2nd Round table. How to Finance Risk Resilience in a climate change context: A reflection from the perspective of the insurance sector, nature-based solutions implementation, and ecosystem services payments

Nature Based solution within Copernicus Operational services

Prof. Andrea Taramelli - University School for Advanced Studies IUSS Pavia

Prepared with Emma Schivon PhD IUSS, Laura Piedelobo PhD IUSS, Arianna Morelli PhD IUSS

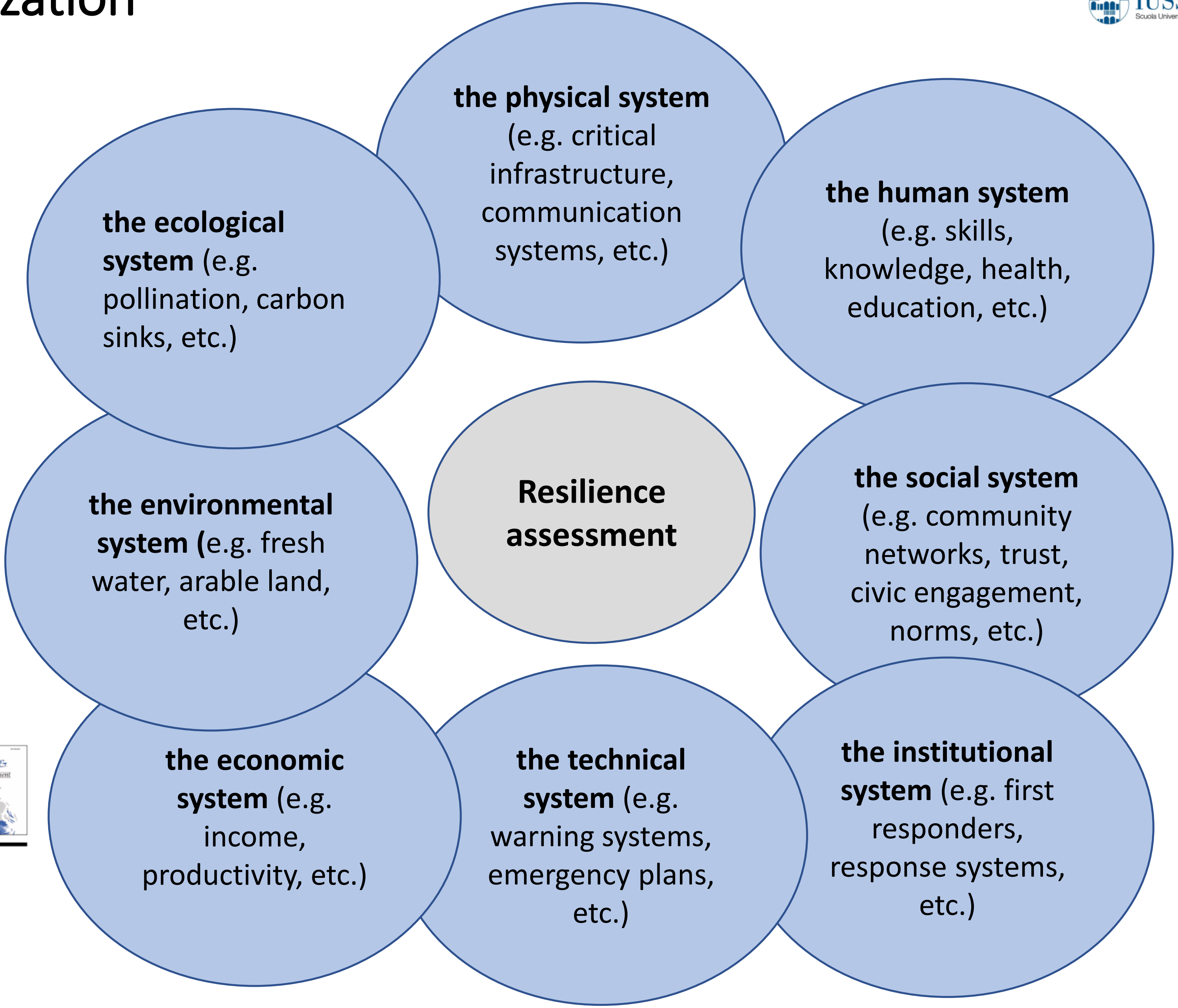
Defining resilience to natural hazards

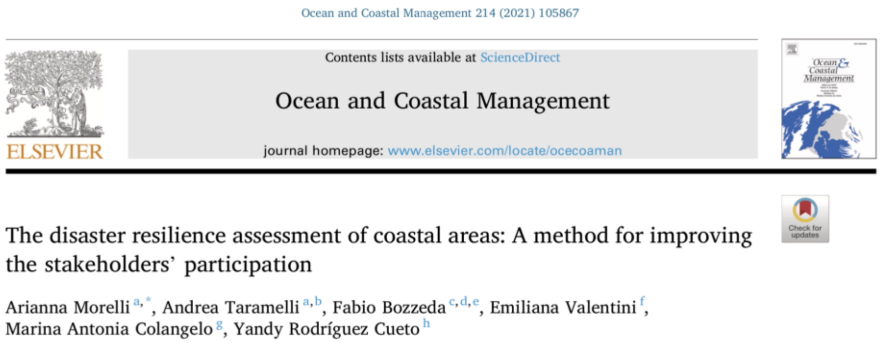
- Resilience is a multifaceted, complex and multidisciplinary concept for which it is difficult to formulate a singular root-cause and to prescribe normative solutions

- In the literatura three types of definitions can be identified (Patel et al., 2017):
    - 'resilience as a process' (i.e. an ongoing process of change and adaptation)
    - 'resilience as absence of adverse effect' (i.e. an ability to maintain stable functioning)
    - 'resilience as range of attributes' (i.e. a broad collection of response-related abilities)

The resilience operationalization

- To operationalize resilience in its entire complexity is challenging
- The format varies as well as the level of details sought
- The resilience assessment approaches can contain quantitative, qualitative (e.g. self-assessments) and mixed-methodologies





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Ocean and Coastal Management

