid
And Civil Protection

Duration: Jan. 2017 – Oct. 2018

Partners

- IABG mbH, Germany
- UNU-EHS - Institute for Environment and Human Security, Germany
- Municipality of Monastir, Tunisia

Urban Disaster Risk Assessment

Identification of goals and priorities

Collection and preparation of Database

Analysis of **current** Risk

Analysis of **future** Risk

Implementation of information system

Capacity building activities

Stakeholder engagement

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Project – Monastir, Tunisia

Kickoff meeting with stakeholders
Assessment of existing capacities and needs
February 2017

- Need for development of a tool for prevention and management of natural hazards
- Enabling urban area to develop response mechanisms to cope with the effects of climate change

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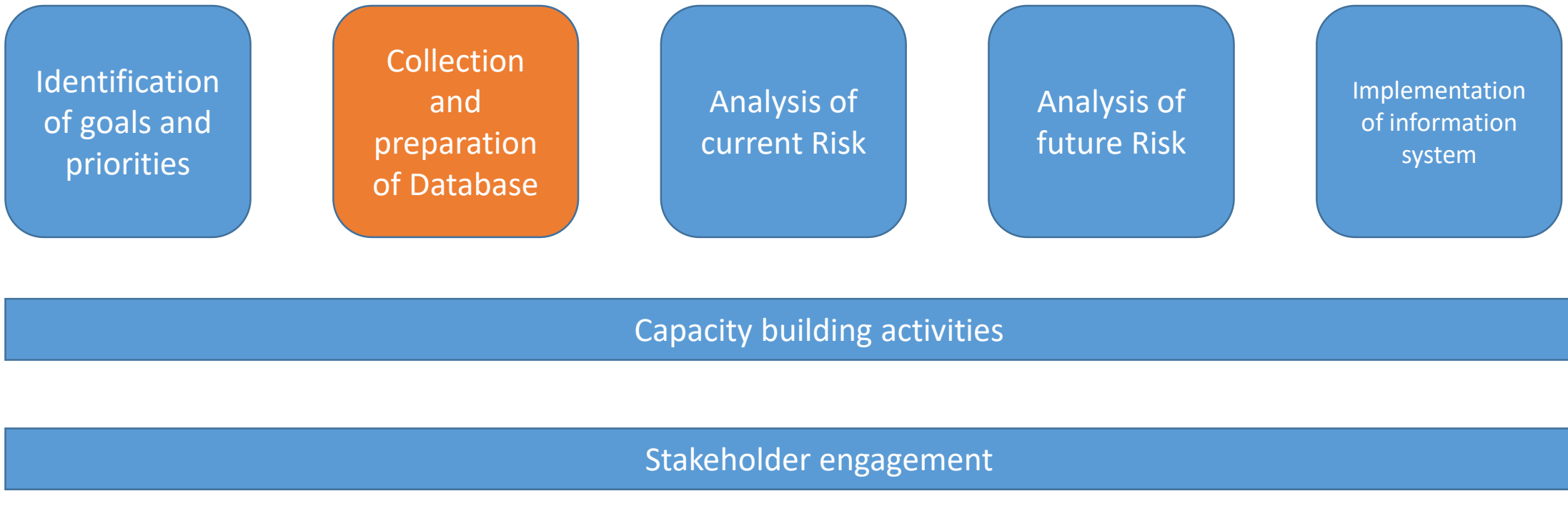
Urban Disaster Risk Assessment



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Data collection

Local

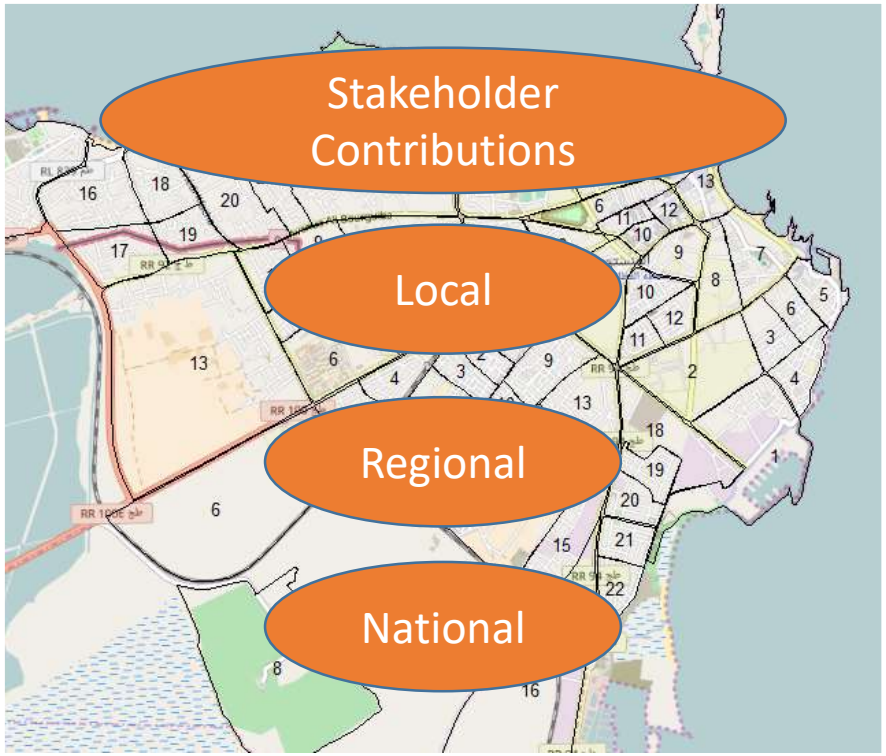
- Municipality of Monastir

Regional

- Office de la Topographie et du Cadastre (OTC)
- Ministère de l'Équipment de l'Habitat et de l'Aménagement du Territoire
- Civil Protection
- …

National

- APAL (Agence de Protection et d'Aménagement du Littoral)
- INS (Institut national de la statistique)
- CNCT (Centre National de la Cartographie et de la Télédétection)
- National Office of Civil Protection (ONPC)
- …



Data

- Critical Infrastructure
- Meteorological Data
- Census data
- Interviews
- Administrative Boundaries
- Historical Aerial Photos
- Land Use and Land Cover
- Reports and data
  - Flash Flood
  - Coastal Erosion
  - Seismic Activity
- …

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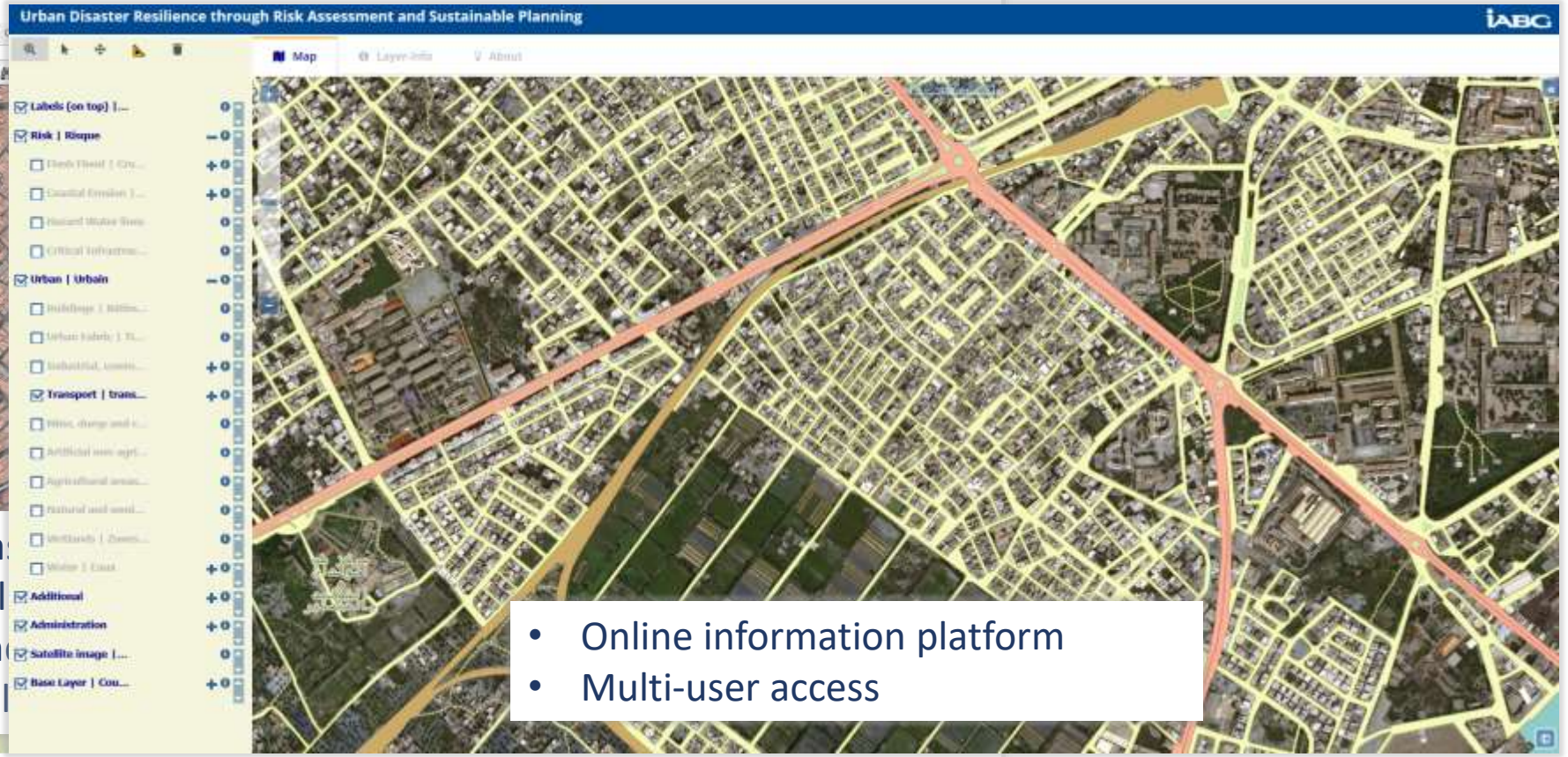
Data preparation

