Guidelines for climate analysis and vulnerability assessment at local level

The Master Adapt perspective and the focus on North Salento

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Guidelines: what are they?

1. Output of action A1 of the Master Adapt project (coordinated by ISPRA)
2. Phase 1 A1: climate analysis of target area
3. Phase 2: guidelines
4. GL are based on acquired experience
5. Made for local administrators
6. Directing climate and vulnerability analysis
7. Suggestions on how to fill indicators
8. Support tool

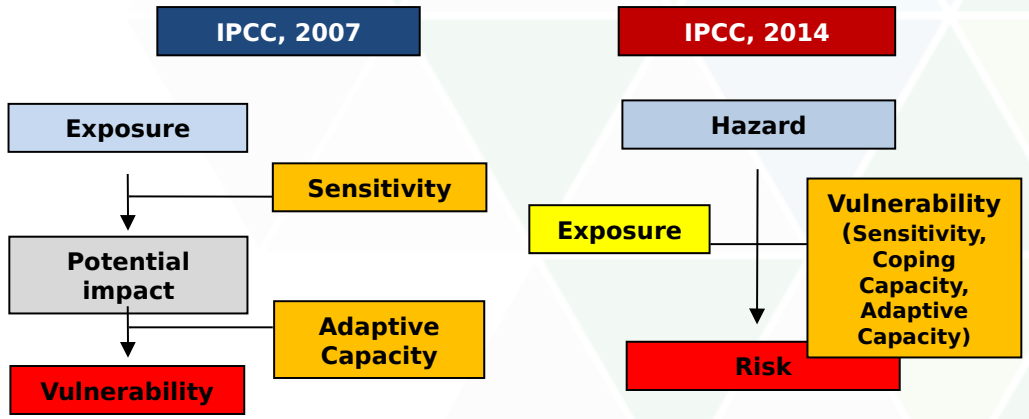
7 target areas= **2** regions and **5** urban areas

target area: union of 7 municipalities nearby Lecce:Campi Salentina, Guagnano, Novoli, Salice Salentino,Squinzano,Surbo,Trepuzzi

Guidelines: framework

- The concepts of exposure, sensitivity, adaptive capacity and vulnerability are always evolving
- IPCC 2014 definitions
- Vulnerability is a component (sensitivity and capacity)
- Risk is the end result

EXAMPLE		IPCC 2007	IPCC 2014
External climate signal	Lack of precipitation	Exposure	Hazard (climate signal)
Direct physical impact	Drought	Potential impact	Hazard (direct physical impact)
Sensitivity	Crop type	Sensitivity	Vulnerability (Sensitivity)
Capacity	Knowledge on water management	Adaptive capacity	Vulnerability (Capacity)
Presence and relevance of exposed elements	Relevance of agriculture in the area	Implicitly included in Sensitivity	Exposure
Final result	Water scarcity in agriculture	Vulnerability	Risk



Guidelines: climate analysis

- Reconstruction of past climate trends (analysing the last decades) and estimate of future projections (climate models)
- Climate trends analysis:
  - data quality control
  - time series selection and homogeneity assessment
  - calculation of extreme indices (temperature and precipitation)
  - calculation of regional series (values of a series against average)
  - assessment of regional series trends
- Future climate projections:
  - extracting projections from climate models according to different emission scenarios
  - calculation of mean values and extreme indices (30 years time frames)
  - assessment of climate projections (difference between reference and thirty years value)

Guidelines: table of contents

- Assessing vulnerability in seven steps

1. SOCIO-ECONOMIC AND ENVIRONMENTAL CONTEXT

2. CLIMATE HAZARDS

3. POTENTIAL IMPACTS

4. EXPOSED ELEMENTS

5. SENSITIVITY

6. ADAPTIVE CAPACITY

7. VULNERABILITY

Step 1: Define the environmental and socio-economic context

- Retrieve data to represent the context
- Selecting an adequate set of indicators (taking relevance and usefulness, analytic consistency and measurability into account)
- Prepare a report on context analysis (summarising the results of the analysis of indicators)
- Some indicators are suggested at the end of the step
- (*e.g.* population density, number of workers, agricultural surface, wooded areas, flood areas, number of health centres, tourist presence, etc.)