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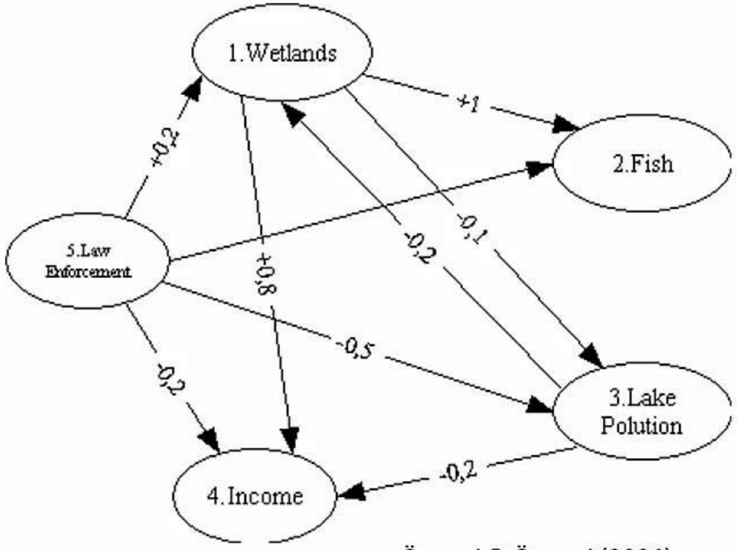
ELSEVIER

The disaster resilience assessment of coastal areas: A method for improving the stakeholders' participation

Arianna Morelli[a,*], Andrea Taramelli[a,b], Fabio Bozzeda[c,d,e], Emiliana Valentini[f], Marina Antonia Colangelo[g], Yandy Rodríguez Cueto[h]

The use of fuzzy logic to identify resilience patterns

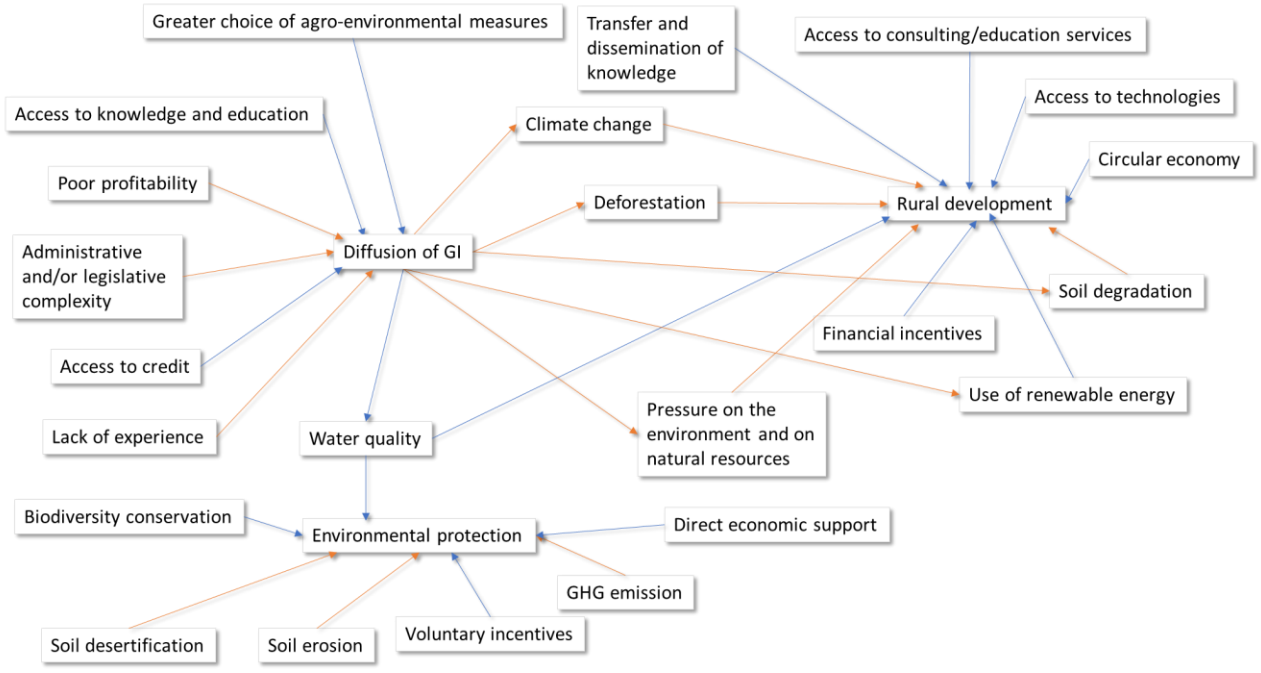
FCM Example



Özesmi & Özesmi (2004)

- Among different **participatory approaches**, the use of **Fuzzy cognitive maps** can be used to **model stakeholder perceptions** and needs to build resilience to natural hazards
- Fuzzy cognitive maps are particularly useful **when modelling issues involving uncertainty** and in **soft knowledge domains** such as the definition of resilience
- Fuzzy cognitive maps represent **causal reasoning** and support the modelling of decision making in social and political systems. These approach uses a **semi-quantitative method for the modelling of complex systems** for which conventional modelling have a limited contribution. Moreover, fuzzy cognitive maps provide a tool to capture and model the **behaviour of any qualitative dynamic system**.

Modelling stakeholder perceptions to assess green infrastructures potential in agriculture through fuzzy logic



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Modelling stakeholder perceptions to assess Green Infrastructures potential in agriculture through fuzzy logic: A tool for participatory governance

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ARTICLE INFO

Keywords:
Green infrastructures
Fuzzy logic
User needs

ABSTRACT

Solutions like Green Infrastructures can restore and maintain key regulative ecosystem services capable of mitigating disaster risk and contributing to climate change adaptation. Given the vulnerabilities that affect agriculture and its role in national economies, GI can play an important role in managing trade-offs between conflicting ecosystem services. However, their use is still lagging behind, and socio-economic dynamics in their uptake in the agricultural sector are partially disregarded. The uncertainty involved in the modelling of ecological processes can be reduced through the use of participatory processes and the involvement of relevant stakeholders to sustain decision-making processes. This article intends to assess stakeholders' perceptions on the implementation of Green Infrastructures in agriculture by capturing critical barriers and facilitators. The implementation of such Green Infrastructures policies is associated to different climate change trends in order to understand the effect of different scenarios on rural development. The study uses fuzzy logic to elicit the stakeholders' needs. The key results show that when there is uncertainty in the state of climate change trends, it is always more efficient to adopt progressive policies investing in the development and diffusion of Green Infrastructures.