Initial Situation
- Plan d'amen
  Urban plan
- Individual p
  centralized

- Databa
- Central
- Fast an
- Possibil



- Online information platform
- Multi-user access

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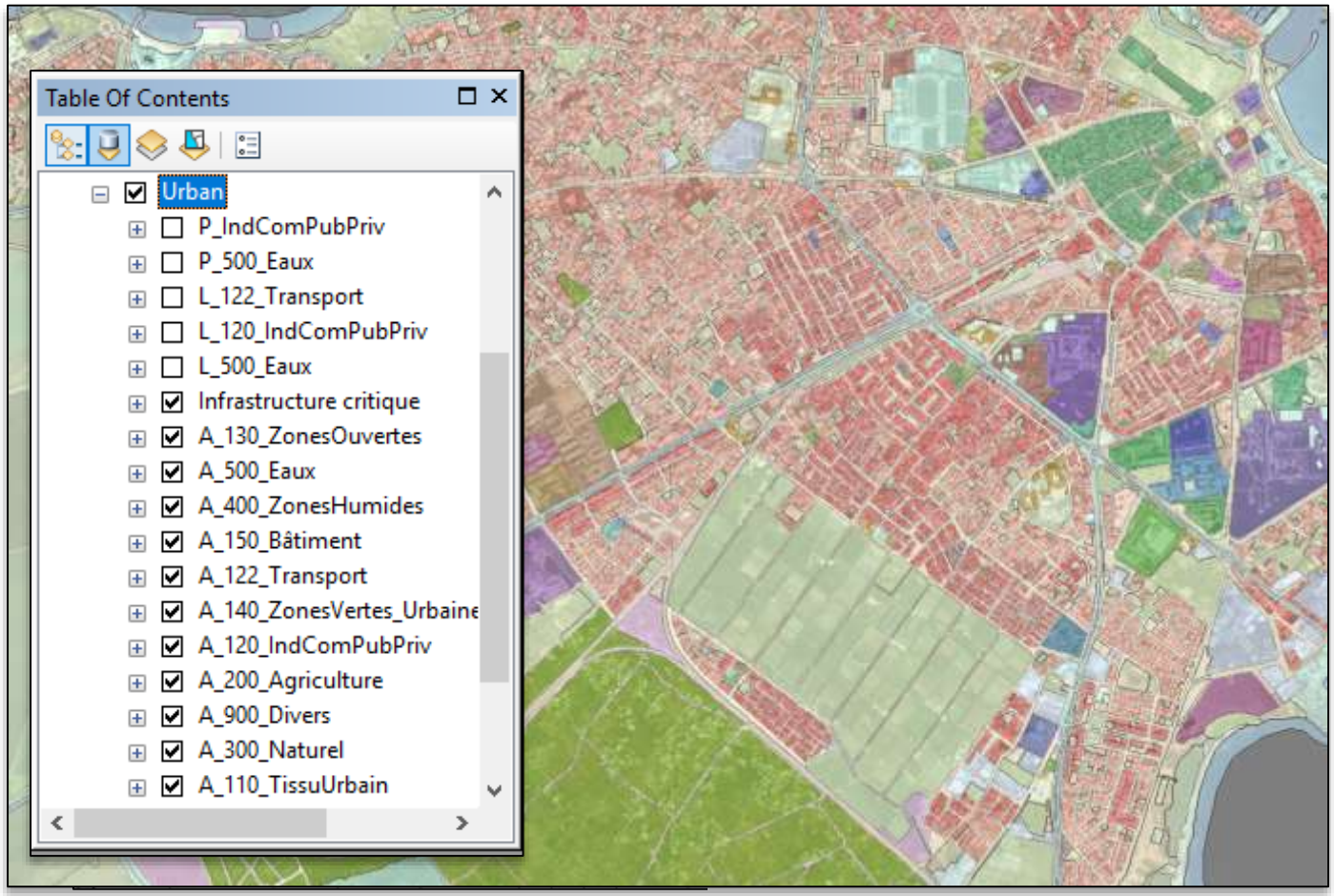
Data preparation

- Transfer of CAD data into standardized GIS structure
- Examination and update of data according to project needs
- Addition of data and analyses using satellite imagery



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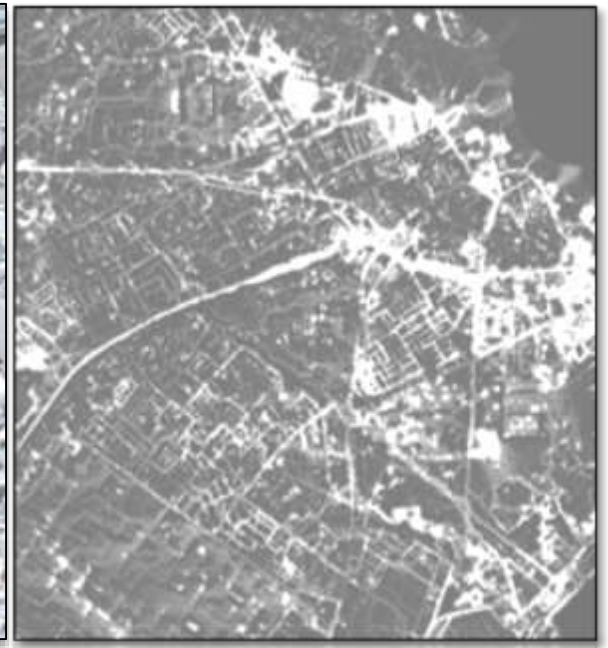
Data Update

Satellite Imagery (World View 3)

- Base information for the update of the PAU and other data
- Creation of an image mosaic as visual baseline for the web system
- Derivation of Digital Terrain Model (DTM)



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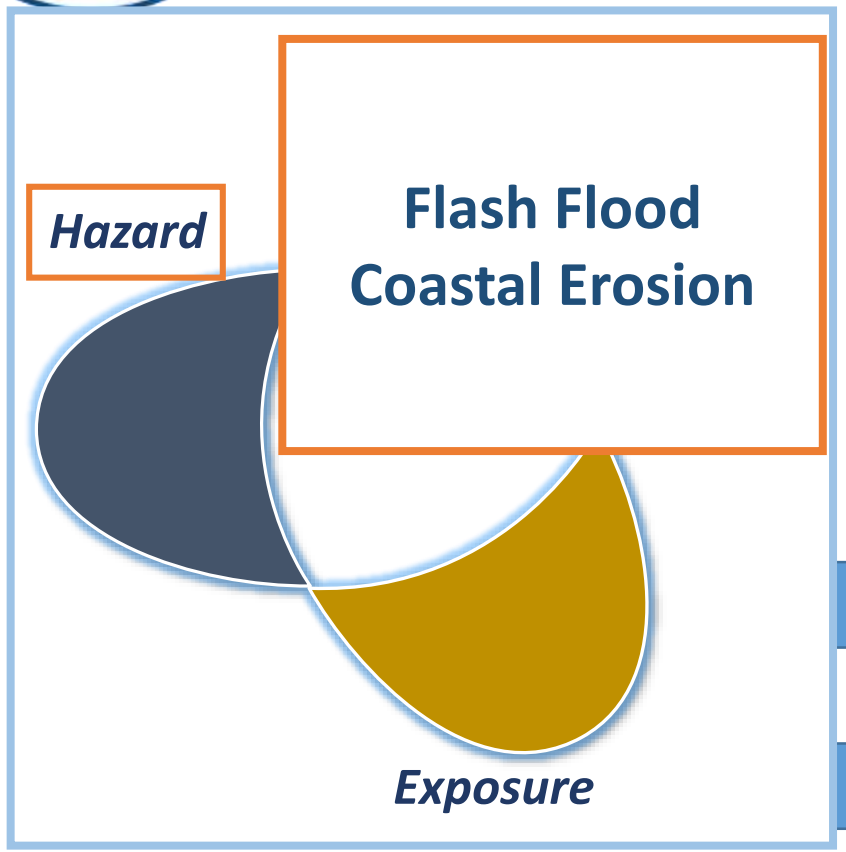
Urban Disaster Risk Assessment



