Climate risk and adaptation services in coastal zones: the case study of the North Adriatic coast.

Antonio Marcomini, Impacts on Soil and Coast Division Euro-Mediterranean Center on Climate Change

Contributors: Silvia Torresan, Valentina Gallina, Anna Sperotto, Elisa Furlan, Andrea Critto.
Stakeholders’ needs for coastal zone management

Include CC impacts in the definition of Policies, Plans and Programs

Integrate CC in Integrated Coastal Zone Management and Strategic Environmental Assessments

Produce hazard and risk maps according to the EU Flood Directive

Compare CC impacts scenarios through user friendly tools

How to produce suitable research products for delivering climate services?
DEcision support SYstem for COastal climate change impact assessment

MAIN OBJECTIVE:
Identify, prioritize and visualize areas and targets at risk from climate change impacts in coastal areas and related ecosystems.

More details on DESYCO at the Tools Expo: «DESYCO: a GIS based Decision Support System to provide climate risk services for coastal managers and improve adaptation decision making». 
DESYCO can be used to:

- Adopt a **Source-Pathway-Receptor-Consequence** risk assessment approach.
- Analyse long-term **climate change** hazard scenarios.
- **Rank** coastal receptors and areas vulnerable to, or at risk from, different climate change impacts.
- Produce **interactive GIS-based maps** (i.e. vulnerability, exposure, risk and damage maps).
- **Transfer information** about potential climate change impacts for **adaptation actions**.
Regional Risk Assessment (RRA):

- To identify potential **HAZARDS** related to future scenarios of **climate change** (e.g. sea-level rise, storm surges variations, heat waves, extreme precipitations);
- To visualize **AREAS POTENTIALLY EXPOSED** to climate change impacts;
- To identify potential **TARGETS** (e.g. agricultural areas, beaches, wetlands) and their **VULNERABILITIES**;
- To identify the **RELATIVE RISK** (e.g. risk erosion for beaches, risk of wetland loss) which provide at the regional scale information about the areas/targets within a region likely to be affected more severely than others;
- To provide a **RELATIVE ESTIMATE** of areas/targets where the potential social, economic and environmental losses would be greater than others.

Useful decision support tools to guide stakeholders and decision makers in the definition of management and adaptation strategies.
Case studies including RRA-based DESYCO:

**COASTAL ZONES**
- Sea level rise;
- Relative sea level rise;
- Storm surge flooding;
- Coastal erosion;
- Water quality variations.

**GROUNDWATER**
- Groundwater table level variations;
- Increase of pollutant concentration;
- Saltwater intrusion.

**RIVERS**
- Floods/Urban floods;
- Landslides.

**PROJECTS**
- CMCC-FISR (Italian)
- CANTICO (ERANET)
- CLIM-RUN (7FP)
- PEGASO (7FP)
- ORIENTGATE (SEE)
- Mauritius (Tender)
- GEMINA (Italian)
- TRUST (Life+)
- SALT (Life+)
- KULTURisk (7FP)
- MulG Risk Assessment
- Multi Risk Assessment
Publications about RRA and DESYCO:

Peer Reviewed Journals:


Publications about RRA and DESYCO:

Peer Reviewed Journals:


CLIM-RUN – Climate Local Information in the Mediterranean region: Responding to User Needs

Objectives:

- To develop new methodologies and improved modeling and downscaling tools for adequate climate information at the regional to local scale that is relevant to and usable by different sectors of society;

- To develop a protocol for providing improved climate services to stakeholders in the Mediterranean area.

Bottom-up approach:

Stakeholder involvement early in the process, in order to:

- identify well defined needs at the regional to local scale;
- utilize the improved modeling and downscaling tools to optimally respond to these specific needs.

Focus on case studies in the greater Mediterranean area (tourism, energy, coastal zones, wildfires).
DESYCO as climate service tool:

**CLIM-RUN Integrated case study:**

Integrated analysis of several systems and sectors (e.g. natural ecosystems, water resources, etc.) in the **Italian coast** of the North Adriatic Sea.