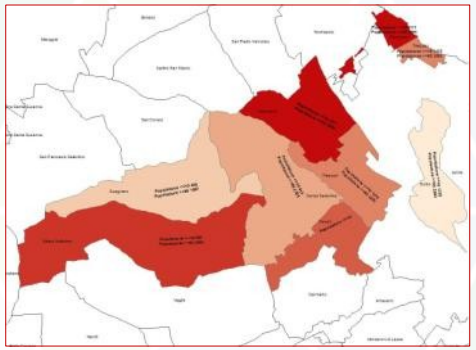
Example of Step 1-Defining the territorial and socio-economic context

social framework, main economic activities

- small urban centers
- local population on constant decline
- elderly people alone increases
- young couples with children decreases
- agricultural soil use
- food and wine fine production: Salice Salentino DOC, Malvasia,
  Negroamaro, etc.
- famous area for the expansion of Xylella fastidiosa bacter
- social activities points on the Union of Municipalities in Northern
  Salento

Salice Salenti no DOC

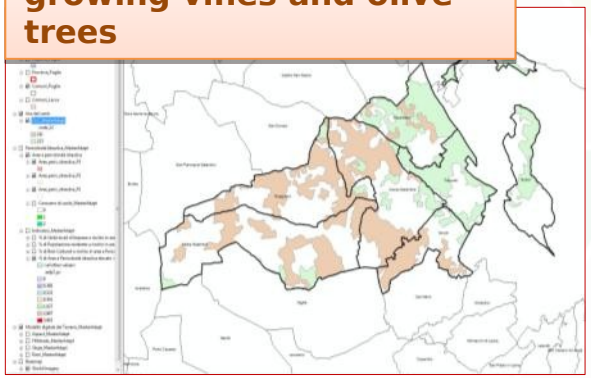
Population density



local architectural structure

Xylella has a great resonance on social networks and TV

growing vines and olive trees



Step 2: Identifying climate hazards

- A hazard is:

  *the potential occurrence of a natural or human-induced physical **event** or **trend** or physical **impact** that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources. In this context, the term hazard usually refers to **climate-related physical events or trends or their physical impacts**.*

- It encompasses both climate signals (e.g. rising temperatures) and direct impacts (e.g. sea level rise)
- Important to identify subsequent risks that can be influenced through adaptation
- Essential to rely on metric indicators to clearly quantify risk
- Start participation and discussion processes

Climate homogenous areas

Example of Step 2-Identifying the climate-related hazards

from Master Adapt "*Report on climate analysis and vulnerability assessment results in the pilot region and in the areas targeted*" on https://masteradapt.eu/strumenti/

based on
available local studies,
research,
scientific sources and
spatial planning documents