Analysis of current Risk

Analysis of future Risk

Implementation of information system

Capacity building activities

Stakeholder engagement

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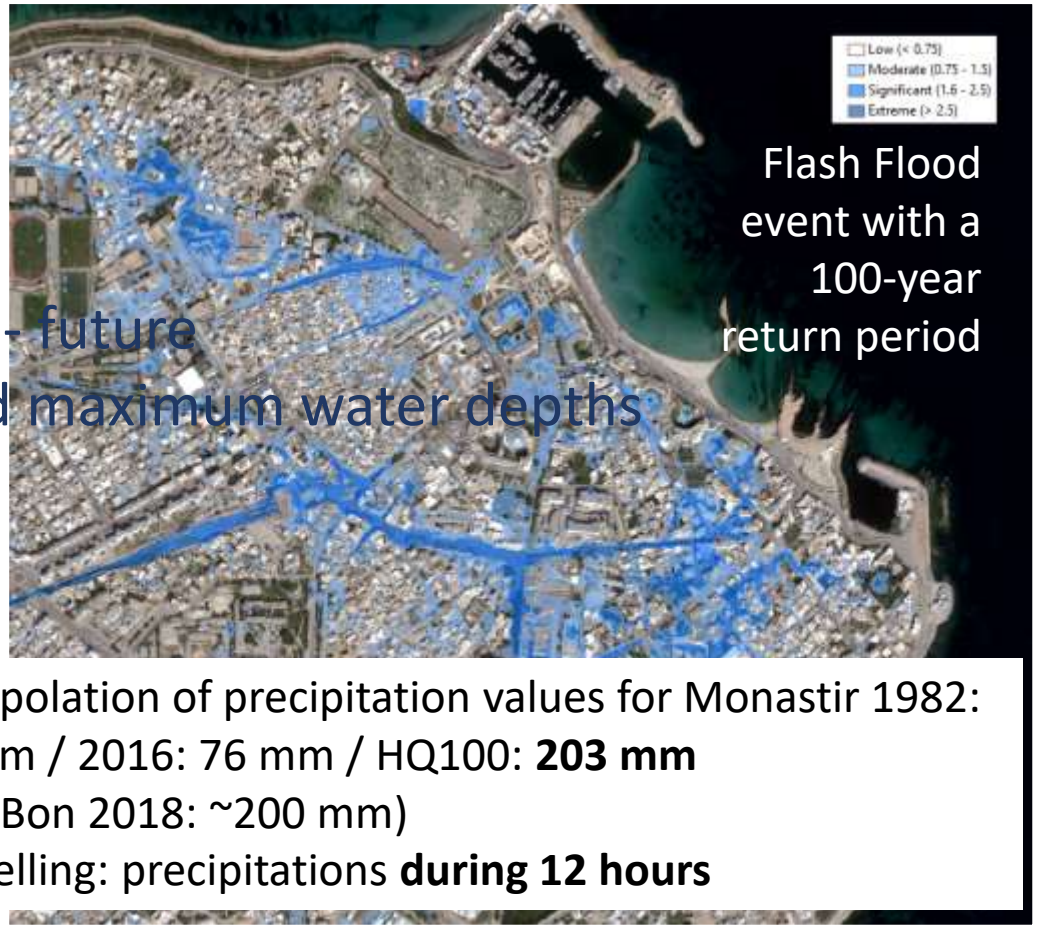
Analysis of current risk
Flash Flood - Hazard

Identification of past **extreme precipitation events**

Date/Year	Measure	Priority
29.01.1997	170.94	1
26.09.1991	135.89	2
29.03.1982	103.89	3
03.01.2013	101.09	4
06.11.1992	82.04	5
21.09.1993	81.03	6
31.10.1982	78.99	7
27.09.1995	75.95	8
09.12.2016	75.95	9
29.01.1982	74.93	10
18.12.1992	71.12	11

delling of past - present - future
ximum flow velocites and maximum water depths
(index-based))



Flash Flood event with a 100-year return period

Extrapolation of precipitation values for Monastir 1982: 75 mm / 2016: 76 mm / HQ100: **203 mm**
(Cap Bon 2018: ~200 mm)
Modelling: precipitations **during 12 hours**

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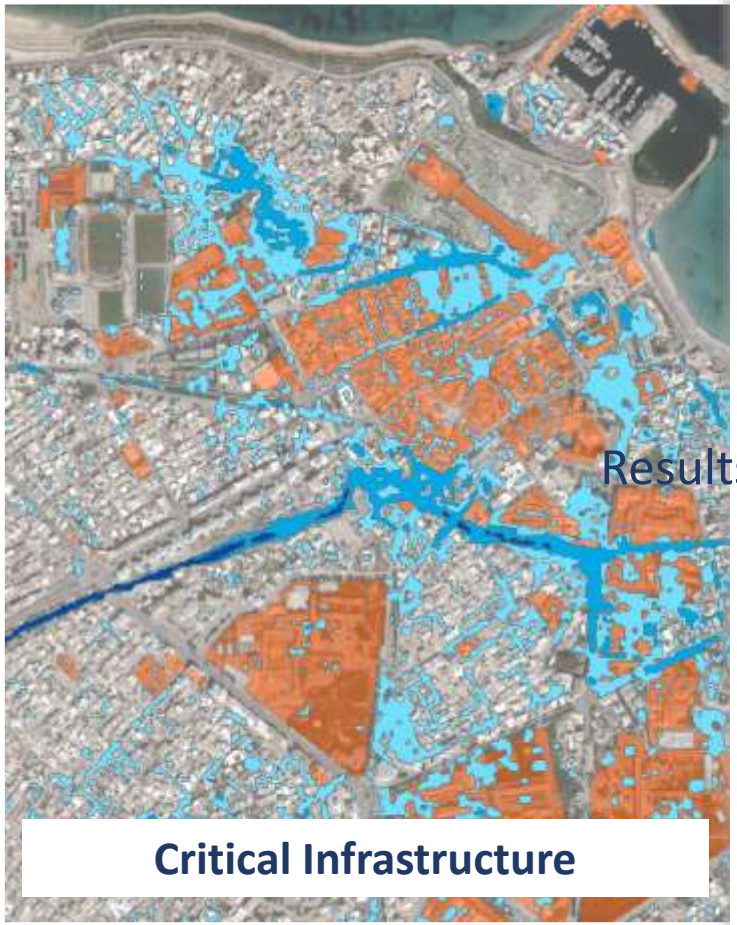
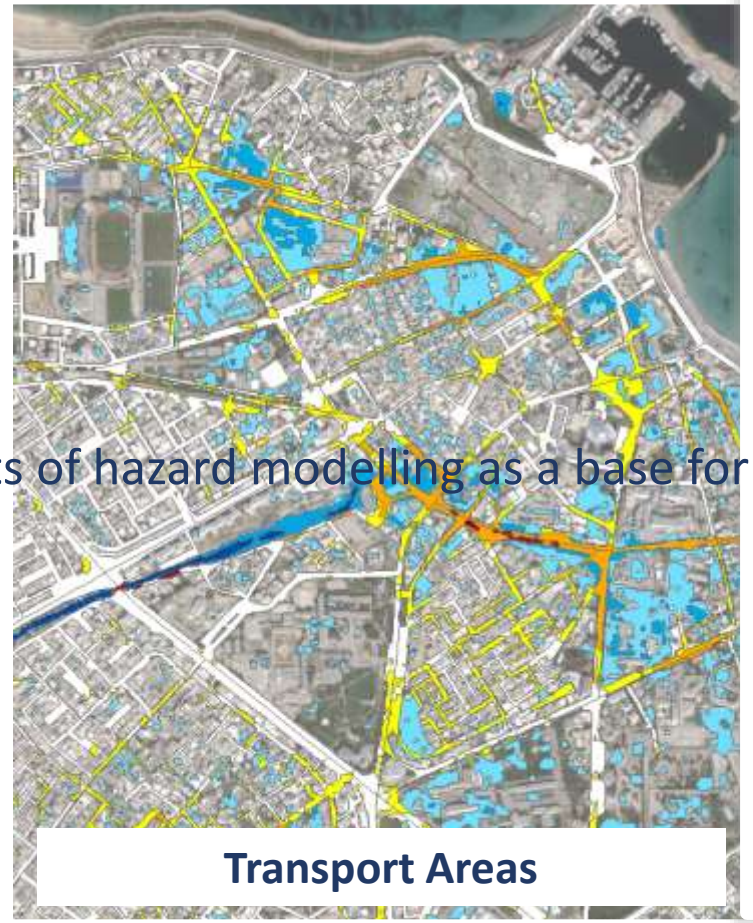
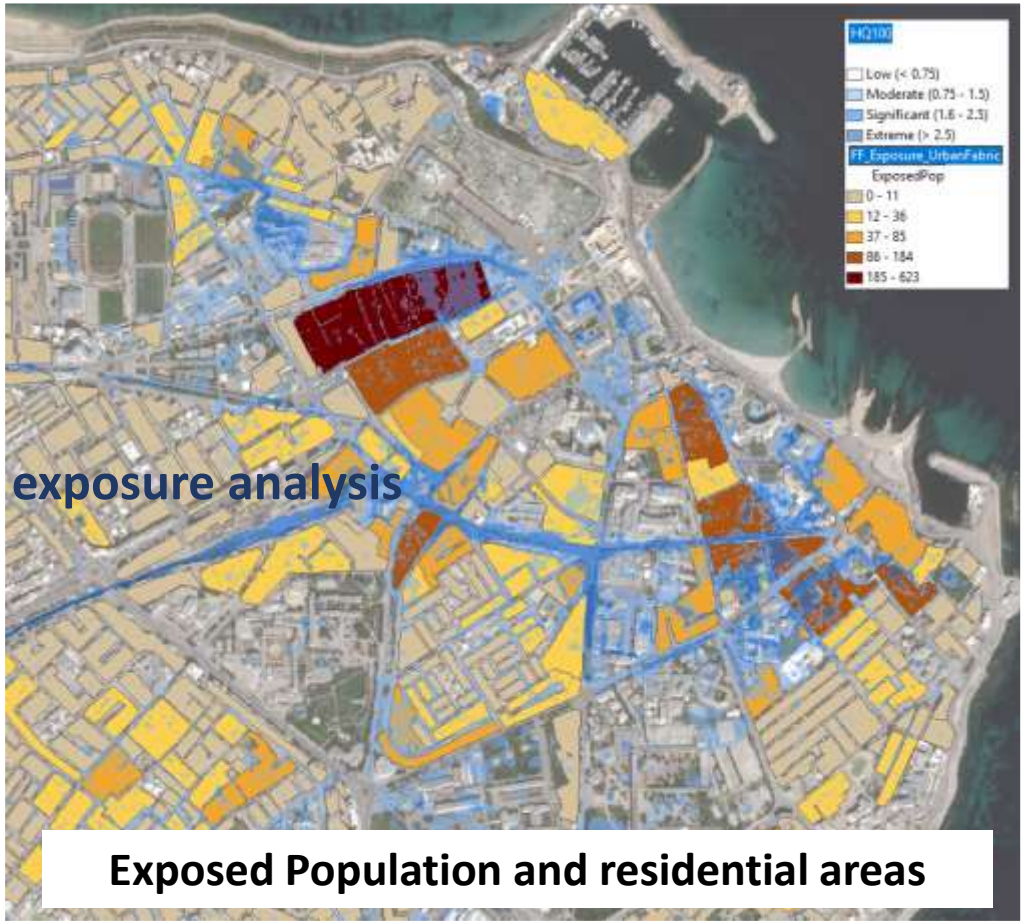
Analysis of current risk
Flash Flood - Exposure