**Objectives:**

- **Impact and risk indicators** for coastal zones based on wide stakeholder involvement;
- Construction of climate change **hazard scenarios based on climate modelling** and downscaling methods;
- Definition of **vulnerable targets and vulnerability indicators** associated to climate change impacts for each sector of interest;
- **GIS-based visualization tools** to transfer climate information from the climate tier to the stakeholders tier.
Climate risk and adaptation services in CLIM-RUN:

1. Participative process
Aimed at understanding the needs and requests of the stakeholders for what concern climate services and information.

2. Climate information
It provides forecasts and projections on future climate change scenarios applying climatic models and statistical downscaling.

3. Climate impacts and vulnerability
It integrates climate data and end-users requests in order to evaluate climate-related risks for different natural and human systems.
1. Participative Process - Phases

13 September 2011
1° Workshop with local stakeholders

28 May 2013
2° Workshop with local stakeholders

26 September 2013
Focus Group

2011
Development of preliminary climate risk services

2014
Development of definitive climate risk services

Discussion on stakeholders’ information needs in terms of:
- Type of impacts and receptors;
- Key climate variables;
- Temporal resolution and horizon;
- Spatial resolution.

Discussion on:
- Testing area for application;
- Hazard scenarios selection;
- Vulnerability factors to be adopted;
- Outputs layout (e.g. type of statistics, legend of maps)

- Presentation of the definitive climate risk services developed by risk experts to stakeholders;
- Cross cutting conclusions

Presentation by Valentina Giannini
1. Participative process – Stakeholders’ questions

<table>
<thead>
<tr>
<th>Level</th>
<th>Istitution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supranational</td>
<td>Adriatic Euroregion</td>
</tr>
<tr>
<td>National</td>
<td>Institute for Environmental Protection and Research</td>
</tr>
<tr>
<td></td>
<td>Civil Protection regional office Friuli Venezia Giulia</td>
</tr>
<tr>
<td>Veneto</td>
<td>Public works office Rovigo</td>
</tr>
<tr>
<td></td>
<td>Soil conservation service</td>
</tr>
<tr>
<td></td>
<td>Integrated hydric service</td>
</tr>
<tr>
<td></td>
<td>Regional Metereological service Teolo</td>
</tr>
<tr>
<td></td>
<td>Venice Water authority</td>
</tr>
<tr>
<td></td>
<td>Venezia Nuova Consortium</td>
</tr>
<tr>
<td></td>
<td>Po River Delta irrigation consortium</td>
</tr>
<tr>
<td></td>
<td>Veneto Orientale irrigation consortium</td>
</tr>
<tr>
<td></td>
<td>Venice port authority</td>
</tr>
<tr>
<td></td>
<td>Geologic service</td>
</tr>
<tr>
<td></td>
<td>Venice municipality</td>
</tr>
<tr>
<td></td>
<td>Tidal Forecasting Centre Venice</td>
</tr>
<tr>
<td>Friuli Venezia Giulia</td>
<td>Geologic service</td>
</tr>
<tr>
<td></td>
<td>Regional Agency for the Protection of the Environment</td>
</tr>
<tr>
<td></td>
<td>Regional Metereological service Friuli Venezia Giulia</td>
</tr>
<tr>
<td></td>
<td>Marine protected area of Miramare</td>
</tr>
<tr>
<td></td>
<td>Ledra Tagliamento irrigation consortium</td>
</tr>
</tbody>
</table>

- How CC will affect **storminess** and **high tide** in Venice?
- Which receptors will be more affected by land losses due to **sea level rise** and **coastal erosion**?
- How CC will increase the occurrence of **floods** due to **heavy rain** in urban areas?
- How CC will affect **marine water quality** and **water resources** availability?
- Which factors play the major role in increasing the **vulnerability** to CC?

(Giannini et al. 2011, 2013; CLIM-RUN Workshop reports)
2. Climate information from the dialogue between climate experts and risk experts.

How to develop hazard scenarios from climate data provided by different climate models, projections and observations?

Discussion with climate experts in order to identify the most appropriate hazard metrics and stressors to be adopted in the risk assessment:

- How to define maximum precipitation thresholds to assess pluvial flood risk?
- How to deal with uncertain projections of sea level rise in the Mediterranean?
- Is the spatial resolution of climate models appropriate to study CC impacts at the coastal/regional scale?
3. Climate risk and adaptation products

E.g. How much CC will affect the occurrence of hydraulic emergencies due to heavy precipitations?