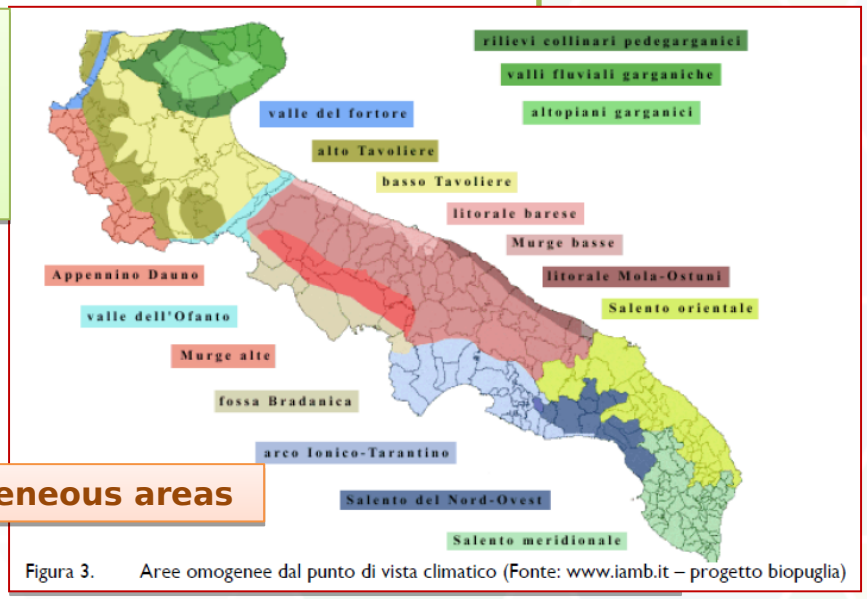
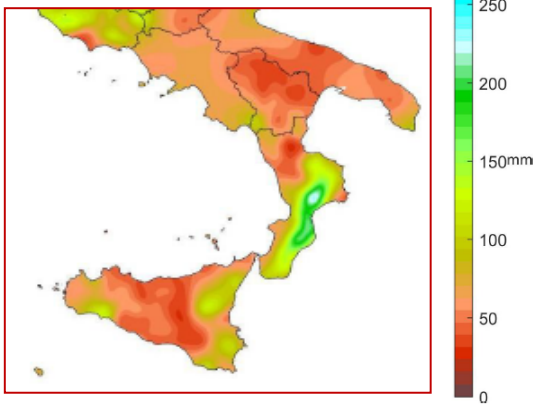


Figura 3. Aree omogenee dal punto di vista climatico (Fonte: www.iamb.it – progetto biopuglia)

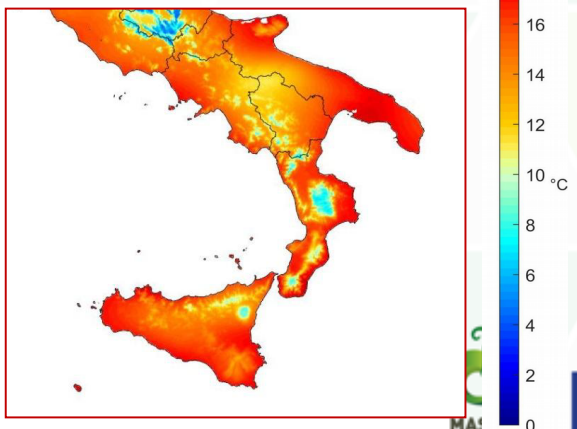
Climate homogeneous areas

Maximum daily precipitation 2017



Anomaly of the 2017 annual cumulated precipitation, percentage values, compared to the normal value 1961-1990.

Average temperature 2017



Step 3: Identify the potential impacts

- Impacts are:

*In the WGII AR5 IPCC report, the term impacts is used primarily to refer to the **effects on natural and human systems** of extreme weather and climate events and of climate change. Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system.*

- Building on the previous step, analysing the available documents on potential impacts
- Not only physical effects, but also social and economic consequences
- Use quantitative indicators (e.g. reduced agricultural productivity)
- Integrate knowledge with participation process

Land use

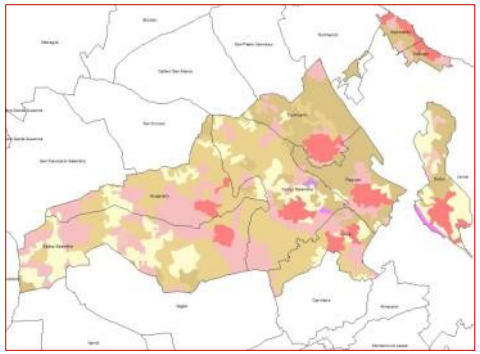
Example of Step 3-Identifying the potential impacts of climate change

based on

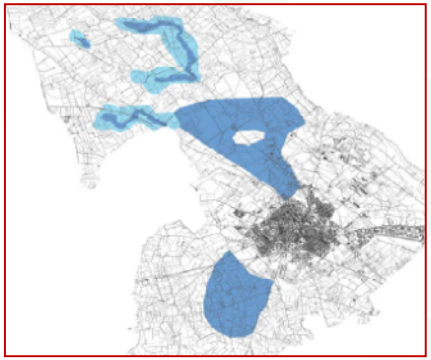
- consultation of **local environmental analyzes** and **local experts** and technicians
- description of **general context :**
  location of the area, hydrogeological structure, natural areas and resources, et