Critical Infrastructure



Transport Areas



Exposed Population and residential areas

Results of hazard modelling as a base for **exposure analysis**

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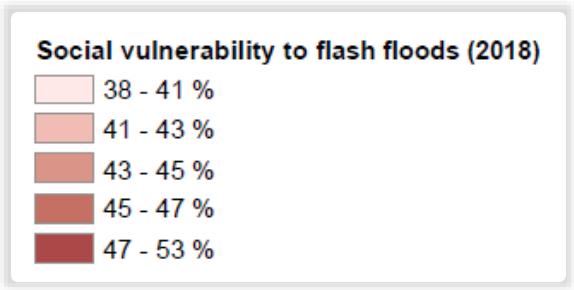
Analysis of current risk
Flash Flood - Vulnerability

Social Vulnerability
towards flash floods at the Unit level
(Information source: Interview of 15 representative units within the city)



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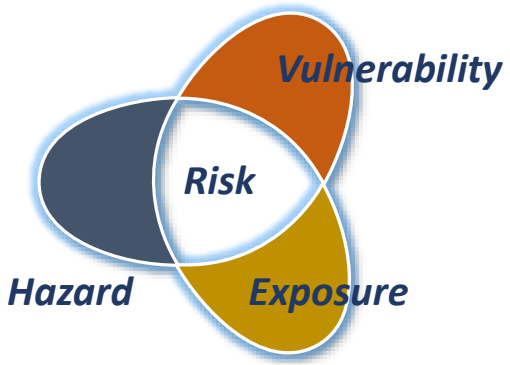
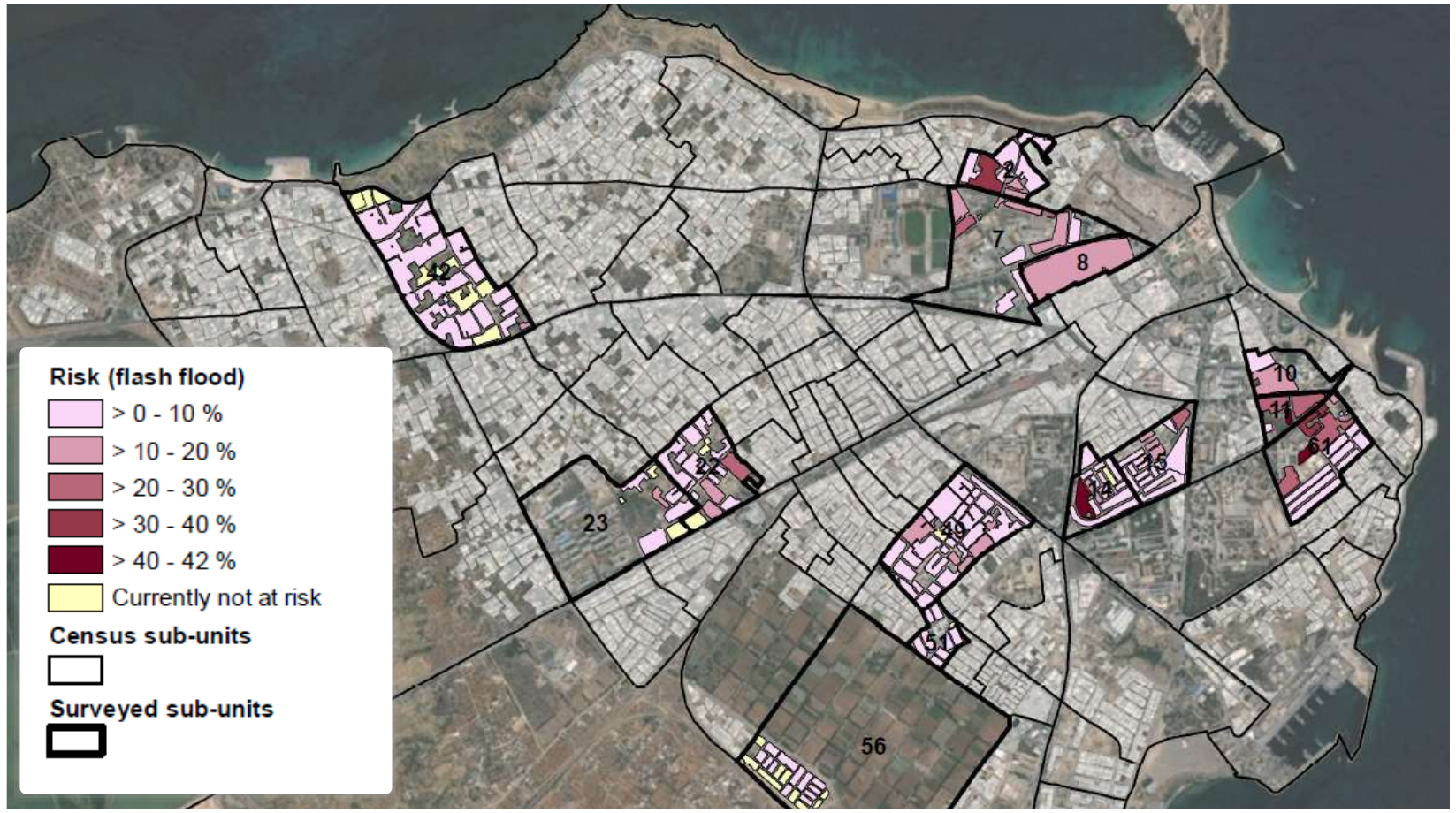
Analysis of current risk
Flash Flood - Risk

Flash Flood Risk

- Calculated for residential areas
- Integration of flash flood hazard, exposure and social vulnerability