In a recent study FCMs have been used to analyze the role of green infrastructures policies in a climate change context, concluding that:

- *Diversification of agro-environmental measures available to farmers promotes the use of green infrastructures in agriculture*
- *The efficiency of investment in green infrastructures decreases over time*
- *The negative effect of conservative policies on rural development is higher than the positive one created by progressive policies*
- *The use of green infrastructures as a nature base solution can improve sustainable rural development only if coupled with climate change mitigation policies and systematic approaches complementary to ECO-DRR strategies*

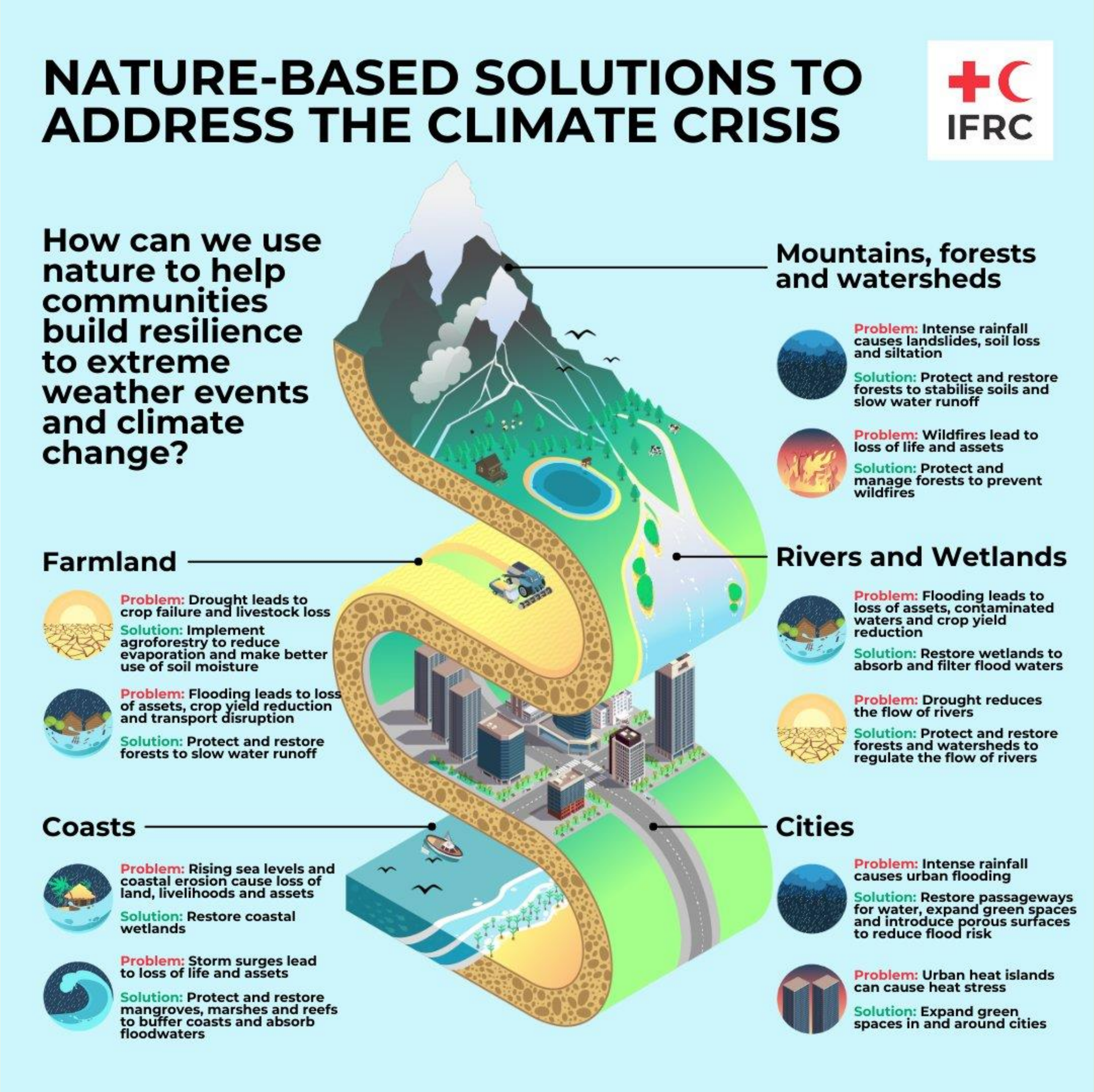
Nature Based Solutions (NBS) / Building with Nature

"Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions." (European Commission, 2020)

Relevance, advantages and disadvantages:

- **NBS have a direct relation with SDG 13.**
- NBS can increase **resilience to climate change effects** (floods, droughts) and can sequester CO2.
- NBS are **subordinate** to their overarching sectoral objective (e.g. water supply, flood risk reduction).
- NBS are **part of a larger system** of infrastructure (green and grey interventions).
- Project sourcing of NBS requires emphasis within **existing methodologies**, not a change.
- NBS is different compared to grey infrastructure, might create **hesitation**.
- There can be a **clear business** case for NBS (**adaptive over time, capturing ecological value, cost-efficient spatial planning**).
- Uncertainty around NBS' performance can affect bankability and might require **innovative procurement techniques.**

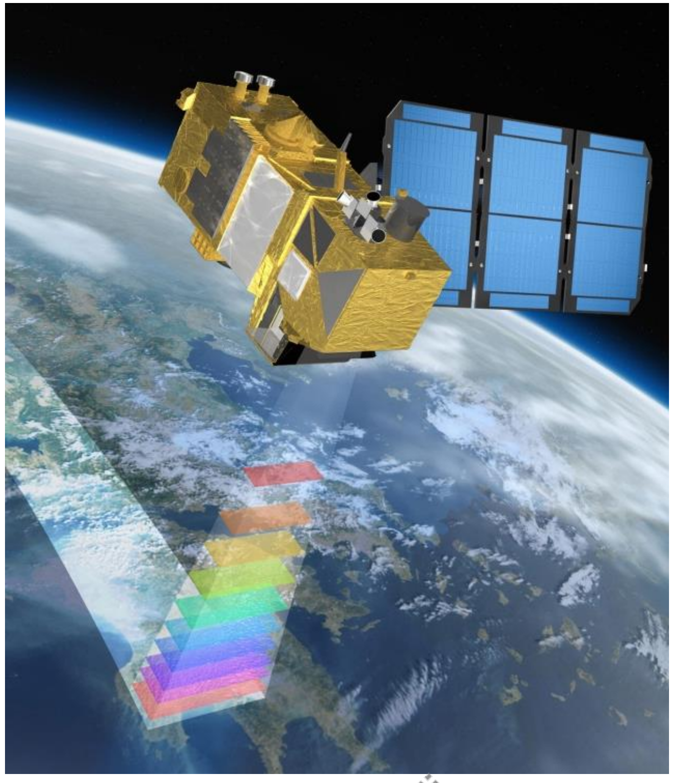
The UN recognises NbS as crucial to responding to climate change and sustainable development challenges at the scale and pace that are needed. Ecosystem-based adaptation (EbA), the use of ecosystem services to help people adapt to climate change, is championed as an effective strategy to address the linked challenges of poverty and climate change because of its comparative affordability and multiple co-benefits that contribute to sustainable development.