hydrogeomorphology

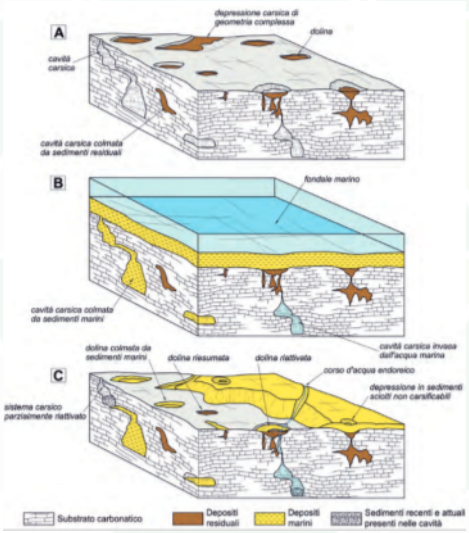
land use



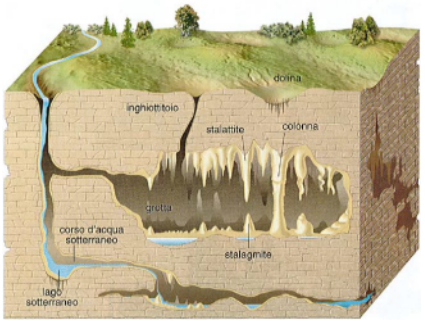
areas with high and medium hydraulic hazard



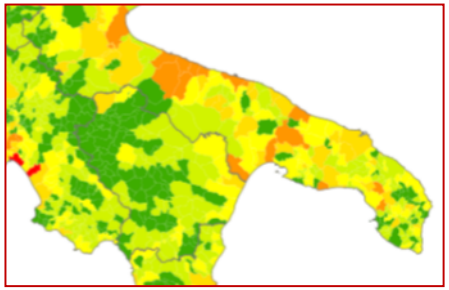
Salt intrusion



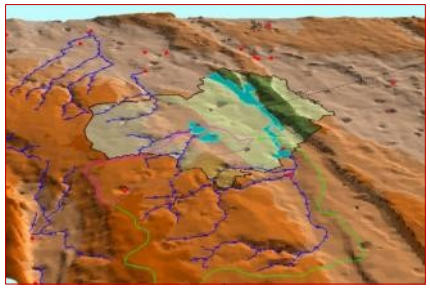
Karst



flooding risk population



flooding risk areas



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Step 4: Identify exposed elements

- Exposure is:

  *the **presence** of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in **places and settings** that could be **adversely affected**.*

- Keep exposure (e.g. resident population) distinct from vulnerability (e.g. resident population at risk)

- 5 steps to elaborate global exposure index: indicators' selection, data retrieval, normalisation, ponderation, indice calculation

- List of possible exposure indicators

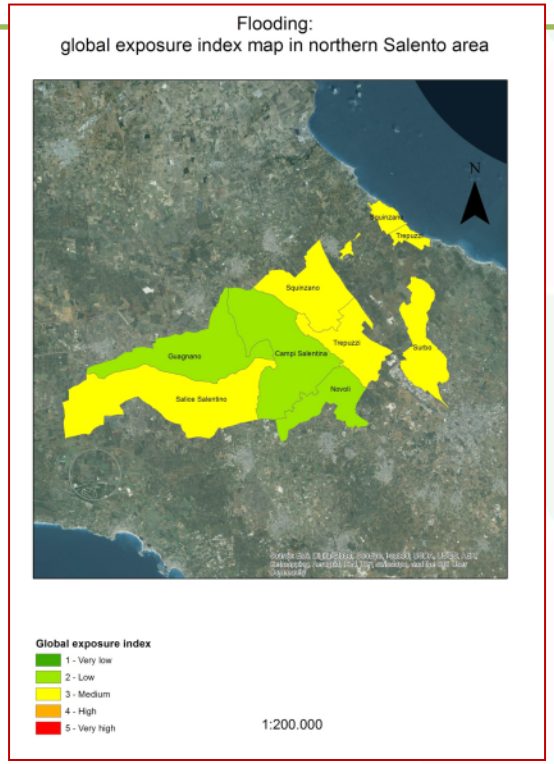
- (e.g. wooded areas surface, urbanised surface, added value in agriculture)