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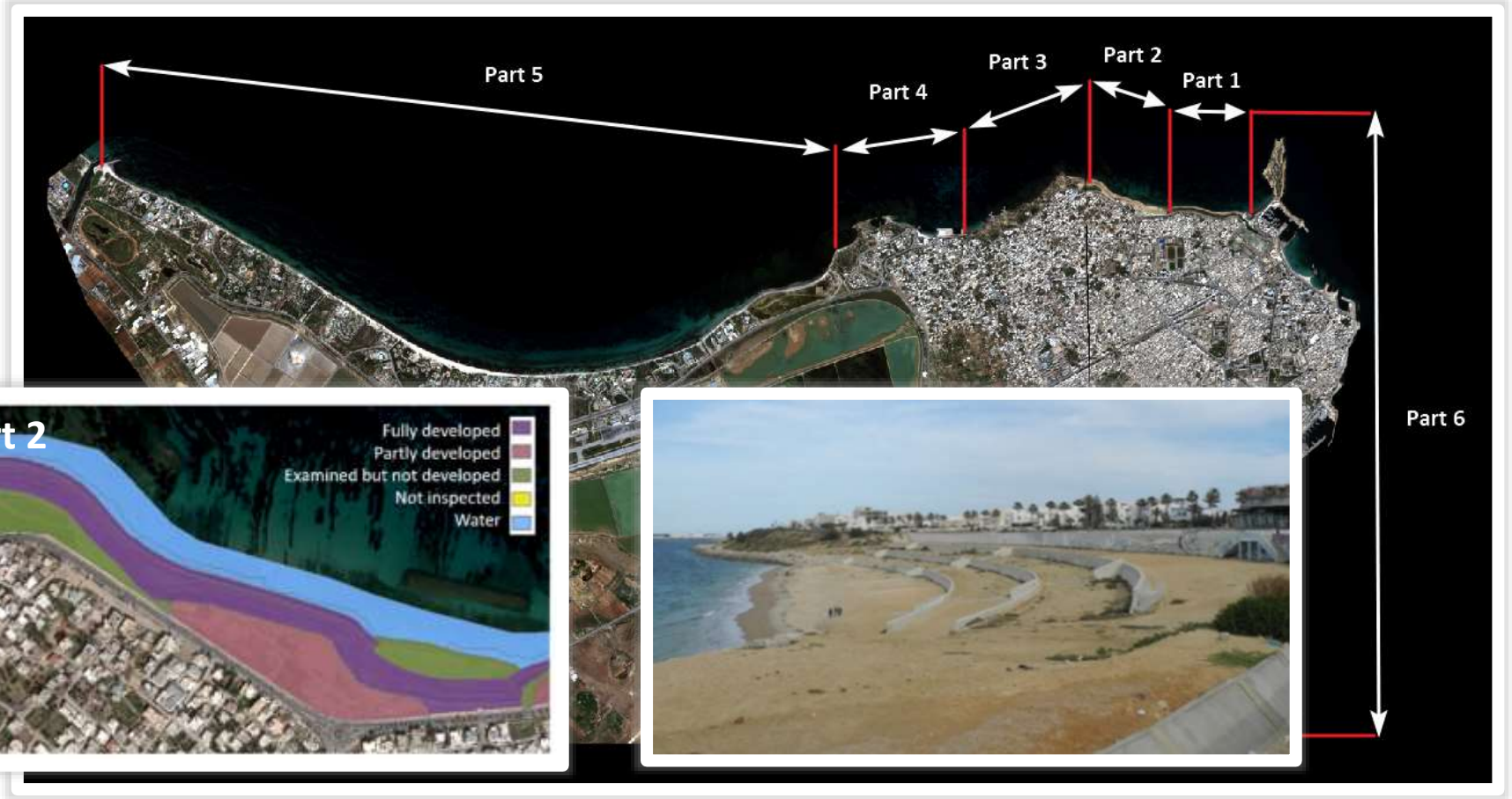
Analysis of current risk
Coastal Erosion - Hazard and Exposure

- Literature analysis
- Analysis of Satellite imagery
- Study area visits



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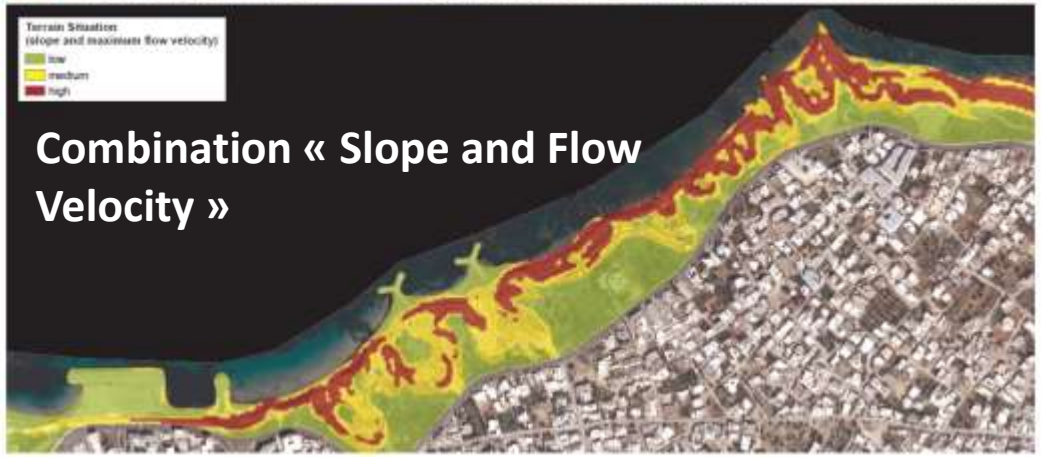
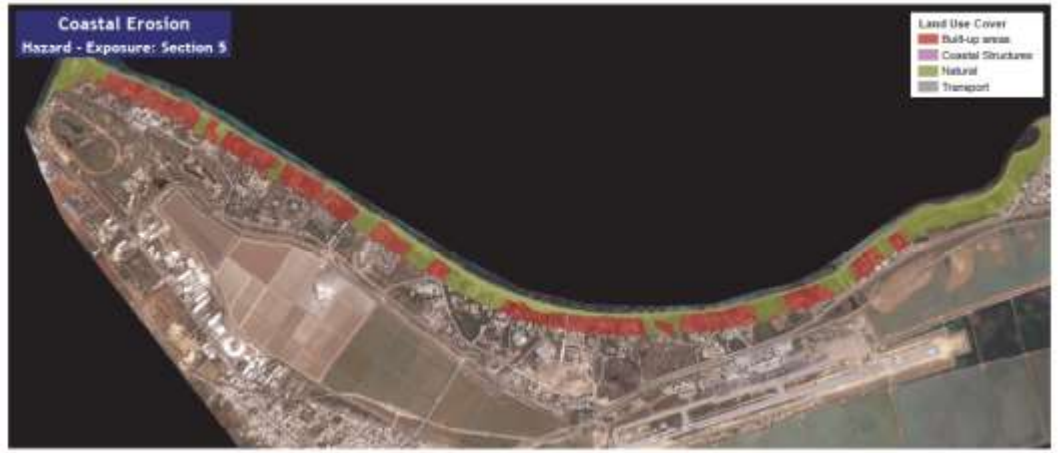
Analysis of current risk
Coastal Erosion - Hazard and Exposure

Land Use and Land Cover Classification



Combination « Slope and Flow Velocity »



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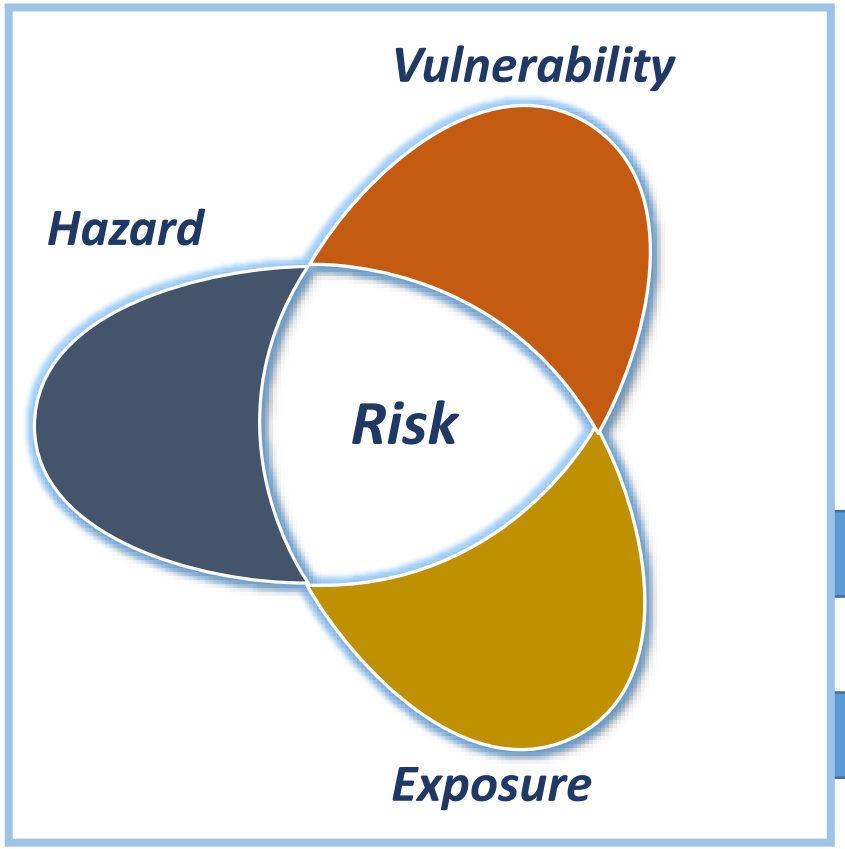
Urban Disaster Risk Assessment