Copernicus – Europe's Eyes on Earth for Operational service

FULL, OPEN AND FREE

Copernicus is the European Union's Earth observation programme, looking at our planet and its environment to benefit all European citizens. It offers information services that draw from satellite Earth Observation and in-situ (non-space) data.

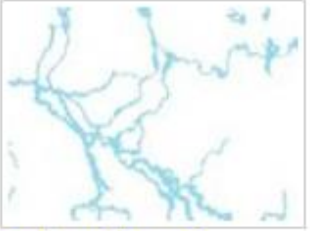


Copernicus Europe's eyes on Earth

Land Monitoring Service

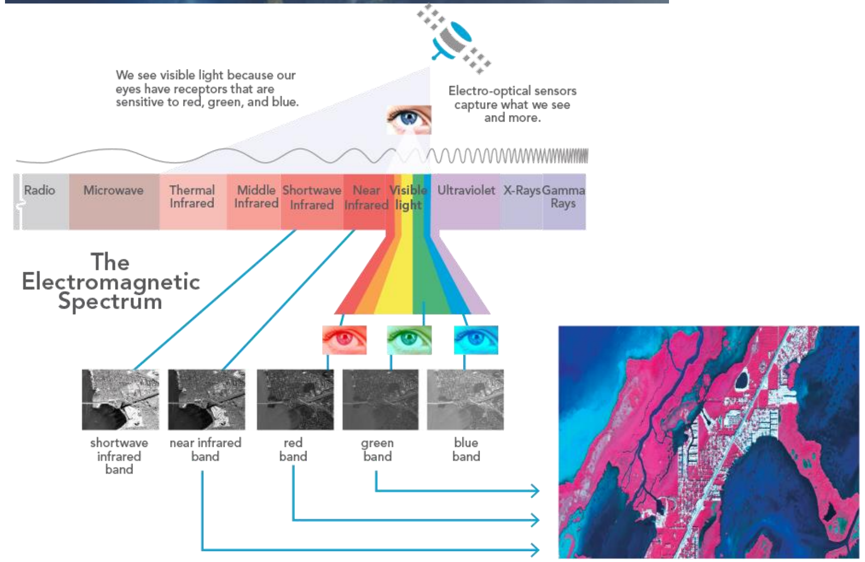
Riparian Zones

Land Cover/ Land Use

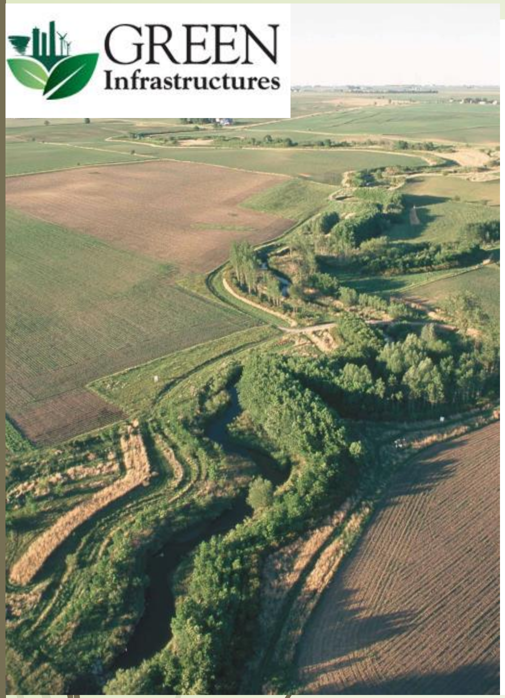


Delineation of Riparian Zones

Green Linear Elements



THE GREEN PROJECT: "Green infrastructures for disaster risk reduction protection: evidence, policy instruments and marketability (G.A. ECHO/SUB/2016/740172/PREV18)"



remote sensing

MDPI

Article

Assessment of Green Infrastructure in Riparian Zones Using Copernicus Programme

Laura Piedelobo [1], Andrea Taramelli [2,3,*], Emma Schiavon [2], Emiliana Valentini [3], José-Luis Molina [1], Alessandra Nguyen Xuan [3] and Diego González-Aguilera [1]

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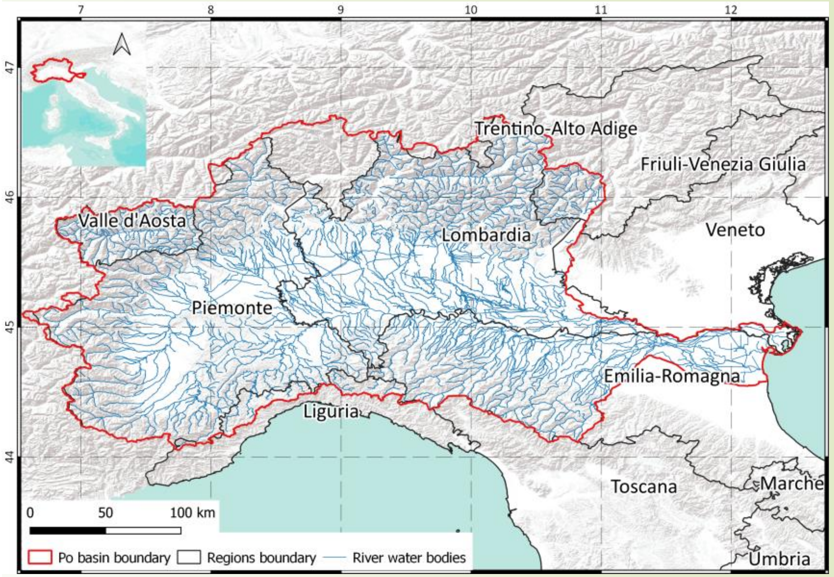


1) The study focuses on **riparian areas** due to their **potential to supply Ecosystem Services (ES)**, such as water quality, biodiversity, soil protection and flood or drought risk reduction.