Global exposure index

Example of Step 4 - Assessing Flooding Exposure of Union of Northern Salento area

The exposure indicators

- **HUMAN CAPITAL**
- **Population density (Inhab/km2)**
- **MANUFACTURED CAPITAL Road network (km);**
- **Urban areas (%)**
- **ECONOMIC CAPITAL Agricultural areas (%)**



map of Global Exposure Index

Global Exposure Index
Campi Salentina 0,38
Guagnano 0,36
Novoli 0,38
Salice Salentino 0,50
Squinzano 0,45
Surbo 0,57
Trepuzzi 0,53

The map shows a medium-low level of elements exposed to flooding, mainly due to a general low population density in the area as well as a limited road network and a low presence of urban areas.
The indicator “Agricultural Areas” shows very high values all over the target area.

Step 5: Assess Sensitivity

- Sensitivity is:

  *the degree to which a **system** or species is **affected**, either adversely or beneficially, by **climate variability or change**. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise).*

- 4 categories/factors: natural, human, morphologic-urban, economic-financial
- List of indicators according to four kinds of impact: flood, heat island, drought, fires
- Important to choose indicators according to two criteria: kind of impact and available knowledge (e.g. % draining surface, built environment density. % green areas)

Global sensitvity index

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Step 6: Assess adaptive capacity

- Adaptive capacity is

  *the **ability** of systems, institutions, humans, and other organisms to **adjust to potential damage**, to take advantage of opportunities, or to respond to consequences.*

- Distinct from sensitivity because it employs a future perspective (e.g. alert systems, % graduates, % air-conditioned homes, no. volunteers)
- 4 categories define adaptive capacity: institutions, knowledge and technology, production and infrastructure, economic resources
- List of indicators according to four kinds of impact: flood, heat island, drought, fires
- As stated previously, it is important to keep the kind of impact and the available knowledge into account

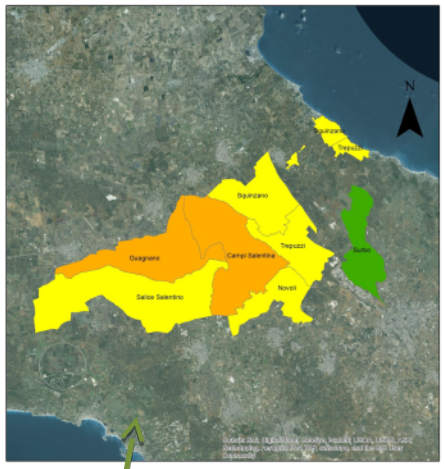
Global adaptive capacity index

Step 5 - Assessing Sensitivity

The Sensitivity indicators
HUMAN CAPITAL
- **Incidence of elderly people >65;**
- **Incidence of very young people<6;**
- **Incidence of illiterates;**
- **Incidence of elderly people alone.**

MANUFACTURED CAPITAL Incidence of buildings in a bad state of conservation %
ECONOMIC CAPITAL Incidence of families in

Flooding:
global sensitivity index map in northern Salento area

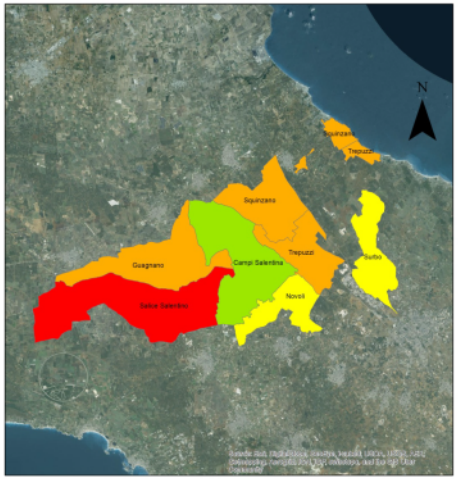


The map shows higher levels of sensitivity in **Campi Salentina** and **Guagnano** and the lower levels in **Surbo**. In Campi we find the higher presence of illiterates and buildings in a bad state of conservation, with high % of elderly people living alone. Guagnano shows the higher values of elderly people and higher incidence of families in potential discomfort.