E.g. In which season will emergencies take place?

Number of hydraulic emergencies in the 2041-2050 for the municipality of Venice.

Total number of hydraulic emergencies in the case study area for each month of the 2041-2050.
3. Climate risk and adaptation products

E.g. Which coastal areas and receptors could be more affected by land loss due to sea level rise?

Sea level rise inundation map for the North Adriatic coast (27 cm sea level rise: provided by PROTHEUS/ESEMBLES model (ENEA), emission scenario A1B).
3. Climate risk and adaptation products

E.g. Which coastal areas are more vulnerable to...

....coastal erosion?  ....pluvial flood events?

Which bio-physycal and environmental factors (e.g. land use, permeability, slope) contribute to increase the vulnerability to CC?

Vulnerability map of coastal erosion for the North Adriatic coastal zones.  Vulnerability map of pluvial floods for the North Adriatic industrial and commercial areas.
3. Climate risk and adaptation products

E.g. Where will I have higher risk of urban floods due to heavy rains?  

Risk map for residential areas in the municipality of Venice for the decade 2040-2050.

E.g. Which targets will be at risk of flooding?  

% of total surface of each receptor in each risk class for pluvial flood in the north Adriatic coast.
3. Climate risk and adaptation products

Which areas will be affected by the highest socio-economic losses?

Total % of permanent culture typology interested by a very high damage scores in the North Adriatic coast: ~ 51%

Total % of stable meadow typology interested by a very high damage scores in the North Adriatic coast: ~ 22%

Total % of arable typology interested by a very high damage scores in the North Adriatic coast: ~ 52%

Damage map for agricultural areas for the low relative sea level rise scenario (17 cm).
Conclusion – Lessons learnt

- **DESYCO** proved to **bridge the gap** between climate impact science and coastal zone policy/planning in order to support **decision making** and **climate proofing** in a wide range of situations (e.g. shoreline planning, land use and water resource management, flood risk reduction, strategic environmental assessment).

- **Climate services: not only climate projections** but also **projections on impacts of climate change** on natural and human coastal systems (e.g. beaches, wetlands, urban and agricultural areas).

- **Early stakeholders’ involvement**: 1. **to get the right questions** - according to stakeholders’ expertises and expectations - in terms of time scenarios, geographical scale and resolution, choice of receptors, vulnerability factors and thresholds; 2. **to develop products more tailored** to their informations **needs**.

- **Data gap**: lack of detailed and homogeneous information about coastal artificial protection, LIDAR, DEM, presence and structure of urban dryanage systems.
### Conclusion – Lessons learnt

- **Screening risk products:** useful as first-pass assessment of critical vulnerabilities => a more detailed analysis is required to respond to very specific needs of stakeholders (e.g. how to improve urban drainage systems, when and where plan irrigations systems);

- It is necessary to go beyond the traditional **impact by impact** approach and to implement **multi-risk assessment** considering that the same area would be potentially affected by several climate-related hazards (i.e. drought, risk of flood, groundwater salinization);

- There is a high level of **uncertainty** due both to unavoidable climate variability and to uncertain model projections: it is necessary to develop **adaptive policies and strategies** to cope with alternating situations (e.g. dry years followed by rainy years).
Thanks

Contact persons:
Prof. Antonio Marcomini
antonio.marcomini@cmcc.it

Dr. Silvia Torresan
silvia.torresan@cmcc.it

More information at:
CMCC, Impacts on Soil and Coast:
http://www.cmcc.it/divisions/isc

Ca' Foscari University Venice - Environmental Risk Assessment Unit: http://www.unive.it/nqcontent.cfm?a_id=138224

Tools Expo:
“DESYCO: a GIS based Decision Support System to provide climate risk services for coastal managers and improve adaptation decision making”

Acknowledgements:
Valentina Giannini, Silvio Gualdi, Alessio Bellucci,
Filippo Giorgi, Erika Coppola, Alessandro dell’Aquila, Paolo Ruti