2) The approach is based on **ES condition indicators, defined by the European Environment Agency (EEA)** to support the policy targets of the 2020 Biodiversity Strategy.

3) **Indicators that can be assessed through remote sensing techniques** are used, namely: capacity to provide ecosystem services, proximity to protected areas, greening response and water stress.

Appropriately identify and detect the condition of existing GI through existing methodologies and free data

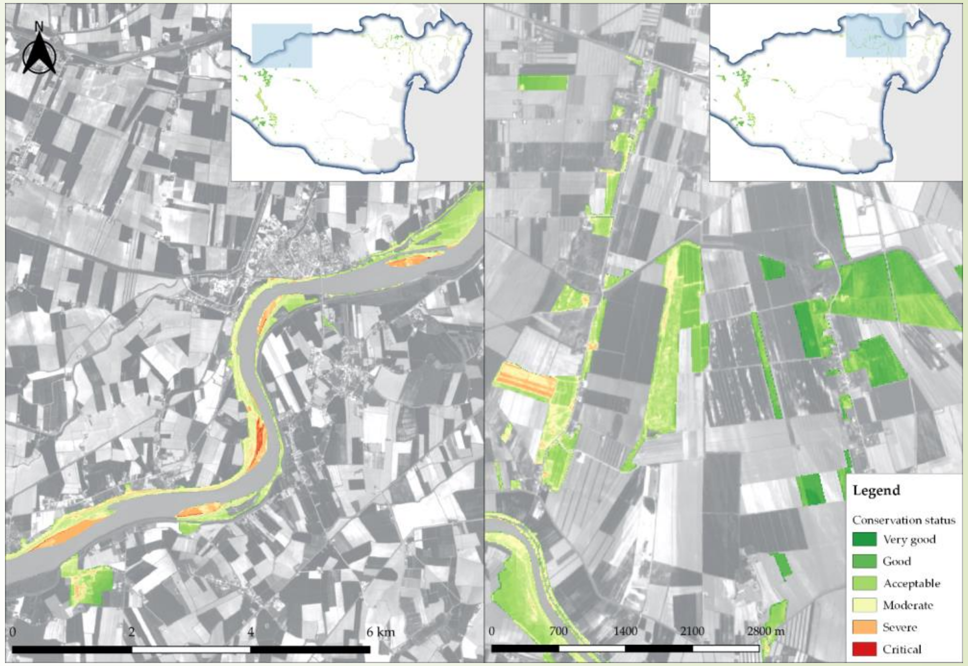
- Contribute to sustainable development in harmony with the environment by identifying and safeguarding valuable existing GI and ecosystem services that spatial planning can take into account, which contributes to cost-effective policymaking.

- Monitor the development of GI towards its full capacity performance.

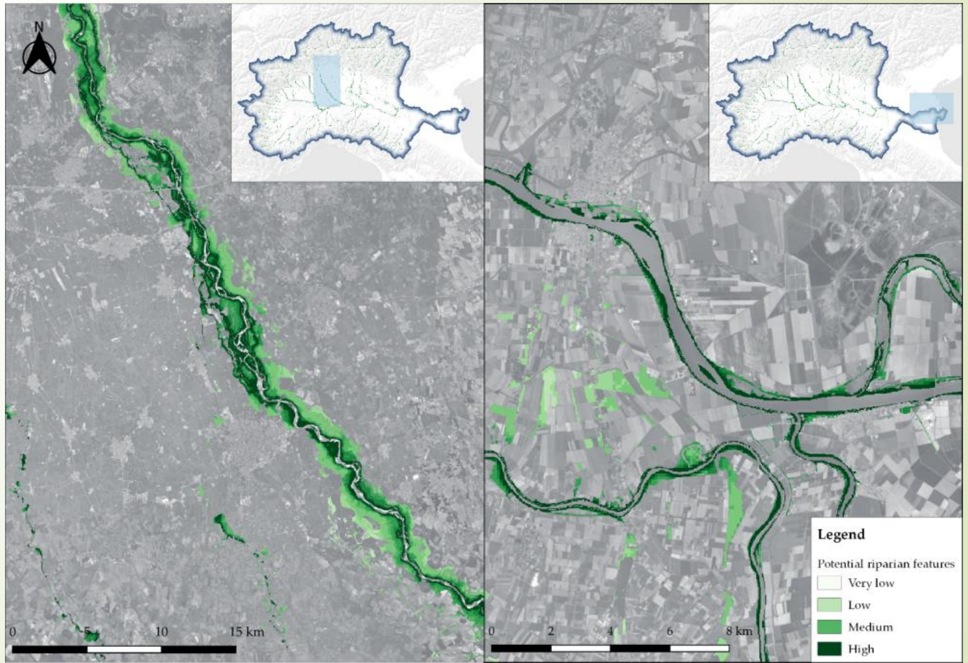
- Identifying and proving the importance of GI sites based on its potential and benefits delivered could speed up the implementation, and even the financing, if the impact and urgency of building or conserving this GI is clearer.

- Using public remotely sensed data to see how GI progresses or deteriorates over time contributes to giving poorer communities an ability to hold their representatives accountable.