Step 6 - Assessing Adaptive capacity

The Adaptive Capacity indicators
INSTITUTIONS
Municipal budget commitment on environmental management (%), International mitigation/adaptation commitment (Y/N).
KNOWLEDGE AND TECHNOLOGY - Adult incidence with degree %/inhab,
ECONOMIC RESOURCES
Per capita income euro/inhab%

Flooding:
global adaptive capacity index map in northern Salento area



characterised by a high adaptive capacity, due to its commitment in international initiatives on cc as well as the highest % of adults with degree and the per capita income. 3 municipalities results in the low class of adaptive c.
Salice Salentino presents the lowest values of adaptive

Step 7: Assess climate change vulnerability

- Vulnerability is

  *the **propensity** or predisposition **to be adversely affected**. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.*

- Result of the combination between sensitivity and adaptive capacity, according to the the formula:

$$V = (S * w_{s1} + AC * w_{ac}) / w_s + w_{ac}$$

where

V = is the Global Vulnerability Index

S = is the Global Sensitivity Index

AC = is the Global Adaptive Capacity Index

w_i = is the weight given to each component

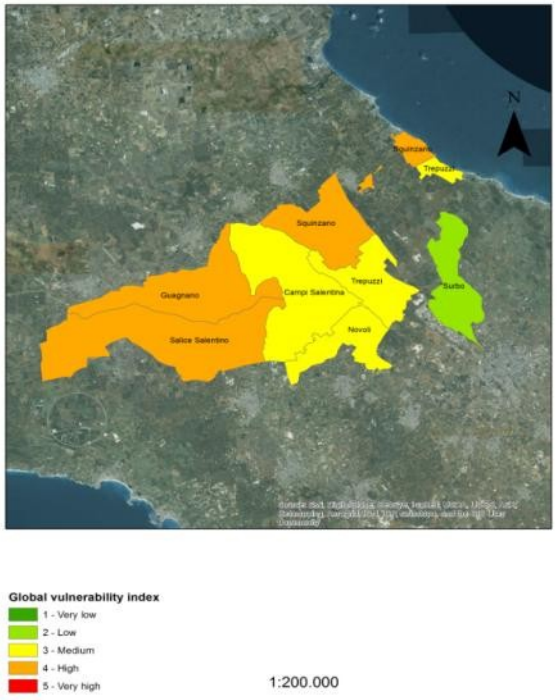
- When vulnerability decreases, resilience increases

Global vulnerability index

Example of Step 7 - Assessing Vulnerability to climate change

Global Sensitivity Index + Global Adaptive Capacity Index
=Global Vulnerability Index

Flooding:
global vulnerability index map in northern Salento area



Global Vulnerability Index
Campi Salentina 0,46
Guagnano 0,64
Novoli 0,48
Salice salentino 0,66
Squinzano 0,61
Surbo 0,38
Trepuzzi 0,58

The highest vulnerable are
low adaptive capacity c
medium-high sensitivit

Salice Salentino is the most

vulnerable municipality.

The most favorable situation is represented by **Surbo** with **the lowest values of vulnerability in the target area**.

Open issues

- New methodology (one of the first attempts in Italy), it has strenghts and weaknesses

- **Strenghts**: robust climate analysis, up-to-date climate models, methodology of vulnerability analysis is accessible and clear,
  easy to replicate
- **Weaknesses**: little availability of historic series in some areas, low resolution of models, few data to populate indicators, vulnerability is relative, not absolute, absence of a method to validate results
- Simplified methodology: it does not describe complexity

- Data quality is essential

- Future perspectives: replicate and develop new case studies, improve the methodology by integrating new indicators, etc.

Thank you for listening!

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www.masteradapt.eu

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