Analysis of current Risk

Analysis of future Risk

Implementation of information system

Capacity building activities

Stakeholder engagement

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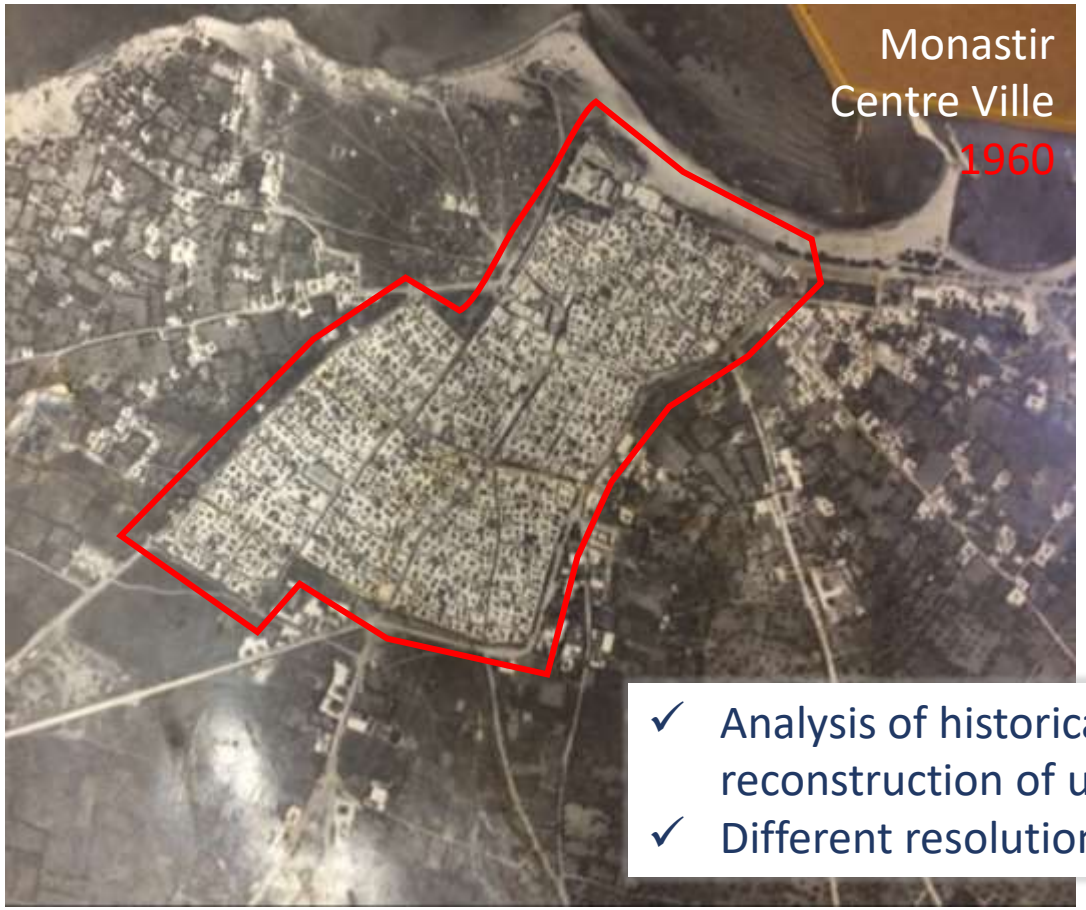
Urban Development



- ✓ Analysis of historical aerial imagery for reconstruction of urban development
- ✓ Different resolution, coverage and quality

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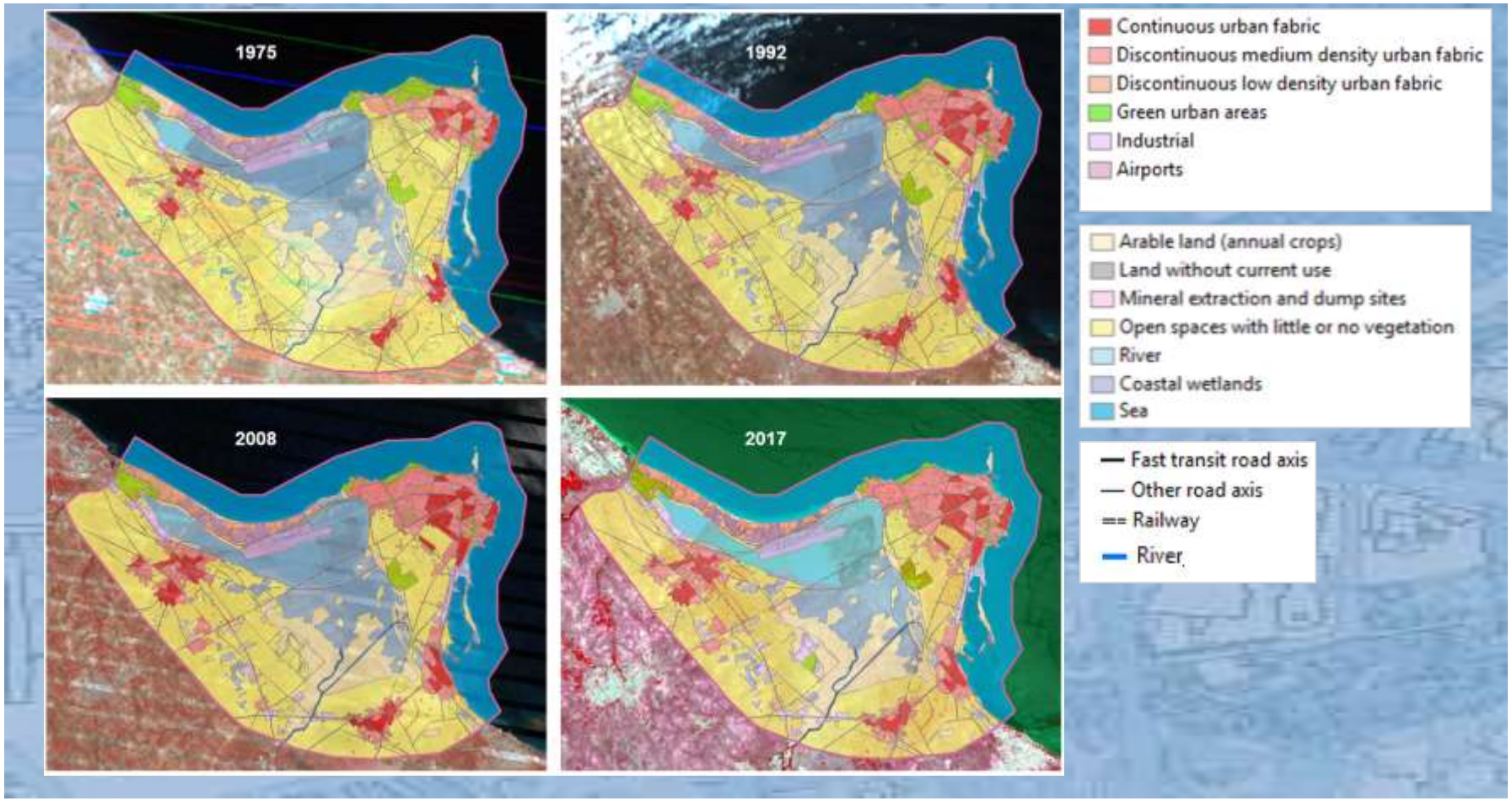
Urban Development

- **Retrospective analysis of Urban development**
- Integration into an **Urban Growth Model**