Conservation status

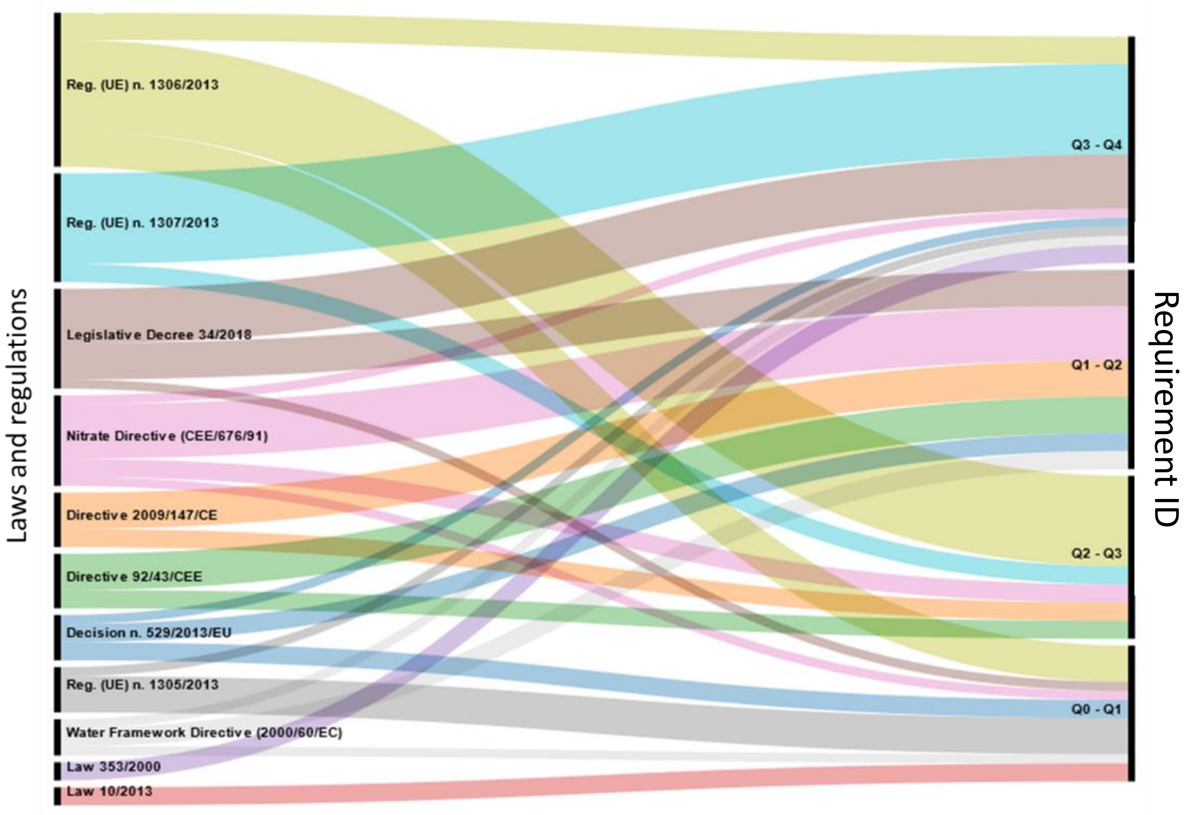


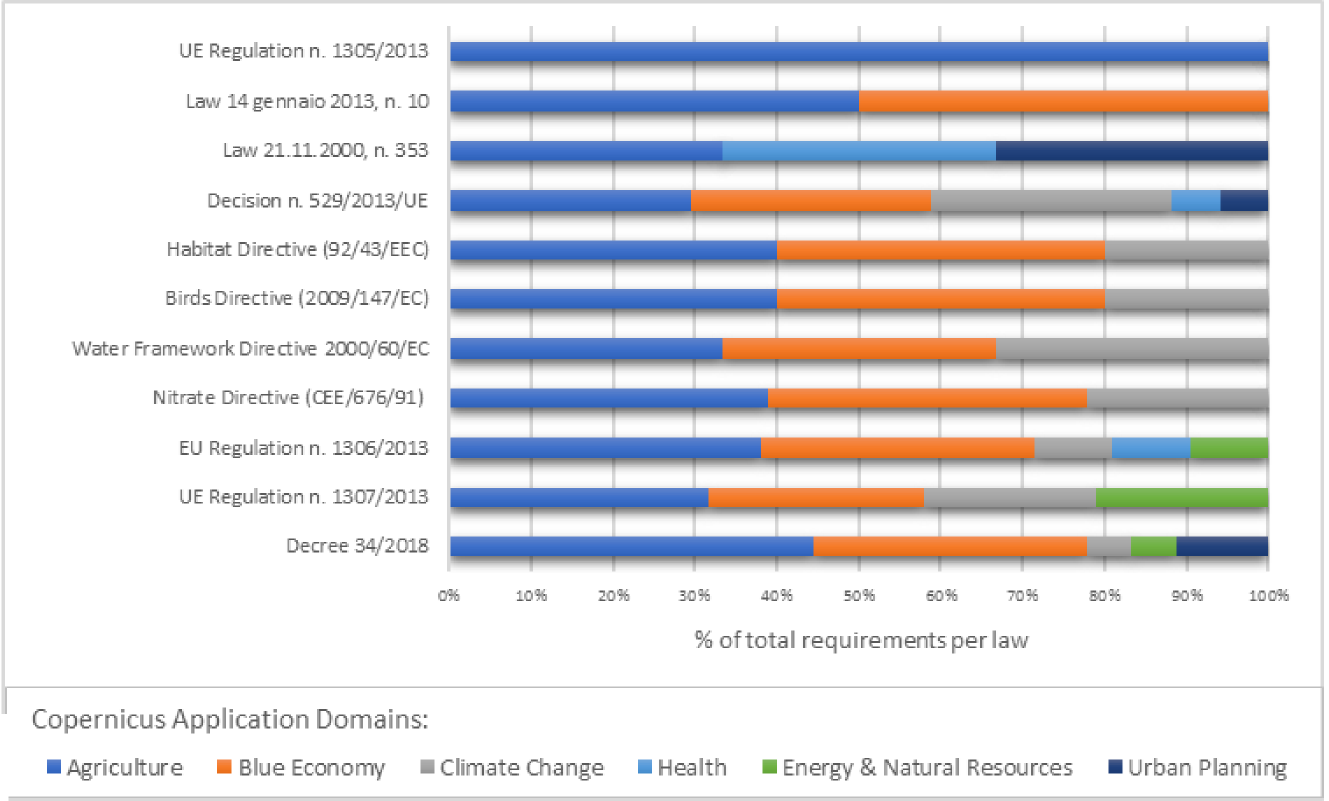
Potential for holding riparian features



How can we invest?