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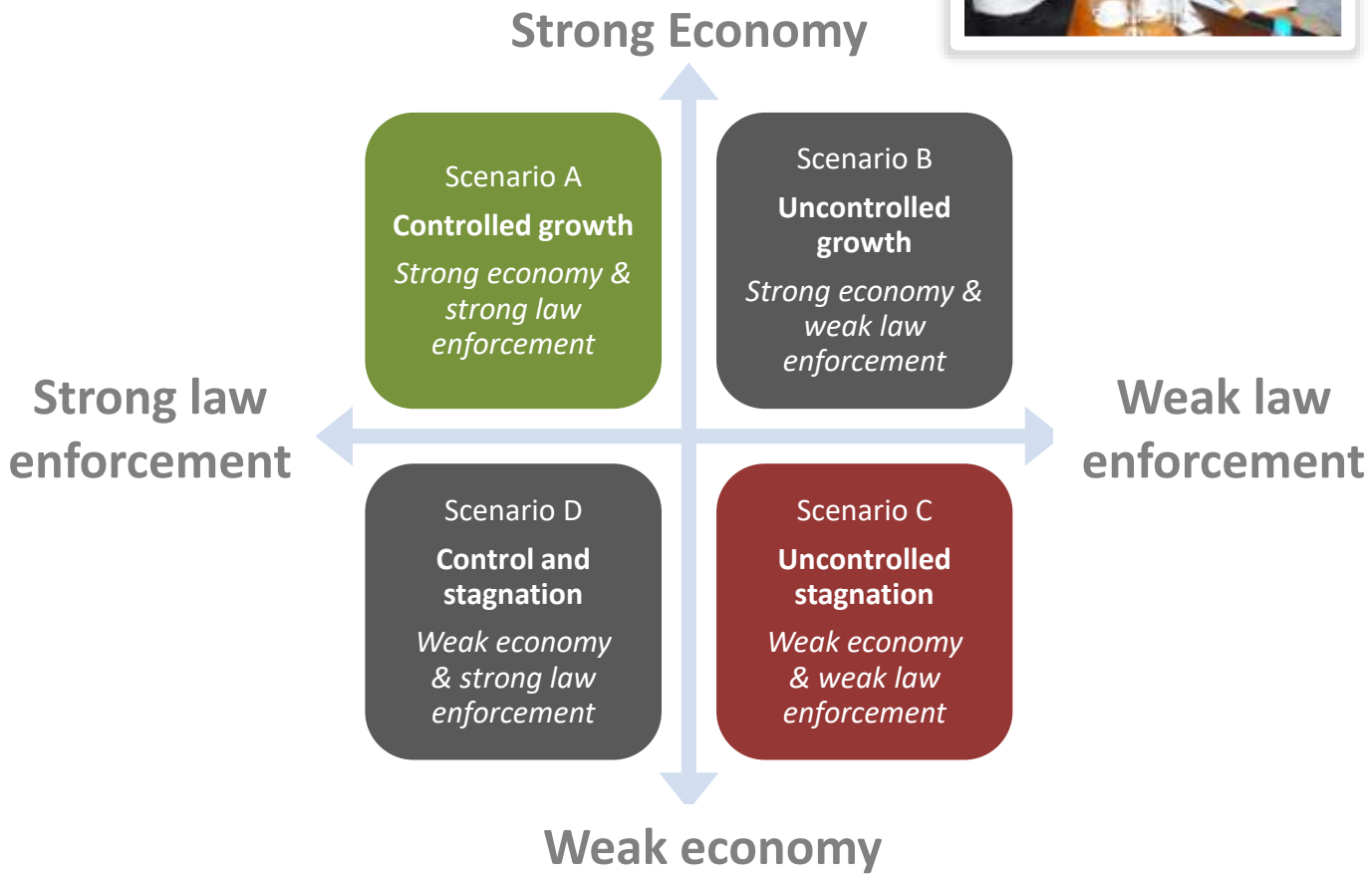
Future Risk Scenarios

Approach

- **2 axes were defined by stakeholders to represent the predominant development trends for Monastir**
- **Result: 4 scenarios modelling future exposure, vulnerability and risk in the city**



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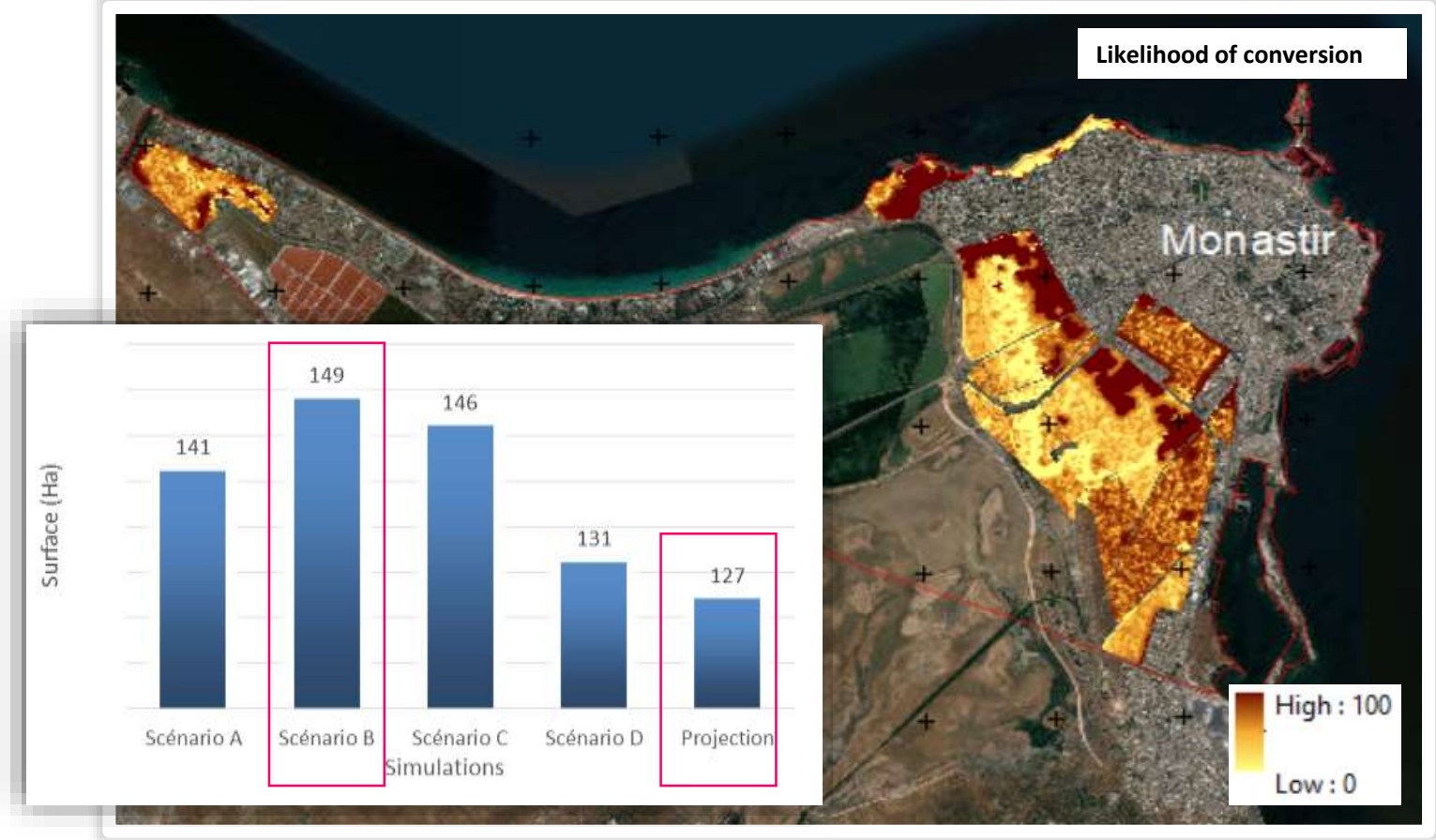
Future Risk Scenarios

Urban Growth Model

- Based on a **«business-as-usual»** projection (statu quo) will probably grow 127 ha before 2030 (**8.1% growth rate**)
- Differences between the scenarios, with **the greatest expansion** (149 ha) **in Scenario B** (**uncontrolled growth**)



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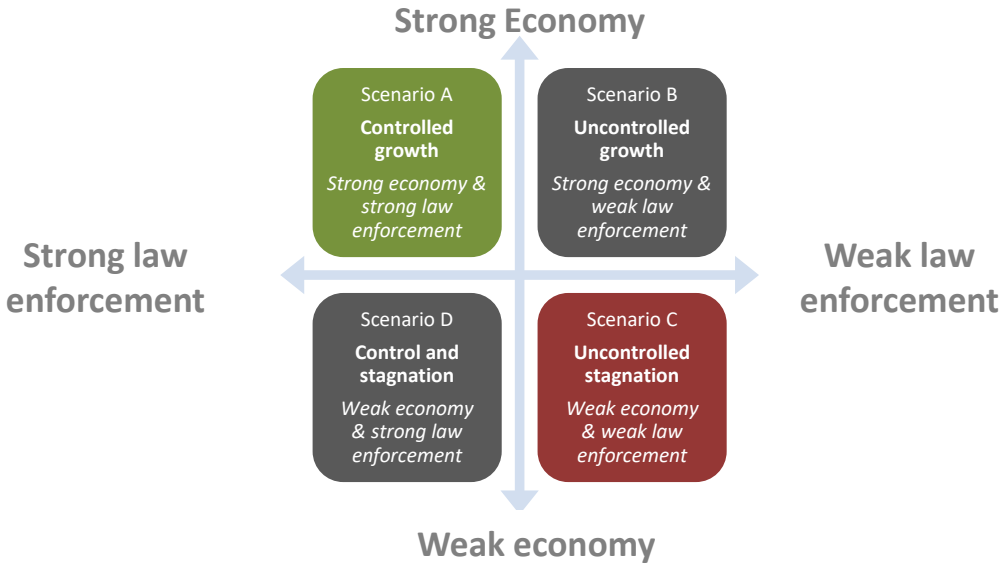
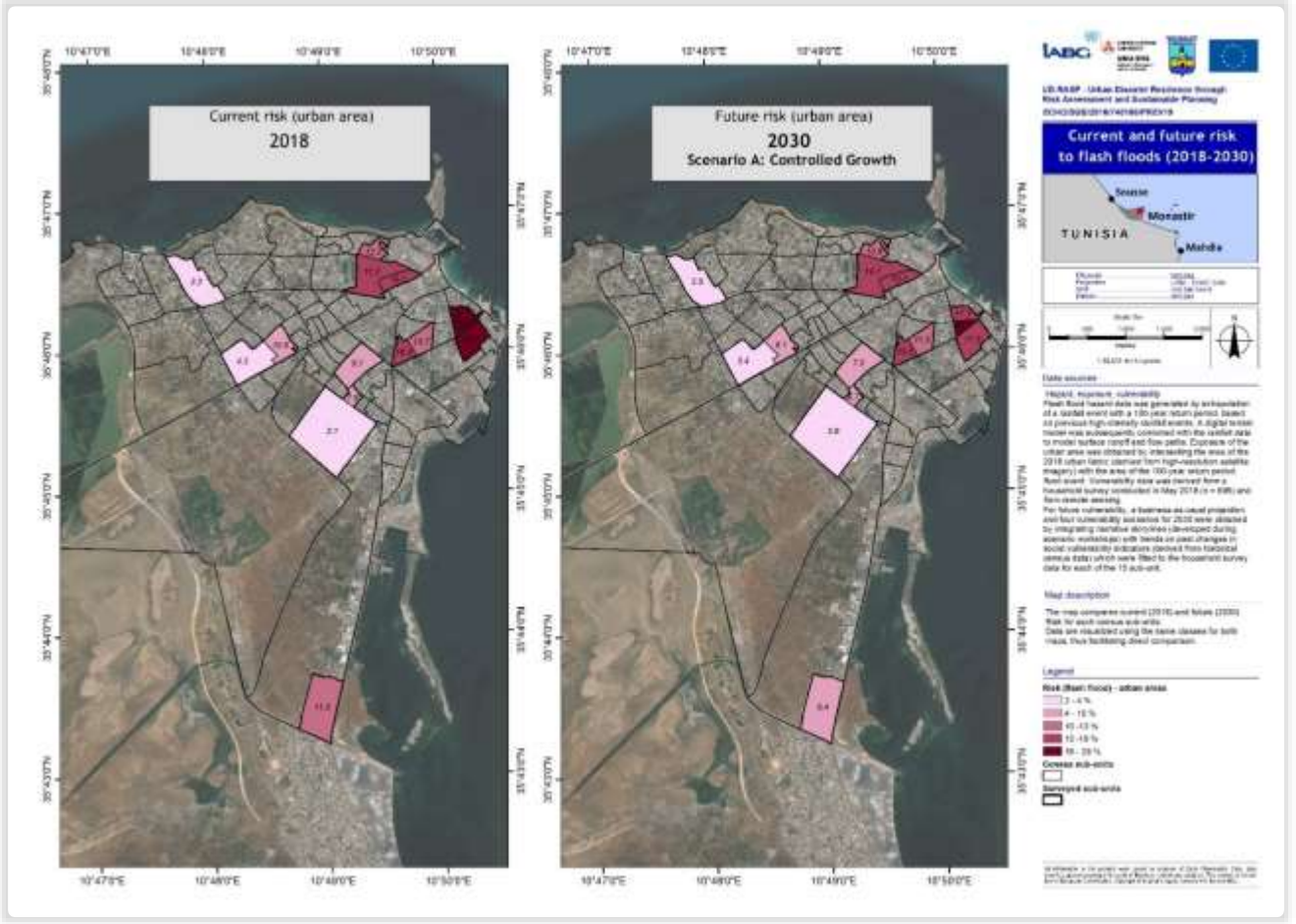
Future Risk Scenarios

Risk Scenario (2030)

- **Future Risk** is **lowest** in **scenario A** and **highest** in **scenario C**





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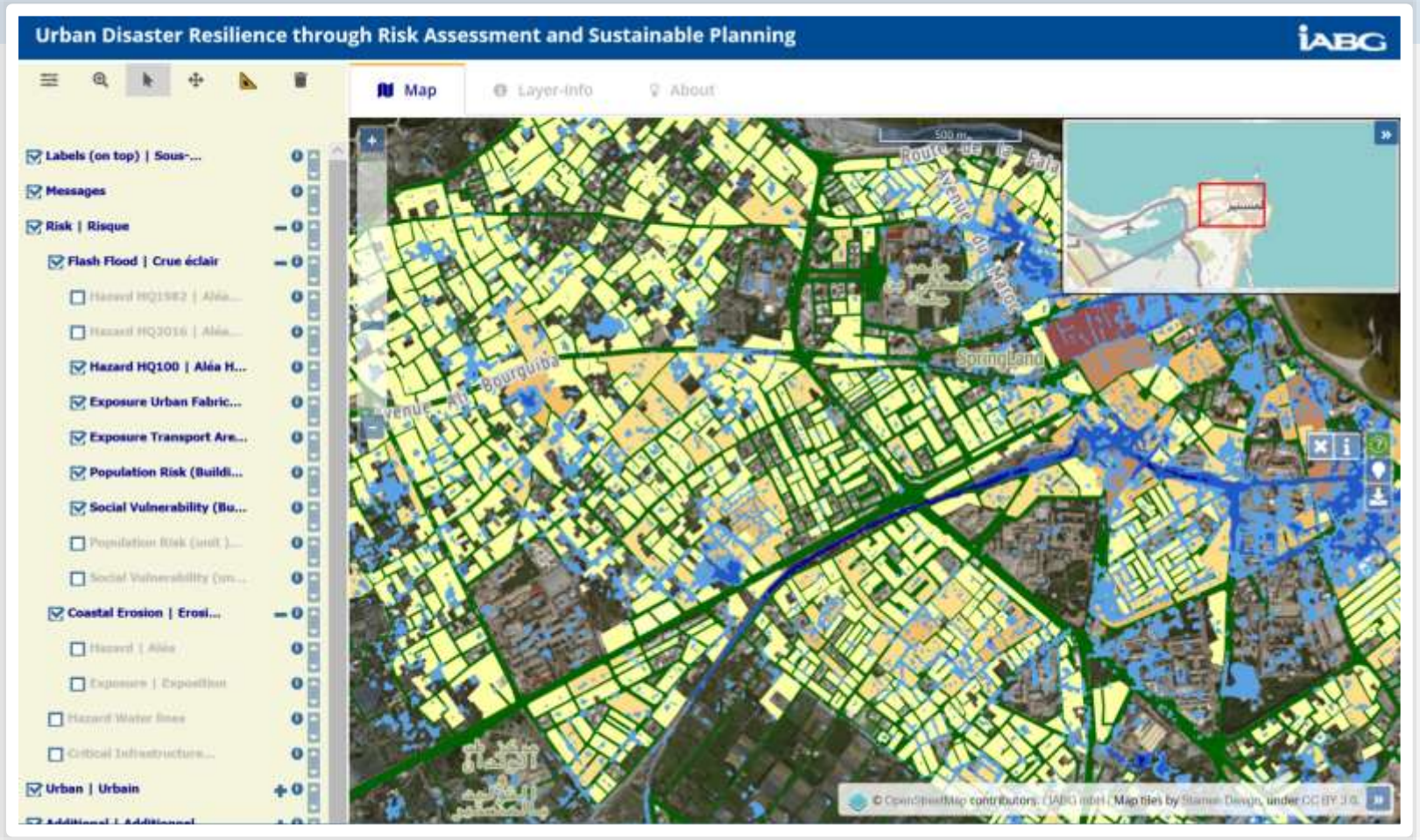
Web-based information system

Information platform

- Urban
- Administration
- Risk (Flash Flood, Coastal Erosion)
  - Hazard
  - Exposure
  - Vulnerability
- Satellite imagery

English – Français



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Stakeholder engagement
Capacity Building

Workshops with project team and stakeholders

- ✓ Kickoff Meeting and Need Assessment with stakeholders – February 2017
- ✓ « Hazards and Risk factors »
- ✓ « GIS and the potentials of remote sensing » (Mai 2017)
- ✓ « Vulnerability and future scenarios » (Part 1) (October 2017)
- ✓ « Future scenarios » (Part 2) (Mai 2018)

Training Municipality

- ✓ GIS Training (Monastir, Tunisia – March 2018)
- ✓ Advanced GIS training (Dresden, Germany – June 2018)
- ✓ « Integration and evaluation of risks in urban planning - results » (Monastir, Tunisia – October 2018)

Other

- ✓ Household survey – interviews – May to June 2018

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Summary

- ✓Identification of urban risks regarding environmental changes, urbanization and climate change
- ✓Evaluation and specification of suitable geospatial data
- ✓Development of a standardized and updated geodatabase
- ✓Implementation of information system to support decision-making process
- ✓Capacity building to support and maintain the implementation activity

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