Aligning technological development to policy operational needs can enhance climate goals using ecosystem services and green infrastructures





Distribution of different Directive, Regulations and national laws identified by users over Copernicus application domains and user requirements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ELSEVIER

Monitoring environmental and climate goals for European agriculture: User perspectives on the optimization of the Copernicus evolution offer

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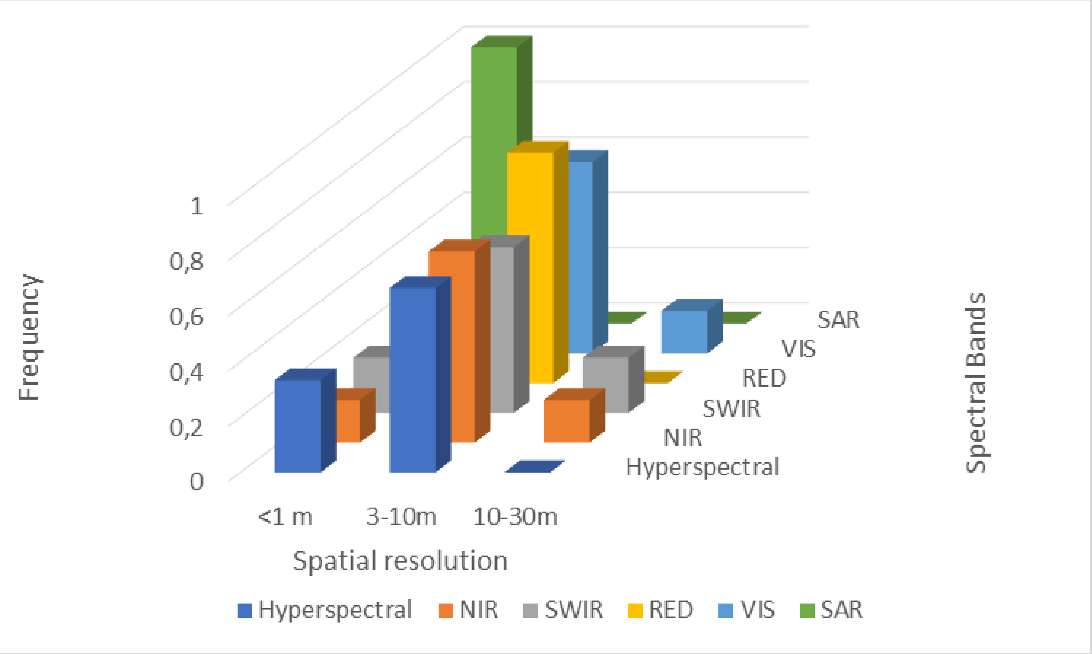
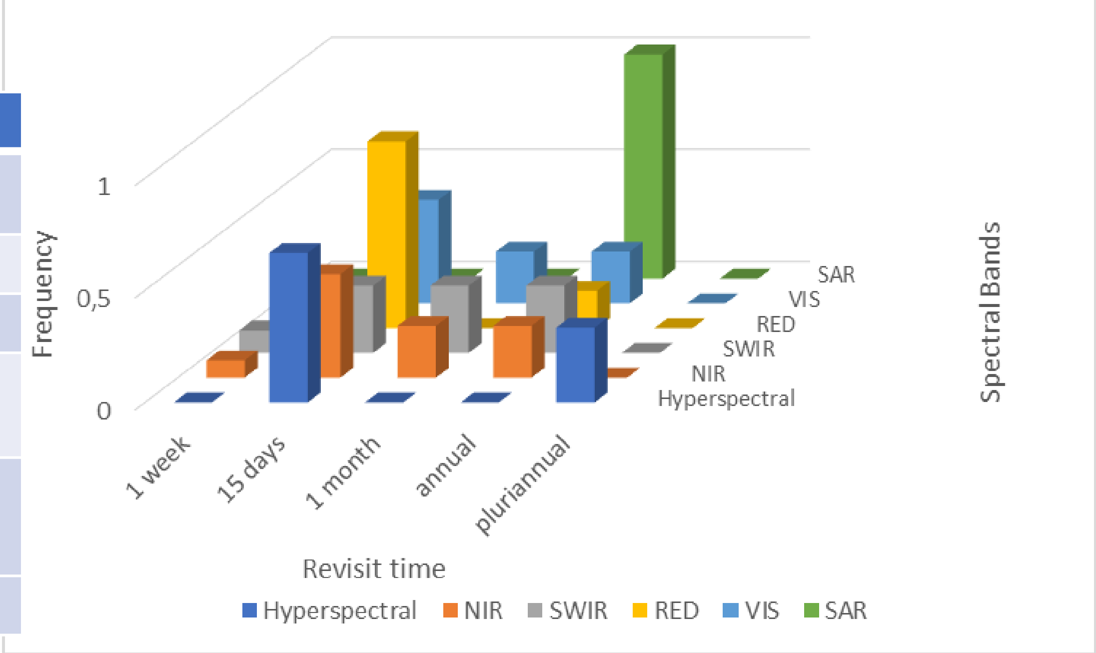
Investing in synergies between earth observation missions can improve the implementation of nature-based solution to support the Common Agricultural Policy post 2020

Offer and demand for earth observation technical specifications for monitoring agro-climatic goals

Spectral bands	Spatial resolution		Revisit time	
	Demand	Offer	Demand	Offer
Hyperspectral	3-10m	30m	15 days	7 days
NIR	3-10m	4x10m	15 days	5-10 days
SWIR	3-10m	6x20m	15 days, 1 month, annual	10 days
RED	3-10m	4x10m	15 days	5-10 days
VIS	3-10m		15 days	
Radar	<1	5m	annual	12 days





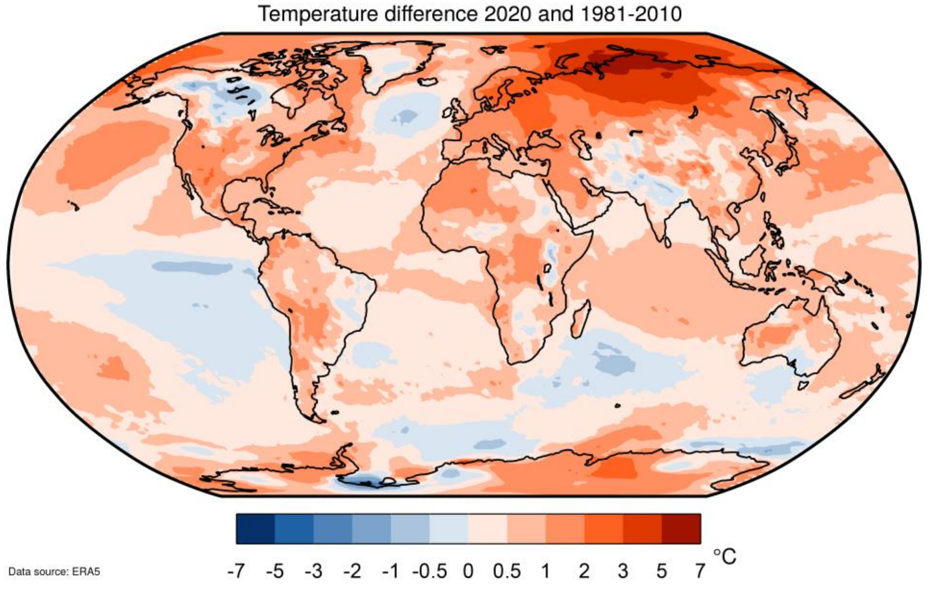
water

MDPI

Article

User Needs Analysis for the Definition of Operational Coastal Services

Serena Geraldini [1,*], Antonello Bruschi [1], Giorgio Bellotti [2] and Andrea Taramelli [1,3]



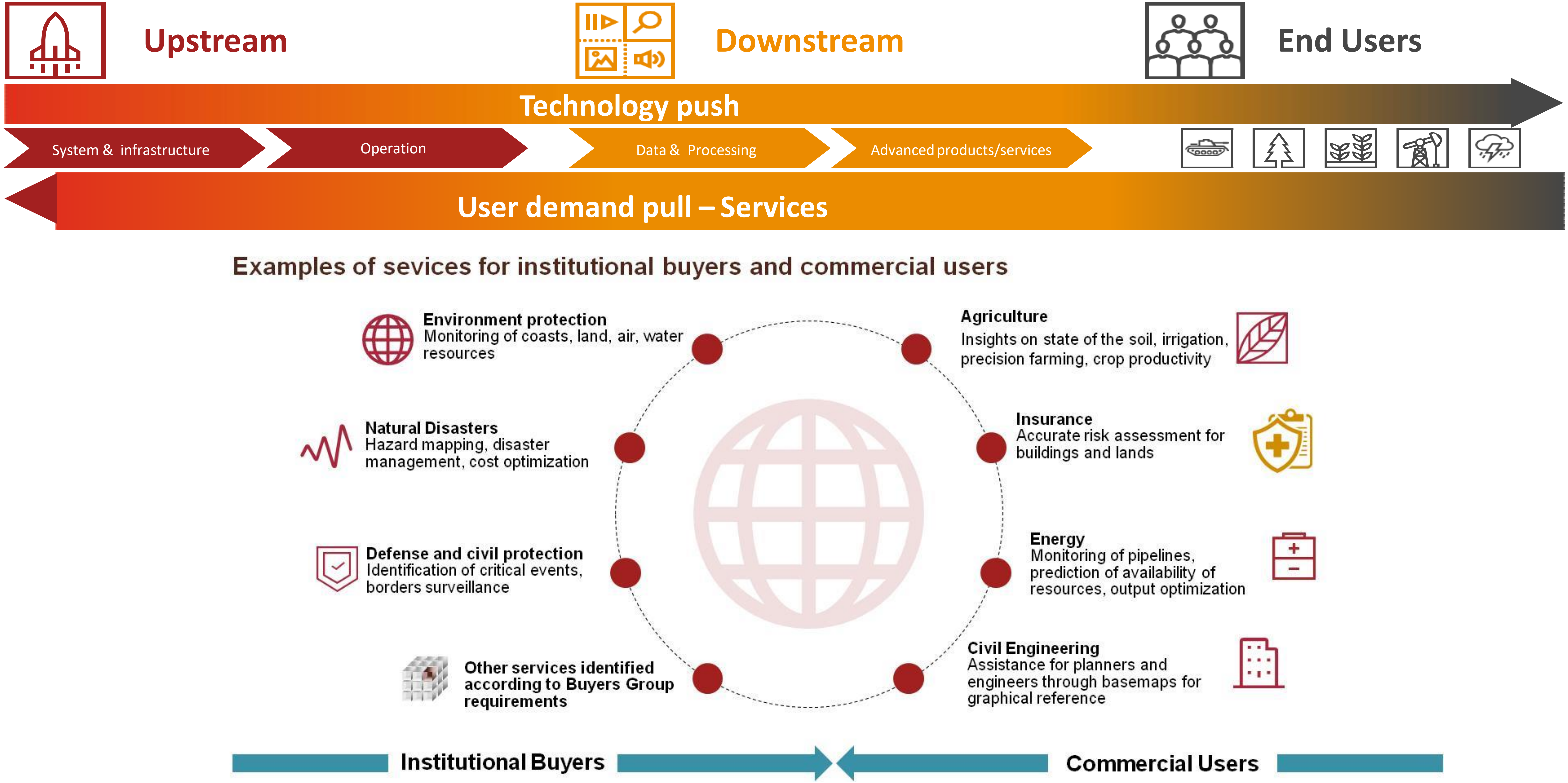
IUSS Scuola Universitaria Superiore Pavia

Climate services in Europe must take into consideration users' perspectives to effectively implement ecosystem-based disaster risk reduction approaches

The EU Commission sets out a development strategy to transform the European Union into a fair and prosperous society without net emissions of greenhouse gases by 2050 and where economic growth is decoupled from resource use. Sustainable management of natural resources and climate action represents the pillars of the European Green Deal for the EU.

1. Climate services have to be user-friendly, simple and accessible. They must provide complete information about the future in order to support planning and management.
2. Users are keen to adopt new technologies as far as they can provide effective support and financial benefits.
3. The EU funding mechanism should be boosted to promote the use of CSs in selecting sustainable farming and irrigation practices, improving air quality.
4. Innovation from projects can go to market but this process needs a specific source of funding and support from the EU.

The Mirror Copernicus space economy value chain is evolving in a user-driven approach, covering more and more companies from multiple sectors



https://www.snpambiente.it/2021/10/12/copernicus-e-le-nuove-frontiere-per-lambiente/

Existing services, tools and models will gradually be replaced by innovative and better ones

Services, Tools and Models Development Path

	As-Is	R&D and Prototyping	To-Be
Phase	**I Use of customized services by selected institutional entities** Adoption of services and models, mainly developed in-house by few institutions	**II Prototyping and development of new services and models** Pilots testing and gradual release of prototypes to end-customers	**III Availability of advanced services and models for multiple institutional and industrial players** Introduction of evolved services and advanced applications in regards of the nowadays existing ones
Available Services	• Existing customized services used to carry out specific functions by institutions	• Existing institutional services • New thematic services prototypes	• Thematic services
Available Tools	• Selected models and tools	• Big data analytics tools prototypes • Post processing models prototypes	• Advanced tools and models fully implemented through application tiers • Decision Support System
Approach	• Vertical approach • Direct relation between services, users and models	• Hybrid approach • Switch from a vertical to an horizontal approach	• Horizontal approach • Flexible services and models adopted by different users for different contexts
	Today	**Phase I & II**	**Phase III & IV**